MOBILE RADIO

MASTR
PROGRESS LINE
Personal Series
MAINTENANCE MANUAL

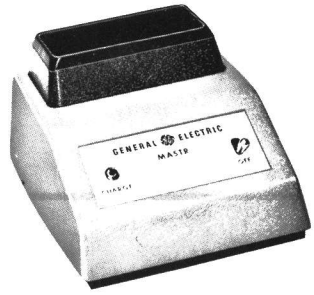
PR MODEL

EXTERNAL MICROPHONE

132–174 MHz

TWO-WAY PERSONAL FM RADIO

LBI-4287E



DESK CHARGER

GENERAL ELECTRIC

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SPECIFICATIONS *

GENERAL

Frequency Range	132–174 MHz
Battery Drain (@7.5 Volts)	
Standby	13 milliamps (18 milliamps with tone option)
Receive	140 milliamps(145 milliamps with tone option)
Transmit	1.35 amperes maximum
Duty Cycle	10% transmit, 10% receive, and 80% standby
Battery Life (at rated Duty Cycle)	
Rechargeable	10 hours
Alkaline Batteries	20 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-90-C
Power Output	
Rechargeable Battery	4.5 watts minimum (1.0 watt minimum in the LO Power position)
Alkaline Batteries	2.7 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	12
Output Impedance	50 ohms
Mike Input Impedance	5000 ohms

RECEIVER

Type Number	ER-56-A
Audio Output	500 Milliwatts
Channel Spacing	30 kHz
Sensitivity	
12-dB SINAD (EIA Method)	0.25 μV
20-dB Quieting Method	0.35 μV
Selectivity	
EIA Two-Signal Method	-75 dB (adjacent channel, 30-kHz channel)
20-dB Quieting Method	-90 dB at +30 kHz
Spurious Response	-70 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	0.15 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	**3** 4.5 Watts	**6** 30 kHz	**L** Local PTT	**A** 1-Freq.Xmit 1-Freq.Rec	**S** Standard	**55** 132–150.8 MHz
			R Remote PTT	**B** 2-Freq.Xmit 1-Freq.Rec	**U** Channel Guard Encoder/Decoder	**66** 150.8–174 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	

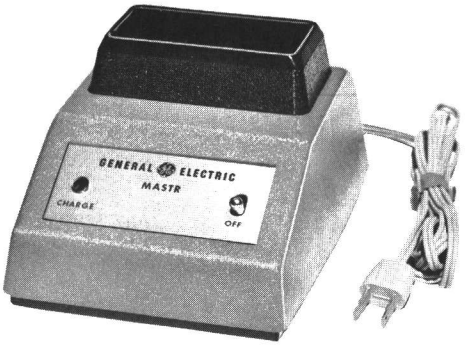
ACCESSORIES

EXTERNAL MICROPHONE

FLEXIBLE ANTENNA

WHIP ANTENNA (Option 4321)

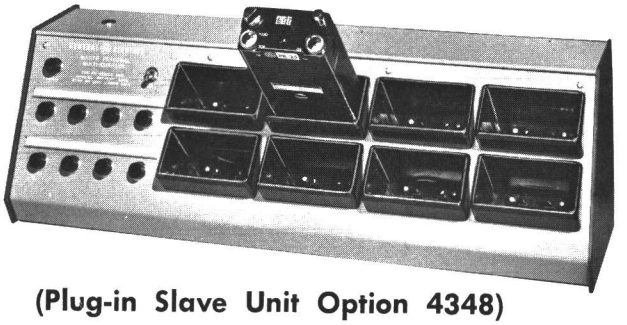
DESK CHARGER MODEL 4EP61A10 (Option 4345)



(With Antenna Jack Option 4346)

VEHICULAR CHARGER MODEL 4EP63A12 & 13 (Options 4353 thru 4357)

MULTI-CHARGER MODEL 4EP62A10 (Option 4347)



(Plug-in Slave Unit Option 4348)

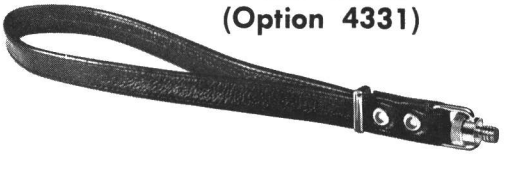
FAST CHARGER MODEL 4EP64A10 (Option 4351)

ANTENNA ADAPTER CABLE

LEATHER CASE (Option 4333)

SHOULDER STRAP (Option 4332)

HAND STRAP (Option 4331)



TEST EQUIPMENT

TEST ADAPTER
MODEL 4EX12A10 (Option 4384)

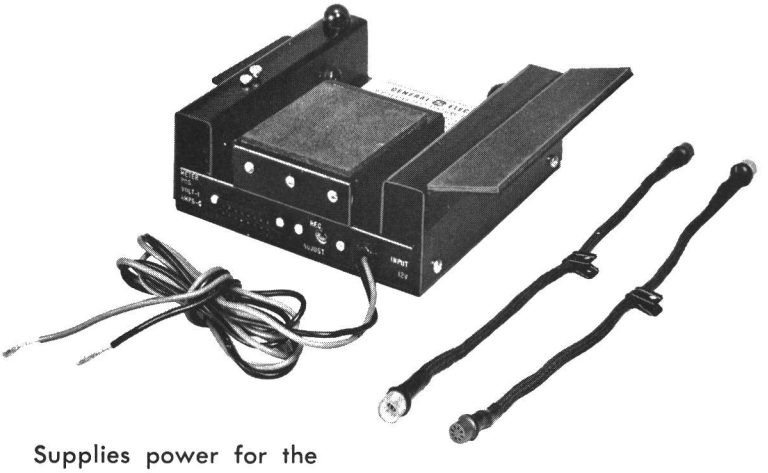
Provides transmitter and receiver audio connections

IF GENERATOR
MODEL 4EX9A10 (Option 4381)

For setting the receiver on frequency and for troubleshooting

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

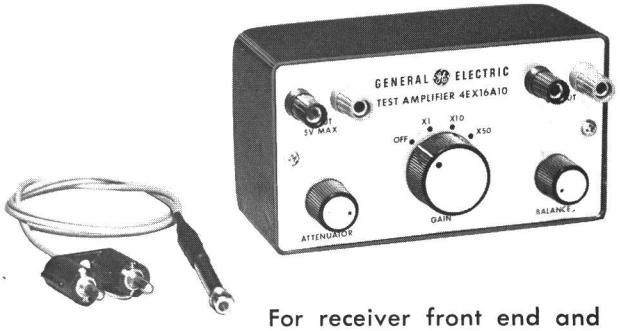
TEST FIXTURE
MODEL 4EX11A10 (Option 4380)



Supplies power for the radio and metering jacks for the transmitter

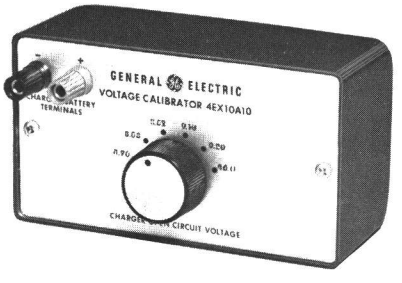
Extension cables for servicing the receiver out of the radio

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 132–174 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 speaker microphone (or across the face of an external microphone) in a normal tone of voice.

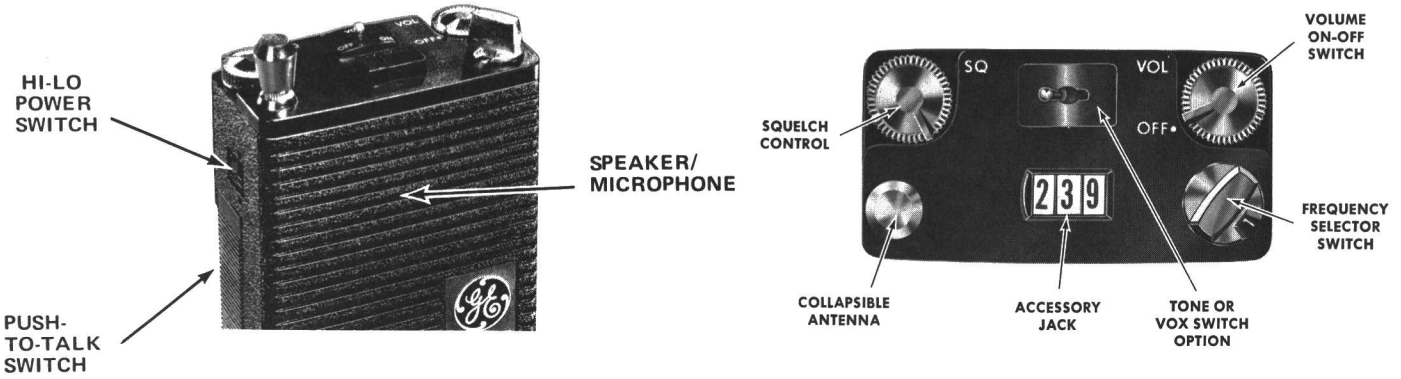


Figure 1 - Operating Controls

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	19C317000G1	
Alkaline Energizers (Package of 12)	19A127771G1	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 Nickel-Cadmium battery pack should be given a minimum initial charge of 16 to 24 hours prior to placing into service. 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.

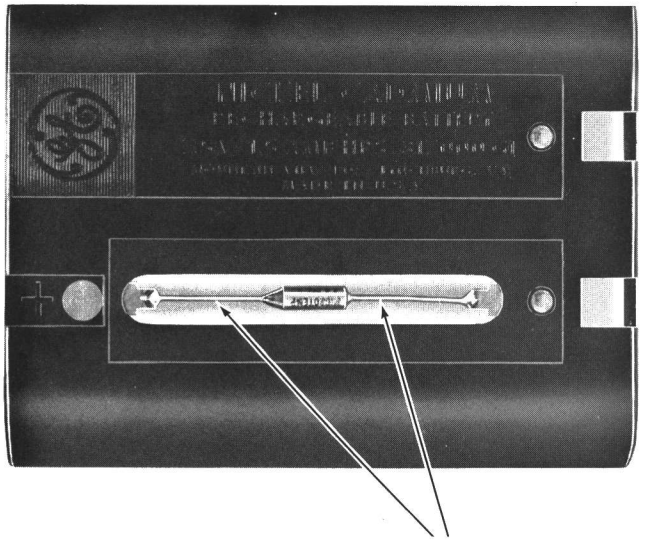


Figure 2 - Replacing Thermal Fuse

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 of 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.

WARNING

Do not dispose of the rechargeable battery packs or mercury batteries by burning them. To do so may cause a battery to explode.

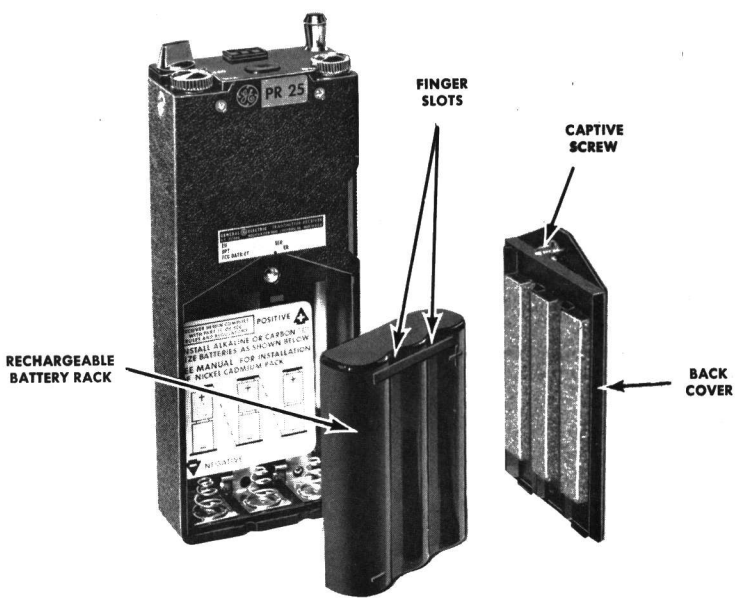


Figure 3 - Battery Pack Replacement

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-90-C is a crystal-controlled, phase modulated transmitter for one- through four-frequency operation in the 132–174 MHz band. The transmitter utilizes both discrete components and Integrated Circuit modules (ICs) to provide a minimum RF power output of 4.5 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.

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 1.

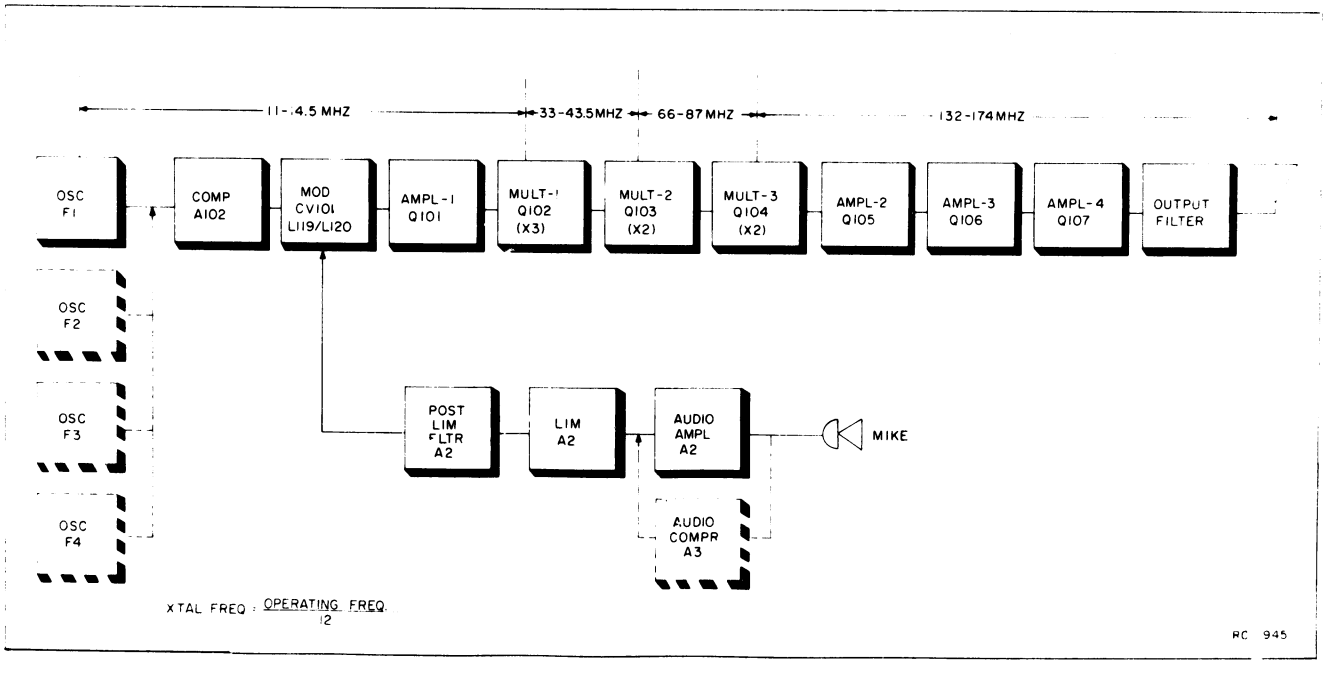


Figure 4 - Transmitter Block Diagram

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
19C317616G1	Local PTT	X			
19C317616G2	Local PTT	X			X
19C317616G3	Remote PTT	X	X		
19C317616G4	Remote PTT	X	X		X
19C317616G5	Remote PTT	X	X	X	
19C317616G6	Remote PTT	X	X	X	X

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 of 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 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.

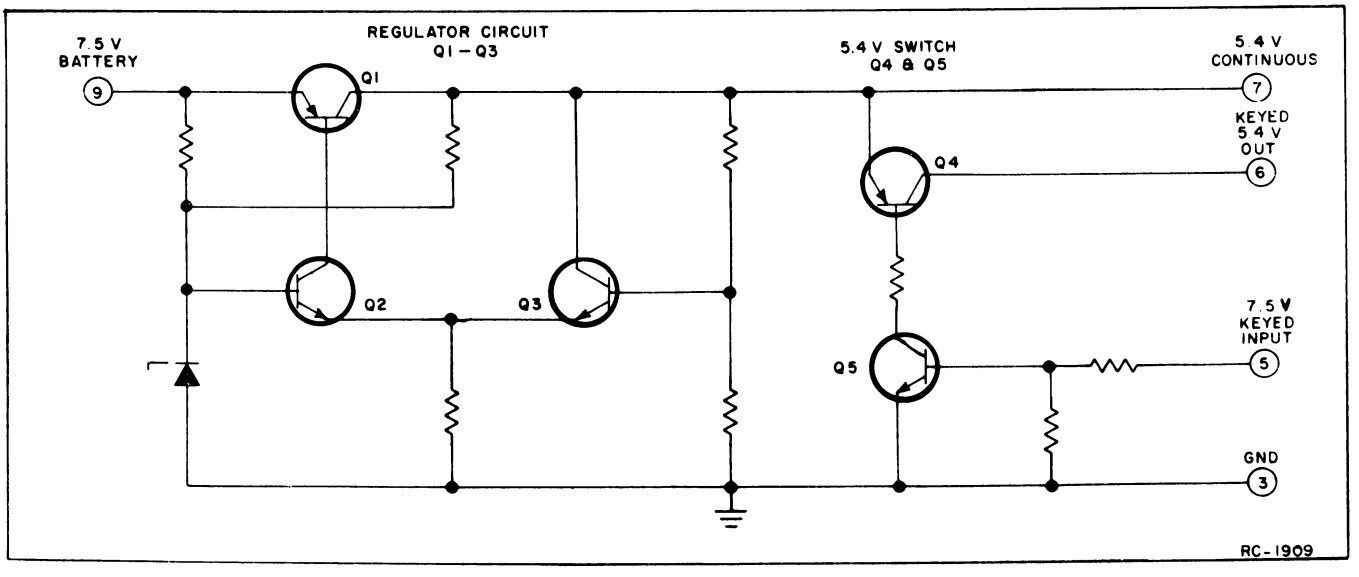


Figure 5 - Typical Regulator Circuit

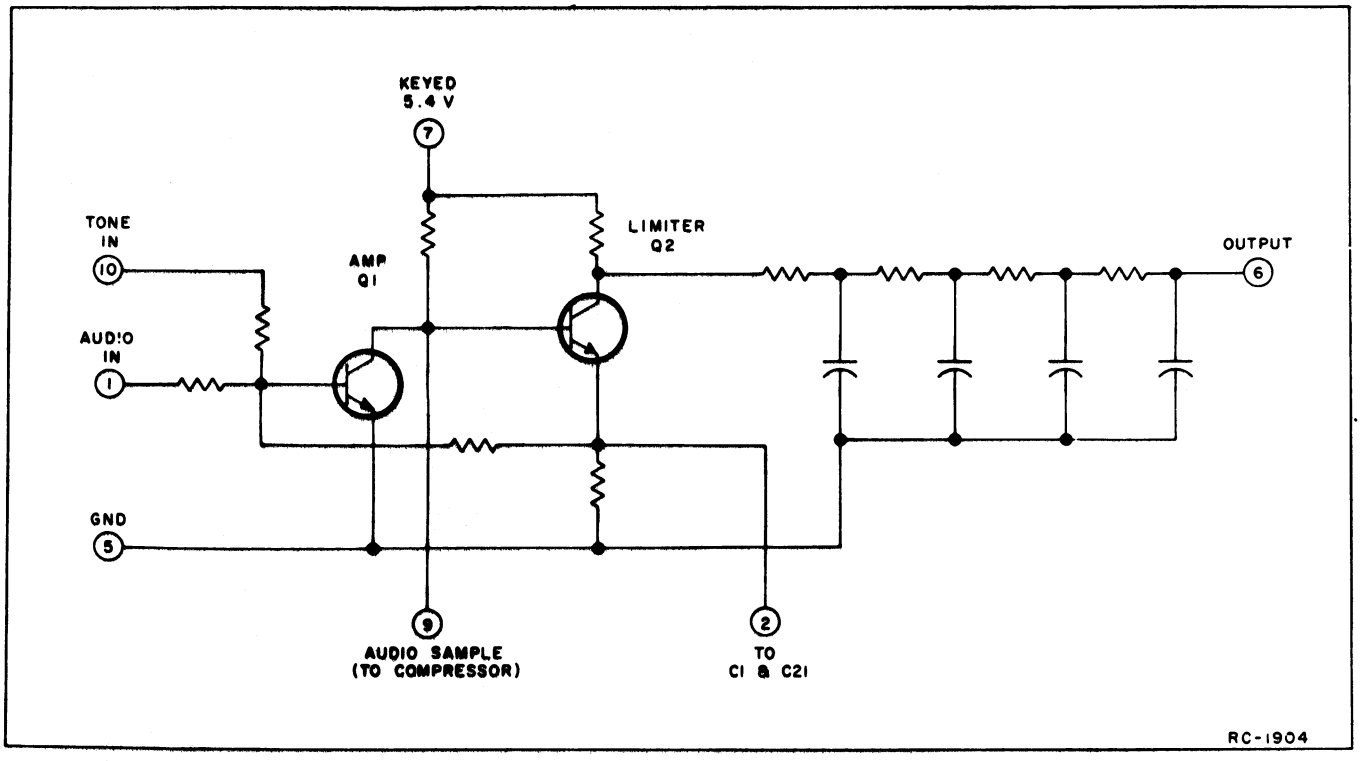


Figure 6 - Typical Audio Amplifier & Limiter Circuit

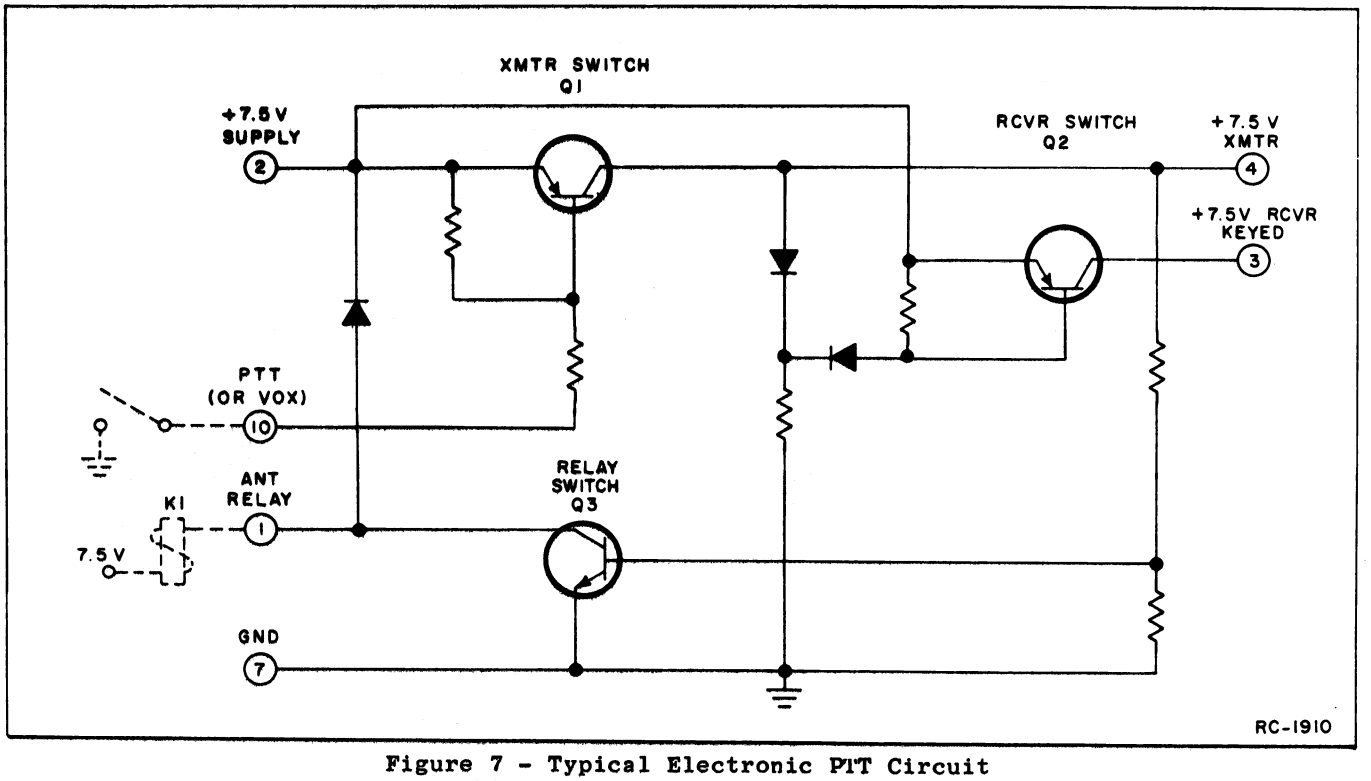


Figure 7 - Typical Electronic PTT Circuit

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 Electronic 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.

Jacks E701, E702 and E703, located at the bottom of the radio housing, provide contacts for external PTT mike input, speaker/mike high and remote PTT when the radio is inserted in the proper charger.

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 defeat switch (S601) on the Control Unit. With the switch in the ON position, audio from the microphone is 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

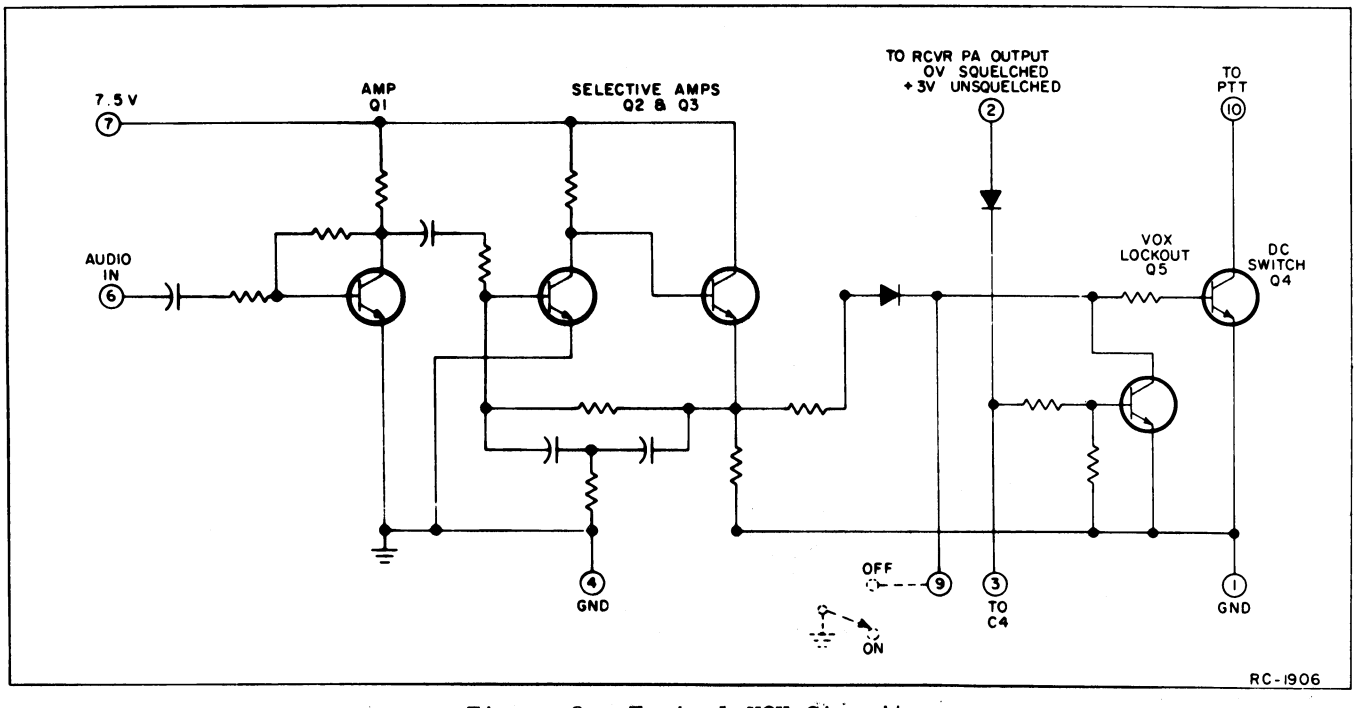


Figure 8 - Typical VOX Circuit

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, 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 control 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:

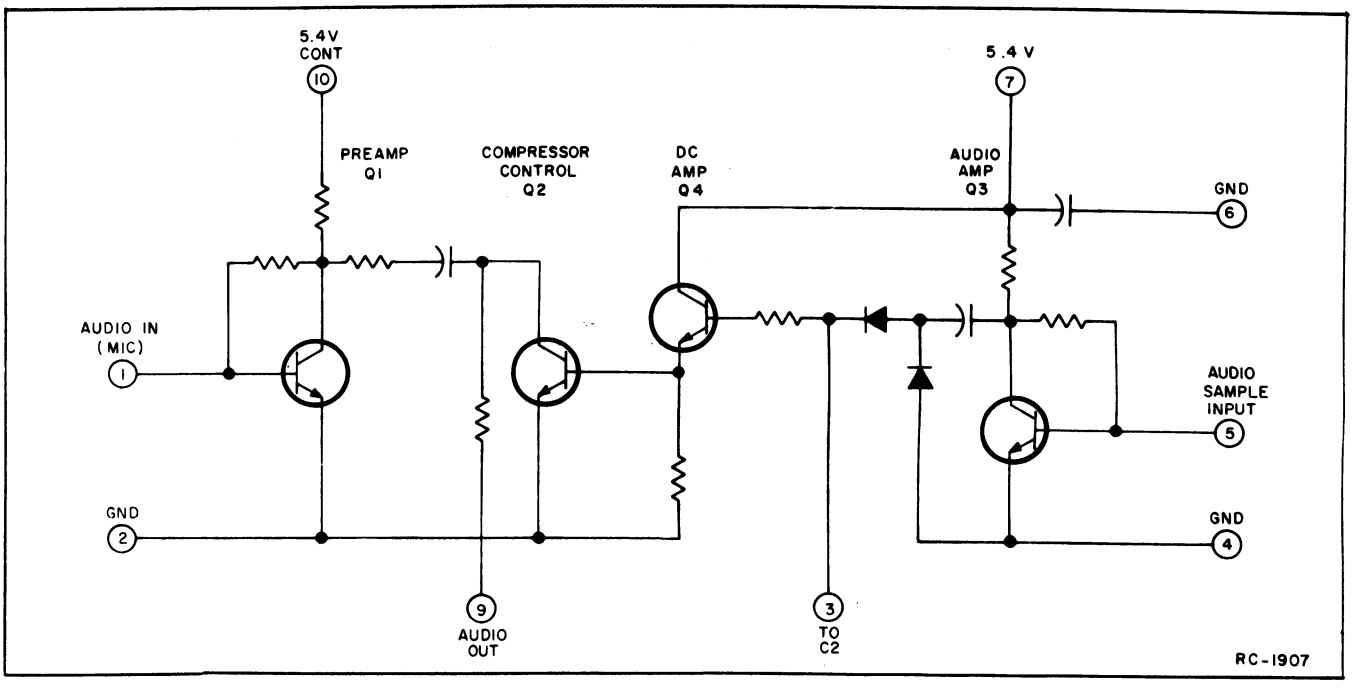


Figure 9 - Typical Audio Compressor Circuit

Model No.	Freq. Range	No. of Freqs.	Type 99 Decoder
4EF34A10	132-150.8 MHz	1 thru 4	
4EF34A11	150.8-174 MHz	1 thru 4	
4EF34A12	132-150.8 MHz	1 or 2	Yes
4EF34A13	150.8-174 MHz	1 or 2	Yes

OSCILLATOR MODULE

Oscillator Model 4EG27A10 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 printed on the top. The crystal frequency ranges from 11 to 14.5 MHz, and the crystal frequency is multiplied 12 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 12 to Hole 13 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 to Pin 3 to the voltage-variable capacitor on the oscillator module where its 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.

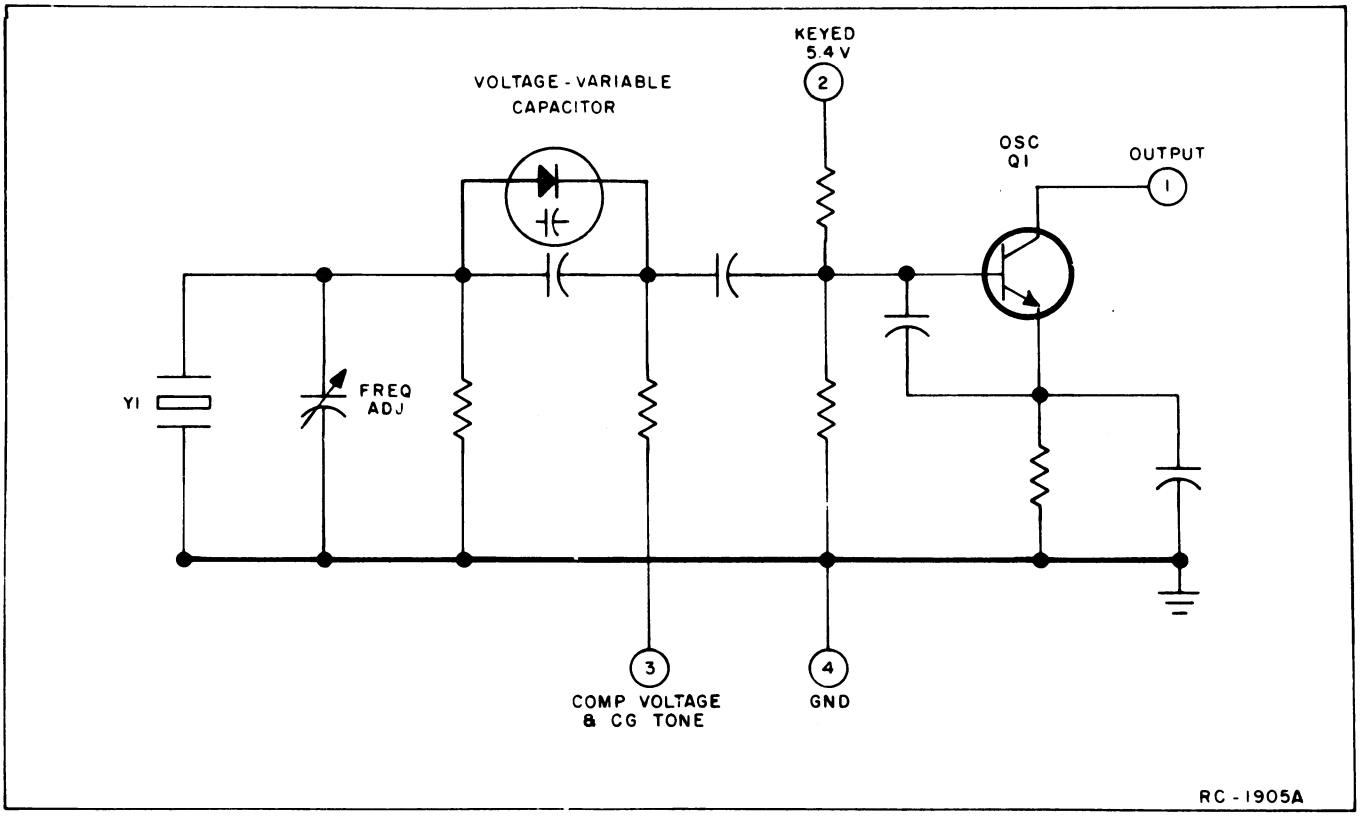


Figure 10 - Typical Oscillator Circuit

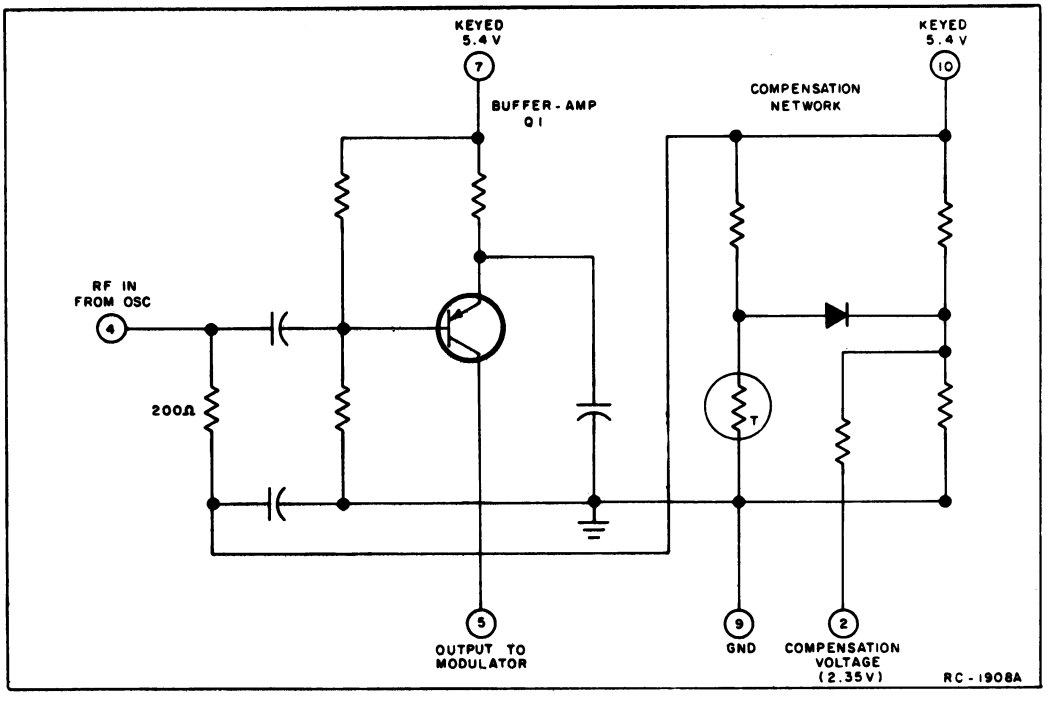


Figure 11 - Typical Compensator Circuit

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 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 L119/L120. This network appears as a series-resonant circuit to the RF output of the oscillator. Applying an audio signal to the modulator varies the bias 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.

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

An Optional 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 R123. This reduces the power output of the transmitter to 1.0 watt, greatly extending the battery life.

3RD & 4TH AMPLIFIERS

Following Q105 are two series-tuned class C power amplifier stages (Q106 and Q107). The output of Q107 is coupled through a band-pass filter (C153, C154, L117 and L118) to the external antenna switch (S704) to the antenna.

RECEIVER

Receiver Models 4ER56A10–15 are single conversion, superheterodyne FM receivers for operation on the 132–174 MHz bands. The complete receiver mounts on a single printed wiring board, and utilizes both discrete components and Integrated Circuit modules. The application of each model receiver is shown in the following chart:

Model No.	Freq. Range	Number of Freqs.	Tone Option
4ER56A10	132–150.8 MHz	1 thru 4	
4ER56A11	150.8–174 MHz	1 thru 4	
4ER56A12	132–150.8 MHz	1 thru 4	Chan.Gd.
4ER56A13	150.8–174 MHz	1 thru 4	Chan.Gd.
4ER56A14	132–150.8 MHz	1 or 2	Type 99 Decoder
4ER56A15	150.8–174 MHz	1 or 2	Type 99 Decoder

References to symbol numbers mentioned in the following text are found on the

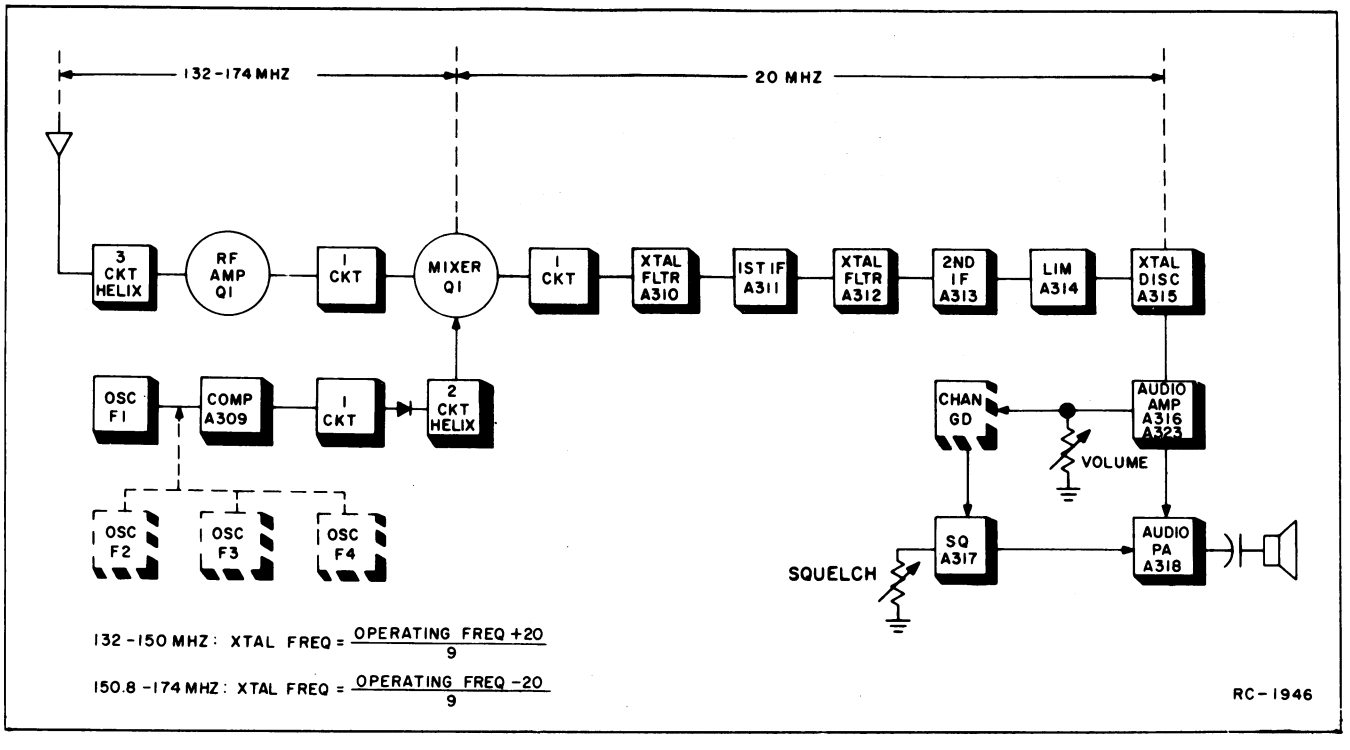


Figure 12 - Receiver Block Diagram

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.

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 and squelch modules, and a keyed 7.5 volts for the remaining receiver stages.

FRONT END A301/A302

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 W301 to a tap on L1/L4. The tap is positioned to provide the proper impedance match to the antenna. RF energy is coupled to the third coil (L3/L6) through openings in the sides of the cans. RF is then coupled from a tap on L3/L6 through C1 to the base of RF amplifier Q1. The output of Q1 is developed across tuned circuit C2-L1 and is applied to the base of the mixer (A305/A306).

OSCILLATOR MODULE

Oscillator Model 4EG28A10 (132–150.8 MHz) and 4EG28A11 (150.8–174 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 14.53 to 18.97 MHz, and the crystal frequency is multiplied 9 times.

The oscillator frequency is temperature compensated to provide instant frequency compensation, with a frequency stability of ±.0002% from 0°C to +55°C and ±.0005% from -30°C to +60°C. The temperature compensation network is contained in Compensator module A309. 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 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 modue. 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 A305/A306

The Multiplier-Mixer module 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 three times the first multiplier frequency for a total multiplication of 9 times. The output of the helical resonators is direct-coupled to the emitter of the mixer transistor. In 132–150.8 MHz receivers, a high side injection frequency is used. In 150.8–174 MHz receivers, a low side injection frequency is used.

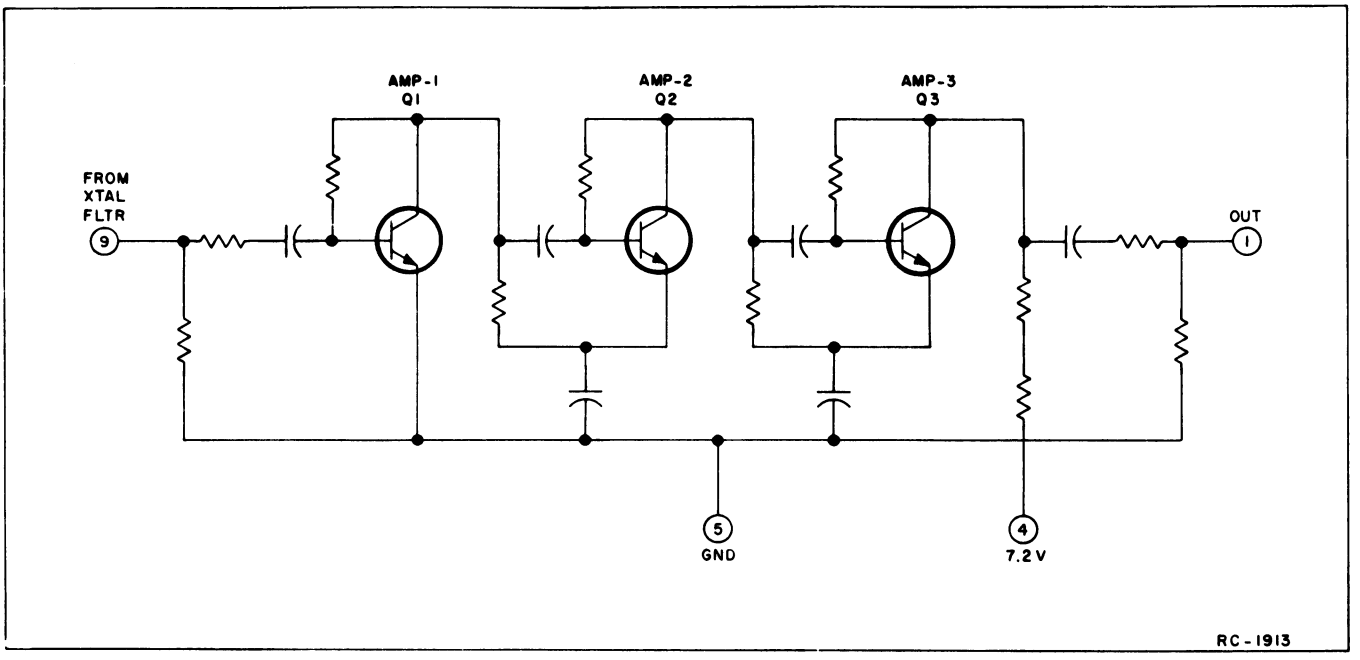


Figure 13 - Typical IF Amplifier Circuit

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.

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.

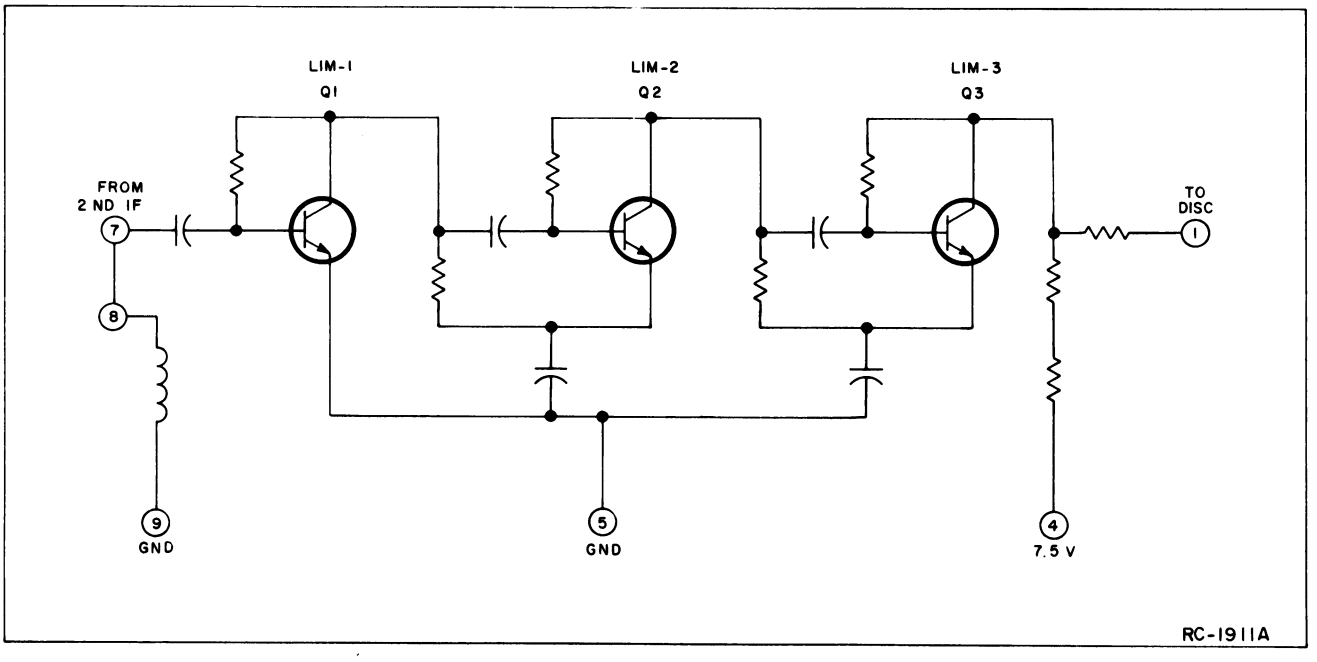


Figure 14 - Typical Limiter Circuit

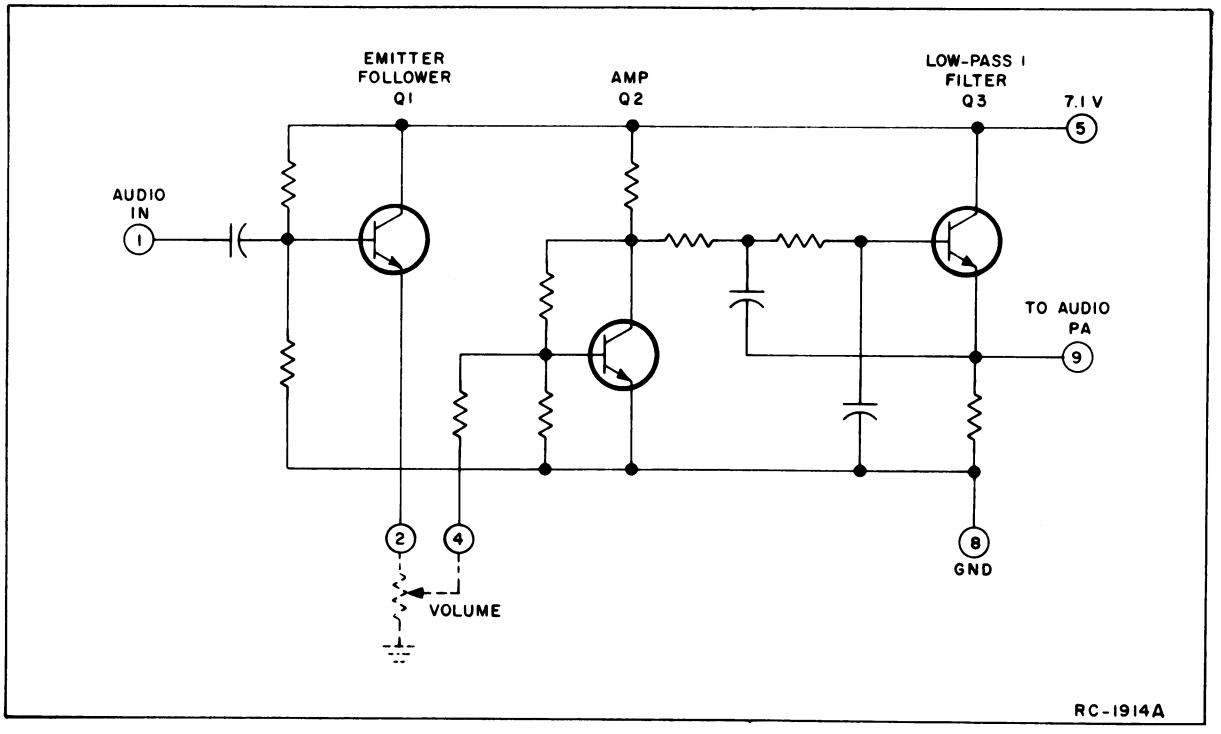


Figure 15 - Typical Audio Amplifier Circuit

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, 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.

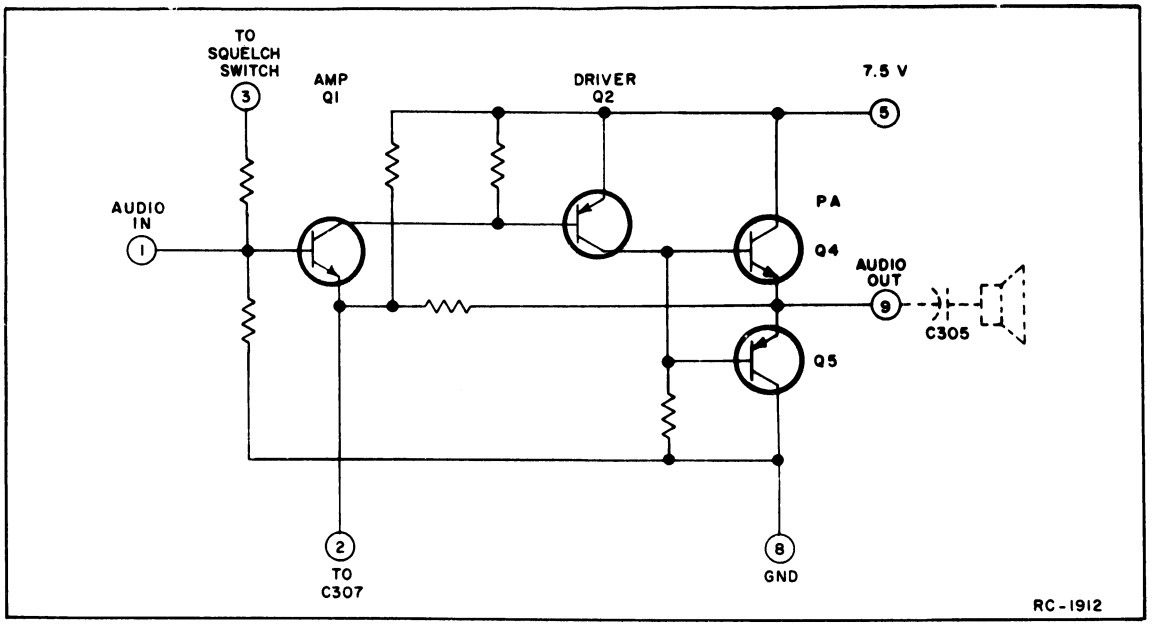


Figure 16 - Typical Audio Circuit

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

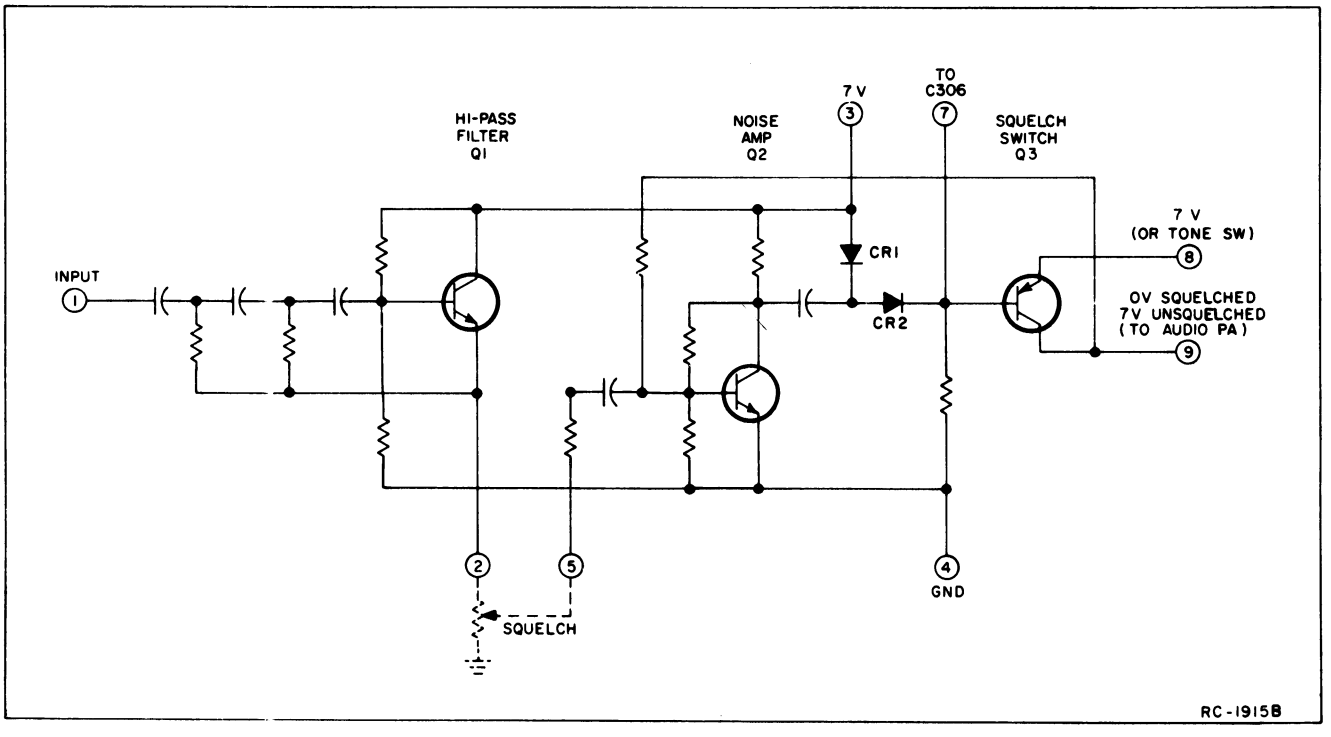


Figure 17 - Typical Squelch Circuit

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.

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.

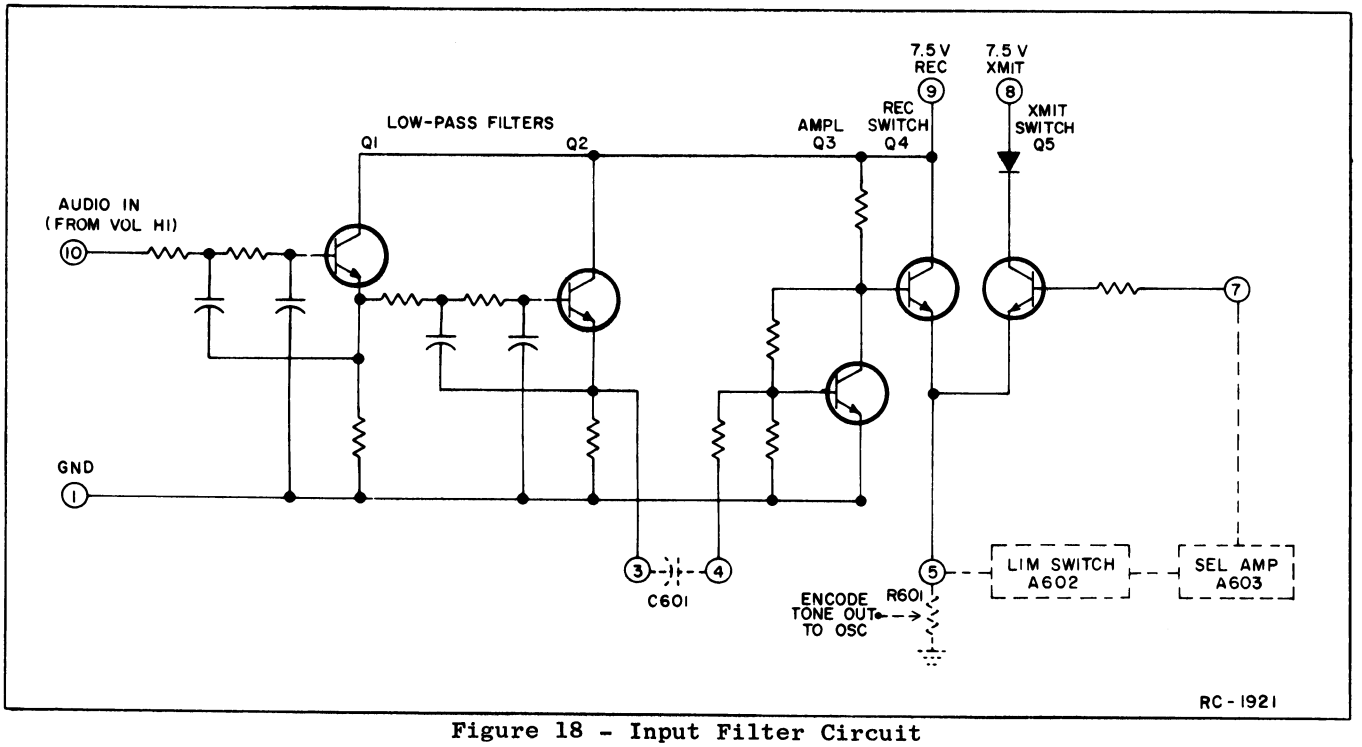


Figure 18 - Input Filter Circuit

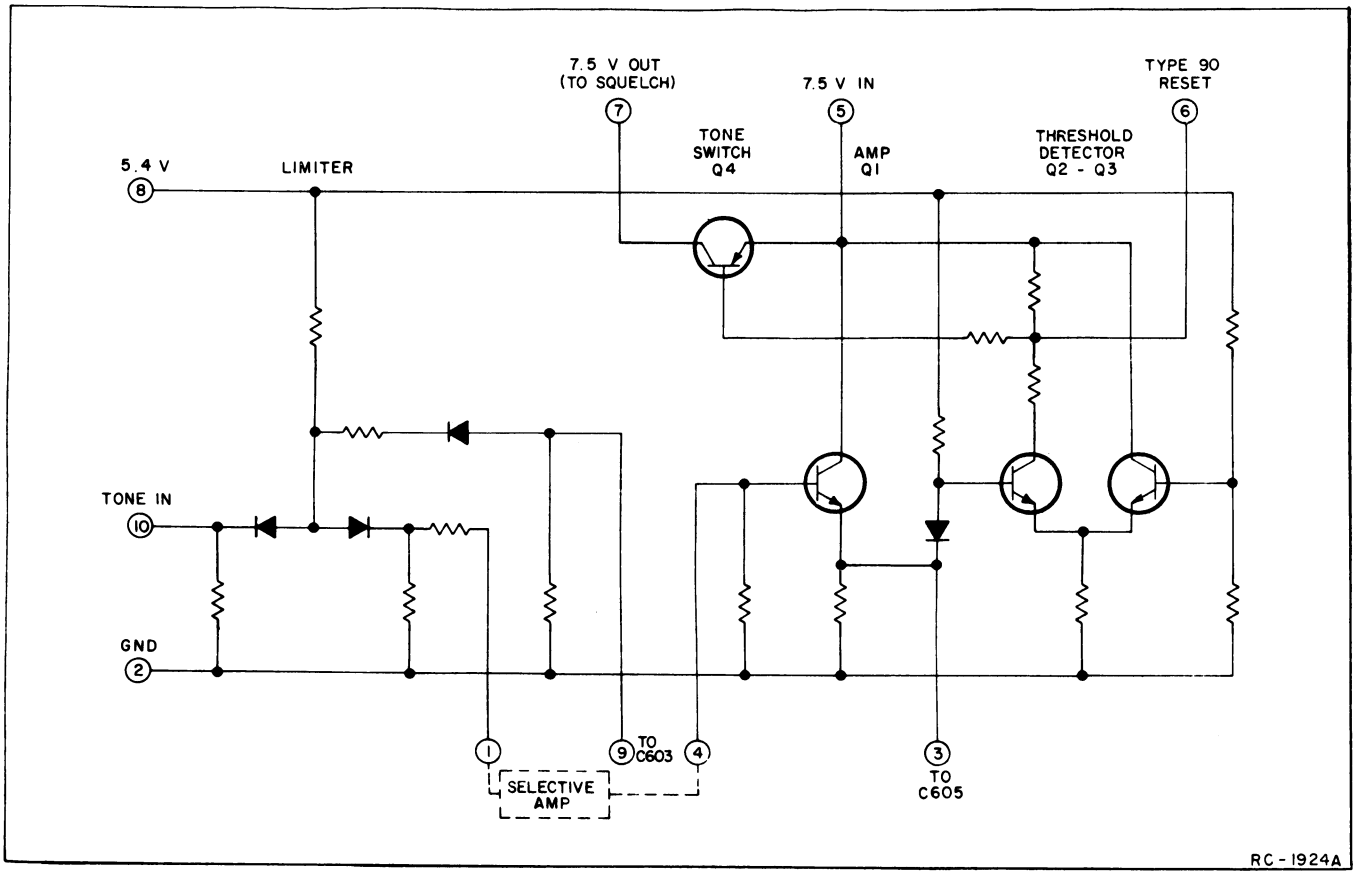


Figure 19 - Limiter-Switch Circuits

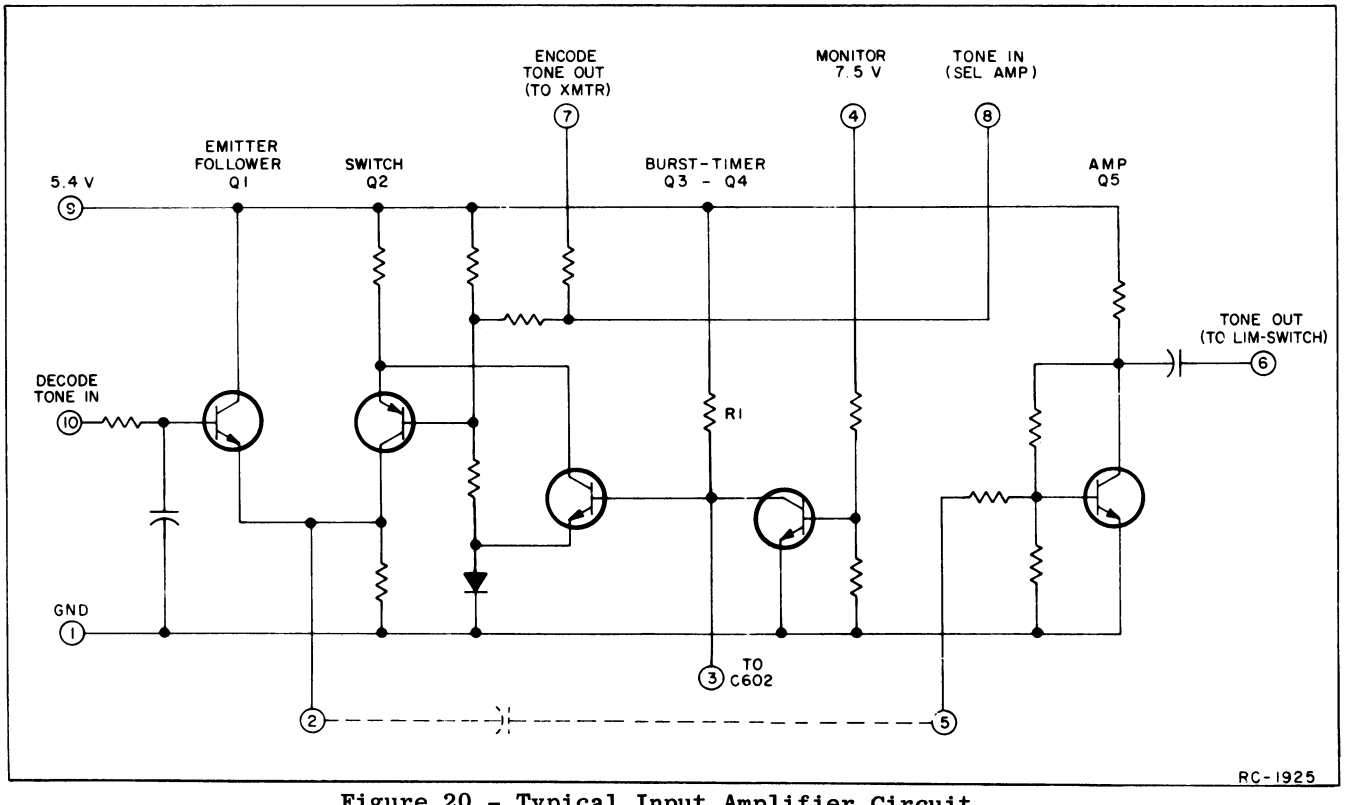


Figure 20 - Typical Input Amplifier Circuit

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.

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. This 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 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.

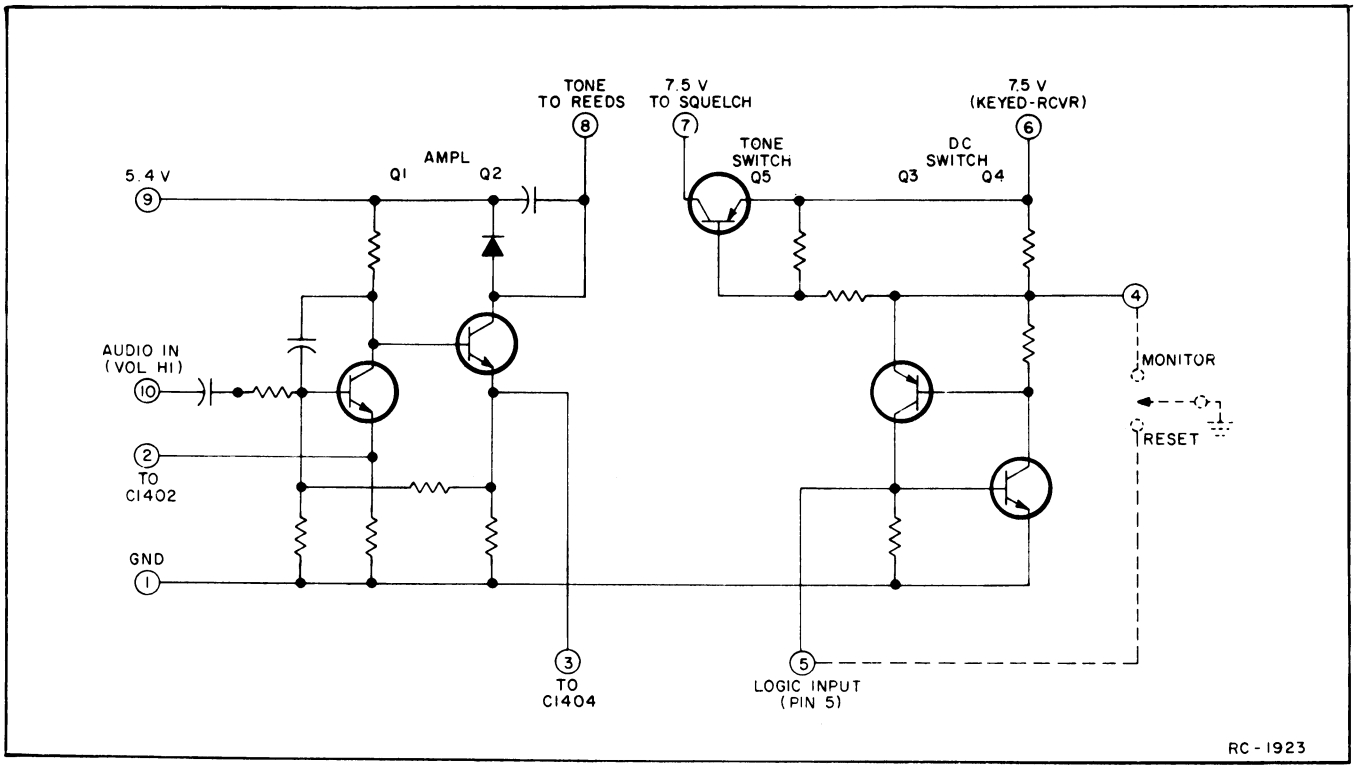


Figure 21 - Amplifier-Switch

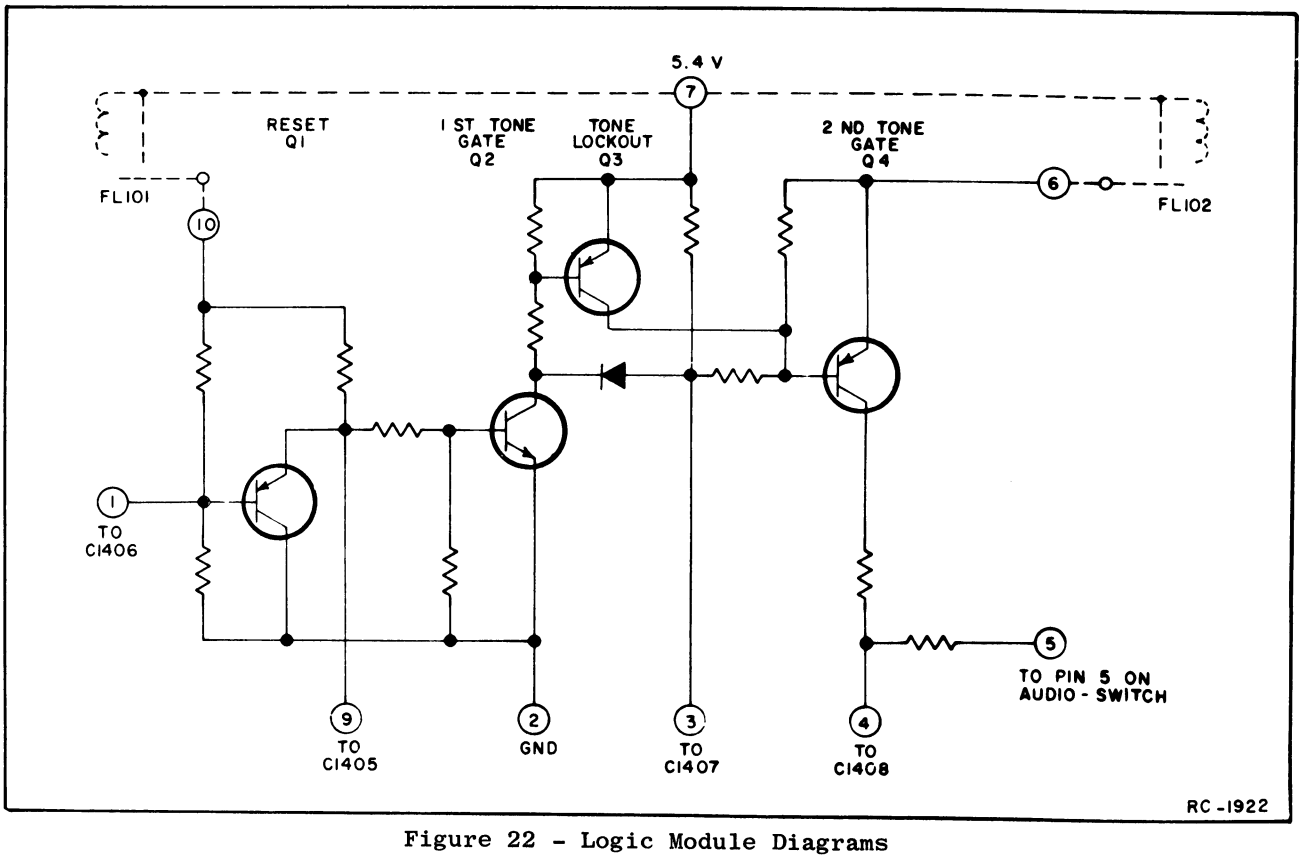


Figure 22 - Logic Module Diagrams

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 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 the transmitter 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-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 FL301 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 cut-off 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 FL102 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.

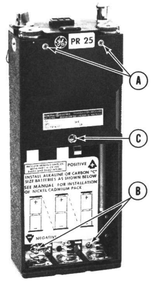
DISASSEMBLY PROCEDURE

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.

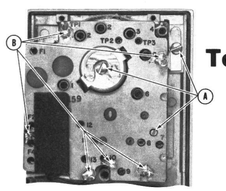


STEP 1.

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.

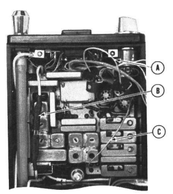
NOTE: When re-assembling the unit, always attach the front cover by first screwing in the captive retaining screw (C) before replacing screws (A) and (B).



STEP 2.

To remove the transmitter board,

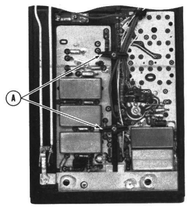
remove the three screws (A) and lift the transmitter off of the front cover. If necessary, remove the transmitter shield by unsoldering the six wire tabs (B).



STEP 3.

To remove the receiver board,

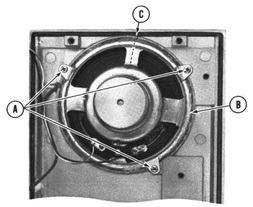
disconnect the two plugs (A) and the cable (B). Lift the receiver board out of the case by the lifting strap (C).



STEP 4.

To remove the audio or tone board,

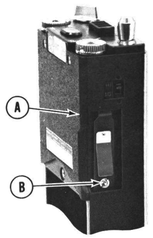
remove the two screws (A) and the two clamps. Carefully lift the board up from the top edge until it clears the clamp mounting posts.



STEP 5.

To replace the speaker-microphone,

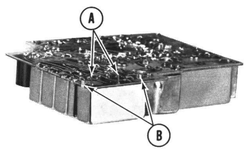
remove the transmitter board according to the directions in Step 2. Remove the three screws (A) and mounting tabs. Then cut around the outside edge of the speaker to separate the weatherproof seal (B). Lift the speaker out of its mounting hole and rub off any of the sealant remaining on the speaker edges. 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. Replace the three mounting tabs and screws.



STEP 6.

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 7.

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 8.

WARNING

The stud mounted RF Power Transistors used in the transmitter contain Beryllium Oxide, a TOXIC substance. If the ceramic or other encapsulation is opened, crushed, broken or abraded, the dust may be hazardous if inhaled. Use care in replacing transistors of this type.

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).

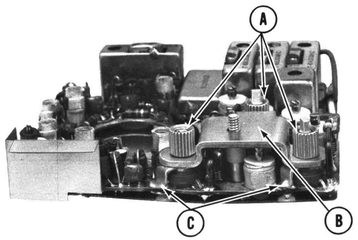
Unsolder the top (C) and bottom (D) ground straps, and unsolder the transistor leads. If replacing Q107, note that one emitter lead is not trimmed, but is soldered to the transmitter shield.

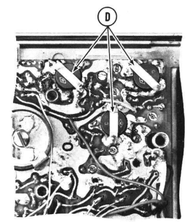
Trim the new transistor leads to the same length as the old, and cut the collector lead at a 45° angle for future identification. If replacing Q106, cut the tip of the stud off approximately 1/8-inch above the threads. (Do not cut into threads).

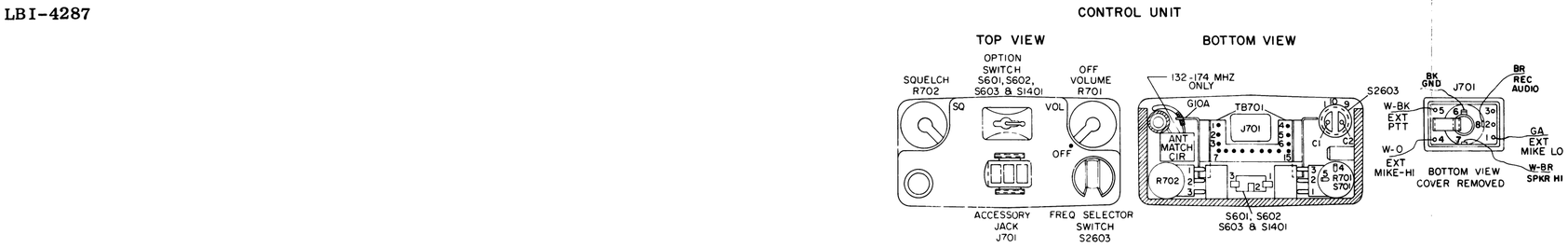
Replace the bottom ground strap (do not solder) and screw down the finned mounting nut finger tight, making sure that the transistor is aligned as shown in the Outline Diagram.

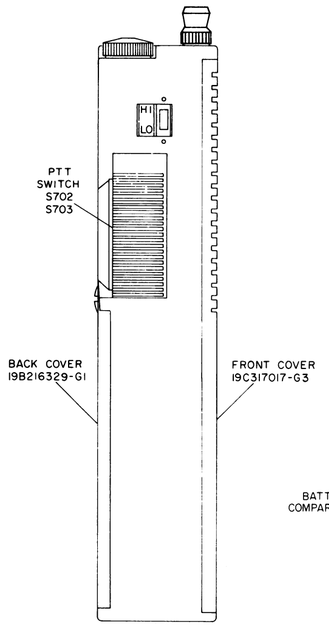
Solder the transistor leads and the top and bottom ground straps to the printed board. If replacing Q107, solder the long collector lead to the transmitter shield when replacing the shield.

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.

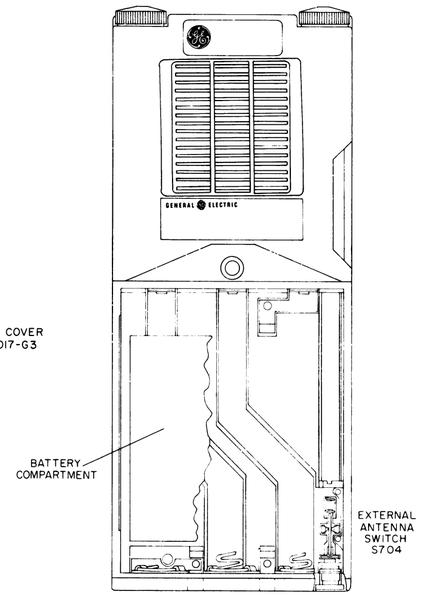




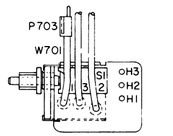


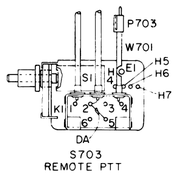


SIDE VIEW



REAR VIEW (COVER REMOVED)





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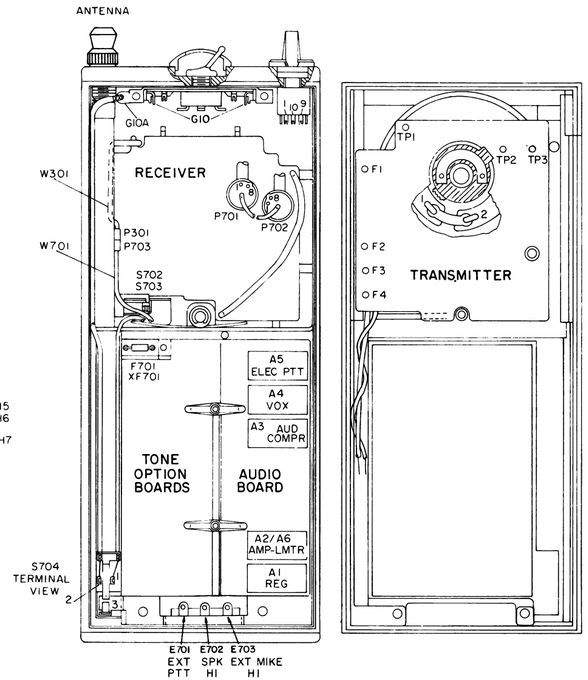


FRONT VIEW (COVER REMOVED)

INSIDE VIEW OF FRONT COVER

MODULE LAYOUT DIAGRAM

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.

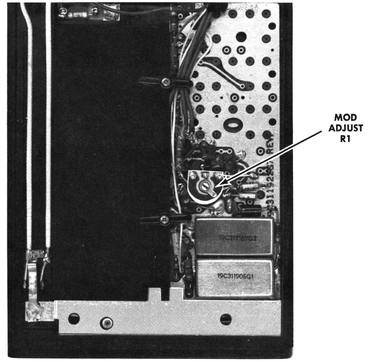
TEST EQUIPMENT

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

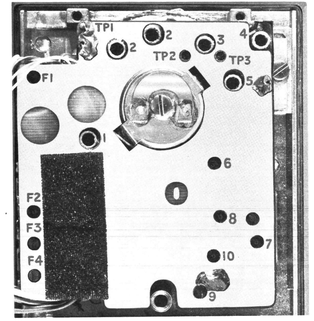
PROCEDURE

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



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 10-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 (L119/L120)	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 TP2.
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 Controls 5 and 4 for maximum transmitter current.
7.	6 (C133)	Maximum mA	Adjust Tuning Control 6 for maximum transmitter current.
8.	7 & 8 (C145 & C144)	Maximum mA	Alternately adjust Tuning Controls 7 and 8 for maximum transmitter current.
9.	9 & 10 (C151 & C150)	Maximum Power Out	Alternately adjust Tuning Controls 9 and 10 for maximum power output.
10.	3 thru 10	Maximum Power Out	Adjust Tuning Control 3 thru 13 for maximum power output.
11.	9 & 10	1.35 amperes maximum	Re-adjust Turning Controls 9 and 10 for the best power output with the lowest transmitter current drain exceeds 1.35 amperes, reduce the current to 1.35 amperes by detuning Tuning C Control 7.
			FREQUENCY ADJUSTMENT
12.			With no modulation, adjust the F1 crystal trimmer for proper oscillator frequency. In multi-frequency units, adjust the F2, F3 or 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:

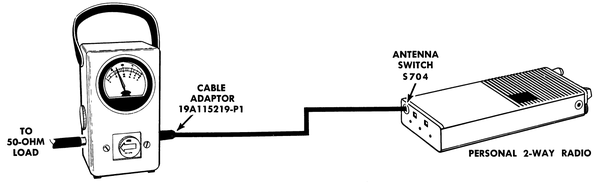
1. Wattmeter similar to:
   Bird # 43
2. VTVM similar to:
   Triplett # 850
   Heath # 1M-21
3. Audio Generator similar to:
   GE Model 4EX6A10 or
   Heath # IG-72
4. Deviation Meter (with a .75 kHz scale) similar to:
   Measurements # 140
   Lampkin # 205A
5. GE Test Adaptor Model 4EX12A10.

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

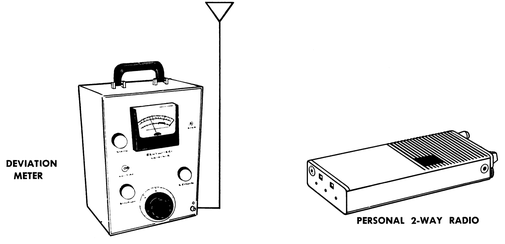
Refer to Service Hints on Transmitter Troubleshooting Procedure.

STEP 2

TONE DEVIATION WITH CHANNEL GUARD

TEST PROCEDURE

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



B. Set MOD adjust R1 for no modulation.

C. 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).

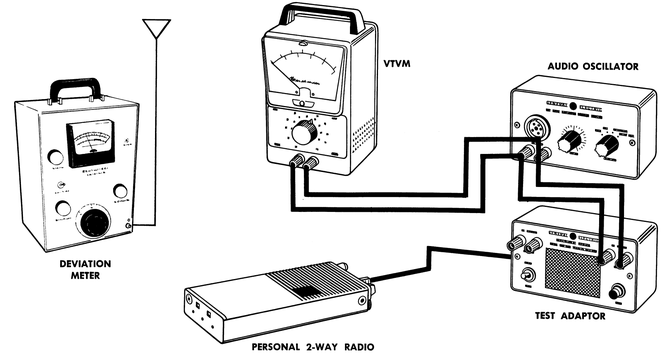
NOTES--The Tone Deviation Test Procedures should be repeated every time the Tone Frequency is changed.

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).

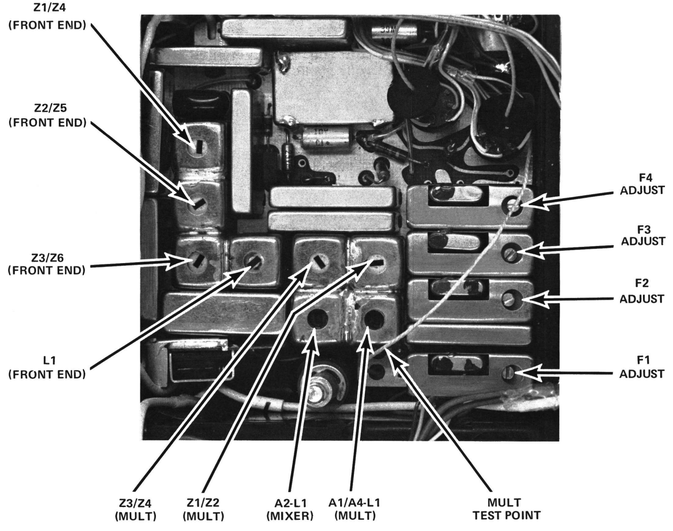
NOTES --MASTR transmitters are adjusted for 4.5 kHz deviation at the factory. The factory adjustment will prevent the transmitter from deviating more than 5.0 kHz under the worst conditions of frequency, voltage and temperature.

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 kHz. Voltage should be LESS than 14 millivolts.

RECEIVER BOARD



RECEIVER ALIGNMENT

EQUIPMENT REQUIRED

1. A 20-HMz signal source (GE IF Generator Model 4EX9A10 or equivalent) and a 132-174 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 Z1/Z2 thru Z3/Z6 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.	A1/A4-L1 (Mult)	Adjust L1 for maximum meter reading.
2.	Z1/Z2 & Z3/Z4 (Mult)	Adjust Z1/Z2 and then Z3/Z4 for a slight change in meter reading.
3.	Z1/Z4 thru Z3/Z6 & L1 (Front End)	Apply on on-frequency signal to P301 and adjust Z1/Z4, Z2/Z5, Z3/Z6 and L1 for best quieting sensitivity.
4.	A2-L1 (Mixer)	Apply on an-frequency signal as above. With the RF probe on Pin 9 of IF Amp A311, tune L1 for maximum meter reading.
5.	A1/A4-L1, Z1/Z2 & Z3/Z4 (Mult)	De-tune A1/A4-L1. Next, increase the on-frequency input signal and tune Z5 and Z6 for best quieting sensitivity. Now re-adjust A1/A4-L1 for maximum meter reading.
		FREQUENCY ADJUSTMENT
6.		While applying an on-frequency signal to P301, loosely couple a 20-MHz signal to the Mixer. 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. Measure the output of the Discriminator with a DC-VTVM at Pin 1 or 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

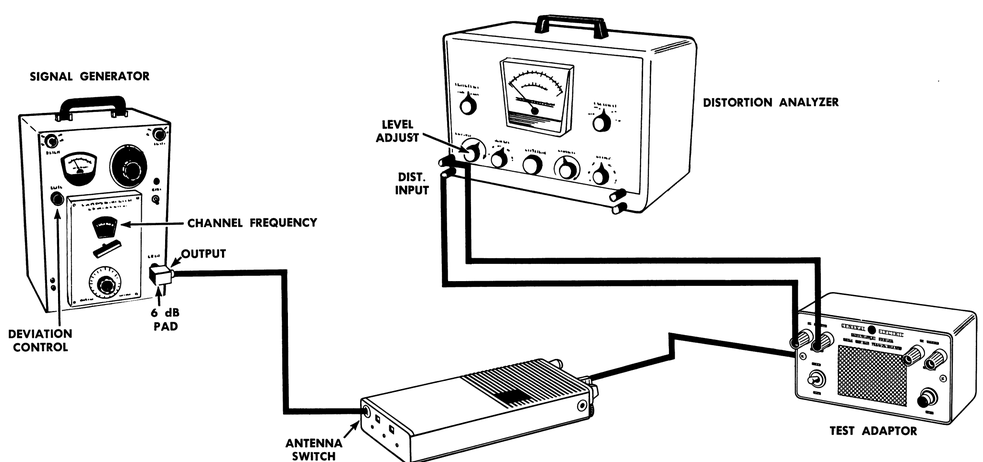
These Test Procedures are designed to help you to service a receiver that is operating---but not properly. The problems encountered could be low power, poor sensitivity, distortion, and low gain. By following the sequence of test steps starting with Step 1, the defect can be quickly localized. Once the 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 0.25 microvolts with audio output at least 250 milliwatts.

SERVICE CHECK

If the sensitivity level is more than 0.25 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.

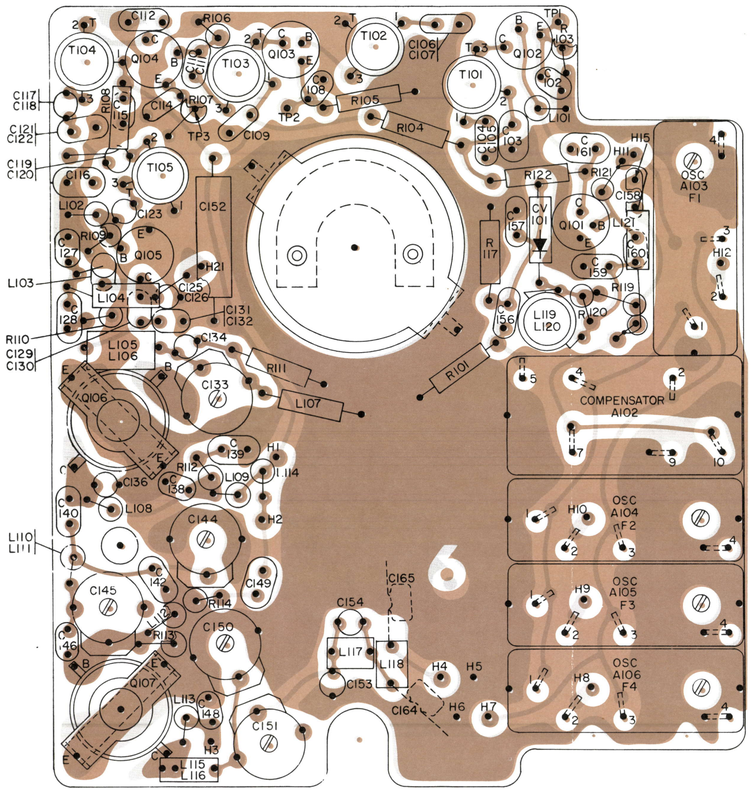
E. Set CONTROL from LEVEL to DISTORTION reading. Repeat Steps 3C, 3D and 3E until difference between readings becomes 12 dB (from +2 dB to -10 dB).

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

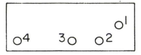


RUNS ON SOLDER SIDE
RUNS ON BOTH SIDES
RUNS ON COMPONENT SIDE

(19D413585, Rev. 6)
(19D413193, Sh. 1, Rev. 6)
(19D413193, Sh. 2, Rev. 6)

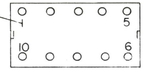
LEAD IDENTIFICATION
(TERMINAL VIEW)

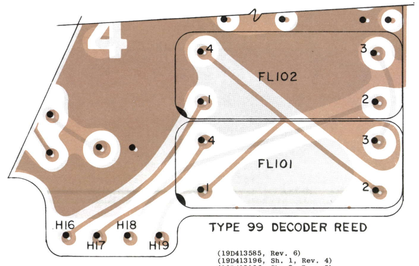
OSCILLATOR MODULE



INTEGRATED CIRCUIT MODULE

INDICATES PIN 1

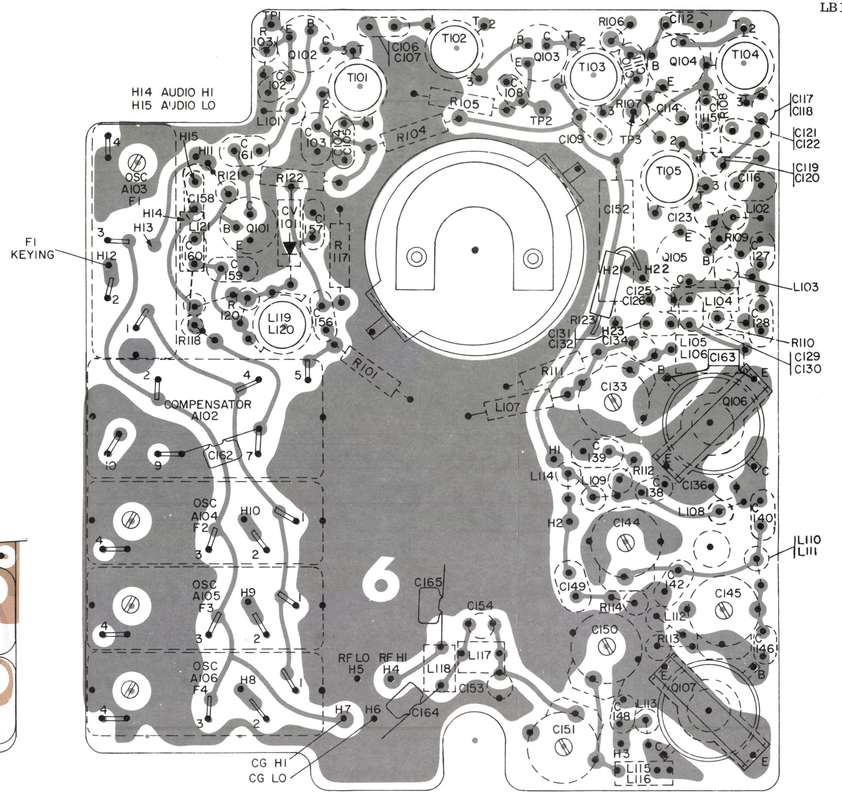




TYPE 99 DECODER REED

(19D413585, Rev. 6)
(19D413196, Sh. 1, Rev. 4)
(19D413196, Sh. 2, Rev. 5)

SOLDER SIDE



Denotes Solder Side

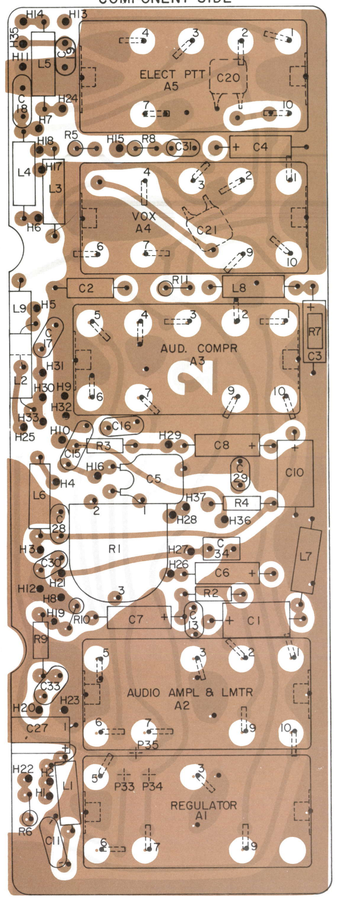
(19D413585, Rev. 6)
(19D413193, Sh. 2, Rev. 6)

(DF-9022)

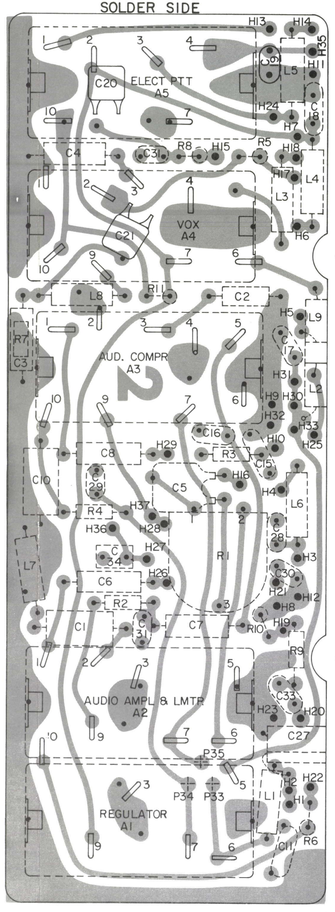
OUTLINE DIAGRAM

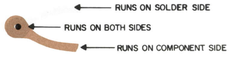
132—174 MHz PERSONAL SERIES
TRANSMITTER PA ASSEMBLY

COMPONENT SIDE

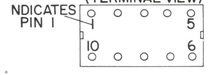


SOLDER SIDE





INTEGRATED CIRCUIT
LEAD IDENTIFICATION
(TERMINAL VIEW)



OUTLINE DIAGRAM

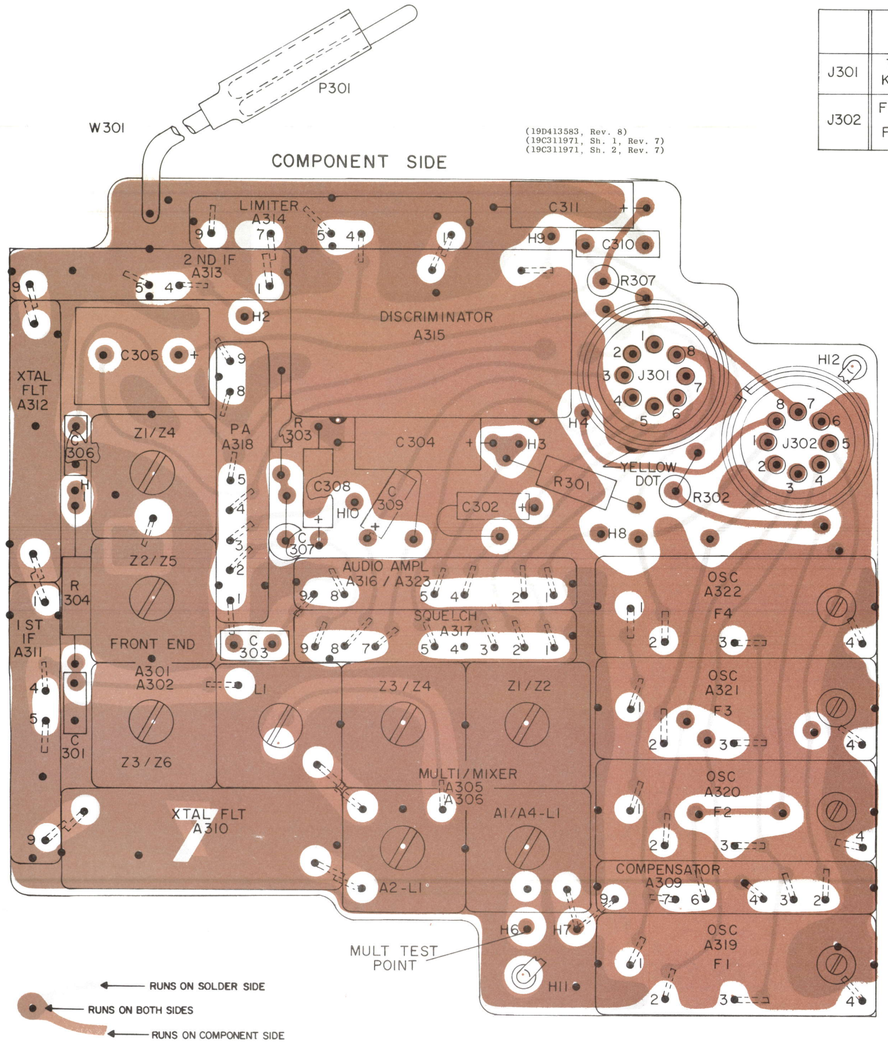
132—174 MHz PERSONAL SERIES
AUDIO BOARD 19C317616

(19C317999, Rev. 3)
(19C317772, Sh. 1, Rev. 2)
(19C317772, Sh. 2, Rev. 2)

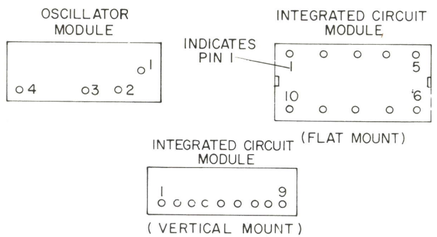
(19C317999, Rev. 3)
(19C317772, Sh. 2, Rev. 2)

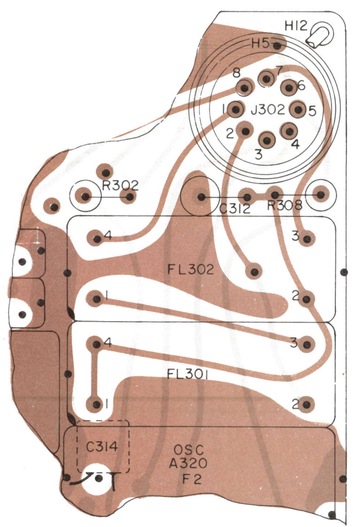
Denotes Solder Side

	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



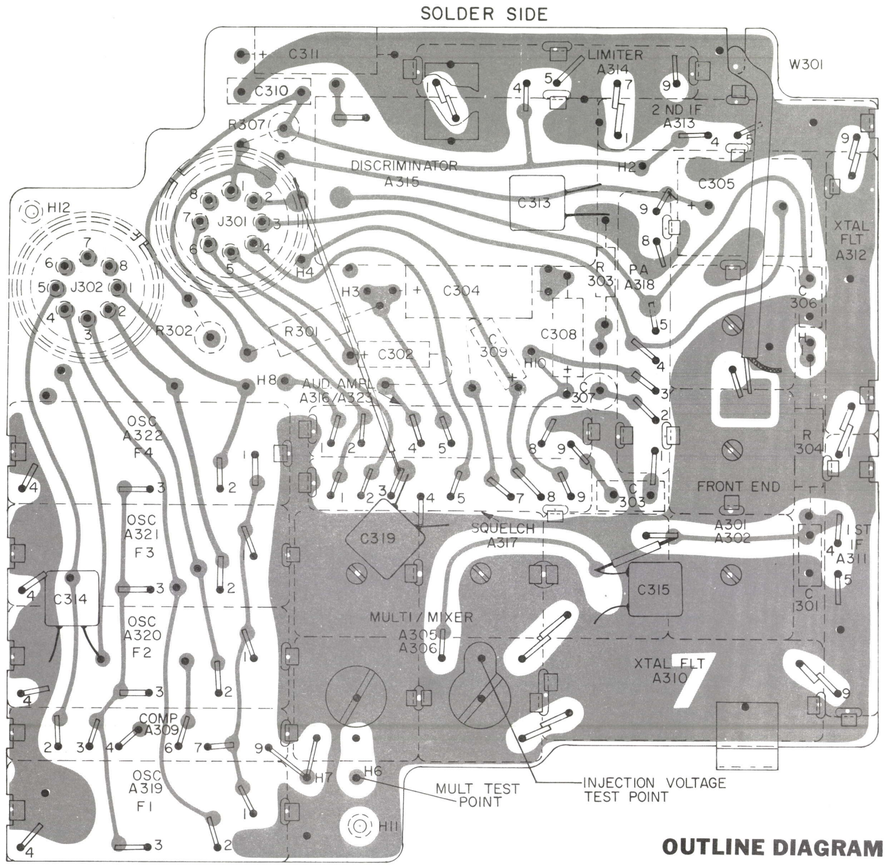
LEAD IDENTIFICATION (TERMINAL VIEW)





(19D413583, Rev. 8)
(19C311970, Sh. 1, Rev. 5)
(19C311970, Sh. 2, Rev. 5)

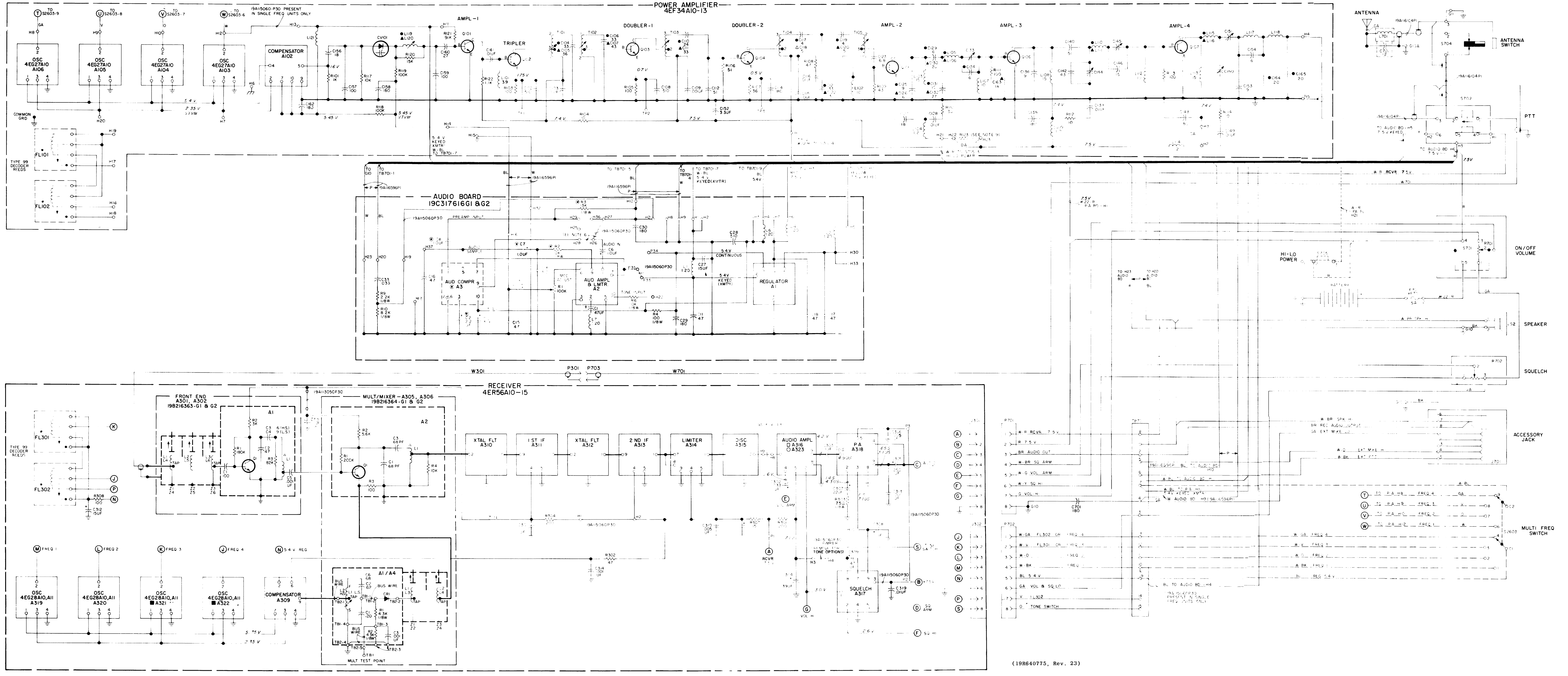
(19D413583, Rev. 8)
(19C311971, Sh. 2, Rev. 7)



Denotes Solder Side

OUTLINE DIAGRAM

132—174 MHz PERSONAL SERIES
RECEIVER MODEL 4ER56A10-15



NOTES

1. ALL WIRES ARE SFT28 EXCEPT AS NOTED.
2. COMPONENTS MARKED WITH ● ARE PRESENT IN PA MODELS 4EF34A11 & A13 ONLY. COMPONENTS MARKED WITH ▲ ARE PRESENT IN PA MODELS 4EF34A10 & A12 ONLY.
3. OSCILLATORS MARKED WITH ■ ARE PRESENT IN 4EF34A10 & A11 PA MODELS 4ER56A10-A13 RECEIVER MODELS ONLY.
4. COMPONENTS MARKED BY ✱ ARE PRESENT IN POWER AMPL MODELS 4EF34A12 & A13 RECEIVER MODELS 4ER56A14 & A15 ONLY.
5. AUDIO AMPLIFIER MARKED WITH □ PRESENT IN 4ER56A10, A11, A14 & A15 ONLY. AUDIO AMPLIFIER MARKED WITH ○ PRESENT IN 4ER56A12 & A13 ONLY.
6. FOR GROUP 2 AUDIO BD REMOVE JUMPER BETWEEN H26 & H27 AND ADD JUMPER BETWEEN H26 & H28 & SLEEVE.
7. COMPONENTS MARKED WITH ◉ ARE PRESENT IN GROUP 2 AUDIO BOARD ONLY.
8. CONNECTIONS SHOWN AS DASHED LINES ARE OPTIONAL AND NOT PART OF OF STANDARD WIRING.
9. FOR HI-LO POWER OPTION REMOVE DA WIRE FROM H22 TO H23 AND ADD R123. VALUE OF R123 VARIES FROM 33 TO 390Ω. VALUE SELECTED AT TEST FOR OPTIMUM LOW POWER PERFORMANCE.

MODEL NO.	REV	FREQ. RANGE (MHZ)	NO. OF FREQ.	TONE OPTION
PA BOARD				
4EF34A10	J	132-150.8	1 THRU 4	
4EF34A11	K	150.8-174	1 THRU 4	
4EF34A12	J	132-150.8	1 OR 2	TYPE 99
4EF34A13	K	150.8-174	1 OR 2	TYPE 99
RECEIVER				
4ER56A10	F	132-150.8	1 THRU 4	
4ER56A11	G	150.8-174	1 THRU 4	
4ER56A12	F	132-150.8	1 THRU 4	CHAN. GD.
4ER56A13	G	150.8-174	1 THRU 4	CHAN. GD.
4ER56A14	F	132-150.8	1 OR 2	TYPE 99
4ER56A15	G	150.8-174	1 OR 2	TYPE 99
PL NUMBER	REV	CONTROL	AUDIO COMPR	
AUDIO BOARD				
19C317616G1		LOCAL PTT		
19C317616 G2		LOCAL PTT	X	
19E500885G3	G			
BTRY PK				
19C317000G1	A			

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 IN 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

132—174 MHz PERSONAL SERIES TRANSMITTER-RECEIVER WITH LOCAL PTT

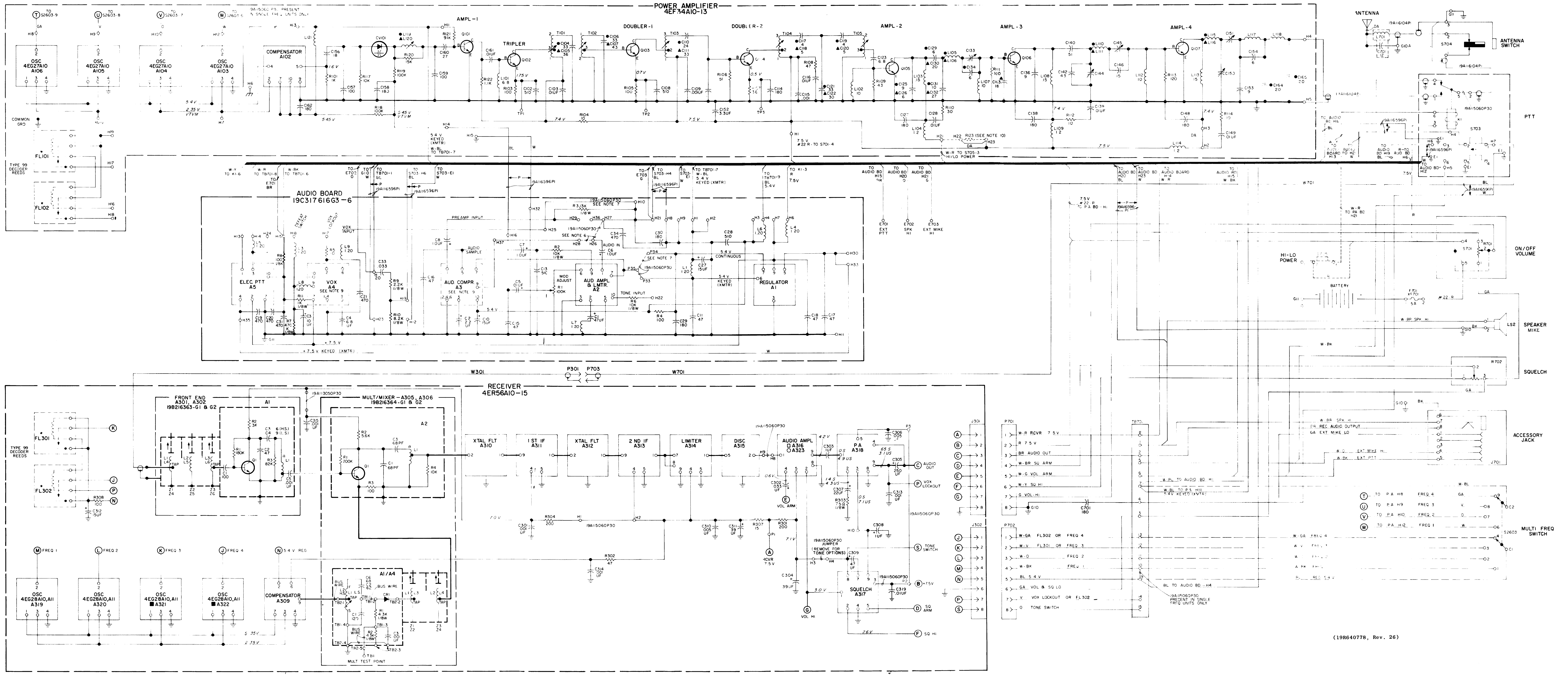
PARTS LIST

LBI-4289E

132-174 MHz TRANSMITTER-RECEIVER
PR36

SYMBOL	GE PART NO.	DESCRIPTION
		POWER AMPLIFIER 4EF34A10-13 (19D413203G1-G4)
A102	19C311891G3	Compensator.
		NOTE: (When reordering A103-A106 give GE Part No. and specify exact frequency needed).
A103 thru A106	4EG27A10	Transmitter Oscillator.
		- - - - - - - - - CAPACITORS - - - - - - - - -
C102	19A116114P13090	Ceramic: 510 pf ±5%, 100 VDCW; temp coef -5600 PPM.
C103	19A116192P1	Ceramic: 0.01 µf ±20%, 50 VDCW; sim to Erie 8121-050-W5R.
C104	19A116114P2047	Ceramic: 33 pf ±5%, 100 VDCW; temp coef -80 PPM.
C105	19A116114P2048	Ceramic: 36 pf ±5%, 100 VDCW; temp coef -80 PPM.
C106	19A116114P2047	Ceramic: 33 pf ±5%, 100 VDCW; temp coef -80 PPM.
C107	19A116114P2051	Ceramic: 43 pf ±5%, 100 VDCW; temp coef -80 PPM.
C108	19A116114P13090	Ceramic: 510 pf ±5%, 100 VDCW; temp coef -5600 PPM.
C109	5495323P12	Ceramic: .001 µf +100% -20%, 75 VDCW.
C110	19A116114P2042	Ceramic: 24 pf ±5%, 100 VDCW; temp coef -80 PPM.
C111	19A116114P2047	Ceramic: 33 pf ±5%, 100 VDCW; temp coef -80 PPM.
C112	19A116114P2054	Ceramic: 51 pf ±5%, 100 VDCW; temp coef -80 PPM.
C114	19A116114P10073	Ceramic: 180 pf ±10%, 100 VDCW; temp coef -3300 PPM.
C115	5495323P12	Ceramic: .001 µf +100% -20%, 75 VDCW.
C116	19A116192P1	Ceramic: 0.01 µf ±20%, 50 VDCW; sim to Erie 8121-050-W5R.
C117	19A116114P14	Ceramic: 4 pf ±5%, 100 VDCW.
C118	19A116114P18	Ceramic: 5 pf ±5%, 100 VDCW.
C119	19A116114P14	Ceramic: 4 pf ±5%, 100 VDCW.
C120	19A116114P18	Ceramic: 5 pf ±5%, 100 VDCW.
C121	19A116114P2047	Ceramic: 33 pf ±5%, 100 VDCW; temp coef -80 PPM.
C122	19A116114P2045	Ceramic: 30 pf ±5%, 100 VDCW; temp coef -80 PPM.
C123	19A116114P22	Ceramic: 6.8 pf ±5%, 100 VDCW.
C125	19A116114P30	Ceramic: 9 pf ±5%, 100 VDCW.
C126	19A116114P20	Ceramic: 6 pf ±5%, 100 VDCW.
C127	19A116114P10073	Ceramic: 180 pf ±10%, 100 VDCW; temp coef -3300 PPM.
C128	19A116192P1	Ceramic: 0.01 µf ±20%, 50 VDCW; sim to Erie 8121-050-W5R.
C129	19A116114P20	Ceramic: 6 pf ±5%, 100 VDCW.
C130	19A116114P2039	Ceramic: 20 pf ±5%, 100 VDCW.
C131	19A116114P32	Ceramic: 10 pf ±5%, 100 VDCW.
C132	19A116114P2044	Ceramic: 27 pf ±5%, 100 VDCW; temp coef -80 PPM.
C133	19A116163P3	Variable: approx 3 to 17 pf, 50 VDCW; sim to Amperex HT10KA/218.
C134	19A116114P20	Ceramic: 6 pf ±5%, 100 VDCW.
C136	19A116114P30	Ceramic: 9 pf ±5%, 100 VDCW.
C138	19A116114P10073	Ceramic: 180 pf ±10%, 100 VDCW; temp coef -3300 PPM.
C139	19A116192P1	Ceramic: 0.01 µf ±20%, 50 VDCW; sim to Erie 8121-050-W5R-103M.
C140	19A116114P2054	Ceramic: 51 pf ±5%, 100 VDCW; temp coef -80 PPM.
C142*	19A116114P2051	Ceramic: 43 pf ±5%, 100 VDCW; temp coef -80 PPM. Deleted by REV D in 4EF34A11, 13; Added by REV E to 4EF34A11, 13.
C144 and C145	19A116163P3	Variable: approx 3 to 17 pf, 50 VDCW; sim to Amperex HT10KA/218.
C146*	19A116114P2036	Ceramic: 15 pf ±5%, 100 VDCW; temp coef -80 PPM.
		In 4EF34A11, 13 REV D:
	19A116114P2045	Ceramic: 30 pf ±5%, 100 VDCW; temp coef -80 PPM.
		In 4EF34A11, 13 of REV C and earlier:
	19A116114P2036	Ceramic: 15 pf ±5%, 100 VDCW; temp coef -80 PPM.
C148	19A116114P10073	Ceramic: 180 pf ±10%, 100 VDCW; temp coef -3300 PPM.
C149	19A116192P1	Ceramic: 0.01 µf ±20%, 50 VDCW; sim to Erie 8121-050-W5R-103M.
C150 and C151	19A116163P3	Variable: approx 3 to 17 pf, 50 VDCW; sim to Amperex HT10KA/218.
C152	5496267P9	Tantalum: 3.3 µf ±20%, 15 VDCW; sim to Sprague Type 150D.
C153	19A116114P30	Ceramic: 9 pf ±5%, 100 VDCW.
C154	19A116114P20	Ceramic: 6 pf ±5%, 100 VDCW.
C156	19A116114P38	Ceramic: 18 pf ±5%, 100 VDCW.
C157	19A116114P7065	Ceramic: 100 pf ±5%, 100 VDCW; temp coef -750 PPM.
C158	19A116114P10073	Ceramic: 180 pf ±10%, 100 VDCW; temp coef -3300 PPM.
C159	19A116114P7065	Ceramic: 100 pf ±5%, 100 VDCW; temp coef -750 PPM.
C160	19A116114P2044	Ceramic: 27 pf ±5%, 100 VDCW; temp coef -80 PPM.
C161	19A116192P1	Ceramic: 0.01 µf ±20%, 50 VDCW; sim to Erie 8121-050-W5R-103M.
C162	19A116114P10074	Ceramic: 180 pf ±10%, 100 VDCW; temp coef -3300 PPM.
C163	19A116114P38	Ceramic: 18 pf ±5%, 100 VDCW.
C164* and C165*	19A116114P2039	Ceramic: 20 pf ±5%, 100 VDCW; temp coef -80 PPM. Added to 4EF34A11, 13 by REV E.
		- - - - - - - DIODES AND RECTIFIERS - - - - - -
CV101	5495769P9	Varactor, silicon: 33 µµf ±10%, at 4 VDC; sim Pacific Semiconductors Varicap Type V-596.
		- - - - - - - - - - FILTERS - - - - - - - - - -
FL101 and FL102		Reeds. Refer to Type 99 Decoder Parts List.
		- - - - - - - - - - INDUCTORS - - - - - - - - -
L101	19B209420P123	Coil, RF: 6.80 µh ±10%, 1.80 ohms DC res max; sim to Jeffers 4446-2.
L102	19B209420P125	Coil, RF: 10.0 µh ±10%, 3.10 ohms DC res max; sim to Jeffers 4446-4.
L103	19B209420P103	Coil, RF: 0.15 µh ±10%, 0.14 ohms DC res max; sim to Jeffers 4416-3.
L104	19B209420P114	Coil, RF: 1.20 µh ±10%, 0.18 ohms DC res max; sim to Jeffers 4436-1.
L105	19B216320P1	Coil.
L106	19B216320P2	Coil.
L107	19B209420P125	Coil, RF: 10.0 µh ±10%, 3.10 ohms DC res max; sim to Jeffers 4446-4.
L108	19B209420P103	Coil, RF: 0.15 µh ±10%, 0.14 ohms DC res max; sim to Jeffers 4416-3.
L109	19B209420P114	Coil, RF: 1.20 µh ±10%, 0.18 ohms DC res max; sim to Jeffers 4436-1.
L110	19B216425P1	Coil.
L111	19B216425P2	Coil.
L112	19B209420P125	Coil, RF: 10.0 µh ±10%, 3.10 ohms DC res max; sim to Jeffers 4446-4.
L113	19B209420P103	Coil, RF: 0.15 µh ±10%, 0.14 ohms DC res max; sim to Jeffers 4416-3.
L114	19B209420P114	Coil, RF: 1.20 µh ±10%, 0.18 ohms DC res max; sim to Jeffers 4436-1.
L115	19B216320P4	Coil.
L116	19B216320P5	Coil.
L117 and L118	19B216320P3	Coil.
L119	19B216580G2	Coil. Includes:
	19B200497P5	Tuning slug.
L120	19B216580G1	Coil. Includes:
	19B200497P5	Tuning slug.
L121	19B209420P114	Coil, RF: 1.20 µh ±10%, 0.18 ohms DC res max; sim to Jeffers 4436-1.
		- - - - - - - - - TRANSISTORS - - - - - - - - -
Q101*	19A116860P1	Silicon, NPN; sim to Type 2N4996.
		In 4EF34A10, 12 of REV E and earlier: In 4EF34A11, 13 of REV F and earlier:
	19A115330P1	Silicon, NPN.
Q102* and Q103*	19A115328P1	Silicon, NPN.
		In 4EF34A10, 12 of REV E and earlier: In 4EF34A11, 13 of REV F and earlier:
	19A115330P1	Silicon, NPN.
Q104*	19A116201P1	Silicon, NPN.
		In 4EF34A10, 12 of REV H and earlier: In 4EF34A11, A13 of REV J and earlier:
	19A115328P1	Silicon, NPN.
Q105	19A116201P1	Silicon, NPN.
Q106*	19A116191P2	Silicon, NPN.
		In 4EF34A10, 12 of REV D and earlier: In 4EF34A11, 13 of REV E and earlier:
	19A116189P1	Silicon, NPN.
Q107	19A116191P1	Silicon, NPN.
		- - - - - - - - - - RESISTORS - - - - - - - - -
R101	3R152P102J	Composition: 1000 ohms ±5%, 1/4 w.
R103	3R152P101J	Composition: 100 ohms ±5%, 1/4 w.
R104	3R152P100K	Composition: 10 ohms ±10%, 1/4 w.
R105	3R152P101J	Composition: 100 ohms ±5%, 1/4 w.
R106*	3R152P510J	Composition: 51 ohms ±5%, 1/4 w.
		In 4EF34A10, 12 of REV H and earlier: In 4EF34A11, 13 of REV J and earlier:
	3R152P101J	Composition: 100 ohms ±5%, 1/4 w.
R107	3R152P360J	Composition: 36 ohms ±5%, 1/4 w.
R108	3R152P470J	Composition: 47 ohms ±5%, 1/4 w.
R109*	3R152P430J	Composition: 43 ohms ±5%, 1/4 w.
		In 4EF34A10, 12 of REV F and earlier: In 4EF34A11, 13 of REV G and earlier:
	3R152P221K	Composition: 220 ohms ±10%, 1/4 w.
R110	3R152P300J	Composition: 30 ohms ±5%, 1/4 w.
R111	3R152P101J	Composition: 100 ohms ±5%, 1/4 w.
R112	3R152P100K	Composition: 10 ohms ±10%, 1/4 w.
R113	3R152P121J	Composition: 120 ohms ±5%, 1/4 w.
R114	3R152P100K	Composition: 10 ohms ±10%, 1/4 w.
R117	3R152P103K	Composition: 10,000 ohms ±10%, 1/4 w.
R118 and R119	3R152P104K	Composition: 0.10 megohm ±10%, 1/4 w.
R120	3R152P153J	Composition: 15,000 ohms ±5%, 1/4 w.
R121*	3R152P913J	Composition: 91,000 ohms ±5%, 1/4 w.
		In 4EF34A10, 12 of REV E and earlier: In 4EF34A11, 13 of REV F and earlier:
	3R152P303J	Composition: 30,000 ohms ±5%, 1/4 w.
R122	3R152P112J	Composition: 1100 ohms ±5%, 1/4 w.
R123*		Deleted in 4EF34A10, 12 by REV H. Deleted in 4EF34A11, 13 by REV J. Refer to Hi/Lo Power Option (19A129432G1) in this parts list for R123.
		- - - - - - - - - TRANSFORMERS - - - - - - - -
T101	19B216579G1	Coil. Includes:
	19B200497P5	Tuning slug.
T102	19B216579G2	Coil. Includes:
	19B200497P5	Tuning slug.
T103	19B216579G3	Coil. Includes:
	19B200497P5	Tuning slug.
T104	19C311854G2	Coil. Includes:
	19B200497P5	Tuning slug.
T105	19C311854G3	Coil. Includes:
	19B200497P5	Tuning slug.
		AUDIO BOARD 19C317616G1 thru G6
A1	19C311905G1	Regulator.
A2	19C317167G2	Audio Amplifier and Limiter.
A3	19C311907G1	Audio Compressor.
A4	19C311898G1	Voice Operated Transmitter (VOX)
A5	19C311908G1	Electronic Push-To-Talk.
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C1	5491674P26	Tantalum: 47 µf ±20%, 4 VDCW; sim to Sprague Type 162D.
C2	5491674P23	Tantalum: 2.2 µf ±20%, 15 VDCW; sim to Sprague Type 162D.
C3*	5491674P2	Tantalum: 10 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
		Earlier than REV A:
	5491674P33	Tantalum: 6.8 µf ±20%, 4 VDCW; sim to Sprague Type 162D.
C4	5491674P33	Tantalum: 6.8 µf ±20%, 4 VDCW; sim to Sprague Type 162D.
C5	19A116192P1	Ceramic: 0.01 µf ±20%, 50 VDCW; sim to Erie 8121-050-W5R.
C6 thru C8	5491674P28	Tantalum: 1.0 µf ±20%, 25 VDCW; sim to Sprague Type 162D.
C10	5491674P34	Tantalum: 15 µf ±20%, 6 VDCW; sim to Sprague Type 162D.
C11	19A116114P6052	Ceramic: 47 pf ±10%, 100 VDCW; temp coef -470 PPM.
C13	5491500P1	Ceramic: 510 pf, ±10%, 75 VDCW, temp coef -5600 PPM.
C15 thru C18	19A116114P6052	Ceramic: 47 pf ±10%, 100 VDCW; temp coef -470 PPM.
C19 thru C21	19A116192P2	Ceramic: 470 pf ±20%, 50 VDCW; sim to Erie 8111-050-W5R.
C27	19C307102P14	Tantalum: 15 µf ±20%, 10 VDCW; sim to Components Inc G156R.
C28	5491500P1	Ceramic: 510 pf, ±10%, 75 VDCW, temp coef -5600 PPM.
C29 and C30	19A116114P10073	Ceramic: 180 pf ±10%, 100 VDCW; temp coef -3300 PPM.
C31	19A116192P2	Ceramic: 470 pf ±20%, 50 VDCW; sim to Erie 8111-050-W5R.
C33	19A116244P6	Ceramic: .033 µf ±20%, 50 VDCW.
C34*	19A116192P2	Ceramic: 470 pf ±20%, 50 VDCW; sim to Erie 8111-050-W5R. Added to 19C317616G5, G6 by REV B.
		- - - - - - - - - - INDUCTORS - - - - - - - -
L1 thru L9	19B209420P114	Coil, RF: 1.20 µh ±10%, 0.18 ohms DC res max; sim to Jeffers 4436-1.
		- - - - - - - - - - RESISTORS - - - - - - - - -
R1	19A116563P2	Variable, carbon film: 100,000 ohms ±20%, 0.05 w; sim to Amperex E086-BD.
R2	3R151P103K	Composition: 10,000 ohms ±10%, 1/8 w.
R3	3R151P133J	Composition: 13,000 ohms ±5%, 1/8 w.
R4	3R151P101K	Composition: 100 ohms ±10%, 1/8 w.
R5	3R151P100K	Composition: 10 ohms ±10%, 1/8 w.
R6	3R151P103K	Composition: 10,000 ohms ±10%, 1/8 w.
R7	3R151P474K	Composition: 0.47 megohm ±10%, 1/8 w.
R8	3R151P101K	Composition: 100 ohms ±10%, 1/8 w.
R9	3R151P222J	Composition: 2200 ohms ±5%, 1/8 w.
R10	3R151P822J	Composition: 8200 ohms ±5%, 1/8 w.
R11	3R151P102K	Composition: 1000 ohms ±10%, 1/8 w.
		RECEIVER 4ER56A10 (19D413197G1) 4ER56A11 (19D413197G3) 4ER56A12 (19D413197G9) 4ER56A13 (19D413197G10) 4ER56A14 (19D413197G2) 4ER56A15 (19D413197G4)
A301 and A302		FRONT END A301 19B216363G1 132-150.8 MHz A302 19B216363G2 150.8-174 MHz
A3 and A4		RF AMPLIFIER A3 19C317623G1 A4 19C317623G2
		- - - - - - - - - CAPACITORS - - - - - - - - -
C1	19A116114P11064	Ceramic: 100 pf ±10%, 100 VDCW; temp coef -4200 PPM.
C2	19A116114P8053	Ceramic: 47 pf ±5%, 100 VDCW; temp coef -1500 PPM.
C3	19A116114P2020	Ceramic: 6 pf ±5%, 100 VDCW; temp coef -80 PPM.
C4	19A116114P2030	Ceramic: 9 pf ±5%, 100 VDCW; temp coef -80 PPM.
C5	5495323P12	Ceramic: .001 µf +100% -20%, 75 VDCW.
		- - - - - - - - - - INDUCTORS - - - - - - - - -
L1	19B216950G2	Coil.
		- - - - - - - - - TRANSISTORS - - - - - - - - -
Q1	19A116159P1	Silicon, NPN.
		- - - - - - - - - - RESISTORS - - - - - - - - -
R1	3R151P184J	Composition: 0.18 megohm ±5%, 1/8 w.
R2	3R151P302J	Composition: 3000 ohms ±5%, 1/8 w.
		- - - - - - - - - INDUCTORS - - - - - - - - - -
L1	19B216441G6	Helical resonator. (Part of Z1). Includes:
	19C311727P1	Tuning slug.
L2	19B216441G7	Helical resonator. (Part of Z2). Includes:
	19C311727P1	Tuning slug.
L3	19B216441G11	Helical resonator. (Part of Z3). Includes:
	19C311727P1	Tuning slug.
L4	19B216441G2	Helical resonator. (Part of Z4). Includes:
	19C311727P1	Tuning slug.
L5	19B216441G3	Helical resonator. (Part of Z5). Includes:
	19C311727P1	Tuning slug.
L6	19B216441G12	Helical resonator. (Part of Z6). Includes:
	19C311727P1	Tuning slug.
		- - - - - - - HELICAL RESONATORS - - - - - -
Z1		Consists of L1 and 19D413132P1 can.
Z2		Consists of L2 and 19D413132P3 can.
Z3		Consists of L3 and 19D413132P4 can.
Z4		Consists of L4 and 19D413132P1 can.
Z5		Consists of L5 and 19D413132P3 can.
Z6		Consists of L6 and 19D413132P4 can.
A305 and A306		MULTIPLIER-MIXER A305 19B216364G1 A306 19B216364G2
A1		MULTIPLIER 19C311873G1
		- - - - - - - - - CAPACITORS - - - - - - - -
C1	19A116114P7068	Ceramic: 120 pf ±5%, 100 VDCW; temp coef -750 PPM.
C2	19A116114P3057	Ceramic: 62 pf ±5%, 100 VDCW; temp coef -150 PPM.
C3	5495323P12	Ceramic: .001 µf +100% -20%, 75 VDCW.
		- - - - - - - DIODES AND RECTIFIERS - - - - - -
CR1	19A116081P1	Silicon.
		- - - - - - - - - - INDUCTORS - - - - - - - -
L1	19B216296P1	Coil.
	19B200497P5	Tuning slug (Not included with L1).
		- - - - - - - - - - RESISTORS - - - - - - - - -
R1 and R2	3R151P432J	Composition: 4300 ohms ±5%, 1/8 w.
A4		MULTIPLIER 19C311873G2
		- - - - - - - - - CAPACITORS - - - - - - - - -
C1	19A116114P7068	Ceramic: 120 pf ±5%, 100 VDCW; temp coef -750 PPM.
C3	5495323P12	Ceramic: .001 µf +100% -20%, 75 VDCW.
C6	19A116114P4059	Ceramic: 68 pf ±5%, 100 VDCW; temp coef -220 PPM.
		- - - - - - - DIODES AND RECTIFIERS - - - - - -
CR1	19A116081P1	Silicon.
		- - - - - - - - - - INDUCTORS - - - - - - - - -
L2	19B216296P2	Coil. Includes:
	19B200495P5	Tuning slug. (Not included with L2).
		- - - - - - - - - - RESISTORS - - - - - - - - -
R1 and R2	3R151P432J	Composition: 4300 ohms ±5%, 1/8 w.
A5		MIXER 19C317625G1
		- - - - - - - - - CAPACITORS - - - - - - - - -
C1 and C2	19A116114P4059	Ceramic: 68 pf ±5%, 100 VDCW; temp coef -220 PPM.
		- - - - - - - - - - INDUCTORS - - - - - - - - -
L1	19B216948G1	Coil.
		- - - - - - - - - TRANSISTORS - - - - - - - - -
Q1	19A116159P1	Silicon, NPN.
		- - - - - - - - - - RESISTORS - - - - - - - - -
R1	3R151P204J	Composition: 0.20 megohm ±5%, 1/8 w.
R2	3R151P562J	Composition: 5600 ohms ±5%, 1/8 w.
R3	3R151P101J	Composition: 100 ohms ±5%, 1/8 w.
R4	3R151P103J	Composition: 10,000 ohms ±5%, 1/8 w.
		- - - - - - - - - - INDUCTORS - - - - - - - -
L1 and L2	19B216441G8	Helical resonator. (Part of Z5). Includes tuning slug 19C311727P1.
L3 and L4	19B216441G4	Helical resonator. (Part of Z6). Includes tuning slug 19C311727P1.
		- - - - - - - HELICAL RESONATORS - - - - - - -
Z1		Consists of L1 and 19D413132P7 can.
Z2		Consists of L2 and 19D413132P10 can.
Z3		Consists of L3 and 19D413132P7 can.
Z4		Consists of L4 and 19D413132P10 can.
A309	19C311891G1	Compensator.
A310	19C304516G1	Crystal Filter.
A311	19C311879G1	1st IF AMPLIFIER.
A312	19C304824G2	Crystal Filter.
A313	19C311879G2	2nd IF Ampifier.
A314	19C311876G5	Limiter.
A315	19C304504G1	Discriminator.
A316	19C311878G1	Audio Amplifier.
A317	19C311880G3	Squelch.
A318	19C311877G1	PA.
		NOTE: (When reordering A319-A322 give GE Part No. and specify exact frequency needed).
A319 thru A322	4EG28A10 4EG28A11	Oscillator. (132-150.8 MHz). Oscillator. (150.8-174 MHz).
A323	19C311995G3	Audio Amplifier (Includes Tone Filter).
		- - - - - - - - - CAPACITORS - - - - - - - - -
C301	5495323P12	Ceramic: .001 µf +100% -20%, 75 VDCW.
C302	5491674P31	Tantalum: .033 µf ±20%, 35 VDCW; sim to Sprague Type 162D.
C303	19A116089P1	Ceramic: 0.1 µf ±20%, 50 VDCW, temp range -55 to +85°C.
C304	5491674P30	Tantalum: 39 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
C305	19A116178P7	Tantalum: 220 µf ±20%, 6 VDCW.
C306	5495323P14	Ceramic: .005 µf +100% -20%, 75 VDCW.
C307	5491674P35	Tantalum: 22 µf ±20%, 4 VDCW; sim to Sprague Type 162D.
C308	5491674P28	Tantalum: 1.0 µf ±20%, 25 VDCW; sim to Sprague Type 162D.
C309	5491674P27	Tantalum: .47 µf ±20%, 35 VDCW; sim to Sprague Type 162D.
C310	5495323P14	Ceramic: .005 µf +100% -20%, 75 VDCW.
C311	5491674P30	Tantalum: 39 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
C312	5491674P37	Tantalum: 10 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
C313 thru C315	5495323P12	Ceramic: .001 µf +100% -20%, 75 VDCW.
C319*	19A116192P1	Ceramic: 0.01 µf ±20%, 50 VDCW; sim to Erie 8121-M050-W5R-103M. Added to 4ER56A10, 12, 14 by REV F. Added to 4ER56A11, 13, 15 by REV G.
		- - - - - - - - - - FILTERS - - - - - - - - -
FL301 and FL302		Reeds. Refer to Type 99 Decoder Parts List.
		- - - - - - - JACKS AND RECEPTACLES - - - - -
J301 and J302	19A116122P1	Feed-thru: sim to Warren Co 1-B-2994-4.
		- - - - - - - - - - PLUGS - - - - - - - - - -
P301		(Part of W301).
		- - - - - - - - - - RESISTORS - - - - - - - - -
R301	3R152P201K	Composition: 200 ohms ±10%, 1/4 w.
R302	3R152P470K	Composition: 47 ohms ±10%, 1/4 w.
R303	3R151P750J	Composition: 75 ohms ±5%, 1/8 w.
R304	3R152P201K	Composition: 200 ohms ±10%, 1/4 w.
R307	3R152P150K	Composition: 15 ohms ±10%, 1/4 w.
R308	3R152P101K	Composition: 100 ohms ±10%, 1/4 w.
		- - - - - - - - - - CABLES - - - - - - - - - -
W301	19B216519G2	Cable: approx 4 inches long. (Includes P301).
		HOUSING 19E500885G3
		- - - - - - - - - - CAPACITORS - - - - - - - -
C701	19A116114P10073	Ceramic: 180 pf ±10%, 100 VDCW; temp coef -3300 PPM.
		- - - - - - - - - TERMINALS - - - - - - - - -
E701 thru E703	19A129019P1	Terminal.
		- - - - - - - - - - FUSES - - - - - - - - - -
F701	19A116196P11	Enclosed link: 5 amp at 125 v; sim to Littelfuse 275005.
		- - - - - - - JACKS AND RECEPTACLES - - - - - -
J701	19B216594G1	Connector, female: 6 contacts. (Includes back cover and wiring).
		- - - - - - - - - - PLUGS - - - - - - - - - -
P701 and P702	19A127569P1	Plug: 8 contacts.
		- - - - - - - - - - RESISTORS - - - - - - - - -
R701	19A116227P1	Variable, composition: 25,000 ohms ±20%, 1/8 w; sim to Mallory Type MLC. (VOLUME).
R702	19A116227P2	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-2187, items 5-14).
S705	19B216610G1	Slide: 0.5 amps at 100 VAC; sim to Sanset SS-12. (HI-LOW Power). Deleted by REV F. (Refer to Hi/Lo Power Option 19A129432G1 parts list for S705).
		- - - - - - - - - TERMINAL BOARDS - - - - - - - - -
TB701	19B216509G1	Terminal board: 15 contacts.
		- - - - - - - - - - - SOCKETS - - - - - - - - - - -
XF701	19B216313G1	Fuseholder.
		HARNESS ASSEMBLY 19E500885G5 (Includes C701, J701, P701, P702, R701, R702, S701, TB701)
		FRONT COVER ASSEMBLY 19C317017G3
		- - - - - - - - - - LOUDSPEAKERS - - - - - - - - -
LS2	19A116151P2	Permanent magnet, 2-1/4 inch: 8 ohms ±10% voice coil imp, 600 Hz ±100% resonance, paper dust cap; sim to Oaktron T1877.
		ASSOCIATED ASSEMBLIES
		HI/LOW POWER OPTION 19A129432G1
		- - - - - - - - - - - RESISTORS - - - - - - - - - -
		NOTE: Select R123 below for 1.0 watt output in the low power position.
R123	3R152P330J	Composition: 33 ohms ±5%, 1/4 w.
R123	3R152P360J	Composition: 36 ohms ±5%, 1/4 w.
R123	3R152P390J	Composition: 39 ohms ±5%, 1/4 w.
R123	3R152P430J	Composition: 43 ohms ±5%, 1/4 w.
R123	3R152P470J	Composition: 47 ohms ±5%, 1/4 w.
R123	3R152P510J	Composition: 51 ohms ±5%, 1/4 w.
R123	3R152P560J	Composition: 56 ohms ±5%, 1/4 w.
R123	3R152P620J	Composition: 62 ohms ±5%, 1/4 w.
R123	3R152P680J	Composition: 68 ohms ±5%, 1/4 w.
R123	3R152P750J	Composition: 75 ohms ±5%, 1/4 w.
R123	3R152P820J	Composition: 82 ohms ±5%, 1/4 w.
R123	3R152P910J	Composition: 91 ohms ±5%, 1/4 w.
R123	3R152P101J	Composition: 100 ohms ±5%, 1/4 w.
R123	3R152P111J	Composition: 110 ohms ±5%, 1/4 w.
R123	3R152P121J	Composition: 120 ohms ±5%, 1/4 w.
R123	3R152P131J	Composition: 130 ohms ±5%, 1/4 w.
R123	3R152P151J	Composition: 150 ohms ±5%, 1/4 w.
R123	3R152P181J	Composition: 180 ohms ±5%, 1/4 w.
R123	3R152P201J	Composition: 200 ohms ±5%, 1/4 w.
R123	3R152P221J	Composition: 220 ohms ±5%, 1/4 w.
R123	3R152P241J	Composition: 240 ohms ±5%, 1/4 w.
R123	3R152P271J	Composition: 270 ohms ±5%, 1/4 w.
R123	3R152P301J	Composition: 300 ohms ±5%, 1/4 w.
R123	3R152P331J	Composition: 330 ohms ±5%, 1/4 w.
R123	3R152P361J	Composition: 360 ohms ±5%, 1/4 w.
R123	3R152P391J	Composition: 390 ohms ±5%, 1/4 w.
		- - - - - - - - - - - SWITCHES - - - - - - - - - -
S705	19B216610G1	Slide: 0.5 amps at 100 VAC; sim to Sanset SS-12.
		MISCELLANEOUS
	N40P1006	Screw: No. 0-80 x 3/8.
		ANTENNA MATCHING CIRCUIT 19A127643G1
C701	19A116114P33	Ceramic: 12 pf ±5%, 100 VDCW; temp coef 0 PPM.
L701	19A127642P1	Coil.
		- -

*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 4EF34A11 & A13 ONLY. COMPONENTS MARKED WITH ▲ ARE PRESENT IN PA MODELS 4EF34A10 & A12 ONLY.
3. OSCILLATORS MARKED WITH ■ ARE PRESENT IN 4EF34A10 & A11 PA MODELS, 4ER56A10-A13 RECEIVER MODELS ONLY.
4. COMPONENTS MARKED BY * ARE PRESENT IN POWER AMPL MODELS 4EF34A12 & A13, RECEIVER MODELS 4ER56A14 & A15 ONLY.
5. AUDIO AMPLIFIER MARKED WITH □ PRESENT IN 4ER56A10, A11, A14 & A15 ONLY. AUDIO AMPLIFIER MARKED WITH O PRESENT IN 4ER56A12 & A13 ONLY.
6. FOR GROUP 4+6 AUDIO BD REMOVE JUMPER BETWEEN H26 & H27 AND ADD JUMPER BETWEEN H26 & H28 & SLEEVE.
7. FOR GROUPS 5 & 6 ADD JUMPER BETWEEN H25 & H10 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 4 & 6 ONLY. VOX A4 AND ASSOCIATED PARTS ARE USED IN GROUPS 5 & 6 ONLY.
10. FOR HI-LO POWER OPTION REMOVE DA WIRE FROM H22 TO H23 AND ADD R123 VALUE OF R123 VARIES FROM 33 TO 390Ω. VALUE SELECTED AT TEST FOR OPTIMUM LOW POWER PERFORMANCE.

MODEL NO.	REV	FREQ. RANGE (MHZ)	NO. OF FREQ.	TONE OPTION	—
PA BOARD					
4EF34A10	J	132-150.8	1 THRU 4		
4EF34A11	K	150.8-174	1 THRU 4		
4EF34A12	J	132-150.8	1 OR 2	TYPE 99	
4EF34A13	K	150.8-174	1 OR 2	TYPE 99	
RECEIVER					
4ER56A10	F	132-150.8	1 THRU 4		
4ER56A11	G	150.8-174	1 THRU 4		
4ER56A12	F	132-150.8	1 THRU 4	CHAN. GD.	
4ER56A13	G	150.8-174	1 THRU 4	CHAN. GD.	
4ER56A14	F	132-150.8	1 OR 2	TYPE 99	
4ER56A15	G	150.8-174	1 OR 2	TYPE 99	
PL NUMBER	REV	CONTROL	ELECTRONIC PTT	VOX	AUDIO COMPR
AUDIO BOARD					
19C317616G3		REMOTE PTT	X		
19C317616G4		REMOTE PTT	X		X
19C317616G5	B	REMOTE PTT	X	X	
19C317616G6	B	REMOTE PTT	X	X	X
19E500885G3	G				
BTRY PK					
19C317000G1	A				

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.

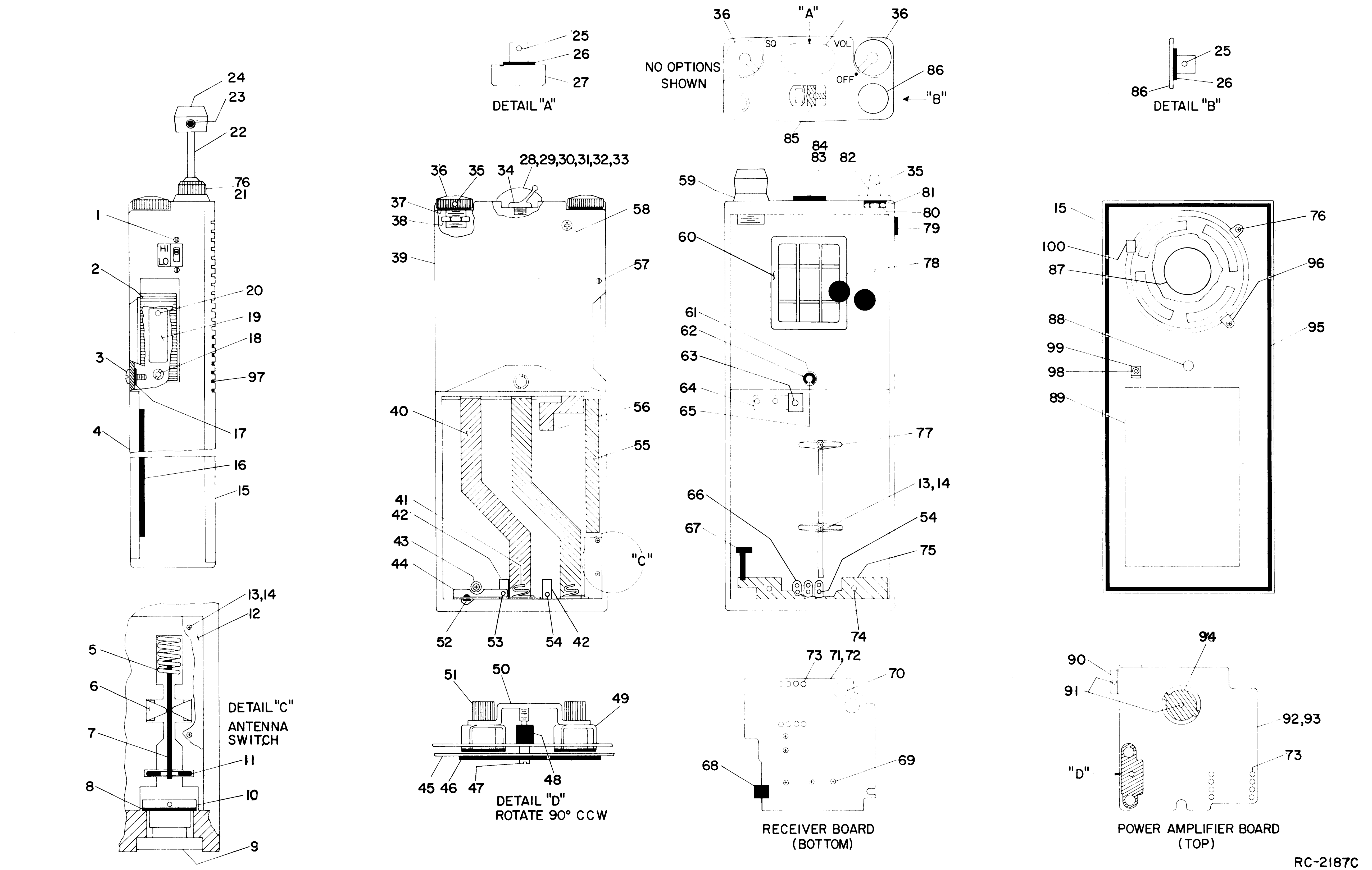
(19R640778, Rev. 26)

SCHEMATIC DIAGRAM

132—174 MHz PERSONAL SERIES
TRANSMITTER-RECEIVER
WITH REMOTE PTT

(DF-9022)

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - - SWITCHES - - - - - - - - - -
S601	4036949P1	Toggle: SPDT, 100 µa at 5 VDC, mounting hardware; sim to Arrow-Hart and Hegeman. (VOX).
S702	19C311865G1	Push To Talk. (LOCAL).
S703	19C311865G2	Push To Talk. (REMOTE).
S2601	19C317067G1	Multi-Frequency. (2 FREQ).
S2602	19C317067G2	Multi-Frequency. (3 FREQ).
S2603	19C317067G3	Multi-Frequency. (4 FREQ).
		- - - - - - - - - - BATTERIES - - - - - - - - - -
	19C317000G1	Rechargable pack: Includes thermal fuse 19A116393P2, and thermal fuse cover NP257851P1.
		- - - - - - - - - - - ANTENNAS - - - - - - - - - - -
	19B219953G1	Telescoping. (See RC-2187, items 21-24, 76).
		MECHANICAL PARTS (RC-2187)
1	N40P1006V	Screw. No. 0-80 x 3/8. (Used with S705, H1-LO).
2	19C311869P1	Button. (PTT switch S702 and S703).
3	19A127340P1	Lockscrew. (Part of Rear Cover).
4	19B216329G1	Rear Cover Assembly. Includes items 16, 17 and 3.
5	19A127390P1	Spring. (Part of Antenna Switch).
6	19B216306P1	Contact spring. (Part of antenna switch).
7	19C311889P1	Printed wiring board. (Part of antenna switch).
8	19A127364P1	Ground lug. (Part of antenna switch).
9	19B216305P1	Bushing. (Part of antenna switch).
10	19A127339P1	Nut. (Part of antenna switch).
11	19A127382P1	Retaining spring. (Part of antenna switch).
12	19C317057P1	Cover. (Antenna Switch).
13	19B201806P11	Insert: No. 0-80 thread; sim to Phelps 71011-0.
14	19A116125P1002	Phillips screw. No. 0-80 x 1/8. (Antenna Switch).
15	19C317814P3	Cover. (For complete cover assembly order 19C317017G3).
16	19B216330P2	Insulator. (Located on Rear Cover).
17	N910P18C13	Retainer ring. (Located on Rear Cover).
18	19A127319P3	Nut. No. 8-36. (Used with PTT switch S702, S703).
19	19B216548P1	Spring. (Used with PTT switch).
20	19B200525P3	Rivet. (Secures item 19).
21	19C320352P1	Bushing, knurled.
22	19C320591P1	Antenna rod. 3 section, 18 inches long.
23	N70P703C13	Setscrew, No. 3-48 x 3/16.
24	19A129649P1	Antenna cap.
25	N509P606C	Pin, 1/16 x 3/8. (Used with dummy plugs).
26	19A115983P3	Gasket: sim to Parker Seal 2-14. (Used with dummy plugs).
27	19C311972P1	Dummy plug. (Replaces Channel Guard, Tone, and VOX Switch).
28	19B216569P1	Cap. (CG OFF-ON).
29	19B216569P2	Cap. (CG A-B-OFF).
30	19B216569P3	Cap. (T99 M-N-R).
31	19B216569P4	Cap. (T90 M-N-R).
32	19B216569P5	Cap. (T90 A-OFF-B).
33	19B216569P6	Cap. (VOX OFF-ON).
34	5490135P3	Boot, moisture seal. (Used with Channel Guard, Tone and VOX Switch).
35	N70P703C13	Set screw: No. 3-48 x 3/16. (Used with OFF-VOLUME, SQUELCH, MULTI FREQ. Knobs).
36	19C317065P1	Knob. (OFF-VOLUME, SQUELCH).
37	19A115983P5	O ring. (Used with OFF-VOLUME, SQUELCH Knobs).
38	19A127319P1	Nut, knurled. No. 8-32. (Used with OFF-VOLUME, SQUELCH Knobs).
39	19D413216G3	Housing.
40	19C311886P1	Contact.
41	19A127392P1	Spring. (Battery terminals).
42	19B216388P1	Contact.
43	19A127310P1	Phillips screw. No. 4-40 x 1/4. (Secures bottom of front cover).
44	19B216312P1	Contact. (Connects to battery spring).
45	19C317152P1	Transmitter shield.
46	19B216330P3	Insulator. (Located on transmitter shield).
47	19A127341P1	Screw. (Secures heat sink to front cover).
48	19B216520P3	Washer. (Used with item 47).
49	19A127362P1	Strap, copper. (Used with Q106-Q108).
50	19B216462P2	Heat sink. (Used with Q106-Q108).
51	19A127337P1	Nut. (Used with Q106-Q108).
52	N327P8008E	Rivet. (Secures 3 battery contacts).
53	N327P6016E	Rivet. (Secures items 42 and 44).
54	N327P6014E	Rivet: .061 inch dia z 7/32 inch long. (Secures items 42 and 66).
55	19A127333P1	Antenna sleeve.
56	19B216326P1	Contact.
57	19A127294P1	Screw. No. 2-56 x 15/16. (Used with PTT button).
58	19A127293P1	Phillips screw. No. 4-40 x 1-15/32. (Secures top of front cover).
59	19A129651P1	Antenna insert.
60	19B219340G1	Ring.
61	19B216520P2	Washer.
62	N910P18C13	Retaining ring.
63	N327P6010E	Rivet: .061 inch dia x 5/32 inch long. (Secures item 64).
64	19B216313G1	Fuseholder.
65	19C311896P1	Fastener. (Secures center of Rear Cover).
66	19A129019P1	Terminal.
67	19B216557P1	Ground strap.
68	19A127737P1	Spring.
69	19A116477P1	Phillips screw. No. 1-64 x 5/32. (Secures A303, A304, A307).
70	19B216316P1	Insulator. (Used with J301 and J302).
71	19D413199P1	Printed wiring board. (Without FL301, FL302).
72	19D413198P1	Printed wiring board. (With FL301, FL302).
73	4036040P1	Pin. (Used with FL101, FL102, FL301, FL302).
74	N330P1503F22	Eyelet: No. 5/32 x 3/32.
75	19B219261P1	Strap.
76	19A129652P1	Nut: thd size No. 7/16-40.
77	19B216549P1	Cable clamp.
78	19A127646P1	Insulator. (Used with P701 and P702- Hung in wiring).
79	19A127329P1	Insert. (Secures Hand strap).
80	19A127319P2	Nut: No. 1/4 x 28.
81	19B216520P1	Washer, nylon.
82	19C311888P1	Knob. (MULTI-FREQ).
83	19C317050P1	Protective Cover. (Used with J701).
84	19A129390P1	Disc. (Located in item 83).
85	19B219540P1	Catch. (Used with J701).
86	19C317123P1	Dummy plug. (Replaces Freq select switch).
87	19B219266P1	Diaphragm.
88	19B216327P1	Spacer.
89	19B216330P1	Insulator.
90	19B216506P1	Shield.
91	N77P9002	Screw: No. 4-4 x 1/8.
92	19D413192P1	Printed wiring board (Without FL101, FL102).
93	19D413195P1	Printed wiring board (With FL101, FL102).
94	19A127363P1	Support. (Secures to LS2 and Printed wiring board).
95	19A127520P1	Gasket, weather seal.
96	19A127334P1	Clamp.
97	NP257868P1	Nameplate. (GE-MASTR).
98	N327P8008E	Rivet, tubular.
99	19B219465P1	Support.
100	19A129214P1	Support.



PR36 TRANSMITTER-RECEIVER

RC-2187C

PRODUCTION CHANGES

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

REV. A thru D - 4EF34A10 & 12

REV. A thru C - 4EF34A11 & 13

REV. A and B - 4ER56A10 - 15

These revisions were incorporated into initial shipments.

REV. C - 4ER56A10 - 15

To improve RF gain. Deleted R3.

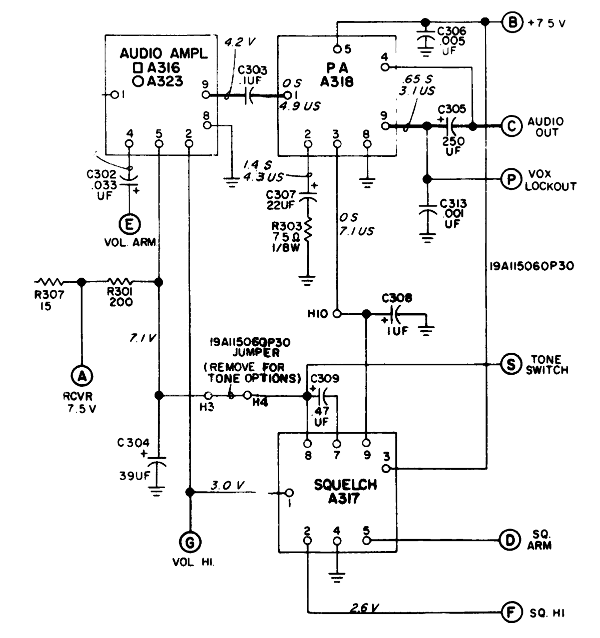
REV. D - 4ER56A11, 13 & 15

To improve band-end tuning of the multiplier. Added L2 and deleted L1.

REV. D - 4ER56A10, 12 & 14
REV. E - 4ER56A11, 13 & 15

To make the receiver compatible with the PTT system. Added three holes on receiver board.

Schematic was:



REV. A - 19E500885G3 (Case Assembly)

To remove the antenna connection wire to the Accessory Jack. Deleted the W wire from J701-3 to the antenna connector.

REV. D - 4EF34A11 & 13

To prevent the final PA stage from oscillating when the unit is unkeyed. Deleted C142 and Changed C146.

REV. E - 4EF34A11 & 13

To allow the transmitter to band end and prevent the final from oscillating when the transmitter is unkeyed. Added C142, C164 and C165. Changed C146.

REV. A - 19C317000G1 (Battery Pack)

To improve insulation between straps and batteries. Added additional insulation.

REV. E - 4EF34A10 & 12
REV. F - 4EF34A11 & 13

To incorporate a new transistor
Changed Q106

REV. F - 4EF34A10 & 12
REV. G - 4EF34A11 & 13

To increase drive from Q101.
Changed R121, Q101, Q102, Q103 and Q104

REV. G - 4EF34A10 & 12
REV. H - 4EF34A11 & 13

To improve efficiency and tuning stability.
Changed R109.

REV. B - 19E500885G3 (Case Assembly)

Not incorporated.

REV. C - To improve squelch action.
Added teflon sleeved jumper between two angles.

REV. D - To add "DISC" and callout.

REV. E - To improve antenna system.
Changed antenna bushing.

REV. B - 19C317000G1 (Battery Pack)

To prevent shorting.
Added two insulators.

REV. B - 19C317616G5 & 6 (VOX Option)

To prevent VOX Option from releasing PTT circuit too quickly after audio signal is removed.
Changed C3.

REV. H - 4EF34A10 & 12

REV. J - 4EF34A11 & 13

To remove HI-LO power switch from standard radio and to add as an option.
Deleted S705, R123 and R111.

REV. J - 4EF34A10 & 12

REV. K - 4EF34A11 & 13

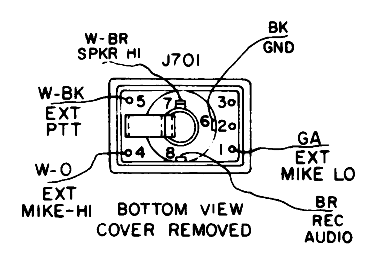
To improve power output.
Changed Q104 and R106.

REV. F - 19E500855G3 (Case Assembly)

To remove HI-LO power switch from standard radio.
Deleted S705 and add cover assembly.

REV. G - To make outline diagram agree with new location of numbered terminals on J701.

Outline Was:



REV. F - 4ER56A10, 12 & 14

REV. G - 4ER56A11, 13 & 15

To improve critical squelch with speaker/mike option.
Added C319.

PRODUCTION CHANGES

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

REV. A – PR Channel Guard Encoder/Decoder (19C317041)

To add RF bypassing for UHF application. Added C616 and C617.

REV. B – To improve filtering of Channel Guard Tone. Changed C608.

REV. C – To improve filtering of Channel Guard Tone. Changed A602, C604 and C608.

REV. D – To improve RF filtering. Added C618.

PARTS LIST

LBI-4072C

CHANNEL GUARD ENCODER/DECODER
19C317041G1

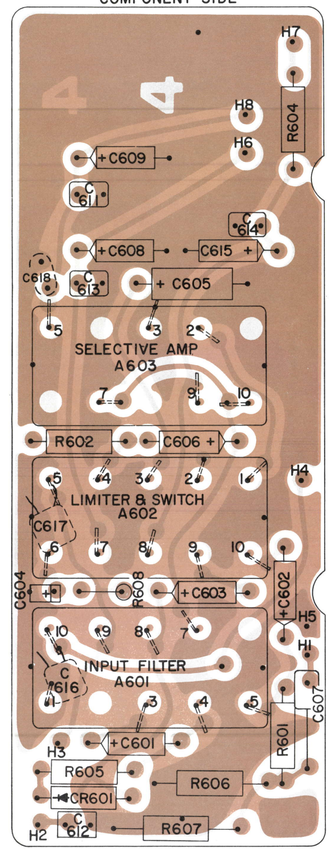
SYMBOL	GE PART NO.	DESCRIPTION
A601	19C317009G1	Input Filter Assembly.
A602*	19C317014G3	Limiter and Switch Assembly.
		In REV B and earlier:
	19C317014G1	Limiter and Switch Assembly.
		NOTE: When reordering A603, give GE Part Number and Specify exact frequency stamped on case of component.
A603	19D413245G1	Selective Amplifier Assembly.
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C601 thru C603	5491674P36	Tantalum: 3.3 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
C604*	19C307102P12	Tantalum: 2.2 µf ±20%, 10 VDCW.
		In REV B and earlier:
	5491674P28	Tantalum: 1.0 µf ±20%, 25 VDCW; sim to Sprague Type 162D.
C605	5491674P35	Tantalum: 22 µf ±20%, 4 VDCW; sim to Sprague Type 162D.
C606	5491674P36	Tantalum: 3.3 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
C607	19A116207P3	Ceramic: 0.1 µf ±20%, 25 VDCW, temp range -55 to 85°C; sim to Aerovox ELA752C104M.
C608*	5491674P36	Tantalum: 3.3 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
		In REV B:
	5496267P10	Tantalum: 22 µf ±20%, 15 VDCW; sim to Sprague Type 150D.
		In REV A and earlier:
	5491674P36	Tantalum: 3.3 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
C609	5491674P36	Tantalum: 3.3 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
C611 thru C614	19A116192P2	Ceramic: 470 pf ±20%, 50 VDCW.
C615	5491674P36	Tantalum: 3.3 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
C616* and C617*	19A116114P2051	Ceramic: 43 pf ±5%, 100 VDCW; temp coef -80 PPM. Added by REV A.
C618*	19A116114P2044	Ceramic: 27 pf ±5%, 100 VDCW; temp coef -80 PPM. Added by REV D.
		- - - - - - - DIODES AND RECTIFIERS - - - - - - -
CR601	19A115250P1	Silicon.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R601	3R152P622J	Composition: 6200 ohms ±5%, 1/4 w.
R602	3R152P155K	Composition: 1.5 megohm ±10%, 1/4 w.
R604	3R152P101K	Composition: 100 ohms ±10%, 1/4 w.
R605	3R152P513J	Composition: 51,000 ohms ±5%, 1/4 w.
R606	3R152P431J	Composition: 430 ohms ±5%, 1/4 w.
R607	3R152P152J	Composition: 1500 ohms ±5%, 1/4 w.
R608*	3R151P392J	Composition: 3900 ohms ±5%, 1/8 w. Added by REV C.
		- - - - - - - - - - SWITCHES - - - - - - - - - -
		NOTE: S601 is not included with 19C317041G1 CHANNEL GUARD ENCODER/DECODER BOARD.
S601	4036949P1	Toggle: SPDT, 100 µa at 5 VDC, mounting hardware; sim to Arrow-Hart and Hegeman 7353. (CG OFF-ON).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

(DF-9022)

OUTLINE DIAGRAM

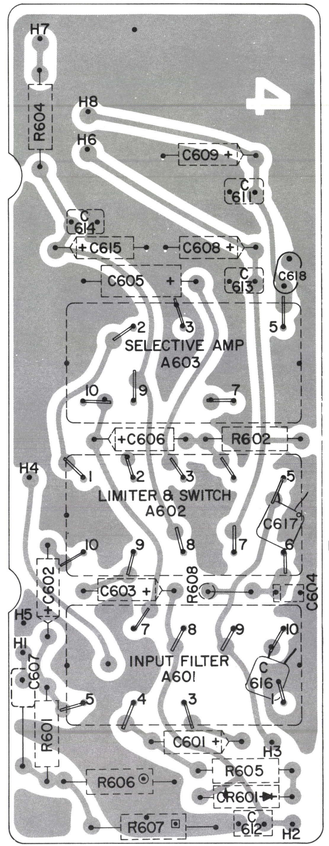
COMPONENT SIDE



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

(19C317374, Rev. 7)
(19C317026, Sh. 1, Rev. 4)
(19C317026, Sh. 2, Rev. 4)

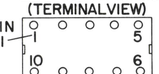
SOLDER SIDE



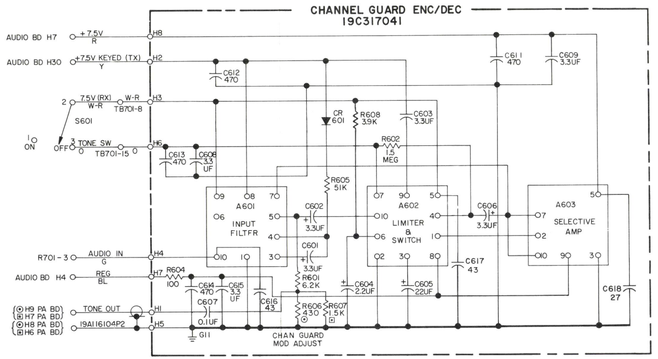
(19C317374, Rev. 7)
(19C317026, Sh. 2, Rev. 4)

Denotes Solder 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.

NOTES:
1. ALL WIRES ARE SFT 28 EXCEPT AS NOTED.
⊙ 4EF35AI0-11 (406-470 MHZ)
⊡ 4EF34AI0-11 (132-174 MHZ)

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

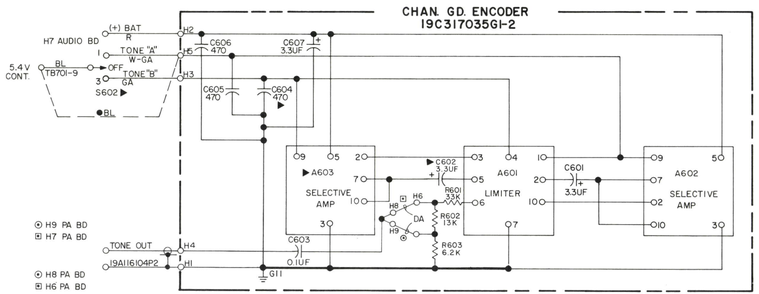
THIS ELEM DIAG APPLIES TO	
MODEL NO	REV LETTER
PL(19C317041G1	D

(19C317071, Rev. 8)

SCHEMATIC & OUTLINE DIAGRAM

132—174 MHz PERSONAL SERIES
CHANNEL GUARD ENCODER/DECODER

SCHEMATIC DIAGRAM



NOTE: ALL WIRES ARE SFT 28 UNLESS OTHERWISE NOTED.

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

(19C317072, Rev. 4)

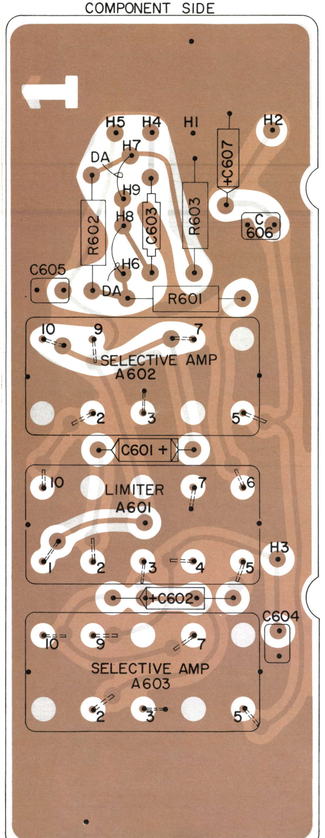
- PRESENT IN 19C317035G1 (1 TONE)
- ▶ PRESENT IN 19C317035G2 (2 TONE)
- ⊙ 4EF35A10-11 (406-470 MHZ)
- ⊡ 4EF34A10-11 (132-174 MHZ)

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

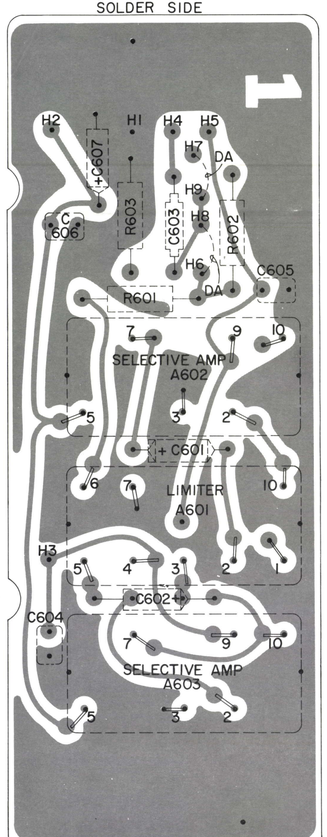
THIS ELEM DIAG APPLIES TO	
MODEL NO	REV LETTER

OUTLINE DIAGRAM

COMPONENT SIDE



SOLDER SIDE



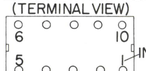
(19C317372, Rev. 3)
(19C317028, Sh. 1, Rev. 1)
(19C317028, Sh. 2, Rev. 1)

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

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

Denotes Solder Side

INTEGRATED CIRCUIT LEAD IDENTIFICATION (TERMINAL VIEW)



PARTS LIST

LBI-4073B

CHANNEL GUARD ENCODER
19C317035G1 1 TONE
19C317035G2 2 TONE

SYMBOL	GE PART NO.	DESCRIPTION
A601	19C317033G1	Limiter.
		NOTE: When reordering A602, A603, give GE Part Number and Specify exact frequency needed.
A602 and A603	19D413245G1	Selective Amplifier. (71.9 Hz to 203.5 Hz freq range).
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C601 and C602	5491674P36	Tantalum: 33 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
C603	19A116207P3	Ceramic: 0.1 µf ±20%, 25 VDCW, temp range -55 to 85°C; sim to Aerovox ELA752C104M.
C604 thru C606	19A116192P2	Ceramic: 470 pf ±20%, 50 VDCW.
C607	5491674P36	Tantalum: 33 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R601	3R152P333J	Composition: 33,000 ohms ±5%, 1/4 w.
R602	3R152P133J	Composition: 13,000 ohms ±5%, 1/4 w.
R603	3R152P622J	Composition: 6200 ohms ±5%, 1/4 w.
		- - - - - - - - - - SWITCHES - - - - - - - - - -
S602	4036949P8	Toggle: SPDT, 100 µa at 5 VDC, mounting hardware; sim to Arrow-Hart and Hegeman TC-3. (CO A-B-OFF).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

SCHEMATIC & OUTLINE DIAGRAM

132—174 MHz PERSONAL SERIES
CHANNEL GUARD ENCODER

PRODUCTION CHANGES

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

REV. A – PM Units with TYPE 90 Encoder/Decoder

To prevent RF from falsing tone Encoder. Added L601, L602, L603, C613, C614, C615, and C616.

PARTS LIST

LBI-4071B

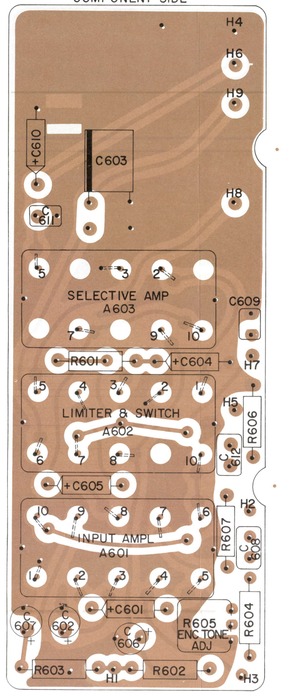
TYPE 90 ENCODER/DECODER
19C317036G1

SYMBOL	GE PART NO.	DESCRIPTION
A601	19C317061G1	Input Amplifier Assembly.
A602	19C317014G1	Limiter and Switch Assembly.
		NOTE: When reordering A603, give GE Part Number and Specify exact frequency stamped on case of component.
A603	19D413245G2	Selective Amplifier Assembly. (1050-3000 Hz).
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C601	5491674P36	Tantalum: 3.3 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
C602	19C307102P15	Tantalum: 22 µf ±20%, 6 VDCW; sim to Components Inc G2268.
C603	19C307102P4	Tantalum: 33 µf ±20%, 10 VDCW; sim to Components Inc D3084.
C604 and C605	5491674P36	Tantalum: 3.3 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
C606	19C307102P15	Tantalum: 22 µf ±20%, 6 VDCW; sim to Components Inc G2268.
C607	19C307102P14	Tantalum: 15 µf ±20%, 10 VDCW; sim to Components Inc G1368.
C608	19A116192P1	Ceramic: 0.01 µf ±20%, 50 VDCW.
C609	19A116192P2	Ceramic: 470 pf ±20%, 50 VDCW.
C610	5491674P36	Tantalum: 3.3 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
C611	19A116192P2	Ceramic: 470 pf ±20%, 50 VDCW.
C612	19A116192P1	Ceramic: 0.01 µf ±20%, 50 VDCW.
C613*	19A116114P2054	Ceramic: 51 pf ±5%, 100 VDCW; temp coef -80 PPM. Added by REV A.
C614*	19A116114P2044	Ceramic: 27 pf ±5%, 100 VDCW; temp coef -80 PPM. Added by REV A.
C615*	19A116114P2054	Ceramic: 51 pf ±5%, 100 VDCW; temp coef -80 PPM. Added by REV A.
C616*	19A116114P2044	Ceramic: 27 pf ±5%, 100 VDCW; temp coef -80 PPM. Added by REV A.
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L601* thru L603*	19B209420P114	Coil, RF; 1.20 µh ±10%, 0.18 ohms DC res max; sim to Jeffers 4436-1. Added by REV A.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R601	3R152P153K	Composition: 15,000 ohms ±10%, 1/4 w.
R602 and R603	3R152P271K	Composition: 270 ohms ±10%, 1/4 w.
R604	3R152P513J	Composition: 51,000 ohms ±5%, 1/4 w.
R605	19A116093P1	Variable, carbon film: 7500 ohms ±20%, 1/20 w; to Centralab Series 2.
R606	3R59P623J	Composition: 62,000 ohms ±5%, 1/4 w.
R607	3R152P104K	Composition: 0.1 megohm ±10%, 1/4 w.
		- - - - - - - - - - SWITCHES - - - - - - - - - -
		NOTE: S603 is not included with Type 90 ENCODER/ DECODER BOARD (19C317036G1).
S603	403694P9	Toggle: SPDT, 100 µa at 5 VDC, mounting hardware; sim to Arrow-Hart and Hegeman TE-3. (TSD R-5-E).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

OUTLINE DIAGRAM

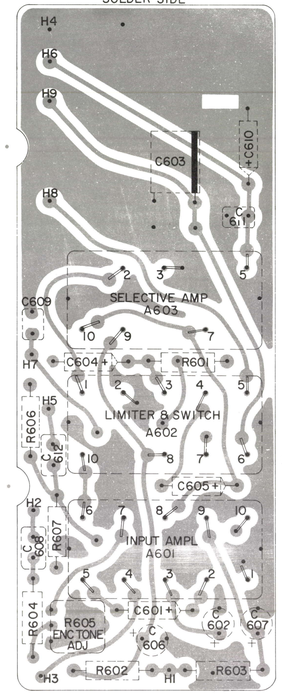
COMPONENT SIDE



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

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

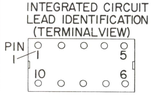
SOLDER SIDE



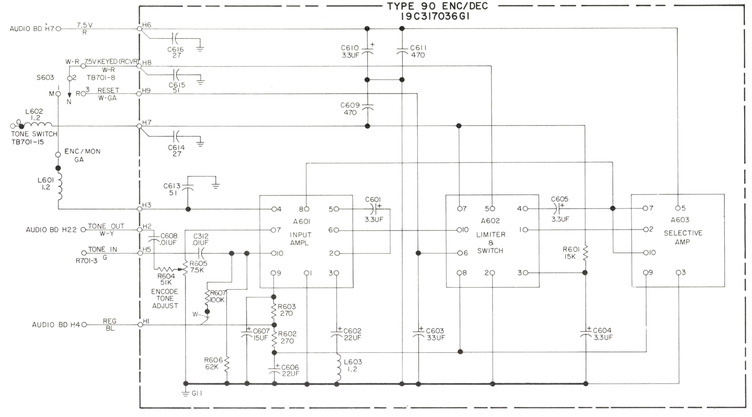
(19C317371, Rev. 2)
(19C317024, Sh. 2, Rev. 1)

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
PL19C317036G1	A

ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG =1,000,000 OHMS. CAPACITOR VALUES IN MICROFARADS (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.

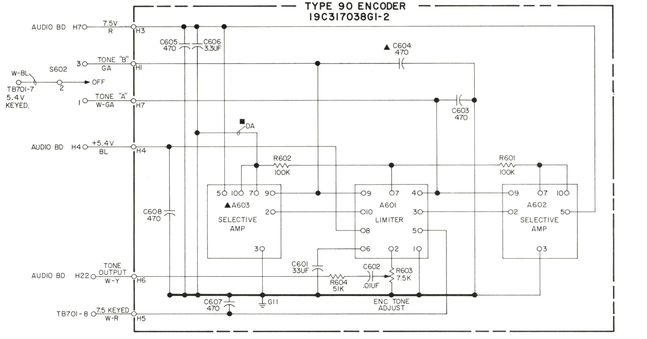
NOTES
1.ALL WIRES ARE SFT 28.

(19C317068, Rev. 4)

SCHEMATIC & OUTLINE DIAGRAM

132—174 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 MICROFARADS (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.

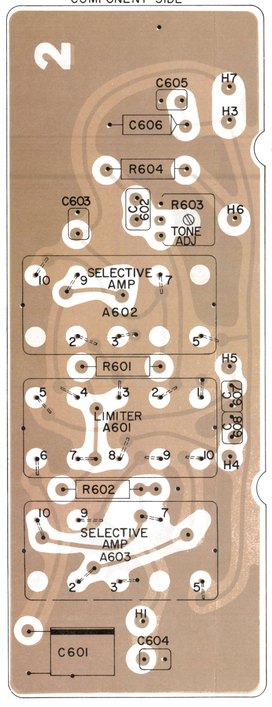
THIS ELEM DIAG APPLIES TO

MODEL NO | REV LETTER

(19C317069, Rev. 3)

OUTLINE DIAGRAM

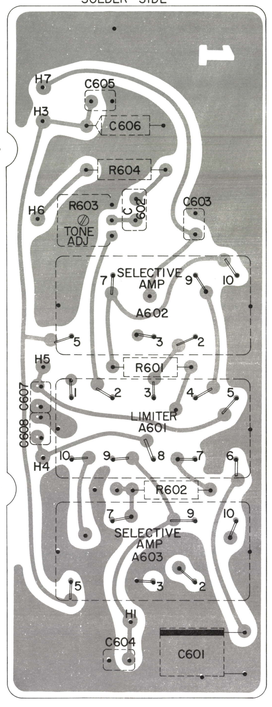
COMPONENT SIDE



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

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

SOLDER SIDE



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

Denotes Solder Side

INTEGRATED CIRCUIT LEAD IDENTIFICATION (TERMINAL VIEW)

PARTS LIST

LBI-4069B

TYPE 90 ENCODER
19C317038G1 1 TONE
19C317038G2 2 TONE

SYMBOL	GE PART NO.	DESCRIPTION
A601	19C317037G1	Limiter. NOTE: When reordering give GE Part No. and specify exact frequency needed.
A602 and A603	19D413245G2	Selective Amplifier. (1000-2400 Hz freq range).
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C601	19C307103P4	Tantalum: 33 µf ±20%, 10 VDCW; sim to Components Inc 333A.
C602	19A116193P1	Ceramic: 0.01 µf ±20%, 50 VDCW.
C603 thru C605	19A116193P2	Ceramic: 470 pf ±20%, 50 VDCW.
C606	5491674P36	Tantalum: 3.3 µf ±20%, 10 VDCW; sim to Sprague Type 1452D.
C607 and C608	19A116192P2	Ceramic: 470 pf ±20%, 50 VDCW.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R601 and R602	3R152P104K	Composition: 0.10 megohm ±10%, 1/4 w.
R603	19A116093P1	Variable, carbon film: 7500 ohms ±20%, 1/20 w; sim to Centralab Series 3 Type 620-1.
R604	3R152P513J	Composition: 51,000 ohms ±5%, 1/4 w.
		- - - - - - - - - - SWITCHES - - - - - - - - - -
		NOTE: S602 is not included with Type 90 ENCODER BOARD (19C317038G1, G2).
S602	4036949P8	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

132—174 MHz PERSONAL SERIES
TYPE 90 ENCODER

PARTS LIST

LBI-4074B

TYPE 99 DECODER AND CHANNEL GUARD ENCODER
19C317039G1 thru G4

SYMBOL	GE PART NO.	DESCRIPTION
A1401*	19C311980G2	Amplifier and Switch Assembly.
		In REV A and earlier:
	19C311980G1	Amplifier and Switch Assembly.
A1402	19C311981G1	Logic Assembly.
A1403	19C317033G1	Limiter Assembly.
		NOTE: When reordering A1404, give GE Part Number and Specify exact frequency stamped on case of component.
A1404	19D413245G1	Selective Amplifier Assembly.
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1401	19A116207P3	Ceramic: 0.1 µf ±20%, 25 VDCW, temp range -55 to 85°C; sim to Aerovox ELA732C104K.
C1402	5491674P36	Tantalum: 3.3 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
C1403	19C307102P15	Tantalum: 22 µf ±20%, 6 VDCW; sim to Components Inc G226R.
C1404	5491674P38	Tantalum: 47 µf ±20%, 4 VDCW; sim to Sprague Type 162D.
C1405	19C307102P15	Tantalum: 22 µf ±20%, 6 VDCW; sim to Components Inc G226R.
C1406	5491674P36	Tantalum: 3.3 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
C1407	5491674P37	Tantalum: 10 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
C1408	5491674P32	Tantalum: 1.0 µf ±10%, 25 VDCW; sim to Sprague Type 162D.
C1409	5491674P36	Tantalum: 3.3 µf ±20%, 10VDCW; sim to Sprague Type 162D.
C1410	19A116207P103	Ceramic: 0.1 µf ±20%, 25 VDCW, temp range -55 to 85°C; sim to Aerovox ELA732C104K.
C1411	5491674P36	Tantalum: 3.3 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
C1412 and C1413	19A116192P2	Ceramic: 470 pf ±20%, 50 VDCW.
C1414*	19A116192P5	Ceramic: 3900 pf ±20%, 50 VDCW. Added by REV A.
		- - - - - - - - - - DECODER REEDS - - - - - - - - - -
FL101 and FL102	19C306580	Decoder Reed. (Check group numbers for desired frequency).
FL201 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	742.5 Hz
	G17	757.5 Hz
	G18	772.5 Hz
	G19	787.5 Hz

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

SYMBOL	GE PART NO.	DESCRIPTION
	19C300580	
	G20	802.5 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
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1401	3R152P101J	Composition: 100 ohms ±5%, 1/4 w.
R1402	3R152P302J	Composition: 3000 ohms ±5%, 1/4 w.
R1403	3R152P333J	Composition: 33,000 ohms ±5%, 1/4 w.
R1404	3R152P133J	Composition: 13,000 ohms ±5%, 1/4 w.
R1405	3R152P622J	Composition: 6200 ohms ±5%, 1/4 w.
		- - - - - - - - - - SWITCHES - - - - - - - - - -
S1401	403694P99	Toggle: SPDT, 1000 µa at 5 VDC, mounting hardware: sim to Arrow-Hart and Hegeman TS-3. (TPP #-S-83).

PRODUCTION CHANGES

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

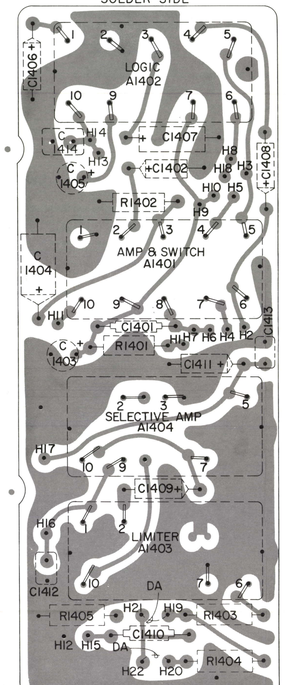
REV. A - Type 99 Decoder 19C317039G1-G4

To improve performance.
Added C1414.

REV. B - To improve decoding performance.
Changed A1401.

OUTLINE DIAGRAM

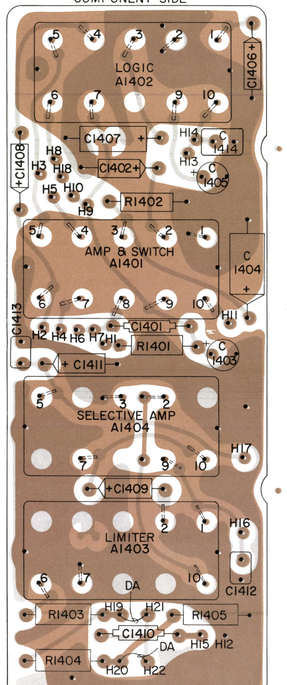
SOLDER SIDE



(19C317370, Rev. 4)
(19C317022, Sh. 2, Rev. 3)

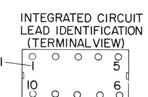
Denotes Solder Side

COMPONENT SIDE



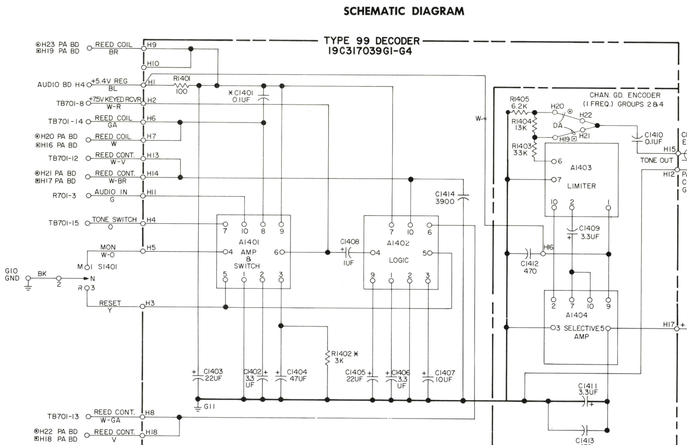
(19C317370, Rev. 4)
(19C317022, Sh. 1, Rev. 3)
(19C317022, Sh. 2, Rev. 3)

INTEGRATED CIRCUIT LEAD IDENTIFICATION (TERMINAL VIEW)



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

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. 5)

* 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 2B EXCEPT AS NOTED.

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

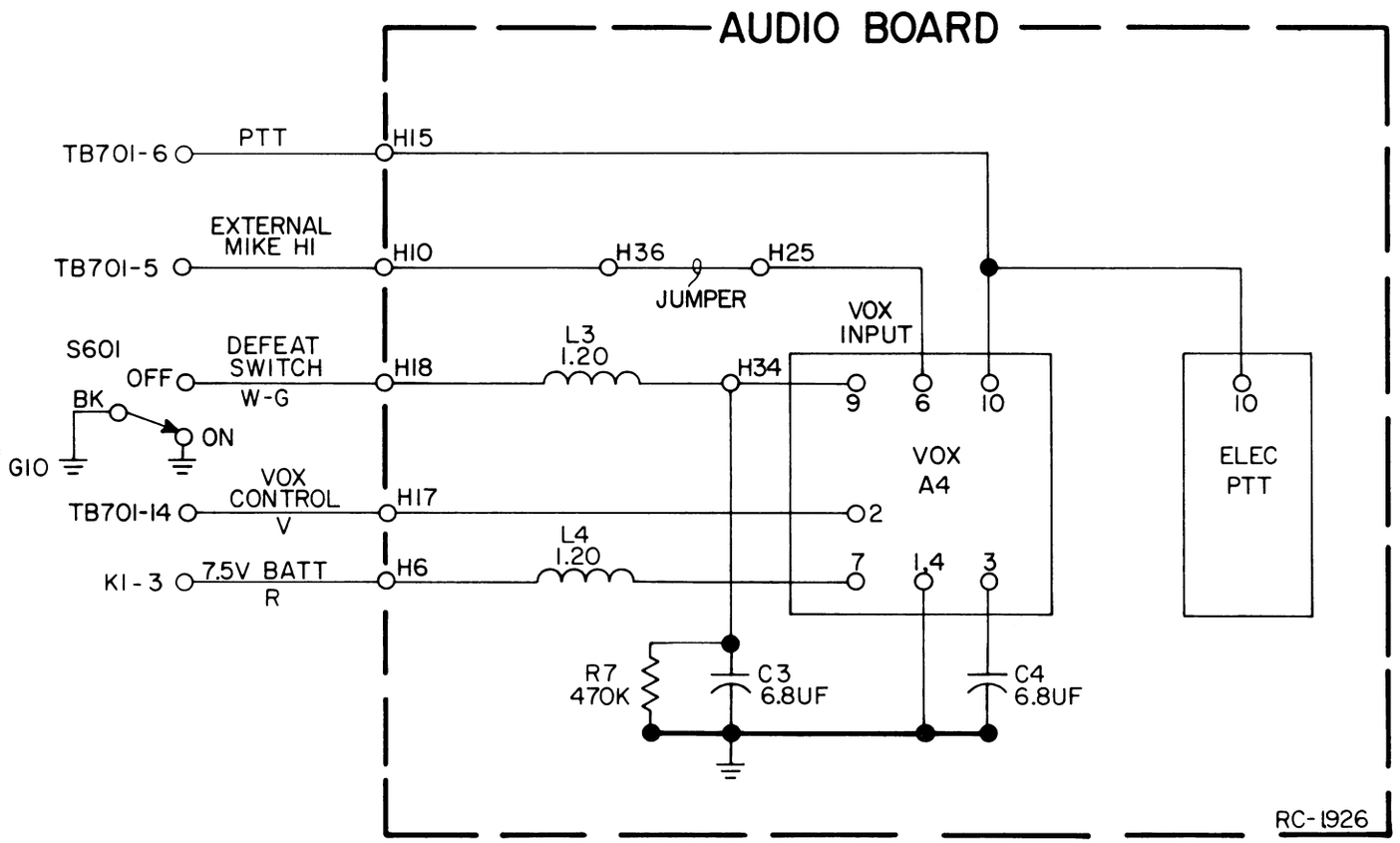
THIS ELEM. DIAG APPLIES TO

MODEL NO.	REV. LETTER
19C317039G1	B
19C317039G2	B
19C317039G3	B
19C317039G4	B

SCHEMATIC & OUTLINE DIAGRAM

132—174 MHz PERSONAL SERIES
TYPE 99 DECODER

(DF-9022)



SCHEMATIC DIAGRAM

132—174 MHz PERSONAL SERIES
VOX OPTION

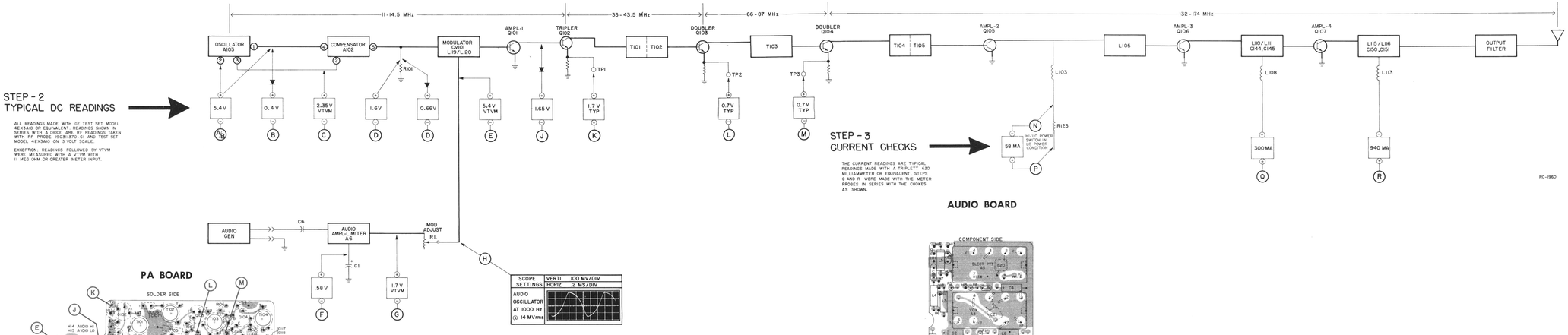
STEP-1 QUICK CHECKS

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 4EX3A1 OR EQUIVALENT. READINGS SHOWN IN SERIES WITH A DIODE ARE RF READINGS TAKEN WITH RF PROBE 19C313572-G1 AND TEST SET MODEL 4EX3A1 ON 3 VOLT SCALE.

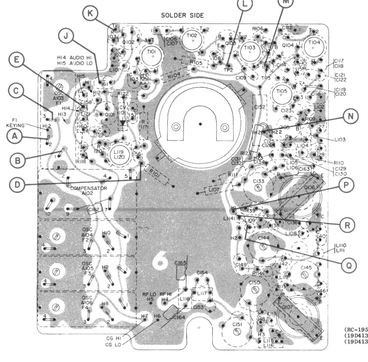
EXCEPTION: READINGS FOLLOWED BY VTVM WERE MEASURED WITH A VTVM WITH 11 MEG OHM OR GREATER METER INPUT.



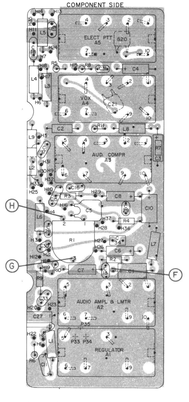
STEP-3 CURRENT CHECKS

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

PA BOARD

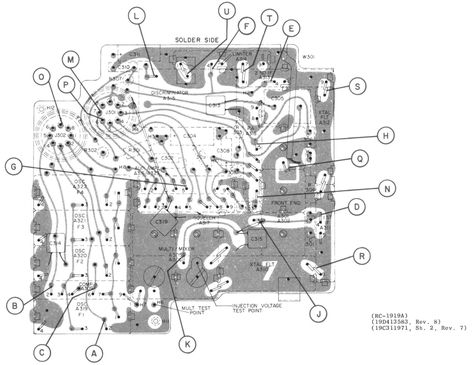


AUDIO BOARD



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)
(19D413582, Rev. 8)
(19C311971, Sh. 2, Rev. 7)

TROUBLESHOOTING PROCEDURE

132—174 MHz PERSONAL SERIES
RECEIVER MODELS 4ER56A10-15

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 reaults with the typical gains shown on the diagram.

Example: 35 dB (dB2) − 15 dB (dB1) = 20 dB gain

PROCEDURE FOR 2ND IF:

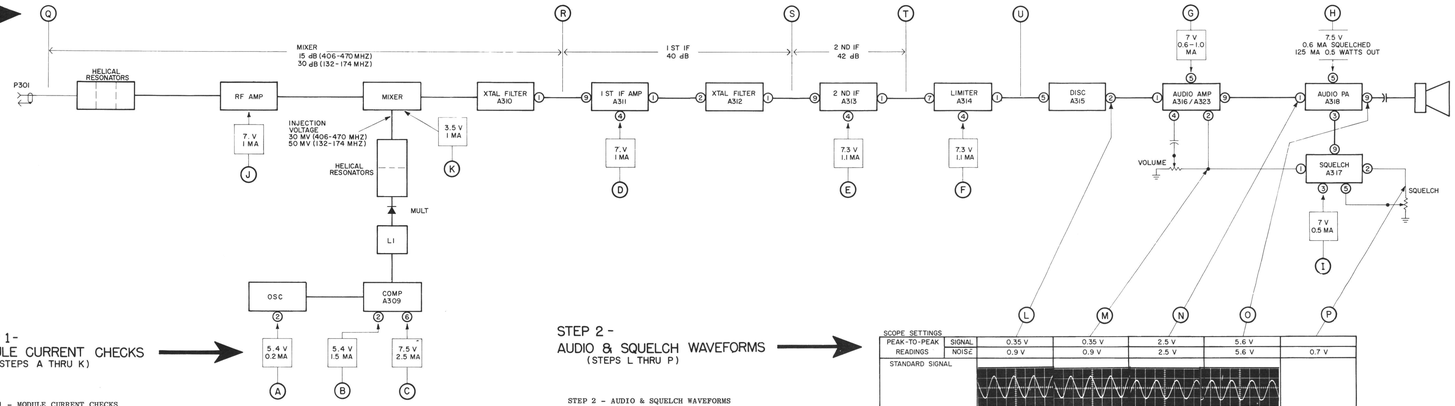
1. With no signal in, connect the RF probe to the output of the 2nd IF module. Increase the signal generator output until the Test Set reading increases by approximately 0.2 volt. Note Test Set and signal generator reading (dB2).
2. Connect the probe to the input of the 2nd IF module. Increase the signal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

LIMITER CHECK

The Limiter module limits on noise so 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 3 - RF GAIN CHECKS (STEPS Q THRU U)



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

STEP 1 - MODULE CURRENT CHECKS

These current readings provide a method of checking the operation of each Integrated Circuit module using a millimeter (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 (STEPS L THRU P)

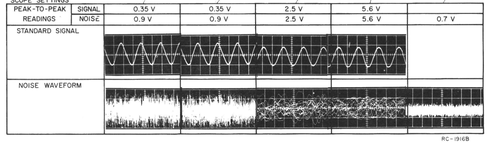
STEP 2 - AUDIO & SQUELCH WAVEFORMS

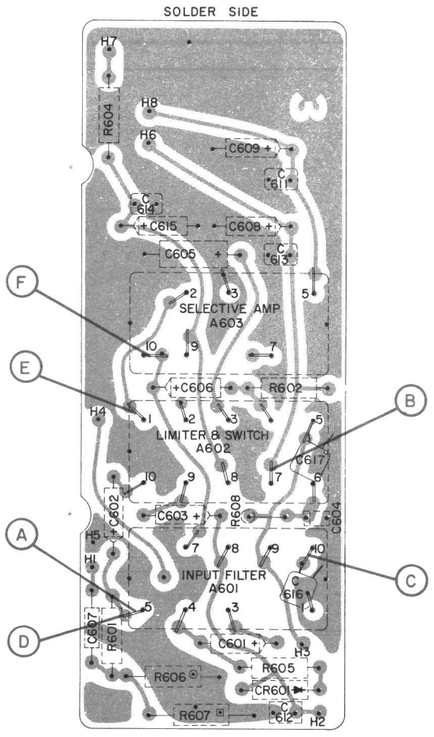
EQUIPMENT REQUIRED:

- 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.

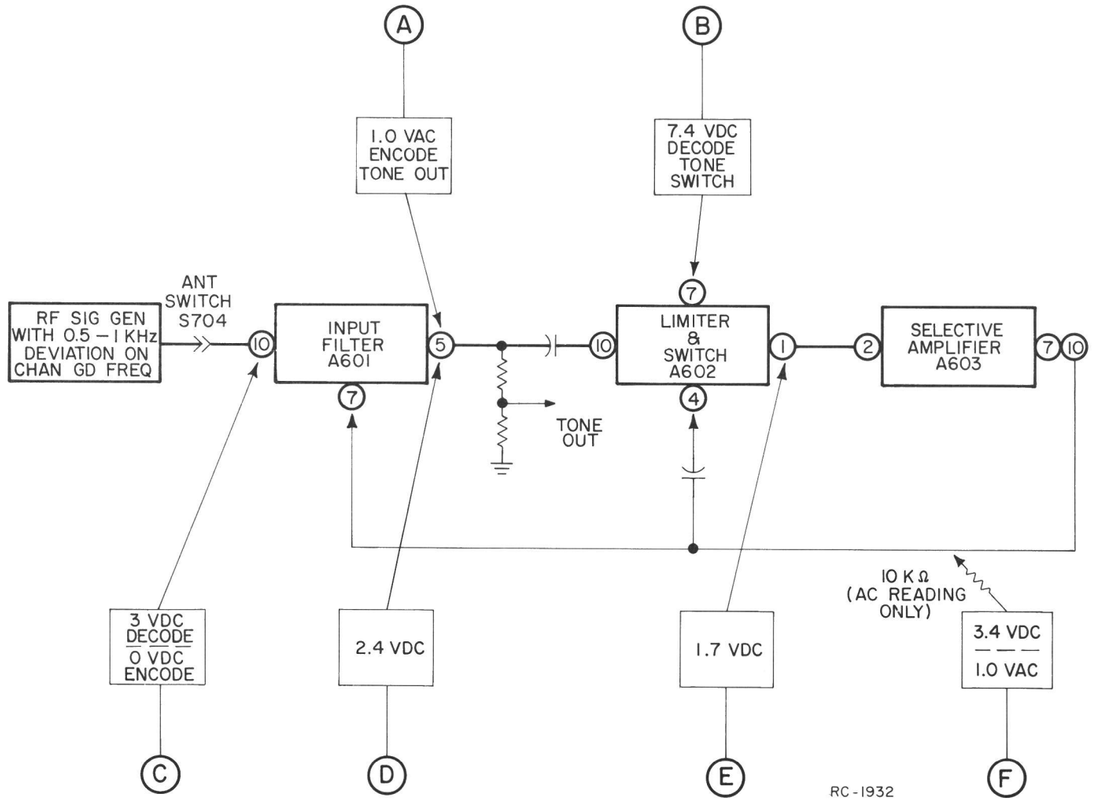


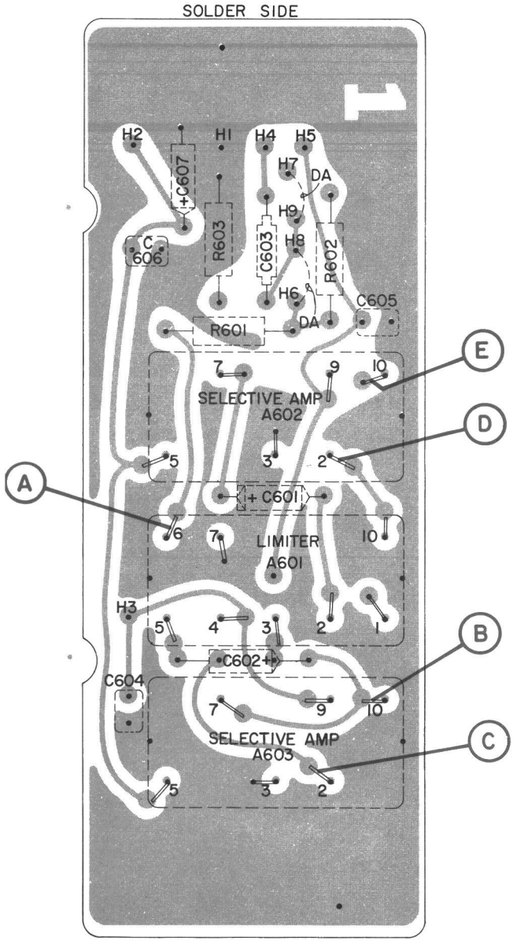


(RC-1935)
(19C317374, Rev. 5)
(19C317026, Sh. 2, Rev. 3)

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)

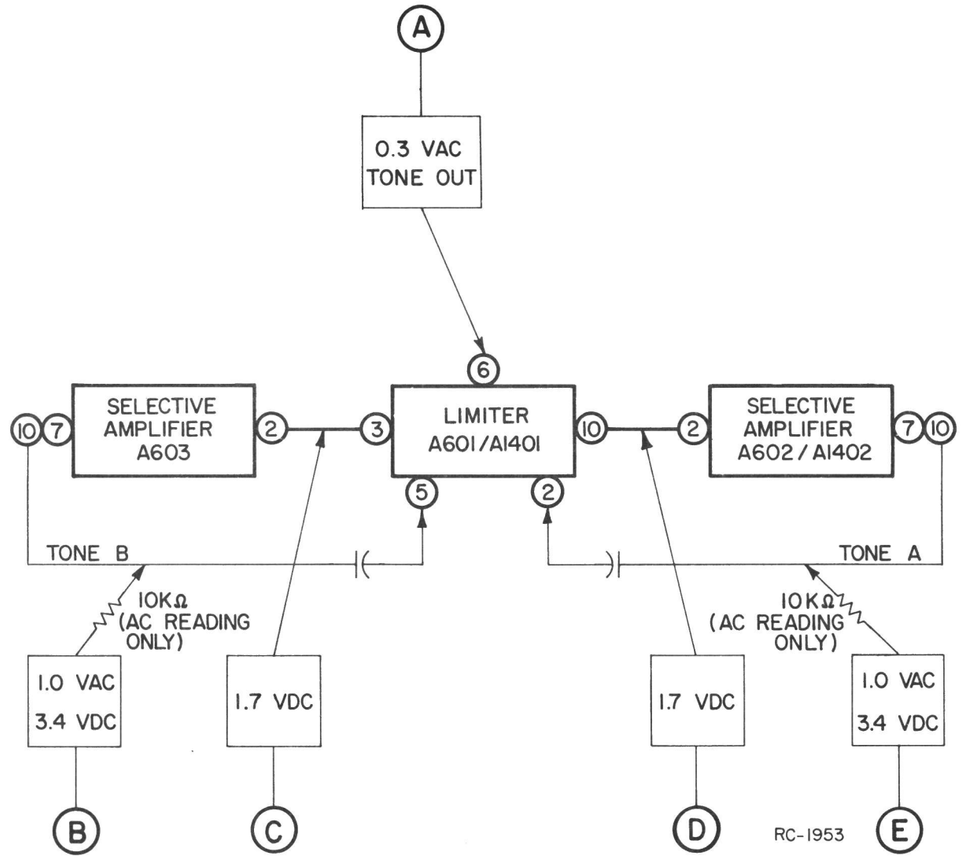
TROUBLESHOOTING

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) .

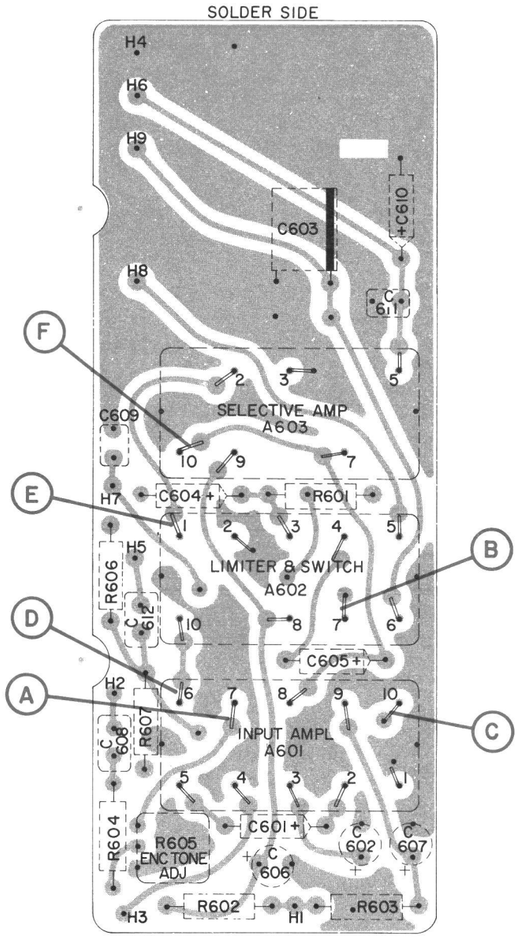
CAUTION

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

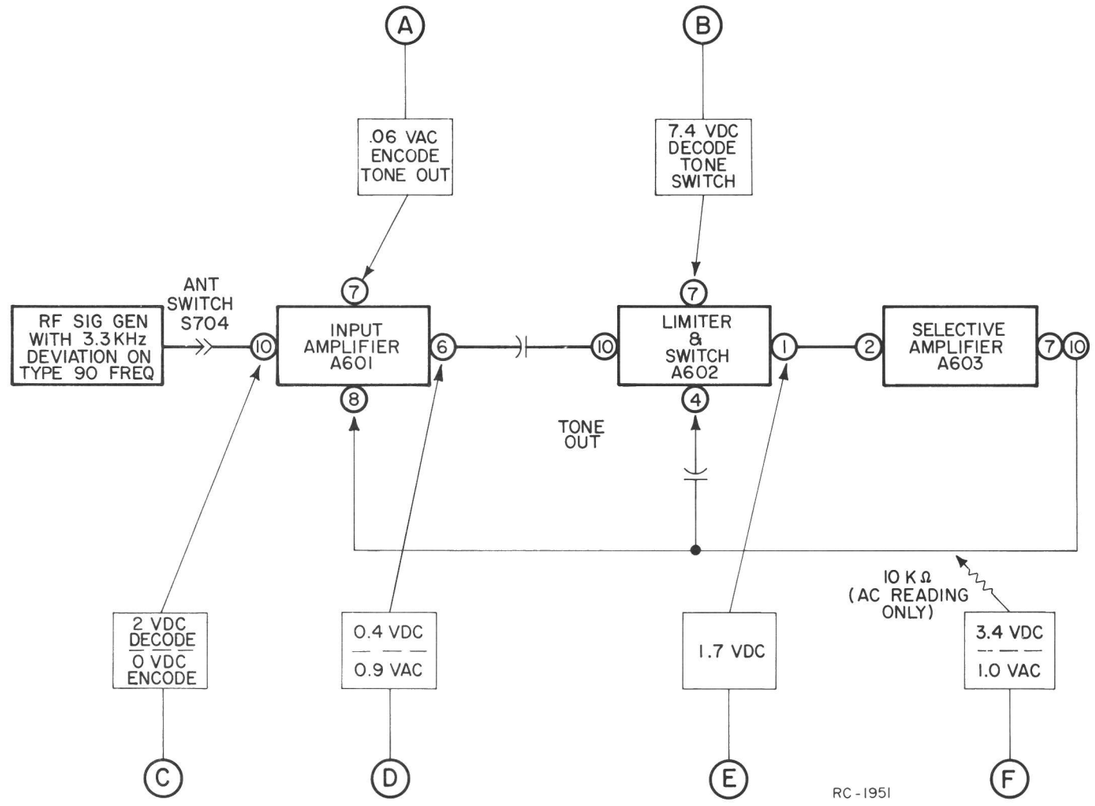
Always connect the board to ground (G11) when removed from the radio for troubleshooting.

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.

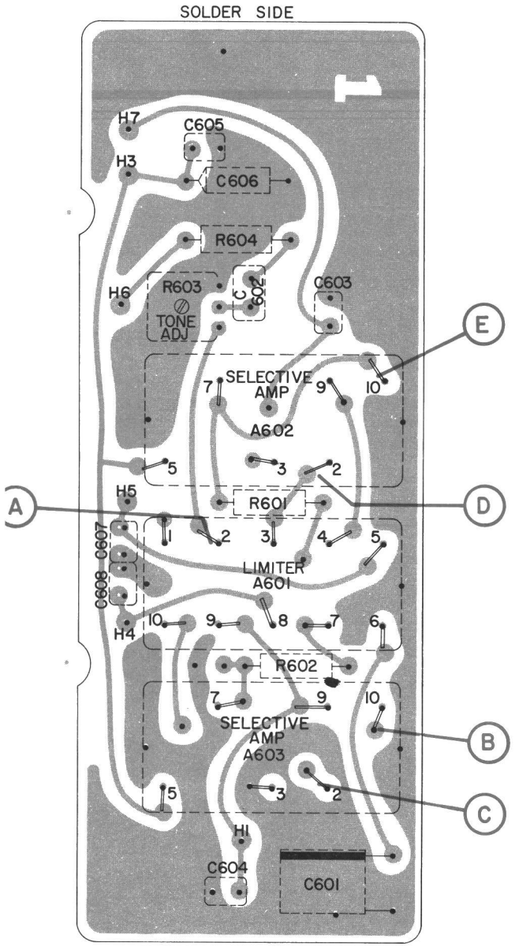
Unit won't decode	1. Place the Type 90 switch (S603) in the Reset and then in the Monitor position and check for proper operation of the receiver. 2. If the receiver operates properly, place the switch in the Reset and then the Normal position. Next, apply the proper Type 90 tone to the radio and check 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 Ⓕ.



(DF-9022)

TROUBLESHOOTING PROCEDURE

TYPE 90 ENCODER/DECODER



(RC-1952)
(19C317373, Rev. 2)
(19C317030, Sh. 2, Rev. 1)

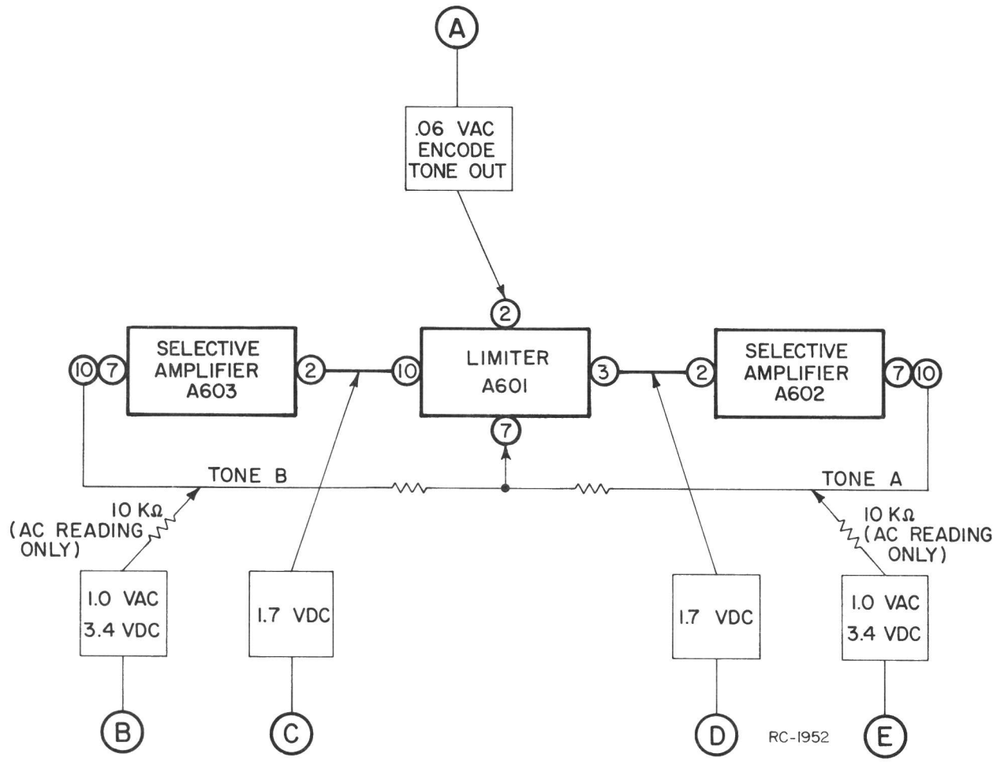
TROUBLESHOOTING

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.



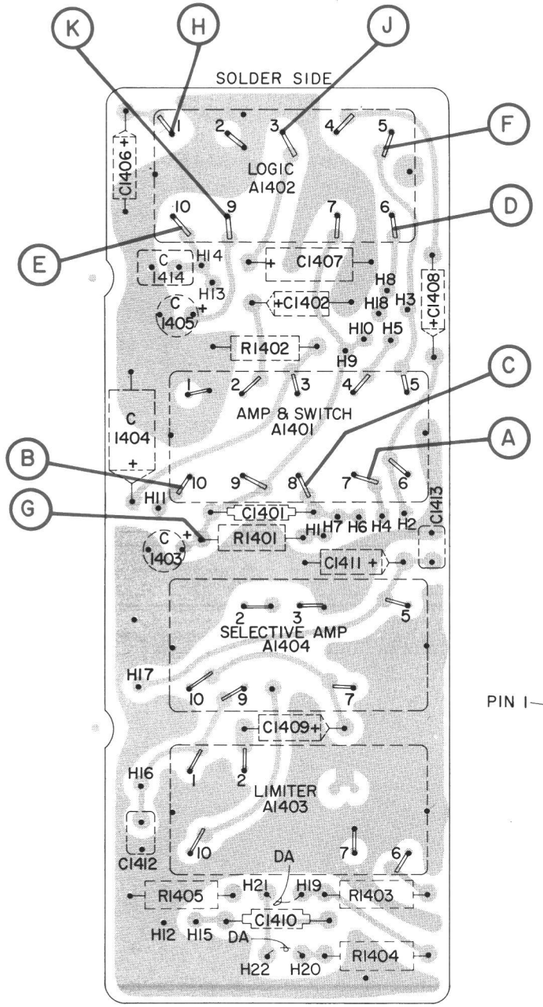
TROUBLESHOOTING PROCEDURE

TYPE 90 ENCODER

TROUBLESHOOTING

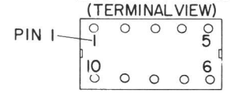
ALWAYS CONNECT THE BOARD TO GROUND WHEN REMOVED FROM THE RADIO FOR TROUBLESHOOTING.

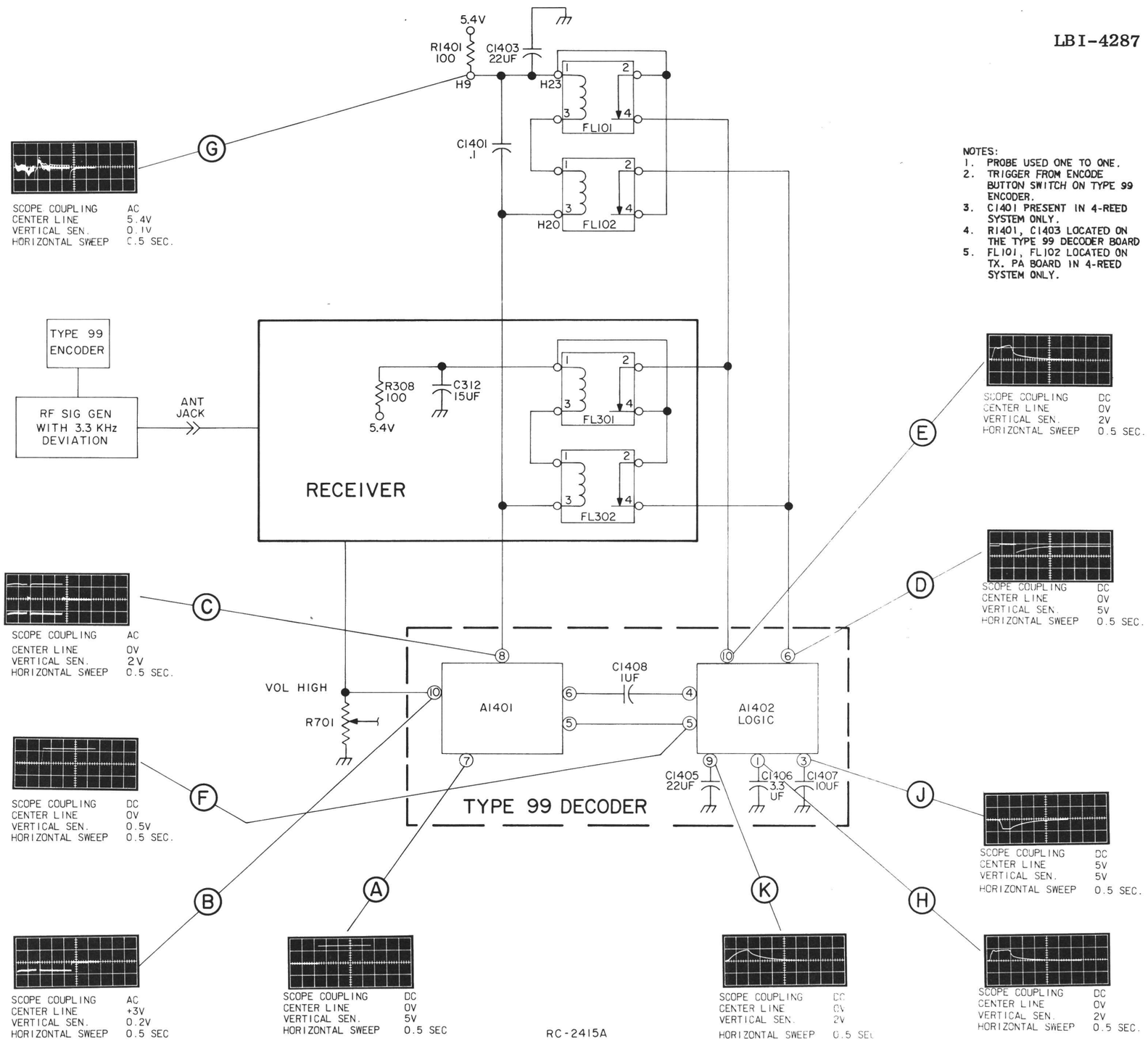
FOLLOW STEPS A THROUGH K IN RC-2415 & RC-2416.



(RC-2416)
(19C317370, Rev. 4)
(19C317022, Sh. 2, Rev. 3)

INTEGRATED CIRCUIT LEAD IDENTIFICATION (TERMINAL VIEW)





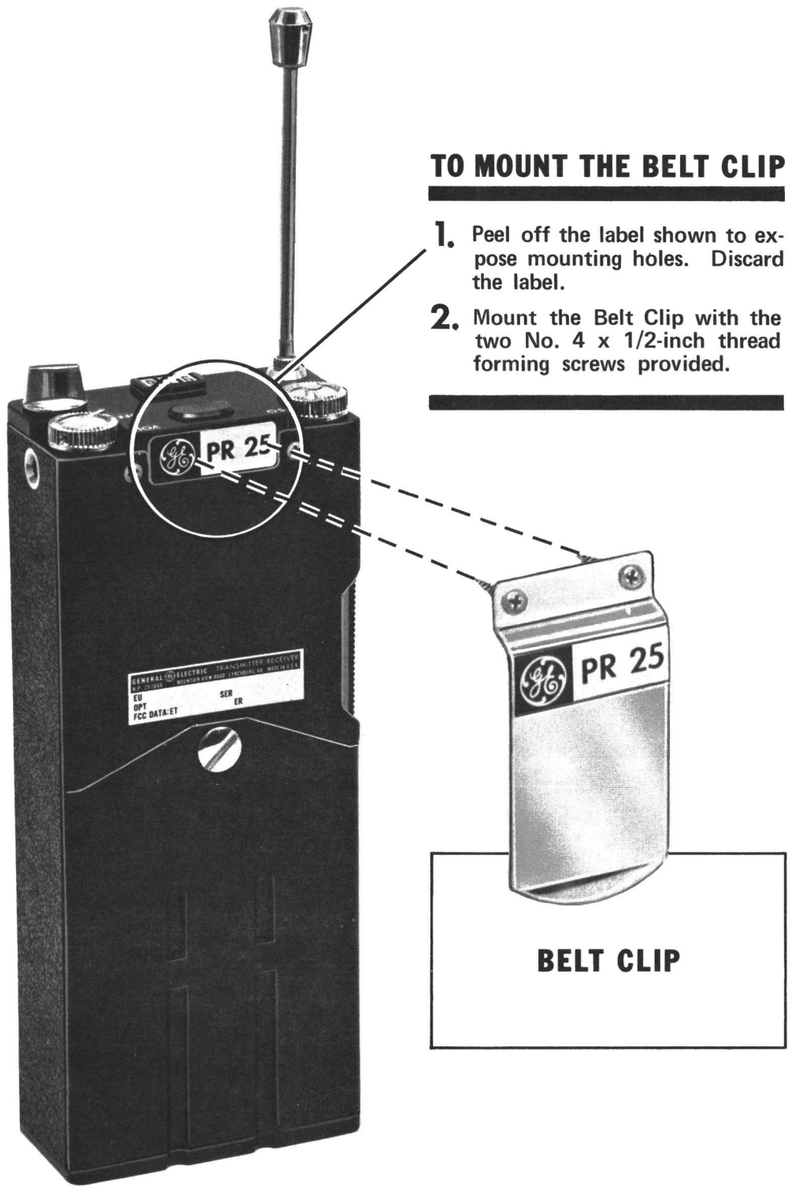
NOTES:
1. PROBE USED ONE TO ONE.
2. TRIGGER FROM ENCODE BUTTON SWITCH ON TYPE 99 ENCODER.
3. C1401 PRESENT IN 4-REED SYSTEM ONLY.
4. R1401, C1403 LOCATED ON THE TYPE 99 DECODER BOARD
5. FL101, FL102 LOCATED ON TX. PA BOARD IN 4-REED SYSTEM ONLY.

RC-2415A

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.

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-4287

MOBILE RADIO DEPARTMENT
GENERAL ELECTRIC COMPANY • LYNCHBURG, VIRGINIA 24502

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