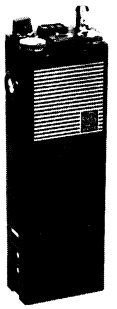
MOBILE RADIO

MASTR
PROGRESS LINE
Personal Series
MAINTENANCE MANUAL



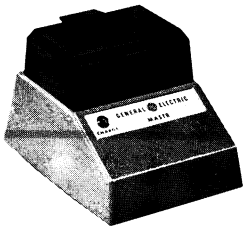
PE MODEL

EXTERNAL MICROPHONE

150.8–174 MHz
8-FREQUENCY
PE MODEL RADIO

TWO-WAY
PERSONAL
FM RADIO

LBI-4366A
DF-9029



DESK CHARGER

GENERAL ELECTRIC

TABLE OF CONTENTS

SPECIFICATIONS *

GENERAL

Frequency Range	150.8-174 MHz
Battery Drain (@7.5 Volts)	
Standby	14.5 milliamps
Receive	140 milliamps
Transmit	
100 milliwatts	150 milliamperes
200 milliwatts	165 milliamperes
1 Watt	340 milliamperes
2 Watts	630 milliamperes
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)
Multi-Frequency Spacing	
Transmitter	±0.6%
Receiver	±0.4%
Frequency Stability	
-30°C to +60°C	±.0005%
0°C to +55°C	±.0002%

TRANSMITTER

Type Number	KT-19-A & KT-20-A
Power Output	
KT-19-A	100 to 200 milliwatts
KT-20-A	1 to 2 Watts
Modulation Deviation	0 to ±5 kHz

Spurious	KT-19-A	KT-20-A
Radiated	-43 dB	-50 dB
Conducted	-43 dB	-60 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
RF Load Impedance	50 ohms

RECEIVER

Type Number	ER-59-B
Audio Output (EIA)	500 milliwatts at less than 5% distortion
Channel Spacing	30 kHz
Sensitivity	
12-dB SINAD (EIA Method)	0.25 µV
20-dB Quieting Method	0.35 µV
Selectivity	
EIA Two-Signal	-75 dB at ±30 kHz
20-dB Quieting Method	-110 dB at ±30 kHz
Spurious Response	-70 dB
Intermodulation (EIA)	-60 dB
Audio Response	+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

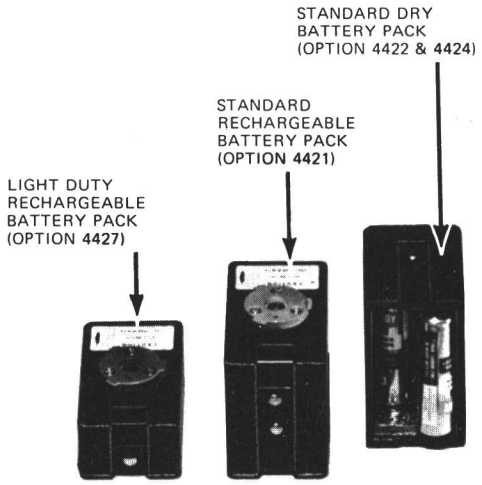
*These specifications are intended primarily for the use of the servicemen. Refer to the appropriate Specification Sheet for the complete specifications.

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	Package	Number of Freq.	Options	Frequency Range
PE Personal Series	**2** 100 - 200 Milliwatts	**6** 30 kHz	**K** Extended	**A** 1-Freq.Xmit 1-Freq.Rec	**S** Standard	**66** 150.8-174 MHz
	5 1 - 2 Watts			**B** 2-Freq.Xmit 1-Freq.Rec	**U** Channel Guard Encoder/Decoder	
				C 2-Freq.Xmit 2-Freq.Rec	**R** 2-Tone Channel Guard Encoder	
				D 1-Freq.Xmit 2-Freq.Rec	**B** Type 90 Encoder/Decoder	
				E 3-Freq.Xmit 3-Freq.Rec	**C** Type 90 2-Tone Encoder	
				F 4-Freq.Xmit 4-Freq.Rec		
				G 5-Freq.Xmit 5-Freq.Rec		
				H 6-Freq.Xmit 6-Freq.Rec		
				J 7-Freq.Xmit 7-Freq.Rec		
				K 8-Freq.Xmit 8-Freq.Rec.		

ACCESSORIES

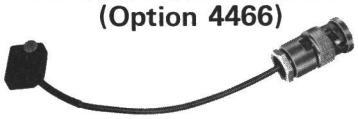
BATTERY PACKS



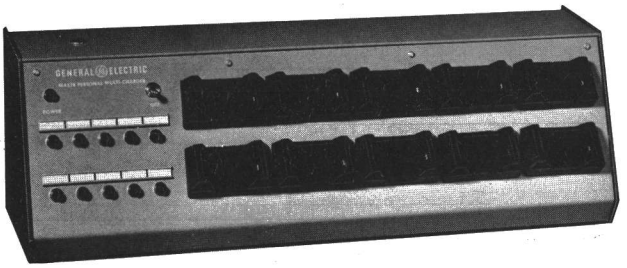
DESK CHARGER
MODEL 4EP71A10 (Option 4436)

FAST CHARGER
MODEL 4EP73A10 (Option 4440)

RF ADAPTER CABLE
(Option 4466)



MULTI-CHARGER
MODEL 4EP68A10 (Option 4445)



(Plug-in Slave Unit Option 4446)

VEHICULAR CHARGER
MODEL 4EP72A10 &11
(Options 4451 thru 4456)

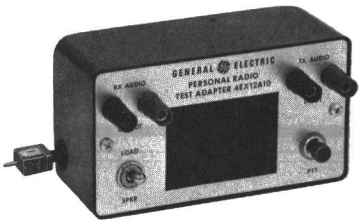
LEATHER CASE
(Option 4408 & 4409)

HAND STRAP
(Option 4406)

SHOULDER STRAP
(Option 4407)

TEST EQUIPMENT

TEST ADAPTOR
MODEL 4EX12A10 (Option 4384)

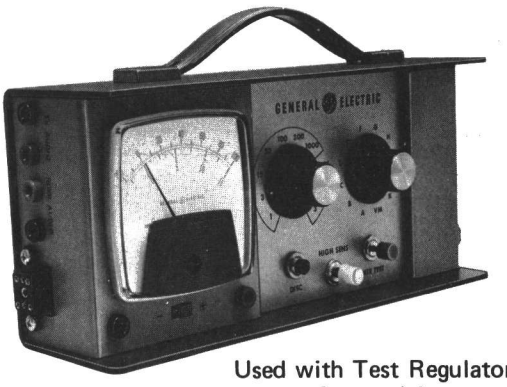


Provides transmitter and receiver audio connections

IF GENERATOR
MODEL 4EX9A10 (Option 4381)

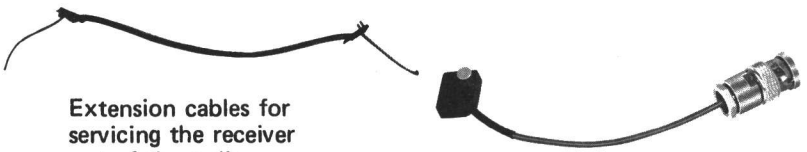
For setting the receiver on frequency and for troubleshooting

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



Used with Test Regulator for servicing

TEST REGULATOR
MODEL 4EX18A10 (Option 4465)



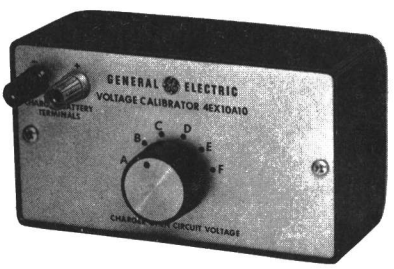
Extension cables for servicing the receiver out of the radio

Transmitter RF Adaptor Cable

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 PE Model personal radios are extremely compact, high performance two-way FM radios designed for one through eight-frequency operation in the 150.8-174 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 vinyl-covered, stainless steel front and back covers. 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 quickly attaches to the bottom section of the case. The battery pack can be recharged either attached or removed from the radio.

A battery pack using dry batteries is available whenever the rechargeable battery pack is not required.

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-4231 for complete operating instructions.

TO RECEIVE A MESSAGE

1. Turn the OFF-VOLUME control about halfway 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. 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. Then listen to make sure that no one is using the channel.
3. While holding the radio so that the antenna is vertical, press the Push-to Talk (PTT) switch and speak directly into the local microphone (or across the face of an external microphone) in a normal tone of voice. 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.

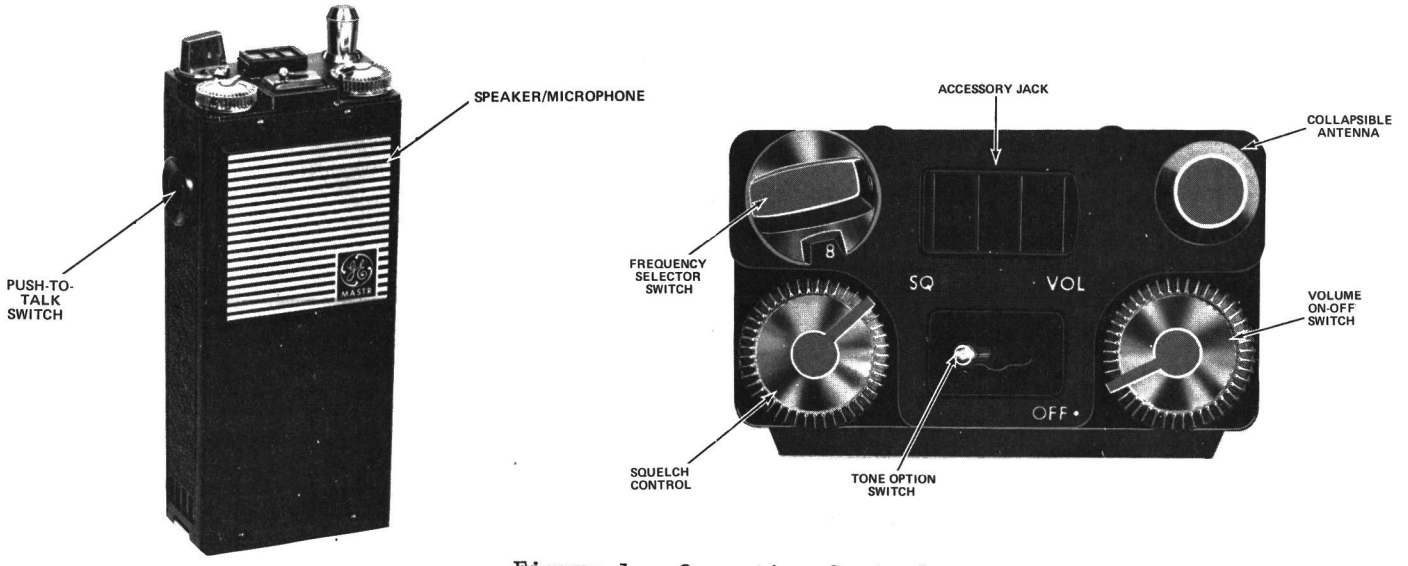


Figure 1 - Operating Controls

- 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 outside 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.

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 dry 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 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).

BATTERY INFORMATION

Two rechargeable battery packs and a dry battery pack are available for operating the radio. The different battery packs are shown in Table 1.

The rechargeable Nickel-Cadmium battery pack should be given a minimum initial charge of 16-24 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 the appropriate battery charger.

All of the battery packs are directly interchangeable. However, the battery pack should be selected according to the power output and battery life required. Battery

Battery Pack	Battery Type	Battery Part Number	Equivalent
Standard 19D413522G1	Rechargeable	19D413522G1	None
Dry Battery Pack 19E500938G1	Carbon-zinc		Eveready 1015
Dry Battery Pack 19E500938G1	Alkaline (Package of 4)	19B200608P2	Eveready E91
Dry Battery Pack 19E500938G1	Mercury (Package of 4)	19A116522P2	Mallory RM15
Light Duty 19D413522G2	Rechargeable	19D413522G2	None

Table 1 - Battery Packs

life for a 10% transmit, 10% receive and 80% standby duty cycle and for the different power levels is shown in Table II.

WARNING

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

BATTERY PACK REPLACEMENT

To remove the battery pack from the radio:

1. Turn the radio OFF.
2. Press the battery retaining latch away from the battery pack as shown in Figure 2, and turn the battery pack one-quarter turn to the left. The battery pack can now be detached from the radio.

To reconnect the battery pack to the radio:

1. Hold the battery pack at a 90° angle to the radio as shown in Figure 2.
2. Align the large tab marked with an arrow on the battery pack connector with the large cut-out marked with an arrow on the radio socket.
3. Press the battery pack connector into the socket on the radio and turn the battery pack one-quarter turn to the right until the latch clicks.

STANDARD DRY BATTERY PACK

Standard battery pack 19E500938G1 is equipped with a removable bottom cover for use with dry batteries. To remove the batteries:

1. Remove the battery pack from the radio.

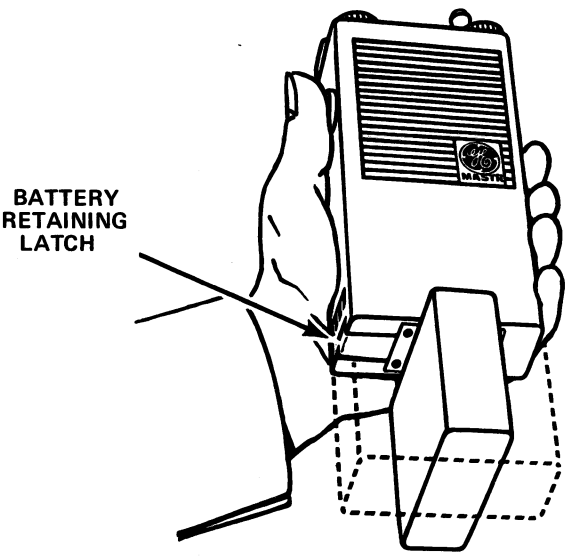


Figure 2 - Battery Pack Replacement

2. Press in and turn the captive screw one-quarter turn to the left to the OPEN position, and lift off the cover.
3. Rap the open end of the battery pack on the palm of one hand over a table or desk to dislodge the batteries.
4. Replace the batteries with the plus (+) end pointing away from the springs as shown on the decal in the battery compartment.
5. Replace the bottom cover with the white dot in corner of the cover over the white dot in the corner of the battery compartment.
6. Turn the locking screw one-quarter turn to the right to the LOCK position.

RF Power Output	EIA BATTERY LIFE IN HOURS				
	Standard Rechargeable	Standard Mercury	Standard Alkaline	Standard Carbon	Light Duty Rechargeable
100 milliwatts	14	48	25	6	5
200 milliwatts	13	46	23	5	4
1 Watt	9	32	16	3	2
1.5 Watts	8	27	14	2	2
2 Watts	7	27	14	2	2

Table II - Battery Life

BATTERY CHECKS

CHARGE LEVEL MEASUREMENT

The charge level of the battery packs can be measured by connecting a voltmeter across the charging contacts and measuring the voltage with the transmitter keyed.

For the rechargeable battery packs, a fully charged battery pack should provide a reading of 7.5 to 8 Volts. A fully discharged battery pack should provide a reading of 6 to 6.5 Volts.

For dry battery packs, replace the batteries if the reading is 5.6 volts or less.

RECHARGEABLE BATTERY CHECK

One of the best service checks for the PE series rechargeable battery packs can be easily obtained by measuring the ampere-hour capacity. The results of the measurement can then be compared with the rated capacity of the battery pack to determine the general condition of the rechargeable batteries.

First, it is necessary to find the percentage of rated capacity. This is obtained by measuring the time it takes to discharge a fully charged battery pack until the voltage drops to 6 Volts. The proper load resistor for each of the battery packs is shown in Table III.

Then use the formula $\frac{T}{60}$ = % where "T" is the time in minutes required to discharge the battery pack to 6 Volts and % is the percentage of rated capacity the battery delivered to a load. For example: assume the standard battery pack voltage dropped to 6 Volts in 50 minutes:

$$\frac{50}{60} = .83 \text{ (percentage of capacity)}$$

Now multiply the percentage of capacity by its rated capacity (see Table III):

$$.83 \times 500 \text{ mA} = 415 \text{ mA}$$

The 415 milliamperes is the actual capacity of the battery pack.

CAUTION

As the voltage drops very fast near the end of the discharge cycle, be very careful to avoid discharging the battery pack below 6 Volts.

BATTERY CHARGERS

Four different PE Series chargers are available for recharging the Standard and the Light Duty rechargeable battery packs. 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 on or off of the radio from 120-Volt, 50/60 Hz source in 16 hours.
- MULTI-CHARGER - Charges up to ten battery packs on or off the radio from a 120-Volt, 50/60 Hz source in 16 hours. Three additional slave charging units can be connected to the multi-charger for charging up to 40 radios or battery packs simultaneously.
- FAST CHARGER - (Standard Battery Pack Only). Charges one radio or battery pack to approximately 70% of capacity in 15 minutes. Fully recharges the battery pack in addition eight hours on trickle charge.
- VEHICULAR CHARGER - Charges one radio from the vehicle battery in 16 hours.

NOTE

Due to the temperature characteristics of the 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 approximately 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.

RECHARGEABLE BATTERY PACK	RATED CAPACITY	DISCHARGE RATE (for 60 minutes)	LOAD RESISTOR (R_L)	END VOLTAGE
STANDARD (6 cells 19D413522G1	500 mA	500 mA	15 ohms, 8 Watts	6 VDC
LIGHT DUTY (6 cells) 19D413522G2	150 mA	150 mA	50 ohms, 2 Watts	6 VDC

Table III - Capacity Measurement Data

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

Desk Charger

To use the Desk Charger, plug the power cable into a 120-Volt, 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 arrow on the yellow label pointing towards the rear of the charger. 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 is equipped with an antenna connector for connecting the unit to an external antenna. Simply placing the radio into the charging insert automatically connects the radio to the external antenna and disconnects the internal antenna. If the automatic external antenna connection is not desired, instructions for disabling the antenna connection are contained in the Desk Charger Maintenance Manual.

Multi-Charger

To use the Multi-Charger, plug the power cable into a 120-Volt, 50/60 Hz source. Next, place the radio(s) into the charging insert(s) with the speaker facing down, or place the battery pack(s) into the insert with the arrow on the yellow label pointing up. Then turn the OFF-ON switch to the ON position. The green CHARGE light will glow when the batteries are charging.

Fast Charger

The fast charger will recharge the Standard battery pack only. To use the Fast Charger, plug the power cable into a 120-Volt, 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 down, or place the Standard battery pack into the insert with the arrow on the yellow label pointing up. The red FAST CHARGE light will glow when the battery is charging.

The battery is charged to approximately 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 th 120-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. Next, turn the OFF-ON switch to the ON position. The red Charge light will glow when the battery is charging.

Lock the charger to secure the radio. This also assures good contact with the external accessory pins during periods of severe vibration.

This charger is shipped with an external antenna. This permits the radio to be used to send and receive messages while charging -- although it will probably take longer to recharge the battery. An optional external microphone is required for this application.

To remove the radio from the charger, simply unlock the charger and pull the radio out of the charging insert.

CIRCUIT ANALYSIS

TRANSMITTER

Transmitter Types KT-19-A and KT-20-A are crystal controlled, phase modulated transmitters for one- through eight-frequency operation in the 150.8-174 MHz band. The transmitters utilize both discrete components and Integrated Circuit Modules (IC's).

The transmitters consist of the audio, regulator, oscillator, compensator and modulator IC's, and plug-in Exciter and PA modules.

Transmitter Type KT-19-A uses a matching network as the final stage to provide and RF output of 200 milliwatts. Transmitter Type KT-20-A uses a transistorized PA module to provide an RF power output of over two watts. All of the transmitter modules

are mounted on System Board A703. Supply voltages for the transmitter are provided by the battery and Regulator. The different transmitter voltages are shown in the following chart:

Voltage	Used for:
Continuous 7.5 Volts	Regulator module
Keyed 7.5 Volts	Regulator 5.4-Volt keying, Exciter and PA modules.
Keyed 5.4 Volts	Compensator, Oscillator, Audio and Modulator modules, and optional Compressor module.

References to symbol numbers mentioned in the following test are found on the Schematic Diagrams, Outline Diagrams and Parts List (see Table of Contents). The typical, simplifier circuit diagrams used in the text are representative of the circuits in the IC modules. A block diagram of the transmitter is shown in Figure 3.

REGULATOR A2

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 4.

Turning on the radio applies the battery voltage to Pin 2 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 4 and applied to the receiver Compensator and Oscillator 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 7 and to the base of Q5, turning it on. This turns on PNP transistor Q4, so that the regulated 5.4 volts at Pin

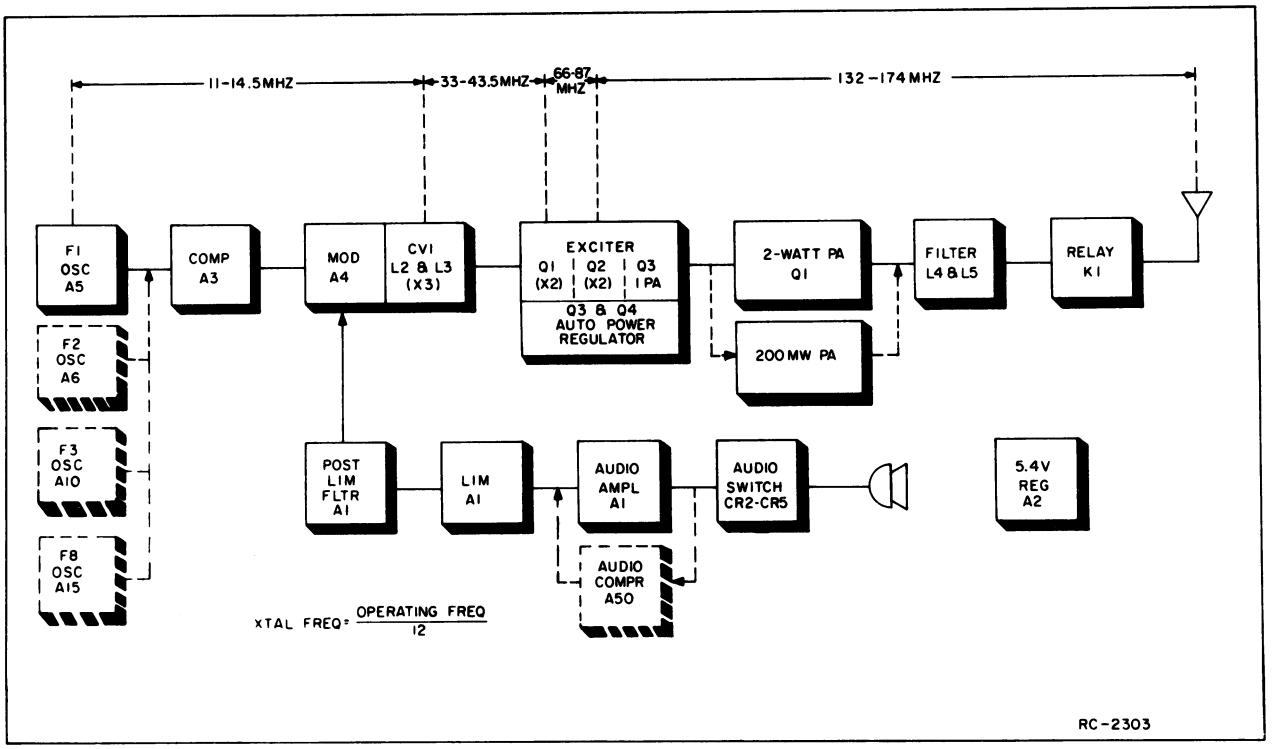


Figure 3 - Transmitter Block Diagram

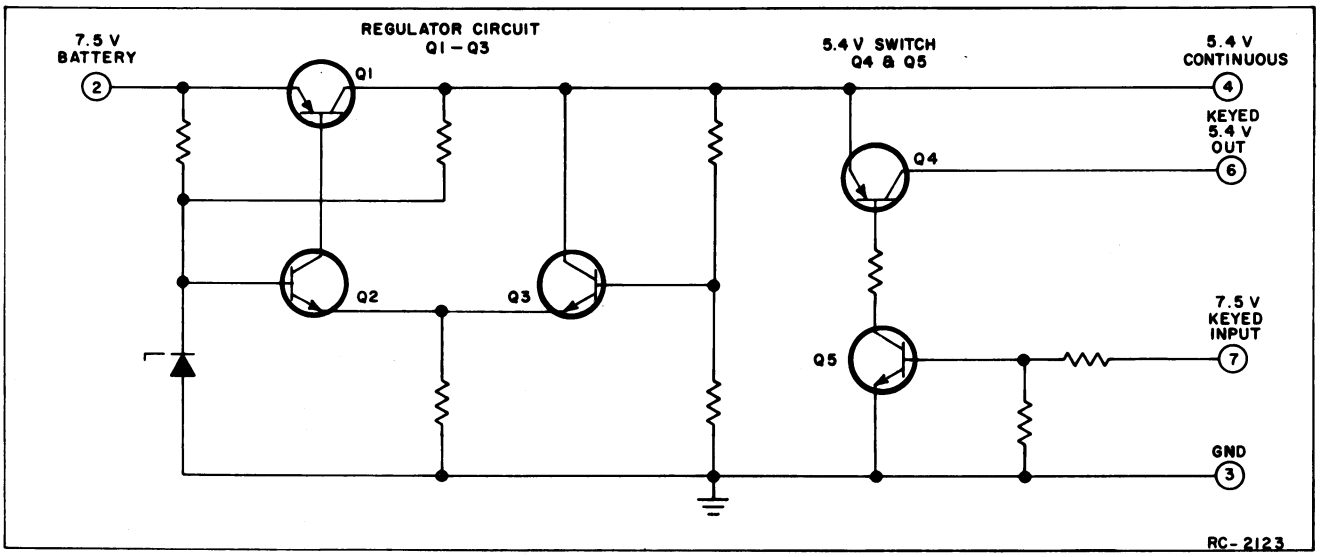


Figure 4 - Typical Regulator Circuit

6 is applied to the transmitter Compensator, Modulator, and audio module, and to the optional Compressor module and multi-frequency switch S1.

OSCILLATOR MODULES

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

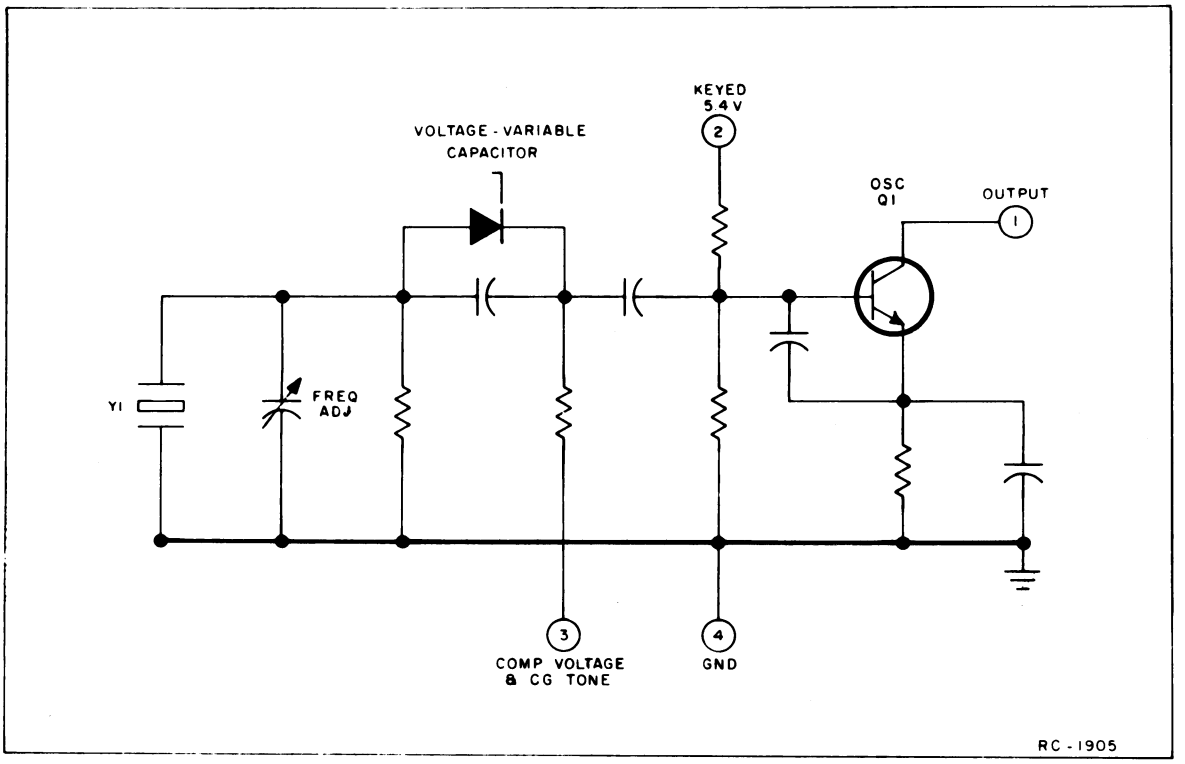


Figure 5 - Typical Oscillator Circuit

compensation network is contained in Compensator module A3.

A typical oscillator circuit is shown in Figure 5.

In single-frequency transmitters, a jumper from Hole 20 to Hole 21 on the System Board connects the keyed 5.4 Volt supply voltage to the oscillator modules. Keying the transmitter applies the supply voltage to the oscillator, turning it on. The oscillator output is applied to Compensator A3.

In multi-frequency transmitters, additional Oscillator Modules are mounted on the 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 S1 on the control unit.

Complete instructions for multi-frequency modifications are contained in the Multi-Frequency Modification diagram (see Table of Contents).

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

NOTE

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

COMPENSATOR A3

Compensator module A3 contains a buffer-amplifier, and the temperature compensating network for the oscillator. A typical Compensator circuit is shown in Figure 6.

RF from the oscillator at Pin 7 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 9 to the modulator.

In the compensation network, the keyed 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 voltage-variable capacitor in the oscillator module. At

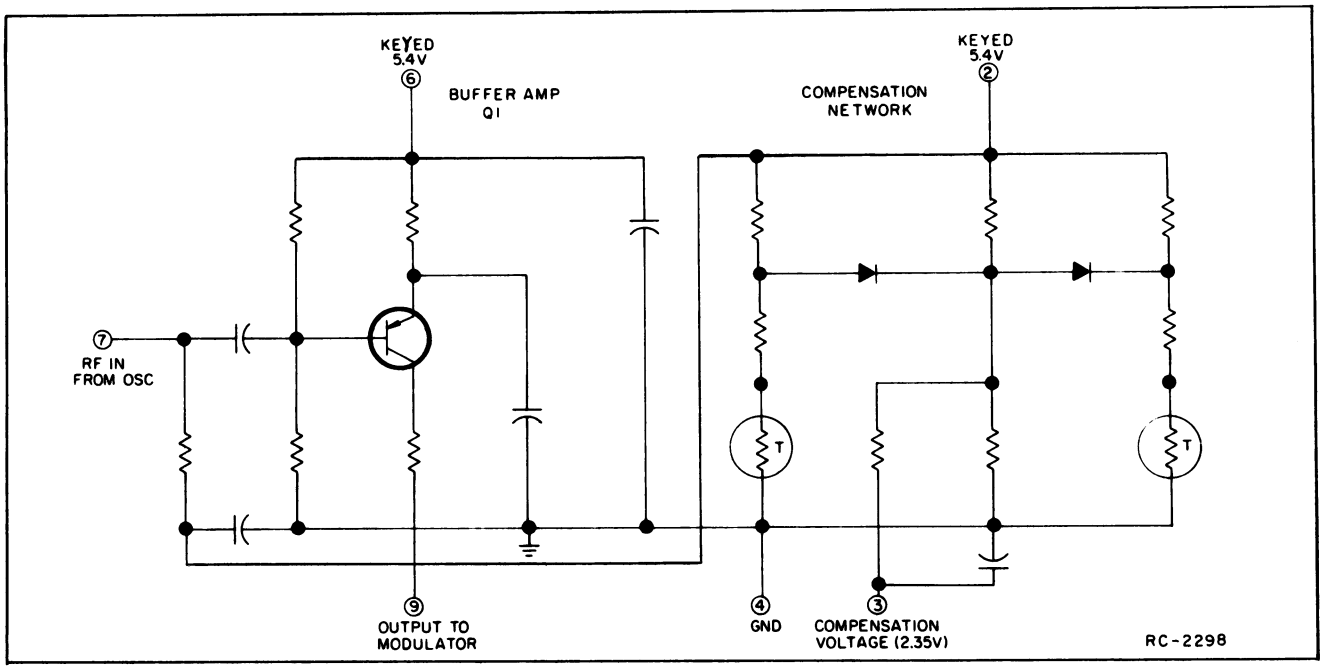


Figure 6 - Typical Compensator Circuit

temperatures below -10°C, the compensated voltage increases to maintain the proper voltage on the oscillator voltage-variable capacitor.

Service Note: An abnormally low VTVM reading (or no reading) at Pin 3 may indicate a short or leakage path in the oscillator. This can be checked by unsoldering Pin 3, raising it off 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.

AUDIO AMPLIFIER AND LIMITER A1

Audio from the microphone is coupled through the audio switching circuit to Pin 1 and then to the base of audio amplifier Q1 (see Figure 7). In Type 90 encoder applications, the encode tone is applied to the amplifier at Pin 2.

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. Q3 operates as an active filter. The filter output at Pin 8 is coupled through Mod Adjust potentiometer R8 to the Modulator module A4.

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 4 to the compressor circuit, keeping the audio output to the modulator constant.

AUDIO COMPRESSOR A50

The optional Audio Compressor Module provides a relatively 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 8.

Audio from the microphone is coupled through R52 on the System Board to Pin 1 of the Compressor. The audio is applied to pre-amplifier Q1 which provides the 13 dB gain. The pre-amplifier output at Pin 4 is Amplifier-Limiter module A1.

At the same time, an audio sample voltage from Audio module A1 is applied to Pin 9 and to audio amplifier Q3 in the Compressor module. The output of Q3 is rectified by the two diodes, and the resultant voltage applied to the base of DC amplifier Q4. The DC output of Q4 controls the operation of the compressor-control transistor Q2.

An increase in the audio sample voltage increases the DC voltage applied to Q2. This reduces the AC impedance of Q2, which decreases the audio output voltage at Pin 4. A decrease in the audio sample voltage

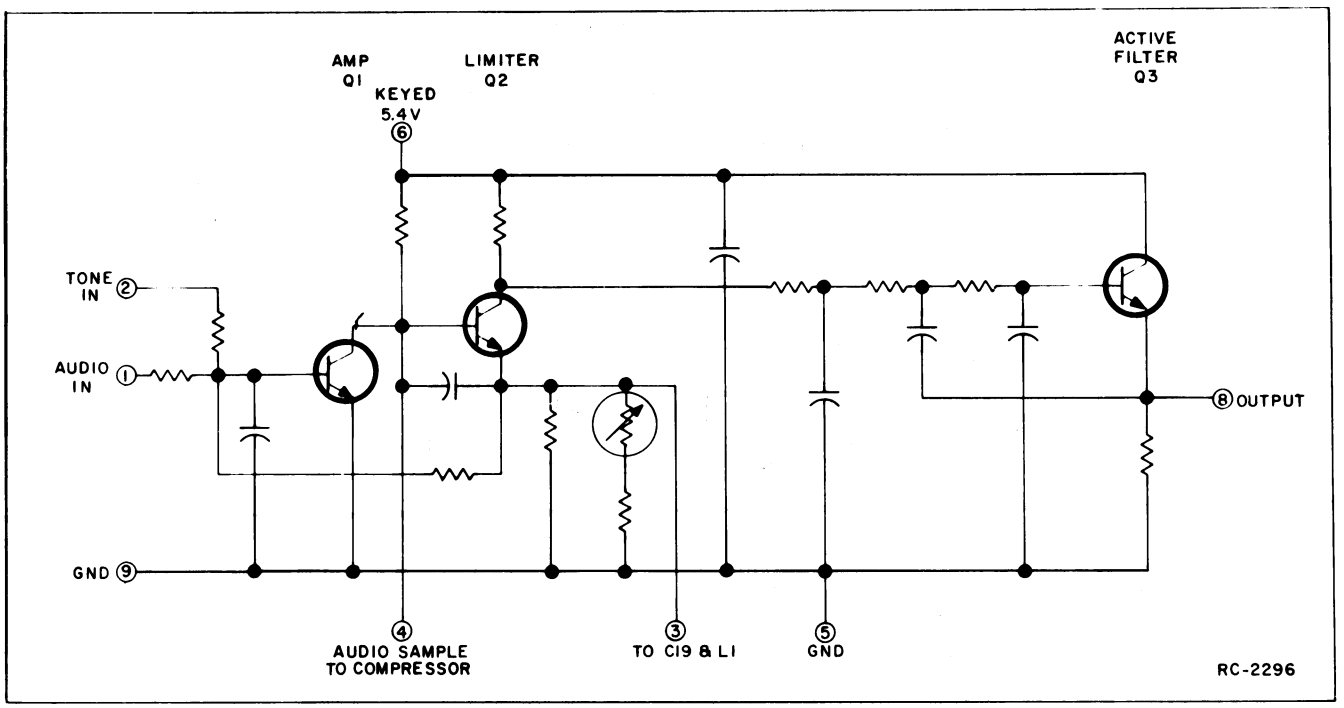


Figure 7 - Typical Audio Amplifier & Limiter Circuit

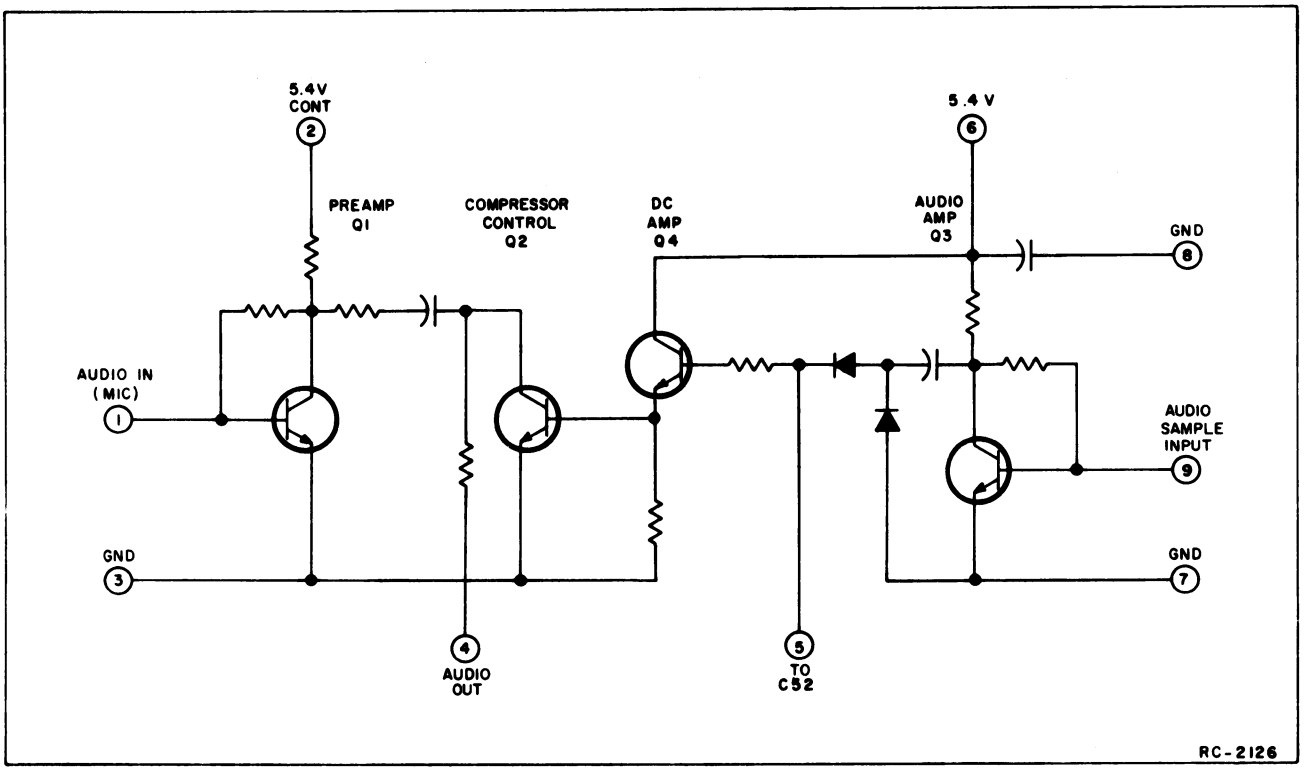


Figure 8 - Typical Audio Compressor Circuit

decreases the DC voltage applied to Q2. This increases the AC impedance of Q2, and increases the audio output voltage at Pin 4.

PHASE MODULATOR

The phase modulator circuit consists of Modulator A4, voltage-variable capacitor CV1 and tuneable coil L2. CV1 and L2 are mounted

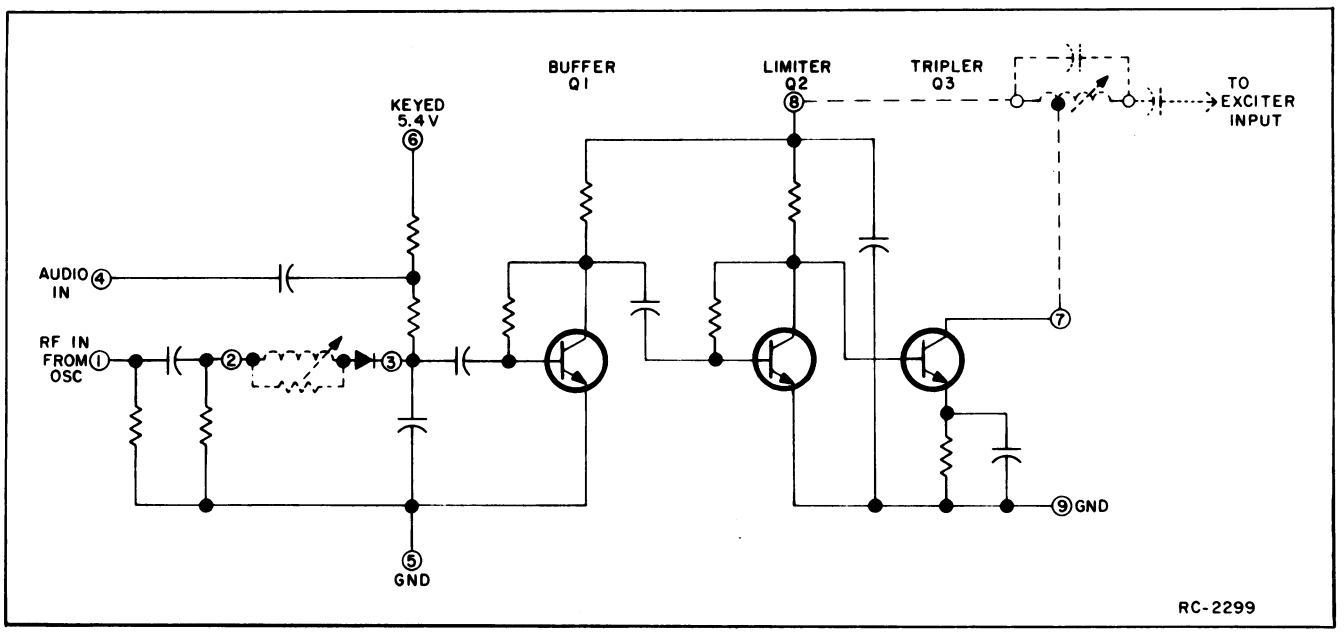


Figure 9 - Typical Phase Modulator Circuit

on System Board A703. A typical modulator circuit is shown in Figure 9.

With CV1 in series with L2, the network appears as a series-resonant circuit when RF from the oscillator is applied to Pin 1. Applying audio from Audio Limiter A1 to Pin 4 of Modulator A4 varies the bias of CV1, resulting in a phase modulated output.

Buffer Q1 isolates the modulator from the loading effects of the following multiplier stage, and also provides some amplification. Following the buffer stage is tripler Q2. The output of Q2 is coupled through L3 (on the System Board) to the exciter module. L3 is tuned to three times the crystal frequency.

EXCITER

Exciter Board Model 4EG29A11 (150.8 - 174 MHz) consists of two class C doubler stages; a class C amplifier stage, and an Automatic Power Level Control (APLC) circuit.

Doubler & Amplifier Stages

The modulator output is coupled through T1 to the base of 1st doubler Q1. The 1st doubler stage as well as the modulator stage is metered at TP1. The 1st doubler output is coupled through T2 to the base of 2nd doubler Q2. T2 is tuned to six times the crystal frequency.

Following the 2nd doubler is an impedance-matching network consisting of C14, C16, C17, C19 and L2. The network matches the high impedance 2nd doubler output to the low impedance amplifier input. L2 is tuned to 12 times the crystal frequency.

2nd doubler Q2, amplifier Q3 and the PA transistor are tuned by measuring the total current drain of the radio. An Ammeter with a one ampere full scale meter is used in series with the radio 7.5-Volt supply. GE Test Regulator Model 4EX18A10 and Test Set Model 4EX3A10 may be used in place of the ammeter.

A constant-K, DC collector feed network consisting of L1, L7, C4 and C12 provides improved 2nd doubler stability. Similar collector-feed networks are used in the amplifier and PA stages.

The output of amplifier Q3 is applied to the PA module.

APLC Circuit

The APLC circuit (Q4 and Q5) provides a more constant transmitter power output by controlling the output of the 1st and 2nd doubler. The circuit also extends the battery life by regulating the current to amplifier Q3.

When Q3 starts to conduct harder and draw more collector current, the voltage drop across R7 increases, causing Q4 to conduct harder. This increases the voltage at the base of Q5. Increasing the voltage at the base of Q5 causes it to conduct less, which increases the voltage drop across Q5 and reduces the collector voltage of Q1 and Q2. This reduces the drive to amplifier Q3 and reduces the collector current.

In low power transmitters, Power Adjust Potentiometer R8 is used to set the power output in 2-Watt transmitters, R8 can be used to limit the maximum power output.

PA MODULES

Two plug-in PA modules are available for use in the transmitter, depending on the power output required.

In one- to two-Watt transmitters, PA module 4EF39A11 (150.8 to 174 MHz) is used. The output of the exciter is coupled through a tuned circuit to the base of Class C amplifier Q1. The amplifier output is applied through a series-tuned circuit to the low-pass filter.

In 100 to 200 milliwatt transmitters, the PA consists of a "T"-Type matching network. The output of the network is applied to the low-pass filter. An RF adaptor cable is available for connecting the transmitter RF output to a wattmeter. Connecting the RF adaptor cable to J702 opens a set of contacts on the antenna strip line assembly. This disconnects the collapsible antenna and connects the transmitter output to J702-3. Connection to chassis ground is made at J702-4.

LOW-PASS FILTER

The low-pass filter is mounted on Systems Board A701. The filter consists of L4, C5, C8, C10 and C18. The filter output is fed to System switching relay K1, and then coupled through a 50-ohm antenna matching network (L701 and C15) to the antenna.

RECEIVER

Receiver Models 4ER59B11 and -13 are single conversion, superheterodyne FM receivers for one through eight frequency operation on the 150.8-174 MHz bands. The complete receiver mounts on a single printed wiring board, and utilizes both discrete components and Integrated Circuit modules.

References to symbol numbers mentioned in the following test are found on the Schematic Diagram, Outline Diagram and Parts List (see Table of Contents). The typical circuit diagrams used in the text

are representative of the circuits used in the Integrated Circuit modules. A block diagram of the receiver is shown in Figure 10.

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

OSCILLATOR MODULES

Oscillator Model 4EG28A11 (150.8-174 MHz) consists of a crystal-controlled Colpitts oscillator similar to the Oscillator module used in the transmitter (see Figure 5). The entire oscillator is contained in a metal can with the receiver operating frequency printed on the top. The crystal frequency ranges from 14.53 to 17.11 MHz, and the crystal frequency is multiplied 9 times.

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

In multi-frequency receivers, additional oscillator modules are mounted on the receiver board. The single-frequency supply jumper is removed, and the proper frequency is selected by connecting the 5.4 Volts to the selected oscillator module through frequency selector switch S1 on the control unit.

Complete instructions for multi-frequency modifications are contained in the Multi-Frequency Modification diagram (see Table of Contents).

NOTE

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

COMPENSATOR A313

Compensator module A313 contains a buffer-amplifier stage, and the temperature compensation network for the oscillator similar to the Compensator used in the transmitter (see Figure 6).

RF from the oscillator is coupled through a DC blocking capacitor to the base

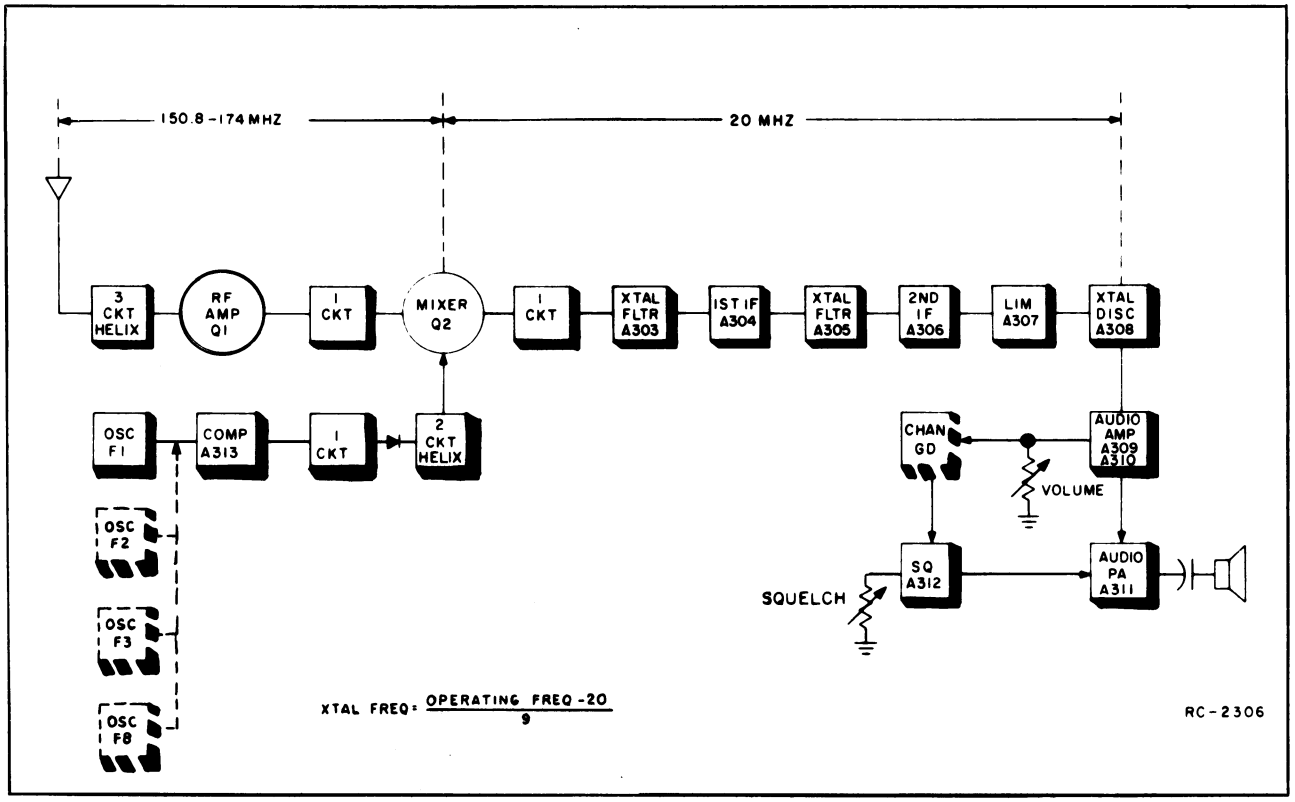


Figure 10 - Receiver Block Diagram

of Q1. The output of Q1 connects to multiplier coil L1 on the Multiplier assembly.

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

SERVICE NOTE

An abnormally low VTVM reading (or no reading) at Pin 3 may indicate a short or leakage path in the oscillator. This can be checked by unsoldering Pin 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.

FRONT END 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 L6. The tap is positioned to provide the proper impedance match to the antenna. RF energy is coupled to the third coil (L8) through openings in the sides of the cans. RF is then coupled from a tap on L8 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.

MULTIPLIER & MIXER A302

The output of the Compensator module is applied to L2 in the Multiplier assembly. L2 is tuned to three times the crystal frequency and is metered at the Mult Test Point (H8) on the receiver board. The output of L2 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.

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

CRYSTAL FILTERS A303 & A305

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

IF AMPS A304 & A306

An IF Amplifier module follows each of the crystal filters, and contain the resistor-matching networks for the filters. A

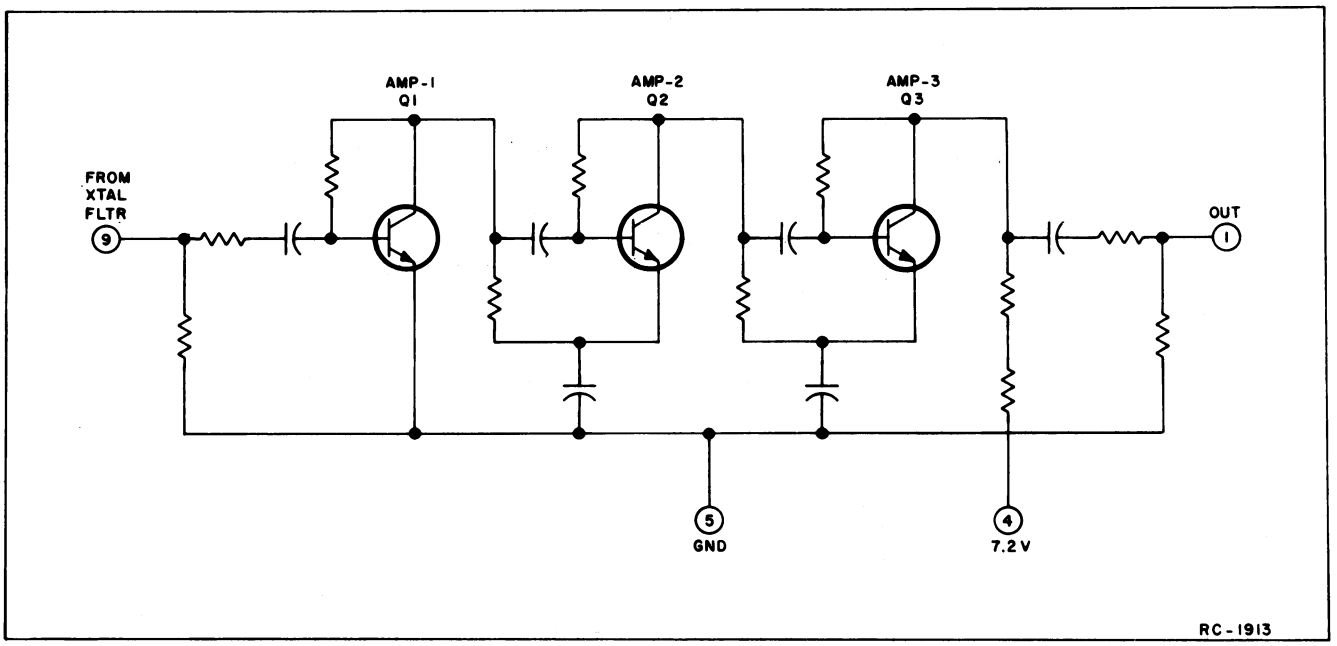


Figure 11 - Typical IF Amplifier Circuit

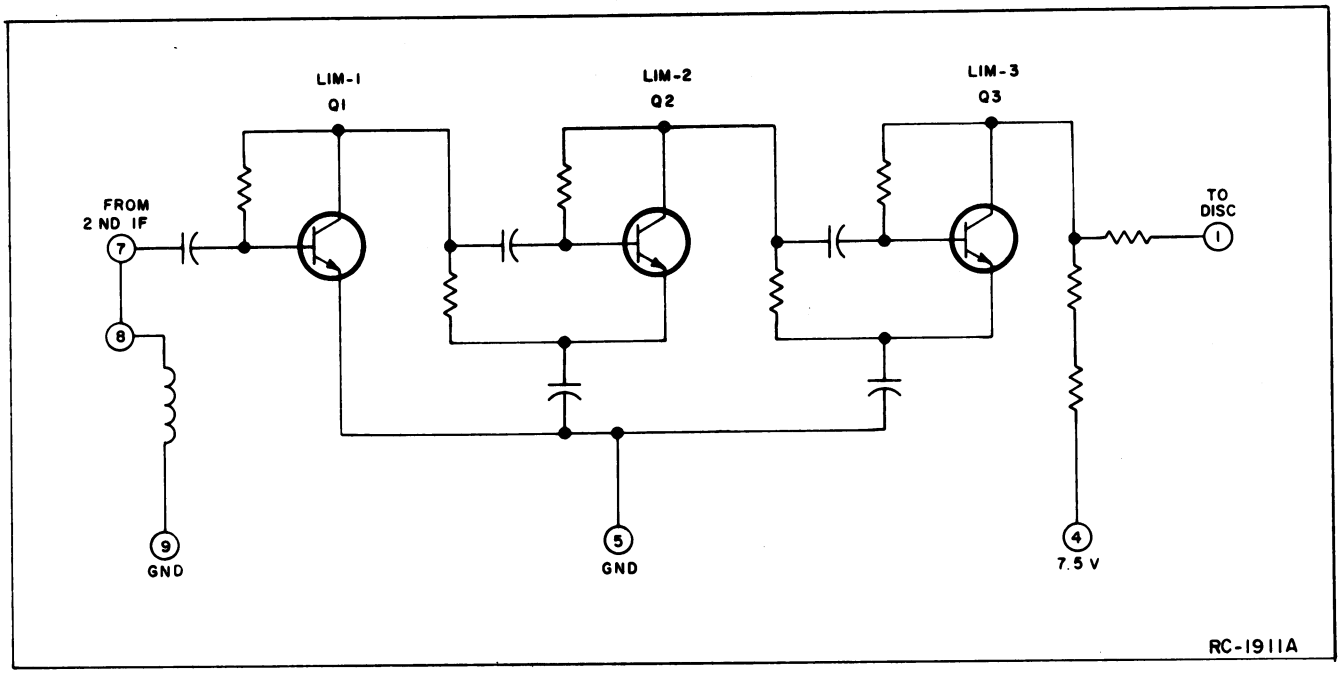


Figure 12 - Typical Limiter Circuit

typical IF amplifier circuit is shown in Figure 11.

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

LIMITER A307 & DISCRIMINATOR A308

Limiter A307 consists of three R-C coupled limiter stages that are DC series connected for reduced drain. The Limiter module also provides some gain. The output of the Limiter is applied to the discriminator. A typical Limiter circuit is shown in Figure 12.

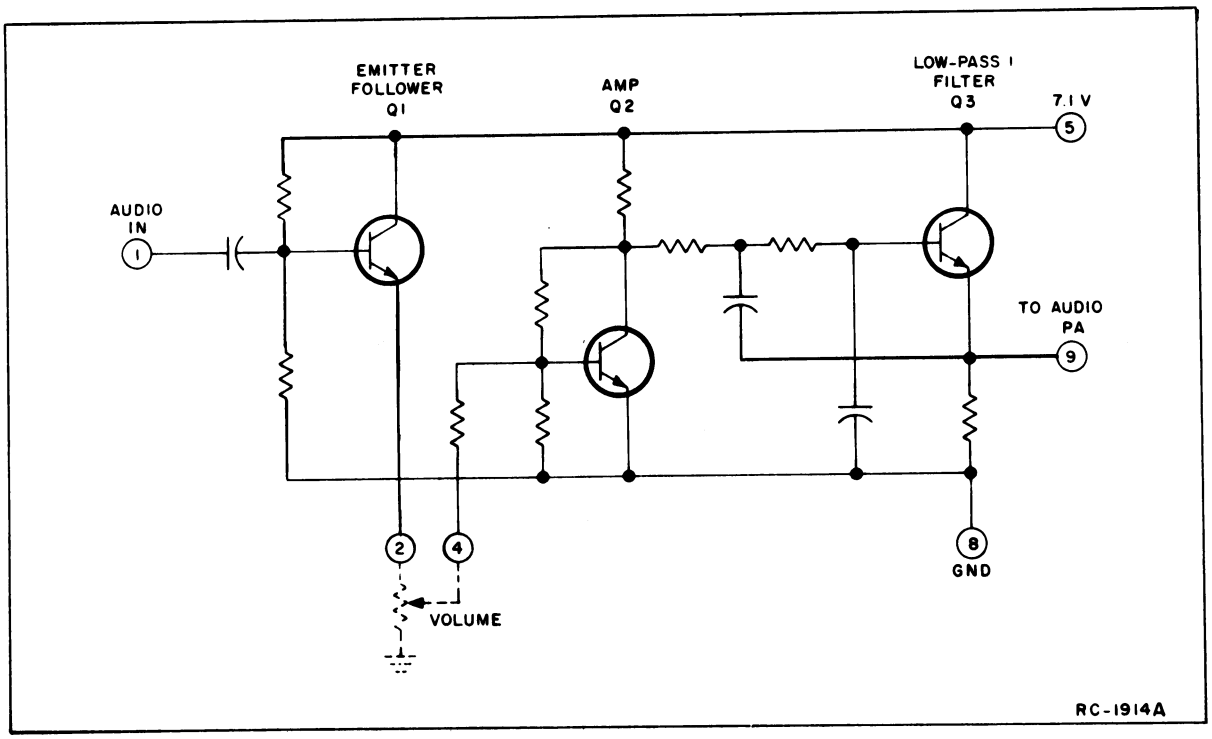


Figure 13 - Typical Audio Amplifier

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

AUDIO AMPLIFIER A309/A310

Audio and noise from the discriminator is applied to Audio Amplifier module A309 (A310 in Channel Guard applications). A typical audio amplifier circuit is shown in Figure 13.

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

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

AUDIO PA A311

When the receiver is quieted by a signal, audio from the active filter is connected to Pin 1 of Audio PA module A311, and then to the base of amplifier Q1. Q1 feeds the audio signal to the base of Q2, which drives PA transistors Q4 and Q5. A typical audio PA circuit is shown in Figure 14.

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

SQUELCH A312

Noise from Audio Amplifier A309/A310 operates the squelch circuit. A typical squelch circuit is shown in Figure 15.

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

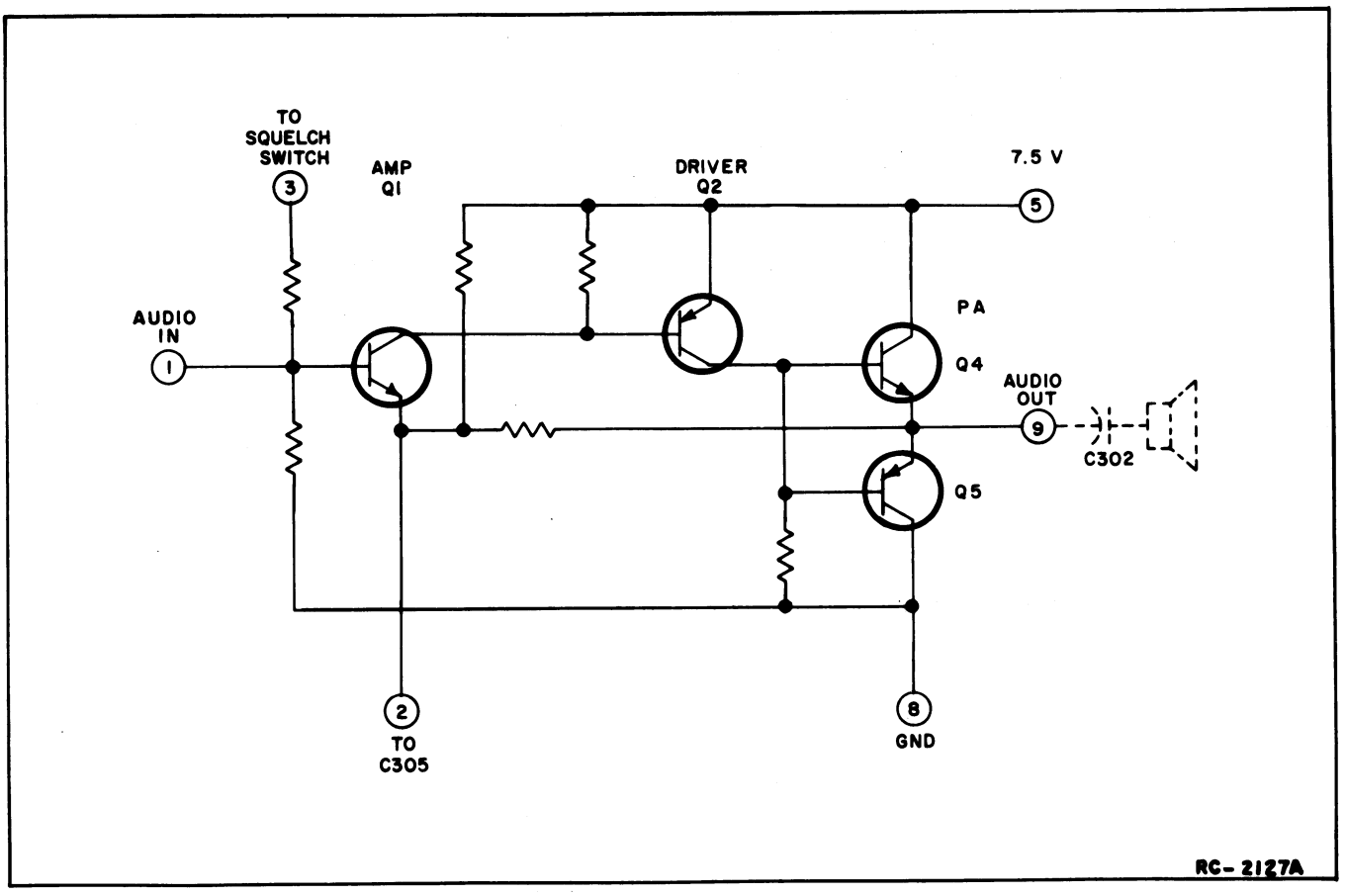


Figure 14 - Typical Audio PA Circuit

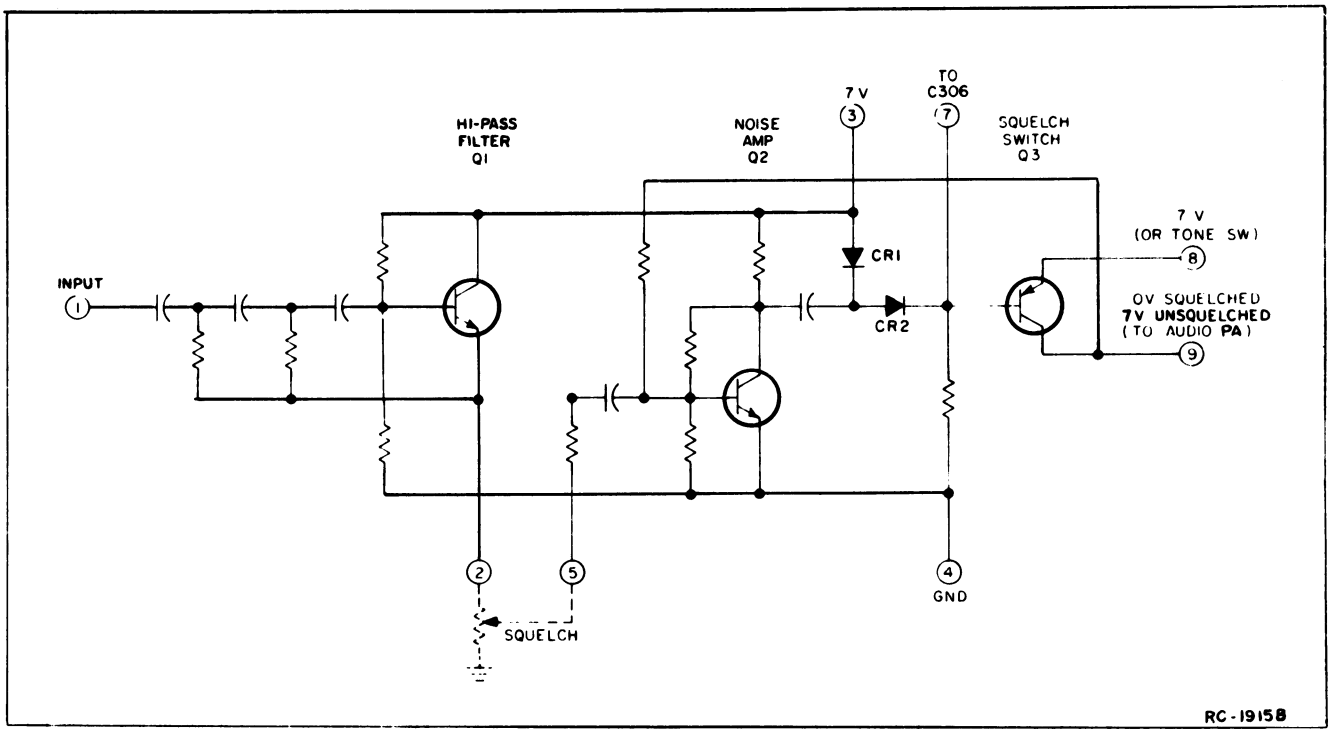


Figure 15 - Typical Squelch Circuit

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

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

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

SYSTEM BOARD

System Board A703 provides system interconnections for the transmitter, receiver, tone options and operating controls. In addition to the transmitter modules, the system

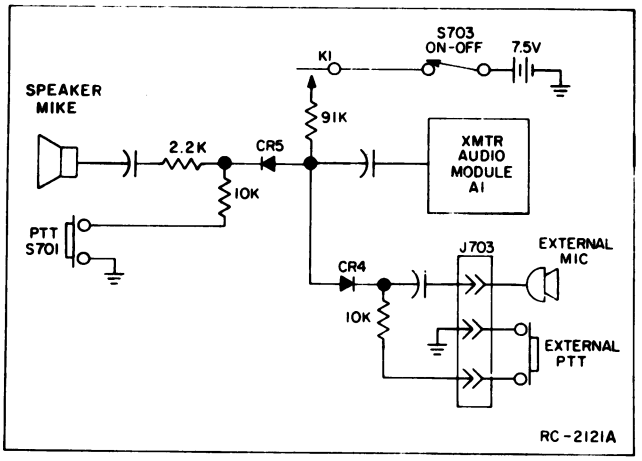


Figure 16 - Audio Switching Circuit

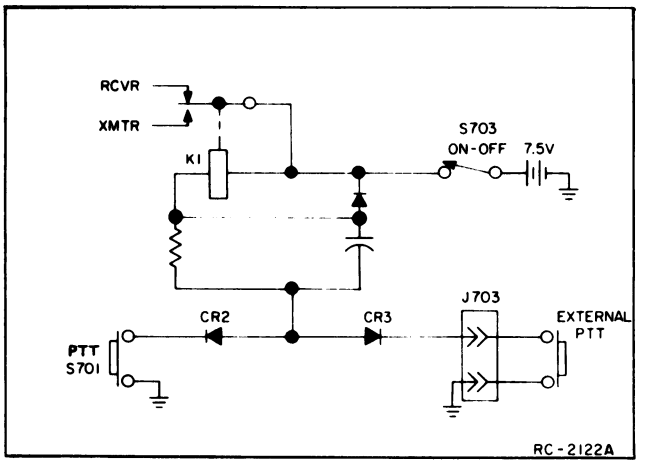


Figure 17 - DC Switching Circuit

board contains the system relay, and the audio and DC switching circuitry.

Jacks J702 and J703 are connected to the system board and provide contacts for an external antenna, speaker, and microphone. J702 provides contacts for the external antenna and speaker, and J703 provides contacts for an external microphone. Placing the radio into the vehicular charger automatically connects the jack contacts to the external circuitry. The radio is also connected to the external antenna when placed in the desk charger.

AUDIO SWITCHING

Audio switching for the Speaker/Microphone LS1 and an external microphone is controlled by a diode as shown in Figure 16.

Pressing P-T-T switch S701 forward biases diode CR5, permitting audio from LS1 to be applied to transmitter audio module A1.

Keying the external microphone permits audio to be applied to the audio module.

DC SWITCHING

Operation of system relay K1 is also controlled by a diode network (see Fig. 17).

Pressing S701 forward biases CR2, completing the relay path to ground. This energizes relay K1, and switches the battery voltage to the transmitter audio and regulator modules. Energizing K1 also connects the transmitter output to the antenna.

Keying the external microphone forward biases CR3 and energizes the relay.

TONE OPTIONS

The following tone options are available in the PE Model Combinations:

- Channel Guard Encoder/Decoder Model 4EK17A11
- Channel Guard Encoder Models 4EH21A10, 11
- Type 90 Encoder/Decoder Model 4EK18A11
- Type 90 Encoder Model 4EH20A10, 11

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 a Wien bridge circuit with an operational amplifier for controlling the encoder frequency stability and the decoder bandwidth.

CHANNEL GUARD ENCODER/DECODER

Encoder/Decoder Model 4EK17A11 is 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 Encoder/Decoder consists of a Tone Control

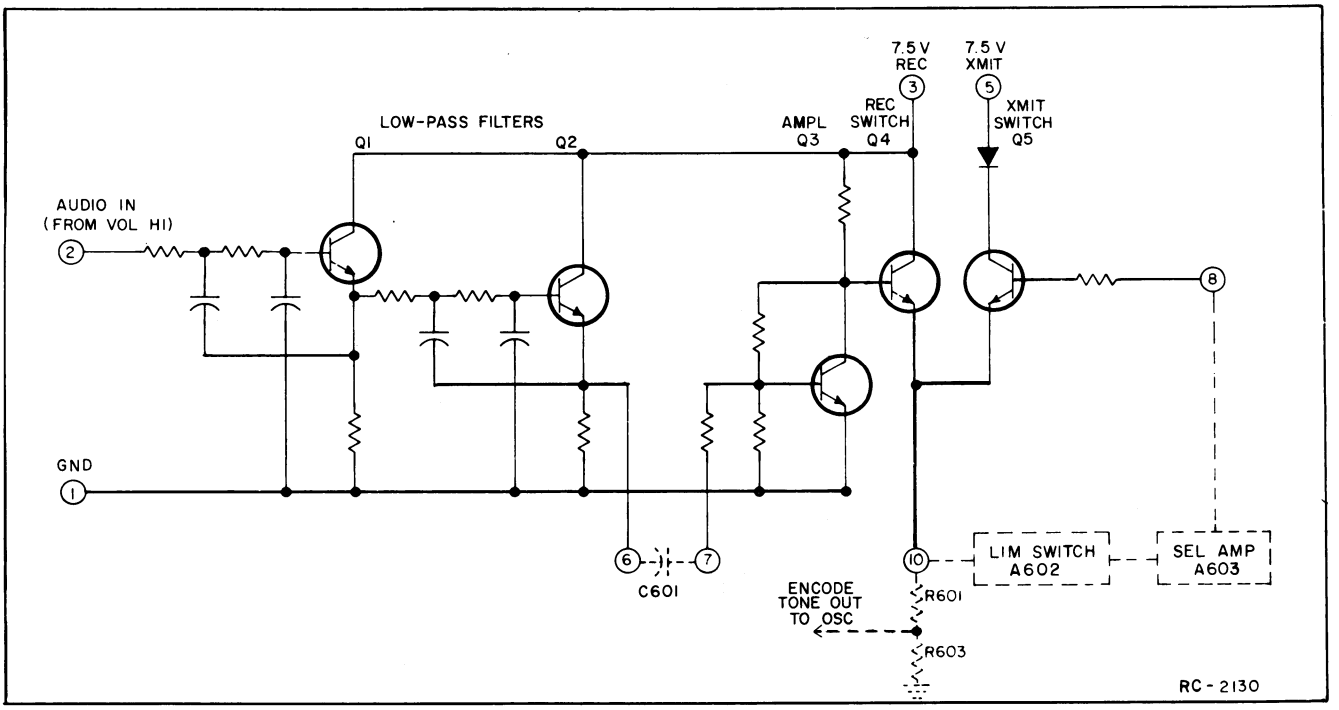


Figure 18 - Input Filter Circuit

board and three Integrated Circuit Modules mounted on a printed wiring board. The Integrated Circuit Modules include 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 CG ON-OFF switch S2 and multi-frequency switch S1 on the control unit. Placing S2 in the OFF position disables the decoder circuits to permit monitoring all calls on the selected channel. Placing S2 in the ON position enables the Encoder/Decoder. Multi-frequency switch S1 selects the channel that will have Channel Guard, and also enables the Tone Control board circuitry.

TONE CONTROL BOARD

The Tone Control board consists of diodes CR1 through CR7, and a three-transistor switching circuit. Placing multi-frequency switch S1 on a frequency with Channel Guard applies 5.4 Volts to the Tone Control board. For example, placing S1 on the channel 1 frequency forward biases CR1 and applies supply voltage to pin 5 of the Limiter-Switch Module, and the Selective Amplifier. In addition, the 5.4 Volts are applied to the base of Q1, turning it on. Turning on Q1 turns on Q2 which turns off Q3. Turning off Q3 removes the 7.5 Volts applied to the receiver Audio PA module so that the radio operates in the Channel Guard mode.

Switching S1 to a non-Channel Guard position removes the 5.4 Volts to the Tone Control Board. This allows Q3 to conduct, applying 7.5 Volts to the squelch switching transistor on Audio PA module so that the receiver operates on noise squelch.

Whenever Channel Guard is not desired on a particular frequency, the lead to the Tone Control board can be removed from the appropriate frequency selector jack on the Systems Board (J25 through J31) and taped back, or the associated diode on the Tone Control board can be removed.

ENCODE

Keying the transmitter applies 7.5 Volts to Pin 5 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.

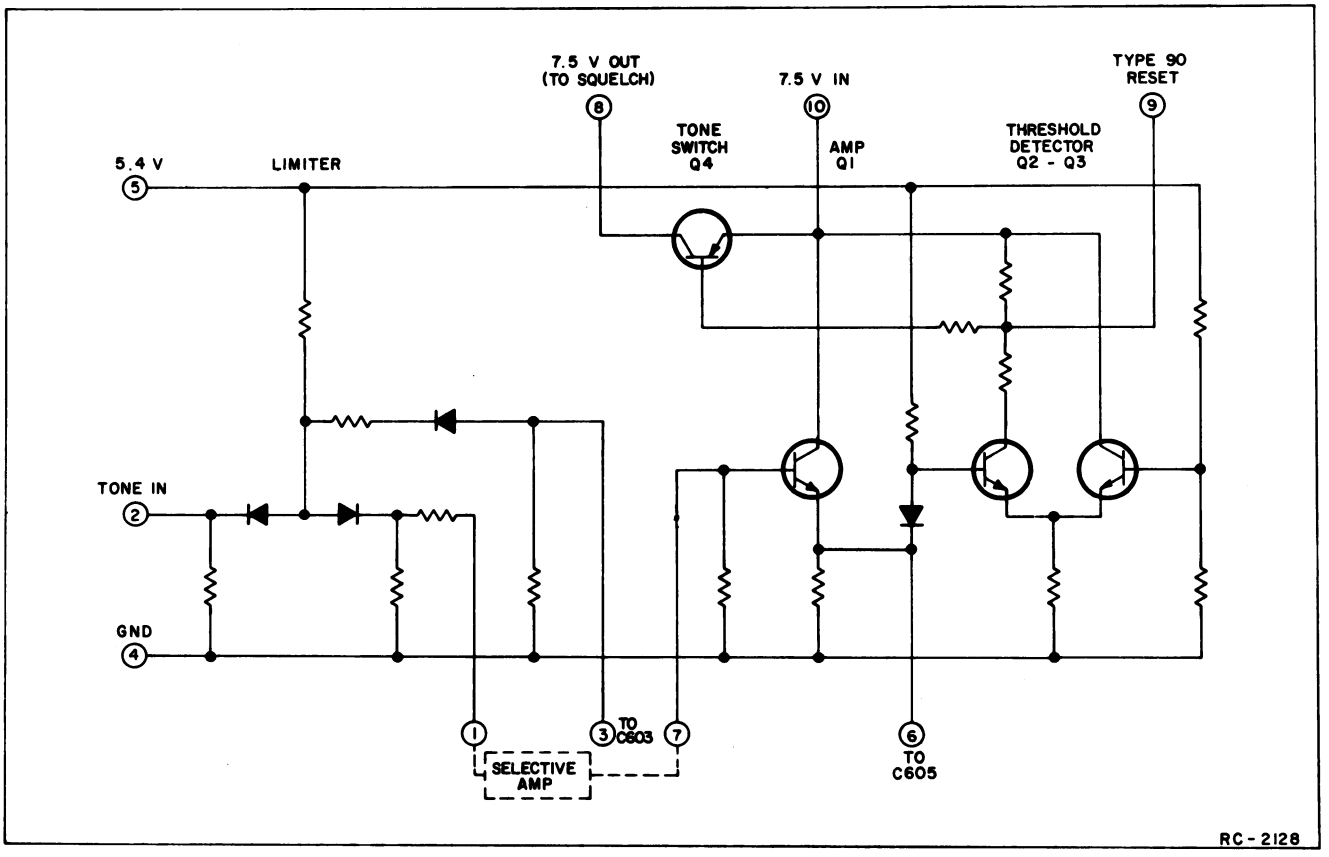


Figure 19 - Limiter Switch Circuit

DECODE

Releasing the PTT switch removes the 7.5 Volts at Pin 5 and applies 7.5 Volts to Pin 3, turning on decode switch Q4. At the same time the signal from R707-3 (Volume HI) is coupled to Pin 2 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. The output of A601 at Pin 10 is applied to Pin 2 of Limiter-Switch A602. 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 applied to A602 is limited by the limiter diodes 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

Encoder Models 4EH21A10 (one-tone) and 4EH21A11 (two-tone) operate on tone frequencies in the 71.9 to 203.5 Hz range. The two-tone encoder consists of Limiter Module A601 and two Selective Amplifier modules A602 and A603. The single-tone encoder assembly 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 9 of the Limiter module is applied to the transmitter oscillator module.

TYPE 90 ENCODER/DECODER

Type 90 Encoder Model 4EK18A11 Decoder is a pulsed tone encoder/decoder assembly for operating on standard Type 90 tone frequencies of 1000 to 3000 Hz. The assembly consists of a Tone Control board and three Integrated Circuit modules mounted on a printed wiring board. The Integrated Circuit modules include 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.

The Type 90 circuit is controlled by Monitor - Normal-Reset switch S2 and multi-frequency switch S1 on the control unit.

Tone switch S2 is a three-position switch that 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 the Normal position for the decoder to operate.

Multi-frequency switch S1 selects the Channel that will have Type 90 tone, and enables the Tone Control board circuitry.

MONITOR

Placing S2 in the Monitor position applies 7.5 Volts to Pin 7 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 5 of the Input Amplifier and is coupled through Q2 to Pin 4 where it is capacity coupled through C601 to amplifier Q5. The amplifier output is applied to Pin 2 of the Limiter-Switch module where it activates the tone switch (Q4), allowing the receiver to operate on noise squelch.

TONE CONTROL BOARD

The Tone Control board consists of diodes CR1 through CR7, and a three-transistor switching circuit.

Placing multi-frequency switch S1 on a channel with Type 90 tone applies 5.4 Volts to the Tone Control board. For example, placing S1 on the channel 1 frequency forward biases CR1 and applies supply voltage to the Input Amplifier and the Selective Amplifier. In addition, the 5.4 Volts is applied to the base of Q1, turning it on. Turning on Q1 turns on Q2 which turns off Q3. Turning off Q3 removes the 7.5 Volts applied to the receiver Audio PA module so that the radio operates in the encode/decode mode.

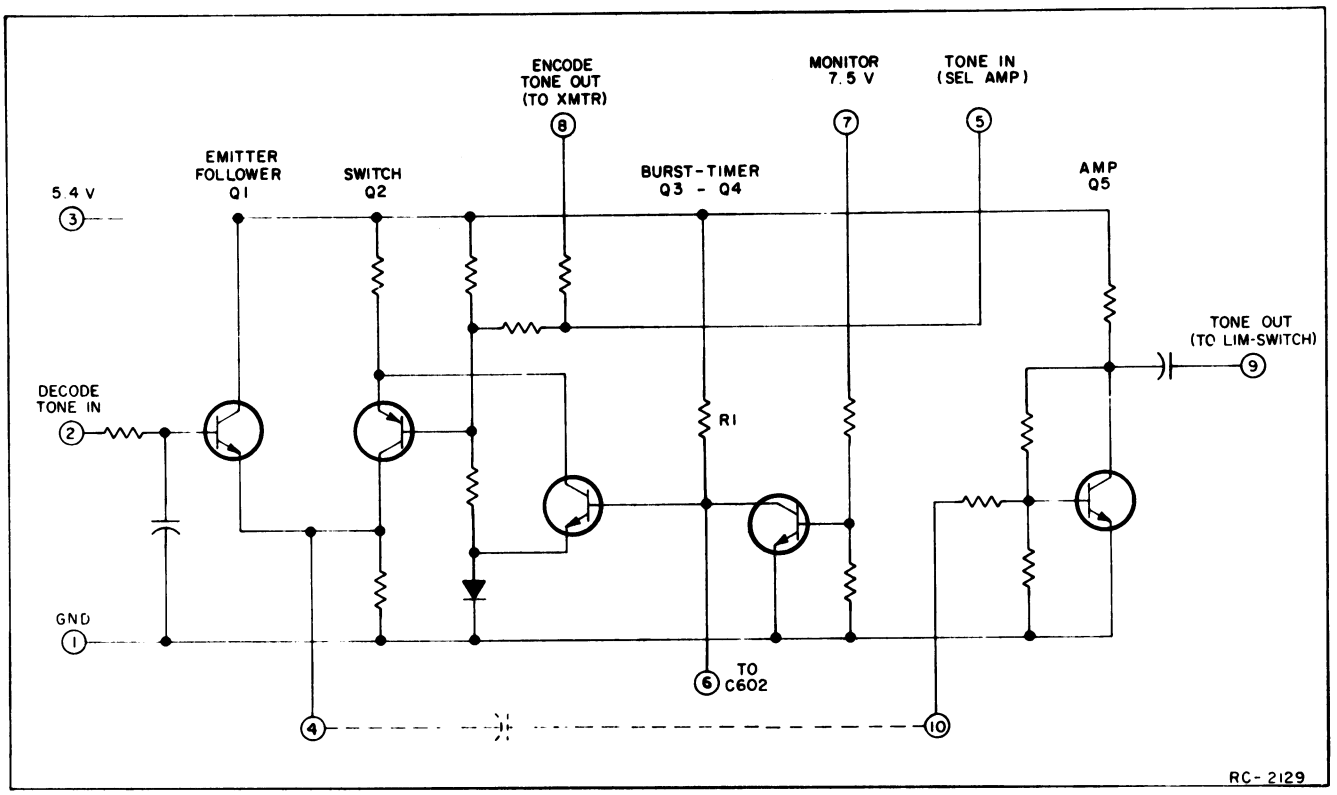


Figure 20 - Typical Input Amplifier Circuit

Switching S1 to a channel without tone removes the 5.4 Volts to the Tone Control Board. This allows Q3 to conduct, applying 7.5 Volts to the squelch switching transistor on the Audio PA module so that the receiver operates on noise squelch.

Whenever tone is not desired on a particular frequency, the lead to the Tone Control board can be removed from the appropriate frequency selector jack on the Systems board (J25 through J31) and taped back, or the associated diode on the Tone Control board can be removed.

ENCODE

Keying the transmitter removes the 7.5 Volts at Pin 7 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-Limiter module on the System Board. R605 is set for a tone output of ±3 kHz.

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

DECODE

When the switch is in the Normal position, the burst-timer circuit is disabled. Audio from R707-3 (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

Type 90 Encoder Models 4EH20A10 (one-tone) and 4EH20A11 (two-tone) are pulsed tone encoders 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. The single-tone encoder 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 on the System Board. R603 is set for ±3 kHz deviation.

REPEATING OSCILLATOR MODULES

Both the transmitter and receiver can be adapted to repeat the use of the same frequency without the use of additional Oscillator Modules. The Oscillator Module is replaced by a diode, allowing the frequency selector switch to have the same frequency on one or more switch positions

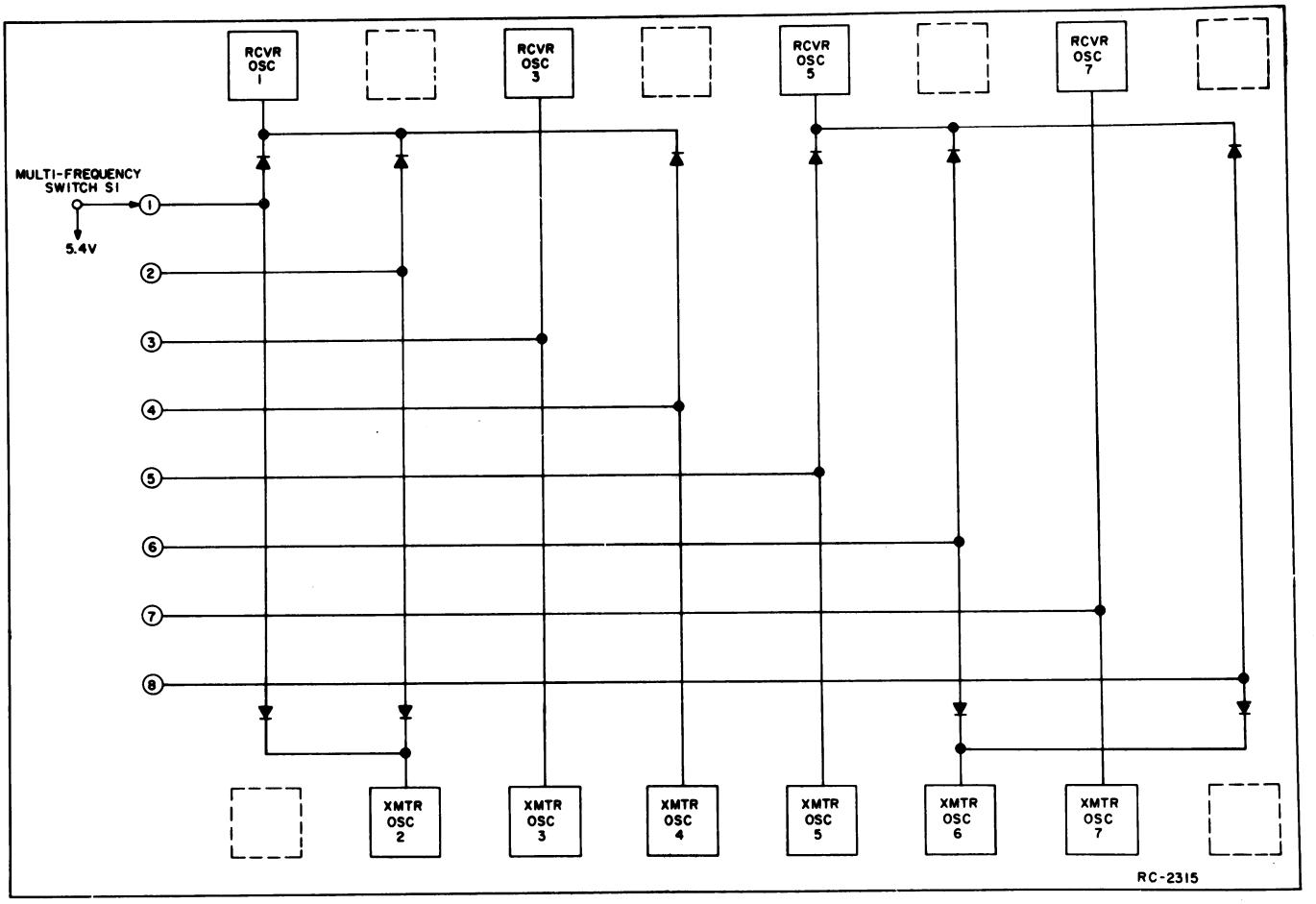


Figure 21 - Repeating Oscillator Modules

even though only one Oscillator Module is used for each of the repeated channels. A typical diagram with repeated Oscillator Modules is shown in Figure 21.

Complete instructions for multi-frequency modifications are contained in the Multi-Frequency Modification diagram (see Table of Contents).

For radios equipped with Channel Guard or Type 99 Encoders/Decoders, repeating Oscillator Modules also permits switching or disabling tones on the same RF frequency with the multi-frequency switch. Also, the tone and RF frequency can be changed at the same time.

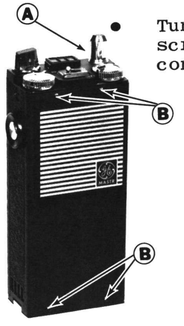
DISASSEMBLY PROCEDURE

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 screwdriver.
- 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.
- Tuning tool 19B219079-P1 for removing Allen-head screws in the cover, and the set screws in the controls and antenna tip.

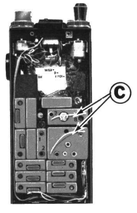


STEP 1.

To remove the antenna, unscrew the antenna nut (A) and pull out the antenna.

STEP 2.

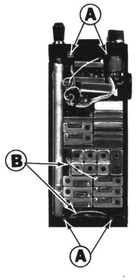
To gain access to the transmitter, remove the four Allen-head screws (B) with the tuning tool, and carefully lift off the front cover to avoid breaking the speaker leads.



The exciter and PA modules can be unplugged by pulling on lifting straps (C) .

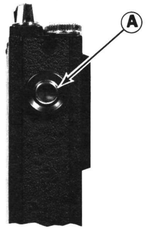
STEP 3.

To gain access to the receiver and tone board, remove the four Allen-head screws (A) in the back cover with the tuning tool and lift off the cover. Lift the receiver board out of the case by lifting strap (B) . The tone board can also be lifted out of the case.



CAUTION

Do not place either board on metal or other conductive surface with power applied. To do so will damage the Integrated Circuit modules. A small "pancake" of Duxseal® provides an excellent insulated work surface for the receiver or tone board.



STEP 4.

To remove the Volume or Squelch Control, remove the set screw (A) in the side of the control with the tuning tool. Then unscrew the slotted nut and remove the control.

To remove the Multi-Frequency switch, remove the set screw (B) as directed above. Then remove the washer, unscrew the slotted nut and remove the control.

STEP 5.

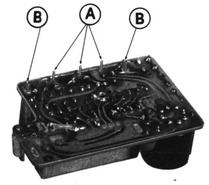
To replace the accessory jack, first remove the tone board if present. Then unscrew the slotted nut (A) , and press down to the top of the jack to break the waterproof seal. Apply RTV-108 (GE Part No. 19A115153P2) around the shoulder on the new jack before inserting the jack into the mounting hole and replacing the slotted nut.

STEP 6.

To replace the speaker, remove the four Phillips-head screws (A) , and lift off the speaker cover. Then push the speaker out of its mounting hole and remove any of the sealant remaining around the edge of the mounting hole. Apply RTV-108 around the edge of the speaker mounting hole and replace the speaker in the hole aligned as shown. Then replace the speaker cover.

STEP 7.

To replace the PTT switch or clean the rubber diaphragm, use a 3/32-inch diameter blade flat-head screwdriver (GE Service Parts No. SPK-528) and remove the two screws holding the PTT ring (A) to the case. Remove the PTT ring and button. Remove the diaphragm, metal disk and spring.

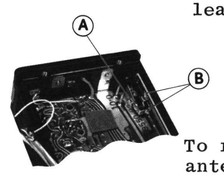


STEP 8.

To replace one of the modules, unsolder and straighten up the module wire leads (A) . Remove any solder accumulation from the leads.

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

If replacing the receiver front end or mixer modules, also remove the small screws holding the helical resonators. Replace the module and solder down the mounting tabs and then the wire leads. Refer to the appropriate Outline Diagram (see Table of Contents) for the wire lead placement, if required.



STEP 9.

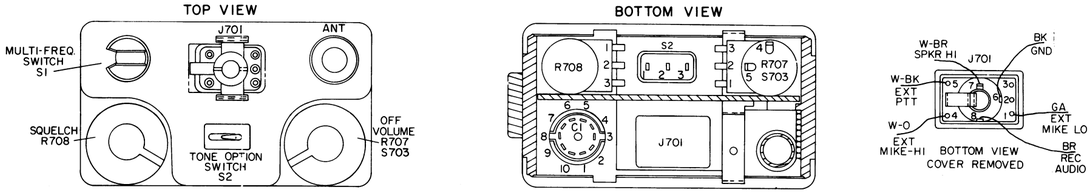
To replace the antenna switch, remove the antenna and the receiver and tone boards from the case. Next, remove the Phillips-head screw (A) and then unsolder the mounting tabs (B) .

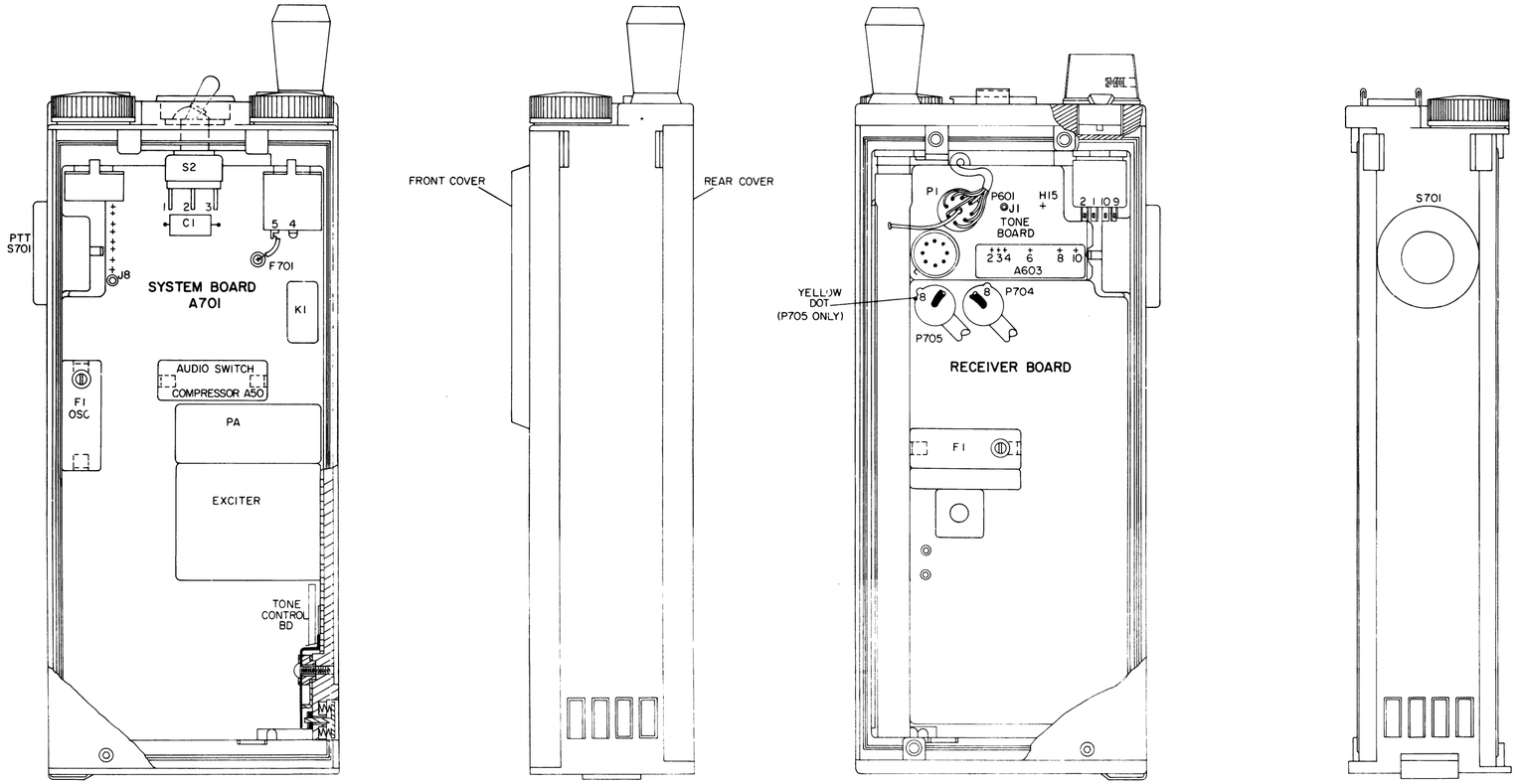
Install the new switch by replacing the Phillips-head screw (A) and then soldering the mounting tabs (B) .

WARNING

The stud mounted RF Power Transistor used in the PA Module 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.

CONTROL UNIT





(19D416839, Rev. 3)

MODULE LAYOUT DIAGRAM

PE MODEL TWO-WAY FM RADIO

MODULATION LEVEL ADJUSTMENT

The MOD ADJUST (R8) 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 deviation meter
3. An output meter or a VTVM
4. Test Adaptor Model 4EX12A10

PROCEDURE

1. Connect the equipment as shown in the Test Procedure on the back of this page.
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 4 (Mike Hi) and Pin 1 of Accessory Jack J701.
3. With the signal applied, adjust Tuning Control 1 for zero modulation symmetry on the lowest channel frequency.
4. For transmitters without Channel Guard, set MOD ADJUST R8 for a 4.5-kilohertz swing with the deviation polarity which gives the highest reading as indicated on the frequency modulation monitor.
5. 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 Step 4 above.
6. For multifrequency transmitters, set the deviation as described in Step 4 on the channel producing the largest amount of deviation.

REDUCED POWER OPERATION

Option 4475 - 1 Watt Output per EIA
Also for Shipboard Marine Applications (FCC Part 83)

In some services, FCC regulations do not permit the use of the two-watt rated output. In addition, operating at a reduced power output will extend the battery life in those applications where the two-watt output is not required. After completing Step 9 of the two-watt alignment Procedure, reduce the output power as follows:

1. Turn Tuning Control 9 (PWR ADJ) clockwise until the power output is reduced by one-half of the difference between the power output noted in Step 9 and the desired power output. For example: If the output noted in Step 9 was 2 watts and the desired output is 1 watt, adjust Tuning Control 9 for an output of 1.5 watts.
2. Adjust Tuning Control 6 to reduce the output to the desired level. Tuning Control 6 has two positions producing the same power output. Select the position having the lowest current drain.
3. If the limit of adjustment on Tuning Control 6 is reached and the power output or current drain is still too high, detune Tuning Control 8 in the direction resulting in less current drain and power output. Then alternately adjust Tuning Controls 6 and 8 for the desired output and drain.

100-200 MILLIWATT TRANSMITTER ALIGNMENT (KT-19-A)

EQUIPMENT REQUIRED:

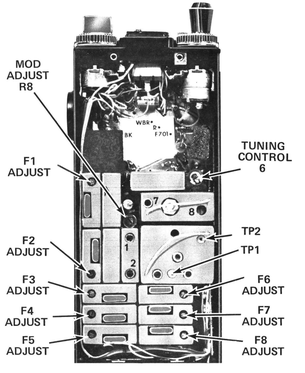
- GE Test Set Model 4EX3A10 (or 4EX8K11) or equivalent 20,000 ohm-per-volt meter.
- GE Test Regulator Model 4EX18A10, or an ammeter capable of measuring 0.25 amperes.
- A 50-ohm, terminating wattmeter connected to external antenna jack J702 thru RF adaptor cable 19C317633G2 (Option 4466).
- A frequency counter.

PRELIMINARY CHECKS AND ADJUSTMENTS

1. In multi-frequency transmitters, set the channel selector switch to the lowest channel frequency.
2. Set the slugs in Tuning Controls 1 thru 5 even with the top of the can. When properly aligned, the slugs will be between the top of the can and the coil.
3. Set Tuning Control 9 (PWR ADJ) fully counterclockwise, and Tuning Control 6 to mid range.
4. If using Test Set 4EX3A10 and Test Regulator 4EX18A10, connect the Test Set to the metering jack on the Test Regulator, and set the Regulator for 7.5 volts. Switch the Test Set range to the Test 1 position. Place the test selector switch on position "I" to check the supply voltage (read on the 1-volt scale as 10-volts full scale. Switch to position "G" for current drain readings (read on the 1-volt scale as 1 ampere full scale).
5. Test Point meter reading made with the (+) meter lead to TP1 and the (-) lead to system ground.
6. All adjustments made with the transmitter keyed.

ADJUSTMENT PROCEDURE

Step	Tuning Control	Typical Meter Reading	Procedure
1	1	Maximum mA	Adjust Tuning Control 1 for maximum transmitter current.
2	2	Minimum mA	Adjust Tuning Control 2 for minimum transmitter current.
3	3		Adjust Tuning Control 3 for maximum meter reading at TP1.
4	1, 2 & 3	0.8 volts	Adjust Tuning Controls 1, 2 and 3 for maximum meter reading at TP1. Repeat the adjustments until no further increase in meter reading is obtained.
5	4 and 5	Maximum mA	Adjust Tuning Controls 4 and 5 for maximum transmitter current.
6	7 and 8	Maximum Power Output	Adjust Tuning Controls 7 and 8 for maximum power output.
7	4, 5, 7, & 8	Maximum Power Output	Adjust Tuning Controls 4, 5, 7 and 8 for maximum power output. Repeat the adjustments until no further increase in power output is obtained.
8	9 (PWR ADJ)		Set Tuning Control 9 (PWR ADJ) for the desired power output (100 to 200 milliwatts)
			FREQUENCY ADJUSTMENT
9			With no modulation, adjust the F1 (and F2 thru F8) crystal trimmer for proper oscillator frequency. 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.



1 to 2 WATT TRANSMITTER ALIGNMENT (KT-20-A) LBI-4366

EQUIPMENT REQUIRED:

- GE Test Set Model 4EX3A10 (or 4EX8K11) or equivalent 20,000 ohm-per-volt meter.
- GE Test Regulator Model 4EX18A10, or an ammeter capable of measuring one ampere.
- A 50-ohm, terminating wattmeter connected to external antenna jack J702 thru RF adaptor cable 19C317633G2 (Option 4466).
- A frequency counter.

PRELIMINARY CHECKS AND ADJUSTMENTS

1. In multi-frequency transmitters, set the channel selector switch to the lowest channel frequency.
2. Set the slugs in Tuning Controls 1 thru 5 even with the top of the can. When properly aligned, the slugs will be between the top of the can and the coil.
3. Set Tuning Control 9 (PWR ADJ) fully counterclockwise, and Tuning Control 6 to mid range.
4. If using Test Set 4EX3A10 and Test Regulator 4EX18A10, connect the Test Set to the metering jack on the Test Regulator. Then connect the Regulator output to J704 on the radio, and set the Regulator for 6 volts. Switch the Test Set range to the Test 1 position. Place the test selector switch on position "I" to check the supply voltage (read on the 1-volt scale as 10-volts full scale). Switch to position "G" for current drain readings (read on the 1-volt scale as 1 ampere full scale).
5. Test Point meter reading made with the (+) meter lead to TP1 and the (-) lead to system ground.
6. All adjustments made with the transmitter keyed.

ADJUSTMENT PROCEDURE

Step	Tuning Control	Typical Meter Reading	Procedure
1	1	Maximum mA	Adjust Tuning Control 1 for maximum transmitter current
2	2	Minimum mA	Adjust Tuning Control 2 for minimum transmitter current
3	3		Adjust Tuning Control 3 for maximum meter reading at TP1
4	1, 2 & 3	0.8 volts	Adjust Tuning Controls 1, 2 and 3 for maximum meter reading at TP1. Repeat the adjustments until no further increase in meter reading is obtained.
5	4, 5, & 7	Maximum mA	Adjust Tuning Controls 4, 5 and 7 for maximum transmitter current.
6	8, 6, 7, 5, & 4	Maximum Power Output	Adjust Tuning Controls 8, 6, 7, 5 and 4 in that order for maximum power output.
7	1, 2 & 3		Repeat Step 4
8			Increase the supply voltage to 7.5 volts
9	7	Maximum Power Output	Adjust Tuning Control 7 for maximum power output and note the power output. If the power output is correct, Tuning Controls 6 and 8 can be alternately tuned for the best ratio of current drain to RF power output. If the power output is too low, refer to Step 10. If the power output is too high, refer to REDUCED POWER OPERATION elsewhere on this page.
10	6, 8 & 7	Maximum Power Output	If the power output is too low, readjust Tuning Controls 6, 8 and 7 in that order for maximum power output. Repeat until the desired power output is obtained.
			FREQUENCY ADJUSTMENT
11			With no modulation, adjust the F1 (and F2 thru F8) crystal trimmer for proper oscillator frequency. 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

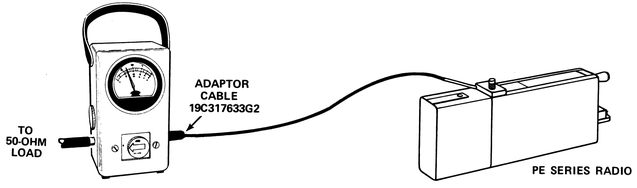
for test hookup shown:

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 19C317633G2 is recommended for accurate power output readings.



B. Key transmitter and check wattmeter for desired power output..

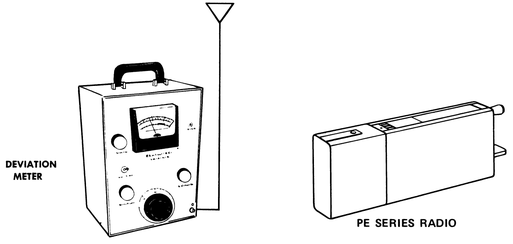
SERVICE CHECK

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 R8 fully counterclockwise.

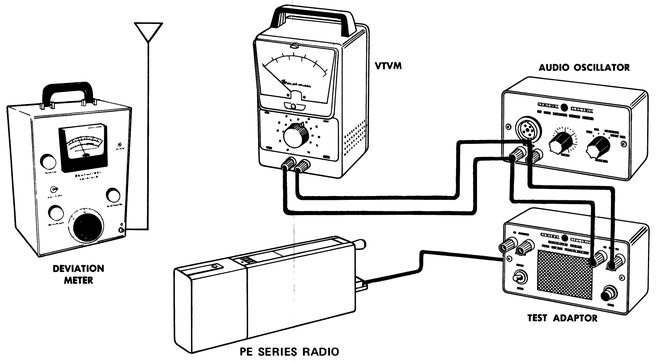
C. Key transmitter and check for approximately 0.75-kHz deviation. If reading is low or high, refer to the Channel Guard Troubleshooting Procedure (see Table of Contents)

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).

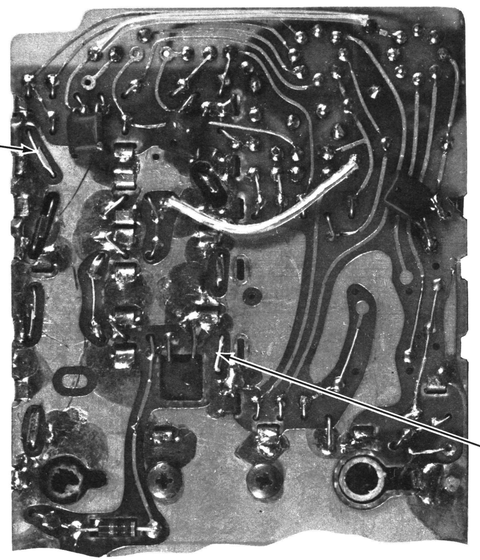
NOTES --These transmitters are adjusted for 4.5 kHz deviation at the factory. The factory adjustment will prevent the transmitter from deviating more than 5.0 kHz under the worst conditions of frequency, voltage and temperature.

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

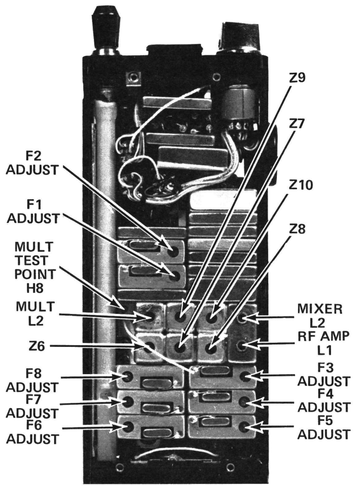
E. Refer to the Modulation Adjustment on the Transmitter Alignment Procedure.

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

SOLDER SIDE



COMPONENT SIDE



EQUIPMENT REQUIRED

1. A 20-MHz signal source (GE IF Generator Model 4EX9A10 or equivalent) and a 150.8-174 MHz source connected to Antenna Switch J702 by Receiver Test Cable 19C317633G1.
2. GE Test Set Model 4EX3A10 or 4EX8K11 or voltmeter with equivalent sensitivity.
3. GE Test Amplifier Model 4EX16A10 and RF probe 19C311370G1, 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 highest frequency.
2. Set the slugs in Z6 thru Z10 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. Set the slug in RF AMP L1 to the top of the coil form for frequencies in the low end of the band, and near the bottom of the coil form for frequencies near the high end of the band.
4. Connect the negative lead of the DC Test Set to the Mult Test Point (H8), and the positive lead to ground. Connect the AC-VTVM across the speaker leads.

ALIGNMENT PROCEDURE

Step No.	Tuning Control	Procedure
1.	MULT L2	Adjust L2 for maximum meter reading.
2.	Z9 and Z10	Adjust Z9 and then Z10 for a slight change in meter reading.
3.	Z6 thru Z8 and RF Amp L1	Apply an on-frequency signal to J702 and adjust Z6, Z7, Z8, and L1 for best quieting sensitivity.
4.	Mixer L2	Apply an on-frequency signal as above. With the RF probe on Pin 9 of IF Amp A304, tune L2 for maximum meter reading.
5.	MULT L2, Z9 and Z10	De-tune L2. Next, increase the on-frequency input signal and tune Z9 and Z10 for best quieting sensitivity. Now re-adjust L2 for maximum meter reading. Where the frequency spread is more than one MHz, de-tune L2 one-eighth turn counterclockwise.
		FREQUENCY ADJUSTMENT
6.		While applying an on-frequency signal to J702, loosely couple a 20-MHz signal to the Mixer. Adjust the Oscillator trimmer(s) for a zero beat frequency between the two signals. Alternate Method: Apply a strong 20 MHz signal to the Mixer. Measure the output of the Discriminator with a DC-VTVM at Pin 1 of A309/A310. Note the reading. Next, remove the 20-MHz signal and apply a strong on-frequency signal to J702. Then tune the oscillator trimmer(s) for the meter reading obtained at Pin 1 of A309/A310.

TEST PROCEDURES

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

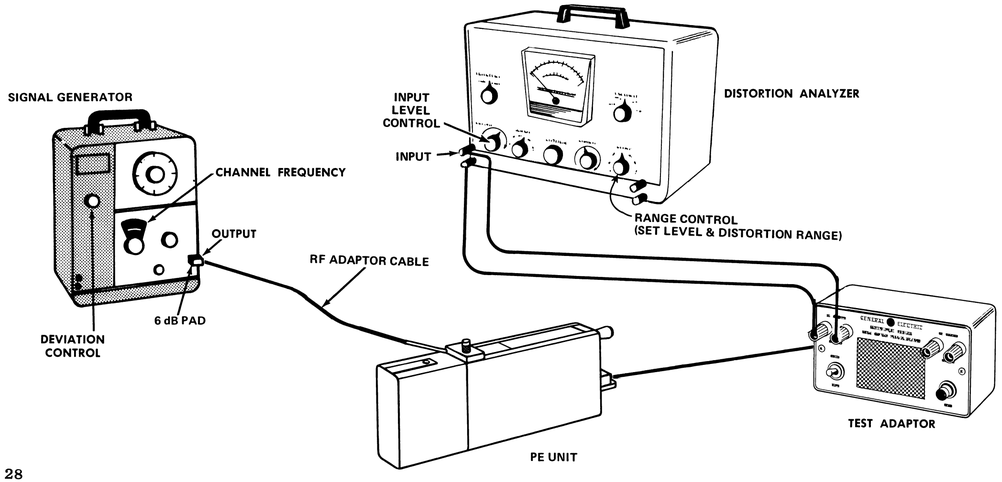
Once the defective stage is pin-pointed, refer to the "Service Check" listed to correct the problem. Additional corrective measures are included in the Troubleshooting Procedure. Before starting with the Receiver Test Procedures, be sure the receiver is tuned and aligned to the proper operating frequency.

TEST EQUIPMENT REQUIRED

- Distortion Analyzer similar to: Heath IM-12
- Signal Generator similar to: Measurements M-800
- 6-dB attenuation pad
- Test Adaptor Model 4EX12A10
- RF Adaptor Cable 19C317633G1

PRELIMINARY ADJUSTMENTS

1. Connect the test equipment to the receiver as shown for all steps of the receiver Test Procedure.
2. Turn the SQUELCH control fully clockwise for all steps of the Test Procedure.
3. Turn on all of the equipment and let it warm up for 20 minutes.



STEP 1

AUDIO POWER OUTPUT AND DISTORTION

TEST PROCEDURE

Measure Audio Power output as follows:

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

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

C. Make distortion measurements according to manufacturer's instructions. Reading should be less than 10% (5% is typical). If the receiver sensitivity is to be measured, leave all controls and equipment as they are.

SERVICE CHECK

If the distortion is more than 5%, or maximum audio output is less than 0.5 watt, make the following checks:

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

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

STEP 2

USABLE SENSITIVITY (12 dB SINAD)

TEST PROCEDURE

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

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

B. Place the RANGE switch on the Distortion Analyzer in the 200 to 2000-Hz distortion range position (1000-Hz filter in the circuit). Tune the filter for minimum reading or null on the lowest possible scale (100%, 30%, etc.)

C. Place the RANGE switch to the SET LEVEL position (filter out of the circuit) and adjust the input LEVEL control for a +2 dB reading on a mid range (30%).

D. While reducing the signal generator output, switch the RANGE control from SET LEVEL to the distortion range until a 12-dB difference (+2 dB to -10 dB) is obtained between the SET LEVEL and distortion range positions (filter out and filter in).

E. The 12-dB difference (Signal plus Noise and Distortion to noise plus distortion ratio) is the "usable" sensitivity level. The sensitivity should be less than rated 12 dB SINAD specification with an audio output of at least 250 milliwatts.

F. Leave all controls as they are and all equipment connected if the Modulation Acceptance Bandwidth test is to be performed.

SERVICE CHECK

If the sensitivity level is more than rated 12 dB SINAD, check the alignment of the RF stages as directed in the Alignment Procedure, and make the gain measurements as shown on the Troubleshooting Procedure.

STEP 3

MODULATION ACCEPTANCE BANDWIDTH (IF BANDWIDTH)

TEST PROCEDURE

If STEPS 1 and 2 check out properly measure the bandwidth as follows:

A. Set the Signal Generator output for twice the microvolt reading obtained in the 12-dB SINAD measurement.

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

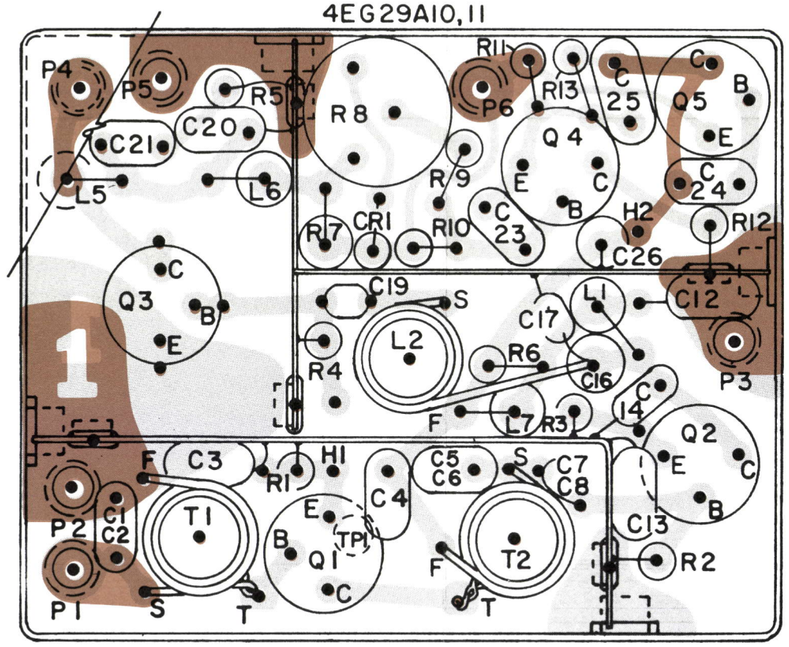
C. While increasing the deviation of the Signal Generator, switch the RANGE control from SET LEVEL to distortion range until a 12-dB difference is obtained between the SET LEVEL and distortion range readings (from +2 dB to -10 dB).

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

SERVICE CHECK

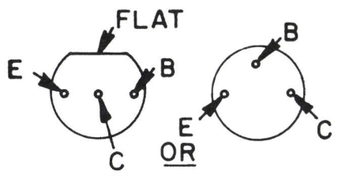
If the Modulation Acceptance Bandwidth test does not indicate the proper width, make gain measurements as shown on the Receiver Troubleshooting Procedure.

EXCITER
4EG29A10,11



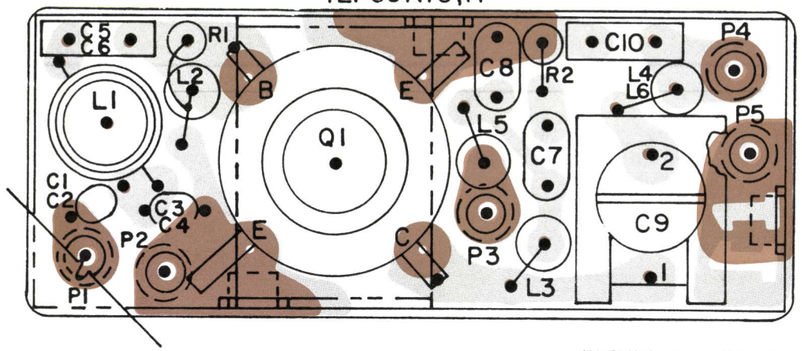
(19B216813, Sh. 1, Rev. 1)
(19B216813, Sh. 2, Rev. 1)

LEAD IDENTIFICATION
FOR EXCITER BD



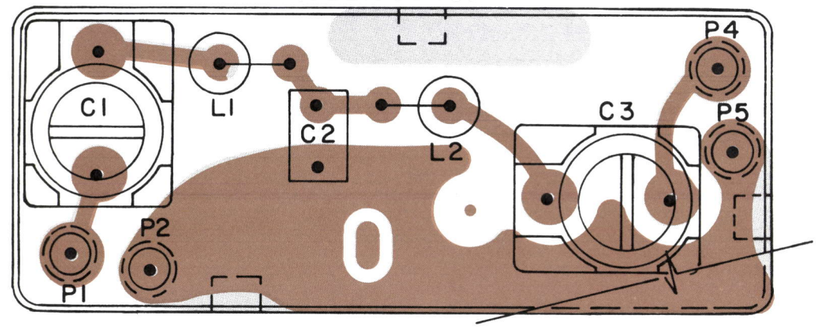
NOTE: LEAD ARRANGEMENT, AND NOT CASE SHAPE, IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.

PA
4EF39A10,11

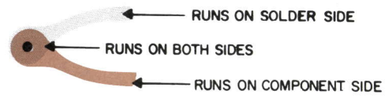


(19B216818, Sh. 1, Rev. 1)
(19B216818, Sh. 2, Rev. 1)

PA
19B219084G1



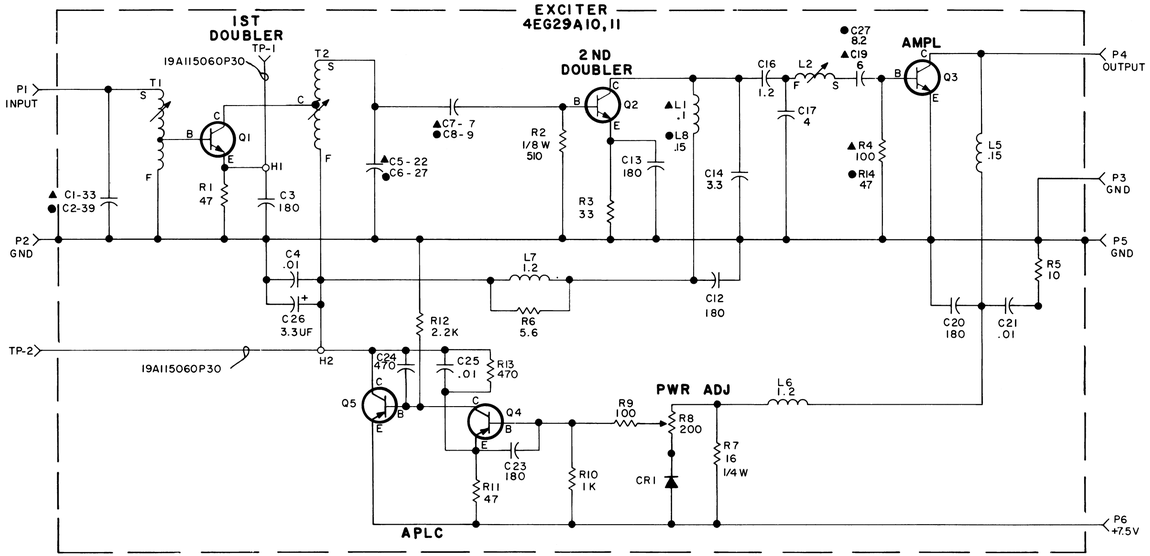
(19B219083, Sh. 1, Rev. 0)
(19B219083, Sh. 2, Rev. 0)



OUTLINE DIAGRAM

(19B219346, Rev. 1)

132—174 MHz TRANSMITTER EXCITER
AND PA ASSEMBLY



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 1/10 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.

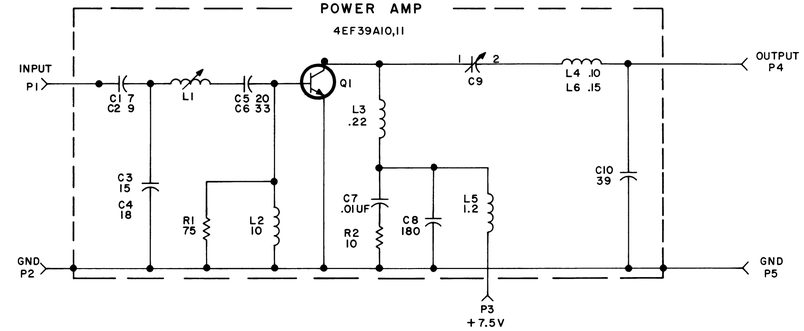
(19C317404, Rev. 6)

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

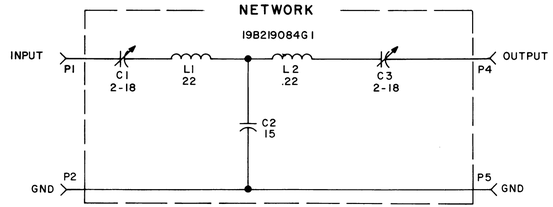
THIS ELEM DIAG APPLIES TO	
MODEL NO	REV LETTER
4EG29A10	C
4EG29A11	B

● 132 TO 150.8MHZ

▲ 150.8 TO 174 MHZ



(19B216893, Rev. 2)



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

(19B216892, Rev. 1)

SCHEMATIC DIAGRAM

132—174 MHz TRANSMITTER EXCITER AND PA ASSEMBLY

PARTS LIST

LBI-4223C

132-174 MHz TRANSMITTER EXCITER AND PA MODULES

SYMBOL	GE PART NO.	DESCRIPTION
		EXCITER MODULE MODEL 4EG29A10 132-150.8 MHz MODEL 4EG29A11 150.8-174 MHz
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1	19A116114P2047	Ceramic: 33 pf ±5%, 100 VDCW; temp coef -80 PPM.
C2	19A116114P2050	Ceramic: 39 pf ±5%, 100 VDCW; temp coef -80 PPM.
C3	19A116114P10073	Ceramic: 180 pf ±10%, 100 VDCW; temp coef -3300 PPM.
C4	19A116192P1	Ceramic: 0.01 µf ±20%, 50 VDCW; sim to Erie 8121-050-W5R.
C5	19A116114P2041	Ceramic: 22 pf ±5%, 100 VDCW; temp coef -80 PPM.
C6	19A116114P2045	Ceramic: 30 pf ±5%, 100 VDCW; temp coef -80 PPM.
C7*	19A116114P24	Ceramic: 7 pf ±5%, 100 VDCW; temp coef 0 PPM.
		Earlier than REV A:
	19A116114P14	Ceramic: 4 pf ±5%, 100 VDCW; temp coef 0 PPM.
C8*	19A116114P30	Ceramic: 9 pf ±5%, 100 VDCW; temp coef 0 PPM.
		Earlier than REV A:
	19A116114P18	Ceramic: 5 pf ±5%, 100 VDCW; temp coef 0 PPM.
C12 and C13	19A116114P10073	Ceramic: 180 pf ±10%, 100 VDCW; temp coef -3300 PPM.
C14	19A116114P12	Ceramic: 3.3 pf ±5%, 100 VDCW; temp coef 0 PPM.
C16	5491601P122	Phenolic: 1.2 pf ±5%, 500 VDCW.
C17	19A116114P14	Ceramic: 4 pf ±5%, 100 VDCW; temp coef 0 PPM.
C19*	19A116114P20	Ceramic: 8 pf ±5%, 100 VDCW; temp coef 0 PPM. Deleted in 4EG29A10 by REV B.
C20	19A116114P10073	Ceramic: 180 pf ±10%, 100 VDCW; temp coef -3300 PPM.
C21	19A116192P1	Ceramic: 0.01 µf ±20%, 50 VDCW; sim to Erie 8121-050-W5R.
C23	19A116114P10073	Ceramic: 180 pf ±10%, 100 VDCW; temp coef -3300 PPM.
C24	19A116192P2	Ceramic: 470 pf ±20%, 50 VDCW; sim to Erie 8111-050-W5R.
C25	19A116192P1	Ceramic: 0.01 µf ±20%, 50 VDCW; sim to Erie 8121-050-W5R.
C26	5491674P36	Tantalum: 3.3 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
C27*	19A116114P28	Ceramic: 8.2 pf ±5%, 100 VDCW; temp coef 0 PPM. Added to 4EG29A10 by REV B.
		- - - - - - - DIODES AND RECTIFIERS - - - - - -
CR1	19A115250P1	Silicon.
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L1*	19B209420P101	Coil, RF: 0.10 µh ±10%, 0.08 ohms DC res max; sim to Jeffers 4416-1. Deleted in 4EG29A10 by REV B.
L2	19B216935G1	Coil. Includes:
	19B209436P1	Tuning slug.
L5	19B209420P103	Coil, RF: 0.15 µh ±10%, 0.10 ohms DC res max; sim to Jeffers 4416-3.
L6 and L7	19B209420P114	Coil, RF: 1.20 µh ±10%, 0.18 ohms DC res max; sim to Jeffers 4436-1.
L8*	19B209420P103	Coil, RF: 0.15 µh ±10%, 0.10 ohms DC res max; sim to Jeffers 4416-3. Added to 4EG29A10 by REV B.
		- - - - - - - - - - PLUGS - - - - - - - - - -
P1 thru P6	19A115834P4	Contact, electrical: sim to AMP 2-332070-9.
		- - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q1	19A115328P1	Silicon, NPN.
Q2*	19A116201P3	Silicon, NPN.
		Earlier than REV A:
	19A116201P1	Silicon, NPN.
Q3	19A116201P1	Silicon, NPN.
Q4 and Q5	19A115768P1	Silicon, PNP; sim to Type 2N3702.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1	3R151P470J	Composition: 47 ohms ±5%, 1/8 w.
R2*	3R151P511J	Composition: 510 ohms ±5%, 1/8 w.
		In 4EG29A10 of REV B and earlier: In 4EG29A11 of REV A and earlier:
	3R151P122J	Composition: 1200 ohms ±5%, 1/8 w.
R3	3R151P330J	Composition: 33 ohms ±5%, 1/8 w.
R4*	3R151P101J	Composition: 100 ohms ±5%, 1/8 w. Deleted in 4EG29A10 by REV B.
R5	3R151P100J	Composition: 10 ohms ±5%, 1/8 w.
R6	3R151P586J	Composition: 5.6 ohms ±5%, 1/8 w.
R7	3R152P160J	Composition: 16 ohms ±5%, 1/4 w.
R8	19A116412P1	Variable, cermet: 200 ohms ±10%, 1/2 w; sim to Helipot Model 62 PF.
R9	3R151P101J	Composition: 100 ohms ±5%, 1/8 w.
R10	3R151P102J	Composition: 1000 ohms ±5%, 1/8 w.
R11	3R151P470J	Composition: 47 ohms ±5%, 1/8 w.
R12	3R151P222J	Composition: 2200 ohms ±5%, 1/8 w.
R13	3R151P471J	Composition: 470 ohms ±5%, 1/8 w.
R14*	3R151P470J	Composition: 47 ohms ±5%, 1/8 w. Added to 4EG29A10 by REV B.
		- - - - - - - - - - TRANSFORMERS - - - - - - -
T1	19B216910G2	Coil. Includes:
	19B209436P1	Tuning slug.
T2	19B216934G1	Coil. Includes:
	19B209436P1	Tuning slug.
		2 WATT PA MODULE MODEL 4EF39A10 132-150.8 MHz MODEL 4EF39A11 150.8-174 MHz
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1	19A116114P24	Ceramic: 7 pf ±5%, 100 VDCW; temp coef 0 PPM.
C2	19A116114P30	Ceramic: 9 pf ±5%, 100 VDCW; temp coef 0 PPM.
C3	19A116114P36	Ceramic: 15 pf ±5%, 100 VDCW; temp coef 0 PPM.
C4	19A116114P38	Ceramic: 18 pf ±5%, 100 VDCW; temp coef 0 PPM.
C5	19A116114P8039	Ceramic: 20 pf ±5%, 100 VDCW; temp coef -80 PPM.
C6	19A116114P2047	Ceramic: 33 pf ±5%, 100 VDCW; temp coef -80 PPM.
C7	19A116192P1	Ceramic: 0.01 µf ±20%, 50 VDCW; sim to Erie 8121-050-W5R.
C8	19A116114P10073	Ceramic: 180 pf ±10%, 100 VDCW; temp coef -3300 PPM.
C9	19A116462P3	Variable: less than 2 pf to more than 20 pf, 100 VDCW, -320 PPM/°C.
C10	19A116114P50	Ceramic: 39 pf ±5%, 100 VDCW; temp coef 0 PPM.
		- - - - - - - - - - PLUGS - - - - - - - - - -
P1 thru P3	19A115834P4	Contact, electrical: sim to AMP 2-332070-9.
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L1	19B216921G1	Coil. Includes:
	19B209436P1	Tuning slug.
L2	19B209420P125	Coil, RF: 10.0 µh ±10%, 3.10 ohms DC res max; sim to Jeffers 4446-4.
L3	19B209420P105	Coil, RF: 0.22 µh ±10%, 0.14 ohms DC res max; sim to Jeffers 4416-5.
L4	19B209420P101	Coil, RF: 0.10 µh ±10%, 0.08 ohms DC res max; sim to Jeffers 4416-1.
L5	19B209420P114	Coil, RF: 1.20 µh ±10%, 0.18 ohms DC res max; sim to Jeffers 4436-1.
L6	19B209420P103	Coil, RF: 0.15 µh ±10%, 0.10 ohms DC res max; sim to Jeffers 4416-3.
		- - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q1	19A116259P1	Silicon, NPN.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1	3R151P750J	Composition: 75 ohms ±5%, 1/8 w.
R2	3R151P100J	Composition: 10 ohms ±5%, 1/8 w.
		200 MILLIWATT PA MODULE 19B219084G1
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1	19A116462P3	Variable: less than 2 pf to 20 pf, 100 VDCW, -320 PPM/°C.
C2	19A116114P36	Ceramic: 15 pf ±5%, 100 VDCW; temp coef 0 PPM.
C3	19A116462P3	Variable: less than 2 pf to 20 pf, 100 VDCW, -320 PPM/°C.
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L1 and L2	19B209420P5	Coil, RF: 0.22 µh ±5%, 0.14 ohms DC res max; sim to Jeffers 4416-5.
		- - - - - - - - - - PLUGS - - - - - - - - - -
P1 thru P5	19A115834P4	Contact, electrical: sim to AMP 2-332070-9.
		- - - - - - - - - - MISCELLANEOUS - - - - - - - -
	19A127337P2	Nut, knurled: 8-32.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

PRODUCTION CHANGES

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

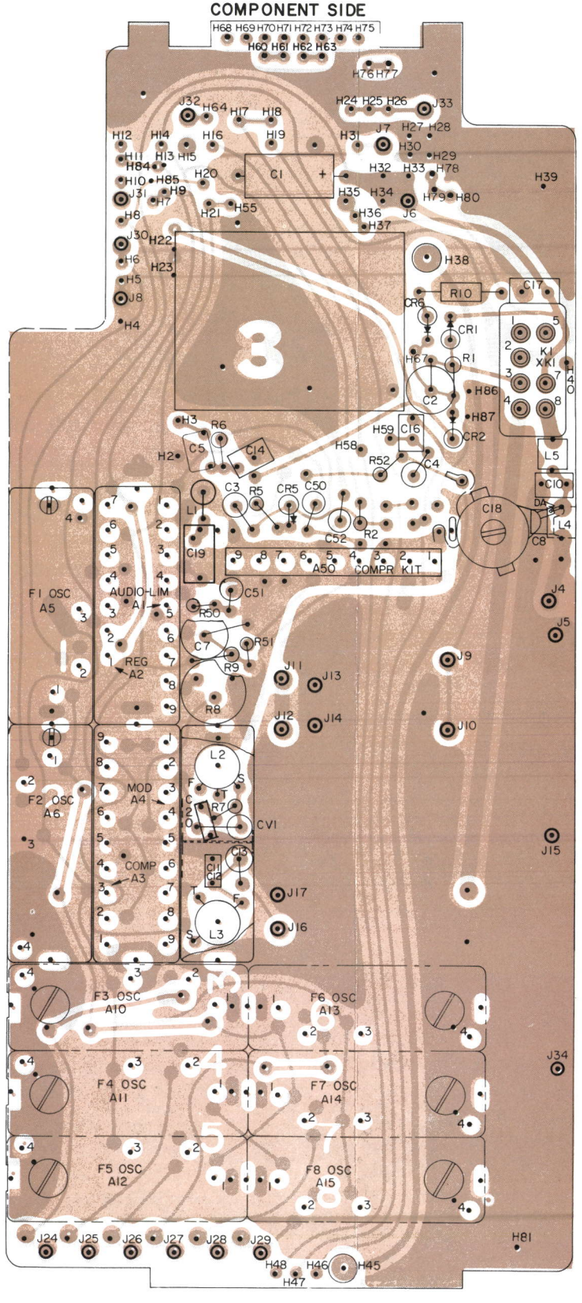
REV. A - Exciter Model 4EG29A10, 11
To increase Power Output. Changed C7, C8 and Q2.

REV. B - Exciter Model 4EG29A10
To improve operation. Added C27, R14 and L8. Changed R6. Deleted C19, L1 and R4.

REV. C - To reduce current drain in exciter.
Changed R2.

REV. B - Exciter Model 4EG29A11
To reduce current drain in exciter.
Changed R2.

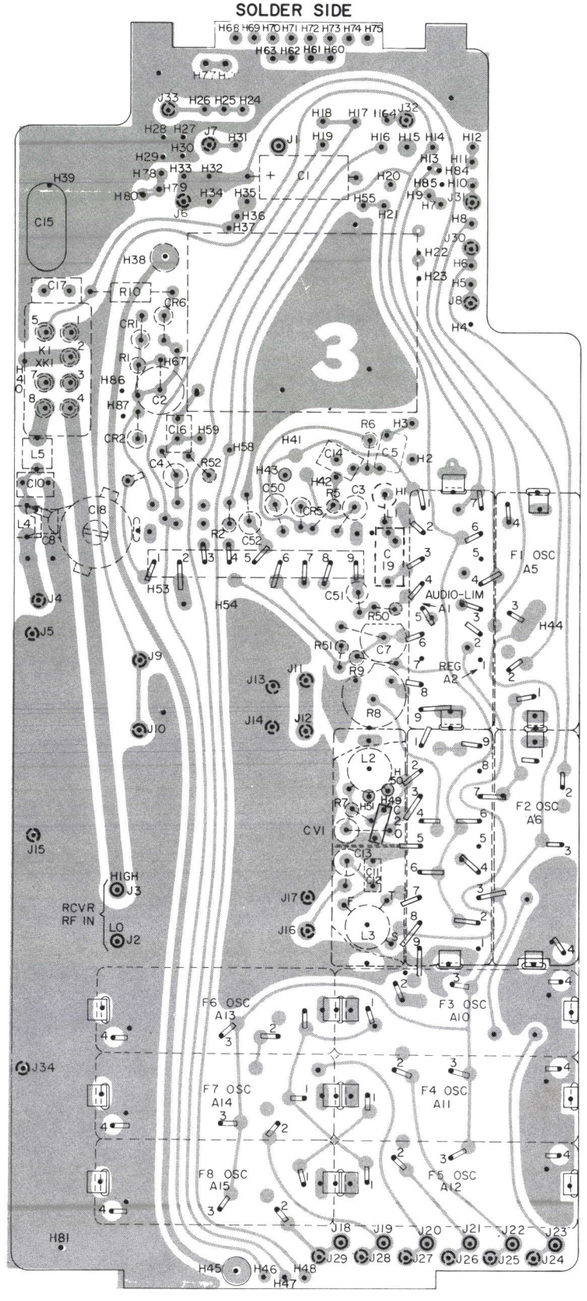
COMPONENT SIDE



(19D416845, Rev. 3)
(19D416505, Sh. 1, Rev. 3)
(19D416505, Sh. 2, Rev. 3)

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

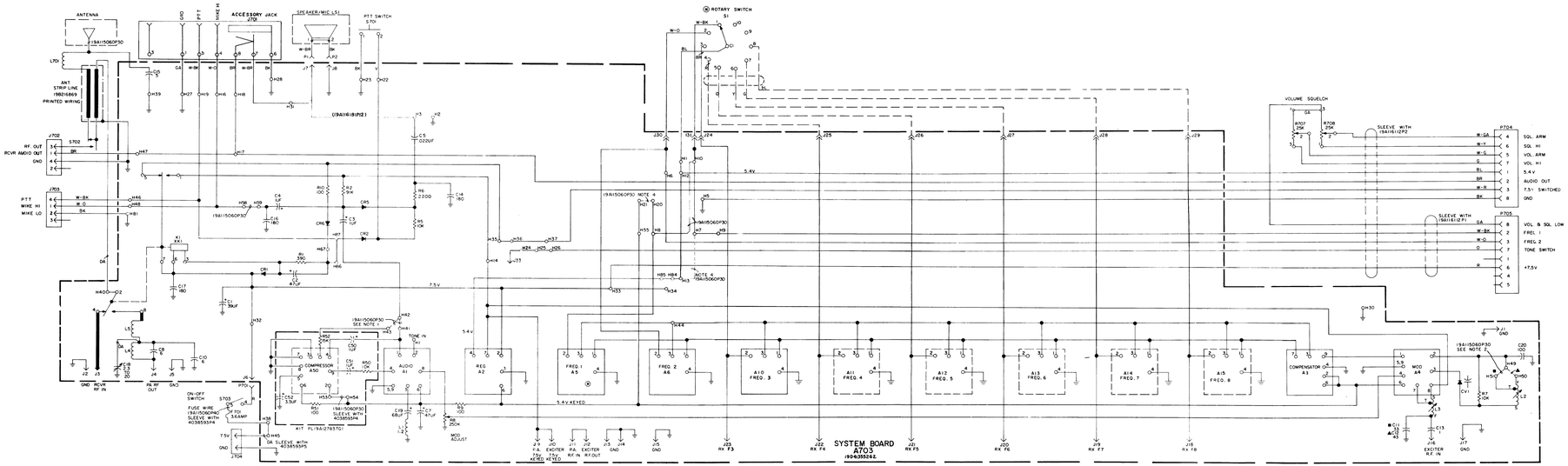
SOLDER SIDE



(19D416845, Rev. 3)
(19D416505, Sh. 2, Rev. 3)

OUTLINE DIAGRAM

132—174 MHz SYSTEM BOARD



(198621795, Rev. 7)

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

THIS ELEM DIAG APPLIES TO

MODEL NO	REV LETTER
PL19D435483G3	B
PL19D435526G2	C

A ALL RESISTORS ARE 1/8 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K = 1000 OHMS OR MEG = 1,000,000 OHMS.
C CAPACITOR VALUES IN PICOFARADS (POUND) UNLESS FOLLOWED BY MF = MICROFARADS OR 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. CONNECT HOLE 42 TO HOLE 41 WHEN COMPRESSOR A50 IS NOT USED.
   CONNECT HOLE 42 TO HOLE 43 WHEN COMPRESSOR A50 IS USED.
2. ▲USED IN LO SPLIT (132-150.8 MHZ)
   ■USED IN HI SPLIT (150.8-174MHZ)
3. DA = #22 AWG
4. Ⓡ THESE ITEMS ARE PART OF SWITCH KIT PL19A129268G1.
5. CONNECT HOLE 7 TO HOLE 15 AND REMOVE JUMPER BETWEEN HOLE 7 AND HOLE 10 FOR SINGLE FREQ RX OPERATION. CONNECT HOLE 20 TO HOLE 21 AND REMOVE JUMPER BETWEEN HOLE 8 AND HOLE 10 FOR SINGLE FREQ TX OPERATION.

SCHEMATIC DIAGRAM

132—174 MHz SYSTEM BOARD

Issue 2

PARTS LIST

LBI-4369A

SYSTEM BOARD/CASE ASSEMBLY
19D413548G3
AND
ASSOCIATED ASSEMBLIES

SYMBOL	GE PART NO.	DESCRIPTION
AT03		SYSTEM BOARD 19D413552G2
A1	19C320062G1	Transmitter Audio Module.
A2	19C311905G2	Regulator Module.
A3	19C320060G1	Oscillator Compensator Module.
A4	19C320084G1	Modulator Module. NOTE: When reordering give GE Part Number and exact crystal frequency. Crystal Freq = Operating Freq / 12
A5 and A6	4EG27A10	Transmitter Oscillator.
A10 thru A15	4EG27A10	Transmitter Oscillator.
		- - - - - - - - - CAPACITORS - - - - - - - - -
C1	5491674P30	Tantalum: 39 pf ±20%, 10 VDCW; sim to Sprague Type 162D.
C2	5491674P42	Tantalum: 47 pf ±20%, 6 VDCW; sim to Sprague Type 162D.
C3 and C4	5491674P1	Tantalum: 1.0 pf +40-20%, 10 VDCW; sim to
C5*	19A116424P2	Ceramic: 0.022 pf ±20%, 50 VDCW. Earlier than REV A:
	5491674P1	Tantalum: 1.0 pf +40-20%, 10 VDCW; sim to Sprague Type 162D.
C7	5491674P42	Tantalum: 47 pf ±20%, 6 VDCW; sim to Sprague Type 162D.
C8	19A116114P20	Ceramic: 6 pf ±5%, 100 VDCW; temp coef 0 PPM.
C10	19A116114P20	Ceramic: 6 pf ±5%, 100 VDCW; temp coef 0 PPM.
C13	5491601P130	Phenolic: 1.0 pf ±5%, 500 VDCW.
C14	19A116114P10073 -3300 PPM.	Ceramic: 180 pf ±5%, 100 VDCW; temp coef
C15	5496218P36	Ceramic disc: 5.0 pf ±0.25 pf, 500 VDCW, temp coef 0 PPM.
C16 and C17	19A116114P10073 -2300 PPM.	Ceramic: 180 pf ±5%, 100 VDCW; temp coef
C18	19B209351P2	Variable: 2.3 to 20 pf, 200 VDCW; -450 ±200 PPM/°C; sim to Matshushita ECV-11-W20P32.
C19	19C307102P19	Tantalum: 68 µf ±20%, 4 VDCW.
C20	19A116114P8065	Ceramic: 100 pf ±5%, 100 VDCW; temp coef -1500 PPM.
		- - - - - - - DIODES AND RECTIFIERS - - - - -
CR1 and CR2	19A115100P1	Silicon: sim to Type 1N456A.
CR3* and CR4*	5494922P1	Silicon; sim to Hughes 1N456. Deleted by REV C.
CR5	19A115100P1	Silicon: sim to Type 1N456A.
CR6	19A115250P1	Silicon.
CV1	5495769P9	Silicon, capacitive.

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - JACKS AND RECEPTACLES - - - - - -
J1 thru J5	19A116364P1	Contact, electrical: sim to Cambion 3232-1.
J6 thru J8	19A116366P2	Contact, electrical: sim to Cambion 3233-1.
J9 thru J31	19A116366P1	Contact, electrical: sim to Cambion 3232-1.
J32 thru J34	19A116366P2	Contact, electrical: sim to Cambion 3233-1.
		- - - - - - - - - INDUCTORS - - - - - - - - -
L1	19B209420P114	Coil, RF: 1.20 µh ±10%, 0.18 ohms DC res max; sim to Jeffers 4436-1.
L2	19A127798G1	Coil: 6.05-6.50 µh.
L3	19B216910G1	Coil.
L4 and L5	19B216320P3	Coil.
		- - - - - - - - - MICROPHONES - - - - - - - - -
MK1*	19B201559P1	Cartridge, controlled magnetic: sim to Shure Bros. MC 30. Deleted by REV A.
		- - - - - - - - - RESISTORS - - - - - - - - -
R1	3815139391J	Composition: 390 ohms ±5%, 1/8 w.
R2	3815119913J	Composition: 91,000 ohms ±5%, 1/8 w.
R3*	3815119103J	Composition: 10,000 ohms ±5%, 1/8 w. Deleted by REV C.
R5	3815119103J	Composition: 10,000 ohms ±5%, 1/8 w.
R6	3815139222J	Composition: 2200 ohms ±5%, 1/8 w.
R7	3815119103J	Composition: 10,000 ohms ±5%, 1/8 w.
R8	19A116412P4	Variable, cermet: 250,000 ohms ±10%, 1/2 w; sim to Helipot Model 62 PF.
R9 and R10	3815119101K	Composition: 100 ohms ±10%, 1/8 w.
		- - - - - - - - - SOCKETS - - - - - - - - - -
XK1	19A115843P5	Contact, electrical: sim to AMP 4-331272-3. (Quantity 7).
		- - - - - - - - - - FUSES - - - - - - - - - -
F701	19A127884G1	Fuse Kit.
		- - - - - - - JACKS AND RECEPTACLES - - - - - -
J701	19B216594G2	Connector, female: 6 contacts.
J702		See Mechanical Parts RC-2314, items 14, 16.
J703		See Mechanical Parts RC-2314, item 14.
J704		See Mechanical Parts RC-2314, items 49-51.
		- - - - - - - - - - RELAYS - - - - - - - - - -
K1	19A127836G1	Relay, sensitive: 95 ohms ±10%, 2 form C contacts, 5.5 to 9.0 VDC (over the temp range indicated); sim to C.P. Clare MF1401G01.
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L701	19A127815P1	Coil.
		- - - - - - - - - - PLUGS - - - - - - - - - -
P701	19A115834P4	Contact, electrical: sim to AMP 2-332070-9.
P704 and P705	19A127369P1	Plug: 8 contacts.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R707	19A116227P1	Resistor/Switch: variable, carbon film, 25,000 ohms ±20%, 1/8 w. (Includes S703). SPST, 3 amp at 125 VAC.

SYMBOL	GE PART NO.	DESCRIPTION
R708	19A116227P2	Variable, carbon film: 25,000 ±20%, 1/8 w.
		- - - - - - - - - - SWITCHES - - - - - - - - - -
S701		See Mechanical Parts RC-2314, items 31-37.
S702		See Mechanical Parts RC-2314, items 38-45.
S703		(Part of R707).
		ASSOCIATED ASSEMBLIES FRONT COVER ASSEMBLY 19C317416G2
		- - - - - - - - - LOUDSPEAKERS - - - - - - - - -
LS1	19A116090P1	Permanent magnet: 2.00 inch, 8 ohms ±10% voice coil imp, 450 Hz 1112 Hz resonant; freq range 400 to 3000 Hz.
		- - - - - - - - - - PLUGS - - - - - - - - - -
P1 and P2	19A115834P4	Contact, electrical: sim to AMP 2-332070-9.
		HI/LOW SPLIT MODIFICATION KIT 19A127836G1 HI SPLIT 19A127838G2 LOW SPLIT
		- - - - - - - - - CAPACITORS - - - - - - - - -
C11	19A116114P2047	Ceramic: 33 pf ±5%, 100 VDCW; temp coef -80 PPM.
C12	19A116114P2051	Ceramic: 43 pf ±5%, 100 VDCW; temp coef -80 PPM.
		MULTI-FREQUENCY MODIFICATION KIT 19A129269G1
		- - - - - - - - - SWITCHES - - - - - - - - -
S1	19B219515G1	Switch, rotary: 1 section, 1 pole, 10 positions (adjustable stop), non-shorting contacts; sim to Grayhill Co. 50H-36-01-1-RH.
		- - - - - - - DIODES AND RECTIFIERS - - - - - - -
	5494922P1	Diode, silicon: sim to Hughes 1N456. (Used for repeated frequencies only).
		COMPRESSOR KIT 19A127837G1
A50	19C311907G2	Audio Compressor Board.
		- - - - - - - - - CAPACITORS - - - - - - - - -
C50 and C51	5491674P1	Tantalum: 1.0 µf +40 -20%, 10 VDCW; sim to Sprague Type 162D,
C52	5491674P36	Tantalum: 3.3 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R50	3815119103J	Composition: 10,000 ohms ±5%, 1/8 w.
R51	3815119101J	Composition: 100 ohms ±5%, 1/8 w.
R52	3815119153J	Composition: 15,000 ohms ±5%, 1/8 w.
R53	3815119433J	Composition: 43,000 ohms ±5%, 1/8 w.
		- - - - - - - - MISCELLANEOUS - - - - - - - -
	19B216897G3	Rear Cover Assembly. (See RC-2314, item 56, 57).
	19B216897G4	Rear Cover Assembly. Clip type. (See RC-2314, 56, 58).
	19B219953G3	Antenna Assembly. (See RC-2314, items 7, 19-22).
	19D413522G1	Battery, rechargeable. Nickel Cadmium.
	4038381P4	Alignment tool. Fork tip.
	19B219079G1	Alignment tool. Allen tip.

SYMBOL	GE PART NO.	DESCRIPTION
		MECHANICAL PARTS (SEE RC-2314)
1	19A116543P1	Cap screw, socket head: No. 2-56 x 1/4.
2	19C317394P2	Gasket.
3	19B204527P2	Diaphragm: No. 2 inches dia.
4	9681P5002C13	Screw, phillips head: No. 2-56 x 1/8.
5	19A127319P1	Nut: No. 14-32.
6	19A115983P5	Seal, "O" ring: sim to Parker Seal 2-13.
7	R70P703C13	Set screw: No. 3-48 x 3/16.
8	19C317065P1	Knob. (SQUELCH, ON-OFF-VOLUME).
9	19B219953G3	Antenna assembly. (Includes items 7, 19-22).
10	19D413531P2	Grille.
11	NP27D290P2	Nameplate. (GE monogram).
12	19D413542G2	Case assembly. (Includes items 14, 15, 18, 26, 31-37, 46, 47).
13	19B216858P1	Insert.
14	19A127753P1	Contact. (Part of J102 and J703).
15	19A116719P1	Insert, screw thread: No. 2-56.
16	19B216822P2	Contact. (Part of J702).
17	19A127779G6	Antenna tube.
18	19B216875P1	Support.
19	19A129649P1	Antenna Cap. (Part of item 9).
20	19C320383P2	Antenna rod. (Part of item 9).
21	19A129652P1	Nut, knurled: thd size 7/16-40. (Part of item 9)
22	19C320535P1	Bushing (Part of item 9).
23	19C317050P1	Protective Cover.
24	19A129390P1	Disc.
25	19C311888P2	Knob.
26	19A129723P1	Rivet.
27	19B219540P1	Catch.
28	R70P702C13	Set screw: No. 3-48 x 1/8.
29	19B216520P4	Washer, nylon: 1/4 inch.
30	19A127319P2	Nut: No. 1/4-28.
31	19C320559P1	Collar. (Part of S701).
32	19C320558P1	Diaphragm. (Part of S701).
33	19C320560P1	Button. (Part of S701).
34	360P1006V	Screw, brass slotted: No. G-80 x 3/8. (Part of S701).
35	19A129733P1	Contact plate. (Part of S701),
36	19B219961G1	Contact. (Part of S701).
37	19A129734P1	Spring. (Part of S701),
38	19B216865P1	Insulator (Part of S702).
39	364?P5004C	Cap screw: 2-56 x 1/4. (Part of S702).
40	19B216864P1	Contact (Part of S702).
41	19B216863P1	Spring contact. (Part of S702).
42	9?10P6C13	Retaining ring. (Part of S702).
43	19A127754P1	Gasket (Part of S702).
44	19A127755P1	Spring (Part of S702).
45	19B216862P1	Contact (Part of S702).
46	333GP603F22	Eyelet, brass: 1/16 x 5/32.
47	833GP603F22	Eyelet, brass: 1/16 x 1/16.
48	19A127762P1	Strap.
49	19B216891G1	Spring assembly. (Part of J704).
50	19D413467P1	Fastener (Part of J704).

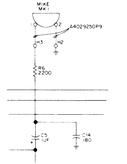
SYMBOL	GE PART NO.	DESCRIPTION
51	883P5005E	Flat head screw: brass, 2-56 x 5/16. (Part of J704).
52	19B216847P1	Insulator, pressure sensitive.
53	19C311491P3	Can. (Used with Regulator, Oscillator Compensator, and Compressor Circuits).
54	19B218510P1	Insulator. (Located between System and Receiver Boards).
55	19A116270P1	Tape, pressure sensitive, (Specify length).
56	19C317394P6	Gasket.
57	19B216897G3	Rear Cover Assembly (without clip).
58	19B216897G4	Rear Cover Assembly (with clip).

PRODUCTION CHANGES

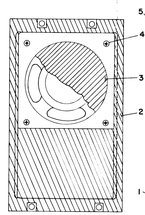
Changes in the equipment to improve performance or to simplify circuits are identified by a "Revision Letter", which is stamped after the model number of the unit. The revision stamped on the unit includes all previous revisions. Refer to the Parts List for descriptions of parts affected by these revisions.

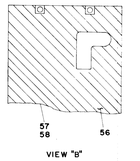
REV. A & B - CASE Assembly 19D413548G3
Incorporated in initial shipment.

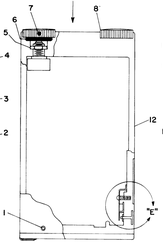
REV. A - Systems Board 19D413552G2
To increase mike sensitivity. Deleted MK1 and Changed C5,
Schematic Diagram was:

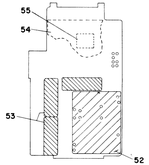


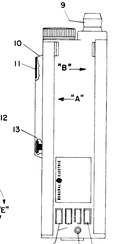
REV. B - To improve transmitter FM hum and noise. Deleted CR3, CR4 and R3.

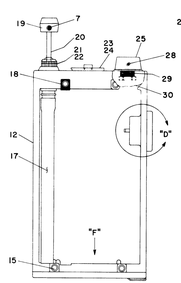


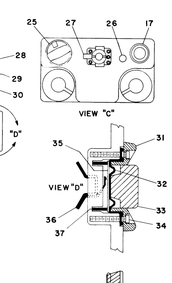










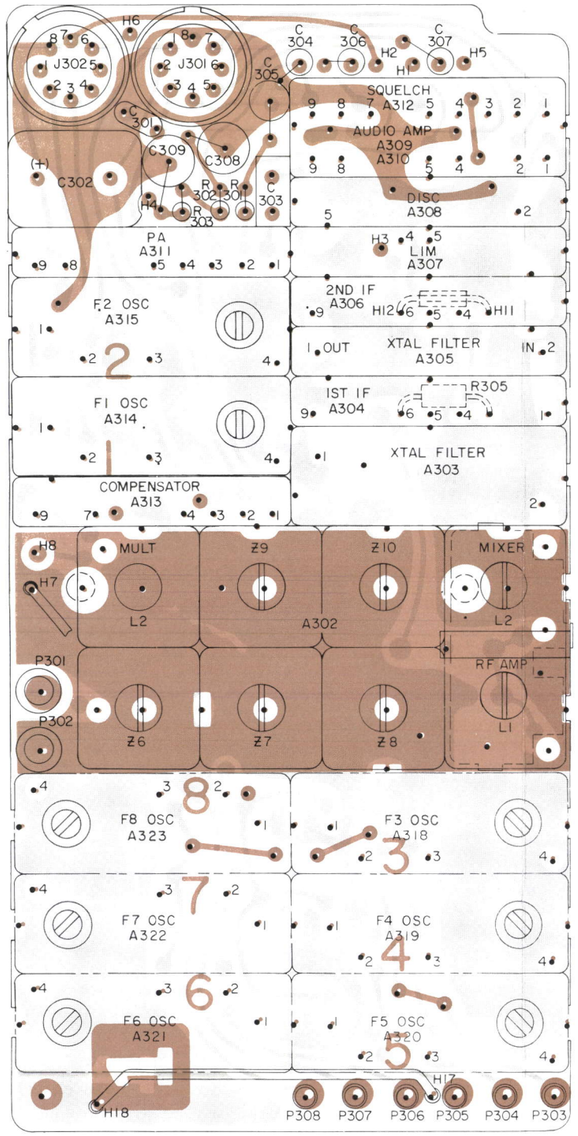


RC-2314A

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

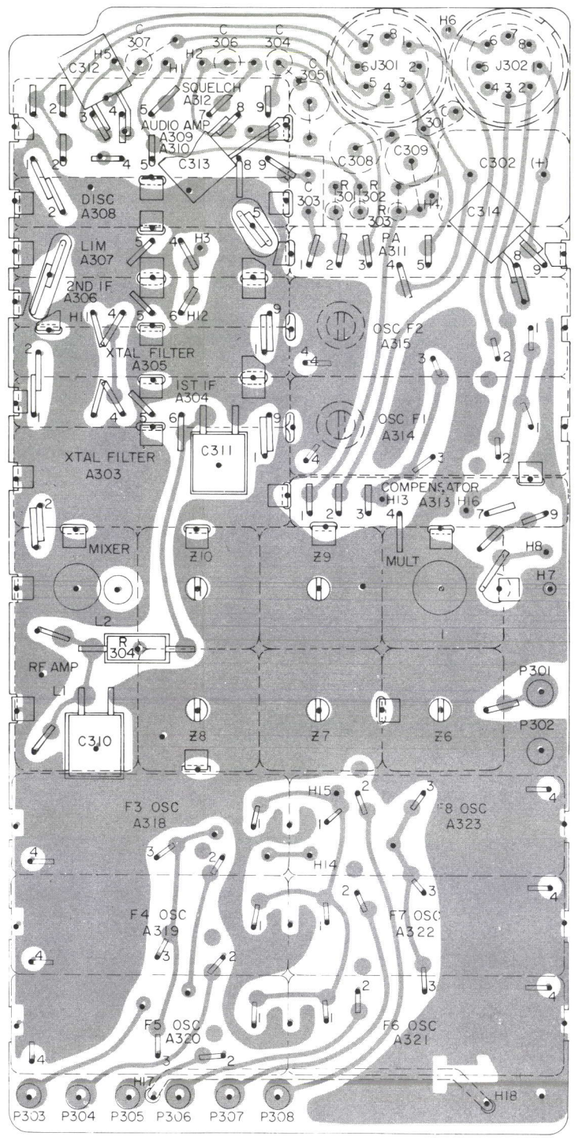
	PIN 1	PIN 2	PIN 3	PIN 4	PIN 5	PIN 6	PIN 7	PIN 8
J301	5.4V	AUDIO OUT	SWITCHED 7.5V	SQ ARM	VOL ARM	SQ HI	VOL HI	GND
J302		FREQ 1	FREQ 2			7.5V	TONE SWITCH	GND

COMPONENT SIDE



(19D416846, Rev. 1)
(19C320014, Sh. 1, Rev. 1)
(19C320014, Sh. 2, Rev. 1)

SOLDER SIDE

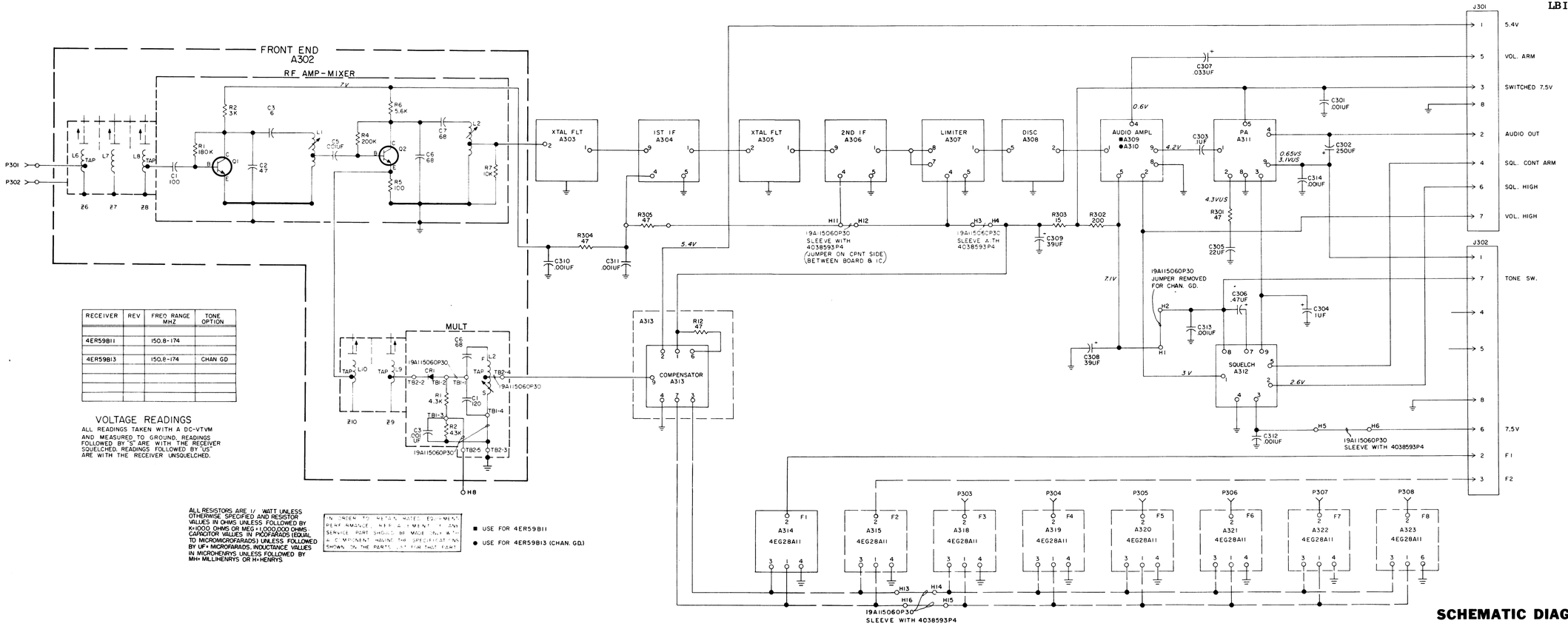


(19D416846, Rev. 1)
(19C320014, Sh. 2, Rev. 1)

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

OUTLINE DIAGRAM

132—174 MHz RECEIVER
MODELS 4ER59B11 & B13



RECEIVER	REV	FREQ RANGE MHZ	TONE OPTION
4ER59B11		150.8-174	
4ER59B13		150.8-174	CHAN GD

VOLTAGE READINGS

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

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

IN ORDER TO REDUCE NOISE, EQUIPMENT PERFORMANCE, AND ASSIGNMENT OF ANY SERVICE, PORT SHOULD BE MADE ONLY WITH A COMPONENT HAVING THE SPECIFICATIONS SHOWN ON THE PARTS LIST FOR THAT PART.

■ USE FOR 4ER59B11

● USE FOR 4ER59B13 (CHAN. GD.)

(19R621798, Rev. 3)

SCHEMATIC DIAGRAM

150.8—174 MHz RECEIVER
MODELS 4ER59B11 & B13

PARTS LIST

LBI-4370A

150.8-174 MHz RECEIVER
MODELS 4ER59B11, 13

SYMBOL	GE PART NO.	DESCRIPTION
A302		FRONT END 19C317295G2 150.8-174 MHz
A1		RF AMPLIFIER 19C317445G1
		- - - - - - - - - - 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.
C5	5495323P12	Ceramic: .001 µf +100% -20%, 75 VDCW.
C6 and C7	19A116114P4059	Ceramic: 68 pf ±5%, 100 VDCW; temp coef -220 PPM.
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L1	19B216950G1	Coil.
L2	19B216948G1	Coil.
		- - - - - - - - - - TRANSISTORS - - - - - - - -
Q1 and Q2	19A116159P1	Silicon, NPN.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1	3R151P184J	Composition: 0.18 megohm ±5%, 1/8 w.
R2	3R151P302J	Composition: 3000 ohms ±5%, 1/8 w.
R4	3R151P204J	Composition: 0.20 megohm ±5%, 1/8 w.
R5	3R151P101J	Composition: 100 ohms ±5%, 1/8 w.
R6	3R151P562J	Composition: 5600 ohms ±5%, 1/8 w.
R7	3R151P103J	Composition: 10,000 ohms ±5%, 1/8 w.
A4		MULTIPLIER 19C311873G5
		- - - - - - - - - - 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.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1 and R2	3R151P432J	Composition: 4300 ohms ±5%, 1/8 w.
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L6	19B216441G2	Helical resonator. (Part of Z6). Includes:
	19C311727P1	Tuning slug.
L7	19B216441G3	Helical resonator. (Part of Z7). Includes:
	19C311727P1	Tuning slug.
L8	19B216441G12	Helical resonator. (Part of Z8). Includes:
	19C311727P1	Tuning slug.
L9 and L10	19B216441G4	Helical resonator. (Part of Z9, Z10). Includes:
	19C311727P1	Tuning slug.
		- - - - - - - HELICAL RESONATORS - - - - - - -
Z6		Consists of L6 and 19D413132P16 can.
Z7		Consists of L7 and 19D413132P3 can.
Z8		Consists of L8 and 19D413132P17 can.
Z9		Consists of L9 and 19D413132P19 can.
Z10		Consists of L10 and 19D413132P20 can.
A303	19C304516G3	Crystal Filter.
A304	19C311879G3	1st IF Amplifier.
A305*	19C304824G1	Crystal Filter.
		Earlier than REV A:
	19C304508G3	Crystal Filter.
A306	19C311879G4	2nd IF Amplifier.
A307	19C311876G2	Limiter.
A308	19C304504G3	Discriminator.
A309	19C311878G2	Audio Amplifier.
A310	19C311995G2	Audio Amplifier. (Includes Tone Filter).
A311	19C311877G2	PA.
A312	19C311880G4	Squelch.
A313	19C320061G1	Compensator.
		- - - - - - - - - OSCILLATORS - - - - - - - - -
		NOTE: When reordering, give GE Part Number and specify exact frequency needed.
A314 and A315	4EG28A11	Oscillator Module. 150.8-174 MHz. Fx = Fo ÷ 20 / 9
A318 thru A323	4EG28A11	Oscillator Module. 150.8-174 MHz. Fx = Fo ÷ 20 / 9
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C301	5495323P12	Ceramic: .001 µf +100% -20%, 75 VDCW.
C302	19A116178P7	Tantalum: 220 µf ±20%, 6 VDCW.
C303	19A116089P1	Ceramic: 0.1 µf ±20%, 50 VDCW, temp range -55 to +85°C.
C304	5491674P28	Tantalum: 1.0 µf ±20%, 25 VDCW; sim to Sprague Type 162D.
C305	5491674P35	Tantalum: 22 µf ±20%, 4 VDCW; sim to Sprague Type 162D.
C306	5491674P27	Tantalum: .47 µf ±20%, 35 VDCW; sim to Sprague Type 162D.
C307	5491674P31	Tantalum: .033 µf ±20%, 35 VDCW; sim to Sprague Type 162D.
C308 and C309	5491674P30	Tantalum: 39 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
C310 thru C314	5495323P12	Ceramic: .001 µf +100% -20%, 75 VDCW.
		- - - - - - - JACKS AND RECEPTACLES - - - - - -
J301 and J302	19A116122P1	Feed-thru: sim to Warren Co 1-B-2994-4.
		- - - - - - - - - - PLUGS - - - - - - - - - -
P301 thru P308	19A115834P4	Contact, electrical: sim to AMP 2-332070-9.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R301	3R151P470J	Composition: 47 ohms ±5%, 1/8 w.
R302	3R151P201J	Composition: 200 ohms ±5%, 1/8 w.
R303	3R151P150J	Composition: 15 ohms ±5%, 1/8 w.
R304 and R305	3R151P470J	Composition: 47 ohms ±5%, 1/8 w.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

PRODUCTION CHANGES

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

REV. A - To improve Squelch action.
Changed A312 and A305.

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 – To prevent RF interference from the transmitter.
Added C616 and C617.

REV. B – To improve RF filtering of +7.5 Volt line.
Added C618.

REV. C – To improve Switch.
Changed S2 and added washer.

REV. D – To make Channel Guard compatible with PE Low Band.
Added R607.

PARTS LIST

LBI-4371B

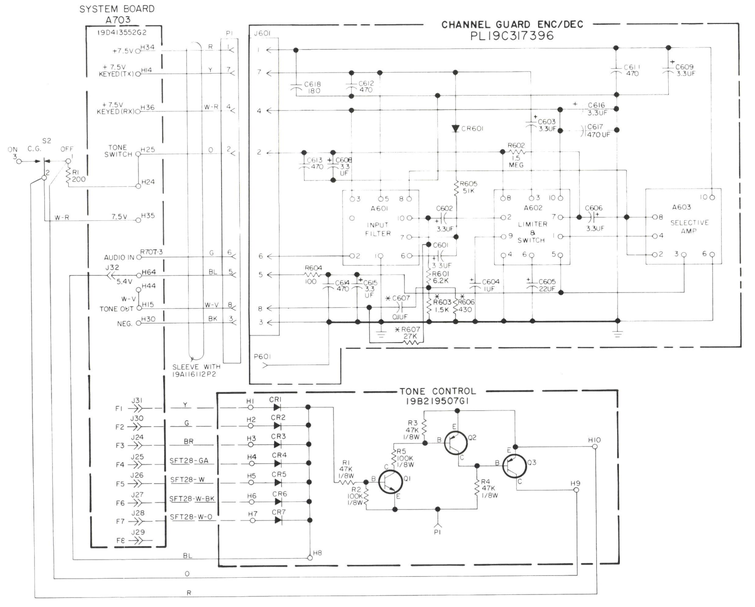
CHANNEL GUARD ENCODER/DECODER
MODEL 4EK17A11

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - - PLUGS - - - - - - - - - - -
P1	19B216958G1	Socket, crystal: 8 contacts.
		- - - - - - - - - - - SWITCHES - - - - - - - - - -
		SWITCH ASSEMBLY 19A127833G1
		- - - - - - - - - - - RESISTORS - - - - - - - - - -
R1	3R151P201J	Composition: 200 ohms ±5%, 1/8 w.
		- - - - - - - - - - - SWITCHES - - - - - - - - - -
S2	19A116648P6	Toggle: SPDT; sim to C and K Components 7101SDG.
		CHANNEL GUARD ENCODER/DECODER BOARD 19C317396G1
A601	19C317009G2	Input Filter.
A602	19C317014G2	Limiter and Switch.
		NOTE: When reordering give GE Part Number and specify exact frequency needed.
A603	19D413245G3	Selective Amplifier. 71.9-203.5 Hz freq range.
		- - - - - - - - - CAPACITORS - - - - - - - - -
C601 thru C603	5491674P36	Tantalum: 3.3 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
C604	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 ELA752C104K.
C608 and C609	5491674P36	Tantalum: 3.3 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
C611 thru C614	19A116192P2	Ceramic: 470 pf ±20%, 50 VDCW; sim to Erie 8111-050-W5R.
C615	5491674P36	Tantalum: 3.3 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
C616*	5491674P36	Tantalum: 3.3 µf ±20%, 10 VDCW; sim to Sprague Type 162D. Added by REV A.
C617*	19A116192P2	Ceramic: 470 pf ±20%, 50 VDCW; sim to Erie 8111-050-W5R. Added by REV A.
C618*	19A116114P10073	Ceramic: 180 pf ±10%, 100 VDCW; temp coef -3300 PPM. Added by REV B.
		- - - - - - - DIODES AND RECTIFIERS - - - - - - -
CR601	19A115250P1	Silicon.
		- - - - - - - JACKS AND RECEPTACLES - - - - - - -
J601	19A116122P1	Terminal, feed-thru: sim to Warren Co 1-B-2994-4.
		- - - - - - - - - - - PLUGS - - - - - - - - - - -
P601	19A115834P4	Contact, electrical: sim to Amp 2-332070-9.

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - - RESISTORS - - - - - - - - -
R601	3R152P622J	Composition: 6200 ohms ±5%, 1/2 w.
R602	3R152P155K	Composition: 1.5 megohm ±10%, 1/4 w.
R603	3R152P152J	Composition: 1500 ohms ±5%, 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*	3R152P273J	Composition: 27,000 ohms ±5%, 1/4 w. Added by REV D.
		TONE CONTROL BOARD 19B219507G1
CR1 thru CR7	5494922P1	Silicon; sim to Hughes 1N456.
		- - - - - - - - - - - PLUGS - - - - - - - - - - -
P1	19A115834P4	Contact, electrical: sim to AMP 2-332070-9.
		- - - - - - - - - TRANSISTORS - - - - - - - - -
Q1	19A129184P1	Silicon, NPN.
Q2 and Q3	19A129187P1	Silicon, PNP.
		- - - - - - - - - - RESISTORS - - - - - - - - -
R1	3R151P473K	Composition: 47,000 ohms ±10%, 1/8 w.
R2	3R151P104K	Composition: 0.10 megohm ±10%, 1/8 w.
R3 and R4	3R151P473K	Composition: 47,000 ohms ±10%, 1/8 w.
R5	3R151P104K	Composition: 0.10 megohm ±10%, 1/8 w.
		- - - - - - - - - MISCELLANEOUS - - - - - - - - -
	5490135P3	Boot, moisture seal. (Used with S2).
	19B216926P1	Decorative cap. (Used with S2).
	19B216316P1	Insulator. (Used with J601).
	4035306P11	Insulator. (Used with Q1-Q3).
	4035306P2	Washer. (Used with S2).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

SCHEMATIC DIAGRAM



(19D416547, Rev. 5)

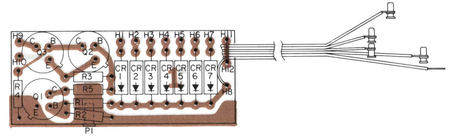
* CLIP R606 & R607 FOR HI BAND (132-174 MHZ)
* CLIP R603 & R607 FOR 450 - (406-470MHZ)
* CLIP R606 & C607 FOR LOW BAND (30-50MHZ)

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
4EK17A11	D

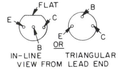
IN ORDER TO RETAIN RATED EQUIPMENT PERFORMANCE, REPLACEMENT OF ANY SERVICE PART SHOULD BE MADE ONLY WITH A COMPONENT HAVING THE SPECIFICATIONS SHOWN ON THE PARTS LIST FOR THAT PART.

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.



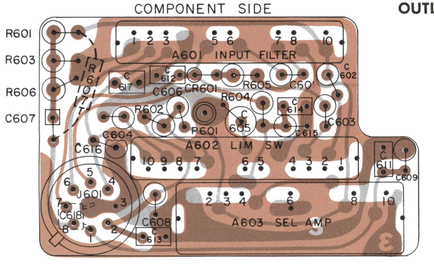
(19B219807, Rev. 0)
(19B219490, Sh. 1, Rev. 1)
(19B219490, Sh. 2, Rev. 1)

LEAD IDENTIFICATION FOR Q1-Q3

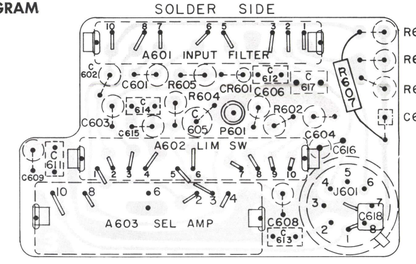


NOTE: LEAD ARRANGEMENT, AND NOT CASE SHAPE, IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.

OUTLINE DIAGRAM



(19C317936, Rev. 4)
(19B216776, Sh. 1, Rev. 3)
(19B216776, Sh. 2, Rev. 3)



(19C317936, Rev. 4)
(19B216776, Sh. 2, Rev. 3)

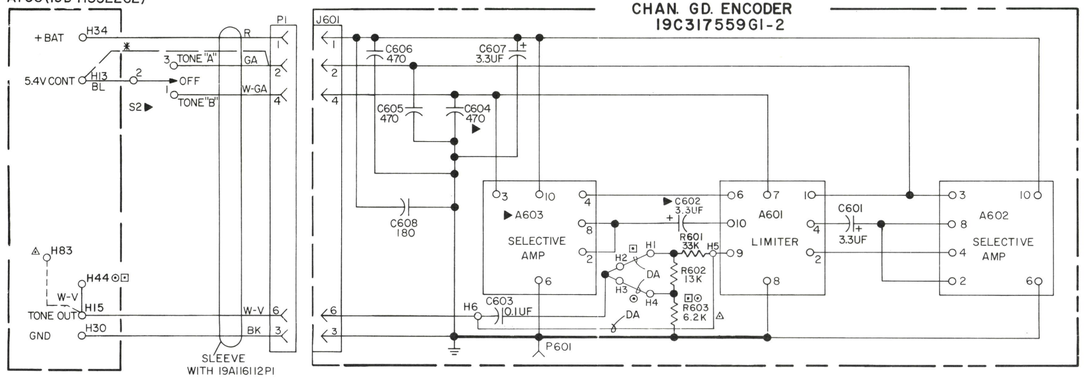
SCHEMATIC & OUTLINE DIAGRAM

CHANNEL GUARD ENCODER/DECODER
MODEL 4EK17A11

SYSTEM BOARD

A701 (19D413552G1)
A702 (19D416438G1)
A703 (19D413522G2)

SCHEMATIC DIAGRAM



(19C317558, Rev. 4)

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.

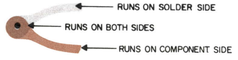
SEE APPLICABLE PRODUCTION CHANGE SHEETS IN INSTRUCTION BOOK SECTION DEALING WITH THIS UNIT, FOR DESCRIPTION OF CHANGES UNDER EACH REVISION LETTER.

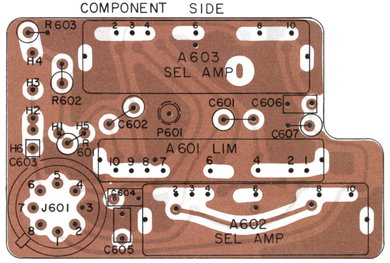
THIS ELEM DIAG APPLIES TO	
MODEL NO	REV LETTER
4EH21A10	B
4EH21A11	C

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.

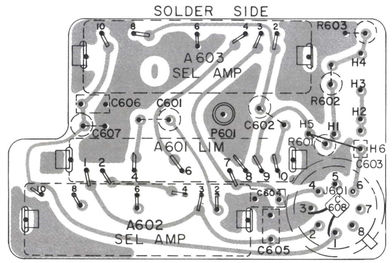
✱ 19C317559G1 ONLY (1 TONE)
▶ 19C317559G2 ONLY (2 TONE)
⊙ (406-470 MHZ)
⊡ (132-174 MHZ)
◬ (30-50 MHZ)

OUTLINE DIAGRAM





(19C317931, Rev. 2)
(19B219044, Sh. 1, Rev. 0)
(19B219044, Sh. 2, Rev. 0)



(19C317931, Rev. 2)
(19B219044, Sh. 2, Rev. 0)

SCHEMATIC & OUTLINE DIAGRAM

CHANNEL GUARD ENCODER
MODELS 4EH21A10, 11

PARTS LIST

LBI-4248B

CHANNEL GUARD ENCODER
MODEL 4EH21A10 1 TONE
MODEL 4EH21A11 2 TONE

SYMBOL	GE PART NO.	DESCRIPTION
A601	19C317033G2	Limiter. NOTE: When reordering give GE Part Number and specify exact frequency needed.
A602 and A603	19D413245G3	Selective Amplifier. 71.9-203.5 Hz freq range.
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C601 and C602	5491674P36	Tantalum: 3.3 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 ELA752C104K.
C604 thru C606	19A116192P2	Ceramic: 470 pf ±20%, 50 VDCW; sim to Erie 8111-050-W5R.
C607	5491674P36	Tantalum: 3.3 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
C608*	19A116114P10073	Ceramic: 180 pf ±10%, 100 VDCW; temp coef -3300 PPM. Added by REV A.
		- - - - - - - - JACKS AND RECEPTACLES - - - - - - -
J601	19A116122P1	Terminal, feed-thru: sim to Warren Co 1-B-2994-4.
		- - - - - - - - - - PLUGS - - - - - - - - - -
P601	19A115834P4	Contact, electrical: sim to Amp 2-332070-9.
		- - - - - - - - - - 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.
		- - - - - - - - - - PLUGS - - - - - - - - - -
P1	19B219050G1	Socket, crystal: 8 contacts.
		- - - - - - - - - - SWITCHES - - - - - - - - - -
S2	19B219053G1	Toggle: SPDT; sim to C and K Components 7103SDG.
		- - - - - - - - - - MISCELLANEOUS - - - - - - - - - -
	19B216926P2	Decorative cap. (Used with S2).
	19B216316P1	Insulator. (Used with J601).
	5490135P3	Boot, moisture seal. (Used with S2).
	4035306P2	Washer. (Used with S2).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

PRODUCTION CHANGES

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

REV. A - Models 4EH21A10,11
To improve RF filtering. Added C608

REV. B - Model 4EH21A11
To improve switch.
Changed S2 and added washer.

REV. B - Model 4EH21A10
REV. C - Model 4EH21A11
To make Channel Guard Encoder compatible with Low Band PS.
Added jumper between H5 and H6.

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 - To improve RF filtering.
Added C614 & C615.

REV. B - To improve Switch.
Changed S2 and added washer.

PARTS LIST

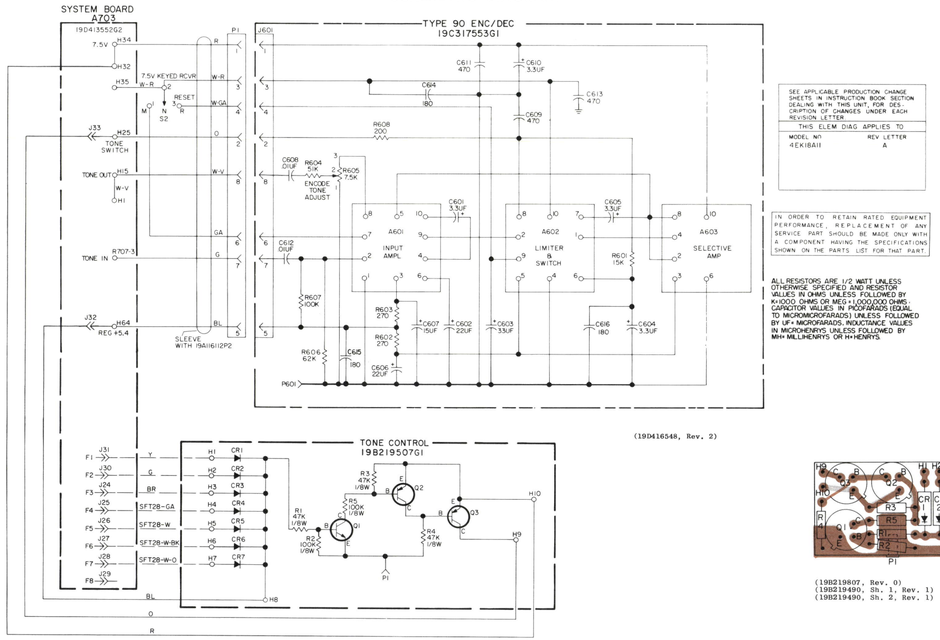
LBI-4372A

TYPE 90 ENCODER/DECODER
MODEL 4EK18A11

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - PLUGS - - - - - - - - - -
P1	19B219052G1	Socket, crystal: 8 contacts.
		- - - - - - - - - - SWITCHES - - - - - - - - - -
S2	19B219053G3	Toggle: SPDT; sim to C and K Components 7107SDG.
		TYPE 90 ENCODER/DECODER BOARD 19C317553G1
A601	19C317061G2	Input Amplifier.
A602	19C317014G2	Limiter and Switch.
		NOTE: When reordering give GE Part Number and specify exact frequency needed.
A603	19D413245G4	Selective Amplifier. 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 Component Inc G226R.
C603	19C307102P4	Tantalum: 33 µf ±20%, 10 VDCW; sim to Component Inc S336R.
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 Component Inc G226R.
C607	19C307102P14	Tantalum: 15 µf ±20%, 10 VDCW; sim to Component Inc G156R.
C608	19A116192P1	Ceramic: 0.01 µf ±20%, 50 VDCW; sim to Erie 8121-050-W5R.
C609	19A116192P2	Ceramic: 470 pf ±20%, 50 VDCW; sim to Erie 8111-050-W5R.
C610	5491674P36	Tantalum: 3.3 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
C611	19A116192P2	Ceramic: 470 pf ±20%, 50 VDCW; sim to Erie 8111-050-W5R.
C612	19A116192P1	Ceramic: 0.01 µf ±20%, 50 VDCW; sim to Erie 8121-050-W5R.
C613	19A116192P2	Ceramic: 470 pf ±20%, 50 VDCW; sim to Erie 8111-050-W5R.
C614* thru C616*	19A116114P10073	Ceramic: 180 pf ±10%, 100 VDCW; temp coef -3300 PPM. Added by REV A.
		- - - - - - - JACKS AND RECEPTACLES - - - - - - -
J601	19A116122P1	Terminal, feed-thru: sim to Warren Co 1-B-2994-4.
		- - - - - - - - - - PLUGS - - - - - - - - - -
P601	19A115834P4	Contact, electrical: sim to Amp 2-332070-9.
		- - - - - - - - - - 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%, 0.20 w; sim to Centralab Series 3 Type 620-1.
R606	3R152P623J	Composition: 62,000 ohms ±5%, 1/4 w.
R607	3R152P104K	Composition: 0.10 megohm ±10%, 1/4 w.
R608	3R152P201J	Composition: 200 ohms ±5%, 1/4 w.
		TONE CONTROL BOARD 19B219507G1
CR1 thru CR7	5494922P1	- - - - - - - - DIODES AND RECTIFIERS - - - - - Silicon; sim to Hughes 1N456.
P1	19A115834P4	- - - - - - - - - - PLUGS - - - - - - - - - - Contact, electrical: sim to AMP 2-332070-9.
Q1	19A129184P1	- - - - - - - - - TRANSISTORS - - - - - - - - - Silicon, NPN.
Q2 and Q3	19A129187P1	Silicon, PNP.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1	3R151P473K	Composition: 47,000 ohms ±10%, 1/8 w.
R2	3R151P104K	Composition: 0.10 megohm ±10%, 1/8 w.
R3 and R4	3R151P473K	Composition: 47,000 ohms ±10%, 1/8 w.
R5	3R151P104K	Composition: 0.10 megohm ±10%, 1/8 w.
		- - - - - - - - - MISCELLANEOUS - - - - - - - - -
	5490135P3	Boot, moisture seal. (Used with S2).
	19B216926P3	Decorative cap. (Used with S2).
	19B216316P1	Insulator. (Used with J601).
	4035306P11	Insulator. (Used with Q1-Q3).
	4035306P2	Washer. (Used with S2).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

SCHEMATIC DIAGRAM



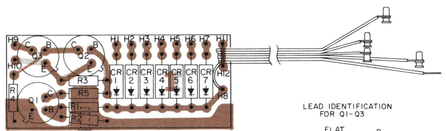
(19D416548, Rev. 2)

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
4EK18A11	A

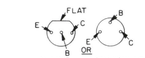
IN ORDER TO RETAIN RATED EQUIPMENT PERFORMANCE, REPLACEMENT OF ANY SERVICE PART SHOULD BE MADE ONLY WITH A COMPONENT HAVING THE SPECIFICATIONS SHOWN ON THE PARTS LIST FOR THAT PART.

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



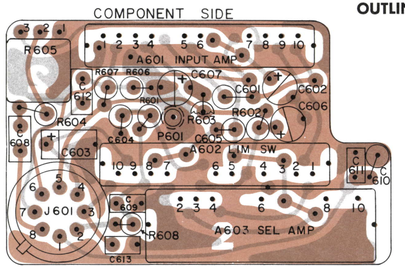
(19B219807, Rev. 0)
(19B219490, Sh. 1, Rev. 1)
(19B219490, Sh. 2, Rev. 1)

LEAD IDENTIFICATION FOR Q1-Q3

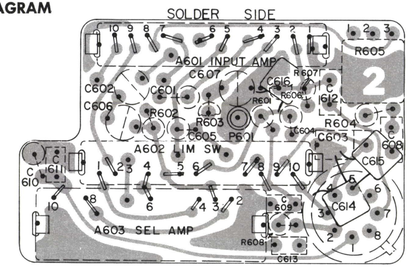


NOTE: LEAD ARRANGEMENT, AND NOT CASE SHAPE, IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.

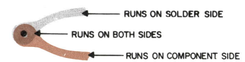
OUTLINE DIAGRAM



(19C317940, Rev. 1)
(19B219040, Sh. 1, Rev. 2)
(19B219040, Sh. 2, Rev. 2)



(19C317940, Rev. 1)
(19B219040, Sh. 2, Rev. 2)

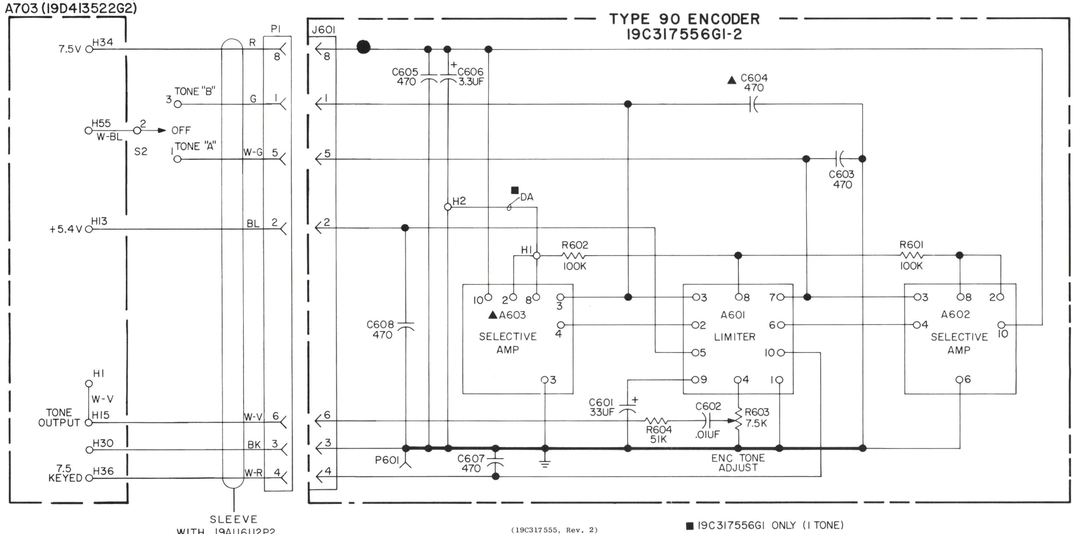


SCHEMATIC & OUTLINE DIAGRAMS

TYPE 90 ENCODER/DECODER
MODEL 4EK18A11

SYSTEM BOARD
A701 (19D413552G1)
A702 (19D416438G1)
A703 (19D413522G2)

SCHEMATIC DIAGRAM



(19C317555, Rev. 2)

■ 19C317556G1 ONLY (1 TONE)
▲ 19C317556G2 ONLY (2 TONE)

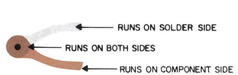
ALL RESISTORS ARE 1/ WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF= MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR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

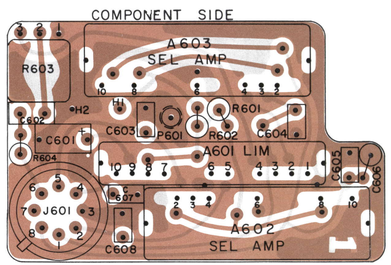
SEE APPLICABLE PRODUCTION CHANGE SHEETS IN INSTRUCTION BOOK SECTION DEALING WITH THIS UNIT, FOR DESCRIPTION OF CHANGES UNDER EACH REVISION LETTER.

THIS ELEM DIAG APPLIES TO	
MODEL NO	REV LETTER

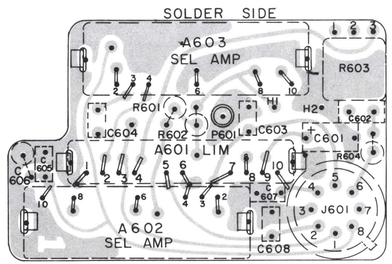
IN ORDER TO RETAIN RATED EQUIPMENT PERFORMANCE, REPLACEMENT OF ANY SERVICE PART SHOULD BE MADE ONLY WITH A COMPONENT HAVING THE SPECIFICATIONS SHOWN ON THE PARTS LIST FOR THAT PART.

OUTLINE DIAGRAM





(19C317933, Rev. 0)
(19B219043, Sh. 1, Rev. 1)
(19B219043, Sh. 2, Rev. 1)



(19C317933, Rev. 0)
(19B219043, Sh. 2, Rev. 1)

SCHEMATIC & OUTLINE DIAGRAMS

TYPE 90 ENCODER
MODELS 4EH20A10, 11

PARTS LIST

LBI-4250A

TYPE 90 ENCODER
MODEL 4EH20A10 1 TONE
MODEL 4EH20A11 2 TONE

SYMBOL	GE PART NO.	DESCRIPTION
A601	19C317037G2	Limiter. NOTE: When reordering give GE Part Number and specify exact frequency needed.
A602 and A603	19D413245G4	Selective Amplifier. 1050-3000 Hz.
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C601	19C307102P4	Tantalum: 33 µf 20%, 10 VDCW.
C602	19A116192P1	Ceramic: 0.01 µf ±20%, 50 VDCW; sim to Erie 8121-050-W5R.
C603 thru C605	19A116192P2	Ceramic: 470 pf ±20%, 50 VDCW; sim to Erie 8111-050-W5R.
C606	5491674P36	Tantalum: 3.3 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
C607 and C608	19A116192P2	Ceramic: 470 pf ±20%, 50 VDCW; sim to Erie 8111-050-W5R.
		- - - - - - - JACKS AND RECEPTACLES - - - - - -
J601	19A116122P1	Terminal, feed-thru: sim to Warren Co 1-B-2994-4.
		- - - - - - - - - - PLUGS - - - - - - - - - -
P601	19A115834P4	Contact, electrical: sim to AMP 2-332070-9.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R601 and R602	3R152P104K	Composition: 0.10 megohm ±10%, 1/4 w.
R603	19A116093P1	Variable, carbon film: 7500 ohms ±20%, 0.20 w; sim to Centralab Series 3 Type 620-1.
R604	3R152P513J	Composition: 51,000 ohms ±5%, 1/4 w.
		- - - - - - - - - - PLUGS - - - - - - - - - -
P1	19B219051G1	Socket, crystal: 8 contacts.
		- - - - - - - - - - SWITCHES - - - - - - - - - -
S2	19B219053G2	Toggle: SPDT; sim to C and K Components 7103SDG.
		- - - - - - - - - - MISCELLANEOUS - - - - - - - - -
	5490135P3	Boot, moisture seal. (Used with S2).
	19B216926P4	Decorative cap. (Used with S2).
	19B216316P1	Insulator. (Used with J601).
	4035306P2	Flat washer. (Used with S2).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

PRODUCTION CHANGES

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

REV. A - Model 4EH20A10&11
To improve switch. Changes S2 and added washer.

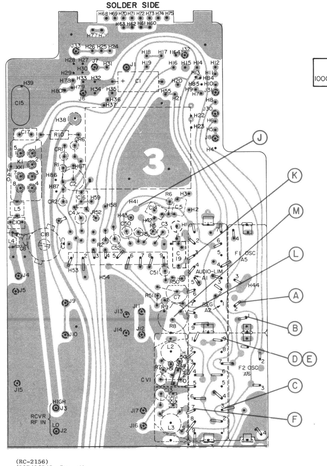
STEP-1 QUICK CHECKS

SYMPTOM	QUICKCHECK
No power output	1. Replace the PA module unit with Network 19B219084G1. Realign the transmitter and check for 200 millivatt output. 2. If the proper output is obtained, replace the PA module. 3. If no power output is obtained after performing Step 1, check the reading at TP1. If no reading is obtained at TP1, check readings at (Y), (K) and (B). If TP1 reading is correct, replace the Exciter module.
Low power output	1. Low battery voltage (refer to Battery Checks in operation section of the manual). 2. Check the transmitter alignment.
Distorted or no audio with normal RF output.	1. Check voltage readings at (J), (K), (L) and (M). 2. Improper setting of Mod Adjust R8. 3. Shorted C3 or C6 on Audio Board. 4. Bad microphone.
No reading at TP1	Check voltage readings at (A), (B), (D), (E) and (F).

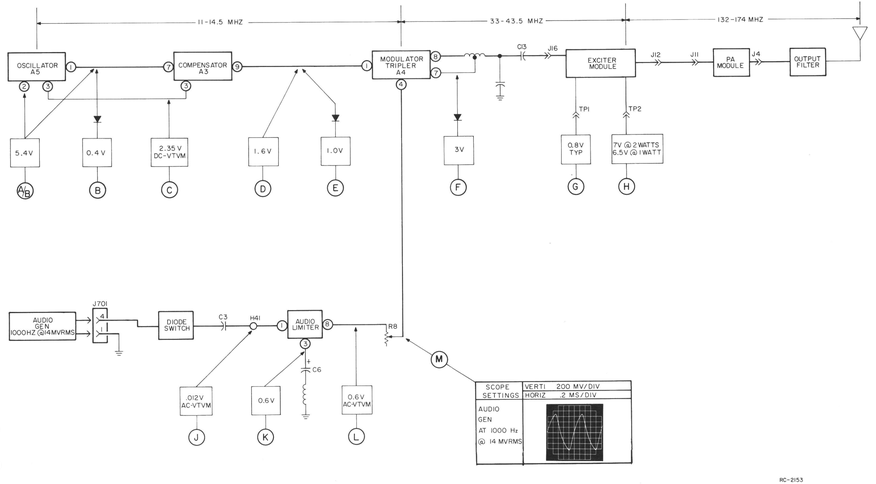
STEP 2 - TYPICAL VOLTAGE READINGS

DC READINGS MADE WITH GE TEST SET MODEL 4EX3A10 OR EQUIVALENT. READINGS SHOWN IN SERIES WITH A DIODE ARE RF READINGS TAKEN WITH RF PROBE 19C311750-G1 AND TEST SET MODEL 4EX3A10 ON 3 VOLT SCALE.

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

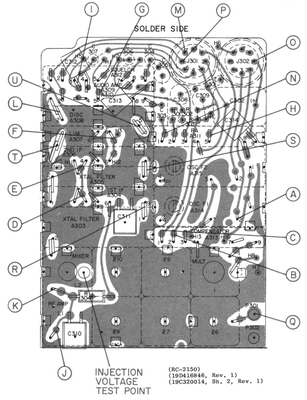


(RC-2156)
(19D416845, Rev. 3)
(19D416505, Sh. 2, Rev. 3)



TROUBLESHOOTING PROCEDURE

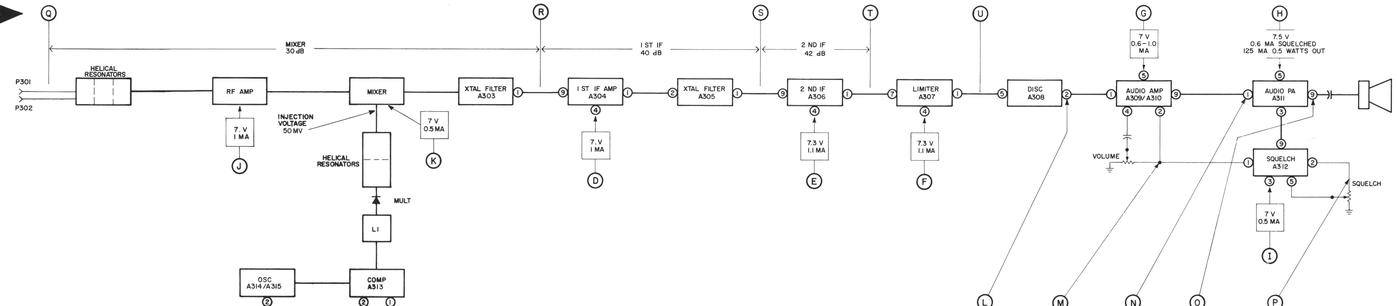
132—174 MHz TRANSMITTER
TYPE KT-19-A & KT-20-A



QUICK CHECKS

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

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



STEP 3 - RF GAIN CHECKS

EQUIPMENT REQUIRED:

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

PROCEDURE FOR MIXER & 1ST IF:

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

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

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

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

STEP 1 - MODULE CURRENT CHECKS

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

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

CAUTION

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

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

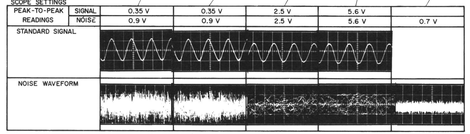
STEP 2 - AUDIO & SQUELCH WAVEFORMS

EQUIPMENT REQUIRED:

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

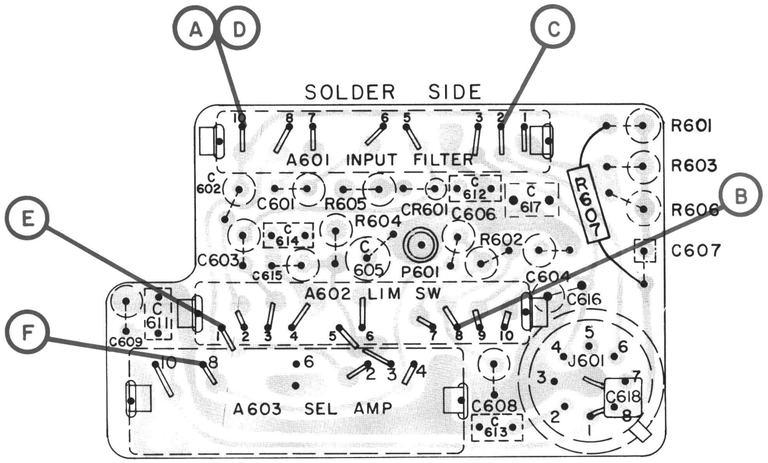
PRELIMINARY STEPS:

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



TROUBLESHOOTING PROCEDURE

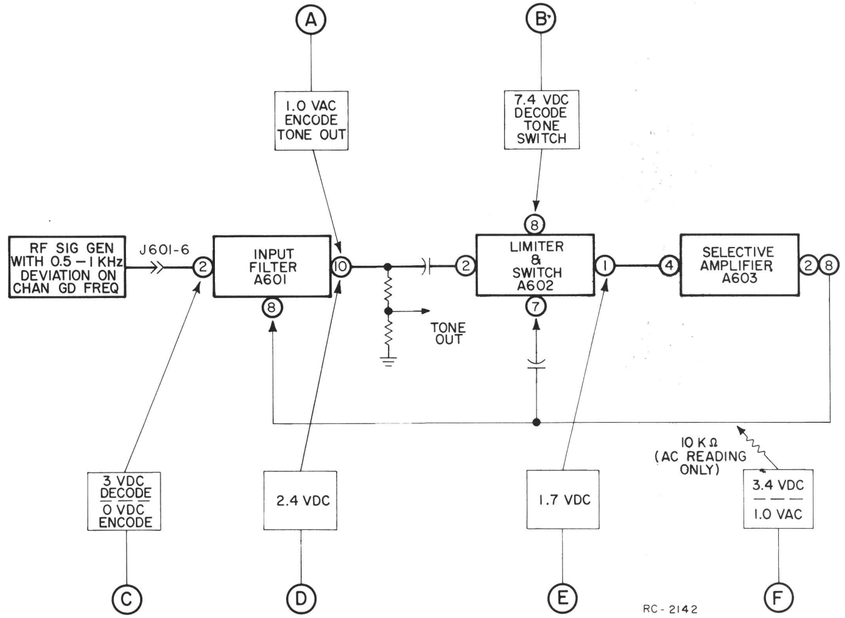
150.8—174 MHz RECEIVER
MODELS 4ER59B11 & B13



(RC-2142)
(19C317936, Rev. 4)
(19B216776, Sh. 2, Rev. 3)

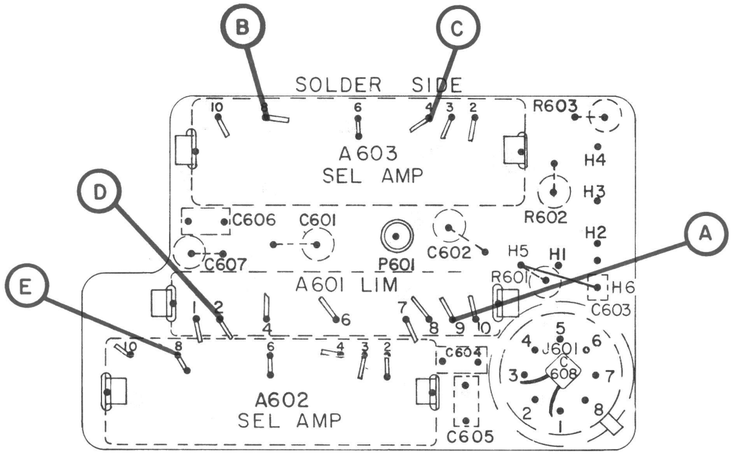
TROUBLESHOOTING

SYMPTOM	PROCEDURE
Unit won't decode	1. Place Channel Guard switch S2 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 2 or 8 on Selective Amplifier A603, or Pin 8 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).



TROUBLESHOOTING PROCEDURE

CHANNEL GUARD ENCODER/DECODER
MODEL 4EK17A11



(RC-2143)
(19C317931, Rev. 2)
(19B219044, Sh. 2, Rev. 0)

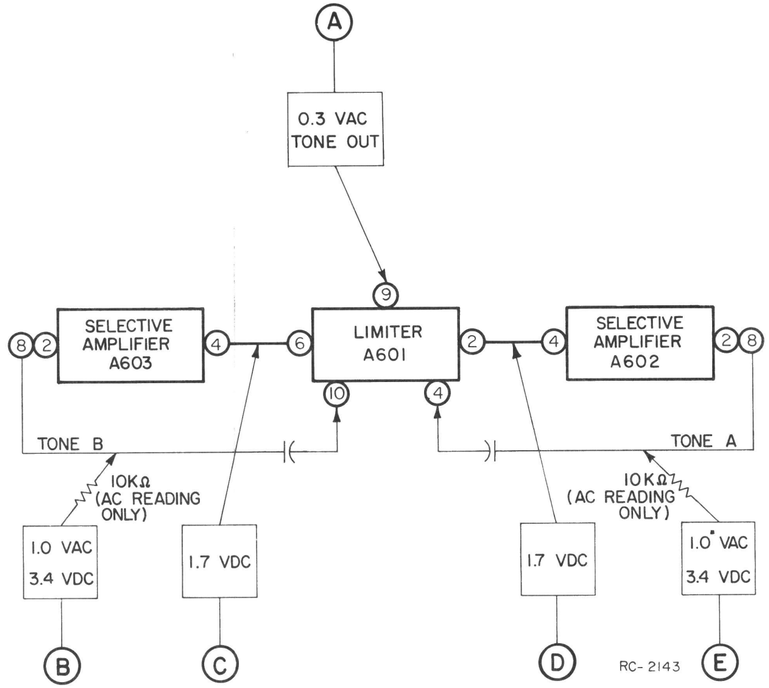
TROUBLESHOOTING

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

1. Place Channel Guard switch S2 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) .

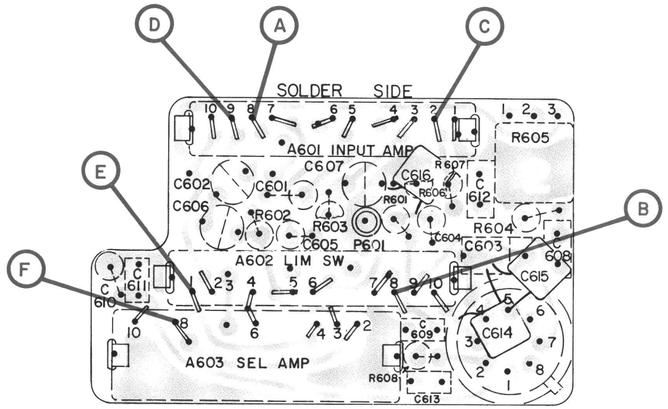
——CAUTION——

Do not ground Pins 2 or 8 on the selective amplifier modules. To do so will destroy the selective amplifier.



TROUBLESHOOTING PROCEDURE

CHANNEL GUARD ENCODER
MODELS 4EH21A10, 11

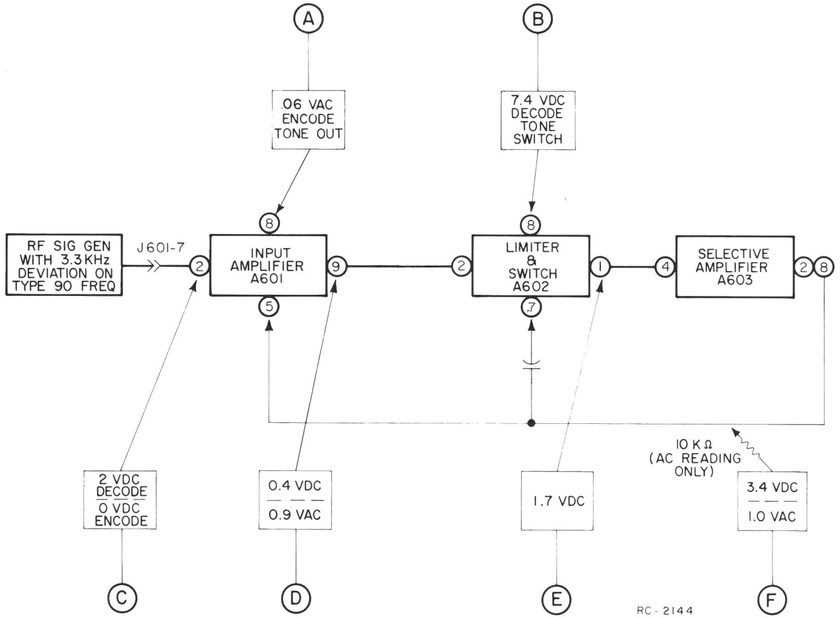


(RC-2144)
(19C317940, Rev. 1)
(19B219040, Sh. 2, Rev. 2)

TROUBLESHOOTING

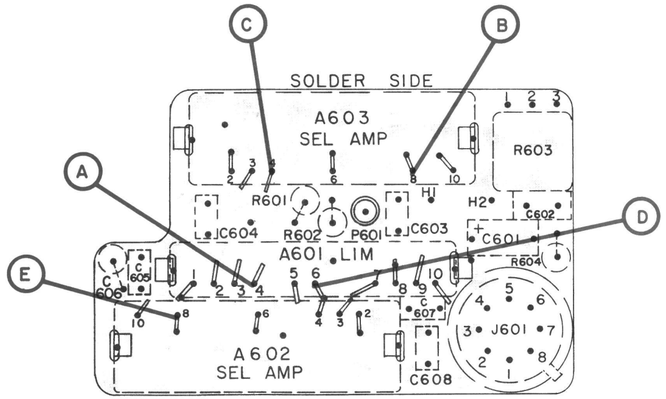
Always connect the board to ground (G11) when removed from the radio for troubleshooting.

SYMPTOM	PROCEDURE
Unit won't encode	1. Place Type 90 switch (S2) in the Monitor (encode) position, and check for .06 volts RMS at position (A). Next, key the transmitter and check for the reading at (A) 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 (C) through (F).
	- CAUTION - Do not ground Pins 2 or 8 on Selective Amplifier A603, or Pin 5 on input amplifier A601. To do so will destroy the Selective Amplifier module.
Unit won't decode	1. Place Type 90 switch S2 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 (B). Next, place the switch in the Reset and then the Normal position and check for zero volts at (B). 3. If the readings are not correct, isolate the defective module by checking readings (C) through (F).



TROUBLESHOOTING PROCEDURE

TYPE 90 ENCODER/DECODER
MODEL 4EK18A11



(RC-2145)
(19C317933, Rev. 0)
(19B219043, Sh. 2, Rev. 1)

TROUBLESHOOTING

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

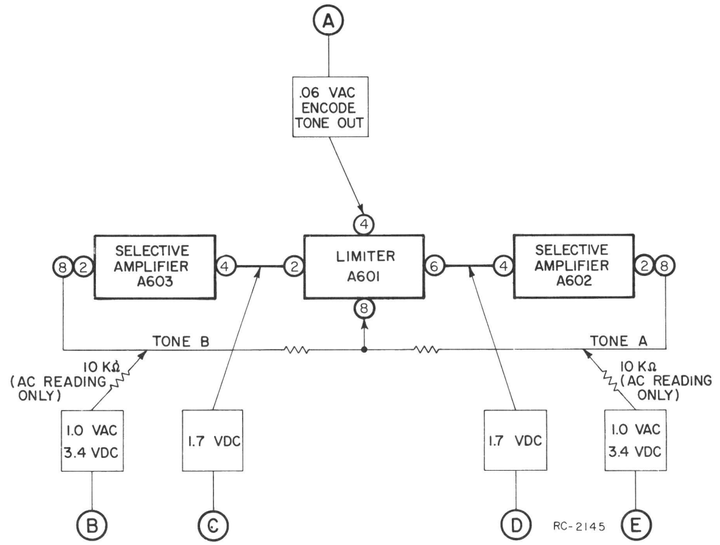
1. Place Type 90 switch S2 in the Tone "A" or "B" position and check for .06 volts RMS at position (A) . Next, key the transmitter and check for the reading at (A) to drop to zero in approximately one second (pulsed tone).

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 (B) through (E) .

- CAUTION -

Do not ground Pins 2 or 8 of Selective Amplifiers A602 and A603, or Pin 8 of limiter A601. To do so will destroy the Selective Amplifier.



TROUBLESHOOTING PROCEDURE

TYPE 90 ENCODER
MODELS 4EH20A10, 11

MULTI-FREQUENCY MODIFICATIONS

(19D416567-Sh. 1, Rev. 3 & Sh. 2, Rev. 2)

The multi-frequency modifications include instructions for adjusting the stop post on multi-frequency switch S1, for adding oscillator modules, for repeating frequencies, and repeating oscillator modules.

1- STOP POST ADJUSTMENT

CAUTION

Due to the small size of the stop posts, be very careful when making adjustments to avoid losing the stops.

1. Remove the multi-frequency switch as directed in the Disassembly Procedure (see Table of Contents).
2. Turn the shaft fully counterclockwise as viewed from the knob end.
3. Unscrew the panel seal to gain access to the stop post (see Figure 1).
4. Install the stop post in the appropriate hole as shown in the following chart.

STOP POST ADJUSTMENTS	
NO. OF FREQS	MOVE ADJUSTMENT STOP TO:
2	H2
3	H3
4	H4
5	H5
6	H6
7	H7
8	H8

5. Replace the panel seal with the side marked "Bottom" against surface "Z".
6. Re-install the Multifrequency Switch.

2- ADDING OSCILLATOR MODULES

1. After completing the stop post adjustment, connect the leads from multi-frequency switch S1 as shown in the following chart (see Figure 3 for connection points). Tape back all unused leads.

CONNECTION CHART			
FROM	TO	WIRE COLOR	S1 POSITION
S1-C1	H11 (solder)	BL	
S1-1	J31	W-BK	1
S1-2	J30	W-O	2
S1-3	J24	B	3
S1-4	J25	R	4
S1-5	J26	O	5
S1-6	J27	Y	6
S1-7	J28	G	7
S1-8	J29	BL	8

2. Place the oscillator module(s) in the proper holes (see Figure 3). Then bend over tabs on the can and solder to the adjacent pads (see Figure 2).
3. Bend the leads of the oscillator module as shown in Figure 2 (or appropriate Outline Diagram) and solder to the adjacent pads.
4. For two or more transmitter frequencies and one receiver frequency, remove the jumper from H7 to H10 and add a sleeved jumper (#26 AWG) from H7 to H13 on the Systems Board.
5. For two or more receiver frequencies and one transmitter frequency, remove the jumper from H8 to H10 and add a sleeved jumper (#26 AWG) from H20 and H21 on the Systems Board.

3- REPEATING FREQUENCIES

For repeating both transmitter and receiver frequencies without adding additional oscillator modules, add a sleeved jumper (#26 AWG) between the frequencies to be repeated. For example, if transmitter and receiver channels 1 and 5 are to be repeated, add the jumper from S1-1 to S1-5.

4- REPEATING OSCILLATOR MODULES

To repeat frequencies for the transmitter only or the receiver only, diodes can be used in place of oscillator modules.

1. Set the stop on S1 and install the oscillator modules whose frequencies are not to be repeated as directed in Section I and II.
2. Install the oscillator(s) whose frequencies are to be repeated as directed above except solder the Number 2 pin to the "E" pad instead of the "P" pad (see Figure 2).
3. For every channel that a frequency is being repeated, assemble a diode (5494922P1) in the space normally intended for the oscillator module by putting the annode lead in the Number 2 hole, bending it over and soldering to the "P" pad. The cathode lead will be terminated later.
4. For each different frequency that is repeated, an additional diode (5494922P1) is to be assembled in respective channel closest to the oscillator module being repeated. Assemble the diode in the Number 1 hole, annode lead down and sleeved, and connect to the associated "E" pad. Then run the jumper from this pad to the "P" pad of related oscillator module.

The cathode end of the diodes should be connected together using mid air connections. Make the connection and run the wire down the side of the diode along the component side of the board to the next diode, and so on until all the diode's cathodes are connected together. Route these wires to give the shortest connections. Now connect a lead to the cathode of the diode that is closest to the repeated oscillator module and run this lead down the side of the diode and through any empty hole or slot to the solder side of the board, and connect the lead to the "E" pad of the oscillator module. Next sleeve the diodes as shown in Figure 4.

Example: Channel 3 and 4 to be same as Channel 1.
Channel 5 and 6 to be same as Channel 2.

1. Assemble the oscillator module in Channels 1 and 2 as normal except connect the Number 2 lead to the "E" pad instead of "P" pad.
2. Assemble (1) diode in the Number 2 hole, anode lead down, in each of Channels 3, 4, 5, & 6 and solder to "P" pads.
3. Since two frequencies are being repeated, two additional diodes will be required, one in the Number 1 hole of Channel 3 and the other in the Number 1 hole of Channel 5. Sleeve, bend, and solder leads to the "E" pad. Connect jumper between the "E" pad of the Number 3 Channel and "P" pad of oscillator module Number 1. Connect a jumper between the "E" pad of Number 5 Channel and "P" pad of oscillator module Number 2.
4. Connect the top lead (cathode) of diodes (3) in Channel 3 and 4 to each other by soldering jumper wire to leads, dressing the wire down the side of the diodes and along the board. Connect a jumper from the top of diode in the Number 1 hole of Channel 3 to the "E" pad of oscillator module Number 1. Run the wire down through the board using any available hole or slot to the solder side. Connect the jumper from the diode in Channel Number 5 to oscillator module Number 2 in the same manner.

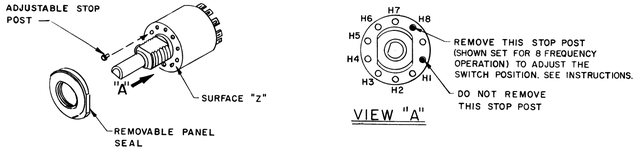


Figure 1 - Stop Post Adjustment

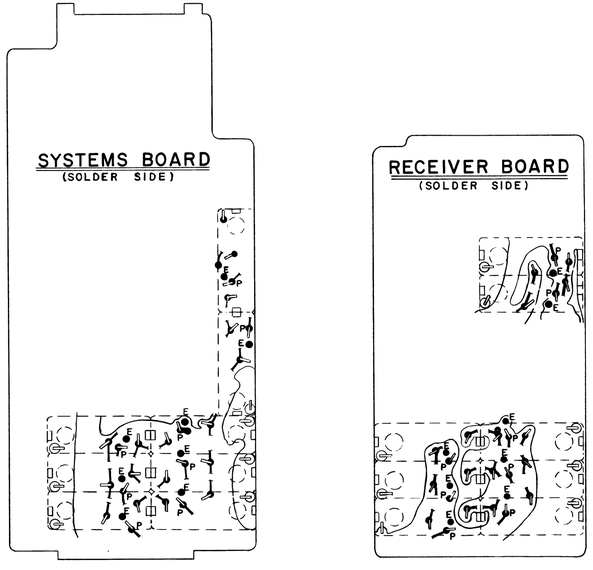


Figure 2 - Oscillator Module and Diode Installation

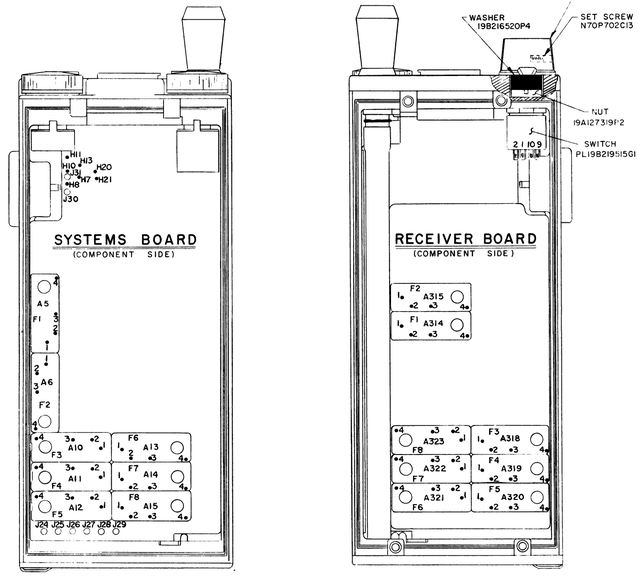


Figure 3 - Oscillator Mounting Positions & S1 Connection Points

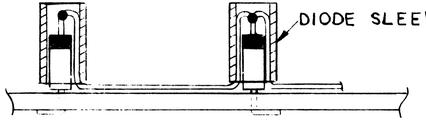
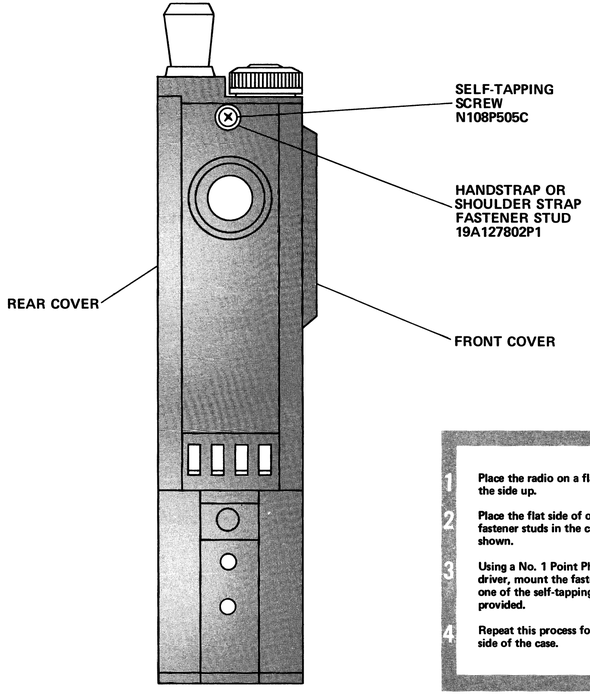


Figure 4 - Typical Diode Mounting

MOUNTING INSTRUCTIONS FOR HANDSTRAP AND SHOULDERSTRAP FASTENER KIT 19A127894G1



1. Place the radio on a flat surface with the side up.
2. Place the flat side of one of the fastener studs in the case recess as shown.
3. Using a No. 1 Point Phillips screwdriver, mount the fastener stud with one of the self-tapping screws provided.
4. Repeat this process for the other side of the case.

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

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MOBILE RADIO DEPARTMENT

GENERAL ELECTRIC COMPANY • LYNCHBURG, VIRGINIA 24502

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