LBI-4032B

MOBILE RADIO

MAINTENANCE MANUAL

148-174 MHz, 1-WATT

POCKET MATE

Personal

TWO-WAY FM RADIO

MODELS 4ES33A2-A5

LBI-4032B

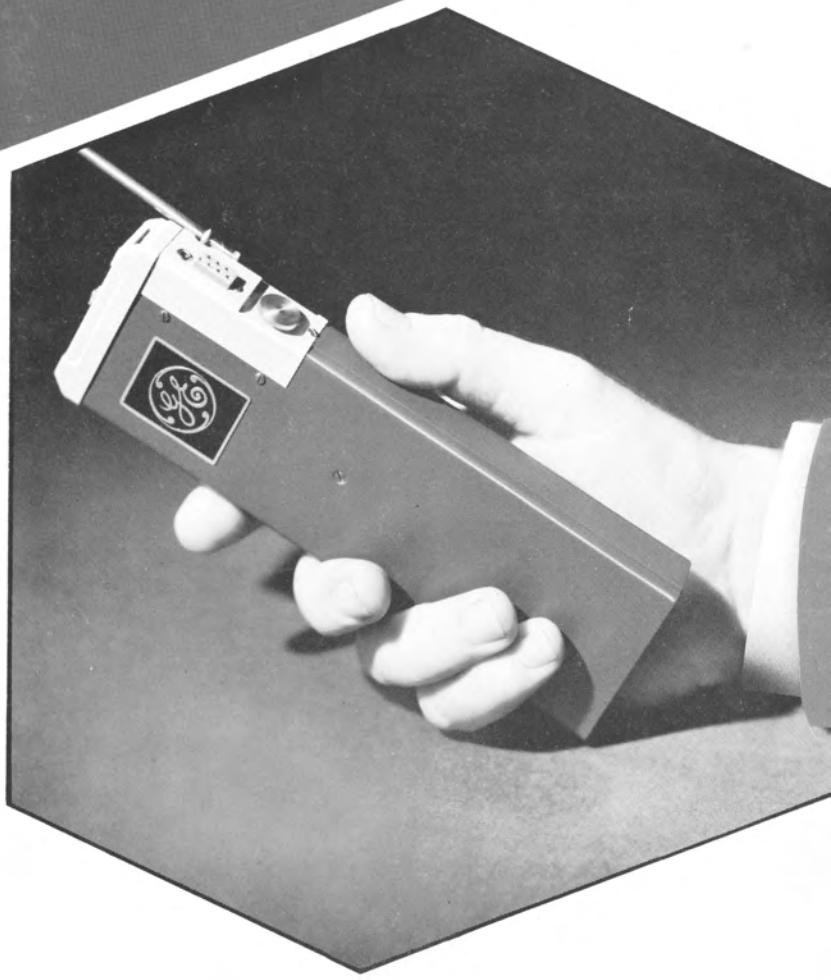


TABLE OF CONTENTS

ILLUSTRATIONS

SPECIFICATIONS *

GENERAL

FCC Filing Designation:	ES-33-A
Frequency Range:	148-174 MHz
Battery Drain	
Receiver Squelched	5 milliamps @ 14.5 VDC
Receiver Rated Audio	20 milliamps @ 14.5 VDC
Transmit	190 milliamps@ 13.5 VDC
Duty Cycle (EIA):	
Standby	80%
Receive	10%
Transmit	10%
Battery Life:	
Rechargeable Battery	One 8-hour day
Dry Battery	Five 8-hour days
Maximum Frequency Spacing:	0.4%

TRANSMITTER

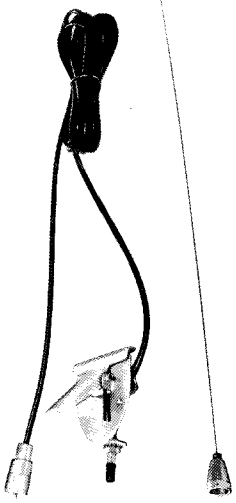
RF Power Output:	1 watt minimum at 13.5 VDC
Spurious and Harmonic Emission:	-45 dB
Modulation Deviation:	0 to ±5 kHz
Frequency Stability:	±0.0025% from -30° C to +60° C, +25° C Reference
Audio Response:	Per EIA
Transmitter Audio Compression:	Controlled compression range of 20 dB.

RECEIVER

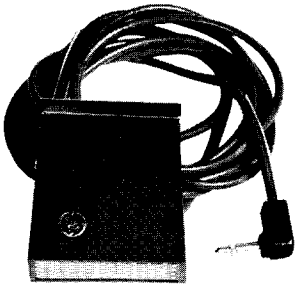
Channel Spacing:	30 kHz
Sensitivity:	
EIA 12-dB SINAD	0.30 μV
20-dB Quieting	0.40 μV
Noise Squelch	0.20 μV
Selectivity:	
EIA 2-Signal (30-kHz channels)	-70 dB
Frequency Stability:	±0.0025% from -30° C to +60° C, +25° C Reference
Modulation Acceptance:	±6 kHz
Spurious and Image Rejection:	-70 dB
Audio Response:	Within +2 and -8 dB of 6 dB/octave de-emphasis, 300 to 3000 Hz
Audio Output:	100 mW at less than 10% distortion

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

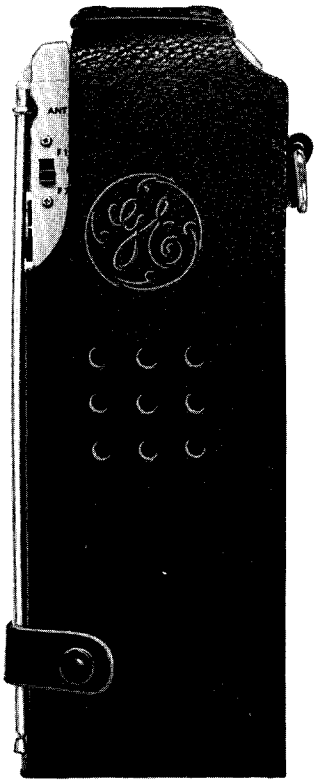
OPTIONS



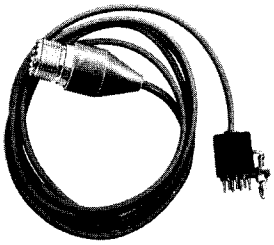
Gutter Mount Antenna
Option 5982
(Also requires Option 5995)



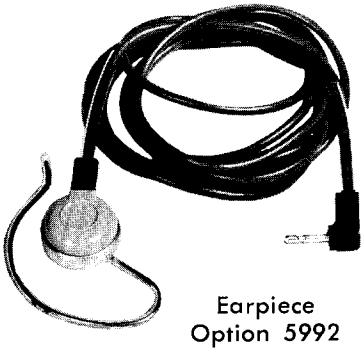
Lapel Speaker
Option 5994



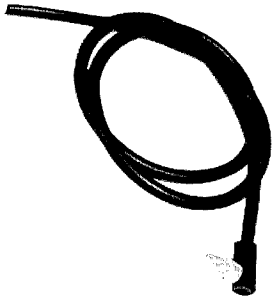
Leather Carrying Case
Option 5991
(Option 5980 with Tone)



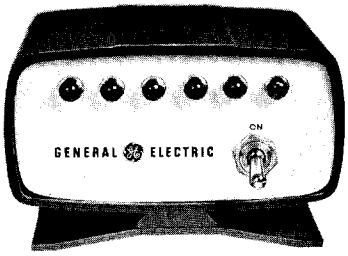
Antenna Connector
Option 5995



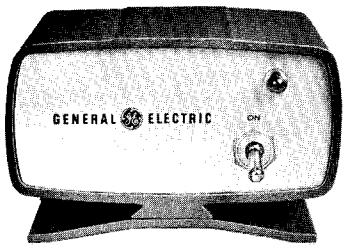
Earpiece
Option 5992



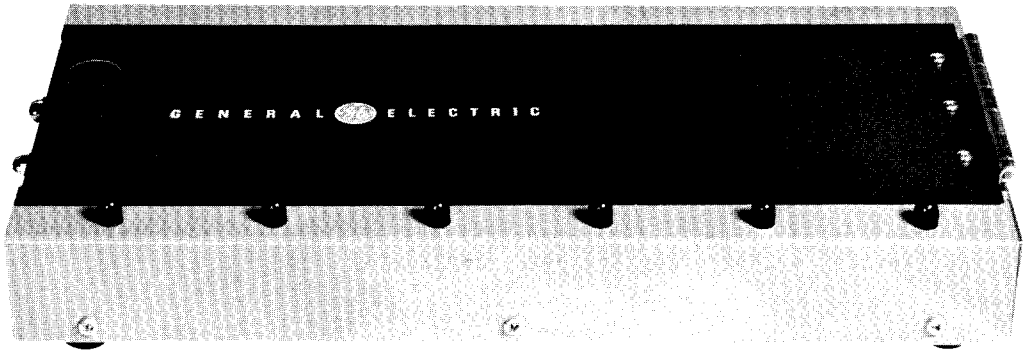
Flexible Wire Antenna
Option 5996



Six-Unit Charger
Option 5987



Single-Unit Charger
Option 5986



Battery Charging Rack
Option 5979

DESCRIPTION

The General Electric Pocket Mate Personal transmitter-receiver is a compact, high performance two-way FM radio designed for operation in the 148 to 174 megahertz range. The audio section of the transmitter contains a compressor circuit to assure proper operation over a wide range of voice input levels. In the receiver, maximum protection against interference is provided by a high IF crystal filter. Both the transmitter and receiver are transistorized for added reliability and low battery drain. Power for the radio is supplied by two rechargeable nickel-cadmium batteries or two easily-replaceable mercury batteries.

The Pocket Mate is housed in a one-piece, stainless steel case for maximum protection. All operating controls are conveniently located on the top side of the radio. The collapsible 18-inch antenna swings down along the side of the case for ease of carrying or for short range communications. When operating the radio with an external antenna, the collapsible antenna should be removed.

Auxiliary jacks are provided for an earphone, lapel speaker, external antenna, battery charger and other accessories.

OPERATION

Before operating the radio, check to see that the batteries have been correctly installed. When using the collapsible antenna, make sure that the antenna is in an upright, fully extended position for maximum range.

TO RECEIVE A MESSAGE

1. Turn the SQUELCH (SQCH) control so that the white dot is visible.
2. Turn the VOLUME-OFF control clockwise until a hissing sound is heard in the speaker.
3. Turn the SQUELCH control clockwise until the hissing sound just fades out.

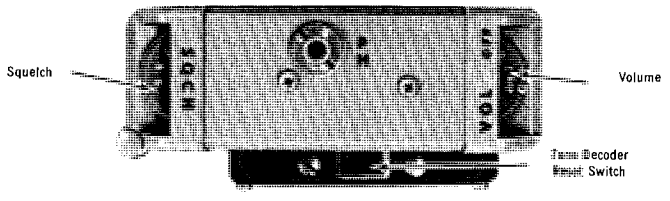


Figure 1 - Control Panel

4. In radios equipped with a Frequency Selector switch (F1-F2), select the proper frequency. You are now ready to receive messages from other radios in your system.

TO SEND A MESSAGE

1. Turn the radio on as described in TO RECEIVE A MESSAGE.
2. In two-frequency radio, select the proper frequency.
3. Holding the radio so that the antenna is vertical, press the Push-To-Talk button to put your transmitter on the air. Identify the unit you are calling and identify yourself. Release the Push-To-Talk button as soon as you stop talking so that you can receive an answer to your call. Your receiver will operate only with the button released. After you receive an answer, complete your message.

NOTE

The audio compressor circuit in the Pocket Mate maintains the proper voice level whether you hold the microphone an inch away from your mouth or an arm's length away. However, the closer you hold the microphone, the less background noise will be picked up. In noisy locations, therefore, hold the microphone about an inch away from your mouth. Always speak in a normal tone of voice.

To turn the radio off, turn the VOLUME-OFF control counterclockwise until it clicks.

FOR POCKET MATES WITH THE TONE DECODER OPTION:

- To disable the decoder, move the Reset Switch to the right (away from antenna). This enables you to hear all calls on your channel, and permits you to monitor the channel before sending a message. Always disable the decoder when sending and receiving messages, and when adjusting the VOLUME and SQUELCH controls.
- To activate the decoder, move the Reset Switch to the left (towards antenna). This keeps your receiver silent until your tone code is transmitted.

When the SQUELCH control is adjusted for critical squelch and the Reset switch in the left position, the decoder will automatically reset itself after each message received. If automatic resetting is not desired, leave the SQUELCH control in the off position (unsquelched). With the

radio unsquelched, the decoder must be reset after each message by slowly moving the Reset switch to the right position and then back to the left position.

OPERATING TIPS

The following conditions will tend to reduce the effective range of the Pocket Mate when sending and receiving messages, and should be avoided whenever possible.

1. Operating the unit in low areas of the terrain.
2. Standing under power lines or bridges.
3. Operating the unit inside of steel buildings, ships, or building constructed with steel frames.
4. 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, first check to see if the antenna is fully extended. Then hold the unit so that the antenna is vertical. If this doesn't help, move to a new location - preferably to a higher area containing less obstructions. This provides a clearer path for the radio waves to follow.

When poor reception is the result of extreme distance, the reception may be improved by turning the SQUELCH control to the left (counterclockwise). However, more noise may be heard.

ADJUSTMENT

TRANSMITTER & RECEIVER ALIGNMENT

The alignment of the transmitter and receiver is described in detail on the ALIGNMENT PROCEDURE Diagrams (see Table of Contents).

AUDIO BIAS ADJUSTMENT

Audio Bias Control R52, on the Audio-Squelch Module has been set at the factory and should not require adjustment unless an audio PA transistor (Q17 or Q18) is changed. If adjustment is required, use the following procedure.

1. Connect a 100-ohm load resistor across the PA output. (A convenient method for making the connection is shown on the Receiver ALIGNMENT PROCEDURE).
2. Connect an oscilloscope across the 100-ohm load resistor.
3. Apply a 1000 μV on-frequency signal, modulated with 1000 Hz at 3.3-kHz deviation, to the antenna jack.
4. Adjust Bias Control R52 for symmetrical limiting on the peaks of the audio sine wave. Set the VOLUME control at the threshold of compression.

MAXIMUM SQUELCH ADJUSTMENT

Maximum Squelch Adjustment R45, on the Audio-Squelch Module, has been set at the factory and will not require adjustment unless circuits of the Lo IF Amplifier are changed. In this case, use the following procedure.

1. Set R45 to maximum clockwise position.
2. Insert signal for 20 dB quieting.
3. Adjust SQUELCH Control R57 for maximum squelch.
4. Adjust R45 until squelch just opens.

MAINTENANCE

SERVICING THE UNIT

If the Pocket Mate should begin to operate improperly, the first thing to suspect is run-down batteries. If a new set of mercury batteries or freshly recharged nickel-cadmium batteries does not restore the radio to its normal operating condition, refer to the Troubleshooting Diagrams and other service procedures contained in this manual for help in isolating and correcting the problem.

BATTERY INFORMATION

The Pocket Mate can be operated with either of the following types of batteries:

Battery Type	GE Part Number	Equivalent
Rechargeable nickel-cadmium	19B201713-P2	
8-volt mercury	19A116083-P1	Mallory 317515-6

The radio should be placed into operation as soon as possible after receiving shipment. If the unit has to be stored for several months, remove the batteries and store them separately in a cool, dry place. Both the mercury and nickel-cadmium batteries may be stored for long periods without damage. However, nickel-cadmium batteries stored for over 30 days should be fully recharged before using.

When the radio is stored, the switches should be operated and the controls rotated every three months to keep contacts free from dust and corrosion.

Battery Checks

The Pocket Mate batteries may be checked in the following manner:

1. Load the battery with a 33 to 75 ohm (2-watt) resistor connected across its terminals.

2. Check with a voltmeter connected across the load resistor for a reading of at least 7 VDC.

To Change the Batteries (Fig. 2)

1. Press down on the bottom cover clip spring as shown in Fig. 2 and slide cover out.

2. Replace the batteries being careful to observe the proper battery polarity. The battery polarities are marked on the bottom cover.

3. After replacing the batteries, firmly press the bottom cover against the bottom of the chassis until the clip spring clicks.

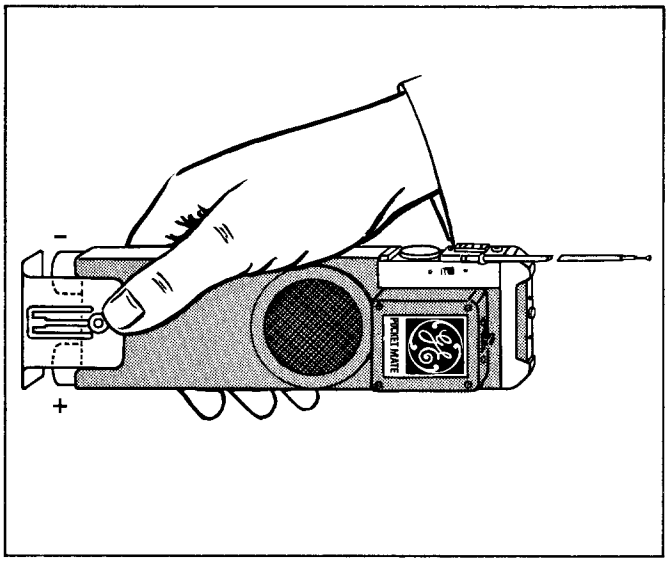


Figure 2 - Changing the Batteries

WARNING

Do not attempt to operate the Pocket Mate with one mercury battery and one nickel-cadmium battery installed; and do not dispose of either battery by burning. To do so may cause a battery to explode.

To Charge the Batteries

Use only the optional GE single-unit or 6-unit charger for recharging the nickel-cadmium batteries while in the radio. To use the unit chargers:

1. Turn the radio OFF. Then check the radio to see that nickel-cadmium batteries are properly installed.

2. Plug the charger power cable into a 117-volt AC source. Then insert the charging plug into the Option Jack located above the radio Push-To-Talk button.

3. Turn the charger ON. The charge light(s) will glow when the batteries are charging properly. Charge the batteries for 16 hours.

An optional battery holder rack is available for charging up to six pairs of nickel-cadmium batteries when they are removed from the Pocket Mate. The battery rack plugs into either of the unit chargers, and will charge the batteries in 16 hours.

WARNING

Do not attempt to recharge the mercury batteries. To do so may cause the batteries to explode.

DISASSEMBLY

Before starting the disassembly, turn the power OFF by turning the VOLUME-OFF switch counterclockwise until it clicks. Then refer to the Disassembly Diagram (Figure 3) and proceed with the following steps:

1. Remove the speaker retaining screws. Carefully lift out the speaker and disconnect the speaker leads. (In some early units, the retaining screws are located on the back, opposite the speaker).

2. Remove the four screws (two each side) near the edge of the Antenna Block.

3. Open the bottom cover and remove the screw shown.

4. Slide the chassis out of the case by pulling gently on the top cap. Then reconnect the speaker leads.

TROUBLESHOOTING THE UNIT

The Outline Diagrams in this book show the printed pattern side of the modules with components on the opposite side shown in phantom (dotted). This facilitates troubleshooting a module without its removal. Troubleshooting Diagrams are included at the back of this manual to aid in isolating and correcting problems.

REMOVAL OF MODULES

Do not attempt to remove a module until troubleshooting indicates that it is

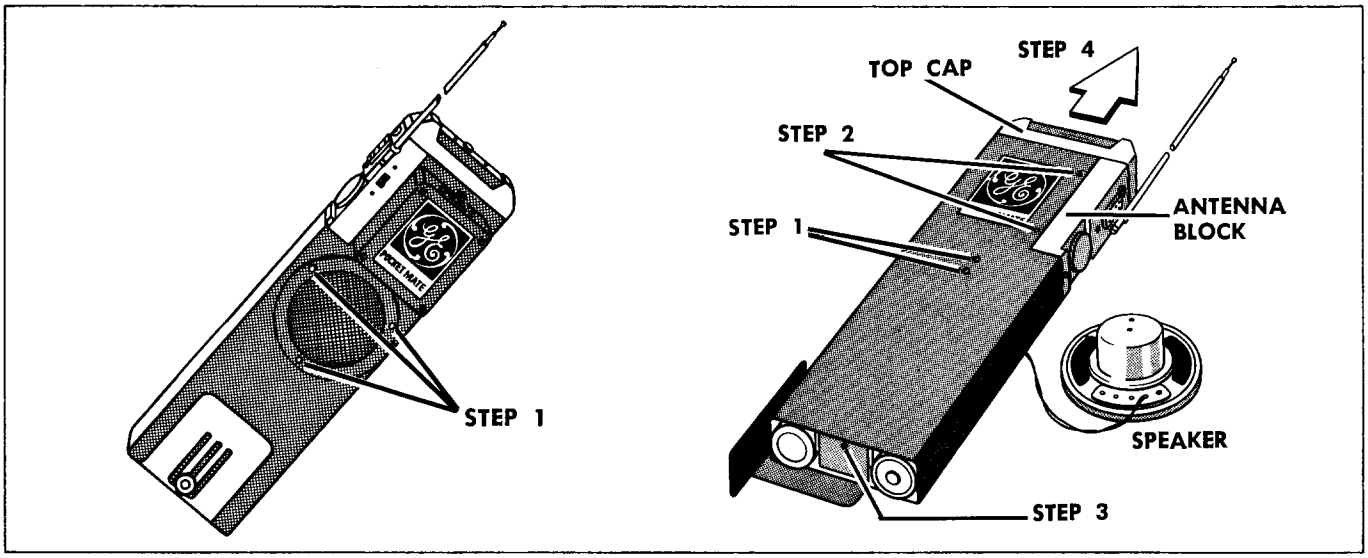


Figure 3 - Disassembly Diagram

defective. When a defective module is isolated, carefully remove it to allow repair or replacement. Suggestions pertaining to module removal follow.

Equipment Required

1. Pencil type Soldering Iron (40-60 watt rating) with fine and medium tips.
   a. Fine Tip - for removing components and wires from modules
   b. Med. Tip - for unsoldering ground straps and other connections to chassis.
2. Small metal pick or scribe.
3. Small screwdriver set.

Audio-Squelch A9

1. Remove the two screws holding the top cover.
2. Remove the knurled nut & washer from phone jack.
3. Grasp the top cover and while applying pressure toward the antenna side lift cover to clear the SQUELCH control.
4. Remove the four screws that secure the module board to the chassis.

Lo-IF Amp & Disc A5

1. Unsolder all wires connected to the printed pattern side of the module.
2. Remove the Audio-Squelch Module as indicated in the foregoing procedure.
3. Unsolder the ground straps (Where possible unsolder the straps at the chassis to avoid excess heat at the module).
4. Lift out the module and disconnect the remaining wires. (These should be unsoldered at the Audio-Squelch Module).

Other Modules

1. Unsolder all wires connected to the module.
2. Unsolder ground strap(s) or ground connections. Where possible, unsolder at the chassis to avoid excess heat at the module.

NOTE

The Power Amplifier and Filter "B" should be removed as one module.

REPLACING THE TRANSMITTER AND RECEIVER OSCILLATOR CRYSTALS

Improper bending of the transmitter and receiver oscillator crystal leads can cause damage in the crystal which may result in frequency drift. It is recommended that the crystal leads be clipped and the connections between the crystal and module be made using additional wire as follows:

1. Clip crystal leads to a length of approximately 1/4 inch. To avoid shock damage to crystal when cutting a lead, grasp the lead below where cut is to be made with a pair of long nose pliers.
2. Using a heat sink (approximately 1/8 inch wide) connect it as close as possible to the crystal.
3. Crimp a piece of sleeved #26 copper wire around each crystal lead (at the top of the heat sink) and solder the connections. Clip off excess lead.
4. Solder the other end of the wires to the module.

CIRCUIT ANALYSIS

TRANSMITTER

The Pocket Mate transmitter is a crystal-controlled, frequency modulated transmitter with a minimum RF output of one watt. The crystals used have a range of 18.5 to 21.75 megahertz, and the crystal frequency is multiplied eight times. The transmitter consists of four modules.

- Audio
- Oscillator-Multiplier
- Power Amplifier (includes Output Filter B)
- Output Filter A (part of Antenna Block)

References to symbol numbers mentioned in the following text are found on the Schematic Diagram, Outline Diagram and Parts List (see Table of Contents). A block diagram of the transmitter is shown in Figure 4.

AUDIO MODULE

Audio from the speaker-microphone is amplified by audio amplifiers Q1-Q5 and connected through MOD ADJUST R18 to the Oscillator-Multiplier. Output to the oscillator-multiplier is automatically controlled by a compressor circuit consisting of Q6, CR2, CR3 and Q7. Approximately 6-dB audio preemphasis is provided by the speaker-microphone in conjunction with C2 and R2.

Resistor R1 and the AC impedance of Q7 act as a voltage divider for the AC input signal (microphone input) to Q1. When the input to the compressor circuit increases, the forward bias on the base of Q7 increases and Q7 conducts more. This reduces the AC impedance of Q7 which decreases the audio voltage to amplifier Q1, keeping the amplifier output constant. When the input to the compressor circuit decreases, Q7 conducts less. This raises the AC impedance of Q7 and increases the audio voltage to Q1, keeping the amplifier output constant.

An optional audio module (Option 5976) is available which does not contain the compressor circuit. In this case, fixed resistor R24 (750 ohms) and R1 form a voltage divider network in the amplifier input.

OSCILLATOR-MULTIPLIER MODULE

The output of the Audio Module is applied to the Oscillator-Modulator through C24.

Transistor Q10 operates in a Colpitts oscillator circuit with feedback developed across C22. A regulated 7-volt supply for the oscillator and modulator varactor CR15 is derived from the 14.5-volt supply by zener diode CR11. Adjusting T5 in series with the varactor changes the series resonance of the crystal circuit for rubbering the oscillator frequency. Drive control potentiometer R22 controls the oscillator gain.

In two-frequency transmitters, a second oscillator stage identical to the F1 oscillator stage is added. The proper frequency is selected by grounding the emitter of the desired oscillator by means of frequency selector switch S2 mounted on the Antenna Block.

Audio from MOD ADJUST R18 varies the capacitance of varactor CR15 at an audio rate. As CR15 is in series with the crystal, the variations frequency-modulate the crystal frequency. The oscillator tank (T7) is tuned to twice the crystal frequency.

Following the oscillator-multiplier, the RF signal undergoes two stages of multiplication by two class C doubler stages (Q12 and Q13). The collector tank of Q12

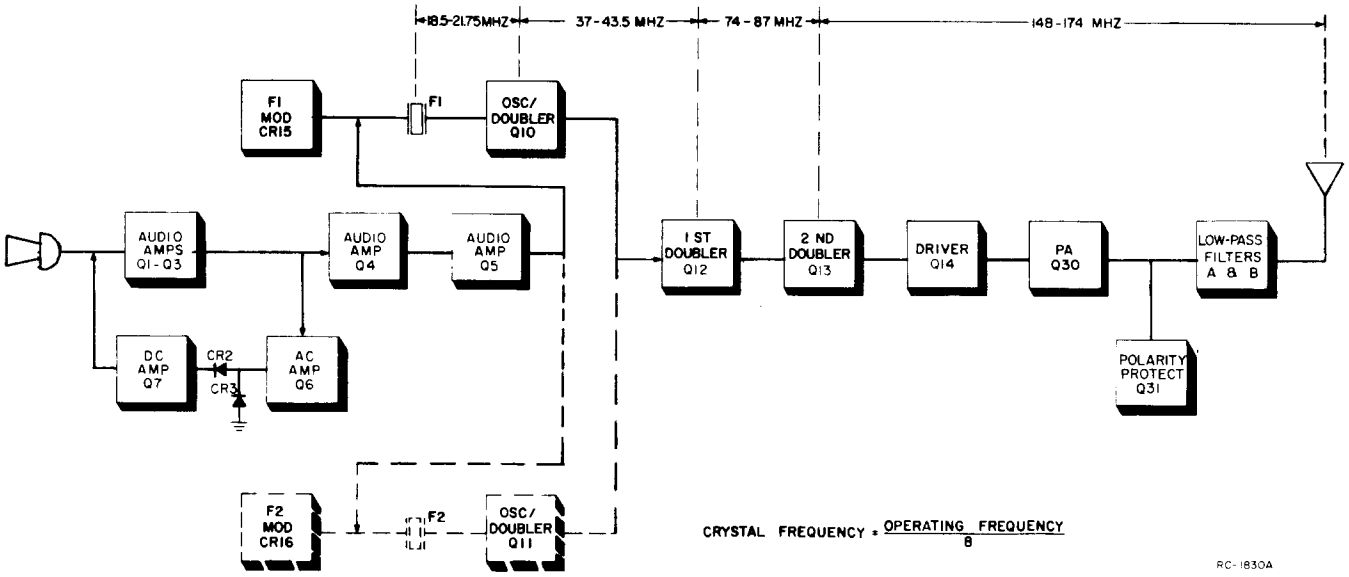


Figure 4 - Transmitter Block Diagram

is tuned to four times the crystal frequency, and the collector tank of Q13 is tuned to eight times the crystal frequency.

Driver Q14 amplifies the second doubler output with the driver tank (T10) tuned to the operating frequency.

POWER AMPLIFIER

Transistor Q30 operates as a class C power amplifier. The output of PA tank L10 is coupled through DC blocking capacitor C54 and applied to two low-pass output filters (Filter B and Filter A) to attenuate any harmonics. The output of Filter A connects through relay K1 (on the Antenna Block) to the antenna.

Transistor Q31 provides reverse voltage protection for the transmitter. Keying the transmitter energizes relay K1 which switches the antenna to the transmitter output and applies the battery voltage to the emitter of Q31. A positive voltage causes Q31 to conduct, and the collector voltage supplies the PA stage while the base voltage supplies the Audio and Oscillator-Multiplier stages. A negative voltage applied to the emitter of Q31 will not turn the transistor on, so no voltage will be supplied to the transmitter stages.

RECEIVER

The Pocket Mate receiver is a double-conversion, superheterodyne receiver for operation on fixed frequencies in the 148 to 174 megahertz range. The complete receiver consists of four modules. The modules include:

- RF oscillator
- Hi IF Crystal Filter
- Lo IF Amplifier and Discriminator
- Audio-Squelch

References to symbol numbers mentioned in the text are found on the Schematic Diagram, Outline Diagram and Parts List (see Table of Contents). A block diagram of the receiver is shown in Figure 5.

RF OSCILLATOR MODULE

RF from the antenna and Positive DC voltage from the battery are applied to the receiver input. The DC volts are coupled through L1 to the anode of voltage protection diode CR1, causing it to conduct. When CR1 is conducting, voltage is connected to the RF Oscillator, Lo IF & Discriminator and Audio-Squelch Modules. Applying a negative voltage to CR1 will not cause it to conduct. This protects the receiver stages against a supply voltage of the wrong polarity.

The RF signal is coupled through DC blocking capacitor C2 and a tuned circuit (L2) to the base of RF amplifier Q2. The output of Q2 is coupled through two tuned circuits to the base of first mixer Q3.

The 1st oscillator used a mode crystal so that the fifth mode is in the 68.6 to 81.6 megahertz region. Feedback for oscillator Q5 is developed across C14. The oscillator will have no output unless oscillator tank coil L10 is tuned to the fifth mode frequency.

In two frequency receivers, a second oscillator stage identical to the F1 oscillator stage is added. The proper frequency is selected by grounding the base of the

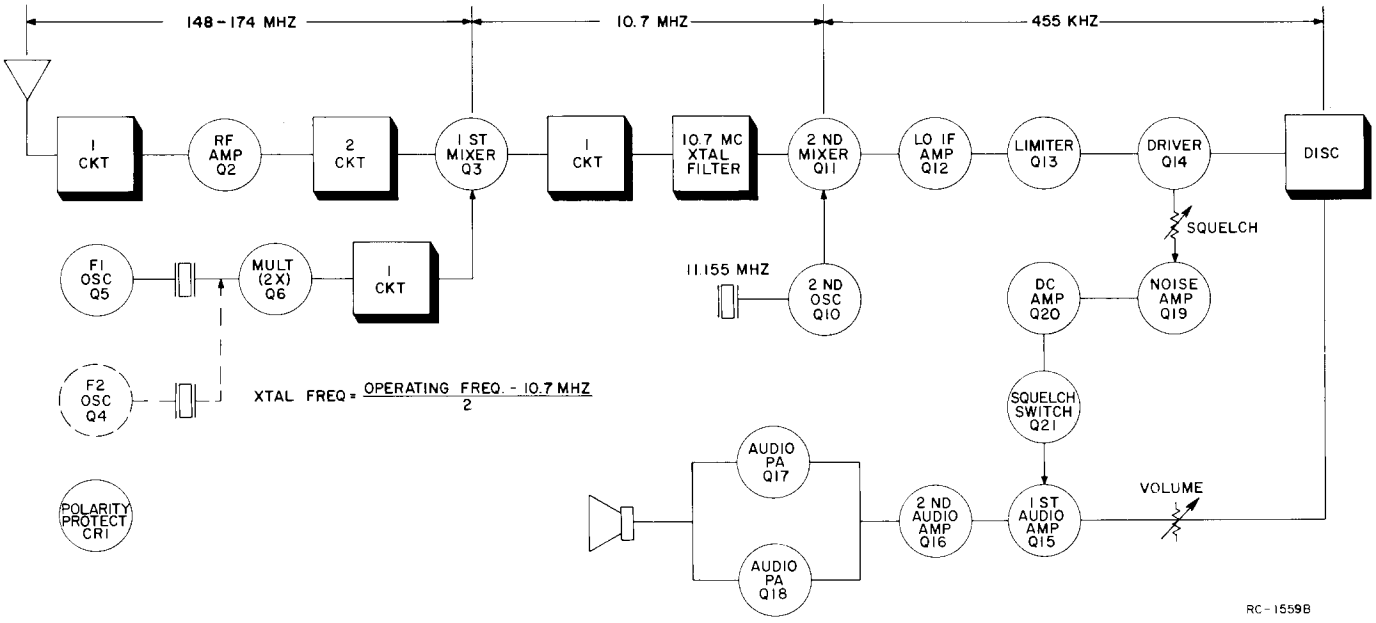


Figure 5 - Receiver Block Diagram

desired oscillator by means of frequency selector switch S2 on the Antenna Block.

The oscillator is followed by doubler Q6, with the output tank tuned to resonance in the 137 to 163 megahertz range. The doubler output is applied to the emitter of 1st mixer Q3 where it is mixed with the RF amplifier output to provide the 10.7-megahertz high IF frequency.

A 6-crystal, 10.7 megahertz filter follows the 1st mixer. This highly-selective filter provides more than -70 dB selectivity for the receiver (EIA two-signal method with 30-kHz channels).

LOW IF AMPLIFIER & DISCRIMINATOR MODULE

A tuned circuit L15 and C31 provides impedance-matching for the output of the crystal filter to the base of 2nd mixer Q11.

The 11.155-megahertz 2nd oscillator injection frequency from Q10 is mixed with the 10.7 megahertz high IF frequency at 2nd mixer Q11 to provide the 455-kHz low IF frequency. The mixer output is amplified by Q12, and fed to a limiter (Q13) and driver stage (Q14).

The driver output connects to a tap on discriminator transformer T3. Diodes CR4 and CR5 rectify the 455-kHz signal to recover the audio. The discriminator output is fed to the Audio-Squelch Module.

AUDIO-SQUELCH MODULE

Audio in the incoming signal connects through VOLUME control R50 to the two class B audio amplifiers (Q15 and Q16). The volume control determines the gain of the amplifiers by varying the bias to the base of Q15. The output of Q16 is DC-coupled to a complementary push-pull audio PA stage (Q17 and Q18). The PA output is applied through C65 to the speaker-microphone.

Noise from the emitter of driver Q14 operates the squelch circuit. A filter consisting of C44, R34 and C48 removes any audio from the noise output. Noise is coupled through SQUELCH control R57 to the class B noise amplifiers (Q19 and Q20). The SQUELCH control determines the gain of the amplifiers by controlling the bias to the base of Q19. The amplified noise signal from the emitter of Q20 turns on squelch switch Q21, and its emitter voltage drops to ground potential. This ground is applied to the DC connected audio amplifier stages, switching them off and squelching the receiver. With the receiver squelched and the audio stages cut off, the receiver drain is only 5 milliamps.

When the receiver is quieted by an input signal, there is no output from the noise amplifiers and squelch switch Q21 does not turn on. The positive supply voltage turns on the audio amplifier stages and sound is heard at the speaker-microphone. A feedback loop consisting of C60, C63, R48 and R49 provides improved frequency response.

DECODER OPTION

Selective Calling Option 5989 is a transistorized sequential tone decoder for operation with any encoder providing two-tone sequential signaling. This includes the GE Encoders (100-, 400-, and 900-call), and Dial Page Terminals. Tone frequencies range from 517.5 Hz to 967.5 Hz.

The decoder mounts in an option housing on the side of the Pocket Mate, above the speaker-microphone. Supply voltage, ground and input connections are made to the Lo IF Amp & Disc Module (A5). The decoder output is connected through the Reset switch to the Audio-Squelch Module (A9). These connections are shown on the Outline Diagrams.

Tone from the receiver audio circuit is applied to direct-coupled amplifiers Q1 and Q2 on the decoder board. The first tone of the two-tone sequential call is applied to FL1-P. If the tone is at the resonant frequency of FL1, a tone voltage is applied to the base of Q3. The positive half cycles of the tone cause Q3 to conduct, which partially discharges capacitor C4 through R9. R8 and R9 prevent C4 from recharging until the tone cycle is completed.

If the second tone is at the resonant frequency of FL2, a tone voltage is applied to the base of Q4. The negative half cycles of the tone voltage turn on PNP transistor Q4. With Q4 conducting, C5 discharges which turns on Q5.

Q5 and Q6 are connected as a bistable multivibrator (flip-flop), and turning on Q5 turns off Q6. The collector of Q6 is connected through Reset Switch S1 to the supply voltage path of the receiver audio stages (junction of R46, R61 and C71 on the audio-squelch board). When Q6 conducts, its collector drops to ground potential. This removes the supply voltage to the receiver audio stages, keeping the stages turned off. When the proper tone sequence switches the flip-flop (turns Q5 on and Q6 off), the supply voltage is re-applied to the receiver audio stages and sound is heard at the speaker.

Moving the Reset switch (see Figure 1) to the left position (toward the antenna) activates the decoder circuit so that no sound will be heard at the speaker until the proper tone code is applied to the decoder. Moving the Reset switch to the right (away from the antenna) disables the decoder circuit so that all calls on the channel can be heard. The decoder circuit should be disabled before sending a message so that the channel can be monitored. The circuit should also be disabled when sending and receiving messages.

When the SQUELCH control is adjusted for critical squelch and the Reset switch in the left position, the decoder will automatically reset itself after each message received. If automatic resetting is not desired, leave the SQUELCH control in the off position (unsquelched). With the radio unsquelched, the decoder must be reset after each message by slowly moving the Reset switch to the right position and then back to the left position.

CHANNEL GUARD ENCODER

Channel Guard Encoder Option 5990 consists of a transistorized tone encoder that is contained in an option housing mounted on the side of the Pocket Mate. The encoder tones are generated by a tone oscillator -- no electromechanical devices are used. The tone frequencies range from 71.9 Hz to 203.5 Hz. Connections for supply voltage, ground and tone output are made to the transmitter oscillator-multiplier Module (A2/A3). Refer to the oscillator-multiplier Outline Diagram.

Keying the transmitter applies 14.5 volts to the 10-volt regulator (Q1, Q2 and Q3). The regulator output is taken from the collector of Q1, and provides a closely-controlled supply voltage for the tone oscillator. Zener diode CR1 provides a reference voltage for the regulator.

The tone oscillator (Q4 and Q5) is a free-running (astable) multivibrator that operates as long as supply voltage is applied. The oscillator frequency range is determined by the R-C time constant of R11-C3 and R12-C4.

Potentiometer R9 is provided for setting the oscillator on frequency. A frequency counter may be connected to the yellow test lead in the encoder wiring harness, and R9 adjusted for the tone frequency (+0.1 Hz). Access to the test lead is obtained by removing the speaker.

The tone oscillator square-wave output is applied to emitter-follower Q6, and then to the base of Q7. Q7 and Q8 (and associated circuitry) convert the tone oscillator square-wave output to a sine wave. R18, R19, R21 and R22 are selected for waveshaping at the different frequencies. The tone output is coupled from the emitter of Q8 through R24 to the transmitter modulation input (junction of R21, R23 and C24 on the oscillator-multiplier board). The value of R24 is selected at the factory to provide 0.75 kHz tone deviation.

BATTERY CHARGERS

Two optional battery chargers and an optional battery charging rack are available for fully recharging the Pocket Mate's nickel-cadmium batteries within 16 hours from a 117-volt AC source. The single-unit charger (Option 5986) and the 6-unit charger (Option 5987) are used to recharge the batteries while they are in the Pocket Mate.The battery charging rack (Option 5979) plugs into either charger for recharging up to six pairs of additional batteries while the Pocket Mate(s) are being recharged. Operating instructions for the chargers are contained in the Battery Information section or listed in the Table of Contents.

WARNING

Do not attempt to charge mercury batteries. To do so may cause them to explode.

References to symbol numbers mentioned in the following text are found on the applicable Schematic Diagram, Outline Diagram or Parts List (see Table of Contents).

UNIT CHARGERS

Both the single-unit and 6-unit chargers are full-wave chargers designed to provide a 20 milliamp charging circuit for the rechargeable batteries. Turning switch S1 to the ON position applies power to the charger. The 117 volts is stepped down by transformer T1 and rectified by diodes CR1 and CR2. In single-unit chargers, the rectified output is coupled through indicator light I1 and current-shunting resistor R1 to the charging cable. The 7-pin plug on the charging cable connects to the option jack on the Pocket Mate. The indicator light glows when the batteries are charging properly.

The 6-unit charger uses the same transformer and rectifiers, and has six charging circuits that are identical to the charging circuit in the single unit charger.

CAUTION

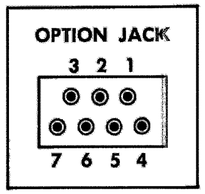
Do not connect either unit charger to the Pocket Mate unless batteries have been installed. To do so may damage the radio.

BATTERY CHARGING RACK

The battery charging rack will recharge from one to six pairs of nickel-cadmium batteries when power is supplied by either of the unit chargers.

Connecting plug P1 to charging jack J1 on the unit charger applies the rectified charger output to the six charging circuits. Each circuit consists of an indicator light (I1 through I6) and a current-shunting resistor (R1 through R6).

Placing a pair of batteries into the charger completes the charging circuit, causing the indicator lights to glow. This shows that the batteries are charging properly. However, the indicator lights will become dimmer as the battery charge increases.



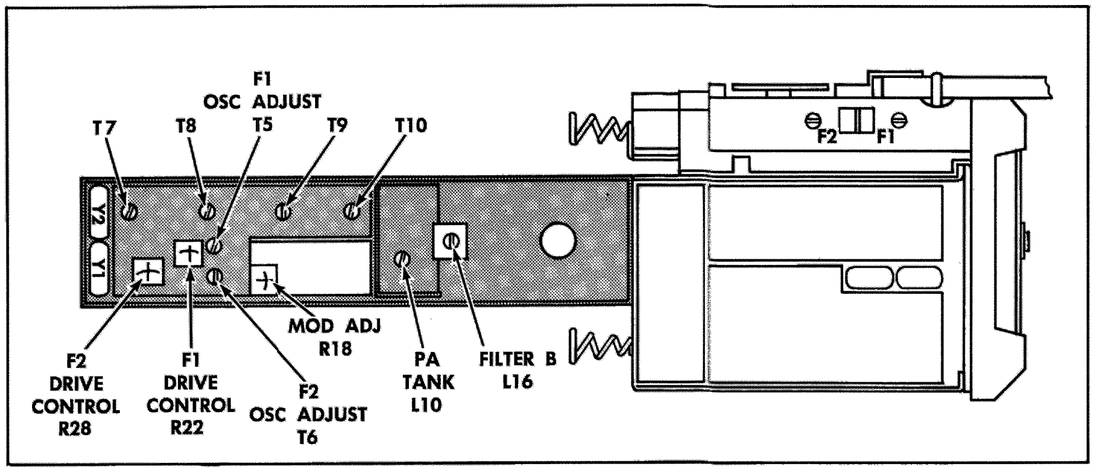
MODULATION LEVEL ADJUSTMENT

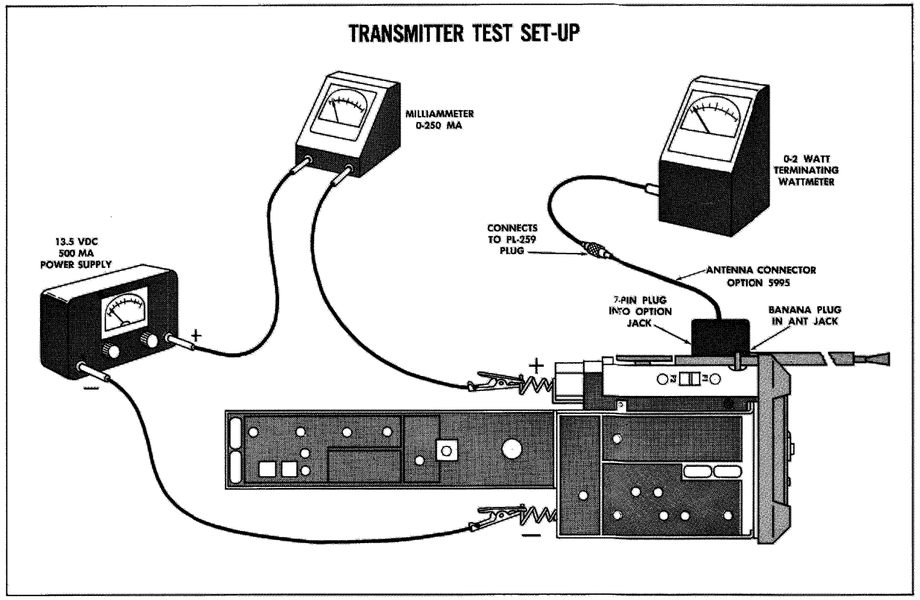
EQUIPMENT REQUIRED

1. Audio signal generator (Model 4EX6A10 or equivalent).
2. Frequency modulation monitor.
3. Adaptor Cable (Option 5995) connected to wattmeter and power supply connected to radio as shown in Test Setup.

PROCEDURE

1. Loosely couple the Pocket Mate output to the deviation monitor using 6 to 8 turns of wire around the connector on the Adaptor Cable option. Adjust the monitor to the channel frequency.
2. Remove the top cap on the 7-pin option plug and apply a 30-millivolt, 1000-Hz signal to pin 1 (audio high) and pin 7 (ground).
3. Key the transmitter and set MOD ADJUST R18 for a 4.5 kilohertz swing with the deviation polarity which gives the highest reading as indicated on the frequency modulation monitor.
4. For multi-frequency transmitters, set the deviation as described in step 3 on the channel producing the largest amount of deviation.





TRANSMITTER ALIGNMENT

EQUIPMENT REQUIRED

1. 13.5-volt DC, 500-milliamp power supply
2. Terminating wattmeter (0 to 2 watts)
3. Milliamp meter (0—300 mA)
4. RF Frequency meter.
5. Antenna connector, Option 5995 - mates with PL-259 coax plug

PRELIMINARY STEPS

1. Remove the chassis from the case as shown in the Disassembly Procedure. Replace the four screws in the Antenna Block and tighten securely. Then place the shielded side of the chassis on a metallic surface (ground).
2. Connect the test equipment as shown in the Setup Procedure.
3. Adjust the power supply for 13.5-volts DC.
4. Turn the radio on. In two-frequency units, set the Frequency Selector switch in the F1 position.
5. Pre-set R22 (and R28 in two-frequency units) to the mid-range position.

NOTE

All adjustments are made with the transmitter keyed.. To protect the transistors, do not key the transmitter over 10 seconds during each adjustment until the alignment is complete.

ALIGNMENT PROCEDURE

STEP	TUNING CONTROL	METER READING	PROCEDURE
1.	T7, T8, T9 and T10	Maximum mA	Adjust T7, T8, T9 and T10 for maximum milliammeter reading.
2.	F1 DRIVE (R22)	100 mA	Adjust F1 Drive for a reading of 100 milliamps.
3.		See Procedure	Repeat Steps 1 and 2.
4.	L10 (PA Tank)	Minimum mA	Adjust L10 for minimum milliammeter reading.
5.	L16 (Filter B)	Maximum	Adjust L16 for maximum milliammeter and wattmeter readings.
6.		See Procedure	Repeat Steps 4 and 5.
7.	T7, T8, T9, T10 and L16	Maximum	Adjust T7, T8, T9, T10 and L16 for maximum wattmeter reading.
8.	F1 DRIVE (R22)	190 mA	Adjust F1 Drive for a reading of 190 milliamps
9.		See Procedure	Repeat Steps 4 and 5. Power output should be a minimum of 1-watt at 190 milliamps or less.
10.	F2 DRIVE (R28)	190 mA	Move the Frequency Selector switch to the F2 position. Adjust F2 Drive for 190 milliamps.
	FREQUENCY ADJUSTMENT		
11.	T5 (and T6 in 2-freq. units)	See Procedure	Move the frequency selector switch to the F1 position. Loosely couple the frequency counter to the transmitter output and adjust T5 for the proper output. For two-frequency units, switch to F2 and adjust T6 for the proper output.

FRONT END ALIGNMENT

This procedure is used for setting the receiver on frequency, and for changing frequency or crystals.

EQUIPMENT REQUIRED

1. 14.5-volt DC, 50 milliamp power supply
2. RF signal generator with 6 dB pad
3. RF frequency meter
4. Antenna connector (Option 5995)
5. Earphone cable (5495088-P10)
6. 20,000 ohm-per-volt meter with 0-3 volt scale.
7. AC-VTVM

PRELIMINARY STEPS

1. Remove the chassis from the case as shown in the Disassembly Procedure. Remove the Antenna. Replace the four screws in the Antenna Block and tighten securely.
2. Make connections as shown in the Test Setup. (The loading effect of the RF frequency meter should be considered when making sensitivity measurements).
3. Adjust the power supply for 14.5-volts DC.
4. Turn the radio on and check the milliammeter for a reading of 10 ma or less with volume set to minimum. In two-frequency units, set the Frequency Selector Switch to the F1 position.

NOTE

Refer to the module Outline Diagrams to obtain test points.

ALIGNMENT PROCEDURE

STEP	TUNING CONTROL	METER READING	PROCEDURE
		OSCILLATOR	
1.	L10	Maximum	Connect the positive probe of the VOM to the +14.5-volt spring and the negative probe to the emitter of Q6 (RF Oscillator). Adjust L10 for Maximum reading.
2.	L7	Slight Change	Adjust L7 for a slight change in VOM reading.
3.	L7	See Procedure	On two-frequency units, set the Frequency Selector switch to the F2 position. If the VOM reading is not within 10% of the F1 reading, readjust L7 slightly to balance the output.
		RF CIRCUITS	
4.			Set the Frequency Selector switch to the F1 position. Adjust the VOLUME control for a zero dB (.707 volts) on the AC-VTVM connected across the 100 ohm audio load resistor (See Test Setup).
5.	L2, L4 and L5	See Procedure	Apply a quieting signal and adjust L2, L4 and L5 for minimum meter reading. Reduce the output of the signal generator during this adjustment to maintain a -10 dB reading on the AC-VTVM. Repeat this step several times to obtain maximum noise quieting.
6.	L10	See Procedure	Connect the AC-VTVM between chassis ground and the audio output (green wire) from the IF AMP A5. While applying an on frequency signal to the antenna jack, tune L10 to read zero volts on the VTVM. NOTE For multi-frequency, switch frequency selector switch to F2 and check that the meter reading is between -0.1 volts and +0.1 volts.
7.	L2, L4, L5 and L7	Maximum quieting	Connect the AC-VTVM across the 100-ohm audio load resistor. While applying an on frequency signal, tune L2, L4, L5 and L7 for maximum quieting.

ALIGNMENT PROCEDURE

148—174 MHz RECEIVER
MODELS 4ES33A2-A5

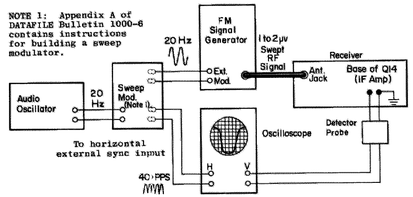


Figure C - Test Setup for 20-Hz Double-Trace Sweep Alignment

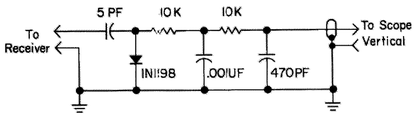


Figure D - Detector Probe for Sweep Alignment

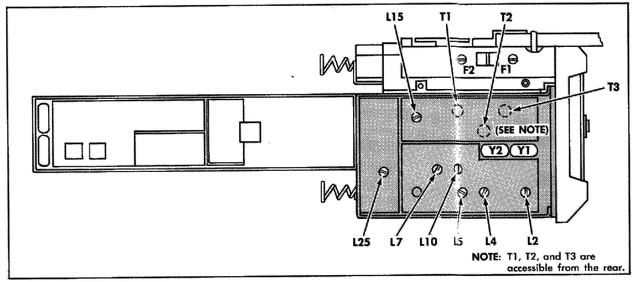


Figure A - Location of Adjustable Components

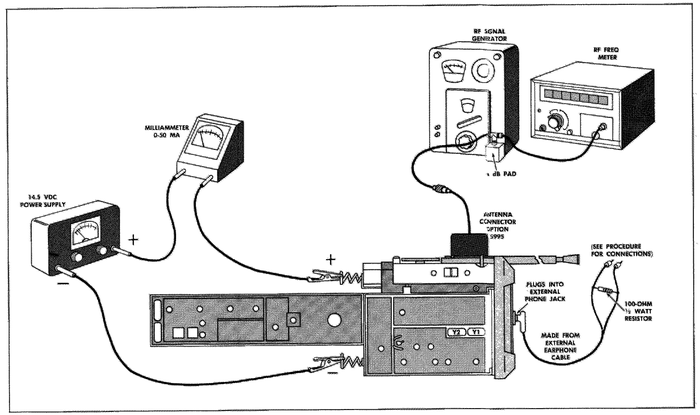


Figure B - Test Setup

COMPLETE RECEIVER ALIGNMENT

EQUIPMENT REQUIRED

1. 14.5-volt DC, 50 milliamp power supply
2. RF signal generator with 6 dB PAD.
3. RF frequency meter
4. Antenna connector (Option 5995)
5. Earphone cable (5495088-P10)
6. 20,000 ohm-per-volt meter with 0-3 volt scale.
7. AC-VTVM

PRELIMINARY STEPS

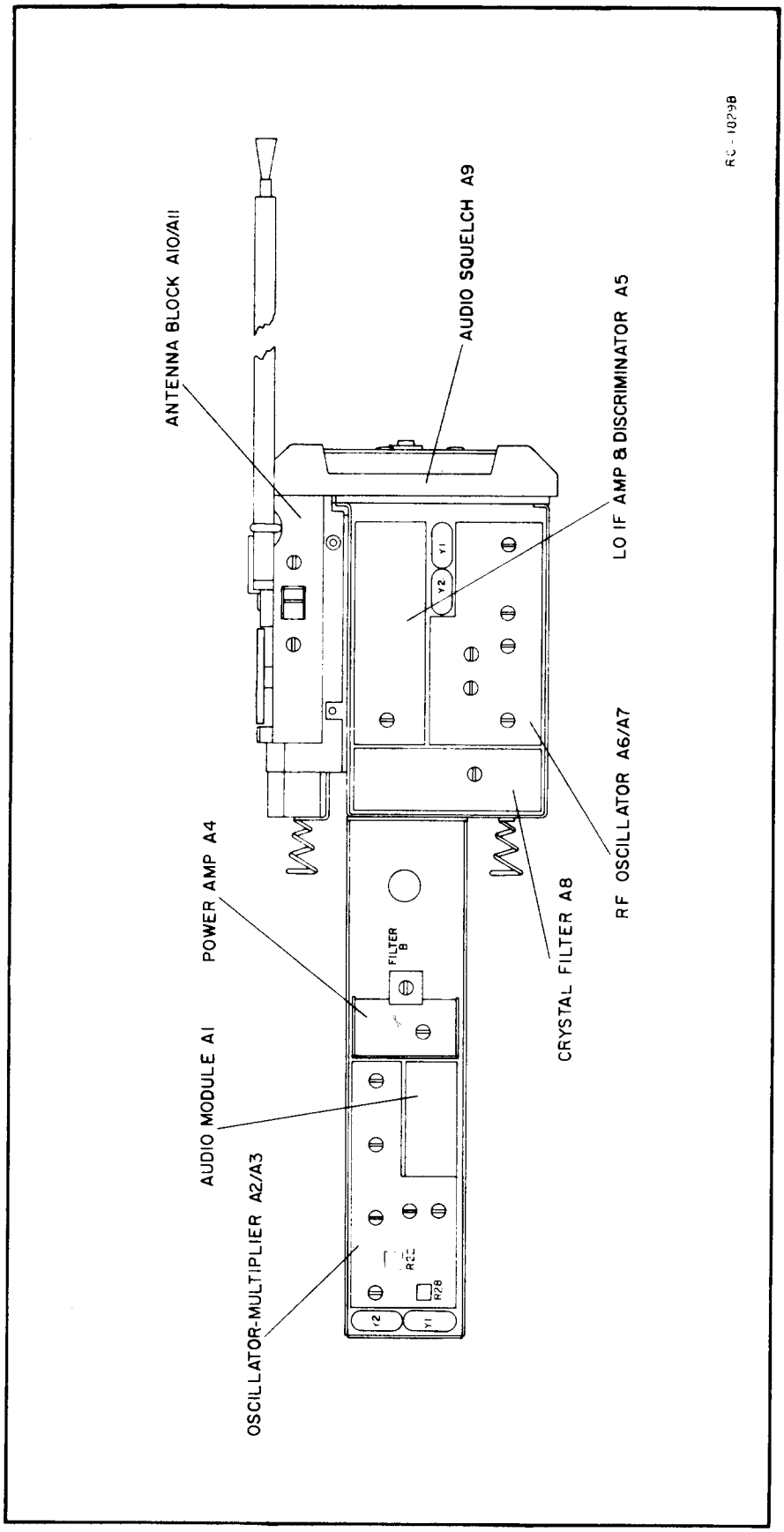
1. Remove the chassis from the case as shown in the Disassembly Procedure. Remove the Antenna. Replace the four screws in the Antenna Block and tighten securely.
2. Make connections as shown in the Test Setup. (The loading effect of the RF frequency meter should be considered when making sensitivity measurements).
3. Adjust the power supply for 14.5-volts DC.
4. Turn the radio on and check the milliammeter for a reading of 10 mA or less with volume set to minimum. In two-frequency units, set the Frequency Selector Switch to the F1 position.

NOTE

Refer to the module Outline Diagram to obtain test points.

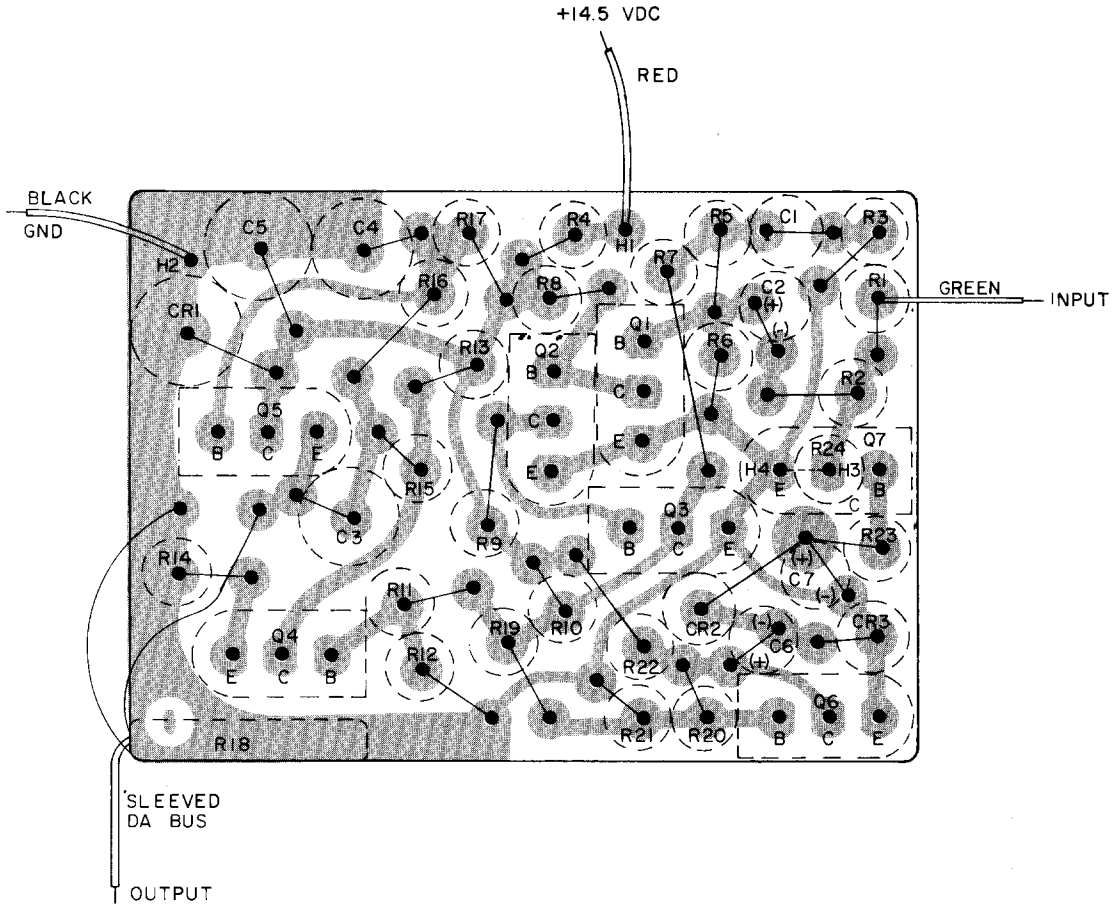
ALIGNMENT PROCEDURE

STEP	TUNING CONTROL	METER READING	PROCEDURE
		OSCILLATOR	
1.	L10	Maximum	Connect the positive probe of the VOM to the +14.5-volt spring and the negative probe to the emitter of Q6 (OSC MULT). Adjust L10 for Maximum reading.
2.	L7	Slight Change	Adjust L7 for a slight change in VOM reading.
3.	L7	See Procedure	On two-frequency units, set the Frequency Selector switch to the F2 position. If the VOM reading is not within 10% of the F1 reading, readjust L7 slightly to balance the output.
		DISCRIMINATOR	
4.	T3	Zero	Connect the AC-VTVM between chassis ground and the audio output (green wire) from IF AMP A5. Apply a 10.7 MHz signal between chassis ground and input crystal Y4 on the crystal filter. Adjust discriminator T3 for zero reading.
		IF ALIGNMENT	
The IF circuits have been aligned at the factory and will normally require no further adjustment. If adjustment is necessary, use the following procedure. NOTE Refer to DATAFILE BULLETIN 1000-6 IF Alignment of Two-way Radio FM Receivers for helpful suggestions on how to determine when IF Alignment is required.			
5.	T1, T2, L15, L7, L6, L5 and L4	Maximum Noise	While monitoring audio noise output on a distortion analyzer connected across the 100 ohm audio load resistor, peak T1, T2, L15, L7, L6, L5 and L4 for maximum noise.
6.			Connect scope, signal generator, and detector as shown in Figure C. Set signal generator level for 1 - 2 µV and modulate with 20 Hz at 10—13 kHz deviation. Adjust L15, L6, L25, T1 and T2 for double trace (as shown on scope pattern) and minimum ripple. NOTE Always use the lowest possible input signal to avoid limiting.
			SWEEP PICTURE OF RECEIVER IF NOTE: Better results may be obtained if the RF generator frequency is adjusted to make the double trace coincide at points A & B then tune the IF as in procedure. This is necessary when the RF generator modulation is not symmetrical.
		RF CIRCUITS	
7.		See Procedure	Connect the AC-VTVM across the 100 ohm audio load resistor. Set the Frequency Selector switch to the F1 position. Adjust the VOLUME control for a zero dB (.707 volts) meter indication.
8.	L2, L4, L5	See Procedure	Apply a quieting signal and adjust L2, L4 and L5 for minimum meter reading. Reduce the output of the signal generator during this adjustment to maintain a -10 dB reading on the AC-VTVM. Repeat this step several times to obtain maximum noise quieting.
9.	L10	See Procedure	Connect the AC-VTVM between chassis ground and the audio output (green wire) from the IF AMP A5. While applying an on frequency signal to the antenna jack, tune L10 to read zero volts on the VTVM. NOTE For multi-frequency, switch frequency selector switch to F2 and check that the meter reading is between -0.1 volts and +0.1 volts.
10.	L2, L4, L5, and L7	Maximum Quieting	Connect the AC-VTVM across the 100 ohm audio load resistor. While applying an on frequency signal, tune L2, L4, L5 and L7 for maximum quieting.



OUTLINE DIAGRAM

MODULE LAYOUT FOR
TRANSMITTER-RECEIVER MODEL 4ES33A2-5

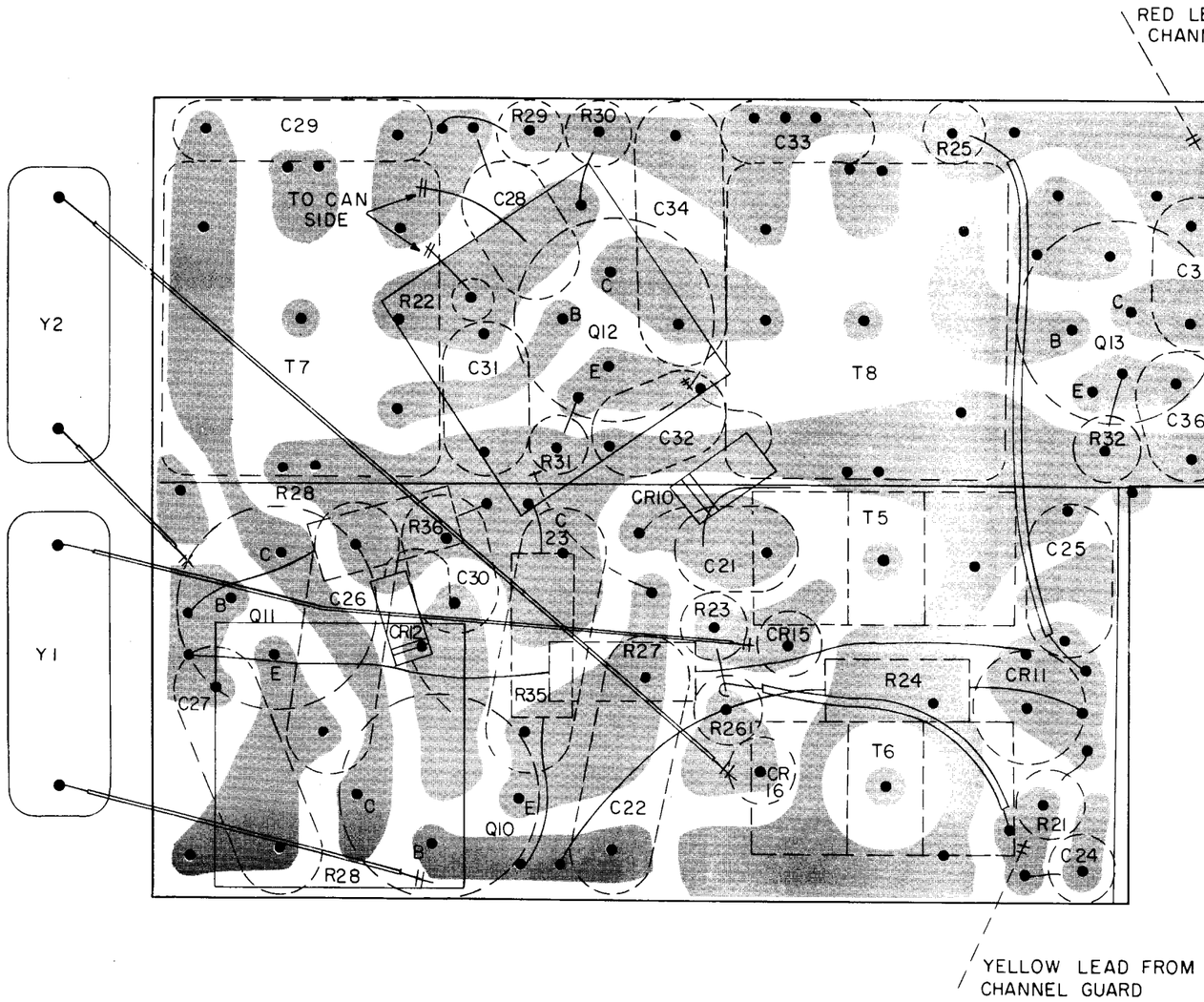


Denotes Solder Side

(19C317031, Rev. 3)
(19C311857, Rev. 0)

OUTLINE DIAGRAM

AUDIO MODULE A1
19C311858-G1 & G2



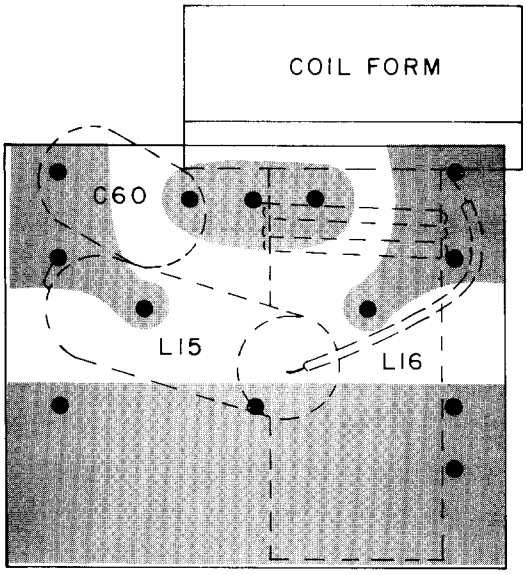
(19D413334, Rev. 2)
(19D413205, Rev. 0)

Denotes Solder Side

OUTLINE DIAGRAM

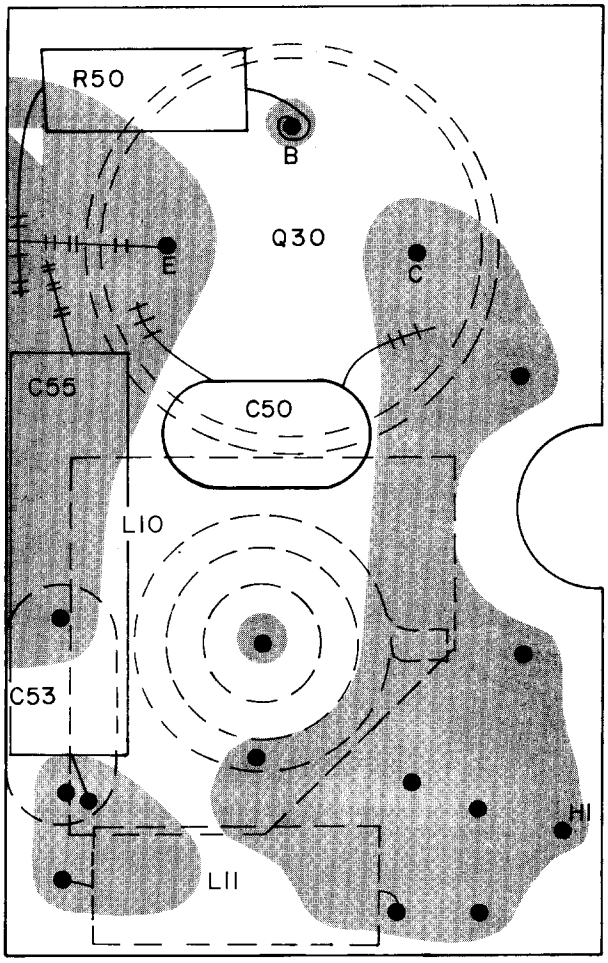
OSCILLATOR-MULTIPLIER A2/A3
19D413207-G1 (1-FREQ)
19D413207-G2 (2-FREQ)

FILTER "B"



(19A127583, Rev. 0)
(19B216412, Rev. 0)

POWER AMPLIFIER

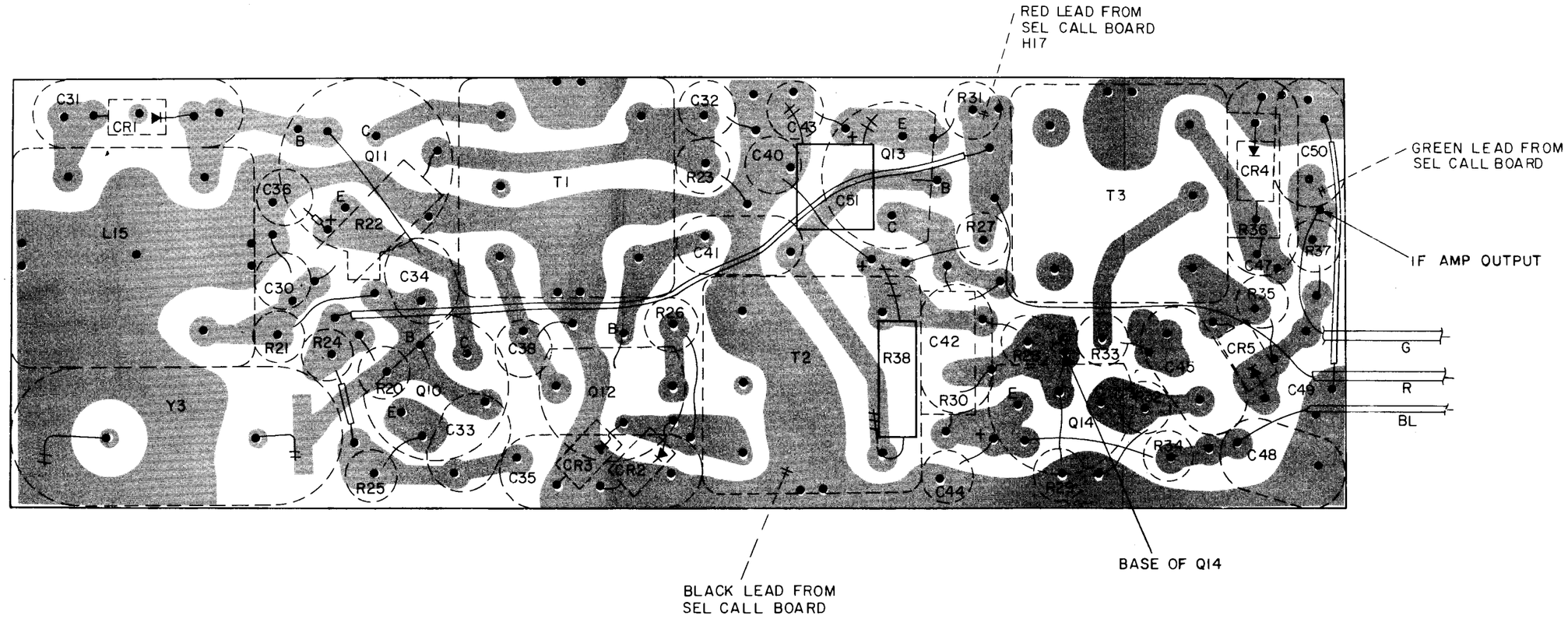


(19B216661, Rev. 2)
(19C317002, Rev. 1)

▒ Denotes Solder Side

OUTLINE DIAGRAM

POWER AMPLIFIER A4
19C317006-G1 &
FILTER "B" 19B216414-G2

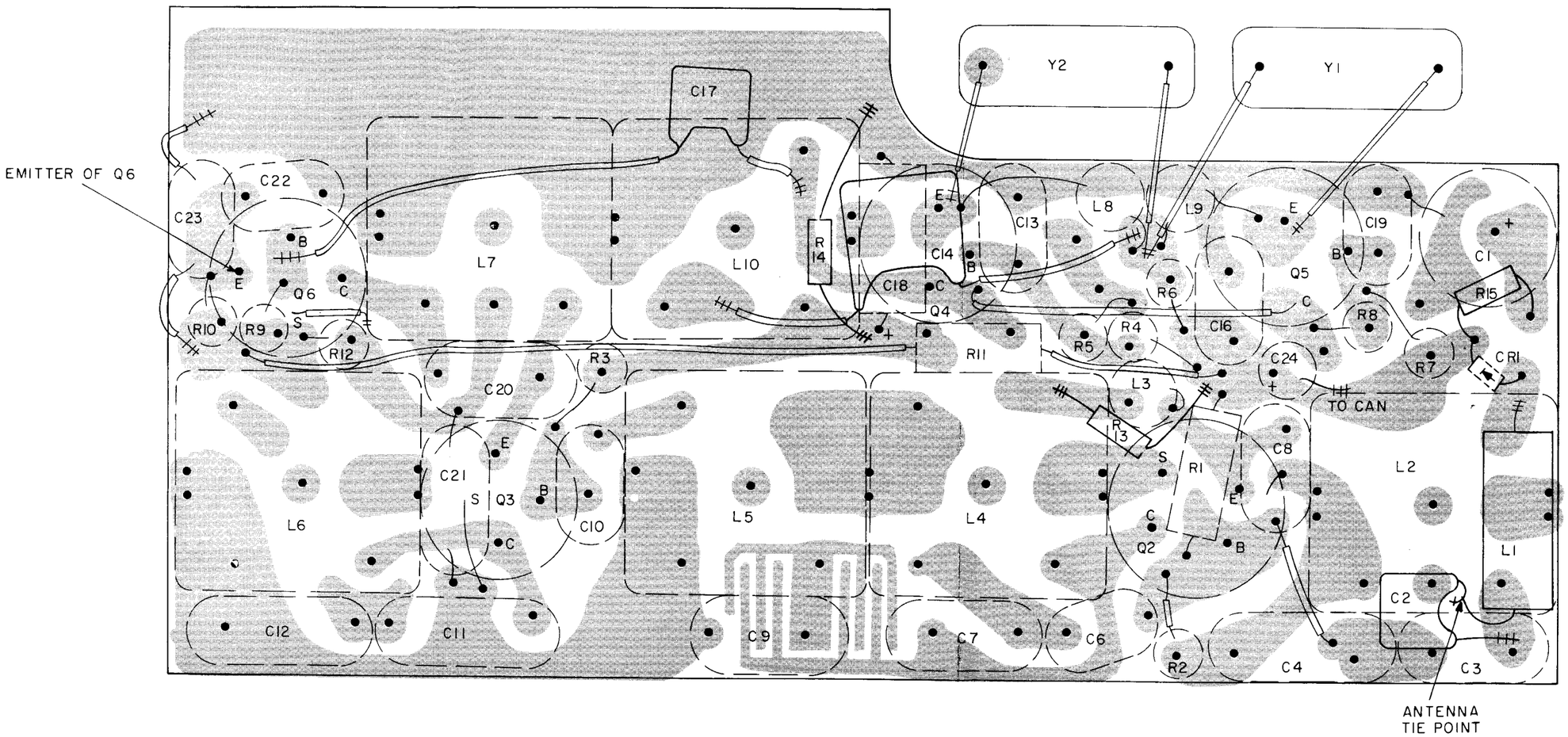


(19D413341, Rev. 2)
(19D413208, Rev. 0)

Denotes Solder Side

OUTLINE DIAGRAM

LO IF AMP & DISC A5
19D413209-G1

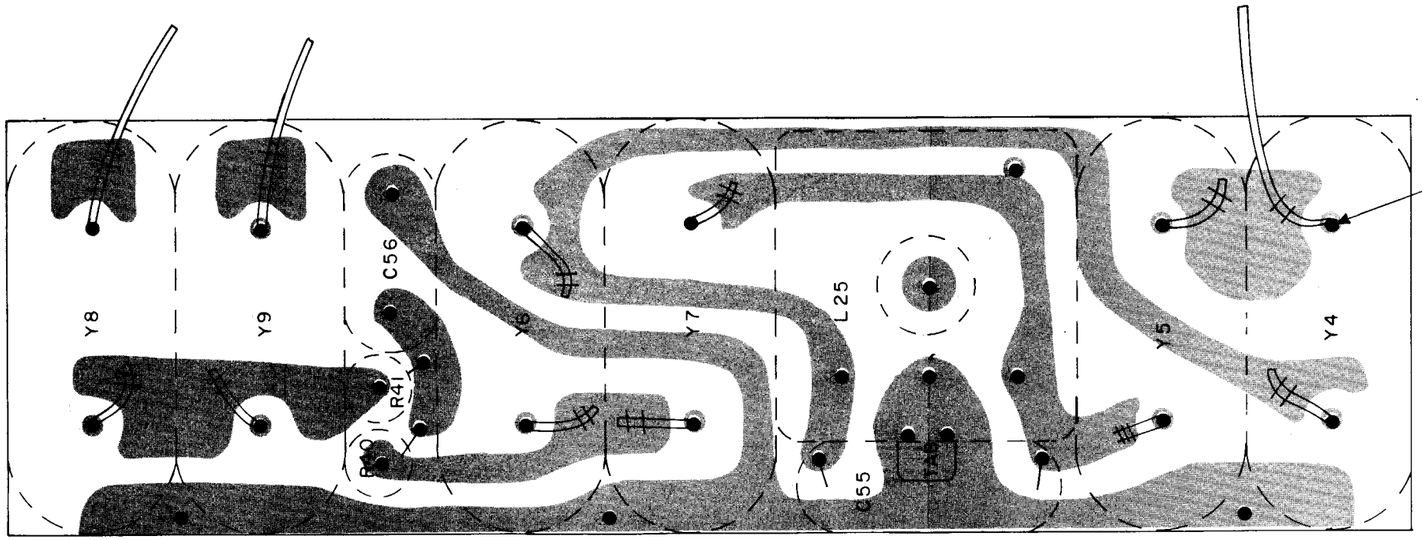


Denotes Solder Side

(19D413337, Rev. 1)
(19C311996, Rev. 0)

OUTLINE DIAGRAMS

RF OSCILLATOR A6/A7
19D413210-G1 (1-FREQ)
19D413210-G2 (2-FREQ)

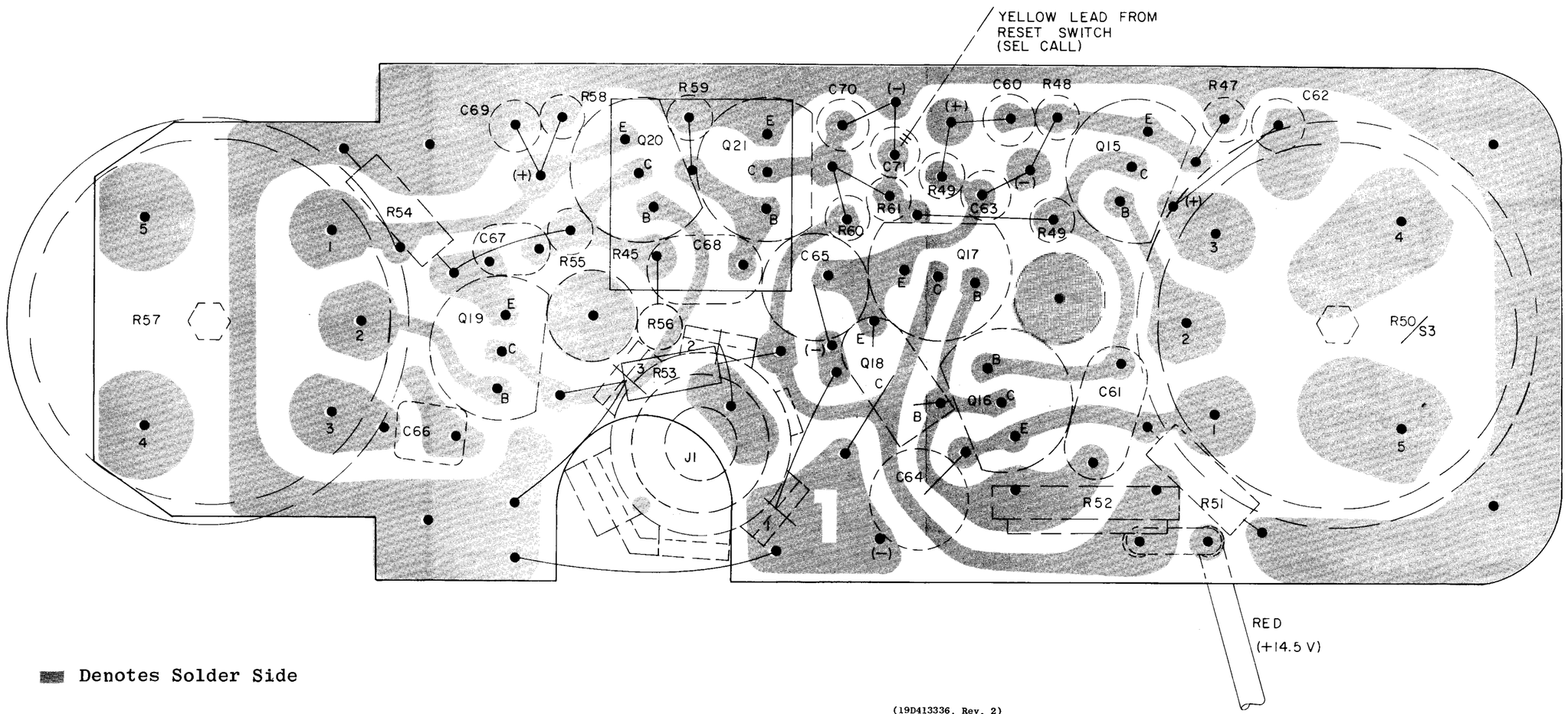


(19C317027, Rev. 0)
(19C311987, Rev. 0)

Denotes Solder Side

OUTLINE DIAGRAM

CRYSTAL FILTER A8
19C311988-G1



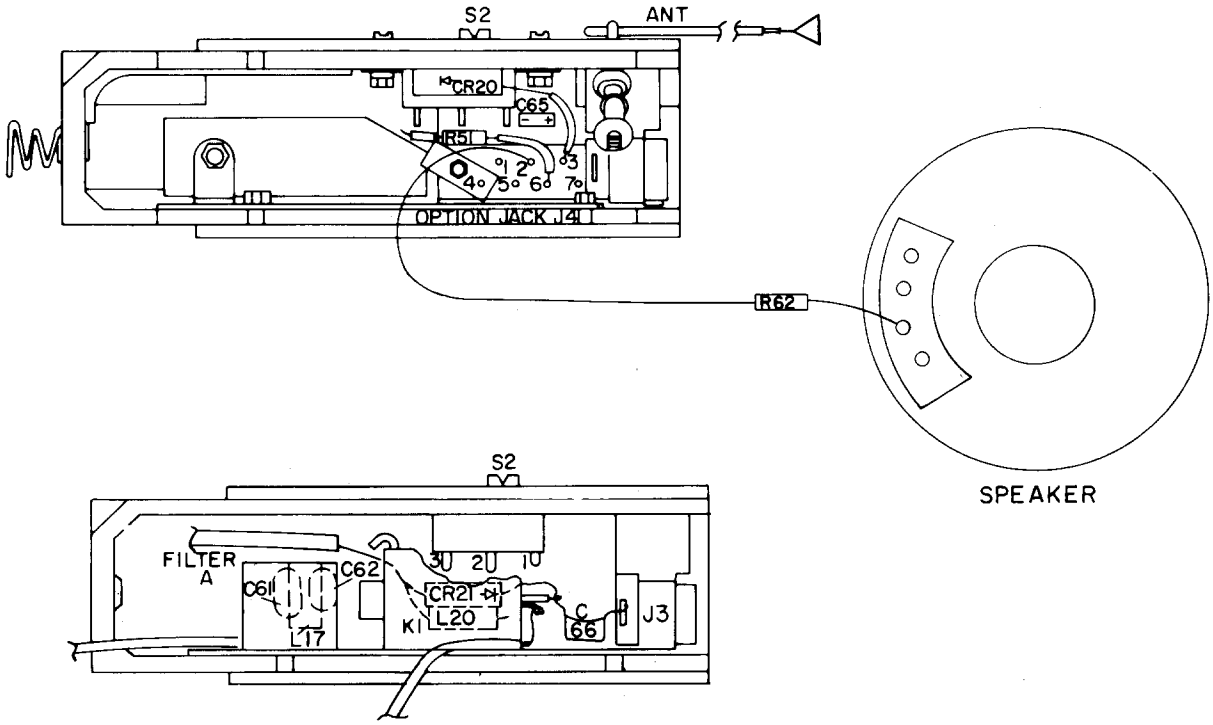
Denotes Solder Side

(19D413336, Rev. 2)
(19D413215, Rev. 1)

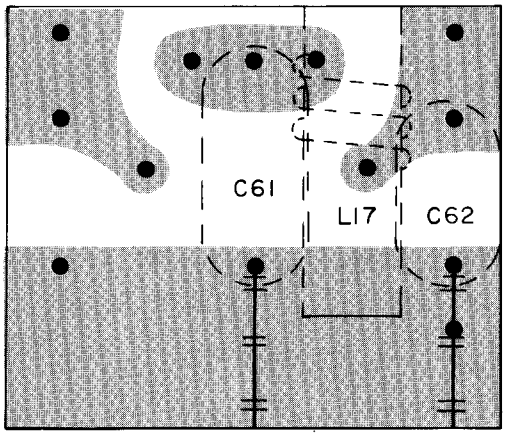
OUTLINE DIAGRAM

AUDIO & SQUELCH A9
19D413213-G1

18 Issue 2



(19B216672, Rev. 1)



(19A127582, Rev. 0)
(19B216412, Rev. 0)

Denotes Solder Side

OUTLINE DIAGRAM

ANTENNA BLOCK A10/A11
19C317012-G1 (1-FREQ)
19C317012-G2 (2-FREQ)
FILTER "A" 19B216414-G1

(PAGE 20 IS BLANK)

PARTS LIST

LBI-4029B

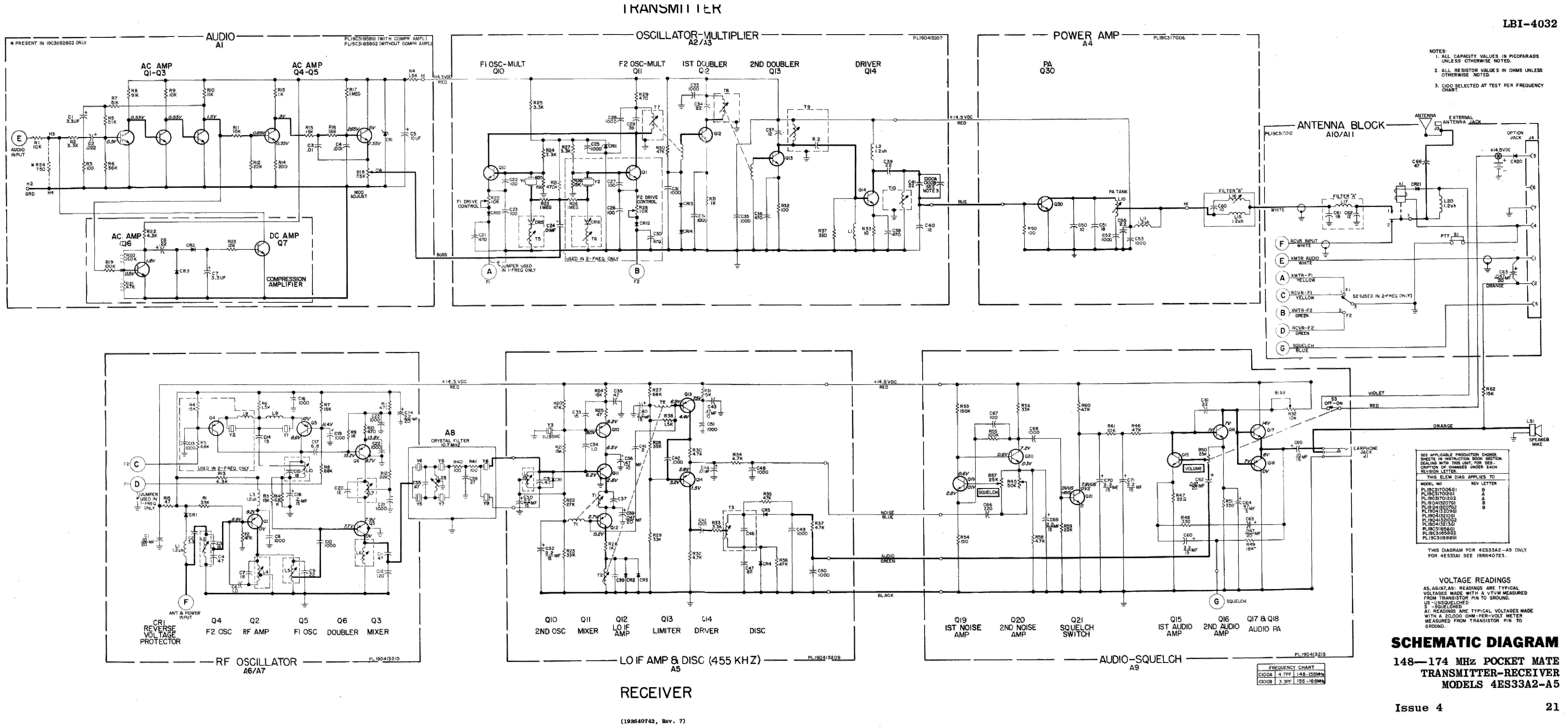
148-174 MHz POCKET MATE
TRANSMITTER-RECEIVER

MODEL 4ES33A2 19D413223-G1, MODEL 4ES33A3 19D413223-G2
MODEL 4ES33A4 19D413223-G3, MODEL 4ES33A5 19D413223-G4

SYMBOL	GE PART NO.	DESCRIPTION
		19D413223-G1 1 FREQ TRANSMIT, 1 FREQ RECEIVE 19D413223-G2 2 FREQ TRANSMIT, 1 FREQ RECEIVE 19D413223-G3 2 FREQ TRANSMIT, 2 FREQ RECEIVE 19D413223-G4 1 FREQ TRANSMIT, 2 FREQ RECEIVE
A1		AUDIO BOARD 19C311858-G1 REV A
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1	5491674-P19	Tantalum: 3.3 µf +50 -20%, 6 VDCW; sim to Sprague Type 162D.
C2	5491674-P20	Tantalum: 0.022 µf +50 -10%, 20 VDCW; sim to Sprague Type 162D.
C3	19A116095-P2	Ceramic: 10,000 pf ±10%, 50 VDCW.
C4	19A116095-P1	Ceramic: 1000 pf ±10%, 100 VDCW.
C5	5491674-P2	Tantalum: 10 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
C6	5491674-P21	Tantalum: 0.22 µf +50 -20%, 20 VDCW; sim to Sprague Type 162D.
C7	5491674-P19	Tantalum: 3.3 µf +50 -20%, 6 VDCW; sim to Sprague Type 162D.
		- - - - - - - - DIODES AND RECTIFIERS - - - - -
CR1	4036887-P5	Silicon, Zener.
CR2 and CR3	19A115250-P1	Silicon.
		- - - - - - - - - - - TRANSISTORS - - - - - - - - -
Q1 thru Q7	19A116144-P1	Silicon, NPN; sim to Type 2N4286.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1	3R151-P103K	Composition: 10,000 ohms ±10%, 1/8 w.
R2	3R151-P332J	Composition: 3300 ohms ±5%, 1/8 w.
R3	3R151-P101K	Composition: 100 ohms ±10%, 1/8 w.
R4	3R151-P132K	Composition: 1300 ohms ±10%, 1/8 w.
R5*	3R151-P563J	Composition: 56,000 ohms ±5%, 1/8 w. Earlier than REV A:
	3R151-P513J	Composition: 51,000 ohms ±5%, 1/8 w.
R6*	3R151-P513J	Composition: 51,000 ohms ±5%, 1/8 w. Earlier than REV A:
	3R151-P563J	Composition: 56,000 ohms ±5%, 1/8 w.
R7	3R151-P513J	Composition: 51,000 ohms ±5%, 1/8 w.
R8	3R151-P913J	Composition: 91,000 ohms ±5%, 1/8 w.
R9	3R151-P103K	Composition: 10,000 ohms ±10%, 1/8 w.
R10	3R151-P113J	Composition: 11,000 ohms ±5%, 1/8 w.
R11	3R151-P103J	Composition: 10,000 ohms ±5%, 1/8 w.
R12	3R151-P223J	Composition: 22,000 ohms ±5%, 1/8 w.
R13	3R151-P102J	Composition: 1000 ohms ±5%, 1/8 w.
R14	3R151-P201J	Composition: 200 ohms ±5%, 1/8 w.
R15 and R16	3R151-P153J	Composition: 15,000 ohms ±5%, 1/8 w.
R17	3R151-P105J	Composition: 1 megohm ±5%, 1/8 w.
R18	19A116093-P1	Variable, carbon film: 7500 ohms ±20%, 1/20 w.
R19	3R151-P104K	Composition: 0.1 megohms ±10%, 1/8 w.

SYMBOL	GE PART NO.	DESCRIPTION
R20	3R151-P154K	Composition: 0.15 megohm ±10%, 1/8 w.
R21	3R151-P473K	Composition: 47,000 ohms ±10%, 1/8 w.
R22	3R151-P432K	Composition: 4300 ohms ±10%, 1/8 w.
R23	3R151-P123K	Composition: 12,000 ohms ±10%, 1/8 w.
A2 and A3		OSCILLATOR/MULTIPLIER A2 19D413207-G1 REV B A3 19D413207-G2 REV B
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C21	19C301438-P8	Ceramic: .00047 µf ±20%, 100 VDCW.
C22 and C23	19A116102-P5	Silver mica: 100 pf ±10%, 100 VDCW.
C24	19A116108-P1	Tantalum: .01 µf ±20%, 20 VDCW.
C25	19C301438-P7	Ceramic: .001 µf ±20%, 100 VDCW.
C26 and C27	19A116102-P5	Silver mica: 100 pf ±10%, 300 VDCW.
C28	19C301438-P7	Ceramic: .001 µf ±20%, 100 VDCW.
C29	19A116102-P2	Silver mica: 39 pf ±10%, 500 VDCW.
C30	19C301438-P8	Ceramic: .00047 µf ±20%, 100 VDCW.
C31 and C32	19C301438-P7	Ceramic: .001 µf ±20%, 100 VDCW.
C33	19A116097-P1	Ceramic: 1000 pf ±20%, 100 VDCW.
C34	19A116114-P40	Ceramic: 22 pf ±10%, 100 VDCW.
C35	19A116097-P1	Ceramic: 1000 pf ±20%, 100 VDCW.
C36	19C301438-P8	Ceramic: .00047 µf ±20%, 100 VDCW.
C37	19A116114-P33	Ceramic: 12 pf ±5%, 100 VDCW.
C38	19C301438-P8	Ceramic: .00047 µf ±20%, 100 VDCW.
C39	19A116114-P40	Ceramic: 22 pf ±10%, 100 VDCW.
C40	19A116114-P33	Ceramic: 12 pf ±5%, 100 VDCW.
C41	19A116114-P40	Ceramic: 22 pf ±10%, 100 VDCW.
		- - - - - - - - DIODES AND RECTIFIERS - - - - -
CR10	19A116174-P1	Silicon.
CR11	4036887-P48	Silicon, Zener.
CR12 thru CR14	19A116174-P1	Silicon.
CR15		(Part of T5).
CR16		(Part of T6).
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L1	19A127420-G1	Coil.
L2	19B209420-P114	Coil, RF: 1.20 µh ±10%, 0.18 ohms DC res max; sim to Jeffers 4436-1K.
		- - - - - - - - - - TRANSISTORS - - - - - - - - -
Q10 thru Q13	19A115330-P1	Silicon, NPN.
Q14*	19A116201-P1	Silicon, NPN. Earlier than REV B:
	19A115330-P1	Silicon, NPN.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R21	3R151-P474K	Composition: 0.47 megohm ±10%, 1/8 w.
R22	19A116128-P2	Variable, carbon film: 10,000 ohms ±25%, 0.1 w.
R23	3R151-P105K	Composition: 1 megohm ±10%, 1/8 w.
R24 and R25	3R151-P332K	Composition: 3300 ohms ±10%, 1/8 w.
R26	3R151-P105K	Composition: 1 megohms ±10%, 1/8 w.
R27	3R151-P332K	Composition: 3300 ohms ±10%, 1/8 w.
R28	19A116128-P2	Variable, carbon film: 10,000 ohms ±25%, 0.1 w.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES.



SCHEMATIC DIAGRAM

148—174 MHz POCKET MATE TRANSMITTER-RECEIVER MODELS 4ES33A2-A5

SYMBOL	GE PART NO.	DESCRIPTION
R29	3R151-P471K	Composition: 470 ohms ±10%, 1/8 w.
R30	3R151-P473J	Composition: 47,000 ohms ±5%, 1/8 w.
R31	3R151-P102K	Composition: 1000 ohms ±10%, 1/8 w.
R32	3R151-P101K	Composition: 100 ohms ±10%, 1/8 w.
R33	3R151-P100K	Composition: 10 ohms ±10%, 1/8 w.
R35 and R36	3R151-P153K	Composition: 15,000 ohms ±10%, 1/8 w.
R37*	3R151-P331K	Composition: 330 ohms ±10%, 1/8 w. Added by REV A.
		- - - - - - - - - - TRANSFORMERS - - - - - - - - -
T5 CR15	19B216424-G1 19A116034-P2	Coil. Includes tuning slug 19A116147-P1. Silicon, capacitive.
T6 CR16	19B216424-G1 19A116034-P2	Coil. Includes tuning slug 19A116147-P1. Silicon, capacitive.
T7	19B216433-G1	Coil.
T8	19B216422-G1	Coil.
T9	19B216426-G1	Coil.
T10	19B216411-G1	Coil.
		- - - - - - - - - - - CRYSTALS - - - - - - - - -
		NOTE: Crystal frequency = operating freq - 8.
Y1	19B213301-P1	18.5 - 22 MHz.
Y2	19B213301-P1	18.5 - 22 MHz. (2 FREQ)
A4		POWER AMPLIFIER MODULE 19C317006-G1 REV B
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C50	19A116114-P31	Ceramic: 10 pf ±10%, 100 VDCW.
C51	19A116101-P1	Ceramic disc: 18 pf ±10%, 500 VDCW, temp coef 0 PPM.
C52 and C53	19C301438-P7	Ceramic: .001 µf ±20%, 100 VDCW.
C54*	19C301438-P7	Ceramic: .001 µf ±20%, 100 VDCW. Deleted by REV B.
C55*	5491674-P17	Tantalum: 2.2 µf ±20%, 20 VDCW; sim to Sprague Type 162D. Added by REV A.
		- - - - - - - - - - INDUCTORS - - - - - - - - -
L10	19B216430-G1	Coil, includes tuning slug 19A116147-P3.
L11	19B209420-P114	Coil, RF: 1.20 µh ±10%, 0.18 ohms DC res max; sim to Jeffers 4436-1K.
		- - - - - - - - - - TRANSISTORS - - - - - - - - -
Q30	19A116016-P1	Silicon, NPN.
Q31*	19A116146-P1	Germanium, PNP. Deleted by REV B.
		- - - - - - - - - - RESISTORS - - - - - - - - -
R50	3R151-P101K	Composition: 100 ohms ±10%, 1/8 w.
		RF FILTER B 19B216414-G2
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C60	19A116114-P31	Ceramic: 10 pf ±10%, 100 VDCW.
		- - - - - - - - - - INDUCTORS - - - - - - - - -
L15	19B209420-P114	Coil, RF: 1.20 µh ±10%, 0.18 ohms DC res max; sim to Jeffers 4436-1K.
L16	19B216428-P1	Coil.
A5		IF AMPLIFIER AND DISCRIMINATOR BOARD 19D413209-G1
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C30	5491674-P23	Tantalum: 2.2 µf ±20%, 15 VDCW; sim to Sprague Type 162D.

SYMBOL	GE PART NO.	DESCRIPTION
C31	19A116114-P52	Ceramic: 47 pf ±10%, 100 VDCW.
C32	5491674-P23	Tantalum: 2.2 µf %20%, 1 VDCW; sim to Sprague Type 162D.
C33	19A116114-P36	Ceramic: 15 pf ±5%, 100 VDCW.
C34	19A116114-P1	Ceramic: 1 pf ±10%, 100 VDCW.
C35	19A116102-P3	Silver mica: 47 pf ±10%, 500 VDCW.
C36	5491674-P24	Tantalum: 0.47 µf +50 -20%, 10 VDCW; sim to Sprague Type 162D.
C37		(Part of T1).
C38	5491674-P25	Tantalum: .047 µf +50 -20%, 20 VDCW; sim to Sprague Type 162D.
C39		(Part of T2).
C40	5491674-P23	Tantalum: 2.2 µf ±20%, 15 VDCW; sim to Sprague Type 162D.
C41	19A116114-P7	Ceramic: 2.2 pf ±10%, 100 VDCW.
C42	19C301438-P7	Ceramic: .001 µf ±20%, 100 VDCW.
C43	5491674-P24	Tantalum: 0.47 µf +50 -20%, 10 VDCW; sim to Sprague Type 162D.
C44	19A116108-P1	Tantalum: .01 µf ±20%, 20 VDCW.
C45	19C301438-P7	Ceramic: .001 µf ±20%, 100 VDCW.
C46		(Part of T3).
C47	19A116102-P4	Silver mica: 82 pf ±10%, 300 VDCW.
C48 thru C51	19C301438-P7	Ceramic: .001 µf ±20%, 100 VDCW.
		- - - - - - - - DIODES AND RECTIFIERS - - - - -
CR1	19A116174-P1	Silicon.
CR2	19A116174-P7	Silicon.
CR3 thru CR5	19A116174-P1	Silicon.
		- - - - - - - - - - INDUCTORS - - - - - - - - -
L15	19B216421-G1	Coil.
		- - - - - - - - - - TRANSISTORS - - - - - - - - -
Q10	19A116407-P1	Silicon, PNP; sim to Type 2N4126.
Q11 and Q12	19A116141-P1	Germanium, PNP; sim to Type 2N3399.
Q13 and Q14	19A116407-P1	Silicon, PNP; sim to Type 2N4126.
		- - - - - - - - - - RESISTORS - - - - - - - - -
R20	3R151-P473K	Composition: 47,000 ohms ±10%, 1/8 w.
R21	3R151-P153K	Composition: 15,000 ohms ±10%, 1/8 w.
R22	3R151-P273K	Composition: 27,000 ohms ±10%, 1/8 w.
R23	3R151-P333K	Composition: 33,000 ohms ±10%, 1/8 w.
R24	3R151-P153K	Composition: 15,000 ohms ±10%, 1/8 w.
R25	3R151-P470K	Composition: 47 ohms ±10%, 1/8 w.
R26	3R151-P102K	Composition: 1000 ohms ±10%, 1/8 w.
R27	3R151-P683K	Composition: 68,000 ohms ±10%, 1/8 w.
R28	3R151-P393K	Composition: 39,000 ohms ±10%, 1/8 w.
R29	3R151-P333K	Composition: 33,000 ohms ±10%, 1/8 w.
R30	3R151-P472K	Composition: 4700 ohms ±10%, 1/8 w.
R31	3R151-P153K	Composition: 15,000 ohms ±10%, 1/8 w.
R32	3R151-P472K	Composition: 4700 ohms ±10%, 1/8 w.
R33	3R151-P332K	Composition: 3300 ohms ±10%, 1/8 w.
R34	3R151-P472K	Composition: 4700 ohms ±10%, 1/8 w.
R35 and R36	3R151-P473K	Composition: 47,000 ohms ±10%, 1/8 w.

SYMBOL	G-E PART NO	DESCRIPTION
R37	3R151-P472K	Composition: 4700 ohms ±10%, 1/8 w.
R38	3R151-P152K	Composition: 1500 ohms ±10%, 1/8 w.
		- - - - - - - - - - TRANSFORMERS - - - - - - - -
T1	19A116165-P2	Intermediate freq: freq range 435 to 475 KHz, Pri: 25,000 ohms imp. Sec: 5000 ohms imp. (Includes C37 capacitor, 180 pf ±20%)).
T2	19A116165-P2	Intermediate freq: freq range 435 to 475 KHz, Pri: 25,000 ohms imp. Sec: 5000 ohms imp. (Includes C39 capacitor, 180 pf ±20%)).
T3	19A116165-P1	Intermediate freq: freq range 435 to 475 KHz, Pri: 50,000 ohms imp. Sec: 500 ohms imp. (Includes C46 capacitor, 180 pf ±20%)).
		- - - - - - - - - - - CRYSTALS - - - - - - - - -
Y3	19B213199-G1	11.155 MHz.
A6 and A7		RF OSCILLATOR A6 19D413210-G1 (Used in 19D413223--G1 and G2) A7 19D413210-G2 (Used in 19D413223--G3 and G4)
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C1	5491674-P40	Tantalum: 10 µf ±20%, 20 VDCW; sim to Sprague Type 162D.
C2	19A116114-P11	Ceramic: 3.3 pf ±10%, 100 VDCW.
C3	19A116114-P37	Ceramic: 18 pf ±10%, 100 VDCW.
C4	19A116102-P3	Silver mica: 47 pf ±10%, 500 VDCW.
C6	19A116114-P1	Ceramic: 1 pf ±10%, 100 VDCW.
C7	19A116114-P37	Ceramic: 18 pf ±10%, 100 VDCW.
C8	19C301438-P7	Ceramic: .001 µf ±20%, 100 VDCW.
C9	19A116114-P76	Ceramic: 220 pf ±10%, 100 VDCW.
C10	19C301438-P7	Ceramic: .001 µf ±20%, 100 VDCW.
C11	19A116102-P3	Silver mica: 47 pf ±10%, 500 VDCW.
C12	19A116102-P6	Silver mica: 120 pf ±10%, 300 VDCW.
C13	19C301438-P7	Ceramic: .001 µf ±20%, 100 VDCW.
C14	19A116114-P70	Ceramic: 150 pf ±10%, 100 VDCW.
C16	19C301438-P7	Ceramic: .001 µf ±20%, 100 VDCW.
C17	19A116114-P21	Ceramic: 6.8 pf ±10%, 100 VDCW.
C18	5491674-P23	Tantalum: 2.2 µf ±20%, 15 VDCW; sim to Sprague Type 162D.
C19	19C301438-P7	Ceramic: .001 µf ±20%, 100 VDCW.
C20	19A116114-P33	Ceramic: 12 pf ±5%, 100 VDCW.
C21 thru C23	19C301438-P7	Ceramic: .001 µf ±20%, 100 VDCW.
C24	5491674-P16	Tantalum: 2.2 µf +50 -20%, 20 VDCW; sim to Sprague Type 162D.
		- - - - - - - - DIODES AND RECTIFIERS - - - - -
CR1	4038642-P1	Germanium.
		- - - - - - - - - - INDUCTORS - - - - - - - - -
L1	19B209420-P114	Coil, RF: 1.20 µh ±10%, 0.18 ohms DC res max; sim to Jeffers 4436-1.
L2	19B216417-G1	Coil.
L3	19B209420-P114	Coil, RF: 1.20 µh ±10%, 0.18 ohms DC res max; sim to Jeffers 4436-1.
L4	19B216432-G1	Coil.
L5	19B216432-G1	Coil.
L6	19B216418-G1	Coil.
L7	19B216415-G1	Coil.
L8 and L9	19B216436-G1	Coil.
L10	19B216419-G1	Coil.

SYMBOL	G-E PART NO	DESCRIPTION
		- - - - - - - - - - TRANSISTORS - - - - - - - - -
Q2 and Q3	19A116141-P1	Germanium, PNP; sim to Type 2N3399.
Q4 and Q5	19A127482-P1	Silicon, PNP; sim to Type 2N3702. (Selected with Beta matched to within 10%).
Q6	19A116141-P1	Germanium, PNP; sim to Type 2N3399.
		- - - - - - - - - - RESISTORS - - - - - - - - -
R1	3R151-P333K	Composition: 33,000 ohms ±10%, 1/8 w.
R2	3R151-P473K	Composition: 47,000 ohms ±10%, 1/8 w.
R3 and R4	3R151-P153K	Composition: 15,000 ohms ±10%, 1/8 w.
R5	3R151-P683K	Composition: 68,000 ohms ±10%, 1/8 w.
R6	3R151-P152K	Composition: 1500 ohms ±10%, 1/8 w.
R7	3R151-P153K	Composition: 15,000 ohms ±10%, 1/8 w.
R8	3R151-P683K	Composition: 68,000 ohms ±10%, 1/8 w.
R9	3R151-P102K	Composition: 1000 ohms ±10%, 1/8 w.
R10 and R11	3R151-P471K	Composition: 470 ohms ±10%, 1/8 w.
R12	3R151-P223K	Composition: 22,000 ohms ±10%, 1/8 w.
R13	3R151-P432J	Composition: 4300 ohms ±5%, 1/8 w.
R14	3R151-P682K	Composition: 6800 ohms ±10%, 1/8 w.
R15	3R152-P470K	Composition: 47 ohms ±10%, 1/4 w.
		- - - - - - - - - - - CRYSTALS - - - - - - - - -
		NOTE: Crystal frequency = operating freq. -10.7 MHz ÷ 2.
Y1 and Y2	19B213197-P1	68.6 - 93.4 MHz.
A8		CRYSTAL FILTER 19C311988-G1
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C55	19A116102-P3	Silver mica: 47 pf ±10%, 500 VDCW.
C56	19A116114-P43	Ceramic: 27 pf ±10%, 100 VDCW.
		- - - - - - - - - - INDUCTORS - - - - - - - - -
L25	19B216420-G1	Coil.
		- - - - - - - - - - RESISTORS - - - - - - - - -
R40 and R41	3R151-P101K	Composition: 100 ohms ±10%, 1/8 w.
		- - - - - - - - - - CRYSTALS - - - - - - - - -
Y4	19B213303-G1	Crystal: 10,691.000 KHz.
Y5	19B213303-G2	Crystal: 10,700.700 KHz.
Y6	19B213303-G1	Crystal: 10,691.000 KHz.
Y7	19B213303-G2	Crystal: 10,700.700 KHz.
Y8	19B213303-G1	Crystal: 10,691.000 KHz.
Y9	19B213303-G2	Crystal: 10,700.700 KHz.
A9		AUDIO SQUELCH 19D413213-G1
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C60	5491674-P23	Tantalum: 2.2 µf ±20%, 15 VDCW; sim to Sprague Type 162D.
C61	19A116114-P40	Ceramic: 22 pf ±10%,100 VDCW.

SYMBOL	GE PART NO.	DESCRIPTION
C62 and C63	5491674-P25	Tantalum: .047 µf +50 -20%, 20 VDCW; sim to Sprague Type 162D.
C64	5491674-P26	Tantalum: 47 µf ±20%, 4 VDCW; sim to Sprague Type 162D.
C65	5491674-P18	Tantalum: 10 µf ±20%, 15 VDCW; sim to Sprague Type 162D.
C66	19C301438-P6	Ceramic: .00022 µf ±20%, 100 VDCW.
C67	19C301438-P5	Ceramic: .0001 µf ±10%, 100 VDCW.
C68	19C301438-P7	Ceramic: .001 µf ±20%, 100 VDCW.
C69 thru C71	5491674-P23	Tantalum: 2.2 µf ±20%, 15 VDCW; sim to Sprague Type 162D.
		- - - - - - JACKS AND RECEPTACLES - - - - - -
J1	19A116134-P1	Jack, telephone; sim to Philmore 606J.
		- - - - - - - - - - TRANSISTORS - - - - - - - - -
Q15 thru Q17	19A116406-P1	Silicon, NPN; sim to Type 2N2925.
Q18	19A116145-P1	Silicon, PNP; sim to Type 2N4290.
Q19 thru Q21	19A116406-P1	Silicon, NPN; sim to Type 2N2925.
		- - - - - - - - - - RESISTORS - - - - - - - - -
R45	19A116093-P2	Variable, carbon film: 50,000 ohms ±20%, 1/20 w.
R46	3R151-P473K	Composition: 47,000 ohms ±10%, 1/8 w.
R47	3R151-P220K	Composition: 22 ohms ±10%, 1/8 w.
R48	3R151-P331K	Composition: 330 ohms ±10%, 1/8 w.
R49	3R151-P183K	Composition: 18,000 ohms ±10%, 1/8 w.
R50	5491442-P7	Variable, carbon film: 25,000 ohms ±20%, 1/10 w; 45 VDC; (switch) SPST, 2.5 amps at 2 VDC and 0.1 amp at 45 VDC; sim to Centralab 6 Control.
R51	3R151-P331K	Composition: 330 ohms ±10%, 1/8 w.
R52	19A116128-P2	Variable, carbon film: 10,000 ohms ±25%, 0.1 w.
R53	3R151-P154K	Composition: 0.15 megohms ±10%, 1/8 w.
R54	3R151-P151K	Composition: 150 ohms ±10%, 1/8 w.
R55	3R151-P104K	Composition: 0.10 megohms ±10%, 1/8 w.
R56	3R151-P333K	Composition: 33,000 ohms ±10%, 1/8 w.
R57	5491442-P7	Variable, carbon film: 25,000 ohms ±20%, 1/10 w, 45 VDC; (switch) SPST, 2.5 amps at 2 VDC or 0.1 amp at 45 VDC; sim to Centralab 6 Control.
R58	3R151-P472K	Composition: 4700 ohms ±10%, 1/8 w.
R59	3R151-P223K	Composition: 22,000 ohms ±10%, 1/8 w.
R60	3R151-P473K	Composition: 47,000 ohms ±10%, 1/8 w.
R61	3R151-P103K	Composition: 10,000 ohms ±10%, 1/8 w.
		- - - - - - - - - - SWITCHES - - - - - - - - -
S3		(Part of R50).
		- - - - - - - - - - MISCELLANEOUS - - - - - - - - -
	19B216416-P1	Knob. (Used with R50 and R57).
A10 and A11		ANTENNA BLOCK A10 19C317012-G1 (Used in 19D413223-G1) A11 19C317012-G2 (Used in 19D413223-G2 thru G4) REV A
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C65	5491674-P25	Tantalum: .047 µf +50 -20%, 20 VDCW; sim to Sprague Type 162D.
C66	19A116102-P3	Silver mica: 47 pf ±10%, 500 VDCW.
		- - - - - - - DIODES AND RECTIFIERS - - - - - -
CR20	5494922-P9	Silicon.
CR21*	4038056-P1	Germanium. Added by REV A.

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - FILTERS - - - - - - - - - -
FL1		RF FILTER A 19B216414-G1
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C61	19A116114-P37	Ceramic: 18 pf ±10%, 100 VDCW.
C62	19A116114-P33	Ceramic: 12 pf ±5%, 100 VDCW.
		- - - - - - - - - - INDUCTORS - - - - - - - - -
L17	19B216407-G1	Coil.
		- - - - - - JACKS AND RECEPTACLES - - - - - -
J4	19A127441-P1	Connector, receptacle.
		- - - - - - - - - - - RELAYS - - - - - - - - - -
K1	19A116143-P1	Reed, dry: 2000 ohms ±10% coil res, 14 VDC.
		- - - - - - - - - - INDUCTORS - - - - - - - - -
L20	19B209420-P114	Coil, RF: 1.20 µh ±10%, 0.18 ohms DC res max; sim to Jeffers 4436-1K.
		- - - - - - - - - - RESISTORS - - - - - - - - -
R62	3R151-P153K	Composition: 15,000 ohms ±10%, 1/8 w.
		- - - - - - - - - - SWITCHES - - - - - - - - -
S1	19A127036-P1 19A127439-P1 7141225-P6 19A116125-P1004 19A127442-P1	Switch assembly. Includes: Button. (Push to talk). Actuator. Hexnut: 0 x 80. Panhead screw: 0 x 80 x 1/4 Phillips SS. Contact.
S2	19A116107-P1	Slide: 0.5 amp at 100 VAC; sim to Sanset SS-12.
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C100A	19A116114-P15	Ceramic: 4.7 pf ±10%, 100 VDCW.
C100B	19A116114-P11	Ceramic: 3.3 pf ±10%, 100 VDCW.
		- - - - - - - - - - MISCELLANEOUS - - - - - - - -
	19A127440-G1	Ground strap. (Antenna block)
	19C317013-P1	Moulding, antenna block. (Single frequency)
	19A127438-P1	Sleeve. (Used with antenna swivel)
	19A127437-P1	Spring. (Used with antenna swivel)
	19B216401-P4	Spring. (Used with battery)
	19A127436-P1	(Antenna swivel).
	N207P5C6	Nut. (Secures battery spring).
	19A116131-P2	Washer, outer: (Used with antenna swivel)
	19A116131-P1	Washer, inner. (Used with antenna swivel)
	N81P5004C6	Screw. (Secures battery spring)
	N406P1	Lockwasher. (Secures J4 and S2)
	7141225-P6	Hexnut. (Secures J4 and S2)
	19A116125-P1004	Screw. (Secures J4 and S2)
	19C317013-P2	Moulding. (2 frequency)
	N402P1	Flat washer. (Secures battery spring)
		- - - - - - - MISCELLANEOUS ASSEMBLIES - - - - -
	19B216423-G1	External Antenna Connector.
	19B216399-G1	Antenna assembly.
	19B216397-G1	Speaker.
	19B216447-G1	Carring case. (Used for Standard and Channel Guard).
	19B216447-G2	Carring case. (Used for Sel Call).

SYMBOL	GE PART NO.	DESCRIPTION
	19C311993-G1	Case. (Used in Standard application).
	19C311993-G2	Case. (Used in Sel Call and Channel Guard).
		FLEXIBLE WIRE ANTENNA 19B216437-G1
	19A127442-P1	Insulator.
	19A127423-P1	Plug, banana.
		- - - - - - - MISCELLANEOUS HARDWARE - - - - - -
	19C317032-P1	Cover. (Audio Squelch)
	N52P1002	Flathead screw: 0 x 80 x 1/8 Phillips SS. (Used to mount A9 to chassis).
	19A116125-P1002	Panhead screw: 0-80 x 1/8 Phillips SS. (Used to Mount A9 to chassis).
	19A116125-P1004	Panhead screw: 0-80 x 1/4 Phillips SS. (Located on face of Audio Squelch Cover).
A1		OPTION 5976 AUDIO BOARD 19C311858-G2 REV A
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C1	5491674-P19	Tantalum: 3.3 µf +50 -20%, 6 VDCW; sim to Sprague Type 162D.
C2	5491674-P20	Tantalum: 0.022 µf +50 -10%, 20 VDCW; sim to Sprague Type 162D.
C3	19A116095-P2	Ceramic: 10,000 pf ±10%, 50 VDCW.
C4	19A116095-P1	Ceramic: 1000 pf ±10%, 100 VDCW.
C5	5491674-P2	Tantalum: 10 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
		- - - - - - - - DIODES AND RECTIFIERS - - - - - -
CR1	4036887-P5	Silicon, Zener.
		- - - - - - - - - - TRANSISTORS - - - - - - - - -
Q1 thru Q5	19A116144-P1	Silicon, NPN; sim to Type 2N4286.
		- - - - - - - - - - RESISTORS - - - - - - - - -
R1	3R151-P103K	Composition: 10,000 ohms ±10%, 1/8 w.
R2	3R151-P332J	Composition: 3300 ohms ±5%, 1/8 w.
R3	3R151-P101K	Composition: 100 ohms ±10%, 1/8 w.
R4	3R151-P132K	Composition: 1300 ohms ±10%, 1/8 w.
R5*	3R151-P563J	Composition: 56,000 ohms ±5%, 1/8 w. Earlier than REV A:
	3R151-P513J	Composition: 51,000 ohms ±5%, 1/8 w.
R6*	3R151-P513J	Composition: 51,000 ohms ±5%, 1/8 w. Earlier than REV A:
	3R151-P563J	Composition: 56,000 ohms ±5%, 1/8 w.
R7	3R151-P513J	Composition: 51,000 ohms ±5%, 1/8 w.
R8	3R151-P913J	Composition: 91,000 ohms ±5%, 1/8 w.
R9	3R151-P103K	Composition: 10,000 ohms ±10%, 1/8 w.
R10	3R151-P113J	Composition: 11,000 ohms ±5%, 1/8 w.
R11	3R151-P103J	Composition: 10,000 ohms ±5%, 1/8 w.
R12	3R151-P223J	Composition: 22,000 ohms ±5%, 1/8 w.
R13	3R151-P102J	Composition: 1000 ohms ±5%, 1/8 w.
R14	3R151-P201J	Composition: 200 ohms ±5%, 1/8 w.
R15 and R16	3R151-P153J	Composition: 15,000 ohms ±5%, 1/8 w.
R17	3R151-P105J	Composition: 1 megohm ±5%, 1/8 w.
R18	19A116093-P1	Variable, carbon film: 7500 ohms ±20%, 1/20 w.
R24	3R151-P751J	Composition: 750 ohms ±5%, 1/8 w.

PRODUCTION CHANGES

Changes to a module to improve performance or to simplify circuits are identified by a "Revision Letter" which is indicated by 3 color dots on the solder side of the module. (See Table 1 "Revision Letter Marking"). The revision indicated on a module includes all previous revisions. Refer to the parts list for descriptions of parts affected by these revisions.

REV. A - Oscillator-Multiplier A2/A3 (19D413207-G1 & G2)
To increase the stability of driver Q14. Added R37.

REV. A - Power Amplifier A4 (19C317006-G1)
To increase decoupling of RF from DC supply line. Added C55.

TABLE 1 - REVISION LETTER MARKING

The Revision Letter of a particular module is indicated by three color dots. Revision Letters and corresponding color dots are shown in the following table.

REVISION LETTER	FIRST COLOR DOT	SECOND COLOR DOT	THIRD COLOR DOT
A	White	White	White
B	White	White	Black
C	White	White	Yellow
D	White	White	Red
E	White	White	Green
F	White	Black	White
G	White	Black	Black
H	White	Black	Yellow
J	White	Black	Red
K	White	Black	Green
L	White	Yellow	White
M	White	Yellow	Black
N	White	Yellow	Yellow
P	White	Yellow	Red
R	White	Yellow	Green
S	White	Red	White
T	White	Red	Black
U	White	Red	Yellow
V	White	Red	Red
W	White	Red	Green

REV. A - Antenna Block A10/A11 (19C317012-G1 & G2)

REV. B - Power Amplifier A4 (19C317006-G1)
To provide reverse-polarity protection for the transmitter. Deleted Q31 and C54. Added CR21.

REV. A - Audio A1 (19C311858-G1 & G2)
To improve modulation symmetry. Changed R5 and R6.

REV. B - Oscillator-Multiplier A2/A3 (19D413207-G1 & G2)
To increase power out of transmitter driver board. Changed Q14.

PARTS LIST

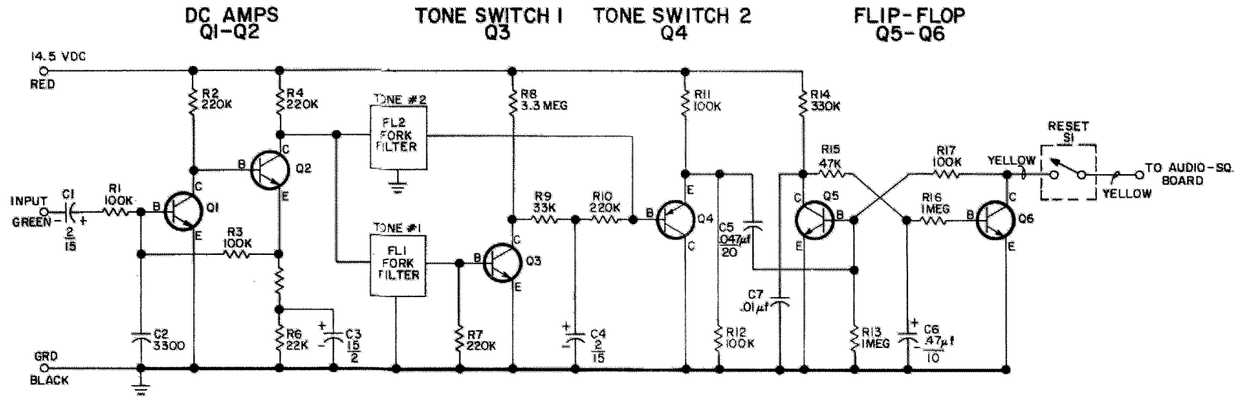
LBI-4030B

SELECTIVE CALLING DECODER
19D413218-G1

SYMBOL	G-E PART NO.	DESCRIPTION
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1	5491674-P23	Tantalum: 2.2 µf ±20%, 15 VDCW; sim to Sprague Type 162D.
C2	19C301438-P11	Ceramic: .0033 µf ±10%, 100 VDCW.
C3	5491674-P22	Tantalum: 15 µf ±20%, 2 VDCW; sim to Sprague Type 162D.
C4	5491674-P23	Tantalum: 2.2 µf ±20%, 15 VDCW; sim to Sprague Type 162D.
C5	5491674-P25	Tantalum: .047 µf +50 -20%, 20 VDCW; sim to Sprague Type 162D.
C6	5491674-P24	Tantalum: .47 µf +50 -20%, 10 VDCW; sim to Sprague Type 162D.
C7	19A116108-P1	Tantalum: .01 µf ±20%, 20 VDCW.
		- - - - - - - - - - FILTERS - - - - - - - - - -
		Note: When recordering, specify exact frequency needed and give drawing number in parts column.
FL1 and FL2	19A122789-P	
	5173	517.5 Hz
	5323	532.5 Hz
	5473	547.5 Hz
	5623	562.5 Hz
	5775	577.5 Hz
	5925	592.5 Hz
	6075	607.5 Hz
	6225	622.5 Hz
	6375	637.5 Hz
	6525	652.5 Hz
	6675	667.5 Hz
	6825	682.5 Hz
	6975	697.5 Hz
	7125	712.5 Hz
	7275	727.5 Hz
	7425	742.5 Hz
	7575	757.5 Hz
	7725	772.5 Hz
	7875	787.5 Hz
	8025	802.5 Hz
	8175	817.5 Hz
	8325	832.5 Hz
	8475	847.5 Hz
	8625	862.5 Hz
	8775	877.5 Hz
	8925	892.5 Hz
	9075	907.5 Hz
	9225	922.5 Hz
	9375	937.5 Hz
	9525	952.5 Hz
	9675	967.5 Hz
		- - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q1 thru Q3	19A116144-P1	Silicon, NPN; sim to Type 2N4286.
Q4	19A127414-P2	Silicon, PNP; sim to Type 2N4284, (Selected with Beta min. of 40 at 1000 µa Ic).
Q5 and Q6	19A116144-P1	Silicon, NPN; sim to Type 2N4286.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1	3R151-P104K	Composition: 0.10 megohms ±10%, 1/8 w.
R2	3R151-P224K	Composition: 0.22 megohms ±10%, 1/8 w.
R3	3R151-P104K	Composition: 0.10 megohms ±10%, 1/8 w.
R4	3R151-P224K	Composition: 0.22 megohms ±10%, 1/8 w.
R5	3R151-P221K	Composition: 220 ohms ±10%, 1/8 w.
R6	3R151-P223K	Composition: 22,000 ohms ±10%, 1/8 w.
R7	3R151-P224K	Composition: 0.22 megohms ±10%, 1/8 w.
R8	3R151-P335K	Composition: 3.3 megohms ±10%, 1/8 w.
R9	3R151-P333K	Composition: 33,000 ohms ±10%, 1/8 w.
R10	3R151-P224K	Composition: 0.22 megohms ±10%, 1/8 w.
R11 thru R12	3R151-P104K	Composition: 0.10 megohms ±10%, 1/8 w.
R13	3R151-P104K	Composition: 0.1 megohm ±10%, 1/8 w.
R14	3R151-P334K	Composition: 0.33 megohms ±10%, 1/8 w.
R15	3R151-P473K	Composition: 47,000 ohms ±10%, 1/8 w.
R16	3R151-P105K	Composition: 1 megohm ±10%, 1/8 w.
R17	3R151-P104K	Composition: 0.10 megohms ±10%, 1/8 w.
		- - - - - - - - - - SWITCHES - - - - - - - - - -
S1	19A127469-P1	Slide: contact rating 0.5 amps at 100 VAC.
		- - - - - - - - - - MISCELLANEOUS - - - - - - - - - -
	19A116125-P1006	Panhead screw: 0-80 x 3/8 Phillips. (2)
	19A116125-P1008	Panhead screw: 0-80 x 1/2 Phillips. (2)
	19A127461-G1	Tone Option Housing.
	19A116111-P1	Socket, Reed. (Used with FL1 and FL2).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES.

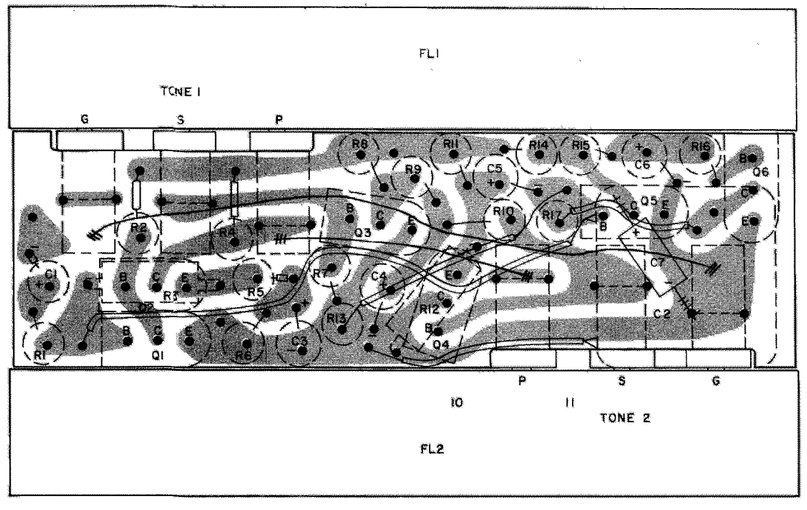
SCHEMATIC DIAGRAM



(19C311967, Rev. 1)

NOTE:
1. ALL CAPACITORS IN PICOFARADS UNLESS OTHERWISE INDICATED.

OUTLINE DIAGRAM



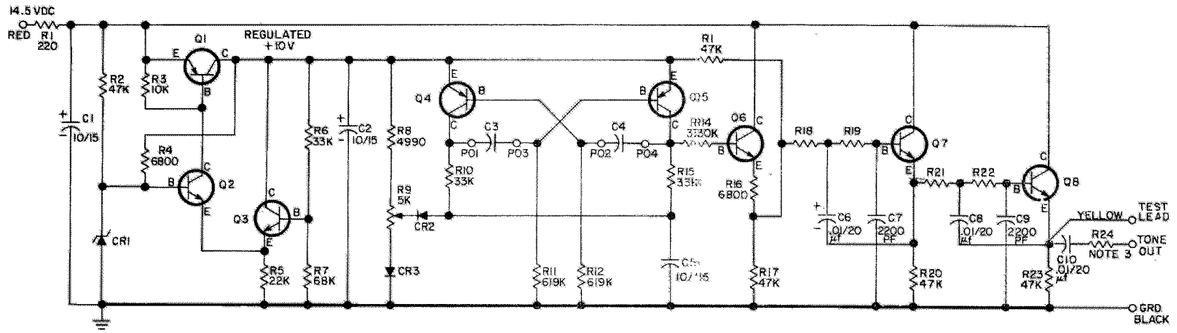
(19D317225, Rev. 2)
(19C317007, Rev. 6)

Denotes Solder Side

SCHEMATIC & OUTLINE DIAGRAMS

SELECTIVE CALLING DECODER
19D413218-G1

SCHEMATIC DIAGRAM



R11, R12	FREQ. RANGE (HZ)	C3, C4 (SELECT AT TEST)
619K	66.1-83.5	.02
	83.5-105.5	*.01, *.005
	105.5-133	*.01, *.002
	133-167	.01
	167-212	*.005, *.002, *.001
	212-270	*.005, *.001

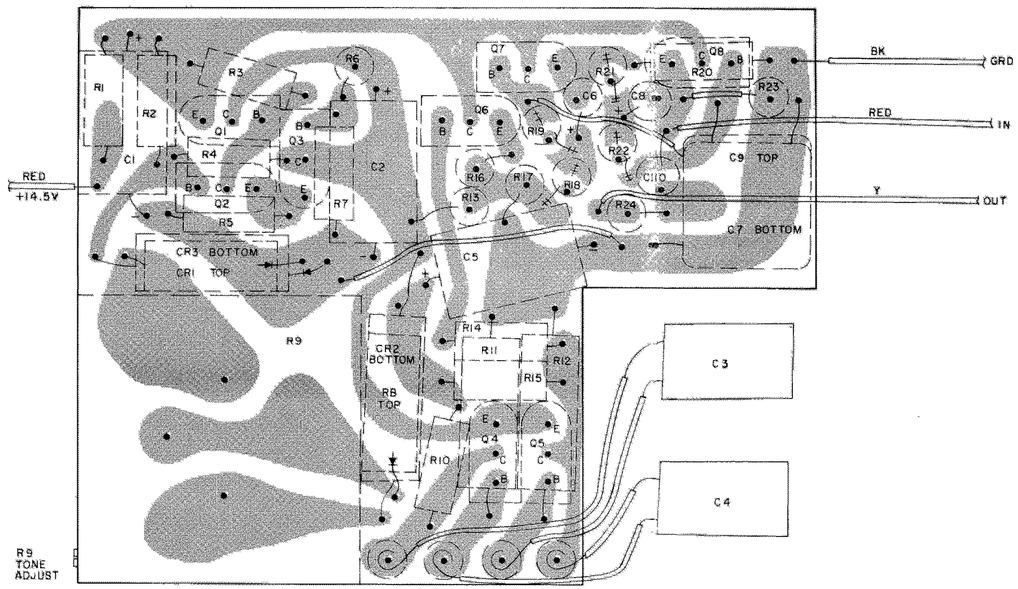
*CONNECTED IN PARALLEL

BAND	FREQ. RANGE (HZ)	SELECT AT TEST R18, R21	SELECT AT TEST R19, R22
1	67-95	150K	680K
2	95-135	100K	470K
3	135-190	68K	330K
4	190-270	47K	220K

NOTES:
1. SELECT 2N4284'S FOR B MIN. OF 40 @ 100 UAIC.
2. ALL CAPACITORS IN PICOFARADS UNLESS OTHERWISE INDICATED.
3. SELECT AT TEST (NOMINAL 3.3 MEGOHMS)

(19C311966, Rev. 0)

OUTLINE DIAGRAM



(19D413340, Rev. 0)
(19D413219, Rev. 0)

SCHEMATIC & OUTLINE DIAGRAMS

CHANNEL GUARD ENCODER
19D413217-G25

Denotes Solder Side

PARTS LIST

LBI-4031A

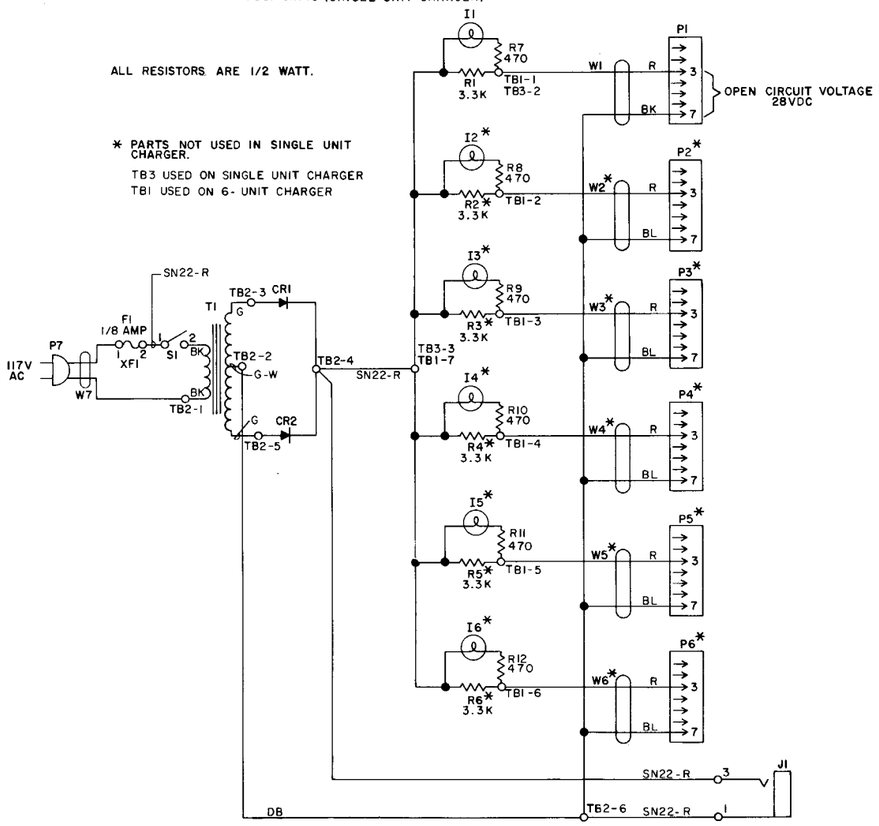
CHANNEL GUARD ENCODER
19D413217-G1-G26

SYMBOL	G-E PART NO.	DESCRIPTION
		19D413217-G1 71.9 Hz 19D413217-G2 77.0 Hz 19D413217-G3 82.5 Hz 19D413217-G4 88.5 Hz 19D413217-G5 94.8 Hz 19D413217-G6 100.0 Hz 19D413217-G7 103.5 Hz 19D413217-G8 107.2 Hz 19D413217-G9 110.9 Hz 19D413217-G10 114.8 Hz 19D413217-G11 118.8 Hz 19D413217-G12 123.0 Hz 19D413217-G13 127.3 Hz 19D413217-G14 131.8 Hz 19D413217-G15 136.5 Hz 19D413217-G16 141.3 Hz 19D413217-G17 146.2 Hz 19D413217-G18 151.4 Hz 19D413217-G19 156.7 Hz 19D413217-G20 162.2 Hz 19D413217-G21 167.9 Hz 19D413217-G22 173.8 Hz 19D413217-G23 179.9 Hz 19D413217-G24 186.2 Hz 19D413217-G25 192.8 Hz 19D413217-G26 203.5 Hz
		---------- CAPACITORS ----------
C1 and C2	5491674-P18	Tantalum: 10 µf ±20%, 15 VDCW; sim to Sprague Type 162D.
C3 and C4	19A116148-P1	Polycarbonate: 0.02 µf ±5%, 75 VDCW. (Used in Groups 1 - 3).
C3 and C4	19A116148-P5	Polycarbonate: 0.015 µf ±5%, 75 VDCW. (Used in Groups 4 - 7).
C3 and C4	19A116148-P4	Polycarbonate: 0.0082 µf ±5%, 75 VDCW. (Used in Groups 21-26).
C3A and C4A	19A116148-P3	Polycarbonate: 0.005 µf ±5%, 75 VDCW. (Used in Groups 8 - 20).
C3B and C4B	19A116148-P3	Polycarbonate: 0.005 µf ±5%, 75 VDCW. (Used in Groups 8 - 20).
C3C and C4C	19A116148-P2	Polycarbonate: 0.002 µf ±5%, 75 VDCW. (Used in Groups 8 - 14).
C5	5491674-P18	Tantalum: 10 µf ±20%, 15 VDCW; sim to Sprague Type 162D.
C6	19A116108-P1	Tantalum: .01 µf ±20%, 20 VDCW.
C7	19C301438-P10	Ceramic: .0022 µf ±20%, 100 VDCW.
C8	19A116108-P1	Tantalum: .01 µf ±20%, 20 VDCW.
C9	19C301438-P10	Ceramic: .0022 µf ±20%, 100 VDCW.
C10	19A116108-P1	Tantalum: .01 µf ±20%, 20 VDCW.
		---------- DIODES AND RECTIFIERS ----------
CR1	4036887-P48	Silicon, Zener.
CR2 and CR3	19A116140-P1	Germanium; sim to Type 1N695.
		---------- TRANSISTORS ----------
Q1	19A116145-P1	Silicon, PNP; sim to Type 2N4280.
Q2 and Q3	19A116144-P1	Silicon, NPN; sim to Type 2N4286.
Q4 and Q5	19A127414-P1	Silicon, PNP; sim to Type 2N4284. (Selected with Beta min. of 40 at 100 µa Ic).
Q6 thru Q8	19A116144-P1	Silicon, NPN; sim to Type 2N4286.
		---------- RESISTORS ----------
R1	3R151-P221K	Composition: 220 ohms ±10%, 1/8 w.
R2	3R151-P473K	Composition: 47,000 ohms ±10%, 1/8 w.
R3	3R151-P103K	Composition: 10,000 ohms ±10%, 1/8 w.
R4	3R151-P682K	Composition: 6800 ohms ±10%, 1/8 w.
R5	3R151-P223K	Composition: 22,000 ohms ±10%, 1/8 w.
R6	3R151-P333K	Composition: 33,000 ohms ±10%, 1/8 w.
R7	3R151-P683K	Composition: 68,000 ohms ±10%, 1/8 w.
R8	19A116092-P1	Metal film: 4990 ohms ±1%, 200 VDCW, 1/8 w; sim to IRC Type CCM.
R9	19A116136-P1	Metal film: 5000 ohms ±10%, 1 w.
R10	3R151-P333K	Composition: 33,000 ohms ±10%, 1/8 w.
R11 and R12	19A116096-P1	Metal film: 0.61 megohms ±1%, 200 VDCW, 1/8 w; Sim to Sprague Type 416E.
R13	3R151-P473K	Composition: 47,000 ohms ±10%, 1/8 w.
R14	3R151-P334K	Composition: 0.33 megohms ±10%, 1/8 w.
R15	3R151-P333K	Composition: 33,000 ohms ±10%, 1/8 w.
R16	3R151-P682K	Composition: 6800 ohms ±10%, 1/8 w.
R17	3R151-P473K	Composition: 47,000 ohms ±10%, 1/8 w.
R18	3R151-P154K	Composition: 0.15 megohms ±10%, 1/8 w. (Used in Groups 1-5).
R18	3R151-P104K	Composition: 0.10 megohms ±10%, 1/8 w. (Used in Groups 6-14).
R18	3R151-P683K	Composition: 68,000 ohms ±10%, 1/8 w. (Used in Groups 15-24).
R18	3R151-P473K	Composition: 47,000 ohms ±10%, 1/8 w. (Used in Groups 25 and 26).
R19	3R151-P684K	Composition: 0.68 megohms ±10%, 1/8 w. (Used in Groups 1-5).
R19	3R151-P474K	Composition: 0.47 megohms ±10%, 1/8 w. (Used in Groups 6-14).
R19	3R151-P334K	Composition: 0.33 megohms ±10%, 1/8 w. (Used in Groups 15-24).
R19	3R151-P224K	Composition: 0.22 megohms ±10%, 1/8 w. (Used in Groups 25 and 26).
R20	3R151-P473K	Composition: 47,000 ohms ±10%, 1/8 w. (Used in Groups 1-24).
R21	3R151-P154K	Composition: 0.15 megohms ±10%, 1/8 w. (Used in Groups 1-5).
R21	3R151-P104K	Composition: 0.10 megohms ±10%, 1/8 w. (Used in Groups 6-14).
R21	3R151-P683K	Composition: 68,000 ohms ±10%, 1/8 w. (Used in Groups 15-24).
R21	3R151-P473K	Composition: 47,000 ohms ±10%, 1/8 w. (Used in Groups 25 and 26).
R22	3R151-P684K	Composition: 0.68 megohms ±10%, 1/8 w. (Used in Groups 1-5).
R22	3R151-P474K	Composition: 0.47 megohms ±10%, 1/8 w. (Used in Groups 6-14).
R22	3R151-P334K	Composition: 0.33 megohms ±10%, 1/8 w. (Used in Groups 15-24).
R22	3R151-P224K	Composition: 0.22 megohms ±10%, 1/8 w. (Used in Groups 25 and 26).
R23	3R151-P473K	Composition: 47,000 ohms ±10%, 1/8 w.
R24	3R151-P335K	Composition: 3.3 megohms ±10%, 1/8 w.
		---------- MISCELLANEOUS ----------
	19A116125-P1006	Panhead screw; 0-80 x 3/8 Phillips SS. (2) (Used with Tone Option Housing).
	19A116125-P1002	Panhead screw; 0-80 x 1/8 Phillips SS. (2) (Used with Tone Option Housing).
	19A127416-P2	Tone Option Housing.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES.

SCHEMATIC DIAGRAM

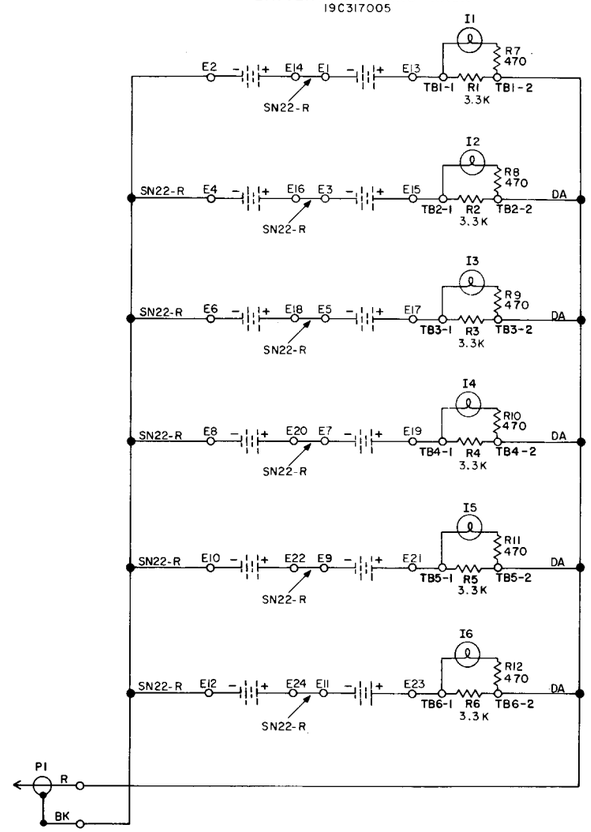
BATTERY CHARGER
19C317011P1 (6-UNIT CHARGER)
19C317011P16 (SINGLE-UNIT CHARGER)



(19C311771, Rev. 3)

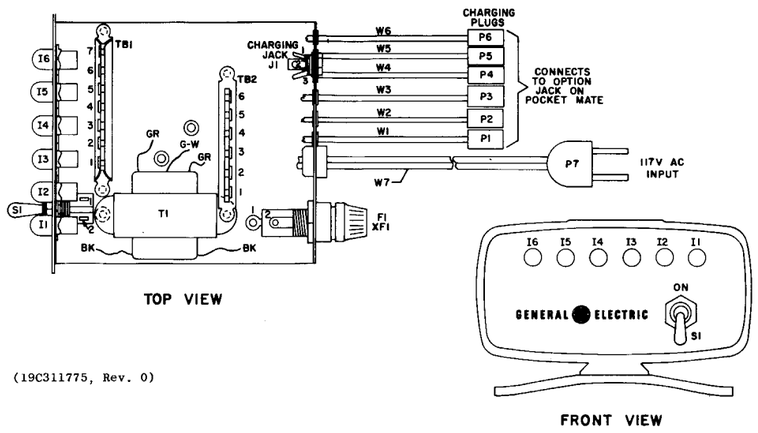
SCHEMATIC DIAGRAM

BATTERY CHARGING RACK
19C317005



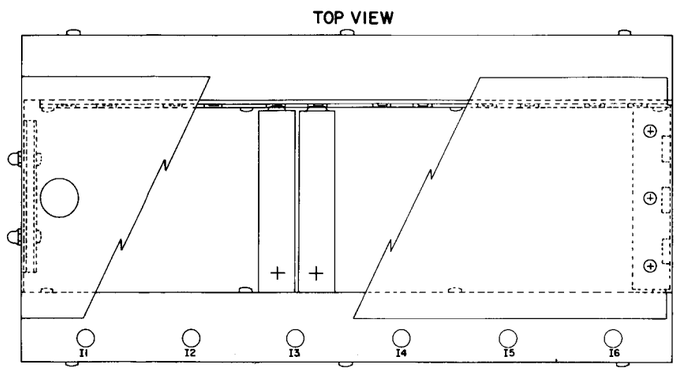
(19C311772, Rev. 2)

OUTLINE DIAGRAM



(19C311775, Rev. 0)

OUTLINE DIAGRAM



(19C311777, Rev. 0)

SCHEMATIC & OUTLINE DIAGRAMS

UNIT CHARGERS 19C317011-G1 & G2
BATTERY CHARGING RACK 19C317005-G1

PARTS LIST

LBI-4033A

SINGLE UNIT CHARGER 19C317011-G2
6 UNIT CHARGER 19C317011-G1

SYMBOL	G-E PART NO.	DESCRIPTION
		- - - - - - - DIODES AND RECTIFIERS - - - - - - -
CR1 and CR2	4037822-P1	Silicon.
		- - - - - - - - - - - FUSES - - - - - - - - - - -
F1	1R16-P12	Quick blowing: 1/8 amp at 250 v; sim to Littelfuse 312.125 or Bussman AGC-1/8.
		- - - - - - - - INDICATING DEVICES - - - - - - -
I1	19A115097-P2	Light, indicator: red transparent lens, 10 volts; sim to Drake 5682.
I2 thru I6	19A115097-P2	Light, indicator: red transparent lens, 10 volts; sim to Drake 5682. (Used in 19C317011-G1 only).
		- - - - - - - JACKS AND RECEPTACLES - - - - - - -
J1	5494642-P1	Jack: telephone, sub-miniature; sim to Switchcraft Tini-Jax 42A.
		- - - - - - - - - - - PLUGS - - - - - - - - - - -
P1 thru P6	19A116126-P2	Plug: 7 pins.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1	3R77-P332J	Composition: 3300 ohms ±5%, 1/2 w.
R2 thru R6	3R77-P332J	Composition: 3300 ohms ±5%, 1/2 w. (Used in 19C317011-G1 only).
R7 thru R12	3R77-P471J	Composition: 470 ohms ±5%, 1/2 w.
		- - - - - - - - - - SWITCHES - - - - - - - - - -
S1	7478623-P1	Toggle: SPST, 3 amps at 250 VDC; sim to Arrow-Hart and Hegeman 20994-BJC.
		- - - - - - - - - TRANSFORMERS - - - - - - - - -
T1	19B209017-P1	Power: rectifier, single phase, Pri: 117 v, 50/60 Hz, Sec 1: 25/25 v.
		- - - - - - - - TERMINAL BOARDS - - - - - - - - -
TB1	7115374-P7	Phen: 7 terminals; sim to HB Jones 326-20-06-210. (Used in 19C317011-G1 only).
TB2	7115374-P6	Phen: 6 terminals; sim to HB Jones 326-20-07-211. (Used in 19C317011-G2 only).
TB3	7775500-P2	Phen: 2 terminals. (Used in 19C317011-G2 only).
		- - - - - - - - - - - CABLES - - - - - - - - - - -
W1	19A127427-G1	Charging cable assembly. (Includes P1).
W2	19A127427-G1	Charging cable assembly. (Includes P2).
W3	19A127427-G1	Charging cable assembly. (Includes P3).
W4	19A127427-G1	Charging cable assembly. (Includes P4).
W5	19A127427-G1	Charging cable assembly. (Includes P5).
W6	19A127427-G1	Charging cable assembly. (Includes P6).
W7	4036441-G1	Power: approx 7 feet long, with 2-contact plug; sim to GE 2073-1.
		- - - - - - - - - - SOCKETS - - - - - - - - - -
XF1	19B209005-P1	Fuseholder, post type, phen: 15 amps at 250 v; sim to Littelfuse 342012.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES.

PARTS LIST

BATTERY HOLDER RACK
19C317005-G1

SYMBOL	G-E PART NO.	DESCRIPTION
		- - - - - - - - INDICATING DEVICES - - - - - - - -
I1 thru I6	19A115097-P2	Light, indicator: red transparent lens, 10 volts; sim to Drake 5682.
		- - - - - - - - - - - PLUGS - - - - - - - - - - -
P1	5494642-P11	Plug: telephone, sub-niniature; sim to Switchcraft Tini-plug-750.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1 thru R6	3R77-P332J	Composition: 3300 ohms ±5%, 1/2 w.
R7 thru R12	3R77-P471J	Composition: 470 ohms ±5%, 1/2 w.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES.

QUICK CHECKS

EQUIPMENT REQUIRED

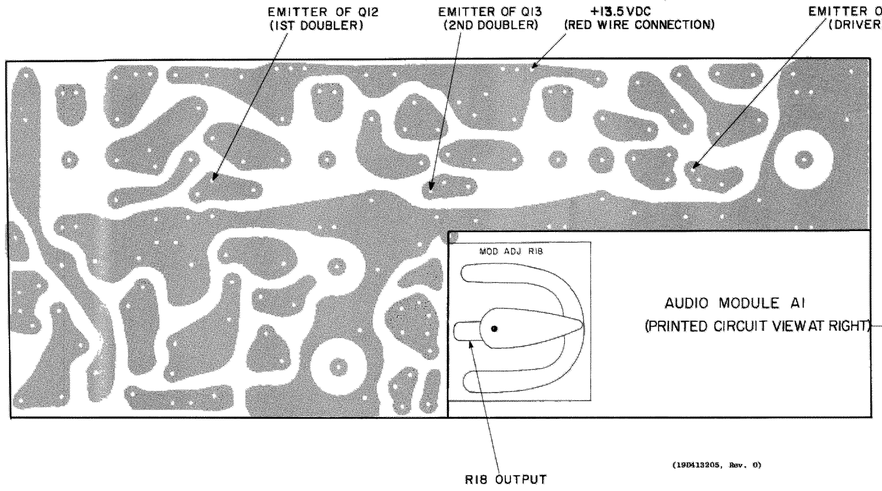
1. AC VTVM or Oscilloscope
2. 20,000 ohm-per-volt meter
3. 13.5 VDC, 500 mA Power Supply (connect as shown on transmitter ALIGNMENT PROCEDURE).

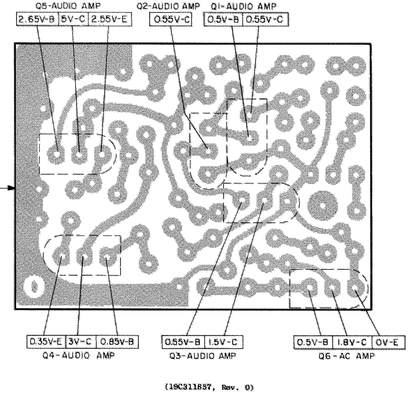
NOTE

The following checks are to be made with the transmitter keyed.

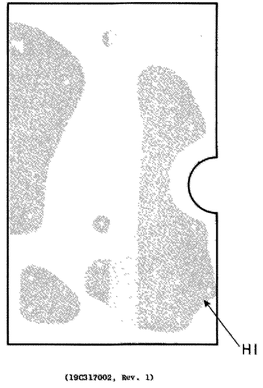
SYMPTOM	PROCEDURE
No Modulation	1. Check output of Speaker-Microphone.
	2. Check for audio at pin 1 of Option Jack J4 on the Antenna Block (see Antenna Block Outline Diagram). If no audio is present, check C65 & R62 on Antenna Block. If audio is present, proceed to step 3.
	3. Check for output from MOD ADJUST Control R18 (center terminal).
	4. If no output is present at MOD ADJUST, troubleshoot the Audio Module by making voltage checks at the transistor terminals, with a 20,000 ohm-per-volt meter. (Audio Module must be removed from its mounting position to reach terminals).
No Voltage to Transmitter	1. Check batteries. (See MAINTENANCE Section for battery information).
	2. With power supply connected, check for +13.5 VDC at red wire on Oscillator-Multiplier Module. If voltage is not present, go to step 3.
	3. Check for +13.5 VDC at H1 on the Power Amplifier A4 MODULE. If voltage is not present, check relay K1 on the Antenna Block.
No Power Output Trans. B+ OK.	Using 20,000 ohm-per-volt meter, make the following checks:
	1. Check voltage at emitter of 1st Doubler Q12 This should be 3.6 volts with F1 or F2 oscillator running or 2.0 volts when oscillator is not running.
	2. With oscillator running, check for 0.30 volts at the emitter of 2nd Doubler Q13.
	3. With oscillator running, check for 0.45 volts at the emitter of Driver Q14.
	4. If the above checks are OK, the PA probably is defective.

OSCILLATOR-MULTIPLIER A2/A3





POWER AMPLIFIER A4



RC-1832B

Denotes Solder Side

QUICK CHECKS

EQUIPMENT REQUIRED

1. AC VTVM
2. Signal Generator (Measurements M560 or equivalent)
3. Oscilloscope
4. Frequency Counter
5. RF Voltmeter
6. 14.5 VDC, 500-mA power supply. (Make power connections to the unit as shown on the Receiver ALIGNMENT PROCEDURE).

SYMPTOM	PROCEDURE
Receiver Dead	1. Check batteries.
	2. With power supply connected, check for +14.5 VDC at the modules (see diagram).
	3. Check oscillator voltage by connecting a VTVM between +14.5 Volts and the emitter of Q6. Reading should be between 0.8 and 1.5 volts.
	4. Check discriminator output with VTVM by varying an on-channel signal (applied to antenna jack) and checking for meter swing. If output is present, check Audio-Squelch module as directed in step 5. If output is not present, go to step 6.
	5. Disconnect blue wire between IF Amp, (A5) and Audio-Squelch (A9), to disable the squelch circuit. If noise is present, check voltages at Q19, Q20, & Q21. If noise is not present, check voltages at Q15, Q16, Q17 & Q18.
	6. Apply a 1000 µV on-frequency RF signal to the antenna jack. Using an RF voltmeter, make GAIN CHECKS "A", "B" and "C" as shown on the diagram. "A" checks the RF Osc, "B" checks the Crystal Filter and "C" checks the Lo IF Amp.
	7. Troubleshoot a defective module by making voltage checks at the transistor terminals.
No Quieting	1. Check oscillator voltage by connecting a VTVM between +14.5 Volts and the emitter of Q6. Reading should be between 0.8 and 1.5 volts.
	2. Check receiver alignment.
	3. Apply a 1000 µV on-frequency RF signal to the antenna jack. Using an RF voltmeter, make GAIN CHECKS "A", "B" and "C" as shown on the diagram. "A" checks the RF Osc, "B" checks the Crystal Filter and "C" checks the Lo IF Amp.
	4. Troubleshoot a defective module by making voltage checks at the transistor terminals.
Low Sensitivity	1. With power supply connected, check for +14.5 VDC at the modules (see diagram).
	2. Check receiver alignment.
	3. Apply a 1000 µV on-frequency RF signal to the antenna jack. Using an RF voltmeter, make GAIN CHECKS "A", "B" and "C" as shown on the diagram. "A" checks the RF Osc, "B" checks the Crystal Filter and "C" checks the Lo IF Amp.
	4. Troubleshoot a defective module by making voltage checks at the transistor terminals.

TROUBLESHOOTING PROCEDURE

RECEIVER
MODEL 4ES33A2-A5

END OF DOCUMENT