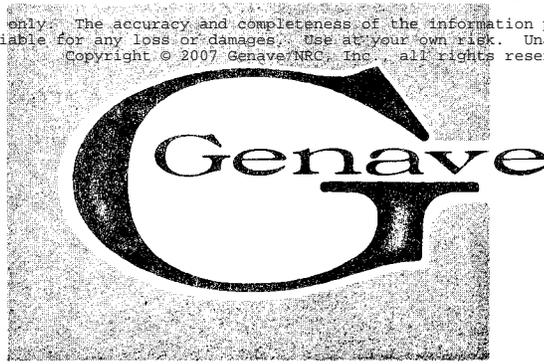


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# ECOM - 4<sup>®</sup> HANDHELD VHF-FM COMMUNICATIONS TRANSCEIVER MAINTENANCE MANUAL

LIMITED

 **WARRANTY** 

General Aviation Electronics, Inc. (Genave), warrants this product to be free from material defects for a period of 90 days from the date of purchase, provided the warranty registration card properly filled out is returned by the purchaser to Genave within 10 days after purchase. This warranty is limited to the original retail purchaser and is not extended to second owners of the product.

Our obligation under this warranty is limited to replacement of any parts (except periodic maintenance items such as bulbs, fuses, etc.) which, upon our examination, appear to us to be defective in materials or workmanship. The parts will be replaced within 45 days after receipt of the unit, provided the unit is delivered to the Factory (Customer Service Dept., General Aviation Electronics, 4141 Kingman Drive, Indianapolis, Indiana 46226) within 90 days after the date of purchase, shipping prepaid. All shipping costs and labor charges shall be born by the purchaser.

The owner may elect to have the unit repaired at an authorized Genave repair facility in which case Genave, within 45 days after receipt of the unit, will replace only those defective parts returned shipping prepaid to the Factory (Customer Service Dept., General Aviation Electronics, 4141 Kingman Drive, Indianapolis, Indiana 46226). Purchaser shall bear any and all other costs including but not limited to labor, transportation and freight.

This warranty does not apply to defects, malfunction, or breakage due to improper installation or to the servicing thereof by other than an authorized Genave dealer nor to units that have been damaged by lightning or other acts of God, excess current, or any units that have had serial number altered or removed. Abuse, misuse, tampering, submersion in water or willful destruction of the unit will also void this warranty.

This warranty gives you specific legal rights. You also have implied warranty rights. In the event of a problem with warranty service or performance, you may be able to go to a small claims court, a State court, or a Federal District court.

Genave offers this warranty in lieu of any and all other guarantees or warranties, either **EXPRESSED or IMPLIED, including but not limited to warranties of merchantability and/or fitness for a particular purpose. Any implied warranties are specifically and expressly limited to the 90-day period specified herein. Damages for breach of any warranties, either expressed or implied are limited to replacement of any defective parts as specified herein and any other incidental or consequential damages are expressly excluded.**

General Aviation Electronics, 4141 Kingman Drive, Indianapolis, Indiana 46226—Area 317-546-1111

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GENERAL AVIATION ELECTRONICS, INC.

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# SECTION I

## GENERAL INFORMATION

### 1-1. INTRODUCTION

This manual contains all the information normally required to license, implement, and operate the Genave ECOM-4 VHF-FM transceiver.

The maintenance manual contains all the above information, in addition to unit schematics, alignment data, and parts lists.

### 1-2. DESCRIPTION

The ECOM-4 is designed to provide reliable, high-quality communications for various business radio services, such as: Public Safety, Industrial Radio, and Land Transportation. The radio was under strict quality control during its fabrication, and was thoroughly checked prior to shipment from the factory. It will provide many years of satisfactory operation, if given reasonable care and handling.

The Genave ECOM-4 is a handheld, portable VHF transceiver designed for the transmission and reception of frequency modulated radio signals on any of four channels within the range from 143.9 to 173.4 MHz. A four-position slide switch selects the desired operating channel - each of which may be either simplex or duplex, depending upon the crystal frequencies installed within the unit.

The transceiver is complete with detachable antenna, nicad batteries, battery charger, carrying case, built-in speaker and microphone. All circuitry employed is the latest state-of-the-art design, using the latest in semiconductor and integrated-circuit technology. The receiver and transmitter circuits each utilize standard quartz crystals with a frequency-netting trimmer provided for each receive and each transmit crystal to allow precise frequency adjustment.

The transmitter provides a typical RF output of 2 watts (1.5 watts minimum) into a standard 52-ohm antenna system over the frequency range from 143.9 MHz to 173.4 MHz. The frequency accuracy is adjustable to  $\pm 200$  Hz and the frequency stability is  $\pm 0.0005\%$ . A 1-kHz modulating audio signal will give a deviation of  $\pm 5$  kHz maximum.

The receiver is a crystal-controlled, dual-conversion superheterodyne employing a 4-pole monolithic crystal filter for good selectivity. A single integrated circuit performs 2nd mixer, 2nd IF amplification, limiting, and detection functions. The 10.7 MHz 1st IF provides good image rejection, while the 455 kHz 2nd IF improves receiver stability. The receiver frequency accuracy is adjustable within  $\pm 500$  Hz and the frequency stability is  $\pm 0.001\%$ . The minimum receiver audio output power is 250 mW.

Power to operate the unit is supplied by the self-contained battery pack, which supplies 7.2-volts DC when nicad cells are used. While six size AA Alkaline penlight batteries can be used, nicad cells are recommended for optimum performance. Provision for charging the transceiver is made by means of an external charging jack and a diode which prevents reversed-polarity charging.

The transceiver is housed in a rugged Lexan case -- this easily-removed, two-piece, durable plastic cover protects the instrument from dirt and physical damage while maintaining the unit's light weight (less than 2 pounds).

The recessed, low-profile controls do not protrude above the radio's surface, and are located on front panel to facilitate one-hand operation. The front panel is designed so that an optional touch-tone encoder can be installed, if desired.

## 1-3. SPECIFICATIONS

### GENERAL:

Control Area Size: 1.7" (4.32 cm) x 1.7" (4.32 cm)  
Over-all Dimensions: 8" (20.32 cm) x 2.875" (7.303 cm) x 1.175" (2.98 cm)  
Power Supply: 6 AA-size penlight batteries - Nicad or Alkaline  
Battery Operating Time: 2 watt 6 hours (Based on "squelched receiver" 90%; transmit 5%; and receive 5% duty cycle)  
Frequency Range: 143.9 to 173.4 MHz  
Number of Channels: 4  
Channel Separation: 2 MHz, maximum  
Temperature Range: -30°C to +60°C  
Weight: Less than 2 Lbs. (0.907 kg)

### RECEIVE:

Sensitivity: 0.5  $\mu$ V maximum for 12 dB SINAD  
Selectivity:  $\pm$ 7.5 kHz, typical  
Squelch Threshold: 0.5  $\mu$ V maximum  
Modulation Acc. Bandwidth:  $\pm$ 7.5 kHz maximum  
Adjacent Chan. Rejection: -35 dB minimum at 25 kHz (12-dB SINAD)  
-40 dB minimum at 30 kHz (12-dB SINAD)  
Intermodulation Response: -45 dB minimum (E.I.A. method)  
Image Response: -40 dB minimum  
Spurious Response: -40 dB  
Audio Output Power: 250 mW minimum  
Hum & Noise Level: 35 dB below 0.25 watts, minimum  
Frequency Accuracy: Adjustable within  $\pm$ 500 Hz  
Frequency Stability:  $\pm$ .001%

### TRANSMIT:

Power Output: 2 watts typical (1.5 watts minimum)  
Frequency Range: 143.9 to 173.4 MHz  
Output Impedance: 50-ohms, typical  
Deviation:  $\pm$ 5kHz maximum with 1 kHz audio  
Frequency Stability:  $\pm$ .0005%  
Frequency Accuracy: Adjustable to  $\pm$  200 Hz  
Touch Tone: External option

## 1-4. EQUIPMENT FURNISHED

- a. Antenna, Helically-loaded, rubber-clad flexible (1)
- b. Crystal, Receive (1)
- c. Crystal, Transmit (1)
- d. Carrying Case (1)
- e. Battery, Penlight, 1.2 V nicad (6)
- f. Charger, Battery (1)

# SECTION II

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## INSTALLATION MANUAL

### 2-1. INTRODUCTION

This manual Section provides installation and charging data for the nicad batteries supplied with this VHF-FM handheld transceiver. Some information concerning the antenna supplied with the unit is also given.

### 2-2. BATTERY INSTALLATION

The six 1.2-volt nicad penlight batteries are not installed in unit at time of shipment from the factory, but are packaged in shipping container with transceiver. The batteries must be installed in instrument, and charged for a minimum of 8-hours, prior to using transceiver.

**NOTE:** Nicad batteries supplied with instrument must be installed in the transceiver in order to charge them with battery charger that is supplied with unit. This charger will NOT overcharge the nicad cells. DO NOT TRANSMIT WITH CHARGER CONNECTED TO TRANSCEIVER.

If the transceiver must be used before the nicad batteries have had time to charge, the nicad cells may be removed and replaced with six size AA alkaline penlight batteries.

The plastic front cover of the transceiver must be removed in order to install batteries. This cover is easily removed as follows (see Figure 2-1):

1. Unscrew antenna (A) from its threaded mounting stud.
2. Remove one #4-40 oval-head machine screw (B) from bottom-center of rear cover.
3. Carefully lay transceiver on its back; now, lift bottom of front cover upward and slide cover off antenna mounting stud.

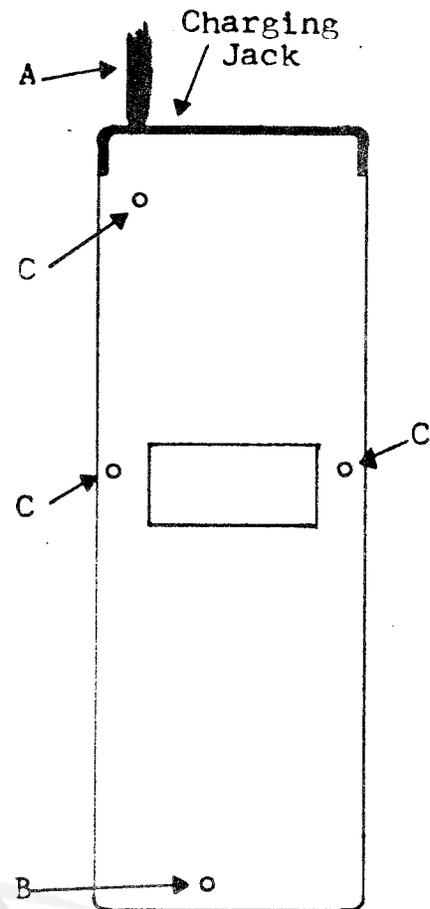


Figure 2-1. Unit Rear View

4. Insert three batteries in each of the two phenolic battery tubes furnished with the radio (Figure 2-2).
5. Insert battery tubes in place between appropriate battery clips on transceiver PC board. PROPER BATTERY POLARITY IS SHOWN IN FIGURE 2-2, AND IS MARKED ON PC BOARD.

**NOTE:** When front cover is removed, speaker is only held in place on PC board by adhesive tape; thus, during battery installation, speaker can be removed, if desired. To re-install speaker, locate leads approximately as shown in Figure 2-2. BE SURE terminals do NOT touch coil cans or shields.

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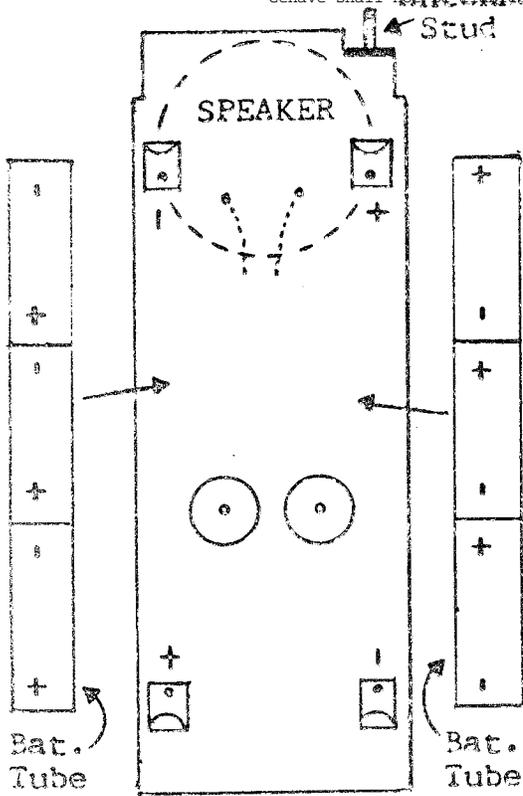


Figure 2-2. Battery Location

6. Replace unit front cover by reversing removal procedure above.
7. Plug cord from battery charger into charging jack (top of unit, adjacent to antenna). Next, insert charger into 120 VAC, 50/60 Hz, receptacle.
8. Be SURE volume control is turned fully counterclockwise to its OFF position. Allow batteries to charge for a minimum of 8 hours, and preferably overnight.

NOTE: Disconnect charger from 120 V source prior to connecting or disconnecting charger and transceiver.

### 2-3. ANTENNA INSTALLATION

All VHF communications are basically limited to "line-of-sight" distances. The range to be expected with any particular system will depend primarily upon two factors: (1) Antenna heights, both at the transmitting station and at the receiving station and, (2) Ground

terrain between transmitting and receiving stations.

The ECOM-4 is designed to operate into a 52-ohm antenna system. The unit is fitted with a threaded 8-32 stud, accessible through a hole in top of unit, for antenna connection. The unit is supplied with a helically-loaded, vinyl clad, flexible antenna which is precut for the proper frequency.

If it should be necessary to replace antenna, the following cutting chart can be used to insure that antenna is adjusted for the desired frequency. To use this chart, find the operating center frequency along the bottom edge of chart; then, read upward to the point at which the curve intersects the frequency line. Now, read across to vertical edge of chart to determine proper antenna length. This is the length from bottom of antenna (see illustration).

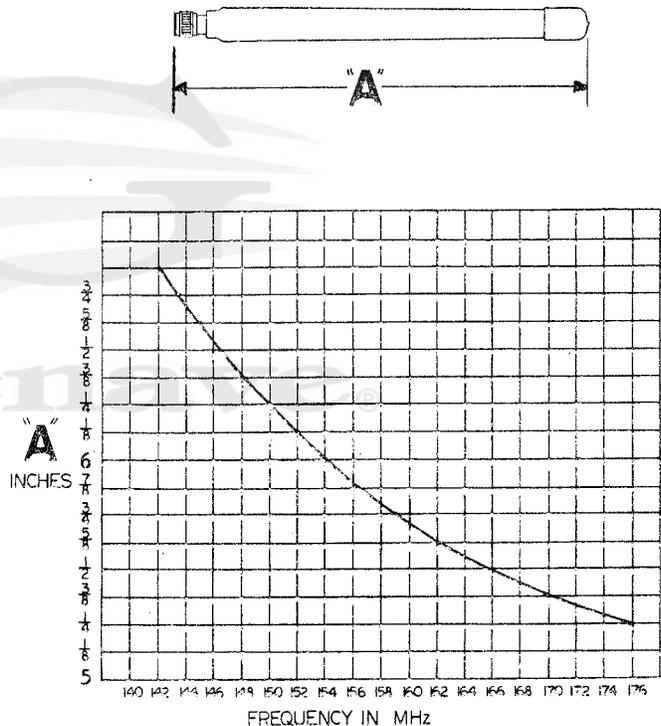


Figure 2-3. Antenna Chart

# SECTION III

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## OPERATING MANUAL

### 3-1. OPERATING CONTROLS

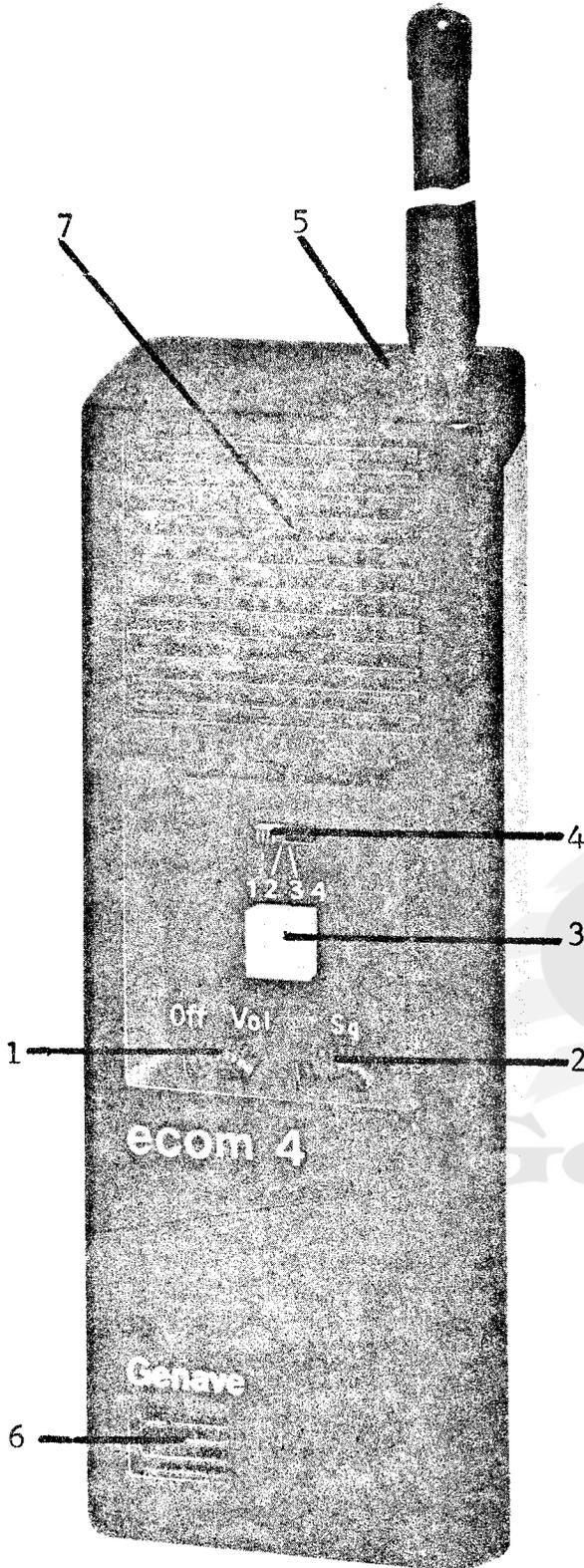
For reliability and operating convenience, only essential operating controls are installed on the unit's front panel. The functions of these controls are as follows:

1. Volume control/On-Off switch
2. Squelch control
3. Push-to-talk switch
4. Channel-selector switch
5. Charging jack to permit charging the internal nicad batteries
6. Built-in microphone
7. Internal loudspeaker

The unit is designed to fit comfortably in the palm of the hand -- permitting easy, one-hand operation.

### 3-2. OPERATING INSTRUCTIONS

1. To operate transceiver, turn unit ON by rotating the Volume control (1) clockwise until switch clicks.
2. Select desired transmit/receive frequency by sliding Channel-Selector switch (4) to desired operating position. Check that ant. is connected.
3. Rotate Squelch control (2) counter-clockwise until noise is heard in speaker (7). Adjust Volume control for desired audio level. Readjust Squelch control clockwise until receiver just quiets.
4. To transmit, depress push-to-talk switch (3) and speak into microphone (6). Release push-to-talk switch to receive.
5. To charge internal batteries, plug charger into Charging Jack (5). Now, insert charger into 120 VAC, 60 Hz, receptacle. Be SURE Volume control is turned fully counterclockwise to its OFF position.



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### 3-3. LICENSING INFORMATION

Licensing requirements vary with the service for which this unit will be used; however, all services require the station transmitter to be licensed. Further, all transmitter adjustments or tests during or coincident with the installation, servicing, or maintenance of a radio station, which may affect the proper operation of such station, shall be made by or under the immediate supervision and responsibility of a person holding a first- or second-class commercial radio operator license, either radiotelephone or radiotelegraph, who shall be responsible for the proper functioning of the station equipment. Note, however, that in many services an unlicensed person, after having been authorized to do so by the station licensee, may operate from a control point a mobile, base, or fixed station or from a dispatch point a base or fixed station, during the course of normal rendition of service. The minimum class of operator authorization required for each specific classification of station is set forth in the appropriate F.C.C. rule part.

If this transceiver is to become part of a new radio-communications system, it should be included as a portable or mobile unit on the initial station license application. Information concerning modification of an existing license (that is, adding additional portable or mobile units, or changing transmitter-type of portable or mobile units) can be found in the F.C.C. Rules and Regulations governing the service in which the system is used.

The following technical information is intended to aid ECOM-4 users in completing the application for radio station authorization. Only technical data pertaining to the transceiver are shown below; all other station particulars must be furnished by the licensee.

|                                   |                        |
|-----------------------------------|------------------------|
| Type Accepted:                    | Yes                    |
| Type Acceptance/Model No:         | T-7040400              |
| Type of Unit:                     | Transceiver            |
| Frequency Range (MHz):            | 143.9 to 173.4         |
| Frequency Tolerance:              | .0005%                 |
| Emission:                         | 16F3                   |
| Transmitter Input Power:          | 4 Watts                |
| Transmitter Output Power:         | 2 Watts                |
| Approved under Rule Part Numbers: | 21, 81, 87, 89, 91, 93 |

For additional information on filling out the appropriate application forms, consult the F.C.C. instruction sheet provided with that form. Note that some forms may be completed either by PRINTING IN INK, or by TYPING; whereas, TYPING is MANDATORY for certain F.C.C. Application forms. Two of the more common forms used to apply for a license for the ECOM-4 VHF transceiver are F.C.C. forms 400 or 425, depending upon the usage and/or geographic location of the proposed station. To determine which form is required, or for answers to specific licensing questions, contact Engineer in Charge at nearest Federal Communications Commission Field Engineering Office as listed below -- they will also supply the appropriate forms.

The procedures for obtaining necessary licenses are found in the Federal Communications Commission Rules and Regulations. The services and the corresponding F.C.C. rule part numbers, under which the ECOM-4 transceiver can be used, are as follows:

Any of these volumes may be purchased from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402

3-3-1. F.C.C. Rule Part Numbers

Domestic Public Radio Services (Other than Maritime Mobile)

F.C.C. Rules & Regulations, Volume VII, Part 21  
Domestic Public Land Mobile Radio Service  
Rural Radio Service

Stations on Land in the Maritime Services

F.C.C. Rules & Regulations, Volume IV, Part 81  
Public Coast Stations  
Marine Utility Stations  
Fixed Stations Associated with the Maritime Mobile Service  
Stations Operated in the Land Mobile Service for Maritime Purposes

Aviation Services

F.C.C. Rules & Regulations, Volume V, Part 87  
Civil Air Patrol Stations

Public Safety Radio Services

F.C.C. Rules & Regulations, Volume V, Part 89  
Local Government Radio Service  
Police Radio Service  
Fire Radio Service  
Highway Maintenance Radio Service  
Forestry-Conservation Radio Service  
Special Emergency Radio Service

Industrial Radio Services

F.C.C. Rules & Regulations, Volume V, Part 91  
Power Radio Service  
Petroleum Radio Service  
Forest Products Radio Service  
Motion Picture Radio Service  
Relay Press Radio Service  
Special Industrial Radio Service  
Business Radio Service  
Manufacturers Radio Service  
Telephone Maintenance Radio Service

Land Transportation Radio Services

F.C.C. Rules & Regulations, Volume V, Part 93  
Motor Carrier Radio Service  
Railroad Radio Service  
Taxicab Radio Service  
Automobile Emergency Radio Service

3-3-2. F.C.C. Field Engineering Offices

ALASKA, ANCHORAGE 99510  
G-63 U.S.P.O. and Courthouse Bldg.  
Box 644, 4th and F Streets

CALIFORNIA, LONG BEACH  
Room 501  
37]] Long Beach Blvd.

CALIFORNIA, SAN DIEGO 92101  
Fox Theatre Bldg.  
1245 7th Ave.

CALIFORNIA, SAN FRANCISCO 94111  
323-A Customhouse  
555 Battery St.

COLORADO, DENVER 80202  
Suite 2925, The Executive Tower  
1405 Curtis St.

DISTRICT OF COLUMBIA, WASHINGTON 20554  
Room 411  
1919 M St. NW.

FLORIDA, MIAMI 33130  
Room 919  
51 Southwest 1st Ave.

FLORIDA, TAMPA 33602  
809 Barnett Office Bldg.  
1000 Ashley Dr.

GEORGIA, ATLANTA 30309  
440 Massell Bldg.  
1365 Peachtree St. NE.

HAWAII, HONOLULU 96808  
502 Federal Bldg.  
Box 1021, 355 Merchant St.

ILLINOIS, CHICAGO 60604  
3935 New Federal Bldg.  
230 South Dearborn St.

LOUISIANA, NEW ORLEANS 70130  
829 F. Edward Hebert Federal Bldg.  
600 South St.

MARYLAND, BALTIMORE 21201  
819 Federal Bldg.  
31 Hopkins Plaza

MASSACHUSETTS, BOSTON 02109  
1600 Customhouse  
165 State St.

MICHIGAN, DETROIT 48226  
1054 Federal Bldg.  
231 West LaFayette St.

MINNESOTA, ST. PAUL 55101  
691 Federal Bldg. & U.S. Courthouse  
316 North Robert St.

MISSOURI, KANSAS CITY 64106  
1703 Federal Bldg.  
601 East 12th St.

NEW YORK, BUFFALO 14202  
1307 Federal Bldg.  
111 West Huron St.

NEW YORK, NEW YORK 10014  
201 Varick St.

OHIO, CINCINNATI 45231  
8620 Winton Road

OREGON, PORTLAND 97204  
1782 Federal Office Bldg.  
1220 Southwest 3d Ave.

PENNSYLVANIA, MONROEVILLE 15146  
(Pittsburgh Area)  
William Penn Highway

PUERTO RICO, HATO REY 00918  
747 Federal Bldg.

TEXAS, DALLAS 75242  
13E7 Earle Cabell Federal Bldg.  
1100 Commerce St.

TEXAS, HOUSTON 77002  
5636 New Federal Office Bldg.  
515 Rusk Ave.

VIRGINIA, NORFOLK 23502  
Military Circle  
870 North Military Highway

WASHINGTON, SEATTLE 98174  
3256 Federal Bldg.  
915 2d Ave.

PENNSYLVANIA, PHILADELPHIA 19106  
James A. Byrne Federal Courthouse  
601 Market St.

# SECTION IV

## MAINTENANCE MANUAL

### 4-1. INTRODUCTION

This Section of the maintenance manual contains theory of operation, alignment data, and schematics. Lists of replacement parts are given in Section 5 of this manual.

The Genave Model ECOM-4 transceiver is a handheld VHF-FM unit designed to transmit and receive 16F3 emissions in the various land-mobile or business-radio services between 143.9 and 173.4 MHz. The instrument supplies a typical RF power output of 2 watts on any of four possible channels.

Basically, the receiver is a dual conversion superheterodyne employing a 4-pole monolithic crystal filter. A single integrated circuit performs 2nd LO, 2nd mixer, limiter, detection, and squelch functions.

In conjunction with the following circuit description, refer to the block

diagram of Figure 4-1 and the transceiver schematic in this section of the manual.

### 4-2. THEORY OF OPERATION - RECEIVER

#### 4-2-1. Input Filter and RF Amplifier

Capacitor C101 couples the incoming signal from antenna to the receiver-input filter, comprised of C102, L101, and L102; this filter applies signal to RF amplifier Q101. The RF amplifier output is applied to a double-tuned circuit consisting of L103, C104, C105, C107, and L104. C108 then routes the amplified signal to base of 1st mixer Q102.

#### 4-2-2. 1st Local Oscillator/Tripler

Q104 and associated components form the modified Colpitts, crystal-controlled, first local oscillator circuitry. SW-103A selects proper crystal in the 44.4 MHz to 54.2333 MHz range to produce

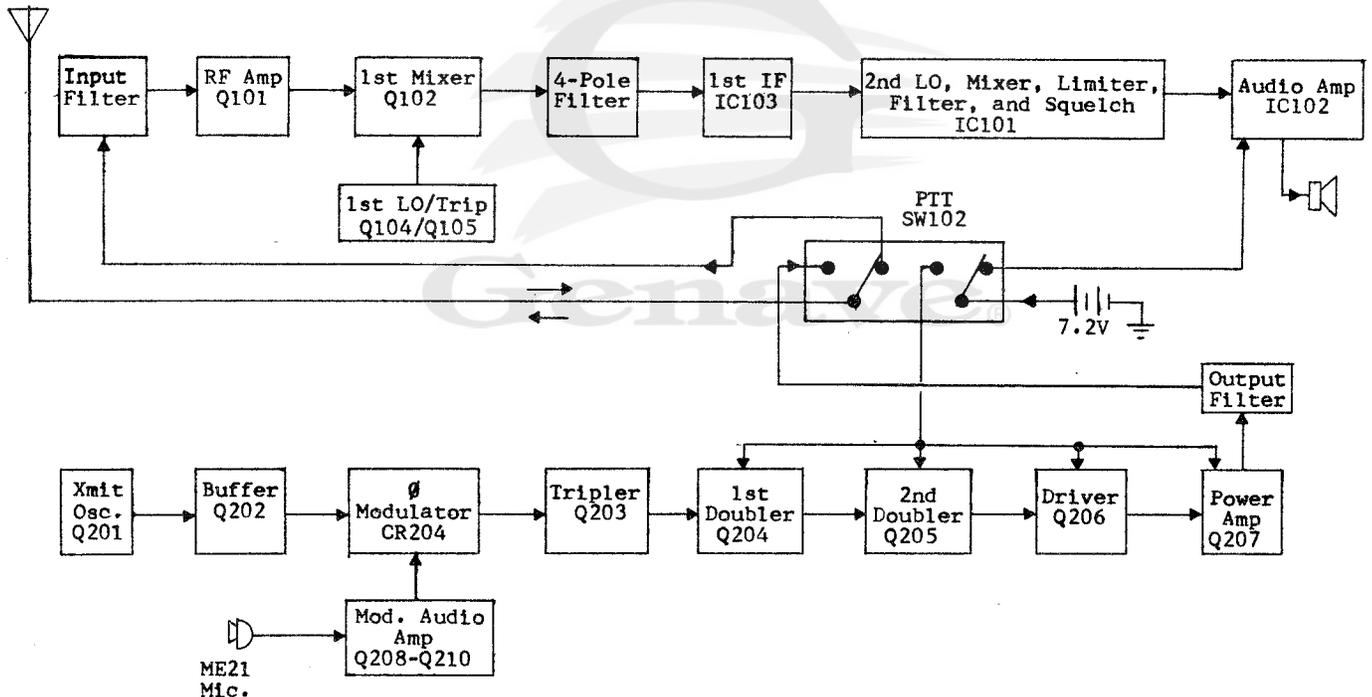


Figure 4-1. Block Diagram.

desired injection frequency. The tuned output circuit of Q105 is tuned to three times the crystal frequency by L111 and C136; then, output of Q105 is capacity-coupled to the base of mixer Q102 by C109. The first LO injection frequency is 10.7 MHz below desired "receive" frequency.

#### 4-2-3. 1st Mixer and 1st IF Amplifier

The 10.7 MHz difference signal, produced in the first mixer, is coupled by T101 to a 4-pole monolithic crystal filter consisting of FL101 and FL102. The output of the filter is transformer coupled by T102 to 1st IF amplifier IC103. T103 tunes the output of IC103 to 10.7 MHz, while C116 couples the amplified signal to input of 2nd mixer in IC101.

#### 4-2-4. 2nd LO, Mixer, Limiter, Detector and Squelch

IC101 is a multi-function integrated circuit, which includes the 2nd local oscillator, 2nd mixer, limiting 2nd IF amplifier, quadrature discriminator, active filter and squelch mute switch in a single chip.

Y105, C121, and C122, together with IC101 pins 1, 2, and 4, form an internally biased Colpitts-type oscillator. The collector, base, and emitter connections are at pins 4, 1, and 2 respectively. Low-side injection is used; therefore, the crystal frequency is 455 kHz below the 10.7 MHz IF or 10.245 MHz.

The mixer-oscillator portion of IC101 converts the 10.7 MHz input frequency down to 455 kHz. T105 tunes mixer output to 455 kHz, and also functions as an external bandpass filter. From T105, the signal is routed to the input of a five-stage limiter at pins 5 and 6 of IC101. The output of the limiter at pin 7 drives a multiplier, both internally directly, and externally through the quadrature coil T104, to detect the FM signal.

The recovered audio is filtered and buffered internally in IC101, then applied to pin 9. From pin 9 on IC101, the audio signal is applied to a de-emphasis network consisting of R114 and C128; then the signal is connected to audio volume control R116.

The detected audio on pin 9 is also applied to input (pin 10) of a bandpass active filter consisting of an internal op-amp and external components R112, R113, C123, and C124. The noise output of the filter, on pin 11, is applied to an external AM detector, CR102, which detects noise ABOVE the normal audio (voice) band. The absence of an input signal permits considerable noise above the desired audio frequencies; whereas, an incoming signal will greatly reduce noise level. An external POSITIVE bias, selected by Squelch potentiometer R109, is applied to pin 12 to set up squelch trigger circuit such that audio-muting switch (pin 14) is an OPEN circuit, which allows audio from volume control R116 to be applied to input of audio amplifier IC102. When pin 12 is pulled down below 0.7 V, pin 14 is internally shorted to ground; thus, grounding audio input to IC102 and squelching receiver.

Thus, with NO input signal, a large noise voltage is applied to CR102. The resultant NEGATIVE DC voltage is applied to IC101 pin 12 where it combines with the POSITIVE voltage supplied by squelch control R109. With a normal setting of the squelch control, the detected noise voltage pulls pin 12 down toward 0V causing pin 14 to short to ground and squelching receiver. With an incoming signal above the squelch level a reduced noise voltage is applied to CR102. The detected noise voltage is again applied to IC101 pin 12, but does not have sufficient amplitude to hold pin 12 below 0.7V; thereby removing the short to ground from pin 14 and allowing audio to be applied to input of audio amplifier IC102.

#### 4-2-5. Audio Output

C129 connects audio signal from volume control R116 to input of amplifier IC-102.

R118 and C130 set the gain of the amplifier, while R119 and C132 are used to prevent high-frequency oscillation of the amplifier.

The reactance of the speaker and C131 provide low-frequency roll off of the audio output.

### 4-3. THEORY OF OPERATION - TRANSMITTER

#### 4-3-1. Modulator

ME21 microphone output is coupled to base of microphone amplifier/limiter Q-208. Two diodes, CR201 and CR202, are connected across transistor Q208 to limit the output above a certain level. The "limited" output is coupled through one pole of modulation filter, R216 and C247. This output is then coupled to a 2-pole active filter, comprised of Q-209, Q210, R217, C249, R218, R223, and C251. This output, as a function of frequency, has the desired 3-pole response of -18 dB per octave roll-off above 3 kHz. R222 controls audio level applied to modulator varactor diode CR-204; R206 provides the necessary DC bias to the modulator diode.

#### 4-3-2. Oscillator / Modulator

Q201 with associated circuitry functions as the transmit oscillator, which is basically a Clapp crystal circuit. The oscillator output is multiplied 12 times in the transmitter multiplier stages.

The oscillator utilizes crystals with a basic frequency of 11.99 MHz to 14.45 MHz to cover the operating frequencies from 143.9 to 173.4 MHz. Variable capacitors are used in series with each crystal to allow exact setting of the generated frequency.

Thermal stabilization is provided by means of C212 and C213. Their temperature coefficient compensates the oscillator circuit to maintain  $\pm 0.0005\%$  frequency stability through the temperature range. Crystals are specified for  $\pm 0.0005\%$  over the temperature range from  $-30^{\circ}\text{C}$  to  $+60^{\circ}\text{C}$ .

Regulated 5.6-volts DC to operate the first three transmitter stages, and to power the voice modulator, is provided by means of CR205 and R209.

Q202 functions as a buffer in a common-gate configuration and, accordingly, isolates the transmit oscillator from voice-modulator circuitry.

The circuitry of T201, CR204, R206, and R207 function as the voice modulator. The voice modulator operates as a phase modulator; that is, it produces frequency deviation of the incoming RF signal by performing shifts in the phase of the signal. It is important to note, however, that pure phase modulation causes the carrier deviation to increase as the modulating frequency increases. By means of the audio correction employed in the voice modulator this characteristic of phase modulation is compensated for; thereby correcting deviation to fit the standard pre-emphasis curves.

#### 4-3-3. Multipliers

The modulated-RF output is applied to Q203, an RF tripler. In this stage an output signal between 35.97 and 43.35 MHz is produced. L203 and L204 serve to filter out harmonics and subharmonics.

The output of L204 is applied to Q204, a Class C doubler Stage. This doubler increases the 35.97 to 43.35 MHz input signal to an output frequency in the 71.94 to 86.7 MHz range. Any undesired signals generated in this stage are removed by L205 and L206.

The output of L206 is applied to base of Q205, the last multiplier stage. Q205 doubles RF-input frequency to produce an output in the 143.9 MHz to 173.4 MHz range. The output of Q205 is coupled to the driver stage by means of L207 and L208 which further reduce any harmonics or subharmonics.

#### 4-3-4. Power Amplifiers

Q206 functions as a Class C driver, and amplifies the approximate 25 mW input from the second doubler. Output from the driver is coupled to final amplifier by means of a frequency selective network formed by L209, C234, C235, and C237. This matching network couples power to final power amplifier, while rejecting any undesirable spurious responses.

Final amplifier Q207 amplifies the RF signal to rated transmitter output power of 2 watts. L210, L211, C239, C240, and C242 comprise a resonant matching network, which matches the output of Q207 to the 50-ohm antenna impedance. The transmitter-output power is supplied to an output filter comprised of L212, C255, L213, C254, L214, and L215. This output filter, in conjunction with the resonant output network of Q207, forms a 5-pole elliptic-function filter which reduces level of all spurious outputs above the operating frequency to at least 46-db below the carrier level.

#### 4-3-5. Power Supply

A self-contained battery pack supplies power to operate the instrument. This pack supplies 7.2-volts DC when six nicad cells are used. Nicad cells are rechargeable, and are recommended for optimum performance. Provision for charging the nicad pack without removing it from the transceiver is made by means of J201, the external charging jack, and CR103 which prevents reversed polarity charging.

R105 and CR104 provide regulated 6.8 volts for IC101 in the receiver, while R209 and CR205 regulate voltage applied

to the transmitter microphone amplifier/limiter, oscillator, buffer, and tripler.

#### 4-4. ALIGNMENT PROCEDURE - GENERAL

The unit is properly aligned when shipped from the factory, and realignment should never be necessary during normal life of the unit unless components are replaced within the instrument. In conjunction with the following alignment instructions, refer to the Component Location Diagram in this Section of the manual for location of adjustment points.

Never attempt to realign circuitry of the unit unless test equipment specified for each section is available.

##### 4-4-1. Disassembly

Prior to performing any service work on the instrument, the plastic front cover must be removed. The back cover need not be removed, unless it is necessary to gain access to bottom-side of main PC board.

To remove front cover, first unscrew antenna from its threaded mounting stud; then, remove one #4-40 oval-head machine screw from bottom-center of rear cover. Carefully lay transceiver on its back; now, lift bottom of front cover upward and slide cover off antenna mounting stud. See Figure 2-1.

To remove rear plastic cover, first remove front cover as given above; then remove remaining three #4-40 machine screws from top and center of rear cover. The cover can now be lifted from the PC board. See Figure 2-1.

##### 4-4-2. Preparation for Alignment

1. For ease of test-equipment connection, a female BNC connector may be soldered temporarily to antenna connector copper pad area & adjacent ground area. See Figure 4-2.

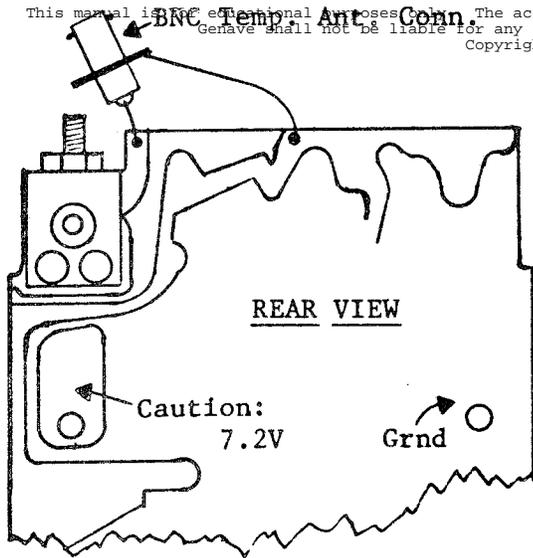


Figure 4-2. Temporary Ant. Conn.

- Power may be supplied by either the internal battery pack, or by a 7.2 volt bench supply.

**CAUTION:** Extensive damage will result if polarity of bench supply, or batteries, is NOT observed!

#### 4-5. ALIGNMENT PROCEDURE - RECEIVER

- Connect unit to 7.2V supply -- See CAUTION note above.

**NOTE:** To prevent accidental keying of transmitter during the receiver tests, temporarily short gate of Q-201 to ground.

- Couple frequency counter to first LO coil L111 with a "pick-up" loop. Turn unit ON, and adjust each receive crystal to its proper frequency with the appropriate crystal netting trimmer. Figure 4-3.

**NOTE:** The crystal frequency is calculated as follows:

$$F_c = (\text{Rec. Freq.} - 10.7) \div 3, \pm .001\%$$

- Turn unit OFF, and remove frequency counter.
- Place channel-selector switch to any working channel position. This will be the test frequency.

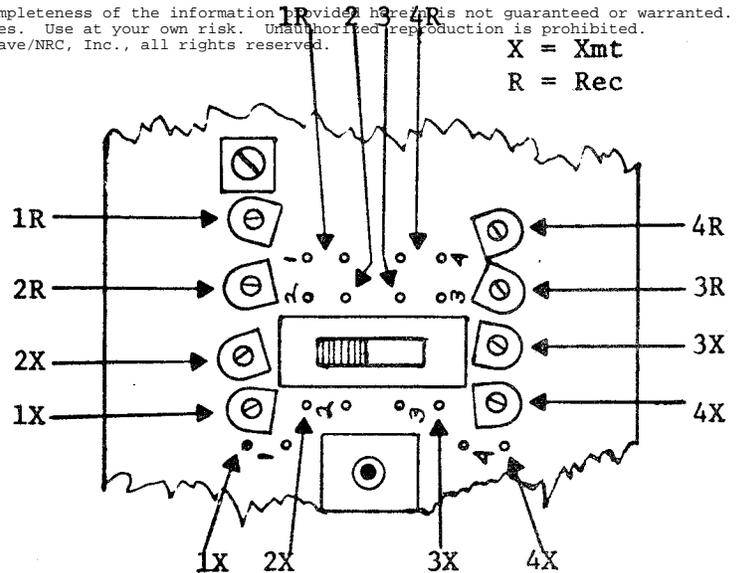


Figure 4-3. Crystal & Trimmer Locations

- Connect scope and SINAD-measuring equipment to unit speaker terminals.
- Connect FM signal generator to antenna-input connector; then, set generator on desired "receive" frequency, and modulate generator with a 1-kHz tone at +5 kHz deviation.
- Turn unit ON, adjust squelch fully counterclockwise, adjust rec. volume control and generator RF output level to usable range of the SINAD-measuring equipment.

**NOTE:** During alignment, the volume control and generator level control should be adjusted as necessary to avoid over-driving unit.

- Adjust C102, L103, L104, L111, T101, T102, T103, T104, and T105 for best SINAD reading.
- Touch up T104 for maximum undistorted sinewave on scope. Repeat steps 8 and 9 until no further improvement is obtained. Turn unit OFF, and disconnect test equipment.

**NOTE:** An alternate (and preferred) method of adjusting T101 and T102 (10.7 MHz crystal filters FL101 and FL102) is by using a sweep generator, detector, and oscilloscope as explained below:

10. To sweep T101 and T102, proceed as follows:

- a) Connect detector input (Figure 4-4) to pin 5 of IF amp. IC103; connect detector output to scope vertical input. Set scope vert. sensitivity to give a usable pattern with minimum sweep-generator input.

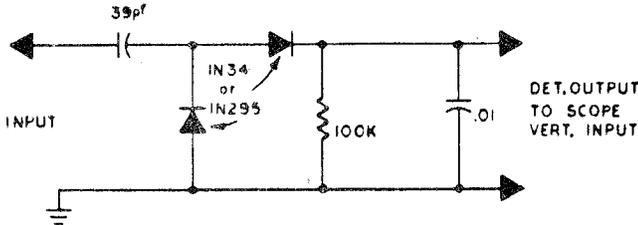


Figure 4-4. High-Impedance Detector

- b) Connection point for sweep-input signal depends upon frequency range of generator being used -- if generator covers 10.7 MHz, the sweep signal can be applied through a 39 pF capacitor to base of mixer Q-102; however, if generator covers the operating frequency, sweep signal can be applied directly to the antenna-input connector.
- c) Set generator sweep width for approximately 25 kHz at a sweep rate of NOT MORE than 40 Hz. During the alignment of T101 and T102, keep generator output low enough to prevent overdriving the detector.
- d) Turn unit ON, and adjust T101 and T102 for a bandpass response similar to Figure 4-5. Ripple should be NOT MORE than 2 db, and is generally 1 dB or less. If necessary, the value of R104 may be changed to improve filter response.

NOTE: After crystal filters have been properly aligned using a swept signal, do NOT change adjustments of T101 or T102.

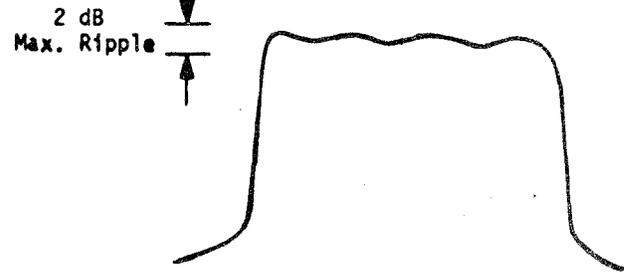


Figure 4-5. IF Response

11. Turn unit OFF, and disconnect test equipment.

#### 4-5-1. RF Input for 20-dB Quieting

1. Connect FM signal generator to unit antenna-input connector, and connect AC voltmeter to speaker terminals.
2. Turn signal generator modulation OFF and set generator RF attenuator for zero output. (Generator must have negligible leakage). Set generator to desired "receive" frequency.
3. Adjust transceiver volume control so that receiver background noise indicates -10 dB on the AC voltmeter.
4. Slowly increase setting of generator RF attenuator, until AC voltmeter indicates -30 dB. Note RF level indicated on signal generator attenuator. This is the RF input required to produce 20-dB receiver quieting. An input of -109 dBm (0.8µV) will quiet receiver 20 dB.

#### 4-5-2. Squelch Operation

1. Set generator to desired "receive" frequency, and set modulation for a 1 kHz tone with +5 kHz deviation. Set RF attenuator for zero RF output.
2. Turn volume control to full volume; now, rotate squelch control fully ccw (squelch OFF), and then rotate squelch control slowly cw until unit just squelches. The receiver should now be completely silent (no RF signal input).

3. Increase setting of signal-generator RF attenuator until receiver squelch just fully opens. The RF attenuator should read no higher than -113 dBm (0.5 $\mu$ V).

4. With no RF generator input, adjust receiver volume to maximum, and adjust squelch control fully clockwise (full squelch). Increase signal generator output level (modulated with 1 kHz tone at  $\pm 5$  kHz deviation) until squelch just opens. The signal generator attenuator should read no more than 2.0  $\mu$ V.

#### 4-5-3. Audio Output Power

1. Set FM signal generator on desired receive frequency, and set modulation for  $\pm 5$  kHz deviation using 1 kHz audio. Set RF attenuator in the vicinity of 5  $\mu$ V.
2. Turn receiver volume control fully clockwise. The AC voltmeter, connected to speaker terminals, should indicate not less than 1.8 volts.
3. Set signal generator for  $\pm 5$  kHz deviation using 500 Hz audio, and note that AC voltmeter indicates at least 1.8 volts with unit volume control fully clockwise.
4. Set signal generator for  $\pm 5$  kHz deviation using 3 kHz audio. Again the AC voltmeter should indicate at least 1.8 volts at maximum setting of the transceiver volume control.
5. If gate of transmit oscillator Q201 was shorted to ground during receiver alignment, remove this short.

### 4-6. ALIGNMENT PROCEDURE - TRANSMITTER

#### 4-6-1. Preparation for Alignment

1. Refer to paragraph 4-4-2 in this Section of manual.
2. Attach a 50-ohm power meter, or a relative output indicating device (Figure 4-6), to transceiver antenna connector.

3. Preset deviation potentiometer R222 to its lowest setting, by rotating it toward squelch potentiometer R109.

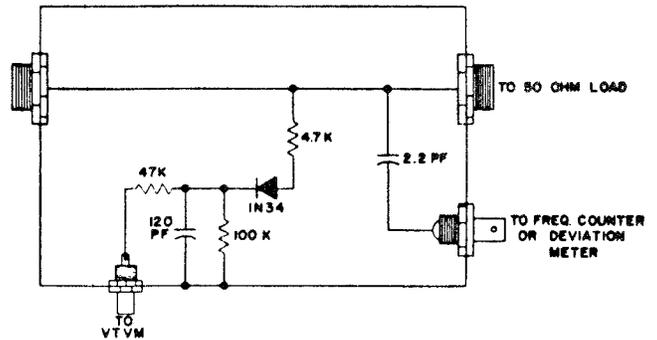


Figure 4-6. Relative Output Indicator

#### 4-6-2. Frequency and Power Alignment

NOTE: The signal peak-voltage measurements in following steps of this Section are made with an RF VTVM. Key transmitter only when adjustments are being made.

1. Place channel-selector switch to a working channel position.
2. Connect VTVM RF probe to base of Q-203 and key transmitter. Adjust T201 for a peak voltage reading of approximately 3.0 volts.
3. Move RF probe to base of Q204. Key transmitter and adjust slugs in L203 and L204 for a peak voltage reading of approximately 3.0 volts.
4. Move RF probe to base of Q205. Key transmitter and adjust L205 and L206 for a peak voltage reading of approximately 3.0 volts.
5. Connect RF probe to base of Q206. Key transmitter and adjust C229 and C231 for a peak voltage reading of approximately 2.5 volts.
6. Move RF probe to base of Q207. Key transmitter and adjust C234 for a peak voltage reading of approximately 5.0 volts.

7. Remove RF probe. Key transmitter and, using the 50-ohm power meter or relative output device, adjust C239 and C242 for a maximum reading.

8. Repeat alignment steps until no further increase in readings is obtained.

#### 4-6-3. Crystal Installation & Frequency Netting

1. Refer to Figure 4-3 for crystal and netting capacitor locations.
2. With crystal installed and channel switch in corresponding position, connect a frequency-indicating device to transceiver -- either by loop coupling to final-power stage or, by connecting to jack on relative output device (Figure 4-6). Adjust appropriate crystal-netting capacitor for correct frequency.

3. Repeat step 2 for each crystal installed.

#### 4-6-4. Power Measurement Procedure

1. Key transmitter and note RF power-output reading. The power should be 1.5 watts minimum on each channel installed in transceiver.

#### 4-6-5. Carrier Deviation Adjustment

1. Preset deviation level pot., R222, by rotating it fully toward squelch potentiometer (minimum deviation), and then backing off approx. 1/4 turn.
2. Connect unit to relative output indicating device (Figure 4-6); then connect deviation monitor to appropriate jack on output indicating device.
3. Key transmitter and feed a 1700 Hz tone into transceiver microphone. Watching the deviation monitor, increase audio tone (1700 Hz) level until no further increase in deviation is indicated. The modulator stage is now saturated.

4. Key transmitter and adjust T201 slightly for a peak deviation.

5. Adjust R222, deviation level pot., for a deviation reading of +5 kHz. If more than 0.4 kHz exists between + and - deviation levels, adjust T201 slightly until the two levels are brought into balance.

6. Turn transceiver OFF, and disconnect all test equipment. Replace front cover on unit.

#### 4-7. FREQUENCY CHANGES

Installation of new frequencies in this transceiver can be easily accomplished by performing the following steps:

NOTE: To aid in obtaining proper crystals for the ECOM-4, complete crystal specifications are given in Section 4-8 of this manual.

1. Remove front and back covers from instrument as explained in Section 4-4-1 of this manual.
2. Locate mounting position for the new crystal(s). "Receive" crystals are mounted on PC board just above the channel-selector switch, whereas the "transmit" crystals are mounted just below channel switch. The channel number of each crystal position is etched on unit PC board, and agrees with selector switch positions. Refer to Figure 4-3 for transmit and receive crystal locations.
3. Insert leads of new crystal through appropriate holes in PC board; then, carefully solder leads to copper pads on back-side of board.

NOTE: When installing new crystals, BE SURE that transmit and receive crystals are properly paired.

4. To bring the receive crystal(s) "on frequency," perform steps 1 and 2 given in Section 4-5 of this manual.

5. To adjust transmit crystal(s) "on frequency," perform steps 1, 2, and 3 given in Section 4-6-3 of this manual.

NOTE: If new frequencies differ appreciably from original alignment frequencies, it may be necessary to completely re-align transmitter and receiver circuits as detailed in Sections 4-5 and 4-6.

it will probably be necessary to replace one or two coils and three capacitors in receiver front-end, as well as three or four capacitors in the transmitter circuitry. Then unit should be re-aligned as given in Sections 4-5 and 4-6.

Refer to Table 4-1 for component values normally used for different frequency ranges.

#### 4-7-1. Large Changes in Frequency

If new frequency differs from original alignment frequency by 6 MHz or more,

NOTE: As given in Section 1-3, the maximum separation between highest and lowest frequency channels installed in the ECOM-4 is 2 MHz.

TABLE 4-1. COMPONENT CHANGES

| Component | <u>Receiver</u> |                    |                             |                  |                  |
|-----------|-----------------|--------------------|-----------------------------|------------------|------------------|
|           | MHz Range       | 144-150            | 151-158                     | 159-165          | 166-174          |
| L101      |                 | 1800116<br>(4½T)   | 1800116<br>(4½T,<br>spread) | 1800105<br>(3½T) | 1800105<br>(3½T) |
| L104      |                 | 1800308<br>(8½T)   | 1800308<br>(8½T)            | 1800308<br>(8½T) | 1800304<br>(4½T) |
| C104      |                 | 1.8pF              | 1.5pF                       | 0.82pF           | 0.47pF           |
| C107      |                 | 0.82pF             | 0.56pF                      | 0.22pF           | 1.5pF            |
| C136      |                 | 4.7pF              | 4.7pF                       | 3.9pF            | 2.7pF            |
|           |                 | <u>Transmitter</u> |                             |                  |                  |
| C218      |                 | 12pF               | 10pF                        | 8.2pF            | 8.2pF            |
| C236      |                 | 18pF               | 18pF                        | 10pF             | None             |
| C235      |                 | 22pF               | 22pF                        | 22pF             | 15pF             |
| C240      |                 | 56pF               | 56pF                        | 47pF             | 33pF             |
| C241      |                 | 33pF               | 22pF                        | 15pF             | 15pF             |

## 4-8. CRYSTAL SPECIFICATIONS

To change a transmit and/or receiver operating frequency in a Model ECOM-4 transceiver requires that a new transmit and/or receive crystal be installed in the unit. The transceiver may also require some realignment to insure proper operation of the new frequency.

Crystals for the ECOM-4 VHF transceivers are available from the factory at nominal cost by calling the factory "Parts Department", and specifying the model number, desired operating frequency, and whether for transmit or receive. Crystals may also be obtained from other sources; therefore, the information necessary for ordering these crystals is given below:

### 4-8-1. Transmit Crystals

|                             |  |
|-----------------------------|--|
| Parallel Mode:              | $C = 32 \text{ pF}$<br>$P$   |
| Fundamental Cut, Tolerance: | $\pm .001\%$ max. calib. tol. @25°C $\pm 1^\circ\text{C}$<br>$\pm .0005\%$ max. drift over temp. range |
| Temperature Range:          | 0° to +50°C  |
| Holder:                     | HC-25/U  |
| Crystal Frequency:          | (Operating Freq) $\div 12$   |
| Series Resistance:          | 25 ohms, maximum   |
| Genave Part Number:         | 2300211 (Spec. Freq.)  |

### 4-8-2. Receive Crystals

|                          |  |
|--------------------------|--|
| Parallel Mode:           | $C_p = 32 \text{ pF}$  |
| 3rd Overtone, Tolerance: | $\pm .001\%$ max. calib. tol. @ 25°C $\pm 1^\circ\text{C}$<br>$\pm .001\%$ max. drift over temp. range |
| Temperature Range:       | -30°C to +60°C   |
| Holder:                  | HC-25/U  |
| Crystal Frequency:       | (Operating Freq - 10.7 MHz) $\div 3$   |
| Series Resistance:       | 40 ohms, maximum   |
| Drive Level:             | One mW   |
| Genave Part Number:      | 2300226 (Spec. Freq.)  |

#### 4-9. SCHEMATIC AND PARTS LOCATION DIAGRAM

This Section of the Handheld Maintenance Manual contains the transceiver schematic, and the component layout of the transceiver PC board.

The schematic shows voltage measurements at strategic points in the transceiver.



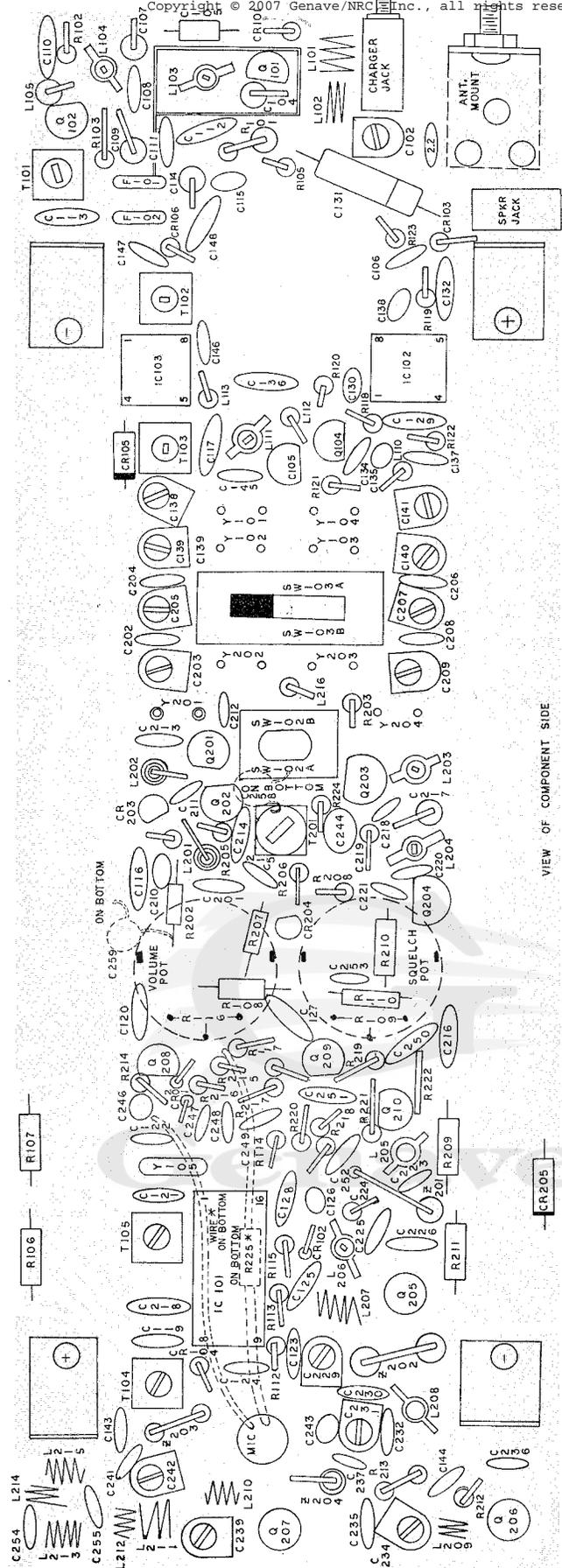
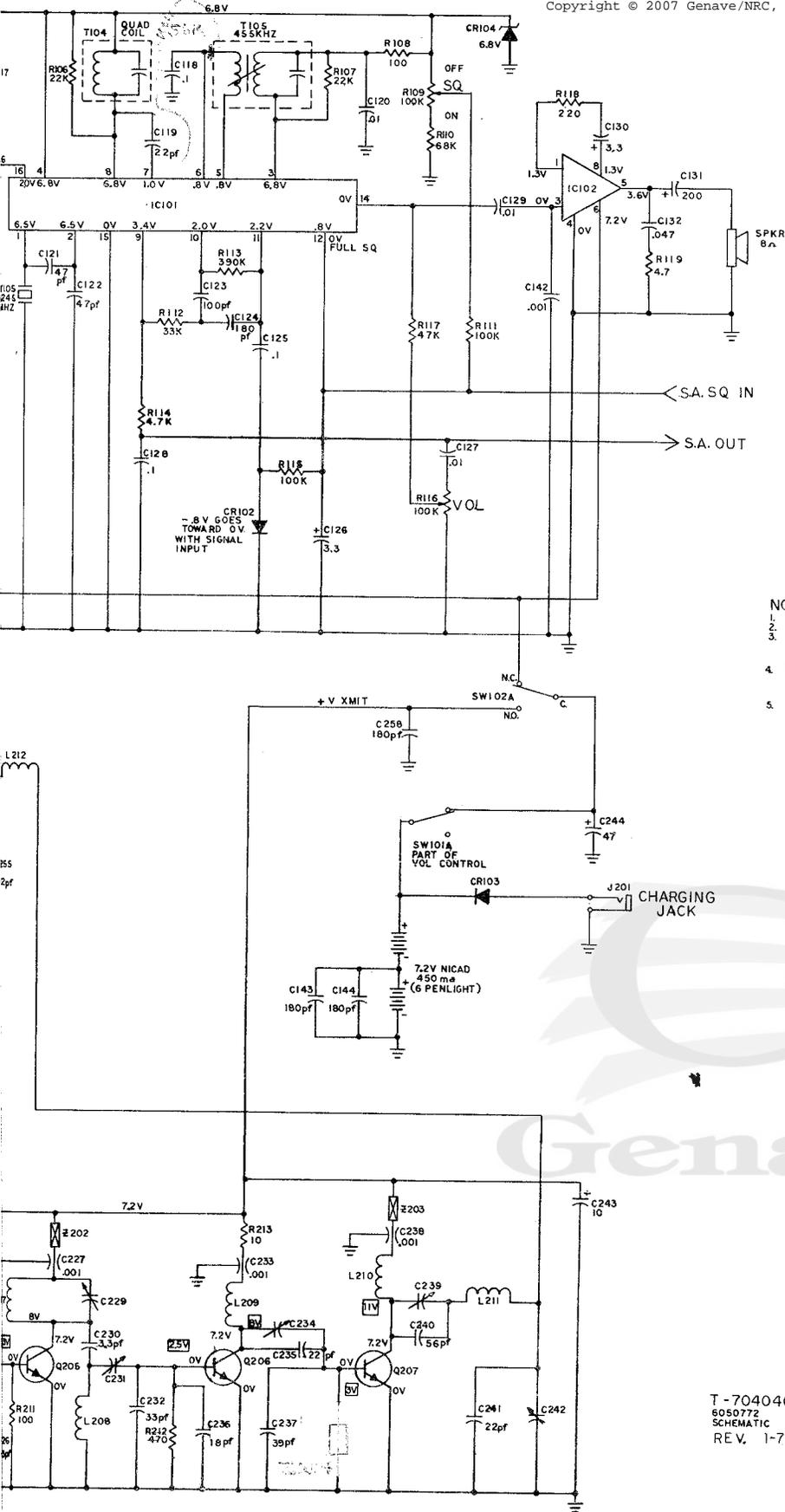


Figure 4-7. Handheld IC Board Component Layout (Rev. 3-2-79)  
(Top View)



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- NOTES:
1. CAPACITANCE IN MICROFARAD UNLESS NOTED OTHERWISE.
  2. RESISTANCE IN OHMS.
  3. D.C. VOLTAGES TAKEN WITH VTVM CHANNEL SWITCH TO UNUSED (NO CRYSTAL) POSITION. READING MAY VARY ± 20% VOL AND SQ FULL C.W. UNLESS NOTED.
  4. [V] VOLTAGES IN SQUARE ARE TAKEN WITH R.F. VTVM WITH UNIT SUPPLYING 2 WATTS OF RF INTO 50Ω LOAD.
  5. WAVEFORMS IN MODULATOR TAKEN WITH SATURATING 1700 HZ TONE INTO MICROPHONE CHANNEL SWITCH IN UNUSED POSITION (NO CRYSTAL).

T-7040400  
6050772  
SCHEMATIC  
REV. 1-79

Figure 4-8. Handheld Transceiver Schematic (Rev. 3-2-79)

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# SECTION V

## PARTS LIST

This section of the Maintenance Manual lists replacement electronic parts, as well as major mechanical components, for use in the ECOM-4 VHF-FM Transceiver.

The first column in the parts list contains component reference numbers as shown on schematics or wiring diagrams.

In general, 100-series numbers pertain to receiver components, while the 200-series numbers are used for transmitter parts. Genave part numbers for replaceable items appear in the Part Number column, while a brief description for each part is shown in the Description column.

| <u>Reference Number</u> | <u>Part Number</u> | <u>Description</u>                   |
|-------------------------|--------------------|--------------------------------------|
| <b>CAPACITORS</b>       |                    |                                      |
| C101                    | 1520001            | NPO Disc, 2.2 pF <u>+10%</u>         |
| 2                       | 1570009            | Trimmer, 5-25 pF                     |
| 3                       | 1520086            | Feedthru, .001 uF, CF777 GMV         |
| 4                       | ---                | Selected Value, see Table 4-1        |
| 5                       | 1510002            | NPO Gimmick, 0.18 pF <u>+10%</u>     |
| 6                       | 1520196            | Z5U Disc, .001 uF                    |
| 7                       | ---                | Selected Value, see Table 4-1        |
| 8                       | 1520197            | NPO Disc, 3.3 pF                     |
| 9                       | 1510011            | NPO Gimmick, 1 pF <u>+10%</u>        |
| 10                      | 1520037            | Y5E Disc, 330 pF                     |
| 11                      | 1520196            | Z5U Disc, .001 uF                    |
| 12                      | 1520051            | M25 Disc, .01 uF <u>+10%</u> , 25V   |
| 13                      | 1520197            | NPO Disc, 3.3 pF                     |
| 14                      | 1520184            | NPO Disc, 5.6 pF                     |
| 15                      | 1550007            | Tant. 10 uF                          |
| 16                      | 1520051            | M25 Disc, .01 uF <u>+10%</u> , 25V   |
| 17                      | 1520051            | M25 Disc, .01 uF <u>+10%</u> , 25V   |
| 18                      | 1520055            | Y5E Disc, .1 uF <u>+80-20%</u> , 12V |
| 19                      | 1520190            | NPO Disc, 22pF                       |
| 20                      | 1520051            | M25 Disc, .01 uF <u>+10%</u> , 25V   |
| 21                      | 1520202            | N750 Disc, 47 pF <u>+5%</u>          |
| 22                      | 1520202            | N750 Disc, 47 pF <u>+5%</u>          |
| 23                      | 1520195            | N2200 Disc, 100 pF <u>+10%</u>       |
| 24                      | 1520208            | N2200 Disc, 180 pF                   |
| 25                      | 1520055            | Y5E Disc, .1 uF <u>+80-20%</u> , 12V |
| 26                      | 1550003            | Tant. 3.3 uF                         |
| 27                      | 1520051            | M25 Disc, .01 uF <u>+10%</u> , 25V   |
| 28                      | 1520055            | Y5E Disc, .1 uF <u>+80-20%</u> , 12V |
| 29                      | 1520051            | M25 Disc, .01 uF <u>+10%</u> , 25V   |
| 30                      | 1550003            | Tant., 3.3 uF                        |
| 31                      | 1550016            | Tant., 200 uF                        |
| 32                      | 1520081            | Mono Cer, .047 uF                    |
| 33                      | ---                | Not assigned                         |
| 34                      | 1520195            | N2200 Disc, 100 pF                   |
| 135                     | 1520195            | N2200 Disc, 100 pF                   |

Reference  
Number

Part  
Number

Description

CAPACITORS (Cont'd.)

|                |         |  |
|----------------|---------|--|
| 136            | 1520004 | NPO Disc, 4.7 pF (Selected Value, see Table 4-1) |
| 37             | 1520196 | Z5U Disc, .001 uF                                |
| 38             | 1570009 | Trimmer, 5-25 pF                                 |
| 39             | 1570009 | Trimmer, 5-25 pF                                 |
| 40             | 1570009 | Trimmer, 5-25 pF                                 |
| 41             | 1570009 | Trimmer, 5-25 pF                                 |
| 42             | 1520196 | Z5U Disc, .001 uF, 25 V                          |
| 43             | 1520208 | N2200 Disc, 180 pF                               |
| 44, 45, 46, 49 | 1520208 | N2200 Disc, 180 pF                               |
| 47             | 1520191 | N750 Disc, 33 pF +10%                            |
| 48             | 1520081 | MONO Cer., .047 uF                               |
| 50             | 1520051 | M25, Disc, .01 uF +10%, 25V                      |
| 201            | 1520051 | M25 Disc, .01 uF +10%, 25V                       |
| 2              | 1520188 | NPO Disc, 15 pF +10%, 25V                        |
| 3              | 1570009 | Trimmer, 5-25 pF                                 |
| 4              | 1520188 | NPO Disc, 15pF +10%, 25V                         |
| 5              | 1570009 | Trimmer, 5-25 pF                                 |
| 6              | 1520188 | NPO Disc, 15 pF +10%, 25V                        |
| 7              | 1570009 | Trimmer, 5-25 pF                                 |
| 8              | 1520188 | NPO Disc, 15pF +10%, 25V                         |
| 9              | 1570009 | Trimmer, 5-25 pF                                 |
| 10             | 1550001 | Tant. .22 uF                                     |
| 11             | 1520204 | N750 Disc, 75 pF                                 |
| 12             | 1520177 | N2200 Disc 47 pF +10%                            |
| 13             | 1520195 | N2200 Disc, 100 pF +10%                          |
| 14             | 1520196 | Z5U Disc, .001 uF                                |
| 15             | 1520195 | N2200 Disc, 100 pF +10%                          |
| 16             | 1520051 | M25 Disc, .01 uF +10%, 25V                       |
| 17             | 1520086 | Feedthru, .001 uF, Cf777 GMV                     |
| 18             | 1520187 | NPO Disc, 10 pF (Selected Value, see Table 4-1)  |
| 19             | 1510014 | NPO Gimmick, 1.8 pF +10%                         |
| 20             | 1520204 | N750 Disc, 75 pF                                 |
| 21             | 1520196 | Z5U Disc, .001 uF                                |
| 22             | 1520086 | Feedthru, .001 uF, CF777 GMV                     |
| 23             | 1520188 | NPO Disc, 15 pF +10%, 25V                        |
| 24             | 1510011 | NPO Gimmick, 1 pF +10%                           |
| 25             | 1520191 | N750 Disc, 33 pF                                 |
| 26             | 1520191 | N750 Disc, 33 pF                                 |
| 27             | 1520086 | Feedthru, .001 uF, CF777 GMV                     |
| 28             | ---     | Not Assigned                                     |
| 29             | 1570009 | Trimmer, 5-25 pF                                 |
| 30             | 1520197 | NPO Disc, 3.3 pF                                 |
| 31             | 1570009 | Trimmer, 5-25 pF                                 |
| 32             | 1520191 | N750 Disc, 33 pF                                 |
| 33             | 1520086 | Feedthru, .001 uF, CF777 GMV                     |
| 34             | 1570009 | Trimmer, 5-25 pF                                 |
| 35             | 1520190 | NPO 22 pF (Selected Value, See Table 4-1)        |
| 36             | 1520010 | NPO 18 pF (Selected Value, See Table 4-1)        |
| 37             | 1520201 | NPO Disc, 39 pF +5%, 25 V                        |
| 38             | 1520086 | Feedthru, .001 uF, CF777 GMV                     |
| 239            | 1570009 | Trimmer, 5-25 pF                                 |

Reference  
Number

Part  
Number

Description

CAPACITORS (Cont'd.)

|      |         |  |
|------|---------|--|
| C240 | 1520203 | N330 Disc, 56 pF (Selected Value, see Table 4-1) |
| 41   | 1520190 | NPO 22 pF (Selected Value, see Table 4-1)        |
| 42   | 1570009 | Trimmer, 5-25 pF                                 |
| 43   | 1550007 | Tant., 10 uF                                     |
| 44   | 1550005 | Tant., 47 uF, 15V                                |
| 45   | ---     | Not Assigned                                     |
| 46   | 1520081 | Mono Cer., .047 F                                |
| 47   | 1500079 | Z5U disk, .005 uF +20%                           |
| 48   | 1520081 | Mono Cer, .047 uF                                |
| 49   | 1500004 | Mylar, .0015 uF +10%, 630V                       |
| 50   | 1520051 | M25 Disc, .01 uF +10%, 25V                       |
| 51   | 1520037 | Y5E Disc, 330 pF                                 |
| 52   | 1520208 | N2200 Disc, 180 pF                               |
| 53   | 1520196 | Z5U Disc, .001 uF                                |
| 54   | 1520189 | N220 Disc, 18 pF +10%                            |
| 55   | 1520190 | NPO Disc, 22 pF                                  |
| 56   | 1520203 | N330 Disc, 56 pF +5%, 25V                        |
| 57   | ---     | Not Assigned                                     |
| 58   | 1520208 | N2200 Disc, 180 pF                               |
| 59   | 1520208 | N2200 Disc, 180 pF                               |
| 260  | ---     | Not Assigned                                     |

DIODES

|       |         |                                  |
|-------|---------|----------------------------------|
| CR101 | 4810017 | Sil., Switching, 1N4148          |
| 2     | 4810017 | Sil., Switching, 1N4148          |
| 3     | 4810013 | Gen Purpose, 100 PRV, 1A, 1N4001 |
| 4     | 4810007 | Zener, 6.8 V, ZS6.8 A            |
| 5     | 4810017 | Sil, Switching, 1N4148           |
| 6     | 4810017 | Sil, Switching, 1N4148           |
| CR107 | ---     | Not Assigned                     |

|       |         |                         |
|-------|---------|-------------------------|
| CR201 | 4810017 | Sil., Switching, 1N4148 |
| 2     | 4810017 | Sil., Switching, 1N4148 |
| 3     | 4812113 | Varicap, MV2113         |
| 4     | 4812113 | Varicap, MV2113         |
| 5     | 4810024 | Zener, 4.7V             |
| 6     | ---     | Not Assigned            |
| 7     | ---     | Not Assigned            |
| 8     | ---     | Not Assigned            |
| 209   | ---     | Not Assigned            |

FILTERS

|               |         |   |
|---------------|---------|---|
| FL101 & FL102 | 2303504 | 10.7 MHz Monolithic Crystal (Matched Set) |
|---------------|---------|---|

| Reference Number           | Part Number | Description               |
|----------------------------|-------------|---------------------------|
| <b>INTEGRATED CIRCUITS</b> |             |                           |
| IC101                      | 3130038     | FM IF and Discr., MC3357P |
| 2                          | 3130025     | Audio Amplifier, LM386    |
| 3                          | 3130366     | IF amp., SC74126P         |
| 104                        | ---         | Not Assigned              |

**INDUCTORS**

|      |                            |                                       |
|------|----------------------------|---------------------------------------|
| L101 | <del>1800115</del> 1800116 | .1 uH (Selected Value, see Table 4-1) |
| 2    | 1800005                    | Coil, .03 uH                          |
| 3    | 1800308                    | Coil, 8-1/2T, Paul Smith              |
| 4    | 1800308                    | Coil, 8-1/2T, Paul Smith              |
| 5    | 1800350                    | Coil, 1 uH, Wilco ML10G               |
| 6    | ---                        | Not Assigned                          |
| 7    | ---                        | Not Assigned                          |
| 8    | ---                        | Not Assigned                          |
| 9    | ---                        | Not Assigned                          |
| 10   | 1800350                    | Coil, 1 uH, Wilco ML10G               |
| 11   | 1800304                    | Coil, 4-1/2T, No Core, Paul Smith     |
| 12   | 1800351                    | Coil, 470 uH                          |
| L113 | 1800332                    | Coil, 56 uH                           |
| L201 | 1800032                    | Coil, 80 uH                           |
| 2    | 1800032                    | Coil, 80 uH                           |
| 3    | 1800316                    | Coil, 16-1/2T, Paul Smith             |
| 4    | 1800306                    | Coil, 6-1/2T, Paul Smith              |
| 5    | 1800306                    | Coil, 6-1/2T, Paul Smith              |
| 6    | 1800306                    | Coil, 6-1/2T, Paul Smith              |
| 7    | 1800014                    | Coil, 4-1/2T, 1/8 ID                  |
| 8    | 1800304                    | Coil, 4-1/2T, No Core, Paul Smith     |
| 9    | 1800270                    | Coil, Driver Output, 2-1/2T, LHH      |
| 10   | 1800271                    | Coil, Power Amp. Output, 4-1/2T, RHH  |
| 11   | 1800272                    | Coil, Xmtr Matching, 3-1/2T, RHH      |
| 12   | 1800105                    | Coil, Output Filter, 4-1/2T           |
| 13   | 1800103                    | Coil, Output Filter, 5-1/2T           |
| 14   | 1800104                    | Coil, 1-1/2T                          |
| 15   | 1800005                    | Coil, .03 uH                          |
| 216  | 1800329                    | Coil, 3.3 uH                          |

**TRANSISTORS**

|      |         |                                     |
|------|---------|-------------------------------------|
| Q101 | 4805484 | JFET, N-Channel, 2N5484             |
| 2    | 4800064 | NPN, Sil., Low-Noise Mixer, MPS-H20 |
| 3    | ---     | Not Assigned                        |
| 4    | 4800024 | NPN, Sil, RF, MPS-3563              |
| 5    | 4805461 | JFET, P-Channel, 2N5461             |
| 6    | ---     | Not Assigned                        |
| 7    | ---     | Not Assigned                        |
| 108  | ---     | Not Assigned                        |

| Reference Number      | Part Number | Description                    |
|-----------------------|-------------|--------------------------------|
| TRANSISTORS (Cont'd.) |             |                                |
| Q201                  | 4805485     | JFET, N-Channel, 2N5485        |
| 2                     | 4805461     | JFET, P-Channel, 2N5461        |
| 3                     | 4800024     | NPN, Sil., RF, MPS-3563        |
| 4                     | 4800024     | NPN, Sil., RF, MPS-3563        |
| 5                     | 4800004     | NPN, Sil., RF Power, 2N3866    |
| 6                     | 4800004     | NPN, Sil., RF Power, 2N3866    |
| 7                     | 4800069     | NPN, Sil., RF Power, MRF-237   |
| 8                     | 4800051     | NPN, Sil., Darlington, MPSA-13 |
| 9                     | 4800070     | NPN, Sil., MPSA-MPSA-18        |
| 210                   | 4800008     | PNP, Sil., 2N5086              |

RESISTORS

|      |                            |   |
|------|----------------------------|---|
| R101 | 4710008                    | 100 ohm +10%, 1/4 W                       |
| 2    | 4710028                    | 8.2K +10%, 1/4 W                          |
| 3    | 4710036                    | 56K +10%, 1/4 W                           |
| 4    | ---                        | Not Assigned                              |
| 5    | 4710012                    | 330 ohm +10%, 1/4 W                       |
| 6    | 4710032                    | 22K +10%, 1/4 W                           |
| 7    | 4710032                    | 22K +10%, 1/4 W                           |
| 8    | 4710008                    | 100 ohm +10%, 1/4 W                       |
| 9    | 4760065                    | 100K, Var., Squelch, VN16E-5              |
| 10   | 4710068                    | 68K +10%, 1/4 W                           |
| 11   | 4710038                    | 100K +10%, 1/4 W                          |
| 12   | 4710033                    | 33K +10%, 1/4 W                           |
| 13   | 4720066                    | 390K +5%, 1/4 W                           |
| 14   | 4710025                    | 4.7K +10%, 1/4 W                          |
| 15   | 4710038                    | 100K +10%, 1/4 W                          |
| 16   | 4760066                    | 100K Var., Audio with ON-OFF Sw., VS16E-5 |
| 17   | 4710035                    | 47K +10%, 1/4 W                           |
| 18   | 4710011                    | 220 ohm +10%, 1/4W                        |
| 19   | 4710048                    | 4.7 ohm +10%, 1/4W                        |
| 20   | 4710027                    | 6.8K +10%, 1/4W                           |
| 21   | 4710032                    | 22K +10%, 1/4 W                           |
| 22   | 4710013                    | 470 ohms +10%, 1/4 W                      |
| 23   | 4710008                    | 100 ohms +10%, 1/4 W                      |
| 25   | 4710036                    | 56K +10%, 1/4W                            |
| 26   | <del>4710021</del> 4710021 | <del>10K</del> 2.2K +10%, 1/4W            |
| 201  | ---                        | Not Assigned                              |
| 2    | 4710046                    | 27K +10%, 1/4 W                           |
| 3    | 4710046                    | 27K +10%, 1/4 W                           |
| 4    | 4710038                    | 100K +10%, 1/4 W                          |
| 5    | 4710011                    | 220 ohm +10%, 1/4 W                       |
| 6    | 4710038                    | 100K +10%, 1/4 W                          |
| 7    | 4710035                    | 47K +10%, 1/4W                            |
| 8    | 4710028                    | 8.2K +10%, 1/4 W                          |
| 9    | 4700011                    | 68 ohm +10%, 1/2 W                        |
| 10   | 4710021                    | 2.2K +10%, 1/4 W                          |
| 211  | 4710008                    | 100 ohm +10%, 1/4 W                       |

Reference  
Number

Part  
Number

Description

RESISTORS (Cont'd.)

|      |         |                     |
|------|---------|---------------------|
| R212 | 4710013 | 470 ohm +10%, 1/4 W |
| 13   | 4710001 | 10 ohm +10%, 1/4 W  |
| 14   | 4710069 | 150K +5%, 1/4 W     |
| 15   | 4710028 | 8.2K +10%, 1/4 W    |
| 16   | 4710024 | 3.9K +10% 1/4 W     |
| 17   | 4710032 | 22K +10%, 1/4 W     |
| 18   | 4710054 | 120K +10%, 1/4 W    |
| 19   | 4710034 | 39K +10%, 1/4 W     |
| 20   | 4710033 | 33K +10%, 1/4 W     |
| 21   | 4710021 | 2.2K +10%, 1/4 W    |
| 22   | 4760005 | 1K, Variable        |
| 23   | 4710032 | 22K, +10%, 1/4 W    |
| 24   | 4710029 | 10K, +10%, 1/4 W    |
| 225  | 4710023 | 3.3K +10%, 1/4W     |

SWITCHES

|       |         |   |
|-------|---------|---|
| SW101 | ---     | Part of Vol. Cont. R116                         |
| 2     | 5100126 | DPDT Key Switch, w/Orange Button, 8221V3 (Mod.) |
| 103   | 5100125 | 2P4T Channel Switch, Alco MSS-2450              |

TRANSFORMERS

|      |         |                          |
|------|---------|--------------------------|
| T101 | 5600044 | Transformer, 10.7 MHz IF |
| 2    | 5600044 | Transformer, 10.7 MHz IF |
| 3    | 5600044 | Transformer, 10.7 MHz IF |
| 4    | 5600043 | Transformer, 455 kHz IF  |
| 5    | 5600043 | Transformer, 455 kHz IF  |
| 6    | ---     | Not Assigned             |
| 7    | ---     | Not Assigned             |
| 201  | 5600072 | Transformer, Modulation  |
| 2    | ---     | Not Assigned             |
| 3    | ---     | Not Assigned             |

CRYSTALS

|      |         |                                     |
|------|---------|-------------------------------------|
| Y101 | 2300226 | Refer to Section 4-8 in this manual |
| 2    | 2300226 | Refer to Section 4-8                |
| 3    | 2300226 | Refer to Section 4-8                |
| 4    | 2300226 | Refer to Section 4-8                |
| 105  | 2300252 | Crystal, 2nd L.O., 10.245 MHz       |
| 201  | 2300211 | Refer to Section 4-8                |
| 2    | 2300211 | Refer to Section 4-8                |
| 3    | 2300211 | Refer to Section 4-8                |
| 4    | 2300211 | Refer to Section 4-8                |

Reference  
Number

Part  
Number

Description

CHOKES

|      |         |   |
|------|---------|---|
| Z201 | 1800339 | Choke, Wideband, Ferroxcube VK200-10/3B   |
| 2    | 1800339 | Choke, Wideband, Ferroxcube VK200-10/3B   |
| 3    | 1800339 | Choke, Wideband, Ferroxcube VK200-10/3B   |
| 4    | 1870003 | Choke, Ferrite Core (3 beads on bus wire) |
| 5    | 1800361 | Choke, 1.5 $\mu$ H                        |

MISC LLANEOUS

|      |         |  |
|------|---------|--|
| ---  | 1200013 | Antenna, Precut to Frequency             |
| ---  | 2510331 | Bracket, Antenna                         |
| ---  | 6070053 | Clip, Battery -- Keystone #206           |
| ---  | 4000006 | Battery - 1.2V Nicad Penlight (6 req'd.) |
| ---  | 6070022 | Tube, Penlight Battery (2 req'd.)        |
| ---  | 4000007 | Charger, Battery                         |
| J201 | 2100263 | Jack, Charging SJ465                     |
| ---  | 1325074 | Microphone, ME-21 (11-021)               |
| ---  | 2509991 | Speaker                                  |
| ---  | 2510284 | Case, Front                              |
| ---  | 2510334 | Cover, Back                              |
| ---  | 2510332 | Carrying Case                            |
| ---  | 2510286 | Knob, Vol. or Squelch (2 req'd.)         |
| ---  | 2510479 | Shield                                   |
| ---  | 2510327 | Switch Shield                            |



# Service Bulletin

GENERAL  
AVIATION  
ELECTRONICS  
INC.



4141 KINGMAN DRIVE  
INDIANAPOLIS, IND. 46226  
AREA 317 • 546-1111

SB-7804

July 19, 1978

SUBJECT: ECOM-4 and GTX-4; Strong Signal Overload

Reports have been received which indicate that, under extremely strong-signal conditions, the ECOM-4 and GTX-4 receivers overload, and may become totally inoperative in the presence of very strong signals.

Engineering tests show that this problem can be cured easily by installing a 1N4148 (4810017) diode in parallel with T103 as shown in Figure 1.

To install this diode (CR105) in either model of transceiver, proceed as follows:

1. Remove front and rear plastic covers from unit as given in Section 4-4-1 of the Maint. Manual.
2. Carefully install diode CR105 as shown in Figure 1 (bottom-side of PC board, adjacent to C142).

**CAUTION:** Install diode flat against PC board, using short leads. Observe polarity - anode lead should be soldered directly to transformer pin.

3. Reinstall front and rear covers on unit, and check for normal operation.

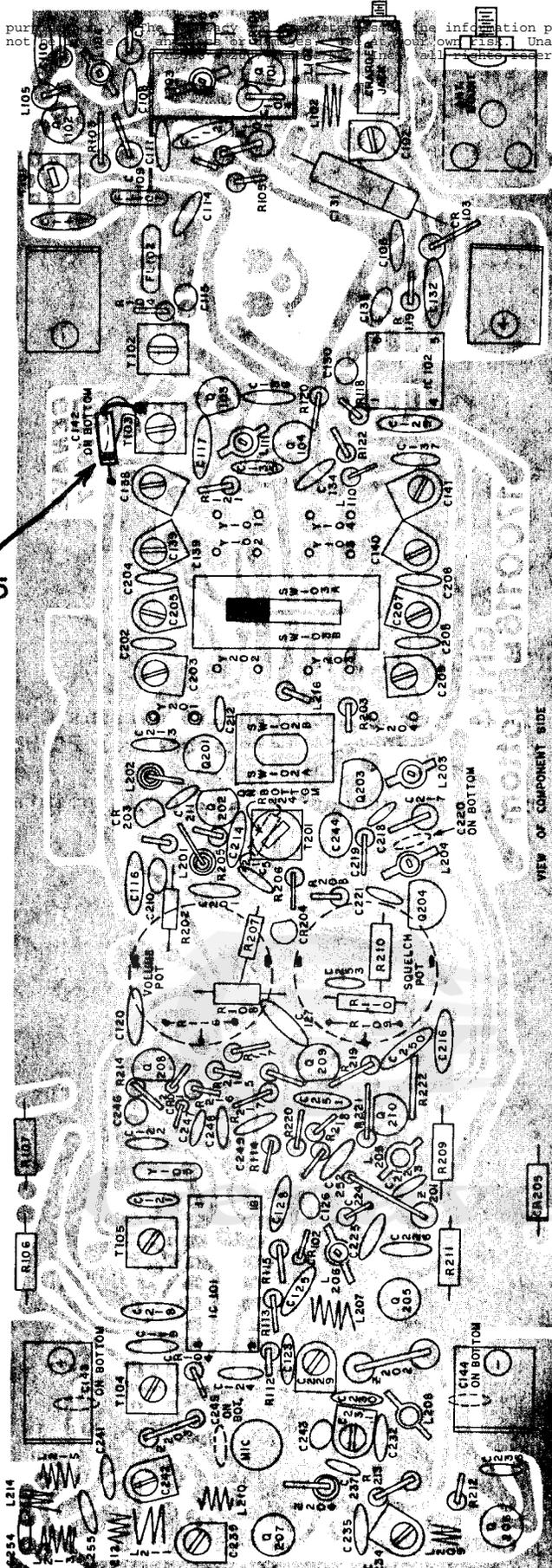
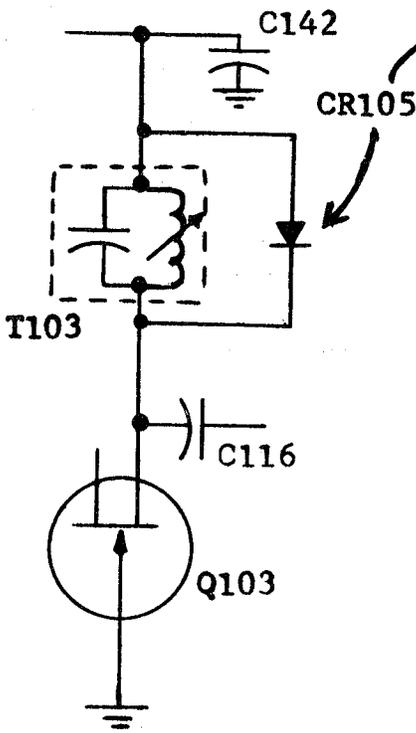


Figure 1. Handheld PC Board Component Layout

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