# ECOM-40
# VHF-FM
# 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 merchantibility 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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Genave

4141 Kingman Drive, Indianapolis, Indiana 46226

AREA (317) 546-1111

Specifications subject to change without notice



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Tech. Pub. No. 0540067

# CONTENTS

# SECTION I
# GENERAL INFORMATION

## 1-1. INTRODUCTION

This manual contains all the information normally required to license, implement, and operate the Genave Model ECOM-40 VHF-FM transceiver.

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

## 1-2. DESCRIPTION

NOTE: The ECOM-40 transceiver has the capability of transmitting and receiving on frequencies assigned by the F.C.C. to the various Business Radio Services, such as: Land Transportation, Industrial Radio, and Public Safety, and thus MUST BE LICENSED PRIOR TO ACTUAL USE. While the seller may assist in filing the license application, the responsibility lies solely with the prospective licensee to assure that transmitting equipment is covered by a valid station license.

The ECOM-40 is a handheld, portable VHF transceiver designed for the transmission and reception of frequency modulated (16F3) radio signals on any one 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 crystal frequencies installed within the unit. Note, however, the maximum spread between highest and lowest frequencies installed in the unit is 2 MHz for either receive or transmit.

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.

If the transceiver is equipped with the CTCSS sub-audible tone option, a tone-override switch on the unit's top panel is provided to permit communications with other transceivers NOT equipped with your sub-audible tone frequency, and to permit monitoring the frequency prior to initiating a call.

The transmitter provides a typical RF output of 1.5 watts minimum into a 52-ohm standard antenna system over the frequency range from 143.9 MHz to 173.4 MHz. The frequency accuracy is adjustable to ±100 Hz, and the frequency stability is ±.001% from -30°C to +50°C. A 1-kHz modulating audio signal will give a deviation of ±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 funcitons. 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 ±500 Hz, and the frequency stability is ±.001%. The receiver audio output power typically is 350 mW at less than 10% distortion.

A self-contained battery pack, consisting of 8 nicad cells, supplies 9.6 VDC to operate the unit. An external charging jack and a diode, which prevents "reversed-polarity" charging, provide for charging the battery pack while installed in the transceiver.

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 transceiver is complete with antenna, 9.6V nicad battery pack, battery charger, and built-in speaker/microphone. A helically-loaded, rubber-clad flexible antenna with an 8-32 threaded mounting is standard equipment with the ECOM-40; however, a helically loaded, rubber-clad flexible antenna with a BNC mounting is available as an option at time of purchase.

All circuitry employed is the latest state-of-the-art design, using the latest in semiconductor and integrated-circuit technology.

All transceiver components are mounted on a single "double-sided," printed-circuit board.

Operating controls for the unit (Volume, Squelch, Charging Jack and Antenna or connector) are mounted on top panel. The Frequency Selector switch is located in the lower, right-hand corner of the front panel. Thus, the controls are easily accessible when needed, yet do not interfere with the portability or operation of the instrument. The push-to-talk switch is mounted on the left-hand side of case for easy one-handed operation.

## 1-3. SPECIFICATIONS

GENERAL:

| | |
|---|---|
| Over-all Dimensions: | 8.625" (21.9 cm) High; 2.938" (7.46 cm) Wide; 1.830" (4.65 cm) Deep |
| Power Supply: | Internal battery pack; 8 nicad cells, 9.6 volts |
| Current Drain: | Standby: 25 mA; Receive: 63 mA; Transmit: 700 mA |
| Battery Operating Time: | 1.5 Watts = 6 hrs, based on 5% transmit, 5% receive, and 90% standby duty cycle |
| Frequency Range: | 143.9 to 173.4 MHz |
| Temperature Range: | -30°C to +50°C |
| Number of Channels: | 4, maximum |
| Weight: | Approx. 1 Lb (0.45 kg) |

RECEIVER:

| | |
|---|---|
| Sensitivity: | 0.35 uV max. (12 dB SINAD) |
| Adjacent Channel Rejection: | -55 dB minimum at 25 kHz (12 dB SINAD) |
| Image Rejection: | 55 dB minimum |
| Spurious Rejection: | 55 dB |
| Intermodulation: | 60 dB, minimum |

RECEIVER (Cont'd):

| | |
|---|---|
| Modulation Acceptance Bandwidth: | ±7.5 kHz, maximum |
| Squelch Threshold: | 0.35 uV, maximum |
| Hum and Noise Level | More than 35 dB below 0.25 watts |
| Audio Output Power: | 350 mW at less than 10% distortion |
| Frequency Accuracy: | Adjustable within ±500 Hz |
| Frequency Stability: | ±.001% |
| Maximum Channel Separation: | 2 MHz |

TRANSMITTER:

| | |
|---|---|
| Output Power | 1.5 watts, minimum |
| Output Impedance: | 50-ohms, nominal |
| Spurious & Harmonics: | More than 46 dB below 1.5 watts |
| Frequency Accuracy: | Adjustable to ±100 Hz |
| Frequency Stability: | ±.001% from -30°C to +50°C |
| Modulation: | Type 16F3, ±5 kHz for 100% modulation with 1000 Hz audio |
| Deviation: | ±5 kHz maximum, with 1 kHz audio |
| Subaudible Tone : | Optional |
| Frequency Range: | 143.9 to 173.4 MHz |
| Maximum Channel Separation: | 2 MHz |

## 1-4. EQUIPMENT FURNISHED

a. ECOM-40 VHF-FM Transceiver

b. Helically - loaded, flexible antenna

c. 9.6 volt battery pack (8 nicad cells) - PSI-32

d. Battery charger - PSI-16

e. Crystal, receive (1) -- specify frequency

f. Crystal, transmit (1) -- specify frequency

## 1-5. OPTIONAL EQUIPMENT AVAILABLE

a. Antenna, helically-loaded, rubber-clad flexible with BNC connector

b. SA-44 CTCSS sub-audible tone squelch module.

c. Leather holster for Ecom-40 (GLC-4)

d. Leather flap for holster (GLC-5)

e. Speaker/Microphone (G22)

f. Spare battery pack (PSI-32)

# SECTION II
# INSTALLATION MANUAL

## 2-1. INTRODUCTION

This manual section provides installation and charging data for the nicad battery pack supplied with the VHF-FM handheld transceiver. Information concerning the antenna supplied with the unit is also given.

## 2-2. BATTERY INSTALLATION

The 9.6-volt nicad battery pack is not installed in unit at time of shipment from the factory, but is packaged in shipping container with transceiver. The battery pack 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.

Remove plastic BACK cover from transceiver in order to install batteries. This cover is easily removed as follows (See Figure 2-1):

1. Carefully lay transceiver on its FRONT on suitable work surface. Be SURE unit is turned OFF.

2. Remove two #4-40 x 1" pan-head machine screws which secure back cover to transceiver (item "A" Fig. 2-1).

3. Lift cover up and off transceiver.

4. Connect battery-pack to mating connector which is attached to ECOM-40 main PC board. Lay battery pack on rear of transceiver main PC board, using foam material supplied to protect PC board.

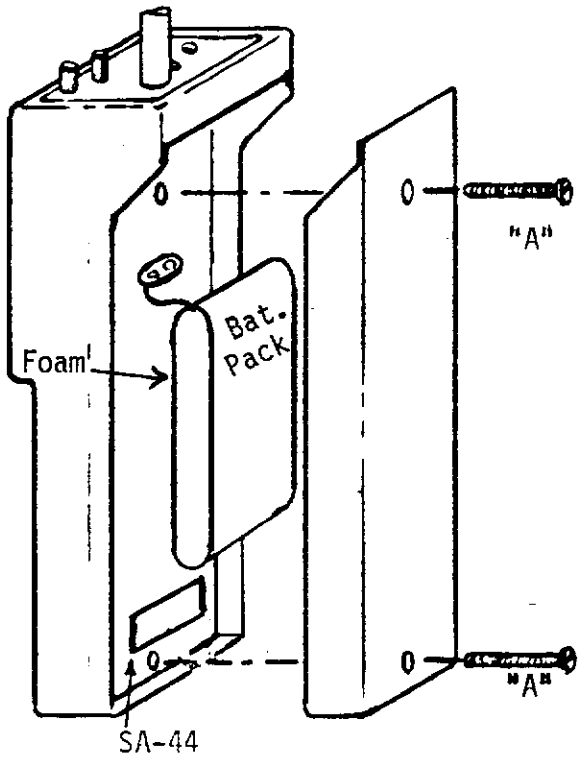



Figure 2-1. Unit Rear View

5. Re-install transceiver rear cover. Be sure cover does not pinch battery wires; then replace two #4-40 x 1" screws removed in step 2 above.

6. Plug cord from battery charger into charging jack on top of unit; then, insert charger into 120 VAC, 50/60 Hz, receptacle.

7. 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 INFORMATION

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.

As a general estimate, two handheld, 2-watt transceivers can communicate in a normal urban environment over approx. 1.5 miles. A 2-watt handheld communicating directly with a 25-watt mobile unit can transmit approx. 2.8 miles to the mobile, but can receive the mobile for approx. 5.8 miles. If a 2-watt unit is working through a VHF Repeater having a 6-dB gain antenna mounted 100 ft. above average terrain, and with transmitter power of 90-watts, the handheld can expect to raise the repeater over a radius of 14 miles; however, the handheld will receive the repeater over a distance of approx. 25 miles.

The ECOM-40 is designed to operate into a 52-ohm antenna system. The unit is normally supplied with a rubber-clad, flexible, helically-loaded antenna with an 8-32 threaded mounting; however, the same antenna, except equipped with a BNC connector, is available as an option at time of purchase.

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 dimension "A" in Figures below. Use Figure 2-2 for stud-mounted antennas, but use Figure 2-3 for antennas with BNC mounting.

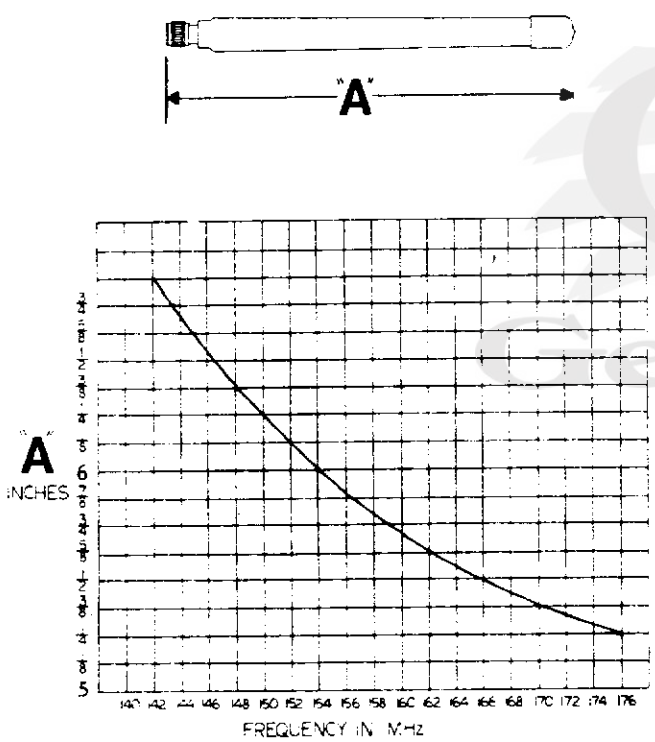



Figure 2-2. Stud-Mounting

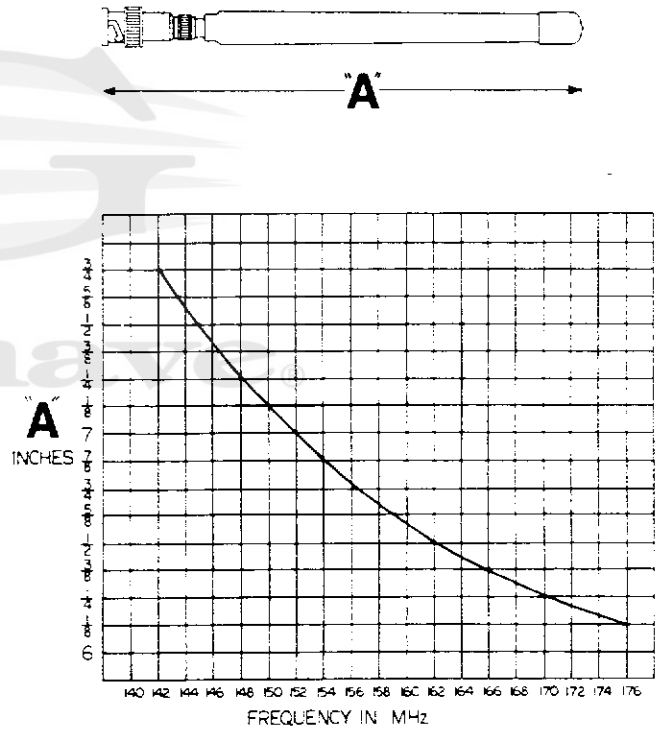
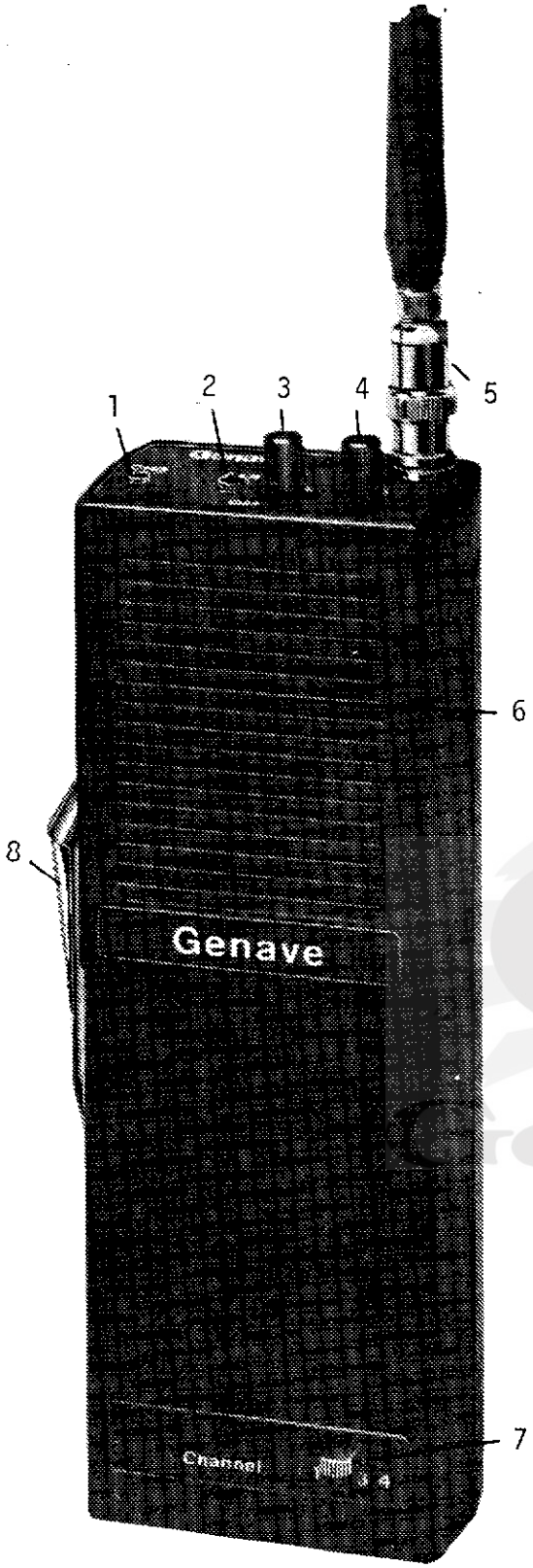



Figure 2-3. BNC-Mounting

# SECTION III
# OPERATING MANUAL




## 3-1. OPERATING CONTROLS

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

1. Charging jack to permit charging the internal nicad battery pack
2. Earphone jack
3. Volume control/On-Off switch
4. Squelch control, and tone-squelch override switch.
5. Flexible antenna, or BNC antenna connector.
6. Built-in Speaker/Microphone
7. Channel-Selector switch
8. Push-to-talk switch

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

## 3-2. OPERATING INSTRUCTIONS

1. To operate transceiver, turn unit ON by rotating the Volume Control (3) clockwise until switch clicks.

2. Select desired transmit/receive frequency by sliding Channel-Selector Switch (7) to desired operating position.

3. Check that helically-loaded, flexible, rubber-clad antenna is properly connected to transceiver.

4. If transceiver is equipped with the SA-44 subaudible-tone option, deactivate tone-squelch by pulling the squelch-control knob OUT to its MONITOR position.

5. Rotate Squelch Control (4) counterclockwise until noise is heard in speaker (6). Adjust Volume Control for desired audio level; then, readjust Squelch Control clockwise until receiver just quiets. DO NOT

ADJUST SQUELCH WHILE A SIGNAL IS BEING RECEIVED.

6. To activate tone-squelch, PUSH the squelch-control knob (4) IN to its SQUELCH position (Do NOT turn knob from position selected in step 5).

7. To transmit, depress Push-to-Talk Switch (8) and speak into microphone (6). Release Push-to-Talk Switch to listen.

NOTE: The carrier-level squelch circuit, which is adjusted by the TOP-PANEL squelch control, quiets the receiver in the absence of an incoming signal on the assigned operating frequency; however, ANY station in your vicinity, operating on this frequency, will be heard.

The SA-44 Subaudible-Tone System is a tone-activated circuit designed to squelch receiver audio until a transmitted signal containing the proper subaudible tone is received. Thus, calls by other licensees who share the channel will not be heard unless transceiver is manually set to its MONITOR position by pulling squelch knob (4) OUT. Note that the channel MUST be monitored prior to initiating a call, to insure that frequency is NOT in use; if channel is clear, PUSH squelch knob (4) IN and proceed to originate call.

8. If an optional, external speaker/microphone is desired, it may be connected to Earphone Jack (2) on unit top panel.

9. To charge internal batteries, plug charger into Charging Jack (1). Now, insert charger into 120 VAC, 60 Hz, receptacle. Be SURE Volume Control is turned fully counterclockwise to its OFF position.

## 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-40 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: | ECOM-40 |
| Type of Unit: | Transceiver |
| Frequency Range (MHz): | 143.9 to 174.0 |
| Frequency Tolerance: | +.001% |
| Emission: | 16F3 |
| Transmitter Input Power: | --- |
| Transmitter Output Power: | 1.5 watts |
| Approved under Rule Part Numbers: | 22, 74, 81,87,90 |

For additional information on filling out the appropriate application forms, consult the F.C.C. instruction sheet provided with the form.

F.C.C. Form 400 and F.C.C. Form 405-A are normally used to apply for a license for the ECOM-40. The Form 400 is used to apply for a NEW station authorization in the Public Safety, Industrial, and Land Transportation Radio Services under F.C.C. Rule Part 90.

Form 405-A may be used in applying for license RENEWAL in the Aviation, Public Safety, Industrial, Land Transportation and Disaster radio services when there has been no change, other than mailing address or licensee's name.

For answers to specific licensing questions, contact the Engineer-in-Charge at nearest Federal Communications Commission Field Engineering Office as listed below -- they will also supply the appropriate form(s).

The procedures for obtaining necessary licenses are found in the Federal Communications Commission Rules and Regulations. These volumes may be purchased from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

The services and the corresponding F.C.C. rule part numbers, under which the ECOM-40 transceiver can be used, are as follows:

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

Public Mobile Radio Services

F.C.C. Rules & Regulations, Volume VII, Part 22

Domestic Public Land Mobile Radio Service
Rural Radio Service

Private Land Mobile Radio Services

F.C.C. Rules & Regulations, Volume V, Part 90

| | |
|---|---|
| Local government radio service | Subpart B |
| Police radio service | |
| Fire radio service | |
| Highway maintenance radio service | |
| Forestry-conservation radio service | |
| Medical services | Subpart C |
| Rescue organizations | |
| Veterinarians | |
| Disaster relief organizations | |
| School buses | |
| Beach patrols | |
| Paging operations | |

Private Land Mobile Radio Services (Cont'd)

| | |
|---|---|
| Power radio service | Subpart D |
| 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 | |
| Motor carrier radio service | Subpart E |
| Railroad radio service | |
| Taxicab radio service | |
| Automobile emergency radio service | |

Stations on Land in the Maritime Services
F.C.C. Rules & Regulations, Volume IV, Part 81
Public Coast Stations
Marine Utility Stations

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

## 3-4. P.C.C FIELD ENGINEERING OFFICES (Engineer - De Gaulle)

Anchorage District Office
1011 E. Tudor Road, Room 240,
P.O. Box 2955
Anchorage, Alaska 99510

Atlanta District Office
Room 440, Massell Building,
1365 Peachtree Street, NE,
Atlanta, Georgia 30309

Baltimore District Office
1017 Federal Building,
31 Hopkins Plaza,
Baltimore, Maryland 21201

Beaumont Office
Jack Brooks Federal Building, Room 323
300 Willow Street,
Beaumont, Texas 77701

Boston District Office
1800 Customhouse,
165 State Street,
Boston, Massachusetts 02109

Buffalo District Office
1307 Federal Building
111 West Huron Street,
Buffalo, New York 14202

Chicago District Office
230 S. Dearborn Street, Room 3935,
Chicago, Illinois 60604

Cincinnati Office
3620 Winton Road,
Cincinnati, Ohio 45231

Dallas District Office
Earle Cabell Federal Building,
U.S. Courthouse, Room 13E7
1100 Commerce Street,
Dallas, Texas 75242

Denver District Office
The Executive Tower, Room 2925
1405 Curtis Street,
Denver, Colorado 80202

Detroit District Office
1054 Federal Building,
231 W. LaFayette Street,
Detroit, Michigan 48226

Honolulu District Office
Prince Kuhio Federal Building,
300 Ala Moana Blvd., Room 7304,
P.O. Box 50223
Honolulu, Hawaii 96850

Houston District Office
New Federal Office Building,
515 Rusk Ave., Room 3636,
Houston, Texas 77002

Kansas City District Office
Brywood Office Tower, Room 320
6800 East 63rd Street,
Kansas City, Missouri 64133

Long Beach District Office
3711 Long Beach Blvd., Room 501
Long Beach, California 90807

Miami District Office
51 S.W. First Ave., Room 919,
Miami, Florida 33130

New Orleans District Office
1007 F. Edward Hebert Federal Bldg.,
600 South Street,
New Orleans, Louisiana 70130

New York District Office
201 Varick Street,
New York, New York 10014

Norfolk District Office
Military Circle,
870 N. Military Highway,
Norfolk, Virginia 23502

Philadelphia District Office
11425 James A. Byrne Federal Courthouse
601 Market Street,
Philadelphia, Pennsylvania 19106

Pittsburgh Office
3755 William Penn Highway,
Monroeville, Pennsylvania 15146

Portland District Office
1782 Federal Building
1220 S.W. Third Avenue,
Portland, Oregon 97204

St. Paul District Office
691 Federal Bldg., & U.S. Courthouse,
316 North Robert Street,
St. Paul, Minnesota 55101

San Diego Office
7840 El Cajon Blvd., Room 405,
La Mesa, California 92041

San Francisco District Office
323-A Customhouse,
555 Battery Street,
San Francisco, California 94111

San Juan District Office
747 Federal Building,
Hato Rey, Puerto Rico 00918

Savannah Office
238 Post Office Bldg. and Courthouse
P.O. Box 8004 (125 Bull Street)
Savannah, Georgia 31412

Seattle District Office
3256 Federal Building,
915 Second Avenue,
Seattle, Washington 98174

Tampa Office
ADP Building, Room 601,
1211 N. Westshore Blvd.,
Tampa, Florida 33607

Washington District Office
6525 Belcrest Road, Room 901-B
P.O. Box 1789,
Hyattsville, Maryland 20788

# 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-40 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 1.5 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, mixer, limiter, detection, and squelch functions.

In conjunction with the following circuit description, refer to the block diagram of Figure 4-1, and to transceiver schematic in this Section of the ECOM-40 maintenance manual.

## 4-2. THEORY OF OPERATION - GENERAL

### 4-2-1. Power Supply

A self-contained battery pack supplies power to operate the instrument. This battery pack supplies 9.6 volts DC, and uses eight (8) Nickel-Cadmium cells.

The battery pack may be charged, while installed in transceiver case, by means of CHARGE jack J102, located on the top panel of ECOM-40 case. A series diode, CR106, prevents the "reversed-polarity" charging of nicad battery pack.

The + TRANSMIT and + RECEIVE voltage lines are each supplied with 9.6 volts DC through On-Off switch SW103, Push-to-Talk switch SW101A, and isolating choke L211. L110 supplies DC current to the receiver devices while at the same time resisting flow of RF currents; L210 performs the same functions for the transmitter solid-state devices. R105 and CR104 drop the 9.6V supply to 6.8 volts for receiver ICs, IC101 and IC102.

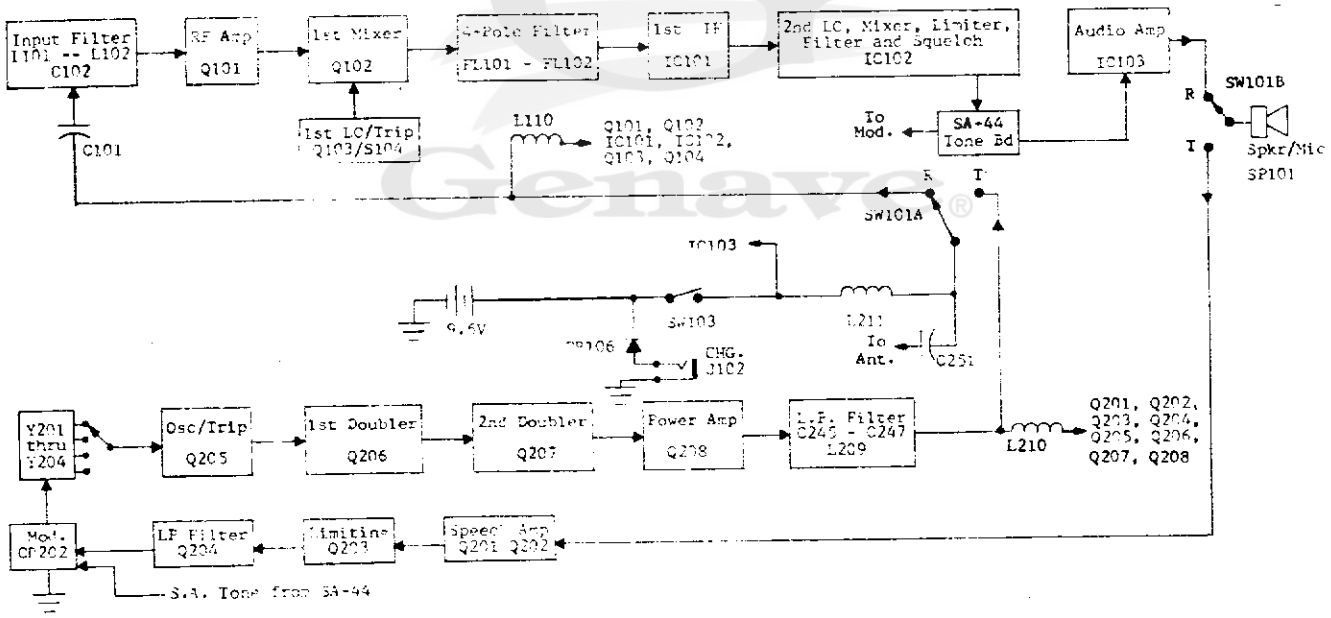



Figure 4-1. Block Diagram

4-2-2. Push-To-Talk Circuitry

On-Off Switch SW103, located on Volume Control R118, applies +9.6-volts to the receiver or transmitter circuitry via Push-To-Talk Switch SW101A. Also P.T.T. SW101A switches antenna between receiver and transmitter circuitry. P.T.T. Switch SW101B connects speaker/microphone SP101 to receiver output when the switch is in its normal resting position, or to transmitter audio input when switch is depressed.

Isolating chokes L110, L210, and L211 allow SW101A to switch DC and RF currents simultaneously. In receive mode, the 9.6-volt supply is applied to Q101, Q102, IC101, IC102, Q103, and Q104 through SW103, L211, SW101A, and L110. At the same time, the RF signal from the antenna is applied to the 2-pole, receiver input filter through C251, SW-101A, and C101. Note that L110 and L211 prevent the incoming RF signal from entering receiver DC circuits.

In the transmit mode, the 9.6-volt supply is switched to transistors Q201, Q202, Q203, Q204, and Q205 through Q208 by means of L211, SW101A, and L210. Simultaneously, transmitter RF output from the L.P. filter is routed to the antenna by SW101A and C251. Chokes L210 and L211 prevent transmitter RF output from appearing across the battery pack or other DC circuitry.

## 4-3. THEORY OF OPERATION - RECEIVER

4-3-1. 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 grounded-gate RF amplifier Q101. The RF amplifier output is routed to a double-tuned circuit consisting of L103, C104, C105, C107, and L104. C108 then applies the amplified signal to base of 1st mixer Q102.

4-3-2. 1st Local Oscillator/Tripler

Q103 and associated components form the modified Colpitts, crystal-controlled first local oscillator circuitry. SW-102A selects proper crystal in the 44.4 MHz to 54.2333 MHz range to produce the desired injection frequency.

The output circuit of FET tripler Q104 is tuned to three times the crystal frequency by L109 and C147; then, output of Q104 is capacity-coupled to base of mixer Q102 by C109. The first LO injection frequency is 10.7 MHz below desired "receive" frequency.

The crystal frequency can be calculated from the following formula, where $F_c$ is the crystal frequency and $F_o$ is the operating frequency:

$$F_c = (F_o - 10.7) / 3$$

4-3-3. 1st Mixer and 4-Pole Filter

The amplified RF input signal and the LO injection signal are each applied to the base circuit of mixer Q102. The 10.7 MHz difference signal, produced in the first mixer, is coupled by T101 to a 4-pole monolithic crystal filter, FL-101 and FL102. T102 matches the filter output to 1st IF amplifier IC101.

4-3-4. 1st IF Amplifier

Integrated-circuit chip, IC101, and the associated components form the 10.7 MHz 1st IF amplifier. CR102, across T102, limits the incoming signal to prevent overdriving IC101. T103 tunes output of IC101 to 10.7 MHz, while C119 couples the amplified signal to input of 2nd mixer in IC102.

4-3-5. 2nd LO, Mixer, Limiter, Detector and Squelch

Integrated-circuit IC102 is a multi-function chip which combines the 2nd local oscillator, 2nd mixer, limiting 2nd IF amplifier, quadrature discriminator, active filter and squelch mute in a single chip.

Y105, C124, and C125, together with IC-102 pins 1, 2, and 4, form an internally biased Colpitts-type oscillator. The collector, base, and emitter connec-

tions 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 IC102 down-converts the 10.7 MHz input frequency to 455 kHz. T105 tunes the mixer output to 455 kHz, and also functions as an external bandpass filter. From T105, the signal is routed to input of a five-stage limiter at pins 5 and 6 of IC102. 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 IC102, then applied to pin 9. From pin 9 on IC102, the audio signal is applied to a de-emphasis network consisting of R112 and C127; then the signal is routed through the SA-44 tone board (if used) to audio volume control R118.

Pin 9 also routes the recovered audio to input (pin 10) of a bandpass active filter, which consists of an internal op-amp and external components R113, R114, C128, and C129. Pin 11 applies noise output from the filter to external AM detector CR105, which detects noise ABOVE normal voice audio band. The absence of an input signal results in considerable noise above the desired audio frequencies; whereas, an incoming signal greatly reduces the noise level. R115 connects the NEGATIVE output of CR105 to IC102 pin 12.

Squelch potentiometer R110 selects and applies an external POSITIVE bias to IC102 pin 12 to set squelch-trigger circuit so that audio-muting switch (pin 14) is an OPEN circuit; this removes ground from pin 1 of audio output IC103 which then turns ON and operates normally. When NEGATIVE output of CR105 pulls IC102 pin 12 below 0.7V, pin 14 is internally grounded; this grounds pin 1 of audio output IC103 which turns OFF and squelches receiver.

Thus, with NO input signal, a large noise voltage is applied to CR105. The resultant NEGATIVE DC voltage is applied to IC102 pin 12 where it combines with the POSITIVE voltage supplied by squelch control R110. With a normal setting of the squelch control, the detected noise voltage pulls pin 12 down toward OV causing pin 14 to short to ground -- thus squelching receiver. With an incoming signal above squelch level, a reduced noise voltage is applied to CR105. The detected noise voltage is again applied to IC102 pin 12, but does NOT have sufficient amplitude to hold pin 12 below 0.7V; therefore, the ground is removed from IC102 pin 14 -- thereby unsquelching the receiver.

### 4-3-6. Audio Output

The audio signal, attenuated by volume control R118, is applied to pin 2 of audio output IC103.

R119 and C134 set gain of the amplifier, while C138 and R120 are used to prevent high-frequency oscillation of the amplifier.

NOTE: A ground applied to pin 1 of IC103 (by pin 14 of IC102) disables the output stage to mute receiver.

The reactance of speaker SP101 and C137 provide low-frequency roll-off of the audio output.

## 4-4. THEORY OF OPERATION - TRANSMITTER

### 4-4-1. Speech Amplifier/Limiter/Filter

In TRANSMIT mode, output of SP101 is applied to a common-base amplifier, Q201. From Q201, the voice signal is coupled to common-emitter amplifier Q-202. Q201 and Q202 amplify the microphone output, as well as providing pre-emphasis of the voice signal.

It is necessary to limit the peak amplitude of the audio signal applied to the modulator, so that deviation of the FM transmitter will not exceed the pre-

set value. Q203 performs the limiting function in the ECOM-40H transceiver.

The limiting process produces high-order harmonics which, if allowed to pass through to the modulator stage, would create unwanted sidebands. Therefore, an audio low-pass filter, Q204 and associated components, is used at the output of the limiter to provide a -18 dB per octave rolloff above 3 kHz. R215 sets the maximum voice modulation deviation.

4-4-2. Voice/Subaudible-Tone Modulator

C213 couples audio from the speech amplifier to the modulator circuitry, consisting of varactor CR202 and associated components.

If the subaudible-tone option is installed in the transceiver, R221 connects subaudible-tone output from the SA-44 tone board to varactor modulator CR202.

Audio voltages applied to varactor CR-202 cause the diode capacitance to vary at an audio rate; therefore, since CR-202 is connected between the common crystal line and ground, any change in diode capacitance will result in the crystal frequency changing by a few Hertz. The crystal frequency multiplies 12 times to reach the output frequency; thus the crystal frequency only has to shift approximately 400 Hz for 5 kHz deviation.

4-4-3. Transmit Oscillator/Tripler

Q205 and associated components form a modified Colpitts, crystal-controlled oscillator. The crystal frequency is multiplied 12 times in the transmitter stages. A 4-position, slide switch, SW-102B, selects proper crystal in the 11.99 MHz to 14.45 MHz range to cover operating frequencies between 143.9 and 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 C225 and C226. Their temperature coefficient compensates the oscillator circuitry to maintain ±.001% frequency stability over the temperature range. Crystals are specified to ±.001% over the temperature range from -30°C to +50°C.

L202, C228, and C230 tune collector circuit of Q205 to three times the crystal-oscillation frequency and match collector of Q205 to base of 1st doubler, Q206.

4-4-4. 1st Doubler

Q206 is a Class C doubler stage, using another silicon, NPN transistor.

L203, C232, L204, C233, and C234 tune output of 1st doubler to the 71.94 to 86.7 MHz frequency range (6 times the crystal frequency), and also match collector impedance of Q206 to input of 2nd doubler, Q207.

4-4-5. 2nd Doubler

Q207 is another Class C doubler stage, using a silicon, NPN transistor. Q207 performs the final frequency multiplication, as well as providing sufficient power to drive the final RF amplifier.

L205, C237, C238, L206, C239, and C240 tune output of 2nd doubler to the 143.9 MHz to 173.4 MHz frequency range (12 times the crystal frequency), and also match collector impedance of Q207 to input of power amplifier, Q208.

4-4-6. Power Amplifier

Class C power amplifier Q208 amplifies the RF signal to provide a power output of approximately 1-1/2 watts.

L208 and C244 match the collector impedance of Q208 to the 50-ohm antenna impedance. C245, C247, C246 and L209 form an elliptic-function, lowpass filter which reduces level of all spurious outputs above the operating frequency to at least 46-dB below the carrier level. The filter output is connected to the antenna via push-to-talk switch SW101A, and DC blocking capacitor C251.

## 4-5. DISASSEMBLY

Prior to performing any service work on the instrument, the plastic BACK cover must be removed. This will allow battery pack to be replaced, TRANSMIT frequency(ies) to be adjusted, or SA-44 Tone Board to be serviced. Any further work will necessitate removing plastic FRONT cover also.

The transceiver covers are easily removed; refer to Figure 4-2 and proceed as follows: (DO NOT BUMP OR MOVE XMIT CRYSTAL TRIMMERS AT BOTTOM, RH-SIDE OF PC BOARD).

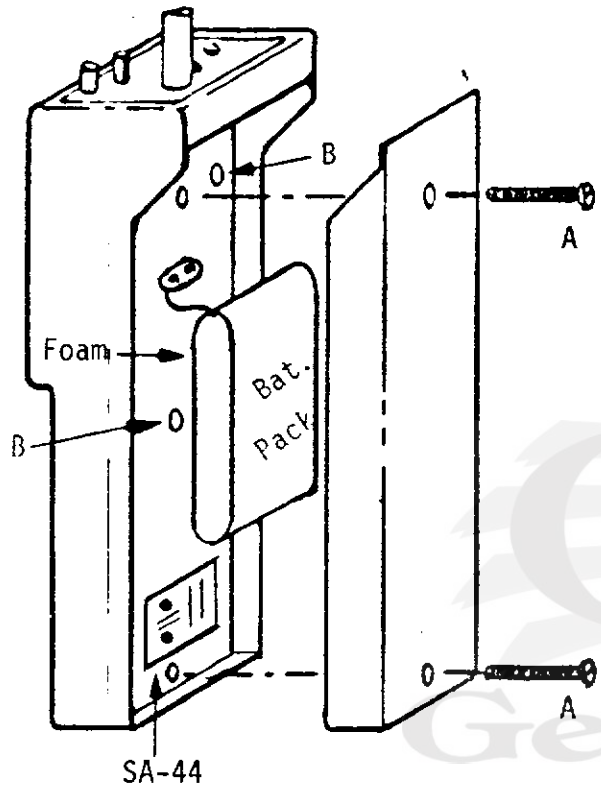



Figure 4-2. Disassembly

### 4-5-1. BACK Cover Removal

1. Carefully lay transceiver on its FRONT on suitable work surface. Be SURE unit is turned OFF.

2. Remove two #4-40 x 1" pan-head machine screws which secure back cover to transceiver (Fig. 4-2, item "A").

3. Lift cover up and off transceiver.

### 4-5-2. FRONT Cover Removal

1. Unscrew the antenna from its 8-32 threaded mounting stud; then, use 0.050" Allen wrench to loosen two setscrews in each control knob. Remove both knobs.

2. Remove BACK cover as given above to gain access to PC-board mounting screws.

3. Disengage battery connector from its mating connector; then, remove battery pack from ECOM-40 Transceiver.

4. Remove two #4-40 pan-head machine screws (Figure 4-2, item "B") which secure PC board to FRONT cover.

5. Place hand across open back-side of transceiver. Carefully grasp unit and turn it over. The PC-board may drop into the palm; but if it does not, push gently on channel-selector switch. Hold PC-board, while sliding FRONT cover off over jacks and control shaves.

CAUTION: The speaker/microphone is simply lying in position on the PC board - DO NOT drop speaker or damage leads.

### 4-5-3. SA-44 Tone-Board Removal

1. Remove BACK cover from transceiver as outlined in Section 4-5-1 above.

2. Grasp SA-44 tone board by its edges and, with a slight rocking motion, lift tone board away from main PC board until tone board clears the seven connecting pins.

3. If service work, such as component replacement, is to be performed on SA-44, it is necessary to remove phenolic insulator from foil side of tone board. The phenolic insulator is secured to tone board with RTV; thus, the insulator can be easily peeled from tone board and re-used.

## 4-6. UNIT REASSEMBLY

As a general rule, items are reassembled on the ECOM-40 transceiver by reversing the disassembly procedure. However, a few points require special attention.

### 4-6-1. FRONT Panel

1. Place the PC board, foil side down, on the palm. Lay speaker/microphone in proper position on the PC board, with its magnet resting on PC board (some boards may have "guide pins" installed to facilitate the speaker placement on PC board).

2. Rotate speaker so that its two solder terminals face in the general direction of the Charging Jack. Be sure speaker terminals DO NOT short against resistor leads or coils; then check routing of speaker wires to insure they will not be pinched when mounting screws "B" or "A" (Figure 4-2) are installed.

3. Align holes in top panel with controls and jacks on PC board; then, carefully slide FRONT cover into position. BE SURE Push-to-Talk button is in its normal-resting position (NOT depressed), otherwise the P.T.T. switch may be damaged.

4. Turn transceiver over on its front side and be sure PC board is fully seated in FRONT cover. Now install two 4-40 machine screws (Figure 4-2, item "B").

### 4-6-2. SA-44 Installation

1. Note that phenolic insulator is in position on foil side of SA-44 Tone Board. This insulator is essential to prevent shorts between the tone board and the main-board circuitry.

2. Align the seven socket pins on tone board with the corresponding male pins on transceiver main board. Push tone board down on pins until the phenolic insulator rests against the main board.

3. Check component side of tone board for a block of foam material designed to press against unit BACK cover and thus hold tone board in place.

### 4-6-3. Battery Pack Installation

1. Turn Volume Control fully counter-clockwise to the OFF position.

2. Lay nicad battery pack on rear of transceiver main PC board, with the foam material toward PC board. The battery pack SHOULD NOT rest against SA-44 Tone Board.

3. Connect battery-pack to mating connector which is attached to ECOM-40 main PC board. BE SURE BACK COVER WILL NOT PINCH BATTERY WIRES.

## 4-7. 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 the adjustment points.

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

### 4-7-1. Preparation for Alignment

1. Remove BACK and FRONT covers as explained in Section 4-5, so that component side of PC board is accessible. For ease of test equipment connection, a female BNC connector may be soldered temporarily to the antenna connector copper-pad area & the adjacent ground area. See Figure 4-3.

2. Power may be supplied by either a fully charged 9.6V battery pack, or a regulated bench supply capable of 1 Amp at 9.6 volts. CAUTION: Observe correct polarity of power supply.

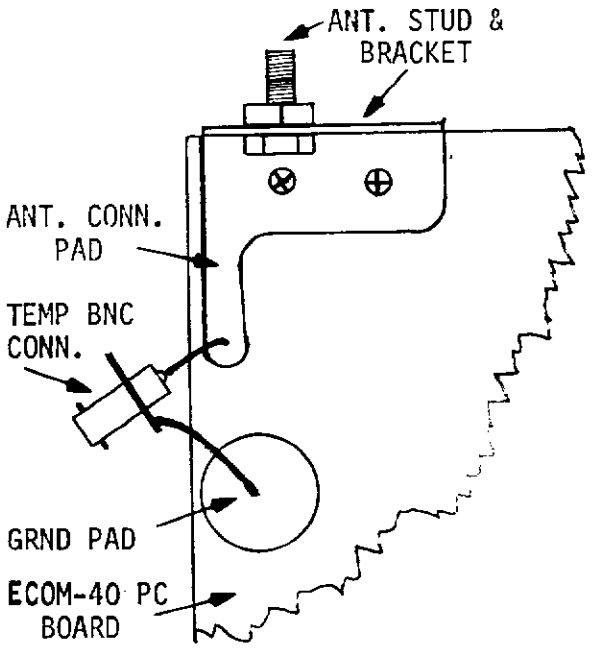



Figure 4-3. Temporary Ant. Conn.

3. To facilitate transceiver test and alignment, the SA-44 tone board (if used) can be temporarily removed and a jumper wire substituted to complete audio circuitry from "Det. Audio" pin to "Audio to Vol. Cont." pin on ECOM-40 PC board. Refer to Component-Location drawing in this Section for pin locations.

NOTE: The SA-44 subaudible tone board (receive "decode" function only) can also be disabled by moving squelch override switch to its MONITOR position; in this event, the transmit "encode" will still be functional. In the first 100 transceivers built, the MONITOR position was with squelch knob turned fully CCW until switch operated; however, this also disabled the carrier level squelch. The squelch control was replaced by a unit having a push-pull switch, in which the squelch knob is pulled OUT to MONITOR. This allows the carrier-level squelch to operate, if desired, while the tone squelch is disabled.

## 4-8. ALIGNMENT PROCEDURE - RECEIVER

1. Connect unit to 9.6V supply -- See CAUTION note above in step 2.

NOTE: To prevent accidental keying of transmitter during the receiver tests, temporarily short base of Q-205 to ground.

2. Couple frequency counter to first LO coil L109 with a "pick-up" loop. Turn unit ON, and adjust each receive crystal to its proper frequency with the appropriate crystal netting trimmer. See Figure 4-4.

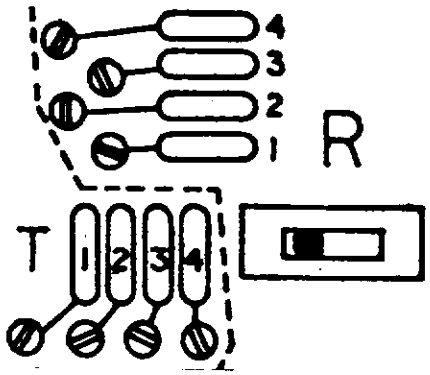



Figure 4-4. Crystal & Trimmer Locations

NOTE: The crystal frequency is calculated as follows:

$F_c$ = (Rec. Freq. - 10.7) ÷ 3, ±.001%

3. Turn unit OFF, and remove frequency counter.

4. Place channel-selector switch to ANY working channel position. This will be the test frequency.

5. Connect scope and SINAD-measuring equipment to unit speaker terminals.

6. Connect FM signal generator to antenna-input connector; then, set the generator on desired "receive" frequency, and modulate generator with a 1-kHz tone at ±5 kHz deviation.

7. 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.

8. Adjust C102, L103, L104, L109, T101, T102, T103, T104, and T105 for best SINAD reading.

9. 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 4-5) to pin 5 of IF amp. IC101; connect detector output to scope vertical input. Set scope vert. sensitivity to give a usable pattern with minimum sweep-generator input.

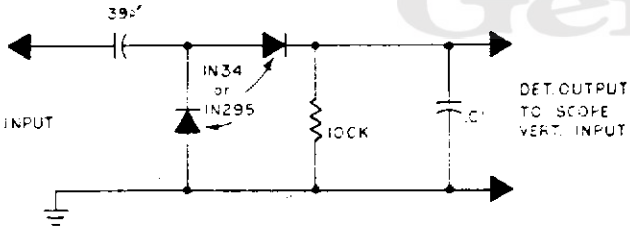



Figure 4-5. High-Impedance Detector

   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 20 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 4-6. Ripple should be NOT MORE than 2 dB, and is generally 1 dB or less.

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

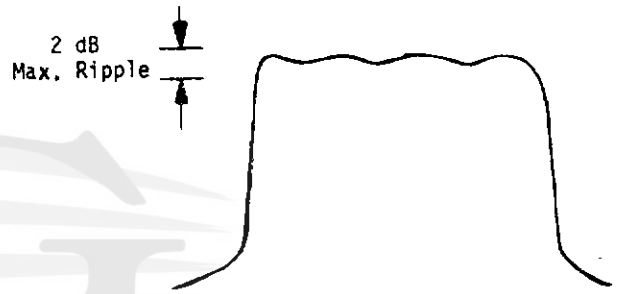



Figure 4-6. IF Response

11. Turn unit OFF, and disconnect test equipment.

4-8-1. 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 (0.8 uV) will quiet receiver 20 dB.

4-8-2. 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 uV).

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 ±5 kHz deviation) until squelch just opens. The signal generator attenuator should read no more than 2.0 uV.

4-8-3. Audio Output Power

1. Set FM signal generator on desired receive frequency, and set modulation for ±5 kHz deviation using 1 kHz audio. Set RF attenuator in the vicinity of 5 uV.

2. Turn receiver volume control fully clockwise. The AC voltmeter, connected to speaker terminals, should indicate not less than 1.0 volts.

3. Set signal generator for ±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 ±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 base of transmit oscillator Q205 was shorted to ground during receiver alignment, remove this short.

6. If SA-44 tone board was removed in step 3 of Section 4-7-1, remove jumper and re-install tone board.

NOTE: If any adjustments are needed for tone board, refer to the SA-44 Maintenance Manual.

## 4-9. ALIGNMENT PROCEDURE - TRANSMITTER

4-9-1. Preparation for Alignment

1. Refer to Section 4-7-1 in this Section of Maintenance Manual.

2. Attach a 50-ohm power meter, or a relative output indicating device (Figure 4-7), to transceiver antenna connector.

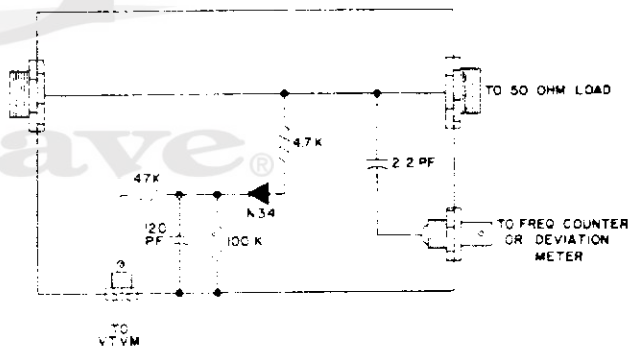



Figure 4-7. Relative Output Indicator

3. Preset deviation potentiometer R215 to its lowest setting, by rotating it fully CLOCKWISE, as viewed from component side of ECOM-40 PC board.

4-9-2. Frequency and Power Alignment

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

1. Place channel-selector switch to an operative channel.

2. Connect VTVM RF probe to base of Q-206 and key transmitter. Adjust L202 for a peak voltage indication on the VTVM.

3. Move RF probe to base of Q207. Key transmitter and adjust slugs in L203 and L204 for a peak reading on VTVM.

4. Move RF probe to base of Q208. Key transmitter and adjust L205 and L206 for a peak voltmeter reading.

5. Remove RF probe. Key transmitter and, using the 50-ohm power meter or relative output device, adjust L208 for a maximum output indication.

6. Touch-up tuning of L202, L203, L204, L205, L206, and L208 for a maximum indication on the power or rel. output indicator.

4-9-3. Transmit Crystal Installation & Frequency Netting

1. Refer to Figure 4-4 for crystal and netting capacitor locations (T).

NOTE: TRANSMIT crystals are mounted on component-side of transceiver PC board, while the netting trimmers are mounted on foil side of board.

2. With a 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 4-7).

3. Key transmitter, and adjust appropriate crystal-netting capacitor for correct frequency.

4. Repeat steps 2 and 3 for each crystal installed in transceiver.

4-9-4. Power-Measurement Procedure

1. Key transmitter, and note RF power-output reading. Typically, the power should be approximately 1.5 watts on each channel installed in unit.

4-9-5. Subaudible-Tone Deviation Adjustment (If Used)

1. Connect unit to relative output indicating device (Figure 4-7); then, connect a Deviation Meter to "Freq. Counter/Deviation Meter" output of the relative output indicator.

2. Adjust FREQ potentiometer, R401, on SA-44 board for desired subaudible tone as given in SA-44 Service Man.

3. Key transmitter, and adjust S.A. DEV potentiometer, R405, on SA-44 for a deviation of ±1 kHz as shown on Deviation Meter.

4-9-6. Carrier Deviation Adjustment

1. Preset DEVIATION-level pot., R215, by rotating it fully CW as viewed from component-side of main board, and then backing pot. off approx. 1/4 turn.

2. Key transmitter, and feed a 1700 Hz tone into transceiver microphone. Watching Deviation Meter, increase audio tone (1700 Hz) level until no further increase in deviation is indicated. The modulator stage is now saturated.

3. Key transmitter, and adjust DEVIATION potentiometer, R215, for a ±5 kHz reading on Deviation Meter.

NOTE: If ECOM-40 is equipped with SA-44 Tone Board, the ±5 kHz deviation consists of the combined 1700 Hz audio and the subaudible tone; whereas, if SA-44 is NOT used the ±5 kHz deviation is due ONLY to the 1700 Hz audio tone.

4. Turn transceiver OFF, and disconnect all test equipment. Replace front cover, install battery pack, and replace rear cover.

## 4-10. 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-40, complete crystal specifications are given in Section 4-11 of this manual.

1. Remove BACK and FRONT covers from ECOM-40, as explained in Section 4-5 of this manual.

2. Locate mounting position for the new crystal(s). Refer to Figure 4-4 for TRANSMIT and RECEIVE crystal locations.

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

3. Insert leads of new crystal through appropriate holes in PC board; then, carefully solder leads to copper pads on back (foil) side of board.

NOTE: Crystal leads MUST BE trimmed close to PC board, to prevent them from cutting into battery pack.

4. To bring the receive crystal(s) "on frequency," perform steps 2 and 3 given in Section 4-8 of this manual.

5. To adjust transmit crystal(s) "on frequency," perform steps 1 through 4 given in Section 4-9-3 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 4-8 and 4-9.

### 4-10-1. Large Changes in Frequency

If new frequency differs from original alignment frequency by 6 MHz or more, it will probably be necessary to replace one or two coils and three capacitors in receiver front-end. Then unit should be re-aligned, as given in Sections 4-8 and 4-9.

Refer to Table 4-1 for component values normally used for different frequency ranges in the ECOM-40 receiver.

NOTE: As given in Section 1-3, the maximum separation between highest- and lowest-frequency channels installed in the ECOM-40 is 2 MHz.

## TABLE 4-1. COMPONENT CHANGES

### Receiver

| Component | MHz Range | 144-150 | 151-158 | 159-165 | 166-174 |
|---|---|---|---|---|---|
| L101 | | 1800116 (4½T) | 1800116 (4½T, spread) | 1800105 (3½T) | 1800105 (3½T) |
| L104 | | 1800308 (8½T) | 1800308 (8½T) | 1800308 (8½T) | 1800304 (4½T) |
| C104 | | 1.8 pF | 1.5 pF | 0.82 pF | 0.47 pF |
| C107 | | 0.82 pF | 0.56 pF | 0.22 pF | 1.5 pF |
| C147 | | 6.8 pF | 6.8 pF | 4.7 pF | 3.9 pF |

## 4-11. CRYSTAL SPECIFICATIONS

To change a transmitter and/or receiver operating frequency in a Model ECOM-40 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-40 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:

### Transmit Crystals

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

### Receive Crystals

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

## 4-12. COMPONENT LAYOUT AND SCHEMATIC

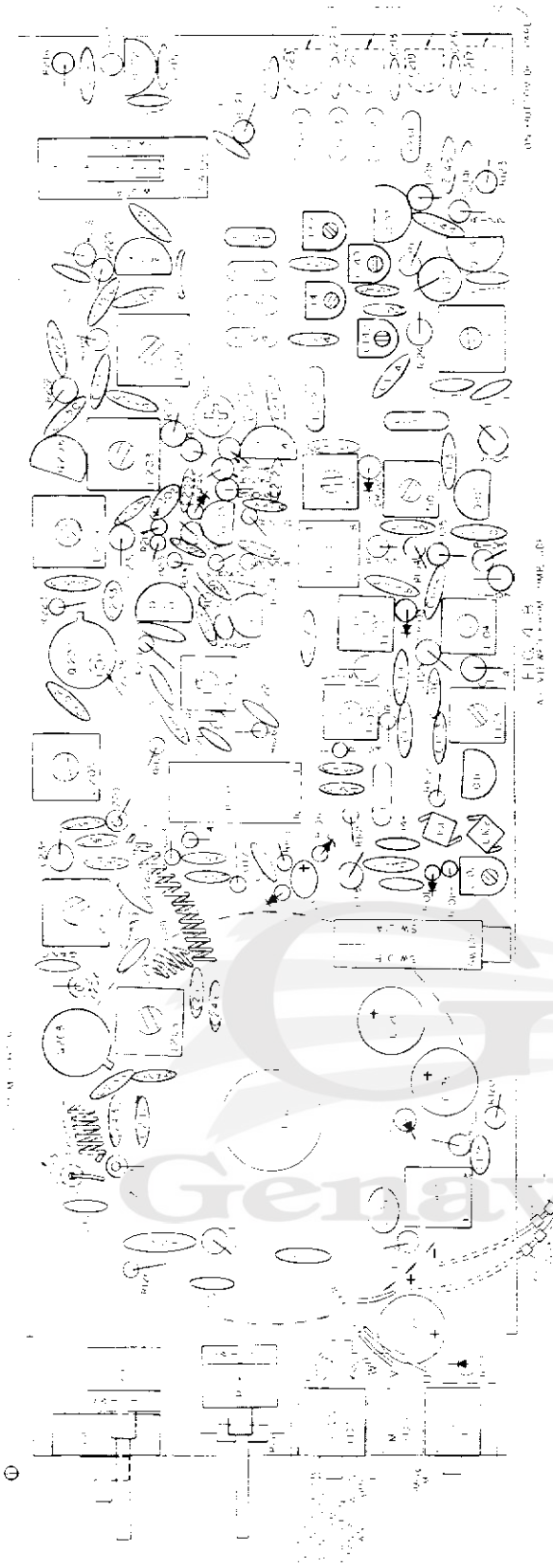
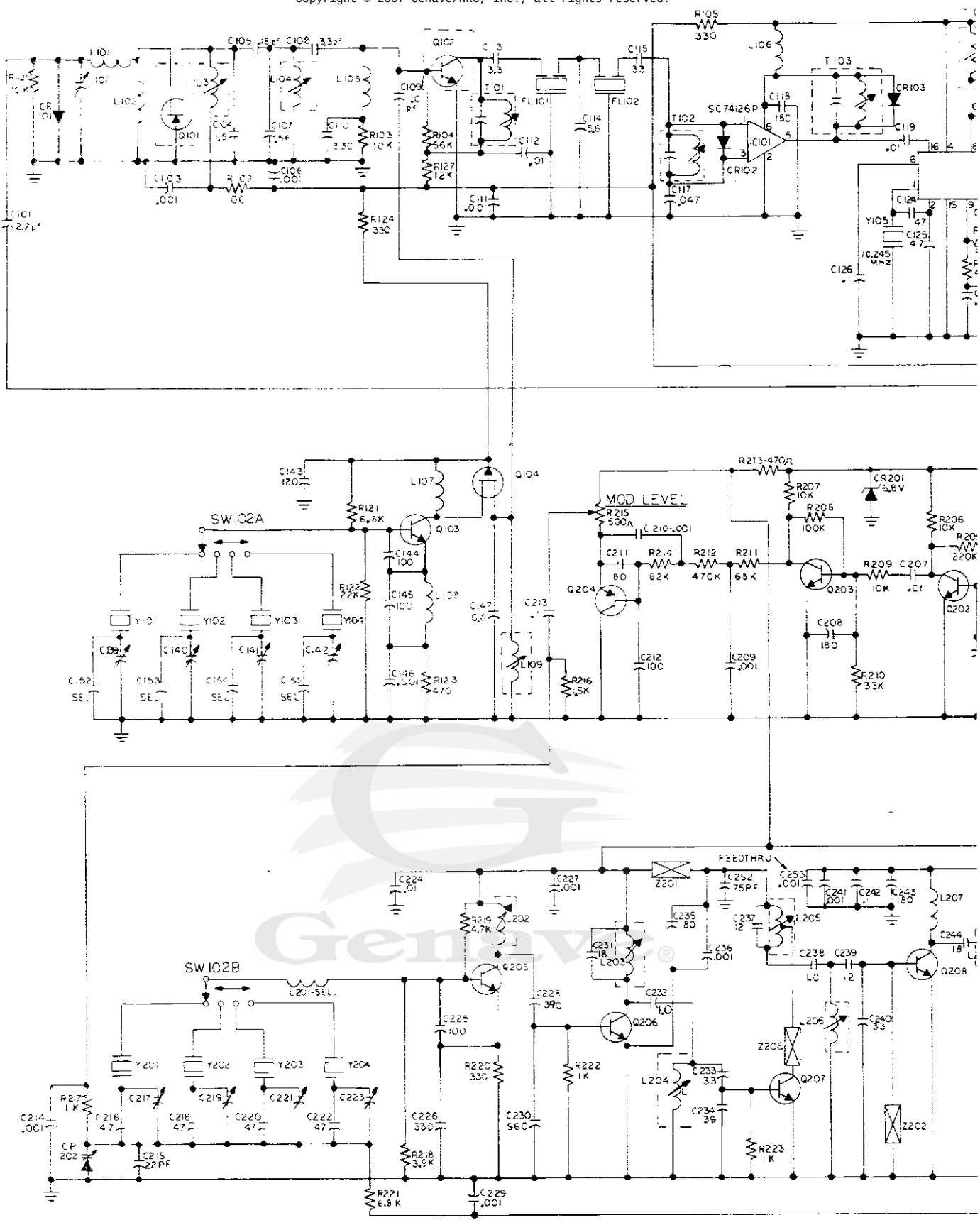
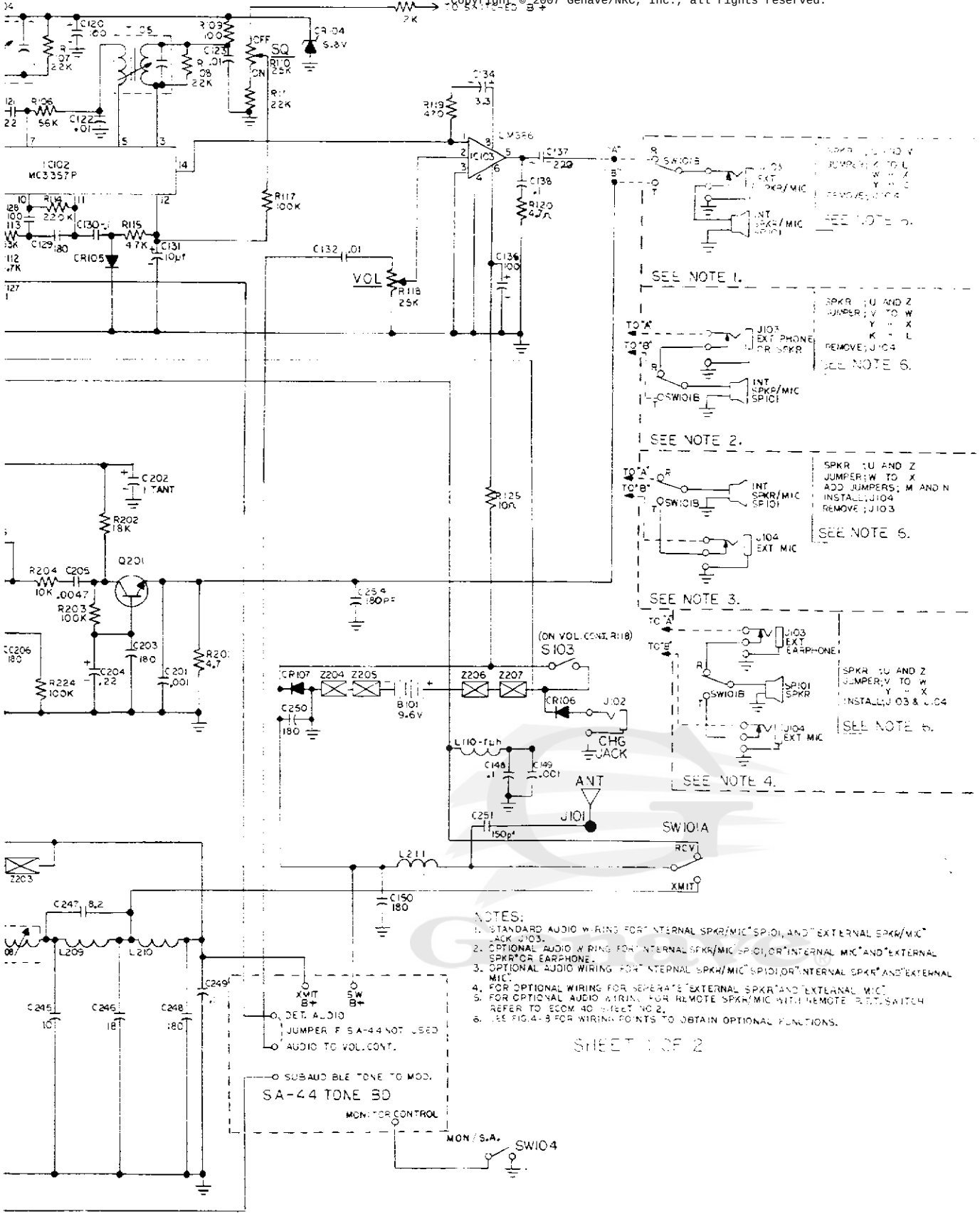


Figure 4-8. ECOM-40 PC Board Component Layout.






NOTES:
1. STANDARD AUDIO WIRING FOR "INTERNAL SPKR/MIC" SP101, AND "EXTERNAL SPKR/MIC" JACK J103.
2. OPTIONAL AUDIO WIRING FOR "INTERNAL SPKR/MIC" SP101, OR "INTERNAL MIC" AND "EXTERNAL SPKR" OR EARPHONE.
3. OPTIONAL AUDIO WIRING FOR "INTERNAL SPKR/MIC" SP101, OR "INTERNAL SPKR" AND "EXTERNAL MIC".
4. FOR OPTIONAL WIRING FOR SEPERATE "EXTERNAL SPKR" AND "EXTERNAL MIC".
5. FOR OPTIONAL AUDIO WIRING FOR REMOTE SPKR/MIC WITH REMOTE P.T.T. SWITCH REFER TO ECOM 40 SHEET NO 2.
6. SEE FIG. 4-8 FOR WIRING POINTS TO OBTAIN OPTIONAL FUNCTIONS.

SHEET 1 OF 2

Figure 4-9. ECOM-40 Transceiver Schematic

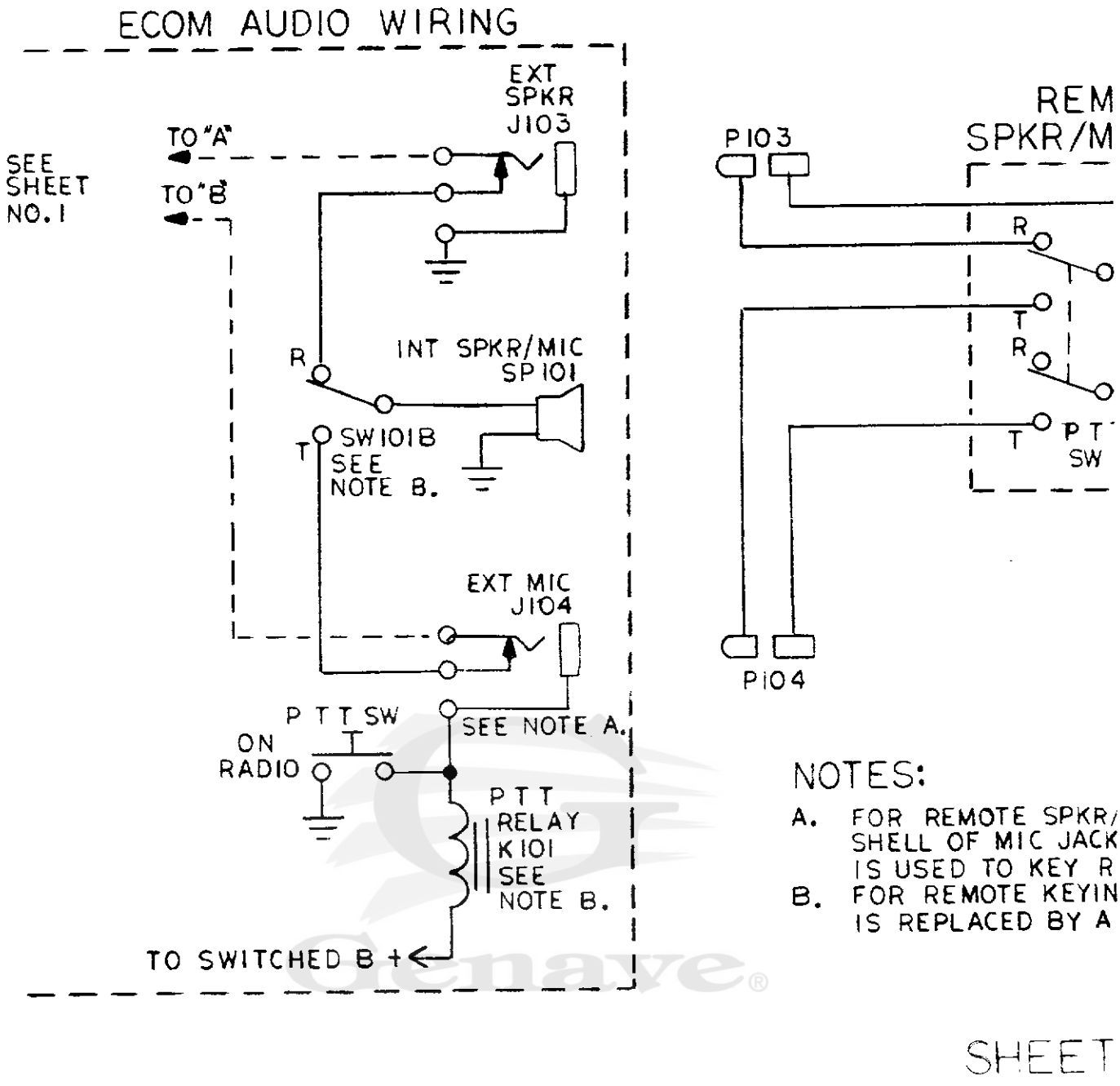
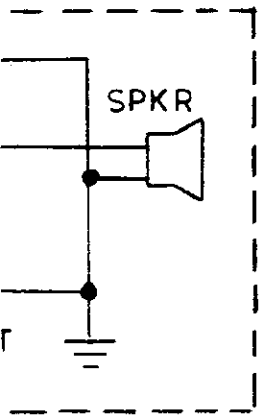



Figure 4-10. Remote Speaker, Microphone, and PTT Wiring

OTE
IC/PTT




'MIC WITH REMOTE KEYING, THE
J104 IS NOT GROUNDED, BUT
ELAY K101.
G, PTT SWITCH SW101 (A & B)
DPDT RELAY K101.

# 4-13. ECOM-40 DC VOLTAGES

## 4-13-1. Receiver Voltages

a) Channel-Switch set to any operative channel.
b) No signal input.
c) P.T.T. Switch in "Rec." position.
d) Unit connected to 9.6V supply.
e) Voltages measured with 10 Meg. input VTVM.
f) Voltages may vary ±20%.

Q101 D - 9.0V
S - 0V
G - 0V

Q102 E - 0V
B - 0.7V
C - 9.2V

Q103 E - 4.4V
B - 5.0V
C - 7.2V

Q104 D - 0V
S - 7.2V
G - 7.4V

| IC-101 | IC-102 | IC-103 |
|---|---|---|
| Pin-1 - 2.6V | Pin-1 - 6.4V | Pin-1 - 1.6V |
| 2 - 0V | 2 - 5.8V | 2 - 0V |
| 3 - 2.6V | 3 - 6.4V | 3 - 0V |
| 4 - 0V | 4 - 6.4V | 4 - 0V |
| 5 - 6.4V | 5 - 1.2V | 5 - 4.8V |
| 6 - 6.4V | 6 - 1.2V | 6 - 9.5V |
| 7 - 6.4V | 7 - 1.2V | 7 - 4.8V |
| 8 - 0V | 8 - 6.4V | 8 - 1.5V |
| | 9 - 2.0V | |
| | 10 - 2.2V | |
| | 11 - 2.6V | |
| | 12 - 1.2V | |
| | 13 - 0V | |
| | 14 - 1.6V | |
| | 15 - 0V | |
| | 16 - 2.2V | |

## 4-13-2. Transmitter Voltages

a) Channel-Switch set to any operative channel.
b) P.T.T. Switch in "Xmit" position (depressed).
c) Unit connected to 9.6V supply.
d) Voltages measured with 10 Meg. input VTVM; detector used to measure Q206, Q207, & Q208.

Q201 E - 0.1V
B - 1.0V
C - 1.0V

Q202 E - 0V
B - 0.8V
C - 2.0V

Q203 E - 0V
B - 0.8V
C - 2.6V

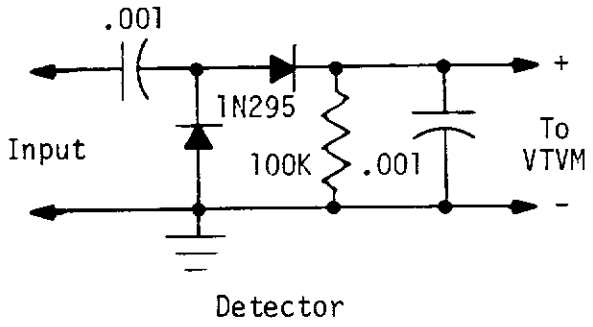
Q204 E - 3.6V
B - 2.5V
C - 0V

Q205 E - 4.0V
B - 3.4V
C - 9.2V

Q206 E - 0V
B - 2.3V
C - 15.0V

Q207 E - 0V
B - 3.5V
C - 10.5V

Q208 E - 0V
B - 1.6V
C - 23.0V



Detector

## 4-14. SPEAKER/MIC. WIRING OPTIONS

### 4-14-1. Optional External Speaker/Mic.

Standard audio wiring for the ECOM-40 utilizes INTERNAL speaker/mic., SP101. Plugging an EXTERNAL speaker/mic. into J103 disables the internal unit. Note 1 on the Schematic (Figure 4-9) depicts these audio connections, while Figure 4-8 shows physical location of jumpers and jacks.

### 4-14-2. Optional Ext. Speaker/Earphone

This option utilizes INTERNAL speaker/mic. SP101, until an EXTERNAL speaker or earphone is plugged into jack J103; then, reception is by means of the external unit, while the internal unit serves as the microphone. Note 2 on the Schematic (Figure 4-9) illustrates the speaker/mic. connections, while Figure 4-8 shows physical location of jumpers and jacks.

### 4-14-3. Optional Ext. Microphone

This wiring option uses the INTERNAL speaker/mic., SP101, until an EXTERNAL microphone is plugged into jack J104. The internal unit then functions as the speaker, while the external unit becomes the microphone. Note 3 on ECOM-40 Schematic (Figure 4-9) gives audio wiring connections, while Figure 4-8 shows physical location of jumpers and jacks.

### 4-14-4. External Earphone and/or Mic.

Again, this wiring utilizes INTERNAL speaker/mic. SP101, if earphone jack J-103 and mic. jack J104 are NOT used. An earphone or speaker may be plugged into J103 for reception, while the internal unit functions as the microphone. If desired, an external microphone can be plugged into J104, while the internal unit functions as the speaker. One of the more practical uses for this option is with a headset having an attached boom microphone; the headset is plugged into J103 and the microphone is plugged into J104.

Note 4 on the Schematic (Figure 4-9) depicts these audio connections, and Figure 4-8 shows physical placement of jumpers and jacks.

### 4-14-5. Optional Ext. Speaker/Mic/PTT

With this option the INTERNAL speaker/mic., SP101, performs the usual receive and transmit functions if headset jack J103 and mic. jack J104 are NOT used. Basically, this option is designed to provide remote speaker, microphone, and push-to-talk operation, with a minimum number of connecting wires, while the transceiver is carried in a belt mounted holster. The speaker or earphone plugs into J103 and the microphone/PTT plugs into mic. jack J104. The normal PTT switch SW101 MUST BE replaced by DPDT relay K101. An auxilliary PTT switch can be added to ECOM-40 case, if desired.

Note 5 on Schematics (Figures 4-9 and 4-10) shows the audio wiring required for this option. Figure 4-8 shows the physical location of jumpers and jacks.

# SECTION V
# PARTS LIST

## 5-1. INTRODUCTION

This section of the Maintenance Manual lists replacement electronic parts, as well as major mechanical components, for use in the Genave ECOM-40H VHF-FM Handheld Transceiver.

The first column in the Parts List contains component reference numbers. The three-digit circuit reference on the schematic is represented in the REFERENCE NUMBER column by the last one or two digits. The first digit represents the assembly, or section, of unit in which the part is located.

The assembly or section number (100, 200, ...) is indicated next to the reference number heading; that is, CAPACITORS C100, or CAPACITORS C200, etc.

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.

| Reference Number | Part Number | Description |
|---|---|---|
| CAPACITORS C100 | | |
| 1, | 1510015 | NPO Gimmick, 2.2 pF ±10% |
| 2, 39, 40, 41, 42 | 1570009 | Trimmer, 5 - 25 pF |
| 3, 6, 11, 46, 49 | 1520196 | Z5U Disc, .001 uF ±10%, 25V |
| 4 | --- | Selected Value (See Table 4-1) |
| 5 | 1510002 | NPO Gimmick, .18 pF ±10% |
| 7 | --- | Selected Value (See Table 4-1) |
| 8, 13 | 1520197 | NPO Disc, 3.3 pF ±10%, 25V |
| 9 | 1510011 | NPO Gimmick, 1.0 pF ±10% |
| 10 | 1520037 | Y5E Disc, 330 pF ±10%, 25V |
| 12, 19, 22, 23, 32 | 1540215 | Mylar, .01 uF ±10%, 100V |
| 14 | 1520184 | NPO Disc, 5.6 pF ±10%, 25V |
| 15 | 1520191 | N750 Disc, 33 pF ±10%, 25V |
| 16 | --- | Not Assigned |
| 17 | 1520081 | Kemet monocer. .047 uF |
| 18, 29, 43, 50 | 1520208 | N2200 Disc, 180 pF ±10% |

| Reference Number | Part Number | Description |
|---|---|---|
| **CAPACITORS C100 (Cont'd)** | | |
| 20, 36 | 1540204 | Electro., 100 uF, 16V |
| 21 | 1520190 | NP0 Disc, 22 pF ±10%, 25V |
| 24, 25 | 1520202 | N150 Disc, 47 pF ±10% |
| 26, 27, 30, 38, 48 | 1520243 | Z5U Disc, .1 uF +80 -20%, 12V |
| 28, 44, 45 | 1520195 | N2200 Disc, 100 pF ±10%, 25V |
| 31 | 1550007 | Tant, 10 uF ±20%, 35V |
| 33 | --- | Not Assigned |
| 34 | 1550003 | Tant., 3.3 uF, 35V |
| 35 | --- | Not Assigned |
| 37 | 1540221 | Elect., 220 uF, 25V |
| 47 | --- | Selected Value (See Table 4-1) |
| **CAPACITORS C200** | | |
| 1, 9, 10, 14, 27, 29, 36, 41 | 1520196 | Z5U Disc, .001 uF ±10%, 25V |
| 2 | 1550002 | Tant., 1 uF ±20%, 35V |
| 3, 6, 8, 11, 35, 43, 48, 50, 54 | 1520208 | N2200 Disc, 180 pF ±10% |
| 4 | 1550001 | Tant., .22 uF ±20%, 35V |
| 5 | 1540216 | Mylar, .0047 uF ±10%, 100V |
| 7, 24 | 1540215 | Mylar, .01 uF ±10%, 100V |
| 12, 25 | 1520195 | N2200 Disc, 100 pF ±10%, 25V |
| 13, 42, 49 | 1520243 | Z5U Disc., .1 uF +80 -20%, 12V |
| 15 | 1520190 | NP0 Disc, 22 pF ±10%, 25V |
| 16, 18, 20, 22 | 1520202 | N150 Disc, 47 pF ±10% |
| 17, 19, 21, 23 | 1570009 | Trimmer, 5 - 25 pF |

| Reference Number | Part Number | Description |
|---|---|---|
| **CAPACITORS C200 (Cont'd)** | | |
| 26 | 1520037 | Y5E Disc, 330 pF ±10%, 25V |
| 28 | 1520039 | Y5E Disc, 390 pF ±10%, 25V |
| 30 | 1520043 | Y5E Disc, 560 pF ±10%, 25V |
| 31, 44, 46 | 1520189 | N220 Disc, 18 pF ±10% |
| 32, 38 | 1510011 | NPO Gimmick, 1.0 pF ±10% |
| 33, 40 | 1520191 | N750 Disc, 33 pF ±10%, 25V |
| 34 | 1520199 | N750 Disc, 39 pF ±5%, 25V |
| 37, 39 | 1520098 | NPO EDPT, 12 pF ±.25 pF |
| 45 | 1520097 | NPO EDPT, 10 pF ±.25 pF |
| 47 | 1520088 | NPO EDPT, 8.2 pF ± .25 pF |
| 51 | 1520027 | N750 Disc, 150 pF ±10% |
| 52 | 1520204 | N750 Disc, 75 pF ±5%, 25V |
| 53 | 1520086 | Feedthru, .001 uF, CF777 GMV |
| **DIODES CR100** | | |
| 1, 2, 3, 5 | 4810017 | Sil., Switching, 1N4148 |
| 4 | 4810007 | Zener, 6.8V, ZS6.8A |
| 6, 7 | 4810013 | Gen. Purpose, 100 PRV, 1N4001 |
| **DIODES CR200** | | |
| 1 | 4810007 | Zener, 6.8V, ZS6.8A |
| 2 | 4812109 | Varactor, MV2109 |
| **FILTERS FL100** | | |
| 1, 2 | 2303504 | 10.7 MHz, 4-Pole Monolithic Crystal (Matched Set) |
| **INTEGRATED CIRCUITS IC100** | | |
| 1 | 3130366 | IF Amp., SC74126P |
| 2 | 3130038 | FM IF and Discr., MC3357P |
| 3 | 3130025 | Audio Amplifier, LM386 |

| Reference Number | Part Number | Description |
|---|---|---|
| **INDUCTORS L100** | | |
| 1 | 1800105 | Coil, 3-1/2T, #24 (Table 4-1) |
| 2 | 1800005 | Coil, .03 uH |
| 3, 4 | 1800308 | Coil, 8-1/2T, (Table 4-1) |
| 5, 8 | 1800350 | Coil, 1.0 uH, Wilco M10G |
| 6 | 1800332 | Coil, 56 uH, Wilco MU560 |
| 7 | 1800351 | Coil, 470 uH, Wilco MU471 |
| 9 | 1800304 | Coil, 4-1/2T (No Core) P. Smith 425 |
| 10 | 1800354 | Coil, 1.0 mH, Wilco ES2735 |
| **INDUCTORS L200** | | |
| 1 | --- | Selected Value |
| 2, 3, 4 | 1800306 | Coil, 6-1/2T, P. Smith 425 |
| 5 | 1800145 | Coil, 3-1/2T, Center-tapped |
| 6 | 1800321 | Coil, 3-1/2T, P. Smith |
| 7 | 1800243 | Coil, 5-1/2T, .1" I.D., LHH #20 buss wire |
| 8 | 1800322 | Coil, 4-1/2T, P. Smith 426 |
| 9 | 1800242 | Coil, 4-1/2T, .1" I.D., LHH #20 buss wire |
| 10 | 1800358 | Coil, 3.9 uH, Wilco W-39G |
| 11 | 1800350 | Coil, 1 uH, Wilco M10G |
| **TRANSISTORS Q100** | | |
| 1 | 4805484 | JFET, N-Channel, 2N5484 |
| 2 | 4800064 | NPN, Sil., Low-Noise Mixer, MPS H20-5 |
| 3 | 4800024 | NPN, Sil., RF, MPS-3563 |

| Reference Number | Part Number | Description |
|---|---|---|
| TRANSISTORS Q100 (Cont'd) | | |
| 4 | 4805461 | JFET, P-Channel, 2N5461 |
| TRANSISTORS Q200 | | |
| 1, 2, 3 | 4800033 | NPN, Gen. Pur., 2N5172 |
| 4 | 4800073 | PNP, Sil., Darlington, MPS-A64 |
| 5, 6 | 4800024 | NPN, Sil., RF, MPS-3563 |
| 7 | 4804427 | NPN, Sil., RF, 2N4427 |
| 8 | 4806089 | NPN, Sil, RF Power, MRF629 |
| RESISTORS R100 | | |
| 1, 3 | 4710029 | Film, 10K ±5%, 1/4W |
| 2, 9 | 4710008 | Film, 100-ohms ±5%, 1/4W |
| 4, 6 | 4710036 | Film, 56K ±5%, 1/4W |
| 5, 24 | 4710012 | Film, 330-ohms ±5%, 1/4W |
| 7, 8, 11, 22 | 4710032 | Film, 22K ±5%, 1/4W |
| 10 | 4760082 | Pot., 25K (Squelch) |
| 12 | 4710025 | Film, 4.7K ±5%, 1/4W |
| 13 | 4710033 | Film, 33K ±5%, 1/4W |
| 14 | 4710041 | Film, 220K ±5%, 1/4W |
| 15 | 4710035 | Comp, 47K ±10%, 1/4W |
| 16 | --- | Not Assigned |
| 17 | 4710038 | Film, 100K ±5%, 1/4W |
| 18 | 4760081 | Pot., 25K (Vol. Cont. w/ON-Off Switch) |
| 19, 23 | 4710013 | Comp, 470-ohms ±10%, 1/4W |

| Reference Number | Part Number | Description |
|---|---|---|
| RESISTORS R100 (Cont'd) | | |
| 20 | 4710048 | Comp, 4.7-ohms ±10%, 1/4W |
| 21 | 4710027 | Film, 6.8K ±5%, 1/4W |
| 25 | 4710001 | Comp, 10-ohm ±10%, 1/4W |
| 26, 27 | 4710050 | Film, 12K ±5%, 1/4W |
| RESISTORS R200 | | |
| 1 | 4710048 | Comp, 4.7-ohms ±10%, 1/4W |
| 2 | 4710031 | Film, 18K ±5%, 1/4W |
| 3, 8, 24 | 4710038 | Film, 100K ±5%, 1/4W |
| 4, 6, 7, 9 | 4710029 | Film, 10K ±5%, 1/4W |
| 5 | 4710041 | Film, 220K ±5%, 1/4W |
| 10 | 4710033 | Film, 33K ±5%, 1/4W |
| 11 | 4710068 | Comp, 68K ±10%, 1/4W |
| 12 | 4710039 | Comp, 470K ±10%, 1/4W |
| 13 | 4710013 | Comp, 470-ohms ±10%, 1/4W |
| 14 | 4710037 | Comp, 82K ±10%, 1/4W |
| 15 | 4760078 | Var., 500-ohms |
| 16 | 4710019 | Comp, 1.5K ±10%, 1/4W |
| 17, 22, 23 | 4710017 | Film, 1K ±5%, 1/4W |
| 18 | 4710024 | Comp, 3.9K ±10%, 1/4W |
| 19 | 4710025 | Film, 4.7K ±5%, 1/4W |
| 20 | 4710012 | Film, 330-ohms ±5%, 1/4W |
| 21 | 4710027 | Film, 6.8K ±5%, 1/4W |

| Reference Number | Part Number | Description |
|---|---|---|
| MISCELLANEOUS | | |
| --- | 2510586 | Knob, Volume or Squelch |
| --- | | |
| --- | 2510550 | Insert, Top |
| --- | 2510533 | Cover, Front |
| --- | 2510534 | Cover, Rear |
| --- | 1200076 | Antenna, Telescoping, 5-Section |
| --- | 2510554 | Bushing, Antenna |
| --- | 2100249 | Connector, BNC, UG-1094/U |
| --- | 1200013 | Antenna, w/ #8 Screw Mounting |
| SP101 | 2509991 | Speaker/Microphone |
| --- | 4000010 | Battery Pack, 9.6 volts |
| --- | 4000007 | Charger, Battery |
| --- | 2100298 | Connector, Battery (9V) |