GMT-240L/425L

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 merchantibility and/or fitness for a particular purpose. Any implied warranties are specifically and expresely 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.

4141 Kingman Drive, Indianapolis, Indiana 46226

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Specifications subject to change without notice

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CONTENTS

SECTION 0

MANUAL CHANGES

In a continuing program of product improvement, changes are incorporated into units as soon as engineering tests are completed; therefore, it is not always possible to incorporate the latest changes in the current manual printing. Manual Change pages thus are used to provide up-to-date information for each unit.

Considerable lead time is required to send out schematics and component location drawings to be photographically reduced and printing plates received, whereas changes to the parts lists can be made quickly in house. Therefore, a discrepancy may exist at times between the value shown on a schematic and the corresponding value given in the parts list. Normally, the value given in the parts list is the most up-to-date.

The following changes should be made to the GMT-240L/425L Maintenance Manual:

Main Board Schematic, Figure 4-11, Page 4-23:

Change fuse F201 from 3AG 7 amp to 3AG 10 amp.

Change R122 from 1 Meg. to 470K.

Change R211 from 220 ohms to 150 ohms.

Change R212 from 22 ohms to 4.7 ohms.

Change R237 from 180K to 47K.

Ref. symbol R231 appears in two places on the schematic. The resistor connected between C251 and the SA MOD OUT point should be changed from R231 to R238; its value should be changed from 47K to 27K.

Change Z209 from a Ferrox Cube to a 10 ohm 1/2 W resistor.

SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION

This manual contains all the information normally required to license, install, and operate the Genave VHF-FM "Low-Band" Business Transceivers.

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

1-2. DESCRIPTION

The GMT-240L is a 2-channel instrument, whereas the GMT-425L accomodates a maximum of 4 channels; otherwise, the two units are identical. The transceivers are designed to provide reliable, high-quality communications for the various business radio services, such as: Public Safety, Industrial Radio, Land Transportation, and Domestic Public Land Mobile Radio Service.

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 units are completely solid-state, VHF-FM transceivers designed for the transmission and reception of frequency modulated (16F3) radio signals within the VHF range from 25 to 50 MHz. The desired, installed frequency is selected by means of a front-panel mounted 2- or 4-position selector switch.

The unit is complete with a plug-in hand microphone and internally-mounted speaker. All circuitry employed is the latest state-of-the-art design, using the latest in semiconductor and integrated circuit technology.

A 15-pin male plug mounted on rear panel of the low-band transceiver is designated as an "Accessory Connector," and mates with a 15-pin female connector to provide a convenient method of connecting power or optional accessories to the unit. Standard wiring of the accessory connector utilizes only five pins, leaving the remainder available for options or customized installation. See Section 2-12.

The internal speaker can be disconnected and replaced by an external speaker via connections to the rear-panel plug.

The receiver is a crystal-controlled, dual-conversion superheterodyne employing an 8-pole monolithic crystal filter at 10.7 MHz for good selectivity. The 10.7 MHz 1st IF provides good image rejection, while the 455 kHz 2nd IF improves receiver stability. A single integrated circuit performs limiting and detection functions.

The transmitter RF output is typically 35 watts (30 watts, minimum) from 25 to 50 MHz. The output impedance is 50-ohms using a standard UHF-type connector (83-1SP or PL259). An improved heatsink provides increased transmit-power stability.

The "low-band" transceivers are designed to operate on +13.75 volts DC primary power. The Genave PSI-10N power supply can be utilized when it is desired to operate the instrument from a 117 volt, 50/60 Hz, source. For mobile operation, the source may be a battery or the vehicle electrical system (negative ground).

Each transceiver is enclosed in a vinyl clad, two-piece, aluminum cover that protects instrument from dust, moisture and physical damage. A combination handle/mounting bracket secures the transceiver for under panel, desk top, or bulk-head mounting.

Provisions are made within each transceiver for the addition of an optional

SA-1 Subaudible Tone Encoder-Decoder. This subaudible-tone system opens the receiver audio circuitry; thus, keeping receiver squelched until a signal containing the proper subaudible, continuous tone is received. The SA-1 board generates a subaudible tone used to modulate the transmitter to activate receivers in the system, and also decodes incoming signals.

Contacts on the frequency-selector, in conjunction with jumper wires on the PC board, allow the subaudible-tone system to be used on desired channels only.

NOTE: All channels which employ subaudible-tone squelch in the unit must utilize the SAME TONE FREQUENCY -- there are no provisions for changing tone frequency on different channels. A ceramic resonator on the SA-1 printed-circuit board determines frequency of subaudible tone being used.

If subaudible-tone squelch system is used, the carrier is automatically modulated by the subaudible tone during entire time that transmission is taking place. Further, the operating frequency MUST BE monitored to ascertain that it is NOT in use prior to originating a call. This monitoring is accomplished automatically by removing the microphone from its hang-up bracket or, in the case of a desk-style microphone, by locking the MONITOR button.

1-3. SPECIFICATIONS

GENERAL:

Front-Panel Size:	6.5" (16.51 cm) x 2.5" (6.35 cm)
Over-all Dimensions:	6.5" (16.51 cm) x 2.5" (6.35 cm) x 11.5" (29.21 cm)
Power Supply:	13.75-volts DC, negative ground
Current Drain:	7.0 amps max. xmit; 0.16 amps max. squelched receive
Frequency Range:	Four ranges available: 25-28 MHz, 29-34 MHz, 34-41 MHz, and 41-50 MHz (Only one range per unit).
Number of Channels:	2 (GMT-240L); 4 (GMT-425L)
Channel Separation:	3% of highest frequency installed
Temperature Range:	-30°C to +50°C
Weight:	Approx. 5 lbs. (2.27 kg)

RECEIVER:

Sensitivity:	0.25 µV for 12 dB SINAD
Selectivity:	±5 kHz, 3 dB or less
Squelch Threshold:	0.2 µV, max.
Frequency Stability:	±.002%
Modulation Acceptance:	±5 kHz, min.
Adjacent Channel Rejection:	70 dB for 12 dB SINAD
Image Response:	More than 65 dB
Intermodulation Response:	70 dB EIA
Hum and Noise Level:	Better than 35 dB below rated output
Frequency Accuracy:	±500 Hz
Spurious Response:	More than 70 dB
Audio Output Power:	5 watts; 4 watts at 15% distortion
Subaudible Squelch Threshold:	0.25 µV with 600 Hz deviation
Subaudible Squelch Bandwidth:	±1% min; ±3% max. with 900 Hz deviation

TRANSMITTER:

Frequency Range:	Four ranges available; 25-28 MHz, 29-34 MHz, 34-41 MHz, and 41-50 MHz (Only one range per unit).
Power Output:	35 watts, typical; 30 watts min.
Output Impedance:	50 ohms
Audio Modulation Deviation:	5 kHz max; 4 kHz min.
Frequency Stability:	±.002%, max.
Frequency Accuracy:	±500 Hz
Subaudible Deviation:	1 kHz ±100 Hz
Subaudible Frequency Tolerance:	±0.3 Hz max.

1-4. EQUIPMENT LISTS

Section 2 of this manual contains lists of equipment normally supplied with each "low-band" Business Transceiver, as well as equipment required but NOT supplied, and optional equipment available.

1-5. OPERATING & LICENSING THE LOW-BAND BUSINESS TRANSCEIVER

Complete operating instructions, and technical information needed for the F.C.C. station-license application, is given in Section 3 of this manual.

SECTION II
INSTALLATION MANUAL

2-1. ANTENNA INSTALLATION WARNING

WARNING: Each year a number of persons are electrocuted while installing radio antennas; therefore, use extreme caution when installing antenna/antenna-support for use with this transceiver. Observe following precautions:

a. Do NOT attempt to erect antenna while a thunderstorm is gathering.

b. If installing antenna in vicinity of overhead wires, use a wooden ladder rather than metallic.

c. Do NOT allow antenna, mast, or cable to touch electric signs or overhead electric wires --- even if only 120- or 240-volt wiring.

d. If antenna or mast starts to fall toward overhead wires, get completely away. If the antenna comes to rest against electrical wires, do NOT attempt to remove it, but call local power company.

e. REMEMBER - UNDER THE RIGHT CONDITIONS, ANY CONTACT WITH AN ELECTRICAL CIRCUIT CAN BE LETHAL.

2-2. INTRODUCTION

This section provides installation data and recommendations for fixed, mobile, or portable operation of the low-band transceiver. For complete technical specifications of the unit, refer to Section 1-3 (Specifications) in this manual.

2-3. EQUIPMENT SUPPLIED

a. Low-Band Communications Transceiver, with hand microphone and hang-up mounting clip.

b. Mounting Bracket, with thumbscrews and washers.

c. Accessory Connector, 15-pin female.

2-4. EQUIPMENT REQUIRED, BUT NOT SUPPLIED

a. Vehicle or Base Antenna, 50-ohm.

b. Antenna Cable, RG-8A/U or RG-58A/U, as required.

c. Co-axial Connector, PL-259 (83-1SP).

d. Cabling for Power and Audio wiring, as required.

2-5. OPTIONAL EQUIPMENT AVAILABLE

a. SA-1 Subaudible-Tone Encoder/Decoder

b. PSI-ION AC Power Supply.

c. PSI-21 Portable Power Pack.

d. G-11, Desk Microphone.

e. G-21, Telephone Handset, w/switch.

f. Remote Speaker.

2-6. PRE-INSTALLATION CHECK

Visually inspect the unit for any obvious external damage- such as broken knobs, dents, damaged microphone or radio case. Any damage NOT related to shipping must be reported to General Aviation Electronics, Inc., 4141 Kingman Drive, Indianapolis, Ind., (46226), Telephone (317) 546-1111, as soon as possible.

If the packing case shows damage, make a notation to that effect on the express receipt or freight bill. Report any damage due to shipping to transportation company, and file a claim with them promptly.

2-7. INSTALLATION PLANNING

The unit has been pre-aligned at the factory on transmit and receive frequencies listed on tag attached to the unit. If it should be necessary to change the transmit or receive frequency, alignment procedures contained in the GMT-240L/425L maintenance manual should be performed by an authorized technician, using proper test equipment; however, if new frequency differs from the factory-alignment frequency by not more than one half of maximum channel separation as listed in the Specifications, it will only be necessary to install and net the new crystal(s).

If transceiver is equipped with optional SA-1 (Subaudible-Tone Squelch) unit, the subaudible-tone frequency will be listed on a tag attached to radio, and also on a label affixed to the inside of transceiver. If it should be necessary to readjust subaudible-tone frequency from factory-set frequency, refer to "Tone-Frequency Adjustment" procedure in this manual (Section 4-9).

Before starting transceiver installation, determine desired mounting method and location. The transceiver may be mounted in any convenient position; unit performance is not affected by the mounting position. However, the unit should NOT be mounted directly above a hot-air register or radiator. Ascertain that required AC or DC power is available; determine location for antenna installation and routing of co-ax cable to transceiver.

NOTE: F.C.C. Rules require that: "Each transmitter shall be so installed and protected that it is not accessible to or capable of operation by persons other than those duly authorized by licensee," and "The operating position must be under the control and supervision of the licensee."

2-8. FIXED OR MOBILE INSTALLATION

1. Refer to Figure 2-1. If mounting yoke has been installed on trans-

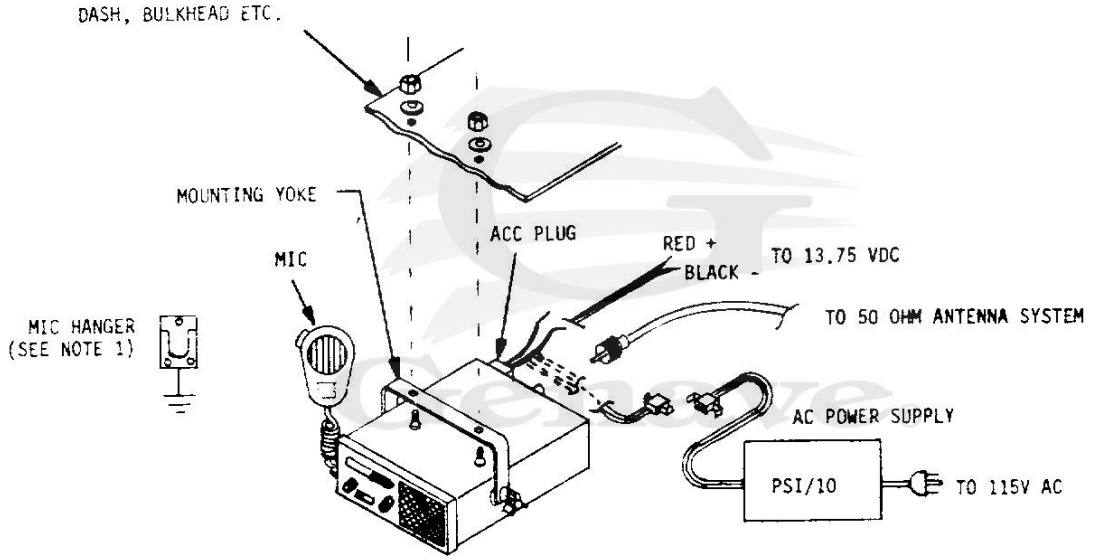


Figure 2-1. Typical Installation.

ceiver, remove yoke temporarily. For fixed operation, yoke may be repositioned on bottom side of unit to function as a supporting stand. For either fixed or mobile operation, the yoke may be secured in the desired location (under dash or shelf, on console or desk top, or overhead, etc.) with appropriate screws or bolts through two holes provided in the mounting yoke.

2. Connect color-coded power leads, terminated in the rear-panel 15-pin connector, to a power source. For fixed operation, the source may be a well-regulated, low-ripple AC power supply, such as the Genave Model PSI-10. For mobile operation, the source may be a battery or the vehicle's electrical system. This transceiver is designed to operate ONLY on a supply with neg. ground.

CAUTION: BE SURE to connect RED power lead to +13.75 volts, and the BLACK lead to ground (-13.75 VDC). If it is necessary to extend power leads use #14, or heavier gauge, insulated copper wire.

If supply polarity is reversed accidentally, the unit will be inoperative. In this event, check wiring polarity (RED to positive, and BLACK to negative), and check the protective fuse located on transceiver circuit board just below the rear-panel power connector. A blown fuse should be replaced with a type 3AG 10 amp. fuse.

3. The low-band transceiver is equipped with a plug-in microphone receptacle which allows use of either a standard Genave hand microphone or desk-style microphone interchangeably. A Genave telephone-type handset can also be connected to the mic. receptacle; however, if transceiver audio is to be cut-off from speaker during two-way communications, or if SA-1 subaudible-tone option is used, then a handset hanger with internal switching is required. Recommended accessory-connector and microphone-wiring changes are shown in this section.

NOTE: If standard hand microphone is used with "subaudible-tone option," the microphone-mounting clip should be attached to the desired mounting surface; then, clip MUST BE electrically connected to chassis ground in order to provide "hang-up" receiver squelching.

4. After any optional or custom wiring has been completed, replace transceiver in mounting yoke, and tighten both thumbscrews, or install the mounting lock. See Section 2-10.

5. Connect microphone or handset to transceiver, and insert 15-pin receptacle on mating rear-panel plug.

6. Install co-axial connector on antenna cable (refer to Section 2-11 below), and connect cable to rear-panel mounted antenna connector.

NOTE: The transceiver is designed to match standard 50-ohm VHF communications antennas. In the interest of maximum efficiency, the antenna system should exhibit a low VSWR.

2-9. PORTABLE OPERATION

1. The easiest method of portable operation is to utilize a Genave PSI-21 Portable Power Pack. The PSI-21 unit includes a rechargeable battery, and an AC-powered charger.

2. Portable operation of the transceiver requires the same basic considerations as fixed or mobile operations -- that is, connections to the power source, antenna system, and microphone.

2-10. MOUNTING-LOCK INSTALLATION

If desired, the mounting lock can be used to secure transceiver to mounting bracket (yoke) when unit is attached to a desk-top, bulkhead, overhead, or an under-panel configuration. The lock can be used when transceiver is secured via

either the top or bottom mounting holes of bracket; however, the bottom mounting holes will assist in concealing the heads of screws used to secure bracket to the mounting surface. To install the mounting lock, preceed as follows:

1. Remove mounting thumbscrew from side of transceiver-mounting bracket to which lock is to be attached.

2. Position mounting lock so that hole in lock and locking tab are aligned with the two holes in vertical leg of mounting bracket.

3. Secure mounting lock to unit, using one of the hex-head mounting screws provided. Be sure that screw passes through correct hole in mounting bracket. Refer to Figure 2-2.

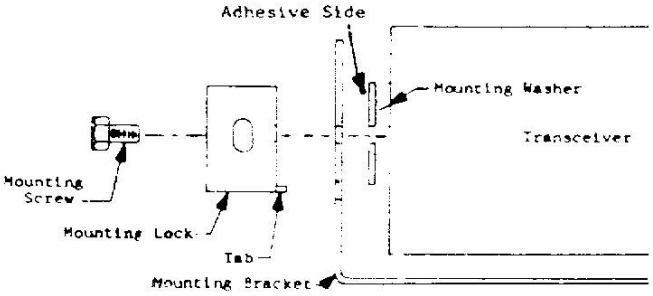


Figure 2-2. Mounting-Lock Installation

4. Attach a padlock through holes in sides of mounting lock, as shown in Figure 2-3; then latch padlock to prevent removal of unit from mounting bracket.

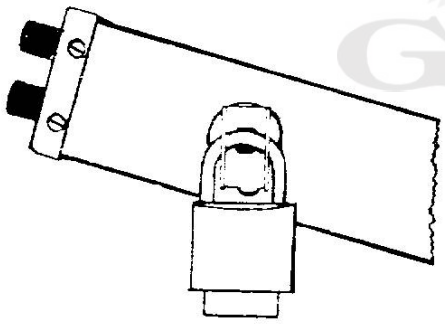


Figure 2-3. Lock Placement

2-11. ANTENNA CONNECTOR ASSEMBLY

For maximum efficiency, the antenna should be fed with low-loss 50-ohm co-axial cable. The loss per 100 feet at 50 MHz is shown in Table 2-1 for several popular types of co-ax cable:

Table 2-1.

Cable Type	Impedance	dB Loss
RG58/A-AU	53-ohms	3.1 dB
RG58 Foam	50-ohms	2.2 dB
RG8/A-AU	52-ohms	1.35 dB
RG8 Foam	50-ohms	1.2 dB

The procedure for installing a PL-259 (83-1SP) antenna connector is dependent upon type co-axial cable used - the PL-259 is installed directly on 0.405" OD cable such as RG8/A, whereas, the plug requires an adapter when used with the 0.195" OD cable such as RG58/A. The procedures for both cable types are given below, and shown in Figure 2-4.

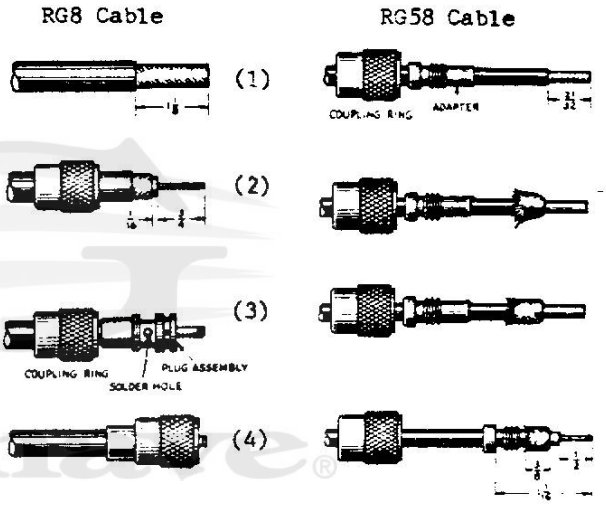


Figure 2-4. Connector Assembly

2-11-1. RG8 Cable Procedure

1. Trim end of cable flush; remove vinyl jacket from 1-1/8" of cable as shown in Figure 2-4 (1). Do NOT nick braid.

2. Bare 3/4" of center conductor. Trim braided shield 1/16" and tin. Slide coupling ring on cable. See Figure 2-4 (2) above.

3. Screw plug assembly on cable; solder plug assembly to braid through solder holes; solder center conductor to plug assembly center pin.

4. Screw coupling ring on assembly.

2-11-2. RG58 Cable Procedure

1. Trim end of cable flush; remove vinyl jacket from 21/32" of cable as shown in Figure 2-4(1). Do NOT nick braid. Slide the coupling ring and adapter on cable.

2. Fan braid slightly and fold back over cable. See Figure 2-4(2).

3. Compress braid around cable, Figure 2-4(3), and position adapter to the dimension given in Figure 2-4 (4). Press braid over adapter sleeve and trim to dimension shown.

4. Bare 1/2" of center conductor as shown --- do NOT nick conductor. Pre-tin exposed center conductor.

5. Screw plug assembly onto adapter sleeve, and solder the braid to plug assembly through solder holes. Next, solder center conductor to plug assembly center pin.

6. Screw coupling ring on plug assembly.

2-12. ACCESSORY CONNECTOR - P101

The 15-pin male plug mounted on rear panel of the low-band transceiver is designated as an "Accessory Connector," and mates with a 15-pin female connector to provide a convenient method of connecting power or optional accessories to the unit. Standard wiring of the accessory connector utilizes five pins, leaving ten pins available for options or customized installation. Figure 2-5 illustrates standard wiring of the accessory connector, and the recommended connections for use with a handset-hanger switch. The connections to the accessory connector pins are described below:

PIN 1 - No connection.

PIN 2 - High-level audio output from receiver section of the transceiver; this audio is applied either to the internal speaker or to an external 4-ohm speaker, as determined by wiring of the accessory connector. To use the internal speaker, a jumper is connected between pins 2 and 10 of the female connector; to connect an external speaker, the speaker leads are connected between pins 2 and 7 of the 15-pin female connector.

If a telephone-style handset is used with the transceiver, the handset-hanger switch should be connected between pins 2 and 10 of the female connector to disable the internal speaker when the handset is removed from its hanger. The handset has an internal earphone which is wired through the microphone plug; thus, cutting off the internal speaker allows the operator some privacy.

PIN 3 - No connection.

PIN 4 - No connection.

PIN 5 - No connection.

PIN 6 - No connection.

PIN 7 - A chassis ground - particularly intended for audio circuitry such as an external speaker, tone-squelch enable, etc.

PIN 8 - No connection, normally; however, if a handset AND "subaudible tone squelch" are both used with transceiver, pin 8 of the male plug should be connected internally to pin 3 of the microphone receptacle to provide a "tone-squelch enable"

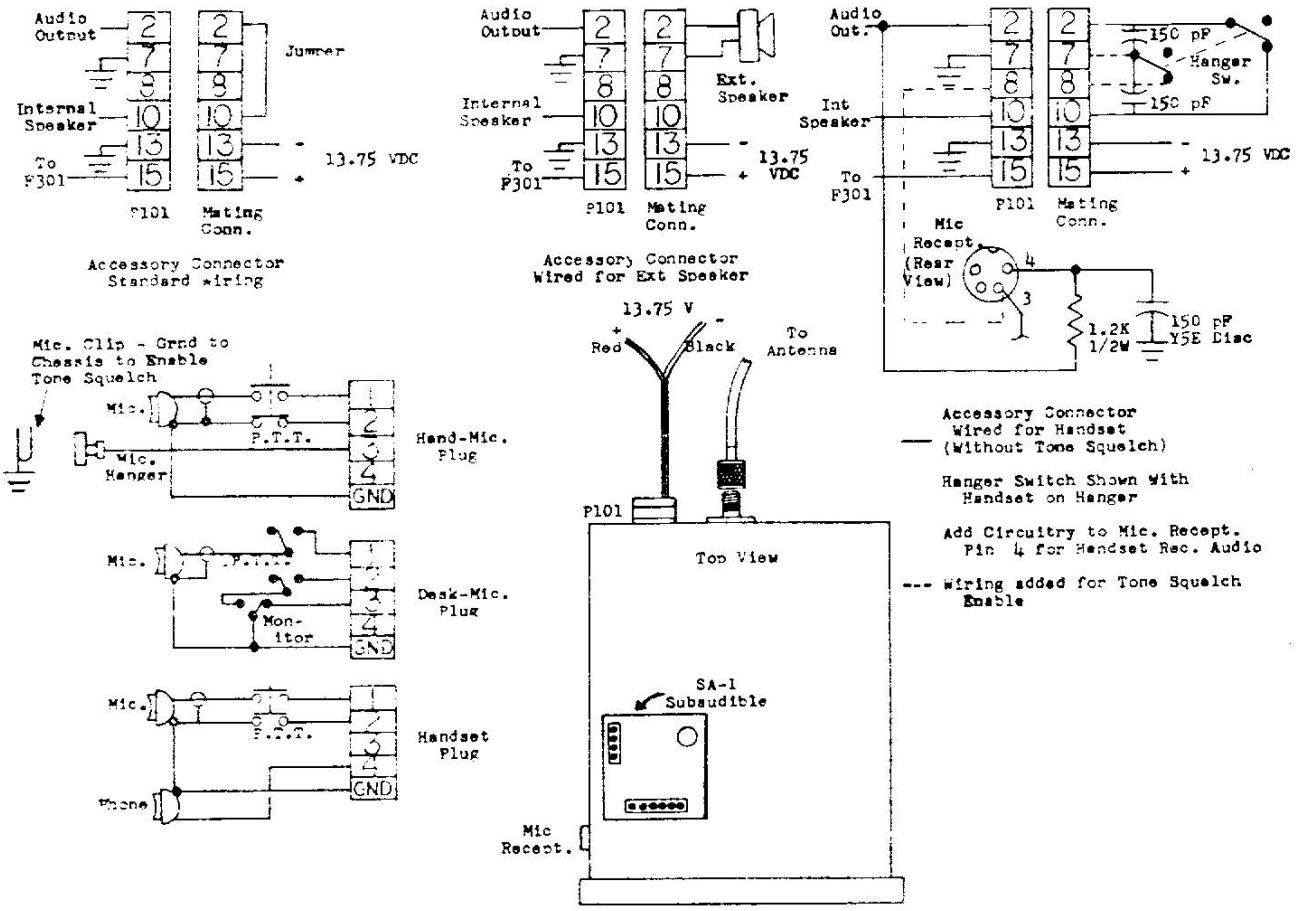


Figure 2-5. Accessory Connector & Mic. Wiring

wire. The handset hanger "tone-squelch enable" switch is then connected to pins 7 and 8 of the 15-pin female connector as shown in Figure 2-5. Therefore, pin 8 will be held at ground potential when the handset is in place on its hanger. The ground will be removed from pin 8 when handset is lifted from the hanger; thus, tone squelch is disabled to allow monitoring of operating frequency prior to starting transmission.

PIN 9 - No connection.

PIN 10 - Input connection to the internal 4-ohm speaker in transceiver. This pin is normally jumpered to pin 2.

PIN 11 - No connection.

PIN 12 - No connection.

PIN 13 - Chassis ground, and DC-input voltage negative connection. The female connector has a black lead, some four feet in length, attached to this pin for connection to the DC-power source.

PIN 14 - No connection

PIN 15 - DC-input voltage positive connection. The female connector has a red lead, approx. four feet in length, attached to this pin for connection to the DC-power source.

2-13. MICROPHONE RECEPTACLE

The microphone receptacle is a 5 conductor jack (4 pins plus shell) mounted on left-side panel of the transceiver. Internal connections are factory-made to this receptacle so that the standard Genave hand microphones, desk-style microphones, or telephone-type handsets can be used interchangeably. However, if a handset is to be used, receiver audio for the handset earphone should be connected to mic. receptacle pin 4 as described below (refer to Figure 2-5). The connections to the microphone receptacle pins are described below;

PIN 1 - Microphone-audio connection to input of transmitter-modulator circuitry.

PIN 2 - Microphone push-to-talk switch connection. When this switch is closed, one side of transmitter keying relay is grounded; thus, energizing relay and applying power to transmitter.

PIN 3 - Tone-squelch enable connection. If transceiver is NOT equipped with SA-1 Subaudible-Tone Option, this pin has no function; however, if tone-squelch option is used, this pin must be connected to ground for the tone-squelch circuitry to squelch the receiver. Removing ground from this pin disables the tone squelch - allowing the frequency to be monitored.

The method of grounding pin 3 is dependent upon type microphone being used: The hand microphone grounds this pin via the mic. hanger and mic. mounting clip; the desk-style microphone grounds pin 3 through contacts on the Monitor Switch; whereas the handset grounds pin 3 by means of switch contacts in the handset hanger. Refer to Figure 2-5.

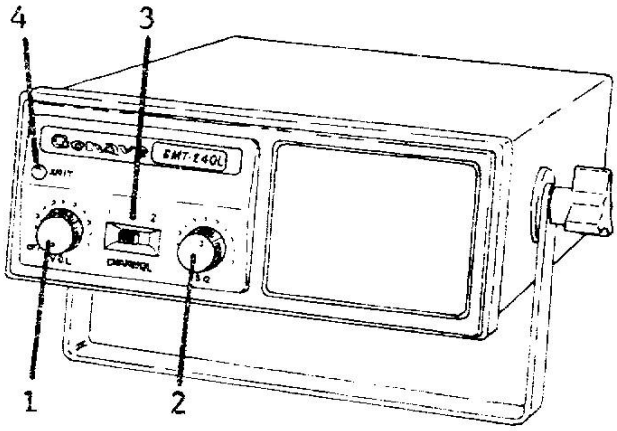
NOTE: If a handset hanger AND tone squelch are to be used with the transceiver, a wire must be connected internally between pin 8 of the rear-panel Accessory Plug and pin 3 of the mic. receptacle as shown in Figure 2-5.

PIN 4 - No connection, normally; however, if a telephone-style handset is used, the receiver audio should be connected to this pin as shown in Figure 2-5. Provisions have been made on the PC board to mount the 1.2K resistor - a copper track on the PC board extends from the resistor mounting pad to the receiver audio putput. A wire must be connected from remaining resistor mounting pad to pin 4 on the microphone receptacle, and a 150 pF disc capacitor should be connected from pin 4 to the chassis ground, using short leads.

NOTE: The value of the 1.2K resistor may be increased or decreased as desired to set the maximum earphone volume.

GND --- Provides a chassis-ground connection for microphone audio and push-to-talk curcuits.

SECTION III
OPERATING MANUAL



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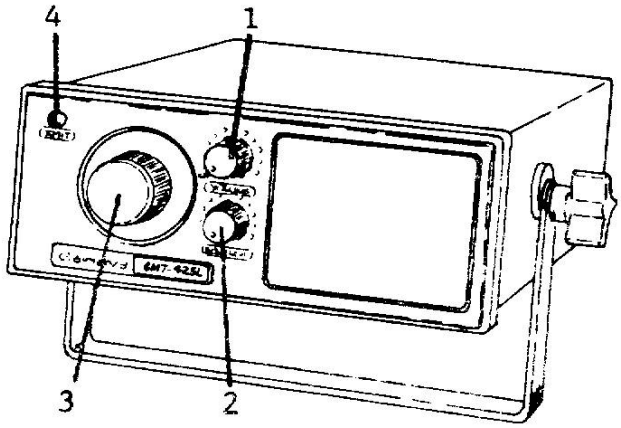


GMT-425L

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. Channel-selector switch
4. Red transmit-indicator lamp

The push-to-talk button on the microphone also functions as an operating control. Unit operation is quite simple, as explained below:

3-2. OPERATING INSTRUCTIONS

1. Turn VOLUME (#1) and SQUELCH (#2) controls fully counterclockwise.

2. Move CHANNEL SELECTOR (#3) to desired operating channel.

3. Rotate VOLUME control clockwise until switch clicks; this turns ON transceiver.

4. If transceiver is equipped with an SA-1 subaudible-tone option, it is necessary to deactivate the tone squelch by removing microphone from its hanger or, by depressing the MONITOR button on desk-style microphone.

5. Now, rotate VOLUME control clockwise to adjust receiver volume to desired level.

6. Turn SQUELCH control clockwise until background noise just disappears.

NOTE: DO NOT attempt to adjust the SQUELCH control if a signal is being received.

7. To transmit, depress the microphone pushbutton. If unit is equipped with subaudible-tone system, it is important to monitor channel before transmitting to insure that it is clear. The hand microphone circuitry is designed in such manner that receiver squelching is deactivated when the microphone is removed from its hanger; while the G-11 desk-style microphone is designed so the TRANSMIT button will not function unless the MONITOR switch has also been depressed.

8. The TRANSMIT-INDICATOR Lamp (#47) will illuminate when transmitter is operating; then, hold microphone 3 to 6 inches from your mouth, and talk in a normal voice.

9. Release the TRANSMIT pushbutton to listen.

NOTE: The squelch circuit, which is adjusted by front-panel control, quiets 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. With the tone-squelch system, however, only transmitted signals carrying the proper subaudible tone are heard, as explained previously.

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.

NOTE: While the seller or installing agency may assist in filing the license application, the responsibility lays solely with the prospective licensee to assure that transmitting equipment is covered by a valid station license PRIOR TO BEGINNING OPERATION.

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.

In addition to the STATION license, the FCC Rules normally require OPERATORs to hold some type of authorization. The minimum class of operator authorization required for each specific classification of station is set forth in the appropriate FCC rule part. The most common authorization permitted by Rules under which the GMT-240L and GMT-425L are approved, is the "restricted radiotelephone operator permit" (FCC Form 753).

The following technical information is intended to aid GMT-240L/425L 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 station licensee.

Transmitter Input Power:	50 watts
Transmitter Output Power:	30 watts
Type of Unit:	Transceiver
Type Acceptance/Model No:	
GMT-240L	T-7023500
GMT-425L	T-7023600
Frequency Range (MHz):	25 - 50
Frequency Tolerance:	.002%
Emission:	16F3
Approved under Rule Part Numbers:	21, 90

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 VHF low-band transceivers are FCC Forms 400 or 425, depending upon the usage and/or geographic location of the proposed station. To determine which form is required, contact nearest FCC 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. Any of these volumes may be purchased from the Supt. of Documents, U.S. Government Printing Office, Washington, D.C., 20402.

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

The services and the corresponding F.C.C. rule part numbers, under which the GMT-240L/425L can be used, are as follows:

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

Part 90 - Private Land Mobile Radio Services

Subpart B - Public Safety Radio Services
- Local Government Radio Service
- Police Radio Service
- Fire Radio Service
- Highway Maintenance Radio Service
- Forestry-Conservation Radio Service

Subpart C - Special Emergency Radio Service
- Medical Services.
- Rescue Organizations
- Veterinarians
- Disaster Relief Organizations
- School Buses
- Beach Patrols

Subpart D - Industrial Radio Services
- 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

Subpart E - Land Transportation Radio Services
- 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.S. and Courthouse Bldg.
Box 644, 4th and F Streets

CALIFORNIA, LONG BEACH
Room 501
3711 Long Beach Blvd.

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

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

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

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

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

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

HAWAII, HONOLULU 96808
502 Federal Bldg.
Box 1021, 335 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

MARYLAND, HYATTSVILLE 20788
Suite 901-B, Presidential Bldg.
6525 Belcrest Road

MASSACHUSETTS, BOSTON 02109
1609 Customhouse
167 State St.

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

MINNESOTA, ST. PAUL 55101
691 Federal Bldg. and 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, PHILADELPHIA 19106
James A. Byrne Federal Courthouse
601 Market St.

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.

SECTION IV
MAINTENANCE MANUAL

4-1. INTRODUCTION

The 2- and 4-channel VHF-FM low-band transceivers are designed to transmit and receive 16F3 emissions on any one of four frequency ranges: 25 to 28 MHz, 29 to 34 MHz, 34 to 41 MHz, and 41 to 50 MHz.

NOTE: Only one RANGE per unit can be installed; however, kits to enable installation of any one of the four possible frequency ranges are available from the factory. For information regarding FREQUENCY and RANGE changes, refer to Section 4-10 in this manual.

Either transceiver model provides an RF power output of 30 watts, minimum, into a 52-ohm load. Basically, the receiver is a dual-conversion superheterodyne, utilizing an 8-pole monolithic crystal filter at 10.7 MHz to provide good selectivity, while the 455 kHz 2nd IF amplifier improves receiver stability. A single integrated circuit performs limiting and detection functions.

This section of the manual provides a circuit description, transmitter and receiver alignment procedures, as well as installation and adjustment procedures for the SA-1 Subaudible-Tone System.

In conjunction with the following circuit description, refer to the block diagram of Figure 4-1, and to the main PC-board schematic in this section.

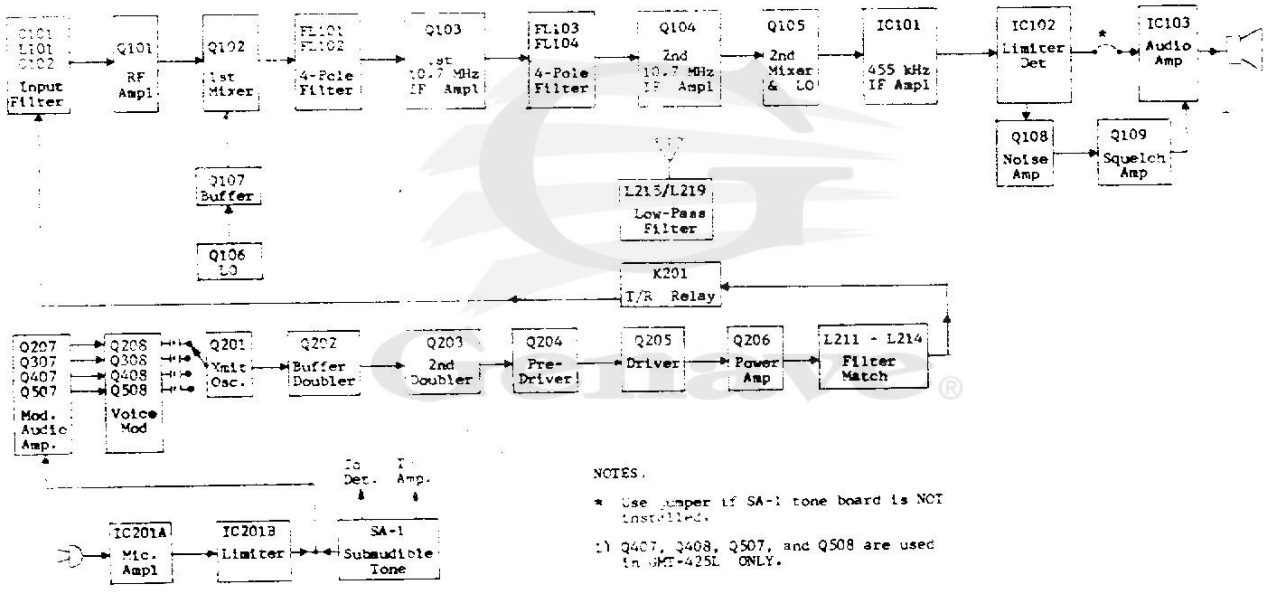


Figure 4-1. Block Diagram

4-2. THEORY OF OPERATION - RECEIVER

4-2-1. Low-Pass Filter

From antenna connector J103, the received signal is applied to an eliptic-function low-pass filter comprised of L215, L216, L217, L218, L219, C233, and C234. In the "transmit" mode, this filter eliminates all transmitter spurious products above 1 GHz. In the "receive" mode, this filter provides some low-pass characteristics thus eliminating much of the UHF noise entering transceiver.

After the signal leaves the low-pass filter, it is routed to pin 9 of T/R relay K201. In the "receive" mode, pin 8 of the T/R relay feeds the incoming signal to the receiver input filter.

4-2-2. Receiver Input Filter

The received signal from pin 8 of relay K201 then is applied to C101, the input capacitor of receiver input filter. This filter is comprised of L101, C101, and C102, which form a bandpass filter. The filter has a nominal bandpass of 1.5 MHz, which should be centered on the receive frequency. The output of the filter is directly coupled to receiver RF amplifier, Q101.

4-2-3. Receiver RF Amplifier

The receiver RF amplifier consists of Q101 and its associated circuitry. Q101 is an N-channel J-FET, operated in a common-gate configuration. The output of the RF amplifier is tuned by L102 and C104; then the amplified signal is capacitively coupled by C147 to the 1st mixer input L103 and C106.

NOTE: The coil taps on L102 and L-103 must be changed when changing receiver from one frequency range to another. L102 and L103 are slug-tuned for the exact frequency in desired range.

4-2-4. Receiver 1st Local Oscillator

The 1st local oscillator consists of Q-106 and associated circuitry in a modified Colpitts crystal oscillator. The desired receive crystal is selected by means of front-panel mounted switch SW-101A; each crystal is grounded through a corresponding series trimmer capacitor used to net the crystal to exact frequency. In the 2-channel GMT-240L, crystal Y101 and trimmer C150 are used for channel 1, while Y102 and trimmer C148 are for channel 2. The crystal utilized will operate within the 23.3 MHz to 44.7 MHz range. The collector circuit of oscillator Q106 is tuned to the fundamental crystal frequency.

4-2-5. Buffer

Output of the 1st local oscillator is directly coupled to the source of buffer amplifier Q107, which functions in a common-gate configuration. This stage is used to isolate the local oscillator from the 1st mixer.

4-2-6. 1st Mixer

The mixer is comprised of a dual-gate MOSFET, Q102, and associated circuitry. When operating on bands 1 or 2 (25-28 MHz or 29-34 MHz), the local oscillator operates at a frequency 10.7 MHz ABOVE the "receive" frequency (high-side injection) but, when operating on bands 3 or 4 (34-41 MHz or 41-50 MHz), the oscillator operates 10.7 MHz BELOW the "receive" frequency (low-side injection). The "receive" frequency and the oscillator-injection frequency are combined in mixer Q102 to provide a 10.7 MHz difference signal across tuned-drain circuit T101.

4-2-7. 1st IF Amplifier

The 10.7 MHz difference signal produced in the 1st mixer is coupled by T101 and C118 to a 4-pole monolithic crystal filter consisting of FL101 and FL102. Output of the filter is transformer coupled by T102 to the first stage, Q-103, of the first IF amplifier. Output from Q103 is coupled by C120 to another 4-pole monolithic crystal filter consisting of FL103 and FL104. The filter output is then transformer coupled by T104 to the second stage, Q104, of the first IF amplifier.

4-2-8. 2nd Mixer/Autodyne Converter

The 10.7 MHz output of Q104 is transformer coupled by T105 to second mixer Q105, which operates as an autodyne converter with crystal Y103 oscillating at 10.245 MHz to produce a second IF of 455 kHz.

4-2-9. Second IF Amplifier

Transformer T106 applies the resultant 455 kHz difference frequency to IC101, which functions as a high-gain 455 kHz IF amplifier.

4-2-10. Audio Limiter/Detector/Squelch

The output of IC101 is coupled by T107 to IC102 pins 1 and 2 -- IC102 performs the limiting and detection functions in the receiver. C129 sets the de-emphasis level in the detection circuitry, while T108, R121, and C130 form the quadrature detector circuit. Detected audio on pin 8 of IC102 is fed through C131 and R122 to the audio amplification circuits via pin 14 on IC102. At the same time, detected audio from pin 8 is also applied to a noise amplifier consisting of Q108 and its associated circuitry. The amplified noise from Q108 is fed to the voltage-doubling detectors CR103 and CR104. The detected noise then charges C136 and biases the base of Q109. The Squelch control, R-127, determines the authority of the detected-noise level on base of Q109 -- as Q109 turns ON, it pulls pin 6 of IC-103 to ground. This action turns IC103 OFF, and completely silences the receiver.

4-2-11. Audio Amplifier

Volume Control R131 sets the level of audio fed to audio amplifier IC103. The frequency-response shaping of the audio amplifier is performed by R133 and C141 while C143, C144, and C140 provide the feedback to various stages within IC-103. Audio output from pin 12 of IC103 is applied through C146 to the speaker.

To quiet receiver audio during transmission, relay K201 removes all receiver DC voltages while the transmitter circuits are energized.

4-3. THEORY OF OPERATION - TRANSMITTER

4-3-1. Microphone Amplifier/Limiter

The microphone amplifier/limiter in the unit is built around a single integrated circuit, IC201. This IC is a dual operational amplifier, and is shown on the schematic as IC201A and IC201B. Audio output of the ceramic microphone is amplified by IC201A -- a 6 dB per octave rising characteristic is given to the audio frequencies by loading the 1500 pF microphone capacitance with the bias resistors, R216 and R237. R216 is the limiting balance adjustment (symmetry adjustment) for balancing the positive and negative clipping of the audio signal. IC201A also provides the limiting function required by symmetrically clipping amplified audio at essentially supply voltage and at ground. Regulated supply voltage for the microphone amplifier/limiter is obtained by applying 13.75-volts DC through R214 and across 6.8-volt zener diode CR202.

Output of the limiter is applied to the input of IC201B, which functions as an active Chebyshev 2-pole, low-pass filter with the cutoff frequency set at 3 kHz. R223 and C248 add a third pole to the filter response to ensure an 18-dB per octave roll-off above 3 kHz.

A separate modulation audio amplifier and reactance modulator is used for each channel in the transceiver; thus, two modulators are used in the GMT-240L whereas the GMT 425L utilizes four separate modulator circuits. R224 sets the deviation on channel 1 by controlling the amount of audio applied to the #1 modulation audio amplifier. R324 sets deviation for channel #2. In a 4 channel GMT-425L, R424 sets deviation for channel #3, while R524 adjusts deviation on channel #4. C249 maintains the low end of all deviation controls at AC ground.

4-3-2. Modulation Audio Amplifiers

NOTE: The GMT-240L employs two modulation audio amplifiers -- one for each channel; whereas, the GMT-425L uses four modulation amplifiers. The amplifiers are identical; thus, it is only necessary to substitute the proper reference numbers in the following circuit description: 200-series for channel #1; 300-series for channel #2; 400-series for #3; and 500-series numbers for channel #4.

Q207 and associated circuitry form a modulation audio amplifier. C250, R225, C251, and R238 form an isolation network for the voice and the subaudible-tone input signals. The combined signals are then fed to base of modulation amplifier Q207. R226 is used to provide constant gain for a regulated-audio output which is fed through C253 and R230 to the base of reactance modulator Q208.

4-3-3. Reactance Modulator

As indicated in the Note above, a separate modulator is used for each channel in the transceiver. The modulator for channel #1 is assigned 200-series reference numbers, while 300-series numbers are used for channel #2. Channels 3 and 4 utilize 400- and 500-series numbers, respectively.

Q208 and associated circuitry form an active reactance modulator. As audio level applied to base of Q208 changes, the input capacitive reactance also changes. This changing reactance at the base of Q208 is applied in series with the appropriate transmit crystal.

To increase crystal frequency modulation deviation in the two lower ranges (25-28 and 29-34 MHz), inductance are added in series with transmit crystals. Z202 is placed in series with channel #1 crystal for band 1 (25-28 MHz); for band 2 (29-34 MHz), Z201 is placed in parallel with Z202. For bands 3 and 4 (34-41 and 41-50 MHz), a shorting jumper is placed in parallel with Z202 and Z201.

Bias Adjust potentiometer R234 is used to adjust reactance level at base of Q-208 to a median value. Crystal trimmer C209 must be adjusted for the correct unmodulated carrier frequency; then, as the reactance level at base of Q208 changes, the carrier frequency will be shifted accordingly. C254 functions to insure starting of transmit crystal and reactance modulator. CR203 provides thermal stabilization of the active reactance modulator.

4-3-4. Transmit Crystal Oscillator

The transmit oscillator is a modified Colpitts crystal-controlled circuit, consisting of Q201 and associated circuitry. The oscillator frequency is controlled by quartz crystal Y201, Y-301, Y401, or Y501, depending upon the setting of channel-selector switch SW-101B. Variable capacitors are used in parallel with each crystal to allow exact setting of the generated frequency: C209/Y201; C309/Y301; C409/Y401; and C509/Y501.

The output of the oscillator will be in the range from 6.25 MHz to 12.5 MHz, depending upon the crystal used. This output is multiplied by four in the following stages to produce an output frequency within the range 25 - 50 MHz.

The transmit oscillator is temperature-compensated through reactance modulator circuitry which is in series with the transmit crystal. As explained in Sec. 4-3-3 above, the input capacitive reactance of Q208 changes as the audio level applied to its base changes. This changing reactance at the base of Q208 is applied in series with the transmit crystal. Because the input capacitive reactance of Q208 will also vary as the voltage gain of the transistor is varied by temperature changes, CR203 is added in base circuit of Q208 to hold its voltage gain constant.

As the temperature increases, the voltage gain and emitter voltage of Q208 tend to increase. At the same time, the temperature change will decrease voltage drop across CR203. This decrease in

voltage drop across CR203 is equal to the voltage increase on emitter of Q208 and is applied to base of Q208. The changing voltage on base of Q208 compensates for temperature changes by holding voltage gain of Q208 constant. With a constant voltage gain, Q208 also maintains a constant median value of input capacitive reactance.

4-3-5. Buffer/Doubler

The modulated RF output of the oscillator is directly coupled to the source of buffer/doubler Q202. In this stage, the 6.25 MHz to 12.5 MHz input frequency is doubled. Harmonics and subharmonics are filtered out by means of a two-pole Chebyshev filter, which is tuned to the second harmonic of the crystal oscillator. The filter utilizes two tapped coils, L201 and L202, which are capacitively coupled by C214; the taps provide an easy way to make frequency adjustments when changing from one band (range) to another. The correct coil taps for each of the four frequency ranges are given in Section 4-10 of this manual. The Chebyshev filter output is coupled through C216 to base of second doubler.

4-3-6. Second Doubler

The signal from C216 is applied to base of second doubler Q203, the last multiplier stage. Q203 doubles RF signal frequency to produce an output in the 25 - 50 MHz range. The output of Q203 is matched to input of the following stage by a second Chebyshev filter, comprised of L203, L204, C218, and C-221. This filter also utilizes tapped coils for frequency adjustment when changing ranges. The correct taps can be determined from Section 4-10. The doubled output is capacitively coupled to predriver Q204 by C222.

4-3-7. Predriver

Predriver Q204 functions as the first Class C power amplifier, and receives approximately 50 mW drive from the second doubler. Q204 amplifies the signal, then couples it to driver stage by means of a frequency-selective matching network formed by Z204, C260, C225, L-205, and C226. This matching network effectively couples power to the driver stage, while rejecting any undesirable spurious responses.

4-3-8. Driver

Q205 functions as the second Class C power amplifier, which amplifies RF signal from Q204 and couples it to the final power amplifier stage. L208, C-229, L209, L210, and C230 match driver stage output to input of power amplifier, and provide rejection of unwanted spurious outputs.

4-3-9. Final Power Amplifier

Final power amplifier Q206 is a Class C amplifier stage which produces a typical RF output of 30 watts. The final amplifier is tuned to the operating frequency, and coupled to output filter, by means of the matching network consisting of L211, L213, C231, and C-232. L212, C261, and L214 are added to, or removed from, this circuit depending upon which range is being used. Proper selection of these components can be determined from Section 4-10 of this manual. The final amplifier output is applied to the low-pass filter via pins 9 and 10 of transmit/receive relay K-201.

4-3-10. Transmit-Indicator LED

Transmit-indicator LED DS101 is connected to the +13.75 V line which supplies voltage to all transmitter stages; therefore, when K201 energizes transmitter circuits, DS101 glows. R239 limits its current through DS101.

4-3-11. Transmit/Receive Relay

K201 is the transmit/receive relay. Depressing microphone push-to-talk button grounds one side of relay windings via CR106 and pin 2 of the microphone jack. CR107 eliminates the overvoltage spike generated by K201 when its coil is de-energized.

When K201 is energized, pins 8, 9, and 10 of the relay switch the antenna and low-pass filter from receiver input to transmitter output. At the same time, pins 11, 12, and 13 remove 13.75 VDC power from receive circuits, while pins 14, 15, and 16 apply 13.75 volts to the transmit circuits and to the transmit-indicator lamp.

4-3-12. Power Supply

+13.75 VDC input from pin 15 of P101 is applied through F201, choke Z208, and SW102 to the SA-1 tone board (if used) and to the modulator circuits. The input voltage is also applied through the T/R relay K201 either to the receiver audio output and 9.7 volt regulator, or to the transmitter circuitry.

The 9.7 volt regulator consists of a zener-diode stabilized pass transistor. R135, CR105, and R136 bias the base of Q110 so that its emitter provides a DC output of approximately 9.7 volts. The regulated output is applied to all receiver stages, except audio output IC-103. CR106/CR108 provide reverse-polarity protection.

4-4. DISASSEMBLY

Prior to performing any service work on the instrument, the aluminum top cover must be removed. The bottom cover need not be removed, unless it is necessary to gain access to bottom-side of main PC board. To remove either cover, remove two 4/40 x 3/8" pan head screws securing each side of cover to transceiver chassis; then, slide cover back and lift it off unit.

With unit top cover removed, the component side of main PC board is accessible for alignment or frequency adjustments. If installed, the SA-1 subaudible tone board is accessible for service with the unit top cover removed.

NOTE: If thumbscrews have NOT been removed from sides of transceiver, they must be loosened a few turns before attempting to remove unit covers.

To remove or replace SA-1 subaudible-tone board, remove the instrument top cover as given above; then, gently but firmly lift SA-1 tone board assembly up and off its mating pins.

NOTE: Certain receiver alignment steps are facilitated by removal of the SA-1 Tone Board; then, a jumper must be installed between pin 4 of P103 and pin 6 of P104 to complete audio circuitry.

Reassemble transceiver by reversing the steps above --- use care not to pinch cables or disturb internal adjustments.

4-5. ALIGNMENT PROCEDURE - GENERAL

The transceiver is prealigned to the desired frequency (cies) at the factory when ordered with the appropriate crystal(s) factory-installed, and realignment should not be necessary during normal life of the unit unless components within the unit are replaced.

CAUTION: If crystals are installed or changed in the field, realignment of the receiver input filter, changes in transmitter and receiver inductor taps, and changes in parts values, as well as a complete realignment of receiver and transmitter circuitry may be required.

The GMT-240L may be operated on a maximum of two channels, while the GMT-425L may accomodate as many as four channels, with up to 3% (of highest frequency installed in unit) frequency separation between lowest and highest installed frequencies.

Band Modification Kits are available from the factory to enable operation on any one of four possible ranges. Refer to Tables 4-1 and 4-2 in Section 4-10 of this manual. These band kits contain those parts which must be replaced in order to change band of operation (input filter). All other circuit changes require only the repositioning of jumpers on bottom side of printed-circuit board.

NEVER attempt to realign the transceiver circuits unless the test equipment specified for each section is available.

The receiver alignment procedure is given in Section 4-6, while the transmitter alignment is contained in Section 4-7 of this manual.

4-6. RECEIVER ALIGNMENT

To properly align receiver section of transceiver, the following test equipment, or its equivalent, is required:

a) Oscilloscope, DC - 8 MHz, DC coupled, calibrated vertical attenuator.

b) RF Signal Generator, 10.7 MHz, and 25 - 50 MHz.

c) Sweep Signal Generator, capable of sweeping frequency range from 25 - 50 MHz.

d) FM Signal Generator, must cover frequency range from 25 MHz to 50 MHz with a deviation of at least 6 kHz using a 1000-Hz tone.

e) Frequency Counter, DC - 50 MHz.

f) AC VTVM, any accurate instrument.

g) DC Power Supply, low ripple, 13.75 volts at 7 amps, minimum.

h) Refer to Figures 4-7 through 4-10 for adjustments and Test Points.

4-6-1. Preparation for Alignment

1. If receiver operating frequencies have been changed, check to insure that proper part values are inserted in receiver for desired band of operation. See Set-Up Chart below.

2. Check that channel separation (if applicable) does not exceed maximum permissible (3% of highest frequency installed).

3. To facilitate test equipment connections to receiver during alignment, short lengths of wire can be soldered to bottom side of receiver board at the following points:

   TP-1; Gate 1 of mixer Q102

   TP-2; Gate 2 of mixer Q102

   TP-3; Junction of T105 & Q104

4. Turn VOLUME and SQUELCH controls fully COUNTERCLOCKWISE.

5. Connect transceiver to 13.75 volt DC power supply.

4-6-2. RF-Input Filter Alignment

NOTE: If SA-1 Tone Board is installed in unit, it may be removed as outlined in Sec. 4-4 to facilitate access to adjustments -- if SA-1 is removed, be sure to install shorting jumper between P103 & P104 to complete audio circuitry.

Receiver Band Set-Up Chart

Band	Tuning Range (MHz)	Coil Pin # L102 L103	Coil Pin # L014 L105	1st Osc Frequency (MHz)	First Mixer Injection
1	25-28	5	1	35.7-38.7	High Side
2	28-34	4	5	38.7-44.7	High Side
3	34-41	2	4	23.3-30.3	Low Side
4	41-50	1	2	30.3-39.3	Low Side

1. With transceiver power OFF, connect RF output cable from sweep generator to transceiver antenna connector J-103. Connect a high-impedance detector (Figure 4-2) to gate 1 of Q102 (TP-1); next, connect detector output to oscilloscope vertical input.

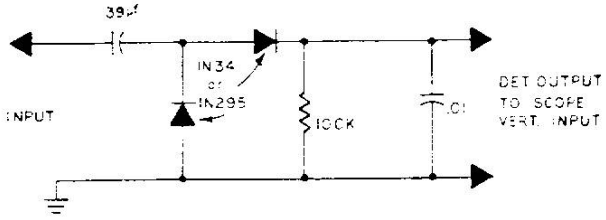


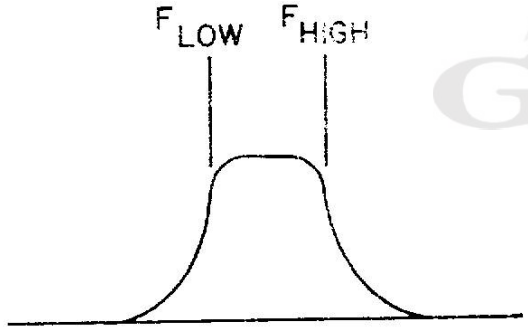
Figure 4-2. High-Impedance Detector

2. Temporarily short L105 to ground by grounding junction of C115 and C116.

3. Set sweep generator to sweep the desired band, and use an RF generator to produce necessary markers, if the markers are not available from sweep generator.

4. Turn transceiver ON. Set scope vert. attenuator to its most sensitive position, and set sweep generator output low enough to prevent overdriving the transceiver's RF amplifier.

5. Adjust C101, L101, C102, L102, and L103 to give a bandpass similar to Figure 4-3.



Note: This wave-form tends to be slightly overcoupled on Band 4 and slightly undercoupled on Band 1

Figure 4-3. Input-Filter Waveform

6. Turn unit OFF, disconnect the test equipment, and REMOVE SHORTING JUMPER from C115/C116 to ground.

4-6-3. 1st Local Osc. Alignment

1. Set transceiver channel - selector switch to first channel to be adjusted.

2. Connect VTVM RF probe to gate 2 of Q102 (TP-2).

3. Turn transceiver ON and adjust slugs in L104 and L105 for maximum reading on VTVM.

4. Set channel-selector switch to each installed channel, and check VTVM reading to ascertain that each crystal is oscillating.

5. Turn transceiver OFF, and disconnect RF probe from TP-2.

6. Connect frequency counter to gate 2 of Q102 (TP-2).

7. Turn transceiver ON, and adjust appropriate trimmer for each crystal for a correct reading on frequency counter.

NOTE: For Bands 1 and 2, ADD 10.7 MHz to OPERATING FREQUENCY to determine LO frequency; but for Bands 3 and 4, SUBTRACT 10.7 MHz from OPERATING FREQUENCY to determine LO frequency.

8. Turn transceiver OFF, and remove test equipment.

4-6-4. 10.7 MHz & 455 kHz IF Alignment

1. Connect a high-impedance detector (Figure 4-2) to drain of FET amplifier Q104 (TP-3) -- this is junction of Q104 and T105; then, connect detector output to scope vertical input. Set scope vertical attenuator to its most sensitive position.

2. The sweep generator frequency range determines the connection point for sweep-input signal: If generator

covers 10.7 MHz, the sweep signal can be applied through a 39 pF capacitor to gate 1 of 1st mixer Q102 (TP-1); however, if generator covers operating frequency of transceiver, the sweep signal can be applied directly to antenna connector J103. Turn transceiver power switch ON.

NOTE: During alignment of monolithic crystal filters, keep sweep signal input level low enough to prevent overdriving the detector -- signal level at the detector should be approximately 10 - 20 mV. Set generator sweep width for approximately 25 kHz at a sweep rate of NOT MORE THAN 40 Hz.

3. Adjust T101, T102, T103, T104, and T105 for a bandpass response similar to that shown in Figure 4-4 below. The ripple should not exceed 2 dB, and in most cases will be 1 dB or less.

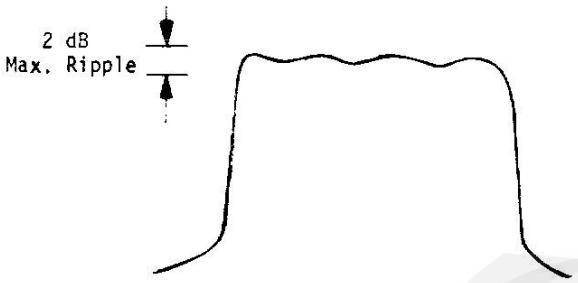


Figure 4-4. IF Response

4. Turn transceiver power OFF, and disconnect sweep generator, detector, and scope.

NOTE: After the 10.7 MHz crystal filters have been properly aligned using a swept signal, DO NOT change adjustments of T101 through T105.

5. Connect an AC voltmeter across unit speaker terminals; turn squelch and volume controls fully counterclockwise.

6. Apply a 10.7 MHz CW signal by either of the following methods:

METHOD #1 -- Inject an accurate 10.7 MHz CW signal into gate 1 of mixer Q102 (TP-1) through a 39 pF capacitor. Short secondary of L105 by applying a ground to junction of C115 and C116.

METHOD #2 -- Connect a signal generator, set to desired RECEIVE frequency, to antenna connector J103, and connect a frequency counter to pin 1 of IF amp. IC101. Turn instrument power switch ON, and increase generator output until counter shows frequency of 2nd IF. "Fine-tune" the signal generator until frequency of 2nd-IF reads exactly 455.0 kHz.

7. Disconnect the CW signal source from transceiver, and with transceiver power switch ON, adjust volume control for a 0.5-volt noise level on the AC voltmeter.

8. Reconnect CW signal generator to the transceiver, and increase unmodulated signal from generator until noise level drops to 0.25 VAC on the voltmeter.

9. Now, adjust T106 and T107, in that order, for maximum quieting as indicated on the AC voltmeter.

If using METHOD #2, now adjust slugs in L104 and L105 for maximum quieting; however, if using METHOD #1, L014 and L105 will be adjusted in step 13 below. During adjustment of L104 and L105, decrease RF input as necessary to maintain a usable reading on AC voltmeter -- repeat step 9 until not further quieting is obtained.

10. Turn transceiver power OFF and disconnect AC voltmeter; now, connect an oscilloscope across speaker terminals, and turn transceiver power switch ON.

11. FM modulate signal generator with a 1-kHz tone at ±5 kHz deviation. Adjust generator RF output to a 10-microvolt level and adjust scope-

input sensitivity to cover about 3/4 of scope screen vertically with the 1-kHz tone.

12. Adjust T108 for maximum amplitude of the 1-kHz tone on scope screen.

13. Now, if METHOD #1 is being used for alignment, turn transceiver power OFF, and remove grounding jumper from junction of C115/C116. Again connect an AC voltmeter across the transceiver speaker terminals.

    Connect a signal generator, set to desired RECEIVE frequency, to antenna connector J103. Set receiver and generator levels as given in steps 7 and 8 above; then, adjust slugs in L104 and L105 for maximum quieting.

14. Turn transceiver power switch OFF, and disconnect all test equipment form unit.

4-6-5. RF Input for 20-dB Quieting

1. Connect FM signal generator to antenna connector J103. Note that generator must have NEGLIGIBLE leakage for quieting tests to give meaningful results. Set generator RF attenuator for ZERO output. Set transceiver and generator for desired channel.

2. Adjust transceiver volume control so that receiver background noise indicates -10 dB on AC VTVM connected across speaker terminals.

3. Slowly increase setting of generator RF attenuator, until AC VTVM indicates -30 dB. Note RF level shown on generator attenuator; this is the RF input required to produce 20-dB receiver quieting. Check additional frequencies as desired.

4-6-6. Squelch Operation

1. Set signal generator to desired RECEIVE frequency, and modulate generator with a 1-kHz tone at ±5 kHz deviation. Set RF attenuator for ZERO RF output.

2. Turn squelch control fully clockwise. Receiver audio control should be set for maximum volume. Receiver is fully squelched, and should be completely silent.

3. Reduce DC-input voltage to approximately 11 volts, and note that receiver is still fully squelched. Return DC input to 13.75 VDC, set volume control at midrange, and adjust squelch control fully counterclockwise; then set squelch clockwise until receiver background noise just disappears.

4. Increase setting of signal-generator RF attenuator until the squelch just fully opens. The RF attenuator should show -119 dBm (0.25 µV) or better.

4-6-7. Audio-Output Power

NOTE: If SA-1 Tone Board was removed in Sec. 4-6-2, it should now be reinstalled. BE SURE TO REMOVE SHORTING JUMPER between P103 and P104.

1. Set FM signal generator on desired RECEIVE frequency, and modulate generator with a 1-kHz tone at ±5 kHz deviation. Set RF attenuator in the vicinity of 5 µV.

2. Disable tone squelch (if unit is so equipped) either by removing hand mic. from its mounting clip or, by unplugging mic. from transceiver. Turn volume control fully clockwise. The AC VTVM should indicate NOT LESS THAN 4 volts (4 watts).

3. Modulate generator with 500-Hz tone at ±5 kHz deviation, and note that AC VTVM indicates at least 4 volts with transceiver volume control fully clockwise.

4. Modulate signal generator with a 3-kHz tone at ±5 kHz deviation. Again AC VTVM should indicate at least 4 volts at maximum setting of the transceiver volume control.

NOTE: Subaudible-tone operation of the complete transceiver should be checked as outlined in Section 4-9 of this manual.

5. Turn OFF transceiver power switch; then, disconnect signal generator and AC VTVM from the instrument.

4-7. TRANSMITTER ALIGNMENT

4-7-1. Test Equipment Required

To properly align the transmitter section of transceiver, the following test equipment, or equivalent, is required.

a) Power Meter, 50 watts @ 50 MHz, or relative output indicating device (Figure 4-5) with 50-ohm load.

b) Frequency Counter, DC - 50 MHz, or other accurate frequency-measuring device.

c) Deviation Meter, to read ±7.5 kHz.

d) Power Supply, 13.75 VDC at 8 amp, minimum, filtered.

e) VTVM any accurate instrument.

f) Audio Generator, capable of generating 1700-Hz.

g) Oscilloscope, DC to 8-MHz, DC coupled.

h) Refer to Figures 4-7 through 4-10 for Test Points and adjustments.

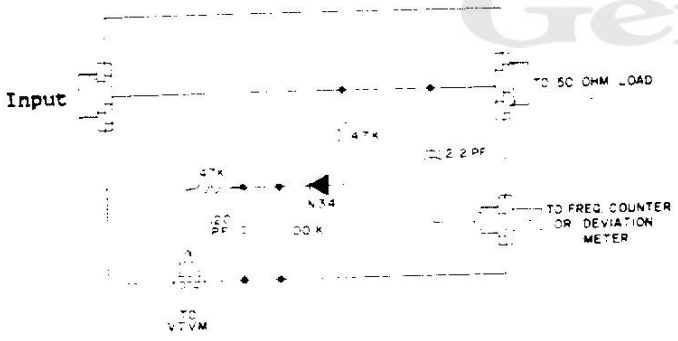


Figure 4-5. Relative Output Indicator

4-7-2. Preparation for Alignment

Before attempting alignment of transmitter, determine the desired operating frequency(cies), and install appropriate crystals in sockets within the instrument. Refer to Section 4-11 in this manual for Crystal Specifications and calculations. If transmitter frequency (cies) are being changed, insure that channel separation does NOT EXCEED the maximum allowable (3% of highest frequency installed).

CAUTION: Insure that proper part values are inserted in transmitter, and that proper jumper connections are made for desired band of operation. Refer to Tables 4-1 and 4-2.

If two operating frequencies are desired which fall in adjacent operating bands, determine "mean frequency of operation" as follows:

$$F_{mean} = (F_1 + F_2)/2$$

The band in which the "mean frequency of operation" falls is the band to which the transmitter should be tuned.

To complete preparation of the transmitter for alignment, perform following steps:

1. Remove transceiver top and bottom covers; set unit "component-side UP" on one of its covers -- this gives normal "circuit-board to cover" capacitance.

NOTE: Transceiver Main PC Boards, as well as Mod PC Boards (if used). have circuit function for each potentiometer etched into board adjacent to pot. as follows: MS = Mic. Symmetry; MG = Mic. Gain; 1D, 2D, 3D, 4D = Deviation pots for channels 1, 2, 3, and 4; while 1B, 2B, 3B, and 4B = Bias pots for channels 1, 2, 3, and 4 respectively.

2. Preset Deviation pots, 1D (R224) and 2D (R324), as well as 3D (R424) and 4D (R524) if applicable, to their minimum setting. Refer to Figure

4-8 and 4-10 for control locations, and for direction of rotation to minimum settings.

3. Connect transceiver to 13.75 volt DC power supply.

4-7-3. Power Alignment

When tuning the transmitter MULTIPLIER stages, proceed by adjusting for maximum emitter current as described in steps below. But, when tuning transmitter POWER AMPLIFIERS, connect an ammeter to measure TOTAL CURRENT applied to the unit. Tune transmitter to get best efficiency -- that is, GREATEST power output at LOWEST input current. Do NOT permit input current to exceed 6 amps. Refer to Component Location Diagrams in this section for location of adjustments and test points.

1. Attach a 50-ohm dummy load to the transceiver RF-output connector J103 through a power meter or relative output indicating device (Figure 4-5).

2. Select the highest operating frequency installed in unit. Turn power switch ON.

NOTE: The voltage measurements in the following steps are made with a VTVM and DC probe. Key transmitter ONLY while adjustments are being made.

3. Connect DC probe to emitter of Q203 (TP-4), key tranmsitter and adjust slugs in L201 and L202 for a maximum voltage indication on the VTVM. Adjust VTVM attenuator for an onscale reading. The voltage should peak at approximately 0.8 volts.

NOTE: The slugs in L201 and L202 will peak in two places -- the peak with the slug farthest from printed circuit board is correct.

4. Move the DC probe to emitter of Q204 (TP-5). Key transmitter and adjust slugs in L203 and L204 for a maximum indication on the VTVM. Adjust VTVM attenuator for an onscale reading. The voltage should peak at approximately 1.0 volts. Each slug should peak somewhere between the coil windings and the outside end of coil form.

5. If the relative output indicating device of Figure 4-5 is used, connect VTVM DC probe to the connector labeled "VTVM," otherwise, observe the wattmeter or other output indicator.

6. Key transmitter, and adjust C226 for maximum relative output as indicated on the relative output indicator or wattmeter.

7. Key transmitter, and adjust C231 and C232 for maximum output.

8. Readjust C226 for maximum relative output.

9. Adjust C229 and C230 for maximum output.

10. Readjust C231 and C232 for maximum output.

11. Repeat steps 7, 8, and 9 until no further increase in power output can be obtained.

12. If it is necessary to reduce output power of the unit in order to comply with the standards of the operating service, reduce capacitance of C232 and adjust C231 for maximum output. Repeat this procedure until desired output level is obtained.

13. Turn OFF transceiver power switch.

4-7-4. Frequency & Deviation Alignment

As explained in the Theory of Operation in Sections 4-3-2 and 4-3-3 of this manual, for optimum modulation a separate modulator circuit is used for each crystal. That is, the GMT-240L has two modulator circuits, whereas the GMT-425L utilizes four modulators. Due to the modulator circuitry employed, the FREQUENCY and DEVIATION adjustments must be made simultaneously in the

exact order given here, in order to reduce interaction between adjustments.

The function of each potentiometer used in the modulator circuitry is etched on the PC board adjacent to the pot. For example, MS = Mic. Symmetry; MG = Mic. Gain; -D = Deviation pots; and -B = Bias pots.

1. With relative output indicator and 50-ohm load still connected to ant. connector J103, connect a deviation meter to appropriate terminal on relative output indicator (Figure 4-5).

2. Connect output of an audio generator to the transceiver mic. audio input through a .1 μF coupling capacitor. Set generator to produce an output frequency of 1700-Hz.

3. Connect oscilloscope vertical input to pin 1 of IC201A (TP-6).

4. Rotate Mic. Gain pot R219 (MG) to approximate center of its rotation.

5. Turn ON transceiver power, and increase audio generator output until audio on scope just begins to limit.

6. Adjust Mic. Symmetry pot R216 (MS) until displayed audio limits evenly on top and bottom.

7. Turn OFF transceiver power switch, and disconnect oscilloscope. DO NOT CHANGE AUDIO GENERATOR OUTPUT LEVEL OR AUDIO GENERATOR CONNECTION TO TRANSCEIVER.

NOTE: STEPS BELOW MUST BE REPEATED FOR EACH CHANNEL INSTALLED IN THE TRANSCEIVER, USING CORRECT POTS. & TRIMMERS.

8. Be sure relative output indicator, 50-ohm load, and deviation meter are connected to transceiver ant. connector J103, as in step 1 above.

   If not already done, select correct choke Z201/Z501 and Z202/Z502, or jumper, for each channel installed. See Table 4-1 in Section 4-10.

9. Set the transceiver channel-selector switch to channel #1. Turn unit power switch ON.

10. Set Voice Deviation pot. R224 (1D) to approximately mid-range.

11. Key transmitter and adjust Bias pot R234 (1B) to produce equal positive and negative deviation of the carrier as indicated on the deviation meter.

NOTE: If SA-1 Tone Board is being used, the SUBAUDIBLE-TONE deviation must be adjusted prior to adjusting VOICE deviation in following steps. Subaudible deviation is ADJUSTED on only ONE channel, even if used on multiple channels.

To adjust subaudible deviation, the audio generator must be disconnected temporarily. Key transmitter and adjust Subaudible-Tone Dev. pot R113 (located on SA-1 board) to produce an output deviation of ±1 kHz, as indicated on the deviation meter, at the subaudible frequency.

12. Reconnect audio generator to transceiver mic. audio input. If moved, return channel-selector switch to channel #1. Key transmitter, and adjust Deviation pot. R224 (1D) for ±5 kHz total deviation.

13. Turn OFF unit, and remove the audio generator; then replace deviation meter with a frequency counter.

14. Set channel-selector switch to #1 channel.

15. Key transmitter, and adjust transmit crystal trimmer C209 to produce proper output frequency indication on frequency counter.

CAUTION: Any further adjustment of Bias pot. R234 (1B) as in step 11 above, may require that step 15 be repeated to insure a correct frequency setting.

16. Repeat steps 8 through 15, with the channel-selector set to channel #2. Adjust Voice Deviation pot R324 (2D), Bias pot R334 (2B), and crystal trimer C309.

17. Repeat steps 8 through 15, with the channel-selector set to channel #3, if used. Adjust Deviation pot R424 (3D), Bias pot R434 (3B), and crystal trimmer C409.

18. Repeat steps 8 through 15, with the channel-selector set to channel #4, if used. Adjust Deviation pot R524 (4D), Bias pot R534 (4B), and crystal trimmer C509.

19. Turn OFF transceiver power switch, and disconnect all test equipment. This completes receiver alignment.

4-8. RESERVED

4-9. SA-1 SUBAUDIBLE-TONE BOARD; INSTALLATION & ADJUSTMENT

This section of the manual provides the information needed for the initial installation of an SA-1 Tone Board in a GMT-240L or a GMT-425L, as well as the procedure for changing tone frequency in an existing installation.

During transmission, the SA-1 ENCODER circuitry uses digital techniques to convert high-frequency square waves, generated in the tone oscillator, to low-frequency sine waves needed to modulate the transmitter, and thus activate receivers equipped with proper decoding. During reception, digital circuitry in the SA-1 also DECODES the received subaudible tone and provides the DC voltage required to unsquelch the receiver audio.

The circuitry of the SA-1 is located on a single printed-circuit board, which can be easily installed on, or removed from, the transceiver main PC board by means of a simple pin and socket arrangement. See SA-1 Service Manual.

4-9-1. SA-1 Tone Board Installation

NOTE: Initial installation of an SA-1 Tone-Board, in either a GMT-240L or 425L, requires installation of a jumper wire for EACH channel to be ENCODED with subaudible tone. The GMT-425L has provisions for activating DECODER on ONLY desired channel(s) by cutting appropriate switch track(s) as explained below. The GMT-240L does NOT contain provisions for activating DECODER on one channel ONLY; therefore, if the tone squelch is not desired on one channel, that channel can be monitored by leaving the mic. off its grounded hanger -- make sure mic. "hang-up" button is NOT touching a grounded part of vehicle or transceiver. To install SA-1 tone board, proceed as follows:

1. Determine channel(s) to be equipped with subaudible tone; then, insert a jumper wire from the "SA Mod. Out" hole in main PC board to appropriate modulator(s). Modulators 1 and 2 are located on the main PC board, but modulators 3 and 4 (GMT-425L) are on the vertical modulator board. Refer to Figures 4-9 and 4-7.

2. GMT-425L ONLY -- Viewing modulator board from front of transceiver, observe that four tracks run from a common connection at top of PC board to contacts on the channel-selector switch wafer. These tracks are numbered 1, 2, 3, or 4. To utilize tone squelch on channel 1, CUT the #1 track on PC board. To use subaudible

tone on channel 2, cut the (2) track; etc. A solid (uncut) track disables tone squelch on that channel, which allows channel to be monitored without necessity for "picking-up" mic. from its grounded hanger.

CAUTION: Cut ONLY the "vertical" track(s) under the appropriate number(s) -- Do NOT cut common line.

3. Remove the jumper wire, or dummy PC board, which connects pin 4 of P103 to pin 6 of P104.

4. Carefully align the two receptacles on tone board with the corresponding plugs on transceiver main PC board. Push SA-1 tone board down until it is fully seated on connecting pins.

5. Refer to Frequency and Deviation Alignment procedure given in Section 4-7-4 of this manual, and adjust the SUBAUDIBLE DEVIATION for ±1 kHz.

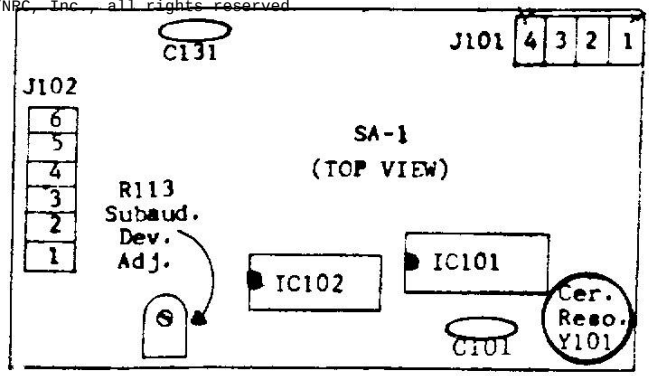
4-9-2. Changing SA-1 Tone Frequency

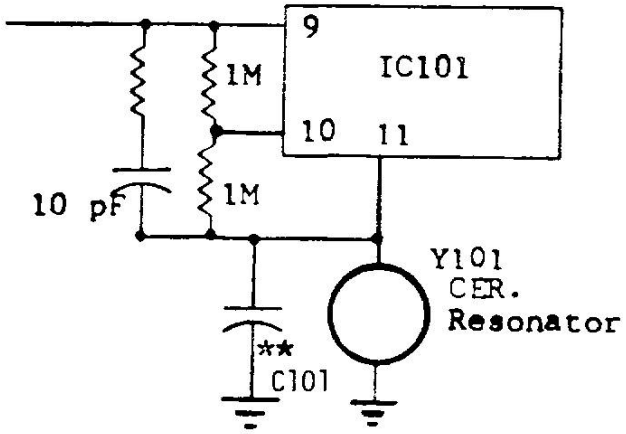
If it is necassary to change SA-1 tone frequency from the factory-set value, proceed as follows:

1. With top cover removed from transceiver, locate ceramic resonator on subaudible-tone PC board. This resonator determines the tone frequency; therefore, a different resonator is required for each discrete subaudible tone frequency. Refer to Figure 4-6 below, and to SA-1 Service Manual.

2. Remove SA-1 subuadible-tone board from transceiver by lifting the SA-1 board up and off mating pins; then, pull resonator from its connecting pins. Unsolder and remove C101.

3. Now, select division ratio for SA-1 oscillator/multiplier by soldering a jumper on bottom side of PC board between IC101 and IC102 as follows: If subaudible tone is BELOW 131.8 Hz, connect pin 8 of IC102 to pin 14 of IC101; but, if frequency is ABOVE





** Add, if req'd, to adj. freq.

Figure 4-6. SA-1 Tone Board

136.5 Hz, connect pin 8 of IC102 to pin 6 of IC101.

4. Align pins of new resonator with PC-sockets; then, push resonator into place.

5. Temporarily replace SA-1 in transceiver, and connect transceiver to its power source. Measure subaudible tone frequency at pin 3 of J102 (6-pin socket). Now, select a capacitor for C101 which will provide correct tone frequency at pin 3. Normally, C101 will be in the range from 0 to 100 pF.

6. After correct value for C101 is determined, solder C101 in place on

the SA-1 board; then, carefully re-place tone board in transceiver. Check receiver and transmitter operation.

7. If another unit with the correct subaudible-tone frequency is available, it may be used for on-the-air testing; otherwise, set a signal generator to a 10 μV level on the appropriate operating frequency with ±1 kHz deviation at the desired SUBAUDIBLE TONE frequency.

8. With test signal (from antenna or signal generator) applied to receiver, note that receiver unsquelches and operates normally.

9. The transmitter SUBAUDIBLE DEVIATION should also be checked. The deviation should be 1 kHz ±100 Hz. Refer to Section 4-7-4 in this manual for the measurement and adjustment procedure.

4-10. FREQUENCY and/or BAND CHANGES

4-10-1. Frequency Changes (within the existing band)

Installation of new crystal frequencies in this unit can be easily accomplished by performing the following steps.

NOTE: To aid in obtaining proper crystals for the GMT-240L/425L, the complete crystal specifications are given in Section 4-11 of this manual.

1. Remove top cover from instrument as explained in Section 4-4 of this manual.

2. Install RECEIVE crystal(s), Y101 to Y104, in appropriate sockets in forward, center section of the main PC board. Refer to Main Board Component Location diagram (Figure 4-10) for crystal locations.

NOTE: The maximum frequency separation between HIGHEST and LOWEST frequencies installed in the unit must NOT exceed 3% of the highest installed frequency.

3. Install TRANSMIT crystal(s), Y201 - Y301, in appropriate sockets in left front quadrant of main PC board. The crystal(s) for channels 3 and 4, Y401 and Y501, (if used) are located on vertical modulator board in GMT-425L only. Refer to Main Board Component Location diagram (Figure 4-10) and to Modulator Board Component Location diagram (Figure 4-8) for TRANSMIT crystal locations.

CAUTION: Be SURE that TRANSMIT and RECEIVE crystals are paired properly.

4. To bring the RECEIVE crystal(s) "on-frequency," perform steps 1 through 8 given in Section 4-6-3 of this manual.

5. To adjust transmit crystal(s) "on-frequency," perform steps 8 through 19 given in Section 4-7-4 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 4-6 and 4-7 of this manual.

4-10-2. Band Changes

The GMT-240L/425L transceivers are designed to operate on any ONE of four possible bands: 25 to 28 MHz, 28 to 34 MHz, 34 to 41 MHz, and 41 to 50 MHz.

NOTE: Only one BAND per unit can be installed; however, kits to enable installation of any ONE of the FOUR possible frequency bands are available from the factory, as follows:

Band	Freq. Range	Kit P/N
1	25 - 28 MHz	7083100
2	28 - 34 MHz	7083200
3	34 - 41 MHz	7083300
4	41 - 50 MHz	7083400

In changing the transceiver operating BAND, if two or more frequencies are involved, insure that channel separation does NOT EXCEED 3% of highest frequency installed in unit.

If two operating frequencies are to be installed, which fall within the allowable 3% separation limits but which are in ADJACENT operating BANDS, it is necessary to determine the "mean frequency of operation." The band in which the "mean frequency" falls is the band to which transceiver must be adjusted.

$$F_{mean} = (F_1 + F_2)/2$$

EXAMPLE: F_1 = 35.0 MHz (band 3)

F_2 = 33.95 MHz (band 2)

$F_1 - F_2$ = 1.05 MHz (3% of F_1)

$F_{mean} = (35.0 + 33.95)/2$

$= 34.475$ MHz (band 3)

Therefore, to operate on 35.0 MHz and 33.95 MHz, a band 3 kit is required for the transceiver. Transmitter and receiver coil taps and jumpers are connected in accordance with Tables 4-1 and 4-2 in this section.

Table 4-1. Receiver Band Set-Up Chart

Receiving Range (MHz)	Band	Jumper Coil Common (Center Tap) to pin number				1st L. O. Frequency (MHz)	First Mixer Injection
		L102	L103	L104	L105		
25-28	1	5	5	1	1	35.7-38.7	High Side
28-34	2	4	4	5	5	38.7-44.7	High Side
34-41	3	2	2	4	4	23.3-30.3	Low Side
41-50	4	1	1	2	2	30.3-39.3	Low Side

Table 4-2. Transmitter Band Setup Chart

Part Ref. No.	Band 1 25-28 MHz	Band 2 28-34 MHz	Band 3 34-41 MHz	Band 4 41-50 MHz
L201	Tap 5	Tap 4	Tap 2	Tap 1
L202	Tap 5	Tap 4	Tap 2	Tap 1
L203	Tap 5	Tap 4	Tap 2	Tap 1
L204	Tap 5	Tap 4	Tap 2	Tap 1
C225*	150 pfd	47 pfd	Not Used	Not Used
C261*	270 pfd	270 pfd	Not Used	Not Used
L209	Used	Used	Not Used	Not Used
L212	Used	Used	Not Used	Not Used
L214	Used	Used	Not Used	Not Used
L215*	16 1/2 Turns	15 1/2 Turns	12 1/2 Turns	9 1/2 Turns
L216*	18 1/2 Turns	20 1/2 Turns	16 1/2 Turns	13 1/2 Turns
L217*	15 1/2 Turns	12 1/2 Turns	9 1/2 Turns	8 1/2 Turns
L218*	2 1/2 Turns	2 1/2 Turns	2 1/2 Turns	2 1/2 Turns
L219*	7 1/2 Turns	6 1/2 Turns	6 1/2 Turns	5 1/2 Turns
C233*	120 pfd	100 pfd	68 pfd	56 pfd
C234*	82 pfd	68 pfd	56 pfd	47 pfd
Z202 (10 µH)	Used	Used	Jumper	Jumper
Z302 (10 µH)	"	"	"	"
Z402 (10 µH)	"	"	"	"
Z502 (10 µH)	"	"	"	"
Z201 (4.7 µH)	Not Used	"	"	"
Z301 (4.7 µH)	" "	"	"	"
Z401 (4.7 µH)	" "	"	"	"
Z501 (4.7 µH)	" "	"	"	"
Xtal Freq, MHz	6.25-7.0	7.0-8.5	8.5-10.25	10.25-12.5
1st Doubler, MHz	12.5-14.0	14.0-17.0	17.0-20.5	20.5-25.0
2nd Doubler, MHz	25-28	28-34	34-41	41-50

* These parts are available as band parts kits and can be ordered from the factory.

ALL RECEIVE FREQUENCIES BELOW 34 MHz (P/N 2300333)

Parallel Mode	C_p = 20 pfd.
3rd Overtone	
Tolerance:	±.001% initial @ 25° C, ±.001% over temp. range.
Temperature Range:	-30° C to +60° C
Holder:	HC-25/U
Series Resistance	25 Ohms, Max.
Crystal Frequency:	Operating Frequency + 10.7 MHz

ALL RECEIVE FREQUENCIES ABOVE 34 MHz (P/N 2300336)

Parallel Mode:	C_p = 20 pfd.
3rd Overtone	
Tolerance:	±.001% initial @ 25° C, ±.001% over temp. range.
Temperature Range:	-30° C to + 60° C
Holder:	HC-25/U
Series Resistance	25 Ohms, Max.
Crystal Frequency:	Operating Frequency - 10.7 MHz

ALL TRANSMIT CRYSTALS (P/N 2300334)

Parallel Mode	C_p = 20 pfd.
Fundamental Cut	
Tolerance:	±.001% initial @ 25° C, ±.001% over temp. range.
Temperature Range:	-30° C to +60° C
Holder:	HC-25/U
Crystal Frequency:	$(\frac{\text{Operating Frequency}}{4}) + 750$ Hz.
Series Resistance:	25 Ohms, Max.

4-12. SCHEMATIC AND COMPONENT LOCATION DIAGRAMS

This section of the GMT-240L/425L Maintenance Manual contains a schematic of the instrument, as well as component location diagrams for the front and rear sides of modulator PC board and top and bottom views of main PC board. Refer to the component location drawings for location of adjustments and test points called out in the transmitter and receiver alignment procedures in Section 4 of this manual.

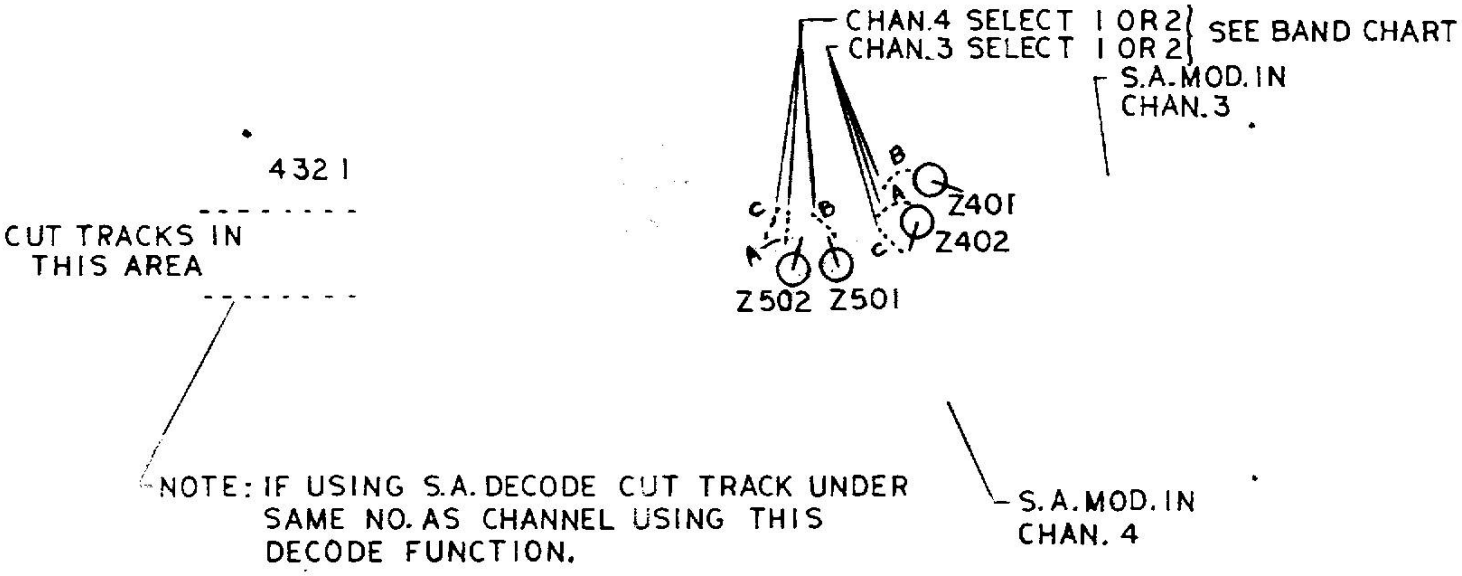


Figure 4-7. Modulator Board (Front View)

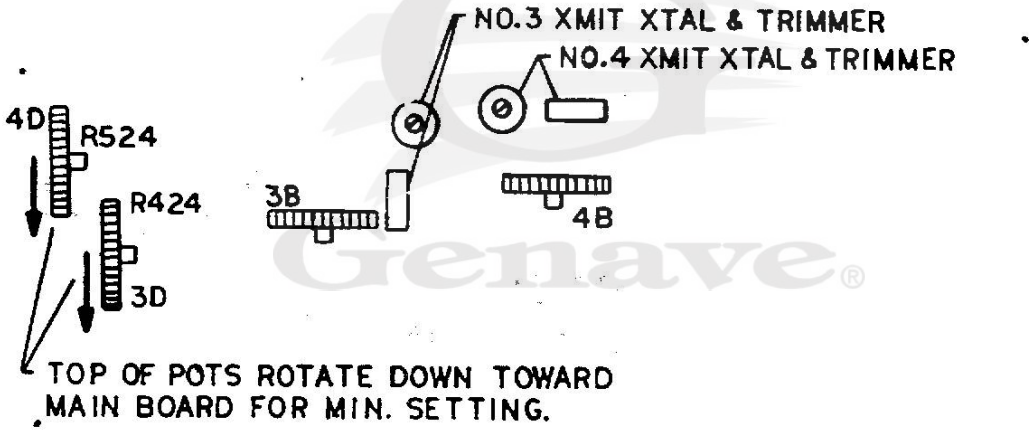


Figure 4-8. Modulator Board (Rear View)

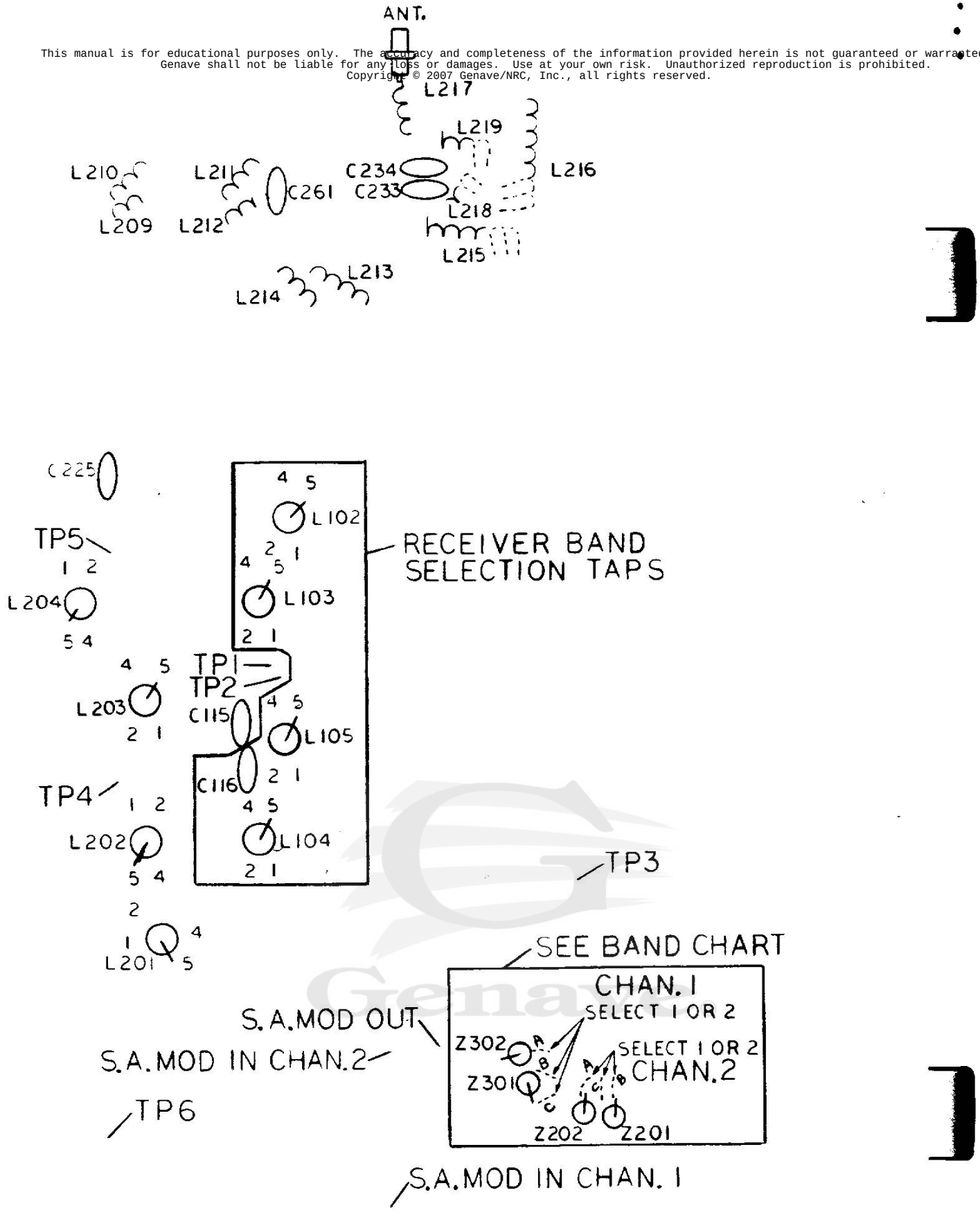


Figure 4-9. Main PC Board (Bottom View)

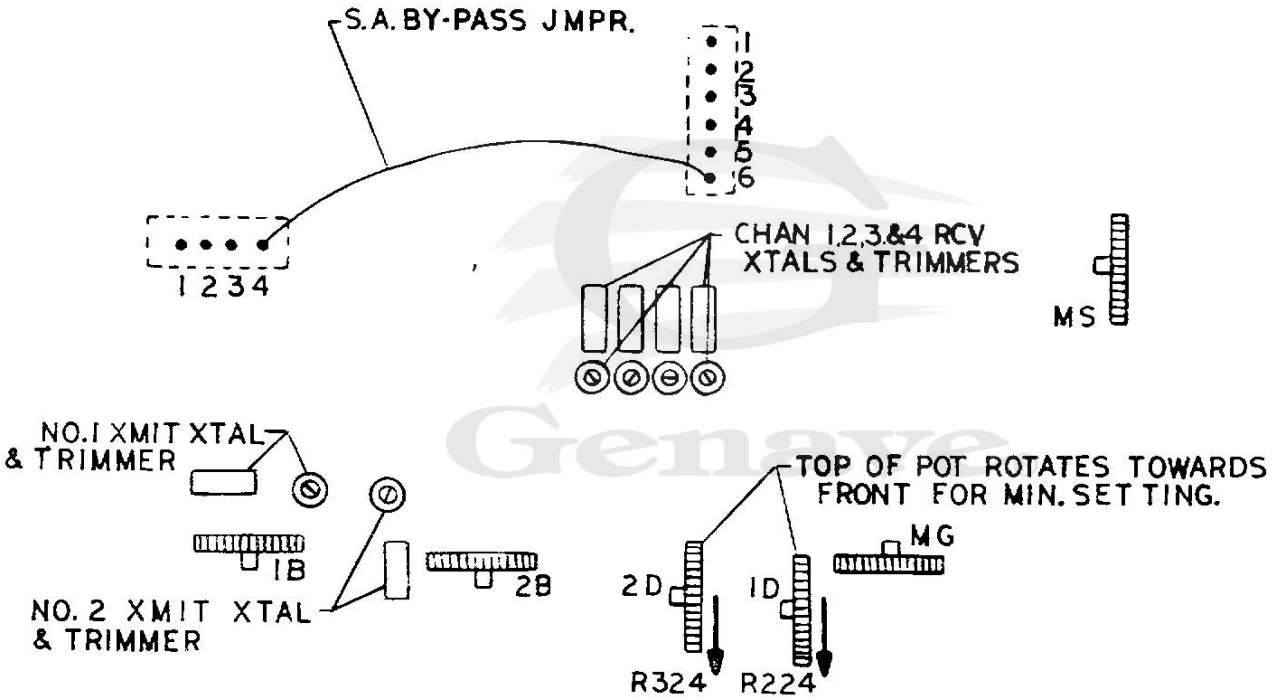
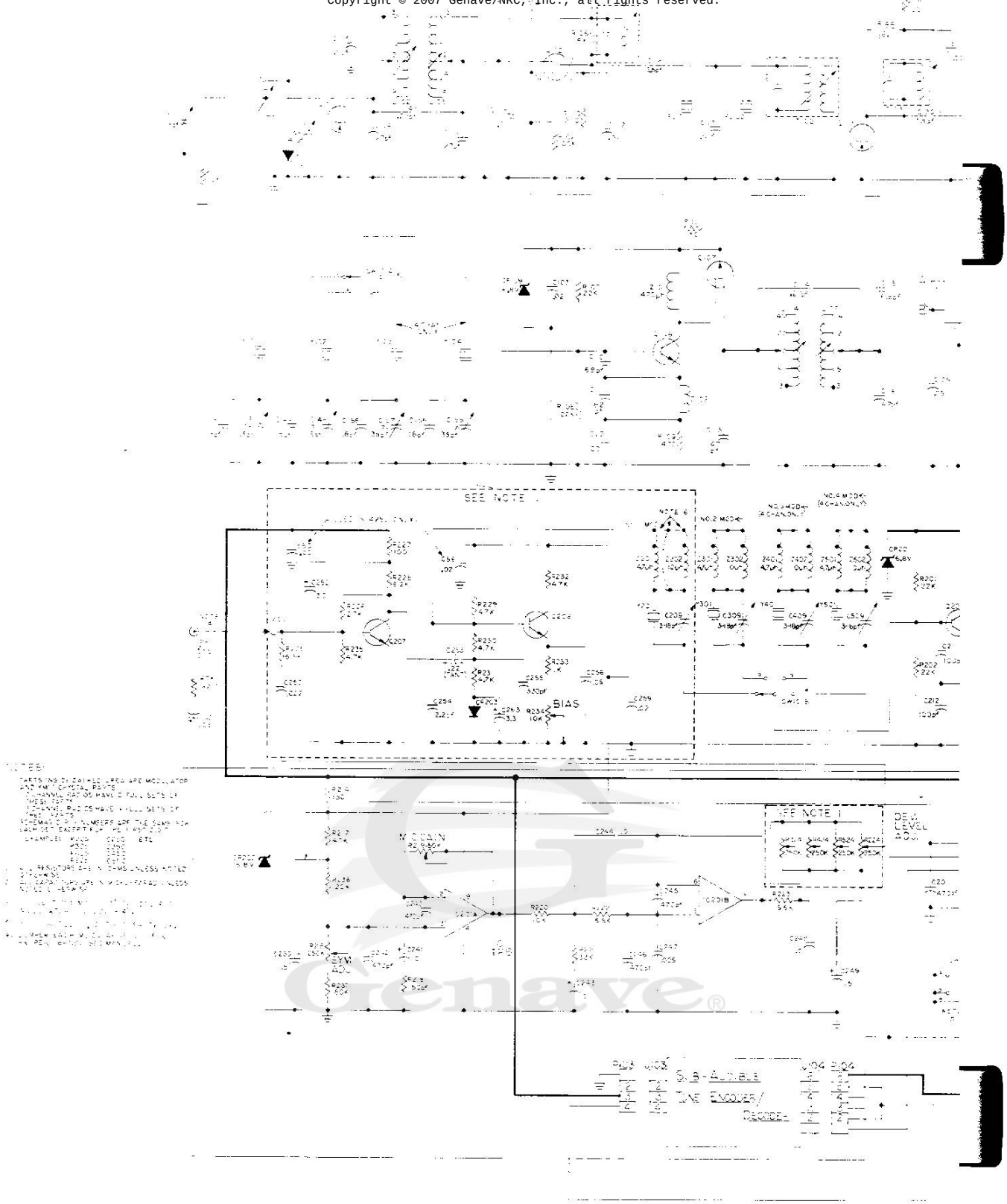


Figure 4-10. Main PC board (Top View)



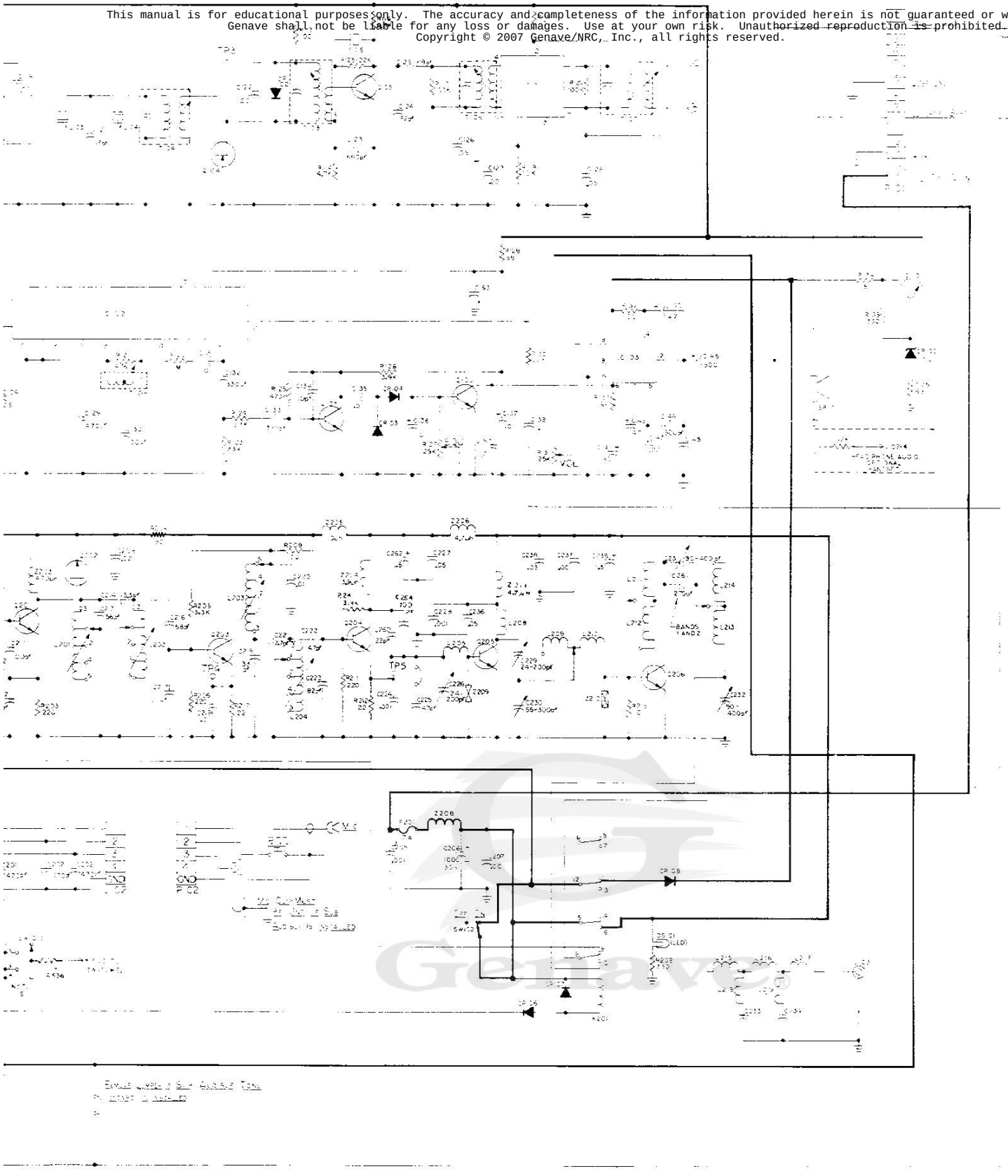


Figure 4-11. GMT-240L/425L Schematic.

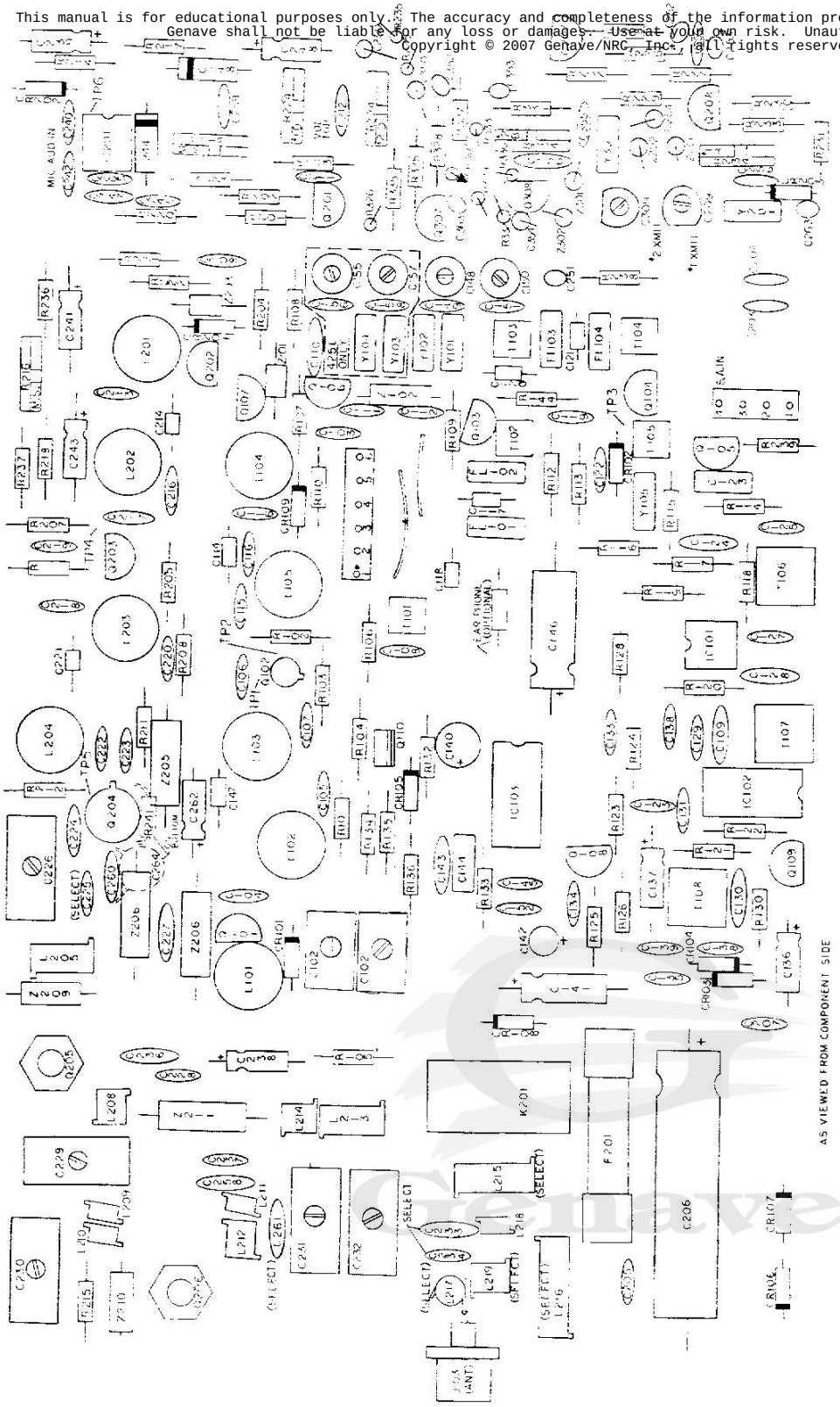


Figure 4-12. Main Board Component Location
(Top View)

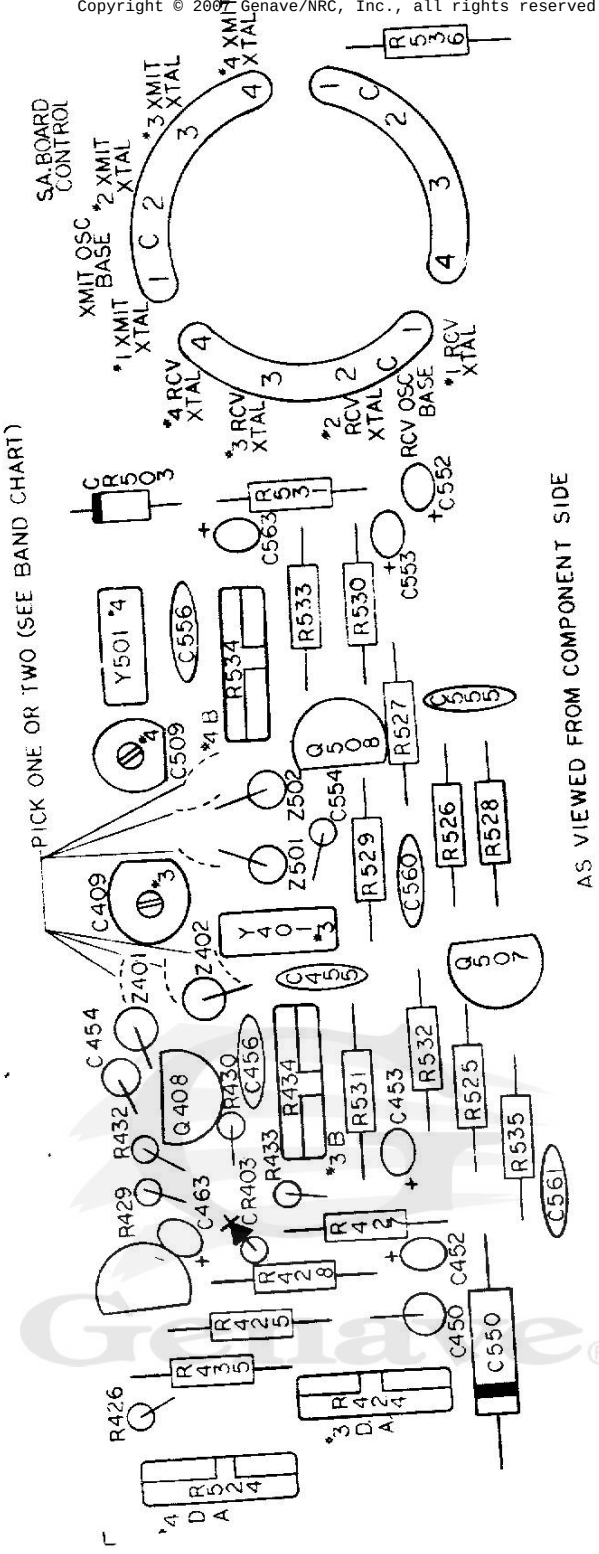


Figure 4-13. Modulator Board Component Location

SECTION V
PARTS LIST

5-1. INTRODUCTION

This section contains a list of all replaceable electronic parts, as well as major mechanical components, for the Genave GMT-240L and GMT-425L transceivers.

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, the following system of numbering is used: 100-series numbers pertain to receiver items; 200-series numbers indicate transmitter and 1st modulator parts; 300-series numbers are used for 2nd modulator items; the 400-series are for 3rd modulator; and 500-series items are used for the 4th modulator.

Genave part numbers for replacement 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	1560406	Trimmer, Mica, 115 pF, max.
2	1560403	Trimmer, 4-40 pF
3	1520053	M25, Disc, .02 µF, ±10%, 25V
4, 6	1520012	NPO, Disc, 27 pF, ±10%
5	1500079	Z5U, Disc, .005 µF, ±20%
7, 8	1520051	Y5U, Disc., .01 µF, ±20%
9, 26, 28	1520230	M25, Disc., .05 µF, +80-20%
10	1520019	NPO, Disc., 68 pF, ±10%
11, 24	1520176	N330, Disc, 82 pF, ±10%
12, 19, 22, 27	1520226	Z5P, Disc., .001 µF, ±10%
13, 16	1520015	N1500, Disc, 47 pF, ±10%

Reference Number	Part Number	Description
CAPACITORS C100 (cont'd)		
14, 47	1510004	NPO, Gimmick, .27 pF, ±10%
15	1520005	NPO, Disc, 6.8 pF, ±10%
17, 21	1510014	NPO, Gimmick, 1.8 pF, ±20%
18, 20	1510026	NPO, Gimmick, 5.6 pF, ±10%
23	1530007	Silver Mica, 680 pF, ±10%
25	1520212	NPO, Disc., 18 pF, ±10%
29	1520042	Y5E, Disc, 470 pF, ±10%
30	1520220	N220, Disc., 100 pF, ±10%
31, 35	1520227	Y5U, Disc., .01 µF, ±20%, 25V
32, 33	1520224	Y5E, Disc., 330 pF, ±10%
34	1520210	NPO, Disc., 10 pF, ±10%
36, 37	1540014	Electrolytic, 10 µF, 25V
38, 45	1520231	Disc., .1 µF, +80-20%, 12V
39	1520229	Y5T, Disc., .033 µF, ±20%
40, 42	1541009	Tant., 47 µF, 16V
41	1540023	Electrolytic, 150 µF, 16V
43	1520232	Disc., .22 µF, +80-20%
44	1500004	Mylar, .0015 µF, ±10%, 630V
46	1540049	Electrolytic, 500 µF, 12V
48, 50	1570121	Trimmer, 5-25 pF
49, 51	1520213	NPO, Disc., 22 pF, ±10%
52, 53, 54, 55, 56, 57, 58, 59, 60	Not Assigned	
CAPACITORS C200		
1, 2, 3, 40, 42, 45, 46	1520042	Y5E, Disc., 470 pF

Reference Number	Part Number	Description
CAPACITORS C200 (cont'd)		
5, 7, 24, 28, 37	1520226	Z5P, Disc., .001 µF, ±10%
6	1540038	Alum. Electrolytic, 1000 µF, 30V
8, 59	1520053	Disc., .02 µF, ±10%
9	1570009	Trimmer, Ceramic, 3-18 pF
11, 12, 17, 33(28-34 MHz), 64	1520022	N220, Disc., 100 pF, ±10%
13, 33(41-50 MHz), 34 (34-41 MHz)	1520018	N220, Disc., 56 pF, ±10%
14	1520017	NPO, Gimmick, 3.3 pF
16, 33(34-41 MHz), 34(28-34 MHz)	1520019	NPO, Disc., 68 pF, ±10%
18	1520013	NPO, Disc., 33 pF
19, 20	1520051	Y5U, Disc., .01 µF, ±20%
21	1510016	NPO, Gimmick, 2.7 pF, ±10%
22, 25, 34(41-50 MHz)	1520015	N1500, Disc., 47 pF, ±10%
23	1520176	N330, Disc., 82 pF, ±10%
26, 29	1560003	Trimmer, Mica 24-200 pF
27, 36, 56, 58	1520230	M25, Disc., .05 µF, +80-20%
30	1560004	Trimmer, Mica, 55-300 pF
31, 32	1560005	Trimmer, Mica, 90-400 pF
33	1520025	1st shunt cap., 120 pF, ±10%, (25-28 MHz)
34	1520021	2nd shunt cap., 82 pF, (25-28 MHz)
38, 39, 49, 62	1540002	Alum electrolytic, 1.5 µF, 63V
41, 43	1540014	Alum. Electrolytic, 10 µF, 16V
44, 48	1500018	Mylar, .01 µF, 100V
47	1500079	Z5U, Disc., .005 µF, ±20%
50	1500024	Mylar, .022 µF, ±10%
51	1550002	Tant., 1 µF, 35V

Reference Number	Part Number	Description
CAPACITORS C500 (425L)		
9	1570009	Trimmer, Ceramic 3-18 pF
50	1500024	Mylar, .022 µF, ±10%
52, 63	1550003	Tant., 3.3 µF, 35V
53	1500038	Tant., .22 µF
54	1510015	NPO, Gimmick, 2.2 pF, ±10%
55	1520037	Y5E, Disc., 330 pF, ±10%
56	1520230	M25, Disc., .05 µF, +80-20%
57, 58, 59, 60, 61, 62	Not Assigned	
DIODES CR100		
1, 2	4810017	IN4148
3, 4	4810021	IN34A, Germanium
5	4810008	Zener, 10V, ±10%, IN4740
6, 7, 8	4810013	General Purpose, 100 PRV, 1 amp.
9	4810007	Zener, 6.8V, ±5%, 3/4W
DIODES CR200		
1, 2	4810007	Zener, 6.8V, ±5%, 3/4W
3	4810017	IN4148
FILTERS FL100		
1, 2, 3, 4	2303504	Crystal Filter, Monolithic, 10.7 MHz (matched set)
INTEGRATED CIRCUITS IC100		
1	3130017	MC1350P, IF amplifier
2	3130024	CA3075, Quadratur Detector
3	3130020	CA810Q, Audio Amplifier
INTEGRATED CIRCUITS IC200		
1	3130012	N5558, Dual OP-AMP

Reference Number	Part Number	Description
INDUCTORS L100		
1	1800231	Coil
2, 3	1800229	Coil
4, 5	1800227	Coil
6	Not Assigned	
INDUCTORS L200		
1, 2	1800228	Coil
3, 4	1800230	Coil
5, 15(41-50 MHz), 17(34-41 MHz)	1800251	Coil, 9½T, #18 LH
8, 19(41-50 MHz)	1800254	Coil, 5½T, #18 LH
9, 10, 12, 18(25-50 MHz)	1800255	Coil, 2½T, #18 LH
11	1800257	Coil, 4½T, #18 LH
13	1800259	Coil, 5½T, #16 LH
14	1800260	Coil, 3½T, #16 LH
15(25-28 MHz), 16 (34-41)	1800261	Coil, 16½ T,
15(28-34 MHz), 17 (25-28 MHz)	1800256	Coil, 15½T, #18 LH
15(34-41 MHz), 17 (28-34 MHz)	1800253	Coil, 12½T
16(25-28 MHz)	1800266	Coil, 18½T, #18 LH
16(28-34 MHz)	1800262	Coil, 20½T, #18 LH
16(41-50 MHz)	1800263	Coil, 13½T, #18 LH
17(41-50 MHz)	1800252	Coil, 8½T, #18 LH
19(25-28 MHz)	1800258	Coil, 7½T, #18 LH
19(28-34 MHz), 19 (34-41 MHz)	1800265	Coil, 6½T, #18 LH
6, 7	Not Assigned	

Reference Number	Part Number	Description
TRANSISTORS Q100		
1	4805485	JFET, N. Channel, 2N5485
2	4800068	MOSFET, Dual Gate, SFE801
3, 4	4805484	JFET, N. Channel, 2N5484
5	4800026	NPN, Sil. MPS3693S, white dot
6	4800044	NPN, Sil., 2N5172
7	4805461	JFET, P. Channel, 2N5461
8, 9	4800028	NPN, Sil, MPS6514S, red dot
10	4800018	NPN, Sil. MPSU01
TRANSISTORS Q200		
1	4800044	NPN, Sil., 2N5172
2	4805461	JFET, P.Channel, 2N5461
3	4800026	NPN, Sil., MPS3693S, white dot
4	4804427	NPN, Sil., 2N4427
5	4800058	NPN, Sil., BLY-87
6	4806088	NPN, Sil., SD1278
7	4800028	NPN, Sil., MPS6514S, red dot
8	4800029	NPN, Sil., SPS1427, orange dot
TRANSISTORS Q300		
7	4800028	NPN, Sil., MPS6514S, red dot
8	4800029	NPN, Sil., SPS1427, orange dot
TRANSISTORS Q400		
7	4800028	NPN, Sil., MPS6514S, red dot
8	4800029	NPN, Sil., SPS1427, orange dot
TRANSISTORS Q500		
7	4800028	NPN, Sil., MPS6514S, red dot
8	4800029	NPN, Sil., SPS1427, orange dot

Reference Number	Part Number	Description
RESISTORS R100		
1, 12, 13, 32	4700013	100Ω, ±10%, 1/2W
2, 17, 20	4700049	100K, ±10%, 1/2W
3	4700018	270Ω, ±10%, 1/2W
4, 19	4700003	10Ω, ±10%, 1/2W
5, 18	4700037	10K, ±10%, 1/2W
6, 44	4700040	18K, ±10%, 1/2W
7, 8, 15, 30	4700041	22K, ±10%, 1/2W
9	4700021	470 Ω, ±10%, 1/2W
10	4700015	150 Ω, ±10%, 1/2W
14	4700033	4.7K, ±10%, 1/2W
16	4700035	6.8K, ±10%, 1/2W
21	4700045	47K, ±10%, 1/2W
22, 25	4700057	470K, ±10%, 1/2W
23, 24	4700043	33K, ±10%, 1/2W
26	4700032	3.9K, ±10%, 1/2W
27	4760051	25K, Variable, ±30%, Linear (squelch)
28, 36	4700011	68 Ω, ±10%, 1/2W
31	4760052	25K, Variable, ±30%, (audio taper, vol.)
33	4700010	56 Ω, ±10%, 1/2W
34	4700004	15 Ω, ±10%, 1/2W
35	4700019	330Ω , ±10%, 1/2W
11, 29, 37	Not Assigned	

Reference Number	Part Number	Description
RESISTORS R200		
1, 2	4700041	22K, ±10%, 1/2W
3	4700023	680 Ω, ±10%, 1/2W
4, 11, 14, 18	4700015	150 Ω, ±10%, 1/2W
5	4700031	3.3K, ±10%, 1/2W
6	4700017	220 Ω, ±10%, 1/2W
7	4700006	22 Ω, ±10%, 1/2W
8, 27	4700013	100 Ω, ±10%, 1/2W
12	4700002	4.7 ohm, ±10%, 1/2W
15, Z209	4700003	10 Ω, ±10%, 1/2W
16, 24	4760022	250K, variable minipot, ±20%
17, 29, 37	4700045	47K, ±10%, 1/2W
19	4760021	50K, variable minipot, ±20%
20	4700037	10K, ±10%, 1/2W
21	4700043	33K, ±10%, 1/2W
22, 25	4700035	6.8K, ±10%, 1/2W
23	4700034	5.6K, ±10%, 1/2W
26	4700042	27K, ±10%, 1/2W
28	4700036	8.2K, ±10%, 1/2W
30, 31, 32, 35	4700033	4.7K, ±10%, 1/2W
33	4700025	1K, ±10%, 1/2W
34	4760019	10K, variable minipot, ±20%
36	4700050	120K, ±10%, 1/2W
38	4700042	27K, ±10%, 1/2W
39	4700019	330Ω, ±10%, 1/2W
41	4700032	3.9K, ±10%, 1/2W
9, 10, 13	Not Assigned	

Reference Number	Part Number	Description
RESISTORS R300		
24	4760022	250K, variable minipot, ±20%
25	4700035	6.8K, ±10%, 1/2W
26	4700042	27K, ±10%, 1/2W
27	4700013	100 Ω, ±10%, 1/2W
28	4700036	8.2K, ±10%, 1/2W
29	4700045	47K, ±10%, 1/2W
30, 31, 32, 35	4700033	4.7K, ±10%, 1/2W
33	4700025	1K, ±10%, 1/2W
34	4760019	10K, variable minipot, ±20%
SWITCHES SW100		
1		Slide, channel selector, DPDT (GMT-240L)
2		ON/OFF
1		4 pos., rotary sw. (GMT-425L
TRANSFORMERS T100		
1, 2, 3, 4	5600098	10.7 MHz, IF, blue
5	5600046	10.7 MHz, IF, orange
6, 7, 8	5600012	455 kHz, IF
CRYSTALS Y100		
1, 2	2300333	<34 MHz, receive
1, 2	2300336	>34 MHz, receive
5	2300252	10.245 MHz, second IF, receive
CRYSTALS Y200		
1	2300334	transmit
CRYSTALS Y300		
1	2300334	transmit

Reference Number	Part Number	Description
CHOKES Z100		
1	1800351	470 µH, Wilco, MU471
2	1800035	1 µH, Wilco, #205-11
CHOKES Z200		
1, 6, 11	1800357	4.7 µH, Wilco, #W-47G
2, 5	1800356	10 µH, Wilco, #W-100
3	1800351	470 µH, Wilco, MU471
4	1800358	3.9 µH, Wilco
7	Not Assigned	
8	1800247	1 MHY, 5 amp., DC
9	4700003	10 ohm, ±10%, 1/2W
10	1800063	RF Driver Input
CHOKES Z300		
1	1800357	4.7 µH, Wilco, #W-47G
2	1800356	10 µH, Wilco, #W-100
CHOKES Z400		
1	1800357	4.7 µH, Wilco, #W-47G
2	1800356	10 µH, Wilco, #W-100
CHOKES Z500		
1	1800357	4.7 µH, Wilco, #W-47G
2	1800356	10 µH, Wilco, #W-100
MISCELLANEOUS		
DS101	3900030	LED, Red, Xmit indicator
P101	2100255	Connector, Molex, 15 pin male
	2100253	Terminal, male, for P101
J101	2100252	Connector, Molex, 15 pin female
	2100254	Terminal, female, for J101
J102	2100077	Mic Jack (chassis mtg)
	1320025	Microphone, ceramic, with cord & plug

Reference Number	Part Number	Description
MISCELLANEOUS (cont'd)		
P103	2100070	Plug, 4-pin for subaudible PC board
P104	2100069	Plug, 6-pin for subaudible PC board
	2100062	Sockets, crystal pin
J103	2100256	Receptacle, coax, amphenol 83-878
F201	5140021	Fuse, 3AG, 10 amp.
	5142068	Clip, fuse, littlefuse
SP101	1320024	Speaker, 3.2 ohm
	2510130	Cover, top
	2510131	Cover, bottom
		Panel, front
	2510156	Knob, volume & squelch
	2510162	Bracket, mounting (handle)
	2400023	Knob, Thumbwhell
		Washer, rubber (used with mounting bracket)
K201	4500008	Relay, 4 PDT
	2510195	Knob, selector