

# **ERC-310**

## **MANPACK TRANSCEIVER**

### **OPERATION AND MAINTENANCE MANUAL**

# CHAPTER 1

## GENERAL INFORMATION

### 1-1. SCOPE OF MANUAL

This manual provides operation and maintenance instructions for the ERC-310 Manpack Transceiver. The manual is divided into seven chapters as follows: Chapter 1, General Information; Chapter 2, Service Upon Receive and Installation; Chapter 3, Operating Instructions; Chapter 4, Principles of Operation; Chapter 5, Preventive Maintenance Checks and Services; Chapter 6, Maintenance; Chapter 7, Parts List; and Chapter 8, Drawings.

### 1-2. PURPOSE AND USE

The ERC-310 is a multi-role, fully synthesized manpack transceiver that can be used as a personal handheld portable radio, a mobile radio, or as a base station. It provides 800 FM channels, at 25 kHz spacing, in the factory installed 20 MHz segment of the 30 to 80 MHz frequency range and is compatible with existing radios employing 25 kHz or 50 kHz channel spacing. The ERC-310 can be operated from a battery pack or can be connected directly to a vehicular or base station 11-30-volt DC power source without a power supply adapter.

### 1-3. DESCRIPTION (See Figures 1-1 through 1-3.)

The ERC-310 in its basic form is equipped with a whip antenna, handset, and a 2 ampere-hour NiCad battery pack. In addition, a full line of accessories and options are offered to provide many alternative methods of deploying the radio. Options and accessories available are described in paragraphs 1.4 and 1.5, respectively. As shown in Figures 1-2 and 1-3 the ERC-310 is completely modular. With the exception of the audio module, which functions for both receiver and transmitter, all modules have one function only. This makes fault finding and maintenance of the radio very simple and makes possible a Mean Time to Repair (MTTR) of approximately 15 minutes, using no specialized test equipment. Locating a faulty module can be achieved by initial audio/visual fault finding, using only the handset and observing the display. Operation of the ERC-310 is accomplished by use of a minimum of controls located on the front panel of the radio. These controls and their functions are described in Chapter 3.

### 1-4. OPTIONS

The following factory installed options are available to extend the capabilities of the ERC-310.

- Extended Channel Memory (up to 10)
- Guard Channel Operation
- 10 Watts RF Power Output
- Channel Hopping Operation (slow)
- 50 kHz Channel Spacing
- 3 AH and 4 AH Battery Packs
- Delta Modulation Speech Scrambling

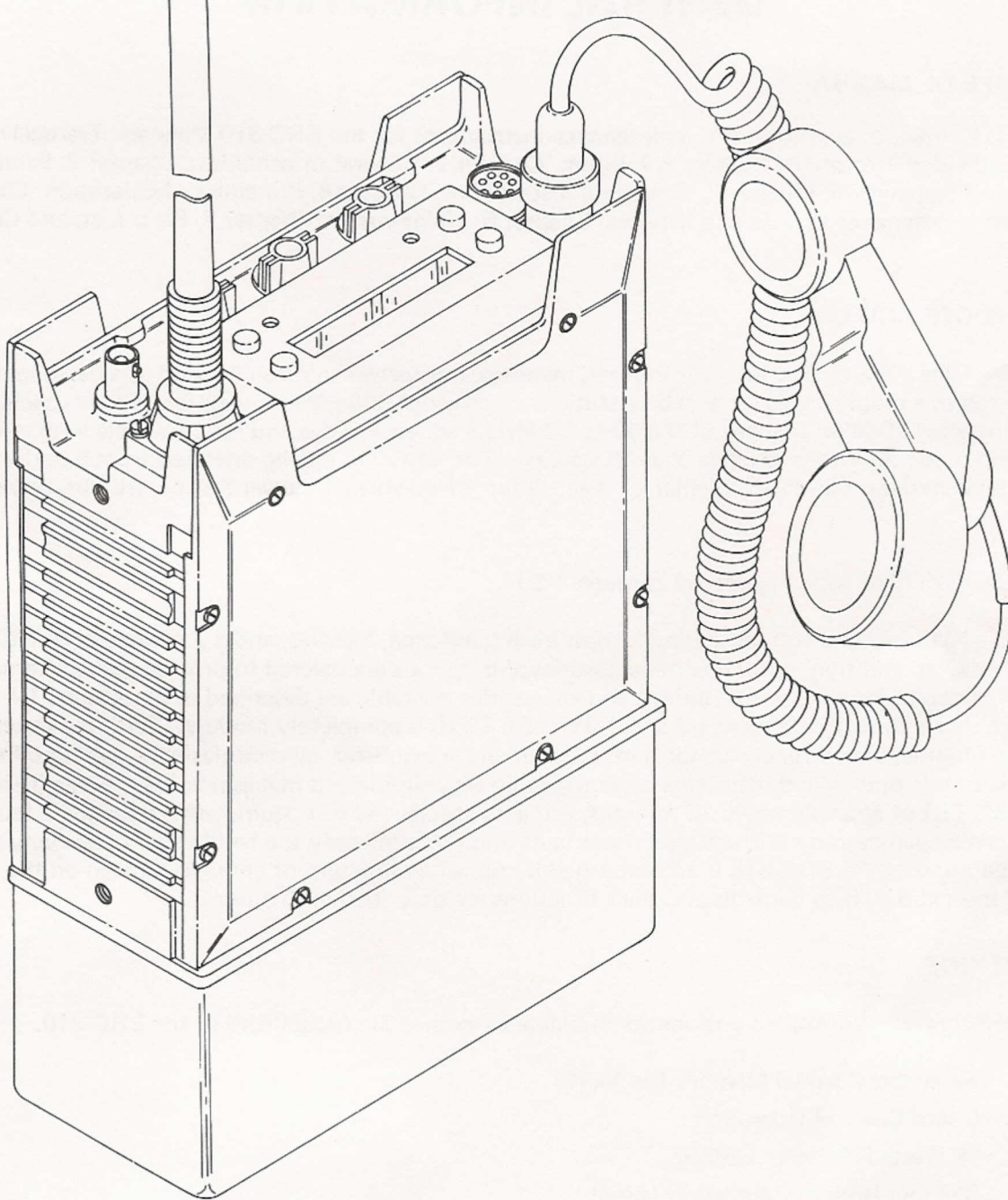


Figure 1-1. ERC-310 Manpack Transceiver, Overall View

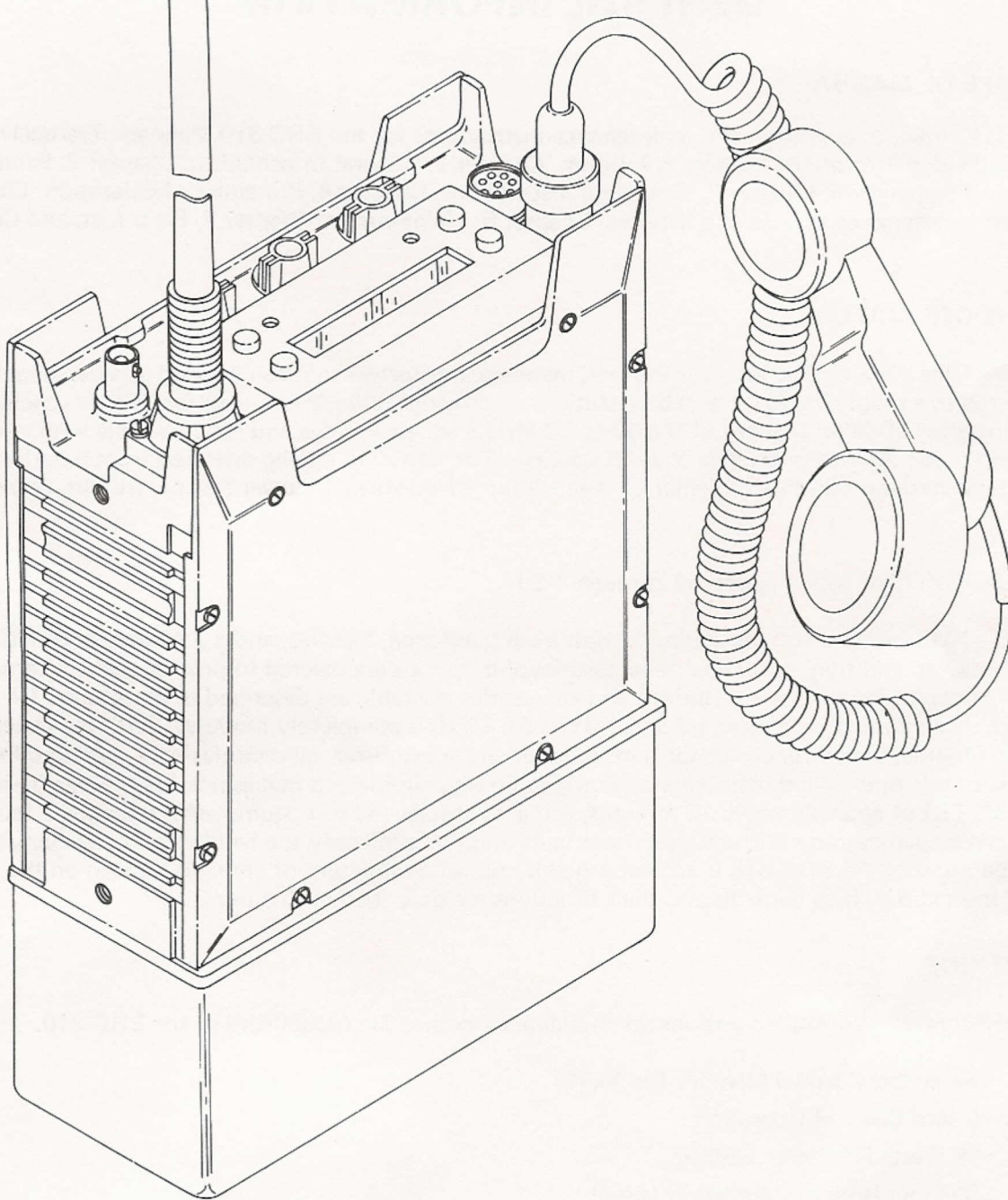


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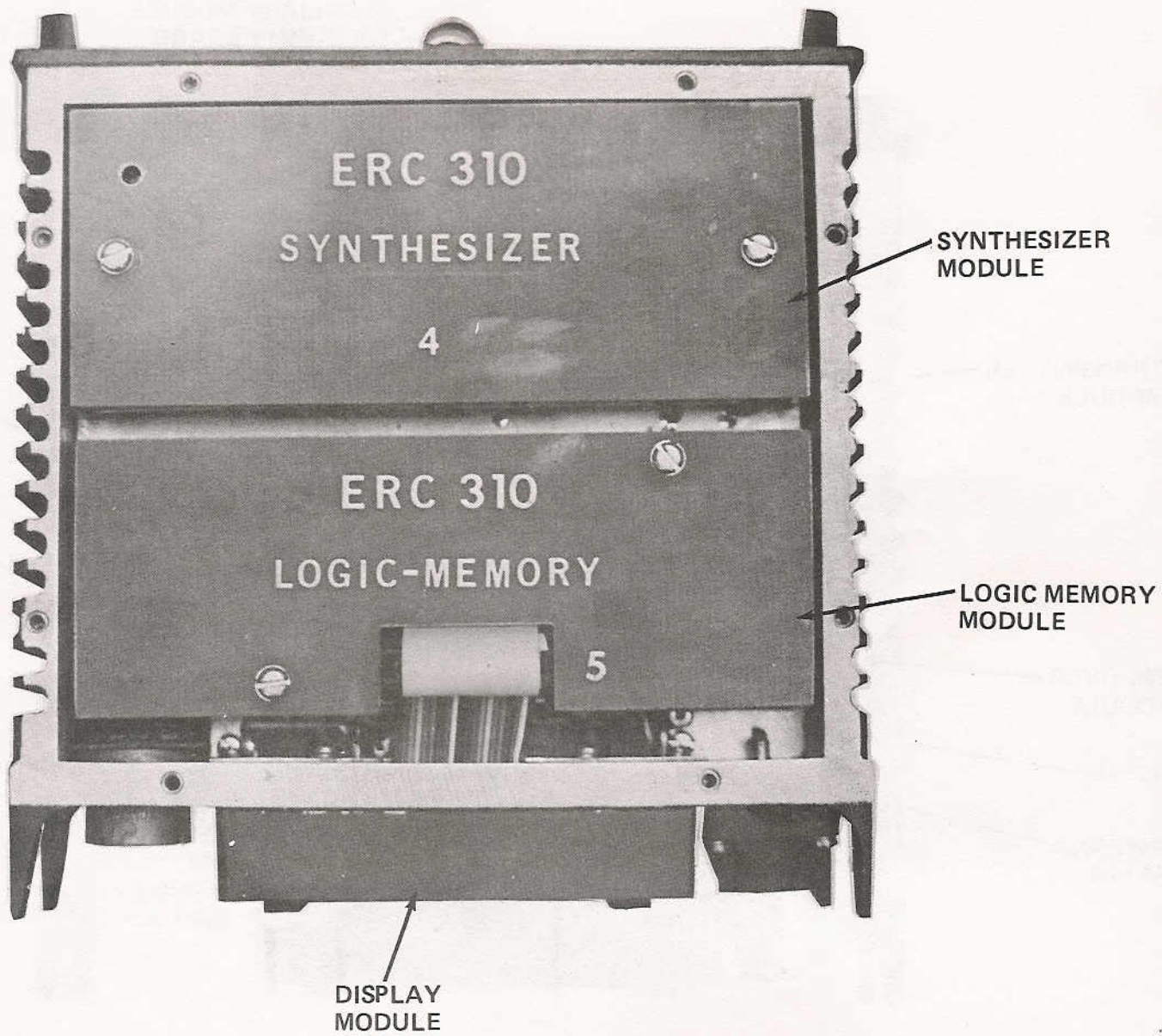


Figure 1-2. ERC-310 Manpack Transceiver, Top View

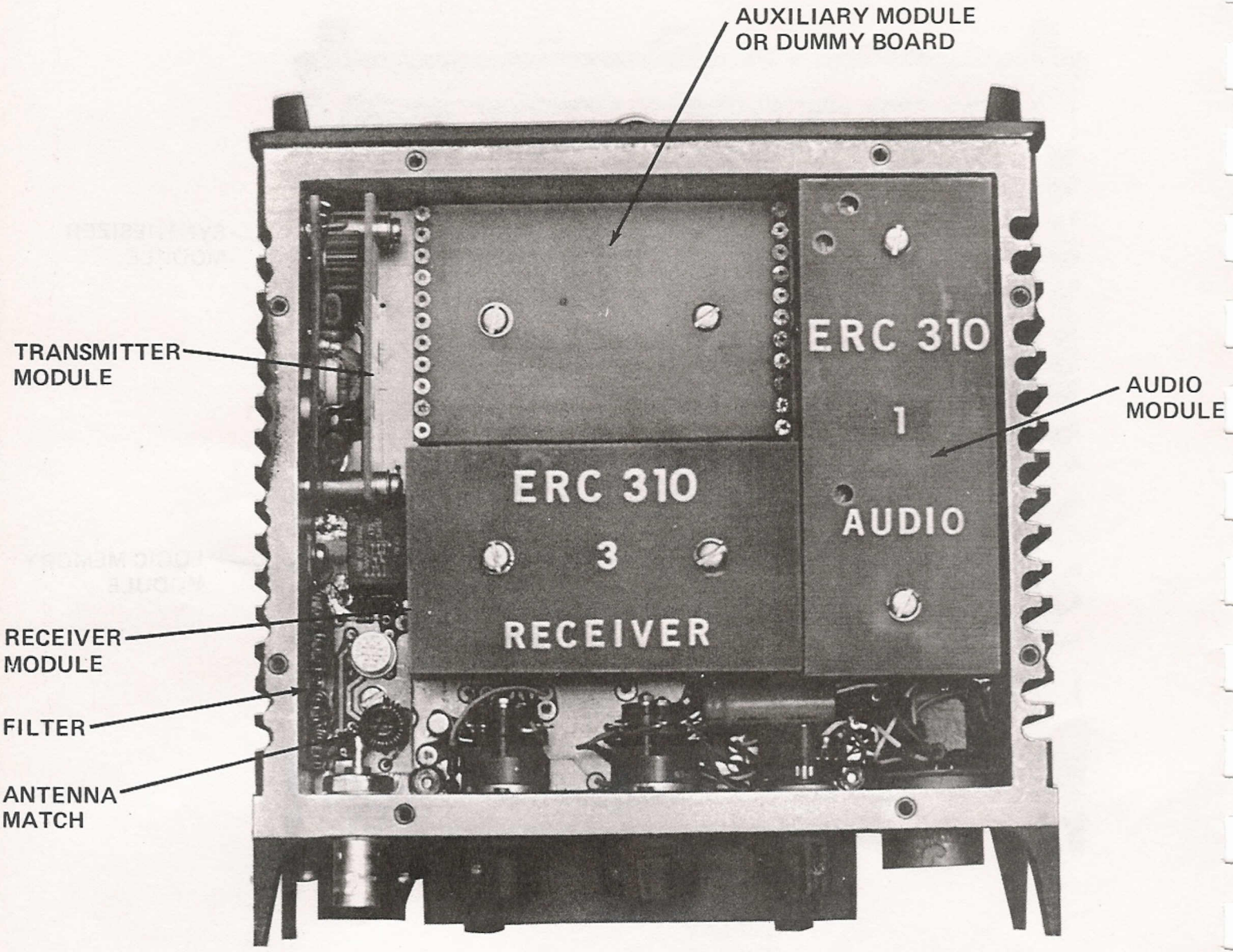


Figure 1-3. ERC-310 Manpack Transceiver Bottom View

# CHAPTER 2

## SERVICE UPON RECEIPT AND INSTALLATION

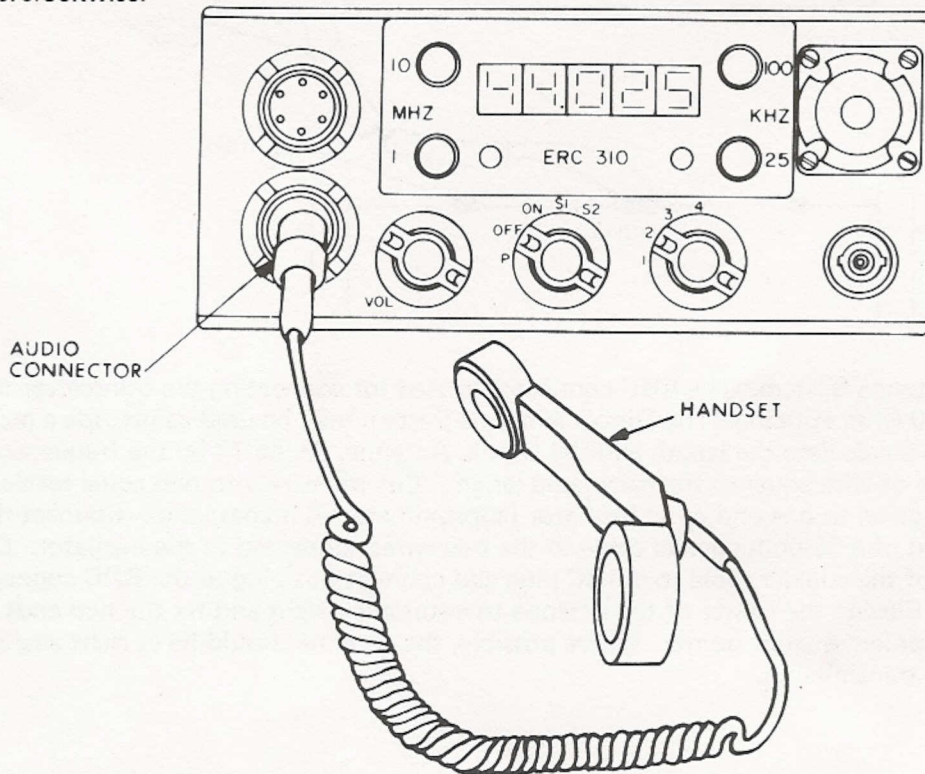
### 2-1. UNPACKING AND INSPECTION

Immediately upon receipt of the ERC-310, inspect the packing box and the unit for signs of possible shipping damage. Ascertain if the transceiver is performing satisfactorily as outlined in the Operating Instructions, Chapter 3. If the transceiver is damaged or fails to operate properly, file immediate claim with the carrier who is responsible to deliver your shipment undamaged. Failure to check for and report damage immediately may result in monetary loss to you.

It is recommended you keep the shipping carton. In the event storage or reshipment becomes necessary it will come in handy.

### 2-2. HANDSET

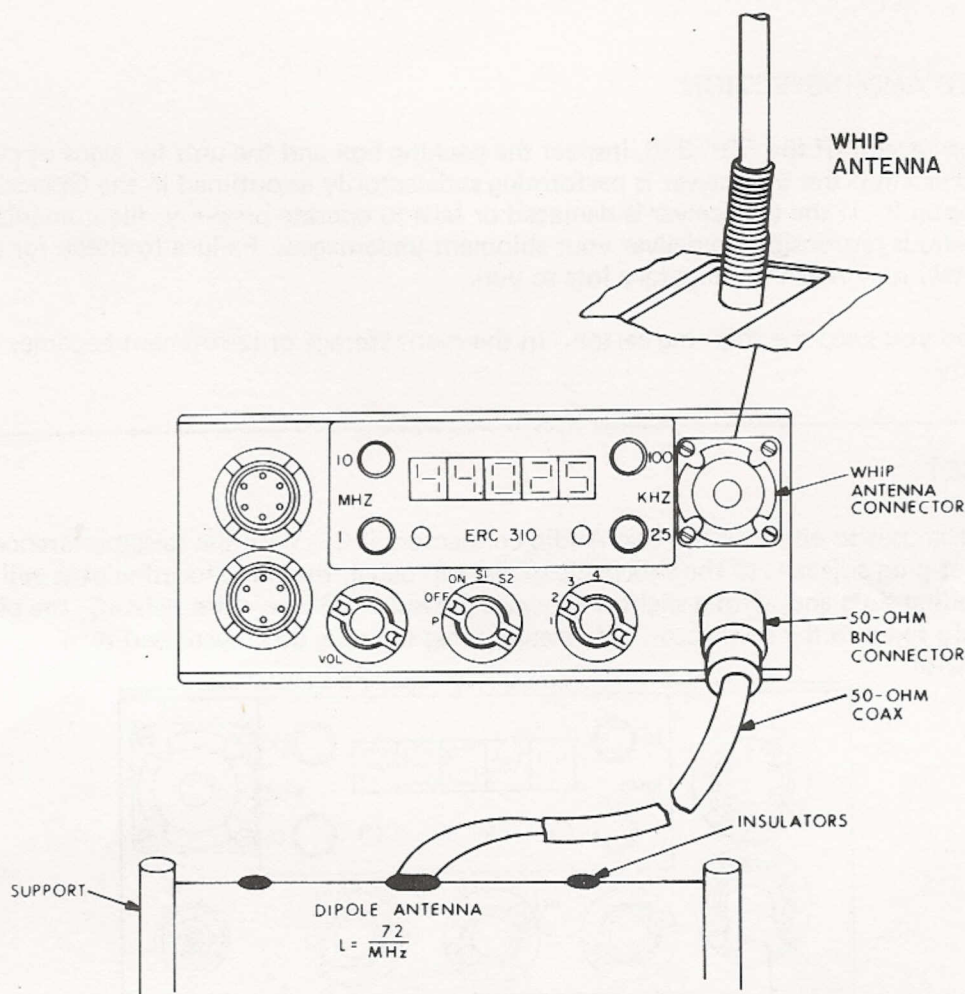
Connect the Handset to either of the two Audio connectors (10). With the raised reference mark on the Handset plug adjacent to the short side of the top panel, the three locating pegs will fit into the corresponding slots and, with a slight downward pressure and clockwise twisting, the plug will be securely fixed to the connector. To release, press the plug downward and turn counterclockwise.



## 2-3. ANTENNA INSTALLATION

**2-3.1 Whip Antenna.** In normal use, a Whip Antenna is inserted into the Whip Antenna connector.

Note: At no time should an antenna be connected to both connectors simultaneously.



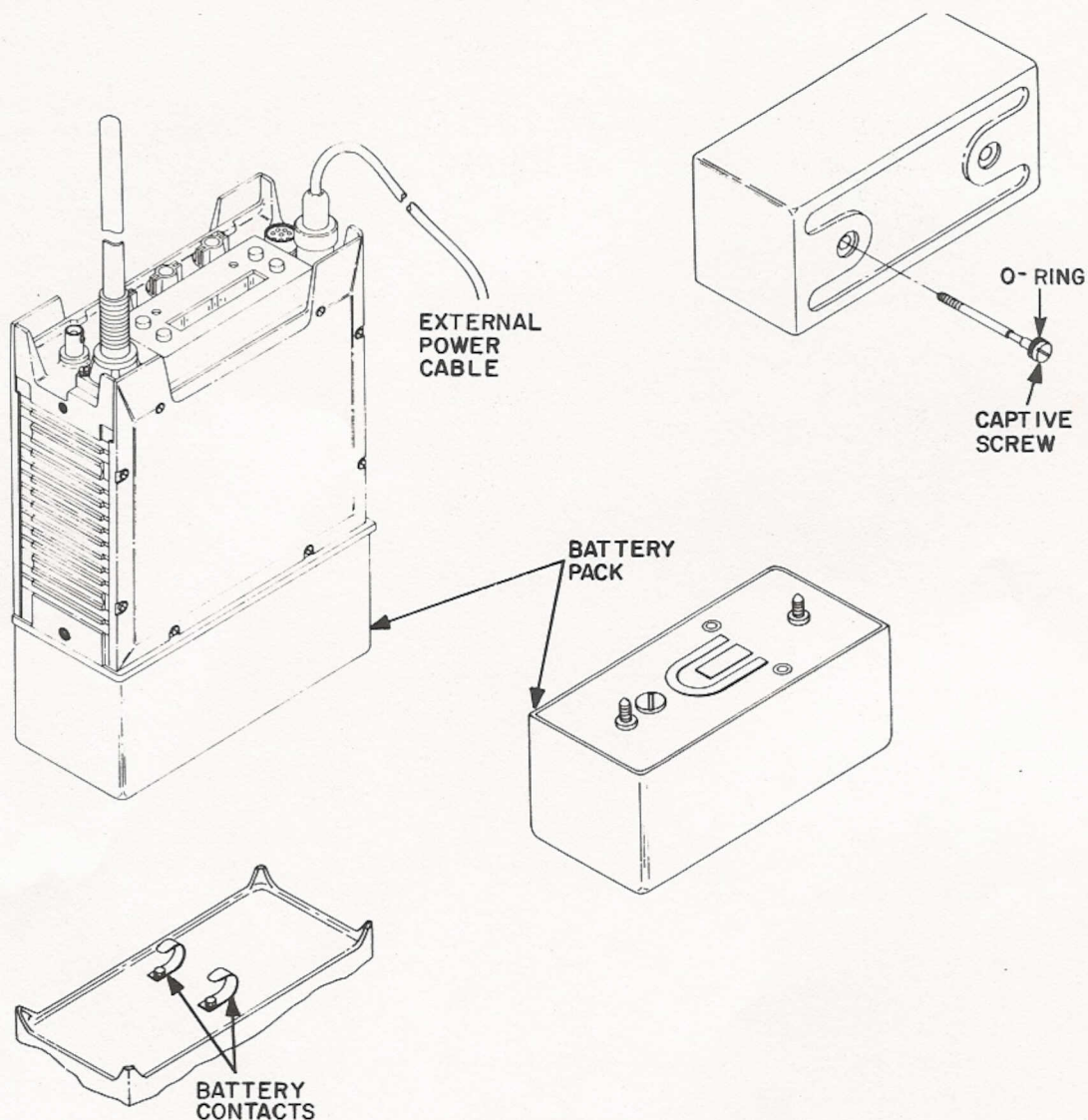
**2-3.2 Alternate Antenna System.** The BNC connector is used for connecting the transceiver to any other type of 50-Ohm antenna. The Dipole Antenna System may be used to provide a more efficient antenna. To calculate the length and the Dipole Antenna, divide 72 by the frequency in MHz and cut a piece of wire equal to the calculated length. Cut the wire into two equal sections and connect each section to one end of an insulator (approximately 6 inches long). Connect the conductor and shield of a 50-ohm coaxial cable to the two wires connected to the insulator. Connect the other end of the coaxial cable to a BNC plug and connect this plug to the BNC connector on the transceiver. Elevate the center of the antenna to a suitable height and fix the two ends of the antenna to convenient anchor points. Where possible, the antenna should be at right angles to the direction of the transmission.



## 2-4. POWER REQUIREMENTS

**2-4.1 External Power Source.** The transceiver can be connected directly to a vehicular or base station 11-30 - volt DC source without a power supply adapter using the external power cable. Connect one end of the cable to either of the two front panel audio connectors as shown below and the other end to the power source.

**NOTE:** On above 18 VDC cannot be used continuously on transmit.



**2-4.2 NiCad Battery Pack.** The NiCad Battery pack provides DC voltage for manpack operation of the transceiver. Mate the contacts on the battery pack with battery contacts on rear of transceiver. Secure the captive screw on rear of battery pack.

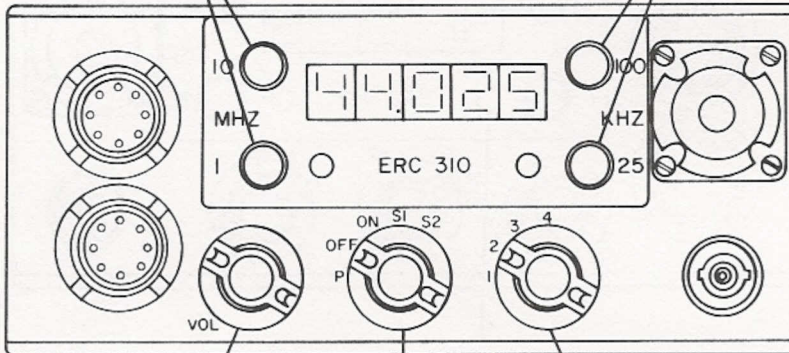
# CHAPTER 3

## OPERATING INSTRUCTIONS

### 3-1. OPERATOR CONTROLS, INDICATORS, AND CONNECTORS

#### 3-1.1 Controls.

**Frequency Selection Pushbuttons** – Preset transceiver frequency of operation in 10 MHz, 1 MHz, 100 kHz, or 25 kHz steps. Depressing any of the pushbuttons illuminates the display for approximately 5 seconds.



**Volume Control** – Adjusts receiver audio level.

**Memory Switch** – Selects up to four preset frequencies.

**Function Switch** – (Program Mode) allows programming up to four specific frequencies into the radio's memory prior to a mission. OFF disconnects radio from the supply voltage. ON allows radio to operate with no squelch. S1 selects tone squelch – audio will be heard if the receiver receives a signal modulated by a 150 Hz tone; otherwise radio remains mute. S2 selects noise squelch – audio will be heard when the RF signal has 6 to 15 dB SINAD (internally presettable); otherwise radio remains mute.

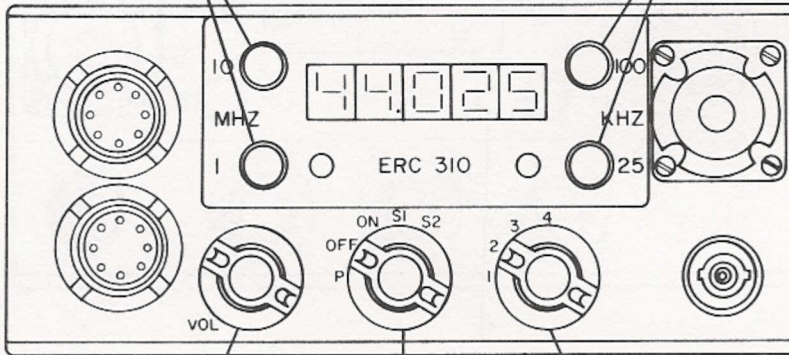
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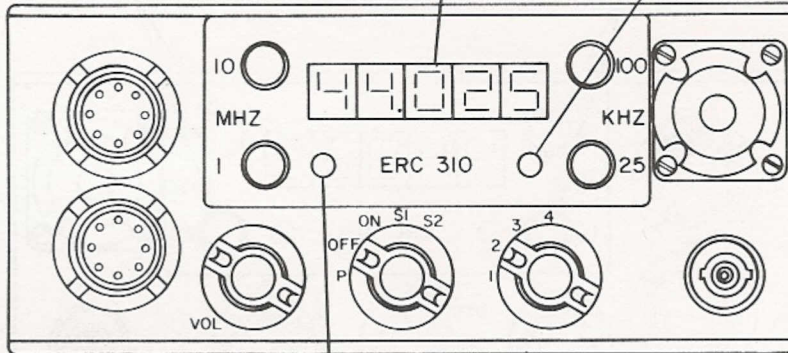
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### 3-1.2 Indicators and Sensor.

**Battery Condition Indicator** — Operates when Display is on to indicate battery condition. Lights to indicate battery state of charge is adequate to assure usable communications. When not illuminated, it indicates that battery is either in a state of discharge or near discharge.

**Display** — Displays frequency present by Frequency Selection pushbuttons.

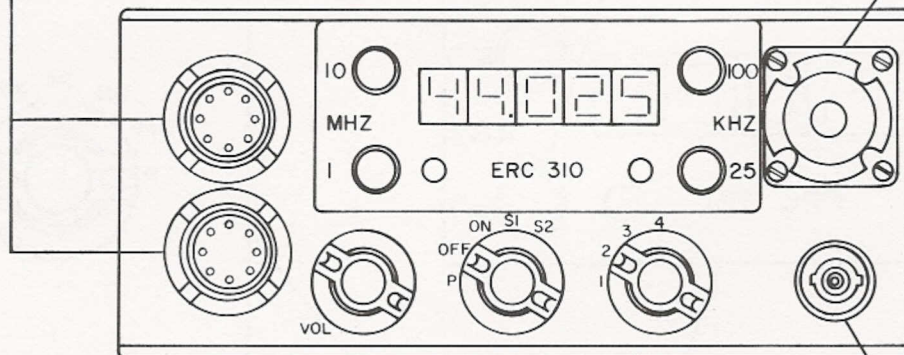


**Display Intensity Sensor** — Determines display brightness. In strong sunlight, display intensity is increased; in darkness, display intensity is decreased.

### 3-1.3 Connectors

**Audio Connectors** – Provides connection to Handset, External Power Cable and Rebroadcast Cable, and other accessories.

**Whip Antenna Connector** – Provides connection of Whip Antenna.



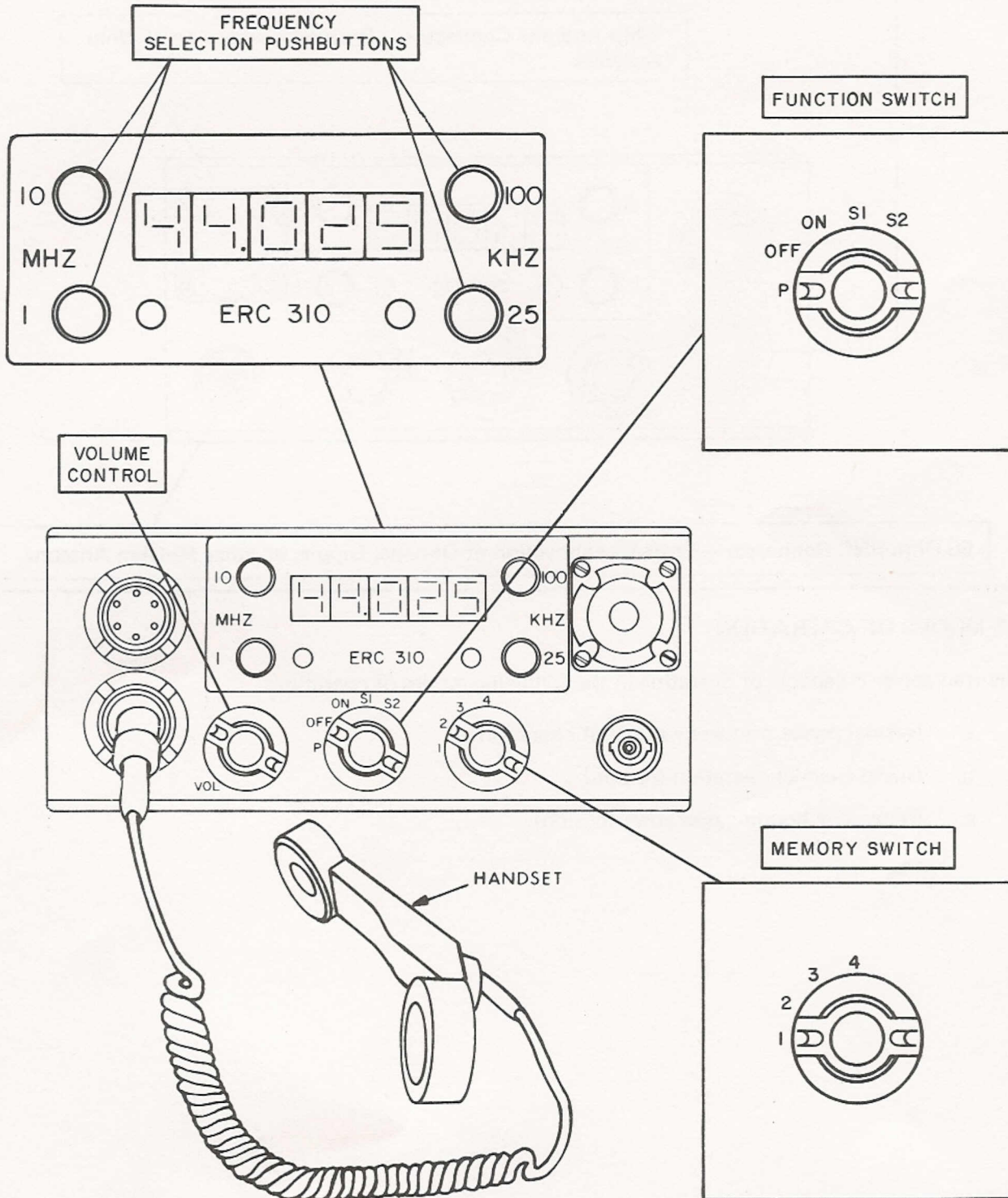
**50-Ohm BNC Connector** – Provides connection of Discone, Dipole, or other 50-Ohm Antenna.

### 3-2 MODES OF OPERATION

The transceiver is capable of operating in the following modes of operation.

- a. Normal preset frequency mode of operation
- b. Guard channel operation (option)
- c. Frequency hopping operation (option).

### 3-3. NORMAL PRESET FREQUENCY MODE OF OPERATION



# CHAPTER 4

## PRINCIPLES OF OPERATION

### Section I. TRANSCEIVER OVERALL FUNCTIONING

#### 4-1. INTRODUCTION.

The ERC-310 is a fully synthesized manpack transceiver providing 800 channels, at 25 KHz spacing, of voice communication in any 20 MHz band of the 30 to 80 MHz frequency range. The 20 MHz operating band of the transceiver is factory installed to any desired 20 MHz band between 30 and 80 MHz (i.e., 30-50 MHz, 35-55 MHz, 40-60 MHz, 50-70 MHz, 60-80 MHz, etc.). The transceiver can be supplied with up to three modes of operation: normal preset channel operation is standard; guard channel operation and semi-duplex operation are optional. A factory installed option is available to provide 400 channels at 50 KHz spacing in lieu of the standard 800 channels at 25 KHz spacing.

#### 4-2. TRANSCEIVER OVERALL BLOCK DIAGRAM FUNCTIONING. (See figure 8-1.)

The ERC-310 can be operated from a battery pack or can be connected directly to a vehicular or base station 24-volt DC power source without a power supply adapter. The applicable power source is connected to the audio module which contains the main power supply for the radio and to a voltage regulator on the logic memory module which provides the operating voltage for the logic memory module circuitry and for the display module. External power is applied to the transceiver via one of the front panel Audio connectors. A front panel Battery Condition Indicator lights to indicate that battery charge is adequate to assure usable communications. When not illuminated, it indicates that battery is either in a state of discharge or near discharge.

Prior to using the radio in the normal preset frequency mode of operation, the operator programs up to four specific frequencies into the radio's memory prior to a mission. This is accomplished by placing the Memory Select switch in the program (P) position and using the Frequency Select pushbuttons to enter a specific frequency for each position of the Memory Select switch. When communications on a predetermined channel is desired, the operator then merely selects the preset number on the Memory Select switch and the radio is immediately on the frequency programmed to that position earlier. A factory installed option can provide up to 10 Memory Channels. Actuation of the Frequency Select pushbuttons when the Function Select switch is on any position other than P will not affect the programmed frequencies.

The receiver module contains the entire receiver with the exception of the audio amplifiers. It is broadband, operating between 30 and 80 MHz and limits the operating band to a 20 MHz segment selected by the user. Although operating in the 30 to 80 MHz band, the receiver has been tested to operate virtually flat to 500 MHz.

The audio module is used for both receiver and transmitter functions. On receive the audio module delivers approximately 4 milliwatts into a 600 ohm headset. The audio module also includes tone and noise squelch generators, selectable by the Function switch. The ON position of the function switch allows the radio to operate with no squelch. Position S1 of the Function switch selects tone squelch,

**4-5. RECEIVE FUNCTIONING.** (See figure 8-2.) When the push-to-talk (PTT) switch on the handset is released, the radio is in the receive mode and any signal present on the frequency to which the radio is set will be heard in the handset. The sequence of operation for the receive function is described below:

In normal use, a whip antenna is inserted into the Whip Antenna connector. The signal received by the whip antenna is fed through the antenna match, filter module, and normally closed relay contacts to the receiver module. The radio can also be connected to any other type of 50 ohm antenna. In this case, the received signal is fed directly from the 50 ohm BNC connector to the filter module. The filter module establishes the upper frequency limit of the receiver.

The receiver input is passive, and there is no RF amplification or tuning required. The incoming RF signal to the receiver module passes through a high pass filter which attenuates all frequencies below 30 MHz by a minimum of 60 dB.

Because the receiver will receive any signal between 30 MHz and 500 MHz, the problems of image rejection and two signal jamming received primary consideration in the design. As mentioned earlier, the high pass filter of the receiver module cuts off below 30 MHz which is the lowest operating frequency of the radio. Image rejection is accomplished with the filter module which also serves as the transmitter low pass filter. Both filters, the low pass in the filter module and the high pass in the receiver are Chebyshev filters with Causer parameters. They have slope factors of approximately 1 to 1.11 to provide extremely steep filter skirts. The filter module provides a rejection of 60 dB at 57 MHz and increases to approximately 75 dB at high frequencies.

A classic way of jamming a manpack radio is generation of two jamming signals with a difference between their frequencies equal to the IF frequency of the radio. For example, a signal of 30 MHz and a signal of 57 MHz generates the 27 MHz IF and renders the radio useless for operation. The ERC-310 is immune to this type of jamming because the receiver bandwidth of 20 MHz does not allow two signals with a difference of 27 MHz to enter the receiver. This "anti-jam" technique is an important feature for tactical applications of the radio.

Another major problem which plagues most receivers is that of cross-modulation or inter-modulation. This phenomena, caused by non-linear mixing products in the front end of a receiver, is virtually non-existent in the ERC-310 because of the unique, totally passive front end employed. There is no RF amplification before the first mixer and signals must exceed approximately 100 millivolts which is an unusually high signal level to be encountered, before any non-linearities occur in the mixer.

The filtered RF signal is then mixed in the first mixer with the receiver tuning signal from the frequency synthesizer. The first mixer is a double balanced, low noise Schottky mixer which will not overload until levels exceed -10 dBm. It has a noise figure of 5 dB and an insertion loss of 5.5 dB.

The first mixer is followed by a low noise IF amplifier (27 MHz) with a gain of 9 dB to compensate for the insertion loss of the mixer and the crystal filter which follows the IF amplifier. The 27 MHz crystal filter is a 10-pole, lattice filter, which provides an adjacent rejection (which in this case is 25 KHz) of 75 dB.

The crystal filter is followed by another low noise IF stage of 27 MHz, which has just enough gain to overcome the noise of the second mixer. The second mixer mixes the 27 MHz IF signal down to the second with a crystal oscillator frequency IF of 455 KHz. The 455 KHz signal is then broadband amplified in a two-stage amplifier. The second amplifier, on the receiver module top board, incorporates



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### Section III. POWER SUPPLY AND DISTRIBUTION

**4-8. POWER REQUIREMENTS.** The ERC-310 can operate either from the 13.2 VDC, 2AH battery pack or can be connected directly to a vehicular or base station 11 to 30 volt DC source without a power supply adapter using the external power cable.

**4-9. POWER SUPPLY AND DISTRIBUTION.** (See figure 8-4).

**4-10. INPUT POWER.** The battery pack voltage or the voltage from the external power source is applied through contacts of relay K1 to Function switch S1-A. From the Function switch, the voltage is applied to the audio module, and the logic memory module.

**4-11. MAIN POWER SUPPLY.** The main power supply for the radio is located on the audio module. It uses a  $\mu$ A78 voltage regulator, U3, which is preset to provide an output voltage of +9VDC at pin 1. This regulated +9VDC is the operating voltage for all circuits of the radio except the circuits on the logic memory module and the display. The voltage at pin 1 of U3 is set at +9VDC by R1, R2, R35, and R36. The output voltage is filtered by C3, C4, R3, and C22.

**4-12. LOGIC MEMORY MODULE POWER SUPPLY.** The logic memory module uses a  $\mu$ A78 voltage regulator, U7, to provide regulated +9VDC to the logic memory module and to the display. The battery input voltage is applied to pin 4 of U7 via an input filter comprising RFC1, C2, C3, and C4. The output voltage from pin 1 is filtered by RFC4, C7, C8, and C9. Resistors R15 and R16 set the output voltage at +9VDC. Battery voltage is sensed by U1A, one gate of a Schmitt trigger NAND gate, which is set by R2 to trigger at +11 VDC. Thus, if the battery voltage is above +11 VDC, the Battery State Indicator on the display module will light. If the battery voltage is below +11 VDC, the Battery State Indicator will be extinguished.

**4-13. SCHOTTKY VOLTAGE REGULATOR.** The low power Schottky voltage regulator on the synthesizer module bottom board is the only circuit in the radio that does not operate from +9 VDC. The +9 VDC regulated voltage from the audio module is dropped to +5 VDC by diode D1 on the synthesizer module bottom board and provided to the Schottky prescaler via RFC2.

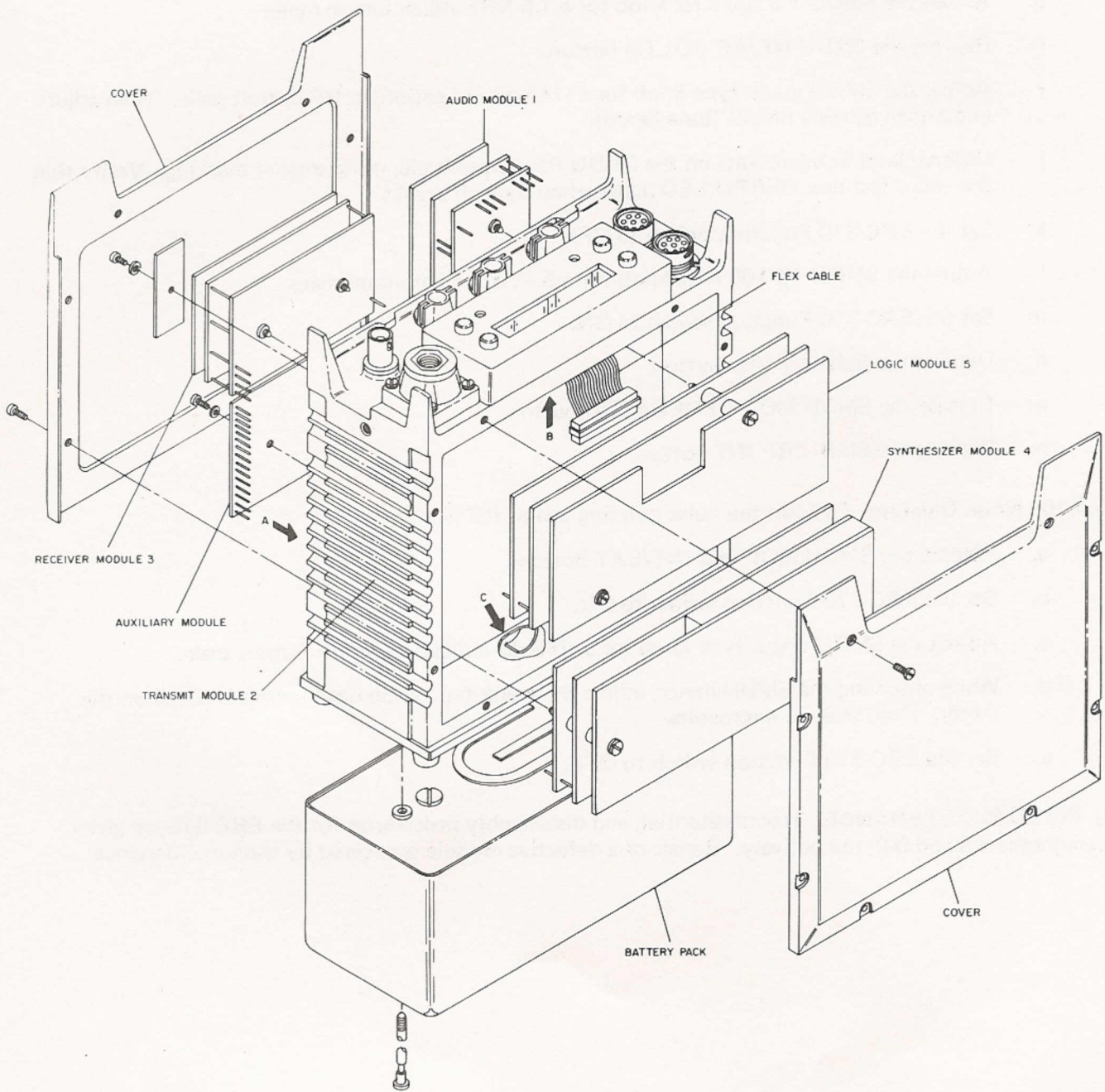


Figure 6-3. ERC-310 Exploded View (Sheet 1 of 3)

### 3-3. NORMAL PRESET FREQUENCY MODE OF OPERATION (Continued)

Refer to the illustration on the opposite page to perform the normal preset frequency mode of operation:

- a. Set the Memory switch to position P.
- b. Set the Function switch to P.
- c. Use the Frequency Selection pushbuttons to preset the desired frequency for Memory switch position 1.
- d. Repeat procedure for positions 2, 3, and 4, as desired of the Memory switch.

#### NOTE

Prior to each daily operation, the Battery Condition indicator should be observed to check battery condition.

- e. Use the Memory switch to select the desired frequency.
- f. Use the Function switch to select squelch operation as follows: ON (no squelch), S1 (tone squelch), or S2 (noise squelch).
- g. Any signal present on the frequency to which the transceiver is set will be heard in the handset. Use the Volume control to adjust audio to desired level.
- h. To transmit, press the switch on the Handset and talk into the Handset. Release the switch to return to receive condition.

### 3-4. REPLACING BATTERY PACK

Replace the Battery Pack by unscrewing the captive screw securing the Battery Pack to the bottom of the transceiver. When replacing with a spare Battery Pack, make sure O-rings are in place.

### 3-5. CHARGING BATTERY PACK

The NiCad Battery Pack has two banana jacks to allow connecting to a source of approximately 18 VDC for charging. The Battery Pack should be charged at a charging rate of 500 ma for 5 hours or 200 ma for 13 hours. Excessive charging periods must be avoided as high pressures can be built up on the individual cells of the Battery Pack and permanent damage could occur. Before charging battery, ensure that vent on battery pack is undone.