

**SINGLE CHANNEL VHF  
EMULATOR  
OPERATION AND MAINTENANCE  
MANUAL**

Document Number 68-P32903C

September 1988

Prepared for Contract # DAAOB07-87-C-A020



**MOTOROLA INC.**

**Government Electronics Group**  
8201 E. McDowell Rd., P.O. Box 1417,  
Scottsdale, Az 85252

## WARRANTY

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## SAFETY SUMMARY

### WARNING

Lithium organic batteries or cells can be used in this equipment. They can be hazardous if misused or tampered with before, during, or after discharge. The following precautions must be strictly observed to prevent injury to personnel or damage to the equipment.

DO NOT heat, incinerate, crush, puncture, disassemble or otherwise mutilate the batteries. DO NOT short circuit, recharge or bypass internal fuses.

DO NOT store batteries in the equipment during periods of non-use for more than 30 days. TURN OFF the equipment immediately if you:

- detect that the battery compartment is becoming unduly hot, or
- hear battery cells venting (hissing), or
- smell irritating sulphur dioxide gas.

### WARNING

Electromagnetic radiation from the antenna can damage eyes and other body tissue when the system is transmitting. In this case, personnel should not be closer than 16 inches to the antenna.

Make sure external power to the system is turned off and DC power cable to system is disconnected from Battery Pack. Set the ON/OFF switch on the VHF assembly to OFF.

Remove the battery only after it is cool (30 to 60 minutes). Dispose of batteries only by following approved procedures. ALWAYS REMOVE BATTERIES when repacking the system. Batteries can vent or discharge undetected, causing severe damage to the equipment and storage facility through fire or corrosion.

The VHF assembly is cooled by a heat sink on the top panel. DO NOT restrict air flow through or around the heat sink by burial, covering with foreign material, or positioning the heat sink below surface level. Restricting air flow may cause overheating and subsequent destruction of internal parts.

### WARNING

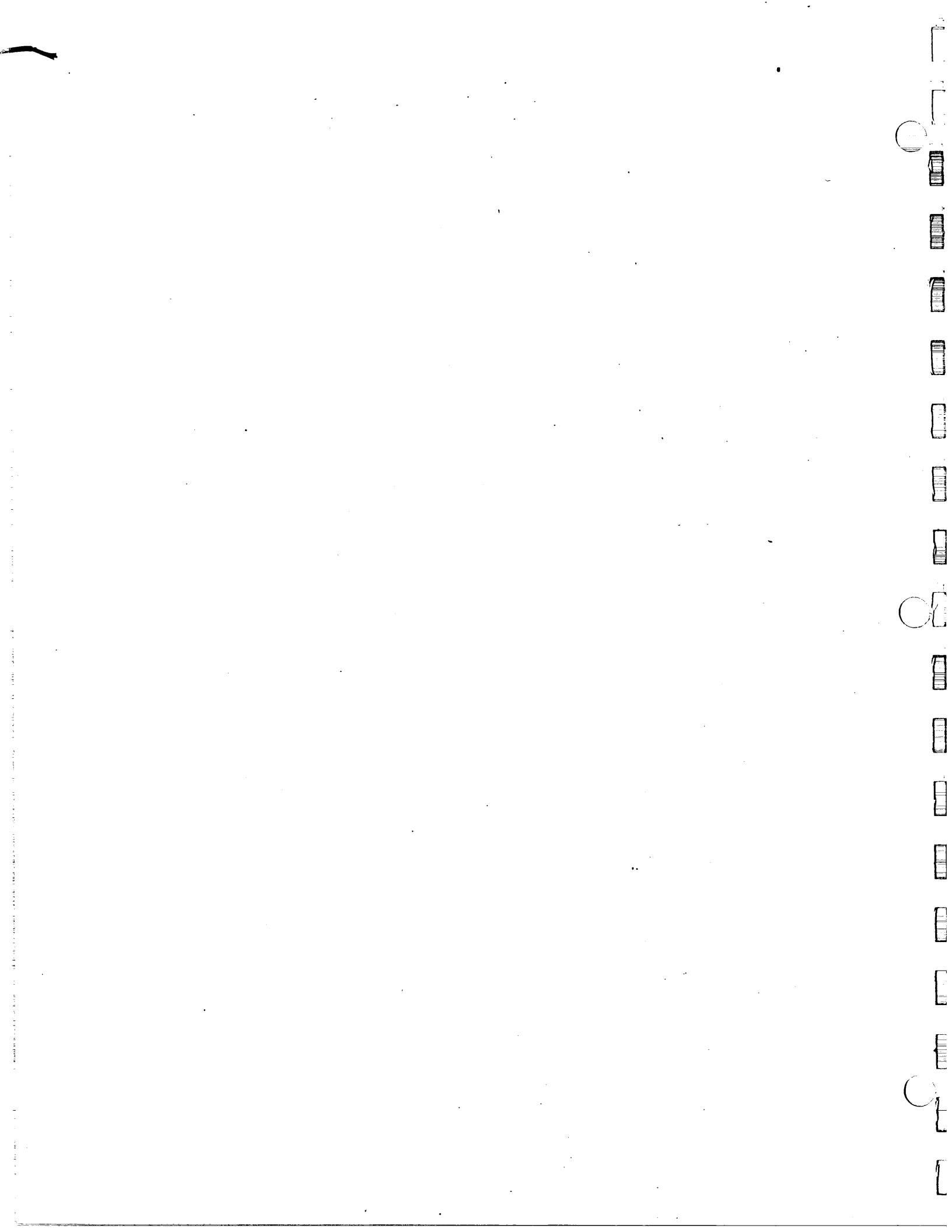
Personnel should be aware that when the system begins transmitting, there is no physical indication to that effect. It will continue to transmit until the power is set to OFF on the VHF assembly or the battery voltage falls below the threshold level.

### WARNING

Make sure external dc power to the system has been removed before performing maintenance on the emulator.

### CAUTION

Do not thrust pointed or sharp tools or instruments into the interior of the carton. Failure to heed this caution could result in damage to the equipment.



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## SECTION 1 INTRODUCTION AND GENERAL DESCRIPTION

### 1-1 INTRODUCTION.

This section of the manual contains a physical and electrical description of the VHF Emulator and states its purpose. It also describes the separate assemblies and accessories that make up the emulator. In addition to defining the depth of coverage and the method used for identifying operator safety warnings, this section provides lists of equipment supplied and equipment required but not supplied with the system. Pertinent electrical specifications and environmental limits are tabulated for reference data. A list of related publications is also included.

### 1-2 SYSTEM DESCRIPTION.

**1-2.1 System Identification and Purpose.** The VHF Emulator shown in Figure 1-1 is a portable, battery operated VHF transmitter that can be deployed in tactical/field environments for the purpose of communications deception. The system emulates the AN/VRC-46 radio set and its companion encryption unit, the KY-57/TSEC. It consists of a VHF assembly, Battery Pack assembly, VHF antenna, antenna pouch, DC power cable, and carry strap.

In field use, the emulator is deployed in a predetermined physical area. Each emulator is powered either from an internal battery set or an external 24 V dc source.

An external Controller Interface Display (CID) sets the mission start time, selects one of four internally generated scenarios, selects up to 16 specific operating frequencies to be transmitted in the emulation and performs a diagnostic test of the emulator. Preloading of scenarios is accomplished via an electronically programmable read-only memory (EPROM). Actual mission operation is controlled by a combination of CID inputs and EPROM information. The configuring of these EPROMs is accomplished by the Scenario Programmer System.

**1-2.2 Scope of Manual.** This manual contains information and instructions to enable qualified personnel at the operator level to install, operate, and maintain the VHF Emulator. It is designed to support a maintenance philosophy whereby users perform limited operator level maintenance utilizing parts provided in Spare Parts Kit P/N 78-P34308C001. Any additional maintenance requires that the VHF assembly with its associated Battery Pack assembly be returned, through proper channels, to the manufacturer for repair. A safety summary page in the front matter compiles the operator warnings that are contained within the manual.

**1-2.3 Equipment Supplied.** A list of the major mechanical assemblies and accessories that comprise the VHF Emulator is provided in Table 1-1.

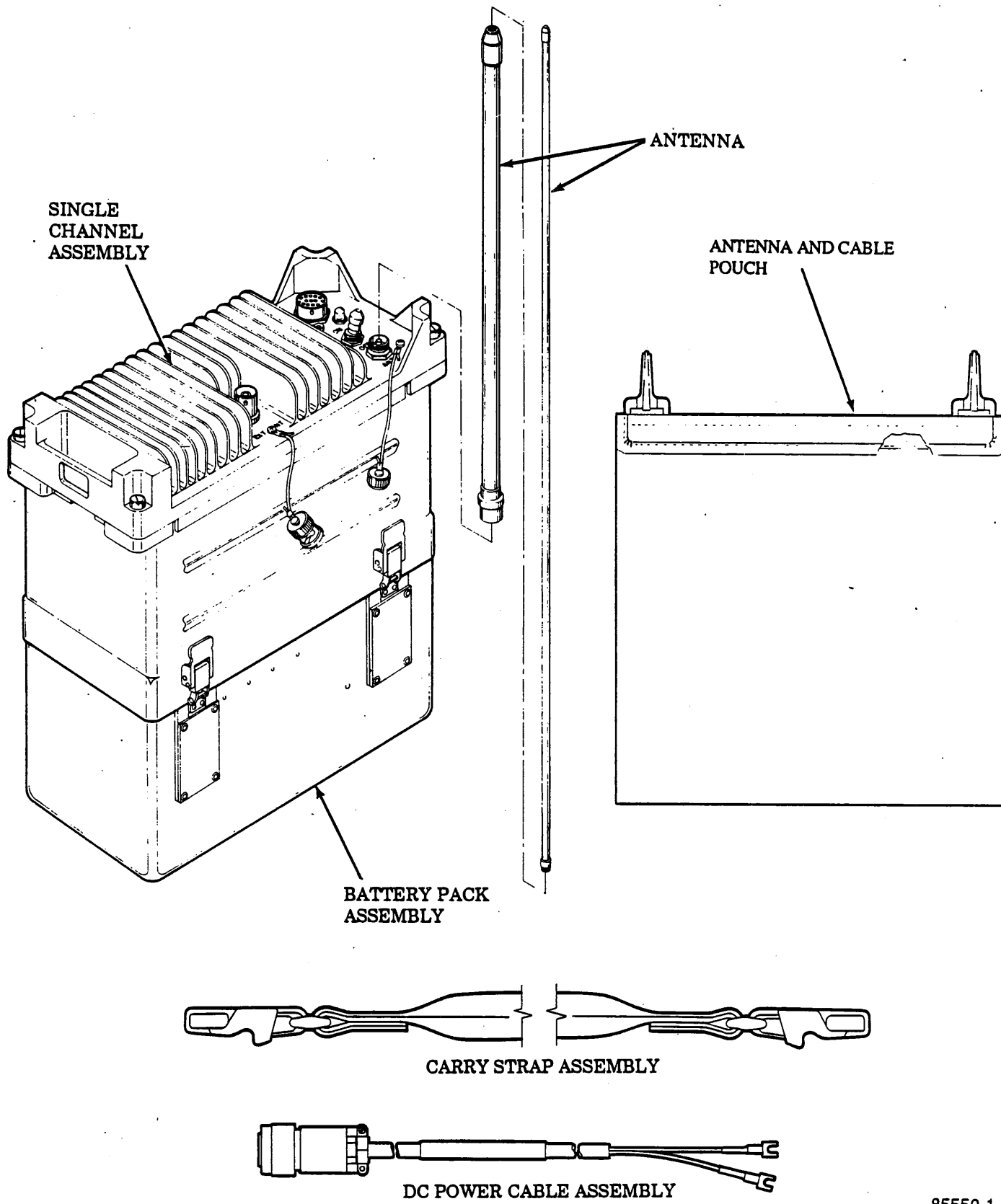


Figure 1-1. Single Channel VHF Emulator System

85550-1

Table 1-1. Equipment Supplied

Qty	Description	Part Number
1	VHF assembly	01-P32900C001
1	Battery Pack assembly	01-P32880C001
1	VHF Antennal	85-P09268W001
1	Antenna Pouch	AA-6188
1	DC Power Cable assembly	30-P32907C001
1	Carry Strap assembly	AA-6288

**1-2.4 Equipment Required but Not Supplied.** Users have the option of selecting either battery power or external power. If the battery option is chosen, users have the option of selecting and supplying either lithium or nickel cadmium (NiCad) batteries with quantities as specified in Table 1-2.

A user supplied external power source capable of providing 23.0 to 30.0 V dc at 5.5 A dc maximum is the remaining option. The DC Power Cable connects the external power source to the VHF assembly via the connector on the Battery Pack assembly (See Figure 1-1).

In order to activate the VHF Emulator, a handheld Controller Interface Display assembly is required. It loads data via the I/O connector to the VHF assembly. Refer to Table 1-2. for a list of equipment required but not supplied.

Table 1-2. Equipment Required But Not Supplied

Qty	Description	Part Number
2 or 3	Lithium Battery	BA-5590/U
2 or 3	NiCad Battery	BB-590/U
1	+24V dc External Power Source	User Supplied
1	Controller Interface Display assembly	01-P21637G001
1	50 ohm VHF antenna	Numerous

### 1-2.5 Physical Characteristics.

**1-2.5.1 Single Channel VHF Assembly.** The VHF assembly is the main item of equipment in the emulator. It is designed to be a portable compact unit to operate on land in harsh field service. However, it can also be operated in a buried position as long as its top surface is left exposed to the air. This surface functions as a heat sink for the internal power amplifier and requires air cooling.

The VHF assembly is rain, sand, and dust resistant. The housing is constructed of lightweight aluminum painted a low-luster olive drab. Operator controls, indicators, and connectors are located on the top panel for easy accessibility. Dust and moisture protective covers with flexible cables are attached to the unit. Additional features include a carrying strap for single-handed carrying and an erasable marking pad for identification of the unit.

**1-2.5.2 Battery Pack Assembly.** The Battery Pack assembly contains the batteries and connects them to the VHF assembly via mating connectors. It is an integral part of the VHF assembly and must be connected during testing and operation. The Battery Pack is designed to be operational in the same environments as the VHF assembly. The housing is constructed of aluminum, painted low luster olive drab.

There are three battery compartments which securely position the batteries and provide shock absorption. A one-piece cover, secured by two quarter-turn fasteners, fits over the battery compartments. Seven indicators and a TEST switch are provided for diagnosing battery conditions.

The VHF and Battery Pack assemblies are mated electrically with a self-aligning connector when the units are joined. Mechanically, the units are fastened together by four latches, two on each side. The two are sealed environmentally when joined and latched together.

A vent in the Battery Pack housing prevents any internal pressure increase from battery outgassing and allows pressure equalization due to environmental changes. Rapid pressure changes due to battery failure are controlled by low shear stress rivets that allow the Battery Pack to open and vent the gases.

The Battery Pack assembly will operate for a shorter period of time with two batteries instead of three. Table 1-3 shows battery mission life under different temperature conditions. Note that there is currently no data available for NiCad battery operation with two batteries.

Table 1-3. Mission Life With Battery Power

Battery Type	Lithium		Lithium		NiCad	
	+25°C		-30°C		+25°C	0°C
Temperature						
Number of Batteries	2.0	3.0	2.0	3.0	3.0	3.0
Available Ampere Hours	12.0	18.0	6.0	9.0	4.5	3.2
Mission Time (Hours)*	64.0	120.0	8.0	36.0	21.0	8.0
* — Includes a maximum of 500 minutes standby for NiCad, and a maximum of 999 minutes for Lithium.						

**1-2.5.3 VHF Antennas.** The VHF Emulator employs a two-section, 48-inch integral whip antenna that attaches directly to the top panel of the VHF assembly for operation.

An external antenna connects via a 50-ohm BNC-type VHF connector port, and can be installed and removed by hand. When this antenna is used, the integral antenna is automatically disconnected, and power is routed to the external antenna.

**1-2.5.4 Antenna Pouch.** The antenna pouch is an olive drab, canvas bag used for storing the VHF antenna and other components of the system, i.e., DC power cable, carry strap, etc.

**1-2.5.5 DC Power Cable Assembly.** The DC power cable assembly is an 8-foot cable assembly terminated on one end with a 5-pin connector which attaches to the Battery Pack assembly. The opposite end terminates in two spade lugs for connection to a user-supplied, external DC power source.

**1-2.5.6 Carry Strap Assembly.** The carry strap assembly is an olive drab, 15-inch strap consisting of 2-inch wide webbing with snap assemblies on each end. The webbing in the grip area is packed with foam for carrying convenience. The snap assemblies on the strap attach to the sockets on the top panel of the VHF Emulator when it is to be hand-carried. To attach or disconnect the strap clamp, pull back on the clamp finger hold to open the clamp.

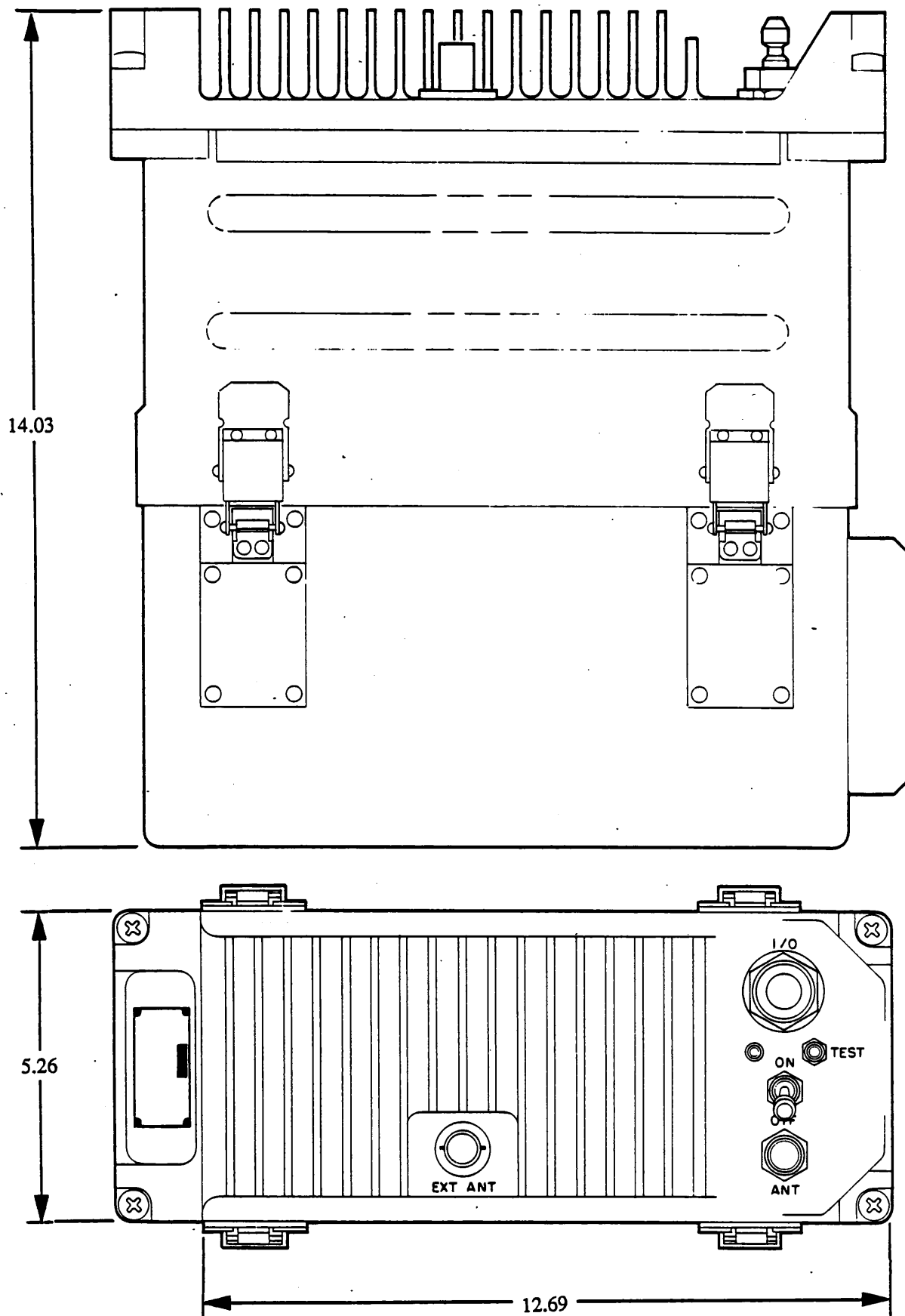


Figure 1-2. Physical Dimensions

85550-2

**INTRO**

The physical dimensions of the unit are shown in Figure 1-2, and the mechanical specifications are listed in Table 1-4.

*Table 1-4. Mechanical Specifications*

Characteristic	Specification
Height	14.03 inches
Width	5.30 inches
Length	12.75 inches
Weight (Battery Pack with no batteries)	10 pounds
Weight (Battery Pack with 3 BB-590/U)	20 pounds 9 ounces
Weight (Battery Pack with 3 BA-5590/U)	16 pounds 15 ounces
Weight (VHF Assembly)	10 pounds

**1-2.6 Electrical Characteristics and Environmental Limitations.** The pertinent electrical characteristics are tabulated in Table 1-5.

*Table 1-5. Electrical Characteristics*

Characteristic	Specification
<b>Power Source Options:</b>	
Lithium Battery	
Part Number	BA-5590/U
Number Required	2 or 3, depending on mission length.
NiCad Battery	
Part Number	BB-590/U
Number Required	3 recommended
Charge Current	200 mA dc per battery
Charge Time (NiCad)	16 hours min. @ 25°C
<b>External Power</b>	
Voltage	23.0 to 30.0 V dc
Current	4.5 amps max. (without NiCad batteries installed) 5.5 amps max (with 3 NiCad batteries installed)
<b>Input Protection</b>	
Line Ripple @ 4.0 Amps	6.0 amp fuse 100 mV P-P max.
<b>Interrupts</b>	0 V dc for 50 ms max. with battery backup
<b>Switch to Battery Backup</b>	22.0 ±0.2 V dc
<b>Switch to External Power</b>	23.0 ±0.2 V dc
<b>Frequency Range</b>	30.0 to 87.975 MHz

Table 1-5. Electrical Characteristics - (cont.)

Characteristic	Specification
Channel Spacing	25 kHz
RF Power Output From 50 Ohm Port	30 W $\pm$ 2 dB
Using optional antenna	10 W $\pm$ 2 dB
Antenna Connector (Integral whip)	Type N
RF Port Connector	BNC
Internal Clock Accuracy	4.5 seconds per day typical (Sync between any two VHF single channels)
Modulation Type	Binary FSK
Peak Deviation	6 -11 kHz
Data Rate	16 Kbps, $\pm$ 10%
Incidental AM	less than 10%
RF Port Impedance	50 ohms nominal
Harmonic Output	less than -40 dBc
Nonharmonic Spurious Output	less than -60 dBc
Transmitter Duty Cycle	Up to 289 transmissions at an average of 10 seconds per scenario; 0% during standby
Emulations	AN/VRC-46 FM radio set KY-57/TSEC encryption unit.
Cipher text data stream	KY-57/TSEC encryption unit
Carrier Frequency Accuracy	$\pm$ 20 ppm
RF Mismatch Survivability	No transmitter degradation or damage with open or short at antenna or RF ports.
Antenna Port Impedance	Variable to match antenna furnished with equipment.

The environmental limitations of the VHF Emulator are listed in Table 1-6.

*Table 1-6. Environmental Limitations*

Characteristic	Specification
Temperature Operating	-30°C to +55°C Ambient
Storage	-40°C to +80°C Ambient
Altitude Operating	Up to 10,000 feet AMSL
Transport	Up to 50,000 feet AMSL
Humidity	Meets requirements of MIL-STD-810C, Method 507.1, Procedure II, operating.
Vibration	Meets requirements of MIL-STD-810C, Method 514.2, Procedure X, Curve AX, non-operating.
Drop	Meets requirements of MIL-STD-810C, Method 516.2, Procedure II, non-operating.
Thermal Flow	Natural convection only

**1-2.7 Related Publications.** A listing of related publications is provided in Table 1-7.

*Table 1-7. Related Publications*

Publication	Document Number
Controller Interface Display Operation and Maintenance Manual	68-P32762C



## SECTION 2 PREPARATION FOR USE

### 2-1 INTRODUCTION.

This section contains instructions that describe the unpacking and initial inspection of the system. It also contains assembly instructions and setup procedures. After an initial checkout of the system, the section concludes with instructions on preparation for storage or shipment.

### 2-2 UNPACKING AND INSPECTION.

The VHF Emulator assemblies and accessories are individually packaged. Each packaged equipment is positioned in a container with packing materials.

#### CAUTION

Do not thrust pointed or sharp tools or instruments into the interior of the carton as damage to the equipment could occur.

#### NOTE

Save all cartons, fiberboard, urethane foam, and fillers for future shipment or storage of the emulator.

Unpack the equipment according to the instructions in Figure 2-1 and 2-2.

After the equipment is unpacked, check it for damage caused during shipment. Also, check the equipment against the packing list to see if the shipment is complete. Report any damages or missing items to the supervisor.

### 2-3 SETUP PROCEDURE.

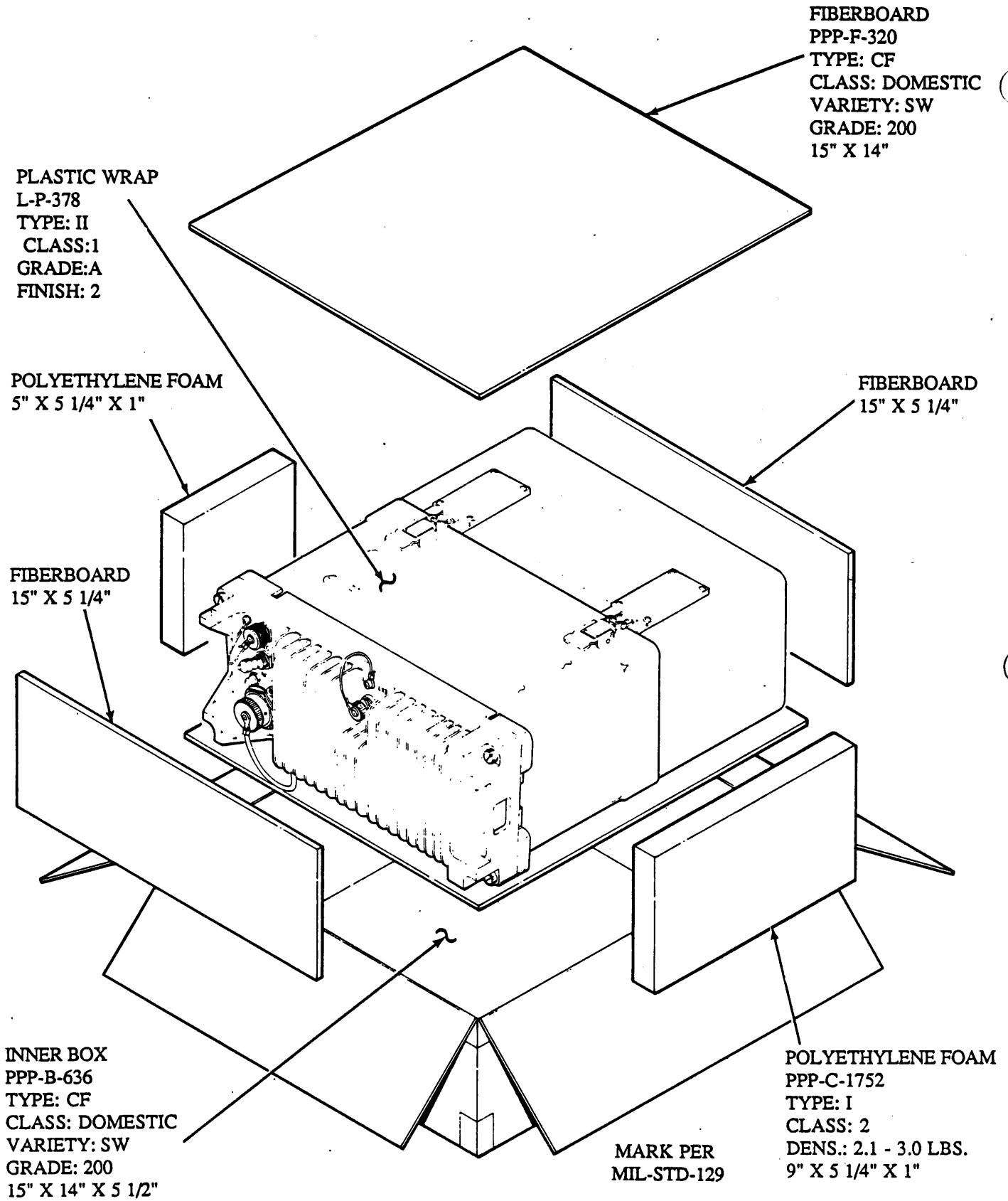
The setup procedure provides instructions to install the batteries and antenna, and to connect the external power source for an electrical checkout of the system prior to operation. Refer to the Initial Checkout in paragraph 2-4, and to the Operating Instructions in Section 4 to perform a complete operational check of the system.

**2-3.1 Install Batteries in Battery Pack Assembly.** If the battery-only operation is selected, fully charged lithium batteries are recommended as a better choice than the rechargeable NiCad batteries because of their greater capacity.

#### CAUTION

Battery types should not be mixed in the same Battery Pack assembly. If NiCad batteries are used, three batteries are recommended. If lithium batteries are used, three batteries are recommended, but two may be used. Improved battery life can be maintained if the three NiCad batteries are kept together for their operational life. Likewise, lithium batteries should be matched with others of comparable battery life.

PREP



85550-4

Figure 2-1. Typical Packing Method - Single Channel VHF Assembly/Battery Pack Assembly

URETHANE  
22" X 18" X 2"

URETHANE  
22" X 18" X 1"

LONG ANTENNA  
OPTION WRAPPED  
WITH MIRCOFOAM

ACCESSORIES

RADIO

URETHANE  
18" X 6" X 2"

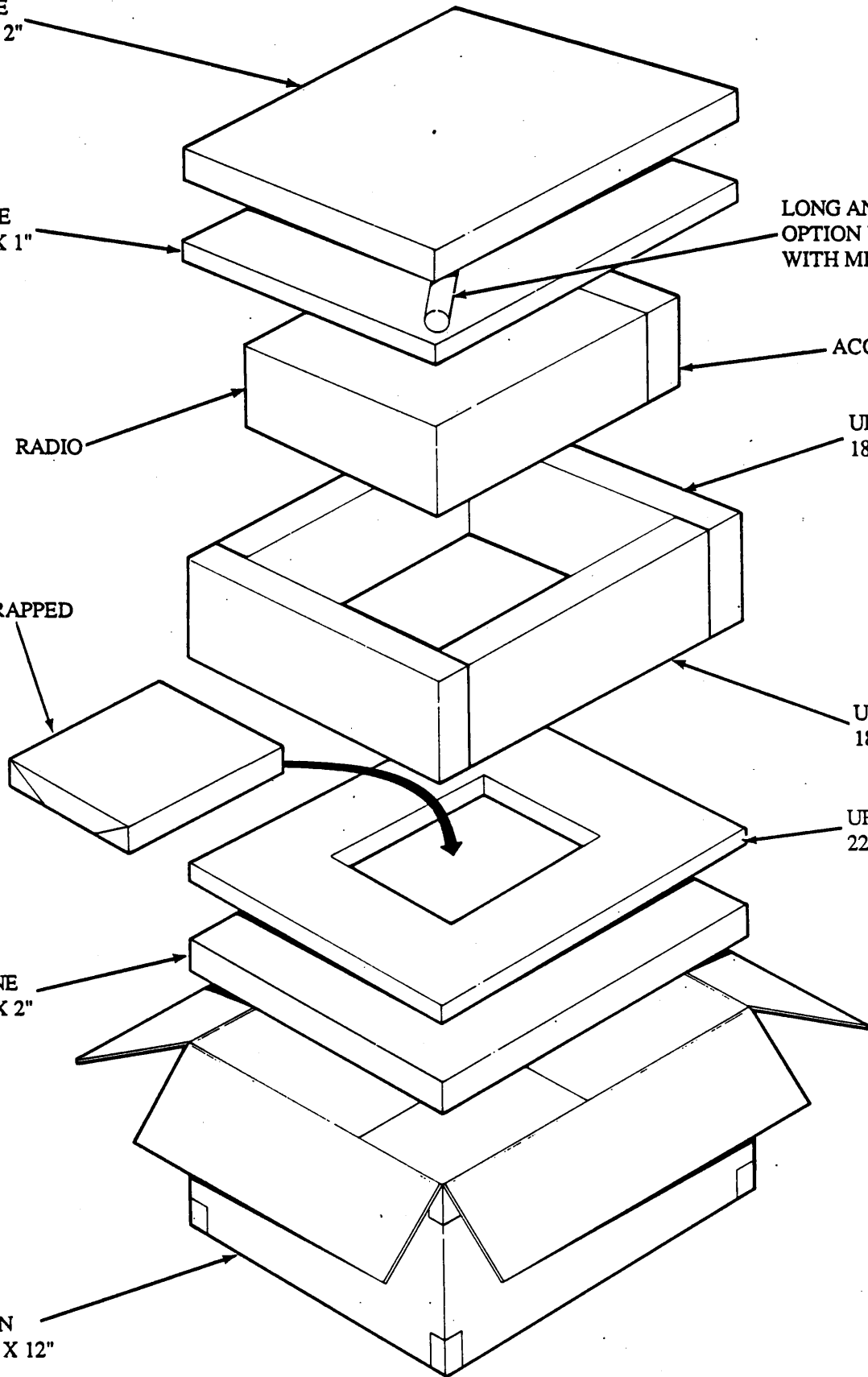
MANUAL  
KRAFTWRAPPED

URETHANE  
18" X 6" X 2"

URETHANE  
22" X 18" X 1"

URETHANE  
22" X 18" X 2"

DOM. CTN  
22" X 18" X 12"



85550-3

Figure 2-2. Typical Packing Method - Single Channel VHF Emulator

**WARNING**

Lithium organic batteries or cells can be used in this equipment. They can be hazardous if misused or tampered with before, during, or after discharge. The following precautions must be strictly observed to prevent injury to personnel or damage to the equipment.

- DO NOT heat, incinerate, crush, puncture, disassemble or otherwise mutilate the batteries.
- DO NOT short circuit, recharge or bypass internal fuses.
- DO NOT store batteries in the equipment during periods of non-use for more than 30 days.
- TURN OFF the equipment immediately if you:
  1. detect that the battery compartment is becoming unduly hot, or
  2. hear battery cells venting (hissing)
  3. smell irritating sulphur dioxide gas.

**WARNING**

Remove the battery only after it is cool (30 to 60 minutes), and dispose of it by following approved procedures.

Refer to Figure 2-3 and install the batteries in the Battery Pack assembly by performing the following steps:

1. On Battery Pack, open battery compartment by rotating two fasteners one-quarter turn counterclockwise.
2. Lift Battery Pack cover to open position.
3. Orient BATT 2 so its connector will mate with connector in Battery Pack when installed.
4. Gently, place battery into desired position and move as necessary for battery to drop into connectors.
5. Carefully, apply gentle force to battery until connectors are fully mated.
6. Position ejector straps for BATT 1 and BATT 3 so that when batteries are installed, their straps are on top.
7. Perform steps 4 and 5 for both batteries.
8. Close battery compartment cover.
9. Rotate fasteners one-quarter turn clockwise.

**2-3.2 Install DC Power Cable Assembly.** If external DC power is to be selected as the power source option, connect the DC power cable to the external connection on the Battery Pack as shown in Figure 2-4 and rotate the outer ring to lock the connector. On the opposite end of the cable, two split lugs are provided for connection to an external power source. Ensure that power is turned off at the external source before making any connections. The black wire connects to the negative (-) terminal, the white wire to the positive (+) terminal. Operation of the system is highly dependent upon clean and tight connections of these leads

**2-3.3 Install VHF Whip Antenna.** Follow these steps to install the 48-inch VHF whip antenna.

1. Remove the two sections of the 48-inch VHF whip antenna from the antenna pouch.
2. Join antenna sections together, and connect the whip assembly to ANT connector on the top panel of the VHF assembly (See Figure 2-5).

NOTE: BATTERIES SHOWN  
INSTALLED

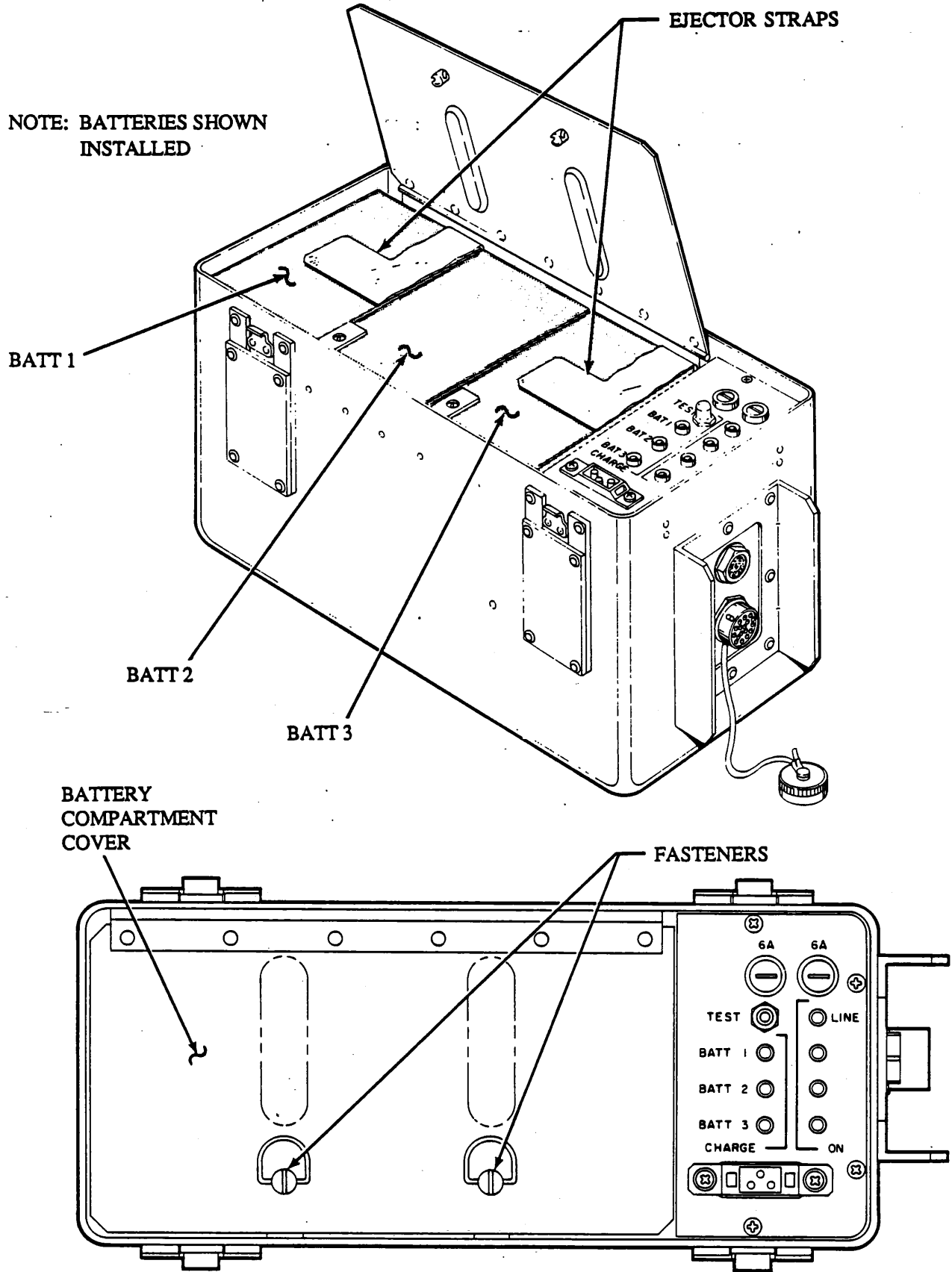


Figure 2-3. Battery Installation

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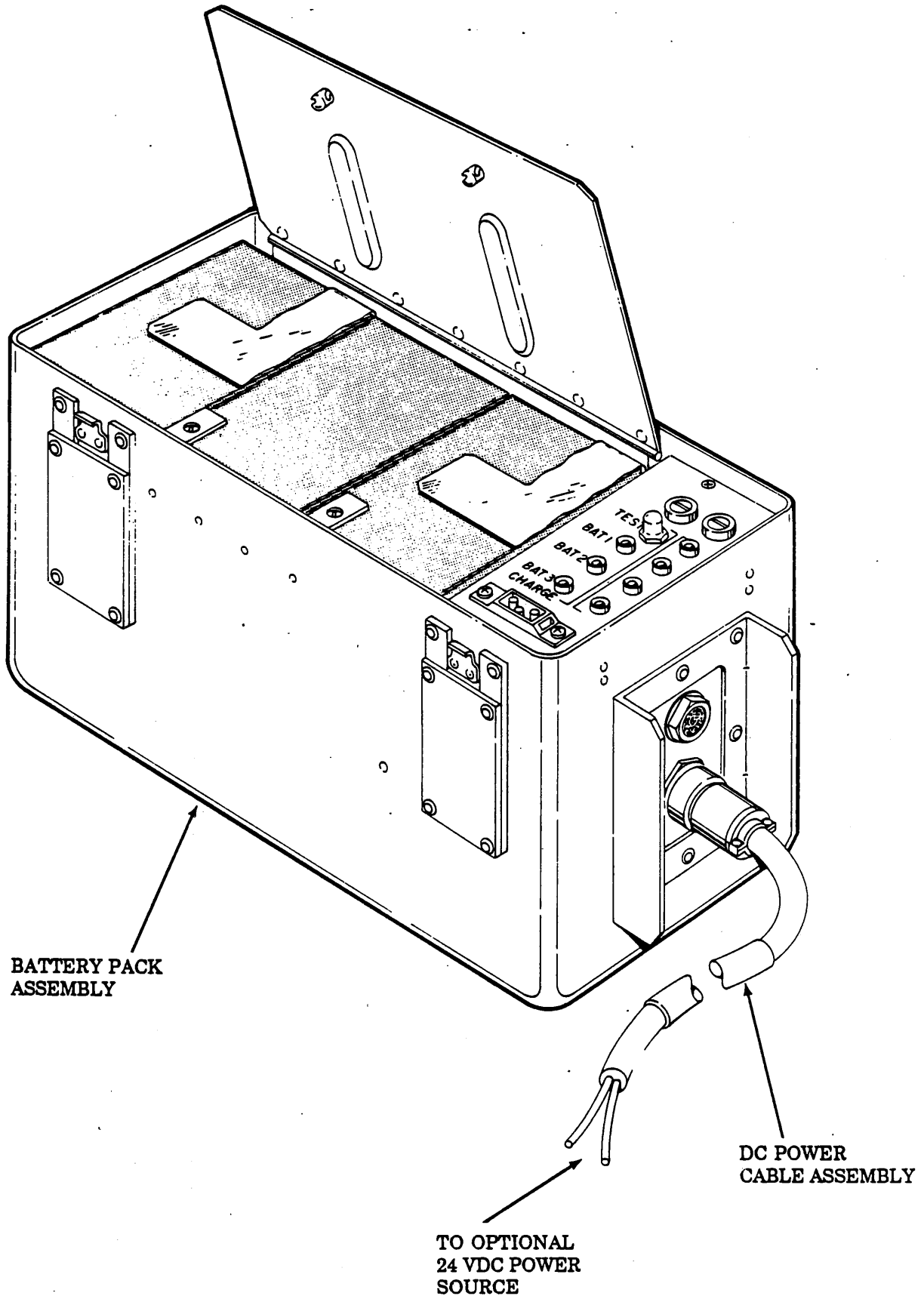


Figure 2-4. DC Power Cable Installation

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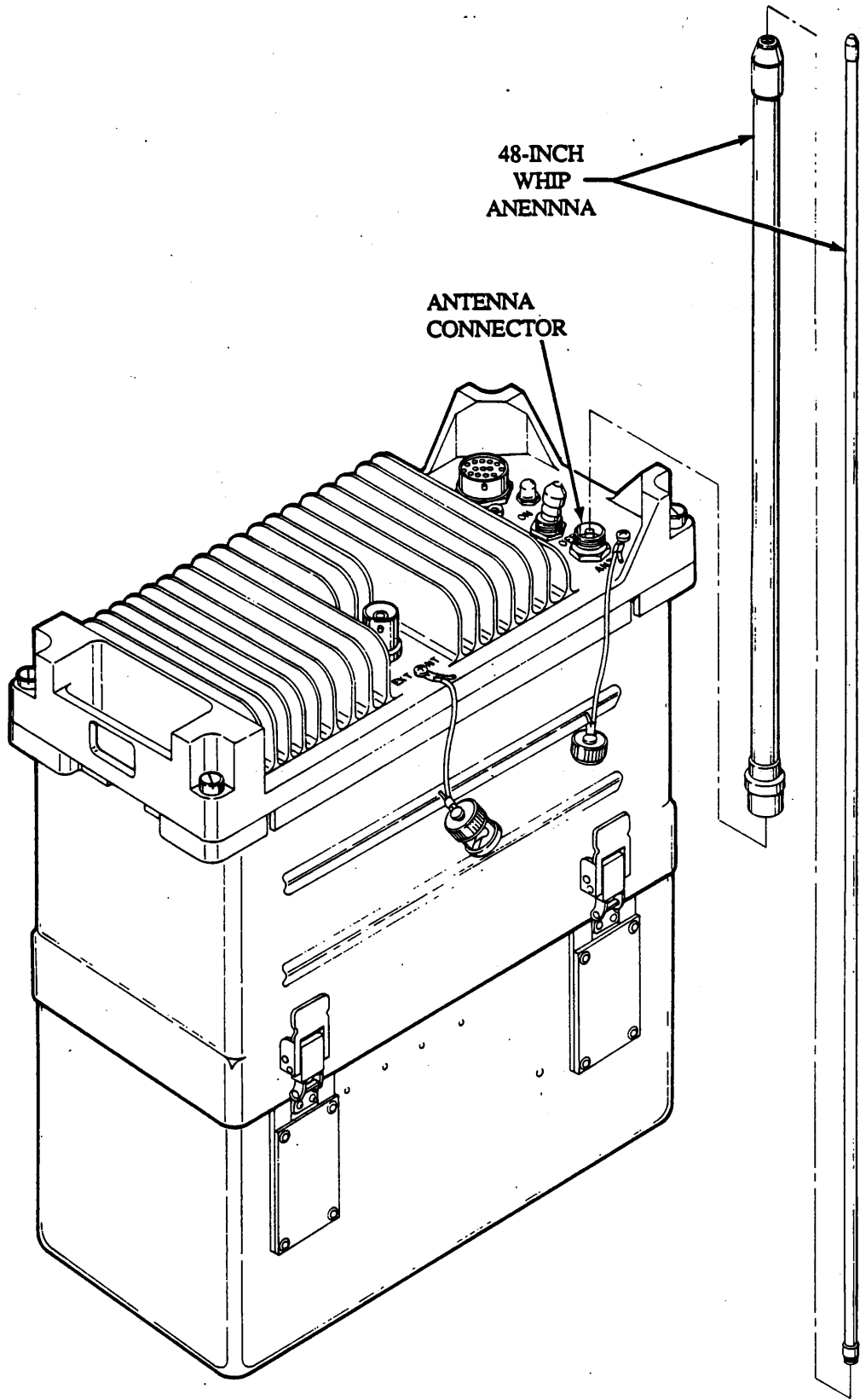


Figure 2-5. VHF Antenna Installation

## PREP

### 2-3.4 Install External VHF Antenna .

1. Obtain designated VHF antenna from stock.
2. Connect VHF antenna to the 50-ohm port connector on the top panel of the VHF assembly. Antenna cable must have a male BNC connector to mate with female emulator connector.

### 2-4 INITIAL CHECKOUT.

The Initial Checkout sequence is a bench test used to confirm that the VHF assembly is properly setup for programming and operation. The VHF assembly performs the test on itself and responds accordingly. The VHF antenna must be connected for this test.

After completing the Setup Procedure in paragraph 2-3, perform the following steps. If a step can not be completed, refer to the appropriate troubleshooting instructions in Section 5 of this manual.

#### 2-4.1 Checkout Procedures. Do the following to check out the unit:

1. Remove Battery Pack from the VHF Emulator.
2. On Battery Pack, depress TEST switch. Observe that green indicators are on for each position for battery-only operation. Release switch.
3. If external DC power is also connected and turned on, perform this step, otherwise go to step 4. Depress TEST switch on Battery Pack. Observe LINE indicator is on, and red BATT CHARGE indicators are on for each position with a NiCad battery installed. If lithium batteries are used, red BATT CHARGE indicators will not come on

#### NOTE

NiCad and lithium batteries may not be mixed within the same Battery Pack.

4. Orient the VHF assembly over the Battery Pack as shown in Figure 2-5. Lower the VHF assembly onto Battery Pack; the connectors should seat automatically. To secure section, snap four latches into their closed position.

#### WARNING

Electromagnetic radiation from the antenna can damage eyes and other body tissue when the system is transmitting. In this case, personnel should not be closer than 16 inches to the antenna.

#### NOTE

Make sure the antenna is installed for the following steps.

5. Set the VHF Emulator ON/OFF switch to ON, and install the antenna.
6. Press and hold the TEST switch for at least 7 seconds. Observe blinking green test light. This indicates the internal "Built-In-Test" has determined that the emulator has tested OK, but is not programmed with the CID.



**NOTE**

If there is no light, refer to the troubleshooting procedures in Section 5.

7. Set the VHF Emulator ON/OFF switch to OFF.

This completes the Initial Checkout procedure. A full operational check of the VHF Emulator is contained in the Operating Instructions provided in Section 4.

**2-5 RESHIPMENT OR STORAGE.**

When the system is to be removed from service for shipment, factory service, or extended non-use, it is recommended that it be repackaged in its original packing materials.

**2-5.1 Disassembly of Equipment.****WARNING**

Make sure external power to the system is turned off and DC power cable to system is disconnected from Battery Pack. Set the ON/OFF switch on the Single Channel VHF assembly to OFF.

1. If connected, remove antenna from the VHF assembly and secure in antenna pouch.
2. Release the four latches that secure Battery Pack to VHF assembly and separate the assemblies.

**WARNING**

**ALWAYS REMOVE BATTERIES** when repacking the system. Batteries can vent or discharge undetected causing severe damage to the equipment and storage facility through fire or corrosion.

3. Open the battery compartment by rotating two fasteners counterclockwise one-quarter turn and lifting cover to open position.
4. Remove two outer batteries by pulling white ejectors and lifting batteries from Battery Pack.
5. Remove center battery by firmly grasping battery and pulling straight up.
6. Perform maintenance on the system according to the maintenance schedule in Section 5.
7. Close the battery compartment cover and secure the fasteners.
8. Reinstall the Battery Pack to the VHF Emulator.

**2-5.2 Repacking.** Refer to paragraph 2-2 and Figures 2-1 and 2-2. Repack the system in its original shipping cartons or in equivalent commercial packaging materials. Perform the unpacking procedure in reverse order.

**2-5.3 Returning Failed Equipment to the Factory.** Return equipment to the factory for major repairs. Package the equipment according to instructions and send it to:

Motorola, Inc.  
Government Electronics Group  
8201 East McDowell Road  
Scottsdale, Arizona 85257



## SECTION 3 THEORY OF OPERATION

### 3-1 INTRODUCTION.

The general theory of operation is presented to the extent necessary to enable personnel who use the VHF Emulator to follow and understand the operating and maintenance procedures prescribed in the manual. A block diagram description of the overall system is included to meet that objective.

### 3-2 OVERALL SYSTEM DESCRIPTION.

This section provides an overall system description at the block diagram level. As shown in Figure 3-1, a powered-up VHF Emulator consists of a Battery Pack assembly and a VHF antenna connected to a VHF assembly. Once the system is programmed by the Controller Interface Device (CID), it activates automatically and begins transmitting signals.

**3-2.1 Single Channel VHF Assembly.** Contained within the VHF assembly are the principle modules which contribute to the power conversion, control, generation, and amplification of the signals. They are the Digital Controller (A3), Synthesizer (A2), Power Amplifier and Antenna Matching Unit (A1), and Power Supply (A7).

The Digital Controller is a microprocessor that directly controls the system. It receives instructions from formatted data stored in the EPROM and from communications with the CID.

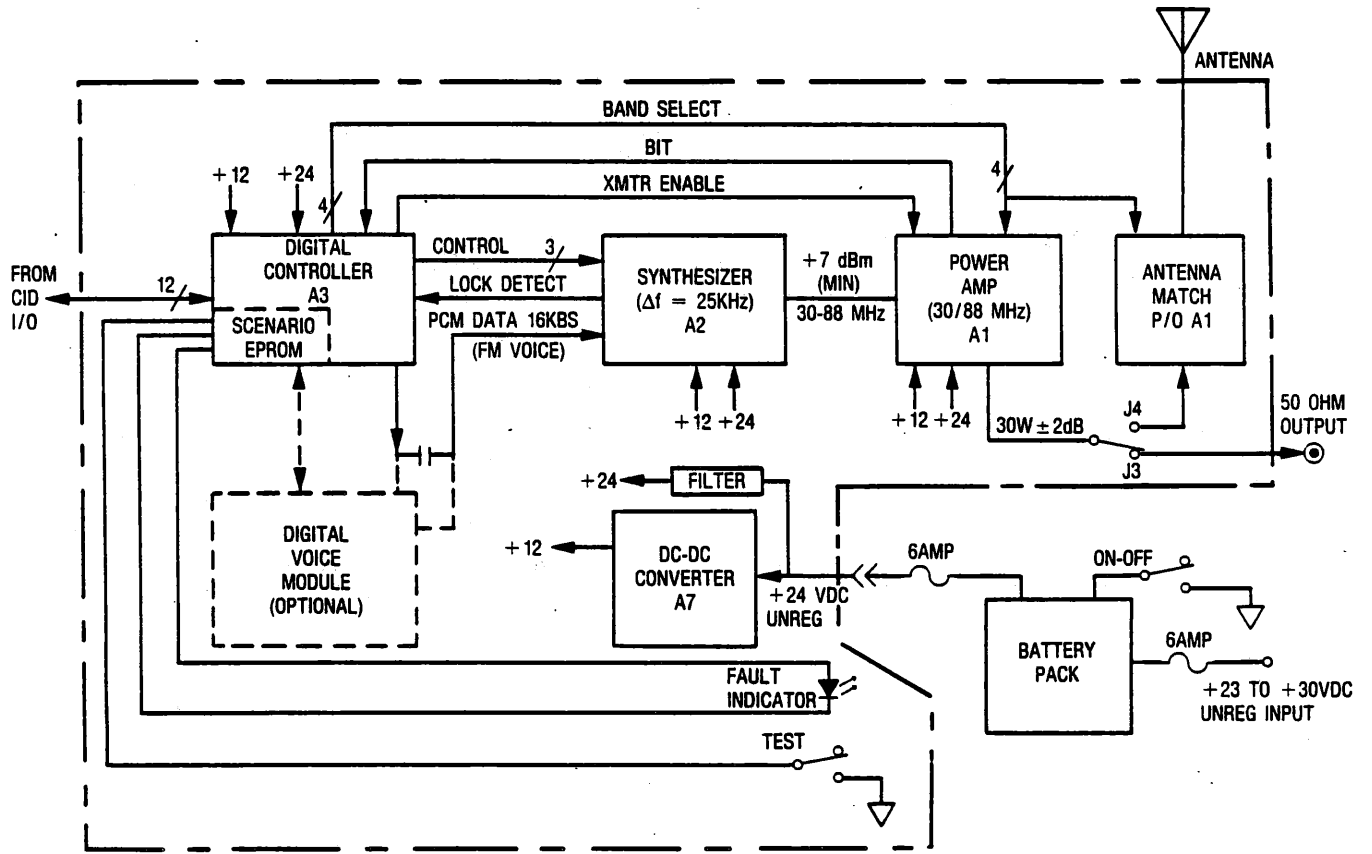
The emulator is activated with the CID which loads the mission start time, the selected scenario and the specific operating frequencies. Prior to activation, the above mentioned EPROM (which contains up to four preloaded scenarios), must be installed. These scenarios contain transmission start times as well as frequency designations and cipher type. The Synthesizer generates the VHF frequencies to be transmitted. It receives digital words from the Digital Controller on the CLOCK, DATA and LATCH lines which contain the frequencies for transmission. PCM signals from the Digital Controller are sent to the Synthesizer where frequency shift keying (FSK) of the carriers takes place with the modulating signals. It also produces a signal (LOCK) which is sent to the Digital Controller to monitor the status of the Synthesizer.

The selected modulated carrier frequency is received by the Power Amplifier on the RF IN line. The signal to be transmitted is amplified to 30.0 watts by the Power Amplifier when it receives a transmit enable (XMIT ENABLE) signal from the Digital Controller to enable the signals. When enabled, the signals are radiated from the system antenna (integral 48-inch whip or other external antenna).

The ON/OFF switch on the front panel of the VHF assembly controls the application of battery and/or external DC power to the system.

The Power Supply module produces the necessary voltages for operating the other modules of the assembly.

The TEST switch on the front panel of the VHF assembly activates a BIT (Built-In Test) of the Emulator. This is a test that, when passed, causes the adjacent indicator to come on. This final operational check is usually performed by the operator who places the Emulator in service.



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Figure 3-1. Single Channel VHF Emulator Block Diagram

The TEST switch on the front panel of the VHF assembly activates a BIT (Built-In Test) of the Emulator. This is a test that, when passed, causes the adjacent indicator to come on. This final operational check is usually performed by the operator who places the Emulator in service.

**3-2.2 Battery Pack Assembly.** The Battery Pack assembly provides unregulated +24 V power to the VHF assembly. In normal operation, the unit operates from batteries. In an optional operation, the Battery Pack provides for the connections of an external +24 V from a user supplied power supply. The unit would continue to use battery power only in the event of a line failure with this optional source.

If NiCad batteries are inserted, recharging will also take place automatically from the external source. Automatic charge prevention is provided for lithium batteries. Normal blow, 6 AMP fuses at the input and output of the Battery Pack provide overcurrent protection. The Battery Pack automatically disconnects the batteries when their output is less than 19.2 V.

Prior to connecting the Battery Pack to the VHF assembly, the operator can diagnose the condition of the Battery Pack by interpreting the indicators which are enabled by the front panel TEST switch.

**3-2.3 VHF Antenna.** There are two antennas that can be used with the VHF Emulator. The first antenna is a 48-inch vertical whip antenna capable of transmitting FSK modulated frequencies between 30.00 and 87.975 MHz at a nominal power level of 30 W.

The whip antenna is mounted on the top panel of the VHF assembly. Another option is the use of a VHF antenna connected via a user supplied cable to the BNC 50-ohm coaxial cable connection on the unit. This antenna performs the same function as the 48-inch vertical whip antenna. The user's antenna should have a voltage standing wave ration (VSWR) of less than 3:1 over the band of frequencies selected for the scenario to achieve full output.



## SECTION 4 OPERATING INSTRUCTIONS

### 4-1 INTRODUCTION.

This section contains preoperational considerations i.e., frequencies of operation, mode of operation, mission standby time and detailed operating instructions. It also includes illustrations and functional descriptions of the controls and indicators of the VHF assembly and Battery Pack assemblies.

### 4-2 PREOPERATIONAL CONSIDERATIONS.

The Single Channel VHF Emulator is a communications device which simulates cipher text transmissions from a VRC-46/KY-57 radio/encryption unit combination. Once programmed, it operates unattended. Programming is completed in two steps. The first is a more extensive programming which defines relative transmit times, transmit duration and frequency designations. This initial programming, which can be done so that several units operating with each other simulate a network of radios, is accomplished through use of a scenario generating subsystem which writes specific parameters to a scenario EPROM. The second type of programming is done locally, using the Controller Interface Display (CID).

This hand-held device, when connected to the VHF assembly, issues a series of prompts which allows the operator to easily select various scenario parameters without changes to the EPROM.

Paragraph 4-4 contains the operating instructions for loading the system. Instructions for programming the CID are found in the CID manual.

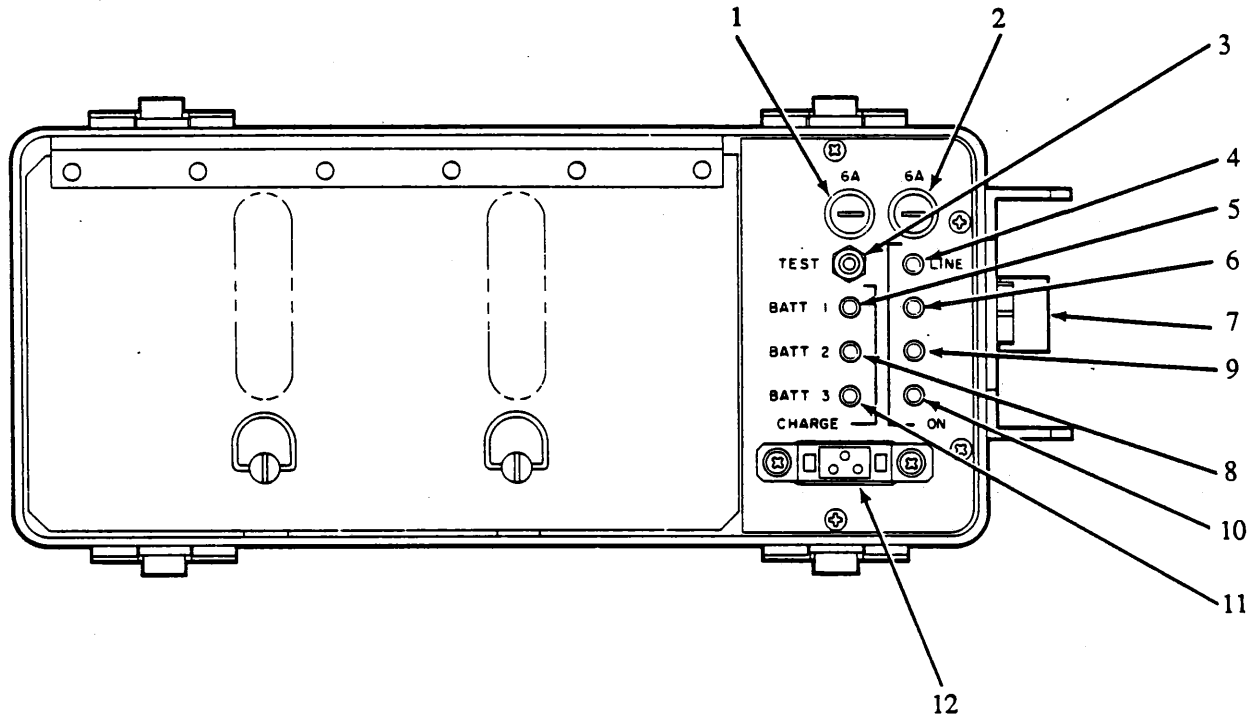
Frequencies of operation for this assembly are selected from the range of 30 to 87.975 MHz at 25 kHz steps. Mission standby time is the time that the system is programmed but not yet transmitting. It is programmed into the CID in hours and minutes to a maximum of 23 hours and 59 minutes. Standby time counts down in the CID and the remaining standby time is calculated when the system is loaded from the CID.

An additional preoperational feature, not requiring programming, is the mission life of the system when only batteries are used. Data in Section 1, table 1-3 must be considered when selecting batteries. Once programmed, the system will continue to transmit its full measure of scenarios until the power switch is set to OFF, the battery voltage drops below the threshold level, or the scenario times out.

### 4-3 CONTROLS AND INDICATORS.

All of the operator controls and indicators are located on either the VHF assembly or the Battery Pack assembly.

**4-3.1 Battery Pack Assembly Controls and Indicators.** The Battery Pack assembly controls and indicators are illustrated in Figure 4-1 and described in Table 4-1.



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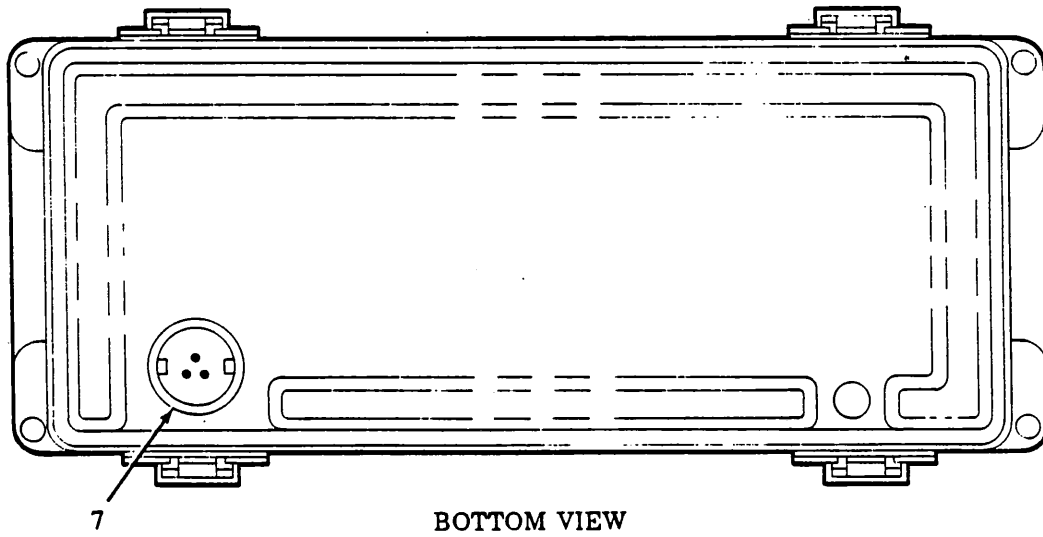
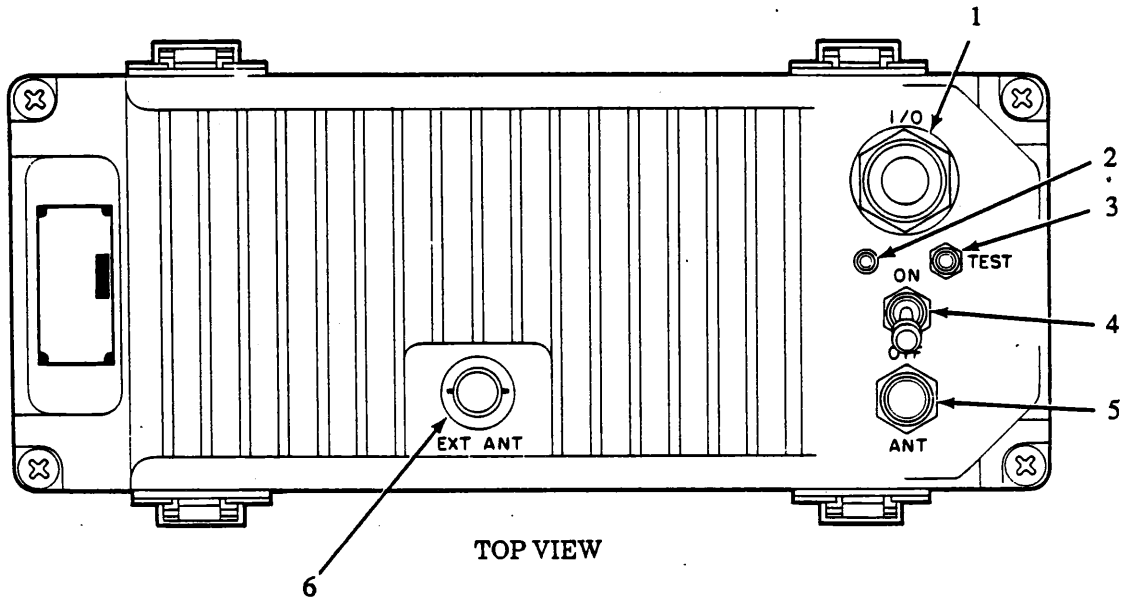
Figure 4-1. Battery Pack Assembly Controls and Indicators



Table 4-1. Battery Pack Assembly Controls and Indicators

Key	Control or Indicator	Function
1	6A	Normal blow fuse - prevents external dc overcurrent
2	6A	Normal blow fuse - prevents system dc overcurrent
3	TEST	Enables indicators (momentary pushbutton) to note the conditions of batteries and Battery Pack.
4	LINE	Green indicator - when lit, indicates proper external dc voltage applied.
5	BATT 1 CHARGE	Red indicator - when lit, battery 1 is charging.
6	BATT 1 ON	Green indicator - when lit, indicates battery 1 installed and good; line either faulty or disconnected.
7	External DC connector	2-pin power connector - provides for use of external dc.
8	BATT 2 CHARGE	Red indicator - when lit, battery 2 is charging.
9	BATT 2 ON	Green indicator - when lit, indicates battery 2 installed and good; line either faulty or disconnected.
10	BATT 3 ON	Green indicator - when lit, indicates battery 3 installed and good; line either faulty or disconnected.
11	BATT 3 CHARGE	Red indicator - when lit, battery 3 is charging.
12.	Power connector	3-pin connector mates with VHF assembly.

**4-3.2 Single Channel VHF Assembly Controls and Indicators.** The VHF assembly controls and indicators are illustrated in Figure 4-2 and described in Table 4-2.



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Figure 4-2. Single Channel VHF Assembly Controls and Indicators

Table 4-2. Single Channel VHF Assembly Controls and Indicators

Key	Control or Indicator	Function
1	I/O cable	Provides connection of emulator to CID.
2	TEST indicator	Used in conjunction with TEST switch to indicate condition of system
3	TEST	Initiates BIT when pressed
4	ON/OFF	Controls system input power.
5	ANT	Antenna connector
6	EXT ANT	Connection for optional external antenna.
7	Connector	Rear panel power connector, mates with Battery Pack assembly

#### 4-4 OPERATING INSTRUCTIONS.

**4-4.1 General.** This paragraph describes how to place the VHF Emulator into operation. A CID is required to program the system for operation. Refer to the CID Operation and Maintenance Manual for detailed information on its operation.

#### CAUTION

The VHF assembly is cooled by a heat sink on the top panel. DO NOT restrict air flow through or around the heat sink by burial, covering with foreign material, or positioning the heat sink below surface level. Restricting air flow may cause overheating and subsequent destruction of internal parts.

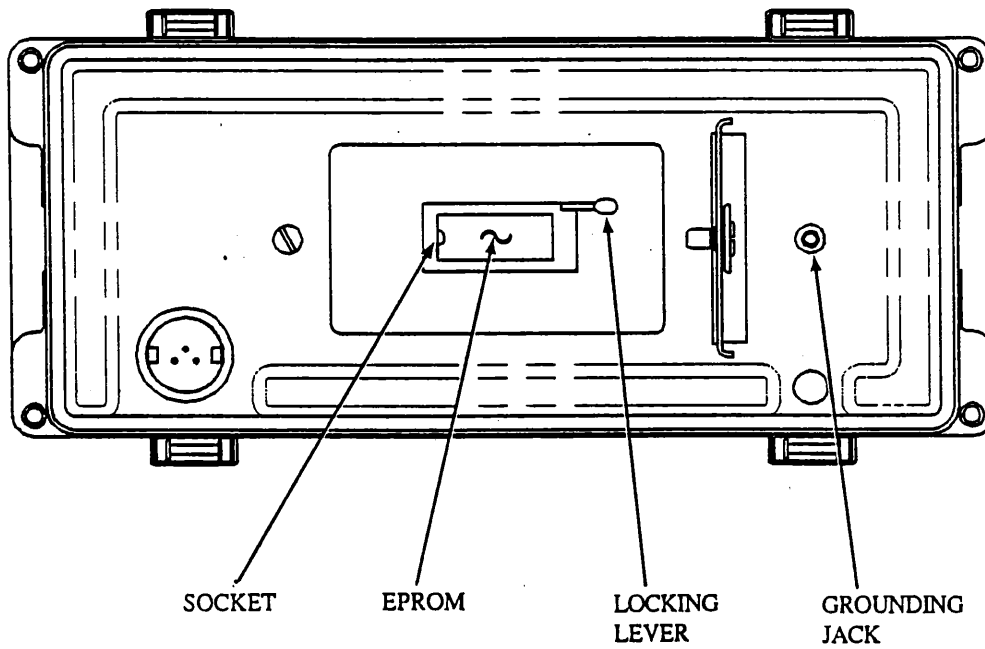
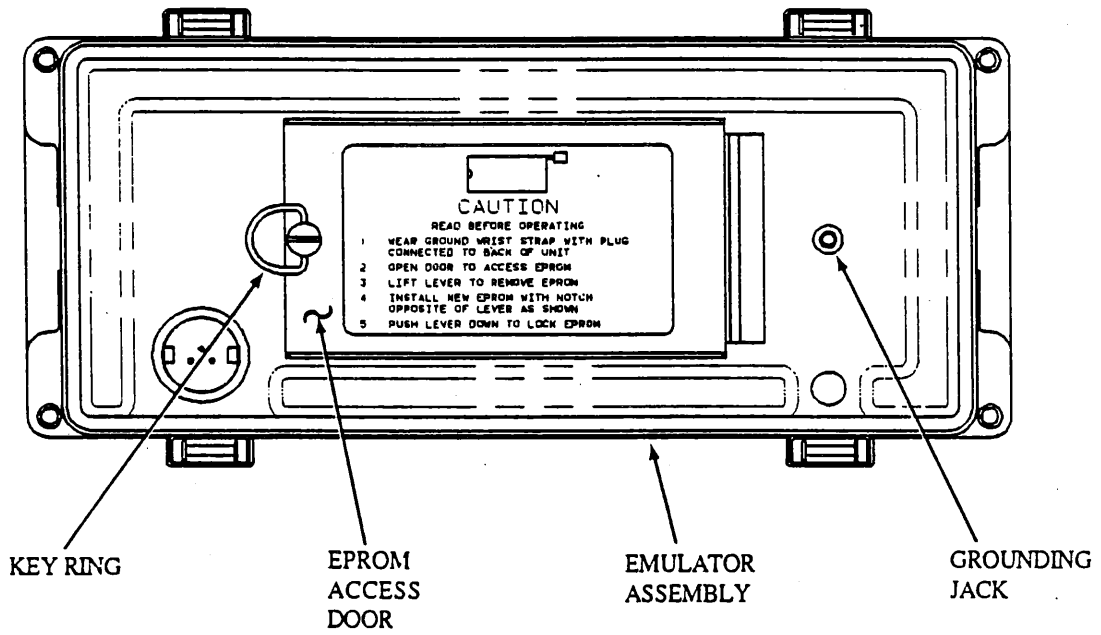
**4-4.2 Operating Procedures.** The following instructions detail how to start operation of the Single Channel VHF Emulator.

1. Remove Battery Pack from the VHF assembly.

#### CAUTION

The scenario EPROM is subject to damage in the event an electrostatic discharge could occur from static electricity from the operator. Wear a grounded wrist strap, or take appropriate grounding measures when handling the EPROM.

2. Connect the wrist strap to the jack on the emulator as shown in Figure 4-3.
3. Open the EPROM access door by twisting the key ring counterclockwise until door releases and swings open.
4. Pull out on the EPROM locking lever to release the EPROM from its hold in the EPROM socket.
5. Remove the EPROM from its socket.



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Figure 4-3. EPROM Location

6. Insert a new programmed EPROM . Note the position of the index on the EPROM.
7. Lock the EPROM into its socket by pushing the locking lever in until it snaps in place.
8. Close the EPROM access door and lock it by turning the key ring.
9. Remove the wrist strap from the emulator.
10. Replace Battery Pack.
11. Write scenario name and radio ID number on the scratch pad on the side panel of emulator.  
The VHF Emulator is now ready for programming by the CID. See instructions in the CID manual.

#### CAUTION

The ON/OFF switch must be left ON after programming to retain "loaded data". To check whether data has been accidentally lost prior to mission start, press the TEST button with the antenna installed. A steady green TEST light indicator indicates no data lost. A blinking green TEST light indicator indicates reprogramming is required with the CID. If no indicator comes on, refer to the troubleshooting procedures in Section 5.

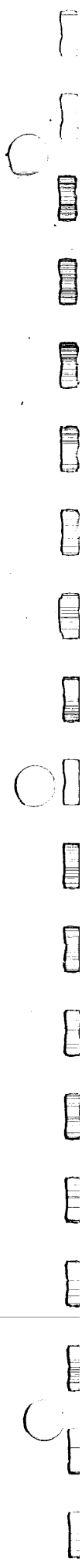
**4-4.3 Mission Life.** The mission life of the system using only batteries (no optional DC use) is provided in Section 1 of this manual.

**4-4.4 Turn Off Procedure.** The VHF emulator that is connected to an external DC power source and backed-up by batteries will transmit according to the preprogrammed scenarios, or until the power switch on the VHF assembly is set to OFF.

If the emulator is not connected to an external DC power source, it will transmit according to its programmed scenarios until the battery voltage falls below the threshold level, then the system will cease to transmit automatically. In this case, the operator should set the power switch to OFF. Refer to Section 5 for battery maintenance.

#### NOTE

The operator can intervene at any time and set the power switch to OFF.



## SECTION 5 MAINTENANCE INSTRUCTIONS

### 5-1 INTRODUCTION.

This section contains detailed operator maintenance instructions which include information about tools, support equipment and repair parts, and the recommended Preventive Maintenance Checks and Services (PMCS). It also contains troubleshooting tables for the Battery Pack and VHF assemblies and specific preventive and corrective maintenance procedures.

### 5-2 COMMON AND SPECIAL TOOLS, SUPPORT EQUIPMENT, AND REPAIR PARTS.

**5-2.1 Common Tools.** Common hand tools are required for operator maintenance.

**5-2.2 Special Tools and Support Equipment.** No special tools are required for maintaining the VHF Emulator. However, the Controller Interface Display (CID) is required for a system preoperational check as specified in the Preventive Maintenance Checks and Services Chart (PMCS) and as an aid in system troubleshooting.

A blank EPROM is included in each assembly when received from the factory. The spare parts kit contains an EPROM eraser for erasing EPROMs prior to programming them with the Scenario Programmer System.

**5-2.3 Repair Parts.** A spare parts Kit, Part Number 78-P34308C001, contains the operator's repair parts for the system. A listing is provided in Table 5-1. These kits are supplied to support multiple equipments in field use.

No spare parts are included with the VHF Emulator. Two 6 Amp fuses are installed in the Battery Pack when shipped; however, no batteries are supplied.

*Table 5-1. Repair Parts List*

Part Number	Description
F02A250V6A	Fuse, 250V-6A
85-P09268W001	Antenna, VHF
30-P32907C001	DC Power Cable Assembly
AA6288	Carry Strap Assembly
AA6188	Pouch, Antenna
DCR04C14SR06-16	Cover, I/O Connector
MX-913	Cover, Connector VHF
KC-89-59	Cover, BNC Connector

### 5-3 PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS).

**5-3.1 General.** Preventive Maintenance Checks and Services (PMCS) are scheduled maintenance performed to ensure that the system is ready for operation at all times. The system should be inspected regularly and carefully, using the procedures in Table 5-2, so that defects can be found and corrected.

No special tools or test equipment are needed for operator preventive maintenance. A common tool kit and a CID is required. The CID is used for the preoperational check of the system according to the PMCS chart.

# MAINT

## 5-3.2 Required Material.

- Cleaning cloth
- Brush
- Mild soap and water solution

**5-3.3 Routine checks.** Routine checks such as cleaning, checking for frayed cables, tightening loose nuts, bolts and screws, correct seating of connectors, and completeness of equipment are not listed in the PMCS. These tasks should be done anytime they are needed.

### NOTE

If any damage is found during preventive maintenance, refer to the troubleshooting procedures in paragraph 5-4 or maintenance procedures in paragraph 5-5 on how to correct it. If the instructions are not there, inform the supervisor.

*Table 5-2. PMCS Chart*

Item No.	Item To Be Inspected	Procedures
1	Battery Pack (No external DC)	If necessary, separate Battery Pack assembly from assembly. Press TEST switch, green indicator comes on for each installed and good battery.
2	System assembly	Secure Battery Pack to VHF assembly. Ensure that fasteners secure assemblies.
3	Preoperational check	Perform the Initial Checkout in paragraph 2.4.
4	VHF antenna	Visually check antenna. Connect antenna to VHF connector on VHF assembly. Ensure a snug fit.
5	Carry strap	Snap carry strap into recesses on top panel of VHF assembly. Ensure that snaps grip properly.
6	Secure system	Set power to OFF, disconnect antenna, disconnect carry strap, secure connector covers on I/O and ANT connectors.
7	Publications	Check for new applicable publications and perform required action.



**5-4. TROUBLESHOOTING.**

**5-4.1 General.** Operator troubleshooting consists of utilizing the test features of the Battery Pack assembly and the VHF assembly and interpreting the results. Red and green indicators on the Battery Pack assembly provide information about the condition of the batteries. One additional feature is the TEST switch and indicator on the VHF assembly. Used as a final test of the system before placing it into full operation, It provides an indication that the BIT passed and the system is programmed by the CID.

This section does not list all of the problems that could happen to the system. If a problem is not listed, or if a problem cannot be fixed by the steps given, notify the supervisor.

**5-4.2 Battery Pack Assembly Troubleshooting.** The Battery Pack is normally checked prior to putting the system in operation for a specific mission. When the Initial Checkout in paragraph 2.4 is performed, the condition of the Battery Pack is noted.

Refer to Table 5-3 for the Battery Pack troubleshooting procedures and to paragraph 5-5 for maintenance.

**NOTE**

The TEST feature on the Battery Pack does NOT check the batteries under full load conditions nor does it indicate remaining battery life. Therefore, whenever the system fails to operate, the operator should always replace the batteries with known good ones, regardless of the status displayed by the indicators, and attempt to operate. The Battery Pack and VHF assemblies should be returned to the factory for repair only as a last resort.

**NOTE**

Any reference to "return to factory" in the troubleshooting tables, refers to the VHF assembly and the Battery Pack assembly. All other system accessories should be retained by the user. These accessories are included in the spare parts kit and should be replaced on an as required basis.

*Table 5-3. Battery Pack Troubleshooting Table*

Malfunction	Possible Cause	Corrective Action
When TEST switch is pressed, one or more green BATT indicators fail to come on.	a. Battery not installed b. Damaged battery c. Defective Battery Pack	a. Install battery b. Replace battery c. Return to factory
When TEST switch is pressed, LINE indicator comes on but red BATT CHARGE indicators stay off.	a. Lithium batteries installed b. Defective NiCad battery c. Defective Battery Pack	a. None, lithium batteries are not rechargeable b. Replace NiCad battery c. Return to factory
With external DC connected and TEST switch pressed, the LINE and BATT CHARGE indicators fail to come on.	a. Incorrect voltage b. Fuse open c. Defective DC power cable d. Clean or repair connection as necessary e. Defective Battery Pack	a. Adjust external DC voltage b. Replace fuse F1 c. Replace DC power cable d. Defective connection to external DC source e. Return to factory

**5-4.3 Single Channel VHF Assembly Troubleshooting.** A TEST switch and green indicator light provide the operator with a method of initiating the built in test capabilities of the VHF assembly and its associated Battery Pack. The CID also serves as a troubleshooting aid and can be used to initiate a partial built in test of the unit. When the battery pack is removed, seven lights and a TEST switch are exposed and can be used to troubleshoot the Battery Pack alone.

**NOTE**

The troubleshooting table for the VHF assembly is designed for a system that is battery powered only. In addition, a "known good" CID is used.

*Table 5-4. Single Channel VHF Assembly Troubleshooting Table*

Malfunction	Probable Cause	Corrective Action
Before programming with CID; VHF assembly power ON, antenna connected; TEST switch pressed, indicator fails to blink.	a. No DC power to VHF assembly - open fuse b. Weak battery c. Defective Battery Pack or VHF assembly	a. Replace fuse F2 b. Lithium - replace all batteries. NiCad - charge batteries. c. Return to factory
After programming with CID and with antenna installed on VHF assembly - TEST switch is pressed, green indicator fails to come on as a steady light.	a. Antenna disconnected b. Power off at VHF assembly. c. Weak battery d. Defective Battery Pack or VHF assemblies.	a. Replace with new antenna b. Perform Initial Checkout, paragraph 2-4. c. When lithium batteries are used, replace all; when NiCad batteries are used, recharge all. d. Return to factory.
After programming with CID when the ASK key is pressed on the CID, CID display reads, <b>BUILT-IN-TEST FAILED.</b>	a. Weak batteries b. Defective CID c. Defective VHF assembly	a. When lithium batteries are used, replace all; when NiCad batteries are used, recharge all. b. Push TEST button on VHF assembly if green indicator comes on, replace CID. c. Return to factory.

**WARNING**

Personnel should be aware that when the system begins transmitting, there is no physical indication to that effect. It will continue to transmit until the power is set to OFF on the VHF assembly or the battery voltage falls below the threshold level. Electromagnetic radiation from the antenna can damage eyes and other body tissue when the system is transmitting. In this case, personnel should not be closer than 16 inches to the antenna.

**5-5 BATTERY PACK MAINTENANCE.**

Either lithium or NiCad batteries can be used to power the system. Discharged batteries are typically detected by a system that does not power-up, although the BATT ON green indicators on the Battery Pack may indicate that batteries are installed and good. Discharged lithium batteries must always be replaced as a set to restore the Battery Pack to operation.

Discharged NiCad batteries may be charged in the Battery Pack or replaced with a charged set of batteries. It is recommended that NiCad batteries be charged and discharged as a set. Charging in the Battery Pack is performed by connecting the Battery Pack to an external DC source (23.0 to 30.0 Vdc). NiCad batteries charged in the Battery Pack require a minimum of 16 hours charging time before returning them to service.

## 5-6 MAINTENANCE PROCEDURES.

The following sections provide instructions for the basic operator maintenance. Any maintenance beyond procedures written here should be referred to higher level before proceeding with the particular maintenance operation.

5-6.1 General. Operator maintenance consists of the following actions:

1. Visual Inspection
2. Testing
  - a. Setup Procedure (para. 2.3)
  - b. Initial Checkout (para. 2.4)
  - c. Operating Instructions (para. 4.4)
3. External Cleaning
4. Replacement
  - a. System
  - b. Batteries
  - c. Fuse(s)
  - d. VHF antenna
  - e. I/O connector cover
  - f. VHF connector cover

### NOTE

No adjustments or lubrication is required.

5-6.2 Visual Inspection.

### WARNING

Make sure external DC power to the system has been removed.

Perform the following checks on the VHF assembly.

1. Battery Pack assembly.  
Look for signs of corrosion.
2. Connectors.  
See that all connectors are properly seated.
3. Cables.  
See that cables are not damaged or frayed.
4. Exterior.  
Check exterior surface for dirt, grease, or fungus.

## MAINT

### 5. Switches.

Check switches for proper movement.

**5-6.3 Testing.** In order to perform an operational test of the system, the operator must perform the following procedures in the order given:

1. Setup Procedure (para 2.3)
2. Initial Checkout (para 2.4)
3. Operating Instructions (para 4.4)

### 5-6.4 Cleaning.

#### WARNING

Make sure external DC power to the system has been removed before cleaning the VHF assembly.

#### 1. Exterior Surface.

Remove dust and loose dirt with a soft cloth. Remove grease, oil, dirt, and fungus with a cloth dampened with a mild solution of soap and water.

#### 2. Connectors.

Clean all connectors with a cloth dampened with mild solution of soap and water.

### 5-6.5 Replacement.

#### 5-6.5.1 System.

#### WARNING

Make sure external DC power has been removed before replacing a system.

A battery powered, operational emulator includes a VHF assembly, Battery Pack assembly, and a VHF antenna. Do not separate the Battery Pack from the VHF assembly. Troubleshoot the system using the procedures in Table 5-3 and Table 5-4 and if necessary, return both to the factory for repair. The VHF antenna is a repair part and need not be returned if it checks good.

To replace an emulator as defined above:

1. Set power to OFF on VHF assembly.
2. Disconnect VHF antenna. Check for damage and replace if necessary.
3. Remove faulty system from its location.
4. Locate good system. Check it out and reprogram as needed.
5. Connect known good VHF antenna.
6. Press TEST on VHF assembly. Adjacent green indicator should come on. The emulator is programmed and operational.

#### 5-6.5.2 Batteries.

#### WARNING

Make sure external DC power has been removed before replacing batteries.

Refer to paragraph 2-2. Figure 2-3 while performing the following procedure to replace the batteries.

1. Open battery compartment by rotating two fasteners counterclockwise one-quarter turn.
2. Lift cover to open position.
3. Remove the two outer batteries by pulling ejector straps on BATT 1 and BATT 3 and lifting the batteries from the Battery Pack.
4. Then, remove center battery by grasping battery and pulling straight up.

To install a replacement, perform the procedures in paragraph 2-3.1.

#### 5-6.5.3 Fuse.

#### WARNING

Make sure external DC power has been removed before replacing fuses.

The two 6 amp (3AG), normal blow fuses, located on the front panel of the Battery Pack, provide circuit overcurrent protection for the power input line (F1) and the power output line (F2) and can be replaced by using the following steps while referring to Figure 5-1.

1. Use a small coin, fingernail, or small straight blade screw driver and rotate the fuseholder approximately one-eighth turn counterclockwise.
2. Remove the fuseholder from the Battery Pack.
3. Remove the fuse from fuseholder.

To install replacement, perform above procedure in reverse order.  
Repeat procedure for other fuse, if required.

#### 5-6.5.5 VHF Antenna

#### WARNING

Ensure that the power switch on the VHF assembly is set to OFF before attempting to replace the VHF antenna.

#### WARNING

Personnel should be aware that when the system begins transmitting, there is no physical indication to that effect. It will continue to transmit until the power is set to OFF on the VHF assembly or the battery voltage falls below the threshold level. Electromagnetic radiation from the antenna can damage eyes and other body tissue when the system is transmitting. In this case, personnel should not be closer than 16 inches to the antenna.

To remove the VHF antenna, refer to Figure 2-5. Perform the reverse of the VHF antenna installation in paragraph 2-3.3 or 2-3.4.

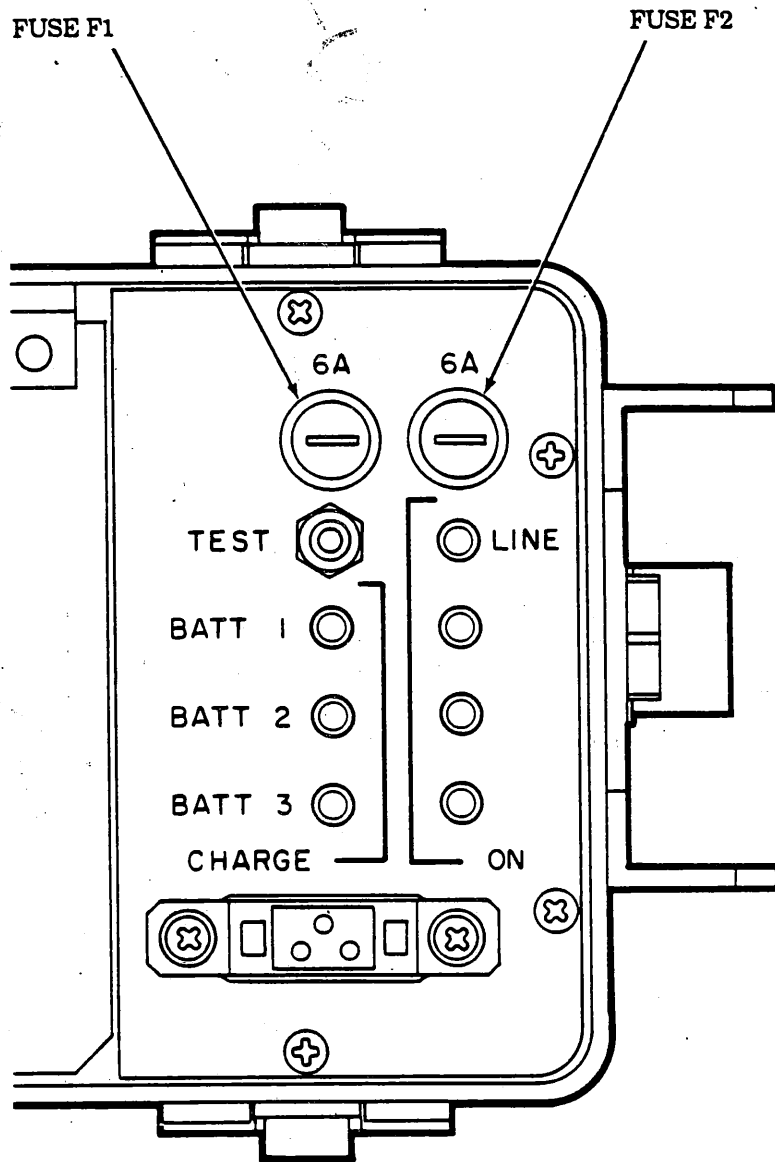
#### 5-6.5.6 I/O Connector Cover.

#### WARNING

Make sure power switch is set to OFF and the VHF antenna is disconnected from the front panel of the VHF assembly before replacing I/O connector cover.

To replace the I/O connector cover on the front panel of the VHF assembly, refer to Figure 5-2 and perform the follow procedure.

1. Use a suitable wrench and carefully, loosen nut on I/O connector.



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Figure 5-1. Fuse Replacement

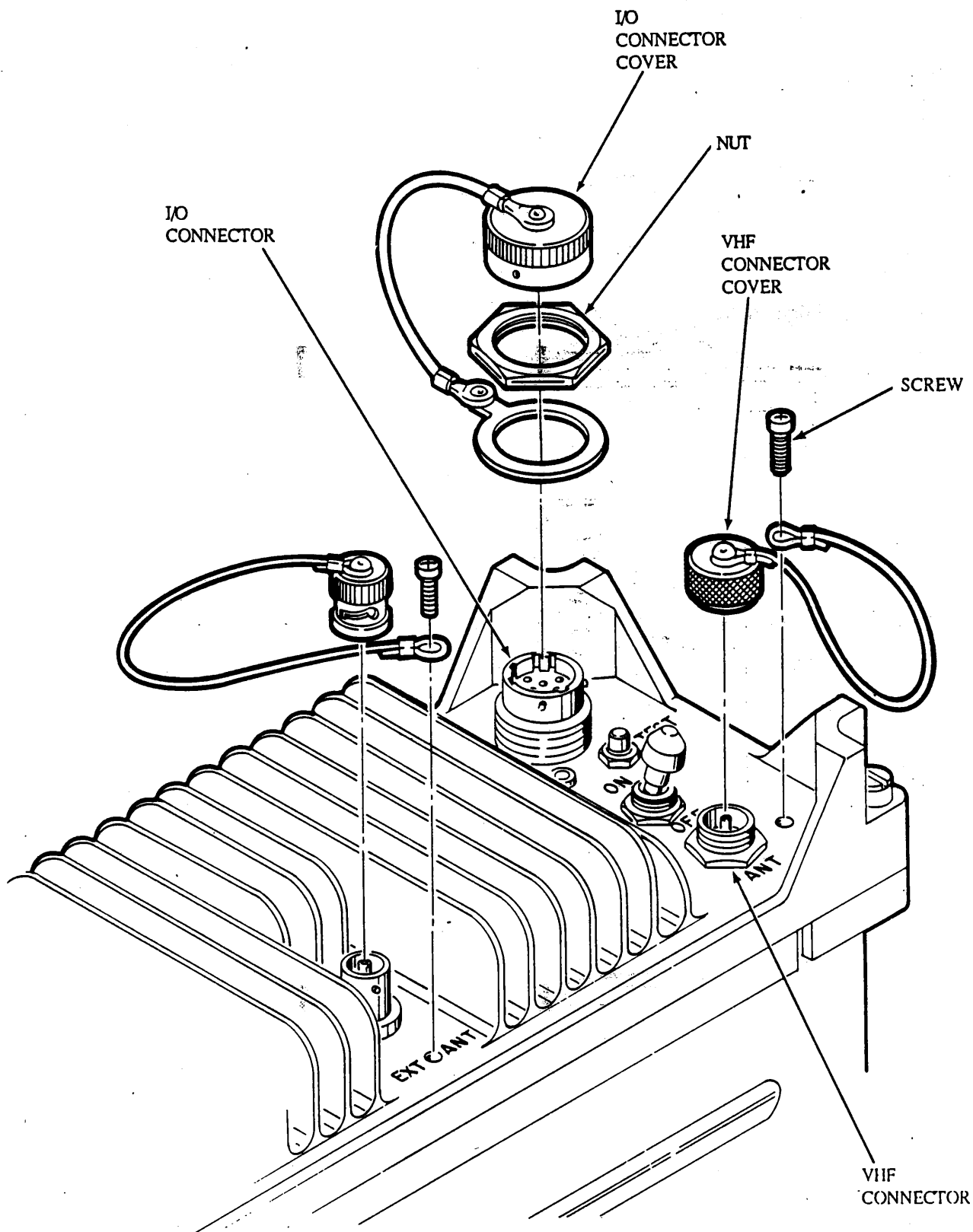


Figure 5-2. I/O and VHF Connector Cover Replacement

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## MAINT

2. Remove the nut. Do not press on connector while nut is removed.
3. Remove connector cover.

To install a replacement, perform the above steps in reverse order. Do not overtighten the nut.

### 5-6.5.7 VHF Connector Cover.

#### WARNING

Make sure power switch is set to OFF and the VHF antenna is disconnected from the front panel of the VHF assembly, before replacing VHF connector cover.

To replace the VHF connector cover on the front panel of the VHF assembly, refer to Figure 5-2 and perform the follow procedure.

1. Use a small, straight blade screw driver and remove screw securing cover to connector.
2. Remove connector cover. To install a replacement, perform the above steps in reverse order. Do not over-tighten screw.