

 **MOBILE RADIO**

MASTR[®]

PROGRESS LINE

Personal Series

MAINTENANCE MANUAL LBI 4709 E

DATAFILE FOLDER DF9029



138-512 MHz
LOCAL/REMOTE
PE MODELS



30-88 MHz
LOCAL/REMOTE
PE MODELS

5-FREQUENCY
PE MODELS
WITH TYPE 99 DECODER

TWO-WAY
PERSONAL
FM RADIOS



DESK CHARGER

GENERAL  ELECTRIC

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— WARNING —

No one should be permitted to handle any portion of the equipment that is supplied with high voltage; or to connect any external apparatus to the units while the units are supplied with power. **KEEP AWAY FROM LIVE CIRCUITS.**

EQUIPMENT INDEX

EQUIPMENT	TYPE OR PART NUMBER
Transmitters 30- 50 MHz 66- 88 MHz 138-174 MHz 406-470 MHz 470-512 MHz	KT-18-A & KT-152-B KT-127-A KT-19-A & KT-107-A KT-22-A & KT-105-A KT-26-B & KT-111-A
Receivers 30- 50 MHz 66- 88 MHz 138-174 MHz 406-470 MHz 470-512 MHz	ER-61-A ER-87-A ER-59-C ER-60-A ER-62-A
System Board & Case Assemblies Local/Remote 30- 50 MHz 66- 88 MHz 138-174 MHz 406-470 MHz 470-512 MHz	19D417103G4 19D423294G3 19D417103G1 19D417103G2 19D417103G3
Type 99 Tone Board Individual Call Individual/Group Call	4EJ21A10 4EJ21A11

SPECIFICATIONS

GENERAL

DIMENSIONS (H x W x D)

	30-88 MHz	138-512 MHz
(With 500 mAh Battery)	8.71" x 2.62" x 1.58"	7.91" x 2.62" x 1.58"
(With 700 mAh Battery)	8.87" x 2.62" x 1.58"	8.40" x 2.62" x 1.58"
(With Intrinsically Safe Battery)		9.30" x 2.62" x 1.58"
(With optional Mercury or Alkaline Battery)	8.81" x 2.62" x 1.58"	8.01" x 2.62" x 1.58"

OPERABLE TEMPERATURE RANGE

Transmitter-Receiver	-30°C to +60°C (-22°F to +140°F)
Rechargeable Battery Pack	-20°C to +45°C (- 4°F to +113°F)
Alkaline Battery	-18°C to +45°C (0°F to +113°F)
Mercury Battery	-6.5°C to +55°C (+20°F to +130°F)

MAXIMUM FREQUENCY SPREAD (MHz)

FREQUENCY RANGE	RECEIVER		TRANSMITTER	
	Full Performance	1 dB Degradation in Sensitivity	Full Performance	1 dB Degradation in Power Output
30-36 MHz	0.36 MHz	0.45 MHz	0.12 MHz	0.24 MHz
36-42 MHz	0.43 MHz	0.54 MHz	0.14 MHz	0.28 MHz
42-50 MHz	0.51 MHz	0.645 MHz	0.17 MHz	0.34 MHz
66-76 MHz	0.6 MHz	1.2 MHz	0.6 MHz	1.2 MHz
75-88 MHz	0.8 MHz	1.6 MHz	0.8 MHz	1.6 MHz
138-145 MHz	0.55 MHz	1.1 MHz	0.83 MHz	2.8 MHz
145-150.8 MHz	0.58 MHz	1.16 MHz	0.87 MHz	2.9 MHz
150.8-174 MHz	0.60 MHz	1.20 MHz	0.90 MHz	3.0 MHz
406-420 MHz	1.62 MHz	3.24 MHz	1.62 MHz	3.24 MHz
450-460 MHz	1.80 MHz	3.6 MHz	1.80 MHz	5.5 MHz
460-470 MHz	1.84 MHz	3.68 MHz	1.84 MHz	5.5 MHz
470-490 MHz	4.0 MHz	-	1.88 MHz	4.0 MHz
490-512 MHz	4.0 MHz	-	1.96 MHz	4.0 MHz

FREQUENCY STABILITY

-30°C to +60°C
0°C to +55°C

±.0005% (30-50 MHz TX Only, ±.002%)
±.0002%

BATTERY DRAIN (@7.5 Volts)

Frequency Range

Standby

Receive

Transmit

2 Watts
5 Watts

30-50 MHz

15 milliamps

140 milliamps

680 milliamps
1.75 amps

Frequency Range

Standby

Receive

Transmit

66-88 MHz

17 milliamperes

145 milliamperes

700 milliamperes

Frequency Range

Standby

Receive

Transmit

100 milliwatts
200 milliwatts
1 Watt
2 Watts
5 Watts

138-174 MHz

14.5 milliamps

140 milliamps

150 milliamperes
165 milliamperes
340 milliamperes
630 milliamperes
1.5 amps

Frequency Range

Standby

Receive

Transmit

1 Watt
4 Watts

406-420 and 450-470 MHz

13 milliamps

140 milliamps

680 milliamps
1.5 amps

Frequency Range

Standby

Receive

Transmit

1 Watt
3.5 Watts

470-512 MHz

14 milliamps

140 milliamps

700 milliamps
1.5 amps

* These specifications are intended primarily for the use of the serviceman. Refer to the appropriate Specification Sheet for the complete specifications.

COMBINATION NOMENCLATURE

1st & 2nd Digit	3rd Digit	4th Digit	5th Digit	6th Digit	7th Digit	8th Digit	9th Digit	10th Digit
PE Personal Series	2 100-700 Milliwatts	4 20 kHz	T 5-Freq Type 99	A 1-Freq. Xmit	L Type 99 Individual Call	A 1-Freq. Rec.	A 30-36 MHz	X No Dual Front End
	4 0.8-1.6 Watts	5 25 kHz		B 2-Freq. Xmit	M Type 99 Individual & Group Call	B 2-Freq. Rec.	B 36-42 MHz	
	5 1.6-3.8 Watts	6 30 kHz		C 3 Freq. Xmit		C 3-Freq. Rec.	C 42-50 MHz	
	6 3.8-6.4 Watts			D 4-Freq. Xmit		D 4-Freq. Rec.	D 66-76 MHz	
				E 5-Freq. Xmit		E 5-Freq. Rec.	E 76-88 MHz	
							G 130-150.8 MHz	
							H 150.8-174 MHz	
							K 406-420 MHz	
							M 450-470 MHz	
							N 470-494 MHz	
							P 494-512 MHz	

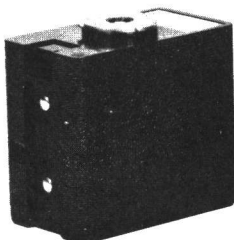
ACCESSORIES

BATTERY PACKS

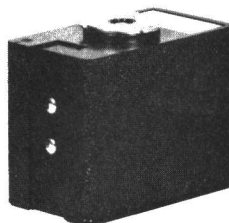
RECHARGEABLE
700 mAh
Intrinsically Safe
Battery Pack
(Option 4671)



RECHARGEABLE
700 mAh
Battery Pack
(Option 4238)



RECHARGEABLE
500 mAh
Battery Pack
(Option 4421)



STANDARD DRY
Battery Pack
(Option 4422&4424)



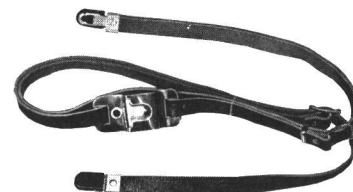
HAND STRAP
(Option 4406)



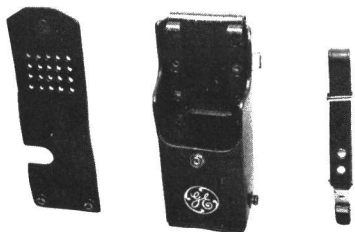
RF ADAPTER CABLE
(Option 4466)



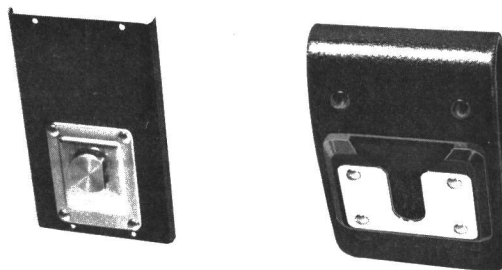
SHOULDER STRAP
Attaches to Radio (Option 4407)
Attaches to Carrying Case (Option 4332)



CARRYING CASE
(Option 4413)
With Swivel Mount and
Belt Loop
(Option 4492)



SWIVEL MOUNT AND BELT LOOP
(Option 4481) (Option 4493)



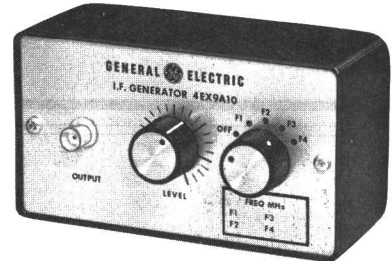
TEST EQUIPMENT

TEST ADAPTOR
MODEL 4EX12A10 (Option 4384)



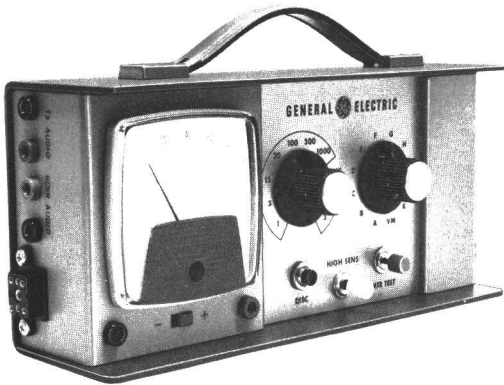
Provides transmitter and receiver audio connections

IF GENERATOR
MODEL 4EX9A10 (Option 4381)



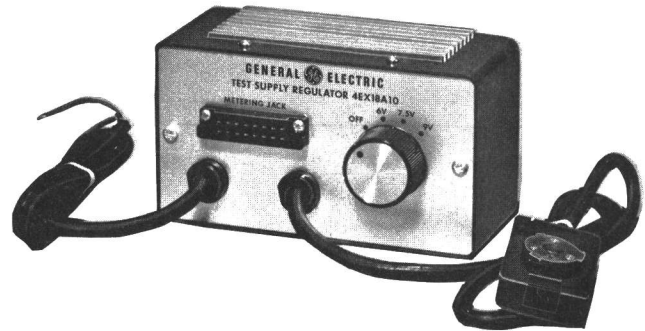
For setting the receiver on frequency and for troubleshooting

TEST SET
MODEL 4EX3A11 (TM-11, 12, 13, 16 & 17)



Used with Test Regulator for servicing

TEST REGULATOR
MODEL 4EX18A10 (Option 4465)



Extension cables for servicing the receiver out of the radio

Transmitter RF Adaptor Cable

TEST AMPLIFIER
MODEL 4EX16A10 &
RF PROBE 19C311370-G1 (Option 4382)



For receiver front end and IF gain measurements

VOLTAGE CALIBRATOR
MODEL 4EX10A10 (Option 4383)



For setting voltages on Personal Battery Chargers

DESCRIPTION

General Electric MASTR®PE Series personal radios are extremely compact, high performance two-way FM radios. The radios are fully transistorized -- utilizing both discrete components and Integrated Circuit modules (IC's).

The radio is contained in a ruggedly-constructed, weatherproof Lexan® case with vinyl-covered, stainless steel front and back covers. All operating controls except the PTT switch are conveniently located on the top of the radio. The accessory jack on the top of the radio is provided for external microphones, earphones and other audio accessories.

Power for the radio is normally supplied by a rechargeable nickel-cadmium battery pack that quickly attaches to the bottom section of the case. The battery pack can be recharged either attached or removed from the radio.

A battery pack using dry batteries is available whenever the rechargeable battery pack is not required.

INTRINSICALLY SAFE COMBINATIONS

Combinations PE45 with option 4670, PE56 with option 4669 and battery pack 19D413522G5 have been approved by Factory Mutual Research Corporation as Intrinsically Safe for use in Class I, Division 1, Group D atmospheres.

Group D atmospheres are described in Table 500.2 in Chapter 5 of the National Electrical Code - 1975.

"Intrinsically Safe equipment and wiring shall not be capable of releasing sufficient electrical or thermal energy under normal or abnormal conditions to cause ignition of a specific hazardous atmospheric mixture in its most easily ignited concentration."

GREEN LABEL

PE Intrinsically Safe combinations, battery pack 19D413522G5, Desk Chargers 381L1A1X and 381M1A1X and Rack Chargers 382L1C1X and 383L1C1X are identifiable as being of the Intrinsically Safe series by a GREEN LABEL.

A PE combination with a GREEN LABEL will only use a battery pack with a GREEN LABEL and the battery pack can only be recharged in a charger with a GREEN LABEL. The GREEN LABEL alone does not imply an Intrinsically Safe rating unless it so states. It does identify an exclusive and different mechanical connection system compatible within this group of equipment.

WARNING

Replacement of any service part must be made with a component having the specification shown on the appropriate parts list. The use of any other parts or circuit modifications is forbidden and their use immediately voids the Intrinsically Safe Rating.

OPERATION

When using the collapsible antenna, make sure that the antenna is in the fully-extended position. Disable the Type 99 tone decode option before adjusting the radio by placing the option switch in the OFF or M(Monitor) position. After adjusting the radio, return the option switch back in the ON or N(Normal) position to enable the Type 99 decoder. Refer to LBI-4231 for complete operating instructions.

TO RECEIVE A MESSAGE

1. Turn the OFF-VOLUME control about half-way to the right.
2. Turn the SQUELCH (SQ) control to the right as far as possible. A hissing sound will be heard from the speaker.
3. Adjust the VOLUME control until the hissing sound is easily heard but not annoyingly loud.
4. Turn the SQUELCH control slowly to the left until the hissing noise just fades out.

In multi-frequency units, select the proper frequency. You are now ready to receive messages from other radios in your system.

TO SEND A MESSAGE

1. Turn on the radio as directed in the "To Receive a Message" section.
2. In multi-frequency units, select the proper frequency. Then listen to make sure that no one is using the channel.
3. While holding the radio so that the antenna is vertical, press the Push-to-Talk (PTT) switch and speak directly into the local speaker/microphone (or across the face of an external speaker/microphone) in a normal tone of voice. Release the PTT switch as soon as you stop talking. You cannot receive messages when the PTT switch is pressed.

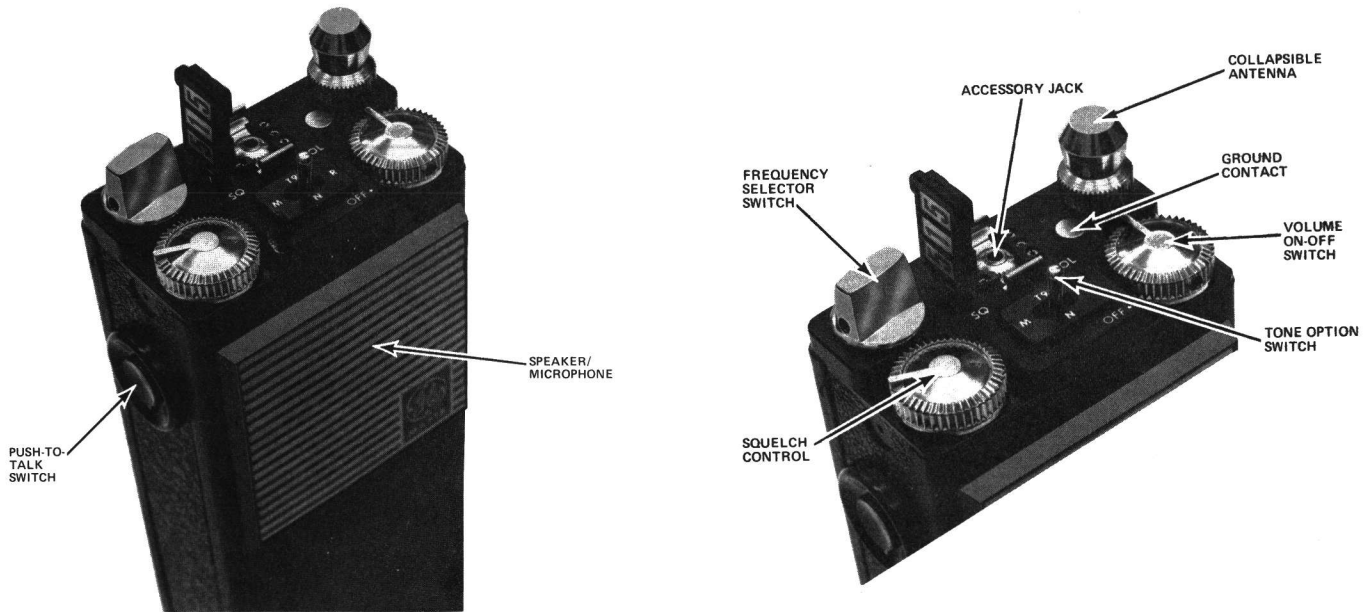


Figure 3 - Operating Controls

OPERATING TIPS

The following conditions tend to reduce the effective range of Two-Way Radios, and should be avoided whenever possible.

- Operating the radio in low areas of the terrain, or while under power lines or bridges.
- Operating the radio inside of a vehicle, or in a metal or steel-framed building unless using an outside antenna.
- Obstructions such as mountains or buildings between the person sending and the person receiving the messages.

In areas where transmission or reception is poor, some improvement may be obtained by insuring the antenna is fully extended and vertical. Moving a few yards in another direction or moving to a higher elevation may also improve communication.

MAINTENANCE

SERVICING THE RADIO

A complete procedure is provided in this manual for disassembling the radio for servicing. The procedure also contains instructions for replacing the different assemblies, Integrated Circuit modules and transmitter PA transistors. Refer to the Disassembly Procedure as listed in the Table of Contents.

If the radio should begin to operate improperly (i.e., transmitted messages

start getting weak and hard to understand, or the receiver won't squelch properly), the first thing to suspect is run-down batteries. If a freshly recharged battery pack or new dry batteries fail to restore the radio to its normal operating condition, refer to the appropriate Troubleshooting Procedure for help in isolating and correcting the problem.

TEST AND TROUBLESHOOTING PROCEDURES

Whenever difficult servicing problems occur, the Test Procedures for the transmitter and receiver can be used by the servicemen to compare the actual performance of the unit to the specifications met by the unit when shipped from the factory.

In addition, specific Troubleshooting Procedures are available for the transmitter, receiver and tone options. For best results, the Test Procedures should be used in conjunction with the Troubleshooting Procedures when servicing the radio. Refer to the applicable maintenance manual.

CHANGING FREQUENCIES

To change the operating frequency of the transmitter or receiver, it is necessary to replace the entire oscillator module as directed in the Disassembly Procedure. Always give the model number of the module and the exact operating frequency required when ordering new oscillator modules.

After replacing the oscillator module, re-align the transmitter or receiver as directed in the Alignment Procedure (Refer to the applicable maintenance manual).

BATTERY INFORMATION

Three rechargeable battery packs and a dry battery pack are available for operating the radio. The different battery packs are shown in Table 1.

The rechargeable Nickel-Cadmium battery pack should be given a 100% charge prior to placing into service. If the radio has been stored for over 30 days, the battery pack should be fully recharged before using. When it is necessary to store the unit for over 30 days, it is recommended that the battery pack be maintained on charge in the appropriate battery charger.

All of the battery packs are not interchangeable. The battery pack should be selected according to the power output, battery life required and application.

INTRINSICALLY SAFE BATTERY PACK

Battery pack 19D413522G5 is designed for use with other PE Intrinsically Safe approved equipment. It consists of a nickel-cadmium, 700 mAh battery pack with a Redundant Current Sensing switch (RCSS). The RCSS protects the battery pack against current drain in excess of 1.50 amperes.

NOTE

There is no way to dispose of mercury batteries without possible pollution except by returning them to the manufacturer for recycling.

Mallory Battery Company will buy all used mercury batteries at the current market price.

General Electric Company recommends batteries to be shipped prepaid, enclosing a packing slip indicating who is to receive payment for the batteries to:

Mallory Battery Company
Plant #2
Lexington, N.C. 27292

WARNING

Do not dispose of battery packs or batteries by burning. To do so may cause an explosion.

BATTERY PACK REPLACEMENT

To remove the battery pack from the radio:

1. Turn the radio OFF.
2. Press the battery retaining latch away from the battery pack as shown in Figure 4 and turn the battery pack one-quarter turn to the left. The battery pack can now be detached from the radio.

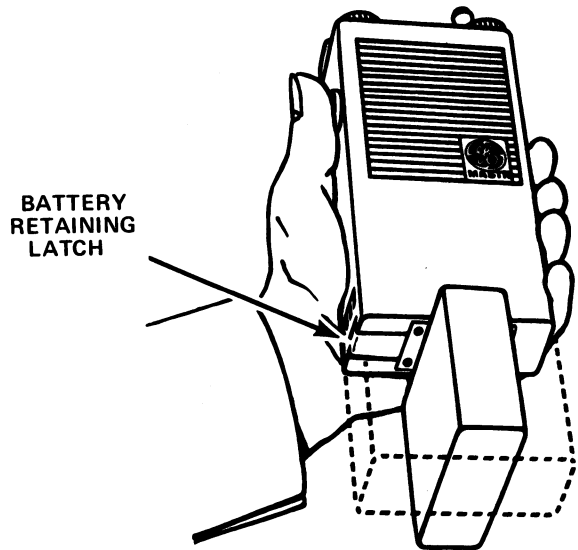


Figure 4 - Battery Pack Replacement

Table 1 - Battery Packs

Battery Pack	Battery Pack	Battery Part No.	Equivalent
Optional 500 mAh	Rechargeable	19D413522G1	None
Standard 700 mAh	Rechargeable	19D413522G4	None
Optional Intrinsically Safe 700 mAh	Rechargeable	19D413522G5	None
Dry Battery Pack 19E500938G1	Carbon-zinc		Eveready 1015
Dry Battery Pack 19E500938G1	Alkaline (Package of 4)	19B200608P2	Eveready E91
Dry Battery Pack 19E500938G1	Mercury (Package of 4)	19A116522P2	Mallory RM15

To reconnect the battery pack to the radio:

1. Hold the battery pack at a 90° angle to the radio as shown in Figure 4.
2. Align the large tab marked with an arrow on the battery pack connector with the large cut-out marked with an arrow on the radio socket.
3. Press the battery pack connector into the socket on the radio and turn the battery pack one-quarter turn to the right until the latch clicks.

STANDARD DRY BATTERY PACK

Standard battery pack 19E500938G1 is equipped with a removable bottom cover for use with dry batteries. To remove the batteries:

1. Remove the battery pack from the radio.
2. Press in and turn the captive screw one-quarter turn to the left to the OPEN position, and lift off the cover.
3. Rap the open end of the battery pack on the palm of one hand over a table or desk to dislodge the batteries.
4. Replace the batteries with the plus (+) end pointing away from the springs as shown on the decal in the battery compartment.
5. Replace the bottom cover by matching the grooves on the battery with the notches on the cover.
6. Turn the locking screw one-quarter turn to the right to the LOCK position.

BATTERY CHECKS

CHARGE LEVEL MEASUREMENT

The charge level of the battery packs can be measured by connecting a voltmeter across the charge contacts and measuring the voltage with the transmitter keyed.

For the rechargeable battery packs, a fully charged battery pack should provide a reading of 7.5 to 8 Volts. A fully discharged battery pack should provide a reading of no less than 6 Volts.

For dry battery packs, replace the batteries if the reading is 6 Volts or less.

RCSS CHECK

The RCSS protective circuitry in battery pack 19D413522G5 should be checked on a routine basis. This can be done by connecting a 2-ohm resistor across the battery pack output terminals. A voltage reading of 0.20 Volt or less across the 2-ohm resistor indicates proper operation. Any reading substantially higher than 0.20 Volt indicates a malfunction in the RCSS. The battery pack should not be used.

RECHARGEABLE BATTERY CHECK

One of the best service checks for the PE series rechargeable battery packs can be easily obtained by measuring the milliamper-hour capacity. The results of the measurement can then be compared with the rated capacity of the battery pack to determine the general condition of the rechargeable batteries.

Table 2 - Capacity Measurement Data

RECHARGEABLE BATTERY PACK	RATED CAPACITY	AVERAGE DISCHARGE RATE (for 60 minutes)	LOAD RESISTOR (R_L)	END VOLTAGE
Optional (6 cells) 19D413522G1	500 mAh	≈ 500 mA	15 ohms, 8 Watts	6 VDC
Standard (6 cells) 19D413522G4	700 mAh	≈ 700 mA	10.5 ohms 10 Watts	6 VDC
Optional Intrinsically Safe (7 cells) 19D413522G5	700 mAh	≈ 700 mA	10 ohms 10 Watts	6 VDC

First, it is necessary to find the percentage of rated capacity. This is obtained by measuring the time it takes to discharge a fully charged battery pack until the voltage drops to 6.0 Volts. The proper load resistor for each of the battery packs is shown in Table 2.

Then use the formula $\frac{T}{60} - \%$ where "T" is the time in minutes required to discharge the battery pack to 6 Volts and % is the percentage of rated capacity the battery delivered to a load. For example: assume the standard battery pack voltage dropped to 6 Volts in 50 minutes:

$$\frac{50}{60} = .83 \text{ (percentage of capacity)}$$

Now multiply the percentage of capacity by its rated capacity (see Table 2):

$$.83 \times 500 \text{ mA} = 415 \text{ mAh}$$

The 415 milliamperes-hours is the actual capacity of the battery pack.

NOTE

As the voltage drops very fast near the end of the discharge cycle, be very careful to avoid discharging the battery pack below 6.0 Volts.

BATTERY CHARGERS

Several different PE Series chargers are available for recharging General Electric nickel-cadmium battery packs. For specific instructions refer to the applicable operating instructions or maintenance manual.

MOBILE RADIO DEPARTMENT
GENERAL ELECTRIC COMPANY • LYNCHBURG, VIRGINIA 24502

GENERAL  ELECTRIC

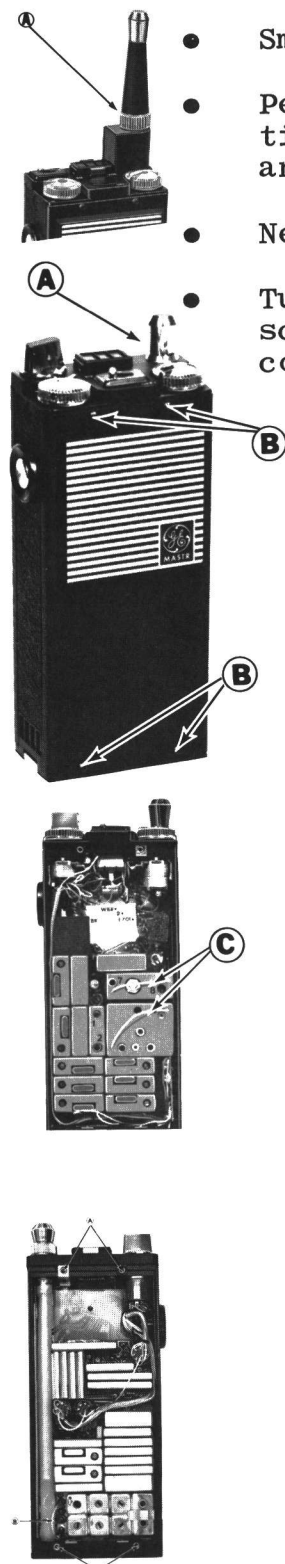
DISASSEMBLY PROCEDURE

Do not attempt to remove a module from the printed wiring board until troubleshooting indicates that the module is bad. Remove or replace the assemblies or modules as directed.

Caution: Always remove the battery before removing any component board to avoid blowing the fuse.

Equipment Required

- Small Phillips-head screwdriver.
- Pencil-type soldering iron (40-60 watts) with a fine tip for unsoldering module leads and component leads, and a medium tip for unsoldering module mounting tabs.
- Needlenose pliers for removing slotted nuts.
- Tuning tool 19B219079-P1 for removing Allen-head screws in the cover, and the set screws in the controls and antenna tip.



STEP 1.

To remove the antenna, unscrew the antenna nut (A) and pull out the antenna.

STEP 2.

To gain access to the transmitter, remove the four Allen-head screws (B) with the tuning tool, and carefully lift off the front cover to avoid breaking the speaker leads.

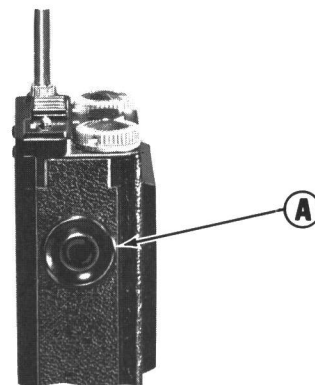
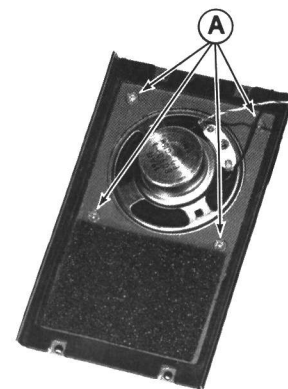
The exciter and PA modules can be unplugged by pulling on lifting straps (C).

STEP 3.

To gain access to the receiver and tone board, remove the four Allen-head screws (A) in the back cover with the tuning tool and lift off the cover. Lift the receiver board out of the case by lifting strap (B). The tone board can also be lifted out of the case.

CAUTION

Do not place either board on metal or other conductive surface with power applied. To do so will damage the Integrated Circuit modules. A small "pancake" of Duxseal® provides an excellent insulated work surface for the receiver or tone board.



STEP 4.

To remove the Volume or Squelch Control, remove the set screw (A) in the side of the control with the tuning tool. Then unscrew the slotted nut and remove the control.

To remove the Multi-Frequency switch, remove the set screw (B) as directed above. Then remove the washer, unscrew the slotted nut and remove the control.

STEP 5.

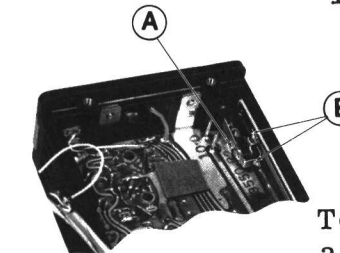
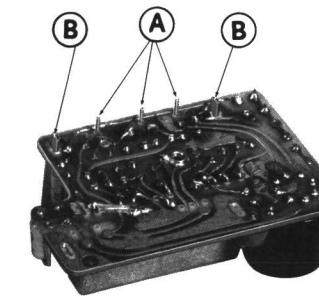
To replace the accessory jack, first remove the tone board if present. Then unscrew the slotted nut (A), and press down to the top of the jack to break the waterproof seal. Apply RTV-108 (GE Part No. 19A115153P2) around the shoulder on the new jack before inserting the jack into the mounting hole and replacing the slotted nut.

STEP 6.

To replace the speaker, remove the four Phillips-head screws (A), and lift off the speaker cover. Then push the speaker out of its mounting hole and remove any of the sealant remaining around the edge of the mounting hole. Apply RTV-108 around the edge of the speaker mounting hole and replace the speaker in the hole aligned as shown. Then replace the speaker cover.

STEP 7.

To replace the PTT switch or clean the rubber diaphragm, use a 3/32-inch diameter blade flat-head screwdriver (GE Service Parts No. SPK-528) and remove the two screws holding the PTT ring (A) to the case. Remove the PTT ring and button. Remove the diaphragm, metal disk and spring.



STEP 8.

To replace one of the modules, unsolder and straighten up the module wire leads (A). Remove any solder accumulation from the leads.

Unsolder and straighten up the module mounting tabs (B) and remove any solder accumulation.

If replacing the receiver front end or mixer modules, also remove the small screws holding the helical resonators. Replace the module and solder down the mounting tabs and then the wire leads. Refer to the appropriate Outline Diagram (see Table of Contents) for the wire lead placement, if required.

STEP 9.

To replace the antenna switch, remove the antenna and the receiver and tone boards from the case. Next, remove the Phillips-head screw (A) and then unsolder the mounting tabs (B).

Install the new switch by replacing the Phillips-head screw (A) and then soldering the mounting tabs (B).

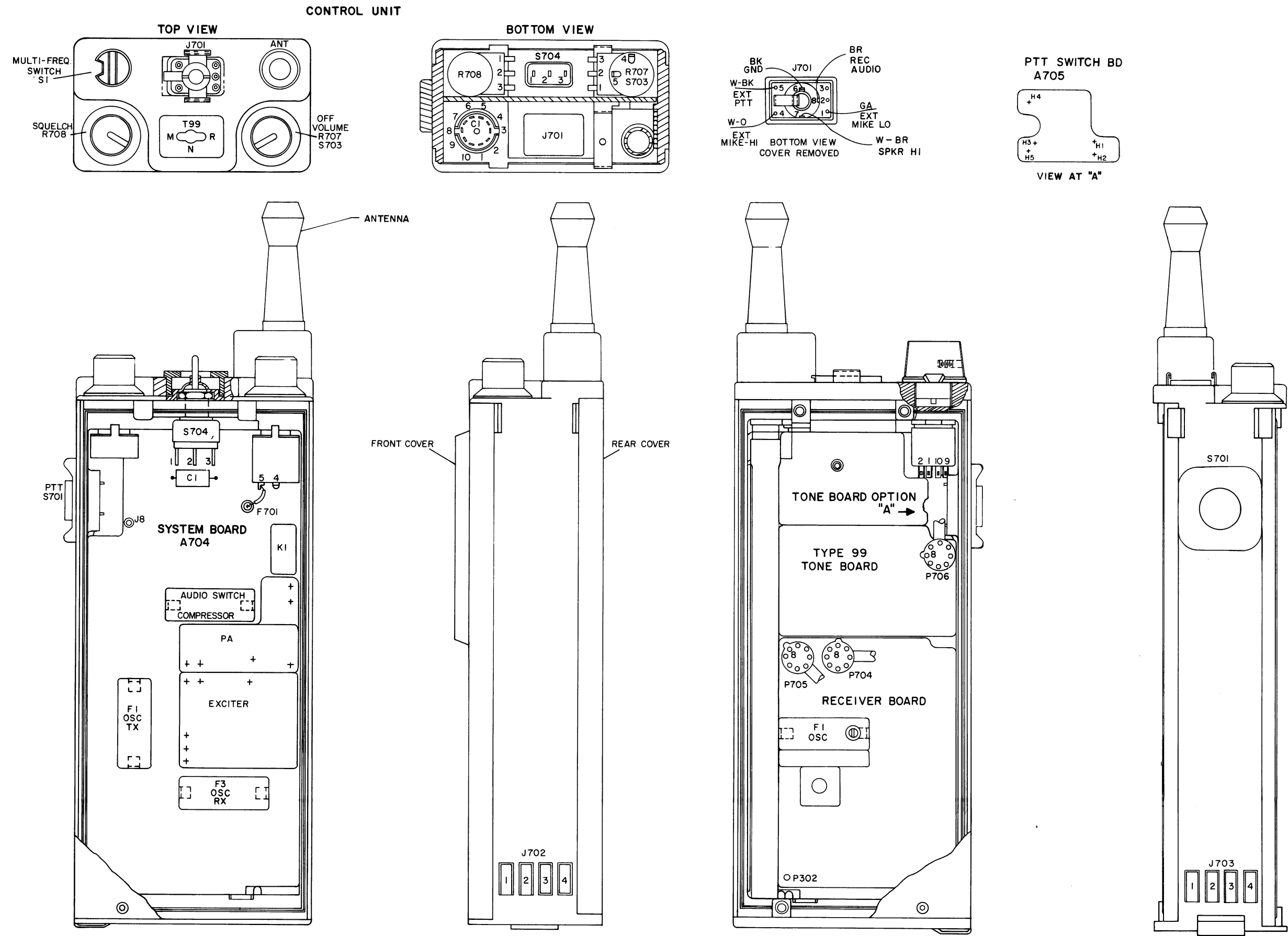
WARNING

The stud mounted RF Power Transistor used in the PA Module contain Beryllium Oxide, a TOXIC substance. If the ceramic or other encapsulation is opened, crushed, broken or abraded, the dust may be hazardous if inhaled. Use care in replacing transistors of this type.

DISASSEMBLY PROCEDURE

PE MODEL TWO-WAY FM RADIO

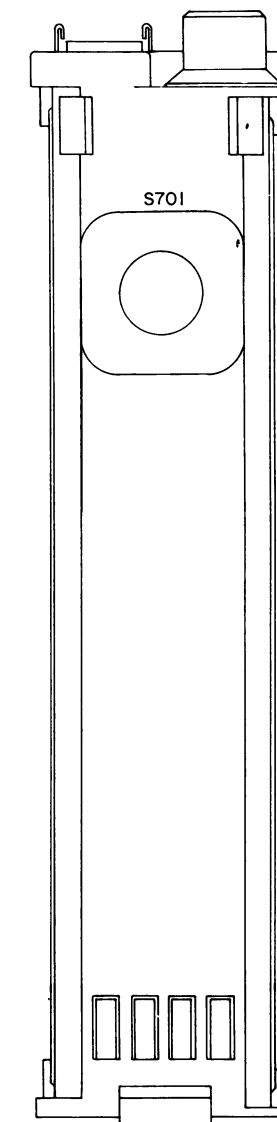
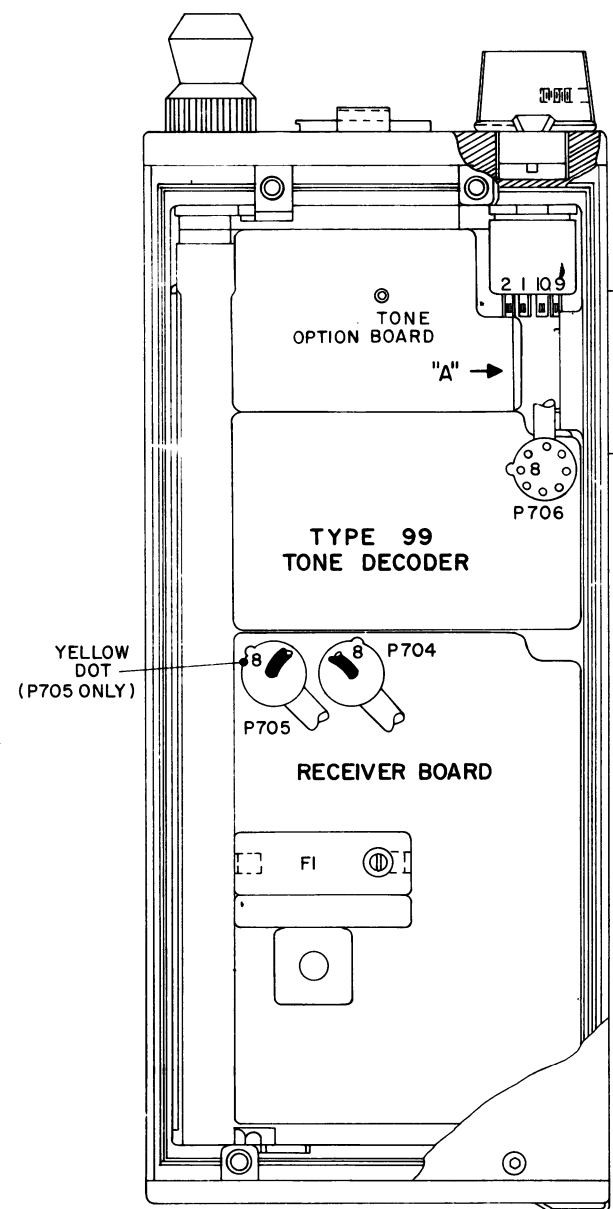
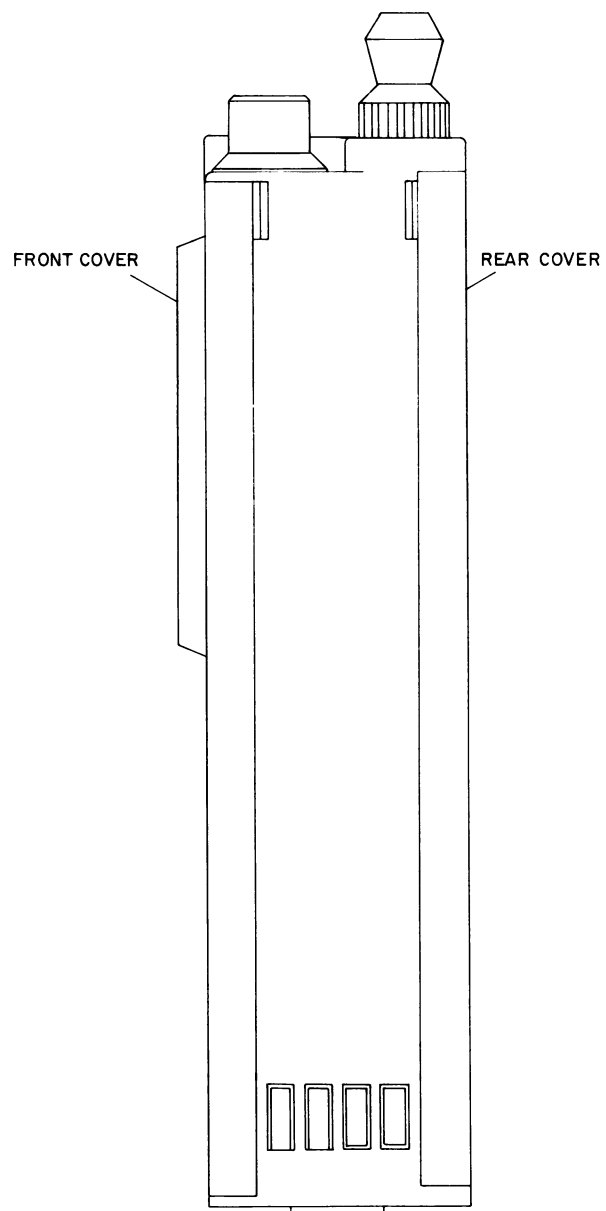
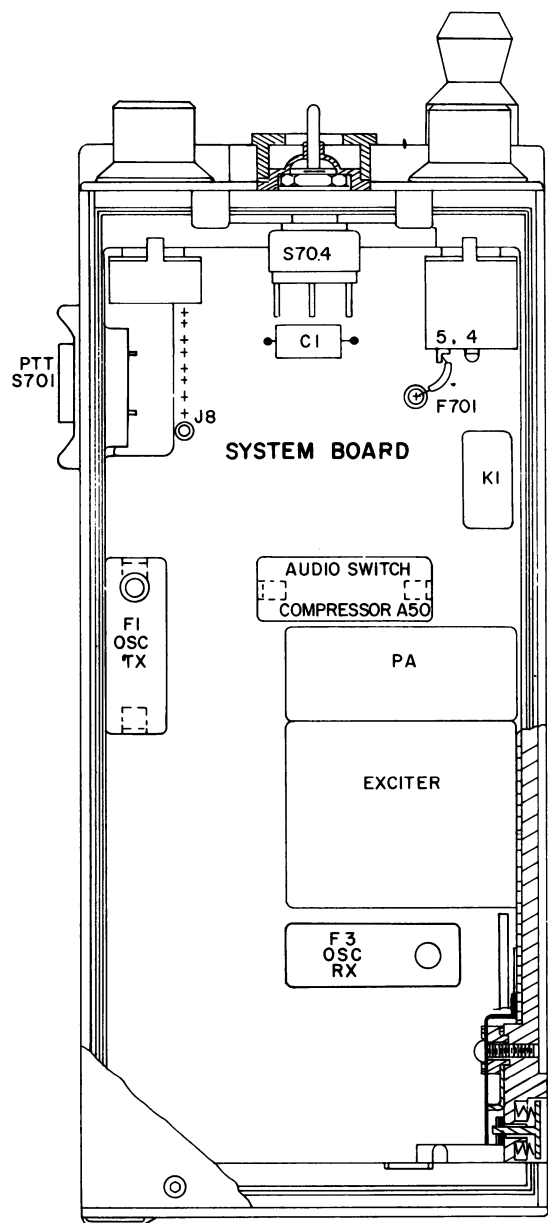
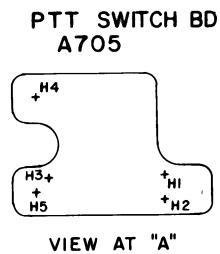
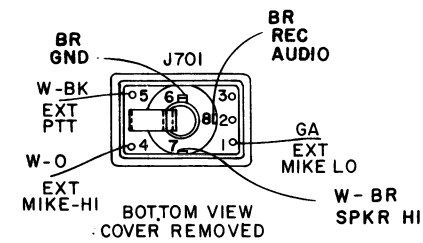
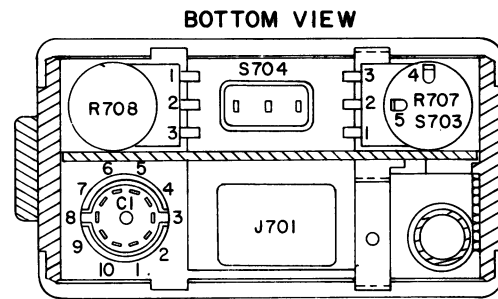
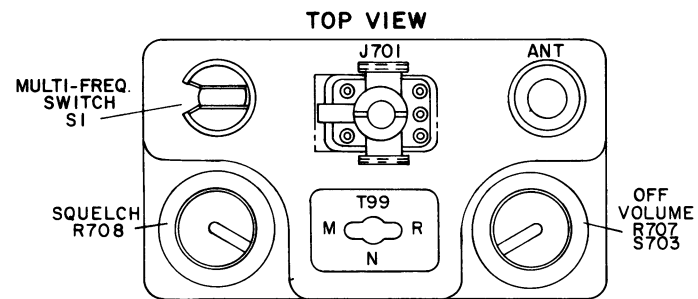
Issue 1



MODULE LAYOUT DIAGRAM

30—50 MHz, PE MODEL TWO-WAY FM RADIO

CONTROL UNIT

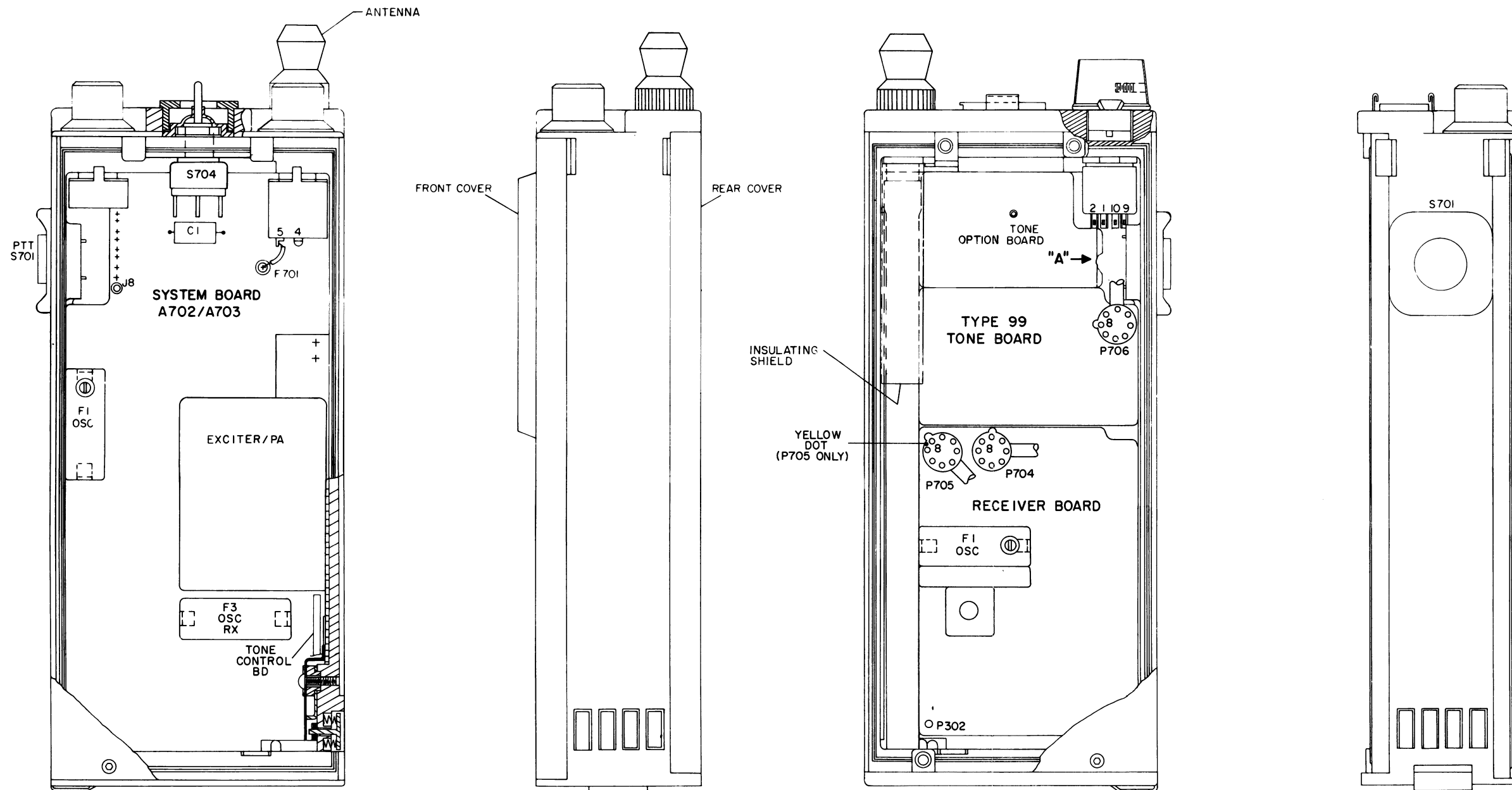
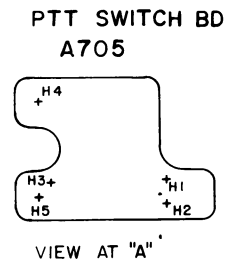
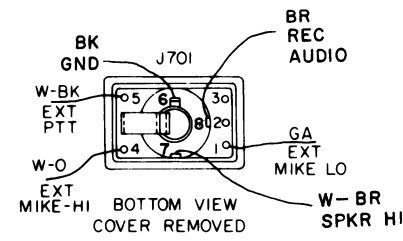
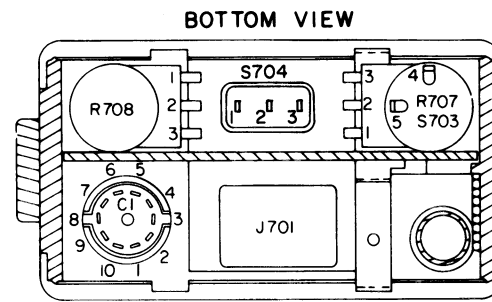
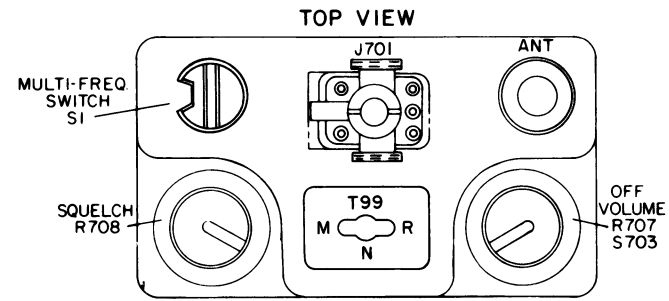


(19D417967, Rev. 3)

MODULE LAYOUT DIAGRAM

150.8—174 MHz PE MODEL
TWO-WAY FM RADIO

CONTROL UNIT



MODULE LAYOUT DIAGRAM

406—512 MHz PE MODEL
TWO-WAY FM RADIO

(19D423013, Rev. 3)

MOUNTING INSTRUCTIONS FOR HANDSTRAP AND SHOULDERSTRAP FASTENER KIT 19A127894G1

