Compact Professional Portable Radios

Basic Service Manual

MOTOROLA

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Safety Information

Product Safety and RF Energy Exposure for Portable Two-Way Radios

The information provided in this document supersedes the general safety information published prior to **February 2002**.

Caution

BEFORE USING THIS RADIO, READ THE FOLLOWING INFORMATION WHICH CONTAINS IMPORTANT OPERATING INSTRUCTIONS FOR SAFE USAGE AND RF ENERGY AWARENESS AND CONTROL INFORMATION AND OPERATIONAL INSTRUCTIONS FOR COMPLIANCE WITH RF ENERGY EXPOSURE LIMITS IN APPLICABLE NATIONAL AND INTERNATIONAL STANDARDS. ALSO READ THE OPERATIONAL INSTRUCTIONS FOR SAFE USAGE. FOR RADIOS THAT HAVE BEEN APPROVED AS INTRINSICALLY SAFE, READ THE INSTRUCTIONS AND INFORMATION ON INTRISINIC SAFETY ON PAGE page vii.

RF Energy Exposure Awareness and Control Information and Operational Instructions for Occupational Use

NOTICE: This radio is intended for use in occupational/controlled conditions where users have full knowledge of their exposure and can exercise control over their exposure to meet the occupational limits in FCC and International standards. This radio device is NOT authorized for general population or consumer use.

This two-way radio uses electromagnetic energy in the radio frequency (RF) spectrum to provide communications between two or more users over a distance. It uses radio frequency (RF) energy or radio waves to send and receive calls. RF energy is one form of electromagnetic energy. Other forms include, but are not limited to, sunlight and x-rays. RF energy, however, should not be confused with these other forms of electromagnetic energy, which when used improperly, can cause biological damage. Very high levels of x-rays, for example, can damage tissues and genetic material.

Experts in science, engineering, medicine, health, and industry work with organizations to develop standards for safe exposure to RF energy. These standards provide recommended levels of RF exposure for both workers and the general public. These recommended RF exposure levels include substantial margins of protection.

All Motorola two-way radios are designed, manufactured, and tested to ensure they meet government-established RF exposure levels. In addition, manufacturers also recommend specific operating instructions to users of two-way radios. These instructions are important because they inform users about RF energy exposure and provide simple procedures on how to control it.

Please refer to the following websites for more information on what RF energy exposure is and how to control your exposure to assure compliance with established RF exposure limits:
http://www.fcc.gov/oet/rfsafety/rf-faqs.html
http://www.osha.gov/SLTC/radiofrequencyradiation/index.html

Federal Communication Commission (FCC) Regulations

The FCC rules require manufacturers to comply with the FCC RF energy exposure limits for portable two-way radios before they can be marketed in the U.S. When two-way radios are used as a consequence of employment, the FCC requires users to be fully aware of and able to control their exposure to meet occupational requirements. Exposure awareness can be facilitated by the use of a product label directing users to specific user awareness information. Your Motorola two-way radio

has a RF exposure product label. Also, your Motorola user manual, or separate safety booklet includes information and operating instructions required to control your RF exposure and to satisfy compliance requirements.

Compliance with RF Exposure Standards

Your Motorola two-way radio is designed and tested to comply with a number of national and International standards and guidelines (listed below) for human exposure to radio frequency electromagnetic energy. This radio complies with the IEEE (FCC) and ICNIRP exposure limits for occupational/controlled RF exposure environments at operating duty factors of up to 50% talk-50% listen and is authorized by the FCC for occupational use only.

In terms of measuring RF energy for compliance with these exposure guidelines, your radio generates measurable RF energy only while it is transmitting (during talking), not when it is receiving (listening) or in standby mode.

NOTE: The approved batteries, supplied with this radio, are rated for a 5-5-90 duty factor (5% talk-5% listen-90% standby) even though this radio complies with FCC occupational exposure limits and may operate at duty factors of up to 50% talk.

Your Motorola two-way radio complies with the following RF energy exposure standards and guidelines:

- United States Federal Communications Commission, Code of Federal Regulations; 47CFR part 2 sub-part J
- American National Standards Institute (ANSI) / Institute of Electrical and Electronic Engineers (IEEE) C95. 1-1992
- Institute of Electrical and Electronic Engineers (IEEE) C95.1-1999 Edition
- International Commission on Non-Ionizing Radiation Protection (ICNIRP) 1998
- Ministry of Health (Canada) Safety Code 6. Limits of Human Exposure to Radiofrequency Electromagnetic Fields in the Frequency Range from 3 kHz to 300 GHz, 1999
- Australian Communications Authority Radiocommunications (Electromagnetic Radiation - Human Exposure) Standard, 2003
- ANATEL ANNEX to Resolution No. 303 of July 2, 2002 "Regulation of limitation of exposure to electrical, magnetic and electromagnetic fields in the radio frequency range between 9 KHz and 300 GHz" and "Attachment to resolution # 303 from July 2, 2002"
  "Additional Requirements for SMR, Cellular and PCS Product Certification"

RF Exposure Compliance and Control Guidelines and Operating Instructions

To control your exposure and ensure compliance with the occupational/controlled environment exposure limits, always adhere to the following procedures.

Guidelines:

- Do not remove the RF Exposure Label from the device.
- User awareness instructions should accompany device when transferred to other users.
- Do not use this device if the operational requirements described herein are not met.

Operating Instructions

- Transmit no more than the rated duty factor of 50% of the time. To transmit (talk), push the Push-To-Talk (PTT) button. To receive calls, release the PTT button. Transmitting 50% of the time, or less, is important because this radio generates measurable RF energy exposure only when transmitting (in terms of measuring for standards compliance).

- Hold the radio in a vertical position in front of the face with the microphone (and other parts of the radio including the antenna) at least one inch (2.5 centimeters) away from the nose or lips.
- Antenna should be kept away from the eye. Keeping the radio at a proper distance is important since RF exposures decrease with increasing distance from the antenna.
- When worn on the body, always place the radio in a Motorola-approved clip, holder, holster, case, or body harness for this product. Using approved body-worn accessories is important because the use of non-Motorola-approved accessories may result in exposure levels, which exceed the FCC occupational/controlled environment RF exposure limits.
- If you are not using a body-worn accessory and are not using the radio in the intended use position in front of the face, ensure the antenna and the radio are kept at least one inch (2.5 centimeters) from the body when transmitting. Keeping the radio at a proper distance is important because RF exposures decrease with increasing distance from the antenna.

Approved Accessories

- Use only Motorola-approved supplied or replacement antennas, batteries, and accessories. Use of Non-Motorola approved antennas, batteries, and accessories may exceed the FCC (IEEE) and ICNIRP RF exposure guidelines.
- For a list of Motorola-approved accessories, visit the following website, which lists approved accessories for your radio model: http://ap.cgiss.motorola.com/AAD/index.html.

Additional Information

For additional information on exposure requirements or other training information, visit http://www.motorola.com/rfhealth.

Electromagnetic Interference/Compatibility

NOTE: Nearly every electronic device is susceptible to electromagnetic interference (EMI) if inadequately shielded, designed, or otherwise configured for electromagnetic compatibility.

Facilities

To avoid electromagnetic interference and/or compatibility conflicts, turn off your radio in any facility where posted notices instruct you to do so. Hospitals or health care facilities may be using equipment that is sensitive to external RF energy.

Aircraft

When instructed to do so, turn off your radio when on board an aircraft. Any use of a radio must be in accordance with applicable regulations per airline crew instructions.

Medical Devices

Pacemakers

The Advanced Medical Technology Association (AdvaMed) recommends that a minimum separation of 6 inches (15 centimeters) be maintained between a handheld wireless radio and a pacemaker. These recommendations are consistent with those of the U.S. Food and Drug Administration.

Persons with pacemakers should:

- ALWAYS keep the radio more than 6 inches (15 centimeters) from their pacemaker when the radio is turned ON.

- Not carry the radio in the breast pocket.
- Use the ear opposite the pacemaker to minimize the potential for interference.
- Turn the radio OFF immediately if there is any reason to suspect that interference is taking place.

Hearing Aids

Some digital wireless radios may interfere with some hearing aids. In the event of such interference, you may want to consult your hearing aid manufacturer to discuss alternatives.

Other Medical Devices

If you use any other personal medical device, consult the manufacturer of your device to determine if it is adequately shielded from RF energy. Your physician may be able to assist you in obtaining this information.

Use of communication devices while driving

Always check the laws and regulations on the use of radios in the areas where you drive.

- Give full attention to driving and to the road.
- Use hands-free operation, if available.
- Pull off the road and park before making or answering a call, if driving conditions or regulations so require.

Operational Warnings

WARNING

For vehicle with air bags

Refer to vehicle manufacturer's manual prior to installation of electronic equipment to avoid interference with air bag wiring.

Do not place a portable radio in the area over an air bag or in the air bag deployment area. Air bags inflate with great force. If a portable radio is placed in the air bag deployment area and the air bag inflates, the radio may be propelled with great force and cause serious injury to occupants of the vehicle.

Potentially Explosive Atmospheres

(Explosive atmospheres refers to hazard classified locations that may contain hazardous gas, vapors, or dusts.)

Turn off your radio prior to entering any area with a potentially explosive atmosphere unless it is a portable radio type especially qualified for use in such areas as Intrinsically Safe (for example, Factory Mutual, CSA, UL, or CENELEC).

Do not remove, install, or charge batteries in such areas. Sparks in a potentially explosive atmosphere can cause an explosion or fire resulting in bodily injury or even death.

The areas with potentially explosive atmospheres referred to above include fueling areas such as below decks on boats, fuel or chemical transfer or storage facilities, and areas where the air contains chemicals or particles such as grain, dust or metal powders. Areas with potentially explosive atmospheres are often, but not always, posted.

Blasting Caps And Blasting Areas

To avoid possible interference with blasting operations, turn off your radio when you are near electrical blasting caps, in a blasting area, or in areas posted: "Turn off two-way radio." Obey all signs and instructions.

Operational Cautions

Antennas

Do not use any portable radio that has a damaged antenna. If a damaged antenna comes into contact with your skin, a minor burn can result.

Batteries

All batteries can cause property damage and/or bodily injury, such as burns, if a conductive material such as jewelry, keys, or beaded chains touches exposed terminals. The conductive material may complete an electrical circuit (short circuit) and become quite hot. Exercise care in handling any charged battery, particularly when placing it inside a pocket, purse, or other container with metal objects.

Intrinsically Safe Radio Information

The Intrinsically safe approval unit refers to a product that has been approved as intrinsically safe by an approval agency (for example FM Approvals, CSA, UL, or Cenelec) and certifies that a particular product meets the Agency's applicable intrinsic safety standards for specific types of hazardous classified locations. A portable radio that has been approved for intrinsic safety will have Approval label attached to the radio to identify the unit as being Approved for specified hazardous atmospheres. This label specifies the hazardous Class/Division/Group along with the part number of the battery that must be used. The intrinsically safe approval label will be located on the portable radio unit.

Operational Cautions for Intrinsic Safe Equipmen

- Do not operate radio communications equipment in a hazardous atmosphere unless it is a type especially qualified (for example, FM, UL, CSA, or CELENELC approved). An explosion or fire may result.
- Do not operate a radio unit that has been approved as intrinsically safe product in a hazardous atmosphere if it has been physically damaged (for example, cracked housing). An explosion or fire may result.
- Do not replace or charge batteries in a hazardous atmosphere. Contact sparking may occur while installing or removing batteries and cause an explosion or fire.

Warnings for Radios Approved as Intrinsically Safe

Radios must ship from the Motorola manufacturing facility with the hazardous atmosphere capability and the intrinsic safety approval labelling (FM, UL, CSA, CENELEC). Radios will not be upgraded to this capability and labeled once they have been shipped to the field.

A modification changes the unit's hardware from its original design configuration. Modifications can only be made by the original product manufacturer.

WARNING

- **Do not replace or change accessories in a hazardous atmosphere. Contact sparking may occur while installing or removing accessories and cause an explosion or fire.**
- **Turn the radio off before removing or installing a battery or accessory.**
- **Do not disassemble an intrinsically safe product in any way that exposes the internal circuits of the unit.**
- **Failure to use an intrinsically safe approved battery or Approved accessories specifically approved for the radio unit may result in the dangerously unsafe condition of an unapproved radio combination being used in a hazardous location.**
- **Unauthorized or incorrect modification of the intrinsically safe approved Product will negate the approval rating of the product.**
- **Incorrect repair or relabeling of any intrinsically safe Agency approved radio could adversely affect the Approval rating of the unit.**
- **Use of a radio that is not intrinsically safe in a hazardous atmosphere could result in serious injury or death.**

Repair

WARNING

REPAIRS FOR MOTOROLA PRODUCTS WITH INTRINSICALLY SAFE APPROVAL ARE THE RESPONSIBILITY OF THE USER.

- **Repairs to a Motorola FM approved radio product should only be done at a location that has been FM audited under the FM 3605 repairs and service standard.**
- **Contact Motorola for assistance regarding repairs and service of Motorola intrinsically safe equipment.**

A repair constitutes something done internally to the unit that would bring it back to its original condition.

Items not considered as repairs are those in which an action is performed on a unit which does not require the outer casing of the unit to be opened in a manner that exposes the internal electrical circuits of the unit.

Do Not Substitute Options or Accessories

The Motorola communications equipment certified as intrinsically safe by the approving agency, (FM, UL, CSA, CENELEC) is tested as a complete system which consists of the listed agency Approved portable, Approved battery, and Approved accessories or options, or both. This Approved portable and battery combination must be strictly observed. There must be no substitution of items, even if the substitute has been previously Approved with a different Motorola communications equipment unit. Approved configurations are listed by the Approving Agency (FM, UL, CSA, CENELEC).

The intrinsically safe Approval label affixed to radio refers to the intrinsically safe classification of that radio product, and the approved batteries that can be used with that system.

The manual PN referenced on the intrinsically safe approval label identifies the approved Accessories and or options that can be used with that portable radio unit.

Using a non Motorola intrinsically safe battery and or accessory with the Motorola approved radio unit will void the intrinsically safe approval of that radio unit.

Table of Contents

Chapter 7 POWER UP SELF-TEST

Chapter 8 MODEL CHART AND TEST SPECIFICATION

Chapter 1

INTRODUCTION

1.0 Scope of Manual

This manual is intended for use by service technicians familiar with similar types of equipment. It contains service information required for the equipment described and is current as of the printing date. Changes which occur after the printing date may be incorporated by a complete Manual revision or alternatively as additions.

NOTE Before operating or testing these units, please read the Safety Information chapter in the front of this manual.

2.0 Warranty and Service Support

Motorola offers long term support for its products. This support includes full exchange and/or repair of the product during the warranty period, and service/ repair or spare parts support out of warranty. Any "return for exchange" or "return for repair" by an authorised Motorola Dealer must be accompanied by a Warranty Claim Form. Warranty Claim Forms are obtained by contacting an Authorised Motorola Dealer.

2.1 Warranty Period and Return Instructions

The terms and conditions of warranty are defined fully in the Motorola Dealer or Distributor or Reseller contract. These conditions may change from time to time and the following notes are for guidance purposes only.

In instances where the product is covered under a "return for replacement" or "return for repair" warranty, a check of the product should be performed prior to shipping the unit back to Motorola. This is to ensure that the product has been correctly programmed or has not been subjected to damage outside the terms of the warranty.

Prior to shipping any radio back to the appropriate Motorola warranty depot, please contact Customer Services. All returns must be accompanied by a Warranty Claim Form, available from your Customer Services representative. Products should be shipped back in the original packaging, or correctly packaged to ensure no damage occurs in transit.

2.2 After Warranty Period

After the Warranty period, Motorola continues to support its products in two ways.

1. Motorola's Accessories and Aftermarket Division (AAD) offers a repair service to both end users and dealers at competitive prices.
2. AAD supplies individual parts and modules that can be purchased by dealers who are technically capable of performing fault analysis and repair.

2.3 European Radio Support Centre (ERSC)

The ERSC Customer Information Desk is available through the following service numbers:

Austria:	08 00 29 75 41	Italy:	80 08 77 387
Belgium:	08 00 72 471	Luxemburg:	08 00 23 27
Denmark:	80 88 05 72	Netherlands:	08 00 22 45 13
Finland:	08 00 11 49 910	Norway:	80 01 11 15
France:	08 00 90 30 90	Portugal:	08 00 84 95 70
Germany:	08 00 18 75 240	Spain:	90 09 84 902
Greece:	00 80 04 91 29 020	Sweden:	02 07 94 307
UK :	08 00 96 90 95	Switzerland:	08 00 55 30 82
Ireland:	18 00 55 50 21	Iceland:	80 08 147

Or dial the European Repair and Service Centre:

Tel: +49 30 6686 1555

Please use these numbers for repair enquiries only.

2.4 Parts Identification and Ordering

Some replacement parts, spare parts, and/or product information can be ordered directly. If a complete Motorola part number is assigned to the part, it is available from Motorola Radio Products and Solutions Organization (RPSO). If no part number is assigned, the part is not normally available from Motorola. If the part number is appended with an asterisk, the part is serviceable by Motorola Depot only. If a parts list is not included, this generally means that no user-serviceable parts are available for that kit or assembly.

Orders for replacement parts, kits and assemblies should be placed directly on Motorola's local distribution/dealer organisation or via Motorola Online at: http://emeaonline.motorola.com

* The Radio Products and Solutions Organization (RPSO) was formerly known as the Radio Products Services Division (RPSD) and/or the Accessories and Aftermarket Division (AAD).

2.5 Technical Support

Motorola Product Services is available to assist the dealer/distributors in resolving any malfunctions which may be encountered.

North Europe - Stephen Woodrow
Telephone: +44 (0) 1256 488 082
Fax: +44 01256 488 080
Email: CSW066@motorola.com

Central and East Europe - Siggy Punzenberger
Telephone: +49 (0) 6128 70 2342
Fax: +49 (0) 6128 95 1096
Email: TFG003@email.mot.comm

Russia and Belarus - Oleg Machnev
Telephone: +7 495 785 0150
Fax: +7 495 785 0185
Email: COM005@email.mot.com

Germany - Customer Connect Team
Telephone: +49 (0) 30 6686 1539
Fax: +49 (0) 30 6686 1916
Email: cgiss.emea@europe.mot.com

Middle East and Africa - Wayne Holmes
Telephone: +27 11 800 7922
Fax: +27 11 800 7923
Email: radiosupport.za@motorola.com

Italy - Ugo Gentile
Telephone: +39 0 2822 0325
Fax: +39 0 2822 0334
Email: C13864@email.mot.com

France - Armand Roy
Telephone: +33 1 6935 7868
Fax: +33 1 6935 7808
Email: armand.roy@motola.com

France - Laurent Irrmann
Telephone: +33 1 6935 7866
Fax: +33 1 6935 7808
Email: laurent.irrmann@motola.com

2.6 Further Assistance From Motorola

You can also contact the Customer Help Desk through the following web address.
http://www.motorola.com/governmentandenterprise/contactus

2.7 Related Documents

The following documents are directly related to the use and maintainability of this product.

Title	Language	Part Number
GP344/GP344R Basic User Guide	Euro	6864110B54
GP388/GP388R Basic User Guide	Euro	6864110B97
GP366R Basic User Guide	Euro	6866577D01
GP644/GP644R Basic User Guide	Euro	6866542D01
GP666R Basic User Guide	Euro	6866577D02
GP688/GP688R Basic User Guide	Euro	6866542D02

3.0 Radio Model Information

The model number and serial number are located on a label attached to the back of your radio. You can determine the RF output power, frequency band, protocols, and physical packages. The example below shows one portable radio model number and its specific characteristics.

Table 1-1 Radio Model Number (Example: MDH38KDC9AN3)

	Type of Unit	Model Series	Freq. Band	Power Level	Physical Packages	Channel Spacing	Protocol	Feature Level
MD	**H**	**38**	**K** VHF (136-174 MHz)	**D** 4-5W	**C** GP344/ GP344R GP644/ GP644R	**9** Programma-ble	**AN** 5-Tone	**3** GP344/ GP344R GP644/ GP644R
			R UHF1 (403-470 MHz)		**F** GP366R GP666R			**5** GP366R GP666R
			S UHF2 (450-527 MHz)		**H** GP388/ GP388R GP688/ GP688R			**6** GP388/ GP388R GP688/ GP688R

H = Portable

MD = Country Code

Chapter 2

INTRINSICALLY SAFE RADIO INFORMATION

1.0 FMRC Approved Equipment

Anyone intending to use a radio in a location where hazardous concentrations of flammable material exist (hazardous atmosphere) is advised to become familiar with the subject of intrinsic safety and with the National Electric Code NFPA 70 (National Fire Protection Association) Article 500 (hazardous [classified] locations).

An Approval Guide, issued by Factory Mutual Research Corporation (FMRC), lists manufacturers and the products approved by FMRC for use in such locations. FMRC has also issued a voluntary approval standard for repair service (“Class Number 3605”).

FMRC Approval labels are attached to the radio to identify the unit as being FM Approved for specified hazardous atmospheres. This label specifies the hazardous Class/Division/Group along with the part number of the battery that must be used. Depending on the design of the portable unit, this FM label can be found on the back of the radio housing or the bottom of the radio housing.Their Approval mark is shown above.

WARNING: Do not operate radio communications equipment in a hazardous atmosphere unless it is a type especially qualified (e.g. FMRC Approved) for such use. An explosion or fire may result.

WARNING: Do not operate the FMRC Approved Product in a hazardous atmosphere if it has been physically damaged (e.g. cracked housing). An explosion or fire may result.

WARNING: Do not replace or charge batteries in a hazardous atmosphere. Contact sparking may occur while installing or removing batteries and cause an explosion or fire.

WARNING: Do not replace or change accessories in a hazardous atmosphere. Contact sparking may occur while installing or removing accessories and cause an explosion or fire.

WARNING: Do not operate the FMRC Approved Product unit in a hazardous location with the accessory contacts exposed. Keep the connector cover in place when accessories are not used.

WARNING: Turn radio off before removing or installing a battery or accessory.

WARNING: Do not disassemble the FMRC Approved Product unit in any way that exposes the internal electrical circuits of the unit.

Radios must ship from the Motorola manufacturing facility with the hazardous atmosphere capability and FM Approval labeling. Radios will not be “upgraded” to this capability and labeled in the field.

A modification changes the unit’s hardware from its original design configuration. Modifications can only be done by the original product manufacturer at one of its FMRC audited manufacturing facilities.

WARNING: Failure to use an FMRC Approved Product unit with an FMRC Approved battery or FMRC Approved accessories specifically approved for that product may result in the dangerously unsafe condition of an unapproved radio combination being used in a hazardous location.

Unauthorized or incorrect modification of an FMRC Approved Product unit will negate the Approval rating of the product.

2.0 Repair of FMRC Approved Products

REPAIRS FOR MOTOROLA FMRC APPROVED PRODUCTS ARE THE RESPONSIBILITY OF THE USER

You should not repair or relabel any Motorola manufactured communication equipment bearing the FMRC Approval label (“FMRC Approved Product”) unless you are familiar with the current FMRC Approval standard for repairs and service (“Class Number 3605”).

You may want to consider using a repair facility that operates under 3605 repair service approval.

WARNING: Incorrect repair or relabelling of any FMRC Approved Product unit could adversely affect the Approval rating of the unit.

WARNING: Use of a radio that is not intrinsically safe in a hazardous atmosphere could result in serious injury or death.

FMRC’s Approval Standard Class Number 3605 is subject to change at any time without notice to you, so you may want to obtain a current copy of 3605 from FMRC. Per the December, 1994 publication of 3605, some key definitions and service requirements are as follows:

2.1 Repair

A repair constitutes something done internally to the unit that would bring it back to its original condition Approved by FMRC. A repair should be done in an FMRC Approved facility.

Items not considered as repairs are those in which an action is performed on a unit which does not require the outer casing of the unit to be opened in a manner which exposes the internal electrical circuits of the unit. You do not have to be an FMRC Approved Repair Facility to perform these actions.

2.2 Relabelling

The repair facility shall have a method by which the replacement of FMRC Approval labels are controlled to ensure that any relabelling is limited to units that were originally shipped from the Manufacturer with an FM Approval label in place. FMRC Approval labels shall not be stocked by the repair facility. An FMRC Approval label shall be ordered from the original manufacturer as needed to repair a specific unit. Replacement labels may be obtained and applied by the repair facility providing satisfactory evidence that the unit being relabelled was originally an FMRC Approved unit.

Verification may include, but is not limited to: a unit with a damaged Approval label, a unit with a defective housing displaying an Approval label, or a customer invoice indicating the serial number of the unit and purchase of an FMRC Approved model.

2.3 Do Not Substitute Options or Accessories

The Motorola communications equipment certified by Factory Mutual is tested as a system and consists of the FM Approved portable, FM Approved battery, and FM Approved accessories or options, or both. This Approved portable and battery combination must be strictly observed. There must be no substitution of items, even if the substitute has been previously Approved with a different Motorola communications equipment unit. Approved configurations are listed in the FM Approval guide published by FMRC, or in the product FM Supplement. This FM Supplement is shipped with FM Approved radio and battery combination from the manufacturer. The Approval guide, or the Approval standard Class Number 3605 document for repairs and service, can be ordered directly through Factory Mutual Research Corporation located in Norwood, Massachusetts.

Chapter 3
MAINTENANCE

1.0 Introduction

This chapter provides details about the following:

- Preventive maintenance (inspection and cleaning)
- Safe handling of CMOS and LDMOS devices
- Disassembly and reassembly of the radio
- Repair procedures and techniques

2.0 Preventive Maintenance

The radios do not require a scheduled preventive maintenance program; however, periodic visual inspection and cleaning is recommended.

2.1 Inspection

Check that the external surfaces of the radio are clean, and that all external controls and switches are functional. It is not recommended to inspect the interior electronic circuitry.

2.2 Cleaning Procedures

The following procedures describe the recommended cleaning agents and the methods to be used when cleaning the external and internal surfaces of the radio. External surfaces include the front cover, housing assembly and battery case. These surfaces should be cleaned whenever a periodic visual inspection reveals the presence of smudges, grease, and/or grime.

NOTE **Internal surfaces should be cleaned only when the radio is disassembled for service or repair.**

The only recommended agent for cleaning the external radio surfaces is a 0.5% solution of a mild dishwashing detergent in water. The only factory recommended liquid for cleaning the printed circuit boards and their components is isopropyl alcohol (70% by volume).


Caution

CAUTION: The effects of certain chemicals and their vapors can have harmful results on certain plastics. Avoid using aerosol sprays, tuner cleaners, and other chemicals.

Cleaning External Plastic Surfaces

Apply the 0.5% detergent-water solution sparingly with a stiff, non-metallic, short-bristled brush to work all loose dirt away from the radio. Use a soft, absorbent, lintless cloth or tissue to remove the solution and dry the radio. Make sure that no water remains entrapped near the connectors, cracks, or crevices.

Cleaning Internal Circuit Boards and Components

Isopropyl alcohol (70%) may be applied with a stiff, non-metallic, short-bristled brush to dislodge embedded or caked materials located in hard-to-reach areas. The brush stroke should direct the dislodged material out and away from the inside of the radio. Make sure that controls or tunable components are not soaked with alcohol. Do not use high-pressure air to hasten the drying process since this could cause the liquid to collect in unwanted places. After completing of the cleaning process, use a soft, absorbent, lintless cloth to dry the area. Do not brush or apply any isopropyl alcohol to the frame, front cover, or back cover.

NOTE Always use a fresh supply of alcohol and a clean container to prevent contamination by dissolved material (from previous usage).

3.0 Safe Handling of CMOS and LDMOS Devices

Complementary metal-oxide semiconductor (CMOS) devices are used in this family of radios, and are susceptible to damage by electrostatic or high voltage charges. Damage can be latent, resulting in failures occurring weeks or months later. Therefore, special precautions must be taken to prevent device damage during disassembly, troubleshooting, and repair.

Handling precautions are mandatory for CMOS circuits and are especially important in low humidity conditions. DO NOT attempt to disassemble the radio without first referring to the following CAUTION statement.

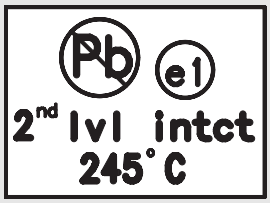
Caution

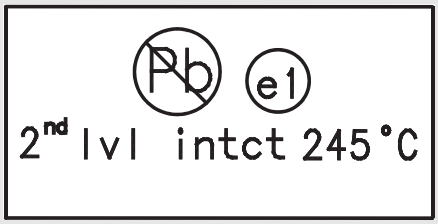
CAUTION: This radio contains static-sensitive devices. Do not open the radio unless you are properly grounded. Take the following precautions when working on this unit:

- Store and transport all CMOS devices in conductive material so that all exposed leads are shorted together. Do not insert CMOS devices into conventional plastic “snow” trays used for storage and transportation of other semiconductor devices.
- Ground the working surface of the service bench to protect the CMOS device. We recommend using the Motorola Static Protection Assembly (part number 0180386A82), which includes a wrist strap, two ground cords, a table mat, and a floor mat.
- Wear a conductive wrist strap in series with a 100k resistor to ground. (Replacement wrist straps that connect to the bench top covering are Motorola part number RSX-4015.)
- Do not wear nylon clothing while handling CMOS devices.
- Do not insert or remove CMOS devices with power applied. Check all power supplies used for testing CMOS devices to be certain that there are no voltage transients present.
- When straightening CMOS pins, provide ground straps for the apparatus used.
- When soldering, use a grounded soldering iron.
- If at all possible, handle CMOS devices by the package and not by the leads. Prior to touching the unit, touch an electrical ground to remove any static charge that you may have accumulated. The package and substrate may be electrically common. If so, the reaction of a discharge to the case would cause the same damage as touching the leads.

4.0 Repair Procedures and Techniques — General

NOTE Environmentally Preferred Products (EPP) (refer to the marking on the printed circuit boards — examples shown below) were developed and assembled using environmentally preferred components and solder assembly techniques to comply with the European Union's **Restriction of Hazardous Substances (ROHS) Directive 2002/95/EC Waste** and **Electrical and Electronic Equipment (WEEE) Directive 2002/96/EC.** To maintain product compliance and reliability, use only the Motorola specified parts in this manual.





Any rework or repair on Environmentally Preferred Products must be done using the appropriate lead-free solder wire and lead-free solder paste as stated in the following table:

Table 3-1 Lead Free Solder Wire Part Number List

Motorola Part Number	Alloy	Flux Type	Flux Content by Weight	Melting Point	Supplier Part number	Diameter	Weight
1088929Y01	95.5Sn/3.8Ag/0.7Cu	RMA Version	2.7-3.2%	217C	52171	0.015"	1lb spool
1088929Y02	95.5Sn/3.8Ag/0.7Cu	RMA Version	2.7-3.2%	217C	52170	0.010"	0.5lb spool
1088929Y03	95.5Sn/3.8Ag/0.7Cu	RMA Version	2.7-3.2%	217C	52173	0.032"	1lb spool

Table 3-2 Lead Free Solder Paste Part Number List

Motorola Part Number	Manufacturer Part Number	Viscosity	Type	Composition & Percent Metal	Liquid Temperature
1085674C03	NC-SMQ230	900-1000KCPs Brookfield (5rpm)	Type 3 (-325/+500)	(95.5%Sn-3.8%Ag-0.7%Cu) 89.3%	217°C

Parts Replacement and Substitution

When damaged parts are replaced, identical parts should be used. If the identical replacement part is not locally available, check the parts list for the proper Motorola part number and order the part from the nearest Motorola Communications parts center listed in the "Piece Parts" section of this manual.

Rigid Circuit Boards

This family of radios uses bonded, multi-layer, printed circuit boards. Since the inner layers are not accessible, some special considerations are required when soldering and unsoldering components. The printed-through holes may interconnect multiple layers of the printed circuit. Therefore, exercise care to avoid pulling the plated circuit out of the hole.

When soldering near the 20-pin and 40-pin connectors:

- Avoid accidentally getting solder in the connector.
- Be careful not to form solder bridges between the connector pins.
- Examine your work closely for shorts due to solder bridges.

Flexible Circuits

The flexible circuits are made from a different material than the rigid boards, and require different soldering techniques. Excessive prolonged heat on a flexible circuit can damage the material. Therefore, avoid excessive heat and excessive bending.

For parts replacement, use the ST-1087 Temperature-Controlled Solder Station with a 600-700°F tip, and use small diameter solder such as ST-633. The smaller size solder will melt faster and require less heat to be applied to the circuit.

To replace a component on a flexible circuit:

1. Grasp with seizers (hemostats) the edge of the flexible circuit near the part to be removed.
2. Pull gently.
3. Apply the tip of the soldering iron to the component connections while pulling with the seizers.

NOTE Do not attempt to puddle-out components. Prolonged application of heat may damage the flexible circuit.

Chip Components

Use either the RLN-4062 Hot-Air Repair Station or the Motorola 0180381B45 Repair Station for chip component replacement. When using the 0180381B45 Repair Station, select the TJ-65 mini-thermojet hand piece. On either unit, adjust the temperature control to 700°F. (370°C), and adjust the airflow to a minimum setting. Airflow can vary due to component density.

- **To remove a chip component**, select a hot-air hand piece and position the nozzle of the hand piece approximately 1/8” above the component to be removed. Begin applying the hot air. Once the solder reflows, remove the component using a pair of tweezers. Using solder wick and a soldering iron or a power desoldering station, remove the excess solder from the pads.
- **To replace a chip component using a soldering iron**, select the appropriate micro-tipped soldering iron and apply fresh solder to one of the solder pads. Using a pair of tweezers, position the new chip component in place while heating the fresh solder. Once solder wicks onto the new component, remove the heat from the solder. Heat the remaining pad with the soldering iron and apply solder until it wicks to the component. If necessary, touch up the first side. All solder joints should be smooth and shiny.
- **To replace a chip component using hot air**, select the hot-air hand piece and reflow the solder on the solder pads to smooth it. Apply a drop of solder paste flux to each pad. using a pair of tweezers, position the new component in place. Position the hot-air hand piece approximately 1/8” above the component and begin applying heat. Once the solder wicks to the component, remove the heat and inspect the repair. All joints should be smooth and shiny.

Shields

Removing and replacing shields will be done with the R-1070 station with the temperature control set to approximately 415°F (215°C); 445°F (230°C) max.

- **To remove the shield**, place the circuit board in the R-1070's holder. Select the proper heat focus head and attach it to the heater chimney. Add solder paste flux around the base of the shield. Position the shield under the heat-focus head. Lower the vacuum tip and attach it to the shield by turning on the vacuum pump. Lower the focus head until it is approximately 1/8" (0.3cm) above the shield. Turn on the heater and wait until the shield lifts off the circuit board. Once the shield is off, turn off the heat, grab the part with a pair of tweezers, and turn off the vacuum pump. Remove the circuit board from the R-1070's circuit board holder.
- **To replace the shield**, add solder to the shield if necessary, using a micro-tipped soldering iron. Next, rub the soldering iron tip along the edge of the shield to smooth out any excess solder. Use solder wick and a soldering iron to remove excess solder from the solder pads on the circuit board. Place the circuit board back in the R1070's circuit board holder. Place the shield on the circuit board using a pair of tweezers. Position the heat-focus head over the shield and lower it to approximately 1/8" above the shield. Turn on the heater and wait for the solder to reflow.
  Once complete, turn off the heat, raise the heat-focus head and wait approximately one minute for the part to cool. Remove the circuit board and inspect the repair. No cleaning should be necessary.

5.0 Servicing IP67 radios

Battery charger is not waterproof. IP67 radios have to be dry prior charging with the battery charger for safety and proper operation. Do not operate the charger when your hand is wet or while holding the wet IP67 radio. For safety operation, do not touch the battery contacts when your hand is wet. Do not put the battery alone into water as this may corrode the metal contacts. Water submersible IP67 radios have to be fitted with Motorola authorized IP67 batteries for proper use. Make sure the IP67 radios are dry before connecting to the testing equipment or performing any testing.

6.0 GP344/GP644 Radio Disassembly and Reassembly — General

Since these radios may be disassembled and reassembled with the use of only four (board to chassis) screws, it is important to pay particular attention to the snaps and tabs, and how parts align with each other.

The following tools are required for disassembling the radio:

- Chassis opener
- Penknife-size screwdriver
- Torx T6 screwdriver

If a unit requires more complete testing or service than is customarily performed at the basic level, send this unit to a Motorola Authorized Service Center. (See Section 1 for a list of authorized service centers.)

The following disassembly procedures should be performed only if necessary:

Chassis Assembly Disassembly (Paragraph 7.2)

Speaker, Microphone, and Universal Connector Flex Disassembly (Paragraph 7.3)

Controller Board, Plain Module and Non-Keypad Disassembly (Paragraph 7.4)

Control Top Disassembly (Paragraph 7.5)

7.0 GP344/GP644 Radio Disassembly — Detailed

7.1 Front Cover from Chassis Disassembly

1. Turn off the radio.
2. Remove the battery:
   a. Pull down on the two battery-release buttons.
   b. With the buttons pulled down, the top of the battery will fall from the radio.
   c. Remove the battery from the radio.

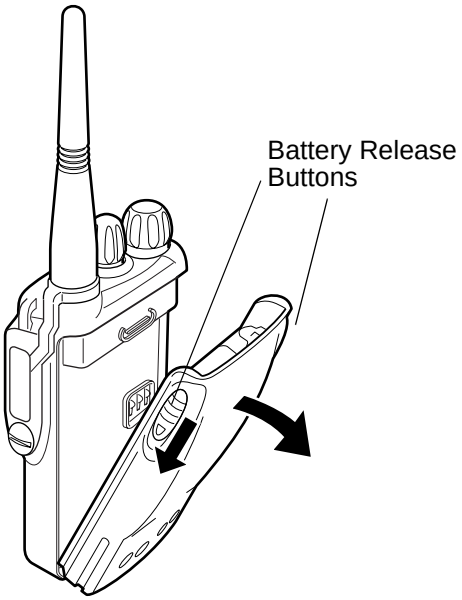


Figure 3-1 Battery Removal

3. Remove the antenna.

4. Pull the volume and channel selector knobs off of their shafts.

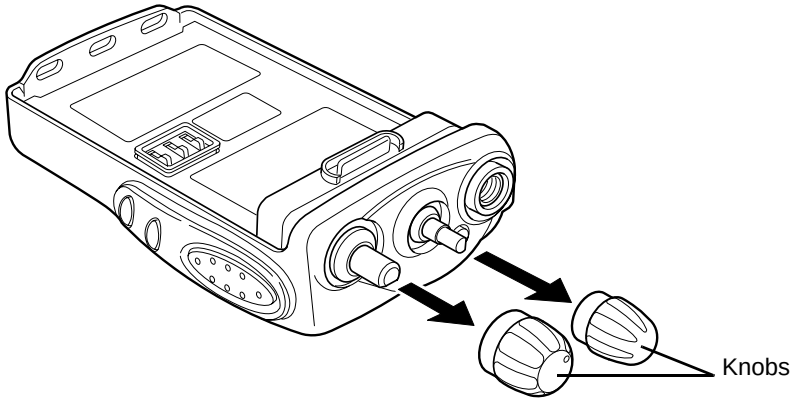


Figure 3-2 Knob Removal

NOTE Both knobs slide on and off. However, they are supposed to fit very tightly on their shafts.

5. Separate the chassis from the internal electronics front cover assembly as follows:

a. Insert a small, flat-blade screwdriver, or similar instrument, in between the thin retaining wall and the chassis at the bottom of the radio. Do not mar the O-ring sealing area on the housing.

b. Slowly pry the bottom of the chassis from the cover by pushing the chassis opener (part number 6680702Z01) down, and prying the handle of the tool over and behind the base of the radio. This prying action forces the thin inner plastic wall toward the base of the radio, releasing the two chassis base tabs.

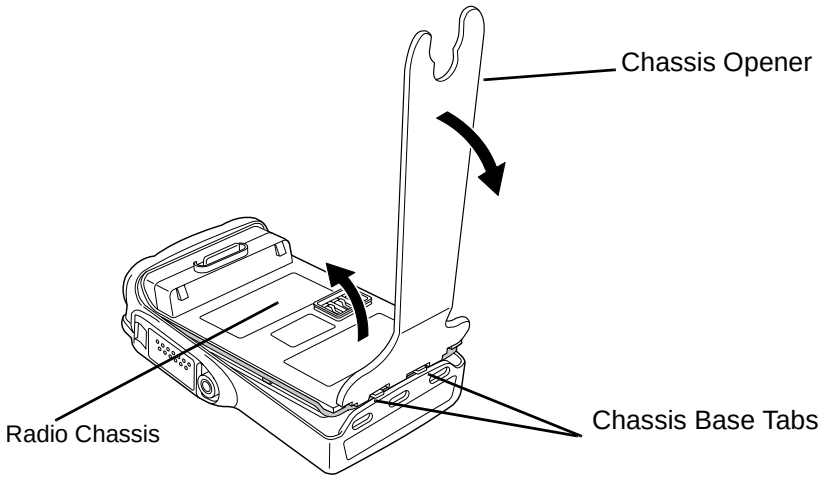


Figure 3-3 Chassis Removal

Caution

CAUTION: Marring the front cover O-ring sealing area will prevent the radio from sealing properly.

NOTE Flexible ribbon circuits (flexes) connecting the front cover assembly and the chassis prevent you from completely separating the two units.

6. Lay the chassis down. Rotate the front cover backward and slightly away from the chassis.
7. Lift the latches on the main circuit board to release the flexes from their connectors.

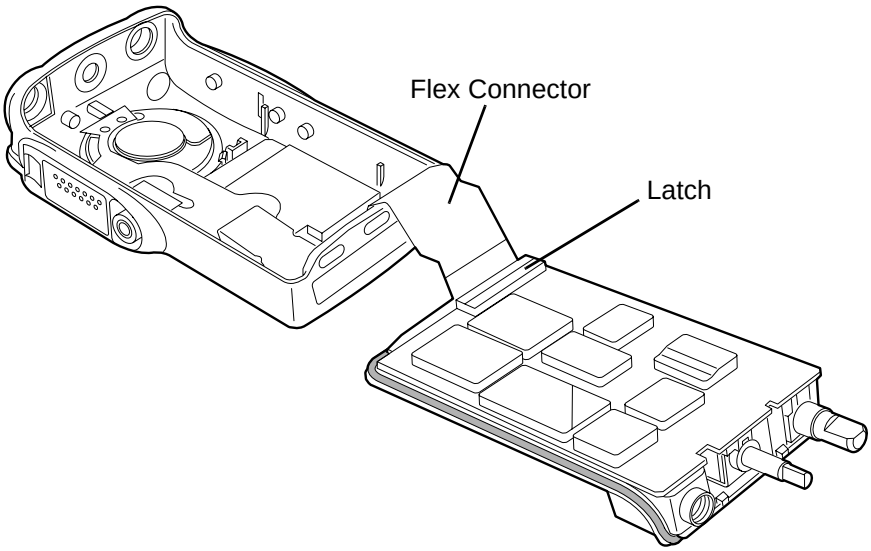


Figure 3-4 Unlatch Flex Connectors

7.2 Chassis Assembly Disassembly

Use a Torx T6 screwdriver to remove the four screws holding the main board to the chassis.

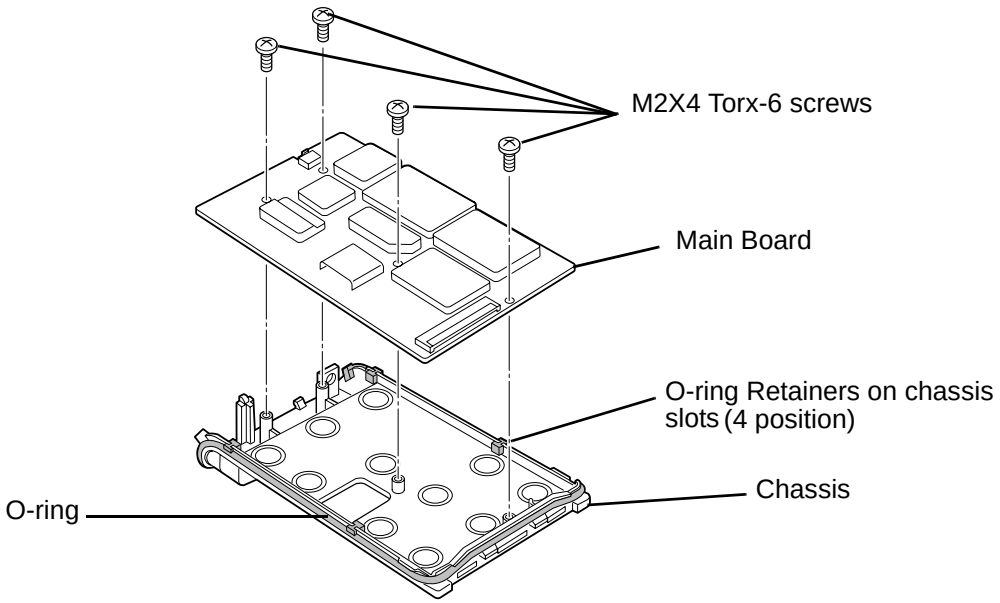


Figure 3-5 Remove Main Board from Chassis

1. Lift the main board from the chassis (See Figure 3-5).

CAUTION: Refer to the CMOS CAUTION paragraph on page 2 of this chapter before removing the main board. Be sure to use ESD protection when handling circuit boards.

2. Remove the four small O-ring retainers from their slots in the chassis. Note the alignment of the retainers for reassembly.
3. Remove the O-ring.
4. Slide off the ground contact from the top corner boss of the radio chassis.

7.3 Speaker, Microphone, and Universal Connector Flex Disassembly

1. Turn the screw at the bottom of the dustcover counterclockwise with your fingers. Lift the dustcover out of its pocket.

NOTE The dustcover must be removed to remove the speaker-microphone assembly flex circuit. The speaker is held in place with a two-legged retainer bracket. The bracket legs are secured by the front cover slots. Be careful not to damage the speaker when removing the retainer bracket.

2. Insert a penknife screwdriver in between the speaker and housing. Then pull up the screwdriver to remove the speaker from the housing.
3. Pull the rubber microphone boot from its seated position. Unless you are replacing the microphone, leave it in the boot.

NOTE The speaker-microphone assembly flex circuit goes through the front cover wall to the outside wall. To replace this assembly, you must peel-off the universal connector escutcheon label. The existing escutcheon and speaker cannot be reassembled; a new part must be used. (See item number 3 on the exploded view drawing.)

4. Peel-off the universal connector flex circuit escutcheon (label).
5. Pry the flex circuit (adhesive held) backer board away from the front cover, and remove the universal connector tail of the speaker-microphone assembly through its opening in the front cover.

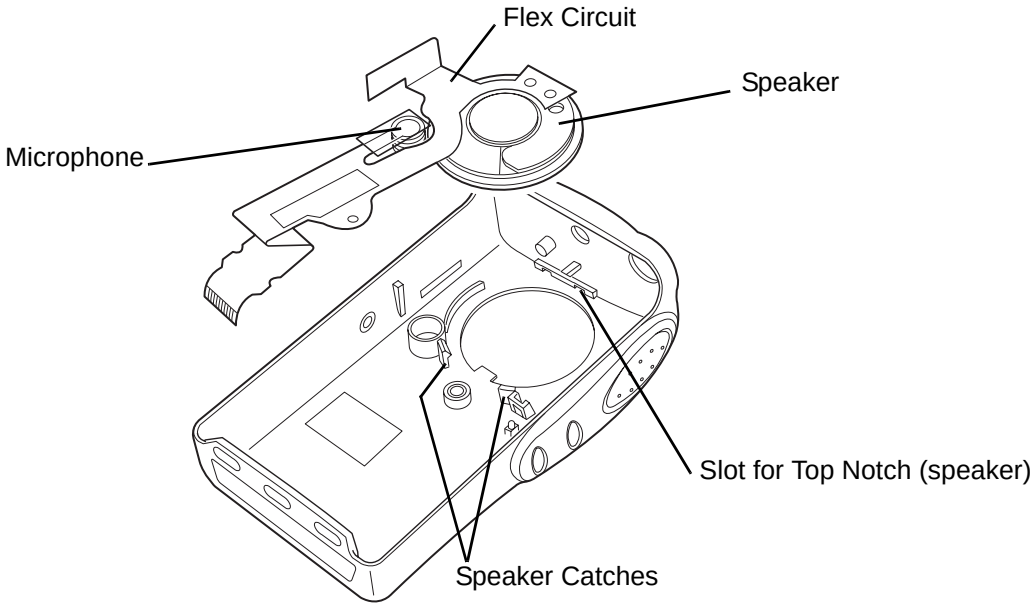


Figure 3-6 Removal Speaker-Microphone Assembly

6. After the universal connector tail of the speaker-microphone assembly is removed, the assembly can be completely removed. If it is necessary to replace the speaker or microphone, or both, do it while the flex circuit is removed from the front cover. When reassembling the microphone in its boot, make sure the microphone port faces the round hole in the bottom of the boot.

7.4 Controller Board, Plain Module and Non-Keypad Disassembly

1. Use a Torx T6 screwdriver to remove the screw from its position.

2. Insert a flat blade screwdriver in between the controller board and front cover. Pull up the screwdriver to disassemble the controller board from front cover. (See Figure 3-7.).

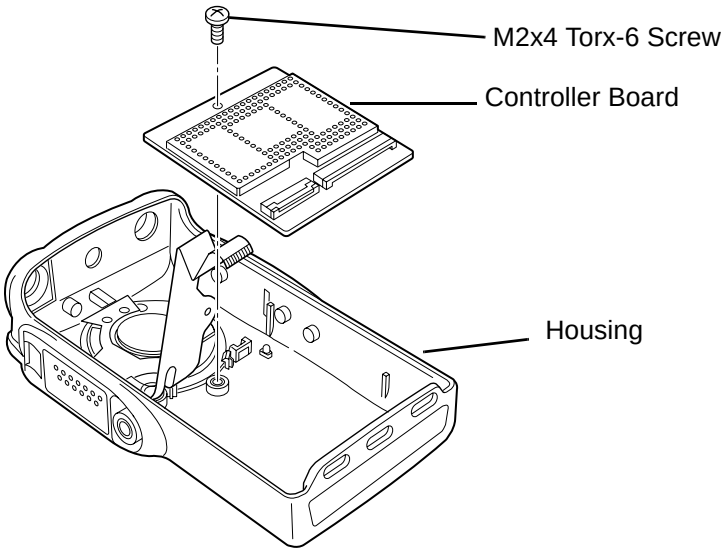


Figure 3-7 Removing the Controller Board from the Radio Body

7.5 Control Top Disassembly

1. To remove the control top assembly, place a screwdriver next to the antenna boss, and pry it against the control top escutcheon. This will lift the control top escutcheon away from its double-sided adhesive. Grab the double-sided adhesive near the volume potentiometer, and lift it away.
2. Remove the control top seal, emergency button, and transmit light pipe.

8.0 GP344/GP644 Radio Reassembly — Detailed

8.1 Control Top Reassembly

1. Replace transmit light pipe, control top seal and top adhesive.
2. Peel off the liners from a new control top escutcheon, and place it in the recess in the front cover. Press the control top escutcheon tightly against the adhesive.

8.2 Speaker, Microphone, and Universal Connector Flex Reassembly

1. Feed the universal connector stiffener of the speaker-microphone flex assembly through the opening in the side wall of the front cover.
2. Peel-off the adhesive liner on the back of the universal connector stiffener of the flex circuit. Attach the flex stiffener to the front cover using the guide pins for correct alignment.
3. Replace the universal connector escutcheon. Make sure that all the connector openings align with the gold pads on the flex circuit.
4. Peel off the adhesive liner on the speaker rubber.
5. Align the top notch in the speaker at the twelve o'clock position with the tab on the front cover. (See Figure 3-22.) Push down the speaker until the two bottom notches fit into the catches on the housing.

8.3 Chassis Assembly Reassembly

1. Slide on the ground contact (if necessary) on the top corner boss of the chassis.
2. Replace the O-ring. The tabs on the O-ring should reach around the chassis and point down.
3. Stretch the O-ring to place it into the retaining pocket at the bottom end of the chassis.

NOTE When properly assembled, the retainers on the O-ring should align with the slots on the chassis. If this is not the case, remove and replace the O-ring until it is aligned with the chassis and completely seated in place around the perimeter.

4. Ensure that the antenna nut insulator is correctly replaced by pushing it all the way to the top of the antenna nut.
5. Replace the battery contact seal (if necessary) surrounding the battery contact.
6. Place the main circuit board straight down on top of the chassis.

NOTE Be sure the battery contact seal protrudes through the chassis and is not pinched under the chassis.

7. Use the Torx T6 screwdriver to fasten the screws holding the main board to the chassis.

8.4 Chassis and Front Cover Reassembly

1. Align the chassis assembly end-to-end with the front cover assembly.
2. Insert the tails of the flex circuits into their respective connectors at the bottom of the front cover.
3. Push down the latches on the connectors to hold the flex circuits to the main board.
4. Slide the volume potentiometer and frequency switch shafts into their respective holes in the front cover.
5. Push the chassis assembly completely into the top of the front cover until it settles in place.
6. Be sure the O-ring is properly seated.
7. Snap the bottom of the chassis into the front cover.
8. Reassemble the knobs, dust cover, antenna, and battery.

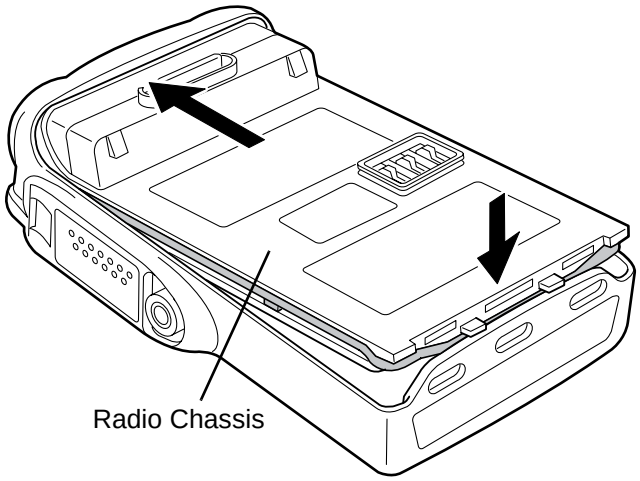


Figure 3-8 Fastening the Chassis

9.0 GP344R/GP644R Radio Disassembly and Reassembly — General

Since these radios may be disassembled and reassembled with the use of only four (board to chassis) screws, it is important to pay particular attention to the snaps and tabs, and how parts align with each other.

The following tools are required for disassembling the radio:

- Chassis opener
- Penknife-size screwdriver
- Torx T6 screwdriver

If a unit requires more complete testing or service than is customarily performed at the basic level, send this unit to a Motorola Authorized Service Center. (See Section 1 for a list of authorized service centers.)

The following disassembly procedures should be performed only if necessary:

Chassis Assembly Disassembly (Paragraph 10.2)

Speaker and Microphone Disassembly (Paragraph 10.3)

Controller Board, Plain Module and Non-Keypad Disassembly (Paragraph 10.4)

Control Top Disassembly (Paragraph 10.5)

10.0 GP344R/GP644R Radio Disassembly — Detailed

10.1 Front Cover from Chassis Disassembly

1. Turn off the radio.

2. Remove the battery:

c. Pull down on the two battery-release buttons.

d. With the buttons pulled down, the top of the battery will fall from the radio.

e. Remove the battery from the radio.

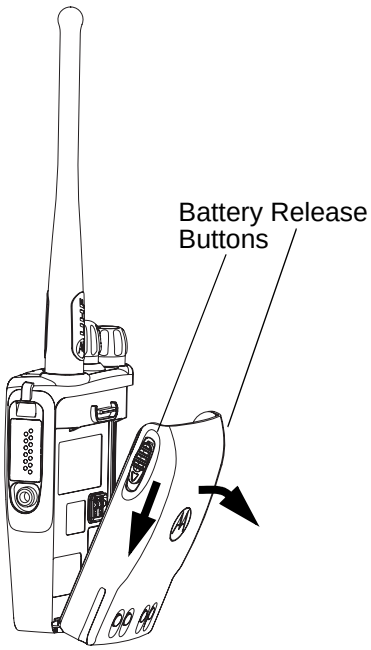


Figure 3-9 Battery Removal

3. Remove the antenna.

4. Pull the volume and channel selector knobs off of their shafts.

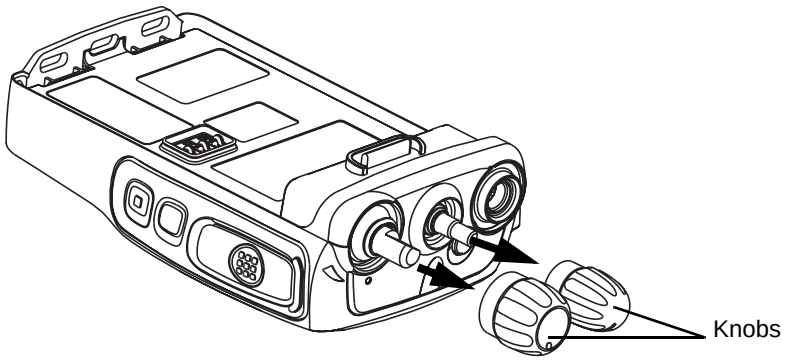


Figure 3-10 Knob Removal

NOTE Both knobs slide on and off. However, they are supposed to fit very tightly on their shafts.

5. Separate the chassis from the internal electronics front cover assembly as follows:

a. Insert a small, flat-blade screwdriver, or similar instrument, in between the thin retaining wall and the chassis at the bottom of the radio. Do not mar the O-ring sealing area on the housing.

b. Slowly pry the bottom of the chassis from the cover by pushing the chassis opener (part number 6685666D01) down, and prying the handle of the tool over and behind the base of the radio. This prying action forces the thin inner plastic wall toward the base of the radio, releasing the two chassis base tabs.

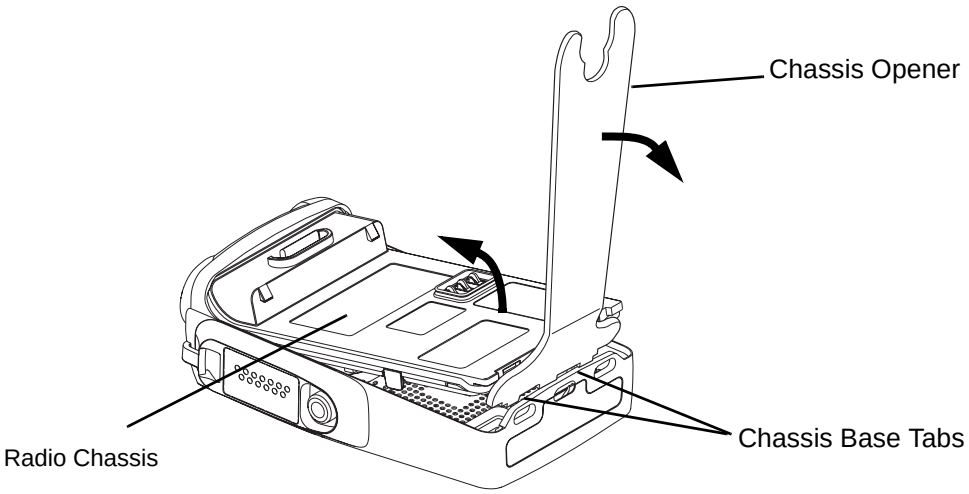


Figure 3-11 Chassis Removal

Caution

CAUTION: Marring the front cover O-ring sealing area will prevent the radio from sealing properly.

NOTE Flexible ribbon circuits (flexes) connecting the front cover assembly and the chassis prevent you from completely separating the two units.

6. Lay the chassis down. Rotate the front cover backward and slightly away from the chassis.
7. Lift the latches on the main circuit board to release the flexes from their connectors.

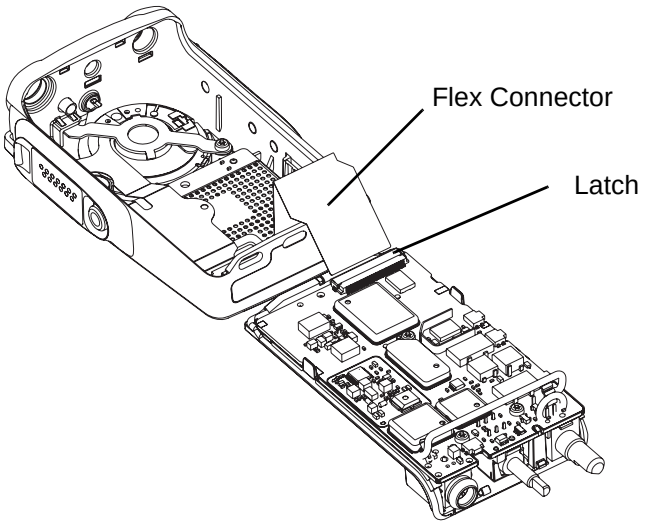


Figure 3-12 Unlatch Flex Connectors

10.2 Chassis Assembly Disassembly

Use a Torx T6 screwdriver to remove the four screws holding the main board to the chassis.

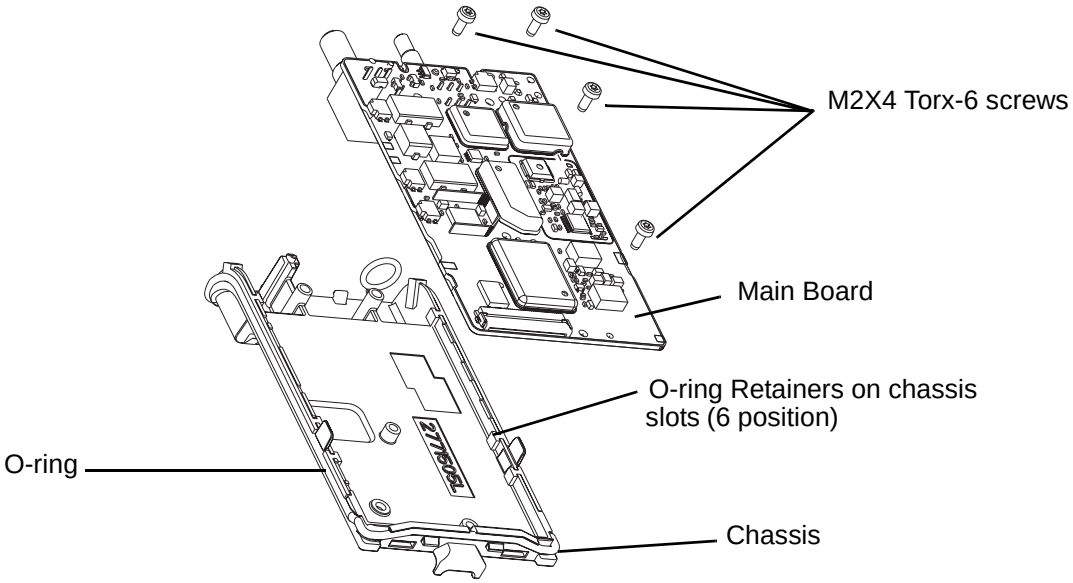


Figure 3-13 Remove Main Board from Chassis

1. Lift the main board from the chassis (See Figure 3-13).

Caution

CAUTION: Refer to the CMOS CAUTION paragraph on page 2 of this chapter before removing the main board. Be sure to use ESD protection when handling circuit boards.

2. Remove the six small O-ring retainers from their slots in the chassis. Note the alignment of the retainers for reassembly.
3. Remove the O-ring.
4. Slide off the ground contact from the top corner boss of the radio chassis.

10.3 Speaker and Microphone Disassembly

1. Turn the screw at the bottom of the dustcover counterclockwise with your fingers. Lift the dustcover out of its pocket.

NOTE The dustcover must be removed to remove the speaker-microphone assembly flex circuit. The speaker is held in place with a two-legged retainer bracket. The bracket legs are secured by the front cover slots. Be careful not to damage the speaker when removing the retainer bracket.

2. Use a Torx T6 screwdriver to remove the screw holding the speaker retainer to the housing.
3. Insert a penknife screwdriver in between the speaker and housing. Then pull up the screwdriver to remove the speaker from the housing.
4. Pull the rubber microphone boot from its seated position. Unless you are replacing the microphone, leave it in the boot.

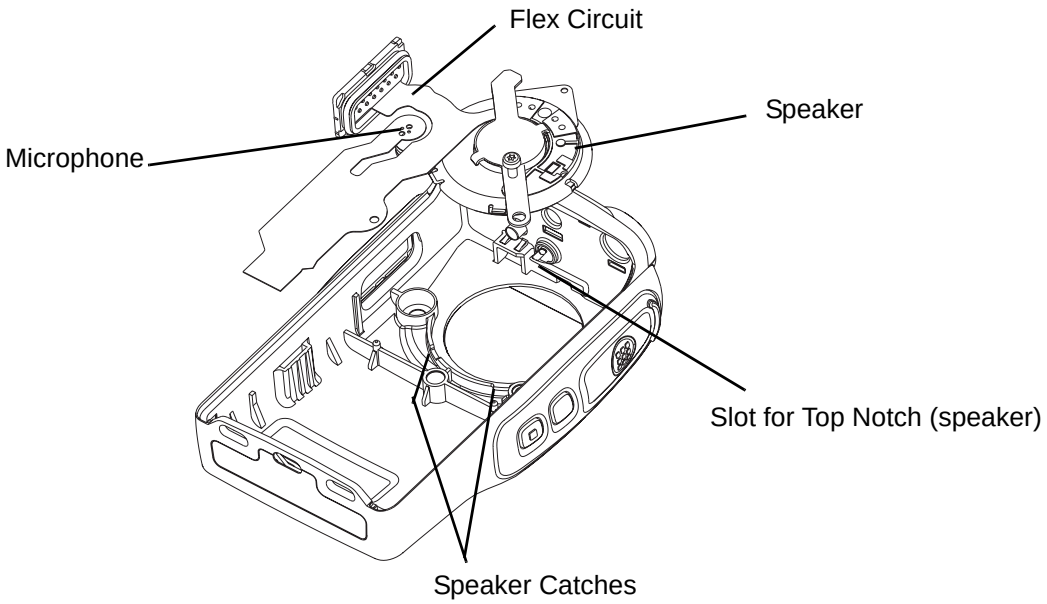


Figure 3-14 Removal Speaker and Microphone

5. When reassembling the microphone in its boot, make sure the microphone port faces the round hole in the bottom of the boot.

10.4 Controller Board, Plain Module and Non-Keypad Disassembly

1. Use a Torx T6 screwdriver to remove the screw from its position.
2. Insert a flat blade screwdriver in between the controller board and front cover. Pull up the screwdriver to disassemble the controller board from front cover. (See Figure 3-15.).

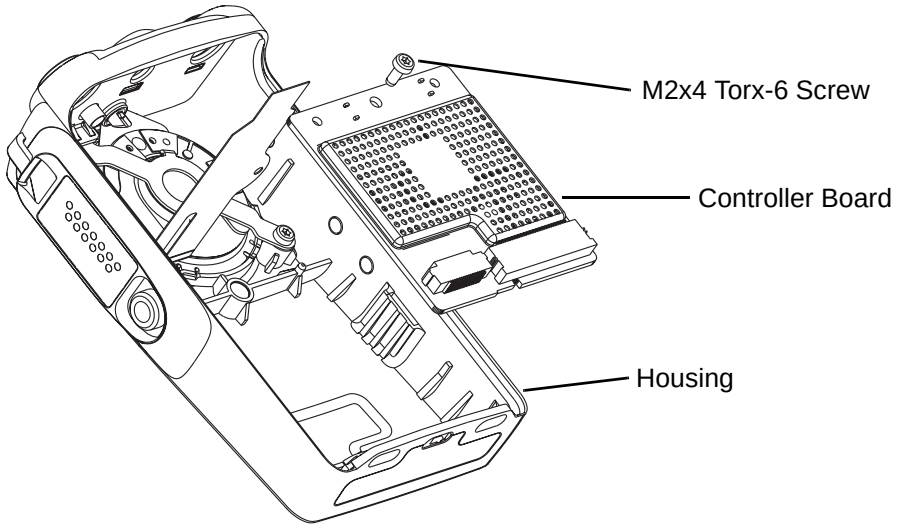


Figure 3-15 Removing the Controller Board from the Radio Body

10.5 Control Top Disassembly

1. To remove the control top assembly, place a screwdriver next to the antenna boss, and pry it against the control top escutcheon. This will lift the control top escutcheon away from its double-sided adhesive. Grab the double-sided adhesive near the volume potentiometer, and lift it away.
2. Remove the control top seal, emergency button, and transmit light pipe.

11.0 GP344R/GP644R Radio Reassembly — Detailed

11.1 Control Top Reassembly

1. Replace transmit light pipe, control top seal and top adhesive.
2. Peel off the liners from a new control top escutcheon, and place it in the recess in the front cover. Press the control top escutcheon tightly against the adhesive.

11.2 Speaker Reassembly

1. Peel off the adhesive liner on the speaker rubber.
2. Align the top notch in the speaker at the twelve o'clock position with the tab on the front cover. (See Figure 3-14.) Push down the speaker until the two bottom notches fit into the catches on the housing.

3. Tongue-in the speaker retainer.
4. Use a Torx T6 screwdriver to fasten the retainer to the housing.

11.3 Chassis Assembly Reassembly

1. Replace the O-ring. The tabs on the O-ring should reach around the chassis and point down.
2. Stretch the O-ring to place it into the retaining pocket at the bottom end of the chassis.

NOTE When properly assembled, the retainers on the O-ring should align with the slots on the chassis. If this is not the case, remove and replace the O-ring until it is aligned with the chassis and completely seated in place around the perimeter.

3. Replace the battery contact seal (if necessary) surrounding the battery contact.
4. Place the main circuit board straight down on top of the chassis.

NOTE Be sure the battery contact seal protrudes through the chassis and is not pinched under the chassis.

5. Use the Torx T6 screwdriver to fasten the screws holding the main board to the chassis.

11.4 Chassis and Front Cover Reassembly

NOTE Before assemble the chassis to the front cover, apply some grease 3M (P/N: 1185937A01) around the front cover where the chassis will be seated.

1. Align the chassis assembly end-to-end with the front cover assembly.
2. Insert the tails of the flex circuits into their respective connectors at the bottom of the front cover.
3. Push down the latches on the connectors to hold the flex circuits to the main board.
4. Slide the volume potentiometer and frequency switch shafts into their respective holes in the front cover.
5. Push the chassis assembly completely into the top of the front cover until it settles in place.
6. Be sure the O-ring is properly seated so that the radio is properly sealed.
7. Snap the bottom of the chassis into the front cover.

8. Reassemble the knobs, dust cover, antenna, and battery.

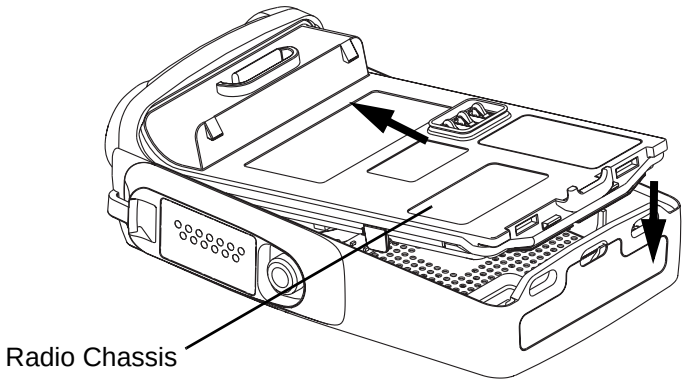


Figure 3-16 Fastening the Chassis

12.0 GP388/GP688 Radio Disassembly and Reassembly — General

Since these radios may be disassembled and reassembled with the use of only four (board to chassis) screws, it is important to pay particular attention to the snaps and tabs, and how parts align with each other.

The following tools are required for disassembling the radio:

- Chassis opener
- Penknife-size screwdriver
- Torx T6 screwdriver

If a unit requires more complete testing or service than is customarily performed at the basic level, send this unit to a Motorola Authorized Service Center. (See Section 1 for a list of authorized service centers.)

The following disassembly procedures should be performed only if necessary:

Chassis Assembly Disassembly (Paragraph 13.2)

Speaker, Microphone, and Universal Connector Flex Disassembly (Paragraph 13.3)

Controller Board, Display Module and Keypad Disassembly (Paragraph 13.4)

Control Top Disassembly (Paragraph 13.5)

13.0 GP388/GP688 Radio Disassembly — Detailed

13.1 Front Cover from Chassis Disassembly

1. Turn off the radio.

2. Remove the battery:

a. Pull down on the two battery-release buttons.

b. With the buttons pulled down, the top of the battery will fall from the radio.

c. Remove the battery from the radio.

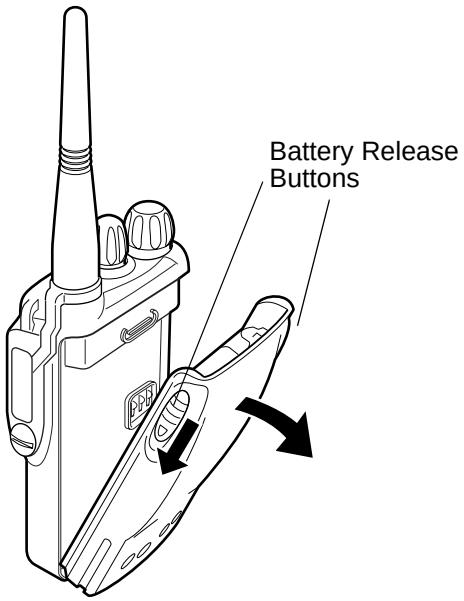


Figure 3-17 Battery Removal

3. Remove the antenna.

4. Pull the volume and channel selector knobs off of their shafts.

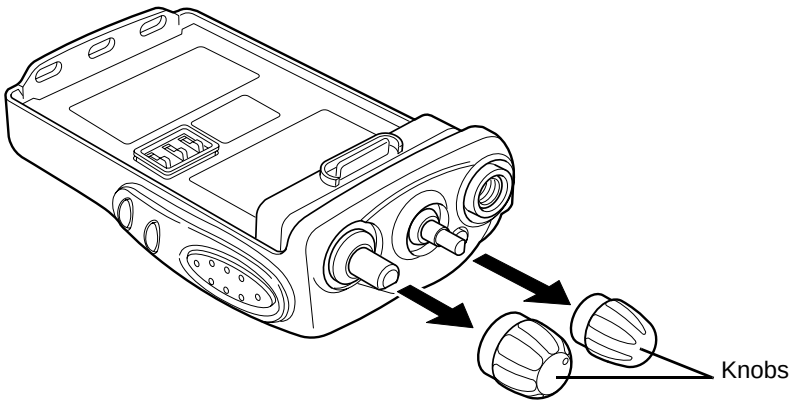


Figure 3-18 Knob Removal

NOTE Both knobs slide on and off. However, they are supposed to fit very tightly on their shafts.

5. Separate the chassis from the internal electronics front cover assembly as follows:

a. Insert a small, flat-blade screwdriver, or similar instrument, in between the thin retaining wall and the chassis at the bottom of the radio. Do not mar the O-ring sealing area on the housing.

b. Slowly pry the bottom of the chassis from the cover by pushing the chassis opener (part number 6680702Z01) down, and prying the handle of the tool over and behind the base of the radio. This prying action forces the thin inner plastic wall toward the base of the radio, releasing the two chassis base tabs.

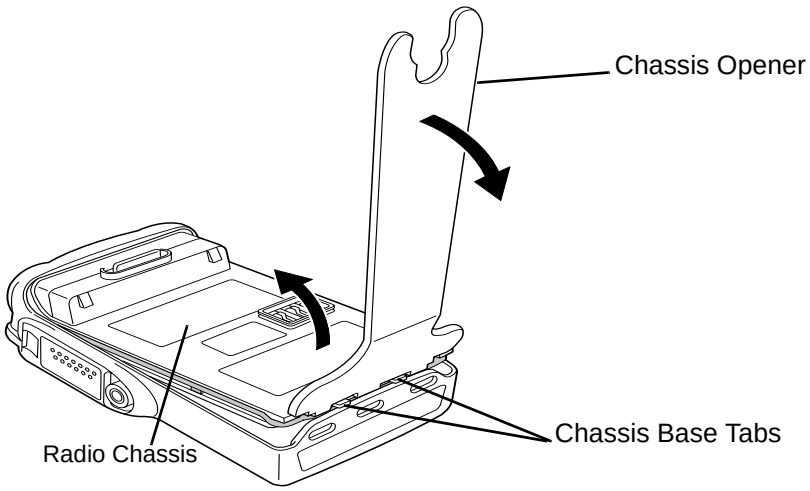


Figure 3-19 Chassis Removal

Caution

CAUTION: Marring the front cover O-ring sealing area will prevent the radio from sealing properly.

NOTE Flexible ribbon circuits (flexes) connecting the front cover assembly and the chassis prevent you from completely separating the two units.

6. Lay the chassis down. Rotate the front cover backward and slightly away from the chassis.

7. Lift the latches on the main circuit board to release the flexes from their connectors.

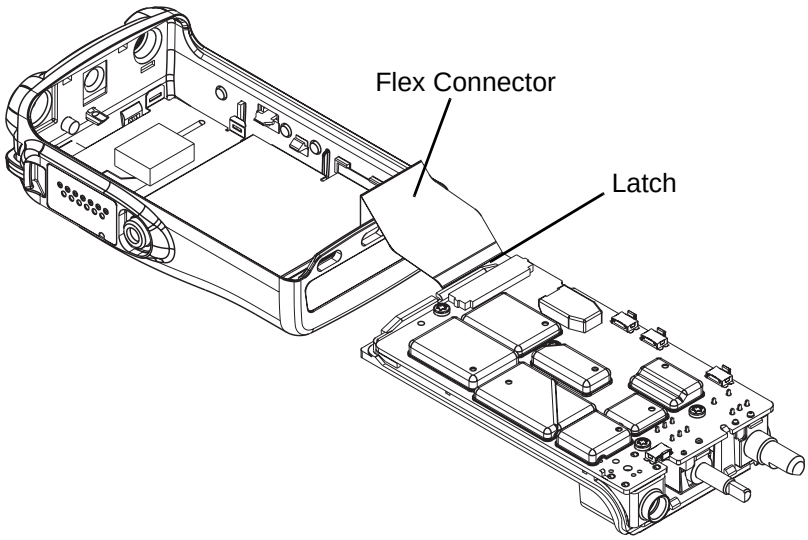


Figure 3-20 Unlatch Flex Connectors

13.2 Chassis Assembly Disassembly

Use a Torx T6 screwdriver to remove the four screws holding the main board to the chassis.

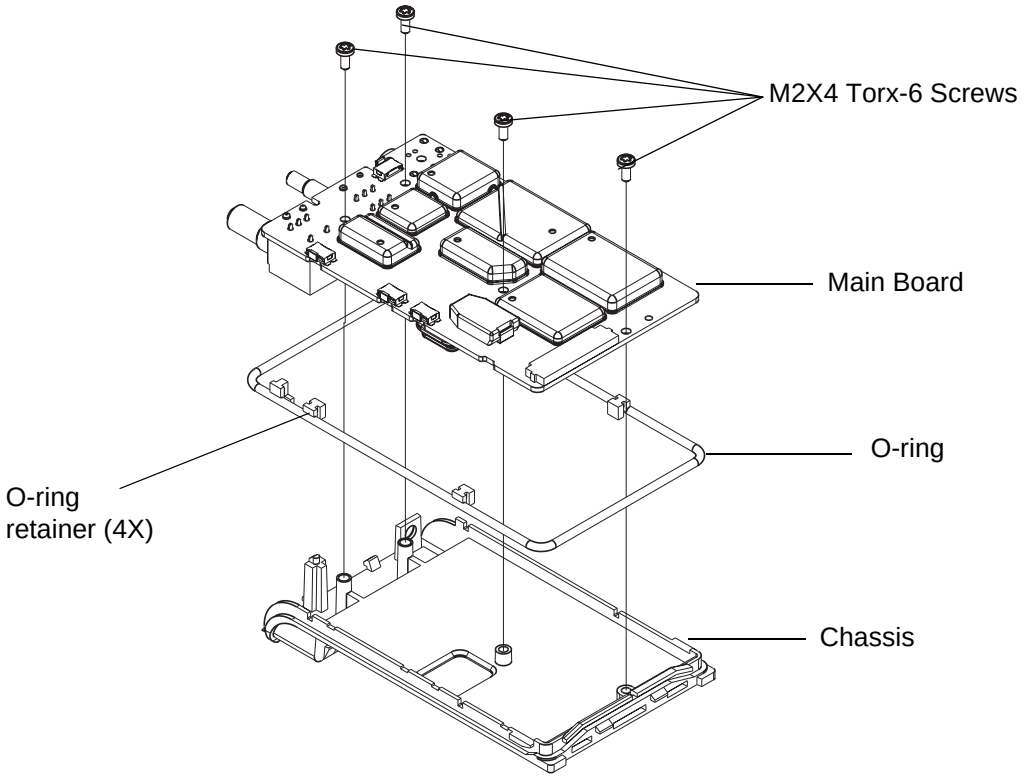


Figure 3-21 Remove Main Board from Chassis

1. Lift the main board from the chassis (See Figure 3-21).

Caution

CAUTION: Refer to the CMOS CAUTION paragraph on page 2 of this chapter before removing the main board. Be sure to use ESD protection when handling circuit boards.

2. Remove the four small O-ring retainers from their slots in the chassis. Note the alignment of the retainers for reassembly.
3. Remove the O-ring.

13.3 Speaker, Microphone, and Universal Connector Flex Disassembly

1. Turn the screw at the bottom of the dustcover counterclockwise with your fingers. Lift the dustcover out of its pocket.

NOTE The dustcover must be removed to remove the speaker-microphone assembly flex circuit.

2. Insert a penknife screwdriver in between the speaker and housing. Then pull up the screwdriver to remove the speaker from the housing.

3. Pull the rubber microphone boot from its seated position. Unless you are replacing the microphone, leave it in the boot.

NOTE The speaker-microphone assembly flex circuit goes through the front cover wall to the outside wall. To replace this assembly, you must peel-off the universal connector escutcheon label. The existing escutcheon and speaker cannot be reassembled; a new part must be used. (See item number 3 on the exploded view drawing.)

4. Peel-off the universal connector flex circuit escutcheon (label).
5. Pry the flex circuit (adhesive held) backer board away from the front cover, and remove the universal connector tail of the speaker-microphone assembly through its opening in the front cover.

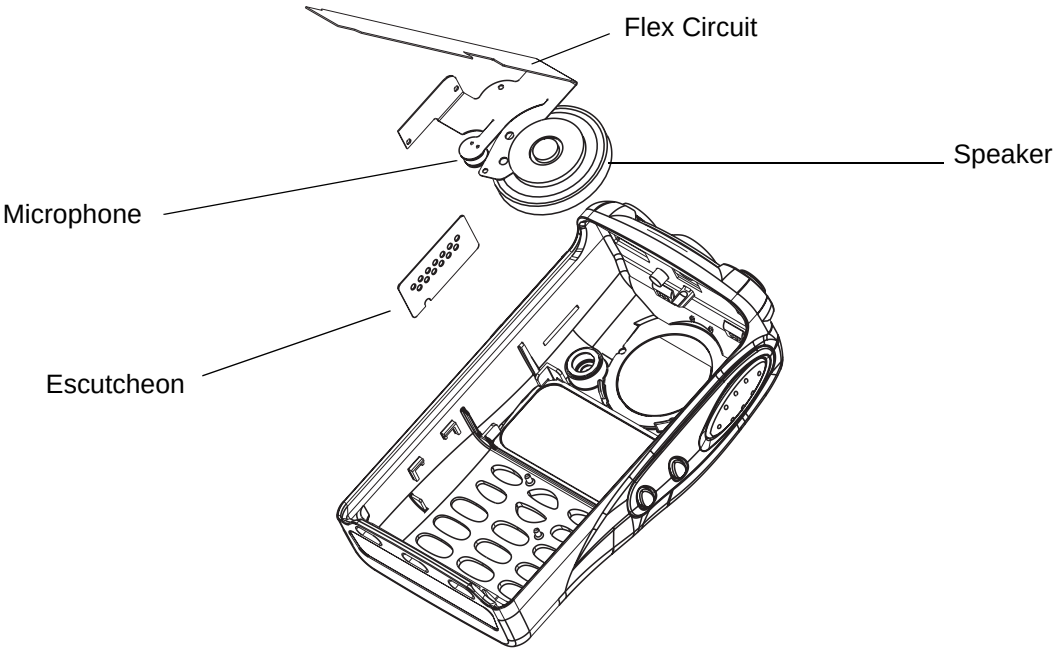


Figure 3-22 Removal Speaker-Microphone Assembly

6. After the universal connector tail of the speaker-microphone assembly is removed, the assembly can be completely removed. If it is necessary to replace the speaker or microphone, or both, do it while the flex circuit is removed from the front cover. When reassembling the microphone in its boot, make sure the microphone port faces the round hole in the bottom of the boot.

13.4 Controller Board, Display Module and Keypad Disassembly

1. Insert a small flat head screwdriver to loosen the retainer catches as shown. Remove the retainer.

2. Remove the controller board, display module, and keypad.

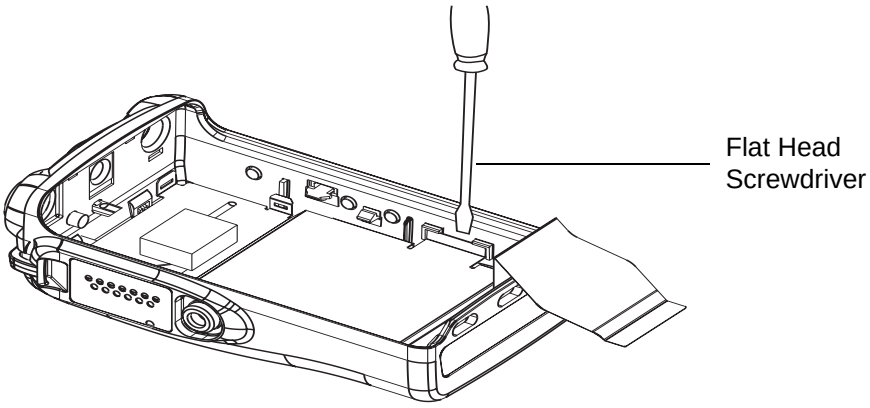


Figure 3-23 Removing the Retainer from the Radio Body

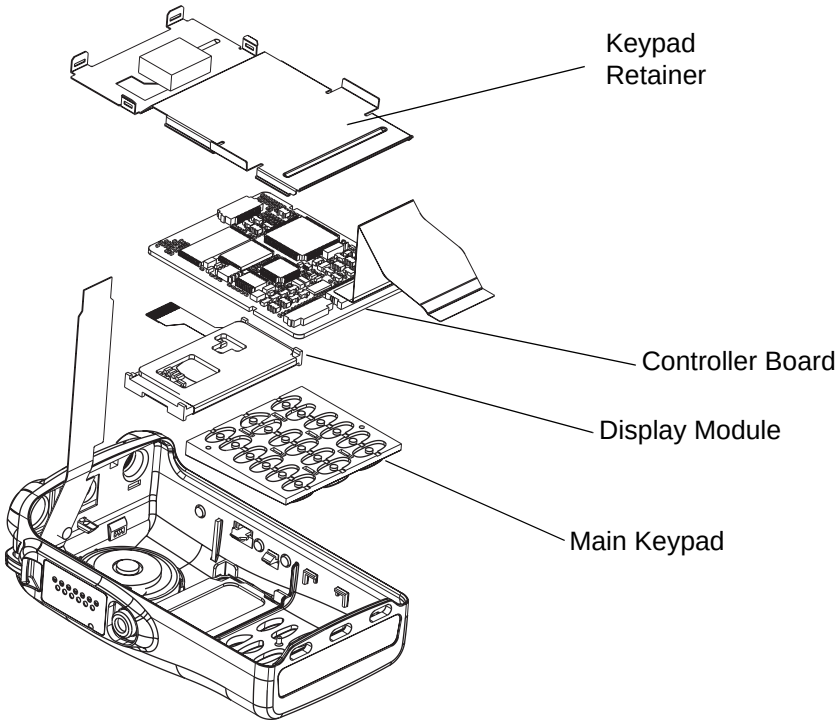


Figure 3-24 Removing the Keypad Retainer and Other Boards from the Radio Body

13.5 Control Top Disassembly

1. To remove the control top assembly, place a screwdriver next to the antenna boss, and pry it against the control top escutcheon. This will lift the control top escutcheon away from its double-sided adhesive. Grab the double-sided adhesive near the volume potentiometer, and lift it away.

2. Remove the control top seal, emergency button, and transmit light pipe.

14.0 GP388/GP688 Radio Reassembly — Detailed

14.1 Control Top Reassembly

1. Replace transmit light pipe, control top seal and top adhesive.
2. Peel off the liners from a new control top escutcheon, and place it in the recess in the front cover. Press the control top escutcheon tightly against the adhesive.

14.2 Speaker, Microphone, and Universal Connector Flex Reassembly

1. Feed the universal connector stiffener of the speaker-microphone flex assembly through the opening in the side wall of the front cover.
2. Peel-off the adhesive liner on the back of the universal connector stiffener of the flex circuit. Attach the flex stiffener to the front cover using the guide pins for correct alignment.
3. Replace the universal connector escutcheon. Make sure that all the connector openings align with the gold pads on the flex circuit.
4. Peel off the adhesive liner on the speaker rubber.
5. Align the top notch in the speaker at the twelve o'clock position with the tab on the front cover. (See Figure 3-22.) Push down the speaker until the two bottom notches fit into the catches on the housing.

14.3 Chassis Assembly Reassembly

1. Slide on the ground contact (if necessary) on the top corner boss of the chassis.
2. Replace the O-ring. The tabs on the O-ring should reach around the chassis and point down.
3. Stretch the O-ring to place it into the retaining pocket at the bottom end of the chassis.

NOTE When properly assembled, the retainers on the O-ring should align with the slots on the chassis. If this is not the case, remove and replace the O-ring until it is aligned with the chassis and completely seated in place around the perimeter.

4. Ensure that the antenna nut insulator is correctly replaced by pushing it all the way to the top of the antenna nut.
5. Replace the battery contact seal (if necessary) surrounding the battery contact.
6. Place the main circuit board straight down on top of the chassis.

NOTE Be sure the battery contact seal protrudes through the chassis and is not pinched under the chassis.

7. Use the Torx T6 screwdriver to fasten the screws holding the main board to the chassis.

14.4 Chassis and Front Cover Reassembly

1. Align the chassis assembly end-to-end with the front cover assembly.
2. Insert the tails of the flex circuits into their respective connectors at the bottom of the front cover.
3. Push down the latches on the connectors to hold the flex circuits to the main board.

4. Slide the volume potentiometer and frequency switch shafts into their respective holes in the front cover.
5. Push the chassis assembly completely into the top of the front cover until it settles in place.
6. Be sure the O-ring is properly seated.
7. Snap the bottom of the chassis into the front cover.
8. Reassemble the knobs, dust cover, antenna, and battery.

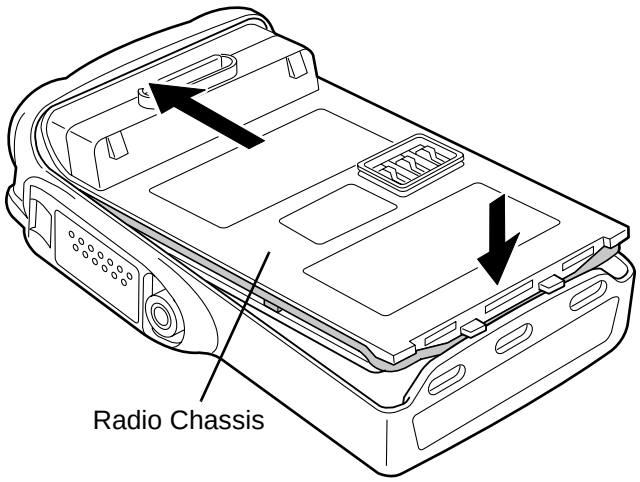


Figure 3-25 Fastening the Chassis

15.0 GP366R/GP388R/GP666R/GP688R Radio Disassembly and Reassembly — General

Since these radios may be disassembled and reassembled with the use of only four (board to chassis) screws, it is important to pay particular attention to the snaps and tabs, and how parts align with each other.

The following tools are required for disassembling the radio:

- Chassis opener
- Penknife-size screwdriver
- Torx T6 screwdriver

If a unit requires more complete testing or service than is customarily performed at the basic level, send this unit to a Motorola Authorized Service Center. (See Section 1 for a list of authorized service centers.)

The following disassembly procedures should be performed only if necessary:

Chassis Assembly Disassembly (Paragraph 16.2)

Speaker and Microphone Disassembly (Paragraph 16.3)

Controller Board, Display Module and Keypad Disassembly (Paragraph 16.4)

Control Top Disassembly (Paragraph 16.5)

16.0 GP366R/GP388R/GP666R/GP688R Radio Disassembly — Detailed

16.1 Front Cover from Chassis Disassembly

1. Turn off the radio.
2. Remove the battery:
   a. Pull down on the two battery-release buttons.
   b. With the buttons pulled down, the top of the battery will fall from the radio.
   c. Remove the battery from the radio.

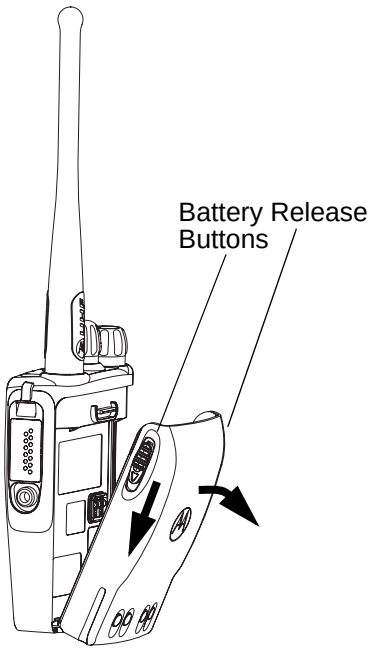


Figure 3-26 Battery Removal

3. Remove the antenna.
4. Pull the volume and channel selector knobs off of their shafts.

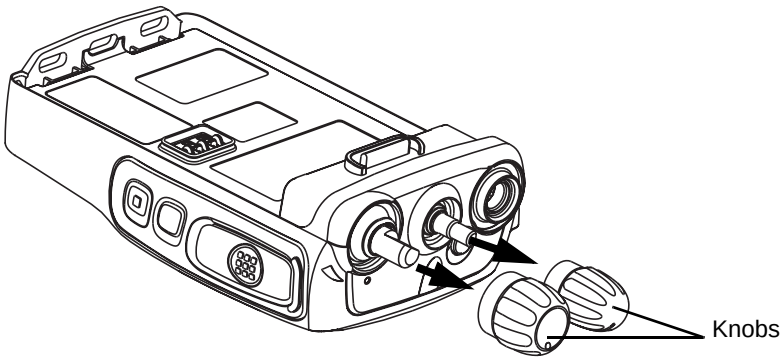


Figure 3-27 Knob Removal

NOTE Both knobs slide on and off. However, they are supposed to fit very tightly on their shafts.

5. Separate the chassis from the internal electronics front cover assembly as follows:

a. Insert a small, flat-blade screwdriver, or similar instrument, in between the thin retaining wall and the chassis at the bottom of the radio. Do not mar the O-ring sealing area on the housing.

b. Slowly pry the bottom of the chassis from the cover by pushing the chassis opener (part number 6685666D01) down, and prying the handle of the tool over and behind the base of the radio. This prying action forces the thin inner plastic wall toward the base of the radio, releasing the two chassis base tabs.

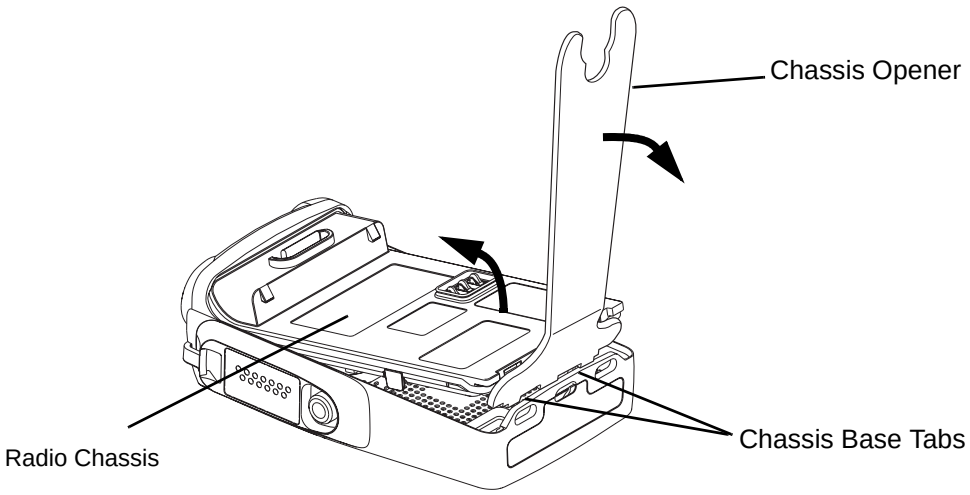


Figure 3-28 Chassis Removal

Caution

CAUTION: Marring the front cover O-ring sealing area will prevent the radio from sealing properly.

NOTE Flexible ribbon circuits (flexes) connecting the front cover assembly and the chassis prevent you from completely separating the two units.

6. Lay the chassis down. Rotate the front cover backward and slightly away from the chassis.

7. Lift the latches on the main circuit board to release the flexes from their connectors.

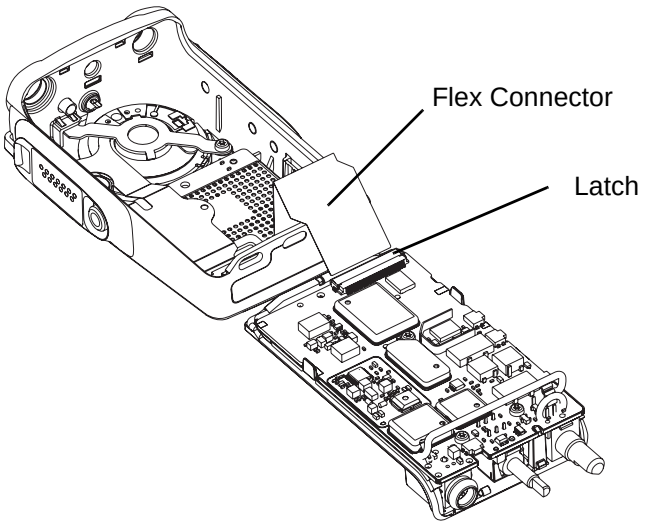


Figure 3-29 Unlatch Flex Connectors

16.2 Chassis Assembly Disassembly

Use a Torx T6 screwdriver to remove the four screws holding the main board to the chassis.

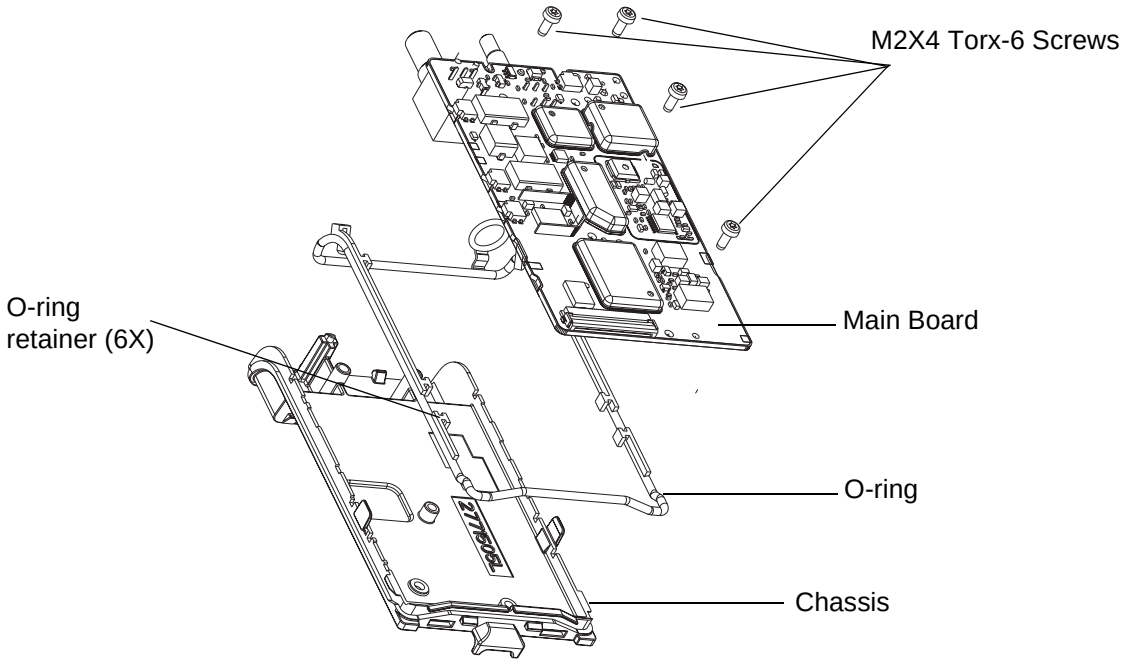


Figure 3-30 Remove Main Board from Chassis

1. Lift the main board from the chassis (See Figure 3-30).

Caution

CAUTION: Refer to the CMOS CAUTION paragraph on page 2 of this chapter before removing the main board. Be sure to use ESD protection when handling circuit boards.

2. Remove the six small O-ring retainers from their slots in the chassis. Note the alignment of the retainers for reassembly.
3. Remove the O-ring.

16.3 Speaker and Microphone Disassembly

1. Turn the screw at the bottom of the dustcover counterclockwise with your fingers. Lift the dustcover out of its pocket.

NOTE The dustcover must be removed to remove the speaker-microphone assembly flex circuit. The speaker is held in place with a two-legged retainer bracket. The bracket legs are secured by the front cover slots. Be careful not to damage the speaker when removing the retainer bracket.

2. Use a Torx T6 screwdriver to remove the screw holding the speaker retainer to the housing.
3. Insert a penknife screwdriver in between the speaker and housing. Then pull up the screwdriver to remove the speaker from the housing.
4. Pull the rubber microphone boot from its seated position. Unless you are replacing the microphone, leave it in the boot.

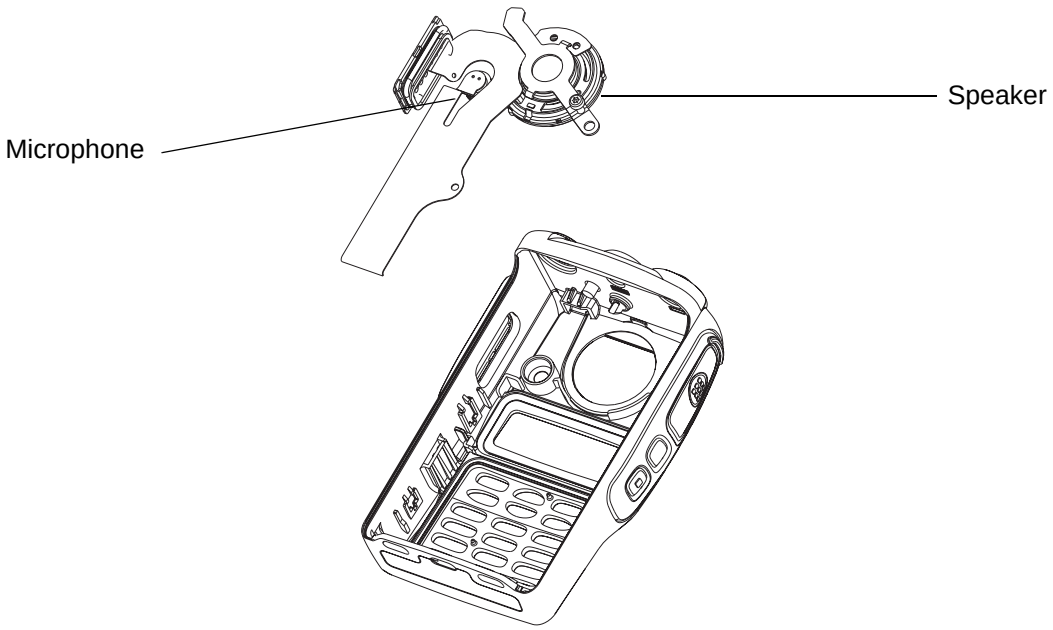


Figure 3-31 Removal Speaker-Microphone Assembly

5. When reassembling the microphone in its boot, make sure the microphone port faces the round hole in the bottom of the boot.

16.4 Controller Board, Display Module and Keypad Disassembly

1. Insert a small flat head screwdriver to loosen the retainer catches as shown. Remove the retainer.
2. Remove the controller board, display module, and keypad.

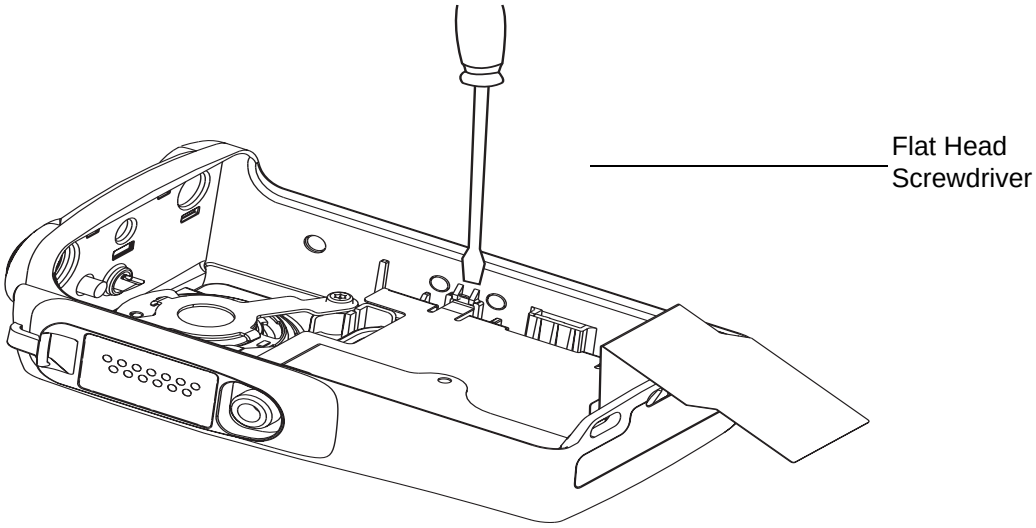


Figure 3-32 Removing the Retainer from the Radio Body

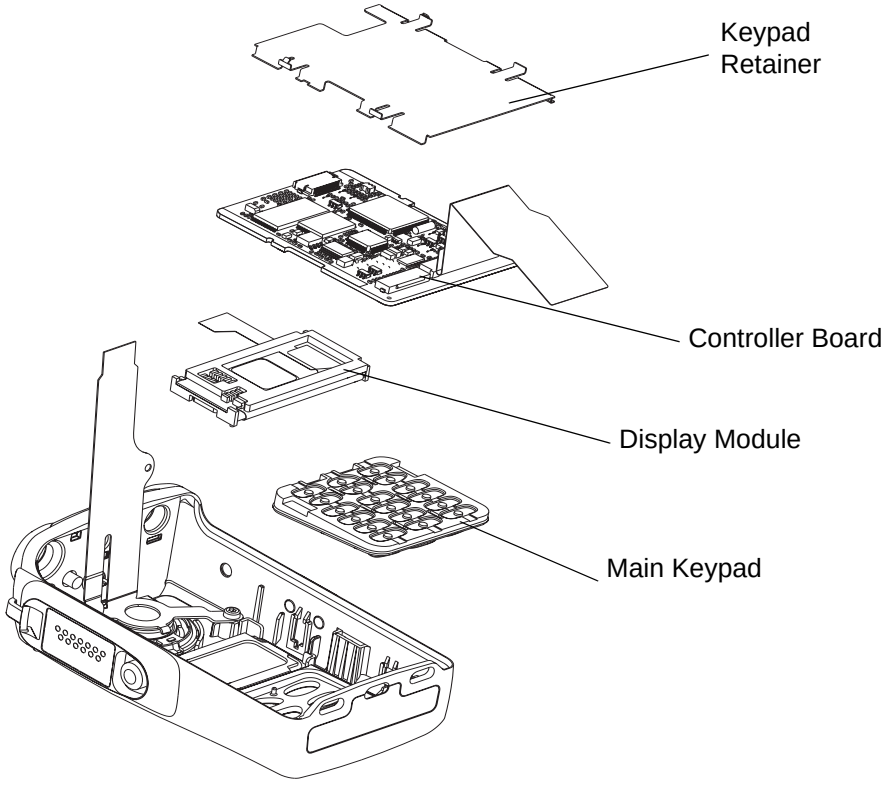


Figure 3-33 Removing the Keypad Retainer and Other Boards from the Radio Body

16.5 Control Top Disassembly

1. To remove the control top assembly, place a screwdriver next to the antenna boss, and pry it against the control top escutcheon. This will lift the control top escutcheon away from its double-sided adhesive. Grab the double-sided adhesive near the volume potentiometer, and lift it away.
2. Remove the control top seal, emergency button, and transmit light pipe.

17.0 GP366R/GP388R/GP666R/GP688R Radio Reassembly — Detailed

17.1 Control Top Reassembly

1. Replace transmit light pipe, control top seal and top adhesive.
2. Peel off the liners from a new control top escutcheon, and place it in the recess in the front cover. Press the control top escutcheon tightly against the adhesive.

17.2 Speaker Reassembly

1. Peel off the adhesive liner on the speaker rubber.
2. Align the top notch in the speaker at the twelve o'clock position with the tab on the front cover. (See Figure 3-31.) Push down the speaker until the two bottom notches fit into the catches on the housing.
3. Tongue-in the speaker retainer.
4. Use a Torx T6 screwdriver to fasten the retainer to the housing.

17.3 Chassis Assembly Reassembly

1. Replace the O-ring. The tabs on the O-ring should reach around the chassis and point down.
2. Stretch the O-ring to place it into the retaining pocket at the bottom end of the chassis.

NOTE When properly assembled, the retainers on the O-ring should align with the slots on the chassis. If this is not the case, remove and replace the O-ring until it is aligned with the chassis and completely seated in place around the perimeter.

3. Replace the battery contact seal (if necessary) surrounding the battery contact.
4. Place the main circuit board straight down on top of the chassis.

NOTE Be sure the battery contact seal protrudes through the chassis and is not pinched under the chassis.

5. Use the Torx T6 screwdriver to fasten the screws holding the main board to the chassis.

17.4 Chassis and Front Cover Reassembly

NOTE Before assemble the chassis to the front cover, apply some grease 3M (P/N: 1185937A01) around the front cover where the chassis will be seated.

1. Align the chassis assembly end-to-end with the front cover assembly.

2. Insert the tails of the flex circuits into their respective connectors at the bottom of the front cover.
3. Push down the latches on the connectors to hold the flex circuits to the main board.
4. Slide the volume potentiometer and frequency switch shafts into their respective holes in the front cover.
5. Push the chassis assembly completely into the top of the front cover until it settles in place.
6. Be sure the O-ring is properly seated so that the radio is properly sealed.
7. Snap the bottom of the chassis into the front cover.
8. Reassemble the knobs, dust cover, antenna, and battery.

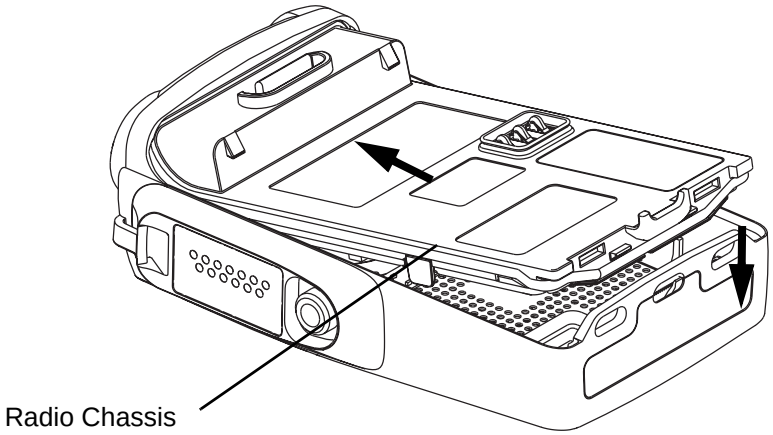


Figure 3-34 Fastening the Chassis

18.0 Ensuring Radio Immersibility

This section discusses radio immersibility concerns, tests, and disassembly and reassembly of GP344R/GP644R, GP366R/GP666Rand GP388R/GP688R, radios.

18.1 Servicing

Radios shipped from the Motorola factory have passed vacuum testing and should be capable of restoring the watertight integrity of the radio.

Caution

CAUTION: It is strongly recommended that the maintenance of the radio be deferred to qualified service personnel and service shops. This is of paramount importance as irreparable damage to the radio can result from service by unauthorized persons. If disassembly is necessary, unauthorized attempts to repair the radio may void any existing warranties or extended performance agreements with Motorola. It is also recommended that immersibility be checked annually by qualified service personnel.

18.2 Accidental Immersion

If the radio is accidentally dropped in water, shake the radio to remove the excess water from the speaker grille and microphone port area before operating; otherwise, the sound may be distorted until the water has evaporated, or is dislodged from these areas.

18.3 Specialized Test Equipment

This section summarizes the specialized test equipment necessary for testing the integrity of the radios.

To ensure that the radio is truly a watertight unit, special testing, test procedures, and specialized test equipment are required. The special testing involves a vacuum check of the radio and pressure testing (troubleshooting) for water leaks if the vacuum check fails. The specialized test equipment is needed to perform the vacuum check and pressure testing, if required.

18.4 Vacuum Pump Kit NLN9839_

The vacuum pump kit includes a vacuum pump with gauge, and a vacuum hose. A connector fitting (part number 5871134M01) and fitting seal (part number 3271133M01) pump connector, which must be ordered separately, connects the vacuum hose to the radio's chassis.

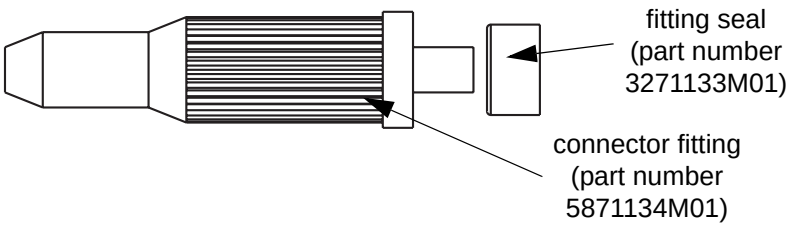


Figure 3-35 Connector Fitting - Fitting Seal Pump Connector

18.5 Pressure Pump Kit NTN4265_

The pressure pump kit includes a pressure pump with gauge, and a pressure hose. As with the vacuum pump kit above, the connector fitting - fitting seal pair connects the pressure hose to the radio's chassis.

18.6 Miscellaneous Hardware

Other items needed for testing the immersibility radio include:

- Large water container
- Deionized (DI) water
- A supply of replacement parts: Main seal O-ring, Battery Contact Seal, Breathing Vent Label and Breathing Vent Membrane. (Refer to Section 19.2 "GP344R/GP644R Exploded View and Parts List" on page 3-45, or Section 19.5 "GP366R/GP666R Exploded View and Parts List" on page 3-52.)

18.7 Disassembly

Disassemble the radio according to Section 10.0 "GP344R/GP644R Radio Disassembly — Detailed" on page 3-13 or Section 16.0 "GP366R/GP388R/GP666R/GP688R Radio Disassembly — Detailed" on page 3-27.

18.8 Reassembly

CAUTION: Do not reassemble the radio without first performing the following preliminary inspection procedure.

To reassemble the radio:

1. Remove the main seal O-ring from the chassis.
2. Inspect the seal area around the chassis for foreign material that might prevent the main seal O-ring from sealing properly.
3. Install a new main seal O-ring, discard the old O-ring.
4. Remove the Battery Contact Seal from the Battery Contact on Main Board.
5. Inspect the Battery Contact on Main Board and surrounding areas for foreign material that might prevent the Battery Contact Seal from sealing properly.
6. Install a new Battery Contact Seal; discard the old Seal.
7. Reassemble the housing.

CAUTION: The main seal O-ring should not be visible when looking at the back side of the radio. If the seal is visible, it is improperly installed.

Continue reassembling the radio according to Section 11.0 "GP344R/GP644R Radio Reassembly — Detailed" on page 3-17 or Section 17.0 "GP366R/GP388R/GP666R/GP688R Radio Reassembly — Detailed" on page 3-32. Tighten all hardware that was loosened or removed.

18.9 Vacuum Test

The vacuum test uses a vacuum pump and gauge. The pump creates a vacuum condition inside the radio, and the gauge monitors the radio for a stable vacuum reading; that is, checking for a properly sealed, watertight unit. Before starting the vacuum test:

- Remove the battery
- Remove the universal connector dustcover to expose the universal connector.
- Remove the breathing vent label and breathing vent membrane.

To conduct the vacuum test:

1. Attach the vacuum hose to the vacuum pump. Check the pump and hose for leaks by blocking off the open end of the hose and operating the pump a few times. The actual reading of the gauge at this point is not important; it is important that the gauge pointer remained steady, indicating no vacuum leaks in the pump.
2. Ensure that the fitting seal is attached to the hose-to-chassis pump connector. Screw the pump connector into the tapped hole in the chassis.
3. Attach the open end of the hose to the pointed end of the pump connector.
4. Place the radio on a flat surface with the chassis facing upward.
5. Operate the pump until the gauge indicates 6 in. Hg of vacuum on the radio.Observe the gauge for approximately 1 minute.

- If the needle falls 1 in. Hg or less (for example, from 6 in. Hg to 5 in. Hg), then the radio has passed the vacuum test and is approved for immersibility. No additional testing will be required.
- If the needle falls more than 1 in. Hg (for example, from 6 in. Hg to less than 5 in. Hg), then the radio has failed the vacuum test and the radio might leak if immersed. Additional troubleshooting of the radio will be required; complete this procedure, then go to Section 18.10 "Pressure Test".

6. Remove the vacuum hose and pump connector from the radio.

18.10 Pressure Test

Pressure testing the radio is necessary only if the radio has failed the vacuum test. Do not perform the pressure test until the vacuum test has been completed. Pressure testing involves creating a positive pressure condition inside the radio, immersing the radio in water, and observing the radio for a stream of bubbles (leak). Since all areas of the radio are being checked, observe the entire unit carefully for the possibility of multiple leaks before completing this test.

To conduct the pressure test:

1. Screw the pump connector (with fitting seal) into the tapped hole in the chassis.

2. Attach one end of the pressure hose to the pump connector and the other end to the pressure pump.

3. Operate the pump until the gauge reads approximately 1 psig.

CAUTION: Pressure any greater than 1 psig might push air around the main seal.

4. Maintain the pressure at 1 psig and immerse the radio into a water-filled container.

5. Watch for any continuous series of bubbles. A stream of bubbles indicates a sign of leakage.

NOTE Some air entrapment may cause the accumulation of bubbles, especially in the grille area, but the bubbles should not be continuous.

6. Note all of the seal areas that show signs of leakage. Pinpoint the problem(s) to one (or more) of the following areas:

- Front Housing
- Chassis (Main Seal O-ring)
- Battery Contact Seal

7. Remove the radio from the water container, and dry the radio thoroughly. Be especially careful to dry the area around the main seal to prevent contamination of the internal electronics while the unit is open.

CAUTION: Keep the area around the chassis's vacuum port dry by ensuring that there is no water around it.

8. Remove the pump connector from the chassis.

9. Radio after performing Pressure Test must undergo baking process in a temperature chamber for constant temperature soaking at 60°C for 1 hour. This is to ensure no moisture is trapped inside the radio and prevent contamination of the internal electronics after reassembling the radio.

18.11 Troubleshooting Leak Areas

Before repairing any leak, first read all of the steps within the applicable section. This will help to eliminate unnecessary disassembly and reassembly of a radio with multiple leaks. Troubleshoot only the faulty seal areas listed in Section 18.10 "Pressure Test" on page 3-36, and when multiple leaks exist, in the order listed.

NOTE Before reassembling the radio, always install a new Main seal O-ring, Battery Contact Seal in the defective area.

18.11.1 Front Housing

Do one or both of the following:

1. If a leak occurs at the Lens (only for GP388R/GP688R), Universal Connector, chassis/ Housing interface, PTT button area of the housing, replace the housing. Refer to Section 10.0 "GP344R/GP644R Radio Disassembly — Detailed" on page 3-13 or Section 16.0 "GP366R/ GP388R/GP666R/GP688R Radio Disassembly — Detailed" on page 3-27.
   a. Remove the housing assembly from the radio.
   b. Discard the housing assembly and main seal O-ring.
   c. Install a new main seal O-ring around the chassis assembly.
   d. Install a new housing assembly to the radio.
   e. Inspect the main seal for proper seating.
   f. Observe carefully to ensure that the main seal O-ring is not pinched between the housing and the chassis interface.
2. If the leak occurs at the control top area, remove the knobs and antenna in order to determine the leak location:
   a. Conduct the Pressure Test.
   b. Identify the leak location.

18.11.2 Chassis (Main Seal O-ring)

To replace the main seal O-ring:

1. Refer to Section 10.1 "Front Cover from Chassis Disassembly" on page 3-13 (GP344R/ GP644R) or Section 16.1 "Front Cover from Chassis Disassembly" on page 3-27 (GP366R/ GP388R/GP666R/GP688R), remove the chassis assembly from the radio.
2. Refer to Section 10.2 "Chassis Assembly Disassembly" on page 3-15 (GP344R/GP644R) or Section 16.2 "Chassis Assembly Disassembly" on page 3-29 (GP366R/GP388R/GP666R/ GP688R), remove the Main Board from chassis.
3. Remove the main seal O-ring.

4. Inspect the seal area around the chassis for foreign material that might prevent the main seal O-ring from sealing properly.
5. Assemble a new O-ring; discard the old O-ring.
6. The O-ring is installed from the bottom of chassis, and ensure the O-ring sits inside the chassis groove.
7. Reassemble the chassis assembly followed by installing into Front Cover. (Refer to Section 11.0 "GP344R/GP644R Radio Reassembly — Detailed" on page 3-17 or Refer to Section 17.0 "GP366R/GP388R/GP666R/GP688R Radio Reassembly — Detailed" on page 3-32.)
8. Inspect the main seal O-ring for proper seating. Observe carefully to ensure that the main seal O-ring is not pinched between the housing and the chassis.

NOTE When installing the assembled chassis to the Front Cover, ensure the O-ring at the top two corners are not dislodged from the chassis groove.

18.11.3 Battery Contact Seal

To replace the Battery Contact Seal:

1. Refer to Section 10.1 "Front Cover from Chassis Disassembly" on page 3-13 (GP344R/GP644R) or Section 16.1 "Front Cover from Chassis Disassembly" on page 3-27 (GP366R/GP388R/GP666R/GP688R), remove the chassis assembly from the radio.
2. Refer to Section 10.2 "Chassis Assembly Disassembly" on page 3-15 (GP344R/GP644R) or Section 16.2 "Chassis Assembly Disassembly" on page 3-29 (GP366R/GP388R/GP666R/GP688R), remove the Main Board from chassis.
3. Remove the Battery Contact Seal from the Battery Contact on Main Board.
4. Inspect the Battery Contact Seal on Main Board and surrounding areas for foreign material that might prevent the Battery Contact Seal from sealing properly.
5. Install a new Battery Contact Seal; discard the old Seal.
6. Replace a new main seal O-ring; discard the old O-ring.
7. Reassemble the chassis assembly followed by installing into Front Cover. (Refer to Section 11.0 "GP344R/GP644R Radio Reassembly — Detailed" on page 3-17 or Section 17.0 "GP366R/GP388R/GP666R/GP688R Radio Reassembly — Detailed" on page 3-32.)
8. Inspect the main seal O-ring for proper seating. Observe carefully to ensure that the main seal O-ring is not pinched between the housing and the chassis.

IMPORTANT: Both Breathing Vent Label (3371478L01) and Breathing Vent Membrane (3271570L01) need to be replaced after vacuum test, pressure test or water leakage troubleshooting .

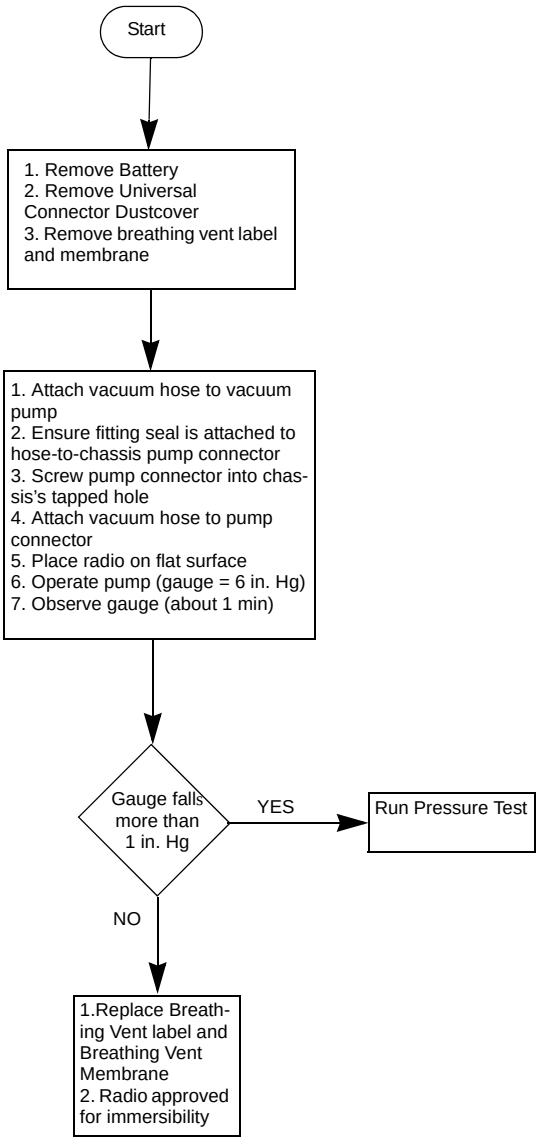
18.12 Breathing Vent Membrane and Breathing Vent Label

To replace the Breathing Vent Membrane and Breathing Vent Label:

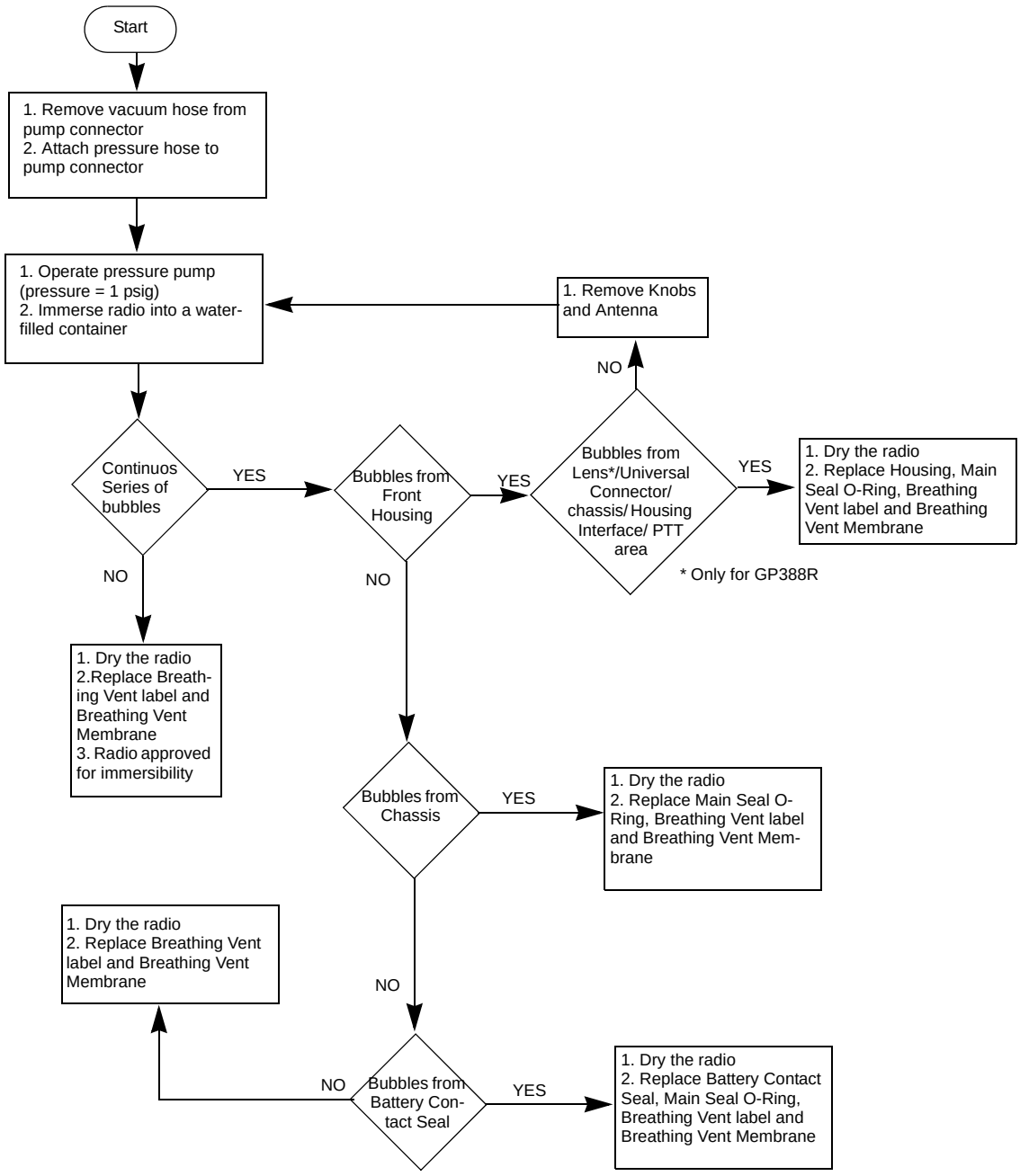
1. Remove the Breathing Vent Label that covers the Breathing Vent Membrane from the chassis.
2. Remove the Breathing Vent Membrane.

3. Ensure that the chassis's surface (at the Breathing Vent Label & Breathing Vent Membrane recessed) is clean, no/minimum scratches and free from any adhesive or other foreign materials.
4. Install a new Breathing Vent Membrane, covering the vent port hole, in the small recessed area in the chassis. Ensure that no oily substance come in contact with the seal.
5. Install a new Breathing Vent Label over the Breathing Vent Membrane in the larger recessed area in the chassis. Press down evenly over the label's surface to ensure good adhesion.

18.13 Troubleshooting Charts



Troubleshooting Flow Chart for Vacuum Test



Troubleshooting Flow Chart for Pressure Test & Leakage Areas

19.0 Mechanical View and Parts List

19.1 GP344/GP644 Exploded View and Parts List

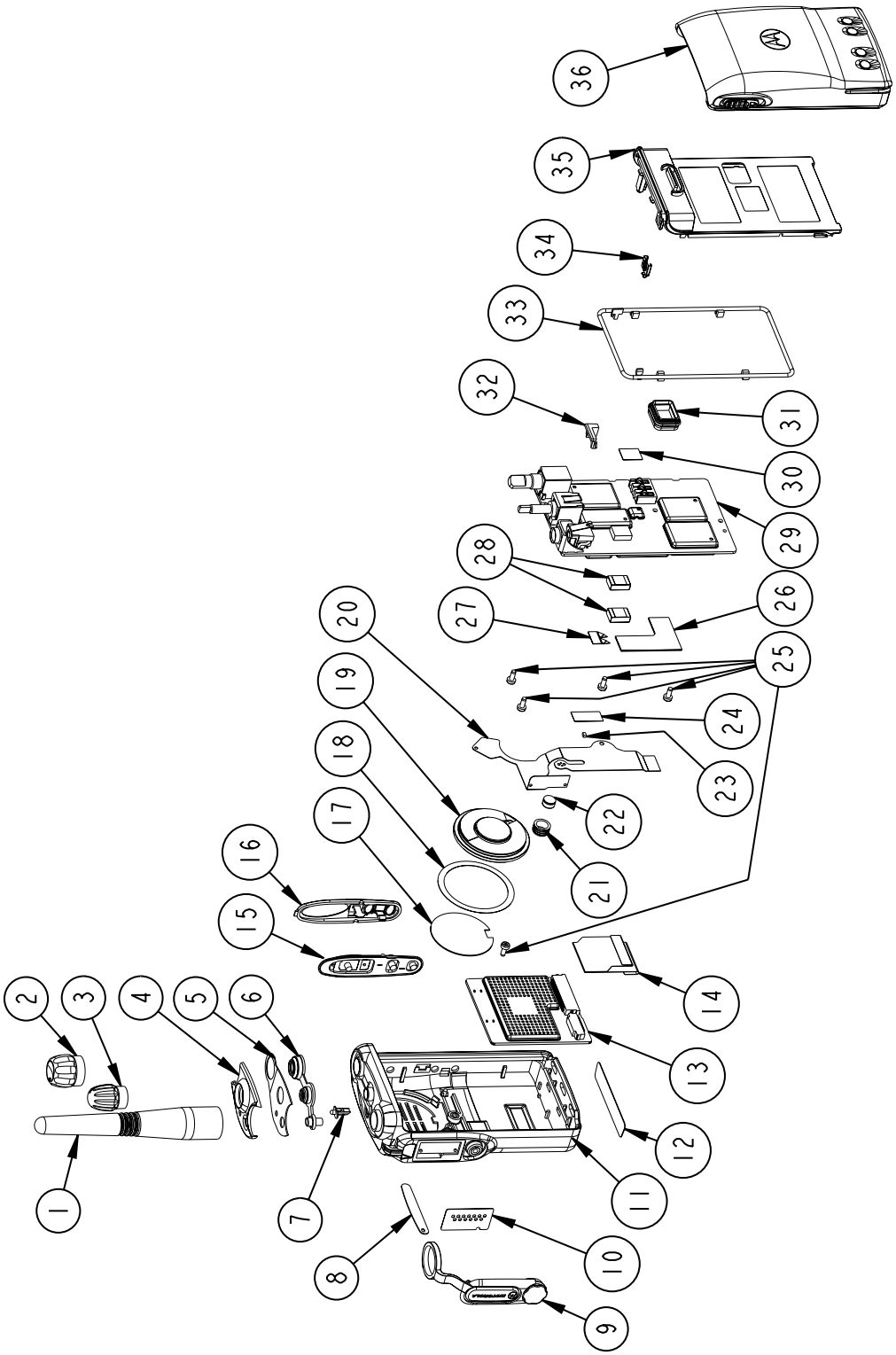


Figure 3-36 GP344/GP644 Radio Exploded View

Item	Motorola Part Number	Description
1	See Chapter 8	Antenna
2	3680529Z01	Knob, Volume
3	3680530Z02	Knob, Frequency
4	1386160Z01 1386160Z04	Escutcheon, Top Escutcheon, Top (4 Channel)
5	3386633Z01	Label, Escutcheon
6	3286159Z03 3286159Z05	Seal, Control Top Seal, Control Top (EPP)
7	6186158Z01	Lightpipe
8	3385959Z07 3385959Z09	Nameplate, GP344 Nameplate, GP644
9	JMLN4638_	Dust Cover, Universal Connector
10	1385905Z01	Escutcheon, Universal Flex
11	1586156Z01	Front Cover
12#	----	Escutcheon, FM
13	0104017J85	Control Board
14	8404078G03	Flex, Keypad/Controller
15	7586090Z01	Keypad, Side Control
16	1386091Z01	Bezel, Side Control
17	3586092Z02 3286092Z04	Felt Speaker Felt Speaker (EPP)
18	3386134Z02	Adhesive Speaker
19	5005679X05 5005679X07	Speaker Speaker (EPP)

Item	Motorola Part Number	Description
20	8404079G07 8415909H01	Flex, UC Flex, UC (EPP)
21	1480577C01	Boot, Microphone
22	5013920A04 5015027H01	Microphone Microphone (EPP)
23	2113740A55 2113944F01	Capacitor Capacitor (EPP)
24	1405307X01	Insulator, Kapton
25	0386104Z01 0386104Z03	Screws Screws (EPP)
26	3386216Z02	FM, Escutcheon
27	3980667Z01 3980667Z04	Contact, Finger (VHF Only) Contact, Finger (VHF Only) (EPP)
28	3905912Z06 3916290H01	Pad, Conductive Foam (Except VHF) Pad, Conductive Foam (Except VHF) (EPP)
29	See Chapter 8	RF Board Kit
30	7580556Z01 7580556Z02	Pad, Thermal Pad, Thermal (EPP)
31	3280534Z02	Seal, Contact
32	1485673Z01	Insulator, Antenna
33	3285892Z01	Gasket, O-Ring
34	3980698Z01	Contact, Ground, Compliant
35	2786154Z02	Chassis
36	See Chapter 8	Battery

Not Field Serviceable

Note: It is recommended to replace a new Front Cover kit (refer Table 3-3), Top Adhesive (3386633Z01), Top Seal/Top Seal EPP (3286159Z03/3286159Z05) and Top Escutcheon (1386160Z01) whenever you change:

1. Front Housing; or
2. Speaker; or
3. Speaker Adhesive; or
4. Speaker Felt; or
5. UC Flex

Table 3-3 List of old and new Front Cover Kits of affected Super Tanapa

No.	Super Tanapa	Description	Old Kit Number	New Kit Number
1	PMUD1675B	GP344 Front Cover 330-400M 4W	PMHD4002A	PMHD4002B
2	PMUE1699B	GP344 Front Cover 403-470M 4W	PMHE4000A	PMHE4000B
3	PMUE1701B	GP344 Front Cover 450-527M 4W	PMHE4002A	PMHE4002B
4	PMUD1673B	GP344 Front Cover 136-174M 5W	PMHD4000A	PMHD4000B
5	JMUE1021B	GP344 Front Housing Kit UHF	JMHE4002B	JMHE4002C
6	JMUD1125B	GP344 Front Housing Kit VHF	JMHD4006B	JMHD4006C
7	PMUE2048A	GP344 Front Cover 403-470M 4W 4CH	PMHE4024A	PMHE4024B
8	PMUE2049A	GP344 Front Cover 450-527M 4W 4CH	PMHE4025A	PMHE4025B
9	PMUD1892A	GP344 Front Cover 136-174M 5W 4CH	PMHD4020A	PMHD4020B

19.2 GP344R/GP644R Exploded View and Parts List

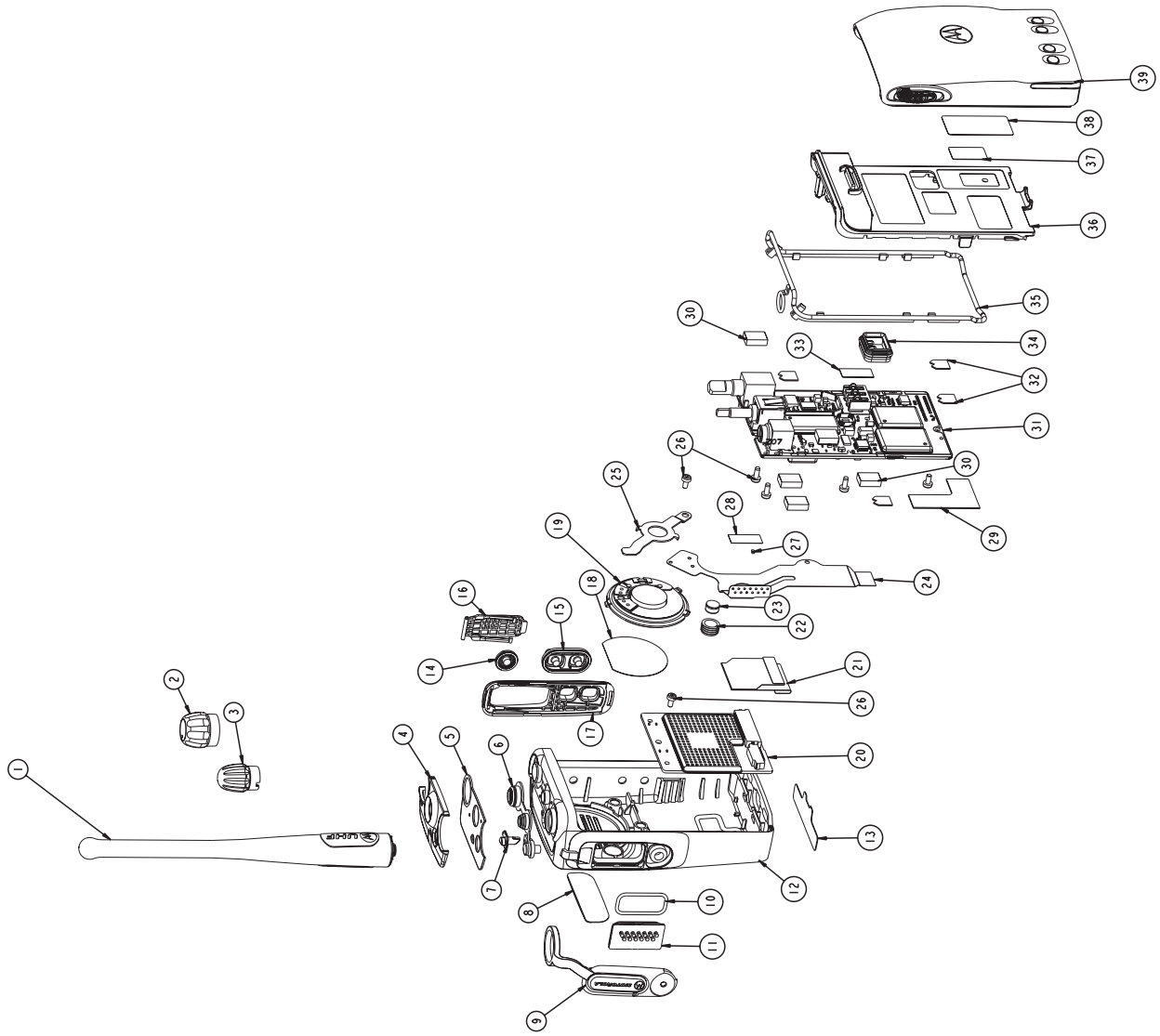


Figure 3-37 GP344R Radio Exploded View

Item	Motorola Part Number	Description
1	See Chapter 8	Antenna
2	3680529Z01	Knob, Volume
3	3680530Z02	Knob, Frequency
4	1371500L02	Escutcheon, Top
5	1171513L01	Adhesive, Top Control
6	3271506L01	Seal, Top Control
7	6171501L01	Light Pipe
8	3371696L05 3371696L06	Nameplate, GP344R Nameplate, GP644R
9	PMLN5121_	Dust Cover, Minnow IP67
10#	NIL	UC O-ring
11#	NIL	Module, UC
12	1571499L01	Housing, Front
13#	NIL	Label, FM
14#	NIL	Seal, PTT
15#	NIL	Button, Side Keypad
16#	NIL	Paddle, PTT
17#	NIL	Bezel, PTT
18	3571515L01	Mesh, Speaker
19	5005679X08	Speaker
20	0104017J85	Control Board
21	84C04078G03	Flex Cable
22	1416418H01	Boot, Microphone
23	5013920A04	Microphone
24#	NIL	Flex, UC
25	4271514L01	Retainer, Speaker
26	0386104Z03	Screws
27	2113944F01	Capacitor
28	1405307X01	Insulator, Kapton
29	3386216Z02	FM, Escutcheon
30	3916290H01	Pad, Conductive Foam

Item	Motorola Part Number	Description
31	See Chapter 8	RF Board Kit
32	3980667Z04	Contact, Finger
33	7580556Z01	Pad, Thermal
34	3280534Z03	Battery Contact Seal
35	3271516L01	O-ring,Main
36	2771505L01	Chassis
37	3271570L01	Breathing Vent Membrane
38	3371478L01	Breathing Vent Label
39	See Chapter 8	Battery

Not Field Serviceable

19.3 GP388/GP688 Exploded View and Parts List

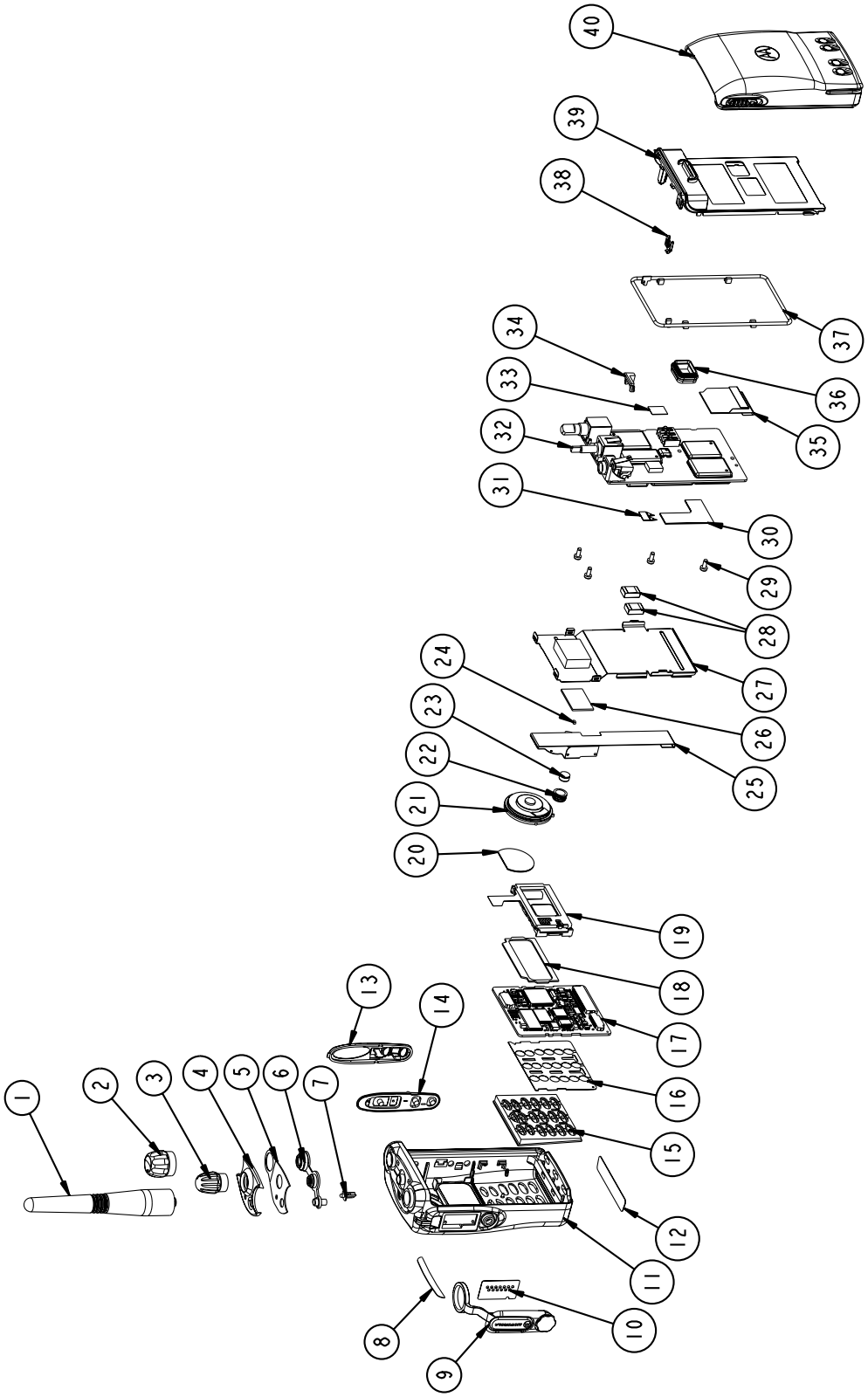


Figure 3-38 GP388 Radio Exploded View

No	Part No	Description
1	See Section 8	Antenna
2	3680529Z01	Knob, Volume
3	3680530Z02	Knob, Frequency
4	1386160Z02	Escutcheon, Top
5	3385906Z01 3315326H01	Label, Escutcheon Label, Escutcheon (EPP)
6	3286159Z01 3286159Z05	Seal, Control Top Seal, Control Top (EPP)
7	6186158Z01	Lightpipe
8	3386098Z05 3386098Z09	Nameplate, GP388 Nameplate, GP688
9	JMLN4638A	Dust Cover, Universal Connector
10	1385905Z01	Escutcheon, Universal Flex
11	1586088Z01	Front Cover
12#	-----	Escutcheon, FM
13	1386091Z01	Bezel, Side Control
14	7586090Z01	Keypad, Side Control
15	7586096Z02	Rubber, Keypad (5T)
16	4086199Z02	Polydome
17	0104017J86	Control Board
18	7580540Z01	Pad LCD Front
19	5104949J12 5104949J21	LCD, Display (5T/MPT) LCD, Display (5T/MPT) (EPP)
20	3586092Z01 3586092Z03	Felt, Speaker Felt, Speaker (EPP)
21	5086094Z01 5086094Z02	Speaker Speaker (EPP)
22	1480577C01	Boot, Microphone
23	5013920A04 5015027H01	Microphone Microphone (EPP)
24	2113740A55 2113944F01	Capacitor Capacitor (EPP)
25	8486095Z01 8486095Z02	Flex, UC Flex, UC (EPP)
26	7580918T02	Pad, Insulator
27	4286097Z01 4286097Z02	Keypad Retainer Keypad Retainer (EPP)
28	3905912Z06 3916290H01	Pad, Conductive Foam (Except VHF) Pad, Conductive Foam (Except VHF) (EPP)
29	0386104Z01 0386104Z03	Screws Screws
30	3386216Z02	FM, Escutcheon
31	3980667Z01 3980667Z04	Contact, Finger (VHF Only) Contact, Finger (VHF Only) (EPP)
32	0104013J75	RF Board Kit
33	7580556Z01 7580556Z02	Pad, Thermal Pad, Thermal (EPP)
34	1485673Z01	Insulator, Antenna
35	8404078G03 8415637H01	Flex, Keypad/Controller Flex, Keypad/Controller (EPP)
36	3280534Z02	Seal, Contact
37	3285892Z01	Gasket, O-Ring
38	3980698Z01	Contact, Ground, Compliant
39	2786154Z02	Chassis
40	See Chapter 8	Battery

Not Field Serviceable

Note: It is recommended to replace a new Front Cover kit (refer Table 3-4), Top Adhesive (3386633Z01), Top Seal/Top Sea l(EPP) (3286159Z03/3286159Z05) and Top Escutcheon (1386160Z01) whenever you change:

1. Front Housing; or
2. Speaker; or
3. Speaker Adhesive; or
4. Speaker Felt; or
5. UC Flex

Table 3-4 List of old and new Front Cover Kits of affected Super Tanapa

No.	Super Tanapa	Description	Old Kit Number	New Kit Number
1	PMUD1742B	GP344 Front Cover 136-174M 5W 4CH	PMHD4004A	PMHD4004B
2	PMUE1817B	GP344 Front Cover 403-470M 4W	PMHE4006A	PMHE4006B
3	PMUE1819B	GP344 Front Cover 450-527M 4W	PMHE4008A	PMHE4008B
4	PMUD1742C	GP344 Front Cover 136-174M 5W 4CH	PMHD4004B	PMHD4004C
5	PMUE1817C	GP344 Front Cover 403-470M 4W	PMHE4006B	PMHE4006C
6	PMUE1819C	GP344 Front Cover 450-527M 4W	PMHE4008B	PMHE4008C

19.4 GP388R/GP688R Exploded View and Parts List

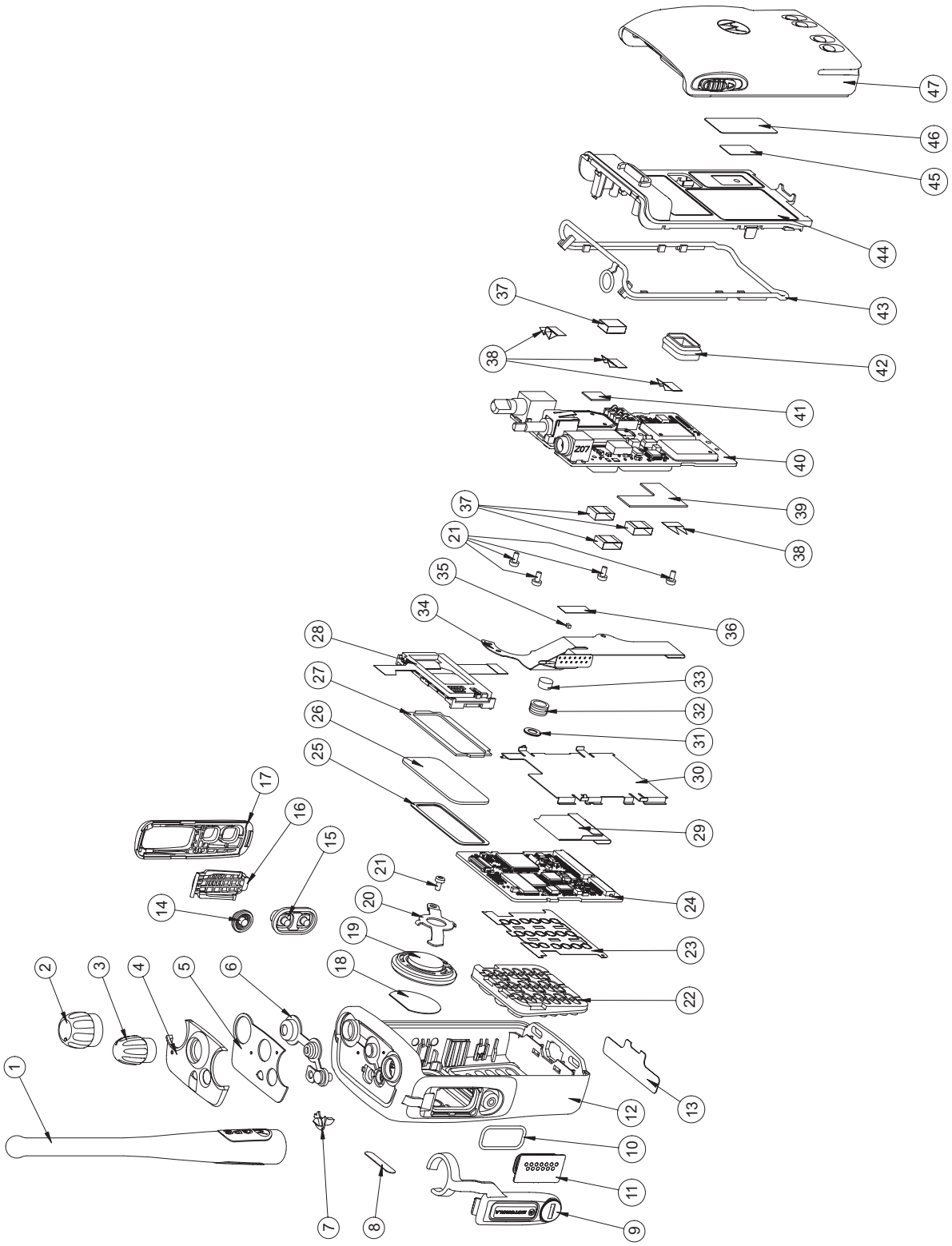


Figure 3-39 GP388R/GP688R Radio Exploded View

No	Part No	Description
1	See Chapter 8	Antenna
2	3680529Z01	Knob, Volume
3	3680530Z02	Knob, Frequency
4	1371500L02	Escutcheon, Top
5	1171513L01	Adhesive, Top Control
6	3271506L01	Seal, Top Control
7	6171501L01	Light Pipe
8	3371697L07 3371697L08	Nameplate, GP388R Nameplate, GP688R
9	PMLN5121_	Dust Cover, Minnow IP67
10#	NIL	UC O-ring
11#	NIL	Module, UC
12	1571519L01	Housing, Front
13#	NIL	Label, FM
14#	NIL	Seal, PTT
15#	NIL	Button, Side Keypad
16#	NIL	Paddle, PTT
17#	NIL	Bezel, PTT
18	7571523L02	Keypad, Main
19	4071633L01	Metal Dome
20	0104017J86	Control Board
21#	NIL	Adhesive, Lens
22#	NIL	Lens
23	7580540Z01	Pad LCD Front
24	5104949J21	LCD Display Module
25	3571525L01	Mesh, Speaker
26	5086094Z02	Speaker
27	1416418H01	Boot, Microphone
28	5013920A04	Microphone
29#	NIL	Flex, UC
30	2113944F01	Capacitor
31	1405307X01	Insulator, Kapton

No	Part No	Description
32	4271514L02	Retainer, Speaker
33	0386104Z03	Screws
34	4271526L01	Retainer, Keypad
35	3916290H01	Pad, Conductive Foam
36	3386216Z02	FM, Escutcheon
37	See Chapter 8	RF Board Kit
38	7580556Z01	Pad, Thermal
39	84C04078G03	Flex Cable
40	3980667Z04	Contact, Finger
41	3280534Z03	Battery Contact Seal
42	3271516L01	O-ring,Main
43	2771505L01	Chassis
44	3271570L01	Breathing Vent Membrane
45	3371478L01	Breathing Vent Label
46	See Chapter 8	Battery

Not Field Serviceable

19.5 GP366R/GP666R Exploded View and Parts List

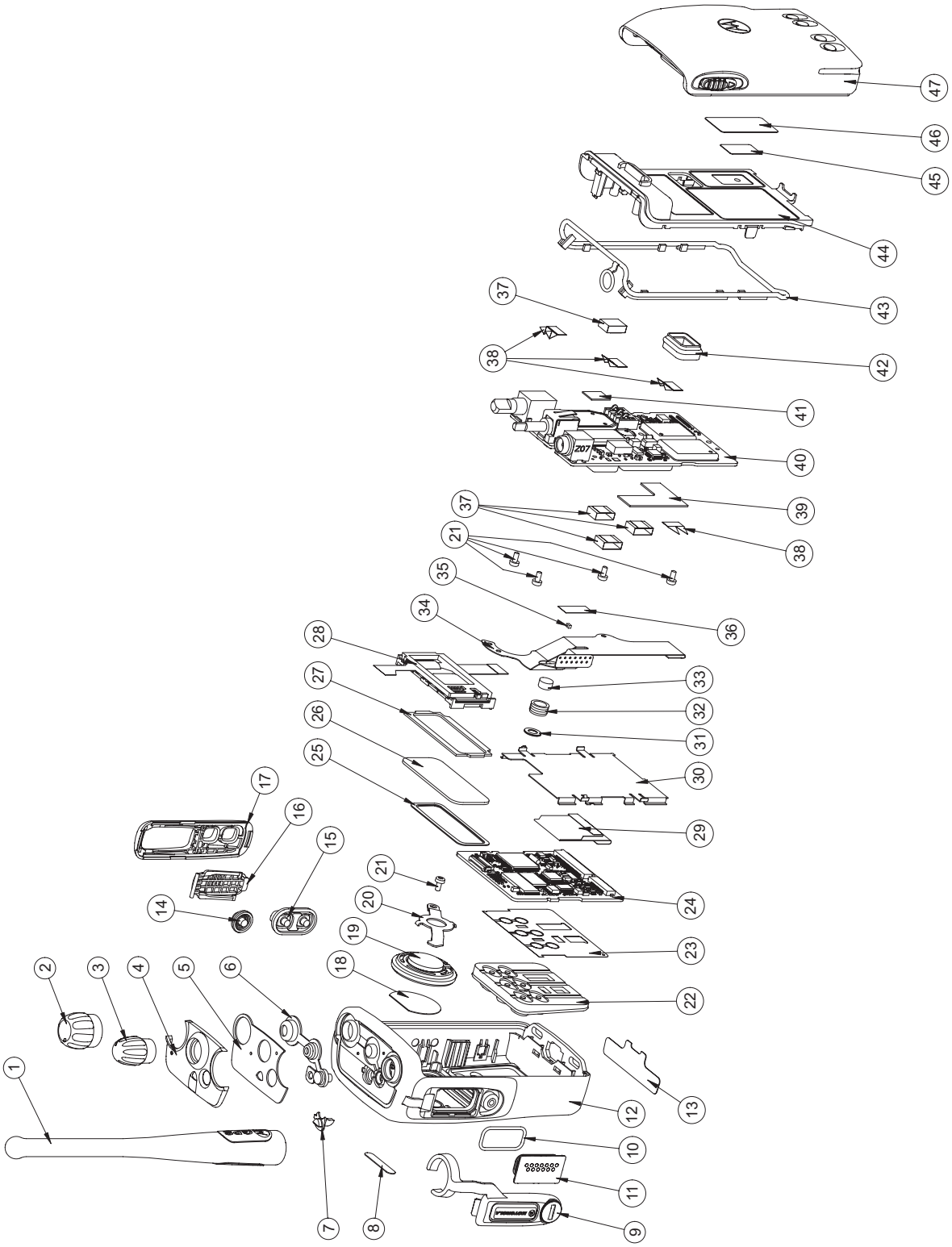


Figure 3-40 GP366R/GP666R Radio Exploded View

Item	Motorola Part Number	Description
1	See Chapter 8	Antenna
2	3680529Z01	Knob, Volume
3	3680530Z02	Knob, Frequency
4	1371500L01	Escutcheon, Top
5	1171513L01	Adhesive, Top Control
6	3271506L01	Seal, Top Control
7	6171501L01	Light Pipe
8	3371697L05 3371697L06	Nameplate GP366R Nameplate GP666R
9	PMLN5121_	Dust Cover, Minnow IP67
10#	–	UC O-ring
11#	–	Module, UC
12	1571519L02	Housing, Front
13#	–	Label, FM
14#	–	Seal, PTT
15#	–	Button, Side Keypad
16#	–	Paddle, PTT
17#	–	Bezel, PTT
18	3571525L01	Mesh, Speaker
19	5086094Z02	Speaker
20	4271514L02	Retainer, Speaker
21	0386104Z03	Screws
22	7571523L01	Keypad, Main
23	4071632L01	Mylar, Metal Dome
24	See Chapter 8	Control Board
25#	–	Adhesive, Lens
26#	–	Lens
27	7580540Z01	Pad, LCD Front
28	5104949J20	LCD Display Module
29	8415637H01	Flex Cable
30	4271526L01	Retainer, Keypad
31	3515248H01	Membrane, Microphone
32	1480577C01	Boot, Microphone
33	5015027H01	Microphone
34#	–	Flex, UC
35	2113944F01	Capacitor
36	1405307X01	Insulator, Kapton
37	3916290H01	Pad, Conductive Foam
38	3980667Z04	Contact, Finger
39	3386216Z02	FM, Escutcheon
40	See Chapter 8	RF Board Kit
41	7580556Z02	Pad, Thermal
42	3280534Z03	Battery Contact Seal
43	3271516L02	O-ring,Main
44	2771505L02 2775843M01	Chassis: PMUExxxxA, PMUDxxxx_ PMUExxxxB
45	3271570L01	Breathing Vent Membrane
46	3371478L01	Breathing Vent Label
47	See Chapter 8	Battery

Not Field Serviceable

20.0 Service Aids

Table 3-5 lists service aids recommended for working on the radios. While all of these items are available from Motorola, most are standard shop equipment items, and any equivalent item capable of the same performance may be substituted for the item listed.

Table 3-5 Service Aids

Motorola Part No.	Description	Application
RLN4460_	Portable Test Set	Enables connection to the audio/accessory jack. Allows switching for radio testing.
RKN4075_	Ribless Programming Cable	Connects radio to Computer.
JMKN4123_	Programming Cable/Test Cable	Connects radio to RIB (RLN4008_).
RLN4008_	Radio Interface Box (RIB)	Enables communications between the radio and the computer's serial communications adapter.
HLN9756_	BNC Adaptor	Adapts radio's antenna port to BNC cabling of test equipment.
HKN9743_	MAP27 Cable	Connects radio to computer for MAP27 applications in MPT requirements.
HLN9742_	Flash Upgrade Adapter	Provides connections to the computer or RIB programming /test cable
0180305G54	Shop Battery Eliminator	Interconnects radio to power supply.
8180384F66	Bench Test Housing Eliminator for long housing.	Provides for troubleshooting of the radio when the housing is removed.
8180384M30	Bench Test Housing Eliminator for short housing.	Provides for troubleshooting of the radio when the housing is removed.
JMKN4125_	Battery Eliminator 7.5V	Interconnects radio to power supply.
EPN4040_	Wall-Mounted Power Supply	Used to supply power to the RIB (UK).
EPN4041_	Wall-Mounted Power Supply	Used to supply power to the RIB (Euro)
3080369B71 or 3080369B72	Computer Interface Cable	Use B72 for the IBM PC AT. All other IBM models use B71. Connects the computer's serial communications adapter to the RIB. (RLN4008_)

21.0 Test Equipment

Table 3-6 lists test equipment required to service two-way radios.

Table 3-6 Recommended Test Equipment

Motorola Part No.	Description	Characteristics	Application
R2600_NT	Comms System Analyzer (non MPT)	This monitor will substitute for items with an asterisk *	Frequency/deviation meter and signal generator for wide-range troubleshooting and alignment
R2680_NT to be ordered with RLN1022_ (H/W) RLN1023_ (S/W)	Comms System Analyzer (MPT1327)	This monitor will substitute for items with an asterisk *	Frequency/deviation meter and signal generator for wide-range troubleshooting and alignment
*R1072_	Digital Multimeter		AC/DC voltage and current measurements
*R1377_	AC Voltmeter	100 μV to 300 V, 5Hz-1MHz, 10 Megohm input impedance	Audio voltage measurements
WADN4133_	Delay Oscilloscope	2 Channel 40 MHz bandwidth, 5 mV/cm - 20 V/cm	Waveform measurements
R1440_ 0180305F22 0180305F30 0180305F39 RLN4610_ *T1013_	Wattmeter, Plug-in Element Plug-in Element Plug-in Element Carry case RF Dummy Load	Thruline 50-Ohm, ±5% accuracy 10W, 50 - 125 MHz 10W, 100 - 250 MHz 10W, 200 - 500 MHz Wattmeter and 6 elements	Transmitter power output measurements
S1339_	RF Millivolt Meter	100mV to 3 VRF, 10 kHz to 1.2 GHz	RF level measurements
S1348_	220V Power Supply	0-20V, 5A	Programmable

22.0 Programming/Test Cable

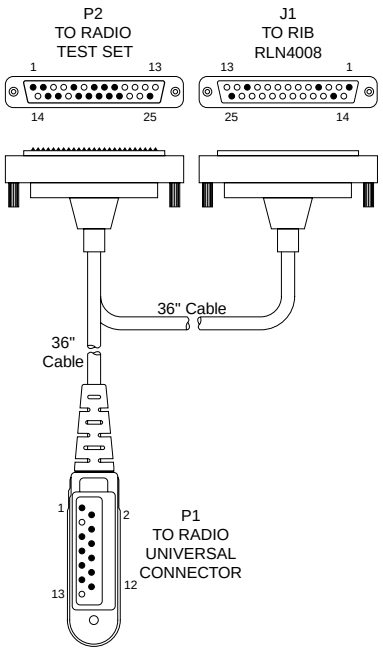


Figure 3-41 Programming/Test Cable

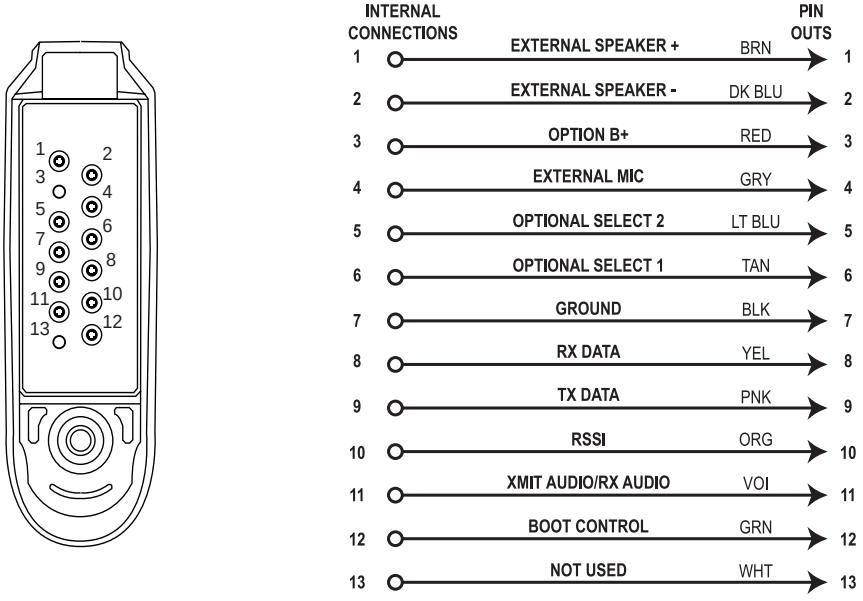


Figure 3-42 Pin Configuration of the Side Connector

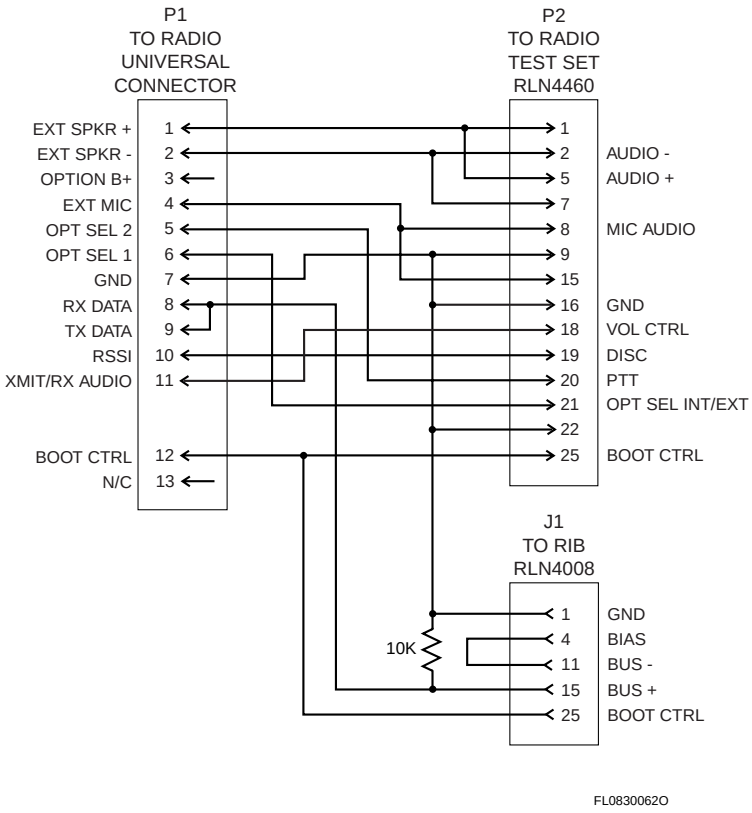


Figure 3-43 Wiring of the Connectors

Chapter 4

TRANSCEIVER PERFORMANCE TESTING GP300 COMPACT SERIES

1.0 Introduction

The radios have been prepared to meet published specifications through their manufacturing process, with the use of laboratory-quality test equipment of highest accuracy. The recommended field service equipment approaches the accuracy of the manufacturing equipment with a few exceptions.

Accuracy of the equipment must be maintained in compliance with the manufacturer's recommended calibration schedule.

2.0 Setup

Supply voltage can be connected from the battery eliminator. The equipment required for alignment procedures is connected as shown in the Radio Alignment Test Setup diagram.

Initial equipment control settings should be as indicated in the following table and should hold for all alignment procedures except as noted in Table 4-1.

Table 4-1 Initial Equipment Control Settings

Service Monitor	Test Set	Power Supply
Monitor Mode: Power Monitor	Spkr set: A	Voltage: 7.5VDC
RF Attn: -70	Spkr/load: Speaker	DC ON/standby: Standby
AM, CW, FM: FM	PTT: OFF	Volt Range: 10V
O'scope Source: Mod O'scope Horiz: 10mSec/Div O'scope Vert: 2.5kHz/Div O'scope Trig: Auto Monitor Image: Hi Monitor BW: Nar Monitor Squelch: mid CW Monitor Vol: 1/4 CW		Current: 2.5A

3.0 Test Mode

3.1 RF Test Mode

When the radio is operating in its normal environment, the radio's microcontroller controls the RF channel selection, transmitter key-up, and receiver muting. However, when the unit is on the bench for testing, alignment or repair, it is removed from its normal environment.

It cannot receive commands from its system and, therefore, the internal microcontroller will not key the transmitter nor unmute the receiver. This prevents the use of normal tune-up procedures. To solve this problem a special routine, called TEST MODE or "air test," has been incorporated in the radio.

To enter test mode:

- Turn the radio on.
- Within ten seconds after the self test is complete, press the side button 2, (SB2) five times in succession.
- After "XXX CHXX SPXX" appears in the display, the radio is on channel XX with one of the signalling environment as shown in Table 4-2.
- Each additional press of SB2 will scroll through to the next channel spacing and a corresponding set of tones will be sounded.
- Pressing SB1 will scroll through and access test environments as shown in Table 4-2.
- Pressing SB2 for 3 seconds will switch the radio to the Control Head Test mode. 'LCD Test' appears on the display.
- Pressing SB1 will cause the radio to turn on all the dots of the first characte. Another SB1 press will turn on all the dots of the next character and so on until the last characater (character 14).
- Pressing SB1 at the end of the LCD test will activate the 'Icon Test'. The next SB1 press will turn on the first icon.
- Pressing SB1 at the end of the Icon test will activate the 'Button Test'. Pressing any side button (except SB1) or any keypad button during the LCD test or Icon test will immediately activate this test.
- Pressing SB2 for 3 seconds in the Control Head Test mode will cause the radio to return to the RF Test mode..

NOTE **XX - channel number (01 - 14)**

Table 4-2 Test Environments

Display	Signalling Environment	Number of Beeps
CSQ	Carrier Squelch	1 (High Tone)
CMP	BINm_12 (speaker unmuted)	11 (Low Tone)
LLE	BINm_12 (speaker unmuted)	12 (Low Tone)
UNSQ	Unsquelched (speaker unmuted)	5 (Low Tone)
DPL	Digital Private Line	2 (Low Tone)

Table 4-2 Test Environments

Display	Signalling Environment	Number of Beeps
TPL	Tone Private Line	1 (Low Tone)
DTMF	Dual Tone Multi-Frequency	3 (Low Tone)
MPT 0	1200 baud with Data 0	9 (Low Tone)
MPT 1	1200 baud with Data 1	10 (Low Tone)
MPT 3	1200 baud with Bit Pattern	4 (Low Tone)
SV-C	Select 5 CCIR	6 (Low Tone)
SV-Z	Select 5 ZVEI	7 (Low Tone)
EXT	External Modulation Balance	8 (Low Tone)

Table 4-3 Test Channel Spacing

No. of BKC	Channel Spacing
1	25 kHz
2	12.5 kHz
3	20 kHz

Table 4-4 Test Frequencies

Channel Selector Switch Position	Test Channel	VHF	UHF1	UHF2
1 Low Power 8 High Power	TX#1 or #8 RX#1 or #8	136.025 136.025	403.025 403.025	450.025 450.025
2 Low Power 9High Power	TX#2 or #9 RX#2 or #9	142.325 142.325	415.025 415.025	462.850 462.850
3 Low Power 10 High Power	TX#3 or #10 RX#3 or #10	148.625 148.625	425.025 425.025	475.675 475.675
4 Low Power 11 High Power	TX#4 or #11 RX#4 or #11	155.025 155.025	436.025 436.025	488.500 488.500
5 Low Power 12 High Power	TX#5 or #12 RX#5 or #12	161.225 161.225	449.025 449.025	501.325 501.325
6 Low Power 13 High Power	TX#6 or #13 RX#6 or #13	167.525 167.525	460.025 460.025	514.150 514.150

Table 4-4 Test Frequencies

Channel Selector Switch Position	Test Channel	VHF	UHF1	UHF2
7 Low Power 14 High Power	TX#7 or #14 RX#7or #14	173.975 173.975	469.975 469.975	526.975 526.975

Table 4-5 Receiver Performance Checks

Test Name	Communications Analyzer	Radio	Test Set	Comments
Reference Frequency	Mode: PWR MON 2nd channel test frequency* Monitor: Frequency error Input at RF In/Out	TEST MODE, Test Channel 2 carrier squelch output at antenna	PTT to continuous (during the performance check)	Frequency error to be ±200 Hz VHF ±600 Hz UHF1 ±600 Hz UHF2
Rated Audio	Mode: GEN Output level: 1.0mV RF 2nd channel test frequency* Mod: 1kHz tone at 3kHz deviation Monitor: DVM: AC Volts	TEST MODE Test Channel 2 carrier squelch	PTT to OFF (center), meter selector to Audio PA	Set volume control to 3.16Vrms
Distortion	As above, except to distortion	As above	As above	Distortion <3.0%
Sensitivity (SINAD)	As above, except SINAD, lower the RF level for 12dB SINAD.	As above	PTT to OFF (center)	RF input to be <0.35µ
Noise Squelch Threshold (only radios with conventional system need to be tested)	RF level set to 1mV RF	As above	PTT to OFF (center), meter selection to Audio PA, spkr/load to speaker	Set volume control to 3.16Vrms
	As above, except change frequency to a conventional system. Raise RF level from zero until radio unsquelches.	out of TEST MODE; select a conventional system	As above	Unsquelch to occur at <0.35µV. Preferred SINAD = 8-10dB

* See Table 4-4

Table 4-6 Transmitter Performance Checks

Test Name	Communications Analyzer	Radio	Test Set	Comments
Reference Frequency	Mode: PWR MON 2nd channel test frequency* Monitor: Frequency error Input at RF In/Out	TEST MODE, Test Channel 2 carrier squelch	PTT to continuous (during the performance check)	Frequency error to be ±200 Hz VHF ±600 Hz UHF1 ±600 Hz UHF2
Power RF	As above	As above	As above	Refer to Maintenance Specifications
Voice Modulation	Mode: PWR MON 2nd channel test frequency* atten to -70, input to RF In/Out Monitor: DVM, AC Volts Set 1kHz Mod Out level for 0.025Vrms at test set, 80mVrms at AC/DC test set jack	As above	As above, meter selector to mic	Deviation: VHF, UHF1,UHF2: ≥ 4.0 kHz but ≤ 5.0 kHz (25 kHz Ch Sp).
Voice Modulation (internal)	Mode: PWR MON 2nd channel test frequency* atten to -70, input to RF In/Out	TEST MODE, Test Channel 2 carrier squelch output at antenna	Remove modulation input	Press PTT switch on radio. Say “four” loudly into the radio mic. Measure deviation: VHF, UHF1, UHF2: ≥ 4.0 kHz but ≤ 5.0 kHz (25 kHz Ch Sp)
DTMF Modulation	As above, 2nd channel test frequency*	TEST MODE, Test Channel 2 DTMF output at antenna	As above	Deviation: VHF, UHF1, UHF2: ≥ 3.05 kHz but ≤ 3.45 kHz (25 kHz Ch Sp)
PL/DPL Modulation	As above 2nd channel test frequency* BW to narrow	TEST MODE, Test Channel 2 TPL DPL	As above	Deviation: VHF, UHF1, UHF2: ≥ 500Hz but ≤ 1000Hz (25 kHz Ch Sp).

* See Table 4-4

3.2 Channel Signalling Selection

Press side button 1 to scroll through the signalling modes as indicated in Table Table 4-2 .

Selection of the signalling mode is indicated on the display and by the number of tones in the loudspeaker.

When the last mode is selected, pressing Side Button 1 returns the selection to the first mode.

Binary signalling (MPT) is detailed in Table Table 4-7 .

Table 4-7 Binary Signalling

Transmit Signalling	Receive Signalling	Tone
MPT 3 BIN2_12 (microphone disabled)	BINm_12	4 (Low Tone)
MPT 0 BIN0_12 (microphone disabled)	Carrier Squelch	9 (Low Tone)
MPT 1 BIN1_12 (microphone disabled)	Carrier Squelch	10 (Low Tone)

For Transmit, the binary sequence is continuously encoded whilst the radio is keyed up.

For Receive, the high tone sounds when the correct binary message has been decoded.

Sequential signalling (Select 5) is detailed in Table Table 4-8 .

Table 4-8 Sequential Signalling

Transmit Signalling	Receive Signalling	Tone
CCIR (microphone disabled)	CCIR (speaker muted)	6 (Low Tone)
ZVEI (microphone disabled)	ZVEI (speaker muted)	7 (Low Tone)

For Transmit, the first tone in the sequence is encoded for a duration of 2 seconds. After the complete tone sequence is encoded, the radio will remain keyed up with the microphone disabled until the PTT is released.

For Receive, the high tone sounds when the correct tone sequence has been decoded.

3.3 Definitions for the types of signalling configurations:

MPT 0 (BIN0_12) Continuous stream of data “0” sent using 1200 baud FFSK modulation.

MPT 1 (BIN1_12) Continuous stream of data “1” sent using 1200 baud FFSK modulation.

MPT 3 Encode (BIN2_12) A pseudo-random bit sequence sent using 1200 baud FFSK modulation.

MPT 3 Decode (BINm_12) A bit pattern “aa aa c4 d7 d2 90 49 f1 f1 bb f5 c7” received using 1200 baud FFSK modulation.

CCIR 13579 1124, 1275, 1446, 1640, 1860Hz

ZVEI 13579 1060, 1270, 1530, 1830, 2200H

Chapter 5

TRANSCEIVER PERFORMANCE TESTING GP600 COMPACT SERIES

1.0 Introduction

The radios have been prepared to meet published specifications through their manufacturing process, with the use of laboratory-quality test equipment of highest accuracy. The recommended field service equipment approaches the accuracy of the manufacturing equipment with a few exceptions.

Accuracy of the equipment must be maintained in compliance with the manufacturer's recommended calibration schedule.

2.0 Setup

Supply voltage can be connected from the battery eliminator. The equipment required for alignment procedures is connected as shown in the Radio Alignment Test Setup diagram.

Initial equipment control settings should be as indicated in the following table and should hold for all alignment procedures except as noted in Table 4-1.

Table 5-1 Initial Equipment Control Settings

Service Monitor	Test Set	Power Supply
Monitor Mode: Power Monitor	Spkr set: A	Voltage: 7.5VDC
RF Attn: -70	Spkr/load: Speaker	DC ON/standby: Standby
AM, CW, FM: FM	PTT: OFF	Volt Range: 10V
O'scope Source: Mod O'scope Horiz: 10mSec/Div O'scope Vert: 2.5kHz/Div O'scope Trig: Auto Monitor Image: Hi Monitor BW: Nar Monitor Squelch: mid CW Monitor Vol: 1/4 CW		Current: 2.5A

3.0 Test Mode

3.1 RF Test Mode

When the radio is operating in its normal environment, the radio's microcontroller controls the RF channel selection, transmitter key-up, and receiver muting. However, when the unit is on the bench for testing, alignment or repair, it is removed from its normal environment.

It cannot receive commands from its system and, therefore, the internal microcontroller will not key the transmitter nor unmute the receiver. This prevents the use of normal tune-up procedures. To solve this problem a special routine, called TEST MODE or "air test," has been incorporated in the radio.

To enter test mode:

- Turn the radio on.
- Within ten seconds after the self test is complete, press the side button 2, (SB2) five times in succession.
- After "XXX CHXX SPXX" appears in the display, the radio is on channel XX with one of the signalling environment as shown in Table 4-2.
- Each additional press of SB2 will scroll through to the next channel spacing and a corresponding set of tones will be sounded.
- Pressing SB1 will scroll through and access test environments as shown in Table 4-2.
- Pressing SB2 for 3 seconds will switch the radio to the Control Head Test mode. 'LCD Test' appears on the display.
- Pressing SB1 will cause the radio to turn on all the dots of the first characte. Another SB1 press will turn on all the dots of the next character and so on until the last characater (character 14).
- Pressing SB1 at the end of the LCD test will activate the 'Icon Test'. The next SB1 press will turn on the first icon.
- Pressing SB1 at the end of the Icon test will activate the 'Button Test'. Pressing any side button (except SB1) or any keypad button during the LCD test or Icon test will immediately activate this test.
- Pressing SB2 for 3 seconds in the Control Head Test mode will cause the radio to return to the RF Test mode..

NOTE **XX - channel number (01 - 14)**

Table 5-2 Test Environments

Display	Signalling Environment	Number of Beeps
CSQ	Carrier Squelch	1 (High Tone)
CMP	BINm_12 (speaker unmuted)	11 (Low Tone)
LLE	BINm_12 (speaker unmuted)	12 (Low Tone)
UNSQ	Unsquelched (speaker unmuted)	5 (Low Tone)
DPL	Digital Private Line	2 (Low Tone)
TPL	Tone Private Line	1 (Low Tone)
DTMF	Dual Tone Multi-Frequency	3 (Low Tone)
MPT 0	1200 baud with Data 0	9 (Low Tone)
MPT 1	1200 baud with Data 1	10 (Low Tone)
MPT 3	1200 baud with Bit Pattern	4 (Low Tone)
SV-C	Select 5 CCIR	6 (Low Tone)
SV-Z	Select 5 ZVEI	7 (Low Tone)
EXT	External Modulation Balance	8 (Low Tone)

Table 5-3 Test Channel Spacing

No. of BKC	Channel Spacing
1	25 kHz
2	12.5 kHz
3	20 kHz

Table 5-4 Test Frequencies

Channel Selector Switch Position	Test Channel	UHF1	330MHz
1 Low Power 8 High Power	TX#1 or #8 RX#1 or #8	403.025 403.025	330.020 330.020
2 Low Power 9High Power	TX#2 or #9 RX#2 or #9	415.025 415.025	341.680 341.680
3 Low Power 10 High Power	TX#3 or #10 RX#3 or #10	425.025 425.025	353.340 353.340
4 Low Power 11 High Power	TX#4 or #11 RX#4 or #11	436.025 436.025	365.000 365.000

Table 5-4 Test Frequencies

Channel Selector Switch Position	Test Channel	UHF1	330MHz
5 Low Power 12 High Power	TX#5 or #12 RX#5 or #12	449.025 449.025	376.660 376.660
6 Low Power 13 High Power	TX#6 or #13 RX#6 or #13	460.025 460.025	388.320 388.320
7 Low Power 14 High Power	TX#7 or #14 RX#7or #14	469.975 469.975	399.980 399.980

Table 5-5 Receiver Performance Checks

Test Name	Communications Analyzer	Radio	Test Set	Comments
Reference Frequency	Mode: PWR MON 2nd channel test frequency* Monitor: Frequency error Input at RF In/Out	TEST MODE, Test Channel 2 carrier squelch output at antenna	PTT to continuous (during the performance check)	Frequency error to be ±600 Hz UHF1
Rated Audio	Mode: GEN Output level: 1.0mV RF 2nd channel test frequency* Mod: 1kHz tone at 3kHz deviation Monitor: DVM: AC Volts	TEST MODE Test Channel 2 carrier squelch	PTT to OFF (center), meter selector to Audio PA	Set volume control to 3.16Vrms
Distortion	As above, except to distortion	As above	As above	Distortion <3.0%
Sensitivity (SINAD)	As above, except SINAD, lower the RF level for 12dB SINAD.	As above	PTT to OFF (center)	RF input to be <0.35µ
Noise Squelch Threshold (only radios with conventional system need to be tested)	RF level set to 1mV RF	As above	PTT to OFF (center), meter selection to Audio PA, spkr/ load to speaker	Set volume control to 3.16Vrms
	As above, except change frequency to a conventional system. Raise RF level from zero until radio unsquelches.	out of TEST MODE; select a conventional system	As above	Unsquelch to occur at <0.35µV. Preferred SINAD = 8-10dB

* See Table 4-4

Table 5-6 Transmitter Performance Checks

Test Name	Communications Analyzer	Radio	Test Set	Comments
Reference Frequency	Mode: PWR MON 2nd channel test frequency* Monitor: Frequency error Input at RF In/Out	TEST MODE, Test Channel 2 carrier squelch	PTT to continuous (during the performance check)	Frequency error to be ±600 Hz UHF1
Power RF	As above	As above	As above	Refer to Maintenance Specifications
Voice Modulation	Mode: PWR MON 2nd channel test frequency* atten to -70, input to RF In/Out Monitor: DVM, AC Volts Set 1kHz Mod Out level for 0.025Vrms at test set, 80mVrms at AC/DC test set jack	As above	As above, meter selector to mic	Deviation: UHF1: ≥ 4.0 kHz but ≤ 5.0 kHz (25 kHz Ch Sp).
Voice Modulation (internal)	Mode: PWR MON 2nd channel test frequency* atten to -70, input to RF In/Out	TEST MODE, Test Channel 2 carrier squelch output at antenna	Remove modulation input	Press PTT switch on radio. Say “four” loudly into the radio mic. Measure deviation: UHF1: ≥ 4.0 kHz but ≤ 5.0 kHz (25 kHz Ch Sp)
DTMF Modulation	As above, 2nd channel test frequency*	TEST MODE, Test Channel 2 DTMF output at antenna	As above	Deviation: UHF1: ≥ 3.05 kHz but ≤ 3.45 kHz (25 kHz Ch Sp)
PL/DPL Modulation	As above 2nd channel test frequency* BW to narrow	TEST MODE, Test Channel 2 TPL DPL	As above	Deviation: UHF1: ≥ 500Hz but ≤ 1000Hz (25 kHz Ch Sp).

* See Table 4-4

3.2 Channel Signalling Selection

Press side button 1 to scroll through the signalling modes as indicated in Table 4-2 .

Selection of the signalling mode is indicated on the display and by the number of tones in the loudspeaker.

When the last mode is selected, pressing Side Button 1 returns the selection to the first mode.

Binary signalling (MPT) is detailed in Table 4-7 .

Table 5-7 Binary Signalling

Transmit Signalling	Receive Signalling	Tone
MPT 3 BIN2_12 (microphone disabled)	BINm_12	4 (Low Tone)
MPT 0 BIN0_12 (microphone disabled)	Carrier Squelch	9 (Low Tone)
MPT 1 BIN1_12 (microphone disabled)	Carrier Squelch	10 (Low Tone)

For Transmit, the binary sequence is continuously encoded whilst the radio is keyed up.

For Receive, the high tone sounds when the correct binary message has been decoded.

Sequential signalling (Select 5) is detailed in Table 4-8 .

Table 5-8 Sequential Signalling

Transmit Signalling	Receive Signalling	Tone
CCIR (microphone disabled)	CCIR (speaker muted)	6 (Low Tone)
ZVEI (microphone disabled)	ZVEI (speaker muted)	7 (Low Tone)

For Transmit, the first tone in the sequence is encoded for a duration of 2 seconds. After the complete tone sequence is encoded, the radio will remain keyed up with the microphone disabled until the PTT is released.

For Receive, the high tone sounds when the correct tone sequence has been decoded.

3.3 Definitions for the types of signalling configurations:

MPT 0 (BIN0_12) Continuous stream of data “0” sent using 1200 baud FFSK modulation.

MPT 1 (BIN1_12) Continuous stream of data “1” sent using 1200 baud FFSK modulation.

MPT 3
Encode (BIN2_12) A pseudo-random bit sequence sent using 1200 baud FFSK modulation.

MPT 3
Decode (BINm_12) A bit pattern “aa aa c4 d7 d2 90 49 f1 f1 bb f5 c7” received using 1200 baud FFSK modulation.

CCIR 13579 1124, 1275, 1446, 1640, 1860Hz

ZVEI 13579 1060, 1270, 1530, 1830, 2200H

Chapter 6

RADIO TUNING AND PROGRAMMING

1.0 Introduction

This chapter provides an overview of the Professional Radios Customer Programming Software (CPS) and Universal Tuner which have been designed for use in a Windows 95 environment. Both these software will essentially cover all the functions of the traditional Radio Service Software (RSS) package.

They are available in separate kits as shown in the table below:

Description	Kit Number
5-Tone Professional Radio CPS CD	ENLN4115_
MPT Professional Radio CPS CD	ENLN4116_

An Installation instruction manual is contained within each kit.

2.0 Radio Tuning Setup

A personal computer and Universal Tuner are required to tune the radio. To perform the tuning procedures, the radio must be connected to the PC, RIB (Radio Interface Box) and Universal Test Set as shown in figure below..

NOTE Refer to appropriate program on-line help files for the tuning procedures.

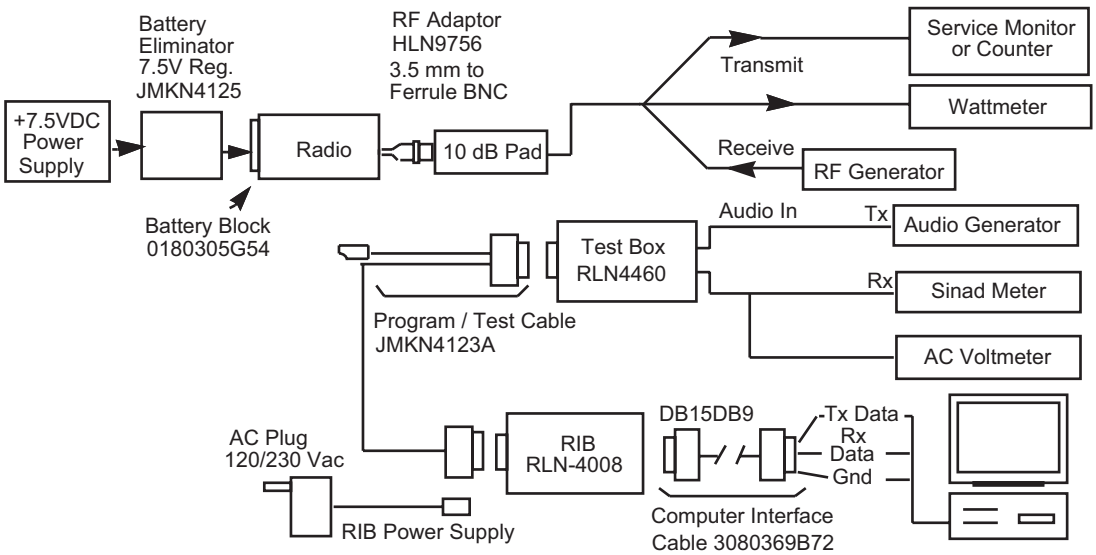


Table 6-1 Radio Tuning Setup

2.1 Initial Test Equipment Setup

The supply voltage is connected to the radio using a Motorola battery eliminator, P/N 0180305G54. The initial test equipment (Figure 5-1) control settings are listed in Table 5-2.

NOTE Refer to appropriate program on-line help files for the tuning procedures.

Table 6-2 Initial Equipment Control Settings

Service Monitor	Test Set	Power Supply
Monitor Mode: Power Monitor	Speaker set: A	Voltage: 7.5Vdc
RF Attenuation: -70	Speaker/load: Speaker	DC on/standby: Standby
AM, CW, FM: FM	PTT: OFF	Volt Range: 10V
Oscilloscope Source: Mod Oscilloscope Horizontal: 10mSec/Div Oscilloscope Vertical: 2.5kHz/Div Oscilloscope Trigger: Auto Monitor Image: Hi Monitor BW: Nar Monitor Squelch: mid CW Monitor Volume: 1/4 CW		Current: 2.5A

3.0 CPS Programming Setup

The CPS programming setup is used to program the radio codeplug.

NOTE Refer to appropriate program on-line help files for the codeplug programming procedures.

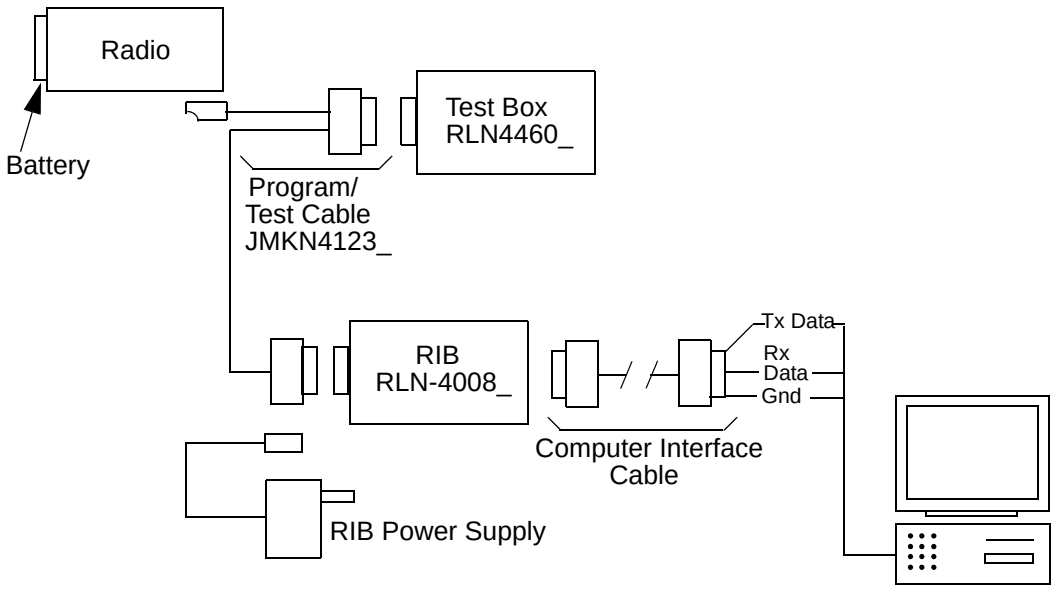


Table 6-3 CPS Programming Setup

Chapter 7

POWER UP SELF-TEST

1.0 Error Codes

Turning on the radio using the ON/OFF volume control starts a self-test routine which checks the RAM, ROM checksum, EEPROM hardware and EEPROM checksum. If these checks are successfully completed, the radio will generate the Self-Test Pass Tone. Radio emits only “bonk” (300 Hz) tone if it fails the self-test.

*Error Code	Explanation	Corrective Action
“RAM TST ERROR”	RAM Test Failure	Retest radio by turning it off and turning it on again. If message reoccurs, replace main board or send radio to nearest Motorola Depot.
“ROM CS ERROR”	ROM Checksum is wrong.	Reprogram FLASH Memory, then retest. If message reoccurs, replace main board or send radio to nearest Motorola Depot.
“EEPRM HW ERROR”	Codeplug structure mismatch, non existence of codeplug.	Reprogram codeplug with correct version and retest radio. If message reoccurs, replace main board or send radio to nearest Motorola Depot.
“EEPRM CS ERROR”	Codeplug checksum is wrong.	Reprogram codeplug.
No Display	Display module is not connected properly. Display module is damaged.	Check connection between main board and display module. Replace with new display module.

* for Display models only.

Notes

Chapter 8

MODEL CHART AND TEST SPECIFICATION

1.0 136-174 MHz

1.1 GP Compact Series

GP300 Series, VHF, 136-174 MHz (IP54)			
Model			Description
MDH38KDC9AN3_E			GP344 136-174 MHz 5W NK/P PMW302C
	MDH38KDH9AN6_E		GP388 136-174 MHz 5W K/P PMW302H
		Item	Description
X		JMHD4005_	GP344 B/C Kit 136-174 MHz Pop. 5W NK/P
	X	PMHD4009_	GP388 B/C Kit 136-174 MHz Pref. 5W K/P
X		PMHD4004_	GP344 F/C Kit 136-174 MHz Pop. 5W NK/P
	X	PMHD4005_	GP388 F/C Kit 136-174 MHz Pref. 5W K/P
X	X	PMAD4012_	Antenna, VHF 136-155 MHz Stubby
X	X	PMAD4013_	Antenna, VHF 155-174 MHz Stubby
X	X	PMAD4014_	Antenna, VHF 136-155 MHz 14 cm
X	X	PMAD4015_	Antenna, VHF 155-174 MHz 14 cm
X	X	PMAD4023_	Antenna, VHF 150-161 MHz 14 cm
X	X	PMAD4025-	Antenna, VHF 150-161 MHz Stubby
X		6864110B54	GP344/GP344R User Guide
	X	6864110B97	GP388/GP388R User Guide

x = Indicates one of each is required.

1.2 GP Series (IP67)

GP300 Series, VHF, 136-174 MHz (IP67)				
Model				Description
MDH38KDC9AN3_ER				GP344R 136-174 MHz 5W NK/P PMR302C
	MDH38KDF9AN5_ER			GP366R 136-174 MHz 5W LK/P PMR302F
		MDH38KDH9AN6_ER		GP388R 136-174 MHz 5W K/P PMR302H
			Item	Description
X			PMHD4027_	GP344R B/C Kit 136-174 MHz 5W 5-T Pop. NK/P
	X		PMHD4028_	GP366R B/C Kit 136-174 MHz 4W 5-T LK/P
		X	PMHD4028_	GP388R B/C Kit 136-174 MHz 5W 5-T Pref. K/P
X			PMHD4035_	GP344R F/C Kit 136-174 MHz 5W 5-T Pop. NK/P
	X		PMHD4043_	GP366R F/C Kit 136-174 MHz 4W 5-T LK/P
		X	PMHD4036_	GP388R F/C Kit 136-174 MHz 5W 5-T Pref. K/P
X	X	X	PMAD4067_	VHF + GPS Helical Antenna, 136-147 MHz
X	X	X	PMAD4068_	VHF + GPS Helical Antenna, 147-160 MHz
X	X	X	PMAD4069_	VHF + GPS Helical Antenna, 160-174 MHz
X			6864110B54	GP344/GP344R User Guide
	X		6866577D01	GP366R User Guide
		X	6864110B97	GP388/GP388R User Guide

x = Indicates one of each is required.

2.0 Specifications

2.1 GP344/GP344R

General

	VHF	
Frequency:	136-174 MHz	
Channel Capacity:	16 Channels	
Power Supply:	7.5 Volts ±20%	
Dimensions: With Standard High Capacity Lithium Battery: With Ultra High Capacity Lithium Battery: With IP67 Li-ion Battery:	 101.5mm x 55.5mm x 30.5mm 101.5mm x 55.5mm x 35.5mm 101.5 mm x 56mm x 37mm	
Weight: With Standard High Capacity Lithium Battery: With Ultra High Capacity Lithium Battery: With IP67 Li-ion Battery:	 250 g 270 g 305 g	
Average Battery Life @ (5-5-90 Duty Cycle) Standard High Capacity Lithium Battery: Ultra High Capacity Lithium Battery: IP67 Li-ion Battery:	Low Power >10 hrs >14 hrs >14 hrs	High Power >7 hrs >10 hrs >10 hrs
Sealing: IP67 Radios: Others:	 Meets MIL-STD-810-C,D, E & F and IPx7 Meets MIL-STD-810-C,D & E and IPx4	
Shock: IP67 Radios: Others:	 Meets MIL-STD-810-C,D,E & F and TIA/EIA 603 Meets MIL-STD-810-C,D & E and TIA/EIA 603	
Vibration: IP67 Radios: Others:	 Meets MIL-STD-810-C,D, E & F and TIA/EIA 603 Meets MIL-STD-810-C,D & E and TIA/EIA 603	
Dust: IP67 Radios: Others:	 Meets MIL-STD-810-C,D, E & F and IP6x Meets MIL-STD-810-C,D & E and IP5x	
Humidity:	50°C 95%	

Transmitter

	VHF	
RF Output Li Ion @ 7.5V:	Low 1W	High 5W
Frequency	136-174 MHz	
Channel Spacing	12.5/20/25 kHz	
Freq. Stability (-30°C to +60°C)	0.00025%	
Spurs/Harmonics:	-36 dBm < 1GHz -30 dBm > 1 GHz	
Audio Response: (from 6 dB/oct. Pre-Emphasis, 300 to 3000Hz)	+1, -3 dB	
Audio Distortion: @ 1000 Hz, 60% Rated Max. Dev.	<5%	
FM Noise:	-40 dB	

Receiver

	VHF 12.5kHz	VHF 20/ 25kHz
Frequency:	136-174MHz	136-174MHz
Sensitivity 12dB EIA SINAD:	0.35 μV	0.35 μV
Adjacent Channel Selectivity ETS	-60 dB	-70 dB
Intermodulation ETS	-65 dB	-65 dB
Freq. Stability (-30°C to +60°C):	0.00025%	0.00025%
Spur Rejection:	-70 dB	-70 dB
Image Rejection:	-70 dB	-70 dB
Audio Output @ <5% Distortion	500 mW	500 mW

All specifications are subject to change without notice.

2.2 GP366R/GP388/GP388R

General

	VHF	
Frequency:	136-174 MHz	
Channel Capacity:	255 Channels	
Power Supply:	7.5 Volts ±20%	
Dimensions: With Standard High Capacity Lithium Battery: With Ultra High Capacity Lithium Battery: With IP67 Li-ion Battery:	 101.5mm x 55.5mm x 33mm 101.5mm x 55.5mm x 38mm 101.5 mm x 56mm x 39mm	
Weight: With Standard High Capacity Lithium Battery: With Ultra High Capacity Lithium Battery: With IP67 Li-ion Battery:	 265 g 285 g 320 g	
Average Battery Life @ (5-5-90 Duty Cycle) Standard High Capacity Lithium Battery: Ultra High Capacity Lithium Battery: IP67 Li-ion Battery:	Low Power >10 hrs >14 hrs >14 hrs	High Power >7 hrs >10 hrs >10 hrs
Sealing: IP67 Radios: Others:	 Meets MIL-STD-810-C,D, E & F and IPx7 Meets MIL-STD-810-C,D & E and IPx4	
Shock: IP67 Radios: Others:	 Meets MIL-STD-810-C,D,E & F and TIA/EIA 603 Meets MIL-STD-810-C,D & E and TIA/EIA 603	
Vibration: IP67 Radios: Others:	 Meets MIL-STD-810-C,D, E & F and TIA/EIA 603 Meets MIL-STD-810-C,D & E and TIA/EIA 603	
Dust: IP67 Radios: Others:	 Meets MIL-STD-810-C,D, E & F and IP6x Meets MIL-STD-810-C,D & E and IP5x	
Humidity:	50°C 95%	

Transmitter

	VHF	
RF Output Li Ion @ 7.5V:	Low 1W	High 5W
Frequency	136-174 MHz	
Channel Spacing	12.5/20/25 kHz	
Freq. Stability (-30°C to +60°C)	0.00025%	
Spurs/Harmonics:	-36 dBm < 1 GHz -30 dBm > 1 GHz	
Audio Response: (from 6 dB/oct. Pre-Emphasis, 300 to 3000Hz)	+1, -3 dB	
Audio Distortion: @ 1000 Hz, 60% Rated Max. Dev.	<5%	
FM Noise:	-40 dB	

Receiver

	VHF 12.5kHz	VHF 20/25kHz
Frequency:	136-174MHz	136-174MHz
Sensitivity 12dB EIA SINAD:	0.35 mV	0.35 mV
Adjacent Channel Selectivity ETS	-60 dB	-70 dB
Intermodulation ETS	-65 dB	-65 dB
Freq. Stability (-30°C to +60°C):	0.00025%	0.00025%
Spur Rejection:	-70 dB	-70 dB
Image Rejection:	-70 dB	-70 dB
Audio Output @ <5% Distortion	500 mW	500 mW

All specifications are subject to change without notice.

3.0 403-470 MHz

3.1 GP300/GP600 Series (IP54)

GP300/GP600 Series, UHF1, 403-470 MHz (IP54)					
Model					**Description**
MDH38RDC9AN3_E					GP344 403-470 MHz UHF1 4W NK/P PMW502C
	MDH38RDH9AN6_E				GP388 403-470 MHz UHF1 4W K/P PMW502H
		MDH38RDC9CK3_E			GP644 403-470 MHz UHF1 B1 NK/P MPW502C
			MDH38RDH9CK6_E		GP688 403-470 MHz UHF1 B1 K/P PMW502H
				Item	Description
X				JMHE4001_	GP344 B/C Kit 403-470 MHz Pop. 4W N/KP
		X		PMHE4022_	GP644 B/C Kit 403-470 MHz Pop. NK/P
	X			PMHE4015_	GP388 B/C Kit 403-470 MHz Pref. 4W K/P
			X	PMHE4023_	GP688 B/C Kit 403-470 MHz Pref.K/P
X				PMHE4006_	GP344 F/C Kit 403-470 MHz Pop. NK/P
		X		PMHE4006_	GP644 F/C Kit 403-470 MHz Pop.NK/P
	X			PMHE4007_	GP388 F/C Kit 403-470 MHz Pref. K/P
			X	PMHE4007_	GP688 F/C Kit UHF1 Pref. K/P
X	X	X	X	NAE6483_	Monopole (Whip) Antenna, UHF1 403-520 MHz
X	X	X	X	PMAE4002_	9 cm Antenna, UHF1 403-433 MHz Stubby
X	X	X	X	PMAE4003_	9 cm Antenna, UHF1 430-470 MHz
X				6864110B54	GP344/ GP344R User Guide
	X			6864110B97	GP388/GP388R User Guide
		X		6866542D01	GP644/GP644R User Guide
			X	6866542D02	GP688/GP688R User Guide

x = Indicates one of each is required.

3.2 GP300/GP600 Series (IP67)

GP300/GP600 Series, UHF1, 403-470 MHz (IP67)							
Model							Description
MDH38RDC9AN3_ER							GP344R 403-470 MHz 4W NK/P PMR502C
	MDH38RDF9AN5_ER						GP366R 403-470 MHz 4W LK/P PMR502F
		MDH38RDH9AN6_ER					GP388R 403-470 MHz 4W K/P PMR502H
			MDH38RDC9CK3_ER				GP644R 403-470 MHz 4W NK/P PMR502C
				MDH38RDF9CK5_ER			GP666R 403-470 MHz 4W LK/P PMR902F
					MDH38RDH9CK6_ER		GP688R 403-470 MHz 4W K/P PMR502H
						Item	Description
X						PMHE4039_	GP344R B/C Kit 403-470 MHz 4W 5-T Pop. NK/P
	X					PMHE4041_	GP366R B/C Kit 403-470 MHz 4W 5-T LK/P
		X				PMHE4041_	GP388R B/C Kit 403-470 MHz 4W 5-T Pref. K/P
			X			PMHE4043_	GP644R B/C Kit 403-470 MHz 4W MPT Pop. NK/P
				X		PMHE4044_	GP666R B/C Kit 403-470 MHz 4W MPT Pref. LK/P
					X	PMHE4044_	GP688R B/C Kit 403-470 MHz 4W MPT Pref. K/P
X						PMHE4049_	GP344R F/C Kit 403-470 MHz 4W 5-T Pop. NK/P
	X					PMHE4059_	GP366R F/C Kit 403-470 MHz 4W 5-T LK/P
		X				PMHE4050_	GP388R F/C Kit 403-470 MHz 4W 5-T Pref. K/P
			X			PMHE4049_	GP644R F/C Kit 403-470 MHz 4W MPT Pop. NK/P
				X		PMHE4059_	GP666R F/C Kit 403-470 MHz 4W MPT LK/P
					X	PMHE4050_	GP688R F/C Kit 403-470 MHz 4W MPT Pref. K/P
X	X	X	X	X	X	PMAE4022_	Whip Antenna, UHF1 400-470 MHz
X						6864110B54	GP344R User Guide
	X					6866577D01	GP366R User Guide
		X				6864110B97	GP388R User Guide
			X			6866542D01	GP644R User Guide
				X		6866577D02	GP666R User Guide
					X	6866542D02	GP688R User Guide

x = Indicates one of each is required.

4.0 Specifications

4.1 GP344/GP344R/GP644/ GP644R

General

	UHF1	
Frequency:	403-470 MHz	
Channel Capacity:	16 Channels	
Power Supply:	7.5 Volts ±20%	
Dimensions: With Standard High Capacity Lithium Battery: With Ultra High Capacity Lithium Battery: With IP67 Li-ion Battery:	 101.5mm x 55.5mm x 30.5mm 101.5mm x 55.5mm x 35.5mm 101.5 mm x 56mm x 37mm	
Weight: With Standard High Capacity Lithium Battery: With Ultra High Capacity Lithium Battery: With IP67 Li-ion Battery:	 250 g 270 g 305 g	
Average Battery Life @ (5-5-90 Duty Cycle) Standard High Capacity Lithium Battery: Ultra High Capacity Lithium Battery: IP67 Li-ion Battery:	Low Power >10 hrs >14 hrs >14 hrs	High Power >7 hrs >10 hrs >10 hrs
Sealing: IP67 Radios: Others:	 Meets MIL-STD-810-C,D, E & F and IPx7 Meets MIL-STD-810-C,D & E and IPx4	
Shock: IP67 Radios: Others:	 Meets MIL-STD-810-C,D,E & F and TIA/EIA 603 Meets MIL-STD-810-C,D & E and TIA/EIA 603	
Vibration: IP67 Radios: Others:	 Meets MIL-STD-810-C,D, E & F and TIA/EIA 603 Meets MIL-STD-810-C,D & E and TIA/EIA 603	
Dust: IP67 Radios: Others:	 Meets MIL-STD-810-C,D, E & F and IP6x Meets MIL-STD-810-C,D & E and IP5x	
Humidity:	50°C 95%	

Transmitter

	UHF1	
RF Output Li Ion @ 7.5V:	Low 1W	High 4W
Frequency	403-470 MHz	
Channel Spacing	12.5/20/25 kHz	
Freq. Stability (-30°C to +60°C)	0.00025%	
Spurs/Harmonics:	-36 dBm < 1 GHz -30 dBm > 1 GHz	
Audio Response: (from 6 dB/oct. Pre-Emphasis, 300 to 3000Hz)	+1, -3 dB	
Audio Distortion: @ 1000 Hz, 60% Rated Max. Dev.	<5%	
FM Noise:	-40 dB	

Receiver

	UHF 12.5kHz	UHF 20/ 25kHz
Frequency:	403-470MHz	403-470MHz
Sensitivity 12dB EIA SINAD:	0.35 µV	0.35 µV
Adjacent Channel Selectivity ETS	-60 dB	-70 dB
Intermodulation ETS	-65 dB	-65 dB
Freq. Stability (-30°C to +60°C):	0.00025%	0.00025%
Spur Rejection:	-70 dB	-70 dB
Image Rejection:	-70 dB	-70 dB
Audio Output @ <5% Distortion	500 mW	500 mW

All specifications are subject to change without notice.

4.2 GP366R/GP388/GP388R/ GP666R/GP688/GP688R

General

	UHF1	
Frequency:	403-470 MHz	
Channel Capacity:	255 Channels	
Power Supply:	7.5 Volts ±20%	
Dimensions: With Standard High Capacity Lithium Battery: With Ultra High Capacity Lithium Battery: With IP67 Li-ion Battery:	 101.5mm x 55.5mm x 33mm 101.5mm x 55.5mm x 38mm 101.5 mm x 56mm x 39mm	
Weight: With Standard High Capacity Lithium Battery: With Ultra High Capacity Lithium Battery: With IP67 Li-ion Battery:	 265 g 285 g 320 g	
Average Battery Life @ (5-5-90 Duty Cycle) Standard High Capacity Lithium Battery: Ultra High Capacity Lithium Battery: IP67 Li-ion Battery:	Low Power >10 hrs >14 hrs >14 hrs	High Power >7 hrs >10 hrs >10 hrs
Sealing: IP67 Radios: Others:	 Meets MIL-STD-810-C,D, E & F and IPx7 Meets MIL-STD-810-C,D & E and IPx4	
Shock: IP67 Radios: Others:	 Meets MIL-STD-810-C,D,E & F and TIA/EIA 603 Meets MIL-STD-810-C,D & E and TIA/EIA 603	
Vibration: IP67 Radios: Others:	 Meets MIL-STD-810-C,D, E & F and TIA/EIA 603 Meets MIL-STD-810-C,D & E and TIA/EIA 603	
Dust: IP67 Radios: Others:	 Meets MIL-STD-810-C,D, E & F and IP6x Meets MIL-STD-810-C,D & E and IP5x	
Humidity:	50°C 95%	

Transmitter

	UHF1	
RF Output Li Ion @ 7.5V:	Low 1W	High 4W
Frequency	403-470 MHz	
Channel Spacing	12.5/20/25 kHz	
Freq. Stability (-30°C to +60°C)	0.00025%	
Spurs/Harmonics:	-36 dBm < 1 GHz -30 dBm > 1 GHz	
Audio Response: (from 6 dB/oct. Pre-Emphasis, 300 to 3000Hz)	+1, -3 dB	
Audio Distortion: @ 1000 Hz, 60% Rated Max. Dev.	<5%	
FM Noise:	-40 dB	

Receiver

	UHF 12.5kHz	UHF 20/ 25kHz
Frequency:	403-470MHz	403-470MHz
Sensitivity 12dB EIA SINAD:	0.35 µV	0.35 µV
Adjacent Channel Selectivity ETS	-60 dB	-70 dB
Intermodulation ETS	-65 dB	-65 dB
Freq. Stability (-30°C to +60°C):	0.00025%	0.00025%
Spur Rejection:	-70 dB	-70 dB
Image Rejection:	-70 dB	-70 dB
Audio Output @ <5% Distortion	500 mW	500 mW

All specifications are subject to change without notice.

5.0 450-527 MHz

5.1 GP300 Compact Series

GP300 Compact Series, UHF2, 450-527 MHz			
Model			Description
MDH38SDC9AN3_E			GP344 450-527 MHz 4W NK/P PMW602C
	MDH38SDH9AN6_E		GP388 450-527 MHz 4W K/P PMW602H
		Item	Description
X		PMHE4004_	GP344 B/C Kit 450-527 MHz UHF2 Pop. 4W NK/P
	X	PMHE4016_	GP388 B/C Kit 450-527 MHz UHF2 Pref. 4W K/P
X		PMHE4008_	GP344 F/C Kit 450-527 MHz UHF2 Pop. 4W NK/P
	X	PMHE4009_	GP388 F/C Kit 450-527 MHz UHF2 Pref. 4W K/P
X	X	NAE6483_	Monopole (Whip) Antenna, UHF2 403-520 MHz
X	X	PMAE4008_	Monopole (Whip) Antenna, UHF2 470-530 MHz
X	X	PMAE4006_	9 cm antenna UHF2, 465-495 MHz
X	X	PMAE4007_	9 cm antenna UHF2, 490-527 MHz
X		6864110B54	GP344/ GP344R User Guide
	X	6864110B97	GP388/ GP388R User Guide

x = Indicates one of each is required.

5.2 GP300 Compact Series (IP67)

GP300 Compact Series, UHF2, 450-527 MHz (IP67)				
Model				Description
MDH38SDC9AN3_ER				GP344R 450-527 MHz 4W NK/P PMR902C (IP67)
	MDH38SDF9AN5_ER			GP366R 450-527 MHz 4W LK/P PMR902F (IP67)
		MDH38SDH9AN6_ER		GP388R 450-527 MHz 4W K/P PMR902H (IP67)
			Item	Description
X			PMHE4046_	GP344R B/C Kit 450-527 MHz 4W 5-T Pop. NK/P
	X		PMHE4045_	GP366R B/C Kit 450-527 MHz 4W 5-T LK/P
		X	PMHE4045_	GP388R B/C Kit 450-527 MHz 4W 5-T Pref. K/P
X			PMHE4054_	GP344R F/C Kit 450-527 MHz 4W 5-T Pop NK/P
	X		PMHE4060_	GP366R F/C Kit 450-527 MHz 4W 5-T LK/P
		X	PMHE4055_	GP388R F/C Kit 450-527 MHz 4W 5-T Pref. K/P
X	X	X	PMAE4025_	Antenna, UHF2 450-527 MHz
X			6864110B54	GP344/ GP344R User Guide
	X		6866577D02	GP366R User Guide
		X	6864110B97	GP388/ GP388R User Guide

x = Indicates one of each is required.

6.0 Specifications

6.1 GP344/GP344R

General

	UHF2	
Frequency:	450-527 MHz	
Channel Capacity:	16 Channels	
Power Supply:	7.5 Volts ±20%	
Dimensions: With Standard High Capacity Lithium Battery: With Ultra High Capacity Lithium Battery: With IP67 Li-ion Battery:	 101.5mm x 55.5mm x 30.5mm 101.5mm x 55.5mm x 35.5mm 101.5 mm x 56mm x 37mm	
Weight: With Standard High Capacity Lithium Battery: With Ultra High Capacity Lithium Battery: With IP67 Li-ion Battery:	 250 g 270 g 305 g	
Average Battery Life @ (5-5-90 Duty Cycle) Standard High Capacity Lithium Battery: Ultra High Capacity Lithium Battery: IP67 Li-ion Battery:	Low Power >10 hrs >14 hrs >14 hrs	High Power >7 hrs >10 hrs >10 hrs
Sealing: IP67 Radios: Others:	 Meets MIL-STD-810-C,D, E & F and IPx7 Meets MIL-STD-810-C,D & E and IPx4	
Shock: IP67 Radios: Others:	 Meets MIL-STD-810-C,D,E & F and TIA/EIA 603 Meets MIL-STD-810-C,D & E and TIA/EIA 603	
Vibration: IP67 Radios: Others:	 Meets MIL-STD-810-C,D, E & F and TIA/EIA 603 Meets MIL-STD-810-C,D & E and TIA/EIA 603	
Dust: IP67 Radios: Others:	 Meets MIL-STD-810-C,D, E & F and IP6x Meets MIL-STD-810-C,D & E and IP5x	
Humidity:	50°C 95%	

Transmitter

	UHF2	
RF Output Li Ion @ 7.5V:	Low 1W	High 4W
Frequency	450-527 MHz	
Channel Spacing	12.5/20/25 kHz	
Freq. Stability (-30°C to +60°C)	0.00025%	
Spurs/Harmonics:	-36 dBm < 1 GHz -30 dBm > 1 GHz	
Audio Response: (from 6 dB/oct. Pre-Emphasis, 300 to 3000Hz)	+1, -3 dB	
Audio Distortion: @ 1000 Hz, 60% Rated Max. Dev.	<5%	
FM Noise:	-40 dB	

Receiver

	UHF 12.5kHz	UHF 20/ 25kHz
Frequency:	450-527MHz	450-527MHz
Sensitivity 12dB EIA SINAD:	0.35 μV	0.35 μV
Adjacent Channel Selectivity ETS	-60 dB	-70 dB
Intermodulation ETS	-65 dB	-65 dB
Freq. Stability (-30°C to +60°C):	0.00025%	0.00025%
Spur Rejection:	-70 dB	-70 dB
Image Rejection:	-70 dB	-70 dB
Audio Output @ <5% Distortion	500 mW	500 mW

All specifications are subject to change without notice.

6.2 GP366R/GP388/GP388R

General

	UHF2	
Frequency:	450-527 MHz	
Channel Capacity:	255 Channels	
Power Supply:	7.5 Volts ±20%	
Dimensions: With Sdard High Capacity Lithium Battery: With Ultra High Capacity Lithium Battery: With IP67 Li-ion Battery:	 101.5mm x 55.5mm x 33mm 101.5mm x 55.5mm x 38mm 101.5 mm x 56mm x 39mm	
Weight: With Standard High Capacity Lithium Battery: With Ultra High Capacity Lithium Battery: With IP67 Li-ion Battery:	 265 g 285 g 320 g	
Average Battery Life @ (5-5-90 Duty Cycle) Standard High Capacity Lithium Battery: Ultra High Capacity Lithium Battery: IP67 Li-ion Battery:	Low Power >10 hrs >14 hrs >14 hrs	High Power >7 hrs >10 hrs >10 hrs
Sealing: IP67 Radios: Others:	 Meets MIL-STD-810-C,D, E & F and IPx7 Meets MIL-STD-810-C,D & E and IPx4	
Shock: IP67 Radios: Others:	 Meets MIL-STD-810-C,D,E & F and TIA/EIA 603 Meets MIL-STD-810-C,D & E and TIA/EIA 603	
Vibration: IP67 Radios: Others:	 Meets MIL-STD-810-C,D, E & F and TIA/EIA 603 Meets MIL-STD-810-C,D & E and TIA/EIA 603	
Dust: IP67 Radios: Others:	 Meets MIL-STD-810-C,D, E & F and IP6x Meets MIL-STD-810-C,D & E and IP5x	
Humidity:	50°C 95%	
FCC ID		

Transmitter

	UHF2	
RF Output Li Ion @ 7.5V:	Low 1W	High 4W
Frequency	450-527 MHz	
Channel Spacing	12.5/20/25 kHz	
Freq. Stability (-30°C to +60°C)	0.00025%	
Spurs/Harmonics:	-36 dBm < 1 GHz -30 dBm > 1 GHz	
Audio Response: (from 6 dB/oct. Pre-Emphasis, 300 to 3000Hz)	+1, -3 dB	
Audio Distortion: @ 1000 Hz, 60% Rated Max. Dev.	<5%	
FM Noise:	-40 dB	

Receiver

	UHF 12.5kHz	UHF 20/ 25kHz
Frequency:	450-527MHz	450-527MHz
Sensitivity 12dB EIA SINAD:	0.35 μV	0.35 μV
Adjacent Channel Selectivity ETS	-60 dB	-70 dB
Intermodulation ETS	-65 dB	-65 dB
Freq. Stability (-30°C to +60°C):	0.00025%	0.00025%
Spur Rejection:	-70 dB	-70 dB
Image Rejection:	-70 dB	-70 dB
Audio Output @ <5% Distortion	500 mW	500 mW

All specifications are subject to change without notice.

GLOSSARY OF TERMS

Term	Definition
ALC	Automatic Level Control: a circuit in the transmit RF path that controls RF power amplifier output, provides leveling over frequency and voltage, and protects against high VSWR (Voltage Standing Wave Ratio).
ASFIC	Audio Signalling Filter Integrated Circuit
CD	Compact Disk
CMP	Compression
CPS	Customer Programming Software
CSQ	Carrier Squelch
DTMF	Dual-Tone Multifrequency
DPL	Digital Private-Line™
EEPROM	Electronically Erasable/Programmable Read-Only Memory: used by the radio to store its personality
Firmware	Software, or a software/hardware combination of computer programs and data, with a fixed logic configuration stores in a read-only memory. Information cannot be altered or reprogrammed.
FGU	Frequency Generation Unit
GaAs	Gallium Arsenide: a type of crystalline material used in some semiconductors.
ISW	Inbound Signalling Word: data transmitted on the control channel from a subscriber unit to the central control unit.
LCD	Liquid Crystal Display: a module used to display the radio's current operating channel or system and scan status.
LH DATA	Longhorn Data: a bidirectional 0-5V, RS-232 line that uses the microntroller's integrated RS-232 asynchronous serial communications interface (SCI) peripheral.
LLE	Low Level Expander: slight amount of volume expansion; used to improve the signal to noise ratio.
LSH	Low-Speed Handshake: 150 baud digital data sent to the radio during trunked operation while receiving audio.
MDC	Motorola Digital Communication
MRTI	Motorola Radio-Telephone Interconnect: a system that provides a repeater connection to the Public Switched Telephone Network (PSTN). The MRTI allows the radio to access the telephone network when the proper access code is received.
MSK	Minimum-Shift Keying

Term	Definition
OMPAC	Over-Molded Pad-Array Carrier: a Motorola custom package, distinguished by the presence of solder balls on the bottom pads.
OSW	Outbound Signalling Word: data transmitted on the control channel from the central controller to the subscriber unit.
PC Board	Printed Circuit Board
PL	Private-Line® tone squelch: a continuous sub-audible tone that is transmitted along with the carrier.
PLL	Phase-Locked Loop: a circuit in which an oscillator is kept in phase with a reference, usually after passing through a frequency divider.
PTT	Push-To-Talk: the switch located on the left side of the radio which, when pressed, causes the radio to transmit.
RAM	Random Access Memory: the radio's RAM is loaded with a copy of the EEPROM data.
Registers	Short-term data-storage circuits within the microcontroller.
Repeater	Remote transmit/receive facility that retransmits received signals to improve communications coverage.
RESET	Reset line: an input to the microcontroller that restarts execution.
RF PA	Radio Frequency Power Amplifier
RIB	Radio Interface Box
ROM	Read Only Memory
RSSI	Received Signal-Strength Indicator: a dc voltage proportional to the received RF signal strength.
RPT/TA	Repeater/Talk-Around
Softpot	Software Potentiometer: a computer-adjustable electronic attenuator
Software	Computer programs, procedures, rules, documentation, and data pertaining to the operation of a system.
SPI (clock and data lines)	Serial Peripheral Interface: how the microcontroller communicates to modules and ICs through the CLOCK and DATA lines.
Squelch	Muting of audio circuits when received signal levels fall below a pre-determined value.
Standby Mode	An operating mode whereby the radio is muted but still continues to receive data
System Central Controller	Main control unit of the trunked dispatch system; handles ISW and OSW messages to and from subscriber units (see ISW and OSW).
System Select	The act of selecting the desired operating system with the system-select switch (also, the name given to this switch).
TOT	Time-Out Timer: a timer that limits the length of a transmission.
TPL	Tone Private-line
µC	Microcontroller

Term	Definition
UHF	Ultra High Frequency
µP	Microprocessor
VCO	Voltage-Controlled Oscillator: an oscillator whereby the frequency of oscillation can be varied by changing a control voltage.
VCOBIC	Voltage-Controlled Oscillator Buffer Integrated Circuit
VHF	Very High Frequency
VSWR	Voltage Standing Wave Ratio

Notes

6866577D06-A