



MOTOROLA

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Commercial Series CP040 Portable Radio

Basic Service Manual

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SAFETY INFORMATION

Read this information before using the radio.

PRODUCT SAFETY AND RF EXPOSURE FOR PORTABLE TWO-WAY RADIOS.

This document provides information and instructions for the safe and efficient operation of Motorola Portable Two-Way Radios. The information provided in this document supersedes information contained in user guides published prior to **February 2002**.

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

Note: This Radio is intended for use in occupational/controlled applications, where users have been made aware of the potential for exposure and can exercise control over their exposure. This radio device is NOT authorized for general population, consumer or similar 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 (US markets only)

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. Do not remove this RF Exposure Label from the device. 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 IEEE/ICNIRP 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 cycle (5% talk–5% listen–90% standby), even though this radio complies with IEEE/ICNIRP occupational exposure limits at usage 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; 47 CFR 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"

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:

- 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).
- 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 IEEE/ICNIRP 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, along side the head in the phone mode (TETRA only), in front of the face in the hand held mode, then ensure the antenna and the radio are kept 2.5 cm (one inch) from the body when transmitting. Keeping the radio at a proper distance is important because RF exposures decrease with increasing distance from the antenna.

Hand-held Mode - Operating Instructions

- 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 2.5 cm (one inch) 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.



Phone Mode (TETRA only) - Operating Instructions

- When placing or receiving a phone call, hold your radio product as you would a wireless telephone. Speak directly into the microphone.

Approved Accessories

- Use only Motorola-approved supplied or replacement antennas, batteries, and accessories. Use of non-Motorola - approved antennas, batteries and accessories may exceed IEEE/ICNIRP RF exposure guidelines. For a list of Motorola-approved antennas, batteries, and other accessories please see your dealer or local Motorola contact. Your nearest dealer can be found at the following web site:

<http://www.motorola.com/cgiss/emea/dealerlocator.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 15 cms (6 inches) 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 15 cms 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 you have 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

Vehicles with an air bag

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



WARNING: 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.)



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

NOTE

The areas with potentially explosive atmospheres referred to above include fuelling areas such as below decks on boats, fuel or chemical transfer or storage facilities, 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 areas



WARNING: 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



CAUTION: 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



CAUTION: All batteries can cause property damage and/or bodily injury such as burns if a conductive material such as jewellery, keys, or beaded chains touch 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, CENELEC or ATEX) 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 Equipment



- Do not operate radio communications equipment in a hazardous atmosphere unless it is a type especially qualified (for example, FM, UL, CSA, or CENELEC or ATEX 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 or ATEX). 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.



- **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



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 which 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 or ATEX) 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 or ATEX).

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.

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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 Section 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 Resources (Please see page 2 and page 3 in this Chapter). 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 Radio Aftermarket and Accessory 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 Piece Parts

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 Aftermarket and Accessory Division (AAD). 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.

All part orders should be directed to :

**Motorola GmbH
Customer Care
Am Borsigturm 130
13507 Berlin
Germany.**

2.5 Technical Support

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

UK/Ireland - Richard Russell
Telephone: +44 (0) 1256 488 082
Fax: +44 01256 488 080
Email: BRR001@email.mot.com

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

Scandinavia
Telephone: +46 8 735 9282
Fax: +46 8 735 9280
Email: C14749@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

France - Lionel Lhermitte
Telephone: +33 1 6929 5722
Fax: +33 1 6929 5904
Email: TXE037@email.mot.com

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

Africa & Middle East - Armand Roy
Telephone: +33 1 6929 5715
Fax: +33 1 6929 5778
Email: armand.roy@Motorola.com

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 mobile radio model number and its specific characteristics.

Table 1-1 Radio Model Number (Example: MDH50KDC9AA2_N)

	Type of Unit	Model Series	Freq. Band	Power Level	Physical Packages	Channel Spacing	Protocol	Feature Level	Model Revision	Model Package
MD ↑ MD = Motorola Internal Use	H ↑ H = Portable	50	J VHF1 (136-162 MHz) K VHF (146-174 MHz) Q UHF1 (403-440 MHz) R UHF2 (438-470 MHz) S UHF3 (465-495 MHz)	D 4W or 5W C 2W	C No Display	9 Program-mable	AA Conventional	1 4 channel 2 16 channel	A	N

Chapter 2

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 and housing assembly. 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: 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 (100%) 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 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 top 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: 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 4280385A59)
- 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

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 Parts centre listed in the “Piece Parts” section in Chapter 1 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 connectors, potentiometers and circuit components:

- 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.

5.0 Disassembling and Reassembling the Radio — General

Since these radios may be disassembled and reassembled with the use of only four (board to casting) 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/assembling the radio:

- Small flat blade screwdriver
- knob remover/chassis opener
- 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 Centre. (See Chapter 1 for a list of authorized service centres.)

The following disassembly procedures should be performed only if necessary:

- Speaker Disassembly (Figure 2-5)
- PTT Disassembly (Figure 2-6)
- Chassis Disassembly (Figure 2.7)

6.0 Radio Disassembly - Detailed

6.1 Front Cover from Chassis Disassembly

1. Turn off the radio.
2. Remove the battery (Figure 2-1) :
 - a. Slide the battery latch into the unlock position. Disengage by pushing downward and holding the latch towards the front of the radio.
 - b. With the battery latch disengaged, slide the battery down from the top of the radio about 15mm. Once the battery is free from the battery rails, lift it directly away from the radio.
 - c. Remove the battery from the radio.
3. Remove the antenna.

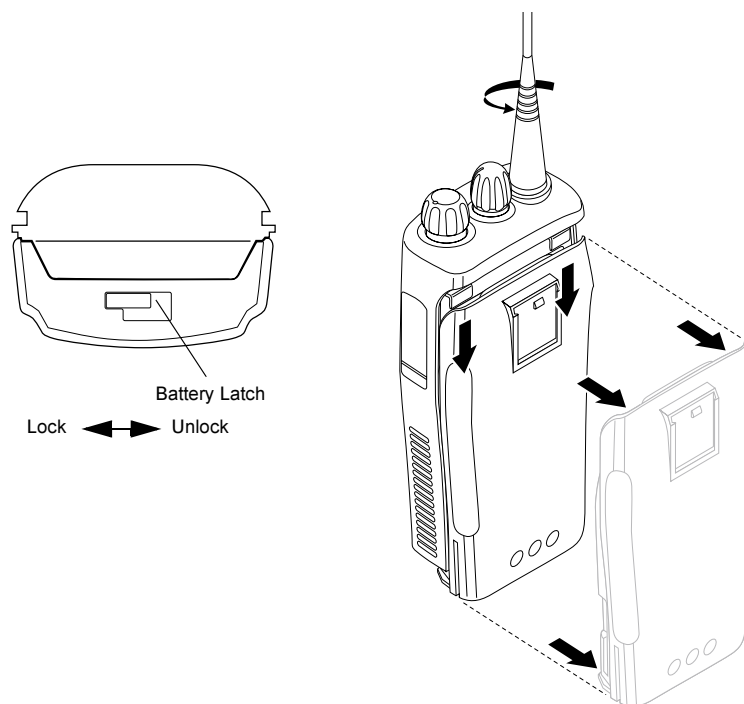


Figure 2-1 Battery Removal

4. Pry off the volume and channel selector knobs from their shafts using the knob remover/chassis opener tool (Motorola part No.6686533Z01) (Figure 2.2).

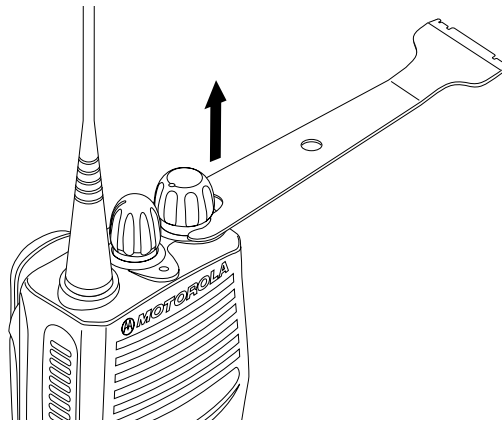


Figure 2-2 Knob Removal

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

5. Separate the chassis from the front housing assembly by using the knob remover/chassis opener tool. Place the broad side of the opener into the slots located at the base of the radio (Figure 2.3). Press the handle of the opener downwards. This pressing action forces the thin inner plastic wall toward the base of the radio, releasing the two chassis base tabs.

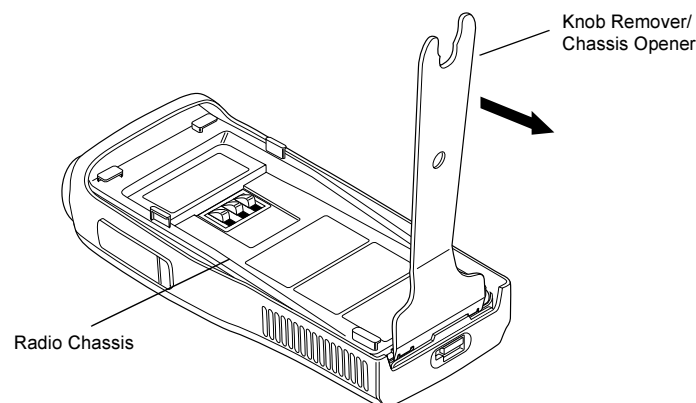


Figure 2-3 Chassis Removal



CAUTION: Marring the front cover O-ring sealing area will prevent the radio from sealing properly. If the O-ring is damaged, replace it with a new one.

NOTE: The speaker wire assembly connecting the front housing assembly, and the chassis prevent you from completely separating the two units.

6. Pull the chassis assembly out of the front cover.
7. Unplug the speaker wire assembly from the 2-pin connector.

6.2 Dust Cover Disassembly

- Gently pry the top of the dust cover away from the body of the radio (Figure 2.4).
- Rotate the dust cover 90° in a counter clockwise direction to allow the key to be removed.
- Separate the dust cover away from the body of the radio. The dust cover key is fragile; apply only light pressure to the key while removing the dust cover.

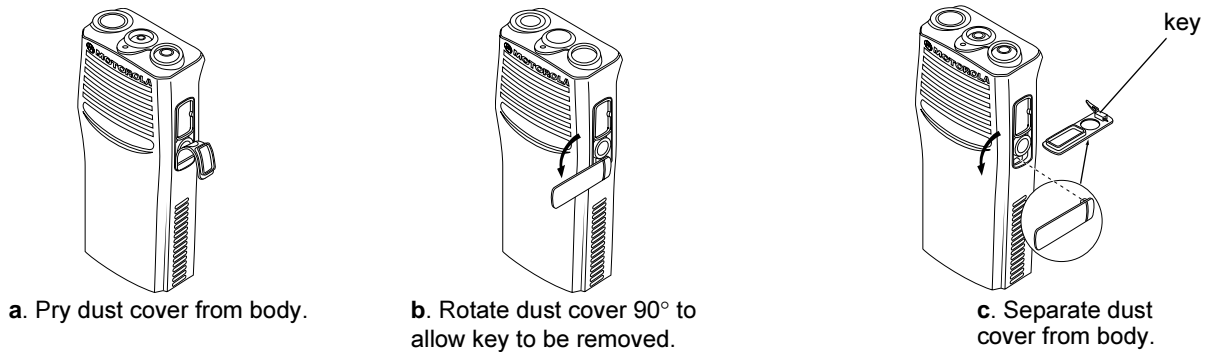


Figure 2-4 Dust Cover Removal

6.3 Speaker Disassembly

NOTE: The speaker is held in place with a retainer bracket. Be careful not to damage the speaker when removing the retainer bracket.

- Remove the two screws from the speaker retainer using a T6 Torx screwdriver.
- Lift the speaker out from the front housing.

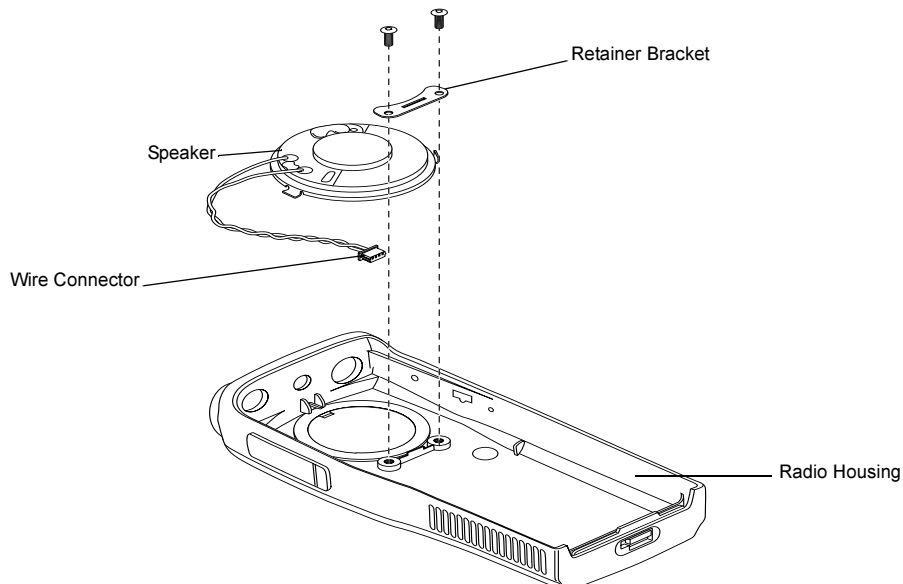


Figure 2-5 Removal Speaker-Microphone Assembly

6.4 PTT Disassembly

1. If required, the PTT (Figure 2-6) can be disassembled using a small screwdriver, as follows:
 - a. Insert the tip of a small screwdriver underneath the PTT and unsnap the top tab.
 - b. Pry the PTT away from the radio housing.
 - c. Inspect the two hooks. If bent or broken, the PTT must be replaced.
 - d. Remove the PTT seal.

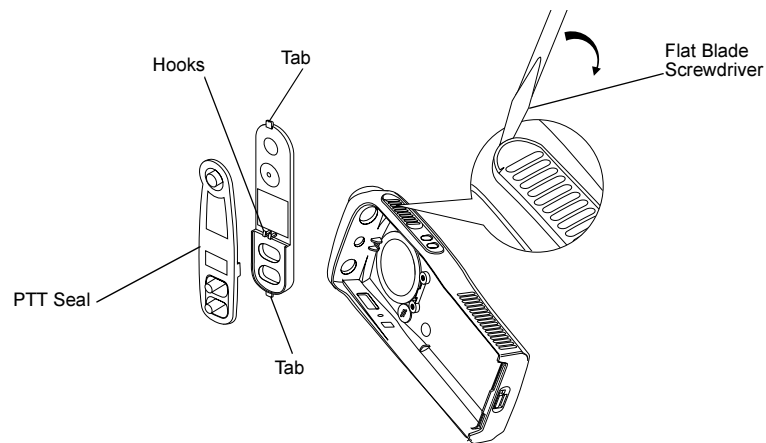


Figure 2-6 PTT Removal

6.5 Chassis Disassembly



CAUTION: Refer to the CMOS CAUTION paragraph (see 3.3) before removing the main board. Be sure to use Electrostatic Discharge protection when handling circuit boards.

1. Remove the O-ring.
2. Use a Torx™ screwdriver with a T6 bit to remove the four screws (Figure 2.7) holding the main board to the chassis.

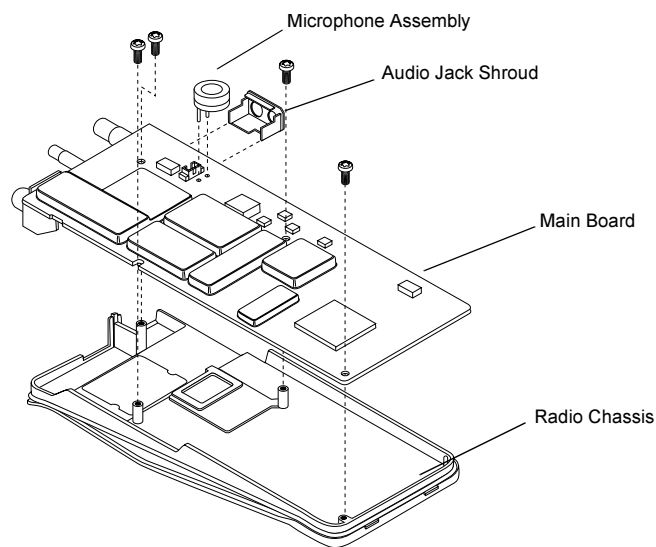


Figure 2-7 Removal of Main Board from Chassis

3. The microphone boot assembly can be unplugged from the main board. If you are replacing the microphone, remove it from the rubber boot.
4. The audio jack shroud can be removed from the main board.
5. Lift the main board from the chassis (Figure 2-7).
6. Remove the battery contact seal.

7.0 Radio Assembly — Detailed

7.1 Chassis Assembly/Reassembly

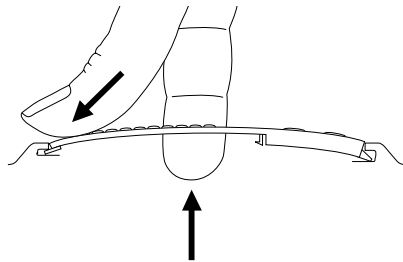
1. Replace the battery contact seal (if necessary) surrounding the battery contact.
2. Remove the old Interface Pad from the chassis by scraping off the pad and adhesive with a straight razor. Use rubbing alcohol and a cloth to completely remove the adhesive from the chassis surface. With the chassis clean and dry, add a new Interface Pad to the chassis.
3. 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.

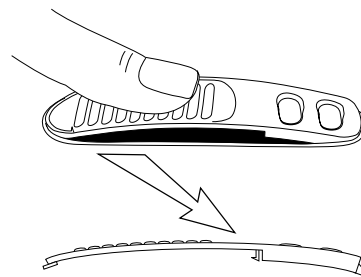
4. Use the T6 Torx screwdriver to fasten the screws holding the main board to the chassis. Tighten to 0.34Nm (3 in/lb).
5. Replace the O-ring by positioning it in the top groove by the volume/frequency switches. Stretch the O-ring to place it into the retaining groove at the bottom end of the chassis.
6. Replace the audio jack shroud.
7. Replace the microphone boot assembly.

7.2 PTT Assembly

1. Place the PTT seal over the ridge around the top hole. Press down to seat the seal around the ridge.
2. Place the bottom tab in the slot inside the front housing PTT opening. Slightly slide down the PTT and bow it by placing one finger under the middle of the PTT, so that the top tab can be aligned and inserted into the top slot (Figure 2-8a).
3. Press the PTT assembly against the front cover opening (Figure 2-8b).



a. Place bottom tab into bottom slot.
Place top tab into top slot.



b. Push down on ribs toward bottom
of radio so hooks do not get crushed.

Figure 2-8 PTT Assembly

7.3 Speaker Reassembly

1. Align the speaker as shown in Figure 2.9.
2. Insert the top of the speaker under the two rails in the housing.
3. Place the speaker retainer bracket onto the two screw bosses. Make sure the tab fits into the retainer bracket slot.
4. Use the T6 Torx screwdriver to fasten the screws holding the retainer bracket to the front cover. Tighten to 0.23Nm (2 in/lb).

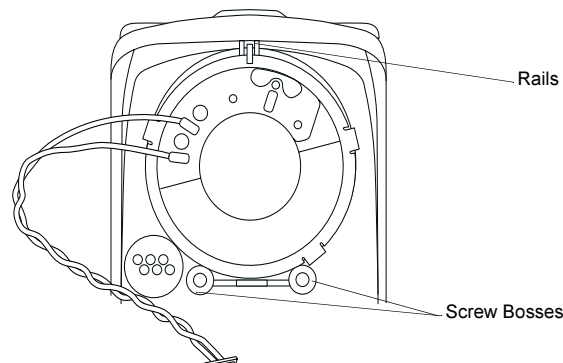


Figure 2-9 Speaker Assembly

7.4 Dust Cover Assembly

- a. Insert the dust cover key into the housing at a 90° angle.
- b. Rotate the dust cover 90° in a clockwise direction to allow the key to fully insert into the housing.
- c. Press the key and dust cover into the housing.

- a. Insert dust cover key into housing at 90° angle.

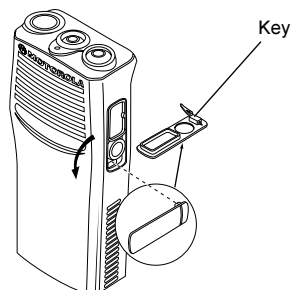


Figure 2-10 Dust Cover Assembly

7.5 Chassis and Front Cover Assembly

1. Dress and connect the speaker wires.

NOTE: Care should be taken when dressing the speaker wires to avoid pinching them between the speaker magnet and shield, under the microphone boot or between the accessory connector and housing.

- a. Form the wires into an “M” shape so it can collapse on itself like an accordion with all of the wire up in the top corner of the radio away from the shields. Place three bends in the wires spaced approximately 1 cm apart to give the wire an “M” shape (Figure 2-11).
- b. Bend the wires up from the speaker so the wires are positioned toward the top of the radio (Figure 2-11).

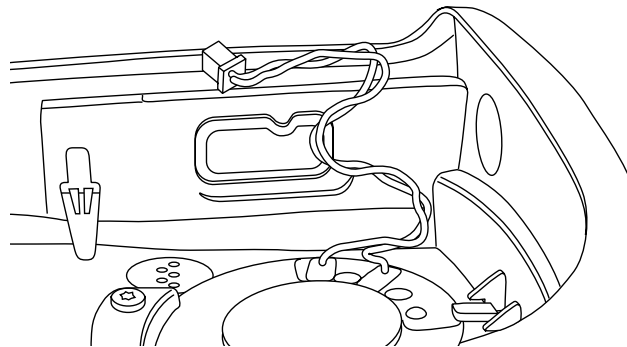


Figure 2-11 Bend the Wires into an “M” Shape

- c. Connect the speaker wire assembly into the 2-pin connector on the main board and bend the wires at the board connector so the wires are positioned toward the top of the radio (Figure 2-12).

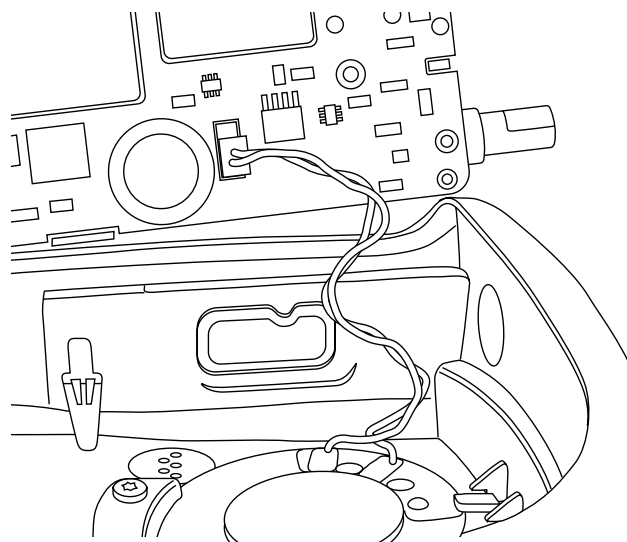


Figure 2-12 Connect Speaker Wire Assembly

2. Slide the volume potentiometer and frequency switch shafts into their respective holes in the front cover. Look through the accessory connector opening to make certain that the wires are not pinched.

3. Push the chassis assembly completely into the top of the front cover (Figure 2-13) until it settles in place.

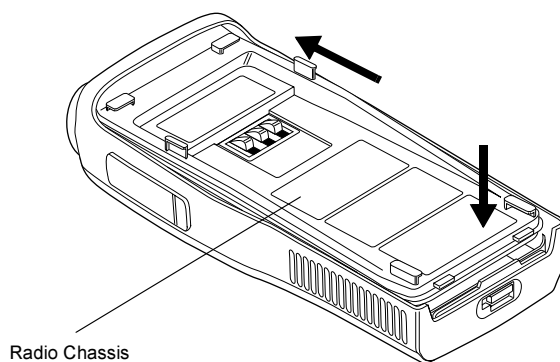


Figure 2-13 Fastening the Chassis

4. Make sure the O-ring is properly seated.
5. Snap the bottom of the chassis into the front cover.
6. Reassemble the knobs, antenna, and battery.

8.0 Mechanical View and Parts List

8.1 CP040 Exploded View and Parts List

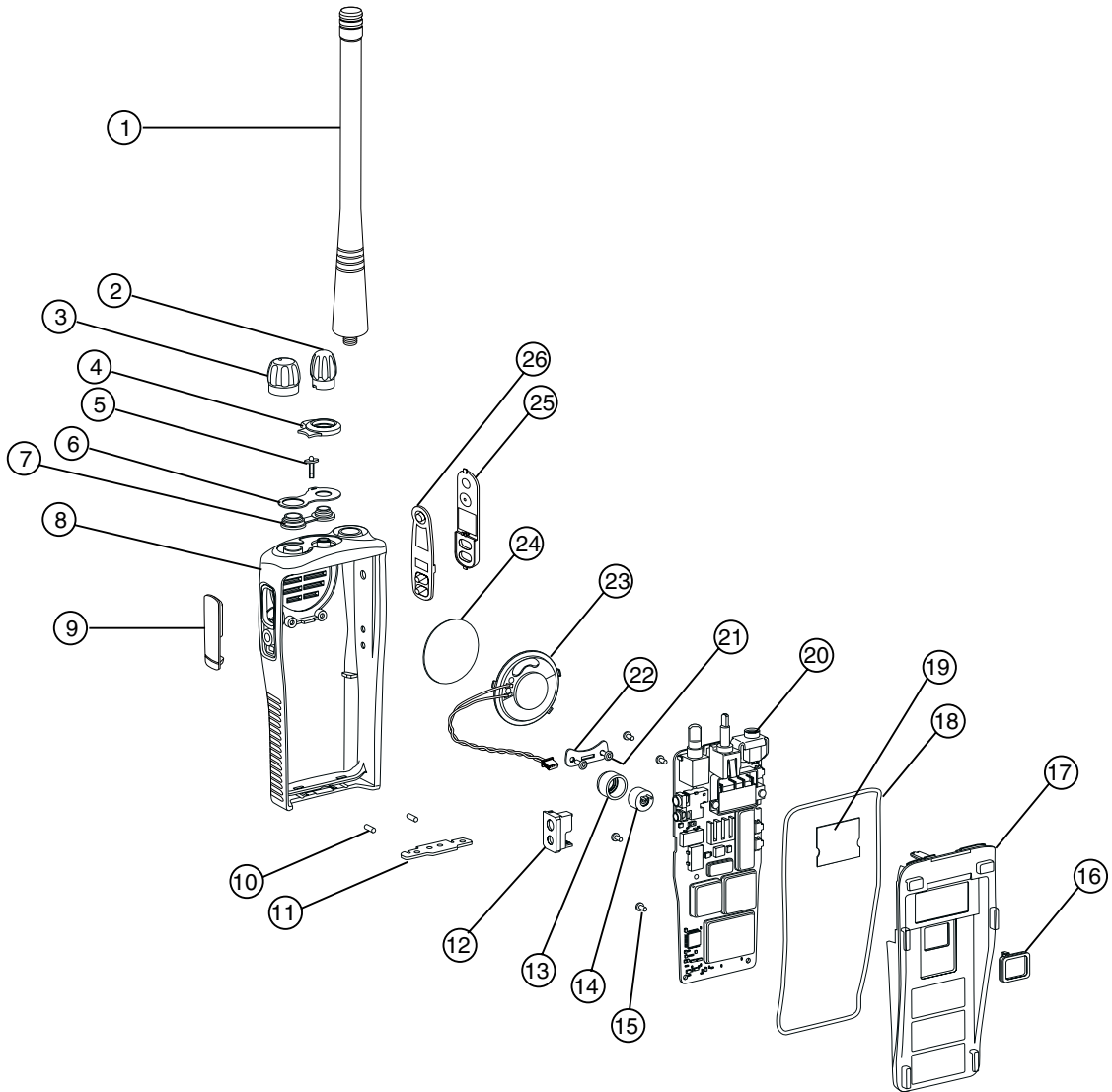


Figure 2-14 CP040 Radio Exploded View

Item	Motorola Part Number	Description
1	See Chapter 6	Antenna
2	3680530Z02	Knob, Frequency
3	3680529Z01	Knob, Volume
4	1386440Z01 1386440Z02	Escutcheon, Top; 4 Ch. Escutcheon, Top; 16 Ch.
5	6186446Z02	Lightpipe
6	3386443Z01	Label, Escutcheon Seal
7	3286432Z01	Seal, Control Shaft
8	1586390Z01	Housing, Front
9	3886441Z01	Cap, Dust
10	4105944K01	Spring, latch; 2 used
11	5586445Z02	Latch assembly
12	1586437Z02	Shroud, audio jack
13	0786469Z01	Boot, microphone
14	5080258E16	Microphone
15	0304726J05	Screws, chassis; 4 used
16	3286435Z01	Seal, battery contact block
17	2786389Z02	Chassis
18	3286431Z05	Seal, main O-ring
19	7586436Z01	Pad, PA interface
20	Refer to Chapter 7 - Model Charts	Main Board Tanapa
21	0386434Z01	Screws, speaker retainer; 2 used
22	0786433Z02	Retainer, speaker
23	5005679X04	Speaker
24	3586092Z02	Felt, speaker
25	4586439Z01	PTT, plastic
26	3886489Z01	PTT, rubber
NON-REFERENCED ITEMS		
	3386488Z01	Nameplate, Motorola
	3386409Z04	Nameplate, CP040

9.0 Service Aids

Table 2-1 lists the service aids recommended for working on the radio. While all of these items are available from Motorola, most are standard workshop equipment items, and any equivalent item capable of the same performance may be substituted for the item listed.

Table 2-1 Service Aids

Motorola Part No.	Description	Application
RLN4460	Portable Test Set	Enables connection to the audio/accessory jack. Allows switching for radio testing.
RLN4510	Battery Interface	Regulates DC current and voltage between radio and power supply.
PMKN4004	Programming Test Cable	Connects radio to RIB (RLN4008).
PMKN4003	Radio to Radio Cloning Cable	Allows a radio to be duplicated from a master radio by transferring programmed data from the master radio to the other.
RLN4008	Radio Interface Box	Enables communications between the radio and the computer's serial communications adapter.
5886564Z01	RF BNC Adaptor	Adapts radio's antenna port to BNC cabling of test equipment.
0180305K08	Shop Battery Eliminator	Interconnects radio to power supply.
EPN4040_	Wall-Mounted Power Supply (UK)	Used to supply power to the RIB
EPN4041_	Wall-Mounted Power Supply (220VAC)	Used to supply power to the RIB
HSN9412	Wall-Mounted Power Supply (120VAC)	Used to supply power to the RIB
3080369B71 or 3080369B72	Computer Interface Cable	Use B72 for the IBM PC AT or newer (9-pin serial port). Use B71 for older models (25-pin serial port). Connects the computer's serial communications adapter to the RIB (RLN4008).
HKN9216	IBM Computer Interface Cable	Connection from computer to RIB.
6680702Z01	Knob Remover/Chassis Opener	Used to remove the front cover assembly.
RSX4043A	TORX screwdriver	Tighten and remove chassis screws
6680387A70	T6 TORX bit	Removable TORX screwdriver bit
WADN4055A	Portable Soldering Station	Digitally controlled soldering iron
6604008K01	0.4mm replacement tip	For WADN4055A Soldering iron
6604008K02	0.8mm replacement tip	For WADN4055A Soldering iron
0180386A82	Anti-static Grounding Kit	Used for all radio assembly/disassembly procedures
6684253C72	Straight Prober	
6680384A98	Brush	
1010041A86	Solder (RMA type)	63/37, 0.5mm diameter, 2.2kg (1lb) spool.

10.0 Test Equipment

Table 2-2 lists test equipment required to service the CP040 Radio and other two-way radios.

Table 2-2 Recommended Test Equipment

Motorola Part No.	Description	Characteristics	Application
R2600 series	Comms System analyzer (non MPT)	This item will substitute for items with an asterisk (*)	Frequency/deviation meter and signal generator for wide-range troubleshooting and alignment
*R1074_	Fluke 87 digital multi-meter	True RMS metering, 200 kHz frequency counter, 32-segment bargraph with backlit display	Digital voltmeter is recommended for AC/DC voltage and current measurements
*R1377_	AC voltmeter	1mV to 300mV, 10 mega-ohm input impedance	Audio voltage measurements
R1611_	Dual channel 100 MHz oscilloscope (Agilent)	Two-channel, 100 MHz bandwidth, 200M sample rate/sec, 2MB memory/channel	Waveform measurements
S1339_	RF millivolt meter	100 μ V to 3V RF, 10 kHz to 1 GHz frequency range	RF level measurements
*R1013_ or *R1370_	SINAD meter or SINAD meter with RMS	Without RMS audio voltmeter or With RMS audio voltmeter	Receiver sensitivity measurements
S1348D	Programmable DC power supply	0-20V DC, 0-5 amps, current limited	Bench supply for 7.5 V DC
R1440A 0180305F14 0180305F30 0180305F39 RLN4610A T1013	Wattmeter, Plug-in Element Plug-in Element Plug-in Element Carry case RF Dummy Load	ThruLine 50-Ohm, \pm 5% accuracy 10W, 25 - 60 MHz 10W, 100 - 250 MHz 10W, 200 - 500 MHz Wattmeter and 6 elements	Transmitter power output measurements

11.0 Programming/Test Cable

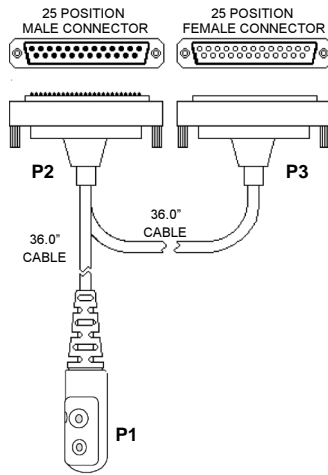


Figure 2-15 Programming/Test Cable

12.0 Wiring of the Connectors

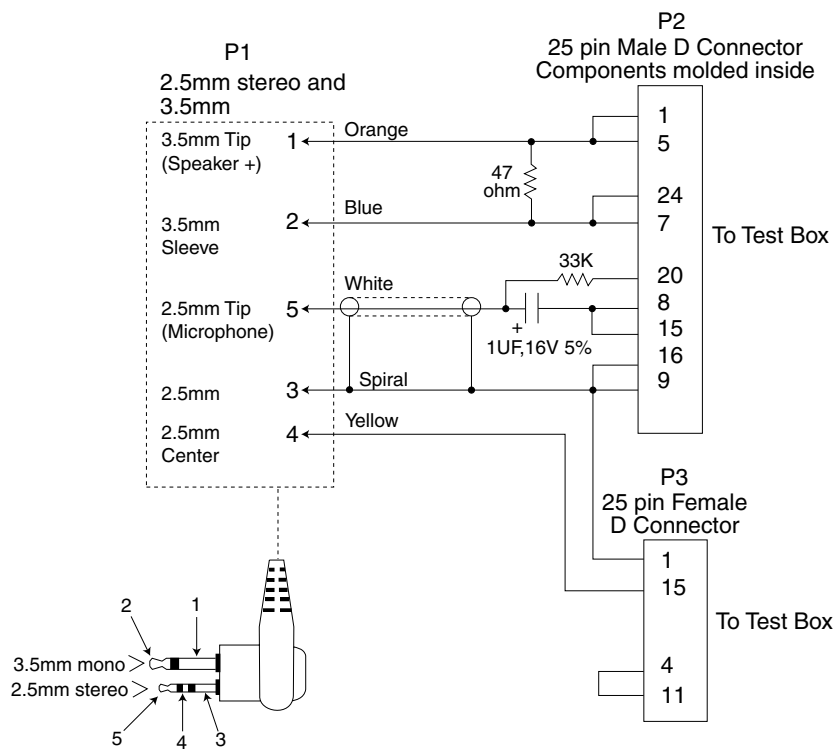


Figure 2-16 Wiring of the Connectors

TRANSCEIVER PERFORMANCE TESTING

1.0 General

These radios meet published specifications through their manufacturing process by utilizing high-accuracy laboratory-quality test equipment. The recommended field service equipment approaches the accuracy of the manufacturing equipment with few exceptions. This accuracy 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 Tuning Setup diagram (Chapter 4, Figure 4-1).

Initial equipment control settings should be as indicated in the following table and should hold for all alignment procedures.

Table 3-1 Initial Equipment Control Settings

Service Monitor	Test Set	Power Supply
Monitor Mode: Power Monitor	Spkr set: A	Voltage: 7.5Vdc
RF Attenuation: -70	Spkr/load: Speaker	DC on/standby: Standby
AM, CW, FM: FM	PTT: OFF	Volt Range: 10V
Oscilloscope Source: Mod Oscilloscope Horiz: 10mSec/Div Oscilloscope Vert: 2.5kHz/Div Oscilloscope 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

The RF Test Mode is a special routine that has been incorporated in the radio. This mode allows bench testing of the radio at various test frequencies across the entire band, at both high and low transmit power (if applicable), at various channel spacings, and with different coded or carrier squelch types. Any customer specific programming in the radio will not be changed or affected by use of the RF Test Mode.

To enter test mode:

1. Turn the radio on.
2. Within ten seconds after the self test is complete (self test tone is heard), press SB2 (Side Button 2 in Chapter 4, Figure 4-3) five times in succession. If the self test complete tone is not heard, see Error Codes information in Chapter 5. Entry into the test mode is indicated by a positive indicator tone followed by a good key chirp (GKC).
3. Upon entering test mode, the radio is on carrier squelch mode.
4. Press SB1 (Side Button 1) and scroll through and access test environments as shown in Table 3-2.
5. Press SB2 and scroll through the channel spacing available as shown in Table 3-3.
6. Turn the channel selector knob to change the test channel for that environment as shown in Table 3-4.
7. Press the PTT on a test channel to cause the radio to transmit at the test frequency for the channel.

Table 3-2 Test Environments

No. of Beeps	Description	Function
1 GKC	Carrier Squelch	RX: unsquelch if carrier detected TX: mic audio
1 BKC	Tone Private-Line	RX: unsquelch if carrier and tone (192.8Hz) detected TX: mic audio + tone (192.8Hz)
2 BKC	Digital Private-Line	RX: unsquelch if carrier and digital code (131) detected TX: mic audio + digital code (131)
5 BKC	Unsquelch Open	RX: constant unsquelch TX: mic audio
9 BKC	High-Speed Signaling	RX: unsquelch if carrier detected TX: 1500Hz tone
11 BKC	Companding	RX: unsquelch if carrier detected TX: mic audio
12 BKC	Low-Level Expansion	Unsupported

Note: "BKC" means Bad Key Chirp, "GKC" means Good Key Chirp

Table 3-3 Test Channel Spacing

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

Table 3-4 Test Frequencies

Channel Selector Switch Position	Test Channel	VHF1	VHF2	UHF1	UHF2	UHF3
1 Low Power 8 High Power	TX#1 or #8 RX#1 or #8	136.625	146.625	403.625	438.625	465.625
2 Low Power 9 High Power	TX#2 or #9 RX#2 or #9	140.325	150.775	409.775	443.775	470.775
3 Low Power 10 High Power	TX#3 or #10 RX#3 or #10	144.525	155.275	415.275	448.275	475.275
4 Low Power 11 High Power	TX#4 or #11 RX#4 or #11	148.875	160.125	421.125	454.125	480.125
5 Low Power 12 High Power	TX#5 or #12 RX#5 or #12	153.325	164.475	427.475	459.475	485.475
6 Low Power 13 High Power	TX#6 or #13 RX#6 or #13	157.875	169.475	443.475	464.475	490.475
7 Low Power 14 High Power	TX#7 or #14 RX#7 or #14	161.975	173.875	439.875	469.875	494.875

Table 3-5 Receiver Performance Checks

Test Name	Communications Analyzer	Radio	Test Set	Comments
Reference Frequency	Mode: PWR MON 4th channel test frequency* Monitor: Frequency error Input at RF In/Out	TEST MODE, Test Channel 4 carrier squelch out- put at antenna	PTT to continuous (during the performance check)	Frequency error to be ± 200 Hz VHF ± 500 Hz UHF
Rated Audio	Mode: GEN Output level: 1.0mV RF 4th channel test frequency* Mod: 1kHz tone at 3kHz deviation Monitor: DVM: AC Volts	TEST MODE Test Channel 4 carrier squelch	PTT to OFF (center), meter selector to Audio PA	Set volume control to 3.46Vrms
Distortion	As above, except to distor- tion	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 <0.30 μ V (0.25 μ V typical).
Noise Squelch Threshold (only radios with conven- tional sys- tem 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 3.46Vrms
	As above, except change frequency to a conventional system. Raise RF level from zero until radio unsquelches.	out of TEST MODE; select a conven- tional system	As above	Unsquelch to occur at <0.25 μ V. Preferred SINAD = 6-9 dB

* See Table 3-4

Table 3-6 Transmitter Performance Checks

Test Name	Communications Analyzer	Radio	Test Set	Comments
Reference Frequency	Mode: PWR MON 4th channel test frequency* Monitor: Frequency error Input at RF In/Out	TEST MODE, Test Channel 4 carrier squelch Output at antenna	PTT to continuous (during the performance check)	Frequency error to be ± 200 Hz VHF ± 500 Hz UHF
Power RF	As above	As above	As above	Refer to Maintenance Specifications
Voice Modulation	Mode: PWR MON 4th channel test frequency* atten to -70, input to RF In/ Out Monitor: DVM, AC Volts Set 1 kHz 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, UHF ≥ 4.0 kHz but ≤ 5.0 kHz (25 kHz Ch Sp).
Voice Modulation (internal)	Mode: PWR MON 4th channel test frequency* atten to -70, input to RF In/ Out	TEST MODE, Test Channel 4 carrier squelch Output at antenna	Remove modulation input	Press PTT switch on radio. Say "four" loudly into the radio mic. Measure devia- tion: VHF, UHF ≥ 4.0 kHz but ≤ 5.0 kHz (25 kHz Ch Sp)
DTMF Modulation	As above, 4th channel test frequency*	TEST MODE, Test Channel 4 DTMF Output at antenna	As above	Deviation: VHF, UHF ≥ 3.05 kHz but ≤ 3.45 kHz (25 kHz Ch Sp)
PL/DPL Modulation	As above 4th channel test frequency* BW to narrow	TEST MODE, Test Channel 4 TPL DPL	As above	Deviation: VHF, UHF ≥ 500 Hz but ≤ 1000 Hz (25 kHz Ch Sp).

* See Table 3-4

RADIO TUNING AND PROGRAMMING

1.0 Introduction

This chapter provides an overview of the Customer Programming Software (CPS) and tuner program designed for use in a Windows 98/ME/NT/2000/XP environment. A CPS/Tuner Installation Manual (6866549D08) is included in this Product Manual.

2.0 CPS Programming/Flashing Setup with RIB

A Windows 98/NT4/2000/ME/XP PC (personal computer) and Global 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 4-1, Radio Tuning Setup, below. Refer to online help files for the tuning procedures.

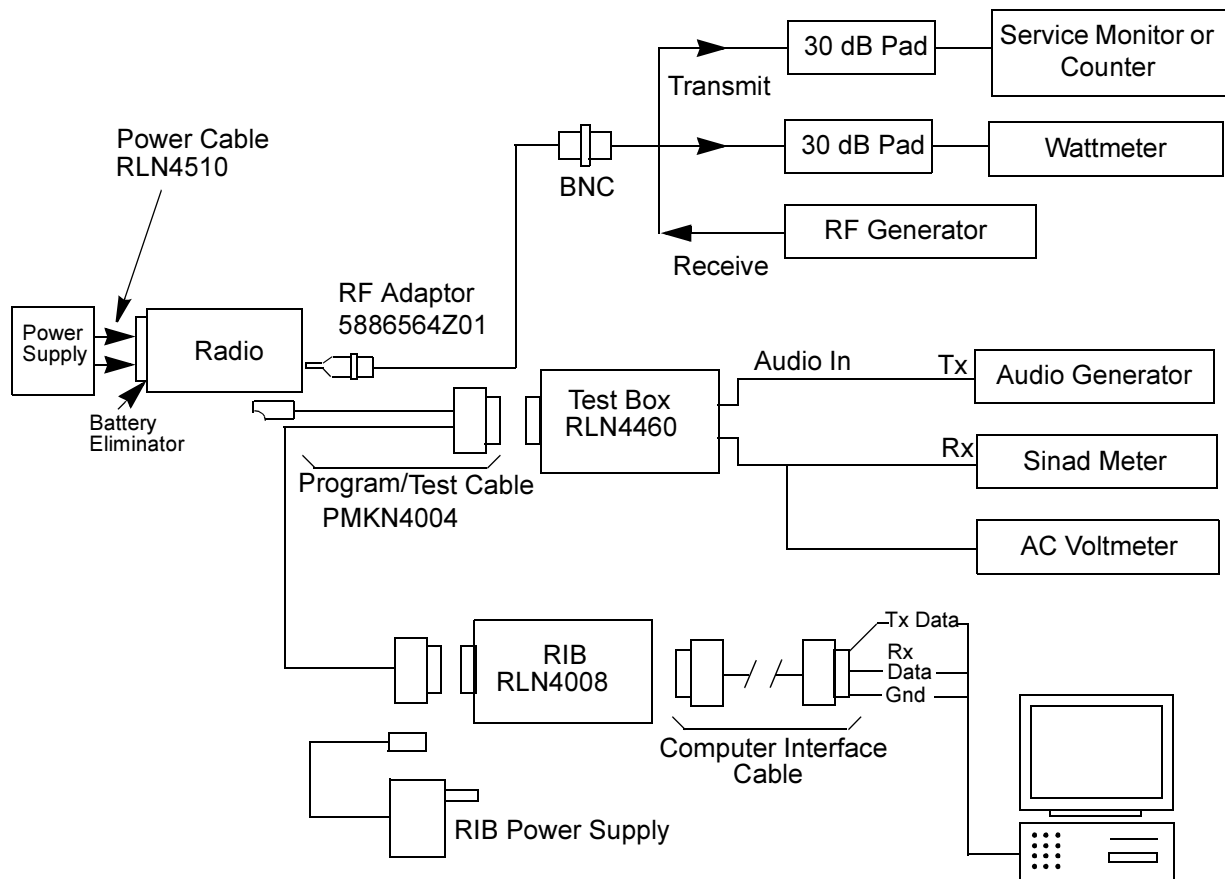


Figure 4-1. Radio Tuning Setup

3.0 CPS Programming Setup

Refer to online help files for the CPS Programming procedures.

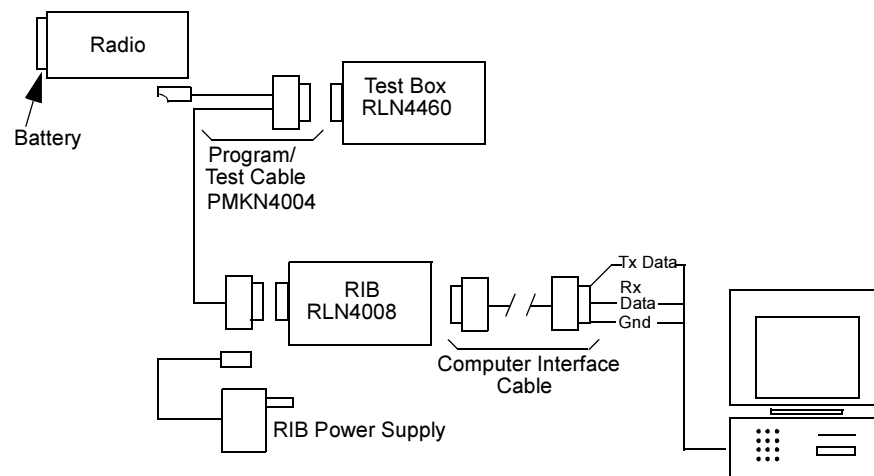


Figure 4-2 CPS Programming Setup

4.0 Radio to Radio Cloning

Cloning is the process of copying the content of one radio (source radio) into another radio (destination radio). Radio content refers to system-type features such as frequency, squelch type options, trunking, etc.

NOTE The source radio's serial number cannot be blank.

Radio functionality inherent in one radio cannot be cloned to another radio that does not contain the same functionality. Tuning and alignment information are not transferable and are not affected by cloning.

Signaling Identification Numbers (IDs) are duplicated in the cloning process. Unique IDs may be assigned with the CPS.

NOTE Unsuccessful cloning attempts generates a continuous tone and may be an indication that the destination radio's codeplug is corrupted.

Procedure:

1. Turn source and target radios off.
2. Connect cloning cable (PMKN4003) to the side connector of both radios.
3. Turn on the destination radio.
4. Press and hold the two side buttons at the same time on the source radio and then power up the source radio (Figure 4-3 Side Button Locations). Both radios produce a "clone-entry" tone.
5. Release both side buttons.
6. When cloning is completed, the source radio produce's a "clone-exit" tone and both the source and destination radios reset.
7. Turn both radios off.
8. Disconnect the cloning cable from both radios and turn them on for normal operation.

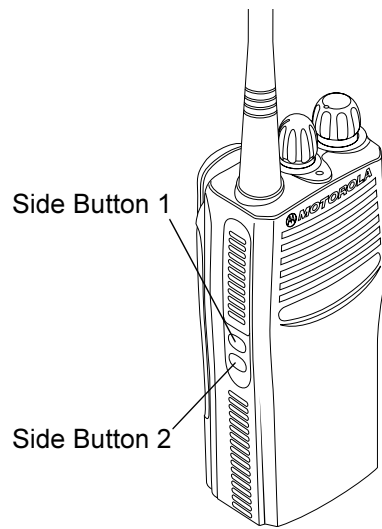


Figure 4-3 Side Button Locations

Chapter 5

POWER UP SELF-TEST

1.0 Self-Test Routine

Turning on the radio using the on/off volume control starts a self-test routine which checks the RAM, EEPROM hardware and EEPROM checksum. Pressing and holding SB1 while turning on the radio causes the self-test routine to check for the ROM checksum as well. If these checks are successfully completed, the radio will generate the Self-Test Pass Tone. If the self-test is not successful, a Self-Test Fail Tone is heard.

Chapter 6

ACCESSORIES

1.0 Accessories

To order, refer to Chapter 1 (paragraph 2.4 - 'Piece Parts') of this manual.

1.1 Antennas

HAD9338AR	VHF Heliflex Antenna 16cm (136-162 MHz)
NAD6502	VHF Heliflex Antenna 15cm (146-174 MHz)
HAD9742	VHF Stubby Antenna, 9cm (146-162 MHz)
HAD9743	VHF Stubby Antenna, 7.5cm (162-174 MHz)
NAE6522	UHF Heliflex Stubby Antenna 7.5cm (438-470 MHz)
8505816K26	UHF Heliflex Stubby 6.5cm (470-520 MHz)
NAE6483	Flexible Whip Antenna 17cm (403-520 MHz)

1.2 Audio Accessories

HMN9752	Earpiece with Volume Control, 1-Wire (plastic earloop) (Beige)
HMN9727	Earpiece without Volume Control, 1-Wire (plastic earloop) (Beige)
RLN4894	Earpiece without Volume Control, 1-Wire (plastic earloop) (Black)
HMN9754	Earpiece with Microphone & PTT Combined, 2-Wire (Beige)
RLN4895	Earpiece with Microphone & PTT Combined, 2-Wire (Black)
HMN9036	Earbud with Microphone & PTT Combined, 2-Wire (Black)
HLN9132	Earbud Single Wire Receive Only (Black)
NTN8370	Extreme Noise Kit
NTN8371	Low Noise Kit
RLN4760	Small Custom Clear Earpiece, Right Ear
RLN4763	Small Custom Clear Earpiece, Left Ear
RLN4761	Medium Custom Clear Earpiece, Right Ear
RLN4764	Medium Custom Clear Earpiece, Left Ear
RLN4762	Large Custom Clear Earpiece, Right Ear
RLN4765	Large Custom Clear Earpiece, Left Ear
BDN6646	Std 95dB Ear Microphone with PTT Interface Module
BDN6706	Std 95dB Ear Microphone with VOX and PTT Interface Module
0180358B38	Ring PTT Switch for Ear Mic Systems

0180300E83	Body PTT Switch for Ear Mic Systems
0180358B33	Medium Earholder for Ear Mic Systems
MDPMLN4442	Earbud with Microphone and PTT Combined
MDPMLN4443	Flexible Ear Receiver with Microphone and PTT Combined

1.3 Headsets

PMMN4001	Ultra-Lite Earset with Mic and PTT
PMLN4445	Ultra-light Headset with Boom Microphone
RLN5238	Lightweight Headset with In-line PTT, NFL Style
HMN9021	Medium Weight Over the Head Dual Muff Headset
HMN9022	Medium Weight Behind the Head Dual Muff Headset
BDN6647	Medium Weight Single Speaker Headset
BDN6648	Heavy Duty Dual Muff Headset with Noise Canceling Microphone
5080371E66	Replacement Ear Pad for BDN6647
RMN5015	Heavy Duty Dual Muff Racing Headset (requires RKN4090 Headset Adapter Cable)
REX4648	Ear Pad and Windscreen Kit
RKN4090	Adapter Cable for use with RMN5015
RMN4051	2-way Hard Hat Mount (Black) Noise Reduction 22dB
RMN4054	Receive Only Hard Hat Mount Headset with 3.5mm right angle plug
RMN4055	Receive Only Headband Style Headset
HLN9133	VOX Adapter Kit for (Receive Headsets only)
RKN4094	GP300 inline PTT Adapter (for use with RMN4051, RMN4052, RMN4053 only)

1.4 Remote Speaker Microphones

HMN9030	Remote Speaker Microphone
PMMN4008	Remote Speaker Microphone

1.5 Chargers

MDWPLN4139	Desktop Rapid Charger 230V with Euro Plug
MDWPLN4162	Rapid Multi Unit Charger 230V with Euro Plug
MDWPLN4140	Desktop Rapid Charger 230V with UK Plug
MDWPLN4163	Rapid Multi Unit Charger 230V with UK Plug
MDWPLN4137	Desktop Rapid Charger (Base Only)
EPNN7990	Power Supply for Desktop Rapid Charger (Base Only) (UK)
EPNN7991	Power Supply for Desktop Rapid Charger (Base Only) (Euro)

1.6 Batteries

NNTN4497	Li-Ion, High Capacity
NNTN4970	Slim Li-Ion
NNTN4851	NiMH

1.7 Carrying Accessories

RLN5383	Hard Leather Case with Belt Loop and D-Shaped Rings
RLN5384	Hard Leather Case with High Activity 2-1/2 inch Swivel Belt Loop
RLN5385	Hard Leather Case with High Activity 3 inch Swivel Belt Loop
HLN9701	Nylon Carry Case with Belt Loop and D-Shaped Rings
HLN8255	3 inch Spring Action Belt Clip
HLN6602	Universal Chest Pack
1505596Z02	Replacement Strap for HLN6602 Universal Chest Pack
RLN4815	Universal RadioPak
4280384F89	Replacement Belt Lengthener for RLN4815 Universal RadioPak
NTN5243	Shoulder Strap for Hard Leather Cases (attaches to D-Shaped Rings on case)
HLN9985	Waterproof Bag

Chapter 7

MODEL CHART AND SPECIFICATION

1.0 VHF1 136-162 MHz

CP040 VHF1 136-162 MHz			
Model			Description
		MDH50JDC9AA1_N	CP040 136-162 MHz 5W 4-Ch
		MDH50JDC9AA2_N	CP040 136-162 MHz 5W 16-Ch
		Item	Description
X		PMUD1981_	CP040 136-162 MHz 5W 4-Ch Tanapa
	X	PMUD1982_	CP040 136-162 MHz 5W 16-Ch Tanapa
X		PMLD4239_	CP040, Back Cover Kit 136-162 MHz 4-Ch
	X	PMLD4240_	CP040, Back Cover Kit 136-162 MHz 16-Ch
X		PMLN4552_	Plain, Front Housing Kit, 4-Ch
	X	PMLN4553_	Plain, Front Housing Kit, 16-Ch
X	X	NTN4497_R	Li-Ion Battery, High Capacity
X	X	WPLN4166	Rapid Desktop Charger (Base Only)
X	X	EPNN7990_	Power Supply for Rapid Desktop Charger (UK)
X	X	EPNN7991_	Power Supply for Rapid Desktop Charger (Euro)
X	X	HLN8255	Belt Clip
X	X	HAD9338AR	Antenna, 136-162 MHz, Heliflex
X	X	6866549D01_	CP040 Basic User Guide
X	X	6864117B25_	Safety Leaflet
X	X	6866546D03_	RTTE Leaflet

X = Indicates one of each is required

2.0 VHF1 136-162 MHz Specifications

General

	VHF	
Frequency:	136-162 MHz	
Channel Capacity:	4 or 16 Channels	
Power Supply:	7.5 Volts ±20%	
Dimensions: with High Capacity Li-Ion Battery and with Standard NiMH Battery: with Slim Li-Ion Battery:	128.7mm H x 61.7mm W x 44.1mm D 128.7mm H x 61.7mm W x 41.3mm D	
Weight: with Slim Li-Ion Battery with High Capacity Li-Ion Battery: with Standard NiMH Battery:	365g 420g 480g	
Average Battery Life @ (5-5-90 Duty Cycle): with Slim Li-Ion Battery: with High Capacity Li-Ion Battery: with Standard NiMH Battery:	1 W 17Hrs. 19 Hrs. 13 Hrs.	5 W 12 Hrs. 14 Hrs. 10 Hrs

Transmitter

	VHF	
RF Output NiMH @ 7.5V:	Low 1 W	High 5W
Frequency:	136-162 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.	<3%	

	VHF
FM Noise:	-40 dB (12.5 kHz) -45 dB (25 kHz)

Receiver

	VHF 12.5 kHz	VHF 20/25kHz
Frequency:	136-162 MHz	
Sensitivity 12dB EIA SINAD:	0.25 µV (typical)	
Adjacent Channel Selectivity:	-65 dB	-70 dB
Intermodulation:	- 70dB	
Freq. Stability (-30°C to +60°C):	0.00025%	
Spur Rejection:	-75 dB	
Image and 1/2 I-F Rejection:	-70 dB	
Audio Output @ <5% Distortion:	500 mW	

All specifications are subject to change without notice.

Self-Quieten Frequencies

VHF
151.200

3.0 VHF2 146-174 MHz

CP040 VHF2 146-174 MHz			
Model			Description
		MDH50KDC9AA1_N	CP040 146-174 MHz 5W 4-Ch
		MDH50KDC9AA2_N	CP040 146-174 MHz 5W 16-Ch
		Item	Description
X		PMUD1820_	CP040 146-174 MHz 5W 4-Ch Tanapa
	X	PMUD1822_	CP040 146-174 MHz 5W 16-Ch Tanapa
X		PMLD4204_	CP040, Back Cover Kit 146-174 MHz 4-Ch
	X	PMLD4205_	CP040, Back Cover Kit 146-174 MHz 16-Ch
X		PMLN4552_	Plain, Front Housing Kit, 4-Ch
	X	PMLN4553_	Plain, Front Housing Kit, 16-Ch
X	X	NTN4497_R	Li-Ion Battery, High Capacity
X	X	WPLN4166	Rapid Desktop Charger (Base Only)
X	X	EPNN7990_	Power Supply for Rapid Desktop Charger (UK)
X	X	EPNN7991_	Power Supply for Rapid Desktop Charger (Euro)
X	X	HLN8255	Belt Clip
X	X	NAD6502_	Antenna, 146-174 MHz, 15cm
X	X	6866549D01_	CP040 Basic User Guide
X	X	6864117B25_	Safety Leaflet
X	X	6866546D03_	RTTE Leaflet

X = Indicates one of each is required

4.0 VHF2 146-174 MHz Specifications

General

	VHF	
Frequency:	146-174 MHz	
Channel Capacity:	4 or 16 Channels	
Power Supply:	7.5 Volts \pm 20%	
Dimensions: with High Capacity Li-Ion Battery and with Standard NiMH Battery: with Slim Li-Ion Battery:	128.7mm H x 61.7mm W x 44.1mm D 128.7mm H x 61.7mm W x 41.3mm D	
Weight: with Slim Li-Ion Battery with High Capacity Li-Ion Battery: with Standard NiMH Battery:	365g 420g 480g	
Average Battery Life @ (5-5-90 Duty Cycle): with Slim Li-Ion Battery: with High Capacity Li-Ion Battery: with Standard NiMH Battery:	1 W 17Hrs. 19 Hrs. 13 Hrs.	5 W 12 Hrs. 14 Hrs. 10 Hrs

Transmitter

	VHF	
RF Output NiMH @ 7.5V:	Low 1 W	High 5W
Frequency:	146-174 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.	<3%	

	VHF
FM Noise:	-40 dB (12.5 kHz) -45 dB (25 kHz)

Receiver

	VHF 12.5 kHz	VHF 20/25kHz
Frequency:	146-174 MHz	
Sensitivity 12dB EIA SINAD:	0.25 μ V (typical)	
Adjacent Channel Selectivity:	-65 dB	-70 dB
Intermodulation:	- 70dB	
Freq. Stability (-30°C to +60°C):	0.00025%	
Spur Rejection:	-75 dB	
Image and 1/2 I-F Rejection:	-70 dB	
Audio Output @ <5% Distortion:	500 mW	

All specifications are subject to change without notice.

Self-Quieten Frequencies

VHF
151.19375
151.200
151.20625
167.99375
168.000
168.00625

5.0 UHF1 403-440 MHz

CP040 UHF1 403-440 MHz			
Model			Description
		MDH50QDC9AA1_N	CP040 403-440 MHz 4W 4-Ch
		MDH50QDC9AA2_N	CP040 403-440 MHz 4W 16-Ch
		Item	Description
X		PMUE1984_	CP040 403-440 MHz 4W 4-Ch Tanapa
	X	PMUE1985_	CP040 403-440 MHz 4W 16-Ch Tanapa
X		PMLE4297_	CP040, Back Cover Kit 403-440 MHz 4-Ch
	X	PMLE4298_	CP040, Back Cover Kit 403-440 MHz 16-Ch
X		PMLN4552_	Plain, Front Housing Kit, 4-Ch
	X	PMLN4553_	Plain, Front Housing Kit, 16-Ch
X	X	NTN4497_R	Li-Ion Battery, High Capacity
X	X	WPLN4166	Rapid Desktop Charger (Base Only)
X	X	EPNN7990_	Power Supply for Rapid Desktop Charger (UK)
X	X	EPNN7991_	Power Supply for Rapid Desktop Charger (Euro)
X	X	HLN8255	Belt Clip
X	X	8505816K24_	Antenna, 400-440 MHz, Heliflex Stubby
X	X	6866549D01_	CP040 Basic User Guide
X	X	6864117B25_	Safety Leaflet
X	X	6866546D03_	RTTE Leaflet

X = Indicates one of each is required

6.0 UHF1 403-440 MHz Specifications

General

	UHF1	
Frequency:	403-440 MHz	
Channel Capacity:	4 or 16 Channels	
Power Supply:	7.5 Volts \pm 20%	
Dimensions: with High Capacity Li-Ion Battery and with Standard NiMH Battery:	128.7mm H x 61.7mm W x 44.1mm D	
with Slim Li-Ion Battery:	128.7mm H x 61.7mm W x 41.3mm D	
Weight: with Slim Li-Ion Battery	365g	
with High Capacity Li-Ion Battery:	420g	
with Standard NiMH Battery:	480g	
Average Battery Life @ (5-5-90 Duty Cycle): with Slim Li-Ion Battery:	1 W	4 W
with High Capacity Li-Ion Battery:	17Hrs.	12 Hrs.
with Standard Li-Ion Battery:	19 Hrs.	14 Hrs
with Standard NiMH Battery:	13 Hrs.	10 Hrs

Transmitter

	UHF1	
RF Output NiMH @ 7.5V:	Low 1 W	High 4W
Frequency:	403-440 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.	<3%	
FM Noise:	-40 dB (12.5 kHz) -45 dB (25 kHz)	

Receiver

	UHF1 12.5 kHz	UHF1 20/25kHz
Frequency:	403-440 MHz	
Sensitivity 12dB EIA SINAD:	0.25 μ V (typical)	
Adjacent Channel Selectivity:	-60 dB	-70 dB
Intermodulation:	-70 dB	
Freq. Stability (-30°C to +60°C):	0.00025%	
Spur Rejection:	-75 dB	
Image and 1/2 I-F Rejection:	-70 dB	
Audio Output @ <5% Distortion:	500 mW	

All specifications are subject to change without notice.

Self-Quieten Frequencies

UHF1
419.993750
420.000000
420.006250 (420+/- 6.25kHz)

7.0 UHF2 438-470 MHz

CP040 UHF2 438-470 MHz			
Model			Description
		MDH50RDC9AA1_N	CP040 438-470 MHz 4W 4-Ch
		MDH50RDC9AA2_N	CP040 438-470 MHz 4W 16-Ch
		Item	Description
X		PMUE1949_	CP040 438-470 MHz 4W 4-Ch Tanapa
	X	PMUE1951_	CP040 438-470 MHz 4W 16-Ch Tanapa
X		PMLE4255_	CP040, Back Cover Kit 438-470 MHz 4-Ch
	X	PMLE4254_	CP040, Back Cover Kit 438-470 MHz 16-Ch
X		PMLN4552_	Plain, Front Housing Kit, 4-Ch
	X	PMLN4553_	Plain, Front Housing Kit, 16-Ch
X	X	NTN4497_R	Li-Ion Battery, High Capacity
X	X	WPLN4166	Rapid Desktop Charger (Base Only)
X	X	EPNN7990_	Power Supply for Rapid Desktop Charger (UK)
X	X	EPNN7991_	Power Supply for Rapid Desktop Charger (Euro)
X	X	HLN8255	Belt Clip
X	X	NAE6522_	Antenna, 438-470 MHz, 7.5cm
X	X	6866549D01_	CP040 Basic User Guide
X	X	6864117B25_	Safety Leaflet
X	X	6866546D03_	RTTE Leaflet

X = Indicates one of each is required

8.0 UHF2 438-470 MHz Specifications

General

	UHF2	
Frequency:	438-470 MHz	
Channel Capacity:	4 or 16 Channels	
Power Supply:	7.5 Volts ±20%	
Dimensions: with High Capacity Li-Ion Battery and with Standard NiMH Battery:	128.7mm H x 61.7mm W x 44.1mm D	
with Slim Li-Ion Battery:	128.7mm H x 61.7mm W x 41.3mm D	
Weight: with Slim Li-Ion Battery	365g	
with High Capacity Li-Ion Battery:	420g	
with Standard NiMH Battery:	480g	
Average Battery Life @ (5-5-90 Duty Cycle): with Slim Li-Ion Battery:	1 W 17Hrs.	4 W 12 Hrs.
with High Capacity Li-Ion Battery:	19 Hrs.	14 Hrs
with Standard NiMH Battery:	13 Hrs.	10 Hrs

Transmitter

	UHF2	
RF Output NiMH @ 7.5V:	Low 1 W	High 4W
Frequency:	438-470 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.	<3%	
FM Noise:	-40 dB (12.5 kHz) -45 dB (25 kHz)	

Receiver

	UHF2 12.5 kHz	UHF2 20/25kHz
Frequency:	438-470 MHz	
Sensitivity 12dB EIA SINAD:	0.25 µV (typical)	
Adjacent Channel Selectivity:	-60 dB	-70 dB
Intermodulation:	-70 dB	
Freq. Stability (-30°C to +60°C):	0.00025%	
Spur Rejection:	-75 dB	
Image and 1/2 I-F Rejection:	-70 dB	
Audio Output @ <5% Distortion:	500 mW	

All specifications are subject to change without notice.

Self-Quieten Frequencies

UHF2
443.93125
443.9375
443.94375
443.950
443.95625
443.9625
443.96875

9.0 UHF3 465-495 MHz

CP040 UHF3 465-495 MHz			
Model			Description
		MDH50SDC9AA1_N	CP040 465-495 MHz 4W 4-Ch
		MDH50SDC9AA2_N	CP040 465-495 MHz 4W 16-Ch
		Item	Description
X		PMUE1986_	CP040 465-495 MHz 4W 4-Ch Tanapa
	X	PMUE1987_	CP040 465-495 MHz 4W 16-Ch Tanapa
X		PMLE4299_	CP040, Back Cover Kit 465-495 MHz 4-Ch
	X	PMLE4300_	CP040, Back Cover Kit 465-495 MHz 16-Ch
X		PMLN4552_	Plain, Front Housing Kit, 4-Ch
	X	PMLN4553_	Plain, Front Housing Kit, 16-Ch
X	X	NTN4497_R	Li-Ion Battery, High Capacity
X	X	WPLN4166	Rapid Desktop Charger (Base Only)
X	X	EPNN7990_	Power Supply for Rapid Desktop Charger (UK)
X	X	EPNN7991_	Power Supply for Rapid Desktop Charger (Euro)
X	X	HLN8255	Belt Clip
X	X	NAE6483_	Antenna, 403-520 MHz, Flexible Whip
X	X	6866549D01_	CP040 Basic User Guide
X	X	6864117B25_	Safety Leaflet
X	X	6866546D03_	RTTE Leaflet

X = Indicates one of each is required

10.0 UHF3 465-495 MHz Specifications

General

	UHF3	
Frequency:	465-495 MHz	
Channel Capacity:	4 or 16 Channels	
Power Supply:	7.5 Volts \pm 20%	
Dimensions: with High Capacity Li-Ion Battery and with Standard NiMH Battery:	128.7mm H x 61.7mm W x 44.1mm D	
with Slim Li-Ion Battery:	128.7mm H x 61.7mm W x 41.3mm D	
Weight: with Slim Li-Ion Battery	365g	
with High Capacity Li-Ion Battery:	420g	
with Standard NiMH Battery:	480g	
Average Battery Life @ (5-5-90 Duty Cycle): with Slim Li-Ion Battery:	1 W	4 W
with High Capacity Li-Ion Battery:	17Hrs.	12 Hrs.
with Standard NiMH Battery:	19 Hrs.	14 Hrs
	13 Hrs.	10 Hrs

Transmitter

	UHF3	
RF Output NiMH @ 7.5V:	Low 1 W	High 4W
Frequency:	465-495 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.	<3%	
FM Noise:	-40 dB (12.5 kHz) -45 dB (25 kHz)	

Receiver

	UHF3 12.5 kHz	UHF3 20/25kHz
Frequency:	465-495 MHz	
Sensitivity 12dB EIA SINAD:	0.25 μ V (typical)	
Adjacent Channel Selectivity:	-60 dB	-70 dB
Intermodulation:	-70 dB	
Freq. Stability (-30°C to +60°C):	0.00025%	
Spur Rejection:	-75 dB	
Image and 1/2 I-F Rejection:	-70 dB	
Audio Output @ <5% Distortion:	500 mW	

All specifications are subject to change without notice.

Self-Quieten Frequencies

UHF3
488.326250
488.332500
488.338750
488.345000
488.351250
488.357500
488.363750 (488.345MHz +/- 18.75kHz)

11.0 MIL Standards

MIL STDS 810 C, D, E, and F: Applicable to UHF and VHF Specifications (8.2 and 8.4)

Military Standards 810 C, D, E, & F: Parameters/Methods/Procedures								
Applicable MIL-STD	810C		810D		810E		810F	
	Methods	Procedures	Methods	Procedures	Methods	Procedures	Methods	Procedures
Low Pressure	500.1	1	500.2	2	500.3	2	500.4	1
High Temperature	501.1	1,2	501.2	1,2	501.3	1,2	501.4	1,2
Low Temperature	502.1	1	502.2	1,2	502.3	1,2	501.4	1,2
Temperature Shock	503.1	1	503.2	1	503.3	1	503.4	1
Solar Radiation	505.1	1	505.2	1	505.3	1	505.4	1
Rain	506.1	1,2	506.2	1,2	506.3	1,2	506.4	1
Humidity	507.1	2	507.2	2,3	507.3	2,3	507.4	3
Salt Fog	509.1	1	509.2	1	509.3	1	509.4	1
Dust	510.1	1	510.2	1	510.3	1	510.4	1
Vibration	514.2	8,10	514.3	1	514.4	1	514.5	1
Shock	516.2	1,2,5	516.3	1,4	516.4	1,4	516.5	1

GLOSSARY

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
BKC	Bad Key Chirp
CD	Compact Disk
CMP	Compression
CPS	Customer Programming Software
CSQ	Carrier Squelch
DTMF	Dual-Tone Multifrequency
DPL	Digital Private-Line™
EEPROM	Electrically 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.
GKC	Good Key Chirp
ISW	Inbound Signalling Word: data transmitted on the control channel from a subscriber unit to the central control unit.
LH DATA	Longhorn Data: a bidirectional 0-5V, RS-232 line protocol that uses the microcontroller'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.
MCU	Micro Controller Unit
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.

OMPAC	Over-Molded Pad-Array Carrier: a Motorola custom package, distinguished by the presence of solder balls on the bottom pads.
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; when pressed, causes the radio to transmit.
RAM	Random Access Memory: the radio's RAM is loaded with a copy of the EE-PROM data.
Registers	Short-term data-storage circuits within the microcontroller.
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	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
TOT	Time-Out Timer: a timer that limits the length of a transmission.
TPL	Tone Private-line
μC	Microcontroller
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

