PM1200

Basic Service Manual
Mobile Radio

MOTOROLA

PM1200
Mobile Radio
Basic Service Manual

Motorola, Inc.
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6880309U09-A

Foreword

This manual covers all models of the PM1200 Low Band Radio, unless otherwise specified. It includes all the information necessary to maintain peak product performance and maximum working time, using levels 1 and 2 maintenance procedures. This level of service goes down to the board replacement level and is typical of some local service centers, self-maintained customers, and distributors.

For details on radio operation or component-level troubleshooting, refer to the applicable manuals available separately. A list of related publications is provided in the section, "Related Publications," on page xiv.

Product Safety and RF Exposure Compliance

Before using this product, read the operating instructions for safe usage contained in the Product Safety and RF Exposure booklet enclosed with your radio.

ATTENTION!

This radio is restricted to occupational use only to satisfy FCC RF energy exposure requirements. Before using this product, read the RF energy awareness information and operating instructions in the Product Safety and RF Exposure section in the user guide (Motorola Publication part number 6880309U08) to ensure compliance with RF energy exposure limits.

For a list of Motorola-approved antennas, batteries, and other accessories, visit the following web site which lists approved accessories: http://www.motorola.com/governmentandenterprise/

Manual Revisions

Changes which occur after this manual is printed are described in FMRs/PMRs (Field/Publication Manual Revisions). These FMRs/PMRs provide complete replacement pages for all added, changed, and deleted items. To obtain FMRs/PMRs, go to http://motorola.com/businessonline.

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Document History

The following major changes have been implemented in this manual since the previous edition:

Edition	Description	Date
6880309U09-A	Initial Release	Oct. 2007

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Related Publications

PM1200 Mobile Radio User Guide CD 6880309U08
PM1200 Mobile Radio Installation Manual.....6880309U11
PM1200 Mobile CPS Installation Guide.....6880309U29
PM1200 Mobile Radio User Kit.....HKLN4350_

Commercial Warranty

Limited Warranty

MOTOROLA COMMUNICATION PRODUCTS

I. What This Warranty Covers And For How Long

MOTOROLA INC. (“MOTOROLA”) warrants the MOTOROLA manufactured Communication Products listed below (“Product”) against defects in material and workmanship under normal use and service for a period of time from the date of purchase as scheduled below:

PM1200	Two (2) Years
Product Accessories	One (1) Year

Motorola, at its option, will at no charge either repair the Product (with new or reconditioned parts), replace it (with a new or reconditioned Product), or refund the purchase price of the Product during the warranty period provided it is returned in accordance with the terms of this warranty. Replaced parts or boards are warranted for the balance of the original applicable warranty period. All replaced parts of Product shall become the property of MOTOROLA.

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IV. How To Get Warranty Service

You must provide proof of purchase (bearing the date of purchase and Product item serial number) in order to receive warranty service and, also, deliver or send the Product item, transportation and insurance prepaid, to an authorized warranty service location. Warranty service will be provided by Motorola through one of its authorized warranty service locations. If you first contact the company which sold you the Product, it can facilitate your obtaining warranty service. You can also call Motorola at 1-888-567-7347 US/Canada.

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A. Defects or damage resulting from use of the Product in other than its normal and customary manner.

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C. Defects or damage from improper testing, operation, maintenance, installation, alteration, modification, or adjustment.

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F. Product which has had the serial number removed or made illegible.

G. Rechargeable batteries if:

- any of the seals on the battery enclosure of cells are broken or show evidence of tampering.
- the damage or defect is caused by charging or using the battery in equipment or service other than the Product for which it is specified.

H. Freight costs to the repair depot.

I. A Product which, due to illegal or unauthorized alteration of the software/firmware in the Product, does not function in accordance with MOTOROLA’s published specifications or the FCC type acceptance labeling in effect for the Product at the time the Product was initially distributed from MOTOROLA.

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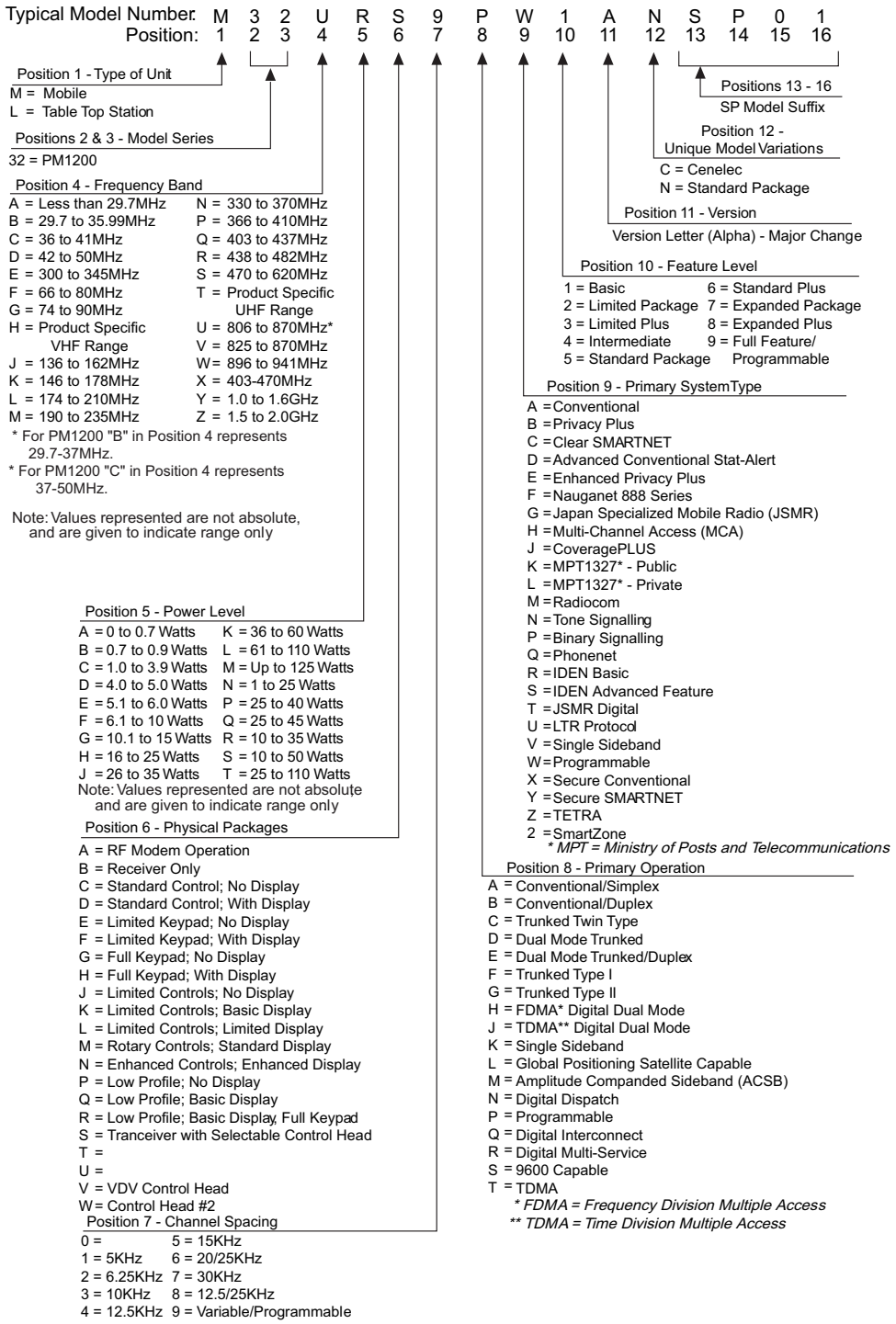
This Warranty is governed by the laws of the State of Illinois, USA.

Model Numbering, Charts, and Specifications

Mobile Radio Model Numbering Scheme



PM1200 Low Band (A) 29.7–37MHz 120 Watt Model Chart

Model		Description
AAM32BMD9PW5AN		**PM1200 29.7–37 MHZ 120W 250CH**
	Item	**Description**
X	HKUB4000_	Standard Tanapa 29.7–37 MHz 120 Watt
X	HKLN4331_	PM1200 Control Head
X	HKLN4334_	Remote Control Head Trunnion Kit
X	HKLN4335_	Main Unit Brd Kit 29.7–37 MHz 120W
X	HKLN4337_	Connector Unit Board Kit 29.7–37 MHz 120W
X	HKLN4338_	PA Unit Board Kit 37–50 MHz 120W
X	HKLN4339_	Spare Fuse
X	HKLN4340_	Power Cable, 20 feet
X	HKLN4341_	Remote Mount Kit, 20 feet
X	HKLN4342_	Tranceiver Trunnion Kit
X	HKLN4350_	PM1200 Users Guide Kit
X	HKLN4373_	Connector Unit Board Kit
X	HKLN4374_	RF-Interface Board Kit
X	AARMN4025_	Standard Palm Microphone

X = Item Included
_ = the latest version kit. When ordering a kit, refer to your specific kit for the suffix number.

PM1200 Low Band (B) 37–50MHz 120 Watt Model Chart

Model		Description
AAM32CMD9PW5AN		PM1200 37–50MHZ 120W 250CH
	Item	Description
X	HKUB4001_	Standard Tanapa 37– 50 MHz 120 Watt
X	HKLN4331_	PM1200 Control Head
X	HKLN4334_	Remote Control Head Trunnion Kit
X	HKLN4336_	Main Unit Brd Kit 37–50 MHz 120W
X	HKLN4337_	Connector Unit Board Kit 29.7–37 MHz 120W
X	HKLN4338_	PA Unit Board Kit 37–50 MHz 120W
X	HKLN4339_	Spare Fuse
X	HKLN4340_	Power Cable, 20 feet
X	HKLN4341_	Remote Mount Kit, 20 feet
X	HKLN4342_	Tranceiver Trunnion Kit
X	HKLN4350_	PM1200 Users Guide Kit
X	HKLN4373_	Connector Unit Board Kit
X	HKLN4374_	RF-Interface Board Kit
X	AARMN4025_	Standard Palm Microphone

X = Item Included
_ = the latest version kit. When ordering a kit, refer to your specific kit for the suffix number.

PM1200 Low-Band (A) 29.7–37MHz Radio Specifications

GENERAL	RECEIVER	TRANSMITTER
FCC Designations: AZ492FT1629	**Frequency Range:**	**Frequency Range:**
Temperature Range:	Low Band A: 29.7–37 MHz	Low Band A: 29.7–37 MHz
Operating: -30°C to +60°C	**Channel Spacing:** 20 kHz	**Rated Output Power:**
Storage: -40°C to +85°C	**Input Impedance:** 50 Ohm	High-Power Radio: 120 Watt
Power Supply: 13.4 Vdc Negative Ground Only	**Reference Sensitivity:**	**Channel Spacing:** 20 kHz
Battery Drain: (Maximum)	12 dB SINAD: -119 dB	**Output Impedance:** 50 Ohm
100 Watt:	**Selectivity:** (per EIA Specifications)	**Frequency Stability:**
Standby @ 13.4 V: 600 mA	(Measured in the Analog Mode)	(-30°C to +60°C; 25°C Ref.): ±348 Hz @ 10ppm
Receive at Rated Audio @ 13.4 V: 2.2 A	20 kHz Channel Spacing: -70 dB	**Modulation Limiting:**
Transmit @ Rated Power:	**Intermodulation:** (per EIA Specifications)	20 kHz Channel Spacing: ±5.0 kHz
120 W 22.0 A	(Measured in the Analog Mode): -70 dB	**FM Hum and Noise:**
Dimensions (H x W x D):	**Spurious Rejection:** -90 dB	20 kHz Channel Spacing: -43 dB
Control Head 3.11" x 7.78" x 3.31" (79 mm x 197.60 mm x 84.07 mm)	**Frequency Stability:**	**Emission (Conduct/Radiated):** 80% of the Rated Deviation
High Power Radio Transceiver 3.15" x 7.56" x 12.07" (80 mm x 192 mm x 306.50 mm)	(-30°C to +60°C; 25°C Reference): 10ppm	**Audio Sensitivity:** 40% of the Rated Deviation
Weight:	**Audio Output:** (per EIA Specifications)	**Audio Response:**
Control Head 1.28 lb (0.58 kg)	(Measured in the Analog Mode):	(Measured in the Analog Mode)
High Power Radio Transceiver 9.94 lb (4.51 kg)	1.5 Watts for Internal Speaker	(6 dB/Octave Pre-Emphasis 300 to 3000Hz): +1, -3 dB
	7.5 Watts for External Speaker	**Audio Distortion:**
		(For 60% Max. Deviation at 1 kHz):10% TIA 603
		Emissions Designators:
		16K0F3E

Specifications subject to change without notice.
All measurements are taken in the test mode at 20 kHz channel spacing except where indicated.

PM1200 Low Band (B) 37–50MHz Radio Specifications

GENERAL	RECEIVER	TRANSMITTER
FCC Designations: AZ492FT1630	**Frequency Range:**	**Frequency Range:**
Temperature Range:	Low Band B: 37–50 MHz	Low Band A: 37–50 MHz
Operating: -30°C to +60°C	**Channel Spacing:** 20 kHz	**Rated Output Power:**
Storage: -40°C to +85°C	**Input Impedance:** 50 Ohm	High-Power Radio: 120 Watt
Power Supply: 13.4 Vdc Negative Ground Only	**Reference Sensitivity:**	**Channel Spacing:** 20 kHz
Battery Drain: (Maximum)	12 dB SINAD: -119 dB	**Output Impedance:** 50 Ohm
100 Watt:	**Selectivity:** (per EIA Specifications)	**Frequency Stability:**
Standby @ 13.4 V: 600 mA	(Measured in the Analog Mode)	(-30°C to +60°C; 25°C Ref.): ±348 Hz @ 10ppm
Receive at Rated Audio @ 13.4 V: 2.2 A	20 kHz Channel Spacing: -70 dB	**Modulation Limiting:**
Transmit @ Rated Power:	**Intermodulation:** (per EIA Specifications)	20 kHz Channel Spacing: ±5.0 kHz
120 W 22.0 A	(Measured in the Analog Mode): -70 dB	**FM Hum and Noise:**
Dimensions (H x W x D):	**Spurious Rejection:** -90 dB	20 kHz Channel Spacing: -43 dB
Control Head 3.11" x 7.78" x 3.31" (79 mm x 197.60 mm x 84.07 mm)	**Frequency Stability:**	**Emission (Conduct/Radiated):**
High Power Radio Transceiver 3.15" x 7.56" x 12.07" (80 mm x 192 mm x 306.50 mm)	(-30°C to +60°C; 25°C Reference): 10ppm	80% of the Rated Deviation
Weight:	**Audio Output:** (per EIA Specifications)	**Audio Sensitivity:**
Control Head 1.28 lb (0.58 kg)	(Measured in the Analog Mode):	40% of the Rated Deviation
High Power Radio Transceiver 9.94 lb (4.51 kg)	1.5 Watts for Internal Speaker	**Audio Response:**
	7.5 Watts for External Speaker	(Measured in the Analog Mode)
		(6 dB/Octave Pre-Emphasis 300 to 3000Hz): +1, -3 dB
		Audio Distortion:
		(For 60% Max. Deviation at 1 kHz):10% TIA 603
		Emissions Designators:
		16K0F3E

Specifications subject to change without notice.
All measurements are taken in the test mode at 20 kHz channel spacing except where indicated.

Chapter 1 Introduction

1.1 Notations Used in This Manual

Throughout the text in this publication, you will notice the use of note, caution, warning, and danger notations. These notations are used to emphasize that safety hazards exist, and due care must be taken and observed.

NOTE: An operational procedure, practice, or condition that is essential to emphasize.

CAUTION indicates a potentially hazardous situation which, if not avoided, might result in equipment damage.

WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or injury.

DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or injury.

1.2 Radio Description

The PM1200 mobile radio is Motorola's newest two-way mobile radio designed for your organization's most demanding needs. The PM1200 radio is available in the following frequency ranges and power levels.

Table 1-1. PM1200 Radio Frequency Ranges and Power Levels

Freq. Band	Bandwidth	Power Level
Low-Band (A)	29.7 – 37 MHz	50 – 20 W variable
Low-Band (B)	37.0 – 50 MHz	50 – 120 W variable

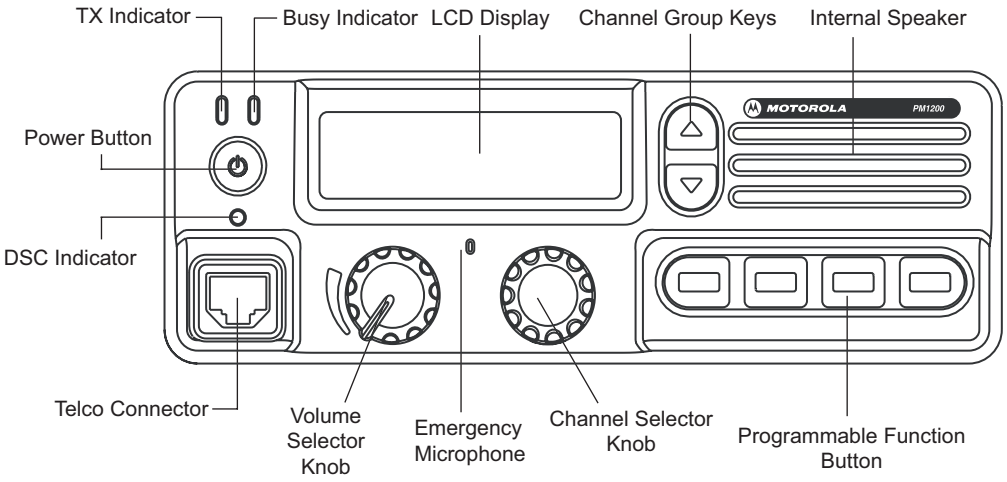
The PM1200 radio is among the most sophisticated two-way radios available. They have a new robust design for radio users who need high performance, quality, and reliability in their daily communications. This new architecture provides the capability of supporting a multitude of legacy and advanced features resulting in a more cost-effective two-way radio communications solution.

1.3 PM1200 Control Head Descriptions

The control head used with the PM1200 radio has microprocessor circuitry that operates the standard and optional features built into the system.

The following illustration shows a typical PM1200 control head.

1.3.1 PM1200 Control Head



1.3.2 PM1200 Controls

- **Power Button** — Turns the transceiver ON and OFF.
- **TX Indicato**r — This lamp glows red when the radio is transmitting.
- **Busy Indicator** — This lamp glows green when the channel is busy.
- **DSC Indicator** — This lamp blinks orange when the position of Volume Selector Knob and/or Channel Selector Knob differs the pre-set position.
- **Channel Group Keys** — Changes the current channel group.
- **Telco Connector** — Connects the microphone to the control head.
- **Volume Selector Knob** — Changes the audio volume.
- **Channel Selector Knob** — Changes the operating channel.
- **Emergency Microphone** — When the emergency feature is activated, this microphone is enabled.
- **Programmable Function Button (PF button)** — Field-programmable buttons.

Chapter 2 Basic Maintenance

2.1 Introduction

This section of the manual describes preventive maintenance, handling precautions, and some basic repair procedures and techniques. Each of these topics provides information vital to the successful operation and maintenance of your radio.

2.2 Preventive Maintenance

Radios are shipped from the factory with a worst-case frequency error of:

- ±10 ppm for Low Band (A) 29.7 – 37 MHz
- ±10 ppm for Low Band (B) 37 – 50 MHz

For radios that have been in storage for over six months from the factory ship date, the reference oscillator should be checked when the radio is initially deployed to the field. It is strongly recommended that the reference oscillator be checked every time the radio is serviced or at least once a year, whichever comes first. The crystal contained in the reference oscillator naturally drifts over time due to its aging characteristic. Periodic (annual) adjustment of the reference oscillator is important for proper radio operation. Improper adjustment can result in both poor performance and interference with other users operating on adjacent channels.

2.2.1 Inspection

Check that the external surfaces of the radio are clean, and that all external controls and switches are functional. A detailed inspection of the interior electronic circuitry is not needed.

NOTE: Verify that all dust covers are in place.

2.2.2 Cleaning

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 control head and radio chassis. These surfaces should be cleaned whenever a periodic visual inspection reveals the presence of smudges, grease, and/or grime. Internal surfaces should be cleaned only when the radio is disassembled for servicing or repair.

Caution The effects of certain chemicals and their vapors can have harmful results on certain plastics. Aerosol sprays, tuner cleaners, and other chemicals should be avoided.

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 (100% by volume).

2.2.2.1 Cleaning External Plastic Surfaces

The detergent-water solution should be applied sparingly with a stiff, non-metallic, short-bristled brush to work all loose dirt away from the radio. A soft, absorbent, lint-free cloth or tissue should be used to remove the solution and dry the radio. Make sure that no water remains entrapped near the connectors, cracks, or crevices.

2.2.2.2 Cleaning Internal Circuit Boards and Components

Isopropyl alcohol 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. Be careful not to break off electrical components.

Alcohol is a high-wetting liquid and can carry contamination into unwanted places if an excessive quantity is used. Make sure that controls or tunable components are not soaked with the liquid. Do not use high-pressure air to hasten the drying process, since this could cause the liquid to puddle and collect in unwanted places.

Upon completion of the cleaning process, use a soft, absorbent, lint-free cloth to dry the area. Do not brush or apply any isopropyl alcohol to any plastic parts.

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

2.2.3 General Radio Care and Handling Precautions

- Avoid physical abuse: do not pound, drop, or throw the radio. Exposed parts, such as controls and connectors, might be damaged.
- Operating the radio without an antenna cable attached may lead to radio failure and may void the warranty.

2.2.4 RF Power Amplifier (RF PA) Heatsinking

Never transmit unless the printed-circuit board (PCB) DC and RF connector clips and internal screws are installed in the chassis. Doing so can result in immediate failure of RF PA devices or greatly reduced RF PA device life. It is possible to transmit with the chassis eliminator for short periods if used properly.

2.3 Handling Precautions

Complementary metal-oxide semiconductor (CMOS) devices, and other high-technology devices, are used in this family of radios. While the attributes of these devices are many, their characteristics make them susceptible to damage by electrostatic discharge (ESD) 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 this radio, and are especially important in low-humidity conditions. DO NOT attempt to disassemble the radio without observing the following handling precautions:

- Eliminate static generators (plastics, styrofoam, etc.) in the work area.
- Remove nylon or double-knit polyester jackets, roll up long sleeves, and remove or tie back loose-hanging neckties.
- Store and transport all static-sensitive devices in ESD-protective containers.
- Disconnect all power from the unit before ESD-sensitive components are removed or inserted unless otherwise noted.

- Use a static-safeguarded workstation, through the use of a wrist strap, two ground cords, a static-control table mat and a static-control floor mat.

  NOTE: Be sure that the table and floor mats are properly grounded.

When these items are not readily available, observing the following techniques will minimize the chance of damage:

- If a static-sensitive device is to be temporarily set down, use a conductive surface for placement of the device.
- Make skin contact with a conductive work surface first and maintain this contact when the device is set down or picked up.
- Always wear a conductive wrist strap when servicing this equipment. The Motorola part number for a replacement wrist strap that connects to the table mat is 4280385A59.

Notes

Chapter 3 Basic Theory of Operation

3.1 Introduction

The PM1200 radio combines the controller and RF sections into a single board and contains the following modules:

- Daughtercard
- RX VCO module
- TX VCO module

It is important to correctly identify the malfunctioning region before replacing expensive modules. To assist with radio repair, descriptions of the sections contained on the PM1200 uniboard are listed below.

3.2 General Overview

The PM1200 radios are wideband, synthesized, fixed-tuned radios and are available with the following frequency bands:

- VHF Low-Band A (29.7 – 37.0 MHz)
- VHF Low-Band B (37.0 – 50.0 MHz)

The PM1200 radios contain the following assemblies and sections:

- Control Head Assembly — The control head assembly contains the DISPLAY-UNIT, KEY-UNT, VR-UNIT, and PANEL-INTERFACE-UNIT to communicate with the RF deck.

  For the remote mount configuration, the control head assembly is attached to the RF-INTERFACE -UNIT via a flex. Each unit is used to communicate with the RF deck.
- RF-INTERFACE-UNIT (Remote mount only) — Provides interface to remote control head assembly. Connects to the RF deck via a flex.
- Power Amplifier (PA) section — contains the antenna switch, directional coupler/ detector, and amplifier(s).
- Front-End Receiver section — contains the preselector, low-noise amplifier (LNA), and mixer.
- IF section — contains the receiver intermediate-frequency (IF) amplifier/filter and the digital receiver back-end integrated circuit (IC).
- Frequency Generation section — contains the synthesizer, voltage-controlled oscillators (VCOs), reference oscillator, and receive and transmit buffers.
- Controller section — contains the following elements:
  - Voltage regulators and data communication circuitry (Accessory Port)
  - Daughter card module (MDC-1200, Quik-Call II Decoder)
  - Modulation D/A conversion circuitry
  - CODEC audio circuitry
  - TX power-control circuitry
  - Emergency circuitry
  - Accessory Interface Boards (Connector-Unit)
  - DC power-in plug

3.3 Controller Section

3.3.1 Introduction

The PM1200 transceiver is primarily a dwi-board design, RF sections and power amplifier sections. The controller section will be discussed here in basic terms, to assist in the overall understanding of what is contained in the controller section, and a simplified purpose of its elemental parts. Some limited warnings and recommendations are offered to prevent common repair-induced damage.

The controller section is divided into two parts:

- Control head (the "Panel Interface Unit" and the "Display Unit ").
- RF Deck.

NOTE: A control head is necessary for the function of the radio, and controller section is critical for the RF sections to function. This is an important point since repairs and troubleshooting of the RF sections usually require that the controller section be operating correctly.

3.3.2 Surrounding Controller Region

3.3.2.1 Introduction

The surrounding controller region contains the regulated power, audio and data translation hardware.

This hardware allows a computer to program the radio's features, maintain an active control of the RF sections, and make necessary mode and audio adjustments as related to feedback from a control head device.

3.3.2.2 Voltage Regulation

The uniboard contains the following voltage regulators: 9 V, 5 V and 13.6V.

The radio's A+ supply is regulated down to additional supplies for various blocks (frequency generation unit (FGU), receiver, transmitter power amplifier, and controller). Specifically, A+ is used to regulate three separate 9-volt supplies: one for the FGU and receiver circuitry, one for the transmitter power amplifier circuitry, and one for the controller sections.

3.3.2.3 Emergency

Circuitry exists to support emergency footswitch operation. If the proper features are enabled in the codeplug using the customer programming software (CPS), then depressing the emergency footswitch will enables alert dispatch. A button on the control head can also be programmed using CPS to activate emergency when the radio is on. The emergency button on the control head will not turn the radio on.

NOTE: This feature is either visual or can be set to covert, and is programmable through the CPS. This functionality is dependent on the CPS version and customer demand for feature availability.

3.4 Control Head Assembly

3.4.1 Controller

The controller consists of three main components, namely the OMAP Applications Processor, Flash and SDRAM. The OMAP Applications Processor is the main controller of the control head. Its main function is to receive inputs from the user and relays the command to the transceiver microprocessor for processing via Serial Synchronous Interface (SSI) link. The Applications Processor will relay back any information from the transceiver microprocessor to the user through the Liquid Crystal Display (LCD). The control head is equipped with an 8MB SDRAM and a 8MB Flash memory for storing and executing commands.

3.4.2 Power Management (Power Control Microcontroller and Voltage Regulators)

3.4.2.1 Voltage Regulators

The control head utilizes seven different voltage levels to operate correctly, namely 13.4V and 5V. There are a total of three main regulator ICs to provide the needed voltages.

3.4.3 User Interface (Keypad, STN Display, Volume Selector Knob, Microphone and Speaker) section

3.4.3.1 Display

The display includes an 8-character alpha-numeric section showing channel and group names, status and identity information, and error messages, seven icons (OPT, Horn Alert, Public Address/Speaker, Selectable Tone, Monitor and Scan).

3.4.3.2 Keypad and Volume Selector Knob

The control head assembly processes all menu button inputs and visual indicators through the application processor. The buttons are programmable to allow different modes of operation through the CPS.

The Volume Selector Knob allows a linear step of the volume and the Power Button integrates the On/Off function.

3.4.3.3 Telco Connector

PM1200 currently supports programming through the Telco Connector as well as operation of the basic palm microphone and keypad microphone.

3.4.3.4 Emergency Microphone

The applications processor operates the emergency microphone if the emergency feature is activated.

3.4.3.5 Internal Speaker

The control head contains a speaker for the receiver audio. The power source supplying to speaker is 8 ohms, 1.5 W. The control head speaker can continue functioning even if an external speaker is connected via the accessory connector.

3.5 Analog Mode of Operation

3.5.1 General

Reception and transmission are switched by “RX” and “TX” lines from the microprocessor unit (MPU). The receiver uses a double-conversion superheterodyne circuitry, with a 17.7 MHz 1st IF and 450 kHz 2nd IF. The 1st LO, which is produced by a PLL synthesizer, yields the 17.7 MHz 1st IF.

The 2nd LO uses a 17.25 MHz (17.7 MHz – 450 kHz) signal generated by a crystal oscillator.

The 2nd mixer and other circuits use a custom IC to convert and amplify the 2nd IF, and detect FM to obtain demodulated signals. During transmitting, the PLL synthesizer oscillates at the desired frequency directly, for amplification to obtain RF power output. Voice modulation and CTCSS (or DCS) modulation are also applied to this synthesizer when the radio is transmitting. Transceiver functions, such as TX/RX control, PLL synthesizer settings, and channel programming, are controlled using the MPU.

3.5.2 Receive Operation

Receiver

Incoming RF signals from the antenna connector are delivered to the PA Unit, and pass through a low-pass filter (LPF) network consisting of coils L6011, L6010, and L6009, capacitors C6047, C6045, C6044, C6075, C6043, C6042 and C6074, and antenna switching relay RL6001 for delivery to the receiver front end in the MAIN Unit.

Signals within the frequency range of the transceiver are then passed through a varactor-tuned band-pass filter consisting of T1001/T1002/T1003 and T1004 before RF amplification by Q1006 (**GN010100R**).

The amplified RF is then band-pass filtered again by varactor-tuned resonators T1001, T1002, T1003 and T1004 to ensure pure in-band input to the 1st mixer 1040 (**SPM5001**).

Buffered output from the VCO Unit is amplified by Q1021 (**2SC5107**) and low-pass filtered by L1030, L1020 and C1161, C1152, C1143 to provide a pure 1st local signal between 54.7 and 67.7 MHz for input to the 1st mixer.

The 17.7 MHz 1st mixer product then passes through dual monolithic crystal filters XF1001 and XF1002 (12 kHz BW), and is amplified by Q1035 (**2SC4215**) and delivered to the input of the FM IF subsystem IC Q1034 (**TA31136FN**). This IC contains the 2nd mixer, 2nd local oscillator, limiter amplifier, FM detector, noise amplifier, and squelch gate.

The 2nd LO in the IF-IC is produced from crystal X1001 (17.25 MHz), and the 1st IF is converted to 450 kHz by the 2nd mixer and stripped of unwanted components by ceramic filter CF1001. After passing through a limiter amplifier, the signal is demodulated by the FM detector.

Demodulated receive audio from the IF-IC is amplified by Q2019 (**CXA1846N**). After volume adjustment by the AF power amplifier Q2018 (**TDA7240AV**), the audio signal is passed to the speaker jack or the internal 4-Ohm loudspeaker.

3.5.3 Transmit Operation

Transmitter

Voice audio from the microphone is delivered via the Mic (Jack) Unit to the MAIN Unit, after passing through amplifier Q3039/Q2108 (**NJM2902V**), pre-emphasis, limiter (IDC instantaneous deviation control), and LPF Q2001 (**NJM2902V**); the signal is adjusted for optimum deviation level and delivered to the next stage.

Voice inputs from the microphone and CTCSS are frequency-modulated to the VCO of the synthesizer, while DCS audio is modulated by the reference frequency oscillator of the synthesizer.

At the output of the synthesizer, the signal passes through diode switch D1022 (1SS321) to obtain the required RF drive prior to delivery to the PA Unit. There the RF signal is amplified by parallel junction transistors Q6006/Q6007 (**SD1405**X2) and passes through antenna switching relay RL6001 and a low-pass filter circuit, and ultimately to the antenna connector.

RF output power from the final amplifier is sampled by a CM coupler and is rectified by D6006/D6007 (**MA729**X2). The resulting DC is fed through Automatic Power Controller Q1038 (**NJM2902V**), Q1001 (**2SC4154E**), Q1004 (**2SB1132Q**) to control the gain of the transmitter RF amplifier and thus regulate the power output.

Generation of spurious products by the transmitter is minimized by the fundamental carrier frequency being equal to the final transmitting frequency, modulated directly in the transmit VCO. Additional harmonic suppression is provided by a low-pass filter consisting of L6009/L6010/L6011 and C6042/C6043/C6044/C6047/C6074/C6075 and C6045, resulting in more than 65 dB of harmonic suppression prior to delivery of the RF energy to the antenna.

3.6 Radio-Frequency Power Amplifier (RF PA) and Output Network (ON)

The RF PA is a three-stage power amplifier consisting of discrete LDMOS transistors:

- Controlled stage
- Driver stage
- Final stage

The RF PA is followed by the ON section, consisting of discrete circuitry with the following functions:

- Antenna switch
- Harmonic filter
- Power detector

3.6.1 Gain Stages

The controlled stage consists of a two-stage, integrated amplifier with external matching, which amplifies the input signal from the VCO buffer and provides drive to the PA-UNIT driver stage.

The next driver stage, Q6004 and Q6005 has a fixed gate bias similar to Q6001. Drain bias is supplied by the +B voltage from the J6002, DC IN terminal.

The driver stage drives the final stage consisting of two transistors (Q6006, Q6007) operating in push-pull. These transistors have separate, fixed base biases (Q6003 2SD882Q), and their drain biases are supplied by the +B voltage from the J6002, DC IN terminal.

The output of the final stage will be routed to the antenna switch, which routes the RF PA to the harmonic filter/power detector/antenna and isolates the RX front-end in transmit mode. Antenna switch routes antenna/power detector/harmonic filter to RX and isolates TX with the RX mode. This mode is determined via J6001 PIN2 TX/RX signal line.

The harmonic filter is a low pass filter that attenuates harmonics generated by the RF PA in transmit mode and provides additional receive selectivity in receive mode.

3.6.2 Circuit Protection

RF PA final-stage drain current, RF PA final-stage temperature, RF PA control voltage, and battery voltage are sensed by the power-control circuitry. If a fault condition is detected, the control voltage is reduced, which cuts back the output power to a level that is safe for the particular conditions.

3.6.3 DC Interconnect

The DC connector (P7001) carries the +B supply for the entire board. This supply is routed directly to the controller and transmitter circuitry for both direct supply and regulating additional supplies. The radio chassis is grounded through the PCB screws and also via direct contact to the board. The dash mount control head receives the +B supply through the 15-pin flex connector.

3.6.4 DCS Demodulator

DCS signals are demodulated on the MAIN-UNIT, and are applied to low-pass filter Q2001 (NJM2902V), as well as the limiter comparator Q2001.

3.6.5 CTCSS encoder/decoder

The CTCSS code is generated and encoded by MPU IC Q2019 (MB90F583B). Demodulation and detection of the CTCSS tones are carried out by IC Q2013 (MX165C).

3.6.6 MPU

Operation is controlled by the 16-bit MPU IC, Q2019 (MB90F583B). The system clock uses a 16.000 MHz crystal as a time base. The IC Q2036 (RN5VL35AA), resets the MPU when the power is on. It also monitors the voltage of the regulated 5 V power supply line.

3.6.7 EEPROM

The EEPROM retains TX and RX data for all memory channels and also CTCSS and DCS data, prescaler dividing, and REF oscillator data (internal/external).

3.7 PLL Synthesizer

The 1st LO maintains stability from the PLL synthesizer by using a 17.25 MHz reference signal from crystal X1001. PLL synthesizer IC Q1029 (SA7025DK) consists of a prescaler, a reference counter, a swallow counter, a programmable counter, a serial data input port to set these counters based on the external data, a phase comparator, and a charge pump. The PLL-IC divides the 17.25 MHz reference signal by 1725 using the reference counter (10.0 kHz comparison frequency). The phase detector comparison frequency to be two times the channel spacing(5 kHz). The VCO output is divided by the prescaler, swallow counter and programmable counter. These two signals are compared by the phase comparator and input to the charge pump. A voltage proportional to their phase difference is delivered to the low-pass filter circuit, then fed back to the VCO as a voltage with phase error, controlling and stabilizing the oscillating frequency. This synthesizer also operates as a modulator during transmit.

The RX-VCO comprises Q1015 (2SK508) and D1017, D1016 (HVU306A x 2). It oscillates between 47.7 and 54.7 MHz according to the programmed receiving frequency. The TX-VCO is comprised of Q1016 (2SC4226), and D1015, D1016, D1013, D1012 (HVU300A x 4). It oscillates between 29.7 and 37.0 MHz (37.0 and 50.0 MHz) according to the programmed transmit frequency. The VCO output passes through a buffer amplifier Q1021 (2SC5107), and a portion is fed to the buffer amplifier Q1023 (2SC4215) of the PLL IC, and at the same time amplified by Q1027 (2SC5415) to obtain stable output. The VCO DC supply is regulated by Q1007 (2SC4154E). Synthesizer output is fed to the 1st mixer by diode switch D1022 (1SS321) during receiving and transmitting. The reference oscillator feeds the PLL synthesizer, which is composed of crystal X1001 (17.2500 MHz), the temperature compensation circuit (D1028 (MC2850) and thermostats TH1002 and TH1001), and transmit (DCS) modulation circuit D1029, D1025 (HVU300A x 2) and D1026 (HVU306A).

Notes

Chapter 4 Test Equipment, Service Aids, and Tools

4.1 Recommended Test Equipment

The list of equipment contained in Table 4-1 includes most of the standard test equipment required for servicing Motorola mobile radios, as well as several unique items designed specifically for servicing this family of radios. The *Characteristics* column is included so that equivalent equipment can be substituted; however, when no information is provided in this column, the specific Motorola model listed is either a unique item or no substitution is recommended.

Table 4-1. Recommended Motorola Test Equipment

Motorola Model Number	Description	Characteristics	Application
R-1611	Dual-Channel 100 MHz Oscilloscope (Agilent)	Two-channel, 100MHz bandwidth, 200 Msample rate/ sec., 2MB memory/channel	Waveform measurements
R-2670 (with options, as applicable)	System Analyzer	This item will substitute for items with an asterisk (*).	Frequency/deviation meter and signal generator for wide-range troubleshooting and alignment

Table 4-2 contains a listing of non-Motorola test equipment recommended for servicing mobile radios.

Table 4-2. Recommended Non-Motorola Test Equipment

Model Number	Description	Application
Hewlett Packard 6033	Power Supply (0–20 V, 0–30 A)	Mobile radio power supply
Agilent 8901	Modulation Analyzer	Frequency, reference oscillator deviation and compensation measurements
Agilent 8903	Audio Analyzer	Audio signal-level, SINAD, and distortion measurements
Agilent 34401	Digital Multimeter	AC/DC voltage measurement
Agilent DS06052A	500 MHz Oscilloscope	Waveform measurements
HP E4430	Digital I/Q Modulation Signal Source	Signal source for transmit and receive digital tests
Weinschel 49 30 43	30 dB RF Attenuator	For tests that require a modulation analyzer or wattmeter

4.2 Service Aids and Recommended Tools

Refer to the tables in this section for a listing and description of the service aids and tools designed specifically for servicing this family of radios, as well as the more common tools required to disassemble and properly maintain the radio. These kits and/or parts are available from the Motorola parts division offices listed in Appendix A. Replacement Parts Ordering.

Table 4-3. Service Aids for PM1200 Board-Level Troubleshooting

Motorola Part Number	Description	Application
RVN5165_	Professional Series Customer Programming Software	Programming and radio alignment software on CD
AARKN4081_	Telco Programming Cable	Used for programming PM1200 High Power through control head.

Table 4-4. Recommended Motorola Tools for Board-Level Troubleshooting

Motorola Part Number	Tools and Supplies
0180386A82	Anti-static grounding kit
8180384S04	Chassis eliminator (High Power)
1185984D01	Electromagnetic Interference (EMI) metallic shielding tape, or equivalent
0180320B16	Magnetic screwdriver set with bits
3085651A01	Mini-UHF to N-type adapter cable
6686119B01	Plastic scraping tool
6680163F01	Removal and insertion tool
RSX4043	Roto-Torq adjustable torque driver
6671833M01	Special nut driver

Table 4-5. Recommended Non-Motorola Tools for Board-Level Troubleshooting

Part Number	Tools and Supplies
–	7 mm hex-key bit
–	CR-V PH1 screwdriver
–	CR-V PH2 screwdriver
MA-800G	Solder aid, (black stick), Hexacon Electric Co.

4.3 Field Programming Equipment

The PM1200 mobile radios can be aligned and programmed in the field. This requires specific equipment and special instructions. Refer to the online help in Customer Programming Software.

4.3.1 PM1200 Field Programming

The PM1200 radios use a flash-memory device to store information about frequencies, squelch codes, signaling codes, time-out timer durations, and other parameters.

The PM1200 radios can be programmed in the field any number of times without removing the flash memory from the radio.

To program the radio, connect Telco CPS Programming cable AARKN4081_ to the Telco connector. Refer to the *CPS Installation Guide* for installation and setup procedures for the software.

4.3.1.1 Field-Programming Items

Once the computer is connected to the radio, the prompts provided by the programming software can be followed. The following items, available through the Radio Products Services Division (except the computer), are required when programming PM1200 radios.

Table 4-6. PM1200 Radio Field-Programming Items

Type or Part Number	Description
Programming Cable	Used to connect radio directly to the computer, Table 4-3.
Computer, IBM or IBM PC-compatible	–
Customer Programming Software and Tuner Software	This software enables you to program the radio's features and align its parameters.

Notes

Chapter 5 Radio Alignment and Programming Procedures

5.1 Introduction of Radio Alignment Procedures

The PM1200 has been carefully aligned at the factory for the specified performance across the frequency range specified for each version.

Realignment should therefore not be necessary except in the event of a component failure, or alteration of version. All component replacement and service should be performed only by an authorized Motorola representative, or the warranty policy may be voided.

The following procedures cover the sometimes critical and tedious adjustments that are not normally required once the transceiver has left the factory. However, if damage occurs and some parts are replaced, realignment may be required. If a sudden problem occurs during normal operation, it is likely due to component failure; realignment should not be done until after the faulty component has been replaced.

We recommend that servicing be performed only by authorized Motorola service technicians who are experienced with the circuitry and fully equipped for repair and alignment. Therefore, if a fault is suspected, contact the dealer from whom the transceiver was purchased for instructions regarding repair. Authorized Motorola service technicians realign all circuits and make complete performance checks to ensure compliance with factory specifications after replacing any faulty components. Those who do undertake any of the following alignments are cautioned to proceed at their own risk. Problems caused by unauthorized attempts at realignment are not covered by the warranty policy. Also, Motorola must reserve the right to change circuits and alignment procedures in the interest of improved performance, without notifying owners. Under no circumstances should any alignment be attempted unless the normal function and operation of the transceiver are clearly understood, the cause of the malfunction has been clearly pinpointed and any faulty components replaced, and the need for realignment determined to be absolutely necessary. The following test equipment (and thorough familiarity with its correct use) is necessary for complete realignment. Correction of problems caused by misalignment resulting from use of improper test equipment is not covered under the warranty policy. While most steps do not require all of the equipment listed, the interactions of some adjustments may require that more complex adjustments be performed afterwards. Do not attempt to perform only a single step unless it is clearly isolated electrically from all other steps. Have all test equipment ready before beginning, and follow all of the steps in a section in the order presented.

5.2 Required Test Equipment

RF signal generator: calibrated output level at 100 MHz (0 dBμ =1.0 μV - terminated circuit)

- Signal Generator (HP 8657A)
- Modulation Analyzer (HP 8901B)
- Audio Analyzer (8903B)
- Flash ROM Adapter (HKLN4376_)
- Radio Alignment Programming Cable (HKLN 4379_)
- Regulated DC Power Supply: adjustable from 10 to 17 VDC, 30 A
- AF Dummy Load: 4Ω, 20 W (Test Box)
- IBM PC/compatible computer with AARKN4081_ programming cable.
- -30 dB Attenuation Pad (Aeroflex/Weinschel 49-30-34-LIM)

5.3 Alignment Preparation & Precautions

A dummy load and wattmeter must be connected to the main antenna jack in all procedures that call for transmission, except where specified otherwise. Correct alignment is not possible with an antenna. After completing one step, read the following step to determine whether the same test equipment will be required. If not, remove the test equipment (except dummy load and wattmeter, if connected) before proceeding.

Correct alignment requires that the ambient temperature be the same as that of the transceiver and test equipment, and that this temperature be held constant between 20 and 30 °C (68 to 86 °F). When the transceiver is brought into the shop from hot or cold air it should be allowed some time for thermal equalization with the environment before alignment. If possible, alignments should be made with oscillator shields and circuit boards firmly affixed in place. Also, the test equipment must be thoroughly warmed up before beginning.

Before beginning, connect the transceiver and PC using the AARKN4081_ programming cable as described in the EEPROM Programming chapter, and download the EEPROM data from the transceiver to the computer.

Store this data in a disk file so that it can be saved and retrieved later. Using the table below, program the channel, CTCSS, and DCS alignment settings for your transceiver version. Upload this file to the transceiver.

NOTE: Signal levels in dB referred to in this procedure are based on 0 dBμ = 0.5 μV (terminated circuit).

Caution

Do not connect this line to ground, and be certain that the speaker has adequate capability to handle the audio output from the radio.

Because of the bridge audio amplifier circuit used in the radio, it is necessary to construct and use a simple audio load test adapter as shown in the schematic diagram above, when conducting receiver alignment steps.

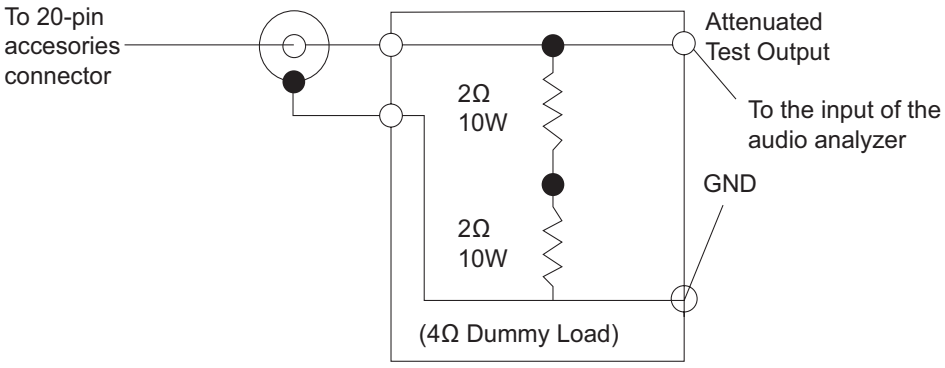


Figure 5-1. AF Test Adapter Schematics

5.4 Alignment

Table 5-1. Alignment Channel Frequencies

Channel	Frequency (MHz) (Simplex)	CTCSS Encode	DCS Encode
CH1	29.71/ 37.01	None	None
CH2	33.35/ 43.01	None	None
CH3	36.99/ 49.99	None	None
CH4	33.35/ 43.01	151.4 Hz	None
CH5	33.35/ 43.01	None	023

5.4.1 PLL & Transmitter

- Set up the test equipment as shown on Figure 5-2 on page 5-5 for transmitter alignment.
- Maintain the supply voltage at 13.4 V DC for all steps.

5.4.2 PLL VCV

1. Connect the positive lead of the DC voltmeter to the test point TP1010 (VCV) on the Main Unit, and the negative lead to chassis ground.
2. Set the transceiver to the high band edge frequency channel, then adjust trimmer-capacitor T1005 on the Unit for 7.0 V on the voltmeter.
3. Key the transmitter, and adjust trimmer-capacitor T1006 on the Unit for 7.0 V on the voltmeter.
4. Next select to the low edge frequency channel and confirm about 1.8 V (1.5 V to 2.1 V) on the voltmeter.
5. Key the transmitter, and confirm about 1.8 V (1.5 V to 2.1 V) on the voltmeter.

5.4.3 PLL Reference Frequency

With the wattmeter, dummy load and frequency counter connected to the antenna jack, and select band center frequency channel, key the transmitter and adjust TC1001 on the Main Unit, if necessary, so the counter frequency is within ±100 Hz of the channel center frequency for the transceiver version.

5.4.4 Transmitter Output Power LVHF

1. Select band center frequency channel, and select high power output level.
2. Key the transmitter and adjust by control commands for high power from the computer for 120 ± 2 Watts as indicated on the wattmeter.
3. Select band center frequency channel, and select low power output level.
4. Key the transmitter and adjust by control commands for low power from the computer for 50 ± 1 Watts as indicated on the wattmeter.

5.4.5 Transmitter Deviation

5.4.5.1 Microphone Audio Modulation Level

1. Select band center frequency channel, and adjust the AF generator for 25 mV (-30 dBm) output at 1 kHz to the microphone jack.
2. Key the transmitter and adjust by control commands for maximum deviation from the computer for 4.2 kHz ± 0.1 kHz deviation as indicated on the deviation meter.

5.4.5.2 CTCSS Modulation Level

1. Select band center frequency channel, with 151.4 Hz CTCSS encode, and reduce the AF generator injection to zero.
2. Key the transmitter and adjust by control commands for CTCSS deviation from the computer for 0.7 kHz ± 0.05 kHz deviation as indicated on the deviation meter.

5.4.5.3 DCS Modulation Level

1. Select band center frequency channel, with DCS 023 enabled, reduce the AF generator injection to zero.
2. Key the transmitter and adjust by control commands for DCS deviation from the computer for 0.7 KHz ± 0.05 KHz deviation as indicated on the deviation meter.

5.4.6 Receiver

Set up the test equipment as shown for receiver alignment, and construct the audio test adapter as described:

1. With the transceiver set to band center frequency channel, and the RF signal generator tuned to the same frequency, set the generator for ± 3.0 kHz deviation with 1 kHz tone modulation, and set the output level for 1 μV at the antenna jack.
2. Adjust by control commands for tune from the computer for optimum SINAD, reducing signal generator output level as necessary for proper meter deflection.
3. After the previous step, final signal generator level should be less than 0.25 μV for 12dB SINAD.

5.4.6.1 Squelch Threshold

1. Select band center frequency channel, and the RF signal generator turned to the same frequency, set the generator for ± 3.0 kHz deviation with 1 kHz tone modulation, and set the output level for -8 dBμ at the antenna jack.
2. Adjust the squelch threshold level by control commands for squelch threshold from the computer so that it just closes (BUSY LED turns off).

5.5 PM1200 Radio Alignment Software

A personal computer (PC) and Radio Alignment Software are required to align the radio.

5.5.1 Installing the Radio Alignment Software

To install the Radio Alignment Software on your computer:

1. Left-click **Alignment Tool.msi** twice.
2. Follow the instructions given by the installation Wizard.

5.5.2 Equipment Setup and Radio Alignment Software Execution

1. To perform the alignment procedures, the radio must be connected to the computer and the test equipment set as shown in Figure 5-2.

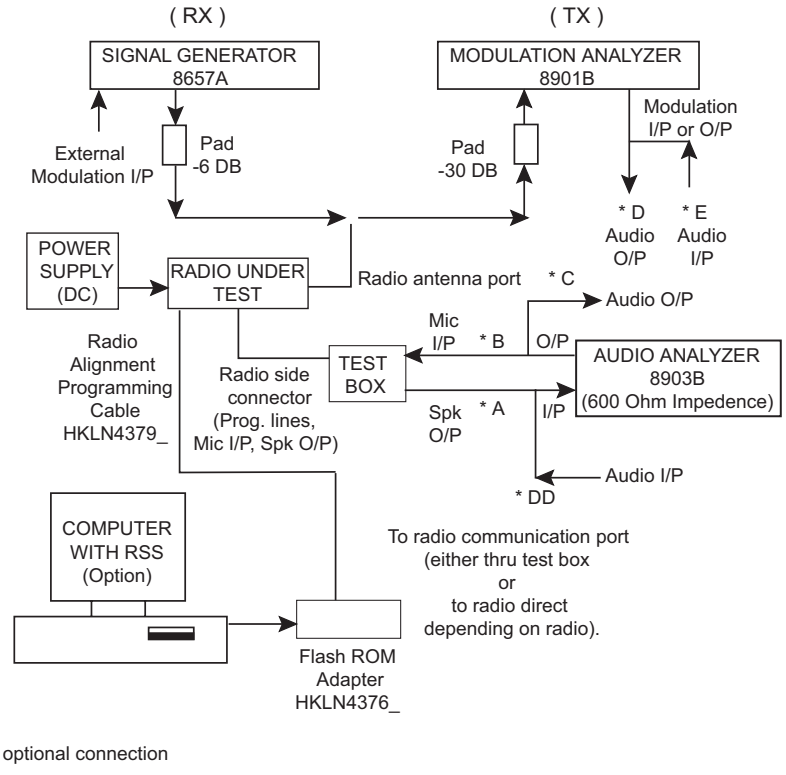


Figure 5-2. Radio RF Test Equipment Setup

2. Turn off the radio.
3. Click the **Start**. button.
4. Select **Program** → **Motorola** → **PM1200 Tools** → **Radio Alignment Software**.

5. Left-click the **Auto ADJ mode** button. The "Power On Start" screen appears.

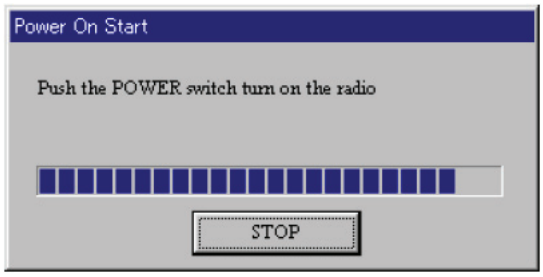


Figure 5-3. Power On Start Screen

6. Within 20 seconds after clicking the **Auto ADJ mode** button, press the **Power** button to turn the radio on. The "Adjustment data setting" screen appears, displaying the current alignment data from the radio..

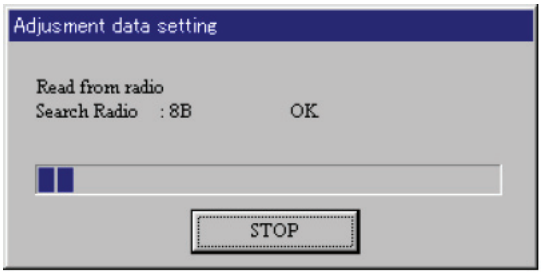


Figure 5-4. Adjustment Data Screen

5.5.3 RX Tune Alignment

1. Left-click the **Rx Tune** tab to align the Rx Tune Circuit.
2. Inject an on channel signal to the radio at -47 dBm with ±3.0 kHz deviation of a 1 kHz audio tone to verify the radio is receiving the desired frequency.
3. Adjust to the rated audio by rotating the Volume Knob to 6.32 V.
4. Reduce the RF Signal Generator output to the Center frequency of the operating band, to a level around -119 dBm in order to get 12dB SINAD.
5. Left-click and hold the mouse button to adjust the coarse receiver SINAD by sliding the Adjust Value slide bar upward or downward. Reduce the Signal Generator output level as necessary for proper SINAD meter deflection.

6. Repeat the same procedure to fine tune the Rx Tune Alignment on each operating frequency programmed for the radio, using the Frequency offset slide bars associated with the various channels.

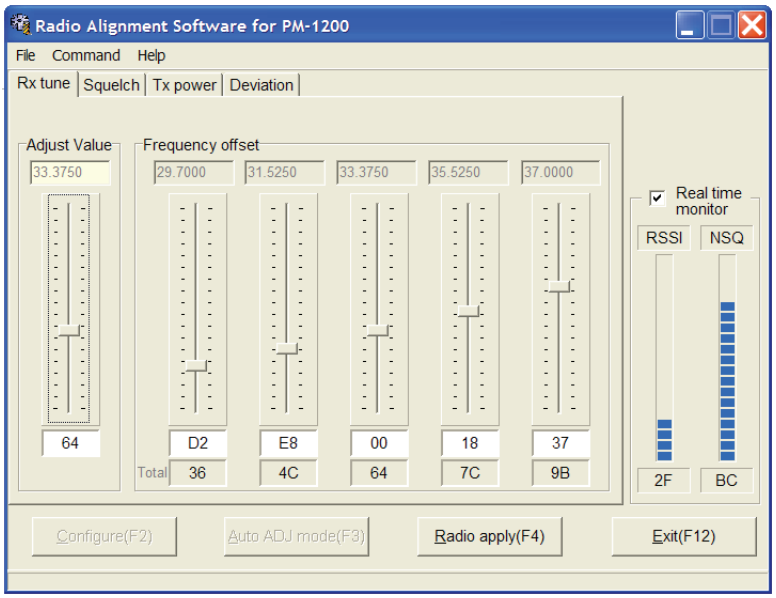


Figure 5-5. RX Tune Alignment Screen

5.5.4 SQL Alignment

5.5.4.1 SQL Threshold Alignment

1. Left-click the **Squelch** tab to align the Squelch Circuit.
2. Left-click **SQL Threshold** to align the Squelch Threshold Level.
3. Toggle the Programmable SQL Function Button and rotate the Channel Knob to SQL 1.
4. Inject an on channel signal to the radio at -47 dBm with ±3.0 kHz deviation of a 1 kHz audio tone to verify the radio is receiving the desired frequency.
5. Adjust to the rated audio by rotating the Volume Knob to 6.32 V.
6. Set the RF Signal Generator output to the Center frequency of the operating band, at a level of -123 dBm signal with ±3.0 kHz deviation of a 1 kHz audio tone.
7. Adjust the RF signal until the radio is totally muted.

8. Left-click **Reflect** to record the Squelch Threshold data.

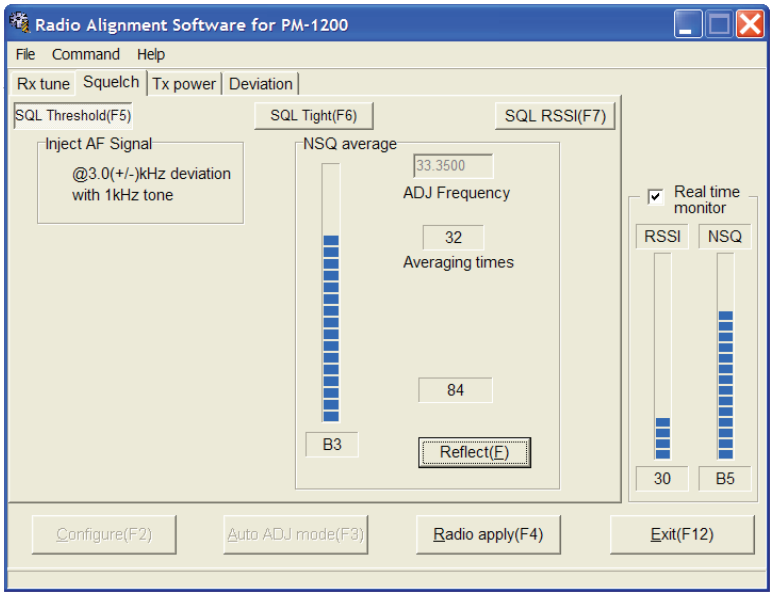


Figure 5-6. SQL Alignment Screen

5.5.4.2 SQL Tight Alignment

1. Left-click **SQL Tight** to align the Squelch Tight Level.
2. Toggle the Programmable SQL Function Button and rotate the Channel Knob to SQL 12.
3. Inject an on channel signal to the radio at -47 dBm with ±3.0 kHz deviation of a 1 kHz audio tone to verify the radio is receiving the desired frequency.
4. Adjust to the rated audio by rotating the Volume Knob to 6.32 V.
5. Set the RF Signal Generator output to the Center frequency of the Operating Band, at a level of -115 dBm signal with ±3.0 kHz deviation of a 1 kHz audio tone.
6. Adjust the RF signal until the radio is totally muted.
7. Left-click **Reflect** to record the Squelch Tight data.

5.5.4.3 SQL RSSI Alignment

1. Left-click **SQL RSSI** to align the Squelch RSSI Level.
2. Inject an on channel signal to the radio at -47 dBm with ±3.0 kHz deviation of a 1 kHz audio tone to verify the radio is receiving the desired frequency.
3. Adjust to the rated audio by rotating the Volume Knob to 6.32V.
4. Set the RF Signal Generator output to the Center frequency of the Operating Band, at a level of -113 dBm signal with ±3.0 kHz deviation of a 1 kHz audio tone.
5. Left-click **Reflect** to record the Squelch RSSI data.

Caution

RSSI levels are Factory tuned. Unless there is a need for re-tuning - such as board replacement, repair, or loss of tuning information - these values should NOT be changed. Tuning to levels other than those defined degrades RSSI - roaming performances.

5.5.5 TX Power Alignment

1. Left-click the **Tx Power** tab to align the Transmitter Power Output.
2. Left-click the **Hi Power**, then left-click **PTT On** to trigger the radio to transmit.
3. Left-click and hold the mouse button to adjust the coarse Transmit Output Power by sliding the Adjust Value slide bar upward or downward.
4. Repeat the same procedure to fine adjust the Transmit Output Power on each of the programmed operating frequencies, using the Frequency offset slide bars associated with the various channel frequencies.
5. Left-click **Low Power** then repeat steps 3 and 4 for the Low Power mode.

Table 5-2. Transmit Output Power

Band	VHF Low
High Power	120 W ± 3 W
Low Power	50 W ± 2 W

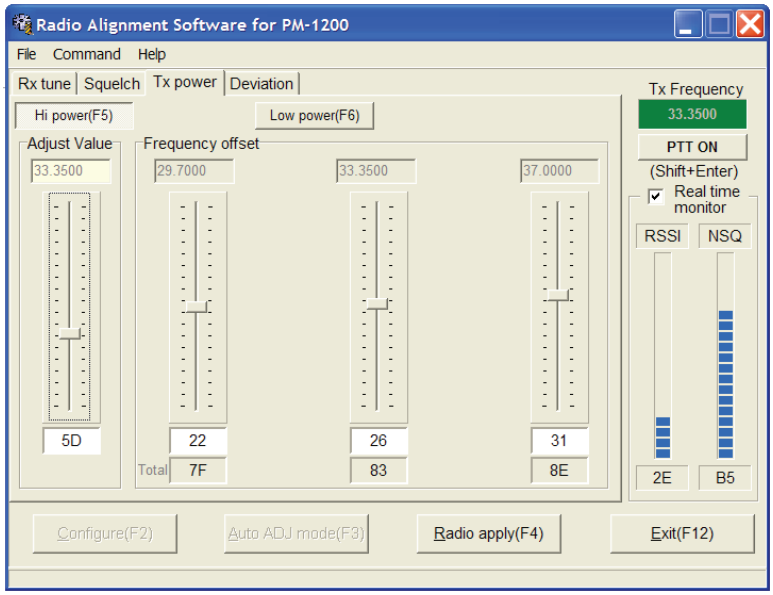


Figure 5-7. TX Power Alignment Screen

5.5.6 TX Deviation Alignment

5.5.6.1 Maximum Deviation

1. Left-click the **Deviation tab** to align the Transmitter Deviation.
2. Left-click **Max Dev**.
3. Inject a 1000 mV, 1 kHz tone signal to the MIC jack, then left-click **PTT On** to engage the transmitter.
4. Left-click and hold the mouse button to adjust the coarse Maximum Deviation ±4.1 kHz (±0.1 kHz)] by sliding the Adjust Value slide bar upward or downward.

5. Repeat the same procedure to fine adjust the Maximum Deviation [±4.1 kHz (±0.1 kHz)] for each operating frequency, using the Frequency offset slide bars associated with the various channels.

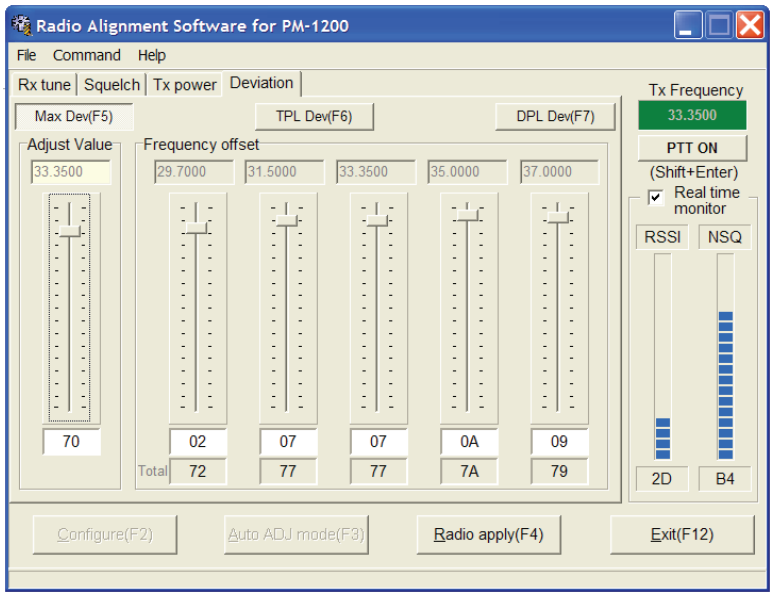


Figure 5-8. Maximum Deviation Screen

5.5.6.2 TPL Deviation

1. Select the band center frequency channel with 151.4Hz TPL encode, and reduce the AF generator injection to zero.
2. Left-click **TPL Dev**.
3. Left-click **PTT On** to engage the transmitter.
4. Adjust the coarse TPL Deviation [±0.75 kHz (±0.03 kHz)] by sliding the Adjust Value slide bar upward or downward while pressing and holding in the left mouse button.
5. Repeat the same procedure to fine adjust the TPL Deviation [±0.75 kHz (±0.03 kHz)] for each operating frequency, using the Frequency offset slide bars associated with the various channels.

5.5.6.3 DPL Deviation

1. Select the band center frequency channel with DPL 023 enabled, and reduce the AF generator injection to zero.
2. Left-click **DPL Dev**.
3. Left-click **PTT On** to engage the transmitter.
4. Adjust the coarse DPL Deviation [±0.65 kHz (±0.05 kHz)] by sliding the Adjust Value slide bar upward or downward while pressing and holding in the left mouse button.
5. Repeat the same procedure to fine adjust the DPL Deviation [±0.65 kHz (±0.05 kHz)] for each operating frequency, using the [Frequency offset] slide bars associated with the various channels.

5.5.7 Writing The Alignment Data to the Radio

1. Left-click **Radio Apply** to write the alignment data into the radio. The Radio Alignment Software writing progress bar is shown in Figure 5-9.

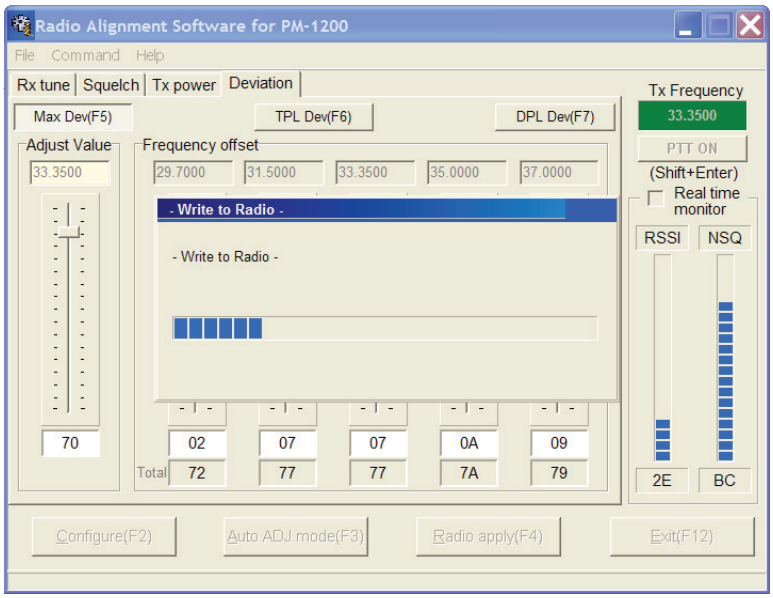


Figure 5-9. Adjustment Data Writing Screen

5.5.8 Exiting the Radio Alignment Software

1. Left-click **Exit** to close the Radio Alignment Software.
2. If the present alignment data has not been written to the radio, the user will be prompted a confirmation window.
3. If the user decides not to write the alignment data to the radio, the original setting data will be written back. The writing progress bar as shown in Figure 5-9 will appear.

> **Caution**
>
> The radio setting will be corrupted if the Radio Alignment Software is closed while the reading or writing process is still in progress.

5.6 Introduction of Programming Procedures

This section provides an overview of the *Customer Programming Software (CPS)* designed for use in Windows 2000/XP environment. Refer to the the *CPS Installation Guide* for the installation and programming procedures of the software.

5.6.1 CPS Programming Setup

Follow the CPS programming setups as shown in Figure 5-10 and Figure 5-11 to program the radio.

NOTE: Refer to the appropriate program on-line help file for detailed programming procedures.

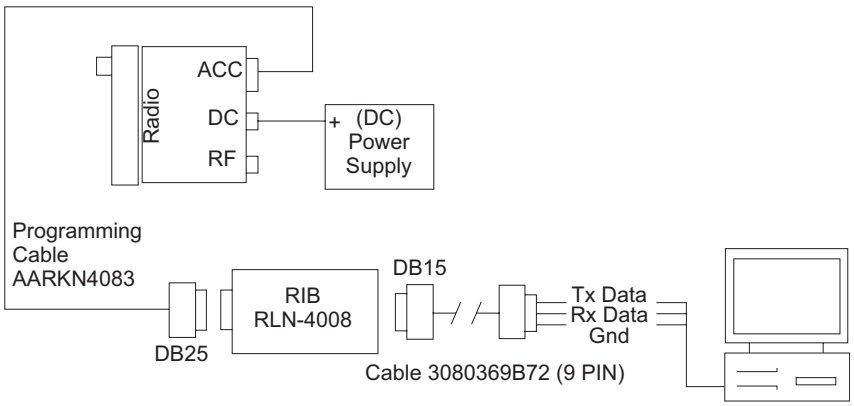


Figure 5-10. CPS Programming Setup with RIB

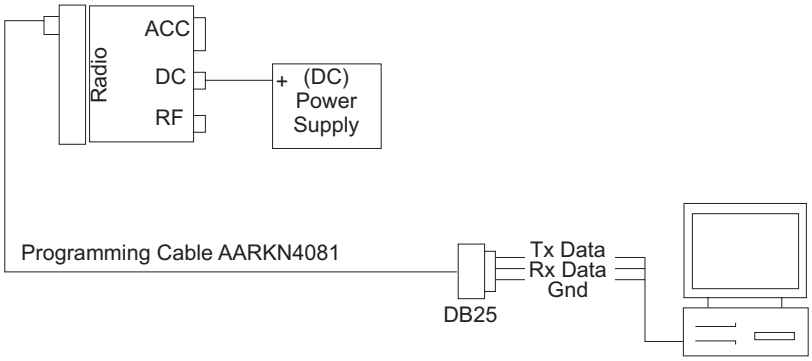


Figure 5-11. CPS Programming Setup Cable with Internal RIB

Chapter 6 Disassembly/Reassembly Procedures

6.1 Introduction

This section details the procedures necessary to remove and replace the printed circuit board in the PM1200 radio. After troubleshooting and determining what needs to be replaced, disconnect the test equipment, the antenna cable, and the power cable.

Disconnect the power cable from the radio before opening and removing the PCB. Failure to remove power can result in unit damage caused by transients or accidental shorts, as well as presenting a shock hazard.

Locate the exploded view of the radio in Chapter 9. Exploded Views and Parts Lists. Keep it handy for reference as you disassemble and reassemble the radio.

When installing a new circuit board, all mounting screws should be started before any are torqued. This will help ensure proper alignment.

After installing a new board, perform a complete alignment procedure as outlined in Chapter 5. Radio Alignment and Programming Procedures.

6.2 Replacement Procedures

After performing alignment procedures, always exit the SERVICE menu entirely (to the MAIN MENU) to properly save all changes. Failure to do so can result in an alignment, or other, failure.

6.2.1 Required Tools and Supplies

Table 6-1. Required Tools and Supplies

Tools and Supplies	Motorola Part Number
Anti-static grounding kit	0180386A82
Chassis eliminator	8180384N71
CR-V PH1 and CR-V PH2 Torq bit	–
CR-V PH1 and CR-V PH2 drivers	–
Dismantling tool	6686119B01
Electromagnetic Interference (EMI) metallic shielding tape, or equivalent	1185984D01
Magnetic screwdriver set with bits	0180320B16
Plastic scraping tool	6686119B01

Table 6-1. Required Tools and Supplies (Continued)

Tools and Supplies	Motorola Part Number
Removal and insertion tool	6680163F01
Roto-Torq adjustable driver	RSX4043
Small, flat-blade screwdriver	–
Solder aid (black stick), Hexacon Electric Co.	MA-800G
Special Nut Driver	6671833M01

6.2.2 Control Head Boards Disassembly/Reassembly

The procedures in this section describe the disassembly and reassembly of each of the control head boards.

6.2.2.1 PM1200 Control Head Disassembly

NOTE: Bracketed numbers are identical to item numbers shown in Figure 9-1. “PM1200 Control Head Exploded View” on page 9-2.

6.2.2.1.1 PM1200 Control Head Back Housing Disassembly

1. Turn off the radio.
2. Lay the control head face down on a clean, flat surface and be careful not to scratch or mar the display.
3. Using a CR-V PH2 screwdriver, remove the 4 binding head screws M4x8 SUS B [34] from the cable strain relief plate [32] as shown in Figure 6-1.

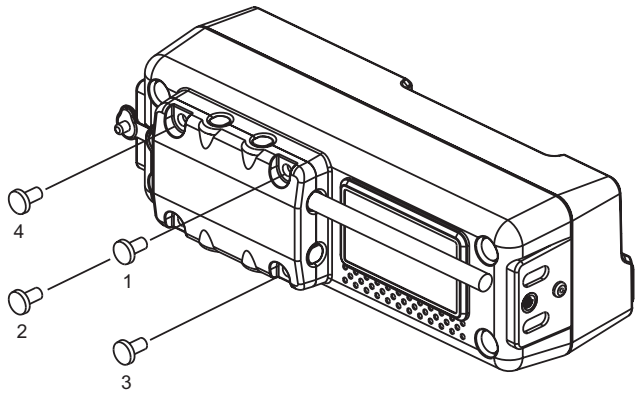


Figure 6-1. Removing Screws from Cable Strain Relief Plate

4. Carefully separate the cable strain relief plate [32] and gasket [31] from the back housing assembly [29].
5. Carefully disconnect the remote radio control cable from the mating connector on the back housing assembly [29] as shown in Figure 6-2.

NOTE: Be careful not to damage the mating connector while unplugging the remote control cable.

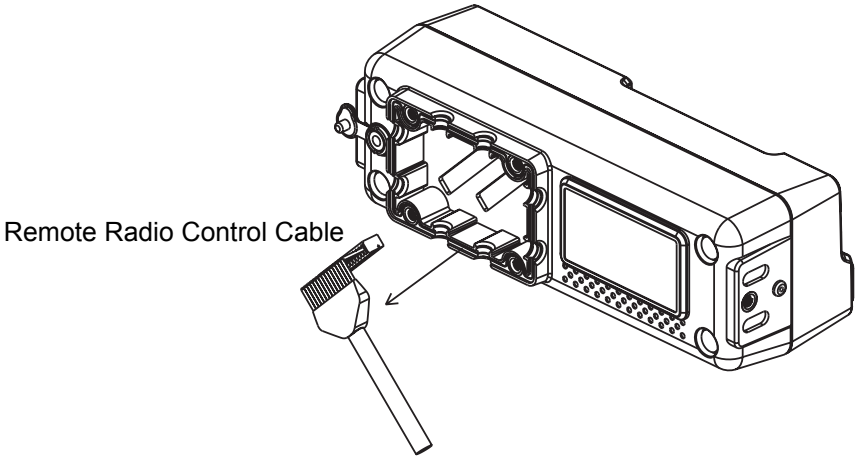


Figure 6-2. Removing Remote Radio Control Cable from Back Housing

6. After unplugging the remote radio control cable connector, use a CR-V PH2 screwdriver to remove the 4 binding head screws M4x8 SUS B [34] with the 4 o-rings [33] from the back housing assembly [29].
7. Using a special nut driver, first remove the special nut [26], then remove the ear cap [30] from the back housing assembly [29] as shown in Figure 6-3.

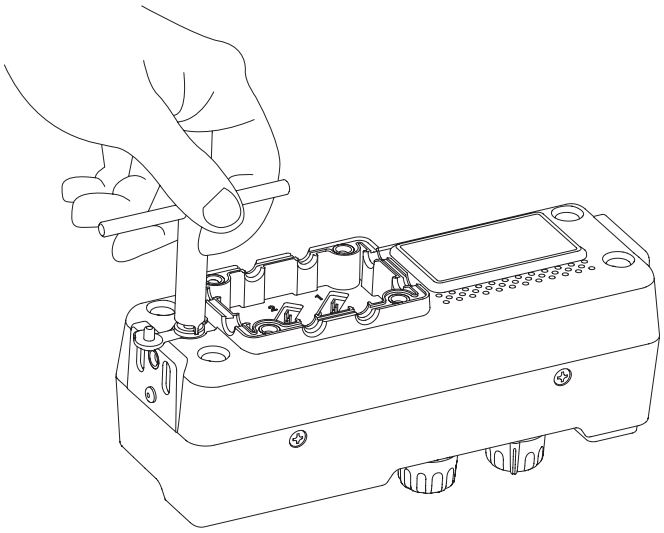


Figure 6-3. Removing Special Nut from Speaker Phone Jack

8. Carefully separate the back housing assembly [29] from the front housing assembly [10].

6.2.2.1.2 PM1200 Control Head Panel-Interface Unit Board Kit Disassembly

1. Carefully separate the foam [27] from the speakerphone jack at the panel-interface unit board kit [25].
2. Using a CR-V PH2 screwdriver, remove the 2 binding head screws M3x8 SUS B [8] from the front housing assembly [10].
3. Lay the bottom side of control head facing upward on a clean, flat surface.
4. Using a CR-V PH2 screwdriver, remove the 2 binding head screws M3x8 SUS B [8] with the 2 o-rings [9] from the front housing assembly [10].
5. Carefully separate the frame [28] from the front housing assembly [10].
6. Carefully disconnect the connection cable from the mating connector on the rear of display unit board kit [22] as shown in Figure 6-4.

NOTE: Be careful not to damage the mating connector while unplugging the connection cable.

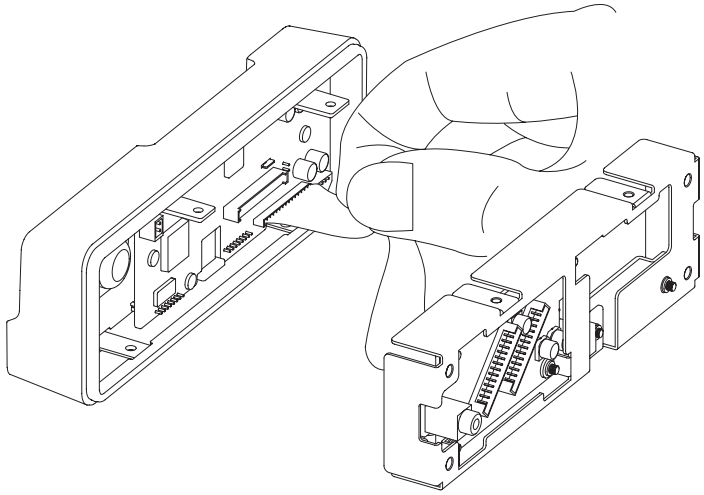


Figure 6-4. Removing Connection Cable (Display Unit Board Connector)

6.2.2.1.3 PM1200 Control Head Display Unit Board Kit Disassembly

1. Carefully separate the rubber packing [11] from the front housing assembly [10].
2. Carefully separate the speaker mating connector from the display unit board kit [22] as shown in Figure 6-5.

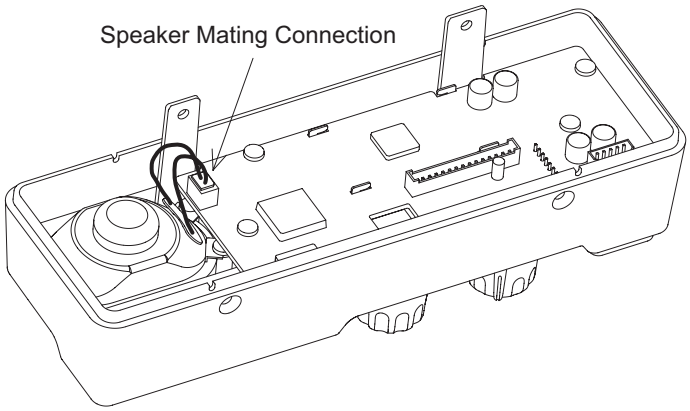


Figure 6-5. Removing Speaker Mating Connector

3. Using a CR-V PH1 screwdriver, remove the 6 taptite screws M2.6x6 [17] from the display unit board kit [22] at the front housing assembly [10].
4. After all the screws have been removed, gently lift up the display unit board kit [22] from the front housing assembly [10].

NOTE: Be careful not to damage the mating connector on the key unit board kit [16] while lifting the control head board.

6.2.2.1.4 PM1200 Control Head VR Unit Board Kit Disassembly

1. Remove the channel group knob [4] and power knob [13].
2. Lay the front side of the front housing assembly [10] facing upward.
3. Pull the volume knob [1] and channel selector knob [2] out of their shafts using the chassis opener as shown in Figure 6-6.

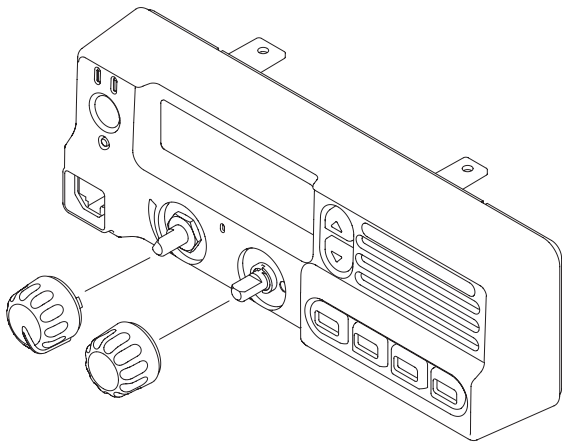


Figure 6-6. Removing Volume Knob and Channel Selector Knob

4. Using a hex nut driver, remove hex nut [19] from front housing assembly [10].
5. Using a special nut driver, remove the special nut [7] from front panel assembly [10] as shown in Figure 6-7.

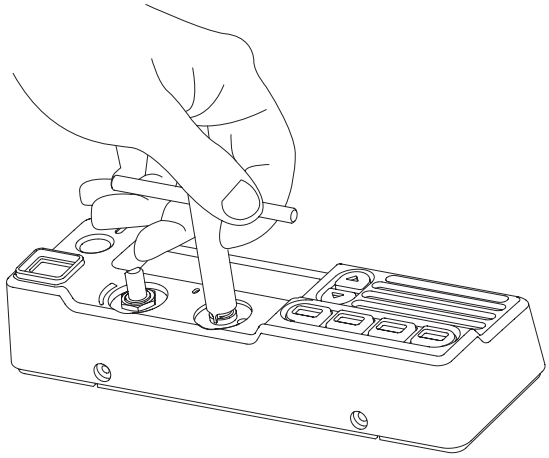


Figure 6-7. Removing Special Nut from Channel Selector Switch

6. Separate the VR unit board kit [18] from front housing assembly [10].

NOTE: Be careful not to damage the mating connector on the key unit board kit [16] while lifting the control head board.

6.2.2.1.5 PM1200 Control Head Key Unit Board Kit Disassembly

1. Lay the rear side of the front housing assembly [10] facing upward.
2. Using a CR-V PH1 screwdriver, remove the 3 taptite screws M2.6x6 [17] from the key unit board kit [16] at the front housing assembly [10].
3. After all the screws have been removed, gently lift up the key unit board kit [16], rubber telco seal [14] and mic holder [15] from the front housing assembly [10].

6.2.2.1.6 PM1200 Control Head Internal Speaker Disassembly

1. Lay the rear side of the front housing assembly [10] facing upward.
2. Using a CR-V PH1 screwdriver, remove the 4 taptite screws M2.6x6 [17] from the internal speaker [20] screws bosses as shown in Figure 6-8.

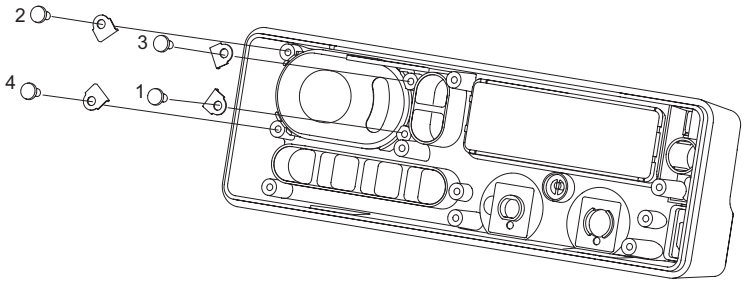


Figure 6-8. Removing the Internal Speaker Screws

3. Carefully remove 4 speaker fittings from internal speaker screws bosses by using long nose pliers as shown in Figure 6-9.

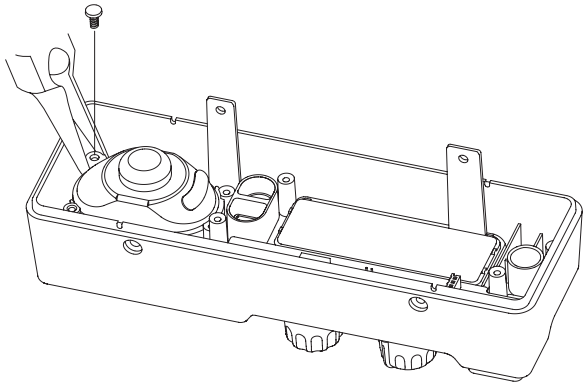


Figure 6-9. Removing the Speaker Fittings from Internal Speaker Bosses

6.2.2.2 PM1200 Control Head Reassembly

6.2.2.2.1 PM1200 Control Head Key Unit Board Kit Reassembly

1. To reassemble, ensure that the functional keypad [12] is fully seated into the front housing.
2. Ensure that the rubber telco seal [14] is properly fitted to the telco connector and the mic holder [15] is also properly fitted to the emergency mic at key unit board kit [16].
3. Place the key unit board kit [16] to the housing by seating the PCB surface to the screw bosses. Ensure that the aligning boss protrudes through the PCB. Refer to Figure 6-10.

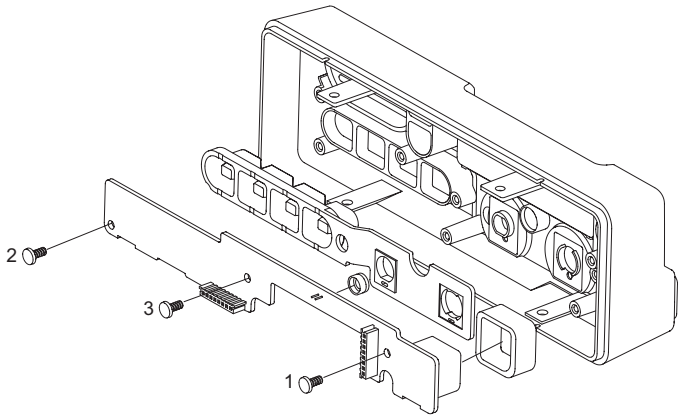


Figure 6-10. Key Unit Board Screws Sequence

4. Using CR-V PH1 torq driver, fasten the 3 taptite head screws M2.6x6 [17] following the sequence as shown in Figure 6-10 (torqued to 3.5–4.6 kgf*cm/ 3–4 in. lbs).

6.2.2.2.2 PM1200 Control Head VR Unit Board Kit Reassembly

1. Lay the front side of the front housing assembly [10] facing upward.

2. Insert the VR unit board kit [18] from the rear side of the front housing assembly [10].
3. Using a hex nut driver, fasten the hex nut [19] to the volume potentiometer at VR unit board kit [18].
4. Using a special nut driver, fasten the special nut [7] to the channel selector switch at VR unit board kit [18] as shown in Figure 6-11 (torqued to 7.5–8.6 kgf*cm/ 6.5–7.5 in. lbs).

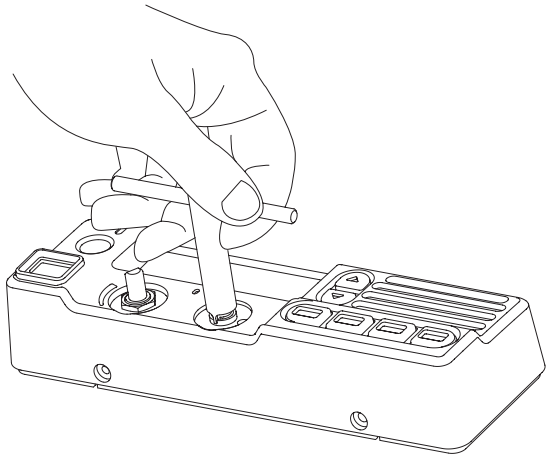


Figure 6-11. Installing Special Nut to Channel Selector Switch

5. Attach the volume knob [1] and channel selector knob [2] as shown in Figure 6-12.

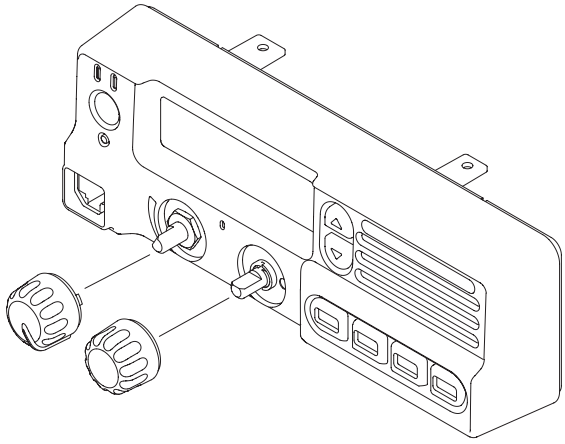


Figure 6-12. Installing Volume Knob and Channel Selector Knob

6.2.2.2.3 PM1200 Internal Speaker Reassembly

1. Lay the rear side of the front housing assembly [10] facing upward.
2. Insert the internal speaker to the front housing assembly as shown in Figure 6-13.

3. With the aid of a pair of long nose pliers, carefully insert each speaker fittings onto the internal speaker [20] screw boss. Next, fasten each taptite head screw M2.6x6 [17] by using a CR-V PH1 torque driver as shown in Figure 6-13. (Torqued to 3.5–4.6 kgf*cm/ 3–4 in.lbs).

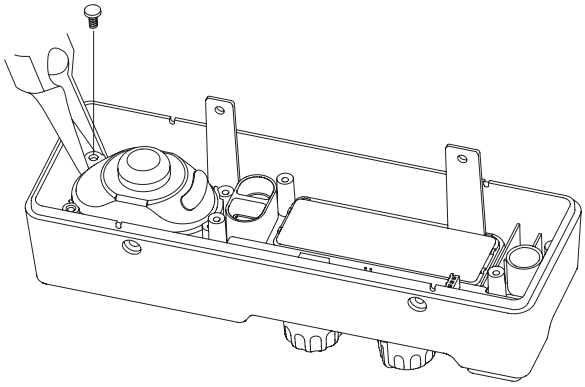


Figure 6-13. Installing Speaker Fittings and Screws to Internal Speaker Bosses

NOTE: Fasten the taptite head screws by following the sequence as shown in Figure 6-14.

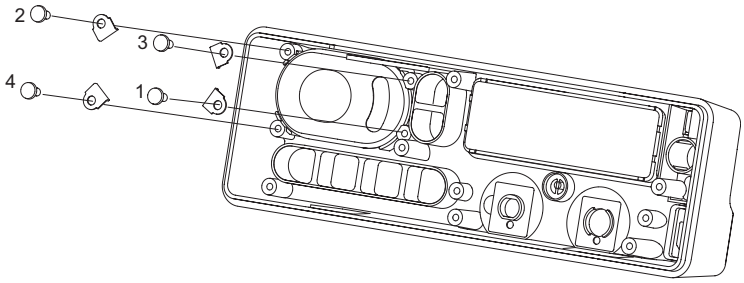


Figure 6-14. Installing the Internal Speaker Screws

6.2.2.2.4 PM1200 Control Head Display Unit Board Kit Reassembly

1. Lay the rear side of the front housing assembly [10] facing upward.
2. Insert the channel group knob [4] and power knob [13] to the front housing assembly [10]. Ensure the knobs are seated properly follow the key feature as shown in Figure 6-15.

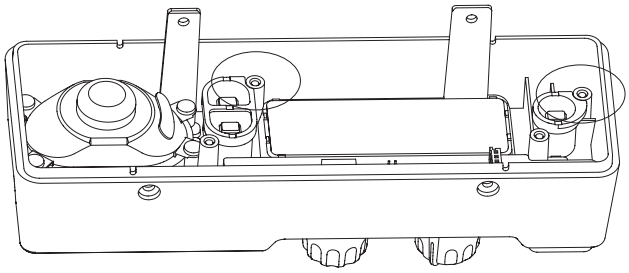


Figure 6-15. Insert Channel Group Knob and Power Knob to Front Housing.

3. Carefully align and insert the display unit board kit [22] to the key unit board kit [16].

NOTE: The male connector pin at the display unit board kit [22] might break if improperly assemble.

4. Carefully place the display unit board kit [22] to ensure the male connector pins are fully engaged to the female connector.
5. Using a CR-V PH1 torque driver, fasten the 6 taptite head screws M2.6x6 [17] following the sequence shown in Figure 6-16 (torqued to 3.5–4.6 kgf*cm/ 3–4 in. lbs).

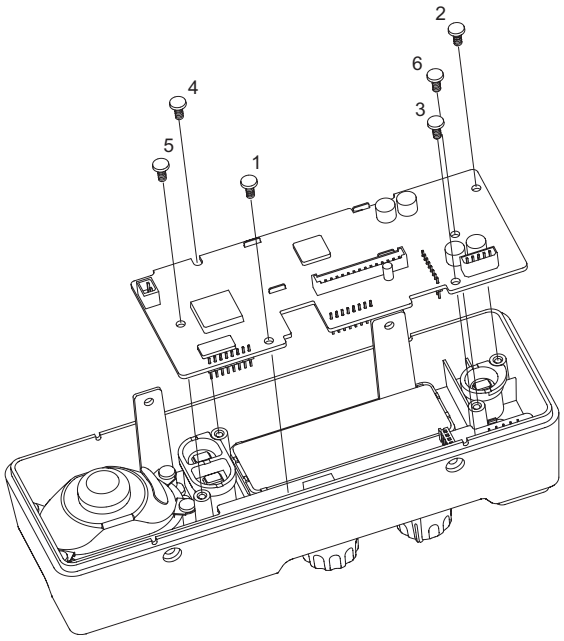


Figure 6-16. Display Unit Board Screw Sequence.

6. Carefully connect the speaker wire to the mating connector as shown in Figure 6-5.

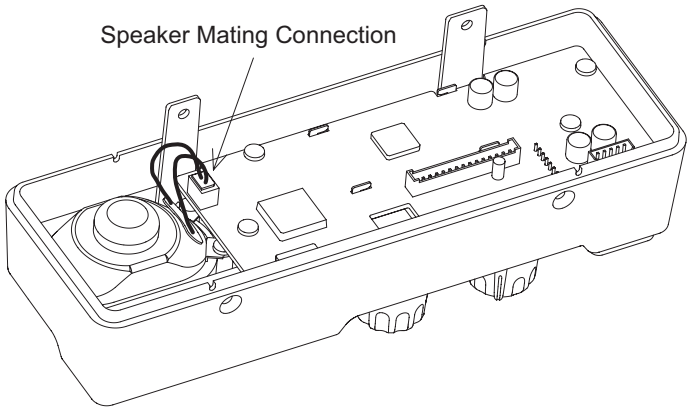


Figure 6-17. Connecting Speaker Mating Connector.

7. Carefully seal the front housing assembly [10] with the rubber packing [11].

6.2.2.2.5 PM1200 Control Head Panel-Interface Unit Board Kit Reassembly

1. Carefully connect the connection cable to the mating connector on the rear of display unit board kit [22] as shown in Figure 6-18.

NOTE: Be careful not to damage the mating connector while unplugging the connection cable.

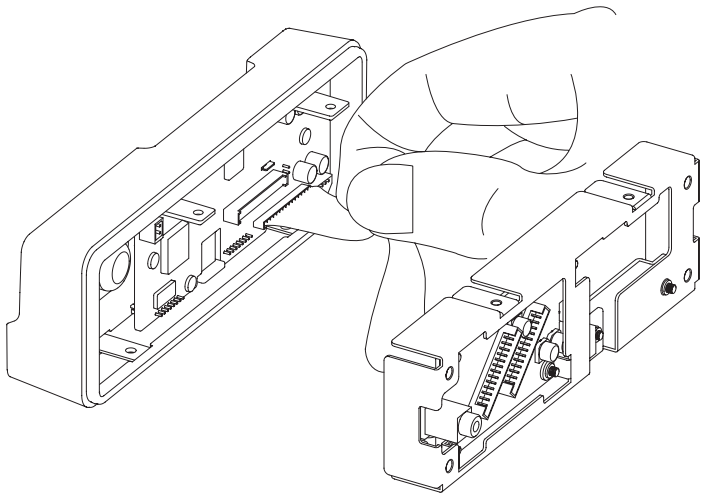


Figure 6-18. Installing Connection Cable (Display Unit Board Connector)

2. Gently insert the frame [28] into front housing assembly [10].
3. Lay the top side of control head facing upward on a clean, flat surface.
4. Using a CR-V PH2 torque driver, fasten the 2 binding head screws M3x8 SUS B [8] to the front housing assembly [10] (torqued to 3.5–4.6 kgf*cm/ 3–4 in. lbs).
5. Lay the bottom side of control head facing upward on a clean, flat surface.
6. Using a CR-V PH2 torque driver, fasten the 2 binding head screws M3x8 SUS B [8] with the 2 o-rings [9] to the front housing assembly [10] (torqued to 3.5–4.6 kgf*cm/ 3–4 in. lbs).
7. Lay the control head facing downward on a clean, flat surface being careful not to scratch or mar the display.
8. Carefully insert the foam [27] to the speakerphone jack at the panel-interface unit board kit [25].

6.2.2.2.6 PM1200 Control Head Back Housing Reassembly

1. Carefully join the back housing assembly [29] to the front housing assembly [10].

2. Using a CR-V PH2 torque driver to fasten the 4 binding head screws M4x8 SUS B [34] and the 4 o-rings [33] to the back housing assembly [29] following the sequence following the sequence as shown in Figure 6-19. (Torqued to 5.8–6.9 kgf*cm/ 5–6 in. lbs).

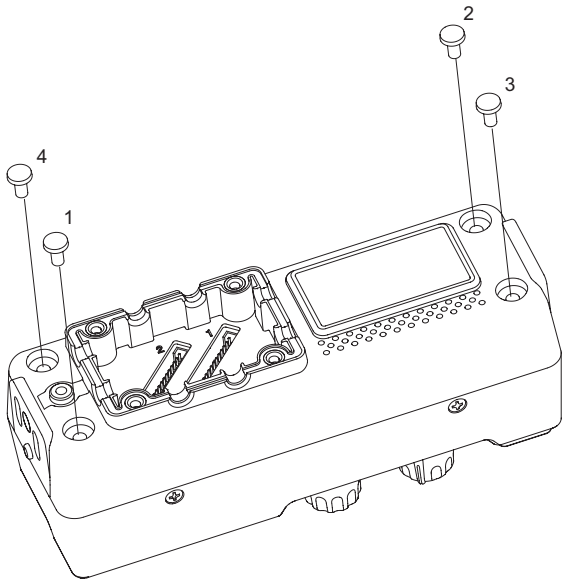


Figure 6-19. Back Housing Screw Sequence

3. Insert the ear cap to the speaker phone jack at panel-interface unit board kit [25].
4. Using a special nut driver, fasten the special nut [26] as shown in Figure 6-20. (Torqued to 4.6–5.8 kgf*cm/ 4–5 in. lbs).

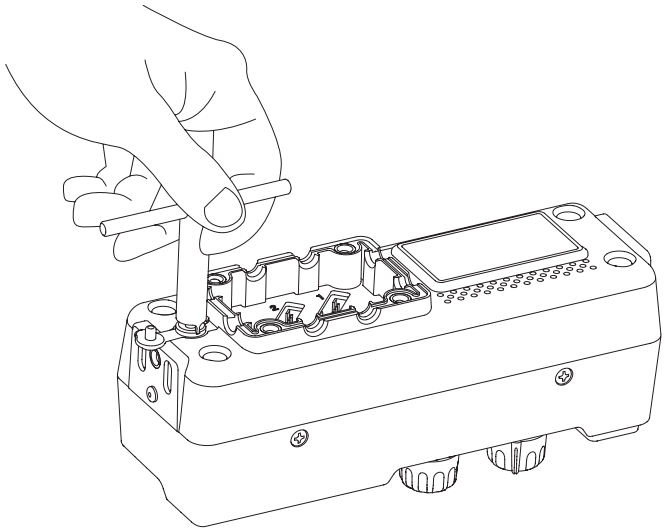


Figure 6-20. Installing Special Nut to Speaker Phone Jack

5. Carefully plug in the remote radio control cable to the mating connector on the back housing assembly [29].

NOTE: Be careful not to damage the mating connector while plugging in the remote radio control cable.

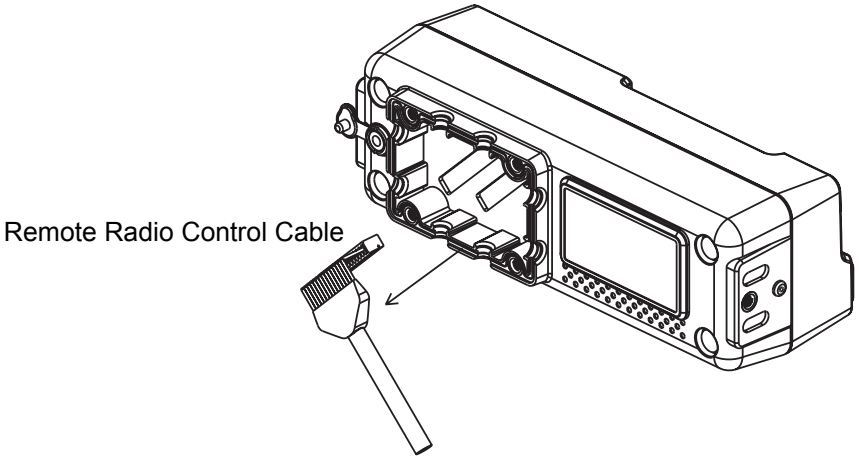


Figure 6-21. Installing Remote Radio Control Cable to Back Housing

6. Neatly bundle the exposed cable wiring, and then install the cable strain relief plate [32] and gasket [31] into the place.
7. Using a CR-V PH2 torque driver, fasten the 4 binding head screws M4x8 SUS B [34] to the cable relief plate [32] follow the sequence as shown in Figure 6-21. (Torqued to 5.8–6.9 kgf*cm/ 5–6 in. lbs).

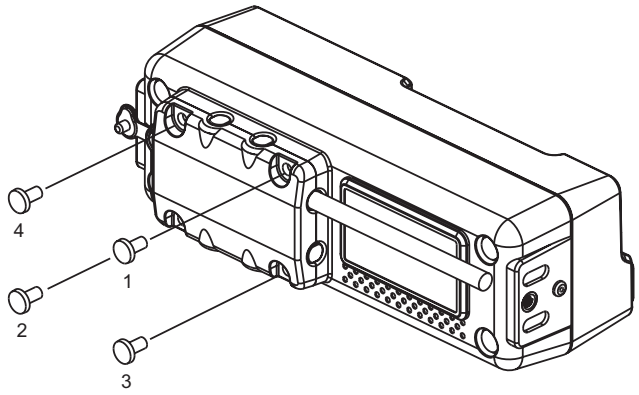


Figure 6-22. Installing Screws to Cable Strain Relief Plate

6.2.3 Radio Disassembly/Reassembly

NOTE: Prior to reassembling the radio, inspect all seals and sealing surfaces for damage (nicks, cuts, etc.) or dirt. Refer to Chapter 9. Exploded Views and Parts Lists for the correct part numbers, and replace parts, as necessary. Reseat all seals on their respective parts.

Begin with the chassis. Thoroughly inspect the chassis gasketing for damage and verify all chassis thermal compound are in place.

6.2.3.1 Transceiver Front Panel Disassembly/Reassembly

NOTE: Bracketed numbers are identical to item numbers shown in Figure 9-2. “PM1200 Radio Exploded View” on page 9-3.

6.2.3.1.1 Transceiver Front Panel Disassembly

1. Ensure all accessory connections, power, antenna, and microphone are unplugged.
2. Using a CR-V PH2 screwdriver, remove the 4 binding head screws M4x8 SUS B [1] from the cable strain relief plate [2] as shown in Figure 6-23.

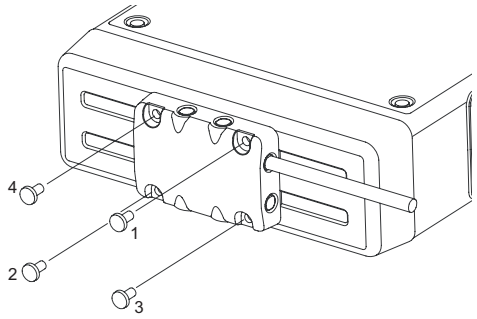


Figure 6-23. Removing Screws from Cable Strain Relief Plate

3. Carefully separate the cable strain relief plate [2] and gasket [3] from the front panel [4].
4. Carefully disconnect the remote radio control cable from the mating connector on the RF-Interface unit board kit [7] as shown in Figure 6-23.

NOTE: Be careful not to damage the mating connector while unplugging the remote control cable.

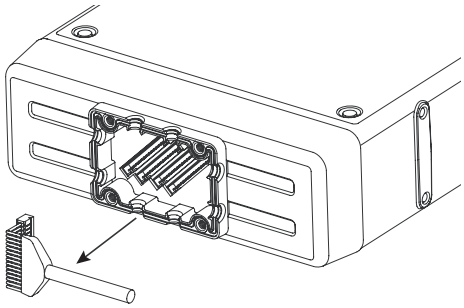


Figure 6-24. Removing Remote Radio Control Cable from Front Panel

5. Using a CR-V PH2 screwdriver, remove 7 binding head screws M3x6 SUS B [23] from the top cover [24] as shown in Figure 6-25. Save them for later use.

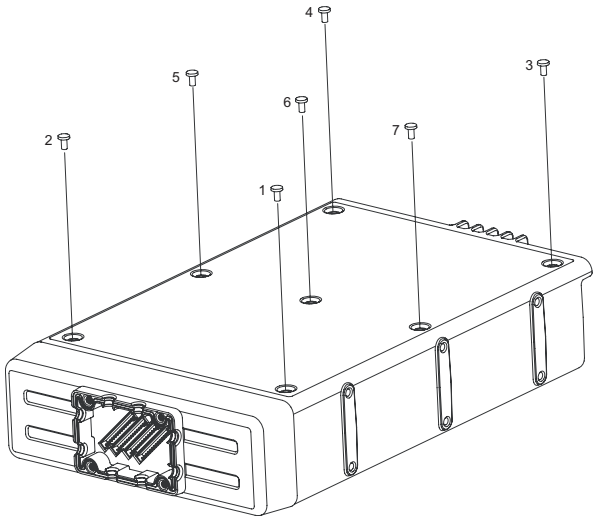


Figure 6-25. Removing Screws from Top Cover

6. Carefully remove the top cover [24] by lifting up the side edges. It may be necessary to gently pry the cover off using a plastic tool.

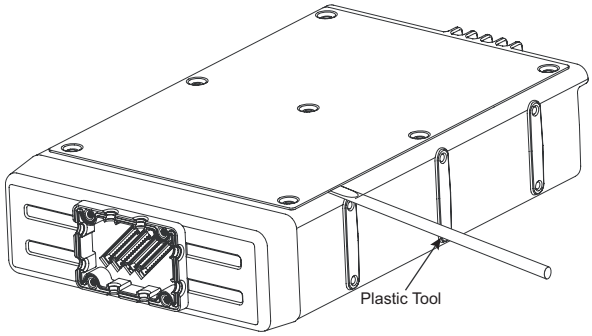


Figure 6-26. Lifting the Top Cover

7. Using a CR-V PH2 screwdriver, remove the 2 binding head screws M3x6 SUS [6] from the transceiver front panel [4].
8. Lay the top of the radio facing downward on a clean, flat surface.
9. Using a CR-V PH2 screwdriver, remove the 2 binding head screws M3x6 SUS B [9] with 2 o-ring [10] from the front panel.
10. Lay the top of the radio facing upward on a clean, flat surface.
11. Carefully separate the front panel [4] from transceiver radio.

12. Carefully disconnect the connection cable from the RF-Interface unit board kit [7] as shown in Figure 6-27.

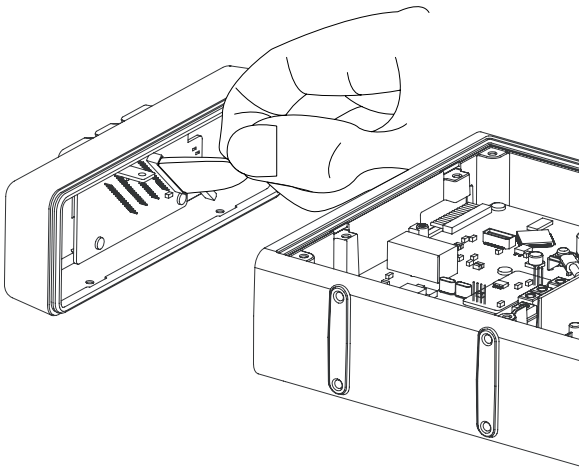


Figure 6-27. Removing Connection Cable

13. Carefully separate the front panel [4] and rubber packing [5] from the radio.

6.2.3.1.2 Transceiver Front Panel Reassembly

1. Seal the front panel [4] with the rubber packing [5].
2. Carefully connect the connection cable to the RF-Interface unit board kit [7] as shown in Figure 6-28.

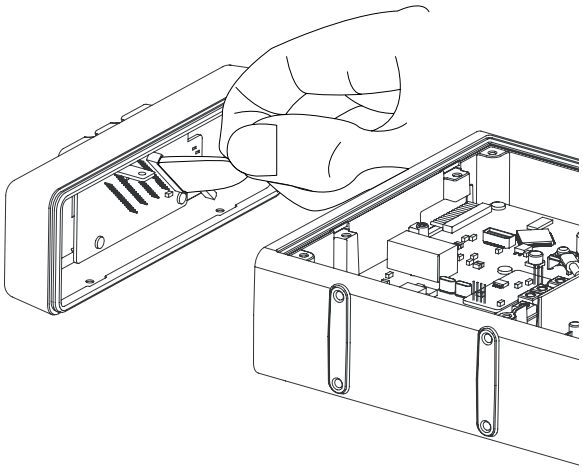


Figure 6-28. Installing the Connection Cable

3. Carefully mate the front panel [4] to the front of the transceiver radio.

4. Using a CR-V PH2 torque driver, fasten the 2 binding head screws M3x6 SUS [6] to the front panel [4] as shown in Figure 6-29. (Torqued to 3.5–4.6 kgf*cm/ 3–4 in. lbs).

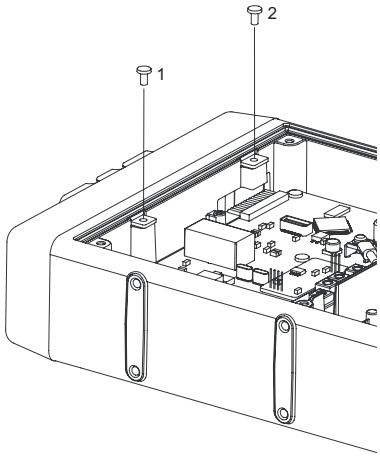


Figure 6-29. Installing Front Panel Screws

5. Carefully lay the top of the radio facing downward on a clean, flat surface.
6. Using a CR-V PH2 torque driver, fasten the 2 binding head screws M3x6 SUS B [9] with 2 o-ring [10] to the front panel as shown in Figure 6-29. (Torqued to 3.5–4.6 kgf*cm/ 3–4 in. lbs).

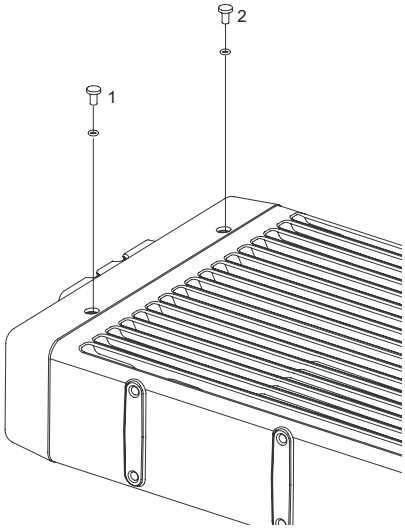


Figure 6-30. Installing Bottom Screws to Front Panel

7. Lay the top of the radio facing upward.
8. Place the top cover [24] on the chassis [11] and seat it properly. Compress the cover and chassis together to squeeze the foam [25] into place and to make torquing the screws easier.

9. Using a CR-V PH2 torque driver, fasten the 7 binding head screws, M3x6 SUS B [23] to the top cover [24] following the sequence as shown in Figure 6-31. (Torqued to 5.8–6.9 kgf*cm/ 5–6 in. lbs).

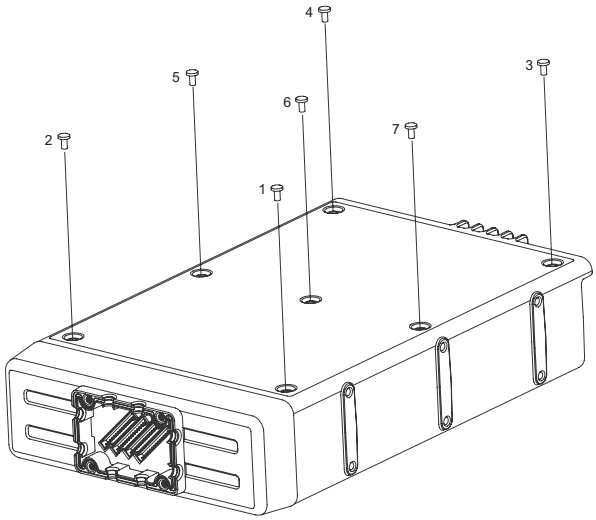


Figure 6-31. Sequence for Installing Top Cover Screws

10. Carefully plug-in the remote radio control cable to the mating connector (red color) on the front panel [4] as shown in Figure 6-32.

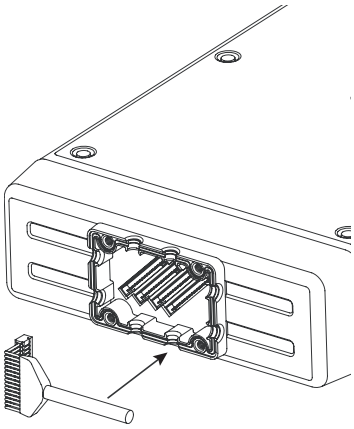


Figure 6-32. Installing Remote Radio Control Cable to Front Panel

11. Neatly bundle the exposed cable wiring, and then install the gasket [3] and cable strain relief plate [2] into the place.

12. Using a CR-V PH2 torque driver, fasten the 4 binding head screws, M4x8 SUS B [1] to the cable relief plate [2] following the sequence as shown in Figure 6-33. (Torqued to 5.8–6.9kgf*cm/ 5–6 in. lbs).

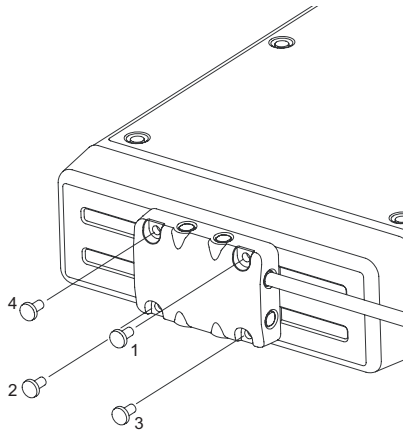


Figure 6-33. Sequence for Installing Cable Relief Plate Screws

6.2.3.2 RF-Interface Board Kit Disassembly/Reassembly

NOTE: Bracketed numbers are identical to item numbers shown in Figure 9-2. “PM1200 Radio Exploded View” on page 9-3.

6.2.3.2.1 RF-Interface Board Kit Disassembly

1. Disassemble the front panel by following the steps outlined in 6.2.3.1: “Transceiver Front Panel Disassembly/Reassembly” on page 6-14.
2. Place the rear of the front panel facing upward on a flat surface and remove the 4 taptite head screws, M2.6x6 [8] with a CR-V PH1 screwdriver as shown in Figure 6-34.

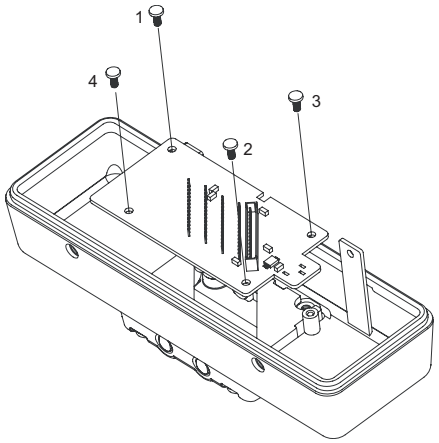


Figure 6-34. Installing Remote Radio Control Cable to Front Panel

3. Carefully separate the RF-Interface unit board kit [7] from the front panel [4].

6.2.3.2.2 RF-Interface Board Kit Reassembly

1. Seat the RF-Interface unit board kit [7] in the front panel [4] to the screw bosses. Ensure that the aligning boss protrudes through the PCB.
2. Using a CR-V PH1 torque driver, fasten the 4 taptite head screws, M2.6x6 [8] following the sequence as shown in Figure 6-34.(Torqued to 3.5–4.6 kgf*cm/ 3–4 in. lbs).

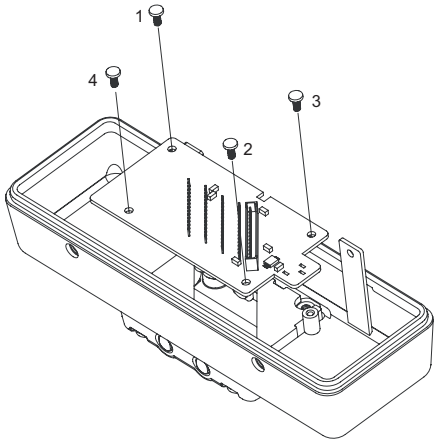


Figure 6-35. Sequence for Installing RF-Interface Kit Screws

3. After installing the RF-Interface board kit, reassemble the front panel by following the steps outlined in 6.2.3.1.2: “Transceiver Front Panel Reassembly” on page 6-16.

6.2.3.3 Main-Unit Board Kit Disassembly/Reassembly

NOTE: Bracketed numbers are identical to item numbers shown in Figure 9-2. “PM1200 Radio Exploded View” on page 9-3.

6.2.3.3.1 Main-Unit Board Kit Disassembly

IMPORTANT: See “Option Board Disassembly/Reassembly” on page 6-44 before disassembly the main Unit

1. Ensure all accessory connections, power, antenna, and microphone are unplugged.
2. Disassemble the front panel by following the steps outlined in 6.2.3.1.1: “Transceiver Front Panel Disassembly” on page 6-14.

3. Using a CR-V PH2 screwdriver, remove the 2 SEMS screws, HSM3x6 NI [17] from the main-unit board kit [13] as shown in Figure 6-36.

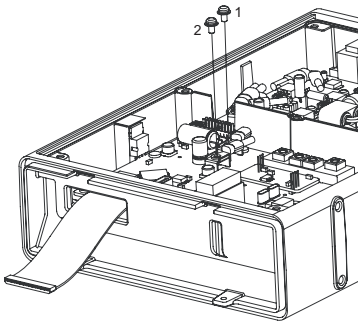


Figure 6-36. Removing Screws from Main-Unit Board Kit

4. Carefully separate the two power wire assembly wires [37] from the original location.
5. Unplug the mating connector [A] on the wire assembly 160mm 20P26P [26] from the main-unit board kit [13] as shown in Figure 6-37.

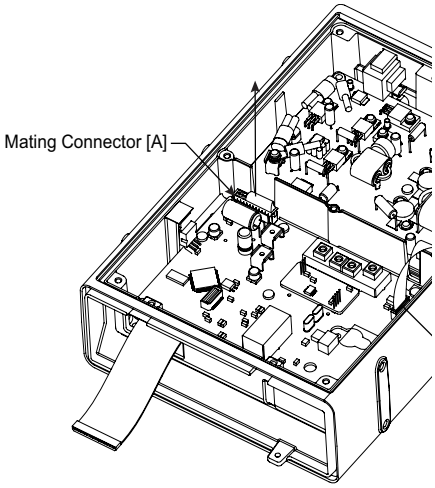


Figure 6-37. Removing Screws from Main-Unit Board Kit

6. Unplug the mating connector [C] of the wire assembly [27] from the main-unit board kit [13] as shown in Figure 6-38.

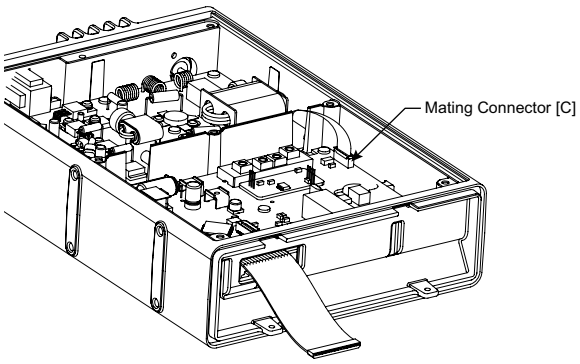


Figure 6-38. Removing Mating Connection from Main-Unit Board Kit

7. Separate the holder [15] from the chassis [11] as shown in Figure 6-39.

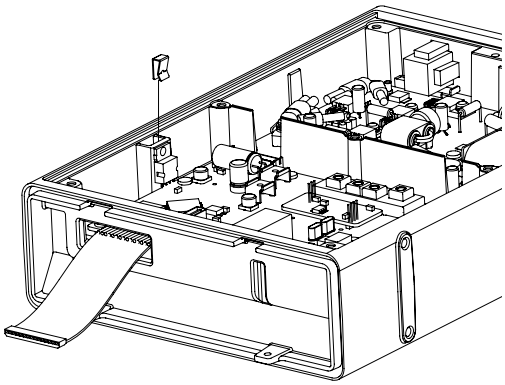


Figure 6-39. Removing Holder from Chassis

8. Carefully desolder the brown 2-wire assemby [16] (Tx and Rx wires) as shown in Figure 6-40.

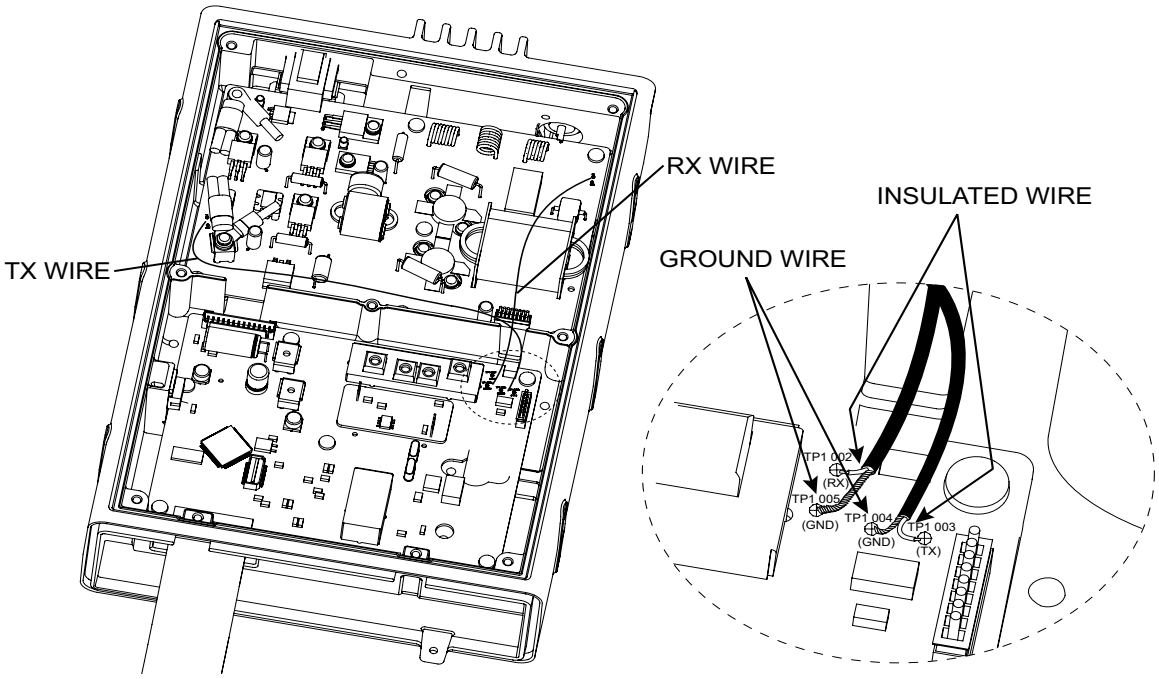


Figure 6-40. Desolder Tx and Rx Wires

9. Using a CR-V PH2 screwdriver, remove the 6 taptite screws, M3x8 NI [14], from the chassis [11] as shown in Figure 6-41.

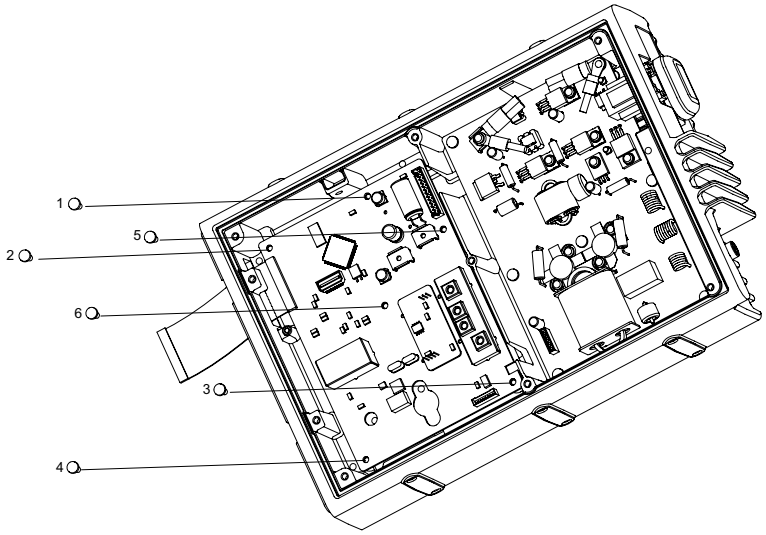


Figure 6-41. Removing Screws from Main-Unit Board Kit

10. Separate the main-unit board kit [13] by holding the metal cover as shown in Figure 6-42 and lifting up the back of the PCB.

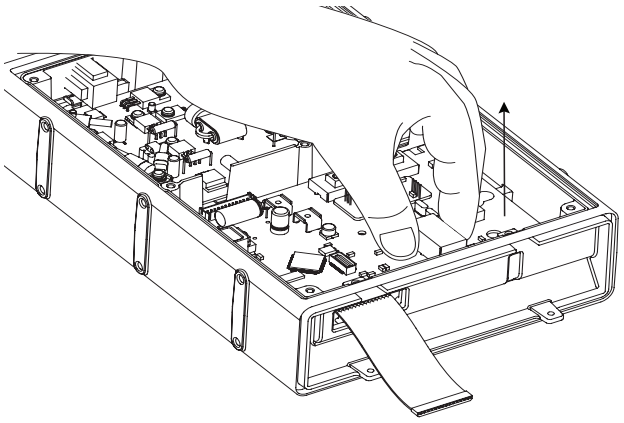


Figure 6-42. Removing the Main-Unit Board Kit

11. Slide the main board towards the back of the chassis [11] and carefully lift it out of the chassis. Hold the main-unit board kit [13] by the edges only, and store it in an antistatic bag.

6.2.3.3.2 Main-Unit Board Kit Reassembly

To assemble your radio:

1. Prior to reassembly the radio, inspect the poron pads [12], [18] and poron pad (VCO) [19] for damage or dirt. Refer to Chapter 9. Exploded Views and Parts Lists for the correct part numbers, and replace parts, as necessary.
2. Take out the main-unit board kit [13] from the antistatic bag by holding the edges of the board.
3. Paste the new poron pad [18] to the main unit board kit [13] as shown in Figure 6-43.

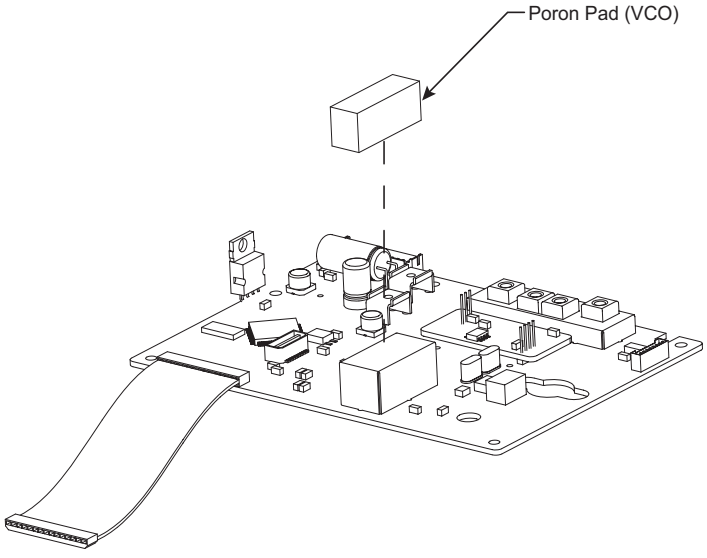


Figure 6-43. Pasting Poron Pad to Main-Unit Board Kit

4. Before reassembling the PCB to the chassis [11], put some thermal compound to the back of the electronic component (Q2018) as shown in Figure 6-44.

NOTE: Refer section 6.3: Chassis Thermal Compound Replacement Procedure on page 6-47.

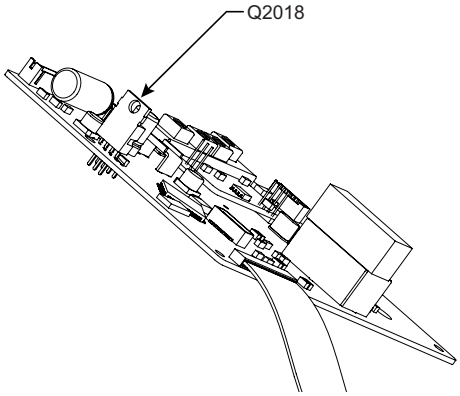


Figure 6-44. Position of Electronic Component – Q2018

5. Tilt the main-unit board kit [13] and slide it into place; insert the connector through the opening provided. Gently push down the PCB to fully seat it. Ensure the main-unit board kit alignment holes are positioned over the chassis alignment bosses and the Main-unit board kit is fully seated.

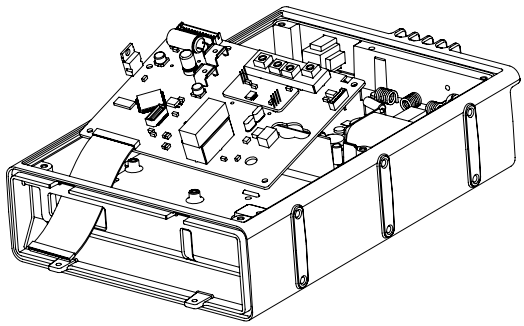


Figure 6-45. Inserting Main-Unit Board Kit into Chassis

6. Using a CR-V PH2 torque driver, fasten the 6 taptite screws, M3x8 NI [14] following the sequence as shown in Figure 6-46. (Torqued to 9.8–10.9 kgf*cm/ 8.5–9.5 in. lbs)

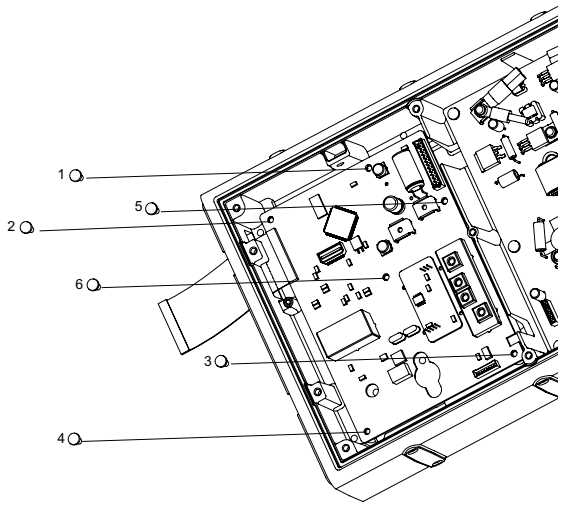


Figure 6-46. Sequence for Installing Main-Unit Board Kit Screws

7. Carefully resolder the 2 wires (Tx and Rx wires) as shown in Figure 6-47.

Caution

Ensure the wires are soldered correctly to the PCB: the insulated wires solder to TP1 002 (RX) and TP1 003 (TX) and ground wire solder to TP1 001 (GND) and TP1 004 (GND).

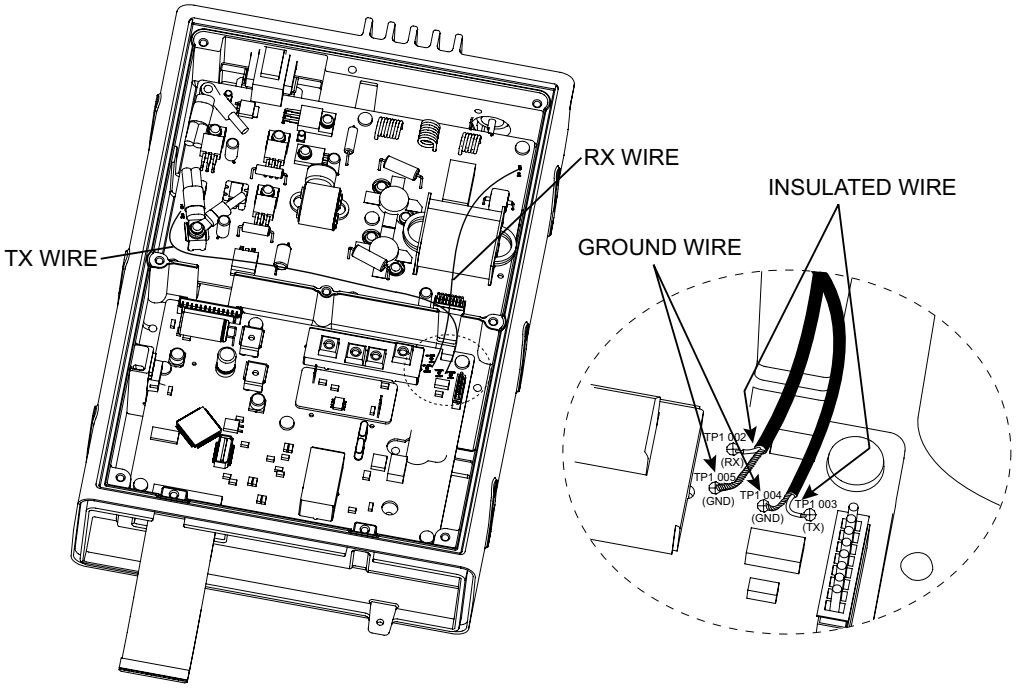


Figure 6-47. Resolder Tx and Rx Wires to Main-Unit Board Kit

8. Insert and press the holder [15] to fix the electronic component (Q2018).

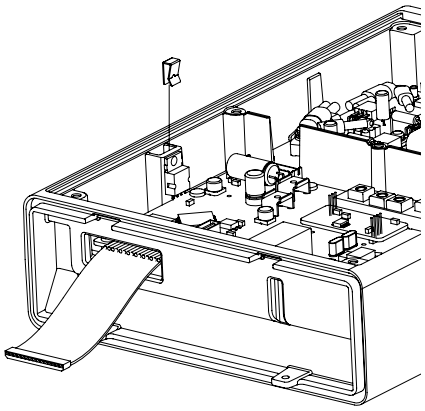


Figure 6-48. Inserting Holder to Fix the Electronic Component

9. Connect the mating connector [A] of wire assembly 160mm 20P26P [26] and the mating connector [C] of wire assembly [27] to the main-unit board kit [13] as shown in Figure 6-49.

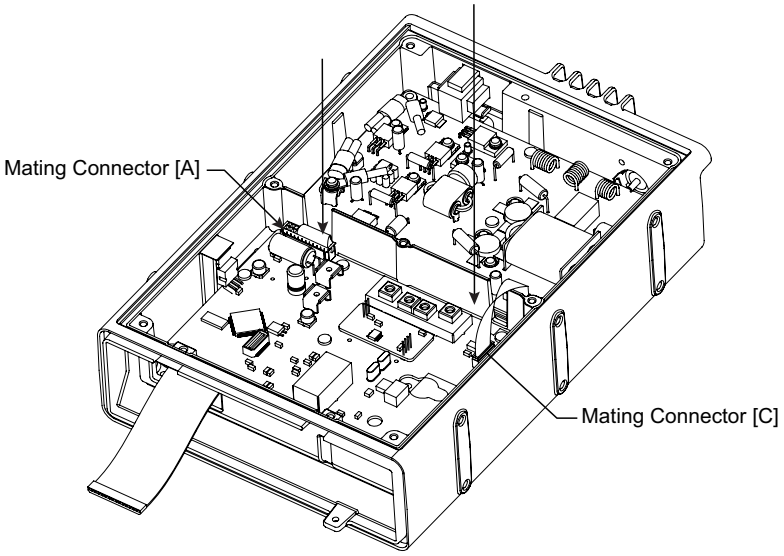


Figure 6-49. Connect Mating Connector to Main-Unit Board Kit

10. Place the power wire assembly [37] to the terminal by using a CR-V PH2 torque driver, fasten the 2 SEMS screws, HSM3x6 NI [17] to the main-unit board kit [13] as shown in Figure 6-50. (Torqued to 5.8–6.9 kgf*cm/ 5–6 in. lbs)

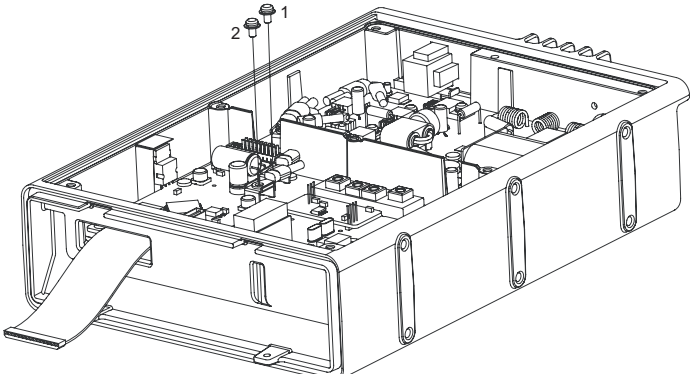


Figure 6-50. Connecting Power Wire Assembly to Main-Unit Board Kit

11. After installing the main-unit board kit, reassemble the front panel by following the steps outlined in 6.2.3.1.2: “Transceiver Front Panel Reassembly” on page 6-16.

6.2.3.4 PA-Unit Board Kit Disassembly/Reassembly

NOTE: Bracketed numbers are identical to item numbers shown in Figure 9-2. “PM1200 Radio Exploded View” on page 9-3.

6.2.3.4.1 PA-Unit Board Kit Disassembly

1. Ensure all accessory connections, power, antenna, and microphone are unplugged.
2. Using a CR-V PH2 screwdriver, remove the 7 binding head screws, M3x6 SUS B [23] from the top cover [24] as shown in Figure 6-51. Save them for later use.

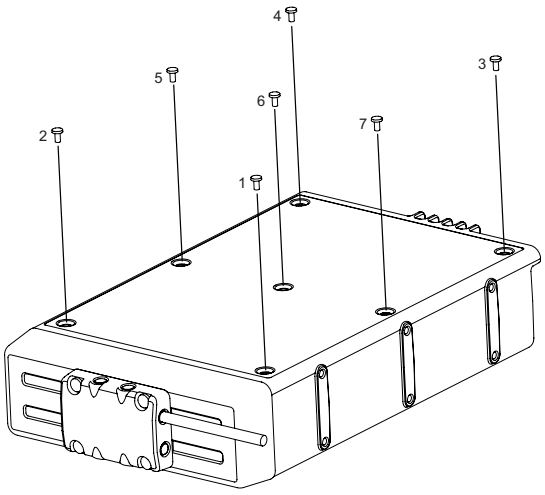


Figure 6-51. Removing Screws from Top Cover

3. Carefully remove the top cover [24] by lifting both side edges. It may be necessary to gently pry the cover off using a plastic tool Figure 6-52.

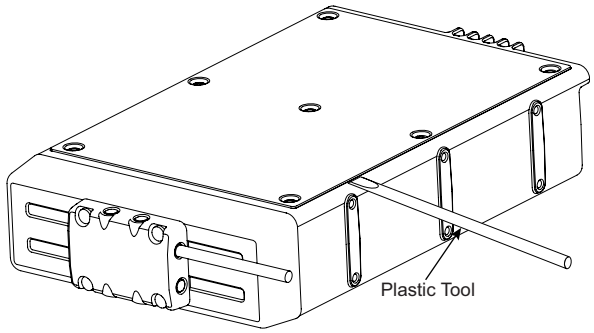


Figure 6-52. Lifting the Top Cover

4. Using a CR-V PH2 screwdriver, remove 3 SEMS screws, HSM3x6 NI [17] and a taptite screw, M3x8 NI [14] from the radio as shown in Figure 6-53.

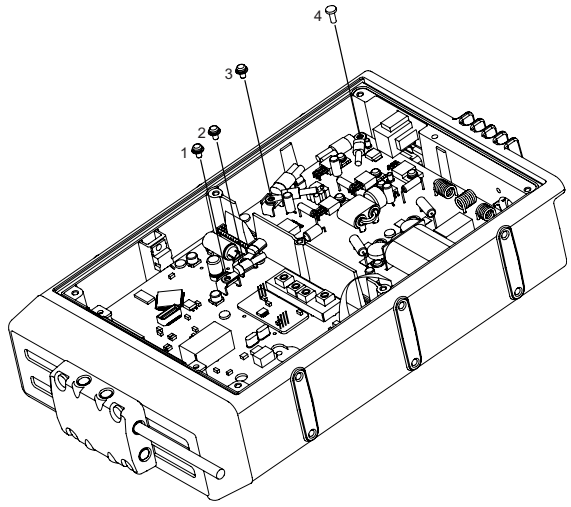


Figure 6-53. Removing Screws from Main-Unit Board Kit and PA-Unit Board Kit

5. Carefully remove the power wire assembly [37] by using a pair of long nose pliers to push the power wire assembly connector inward as shown in Figure 6-54.

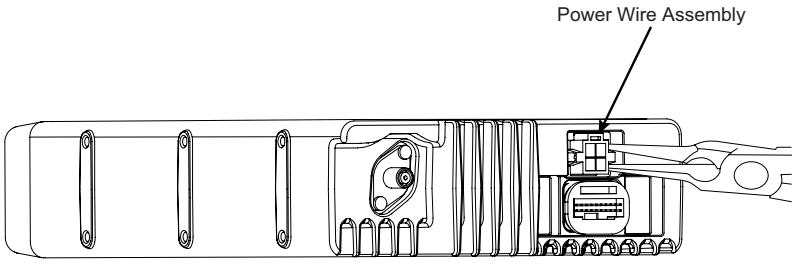


Figure 6-54. Removing Power Wire Assembly from the Chassis

6. Separate the mating connector [D] of wire assembly [27] from the PA-unit board kit [20] as shown in Figure 6-55.

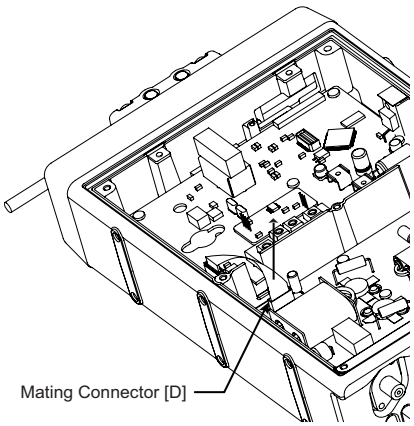


Figure 6-55. Removing Mating Connection from PA-Unit Board Kit

7. Using a CR-V PH2 screwdriver, remove the 2 binding head screws, M3x6 SUS [6] from the antenna connector [32] as shown in Figure 6-56.

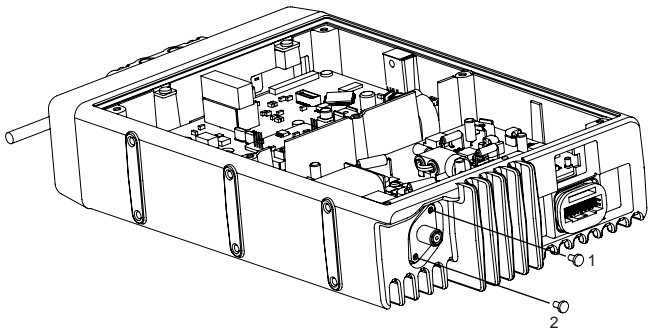


Figure 6-56. Removing Screws from Antenna Connector

8. Carefully desolder the antenna connector [32] and earth plate [33] from the PA-unit board kit [20] and remove them from the chassis [11] as shown in Figure 6-56.

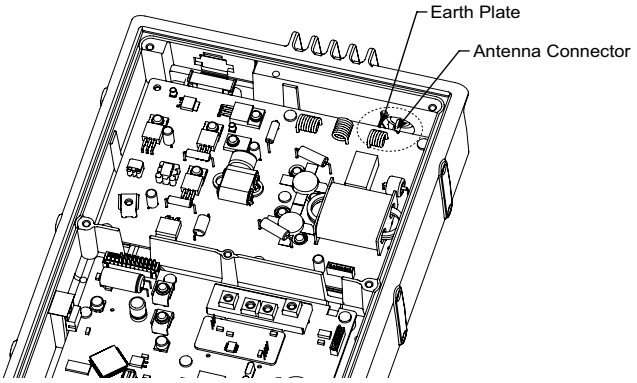


Figure 6-57. Desoldering Antenna Connector and Earth Plate from PA-Unit Board Kit

9. Carefully desolder the brown 2-wire assembly (Tx and Rx wires) as shown in Figure 6-58.

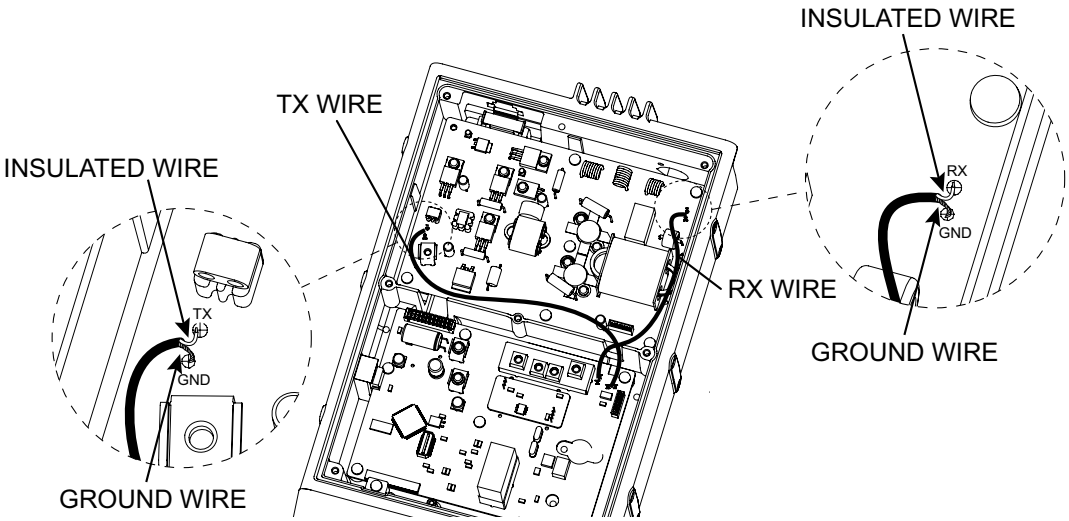


Figure 6-58. Desoldering Tx and Rx Wires

10. Using a CR-V PH2 screwdriver, remove the 5 SEMS screws, ASM3x8 NI [22] from the PA-unit board kit [20] as shown in Figure 6-59.

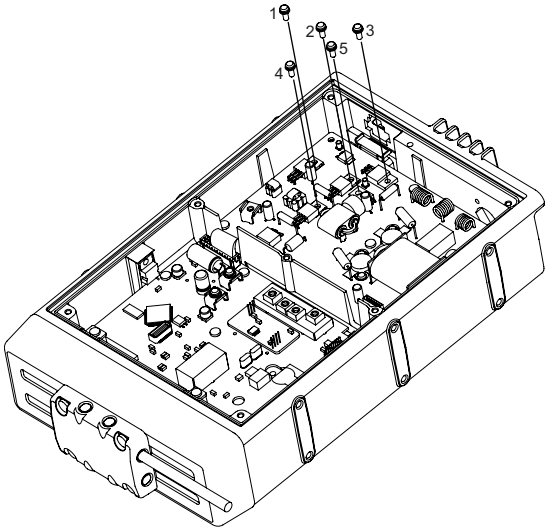


Figure 6-59. Removing 5 SEMS Screws from PA-Unit Board Kit.

11. Using a CR-V PH2 screwdriver, remove the 4 SEMS screws, SM3x8 NI [21] from the PA-unit board kit [20] as shown in Figure 6-60.

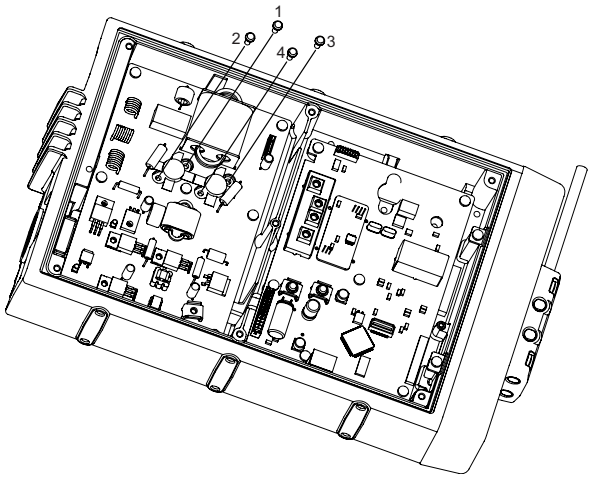


Figure 6-60. Removing 4 SEMS Screws from PA-Unit Board Kit.

12. Using a CR-V PH2 screwdriver, remove another 6 taptite screws M3x8 NI [14] from the PA-unit board kit [20] as shown in Figure 6-61.

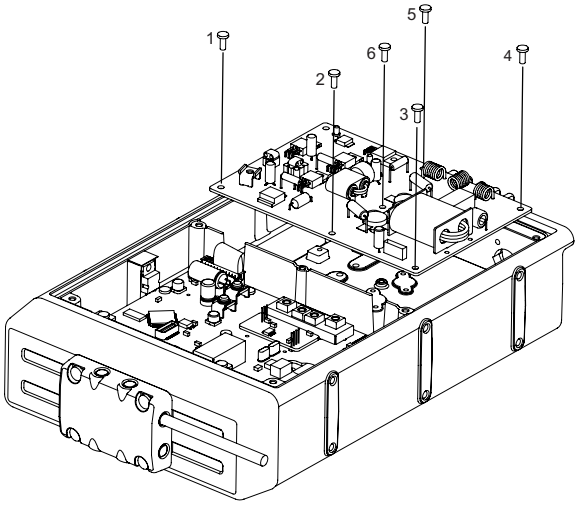


Figure 6-61. Removing Taptite Screws from PA-Unit Board Kit.

13. Remove the PA-Unit board kit [20] by holding the edges of the PCB and lift it out of the chassis. Store it in an antistatic bag.

6.2.3.4.2 PA-Unit Board Kit Reassembly

1. Use a soft cloth to remove any remaining residue. Put the thermal compound to the chassis as shown in Figure 6-62.

NOTE: Refer 6.3: “Chassis Thermal Compound Replacement Procedure” on page 6-47.

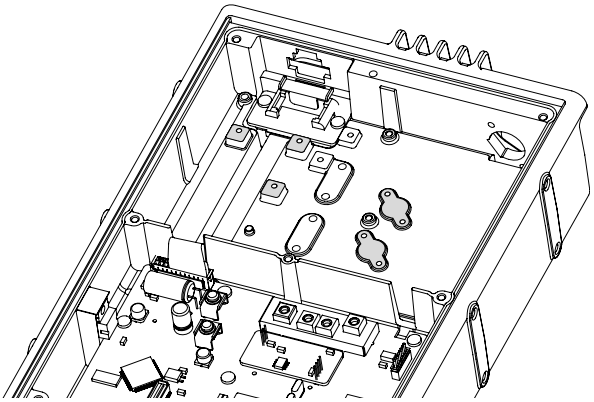


Figure 6-62. Location for Thermal Compound.

2. Hold the PA-unit board kit [20] by its edges only, and take it out from an antistatic bag. Check the replacement PA unit. There should not be any transistor fins vent shape and crack at the solder joint points
3. Place the PA-unit board kit [20] into place by gently pushing down the PCB to fully seat it as shown in Figure 6-63. Move the PCB gently, 2 or 3 times to exclude any air gaps between both surfaces. Ensure that the PA-unit board kit alignment holes are positioned over the chassis alignment bosses and that the Main-unit board kit is fully seated.

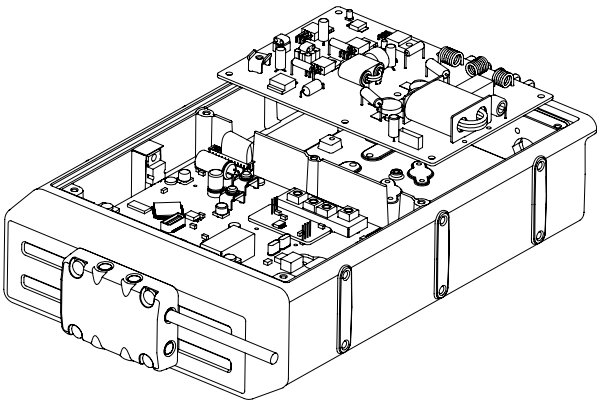


Figure 6-63. Placing PA-Unit Board Kit into Chassis.

4. Using a CR-V PH2 torque driver, fasten the 5 SEMS screws ASM3x8 NI [22] following the sequence as shown in Figure 6-64. (Torqued to 4.6–5.8 kgf*cm/ 4–5 in. lbs)

> **Caution**
>
> Do not over torque the screws. It may damage the semiconductors and transistors.

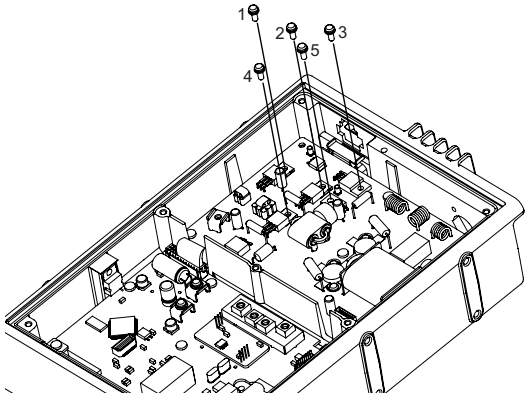


Figure 6-64. Connecting Power Wire Assembly to Main-Unit Board Kit

5. Using a CR-V PH2 torque driver, fasten the 4 SEMS screws, SM3x8 NI [21] following the sequence as shown in Figure 6-65. (Torqued to 5.8–6.9 kgf*cm/ 5–6 in. lbs)

> **Caution**
>
> Do not over torque the screws. It may damage the semiconductors and transistors.

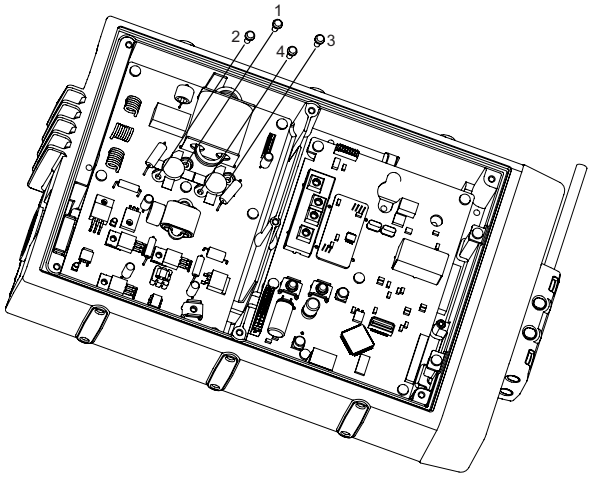


Figure 6-65. Installing Sequence for PA-Unit Board Kit Screws

6. Using a CR-V PH2 torque driver, fasten 6 taptite screws M3x8 NI [14] follow the sequence as shown in Figure 6-66. (Torqued to 9.8–10.9 kgf*cm/ 8.5–9.5 in. lbs).

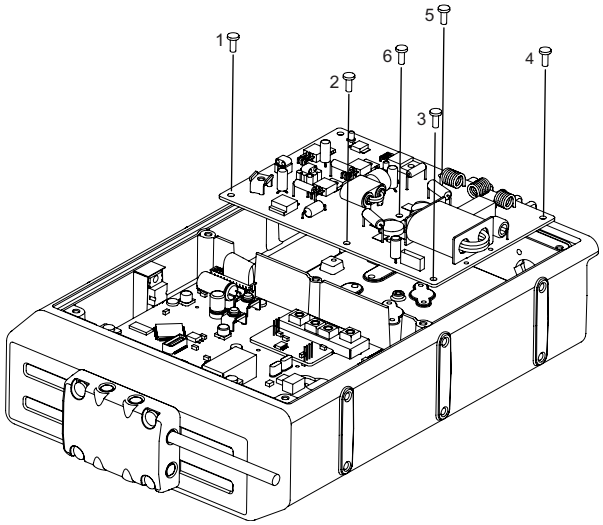


Figure 6-66. Sequence for Installing Taptite Screws on PA-Unit Board Kit

7. Carefully resolder the 2 wires (Tx and Rx wires) as shown in Figure 6-67.

> **Caution** Ensure that the wires are soldered correctly to the PCB with the insulated wires solder to TP1 002 (RX) and TP1 003 (TX) and ground wire solder to TP1 001 (GND) and TP1 004 (GND).

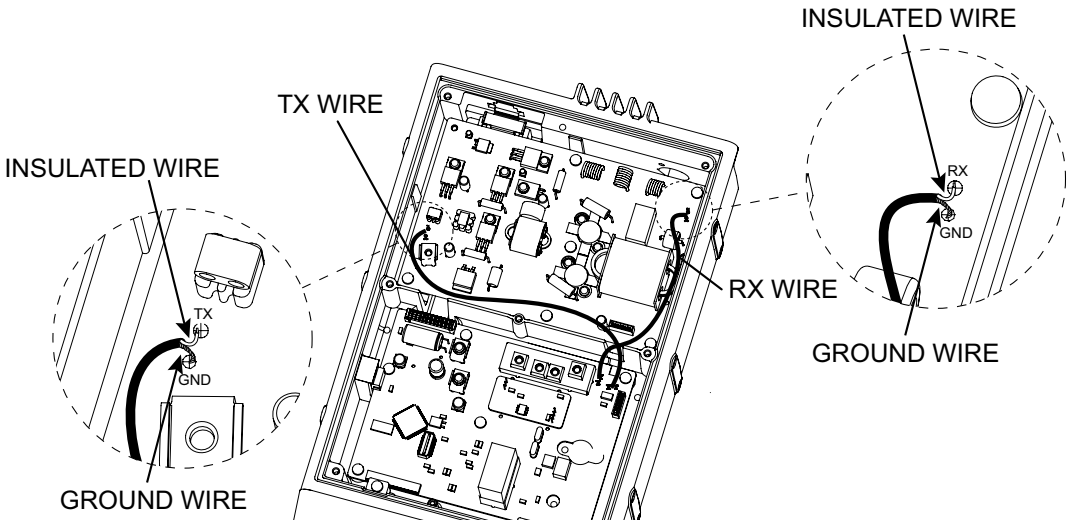


Figure 6-67. Resolder Tx and Rx Wire to PA-Unit Board Kit.

8. Using a CR-V PH2 torque driver, fasten the 2 binding head screws, M3x6 SUS [6] to the assemble earth plate [33] and the antenna connector [32] to the chassis [11] as shown in Figure 6-68. (Torqued to 3.5–4.6 kgf*cm/ 3–4 in. lbs)

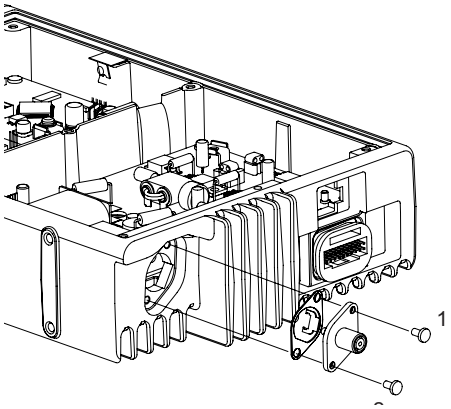


Figure 6-68. Sequence for Installing Binding Head Screws on PA-Unit Board Kit

9. Carefully resolder the antenna connector [32] and the earth plate [33] to the PCB as shown in Figure 6-69.

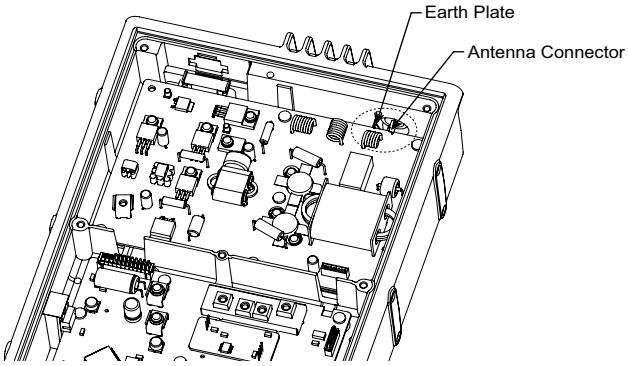


Figure 6-69. Resoldering Antenna Connector and Earth Plate.

10. Connect the mating connector [D] of wire assembly [27] to the PA-unit board kit [20] as shown in Figure 6-70.

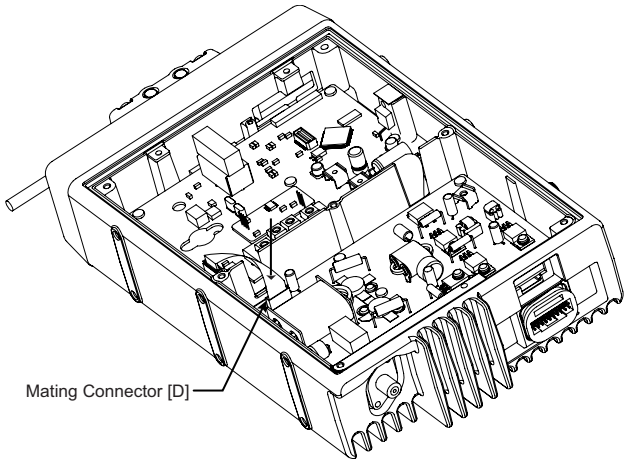


Figure 6-70. Connecting Mating Connector to PA-Unit Board Kit.

11. Push the power wire assembly [37] from within the chassis through the provided opening. Figure 6-71.

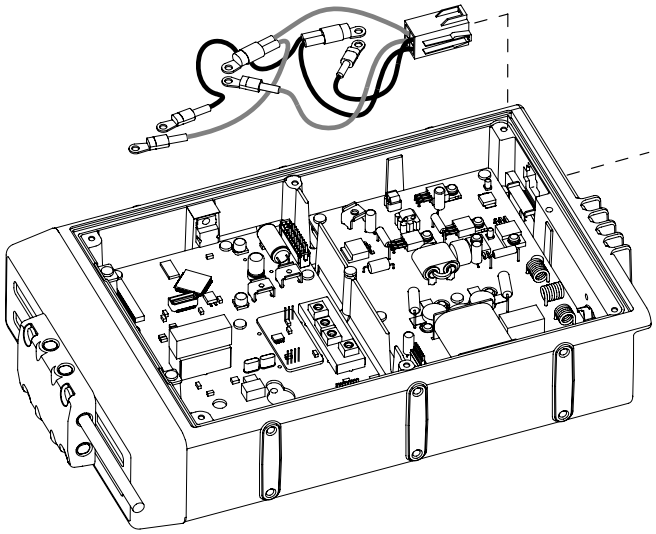


Figure 6-71. Inserting Power Wire Assembly into the Chassis

12. Place the power wire assembly [37] to the terminal by using a CR-V PH2 torque driver and fasten the taptite screw, M3x8 NI [14] to the PA-unit board kit [20]. (Torqued to 9.8–10.9 kgf*cm/ 8.5–9.5 in. lbs).

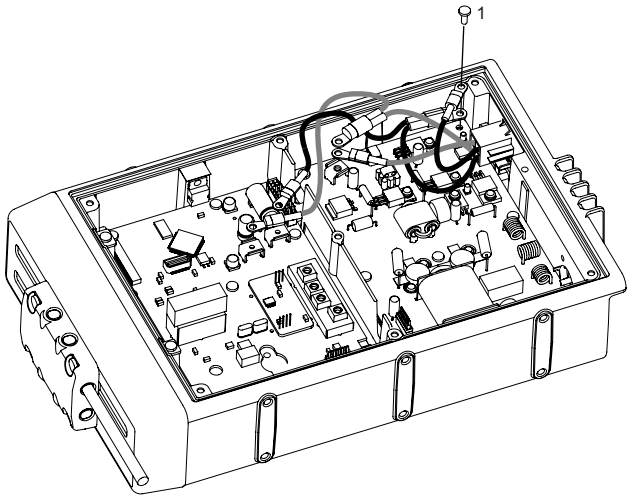


Figure 6-72. Connecting Power Wire Assembly to PA-Unit Board Kit

13. Place the power wire assembly [37] to the terminal by using a CR-V PH2 torque driver and fasten the 3 SEMS screws, HSM3x6 NI [17] to the main-unit board kit [13] and PA-unit board kit [20] follow the sequence. (Torqued to 5.8–6.9 kgf*cm/ 5–6 in. lbs).

Caution

Make sure the power wires are stored in the opening in the chassis.

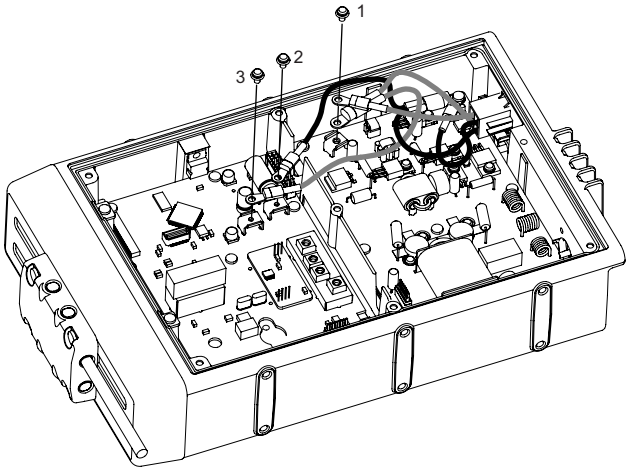


Figure 6-73. Inserting Power Wire Assembly into the Chassis

14. Place the top cover [24] on the chassis [11] and seat it properly. Compress the cover and chassis together to squeeze the foam [25] into place and make torquing of the screws easier.
15. Using a CR-V PH2 torque driver, fasten the 7 binding head screws M3x6 SUS B [23] to the top cover [24] follow the sequence as shown in Figure 6-74 (Torqued to 5.8–6.9 kgf*cm/ 5–6 in. lbs).

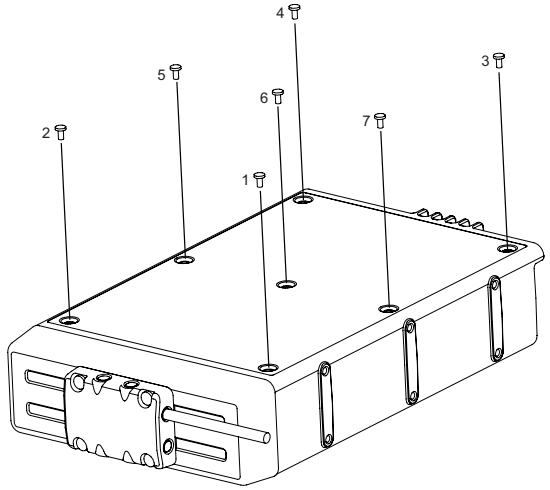


Figure 6-74. Sequence for Installing Top Cover Screws

6.2.3.5 Connector-Unit Board Kit Disassembly/Reassembly

NOTE: Bracketed numbers are identical to item numbers shown in Figure 9-2. “PM1200 Radio Exploded View” on page 9-3.

6.2.3.5.1 Connector-Unit Board Kit Disassembly

1. Before disassembling the FR-Interface board kit, perform a complete PA-Unit Board Kit disassembly by following the steps outlined in 6.2.3.4.1: “PA-Unit Board Kit Disassembly” on page 6-28.

2. After completing the PA-Unit Board Kit disassemble procedure, remove the lock plate [28] from the connector assembly [30] by using a pair of long nose pliers as shown in Figure 6-75.

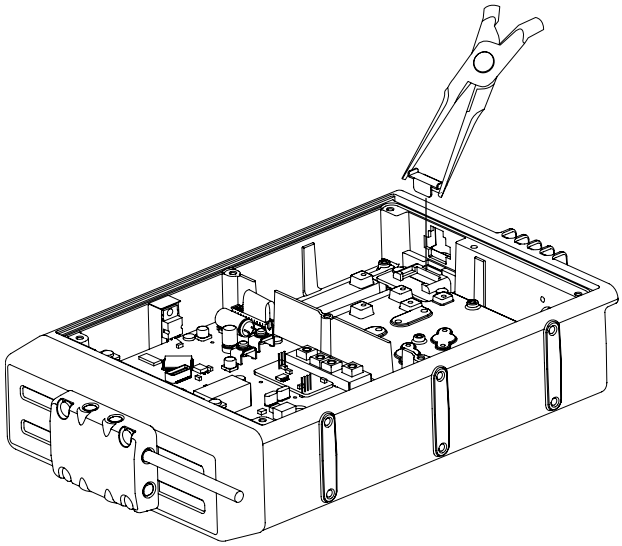


Figure 6-75. Removing Lock Plate

3. Pull the connector assembly [30] out of the Connector-Unit Board Kit [29] as shown in Figure 6-76.

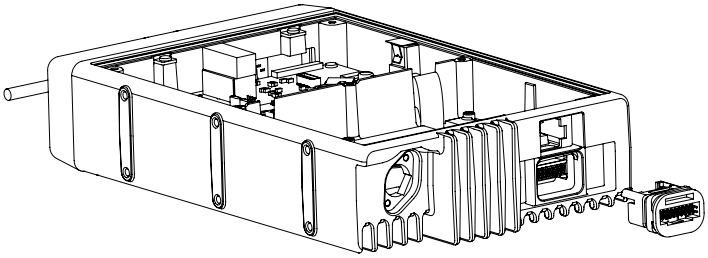


Figure 6-76. Removing Connector Assembly

4. Using a CR-V PH2 screwdriver, remove the 2 taptite screws, M3x8 NI [14] from the connector-unit board kit [29] as shown in Figure 6-77.

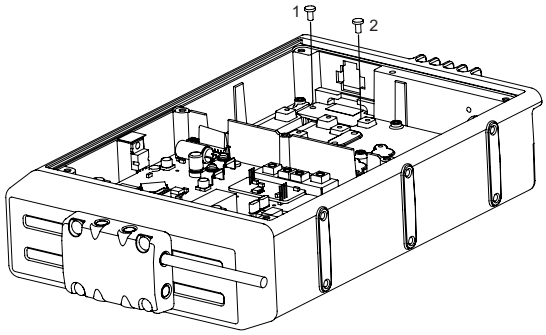


Figure 6-77. Removing Taptite Screws from Connector-Unit Board

5. Separate the connector-unit board kit [29] from the chassis [11].
6. Separate the mating connector [B] of the wire assembly 160mm 20P26P [26] from the connector-unit board kit [29] as shown in Figure 6-78.

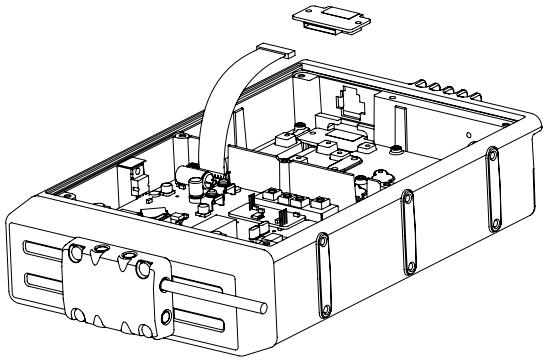


Figure 6-78. Removing Mating Connection from Connector-Unit Board Kit

6.2.3.5.2 Connector-Unit Board Kit Reassembly

1. Connect the mating connector [B] of the wire assembly 160mm 20P26P [26] to the connector-unit board kit [29] as shown in Figure 6-79.

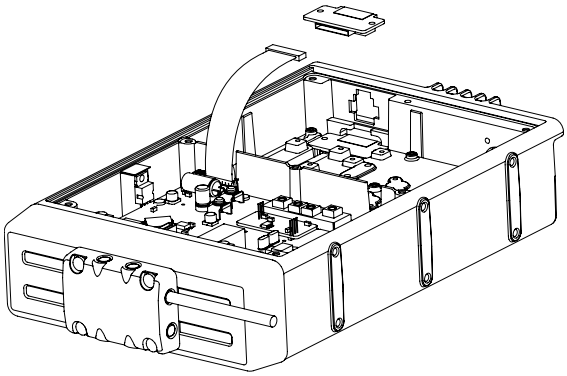


Figure 6-79. Removing Mating Connection from Connector-Unit Board Kit

2. Place the connector-unit board kit [29] in the chassis [11].

3. Using a CR-V PH2 torque driver, fasten the 2 taptite screws, M3x8 NI [14] to the connector-unit board kit [29] as shown in Figure 6-80 (Torqued to 9.8–10.9 kgf*cm/ 8.5–9.5 in. lbs).

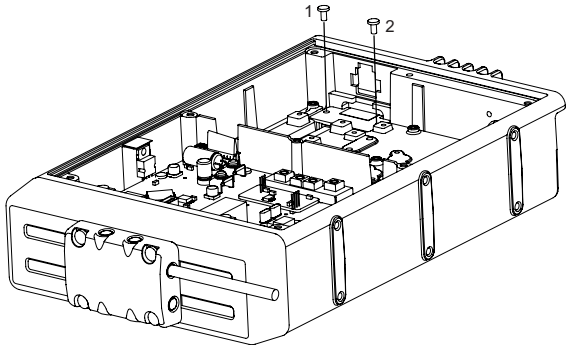


Figure 6-80. Sequence for Installing Connector-Unit Board Kit Screws

4. Attach the connector assembly [30] to the connector-unit board kit [29] as shown in Figure 6-79.

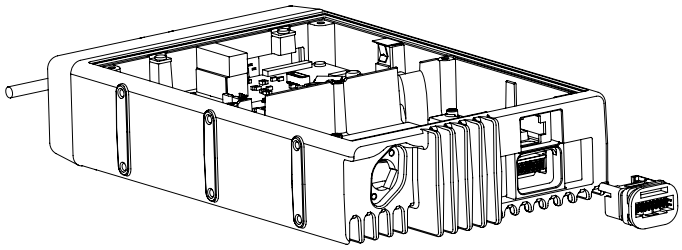


Figure 6-81. Installing Connector Assembly

5. Attach the lock plate [28] to the connector assembly [30] as shown in Figure 6-82. Ensure that the lock plate [28] clamp the connector assembly [30] properly.

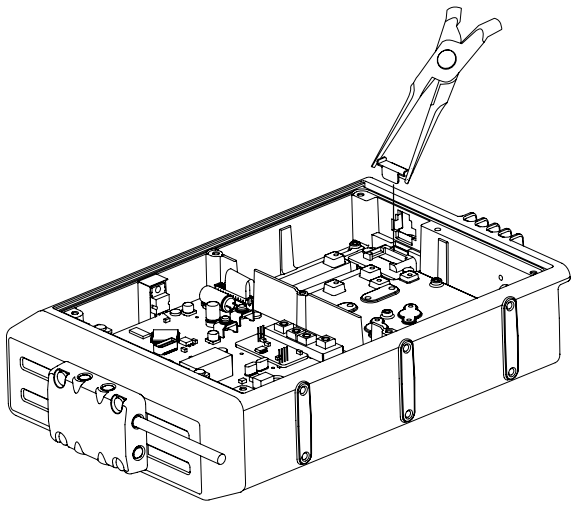


Figure 6-82. Installing Lock Plate to Connector Assembly

6. After installing the connector-unit board kit [29], assemble the radio by following the steps outlined in 6.2.3.4.2: “PA-Unit Board Kit Reassembly” on page 6-34.

6.2.3.6 Option Board Disassembly/Reassembly

NOTE: The two types of option boards available are: the PM1200 Quik Call II Decoder Option Board (HKLN4346_) and the PM1200 Digital ANI Encoder Option Board (HKLN4347_). These option boards need to be installed together with an Interface Board (HKLN4345_).

NOTE: Bracketed numbers are identical to item numbers shown in Figure 9-2. “PM1200 Radio Exploded View” on page 9-3.

6.2.3.6.1 Option Board Disassembly

1. Ensure all the accessory connections, power, antenna, and microphone are unplugged.
2. Using a CR-V PH2 screwdriver, remove the 7 binding head screws, M3x6 SUS B from the top cover as shown in Figure 6-82.

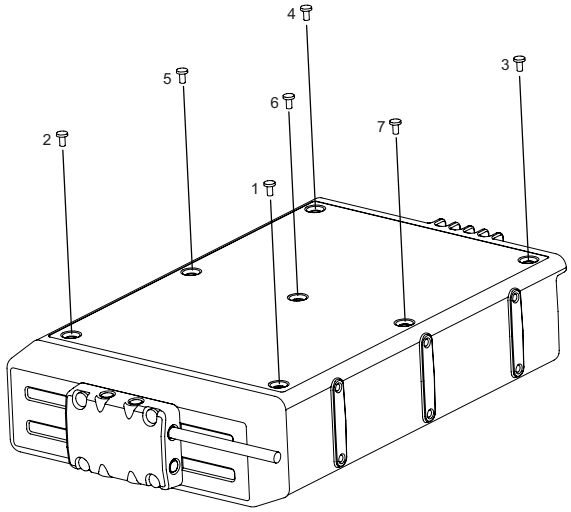


Figure 6-83. Removing Screws from Top Cover

3. Using a CR-V PH1 screwdriver, remove a taptite screw M2.6x6 from the chassis as shown in Figure 6-84.

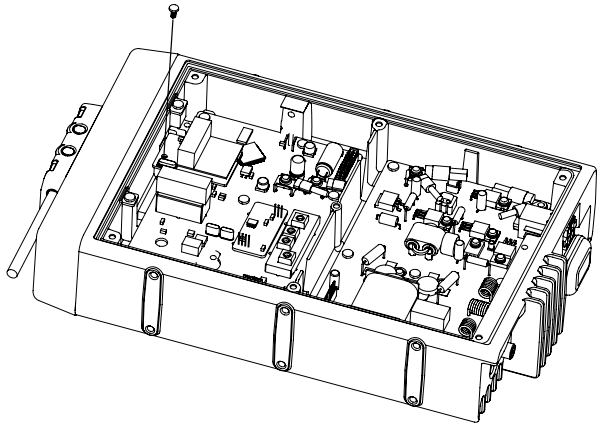


Figure 6-84. Removing Screws from Chassis

4. Separate the Interface Board and Option Board (Digital ANI Encoder Option Board/ Quik-Call II Decoder Option Board) from the main-unit board kit Figure 6-85.

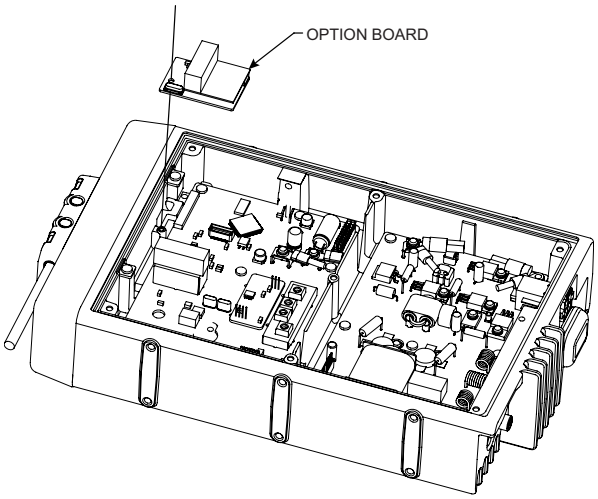


Figure 6-85. Removing Interface Board and sOption Board

5. Remove the Interface Board and Option Board by holding the edges of the PCB and lift them out of the chassis. Store them in an antistatic bag.

6.2.3.6.2 Option Board Reassembly

1. Handle the interface board and option board by the edges only, and take them out from the antistatic bag.
2. Attach the thinner foam to the Interface Board as shown in Figure 6-86 by first separating the adhesive cover from the bottom of the foam.

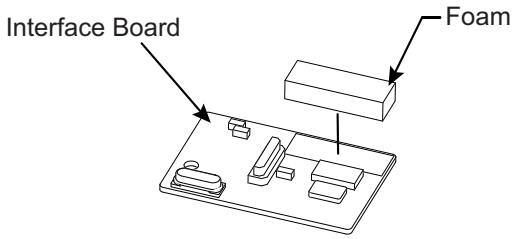


Figure 6-86. Pasting Foam to Interface Board

3. Separate the adhesive cover from the top of the thinner foam.

4. Attach the Interface Board onto the Main Unit PCB. Then, using a CR-V PH2 torque driver, fasten the provided taptite screw M2.6X6 to the chassis as shown in Figure 6-87 (Torqued to 3.5–4.6 kgf*cm/ 3–4 in. lbs).

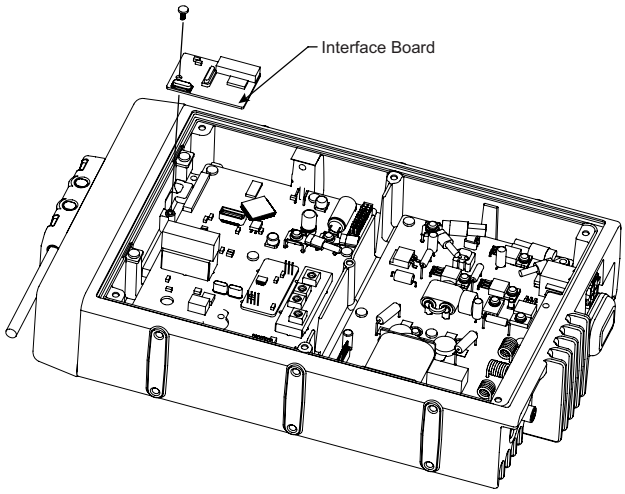


Figure 6-87. Installing Interface Board to Chassis

5. Attach the thicker foam on top of the connector of option board as shown in Figure 6-88 by first removing the adhesive cover.

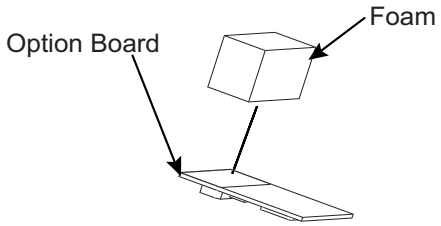


Figure 6-88. Paste Foam to Option Board

6. Attach the option board to the Interface Board as shown in Figure 6-89.

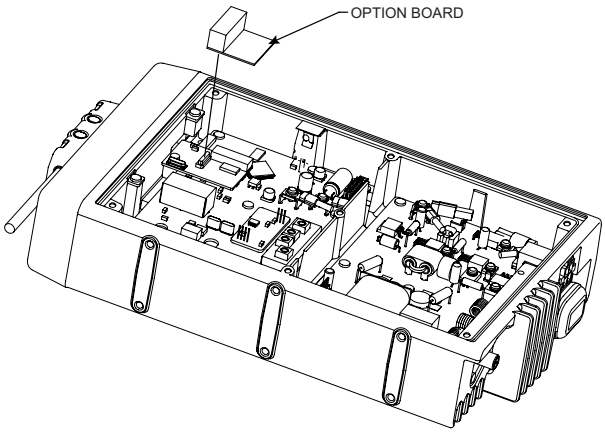


Figure 6-89. Attach Option Board to Interface Board

7. Place the top cover on the chassis and seat it properly. Compress the cover and chassis together to squeeze the foam into place and make torquing the screws easier.
8. Using a CR-V PH2 torque driver, fasten the 7 binding head screws, M3x6 SUS B to the top cover following the sequence as shown in Figure 6-90 (Torqued to 5.8–6.9 kgf*cm/ 5–6 in. lbs).

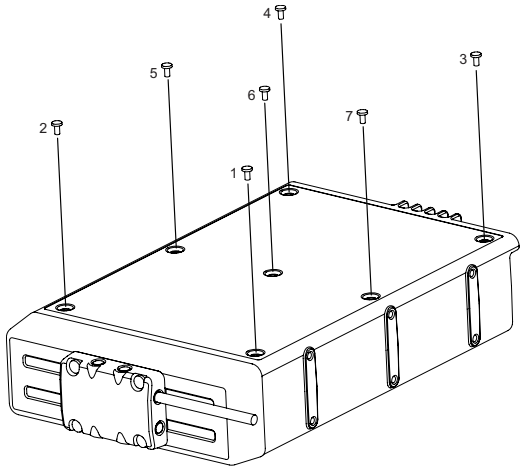


Figure 6-90. Sequence for Installing Top Cover Screws

6.3 Chassis Thermal Compound Replacement Procedure

Follow the following procedures when replacing the chassis thermal compounds.

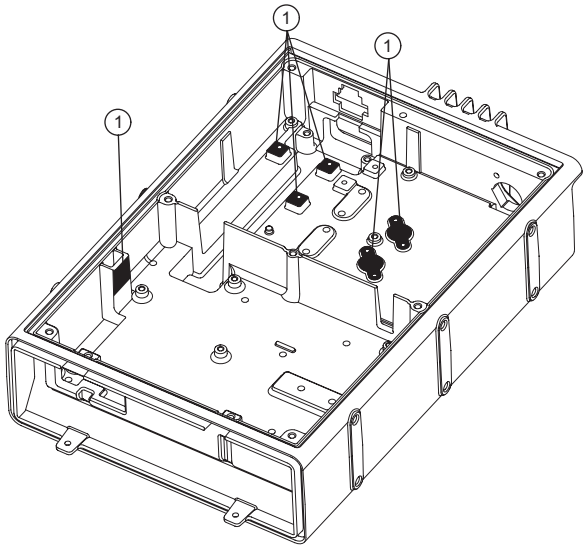


Figure 6-91. Chassis Thermal Compound Locations

Table 6-2. Chassis Thermal Pad Parts

Item No.	Part No.	Description
1	1110022D23	Silicone Thermal Compound

1. Use a soft cloth to remove any remaining residue. Alcohol may also be used, if necessary.
2. The thermal compound is applied to both the chassis surface and the PCB surface.
3. Apply pressure to the PCB and chassis to remove any air gaps between both surfaces.

6.4 Fastener Torque Chart

Table 6-3 lists the various fasteners by part number and description, followed by the torque values and the location where used. Torque all fasteners to the recommended value when assembling the radio.

Table 6-3. Fastener Torque Chart

Part Number	Description	Repair Torque (kgf*cm)	Repair Torque (in.lbs.)	Where Used
HKLN4371_	Hex Nut - Supplied with VR Unit Board Kit	7.5 – 8.6	6.5 – 7.5	Volume Potentiometer
0208800H17	Special Nut	7.5 – 8.6	6.5 – 7.5	Channel Selector Switch
HKLN4372_	Special Nut - Supplied with Panel Interface Board Kit	4.6 – 5.8	4 – 5	Speakerphone Jack
0308800H22	Screw, Taptite screw M2.6x6	3.5 – 4.6	3 – 4	Key Unit Board Kit, Display Unit Board Kit, Internal Speaker
0308800H21	Screw, Binding Head screw M3x6 SUS B	3.5 – 4.6	3 – 4	Control Head Front Housing, Transceiver Front Panel (Bottom)
0308800H24	Screw, Binding Head screw M4x8 SUS B	5.8 – 6.9	5 – 6	Cable Strain Relief Plate, Control Head Back Housing Assembly
0308800H23	Screw, Binding Head screw M3x6 NI	5.8 – 6.9	5 – 6	Heat Sink, Panel-Interface Unit Board Kit
0308800H39	Screw, Binding Head screw M3x6 SUS	3.5 – 4.6	3 – 4	Transceiver Front Panel, Antenna Connector
0308800H22	Screw, Taptite screw M2.6x6	3.5 – 4.6	3 – 4	RF-Interface Board Kit
0308800H40	Screw, Taptite screw M3x8 NI	9.8 – 10.9	8.5 – 9.5	Main-Unit Board Kit and PA-Unit Board Kit
0308800H41	Screw, SEMS screw HSM3x6 NI	5.8 – 6.9	5 – 6	Main-Unit Board Kit terminal and PA-Unit Board Kit terminal
0308800H42	Screw, SEMS screw SM3x8 NI	5.8 – 6.9	5 – 6	PA-Unit Board Kit
0308800H43	Screw, SEMS screw ASM3x8 NI	4.6 – 5.8	4 – 5	PA-Unit Board Kit

Table 6-3. Fastener Torque Chart (Continued)

Part Number	Description	Repair Torque (kgf*cm)	Repair Torque (in.lbs.)	Where Used
0308800H44	Screw, Binding Head screw M3x6 SUS B with Nylok	5.8 – 6.9	5 – 6	Top Cover

Notes

Chapter 7 Basic Troubleshooting

7.1 Introduction

This chapter contains troubleshooting charts which can help isolate a problem to the board level. Board-level troubleshooting does not attempt to isolate problems to the component level.

Caution

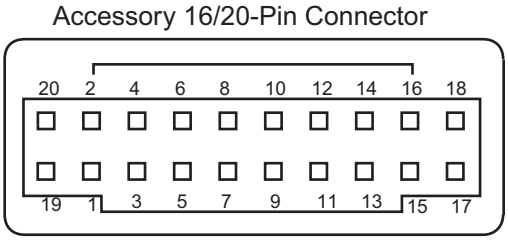
When performing *both* transmit and, especially, receive tests, it is still possible that equipment might be damaged by the radio transmitter. Besides a possible radio failure, the radio might also transmit while in receive under the following conditions: trunking-mode affiliation, missing emergency jumper, a defective PTT button, or other unintentional PTT activations.

With the exception of some inputs on service monitors, a suitable attenuator rated at 100 W or more should always be used with all test equipment connected to the RF connector.

7.2 Accessory Connectors

7.2.1 20-Pin Accessory Connector

A 20-Pin accessory connector is located on the rear of the transceiver. External TX audio line input, PTT (Push To Talk), Squelch, and external RX audio line output signal may be obtained from this connector for use with data transmission/ reception modem and other accessories.



1 - SPEAKER
2 - EXT_MIC_AUDIO
3 - DIG_IN1 (Data PTT)
4 - DIG_OUT2 (EXTERNAL ALARM)
5 - FLAT_TX_AUDIO
6 - DIG_IN3 = Sel5/MDC
7 - GROUND
8 - DIG_IN_OUT_4 = Sel5/MDC
9 - DIG_IN5 WITH WAKEUP (EMERGENCY)
10 - DIG_IN6 WITH WAKEUP (IGNITION)
11 - FLAT/FILTERED_RX_AUDIO
12 - DIG_IN_OUT_7
13 - SWB+
14 - DIG_IN_OUT_8
15 - RSSI
16 - SPEAKER+
17 - BUS+
18 - BOOT_CNTRL
19 - N.C.
20 - N.C.

Figure 7-1. Transceiver Rear Accessory Connector Pin Configuration

7.3 Replacement Board Procedures

Once a problem has been isolated to a specific board, use one of the following recommended repair procedures:

- Install a good board from your inventory into the radio.
- Order a replacement board from Radio Products Services Division. Refer to "Appendix A Replacement Parts Ordering" on page A-1 for further information.

7.4 Transmitter Troubleshooting

Table 7-1 can help troubleshoot problems that might occur in the transmitter section of the radio.

Table 7-1. Transmitter Troubleshooting Chart

Symptom	Possible Cause	Correction or Test (Measurements Taken at Room Temperature)
No RF Power Output	Microphone	Is the PTT switch being pressed correctly? If yes, there is a possibility that there is no contact inside the microphone.
	Power current capacity	Check whether there is a drop in supplied voltage.
Distorted Modulation	Frequency Setting	Check to ensure the correct channel/ frequency is selected.
No Modulation, Bad Microphone Sensitivity	Microphone	Speak loudly into the microphone while monitoring the microphone line (pin 5 of J3402 in dash configuration). If the voltage of pin 5 of J3402 is not greater than 80 mVrms, then check the microphone.
No/Low Signaling (PL, DPL, Trunking, MDC)	Check Programming	Reprogram the codeplug using CPS.

7.5 Receiver Troubleshooting

Table 7-2 can help troubleshoot problems that might occur in the receiver section of your radio.

Table 7-2. Receiver Troubleshooting Chart

Symptom	Possible Cause	Correction or Test (Measurements Taken at Room Temperature)
Radio does not power-up	Blown power fuse	Check the fuse in the DC cable.
	RF deck	Measure the voltage of MAIN UNIT J1001. The voltage from a battery is applied all the time in this part (+B). If +B is low, check the P7001 (DC Connector) and DC cable.
	Control Head / RF deck flex	If +B is not present on J5006 pin 12, then the flex is suspected. Replace the flex.
No Receiver Audio or Receive Does Not Unsquelch	Code Plug	Check the codeplug to ensure correct frequency and signaling (PL, DPL) is enabled by using CPS.
	Speaker	Check for speaker leads shorted to ground or open speaker wires. Replace, if necessary.
Audio Distorted or Not Loud Enough	Codeplug	Ensure the codeplug is properly configured, including bandwidth and signaling.
	Synthesizer Not On Frequency/Working	Check the local oscillator frequency.
RF Sensitivity Poor	Synthesizer Not On Frequency/Working	Check the local oscillator frequency.
Radio Will Not Squelch	Codeplug	Check the offending channel for spurious activity by benchmarking with a known-good radio or service monitor. If not, increase the squelch level using the appropriate radio-programming software.
Excessive Noise in Fading Conditions	Check Programming for Correct Bandwidth	Reprogram the codeplug with the correct bandwidth.

Notes

Chapter 8 Functional Block Diagrams and Connectors

This chapter contains the PM1200 digital mobile radio functional block diagrams and connector locations.

Table 8-1. Table of Functional Block Diagrams and Connectors

8.1 PM1200 Functional Block Diagram 1

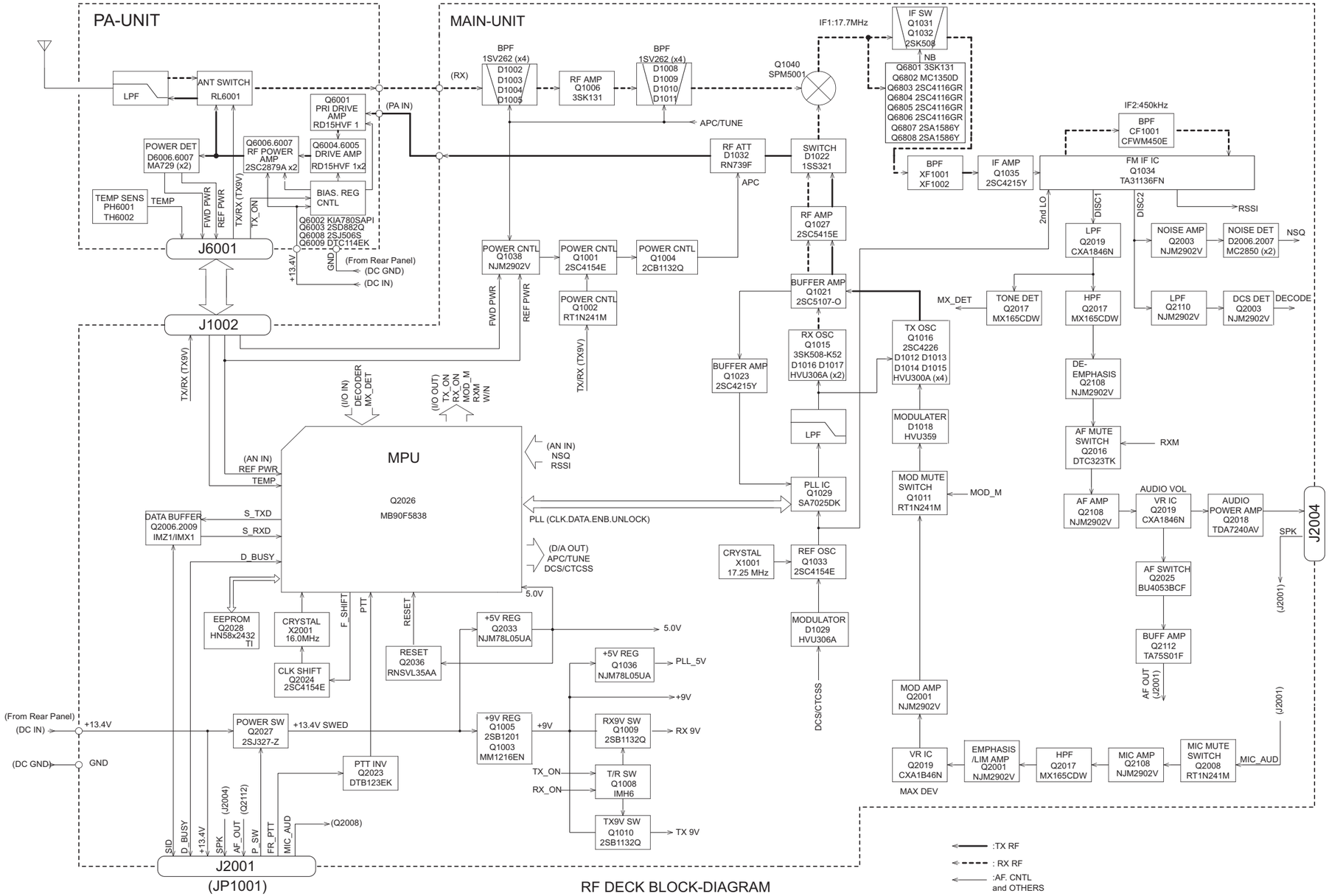


Figure 8-1. PM1200 Functional Block Diagram

8.2 PM1200Functional Block Diagram 2

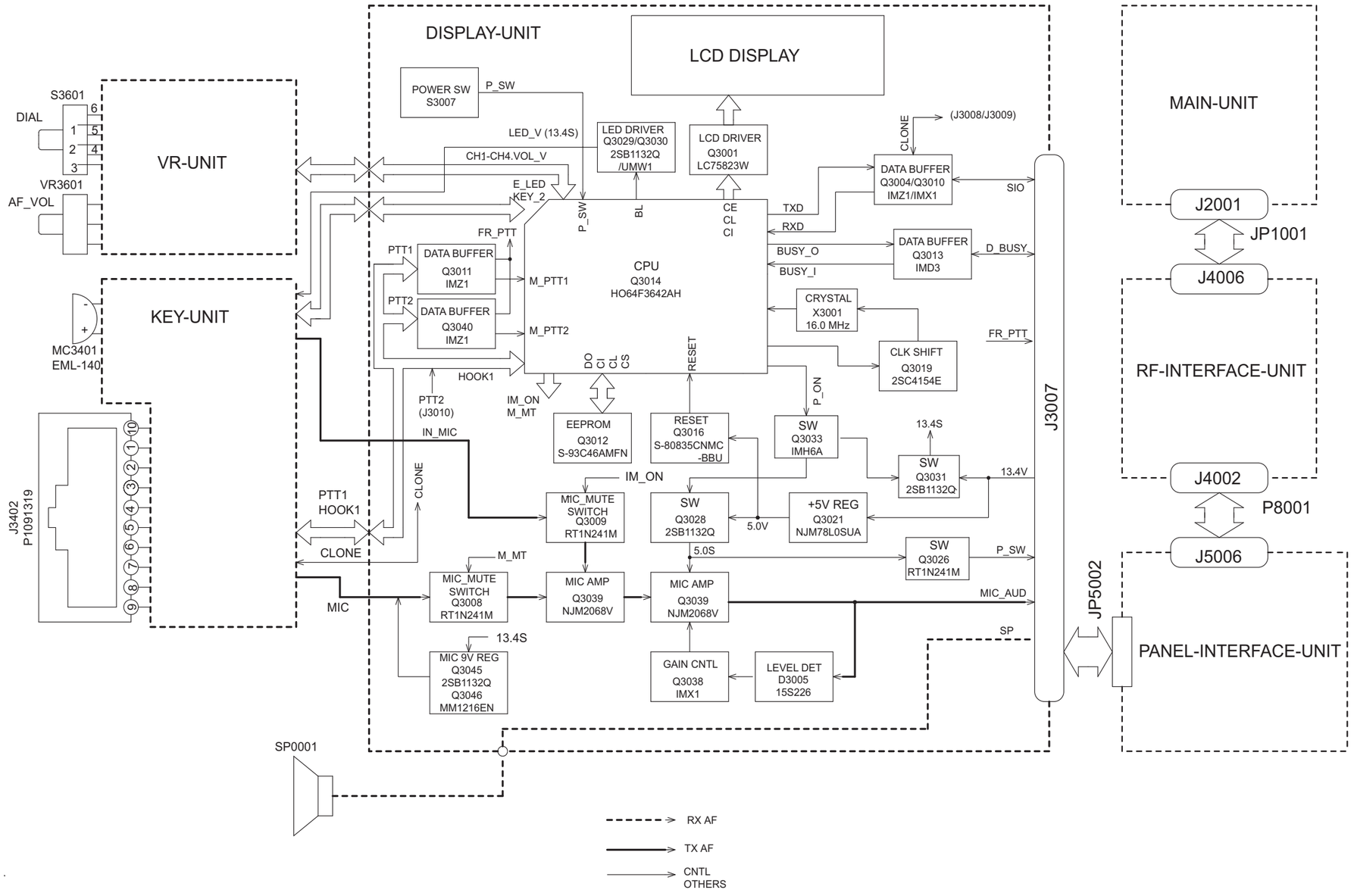


Figure 8-2. PM1200 Functional Block Diagram 2

8.3 PM1200 Functional Block Diagram 3

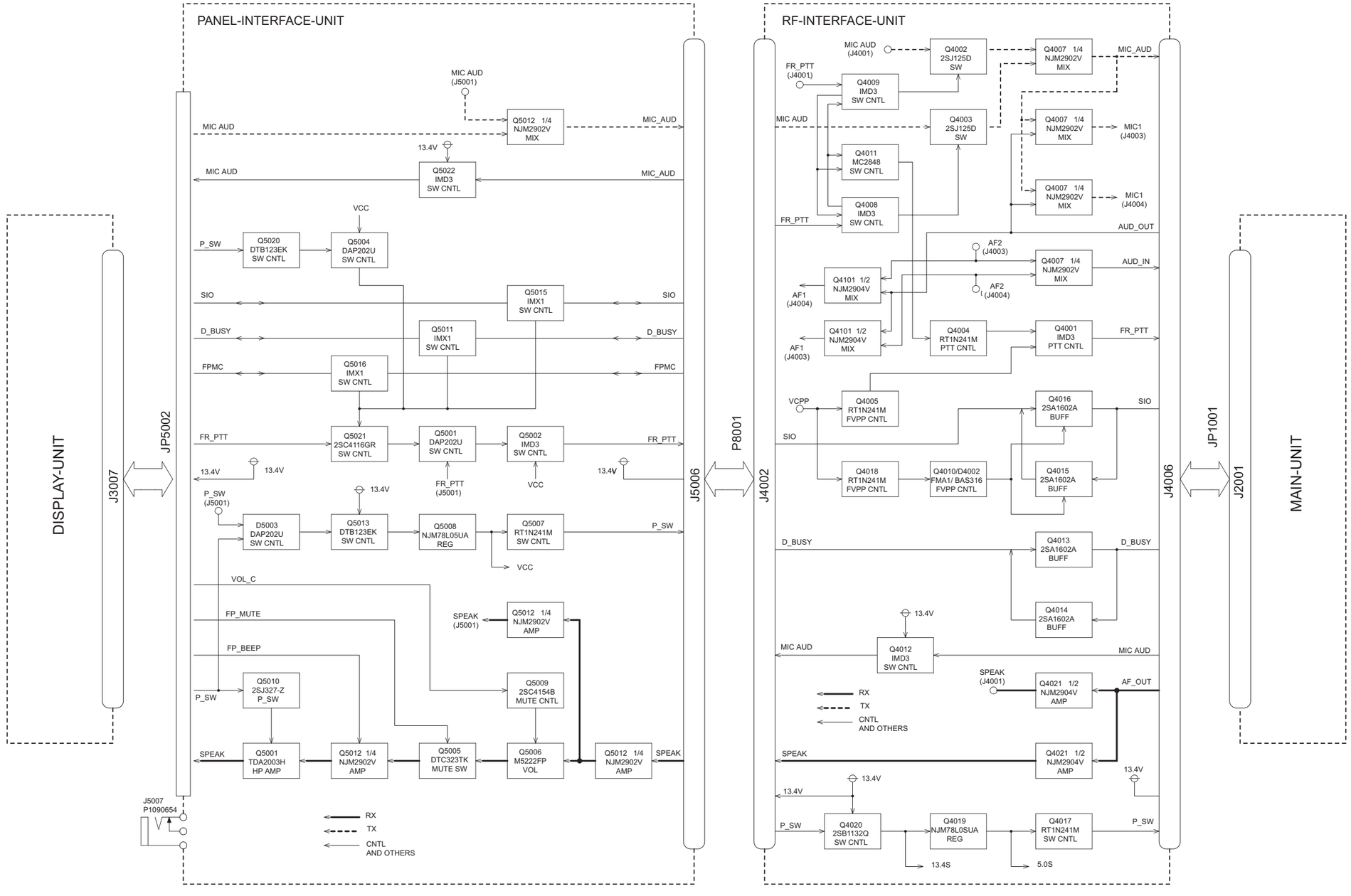


Figure 8-3. PM1200 Functional Block Diagram 3

8.4 PM1200 Connection Diagram

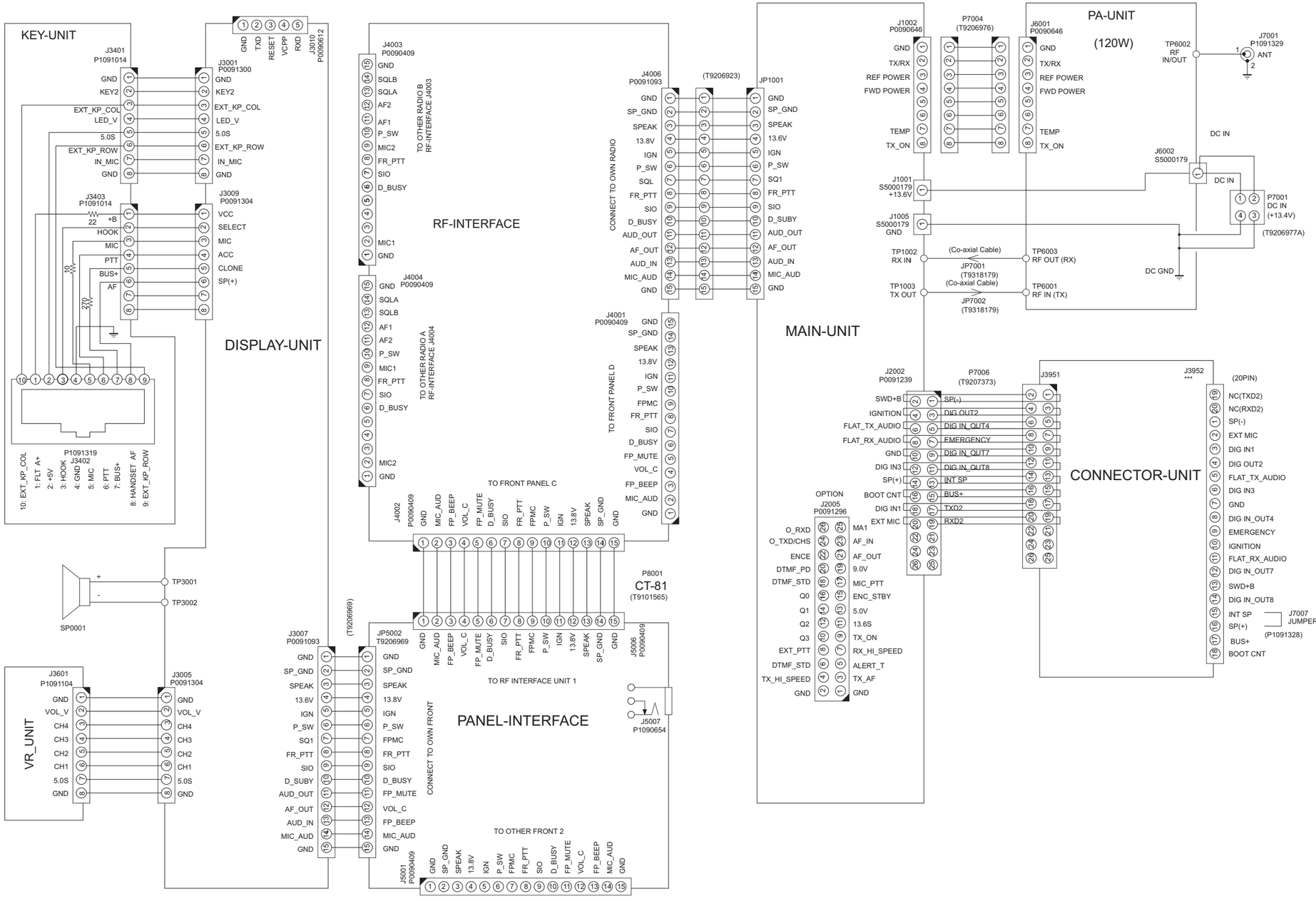


Figure 8-4. PM1200 Connection Diagram

8.5 Transmitter Block Diagram

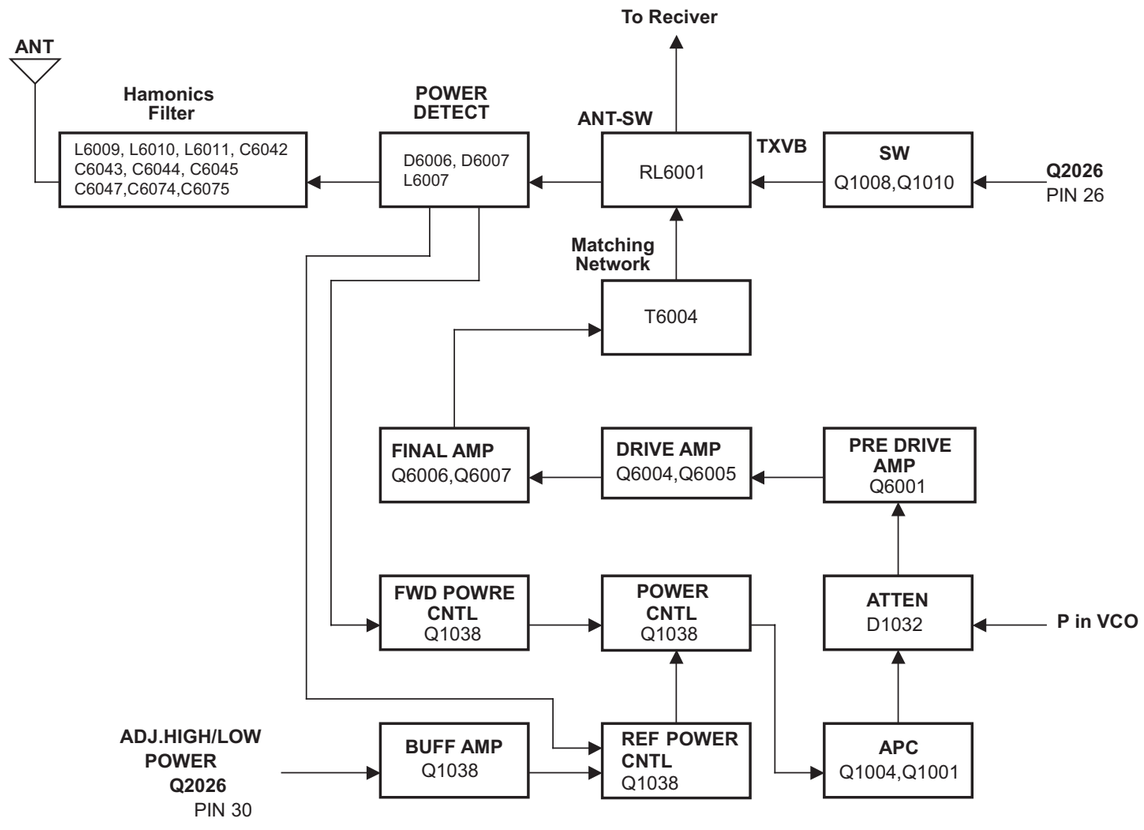


Figure 8-5. Transmitter Block Diagram

8.6 Synthesizer Block Diagram

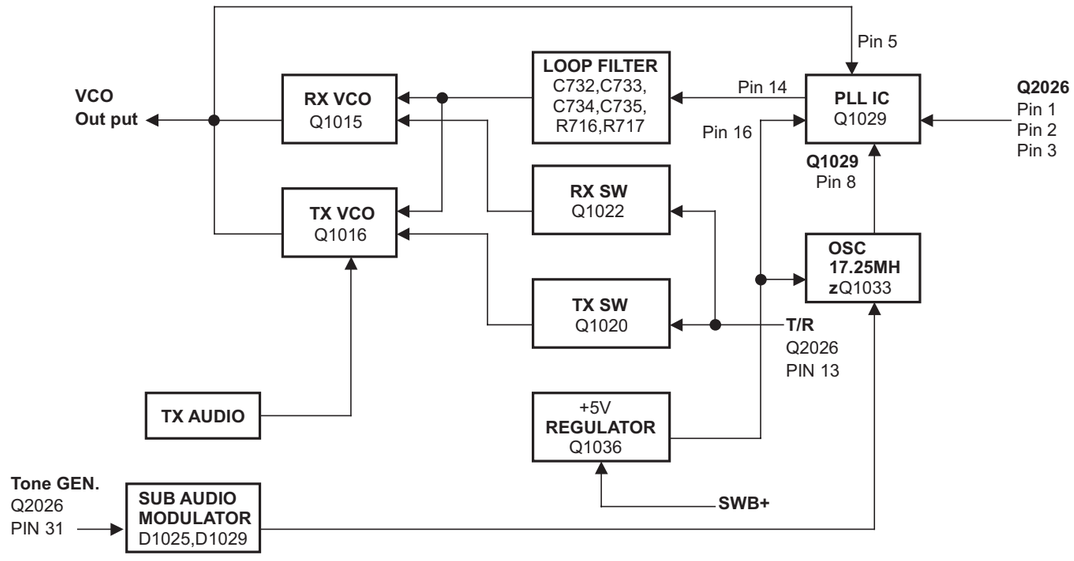


Figure 8-6. Synthesizer Block Diagram

8.7 Transmit Audio Block Diagram

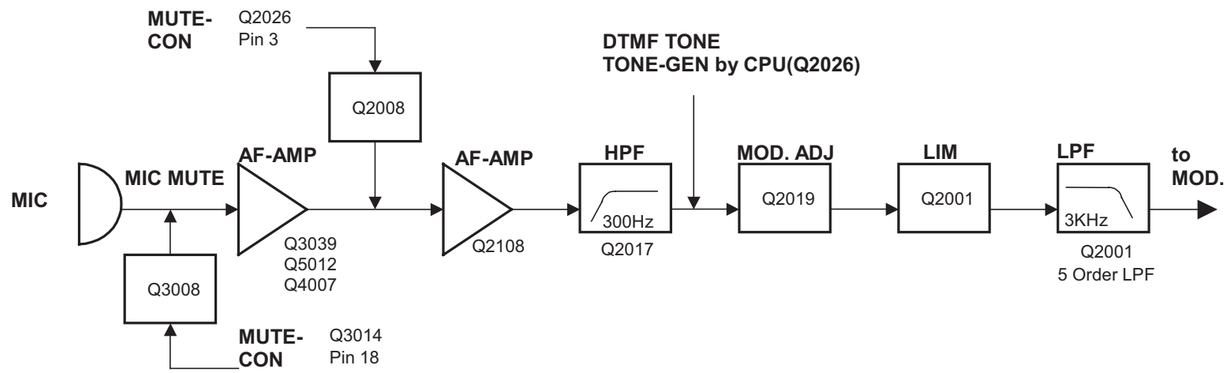


Figure 8-7. Transmit Audio Block Diagram

8.8 Radio Connector Locations

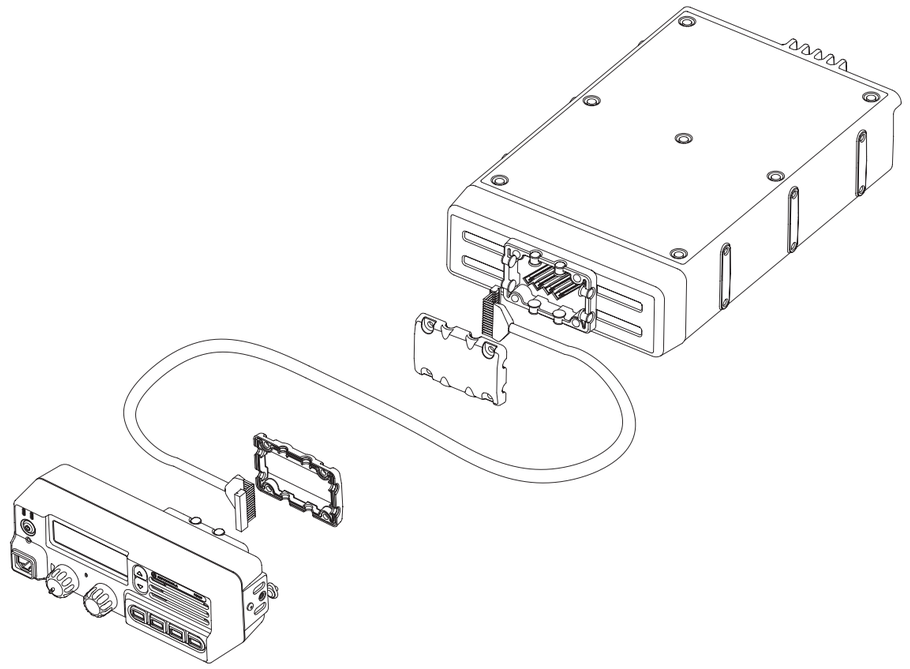


Figure 8-8. Remote-Mount Radio Connector Locations

8.9 Radio Connector Locations (cont.)

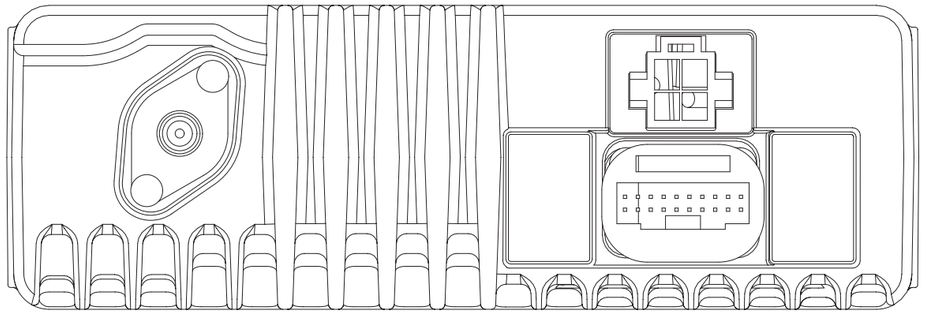


Figure 8-9. PA Unit Board Connector Location

Chapter 9 Exploded Views and Parts Lists

This chapter contains the exploded views and associated parts lists for the PM1200 digital mobile radio and accessories. Tables containing pushbutton parts lists are also included at the end of this chapter.

Table 9-1. Table of Exploded Views

9.1 PM1200 Control Head Exploded View

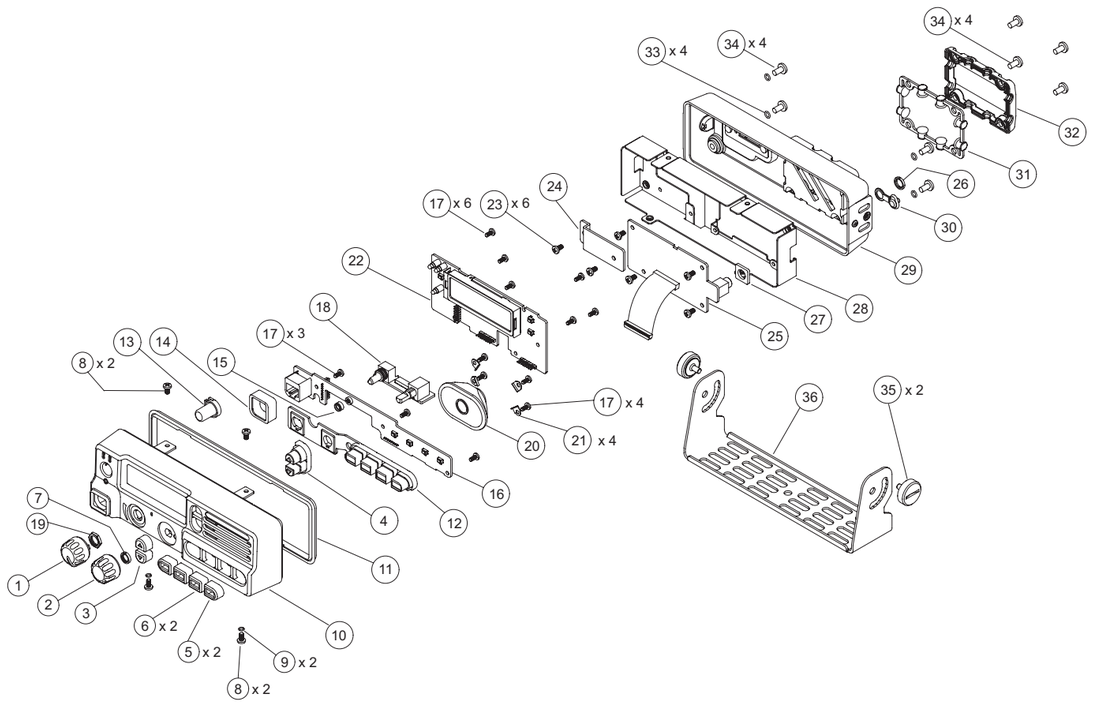


Figure 9-1. PM1200 Control Head Exploded View

Table 9-2. PM1200 Control Head Parts List

Item No.	Motorola Part No.	Description
1	3608800H07	Volume Knob
2	3608800H08	Channel Selector Knob
3	3808800H06	Keycap (Group)
4		Channel Group Knob
5	3808800H05	Keycap (Functional 1)
6		Keycap (Functional 2)
7	0208800H17	Special Nut
8	0308800H21	Screw, Binding Head Screw M3x6 Sus B
9	4208800H19	O-ring (2.5x1)
10	1508800G99	Front Housing Assembly
11	3208800H14	Rubber Packing
12	3808800H04	Functional Keypad
13	3808800H13	Power Knob
14	3208800H11	Rubber Telco Seal
15	1408800H12	Mic Holder
16	HKLN4370_	Key Unit Board Kit
17	0308800H22	Screw, Taptite Screw M2.6x6
18	HKLN4371_	VR Unit Board Kit
19		Hex Nut
20	5008800G97	Internal Speaker
21	5808800H15	Speaker Fitting
22	HKLN4369_	Display Unit Board Kit
23	0308800H23	Screw, Binding Head Screw M3x6 Ni
24	2608800H03	Heat Sink
25	HKLN4372_	Panel-interface Unit Board Kit
26		Special Nut
27	7508800H18	Foam (Speaker Jack)
28	0708800H02	Frame
29	1508800H01	Back Housing Assembly
30	3808800H16	Ear Cap
31	3208800H10	Gasket
32	6408800H09	Cable Strain Relief Plate
33	4208800H20	O-ring (3.7x1)
34	0308800H24	Screw, Binding Head Screw M4x8 Sus B
35	HKLN4334_	Knob Screw
36		Control Head Bracket
37	HKLN4341_	Remote Mount Cable 20 Ft (Not Shown)
38	3308800H25	Key Label (Not Shown)

9.2 PM1200 Radio Exploded View

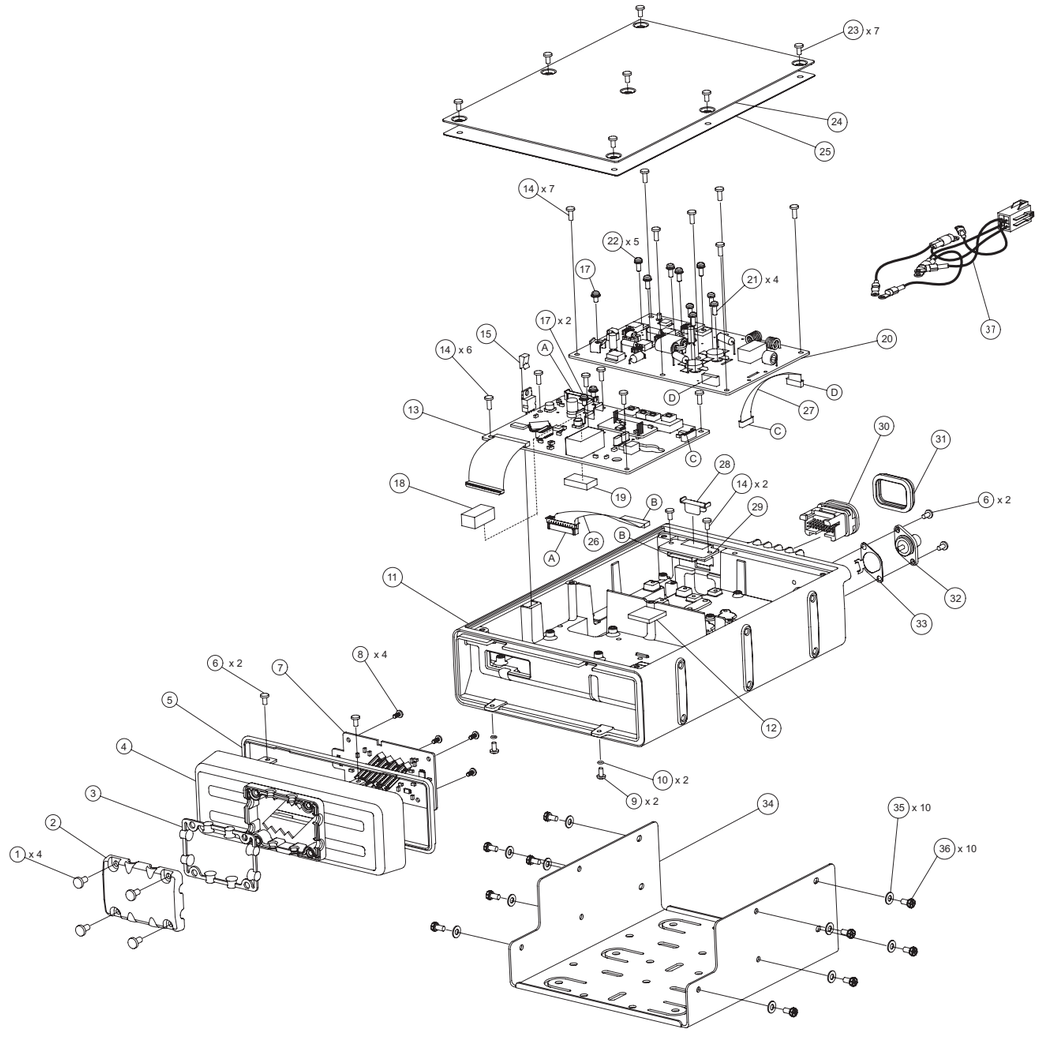


Figure 9-2. PM1200 Radio Exploded View

Table 9-3. PM1200 Radio Parts List

Item No.	Motorola Part No.	Description
1	0308800H24	Screw, Binding Head Screw M4x8 Sus B
2	6408800H09	Cable Strain Relief Plate
3	3208800H10	Gasket
4	1508800H26	Front Panel
5	3208800H14	Rubber Packing
6	0308800H39	Screw, Binding Head Screw M3x6 Sus
7	HKLN4374_	Rf-interface Unit Board Kit
8	0308800H22	Screw, Taptite Screw M2.6x6
9	0308800H21	Screw, Binding Head Screw M3x6 Sus B
10	4208800H19	O-ring (2.5x1)
11	2708800H27	Chassis
12	7508800H28	Poron Pad
13	HKLN4335_	Main-Unit Board Kit 29.7-37 MHz 120 W
	HKLN4336_	Main-Unit Board Kit 37-50 MHz 120 W
14	0308800H40	Screw, Taptite Screw M3x8 Ni
15	5808800H29	Holder
16	3008800H36	Wire Assembly (Brown) (Not Shown)
17	0308800H41	Screw, Sems Screw HSM 3x6 Ni
18	7508800H30	Poron Pad
19	7508800H31	Poron Pad (VCO)
20	HKLN4337_	PA-Unit Board Kit 29.7-37 Mhz 120 W
	HKLN4338_	PA-Unit Board Kit 37-50 Mhz 120 W
21	0308800H42	Screw, Sems Screw SM 3x8 Ni
22	0308800H43	Screw, Sems Screw ASM 3x8 Ni
23	0308800H44	Screw, Binding Head Screw M3x6 Sus B With Nylok
24	6408800H32	Top Cover
25		Foam
26	3008800H34	Wire Assembly 160mm20p26p
27	3008800H35	Wire Assembly
28	5808800H33	Lock Plate
29	HKLN4373_	Connector-unit Board Kit
30	2886122B03	Connector Assembly
31	3202607Y01	Gasket Cover
32	0908800H38	Antenna Connector VS-Mini UHF-N/Br1
33		Earth Plate
34	HKLN4342_	Transceiver Bracket
35		Plain Washer Fw4 Al
36		Screw, SM4x8 Sus
37	3008800H37	Power Wire Assembly

Notes

Appendix A Replacement Parts Ordering

A.1 Basic Ordering Information

When ordering replacement parts or equipment information, the complete identification number should be included. This applies to all components, kits, and chassis. If the component part number is not known, the order should include the number of the chassis or kit of which it is a part, and sufficient description of the desired component to identify it.

Crystal orders should specify the crystal type number, crystal and carrier frequency, and the model number in which the part is used.

A.2 Motorola Online

Motorola Online users can access our online catalog at

http://www.motorola.com/businessonline

To register for online access, please call 1-800-422-4219 (for U.S. and Canada Service Centers only). International customers can obtain assistance at http://www.motorola.com/businessonline.

A.3 Mail Orders

Mail orders are only accepted by the US Federal Government Markets Division (USFGMD).

Motorola
7031 Columbia Gateway Drive
3rd Floor – Order Processing
Columbia, MD 21046
U.S.A.

A.4 Telephone Orders

Radio Products and Solutions Organization*
(United States and Canada)
7:00 AM to 7:00 PM (Central Standard Time)
Monday through Friday (Chicago, U.S.A.)
1-800-422-4210
1-847-538-8023 (United States and Canada)

U.S. Federal Government Markets Division (USFGMD)
1-877-873-4668
8:30 AM to 5:00 PM (Eastern Standard Time)

A.5 Fax Orders

Radio Products and Solutions Organization*
(United States and Canada)
1-800-622-6210
1-847-576-3023 (United States and Canada)

USFGMD
(Federal Government Orders)
1-800-526-8641 (For Parts and Equipment Purchase Orders)

A.6 Parts Identification

Radio Products and Solutions Organization*
(United States and Canada)
1-800-422-4210

A.7 Product Customer Service

Radio Products and Solutions Organization (United States and Canada)

1-800-927-2744

* 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).

Appendix B Motorola Service Centers

B.1 Servicing Information

If a unit requires further complete testing, knowledge and/or details of component level troubleshooting or service than is customarily performed at the basic level, please send the radio to a Motorola Service Center as listed below.

B.2 Motorola Service Center

45D Butterfield Trail
El Paso, TX 79906
Tel: 1-800-227-6772

B.3 Motorola Federal Technical Center

4395 Nicole Drive
Lanham, MD 20706
Tel: 1-800-969-6680
Fax: 1-800-784-4133

Notes

Glossary

This glossary contains an alphabetical listing of terms and their definitions that are applicable to portable and mobile subscriber radio products. All terms do not necessarily apply to all radios, and some terms are merely generic in nature.

Term	Definition
A/D	*See analog-to-digital conversion.*
ADC	*See analog-to-digital converter.*
analog	Refers to a continuously variable signal or a circuit or device designed to handle such signals. *See also digital.*
analog-to-digital conversion	Conversion of an instantaneous dc voltage level to a corresponding digital value. *See also D/A.*
analog-to-digital converter	A device that converts analog signals into digital data. *See also DAC.*
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.
band	Frequencies allowed for a specific purpose.
baseband interface port	Synchronous serial interface to the transceiver board used to transfer transmit and receive audio data.
ball grid array	A type of IC package characterized by solder balls arranged in a grid that are located on the underside of the package.
CODEC	*See coder/decoder.*
coder/decoder	A device that encodes or decodes a signal.
CPS	*See Customer Programming Software.*
Customer Programming Software	Software with a graphical user interface containing the feature set of a radio.
D/A	*See digital-to-analog conversion.*
DAC	*See digital-to-analog converter.*

Term	Definition
Data communication equipment	Definition for device (such as radio) data communications using the RS232 protocol. The correct data communication wiring requires the device's TX pins (output) to connect to the RX pins (input) and the RTS pins (output) to connect to the CTS pins (input). It is incorrect to attach device pins having the same name to each other.
Data terminal equipment	Data terminal equipment; for example, a computer.
DCE	*See Data communication equipment.*
default	A pre-defined set of parameters.
digital	Refers to data that is stored or transmitted as a sequence of discrete symbols from a finite set; most commonly this means binary data represented using electronic or electromagnetic signals. *See also analog.*
digital-to-analog conversion	Conversion of a digital signal to a voltage that is proportional to the input value. *See also A/D.*
digital-to-analog converter	A device that converts digital data into analog signals. *See also ADC.*
Digital Private-Line	A type of digital communications that utilizes privacy call, as well as memory channel and busy channel lock out to enhance communication efficiency.
digital signal processor	A microcontroller specifically designed for performing the mathematics involved in manipulating analog information, such as sound, that has been converted into a digital form. DSP also implies the use of a data compression technique.
digital signal processor code	Object code executed by the Digital Signal Processor in a subscriber radio. The DSP is responsible for computation-intensive tasks, such as decoding signaling.
DPL	*See Digital Private-Line. See also PL.*
DSP	*See digital signal processor.*
DSP code	*See digital signal processor code.*
DTMF	*See dual tone multi-frequency.*
dual tone multi-frequency	The system used by touch-tone telephones. DTMF assigns a specific frequency, or tone, to each key so that it can easily be identified by a microprocessor.
EEPROM	*See Electrically Erasable Programmable Read-Only Memory.*

Term	Definition
Electrically Erasable Programmable Read-Only Memory	A special type of PROM that can be erased by exposing it to an electrical charge. An EEPROM retains its contents even when the power is turned off.
FCC	Federal Communications Commission.
firmware	Code executed by an embedded processor such as the Host or DSP in a subscriber radio. This type of code is typically resident in non-volatile memory and as such is more difficult to change than code executed from RAM.
FGU	*See frequency generation unit.*
flash	A non-volatile memory device similar to an EEPROM. Flash memory can be erased and reprogrammed in blocks instead of one byte at a time.
FLASHport	A Motorola term that describes the ability of a radio to change memory. Every FLASHport radio contains a FLASHport EEPROM memory chip that can be software written and rewritten to, again and again.
FMR	*See Field Manual Revision..*
Field Manual Revision	A publication that provides supplemental information for its parent publication before it is revised and reissued.
FPGA	Field Programmable Gate Array.
frequency	Number of times a complete electromagnetic-wave cycle occurs in a fixed unit of time (usually one second).
frequency generation unit	This unit generates ultra-stable, low phase noise master clock and other derived synchronization clocks that are distributed throughout the communication network.
IC	*See integrated circuit.*
IF	Intermediate Frequency.
integrated circuit	An assembly of interconnected components on a small semiconductor chip, usually made of silicon. One chip can contain millions of microscopic components and perform many functions.
kHz	*See kilohertz.*
kilohertz	One thousand cycles per second. Used especially as a radio-frequency unit.
LCD	*See liquid-crystal display.*
LED	*See light emitting diode.*
light emitting diode	An electronic device that lights up when electricity is passed through it.

Term	Definition
liquid-crystal display	An LCD uses two sheets of polarizing material with a liquid-crystal solution between them. An electric current passed through the liquid causes the crystals to align so that light cannot pass through them.
LO	See Local oscillator.
Local Oscillator	Oscillator used in a super heterodyne receiver to down-convert a received signal to the intermediate frequency.
Master In Slave Out	SPI data line from a peripheral to the MCU.
Master Out Slave In	SPI data line from the MCU to a peripheral.
MCU	*See microcontroller unit.*
MDC	Motorola Digital Communications.
MHz	*See Megahertz.*
Megahertz	One million cycles per second. Used especially as a radio-frequency unit.
microcontroller unit	Also written as µC. A microprocessor that contains RAM and ROM components, as well as communications and programming components and peripherals.
MISO	*See Master In Slave Out.*
MOSI	*See Master Out Slave In.*
multiplexer	An electronic device that combines several signals for transmission on some shared medium (e.g., a telephone wire).
MUX	*See multiplexer.*
oscillator	An electronic device that produces alternating electric current and commonly employs tuned circuits and amplifying components.
PA	Power amplifier.
PC Board	Printed Circuit Board. Also referred to as a PCB.
phase-locked loop	A circuit in which an oscillator is kept in phase with a reference, usually after passing through a frequency divider.
PL	*See private-line tone squelch.*
PLL	*See phase-locked loop.*
private-line tone squelch	A continuous sub-audible tone that is transmitted along with the carrier. *See also DPL.*
Programmable Read-Only Memory	A memory chip on which data can be written only once. Once data has been written onto a PROM, it remains there forever.

Term	Definition
programming cable	A cable that allows the CPS to communicate directly with the radio using RS232.
PROM	*See Programmable Read-Only Memory.*
PTT	*See Push-to-Talk.*
Push-to-Talk	The switch or button usually located on the left side of the radio which, when pressed, causes the radio to transmit. When the PTT is released, the unit returns to receive operation.
radio frequency	The portion of the electromagnetic spectrum between audio sound and infrared light (approximately 10 kHz to 10 GHz).
radio frequency power amplifier	Amplifier having one or more active devices to amplify radio signals.
RAM	*See random access memory.*
random access memory	A type of computer memory that can be accessed randomly; that is, any byte of memory can be accessed without touching the preceding bytes.
read-only memory	A type of computer memory on which data has been prerecorded. Once data has been written onto a ROM chip, it cannot be removed and can only be read.
real-time clock	A module that keeps track of elapsed time even when a computer is turned off.
receiver	Electronic device that amplifies RF signals. A receiver separates the audio signal from the RF carrier, amplifies it, and converts it back to the original sound waves.
Receiver Back-End IC	A custom integrated circuit providing a digital receiver intermediate frequency (IF) backend.
registers	Short-term data-storage circuits within the microcontroller unit or programmable logic IC.
repeater	Remote transmit/receive facility that re-transmits received signals in order to improve communications range and coverage (conventional operation).
repeater/talkaround	A conventional radio feature that permits communication through a receive/transmit facility, which re-transmits received signals in order to improve communication range and coverage.
RESET	Reset line: an input to the microcontroller that restarts execution.
RF	*See radio frequency.*
RF PA	*See radio frequency power amplifier.*
ROM	*See read-only memory.*

Term	Definition
RPCIC	Regulator/power control IC.
RTC	*See real-time clock.*
RX	Receive.
RX DATA	Recovered digital data line.
SAP	*See Serial Audio Port.*
Serial Audio Port	SSI to and from the CODEC used to transfer transmit and receive audio data.
Serial Peripheral Interface	A serial interface comprised of two data lines and a clock line. This interface is typically used to communicate with other modules and ICs in the radio.
signal	An electrically transmitted electromagnetic wave.
software	Computer programs, procedures, rules, documentation, and data pertaining to the operation of a system.
spectrum	Frequency range within which radiation has specific characteristics.
SPI	*See Serial Peripheral Interface.*
squelch	Muting of audio circuits when received signal levels fall below a pre-determined value. With carrier squelch, all channel activity that exceeds the radio's preset squelch level can be heard.
SRAM	*See static RAM.*
SSI	*See Synchronous Serial Interface.*
Standby mode	An operating mode in which the radio is muted but still continues to monitor data.
static RAM	A type of memory used for volatile, program/data memory that does not need to be refreshed.
Synchronous Serial Interface	DSP interface to peripherals that consists of a clock signal line, a frame synchronization signal line, and a data line.
time-out timer	A timer that limits the length of a transmission.
TOT	*See time-out timer.*
transceiver	Transmitter-receiver. A device that both transmits and receives analog or digital signals. Also abbreviated as XCVR.
transmitter	Electronic equipment that generates and amplifies an RF carrier signal, modulates the signal, and then radiates it into space.
TX	Transmit.

Term	Definition
UHF	Ultra-High Frequency.
VCO	*See voltage-controlled oscillator.*
voice encoder	The DSP-based system for digitally processing analog signals, and includes the capabilities of performing voice compression algorithms or voice encoding.
voltage-controlled oscillator	An oscillator in which the frequency of oscillation can be varied by changing a control voltage.

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W

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