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Maintenance Manual
14221-1510-5000
Oct/12

XG-25M Mobile Radio

50-Watt, 136 to 174 MHz
14015-0010-01

MANUAL REVISION HISTORY

REV.	DATE	REASON FOR CHANGE
-	Oct/12	Initial release.

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Repairs to this equipment should be made only by an authorized service technician or facility designated by the supplier. Any repairs, alterations or substitutions of recommended parts made by the user to this equipment not approved by the manufacturer could void the user's authority to operate the equipment in addition to the manufacturer's warranty.

This product conforms to the European Union WEEE Directive 2002/96/EC. Do not dispose of this product in a public landfill. Take it to a recycling center at the end of its life.

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1 SAFETY SYMBOL CONVENTIONS

The following conventions are used in this manual to alert the user to general safety precautions that must be observed during all phases of operation, installation, service, and repair of this product. Failure to comply with these precautions or with specific warnings elsewhere violates safety standards of design, manufacture, and intended use of the product. Harris Corporation assumes no liability for the customer's failure to comply with these standards.

The WARNING symbol calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in personal injury. Do not proceed beyond a WARNING symbol until the conditions identified are fully understood or met.

The **CAUTION** symbol calls attention to an operating procedure, practice, or the like, which, if not performed correctly or adhered to, could result in damage to the equipment or severely degrade equipment performance.

The **NOTE** symbol calls attention to supplemental information, which may improve system performance or clarify a process or procedure.

The **ESD** symbol calls attention to procedures, practices, or the like, which could expose equipment to the effects of **E**lectro-**S**tatic **D**ischarge. Proper precautions must be taken to prevent ESD when handling circuit boards or modules.

2 OPERATIONAL SAFETY RECOMMENDATIONS

2.1 TRANSMITTER HAZARDS

WARNING

The operator of any mobile radio should be aware of certain hazards common to the operation of vehicular radio transmissions. Possible hazards include but are not limited to:

- **Explosive Atmospheres** — Just as it is dangerous to fuel a vehicle while its engine is running, be sure to turn the radio **OFF** while fueling the vehicle. If the radio is mounted in the trunk of the vehicle, **DO NOT** carry containers of fuel in the trunk.

  Areas with potentially explosive atmosphere are often, but not always, clearly marked. Turn the radio **OFF** when in any area with a potentially explosive atmosphere. It is rare, but not impossible that the radio or its accessories could generate sparks.

- **Interference To Vehicular Electronic Systems** — Electronic fuel injection systems, electronic anti-skid braking systems, electronic cruise control systems, etc., are typical of the types of electronic devices that can malfunction due to the lack of protection from radio frequency (RF) energy present when transmitting. If the vehicle contains such equipment, consult the dealer for the make of vehicle and enlist his/her aid in determining if such electronic circuits perform normally when the radio is transmitting.
- **Electric Blasting Caps** — To prevent accidental detonation of electric blasting caps, **DO NOT** use two-way radios within 1000 feet (305 meters) of blasting operations. Always obey the "**Turn Off Two-Way Radios**" (or equivalent) signs posted where electric blasting caps are being used (OSHA Standard: 1926.900).
- **Radio Frequency Energy** — To prevent burns or related physical injury from radio frequency energy, do not operate the transmitter when anyone outside of the vehicle is within the minimum safe distance from the antenna as specified in the respective *Installation and Product Safety Manual*.
- **Vehicles Powered By Liquefied Petroleum (LP) Gas** — Radio installation in vehicles powered by liquefied petroleum gas, where the LP gas container is located in the trunk or other sealed-off space within the interior of the vehicle, must conform to the **N**ational **F**ire **P**rotection **A**ssociation standard **NFPA 58**. This requires:
  - ➢ The space containing the radio equipment must be isolated by a seal from the space containing the LP gas container and its fittings.
  - ➢ Outside filling connections must be used for the LP gas container.
  - ➢ The LP gas container space shall be vented to the outside of the vehicle.

2.2 SAFE DRIVING RECOMMENDATIONS

The American Automobile Association (AAA) advocates the following key safe driving recommendations:

- Read the literature on the safe operation of the radio.
- Keep both hands on the steering wheel and the microphone in its hanger whenever the vehicle is in motion.
- Place calls only when the vehicle is stopped.
- When talking from a moving vehicle is unavoidable, drive in the slower lane. Keep conversations brief.

- If a conversation requires taking notes or complex thought, stop the vehicle in a safe place and continue the call.
- Whenever using a mobile radio, exercise caution.

2.3 OPERATING RULES AND REGULATIONS

Two-way radio systems must be operated in accordance with the rules and regulations of the local, regional, or national government.

In the United States, the XG-25M mobile radio must be operated in accordance with the rules and regulations of the Federal Communications Commission (FCC). Operators of two-way radio equipment must be thoroughly familiar with the rules that apply to the particular type of radio operation. Following these rules helps eliminate confusion, assures the most efficient use of the existing radio channels, and results in a smoothly functioning radio network.

When using a two-way radio, remember these rules:

- It is a violation of FCC rules to interrupt any distress or emergency message. The radio operates in much the same way as a telephone "party line." Therefore, always listen to make sure the channel is clear before transmitting. Emergency calls have priority over all other messages. If someone is sending an emergency message – such as reporting a fire or asking for help in an accident, do not transmit unless assistance can be offered.
- The use of profane or obscene language is prohibited by Federal law.
- It is against the law to send false call letters or false distress or emergency messages. The FCC requires keeping conversations brief and confined to business. Use coded messages whenever possible to save time.
- Using the radio to send personal messages (except in an emergency) is a violation of FCC rules. Send only essential messages.
- It is against Federal law to repeat or otherwise make known anything overheard on the radio. Conversations between others sharing the channel must be regarded as confidential.
- The FCC requires self-identification at certain specific times by means of call letters. Refer to the rules that apply to the particular type of operation for the proper procedure.
- No changes or adjustments shall be made to the equipment except by an authorized or certified electronics technician.

CAUTION

Under U.S. law, operation of an unlicensed radio transmitter within the jurisdiction of the United States may be punishable by a fine of up to $10,000, imprisonment for up to two (2) years, or both.

2.4 OPERATING TIPS

The following conditions tend to reduce the effective range of two-way radios and should be avoided whenever possible:

- Operating the radio in areas of low terrain, or while under power lines or bridges.
- Obstructions such as mountains and buildings.

NOTE

In areas where transmission or reception is poor, communication improvement may sometimes be obtained by moving a few yards in another direction, or moving to a higher elevation.

3 SPECIFICATIONS[1]

3.1 GENERAL

Dimensions: (Height x Width x Depth)	2.8 x 7.24 x 7.9 inches (7.1 x 18.4 x 20 centimeters) (Includes knobs but not space required for mounting bracket and cables at rear of radio)
Weight:	5.9 pounds (2.68 kilograms), does not include bracket
Operating Ambient Temperature Range:	-22 to +140° Fahrenheit (-30 to +60° Celsius)
Storage Temperature Range:	-40 to +176° Fahrenheit (-40 to +80° Celsius)
Altitude	
Operating:	15,000 feet (4572 meters) maximum
Transport/Storage:	50,000 feet (15240 meters) maximum
DC Supply Voltage Operating Ranges	
For Full Performance:	+13.6 Vdc ±10% (Normal range per TIA-603)
Overall Operating Range:	+13.6 Vdc ±20%
Power Transients/Surge:	Per ISO7637-2
DC Supply Current Requirements	
Receive	
With Speaker Muted:	1.4 amps maximum
With 15-Watt Ext. Spkr. Output Power:	4.0 amps maximum
Transmit at 50 Watts:	15 amps maximum
Quiescent/Off Current:	2 milliamps maximum
Environmental:	Meets or exceeds MIL-STD-810G Standard[2]; IEC 60529 Standard (IP54); U.S. Forest Service Vibration (10 to 60 Hz) USDA LMR Standard, Section 2.15; TIA-603-C Shock Standard (1-meter drop) Paragraph 3.3.5.3

3.2 TRANSCEIVER

Frequency Range:	136 to 174 MHz (transmit and receive)
Transmit Power:	10 to 50 watts (programmable range)
Antenna Port Impedance:	50 ohms
Channel Spacing:	12.5 kHz or 25 kHz (mode dependent)[3]
Voice and Data Communications Modes:	Half-Duplex
Frequency Stability:	±2 ppm
Receiver Sensitivity:	
Analog Mode:	better than -119 dBm (0.25 µV) at 12 dBm SINAD
P25 Mode (TIA-102 Method):	better than -116 dBm (0.35 µV) at 5% static BER

[1] These specifications are primarily intended for the use of the service technician. See the appropriate Specifications Sheet for the additional specifications.
[2] Also meets or exceeds equivalent superseded MIL-STD-810D, -E and -F.
[3] VHF radio is compliant with applicable FCC narrowbanding mandate below 512 MHz.

Audio Frequency Response:	300 to 3000 Hz (transmit and receive)
Microphone Input Sensitivity:	82 ±28 mV rms (typical)
Microphone Audio Frequency Response:	±0.5 dB from 100 Hz to 3000 Hz
Microphone Connector:	12-pin locking connector located on front panel
Speaker Audio Output Power:	
Internal Speaker:	3 watts RMS (8-ohm speaker)
External Speaker:	15 watts RMS into 4-ohm speaker
Speaker Audio Output Distortion:	
Internal Speaker:	< 3% at 3 watts RMS audio output
External Speaker:	< 3% at 15 watts RMS audio output into a 4-ohm speaker

3.3 REGULATORY

3.3.1 General

FCC Type Acceptance	OWDTR-0075-E
Applicable FCC Rules:	Part 15, Part 80 and Part 90
Industry Canada Certification	3636B-0075
Applicable Industry Canada Rules:	RSS-119

3.3.2 FCC Part 15 Statement

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and
2. This device must accept any interference received, including interference that may cause undesired operation.

3.3.3 Industry Canada RSS Statement

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

4 INTRODUCTION

This manual contains maintenance information for the XG-25M mobile radio. Information includes general information about the radio, radio RF performance test procedures, radio RF alignment procedures, parts lists, schematic diagrams, an internal radio interconnection diagram, and assembly diagrams.

The XG-25M mobile radio is a high-performance 136 to 174 MHz 50-Watt digital mobile radio. It can operate in Project 25 (P25) conventional and analog conventional modes. The radio's transmit output power is rated at 50 watts, with the power level adjustable from 10 to 50 watts via radio personality programming. The XG-25M is considered a front-mount radio, since its control head is an integral part of the radio. The head cannot be mounted separately from the radio.

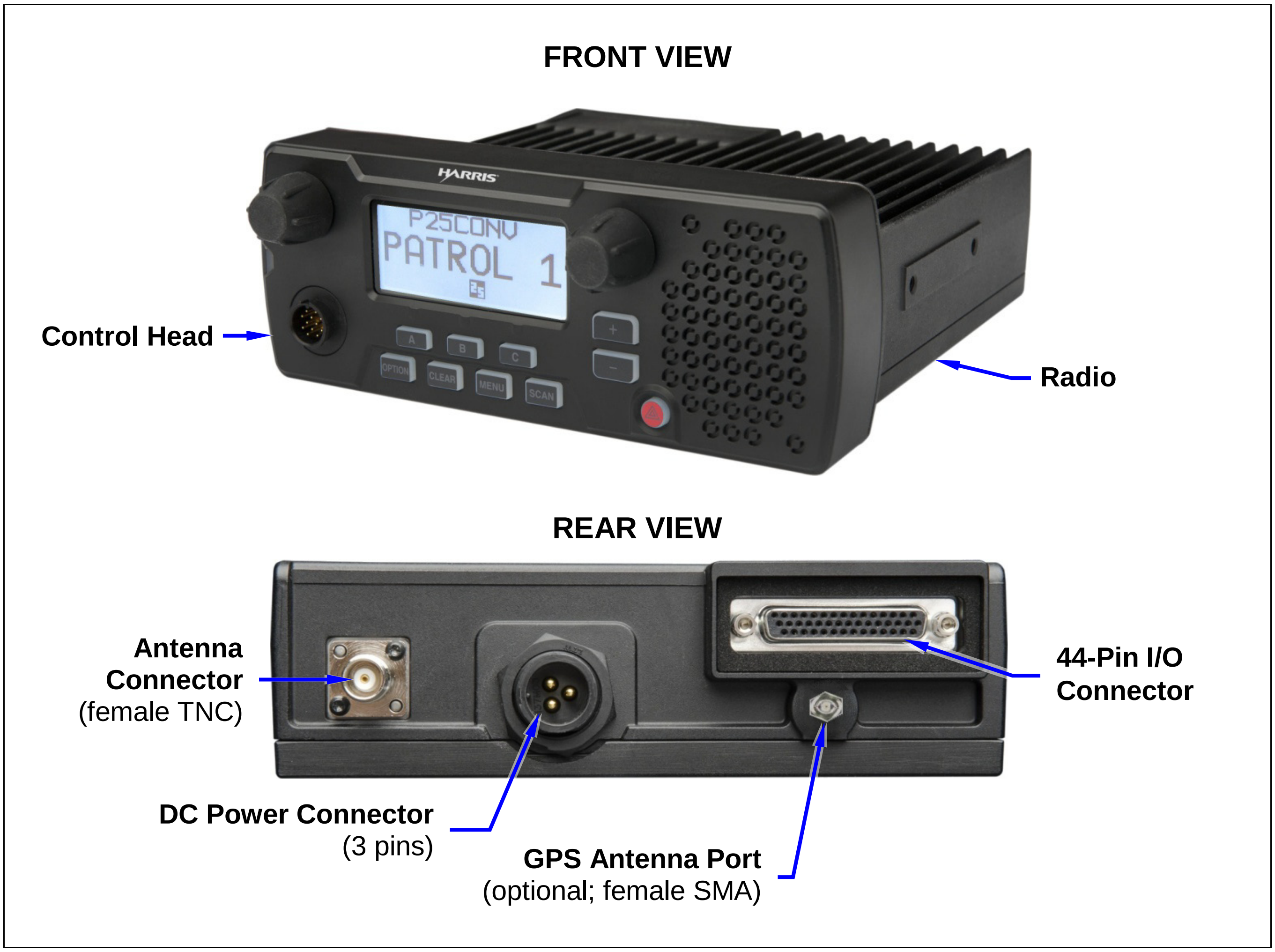


Figure 4-1: XG-25M Mobile Radio — Front and Rear Views

The XG-25M radio is designed to operate in a mobile environment, typically within a motor vehicle. It must be connected to an external transmit/receive antenna such as one mounted to the vehicle's rooftop or trunk lid. Several different types of external-mount antennas are approved and available for use with the radio, as listed in the radio's *Installation and Product Safety Manual*, publication 14221-1510-4000.

The radio provides half-duplex voice and data communications. Voice communications are accomplished via a "push-to-talk" (PTT) type microphone and an external speaker connected to the radio's control head.

The radio's control head features a large text and graphics-based liquid-crystal display (LCD), and front panel controls for user control of the radio.

The XG-25M must be powered by an external +13.6-volt (nominal) DC power source. In mobile applications, the motor vehicle's electrical system is utilized as the source of DC power. Specifications are included in Section 3 of this manual.

The XG-25M may be equipped with an optional built-in Global Positioning System (GPS) tracking receiver. The GPS antenna can be integrated into the mobile transmit/receive antenna (i.e., a "combination" antenna). Alternately, the GPS antenna can be located/mounted completely separate from the mobile transmit/receive antenna.

The XG-25M exceeds many tough environmental specifications included within military standard MIL-STD-810G, the radio industry standard TIA/EIA-603, and the radio standard established by the U.S. Forest Service.

The radio supports operation on APCO Project 25 compliant Common Air Interface (P25 CAI) radio networks, and operation in a talk-around mode in accordance with the APCO Project 25. P25 radio systems utilize Improved Multi-Band Excitation (IMBE) speech and data compression technology, developed by Digital Voice Systems, Inc.

CAUTION

Harris recommends the buyer use only an authorized representative to install and service this product. The warranties provided to the buyer under the terms of sale shall be null and void if this product is installed or serviced improperly, and Harris shall have no further obligation to the buyer for any damage caused to the product or to any person or personal property.

5 RELATED PUBLICATIONS

The following publications contain additional information about the XG-25M mobile radio:

- Quick Guide: 14221-1510-1000
- Operator's Manual: 14221-1510-2000
- Installation and Product Safety Manual: 14221-1510-4000

A Quick Guide is included with each mobile radio equipment package when it ships from the factory. Quick Guides and the Operator's Manuals are available at www.pspc.harris.com without a login. Obtaining the Installation and Product Safety Manual or this Maintenance Manual from that web site requires an Information Center log-in, then browsing to Tech-Link's Technical Manual Library.

6 REPLACEMENT PARTS

Parts listed in Section 8 of this manual can be ordered via our Customer Care center. To order replacement parts, contact the Customer Care center at http://www.pspc.harris.com/CustomerService or:

United States:

- Phone Number: 1-800-368-3277
- Fax Number: 1-321-409-4393 (U.S. Only)
- E-mail: PSPC_CustomerFocus@harris.com

International:

- Phone Number: 434-455-6403
- Fax Number: 321-409-4394
- E-mail: PSPC_InternationalCustomerFocus@harris.com

7 TECHNICAL ASSISTANCE

If any of the radio equipment requires repair, or if there are questions or concerns about the installation of this equipment, contact the Harris Technical Assistance Center (TAC) using the following telephone numbers or e-mail address:

- United States and Canada: 1-800-528-7711 (toll free)
- International: 1-434-385-2400
- Fax: 1-434-455-6712
- E-mail: PSPC_tac@harris.com

8 CATALOG AND PART NUMBERS

8.1 MOBILE RADIO

Table 8-1: XG-25M Mobile Radio Catalog and Part Numbers

CATALOG NUMBER*	RADIO PART NUMBER	DESCRIPTION
DM-MV1B	14015-0010-01	XG-25M VHF 50-Watt Mobile Radio

* In addition to the radio, the catalog package also contains an *Installation and Product Safety Manual* and a *Quick Guide*.

8.2 INSTALLATION-RELATED COMPONENTS

For detailed information on installation-related components, refer to the *Installation and Product Safety Manual*, publication 14221-1510-4000.

8.3 SERVICE PARTS

This section lists service parts available for the 50-Watt VHF XG-25M mobile radio. See Section 6 on page 15 for parts ordering information.

Table 8-2: Service Parts for the 50-Watt VHF XG-25M Mobile Radio

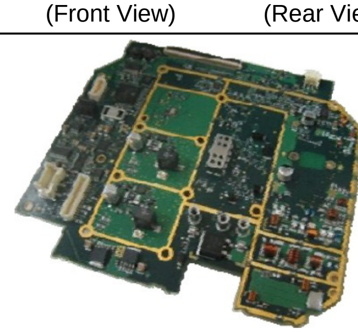
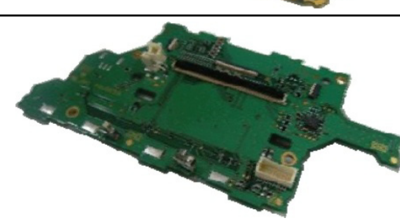
SERVICE PARTS PART NUMBER	DESCRIPTION	ILLUSTRATION
14015-0203-01	Assembly, Control Head	 (Front View) (Rear View)
14015-0203-02	Board, Main, VHF	
14015-0203-06	Board, Front Panel	

Table 8-2: Service Parts for the 50-Watt VHF XG-25M Mobile Radio

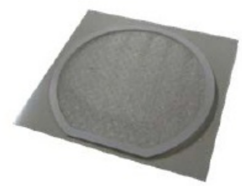
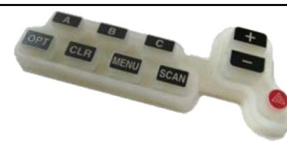
SERVICE PARTS PART NUMBER	DESCRIPTION	ILLUSTRATION
14015-0203-07	Kit, Bottom Cover (includes cover and four M4 x 12-mm screws)	
14015-0203-08	Kit, Speaker (includes pre-wired speaker and speaker cloth)	
14015-0203-09	Speaker Cloth	
14015-0203-10	Keypad	
14015-0203-11	Module, LCD	
14015-0203-12	Panel, Front (includes front panel with pre-installed speaker cloth)	
14015-0203-13	Kit, Volume Knob	

Table 8-2: Service Parts for the 50-Watt VHF XG-25M Mobile Radio

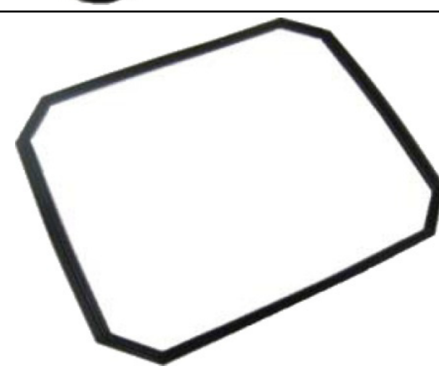
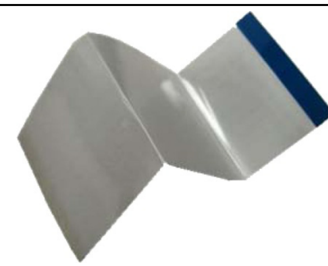
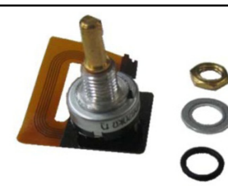
SERVICE PARTS PART NUMBER	DESCRIPTION	ILLUSTRATION
14015-0203-14	Kit, Channel Knob	
14015-0203-15	Kit, Outer Knobs	
14015-0203-16	Kit, DB-44 Connector (includes pre-wired connector and M3 mounting hardware)	
14015-0203-17	Connector, Microphone	
14015-0203-18	Cap, Microphone	
14015-0203-19	Gasket, Front Panel	
14015-0203-20	Gasket, Bottom Cover	

Table 8-2: Service Parts for the 50-Watt VHF XG-25M Mobile Radio

SERVICE PARTS PART NUMBER	DESCRIPTION	ILLUSTRATION
14015-0203-21	Kit, Internal Screw	
14015-0203-22	Kit, External Screw	
14015-0203-23	Cable, Flex	
14015-0203-24	Kit, Volume-On-Off Control (includes control with flex cable attached and mounting hardware)	
14015-0203-25	Kit, Channel Control (includes control with flex cable attached and mounting hardware)	
14015-0203-26	Connector, DC Power	
14015-0203-27	Tool, Knob Removal	

8.4 GPS RECEIVER FIELD UPGRADE KIT

GPS Receiver Field Upgrade Kit KT-015605-001 is available which includes a GPS receiver module, software, and an installation manual. This optional kit allows an XG-25M mobile radio that was not originally equipped with the GPS receiver option to be upgraded in the field with an internal GPS receiver. Refer to the kit's installation manual, publication number MM-015617-001 for installation instructions.

The kit can also be ordered via part number KT-012350-001. This kit does not include the installation manual. Otherwise, it is the same as kit KT-015605-001.

To order a kit, contact the Customer Care center using the contact information included in Section 6 of this manual.

9 OPERATING INFORMATION

For detailed operating instructions, refer to operator's manual publication number 14221-1510-2000. This and other publications are available at www.pspc.harris.com via an Information Center login and Tech-Link.

10 PROGRAMMING AND CONFIGURATION

10.1 RADIO PERSONALITY MANAGER (RPM) TQS3385 AND TQS3389

Radio Personality Manager (RPM) programming software TQS3385 (part number SK-104768-001) is used to program the XG-25M mobile radio for operations in trunked radio systems. TQS3385 can also be used to program the radio for analog conventional and P25 conventional operations. For additional information, refer to RPM's built-in help and/or RPM Software Release Notes, publication number MS-012550-001.

Conventional RPM programming software TQS3389 (part number SK-012177-001) is used to program the XG-25M mobile radio for analog conventional and P25 conventional operations. Trunking mode programming is disabled in TQS3389. For additional information, refer to RPM's built-in help and/or Conventional RPM Software Release Notes, publication number MS-012761-001.

Both RPM programs also support other radios such as the M7100, M7200, and Unity XG-100M mobile radios, and the P7200, P7300, and Unity XG-100P portable radios.

NOTE

Use the information and procedures in this section and RPM's built-in help as a guideline for programming and configuring an XG-25M mobile radio. **Additional configurations not covered in this manual must be applied to meet specific customer requirements.**

10.2 LOADING NEW ECP CODE ("FLASHING" THE RADIO)

EDACS Conventional P25 (ECP) application firmware code is loaded into the radio before it ships from the factory. Therefore, typically this procedure can be bypassed. However in some cases, before the mobile radio is deployed for use, the ECP code must be updated by loading new ECP code.

CAUTION

Before loading new ECP code into the radio, consult with the Harris Technical Assistance Center (TAC) and/or respective Software Release Notes as necessary. TAC contact information is included on page 15 of this manual. Software Release Notes are available at www.pspc.harris.com via an Information Center login and a Tech-Link account.

Follow this procedure to load ECP code into the XG-25M mobile radio:

1. Connect the 44-pin connector of Option Cable 14002-0174-08 to the 44-pin connector on the rear of the radio. Tighten the two jackscrews securely.
2. Connect the DB-9 connector labeled "XG-25M Prog" of the Option Cable to a standard DB-9 serial programming cable. Next, connect the other end of the programming cable to the DB-9 serial port connector of a personal computer with the Radio Personality Manager (RPM) programming software installed on it. For a standard serial programming cable, use Serial Programming Cable CA-104861 (5 feet long) or CA-013671-020 (20 feet long), or equivalent.

NOTE

If the utilized personal computer (PC) is not equipped with a DB-9 type serial port connector, the use of a suitable adapter is required, such as USB-to-RS-232 Adapter Cable CN24741-0001. As of the publication of this manual, CN24741-0001 is available via the Harris Customer Care center; refer to Section 6 on page 15 for the respective contact information.

NOTE

Optionally, Front Panel Programming Cable 14015-0200-01 can be used to program the radio via the microphone connector on the front panel of the radio. The radio auto-senses between a serial device connected to the serial port of the mic connector and the serial port of the rear panel connector.

3. Power-up the PC that has the RPM programming software installed on it, and start Windows.
4. Optional: Turn the radio off via the power on/off/volume control.
5. Optional: While simultaneously depressing the radio's A and C preset buttons, turn the radio on via the power on/off/volume control, then release both buttons. After the "Booting" message clears, a "PROGRAM Please Wait…" message should appear in the display. This indicates the radio is in programming mode.

NOTE

Cycling power (with the A and C preset buttons depressed at power-up) is not necessary. RPM will automatically place the radio into program mode before loading ECP code to it.

6. In RPM, click the Radio menu, and then click Standard Serial Connection > Load Compressed Code.
7. In the Load Compressed Code dialog box, click the ECP Code's ... button and then select the location of the compressed XG-25M radio ECP code, named **ECP_RxxXxxx_XG25M.cmp** (where **RxxXxxx** is the required software version). After selecting the correct file, click the Open button in the Open dialog box, and then click the OK button in the Load Compressed Code dialog box.

NOTE

The compressed code is included with Media Kit 14004-0055-01. That Media Kit is included with Software Distribution Kit 14005-0055-01. For additional information, refer to Software Release Notes MS-010366-001.

8. RPM will begin loading the selected code to the mobile radio, with load status displayed in the Serial I/O Status box. The code is loaded successfully when the Serial I/O Status box disappears.
9. When the Serial I/O Status box disappears, continue with radio personality programming, as presented in the following section.

10.3 RADIO PERSONALITY PROGRAMMING

1. Connect the 44-pin connector of Option Cable 14002-0174-08 to the 44-pin connector on the rear of the radio. Tighten the two jackscrews securely.
2. Connect the DB-9 connector labeled "XG-25M Prog" of the Option Cable to a standard DB-9 serial programming cable. Next, connect the other end of the programming cable to the DB-9 serial port connector of a personal computer with the Radio Personality Manager (RPM) programming software installed on it. For a standard serial programming cable, use Serial Programming Cable CA-104861 (5 feet long) or CA-013671-020 (20 feet long), or equivalent.

NOTE

Optionally, Front Panel Programming Cable 14015-0200-01 can be used to program the radio via the microphone connector on the front panel of the radio. The radio auto-senses between a serial device connected to the serial port of the mic connector and the serial port of the rear panel connector.

3. Power-up the PC that has the RPM programming software installed on it, and start Windows.

4. Start the RPM programming software.
5. Open an existing VHF band personality, or start a new XG-25M personality in the VHF band, or read the existing personality from the radio. Consult RPM's built-in help as necessary.
6. As shown in the following figure, verify the Radio Type is set to XG-25M in RPM's main dialog box. If it is not, make this change.

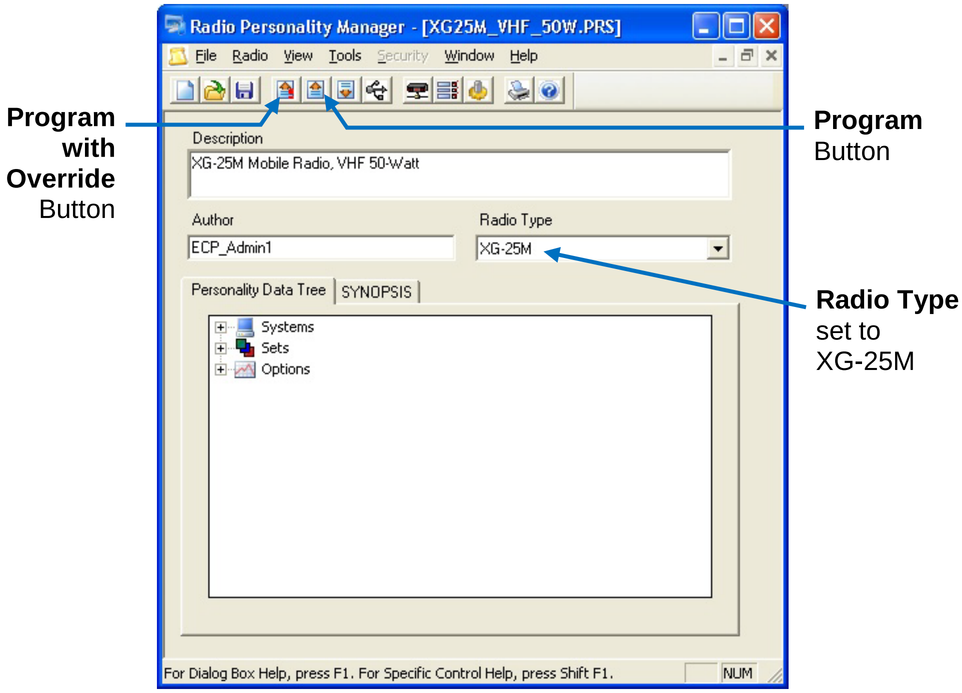


Figure 10-1: RPM's Program and Program with Override Buttons (Example Main Dialog Box)

7. Complete the personality programming as required for the radio. Consult with the radio system(s) network administration personnel and/or RPM's built-in help as necessary.
8. Save the personality, using a unique filename if necessary.
9. If logical ID (LID) values and the radio's IP address (if required) currently in the personality are correct for this radio, click on the Program button in the RPM toolbar.

   Otherwise, in RPM's toolbar, click the Program with Override button and in the Override Options dialog box, enter the radio's LID number(s) and other relative information as required for the respective radio. Consult with radio network administration personnel as necessary. The figure to the right shows example LID numbers.

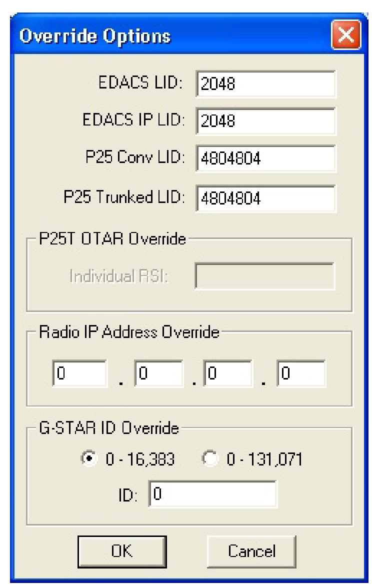


Figure 10-2: RPM's Override Options Dialog Box (with Example LID Numbers)

10. Click the OK button to start the personality write operation. After it is completely written, the radio automatically reboots.
11. Disconnect cables and check for proper radio operation.

10.4 ADDING SOFTWARE FEATURE PACKAGES TO THE RADIO

10.4.1 Displaying the Currently Enabled Software Feature Packages

To display the radio's software feature packages which are currently enabled:

1. If not already, use RPM to add the FEATURES programmable menu function to the radio's menu(s). Do this by modifying the personality. In RPM, access the respective dialog box by double-clicking on Programmable Menus the Options limb of RPM's Personality Data Tree. There is one menu used during trunked operations and one menu used during conventional operations.
2. Program/Write the modified personality to the radio.
3. At the radio, press the MENU button, then use the + or – buttons to scroll through the menu until FEATURES appears in the middle line of the display.
4. Press the MENU button again.
5. Use the + or – buttons to scroll through the features list, as necessary. Feature numbers are displayed as a list of 2-digit numbers separated by spaces. See Table 10-1 for feature number descriptions.
6. Press the MENU or CLEAR button to exit the features list.

10.4.2 Enabling Software Feature Packages

To enable software feature packages:

1. Contact the Harris Technical Assistance Center (TAC) to obtain a new software feature data string for new (and existing) features. TAC contact information is listed on page 15. Be prepared to report the radio's serial number, new feature(s) needed, and the respective customer information.
2. If it is running, exit the RPM programming software.
3. Connect the 44-pin connector of Option Cable 14002-0174-08 to the 44-pin connector on the rear of the radio. Tighten the two jackscrews securely.
4. Connect the DB-9 connector labeled "XG-25M Prog" of the Option Cable to the DB-9 serial port connector of a personal computer with the Radio Personality Manager (RPM) programming software installed on it. If cable length is insufficient, use Serial Programming Cable CA-104861 (5 feet long) or CA-013671-020 (20 feet long), or equivalent, to extend this connection.

> **NOTE:** Optionally, Front Panel Programming Cable 14015-0200-01 can be used to program the radio via the microphone connector on the front panel of the radio. The radio auto-senses between a serial device connected to the serial port of the mic connector and the serial port of the rear panel connector.

5. Start RPM's Radio Maintenance Utility application by clicking Start > (All) Programs > Harris Radio Personality Manager > RPM Radio Maintenance Utility.
6. On the utility's Radio menu, select Read > Feature Data from Radio to read the existing feature data string from the radio.
7. Select the tab that includes XG25 (and other radios) tab.
8. Click the Feature Data Edit button and replace the existing feature data string with the new feature data string supplied by TAC. If necessary, refer to the application's built-in help for additional information.
9. Click the OK button.

10. On the utility's Radio menu, select Write > Feature Data to Radio function to send the new feature data string to the radio. The radio briefly displays an "install" prompt and the utility displays a Command Response dialog box.
11. Verify the dialog box reports the feature data transfer is complete.
12. Click the dialog box's OK button, and exit the utility.

10.4.3 List of Feature-Encrypted Features

The radio's currently-enabled feature-encrypted features are indicated at the end of the Features Encryption Display by a list of 2-digit decimal numbers as defined in the following table. After entering the Features Encryption Display, press the **+** or **-** buttons several times to display these numbers.

Table 10-1: ECP Feature Numbers

FEATURE NUMBER	FEATURE DESCRIPTION	STANDARD OR OPTIONAL
01	Conventional Priority Scan	Standard
06	P25 System Scan: ProScan/Wide Area Scan	Standard
07	Dynamic Regroup	Standard
08	Trunked Emergency	Standard
09	Type 99 Encode and Decode	Standard
10	Conventional Emergency	Standard
12	Digital Voice	Optional
14	DES Enryption	Optional
16	Mobile Data	Optional
17	Status (RSM) and Message (RTT)	Optional
21	Security Key/Personality Lock	Optional
22	ProFile™	Optional
23	Narrowband	Standard
33	P25 Common Air Interface	Standard
35	P25 Over-The-Air Rekeing (P25 OTAR)	Optional
37	P25 256-Bit AES Encryption	Optional
38	Radio TextLink	Optional
39	P25 Trunking	Optional
45	DES Encryption CFB	Optional
46	Vote Scan	Optional
47	Phase II TDMA	Optional
48	GPS	Optional
50	Wideband Disable	Optional
51	MDC-1200 Signaling	Optional

11 CIRCUIT ANALYSIS

11.1 RECEIVER CIRCUITS

The XG-25M VHF mobile radio's 136 to 174 MHz receiver is a single-conversion I/Q receiver that employees a 45.1 MHz intermediate frequency (IF). The IF signal is sampled by a Analog-to-Digital Converter (ADC) circuit at a sub-sampling rate of 96 kHz to translate the filtered signal to a baseband signal. The baseband signal is then processed and demodulated before being applied to an audio power amplifier and speaker.

11.1.1 RX Front-End Circuit

The receiver's front-end circuit consists of the Tx/Rx switch and filters to reject the unwanted signals. The VHF-band receiving signal is subjected to Low Pass Filter (LPF), Antenna Switch (ANT SW), Low-Noise Amplifier (LNA), and a three Bandpass Filters (BPF). The LPF is a seventh-order L-C filter. The ANT SW consist of pin diodes CD22 and CD2102. The low-noise amplifier is a 2-stage amp formed by NPN transistors TR2201 and TR49.

The bandpass filters are a narrow bandwidth with low insertion loss. BPF1, BPF2 and BPF3 are tunable filters each with a varactor diode and capacitor switch. This combination suppress spurious component of the first IF image and of the ½-IF image.

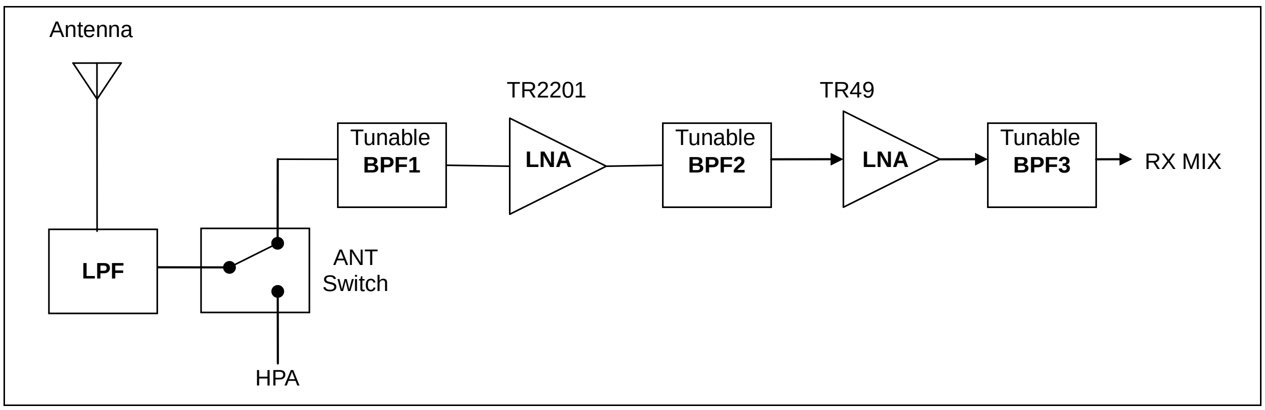


Figure 11-1: Receiver Front-End Block Diagram

11.1.2 Rx Mixer and IF Amplifier Circuit

The receiver's mixer circuit converts the 136 to 174 MHz RF signal to a 45.1 MHz IF frequency. It is integrated circuit IC2 (RX Mixer) and the associated components. IC2 features low power consumption and high Intercept Point (IP) performance.

The receiver's intermediate frequency (IF) amp circuit is a 3-stage amp that employs crystal filters for adjacent channel suppression for both wide and narrowband RF channels. These filters are FL2201 and FL2202 located immediately after the first and second amplifier stages.

Transistor TR2204 and the associated components (IFAMP1) is a VHF/UHF amplifier stage. Integrated circuit IC2201 is a low-noise MMIC amplifier. This IC and the associated components form the second IF amplifier stage (IFAMP2).

Dual-gate field-effect transistor (FET) TR31 and the associated components form the third AGC amplifier stage (IFAMP3). Automatic Gain Control (AGC) incorporated into this stage helps prevent saturation of the ADC circuit that follows during high input signal level conditions on the desired channel and adjacent channels. The radio's RSSI range is limited during an AGC amplifier saturating condition. This stage consists of level detect circuit op-amp IC2208 and the associated components and the dual-gate FET stage formed by TR31 and the associated components. One gate of the FET is used to control overall stage gain, as controlled by the output of the op-amp.

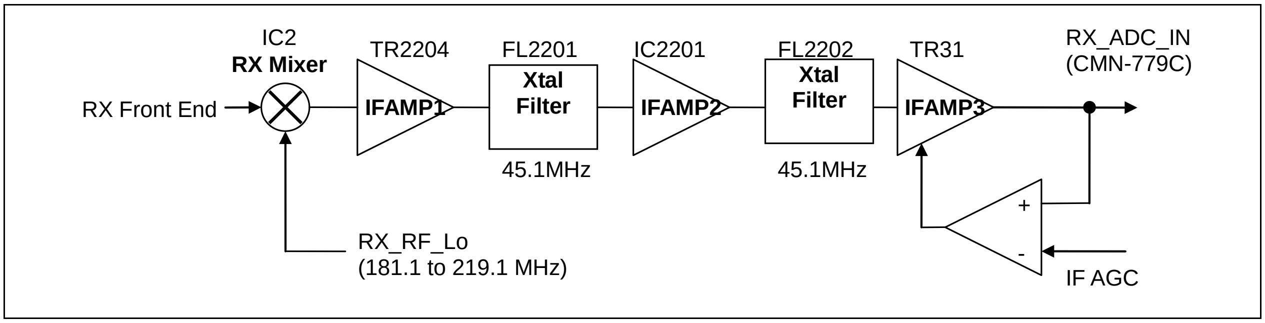


Figure 11-2: Receiver IF Block Diagram

11.1.3 Rx Backend Circuit

The receiver's backend circuit is contained in integrated circuit IC2501. This IC is the RFLSI module that performs the Rx backend and many other functions. The backend circuit consists of a fourth 45.1 MHz IF amplifier stage (IFAMP4) and a 12-bit ADC stage. The amplifier stage has an unbalanced input and a balanced output.

The 12-bit ADC samples the IF signal using a 15.84 MHz clock. Within the RFLSI module, this stage demodulates the IF signal into quadrate I and Q signals at a 96 kHz output sampling rate. Output data on RX ADC DATA is transferred via 16-bit words.

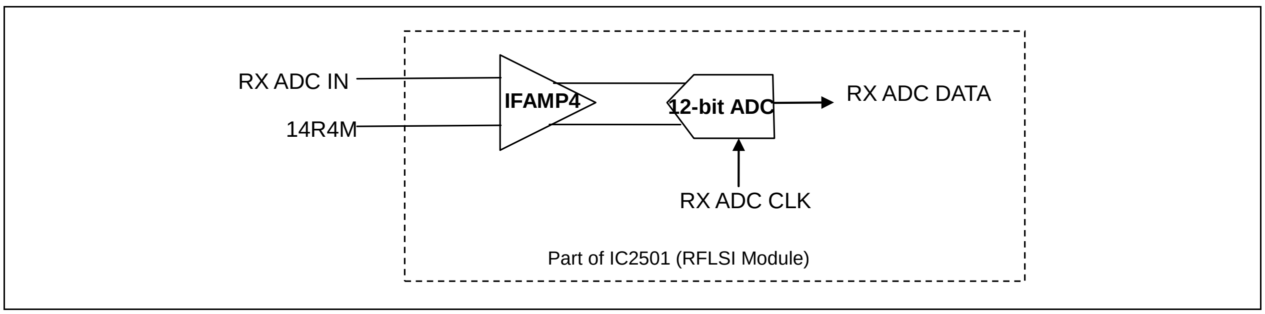


Figure 11-3: Receiver Backend Block Diagram

11.2 TRANSMITTER CIRCUITS

The XG-25M VHF mobile radio's 136 to 174 MHz transmitter is a direct baseband-to-RF single up-conversion transmitter which takes a complex pair of I/Q signals from the baseband dual digital-to-analog converter (DAC) and creates a representative I/Q-modulated RF signal in VHF band. RF amplification is provided by a High-Power Amplifier (HPA) module. The output of the HPA module is filtered then routed through the radio's Tx/Rx switch before being applied to the radio's antenna connector. The design is multi-mode, so the radio can operate on analog or digital channels.

The board's control logic circuits provide all the necessary program management, memory, and operational control of the radio. Details on the control logic circuits are provided in later sections of this manual. Software running in the processor selects the desired frequency.

11.2.1 Tx I/Q Modulator Circuit

A portion of the transmitter's I/Q modulator circuit is contained in integrated circuit IC2501, the RFLSI module. This includes two 12-bit Digital-to-Analog Converters (DACs), buffer op-amps, and low-pass filters. The DAC outputs the I/Q baseband signals at sampling rate of 96 kHz. The I and Q signals are then buffered and low-pass filtered prior to application to the I/Q modulator.

The I/Q modulator is formed by integrated circuit IC2305 and the associated components. This stage modulates the filtered baseband I and Q signals with the RF signal from the Tx local oscillator. The Tx local oscillator signal (TXRF_LO) is twice that of the radio's transmit frequency. Image rejection is performed via phase, amplitude, and DC offset alignment.

12-bit ADC IC2305 is a differential current output type ADC that includes a current-to-voltage converter amplifier. This IC's output voltage is 1 Vpp maximum on a 1.0-volt DC bias.

The I/Q modulated RF signal from IC2305 is low-pass filtered and applied to TX_RF_OUT. The filter rejects harmonics and out-of-band noise.

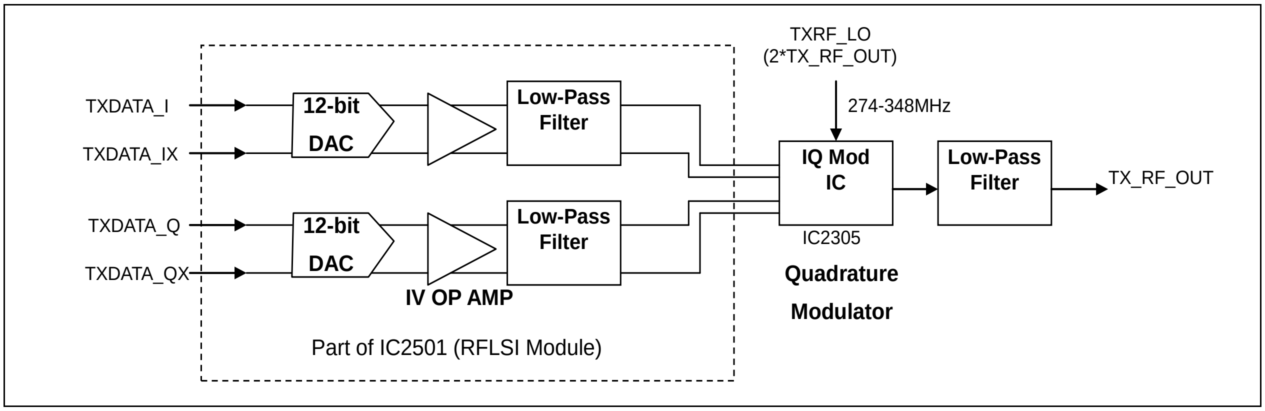


Figure 11-4: Transmitter I/Q Modulator Block Diagram

11.2.2 Tx Automatic Power Control (APC) Circuit

The transmitter's Automatic Power Control Circuit (APC) has a 50 dB range with a resolution of approximately 0.2 dB. APC functions monitor the HPA output power and control the transmit power by software. This can perform a 10 to 50-watt output power adjustment, and power compensation per temperature or voltage changes.

The modulated TX_RF_OUT signal from the I/Q modulator circuit is applied to the input of the Tx Automatic Power Control (APC) circuit. Transistor TR2103 and the associated components (TX AMP1) form a low-noise amplifier stage before AGC control. Transistor TR2104 and the associated components (TX AM2) form a low-noise amplifier stage after AGC control.

CD2101 is a variable attenuator pin diode—the gain control element for this circuit. It is controlled by the TX APC CTRL line, as level-shifted by the op-amp stage formed by IC2111 and the associated components.

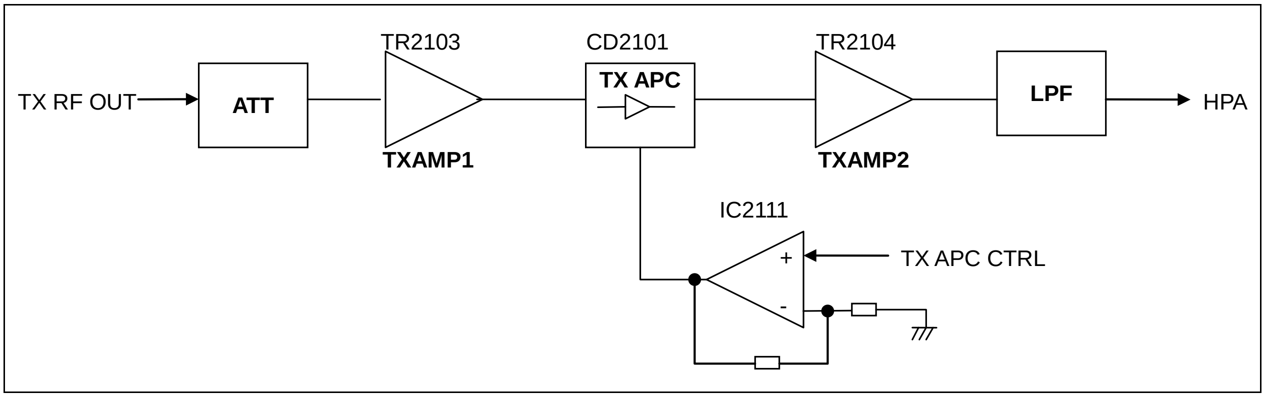


Figure 11-5: Transmitter Automatic Power Control (APC) Block Diagram

11.2.3 Tx High Power Amplifier (HPA) Circuit

The radio's Tx HPA is a design with a maximum output power of 47.3 dBm (53.7 watts). The design features high linearity for improved adjacent-channel power (ACP) and spurious performance.

RF driver amp TR2105 and RF final amp TR2106 are Metal-Oxide Semiconductor Field-Effect Transistor (MOSFET) type devices. The gate of final amp TR2106 is controlled by the TX_FINAL_GATE line via op-amp IC19 and the associated components.

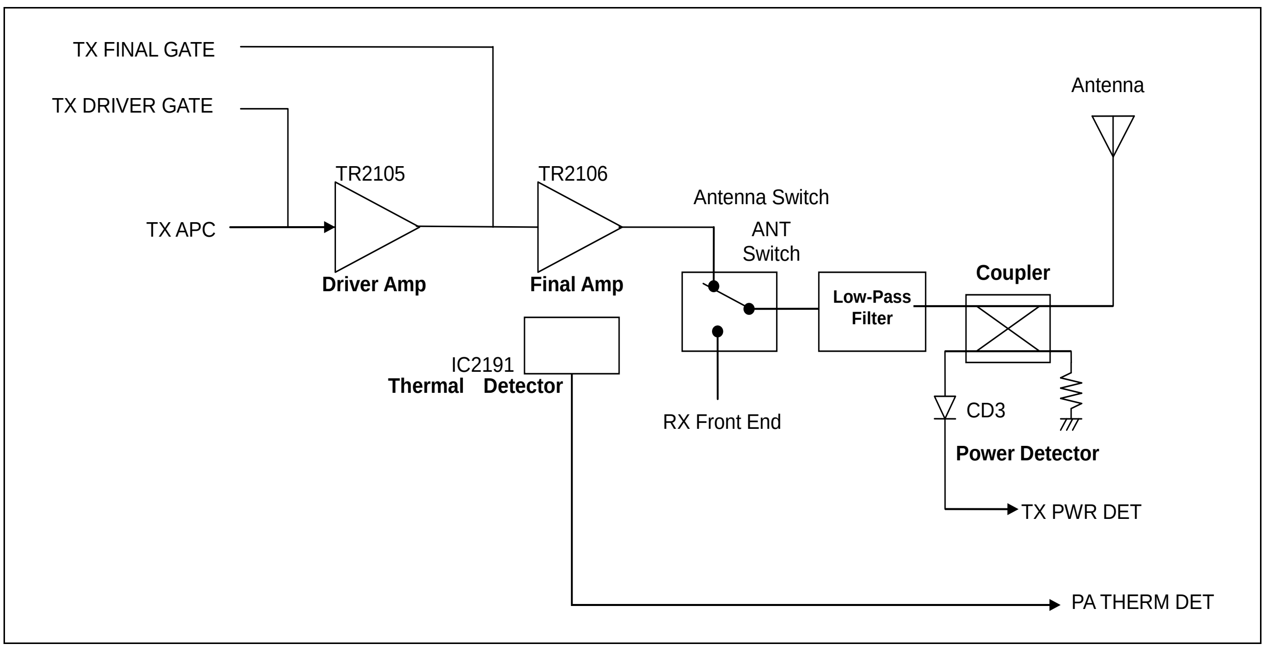


Figure 11-6: Transmitter Automatic Power Control (APC) Block Diagram

11.2.4 Tx/Rx Antenna Switch, Tx Antenna Low-Pass Filter, and Power Detector Circuits

The Tx/Rx antenna switch (ANTSW) is formed by pin diodes CD22, CD2102, and the associated components. Tx vs. Rx switching of is controlled by the presence of or lack of transmit RF power from the HPA using transistors TR6, TR50, and the associated components.

The antenna port's low-pass filter is a nine-order filter. It provides approximately 40 dB of attenuation of 2^{nd} and 3^{rd} order transmit RF harmonics.

An output of strip-line coupler and diode CD3 are used for output power level detection. Detection level range is approximately 30 dB. Detection resolution by the board's microprocessor is approximately 0.05 dB.

11.2.5 Tx Temperature Sensor Circuit

Thermal detector integrated circuit IC2191 and the associated components form a circuit that monitors the temperature around the transmitter's final RF amplifier. This provides APC temperature compensation and HPA junction temperature. The PA_THERM_DET output line from this circuit is applied to an ADC input of RFLSI module IC2501. This allows the microprocessor the ability to determine the HPA temperature and make adjustments accordingly.

11.3 SYNTHESIZER CIRCUITS

The radio's RF synthesizer circuits include a transmit synthesizer, a receive synthesizer, and a 14.4 MHz reference oscillator. The two synthesizers are Phase-Locked-Loop (PLL) type synthesizers that generate the required Tx and Rx local oscillator signals from the 14.4 MHz reference signal.

11.3.1 Rx Synthesizer Circuit

The receive synthesizer circuit consists of a dual fractional-N PLL in the RFLSI module IC2501, a discrete Voltage-Controlled Oscillator (VCO), and an active loop filter. The loop filter is formed by dual op-amp IC2301, single op-amp IC2302, and the associated components. The VCO incorporates 2-bit band switching (4 bands), as controlled by the board's microprocessor circuits. To achieve fast lock times, charge-pump current and loop time constant is changed from slow mode to fast mode at synthesizer frequency changes.

RF output on RX_1ST_LOCAL is approximately 1.6 dBm in the 181.1 to 219.1 MHz frequency range. This signal is the Local Oscillator (LO) injection signal that is fed to the receiver's mixer circuit.

11.3.2 Tx Synthesizer Circuit

The transmit synthesizer consists of a dual fraction –N PLL in RFLSI module IC2501, a discrete VCO, and an active loop filter. The loop filter is formed by dual op-amp IC2402, single op-amp IC2401, and the associated components. Like the receiver VCO, the transmit VCO incorporates 2-bit band switching (4 bands), as controlled by the board's microprocessor circuits.

RF output of the VCO buffer stage formed by TR23, TR24, and the associated components is at a frequency four times the 336 to 374 MHz frequency range. This is applied to an image rejection filter prior to application to the quadrature modulator circuit.

11.3.3 Tx Synthesizer Circuit

The 14.4 MHz reference frequency for the two PLL RF synthesizers is generated by integrated circuit XU1 and the associated components. XU1 is a Temperature-Compensated Crystal Oscillator (TCXO).

Microprocessor-controlled frequency adjustment is provided by the AFC line from an Digital-to-Analog Converter (DAC) in RFLSI module IC2501, and the associated components. The stage formed by op-amp IC1 and the associated components buffers and low-pass filters the DC level on the AFC line prior to application to XU1's frequency adjust input.

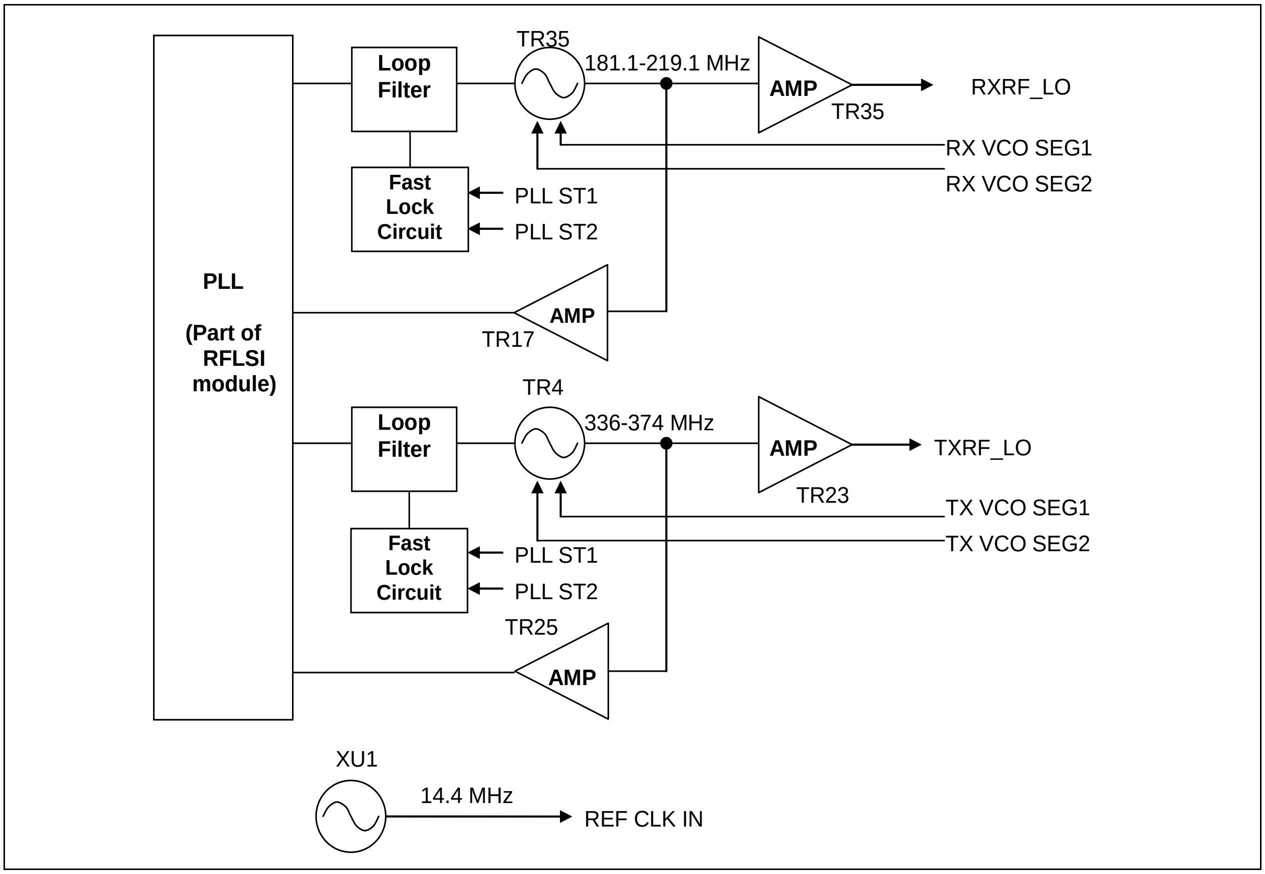


Figure 11-7: Synthesizer Block Diagram

11.4 LOGIC SECTION

The radio's logic section contains the microprocessor, audio, power supply, and external UART circuitry of the radio. These circuits are described in the following subsections.

11.4.1 Microprocessor Circuits

The main microprocessor circuits of XG-25M mobile radio include dual-core OMAP processor IC0602, 256M-bit flash ROM IC0801, 64M-bit SDRAM IC0802, CPLD IC0601, four-channel A/D converter IC0703, and dot matrix Liquid Crystal Display (LCD) DD1.

The main clock of the dual core processor is a 12.0 MHz clock from integrated circuit XU0701 (VCXO). In addition, a 32 kHz oscillator is used by OMAP processor IC0602 for clocking of its real-time clock.

To support audio functions, audio CODEC integrated circuit IC1001 is connected to OMAP processor IC0602 via an I2C serial link for control and by an I2S serial link for audio signals.

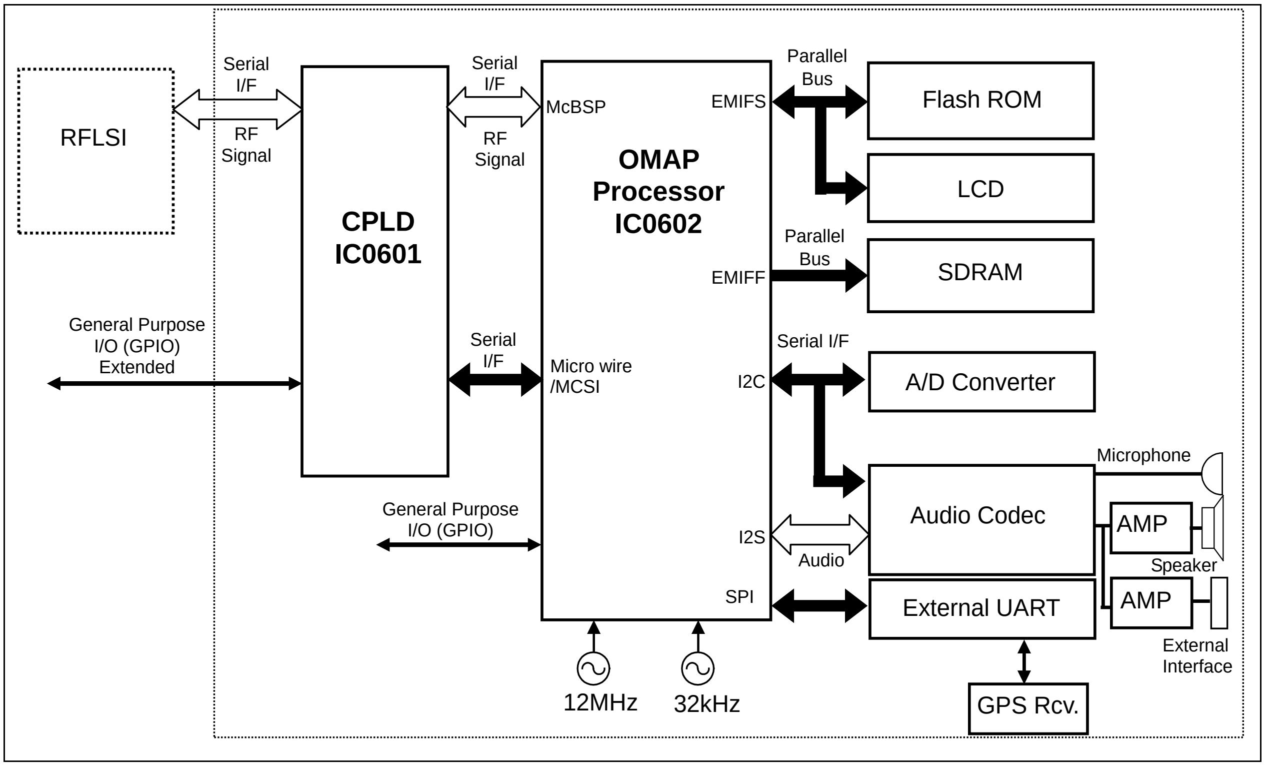


Figure 11-8: Microprocessor Circuits Block Diagram

11.4.1.1 OMAP Processor IC0602

OMAP Processor IC0602 is a dual-core processor. It contains an ARM925-based Microprocessor Unit (MPU) core and a C55x Digital Signal Processor (DSP) subsystem core with internal memory and control. The processor has a slow parallel interface called EMIFS that is used to communicate with on-board flash ROM, SRAM and the display circuits. The processor boots from the Flash ROM.

The MPU core manages high layer protocol processing, user interface (display and keys), and audio routing control including microphone and speaker selection. The DSP core manages modulation, demodulation and filtering for both the radio (baseband) and audio frequency signals.

The ARM and DSP cores are internally clocked at 144 MHz. This clock is generated from the 12.0 MHz clock by a Phase-Locked Loop (PLL) circuit within the processor.

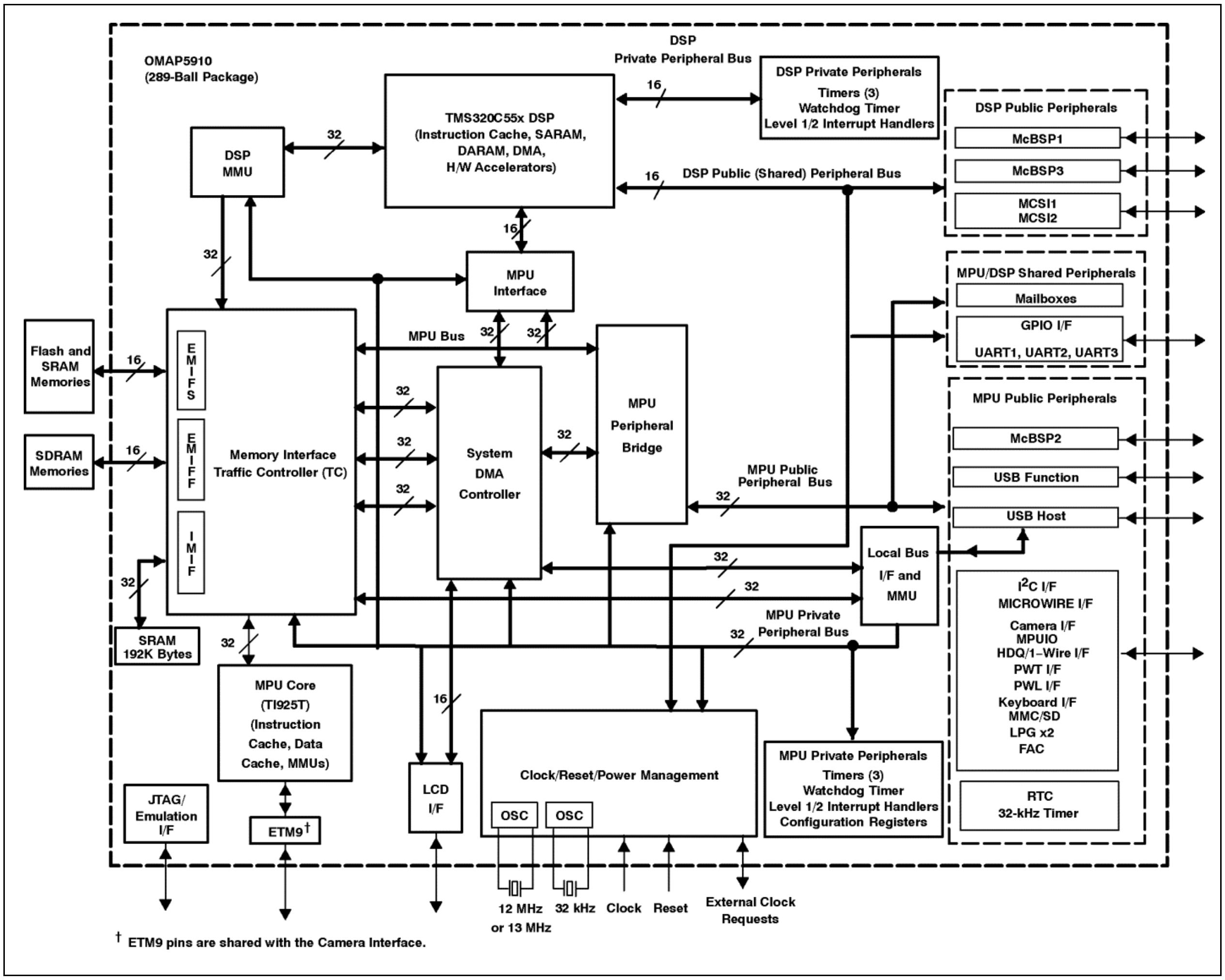


Figure 11-9: OMAP Processor IC0602 Block Diagram

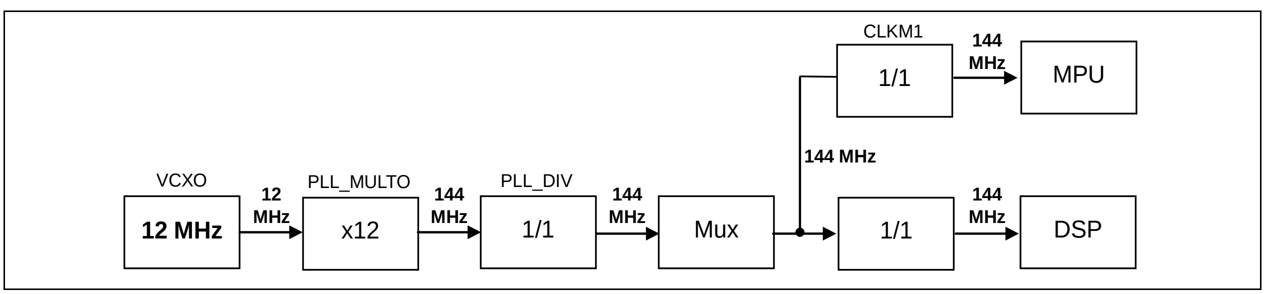


Figure 11-10: OMAP Processor Clocks Generation and Distribution Block Diagram

11.4.1.2 Flash ROM IC0801

Flash ROM integrated circuit IC0801 stores the main software, boot software, personality data, and calibration (tracking) data for the radio. This is an 8M x 16-bit flash ROM. The memory space is allocated to the CS0 line of the OMAP processor’s EMIFS parallel bus.

11.4.1.3 Synchronous Dynamic RAM IC0802

Synchronous Dynamic RAM integrated circuit IC0802 is a 4M x 16-bit SDRAM. Its memory space is on the EMIFF parallel bus of the OMAP processor.

11.4.1.4 Liquid Crystal Display DD1

Liquid Crystal Display (LCD) module DD1 is a full dot-matrix monochrome type LCD module. It is interfaced to the OMAP processor via the processor's EMIFS parallel bus. The display's memory space is allocated to the CS2 line of the OMAP processor's EMIFS parallel bus.

11.4.1.5 CMOS Programmable Logic Device (CPLD) IC0601

CMOS Programmable Logic Device (CPLD) integrated circuit IC0601 converts the interface difference between OMAP processor and the RFLSI module. A block diagram of this interface is shown in Figure 11-11.

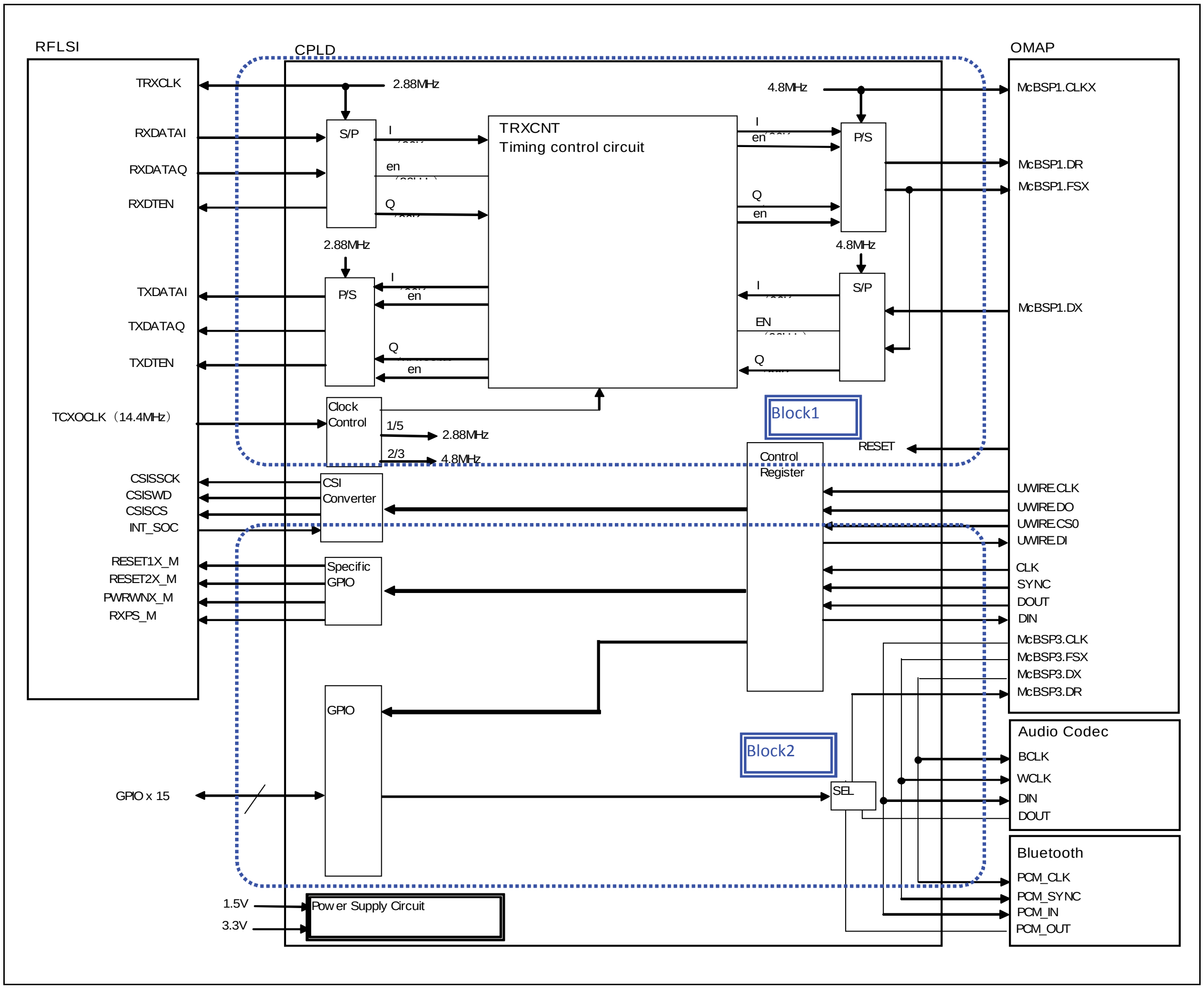


Figure 11-11: CPLD Interface Block Diagram

CPLD IC0601 has two main functions.

- **Baseband Signal Conversion Between the OMAP Processor and the RFLSI Module (Block1)**—The RFLSI module that manages the RF hardware has parallel I and Q signals. The DSP core of OMAP processor has serial I and Q signals. The CPLD performs serial-to-parallel conversions of the I and Q signals. In addition, the CPLD is the clock master for OMAP processor and RFLSI module. The clock speed is 4.8 MHz for the OMAP processor and 2.88 MHz for RFLSI module. The CPLD also provides frame sync timing (96 kHz) to and synchronization to both.

- **Extension of GPIO (Block2)**—The CPLD has 15 expansion General Purpose I/O (GPIO) lines. These lines are read by and written from the OMAP processsor's Microwire Interface (MI) and Multichannel Serial Interface (MCSI). Both the MPU and DSP cores can access the GPIO lines. The MPU core accesses the GPIO lines by the MI. The DSP core accesses the GPIO lines by the MCSI. In addition, the GPIO's controller has controls access rights of the MPU and DSP cores to prevent simultaneous accesses. The OMAP processor has to set the access right at initial board boot-up.

11.4.1.6 Four-Channel A/D Converter IC0703

Four-Channel A/D Converter (ADC) integrated circuit IC0703 is a 4-channel 12-bit analog-to-digital converter. It is connected to the OMAP processor via the OMAP processor's 2-wire I2C bus.

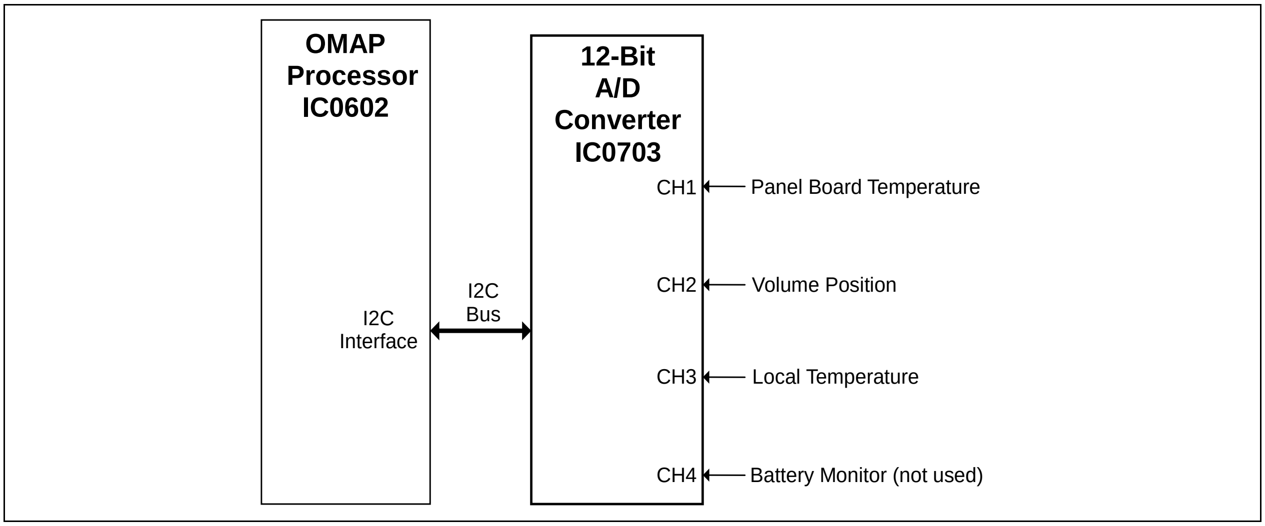


Figure 11-12: Four-Channel A/D Converter Block Diagram

The first channel of this ADC is used to monitor the temperature of Panel Board. A temperature sensor on the Panel Board supports this Main Board function.

The second channel of this ADC is used to monitor the position of volume control. The OMAP processor then controls the audio level based on this monitored ADC input.

The third channel of this ADC is used to monitor the local temperature of the Main Board. Thermistor RT0701 on the Main Board is the temperature sensing element. The OMAP processor lowers the radio's transmit RF power level when excessive heat is sensed via this thermistor and ADC input.

The forth channel of the ADC is not used.

11.4.1.7 Bluetooth Module IC1 (on Panel Board)

The Bluetooth module IC1 on Panel Board is connected to OMAP processor IC0602 via the processor's UART and I2S serial interfaces. The OMAP processor communicates controlling data to the Bluetooth module via this interface using a BlueCore Serial Protocol (BCSP). For audio interface, The OMAP processor's I2S interface is employed. The I2S interface is shared with the audio CODEC integrated circuit. The processor is the clock master and it selects the audio routing for two ICs.

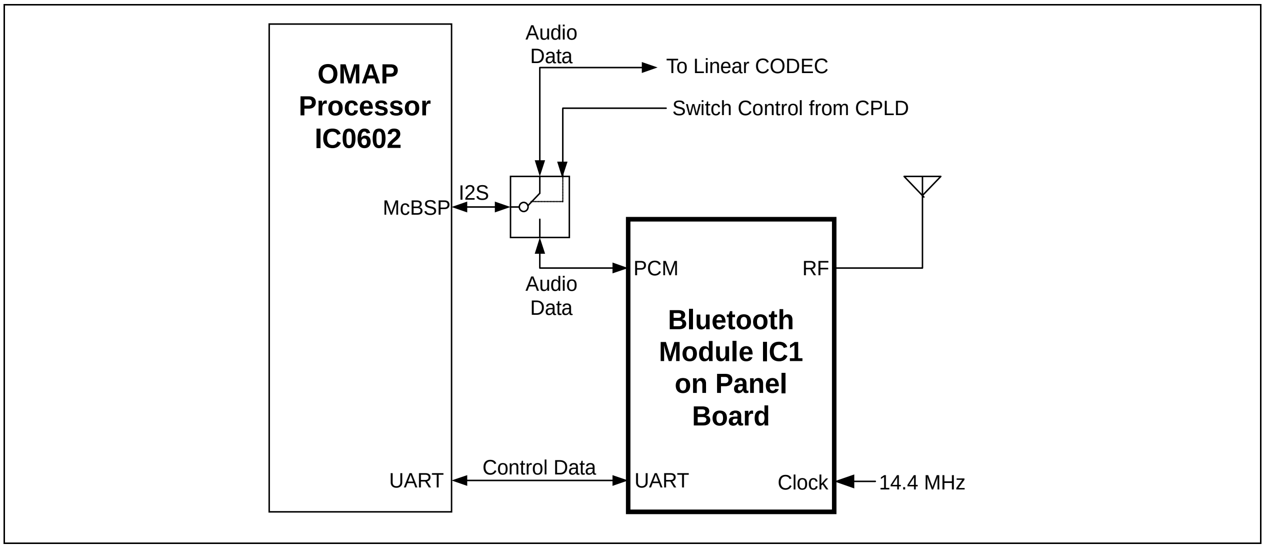


Figure 11-13: Bluetooth Module Interfaces Block Diagram

11.4.1.8 Reset Circuit IC1113

Integrated circuit IC1113 and the associated components on the Main Board reset the radio at power-up and if required, at other times. Power-up reset time is dependent upon the 3.3V supply line's ramp-up time. The reset line is applied to OMAP processor IC0602.

11.4.2 Audio Circuits

Audio circuits on the Main Board support the radio's audio inputs and outputs. A basic block diagram is shown in Figure 11-14.

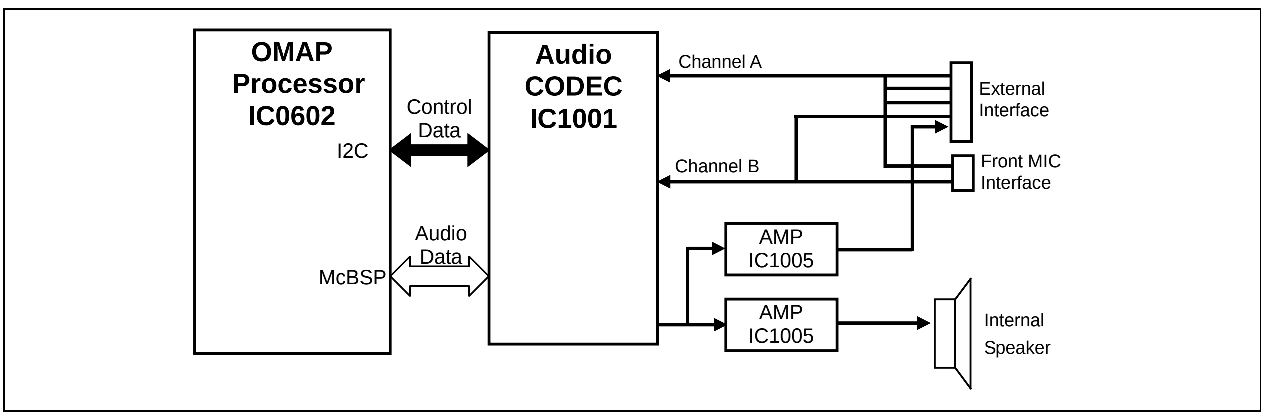


Figure 11-14: Audio Circuits Block Diagram

11.4.2.1 Audio CODEC IC1001

Audio CODEC IC1001 on the Main Board converts digital signals to analog audio when the radio is receiving and it converts microphone analog audio signals to digital signals when the radio is transmitting. The audio CODEC is connected to OMAP processor IC0602 via I2C and I2S interfaces. I2C interface is used for transferring control data, and the I2S interface is used for transferring digital audio signals.

The audio CODEC has two channels for transmission audio. One supports the hand-held microphone and the other supports the radio's external audio interface (i.e. provided at the rear connector).

Receive audio from the audio CODEC is routed to two different on-board speaker amplifiers. One amp drives the speaker in the front panel of the radio and the other amp can drive an external speaker connected to the radio via its rear panel connector. These speaker amplifiers are described in the following sections.

11.4.2.2 Speaker Amplifier1 IC1004

The speaker amplifier1 integrated circuit IC1004 on the Main Board drives the radio's internal speaker located in the radio's front panel. In circuit, it is located between the audio CODEC and internal speaker. Its output drives the internal speaker with received audio. This amp is a Class D type amp. To avoid speaker damage at high volume levels, its maximum output power is limited by software. Amplifier on/off control is performed via GPIO output line from the OMAP processor named INTSP_SHTDWN.

11.4.2.3 Speaker Amplifier2 IC1005

The speaker amplifier2 integrated circuit IC1005 on the Main Board drives the radio's optionally-connected external speaker, if connected. In circuit, it is located between the audio CODEC and external speaker. Like speaker amplifier1, this amp is a Class D type amp. To avoid speaker damage at high volume levels, its maximum output power is limited by software. Amplifier on/off control is performed via GPIO output line from the OMAP processor named EXTSP_SHTDWN.

11.4.3 Power Supply Circuits

Power supply circuits on the Main Board include several DC-to-DC switching voltage regulators and several linear voltage regulators. Outputs of these supplies power the circuits on the Main Board and on the Panel Board. Main 12-volt (nominal) DC input power is provided from a DC power source external of the radio such as a vehicle's battery system or an external DC-output power supply.

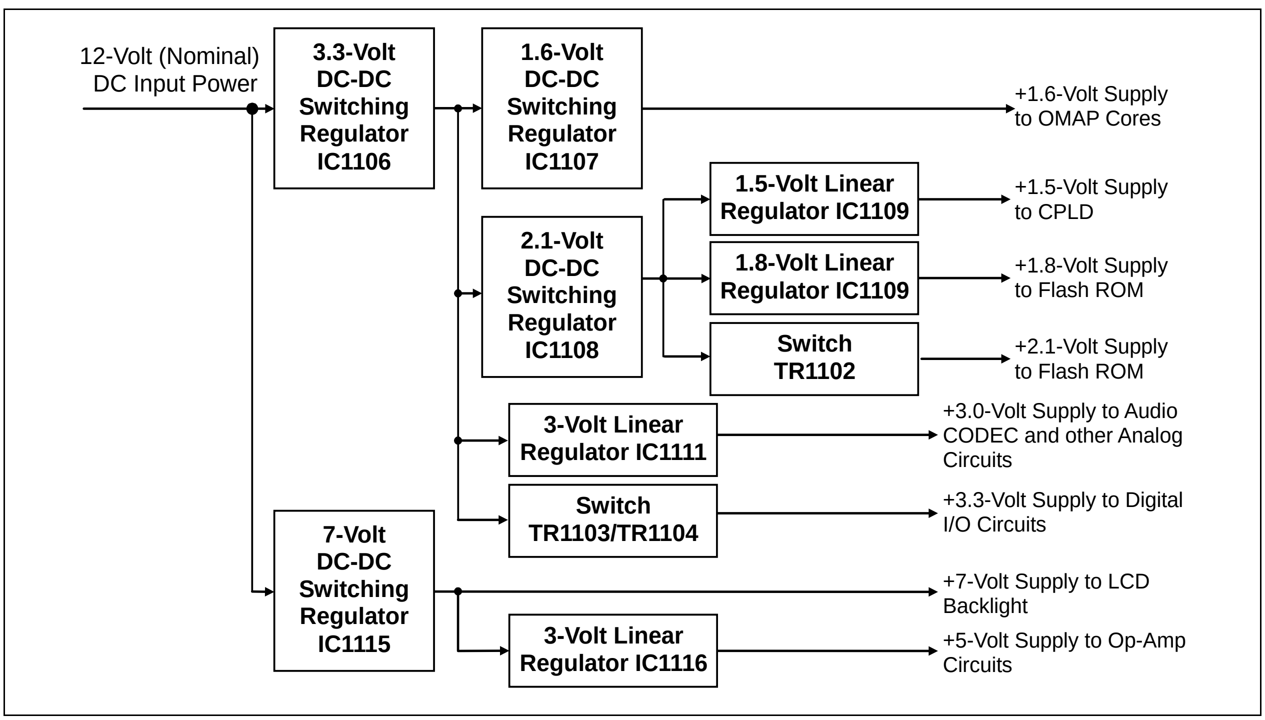


Figure 11-15: Power Supply Circuits Block Diagram

11.4.3.1 DC-to-DC Switching Regulators IC1106, IC1107, IC1108 and IC1115

IC1106 is the primary DC-to-DC switching regulator on the Main Board. It delivers 3.3-volt DC power to several regulators and a switch circuit that follow it. IC1106 also supplies power to several logic circuits on the Main Board and on the Panel Board. This ICs input power source is the radio's main 12-volt (nominal) DC input power.

IC1107 regulates the 3.3-volt output power from IC1106 down to 1.6 volts. The 1.6-volt output from this switching regulator powers the cores of OMAP processor IC0602.

IC1108 is a third switching regulator on the Main Board. Its 2.1-volt output supplies power to RFLSI module IC2501. IC1108 is also powered by the 3.3-volt output from IC1106.

IC1115 is another DC-to-DC switching regulator on the Main Board. It supplies regulated 7-volt DC power to the LCD backlight located on the Panel Board. Input power for IC1115 is sourced from the radio's main 12-volt (nominal) DC input power.

11.4.3.2 Linear Voltage Regulators IC1109, IC1110, IC1111 and IC1116

IC1109 is a 1.5-volt linear voltage regulator that supplies power to the core of CPLD IC0601. Its input DC power is sourced from the 2.1-volt switching regulator.

IC1110 is a 1.8-volt linear voltage regulator that supplies power to the flash ROM. Its input DC power is also sourced from the 2.1-volt switching regulator.

IC1111 is a 3.0-volt linear voltage regulator. This regulator supplies 3.3-volt power to many of the radio's analog circuits.

IC1116 supplies regulated 5.0-volt power to on-board op-amps. This regulator is sourced DC power from the 7-volt switching regulator.

11.4.4 UART for External Serial Links

IC1301 on the Main Board is a dual-channel Universal Asynchronous Receiver-Transmitter (UART) integrated circuit. This IC is interfaced to the OMAP processor via the processor's SPI interface.

UART channel 1 supports the radio's optional GPS receiver module. This serial channel controls the GPS receiver module and it is used to receive GPS location information from the module.

UART channel 2 is not used. Channel 2 is wired to the 40-pin front panel connector J1201.

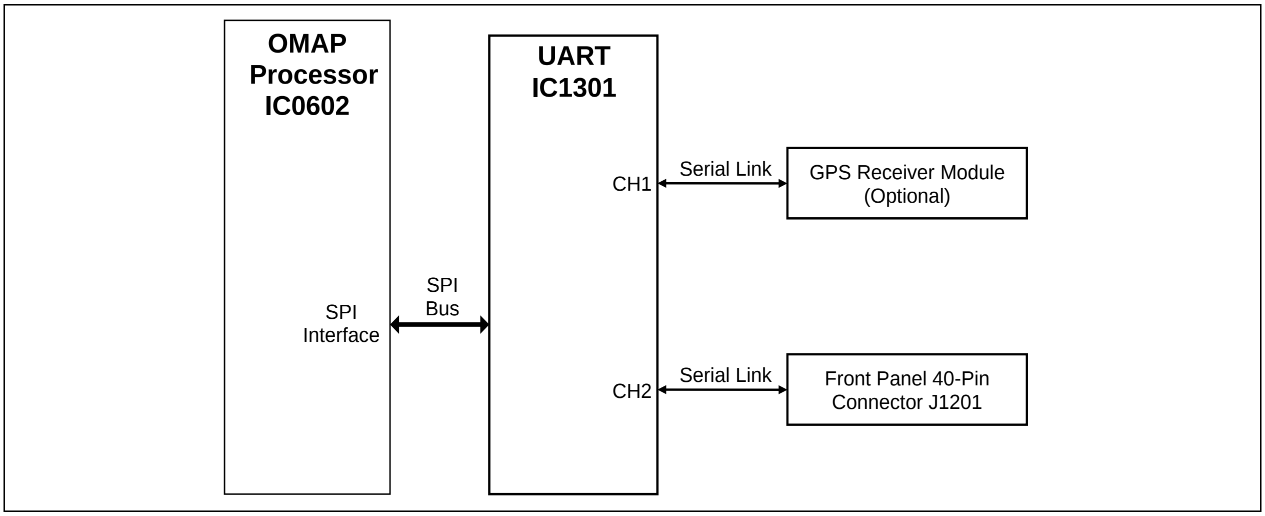


Figure 11-16: Four-Channel A/D Converter Block Diagram

12 MAINTENANCE

12.1 GENERAL INFORMATION

Technicians servicing this radio should generally be concerned with isolating a problem to either a hardware failure or a software problem. Hardware repair of this radio is limited. Radio problems resulting from software errors can usually be corrected by re-configuration of the utilized personality, reloading the radio's personality, and/or (re)flashing the radio's application code.

CAUTION

An in-warranty XG-25M mobile radio **must** be serviced by a Harris authorized service center. Service performed by any non-authorized service center will void the radio's warranty.

WARNING

Improper radio service may void the radio's RF integrity and cause it to violate FCC rules and regulations. Do not return the radio to field use until it is fully tested to ensure proper operation.

If the radio's Main Board is replaced, always successfully complete all applicable test and alignment procedures presented in this manual before returning the radio to the customer. The radio should also be fully tested and (where necessary) aligned if any component in an RF signal path of the Main board is replaced, retuned, or disturbed in any way.

For technical assistance, contact the Technical Assistance Center using the contact information listed in Section 7.

12.2 PREVENTIVE MAINTENANCE

Preventive maintenance on the radio installation should be performed periodically. Harris recommends performing preventive maintenance on an annual basis or more often in harsh environments such as an installation in a fire truck. Preventive maintenance should include:

- Inspecting all mobile radio related hardware to verify it is in place and securely tight. Any missing or loose hardware should be replaced and/or tightened as necessary.
- Inspecting all cabling to verify it is not damaged, it is securely tied-and-stowed, and all related cable connectors are tight. Repair as necessary.
- Performing radio and antenna system performance tests as described in the radio's *Installation And Product Safety Manual*, publication number 14221-1510-4000. Repair as necessary.
- Verifying overall radio operation by performing an operations check.

12.3 STATUS AND ERROR CODES DISPLAYED BY RADIO

The following table lists and defines radio error codes that may be displayed by the radio. Fatal errors typically cause the radio to automatically reset after a short delay. For non-fatal errors, the radio will typically resume operation after a short delay.

Table 12-1: Radio Error Codes

DISPLAYED CODE	MEANING
FATAL SYSTEM ERROR CODES:	
Startup Errors	
0001	Non-maskable interrupt occurred outside of sleep routine
0002	32k RAM test error
0003	Not used
0004	Flash memory checksum test error
0005	Flash memory part is unknown
0009	Flash memory write error
0010	Timing generator driver failed initialization
0011	DSP driver failed initialization
0012	Abbie driver failed initialization
0013	EEPROM memory driver failed initialization
0014	ICP digital failed initialization
0015	INTOUT driver failed initialization
0016	INTIN driver failed initialization
0017	RADIO driver failed initialization
0018	MODEM driver failed initialization
0019	EXTIO driver failed initialization
0020	SCI driver failed initialization
0021	ICP PROM checksum error
0022	I2C driver initialization error
0023	I2C driver mode change error
0024	I2C driver write error
0025	UART driver failed initialization
0026	Timer failed initialization
ADI Driver Fatal Error Code	
0030	ADI did not respond to command
LCD Driver Fatal Error Codes	
0040	LCD did not acknowledge message
0041	LCD hardware is invalid
SCI Driver Fatal Error Codes	
0050	SCI out of heap space
IPC DSP Driver Fatal Error Codes	
0070	DSP did not read a message within 500 milliseconds
0071	DSP gave a response longer than buffer
0072	DSP did not read stream data within 500 milliseconds
0073	ARM tried to write more data than DSP could store
0074	ARM tried to write DSP code and failed
0075	ARM did not get an acknowledgement of a command to the DSP

Table 12-1: Radio Error Codes (Continued)

DISPLAYED CODE	MEANING
Radio Driver Fatal Error Codes	
0080	Transceiver failed to program synthesizer due to data collision(s)
0081	Transceiver failed to program MCU
0082	Transceiver failed to find proper calibration data
0083	Transceiver MCU failed to program receiver ADC
Boot Loader Fatal Error Codes	
0090	No memory space for ROM task
0091	No memory space for BL task
0092	Boot loader could not attach to SCI
McBSP Fatal Error Code	
0093	McBSP configuration error
RXSIF Primitive Fatal Error Code	
0098	RXSIF fatal error
Operating System Fatal Error Codes	
0100	Interrupt had no handler
0101	Pre-fetch abort handler
0102	Data abort handler
0103	Reserved interrupt handler
0104	Unexpected interrupt handler
0105	Interrupt handler failed to set-up the IRQ
0106	OS fork creation process failed
0107	OS pipe creation process failed
0108	OS task creation process failed
0109	Task stack overflowed
0110	OS timer task creation failed
0111	OS returned fatal error
0112	OS fork stack overflowed
0113	OS priority fork stack overflowed
0114	GPIO config was wrong - check radio config
0115	MPUIO config was wrong - check radio config
0116	Could not set radio type right using sector 0
0117	Failure in download system
0118	Memory allocation failed
0119	Semaphore pending error
0120	Semaphore post operation error
0121	OS fork stack had nucleus error
0122	OS priority fork stack had nucleus error
FATAL APPLICATION ERROR CODES:	
RADC Fatal System Error Codes	
2200	PERS tracking data error
5201	PERS hardware data error

Table 12-1: Radio Error Codes (Continued)

DISPLAYED CODE	MEANING
4202	PERS frequency data error
1203	PERS tracking data memory error
1204	PERS tracking data checksum error
1205	Hardware revision could not be determined
DACS Fatal System Error Codes	
3300	No lock message
1301	Unable to correctly configure modem
1302	ProSound scan failed
1303	CISYS message buffer not enabled
1304	Failure in Tx frequency load
1305	Failure in Rx frequency load
1306	Failure to transmit CC header data
1307	Failure to set up CC receiver
1308	Failure to set up WC receiver
1309	Failure to set up WC LSD receiver
1310	Failure to set up WC HSDreceiver
1311	Failure to transmit body of CC message
1312	Failure to idle transmitter
1313	Failure to transmit body of WC message
1314	Failure in RADC speaker function
1315	Failure to transmit WC HSD
1316	Failure to select TX hardware path
1317	Failure to transmit DTMF digit
1318	Failure to transmit LSD
1319	Failure of HSD sync setup
EA Fatal System Error Codes	
1350	Memory failure message
Conventional Fatal System Error Codes	
1400	Error calling RADC function
3401	Synthesizer became unlocked
1402	UI message buffer not enabled
1403	Conventional digital voice modem overflow
1404	Conventional digital voice modem underflow
1405	Unable to correctly configure the modem for conventional digital voice operation
5407	Conventional personality error
1408	Error calling RADC function in ECP1 scan
1409	Error calling RADC function in CHANUTIL - channelized
1410	Error calling RADC function in CHANUTIL - absolute frequency
1411	Error calling RADC function in CONVTX – channelized
1412	Error calling RADC function in CONVTX - absolute frequency
1413	Error calling RADC function in CONVTX - idle mode

Table 12-1: Radio Error Codes (Continued)

DISPLAYED CODE	MEANING
1450	Error calling RADC function in CONVTX - idle mode
1451	Error calling RADC function in trunked P25
1452	Error reading serial number
1453	Bad message type requested
Personality Interface Fatal System Error Codes	
5500	Personality data is not present
5501	Flash personality Cyclic Redundancy Check (CRC) did not match EEPROM's CRC
5502	Personality descriptor table CRC error
1503	Descriptor table memory error
5504	Custom frequency set table error
User Interface Fatal System Error Codes	
5600	Input/Output device error
1601	Out of memory
1602	Maximum number of timers exceeded
1603	Too many open windows
1604	Out of memory
1605	Invalid parameter
1606	RI BBOS message buffer full error
1607	RI System (message buffer full error)
1608	CI BBOS message buffer full error
5609	I/O device type from personality not supported
1610	No more memory
5611	Network I/O device error
6612	Control head ID is invalid
5613	No tone data is available in personality
1614	UI IBBOS message buffer full error
1615	No more memory
1616	No more memory
1617	UI message received error
Test Unit Fatal System Error Codes	
1701	Rx message buffer memory failed
1702	Tx message buffer memory failed
1703	BB message to UI task failed
1704	BB message to RISYS task failed
1705	BIOS call for voter monitor failed
NON-FATAL APPLICATION ERROR CODES:	
Common Error Messages	
1	Feature encryption error message
2	Synthesizer unlocked
3	No key banks allocated in personality
5	Tracking data was in error; using default

Table 12-1: Radio Error Codes (Continued)

DISPLAYED CODE	MEANING
6	Dual personality recoverable error message
7	G-STAR error
8	Tone encode error
9	Traffic encryption keys Cyclic Redundancy Check (CRC) error
10	DSP did not respond to key query
11	AES configuration error
12	DES configuration error
Flags to Set Persistent Error Messages	
8000	Set persisting error condition, error will be cleared with another call
1000	Clear persisting error condition
Personality Interface Non-Fatal System Error Codes (Feature Encryption Errors)	
0550	Cannot read SROM
0551	Personalities sizes don't match
0552	Decryption failure
0553	Tracking data failure
Dual Personality Errors	
0580	Personality failure
0581	Tracking data failure
0582	Feature data failure
0583	Image failure
Calibration Parameter Error Codes	
0560	ECP calibration data missing; data updated to current defaults
0561	Calibration data update failed
0562	ECP calibration data older than current revision; data updated to current defaults
0563	ECP calibration data newer than current revision
0590	TestApp calibration data missing; data updated
0591	TestApp calibration data update failed
0592	TestApp calibration data older than current revision; data updated to current defaults
0593	TestApp calibration data newer than current revision
USER INTERFACE NON-FATAL SYSTEM ERROR CODES:	
0880	Group is set to digital but system vocoder is set to analog
0883	IMBE is not supported by DSP
0885	Attempt to use IMBE vocoder with IMBE feature turned off
0886	Attempt to use encryption but DSP doesn't support encryption
0887	Attempt to use encryption but encryption is turned off
0890	Hardware revision could not be determined
0891	No G-STAR response from DSP
0892	No tone encode response from DSP
0894	DSP did not respond to key query

12.4 RF PERFORMANCE TESTS

12.4.1 General Information

This section includes RF performance test procedures for the 50-Watt VHF XG-25M mobile radio. Basic receiver and transmitter RF performance test procedures are included, along with details on the configuration of a recommended conventional test personality, and a list of recommended test equipment. All test procedures in this section are performed in either an analog conventional mode or P25 conventional mode.

Performance test procedures for a complete radio installation are included in the *Installation and Product Safety Manual*, publication number 14221-1510-4000. These test procedures test basic aspects of the radio installation, including the installation's antenna system.

WARNING

Improper radio service may void the radio's RF integrity and cause it to violate FCC rules and regulations. Do not return the radio to field use until it is fully tested to ensure proper operation.

If the radio's Main Board is replaced, always successfully complete all applicable test and alignment procedures presented in this manual before returning the radio to the customer. The radio should also be fully tested and (where necessary) aligned if any component in an RF signal path of the Main board is replaced, retuned, or disturbed in any way.

Observe precautions for damage due to **E**lectro-**S**tatic **D**ischarge (**ESD**). Always use proper grounding techniques (wrist or waist straps with grounding cords, grounded table-top mats, etc.) and other approved methods in order to minimize the chance of damage from ESD.

For technical assistance, contact the Technical Assistance Center using the contact information listed in Section 7.

NOTE

Test procedures included in this section can be performed on customer frequencies/channels, if possible. This will prevent unnecessary radio personality reprogramming operations.

However, if customer frequencies/channels are not available and/or the utilized test equipment does not allow testing on these frequencies/channels or radio operating mode, a conventional test personality should be created and used as described in Section 12.4.3 that follows.

12.4.2 Test Equipment

Table 12-2 lists test equipment required for mobile radio RF performance tests included in this manual.

Table 12-2: Test Equipment for RF Performance Tests and Alignments

EQUIPMENT	RECOMMENDED TYPES / MODEL NUMBERS
RF Communications Test Set	Any RF Communications Test Set capable of generating a standard P25 1011 Test Pattern, such as an Aeroflex™ IFR 2975 or Aeroflex™ 3920
RF Cable, 50-Ohm: TNC Male to Type-N Male	Pasternack Enterprises PE3661-36 or equivalent
RF Cable, 50-Ohm: Type-N Male to Type-N Male*	Pasternack Enterprises PE3441-36 or equivalent
RF Attenuator, 50-Ohm: 30 dB, 100-Watt, Type-N Female*	Bird Tenuline® 100-SA-FFN-30 or 100-A-FFN-30 or equivalent
Modified Microphone**	Harris Part Number MC-101616-060 modified similar to Tech Tips modification instructions in the Technical Training Toolbox on the Tech-Link web site. (https://premier.pspc.harris.com/infocenter/TechLink)
Modified Speaker**	Harris Part Number LS102824V10 modified similar to Tech Tips modifications instructions in the Technical Training Toolbox on the Tech-Link web site. (https://premier.pspc.harris.com/infocenter/TechLink)
Personal Computer (PC) with Radio Personality Manager (RPM) Programming Software	Laptop PC recommended with RPM Release R9A or later (See Section 10.1 on page 21 and/or Table 12-6 on page 58 for additional information).
Serial Programming Cable***	CA-104861 (5 feet long) or CA-013671-020 (20 feet long) or equivalent
DC Power Cable with Fuses	Harris Part Number CA-012365-001
Option Cable	Harris Part Number 14002-0174-08
Power Supply	Adjustable Regulated DC-Output Power Supply capable of adjustment from 12 to 15 Vdc (minimum) and 20-ampere output current (minimum)

* An RF attenuator is required if the utilized RF Communications Test Set does not have a high-power input port capable of at least 60 watts of continuous RF input power.

** Not Required for Transmitter/TCXO Error Test and Transmitter Power Test.

*** If the utilized PC is not equipped with a DB-9 type serial port connector, the use of a suitable adapter is required, such as USB-to-RS-232 Adapter Cable CN24741-0001. As of the publication of this manual, CN24741-0001 is available via the Harris Customer Care center; refer to Section 6 on page 15 for the respective contact information.

NOTE

The RF Communications Test Set should have a frequency accuracy equal to or better than 0.2 ppm. If not, an appropriate external timebase reference which meets or exceeds this specification must be applied to the external timebase reference input of the test set/frequency counter, and the test set/frequency counter must be configured to use this external reference.

12.4.3 Recommended Conventional Test Personality

Use RPM to create the following conventional test personality and program it into the radio. Refer to Section 10.3 and/or RPM's built-in help as necessary:

Read and Save the Existing Personality

1. Use RPM's read function to read the personality currently in the radio.

2. In the RPM's main dialog box, verify Radio Type is set to XG-25M.
3. If this personality is not available/archived on computer storage media, save it for later restoration.

Create the Analog Conventional Test System

4. In the Personality Data Tree, double-click on Systems to open the System Setup dialog box to the General tab.
5. Click the Add New System button and create a new conventional system for RF tests. Use any appropriate name.
6. Configure this new conventional system with the analog conventional test channels listed in Table 12-3. Achieve this by creating a new conventional (channel) set with the listed channels and assigning the set to the new system.
7. Verify each channel's Voice Mode is set to Analog. If not, make this change.

Table 12-3: Analog Conventional and P25 Conventional Test Channels

TX FREQ. (MHz)	RX FREQ. (MHz)	RECOMMENDED NAME FOR ANALOG CONV. SYSTEM	RECOMMENDED NAME FOR P25 CONV. SYSTEM	BANDWIDTH	OTHER SETTINGS
136.025	136.025	136.025A	136.025P	See NOTE that follows	Leave at RPM Defaults
155.000	155.000	155.000A	155.000P		
173.975	173.975	173.975A	173.975P		

NOTE

If the radio is wideband-capable, set Bandwidth to "Wide" (25 kHz) for analog conventional test system channels and set Bandwidth to "C4FM" for P25 conventional test system channels.

If the radio is not wideband-capable, set Bandwidth to "Narrow" (12.5 kHz) for analog conventional test system channels and set Bandwidth to "C4FM" for P25 conventional test system channels.

To determine if the radio is wideband-capable or not, check for the presence or absence of feature number 50, which is sometimes called the "Wideband Disable Bit" (bit 49). If feature number 50 is not present, the radio is wideband-capable. If feature number 50 is present, the radio is not wideband-capable. The procedure in Section 10.4.1 (page 24) describes how to display the currently enabled feature numbers/packages.

NOTE

Within RPM, a period (.) can be entered into the Name field of the Conventional Frequency Sets dialog box using a right-click and paste action. This assumes a period or the complete frequency in MHz has been previously copied to the Windows clipboard.

8. In the System Setup dialog box, click the General tab and select the test system.
9. Verify "MAX" is present in the Power Level text box. If not, enter MAX in the text box so the radio will transmit at full-power when it is set to high-power transmit level. Exit this dialog box and save changes by clicking the OK button.

10. In the Personality Data Tree, double-click on Programmable Menus and use that dialog box to set the TX POWER function as a selection on the conventional menu. This menu is necessary for the transceiver performance test procedures in Section 12.4.4.
11. Add the SQUELCH function as a selection on the conventional menu. This menu is necessary for the receiver performance test procedures in Section 12.4.5. This function can also be added to a radio button, such as the A button.

NOTE

To add a function to a radio button, in RPM's Personality Data Tree's Options limb, use Control Unit Keypad Options to access the XG-25M Keypad dialog box, then select the desired function via the respective button drop-down, and then click the OK button.

12. Add the FCC MENU function as a selection on the conventional menu. This menu is necessary for P25-related test procedures in Sections 12.4.4 and 12.4.5. This function can also be added to a radio button, such as the B button.
13. Add the EXT SPKR function as a selection on the conventional menu. This menu is necessary for the receiver performance test procedures in Section 12.4.5. This function can also be added to a radio button, such as the C button.

Create the P25 Conventional Test System

14. Create a new P25 conventional system using RPM's Add New System button.
15. Configure this new P25 conventional system with the P25 conventional test channels listed in Table 12-3. To do this, create a new P25 conventional (channel) set with the listed channels and assign the set to the new system.
16. Set each P25 test channel's Voice Mode to P25 and Bandwidth to C4FM.
17. Set each channel's Tx NAC and Rx NAC as desired, or leave them at the default values of 293.
18. In the System Setup dialog box's Project 25 Conventional tab, set the radio's Unit ID number as required (range = 1 to 9,999,999 decimal).
19. Save this personality and program it to the radio. Refer to Section 10.3 and/or RPM's built-in help as necessary.

12.4.4 Transmitter Performance Tests

12.4.4.1 Tx Frequency Test

Use the procedure in this section to check the accuracy of the radio's Temperature-Compensated Crystal Oscillator (TCXO) frequency and transmit frequency. TCXO performance affects both transmitter and receiver performance. The TCXO is the radio's reference oscillator.

NOTE

The radio's TCXO reference oscillator is a highly accurate and stable crystal reference oscillator. The use of a recently-calibrated RF Communications Test Set and/or Frequency Counter is recommended. **The utilized test equipment should have a specified frequency accuracy equal to or better than 0.2 ppm.**

NOTE

This test should be performed with the radio and test equipment at a room temperature between 68 and 77° Fahrenheit (20 to 25° Celsius). After radio power-up, always wait at least 15 minutes before taking a measurement. This warm-up time will allow the temperature of the radio's circuits to properly stabilize.

1. With the DC power supply output **off**, connect the radio to the supply. Use cable CA-012365-001 with a 15-amp fuse in its red wire (main power) to the power supply's positive (+) output terminal. Connect the cable's black wire to the power supply's negative (-) output terminal. Connect the white wire via a 3-amp fuse to the power supply's positive (+) output terminal or to a switched power source.

CAUTION

Always observe polarity when making connections to the power supply!

2. Connect the radio's TNC antenna port connector to the RF Communications Test Set's high-power RF input port. To make this connection, use only high-quality RF coax cable(s). If the utilized test set does not have a high-power input port capable of at least 60 watts of continuous RF power, use an external RF attenuator between the radio and test set. The attenuator should have a minimum power rating of 60 watts.
3. Connect a microphone to the radio's front panel mic connector. Either an unmodified or a modified mic can be used for this test. If using the modified microphone, place its PTT toggle switch in the center (off/not keyed) position.
4. Set the DC power supply's output voltage to 13.6 Vdc with a current limit between 15 and 20 amps.
5. **Power-up the radio and allow at least a 15-minute warm-up period.**
6. Select the analog conventional test system and then select one of the test channels within that system.
7. Configure the test set's frequency counter for an in-band frequency count.
8. Key the radio by depressing the microphone's PTT button and verify the radio is transmitting per an illuminated red TX/BUSY indicator on the radio's front panel.
9. Use the test set's frequency counter function to accurately measure the transmit frequency. Record the measured frequency in Table 12-4.
10. Unkey the radio.
11. Change channels and repeat the transmit frequency measurements for the other two (2) test channels listed in Table 12-4. Always unkey the radio before making a channel change.
12. Verify each measured transmit frequency is within the respective error limits listed in Table 12-4. Any error outside of the listed limits indicates TCXO reference oscillator alignment is needed or there is a TCXO reference oscillator or transceiver synthesizer circuit problem in the radio. Record the overall pass/fail result in the table.

NOTE

The TCXO reference oscillator alignment procedure is included in Section 12.5.5.2 which begins on page 76. This alignment is sometimes referred to as "Automatic Frequency Control" (AFC) alignment.

13. Unkey the radio.
14. If no other tests are required at this time, disconnect all test equipment and remove the conventional test personality from the radio. The test personality **must** be removed from the radio and the original personality restored before the radio is returned to normal service.

Table 12-4: Maximum Transmit Frequency Errors for Recommended Test Channels

TEST TX FREQUENCY (MHz)	MAXIMUM TRANSMIT FREQUENCY ERROR (±2 ppm)	MINIMUM TX FREQUENCY (MHz)	MAXIMUM TX FREQUENCY (MHz)	MEASURED FREQUENCY (MHz)	PASS/ FAIL
136.025	272 Hz	136.024728	136.025272		
155.000	310 Hz	154.999690	155.000310		
173.975	348 Hz	173.974652	173.975348		

Radio Part Number:	Radio Serial Number:	PASS/ FAIL	Test Date:	Technician's Initials:
14015-0010-01				

CAUTION

Do **not** return the radio to normal use if any tested channel has a transmit frequency error exceeding ±2 ppm.

12.4.4.2 Tx Power Levels Test

Follow this procedure to check the radio's transmitter output power levels.

1. If the transmit frequency test procedure has not been performed per Section 12.4.4.1, do that now. Leave the radio and test equipment connected and configured as described in that procedure.
2. Zero out (i.e., account for) all RF loss in utilized test cable(s), attenuator, adapter(s), etc. Refer to the RF Communications Test Set's documentation and the equipment's RF loss data as necessary.
3. While in high-power transmit level, select each test frequency listed in Table 12-5, key the radio by depressing the microphone's PTT button, and verify the transmit power level is within the respective range listed in the table. If not, check cable connections, etc., and re-test if necessary.
4. Switch the radio to low-power transmit level.

NOTE

To switch between high-power and low-power transmit levels, press the MENU button, then use + or – buttons to scroll through the menu until TX POWER appears in the middle line of the display. Finally, toggle to the other power level by pressing the MENU button again. Afterwards, if another menu function is not selected, the power level can be toggled again by simply pressing the MENU button twice.

Alternately, if the TX POWER function is programmed to a button, simply press the button once to toggle the power level to the other level.

When the low transmit power level is selected, the ↓ status icon appears at the bottom of the display and LOW PWR briefly appears at the top. When the high transmit power level is selected, the ↓ status icon disappears and HIGH PWR briefly appears at the top.

5. Select each test transmit frequency listed in Table 12-3, key the radio by depressing the microphone's PTT button, and verify the low-power transmit level is within the respective range listed in Table 12-4. If not, check cable connections, etc., and re-test if necessary. Before making a channel change, unkey the radio and record measured results in Table 12-4.

Table 12-5: Transmitter Power Test—Maximum Errors

TX POWER LEVEL SETTING	TOLERANCE (dB)	LIMITS MINIMUM TX POWER (Watts)	LIMITS MAXIMUM TX POWER (Watts)	MEASURED TX POWER (Watts)	PASS/ FAIL
Low (10 watts)	±0.5 dB	8.9	11.2		
High (50 watts)	±0.25 dB	47.2	52.9		

Radio Part Number:	Radio Serial Number:	PASS/ FAIL	Test Date:	Technician's Initials:
14015-0010-01				

NOTE

Transmit power level alignment information is included in Section 12.5.5.3 (page 78).

6. Unkey the radio.
7. If no additional tests are to be performed, disconnect all test equipment and remove the conventional test personality from the radio. The test personality **must** be removed from the radio and the original personality restored before the radio is returned to normal service.

CAUTION

Do **not** return the radio to service if any measured transmit power level is outside of the respective limits listed in Table 12-5.

12.4.4.3 Conventional Tx Modulation Limiting Tests

Follow this test procedure to check the radio's analog conventional modulation limiting and symmetry:

1. If the transmit frequency test procedure has not been performed per Section 12.4.4.1, do that now. Leave the radio and test equipment connected and configured as described in that procedure.
2. If an unmodified microphone was used for the transmit frequency test procedure, disconnect it and connect the modified mic. Refer to Table 12-2 on page 46 as necessary.
3. Adjust the RF Communication Test Set's audio signal generator output for a 1 kHz audio signal at a level of 200 mV rms.
4. Connect this 1 kHz signal to the radio's microphone input. To make this connection, use a modified microphone (see Table 12-2 for additional information) along with a BNC cable and an adapter(s) appropriate for the test set. Apply the signal to the modified microphone's mic audio BNC input connector.
5. Select the analog conventional test system and select any test channel within that system.
6. Switch the radio to high-power transmit level.
7. Configure the test set for an on-frequency transmitter FM deviation measurement.
8. Key the radio via the modified microphone and verify it is transmitting per an illuminated red TX/BUSY indicator.
9. Measure FM deviation and verify it is within the respective range listed in the following table.

Table 12-6: Analog Voice FM Deviation Ranges for Narrowband and Wideband Channels

MODE	DEVIATION RANGE (NO CG OR DCG)
Narrowband Analog	2.15 to 2.35 kHz
Wideband Analog	4.3 to 4.7 kHz

10. Record the pass/fail result in the following table:

Conventional Tx Modulation Limiting Tests

Radio Part Number:	Radio Serial Number:	PASS/ FAIL	Test Date:	Technician's Initials:
14015-0010-01				

CAUTION

FM deviation in excess of the respective range listed in Table 12-6 may violate FCC rules.

NOTE

FM deviation alignment information is included in Section 12.5.5.5 which begins on page 86.

11. Unkey the radio.
12. If no additional tests are to be performed, disconnect all test equipment and remove the conventional test personality from the radio. The test personality **must** be removed from the radio and the original personality restored before the radio is returned to normal service.

CAUTION

Do **not** return the radio to service if any measured parameter exceeds the respective limits.

12.4.4.4 P25 (C4FM) Tx Modulation Test

Follow this procedure to test the radio transmitter's P25 modulation performance:

1. If the transmit frequency test procedure has not been performed per Section 12.4.4.1, do that now. Leave the radio and test equipment connected and configured as described in that procedure.
2. If an unmodified microphone was used for the transmit frequency test procedure, disconnect it and connect the modified mic. Refer to Table 12-2 on page 46 as necessary.
3. Select the P25 conventional test system and select any test channel within that system.
4. Configure the test set for an on-frequency transmitter peak-positive FM deviation measurement.
5. Configure the test set deviation meter's audio bandwidth response with a high-pass frequency at $\leq$ 15 Hz and a low-pass frequency at $\geq$ 3 kHz.
6. Disable the deviation meter's de-emphasis function.
7. Press the radio's MENU button, then use the + or – buttons to scroll through the menu until FCC MENU appears in the middle line of the display, and then press the MENU button again.

8. Use the + or – buttons to scroll through the FCC menu until P25 HIGH appears, and select that function by pressing the MENU button again. The radio will begin transmitting a standard C4FM symbol rate pattern.
9. Measure the deviation with the test set and verify it is within the respective range listed in the following table.

Table 12-7: P25 (C4FM) Deviation Ranges for Narrowband and Wideband Channels

MODE	DEVIATION RANGE (NO CG OR DCG)
Narrowband Analog	1.95 to 2.05 kHz
Wideband Analog	2.54 to 3.12 kHz

10. Record the pass/fail result in the following table:

P25 (C4FM) Tx Modulation Test

Radio Part Number:	Radio Serial Number:	PASS/ FAIL	Test Date:	Technician's Initials:
14015-0010-01				

NOTE

For related alignment information, refer to the I/Q Data Modulation Alignment procedure in Section 12.5.5.4 (page 83). This alignment is performed in a single side-band mode.

11. Press the MENU button again to unkey the radio.
12. If no additional tests are to be performed, disconnect all test equipment and remove the conventional test personality from the radio. The test personality **must** be removed from the radio and the original personality restored before the radio is returned to normal service.

12.4.5 Receiver Performance Tests

Receiver performance test procedures in this section should be performed in the order presented.

12.4.5.1 Audio Output Power, Distortion, and Internal Speaker Tests

Receiver audio output and distortion levels should always be verified as being good **before** performing any receiver-related test. Passing this test procedure ensures the respective audio circuits in the radio have sufficient output capability and minimal distortion, and that other related circuits are operating properly. Follow this procedure to check the audio output and distortion levels:

1. With the DC power supply output off, connect the radio to the supply. To make these connections, use standard DC power installation cables with fuses as described in step 1 of Section 12.4.4.1 (page 49). **Always observe polarity when making connections to the power supply!**
2. Connect the modified speaker to the radio via Option Cable 14002-0174-08. The option cable's 44-pin connector mates to the 44-pin connector on the rear of the radio. The 2-pin rectangular connector of the modified speaker's cable mates to the 2-pin rectangular connector of the option cable.
3. Connect the speaker output of the radio to the RF Communication Test Set's audio input measurement port. Make this connection at the 4-ohm load resistor in the modified speaker (see Table 12-2 for additional information).

CAUTION

The modified speaker contains a 1:1 audio coupling transformer to couple the radio's differential-type speaker output to the modified speaker's unbalanced test port output (BNC connector or banana plug). This output **must** only be connected to a high-impedance load (of any test equipment). Loading this output with a speaker could damage the transformer.

4. Switch the modified speaker's double-pole switch to the speaker position (i.e., speaker on).
5. Set the DC power supply's output voltage at 13.6 Vdc at a current limit between 6 and 8 amps.
6. Turn the power supply's output on, if it is not already.
7. **Power-up the radio and the radio and allow at least a 5-minute warm-up period.**

CAUTION

Do **not** key the radio during this test. Doing so could damage to the RF Communication Test Set.

Using an external 20 or 30 dB attenuator between the radio's antenna port and the test set's generator/low-power RF output port can help to prevent damage to the test set if the radio is accidentally keyed. If an external attenuator is used, all RF signal level measurements must be adjusted accordingly when making RF signal level measurements.

8. Set the radio's volume control to a mid-range position.
9. Select the analog conventional test system.
10. Select any analog conventional test channel listed in Table 12-3. Make a system and channel change as necessary.

    Alternately, select any customer channel that can be used for radio testing.
11. Connect the radio's TNC antenna port connector to the RF Communications Test Set's signal generator/low-power RF output port. To make this connection, use only high-quality RF coax cable(s).
12. Set the RF Communication Test Set on-frequency with an RF output level of -47 dBm (1000 µV). Modulate the RF output with a 1 kHz tone at the respective deviation listed in Table 12-8.

Table 12-8: Analog FM Deviation Setting for Narrowband and Wideband Channels

MODE	DEVIATION SETTING (60% of Rated System Deviation)
Narrowband Analog	1.5 kHz
Wideband Analog	3.0 kHz

NOTE

If the radio is not wideband-capable, use the narrowband deviation setting. Otherwise, use the setting that corresponds to programmed bandwidth of the selected analog conventional test channel.

13. At the RF Communication Test Set, enable a low-pass filter on the set's audio input port being used for this test. Use a filter that has a 3 dB roll-off point between 10 and 20 kHz.
14. Verify the radio is receiving the full-quieting RF signal. If not, recheck connections and/or radio and test equipment configurations.

15. Enable the radio's external speaker output. To do this, either use a button programmed with the EXT SPKR function or select that function from the menu.
16. Verify SPKR ON is shown in the top line of the display indicating the radio's external speaker output is now on.
17. Verify the 1 kHz tone is heard in the modified speaker. If necessary, adjust the volume to a comfortable level.
18. Switch the modified speaker's double-pole switch to the load position (i.e., speaker off).
19. While monitoring the test set's audio analyzer or AC voltmeter, adjust the radio's volume control for a speaker output audio level of 7.745 Vrms. This is 15 watts into the 4-ohm speaker load.
20. Using the test set's audio analyzer, measure the distortion level of the 1 kHz tone from the radio. It should be less than 3%.
21. Reduce the volume control to a relatively low setting.
22. Switch the modified speaker's double-pole switch to the speaker position (i.e., speaker on).
23. Disable the radio's external speaker output. To do this, either use a button programmed with the EXT SPKR function or select that function from the menu. When disabled, SPKR OFF briefly shows in the top line of the display, and then the selected system is indicated in that line.
24. Verify the 1 kHz tone from the radio's internal speaker is loud and clear. Adjust volume as necessary.
25. At a comfortable volume level, listen to the radio's internal speaker while slowly increasing and decreasing the test set's test tone frequency between approximately 300 and 4 kHz. Using 100 Hz incremental steps is adequate. The speaker audio should be clear without speaker rattle. The level of audio will taper off rapidly below 300 Hz and above 3.6 kHz; this is normal. Setting the volume control too high will cause significant distortion as some frequencies; this is normal. Passing this step verifies the speaker is in good order, with receive audio response as expected.
26. Record overall pass/fail results in the following table:

Audio Output and Distortion Levels Tests

Radio Part Number:	Radio Serial Number:	PASS/ FAIL	Test Date:	Technician's Initials:
14015-0010-01				

27. If no additional tests are to be performed, disconnect all test equipment and remove the test personality from the radio. The test personality **must** be removed from the radio and the original personality restored before the radio is returned to normal service.

12.4.5.2 12 dB SINAD Rx Sensitivity Test

Use this test procedure to determine the radio's 12 dB SINAD receiver sensitivity level:

1. Complete the Audio Output and Distortion Levels Tests presented in Section 12.4.5.1. Leave the radio and all test equipment interconnected and configured per that procedure.

NOTE

Receiver audio output and distortion levels should always be verified as being good **before** performing any receiver-related test. Passing this test procedure ensures the respective audio circuits in the radio have sufficient output capability and minimal distortion, and that other related circuits are operating properly.

2. Enable the radio's external speaker output. To do this, either use a button programmed with the EXT SPKR function or select that function from the menu.
3. Verify SPKR ON is shown in the top line of the display indicating the radio's external speaker output is now on.
4. If using the recommended test channels, select the first test channel listed in Table 12-3. Make a system and channel change as necessary.

   If using the customer's channels, select the channel with the lowest frequency.
5. Disable squelch by adjusting it to a minimum setting. Refer to the following NOTE as necessary.

> **NOTE**
>
> Before squelch can be disabled/adjusted, the SQUELCH programmable menu function must be programmed to a radio button and/or to the conventional menu as described in Section 12.4.3. With such programming, disable squelch as follows:
>
> - Enter the SQUELCH function by either pressing the button programmed with that function or by selecting the function from the radio's menu.
> - Press the – (minus) button until SQLCH= 1 appears in the display. At this point, squelch is at a minimum setting and essentially disabled.

6. Set the RF Communication Test Set on frequency with an initial RF output level of approximately -100 dBm (2.25 µV), and verify the radio is receiving the RF signal from the test set. If not, recheck connections and/or radio and test equipment configurations.
7. Configure the RF Communication Test Set for a 12 dB SINAD level measurement. Modulate its RF output with a 1 kHz tone at the respective deviation listed in Table 12-8. Reduce/Adjust the test set's RF output level as necessary to obtain a 12 dB SINAD level reading. Radio volume control adjustments may also be necessary.
8. Verify the 12 dB SINAD level measurement against specifications listed in Section 3.2. If the 12 dB SINAD level measurement is worse than (i.e., RF signal level greater than) the respective specification, first recheck connections and test set configuration. If the problem cannot be resolved, verify RF channel programming before contacting the Harris Technical Assistance Center (TAC) for assistance.
9. If using the recommended test channels, select the next test channel listed in the table, change the test set to the corresponding frequency, and measure the 12 dB SINAD level on the channel. Verify the measured value against the respective specification.

   If using the customer's channels, select the channel with the highest frequency.
10. Repeat until all test channels have been measured. Record the overall pass/fail result in the following table:

12 dB SINAD Rx Sensitivity Test

Radio Part Number:	Radio Serial Number:	PASS/ FAIL	Test Date:	Technician's Initials:
14015-0010-01				

11. Use the SQUELCH function to re-enable squelch and return it to the original setting.
12. Disable the external speaker. To do this, either use a button programmed with the EXT SPKR function or select that function from the menu. When disabled, SPKR OFF briefly shows in the top line of the display, and then the selected system is indicated in that line.

13. If no additional tests are to be performed, disconnect all test equipment and remove the conventional test personality from the radio. The test personality **must** be removed from the radio and the original personality restored before the radio is returned to normal service.

12.4.5.3 P25 (C4FM) Rx Sensitivity Test

Follow this test procedure to check P25 (C4FM) receiver sensitivity:

1. Complete the Audio Output and Distortion Levels Tests presented in Section 12.4.5.1. Leave the radio and all test equipment interconnected and configured per that procedure.
2. Select the P25 conventional test system and a test channel within that system.
3. Set the RF Communication Test Set on frequency at an RF output level of -116 dBm (0.35 µV).
4. Modulate the test set with a standard 1011 P25 (C5FM) test pattern.
5. Enter the FCC Menu. To do this, either use a button programmed with the FCC MENU function or select that function from the menu.
6. Use the + or – buttons to scroll through the FCC menu until IBERC4FM appears, then select that function by pressing the MENU button. The radio displays the internally calculated Bit Error Rate (BER) of the received test pattern.
7. Press the MENU button again to toggle the display from fast BER to slow (averaging) BER.
8. Verify the displayed BER is not 0%, but less than 5%. If a 0% is displayed, the radio is not receiving an on-channel RF signal from the test set.
9. Repeat BER measurements on the other test channels. Record the overall pass/fail result in the following table:

P25 (C4FM) Rx Sensitivity Test

Radio Part Number:	Radio Serial Number:	PASS/ FAIL	Test Date:	Technician's Initials:
14015-0010-01				

10. If no additional tests are to be performed, disconnect all test equipment and remove the conventional test personality from the radio. The test personality **must** be removed from the radio and the original personality restored before the radio is returned to normal service.

12.5 RADIO ALIGNMENT

Programming, alignment, and servicing aspects of maintaining a XG-25M mobile radio rely on Harris RPM programming software. A software-based Radio Maintenance Utility is included with the RPM software. This tool is installed on the personal computer (PC) when RPM is installed. It is used for various radio alignment and restoration activities, as described in the following subsections.

12.5.1 Required RPM Programming Software, Radio Code and Test Equipment

Prerequisites required to perform the radio alignment procedures presented in this manual include:

- The minimum version of the RPM programming software, as listed in Table 12-6, must be installed and operating on the technician's PC.
- The minimum version of ECP radio firmware codes, as listed in Table 12-7, must be installed into the radio.
- Test equipment as listed in Table 12-2 (page 46) is necessary to complete the alignment procedures.

This section also assumes the technician is familiar with the general operation of RPM and that the COM port assigned to the programming cable is properly configured in RPM.

The instructions in this manual are based on the RPM software revisions listed in Table 12-6 which are required when programming, aligning, and servicing the XG-25M mobile radios.

Table 12-9: Minimum RPM Programming Software Versions

RPM RADIO SOFTWARE	PART NUMBER	VERSION
RPM for EDACS, ProVoice and P25 Trunked Systems	TQS3385	R09A or later
RPM for Conventional and P25 Conventional Systems	TQS3389	R09A or later

The minimum version of radio ECP firmware codes listed in Table 12-7 must be loaded into the radio. Otherwise, the Radio Maintenance Utility will not function properly with the radio. Determining if a radio has the minimum code versions installed is accomplished by using the Radio Maintenance Utility to read the calibration data from the radio. A pop-up message will appear when the radio does not meet the required minimum ECP firmware code versions.

Table 12-10: Minimum Versions of ECP Radio Firmware Codes for XG-25M Radios

OMAP RADIO SOFTWARE	VERSION
BootApp	R01A00 or later
LoaderApp	R12B or later
BurnApp	R11A or later
ECP Radio Code	R16A or later

12.5.2 Overview of the Radio Maintenance Utility

As previously stated, the software-based Radio Maintenance Utility is included with the RPM programming software. It is installed on the PC along with the RPM programming software. This utility may be used to align many Harris mobile and mobile products, including the XG-25M mobile radio.

The Radio Maintenance Utility is primarily used with the radio operating from a test personality in analog conventional mode. Test systems and frequency sets must be added to the radio's existing personality to complete the tests. Alternately, a "shop" test personality which includes the test system and frequency sets may be developed and used to align the radio.

Within the Radio Maintenance Utility, most transmitter (Tx) and receiver (Rx) alignment fields contain multiple data points within each alignment test. Some tests use up to forty (40) data points. Each data point sets alignment of a specific function at different frequencies spread across the radio's entire operating frequency range.

Since a radio's RF performance can change over a wide frequency range, this multi-point alignment procedure assures the best possible radio performance at all programmed operating frequencies. Alignment values for frequencies between the specific alignment data points are interpolated from the data points above and below the programmed operating frequency. Therefore, precision alignment at each specific operating frequency is obtained.

12.5.3 Reading and Saving Feature License Data, Calibration Data, and Personality Files

XG-25M mobile radios depend upon feature license data and calibration data for their proper and legal performance. These data sets are specific to an individual radio. Without these data sets, the radio will not function. Should anything happen to the radio resulting in the corruption or loss of this data, a previously saved feature data file can be used to restore corrupted or lost data.

CAUTION

Feature license data and calibration data is very important because **the data sets are specific to each individual radio.** In other words, every radio is different and has different data sets!

CAUTION

Use caution when selecting and loading a calibration data file into a radio. Loading an incorrect calibration data file into a radio may prevent the radio from functioning properly.

Radio Maintenance Utility is used to read, write, update, and save feature and calibration data files. This section focuses on reading feature and calibration data files from a XG-25M radio.

Each radio's feature license and calibration data can be backed up locally (i.e., on the PC hard disk or other storage media). Then, if the radio's data becomes corrupt or lost, it may be restored via the Radio Maintenance Utility.

NOTE

It is highly recommended to read each radio's feature license data and calibration data and save these data sets to local files. This is in preparation for radio repairs which may require data reloads. The following sub-sections provide instruction for preparing the radio for the various data acquisitions and updates required to maintain XG-25M radios.

12.5.3.1 Entering Programming Mode

***Automatically Entering Programming Mode*:**

Perform these steps to automatically place the radio into programming mode:

1. Connect the 44-pin connector of Option Cable 14002-0174-08 to the 44-pin connector on the rear of the radio. Tighten the two jackscrews securely.
2. Connect the DB-9 connector labeled "XG-25M Prog" of the Option Cable to a standard DB-9 serial programming cable. Next, connect the other end of the programming cable to the DB-9 serial port connector of a personal computer with the Radio Personality Manager (RPM) programming software installed on it. For a standard serial programming cable, use Serial Programming Cable CA-104861 (5 feet long) or CA-013671-020 (20 feet long), or equivalent.

NOTE

If the utilized personal computer (PC) is not equipped with a DB-9 type serial port connector, the use of a suitable adapter is required, such as USB-to-RS-232 Adapter Cable CN24741-0001. As of the publication of this manual, CN24741-0001 is available via the Harris Customer Care center; refer to Section 6 on page 15 for the respective contact information.

NOTE

Optionally, Front Panel Programming Cable 14015-0200-01 can be used to program the radio via the microphone connector on the front panel of the radio. The radio auto-senses between a serial device connected to the serial port of the mic connector and the serial port of the rear panel connector.

3. Turn off the radio via its power on/off/volume control.
4. Connect the radio to a DC power source.
5. Power-up the PC that has the RPM programming software installed on it, and start Windows.
6. Start the RPM programming software.
7. Using a serial programming cable, connect the radio to the PC with the RPM programming software. See Figure 12-1 on page 75.
8. Turn on the radio. After RPM communicates with the radio, Program appears in the display, indicating the radio has automatically entered program mode.
9. Continue with personality programming or calibration procedures as described elsewhere in this manual.
10. Turn the radio off and disconnect the programming cable after programming is complete.

If this automatic method fails, retry the procedure or try one of the manual methods that follow.

Manually Enter Programming Mode via A and C Preset Buttons:

1. Connect the equipment as described in the previous section.
2. Turn off the radio via its power on/off/volume control.
3. While simultaneously depressing the radio's A and C preset buttons, turn the radio on via its power on/off/volume control, then release both buttons. Afterwards, Program should appear in the radio's display. This indicates the radio is in programming mode.
4. Continue with personality programming or calibration procedures as described elsewhere in this manual.
5. Turn the radio off and disconnect the programming cable after programming is complete.

Manually Enter Programming Mode via Program Function:

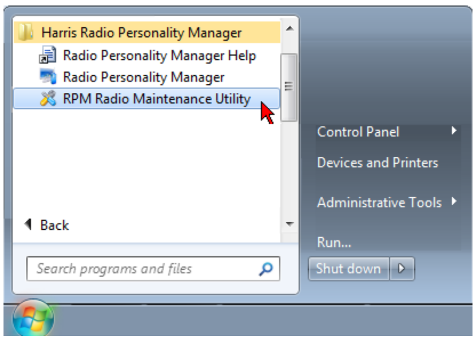
If the existing personality in the radio has the PROGRAM function on the active menu, the programming mode can be manually entered by selecting this function on the menu, pressing the + button (to display PROGRAM twice), and then pressing the MENU button.

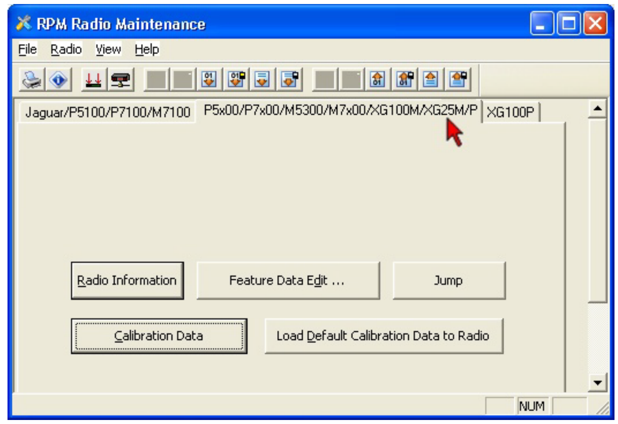
12.5.3.2 Reading and Saving Feature License Data

Follow this procedure to read and save a radio's feature license data:

1. Enter programming mode as described in Section 12.5.3.1.
2. At the PC with the RPM programming software, start the Radio Maintenance Utility:

   Click: **Start > Programs > Harris Radio Personality Manager > RPM Radio Maintenance Utility**



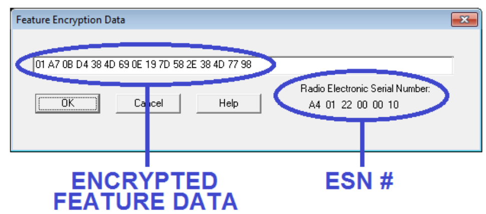


3. Within the utility, click on the tab that includes **XG25** (and other radios).
4. From the utility's menu:

   Select: **Radio > Read > Feature Data from Radio**
5. When the Read Feature Data Complete message box appears:

   Click: **OK**
6. In the tab that includes **XG25** (and other radios):

   Click: **Feature Data Edit**
7. The Feature Encryption Data dialog box opens. This dialog box includes the radio's Electronic Serial Number (ESN). Record the ESN for later use. Click **OK** or **Cancel** to exit the box.



8. From the utility's menu:

   Select: **Radio > Write > Feature Data to File**

   This action **opens** up the Save As dialog box to the default calibration and feature data folder. If desired, the folder/path may be changed.
9. Enter a unique file name which clearly identifies the radio (such as the serial number of the radio or a property tag number) and the electronic serial number, found on the Feature Encryption Data dialog box.

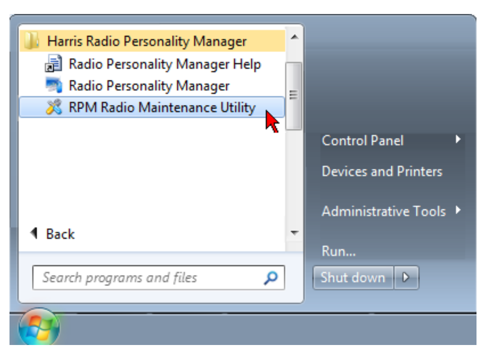
   Select: **Save**

12.5.3.3 Reading and Saving Calibration Data

Follow this procedure to read and save a radio's calibration data:

NOTE

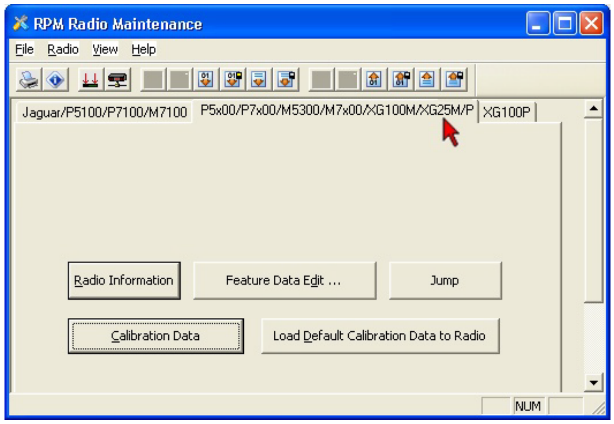
The radio must have R16A or later code before calibration data can be read from or written to it. See Section 12.5.1 on page 57 for details.



1. Enter programming mode as described in Section 12.5.3.1.
2. At the PC with the RPM programming software, start the Radio Maintenance Utility:

   Click: **Start > Programs > Harris Radio Personality Manager > RPM Radio Maintenance Utility**

3. Within the utility, click on the tab that includes **XG25** (and other radios).



4. From the utility's menu:

   Select: **Radio > Read > Calibration Data from Radio**

5. When the "Reading Calibration Data done." message box appears:

   Click: **OK**

6. From the utility's menu:

   Select: **Radio > Write > Calibration Data to File**

   This action opens up the Save As dialog box to the default calibration and feature data folder. If desired, the folder/path may be changed.

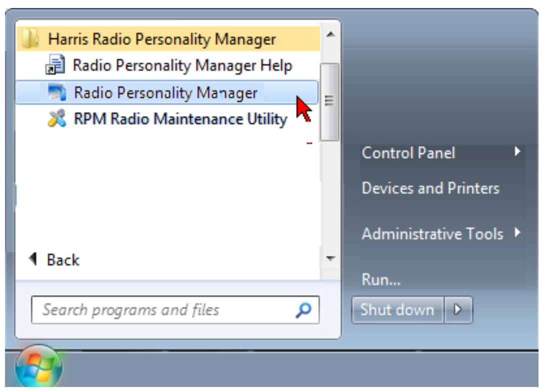
7. Enter a unique file name which clearly identifies the radio (such as the serial number of the radio or a property tag number) and the electronic serial number, found on the Feature Encryption Data dialog box.

   Select: **Save**

12.5.3.4 Reading and Saving the Radio Personality

A *personality* file is a computer file created within RPM. It contains the operating characteristics and frequencies for the radio. The personality file is downloaded and stored in the radio. Before beginning any alignment or test procedures, it is highly recommended to save a copy of the personality file to local archive (i.e., on the PC hard disk or other storage media).

1. Enter programming mode as described in Section 12.5.3.1.



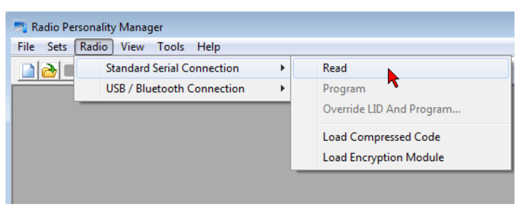
2. At the PC with the RPM programming software, start this software:

   Click: **Start > Programs > Harris Radio Personality Manager > Radio Personality Manager**

3. From RPM's main menu:

   Select: **Radio > Standard Serial Connection > Read**

   After the radio personality is read, the Personality window will appear.



4. Within the personality window, information may be entered in the “Description” and “Author” fields.
5. On the RPM’s main menu:

   Click: **File > Save As**

   When reading and saving a radio’s personality, always use the Save As feature to prevent overwriting any existing file. RPM can determine the last known personality file name from the radio’s personality. Avoid using the Save icon so a previously saved personality is not overwritten.
6. Enter a unique file name which clearly identifies the radio (such as the serial number of the radio, a unit number, a person’s name, etc.).

   Select: **Save**

12.5.4 Adding and Removing Radio Alignment Test Systems to Personalities

Radio alignment is performed at specific frequencies across the entire RF operating range of the radio. Performing a full radio alignment requires multiple conventional test systems with specific test channels to be added to a personality. The following procedure adds conventional test systems to an existing personality.

12.5.4.1 Adding Radio Alignment Test Systems to the Personality

1. Connect the radio to the PC with the RPM programming software and enter programming mode. Refer to Section 12.5.3.1 as necessary.
2. Verify the feature and calibration data files have been saved to local disk. Refer to Sections 12.5.3.2 and 12.5.3.3 as necessary.
3. Read and save the radio’s personality. Be sure to save a copy of the original personality to a local file before making changes to the personality. Refer to Section 12.5.3.4 as necessary.

NOTE

> Instead of modifying the customer’s personality each time a radio is serviced, it is recommended that a “shop” test personality for the radio be developed and used when radio service is required. Always be sure to save the radio’s original personality before loading any test personality. After tests/alignments are complete, be sure to re-load the original personality back into the radio.

4. In the Personality Data Tree:

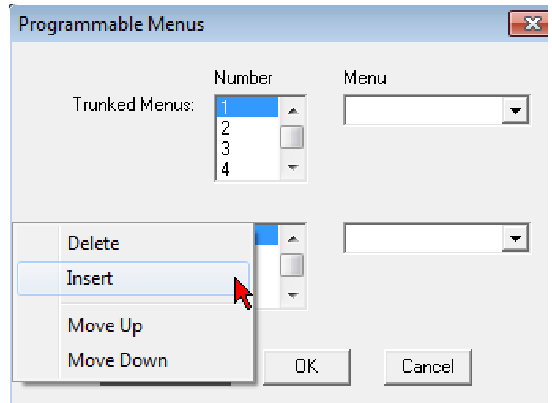
   Click: **Options**
5. Scroll down the Options limb:

   Double-click: **Programmable Menus**

6. Within the Conventional Menus Number box:

   Double-click: **1**

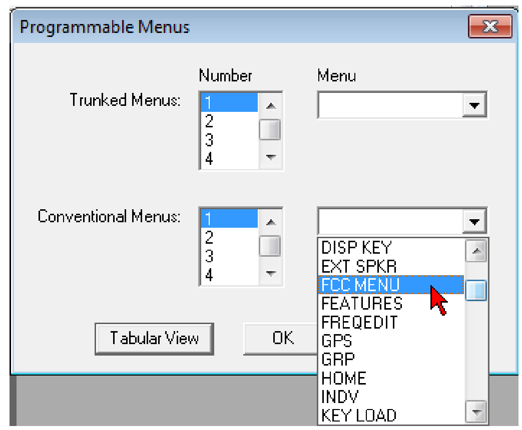
   Click: **Insert**



7. Within the dropdown menu choices:

   Select: **FCC MENU**

   Click: **OK**



NOTE

To support radio alignment and testing, the FCC Menu and several additional conventional frequency sets must be added to the radio's personality. This facilitates proper alignment of the radio.

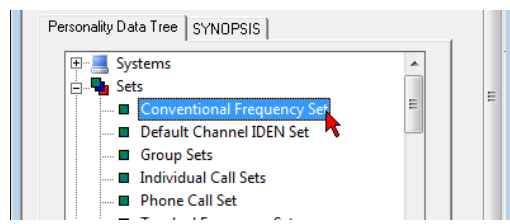
8. In the Personality Data Tree:

   Double-click: **Sets**

   The Sets limb expands.

   Double-click: **Conventional Frequency Set**

   The Conventional Frequency Sets dialog box opens.



NOTE

In the steps that follow, several unique frequency sets will be created and later used to perform alignment test. These sets provide access to various features being tested and the correct test points (frequencies) spread across the radio's RF operating range.

NOTE

If the radio is not wideband-capable, skip the following step. In this case, the 25MV TXW frequency set does <u>not</u> need to be created.

9. In the Conventional Frequency Sets tab of the Conventional Frequency Sets dialog box, add a new set to the existing personality as follows:

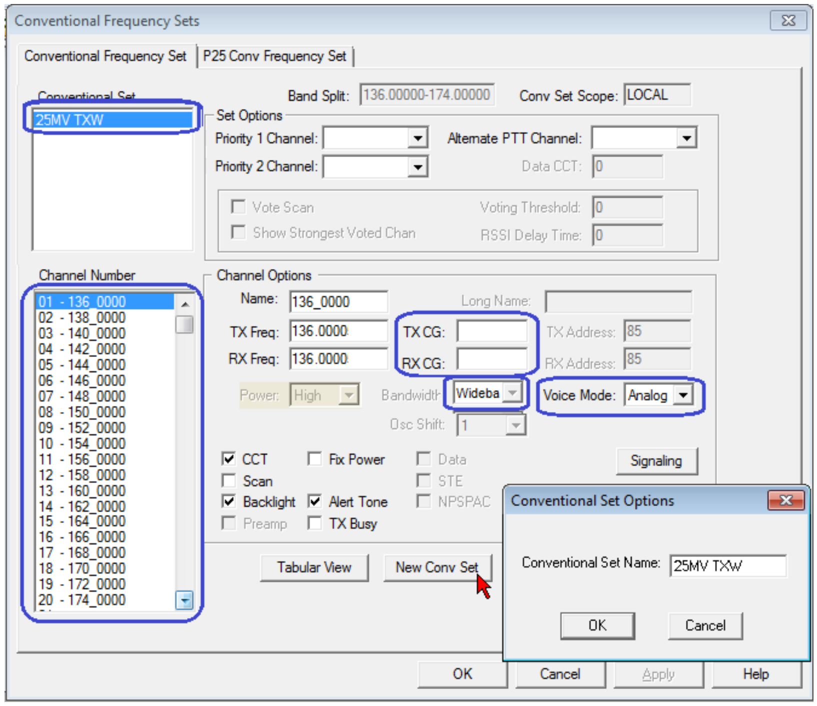
   Click: **New Conv Set**

   Type: **25MV TXW**

   Click: **OK**

   Use the illustration to the right, or reference Table 12-11, and enter for each channel, the channel name, TX and RX frequencies, and set any other features as indicated by the outlined boxes. Enter all 20 channels.

   For a wideband-capable radio, this set is used to align the radio's reference oscillator (TCXO), its high, mid, and low TX power, and its FM wideband deviation.



10. In the Conventional Frequency Sets tab of the Conventional Frequency Sets dialog box, add a new set to the existing personality as follows:

    Click: **New Conv Set**

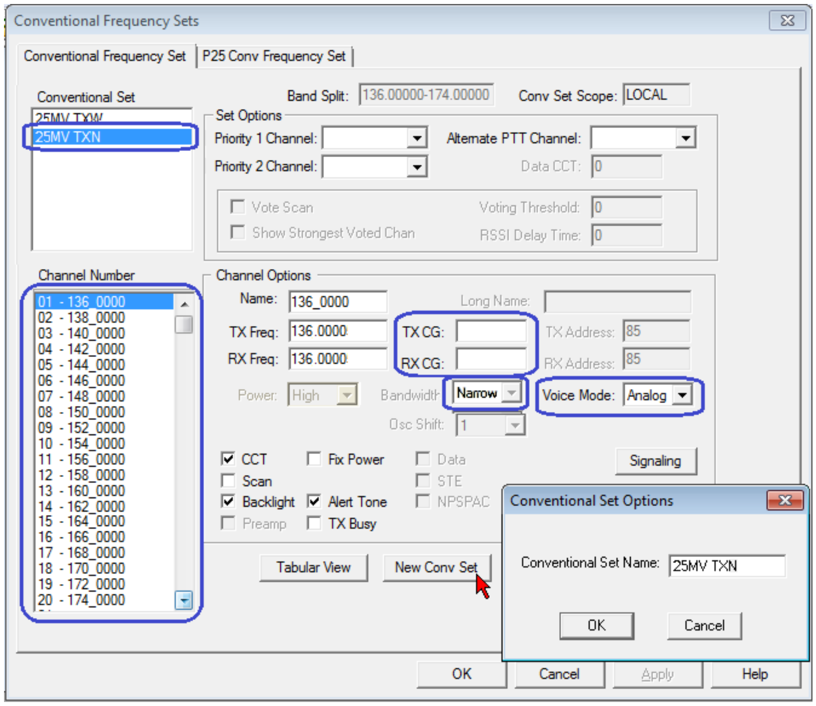
    Type: **25MV TXN**

    Click: **OK**

    Use the illustration to the right, or reference Table 12-11, and enter for each channel, the channel name, TX and RX frequencies, and set any other features as indicated by the outlined boxes. Enter all 20 channels.

    For a radio that is not wideband-capable, this set is used to align the radio's reference oscillator (TCXO), its high, mid, and low TX power, and its FM narrowband deviation.

    For a radio that is wideband-capable, this set is used to align FM narrowband deviation only.



11. In the Conventional Frequency Sets tab of the Conventional Frequency Sets dialog box, add a new set to the existing personality as follows:

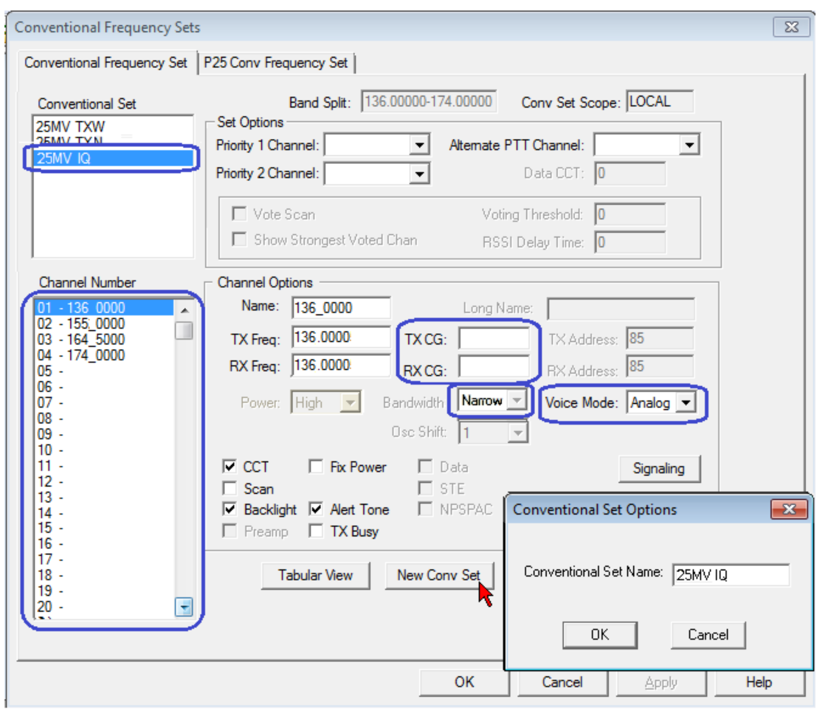
    Click: **New Conv Set**

    Type: **25MV IQ**

    Click: **OK**

    Use the illustration to the right, or reference Table 12-12, and enter the channel name, TX and RX frequencies, and set any other features as indicated by the outlined boxes. Enter all 4 channels.

    This set is used to align the radio's IQ modulation.



NOTE

If the radio is not wideband-capable, skip the following step. In this case, the 25MV CGW frequency set does not need to be created.

12. In the Conventional Frequency Sets tab of the Conventional Frequency Sets dialog box, add a new set to the existing personality as follows:

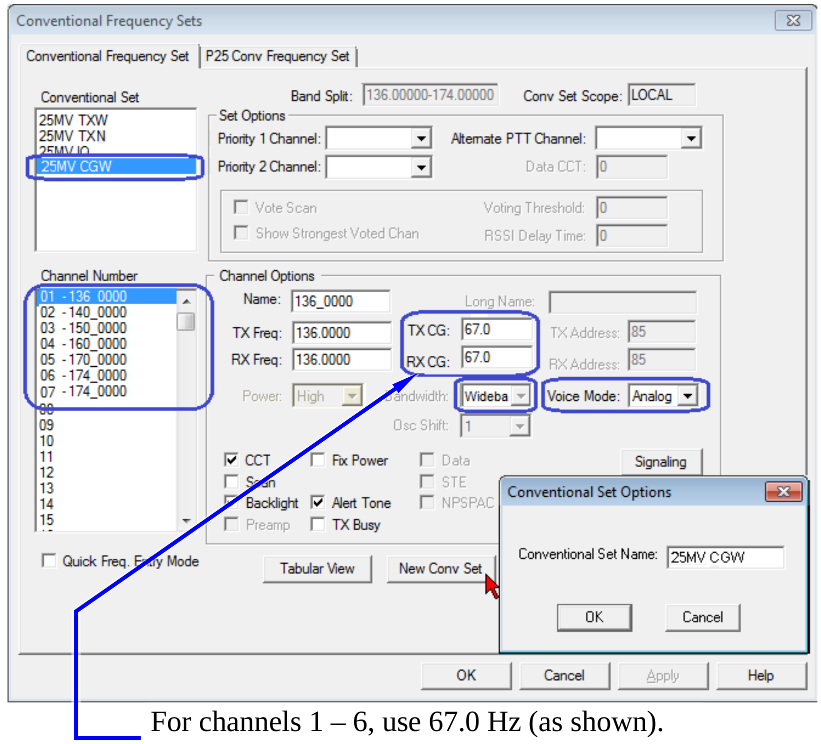
    Click: **New Conv Set**

    Type: **25MV CGW**

    Click: **OK**

    Use the illustration to the right, or reference Table 12-13, and enter the channel name, frequency, and set any other features as indicated by the outlined boxes. Enter all 7 channels.

    This conventional channel set is used for aligning wideband Channel Guard and Digital Channel Guard deviation.



For channels 1 – 6, use 67.0 Hz (as shown).
For channel 7, use code 627.

13. In the Conventional Frequency Sets tab of the Conventional Frequency Sets dialog box, add a new set to the existing personality as follows:

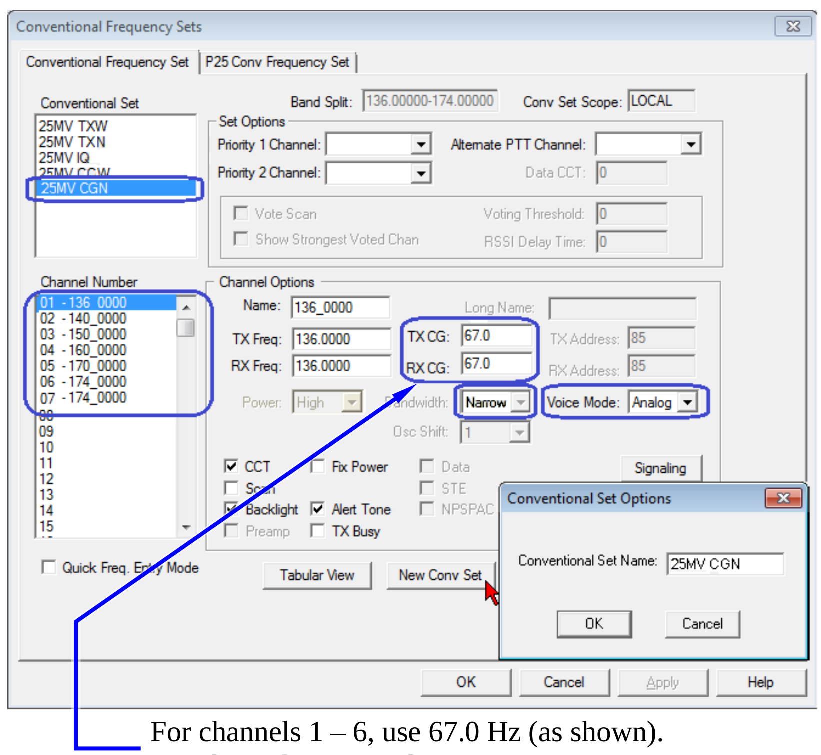
    Click: **New Conv Set**

    Type: **25MV CGN**

    Click: **OK**

    Use the illustration to the right, or reference Table 12-13, and enter the channel name, frequency, and set any other features as indicated by the outlined boxes. Enter all 7 channels.

    This conventional channel set is used for aligning narrowband Channel Guard and Digital Channel Guard deviation.



For channels 1 – 6, use 67.0 Hz (as shown).
For channel 7, use code 627.

> **NOTE**
>
> **If the radio is not wideband-capable, skip the following step. In this case, the 25MV SQW frequency set does not need to be created.**

14. In the Conventional Frequency Sets tab of the Conventional Frequency Sets dialog box, add a new set to the existing personality as follows:

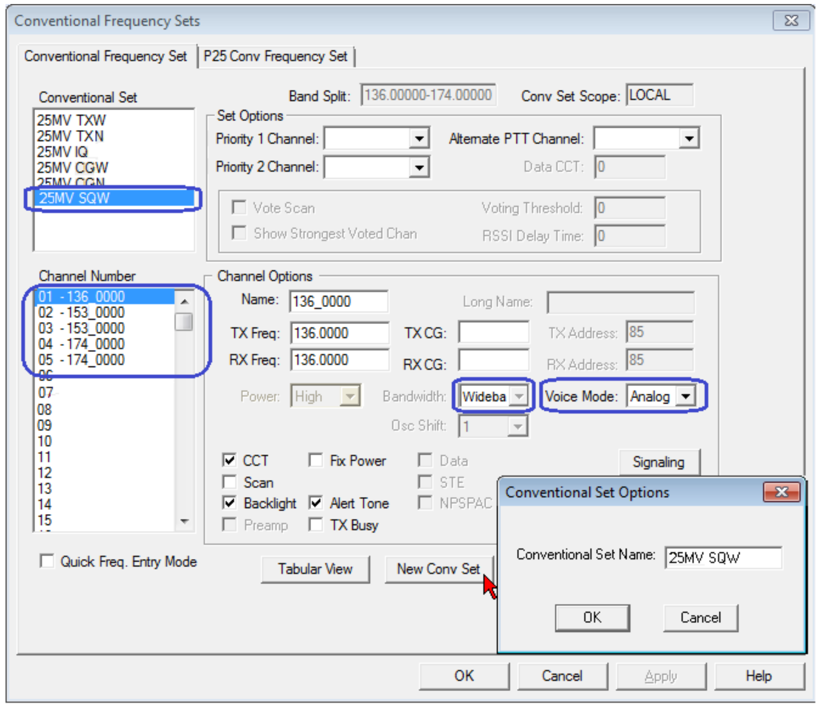
    Click: **New Conv Set**

    Type: **25MV SQW**

    Click: **OK**

    Use the illustration to the right, or reference Table 12-14, and enter the channel name, frequency, and set any other features as indicated by the outlined boxes. Enter all 5 channels.

    This conventional channel set is used for aligning wideband analog squelch. Settings also effect C4FM squelch operation.



> **NOTE**
>
> In the 25MV SQW and 25MV SQN frequency sets, channels 2 and 3 are programmed identically (at 153.000 MHz), and channels 4 and 5 are programmed identically. This is recommended for these frequency sets. Creating one of these sets with only 3 channels may cause confusion when measuring and aligning the 5 respective alignment points.

15. In the Conventional Frequency Sets tab of the Conventional Frequency Sets dialog box, add a new set to the existing personality as follows:

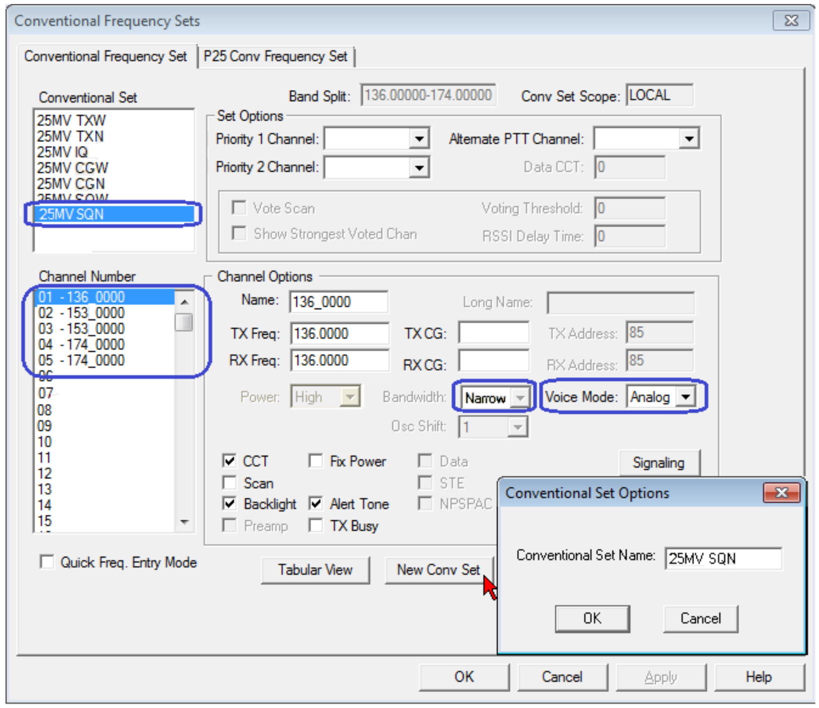
    Click: **New Conv Set**

    Type: **25MV SQN**

    Click: **OK**

    Use the illustration to the right, or reference Table 12-14, and enter the channel name, frequency, and set any other features as indicated by the outlined boxes. Enter all 5 channels.

    This conventional channel set is used for aligning narrowband squelch.



16. To exit the Conventional Frequency Sets dialog box, click: **OK**

17. To assign these newly-created frequency sets to new systems, in the Personality Data Tree:

    Double-click: **Systems**

18. In the General tab of the System Setup dialog box:

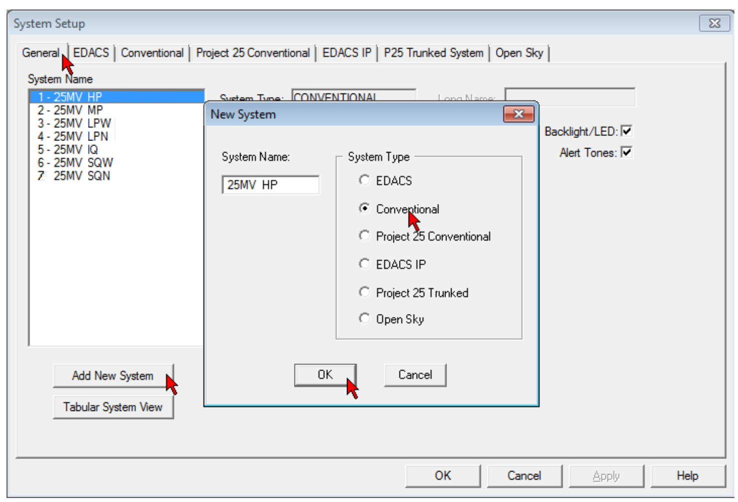
    Click: **Add New System**

19. In the New System box:

    Type: **25MV HP**

    Select: **Conventional**

    Click: **OK**



20. Repeat steps 18 and 19, except create a new system for each of the following previously-created frequency sets:

    25MV MP

    25MV LPW (only needed if the radio is wideband-capable)

    25MV LPN

    25MV IQ

    25MV CGW (only needed if the radio is wideband-capable)

    25MV CGN

    25MV SQW (only needed if the radio is wideband-capable)

    25MV SQN

21. In the System Setup dialog box, assign a frequency set to each system:

    Click: **Conventional** tab

22. In the System Name field:

    Select: **25MV HP**

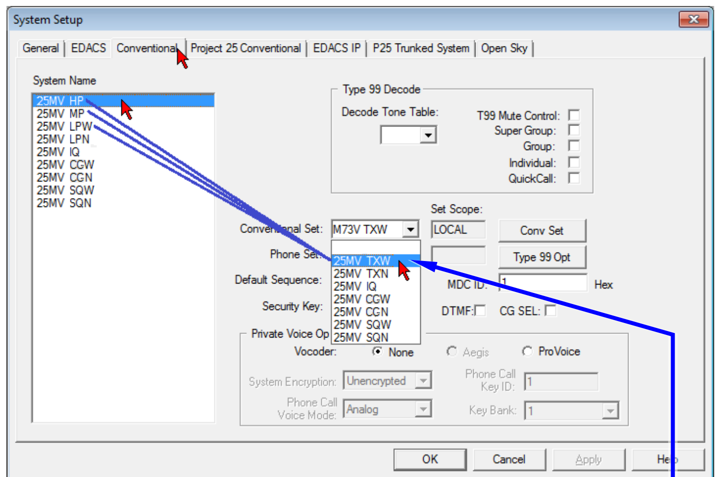
23. In the Conventional Set dropdown, select:

    25MV TXW if the radio is wideband-capable, otherwise, select:

    25MV TXN

24. Click the **General** tab and set the **Power Level** to **MAX**.

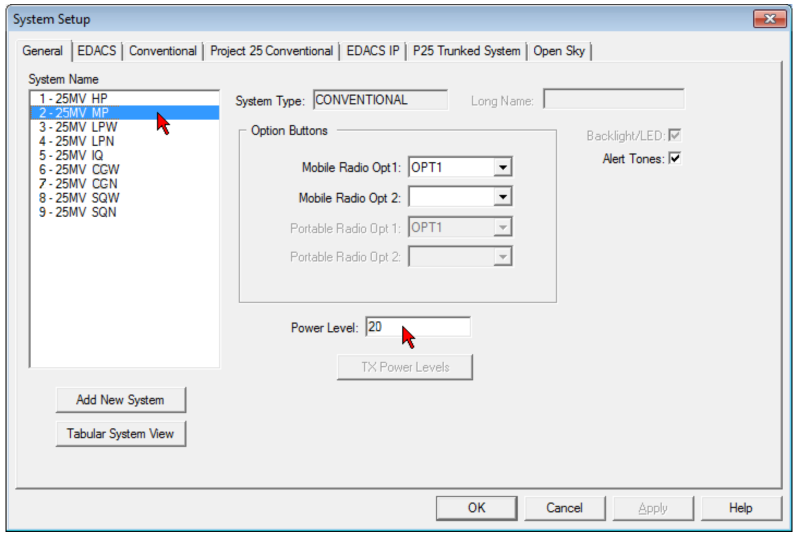
    (Using "MAX" forces the radio to use the high power alignment values for each channel in this system.)



If the radio is wideband-capable, use **25MV TXW** three times and use **25MV TXN** one time.
If the radio is not wideband-capable, do <u>not</u> use **25MV TXW** but use **25MV TXN** three times.

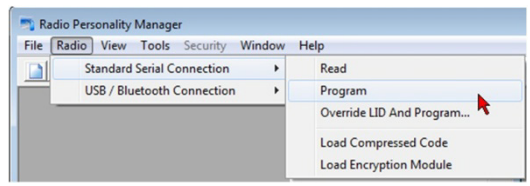
25. Repeat steps 21 through 23 to associate each additional new conventional frequency set with its corresponding system name, as shown below. Also set the system's Power Level via the General tab:

System Name	Conv. Freq. Set If Wideband-Capable	Conv. Freq. Set If Not Wideband-Capable	Power Level (Watts)
25MV MP	**25MV TXW**	**25MV TXN**	**20**
25MV LPW	**25MV TXW**	(n/a)	**10**
25MV LPN	**25MV TXN**	**25MV TXN**	**10**
25MV IQ	**25MV IQ**	**25MV IQ**	**10**
25MV CGW	**25MV CGW**	(n/a)	**10**
25MV CGN	**25MV CGN**	**25MV CGN**	**10**
25MV SQW	**25MV SQW**	(n/a)	**10**
25MV SQN	**25MV SQN**	**25MV SQN**	**10**



The numeric value entered in the **Power Level** box is used to set the TX power in **watts**. Only whole numbers may be entered. Entering a value that is outside the High or Low Power reference levels range entered during alignment results in the radio defaulting to the high or low alignment value. See Section 12.5.5.3 on page 78 for additional information).

The value used for aligning the mid power level is not critical, as long as the measured transmitter power output matches the reference value shown in the mid power "Tx Power" field.



26. From RPM's main menu:

    Select: **Radio > Standard Serial Connection > Program**

27. After the radio personality is programmed, it is recommended to save the updated personality file to a different name for future reference as a test personality for the radio.

Table 12-11: Frequencies for Conventional Frequency Sets 25MV TXW and 25MV TXN

CHANNEL NUMBER	FREQUENCY IN MHz (TX and RX)	CHANNEL NUMBER	FREQUENCY IN MHz (TX and RX)
1	136.0000	11	156.0000
2	138.0000	12	158.0000
3	140.0000	13	160.0000
4	142.0000	14	162.0000
5	144.0000	15	164.0000
6	146.0000	16	166.0000
7	148.0000	17	168.0000
8	150.0000	18	170.0000
9	152.0000	19	172.0000
10	154.0000	20	174.0000

Table 12-12: Frequencies for I/Q Modulation Frequency Set 25MV IQ

CHANNEL NUMBER	FREQUENCY IN MHz (TX and RX)
1	136.0000
2	155.0000
3	164.5000
4	174.0000

Table 12-13: Frequencies for Channel Guard and Digital Channel Guard Modulation Frequency Sets 25MV CGW and 25MV CGN

CHANNEL NUMBER	FREQUENCY IN MHz (TX and RX)	CHANNEL GUARD/DIGITAL CHANNEL GUARD
1	136.0000	67.0 Hz
2	140.0000	67.0 Hz
3	150.0000	67.0 Hz
4	160.0000	67.0 Hz
5	170.0000	67.0 Hz
6	174.0000	67.0 Hz
7	174.0000	Code 627

Table 12-14: Frequencies for Receiver Frequency Sets 25MV SQW and 25MV SQN

CHANNEL NUMBER	FREQUENCY IN MHz (TX and RX)
1	136.0000
2	153.0000
3	153.0000

CHANNEL NUMBER	FREQUENCY IN MHz (TX and RX)
4	174.0000
5	174.0000

NOTE

In the 25MV SQW and 25MV SQN frequency sets, channels 2 and 3 are programmed identically (at 153.000 MHz), and channels 4 and 5 are programmed identically. This is recommended for these frequency sets. Creating one of these sets with only 3 channels may cause confusion when measuring and aligning the 5 respective alignment points.

12.5.4.2 Removing Radio Alignment Test Systems from the Personality

CAUTION

*****IMPORTANT*****

The systems added to the radio for accessing the test conventional frequency sets must **not** be accessible to the end radio user. When testing is completed, reload the radio's original personality, **or** remove the test systems as described in this section.

In general, deleting the new frequency sets created for radio testing from the radio's personality is not necessary. Simply deleting the test Systems from the System Setup's General tab in RPM and re-programming the radio with this modified personality removes radio user access to the frequency sets used for testing. The respective steps are presented in this procedure:

1. Connect the radio to the PC with the RPM programming software and enter programming mode. Refer to Section 12.5.3.1 as necessary.
2. Verify the feature and calibration data files have been saved to local disk. Refer to Sections 12.5.3.2 and 12.5.3.3 as necessary.
3. Read the radio's personality. Refer to Section 12.5.3.4 as necessary.
4. In the Personality Data Tree tab:

   Click: **Options**

5. Scroll down the Options limb:

   Double-click: **Programmable Menus**

6. Within the Conventional Menus Number box:

   Double-click: **1** ("FCC Menu")

   Click: **Delete**

   Click: **OK**

7. In the Personality Data Tree tab:

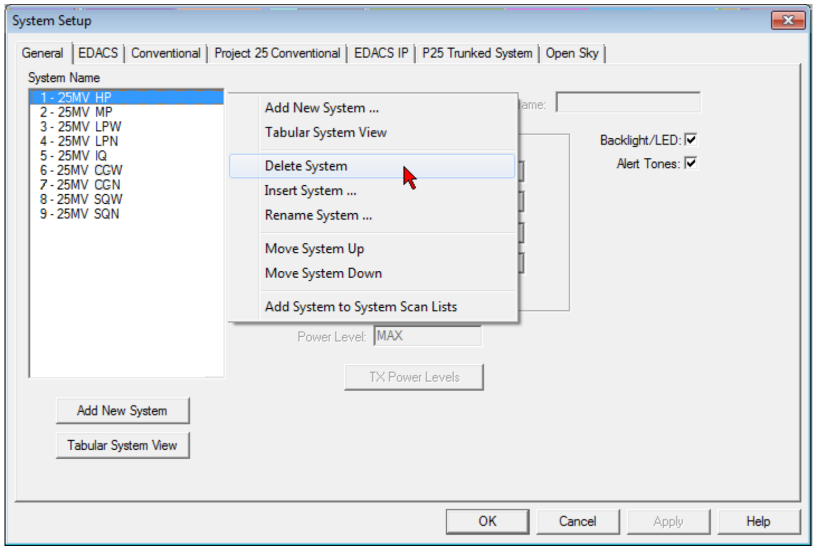
   Double-click: **Systems**

   The System Setup dialog box opens.

8. In the General tab of the System Setup dialog box:

   Double-click: **25MV HP**

   Click: **Delete System**



9. Repeat to delete each of the other systems previously added for testing:

   25MV MP

   25MV LPW

   25MV LPN

   25MV IQ

   25MV CGW

   25MV CGN

   25MV SQW

   25MV SQN

NOTE

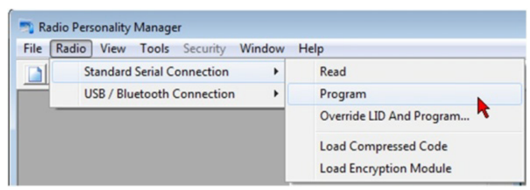
In general, deleting the new frequency sets created for radio testing from the radio's personality is not necessary. Simply deleting the test Systems from the System Setup's General tab in RPM and re-programming the radio with this modified personality removes radio user access to the frequency sets used for testing.

10. When all new conventional systems created for testing are deleted, click **OK**.

11. From RPM's main menu:

    Select: **Radio > Standard Serial Connection > Program**

12. Wait for the re-programming operation to complete.



12.5.5 Radio Alignment Procedures

12.5.5.1 General Information

Before beginning any radio alignment procedure, a careful review of Sections 12.5.1 through 12.5.4 is recommended. The minimum radio firmware code versions and RPM version listed in Section 12.5.1 (page 57), and the required test equipment must be in place. Unless otherwise stated, each alignment procedure is written as a standalone procedure; in other words, it may be performed without performing the full battery of procedures.

The following flow of events should be performed before beginning radio alignment:

- Read and save the original feature data, calibration data, and personality data files before making any changes. Refer to Section 12.5.3 (page 58) as necessary.
- Update the existing personality in the radio with conventional test frequency sets. Refer to Section 12.5.4 (page 63) as necessary.
- Test the radio per the alignment procedures in this manual and align with updated calibration data as necessary.

- Save the final calibration data to a local file. Refer to Section 12.5.3.3 (page 61) as necessary.
- Reload the radio's original personality and verify operation.

CAUTION

*****IMPORTANT*****

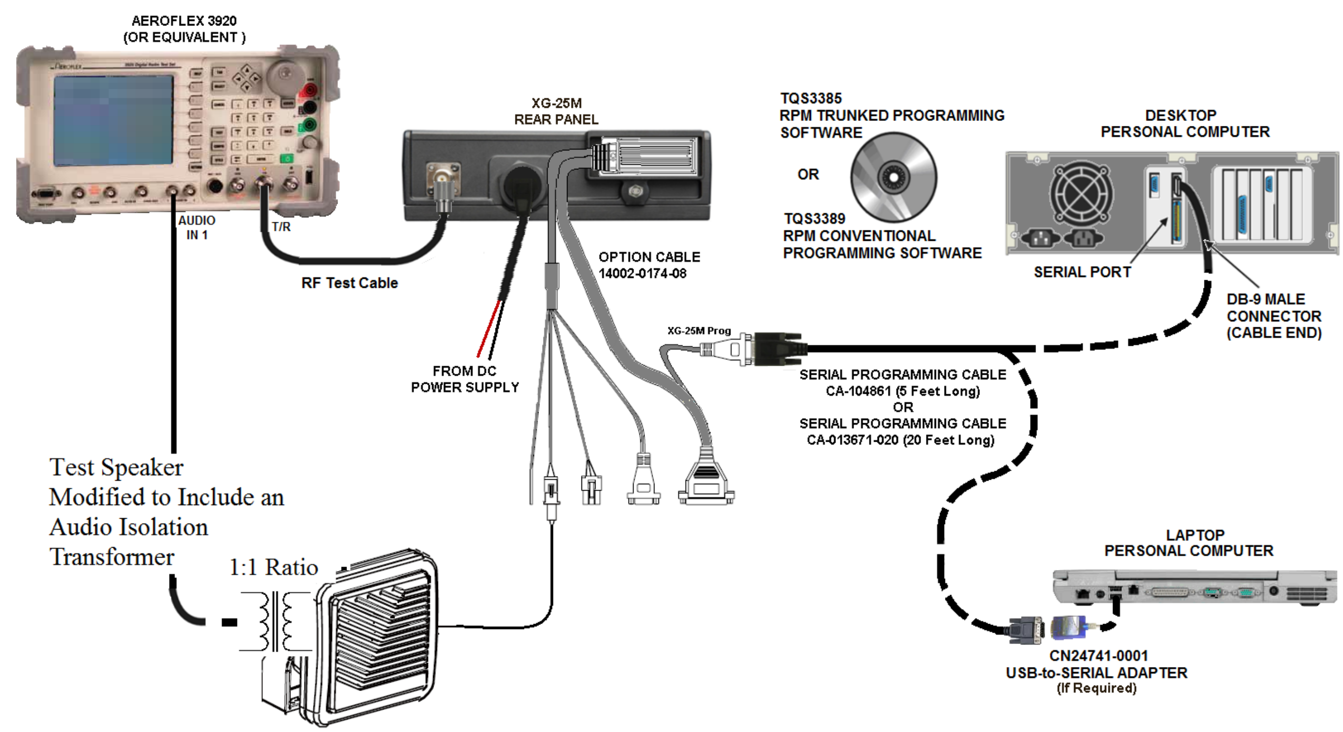
The systems added to the radio for accessing the test conventional frequency sets must **not** be accessible to the end radio user. When testing is completed, reload the radio's original personality, or remove the test systems as described in Section 12.5.4.2 on page 73.

CAUTION

RF test cables used to connect the radio to the RF Communications Test Set will affect RF power by adding losses. The longer the cable, the greater the loss. For optimum results, connect the radio to the RF test equipment using only high-quality cables as listed in Table 12-2 (page46).

NOTE

The use of an RF attenuator between the radio and the test equipment is recommended, and it may be required for some test equipment. Consult the test equipment's specifications as necessary. An attenuator is not shown in the following figure. When an attenuator is used, be sure to compensate all measurements accordingly.



Connect the modified speaker to the radio via Option Cable 14002-0174-08.
The option cable mates to the 44-pin connector on the rear of the radio. The 2-pin rectangular connector of the modified speaker's cable mates to the 2-pin rectangular connector of the option cable.

Figure 12-1: Test Equipment Connections for Radio Alignment

12.5.5.2 Automatic Frequency Control (TCXO Reference Oscillator) Alignment

NOTE

The radio's TCXO reference oscillator is a highly accurate and stable crystal reference oscillator which should **not** normally require re-alignment. The use of a recently-calibrated RF Communications Test Set or Frequency Counter is recommended. **The utilized test equipment should have a specified frequency accuracy/stability equal to or better than 0.2 ppm.** If not, an appropriate external timebase reference which meets or exceeds this specification must be applied to the external timebase reference input of the test set/frequency counter, and the test set/frequency counter must be configured to use this external reference.

NOTE

This alignment should be performed with the radio and test equipment at a room temperature between 68 and 77° Fahrenheit (20 to 25° Celsius). After radio power-up, always wait at least 15 minutes before taking a measurement. This warm-up time will allow the temperature of the radio's circuits to properly stabilize.

NOTE

If frequency alignment is necessary, maximum errors less than or equal to ±150 Hz should be obtained.

CAUTION

DO NOT attempt AFC alignment while in trunked mode!

Only align the AFC value in analog conventional mode. During trunked mode, an additional AFC compensation value is applied to the radio's reference oscillator frequency control.

The additional compensation value is temporary and refreshed each time the radio locks onto a Control Channel. While locked on a Control Channel, the radio's reference oscillator is precision-aligned to match the Control Channel base station's true frequency.

The Automatic Frequency Control (AFC) adjusts the frequency of the radio's TCXO reference oscillator. Follow this procedure to align this oscillator:

1. Setup and power-up the radio and test equipment as described in the Tx Frequency Test procedure, Section 12.4.4.1 (do steps 1 through 7 of that procedure). Also see Figure 12-1.
2. Add conventional test systems to the radio personality. Refer to Section 12.5.4 as necessary.
3. Select conventional test system **25MV LPW** (low power transmit with wideband deviation) or **25MV LPN** (low power transmit with narrowband deviation).
4. Select **Channel 20** (174.0000 MHz). See Table 12-11 on page 71 for all channels/frequencies used in this procedure.
5. Configure the RF Communications Test Set's frequency counter for an in-band frequency count.
6. **If at least 15 minutes has passed since the radio was powered-up, continue to the next step. Otherwise, wait until this period has passed, to allow the frequency of the radio's TCXO reference oscillator to stabilize.**
7. Key the radio by depressing the microphone's PTT button, and measure the radio's transmit frequency.

8. If the measured frequency is within 150 Hz of 174.0 MHz (i.e., between 173.999850 and 174.000150 MHz), unkey the radio and advance to step 21.

   If the measured frequency is not within 150 Hz of 174.0000 MHz, unkey the radio and go to step 9.

9. Turn off the radio.
10. Using a serial programming cable, connect the radio to the PC with the RPM programming software. See Figure 12-1 on page 75.
11. Turn on the radio.
12. At the PC with the RPM programming software, start the Radio Maintenance Utility:

    Click: **Start > Programs > Harris Radio Personality Manager > RPM Radio Maintenance Utility**

13. In the utility, click on the tab that includes **XG25** (and other radios).
14. From utility's main menu:

    Select: **Radio > Read > Calibration Data from Radio**

15. When the "Reading Calibration Data done." message box appears:

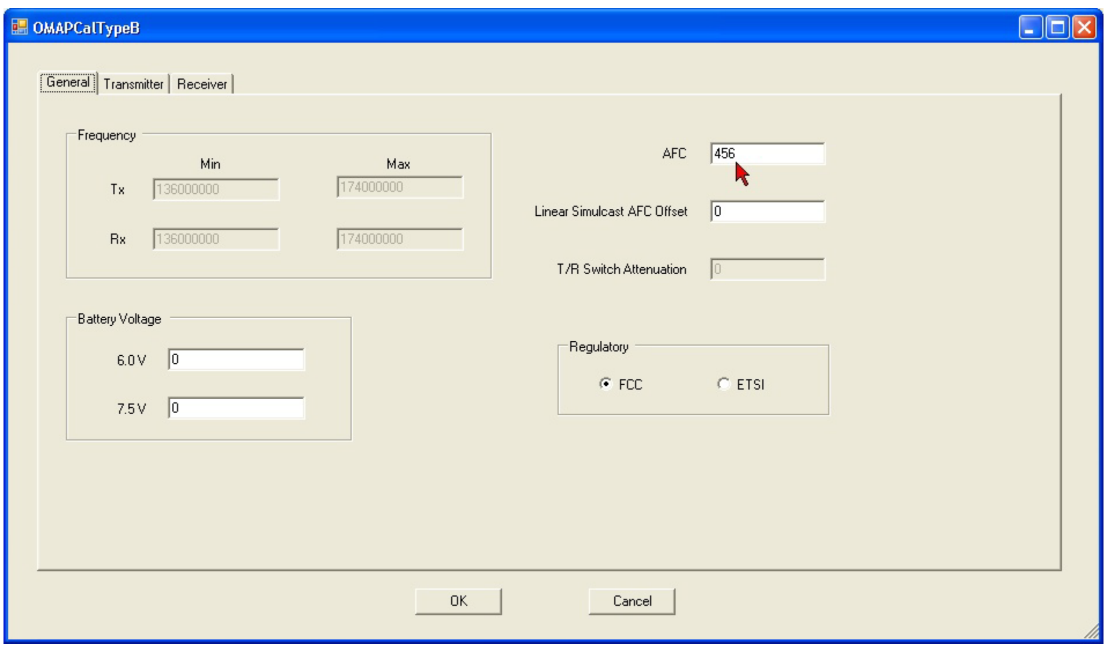
    Click: **OK**

16. In the tab that includes **XG25**:

    Click: **Calibration Data**

17. In the General tab, adjust the AFC value up or down. The TX frequency is proportional to the change in AFC value: Increasing the value increases the TX frequency while decreasing the value decreases the TX Frequency.

    Click: **OK**



CAUTION

Do **not** change any of the other fields in the General tab.

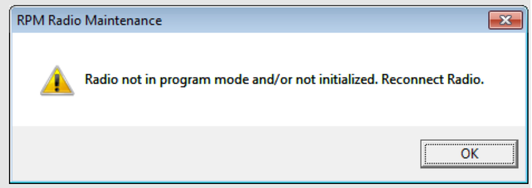
18. From the utility’s main menu:

    Select: **Radio > Write > Calibration Data to Radio**

19. When the “Write Calibration Data done.” message box appears:

    Click: **OK**

    Cycle power to the radio or click the **JUMP** button to reset the radio after programming.

> **NOTE**
>
> If an error message box appears similar to the one shown at the right, try re-reading the calibration data. If a second write attempt does not resolve the issue, first verify serial programming cable connections. Next, within the utility, verify serial port settings by clicking **Radio > Comm Settings** on the utility’s main menu.
>
> 
>

20. Repeat from step 3 until the measured transmit frequency is within 150 Hz of 174.0 MHz (i.e., between 173.999850 and 174.000150 MHz). Step resolution of the AFC increment/decrement value may not allow setting to the exact frequency. In that case, use a value which results in a transmit frequency as close as possible, and within 150 Hz of it. When performing alignment, do **not** use the maximum frequency errors listed in Table 12-4, as they are based on ±2 ppm across the entire operating temperature range of the radio.

21. If no other alignment or testing will be performed, do the following:

    a. Save the final calibration data to a local file.

    b. If a “shop” test personality was used to test the radio, reload the original personality and verify radio operation.

    c. If conventional test systems were added to the original personality, remove the test systems, and verify radio operation. Refer to Section 12.5.4.2 on page 73 as necessary.

12.5.5.3 TX Power Alignment

The Radio Maintenance Utility’s Calibration Data button accesses several tabs that can be used for aligning radio transmit power output levels. These levels include:

- TX Power Low
- TX Power Mid
- TX Power High

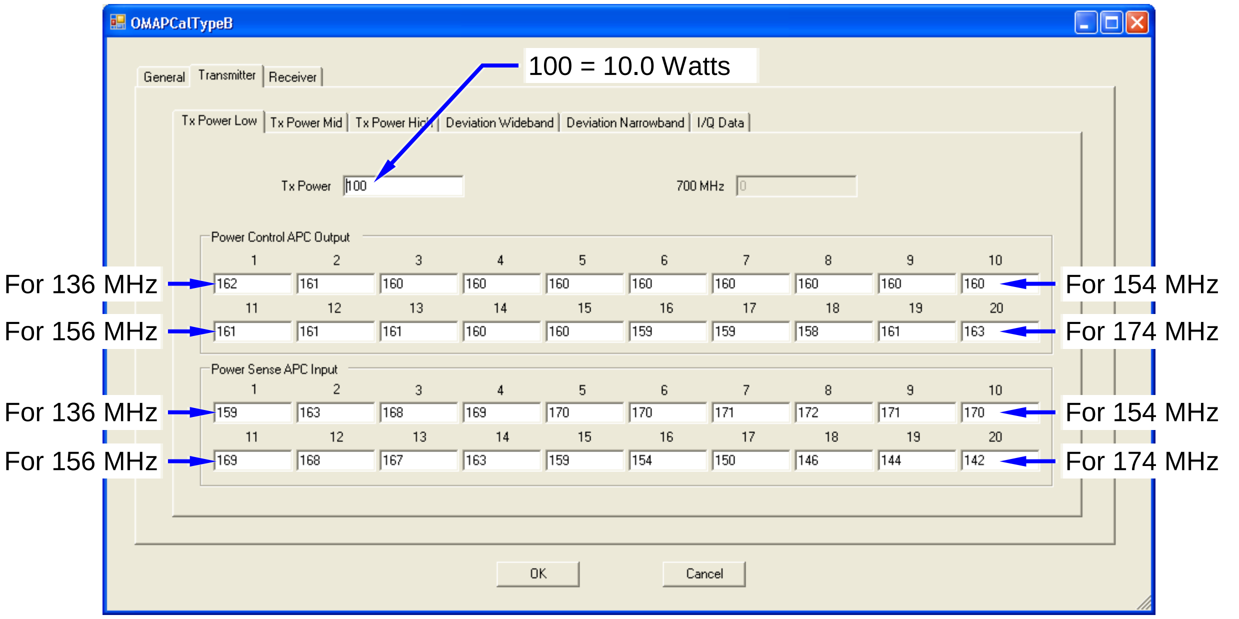
As illustrated in the following figure, each power level tab includes the following three (3) types of compensation factors:

- TX Power reference
- Power Control APC Output
- Power Sense APC Input

Field alignment of the RF power output is performed at the high (maximum) and low (minimum) power levels. In each Tx Power tab, the value entered in the Tx Power box represents the RF output level which the radio is aligned to in deciwatts (i.e., divide by 10 for watts). For example, an entry of “500” equals an RF power output of 50 watts, and an entry of “100” equals 10 watts.

For the Power Control APC Output and Power Sense APC Input alignment data points, increasing a data point value increases the power output at the corresponding test frequency. Values for frequencies between the 20 specific alignment data points/frequencies are interpolated from the 20 data point values.

Example Data Values Shown for Low Power



See Table 12-11 for a Complete List of Frequencies vs. Channels/Alignment Data Points

Power Control APC Output values prevent the radio from producing excessive RF during initial transmit key-up. Power Sense APC Input values set the radio's steady state power after being keyed for a short period of time (i.e., settling time).

CAUTION

TX power levels are factory aligned. Factory alignment establishes the appropriate transmit power levels for the radio. New values should not be entered unless original values are lost, corrupted, or associated hardware is replaced (e.g., TX Power Amplifier module).

CAUTION

For optimum performance, minimum DC current drain, TX power amplifier protection, and to assure compliance with FCC requirements, DO NOT exceed nominal RF power output settings.

Perform the following to align the transmit RF power output of the radio:

1. Setup and power-up the radio and test equipment as described in the Tx Frequency Test procedure, Section 12.4.4.1 (do steps 1 through 7 of that procedure). Also see Figure 12-1.
2. Add conventional test systems to the radio's personality. Refer to Section 12.5.4 as necessary.
3. Select conventional test system **25MV LPW** (low power transmit with wideband deviation) or **25MV LPN** (low power transmit with narrowband deviation).
4. Select **Channel 20** (174.0000 MHz), the next test channel, or the channel being aligned. See Table 12-11 on page 71 for all channels/frequencies used in this procedure.
5. Key the radio by depressing the microphone's PTT button, and wait for the transmit power to stabilize (typically one to two seconds).

6. Measure the steady-state transmit power. Figure 12-2 shows the Channel Analyzer function of the Aeroflex 3920.
7. Unkey radio.
8. Turn on the test set's Peak Hold function.
9. Rekey the radio and measure the initial transmit power. Typically, this measurement is higher than this channel's steady-state transmit power. See Figure 12-2 for an example display.
10. Unkey the radio.

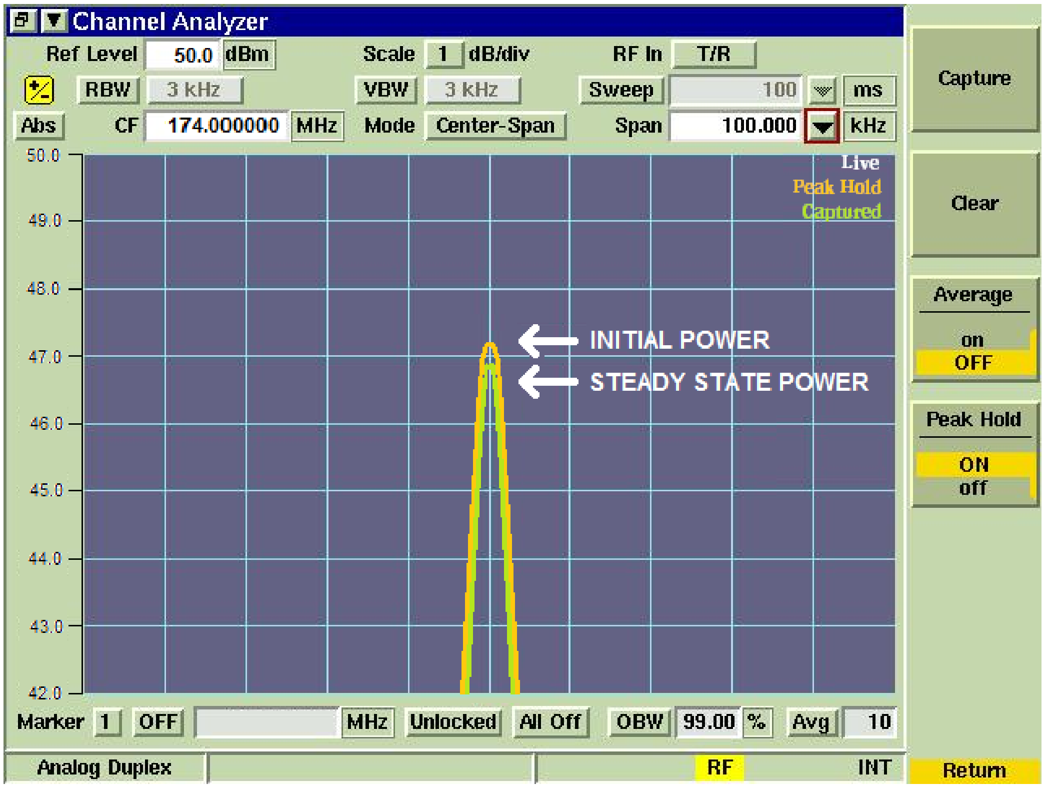


Figure 12-2: Measuring and Aligning APC Input and Output Power with Aeroflex 3920

11. Use the applicable case below to continue:
    a. If the difference between the initial transmit power and the steady-state transmit power is greater than 0.8 dB, or the steady-state power measurement is not within ±0.25 dB of the set power level, then advance to step 12 and align the power settings for the channel being tested.
    b. If the difference between the initial transmit power and the steady-state transmit power is less than 0.8 dB, <u>and</u> the steady-state transmit power is within ±0.25 dB of the set power level:
        i. Select the next lower test frequency in the selected system.
        ii. Repeat the test and alignment process, beginning with step 4, until all channels in the selected system have been tested and aligned.
    c. If all data points are aligned in the low power system:
        i. Select high power system **25MV HP**.
        ii. Repeat the test and alignment process, beginning with step 4, until all channels in the selected system have been tested and aligned for high power.

d. If all data points are aligned in the high power system:

   i. Select mid power system **25MV MP**.

   ii. Repeat the test and alignment process, beginning with step 4, until all channels in the selected system have been tested and aligned for mid power.

e. If high, mid, and low power testing has been completed for all test channels, advance to step 27.

12. Turn off the radio.

13. Using a serial programming cable, connect the radio to the PC with the RPM programming software. See Figure 12-1 on page 75.

14. Turn on the radio.

15. At the PC with the RPM programming software, start the Radio Maintenance Utility:

    Click: **Start > Programs > Harris Radio Personality Manager > RPM Radio Maintenance Utility**

16. In the utility, click on the tab that includes **XG25** (and other radios).

17. From the utility's main menu:

    Select: **Radio > Read > Calibration Data from Radio**

18. When the "Reading Calibration Data done." message box appears:

    Click: **OK**

19. In the tab that includes **XG25**:

    Click: **Calibration Data**

20. In the Transmitter tab, review the TX Power Low, Mid, and High tabs and verify the Tx Power input boxes show correct values (ignore the 700 MHz input box in the low power tab):

    For Low Power: **100**

    For Mid Power: **200**

    For High Power: **500** (see Figure 12-3)

NOTE

> The Tx Power input box values represent the transmit power output levels associated to each Tx Power Tab (High, Mid, and Low) in deciwatts. Divide by 10 for watts. For example, "500" equals an RF power output of 50 watts, and "100" equals 10 watts.

21. Adjust the Power Control APC Output and Power Sense APC Input values accordingly for the frequency (test channel) being tested. Increasing the values increases transmit power output.

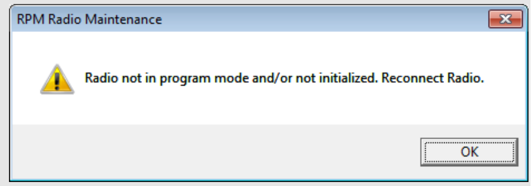
22. Click **OK**.

23. From the utility's main menu:

    Select: **Radio > Write > Calibration Data to Radio**

NOTE

If an error message box appears similar to the one shown at the right, try re-reading the calibration data. If a second write attempt does not resolve the issue, first verify serial programming cable connections. Next, within the utility, verify serial port settings by clicking **Radio > Comm Settings** on the utility's main menu.



24. When the "Write Calibration Data done." message box appears, click **OK**.
25. Cycle power to the radio or click the **JUMP** button to reset the radio after programming.
26. Return to step 4 and retest the channel.
27. Save the final calibration data to a local file.
28. If no other alignment or testing will be performed, do the following:
    a. If a "shop" test personality was used to test the radio, reload the original personality and verify operation.
    b. If test systems were added to the original personality, refer to Section 12.5.4.2 (page 73), remove the systems, and verify radio operation.

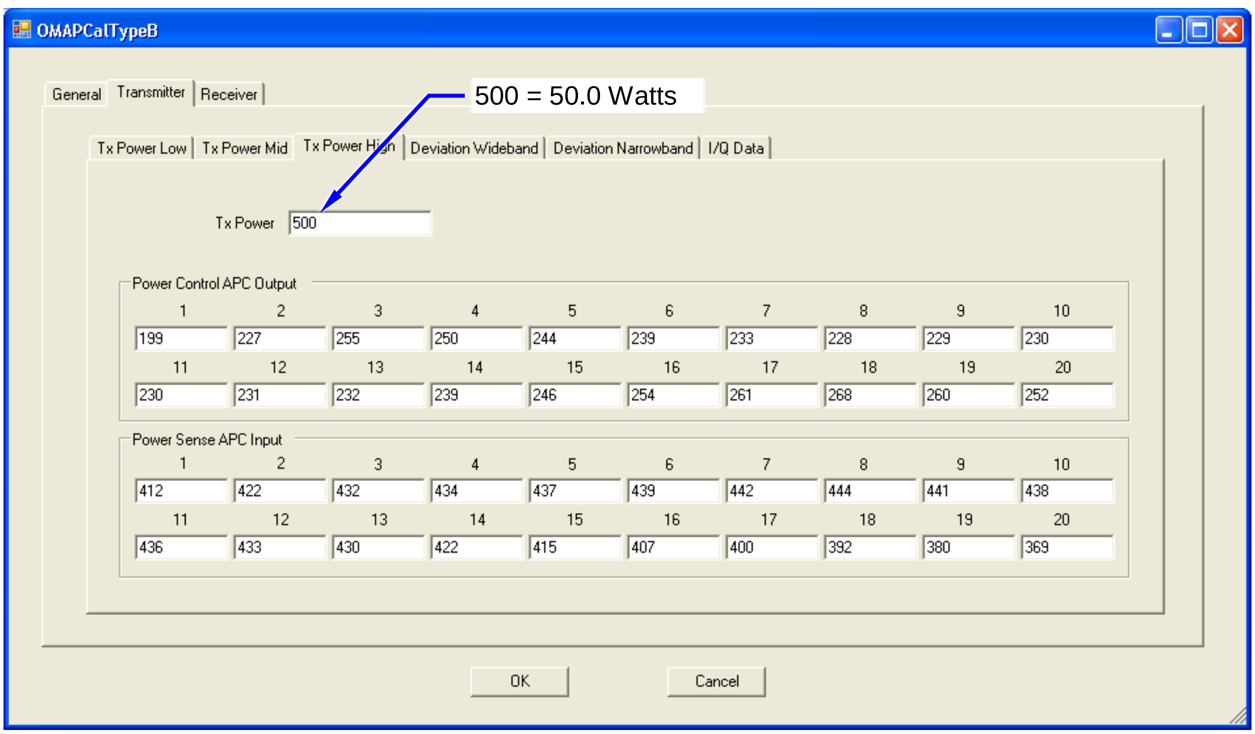


Figure 12-3: Example Data Values for Tx High Power

12.5.5.4 I/Q Data Modulation Alignment

The Radio Maintenance Utility can be used to align the following I and Q data modulation parameters: DC offset, amplitude, and vector arrays. This alignment affects radio transmissions when operating on a channel programmed for C4FM mode.

CAUTION

I/Q data modulation alignment should only be necessary if hardware components affecting transmitter performance have been replaced or the radio has been reset to default factory data. Under any other circumstances where I/Q misalignment is suspected, it is recommended to first verify the test setup, and then determine and correct the cause of radio failure before proceeding with an alignment.

Follow this procedure to verify and align I and Q data modulation:

1. Setup and power-up the radio and test equipment as described in the Tx Frequency Test procedure, Section 12.4.4.1 (do steps 1 through 5 of that procedure). Also see Figure 12-1.
2. Add conventional test systems to the radio's personality. Refer to Section 12.5.4 as necessary.
3. Select conventional test system **25MV IQ**.
4. Select **Channel 4** (174.000 MHz). See Table 12-12 on page 72 for all channels/frequencies used in this procedure.
5. Setup the RF Communications Test Set's RF spectrum analyzer for on-frequency measurements. Refer to Figure 12-4.
6. Press the radio's **MENU** button, then use + or – buttons to scroll through the menu until **FCC MENU** appears in the middle line of the display, and then press the **MENU** button again. The third line of the display now alternates between the selected RX frequency and the present RF input level (in dBm) applied to the radio.
7. Press the + or – buttons to select **SSB MODE** (single side-band mode).

NOTE

While in the FCC Menu's SSB MODE submenu, use the **MENU** button to key and unkey the radio. This is a latching PTT function. The radio's TX/BUSY indicator will illuminate red when the radio is transmitting.

8. Press the **MENU** button to key the radio.
9. Using the spectrum analyzer display, measure the difference between the RF carrier and any carrier leakage or sidebands. See Figure 12-4 for an example analyzer display. Record the suppressed carrier leakage and sidebands on this channel/frequency. Each must be at least -45 dBc (i.e., at least 45 dB below the carrier).
10. Press the **MENU** button to unkey the radio.

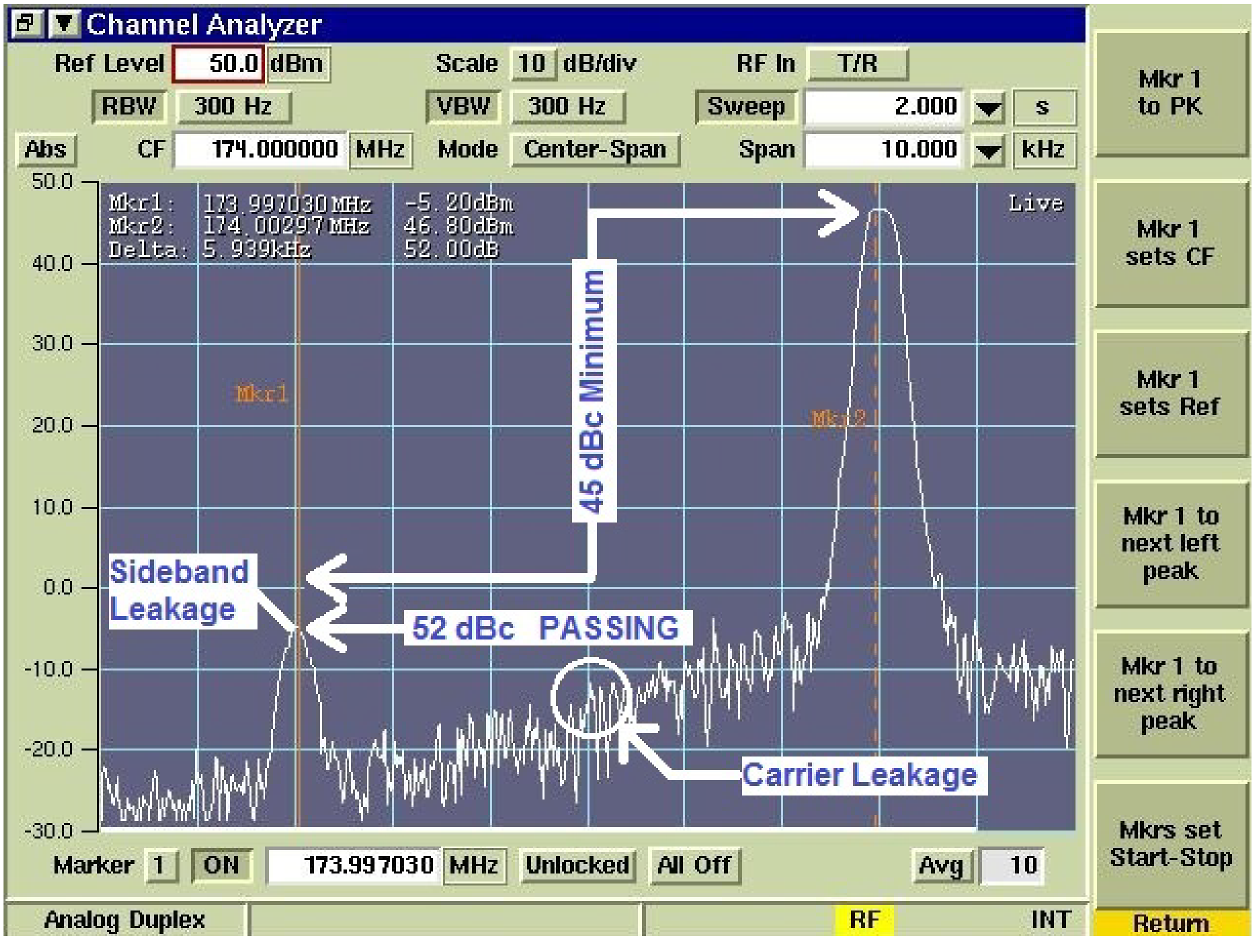


Figure 12-4: I and Q Alignment using FCC Menu SSB MODE

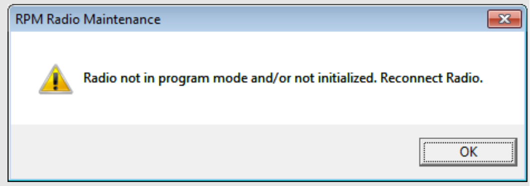
11. Select the next lowest channel/frequency and repeat steps 5 through 10 until carrier leakage and sideband measurements have been recorded for all four (4) test channels/frequencies.
12. If carrier leakage or sideband leakage on any test frequency exceeded the -45 dBc limit, go to step 13. Otherwise, advance to step 27 and save data.
13. Turn off the radio.
14. Using a serial programming cable, connect the radio to the PC with the RPM programming software. See Figure 12-1 on page 75.
15. Turn on the radio.
16. At the PC with the RPM programming software, start the Radio Maintenance Utility:

    Click: **Start > Programs > Harris Radio Personality Manager > RPM Radio Maintenance Utility**
17. In the utility, click on the tab that includes **XG25** (and other radios).
18. From the utility's main menu:

    Select: **Radio > Read > Calibration Data from Radio**

NOTE

If an error message box appears similar to the one shown at the right, try re-reading the calibration data. If a second read attempt does not resolve the issue, first verify serial programming cable connections. Next, within the utility, verify serial port settings by clicking **Radio > Comm Settings** on the utility's main menu.



19. When the "Reading Calibration Data done." message box appears:

    Click: **OK**

20. In the tab that includes **XG25**:

    Click: **Calibration Data**

NOTE

Adjusting I and Q values is an iterative (manual) and time-consuming process. The values interact with each other. Start by adjusting the "I" DC Offset up or down and retesting the channel. If an improvement in carrier and sideband suppression is noted, continue updating the value until the improvement ends.

When starting out, it may be helpful to update the values in steps of 50 and note the changes to the RF signal. Once several stepped updates seem to pass by a null, go back and update the values in steps of 5 or 10 until the best (or a passing) result is achieved.

Continue alignment by systematically adjusting, Q DC Offset, I Amplitude, Q Amplitude, I Vector, and Q Vector until the best (or a passing) result is achieved, adjust only one value at a time. However, all failing channels may be adjusted at the same time (or just one at a time), whichever is least confusing and the most efficient.

21. Within the Transmitter tab, select a test channel requiring alignment.
22. Adjust the fields, one at a time, and retest until the best (or a passing) result is achieved.

    Adjust the fields in the following order, making sure to retest each change before moving onto the next field:

    "I" DC Offset

    "Q" DC Offset

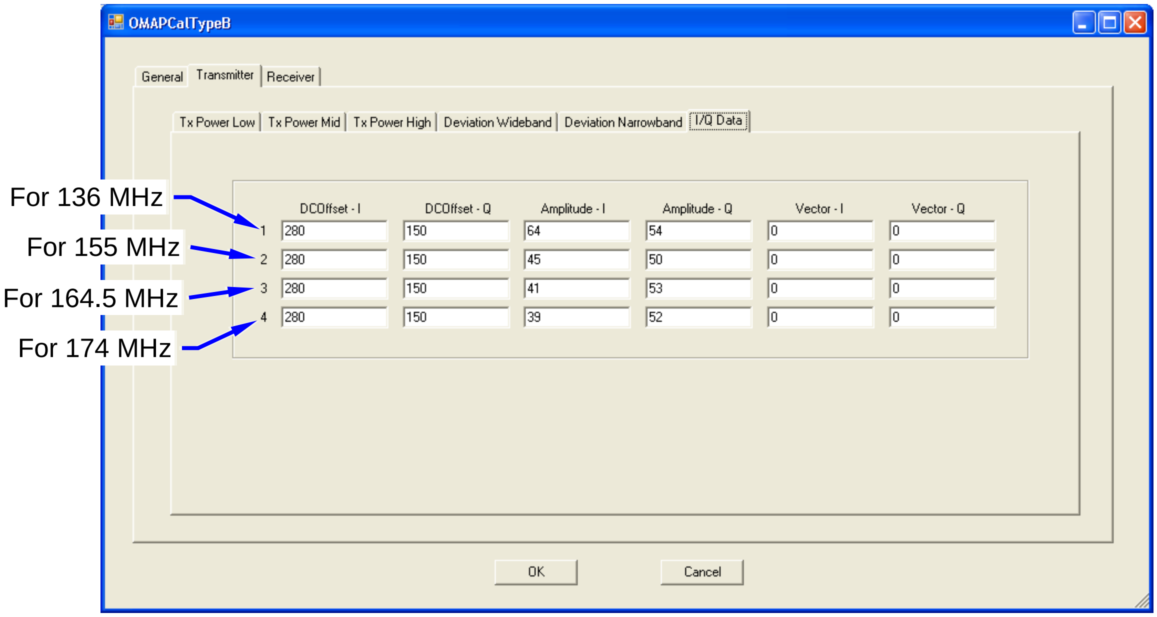
    "I" Amplitude

    "Q" Amplitude

    "I" Vector

    "Q" Vector

Example Data Values Shown for I/Q Data Modulation



23. From the utility's main menu:

    Select: **Radio > Write > Calibration Data to Radio**

24. When the "Write Calibration Data done." message box appears:

    Click: **OK**

25. Cycle power to the radio or click the **JUMP** button to reset the radio after programming.
26. Return to step 3 and repeat the procedure until all channels are correctly aligned.
27. Save the final calibration data to a local file.
28. If no other testing is to be performed, do the following:
    a. If a "shop" test personality was used to test the radio, reload the original personality into the radio and verify operation.
    b. If conventional test frequency sets were added to the original personality, refer to Section 12.5.4.2, remove the test sets, and verify radio operation.

12.5.5.5 FM Deviation Alignment

12.5.5.5.1 General Information

Compensation factors are used to maintain consistent modulation characteristics across the radio's RF operating range. These factors are applied at 20 different frequencies across the radio's RF operating range.

Additional input fields for compensating deviations for Transmit Channel Guard (TCG), data, and Digital Channel Guard (DCG) modes of operation are aligned in a later section of this manual. The wideband and narrowband analog deviation factors used across the 20 frequencies must be adjusted first. The 6 TCG frequencies followed by scalar values are aligned in a later section. Any other order may result in a misaligned radio.

12.5.5.5.2 Wideband FM Deviation Alignment

NOTE

If the radio is not wideband-capable, skip this procedure.

CAUTION

Follow the steps in this alignment procedure in the order which they appear. **Failure to do so may result in a misaligned radio.** Always verify and align the wideband and narrowband deviation values first, before aligning any scalar values.

Follow this procedure to verify and align wideband FM deviation:

1. Setup and power-up the radio and test equipment as described in the Tx Frequency Test procedure, Section 12.4.4.1 (do steps 1 through 5 of that procedure). Also see Figure 12-1.
2. Add conventional test systems to the radio's personality. Refer to Section 12.5.4 as necessary.
3. Configure the RF Communications Test Set to generate a 1 kHz sine wave output at 200 mV rms.
4. Connect this 1 kHz signal to the radio's microphone input. To make this connection, use a modified microphone (see Table 12-2 for additional information) along with a BNC cable and an adapter(s) appropriate for the test set. Apply the signal to the modified microphone's mic audio BNC input connector.
5. At the radio, select conventional test system **25MV LPW** (low power transmit with wideband deviation).
6. Select **Channel 20** (174.0000 MHz).
7. Configure the test set to measure FM deviation on this frequency.
8. Key the radio by depressing the microphone's PTT button, and wait for the transmit power to stabilize (typically one to two seconds).
9. Measure the deviation and then unkey the radio. Record the deviation measured on this test frequency.
10. Select the next lower test frequency (per Table 12-11 on page 71).
11. Return to step 7 and measure deviation again. Repeat until deviation is measured on all 20 test frequencies.
12. Compare the deviation measurements to the wideband analog deviation range listed in Table 12-6 on page 52. These ranges are *without* any Channel Guard/Digital Channel Guard signaling. If any channel is out of range, advance to step 13 for alignment instructions. Otherwise, advance to step 27.

CAUTION

It is the responsibility of anyone entering new alignment data to confirm the radio performs within the legal and operational limits governing the service area that the radio is operated in. If at any time during the deviation tests the measured deviation is not as expected and resembles the deviation for another mode, check the radio personality settings from RPM first, before attempting realignment.

13. Turn off the radio.
14. Using a serial programming cable, connect the radio to the PC with the RPM programming software. See Figure 12-1 on page 75.

15. Turn on the radio.
16. At the PC with the RPM programming software, start the Radio Maintenance Utility:

    Click: **Start > Programs > Harris Radio Personality Manager > RPM Radio Maintenance Utility**
17. In the utility, click on the tab that includes **XG25** (and other radios).
18. From the utility's main menu:

    Select: **Radio > Read > Calibration Data from Radio**
19. When the Calibration Data Complete dialog box opens:

    Click: **OK**
20. In the tab that includes **XG25**:

    Click: **Calibration Data**
21. Click the **Deviation Wideband** tab.
22. Refer to the previously recorded measurements and to Table 12-6 (page 52) and adjust the deviation values for all frequencies requiring alignment. Increasing a deviation value increases deviation on the corresponding frequency (i.e., 1 of 20).
23. From the utility's main menu:

    Select: **Radio > Write > Calibration Data to Radio**
24. When the Calibration Data Write Complete dialog box appears, click **OK**.
25. Turn off the radio and then turn it back on to apply the changes.
26. Measure deviation again on this frequency(ies) to verify alignment per the wideband analog range listed in Table 12-6 (page 52).
27. If no other testing is to be performed, do the following:
    a. Save the final calibration data to a local file.
    b. If a "shop" test personality was used to test the radio, reload the original personality and verify operation.
    c. If test systems were added to the original personality, refer to Section 12.5.4.2, remove the systems, and verify radio operation.

12.5.5.5.3 Narrowband FM Deviation Alignment

CAUTION

Follow the steps in this alignment procedure in the order which they appear. **Failure to do so may result in a misaligned radio.** Always verify and align the wideband and narrowband deviation values first, before aligning any scalar values.

Follow this procedure to verify and align narrowband FM deviation:

1. Setup and power-up the radio and test equipment as described in the Tx Frequency Test procedure, Section 12.4.4.1 (do steps 1 through 5 of that procedure). Also see Figure 12-1.
2. Add conventional test systems to the radio's personality. Refer to Section 12.5.4 as necessary.
3. Configure the RF Communications Test Set to generate a 1 kHz sine wave output at 200 mV rms.

4. Connect this 1 kHz signal to the radio's microphone input. To make this connection, use a modified microphone (see Table 12-2 for additional information) along with a BNC cable and an adapter(s) appropriate for the test set. Apply the signal to the modified microphone's mic audio BNC input connector.
5. At the radio, select conventional test system **25MV LPN** (low power transmit with narrowband deviation).
6. Select **Channel 20** (174.0000 MHz).
7. Configure the test set to measure FM deviation on this frequency.
8. Key the radio by depressing the microphone's PTT button, and wait for the transmit power to stabilize (typically one to two seconds).
9. Measure the deviation and then unkey the radio. Record the deviation measured on this test frequency.
10. Select the next lower test frequency (per Table 12-11 on page 71).
11. Return to step 7 and measure deviation again. Repeat until deviation is measured on all 20 test frequencies.
12. Compare the deviation measurements to the narrowband analog deviation range listed in Table 12-6 on page 52. These ranges are *without* any Channel Guard/Digital Channel Guard signaling. If any channel is out of range, advance to step 13 for alignment instructions. Otherwise, advance to step 27.

CAUTION

It is the responsibility of anyone entering new alignment data to confirm the radio performs within the legal and operational limits governing the service area that the radio is operated in. If at any time during the deviation tests the measured deviation is not as expected and resembles the deviation for another mode, check the radio personality settings from RPM first, before attempting realignment.

13. Turn off the radio.
14. Using a serial programming cable, connect the radio to the PC with the RPM programming software. See Figure 12-1 on page 75.
15. Turn on the radio.
16. At the PC with the RPM programming software, start the Radio Maintenance Utility:

    Click: **Start > Programs > Harris Radio Personality Manager > RPM Radio Maintenance Utility**
17. In the utility, click on the tab that includes **XG25** (and other radios).
18. From the utility's main menu:

    Select: **Radio > Read > Calibration Data from Radio**
19. When the Calibration Data Complete dialog box opens:

    Click: **OK**
20. In the tab that includes **XG25**:

    Click: **Calibration Data**
21. Click the **Deviation Narrowband** tab.

22. Refer to the previously recorded measurements and to Table 12-6 (page 52) and adjust the deviation values for all frequencies requiring alignment. Increasing a deviation value increases deviation on the corresponding frequency (i.e., 1 of 20).

23. From the utility's main menu:

    Select: **Radio > Write > Calibration Data to Radio**

24. When the Calibration Data Write Complete dialog box appears, click **OK**.

25. Turn off the radio and then turn it back on to apply the changes.

26. Measure deviation again on this frequency(ies) to verify alignment per the narrowband analog range listed in Table 12-6 (page 52).

27. If no other testing is to be performed, do the following:

    d. Save the final calibration data to a local file.

    e. If a "shop" test personality was used to test the radio, reload the original personality and verify operation.

    f. If test systems were added to the original personality, refer to Section 12.5.4.2, remove the systems, and verify radio operation.

12.5.5.6 Channel Guard Deviation and DCG Scalar Alignment

12.5.5.6.1 Wideband CG and DCG FM Deviation Alignment

NOTE

If the radio is not wideband-capable, skip this procedure.

CAUTION

Follow the steps in this alignment procedure in the order which they appear. Always verify and align the wideband and narrowband deviation values first before aligning any scalar values. Failure to do so may result in a misaligned radio.

Follow this procedure to verify and align Channel Guard and Digital Channel Guard deviation on wideband channels:

1. Setup and power-up the radio and test equipment as described in the Tx Frequency Test procedure, Section 12.4.4.1 (do steps 1 through 5 of that procedure).

2. Disconnect the RF Communications Test Set's audio output signal from the modified microphone.

3. Add conventional test systems to the radio's personality. Refer to Section 12.5.4 as necessary.

4. At the radio, select conventional test system **25MV CGW** (low power transmit with Channel Guard/Digital Channel Guard and wideband deviation).

5. At the radio, select **Channel 6** (174 MHz with 67.0 Hz tone CG). Other channels that will be tested/aligned later are listed in Table 12-13 on page 72.

6. Configure the test set for an on-frequency FM deviation measurement, with an audio filter of 20 to 300 Hz.

7. Key the radio by depressing the microphone's PTT button, and wait for the transmit power to stabilize (typically one to two seconds).

8. Measure and record the deviation, and then unkey the radio.
9. Select the next lower channel in this system and perform an on-frequency deviation measurement. Repeat until all six (6) channels with the 67.0 Hz tone CG are measured. Be sure to record all six (6) deviation measurements.
10. Compare the deviation measurements to the range listed in Table 12-15. If any channel is out of range, advance to step 14 for alignment instructions.

NOTE

On the Deviation Wideband tab, the DCG Deviation Scalar is a compensation value applied to all channels' TCG Deviation settings (narrowband and wideband) during DCG operations. Therefore, do not adjust the DCG Deviation Scalar setting until the respective TCG Deviation settings are properly aligned.

11. After all tone CG deviation levels are measured on channels 1 through 6, select **Channel 7** (174 MHz) to perform similar deviation measurements on this channel programmed with a DCG code of 627. Refer to Table 12-13 on page 72 as necessary.
12. If DCG deviation measurement is not within the range shown in Table 12-16, adjust the DCG Deviation Scalar value up or down. Save the updated data to the radio and retest to verify proper deviation.
13. When all tone CG and DCG deviation measurements are within the range listed in Table 12-15, advance to step 28 to save the updated data.

Table 12-15: CG/DCG Deviation Ranges for Wideband Channels

MODE	CG/DCG DEVIATION RANGE
Wideband Tone CG	700 to 800 Hz
Wideband Digital CG	550 to 650 Hz

14. Turn off the radio.
15. Using a serial programming cable, connect the radio to the PC with the RPM programming software. See Figure 12-1 on page 75.
16. Turn on the radio.
17. At the PC with the RPM programming software, start the Radio Maintenance Utility:

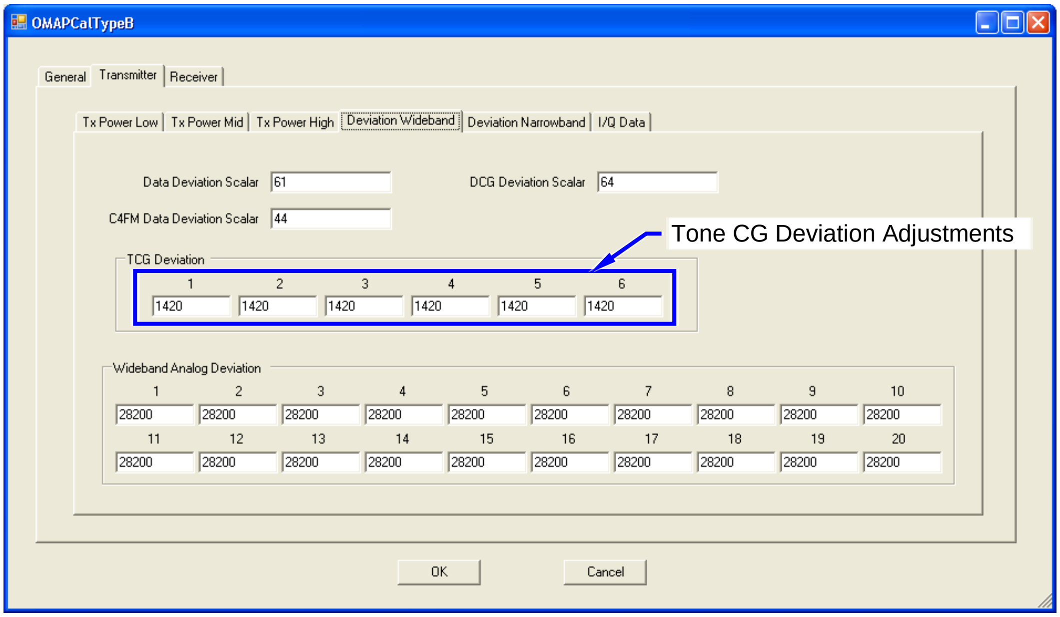
    Click: **Start > Programs > Harris Radio Personality Manager > RPM Radio Maintenance Utility**
18. In the utility, click on the tab that includes **XG25** (and other radios).
19. From the utility's main menu:

    Select: **Radio > Read > Calibration Data from Radio**
20. When the Calibration Data Complete dialog box opens:

    Click: **OK**
21. In the tab that includes **XG25**:

    Click: **Calibration Data**
22. Select: **Deviation Wideband** tab.
23. Refer to Table 12-16 and adjust the TCG Deviation values as necessary. Increasing TCG values increases deviation. Example data values are shown in the following illustration.

Example Data Values Shown for Wideband Deviation



24. From the menu:

    Select: **Radio > Write > Calibration Data to Radio**

25. When the Calibration Data Write Complete dialog box appears:

    Click: **OK**

26. Turn off the radio and then turn it back on to apply the changes.

27. Return to step 4 to repeat the test and alignment procedure until all wideband CG and DCG deviations are correctly aligned.

28. Save the final calibration data to a local file.

29. If no other testing is to be performed, do the following:

    a. If a “shop” test personality was used to test the radio, reload the original personality and verify operation.

    b. If test systems were added to the original personality, refer to Section 12.5.4.2, remove the systems, and verify radio operation.

12.5.5.6.2 Narrowband CG and DCG FM Deviation Alignment

CAUTION

> Follow the steps in this alignment procedure in the order which they appear. Always verify and align the wideband and narrowband deviation values first before aligning any scalar values. Failure to do so may result in a misaligned radio.

Follow this procedure to verify and align Channel Guard and Digital Channel Guard deviation on narrowband channels:

1. Setup and power-up the radio and test equipment as described in the Tx Frequency Test procedure, Section 12.4.4.1 (do steps 1 through 5 of that procedure).

2. Disconnect the RF Communications Test Set's audio output signal from the modified microphone.
3. Add conventional test systems to the radio's personality. Refer to Section 12.5.4 as necessary.
4. At the radio, select conventional test system **25MV CGN** (low power transmit with Channel Guard/Digital Channel Guard and narrowband deviation).
5. At the radio, select **Channel 6** (174 MHz with 67.0 Hz tone CG). Other channels that will be tested/aligned later are listed in Table 12-13 on page 72.
6. Configure the test set for an on-frequency FM deviation measurement, with an audio filter of 20 to 300 Hz.
7. Key the radio by depressing the microphone's PTT button, and wait for the transmit power to stabilize (typically one to two seconds).
8. Measure and record the deviation, and then unkey the radio.
9. Select the next lower channel in this system and perform an on-frequency deviation measurement. Repeat until all six (6) channels with the 67.0 Hz tone CG are measured. Be sure to record all six (6) deviation measurements.
10. Compare the deviation measurements to the range listed in Table 12-16. If any channel is out of range, advance to step 14 for alignment instructions.

NOTE

On the Deviation Wideband tab, the DCG Deviation Scalar is a compensation value applied to all channels' TCG Deviation settings (narrowband and wideband) during DCG operations. Therefore, do not adjust the DCG Deviation Scalar setting until the respective TCG Deviation settings are properly aligned.

11. After all tone CG deviation levels are measured on channels 1 through 6, select **Channel 7** (174 MHz) to perform similar deviation measurements on this channel programmed with a DCG code of 627. Refer to Table 12-13 on page 72 as necessary.
12. If DCG deviation measurement is not within the range shown in Table 12-16, adjust the DCG Deviation Scalar value up or down. Save the updated data to the radio and retest to verify proper deviation.
13. When all tone CG and DCG deviation measurements are within the range listed in Table 12-16, advance to step 28 to save the updated data.

Table 12-16: CG/DCG Deviation Ranges for Narrowband Channels

CG/DCG DEVIATION RANGE
350 to 450 Hz

14. Turn off the radio.
15. Using a serial programming cable, connect the radio to the PC with the RPM programming software. See Figure 12-1 on page 75.
16. Turn on the radio.
17. At the PC with the RPM programming software, start the Radio Maintenance Utility:

    Click: **Start > Programs > Harris Radio Personality Manager > RPM Radio Maintenance Utility**
18. In the utility, click on the tab that includes **XG25** (and other radios).

19. From the utility's main menu:

    Select: **Radio > Read > Calibration Data from Radio**

20. When the Calibration Data Complete dialog box opens:

    Click: **OK**

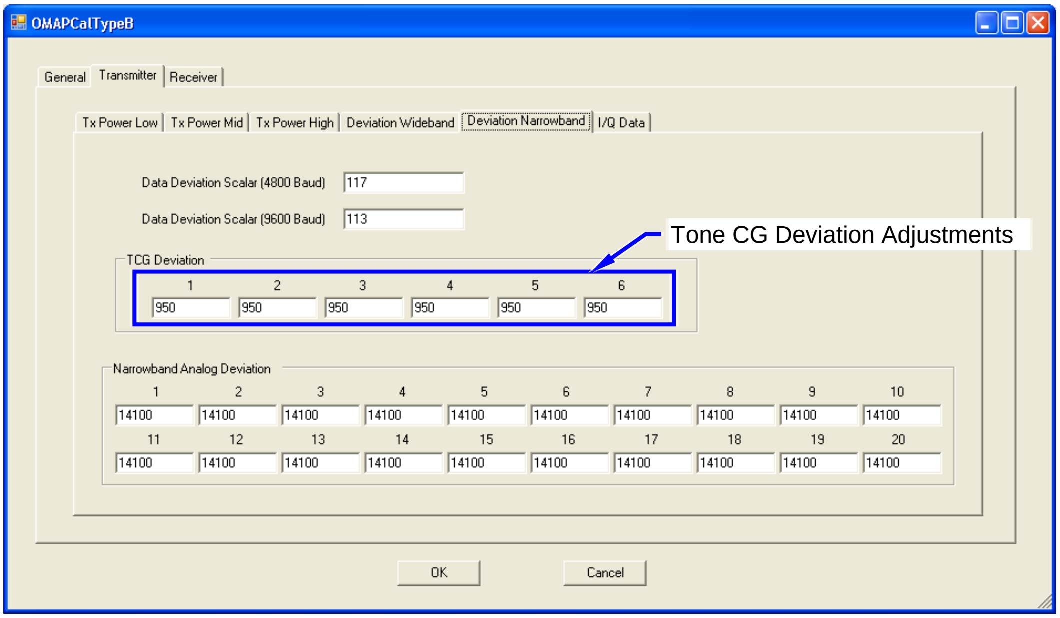
21. In the tab that includes **XG25**:

    Click: **Calibration Data**

22. Select: **Deviation Narrowband** tab.

23. Refer to Table 12-16 and adjust the TCG Deviation values as necessary. Increasing TCG values increases deviation. Example data values are shown in the following illustration.

Example Data Values Shown for Narrowband Deviation



24. From the menu:

    Select: **Radio > Write > Calibration Data to Radio**

25. When the Calibration Data Write Complete dialog box appears:

    Click: **OK**

26. Turn <u>off</u> the radio and then turn it back <u>on</u> to apply the changes.

27. Return to step 4 to repeat the test and alignment procedure until all narrowband CG and DCG deviations are correctly aligned.

28. Save the final calibration data to a local file.

29. If no other testing is to be performed, do the following:

    a. If a "shop" test personality was used to test the radio, reload the original personality and verify operation.

    b. If test systems were added to the original personality, refer to Section 12.5.4.2, remove the systems, and verify radio operation.

12.5.5.7 Data Deviation Scalars Alignment

The Radio Maintenance Utility's Deviation Wideband and Deviation Narrowband tabs include several configurable deviation scalar values. In the Deviation Wideband tab, the Data Deviation Scalar value controls high-speed (wideband) deviation. Also in this tab, the DCG Scalar Deviation Scalar value controls both wideband and narrowband DCG deviation. The Deviation Narrowband tab includes scalars for 4800 and 9600 baud data on narrowband frequencies.

Scalar alignment requires the use of the radio's FCC Menu. This menu is added to a radio's personality by the procedure in Section 12.5.4.1 (see step 7).

Follow this procedure to verify and align deviation scalar alignment:

1. Setup and power-up the radio and test equipment as described in the Tx Frequency Test procedure, Section 12.4.4.1 (do steps 1 through 5 of that procedure).
2. Disconnect the RF Communications Test Set's audio output signal from the modified microphone.
3. Add conventional test systems to the radio's personality. Refer to Section 12.5.4 as necessary.
4. At the radio, select conventional test system **25MV LPN** (low power transmit with narrowband deviation).
5. At the radio, select **Channel 20** (174.0000 MHz).
6. Configure the test set for an on-frequency FM deviation measurement.
7. Press the radio's **MENU** button, then use + or – buttons to scroll through the menu until **FCC MENU** appears in the middle line of the display, and then press the **MENU** button again. The third line of the display now alternates between the selected RX frequency and the present RF input level (in dBm) applied to the radio.

CAUTION

This procedure uses the radio's **MENU** button to key and unkey the radio, not the microphone's PTT button.

8. Measure narrowband 9600 baud transmit data deviation as follows:
   a. Use the + or – buttons to scroll through the menu until **TX 9600N** appears in the middle line of the display.
   b. Press the **MENU** button to key the radio.
   c. Measure and record the deviation. This measurement is affected by the Deviation Narrowband tab's Data Deviation Scalar (9600 Baud) value.
   d. Press the **MENU** button to unkey the radio.
9. Measure the narrowband 4800 baud transmit data deviation as follows:
   a. Use the + or – buttons to scroll through the menu until **TX 4800N** appears in the middle line of the display.
   b. Press the **MENU** button to key the radio.
   c. Measure and record the deviation. This measurement is related to the Deviation Narrowband tab's Data Deviation Scalar (4800 baud) value.
   d. Press the **MENU** button to unkey the radio.
10. Press the **CLEAR** button to exit the FCC Menu.

11. At the radio, select conventional test system **25MV LPW** (low power transmit with wideband deviation).
12. At the radio, select **Channel 20** (174.0000 MHz).
13. Configure the test set for an on-frequency FM deviation measurement.
14. Press the radio's **MENU** button, then use + or – buttons to scroll through the menu until **FCC MENU** appears in the middle line of the display, and then press the **MENU** button again.
15. Measure wideband transmit data deviation as follows:
    a. Use the + or – buttons to scroll through the menu until **TX 9600W** appears in the middle line of the display.
    b. Press the **MENU** button to key the radio.
    c. Measure and record the deviation. This measurement is affected by the Deviation Wideband tab's Data Deviation Scalar value.
    d. Press the **MENU** button to unkey the radio.
16. Measure the C4FM transmit data deviation as follows:
    a. Use the + or – buttons to scroll through the menu until **P25 HIGH** appears in the middle line of the display.
    b. Press the **MENU** button to key the radio.
    c. Measure and record the deviation. This measurement is related to the Deviation Wideband tab's C4FM Data Deviation Scalar value.
    d. Press the **MENU** button to unkey the radio.
17. Compare the measurements made in the previous two steps to the respective ranges listed in Table 12-17. If any modulation mode is out of range, advance to step 18 and realign the scalar(s). Otherwise, advance to step 34.

Table 12-17: Scalar Deviation Ranges

SCALAR	FCC MENU TEST FUNCTION	DEVIATION RANGE
Narrowband 4800 Baud	TX 4800N	1.65 kHz ±25 Hz
Narrowband 9600 Baud	TX 9600N	2.8 kHz ±25 Hz
Wideband 9600 Baud	TX 9600W	4.5 kHz ±50 Hz
C4FM	P25 HIGH	2.826 kHz ±25 Hz

18. Turn off the radio.
19. Using a serial programming cable, connect the radio to the PC with the RPM programming software. See Figure 12-1 on page 75.
20. Turn on the radio.
21. At the PC with the RPM programming software, start the Radio Maintenance Utility:

    Click: **Start > Programs > Harris Radio Personality Manager > RPM Radio Maintenance Utility**
22. In the utility, click on the tab that includes **XG25** (and other radios).

23. From the utility's main menu:

    Select: **Radio > Read > Calibration Data from Radio**

24. When the Calibration Data Complete dialog box opens:

    Click: **OK**

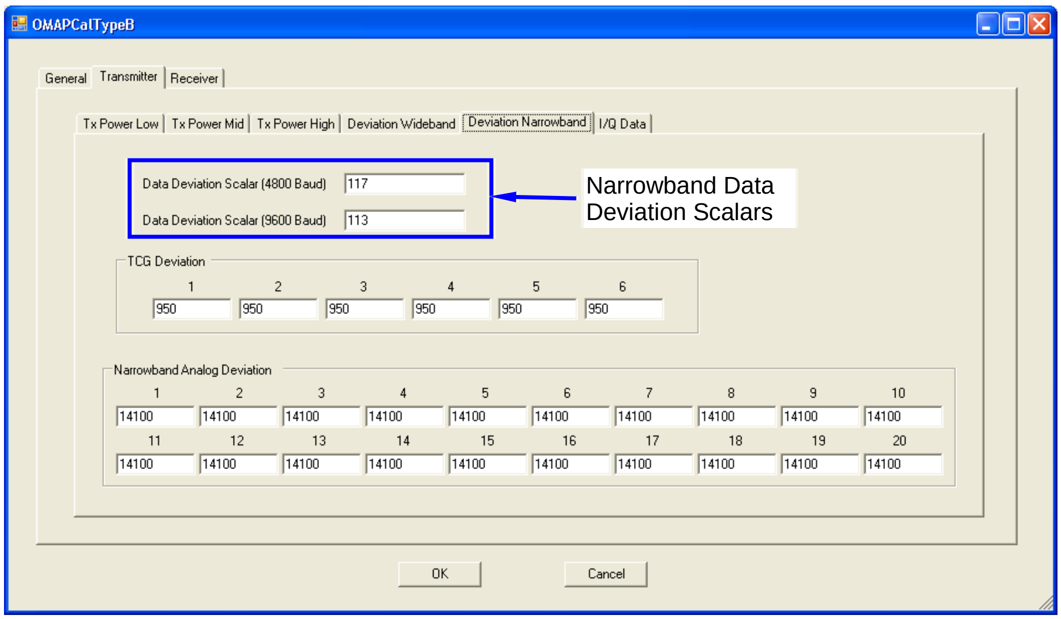
25. In the tab that includes **XG25**:

    Click: **Calibration Data**

26. Select: **Deviation Narrowband** tab.

27. Refer to step 17 and adjust the 4800 Baud Data Deviation Scalar (TX 4800N) and 9600 Baud Data Deviation Scalar (TX 9600N) as necessary. Increasing the value increases associated deviation.

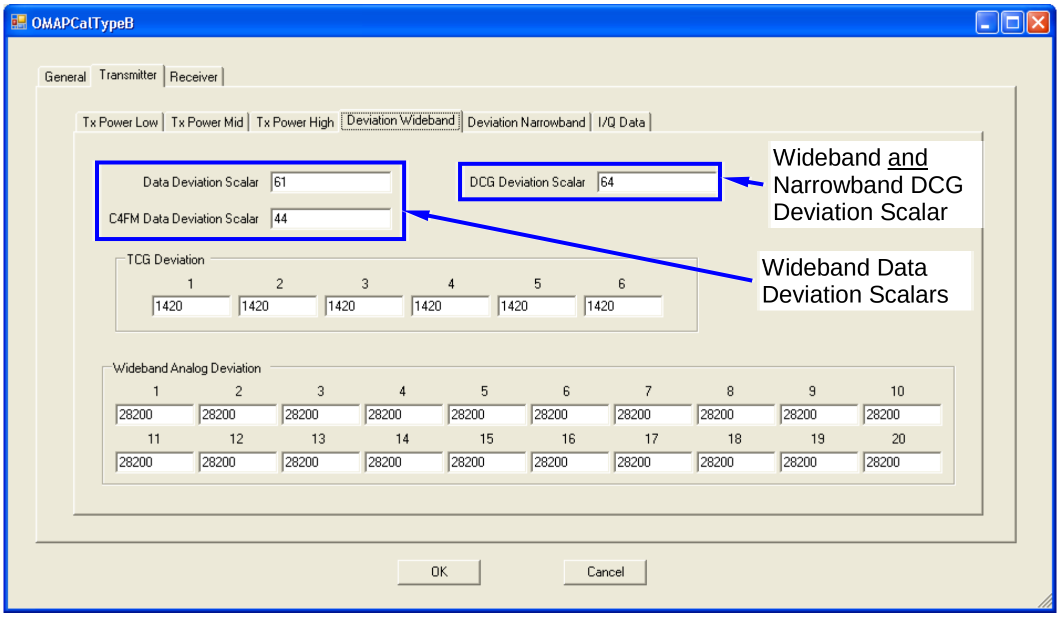
Example Data Values Shown for Narrowband Deviation



28. Select: **Deviation Wideband** tab.

29. Refer to step 17 and adjust the Data Deviation Scalar (TX 9600W) and C4FM Data Deviation Scalar (P25 HIGH) as necessary. Increasing the value increases associated deviation.

Example Data Values Shown for Wideband Deviation



NOTE

Use the Deviation Wideband values for aligning NPSPAC channels. Channels set to NPSPAC are compensated within the radio code by an additional predetermined factory-compensation value which further reduces the deviation as required to produce the correct on-air NPSPAC deviation.

30. From the utility's main menu:

    Select: **Radio > Write > Calibration Data to Radio**

31. When the Calibration Data Write Complete dialog box appears:

    Click: **OK**

32. Turn <u>off</u> the radio and then turn it back <u>on</u> to apply the changes.

33. Return to step 4 and repeat the test and alignment procedure until all deviation scalars are correctly aligned.

34. Save the final calibration data to a local file.

35. If no other testing is to be performed, do the following:

    a. If a "shop" test personality was used to test the radio, reload the original personality and verify operation.

    b. If test systems were added to the original personality, refer to Section 12.5.4.2, remove the systems, and verify radio operation.

12.5.5.8 RSSI Alignment

The Radio Maintenance Utility's Receiver tab includes input fields for aligning the Receive Signal Strength Indication (RSSI) detection. This alignment is based on weak, medium, and strong input RF signal levels as measured on five (5) test frequencies spread across the entire RF operating range of the radio. Correct alignment ensures the proper values are displayed in the FCC menu, and that received signal strength reports sent over-the-air from the radio are accurate.

Follow this procedure to test and align RSSI values:

1. Connect and power-up the radio and test equipment as described in the Audio Output and Distortion Levels Tests presented in Section 12.4.5.1 (do steps 1 through 9 of that procedure). Also see Figure 12-1. Distortion levels do not need to be tested (i.e., do not need to be verified as good) before performing this procedure.
2. Add conventional test systems to the radio's personality. Refer to Section 12.5.4 as necessary.
3. Connect the radio's TNC antenna port connector to the RF Communications Test Set's signal generator/low-power RF output port. To make this connection, use only high-quality RF coax cable(s).
4. Select conventional test system **25MV SQN** (narrowband channels).
5. Select **Channel 1** (136.000 MHz). See Table 12-14 on page 72 for all channels/frequencies used in this procedure.
6. Press the radio's **MENU** button, then use the + or – buttons to scroll through the menu until **FCC MENU** appears in the middle line of the display, and then press the **MENU** button again. The second line of the display now alternates between the selected RX frequency and the present RF input level (in dBm) applied to the radio.
7. Configure the test set to generate an on-frequency FM carrier at a -110 dBm RF output level. This RF level is a reference level for verifying "weak" RSSI alignment values.
8. Record the displayed RSSI level.
9. Change the test set's RF output level to -90 dBm. This RF level is a reference level for verifying "medium" RSSI alignment values.
10. Record the displayed RSSI level.
11. Change the test set's RF output level to -70 dBm. This RF level is a reference level for verifying "strong" RSSI alignment values.
12. Record the displayed RSSI level.
13. Change the channel to the next higher channel/frequency and repeat steps 6 through 12 until weak, medium and strong RSSI measurements are done on all five (5) receive frequencies. The five channels/frequencies are listed in Table 12-14 on page 72.
14. If any of the measured RSSI level measurement is more than ±1.0 dB from the test set's RF output level, continue with step 15 to align the radio. Otherwise, advance to step 29 and save data.
15. Turn off the radio.
16. Using a serial programming cable, connect the radio to the PC with the RPM programming software. See Figure 12-1 on page 75.
17. Turn on the radio.

18. At the PC with the RPM programming software, start the Radio Maintenance Utility:

    Click: **Start > Programs > Harris Radio Personality Manager > RPM Radio Maintenance Utility**

19. In the utility, click on the tab that includes **XG25** (and other radios).

20. From the utility's main menu:

    Select: **Radio > Read > Calibration Data from Radio**

21. When the "Reading Calibration Data done." message box appears:

    Click: **OK**

22. In the tab that includes **XG25**:

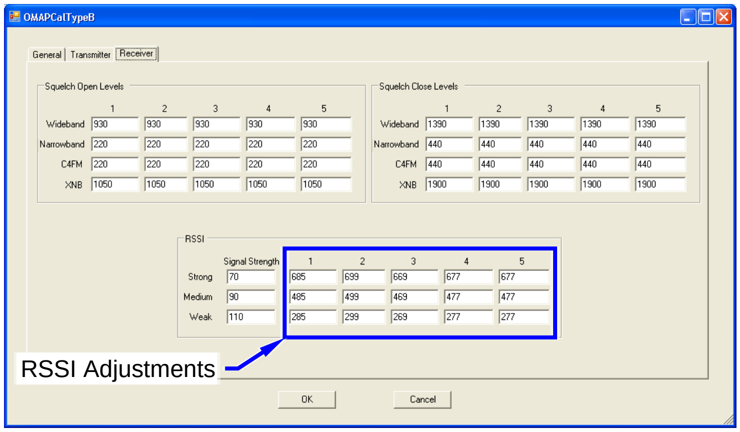
    Click: **Calibration Data**

23. Select: **Receiver** tab.

    Refer to step 14 and adjust the Strong, Medium, and Weak RSSI values as necessary.

    Do **not** change the Signal Strength values in the first column.

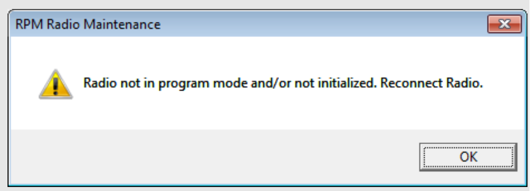
24. Click: **OK**



25. From the utility's main menu:

    Select: **Radio > Write > Calibration Data to Radio**

> **NOTE**
>
> If an error message box appears similar to the one shown at the right, try re-reading the calibration data. If a second write attempt does not resolve the issue, first verify serial programming cable connections. Next, within the utility, verify serial port settings by clicking **Radio > Comm Settings** on the utility's main menu.



26. When the "Write Calibration Data done." message box appears:

    Click: **OK**

27. Cycle power to the radio or click the **JUMP** button to reset the radio after programming.

28. Return to step 4 and repeat the test and alignment procedure until all RSSI values are correctly aligned.

29. Save the final calibration data to a local file.

30. If no other testing is to be performed, do the following:

    a. If a "shop" test personality was used to test the radio, reload the original personality and verify operation.

b. If conventional test systems were added to the original personality, refer to Section 12.5.4.2, remove the test systems, and verify radio operation.

12.5.5.9 Squelch Open and Close Alignment

The Radio Maintenance Utility's Receiver tab includes input fields for Squelch Open Levels and Squelch Close Levels. Values entered into these fields determine the received signal level required to unsquelch the receiver. A higher value equates to a weaker RF signal required to unsquelch the radio on the respective channel/frequency.

Radios like the XG-25M that support multiple modes of operation and wide and narrow bandwidths require different squelch levels for each mode. Squelch Open Levels and Squelch Close Levels input fields are provided for wide-band, narrowband, C4FM, and XNB operations. Values for wideband and narrowband operation are aligned for squelch open and squelch close at five (5) frequencies spread across the entire RF operating range of the radio.

NOTE

The C4FM Squelch Open Levels and C4FM Squelch Closed Levels values are not used with a VHF XG-25M radio. Do not change these values in a VHF XG-25M radio.

Likewise, the XNB Squelch Open Levels and XNB Squelch Close Levels values are not used with a VHF XG-25M radio. Do not change these values in a VHF XG-25M radio.

Each compliment of Squelch Open Level and Squelch Close Level values are set such that a stronger signal is required to open the squelch (Squelch Open Levels) and it doesn't close until the signal level weakens (Squelch Close Levels). This is squelch hysteresis. Without hysteresis, squelch response to weak signals would result in broken-up receive audio in the speaker.

Squelch alignment is based on the industry-standard SIgnal, Noise, And Distortion (SINAD) ratio. This is a comparison of no signal (all noise) to the desired signal being received. A hysteresis value of between 1.5 and 3.0 dB in SINAD is considered optimal. Factory alignment sets the Squelch Open Level for 8 dB ±2 dB SINAD.

Follow this procedure to test and align squelch open and close levels:

1. Connect and power-up the radio and test equipment as described in the Audio Output and Distortion Levels Tests presented in Section 12.4.5.1 (do steps 1 through 9 of that procedure). Also see Figure 12-1. Distortion levels do not need to be tested (i.e., do not need to be verified as good) before performing this procedure.
2. Add conventional test systems to the radio's personality. Refer to Section 12.5.4 as necessary.
3. Connect the radio's TNC antenna port connector to the RF Communications Test Set's signal generator/low-power RF output port.
4. Select a conventional test system as listed in Table 12-11.
5. Select **Channel 1** (136.000 MHz).
6. Configure the test set to generate an on-frequency FM carrier at a minimum RF output level (-125 dBm or lower) and modulated with a 1 kHz tone at a deviation level per the respective operating mode in Table 12-11.

Table 12-18: FM Deviation Levels for Aligning Squelch

SELECTED TEST SYSTEM	MODE	1 kHz TONE DEVIATION (NO CG OR DCG)
25MV SQN	Narrowband (Analog)	1.35 kHz +/- 100 Hz
25MV SQW	Wideband (Analog)	2.7 kHz +/- 200 Hz

7. Also prepare the test set for a SINAD measurement.

NOTE

While it may be desirable to perform SINAD testing simply by listening to the audio heard from the speaker, it is highly recommended to set-up the test equipment for a SINAD measurement, and let it make accurate and repeatable measurements.

8. Press the radio's **MENU** button, then use the + or – buttons to scroll through the menu until **FCC MENU** appears in the middle line of the display, and then press the **MENU** button again. The second line of the display now alternates between the selected channel's RX frequency and the RF input level (in dBm) currently applied to the radio. Typically, the displayed RF input level will be -125 dBm or less. It is important to verify the frequency is clear (no undesired receive signals).
9. Press the – button to select: **SQ #####**, where #### represents a randomly changing number, typically between 1000 and 4000. This is the Squelch Reference value. It represents the received noise level currently being detected by the receiver's squelch circuit.
10. Record the Squelch Reference value displayed for this channel/frequency.
11. While monitoring the SINAD level, slowly increase the test set's RF output level until the squelch just opens. Record the measured SINAD level at this RF level for this channel/frequency.
12. While monitoring the SINAD level, slowly decrease the test set's RF output level until the squelch closes. Record the measured SINAD level just before squelch closing for this channel/frequency.
13. Select the next higher channel/frequency, then return to step 6 and repeat measurements on this frequency. Repeat this until the SINAD levels are measured and recorded on all five (5) wide-band channels/frequencies. Table 12-14 on page 72 lists the channels/frequencies.

NOTE

C4FM squelch operation works as a conventional analog squelch and thus C4FM squelch is aligned as analog squelch. When a P25 signal's RF signal strength satisfies the C4FM Squelch Open Level value (RF signal quality), the radio then verifies P25 synchronization. If synchronization is present, the audio path opens in P25 mode. Otherwise, if a valid CG is detected (or if the channel is programmed for carrier squelch), the audio path is opened in analog voice mode.

14. If any channel opens at a level of 9 dB SINAD or greater, or closes at a value 5 dB SINAD or less, then continue with step 15 to realign the Squelch Open Level and Squelch Close Level values. Otherwise, advance to step 29 and save data.
15. Turn off the radio.
16. Using a serial programming cable, connect the radio to the PC with the RPM programming software. See Figure 12-1 on page 75.
17. Turn on the radio.
18. At the PC with the RPM programming software, start the Radio Maintenance Utility:

    Click: **Start > Programs > Harris Radio Personality Manager > RPM Radio Maintenance Utility**

19. In the utility, click on the tab that includes **XG25** (and other radios).

20. From the utility's main menu:

    Select: **Radio > Read > Calibration Data from Radio**

21. When the "Reading Calibration Data done." message box appears:

    Click: **OK**

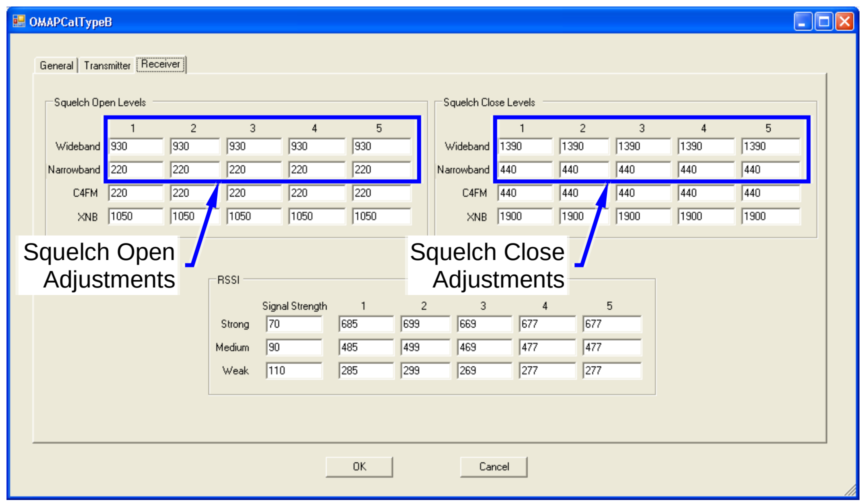
22. In the tab that includes **XG25**:

    Click: **Calibration Data**

23. Select: **Receiver** tab

    Refer to steps 11 and 12 to adjust the values for any of the channels where the squelch did not open or close as expected. Decreasing the input value tightens the squelch function.

24. Click: **OK**



NOTE

A Squelch Open Level value must always be <u>lower</u> than the respective Squelch Close Level value.

NOTE

It may be advantageous to initially set each Squelch Open Level value 200 to 300 points lower than the displayed no-carrier **SQ #####** value, and then set the respective Squelch Close Level value 100 to 200 points lower than the displayed no-carrier **SQ #####** value.

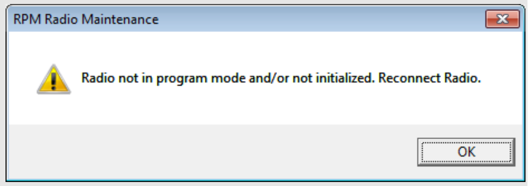
This allows the radio's audio path to open with a very weak RF input signal and prevent the squelch from closing too soon. This allows the **SQ #####** value to be monitored while varying the RF generator's signal strength to near 0 dB SINAD. Afterward, the **SQ #####** values seen when 8 dB SINAD (Squelch Open) and 6 dB SINAD (Squelch Close) signal levels are achieved may be used to program the Squelch Open Levels and Squelch Close Levels values for each test channel/frequency, thus achieving alignment in a simplified test.

25. From the menu:

    Select: **Radio > Write > Calibration Data to Radio**

NOTE

If an error message box appears similar to the one shown at the right, try re-reading the calibration data. If a second write attempt does not resolve the issue, first verify serial programming cable connections. Next, within the utility, verify serial port settings by clicking **Radio > Comm Settings** on the utility's main menu.



26. When the "Write Calibration Data done." message box appears:

    Click: **OK**

27. Cycle power to the radio or click the **JUMP** button to reset the radio after programming.
28. Return to step 6 and repeat the test and alignment procedure until all squelch level values are correctly aligned.
29. Save the final calibration data to a local file.
30. If no other testing is to be performed, do the following:
    a. If a "shop" test personality was used to test the radio, reload the original personality and verify operation.
    b. If conventional test systems were added to the original personality, refer to Section 12.5.4.2, remove the test systems, and verify radio operation.

13 RADIO CONNECTOR PIN-OUTS

13.1 44-PIN I/O CONNECTOR (OPTION/ACCESSORY CONNECTOR)

The 44-pin D-subminiature (DB-44) connector on the rear panel of the radio is a connection point for optional inputs and outputs. The pin-out for this connector and the respective connectors of Option Cable 14002-0174-08 are included in the following table. It is also shown in the radio's internal interconnection diagram on page 148.

Table 13-1: 44-Pin I/O Connector Pin-Out

<table>
<tr><th>PIN</th><th>SIGNAL NAME</th><th>OPTION CABLE 14002-0174-08</th><th>DESCRIPTION</th></tr>
<tr><td>19</td><td rowspan="2">SPKR1</td><td rowspan="2">P2 pin 1</td><td rowspan="4">Speaker Audio Outputs 1 and 2 (differential). This output can be used to drive an optional external/remote speaker connected to the radio.
Enable/Disable this and the radio's internal speaker via Radio Personality Manager (RPM). By default, only the internal speaker is enabled.</td></tr>
<tr><td>20</td></tr>
<tr><td>21</td><td rowspan="2">SPKR2</td><td rowspan="2">P2 pin 2</td></tr>
<tr><td>22</td></tr>
<tr><td>10</td><td>OUT2</td><td>P3 pin 1</td><td>Digital Output 2 for auxiliary control. Open-collector, 10 milliamps / 16 volts maximum. External pull-up resistor needed if required by the external device's input during the high/off state. Use P3 pin 2 or 4 for ground.
Configure via the "External Output Control Line 2" in RPM's External I/O dialog box. For example, an external logging recorder's record enable/disable input can be controlled by setting "External Output Control Line 2" to "Extern. Tx Indicator."</td></tr>
<tr><td>7</td><td>GND</td><td>P3 pins 2 & 4</td><td>Chassis Ground.</td></tr>
<tr><td>26</td><td>HKSW</td><td>P3 pin 3</td><td>Digital Input for Hookswitch. Active = Ground. Inactive = Open.</td></tr>
<tr><td>25</td><td>INP2</td><td>P3 pin 5</td><td>Digital Input 2. Active = Ground. Inactive = Open. Use P3 pin 2 or 4 for ground.
Configure via the "Auxiliary Input 2" in RPM's External I/O dialog Box.</td></tr>
<tr><td>28</td><td>SWA+</td><td>P3 pin 6</td><td>Switched A+ Output. Approximately 12 volts DC.</td></tr>
<tr><td>8</td><td>GND</td><td>P4 pin 1</td><td>Chassis Ground.</td></tr>
<tr><td>30</td><td>DGPS_ DATA</td><td>P4 pin 4</td><td>NMEA-Formatted GPS Receiver Module DGPS Correction Data Serial Data Input. ±15-volt RS-232 input level.</td></tr>
<tr><td>4</td><td>EXTRX</td><td>P4 pin 5</td><td>External Rx Audio Input (from external/2nd receiver; summed; typically not used).</td></tr>
<tr><td>9</td><td>(reserved)</td><td>P4 pin 7</td><td>Pin is not used.</td></tr>
<tr><td>3</td><td>(reserved)</td><td>P4 pin 8</td><td>Pin is not used.</td></tr>
<tr><td>5</td><td>FDISC</td><td>P4 pin 9</td><td>Buffered Filtered Discriminator Audio Output (typically not used). A fixed-level audio output with DC bias. Approximately 200 mV rms into a 600-ohm load at rated deviation. Does not contain signaling (e.g., CTCSS). Mutes when speaker mutes. Use a 33 µF / 50 V (or greater) AC-coupling capacitor to couple to a 600-ohm load. Use P4 pin 12 for ground.</td></tr>
</table>

Table 13-1: 44-Pin I/O Connector Pin-Out

PIN	SIGNAL NAME	OPTION CABLE 14002-0174-08	DESCRIPTION
13	ALO	P4 pin 10	MICHI is a microphone audio input, the same as the front/main mic. 82 mV rms produces SRD. 600-ohm input impedance. Typically not used. ALO is ground/return for MICHI.
12	MICHI	P4 pin 11	
1	SUPGND	P4 pin 12	Low-power audio output for an optional external amplifier and speaker. VOLHI is a single-ended AC-coupled audio signal. Use SUPGND as return/ground for VOLHI. Rated audio signal level is approximately 500 mV rms.
14	VOLHI	P4 pin 13	
15	(reserved)	P4 pin 14	Pin is not used.
16	XTONEENC	P4 pin 15	External Tone Encode Audio Input. Reference input audio level is 220 mV rms. 47k ohm input impedance.
17	XTONEDEC	P4 pin 16	External Tone Decode Audio Output.
6	EXTALO	P4 pin 17	Reference/Ground for external audio (EXTMIC).
24	(reserved)	P4 pin 18	Pin is not used.
23	(reserved)	P4 pin 19	Pin is not used.
18	INP1	P4 pin 21	Digital Input 1. Active = Ground. Inactive = Open. Use P4 pin 1 for ground. Configure via the “Auxiliary Input 1” in RPM’s External I/O dialog box.
2	OUT1	P4 pin 22	Digital Output 1 for auxiliary control. Open-collector, 10 milliamps / 16 volts maximum. External pull-up resistor needed if required by the external device’s input during the high/off state. Use P4 pin 1 for ground. Configure via the “External Output Control Line 1” in Radio Personality Manager’s (RPM’s) External I/O dialog Box.
29	(reserved)	P4 pin 23	Pin is not used.
27	EXTMIC	P4 pin 24	External/Auxiliary Mic Audio Input. Reference input audio level is 82 mV rms. 2.2k ohm input impedance. Use P4 pin 17 for ground.
28	SWA+	P4 pin 25	Switched A+ DC Power Output. Typically, this output is not used.
32	GPS_NMEA_RX	P5 pin 2	NMEA-Formatted GPS Receiver Position Data Serial Data Output. ±5-volt minimum RS-232 output level; ±5.4-volt typical.
31	GPS_NMEA_TX	P5 pin 3	NMEA-Formatted GPS Receiver Module Initialization Data Serial Data Input. ±15-volt RS-232 input level.
7	GND	P5 pin 5	Ground for GPS Serial Data Signals.
33	MIC_NOISE	(none)	Background noise microphone input (MIC_NOISE) and input ground/reference (MIC_NOISE_ALO). As of the publication of this manual, this input/function is not supported. 600-ohm input impedance. MIC_NOISE_ALO is connected to ground.
36	MIC_NOISE_ALO	(none)	
38	TD_B	P6 pin 2	Transmit Data, Receive Data, Clear-To-Send, and Ready-To-Send, and Ground/Reference lines for serial port B. This radio
39	RD_B	P6 pin 3	

Table 13-1: 44-Pin I/O Connector Pin-Out

PIN	SIGNAL NAME	OPTION CABLE 14002-0174-08	DESCRIPTION
42	CTS_B	(none)	programming port is active when the front panel mic connector's sense pin is not grounded. This port's Clear-To-Send and Ready-To-Send handshake lines are not available at P6.
43	RTS_B	(none)	
1	GND	P6 pin 5	
11, 34, 35, 37, 40, 41 and 44	(reserved)	(none)	These pins are not used.

14 DISASSEMBLY AND REASSEMBLY

This section includes disassembly and reassembly procedures for the radio. Also refer to the assembly diagrams shown in Section 15 as necessary.

Observe precautions for damage due to **E**lectro-**S**tatic **D**ischarge (**ESD**). Use proper grounding techniques (wrist or waist straps with grounding cords, grounded table-top mats, etc.) and other approved methods in order to minimize the chance of damage from ESD.

14.1 TOOLS REQUIRED

- Flat-Blade Screwdriver, $^{3}/_{16}$ or ¼-inch wide blade
- Flat-Blade Screwdriver, ⅛-inch wide blade — 2 are recommended for control head disassembly
- T10 Torx Screwdriver
- Torque Screwdriver with Torx T10 Torx bit
- Deep-Well Nutdriver, $^{5}/_{16}$-inch <u>or</u> 8-millimeter — Required for removal of a rotary control
- 1.27-millimeter hex key (i.e., Allen wrench) — Required for removal of a rotary control
- Knob Removal Tool 14015-0203-27 (or equivalent) — Required for removal of a rotary control
- 5.5-Millimeter Wrench or Nutdriver — Required only if the radio has the optional GPS receiver

The following items are also needed for removal and reinstallation of the Main Board:

- T8 Torx® Screwdriver
- T15 Torx Screwdriver
- Torque Screwdriver with Torx T8 and T15 Torx bits
- Thermal Heat-Transfer Compound: Dow Chemical 340 or equivalent
- ESD-Safe Temperature Controlled Soldering Iron/Station
- Solder and ¼-Inch Solder Wick

14.2 REMOVING THE CONTROL HEAD FROM THE RADIO

Follow this procedure to remove the control head from the radio:

1. Lay the radio on a flat ESD-safe surface, in a bottom-up position.
2. As illustrated in Figure 14-1, using a flat-blade screwdriver, gently pry up on the two large tabs on the bottom of the control head until each one disengages from its chamfered location in the radio chassis.
3. Carefully hinge the control head away from the radio chassis.
4. Disconnect the 2-pin speaker connector from the 2-pin connector in the front of the radio chassis. See Figure 14-2.
5. Locate the flex cable connector in the front of the radio chassis and then use a small flat-blade screwdriver to flip the connector's latch to an unlocked position. This connector is a part of the Main Board in the radio chassis.

   Alternately, the flex cable can be disconnected from the flex cable connector in the control head using a similar method. This connector is a part of the Front Panel Board.
6. Gently pull the flex cable from the connector. The control head is now completely separate from the radio chassis.

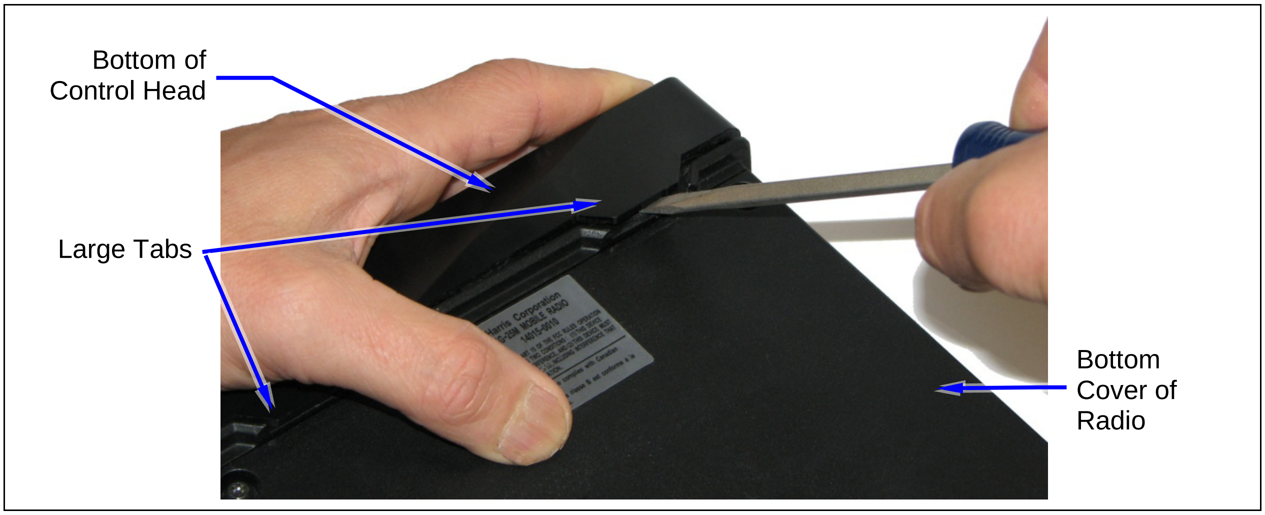


Figure 14-1: Removing the Control Head (1 of 2)

Figure 14-2: Removing the Control Head (2 of 2)

14.3 ATTACHING THE CONTROL HEAD TO THE RADIO

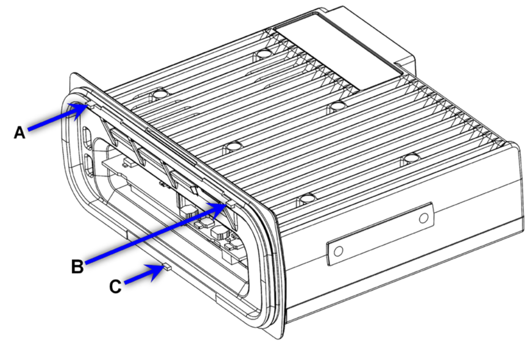
CAUTION

Prior to attaching the control head to the radio, always inspect the condition of the gasket around the perimeter of the front of the radio chassis. This gasket must be in good condition and properly installed in its groove at the front of the radio chassis, as described in the following section. Otherwise, the radio's environmental performance will be affected.

14.3.1 Installing the Gasket into the Groove of the Radio Chassis

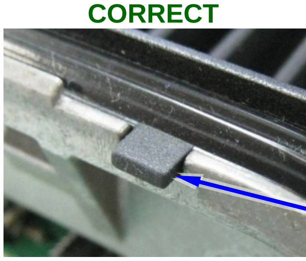
To properly install the gasket into the groove at the front of the radio chassis, follow this procedure:

1. Verify the gasket planned for installation is not damaged in any way. If any damage is found, obtain a new one as a replacement. Refer to Table 8-2 which begins on page 16 as necessary.
2. Verify there is foreign material in the groove of the radio chassis. Clean the groove if necessary.
3. Lay the radio on a flat ESD-safe surface, in a top-up position.
4. Position the gasket just in front of the radio with the three (3) tabs of the gasket lined-up with the three respective notches at the front of the radio chassis. (This action is not illustrated at the right.) There are two (2) tabs at the top (**A** and **B**) and one at the bottom (**C**).



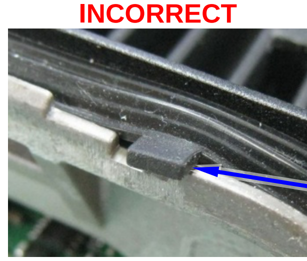
5. Starting at the top, position the gasket into the groove in the radio chassis so each tab completely seats into its respective notch. Correct and incorrect tab-to-notch seating is shown below.

CORRECT



Gasket tab fully seated in notch

INCORRECT



Gasket tab not fully seated in notch

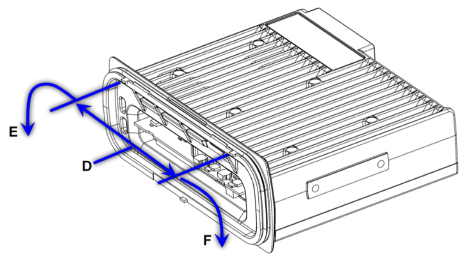
6. Completely seat the top and side sections of the gasket into the groove according to the following sub-steps. Refer to the three (3) illustrations that follow as necessary:

   a. Using a finger, firmly press the gasket into the groove at the section located between the top two tabs/notches (section **D**). Press multiple times as necessary to completely seat the gasket into the groove in this section (i.e., between these two top notches). A rubbing action is not recommended because that will stretch or compress the gasket and/or cause gasket tabs to slip out of their notches.

   b. Using fingers of both hands, simultaneously press the gasket into the groove at the two side sections (**E** and **F**) to seat these gasket sections completely into the groove. A rubbing action is not recommended because that will stretch or compress the gasket and/or cause gasket tabs to slip out of their notches.

   If a tab comes out of its notch, slightly slide/reposition the gasket as necessary to bring the tab back into a fully-seated position.

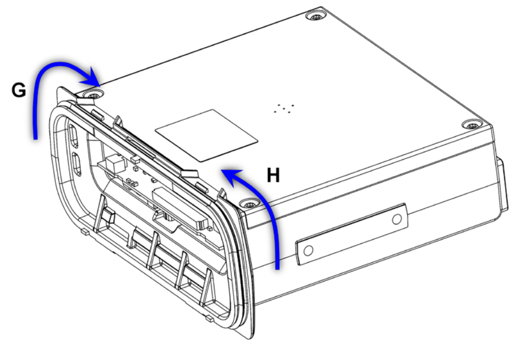
GASKET SECTIONS D, E and F



SEATING GASKET SECTION D

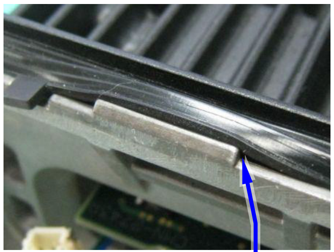
SEATING GASKET SECTIONS E and F

7. Flip the radio over to a bottom-up position.
8. Press the gasket into the groove at the two bottom-corner sections (**G** and **H**) to seat these gasket sections completely into the groove. A rubbing action is not recommended because that will stretch or compress the gasket and/or cause gasket tabs to slip out of their notches.



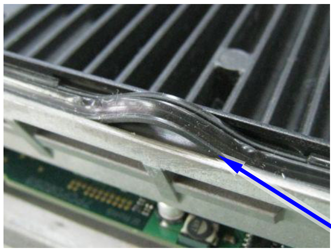
9. Inspect the entire perimeter of the gasket for proper placement and correct any misplacement. Incorrect placements are shown in the illustrations that follow:

INCORRECT



Gasket not fully seated in groove

INCORRECT

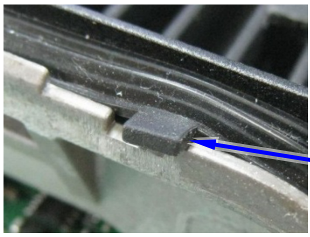


Gasket not fully seated in groove (and stretched excessively)

INCORRECT

Gasket wrinkled

INCORRECT



Gasket tab not fully seated in notch

10. Continue with the control head attachment procedure presented in the next section.

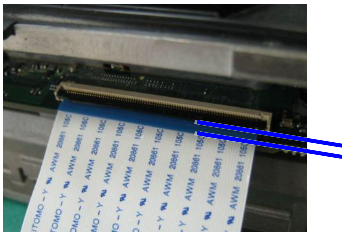
14.3.2 Attaching the Control Head to the Radio

Follow this procedure to attach the control head to the radio chassis:

1. Verify the gasket is installed correctly in the groove at the front of the radio chassis, and that it is not damaged. Refer to the previous section as necessary.
2. Lay the radio on a flat ESD-safe surface, in a bottom-up position.
3. Lay the control head in front of the radio chassis in a bottom-up position.
4. If a flex cable is not mated to the large flex connector in the control head, obtain one (refer to Table 8-2 which begins on page 16 if necessary) and connect it to this connector in the head. The un-insulated conductors on the end of the strip must be facing the board and the blue backing support of the flex cable must be facing the connector's latch. Be sure to completely insert the cable into the connector before locking the latch. The blue backing support must be parallel with the connector's latch.
5. Mate the 2-pin speaker connector from the head to the 2-pin connector at the front of the radio chassis. These connectors are keyed to prevent reverse mating.

6. Mate and lock the other end of the flex cable to the flex cable connector in the radio chassis. Be sure to completely insert the cable into the connector before pressing the latch down to lock it.
7. Verify the flex cable's blue backing support is parallel with the connector's latch. Parallel (correct) and non-parallel (incorrect) mating is shown in the following illustrations:

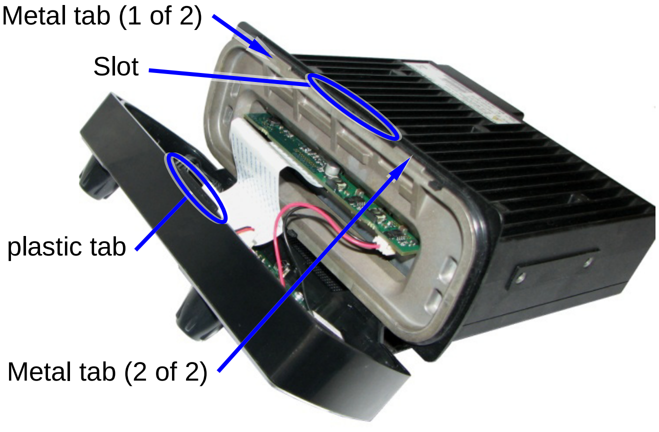
CORRECT



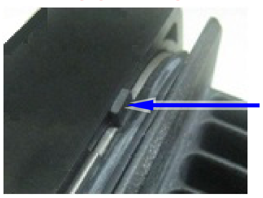
INCORRECT

8. Carefully grasp the rear of the radio in one hand and the front of the control head with the other then simultaneously invert the two assemblies to a top-up position. Do not allow the two assemblies to separate so the cables are not stressed or pulled any.

9. Observe the plastic tab at the top-rear of the control head's front panel, and the corresponding slot at the top-front of the radio casting. Also take note of the two metal tabs at the top-front of the radio chassis, and the corresponding slots inside and at the top-rear of the front panel.



10. As illustrated at the right, fit the top-rear edge of the control head to the top of the radio chassis, so the 3 tabs engage into their respective slots. This is the tab-slot fulcrum (i.e., pivot axis) for a later step. When fitting the two together, do not distort the gasket's tabs. Gasket tabs should remain inside the front panel.



11. Invert the two assemblies to a bottom-up position. When doing so, keep pressure at the top of the front panel so the tab-slot fulcrum does not disengage.

12. If necessary, reposition the two speaker wires towards the center of the front panel's interior so they will not become pinched between the edges of the front panel and radio chassis. Again, keep pressure at the top of the front panel so the tab-slot fulcrum does not disengage.

13. Rotate the head about the tab-slot fulcrum until the two large extensions on the bottom-rear of the front panel begin to engage into the respective chamfered positions in the front of the radio chassis.

14. Lock the head to the radio chassis by <u>simultaneously</u> pressing the front panel's <u>lower-front</u> and the <u>bottom-center</u> surfaces towards the radio. Each of the two large extensions should snap into position in its chamfered location at the bottom of the radio chassis. In addition, the bottom-center surface of the front panel should also snap into position.

    If no snap(s) is heard the gasket may be distorted and thus interfering with proper mating of the control head and radio chassis. In this case, remove the head, inspect and correct the gasket, and repeat the fitting as necessary.

15. Verify none of the 3 gasket tabs are visible. If any are, separate the control head from the radio, correct the problem, and repeat this procedure as necessary.
16. Around the perimeter of the front panel, verify there is an approximate 0.020-inch (½-millimeter) gap between the back edge of the front panel and the front edge of the radio chassis. If the gap is approximately 0.040 inches (1 millimeter) or more, there is most-likely a gasket problem that will result in a poor seal between the two assemblies. In this case, the two assemblies must be separated, the problem corrected, and the two re-assembled. Correct and incorrect gaps sizes are shown in the following illustrations:

CORRECT

Correct size gap—
Approximately
0.020 inches
(½-millimeter)

INCORRECT

Too much gap—
Approximately
0.040 inches
(1-millimeter) or more

14.4 REMOVING THE MAIN BOARD

Follow this procedure to remove the Main Board from the radio chassis:

1. To remove the Main Board, the flex cable and the speaker wires between the control head and the Main Board must be disconnected. This requires removal of the control head from the radio chassis. To accomplish this, complete the procedure in Section 14.2.
2. Place the radio on a flat ESD-safe surface.

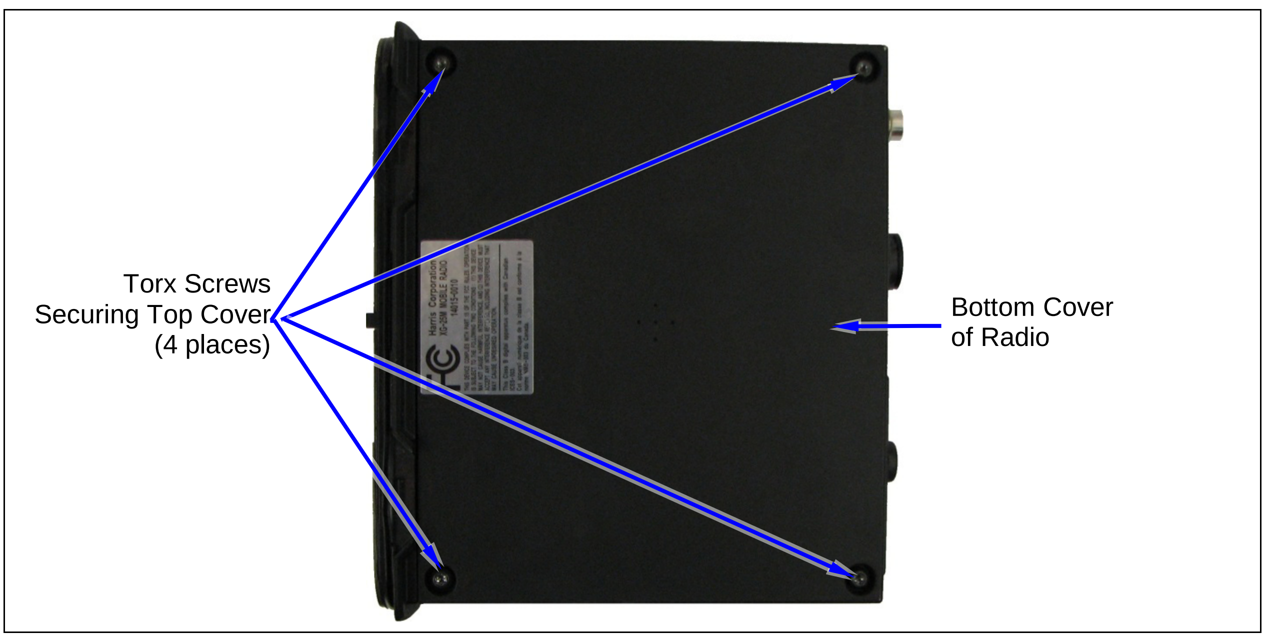


Figure 14-3: Removing the Main Board (Bottom Cover Removal)

3. Using a T15 Torx screwdriver, loosen and remove the four (4) screws securing the bottom cover to the radio. See Figure 14-3.
4. Lift and remove the bottom cover (with gasket) off of the radio chassis.

5. Near the rear of the radio chassis, unplug the connectors mated to connectors J1203 and J1204 on the Main Board. See Figure 14-4. The connector mated to 4-pin connector J1204 has a locking tab that must be depressed before the connectors are pulled apart.

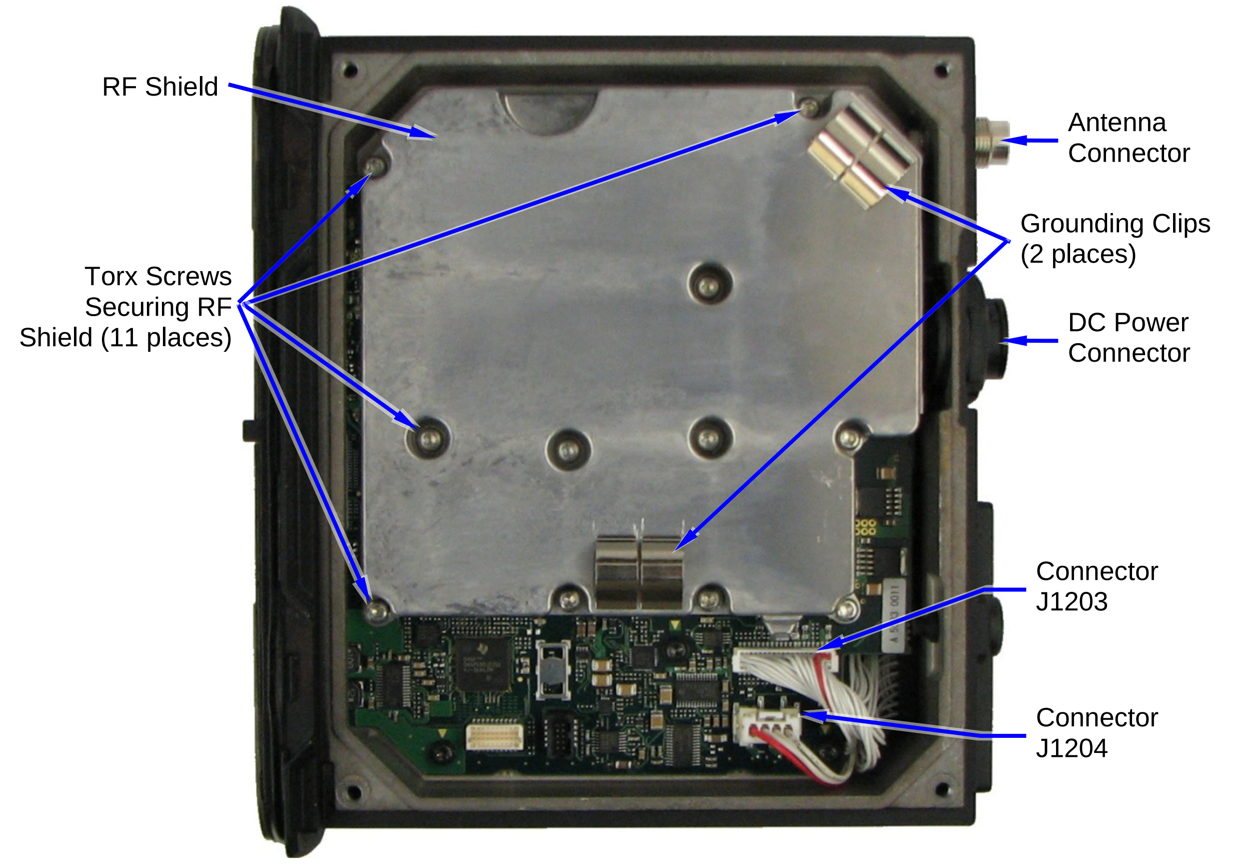


Figure 14-4: Removing the Main board (Radio Shown Without Bottom Cover)

6. Using a T10 Torx screwdriver, completely loosen the eleven (11) screws securing the casted RF shield to the radio chassis.
7. Carefully lift and remove the RF shield and screws from the radio chassis.
8. If the radio is equipped with the optional GPS receiver module, loosen and remove the screw that secures the module, then lift it up to unplug the module from connector J0901 of the Main Board. The module is not shown in Figure 14-4.
9. Using a T10 Torx screwdriver, carefully loosen and remove the three (3) screws securing the wires from the DC power connector to the three (3) metal standoffs on the Main Board. See Figure 14-5.
10. Using a T8 Torx screwdriver, loosen and remove the two (2) screws securing the antenna connector to the chassis.
11. Using a soldering iron, carefully heat the solder joint at the pad for the antenna center conductor until the solder flows and then gently pull the connector (with center conductor) out of the chassis. **Use great care to avoid damaging board pads, traces, and all board components!** There is a rubber O-ring between the base of the connector and the radio chassis. Retain this O-ring for use at connector reinstallation.
12. Using solder wick, carefully remove excess solder from this pad of the Main Board.

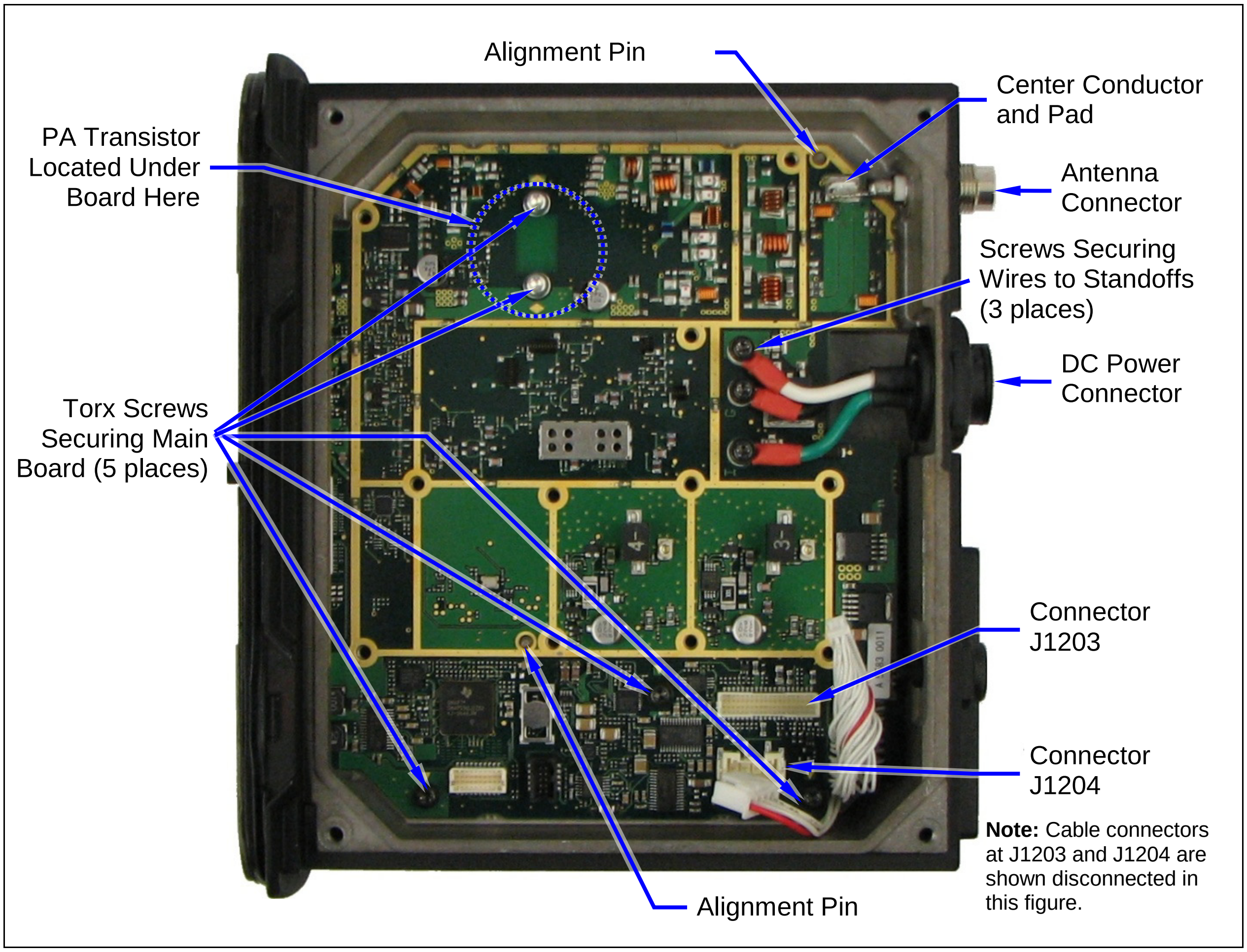


Figure 14-5: Removing the Main board (Radio Shown without Bottom Cover and RF Shield)

13. Using a T10 Torx screwdriver, loosen and remove the five (5) remaining screws securing the Main Board to the radio chassis. If the radio is equipped with the optional GPS receiver module, there are four (4) screws remaining and one (1) hex standoff which must be loosened and removed.
14. Carefully lift and remove the Main Board from the chassis.

14.5 INSTALLING THE MAIN BOARD

Follow this procedure to install a Main Board into the radio:

1. If necessary, obtain a replacement Main Board. See Table 8-2 which begins on page 16 as necessary.
2. Lay the radio chassis on a flat ESD-safe surface, in a bottom-up position.
3. Verify the lower cavity of the radio chassis is completely clear of any foreign material such as loose screws, dirt, dust, etc. Clean and/or vacuum it as necessary.
4. Carefully apply a thin layer of thermal compound/grease to the bottom surface of the RF PA transistor located on the underside of the Main Board.
5. Carefully lay the Main Board into the radio chassis. Insert the front edge of the board into the large slot at the front of the chassis, then lay the rear of the board down onto the chassis. The entire board should be flat on the floor of the chassis, and the two (2) alignment pins should be extending through the holes in the board. See Figure 14-5.

6. At the location of the PA transistor, start (but do not tighten) two **13-millimeter-long** T10 Torx-head nickel-plated screws into the two threaded holes of the chassis. See Figure 14-5. Be sure to use the correct screws.
7. Start (but do not tighten) three **9-millimeter-long** T10 Torx-head black-anodized screws into the three threaded holes of the chassis nearest to connectors J0901, J1203 and J1204. See Figure 14-5. Be sure to use the correct screws.
8. Torque these three (3) screws to 7.4 inch-pounds (8.5 kgf/cm).
9. Torque the two (2) screws at the PA transistor to 4.3 inch-pounds (5.0 kgf/cm).
10. Using a **9-millimeter-long** T10 Torx-head black-anodized screw, attach the green wire from the DC power connector to the "I" standoff.
11. Using a **9-millimeter-long** T10 Torx-head black-anodized screw, attach the black wire from the DC power connector to the "G" standoff.
12. Using a **9-millimeter-long** T10 Torx-head black-anodized screw, attach the white wire from the DC power connector to the "A" standoff.
13. Torque these three screws to 4.3 inch-pounds (5.0 kgf/cm).
14. Place the rubber O-ring on the internal side of the antenna connector. This O-ring seals the base of this connector to the rear panel of the radio chassis.
15. Insert antenna connector (with terminal extension) into its hole in the rear of the radio chassis and then start two 8**-millimeter-long** T8 Torx-head black-anodized screws.
16. Torque these two screws to 4.3 inch-pounds (5.0 kgf/cm).
17. Solder the terminal extension on the antenna connector's center conductor to the respective pad on the Main Board. **Use great care to avoid damaging board pads, traces, and all board components!**
18. Install the RF shield into position over the Main Board. See Figure 14-4.
19. Secure the RF shield to the radio chassis and Main Board using eleven **13-millimeter-long** T10 Torx-head nickel-plated screws. Be sure to use the correct screws.
20. Connect the two cable connectors to connectors J1203 and J1204. See Figure 14-4.
21. Place the bottom cover (with gasket) onto the bottom of the radio chassis and secure it using four T15 Torx-head black-anodized screws.
22. Torque these four screws to 10.4 inch-pounds (12.0 kgf/cm).

14.6 CONTROL HEAD DISASSEMBLY AND REASSEMBLY

14.6.1 Removing the Main Board and Display from the Front Panel

Follow this procedure to remove the Main Board and display from the control head's front panel. It is assumed the head has been removed from the radio:

1. Lay the control head on a flat ESD-safe surface, with its interior side up.
2. Disconnect the 2-pin cable connector located near the center of the Front Panel Board. Do this by gently squeezing the connector's latch and then pulling the connector straight up. Do not pull by the two wires. This is the display backlight power connection. See Figure 14-6.
3. Disconnect the cable to the mic connector. Do this by gently pulling straight up by the edges of the connector's body. Do not pull by the wires.

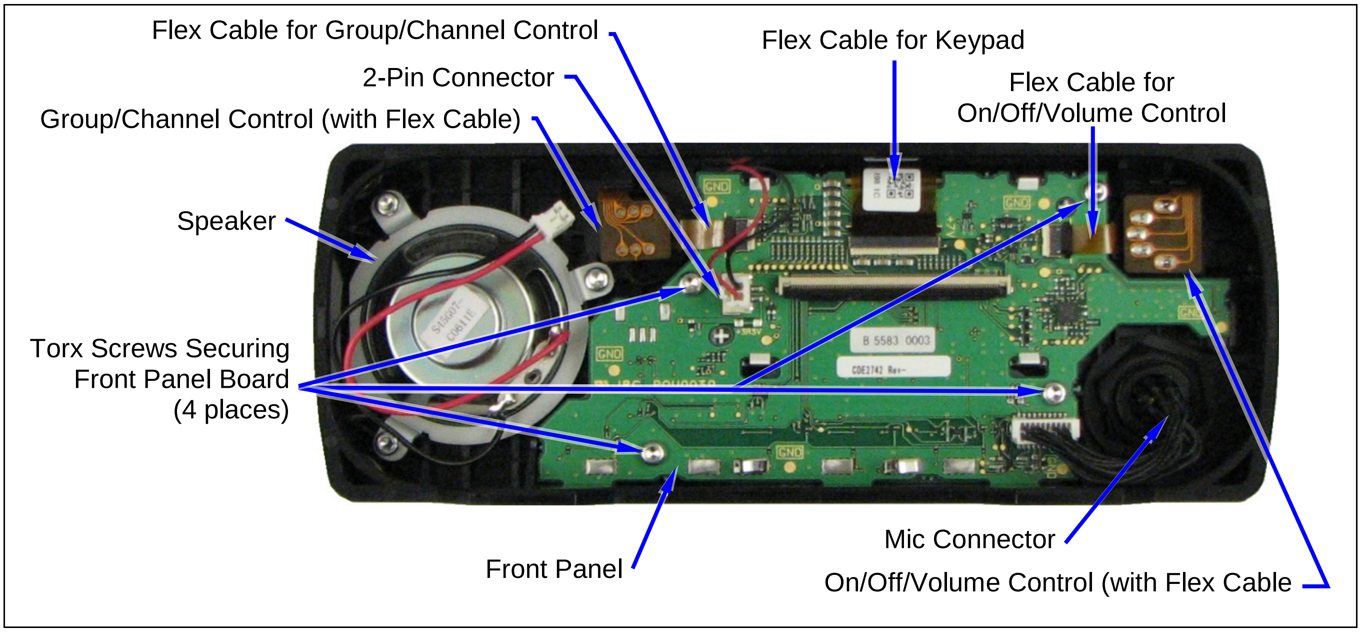


Figure 14-6: Removing the Front Panel Board and Display from the Front Panel

4. Using two small flat-blade screwdrivers, gently disconnect each of the two (2) smaller flex cables by gently pushing each cable out of its connector via the two small "wing" tabs on the cable stiffener. The larger flex cable is for the display and it does not need to be disconnected at this time.
5. Using a T10 Torx screwdriver, loosen and remove the four (4) screws that secure the Front Panel Board to the front panel.
6. Gently lift the top of the Front Panel Board up and out of the front panel, then lift and remove the entire board (with display attached) from the front panel.
7. To separate the display from the Front Panel Board, first disconnect the flex cable and then gently press the four (4) plastic tabs of the display so they disengage from to board. Next, separate the two assemblies by pulling them apart.

14.6.2 Installing the Main Board and Display into the Front Panel

Follow this procedure to install the Main Board and display into the front panel. It is assumed the head is currently removed from the radio and that the display is already attached to the Front Panel Board:

1. Lay the front panel on a flat ESD-safe surface, with its interior side up.
2. Verify the interior of the front panel is completely clear of any foreign material such as loose screws, dirt, dust, etc. Clean and/or vacuum as necessary.
3. Using a soft clean lent-free cloth, clean the interior of the lens in the front panel and the lens of the display.
4. Verify the Bluetooth antenna is in place in the interior of the front panel near the on/off/volume control.
5. Verify the keypad is in place in the lower portion of the interior of the front panel.
6. Place the three (3) tabs on the bottom edge of the Front Panel Board into their corresponding slots in the bottom of the front panel, then swing the two small flex cables apart so they will clear the edges of the board, and then lay the board completely down into the front panel.
7. Install the four (4) T10 Torx-head screws into the holes in the board and panel. Start all four screws first, then torque them to 4.3 inch-pounds (5.0 kgf/cm).

8. Carefully connect the two flex cables, the 2-pin cable, and the cable from the mic connector to their respective connectors on the board.
9. Verify the display's flex connector at the top of the board is fully mated to its connector.

14.6.3 Replacing a Rotary Control (On/Off/Volume and/or Channel/Group)

Follow this procedure to replace one of the rotary controls in the control head. It is assumed the head is currently removed from the radio:

1. Lay the control head on a flat ESD-safe surface, with its interior side up.
2. Disconnect the control's flex cable from its connector on the Front Panel Board. Do this by gently pushing the cable out of its connector via the two small "wing" tabs on the cable stiffener.
3. Return the control head to an up-right position.
4. Using Knob Removal Tool 14015-0203-27 (or equivalent), remove the control's plastic knob.
5. Using a 1.27-millimeter hex key (i.e., Allen wrench), loosen the small hex screw securing the metal insert to the control's shaft, then lift and remove the insert from the shaft.

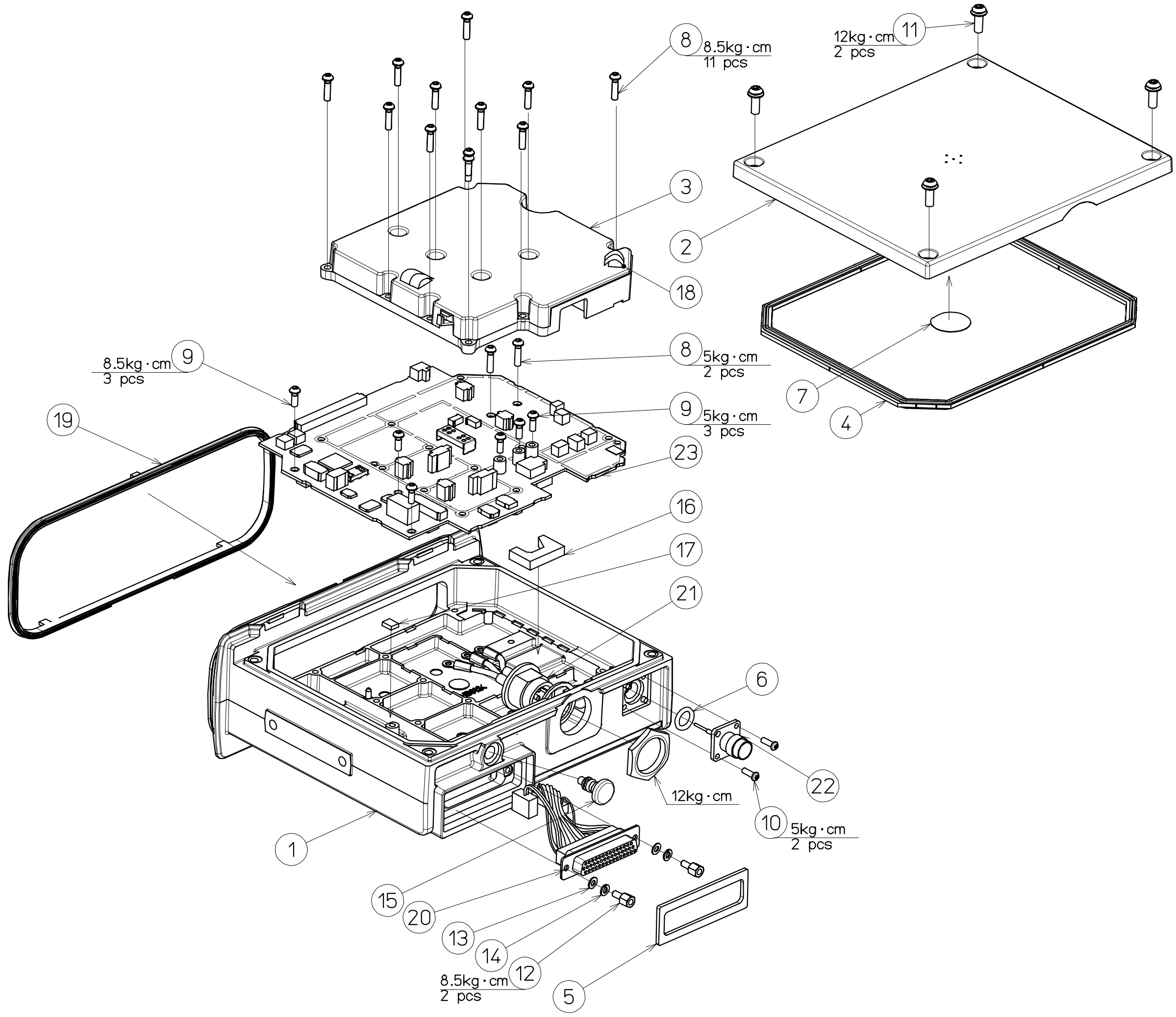
> **NOTE**
>
> The on/off/volume control's insert has a round rubber seal around its outer perimeter that seals to the front panel when the insert is on the shaft. The group/channel control does not have this seal. The on/off volume control's insert also has a larger base to accommodate this seal. The shaft of the on/off/volume control is slightly larger in diameter than the shaft of the group/channel control.

6. Using a $^{5}/_{16}$-inch or 8-millimeter deep-well nutdriver, loosen and remove the hex nut that secures the control to the front panel, and then remove the nut and flatwasher from the control's shaft.
7. Remove the control (with flex cable and rubber O-ring) from the interior of the front panel. The small rubber O-ring on the threaded portion of the control typically remains with the control when it is removed from the front panel. Discard this control.
8. Obtain a replacement control. Refer to Table 8-2 as necessary.
9. Place the small rubber O-ring (include with a replacement control) fully onto the threaded portion of the replacement control.
10. Place the control (with O-ring) into position inside the front panel. The on/off/volume control has a small metal tab that must be seated within a small rectangular notch inside the front panel. The group/channel control has a D-shaped shaft and a respective D-shaped hole in the front panel. Be sure the control's flex cable is properly positioned and not pinched or bent sharply.
11. On the front of the front panel, install the flatwasher and hex nut included with the control, and then torque the nut to 4.3 inch-pounds (5.0 kgf/cm).
12. Place the metal insert fully onto the control's shaft. The on/off/volume control's insert has a round rubber gasket. The group/channel control's insert does not. Do not use an on/off/volume control's insert on the group/channel control. Using the group/channel control's insert on the on/off/volume control is not possible due to shaft and hole size.
13. Torque the insert's small hex screw to 4.3 inch-pounds (5.0 kgf/cm).
14. Place the plastic knob onto the insert. The knob and insert are indexed via different size notches/tabs (notches on metal insert, tabs inside knob). Also, the on/off/volume control's knob has an index mark on its crown, but the group/channel control's knob does not.
15. Press firmly on the knob until it snaps into place.

16. Mate the control’s flex cable to the connector on the Front Panel Board.
17. Attach the control head to the radio. Refer to Section 14.3 as necessary.

15 ASSEMBLY DIAGRAMS

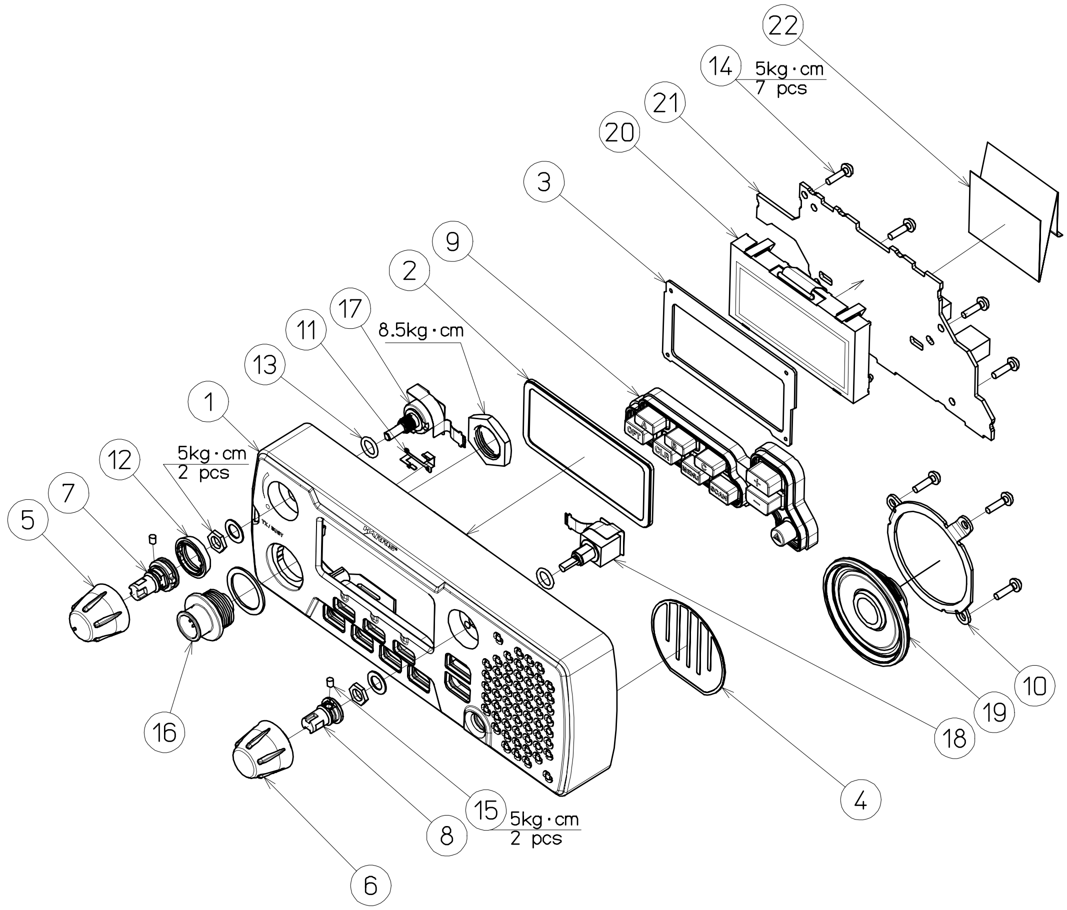
15.1 EXPLODED VIEW — RADIO



No.	NOMENCLATOR	CODE	Q'TY
1	CHASSIS	MTC301939	1
2	COVER	MTC301940	1
3	SHIELD CASE	MTC301941	1
4	COVER GASKET	MTV305014	1
5	DB44 CUSHION	MTZ304454	1
6	PACKING(ANT CONNECTOR)	MPPK01858	1
7	AIR VENT FILTER	BRPK05034	1
8	TORX SCREW	MPTG31713	13
9	TORX SCREW	MPTG31708	6
10	TORX SCREW	MPTG31709	2
11	TORX SCREW	MPTG32258	4
12	SPACER	MPTG32281	2
13	WASHER	BSLW03000R	2
14	SPRING WASHER	BSSW03000S	2
15	GPS CAP	MPPK31549	1
16	HEAT DISSIPATION SHEET	MTT314586	1
17	HEAT DISSIPATION SHEET2	MTT314439	1
18	SHIELD FINGER	MPSR30676	2
19	PANEL GASKET	MTV305013	1
20	DB44 CONNECTOR	H-7ZCPD0659	1
21	POWER SUPPLY CONNECTOR	H-7ZCPD0654A	1
22	ANT CONNECTOR	ALB51A	1
23	MAIN BORD	CMN-2743B	1

(SPBC05204, Rev. 20120406)

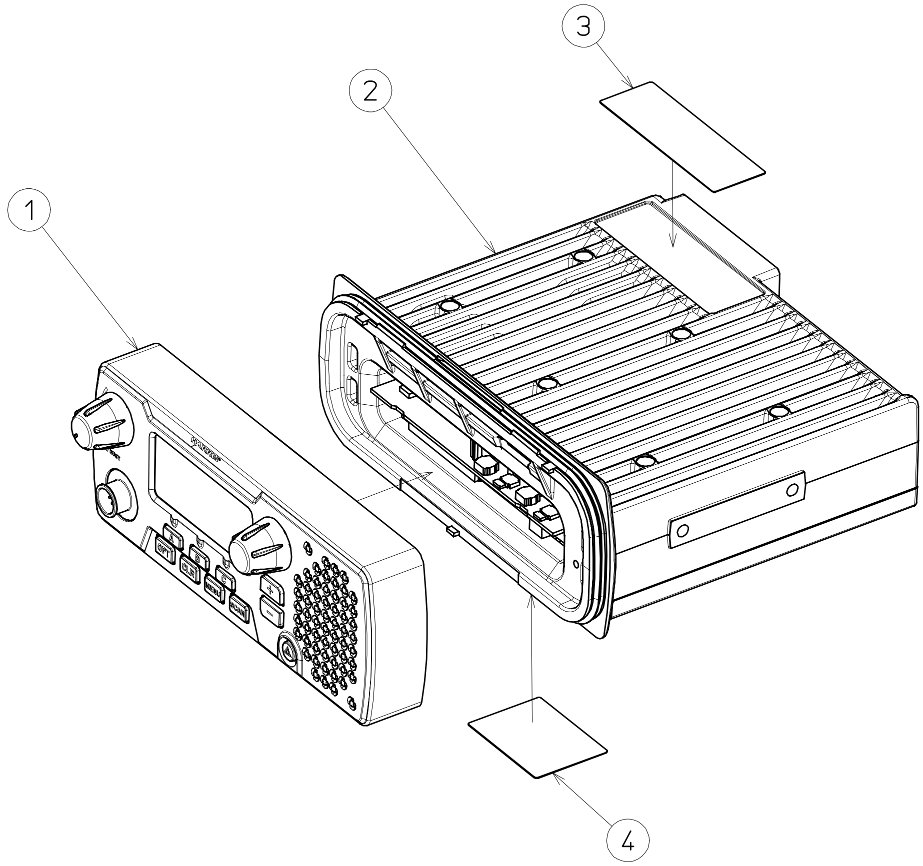
15.2 EXPLODED VIEW — CONTROL HEAD



No.	NOMENCLATOR	CODE	Q'TY
1	PANEL	MTV304985	1
2	LCD LENS	MPOL30426	1
3	LCD CUSHION	MTZ304452	1
4	SPEAKER CLOTH	MTZ304453	1
5	Vol KNOB	MTV305035	1
6	CH KNOB	MTV305036	1
7	Vol KNOB HOLDER	MTC301942	1
8	CH KNOB HOLDER	MTC301943	1
9	KEYPAD	MPPK31638	1
10	SP MOUNTING BRACKET	MTD301949	1
11	BLUETOOTH ANTENNA	MTD301949	1
12	VOL KNOB PACKING	MTV305015	1
13	VOL&CH SW O-RING	MPPK31597	1
14	PANEL SCREW	MPTG32266	7
15	KNOB HOLDER SET SCREW	MPTG32191	2
16	MIC CONNECTOR	H-7ZCPD0655	1
17	VOL SWITCH	CDK-2742A	1
18	CH SWITCH	CDK-2743A	1
19	SPEAKER	S45G07-C061EE	1
20	LCD UNIT	H-7WSPD0007	1
21	PANEL BOARD	CDE-2742	1
22	FLAT CABLE	H-7PCPD0267	1

(SPBC05203, Rev. 20120406)

15.3 EXPLODED VIEW — FINAL ASSEMBLY (RADIO AND HEAD)



No.	NOMENCLATOR	CODE	Q'TY
1	Control unit	SPBC05203	1
2	Transceiver unit	SPBC05204	1
3	FCC ID LABEL	MPNN47599	1
4	FCC LABEL	MPNN47600	1

(SDJHM5056, Rev. 20120406)

16 PARTS LISTS

16.1 MAIN BOARD

(DE00-CMN-2743B; 20120329)

SYMBOL	DESCRIPTION
	-------------------- SURGE ABSORBERS ----------------------
AR1	Similar to Panasonic ERZVF2M220.
AR2	Similar to KOA NV73A2ATTE22.
	------------------------ CAPACITORS --------------------------
C1	0.01 µF ±10% 50V; similar to Murata GRM188R11H103KA01D.
C2 and C3	1 pF ±0.05 pF 50V; similar to Murata GRM1554C1H1R0WA01D.
C4	5 pF ±0.05 pF 50V; similar to Murata GRM1552C1H5R0WA01D.
C5	0.01 µF ±10% 25V; similar to Murata GRM155R11E103KA01D.
C6	1000 pF ±5% 50V; similar to Murata GRM1552C1H102JA01D.
C7	1 µF ±10% 16V; similar to TAIYO YUDEN EMK107BJ105KA-T
C8 and C9	(not installed)
C10	0.01 µF ±5% 16V; similar to Panasonic ECHU1C103JX5
C11	0.1 µF ±10% 16V; similar to Murata GRM155R11C104KA88D
C12	(not installed)
C13	10 pF ±1% 50V; similar to Murata GRM1552C1H100FA01D
C14	22 pF ±1% 50V; similar to Murata GRM1552C1H220FA01D
C15	6 pF ±0.5 pF 500V; similar to Murata GRM31M2C2H6R0DV01L
C16	5 pF ±0.05 pF 50V; similar to Murata GRM1552C1H5R0WA01D
C17	12 pF ±5% 630V; similar to Murata GRM31A5C2J120JW01D
C18 and C19	10 pF ±5% 630V; similar to Murata GRM31A5C2J100JW01D
C20	6 pF ±0.5 pF 500V; similar to Murata GRM31M2C2H6R0DV01L
C21	(not installed)
C22	18 pF ±1% 50V; similar to Murata GRM1552C1H180FA01D
C23	12 pF ±5% 50V; similar to Murata GRM1552C1H120FA01D

SYMBOL	DESCRIPTION
C24	18 pF ±1% 50V; similar to Murata GRM1552C1H180FA01D
C26	1000 pF ±5% 50V; similar to Murata GRM1552C1H102JA01D
C27	0.1 µF ±10% 50V; similar to Murata GRM188R11H104KA93D
C28 and C29	1000 pF ±5% 50V; similar to Murata GRM1552C1H102JA01D
C30	47 pF ±1% 50V; similar to Murata GRM1552C1H470FA01D
C31	56 pF ±5% 50V; similar to Murata GRM1552C1H560JA01D
C32 and C33	68 pF ±5% 50V; similar to Murata GRM1552C1H680JA01D
C34	1000 pF ±5% 50V; similar to Murata GRM1552C1H102JA01D
C35	0.1 µF ±10% 16V; similar to Murata GRM155R11C104KA88D
C36	1000 pF ±15% 100V; similar to MARUWA CTH32R102S20A-TM
C37 thru C40	22 µF ±10% 25V; similar to Murata GRM32ER71E226KE15L
C41 and C42	3 pF ±0.1 pF 50V; similar to Murata GRM1553C1H3R0BA01D
C43	0.1 µF ±10% 16V; similar to Murata GRM155R11C104KA88D
C44 and C45	15 pF ±1% 50V; similar to Murata GRM1552C1H150FA01D
C46 and C47	12 pF ±5% 50V; similar to Murata GRM1552C1H120FA01D
C48	10 pF ±1% 50V; similar to Murata GRM1552C1H100FA01D
C49 and C50	0.022 µF ±5% 16V; similar to Panasonic ECHU1C223JX5
C51 and C52	27 pF ±5% 50V; similar to Murata GRM1882C1H270JA01D
C53	1 µF ±10% 16V; similar to TAIYO YUDEN EMK107BJ105KA-T
C54	(not installed)
C55	1000 pF ±5% 50V; similar to Murata GRM1882C1H102JA01D
C56	12 pF ±5% 630V; similar to Murata GRM31A5C2J120JW01D
C57	22 pF ±1% 50V; similar to Murata GRM1552C1H220FA01D

SYMBOL	DESCRIPTION
C58	27 pF ±1% 50V; similar to Murata GRM1552C1H270FA01D
C59 thru C61	(not installed)
C62	0.1 µF ±10% 16V; similar to Murata GRM155R11C104KA88D
C63	(not installed)
C64	0.01 µF ±10% 25V; similar to Murata GRM155R11E103KA01D
C65	4 pF ±0.1 pF 50V; similar to Murata GRM1552C1H4R0BA01D
C66	1 µF ±20% 16V; similar to Nichicon F931C105MAA
C67	4.7 µF ±20% 16V; similar to Nichicon F931C475MAA
C68	4 pF ±0.1 pF 50V; similar to Murata GRM1552C1H4R0BA01D
C69	0.022 µF ±10% 50V; similar to Murata GRM188R11H223KA01D
C70	33 pF ±1% 50V; similar to Murata GRM1552C1H330FA01D
C71 thru C74	1000 pF ±5% 100V; similar to Murata GRM2192C2A102JA01D
C76	20 pF ±1% 50V; similar to Murata GRM1552C1H200FA01D
C77	22 pF ±1% 50V; similar to Murata GRM1552C1H220FA01D
C79	20 pF ±1% 50V; similar to Murata GRM1552C1H200FA01D
C80	5 pF ±0.05 pF 50V; similar to Murata GRM1552C1H5R0WA01D
C82	15 pF ±5% 630V; similar to Murata GRM31A5C2J150JW01D
C83 and C85	220 µF ±20% 16V; similar to Nippon Chemi-Con EMVY160ADA221MF80G
C86 and C87	0.1 µF ±20% 16V; similar to Panasonic ECPU1C104MA5
C90	10 pF ±5% 50V; similar to Murata GRM1882C1H100JA01D
C91	8 pF ±0.05 pF 50V; similar to Murata GRM1552C1H8R0WA01D
C93	1 µF ±10% 16V; similar to Murata GRM188B31C105KA92D
C94 thru C100	1000 pF ±5% 50V; similar to Murata GRM1552C1H102JA01D
C101	0.01 µF ±10% 25V; similar to Murata GRM155R11E103KA01D
C102	(not installed)

SYMBOL	DESCRIPTION
C103 and C104	1000 pF ±5% 50V; similar to Murata GRM1552C1H102JA01D
C105 and C106	(not installed)
C107	1000 pF ±5% 50V; similar to Murata GRM1552C1H102JA01D
C108	0.01 µF ±10% 25V; similar to Murata GRM155R11E103KA01D
C111	(not installed)
C112 and C113	1000 pF ±5% 50V; similar to Murata GRM1552C1H102JA01D
C114	470 pF ±5% 50V; similar to Murata GRM1552C1H471JA01D
C115	27 pF ±5% 50V; similar to Murata GRM1882C1H270JA01D
C116	1000 pF ±5% 50V; similar to Murata GRM1552C1H102JA01D
C117	27 pF ±5% 50V; similar to Murata GRM1882C1H270JA01D
C129 and C130	(not installed)
C131	5 pF ±0.05 pF 50V; similar to Murata GRM1552C1H5R0WA01D
C133	0.01 µF ±10% 50V; similar to Murata GRM188R11H103KA01D
C134	1000 pF ±5% 50V; similar to Murata GRM1552C1H102JA01D
C135 and C136	(not installed)
C137 and C138	1000 pF ±15% 100V; similar to MARUWA CTH32R102S20A-TM
C140 and C141	(not installed)
C144	100 pF ±5% 50V; similar to Murata GRM1552C1H101JA01D
C153	0.1 µF ±10% 50V; similar to Murata GRM188R11H104KA93D
C157	1000 pF ±5% 50V; similar to Murata GRM1552C1H102JA01D
C158	(not installed)
C159	1000 pF ±5% 50V; similar to Murata GRM1552C1H102JA01D
C163	27 pF ±5% 50V; similar to Murata GRM1882C1H270JA01D

SYMBOL	DESCRIPTION
C169 and C172	0.01 µF ±10% 25V; similar to Murata GRM155R11E103KA01D
C174	0.01 µF ±10% 25V; similar to Murata GRM155R11E103KA01D
C177 thru C181	1000 pF ±5% 50V; similar to Murata GRM1882C1H102JA01D
C182	15 pF ±1% 50V; similar to Murata GRM1552C1H150FA01D
C183 thru C185	1000 pF ±5% 50V; similar to Murata GRM1552C1H102JA01D
C187	1000 pF ±5% 50V; similar to Murata GRM1552C1H102JA01D
C188	0.01 µF ±10% 25V; similar to Murata GRM155R11E103KA01D
C189	1000 pF ±5% 50V; similar to Murata GRM1552C1H102JA01D
C195 and C196	1000 pF ±5% 50V; similar to Murata GRM1552C1H102JA01D
C200 and C202	1000 pF ±5% 50V; similar to Murata GRM1552C1H102JA01D
C204	1000 pF ±5% 50V; similar to Murata GRM1552C1H102JA01D
C205 and C206	(not installed)
C207 thru C209	1000 pF ±5% 50V; similar to Murata GRM1552C1H102JA01D
C212 thru C214	1000 pF ±5% 50V; similar to Murata GRM1552C1H102JA01D
C216 thru C218	1000 pF ±5% 50V; similar to Murata GRM1552C1H102JA01D
C219	18 pF ±5% 630V; similar to Murata GRM31A5C2J180JW01D
C220 and C221	15 pF ±1% 50V; similar to Murata GRM1552C1H150FA01D
C222	9 pF ±0.05 pF 50V; similar to Murata GRM1552C1H9R0WA01D
C223	15 pF ±1% 50V; similar to Murata GRM1552C1H150FA01D
C224 and C226	0.47 µF ±10% 50V; similar to Murata GRM21BR71H474KA88L
C227 and C228	0.47 µF ±10% 50V; similar to Murata GRM21BR71H474KA88L

SYMBOL	DESCRIPTION
C229	3.5 pF ±0.05 pF 50V; similar to Murata GRM1553C1H3R5WA01D
C230	4700 pF ±5% 16V; similar to Panasonic ECHU1C472JX5
C231 and C232	0.1 µF ±10% 25V; similar to TAIYO YUDEN TMK105BJ104KV-F
C235 and C236	0.047 µF ±10% 25V; similar to Murata GRM188R11E473KA01D
C237 thru C240	10 µF ±10% 16V; similar to Murata GRM31CR61C106KA88L
C245 and C246	0.68 µF ±20% 16V; similar to Panasonic ECPU1C684MA5
C247 thru C249	1000 pF ±5% 50V; similar to Murata GRM1552C1H102JA01D
C250	(not installed)
C253	6.5 pF ±0.05 pF 50V; similar to Murata GRM1552C1H6R5WA01D
C256	1 µF ±10% 16V; similar to TAIYO YUDEN EMK107BJ105KA-T
C258 and C259	18 pF ±1% 50V; similar to Murata GRM1552C1H180FA01D
C260 and C261	7 pF ±0.05 pF 50V; similar to Murata GRM1552C1H7R0WA01D
C273	(not installed)
C276	470 pF ±5% 50V; similar to Murata GRM1552C1H471JA01D
C278	0.022 µF ±10% 50V; similar to Murata GRM188R11H223KA01D
C290	6 pF ±0.1 pF 50V; similar to Murata GRM1552C1H6R0BA01D
C291	100 pF ±5% 50V; similar to Murata GRM1552C1H101JA01D
C292 thru C294	0.01 µF ±10% 25V; similar to Murata GRM155R11E103KA01D
C298 thru C303	(not installed)
C305 thru C307	(not installed)
C316	27 pF ±1% 50V; similar to Murata GRM1552C1H270FA01D
C317	8 pF ±0.05 pF 50V; similar to Murata GRM1552C1H8R0WA01D

SYMBOL	DESCRIPTION
C318 thru C320	0.01 µF ±10% 25V; similar to Murata GRM155R11E103KA01D
C324 and C325	0.01 µF ±10% 25V; similar to Murata GRM155R11E103KA01D
C327 and C329	0.01 µF ±10% 25V; similar to Murata GRM155R11E103KA01D
C330	47 µF ±20% 35V; similar to Panasonic EEEFK1V470P
C334	(not installed)
C335	27 pF ±5% 250V; similar to Murata GRM21A5C2E270JW01D
C338	10 pF 500V; similar to ATC 100B100JT500XT
C341 thru C351	1000 pF ±5% 50V; similar to Murata GRM1882C1H102JA01D
C361 thru C367	18 pF ±5% 250V; similar to Murata GQM2195C2E180JB12D
C368 thru C375	33 pF ±5% 250V; similar to Murata GQM2195C2E330JB12D
C381	18 pF ±1% 50V; similar to Murata GRM1552C1H180FA01D
C389	1000 pF ±5% 50V; similar to Murata GRM1552C1H102JA01D
C391 thru C396	1000 pF ±5% 50V; similar to Murata GRM1552C1H102JA01D
C397	0.022 µF ±10% 16V; similar to Murata GRM155R11C223KA01D
C398	1000 pF ±5% 50V; similar to Murata GRM1552C1H102JA01D
C399	0.022 µF ±10% 16V; similar to Murata GRM155R11C223KA01D
C401 thru C403	1 µF ±10% 50V; similar to Murata GRM21BR71H105KA12L
C404	(not installed)
C405 and C406	1 µF ±10% 50V; similar to Murata GRM21BR71H105KA12L
C407 thru C409	(not installed)
C410	1 µF ±10% 50V; similar to Murata GRM21BR71H105KA12L
C411 thru C414	(not installed)
C420	1000 pF ±5% 50V; similar to Murata GRM1552C1H102JA01D

SYMBOL	DESCRIPTION
C421 and C422	1 µF ±10% 50V; similar to Murata GRM21BR71H105KA12L
C0701	0.01 µF ±10% 16V; similar to Murata GRM155R11C103KA01D
C0702	0.1 µF ±10% 16V; similar to Murata GRM155R11C104KA88D
C0707	(not installed)
C0708	0.01 µF ±10% 16V; similar to Murata GRM155R11C103KA01D
C0709	(not installed)
C0710	0.1 µF ±10% 16V; similar to Murata GRM155R11C104KA88D
C0711	0.33 µF ±10% 16V; similar to Murata GRM188R11C334KA01D
C0712 and C0713	0.1 µF ±10% 16V; similar to Murata GRM155R11C104KA88D
C0714 thru C0716	0.01 µF ±10% 16V; similar to Murata GRM155R11C103KA01D
C0717 and C0718	0.1 µF ±10% 16V; similar to Murata GRM155R11C104KA88D
C0719	270 pF ±5% 50V; similar to Murata GRM1552C1H271JA01D
C0720	0.1 µF ±10% 16V; similar to Murata GRM155R11C104KA88D
C0721	0.01 µF ±10% 16V; similar to Murata GRM155R11C103KA01D
C0723 and C0724	22 pF ±1% 50V; similar to Murata GRM1552C1H220FA01D
C0725	(not installed)
C0728	1000 pF ±5% 50V; similar to Murata GRM1552C1H102JA01D
C0729	1 µF ±10% 16V; similar to Murata GRM155R61C105KA12D
C0801 and C0802	0.01 µF ±10% 16V; similar to Murata GRM155R11C103KA01D
C0803	0.1 µF ±10% 16V; similar to Murata GRM155R11C104KA88D
C0805 thru C0811	0.01 µF ±10% 16V; similar to Murata GRM155R11C103KA01D
C0812	1 µF ±10% 16V; similar to Murata GRM155R61C105KA12D
C0813	0.1 µF ±10% 16V; similar to Murata GRM155R11C104KA88D
C0814 thru C0820	0.01 µF ±10% 16V; similar to Murata GRM155R11C103KA01D

SYMBOL	DESCRIPTION
C0821	(not installed)
C0830 and C0831	0.1 µF ±10% 16V; similar to Murata GRM155R11C104KA88D
C0832 and C0833	0.01 µF ±10% 16V; similar to Murata GRM155R11C103KA01D
C0901	100 pF ±5% 50V; similar to Murata GRM1552C1H101JA01D
C0933 thru C0936	0.1 µF ±10% 16V; similar to Murata GRM155R11C104KA88D
C0939 and C0940	0.1 µF ±10% 25V; similar to Murata GRM188R11E104KA01D
C0941	10 µF ±10% 16V; similar to Murata GRM31CR61C106KA88L
C0942 thru C0945	0.1 µF ±10% 25V; similar to Murata GRM188R11E104KA01D
C1001	47 µF ±10% 16V; similar to Murata GRM32ER61C476KE15L
C1002	0.1 µF ±10% 16V; similar to Murata GRM155R11C104KA88D
C1003	100 µF ±20% 25V; similar to Murata GRM21BR11C105KA01L
C1004	47 pF ±1% 50V; similar to Murata GRM1552C1H470FA01D
C1005	100 µF ±20% 25V; similar to Murata GRM21BR11C105KA01L
C1006	47 µF ±10% 16V; similar to Murata GRM32ER61C476KE15L
C1007	0.1 µF ±10% 16V; similar to Murata GRM155R11C104KA88D
C1008	47 µF ±10% 16V; similar to Murata GRM32ER61C476KE15L
C1009	0.1 µF ±10% 16V; similar to Murata GRM155R11C104KA88D
C1010	47 µF ±10% 16V; similar to Murata GRM32ER61C476KE15L
C1011	0.1 µF ±10% 16V; similar to Murata GRM155R11C104KA88D
C1013 thru C1015	0.1 µF ±10% 25V; similar to Murata GRM188R11E104KA01D
C1016	0.1 µF ±10% 16V; similar to Murata GRM155R11C104KA88D
C1017	1 µF ±10% 16V; similar to Murata GRM155R61C105KA12D
C1018 thru C1020	0.01 µF ±10% 16V; similar to Murata GRM155R11C103KA01D

SYMBOL	DESCRIPTION
C1021 thru C1023	0.1 µF ±10% 16V; similar to Murata GRM155R11C104KA88D
C1024	0.01 µF ±10% 25V; similar to Murata GRM155R11E103KA01D
C1025	0.1 µF ±10% 16V; similar to Murata GRM155R11C104KA88D
C1026	68 pF ±5% 50V; similar to Murata GRM1552C1H680JA01D
C1027	1800 pF ±5% 50V; similar to Murata GRM1882C1H182JA01D
C1028	0.01 µF ±10% 25V; similar to Murata GRM155R11E103KA01D
C1029	2200 pF ±5% 50V; similar to Murata GRM1882C1H222JA01D
C1030	0.01 µF ±10% 25V; similar to Murata GRM155R11E103KA01D
C1031	(not installed)
C1032	2.2 µF ±10% 25V; similar to Murata GRM21BR71E225KA73L
C1033 thru C1038	100 µF ±20% 25V; similar to Murata GRM21BR11C105KA01L
C1039	1000 pF ±5% 50V; similar to Murata GRM1552C1H102JA01D
C1040	0.1 µF ±10% 25V; similar to Murata GRM188R11E104KA01D
C1041	100 µF ±20% 25V; similar to Panasonic EEEHD1E101AP
C1042	0.47 µF ±10% 25V; similar to Murata GRM21BR11E474KA01L
C1043	(not installed)
C1044	0.47 µF ±10% 25V; similar to Murata GRM21BR11E474KA01L
C1045	(not installed)
C1046	1000 pF ±5% 50V; similar to Murata GRM1552C1H102JA01D
C1047	0.1 µF ±10% 25V; similar to Murata GRM188R11E104KA01D
C1048	100 µF ±20% 25V; similar to Panasonic EEEHD1E101AP
C1049 and C1050	0.47 µF ±10% 25V; similar to Murata GRM21BR11E474KA01L
C1051 and C1052	1000 pF ±5% 50V; similar to Murata GRM1552C1H102JA01D
C1053 thru C1056	100 µF ±20% 25V; similar to Murata GRM21BR11C105KA01L
C1057	100 µF ±20% 25V; similar to Murata GRM21BR11E105KA99L

SYMBOL	DESCRIPTION
C1058	100 µF ±20% 25V; similar to Murata GRM188R71E105KA12D
C1059	1000 pF ±5% 50V; similar to Murata GRM1552C1H102JA01D
C1060	0.1 µF ±10% 25V; similar to Murata GRM188R11E104KA01D
C1061	100 µF ±20% 25V; similar to Panasonic EEEHD1E101AP
C1062	0.47 µF ±10% 25V; similar to Murata GRM21BR11E474KA01L
C1063	(not installed)
C1064	0.47 µF ±10% 25V; similar to Murata GRM21BR11E474KA01L
C1065	(not installed)
C1066	1000 pF ±5% 50V; similar to Murata GRM1552C1H102JA01D
C1067	0.1 µF ±10% 25V; similar to Murata GRM188R11E104KA01D
C1068	100 µF ±20% 25V; similar to Panasonic EEEHD1E101AP
C1069 and C1070	0.47 µF ±10% 25V; similar to Murata GRM21BR11E474KA01L
C1071 and C1072	1000 pF ±5% 50V; similar to Murata GRM1552C1H102JA01D
C1073	47 µF ±10% 16V; similar to Murata GRM32ER61C476KE15L
C1074 and C1075	(not installed)
C1076 thru C1078	470 pF ±5% 50V; similar to Murata GRM1552C1H471JA01D
C1079 thru C1081	0.1 µF ±10% 16V; similar to Murata GRM155R11C104KA88D
C1082	0.1 µF ±10% 25V; similar to Murata GRM188R11E104KA01D
C1083	0.1 µF ±10% 16V; similar to Murata GRM155R11C104KA88D
C1084 thru C1088	47 µF ±20% 16V; similar to TDK C3216JB1C476M(160AB)
C1106	0.1 µF ±10% 16V; similar to Murata GRM155R11C104KA88D
C1107	0.022 µF ±10% 16V; similar to Murata GRM155R11C223KA01D
C1112	10 µF ±20% 50V; similar to TAIYO YUDEN UMK325BJ106MM-T
C1113	470 nF ±10% 16V; similar to TAIYO YUDEN EMK212BJ474KD-T

SYMBOL	DESCRIPTION
C1114	240 pF ±1% 50V; similar to Murata GRM1552C1H241FA01D
C1115	10 µF ±10% 25V; similar to Murata GRM31CR71E106KA12L
C1116	(not installed)
C1118	4.7 µF ±10% 10V; similar to Murata GRM21BR71A475KA73L
C1119	56 pF ±5% 50V; similar to Murata GRM1552C1H560JA01D
C1120	10 µF ±10% 16V; similar to Murata GRM21BR61C106KE15L
C1121	4.7 µF ±10% 10V; similar to Murata GRM21BR71A475KA73L
C1122	(not installed)
C1123	120 pF ±5% 50V; similar to Murata GRM1552C1H121JA01D
C1124	10 µF ±10% 16V; similar to Murata GRM21BR61C106KE15L
C1125	1 µF ±10% 16V; similar to Murata GRM155R61C105KA12D
C1126	(not installed)
C1127 thru C1131	1 µF ±10% 16V; similar to Murata GRM155R61C105KA12D
C1134	0.33 µF ±10% 16V; similar to Murata GRM188R11C334KA01D
C1135	(not installed)
C1150	10 µF ±20% 50V; similar to TAIYO YUDEN UMK325BJ106MM-T
C1151	(not installed)
C1152	470 nF ±10% 16V; similar to TAIYO YUDEN EMK212BJ474KD-T
C1153	100 pF ±5% 50V; similar to Murata GRM1552C1H101JA01D
C1154	47 µF 25V; similar to SUN Electronic 25HVH47M
C1155	0.1 µF ±10% 25V; similar to Murata GRM188R11E104KA01D
C1156	0.1 µF ±10% 16V; similar to Murata GRM155R11C104KA88D
C1201	1000 pF ±5% 50V; similar to Murata GRM1552C1H102JA01D
C1202 and C1203	0.01 µF ±10% 16V; similar to Murata GRM155R11C103KA01D
C1204	0.1 µF ±10% 16V; similar to Murata GRM155R11C104KA88D
C1205 thru C1266	(not installed)

SYMBOL	DESCRIPTION
C1267 and C1268	1000 pF ±5% 50V; similar to Murata GRM1552C1H102JA01D
C1269 and C1270	(not installed)
C1271	0.22 µF ±10% 16V; similar to Murata GRM188R11C224KA01D
C1272 and C1273	(not installed)
C1301 thru C1304	0.1 µF ±10% 16V; similar to Murata GRM155R11C104KA88D
C2128	33 pF ±1% 50V; similar to Murata GRM1552C1H330FA01D
C2129 thru C2132	1000 pF ±5% 50V; similar to Murata GRM1552C1H102JA01D
C2133	18 pF ±1% 50V; similar to Murata GRM1552C1H180FA01D
C2136	0.1 µF ±10% 16V; similar to Murata GRM155R11C104KA88D
C2137 thru C2139	470 pF ±5% 50V; similar to Murata GRM1552C1H471JA01D
C2140	0.1 µF ±10% 16V; similar to Murata GRM155R11C104KA88D
C2141 thru C2144	470 pF ±5% 50V; similar to Murata GRM1552C1H471JA01D
C2145	12 pF ±5% 50V; similar to Murata GRM1552C1H120FA01D
C2146	27 pF ±1% 50V; similar to Murata GRM1552C1H270FA01D
C2147 and C2149	470 pF ±5% 50V; similar to Murata GRM1552C1H471JA01D
C2150	4.7 µF ±10% 50V; similar to Murata GRM32ER71H475KA88L
C2151	470 pF ±5% 50V; similar to Murata GRM1552C1H471JA01D
C2153	(not installed)
C2154	470 pF ±5% 50V; similar to Murata GRM1882C1H471JA01D
C2156	8 pF ±5% 200V; similar to Murata GRM2192C2D8R0DY21D
C2157	(not installed)
C2158	1000 pF ±5% 50V; similar to Murata GRM1552C1H102JA01D
C2160 thru C1262	(not installed)

SYMBOL	DESCRIPTION
C2163	1000 pF ±5% 50V; similar to Murata GRM1552C1H102JA01D
C2164	47 µF ±20% 35V; similar to Panasonic EEEFK1V470P
C2165	4.7 µF ±10% 50V; similar to Murata GRM32ER71H475KA88L
C2166	1000 pF ±5% 50V; similar to Murata GRM1882C1H102JA01D
C2167	470 pF ±5% 50V; similar to Murata GRM1882C1H471JA01D
C2169	47 pF ±5% 250V; similar to Murata GRM21A5C2E470JW01D
C2170	27 pF ±5% 250V; similar to Murata GRM21A5C2E270JW01D
C2171	(not installed)
C2172	15 pF ±5% 250V; similar to Murata GRM21A5C2E150JW01D
C2173	(not installed)
C2174	470 pF ±5% 50V; similar to Murata GRM2162C1H471JA01D
C2175	27 pF ±5% 250V; similar to Murata GRM21A5C2E270JW01D
C2176	18 pF ±5% 250V; similar to Murata GRM21A5C2E180JW01D
C2177	1000 pF ±5% 50V; similar to Murata GRM1552C1H102JA01D
C2178	(not installed)
C2179 and C2180	100 pF ±5% 50V; similar to Murata GRM2162C1H101JA01D
C2181	(not installed)
C2184 and C2185	220 pF ±5% 50V; similar to Murata GRM2162C1H221JA01D
C2186	1000 pF ±5% 50V; similar to Murata GRM1882C1H102JA01D
C2189 and C2190	18 pF ±5% 250V; similar to Murata GQM2195C2E180JB12D
C2191	(not installed)
C2192 thru C2194	18 pF ±5% 250V; similar to Murata GQM2195C2E180JB12D
C2195 and C2196	(not installed)
C2197	1000 pF ±5% 630V; similar to Murata GRM31A7U2J102JW31D
C2198	4 pF ±0.25 pF 500V; similar to Murata GRM31M2C2H4R0CY21L
C2200	27 pF ±5% 630V; similar to Murata GRM31A7U2J270JW31D

SYMBOL	DESCRIPTION
C2201	22 pF ±1% 50V; similar to Murata GRM1552C1H220FA01D
C2202	12 pF ±5% 50V; similar to Murata GRM1552C1H120FA01D
C2203	33 pF ±1% 50V; similar to Murata GRM1552C1H330FA01D
C2204	15 pF ±1% 50V; similar to Murata GRM1552C1H150FA01D
C2205	1000 pF ±5% 50V; similar to Murata GRM1552C1H102JA01D
C2206	8 pF ±0.05 pF 50V; similar to Murata GRM1552C1H8R0WA01D
C2207	15 pF ±1% 50V; similar to Murata GRM1552C1H150FA01D
C2208	1000 pF ±5% 50V; similar to Murata GRM1552C1H102JA01D
C2209	33 pF ±1% 50V; similar to Murata GRM1552C1H330FA01D
C2210	15 pF ±1% 50V; similar to Murata GRM1552C1H150FA01D
C2211	18 pF ±1% 50V; similar to Murata GRM1552C1H180FA01D
C2212	1000 pF ±5% 50V; similar to Murata GRM1552C1H102JA01D
C2213	0.01 µF ±10% 25V; similar to Murata GRM155R11E103KA01D
C2214	1000 pF ±5% 50V; similar to Murata GRM1552C1H102JA01D
C2215 and C2216	0.01 µF ±10% 25V; similar to Murata GRM155R11E103KA01D
C2217	1000 pF ±5% 50V; similar to Murata GRM1552C1H102JA01D
C2218	18 pF ±1% 50V; similar to Murata GRM1552C1H180FA01D
C2219 and C2220	1000 pF ±5% 50V; similar to Murata GRM1552C1H102JA01D
C2221 and C2222	1000 pF ±5% 50V; similar to Murata GRM1552C1H102JA01D
C2223	0.01 µF ±10% 25V; similar to Murata GRM155R11E103KA01D
C2224	10 pF ±1% 50V; similar to Murata GRM1552C1H100FA01D
C2225	1000 pF ±5% 50V; similar to Murata GRM1552C1H102JA01D
C2226	6 pF ±0.1 pF 50V; similar to Murata GRM1552C1H6R0BA01D
C2227	4 pF ±0.1 pF 50V; similar to Murata GRM1552C1H4R0BA01D

SYMBOL	DESCRIPTION
C2228	1000 pF ±5% 50V; similar to Murata GRM1552C1H102JA01D
C2229	10 pF ±1% 50V; similar to Murata GRM1552C1H100FA01D
C2230 thru C2232	1000 pF ±5% 50V; similar to Murata GRM1552C1H102JA01D
C2233	6 pF ±0.1 pF 50V; similar to Murata GRM1552C1H6R0BA01D
C2234	(not installed)
C2235	1000 pF ±5% 50V; similar to Murata GRM1552C1H102JA01D
C2236	(not installed)
C2237	24 pF ±1% 50V; similar to Murata GRM1552C1H240FA01D
C2238	240 pF ±1% 50V; similar to Murata GRM1552C1H241FA01D
C2239 and C2240	(not installed)
C2241	24 pF ±1% 50V; similar to Murata GRM1552C1H240FA01D
C2242	6 pF ±0.1 pF 50V; similar to Murata GRM1552C1H6R0BA01D
C2243	10 pF ±1% 50V; similar to Murata GRM1552C1H100FA01D
C2244 thru C2247	1000 pF ±5% 50V; similar to Murata GRM1552C1H102JA01D
C2248	6 pF ±0.1 pF 50V; similar to Murata GRM1552C1H6R0BA01D
C2249	4 pF ±0.1 pF 50V; similar to Murata GRM1552C1H4R0BA01D
C2251 thru C2254	1000 pF ±5% 50V; similar to Murata GRM1552C1H102JA01D
C2255	(not installed)
C2256	68 pF ±5% 50V; similar to Murata GRM1552C1H680JA01D
C2257	6 pF ±0.1 pF 50V; similar to Murata GRM1552C1H6R0BA01D
C2258	4 pF ±0.1 pF 50V; similar to Murata GRM1552C1H4R0BA01D
C2259 thru C2262	1000 pF ±5% 50V; similar to Murata GRM1552C1H102JA01D
C2264	9 pF ±0.05 pF 50V; similar to Murata GRM1552C1H9R0WA01D
C2265	1000 pF ±5% 50V; similar to Murata GRM1552C1H102JA01D
C2266	8 pF ±0.05 pF 50V; similar to Murata GRM1552C1H8R0WA01D

SYMBOL	DESCRIPTION
C2267	(not installed)
C2268	1000 pF ±5% 50V; similar to Murata GRM1552C1H102JA01D
C2269	(not installed)
C2270	24 pF ±1% 50V; similar to Murata GRM1552C1H240FA01D
C2271	240 pF ±1% 50V; similar to Murata GRM1552C1H241FA01D
C2272 and C2273	(not installed)
C2274	24 pF ±1% 50V; similar to Murata GRM1552C1H240FA01D
C2275	6 pF ±0.1 pF 50V; similar to Murata GRM1552C1H6R0BA01D
C2276	9 pF ±0.05 pF 50V; similar to Murata GRM1552C1H9R0WA01D
C2277	(not installed)
C2278 thru C2281	1000 pF ±5% 50V; similar to Murata GRM1552C1H102JA01D
C2282	6 pF ±0.1 pF 50V; similar to Murata GRM1552C1H6R0BA01D
C2283	4 pF ±0.1 pF 50V; similar to Murata GRM1552C1H4R0BA01D
C2284	12 pF ±5% 50V; similar to Murata GRM1552C1H120FA01D
C2285	0.1 µF ±10% 16V; similar to Murata GRM155R11C104KA88D
C2286	(not installed)
C2287	3 pF ±0.1 pF 50V; similar to Murata GRM1553C1H3R0BA01D
C2288	0.01 µF ±10% 16V; similar to Murata GRM155R11C103KA01D
C2289	56 pF ±5% 50V; similar to Murata GRM1552C1H560JA01D
C2290 thru C2293	(not installed)
C2294	100 pF ±5% 50V; similar to Murata GRM1552C1H101JA01D
C2295	0.01 µF ±10% 25V; similar to Murata GRM155R11E103KA01D
C2296	0.1 µF ±10% 16V; similar to Murata GRM155R11C104KA88D
C2297 and C2298	12 pF ±5% 50V; similar to Murata GRM1552C1H120FA01D
C2299	22 pF ±1% 50V; similar to Murata GRM1552C1H220FA01D

SYMBOL	DESCRIPTION
C2301 and C2302	0.1 µF ±10% 16V; similar to Murata GRM155R11C104KA88D
C2303 and C2304	(not installed)
C2305	1000 pF ±5% 50V; similar to Murata GRM1552C1H102JA01D
C2306 thru C2309	0.1 µF ±10% 16V; similar to Murata GRM155R11C104KA88D
C2310 thru C2312	1000 pF ±5% 50V; similar to Murata GRM1552C1H102JA01D
C2313	15 pF ±1% 50V; similar to Murata GRM1552C1H150FA01D
C2314	27 pF ±1% 50V; similar to Murata GRM1552C1H270FA01D
C2315	22 pF ±1% 50V; similar to Murata GRM1552C1H220FA01D
C2316	7 pF ±0.05 pF 50V; similar to Murata GRM1552C1H7R0WA01D
C2317 and C2318	12 pF ±5% 50V; similar to Murata GRM1552C1H120FA01D
C2319	3 pF ±0.1 pF 50V; similar to Murata GRM1553C1H3R0BA01D
C2320	(not installed)
C2601	0.33 µF ±5% 50V; similar to Murata GRM219R71H334KA88D
C2602	10 µF ±10% 16V; similar to Murata GRM31CR61C106KA88L
C2603	0.01 µF ±10% 25V; similar to Murata GRM155R11E103KA01D
C2604	22 µF ±10% 25V; similar to Murata GRM32ER71E226KE15L
C2605	0.47 µF ±10% 50V; similar to Murata GRM21BR71H474KA88L
C3000	0.1 µF ±10% 16V; similar to Murata GRM155R11C104KA88D
C21199	7 pF ±0.05 pF 50V; similar to Murata GRM1552C1H7R0WA01D
C22101	8 pF ±0.05 pF 50V; similar to Murata GRM1552C1H8R0WA01D
C22103	22 pF ±1% 50V; similar to Murata GRM1552C1H220FA01D
	---------------------------- DIODES ------------------------------
CD1	Similar to Renesas RD2.4S-T1-AT
CD2 thru CD5	Similar to Renesas HSU88TRF-E

SYMBOL	DESCRIPTION
CD6 thru CD13	Similar to Toshiba 1SS381(TPL3 F)
CD14	Similar to Toshiba JDH2S01FS(TPL3)
CD15 thru CD17	Similar to Renesas RKS151KJ-P1
CD18 thru CD21	Similar to Toshiba 1SV228(TPH3 F)
CD22	Similar to Litec L8103R
CD23	Similar to Renesas RD2.4S-T1-AT
CD24	Similar to Toshiba 1SS362FV(TPL3)
CD25	Similar to Renesas RKS151KJ-P1
CD27 thru CD30	Similar to Renesas HVC383BTRF-E
CD31	Similar to Shindengen DF25V60-5072
CD33	Similar to Renesas RKS151KJ-P1
CD34	Similar to Shindengen D1F60-5053
CD0701	Similar to ROHM DAN217WTL
CD1102 thru CD1104	Similar to Toshiba HN2S03FE(TE85L F)
CD1105 and CD1110	Similar to Toshiba CMS16(TE12L_Q)
CD1201	Similar to ROHM RB520CS-30T2R
CD1202 and CD1203	Similar to Renesas HZC18TRF-E
CD1204 and CD1205	Similar to Toshiba DF5A6.8CFU(TE85L,F
CD1206 thru CD1209	Similar to Renesas HZC18TRF-E
CD1210 and CD1211	Similar to Renesas HZC24TRF-E
CD1212 thru CD1214	(not installed)
CD2101	Similar to Avago Technologies HSMP-3816-TR1G
CD2102 thru CD2105	Similar to Litec L8103R
CD2106	(not installed)
CD2201	Similar to Renesas RKV501KJ-R1
CD2202 and CD2203	Similar to Renesas RKS151KJ-P1

SYMBOL	DESCRIPTION
CD2204	Similar to Renesas RKV501KJ-R1
CD2205 and CD2206	Similar to Renesas RKS151KJ-P1
CD2207 and CD2208	Similar to Renesas RKV501KJ-R1
CD2209 thru CD2211	Similar to Renesas RKS151KJ-P1
CD2212	Similar to Toshiba JDH2S01FS(TPL3)
CD2213 and CD2214	Similar to Renesas RKV501KJ-R1
CV1 and CV2	10 pF 110V; similar to Voltronics JZ100
CV2201 and CV2202	(not installed)
CV2205 and CV2206	(not installed)
	-----------------------SHIELD FRAMES-----------------------
E1	Similar to MTD301950
E2	Similar to MTD301952
	------------------ON-BOARD CONTACTS------------------
EB2501 thru EB2536	Similar to Kitagawa OG-320816
	-----------------------------FUSES-----------------------------
F1203	Similar to Matsuo KAB3202 102NA 29 010
F1205	Similar to Matsuo KAB2402 322 NA31010
F1206 thru	Similar to Matsuo KAB3202 102NA 29 010
F1207 and F1208	Similar to Matsuo KAB3202 102NA 29 010
FL3 and FL0801	Similar to Murata NFM21PC105B1C3D
FL1001 thru FL1003	(not installed)
FL1004 thru FL1007	Similar to Murata BLM18KG121TN1D
FL1008	Similar to Murata NFM21PC105B1C3D
FL1101 and FL1102	(not installed)

SYMBOL	DESCRIPTION
FL2201 and FL2202	45.1 MHz; similar to NDK (JRC H-7XMPD0029)
FL2501 and FL2502	Similar to Murata NFM21PC105B1C3D
	------------------ INTEGRATED CIRCUITS -------------------
IC1	Similar to National Semiconductor LMV931MGX/NOPB
IC2	Similar to Peregrine PE4140-52
IC3	Similar to RICOH R1501J090B-T1-FE
IC4	Similar to RICOH RP102K301D-TR
IC5 thru IC7	Similar to RICOH R1501J090B-T1-FE
IC9	Similar to RICOH R1501J090B-T1-FE
IC11	Similar to New JRC NJM7805DL1A-TE1-#ZZZB
IC18 and IC19	Similar to New JRC NJM2125F-TE1-#ZZZB
IC0601	Similar to ACTEL (JRC H-7DDPD0039A)
IC0602	Similar to Texas Instruments OMAP5910JZZG2
IC0703	Similar to Texas Instruments ADS7924IRTER
IC0704	Similar to AnalogDevices AD5245BRJZ50-RL7
IC0801	Similar to Spansion (JRC H-7DEPD0034A)
IC0802	Similar to ISSI IS42S16400F-7TLI
IC0902	Similar to EXAR SP3238EEY-L/TR
IC0903	Similar to Texas Instruments TS3A24159DRCR
IC0905 and IC0906	Similar to Texas Instruments SN74LVC8T245PWR
IC1001	Similar to Texas Instruments TLV320AIC3105IRHBR
IC1002	Similar to New JRC NJM3404AV(TE1)-#ZZZB
IC1003	Similar to New JRC NJM3403AV(TE1)-#ZZZB
IC1004	Similar to Texas Instruments TPA3111D1PWPR
IC1005	Similar to Texas Instruments TPA3112D1PWPR
IC1006	Similar to TOREX XC8102AA017R-G
IC1007	Similar to New JRC NJM3403AV(TE1)-#ZZZB
IC1105	Similar to RICOH R3119N080A-TR-FE
IC1106	Similar to RICOH R1243S001A-E2-FE
IC1107 and IC1108	Similar to TOREX XC9235F08DER-G
IC1109	Similar to RICOH RP109Q152D-TR-FE
IC1110	Similar to RICOH RP102K181D-TR
IC1111	Similar to RICOH RP102K301D-TR

SYMBOL	DESCRIPTION
IC1113	Similar to RICOH R3116K271A-TR
IC1115	Similar to RICOH R1243S001A-E2-FE
IC1116	Similar to RICOH R1154L050B-TR
IC1301	Similar to MAXIM MAX3109ETJ+T
IC2111	Similar to New JRC NJM2125F-TE1-#ZZZB
IC2191	Similar to Seiko Instruments S-58LM20A-I4T1G
IC2201	Similar to New JRC NJG1146KG1(TE3)-#ZZZB
IC2202	Similar to New JRC NJM2125F-TE1-#ZZZB
IC2208	Similar to National Semiconductor LMV931MGX/NOPB
IC2301	Similar to New JRC NJM3404AV(TE1)-#ZZZB
IC2302	Similar to New JRC NJM2125F-TE1-#ZZZB
IC2303	(not installed)
IC2304	(not installed)
IC2305	Similar to AnalogDevices ADL5385ACPZ-R7
IC2401	Similar to New JRC NJM2125F-TE1-#ZZZB
IC2402	Similar to New JRC NJM3404AV(TE1)-#ZZZB
IC2501	Similar to JRC CMN-779C
	------------------------ CONNECTORS --------------------------
J0701	Selectable Part. If installed, similar to HIROSE DF20F-20DP-1V(56)
J0901	Similar to Suyin Connector 127174MA010G200ZR
J1201	Similar to Molex 502790-8091
J1202	Similar to JST S2B-PH-SM4-TB(LF)(SN)
J1203	Similar to JST BM40B-SRDS-G-TFC(LF)(SN)
J1204	Similar to JST BM04B-XASS-TF(LF)(SN)
	------------------------- INDUCTORS ---------------------------
L1 thru L4	470 nH ±5% 100mA; similar to TOKO LLQ1608-FR47J
L5	39 nH ±5% 200mA; similar to TOKO LL1005-FHL39NJ
L6	(not installed)
L7	15 nH ±5% 300mA; similar to TOKO LL1005-FHL15NJ
L8	47 nH ±5% 200mA; similar to TOKO LL1005-FHL47NJ
L9	56 nH ±5% 200mA; similar to TOKO LL1005-FHL56NJ
L10 and L11	10 nH ±5% 400 mA; similar to TOKO LL1005-FHL10NJ
L12 thru L15	820 nH ±5% 180mA; similar to TOKO LLQ2012-FR82J

SYMBOL	DESCRIPTION
L16 and L17	220 nH ±5% 200mA; similar to TOKO LLQ1608-FR22J
L18	680 nH ±5% 400mA; similar to Murata LQW2UASR68J00L
L19	(not installed)
L23	33 nH ±5% 200mA; similar to TOKO LL1005-FHL33NJ
L25	180 nH ±2% 140 mA; similar to Murata LQW18ANR18G00D
L26 and L27	(not installed)
L28	15 nH ±5% 300mA; similar to TOKO LL1005-FHL15NJ
L29	120 nH ±5% 200mA; similar to TOKO LL1608-FSLR12J
L30	27 nH ±5% 300mA; similar to TOKO LL1005-FHL27NJ
L31	100 nH ±5% 200mA; similar to TOKO LL1005-FHLR10J
L32	220 nH ±5% 400mA; similar to TOKO LLQ2012-FR22J
L33	47 nH; similar to KORIN AS050730-47NJ
L34	39 nH ±5% 500mA; similar to TOKO LLQ2012-F39NJ
L35	68 nH ±5% 200mA; similar to TOKO LL1005-FHL68NJ
L36 thru L40	680 nH ±5% 190mA; similar to TOKO LLQ2012-FR68J
L41	17 nH ±5%; similar to Midori Musen (JRC H-7LAPD0053)
L42	27 nH ±5% 500mA; similar to TOKO LLQ2012-F27NJ
L43	11 nH ±5%; similar to Midori Musen (JRC H-7LAPD0054)
L47	470 nH ±2% 75mA; similar to Murata LQW18ANR47G00D
L48	82 nH ±2% 250mA; similar to Murata LQW18AN82NG00D
L49	120 nH ±5% 200mA; similar to TOKO LL1608-FSLR12J
L50	0 ohm 1A; similar to Panasonic ERJ2GE0R00X
L51	82 nH ±5% 200mA; similar to TOKO LL1005-FHL82NJ
L1001	2.2 uH; similar to TAIYO YUDEN NRS6020T2R2NMGJ
L1002 and L1003	10 µH ±20%; similar to TAIYO YUDEN NRS6045T100MMGK
L1004	Similar to TDK SLF7055T-2R2N3R5-3PF

SYMBOL	DESCRIPTION
L1005 and L1006	10 µH ±20%; similar to TAIYO YUDEN NRS6045T100MMGK
L1102 and L1103	1.5 µH ±30% 1200mA; similar to Murata LQM2MPN1R5NG0L
L1111 and L1120	Similar to TDK RLF7030T-4R7M3R4
L1201	470 nH ±2% 75mA; similar to Murata LQW18ANR47G00D
L2113	56 nH ±5% 200mA; similar to TOKO LL1005-FHL56NJ
L2114 and L2115	68 nH ±5% 200mA; similar to TOKO LL1005-FHL68NJ
L2116	180 nH ±5% 130mA; similar to Murata LQG15HSR18J02D
L2117	39 nH ±5% 200mA; similar to TOKO LL1005-FHL39NJ
L2118	47 nH ±5% 200mA; similar to TOKO LL1005-FHL47NJ
L2121	57.5 nH; similar to KORIN AS030921-57R5NJ
L2122	33.8 nH; similar to KORIN AS030621-33R8NJ
L2123	51 nH; similar to KORIN AS030821-51R0NJ
L2124	33.8 nH; similar to KORIN AS030621-33R8NJ
L2125	6.8 nH; similar to KORIN AP040425-6R8N-T
L2126 and L2127	(not installed)
L2128	15 nH; similar to KORIN AS100440-15NJ-T
L2129	9.3 nH; similar to KORIN AS120252-9R3N-T
L2130	23.9 nH; similar to KORIN AS100447-23R9NJ-T
L2131	680 nH ±5% 400mA; similar to Murata LQW2UASR68J00L
L2133	23.9 nH; similar to KORIN AS100447-23R9NJ-T
L2134 and L2135	31.8 nH; similar to KORIN AS100547-31R8NJ
L2136	47 nH; similar to KORIN AS050730-47NJ
L2137	(not installed)
L2138 and L2139	47 nH; similar to KORIN AS050730-47NJ
L2140	270 nH ±5% 350mA; similar to TOKO LLQ2012-FR27J
L2201	Similar to Coilcraft A05TGLC
L2202 and L2203	560 nH ±5% 230mA; similar to TOKO LLQ2012-FR56J

SYMBOL	DESCRIPTION
L2204	Similar to Coilcraft A05TGLC
L2205	39 nH ±5% 200mA; similar to TOKO LL1005-FHL39NJ
L2206	47 nH ±5% 200mA; similar to TOKO LL1005-FHL47NJ
L2207	270 nH ±5% 350mA; similar to TOKO LLQ2012-FR27J
L2208 and L2209	560 nH ±5% 230mA; similar to TOKO LLQ2012-FR56J
L2220	390 nH ±2% 80mA; similar to Murata LQW18ANR39G00D
L2221	15 nH ±2% 160mA; similar to Murata LQW18ANR15G00D
L2230 and L2231	Similar to Coilcraft B09TGLC
L2232 and L2233	560 nH ±5% 230mA; similar to TOKO LLQ2012-FR56J
L2234	270 nH ±5% 350mA; similar to TOKO LLQ2012-FR27J
L2235	100 nH ±5% 200mA; similar to TOKO LL1005-FHLR10J
L2236 and L2237	560 nH ±5% 230mA; similar to TOKO LLQ2012-FR56J
L2238	270 nH ±5% 350mA; similar to TOKO LLQ2012-FR27J
L2239 and L2240	Similar to Coilcraft B09TGLC
L2241 and L2242	560 nH ±5% 230mA; similar to TOKO LLQ2012-FR56J
L2243	270 nH ±5% 350mA; similar to TOKO LLQ2012-FR27J
L2244 and L2245	820 nH ±5% 180mA; similar to TOKO LLQ2012-FR82J
L2246	39 nH ±5% 200mA; similar to TOKO LL1005-FHL39NJ
L2247	390 nH ±2% 80mA; similar to Murata LQW18ANR39G00D
L2248 and L2249	560 nH ±5% 230mA; similar to TOKO LLQ2012-FR56J
L2301 thru L2303	47 nH ±5% 600mA; similar to TOKO LLQ1608-F47NJ
	------------------- THREADED SPACERS---------------------
P2	Similar to Mac-Eight TH-1.6-7.0-M3
P3	Similar to Mac-Eight TH-1.6-7.0-M3

SYMBOL	DESCRIPTION
P4	Similar to Mac-Eight TH-1.6-7.0-M3
	------------------------- RESISTORS ---------------------------
R1	47 ohm ±5% 0.125W; similar to Panasonic ERJ6GEYJ470V
R2	47 ohm ±5% 100mW; similar to Panasonic ERJ2GEJ470X
R3	(not installed)
R4	47 ohm ±5% 100mW; similar to Panasonic ERJ2GEJ470X
R5	180 ohm ±5% 100mW; similar to Panasonic ERJ2GEJ181X
R6	1k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ102X
R7 and R9	470 ohm ±5% 100mW; similar to Panasonic ERJ2GEJ471X
R10	(not installed)
R11	100 ohm ±1% 0.125W; similar to Panasonic ERJ6ENF1000V
R12 and R13	1.8k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ182X
R14 and R15	4.7k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ472X
R16	2.7k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ272X
R17 and R18	4.7k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ472X
R20	8.2k ohm ±5% 0.1W; similar to Panasonic ERJ3GEYJ822V
R21 and R22	8.2k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ822X
R23	3.9k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ392X
R25	47k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ473X
R26	100k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ104X
R28	(not installed)
R29 thru R31	10 ohm ±5% 100mW; similar to Panasonic ERJ2GEJ100X
R33 and R34	100 ohm ±5% 100mW; similar to Panasonic ERJ2GEJ101X
R35 and R36	1k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ102X

SYMBOL	DESCRIPTION
R38 and R39	1k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ102X
R40	1k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ102X
R41	1.2k ohm ±5% 0.1W; similar to Panasonic ERJ3GEYJ122V
R42	1.2k ohm ±5% 100mw; similar to Panasonic ERJ2GEJ122X
R43	1.5k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ152X
R44	8.2k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ822X
R45	1.2k ohm ±5% 100mw; similar to Panasonic ERJ2GEJ122X
R46	1k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ102X
R47 and R48	150 ohm ±5% 100mW; similar to Panasonic ERJ2GEJ151X
R50	18 ohm ±5% 100mW; similar to Panasonic ERJ2GEJ180X
R52	100k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ104X
R54 and R55	1.5k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ152X
R56 and R57	1M ohm ±5% 100mW; similar to Panasonic ERJ2GEJ105X
R58 thru R61	560 ohm ±5% 0.25W; similar to Panasonic ERJ8GEYJ561V
R62 and R63	180 ohm ±5% 100mW; similar to Panasonic ERJ2GEJ181X
R64 and R65	22 ohm ±5% 100mW; similar to Panasonic ERJ2GEJ220X
R66	3.3k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ332X
R68 and R69	150k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ154X
R70 and R71	5.6k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ562X
R72	56k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ563X
R73	1k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ102X
R74	10k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ103X

SYMBOL	DESCRIPTION
R75	270 ohm ±5% 100mW; similar to Panasonic ERJ2GEJ271X
R76	22 ohm ±5% 100mW; similar to Panasonic ERJ2GEJ220X
R77 thru R80	2.2k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ222X
R81	10k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ103X
R83	(not installed)
R85 and R86	330 ohm ±5% 0.75W; similar to Panasonic ERJ12YJ331U
R88	270 ohm ±1% 0.125W; similar to Panasonic ERJ6ENF2700V
R89	2.2k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ222X
R90	56 ohm ±5% 100mW; similar to Panasonic ERJ2GEJ560X
R91	10 ohm ±5% 100mW; similar to Panasonic ERJ2GEJ100X
R93	2.7k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ272X
R94 and R95	6.8k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ682X
R96	22 ohm ±5% 100mW; similar to Panasonic ERJ2GEJ220X
R97	1.8k ohm ±5% 0.1W; similar to Panasonic ERJ3GEYJ182V
R98	3.3k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ332X
R100	4.7k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ472X
R101 thru R104	(not installed)
R105	10 ohm ±5% 100mW; similar to Panasonic ERJ2GEJ100X
R106	10k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ103X
R107 and R108	100k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ104X
R109	4.7k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ472X
R113 thru R117	(not installed)
R119	680 ohm ±5% 100mW; similar to Panasonic ERJ2GEJ681X
R120	100k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ104X

SYMBOL	DESCRIPTION
R121 and R122	4.7k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ472X
R124	3.9 ohm ±5% 0.5W; similar to Panasonic ERJ14YJ3R9U
R137	4.7k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ472X
R151 and R152	0 ohm 1A; similar to Panasonic ERJ2GE0R00X
R187	3.9k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ392X
R189	39k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ393X
R191	2.2k ohm ±5% 0.1W; similar to Panasonic ERJ3GEYJ222V
R192	8.2k ohm ±5% 0.1W; similar to Panasonic ERJ3GEYJ822V
R193 thru R195	(not installed)
R197 and R198	330 ohm ±5% 0.5W; similar to Panasonic ERJ14YJ331U
R199	2.7k ohm ±5% 0.1W; similar to Panasonic ERJ3GEYJ272V
R204 thru R207	(not installed)
R208	100k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ104X
R209	12k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ123X
R210	22k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ223X
R222	1k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ102X
R0701	47k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ473X
R0702	560k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ564X
R0703	(not installed)
R0704 and R0705	560k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ564X
R0706 and R0707	1k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ102X
R0708 and R0709	10k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ103X
R0712	100k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ104X

SYMBOL	DESCRIPTION
R0713	1k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ102X
R0714	10k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ103X
R0715	330k ohm ±1% 0.1W; similar to Panasonic ERJ2RKF3303X
R0716	39k ohm ±1% 0.1W; similar to Panasonic ERJ2RKF393X
R0717 and R0718	4.7k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ472X
R0719 thru R0721	(not installed)
R0723 and R0724	(not installed)
R0726	1.2k ohm ±5% 100mw; similar to Panasonic ERJ2GEJ122X
R0727	1k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ102X
R0728	0 ohm 1A; similar to Panasonic ERJ2GE0R00X
R0729 and R0730	47k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ473X
R0731 and R0732	560k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ564X
R0738 and R0739	270k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ274X
R0740	560k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ564X
R0741 thru R0744	0 ohm 1A; similar to Panasonic ERJ2GE0R00X
R0747	10 ohm ±5% 100mW; similar to Panasonic ERJ2GEJ100X
R0748	47k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ473X
R0853	(not installed)
R0858	10k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ103X
R0859	(not installed)
R0861	10 ohm ±5% 100mW; similar to Panasonic ERJ2GEJ100X
R0862	0 ohm 1A; similar to Panasonic ERJ2GE0R00X
R0901	47k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ473X
R0902 thru R0911	0 ohm 1A; similar to Panasonic ERJ2GE0R00X

SYMBOL	DESCRIPTION
R0912	1k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ102X
R0915 thru R0918	0 ohm 1A; similar to Panasonic ERJ2GE0R00X
R0919 thru R0923	100k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ104X
R0933 and R0934	100k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ104X
R0935	0 ohm 1A; similar to Panasonic ERJ2GE0R00X
R0936	(not installed)
R1001	2.2k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ222X
R1002	47k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ473X
R1003 and R1004	100k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ104X
R1005	1.2k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ122X
R1006	680 ohm ±5% 100mW; similar to Panasonic ERJ2GEJ681X
R1007	1.2k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ122X
R1008	680 ohm ±5% 100mW; similar to Panasonic ERJ2GEJ681X
R1009	1.2k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ122X
R1010	680 ohm ±5% 100mW; similar to Panasonic ERJ2GEJ681X
R1011	1.2k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ122X
R1012	680 ohm ±5% 100mW; similar to Panasonic ERJ2GEJ681X
R1014 and R1015	47k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ473X
R1016	18k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ183X
R1017	680 ohm ±5% 100mW; similar to Panasonic ERJ2GEJ681X
R1018	100k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ104X
R1019	47k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ473X
R1020	68k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ683X
R1021	56k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ563X

SYMBOL	DESCRIPTION
R1022	3.3k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ332X
R1023	100 ohm ±5% 100mW; similar to Panasonic ERJ2GEJ101X
R1024	3.3k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ332X
R1025	100 ohm ±5% 100mW; similar to Panasonic ERJ2GEJ101X
R1026	27k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ273X
R1027	56k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ563X
R1028 thru R1030	100k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ104X
R1031	10 ohm ±5% 0.125W; similar to Panasonic ERJ6GEYJ100V
R1032	1k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ102X
R1033	(not installed)
R1034	0 ohm 1A; similar to Panasonic ERJ2GE0R00X
R1035	1.8k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ182X
R1036	3.3k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ332X
R1037 and R1038	(not installed)
R1039 thru R1041	100k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ104X
R1042	10 ohm ±5% 0.125W; similar to Panasonic ERJ6GEYJ100V
R1043	1k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ102X
R1044	0 ohm 1A; similar to Panasonic ERJ2GE0R00X
R1045 and R1046	(not installed)
R1047	0 ohm 1A; similar to Panasonic ERJ2GE0R00X
R1048 and R1049	(not installed)
R1050 thru R1054	82k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ823X
R1055	0 ohm 1A; similar to Panasonic ERJ2GE0R00X
R1056 and R1057	270k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ274X

SYMBOL	DESCRIPTION
R1058 thru R1060	22k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ223X
R1061	0 ohm 1A; similar to Panasonic ERJ2GE0R00X
R1062 and R1063	100k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ104X
R1064	(not installed)
R1065	680 ohm ±5% 100mW; similar to Panasonic ERJ2GEJ681X
R1103 and R1104	270k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ274X
R1105	27k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ273X
R1108	150k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ154X
R1109	560k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ564X
R1110	10k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ103X
R1111	0 ohm 1A; similar to Panasonic ERJ2GE0R00X
R1112	10k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ103X
R1113	0 ohm 0.1W; similar to Panasonic ERJ3GEY0R00V
R1114	100k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ104X
R1123 and R1124	5.6k ohm ±1% 0.1W; similar to Panasonic ERJ2RKF562X
R1125	2.0k ohm ±1% 0.1W; similar to Panasonic ERJ2RKF202X
R1128	560k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ564X
R1129 and R1130	470k ohm ±1% 0.1W; similar to Panasonic ERJ2RKF474X
R1131	150k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ154X
R1132	560k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ564X
R1133	390k ohm ±1% 0.1W; similar to Panasonic ERJ2RKF394X
R1134	240k ohm ±1% 0.1W; similar to Panasonic ERJ2RKF244X
R1135	150k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ154X
R1136 thru R1139	560k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ564X

SYMBOL	DESCRIPTION
R1141 and R1142	1k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ102X
R1143	(not installed)
R1144	1k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ102X
R1145	10k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ103X
R1150	0 ohm 0.125W; similar to Panasonic ERJ6GEY0R00V
R1151	560k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ564X
R1152	24k ohm ±1% 0.1W; similar to Panasonic ERJ2RKF243X
R1153 and R1154	2.0k ohm ±1% 0.1W; similar to Panasonic ERJ2RKF202X
R1155 and R1157	560k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ564X
R1201	560k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ564X
R1202	100k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ104X
R1203 and R1204	560k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ564X
R1205	100k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ104X
R1206 and R1207	560k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ564X
R1208 and R1209	10k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ103X
R1210	56 ohm ±5% 100mW; similar to Panasonic ERJ2GEJ560X
R1211	Selectable Part. If installed, 0 ohm 0.1W; similar to Panasonic ERJ3GEY0R00V.
R1212	330 ohm ±5% 100mW; similar to Panasonic ERJ2GEJ331X
R1213	(not installed)
R1214 thru R1217	22k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ223X
R1218	10k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ103X
R1219	470 ohm ±5% 0.125W; similar to Panasonic ERJ6GEYJ471V
R1220	10k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ103X
R1221	470 ohm ±5% 0.125W; similar to Panasonic ERJ6GEYJ471V

SYMBOL	DESCRIPTION
R1222	100k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ104X
R1223 thru R1242	0 ohm 0.05W; similar to Panasonic ERJ1GN0R00C
R1243	10k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ103X
R1244	270k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ274X
R1301	10k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ103X
R1302 thru R1305	0 ohm 1A; similar to Panasonic ERJ2GE0R00X
R2109	12 ohm ±5% 100mW; similar to Panasonic ERJ2GEJ120X
R2110 and R2111	390 ohm ±5% 100mW; similar to Panasonic ERJ2GEJ391X
R2112	5.6k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ562X
R2113	2.7k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ272X
R2114	1k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ102X
R2115	10 ohm ±5% 100mW; similar to Panasonic ERJ2GEJ100X
R2116	33 ohm ±5% 0.125W; similar to Panasonic ERJ6GEYJ330V
R2117	12 ohm ±5% 100mW; similar to Panasonic ERJ2GEJ120X
R2118 and R2119	390 ohm ±5% 100mW; similar to Panasonic ERJ2GEJ391X
R2120	330 ohm ±5% 100mW; similar to Panasonic ERJ2GEJ331X
R2121	(not installed)
R2122	5.6k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ562X
R2123	820 ohm ±5% 100mW; similar to Panasonic ERJ2GEJ821X
R2124 and R2125	150 ohm ±5% 100mW; similar to Panasonic ERJ2GEJ151X
R2126	47k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ473X
R2127 and R2128	10k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ103X
R2129	330 ohm ±5% 100mW; similar to Panasonic ERJ2GEJ331X
R2130	(not installed)

SYMBOL	DESCRIPTION
R2131	330 ohm ±5% 100mW; similar to Panasonic ERJ2GEJ331X
R2132	12 ohm ±5% 100mW; similar to Panasonic ERJ2GEJ120X
R2133 and R2134	390 ohm ±5% 100mW; similar to Panasonic ERJ2GEJ391X
R2135	1.2k ohm ±5% 100mw; similar to Panasonic ERJ2GEJ122X
R2136	12 ohm ±5% 100mW; similar to Panasonic ERJ2GEJ120X
R2137	1.2k ohm ±5% 100mw; similar to Panasonic ERJ2GEJ122X
R2141	12k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ123X
R2142	22k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ223X
R2143	(not installed)
R2144	56 ohm ±5% 0.1W; similar to Panasonic ERJ3GEYJ560V
R2145	(not installed)
R2146 and R2147	5.6 ohm ±5% 0.25W; similar to Panasonic ERJ8GEYJ5R6V
R2149	100 ohm ±5% 1W; similar to Panasonic ERJ1TYJ101U
R2150	1k ohm ±5% 0.1W; similar to Panasonic ERJ3GEYJ102V
R2151	100k ohm ±5% 0.1W; similar to Panasonic ERJ3GEYJ104V
R2152	33k ohm ±5% 0.1W; similar to Panasonic ERJ3GEYJ333V
R2153	33k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ333X
R2154	100k ohm ±5% 0.5W; similar to Panasonic ERJ14YJ104U
R2155	(not installed)
R2156	27 ohm ±5% 0.125W; similar to Panasonic ERJ6GEYJ270V
R2157 and R2158	68 ohm ±5% 0.125W; similar to Panasonic ERJ6GEYJ680V
R2159	100k ohm ±5% 0.1W; similar to Panasonic ERJ3GEYJ104V
R2160	12k ohm ±5% 0.1W; similar to Panasonic ERJ3GEYJ123V
R2161	100k ohm ±5% 0.1W; similar to Panasonic ERJ3GEYJ104V
R2162	12k ohm ±5% 0.1W; similar to Panasonic ERJ3GEYJ123V
R2163	220 ohm ±5% 1W; similar to Panasonic ERJ1TYJ221U

SYMBOL	DESCRIPTION
R2164	(not installed)
R2182 and R2183	5.6k ohm ±5% 0.1W; similar to Panasonic ERJ3GEYJ562V
R2191	100 ohm ±5% 100mW; similar to Panasonic ERJ2GEJ101X
R2192 and R2193	27k ohm ±1% 0.1W; similar to Panasonic ERJ2RKF273X
R2201	56k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ563X
R2202	1.5k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ152X
R2203	3.3k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ332X
R2204 and R2205	1k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ102X
R2206	10 ohm ±5% 100mW; similar to Panasonic ERJ2GEJ100X
R2207	18 ohm ±5% 0.125W; similar to Panasonic ERJ6GEYJ180V
R2208	12 ohm ±5% 100mW; similar to Panasonic ERJ2GEJ120X
R2209 and R2210	470 ohm ±5% 100mW; similar to Panasonic ERJ2GEJ471X
R2211	3.3k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ332X
R2212	1.5k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ152X
R2213	56k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ563X
R2214 and R2215	100k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ104X
R2216	1.5k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ152X
R2217	3.3k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ332X
R2218	33 ohm ±5% 100mW; similar to Panasonic ERJ2GEJ330X
R2219	1.5k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ152X
R2220 and R2221	470 ohm ±5% 100mW; similar to Panasonic ERJ2GEJ471X
R2222	(not installed)
R2223 and R2224	10 ohm ±5% 0.25W; similar to Panasonic ERJ8GEYJ100V
R2225	(not installed)

SYMBOL	DESCRIPTION
R2226	33 ohm ±5% 100mW; similar to Panasonic ERJ2GEJ330X
R2227	3.3k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ332X
R2228	680 ohm ±5% 0.25W; similar to Panasonic ERJ8GEYJ681V
R2229	3.9k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ392X
R2231	1.5k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ152X
R2232	56k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ563X
R2233 and R2234	100k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ104X
R2235	1.5k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ152X
R2236	3.3k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ332X
R2237	33 ohm ±5% 100mW; similar to Panasonic ERJ2GEJ330X
R2238 and R2239	180 ohm ±5% 100mW; similar to Panasonic ERJ2GEJ181X
R2240 thru R2242	(not installed)
R2243	12 ohm ±5% 100mW; similar to Panasonic ERJ2GEJ120X
R2244 and R2245	470 ohm ±5% 100mW; similar to Panasonic ERJ2GEJ471X
R2249	(not installed)
R2250	12k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ123X
R2251	56 ohm ±5% 100mW; similar to Panasonic ERJ2GEJ560X
R2252	10 ohm ±5% 100mW; similar to Panasonic ERJ2GEJ100X
R2253	1k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ102X
R2254 and R2255	(not installed)
R2256	100 ohm ±5% 100mW; similar to Panasonic ERJ2GEJ101X
R2257	22k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ223X
R2260	(not installed)
R2261	10k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ103X

SYMBOL	DESCRIPTION
R2262	22k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ223X
R2263	1.8k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ182X
R2264 and R2265	15k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ153X
R2266	470 ohm ±5% 100mW; similar to Panasonic ERJ2GEJ471X
R2267	1.8k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ182X
R2268	(not installed)
R2270 and R2271	10k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ103X
R2272	24k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ243X
R2273	10k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ103X
R2289	(not installed)
R2290	22k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ223X
R2291	10k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ103X
R2301 thru R2303	(not installed)
R2304	1.2k ohm ±1% 0.1W; similar to Panasonic ERJ2RKF122X
R2305	1.2k ohm ±1% 0.1W; similar to Panasonic ERJ2RKF1201X
R2306 thru R2308	(not installed)
R2309	1.2k ohm ±1% 0.1W; similar to Panasonic ERJ2RKF122X
R2310	1.2k ohm ±1% 0.1W; similar to Panasonic ERJ2RKF1201X
R2311 thru R2313	(not installed)
R2314 and R2315	1.2k ohm ±1% 0.1W; similar to Panasonic ERJ2RKF1201X
R2316 thru R2318	(not installed)
R2319 and R2320	1.2k ohm ±1% 0.1W; similar to Panasonic ERJ2RKF1201X
R2321 and R2322	(not installed)

SYMBOL	DESCRIPTION
R2323	18 ohm ±5% 100mW; similar to Panasonic ERJ2GEJ180X
R2324 and R2325	270 ohm ±5% 100mW; similar to Panasonic ERJ2GEJ271X
R2326 thru R2332	(not installed)
R2503	270k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ274X
R2504	27k ohm ±1% 0.1W; similar to Panasonic ERJ2RKF273X
R2505	1.8k ohm ±1% 0.1W; similar to Panasonic ERJ2RKF1801X
R2506	1.8k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ182X
R2507	330 ohm ±5% 100mW; similar to Panasonic ERJ2GEJ331X
R2511	270k ohm ±5% 100mW; similar to Panasonic ERJ2GEJ274X
	------------------------THERMISTORS ------------------------
RT0701	Similar to Murata NCP15XH103J03RC
RT2101 and RT2102	(not installed)
	---------------------- TRANSFORMERS-----------------------
T2201	Similar to TOKO #617PT-1669=P3
T2202	Similar to TOKO #617DB-1674=P3
T2203	Similar to TOKO #617DB-1655=P3
	------------------------ TRANSISTORS--------------------------
TR1 and TR2	Similar to Renesas 2SB798-T2-AZ DK
TR3	(not installed)
TR4	Similar to Renesas 2SC3356-T1B-A R
TR5	Similar to ROHM US6M11TR
TR6	Similar to Renesas 2SD596-T1B-A DV5
TR7 thru TR9	Similar to ROHM UMG3NTR
TR10 thru TR15	Similar to Toshiba RN1301(TE85L F)
TR17 thru TR19	Similar to Renesas 2SC3356-T1B-A R
TR23	Similar to Renesas 2SC3356-T1B-A R
TR24	(not installed)
TR25	Similar to Renesas 2SC3356-T1B-A R

SYMBOL	DESCRIPTION
TR26 and TR27	Similar to ROHM 2SD1781KT146R
TR29	Similar to ROHM 2SD1781KT146R
TR30	Similar to Toshiba 2SC4215-Y(TE85L F)
TR31	Similar to NXP BF1212R_215
TR32 and TR34	Similar to Toshiba RN1305(TE85L F)
TR35	Similar to Renesas 2SC5772FR-TL-E
TR36 and TR37	Similar to ROHM 2SA1037AKT146R
TR38	Similar to Renesas 2SC3357-T1-A RF
TR39 thru TR44	Similar to ON Semiconductor BSS138LT1G
TR45	Similar to Toshiba 2SC4116GR-(TE85L F)
TR46	Similar to Renesas 2SB798-T2-AZ DK
TR47	Similar to Toshiba RN1301(TE85L F)
TR48	Similar to Renesas 2SJ553STR-E
TR49	Similar to Renesas 2SC5337-T1-AZ QS
TR50	Similar to Renesas 2SD596-T1B-A DV5
TR0701	Similar to ROHM US6M11TR
TR0703 and TR1101	Similar to ROHM EM6M1T2R
TR1102	Similar to ROHM US6M11TR
TR1103	Similar to ROHM RW1A030APT2CR
TR1104	Similar to ROHM RUE002N02TL
TR1106	Similar to ROHM DTC144EMT2L
TR1201	Similar to ROHM RUE002N02TL
TR1202 and TR1203	Similar to Toshiba SSM3K36FS(TE85L_F)
TR1204	Similar to ROHM US6M11TR
TR1205	Similar to Toshiba 2SC4116GR-(TE85L F)
TR1206	Similar to Toshiba 2SC2859-Y(TE85L F)
TR1207	Similar to SANYO 2SC5964-TD-E
TR1208	Similar to Toshiba 2SC2859-Y(TE85L F)
TR1209	Similar to SANYO 2SC5964-TD-E
TR1210	Similar to ROHM UMG2NTR
TR2103	Similar to Renesas 2SC3357-T1-A RF
TR2104	Similar to Mitsubishi RD01MUS1-T113
TR2105	Similar to Mitsubishi RD04HMS2-T112
TR2106	Similar to Mitsubishi RD70HUF2-T1105

SYMBOL	DESCRIPTION
TR2201	Similar to Renesas 2SC5337-T1-AZ QS
TR2203 and TR2204	Similar to ON Semiconductor MMBFJ310LT1G
TR2501	Similar to ROHM EM6M1T2R
TR3000	Similar to ROHM UMG3NTR
X0701	32.768 kHz; similar to NDK NX3215SA-32.768K-STD-MUA-8
XU1	14.4 MHz; similar to NDK (JRC H-7XNPD0013)
XU0701	12 MHz; similar to NDK (JRC H-7XNPD0012)

16.2 FRONT PANEL BOARD

(DE03-CDE-2742; 20120329)

SYMBOL	DESCRIPTION
	------------------------ CAPACITORS --------------------------
C1 and C2	2.2 µF ±10%, 10V; similar to Murata GRM188R71A225KE15D
C3	2.2 µF ±10%, 10V; similar to Murata GRM188R71A225KE15D
C4	(Not Mounted)
C5	0.1 µF ±10%, 16V; similar to Murata GRM155R11C104KA88D
C6	10 pF ±1%, 50V; similar to Murata GRM1552C1H100FA01D
C7 thru C16	47 pF ±5%, 50V; similar to Murata GRM1552C1H470JA01D
C17	47 pF ±5%, 50V; similar to Murata GRM1882C1H470JA01D
C18	47 pF ±5%, 50V; similar to Murata GRM1552C1H470JA01D
C19	(Not Mounted)
C20 thru C23	2.2 µF ±10%, 25V; similar to Murata GRM21BR71E225KA73L
C24	(Not Mounted)
C25	Selectable Part. If installed, 0.01 uF
C26 and C27	(Not Mounted)
C28 thru C32	0.47 µF ±10%, 25V; similar to Murata GRM21BR11E474KA01L
C33	(Not Mounted)
C34	0.01 µF ±10%, 16V; similar to Murata GRM155R11C103KA01D
C35 thru C37	47 pF ±5%, 50V; similar to Murata GRM1552C1H470JA01D

SYMBOL	DESCRIPTION
C38	0.22 µF ±10%, 16V; similar to Murata GRM188R11C224KA01D
C39 thru C49	(Not Mounted)
C50	2 pF ±0.1pF, 50V; similar to Murata GRM1554C1H2R0BA01D
C51 thru C65	(Not Mounted)
C66 thru C68	47 pF ±5%, 50V; similar to Murata GRM1552C1H470JA01D
C69	47 pF ±5%, 50V; similar to Murata GRM1882C1H470JA01D
C70	47 pF ±5%, 50V; similar to Murata GRM1552C1H470JA01D
	----------------------------DIODES------------------------------
CD1 thru CD4	Similar to Renesas HZC18TRF-E
CD5	Similar to ROHM SML-522MUWT86
CD6 thru CD15	Similar to ROHM RB520CS-30T2R
CD16 thru CD20	Similar to Toshiba DF5A6.8JE(TE85L_F)
CD21 thru CD30	Similar to ROHM SML-E12M8WT86T
CD31	Similar to Renesas HZC18TRF-E
CD32 thru CD35	Similar to ROHM RB520CS-30T2R
CD36	Similar to Toshiba DF5A6.8JE(TE85L_F)
CD37	Similar to Renesas RKZ27TWAQE
CD38	IC; similar to Renesas HZC24TRF-E
CD39	(Not Mounted)
	------------CONNECTORS AND CONTACTS -------------
EB2	Contact; similar to Kitagawa Industries OG-321022
EB3	Similar to Kitagawa Industries OG-363050
EB4 and EB5	(Not Mounted)
EB6	Contact; similar to Kitagawa Industries OG-603070
EB7	(Not Mounted)
EB8	Contact; similar to Kitagawa Industries OG-603070
EB9	(Not Mounted)

SYMBOL	DESCRIPTION
	------------------------------FUSES ------------------------------
F1 thru F3	Similar to Matsuo KAB3202 102NA 29 010
	--------- INTEGRATED CIRCUITS/MODULES -----------
IC1	Module, Bluetooth; similar to Murata LBMA44TLJZ-345
IC2	(Not Mounted)
	------------------------CONNECTORS-------------------------
J1 and J2	Similar to Panasonic AYF530865
J3	Similar to Panasonic AYF533235
J4	Similar to JST BM20B-SRDS-G-TF(LF)(SN)
J5	Similar to JST BM02B-PASS-TF(LF)(SN)
J6	(Not Mounted)
	--------------------------INDUCTORS --------------------------
L1 and L2	(Not Mounted)
	-------------------------CONNECTOR--------------------------
P1	Similar to Molex 502790-8091
	--------------------------RESISTORS---------------------------
R1	(Not Mounted)
R2 and R3	100k ohm ±5%, 100 mW; similar to Panasonic ERJ2GEJ104X
R4	100k ohm ±5%, 100 mW; similar to Panasonic ERJ2GEJ104X
R5	1.5k ohm ±5%, 100 mW; similar to Panasonic ERJ2GEJ152X
R6	220 ohm ±5%, 100 mW; similar to Panasonic ERJ2GEJ221X
R7	330 ohm ±5%, 100 mW; similar to Panasonic ERJ2GEJ331X
R8	1.5k ohm ±5%, 100 mW; similar to Panasonic ERJ2GEJ152X
R9 thru R18	(Not Mounted)
R19 thru R26	0 ohm (jumper), 1A; similar to Panasonic ERJ2GE0R00X
R27 thru R30	1.5k ohm ±5%, 100 mW; similar to Panasonic ERJ2GEJ152X
R31	820 ohm ±5%, 100 mW; similar to Panasonic ERJ2GEJ821X

SYMBOL	DESCRIPTION
R32 thru R34	1.5k ohm ±5%, 100 mW; similar to Panasonic ERJ2GEJ152X
R35 thru R38	(Not Mounted)
R39	2.2 ohm ±5%, 100 mW; similar to Panasonic ERJ2GEJ2R2X
R40	(Not Mounted)
R41 and R42	Selectable Part. If installed, 0 ohm.
R43 and R44	(Not Mounted)
R45	0 ohm 1A; similar to Panasonic ERJ2GE0R00X
R46 thru R53	(Not Mounted)
R54	10k ohm ±5%, 100 mW; similar to Panasonic ERJ2GEJ103X
R58	(Not Mounted)
	------------------------ THERMISTOR ---------------------------
RT1	Similar to Murata NCP15XH103J03RC
	-------------------------- SWITCHES ----------------------------
S1 thru S10	(Part of printed circuit board)
	------------------------ TRANSISTORS --------------------------
TR1	Bipolar, NPN; similar to ROHM EMH9T2R
TR2 and TR3	Field-Effect Transistor (FET); similar to ROHM RUE002N02TL

SYMBOL	DESCRIPTION
	-------------------INTEGRATED CIRCUIT---------------------
XU1	Selectable Part. If installed, DSB211SCL/NT2016SA

16.3 RADIO ASSEMBLY

(DE02-CWB-1520; 20120329)

SYMBOL	DESCRIPTION
J1	Connector, TNC Male; similar to Nihon Eleparts Co. Ltd. ALB51A
W1	Connector with Cable, DB-44; similar to H-7ZCPD0659 (See Table 8-2 on page 16)
W2	Connector with Calbe, 3-Pin DC Power; similar to H-7ZCPD0654A (See Table 8-2 on page 16)

16.4 FRONT PANEL ASSEMBLY

(DE02-CWB-1521; 20120329)

SYMBOL	DESCRIPTION
DD1	Display, LCD; similar to H-7WSPD0007 (See Table 8-2 on page 16)
W1	Connector with Cable, Mic; similar to H-7ZCPD0655 (See Table 8-2 on page 16)
W2	Switch with Flex Cable, Volume; similar to CDK-2742A (See Table 8-2 on page 16)
W3	Switch with Flex Cable, Group/Channel; similar to CDK-2743A (See Table 8-2 on page 16)
W4	Cable, Flat Flex (FFC), Control Head; similar to H-PCPD0267 (See Table 8-2 on page 16)
SP1	Speaker; similar to Toko Speaker S45G07-C061EE (See Table 8-2 on page 16)

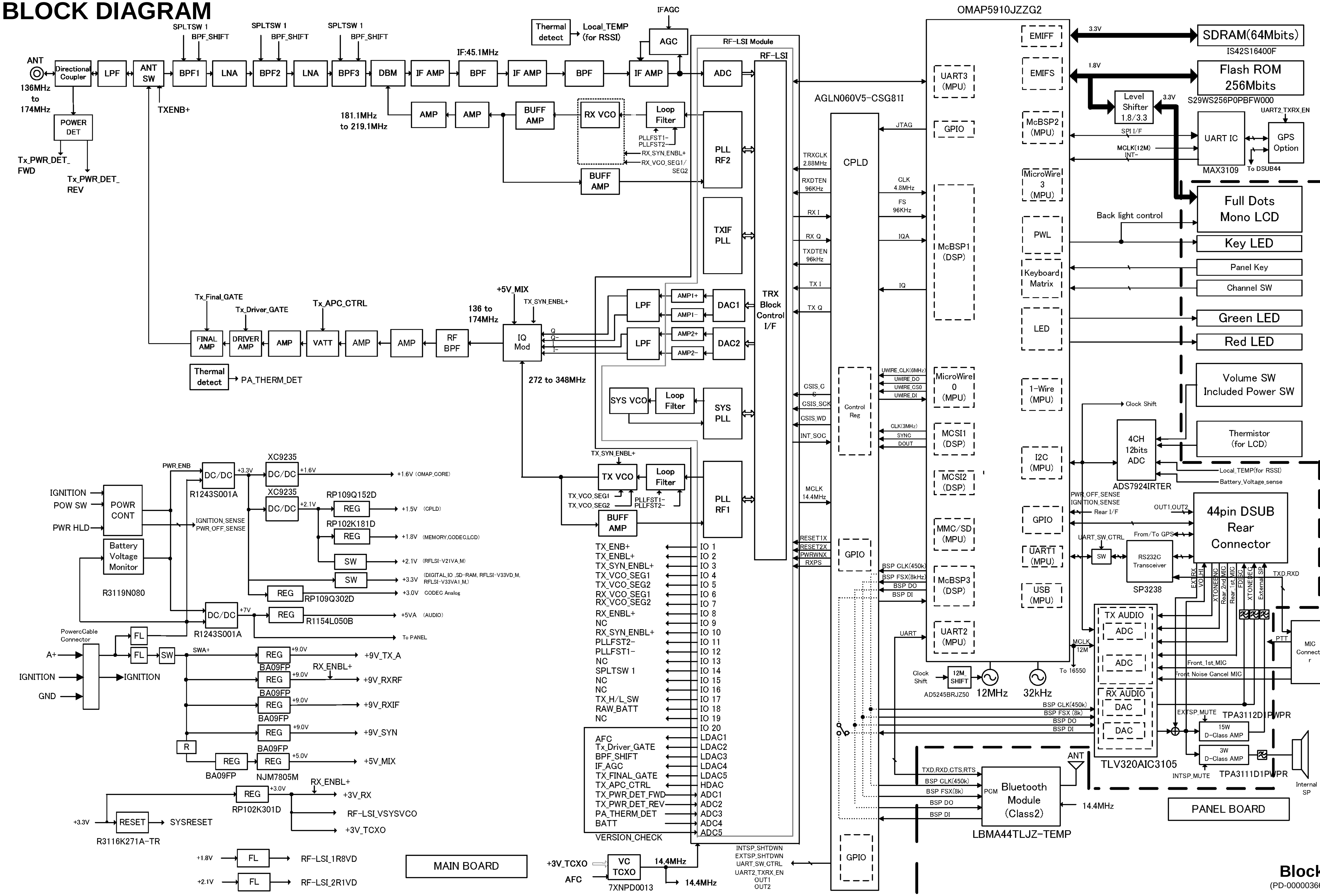
17 PRODUCTION CHANGES

Changes in the equipment to improve performance or to simplify circuits are identified by a “Revision Letter” which is followed by a number in some cases. The revision includes all previous revisions. Refer to the Parts List for the descriptions of parts affected by these revisions.

50-Watt XG-25M Mobile Radio, 136 – 174 MHz (14015-0010-01)

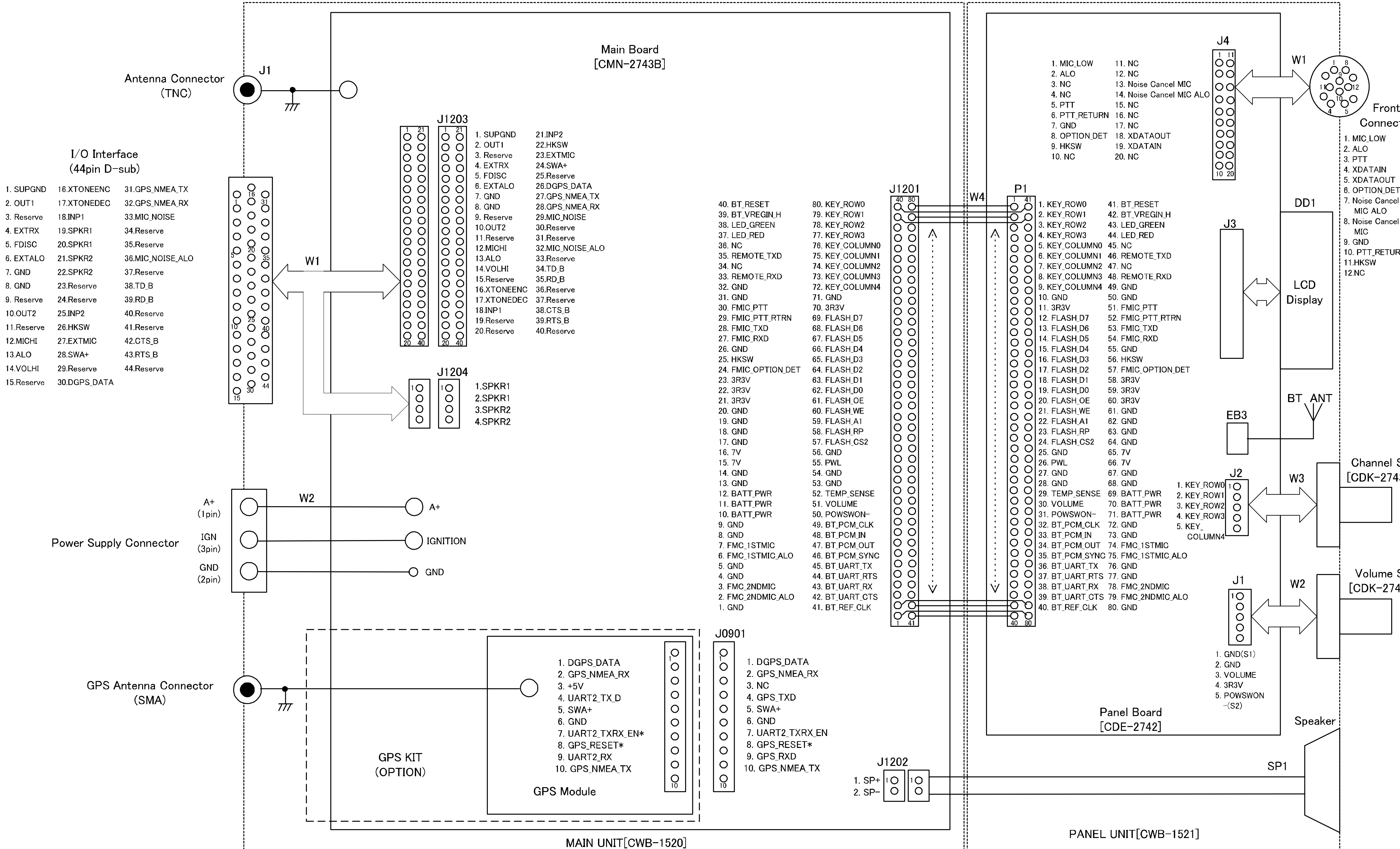
Rev. – Initial release.

18 BLOCK DIAGRAM



Block Diagram
(PD-000003663B, Rev. 3-30-2012)

19 INTERCONNECTION DIAGRAM

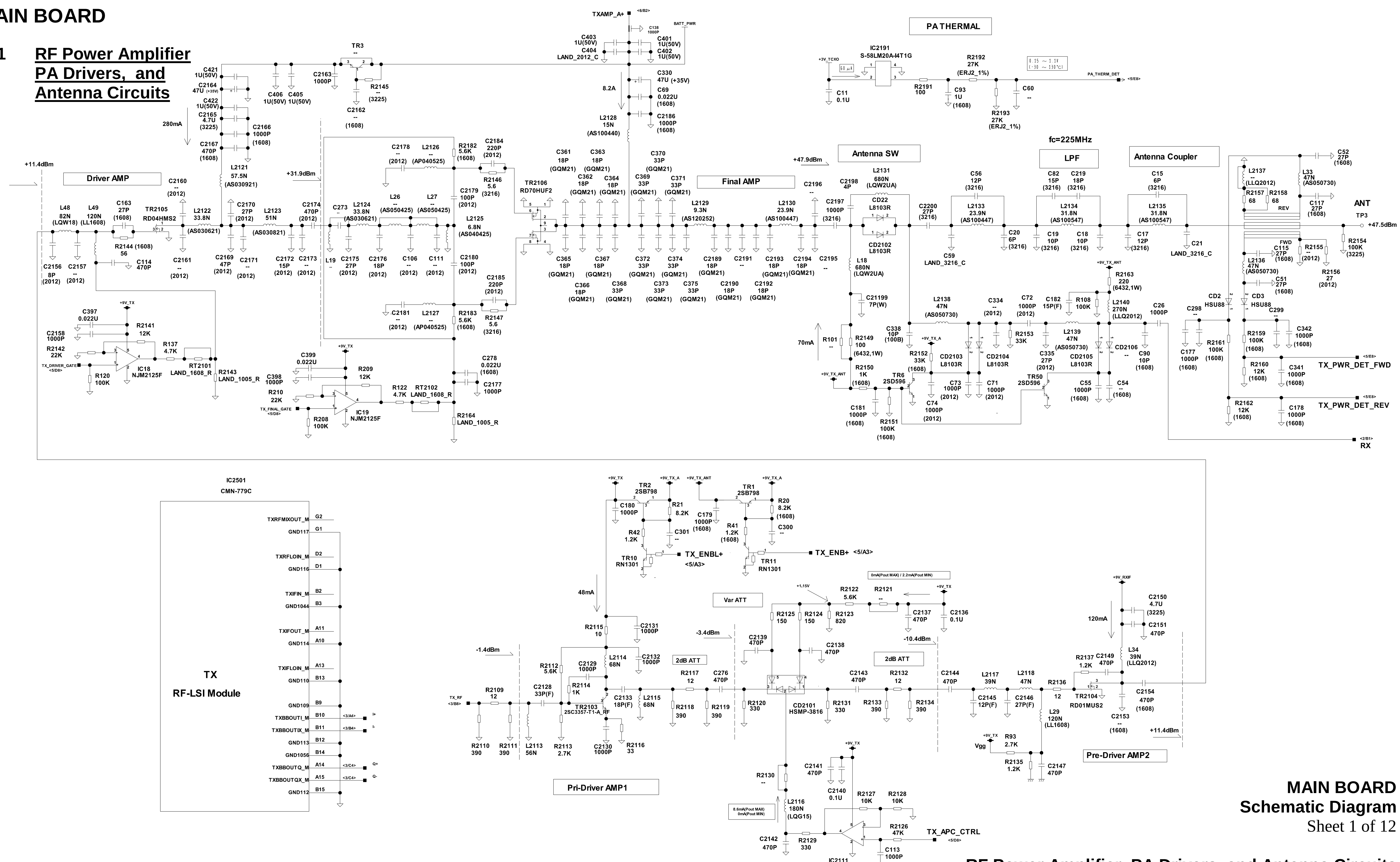


Interconnection Diagram
(Rev. 3-30-2012)

20 SCHEMATIC DIAGRAMS

20.1 MAIN BOARD

20.1.1 RF Power Amplifier PA Drivers, and Antenna Circuits

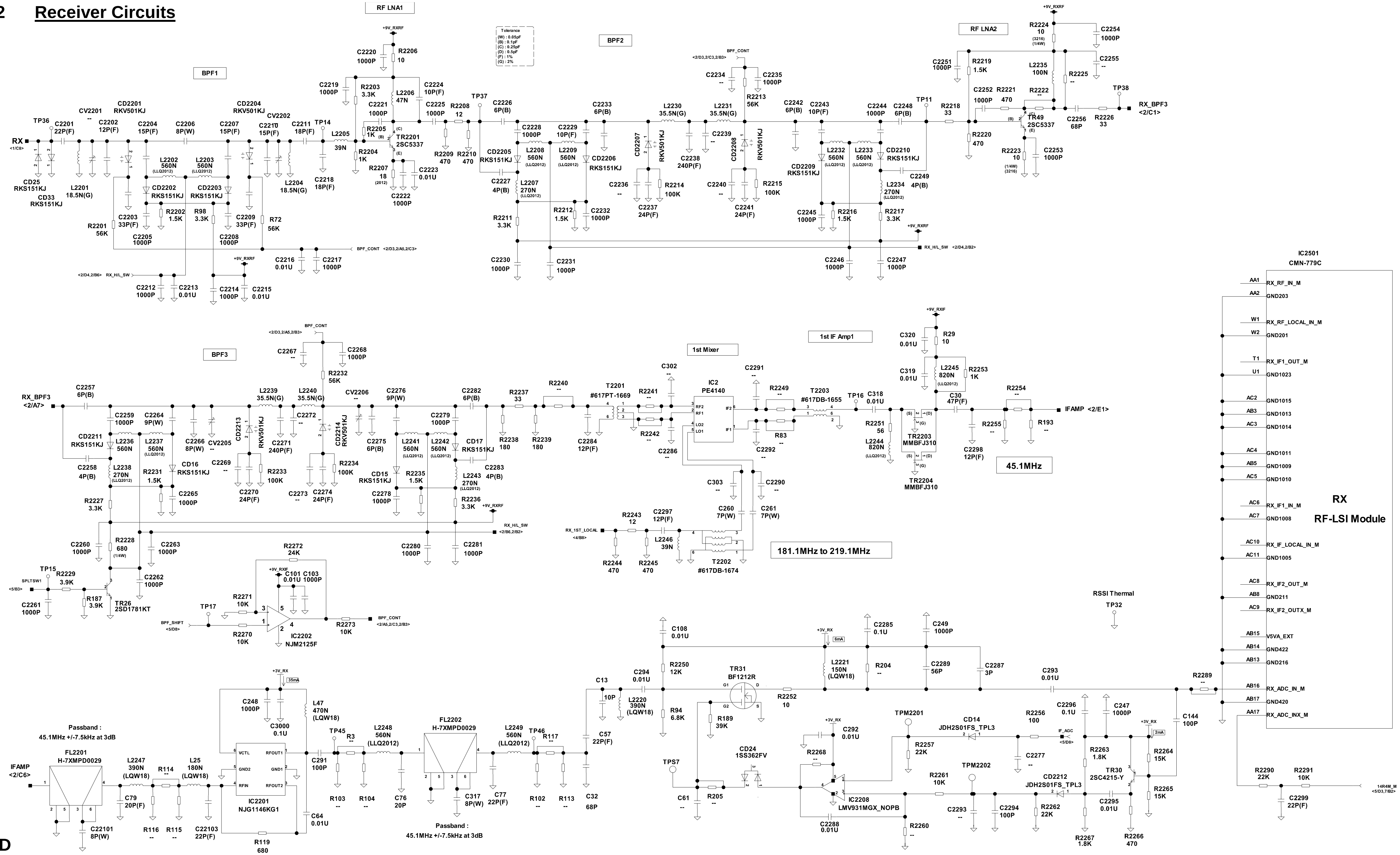


MAIN BOARD
Schematic Diagram
Sheet 1 of 12

RF Power Amplifier, PA Drivers, and Antenna Circuits

(DD00-CMN-2743B)

20.1.2 Receiver Circuits



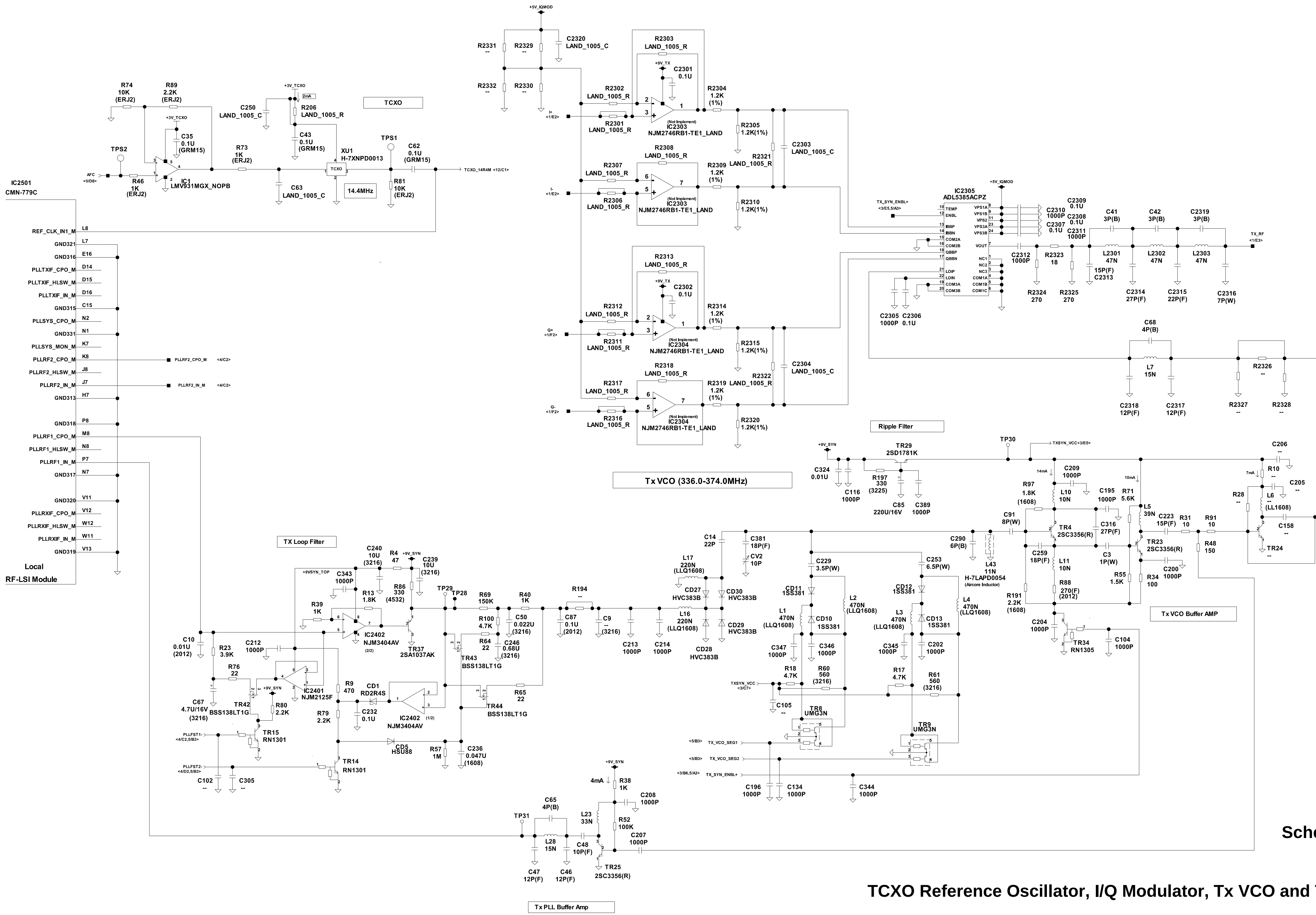
MAIN BOARD Schematic Diagram

Sheet 2 of 12

Receiver Circuits

(DD00-CMN-2743B)

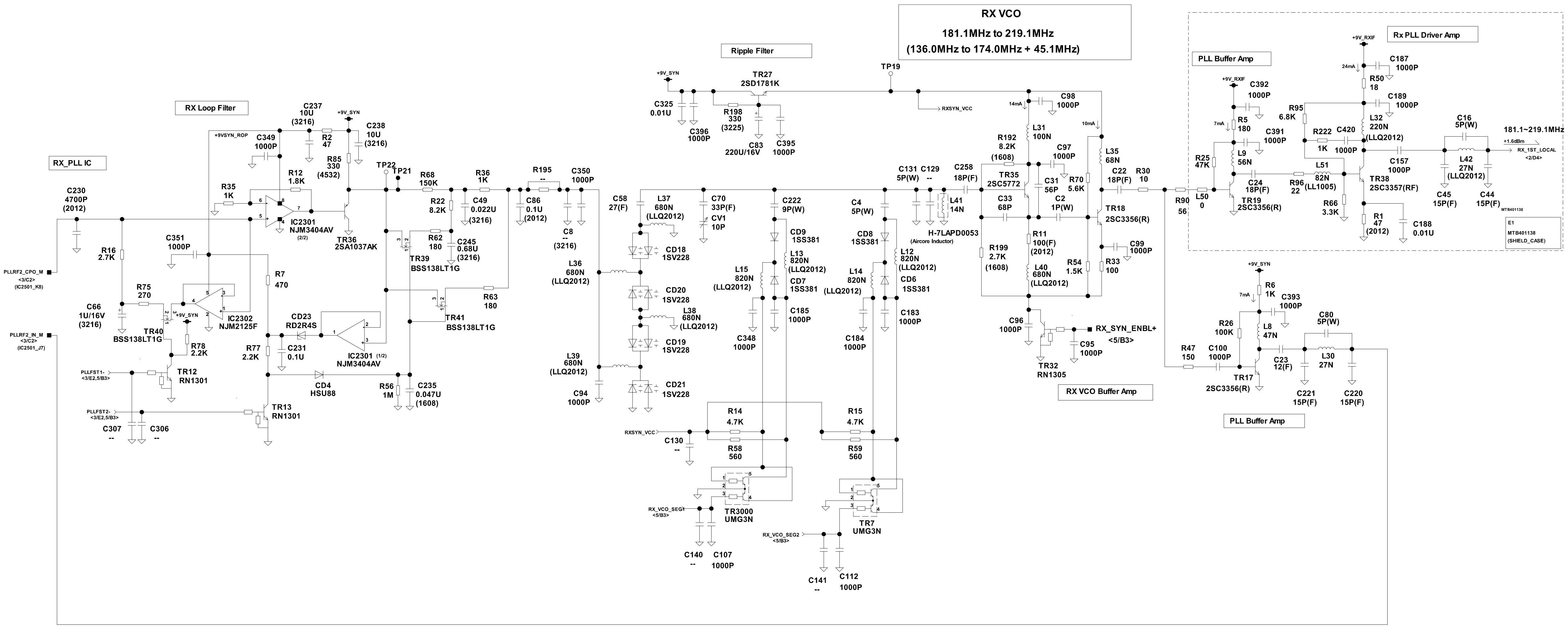
20.1.3 TCXO Reference Oscillator, I/Q Modulator, Tx VCO and Tx PLL Circuits



MAIN BOARD
Schematic Diagram
Sheet 3 of 12

TCXO Reference Oscillator, I/Q Modulator, Tx VCO and Tx PLL Circuits
(DD00-CMN-2743B)

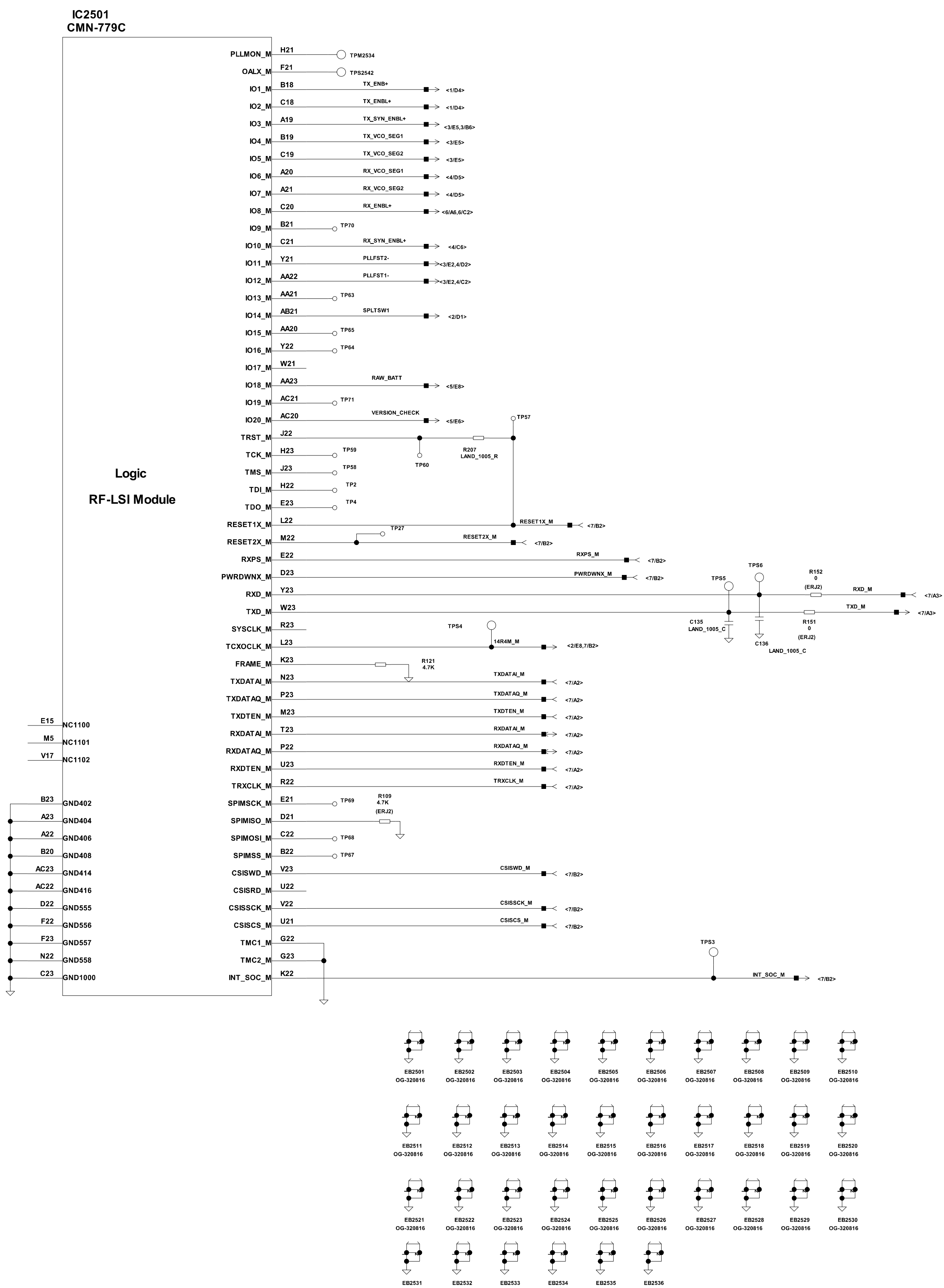
20.1.4 Rx VCO and Rx PLL Circuits

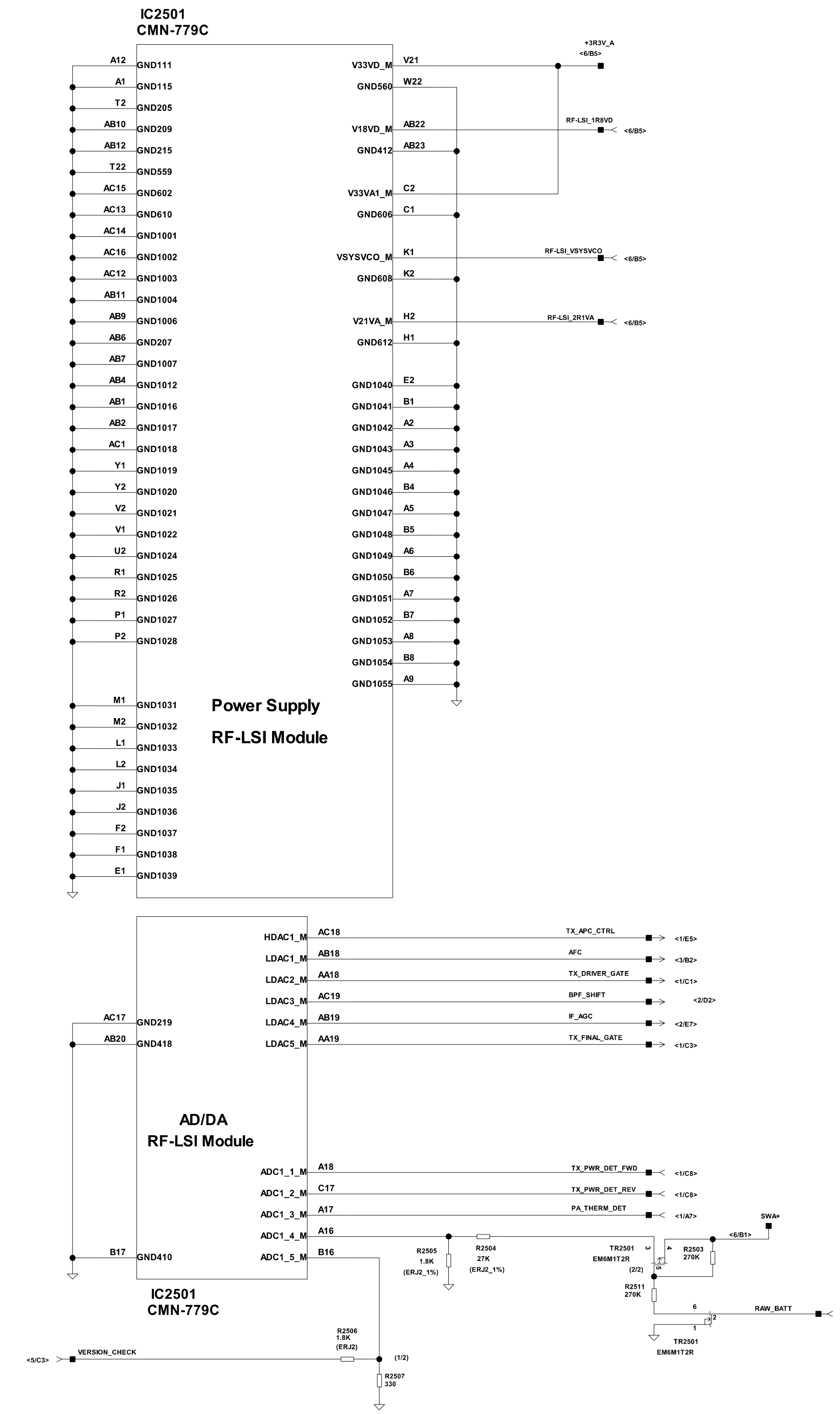


MAIN BOARD
Schematic Diagram
Sheet 4 of 12

Rx VCO and Rx PLL Circuits
(DD00-CMN-2743B)

20.1.5 RF-to-LSI Module Blocks

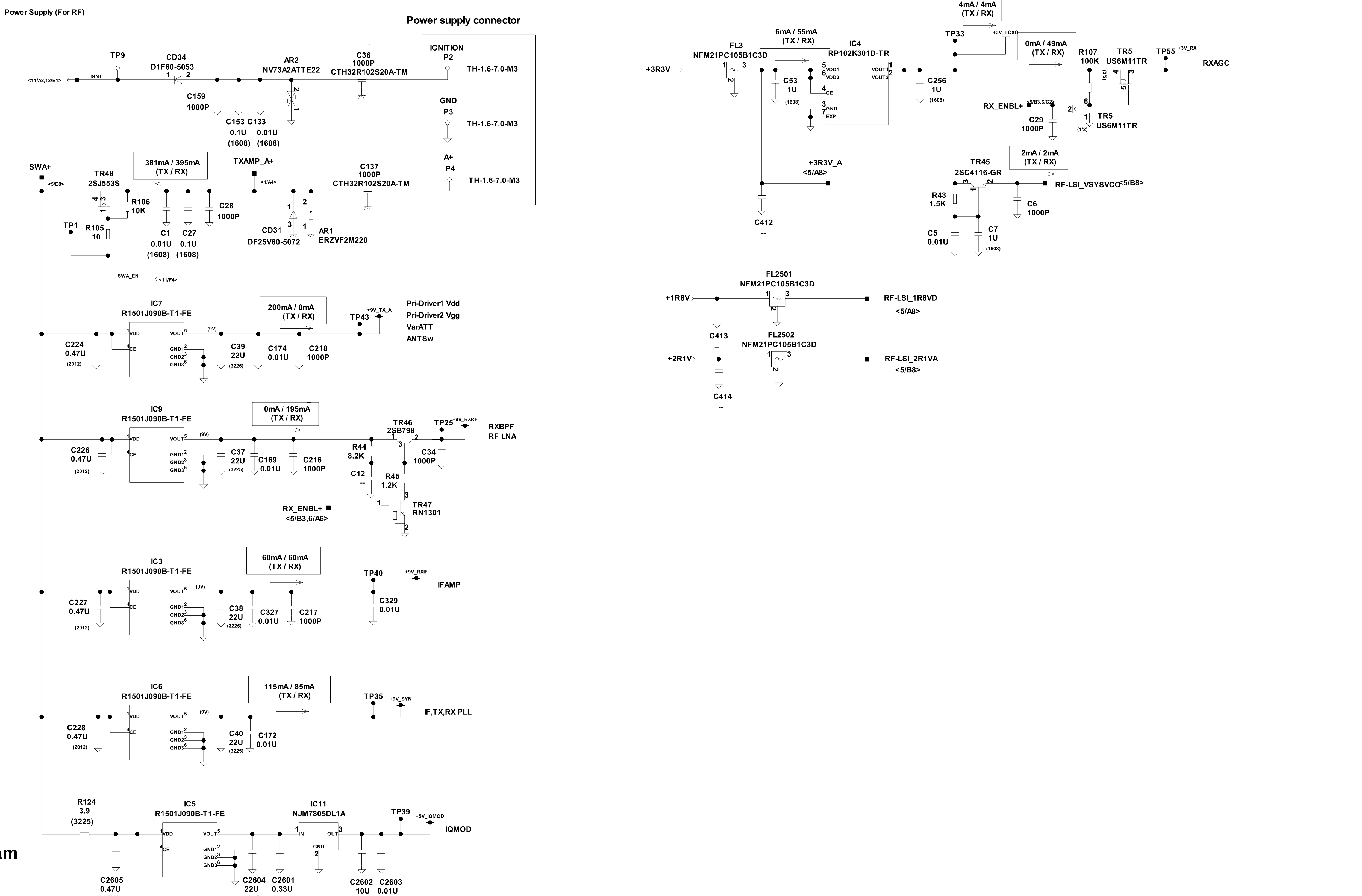




MAIN BOARD
Schematic Diagram
Sheet 5 of 12

RF-to-LSI Module Blocks
(DD00-CMN-2743B)

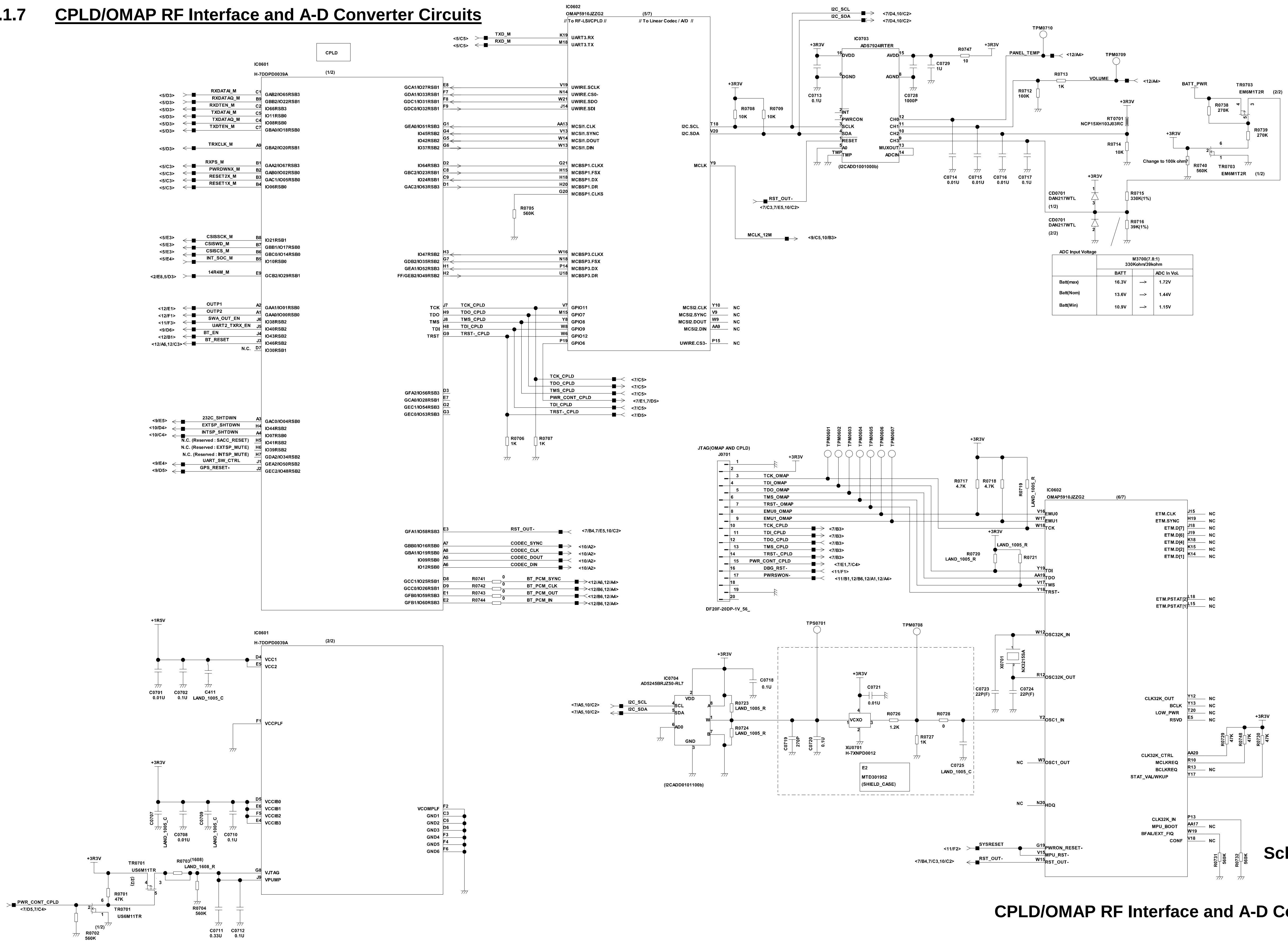
20.1.6 Power Supplies/Regulators for RF Circuits



MAIN BOARD
Schematic Diagram
Sheet 6 of 12

Power Supplies/Regulators for RF Circuits
(DD00-CMN-2743B)

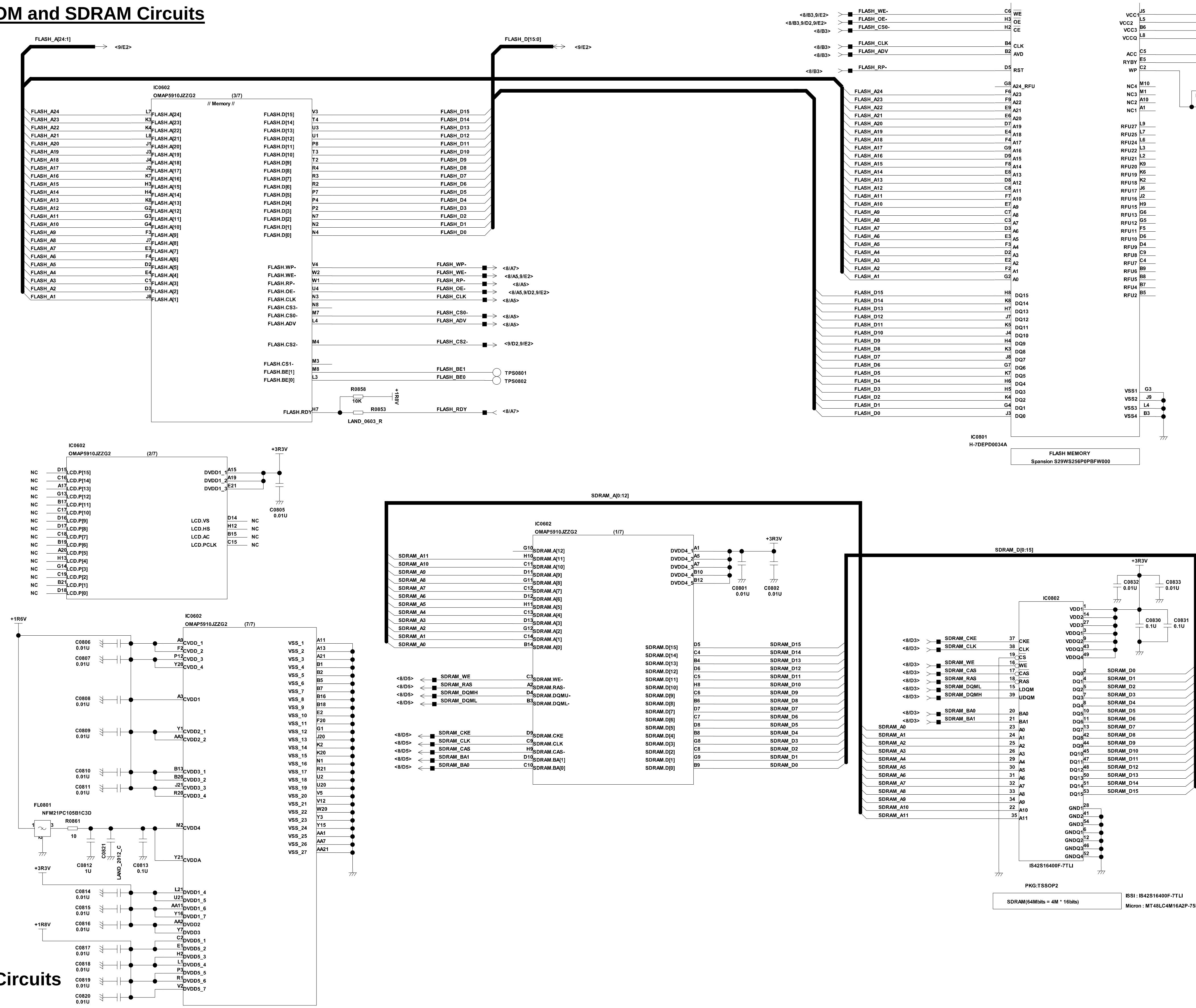
20.1.7 CPLD/OMAP RF Interface and A-D Converter Circuits



MAIN BOARD
Schematic Diagram
Sheet 7 of 12

CPLD/OMAP RF Interface and A-D Converter Circuits
(DD00-CMN-2743B)

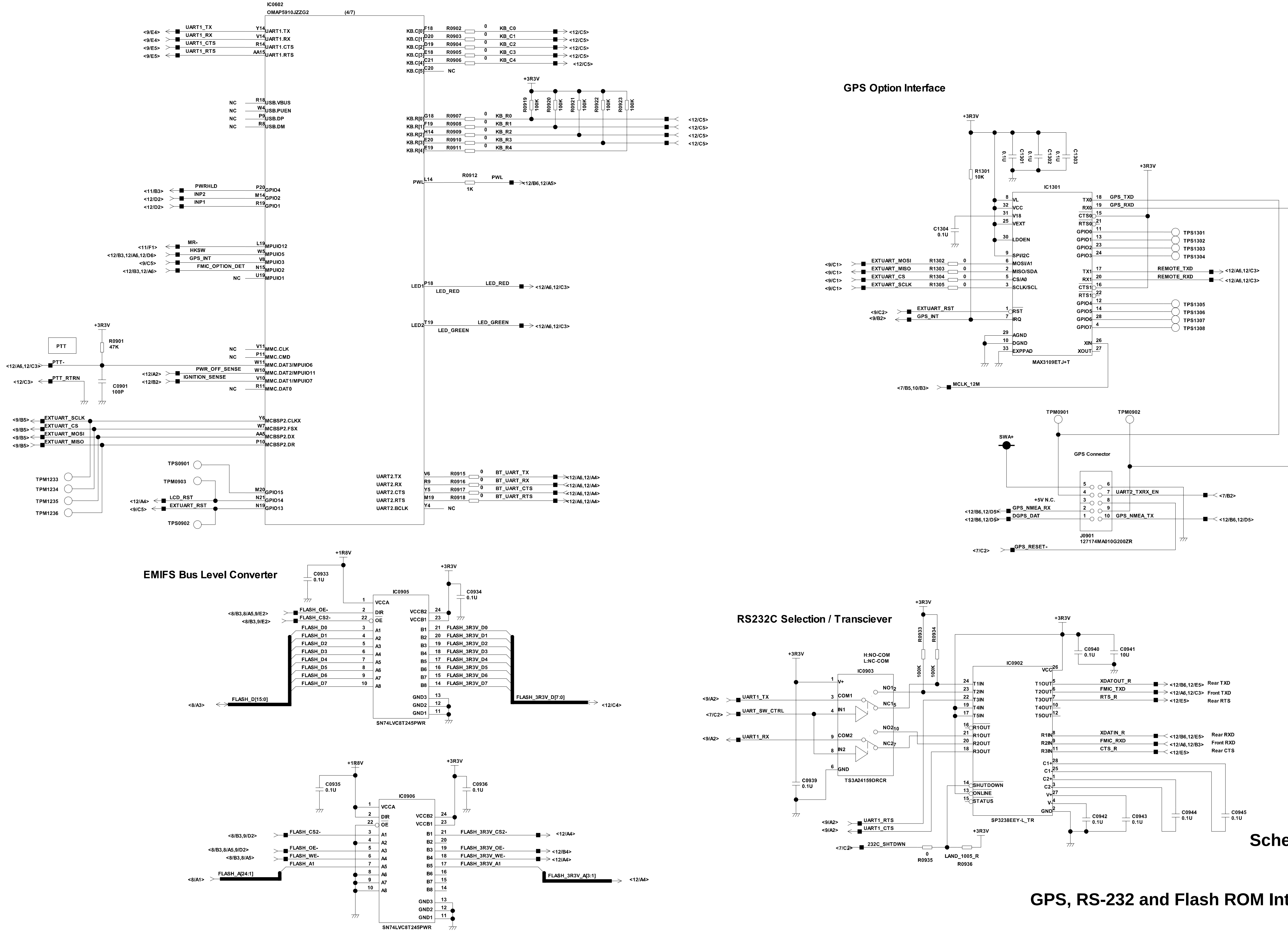
20.1.8 Flash ROM and SDRAM Circuits



MAIN BOARD
Schematic Diagram
Sheet 8 of 12

Flash ROM and SDRAM Circuits
(DD00-CMN-2743B)

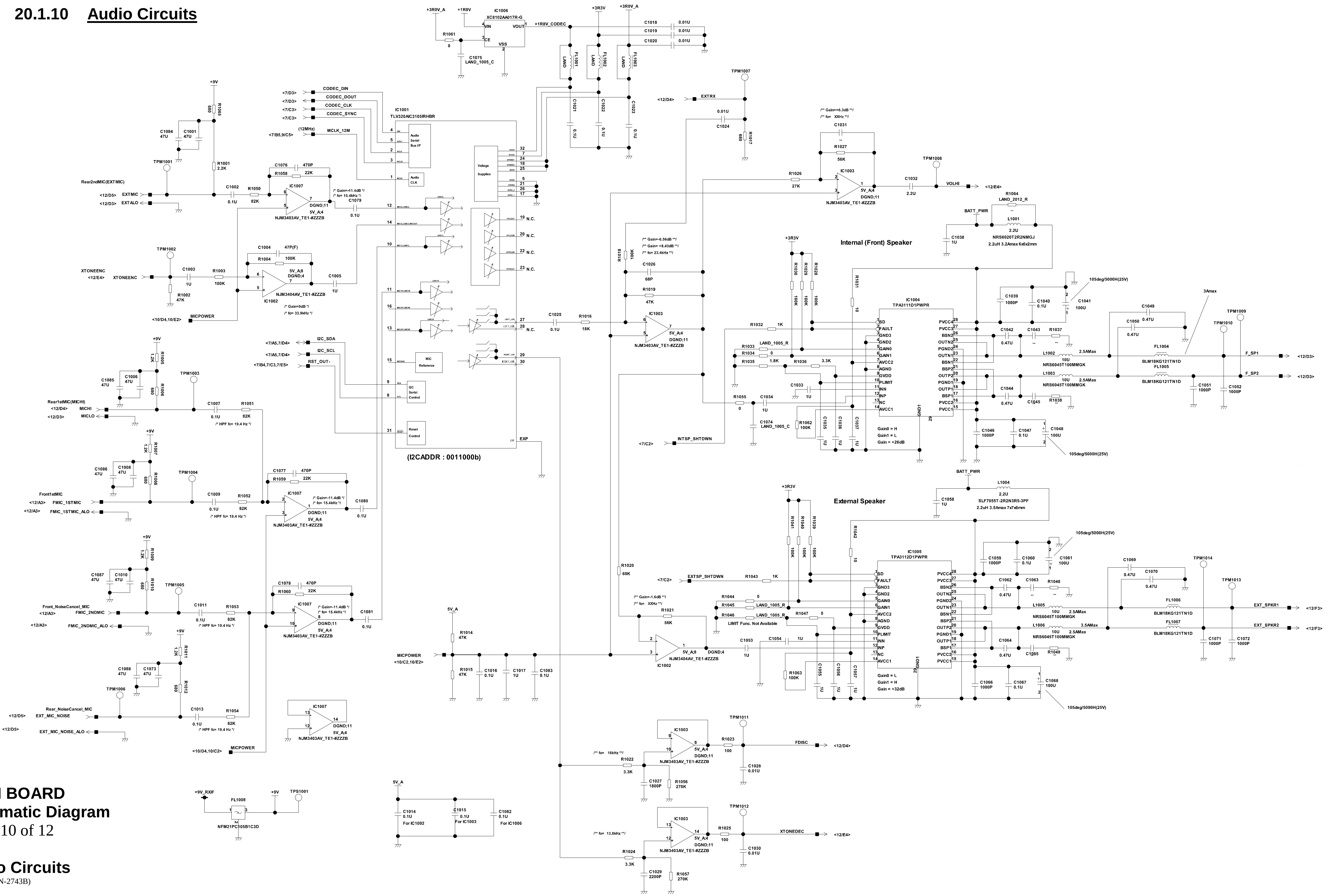
20.1.9 GPS, RS-232 and Flash ROM Interface Circuits



MAIN BOARD
Schematic Diagram
Sheet 9 of 12

GPS, RS-232 and Flash ROM Interface Circuits
(DD00-CMN-2743B)

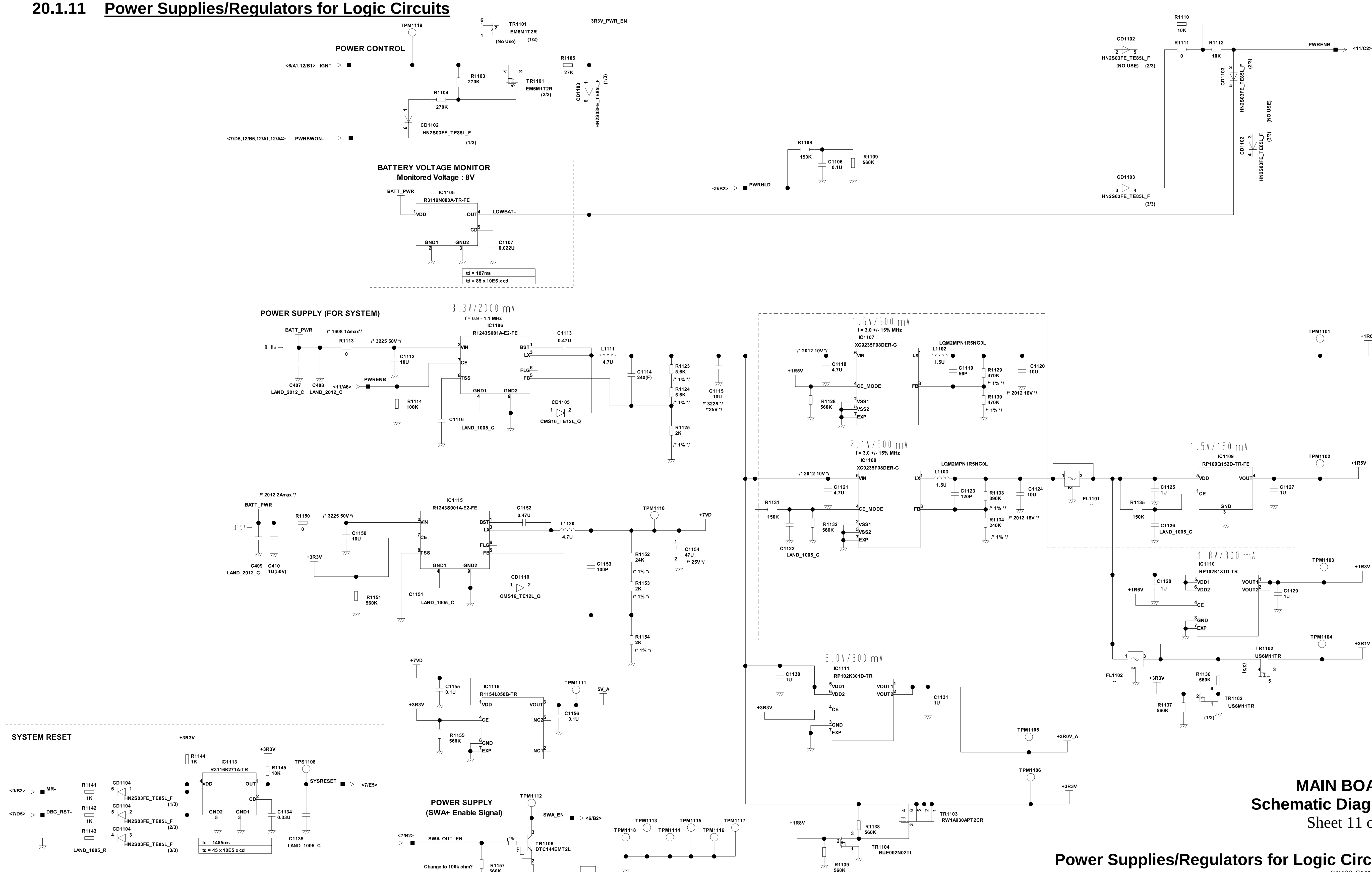
20.1.10 Audio Circuits



MAIN BOARD
Schematic Diagram
Sheet 10 of 12

Audio Circuits
(DD00-CMN-2743B)

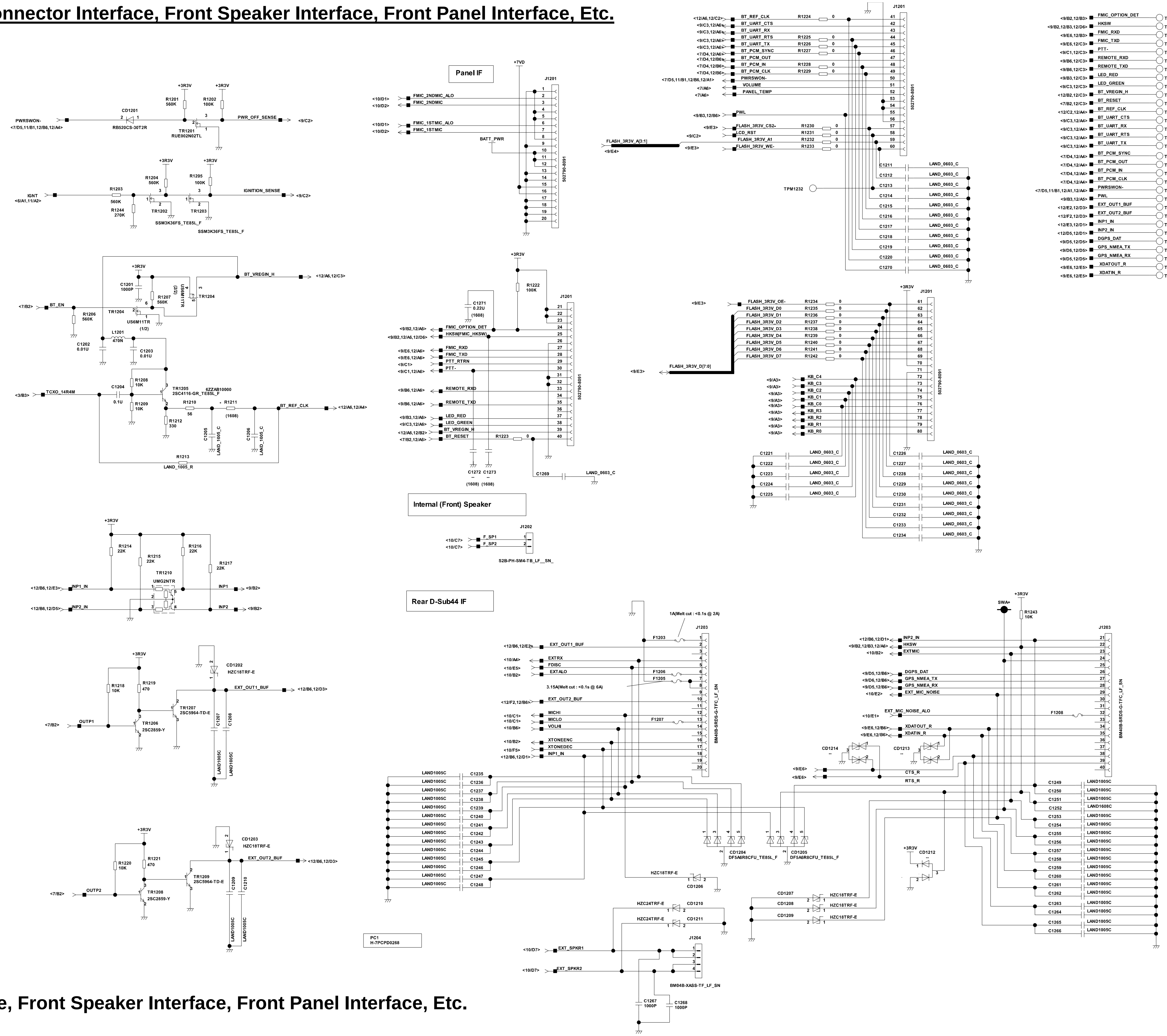
20.1.11 Power Supplies/Regulators for Logic Circuits



MAIN BOARD
Schematic Diagram
Sheet 11 of 12

Power Supplies/Regulators for Logic Circuits
(DD00-CMN-2743B)

20.1.12 Rear Connector Interface, Front Speaker Interface, Front Panel Interface, Etc.

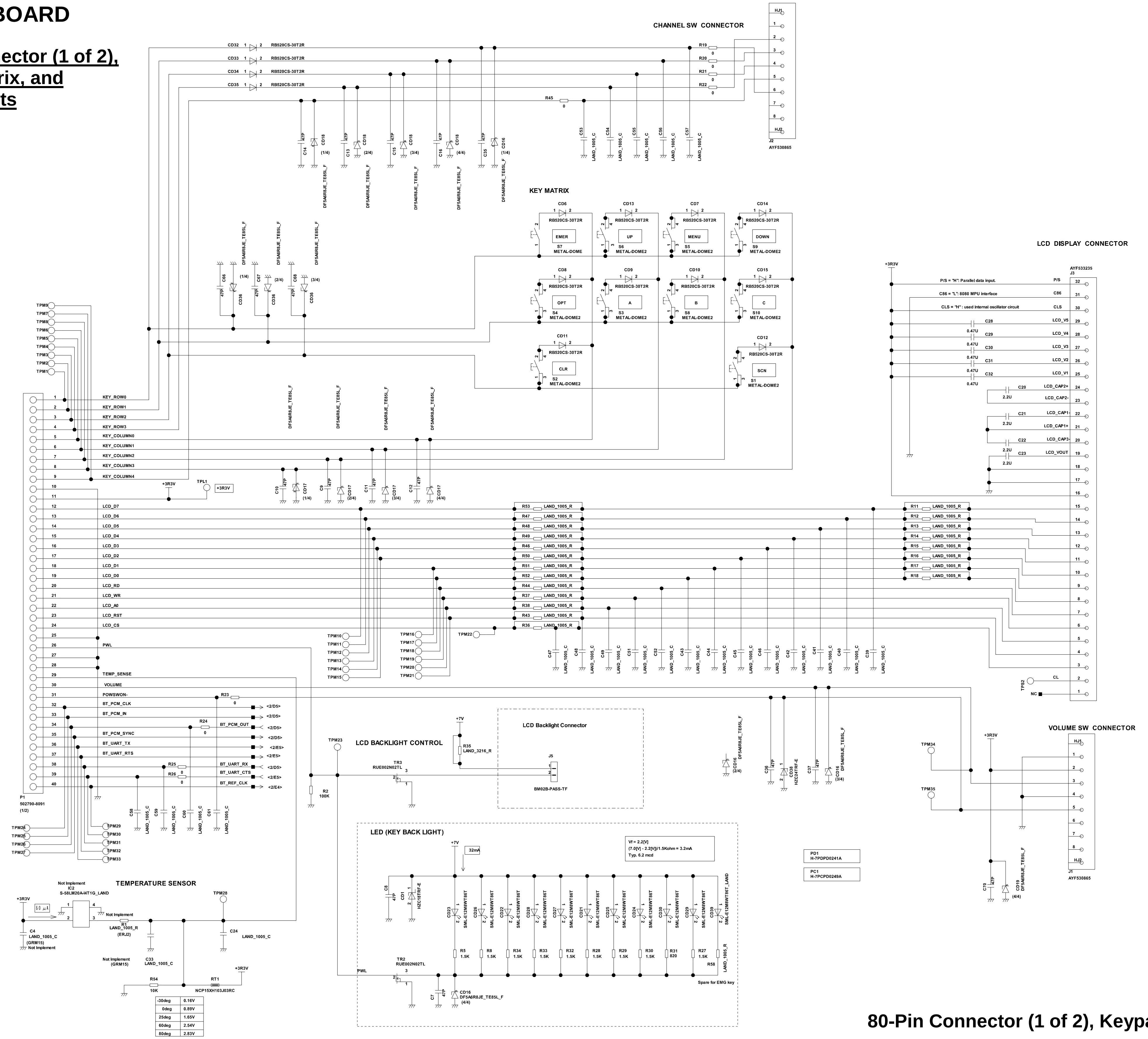


MAIN BOARD
Schematic Diagram
Sheet 12 of 12

Rear Connector Interface, Front Speaker Interface, Front Panel Interface, Etc.
(DD00-CMN-2743B)

20.2 FRONT PANEL BOARD

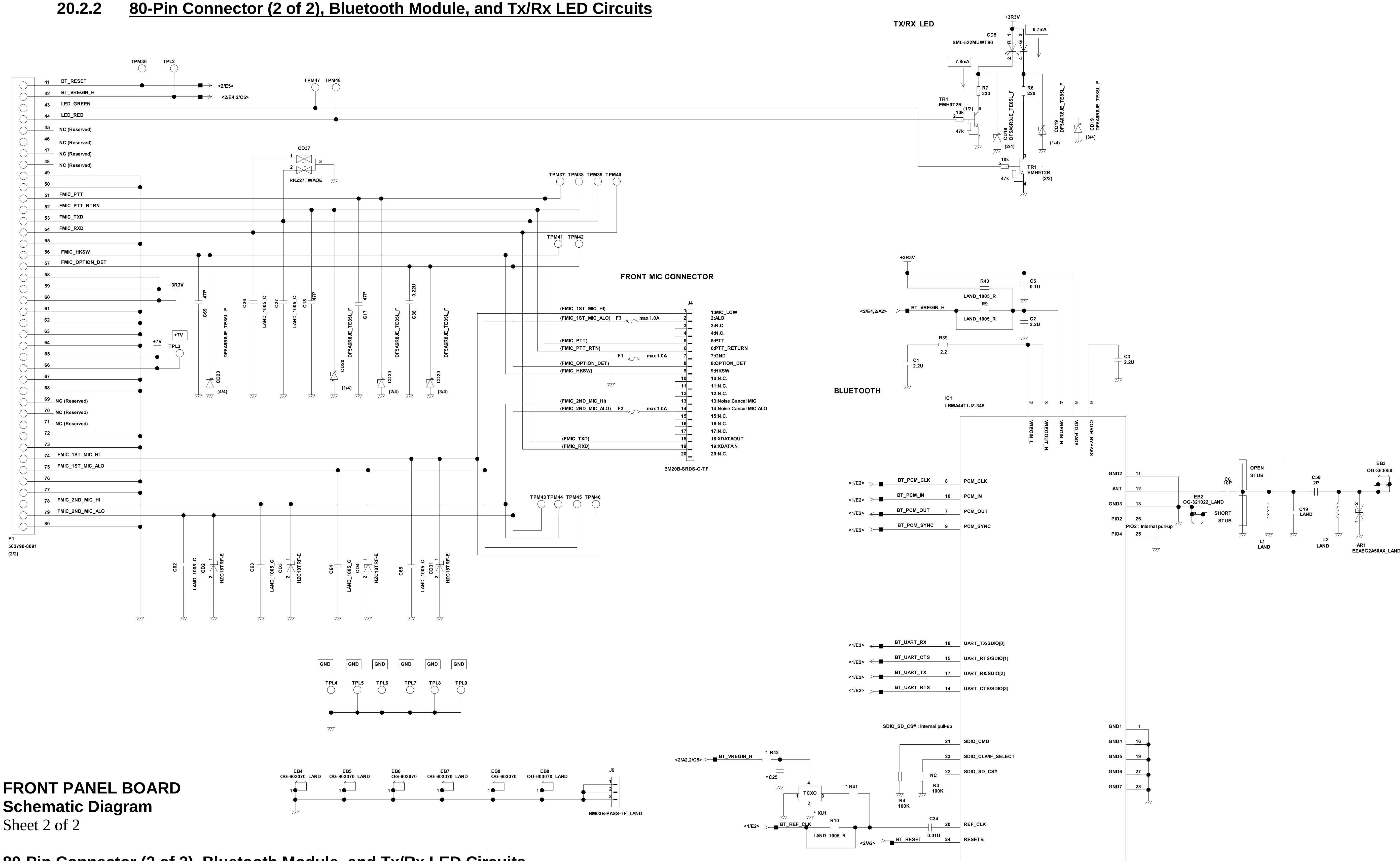
20.2.1 80-Pin Connector (1 of 2), Keypad Matrix, and Other Circuits



FRONT PANEL BOARD
Schematic Diagram
Sheet 1 of 2

80-Pin Connector (1 of 2), Keypad Matrix, and Other Circuits
(DD05-CDE-2742)

20.2.2 80-Pin Connector (2 of 2), Bluetooth Module, and Tx/Rx LED Circuits



FRONT PANEL BOARD
Schematic Diagram
Sheet 2 of 2

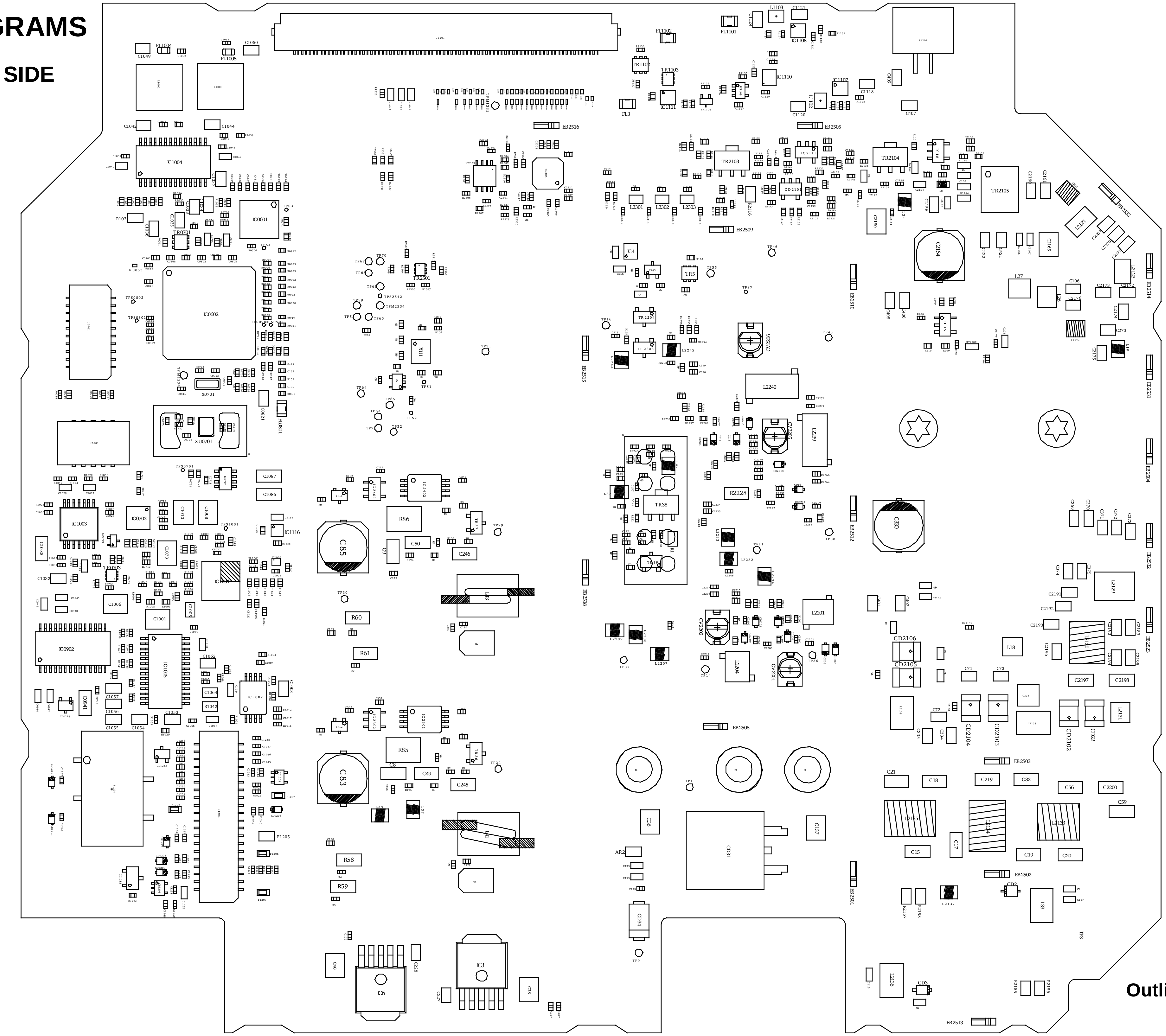
80-Pin Connector (2 of 2), Bluetooth Module, and Tx/Rx LED Circuits

(DD05-CDE-2742)

21 BOARD OUTLINE DIAGRAMS

21.1 MAIN BOARD — PRIMARY SIDE

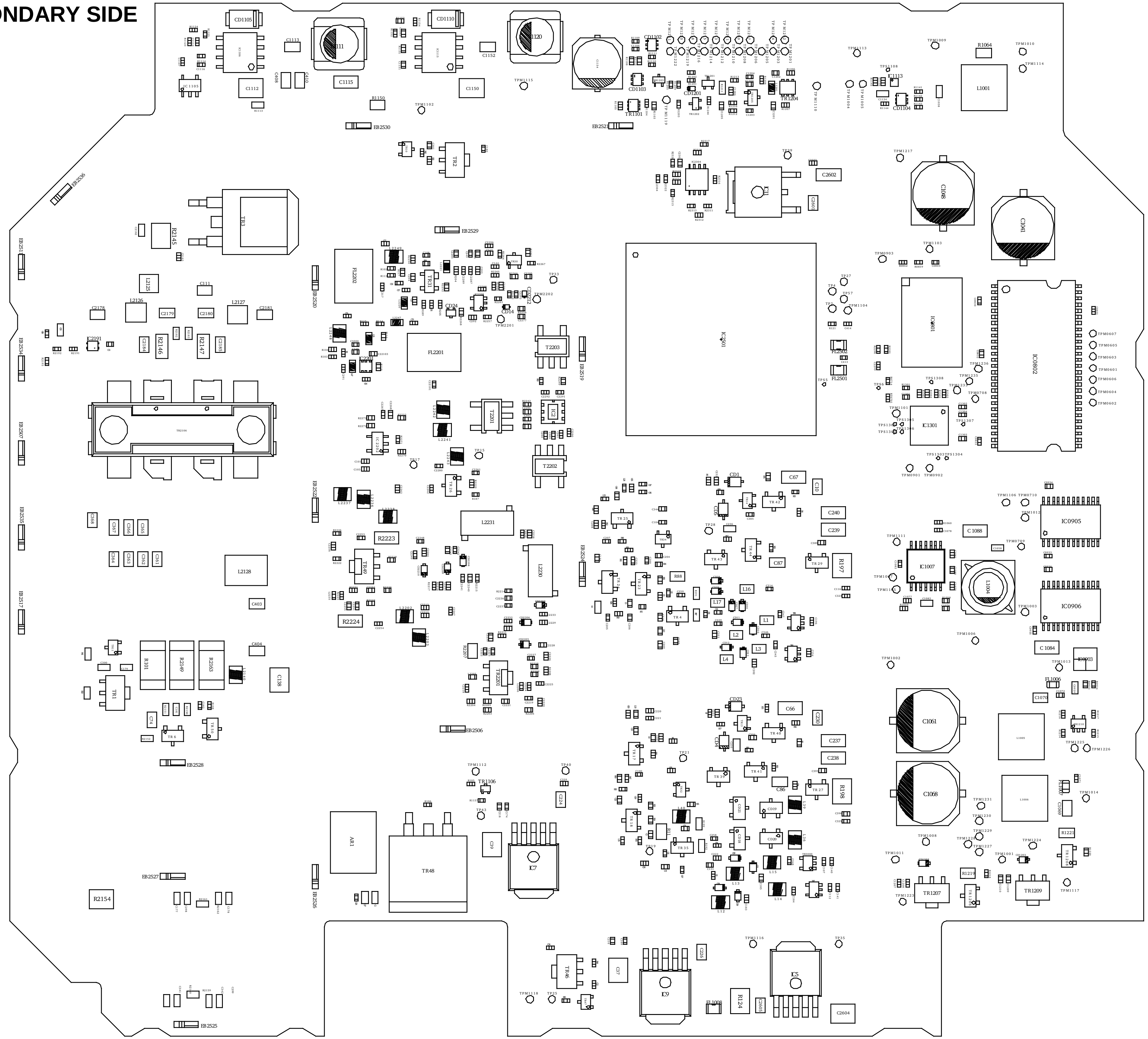
Observe precautions to prevent damage due to **E**lectro-**S**tatic **D**ischarge (**ESD**)!



MAIN BOARD
Outline Diagram —
Primary Side
(Rev. 3/29/2012)

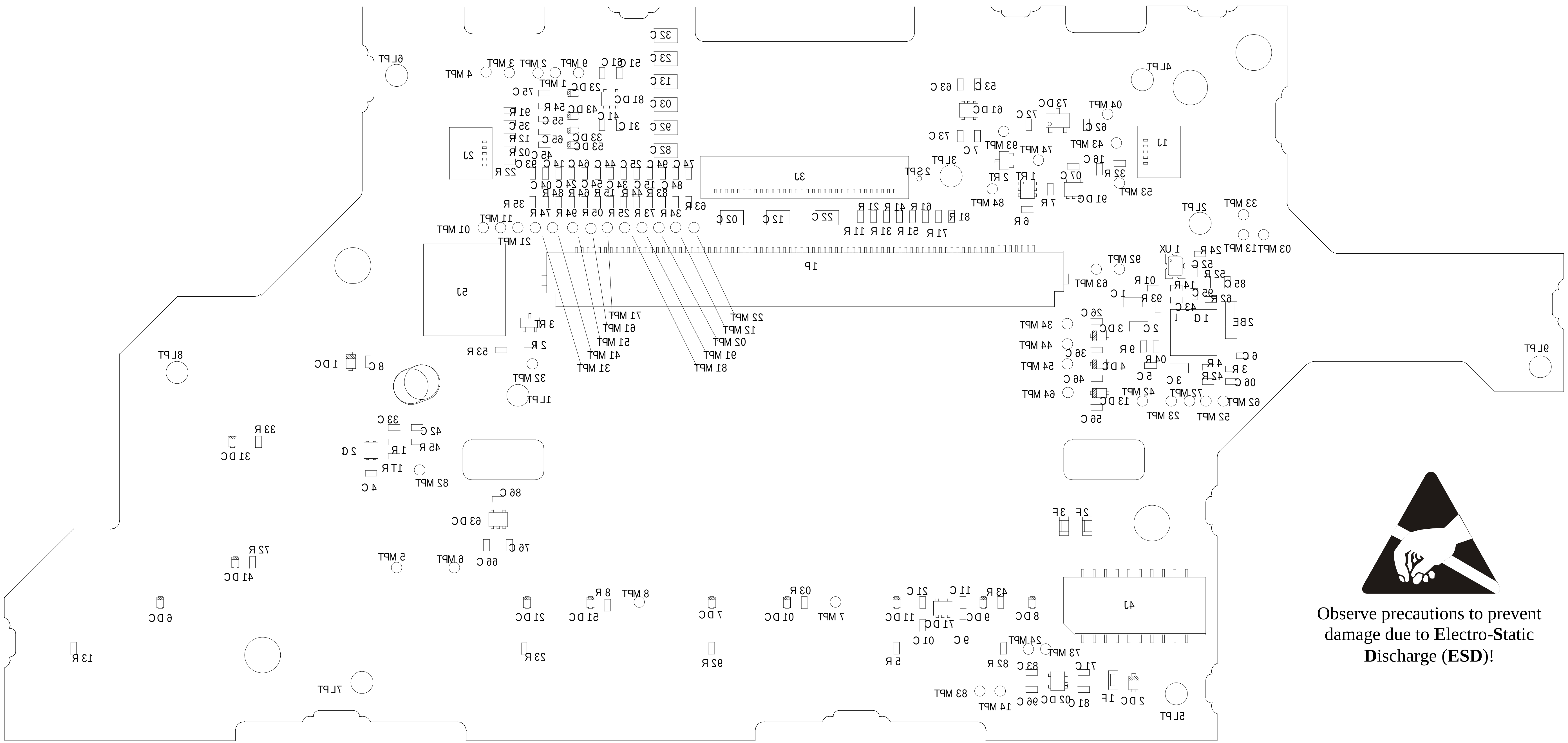
21.2 MAIN BOARD — SECONDARY SIDE

Observe precautions to prevent damage due to **E**lectro-**S**tatic **D**ischarge (**ESD**)!



MAIN BOARD
Outline Diagram — Secondary Side
(Rev. 3/29/2012)

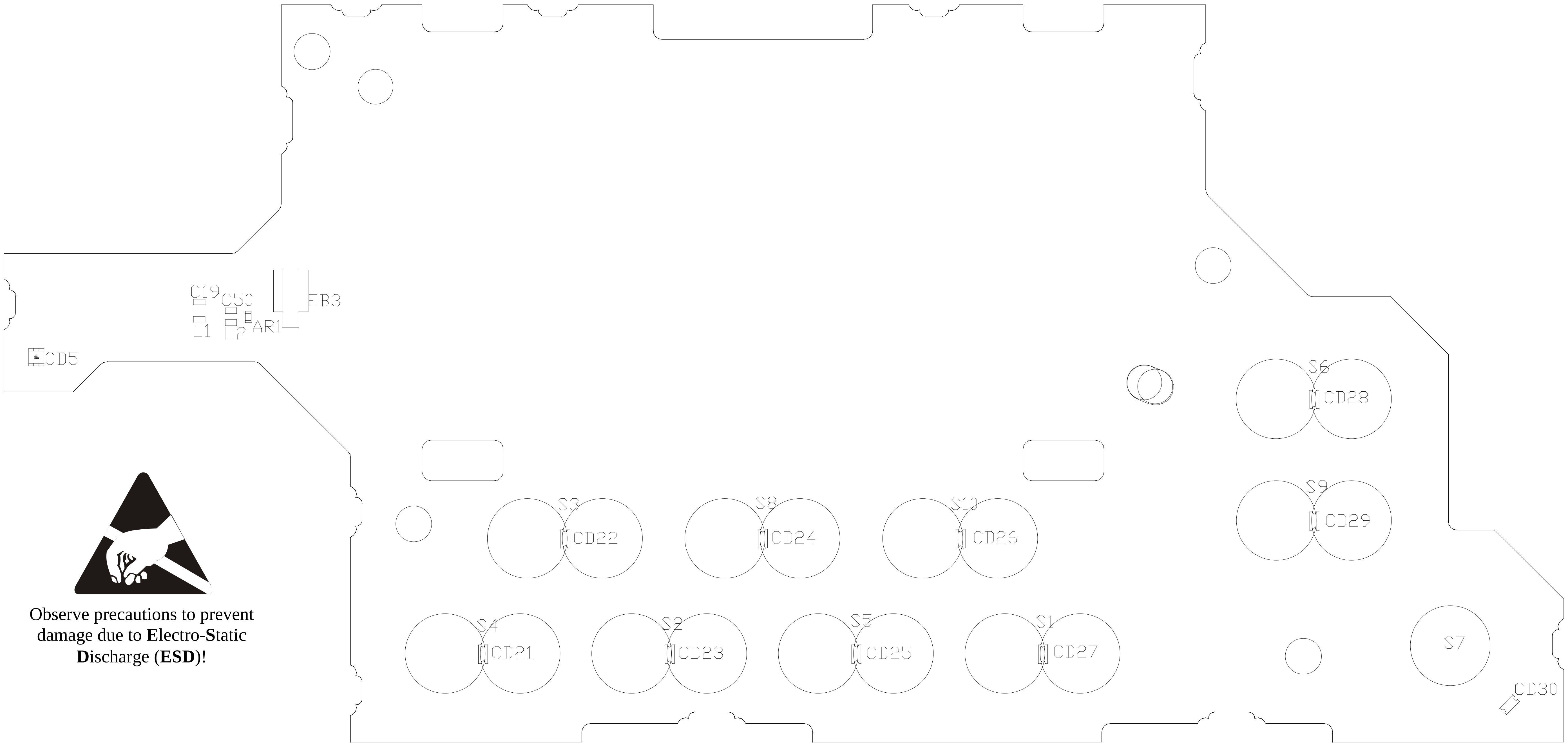
21.3 FRONT PANEL BOARD — PRIMARY SIDE



Observe precautions to prevent damage due to **E**lectro-**S**tatic **D**ischarge (**ESD**)!

FRONT PANEL BOARD
Outline Diagram — Primary Side
(Rev. 3/29/2012)

21.4 FRONT PANEL BOARD — SECONDARY SIDE



Observe precautions to prevent damage due to **E**lectro-**S**tatic **D**ischarge (**ESD**)!

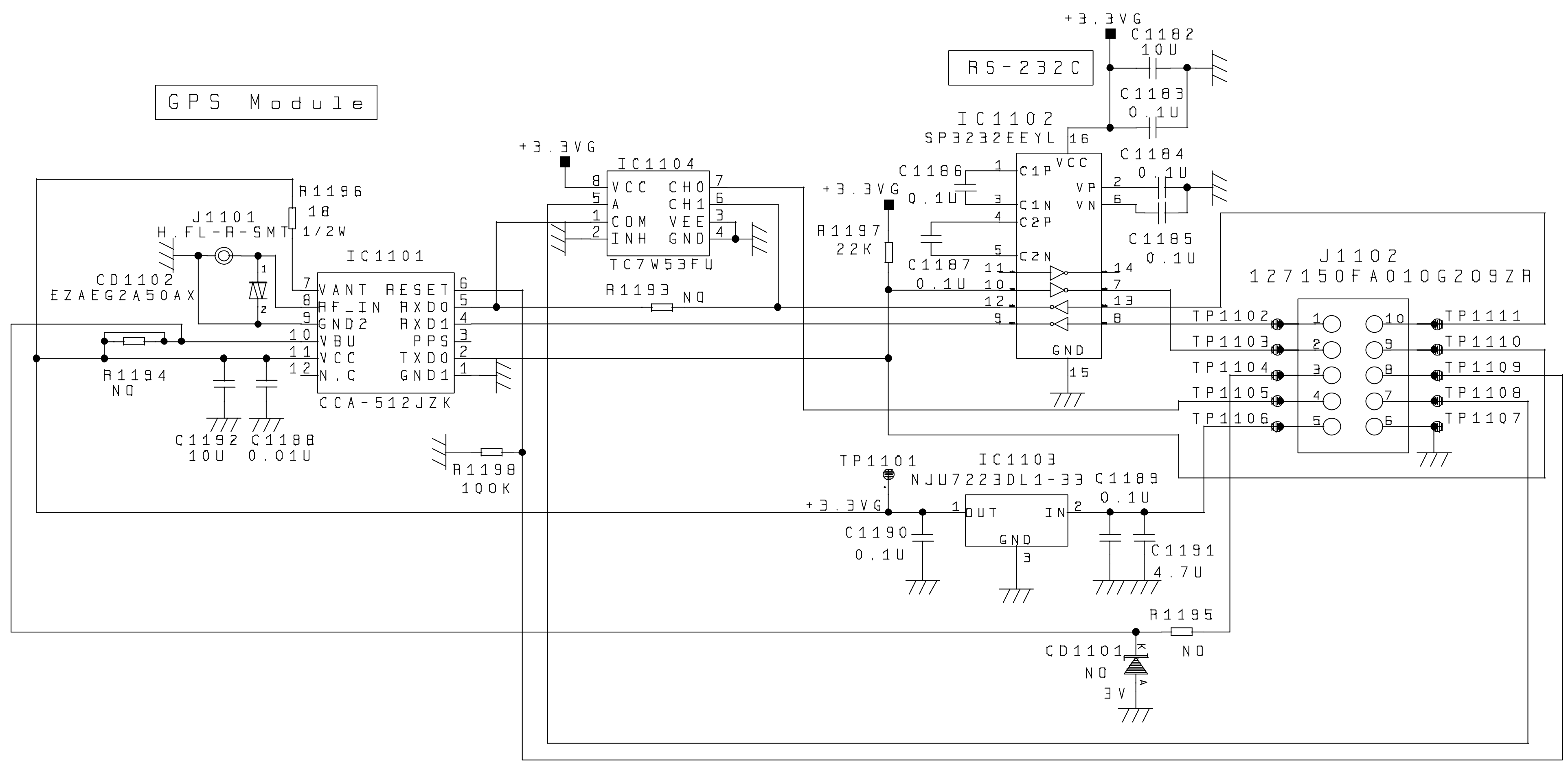
FRONT PANEL BOARD
Outline Diagram — Secondary Side
(Rev. 3/29/2012)

22 SERVICE SHEET

22.1 GPS RECEIVER MODULE (OPTIONAL)

J1102 Pin-Out

PIN	MAIN BOARD SIGNAL NAME	SOURCE	DESCRIPTION
1	DGPS_DATA	External	DGPS Correction Data Input (RXD1); RS-232C
2	GPS_NMEA_RX	GPS	Position Data Output (TXD0); RS-232C
3	+5V	Radio	Backup Power (Not used.)
4	UART2_TX_D	Radio	Initial Setting Data Input (RXD0); +3.3V
5	SWA+	Radio	Switched A+ (+13.6V)
6	GND	Radio	GND
7	UART2_TXRX_EN*	Radio	Select signal of RXD0 H: External GPS_NMEA_TX L: Radio UART2_TX_D
8	GPS_RESET*	Radio	Reset for GPS
9	UART2_RX	GPS	Position Data Output (TXD0); +3.3V
10	GPS_NMEA_TX	External	Initial Setting Data Input (RXD0) RS-232C



GPS RECEIVER MODULE (OPTIONAL)
Service Sheet
Sheet 1 of 1
(CMZ/CMA-910 Rev. 20070320)

BLOCK DIAGRAMS
SCHEMATIC DIAGRAMS
and
BOARD OUTLINE DIAGRAMS
Inside
for
Main Board, Front Panel Board, and GPS Receiver Module

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