

## **M7300 Mobile Radio**

110-Watt, 136 to 174 MHz  
RU-144750-051



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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



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 **National Fire Protection Association** 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 M7300 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.



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.



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<sup>1</sup>

### 3.1 GENERAL

<b>Dimensions, Mobile Radio:</b> (Height x Width x Depth)	2.4 x 6.93 x 11.0 inches (6.1 x 17.6 x 28.0 centimeters) (Does <u>not</u> include space required for mounting bracket and cables at rear of radio)
<b>Dimensions, CH-721 Control Head:</b> (Height x Width x Depth)	2.4 x 6.9 x 3.9 inches (6 x 17.5 x 10 centimeters) (Does <u>not</u> include bracket and mounting screws)
<b>Dimensions, HHC-731 Hand-Held Controller:</b> (Height x Width x Depth)	4.7 x 2.5 x 1.2 inches (11.9 x 6.4 x 3.1 centimeters) (Does <u>not</u> include coiled cable and mic hanger)
<b>Weight, Mobile Radio:</b>	7.55 pounds (3.42 kilograms), does not include bracket
<b>Weight, CH-721 Control Head:</b>	1.25 pounds (0.57 kilograms), does not include bracket
<b>Weight, HHC-731 Hand-Held Controller:</b>	0.65 pounds (0.29 kilograms), includes coiled cable
<b>Operating Ambient Temperature Range:</b>	-22 to +140° Fahrenheit (-30 to +60° Celsius)
<b>Storage Temperature Range:</b>	-40 to +185° Fahrenheit (-40 to +85° Celsius)
<b>Altitude:</b>	15,000 feet (4572 meters) maximum
<b>DC Supply Voltage Operating Ranges</b>	
For Full Performance:	+13.6 Vdc $\pm$ 10% (Normal range per TIA-603)
Overall Operating Range:	+10.8 to +16.6 Vdc
Continuous without Damage:	0 to +17 Vdc
<b>DC Supply Current Requirements</b>	
Receive (includes CH-721 control head):	
With Speaker Muted:	1.1 amps maximum
With 0.5-Watt Speaker Output Power:	1.5 amps maximum
With 10-Watt Speaker Output Power:	3.5 amps maximum
With 15-Watt Speaker Output Power:	4.0 amps maximum
Transmit (includes CH-721 control head):	
At 110 Watts:	25 amps maximum, 23 amps typical
HHC-731 Hand-Held Controller:	0.5 amps maximum
<b>Quiescent/Off Currents</b>	
Mobile Radio:	2 milliamps maximum
CH-721 Control Head:	100 microamps maximum
HHC-731 Hand-Held Controller:	500 microamps maximum

### 3.2 TRANSCEIVER

<b>Frequency Range:</b>	136 to 174 MHz (transmit and receive)
<b>Transmit Power:</b>	50 to 110 watts (programmable—see footnote <sup>2</sup> )
<b>Channel Spacing:</b>	12.5 kHz or 25 kHz (mode dependent)

<sup>1</sup> These specifications are primarily intended for the use of the service technician. See the appropriate Specifications Sheet for the additional specifications.

<sup>2</sup> As of the publication of this manual, the minimum transmit power level per FCC regulations for this radio is 50 watts.

<b>Channel Tuning Increment:</b>	6.25 kHz and 2.5 kHz
<b>Voice and Data Communications Modes:</b>	Half-Duplex
<b>Frequency Stability:</b>	±1.5 ppm
<b>Receiver Sensitivity:</b>	
P25 Mode (TIA-102 Method):	-116 dBm (0.35 µV) minimum at 5% Static BER
EDACS & Analog Conventional Modes:	-119 dBm (0.25 µV) minimum at 12 dB SINAD
<b>Receiver Intermodulation Rejection:</b>	77 dB typical
<b>Audio Frequency Response:</b>	300 to 3000 Hz (transmit and receive)
<b>Microphone Input Sensitivity:</b>	82 ±28 mV rms (typical)
<b>Microphone Maximum Input Level:</b>	2500 mV peak-to-peak
<b>Microphone Input Impedance:</b>	600 ohms
<b>Microphone Audio Frequency Response:</b>	±0.5 dB from 100 Hz to 3000 Hz
<b>Microphone Connector:</b>	17-pin Conxall-style flush-mount thumbscrew-locking connector located on front panel of CH-721 control head
<b>Microphone Types Available:</b>	Standard, DTMF, and Noise-Canceling
<b>Speaker Audio Output Power:</b>	15 watts RMS minimum into 4-ohm external speaker
<b>Speaker Audio Output Distortion:</b>	< 5% at 15 watts RMS into 4-ohm external speaker
<b>Headset Audio Output Power</b>	
At CH-721 Microphone Connector:	1 watt minimum into 4-ohm headset/speaker
At CH-721 DB-25 Rear Panel Connector:	35 milliwatts maximum into 24-ohm headset
At HHC-731 DB-25 Connector:	1 watt minimum into 8-ohm headset/speaker
<b>External Speaker Connection</b>	
Remote Control (Trunk-Mount Radio):	2-pin audio connector on rear of control head
Remote Control with HHC-731:	DB-44 connector on rear of radio
<b>Mic A-D and Speaker D-A Audio Conversion</b>	
CODEC Audio Sampling Rate:	8 kHz
CODEC Algorithm (Vocoding Method):	Sigma-Delta (ΣΔ)
<b>Modulation and Data Rates</b>	
EDACS and ProVoice Modes:	FM and 2-Level GFSK at 9600 bits-per-second
Analog Conventional Mode:	FM
P25 Phase 1 Mode:	C4FM at 4800 symbols-per-second
<b>Voice-Coding Method</b>	
EDACS, ProVoice and P25 Modes:	Improved Multi-Band Excitation (IMBE®)
Analog Conventional Mode:	(none)

### **3.3 REGULATORY**

#### **3.3.1 General**

<b>FCC Type Acceptance:</b>	OWDTR-0056-E
<b>Applicable FCC Rules:</b>	Part 15 and Part 90
<b>Industry Canada Certification:</b>	3636B-0056

**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**

The 110-Watt VHF M7300 mobile radio is a multi-mode digital mobile radio designed to meet the critical demands of radio users. The radio covers the 136 to 174 MHz VHF frequency band and it can provide 110-watts of transmit output power when it is transmitting in full-power mode. Refer to Section 3 for detailed specifications.

This radio supports multiple operating modes, including P25 digital trunked mode, P25 digital conventional mode, Enhanced Digital Access Communications System (EDACS®) or ProVoice™ trunked modes, and analog conventional mode. Advanced Encryption Standard (AES) is optionally available for maximum communications security.

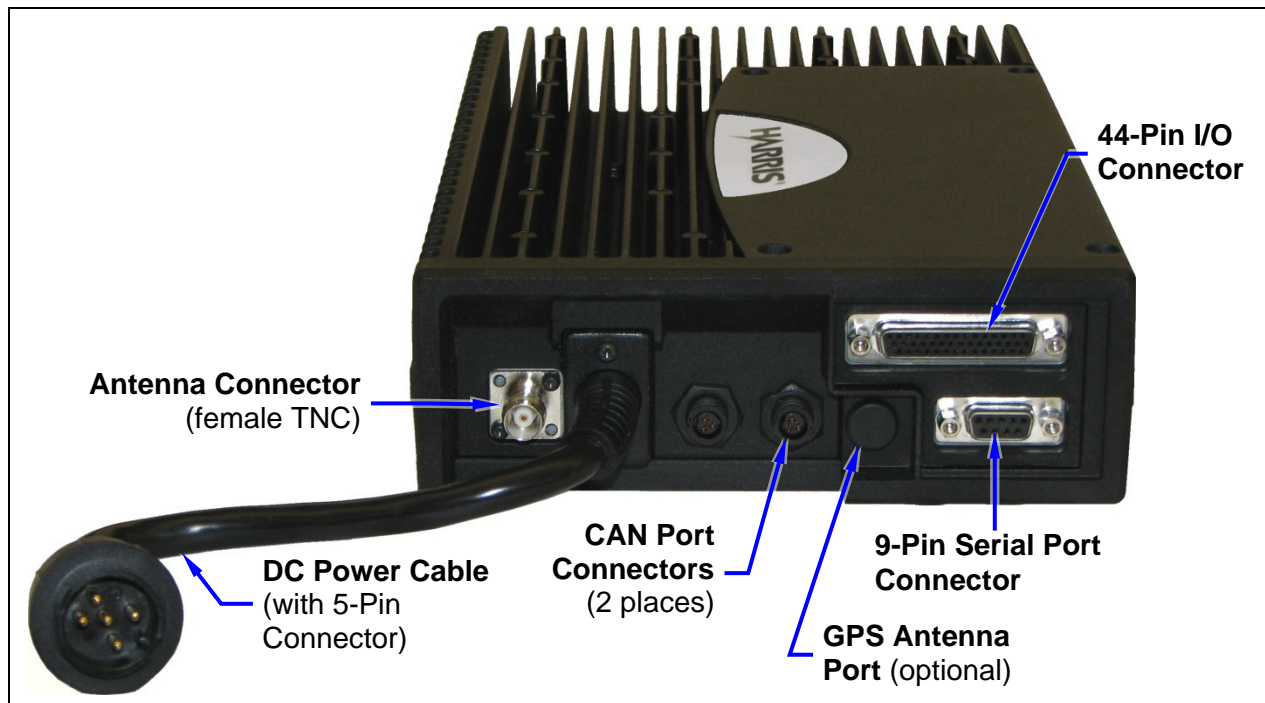
The radio can also be optionally equipped with a Global Positioning System (GPS) receiver module. This module provides standard GPS-formatted data over-the-air for vehicle tracking systems.

The 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*. Manual publication numbers are listed in Section 5 on page 18.

The 110-Watt VHF M7300 mobile radio is designed for remote mounting in a motor vehicle's trunk, or some other preferably unoccupied section in a vehicle, such as a fire truck's equipment shelf. The radio is remotely controlled by a control head(s) connected to it via 3-wire Controller Area Network (CAN) cables. Between the radio and control head(s), the CAN link carries digitized microphone and speaker audio, controlling data such as button presses and radio messages, and user data. CAN port connectors are located on the rear of the radio and control heads as illustrated in Figure 4-2 and Figure 4-5 respectively. For proper operation, the CAN link must be appropriately terminated on each end of the CAN link.



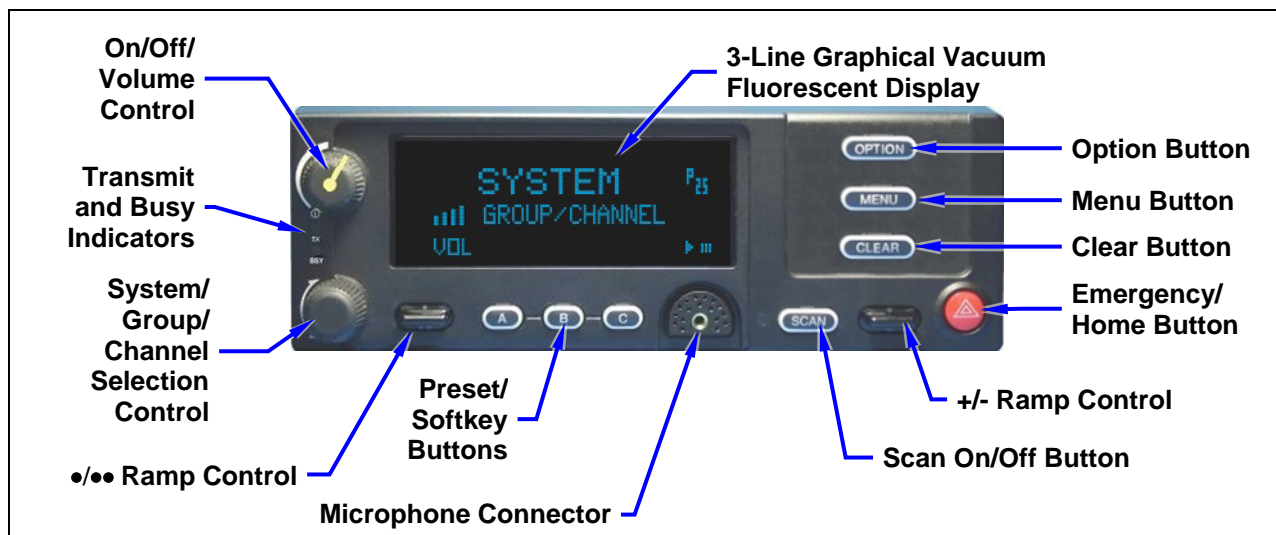
**Figure 4-1: 110-Watt VHF M7300 Mobile Radio**



**Figure 4-2: 110-Watt VHF M7300 Mobile Radio (Rear View)**

The EDACS Conventional P25 (ECP) operating mode/radio firmware code supports dual (two) control heads. In a dual control head installation, two control heads are interconnected to the mobile radio in a series (“daisy-chain”) fashion via CAN cables.

Control heads used with the M7300 radio include the CH-721 Scan and the CH-721 System model control heads. See Figure 4-3 and Figure 4-4. Both heads feature a large 3-line graphical vacuum-fluorescent display, front panel controls and buttons/keys for user control of the mobile radio, an internal high-power audio amplifier to drive an externally-connected speaker, and a front panel microphone connector. The CH-721 System control head also has a 12-button numeric keypad that provides Dual-Tone Multi-Frequency (DTMF) functionality and easier operator system/group selection control at the control head’s front panel.



**Figure 4-3: CH-721 Scan Model Control Head (Front Panel)**



As shown in Figure 4-5, the CH-721 Scan and System model control heads used in remote-mount mobile radio installations have several connectors located on the head's rear panel. These connectors include a DC power connector, two (2) CAN port connectors used for CAN link interconnections, an external speaker connector, a 9-pin serial port connector for connecting optional equipment such as a mobile data terminal, and a 25-pin accessory connector. Both CH-721 models can interface to an optional Federal Signal Electronic siren/light control system for broadcasting via a public address (PA) speaker.



**Figure 4-6: HHC-731 Hand-Held Controller Front View**

The radio and control head/hand-held controller 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. The CH-721 control head(s) or the HHC-731 hand-held controller connected to the radio is also powered by the same DC power source, but separately fused. When the control head/hand-held controller is powered-up by the operator, it "wakes up" the radio by transmitting data to the radio via the CAN link.

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 control head. The HHC-731 hand-held controller has an integrated microphone and PTT button/key. When a control head is employed in a mobile radio installation, an audio amplifier in the head drives the speaker. When the hand-held controller is employed, an audio amplifier in the remote-mounted mobile radio drives the speaker.

For data communications, the radio has an industry-standard 9-pin serial interface port for connecting optional data-type equipment, such as a Mobile Data Terminal (MDT), a laptop personal computer (PC), an external display, or a key-entry device. This port works seamlessly with equipment from popular manufacturers and off-the-shelf applications.

The radio may be equipped with an optional built-in Global Positioning System (GPS) tracking receiver. The GPS receiver determines the unit's location and the radio transmits it to the network, either when polled by the network or automatically on a predetermined periodic basis. 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 M7300 mobile radio, the CH-721 control head and the HHC-731 hand-held controller exceed tough environmental specifications included within military standard MIL-STD-810F, the radio industry standard TIA/EIA-603, and the radio standard established by the U.S. Forest Service.

The M7300 mobile radio supports operation on APCO Project 25 phase I compliant Common Air Interface (P25 CAI) trunked radio networks, and operation in a talk-around mode in accordance with the APCO Project 25 phase I standard. P25 radio systems utilize Improved Multi-Band Excitation (IMBE) speech and data compression technology, developed by Digital Voice Systems, Inc.

EDACS and ProVoice trunked radio networks employ analog FM and 2-level Gaussian Frequency-Shift Keying (GFSK) modulation techniques on the RF channels. Data is transmitted on an RF channel at a 9600 bits-per-second rate. ProVoice also employs IMBE technology.

For over-the-air secure radio communications, the M7300 mobile radio may be equipped for 64-bit DES (Data Encryption Standard) encryption or 128/256-bit AES (Advanced Encryption Standard) encryption. With encryption, voice and/or user data signals transmitted and received by the radio on an RF channel are digitally encrypted ("scrambled") to virtually eliminate unauthorized monitoring via the RF channel.



**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 radio:

- Installation and Product Safety Manual: MM-014763-001
- Quick Guide for CH-721: MM-014369-001
- Operator's Manual for CH-721: MM-014716-001
- Operator's Manual for HHC-731 Hand-Held Controller: MM-018321-001
- Maintenance Manual for CH-721 Scan and System Control Heads: MM-008918-001  
(included with this manual)
- Maintenance Manual for HHC-731 Hand-Held Controller: MM-018323-001  
(included with this manual)

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](http://www.pspc.harris.com) without a login. Obtaining the Installation and Product Safety Manual or a 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](mailto:PSPC-CustomerFocus@harris.com)

### International:

- Phone Number: 434-455-6403
- Fax Number: 321-409-4394
- E-mail: [PSPC-InternationalCustomerFocus@harris.com](mailto: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](mailto:PSPC-tac@harris.com)

## 8 CATALOG AND PART NUMBERS

### 8.1 RADIOS AND CONTROL HEADS

**Table 8-1: VHF M7300 Mobile Radio Catalog and Part Numbers**

CATALOG NUMBER	RADIO PART NUMBER	DESCRIPTION
MAMW-SHHXX*	RU-144750-051	VHF 110-Watt M7300 Mobile Radio

\* Catalog package also includes installation and product safety manual and quick-reference operating guide.

**Table 8-2: CH-721 Control Head Catalog and Part Numbers**

CONTROL HEAD CATALOG NUMBER	CONTROL HEAD PART NUMBER	DESCRIPTION
MAMW-NCP9E	CU23218-0002	CH-721 Scan Control Head, Remote-Control for Use with a Remote-Mount Mobile Radio
MAMW-NCP9F	CU23218-0004	CH-721 System Control Head, Remote-Control for Use with a Remote-Mount Mobile Radio

**Table 8-3: AES and DES Encryption Catalog Numbers for M7300 Mobile Radios**

CATALOG NUMBER	DESCRIPTION
MAMW-NPL7M	256-Bit Advanced Encryption Standard (AES) for EDACS, Conventional and P25 (ECP) Modes
MAMW-NPL3V	64-Bit Data Encryption Standard (DES) for ECP Modes
MAMW-PKG8C	256-Bit AES for ECP and OpenSky Modes, and 64-Bit DES for ECP Modes
MAMW-PKG8F	256-Bit AES and 64-Bit DES for ECP Modes

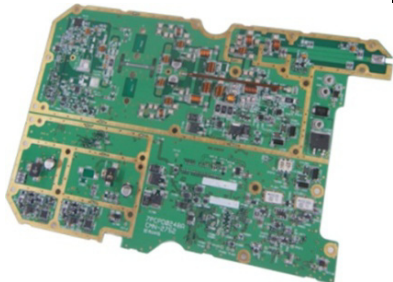
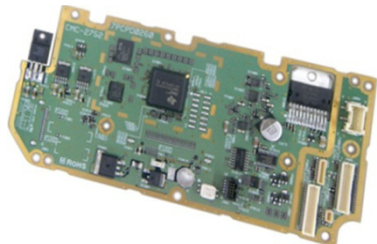


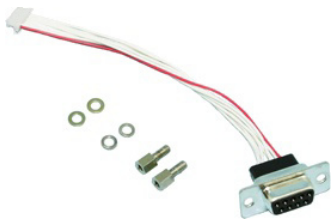

### 8.2 INSTALLATION-RELATED COMPONENTS

For detailed information on installation-related components, refer to the *Installation and Product Safety Manual*, publication MM-014763-001, revision J or later.









## 8.3 SERVICE PARTS

This section lists service parts available for the 110-Watt VHF M7300 mobile radio. See Section 6 on page 18 for parts ordering information.




**Table 8-4: Service Parts for the 110-Watt VHF M7300 Mobile Radio**

SERVICE PARTS PART NUMBER	DESCRIPTION	ILLUSTRATION
14018-0178-01	Board Assembly, 110-Watt VHF RF Processor (CMN-2752/-MDHW10779)	
14018-0178-02	Board Assembly, PK (CMC-2752/-MDCW11279)	
14018-0178-03	Kit, Pigtail DC Power (includes cable and mounting hardware)	
CA-013891	Kit, CAN Cable Assembly (includes connectors cables, and mounting hardware)	
CA-013870	Kit, DB-9 Cable Assembly (includes cable assembly and mounting hardware)	
CA-015586	Kit, DB-44 Cable Assembly (includes cable assembly and mounting hardware)	

**Table 8-4: Service Parts for the 110-Watt VHF M7300 Mobile Radio**

SERVICE PARTS PART NUMBER	DESCRIPTION	ILLUSTRATION
14002-0177-01	Kit, Rear Connector Jackscrews (includes 4 jackscrews, 4 lockwashers, and 4 flat washers)	
CN-013898	Kit, TNC Antenna Connector (includes connector, mounting hardware, and O-ring gasket)	
AM-015589	Integrated Circuit, TDA7391 Audio Amp (IC905 of PK Board)	
IC-015593	Integrated Circuit, NJM7805FA Fixed 5-Volt Regulator (IC908 of PK Board)	
14018-0178-06	Kit, Fuses for PK Board. Includes: <ul style="list-style-type: none"> <li>• Mastuo KAB3202 102NA 29 010 1.0-Amp / 1.6 x 0.8 mm (8 pcs)</li> <li>• Mastuo KAB2402 322 NA31010 3.15-Amp / 2.0 x 1.25 mm (1 pcs)</li> <li>• Littelfuse® 0453005.MR 5.0-Amp / 6.10 x 2.69 mm (1 pcs)</li> </ul>	
14018-0178-04	Kit, Internal Screws	
14018-0178-05	Kit, External Screws	
MA-013861	Cover, Top (includes metal cover, gasket and label)	

**Table 8-4: Service Parts for the 110-Watt VHF M7300 Mobile Radio**

SERVICE PARTS PART NUMBER	DESCRIPTION	ILLUSTRATION
14018-0178-07	Cover, Bottom (includes metal cover, gasket and air valve)	
NP-013868	Label, Harris (for Top Cover)	
FM-013890	Cap, GPS	



For CH-721 control head parts, refer to the CH-721 maintenance manual included with this manual set, publication number MM-008918-001.

For HHC-731 hand-held controller parts, refer to the HHC-731 maintenance manual included with this manual set, publication number MM-018323-001.

## 9 BASIC OPERATING INFORMATION






This section provides basic operating information for the radio connected to a CH-721 control head. For detailed CH-721-based operating instructions, refer to operator's manual publication number MM-014716-001. For detailed HHC-721 hand-held controller operating instructions, refer to operator's manual MM-018321-001. These and other publications are available at [www.pspc.harris.com](http://www.pspc.harris.com) via an Information Center login and Tech Link.

### 9.1 CONTROLS OF THE CH-721 CONTROL HEAD

The front panel of the CH-721 control head includes a dot matrix display, controls for menu navigation, an emergency button, three pre-set buttons, a power button/rotary volume dial, and a microphone connector. In addition, the system model control head features a DTMF keypad. Table 9-1 lists the controls and their default functions. Also refer to Figure 4-4 and Figure 4-3 as necessary.

The buttons on the front panel are backlit for operation in a low ambient light level such as nighttime operation. Some buttons also flash to provide feedback of various operating conditions.

**Table 9-1: Controls of the CH-721 Scan and System Control Heads**

CONTROL	FUNCTION
 On/Off/Volume Control Knob	To turn the radio and control head on, rotate this knob clockwise out of the detent position. Clockwise rotation also increases volume. Turn this knob counter-clockwise to decrease volume, and to turn off the radio and control head.
 System/Group/Channel Knob	Use the System/Group/Channel knob to select systems or groups/channels, depending upon radio programming.
 Emergency/Home Button	Use this button to declare an emergency, if the emergency feature is enabled. Alternately, this button can also be programmed to, when pressed, switch the radio to a home group/channel.
 Ramp Control	This rocker-type ramp control has multiple functions. It is used to display the current scan status for a group/channel, and to then add or delete the group/channel from the system scan list. Pressing the add/delete button twice while the radio is actively receiving or three times when the radio is not receiving selects the last scanned channel (last scanned channel recall). It is also used for various other selection-type functions.
 Ramp Control	This rocker-type ramp control also has multiple functions. Its primary function is to scroll through the System list or the Group/Channel list, depending upon programming. Its secondary function is to increment or decrement a selection of items within a list (e.g., a phone list).
<b>OPT</b> (Option Button)	The OPT (option) button is used to toggle a programmable feature on and off.


(Table Continued on Next Page)

Table 9-1: Controls of the CH-721 Scan and System Control Heads (Continued)

CONTROL	FUNCTION
<b>MENU</b> (Menu Button)	The primary function of the MENU button is to access the menu list. This is a list of additional features that are not available directly from the keypad. As a secondary function, the MENU button activates a selected item within a list, similar to an enter button/key.
<b>CLR</b> (Clear Button)	<u>EDACS and P25 Modes:</u> In these modes, the CLR (clear) button cancels the current operation and removes all displays associated with it. The radio and display return to the group/channel receive state. <u>Conventional Mode:</u> Unmutes the radio's receiver so activity on the selected channel can be monitored. When pressed and held for approximately 3 seconds, this button toggles conventional channel decoding (Channel Guard, Digital Channel Guard, T99) on and off, if programmed for the selected channel.
<b>SCAN</b> (Scan Button)	Press the SCAN button to toggle group/channel scan operation on and off.
<b>A, B and C</b> Pre-Set Buttons	A preset button may be pre-programmed to perform a particular pre-determined task. For example, a preset button can be used to store and recall user-selectable parameters.
<b>SYS</b> (System Key)	Press this key to enter the system select mode.
<b>GRP</b> (Group Key)	Press this key to enter the group select mode.
<b>DIS</b> (Display Key)	Press to display the encryption key's ID number, and whether or not the key is valid or available.
<b>IND</b> (Individual Call Key)	Use this key to make an individual call or make an all-call via the individual call function.
<b>PHN</b> (Phone Key)	Use this key to place telephone calls through the radio system via the telephone interconnect special call function.
<b>STS</b> (Status Key)	Use this key to send pre-programmed status conditions to a trunked radio network.
<b>MSG</b> (Message Key)	Use this key to send pre-programmed message text to a trunked radio network.

## 9.2 LOCKING AND UNLOCKING THE KEYPAD

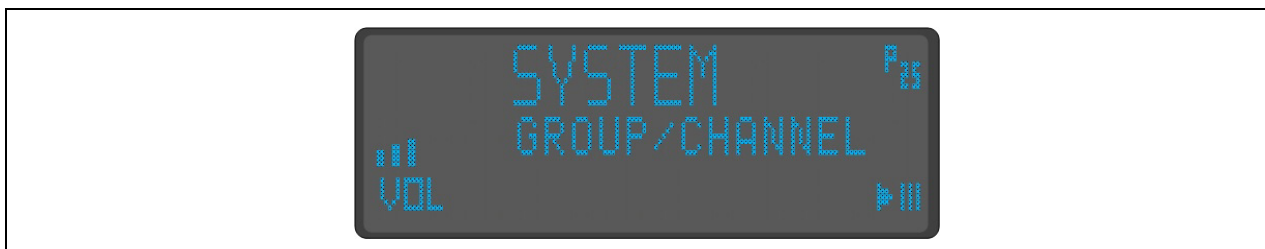
The control head's keypad can be locked to prevent accidental button press operations. Lock and unlock it as follows:

1. Press the control head's **MENU** button.
2. Use the  ramp control to scroll through the menu until **KEY LOCK** appears in the middle line of the display.
3. Press the **MENU** button again to lock the head's keypad.

To unlock the keypad, simply press the **MENU** and **CLR** (Clear) buttons simultaneously.












### 9.3 RADIO STATUS ICONS

Status icons are indications on the control head's display that indicate various operating characteristics of the radio.



**Figure 9-1: Typical Display during P25 Trunked Operation**

**Table 9-2: Radio Status Icons**

ICON	DESCRIPTION
	Indicates the EDACS system is in Failsoft™ mode (if enabled through programming).
	Indicates selected group or channel is in scan list.
	Indicates selected group or channel is programmed as Priority 1 in scan list.
	Indicates selected group or channel is programmed as Priority 2 in scan list.
	Scan mode enabled.
	Volume bars – indicates relative volume level.
	Indicates the current channel is set up as an analog channel.
	Indicates the current channel is set up as a ProVoice channel.
	Transmitting or receiving in encrypted mode.
	Indicates the current channel is set up as a Project 25 (P25) channel.
	Indicates a conventional channel enabled with Channel Guard Function.

## 9.4 ALERT TONES

The radio provides audible alert tones or “beeps” to indicate the various operating conditions. These alert tones can be enabled or disabled through programming.

**Table 9-3: Alert Tones for P25 Trunked Operation**

NAME	tone	DESCRIPTION
Call Originate	1 short mid-pitched tone	Sounds after keying the radio via its Push-To-Talk (PTT) button. Indicates the radio has been assigned a working channel. After it sounds, begin speaking into the microphone, while holding the PTT button depressed.
Autokey	1 mid-pitched tone	After being placed in a queue or releasing the PTT button prior to a working channel assignment, the site calls the radio when a channel becomes available. At this point, the radio automatically keys the transmitter (autokey) for a short period to hold the channel. The radio sounds a mid-pitched tone when it is clear to talk. Immediately press the PTT button to keep the assigned channel.
Call Queued	1 high-pitched tone	Sounds after pressing the PTT button indicating the system has placed the call request in the queue. The receiving unit(s) also sound(s) the tone to indicate they will receive a call shortly.
System Busy	3 low-pitched tones	Sounds if the radio is keyed when the system is busy, if no channels are available for sending the message, if the call queue is full, or if an individual call is being attempted to a radio that is transmitting.
Call Denied	1 low-pitched tone	Indicates the radio is not authorized on the system that has been selected.
Carrier Control Timer	5 short high-pitched warning tones followed by 1 long low-pitched tone	Sounds if the programmed time for continuous transmission is exceeded. The transmitter will shut down shortly after the alert, interrupting communications. Release and re-key the PTT button to maintain communications. This will reset the carrier control timer and turn the transmitter back on.
Key Press Alert	1 short tone	Indicates a key has been pressed. A short low-pitched tone indicates no action was taken because the key is not active in the current mode.
Page (P25 Trunked Only)	3 high-pitched tones	In P25 trunked mode, if the receiving radio accepts a page, both the receiving and transmitting radios emit three high-pitched tones.
Out of Range	1 low pitched tone	Indicates the radio is in Wide Area Scan. Radio will periodically beep when in Wide Area Scan.

## 9.5 HHC-731 HAND-HELD CONTROLLER OPERATION

Operating information for the HHC-731 Hand-Held Controller is contained in *Operator's Manual* publication MM-018321-001. See Section 5 on page 18 for additional information.

## 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 M7300 mobile radio for operations in EDACS, ProVoice, and P25 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 M7300 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.



Use the information and procedures in this section and RPM's built-in help as a guideline for programming and configuring an M7300 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.



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 18 of this manual. Software Release Notes are available at [www.pspc.harris.com](http://www.pspc.harris.com) via a Wireless Systems Information Center login and Tech Link.

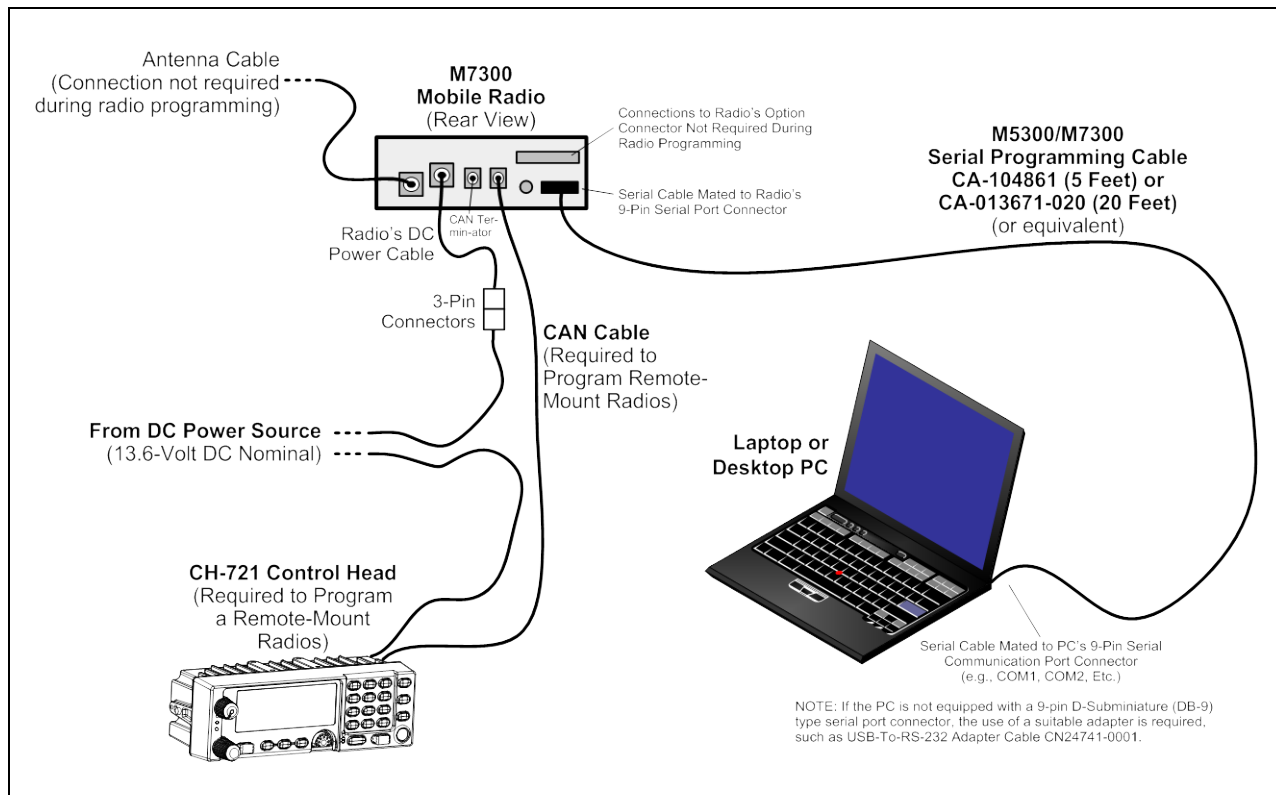
Follow this procedure to load ECP code into the M7300 mobile radio:

1. As illustrated in Figure 10-1, connect the radio to a personal computer with the Radio Personality Manager (RPM) programming software installed on it. Use Serial Programming Cable CA-104861 (5 feet long), CA-013671-020 (20 feet long), or equivalent, to connect the computer's serial port to the 9-pin (DB-9) connector on the rear of the radio.



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 18 for the respective contact information.

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



**Figure 10-1: Cable Connections for Radio Programming**

4. **Optional:** Turn the radio and control head off via the on/off/volume control on the control head.
5. **Optional:** While simultaneously depressing the control head's A and C preset buttons, turn the radio and control head on via the head's on/off/volume knob, then release both buttons. After the "Booting" message clears, a "PROGRAM Please Wait..." message should appear in the control head's display. This indicates the radio is in programming mode.



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 M7300 mobile radio ECP code, named **m7200\_ecp\_RxxXxx.cmp** (where **RxxXxx** is the required software version). After selecting the correct code file, click the Open button in the Open dialog box, and then click the OK button in the Load Compressed Code dialog box.

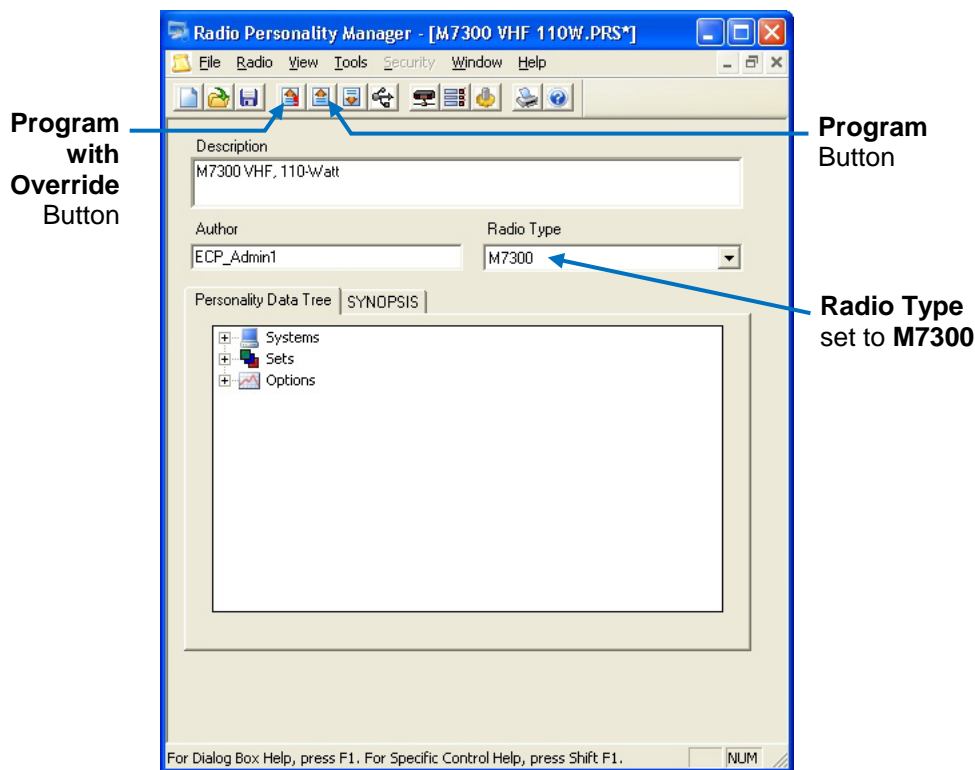


The 110-Watt VHF M7300 mobile radio requires release R15A (or later) code. The compressed code (file named **m7200\_ecp\_RxxXxx.cmp**) is included with Media Kit SK-011983-001. That Media Kit is included with Software Distribution Kit ST-011986-001. For additional information, refer to Software Release 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

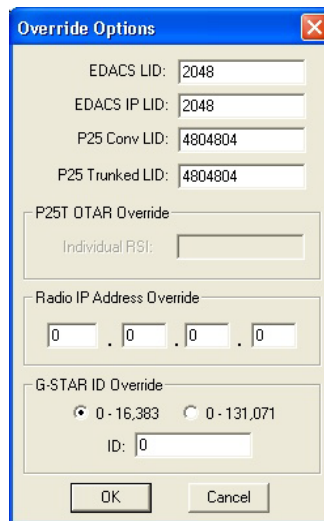
1. Connect the radio to a personal computer with the Radio Personality Manager (RPM) programming software installed on it. Use Serial Programming Cable CA-104861 (5 feet long) or CA-013671-020 (20 feet long), or equivalent, to connect the computer's serial port to the 9-pin (DB-9) connector on the rear of the radio. Connections are illustrated in Figure 10-1.
2. Power-up the PC that has the RPM programming software installed on it, and start Windows.
3. Start the RPM programming software.
4. Open an existing VHF band personality, or start a new M7300 personality in the VHF band, or read the existing personality from the radio. Consult RPM's built-in help as necessary.
5. As illustrated in Figure 10-2, verify the Radio Type is set to M7300 in RPM's main dialog box. If it is not, make this change.



**Figure 10-2: RPM's Program and Program with Override Buttons (Example Main Dialog Box)**

6. 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.
7. Save the personality, using a unique filename if necessary.
8. 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 following figure shows example LID numbers only:



**Figure 10-3: RPM's Override Options Dialog Box (with Example LID Numbers)**

9. Click the **OK** button to start the personality write operation. After it is completely written, the M7300 radio automatically reboots.
10. 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 CH-721 control head, press the **MENU** button, then use the **•/••** ramp control to scroll through the menu until **FEATURES** appears in the middle line of the display.
4. Press the **MENU** button again.
5. Use the **•/••** ramp control through the features list, as necessary.
6. Press the **MENU** or **CLR** (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 18. 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 radio to a personal computer with the RPM programming software installed on it. Use Serial Programming Cable CA-104861 (5 feet long) or CA-013671-020 (20 feet long), or equivalent, to connect the computer's serial port to the 9-pin (DB-9) connector on the rear of the radio. Connections are illustrated in Figure 10-1.
4. Start RPM's Radio Maintenance Utility application by clicking **Start > (All) Programs > Harris Radio Personality Manager > RPM Radio Maintenance Utility**.
5. On the utility's **Radio** menu, select **Read > Feature Data from Radio** to read the existing feature data string from the radio.
6. Select the **P5x00/P7x00/M5300/M7x00/XG100M** tab.
7. 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.
8. Click the **OK** button.
9. 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.
10. Verify the dialog box reports the feature data transfer is complete.
11. Click the dialog box's **OK** button, and exit the utility.

## 11 MAINTENANCE

### 11.1 GENERAL INFORMATION

Technicians servicing this radio should generally be concerned with isolating a problem to either caused by 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.



An in-warranty M7300 mobile radio, **must** be serviced by a Harris Corporation-authorized service center. Service performed by any non-authorized service center will void the radio's warranty.



**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.**

**The PK Board and the RF Processor Board are serialized during final test procedures performed at the factory. If board replacement is deemed necessary, returning the complete radio to Harris for repair is highly recommended. If any component in an RF signal path is replaced, retuned, or disturbed in any way, the complete radio should be tested and aligned per the respective procedures in this manual or the radio should be returned to Harris for repair.**

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

### 11.2 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 control head 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 MM-014763-001. Repair as necessary.

Verifying overall radio operation by performing an operations check.

### 11.3 STATUS AND ERROR CODES DISPLAYED AT CONTROL HEAD

The following table lists and defines error codes for EDACS, conventional and P25 modes. 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 11-1: Error Codes for EDACS, Conventional and P25 (ECP) Modes

DISPLAYED CODE	MEANING
<b>FATAL SYSTEM ERROR CODES:</b>	
<b>Startup Errors</b>	
(0x0001)	Non-maskable interrupt occurred outside of sleep routine
(0x0002)	32k RAM test error
(0x0003)	Not used
(0x0004)	Flash memory checksum test error
(0x0005)	Flash memory part is unknown
(0x0006)	FIPS random IV test error
(0x0007)	FIPS bypass test error
(0x0008)	FIPS no voice keys error
(0x0009)	Flash memory write error
(0x0010)	Timing generator driver failed initialization
(0x0011)	DSP driver failed initialization
(0x0012)	Abbie driver failed initialization
(0x0013)	EEPROM memory driver failed initialization
(0x0014)	ICP digital failed initialization
(0x0015)	INTOUT driver failed initialization
(0x0016)	INTIN driver failed initialization
(0x0017)	RADIO driver failed initialization
(0x0018)	MODEM driver failed initialization
(0x0019)	EXTIO driver failed initialization
(0x0020)	SCI driver failed initialization
(0x0021)	ICP PROM checksum error
(0x0022)	I2C driver initialization error
(0x0023)	I2C driver mode change error
(0x0024)	I2C driver write error
(0x0025)	UART driver failed initialization
(0x0026)	Timer failed initialization
<b>ADI Driver Fatal Error Codes</b>	
(0x0030)	ADI did not respond to command
(0x0039)	FIPS DES self test had incorrect result
<b>LCD Driver Fatal Error Codes</b>	
(0x0040)	LCD did not acknowledge message
(0x0041)	LCD hardware is invalid
<b>SCI Driver Fatal Error Codes</b>	
(0x0050)	SCI out of heap space
<b>CAN Driver Fatal Error Codes</b>	
(0x0060)	CAN server semaphore initialization failure
<b>IPC DSP Driver Fatal Error Codes</b>	
(0x0070)	DSP did not read a message within 500 milliseconds

**Table 11-1: Error Codes for EDACS, Conventional and P25 (ECP) Modes** (Continued)

DISPLAYED CODE	MEANING
(0x0071)	DSP gave a response longer than buffer
(0x0072)	DSP did not read stream data within 500 milliseconds
(0x0073)	ARM tried to write more data than DSP could store
(0x0074)	ARM tried to write DSP code and failed
(0x0075)	ARM did not get an acknowledgement of a command to the DSP
<b>Radio Driver Fatal Error Codes</b>	
(0x0080)	Transceiver failed to program synthesizer due to data collision(s)
(0x0081)	Transceiver failed to program MCU
(0x0082)	Transceiver failed to find proper calibration data
(0x0083)	Transceiver MCU failed to program receiver ADC
<b>Boot Loader Fatal Error Codes</b>	
(0x0090)	No memory space for ROM task
(0x0091)	No memory space for BL task
(0x0092)	Boot loader could not attach to SCI
<b>MCBSP Fatal Error Codes</b>	
(0x0093)	McBSP configuration error
<b>RXSIF Primitive Fatal Error Codes</b>	
(0x0098)	RXSIF fatal error
<b>Operating System Fatal Error Codes</b>	
(0x0100)	Interrupt had no handler
(0x0101)	Pre-fetch abort handler
(0x0102)	Data abort handler
(0x0103)	Reserved interrupt handler
(0x0104)	Unexpected interrupt handler
(0x0105)	Interrupt handler failed to set-up the IRQ
(0x0106)	OS fork creation process failed
(0x0107)	OS pipe creation process failed
(0x0108)	OS task creation process failed
(0x0109)	Task stack overflowed
(0x0110)	OS timer task creation failed
(0x0111)	OS returned fatal error
(0x0112)	OS fork stack overflowed
(0x0113)	OS priority fork stack overflowed
(0x0114)	GPIO config was wrong - check radio config
(0x0115)	MPUIO config was wrong - check radio config
(0x0116)	Could not set radio type right using sector 0
(0x0117)	Failure in download system
(0x0118)	Memory allocation failed
(0x0119)	Semaphore pending error
(0x0120)	Semaphore post operation error
(0x0121)	OS fork stack had nucleus error

**Table 11-1: Error Codes for EDACS, Conventional and P25 (ECP) Modes** (Continued)

DISPLAYED CODE	MEANING
(0x0122)	OS priority fork stack had nucleus error
<b>FATAL APPLICATION ERROR CODES:</b>	
<b>RADC Fatal System Error Codes</b>	
(0x2200)	PERS tracking data error
(0x5201)	PERS hardware data error
(0x4202)	PERS frequency data error
(0x1203)	PERS tracking data memory error
(0x1204)	PERS tracking data checksum error
(0x1205)	Hardware revision could not be determined
<b>DACS Fatal System Error Codes</b>	
(0x3300)	No lock message
(0x1301)	Unable to correctly configure modem for EDACS operation
(0x1302)	ProSound scan failed
(0x1303)	CISYS message buffer not enabled
(0x1304)	Failure in Tx frequency load
(0x1305)	Failure in Rx frequency load
(0x1306)	Failure to transmit CC header data
(0x1307)	Failure to set up CC receiver
(0x1308)	Failure to set up WC receiver
(0x1309)	Failure to set up WC LSD receiver
(0x1310)	Failure to set up WC HSD receiver
(0x1311)	Failure to transmit body of CC message
(0x1312)	Failure to idle transmitter
(0x1313)	Failure to transmit body of WC message
(0x1314)	Failure in RADC speaker function
(0x1315)	Failure to transmit WC HSD
(0x1316)	Failure to select TX hardware path
(0x1317)	Failure to transmit DTMF digit
(0x1318)	Failure to transmit LSD
(0x1319)	Failure of HSD sync setup
<b>EA Fatal System Error Codes</b>	
(0x1350)	Memory failure message
<b>Conventional Fatal System Error Codes</b>	
(0x1400)	Error calling RADC function
(0x3401)	Synthesizer became unlocked
(0x1402)	UI message buffer not enabled
(0x1403)	Conventional digital voice modem overflow
(0x1404)	Conventional digital voice modem underflow
(0x1405)	Unable to correctly configure the modem for conventional digital voice operation
(0x5407)	Conventional personality error

**Table 11-1: Error Codes for EDACS, Conventional and P25 (ECP) Modes** (Continued)

DISPLAYED CODE	MEANING
(0x1408)	Error calling RADC function in ECP1 scan
(0x1409)	Error calling RADC function in CHANUTIL - channelized
(0x1410)	Error calling RADC function in CHANUTIL - absolute frequency
(0x1411)	Error calling RADC function in CONVTX – channelized
(0x1412)	Error calling RADC function in CONVTX - absolute frequency
(0x1413)	Error calling RADC function in CONVTX - idle mode
(0x1450)	Error calling RADC function in CONVTX - idle mode
(0x1451)	Error calling RADC function in trunked P25
(0x1452)	Error reading serial number
(0x1453)	Bad message type requested
<b>Personality Interface Fatal System Error Codes</b>	
(0x5500)	Personality data is not present
(0x5501)	Flash personality Cyclic Redundancy Check (CRC) did not match EEPROM's CRC
(0x5502)	Personality descriptor table CRC error
(0x1503)	Descriptor table memory error
(0x5504)	Custom frequency set table error
<b>User Interface Fatal System Error Codes</b>	
(0x5600)	Input/Output device error
(0x1601)	Out of memory
(0x1602)	Maximum number of timers exceeded
(0x1603)	Too many open windows
(0x1604)	Out of memory
(0x1605)	Invalid parameter
(0x1606)	RI BBOS message buffer full error
(0x1607)	RI System (EDACSBOS message buffer full error)
(0x1608)	CI BBOS message buffer full error
(0x5609)	I/O device type from personality not supported
(0x1610)	No more memory
(0x5611)	Network I/O device error
(0x6612)	Control head ID is invalid
(0x5613)	No tone data is available in personality
(0x1614)	UI IBBOS message buffer full error
(0x1615)	No more memory
(0x1616)	No more memory
(0x1617)	UI message received error
<b>Test Unit Fatal System Error Codes</b>	
(0x1701)	Rx message buffer memory failed
(0x1702)	Tx message buffer memory failed
(0x1703)	BB message to UI task failed
(0x1704)	BB message to RISYS task failed
(0x1705)	BIOS call for voter monitor failed

**Table 11-1: Error Codes for EDACS, Conventional and P25 (ECP) Modes** (Continued)

DISPLAYED CODE	MEANING
<b>FIPS 140 Fatal System Error Codes</b>	
(0x1902)	Invalid DESMAC key
(0x1903)	DESMAC checksum failed
(0x1904)	DESMAC DSP attach failed
<b>RI Fatal System Error Codes</b>	
(0x6901)	Multi-radio devices stopped communicating
<b>NON-FATAL APPLICATION ERROR CODES:</b>	
<b>Common Error Messages</b>	
(1)	Feature encryption error message
(2)	Synthesizer unlocked
(3)	No key banks allocated in personality
(5)	Tracking data was in error; using default
(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
<b>Flags to Set Persistent Error Messages</b>	
(0x8000)	Set persisting error condition, error will be cleared with another call
(0x1000)	Clear persisting error condition
<b>Personality Interface Non-Fatal System Error Codes (Feature Encryption Errors)</b>	
(0x0550)	Cannot read SROM
(0x0551)	Personalities sizes don't match
(0x0552)	Decryption failure
(0x0553)	Tracking data failure
<b>Dual Personality Errors</b>	
(0x0580)	Personality failure
(0x0581)	Tracking data failure
(0x0582)	Feature data failure
(0x0583)	Image failure
<b>Calibration Parameter Error Codes</b>	
(0x0560)	ECP calibration data missing; data updated to current defaults
(0x0561)	Calibration data update failed
(0x0562)	ECP calibration data older than current revision; data updated to current defaults
(0x0563)	ECP calibration data newer than current revision
(0x0590)	TestApp calibration data missing; data updated
(0x0591)	TestApp calibration data update failed
(0x0592)	TestApp calibration data older than current revision; data updated to current defaults

**Table 11-1: Error Codes for EDACS, Conventional and P25 (ECP) Modes** (Continued)

DISPLAYED CODE	MEANING
(0x0593)	TestApp calibration data newer than current revision
<b>USER INTERFACE NON-FATAL SYSTEM ERROR CODES:</b>	
(0x0880)	Group is set to digital but system vocoder is set to analog
(0x0883)	IMBE is not supported by DSP
(0x0885)	Attempt to use IMBE vocoder with IMBE feature turned off
(0x0886)	Attempt to use encryption but DSP doesn't support encryption
(0x0887)	Attempt to use encryption but encryption is turned off
(0x0890)	Hardware revision could not be determined
(0x0891)	No G-STAR response from DSP
(0x0892)	No tone encode response from DSP
(0x0894)	DSP did not respond to key query

## 11.4 RF PERFORMANCE TESTS

### 11.4.1 General Information

This section includes RF performance test procedures for the VHF M7300 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 110-Watt VHF M7300 mobile radio installation are included in the *Installation and Product Safety Manual*, publication number MM-014763-001, revision J (or later). These test procedures test basic aspects of the radio and control head installation, including the installation's antenna system.



**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.**

**The PK Board and the RF Processor Board are serialized during final test procedures performed at the factory. If board replacement is deemed necessary, returning the complete radio to Harris for repair is highly recommended. If any component in an RF signal path is replaced, retuned, or disturbed in any way, the complete radio should be tested and aligned per the respective procedures in this manual or the radio should be returned to Harris for repair.**



Observe precautions for damage due to **Electro-Static Discharge (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.



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 11.4.3 that follows.

### 11.4.2 Test Equipment

Table 11-2 lists test equipment required for mobile radio RF performance tests included in this manual.

**Table 11-2: Test Equipment for RF Performance Tests and Alignments**

<b>EQUIPMENT</b>	<b>RECOMMENDED TYPES / MODEL NUMBERS</b>
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, 150-Watt, Type-N Female*	Bird Tenuline® 150-SA-FFN-30 or 150-A-FFN-30 or equivalent
Modified Microphone**	Harris Part Number MC-101616-041 modified similar to Tech Tips modification instructions in the Technical Training Toolbox on the Tech Link web site. ( <a href="https://premier.pspc.harris.com/infocenter/TechLink">https://premier.pspc.harris.com/infocenter/TechLink</a> )
Modified Speaker**	Harris Part Number LS102824V10 modified similar to Tech Tips modifications instructions in the Technical Training Toolbox on the Tech Link web site. ( <a href="https://premier.pspc.harris.com/infocenter/TechLink">https://premier.pspc.harris.com/infocenter/TechLink</a> )
Personal Computer (PC) with Radio Personality Manager (RPM) Programming Software	Laptop PC recommended with RPM Release R8A or later (See Section 10.1 on page 27 and/or Table 11-6 on page 51 for additional information).
Serial Programming Cable***	CA-104861 (5 feet long) <u>or</u> CA-013671-020 (20 feet long) <u>or</u> equivalent
DC Power Cable with Fuses (for Powering Radio)	Harris Part Number 14002-0167-01
DC Power Cable with Fuses (for Powering Control Head)	Harris Part Number CA-012616-001
CAN Cable	Harris Part Number CA-009562-030
CAN Terminators (2)	Harris Part Number CD-014027-001
Speaker Cable	Harris Part Number MAMROS0034-NN006
Option Cable	Harris Part Number CA-012349-001
Power Supply	Adjustable Regulated DC-Output Power Supply capable of adjustment from 12 to 15 Vdc (minimum) and 30-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 150 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 18 for the respective contact information.

**NOTE**

**The RF Communications Test Set should have a frequency accuracy equal to or better than 0.15 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.**

### 11.4.3 Recommended Conventional Test Personality

To create a conventional test personality for M7300 radio testing, use RPM to create and program one into the radio as follows. Also refer to Section 10.3 and/or RPM's built-in help as necessary:

1. If the personality currently in the radio is not available on computer storage media, use RPM's read function to read it from the radio and store it for later restoration.

#### Create the Analog Conventional Test System

2. Create a new conventional system using RPM's Add New System button. This button is located on the System Setup dialog box's General tab.
3. Configure this new conventional system with at least the analog conventional test channels listed in Table 11-3. Achieve this by creating a new conventional (channel) set with the listed channels and assigning the set to the new system.
4. Verify each channel's Voice Mode is set to Analog. If not, make this change.

**Table 11-3: 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	RX CG (Hz)	TX CG (Hz)	OTHER SETTINGS
136.025	136.025	136.025A	136.025P	"Wide" (25 kHz) for Analog Conv.; "C4FM" (12.5 kHz) for P25 Conv.	156.7	156.7	Leave at RPM Defaults
155.000	155.000	155.000A	155.000P				
173.975	173.975	173.975A	173.975P				



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.

5. In the System Setup dialog box, click the General tab and select the test system.
6. Verify "MAX" is present in the Power Level text box. If not, enter that so the radio will transmit at full-power when in high-power transmit level. Exit this dialog box and save changes by clicking the OK button.
7. 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 11.4.4.
8. Add the SQUELCH function as a selection on the conventional menu. This menu is necessary for the receiver performance test procedures in Section 11.4.5.
9. Add the FCC MENU function as a selection on the conventional menu. This menu is necessary for P25-related test procedures in Sections 11.4.4 and 11.4.5.
10. Continue by creating a new P25 test system.

#### Create the P25 Conventional Test System

11. Create a new P25 conventional system using RPM's Add New System button.

12. Configure this new P25 conventional system with at least the P25 conventional test channels listed in Table 11-3. To do this, create a new P25 conventional (channel) set with the listed channels and assigning the set to the new system.
13. Set each P25 test channel's Voice Mode to P25 and Bandwidth to C4FM.
14. Set each channel's Tx NAC and Rx NAC as desired, or leave them at the default values of 293.
15. 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).
16. Save this personality and program it to the radio. Refer to Section 10.3 and/or RPM's built-in help as necessary.

#### 11.4.4 Transmitter Performance Tests

##### 11.4.4.1 Tx Frequency Test

Use the procedure in this section to check the accuracy of the radio's Temperature-Compensated Crystal Oscillator (TCXO) frequency and transmitter 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 0.15 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).

1. With the DC power supply output **off**, connect the radio and control head to the supply. To make these connections, use standard DC power installation cables with fuses as follows:

**Radio to Power Supply:** Use cable 14002-0167-01 with a 30-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. Leave the cable's white wire unconnected and insulated.


**Control Head to Power Supply:** Use cable CA-012616-001 with a 5-amp fuse in the 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 cable's white wire to the power supply's positive output terminal with a 3-amp fuse in the white wire (switched power).



CAUTION

**Always observe polarity when making connections to the power supply!**

2. Connect the control head to the radio via the CAN cable.
3. Terminate both ends of the CAN link by installing a CAN terminator onto each unterminated CAN port connector.
4. Connect the modified speaker to the control head via speaker cable MAMROS0034-NN006. One end of this 6-inch speaker cable mates to the 2-pin circular connector on the rear of the control head, and the other end mates to the 2-pin rectangular connector of the modified speaker's cable.

5. 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 150 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 150 watts.
6. Set the DC power supply's output voltage to 13.6 Vdc with a current limit between 25 and 30 amps.
7. **Power-up the radio and the control head and allow at least a 15-minute warm-up period.**
8. At the control head, select the analog conventional test system and then select one of the test channels within that system.
9. Configure the test set's frequency counter for an in-band frequency count.
10. Temporarily disable receive and transmit CTCSS operation (i.e., Channel Guard) by depressing the control head's CLR button for approximately two (2) seconds. The display's  icon remains off when CTCSS operation is disabled.
11. Key the radio by depressing the microphone's PTT button and verify the radio is transmitting per a lit red Tx (transmit) indicator at the control head.
12. Use the test set's frequency counter function to accurately measure the transmit frequency.
13. Unkey the radio.
14. Change channels at the control head and repeat the transmit frequency measurements for the other two (2) test channels listed in Table 11-4. After changing channels, be sure to disable CTCSS operation. Always unkey the radio before making a channel change.
15. Verify each measured transmit frequency is within the respective error limits listed in Table 11-4. 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**

TCXO reference oscillator alignment procedures are included in Section 11.5.5.2 which begins on page 68. This alignment is sometimes referred to as "Automatic Frequency Control" (AFC) alignment.

16. Unkey the radio.
17. 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 11-4: Maximum Transmit Frequency Errors for Recommended Test Channels

TEST TX FREQUENCY (MHz)	MAXIMUM TRANSMIT FREQUENCY ERROR ( $\pm 1.5$ ppm)	MINIMUM TX FREQUENCY (MHz)	MAXIMUM TX FREQUENCY (MHz)	MEASURED FREQUENCY (MHz)	PASS/ FAIL
136.025	204 Hz	136.024796	136.025204		
155.000	232 Hz	154.999768	155.000232		
173.975	261 Hz	173.974739	173.975261		

Radio Part Number:	Radio Serial Number:	PASS/ FAIL	Test Date:	Technician's Initials:
RU-144750-051				



Do **not** return the radio to normal use if any channel's transmit frequency exceeds an error limit.

#### 11.4.4.2 Tx Power Levels Test

Follow this procedure to check the M7300 radio's transmitter output power levels.

1. If the transmitter frequency test procedure has not been performed per Section 11.4.4.1, 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 11-5, 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. At the control head, switch the radio to low-power transmit level.



To switch between high-power and low-power transmit levels, press the control head's MENU button, then use the ●/●● ramp control 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.

5. Select each test transmit frequency listed in Table 11-3, 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 11-4. 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 11-4.

Table 11-5: Transmitter Power Test—Maximum Errors

TX POWER LEVEL SETTING	TOLERANCE (dB)	LIMITS		MEASURED TX POWER (Watts)	PASS/ FAIL
		MINIMUM TX POWER (Watts)	MAXIMUM TX POWER (Watts)		
Low (50 watts)	±0.5 dB	44.5	56.1		
High (110 watts)	±0.25 dB	103.8	116.4		

Radio Part Number:	Radio Serial Number:	PASS/ FAIL	Test Date:	Technician's Initials:
RU-144750-051				



NOTE

Transmit power level alignment information is included in Section 11.5.5.3 (page 70).

- Unkey the radio.
- 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 11-5.

### 11.4.4.3 Conventional Tx Modulation Limiting Tests

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

- If the transmitter frequency test procedure has not been performed per Section 11.4.4.1, do that now. Leave the radio and test equipment connected and configured as described in that procedure.
- Adjust the RF Communication Test Set's audio signal generator output for a 1 kHz audio signal at a level of 200 mV rms.
- Connect this 1 kHz signal to the control head's microphone input. To make this connection, use a modified microphone (see Table 11-2 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.
- Select the analog conventional test system and select any test channel within that system.
- Switch the radio to high-power transmit level via the control head.
- Configure the test set for an on-frequency transmitter FM deviation measurement.
- Temporarily disable receive and transmit CTCSS operation (i.e., Channel Guard) by depressing the control head's CLR button for approximately two (2) seconds. The display's  $\text{C}_\text{G}$  icon remains off when CTCSS operation is disabled.
- Key the radio via the modified microphone and verify it is transmitting per a lit red Tx (transmit) indicator at the control head.

9. Measure FM deviation and verify it is between 4.3 and 4.7 kHz. 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:
RU-144750-051				



FM deviation in excess of 5.0 kHz on a wideband (25 kHz) channel may violate FCC rules on wideband RF channels.



FM deviation alignment information is included in Section 11.5.5.5 which begins on page 77.

10. Unkey the radio.

11. 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.



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

#### 11.4.4.4 P25 (C4FM) Tx Modulation Test

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

1. If the transmitter frequency test procedure has not been performed per Section 11.4.4.1, do that now. Leave the radio and test equipment connected and configured as described in that procedure.
2. Select the P25 conventional test system and select any test channel within that system.
3. Configure the test set for an on-frequency transmitter peak-positive FM deviation measurement.
4. 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.
5. Disable the deviation meter's de-emphasis function.
6. Press the control head's MENU button, then use the  $\bullet/\bullet\bullet$  ramp control to scroll through the menu until FCC Menu appears in the middle line of the display, and then press the MENU button again.
7. Use the  $\bullet/\bullet\bullet$  ramp control 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.
8. Measure the deviation at the test set. It should be between 2544 and 3111 Hz. 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:
RU-144750-051				



NOTE

For related alignment information, refer to the I/Q Data Modulation Alignment procedure in Section 11.5.5.4 (page 74). This alignment is performed in a single side-band mode.

9. Press the MENU button again to unkey the radio.
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.

### 11.4.5 Receiver Performance Tests

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

#### 11.4.5.1 Audio Output and Distortion Levels 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 control head 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 and control head to the supply. To make these connections, use standard DC power installation cables with fuses as described in step 1 of Section 11.4.4.1 (page 42). **Always observe polarity when making connections to the power supply!**
2. Connect the control head to the radio via the CAN cable.
3. Terminate both ends of the CAN link by installing a CAN terminator onto each unterminated CAN port connector.
4. Connect the modified speaker to the control head via speaker cable MAMROS0034-NN006. One end of this 6-inch speaker cable mates to the 2-pin circular connector on the rear of the control head, and the other end mates to the 2-pin rectangular connector of the modified speaker's cable.
5. Connect the speaker output of the control head 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 11-2 for additional information).



CAUTION

The modified speaker contains a 1:1 audio coupling transformer to couple the control head'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.


6. Switch the modified speaker's double-pole switch to the load position (i.e., speaker off).
7. Set the DC power supply's output voltage at 13.6 Vdc at a current limit between 6 and 8 amps.
8. Turn the power supply's output on, if it is not already.

9. **Power-up the radio and the control head and allow at least a 5-minute warm-up period.**



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.

10. Set the control head's volume control to a mid-range position.
11. Select the analog conventional test system.
12. Select any analog conventional test channel listed in Table 11-3. Make a system and channel change as necessary.  
Alternately, select any customer channel that can be used for radio testing.
13. Temporarily disable receive and transmit CTCSS operation (i.e., Channel Guard) by depressing the control head's CLR button for approximately two (2) seconds. The display's  icon remains off when CTCSS operation is disabled.
14. 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).
15. Set the RF Communication Test Set on-frequency with an RF output level of -47 dBm (1000  $\mu$ V). Modulate the RF output with a 1 kHz tone with a 3 kHz deviation (60% rated system deviation for wideband channel). This is considered a full-quieting RF signal for a wideband channel.
16. Verify the radio is receiving the full-quieting RF signal. If not, recheck connections and/or radio and test equipment configurations.
17. Set the control head's volume control to maximum (fully clockwise).
18. Using the test set's audio analyzer or AC voltmeter, verify the speaker output audio level is at least 7.745 Vrms. This is 15 watts into the 4-ohm speaker load.
19. Using the test set's audio analyzer, measure the distortion level of the 1 kHz tone from the radio/control head. It should be less than 5%.
20. Reduce the volume control to a relatively low setting.
21. Switch the modified speaker's double-pole switch to the speaker position.
22. Adjust the volume control to at least a mid-range setting to verify the 1 kHz tone from the speaker is loud and clear.
23. 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:
RU-144750-051				

24. 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.

### 11.4.5.2 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 11.4.5.1. 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 control head have sufficient output capability and minimal distortion, and that other related circuits are operating properly.

2. If using the recommended test channels, select the first test channel listed in Table 11-3. Make a system and channel change as necessary.

If using the customer's channels, select the channel with the lowest frequency.

3. 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 the conventional menu as described in Section 11.4.3. In this case, disable squelch as follows:

- Press the control head's **MENU** button.
- Press the **•/••** ramp control to scroll through the conventional menu until **SQUELCH** appears in the middle line of the display.
- Press the **MENU** button again.
- Press the **•/••** ramp control **down** until **SQUELCH=1** appears in the top line of the display. At this point, squelch is at a minimum setting and essentially disabled.

4. Set the RF Communication Test Set on frequency with an initial RF output level of approximately -100 dBm (2.25  $\mu$ V), and verify the radio is receiving the RF signal from the test set. If not, recheck connections and/or radio and test equipment configurations.
5. Configure the RF Communication Test Set for a 12 dB SINAD level measurement. Modulate its RF output with a 1 kHz tone at 3 kHz deviation (60% rated system deviation for wideband channel). Reduce/Adjust the test set's RF output level as necessary to obtain a 12 dB SINAD level reading. Control head volume control adjustments may also be necessary.
6. 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. The channel must be programmed for wideband operation.
7. 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.

8. 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:
RU-144750-051				

9. Using the SQUELCH menu, re-enable squelch by returning its level to the original setting.
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.

### 11.4.5.3 P25 (C4FM) Rx Sensitivity Test

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

- Complete the Audio Output and Distortion Levels Tests presented in Section 11.4.5.1. Leave the radio and all test equipment interconnected and configured per that procedure.
- Select the P25 conventional test system and a test channel within that system.
- Set the RF Communication Test Set on frequency at an RF output level of -116 dBm (0.35  $\mu$ V).
- Modulate the test set with a standard 1011 P25 (C5FM) test pattern.
- Press the control head's MENU button, then use the  $\bullet/\bullet\bullet$  ramp control to scroll through the menu until FCC Menu appears in the middle line of the display, and then press the MENU button again.
- Use the  $\bullet/\bullet\bullet$  ramp control to scroll through the FCC menu until IBERC4FM appears, and select that function by pressing the MENU button again. The radio displays the internally calculated Bit Error Rate (BER) of the received test pattern.
- Press the MENU button again to toggle the display from fast BER to slow (averaging) BER.
- 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.
- 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:
RU-144750-051				



For related alignment information, refer to the procedure in Section 11.5.5.7.

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.

## 11.5 RADIO ALIGNMENT

Programming, alignment, and servicing aspects of maintaining a M7300 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.

### 11.5.1 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 11-6, must be installed and operating on the technician's PC.
- The minimum version of ECP radio firmware codes, as listed in Table 11-7, must be installed into the radio.
- Test equipment as listed in Table 11-2 (page 40) 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 11-6 which are required when programming, aligning, and servicing the M7300 mobile radios.

**Table 11-6: Minimum RPM Programming Software Versions**

RPM RADIO SOFTWARE	PART NUMBER	VERSION
RPM for EDACS, ProVoice and P25 Trunked Systems	TQS3385	R08B or later
RPM for Conventional and P25 Conventional Systems	TQS3389	R08B or later

The minimum version of radio ECP firmware codes listed in Table 11-7 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 11-7: Minimum Versions of ECP Radio Firmware Codes for M7300 Radios**

OMAP RADIO SOFTWARE	VERSION
BootApp	R12A or later
LoaderApp	R12B or later
BurnApp	R10A or later
ECP Radio Code	R15A or later

### 11.5.2 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 M7300 mobile radio.

The Radio Maintenance Utility is primarily used with the radio operating from a test personality in analog conventional mode. C4FM squelch alignment uses a P25 conventional system to align analog conventional squelch. 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.

### 11.5.3 Reading and Saving Feature License Data, Calibration Data, and Personality Files

M7300 mobile radios depend upon feature license data and calibration data for its 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.



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!



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 procedure focuses on reading feature and calibration data files from a M7300 series 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.



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 of 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 M7300 radios.

#### 11.5.3.1 Entering Programming Mode

##### Automatically Entering Programming Mode:

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

1. As illustrated in Figure 10-1 on page 28, connect the control head to the radio and connect the control head and radio to a DC power source.
2. Turn off the radio and control head via the control head’s on/off/volume knob.

3. Power-up the PC that has the RPM programming software installed on it, and start Windows.
4. Start the RPM programming software.
5. Using a serial programming cable, connect the radio to the PC with the RPM programming software. See Figure 10-1.
6. Turn on the radio and control head. After RPM communicates with the radio, “PROGRAM” appears in the control head’s display, indicating the radio has automatically entered program mode.
7. Continue with personality programming or calibration procedures as described elsewhere in this manual.
8. Turn the radio off and disconnect the programming cable after programming is complete.

If at any time 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 illustrated in Figure 10-1 on page 28.
2. Turn off the radio and control head via the control head’s on/off/volume knob.
3. While simultaneously depressing the control head’s A and C preset buttons, turn the radio and control head on via the head’s on/off/volume knob, then release both buttons. After the “Booting” message clears, a “PROGRAM Please Wait...” message should appear in the control head’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 Menu:**

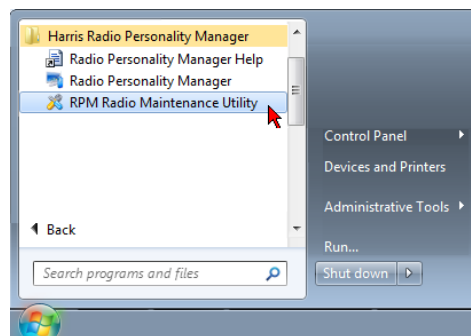
If the existing personality in the radio has the Program menu enabled, the programming mode can be manually entered by selecting this menu.

## 11.5.3.2 Reading and Saving Feature License Data

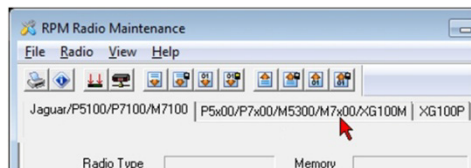
Follow this procedure to read and save a radio’s feature license data:

1. Enter programming mode as described in Section 11.5.3.1.
2. At the PC with the RPM programming software, start the Radio Maintenance Utility:

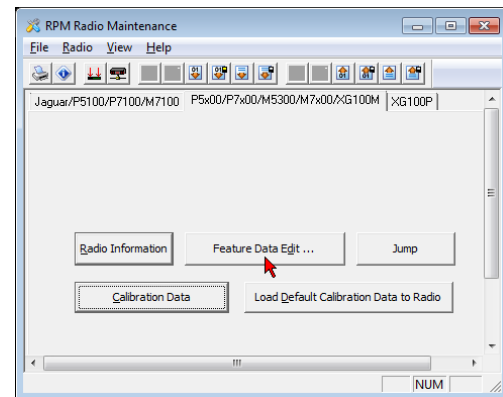
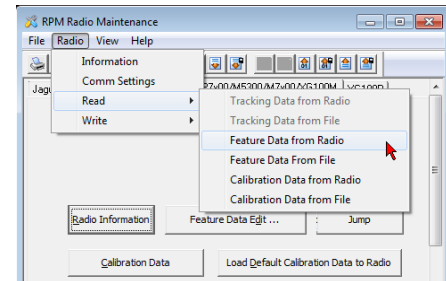
Click: **Start > Programs > Harris Radio Personality Manager > RPM Radio Maintenance Utility**



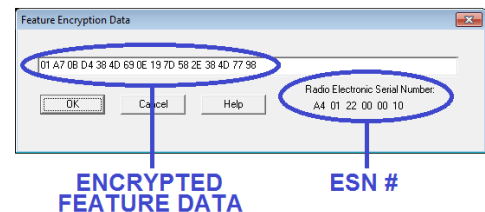
3. Within the utility, click on the tab that includes **M7x00** (for the M7300 and other radios).



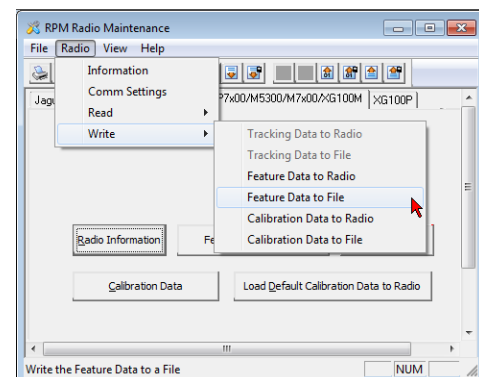
4. From the utility's menu:  
Select: **Radio > Read > Feature Data from Radio**
5. When the Read Feature Data Complete message box appears:  
Click: **OK**
6. In the tab that includes **M7x00**:  
Click: **Feature Data Edit**



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.

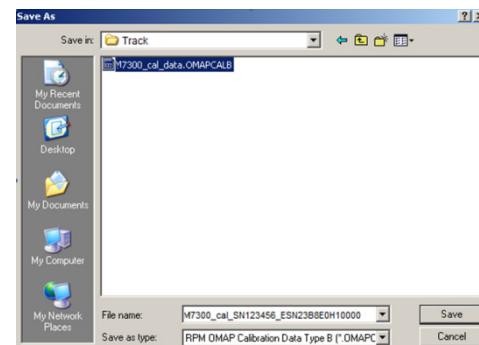


8. From the utility's menu:  
Select: **Radio > Write > Feature Data to File**  
This action opens up the "Save As" dialog box to the default calibration and feature data folder. If desired, the folder/path may be changed.



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**



## 11.5.3.3 Reading and Saving Calibration Data

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

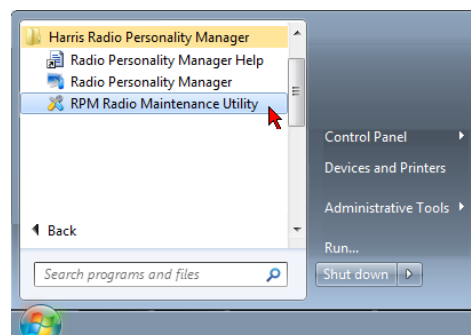


NOTE

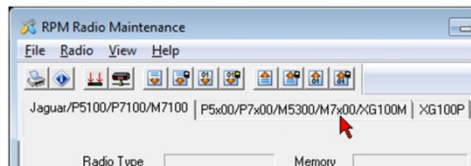
The radio must have R15A or later code before calibration data can be read from or written to it. See Section 11.5.1 on page 51 for details.

1. Enter programming mode as described in Section 11.5.3.1.
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. Click on the tab that includes **M7x00** (for the M7300 and other radios).

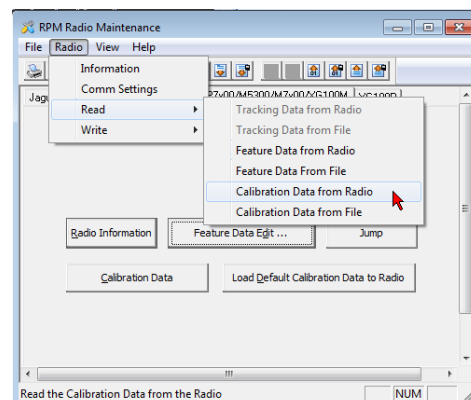


4. From the utility's menu:

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

5. When the Calibration Data Complete dialog box opens:

Click: **OK**



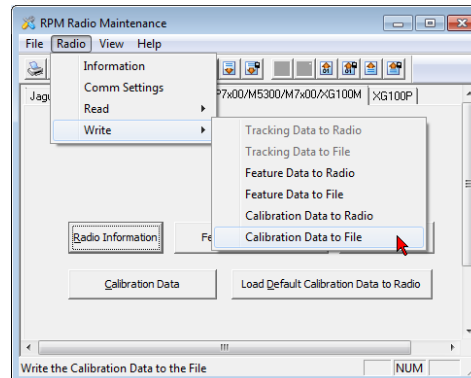
6. From the utility's menu:

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**

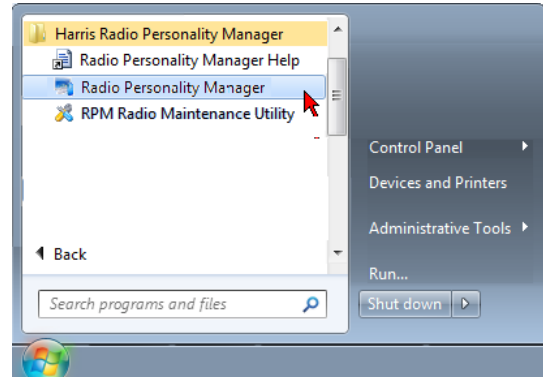


### 11.5.3.4 Reading and Saving the Radio Personality

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 11.5.3.1.
2. At the PC with the RPM programming software, start this software:

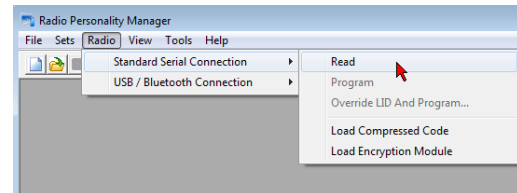
Click: **Start > Programs > Harris Radio Personality Manager > Radio Personality Manager**



3. From RPM's main menu:

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

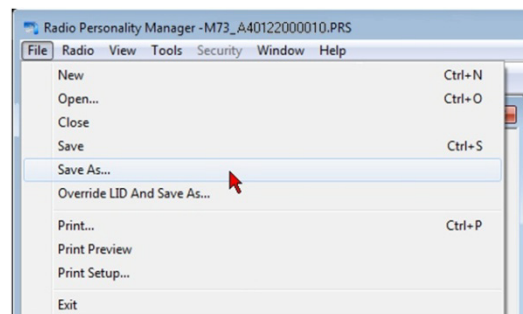
After the radio personality is read, the Personality window will appear.



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

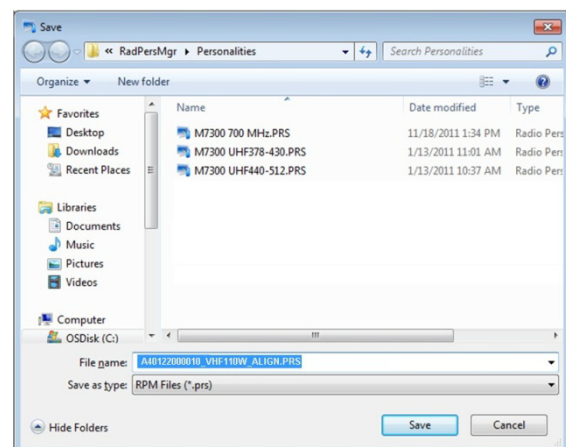
Click: **File > Save As**

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**



## 11.5.4 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. However, this procedure may be adapted to the creation of a new “shop” test personality specific to each RF band of the M7300 mobile radio series.

### 11.5.4.1 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 11.5.3.1 as necessary.
2. Verify the feature and calibration data files have been saved to local disk. Refer to Sections 11.5.3.2 and 11.5.3.3 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 11.5.3.4 as necessary.

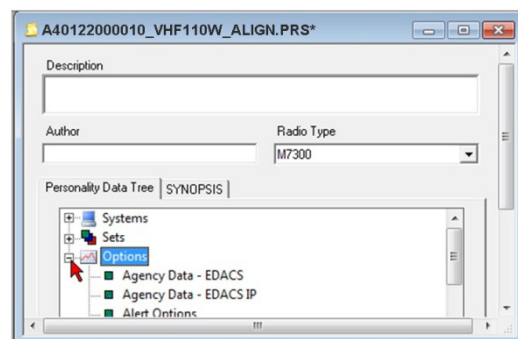


NOTE

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.

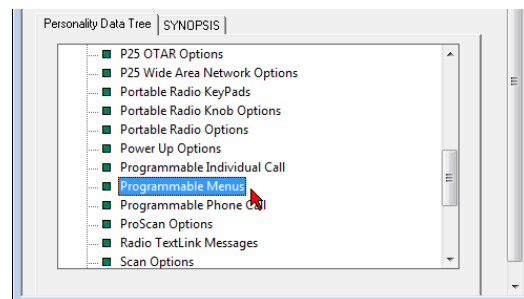
4. In the Personality Data Tree:

Click: **Options**



5. Scroll down the Options limb:

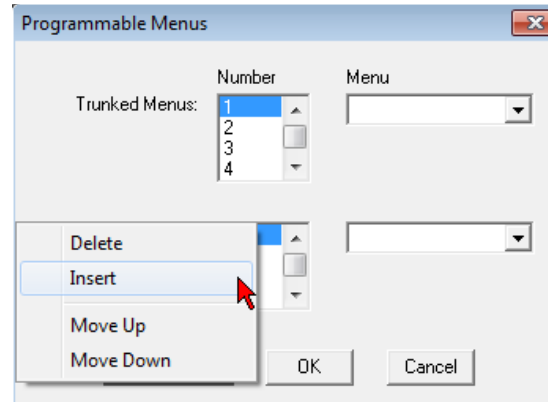
Double-click: **Programmable Menus**



6. Within the Conventional Menus Number box:

Double-click: **1**

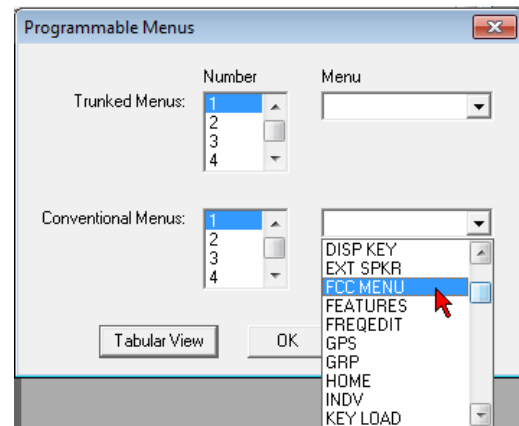
Click: **Insert**



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.

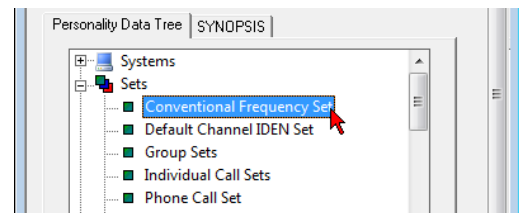
8. In the Personality Data Tree:

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.

- 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: **M73V TXW**

Click: **OK**

Use the illustration to the right, or reference Table 11-8, and enter for each channel, the channel name, TX and RX frequencies, select High Power, and set any other features as indicated by the outlined boxes. Enter all 20 channels.

This set is used to align the radio's reference oscillator (TCXO), and its high, mid, and low TX power.

- 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: **M73V IQ**

Click: **OK**

Use the illustration to the right, or reference Table 11-9, and enter the channel name, TX and RX frequencies, select High Power, 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.

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: **M73V SQW**

Click: **OK**

Use the illustration to the right, or reference Table 11-10, 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 wide-band squelch.

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: **M73V SQN**

Click: **OK**

Use the illustration to the right, or reference Table 11-10, 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 narrow-band squelch.

13. In the P25 Conv Frequency Set tab of the Conventional Frequency Sets dialog box, add the following new P25 frequency set:

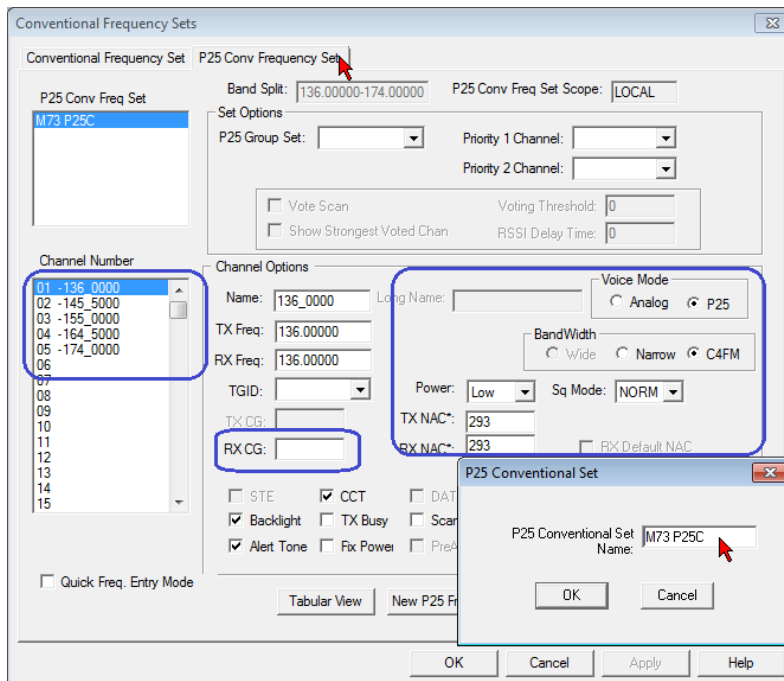
Click: **New P25 Freq Set**

Type: **M73 P25C**

Click: **OK**

This set is used for aligning C4FM squelch functions.

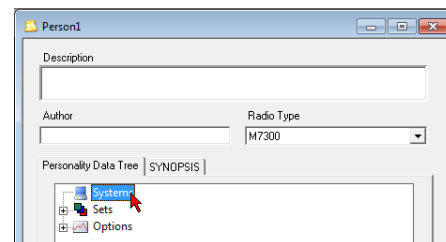
Use the illustration to the right, or reference Table 11-10, and enter the channel name, frequency, and set any other features as indicated by the outlined boxes. Enter all 5 channels.



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

15. In the Personality Data Tree, assign these newly-created frequency sets to new systems:

Double-click: **Systems**



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

Click: **Add New System**

17. In the New System box:

Type: **M73V HP**

Select: **Conventional**

Click: **OK**

18. Repeat steps 16 and 17, except create a new system for each of the following previously-created frequency sets:

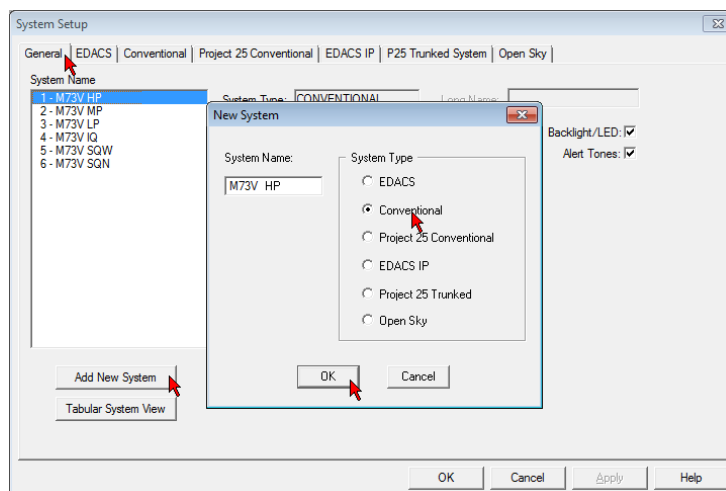
**M73V MP**

**M73V LP**

**M73V IQ**

**M73V SQW**

**M73V SQN**



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

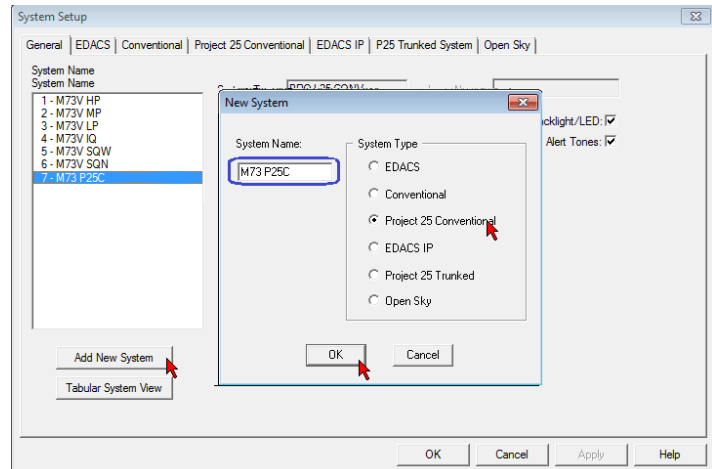
Click: **Add New System**

20. In the New System box:

Select: **Project 25 Conventional**  
(tab)

Type: **M73 P25C**

Click: **OK**



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

Click: **Conventional** tab

22. In the System Name field:

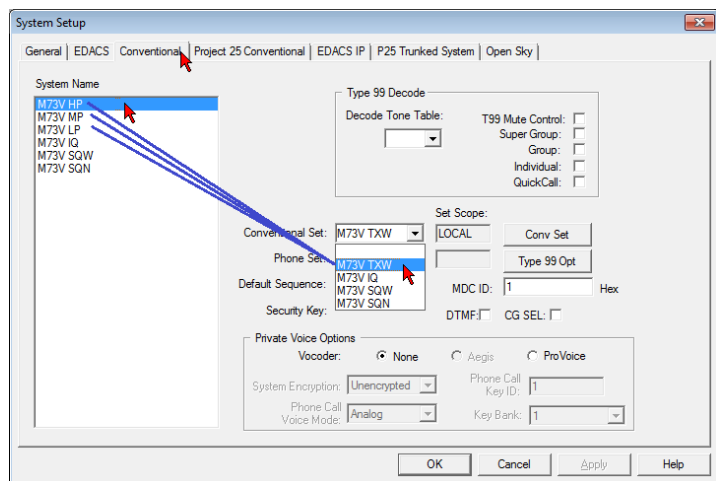
Select: **M73V HP**

23. In the Conventional Set dropdown:

Select: **M73V TXW**

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.)



25. Repeat steps 22 and 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:

<u>System Name</u>	<u>Conv. Freq. Set</u>	<u>Power Level</u>
<b>M73V MP</b>	<b>M73V TXW</b>	<b>80</b>
<b>M73V LP</b>	<b>M73V TXW</b>	<b>50</b>
<b>M73V IQ</b>	<b>M73V IQ</b>	<b>50</b>
<b>M73V SQW</b>	<b>M73V SQW</b>	<b>50</b>
<b>M73V SQN</b>	<b>M73V SQN</b>	<b>50</b>

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 11.5.5.3 on page 70 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. In the System Setup dialog box:

Click: **Project 25 Conventional** (tab)

27. In the System Name field:

Select: **M73 P25C**

28. In the P25 Conv Freq Set dropdown:

Select: **M73 P25C**

29. In the Unit ID field:

Type: **1**

Click: **OK**

30. From RPM’s main menu:

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

31. 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.

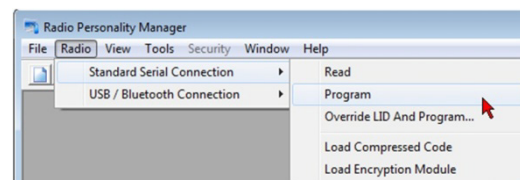
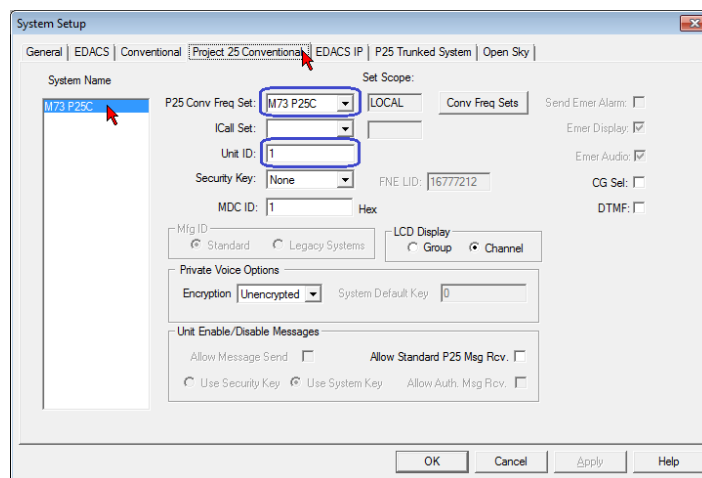
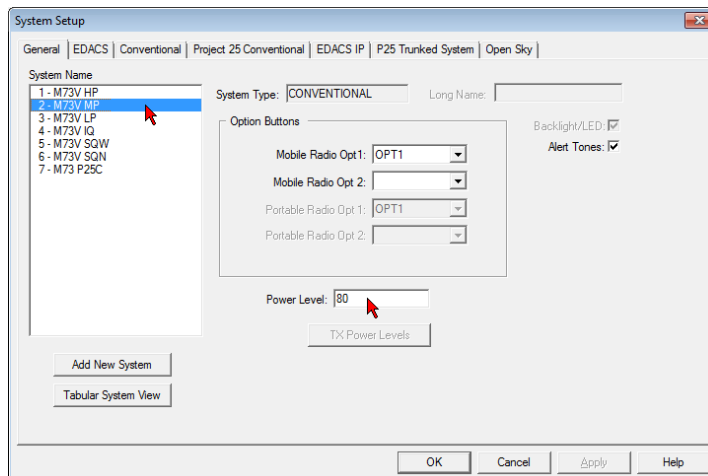


Table 11-8: Frequencies for Conventional Frequency Set M73V TXW

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 11-9: Frequencies for I/Q Modulation Frequency Set M73V IQ

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

Table 11-10: Frequencies for Receiver Frequency Sets M73V SQW, M73V SQN, and M73 P25C

CHANNEL NUMBER	FREQUENCY IN MHz (TX and RX)	CHANNEL NUMBER	FREQUENCY IN MHz (TX and RX)
1	136.0000	4	164.5000
2	145.5000	5	174.0000
3	155.0000		

#### 11.5.4.2 Removing Radio Alignment Test Systems from the Personality



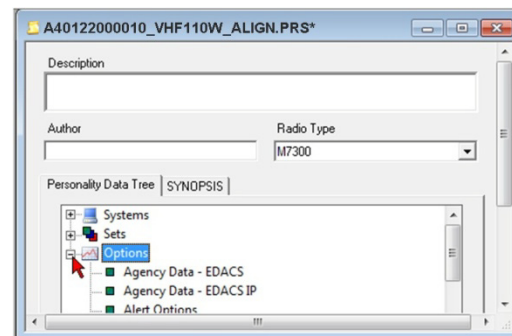
#### \*\*\*IMPORTANT\*\*\*

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:

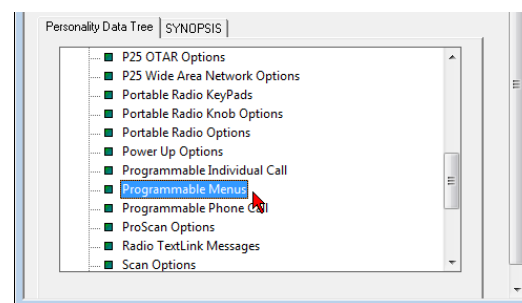
1. Connect the radio to the PC with the RPM programming software and enter programming mode. Refer to Section 11.5.3.1 as necessary.
2. Verify the feature and calibration data files have been saved to local disk. Refer to Sections 11.5.3.2 and 11.5.3.3 as necessary.
3. Read the radio's personality. Refer to Section 11.5.3.4 as necessary.
4. In the Personality Data Tree tab:

Click: **Options**



5. Scroll down the Options limb:

Double-click: **Programmable Menus**

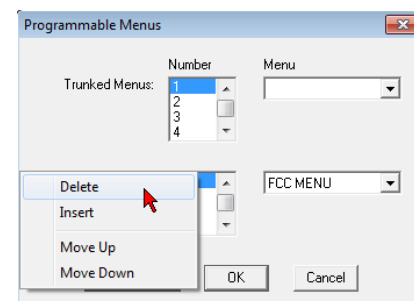


6. Within the Conventional Menus Number box:

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

Click: **Delete**

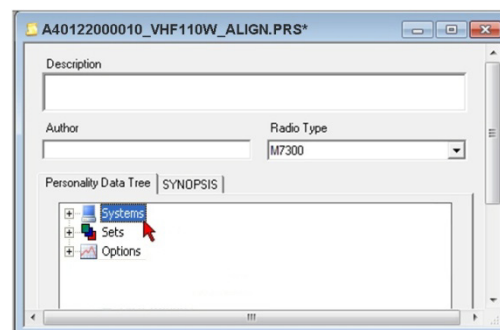
Click: **OK**



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: **M73V HP**

Click: **Delete System**

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

**M73V MP**

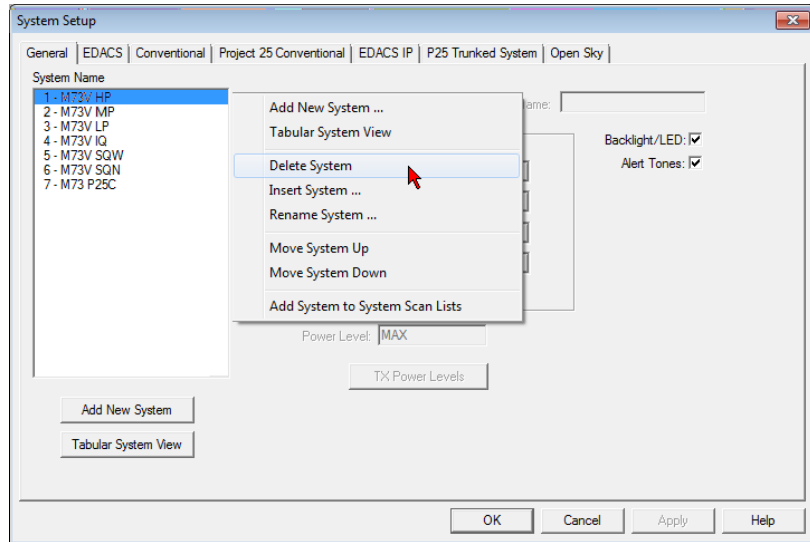
**M73V LP**

**M73V IQ**

**M73V SQW**

**M73V SQN**

**M73 P25C**



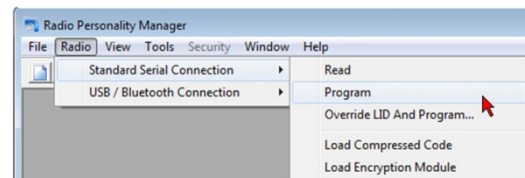
In general, deleting the new frequency sets created for radio testing from the radio's personality is not necessary. Simply deleting the test Systems from the System Setup's General tab in RPM and re-programming the radio with this modified personality removes radio user access to the frequency sets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



## 11.5.5 Radio Alignment Procedures

### 11.5.5.1 General Information

Before beginning any radio alignment procedure, a careful review of Sections 11.5.1 through 11.5.4 is recommended. The minimum radio firmware code versions and RPM version listed in Section 11.5.1 (page 51), 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 11.5.3 (page 52) as necessary.
- Update the existing personality in the radio with conventional test frequency sets. Refer to Section 11.5.4 (page 57) 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 11.5.3.3 (page 55) 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 11.5.4.2 on page 64.



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 11-2 (page 40).



NOTE

The use of an RF attenuator between the radio and the test equipment is recommended, and it may be required with certain 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.

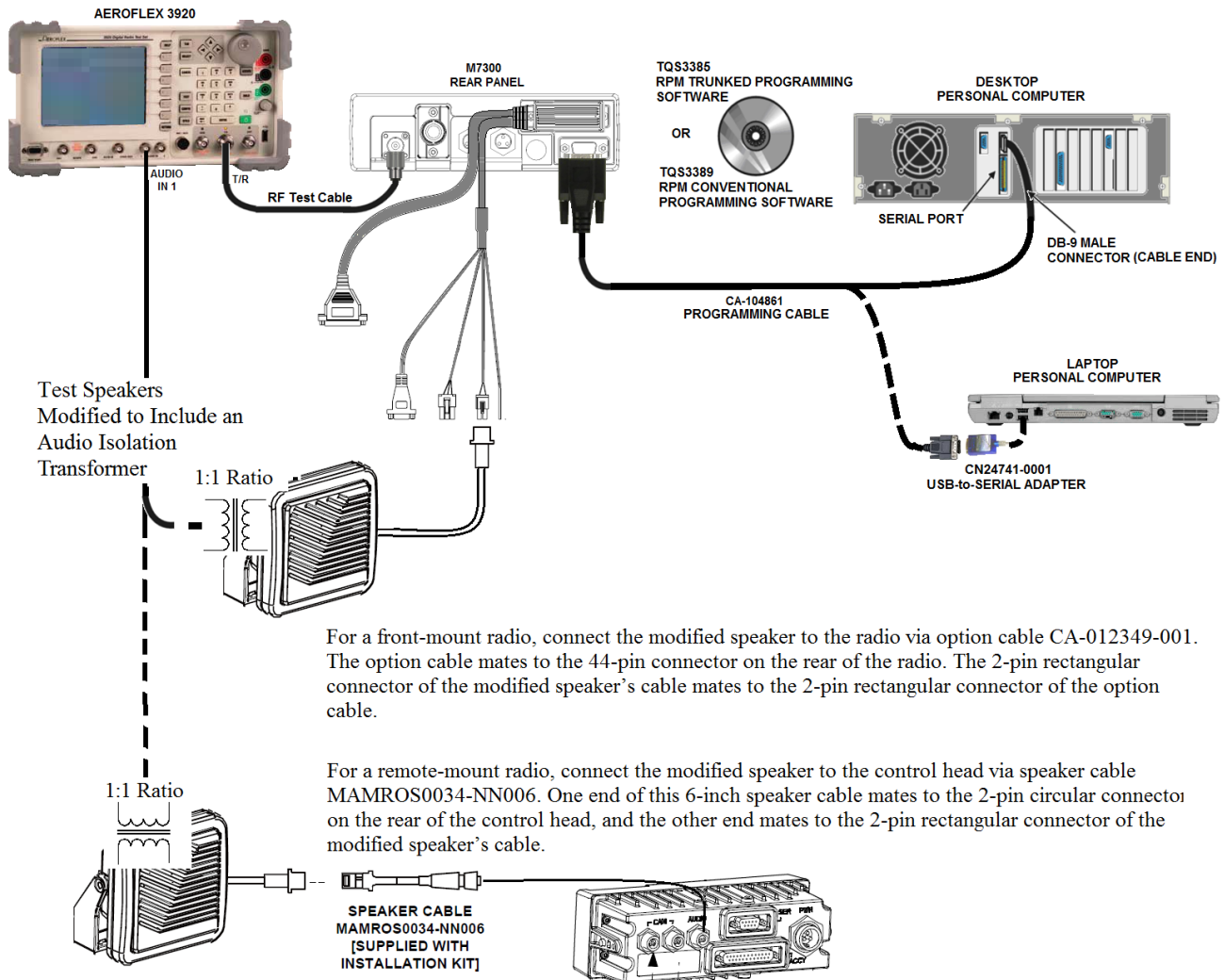


Figure 11-1: Test Equipment Connections for Radio Alignment

### 11.5.5.2 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 0.15 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 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.



NOTE

If frequency alignment is necessary, maximum errors less than or equal to  $\pm 150$  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:

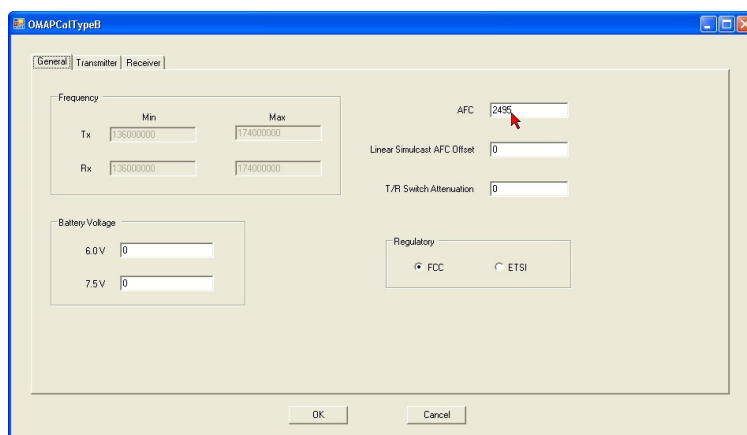
1. Setup and power-up the radio, control head, and test equipment as described in the Tx Frequency Test procedure, Section 11.4.4.1 (do steps 1 through 7 of that procedure). Also see Figure 11-1.
2. Add conventional test systems to the radio personality. Refer to Section 11.5.4 as necessary.
3. Select conventional test system **M73V LP** (low power transmit).
4. Select **Channel 20** (174.0000 MHz).
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 22.

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 and the control head.

10. Using a serial programming cable, connect the radio to the PC with the RPM programming software. See Figure 10-1 on page 28.
11. Turn on the radio and control head.
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 **M7x00** (for the M7300 and other radios).
14. From utility's main menu:  
Select: **Radio > Read > Calibration Data from Radio**
15. When the Calibration Data Complete dialog box opens:  
Click: **OK**
16. In the tab that includes **M7x00**:  
Click: **Calibration Data**

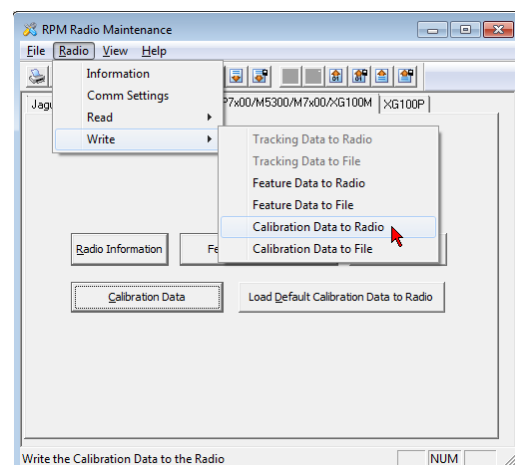
17. In the General tab, adjust the AFC value up or down. The TX frequency is proportional to the change in AFC value: Increasing the value increases the TX frequency while decreasing the value decreases the TX frequency.  
Click: **OK**



**CAUTION**

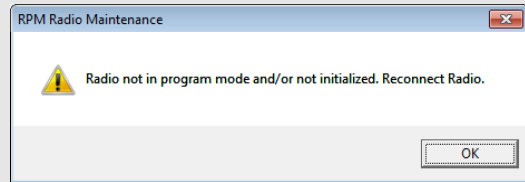
Do **not** change any of the other fields in the General tab.

18. From the utility's main menu:  
Select: **Radio > Write > Calibration Data to Radio**
19. When the Calibration Data Write Complete dialog box appears:  
Click: **OK**
20. Cycle power to the radio or click the **JUMP** button to reset the radio after programming. Power cycling the control head is not necessary.



**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 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.



21. 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 11-4, as they are based on  $\pm 1.5$  ppm across the entire operating temperature range of the radio.
22. 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 11.5.4.2 on page 64 as necessary.

### 11.5.5.3 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:

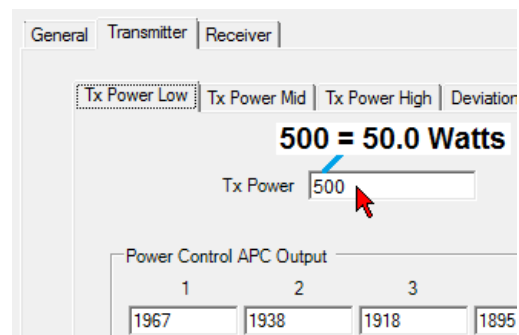
- TX Power Low
- TX Power Mid
- TX Power High

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 “1100” equals 110 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

Power Control APC Output									
1	2	3	4	5	6	7	8	9	10
For 136 MHz → 2007	2003	2000	1996	1994	1991	2008	2012	2017	2021 → For 154 MHz
11	12	13	14	15	16	17	18	19	20
For 156 MHz → 2024	2028	2031	2050	2068	2087	2135	2167	2200	2232 → For 174 MHz
Power Sense APC Input									
1	2	3	4	5	6	7	8	9	10
For 136 MHz → 1586	1593	1598	1604	1607	1612	1644	1647	1652	1655 → For 154 MHz
11	12	13	14	15	16	17	18	19	20
For 156 MHz → 1658	1661	1732	1756	1781	1805	1834	1855	1875	1896 → For 174 MHz

See Table 11-8 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).

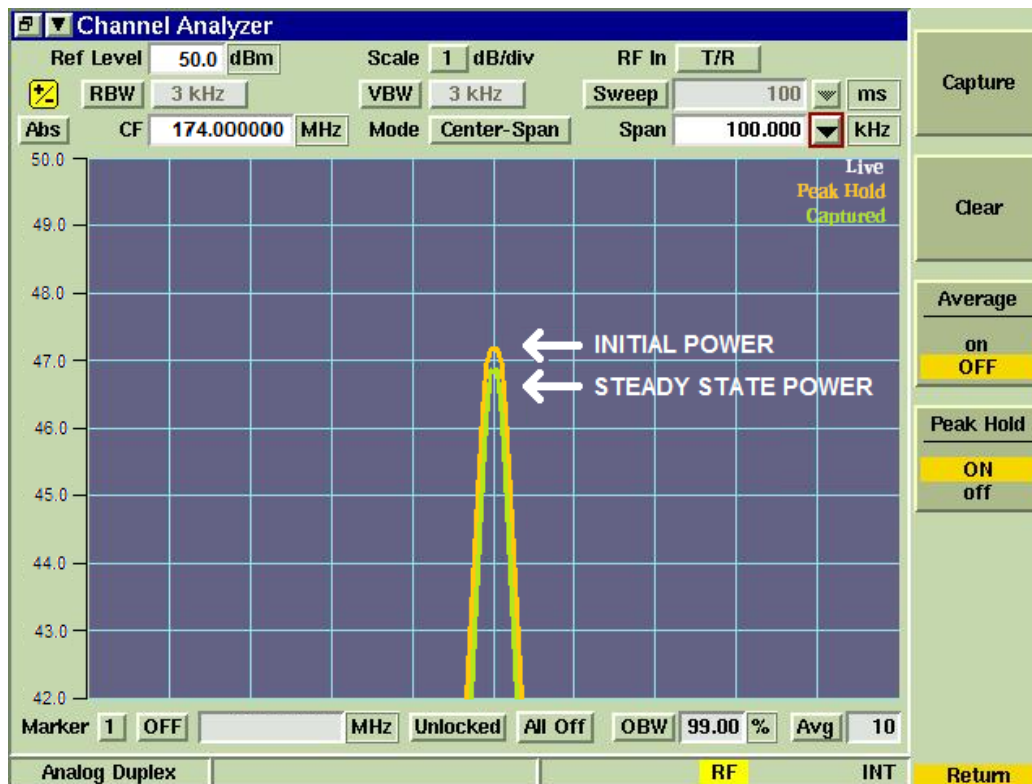


CAUTION

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, control head, and test equipment as described in the Tx Frequency Test procedure, Section 11.4.4.1 (do steps 1 through 7 of that procedure). Also see Figure 11-1.
2. Add conventional test systems to the radio's personality. Refer to Section 11.5.4 as necessary.
3. At the control head, select conventional test system **M73V LP** (low power transmit).
4. Select **Channel 20** (174.0000 MHz), the next test channel, or the channel being aligned.
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 11-2 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 11-2 for an example display.
10. Unkey the radio:



**Figure 11-2: 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  $\pm 0.25$  dB of the set power level (i.e., 110 watts for high power, 80 watts for mid power, or 50 watts for low power), 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, and the steady-state transmit power is within  $\pm 0.25$  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 **M73V 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 **M73V 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 and control head.

13. Using a serial programming cable, connect the radio to the PC with the RPM programming software. See Figure 10-1 on page 28.
14. Turn on the radio and control head.
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 **M7x00** (for the M7300 and other radios).
17. From the utility's main menu:  
Select: **Radio > Read > Calibration Data from Radio**
18. When the Calibration Data Complete dialog box opens:  
Click: **OK**
19. In the tab that includes **M7x00**:  
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):  
For Low Power: **500** (see Figure 11-3)  
For Mid Power: **800**  
For High Power: **1100**



NOTE

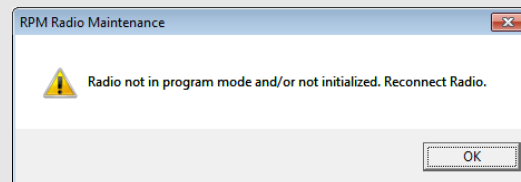
The Tx Power input box values represent the transmit power output level associated to each Tx Power Tab (High, Mid, and Low) in deciwatts. Divide by 10 for watts. For example, "500" equals an RF power output of 50 watts, and "1100" equals 110 watts.

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 read 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 Calibration Data Write Complete dialog box appears, click **OK**.
25. Cycle power to the radio or click the **JUMP** button to reset the radio after programming. Power cycling the control head is not necessary.
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:
- If a “shop” test personality was used to test the radio, reload the original personality and verify operation.
  - If test systems were added to the original personality, refer to Section 11.5.4.2 (page 64), remove the systems, and verify radio operation.

The screenshot shows the OMAPCalTypeB software window with the 'Receiver' tab selected. Inside, the 'Tx Power Low' sub-tab is active. It displays a 'Tx Power' field set to 500 and a '700 MHz (M7300 Only)' field. Below these are two tables of power settings:

Power Control APC Output									
1	2	3	4	5	6	7	8	9	10
2040	2013	1985	1958	1930	1903	1876	1848	1821	1793
11	12	13	14	15	16	17	18	19	20
1766	1739	1712	1684	1657	1630	1603	1575	1548	1521

Power Sense APC Input									
1	2	3	4	5	6	7	8	9	10
605	595	585	575	565	554	544	534	524	514
11	12	13	14	15	16	17	18	19	20
504	494	484	474	464	455	445	435	425	415

At the bottom of the window are 'OK' and 'Cancel' buttons.

Figure 11-3: Example of TX Power Low APC Input and Output Power Settings

#### 11.5.5.4 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.



I/Q data modulation alignment should only be necessary if hardware components affecting transmitter performance have been replaced or the radio has 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:

- Setup and power-up the radio, control head, and test equipment as described in the Tx Frequency Test procedure, Section 11.4.4.1 (do steps 1 through 7 of that procedure). Also see Figure 11-1.
- Add conventional test systems to the radio's personality. Refer to Section 11.5.4 as necessary.
- At the control head, select conventional test system **M73V IQ**.
- At the control head, select **Channel 4** (174.000 MHz). See Table 11-9 on page 64 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 11-4.
6. Press the control head's **MENU** button, then use the **•/••** ramp control 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. Press the **•/••** ramp control down to select **SSB MODE** (single side-band mode).



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 control head's transmit 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 11-4 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.

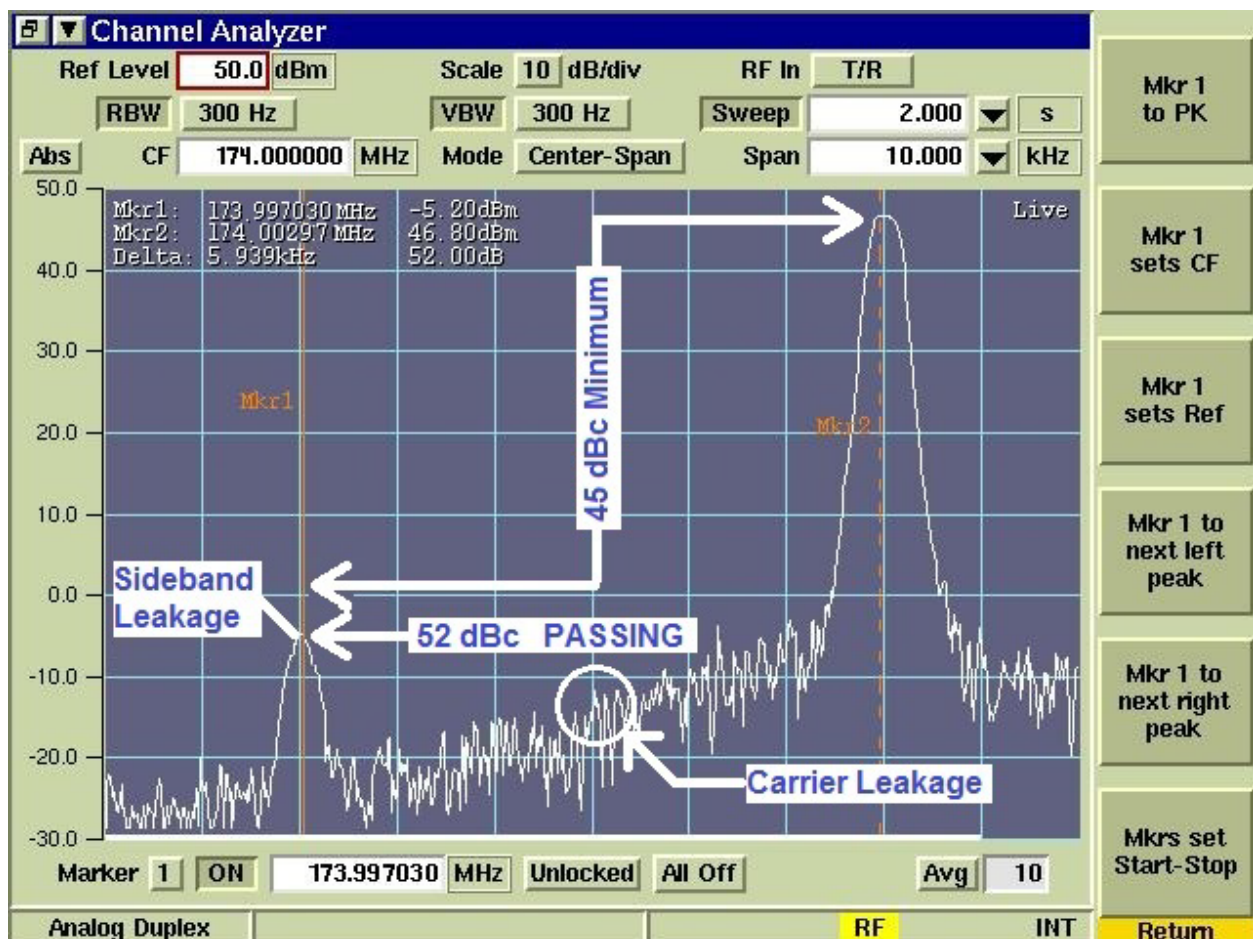


Figure 11-4: I and Q Alignment using FCC Menu SSB MODE

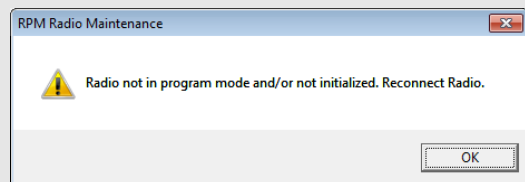
11. Select the next lowest channel/frequency and repeat steps 5 through 10 until carrier leakage and sideband measurements have been recorded for all four (4) test channels/frequencies.
12. If carrier leakage or sideband leakage on any test frequency exceeded the -45 dBc limit, go to step 13. Otherwise, advance to step 27 and save data.
13. Turn off the radio and control head.
14. Using a serial programming cable, connect the radio to the PC with the RPM programming software. See Figure 10-1 on page 28.
15. Turn on the radio and control head.
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 **M7x00** (for the M7300 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 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 Calibration Data Complete dialog box opens:

Click: **OK**

20. In the tab that includes **M7x00**:

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

	DCOffset - I	DCOffset - Q	Amplitude - I	Amplitude - Q	Vector - I	Vector - Q
1	130	80	28000	28000	250	32767
2	130	70	28000	28000	60	32767
3	130	70	28000	28000	10	32767
4	130	80	28000	28000	50	32767

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. Cycle power to the radio or click the **JUMP** button to reset the radio after programming. Power cycling the control head is not necessary.
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 11.5.4.2, remove the test sets, and verify radio operation.

### 11.5.5.5 FM Deviation Alignment (Not Required)

While the Radio Maintenance Utility's user interface is generically written for most OMAP radios, it provides alignment tabs for the wide-band and narrowband deviation alignment. However, these tabs only apply to portable products and the 900 MHz M5300 mobile radio.



NOTE

Changing values within the Deviation Wideband tab or Deviation Narrowband tab will not affect radio alignment for VHF, UHF, 700 or 800 MHz M7300 mobile radios.

### 11.5.5.6 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, control head, and test equipment as described in the Audio Output and Distortion Levels Tests presented in Section 11.4.5.1 (do steps 1 through 9 of that procedure). Also see Figure 11-1. 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 11.5.4 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. At the control head, select conventional test system **M73V SQN** (narrowband channels).
5. At the control head, select **Channel 1** (136.000 MHz).
6. Press the control head's **MENU** button, then use the **•/••** ramp control 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. At the control head, 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 11-10 on page 64.
14. If any of the measured RSSI level measurement is more than  $\pm 1.0$  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 and control head.
16. Using a serial programming cable, connect the radio to the PC with the RPM programming software. See Figure 10-1 on page 28.
17. Turn on the radio and control head.
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 **M7x00** (for the M7300 and other radios).
20. From the utility's main menu:  
Select: **Radio > Read > Calibration Data from Radio**

21. When the Calibration Data Complete dialog box opens:

Click: **OK**

22. In the tab that includes **M7x00**:

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**

Squelch Open Levels					
	1	2	3	4	5
Wideband	900	900	900	900	900
Narrowband	270	270	270	270	270
C4FM	270	270	270	270	270
XNB	1050	1050	1050	1050	1050

Squelch Close Levels					
	1	2	3	4	5
Wideband	1200	1200	1200	1200	1200
Narrowband	400	400	400	400	400
C4FM	420	420	420	420	420
XNB	1900	1900	1900	1900	1900

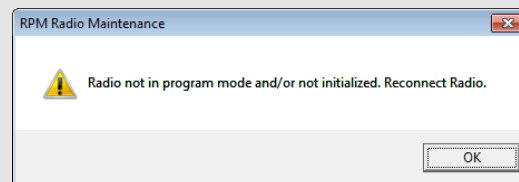
RSSI					
Signal Strength	1	2	3	4	5
Strong	70	712	708	704	701
Medium	90	511	508	504	500
Weak	110	314	308	302	300

25. From the utility's main menu:

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



If an error message box appears similar to the one shown at the right, try re-reading the calibration data. If a second read 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 Calibration Data Write Complete dialog box appears:

Click: **OK**

27. Cycle power to the radio or click the **JUMP** button to reset the radio after programming. Power cycling the control head is not necessary.

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:

- If a "shop" test personality was used to test the radio, reload the original personality and verify operation.
- If conventional test systems were added to the original personality, refer to Section 11.5.4.2, remove the test systems, and verify radio operation.

## 11.5.5.7 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 M7300 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. Each mode of operation is aligned at five (5) frequencies spread across the entire RF operating range of the radio.



NOTE

The XNB Squelch Open Levels and XNB Squelch Close Levels values only apply to 900 MHz radios. For VHF radios, do not change these values.

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  $\pm$  2 dB SINAD.

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

1. Connect and power-up the radio, control head, and test equipment as described in the Audio Output and Distortion Levels Tests presented in Section 11.4.5.1 (do steps 1 through 9 of that procedure). Also see Figure 11-1. 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 11.5.4 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. At the control head, select a conventional test system as listed in Table 11-11.
5. At the control head, 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 mode in Table 11-11.

**Table 11-11: FM Deviation Levels for Aligning Squelch**

SELECTED TEST SYSTEM	MODE	1 kHz TONE DEVIATION (NO CG OR DCG)
<b>M73V SQN</b>	Narrowband (Analog)	1.35 kHz +/- 100 Hz
<b>M73V SQW</b>	Wideband (Analog)	2.7 kHz +/- 200 Hz
<b>M73 P25C</b>	C4FM (P25 Conventional)	1.35 kHz +/- 100 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 control head's **MENU** button, then use the **•/••** ramp control 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 **•/••** ramp control down 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. At the control head, 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 11-10 on page 64 lists the channels/frequencies.
14. At the control head, select P25 conventional test system **M73 P25C**.



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.

15. Repeat SINAD level measurements until measurements are taken and recorded for all five (5) channels of the P25 conventional test system (i.e., repeat starting at step 6). When making these measurements, the test set should generate an on-frequency analog conventional RF signal (i.e., an on-frequency FM-modulated RF signal).
16. 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 17 to realign the Squelch Open Level and Squelch Close Level values. Otherwise, advance to step 31 and save data.
17. Turn off the radio and control head.
18. Using a serial programming cable, connect the radio to the PC with the RPM programming software. See Figure 10-1 on page 28.
19. Turn on the radio and control head.
20. At the PC with the RPM programming software, start the Radio Maintenance Utility:  
Click: **Start > Programs > Harris Radio Personality Manager > RPM Radio Maintenance Utility**
21. In the utility, click on the tab that includes **M7x00** (for the M7300 and other radios).
22. From the utility's main menu:  
Select: **Radio > Read > Calibration Data from Radio**
23. When the Calibration Data Complete dialog box opens:  
Click: **OK**

24. In the tab that includes **M7x00**:

Click: **Calibration Data**

25. 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.

26. Click: **OK**



NOTE

A Squelch Open Level value must always be lower 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.

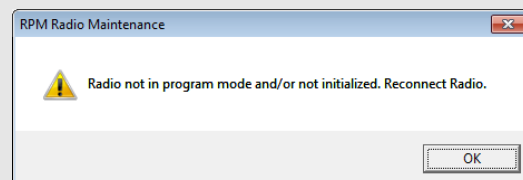
27. From the menu:

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 read 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.



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

Click: **OK**

29. Cycle power to the radio or click the **JUMP** button to reset the radio after programming. Power cycling the control head is not necessary.

30. Return to step 6 and repeat the test and alignment procedure until all squelch level values are correctly aligned.

31. Save the final calibration data to a local file.
32. 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 11.5.4.2, remove the test systems, and verify radio operation.

## 11.6 DISASSEMBLY AND REASSEMBLY PROCEDURES

The following subsections include disassembly and reassembly procedures for the M7300 mobile radio. A list of tools required to perform the procedures is also included.



Observe precautions for damage due to **Electro-Static Discharge (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.

### 11.6.1 Tools Required

- T10 Torx Screwdriver
- T15 Torx Screwdriver
- Torque Screwdriver with Torx T10, and T15 bits
- Small Flat-Blade Screwdriver
- 5.5-Millimeter Wrench or Nutdriver (required only if the radio has the optional GPS receiver)

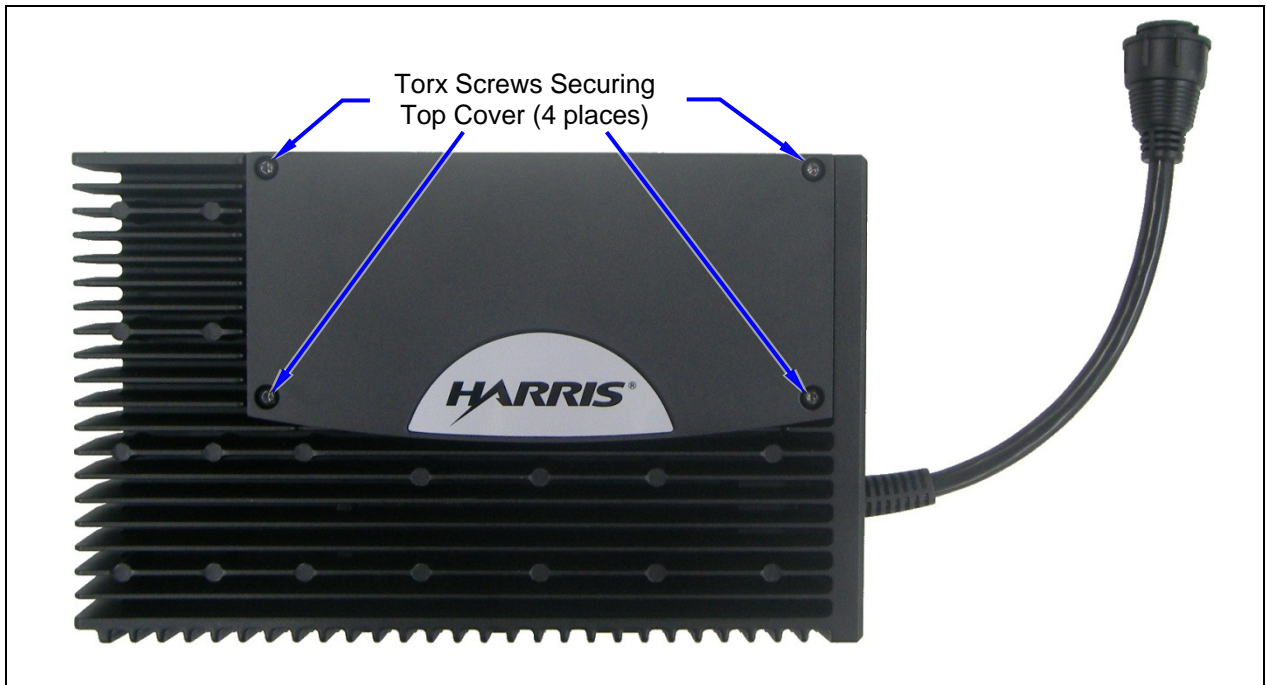
The following items are only needed for M7300 Transceiver Board removal and installation:

- Thermal Heat-Transfer Compound: Dow Chemical 340 or equivalent
- ESD-Safe Temperature Controlled Soldering Iron/Station
- Solder and 1/4-Inch Solder Wick

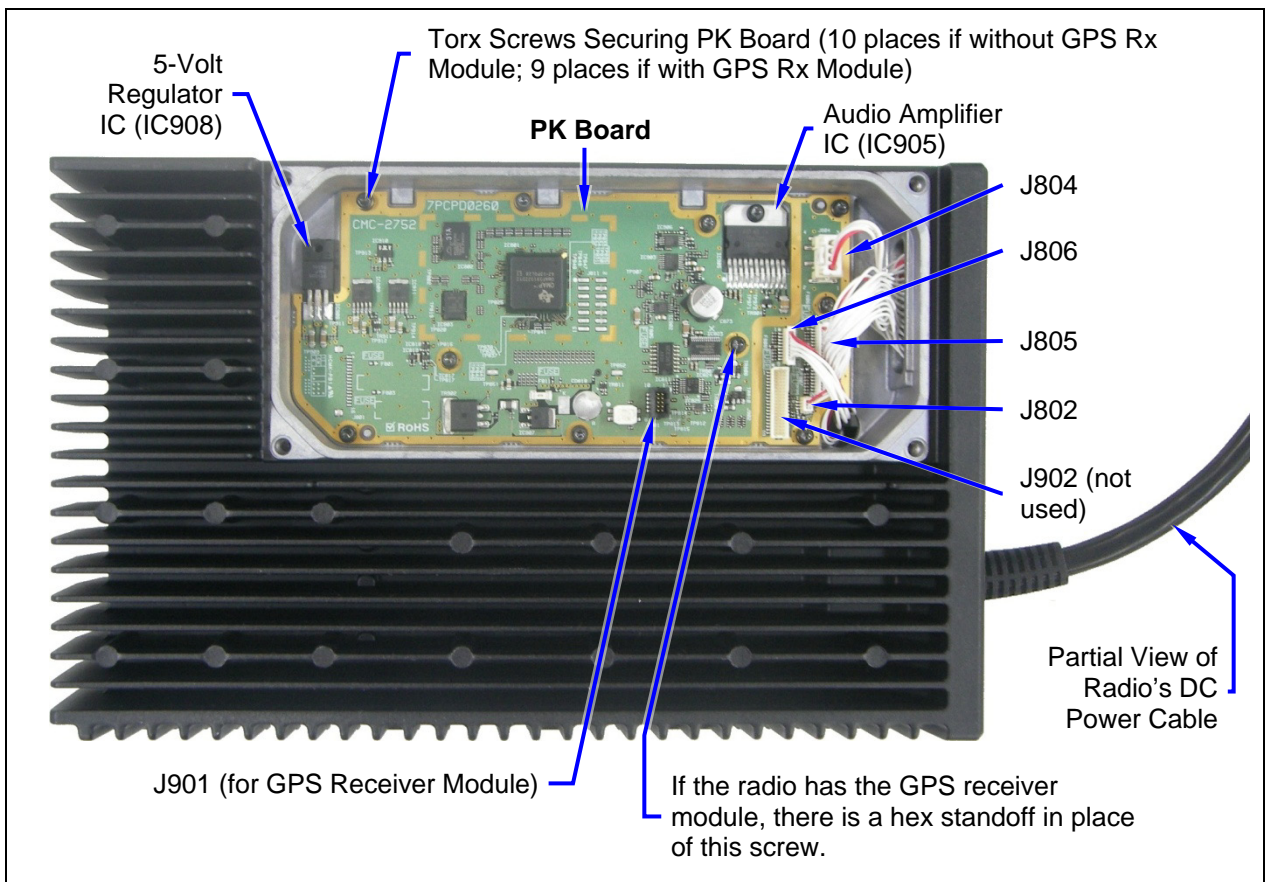
### 11.6.2 Removing the PK Board

Follow this procedure to remove the PK Board:

1. Lay the radio on a flat ESD-safe surface, in a top-up position. See Figure 11-5.
2. Using a T15 Torx screwdriver, loosen the four (4) screws securing the top cover to the radio. These are captive-type screws, so complete removal from the cover is not required.
3. Lift and remove the cover (with screws and gasket) from the radio chassis.
4. Unplug the cables mated to connectors J802, J804, J805, and J806 of the PK Board. See Figure 11-6.
5. 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 it from connector J901 of the PK Board. The module is not shown in Figure 11-6.
6. Using a T10 Torx screwdriver, loosen and remove the two (2) screws securing the audio amplifier IC (IC905) and the 5-volt regulator IC (IC908) to the radio chassis.
7. Using a T10 Torx screwdriver, loosen and remove the ten (10) screws securing the PK Board to the radio chassis. If the radio is equipped with the optional GPS receiver module, there are nine (9) screws and one (1) hex standoff which must be removed; in this case, also loosen and remove this stand-off.
8. Carefully lift and remove the PK Board from the chassis. The 40-pin board-to-board connector on the bottom of the board (J7807) must be carefully disengaged from the connector of the RF Processor Board.



**Figure 11-5: Removing the Top Cover**



**Figure 11-6: PK Board Removal**

### 11.6.3 Installing the PK Board

Follow this procedure to install a PK Board into the radio chassis:

1. Obtain a replacement PK Board. Refer to Table 8-4 which begins on page 20 as necessary.
2. Lay the radio on a flat ESD-safe surface, in a top-up position.
3. Verify the upper cavity of the chassis is completely clear of any and all foreign material such as loose screws, dirt, dust, etc. Clean and/or vacuum it as necessary.
4. Carefully lay the PK Board into the chassis so the 40-pin board-to-board connector on the bottom of the board (J807) smoothly mates to the connector of the RF Processor Board. Connector mating should be sensed and the board should lay completely flat on the floor of the casting. Thermal compound/grease on the two ICs that mount to the chassis (IC905 and IC908) is not required.
5. Start but do not tighten all ten T10 Torx-head screws into the threaded holes of the chassis. Be sure to use the correct screws. **The correct screws are between 9 and 10 millimeters long.**
6. Start but do not tighten a T10 Torx-head screw in each of the two ICs that mount to the chassis (IC905 and IC908). **The correct screws are between 9 and 10 millimeters long.**



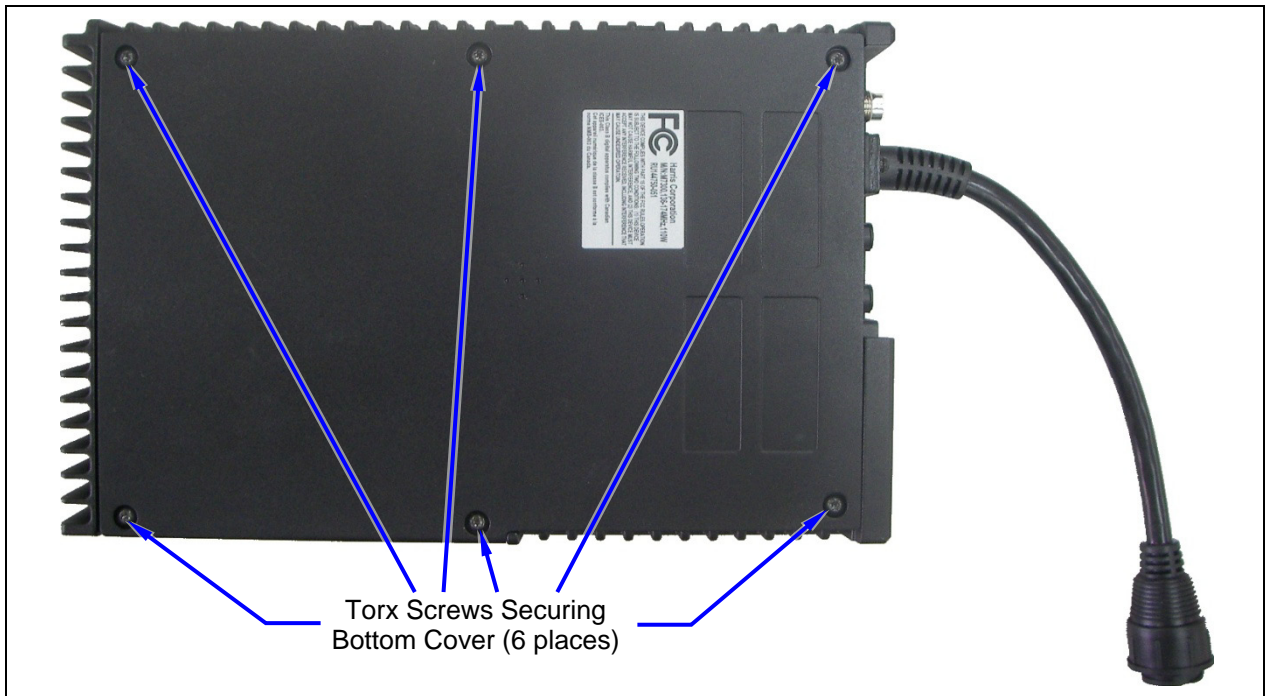
Using screws longer than specified will damage the RF Processor Board in the bottom cavity of the radio chassis.

7. Using a T10 Torx bit and a torque driver, torque the two (2) screws nearest to the center of the board first, and then torque the remaining eight (8) screws around the perimeter of the board. Torque all ten (10) screws to 7.4 inch-pounds (8.5 kg/cm).
8. Torque the two (2) screws securing the two ICs to the chassis to 7.4 inch-pounds (8.5 kg/cm).
9. At the rear of the radio, mate the four cables to the corresponding header connectors on the PK Board. Refer to Figure 11-6 as necessary. Be sure to observe correct connector orientation.
10. Verify the top cover's perimeter gasket is in good condition and embedded into the groove in the interior side of the cover.
11. Place the top cover (with screws and gasket) on to the top of the radio.
12. Using a T15 Torx bit and torque driver, tighten the cover's four (4) screws to 10.4 inch-pounds (12 kg/cm). Use an "X" pattern torque pattern sequence.

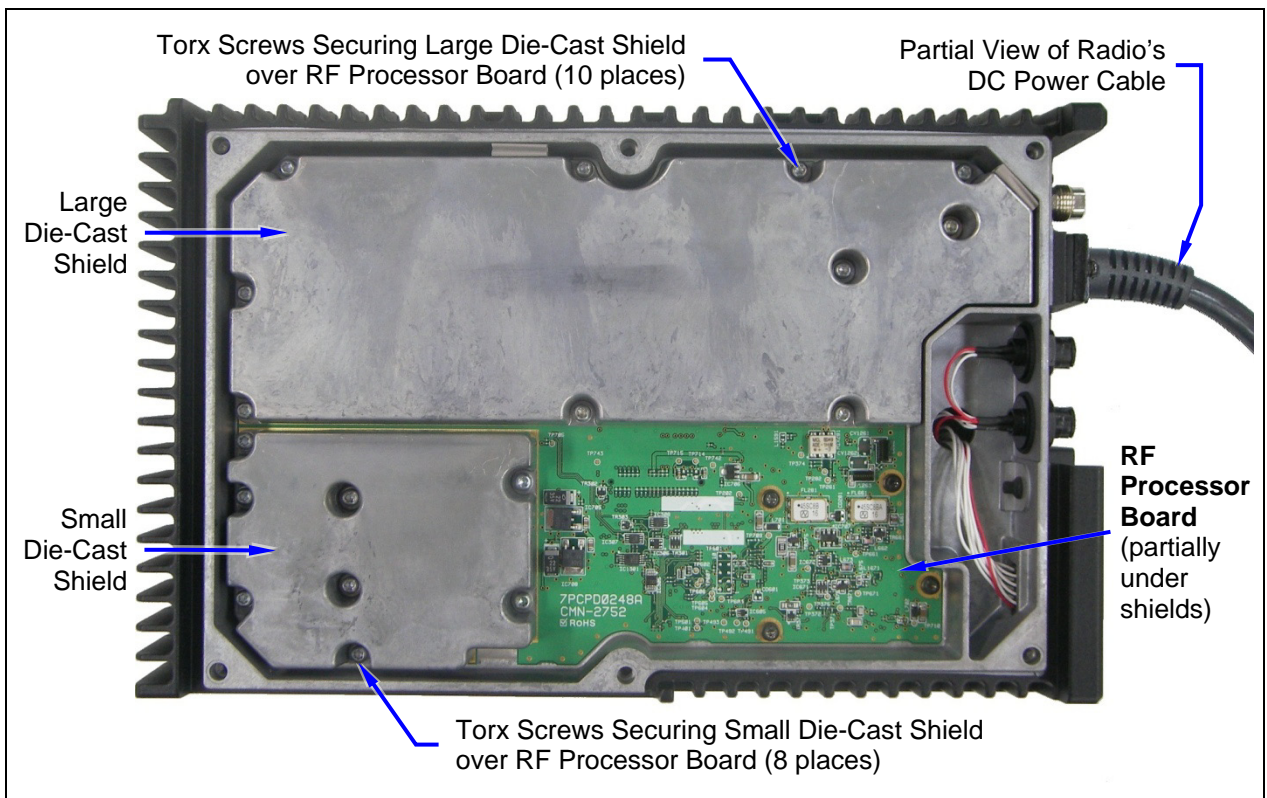
### 11.6.4 Removing the RF Processor Board

Follow this procedure to remove the radio's RF Processor Board:

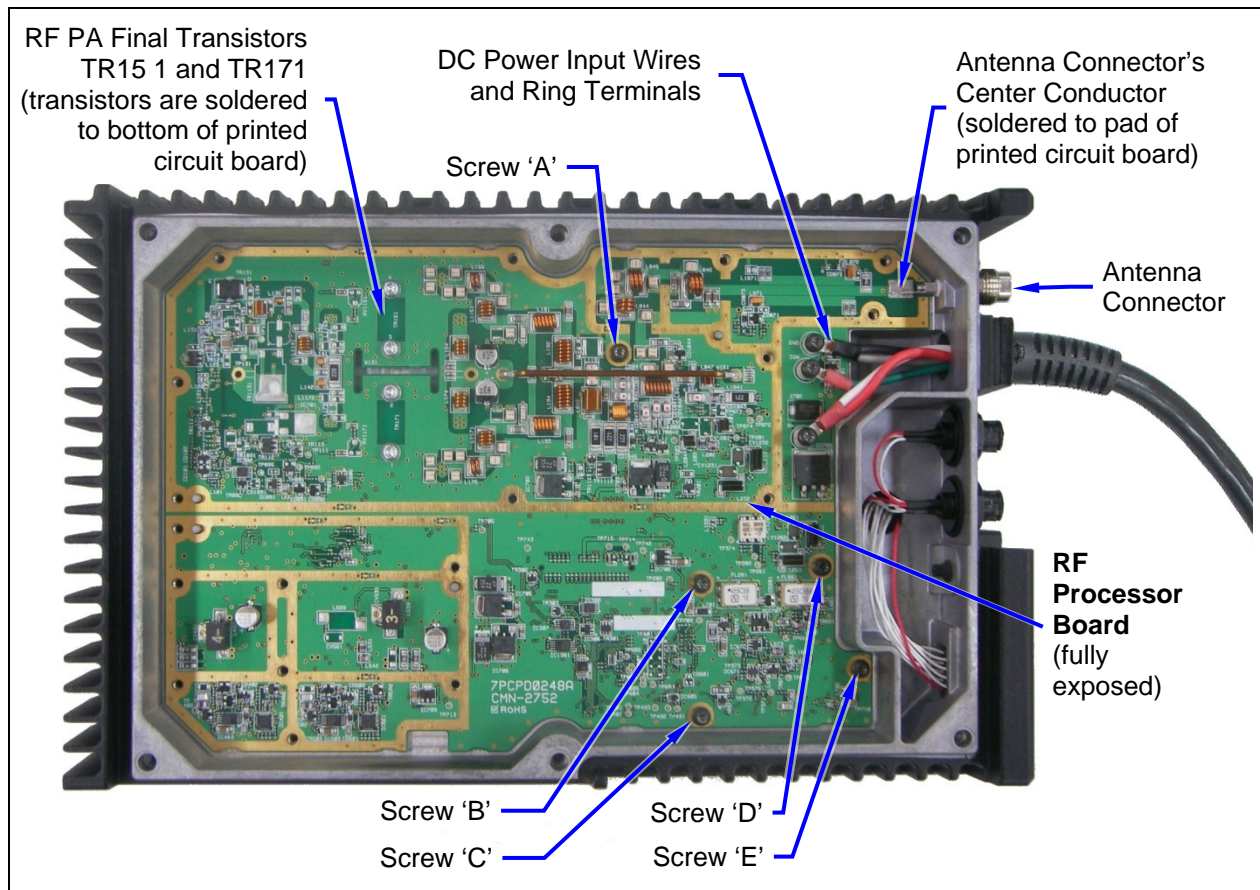
1. Lay the radio on a flat ESD-safe surface, in a bottom-up position. See Figure 11-7.
2. Using a T15 Torx screwdriver, loosen the six (6) captive screws securing the bottom cover to the radio. These are captive-type screws, so complete removal from the cover is not required.
3. Lift and remove the cover (with screws and gasket) off of the radio chassis.
4. Using a T10 Torx screwdriver, loosen and remove the eighteen (18) screws securing the two (2) die-cast shields.
5. Carefully lift and remove the two die-cast shields from the chassis. Figure 11-9 on page 88 shows the radio with the two shields removed.
6. Unsolder the center conductor of the antenna connector. Avoid damaging the pad or components of the board.



**Figure 11-7: Removing the Bottom Cover**



**Figure 11-8: Removing the RF Processor Board — Die-Cast Shield Removal**



**Figure 11-9: Removing the RF Processor Board (shown without both die-cast shields)**

7. Remove the two (2) screws securing the antenna connector to the chassis, and then carefully slide the connector out of the chassis. Re-heating of the center conductor and pad may be necessary to ensure the board's pad is not damaged when the connector is removed from the chassis.
8. Using a T10 Torx screwdriver, loosen and remove the three (3) screws that secure the DC input wires and ring terminals at the rear of the board.
9. Loosen and remove the four (4) screws that secure the two (2) RF PA final transistors (TR151 and TR171) to the chassis. These screws are silver in color.
10. Loosen and remove the five (5) remaining screws securing the board to the chassis. These screw locations are indicated in Figure 11-9 as 'A' through 'E'.
11. Carefully lift and remove the RF Processor Board from the chassis. The 40-pin board-to-board connector on the bottom of the board must be carefully disengaged from the connector of the PK Board.

### **11.6.5 Installing the RF Processor Board**

Follow this procedure to install a RF Processor Board into the radio chassis. The RF PA transistors are soldered to the bottom of the board:

1. Obtain a replacement RF Processor Board. Refer to Table 8-4 which begins on page 20 as necessary.
2. Lay the radio on a flat ESD-safe surface, in a bottom-up position.
3. Verify the lower cavity of the chassis is completely clear of any foreign material such as loose screws, dirt, dust, etc. Clean and/or vacuum it as necessary.

4. Apply a thin layer of thermal compound/grease to the bottom surface of the two (2) RF PA transistors.
5. Carefully lay the RF Processor Board into the chassis so the 40-pin board-to-board connector on the bottom of the board smoothly mates to the connector of the PK Board. Connector mating should be sensed and the board should lay completely flat on the floor of the casting.
6. Start but do not tighten five (5) T10 Torx-head screws into the threaded holes of the chassis at locations 'A' through 'E'. These locations are shown in Figure 11-9. Be sure to use the correct screws, as screws that are too long may damage the PK Board in the opposite cavity of the chassis. **The correct screws are between 9 and 10 millimeters long.**
7. Install four (4) T10 Torx-head screws to secure the two RF PA transistors to the chassis. The correct screws are silver in color and **they are between 13 and 13.5 millimeters long.**
8. Torque these nine (9) screws to 7.4 inch-pounds (8.5 kg/cm).
9. Carefully install the antenna connector into its hole in the rear panel and secure it to the rear panel using two (2) screws. Torque these two screws to 4.3 inch-pounds (5.0 kg/cm).
10. Solder the center conductor of the antenna connector to the respective pad of the RF Processor Board.
11. Using a T10 Torx-head screw, connect the DC power cable's ring terminal with the red and black wires to the threaded post identified by A+ board silkscreen labelling. The correct screw is between 9 and 10 millimeters long.
12. Using a T10 Torx-head screw, connect the DC power cable's ring terminal with the green wire to the threaded post identified by IGN board silkscreen labelling. The correct screw is between 9 and 10 millimeters long.
13. Using a T10 Torx-head screw, connect the DC power cable's ring terminal with the black and gray green wires to the threaded post identified by GND board silkscreen labelling. The correct screw is between 9 and 10 millimeters long.
14. Torque these three (3) screws to 7.4 inch-pounds (8.5 kg/cm).
15. Carefully lay the two (2) die-cast shields into the casting.
16. To secure the shields, first start but do not tighten all eighteen (18) T10 Torx-head screws. Be sure to use the correct screws, as screws that are too long will damage the PK Board in the opposite cavity of the chassis. **The correct screws are between 13 and 13.5 millimeters long.**
17. Torque these eighteen (18) screws to 7.4 inch-pounds (8.5 kg/cm).
18. Verify the bottom cover's perimeter gasket is in good condition and embedded into the groove in the interior side of the cover.
19. Place the bottom cover (with screws and gasket) on to the bottom of the radio.
20. Using a T15 bit and torque driver, tighten the cover's six (6) screws to 10.4 inch-pounds (12 kg/cm). Use an "X" pattern torque pattern sequence.

## **11.7 GPS RECEIVER FIELD UPGRADE KIT**

M5300/M7300 GPS Receiver Field Upgrade Kit KT-015605-001 is available which includes a GPS receiver module and software. This optional kit allows an M5300 or M7300 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 complete information. This kit can be ordered from the Customer Care center using the contact information included in Section 6.

## 11.8 RADIO CONNECTOR PIN-OUTS

### 11.8.1 9-Pin I/O Connector on Rear Panel (TIA/EIA/RS-232C Serial Port)

The 9-pin D-subminiature (DB-9) connector on the rear panel of the radio is a multi-purpose TIA/EIA/RS-232C serial port. Its pin-out is included in Table 11-12 below. It is also shown in the radio's internal interconnection diagram on page 123.

This serial port is used during radio programming operations. In this manual, see Sections 10.2 and 10.3 for details. Radio programming information, including cable hook-up diagrams, is also included in RPM's built-in help.

This serial port can also be used for connection to optional serially-interfaced equipment such as a computer/laptop running Mobile Data Terminal (MDT) software. For connections details, refer to the radio's *Installation and Product Safety Manual*, publication MM-014763-001.

In addition, this port is used for diagnostic testing performed at the factory.

**Table 11-12: 9-Pin I/O Connector Pin-Out**

PIN	SIGNAL NAME	DESCRIPTION
1	DCD_A	RS-232 Data-Carrier-Detect output
2	TD_A	RS-232 Transmit-Data output
3	RD_A	RS-232 Receive-Data input
4	DSR_A	RS-232 Data-Set-Ready input
5	GND	RS-232 signal ground/reference
6	DTR_A	RS-232 Data-Terminal Ready output
7	CTS_A	RS-232 Clear-To-Send input
8	RTS_A	RS-232 Ready-To-Send output
9	RI_A	RS-232 Ring Indicator output

### 11.8.2 44-Pin I/O Connector on Rear Panel (for Optional/Accessory Connections)

The 44-pin D-subminiature (DB-44) connector of 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 CA-012349-001 are included in the following table. It is also shown in the radio's internal interconnection diagram on page 123.

**Table 11-13: 44-Pin I/O Connector Pin-Out**

PIN	SIGNAL NAME	OPTION CABLE CA-012349-001	DESCRIPTION
19	SPKR1	P2 pin 1	Speaker Audio Outputs 1 and 2. This differential speaker output is not used in a remote-mount radio installation with a CH-721 control head. However, with an HHC-731 hand-held controller, this output drives the radio installation's external speaker.
20	SPKR1		
21	SPKR2	P2 pin 2	
22	SPKR2		

Table 11-13: 44-Pin I/O Connector Pin-Out

PIN	SIGNAL NAME	OPTION CABLE CA-012349-001	DESCRIPTION
10	OUT2	P3 pin 1	Digital Output 2 (open-collector, 100 mA / 17 V 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 Radio Personality Manager's (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."
7	GND	P3 pins 2 & 4	Chassis Ground. Over-current-protected by a fuse on radio's PK Board.
26	HKSW	P3 pin 3	Digital Input for Hookswitch (default) or for radio PTT. Active = Ground. Inactive = Open.
25	INP2	P3 pin 5	Digital Input 2. Active = Ground. Inactive = Open. Use P3 pin 2 or 4 for ground. Configure via the "Auxiliary Input 2" in Radio Personality Manager's (RPM's) External I/O dialog Box.
28	SWA+	P3 pin 6	Switched A+ (DC Power) Output.
8	GND	P4 pin 1	Chassis Ground. Over-current-protected by a fuse on radio's PK Board.
30	DGPS_DATA	P4 pin 4	GPS Receiver Module DGPS Correction Data Serial Data Input (NMEA-Formatted).
4	EXTRX	P4 pin 5	External Rx Audio Input (from external/2 <sup>nd</sup> receiver; summed).
9	EXTMOD	P4 pin 7	External Tx Audio Input (typically not used).
3	SDATA	P4 pin 8	See footnote <sup>3</sup> .
5	FDISC	P4 pin 9	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 <u>not</u> contain signaling (e.g., CTCSS). Mutes when speaker mutes. Use a 33 $\mu$ F / 50 V (or greater) AC-coupling capacitor to couple to a 600-ohm load. Use P4 pin 12 for ground.
13	ALO	P4 pin 10	These two pins of the radio's DB-44 connector are not functional.
12	MICHI	P4 pin 11	
1	EXTALO	P4 pin 12	These two pins can provide an unmuted volume-level-controlled single-ended audio signal to external devices. P1 pin 1 is over-current protected by a fuse on radio's PK Board.
14	VOLHI	P4 pin 13	
15	CTLON	P4 pin 14	Control-On Digital Input for data-only radio on/off power control.
16	XTONEENC	P4 pin 15	External Tone Encode Audio Input (default) or Auxiliary Mic Audio Input.

<sup>3</sup> In a remote-mount M5300/M7300 mobile radio installation, this pin on the radio's DB-44 connector is typically not used. For the CH-721 control head, use the respective pin on the CH-721 Option Cable's female DB-25 pin connector. For the HHC-731 hand-held controller, use the respective pin on the HHC-731 Interface Cable's female DB-25 connector.

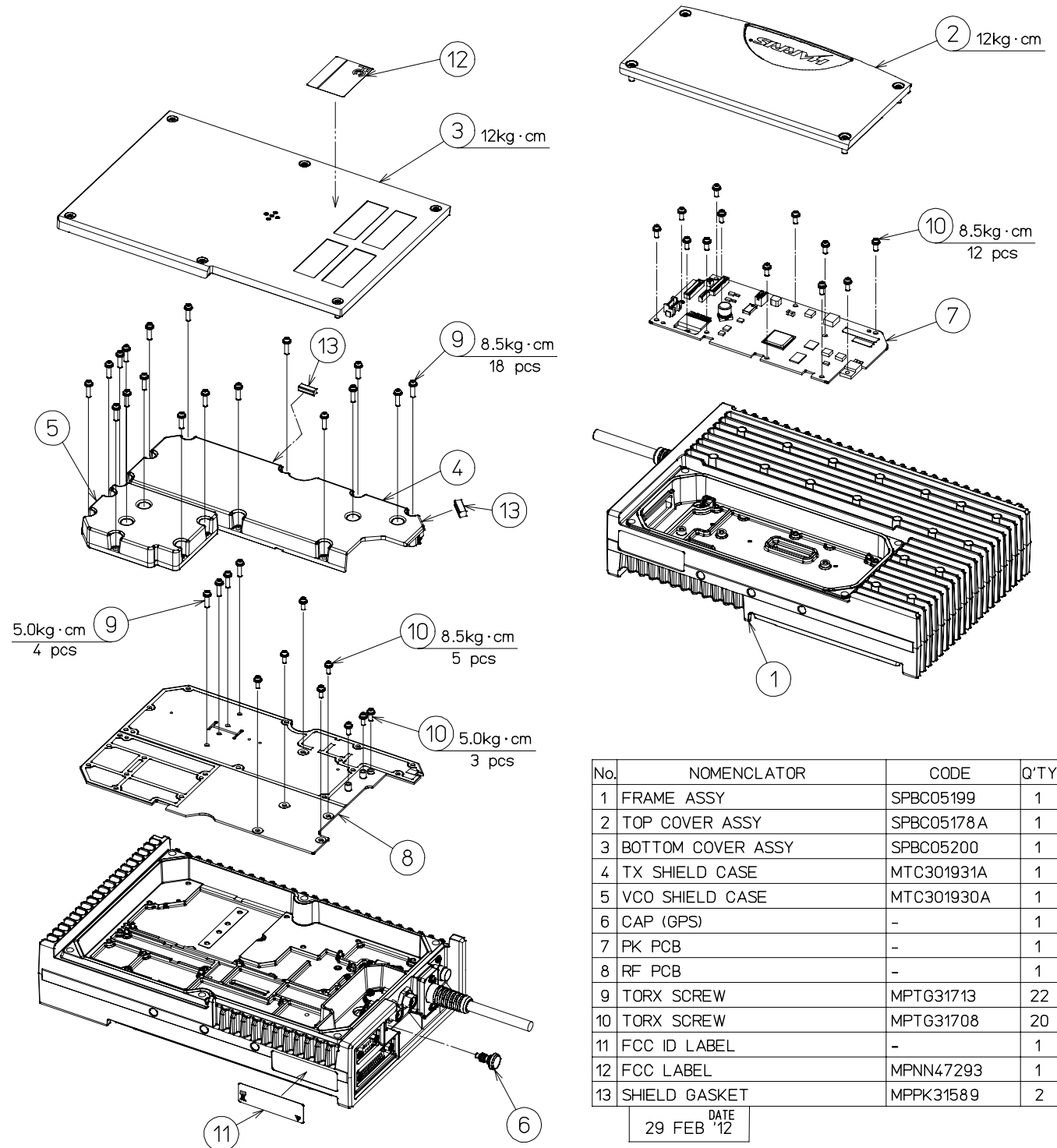
Table 11-13: 44-Pin I/O Connector Pin-Out

PIN	SIGNAL NAME	OPTION CABLE CA-012349-001	DESCRIPTION
17	XTONEDEC	P4 pin 16	External Tone Decode Audio Output.
6	EXTALO	P4 pin 17	Reference/Ground for external audio. Over-current protected by a fuse on radio's PK Board.
24	HORNRING	P4 pin 18	See footnote <sup>3</sup> .
23	SONOFF	P4 pin 19	See footnote <sup>3</sup> .
18	INP1	P4 pin 21	Digital Input 1. Active = Ground. Inactive = Open. Use P4 pin 1 for ground. For ECP, configure via the "Auxiliary Input 1" in Radio Personality Manager's (RPM's) External I/O dialog Box.
2	OUT1	P4 pin 22	Digital Output 1 (open-collector, 100 mA / 17 V 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. For ECP, configure via the "External Output Control Line 1" in Radio Personality Manager's (RPM's) External I/O dialog Box.
29	TXENB+	P4 pin 23	Transmit Enable B+ Output (open-collector, 100 mA / 17 V maximum). Radio transmitting = low/on. Radio not transmitting = high/off. External pull-up resistor needed if required by the external device's input during the high/off state. Use P4 pin 1 for ground. Typically, this output is not used.
27	EXTMIC	P4 pin 24	External/Auxiliary Mic Audio Input. Fixed-level audio input (i.e., input gain is not adjustable). Approximately 120 mV rms gives full-rated deviation. 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.
31	GPS_NMEA_TX	P5 pin 3	NMEA-Formatted GPS Receiver Module Initialization Data Serial Data Input.
7	GND	P5 pin 5	Ground for GPS Serial Data Signals. Over-current-protected by a fuse on radio's PK Board.
11	IGNITION	Yellow Wire	Unused/Spare ignition sense input.
33 — 44	—	(no connections)	These twelve pins of P1 (i.e., the 44-pin connector on the rear of the radio) are not used/not connected when M5300/M7300 Option Cable CA-012349-001 is connected to P1.

## 12 ASSEMBLY DIAGRAMS

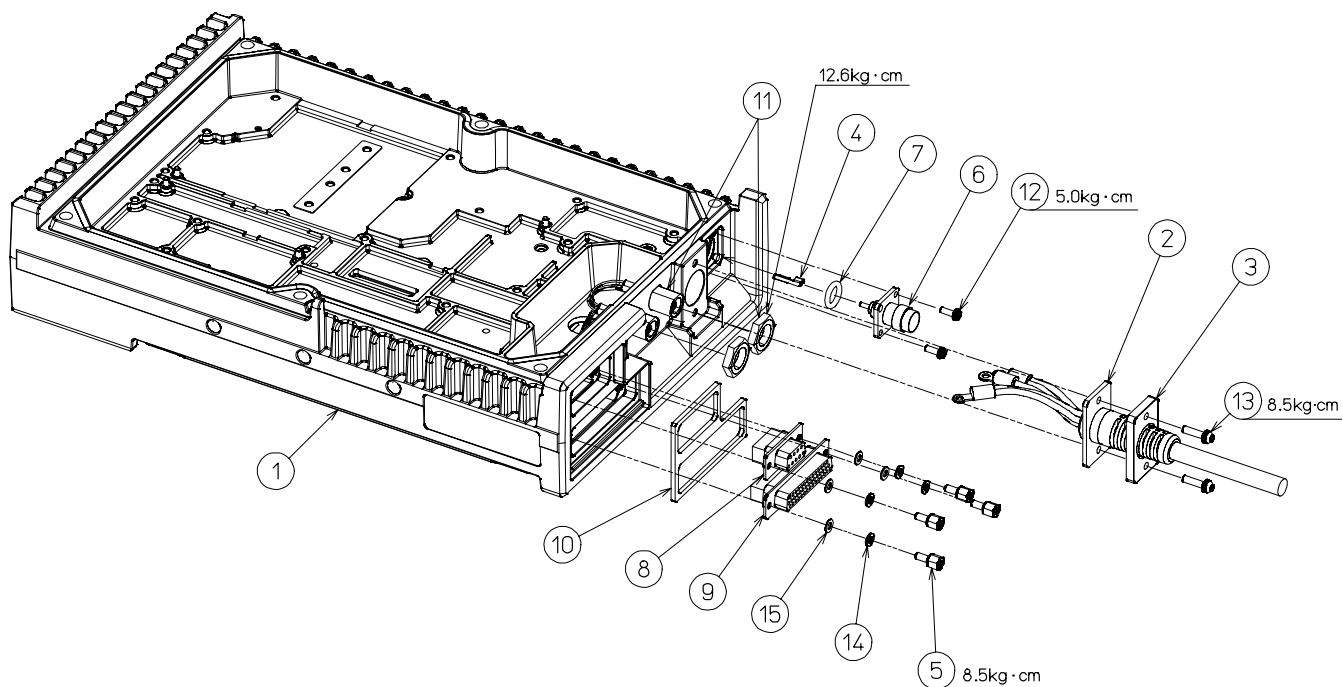
### 12.1 EXPLODED VIEWS

#### 12.1.1 Final Assembly Exploded Views



(SDJHM5048-0101, Rev. 20120229)

## 12.1.2 Frame Sub-Assembly Exploded View

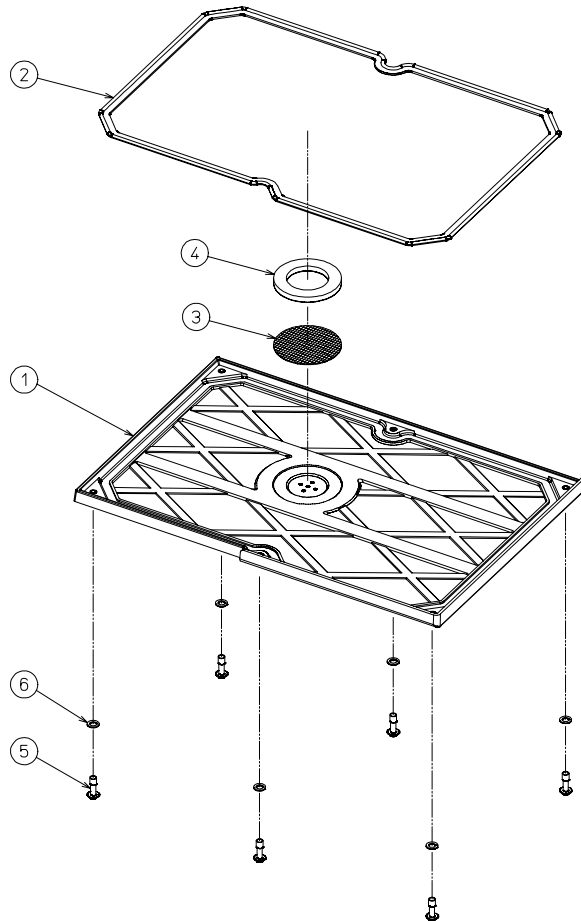


No.	NOMENCLATOR	CODE	Q'TY
1	CHASSIS	MTC301929A	1
2	PIGTAIL CABLE	-	1
3	CLAMP	-	1
4	ANTENNA BRACKET	-	1
5	SCREW LOCK	MTL322391	4
6	ANTENNA CONNECTOR	-	1
7	O-RING	MPPK01858	1
8	DB9 CONNECTOR	-	1
9	DB44 CONNECTOR	-	1
10	GASKET	MTZ303709	1
11	CAN CONNECTOR	-	2
12	TORX SCREW	MPTG31709	2
13	TORX SCREW	MPTG31984	2
14	SPRING LOCK WASHER	BSSW03000S	4
15	PLAIN WASHER	BSLW03000R	4

DATE  
29 FEB '12

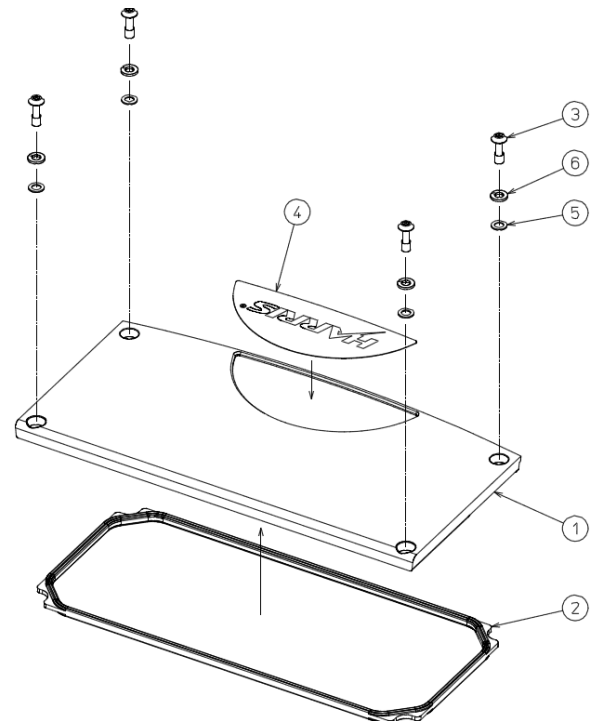
(SPBC05199-0101, Rev. 20120229)

## 12.1.3 Bottom and Top Cover Assemblies Exploded Views



No.	NOMENCLATOR	CODE	Q'TY
1	BOTTOM COVER	-	1
2	GASKET	-	1
3	VEBT FILTER	-	1
4	SPANGE	-	1
5	TORX SCREW	MPTG31710	6
6	PLAIN WASHER	BRTG00198	6

DATE  
29 FEB '12



No.	NOMENCLATOR	CODE	Q'TY
1	TOP COVER	MTC301588	1
2	GASKET	-	1
3	TORX SCREW	MPTG31710	4
4	LOGO LABEL	MPNM35816	1
5	PLAIN WASHER	MPTG31711	4
6	SPRING LOCK WASHER	BRTG09206	4

DATE  
30 SEP '09

## 13 PARTS LISTS

### 13.1 PK BOARD

#### PK BOARD

(CMC-2752 Rev. -)

SYMBOL	DESCRIPTION
	----- CAPACITORS -----
C801 thru C806	0.01 $\mu$ F; similar to Murata GRM155B11E103KA01D.
C809 thru C817	0.01 $\mu$ F; similar to Murata GRM155B11E103KA01D.
C818	10 pF; similar to Taiyo Yuden UMK105CH100DV-F.
C819	9 pF; similar to Taiyo Yuden UMK105CH090DV-F.
C820	0.01 $\mu$ F; similar to Murata GRM155B11E103KA01D.
C821	10 $\mu$ F; similar to Murata GRM31CR61C106KA88L.
C822	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C823 thru C826	0.01 $\mu$ F; similar to Murata GRM155B11E103KA01D.
C830	0.1 $\mu$ F; similar to Murata GRM155B11A104KA01D.
C831	0.22 $\mu$ F; similar to Murata GRM188B11A224KA01D.
C832	0.01 $\mu$ F; similar to Murata GRM155B11E103KA01D.
C833	22 pF; similar to Taiyo Yuden UMK105CH220JV-F.
C834	18 pF; similar to Taiyo Yuden UMK105CH180JV-F.
C835	15 pF; similar to Taiyo Yuden UMK105CH150JV-F.
C836	18 pF; similar to Taiyo Yuden UMK105CH180JV-F.
C837 thru C844	0.01 $\mu$ F; similar to Murata GRM155B11E103KA01D.
C845	10 $\mu$ F; similar to Murata GRM31CR61C106KA88L.
C846	0.1 $\mu$ F; similar to Murata GRM155B11A104KA01D.
C847	10 $\mu$ F; similar to Murata GRM31CR61C106KA88L.
C848	0.1 $\mu$ F; similar to Murata GRM155B11A104KA01D.
C849	0.01 $\mu$ F; similar to Murata GRM155B11E103KA01D.
C851	10 $\mu$ F; similar to Murata GRM31CR61C106KA88L.
C852	0.1 $\mu$ F; similar to Murata GRM155B11A104KA01D.
C853	470 pF; similar to Taiyo Yuden UMK105BJ471KV-F.
C854	0.1 $\mu$ F; similar to Murata GRM155B11A104KA01D.
C855	4.7 $\mu$ F; similar to Murata GRM21BB31E475KA75L.
C856	0.1 $\mu$ F; similar to Murata GRM155B11A104KA01D.
C857	4.7 $\mu$ F; similar to Murata GRM21BB31E475KA75L.
C858	1 $\mu$ F; similar to Taiyo Yuden LMK105BJ105KV-F.
C859	47 pF; similar to Murata GRM1552C1H470JA01D.
C860	1 $\mu$ F; similar to Taiyo Yuden LMK105BJ105KV-F.

SYMBOL	DESCRIPTION
C861	0.1 $\mu$ F; similar to Murata GRM155B11A104KA01D.
C862	0.01 $\mu$ F; similar to Murata GRM155B11E103KA01D.
C863	0.1 $\mu$ F; similar to Murata GRM155B11A104KA01D.
C864	4.7 $\mu$ F; similar to Murata GRM21BB31E475KA75L.
C865 and C866	0.1 $\mu$ F; similar to Murata GRM155B11A104KA01D.
C867	47 pF; similar to Murata GRM1552C1H470JA01D.
C868	0.01 $\mu$ F; similar to Murata GRM155B11E103KA01D.
C869	0.47 $\mu$ F; similar to Murata GRM155B30J474KE18D.
C870 and C871	0.22 $\mu$ F; similar to Murata GRM188B11A224KA01D.
C872	0.1 $\mu$ F; similar to Murata GRM188B11E104KA01D.
C873	220 $\mu$ F; similar to Nippon Chemi-Con EMVH350ADA221MJA0G.
C874	22 $\mu$ F; similar to Murata GRM32EB31E226KE15L.
C875	0.01 $\mu$ F; similar to Murata GRM155B11E103KA01D.
C876	0.1 $\mu$ F; similar to Murata GRM155B11A104KA01D.
C878	2.2 $\mu$ F; similar to Murata GRM21BB31E225KA75L.
C879	0.01 $\mu$ F; similar to Murata GRM155B11E103KA01D.
C882	1800 pF; similar to Murata GRM188B11H182KA01D.
C883 and C884	0.01 $\mu$ F; similar to Murata GRM155B11E103KA01D.
C885	2200 pF; similar to Murata GRM155B11H222KA01D.
C886	0.01 $\mu$ F; similar to Murata GRM155B11E103KA01D.
C887	0.1 $\mu$ F; similar to Murata GRM188B11E104KA01D.
C888	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C889	4.7 $\mu$ F; similar to Murata GRM21BB31E475KA75L.
C890	22 $\mu$ F; similar to Taiyo Yuden EMK325BJ226MM-T.
C892	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C893	0.1 $\mu$ F; similar to Murata GRM155B11A104KA01D.
C894	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C895	0.01 $\mu$ F; similar to Murata GRM155B11E103KA01D.
C896	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C897	0.33 $\mu$ F; similar to Murata GRM319B11E334KA01D.
C898	0.1 $\mu$ F; similar to Murata GRM155B11A104KA01D.
C899	10 $\mu$ F; similar to Murata GRM31CR61C106KA88L.
C900	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C901	0.01 $\mu$ F; similar to Murata GRM155B11E103KA01D.
C902	0.33 $\mu$ F; similar to Murata GRM319B11E334KA01D.
C903	4.7 $\mu$ F; similar to Murata GRM21BB31E475KA75L.

SYMBOL	DESCRIPTION
C905 and C906	0.1 $\mu$ F; similar to Murata GRM155B11A104KA01D.
C907	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C908	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C909	0.33 $\mu$ F; similar to Murata GRM319B11E334KA01D.
C910	4.7 $\mu$ F; similar to Murata GRM21BB31E475KA75L.
C911 and C912	0.1 $\mu$ F; similar to Murata GRM188B11E104KA01D.
C913	1 $\mu$ F; similar to Taiyo Yuden LMK105BJ105KV-F.
C914	0.01 $\mu$ F; similar to Murata GRM155B11E103KA01D.
C920 and C921	0.1 $\mu$ F; similar to Murata GRM188B11E104KA01D.
C922	10 $\mu$ F; similar to Murata GRM31CR61C106KA88L.
C923 thru C925	0.1 $\mu$ F; similar to Murata GRM188B11E104KA01D.
C926 thru C936	0.01 $\mu$ F; similar to Murata GRM155B11E103KA01D.
C937	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C938	0.01 $\mu$ F; similar to Murata GRM155B11E103KA01D.
C939 and C941	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C943	0.1 $\mu$ F; similar to Murata GRM155B11A104KA01D.
C944 thru C946	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C947 and C948	10 pF; similar to Taiyo Yuden UMK105CH100DV-F.
C951	0.01 $\mu$ F; similar to Murata GRM155B11E103KA01D.
C952	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C953	0.01 $\mu$ F; similar to Murata GRM155B11E103KA01D.
C954	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C955	0.01 $\mu$ F; similar to Murata GRM155B11E103KA01D.
C956	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C957	0.1 $\mu$ F; similar to Murata GRM155B11A104KA01D.
C959	0.01 $\mu$ F; similar to Murata GRM155B11E103KA01D.
C960	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C961	0.01 $\mu$ F; similar to Murata GRM155B11E103KA01D.
C962 and C966	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C967	0.01 $\mu$ F; similar to Murata GRM155B11E103KA01D.

SYMBOL	DESCRIPTION
C968	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C969	0.01 $\mu$ F; similar to Murata GRM155B11E103KA01D.
C970	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C971	0.01 $\mu$ F; similar to Murata GRM155B11E103KA01D.
C972	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C973	0.01 $\mu$ F; similar to Murata GRM155B11E103KA01D.
C974	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C975	0.01 $\mu$ F; similar to Murata GRM155B11E103KA01D.
C976	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C977	0.01 $\mu$ F; similar to Murata GRM155B11E103KA01D.
C978	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C979	0.01 $\mu$ F; similar to Murata GRM155B11E103KA01D.
C980 thru C991	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C992	0.01 $\mu$ F; similar to Murata GRM155B11E103KA01D.
C993 thru C995	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C998	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C1121 thru C1132	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C1133 thru C1137	0.1 $\mu$ F; similar to Murata GRM188B11E104KA01D.
C1138	10 $\mu$ F; similar to Murata GRM31CR61C106KA88L.
C1148 thru C1156	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C1158 thru C1166	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C1170 thru C1172	0.01 $\mu$ F; similar to Murata GRM155B11E103KA01D.
C1173	0.1 $\mu$ F; similar to Murata GRM188B11E104KA01D.
----- DIODES -----	
CD805	Zener: 24-Volt; Similar to Toshiba DF2S24FS(TPL3).
CD806 and CD807	Zener: 6.8-Volt; Similar to Toshiba DF7A6.8CFU(TE85L F).
CD808 thru CD810	Zener: 24-Volt; Similar to Toshiba DF2S24FS(TPL3).
CD811 and CD815	Zener: 6.8-Volt; Similar to Toshiba DF7A6.8CFU(TE85L F).

SYMBOL	DESCRIPTION
CD816 and CD817	Zener: 24-Volt; Similar to Toshiba DF2S24FS(TPL3).
----- FUSES -----	
F804 thru F806	1.0 Amp; similar to Mastuo KAB3202 102NA 29 010.
F808	1.0 Amp; similar to Mastuo KAB3202 102NA 29 010.
F810	3.15 Amp; similar to Mastuo KAB2402 322 NA31010.
F811	5 Amp; similar to Littelfuse 0453005.MR.
----- INTEGRATED CIRCUITS -----	
IC801	Similar to Texas Instruments OMAP5910JZDY2.
IC802	Similar to Fujitsu Electronics H-7DLPD0031A.
IC802-1	Similar to Spansion S29WS128J0PBFW000A.
IC803	Similar to Cypress CY62167EV18LL-55BVXIT.
IC804	Similar to Texas Instruments SN74LVCH16652ADGGR.
IC805	Similar to Toshiba TC74VCX164245(EL F).
IC806	Similar to Renesas HD74LV1G126ACME-E.
IC807	Similar to Renesas HD74LV2G32AUSE-E.
IC808	Similar to Microchip MCP2515T-I/ST.
IC809	Similar to Texas Instruments SN65HVD251DR.
IC810	Similar to Toshiba TC74HCT32AF(EL F).
IC811	Similar to Renesas RD74LVC32BFPEL-E.
IC812	Similar to Renesas HD74LV2G125AUSE-E.
IC813	Similar to Renesas HD74LV1G125ACME-E.
IC814	Similar to Fairchild NC7SZ373P6X.
IC815	Similar to Renesas HD74LV1G125ACME-E.
IC817	Similar to Renesas HD74LV1G02ACME-E.
IC818	Similar to Renesas HD74LV1G08ACME-E.
IC819	Similar to Ricoh R3112Q441C-TR-F.
IC820	Similar to Toshiba TC74HC244AF(EL F).
IC821	Similar to Sipex SP3238EEY-L/TR.
IC822	Similar to Etron EM636165TS-7IG.
IC823	Similar to Sipex SP3243EBEY-L/TR.
IC824	Similar to Toshiba TC74VHC04FT-EL.
IC825	Similar to Renesas HD74LV2GT04AUSE-E.
IC901	Similar to Texas Instruments TLV320AIC26IRHBG4.
IC902	Similar to New JRC NJM3404AV(TE1).
IC903	Similar to New JRC NJM3403AV(TE1).
IC904	Similar to Toshiba TC7S66FU(TE85L F).
IC905	Similar to STMicroelectronics TDA7391. <i>See Table 8-4 which begins on page 20 for Harris part number.</i>

SYMBOL	DESCRIPTION
IC906	Similar to New JRC NJM3404AV(TE1).
IC907	Similar to Toshiba TA58M05F(TE16L1_NQ).
IC908	Similar to New JRC NJM7805FA. <i>See Table 8-4 which begins on page 20 for Harris part number.</i>
IC909	Similar to New JRC NJM2887DL3(TE1).
IC910	Similar to Ricoh R1130H181B-T1-F.
IC911	Similar to New JRC NJM2887DL3(TE1).
----- CONNECTORS -----	
J802	3-pin; similar to JST BM03B-SRSS-TB(LF)(SN).
J804	4-pin; similar to JST BM04B-XASS-TF(LF)(SN).
J805	40-pin; similar to JST BM40B-SRDS-G-TFC(LF)(SN).
J806	9-pin; similar to JST BM09B-SRSS-TB(LF)(SN).
J807	40-pin; similar to SUYIN 127150FA040G209ZR.
J901	14-pin; similar to SUYIN 127174MA010G200ZR.
J902	40-pin; similar to JST BM40B-SRDS-G-TFC(LF)(SN).
----- INDUCTORS -----	
L801	2.2 mH; similar to EPCOS B82790C0225N265.
L901 and L902	60 ohm at 100 MHz; similar to Murata BLM18PG600SN1D.
----- RESISTORS -----	
R801 thru R807	100 ohm; similar to Panasonic EXB28V101JX.
R808	51 ohm; similar to Panasonic EXB28V510JX.
R809	100 ohm; similar to Panasonic EXB28V101JX.
R810 thru R822	33 ohm; similar to Panasonic EXB28V330JX.
R823 thru R830	82 ohm; similar to Panasonic EXB28V820JX.
R831	10k ohm; similar to Panasonic ERJ2GEJ103X.
R832	470 ohm; similar to Panasonic ERJ6GEYJ471V.
R833	10k ohm; similar to Panasonic ERJ2GEJ103X.
R834	470 ohm; similar to Panasonic ERJ6GEYJ471V.
R835	100 ohm; similar to Panasonic ERJ2GEJ101X.
R840 thru R855	0 ohm; similar to Panasonic ERJ2GE0R00X.
R857	22k ohm; similar to Panasonic ERJ2GEJ223X.
R860 thru R862	22k ohm; similar to Panasonic ERJ2GEJ223X.
R868 thru R870	22k ohm; similar to Panasonic ERJ2GEJ223X.

SYMBOL	DESCRIPTION
R887 and R888	10k ohm; similar to Panasonic ERJ2GEJ103X.
R890 thru R897	22k ohm; similar to Panasonic ERJ2GEJ223X.
R898 thru R900	150 ohm; similar to Panasonic ERJ2GEJ151X.
R901 thru R903	22k ohm; similar to Panasonic ERJ2GEJ223X.
R904	10k ohm; similar to Panasonic ERJ2GEJ103X.
R905 thru R907	51 ohm; similar to Panasonic ERJ2GEJ510X.
R908 and R909	82 ohm; similar to Panasonic ERJ2GEJ820X.
R910	33 ohm; similar to Panasonic ERJ2GEJ330X.
R911 thru R913	22k ohm; similar to Panasonic ERJ2GEJ223X.
R915 thru R920	22k ohm; similar to Panasonic ERJ2GEJ223X.
R921	75 ohm; similar to Hokuriku CR10-750FV.
R922	6.8k ohm; similar to Panasonic ERJ2GEJ682X.
R923 thru R928	22k ohm; similar to Panasonic ERJ2GEJ223X.
R929	10k ohm; similar to Panasonic ERJ2GEJ103X.
R932 thru R936	4.7k ohm; similar to Panasonic ERJ2GEJ472X.
R939 and R940	22k ohm; similar to Panasonic ERJ2GEJ223X.
R942	22k ohm; similar to Panasonic ERJ2GEJ223X.
R944	47k ohm; similar to Panasonic ERJ2GEJ473X.
R945	1.5k ohm; similar to Panasonic ERJ2GEJ152X.
R946 and R947	10 ohm; similar to Panasonic ERJ2GEJ100X.
R949	22k ohm; similar to Panasonic ERJ2GEJ223X.
R951	82k ohm; similar to Panasonic ERJ2GEJ823X.
R952	2.2k ohm; similar to Panasonic ERJ2GEJ222X.
R953	22k ohm; similar to Panasonic ERJ2GEJ223X.
R954	47k ohm; similar to Panasonic ERJ2GEJ473X.
R955	100k ohm; similar to Panasonic ERJ2GEJ104X.
R957	4.7k ohm; similar to Panasonic ERJ2GEJ472X.

SYMBOL	DESCRIPTION
R958	100k ohm; similar to Panasonic ERJ2GEJ104X.
R959	22k ohm; similar to Panasonic EXB28V223JX.
R960 and R961	120 ohm; similar to Panasonic EXB28V121JX.
R962	100k ohm; similar to Panasonic ERJ2GEJ104X.
R963	150k ohm; similar to Panasonic ERJ2GEJ154X.
R964 thru R968	22k ohm; similar to Panasonic ERJ2GEJ223X.
R970	22k ohm; similar to Panasonic ERJ2GEJ223X.
R971 and R972	120 ohm; similar to Panasonic ERJ2GEJ121X.
R973 and R974	22k ohm; similar to Panasonic ERJ2GEJ223X.
R975	10k ohm; similar to Panasonic ERJ2GEJ103X.
R976	56k ohm; similar to Panasonic ERJ2GEJ563X.
R977	270k ohm; similar to Panasonic ERJ2GEJ274X.
R978	150k ohm; similar to Panasonic ERJ2GEJ154X.
R979	56k ohm; similar to Panasonic ERJ2GEJ563X.
R980	0 ohm; similar to Panasonic ERJ2GE0R00X.
R982 and R983	56k ohm; similar to Panasonic ERJ2GEJ563X.
R984	33k ohm; similar to Panasonic ERJ2GEJ333X.
R985	68k ohm; similar to Panasonic ERJ2GEJ683X.
R986	680 ohm; similar to Panasonic ERJ2GEJ681X.
R987	0 ohm; similar to Panasonic ERJ2GE0R00X.
R988	3.3k ohm; similar to Panasonic ERJ2GEJ332X.
R990	100 ohm; similar to Panasonic ERJ2GEJ101X.
R991	3.3K ohm; similar to Panasonic ERJ2GEJ332X.
R994	100 ohm; similar to Panasonic ERJ2GEJ101X.
R995	10k ohm; similar to Panasonic ERJ2GEJ103X.
R996	10 ohm; similar to Panasonic ERJ2GEJ100X.
R997	56k ohm; similar to Panasonic ERJ2GEJ563X.
R998	470k ohm; similar to Panasonic ERJ2GEJ474X.
R1100 and R1101	22k ohm; similar to Panasonic ERJ2GEJ223X.
R1102	100k ohm; similar to Panasonic ERJ2GEJ104X.
R1103	24k ohm; similar to Hokuriku CR10-243FV.
R1104 thru R1106	22k ohm; similar to Panasonic ERJ2GEJ223X.

SYMBOL	DESCRIPTION
R1107 and R1108	33 ohm; similar to Panasonic EXB28V330JX.
R1109 and R1110	22k ohm; similar to Panasonic ERJ2GEJ223X.
R1112	22k ohm; similar to Panasonic ERJ2GEJ223X.
R1113 and R1114	4.7k ohm; similar to Panasonic ERJ2GEJ472X.
R1115	22k ohm; similar to Panasonic ERJ2GEJ223X.
R1116	22k ohm; similar to Panasonic EXB28V223JX.
R1120	22k ohm; similar to Panasonic ERJ2GEJ223X.
R1121	33 ohm; similar to Panasonic ERJ2GEJ330X.
R1124	22k ohm; similar to Panasonic ERJ2GEJ223X.
R1130 thru R1133	22k ohm; similar to Panasonic ERJ2GEJ223X.
R1136	22k ohm; similar to Panasonic ERJ2GEJ223X.
R1137 and R1138	22k ohm; similar to Panasonic EXB28V223JX.
R1139 and R1140	10k ohm; similar to Panasonic ERJ2GEJ103X.
R1142 thru R1150	0 ohm; similar to Panasonic ERJ2GE0R00X.
R1151 thru R1161	22k ohm; similar to Panasonic ERJ2GEJ223X.
R1163 thru R1166	33 ohm; similar to Panasonic ERJ2GEJ330X.
R1168	22k ohm; similar to Panasonic ERJ2GEJ223X.
----- TEST POINTS -----	
TP851 and TP852	HK-2; similar to MAC8 HK-2-S.
----- TRANSISTORS -----	
TR801	Similar to Toshiba 2SK1829(TE85L F).
TR802	Similar to ROHM UMD2NTR.
TR803	Similar to ROHM QS6M3TR.
TR804	Similar to ROHM UMD2NTR.
TR805	Similar to Toshiba RN1304(TE85L F).
TR806	Similar to ROHM UMG2NTR.
TR807	Similar to Toshiba 2SC2859-Y(TE85L F).
TR808	Similar to Toshiba 2SC5810(TE12L F).
TR809	Similar to Toshiba 2SC2859-Y(TE85L F).

SYMBOL	DESCRIPTION
TR810	Similar to Toshiba 2SC5810(TE12L F).
TR811	Similar to ROHM UMG2NTR.
TR813 thru TR815	Similar to ROHM UMD2NTR.
TR816	Similar to Toshiba RN1304(TE85L F).
TR901	Similar to ROHM UMG2NTR.
TR902	Similar to Renesas 2SJ553STR-E.
TR904	Similar to Toshiba 2SC2859-Y(TE85L F).
TR905 thru TR907	Similar to ROHM UMD2NTR.
TR908	Similar to ROHM UMG2NTR.
TR909 thru TR911	Similar to ROHM UMD2NTR.
----- OSCILLATOR MODULES AND CRYSTALS -----	
X801	12.0 MHz; similar to NDK NX1255GB-12MHZ-30PPM.
X802	32.768 kHz; similar to Epson Toyocom MC-306-32.768KHZ-12.5/20-L-F.
X803	40.0 MHz; similar to Epson Toyocom FA-365-40MHZ-18PF/50PPM-F.

## 13.2 RF PROCESSOR BOARD

### 110-Watt 136 – 174 MHz RF PROCESSOR BOARD

(CMN-2752, Rev. -)

SYMBOL	DESCRIPTION
----- CAPACITORS -----	
C101 thru C106	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C111	33 pF; similar to Taiyo Yuden UMK105CH330JV-F.
C112 thru C115	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C116	18 pF; similar to Taiyo Yuden UMK105CH180JV-F.
C117	0.1 $\mu$ F; similar to Murata GRM188R11H104KA93D.
C118 and C121	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C122 and C123	18 pF; similar to Murata GRM1552C1H180JA01D.
C124 and C125	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C126	1000 pF; similar to Murata GRM1882C1H102JA01D.

SYMBOL	DESCRIPTION
C127	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C128	4.7 $\mu$ F; similar to Murata GRM32ER71H475KA88L.
C131	56 pF; similar to Murata GRM1882C1H560JA01D.
C132	75 pF; similar to Murata GRM1882C1H750JA01D.
C133	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C134 and C135	(Not Used).
C136	39 pF; similar to Murata GRM21A5C2E390JW01D.
C137	470 pF; similar to Murata GRM2162C1H471JA01D.
C138	47 pF; similar to Murata GRM1882C1H470JA01D.
C139	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C140	4.7 $\mu$ F; similar to Murata GRM32ER71H475KA88L.
C141	82 pF; similar to Murata GRM21A5C2E820JW01D.
C142 and C143	39 pF; similar to Murata GRM21A5C2E390JW01D.
C144	0.1 $\mu$ F; similar to Murata GRM188R11H104KA93D.
C145	0.01 $\mu$ F; similar to Murata GRM188R11H103KA01D.
C146	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C147	1000 pF; similar to Murata GRM1882C1H102JA01D.
C148	0.01 $\mu$ F; similar to Murata GRM188R11H103KA01D.
C149	0.1 $\mu$ F; similar to Murata GRM188R11H104KA93D.
C151 and C152	100 pF; similar to Murata GRM2162C1H101JA01D.
C153 and C154	1500 pF; similar to Murata GRM2162C1H152JA01D.
C155 and C156	220 pF; similar to Murata GRM2162C1H221JA01D.
C157	0.1 $\mu$ F; similar to Murata GRM188R11H104KA93D.
C158	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C159 thru C164	56 pF; similar to American Technical Ceramics 100B560JT500XT.
C165	68 pF; similar to American Technical Ceramics 100B680JT500XT.
C166	1000 pF; similar to Murata GRM31A7U2J102JW31D.
C167	1000 pF; similar to Murata GRM1882C1H102JA01D.
C168	0.022 $\mu$ F; similar to Murata GRM188R11H223KA01D.
C169	47 $\mu$ F; similar to Panasonic EEEFK1V470P.
C171 and C172	100 pF; similar to Murata GRM2162C1H101JA01D.

SYMBOL	DESCRIPTION
C173 and C174	1500 pF; similar to Murata GRM2162C1H152JA01D.
C175 and C176	220 pF; similar to Murata GRM2162C1H221JA01D.
C177	0.1 $\mu$ F; similar to Murata GRM188R11H104KA93D.
C178	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C179 thru C184	56 pF; similar to American Technical Ceramics 100B560JT500XT.
C185	68 pF; similar to American Technical Ceramics 100B680JT500XT.
C186	1000 pF; similar to Murata GRM31A7U2J102JW31D.
C187	1000 pF; similar to Murata GRM1882C1H102JA01D.
C188	0.022 $\mu$ F; similar to Murata GRM188R11H223KA01D.
C189	47 $\mu$ F; similar to Panasonic EEEFK1V470P.
C191	5 pF; similar to Murata GRM31M2C2H5R0CY21L.
C192	6 pF; similar to Murata GRM31M2C2H6R0DV01L.
C193	5 pF; similar to Murata GRM31M2C2H5R0CY21L.
C194	6 pF; similar to Murata GRM31M2C2H6R0DV01L.
C195 and C196	10 pF; similar to Murata GRM31A5C2J100JW01D.
C201	18 pF; similar to Murata GRM1552C1H180FA01D.
C202	10 pF; similar to Murata GRM1552C1H100FA01D.
C203	33 pF; similar to Murata GRM1552C1H330FA01D.
C204	15 pF; similar to Murata GRM1552C1H150FA01D.
C205	9 pF; similar to Murata GRM1552C1H9R0BA01D.
C206	15 pF; similar to Murata GRM1552C1H150FA01D.
C207	33 pF; similar to Murata GRM1552C1H330FA01D.
C208	10 pF; similar to Murata GRM1552C1H100FA01D.
C209	18 pF; similar to Murata GRM1552C1H180FA01D.
C210 thru C212	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C213	(Not Used).
C214 thru C218	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C219	0.01 $\mu$ F; similar to Murata GRM155B11E103KA01D.
C221	15 pF; similar to Murata GRM1552C1H150JA01D.
C222 and C223	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C224	10 pF; similar to Murata GRM1552C1H100JA01D.
C225	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.

SYMBOL	DESCRIPTION
C226	0.01 $\mu$ F; similar to Murata GRM155B11E103KA01D.
C227 and C228	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C231	6 pF; similar to Murata GRM1552C1H6R0BA01D.
C232	8 pF; similar to Murata GRM1552C1H8R0BA01D.
C233	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C234	10 pF; similar to Murata GRM1552C1H100FA01D.
C235	24 pF; similar to Murata GRM1552C1H240FA01D.
C236	240 pF; similar to Murata GRM1552C1H241FA01D.
C237	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C238	24 pF; similar to Murata GRM1552C1H240FA01D.
C239	10 pF; similar to Murata GRM1552C1H100FA01D.
C240	8 pF; similar to Murata GRM1552C1H8R0BA01D.
C241	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C242	6 pF; similar to Murata GRM1552C1H6R0BA01D.
C243 thru C246	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C251 and C252	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C253	47 pF; similar to Murata GRM1552C1H470JA01D.
C254 and C255	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C261	6 pF; similar to Murata GRM1552C1H6R0BA01D.
C262	8 pF; similar to Murata GRM1552C1H8R0BA01D.
C263	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C264	10 pF; similar to Murata GRM1552C1H100FA01D.
C265	24 pF; similar to Murata GRM1552C1H240FA01D.
C266	240 pF; similar to Murata GRM1552C1H241FA01D.
C267	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C268	24 pF; similar to Murata GRM1552C1H240FA01D.
C269	10 pF; similar to Murata GRM1552C1H100FA01D.
C270	8 pF; similar to Murata GRM1552C1H8R0BA01D.
C271	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C272	6 pF; similar to Murata GRM1552C1H6R0BA01D.
C273 thru C276	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C281	0.01 $\mu$ F; similar to Murata GRM155R11E103KA01D.
C282	(Not Used).
C283	0.01 $\mu$ F; similar to Murata GRM155R11E103KA01D.
C284	56 pF; similar to Murata GRM1552C1H560JA01D.

SYMBOL	DESCRIPTION
C285 and C286	12 pF; similar to Murata GRM1552C1H120JA01D.
C287 and C291	0.01 $\mu$ F; similar to Murata GRM155R11E103KA01D.
C292 and C293	0.01 $\mu$ F; similar to Murata GRM155R11E103KA01D.
C294	10 pF; similar to Murata GRM1552C1H100JA01D.
C301	10 $\mu$ F; similar to Murata GRM31CR61C106KA88L.
C302 thru C305	0.01 $\mu$ F; similar to Murata GRM155R11E103KA01D.
C306	0.1 $\mu$ F; similar to Taiyo Yuden TMK105BJ104KV-F.
C307	0.01 $\mu$ F; similar to Murata GRM155R11E103KA01D.
C308 thru C311	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C321	1.0 $\mu$ F; similar to Taiyo Yuden LMK212BJ105KG-T.
C322	2200 pF; similar to Panasonic ECHU1C222JX5.
C323 and C324	0.1 $\mu$ F; similar to Taiyo Yuden TMK105BJ104KV-F.
C325 and C326	2200 pF; similar to Panasonic ECHU1C222JX5.
C328	2200 pF; similar to Panasonic ECHU1C222JX5.
C329	0.1 $\mu$ F; similar to Taiyo Yuden TMK105BJ104KV-F.
C330	(Not Used).
C331	560 pF; similar to Murata GRM1552C1H561GA01D.
C332	220 pF; similar to Murata GRM1552C1H221GA01D.
C333	560 pF; similar to Murata GRM1552C1H561GA01D.
C334	220 pF; similar to Murata GRM1552C1H221GA01D.
C335	100 pF; similar to Murata GRM1552C1H101JA01D.
C336	0.1 $\mu$ F; similar to Taiyo Yuden TMK105BJ104KV-F.
C337	(Not Used).
C338	560 pF; similar to Murata GRM1552C1H561GA01D.
C339	220 pF; similar to Murata GRM1552C1H221GA01D.
C340	560 pF; similar to Murata GRM1552C1H561GA01D.
C341	220 pF; similar to Murata GRM1552C1H221GA01D.
C342	100 pF; similar to Murata GRM1552C1H101JA01D.
C343	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C344	0.1 $\mu$ F; similar to Taiyo Yuden TMK105BJ104KV-F.
C345	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C346	0.1 $\mu$ F; similar to Taiyo Yuden TMK105BJ104KV-F.

SYMBOL	DESCRIPTION
C347 and C348	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C349	0.1 $\mu$ F; similar to Taiyo Yuden TMK105BJ104KV-F.
C350 and C351	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C357 and C358	3 pF; similar to Murata GRM1553C1H3R0WA01D.
C359	12 pF; similar to Taiyo Yuden UMK105CH120JV-F.
C360	27 pF; similar to Taiyo Yuden UMK105CH270JV-F.
C361	22 pF; similar to Taiyo Yuden UMK105CH220JV-F.
C362	3 pF; similar to Murata GRM1553C1H3R0WA01D.
C363	12 pF; similar to Taiyo Yuden UMK105CH120JV-F.
C371	1000 pF; similar to Panasonic ECHU1H102JX5.
C372	0.01 $\mu$ F; similar to Panasonic ECHU1H103JX5.
C373 and C374	100 pF; similar to Murata GRM1552C1H101JA01D.
C375	47 pF; similar to Murata GRM1552C1H470FA01D.
C376	22 pF; similar to Murata GRM1552C1H220FA01D.
C377	7 pF; similar to Murata GRM1552C1H7R0BA01D.
C378	22 pF; similar to Murata GRM1552C1H220FA01D.
C379	0.01 $\mu$ F; similar to Murata GRM155R11E103KA01D.
C380	100 pF; similar to Murata GRM1552C1H101JA01D.
C381	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C382	47 pF; similar to Murata GRM1552C1H470FA01D.
C383 and C384	82 pF; similar to Murata GRM1552C1H820GA01D.
C385	2 pF; similar to Murata GRM1552C1H2R0BA01D.
C386	0.01 $\mu$ F; similar to Murata GRM155R11E103KA01D.
C387	39 pF; similar to Murata GRM1552C1H390JA01D.
C388	0.01 $\mu$ F; similar to Murata GRM155R11E103KA01D.
C389	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C390	18 pF; similar to Taiyo Yuden UMK105CH180JV-F.
C391 and C392	100 pF; similar to Murata GRM1552C1H101JA01D.
C397	0.01 $\mu$ F; similar to Murata GRM155R11E103KA01D.
C398	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C399	10 $\mu$ F; similar to Murata GRM31CR61C106KA88L.
C401	(Not Used).
C402	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C403	(Not Used).

SYMBOL	DESCRIPTION
C404	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C405 and C406	0.22 $\mu$ F; similar to Murata GRM188R11C224KA01D.
C407	100 pF; similar to Murata GRM1552C1H101JA01D.
C408	0.01 $\mu$ F; similar to Panasonic ECHU1C103JX5.
C409	4.7 $\mu$ F; similar to Nichicon F931C475MAA.
C410	10 $\mu$ F; similar to Murata GRM31CR61C106KA88L.
C411 and C412	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C413	10 $\mu$ F; similar to Murata GRM31CR61C106KA88L.
C414	0.68 $\mu$ F; similar to Panasonic ECPU1C684MA5.
C415	0.022 $\mu$ F; similar to Panasonic ECHU1C223JX5.
C416	0.1 $\mu$ F; similar to Panasonic ECPU1C104MA5.
C417	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C418	0.1 $\mu$ F; similar to Taiyo Yuden TMK105BJ104KV-F.
C419	0.047 $\mu$ F; similar to Murata GRM188R11E473KA01D.
C421	0.01 $\mu$ F; similar to Murata GRM155R11E103KA01D.
C422	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C423	220 $\mu$ F; similar to Nippon Chemi-Con EMVY160ADA221MF80G.
C424 and C425	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C431	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C432	27 pF; similar to Murata GRM1552C1H270FA01D.
C433	18 pF; similar to Murata GRM1552C1H180JA01D.
C434	33 pF; similar to Murata GRM1552C1H330FA01D.
C435	5 pF; similar to Murata GRM1552C1H5R0BA01D.
C436	7 pF; similar to Murata GRM1552C1H7R0BA01D.
C437 thru C440	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C441	7 pF; similar to Murata GRM1552C1H7R0BA01D.
C442	8 pF; similar to Murata GRM1552C1H8R0BA01D.
C443	18 pF; similar to Murata GRM1552C1H180FA01D.
C444	27 pF; similar to Murata GRM1552C1H270FA01D.
C445	1 pF; similar to Murata GRM1554C1H1R0BA01D.
C446 thru C448	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C451	15 pF; similar to Taiyo Yuden UMK105CH150JV-F.
C452 thru C454	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C455	10 pF; similar to Murata GRM1552C1H100JA01D.

SYMBOL	DESCRIPTION
C456	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C485 thru C487	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C491	0.1 $\mu$ F; similar to Taiyo Yuden TMK105BJ104KV-F.
C492	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C493 and C494	0.1 $\mu$ F; similar to Taiyo Yuden TMK105BJ104KV-F.
C495	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C496 and C497	0.1 $\mu$ F; similar to Taiyo Yuden TMK105BJ104KV-F.
C501	(Not Used).
C502	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C503	(Not Used).
C504	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C505 and C506	0.22 $\mu$ F; similar to Murata GRM188R11C224KA01D.
C507	100 pF; similar to Murata GRM1552C1H101JA01D.
C508	4700 pF; similar to Panasonic ECHU1C472JX5.
C509	4.7 $\mu$ F; similar to Nichicon F931C475MAA.
C510	10 $\mu$ F; similar to Murata GRM31CR61C106KA88L.
C511 and C512	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C513	10 $\mu$ F; similar to Murata GRM31CR61C106KA88L.
C514	0.68 $\mu$ F; similar to Panasonic ECPU1C684MA5.
C515	0.022 $\mu$ F; similar to Panasonic ECHU1C223JX5.
C516	0.1 $\mu$ F; similar to Panasonic ECPU1C104MA5.
C517	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C518	0.1 $\mu$ F; similar to Taiyo Yuden TMK105BJ104KV-F.
C519	0.047 $\mu$ F; similar to Murata GRM188R11E473KA01D.
C521	0.01 $\mu$ F; similar to Murata GRM155R11E103KA01D.
C522	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C523	220 $\mu$ F; similar to Nippon Chemi-Con EMVY160ADA221MF80G.
C524 thru C527	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C528	(Not Used).
C531	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C532	18 pF; similar to Murata GRM1552C1H180FA01D.
C533	33 pF; similar to Murata GRM1552C1H330FA01D.
C535	5 pF; similar to Murata GRM1552C1H5R0WA01D.
C536	9 pF; similar to Murata GRM1552C1H9R0WA01D.

SYMBOL	DESCRIPTION
C537	(Not Used).
C538 thru C541	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C542	(Not Used).
C543	(Not Used).
C544	18 pF; similar to Murata GRM1552C1H180FA01D.
C545	68 pF; similar to Murata GRM1552C1H680JA01D.
C546	56 pF; similar to Murata GRM1552C1H560JA01D.
C547	1 pF; similar to Murata GRM1554C1H1R0BA01D.
C548 and C549	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C550	(Not Used).
C551 and C552	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C561 thru C579	(Not Used).
C581 and C582	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C583	18 pF; similar to Murata GRM1552C1H180JA01D.
C584 and C585	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C586	15 pF; similar to Murata GRM1552C1H150JA01D.
C587	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C589 and C590	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C591	18 pF; similar to Murata GRM1552C1H180JA01D.
C592 and C593	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C594	22 pF; similar to Murata GRM1552C1H220JA01D.
C595	0.01 $\mu$ F; similar to Murata GRM155R11E103KA01D.
C596	4 pF; similar to Murata GRM1552C1H4R0BA01D.
C597 and C598	15 pF; similar to Murata GRM1552C1H150JA01D.
C601 thru C604	(Not Used).
C605 thru C607	0.1 $\mu$ F; similar to Taiyo Yuden TMK105BJ104KV-F.
C608	1.0 $\mu$ F; similar to Taiyo Yuden EMK107BJ105KA-T.

SYMBOL	DESCRIPTION
C609 and C610	0.1 $\mu$ F; similar to Taiyo Yuden TMK105BJ104KV-F.
C611	0.01 $\mu$ F; similar to Murata GRM155R11E103KA01D.
C612	10 $\mu$ F; similar to Murata GRM31CR61C106KA88L.
C613	0.1 $\mu$ F; similar to Taiyo Yuden TMK105BJ104KV-F.
C614 and C615	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C616	(Not Used).
C620	0.1 $\mu$ F; similar to Taiyo Yuden TMK105BJ104KV-F.
C621	1.0 $\mu$ F; similar to Taiyo Yuden EMK107BJ105KA-T.
C622 thru C626	0.1 $\mu$ F; similar to Taiyo Yuden TMK105BJ104KV-F.
C627	0.1 $\mu$ F; similar to Murata GRM188R11E104KA01D.
C628 thru C630	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C632 thru C634	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C636 thru C638	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C643 thru C649	(Not Used).
C650	0.01 $\mu$ F; similar to Murata GRM155R11E103KA01D.
C651	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C652	0.01 $\mu$ F; similar to Murata GRM155R11E103KA01D.
C653	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C654	(Not Used).
C661	10 pF; similar to Murata GRM1552C1H100FA01D.
C662	0.01 $\mu$ F; similar to Murata GRM155R11E103KA01D.
C663	(Not Used).
C664	0.01 $\mu$ F; similar to Murata GRM155R11E103KA01D.
C665	39 pF; similar to Murata GRM1552C1H390JA01D.
C671 and C672	0.01 $\mu$ F; similar to Murata GRM155R11E103KA01D.
C674 and C675	0.01 $\mu$ F; similar to Murata GRM155R11E103KA01D.
C677	33 pF; similar to Murata GRM1552C1H330FA01D.
C678 thru C681	0.01 $\mu$ F; similar to Murata GRM155R11E103KA01D.
C682	22 pF; similar to Taiyo Yuden UMK105CH220JV-F.

SYMBOL	DESCRIPTION
C683	0.01 $\mu$ F; similar to Murata GRM155R11E103KA01D.
C684	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C685	0.1 $\mu$ F; similar to Taiyo Yuden TMK105BJ104KV-F.
C686	(Not Used).
C687	0.047 $\mu$ F; similar to Murata GRM155R11C473KA01D.
C688	0.1 $\mu$ F; similar to Taiyo Yuden TMK105BJ104KV-F.
C701 thru C704	(Not Used).
C705	0.33 $\mu$ F; similar to Murata GRM219R71H334KA88D.
C706	22 $\mu$ F; similar to Nichicon F931V226MNC.
C707	(Not Used).
C708	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C709	0.33 $\mu$ F; similar to Murata GRM219R71H334KA88D.
C710	22 $\mu$ F; similar to Nichicon F931V226MNC.
C711	(Not Used).
C712	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C713	0.33 $\mu$ F; similar to Murata GRM219R71H334KA88D.
C714	10 $\mu$ F; similar to Murata GRM31CR61C106KA88L.
C715	(Not Used).
C716 and C717	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C718	0.33 $\mu$ F; similar to Murata GRM219R71H334KA88D.
C719	22 $\mu$ F; similar to Nichicon F931V226MNC.
C720	(Not Used).
C721	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C722	0.01 $\mu$ F; similar to Murata GRM155R11E103KA01D.
C723	0.1 $\mu$ F; similar to Taiyo Yuden TMK105BJ104KV-F.
C724	10 $\mu$ F; similar to Murata GRM31CR61C106KA88L.
C725	0.01 $\mu$ F; similar to Murata GRM155R11E103KA01D.
C726	0.22 $\mu$ F; similar to Murata GRM188R11C224KA01D.
C727	0.01 $\mu$ F; similar to Murata GRM155R11E103KA01D.
C728	1.0 $\mu$ F; similar to Taiyo Yuden EMK107BJ105KA-T.
C729 and C730	10 $\mu$ F; similar to Murata GRM31CR61C106KA88L.
C731	0.33 $\mu$ F; similar to Murata GRM219R71H334KA88D.
C732	22 $\mu$ F; similar to Nichicon F931V226MNC.
C733	0.01 $\mu$ F; similar to Murata GRM155R11E103KA01D.
C734	0.1 $\mu$ F; similar to Taiyo Yuden TMK105BJ104KV-F.
C735	10 $\mu$ F; similar to Murata GRM31CR61C106KA88L.
C736	0.01 $\mu$ F; similar to Murata GRM155R11E103KA01D.
C737	1.0 $\mu$ F; similar to Taiyo Yuden EMK107BJ105KA-T.

SYMBOL	DESCRIPTION
C738	0.01 $\mu$ F; similar to Murata GRM155R11E103KA01D.
C739	1.0 $\mu$ F; similar to Taiyo Yuden EMK107BJ105KA-T.
C740	0.01 $\mu$ F; similar to Murata GRM188R11H103KA01D.
C741	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C742	0.01 $\mu$ F; similar to Murata GRM188R11H103KA01D.
C743	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C744	0.01 $\mu$ F; similar to Murata GRM188R11H103KA01D.
C745	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C746	0.01 $\mu$ F; similar to Murata GRM188R11H103KA01D.
C747	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C748 thru C751	(Not Used).
C752	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C753 and C754	(Not Used).
C755	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C756 thru C766	(Not Used).
C767 thru C773	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C774 thru C780	(Not Used).
C801	1.0 $\mu$ F; similar to Taiyo Yuden EMK107BJ105KA-T.
C802	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C803	0.1 $\mu$ F; similar to Taiyo Yuden TMK105BJ104KV-F.
C804	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C805	0.1 $\mu$ F; similar to Taiyo Yuden TMK105BJ104KV-F.
C806	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C807	0.1 $\mu$ F; similar to Taiyo Yuden TMK105BJ104KV-F.
C808	0.1 $\mu$ F; similar to Taiyo Yuden TMK105BJ104KV-F.
C809 and C810	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C811	0.22 $\mu$ F; similar to Murata GRM188R11C224KA01D.
C812 and C813	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C814 and C815	0.01 $\mu$ F; similar to Murata GRM155R11E103KA01D.
C816	0.22 $\mu$ F; similar to Murata GRM188B11C224KA01D.
C817	1.0 $\mu$ F; similar to Taiyo Yuden EMK107BJ105KA-T.
C818	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.

SYMBOL	DESCRIPTION
C819	100 pF; similar to Murata GRM1552C1H101JA01D.
C820	0.01 $\mu$ F; similar to Murata GRM155R11E103KA01D.
C821	100 pF; similar to Murata GRM1552C1H101JA01D.
C822	15 pF; similar to Taiyo Yuden UMK105CH150JV-F.
C823	0.01 $\mu$ F; similar to Murata GRM155R11E103KA01D.
C824 and C825	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C826 and C827	0.1 $\mu$ F; similar to Taiyo Yuden TMK105BJ104KV-F.
C828	2200 pF; similar to Taiyo Yuden UMK105BJ222KV-F.
C829 and C830	100 pF; similar to Murata GRM1552C1H101JA01D.
C831	180 pF; similar to Taiyo Yuden UMK105CH181JV-F.
C832	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C833 and C834	0.1 $\mu$ F; similar to Taiyo Yuden TMK105BJ104KV-F.
C841	330 pF; similar to American Technical Ceramics 100B331JT200XT.
C842	1000 pF; similar to Murata GRM31A7U2J102JW31D.
C843	330 pF; similar to American Technical Ceramics 100B331JT200XT.
C844	18 pF; similar to American Technical Ceramics 100B180JT500XT.
C845	12 pF; similar to American Technical Ceramics 100B120JT500XT.
C846	15 pF; similar to American Technical Ceramics 100B150JT500XT.
C848	5.6 pF; similar to American Technical Ceramics 100B5R6BT500XT.
C849	18 pF; similar to American Technical Ceramics 100B180JT500XT.
C850	15 pF; similar to American Technical Ceramics 100B150JT500XT.
C851	3 pF; similar to American Technical Ceramics 100B3R0CT500XT.
C852 and C853	6 pF; similar to Murata GRM31M2C2H6R0DV01L.
C854	1000 pF; similar to Murata GRM1882C1H102JA01D.
C855	18 pF; similar to American Technical Ceramics 100B180JT500XT.
C856	15 pF; similar to American Technical Ceramics 100B150JT500XT.
C857	1000 pF; similar to Murata GRM1882C1H102JA01D.
C858	(Not Used).
C859	1000 pF; similar to Murata GRM1882C1H102JA01D.

SYMBOL	DESCRIPTION
C860	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C861	7 pF; similar to Murata GRM2192C2D7R0DY21D.
C862	8 pF; similar to Murata GRM2192C2D8R0DY21D.
C863	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C871 and C872	22 pF; similar to Murata GRM1882C1H220JA01D.
C873 thru C878	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C891 and C892	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C893	2.2 $\mu$ F; similar to Taiyo Yuden EMK107BJ225KA-T.
C894 and C895	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C896	10 $\mu$ F; similar to Taiyo Yuden EMK212BJ106KG-T.
C897	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C898	0.047 $\mu$ F; similar to Murata GRM188R11H473KA61D.
C1111 and C1112	(Not Used).
C1117	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C1121	(Not Used).
C1131	33 pF; similar to Murata GRM1882C1H330JA01D.
C1132 thru C1134	(Not Used).
C1136 thru C1138	(Not Used).
C1139	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C1141 and C1142	39 pF; similar to Murata GRM21A5C2E390JW01D.
C1143 and C1144	100 pF; similar to Murata GRM1552C1H101JA01D.
C1145	0.01 $\mu$ F; similar to Murata GRM188R11H103KA01D.
C1146	100 pF; similar to Murata GRM1882C1H101JA01D.
C1151	15 pF; similar to American Technical Ceramics 100B150JT500XT.
C1152	22 pF; similar to American Technical Ceramics 100B220JT500XT.
C1153 thru C1155	(Not Used).
C1161 and C1162	47 pF; similar to American Technical Ceramics 100B470JT500XT.

SYMBOL	DESCRIPTION
C1163	56 pF; similar to American Technical Ceramics 100B560JT500XT.
C1164 and C1165	(Not Used).
C1171	15 pF; similar to American Technical Ceramics 100B150JT500XT.
C1172	22 pF; similar to American Technical Ceramics 100B220JT500XT.
C1173 thru C1175	(Not Used).
C1181 and C1182	47 pF; similar to American Technical Ceramics 100B470JT500XT.
C1183	56 pF; similar to American Technical Ceramics 100B560JT500XT.
C1184 and C1185	(Not Used).
C1186	330 pF; similar to American Technical Ceramics 100B331JT200XT.
C1191 and C1201	(Not Used).
C1221	(Not Used).
C1231	4 pF; similar to Murata GRM1552C1H4R0BA01D.
C1232	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C1233 and C1234	(Not Used).
C1235	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C1236	4 pF; similar to Murata GRM1552C1H4R0BA01D.
C1237	(Not Used).
C1261	4 pF; similar to Murata GRM1552C1H4R0BA01D.
C1262	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C1263 and C1264	(Not Used).
C1265	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C1266	4 pF; similar to Murata GRM1552C1H4R0BA01D.
C1281	(Not Used).
C1291 and C1292	(Not Used).
C1293	560 ohm; similar to Panasonic ERJ2GEJ561X.
C1301 and C1302	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C1303	0.1 $\mu$ F; similar to Taiyo Yuden TMK105BJ104KV-F.

SYMBOL	DESCRIPTION
C1304	0.01 $\mu$ F; similar to Murata GRM155R11E103KA01D.
C1305	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C1306	(Not Used).
C1350	4 pF; similar to Murata GRM1552C1H4R0BA01D.
C1351 and C1352	12 pF; similar to Murata GRM1552C1H120JA01D.
C1371	0.01 $\mu$ F; similar to Murata GRM155R11E103KA01D.
C1372 and C1373	(Not Used).
C1375	(Not Used).
C1376	0.01 $\mu$ F; similar to Murata GRM155R11E103KA01D.
C1377	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C1401 thru C1404	(Not Used).
C1410 thru C1412	(Not Used).
C1421 and C1422	(Not Used).
C1431	4 pF; similar to Murata GRM1552C1H4R0BA01D.
C1433 and C1434	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C1437	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C1451 thru C1454	(Not Used).
C1456	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C1458 thru C1460	(Not Used).
C1491 thru C1493	(Not Used).
C1501 thru C1504	(Not Used).
C1510 thru C1512	(Not Used).
C1521 thru C1523	(Not Used).
C1534	8 pF; similar to Murata GRM1552C1H8R0BA01D.
C1535	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C1564 thru C1566	(Not Used).

SYMBOL	DESCRIPTION
C1568 thru C1573	(Not Used).
C1591 thru C1594	(Not Used).
C1601	0.01 $\mu$ F; similar to Murata GRM155R11E103KA01D.
C1602	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C1603	0.01 $\mu$ F; similar to Murata GRM155R11E103KA01D.
C1604	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C1661 thru C1663	(Not Used).
C1664	220 ohm; similar to Panasonic ERJ2GEJ221X.
C1671 thru C1674	(Not Used).
C1740 and C1741	(Not Used).
C1801	(Not Used).
C1842	1000 pF; similar to Murata GRM31A7U2J102JW31D.
C1843	330 pF; similar to American Technical Ceramics 100B331JT200XT.
C1844	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C1845 and C1846	(Not Used).
C1847	1000 pF; similar to Murata GRM1882C1H102JA01D.
C1849	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C1851	0.01 $\mu$ F; similar to Murata GRM188R11H103KA01D.
C1852	1000 pF; similar to Murata GRM1882C1H102JA01D.
C1853	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C1854	0.01 $\mu$ F; similar to Murata GRM155R11E103KA01D.
C1855 and C1856	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C1857	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C1858 thru C1861	0.01 $\mu$ F; similar to Murata GRM155R11E103KA01D.
C1862	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F.
C1863 and C1864	6 pF; similar to Murata GRM31M2C2H6R0DV01L.
C1872 thru C1874	(Not Used).
C1891 thru C1898	(Not Used).

SYMBOL	DESCRIPTION
	-----PIN AND VARACTOR DIODES-----
CD101 and CD102	Similar to Avago HSMP-3864-TR1G.
CD201	Similar to Renesas RKV501KJ-R1.
CD202 and CD203	Similar to Renesas RKS151KJ-P1.
CD204	Similar to Renesas RKV501KJ-R1.
CD231 and CD232	Similar to Renesas RKS151KJ-P1.
CD233 and CD234	Similar to Renesas RKV501KJ-R1.
CD235 and CD236	Similar to Renesas RKS151KJ-P1.
CD261 and CD262	Similar to Renesas RKS151KJ-P1.
CD263 and CD264	Similar to Renesas RKV501KJ-R1.
CD265 and CD266	Similar to Renesas RKS151KJ-P1.
CD281	Similar to Renesas HSM88ASTL-E.
CD371	Similar to Toshiba 1SV276(TPH3 F).
CD372	Similar to Toshiba 1SS381(TPL3 F).
CD401	Similar to Renesas RD2.4S-T1-AT.
CD402	Similar to Renesas HSU88TRF-E.
CD431 thru CD434	Similar to Renesas HVC383BTRF-E.
CD435 thru CD438	Similar to Toshiba 1SS381(TPL3 F).
CD501	Similar to Renesas RD2.4S-T1-AT.
CD502	Similar to Renesas HSU88TRF-E.
CD531 thru CD534	Similar to Toshiba 1SV228(TPH3 F).
CD535 thru CD538	Similar to Toshiba 1SS381(TPL3 F).
CD539 and CD540	(Not Used).
CD561 and CD563	(Not Used).

SYMBOL	DESCRIPTION
CD565 thru CD568	(Not Used).
CD601	(Not Used).
CD671 and CD672	Similar to Avago HSMP-3864-TR1G.
CD701	Similar to Shindengen D1F60-5053.
CD702	Similar to Shindengen DF25V60-5072.
CD801	Similar to Asahi Kasei Power Devices KV1870STL-G.
CD841 thru CD844	Similar to Litec L709CER.
CD871	Similar to Renesas HSM88ASTL-E.
CD872 and CD873	Similar to Renesas HSU88TRF-E.
CD891 and CD892	Similar to Renesas HSM88ASTL-E.
CD1371	(Not Used).
CD1431 and CD1432	Similar to Toshiba 1SS381(TPL3 F).
CD1841 and CD1842	Similar to Litec L709CER.
CD1843	(Not Used).
CD1844	Similar to Renesas HSM88ASTL-E.
CD1845	Similar to Renesas HSU88TRF-E.
CD1846	Similar to Litec L709CER.
CD1891	(Not Used).
	----- VARIABLE CAPACITORS-----
CV431 and CV531	Similar to Voltronics JZ100.
CV561	(Not Used).
CV1201 and CV1202	(Not Used).
CV1231 and CV1232	(Not Used).
CV1261 and CV1262	(Not Used).
	-----GROUNDING CONTACTS-----
EB101 thru EB104	Similar to Kitagawa Industries OG-320816.

SYMBOL	DESCRIPTION
EB111 thru EB113	Similar to Kitagawa Industries OG-320816.
EB321 thru EB323	Similar to Kitagawa Industries OG-320816.
EB331 thru EB333	Similar to Kitagawa Industries OG-320816.
EB531 and EB541	Similar to Kitagawa Industries OG-320816.
----- FILTERS -----	
FL281	Similar to NDK H-7XMPD0020.
FL601	Similar to Murata BLA2ABD601SN4D.
FL602 and FL603	Similar to Murata BLM18BD601SN1D.
FL604 thru FL606	Similar to Murata BLM18BD601SN1D.
FL607 and FL608	Similar to Murata BLA2ABD601SN4D.
FL609 and FL610	Similar to Murata BLM18BD601SN1D.
FL661	Similar to NDK H-7XMPD0021.
----- INTEGRATED CIRCUITS -----	
IC301	Similar to Asahi Kasei Microdevices AK4386VT-E2.
IC302	Similar To Cypress H-7DLPD0023B.
IC303	Similar to Toshiba TC74VHC4040FK(EL_K).
IC304	Similar to Toshiba TC74VHC74FK(EL_K).
IC305	Similar to Analog Devices AD5304ARMZ-REEL7.
IC306	Similar to New JRC NJM2125F-TE1-#ZZZB.
IC307	Similar to Toshiba TC4W66FU(TE12L F).
IC308	Similar to Toshiba TC4W53FU(TE12L F).
IC321 thru IC323	Similar to New JRC NJM2746RB1(TE1)-#ZZZB.
IC324	Similar to Analog Devices ADL5385ACPZ-R7.
IC401	Similar to Asahi Kasei Microdevices AK1541-L.
IC402	Similar to New JRC NJM2125F-TE1-#ZZZB.
IC403	Similar to New JRC NJM3404AV(TE1)-#ZZZB.
IC501	Similar to Asahi Kasei Microdevices AK1541-L.
IC502	Similar to New JRC NJM2125F-TE1-#ZZZB.
IC503	Similar to New JRC NJM3404AV(TE1)-#ZZZB.
IC601	Similar to Silicon Laboratories H-7DLPD0029.

SYMBOL	DESCRIPTION
IC602	Similar to Toshiba TC7S04FU(TE85L F).
IC603	Similar to Toshiba TC74VHC125FT-EL.
IC605	Similar to New JRC NJM2741F3(TE1)-#ZZZB.
IC606	Similar to New JRC NJM2125F-TE1-#ZZZB.
IC671	Similar to Linear Technology LTC5507ES6#TRPBF.
IC672	Similar to New JRC NJM2125F-TE1-#ZZZB.
IC701	(Not Used).
IC702 and IC703	Similar to ROHM BA09FP-E2.
IC704	Similar to New JRC NJM7805DL1A-TE1-#ZZZB.
IC705	Similar to ROHM BA09FP-E2.
IC706	Similar to New JRC NJM78L05UA(TE1)-#ZZZB.
IC707	Similar to Asahi Kasei Power Devices TK11233CUCB-G.
IC708	Similar to ROHM BA09FP-E2.
IC709	Similar to New JRC NJM78L05UA(TE1)-#ZZZB.
IC710	Similar to RICOHR1114D301B-TR-F.
IC801	Similar to Analog Devices AD9864BCPZRL.
IC891	Similar to New JRC NJM2125F-TE1-#ZZZB.
IC892	Similar to Toshiba TC4W53FU(TE12L F).
IC1301	Similar to New JRC NJM3404AV(TE1)-#ZZZB.
----- CONNECTORS -----	
J701	Similar to Suyin Connector 127180MA040G200ZR.
----- INDUCTORS -----	
L101 and L102	Similar to Panasonic ERJ3GEY0R00V.
L103	270 nH; similar to TOKO LLQ1608-FR27G.
L111	56 nH; similar to TOKO LL1005-FHL56NJ.
L112 and L113	68 nH; similar to TOKO LL1005-FHL68NJ.
L121	56 nH; similar to TOKO LL1608-FSL56NJ.
L122	47 nH; similar to TOKO LL1608-FSL47NJ.
L123	150 nH; similar to TOKO LL1608-FSLR15J.
L124	68 nH; similar to TOKO LLQ2012-F68NJ.
L131	18 nH; similar to TOKO LLQ2012-F18NJ.
L132	15 nH; similar to TOKO LLQ2012-F15NJ.
L134	47.0 nH; similar to Korin Electronics AS050730-47R0NJ-T.
L135	17 nH; similar to Korin Electronics AS030616-17NJ.
L141 and L142	8.8 nH; similar to Korin Electronics AS050325-8R8NJ.

SYMBOL	DESCRIPTION
L151	6.8 nH; similar to Korin Electronics AP040425-6R8N-T.
L152 and L153	9.4 nH; similar to Korin Electronics AP040525-9R4N.
L154	15 nH; similar to Korin Electronics AS100440-15NJ-T.
L155	9.3 nH; similar to Korin Electronics AS120252-9R3N-T.
L171	6.8 nH; similar to Korin Electronics AP040425-6R8N-T.
L172 and L173	9.4 nH; similar to Korin Electronics AP040525-9R4N.
L174	15 nH; similar to Korin Electronics AS100440-15NJ-T.
L175	9.3 nH; similar to Korin Electronics AS120252-9R3N-T.
L191 thru L194	39.6 nH; similar to Korin Electronics AS100647-39R6NJ-T.
L201	18.5 nH; similar to Coilcraft A05TGLC.
L202 and L203	560 nH; similar to TOKO LLQ2012-FR56J.
L204	18.5 nH; similar to Coilcraft A05TGLC.
L221	39 nH; similar to TOKO LL1005-FHL39NJ.
L222	47 nH; similar to TOKO LL1005-FHL47NJ.
L231	560 nH; similar to TOKO LLQ2012-FR56J.
L232 and L233	35.5 nH; similar to Coilcraft B09TGLC.
L234	560 nH; similar to TOKO LLQ2012-FR56J.
L251	100 nH; similar to TOKO LL1005-FHLR10J.
L261	560 nH; similar to TOKO LLQ2012-FR56J.
L262 and L263	35.5 nH; similar to Coilcraft B09TGLC.
L264	560 nH; similar to TOKO LLQ2012-FR56J.
L281 and L282	820 nH; similar to TOKO LLQ2012-FR82J.
L283	470 nH; similar to TOKO LLQ2012-FR47J.
L291	680 nH; similar to TOKO LLQ2012-FR68J.
L301	1.0 $\mu$ H; similar to Murata LQH31MN1R0K03L.
L323 thru L325	47 nH; similar to TOKO LLQ1608-F47NJ.
L371 and L372	15 $\mu$ H; similar to Murata LQH31MN150J03L.
L373	270 nH; similar to TOKO LLQ2012-FR27G.

SYMBOL	DESCRIPTION
L374 and L375	820 nH; similar to TOKO LLQ2012-FR82J.
L377	330 nH; similar to Taiyo Yuden LK1608 R33K-T.
L378	120 nH; similar to TOKO LL1608-FSLR12J.
L431 thru L436	220 nH; similar to TOKO LLQ1608-FR22J.
L437	11 nH; similar to Midori MusenH-7LAPD0054.
L438 and L439	10 nH; similar to TOKO LL1005-FHL10NJ.
L451	39 nH; similar to TOKO LL1005-FHL39NJ.
L452	33 nH; similar to TOKO LL1005-FHL33NJ.
L531 and L532	680 nH; similar to TOKO LLQ2012-FR68J.
L533 thru L535	820 nH; similar to TOKO LLQ2012-FR82J.
L536	820 nH; similar to TOKO LLQ2012-FR82J.
L537 and L538	(Not Used).
L539	14 nH; similar to Midori Musen H-7LAPD0053.
L540	100 nH; similar to Murata LQW18ANR10J00D.
L541 thru L543	680 nH; similar to TOKO LLQ2012-FR68J.
L561 thru L566	(Not Used).
L569 thru L571	(Not Used).
L581	68 nH; similar to Taiyo Yuden HK1005 68NJ-T.
L582	47 nH; similar to Taiyo Yuden HK1005 47NJ-T.
L584	47 nH; similar to TOKO LL1608-FSL47NJ.
L585	47 nH; similar to TOKO LLQ2012-F47NJ.
L586	27 nH; similar to TOKO LLQ2012-F27NJ.
L661	680 nH; similar to TOKO LLQ2012-FR68J.
L662	390 nH; similar to TOKO LLQ2012-FR39J.
L671 thru L673	820 nH; similar to TOKO LLQ2012-FR82J.
L674	470 nH; similar to Taiyo Yuden LK1608 R47K-T.
L675	180 nH; similar to TOKO LL1608-FSLR18J.
L676	270 nH; similar to TOKO LL1608-FSLR27J.

SYMBOL	DESCRIPTION
L701 and L702	1.0 $\mu$ H; similar to Murata LQH31MN1R0K03L.
L801	1.2 $\mu$ H; similar to Murata LQH31MN1R2K03L.
L802	390 nH; similar to Taiyo Yuden LK1005 R39K-T.
L803 and L804	10 $\mu$ H; similar to Murata LQH32CN100K23L.
L841	700 nH; similar to Korin Electronics AS050847D-700N.
L842	244 nH; similar to Korin Electronics AS051147-244NJ.
L843	47 nH; similar to Korin Electronics AS100747-47NJ.
L844	26 nH; similar to Midori Musen H-7LAPD0059.
L845 and L846	32 nH; similar to Midori Musen H-7LAPD0060.
L847	38.5 nH; similar to Korin Electronics AS050630-38R5NJ-T.
L871 and L872	57.5 nH; similar to Korin Electronics AS030921-57R5NJ.
L1141	22.4 nH; similar to Korin Electronics AS080440-22R4NJ.
L1151	23.9 nH; similar to Korin Electronics AS100447-23R9NJ-T.
L1152 and L1153	(Not Used).
L1171	23.9 nH; similar to Korin Electronics AS100447-23R9NJ-T.
L1172 and L1173	(Not Used).
L1191	(Not Used).
L1231	270 nH; similar to TOKO LLQ2012-FR27J.
L1232 and L1233	560 nH; similar to TOKO LLQ2012-FR56J.
L1234 and L1261	270 nH; similar to TOKO LLQ2012-FR27J.
L1262 and L1263	560 nH; similar to TOKO LLQ2012-FR56J.
L1264	270 nH; similar to TOKO LLQ2012-FR27J.
L1291	(Not Used).
L1350	15 nH; similar to TOKO LL1005-FHL15NJ.
L1371 and L1421	(Not Used).

SYMBOL	DESCRIPTION
L1431 and L1432	220 nH; similar to TOKO LLQ1608-FR22J.
L1435 and L1451	(Not Used).
L1521 and L1563	(Not Used).
L1571 and L1591	(Not Used).
L1671	(Not Used).
L1841	820 nH; similar to TOKO LLQ2012-FR82J.
L1871	(Not Used).
----- INTEGRATED CIRCUITS -----	
MIX281	Similar to Mini-Circuits ADE-1HW-3+-TR.
----- RESISTORS -----	
R101	18 ohm; similar to Panasonic ERJ2GEJ180X.
R102 and R103	270 ohm; similar to Panasonic ERJ2GEJ271X.
R104 and R105	560 ohm; similar to Panasonic ERJ2GEJ561X.
R106	150 ohm; similar to Panasonic ERJ2GEJ151X.
R107 and R108	2.2K ohm; similar to Panasonic ERJ2RKF2201X.
R109	560 ohm; similar to Panasonic ERJ2GEJ561X.
R110	1.5K ohm; similar to Panasonic ERJ2GEJ152X.
R111	18 ohm; similar to Panasonic ERJ2GEJ180X.
R112 and R113	270 ohm; similar to Panasonic ERJ2GEJ271X.
R114	10 ohm; similar to Panasonic ERJ2GEJ100X.
R115	5.6K ohm; similar to Panasonic ERJ2GEJ562X.
R116	2.7K ohm; similar to Panasonic ERJ2GEJ272X.
R117	1000 ohm; similar to Panasonic ERJ2GEJ102X.
R118	82 ohm; similar to Panasonic ERJ2GEJ820X.
R119	18 ohm; similar to Panasonic ERJ2GEJ180X.
R120 and R121	270 ohm; similar to Panasonic ERJ2GEJ271X.
R122	8.2K ohm; similar to Panasonic ERJ2GEJ822X.
R123	1.2K ohm; similar to Panasonic ERJ2RKF1201X.
R124	3.9K ohm; similar to Panasonic ERJ2GEJ392X.
R125	1.8K ohm; similar to Panasonic ERJ2GEJ182X.

SYMBOL	DESCRIPTION
R126	12 ohm; similar to Panasonic ERJ2GEJ120X.
R127	820 ohm; similar to Panasonic ERJ2GEJ821X.
R131	56 ohm; similar to Panasonic ERJ6GEYJ560V.
R132	120 ohm; similar to Panasonic ERJ2GEJ121X.
R133	1.2K ohm; similar to Panasonic ERJ2GEJ122X.
R134	Similar to Susumu RL1220S-R10-F.
R135	15 ohm; similar to Panasonic ERJ6GEYJ150V.
R141	22 ohm; similar to Panasonic ERJ1TYJ220U.
R151 and R152	5.6K ohm; similar to Panasonic ERJ3GEYJ562V.
R153 and R154	5.6 ohm; similar to Panasonic ERJ8GEYJ5R6V.
R171 and R172	5.6K ohm; similar to Panasonic ERJ3GEYJ562V.
R173 and R174	5.6 ohm; similar to Panasonic ERJ8GEYJ5R6V.
R191	100 ohm; similar to Barry Industries REC1206CT-1000JN-2S(TR).
R201 and R202	56K ohm; similar to Panasonic ERJ2RKF5602X.
R203	1.5K ohm; similar to Panasonic ERJ2GEJ152X.
R204	3.3K ohm; similar to Panasonic ERJ2RKF3301X.
R205	560 ohm; similar to Panasonic ERJ6GEYJ561V.
R206 and R207	3.9K ohm; similar to Panasonic ERJ2GEJ392X.
R221	10 ohm; similar to Panasonic ERJ2GEJ100X.
R222	3.3K ohm; similar to Panasonic ERJ2RKF3301X.
R223	1000 ohm; similar to Panasonic ERJ2GEJ102X.
R224	18 ohm; similar to Panasonic ERJ6GEYJ180V.
R225	1000 ohm; similar to Panasonic ERJ2GEJ102X.
R226	12 ohm; similar to Panasonic ERJ2GEJ120X.
R227 and R228	470 ohm; similar to Panasonic ERJ2GEJ471X.
R231	3.3K ohm; similar to Panasonic ERJ2RKF3301X.
R232	1.5K ohm; similar to Panasonic ERJ2GEJ152X.
R233	100K ohm; similar to Panasonic ERJ2GEJ104X.
R234	56K ohm; similar to Panasonic ERJ2RKF5602X.
R235	100K ohm; similar to Panasonic ERJ2GEJ104X.
R236	1.5K ohm; similar to Panasonic ERJ2GEJ152X.
R237	3.3K ohm; similar to Panasonic ERJ2RKF3301X.

SYMBOL	DESCRIPTION
R251	33 ohm; similar to Panasonic ERJ2GEJ330X.
R252	10 ohm; similar to Panasonic ERJ8GEYJ100V.
R253	1.5K ohm; similar to Panasonic ERJ2GEJ152X.
R254	470 ohm; similar to Panasonic ERJ2GEJ471X.
R255	10 ohm; similar to Panasonic ERJ8GEYJ100V.
R256	470 ohm; similar to Panasonic ERJ2GEJ471X.
R257	33 ohm; similar to Panasonic ERJ2GEJ330X.
R261	3.3K ohm; similar to Panasonic ERJ2RKF3301X.
R262	1.5K ohm; similar to Panasonic ERJ2GEJ152X.
R263	100K ohm; similar to Panasonic ERJ2GEJ104X.
R264	56K ohm; similar to Panasonic ERJ2RKF5602X.
R265	100K ohm; similar to Panasonic ERJ2GEJ104X.
R266	1.5K ohm; similar to Panasonic ERJ2GEJ152X.
R267	3.3K ohm; similar to Panasonic ERJ2RKF3301X.
R281	18 ohm; similar to Panasonic ERJ2GEJ180X.
R282 and R283	270 ohm; similar to Panasonic ERJ2GEJ271X.
R284	12 ohm; similar to Panasonic ERJ2GEJ120X.
R285 and R286	470 ohm; similar to Panasonic ERJ2GEJ471X.
R287	56 ohm; similar to Panasonic ERJ2GEJ560X.
R288	(Not Used).
R289	1.2K ohm; similar to Panasonic ERJ2RKF1201X.
R290	330 ohm; similar to Panasonic ERJ2GEJ331X.
R291 and R292	1.8K ohm; similar to Panasonic ERJ2GEJ182X.
R293	1000 ohm; similar to Panasonic ERJ2GEJ102X.
R294	330 ohm; similar to Panasonic ERJ6GEYJ331V.
R295	330K ohm; similar to Panasonic ERJ2GEJ334X.
R296	10 ohm; similar to Panasonic ERJ2GEJ100X.
R298	820 ohm; similar to Panasonic ERJ2GEJ821X.
R299 and R300	1000 ohm; similar to Panasonic ERJ2GEJ102X.
R301	10K ohm; similar to Panasonic EXB28V103JX.
R302 thru R305	10K ohm; similar to Panasonic ERJ2RKF1002X.
R306	47K ohm; similar to Panasonic ERJ2RKF4702X.
R309	10K ohm; similar to Panasonic ERJ2RKF1002X.
R310	15K ohm; similar to Panasonic ERJ2GEJ153X.
R311	820 ohm; similar to Panasonic ERJ2GEJ821X.

SYMBOL	DESCRIPTION
R321	2.2K ohm; similar to Panasonic ERJ2RKF2201X.
R322 and R323	10K ohm; similar to Panasonic ERJ2RKF1002X.
R324	10K ohm; similar to Panasonic ERJ2RKF1002X.
R325 and R326	2.2K ohm; similar to Panasonic ERJ2RKF2201X.
R327 thru R329	10K ohm; similar to Panasonic ERJ2RKF1002X.
R330	2.2K ohm; similar to Panasonic ERJ2RKF2201X.
R331	2.7K ohm; similar to Panasonic ERJ2RKF2701X.
R332	10K ohm; similar to Panasonic ERJ2RKF1002X.
R333	18K ohm; similar to Panasonic ERJ2RKF1802X.
R334	10K ohm; similar to Panasonic ERJ2RKF1002X.
R335	3.3K ohm; similar to Panasonic ERJ2RKF3301X.
R336	1.2K ohm; similar to Panasonic ERJ2RKF1201X.
R337	2.7K ohm; similar to Panasonic ERJ2RKF2701X.
R338	10K ohm; similar to Panasonic ERJ2RKF1002X.
R339	18K ohm; similar to Panasonic ERJ2RKF1802X.
R340	10K ohm; similar to Panasonic ERJ2RKF1002X.
R341	3.3K ohm; similar to Panasonic ERJ2RKF3301X.
R342	1.2K ohm; similar to Panasonic ERJ2RKF1201X.
R343	56K ohm; similar to Panasonic ERJ2RKF5602X.
R344	2.7K ohm; similar to Panasonic ERJ2RKF2701X.
R345	10K ohm; similar to Panasonic ERJ2RKF1002X.
R346	18K ohm; similar to Panasonic ERJ2RKF1802X.
R347	10K ohm; similar to Panasonic ERJ2RKF1002X.
R348	3.3K ohm; similar to Panasonic ERJ2RKF3301X.
R349	1.2K ohm; similar to Panasonic ERJ2RKF1201X.
R350	2.7K ohm; similar to Panasonic ERJ2RKF2701X.
R351	10K ohm; similar to Panasonic ERJ2RKF1002X.
R352	18K ohm; similar to Panasonic ERJ2RKF1802X.
R353	10K ohm; similar to Panasonic ERJ2RKF1002X.
R354	3.3K ohm; similar to Panasonic ERJ2RKF3301X.
R355	1.2K ohm; similar to Panasonic ERJ2RKF1201X.
R356	56K ohm; similar to Panasonic ERJ2RKF5602X.
R357	18 ohm; similar to Panasonic ERJ2GEJ180X.
R358 and R359	270 ohm; similar to Panasonic ERJ2GEJ271X.
R360 thru R362	18K ohm; similar to Panasonic ERJ2RKF1802X.

SYMBOL	DESCRIPTION
R371	36K ohm; similar to Panasonic ERJ2GEJ363X.
R372	12K ohm; similar to Panasonic ERJ2GEJ123X.
R373	10K ohm; similar to Panasonic ERJ2GEJ103X.
R374	2.7K ohm; similar to Panasonic ERJ2GEJ272X.
R375	10K ohm; similar to Panasonic ERJ2RKF1002X.
R376	560 ohm; similar to Panasonic ERJ8GEYJ561V.
R377 and R278	2.7K ohm; similar to Panasonic ERJ2GEJ272X.
R379	820 ohm; similar to Panasonic ERJ2GEJ821X.
R380	33 ohm; similar to Panasonic ERJ2GEJ330X.
R381	220 ohm; similar to Panasonic ERJ2GEJ221X.
R382	3.3K ohm; similar to Panasonic ERJ2RKF3301X.
R389	330 ohm; similar to Panasonic ERJ14YJ331U.
R401	27K ohm; similar to Panasonic ERJ2GEJ273X.
R402	(Not Used).
R403	4.7K ohm; similar to Panasonic ERJ2GEJ472X.
R404	22 ohm; similar to Panasonic ERJ2GEJ220X.
R405	2.2K ohm; similar to Panasonic ERJ2RKF2201X.
R406	47 ohm; similar to Panasonic ERJ2GEJ470X.
R407	1000 ohm; similar to Panasonic ERJ2GEJ102X.
R408	820 ohm; similar to Panasonic ERJ2GEJ821X.
R409	330 ohm; similar to Panasonic ERJ12YJ331U.
R410	180K ohm; similar to Panasonic ERJ2GEJ184X.
R411	6.8K ohm; similar to Panasonic ERJ2GEJ682X.
R412	1000 ohm; similar to Panasonic ERJ2GEJ102X.
R413 and R414	180 ohm; similar to Panasonic ERJ2GEJ181X.
R415	470 ohm; similar to Panasonic ERJ2GEJ471X.
R416	2.2K ohm; similar to Panasonic ERJ2RKF2201X.
R417	1000K ohm; similar to Panasonic ERJ2GEJ105X.
R421	330 ohm; similar to Panasonic ERJ14YJ331U.
R431	1.8K ohm; similar to Panasonic ERJ3GEYJ182V.
R432	2.2K ohm; similar to Panasonic ERJ3GEYJ222V.
R433	270 ohm; similar to Panasonic ERJ6GEYJ271V.
R451	5.6K ohm; similar to Panasonic ERJ2GEJ562X.
R452	1.5K ohm; similar to Panasonic ERJ2GEJ152X.
R453	100 ohm; similar to Panasonic ERJ2GEJ101X.
R454 and R455	10 ohm; similar to Panasonic ERJ2GEJ100X.
R456	150 ohm; similar to Panasonic ERJ2GEJ151X.
R458	1000 ohm; similar to Panasonic ERJ2GEJ102X.

SYMBOL	DESCRIPTION
R459	100K ohm; similar to Panasonic ERJ2GEJ104X.
R460	47 ohm; similar to Panasonic ERJ2GEJ470X.
R471	4.7K ohm; similar to Panasonic ERJ2GEJ472X.
R472	560 ohm; similar to Panasonic ERJ8GEYJ561V.
R473	4.7K ohm; similar to Panasonic ERJ2GEJ472X.
R474	560 ohm; similar to Panasonic ERJ8GEYJ561V.
R491	470 ohm; similar to Panasonic ERJ2GEJ471X.
R492	150K ohm; similar to Panasonic ERJ2GEJ154X.
R501	27K ohm; similar to Panasonic ERJ2GEJ273X.
R502	(Not Used).
R503	6.8K ohm; similar to Panasonic ERJ2GEJ682X.
R504	22 ohm; similar to Panasonic ERJ2GEJ220X.
R505	2.2K ohm; similar to Panasonic ERJ2RKF2201X.
R506	47 ohm; similar to Panasonic ERJ2GEJ470X.
R507	1000 ohm; similar to Panasonic ERJ2GEJ102X.
R508	820 ohm; similar to Panasonic ERJ2GEJ821X.
R509	330 ohm; similar to Panasonic ERJ12YJ331U.
R510	150K ohm; similar to Panasonic ERJ2GEJ154X.
R511	8.2K ohm; similar to Panasonic ERJ2GEJ822X.
R512	1000 ohm; similar to Panasonic ERJ2GEJ102X.
R513	6.8K ohm; similar to Panasonic ERJ2GEJ682X.
R514	100 ohm; similar to Panasonic ERJ2GEJ101X.
R515	470 ohm; similar to Panasonic ERJ2GEJ471X.
R516	2.2K ohm; similar to Panasonic ERJ2RKF2201X.
R517	1000K ohm; similar to Panasonic ERJ2GEJ105X.
R521	330 ohm; similar to Panasonic ERJ14YJ331U.
R522	4.7K ohm; similar to Panasonic ERJ2GEJ472X.
R523	560 ohm; similar to Panasonic ERJ8GEYJ561V.
R524	4.7K ohm; similar to Panasonic ERJ2GEJ472X.
R525	560 ohm; similar to Panasonic ERJ8GEYJ561V.
R526 and R527	(Not Used).
R531	8.2K ohm; similar to Panasonic ERJ3GEYJ822V.
R532	2.7K ohm; similar to Panasonic ERJ3GEYJ272V.
R533	100 ohm; similar to Panasonic ERJ6GEYJ101V.
R561 thru R564	(Not Used).
R581	(Not Used).
R582	5.6K ohm; similar to Panasonic ERJ2GEJ562X.
R583	1.5K ohm; similar to Panasonic ERJ2GEJ152X.
R584	100 ohm; similar to Panasonic ERJ2GEJ101X.

SYMBOL	DESCRIPTION
R585	10 ohm; similar to Panasonic ERJ2GEJ100X.
R586	68 ohm; similar to Panasonic ERJ2GEJ680X.
R587	150 ohm; similar to Panasonic ERJ2GEJ151X.
R589	1000 ohm; similar to Panasonic ERJ2GEJ102X.
R590	100K ohm; similar to Panasonic ERJ2GEJ104X.
R591	47 ohm; similar to Panasonic ERJ2GEJ470X.
R593	390 ohm; similar to Panasonic ERJ2GEJ391X.
R594	47K ohm; similar to Panasonic ERJ2RKF4702X.
R595	18 ohm; similar to Panasonic ERJ2GEJ180X.
R596	6.8K ohm; similar to Panasonic ERJ2GEJ682X.
R597	3.3K ohm; similar to Panasonic ERJ2GEJ332X.
R598	47 ohm; similar to Panasonic ERJ6GEYJ470V.
R601	(Not Used).
R602 and R603	22K ohm; similar to Panasonic ERJ2GEJ223X.
R604 and R605	33K ohm; similar to Panasonic ERJ2GEJ333X.
R606	10K ohm; similar to Panasonic ERJ2RKF1002X.
R607 thru R610	(Not Used).
R611	22K ohm; similar to Panasonic ERJ2GEJ223X.
R612	22K ohm; similar to Panasonic EXB28V223JX.
R613	33 ohm; similar to Panasonic ERJ2GEJ330X.
R614	(Not Used).
R615	33 ohm; similar to Panasonic ERJ2GEJ330X.
R616	10K ohm; similar to Panasonic ERJ2RKF1002X.
R617	18K ohm; similar to Panasonic ERJ2RKF1802X.
R618	2.2 ohm; similar to Panasonic ERJ2GEJ2R2X.
R619	51K ohm; similar to Panasonic ERJ2RKF5102X.
R620	47K ohm; similar to Panasonic ERJ2RKF4702X.
R621	51K ohm; similar to Panasonic ERJ2RKF5102X.
R622	27K ohm; similar to Panasonic ERJ2RKF2702X.
R623	51K ohm; similar to Panasonic ERJ2RKF5102X.
R624	10K ohm; similar to Panasonic ERJ2RKF1002X.
R625	51K ohm; similar to Panasonic ERJ2RKF5102X.
R626	10K ohm; similar to Panasonic ERJ2RKF1002X.
R627	200K ohm; similar to Panasonic ERJ2RKF2003X.
R628	27K ohm; similar to Panasonic ERJ2RKF2702X.
R629	22K ohm; similar to Panasonic EXB28V223JX.
R630 thru R632	22K ohm; similar to Panasonic ERJ2GEJ223X.

SYMBOL	DESCRIPTION
R633 thru R637	(Not Used).
R638	10K ohm; similar to Panasonic EXB28V103JX.
R639 thru R641	10K ohm; similar to Panasonic ERJ2RKF1002X.
R642	(Not Used).
R643	47K ohm; similar to Panasonic ERJ2RKF4702X.
R644	12K ohm; similar to Panasonic ERJ2GEJ123X.
R645	(Not Used).
R646	27K ohm; similar to Panasonic ERJ2GEJ273X.
R647	47K ohm; similar to Panasonic ERJ2RKF4702X.
R650	(Not Used).
R661	1.2K ohm; similar to Panasonic ERJ2GEJ122X.
R662	330 ohm; similar to Panasonic ERJ6GEYJ331V.
R663	330K ohm; similar to Panasonic ERJ2GEJ334X.
R664	10 ohm; similar to Panasonic ERJ2GEJ100X.
R671	2.2K ohm; similar to Panasonic ERJ2RKF2201X.
R672	680 ohm; similar to Panasonic ERJ2GEJ681X.
R673 and R674	2.2K ohm; similar to Panasonic ERJ2RKF2201X.
R675 and R676	560 ohm; similar to Panasonic ERJ2GEJ561X.
R677	820 ohm; similar to Panasonic ERJ2GEJ821X.
R678 thru R680	18 ohm; similar to Panasonic ERJ2GEJ180X.
R681	47 ohm; similar to Panasonic ERJ2GEJ470X.
R682	100K ohm; similar to Panasonic ERJ2GEJ104X.
R683	22K ohm; similar to Panasonic ERJ2GEJ223X.
R684	68 ohm; similar to Panasonic ERJ2GEJ680X.
R685	1.2K ohm; similar to Panasonic ERJ2RKF1201X.
R686	1000 ohm; similar to Panasonic ERJ2GEJ102X.
R687	15K ohm; similar to Panasonic ERJ2GEJ153X.
R688	1000 ohm; similar to Panasonic ERJ2GEJ102X.
R689	82K ohm; similar to Panasonic ERJ2GEJ823X.
R701 and R702	27 ohm; similar to Panasonic ERJ1TYJ270U.
R801	47 ohm; similar to Panasonic ERJ2GEJ470X.
R802	22K ohm; similar to Panasonic ERJ2GEJ223X.
R803	2.2K ohm; similar to Panasonic ERJ2RKF2201X.
R804	820 ohm; similar to Panasonic ERJ2GEJ821X.

SYMBOL	DESCRIPTION
R805	1000 ohm; similar to Panasonic ERJ2GEJ102X.
R806	100K ohm; similar to Panasonic ERJ2GEJ104X.
R807	33 ohm; similar to Panasonic EXB28V330JX.
R808	82 ohm; similar to Panasonic ERJ2GEJ820X.
R809 and R810	47 ohm; similar to Panasonic ERJ2GEJ470X.
R841	220 ohm; similar to Panasonic ERJ1TYJ221U.
R842	33K ohm; similar to Panasonic ERJ2GEJ333X.
R843	1000 ohm; similar to Panasonic ERJ2GEJ102X.
R844	100K ohm; similar to Panasonic ERJ2GEJ104X.
R845	33K ohm; similar to Panasonic ERJ2GEJ333X.
R871 and R872	56 ohm; similar to Panasonic ERJ6GEYJ560V.
R873	47 ohm; similar to Panasonic ERJ6GEYJ470V.
R874	100 ohm; similar to Panasonic ERJ6GEYJ101V.
R875 and R876	100K ohm; similar to Panasonic ERJ14YJ104U.
R877	22K ohm; similar to Panasonic ERJ2GEJ223X.
R878	100K ohm; similar to Panasonic ERJ2GEJ104X.
R879	22K ohm; similar to Panasonic ERJ2GEJ223X.
R880	3.3K ohm; similar to Panasonic ERJ2GEJ332X.
R881	5.6K ohm; similar to Panasonic ERJ2GEJ562X.
R882	1.8K ohm; similar to Panasonic ERJ2GEJ182X.
R887	47K ohm; similar to Panasonic ERJ2RKF4702X.
R889	0 ohm; similar to Panasonic ERJ2GE0R00X.
R890	10K ohm; similar to Panasonic ERJ2RKF1002X.
R891	100 ohm; similar to Panasonic ERJ2GEJ101X.
R892	27K ohm; similar to Panasonic ERJ2GEJ273X.
R893	2.2K ohm; similar to Panasonic ERJ2RKF2201X.
R894	820 ohm; similar to Panasonic ERJ2GEJ821X.
R895	56K ohm; similar to Panasonic ERJ2RKF5602X.
R896	1000 ohm; similar to Panasonic ERJ2GEJ102X.
R897 and R898	4.7K ohm; similar to Panasonic ERJ2GEJ472X.
R899	0 ohm; similar to Panasonic ERJ2GE0R00X.
R1101	1.5K ohm; similar to Panasonic ERJ2GEJ152X.
R1122	8.2K ohm; similar to Panasonic ERJ2GEJ822X.
R1123	1.2K ohm; similar to Panasonic ERJ2RKF1201X.
R1124 and R1125	(Not Used).

SYMBOL	DESCRIPTION
R1131	(Not Used).
R1151 and R1171	1.2K ohm; similar to Panasonic ERJ2GEJ122X.
R1191 and R1221	(Not Used).
R1251 and R1252	(Not Used).
R1281 thru R1283	(Not Used).
R1291	(Not Used).
R1292	0 ohm; similar to Panasonic ERJ2GE0R00X.
R1293	(Not Used).
R1301 and R1303	820 ohm; similar to Panasonic ERJ2GEJ821X.
R1305 and R1306	10K ohm; similar to Panasonic ERJ2RKF1002X.
R1307 and R1308	15K ohm; similar to Panasonic ERJ2GEJ153X.
R1371	5.6K ohm; similar to Panasonic ERJ2GEJ562X.
R1372	220 ohm; similar to Panasonic ERJ2GEJ221X.
R1373 thru 1375	(Not Used).
R1378 thru R1380	(Not Used).
R1401 and R1410	(Not Used).
R1451 and R1452	(Not Used).
R1459	560 ohm; similar to Panasonic ERJ8GEYJ561V.
R1460	4.7K ohm; similar to Panasonic ERJ2GEJ472X.
R1491	(Not Used).
R1492	100 ohm; similar to Panasonic ERJ2GEJ101X.
R1501 and R1510	(Not Used).
R1583	33 ohm; similar to Panasonic ERJ2GEJ330X.
R1591 and R1661	(Not Used).
R1662	0 ohm; similar to Panasonic ERJ2GE0R00X.
R1663	100 ohm; similar to Panasonic ERJ2GEJ101X.

SYMBOL	DESCRIPTION
R1664 and R1665	82 ohm; similar to Panasonic ERJ2GEJ820X.
R1666	(Not Used).
R1671 thru R1673	(Not Used).
R1701 and R1702	(Not Used).
R1841 and R1842	220 ohm; similar to Panasonic ERJ1TYJ221U.
R1843	180 ohm; similar to Panasonic ERJ1TYJ181U.
R1844	33K ohm; similar to Panasonic ERJ8GEYJ333V.
R1845	12K ohm; similar to Panasonic ERJ6GEYJ123V.
R1846	15K ohm; similar to Panasonic ERJ2GEJ153X.
R1891 and R1892	(Not Used).
----- THERMISTORS -----	
RT131	(Not Used).
RT132	1K ohm; similar to KOA LA731JTDD102J2600.
RT151	(Not Used).
RT152	1K ohm; similar to KOA LA731JTDD102J2600.
RT171	(Not Used).
RT172	1K ohm; similar to KOA LA731JTDD102J2600.
RT891	Similar to Murata PRF18BB471QS5RB.
----- VARIABLE RESISTORS -----	
RV131	(Not Used).
RV1151 and RV1171	(Not Used).
----- THREADED SPACERS/POSTS -----	
TE701 thru TE703	Similar to Mac-EightTH-1.6-5.0-M3.
----- TRANSISTORS -----	
TR111	Similar to Renesas 2SC3356-T1B-A R.
TR112	Similar to Renesas 2SB798-T2-AZ DK.
TR113	Similar to Toshiba RN1301(TE85L F).
TR121	Similar to Mitsubishi RD01MUS2-T113.
TR131	Similar to Freescale MRF1518NT1.
TR151 and TR171	Similar to Mitsubishi RD70HUF2-T1105.
TR201	Similar to ROHM 2SD1781KT146R.

SYMBOL	DESCRIPTION
TR221 and TR251	Similar to Renesas 2SC5337-T1-AZ QS.
TR281 and TR282	Similar to ON Semiconductor MMBFJ310LT1G.
TR291	Similar to Toshiba 2SC2714-Y(TE85L F).
TR301	Similar to ROHM QS6M3TR.
TR302 and TR303	Similar to Toshiba RN1301(TE85L F).
TR371	Similar to ROHM UMG3NTR.
TR372	Similar to Renesas 2SC3356-T1B-A R.
TR373	Similar to Toshiba 2SC2714-Y(TE85L F).
TR375	Similar to ROHM 2SD1781KT146R.
TR401	Similar to Sanyo 2SK536-TB-E.
TR402	Similar to Toshiba RN1301(TE85L F).
TR403	Similar to ROHM 2SA1037AKT146R.
TR404 and TR405	Similar to Sanyo 2SK536-TB-E.
TR406	Similar to Toshiba RN1301(TE85L F).
TR421	Similar to ROHM 2SD1781KT146R.
TR431	Similar to Renesas 2SC3356-T1B-A R.
TR432	Similar to Toshiba RN1305(TE85L F).
TR451 and TR452	Similar to Renesas 2SC3356-T1B-A R.
TR456 and TR457	Similar to ROHM UMG3NTR.
TR491	Similar to Toshiba 2SC2712-BL(TE85L F).
TR501	Similar to Sanyo 2SK536-TB-E.
TR502	Similar to Toshiba RN1301(TE85L F).
TR503	Similar to ROHM 2SA1037AKT146R.
TR504 and TR505	Similar to Sanyo 2SK536-TB-E.
TR506	Similar to Toshiba RN1301(TE85L F).
TR521	Similar to ROHM 2SD1781KT146R.

SYMBOL	DESCRIPTION
TR522 and TR523	Similar to ROHM UMG3NTR.
TR524	(Not Used).
TR531	Similar to Renesas 2SC5772FR-TL-E.
TR532	(Not Used).
TR533	Similar to Toshiba RN1305(TE85L F).
TR561 thru TR563	(Not Used).
TR581 thru TR583	Similar to Renesas 2SC3356-T1B-A R.
TR584	Similar to Renesas 2SC3357-T1-A RF.
TR661 and TR671	Similar to Toshiba 2SC2714-Y(TE85L F).
TR841 and TR842	Similar to Renesas 2SD596-T1B-A DV5.
TR891	Similar to ROHM 2SD1781KT146R.
TR892	Similar to Toshiba RN1301(TE85L F).
TR1112	Similar to Renesas 2SB798-T2-AZ DK.
TR1113	Similar to Toshiba RN1301(TE85L F).
TR1131 and TR1371	(Not Used).
TR1451	Similar to ROHM UMG3NTR.
TR1452 and TR1891	(Not Used).
-----JUMPER WIRES -----	
W131	(Not Used).
W151	Similar to Midori Musen H-7ZCPD0269.
-----OSCILLATOR -----	
XU491	Similar to NDK H-7XNPD0004.
-----SURGE ABSORBER-----	
Z701	Similar to KOA NV73A2ATTE22.
Z702	Similar to Panasonic ERZCF2MK220.

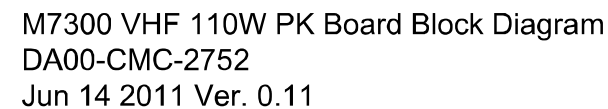
## **14 PRODUCTION CHANGES**

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.

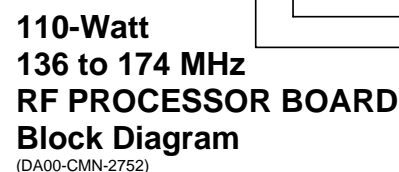
- Rev. –**      **110-Watt M7300 Mobile Radio, 136 – 174 MHz (RU-144750-051)**  
Initial release.
- Rev. -**      **PK Board (CMC-2752)**  
Board revision at initial release of radio production.
- Rev. –**      **RF Processor Board, 110-Watt, 136 – 174 MHz (CMN-2752)**  
Board revision at initial release of radio production.

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## 15.1 PK BOARD

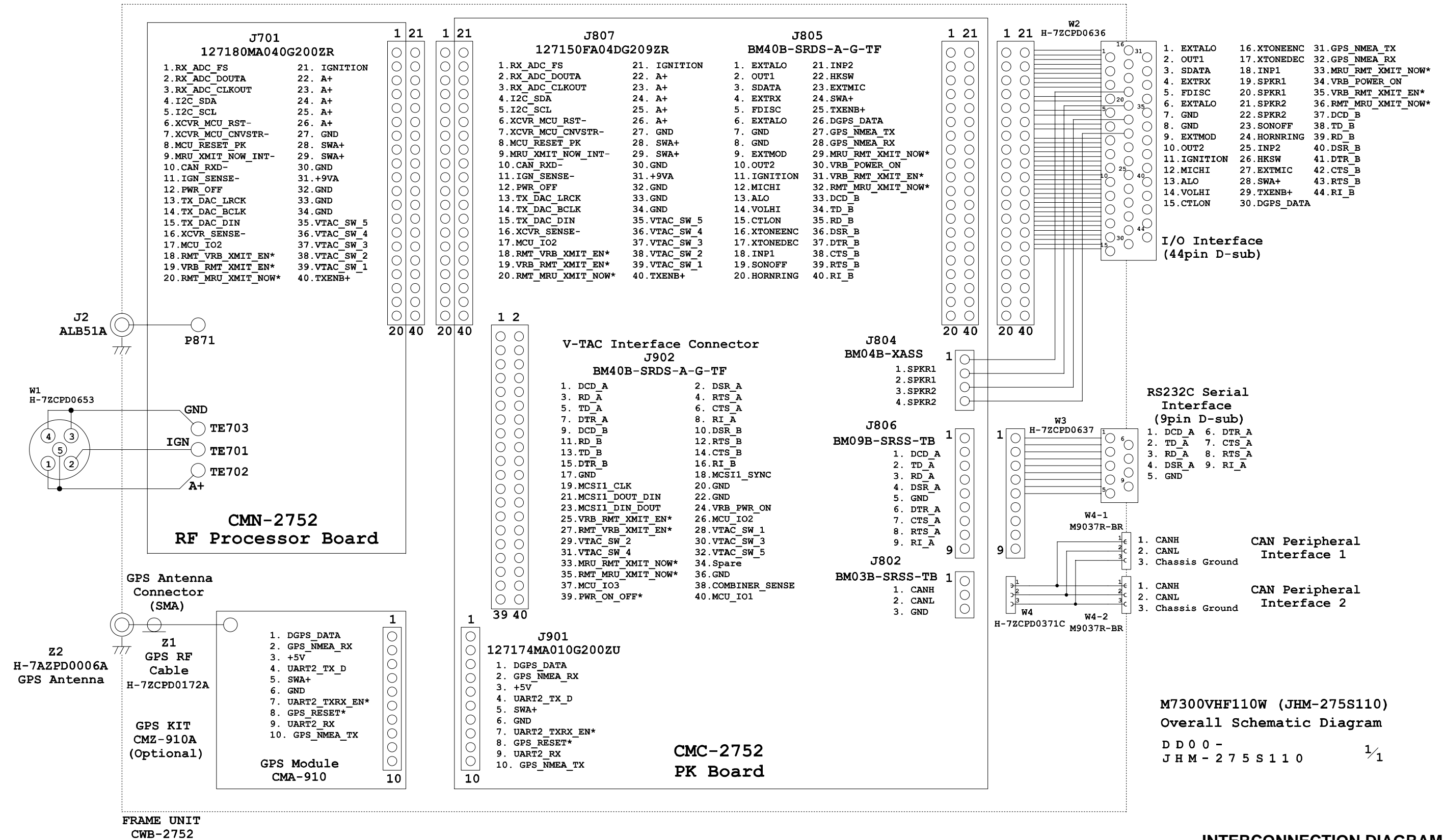


**RX 2nd Local = 1st IF - 2nd IF**  
**= 45.1 - 2.16 MHz**  
**= 42.940 MHz (Default)**  
 (at Specific Frequency: 1st IF + 2nd IF = 47.260MHz)      IF IC      2nd IF = 2.16MHz



**M7300 VHF 110W RF Processor Block Diagram**  
**DA00-CMN-2752**  
**Dec 20 2011 Ver.0.32**

16 INTERCONNECTION DIAGRAM



INTERCONNECTION DIAGRAM

(DD00-JHM-275S110, Rev. 20111220)

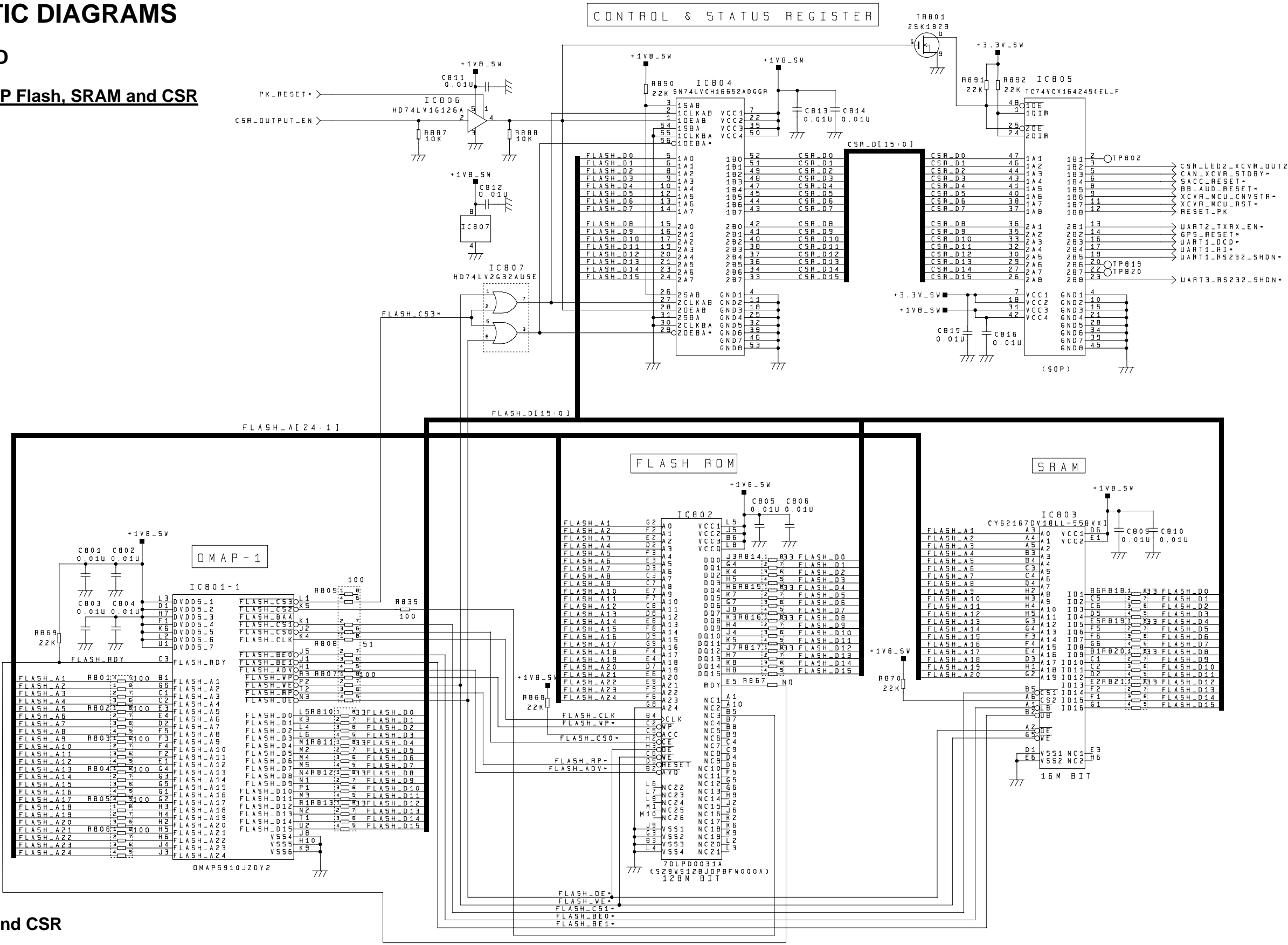
# 17 SCHEMATIC DIAGRAMS

## 17.1 PK BOARD

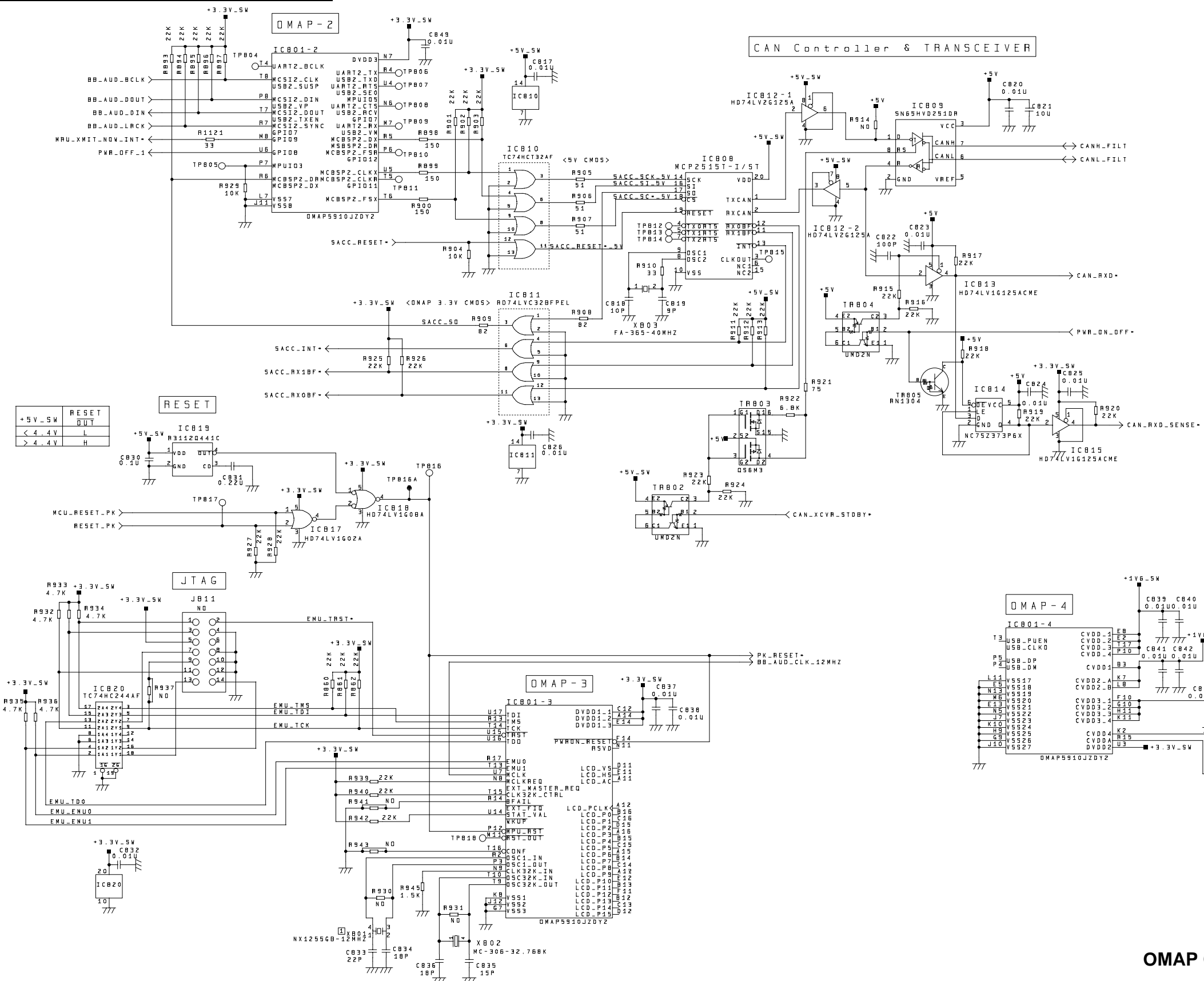
### 17.1.1 OMAP Flash, SRAM and CSR

PK BOARD  
Schematic Diagram  
Sheet 1 of 6

OMAP Flash, SRAM and CSR  
(DD00-CMC-2752, Rev. 20111220)



### 17.1.2 OMAP CAN Interface, JTAG and Reset



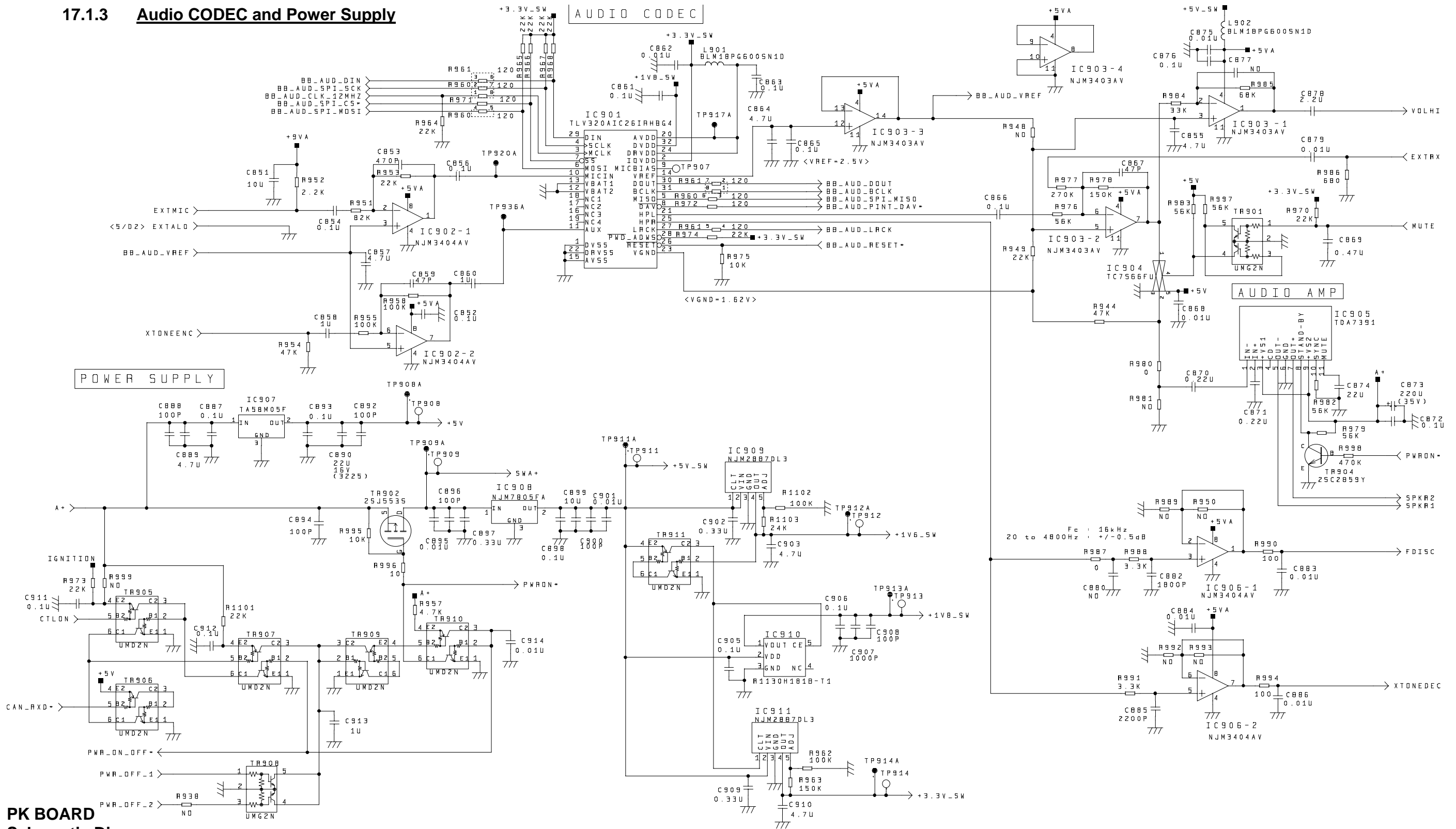
**PK BOARD**  
**Schematic Diagram**  
Sheet 2 of 6

# OMAP CAN Interface, JTAG and Reset

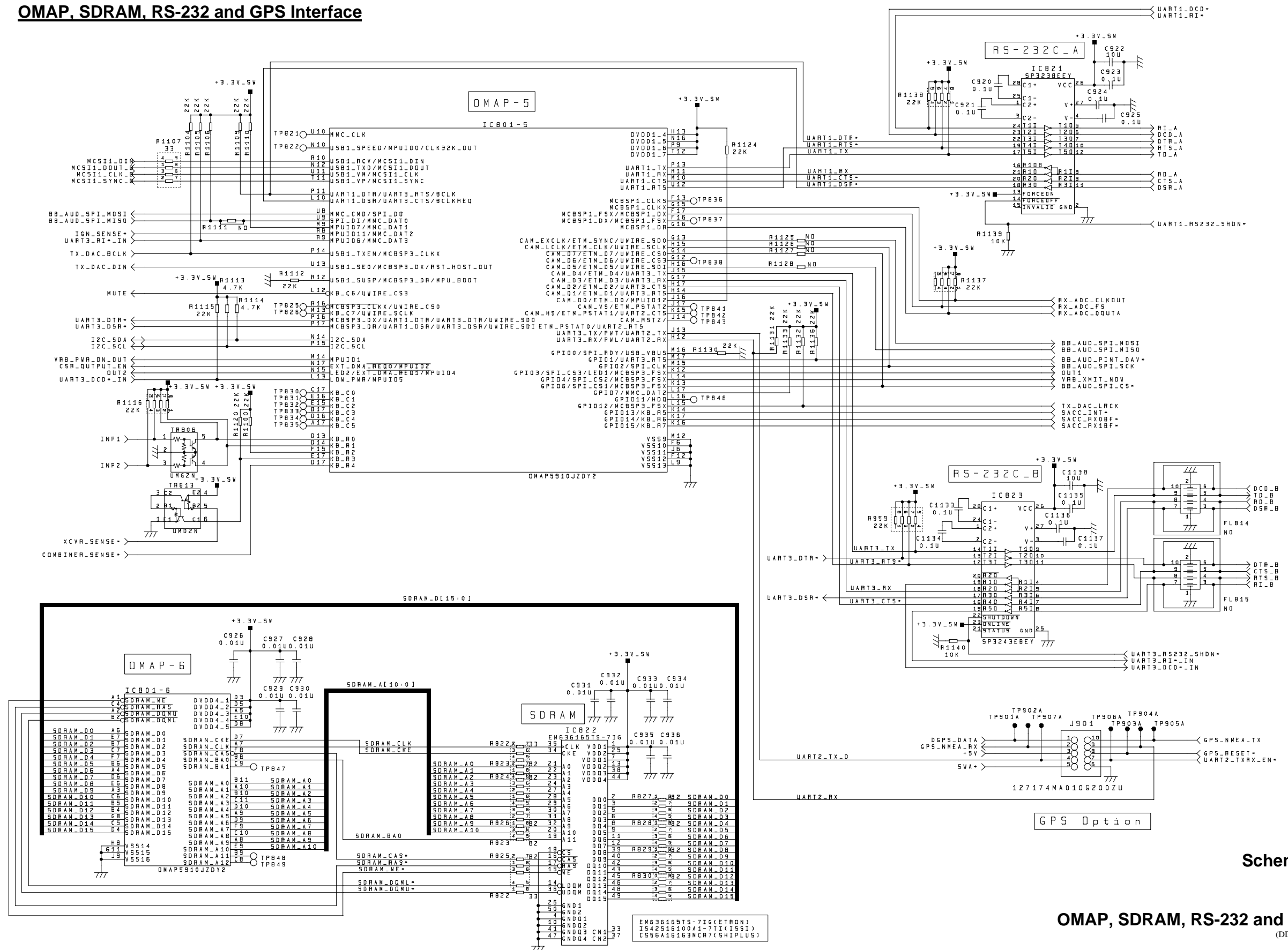
(DD00-CMC-2752, Rev. 20111220)

**PK BOARD**  
**Schematic Diagram**  
Sheet 3 of 6

## 126



## 17.1.4 OMAP, SDRAM, RS-232 and GPS Interface



PK BOARD  
Schematic Diagram  
Sheet 4 of 6

OMAP, SDRAM, RS-232 and GPS Interface

(DD00-CMC-2752, Rev. 20111220)

### 17.1.5

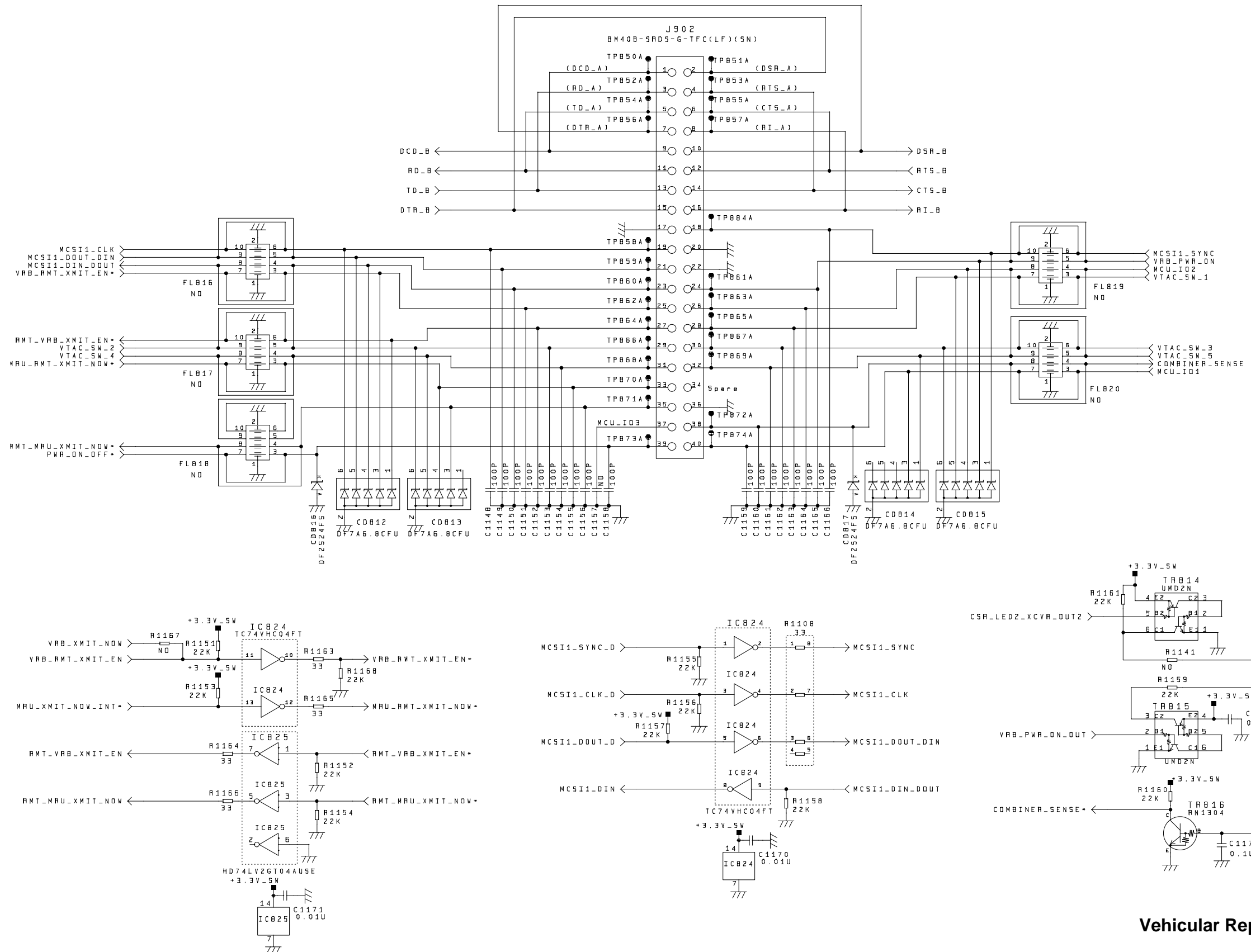


Sheet 5 of 6

## PK Board I/O and RF Processor Board Interface

(DD00-CMC-2752, Rev. 20111220)

## VTAC Interface



ER-SENSE

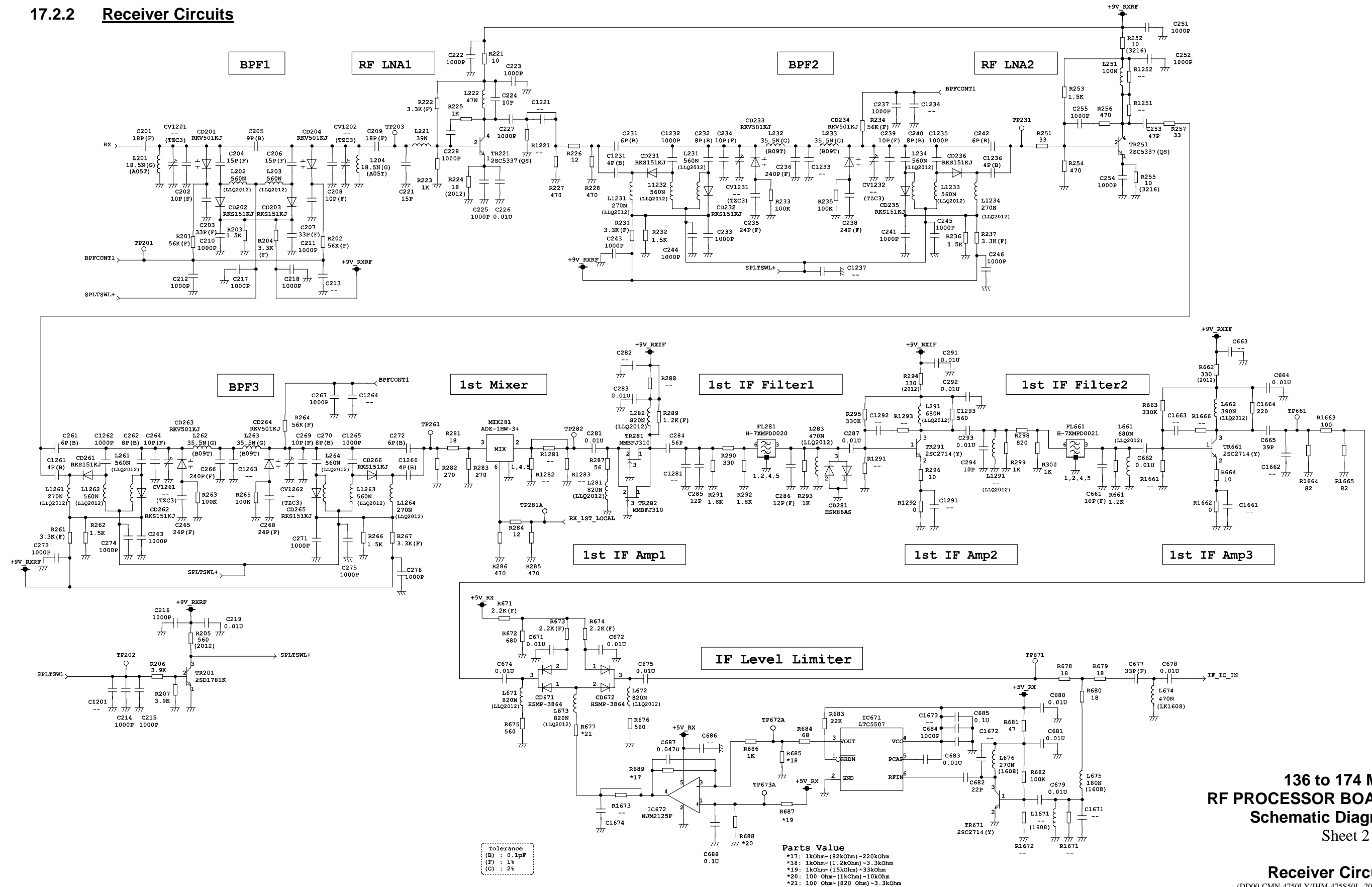
**PK BOARD**

**Schematic Diagram**

Sheet 6 of 6



## 17.2.2 Receiver Circuits



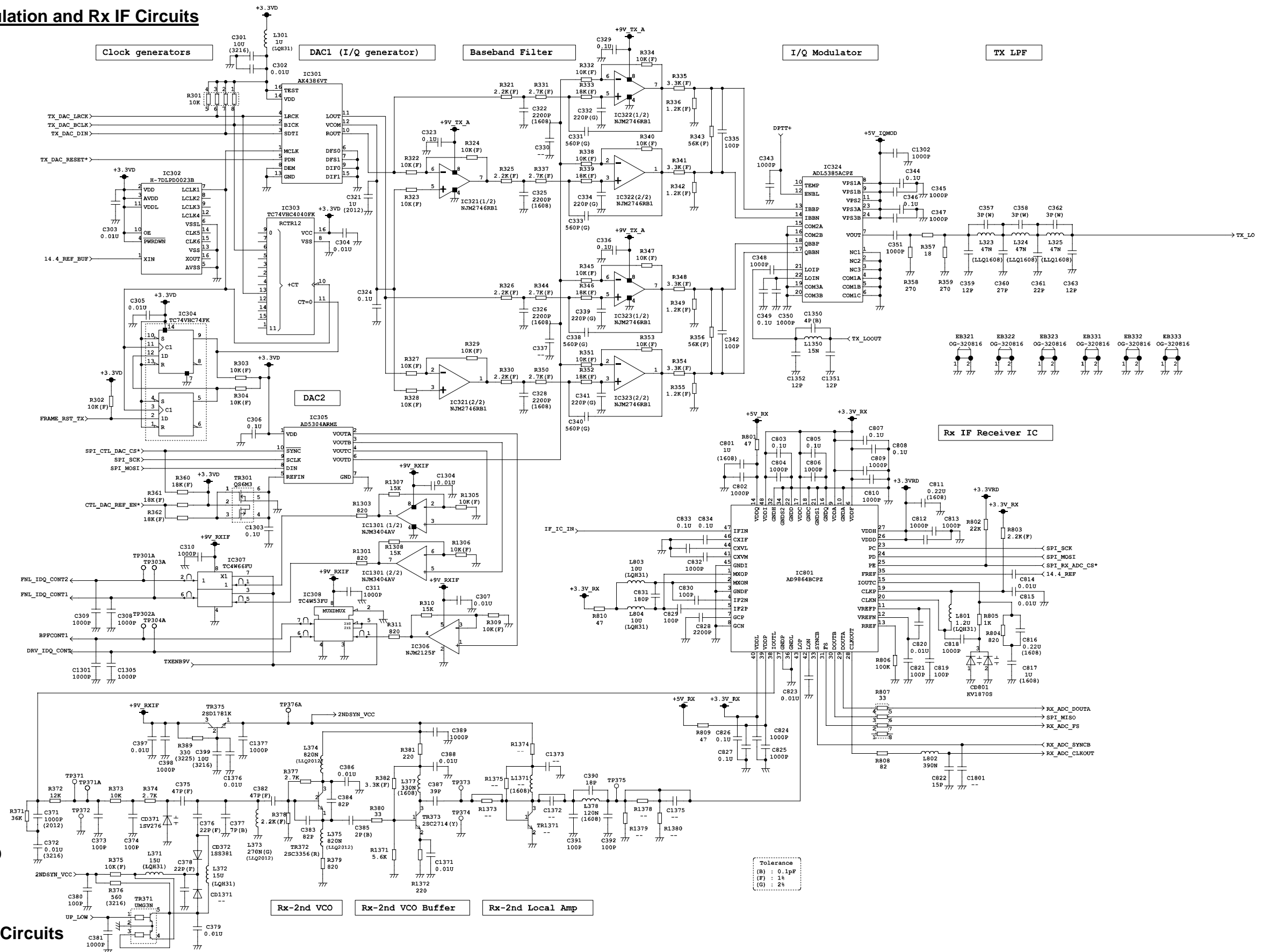
**136 to 174 MHz  
RF PROCESSOR BOARD  
Schematic Diagram  
Sheet 2 of 7**

## Receiver Circuits

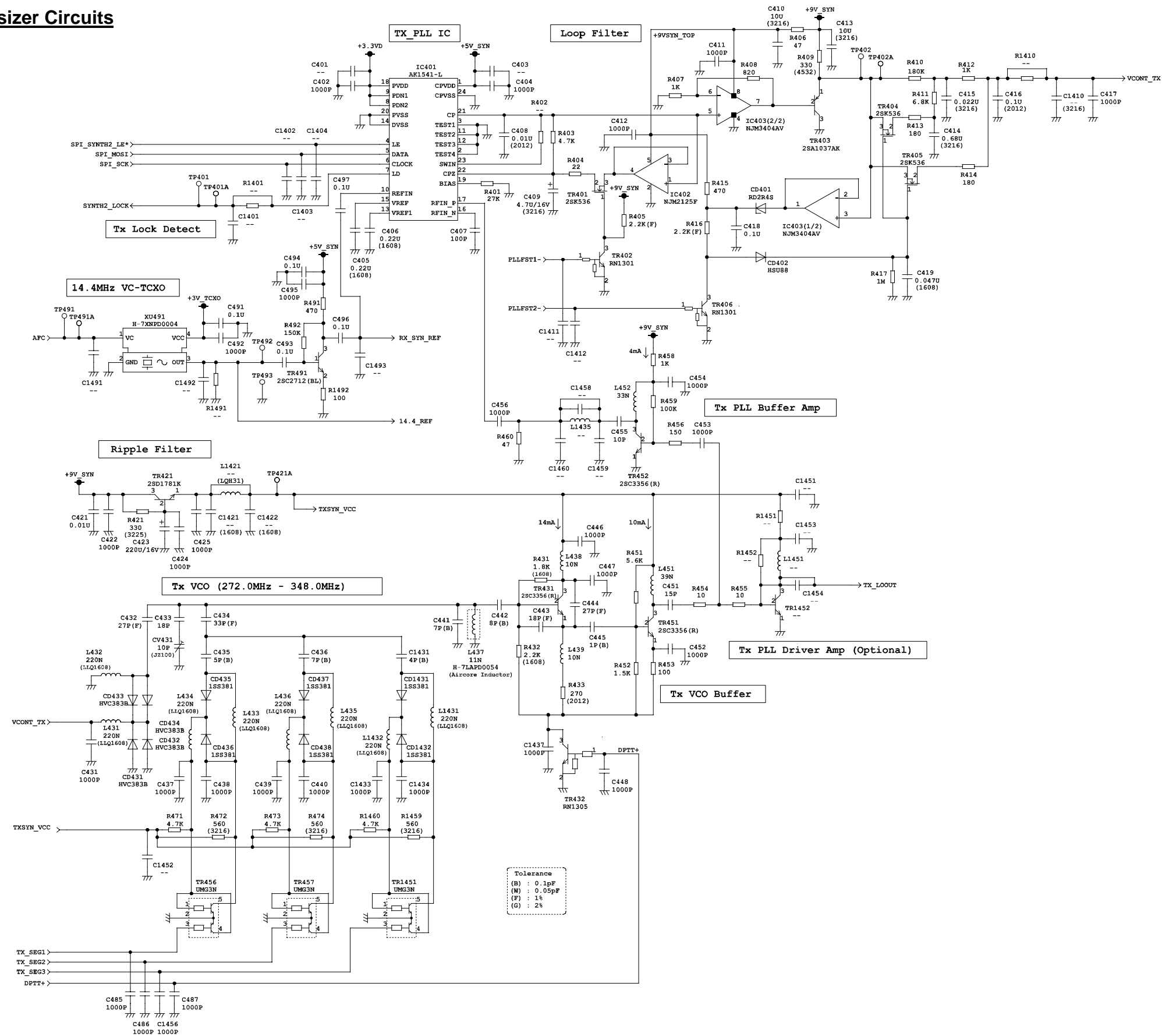
(DD00-CMN-4750LY/JHM-475S50L, 20101005)

**136 to 174 MHz  
RF PROCESSOR BOARD  
Schematic Diagram**  
Sheet 3 of 7

132



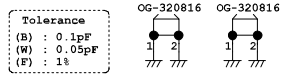
## 17.2.4 Tx Synthesizer Circuits



136 to 174 MHz  
RF PROCESSOR BOARD  
Schematic Diagram  
Sheet 4 of 7

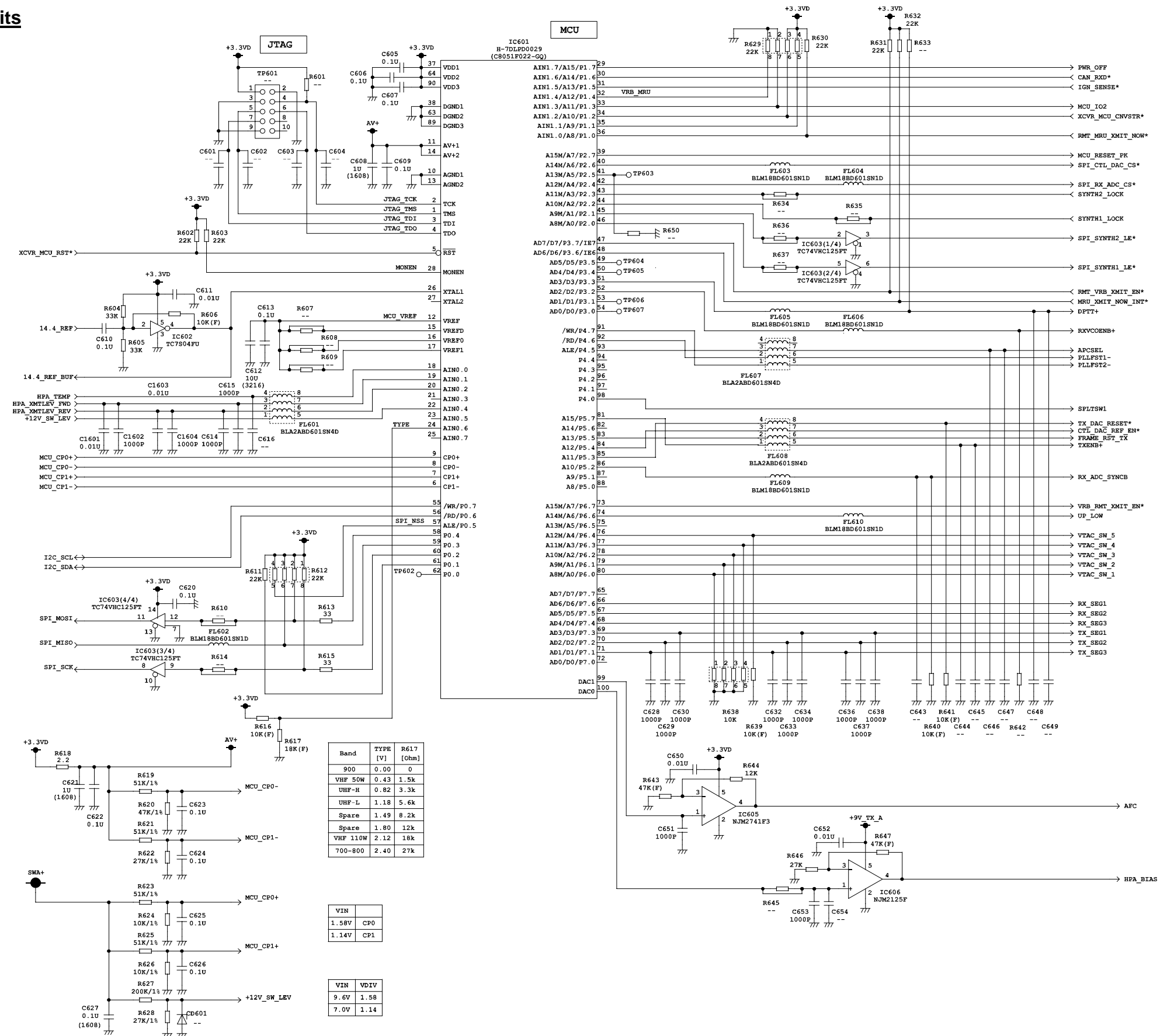
**136 to 174 MHz  
RF PROCESSOR BOARD  
Schematic Diagram**  
Sheet 5 of 7

(DD00-CMN-4750LY/JHM-475S50L, 20101005)

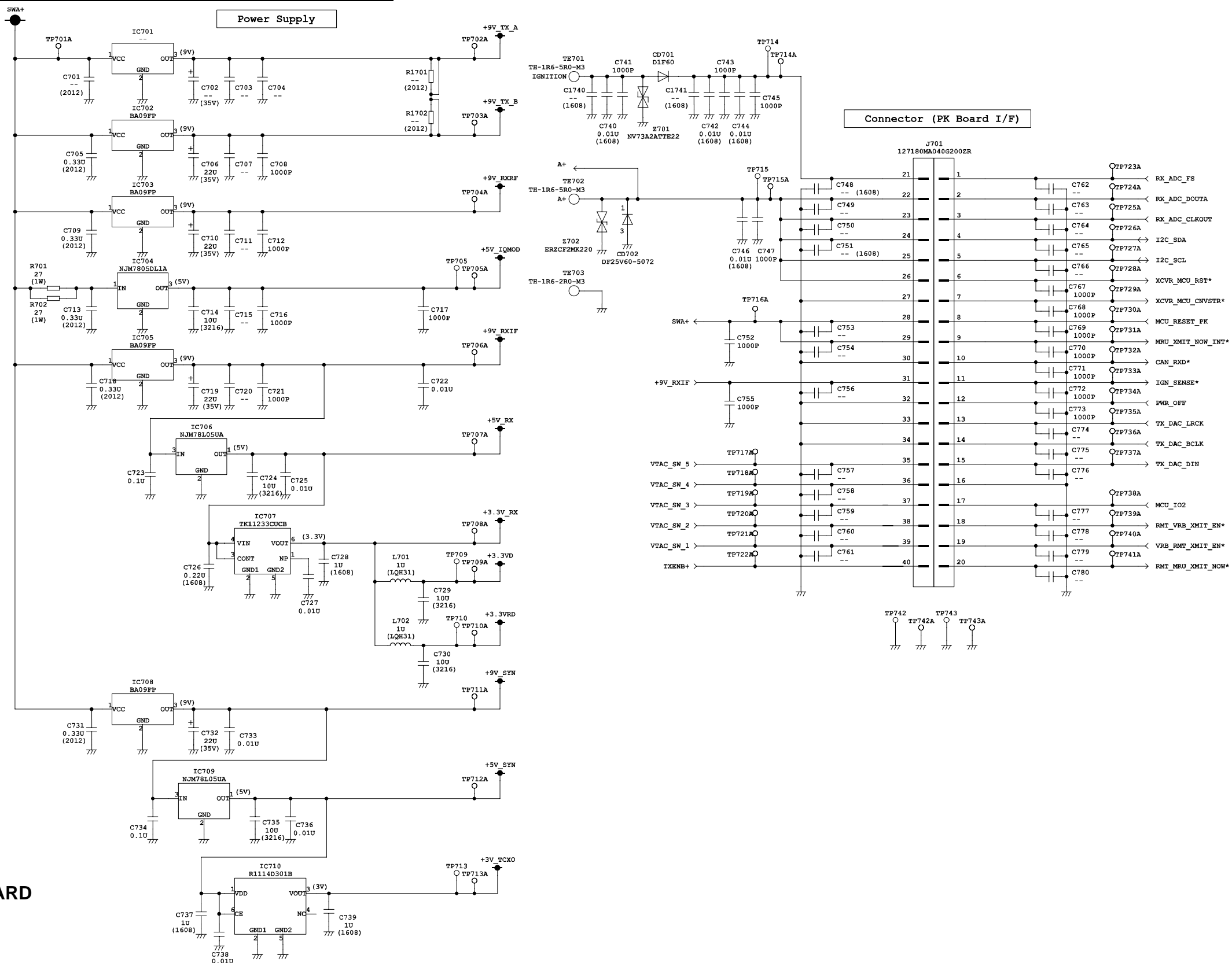


**136 to 174 MHz**  
**RF PROCESSOR BOARD**  
**Schematic Diagram**  
Sheet 6 of 7

(DD00-CMN-4750LY/JHM-475S50L, 20101005)



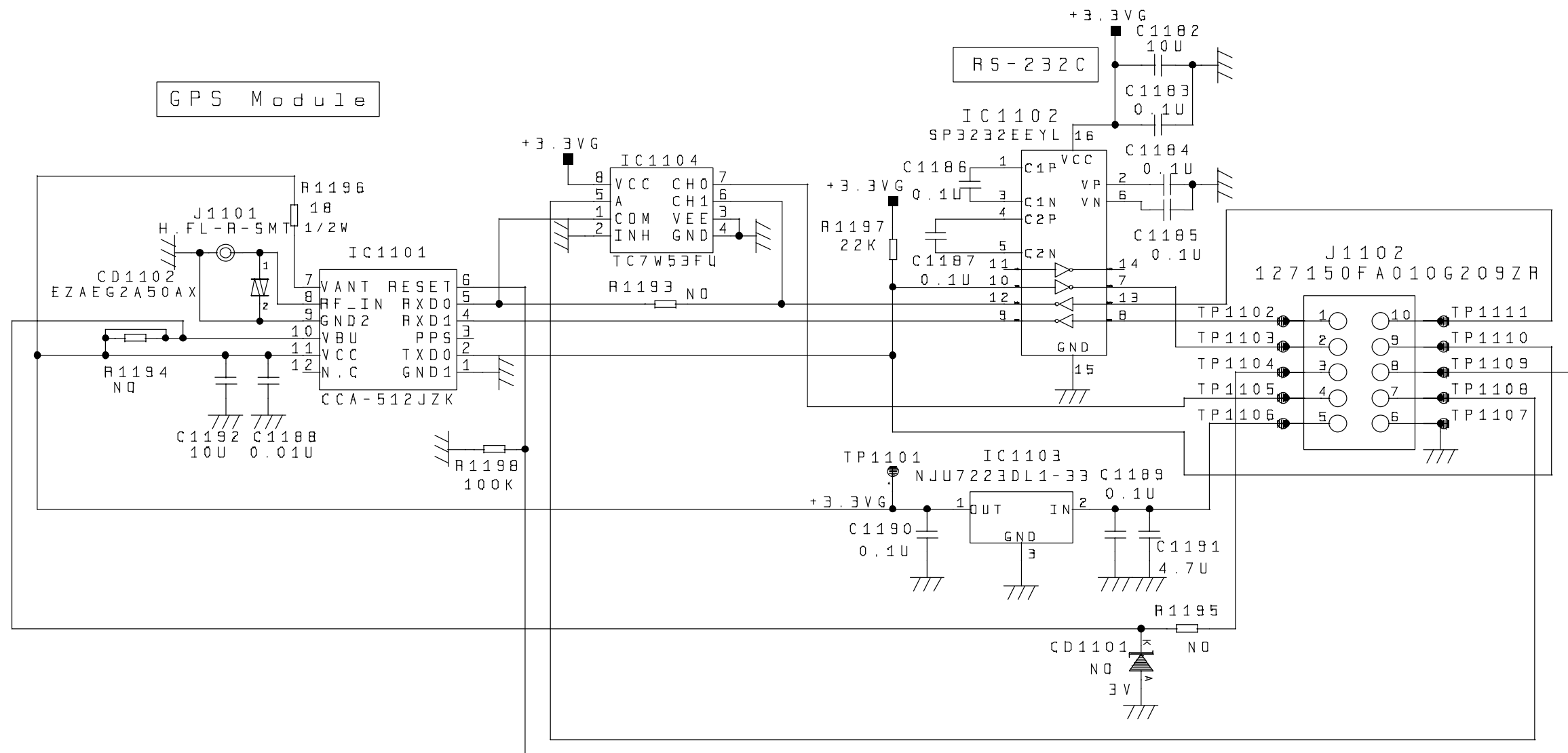
17.2.7 **Power Supplies and PK Board Connector Circuits**



136 to 174 MHz  
RF PROCESSOR BOARD  
Schematic Diagram  
Sheet 7 of 7

**Power Supplies and PK Board Connector Circuits**  
(DD00-CMN-4750LY/JHM-4755S0L, 20101005)

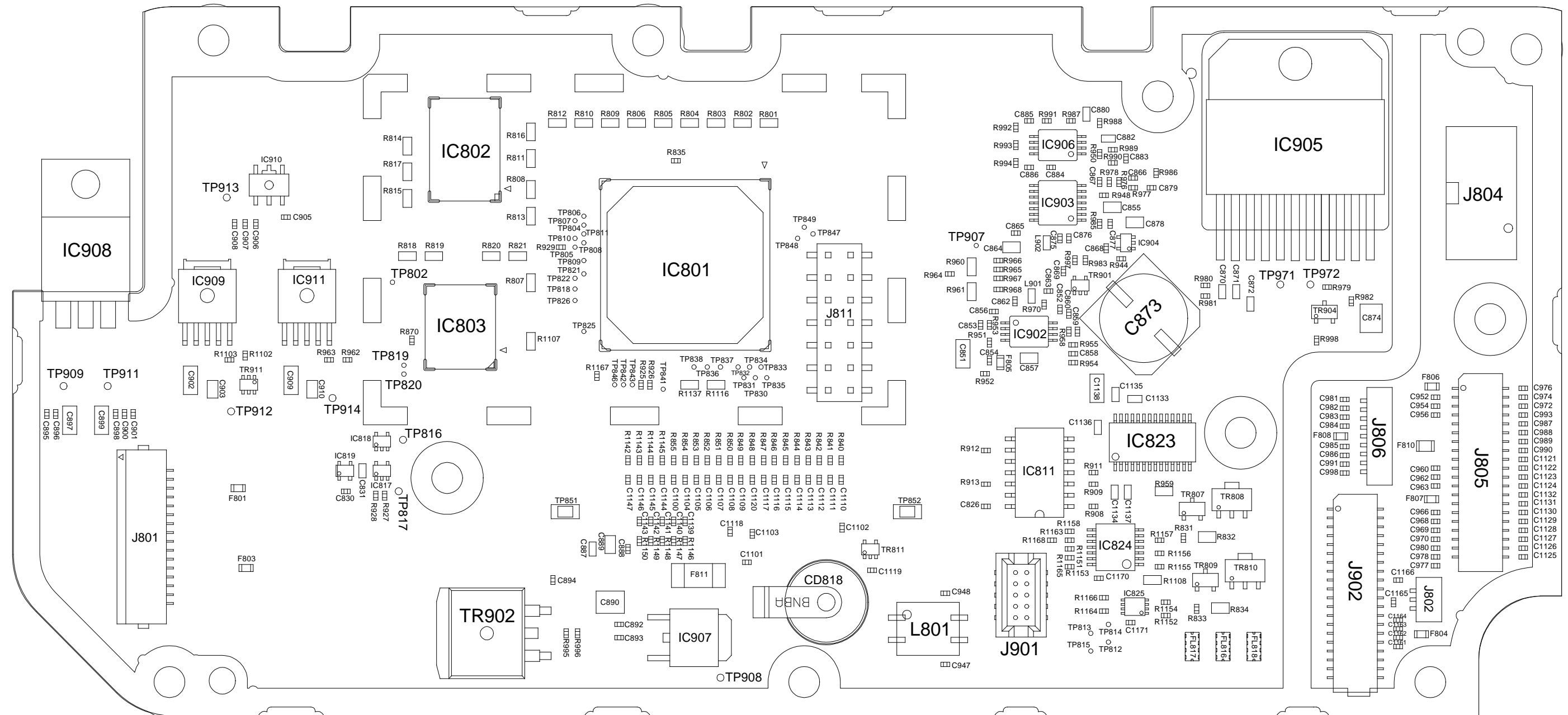
### 17.3 GPS RECEIVER MODULE



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## 18 BOARD OUTLINE DIAGRAMS

### 18.1 PK BOARD — PRIMARY SIDE

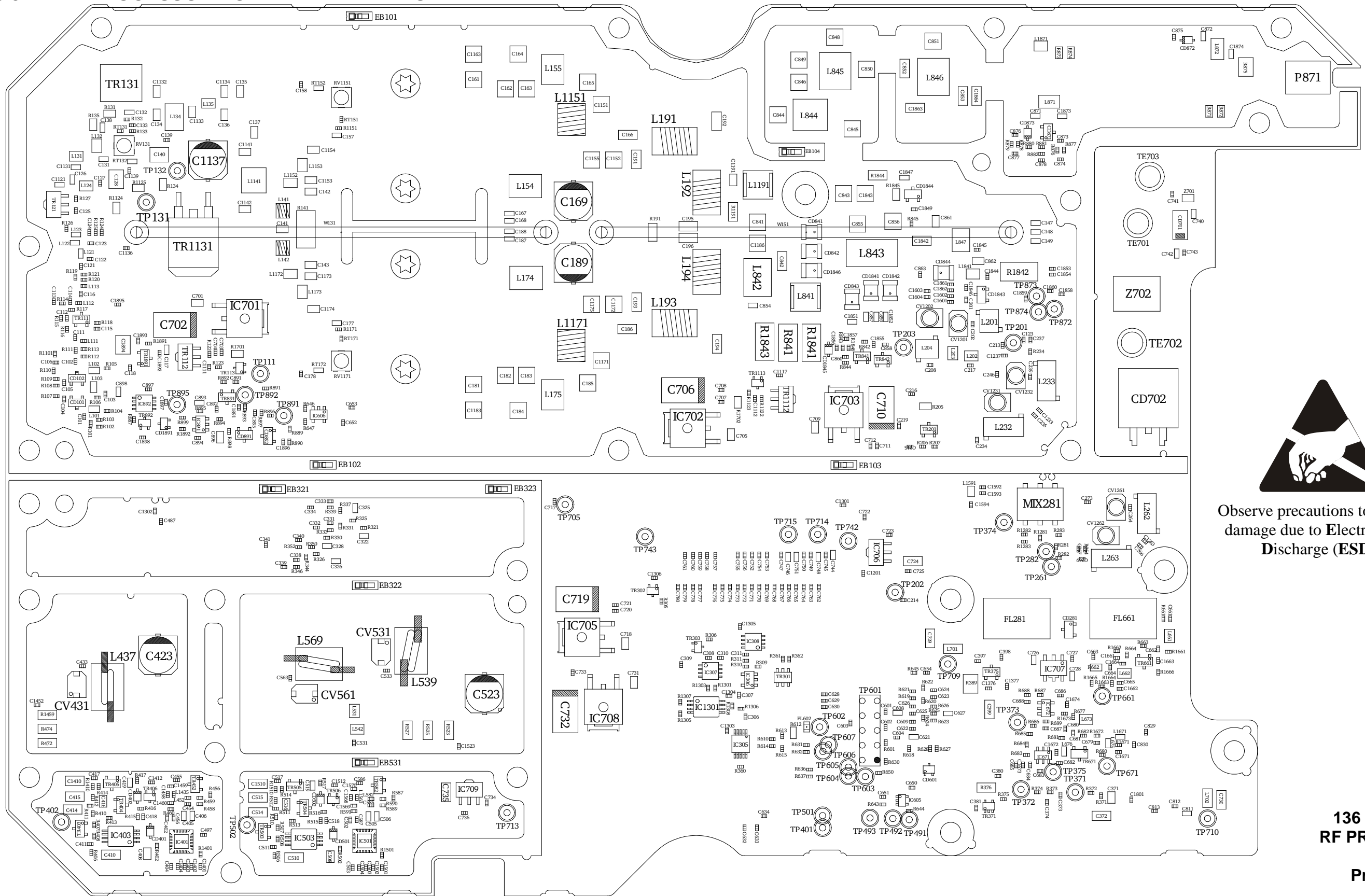


Observe precautions to prevent damage due to Electro-Static Discharge (ESD)!

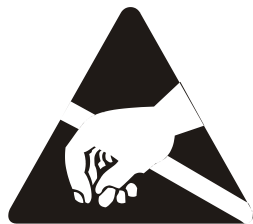
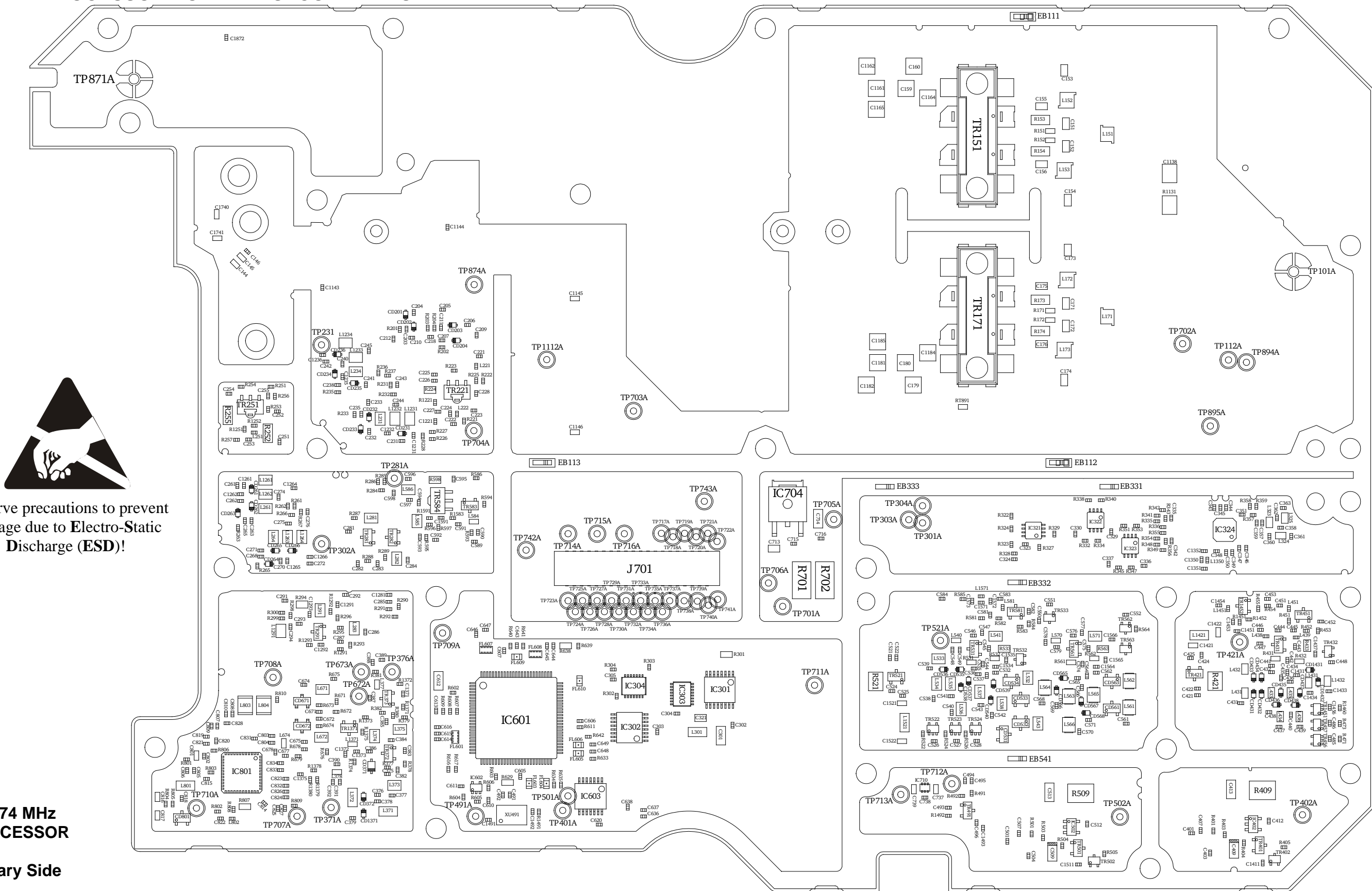


**PK BOARD**  
**Secondary Side**  
(Rev. 12/20/2011)

### 18.3 RF PROCESSOR BOARD — PRIMARY SIDE



**18.4 RF PROCESSOR BOARD — SECONDARY SIDE**



Observe precautions to prevent damage due to **Electro-Static Discharge (ESD)**!

**136 to 174 MHz  
RF PROCESSOR  
BOARD  
Secondary Side**  
(Rev. 12/20/2011)

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**BLOCK DIAGRAMS  
SCHEMATIC DIAGRAMS  
AND  
BOARD OUTLINE DIAGRAMS  
INSIDE  
for  
PK Board and RF Processing Board**