



## **M7300 Mobile Radio**

50-Watt, 136 to 174 MHz  
RU-144750-041



### MANUAL REVISION HISTORY

REV.	DATE	REASON FOR CHANGE
A	May/10	Revised drawings, parts lists, and GPS module installation section. Added keypad lock/unlock procedure.
B	Apr/12	Updated specifications, disassembly and reassembly procedures, parts lists, and production changes. Added programming and configuration information, test and alignment procedures, and rear panel connector pin-out section.

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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, Front-Mount Radio:</b> (Height x Width x Depth)	2.4 x 6.9 x 11.3 inches (6.1 x 17.5 x 28.7 centimeters) (Includes knobs but <u>not</u> space required for mounting bracket and cables at rear of radio)
<b>Dimensions, Remote-Mount Radio:</b> (Height x Width x Depth)	2.0 x 6.9 x 9.2 inches (5.1 x 17.5 x 23.4 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, Front-Mount Radio:</b>	5.9 pounds (2.68 kilograms), does not include bracket
<b>Weight, Remote-Mount 35/50-Watt Radio:</b>	5.25 pounds (2.38 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 ±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 10 Watts RF:	8.9 amps maximum, 8.5 amps typical
At 20 Watts RF:	9.6 amps maximum, 9 amps typical
At 50 Watts RF:	15 amps maximum, 11 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

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

## 3.2 TRANSCEIVER

<b>Frequency Range:</b>	136 to 174 MHz (transmit and receive)
<b>Transmit Power:</b>	10 to 50 watts (programmable range)
<b>Channel Spacing:</b>	12.5 kHz or 25 kHz (mode dependent)
<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 $\mu$ V) minimum at 5% Static BER
EDACS & Analog Conventional Modes:	-119 dBm (0.25 $\mu$ V) minimum at 12 dB SINAD
<b>Receiver Intermodulation Rejection:</b>	77 dB minimum at 12.5 kHz
<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>	
Local Control (Front-Mount Radio):	2-pin audio connector on radio's option cable
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 ( $\Sigma\Delta$ )
<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®)
P25 Phase 1 Mode:	AMBE+™
Analog Conventional Mode:	(none)

### 3.3 REGULATORY

#### 3.3.1 General

FCC Type Acceptance:	OWDTR-0055-E
Applicable FCC Rules:	Part 15 and Part 90
Industry Canada Certification:	3636B-0055
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 50-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 50-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.

Front-mount and remote-mount radio configurations are available, as illustrated in Figure 4-1 below. In the front-mount configuration, the control head is an integral part of the mobile radio. In the remote-mount configuration, the control head is located near the radio operator's position and the radio is mounted remotely from the control head, typically in the vehicle's trunk. In addition, a hand-held controller can be connected to a remote-mount radio in place of the control head.



**Figure 4-1: Front-Mount and Remote-Mount VHF M7300 Mobile Radios**

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.

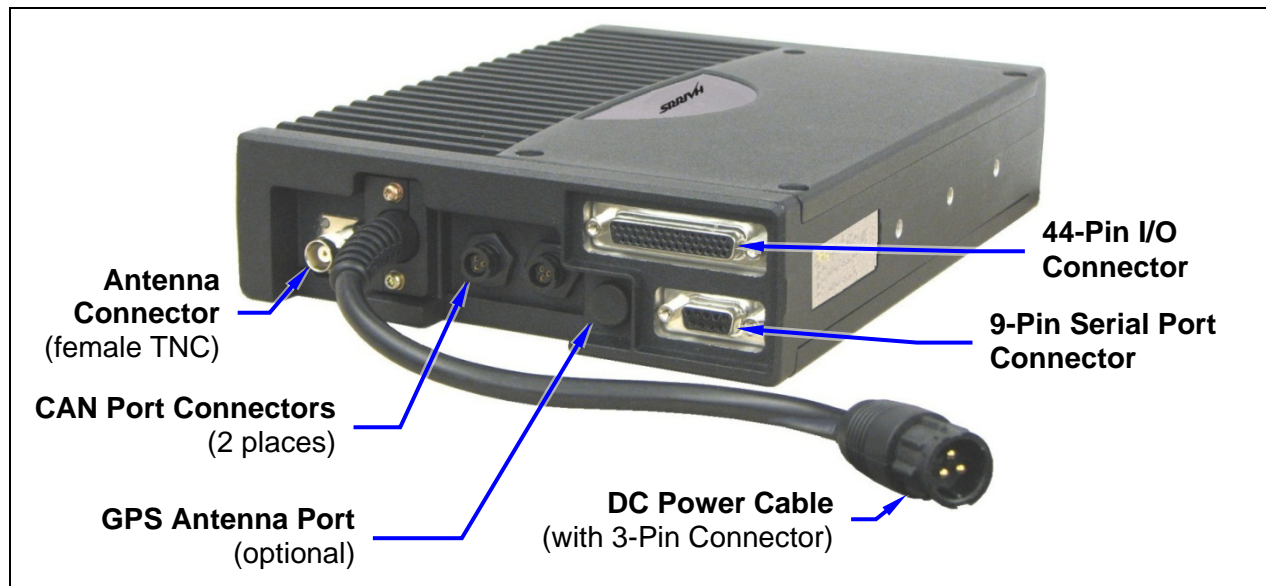


Figure 4-2: VHF M7300 Mobile Radio (Rear View)

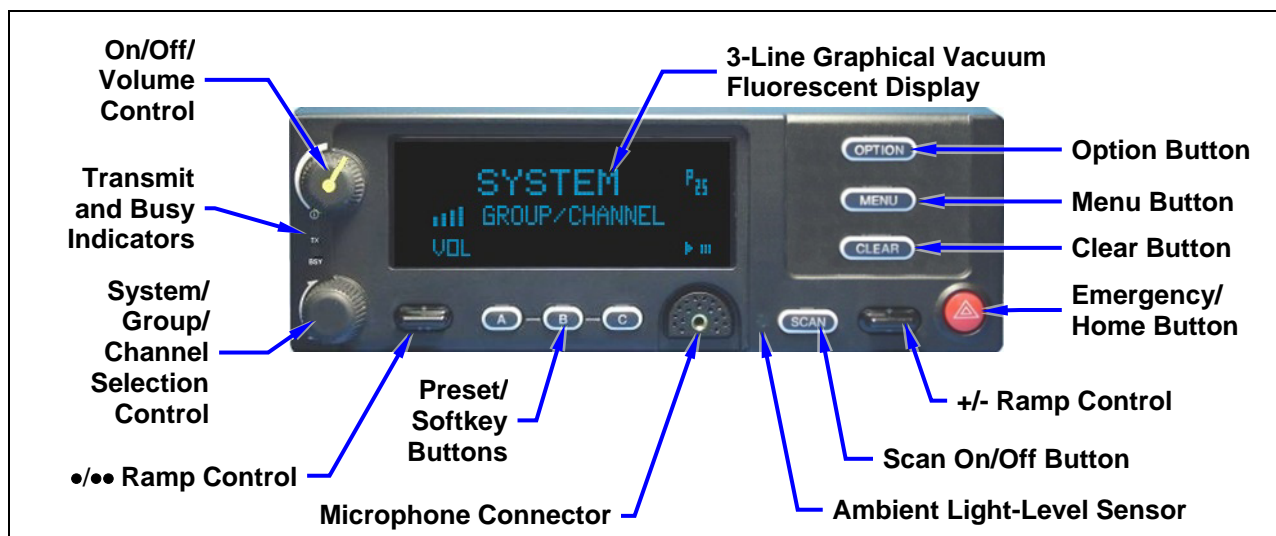


Figure 4-3: CH-721 Scan Model Control Head Front Panel

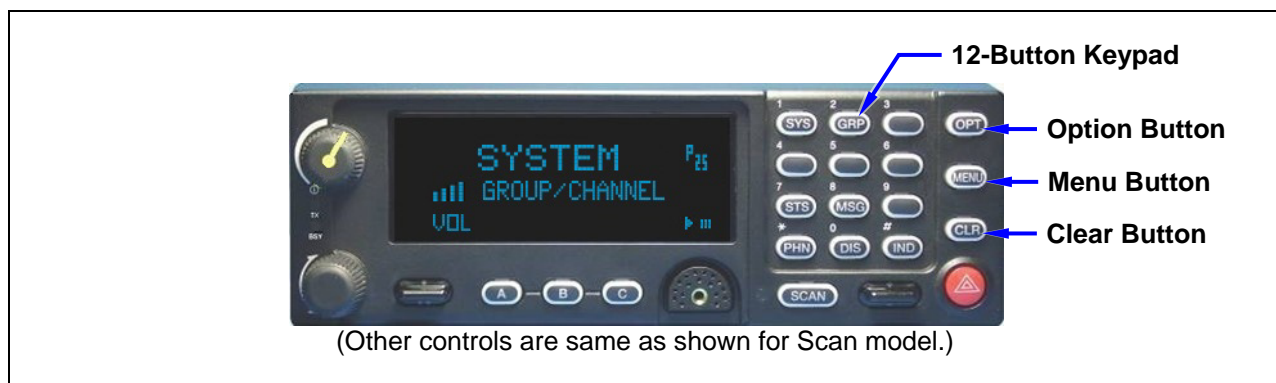
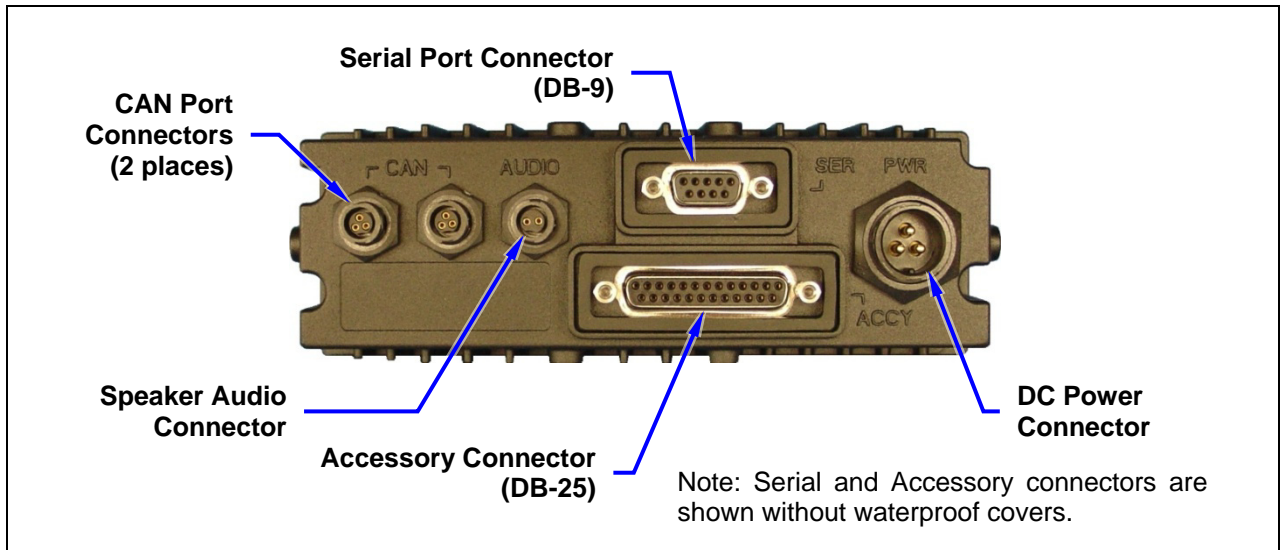


Figure 4-4: CH-721 System Model Control Head Front Panel



**Figure 4-5: CH-721 Rear Panel (Both Control Head Models)**

In a remote-mount M7300 mobile radio installation, the HHC-731 hand-held controller can be employed in place of the CH-721 control head. This easy-to-use hand-held mobile radio controller is primarily designed for use in harsh environments such as maritime (i.e., boating) applications and All-Terrain Vehicle (ATV) applications. The HHC-731 hand-held controller has easy-to-use buttons, a tough liquid-crystal display (LCD), and a built-in microphone. As of the publication of this manual, only one (1) HHC-731 hand-held controller can be connected to a radio, and without any connected CH-721 control heads. The front of the HHC-731 hand-held controller is shown in Figure 4-6.



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

The remote-mount M7300 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. EDACS Conventional P25 (ECP) mode supports dual control heads. For a front-mount radio, this includes the head in the radio. 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 such as that for a mobile data terminal connected to the serial port of the radio or control head. For proper operation, the CAN link must be terminated appropriately on each end. In multiple control head installations, heads are interconnected to the mobile radio in a series ("daisy-chain") fashion via CAN link cables. CAN port connectors are located on the rear of the radio and control heads, as illustrated in Figure 4-2 and Figure 4-5.

The 44-pin D-subminiature connector on the rear panel of the radio provides a connection point for various types of optional equipment. For example, with a front-mount radio, this connector can provide connections for an optional Federal Signal Electronic siren/light control system via an optional interconnect cable.

As shown in Figure 4-5, the CH-721 Scan and System model control heads used in remote-mount 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.

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. In a remote-mount radio installation, 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 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 has 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)
- Installation Manual for GPS Receiver Field Upgrade Kit MM-015617-001

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: Radio Catalog and Part Numbers**

CATALOG NUMBER	RADIO PART NUMBER	DESCRIPTION
MAMW-SHMXX*	RU-144750-041	50-Watt VHF M7300 Mobile Radio

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

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

CONTROL HEAD CATALOG NUMBER	CONTROL HEAD PART NUMBER	DESCRIPTION
MAMW-NCP9G	CU23218-0001	CH-721 Scan Control Head, Local-Control for Use on a Front-Mount Mobile Radio
MAMW-NCP9E	CU23218-0002	CH-721 Scan Control Head, Remote-Control for Use with a Remote-Mount Mobile Radio
MAMW-NCP9H	CU23218-0003	CH-721 System Control Head, Local-Control for Use on a Front-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

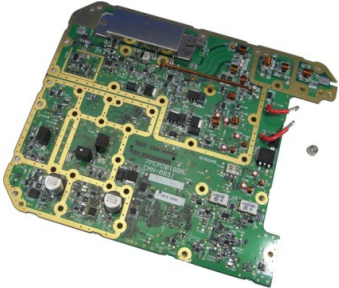



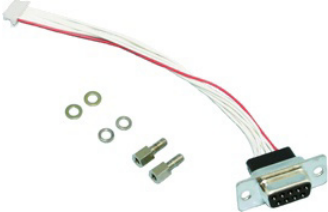

### 8.2 INSTALLATION-RELATED COMPONENTS

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

## 8.3 SERVICE PARTS

This section lists service parts available for the 50-Watt VHF M7300 mobile radio. See Section 6 on page 18 for parts ordering information.

**Table 8-4: Service Parts for the 50-Watt VHF M7300 Mobile Radio**

SERVICE PARTS PART NUMBER	DESCRIPTION	ILLUSTRATION
CB-016584	Board Assembly, 50-Watt VHF RF Processor (Includes RF PA Module and Spacer for Thermistor RT101) [CMN-6831Z]	
CB-015585	Board Assembly, PK [CMC-1294E/-MDCW11220]	
CA-013869	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 50-Watt VHF M7300 Mobile Radio**






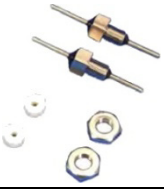


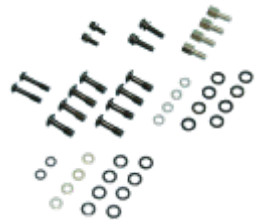





SERVICE PARTS PART NUMBER	DESCRIPTION	ILLUSTRATION
14002-0177-01	Kit, Rear Connector Jackscrews (includes 4 jackscrews, 4 lockwashers, and 4 flat washers)	
CN-013898	Kit, TNC Antenna Connector (includes connector, mounting hardware, and O-ring gasket)	
EA-016593	Module, RF Power Amplifier, VHF (IC101 of RF Processor Board; similar to Mitsubishi RA60H1317M1A-238)	
AM-015589	Integrated Circuit, TDA7391 Audio Amp (IC905 of PK Board)	
IC-015593	Integrated Circuit, NJM7805FA Fixed 5-Volt Regulator (IC908 of PK Board)	
XD-016595	Kit, Feed-Through Capacitors, Ceramic (includes spacers and nuts)	
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>	
SC-014865	Kit, Internal Screws	

Table 8-4: Service Parts for the 50-Watt VHF M7300 Mobile Radio

SERVICE PARTS PART NUMBER	DESCRIPTION	ILLUSTRATION
SC-013867	Kit, External Screws	
FM-015596	Cover, Bottom (includes metal cover and shield gasket)	
MA-013861	Cover, Top (includes metal cover, gasket and label)	
NP-013868	Label, Harris (for Top Cover)	
FM-013890	Cap, GPS	
MA-013357	Kit, Front Panel	



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




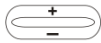

This section provides basic operating information for the radio connected to a CH-721 control head. For detailed CH-721-based operating instructions, refer to operator's manual publication number MM-014716-001. For detailed HHC-721 hand-held controller operating instructions, refer to operator's manual 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> (Optional 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

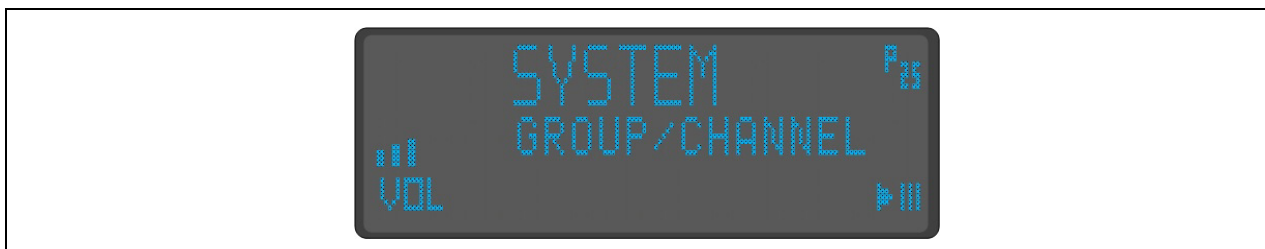
The control head's keypad can be locked to prevent accidental button press operations. Lock and unlock it as follows:

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.



NOTE

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.



CAUTION

Before loading new ECP code into the radio, consult with the Harris Technical Assistance Center (TAC) and/or respective Software Release Notes as necessary. TAC contact information is included on page 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:

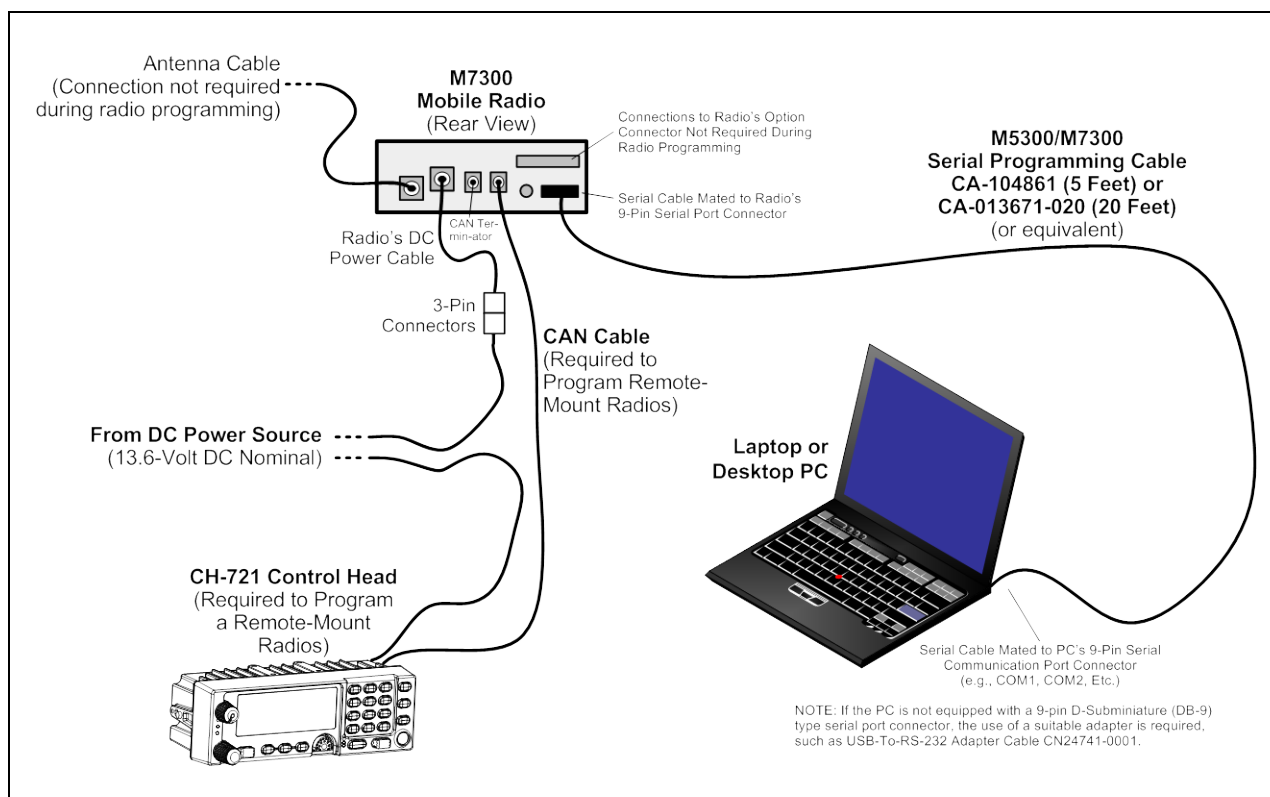
1. As illustrated in Figure 10-1, connect the radio to a personal computer with the Radio Personality Manager (RPM) programming software installed on it. Use Serial Programming Cable CA-104861 (5 feet long), CA-013671-020 (20 feet long), or equivalent, to connect the computer's serial port to the 9-pin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



NOTE

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



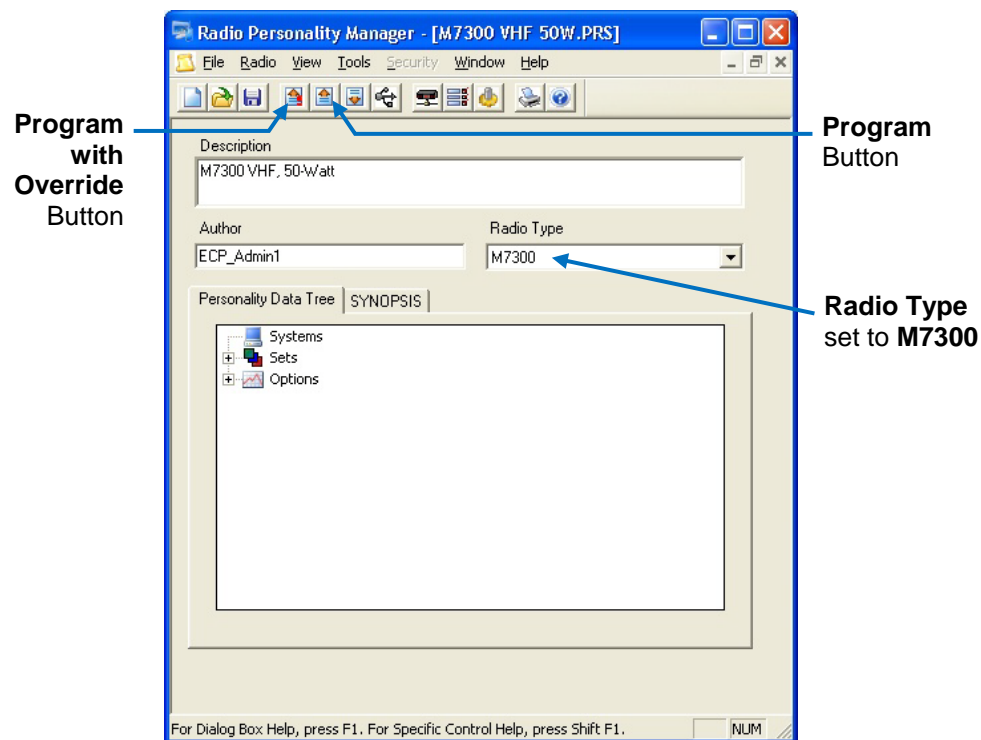
The compressed code (file named **m7200\_ecp\_RxxXxx.cmp**) is included with Media Kit SK-011983-001. That Media Kit is included with Software Distribution Kit ST-011986-001. For additional information, refer to Software Release Notes MS-010366-001.

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

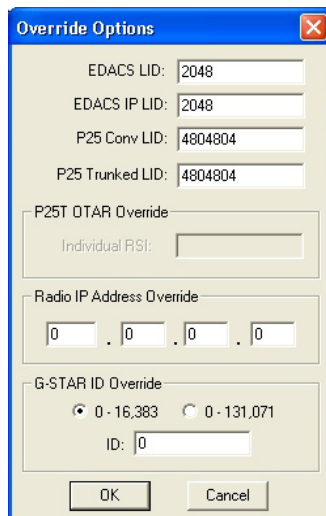
1. Connect the radio to a personal computer with the Radio Personality Manager (RPM) programming software installed on it. Use Serial Programming Cable CA-104861 (5 feet long) or CA-013671-020 (20 feet long), or equivalent, to connect the computer's serial port to the 9-pin (DB-9) connector on the rear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

### 11.1 PROCESSING KERNEL (PK) BOARD

The Processing Kernel (PK) Board contains the majority of the microprocessor and digital signal processing circuitry in the radio. Circuits are analyzed in the following subsections.

#### 11.1.1 Logic Circuit

The main microcomputer circuit in the radio consists of the OMAP processor (IC801), flash ROM (IC802), and SDRAM (IC822). This circuit is synchronized by the 14.4 MHz TCXO located on the RF Processor board.

OMAP processor IC801 handles modulation, de-modulation, and audio coder-decoder (CODEC). The RS-232 (IC821 and IC823) and CAN interface (IC808 and IC809) provide the external man-machine interface. Reset circuit (IC819) handles resetting the radio at power ramped up timing.

##### 11.1.1.1 **OMAP IC801**

OMAP processor IC801 is a highly-integrated, dual-core microprocessor. The OMAP has a built-in TI925T 32-bit Reduced Instruction Set Computer (RISC) core and a TMS320C55x Digital Signal Processor (DSP) core.

Functions performed by IC801 include:

- Flash ROM, Static RAM (SRAM) and Synchronous Dynamic (SDRAM) control;
- TRX/Synthesizer control; and,
- External interface control for the radio data (e.g., channel number and signaling).

##### 11.1.1.2 **Flash ROM IC802**

The flash ROM (IC802) is a 128 Mb simultaneous read/write, burst mode flash memory device. IC802 stores the firmware executed by OMAP processor IC801. This firmware includes the “BurnApp” flash software code used to copy the application software and the application software itself. Operating power is provided from the 1.8-volt switched supply line, +1V8\_SW.

IC802 interfaces to OMAP IC801 via the external memory interface-slow (EMIFS) traffic controller. Data transfers between IC802 and IC801 via the 16-bit bi-directional data bus identified FLASH\_D(15:0). Twenty-four bit address bus FLASH\_A(24:1) addresses both flash memory IC802 and SRAM IC803.

##### 11.1.1.3 **Static RAM IC803**

SRAM IC803 is a high-performance CMOS static RAM organized as 1024 K words by 16 bits. Operating power is provided by the 1.8-volt switched supply line, +1V8\_SW. Like flash memory IC802, SRAM IC803 interfaces to OMAP IC801 via the EMIFS traffic controller. Data transfers between IC803 and IC801 via the 16-bit bi-directional data bus identified FLASH\_D(15:0). Twenty-four bit address bus FLASH\_A(24:1) addresses both flash memory IC802 and static RAM IC803; however, only the lower twenty lines are utilized for SRAM addressing. Byte-wide vs. word-wide reads/writes are controlled by the two byte-enable logic lines identified FLASH\_BE0 and FLASH\_BE1 from IC801’s J5 and J1 respectively.

#### **11.1.1.4 Synchronous Dynamic RAM IC822**

SDRAM IC822 is a high-speed CMOS synchronous DRAM containing 16 Mb. It is internally configured as a dual 512K word x 16 DRAM with a synchronous interface. IC822 is rated for clock frequencies up to 143 MHz.

OMAP IC801 addresses SDRAM IC822 via the address bus identified SDRAM\_A(10:0), together with row buffer, column buffer, and command decoder logic within IC822, and the respective active-low control lines from IC801 to IC822. These active-low control lines include write-enable SDRAM\_WE, column-address SDRAM\_CAS, and row-address SDRAM\_RAS. SDRAM\_WE also provides read/write directional control. Bank selection is accomplished via the SDRAM\_BA0 logic line from IC801 which controls IC822's bank-select address line, A11.

Data transfers between IC801 and IC822 via the 16-bit bi-directional data bus identified SDRAM\_D(15:0). Directional control is determined by SDRAM\_WE.

SDRAM\_CLK is the clock line from OMAP IC801 to IC822. All data and commands are registered on the positive edge of the clock signal, SDRAM\_CLK. SDRAM\_CKE from IC801 to IC822 is an active-high clock enable line. When the clock-enable line is high, data and commands transfer between IC801 and IC822. When it is low, no data transfers and IC822 enters either a power-down mode or a self-refresh mode.

#### **11.1.1.5 CAN Controller and Transceiver (IC808 & IC809)**

The Stand Alone Can Controller IC808 is one of the two main ICs in the PK Board's CAN link interface circuit which meets the requirements of the CAN 2.0 specification. It interfaces to IC801's Multi-Channel Buffered Serial Port 2 (McBSP2) which handles CAN link data for the radio. SACC IC808 is a 5-volt device, as shown by the +5V power supply connection at pin 20.

SACC IC808 has an internal oscillator that, together with crystal X803 between IC808 pins 8 and 9, generates a 40 MHz crystal-timebase reference clock for IC808. The clock output from IC808 pin 3 is not utilized (test point TP815).

CAN-formatted data transfers between SACC IC808 and CAN link transceiver IC809 occur over the two 5-volt logic lines between IC808 pins 1 and 2 and IC809 pins 1 and 4. 5-volt level CAN transmit data from SACC IC808 pin 1 is buffered by 3-state buffer IC812-1 and applied to IC809 pin 1. Likewise, 5-volt level CAN receive data from CAN link transceiver IC809, pin 4 is buffered by 3-state buffer IC812-2 and applied to SACC IC808 pin 2.

CAN link transceiver IC809 transfers and converts SACC IC808's separate single-ended receive and transmit 5-volt level CAN logic signals onto the common 2-wire differential CAN link. The 2-wire differential connections at U32 pins 6 and 7 are identified CANH (for CAN high) and CANL (for CAN low) on the schematic.

#### **11.1.1.6 RS-232 (IC821 and IC823)**

RS-232 transceivers IC821 and IC823 meet the EIA/TIA-232 specifications.

IC821 is located between the radio unit and the DB-9 connector. IC823 is located between the VTAC 40-pin connector and the DB-44 connector.

#### **11.1.1.7 Reset Circuit (IC819)**

IC819 is a low voltage detector with output delay used to reset the radio. The reset signal is generated when the +5V\_SW level is greater than 4.4 V. The delay time is set by C831. The generated reset signal is then injected in IC801 at pin 12.

#### **11.1.1.8 Control and Status Register (CSR)**

The PK board's CSR functions as a 16-bit, 3.3-volt logic output port by providing sixteen latched logic outputs to various other logic circuits on the PK Board. It is formed by 16-bit transceiver and register IC804, 16-bit dual supply bus transceiver IC805, dual input OR gate IC807, buffer IC806, and associated resistors and capacitors. IC804 latches a 16-bit word sent to it via processor IC801's flash data bus, identified FLASH\_D(15:0) on the schematic. This 16-bit word is applied to IC805 for 1.8-volt to 3.3-volt logic level conversion via a secondary bus between the two transceivers identified CSR\_D(15:0). Circuit control originates from OMAP IC801's EMIFS traffic controller, IC801-1.

#### **11.1.2 Audio Circuit**

The audio circuit provides the audio output to the speaker and is comprised of audio CODEC IC901, audio amplifiers IC903 and IC905, and analog switch IC904.

##### **11.1.2.1 Audio CODEC (IC901)**

Audio CODEC IC901 converts digital audio to analog audio for RX and analog audio to digital audio for TX. IC901 is a high-performance audio codec with 16/20/24/32-bit, 97-dBA stereo playback, mono record functionality at up to 48 kbps. A microphone input includes a built-in preamp and hardware automatic gain control, with single-ended or fully-differential input capability.

Digitized audio signals transfer between IC901's digital audio processing circuits and OMAP processor IC801 via IC801's second Multichannel Serial Interface (MCSI2). A Serial Peripheral Interface (SPI) link interface between IC801 and IC901 is utilized to transfer control information from IC801's subsection 5 to IC901's internal control registers. This allows IC801 to set various IC901 operating parameters such as the reference voltage at IC901 pin 14, CODEC audio levels, and audio routing paths inside IC901.

##### **11.1.2.2 Audio Amplifier (IC903 and IC905)**

The Audio Amplifiers IC903 and IC905 are located between the CODEC and speaker amplifier. They amplify the output signal from the CODEC (IC901) to the adequate level for driving the speaker.

##### **11.1.2.3 Analog Switch (IC904)**

The Analog Switch (IC904) is used to mute the voice line. When the control signal on pin 4 is high, the voice line is active.

#### **11.1.3 Voltage Regulators**

Voltage regulators IC907 and IC908 provide 5 VDC for primary system control. Voltage regulator IC909 provides 1.6 VDC for the OMAP core (IC801), FLASH (IC802), SRAM (IC803), and CODEC (IC901). Voltage regulator IC911 provides 3.3 VDC for the OMAP (IC801) and SDRAM (IC822).

#### **11.1.4 GPS Receiver (Optional)**

The optional GPS receiver connects to J901 on the PK board. Refer to Section 14.6 on page 102 for additional information.

## **11.2 RF PROCESSOR BOARD**

Circuits of the RF Processor Board are analyzed in the following subsections.

### **11.2.1 PA Block**

#### **11.2.1.1 Variable Attenuator (CD116, CD117)**

The RF (136 to 174 MHz) output signal of the low pass filter is fed to variable attenuator (CD116, CD117, and associated components). The RF signal level is about 0 dBm at TP101. The range of this attenuator is about 0 to -30 dB. This circuit is controlled by the Auto Power Control (APC) circuit and is enabled by "TXENB+."

#### **11.2.1.2 TX Amplifier (TR102)**

The output of RF signal from variable attenuator is fed to TX amplifier (TR102) via the 5 dB attenuator. This amplifier is enabled by "TXENB+" and its gain is about 23 dB. The output level of the TX amplifier is about +10 to -20 dBm.

#### **11.2.1.3 Driver (TR103)**

The output of the RF signal from the TX amplifier is fed to driver TR103 via the 2 dB attenuator. The RF signal is amplified to approximately +20 dBm at the driver amplifier. This driver is controlled by "TXENB+" and the input level of the PA module is approximately +17 to -13 dBm.

#### **11.2.1.4 PA Module (IC101)**

The output of driver TR103 is fed to the input of PA module IC101 via a 3 dB attenuator. The RF signal is amplified to approximately 50 W by the PA module at rated power. The gate voltage "V<sub>gg</sub>" of the PA module is enabled by "TXENB+" and the drain voltage "V<sub>dd</sub>" is supplied from A+. The PA module consists of 2 stage FET amplifiers. These amplifiers are operated in Class-AB.

#### **11.2.1.5 Automatic Power Control (IC103, CD108, CD109, IC701)**

The Automatic Power Control circuit (APC) controls the output power to the antenna to maintain a constant power level. The Forward Power Detector picks up TX power and supplies it to diode CD109 for rectifying. CD109 produces a positive DC voltage proportional to the TX power level. When the RF load causes a mismatch, the reverse power detector picks up the reflected power from antenna port and it is rectified by diode CD108.

Each rectified signal is summed in the adder circuit (R159, R160, and R163). The added signal is compared to "HPA\_BIAS" at comparator IC103, which controls the variable attenuator for constant Tx Power. "HPA\_BIAS" is produced from the DAC in Micro Controller Unit (MCU) IC701.

The temperature monitor circuit (RT101 and TR104) performs thermal monitoring and detection for PA module protection. When the temperature of the PA module heat sink is higher than +90° C, this circuit reduces power approximately 3 dB.

#### **11.2.1.6 Antenna Switch and RF LPF (CD101 to CD104, IC192, L111 to L113)**

The antenna switch consists of CD101 to CD104, IC102 and associated components. The RF low pass filter consists of L111 to L113. During transmit, the "TXENB+" signal is switched high. The "TXENB+" signal from the MCU is connected to the base of TR111 and TR120 for controlled antenna switch. When the diode (CD101, CD102) impedance for the antenna switch is low, the output power from the PA

module passes to a low pass filter. At the same time, the TX power fed to the receiver is reduced by diodes CD103 and CD104, and switch IC102.

During RX operation, the “TXENB+” signal is low. The receiver RF signal from the antenna port is fed to the input of the receiver via a low pass filter (L111 to L113 and associated components) and the antenna switch.

#### **11.2.1.7 5 W Detect (CD105)**

The 5 W detect circuit is the power detector for the antenna port. When a strong RF signal (greater than 1 W) is injected at the antenna port, it is rectified in by CD105. Then SPDT switch IC102 turns on for receiver protection.

#### **11.2.1.8 Smoothing Filter (TR116)**

The smoothing filter is voltage follower using transistor TR116. It reduces the alternate noise of battery (A+) for comparator circuit IC103.

### **11.2.2 RX Block**

The receiver is double super-heterodyne receiver that operates at 136 to 174 MHz. The receiver employs a 45.1 MHz 1st Intermediate Frequency (IF) and a 2.16 MHz 2nd IF. A receiver backend integrated circuit (IC301) converts the 2.16 MHz second IF signal into a complex pair of I/Q baseband digital signals. The I/Q baseband digital signals are then transferred by a Synchronous Serial Interface (SSI) to the Digital Signal Processing (DSP) circuits on the radio's PK Board for digital filtering and demodulation. Final RF channel selectivity filtering for the different radio modes is performed by the DSP circuits on the PK Board.

The IF block consist of two 1st IF filters, 3 stage IF amplifiers, RX IF level limiter, and a 2nd Mixer/2nd IF AMP/ADC within IC301. This block filters the 1st IF signal, converts from the 1st IF signal to the 2nd IF signal, and converts from the 2nd IF signal to the digital baseband signals by Analog Digital Converter.

#### **11.2.2.1 1<sup>st</sup> Band Pass Filter and 1<sup>st</sup> RF Amplifier (L201 to L206, CD201 to CD204 and TR201)**

The 1<sup>st</sup> band pass filter is a tunable band pass filter controlled by varactor diodes CD201 and CD204. Frequency is switched by PIN diodes CD202 and CD203. The RF signal from the antenna is fed to the 1<sup>st</sup> band pass filter which rejects unwanted signals. The 1<sup>st</sup> band pass filter is designed mainly for low insertion loss. The output of the 1<sup>st</sup> band pass filter is amplified by the 1<sup>st</sup> RF amplifier (TR201) that is a low noise amplifier.

#### **11.2.2.2 2<sup>nd</sup> Band Pass Filter, 2<sup>nd</sup> RF Amplifier and 3<sup>rd</sup> Band Pass Filter (L207 to L214, CD205 to CD210, TR202, L216, L217 to L221, CD211 to CD216)**

The 2<sup>nd</sup> band pass filter is also a tunable band pass filter that is controlled by varactor diodes CD207 and CD208. The frequency is switched by PIN diodes CD205, CD206, CD209, and CD210. The RF signal from the 1<sup>st</sup> RF amplifier is fed to the 2<sup>nd</sup> band pass filter and unwanted signals are rejected.

The bandwidth of the 2<sup>nd</sup> band pass filter is narrower than the 1<sup>st</sup> band pass filter. The output of the 2<sup>nd</sup> band pass filter is amplified by the 2<sup>nd</sup> RF amplifier (TR202) which is a low noise amplifier.

The output of the 2<sup>nd</sup> RF amplifier (TR202) is fed to the 3<sup>rd</sup> band pass filter (L220, L221, and associated components). The 3<sup>rd</sup> band pass filter also rejects unwanted signals.

### **11.2.2.3 1<sup>st</sup> Mixer (HC201)**

The 1<sup>st</sup> mixer (HC201) is a double-balanced-mixer that converts an RF signal (136 to 174 MHz) to the 1<sup>st</sup> IF frequency (45.1 MHz). To produce the 45.1 MHz IF, the upper side frequency (181.1 to 219.1 MHz) 1<sup>st</sup> local signal is injected to the mixer from Rx 1<sup>st</sup> local synthesizer

### **11.2.2.4 1<sup>st</sup> IF Amplifier1 and 1<sup>st</sup> IF Filter1 (TR301, TR302, FL301)**

The RX IF signal from the 1<sup>st</sup> mixer output is fed to the 1<sup>st</sup> IF amplifier1 (TR301, TR302, and associated components). The IF signal is filtered at the 1<sup>st</sup> IF filter1 (FL301).

### **11.2.2.5 1<sup>st</sup> IF Amplifier2 and 1<sup>st</sup> IF FILTER2 (TR303, FL302)**

The output of 1<sup>st</sup> IF filter is amplified by 1st IF amplifier2 (TR303 and associated components) and filtered by the 1<sup>st</sup> IF filter2 (FL302). Both IF filter 1 and 2 are crystal filters that reject the adjacent channel power.

### **11.2.2.6 1<sup>st</sup> IF Amplifier3 (TR304)**

The output of the 1<sup>st</sup> IF filter2 is amplified by the 1<sup>st</sup> IF amplifier3 (TR304 and other).

### **11.2.2.7 IF Level Limiter (IC302, IC303, TR305, CD301, and CD302)**

An automatic IF signal level limiter circuit is included in the closed-loop circuit that employs a variable attenuator, a wide-band power detector, and an inverting op-amp buffer stage. The variable attenuator is installed in the path between 1<sup>st</sup> IF amplifier3 (TR304) input of the IF IC (IC301).

The power detector senses the power level of the IF signal applied to IF ICs input and the attenuator is adjusted via the op-amp buffer when the limiting point is reached. The limiting point is approximately - 32 dBm at the input port of IF IC.

### **11.2.2.8 IF IC (IC301)**

The IF IC (IC301) is a one chip IC for radio communication system that is capable of demodulating FM, AM, and other. This IC is included in the 2<sup>nd</sup> Mixer, AD Converter, and 2<sup>nd</sup> PLL synthesizer. The 1<sup>st</sup> IF signal is fed to the input port of the 2<sup>nd</sup> mixer in IC301. The 2<sup>nd</sup> mixer converts the 1<sup>st</sup> IF signal (45.1 MHz) to the 2<sup>nd</sup> IF frequency (2.16 MHz) with the synthesized 2<sup>nd</sup> local signal (47.26 or 42.94 MHz).

The ADC circuit converts the receiver's 2.16 MHz 2<sup>nd</sup> IF signal to a complex pair of I/Q baseband digital signals. The I/Q baseband digital signals are then transferred by a Synchronous Serial Interface (SSI) to the Digital Signal Processing (DSP) circuits on the radio's PK Board for digital filtering and demodulation.

### **11.2.2.9 2<sup>nd</sup> Local Oscillator and 2<sup>nd</sup> Local Buffer Amplifier (TR310 to TR312, CD310 to CD312)**

The 2<sup>nd</sup> local signal is generated by the PLL synthesizer in IF IC IC301. The 2<sup>nd</sup> local VCO (TR310) generates the 2nd Local signal (47.26 or 42.94 MHz), which is injected to the 2<sup>nd</sup> mixer through the 2<sup>nd</sup> local amplifier (TR311, TR313). The 2<sup>nd</sup> PLL circuit controls the frequency of the 2<sup>nd</sup> local signal with high stability.

### 11.2.3 PLL Block

The RF Processor Board employs RF local synthesizers for transmit and receive, and a 2<sup>nd</sup> local synthesizer in the Rx IF IC (IC301). Each synthesizer's operating frequency is determined by data received from MCU (IC701) based upon the radio's current operating mode and programming channel.

The PLL frequency synthesizer IC (IC501 and IC504) integrates an RF fractional frequency synthesizer. The RF local synthesizer circuit receives PLL data and control information from the MCU based on the synthesizer data from OMAP. This circuit then generates RF Local frequency for the TX/RX RF frequencies.

The synthesizer circuit consists of the Reference Oscillator, PLL Frequency Synthesizer IC, Loop filter, VCO, and Feedback Buffer Amplifier. The VCO is locked on the divided frequency of the reference oscillator by a single synthesis loop consisting of the feedback buffer and PLL frequency synthesizer IC which has an internal divider and pre-scalars. There are two RF VCOs, one for Tx and one for the Rx 1<sup>st</sup> local signal.

The RF VCOs generate the RX 1<sup>st</sup> local signal and transmit local signal. The transmit local signal frequency is twice the transmit frequency. The circuit provides lock/unlock information to the MCU.

#### 11.2.3.1 **VC-TCXO (X501, TR508)**

VC-TCXO (Voltage Control Temperature Controlled Compensated Crystal Oscillator) X501 is the reference oscillator. The reference oscillator frequency is 14.4 MHz. The VC-TCXO is enclosed in a shielded can for RF shielding. The VC-TCXO frequency is compensated by an internal temperature compensated circuit against both low and high temperature. The VC-TCXO frequency is compensated to within a +/-1.5 ppm frequency range under temperatures from -30 deg C to +60 deg C. It has +/-7.5 to 12.5 ppm tuning range and is used for Automatic Frequency Control (AFC).

#### 11.2.3.2 **RX PLL IC and TX PLL IC (IC501, IC504)**

This synthesizer has two PLL ICs. The first is RX PLL IC (IC501) and the other is TX PLL IC (IC504). Both PLL ICs consist of a pre-scalar, a programmable reference oscillator divider (that uses an "R" counter), phase detector, and programmable VCO dividers (use "N" and "A" counter) which are Fractional Divider Type. The "N," "A" counters receive a divided signal, whose source is the VCO output signal divided by the Pre-scalar. The counters are programmed by MCU.

#### 11.2.3.3 **Rx/Tx PLL Loop Filter (IC502, IC503, TR501-TR506, IC505, IC506 TR510-TR515)**

The RX PLL loop filter consists of IC502, IC503, TR501-TR506, and associated components. This filter controls the bandwidth and the stability of the synthesizer loop. FET TR501 is controlled by "PLLFAST1-." FETs TR505 and TR506 are controlled by "PLLFAST2-" for the fast PLL lockup time. The output signal of the loop filter is fed to RX VCO1 and RX VCO2.

The TX PLL loop filter consists of IC505, IC506, TR510-TR515, and associated components. FET TR510 is controlled by "PLLFAST1-." FETs TR514 and TR515 are controlled by "PLLFAST2-" for the fast PLL lockup time. The output signal of the loop filter is fed to the TX VCO.

#### 11.2.3.4 **RX Feedback Amplifier and TX Feedback Amplifier (TR509, TR516)**

The divided signal "RX\_SYNOUT" from the RX VCO amplifier (TR407) is amplified to -5 dBm by the RX feedback amplifier (TR509) via an attenuator and fed to the RX PLL IC (IC501).

The divided signal "TX\_SYNOUT" from the TX VCO amplifier (TR422) is amplified to -5 dBm by the TX feedback amplifier (TR516) via an attenuator and fed to the TX PLL IC (IC504).

### 11.2.3.5 RX Lock Detect and TX Lock Detect

The Rx lock signal “SYNTH1\_LOCK” signal is output from IC501. The Tx lock signal “SYNTH2\_LOCK” signal is output from IC522. In case of an unlock condition, the lock detect signal goes to “L” and is fed to the MCU (IC701).

## 11.2.4 TX VCO & RX VCO Block

### 11.2.4.1 RX VCO1, RX VCO2 and RX VCO Amplifier (TR401, TR404, TR407)

There are two RX VCOs for wideband and high quality C/N. The RX VCO1 (TR404) is for RX frequencies 136 to 152.9875 MHz and the RX VCO2 (TR401) is for RX frequencies 153 to 174 MHz. RX VCO1 consists of Bipolar Transistor oscillator (TR404), varactor diodes (CD407, CD408), switched diodes (CD409 to CD412) and the associated components. RX VCO2 consists of a bipolar transistor oscillator (TR401), varactor diodes (CD401, CD402), switched diodes (CD304 to CD306), and the associated components.

Each RX VCO is controlled by “RXVCOENB+,” and selects the frequency shift by “SPLTSW1,” “Rx\_SEG1,” and “Rx\_SEG2.” There are 3 Segments for each RX VCO to divide separate frequency bands as detailed in the table below.

	RX Frequency (MHz)	VCO Frequency (MHz)	"RXVCOENB+"	"SPLTSW1"	"Rx_SEG1"	"Rx_SEG2"
RX VCO1	136.0 to 140.0875	RX Frequency + 45.1	High	Low	High	High
	140.1 to 144.2875		High	Low	High	Low
	144.3 to 152.9875		High	Low	Low	Low
RX VCO2	153.0 to 159.0875		High	High	High	High
	159.1 to 165.2875		High	High	High	Low
	165.3 to 174.0		High	High	Low	Low

The output of both RX VCOs is fed to the RX VCO amplifier (TR407). The output is divided by R411, R412, and R413. The divided RF signal is fed to RX feedback amplifier (TR509) and RX Local amplifier1 (TR408).

### 11.2.4.2 RX Local Amplifier1 and RX LOCAL Amplifier2 (TR408, TR409)

The output of RX local amplifier1 is amplified by two-stage amplifiers TR408 and TR409. The output level of the RX local amplifier2 is approximately +20 dBm.

### 11.2.4.3 TX VCO (TR421)

The TX VCO consists of bipolar transistor oscillator TR421, varactor diodes CD421-CD424, switched diodes CD425-CD432, and the associated components.

The TX VCO is controlled by “DPTT+” and selects the frequency shift by “Tx\_SEG1,” “Tx\_SEG2,” “Tx\_SEG3,” “Tx\_SEG4.” The TX VCO has 5 Segments to divide frequency band as detailed in the following table.

	TX Frequency (MHz)	VCO Frequency (MHz)	"Tx_SEG1"	"Tx_SEG2"	"Tx_SEG3"	"Tx_SEG4"
TX VCO	136.0 to 141.5875	TX Frequency x2	High	High	High	High
	141.6 to 146.5875		High	High	High	Low
	147.6 to 154.1875		High	High	Low	Low
	154.2 to 161.6875		High	Low	Low	Low
	161.7 to 174.0		Low	Low	Low	Low

#### **11.2.4.4 TX VCO AMP1 (TR422)**

The output of the TX VCO is connected to TX VCO amplifier1 TR422. The output is divided by R457, R458, and R459. The divided RF signal is connected to TX Feedback amplifier TR516 and IQ modulator IC613. The TX VCO amplifier1 is controlled by “DPTT+.”

#### **11.2.5 IQ Modulator Block**

The RF Board has an IQ modulator (IC613) and related circuit. The base band signal is generated by the DAC1 (IC606). The I and Q signal of DAC1 is fed to base band filter (IC610-IC612). The filtered signal is fed to the IQ modulator (IC613).

##### **11.2.5.1 DAC1 (Base Band Signal Generator) IC606**

The base band signal is generated by the DAC1 (IC606). The base band signal contains modulation signal and DC bias (VMID).

##### **11.2.5.2 DAC2 (DC Offset) IC608**

The DC offset of the base band signal generator is generated by the DAC2 (IC608) for carrier suppression adjustment.

##### **11.2.5.3 Base Band Filter (IC610 - IC612)**

The base band I and Q signals are filtered in the OP amp (IC610-IC612). These filter circuits generate an inverse signal for each I and Q to produce a balanced signal. The balanced I and Q signals are fed to the IQ modulator (IC613).

##### **11.2.5.4 I/Q Modulator (IC613)**

The IQ modulator (IC613) modulates the base band signal (I and Q) with the Tx Local RF signal. The input frequency of the IQ modulator is divided by 2 and the output frequency is equal to the transmit frequency.

##### **11.2.5.5 Low Pass Filter (L605 - L607)**

The low pass filter consists of L605 to L607 and associated components. The RF signal from the IQ modulator output is filtered by the low pass filter to reject harmonics of RF signal and out band noise.

#### **11.2.6 MCU and Power Supply Block**

##### **11.2.6.1 Micro Controller Unit (IC701)**

The Micro Controller Unit (MCU: IC701) performs all setup and local control functions for the RF Processor Board. This mixed signal micro-controller has an 8051-type 8-bit core that can perform up to 25 MIPS at a 25 MHz clock rate. Other circuits integrated into IC701 and used by the RF Processor Board include:

- **64K Bytes of Flash Memory** - This memory stores the RF Processor Board’s operating firmware. It is flash programmed at the factory.
- **4K Bytes of Random-Access Memory (RAM)** - The operating firmware uses this memory for “scratch pad” functions. No external RAM is required on the RF Processor Board.
- **I2C Communications Port** - A 2-wire I<sup>2</sup>C-type serial inter-board communications link between IC701 and the OMAP processor on the PK Board passes commands and status messages back-and-

forth between the two boards. All commands originate from the OMAP processor on the PK Board and all status messages originate from IC701. This type of interface is sometimes referred to as a “System Management Bus.”

- **Serial Peripheral Interface (SPI) Bus** - Internal SPI bus is used to load the frequency programming data into the on-board phase-lock-loop RF/IF synthesizer IC, to load the configuration data into the receiver’s IF IC.
- **Twenty-Three Digital Output Bits** - These digital output lines provide logic control for various circuits on the RF Processor Board such as those for any switching, and gating control for the SPI logic signals during loads of the on-board synthesizer IC.
- **Seven Digital Input Bits** - IC701 uses these digital input lines to monitor various conditions such as the state of the radio’s vehicle ignition sense input and the phase-lock status of the on-board synthesizers.
- **Two 12-Bit Digital-to-Analog Converter (DAC) Channels** – The MCU has two DACs. One DAC channel output is used during factory calibration of the board’s 14.4 MHz reference oscillator and to implement automatic frequency control (AFC) of this oscillator. This oscillator provides the 14.4 MHz reference clock for the entire radio (for the RF Processor Board and the PK Board).

The other DAC channel output provides the reference voltage in the transmitter to support the radio’s automatic power-level control (APC) loop function.

- **Five 10-Bit Analog-to-Digital Converter (ADC) Channels** – The MCU has five ADCs. It is used for inputs to detect various conditions such as transmitter power and frequency band type of the RF Processor Board.

#### **11.2.6.2 Power Supply (IC801 - IC811)**

RF processor Board has voltage regulators to stabilize the DC voltage as 9V, 5V, 3.3V, 3V. The 9-volt regulator is used mainly for the RF circuits and the 5-volt and less are used mainly for the logic circuit.

## 12 MAINTENANCE

### 12.1 GENERAL INFORMATION

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



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 testing and tuning procedures 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.

### 12.2 PREVENTIVE MAINTENANCE

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

- Inspecting all mobile radio related hardware to verify it is in place and securely tight. Any missing or loose hardware should be replaced and/or tightened as necessary.
- Inspecting all 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.

### 12.3 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 12-1: 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 12-1: 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 12-1: 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 12-1: 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 12-1: 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 12-1: 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

## 12.4 RF PERFORMANCE TESTS

### 12.4.1 General Information

This section includes RF performance test procedures for the 50-Watt 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 complete 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 testing and tuning procedures 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 12.4.3 that follows.

### 12.4.2 Test Equipment

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

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

EQUIPMENT	RECOMMENDED TYPES / MODEL NUMBERS
RF Communications Test Set	Any RF Communications Test Set capable of generating a standard P25 1011 Test Pattern, such as an Aeroflex™ IFR 2975 or Aeroflex™ 3920
RF Cable, 50-Ohm: TNC Male to Type-N Male	Pasternack Enterprises PE3661-36 or equivalent
RF Cable, 50-Ohm: Type-N Male to Type-N Male*	Pasternack Enterprises PE3441-36 or equivalent
RF Attenuator, 50-Ohm: 30 dB, 100-Watt, Type-N Female*	Bird Tenuline® 100-SA-FFN-30 or 100-A-FFN-30 or equivalent
Modified Microphone**	Harris Part Number MC-101616-041 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 R8B or later (See Section 10.1 on page 27 and/or Table 12-6 on page 61 for additional information).
Serial Programming Cable***	CA-104861 (5 feet long) or CA-013671-020 (20 feet long) or equivalent
DC Power Cable with Fuses (for Powering Radio)	Harris Part Number CA-012365-001
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 20-ampere output current (minimum)

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

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

\*\*\* If the utilized PC is not equipped with a DB-9 type serial port connector, the use of a suitable adapter is required, such as USB-to-RS-232 Adapter Cable CN24741-0001. As of the publication of this manual, CN24741-0001 is available via the Harris Customer Care center; refer to Section 6 on page 18 for the respective contact information.

\*\*\*\* DC Power Cable CA-012616-001 (with fuses) and CAN Cable CA-009562-030 are not required for testing a front-mount radio.



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.**

### 12.4.3 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 12-3. 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 12-3: Analog Conventional and P25 Conventional Test Channels**

TX FREQ. (MHz)	RX FREQ. (MHz)	RECOMMENDED NAME FOR ANALOG CONV. SYSTEM	RECOMMENDED NAME FOR P25 CONV. SYSTEM	BANDWIDTH	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				



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 12.4.4.
8. Add the SQUELCH function as a selection on the conventional menu. This menu is necessary for the receiver performance test procedures in Section 12.4.5.
9. Add the FCC MENU function as a selection on the conventional menu. This menu is necessary for P25-related test procedures in Sections 12.4.4 and 12.4.5.
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 12-3. To do this, create a new P25 conventional (channel) set with the listed channels and assign 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.

## 12.4.4 Transmitter Performance Tests

### 12.4.4.1 Tx Frequency Test

Use the procedure in this section to check the accuracy of the radio's Temperature-Compensated Crystal Oscillator (TCXO) frequency and 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). After radio power-up, always wait at least 15 minutes before taking a measurement. This warm-up time will allow the temperature of the radio's circuits to properly stabilize.

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

To connect the radio to the power supply, use cable CA-012365-001 with a 15-amp fuse in its red wire (main power) to the power supply's positive (+) output terminal. Connect the cable's black wire to the power supply's negative (-) output terminal. For a remote-mount radio, leave the cable's white wire unconnected and insulated. For a front-mount radio, connect the white wire via a 3-amp fuse to the power supply's positive (+) output terminal or to a switched power source.

To connect the control head to the 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. For a remote-mount radio, 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. For a remote-mount radio, 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.

For a front-mount radio, connect the modified speaker to the radio via option cable CA-012349-001. The option cable mates to the 44-pin connector on the rear of the radio. The 2-pin rectangular connector of the modified speaker's cable mates to the 2-pin rectangular connector of the option cable.

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 60 watts of continuous RF power, use an external RF attenuator between the radio and test set. The attenuator should have a minimum power rating of 60 watts.
6. Set the DC power supply's output voltage to 13.6 Vdc with a current limit between 15 and 20 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 12-4. 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 12-4. Any error outside of the listed limits indicates TCXO reference oscillator alignment is needed or there is a TCXO reference oscillator or transceiver synthesizer circuit problem in the radio. Record the overall pass/fail result in the table.



TCXO reference oscillator alignment procedures are included in Section 12.5.5.2 which begins on page 77. 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 12-4: 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-144750-041				



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

#### 12.4.4.2 Tx Power Levels Test

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

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

Table 12-5: Transmitter Power Test—Maximum Errors

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

Radio Part Number:	Radio Serial Number:	PASS/ FAIL	Test Date:	Technician's Initials:
RU-144750-041				



NOTE

Transmit power level alignment information is included in Section 12.5.5.3 (page 79).

- 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 12-5.

#### 12.4.4.3 Conventional Tx Modulation Limiting Tests

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

- If the transmitter frequency test procedure has not been performed per Section 12.4.4.1, do that now. Leave the radio and test equipment connected and configured as described in that procedure.
- 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 12-2 for additional information) along with a BNC cable and an adapter(s) appropriate for the test set. Apply the signal to the modified microphone's mic audio BNC input connector.
- 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-144750-041				



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 12.5.5.5 which begins on page 87.

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.

#### 12.4.4.4 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 12.4.4.1, 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-144750-041				



For related alignment information, refer to the I/Q Data Modulation Alignment procedure in Section 12.5.5.4 (page 84). 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.

## 12.4.5 Receiver Performance Tests

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

### 12.4.5.1 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 12.4.4.1 (page 52). **Always observe polarity when making connections to the power supply!**
2. For a remote-mount radio, 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. For a remote-mount radio, 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.  
For a front-mount radio, connect the modified speaker to the radio via option cable CA-012349-001. The option cable mates to the 44-pin connector on the rear of the radio. The 2-pin rectangular connector of the modified speaker's cable mates to the 2-pin rectangular connector of the option cable.
5. Connect the speaker output of the control head/radio to the RF Communication Test Set's audio input measurement port. Make this connection at the 4-ohm load resistor in the modified speaker (see Table 12-2 for additional information).



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 12-3. 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-144750-041				

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.

## 12.4.5.2 12 dB SINAD Rx Sensitivity Test

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

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



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 12-3. 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.



Before squelch can be disabled/adjusted, the SQUELCH programmable menu function must be programmed to the conventional menu as described in Section 12.4.3. 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.

- 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.

- 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-144750-041				

- Using the SQUELCH menu, re-enable squelch by returning its level to the original setting.
- If no additional tests are to be performed, disconnect all test equipment and remove the conventional test personality from the radio. The test personality **must** be removed from the radio and the original personality restored before the radio is returned to normal service.

#### 12.4.5.3 P25 (C4FM) Rx Sensitivity Test

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

- Complete the Audio Output and Distortion Levels Tests presented in Section 12.4.5.1. Leave the radio and all test equipment interconnected and configured per that procedure.
- 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-144750-041				

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

## 12.5 RADIO ALIGNMENT

Programming, alignment, and servicing aspects of maintaining a 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.

### 12.5.1 Required RPM Programming Software, Radio Code and Test Equipment

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

- The minimum version of the RPM programming software, as listed in Table 12-6, must be installed and operating on the technician's PC.
- The minimum version of ECP radio firmware codes, as listed in Table 12-7, must be installed into the radio.
- Test equipment as listed in Table 12-2 (page 50) is necessary to complete the alignment procedures.

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

The instructions in this manual are based on the RPM software revisions listed in Table 12-6 which are required when programming, aligning, and servicing the M7300 mobile radios.

**Table 12-6: 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 12-7 must be loaded into the radio. Otherwise, the Radio Maintenance Utility will not function properly with the radio. Determining if a radio has the minimum code versions installed is accomplished by using the Radio Maintenance Utility to read the calibration data from the radio. A pop-up message will appear when the radio does not meet the required minimum ECP firmware code versions.

**Table 12-7: 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

### 12.5.2 Overview of the Radio Maintenance Utility

As previously stated, the software-based Radio Maintenance Utility is included with the RPM programming software. It is installed on the PC along with the RPM programming software. This utility may be used to align many Harris mobile and mobile products, including the M7300 mobile radio.

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

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

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

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

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.

#### 12.5.3.1 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.

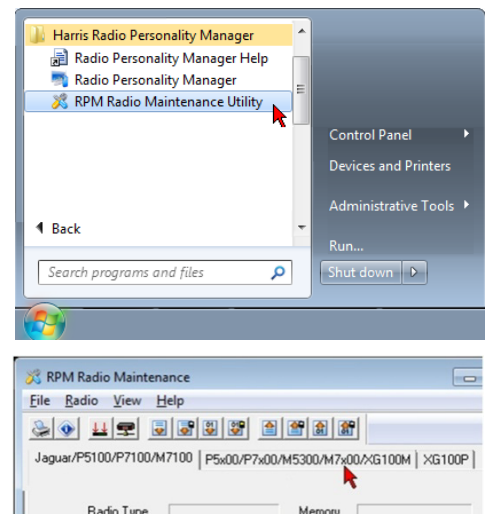
## **12.5.3.2 Reading and Saving Feature License Data**

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

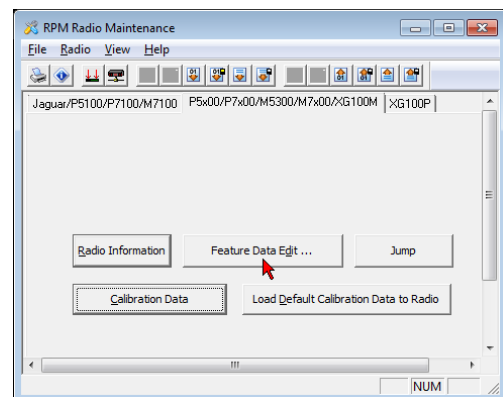
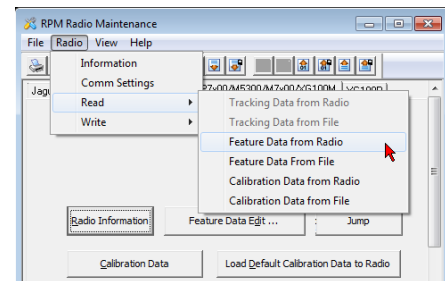
1. Enter programming mode as described in Section 12.5.3.1.
2. At the PC with the RPM programming software, start the Radio Maintenance Utility:

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

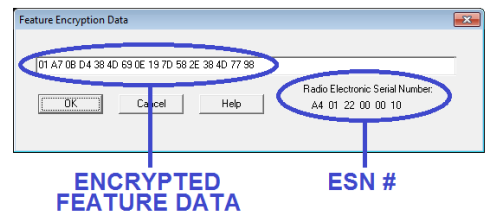
3. Within the utility, click on the tab that includes **M7x00** (for the M7300 and other radios).



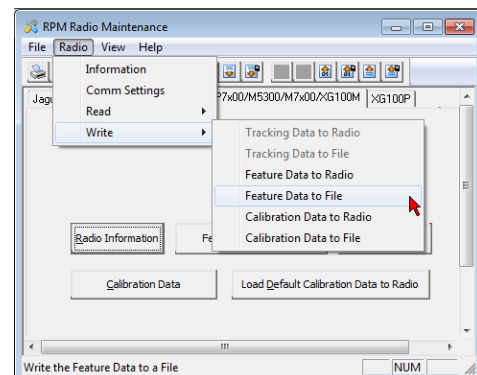
4. From the utility's menu:  
Select: **Radio > Read > Feature Data from Radio**
5. When the Read Feature Data Complete message box appears:  
Click: **OK**
6. In the tab that includes **M7x00**:  
Click: **Feature Data Edit**



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.

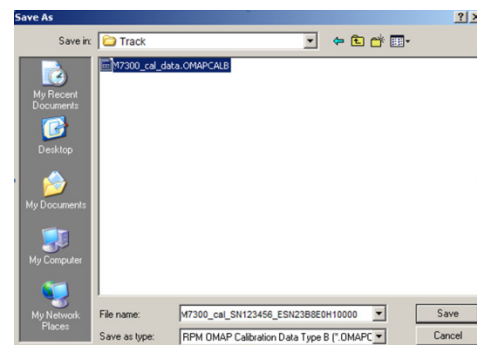


8. From the utility's menu:  
Select: **Radio > Write > Feature Data to File**  
  
This action opens up the "Save As" dialog box to the default calibration and feature data folder. If desired, the folder/path may be changed.



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**



## 12.5.3.3 Reading and Saving Calibration Data

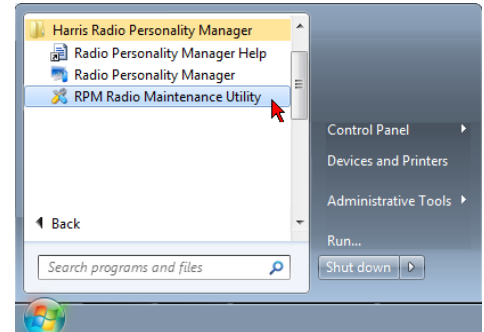
Follow this procedure to read and save a radio's calibration data:



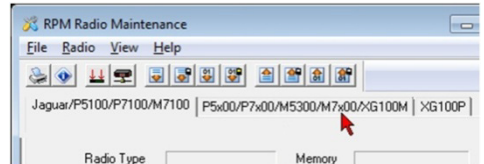
The radio must have R15A or later code before calibration data can be read from or written to it. See Section 12.5.1 on page 61 for details.

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

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



3. Click on the tab that includes **M7x00** (for the M7300 and other radios).

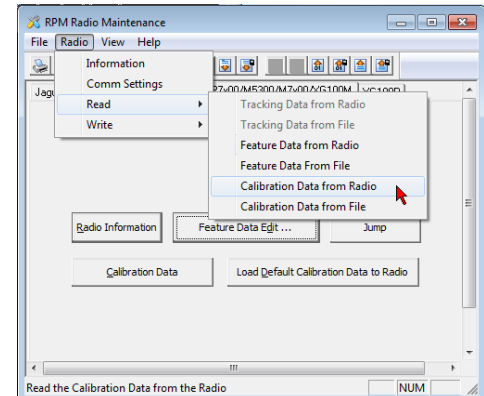


4. From the utility's menu:

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

5. When the Calibration Data Complete dialog box opens:

Click: **OK**



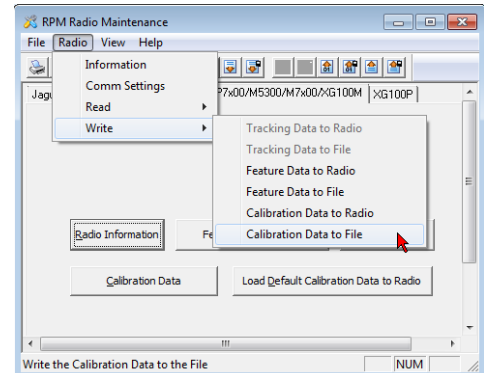
6. From the utility's menu:

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**

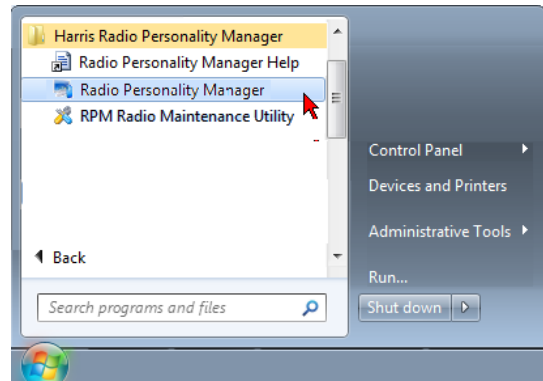


### 12.5.3.4 Reading and Saving the Radio Personality

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

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

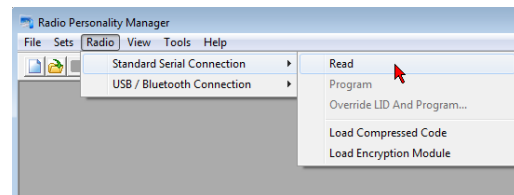
Click: **Start > Programs > Harris Radio Personality Manager > Radio Personality Manager**



3. From RPM's main menu:

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

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

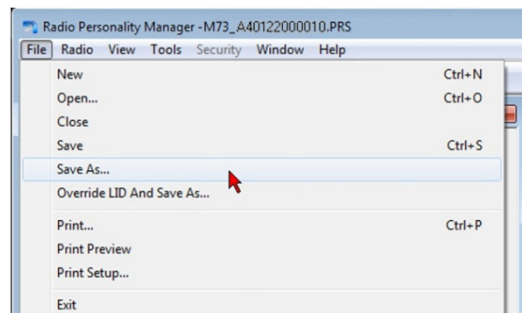


4. Within the personality window, information may be entered in the "Description" and "Author" fields.

5. On the RPM's main menu:

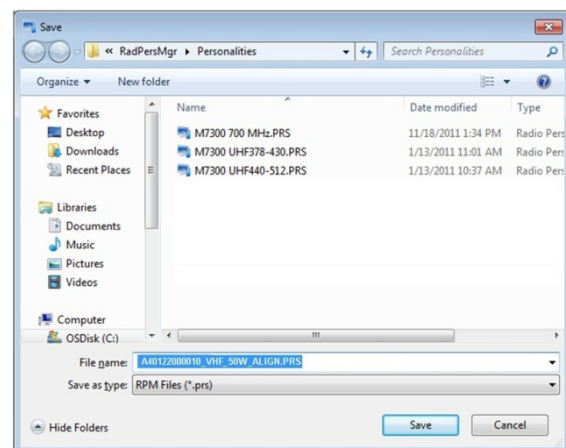
Click: **File > Save As**

When reading and saving a radio's personality, always use the Save As feature to prevent overwriting any existing file. RPM can determine the last known personality file name from the radio's personality. Avoid using the Save icon so a previously saved personality is not overwritten.



6. Enter a unique file name which clearly identifies the radio (such as the serial number of the radio, a unit number, a person's name, etc.).

Select: **Save**



## 12.5.4 Adding and Removing Radio Alignment Test Systems to Personalities

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

### 12.5.4.1 Adding Radio Alignment Test Systems to the Personality

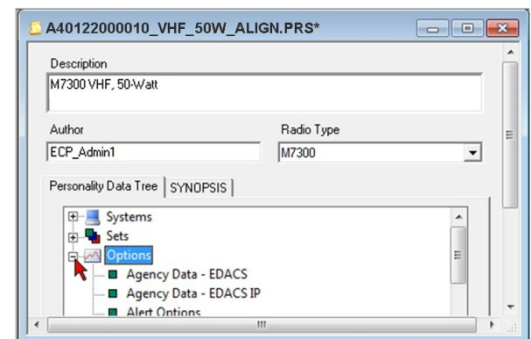
1. Connect the radio to the PC with the RPM programming software and enter programming mode. Refer to Section 12.5.3.1 as necessary.
2. Verify the feature and calibration data files have been saved to local disk. Refer to Sections 12.5.3.2 and 12.5.3.3 as necessary.
3. Read and save the radio’s personality.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



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.

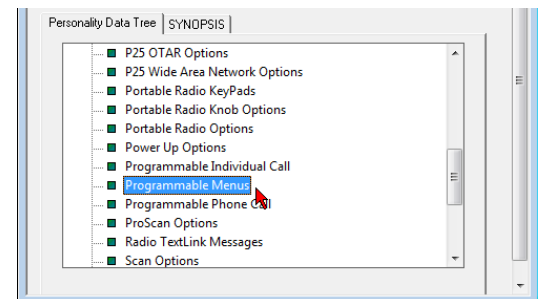
4. In the Personality Data Tree:

Click: **Options**



5. Scroll down the Options limb:

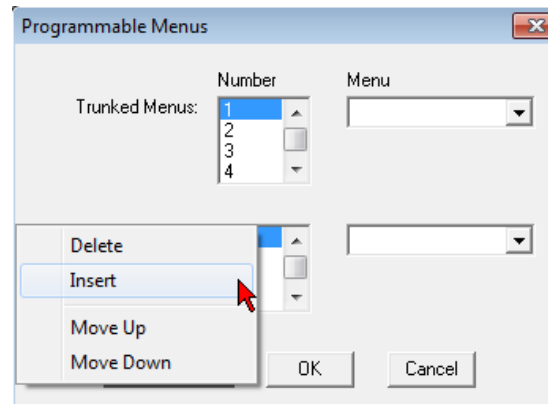
Double-click: **Programmable Menus**



6. Within the Conventional Menus Number box:

Double-click: **1**

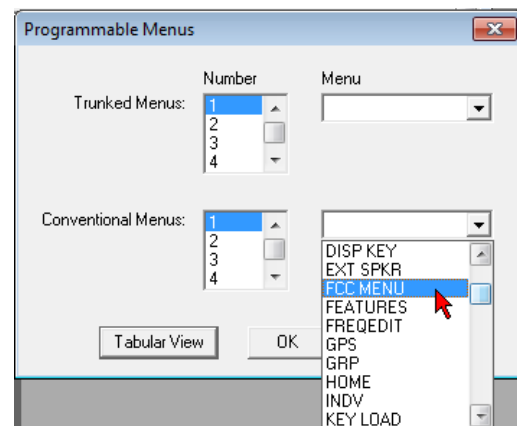
Click: **Insert**



7. Within the dropdown menu choices:

Select: **FCC MENU**

Click: **OK**



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.

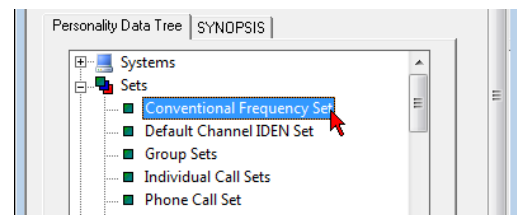
8. In the Personality Data Tree:

Double-click: **Sets**

The Sets limb expands.

Double-click: **Conventional Frequency Set**

The Conventional Frequency Sets dialog box opens.



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 12-8, 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 12-9, 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 12-10, 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 analog squelch. Settings also effect C4FM squelch operation.

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**

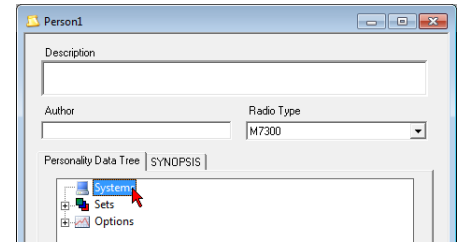
Use the illustration to the right, or reference Table 12-10, and enter the channel name, frequency, and set any other features as indicated by the outlined boxes. Enter all 5 channels.

This conventional channel set is used for aligning narrow-band squelch.

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

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

Double-click: **Systems**



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

Click: **Add New System**

16. In the New System box:

Type: **M73V HP**

Select: **Conventional**

Click: **OK**

17. Repeat steps 15 and 16, except create a new system for each of the following previously-created frequency sets:

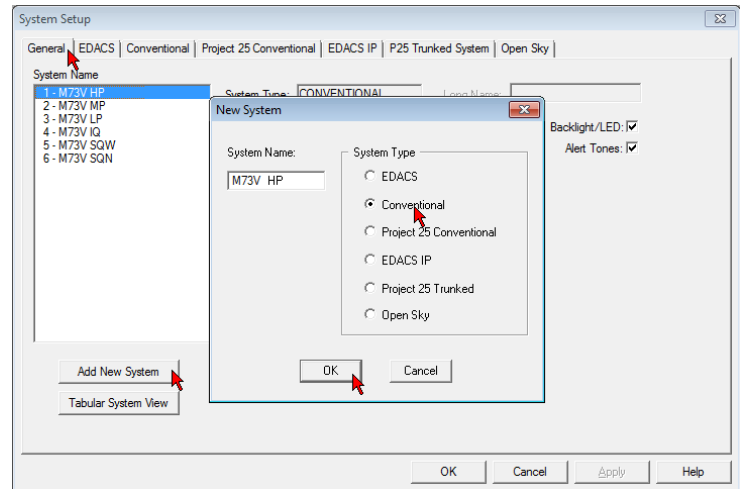
**M73V MP**

**M73V LP**

**M73V IQ**

**M73V SQW**

**M73V SQN**



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

Click: **Conventional** tab

19. In the System Name field:

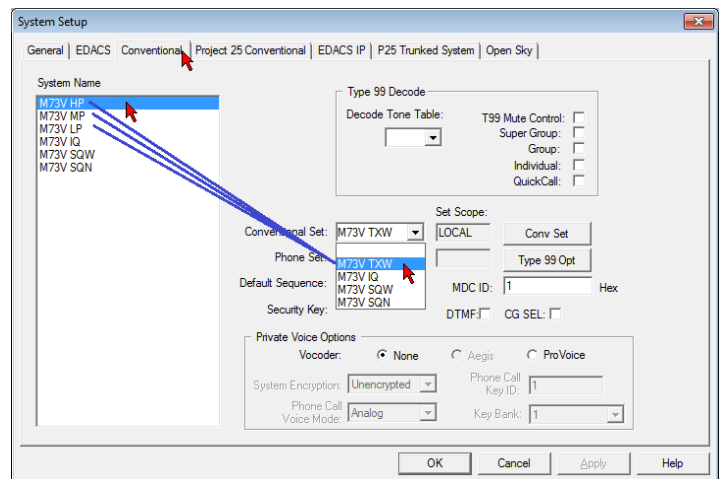
Select: **M73V HP**

20. In the Conventional Set dropdown:

Select: **M73V TXW**

21. 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.)



22. Repeat steps 19 and 20 to associate each additional new conventional frequency set with its corresponding system name, as shown below. Also set the system's Power Level via the General tab:

System Name	Conv. Freq. Set	Power Level (Watts)
M73V MP	M73V TXW	20 (see NOTE)
M73V LP	M73V TXW	10
M73V IQ	M73V IQ	10
M73V SQW	M73V SQW	10
M73V SQN	M73V SQN	10

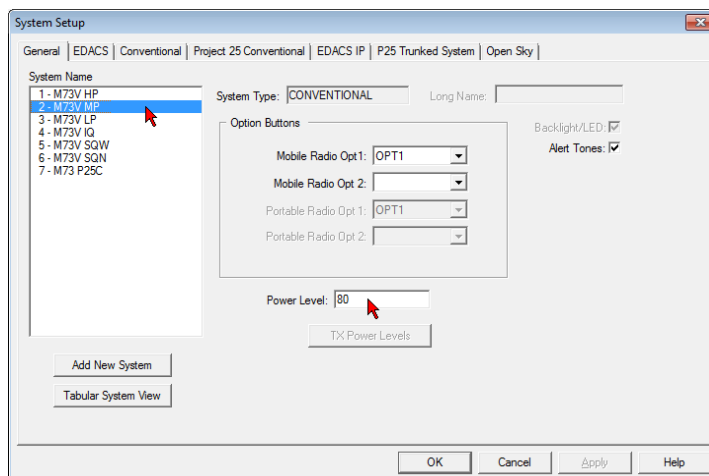


NOTE

If the radio is used in a motorcycle application, set the medium-power system to 15 (for 15 watts) instead of 20.

The numeric value entered in the **Power Level** box is used to set the TX power in Watts. Only whole numbers may be entered. Entering a value that is outside the High or Low Power reference levels range entered during alignment results in the radio defaulting to the high or low alignment value. See Section 12.5.5.3 on page 79 for additional information).

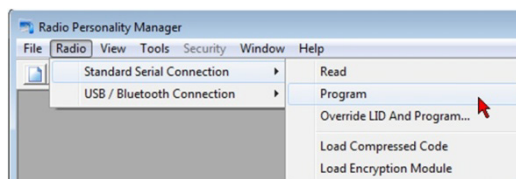
The value used for aligning the mid power level is not critical, as long as the measured transmitter power output matches the reference value shown in the mid power "Tx Power" field.



23. From RPM's main menu:

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

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



**Table 12-8: 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 12-9: 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 12-10: Frequencies for Receiver Frequency Sets M73V SQW, and M73V SQN**

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		

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


**CAUTION**

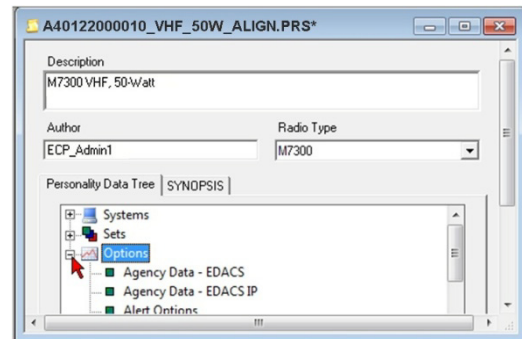
#### \*\*\*IMPORTANT\*\*\*

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

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

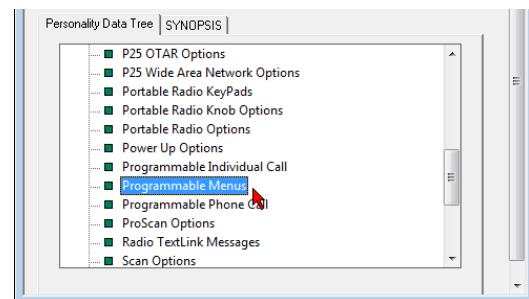
1. Connect the radio to the PC with the RPM programming software and enter programming mode. Refer to Section 12.5.3.1 as necessary.
2. Verify the feature and calibration data files have been saved to local disk. Refer to Sections 12.5.3.2 and 12.5.3.3 as necessary.
3. Read the radio's personality. Refer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

Click: **Options**



5. Scroll down the Options limb:

Double-click: **Programmable Menus**

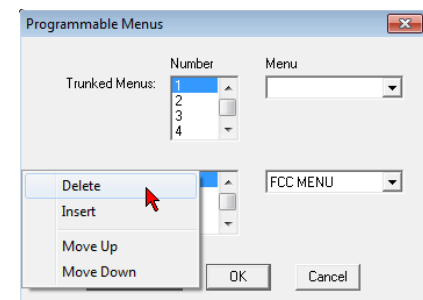


6. Within the Conventional Menus Number box:

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

Click: **Delete**

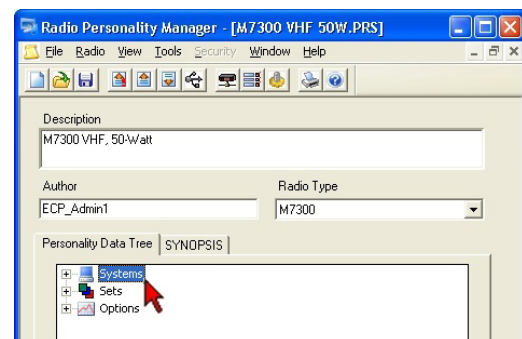
Click: **OK**



7. In the Personality Data Tree tab:

Double-click: **Systems**

The System Setup dialog box opens.



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

Double-click: **M73V HP**

Click: **Delete System**

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

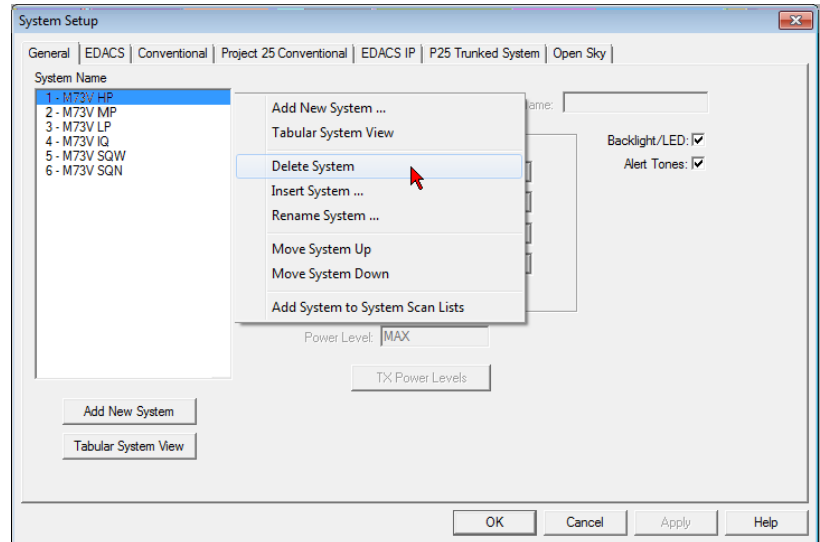
**M73V MP**

**M73V LP**

**M73V IQ**

**M73V SQW**

**M73V SQN**



**NOTE**

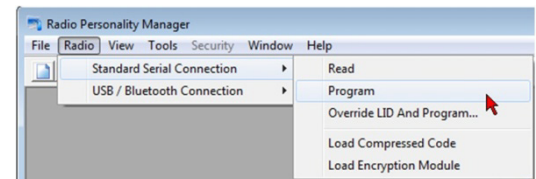
In general, deleting the new frequency sets created for radio testing from the radio's personality is not necessary. Simply deleting the test Systems from the System Setup's General tab in RPM and re-programming the radio with this modified personality removes radio user access to the frequency sets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

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

11. From RPM's main menu:

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

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



## 12.5.5 Radio Alignment Procedures

### 12.5.5.1 General Information

Before beginning any radio alignment procedure, a careful review of Sections 12.5.1 through 12.5.4 is recommended. The minimum radio firmware code versions and RPM version listed in Section 12.5.1 (page 61), and the required test equipment must be in place. Unless otherwise stated, each alignment procedure is written as a standalone procedure; in other words, it may be performed without performing the full battery of procedures.

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

- Read and save the original feature data, calibration data, and personality data files before making any changes. Refer to Section 12.5.3 (page 62) as necessary.
- Update the existing personality in the radio with conventional test frequency sets. Refer to Section 12.5.4 (page 67) as necessary.
- Test the radio per the alignment procedures in this manual and align with updated calibration data as necessary.
- Save the final calibration data to a local file. Refer to Section 12.5.3.3 (page 65) as necessary.
- Reload the radio's original personality and verify operation.



CAUTION

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

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



CAUTION

RF test cables used to connect the radio to the RF Communications Test Set will affect RF power by adding losses. The longer the cable, the greater the loss. For optimum results, connect the radio to the RF test equipment using only high-quality cables as listed in Table 12-2 (page 50).



NOTE

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

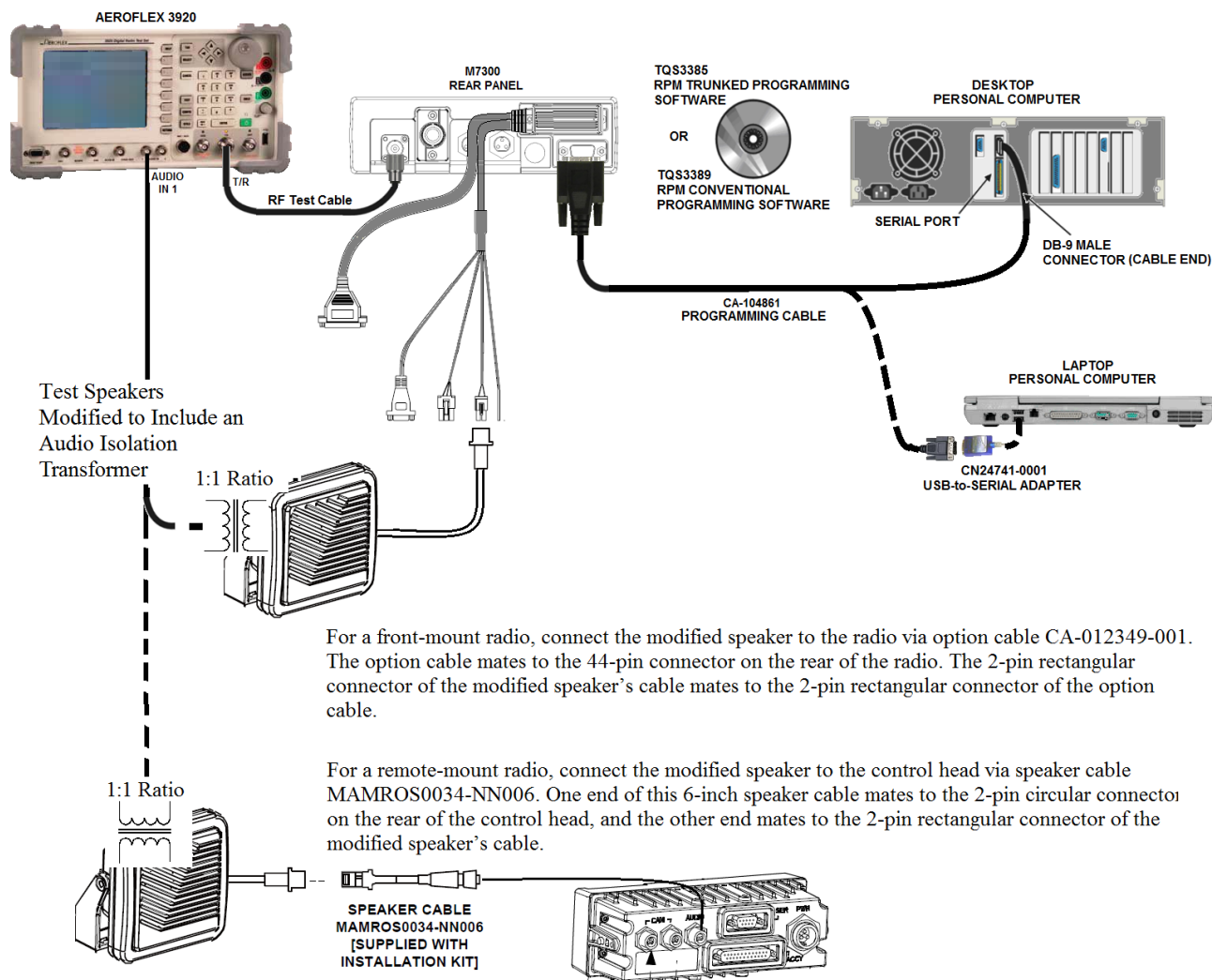


Figure 12-1: Test Equipment Connections for Radio Alignment

### 12.5.5.2 Automatic Frequency Control (TCXO Reference Oscillator) Alignment



NOTE

The radio's TCXO reference oscillator is a highly accurate and stable crystal reference oscillator which should **not** normally require re-alignment. The use of a recently-calibrated RF Communications Test Set or Frequency Counter is recommended. **The utilized test equipment should have a specified frequency accuracy/stability equal to or better than 0.15 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 alignment should be performed with the radio and test equipment at a room temperature between 68 and 77° Fahrenheit (20 to 25° Celsius). After radio power-up, always wait at least 15 minutes before taking a measurement. This warm-up time will allow the temperature of the radio's circuits to properly stabilize.



NOTE

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

#### **DO NOT attempt AFC alignment while in trunked mode!**



CAUTION

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:

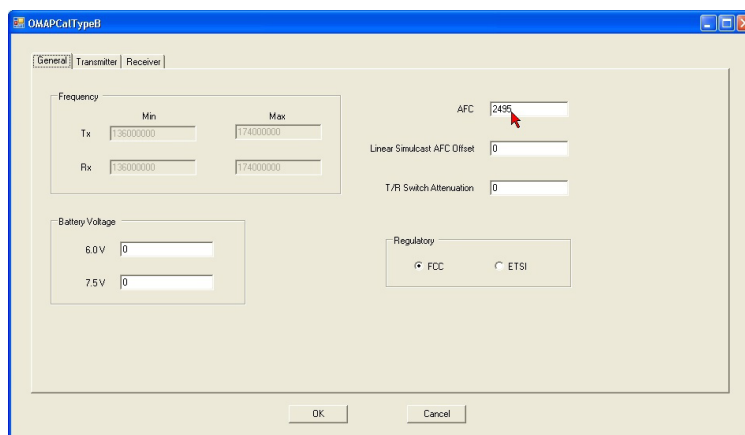
1. Setup and power-up the radio, control head, and test equipment as described in the Tx Frequency Test procedure, Section 12.4.4.1 (do steps 1 through 7 of that procedure). Also see Figure 12-1.
2. Add conventional test systems to the radio personality. Refer to Section 12.5.4 as necessary.
3. Select conventional test system **M73V LP** (low power transmit).
4. Select **Channel 20** (174.0000 MHz). See Table 12-8 on page 73 for all channels/frequencies used in this procedure.
5. Configure the RF Communications Test Set's frequency counter for an in-band frequency count.
6. **If at least 15 minutes has passed since the radio was powered-up, continue to the next step. Otherwise, wait until this period has passed, to allow the frequency of the radio's TCXO reference oscillator to stabilize.**
7. Key the radio by depressing the microphone's PTT button, and measure the radio's transmit frequency.
8. If the measured frequency is within 150 Hz of 174.0 MHz (i.e., between 173.999850 and 174.000150 MHz), unkey the radio and advance to step 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.

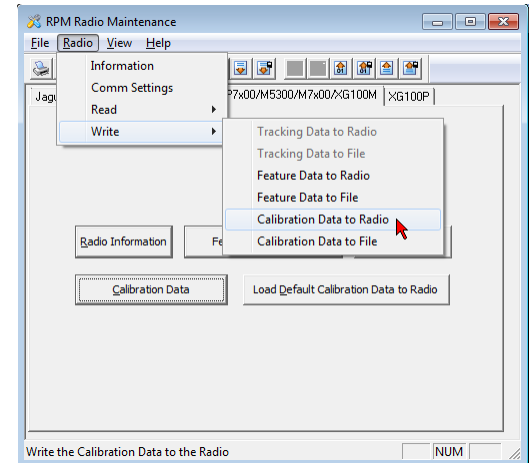
18. From the utility's main menu:

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

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

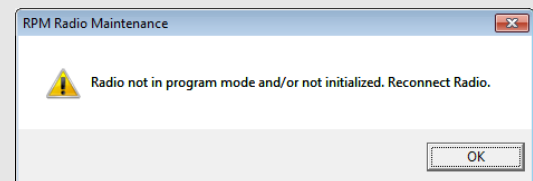
Click: **OK**

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 12-4, 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:

- Save the final calibration data to a local file.
- If a “shop” test personality was used to test the radio, reload the original personality and verify radio operation.
- If conventional test systems were added to the original personality, remove the test systems, and verify radio operation. Refer to Section 12.5.4.2 on page 73 as necessary.

### 12.5.5.3 TX Power Alignment

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

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

Each power level tab includes the following three (3) types of compensation factors:

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

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

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

### Example Data Values Shown

Example Data Values Given:

Power Control APC Output																			
1	2	3	4	5	6	7	8	9	10										
1050	1034	1017	1000	984	968	951	934	918	902										
11	12	13	14	15	16	17	18	19	20										
885	879	873	867	861	854	848	842	836	830										

Power Sense APC Input																			
1	2	3	4	5	6	7	8	9	10										
347	341	335	329	323	316	310	304	298	292										
11	12	13	14	15	16	17	18	19	20										
286	284	281	279	276	274	271	269	266	264										

See Table 12-8 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).



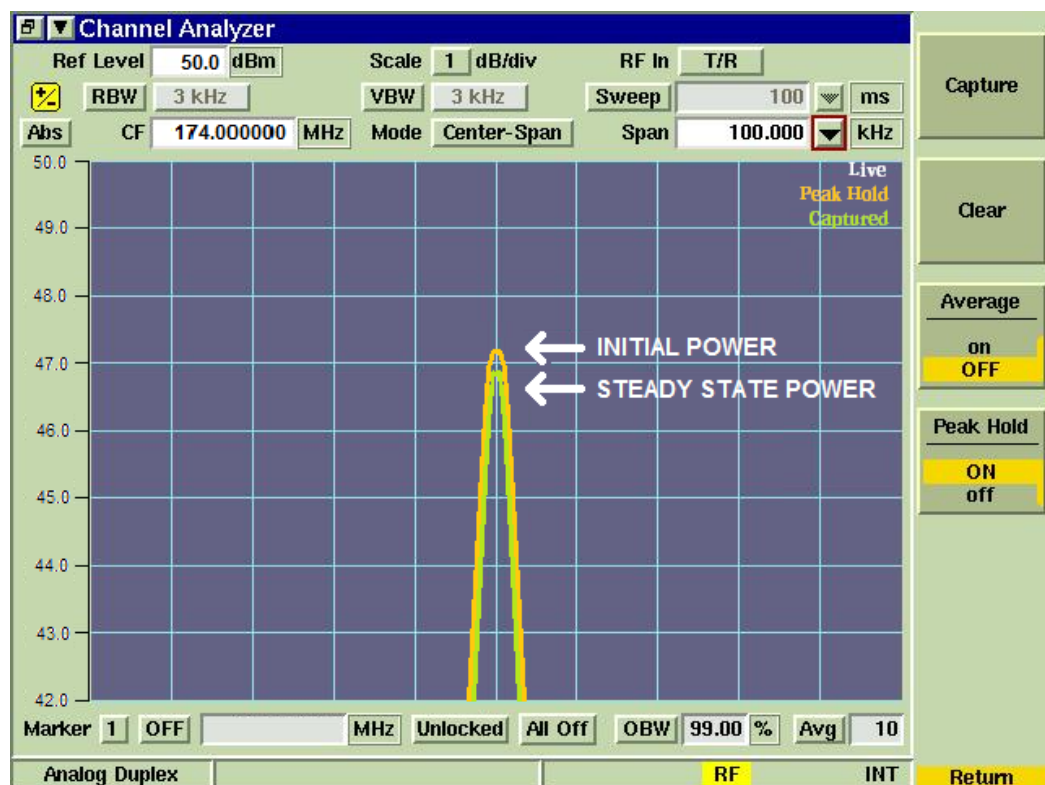
CAUTION

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 12.4.4.1 (do steps 1 through 7 of that procedure). Also see Figure 12-1.
2. Add conventional test systems to the radio's personality. Refer to Section 12.5.4 as necessary.
3. 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. See Table 12-8 on page 73 for all channels/frequencies used in this procedure.
5. Key the radio by depressing the microphone's PTT button, and wait for the transmit power to stabilize (typically one to two seconds).
6. Measure the steady-state transmit power. Figure 12-2 shows the Channel Analyzer function of the AeroFlex 3920.
7. Unkey radio.
8. Turn on the test set's Peak Hold function.
9. Rekey the radio and measure the initial transmit power. Typically, this measurement is higher than this channel's steady-state transmit power. See Figure 12-2 for an example display.
10. Unkey the radio:



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

11. Use the applicable case below to continue:
  - a. If the difference between the initial transmit power and the steady-state transmit power is greater than 0.8 dB, or the steady-state power measurement is not within  $\pm 0.25$  dB of the set power level, then advance to step 12 and align the power settings for the channel being tested.
  - b. If the difference between the initial transmit power and the steady-state transmit power is less than 0.8 dB, 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.



NOTE

To meet Maximum Permissible Exposure (MPE) requirements, mobile radios used in motorcycle applications are factory-set in radio code to limit RF power output to 20 watts. In this case, realign all high power settings for 20 watts, and all mid power settings for 15 watts.

MODIFIED AND POWER TURNED DOWN  
FOR MOTORCYCLE APPLICATIONS

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: **100** (see Figure 12-3)  
For Mid Power: **200** (however, if realigning a motorcycle radio, use **150**)  
For High Power: **500** (however, if realigning a motorcycle radio, use **200**)



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 "100" equals 10 watts.

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

22. Click **OK**.

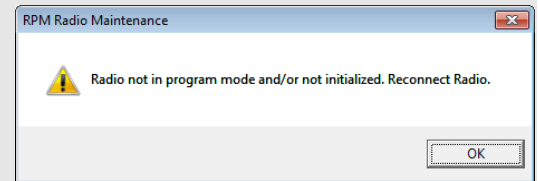
23. From the utility's main menu:

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



**NOTE**

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

- a. If a "shop" test personality was used to test the radio, reload the original personality and verify operation.
- b. If test systems were added to the original personality, refer to Section 12.5.4.2 (page 73), remove the systems, and verify radio operation.

The screenshot shows the 'OMAPCalTypeB' utility window with the 'Receiver' tab selected. The 'Tx Power Low' sub-tab is active, displaying a 'Tx Power' field set to 100 and a '700 MHz (M7300 Only)' field set to 0. Below these are two tables of power settings:

Power Control APC Output									
1	2	3	4	5	6	7	8	9	10
1050	1034	1017	1000	984	968	951	934	918	902
11	12	13	14	15	16	17	18	19	20
885	879	873	867	861	854	848	842	836	830

Power Sense APC Input									
1	2	3	4	5	6	7	8	9	10
347	341	335	329	323	316	310	304	298	292
11	12	13	14	15	16	17	18	19	20
286	284	281	279	276	274	271	269	266	264

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

**Figure 12-3: Example of TX Power Low APC Input and Output Power Settings**

### 12.5.5.4 I/Q Data Modulation Alignment

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



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:

1. Setup and power-up the radio, control head, and test equipment as described in the Tx Frequency Test procedure, Section 12.4.4.1 (do steps 1 through 7 of that procedure). Also see Figure 12-1.
2. Add conventional test systems to the radio's personality. Refer to Section 12.5.4 as necessary.
3. At the control head, select conventional test system **M73V IQ**.
4. At the control head, select **Channel 4** (174.000 MHz). See Table 12-9 on page 73 for all channels/frequencies used in this procedure.
5. Setup the RF Communications Test Set's RF spectrum analyzer for on-frequency measurements. Refer to Figure 12-4.
6. Press the 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 12-4 for an example analyzer display. Record the suppressed carrier leakage and sidebands on this channel/frequency. Each must be at least -45 dBc (i.e., at least 45 dB below the carrier).
10. Press the **MENU** button to unkey the radio.

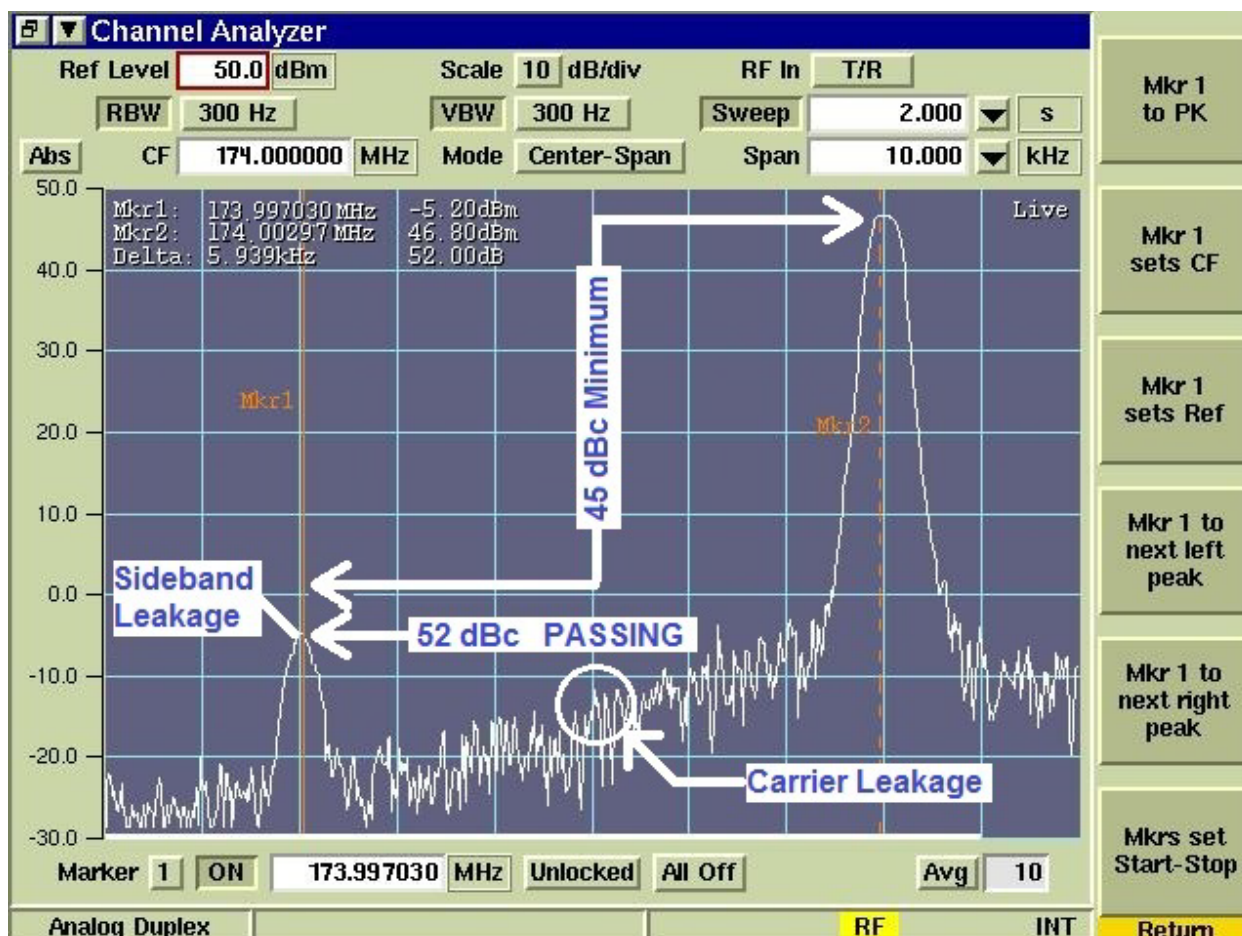
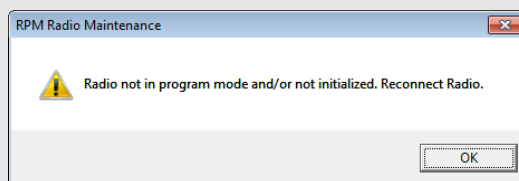


Figure 12-4: I and Q Alignment using FCC Menu SSB MODE

11. Select the next lowest channel/frequency and repeat steps 5 through 10 until carrier leakage and sideband measurements have been recorded for all four (4) test channels/frequencies.
12. If carrier leakage or sideband leakage on any test frequency exceeded the -45 dBc limit, go to step 13. Otherwise, advance to step 27 and save data.
13. Turn off the radio 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

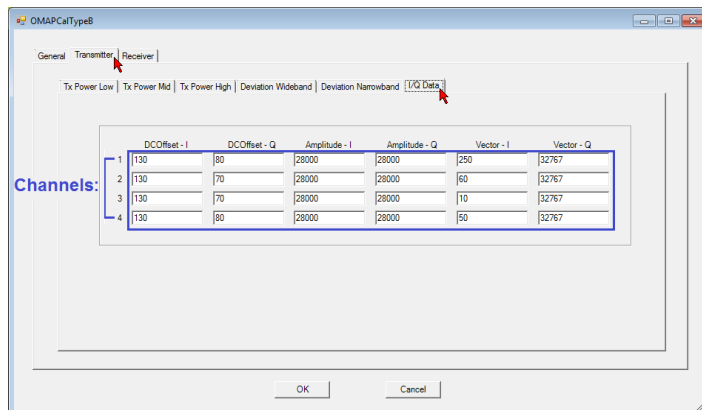
"Q" Amplitude

"I" Vector

"Q" Vector

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 12.5.4.2, remove the test sets, and verify radio operation.

### 12.5.5.5 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.



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.

### 12.5.5.6 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:

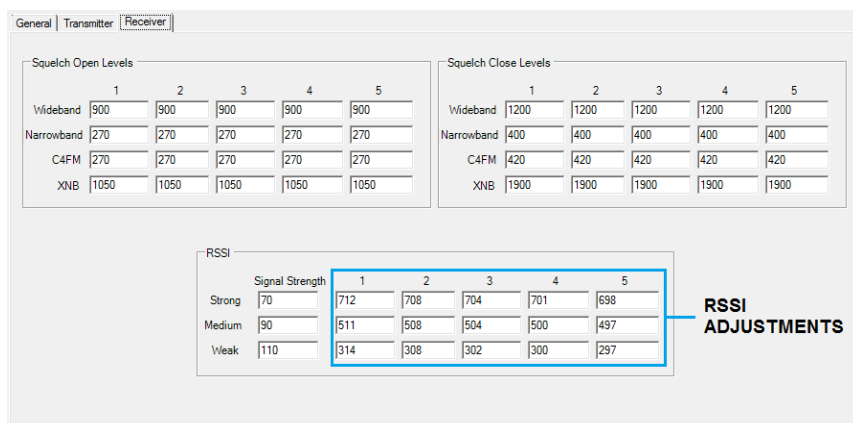
1. Connect and power-up the radio, control head, and test equipment as described in the Audio Output and Distortion Levels Tests presented in Section 12.4.5.1 (do steps 1 through 9 of that procedure). Also see Figure 12-1. Distortion levels do not need to be tested (i.e., do not need to be verified as good) before performing this procedure.
2. Add conventional test systems to the radio’s personality. Refer to Section 12.5.4 as necessary.
3. Connect the radio’s TNC antenna port connector to the RF Communications Test Set’s signal generator/low-power RF output port. To make this connection, use only high-quality RF coax cable(s).
4. At the control head, select conventional test system **M73V SQN** (narrowband channels).
5. At the control head, select **Channel 1** (136.000 MHz). See Table 12-10 on page 73 for all channels/frequencies used in this procedure.
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 12-10 on page 73.
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**



The screenshot shows the 'Receiver' tab in the RPM Radio Maintenance Utility. It contains three main tables for calibration data:

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	698
Medium	90	511	508	504	497
Weak	110	314	308	302	297

A blue box highlights the RSSI Signal Strength values for Strong, Medium, and Weak across the five channels. An arrow points from the text 'RSSI ADJUSTMENTS' to this box.

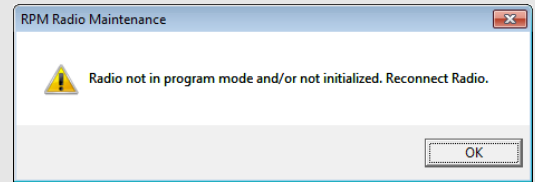
25. From the utility's main menu:

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



NOTE

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

- a. If a "shop" test personality was used to test the radio, reload the original personality and verify operation.
- b. If conventional test systems were added to the original personality, refer to Section 12.5.4.2, remove the test systems, and verify radio operation.

## 12.5.5.7 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. Values for wideband and narrowband operation are aligned for squelch open and squelch close at five (5) frequencies spread across the entire RF operating range of the radio.



NOTE

The C4FM Squelch Open Levels and C4FM Squelch Closed Levels values are not used with a 50-Watt VHF M7300 radio. These values are only used with a 110-Watt VHF M7300 radio. Do not change these values in a 50-Watt VHF radio.

Likewise, the XNB Squelch Open Levels and XNB Squelch Close Levels values are not used with a 50-Watt VHF M7300 radio. These values only apply to a 900 MHz radio. Do not change these values in a VHF radio (50 or 110-Watt).

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 12.4.5.1 (do steps 1 through 9 of that procedure). Also see Figure 12-1. Distortion levels do not need to be tested (i.e., do not need to be verified as good) before performing this procedure.
2. Add conventional test systems to the radio's personality. Refer to Section 12.5.4 as necessary.
3. Connect the radio's TNC antenna port connector to the RF Communications Test Set's signal generator/low-power RF output port.
4. At the control head, select a conventional test system as listed in Table 12-11.
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 operating mode in Table 12-11.

**Table 12-11: 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

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



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 12-10 on page 73 lists the channels/frequencies.



NOTE

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

14. If any channel opens at a level of 9 dB SINAD or greater, or closes at a value 5 dB SINAD or less, then continue with step 15 to realign the Squelch Open Level and Squelch Close Level values. Otherwise, advance to step 29 and save data.
15. Turn off the radio 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 steps 11 and 12 to adjust the values for any of the channels where the squelch did not open or close as expected. Decreasing the input value tightens the squelch function.

24. Click: **OK**

Squelch Open Levels						Squelch Close Levels					
	1	2	3	4	5		1	2	3	4	5
Wideband	1750	1750	1750	1750	1750	Wideband	2550	2550	2550	2550	2550
Narrowband	720	720	720	1400	1400	Narrowband	1500	1500	1500	2250	2250
C4FM	720	720	720	1400	1400	C4FM	1500	1500	1500	2250	2250
XNB	600	600	600	600	600	XNB	1600	1600	1600	1600	1600

RSSI					
Signal Strength	1	2	3	4	5
Strong	60	2714	2721	2690	2658
Medium	85	2035	2042	2004	1983
Weak	110	1257	1275	1245	1228



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.

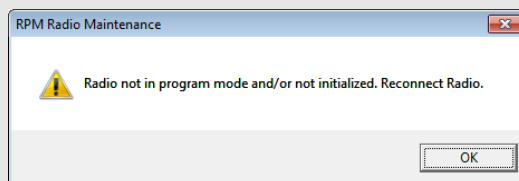
25. From the menu:

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



NOTE

If an error message box appears similar to the one shown at the right, try re-reading the calibration data. If a second 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 6 and repeat the test and alignment procedure until all squelch level values are correctly aligned.

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

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

- a. If a "shop" test personality was used to test the radio, reload the original personality and verify operation.
- b. If conventional test systems were added to the original personality, refer to Section 12.5.4.2, remove the test systems, and verify radio operation.

## 13 RADIO CONNECTOR PIN-OUTS

### 13.1 9-PIN I/O CONNECTOR (SERIAL PORT CONNECTOR)

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 13-1 below. It is also shown in the radio's internal interconnection diagram on page 151.

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 13-1: 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

### 13.2 44-PIN I/O CONNECTOR (OPTION/ACCESSORY CONNECTOR)

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 151.

**Table 13-2: 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, in a front-mount radio installation, and in a remote-mount radio installation 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 13-2: 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. For ECP, 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. For ECP, 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	In a front-mount M5300/M7300 radio installation, this pin for the siren/PA interface is the siren serial data output (open-collector/open-drain) from the radio's mounted (local) CH-721. It serially transfers siren and light control data from the CH-721 to a connected third-party siren and light system (e.g., Federal Signal SS2000 SmartSiren). Data rate = 1200 bps. Connects to SS2000's DB-9 pin 3. For a remote-mount radio installation, see footnote <sup>2</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.

<sup>2</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 13-2: 44-Pin I/O Connector Pin-Out

PIN	SIGNAL NAME	OPTION CABLE CA-012349-001	DESCRIPTION
13	ALO	P4 pin 10	In a front-mount M5300/M7300 radio installation, this 600-ohm AC-coupled differential audio output from the mounted (local) CH-721 is typically not used. In a remote-mount M5300/M7300 radio installation, these two pins of the radio's DB-44 connector are not functional.
12	MICHI	P4 pin 11	
1	EXTALO	P4 pin 12	In a front-mount M5300/M7300 radio installation, VOLHI (a single-ended AC-coupled audio signal) and EXTALO (signal ground) provide public address (PA) mic audio from the mounted (local) CH-721 to a siren and light system, such as the Federal Signal SS2000 SmartSiren. Pin 13 connects to SS2000's DB-9 pin 5. Pin 12 connects to SS2000's DB-9 pin 6. For a remote-mount radio installation, 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.
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	In a front-mount M5300/M7300 radio installation, this pin for the siren/PA interface is the horn/ring logic input to the radio's mounted (local) CH-721. When a connected third-party siren and light system (e.g., Federal Signal SmartSiren SS2000) has its horn/ring function active, this input is used to signal the head/radio as such. Connects to SS2000's DB-9 pin 8. For a remote-mount radio installation, see footnote <sup>2</sup> .
23	SONOFF	P4 pin 19	In a front-mount M5300/M7300 radio installation, this pin for the siren/PA interface is the siren on/off logic output (open-collector) from the radio's mounted (local) CH-721. It is the signal that powers the connected third-party siren and light system (e.g., Federal Signal SmartSiren SS2000) on and off. Connects to SS2000's DB-9 pin 4. For a remote-mount radio installation, see footnote <sup>2</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.

Table 13-2: 44-Pin I/O Connector Pin-Out

PIN	SIGNAL NAME	OPTION CABLE CA-012349-001	DESCRIPTION
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.

## 14 DISASSEMBLY AND REASSEMBLY

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



Observe precautions for damage due to **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.

### 14.1 TOOLS REQUIRED

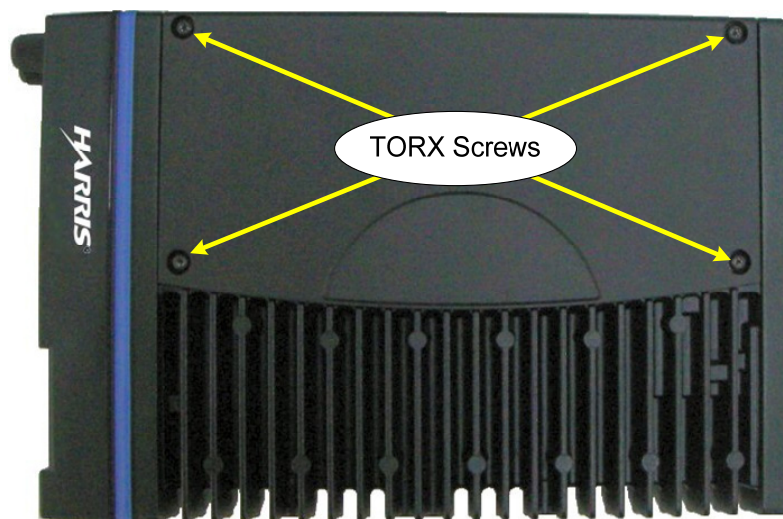
- T7 Torx® Screwdriver
- T10 Torx Screwdriver
- T15 Torx Screwdriver
- Torque Screwdriver with Torx T7, T10 and T15 Torx bits
- 5.5-Millimeter Wrench or Nutdriver (required only if the radio has the optional GPS receiver)

The following items are only needed for RF Processor Board and RF Power Amplifier (PA) Module removal and installation:

- Thermal Heat-Transfer Compound: Dow Chemical 340 or equivalent
- ESD-Safe Temperature Controlled Soldering Iron/Station
- Solder and ¼-Inch Solder Wick

### 14.2 REMOVING THE PK BOARD

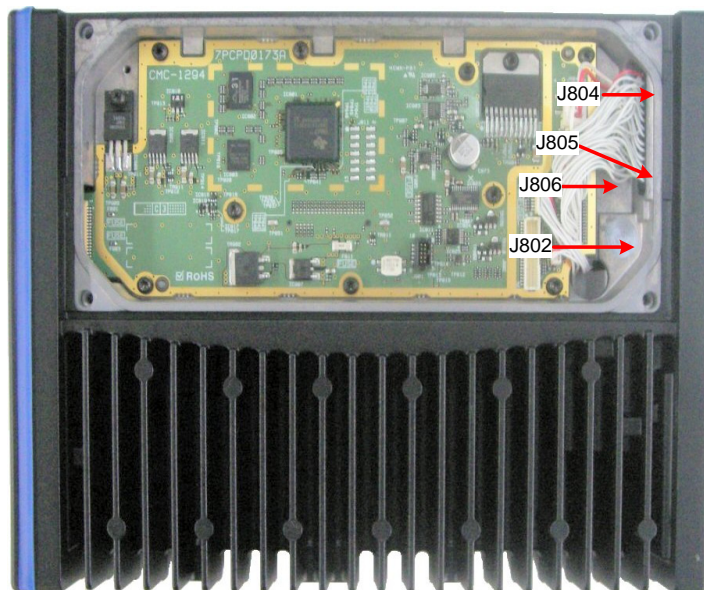
1. Lay the radio on a flat ESD-safe surface, in a top-up position. See Figure 14-1.
2. Using a T15 Torx screwdriver, loosen the four (4) screws securing the top cover to the radio. These are captive-type screws, so complete removal from the cover is not required.



**Figure 14-1: Removing the Top Cover**

3. Lift and remove the cover (with screws and gasket) off of the radio chassis.

4. Unplug the cables mated to J802, J804, J805, and J806 of the PK Board. See Figure 14-2.
5. 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.
6. If the radio is equipped with the optional GPS receiver module, loosen and remove the screw that secures the module, then lift it up to unplug the module from connector J901 of the PK Board. The module is not shown in Figure 14-2.



**Figure 14-2: Removing the PK Board (Shown without Top Cover)**

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 loosened and removed.
8. Carefully lift and remove the PK 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 RF Processor Board.

### 14.3 INSTALLING THE PK BOARD

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

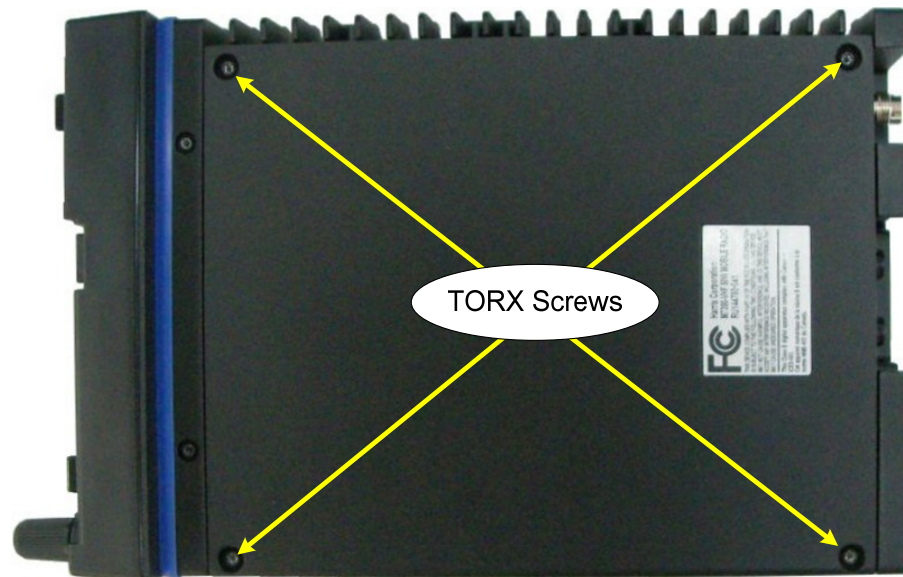
1. Obtain a replacement PK Board. Refer to Table 8-4 which begins on page 20 as necessary.
2. Lay the radio on a flat ESD-safe surface, in a top-up position.
3. Verify the upper cavity of the chassis is completely clear of any foreign material such as loose screws, dirt, dust, etc. Clean and/or vacuum 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 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, as screws that are too long will damage the RF Processor Board in the opposite cavity of the chassis. **The correct screws are 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 10 millimeters long.**
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 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 14-2 as necessary.
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 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.

## 14.4 REMOVING THE RF PROCESSOR BOARD AND RF PA MODULE

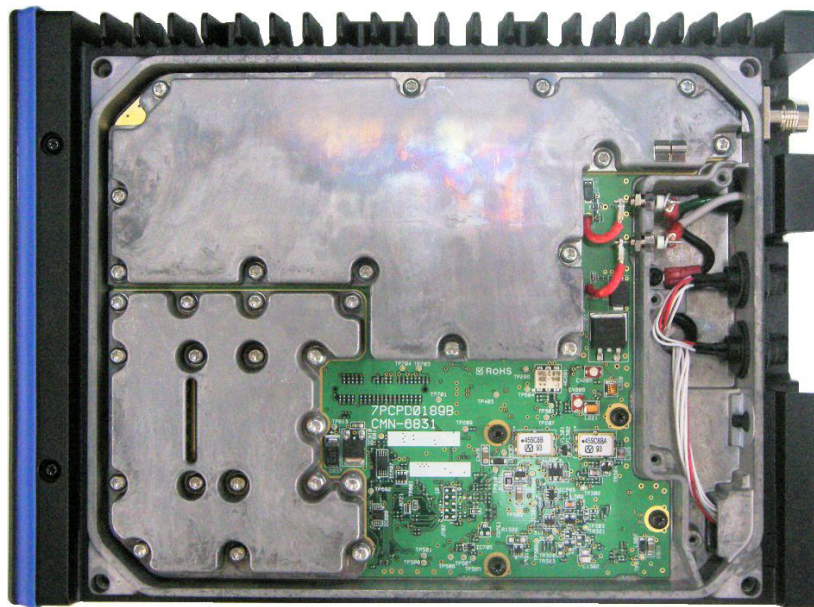
Follow this procedure to remove the radio's RF Processor Board and RF PA module:

1. Lay the radio on a flat ESD-safe surface, in a bottom-up position. See Figure 14-3.
2. Using a T15 Torx screwdriver, loosen the four (4) screws securing the bottom cover to the radio. These are captive-type screws, so complete removal from the cover is not required.



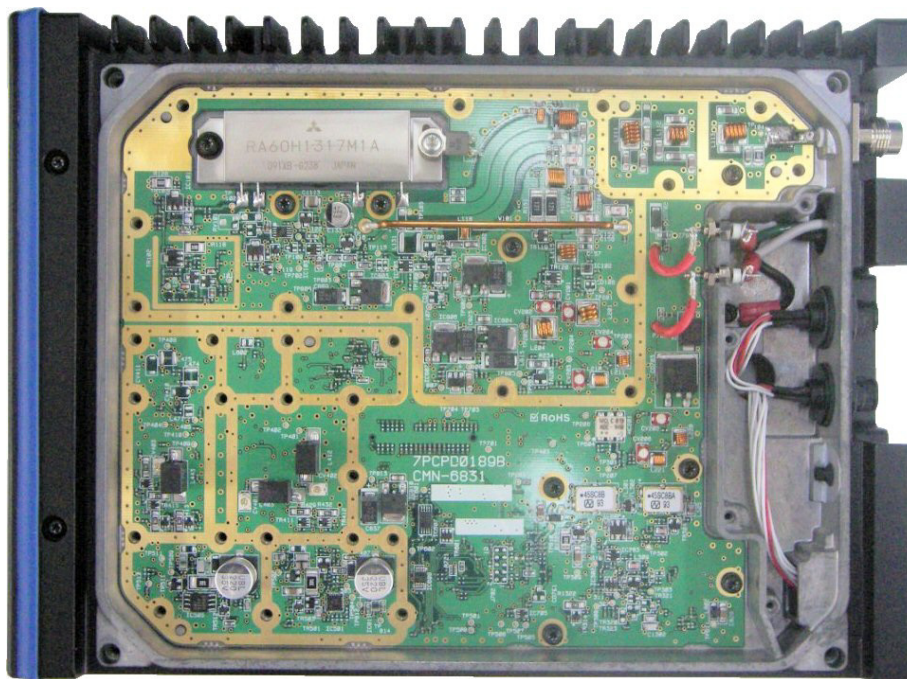
**Figure 14-3: Removing the Bottom Cover**

3. Lift and remove the cover (with screws and gasket) off of the radio chassis.
4. Near the rear of the chassis, carefully unsolder the two (2) red wires from the two feed-through capacitors. See Figure 14-4. These two wires are soldered to pads P701 (the "IGNITION" switched power DC input) and P702 (the "A+" main power DC input) of the PK Board. **Use great care to avoid damaging board pads, traces, and all board components!**
5. Using a T10 Torx screwdriver, loosen and remove the thirty (30) screws securing the two (2) die-cast shields.



**Figure 14-4: Removing the RF Processor Board and RF PA Module (Shown with RF Shields in Place)**

6. Carefully lift and remove the two die-cast shields from the chassis.
7. Unsolder the center terminal of the antenna connector (P104). Use **great care to avoid damaging board pads, traces, and all board components!**
8. Using a T7 Torx screwdriver, remove the two (2) screws securing the antenna connector to the chassis, and then carefully slide the connector out of the chassis.



**Figure 14-5: Removing the RF Processor Board and RF PA Module (Shown with RF Shields Removed)**

9. Carefully unsolder the four (4) leads of the RF PA module. Use caution as to not damage the board's pads or components.

10. Loosen and remove the two (2) screws that secure the module to the chassis, then lift and remove the module from the chassis.
11. Loosen and remove the eight (8) remaining screws securing the board to the chassis.
12. 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.

## 14.5 INSTALLING THE RF PROCESSOR BOARD AND RF PA MODULE

Follow this procedure to install the radio's RF Processor Board and PA module:

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. Carefully apply a thin layer of thermal compound/grease to the bottom surface of the RF PA module. Avoid bending the leads of the module, as to not stress the leads or the respective pads of the printed circuit board.



The board may be supplied separately from the module. In this case, install the board into the radio chassis first, and then install the module. Before installing the large RF shield, be sure to solder the leads of the module to the respective pads on the board.

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 eight **10-millimeter-long** T10 Torx-head screws into the threaded holes of the chassis. See Figure 14-5. 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.
7. Install a **9-millimeter-long** T10 Torx-head screw into the hole in the metal tab of the RF PA module closest to the front corner of the board/radio.
8. Install a **13-millimeter-long** screw and spacer at the hole in the metal tab of the RF PA module closest to the rear of the board/radio. This screw also secures the temperature-sensing thermistor (RT101). The spacer must be located between the metal tabs of the module and thermistor.
9. Torque these ten (10) screws to 7.4 inch-pounds (8.5 kg/cm).
10. 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).
11. Solder the center terminal of the antenna connector to the respective pad of the RF Processor Board. **Use great care to avoid damaging board pads, traces, and all board components!**
12. Carefully lay the two (2) die-cast shields into the casting.
13. To secure the shields, first start but do not tighten all thirty **13-millimeter-long** 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.
14. Torque these thirty (30) screws to 7.4 inch-pounds (8.5 kg/cm).

15. Carefully solder the two red wires to the feed-through capacitors. As illustrated in Figure 14-4, these two wires should not cross each other. The wire soldered to pad P701 is the “IGNITION” switched power DC input. The wire soldered to pad P702 is the “A+” main power DC input.
16. Verify the bottom cover’s perimeter gasket is in good condition and embedded into the groove in the interior side of the cover.
17. Place the bottom cover (with screws and gasket) on to the bottom of the radio.
18. Using a T15 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.

## **14.6 GPS RECEIVER FIELD UPGRADE KIT**

M5300/M7300 GPS Receiver Field Upgrade Kit KT-015605-001 is available which includes a GPS receiver module, software, and an installation manual. This optional kit allows an 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 installation instructions.

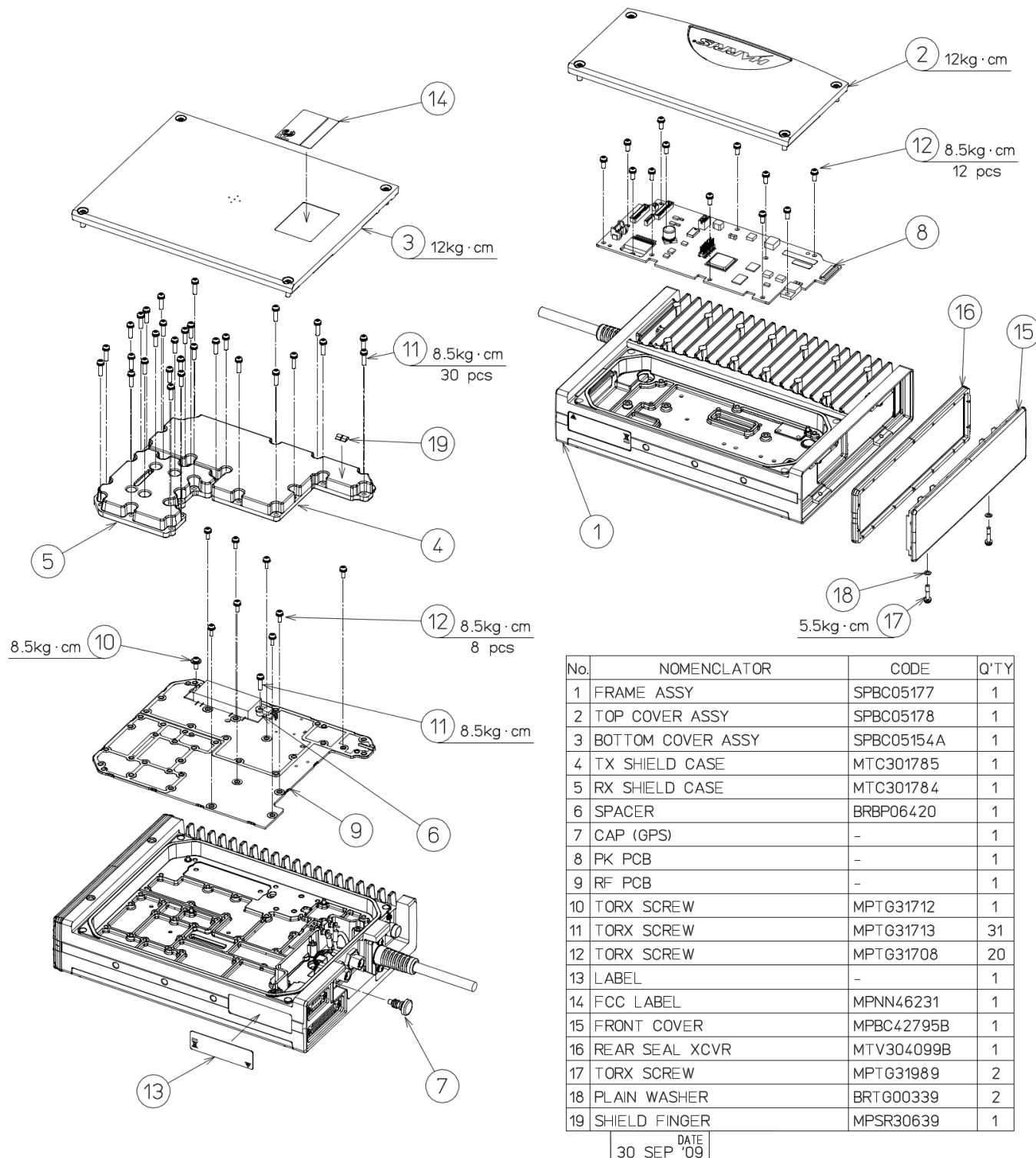
The kit can also be ordered via part number KT-012350-001. This kit does not include the installation manual. Otherwise, it is the same as kit KT-015605-001.

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

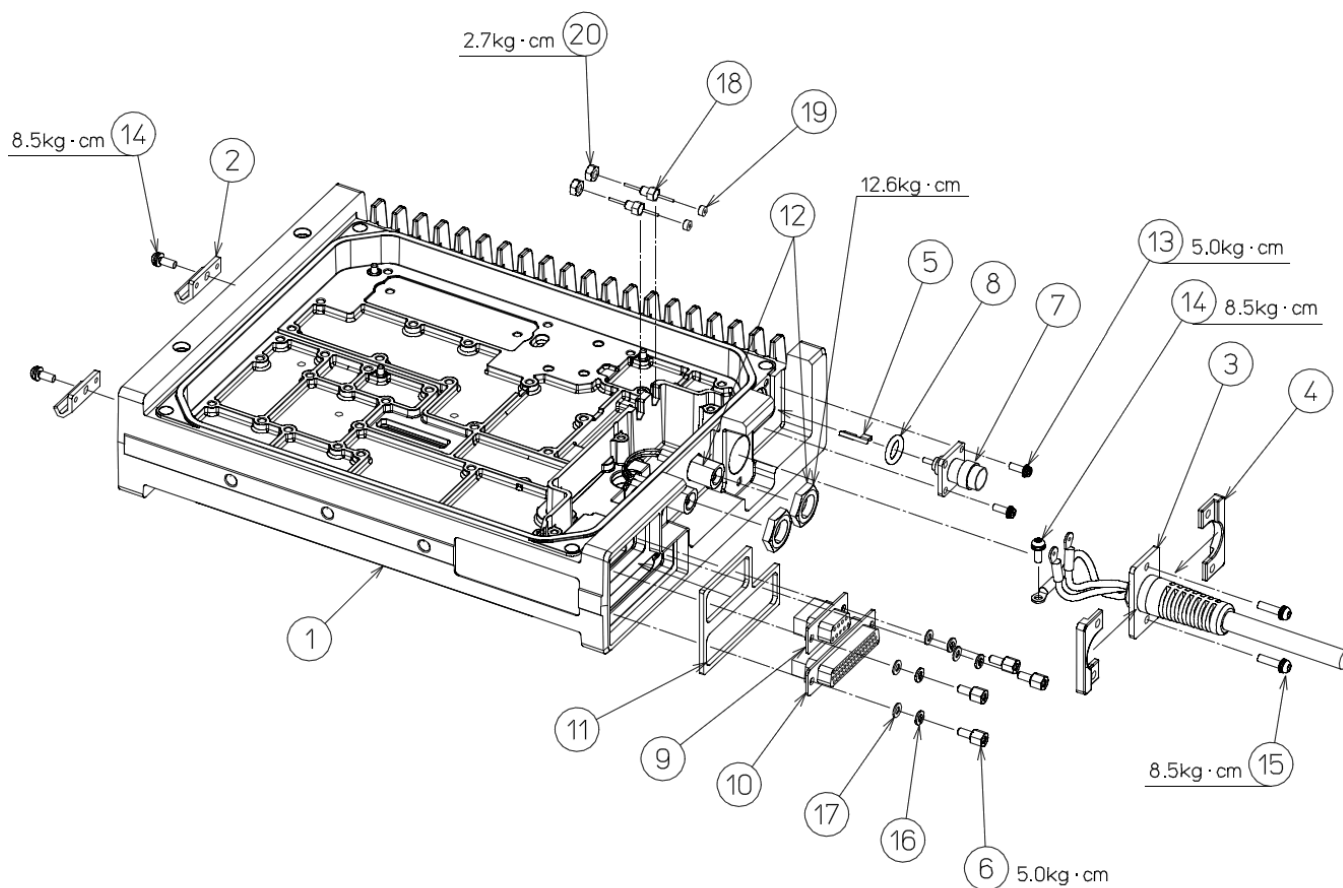
## 15 ASSEMBLY DIAGRAMS

### 15.1 EXPLODED VIEWS

#### 15.1.1 Final Assembly Exploded Views



### 15.1.2 Frame Sub-Assembly Exploded View

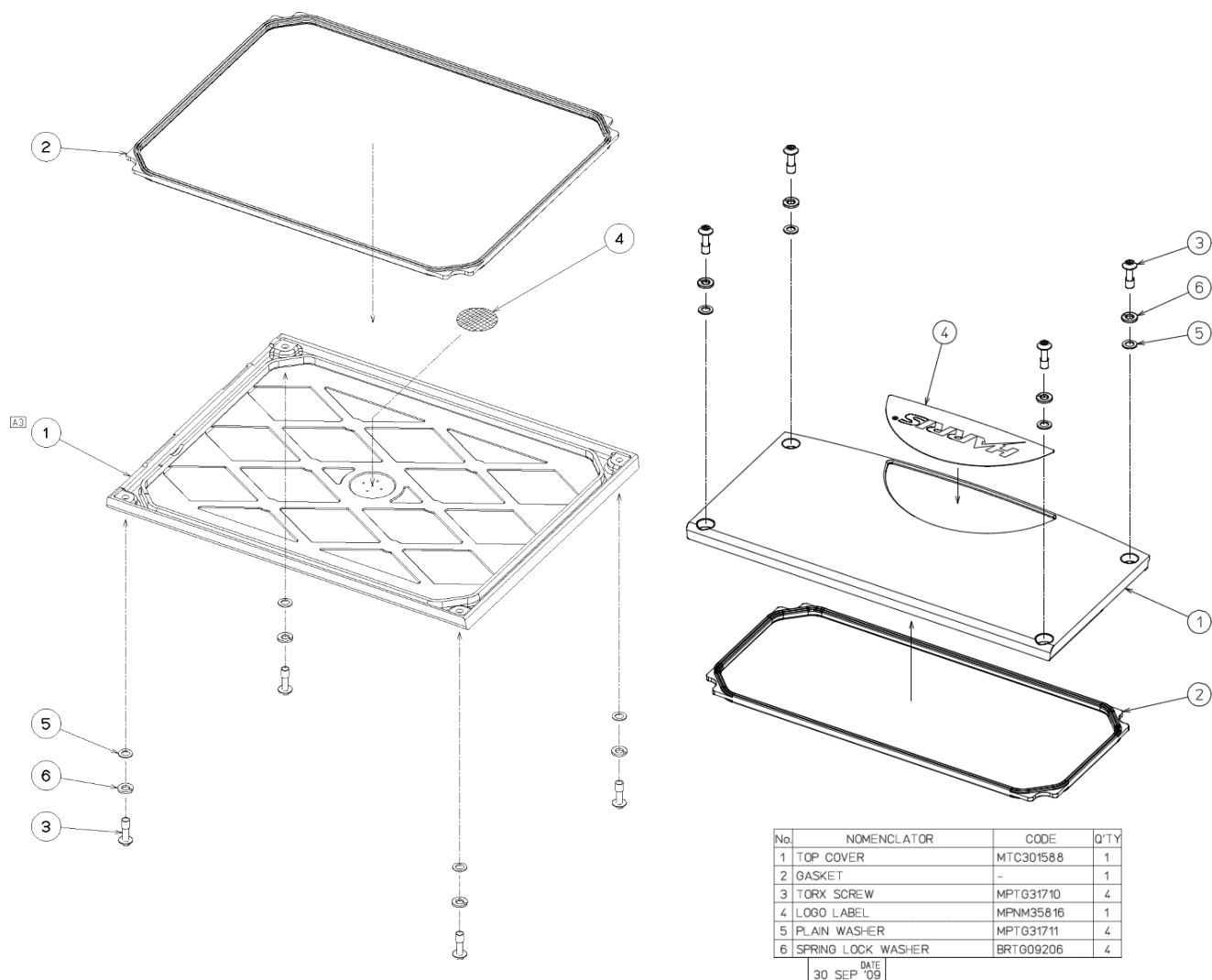


No.	NOMENCLATOR	CODE	Q'TY
1	CHASSIS	MTC301782	1
2	BRACKET	MTV300093	2
3	PIGTAIL CABLE	-	1
4	CLAMP	MTC301592	2
5	ANTENNA BRACKET	-	1
6	SCREW LOCK	MTL322391	4
7	ANTENNA CONNECTOR	-	1
8	O-RING	MPPK01858	1
9	DB9 CONNECTOR	-	1
10	DB44 CONNECTOR	-	1
11	GASKET	MTZ303709	1
12	CAN CONNECTOR	-	2
13	TORX SCREW	MPTG31709	2
14	TORX SCREW	MPTG31708	3
15	TORX SCREW	MPTG31984	2
16	SPRING LOCK WASHER	BSSW03000S	4
17	PLAIN WASHER	BSLW03000R	4
18	FEEDTHROUGH TYPE CERAMIC CAPACITOR	-	2
19	SPACER	BRBP07139	2
20	HEX NUT	-	2

 DATE  
30 SEP '09

(SPBC05177-0101, Rev. 20090930)

## 15.1.3 Bottom and Top Cover Assemblies Exploded Views



No	NOMENCLATOR	CODE	Q'TY
1	BOTTOM COVER	MTC301589A <sup>A3</sup>	1
2	GASKET	-	1
3	TORX SCREW	MPTG31710	4
4	VENT FILTER	BRPK05034	1
5	PLAIN WASHER	MPTG31711	4
6	SPRING LOCK WASHER	BRTG09206	4

DATE  
28 SEP '07

## 16 PARTS LISTS

### 16.1 PK BOARD

#### PK BOARD (CMC-1294E, Rev. B)

SYMBOL	DESCRIPTION
	----- CAPACITORS -----
C801	0.01 uF; similar to Murata GRM155B11E103KA01D.
C802	0.01 uF; similar to Murata GRM155B11E103KA01D.
C803	0.01 uF; similar to Murata GRM155B11E103KA01D.
C804	0.01 uF; similar to Murata GRM155B11E103KA01D.
C805	0.01 uF; similar to Murata GRM155B11E103KA01D.
C806	0.01 uF; similar to Murata GRM155B11E103KA01D.
C809	0.01 uF; similar to Murata GRM155B11E103KA01D.
C810	0.01 uF; similar to Murata GRM155B11E103KA01D.
C811	0.01 uF; similar to Murata GRM155B11E103KA01D.
C812	0.01 uF; similar to Murata GRM155B11E103KA01D.
C813	0.01 uF; similar to Murata GRM155B11E103KA01D.
C814	0.01 uF; similar to Murata GRM155B11E103KA01D.
C815	0.01 uF; similar to Murata GRM155B11E103KA01D.
C816	0.01 uF; similar to Murata GRM155B11E103KA01D.
C817	0.01 uF; 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 uF; similar to Murata GRM155B11E103KA01D.
C821	10 uF; similar to Murata GRM31CR61C106KA88L.
C822	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C823	0.01 uF; similar to Murata GRM155B11E103KA01D.
C824	0.01 uF; similar to Murata GRM155B11E103KA01D.
C825	0.01 uF; similar to Murata GRM155B11E103KA01D.
C826	0.01 uF; similar to Murata GRM155B11E103KA01D.
C830	0.1 uF; similar to Murata GRM155B11A104KA01D.
C831	0.22 uF; similar to Murata GRM188B11A224KA01D.
C832	0.01 uF; 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	0.01 uF; similar to Murata GRM155B11E103KA01D.
C838	0.01 uF; similar to Murata GRM155B11E103KA01D.
C839	0.01 uF; similar to Murata GRM155B11E103KA01D.
C840	0.01 uF; similar to Murata GRM155B11E103KA01D.

SYMBOL	DESCRIPTION
C841	0.01 uF; similar to Murata GRM155B11E103KA01D.
C842	0.01 uF; similar to Murata GRM155B11E103KA01D.
C843	0.01 uF; similar to Murata GRM155B11E103KA01D.
C844	0.01 uF; similar to Murata GRM155B11E103KA01D.
C845	10 uF; similar to Murata GRM31CR61C106KA88L.
C846	0.1 uF; similar to Murata GRM155B11A104KA01D.
C847	10 uF; similar to Murata GRM31CR61C106KA88L.
C848	0.1 uF; similar to Murata GRM155B11A104KA01D.
C849	0.01 uF; similar to Murata GRM155B11E103KA01D.
C851	10 uF; similar to Murata GRM31CR61C106KA88L.
C852	0.1 uF; similar to Murata GRM155B11A104KA01D.
C853	470 pF; similar to Taiyo Yuden UMK105BJ471KV-F.
C854	0.1 uF; similar to Murata GRM155B11A104KA01D.
C855	4.7 uF; similar to Murata GRM21BB31E475KA75L.
C856	0.1 uF; similar to Murata GRM155B11A104KA01D.
C857	4.7 uF; similar to Murata GRM21BB31E475KA75L.
C858	1 uF; similar to Taiyo Yuden LMK105BJ105KV-F.
C859	10 pF; similar to Murata GRM1552C1H100JZ01D.
C860	1 uF; similar to Taiyo Yuden LMK105BJ105KV-F.
C861	0.1 uF; similar to Murata GRM155B11A104KA01D.
C862	0.01 uF; similar to Murata GRM155B11E103KA01D.
C863	0.1 uF; similar to Murata GRM155B11A104KA01D.
C864	4.7 uF; similar to Murata GRM21BB31E475KA75L.
C865	0.1 uF; similar to Murata GRM155B11A104KA01D.
C866	0.1 uF; similar to Murata GRM155B11A104KA01D.
C867	47 pF; similar to Murata GRM1552C1H470JZ01D.
C868	0.01 uF; similar to Murata GRM155B11E103KA01D.
C869	0.47 uF; similar to Murata GRM155B30J474KE18D.
C870	0.22 uF; similar to Murata GRM188B11A224KA01D.
C871	0.22 uF; similar to Murata GRM188B11A224KA01D.
C872	0.1 uF; similar to Murata GRM188B11E104KA01D.
C873	220 uF; similar to NIPON CHEMI-CON EMVH350ADA221MJA0G.
C874	22 uF; similar to Murata GRM32EB31E226KE15L.
C875	0.01 uF; similar to Murata GRM155B11E103KA01D.
C876	0.1 uF; similar to Murata GRM155B11A104KA01D.
C878	2.2 uF; similar to Murata GRM21BB31E225KA75L.
C879	0.01 uF; similar to Murata GRM155B11E103KA01D.
C882	1800 pF; similar to Murata GRM188B11H182KA01D.
C883	0.01 uF; similar to Murata GRM155B11E103KA01D.
C884	0.01 uF; similar to Murata GRM155B11E103KA01D.
C885	2200 pF; similar to Murata GRM155B11H222KA01D.

SYMBOL	DESCRIPTION
C886	0.01 uF; similar to Murata GRM155B11E103KA01D.
C887	0.1 uF; similar to Murata GRM188B11E104KA01D.
C888	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C889	4.7 uF; similar to Murata GRM21BB31E475KA75L.
C890	22 uF; similar to Taiyo Yuden EMK325BJ226MM-T.
C892	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C893	0.1 uF; similar to Murata GRM155B11A104KA01D.
C894	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C895	0.01 uF; similar to Murata GRM155B11E103KA01D.
C896	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C897	0.33 uF; similar to Murata GRM319B11E334KA01D.
C898	0.1 uF; similar to Murata GRM155B11A104KA01D.
C899	10 uF; similar to Murata GRM31CR61C106KA88L.
C900	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C901	0.01 uF; similar to Murata GRM155B11E103KA01D.
C902	0.33 uF; similar to Murata GRM319B11E334KA01D.
C903	4.7 uF; similar to Murata GRM21BB31E475KA75L.
C905	0.1 uF; similar to Murata GRM155B11A104KA01D.
C906	0.1 uF; 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 uF; similar to Murata GRM319B11E334KA01D.
C910	4.7 uF; similar to Murata GRM21BB31E475KA75L.
C911	0.1 uF; similar to Murata GRM188B11E104KA01D.
C912	0.1 uF; similar to Murata GRM188B11E104KA01D.
C913	1 uF; similar to Taiyo Yuden LMK105BJ105KV-F.
C914	0.01 uF; similar to Murata GRM155B11E103KA01D.
C920	0.1 uF; similar to Murata GRM188B11E104KA01D.
C921	0.1 uF; similar to Murata GRM188B11E104KA01D.
C922	10 uF; similar to Murata GRM31CR61C106KA88L.
C923	0.1 uF; similar to Murata GRM188B11E104KA01D.
C924	0.1 uF; similar to Murata GRM188B11E104KA01D.
C925	0.1 uF; similar to Murata GRM188B11E104KA01D.
C926	0.01 uF; similar to Murata GRM155B11E103KA01D.
C927	0.01 uF; similar to Murata GRM155B11E103KA01D.
C928	0.01 uF; similar to Murata GRM155B11E103KA01D.
C929	0.01 uF; similar to Murata GRM155B11E103KA01D.
C930	0.01 uF; similar to Murata GRM155B11E103KA01D.
C931	0.01 uF; similar to Murata GRM155B11E103KA01D.
C932	0.01 uF; similar to Murata GRM155B11E103KA01D.
C933	0.01 uF; similar to Murata GRM155B11E103KA01D.

SYMBOL	DESCRIPTION
C934	0.01 uF; similar to Murata GRM155B11E103KA01D.
C935	0.01 uF; similar to Murata GRM155B11E103KA01D.
C936	0.01 uF; similar to Murata GRM155B11E103KA01D.
C937	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C938	0.01 uF; similar to Murata GRM155B11E103KA01D.
C939	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C941	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C943	0.1 uF; similar to Murata GRM155B11A104KA01D.
C944	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C945	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C946	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C947	10 pF; similar to Taiyo Yuden UMK105CH100DV-F.
C948	10 pF; similar to Taiyo Yuden UMK105CH100DV-F.
C951	0.01 uF; similar to Murata GRM155B11E103KA01D.
C952	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C953	0.01 uF; similar to Murata GRM155B11E103KA01D.
C954	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C955	0.01 uF; similar to Murata GRM155B11E103KA01D.
C956	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C957	0.1 uF; similar to Murata GRM155B11A104KA01D.
C959	0.01 uF; similar to Murata GRM155B11E103KA01D.
C960	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C961	0.01 uF; similar to Murata GRM155B11E103KA01D.
C962	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C966	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C967	0.01 uF; similar to Murata GRM155B11E103KA01D.
C968	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C969	0.01 uF; similar to Murata GRM155B11E103KA01D.
C970	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C971	0.01 uF; similar to Murata GRM155B11E103KA01D.
C972	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C973	0.01 uF; similar to Murata GRM155B11E103KA01D.
C974	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C975	0.01 uF; similar to Murata GRM155B11E103KA01D.
C976	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C977	0.01 uF; similar to Murata GRM155B11E103KA01D.
C978	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C979	0.01 uF; similar to Murata GRM155B11E103KA01D.
C980	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C981	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C982	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.

SYMBOL	DESCRIPTION
C983	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C984	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C985	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C986	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C987	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C988	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C989	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C990	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C991	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C992	0.01 uF; similar to Murata GRM155B11E103KA01D.
C993	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C994	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C995	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C998	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C1121	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C1122	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C1123	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C1124	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C1125	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C1126	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C1127	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C1128	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C1129	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C1130	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C1131	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C1132	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C1133	0.1 uF; similar to Murata GRM188B11E104KA01D.
C1134	0.1 uF; similar to Murata GRM188B11E104KA01D.
C1135	0.1 uF; similar to Murata GRM188B11E104KA01D.
C1136	0.1 uF; similar to Murata GRM188B11E104KA01D.
C1137	0.1 uF; similar to Murata GRM188B11E104KA01D.
C1138	10 uF; similar to Murata GRM31CR61C106KA88L.
C1148	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C1149	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C1150	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C1151	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C1152	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C1153	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C1154	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C1155	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C1156	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.

SYMBOL	DESCRIPTION
C1158	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C1159	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C1160	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C1161	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C1162	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C1163	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C1164	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C1165	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C1166	100 pF; similar to Taiyo Yuden UMK105CH101JV-F.
C1170	0.01 uF; similar to Murata GRM155B11E103KA01D.
C1171	0.01 uF; similar to Murata GRM155B11E103KA01D.
C1172	0.01 uF; similar to Murata GRM155B11E103KA01D.
C1173	0.1 uF; similar to Murata GRM188B11E104KA01D.
----- DIODES -----	
CD805	Similar to Toshiba DF2S24FS(TPL3).
CD806	Similar to Toshiba DF7A6.8CFU(TE85L_F).
CD807	Similar to Toshiba DF7A6.8CFU(TE85L_F).
CD808	Similar to Toshiba DF2S24FS(TPL3).
CD809	Similar to Toshiba DF2S24FS(TPL3).
CD810	Similar to Toshiba DF2S24FS(TPL3).
CD811	Similar to Toshiba DF7A6.8CFU(TE85L_F).
CD812	Similar to Toshiba DF7A6.8CFU(TE85L_F).
CD813	Similar to Toshiba DF7A6.8CFU(TE85L_F).
CD814	Similar to Toshiba DF7A6.8CFU(TE85L_F).
CD815	Similar to Toshiba DF7A6.8CFU(TE85L_F).
CD816	Similar to Toshiba DF2S24FS(TPL3).
CD817	Similar to Toshiba DF2S24FS(TPL3).
----- FUSES -----	
F801	1.0 Amp; similar to Mastuo KAB3202 102NA 29 010.
F803	1.0 Amp; similar to Mastuo KAB3202 102NA 29 010.
F804	1.0 Amp; similar to Mastuo KAB3202 102NA 29 010.
F805	1.0 Amp; similar to Mastuo KAB3202 102NA 29 010.
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 Spansion S29WS128J0PBFW000A.
IC803	Similar to Cypress CY62167EV18LL-55BVXIT.

SYMBOL	DESCRIPTION
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.
IC824	Similar to Toshiba TC74VHC04FT-EL.
IC825	Similar to Renesas HD74LV2GT04AUSE-E.
IC901	Similar to Texas Instruments TLV320AIC26IRHBG4.
IC902	Similar to NJRC NJM3404AV(TE1)-#ZZZB.
IC903	Similar to NJRC NJM3403AV(TE1)-#ZZZB.
IC904	Similar to Toshiba TC7S66FU(TE85L_F).
IC905	Similar to STMicroelectronics TDA7391. See Table 8-4 which begins on page 20 for Harris part number.
IC906	Similar to NJRC NJM3404AV(TE1)-#ZZZB.
IC907	Similar to Toshiba TA58M05F(TE16L1,NQ.
IC908	Similar to NJRC NJM7805FA-#ZZZB. See Table 8-4 which begins on page 20 for Harris part number.
IC909	Similar to NJRC NJM2887DL3(TE1)-#ZZZB.
IC910	Similar to Ricoh R1130H181B-T1-F.
IC911	Similar to NJRC NJM2887DL3(TE1)-#ZZZB.
----- CONNECTOR -----	
J801	16-pin; similar to HIROSE FH12-16S-1SH(55).
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.

SYMBOL	DESCRIPTION
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	60 ohm at 100 MHz; similar to Murata BLM18PG600SN1D.
L902	60 ohm at 100 MHz; similar to Murata BLM18PG600SN1D.
----- RESISTORS -----	
R801	100 ohm; similar to Panasonic EXB28V101JX.
R802	100 ohm; similar to Panasonic EXB28V101JX.
R803	100 ohm; similar to Panasonic EXB28V101JX.
R804	100 ohm; similar to Panasonic EXB28V101JX.
R805	100 ohm; similar to Panasonic EXB28V101JX.
R806	100 ohm; similar to Panasonic EXB28V101JX.
R807	100 ohm; similar to Panasonic EXB28V101JX.
R808	51 ohm; similar to Panasonic EXB28V510JX.
R809	100 ohm; similar to Panasonic EXB28V101JX.
R810	33 ohm; similar to Panasonic EXB28V330JX.
R811	33 ohm; similar to Panasonic EXB28V330JX.
R812	33 ohm; similar to Panasonic EXB28V330JX.
R813	33 ohm; similar to Panasonic EXB28V330JX.
R814	33 ohm; similar to Panasonic EXB28V330JX.
R815	33 ohm; similar to Panasonic EXB28V330JX.
R816	33 ohm; similar to Panasonic EXB28V330JX.
R817	33 ohm; similar to Panasonic EXB28V330JX.
R818	33 ohm; similar to Panasonic EXB28V330JX.
R819	33 ohm; similar to Panasonic EXB28V330JX.
R820	33 ohm; similar to Panasonic EXB28V330JX.
R821	33 ohm; similar to Panasonic EXB28V330JX.
R822	33 ohm; similar to Panasonic EXB28V330JX.
R823	82 ohm; similar to Panasonic EXB28V820JX.
R824	82 ohm; similar to Panasonic EXB28V820JX.
R825	82 ohm; similar to Panasonic EXB28V820JX.
R826	82 ohm; similar to Panasonic EXB28V820JX.
R827	82 ohm; similar to Panasonic EXB28V820JX.
R828	82 ohm; similar to Panasonic EXB28V820JX.
R829	82 ohm; similar to Panasonic EXB28V820JX.
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.

SYMBOL	DESCRIPTION
R834	470 ohm; similar to Panasonic ERJ6GEYJ471V.
R835	100 ohm; similar to Panasonic ERJ2GEJ101X.
R840	0 ohm; similar to Panasonic ERJ2GE0R00X.
R841	0 ohm; similar to Panasonic ERJ2GE0R00X.
R842	0 ohm; similar to Panasonic ERJ2GE0R00X.
R843	0 ohm; similar to Panasonic ERJ2GE0R00X.
R844	0 ohm; similar to Panasonic ERJ2GE0R00X.
R845	0 ohm; similar to Panasonic ERJ2GE0R00X.
R846	0 ohm; similar to Panasonic ERJ2GE0R00X.
R847	0 ohm; similar to Panasonic ERJ2GE0R00X.
R848	0 ohm; similar to Panasonic ERJ2GE0R00X.
R849	0 ohm; similar to Panasonic ERJ2GE0R00X.
R850	0 ohm; similar to Panasonic ERJ2GE0R00X.
R851	0 ohm; similar to Panasonic ERJ2GE0R00X.
R852	0 ohm; similar to Panasonic ERJ2GE0R00X.
R853	0 ohm; similar to Panasonic ERJ2GE0R00X.
R854	0 ohm; similar to Panasonic ERJ2GE0R00X.
R855	0 ohm; similar to Panasonic ERJ2GE0R00X.
R857	22k ohm; similar to Panasonic ERJ2GEJ223X.
R860	22k ohm; similar to Panasonic ERJ2GEJ223X.
R861	22k ohm; similar to Panasonic ERJ2GEJ223X.
R862	22k ohm; similar to Panasonic ERJ2GEJ223X.
R868	22k ohm; similar to Panasonic ERJ2GEJ223X.
R869	22k ohm; similar to Panasonic ERJ2GEJ223X.
R870	22k ohm; similar to Panasonic ERJ2GEJ223X.
R887	10k ohm; similar to Panasonic ERJ2GEJ103X.
R888	10k ohm; similar to Panasonic ERJ2GEJ103X.
R890	22k ohm; similar to Panasonic ERJ2GEJ223X.
R891	22k ohm; similar to Panasonic ERJ2GEJ223X.
R892	22k ohm; similar to Panasonic ERJ2GEJ223X.
R893	22k ohm; similar to Panasonic ERJ2GEJ223X.
R894	22k ohm; similar to Panasonic ERJ2GEJ223X.
R895	22k ohm; similar to Panasonic ERJ2GEJ223X.
R896	22k ohm; similar to Panasonic ERJ2GEJ223X.
R897	22k ohm; similar to Panasonic ERJ2GEJ223X.
R898	150 ohm; similar to Panasonic ERJ2GEJ151X.
R899	150 ohm; similar to Panasonic ERJ2GEJ151X.
R900	150 ohm; similar to Panasonic ERJ2GEJ151X.
R901	22k ohm; similar to Panasonic ERJ2GEJ223X.
R902	22k ohm; similar to Panasonic ERJ2GEJ223X.
R903	22k ohm; similar to Panasonic ERJ2GEJ223X.

SYMBOL	DESCRIPTION
R904	10k ohm; similar to Panasonic ERJ2GEJ103X.
R905	51 ohm; similar to Panasonic ERJ2GEJ510X.
R906	51 ohm; similar to Panasonic ERJ2GEJ510X.
R907	51 ohm; similar to Panasonic ERJ2GEJ510X.
R908	82 ohm; similar to Panasonic ERJ2GEJ820X.
R909	82 ohm; similar to Panasonic ERJ2GEJ820X.
R910	33 ohm; similar to Panasonic ERJ2GEJ330X.
R911	22k ohm; similar to Panasonic ERJ2GEJ223X.
R912	22k ohm; similar to Panasonic ERJ2GEJ223X.
R913	22k ohm; similar to Panasonic ERJ2GEJ223X.
R915	22k ohm; similar to Panasonic ERJ2GEJ223X.
R916	22k ohm; similar to Panasonic ERJ2GEJ223X.
R917	22k ohm; similar to Panasonic ERJ2GEJ223X.
R918	22k ohm; similar to Panasonic ERJ2GEJ223X.
R919	22k ohm; similar to Panasonic ERJ2GEJ223X.
R920	22k ohm; similar to Panasonic ERJ2GEJ223X.
R921	75 ohm; similar to HOKURIKUDENNKI CR10-750FV.
R922	6.8k ohm; similar to Panasonic ERJ2GEJ682X.
R923	22k ohm; similar to Panasonic ERJ2GEJ223X.
R924	22k ohm; similar to Panasonic ERJ2GEJ223X.
R925	22k ohm; similar to Panasonic ERJ2GEJ223X.
R926	22k ohm; similar to Panasonic ERJ2GEJ223X.
R927	22k ohm; similar to Panasonic ERJ2GEJ223X.
R928	22k ohm; similar to Panasonic ERJ2GEJ223X.
R929	10k ohm; similar to Panasonic ERJ2GEJ103X.
R932	4.7k ohm; similar to Panasonic ERJ2GEJ472X.
R933	4.7k ohm; similar to Panasonic ERJ2GEJ472X.
R934	4.7k ohm; similar to Panasonic ERJ2GEJ472X.
R935	4.7k ohm; similar to Panasonic ERJ2GEJ472X.
R936	4.7k ohm; similar to Panasonic ERJ2GEJ472X.
R939	22k ohm; similar to Panasonic ERJ2GEJ223X.
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	10 ohm; similar to Panasonic ERJ2GEJ100X.
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.

SYMBOL	DESCRIPTION
R954	47k ohm; similar to Panasonic ERJ2GEJ473X.
R955	100k ohm; similar to Panasonic ERJ2GEJ104X.
R957	4.7k ohm; similar to Panasonic ERJ2GEJ472X.
R958	470k ohm; similar to Panasonic ERJ2GEJ474X.
R959	22k ohm; similar to Panasonic EXB28V223JX.
R960	120 ohm; similar to Panasonic EXB28V121JX.
R961	120 ohm; similar to Panasonic EXB28V121JX.
R962	100k ohm; similar to Panasonic ERJ2GEJ104X.
R963	150k ohm; similar to Panasonic ERJ2GEJ154X.
R964	22k ohm; similar to Panasonic ERJ2GEJ223X.
R965	22k ohm; similar to Panasonic ERJ2GEJ223X.
R966	22k ohm; similar to Panasonic ERJ2GEJ223X.
R967	22k ohm; similar to Panasonic ERJ2GEJ223X.
R968	22k ohm; similar to Panasonic ERJ2GEJ223X.
R970	22k ohm; similar to Panasonic ERJ2GEJ223X.
R971	120 ohm; similar to Panasonic ERJ2GEJ121X.
R972	120 ohm; similar to Panasonic ERJ2GEJ121X.
R973	22k ohm; similar to Panasonic ERJ2GEJ223X.
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	56k ohm; similar to Panasonic ERJ2GEJ563X.
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	22k ohm; similar to Panasonic ERJ2GEJ223X.
R1101	22k ohm; similar to Panasonic ERJ2GEJ223X.

SYMBOL	DESCRIPTION
R1102	100k ohm; similar to Panasonic ERJ2GEJ104X.
R1103	24k ohm; similar to HOKURIKUDENNKI CR10-243FV.
R1104	22k ohm; similar to Panasonic ERJ2GEJ223X.
R1105	22k ohm; similar to Panasonic ERJ2GEJ223X.
R1106	22k ohm; similar to Panasonic ERJ2GEJ223X.
R1107	33 ohm; similar to Panasonic EXB28V330JX.
R1108	33 ohm; similar to Panasonic EXB28V330JX.
R1109	22k ohm; similar to Panasonic ERJ2GEJ223X.
R1110	22k ohm; similar to Panasonic ERJ2GEJ223X.
R1112	22k ohm; similar to Panasonic ERJ2GEJ223X.
R1113	4.7k ohm; similar to Panasonic ERJ2GEJ472X.
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	22k ohm; similar to Panasonic ERJ2GEJ223X.
R1131	22k ohm; similar to Panasonic ERJ2GEJ223X.
R1132	22k ohm; similar to Panasonic ERJ2GEJ223X.
R1133	22k ohm; similar to Panasonic ERJ2GEJ223X.
R1136	22k ohm; similar to Panasonic ERJ2GEJ223X.
R1137	22k ohm; similar to Panasonic EXB28V223JX.
R1138	22k ohm; similar to Panasonic EXB28V223JX.
R1139	10k ohm; similar to Panasonic ERJ2GEJ103X.
R1140	10k ohm; similar to Panasonic ERJ2GEJ103X.
R1142	0 ohm; similar to Panasonic ERJ2GE0R00X.
R1143	0 ohm; similar to Panasonic ERJ2GE0R00X.
R1144	0 ohm; similar to Panasonic ERJ2GE0R00X.
R1145	0 ohm; similar to Panasonic ERJ2GE0R00X.
R1146	0 ohm; similar to Panasonic ERJ2GE0R00X.
R1147	0 ohm; similar to Panasonic ERJ2GE0R00X.
R1148	0 ohm; similar to Panasonic ERJ2GE0R00X.
R1149	0 ohm; similar to Panasonic ERJ2GE0R00X.
R1150	0 ohm; similar to Panasonic ERJ2GE0R00X.
R1151	22k ohm; similar to Panasonic ERJ2GEJ223X.
R1152	22k ohm; similar to Panasonic ERJ2GEJ223X.
R1153	22k ohm; similar to Panasonic ERJ2GEJ223X.
R1154	22k ohm; similar to Panasonic ERJ2GEJ223X.
R1155	22k ohm; similar to Panasonic ERJ2GEJ223X.
R1156	22k ohm; similar to Panasonic ERJ2GEJ223X.

SYMBOL	DESCRIPTION
R1157	22k ohm; similar to Panasonic ERJ2GEJ223X.
R1158	22k ohm; similar to Panasonic ERJ2GEJ223X.
R1159	22k ohm; similar to Panasonic ERJ2GEJ223X.
R1160	22k ohm; similar to Panasonic ERJ2GEJ223X.
R1161	22k ohm; similar to Panasonic ERJ2GEJ223X.
R1163	33 ohm; similar to Panasonic ERJ2GEJ330X.
R1164	33 ohm; similar to Panasonic ERJ2GEJ330X.
R1165	33 ohm; similar to Panasonic ERJ2GEJ330X.
R1166	33 ohm; similar to Panasonic ERJ2GEJ330X.
R1168	22k ohm; similar to Panasonic ERJ2GEJ223X.
----- TEST POINTS -----	
TP851	HK-2; similar to MAC8 HK-2-S.
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 NEC 2SC3736T1-AZ OK.
TR809	Similar to Toshiba 2SC2859-Y(TE85L_F.
TR810	Similar to NEC 2SC3736T1-AZ OK.
TR811	Similar to ROHM UMG2NTR.
TR813	Similar to ROHM UMD2NTR.
TR814	Similar to ROHM UMD2NTR.
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	Similar to ROHM UMD2NTR.
TR906	Similar to ROHM UMD2NTR.
TR907	Similar to ROHM UMD2NTR.
TR908	Similar to ROHM UMG2NTR.
TR909	Similar to ROHM UMD2NTR.
TR910	Similar to ROHM UMD2NTR.
TR911	Similar to ROHM UMD2NTR.

SYMBOL	DESCRIPTION
-----OSCILLATOR MODULES AND CRYSTALS -----	
X801	12.0 MHz; similar to CITIZEN CS20_12.000.000MABJT, or NDK NX1255GB-12MHZ-30PPM..
X802	32.768 kHz; similar to Epson Toyocom MC-306-32.768KHZ-12.5/2.
X803	40.0 MHz; similar to CITIZEN CS10_40.000.000MABJT or Epson Toyocom FA-365-40MHZ-18PF/50PPM-F.

## 16.2 RF PROCESSOR BOARD

### 50-Watt 136 – 174 MHz RF PROCESSOR BOARD (CMN-6831 Rev. C)

SYMBOL	DESCRIPTION
-----CAPACITORS-----	
C108	33 pF; similar to Taiyo Yuden UMK105CH330JV-F
C109	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C110	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C111	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C112	18 pF; similar to Taiyo Yuden UMK105CH180JV-F
C114	180 pF; similar to Taiyo Yuden UMK105CH181JV-F
C115	10 pF; similar to Taiyo Yuden UMK105CH100DV-F
C116	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C117	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C118	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C121	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C122	39 pF; similar to MURATA GRM1552C1H390JZ01D
C123	15 pF; similar to Taiyo Yuden UMK105CH150JV-F
C124	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C125	180 pF; similar to Taiyo Yuden UMK105CH181JV-F
C126	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C127	0.1 uF; similar to MURATA GRM188R11E104KA01D
C132	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C133	47 uF; similar to Panasonic EEEFK1V470P
C134	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C135	0.047 uF; similar to MURATA GRM188R11H473KA61D
C137	1000 pF; similar to MURATA GRM31A7U2J102JW31D
C138	1000 pF; similar to MURATA GRM31A7U2J102JW31D
C139	1000 pF; similar to MURATA GRM31A7U2J102JW31D
C140	1 pF; similar to MURATA GRM31M4C2H1R0CY21L

SYMBOL	DESCRIPTION
C141	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C142	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C143	8 pF; similar to MURATA GRM31M2C2H8R0DV01L
C144	3 pF; similar to MURATA GRM31M3C2H3R0CY21L
C146	18 pF; similar to MURATA GRM31M2C2H180JV01L
C147	22PF 500V; similar to MURATA GRM31M2C2H220JV01L
C148	27 pF; similar to MURATA GRM31M2C2H270JV01L
C149	10 pF; similar to MURATA GRM31M2C2H100JV01L
C150	10 pF; similar to MURATA GRM31M2C2H100JV01L
C151	8 pF; similar to MURATA GRM31M2C2H8R0DV01L
C152	8 pF; similar to MURATA GRM31M2C2H8R0DV01L
C154	27 pF; similar to MURATA GRM31M2C2H270JV01L
C155	1000 pF; similar to MURATA GRM31A7U2J102JW31D
C156	27 pF; similar to MURATA GRM2162C1H270JZ01D
C158	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C161	100 pF; similar to Taiyo Yuden UMK105CH101JV-F
C162	10 pF; similar to Taiyo Yuden UMK105CH100DV-F
C163	10 pF; similar to Taiyo Yuden UMK105CH100DV-F
C164	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C165	0.01 uF; similar to MURATA GRM155B11E103KA01D
C166	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C167	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C169	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C171	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C172	33 pF; similar to MURATA GRM2192C2D330JV01D
C173	33 pF; similar to MURATA GRM2192C2D330JV01D
C174	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C175	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C176	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C177	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C178	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C179	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C180	10 uF; similar to Taiyo Yuden EMK212BJ106KG-T
C181	2.2 uF; similar to Taiyo Yuden EMK107BJ225KA-T
C182	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C185	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C188	0.047U; similar to MURATA GRM188R11H473KA61D
C189	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C190	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C191	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F

SYMBOL	DESCRIPTION
C201	22 pF; similar to Taiyo Yuden UMK105CH220JV-F
C202	3 pF; similar to Taiyo Yuden UMK105CJ030CW-F
C203	15 pF; similar to Taiyo Yuden UMK105CH150JV-F
C204	15 pF; similar to Taiyo Yuden UMK105CH150JV-F
C205	11 pF; similar to MURATA GRM1552C1H110FZ01D
C206	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C207	33 pF; similar to Taiyo Yuden UMK105CH330JV-F
C208	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C209	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C210	33 pF; similar to Taiyo Yuden UMK105CH330JV-F
C211	22 pF; similar to Taiyo Yuden UMK105CH220JV-F
C212	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C213	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C214	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C215	15 pF; similar to Taiyo Yuden UMK105CH150JV-F
C216	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C217	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C218	10 pF; similar to Taiyo Yuden UMK105CH100DV-F
C219	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C220	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C221	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C222	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C223	5 pF; similar to Taiyo Yuden UMK105CH050CW-F
C224	6 pF; similar to Taiyo Yuden UMK105CH060DW-F
C225	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C226	4 pF; similar to Taiyo Yuden UMK105CH040CW-F
C227	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C228	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C229	10 pF; similar to Taiyo Yuden UMK105CH100DV-F
C230	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C232	24 pF; similar to MURATA GRM1552C1H240FZ01D
C235	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C236	300 pF; similar to MURATA GRM1552C1H301FA01D
C239	24 pF; similar to MURATA GRM1552C1H240FZ01D
C241	10 pF; similar to Taiyo Yuden UMK105CH100DV-F
C242	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C243	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C244	6 pF; similar to Taiyo Yuden UMK105CH060DW-F
C245	4 pF; similar to Taiyo Yuden UMK105CH040CW-F
C246	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C247	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F

SYMBOL	DESCRIPTION
C249	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C250	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C251	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C252	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C253	47 pF; similar to Taiyo Yuden UMK105CH470JV-F
C254	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C255	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C256	4 pF; similar to MURATA GRM1552C1H4R0BZ01D
C257	6 pF; similar to Taiyo Yuden UMK105CH060DW-F
C258	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C259	10 pF; similar to Taiyo Yuden UMK105CH100DV-F
C260	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C263	24 pF; similar to MURATA GRM1552C1H240FZ01D
C264	300 pF; similar to MURATA GRM1552C1H301FA01D
C266	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C268	24 pF; similar to MURATA GRM1552C1H240FZ01D
C270	10 pF; similar to Taiyo Yuden UMK105CH100DV-F
C271	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C272	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C273	6 pF; similar to Taiyo Yuden UMK105CH060DW-F
C274	4 pF; similar to MURATA GRM1552C1H4R0BZ01D
C275	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C276	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C277	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C278	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C279	0.01 uF; similar to MURATA GRM155B11E103KA01D
C280	0.1 uF; similar to MURATA GRM155R11C104KA88D
C281	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C301	0.01 uF; similar to MURATA GRM155B11E103KA01D
C302	0.01 uF; similar to MURATA GRM155B11E103KA01D
C303	0.01 uF; similar to MURATA GRM155B11E103KA01D
C304	56 pF; similar to Taiyo Yuden UMK105CH560JV-F
C306	12 pF; similar to Taiyo Yuden UMK105CH120JV-F
C307	2 pF; similar to Taiyo Yuden UMK105CK020CW-F
C308	0.01 uF; similar to MURATA GRM155B11E103KA01D
C309	0.01 uF; similar to MURATA GRM155B11E103KA01D
C310	0.01 uF; similar to MURATA GRM155B11E103KA01D
C312	10 pF; similar to Taiyo Yuden UMK105CH100DV-F
C313	2 pF; similar to Taiyo Yuden UMK105CK020CW-F
C314	0.01 uF; similar to MURATA GRM155B11E103KA01D
C315	0.01 uF; similar to MURATA GRM155B11E103KA01D

SYMBOL	DESCRIPTION
C316	39 pF; similar to MURATA GRM1552C1H390FZ01D
C319	0.01 uF; similar to MURATA GRM155B11E103KA01D
C320	0.01 uF; similar to MURATA GRM155B11E103KA01D
C321	0.01 uF; similar to MURATA GRM155B11E103KA01D
C322	0.01 uF; similar to MURATA GRM155B11E103KA01D
C324	0.047 uF; similar to MURATA GRM155R11C473KA01D
C325	0.1 uF; similar to MURATA GRM155R11C104KA88D
C327	0.01 uF; similar to MURATA GRM155B11E103KA01D
C329	0.1 uF; similar to MURATA GRM155R11C104KA88D
C330	100 pF; similar to Taiyo Yuden UMK105CH101JV-F
C331	0.01 uF; similar to MURATA GRM155B11E103KA01D
C334	33 pF; similar to Taiyo Yuden GRM1552C1H330FZ
C335	0.01 uF; similar to MURATA GRM155B11E103KA01D
C336	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C337	0.1 uF; similar to MURATA GRM155R11C104KA88D
C338	180 pF; similar to Taiyo Yuden UMK105CH181JV-F
C339	100 pF; similar to Taiyo Yuden UMK105CH101JV-F
C340	100 pF; similar to Taiyo Yuden UMK105CH101JV-F
C341	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C342	0.1 uF; similar to MURATA GRM155R11C104KA88D
C343	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C344	0.1 uF; similar to MURATA GRM155R11C104KA88D
C345	2200 pF; similar to MURATA GRM155R11H222KA01D
C346	100 pF; similar to Taiyo Yuden UMK105CH101JV-F
C347	100 pF; similar to Taiyo Yuden UMK105CH101JV-F
C348	0.01 uF; similar to MURATA GRM155B11E103KA01D
C349	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C350	0.22 uF; similar to MURATA GRM188R11C224KA01D
C351	1 uF; similar to MURATA GRM188B31C105KA92D
C352	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C353	0.1 uF; similar to MURATA GRM155R11C104KA88D
C354	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C355	0.01 uF; similar to MURATA GRM155B11E103KA01D
C356	1 uF; similar to MURATA GRM188B31C105KA92D
C357	0.1 uF; similar to MURATA GRM155R11C104KA88D
C358	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C359	0.1 uF; similar to MURATA GRM155R11C104KA88D
C360	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C361	0.01 uF; similar to MURATA GRM155B11E103KA01D
C363	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F

SYMBOL	DESCRIPTION
C365	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C366	0.01 uF; similar to MURATA GRM155B11E103KA01D
C367	0.01 uF; similar to MURATA GRM155B11E103KA01D
C368	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C369	0.1 uF; similar to MURATA GRM155R11C104KA88D
C370	0.1 uF; similar to MURATA GRM155R11C104KA88D
C372	0.01 uF; similar to MURATA GRM155B11E103KA01D
C373	0.01 uF; similar to MURATA GRM155B11E103KA01D
C374	22 pF; similar to Taiyo Yuden UMK105CH220JV-F
C375	22 pF; similar to Taiyo Yuden UMK105CH220JV-F
C401	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C402	22 pF; similar to MURATA GRM1552C1H220FZ01D
C403	47 pF; similar to MURATA GRM1552C1H470FZ01D
C404	7 pF; similar to MURATA GRM1552C1H7R0BZ01D
C405	8 pF; similar to MURATA GRM1552C1H8R0GZ01D
C406	15 pF; similar to MURATA GRM1552C1H150FZ01D
C407	10 pF; similar to MURATA GRM1552C1H100FZ01D
C408	12 pF; similar to MURATA GRM1552C1H120FZ01D
C409	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C410	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C411	12 pF; similar to MURATA GRM1552C1H120FZ01D
C412	15 pF; similar to MURATA GRM1552C1H150FZ01D
C413	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C414	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C415	8 pF; similar to MURATA GRM1552C1H8R0GZ01D
C416	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C417	33 pF; similar to MURATA GRM1552C1H330FZ01D
C418	27 pF; similar to MURATA GRM1552C1H270FZ01D
C419	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C420	1 pF; similar to Taiyo Yuden UMK105CK010CW-F
C421	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C422	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C423	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C424	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C425	22 pF; similar to MURATA GRM1552C1H220FZ01D
C427	47 pF; similar to MURATA GRM1552C1H470FZ01D
C428	7 pF; similar to MURATA GRM1552C1H7R0BZ01D
C429	8 pF; similar to MURATA GRM1552C1H8R0GZ01D
C430	10 pF; similar to MURATA GRM1552C1H100FZ01D
C431	12 pF; similar to MURATA GRM1552C1H120FZ01D
C432	15 pF; similar to MURATA GRM1552C1H150FZ01D

SYMBOL	DESCRIPTION
C433	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C434	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C435	15 pF; similar to MURATA GRM1552C1H150FZ01D
C436	15 pF; similar to MURATA GRM1552C1H150FZ01D
C437	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C438	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C439	7 pF; similar to MURATA GRM1552C1H7R0BZ01D
C440	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C441	22 pF; similar to MURATA GRM1552C1H220FZ01D
C442	33 pF; similar to MURATA GRM1552C1H330FZ01D
C443	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C444	1 pF; similar to Taiyo Yuden UMK105CK010CW-F
C445	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C446	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C447	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C448	18 pF; similar to Taiyo Yuden UMK105CH180JV-F
C449	15 pF; similar to Taiyo Yuden UMK105CH150JV-F
C450	15 pF; similar to Taiyo Yuden UMK105CH150JV-F
C451	5 pF; similar to Taiyo Yuden UMK105CH050CW-F
C452	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C453	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C455	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C456	18 pF; similar to Taiyo Yuden UMK105CH180JV-F
C458	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C459	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C460	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C462	33 pF; similar to Taiyo Yuden UMK105CH330JV-F
C463	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C479	15 pF; similar to Taiyo Yuden UMK105CH150JV-F
C480	15 pF; similar to Taiyo Yuden UMK105CH150JV-F
C481	4 pF; similar to Taiyo Yuden UMK105CH040CW-F
C482	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C483	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C484	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C485	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C486	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C487	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C488	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C489	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C491	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C505	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F

SYMBOL	DESCRIPTION
C506	1000 pF; similar to MURATA GRM1882C1H102JA01D
C507	100 pF; similar to Taiyo Yuden UMK105CH101JV-F
C508	2.2 uF; similar to MURATA GRM188R11C224KA01D
C509	2.2 uF; similar to MURATA GRM188R11C224KA01D
C510	4.7 uF; similar to NICHICON F931C475MAA
C511	4700 pF; similar to Panasonic ECHU1C472JX5
C512	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C513	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C514	10 uF; similar to MURATA GRM31CR61C106KA88L
C515	0.1 uF; similar to MURATA GRM155R11C104KA88D
C516	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C517	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C518	10 uF; similar to MURATA GRM31CR61C106KA88L
C519	0.047 uF; similar to MURATA GRM188R11E473KA01D
C520	0.022 uF; similar to Panasonic ECHU1C223JX5
C521	0.68 uF; similar to Panasonic ECPU1C684MA5
C522	0.1 uF; similar to Panasonic ECPU1C104MA5
C524	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C525	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C526	0.01 uF; similar to MURATA GRM155B11E103KA01D
C529	0.01 uF; similar to MURATA GRM155B11E103KA01D
C530	0.01 uF; similar to MURATA GRM155B11E103KA01D
C531	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C532	0.01 uF; similar to MURATA GRM155B11E103KA01D
C536	0.01 uF; similar to MURATA GRM155B11E103KA01D
C537	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C538	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C539	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C540	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C546	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C547	1000 pF; similar to MURATA GRM1882C1H102JA01D
C548	100 pF; similar to Taiyo Yuden UMK105CH101JV-F
C549	0.22 uF; similar to MURATA GRM188R11C224KA01D
C550	0.22 uF; similar to MURATA GRM188R11C224KA01D
C551	4.7 uF; similar to NICHICON F931C475MAA
C552	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C553	0.01 uF; similar to Panasonic ECHU1C103JX5
C554	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F

SYMBOL	DESCRIPTION
C555	0.1 uF; similar to MURATA GRM155R11C104KA88D
C556	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C557	10 uF; similar to MURATA GRM31CR61C106KA88L
C558	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C559	10 uF; similar to MURATA GRM31CR61C106KA88L
C560	0.047 uF; similar to MURATA GRM188R11E473KA01D
C561	0.68 uF; similar to Panasonic ECPU1C684MA5
C562	0.022 uF; similar to Panasonic ECHU1C223JX5
C563	0.1 uF; similar to Panasonic ECPU1C104MA5
C565	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C566	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C567	6 pF; similar to Taiyo Yuden UMK105CH060DW-F
C568	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C569	10 pF; similar to Taiyo Yuden UMK105CH100DV-F
C601	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C602	0.01 uF; similar to MURATA GRM155B11E103KA01D
C603	0.01 uF; similar to MURATA GRM155B11E103KA01D
C604	0.01 uF; similar to MURATA GRM155B11E103KA01D
C606	10 uF; similar to MURATA GRM31CR61C106KA88L
C607	0.01 uF; similar to MURATA GRM155B11E103KA01D
C608	1 uF; similar to MURATA GRM188B31C105KA92D
C609	0.01 uF; similar to MURATA GRM155B11E103KA01D
C610	0.1 uF; similar to MURATA GRM155R11C104KA88D
C611	0.1 uF; similar to MURATA GRM155R11C104KA88D
C622	2200 pF; similar to Panasonic ECHU1C222JX5
C623	220 pF; similar to MURATA GRM1552C1H221GA01D
C624	560 pF; similar to MURATA GRM1552C1H561GA01D
C625	0.1 uF; similar to MURATA GRM155R11C104KA88D
C626	0.1 uF; similar to MURATA GRM155R11C104KA88D
C627	2200 pF; similar to Panasonic ECHU1C222JX5
C628	220 pF; similar to MURATA GRM1552C1H221GA01D
C629	560 pF; similar to MURATA GRM1552C1H561GA01D
C630	0.1 uF; similar to MURATA GRM155R11C104KA88D
C631	100 pF; similar to Taiyo Yuden UMK105CH101JV-F
C633	2200 pF; similar to Panasonic ECHU1C222JX5
C634	220 pF; similar to MURATA GRM1552C1H221GA01D
C635	560 pF; similar to MURATA GRM1552C1H561GA01D
C636	0.1 uF; similar to MURATA GRM155R11C104KA88D
C637	2200 pF; similar to Panasonic ECHU1C222JX5
C638	220 pF; similar to MURATA GRM1552C1H221GA01D
C639	560 pF; similar to MURATA GRM1552C1H561GA01D

SYMBOL	DESCRIPTION
C640	0.1 uF; similar to MURATA GRM155R11C104KA88D
C641	100 pF; similar to Taiyo Yuden UMK105CH101JV-F
C651	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C652	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C653	0.1 uF; similar to MURATA GRM155R11C104KA88D
C655	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C656	0.1 uF; similar to MURATA GRM155R11C104KA88D
C658	0.1 uF; similar to MURATA GRM155R11C104KA88D
C659	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C661	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C662	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C667	12 pF; similar to Taiyo Yuden UMK105CH120JV-F
C668	27 pF; similar to Taiyo Yuden UMK105CH270JV-F
C669	22 pF; similar to Taiyo Yuden UMK105CH220JV-F
C670	12 pF; similar to Taiyo Yuden UMK105CH120JV-F
C671	3 pF; similar to Taiyo Yuden UMK105CJ030CW-F
C673	3 pF; similar to Taiyo Yuden UMK105CJ030CW-F
C675	3 pF; similar to Taiyo Yuden UMK105CJ030CW-F
C701	0.1 uF; similar to MURATA GRM155R11C104KA88D
C702	0.01 uF; similar to MURATA GRM155B11E103KA01D
C707	0.1 uF; similar to MURATA GRM155R11C104KA88D
C708	0.1 uF; similar to MURATA GRM155R11C104KA88D
C709	0.1 uF; similar to MURATA GRM155R11C104KA88D
C710	1 uF; similar to MURATA GRM188B31C105KA92D
C711	0.1 uF; similar to MURATA GRM155R11C104KA88D
C712	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C714	0.01 uF; similar to MURATA GRM155B11E103KA01D
C715	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C716	0.01 uF; similar to MURATA GRM155B11E103KA01D
C717	0.1 uF; similar to MURATA GRM155R11C104KA88D
C737	10 uF; similar to MURATA GRM31CR61C106KA88L
C738	0.1 uF; similar to MURATA GRM155R11C104KA88D
C739	1 uF; similar to MURATA GRM188B31C105KA92D
C740	0.1 uF; similar to MURATA GRM155R11C104KA88D
C741	0.1 uF; similar to MURATA GRM155R11C104KA88D
C742	0.1 uF; similar to MURATA GRM155R11C104KA88D
C743	0.1 uF; similar to MURATA GRM155R11C104KA88D
C744	0.1 uF; similar to MURATA GRM155R11C104KA88D
C745	0.1 uF; similar to Taiyo Yuden TMK105BJ104KV-F
C746	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C747	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F

SYMBOL	DESCRIPTION
C748	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C767	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C768	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C769	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C770	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C771	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C772	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C773	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C781	0.01 uF; similar to MURATA GRM155B11E103KA01D
C782	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C783	0.01 uF; similar to MURATA GRM155B11E103KA01D
C784	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C785	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C786	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C787	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C788	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C789	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C790	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C791	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C792	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C793	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C794	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C795	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C796	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C797	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C804	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C805	0.01 uF; similar to MURATA GRM155B11E103KA01D
C806	22 uF; similar to NICHICON F931V226MNC
C807	0.33 uF; similar to MURATA GRM21BB11E334KA01L
C808	0.01 uF; similar to MURATA GRM155B11E103KA01D
C809	22 uF; similar to NICHICON F931V226MNC
C810	0.33 uF; similar to MURATA GRM21BB11E334KA01L
C811	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C812	0.01 uF; similar to MURATA GRM155B11E103KA01D
C813	22 uF; similar to NICHICON F931V226MNC
C814	0.33 uF; similar to MURATA GRM21BB11E334KA01L
C816	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C817	0.01 uF; similar to MURATA GRM155B11E103KA01D
C818	10 uF; similar to MURATA GRM31CR61C106KA88L
C819	0.33 uF; similar to MURATA GRM21BB11E334KA01L
C820	0.01 uF; similar to MURATA GRM155B11E103KA01D

SYMBOL	DESCRIPTION
C821	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C822	0.01 uF; similar to MURATA GRM155B11E103KA01D
C823	22 uF; similar to NICHICON F931V226MNC
C824	0.33 uF; similar to MURATA GRM21BB11E334KA01L
C825	0.01 uF; similar to MURATA GRM155B11E103KA01D
C826	10 uF; similar to MURATA GRM31CR61C106KA88L
C827	0.1 uF; similar to MURATA GRM155R11C104KA88D
C828	10 uF; similar to MURATA GRM31CR61C106KA88L
C829	10 uF; similar to MURATA GRM31CR61C106KA88L
C830	0.22 uF; similar to MURATA GRM188R11C224KA01D
C831	1 uF; similar to MURATA GRM188B31C105KA92D
C832	0.01 uF; similar to MURATA GRM155B11E103KA01D
C833	0.01 uF; similar to MURATA GRM155B11E103KA01D
C834	10 uF; similar to MURATA GRM31CR61C106KA88L
C835	0.1 uF; similar to MURATA GRM155R11C104KA88D
C836	0.01 uF; similar to MURATA GRM155B11E103KA01D
C837	22 uF; similar to NICHICON F931V226MNC
C838	0.33 uF; similar to MURATA GRM21BB11E334KA01L
C839	1 uF; similar to MURATA GRM188B31C105KA92D
C840	1 uF; similar to MURATA GRM188B31C105KA92D
C841	0.01 uF; similar to MURATA GRM155B11E103KA01D
C1101	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C1102	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C1103	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C1104	0.01 uF; similar to MURATA GRM155B11E103KA01D
C1105	0.1 uF; similar to MURATA GRM188R11E104KA01D
C1108	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C1110	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C1111	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C1112	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C1113	22 uF; similar to MURATA GRM32EB31C226KE16L
C1114	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C1115	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C1116	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C1117	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C1118	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C1119	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C1120	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C1121	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C1122	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C1123	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F

SYMBOL	DESCRIPTION
C1124	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C1125	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C1126	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C1127	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C1301	4700 pF; similar to Panasonic ECHU1C472JX5
C1302	0.047 uF; similar to Panasonic ECHU1C473JX5
C1303	1000 pF; similar to MURATA GRM1552C1H102JA01D
C1304	1000 pF; similar to MURATA GRM1552C1H102JA01D
C1305	47 pF; similar to MURATA GRM1552C1H470FZ01D
C1306	15 pF; similar to MURATA GRM1552C1H150FZ01D
C1307	15 pF; similar to MURATA GRM1552C1H150FZ01D
C1308	22 pF; similar to MURATA GRM1552C1H220FZ01D
C1309	22 pF; similar to MURATA GRM1552C1H220FZ01D
C1310	0.01 uF; similar to MURATA GRM155B11E103KA01D
C1311	47 pF; similar to MURATA GRM1552C1H470FZ01D
C1312	82 pF; similar to MURATA GRM1552C1H820JZ01D
C1313	82 pF; similar to MURATA GRM1552C1H820JZ01D
C1314	0.01 uF; similar to MURATA GRM155B11E103KA01D
C1315	1 pF; similar to Taiyo Yuden UMK105CK010CW-F
C1316	0.01 uF; similar to MURATA GRM155B11E103KA01D
C1318	0.01 uF; similar to MURATA GRM155B11E103KA01D
C1320	33 pF; similar to Taiyo Yuden UMK105CH330JV-F
C1321	0.01 uF; similar to MURATA GRM155B11E103KA01D
C1322	0.01 uF; similar to MURATA GRM155B11E103KA01D
C1323	18 pF; similar to Taiyo Yuden UMK105CH180JV-F
C1324	0.01 uF; similar to MURATA GRM155B11E103KA01D
C1325	100 pF; similar to Taiyo Yuden UMK105CH101JV-F
C1326	100 pF; similar to Taiyo Yuden UMK105CH101JV-F
C1327	18 pF; similar to Taiyo Yuden UMK105CH180JV-F
C1328	0.01 uF; similar to MURATA GRM155B11E103KA01D
C1329	0.01 uF; similar to MURATA GRM155B11E103KA01D
C1330	0.01 uF; similar to MURATA GRM155B11E103KA01D
C1331	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C1332	0.01 uF; similar to MURATA GRM155B11E103KA01D
C1333	10 uF; similar to MURATA GRM31CR61C106KA88L
C1334	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C1335	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C1336	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C1341	0.01 uF; similar to MURATA GRM155B11E103KA01D
C1401	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F

SYMBOL	DESCRIPTION
C1402	27 pF; similar to MURATA GRM1552C1H270FZ01D
C1403	18 pF; similar to MURATA GRM1552C1H180JZ01D
C1404	15 pF; similar to MURATA GRM1552C1H150FZ01D
C1405	12 pF; similar to MURATA GRM1552C1H120FZ01D
C1406	33 pF; similar to MURATA GRM1552C1H330FZ01D
C1407	8 pF; similar to MURATA GRM1552C1H8R0GZ01D
C1408	9 pF; similar to MURATA GRM1552C1H9R0BZ01D
C1409	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C1410	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C1411	9 pF; similar to MURATA GRM1552C1H9R0BZ01D
C1412	9 pF; similar to MURATA GRM1552C1H9R0BZ01D
C1413	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C1414	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C1415	10 pF; similar to MURATA GRM1552C1H100FZ01D
C1416	12 pF; similar to MURATA GRM1552C1H120FZ01D
C1417	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C1418	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C1419	15 pF; similar to MURATA GRM1552C1H150FZ01D
C1420	15 pF; similar to MURATA GRM1552C1H150FZ01D
C1421	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C1422	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C1423	8 pF; similar to MURATA GRM1552C1H8R0GZ01D
C1424	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C1425	18 pF; similar to MURATA GRM1552C1H180JZ01D
C1426	27 pF; similar to MURATA GRM1552C1H270FZ01D
C1427	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C1428	1 pF; similar to Taiyo Yuden UMK105CK010CW-F
C1429	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C1430	15 pF; similar to MURATA GRM1552C1H150FZ01D
C1431	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C1432	12 pF; similar to Taiyo Yuden UMK105CH120JV-F
C1433	12 pF; similar to Taiyo Yuden UMK105CH120JV-F
C1434	4 pF; similar to Taiyo Yuden UMK105CH040CW-F
C1435	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C1436	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C1437	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C1438	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C1439	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C1440	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C1442	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C1444	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F

SYMBOL	DESCRIPTION
C1445	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C1451	0.047 uF; similar to MURATA GRM188R11E473KA01D
C1452	0.047 uF; similar to MURATA GRM188R11E473KA01D
C1453	0.01 uF; similar to MURATA GRM155B11E103KA01D
C1454	0.01 uF; similar to MURATA GRM155B11E103KA01D
C1455	22 uF; similar to RUBYCON 35SEV220M 10X10.5
C1456	0.01 uF; similar to MURATA GRM155B11E103KA01D
C1457	0.01 uF; similar to MURATA GRM155B11E103KA01D
C1458	0.047 uF; similar to MURATA GRM188R11E473KA01D
C1459	0.047 uF; similar to MURATA GRM188R11E473KA01D
C1460	0.01 uF; similar to MURATA GRM155B11E103KA01D
C1461	0.01 uF; similar to MURATA GRM155B11E103KA01D
C1463	22 uF; similar to RUBYCON 35SEV220M 10X10.5
C1464	0.01 uF; similar to MURATA GRM155B11E103KA01D
C1465	0.01 uF; similar to MURATA GRM155B11E103KA01D
C1466	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C1467	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C1492	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C1701	0.01 uF; similar to MURATA GRM155B11E103KA01D
C1702	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C1703	1000 pF; similar to Taiyo Yuden UMK105BJ102KV-F
C1704	0.01 uF; similar to MURATA GRM155B11E103KA01D
CV201	VARIABLE TZX3P200A110; similar to MURATA TZX3P200A110R00
CV202	VARIABLE TZX3P200A110; similar to MURATA TZX3P200A110R00
CV203	VARIABLE TZX3P200A110; similar to MURATA TZX3P200A110R00
CV204	VARIABLE TZX3P200A110; similar to MURATA TZX3P200A110R00
CV205	VARIABLE TZX3P200A110; similar to MURATA TZX3P200A110R00
CV206	VARIABLE TZX3P200A110; similar to MURATA TZX3P200A110R00
CV401	VARIABLE TC03C100A; similar to SANSIN TC03C100A-TP02
CV402	VARIABLE TC03C100A; similar to SANSIN TC03C100A-TP02
CV403	VARIABLE TC03C100A; similar to SANSIN TC03C100A-TP02
----- DIODES -----	
CD101	Similar to Litec L709CER

SYMBOL	DESCRIPTION
CD102	Similar to Litec L709CER
CD103	Similar to Litec L709CER
CD104	Similar to Litec L709CER
CD105	Similar to Panasonic MA3X71600L
CD107	Similar to Toshiba 1SS302(TE85L,F)
CD108	Similar to Panasonic MA2J72800L
CD109	Similar to Panasonic MA2J72800L
CD111	Similar to Panasonic MA2J72800L
CD112	Similar to Panasonic MA2J72800L
CD116	Similar to Agilent HSMP-3864-TR1G
CD117	Similar to Agilent HSMP-3864-TR1G
CD120	Similar to Panasonic MA2J72800L
CD121	Similar to Panasonic MA2J72800L
CD122	Similar to Panasonic MA2J72800L
CD201	Similar to Renesas RKV501KJ-R1
CD202	Similar to Renesas RKS151KJ-P1
CD203	Similar to Renesas RKS151KJ-P1
CD204	Similar to Renesas RKV501KJ-R1
CD205	Similar to Renesas RKS151KJ-P1
CD206	Similar to Renesas RKS151KJ-P1
CD207	Similar to Renesas RKV501KJ-R1
CD208	Similar to Renesas RKV501KJ-R1
CD209	Similar to Renesas RKS151KJ-P1
CD210	Similar to Renesas RKS151KJ-P1
CD211	Similar to Renesas RKS151KJ-P1
CD212	Similar to Renesas RKS151KJ-P1
CD213	Similar to Renesas RKV501KJ-R1
CD214	Similar to Renesas RKV501KJ-R1
CD215	Similar to Renesas RKS151KJ-P1
CD216	Similar to Renesas RKS151KJ-P1
CD301	Similar to Agilent HSMP-3864-TR1G
CD302	Similar to Agilent HSMP-3864-TR1G
CD303	Similar to Toko KV1870STL-G
CD304	Similar to Panasonic MA3X71600L
CD310	Similar to Toshiba 1SV276(TPH3,F)
CD311	Similar to Toshiba 1SS381(TPL3,F)
CD312	Similar to Toshiba 1SS381(TPL3,F)
CD401	Similar to Toshiba 1SV228(TPH3,F)
CD402	Similar to Toshiba 1SV228(TPH3,F)
CD403	Similar to Toshiba 1SS381(TPL3,F)
CD404	Similar to Toshiba 1SS381(TPL3,F)

SYMBOL	DESCRIPTION
CD405	Similar to Toshiba 1SS381(TPL3,F)
CD406	Similar to Toshiba 1SS381(TPL3,F)
CD407	Similar to Toshiba 1SV228(TPH3,F)
CD408	Similar to Toshiba 1SV228(TPH3,F)
CD409	Similar to Toshiba 1SS381(TPL3,F)
CD410	Similar to Toshiba 1SS381(TPL3,F)
CD411	Similar to Toshiba 1SS381(TPL3,F)
CD412	Similar to Toshiba 1SS381(TPL3,F)
CD421	Similar to Renesas HVC383BTRF-E
CD422	Similar to Renesas HVC383BTRF-E
CD423	Similar to Renesas HVC383BTRF-E
CD424	Similar to Renesas HVC383BTRF-E
CD425	Similar to Toshiba 1SS381(TPL3,F)
CD426	Similar to Toshiba 1SS381(TPL3,F)
CD427	Similar to Toshiba 1SS381(TPL3,F)
CD428	Similar to Toshiba 1SS381(TPL3,F)
CD429	Similar to Toshiba 1SS381(TPL3,F)
CD430	Similar to Toshiba 1SS381(TPL3,F)
CD431	Similar to Toshiba 1SS381(TPL3,F)
CD432	Similar to Toshiba 1SS381(TPL3,F)
CD501	Similar to Toshiba 02CZ2.4-X(TE85R,F)
CD502	Similar to Renesas HSU88TRF-E
CD503	Similar to Toshiba 02CZ2.4-X(TE85R,F)
CD504	Similar to Renesas HSU88TRF-E
CD702	Similar to Shindengen D1F60-5063
CD703	Similar to Shindengen DF25V60-5072
----- FILTERS -----	
FL301	Similar to NDK H-7XMPD0020
FL302	Similar to NDK H-7XMPD0021
-----CONNECTOR-----	
J701	40-pin; similar to Suyin Conne 127180MA040G200ZR
----- INDUCTORS -----	
L104	68 nH; similar to TOKO LL1005-FHL68NJ
L105	47 nH; similar to TOKO LL1005-FHL47NJ
L106	22 nH; similar to TOKO LLQ2012-F22NJ
L107	33 nH; similar to TOKO LL1608-FSL33NJ
L110	0.7 uH; similar to KORIN AS050847D-700N
L111	31.8 nH; similar to KORIN AS100547-31R8NJ
L112	23.9 nH; similar to KORIN AS100447-23R9NJ
L113	31.8 nH; similar to KORIN AS100547-31R8NJ
L114	33.7 nH; similar to KORIN AS080447-33R7NJ

SYMBOL	DESCRIPTION
L115	33.7 nH; similar to KORIN AS080447-33R7NJ
L116	160 nH; similar to KORIN AS050847-160NJ-T
L117	60 nH; similar to KORIN AS030921-60NJ-T
L118	60 nH; similar to KORIN AS030921-60NJ-T
L120	0.27 uH; similar to TOKO LLQ1608-FR27G
L121	0.27 uH; similar to TOKO LLQ1608-FR27G
L122	0.27 uH; similar to TOKO LLQ1608-FR27G
L130	56 nH; similar to TOKO LL1005-FHL56NJ
L132	68 nH; similar to TOKO LL1005-FHL68NJ
L201	15 nH; similar to KORIN AS120352-15NJ-T
L202	0.68 uH; similar to TOKO LLQ2012-FR68J
L203	0.68 uH; similar to TOKO LLQ2012-FR68J
L204	15 nH; similar to KORIN AS120352-15NJ-T
L205	39 nH; similar to TOKO LL1005-FHL39NJ
L206	47 nH; similar to TOKO LL1005-FHL47NJ
L207	0.27 uH; similar to TOKO LLQ2012-FR27J
L208	0.68 uH; similar to TOKO LLQ2012-FR68J
L209	0.68 uH; similar to TOKO LLQ2012-FR68J
L210	30 nH; similar to KORIN AS050530-30NK-T
L211	30 nH; similar to KORIN AS050530-30NK-T
L212	0.68 uH; similar to TOKO LLQ2012-FR68J
L213	0.68 uH; similar to TOKO LLQ2012-FR68J
L214	0.27 uH; similar to TOKO LLQ2012-FR27J
L216	0.1 uH; similar to TOKO LL1005-FHLR10J
L217	0.27 uH; similar to TOKO LLQ2012-FR27J
L218	0.68 uH; similar to TOKO LLQ2012-FR68J
L219	0.68 uH; similar to TOKO LLQ2012-FR68J
L220	30 nH; similar to KORIN AS050530-30NK-T
L221	30 nH; similar to KORIN AS050530-30NK-T
L222	0.68 uH; similar to TOKO LLQ2012-FR68J
L223	0.68 uH; similar to TOKO LLQ2012-FR68J
L224	0.27 uH; similar to TOKO LLQ2012-FR27J
L301	0.82 uH; similar to TOKO LLQ2012-FR82J
L302	0.82 uH; similar to TOKO LLQ2012-FR82J
L303	0.56 uH; similar to TOKO LLQ2012-FR56J
L304	0.68 uH; similar to TOKO LLQ2012-FR68J
L305	0.68 uH; similar to TOKO LLQ2012-FR68J
L306	0.39 uH; similar to TOKO LLQ2012-FR39J
L307	0.82 uH; similar to TOKO LLQ2012-FR82J
L308	0.82 uH; similar to TOKO LLQ2012-FR82J
L309	0.82 uH; similar to TOKO LLQ2012-FR82J

SYMBOL	DESCRIPTION
L310	0.47 uH; similar to Taiyo Yuden LK1608 R47K-T
L311	10 uH; similar to MURATA LQH32CN100K23L
L312	10 uH; similar to MURATA LQH32CN100K23L
L313	1.2 uH; similar to MURATA LQH31MN1R2K03L
L315	0.27 uH; similar to TOKO LL1608-FSLR27J
L316	0.18 uH; similar to TOKO LL1608-FSLR18J
L317	0.39 uH; similar to Taiyo Yuden LK1005 R39K-T
L320	15 uH; similar to MURATA LQH31MN150J03L
L321	15 uH; similar to MURATA LQH31MN150J03L
L322	0.27 uH; similar to TOKO LLQ2012-FR27G
L323	0.82 uH; similar to TOKO LLQ2012-FR82J
L324	0.82 uH; similar to TOKO LLQ2012-FR82J
L325	0.47 uH; similar to Taiyo Yuden LK1608 R47K-T
L327	0.56 uH; similar to Taiyo Yuden LK1608 R56K-T
L328	0.12 uH; similar to TOKO LL1608-FSLR12J
L401	2.2 uH; similar to TOKO #FSLM2520-2R2J=P2
L402	2.2 uH; similar to TOKO #FSLM2520-2R2J=P2
L403	Similar to MIDORI H-7LAPD0053
L404	3.3 uH; similar to TOKO #FSLM2520-3R3J=P2
L405	3.3 uH; similar to TOKO #FSLM2520-3R3J=P2
L406	3.3 uH; similar to TOKO #FSLM2520-3R3J=P2
L407	3.3 uH; similar to TOKO #FSLM2520-3R3J=P2
L408	0.1 uH; similar to TOKO LL1005-FHLR10J
L409	0.47 uH; similar to TOKO LLQ1608-FR47J
L410	2.2 uH; similar to TOKO #FSLM2520-2R2J=P2
L411	2.2 uH; similar to TOKO #FSLM2520-2R2J=P2
L412	Similar to MIDORI H-7LAPD0052
L413	3.3 uH; similar to TOKO #FSLM2520-3R3J=P2
L414	3.3 uH; similar to TOKO #FSLM2520-3R3J=P2
L415	3.3 uH; similar to TOKO #FSLM2520-3R3J=P2
L416	3.3 uH; similar to TOKO #FSLM2520-3R3J=P2
L417	0.1 uH; similar to TOKO LL1005-FHLR10J
L418	0.47 uH; similar to TOKO LLQ1608-FR47J
L419	68 nH; similar to TOKO LL1608-FSL68NJ
L420	27 nH; similar to TOKO LL1608-FSL27NJ
L421	47 nH; similar to TOKO LLQ2012-F47NJ
L423	56 nH; similar to TOKO LLQ2012-F56NJ
L430	27 nH; similar to TOKO LLQ2012-F27NG
L441	0.22 uH; similar to TOKO LLQ1608-FR22J
L442	0.22 uH; similar to TOKO LLQ1608-FR22J
L443	Similar to MIDORI H-7LAPD0054

SYMBOL	DESCRIPTION
L444	0.47 uH; similar to TOKO LLQ1608-FR47J
L445	0.47 uH; similar to TOKO LLQ1608-FR47J
L446	0.47 uH; similar to TOKO LLQ1608-FR47J
L447	0.47 uH; similar to TOKO LLQ1608-FR47J
L448	0.47 uH; similar to TOKO LLQ1608-FR47J
L449	0.47 uH; similar to TOKO LLQ1608-FR47J
L450	0.47 uH; similar to TOKO LLQ1608-FR47J
L451	0.47 uH; similar to TOKO LLQ1608-FR47J
L452	10 nH; similar to TOKO LL1005-FHL10NJ
L453	10 nH; similar to TOKO LL1005-FHL10NJ
L454	39 nH; similar to TOKO LL1608-FSL39NJ
L455	15 nH; similar to TOKO LL1005-FHL15NJ
L456	4.7 uH; similar to MURATA LQH31MN4R7J03L
L457	4.7 uH; similar to MURATA LQH31MN4R7J03L
L503	39 nH; similar to TOKO LL1005-FHL39NJ
L601	1 uH; similar to MURATA LQH31MN1R0K03L
L605	47 nH; similar to TOKO LLQ1608-F47NJ
L606	47 nH; similar to TOKO LLQ1608-F47NJ
L607	47 nH; similar to TOKO LLQ1608-F47NJ
----- FILTERS -----	
L702	600-ohm; similar to MURATA BLM18BD601SN1D
L703	600-ohm; similar to MURATA BLM18BD601SN1D
L704	600-ohm; similar to MURATA BLM18BD601SN1D
L705	600-ohm; similar to MURATA BLM18BD601SN1D
L706	600-ohm; similar to MURATA BLM18BD601SN1D
L707	600-ohm; similar to MURATA BLM18BD601SN1D
L708	600-ohm; similar to MURATA BLM18BD601SN1D
L709	600-ohm; similar to MURATA BLM18BD601SN1D
L710	600-ohm; similar to MURATA BLM18BD601SN1D
L711	600-ohm; similar to MURATA BLM18BD601SN1D
L713	600-ohm; similar to MURATA BLM18BD601SN1D
L714	600-ohm; similar to MURATA BLM18BD601SN1D
L717	600-ohm; similar to MURATA BLM18BD601SN1D
L719	600-ohm; similar to MURATA BLM18BD601SN1D
L720	600-ohm; similar to MURATA BLM18BD601SN1D
L721	600-ohm; similar to MURATA BLM18BD601SN1D
L722	600-ohm; similar to MURATA BLM18BD601SN1D
L723	600-ohm; similar to MURATA BLM18BD601SN1D
L801	1 uH; similar to MURATA LQH31MN1R0K03L
L802	1 uH; similar to MURATA LQH31MN1R0K03L

SYMBOL	DESCRIPTION
-----TRANSISTORS-----	
TR102	Similar to NEC 2SC3357-T1-A RF
TR103	Similar to Mitsubishi RD01MUS1-T113
TR104	Similar to ROHM 2SD1781KT146R
TR110	Similar to NEC 2SB798-T2-AZ DK
TR111	Similar to Toshiba RN1301(TE85L,F)
TR114	Similar to NEC 2SB798-T2-AZ DK
TR115	Similar to Toshiba RN1301(TE85L,F)
TR116	Similar to ROHM 2SD1781KT146R
TR117	Similar to Panasonic XP0121600L
TR119	Similar to ROHM 2SD1781KT146R
TR120	Similar to Toshiba RN1501(TE85L,F)
TR201	Similar to NEC 2SC5337-T1-AZ QS
TR202	Similar to NEC 2SC5337-T1-AZ QS
TR203	Similar to ROHM 2SD1781KT146R
TR301	Similar to On Semiconductor MMBFJ310LT1G
TR302	Similar to On Semiconductor MMBFJ310LT1G
TR303	Similar to Toshiba 2SC2714-Y(TE85L,F)
TR304	Similar to Toshiba 2SC2714-Y(TE85L,F)
TR305	Similar to Toshiba 2SC2714-Y(TE85L,F)
TR310	Similar to NEC 2SC3356-T1B-A R
TR311	Similar to Toshiba 2SC2714-Y(TE85L,F)
TR312	Similar to Toshiba 2SC2714-Y(TE85L,F)
TR313	Similar to ROHM 2SD1781KT146R
TR314	Similar to Panasonic XP0121600L
TR401	Similar to Renesas 2SC5772FR-TL-E
TR402	Similar to Toshiba RN1305(TE85L,F)
TR403	Similar to Toshiba RN1305(TE85L,F)
TR404	Similar to Renesas 2SC5772FR-TL-E
TR405	Similar to Toshiba RN1301(TE85L,F)
TR406	Similar to Toshiba RN1305(TE85L,F)
TR407	Similar to NEC 2SC3356-T1B-A R
TR408	Similar to NEC 2SC3357-T1-A RF
TR409	Similar to NEC 2SC3357-T1-A RF
TR411	Similar to Panasonic XP0121600L
TR412	Similar to Panasonic XP0121600L
TR413	Similar to Panasonic XP0121600L
TR414	Similar to Panasonic XP0121600L
TR415	Similar to Panasonic XP0121600L
TR416	Similar to Panasonic XP0121600L
TR421	Similar to Renesas 2SC5890FS-TL-E

SYMBOL	DESCRIPTION
TR422	Similar to NEC 2SC3356-T1B-A R
TR423	Similar to Toshiba RN1305(TE85L,F)
TR424	Similar to ROHM 2SD1781KT146R
TR425	Similar to ROHM 2SD1781KT146R
TR501	Similar to Sanyo 2SK536-TB-E
TR502	Similar to ROHM 2SA1037AKT146R
TR503	Similar to Toshiba RN1301(TE85L,F)
TR504	Similar to Toshiba RN1301(TE85L,F)
TR505	Similar to Sanyo 2SK536-TB-E
TR506	Similar to Sanyo 2SK536-TB-E
TR508	Similar to Toshiba 2SC2712-BL(TE85L,F)
TR509	Similar to NEC 2SC3356-T1B-A R
TR510	Similar to Sanyo 2SK536-TB-E
TR511	Similar to ROHM 2SA1037AKT146R
TR512	Similar to Toshiba RN1301(TE85L,F)
TR513	Similar to Toshiba RN1301(TE85L,F)
TR514	Similar to Sanyo 2SK536-TB-E
TR515	Similar to Sanyo 2SK536-TB-E
TR516	Similar to NEC 2SC3356-T1B-A R
TR601	Similar to ROHM QS6M3TR
----- RESISTORS -----	
R101	180 ohm; similar to Panasonic ERJ2GEJ181X
R102	180 ohm; similar to Panasonic ERJ2GEJ181X
R103	27 ohm; similar to Panasonic ERJ2GEJ270X
R112	150 ohm; similar to Panasonic ERJ2GEJ151X
R113	150 ohm; similar to Panasonic ERJ2GEJ151X
R114	39 ohm; similar to Panasonic ERJ2GEJ390X
R115	5.6K ohm; similar to Panasonic ERJ2GEJ562X
R116	2.7K ohm; similar to Panasonic ERJ2GEJ272X
R117	1k ohm; similar to Panasonic ERJ2GEJ102X
R118	33 ohm; similar to Panasonic ERJ14YJ330U
R120	10 ohm; similar to Panasonic ERJ2GEJ100X
R121	470 ohm; similar to Panasonic ERJ2GEJ471X
R122	470 ohm; similar to Panasonic ERJ2GEJ471X
R123	12 ohm; similar to Panasonic ERJ2GEJ120X
R124	0 ohm; similar to Panasonic ERJ2GE0R00X
R125	2.7K ohm; similar to Panasonic ERJ2GEJ272X
R126	1.2K ohm; similar to Panasonic ERJ2GEJ122X
R127	270 ohm; similar to Panasonic ERJ2GEJ271X
R128	0 ohm; similar to Panasonic ERJ14Y0R00U
R129	270 ohm; similar to Panasonic ERJ2GEJ271X

SYMBOL	DESCRIPTION
R130	5.6 ohm; similar to Panasonic ERJ2GEJ5R6X
R133	560 ohm; similar to Panasonic ERJ2GEJ561X
R134	680 ohm; similar to Panasonic ERJ2GEJ681X
R135	270 ohm; similar to Panasonic ERJ2GEJ271X
R136	270 ohm; similar to Panasonic ERJ2GEJ271X
R137	18 ohm; similar to Panasonic ERJ2GEJ180X
R138	12k ohm; similar to Panasonic ERJ6GEYJ123V
R139	100k ohm; similar to Panasonic ERJ14YJ104U
R145	10k ohm; similar to Panasonic ERJ2GEJ103X
R146	1k ohm; similar to Panasonic ERJ2GEJ102X
R148	100k ohm; similar to Panasonic ERJ2GEJ104X
R149	15k ohm; similar to Panasonic ERJ2GEJ153X
R150	1k ohm; similar to Panasonic ERJ2GEJ102X
R151	120 ohm; similar to Panasonic ERJ1TYJ121U
R152	120 ohm; similar to Panasonic ERJ1TYJ121U
R153	68 ohm; similar to Panasonic ERJ6GEYJ680V
R154	82 ohm; similar to Panasonic ERJ6GEYJ820V
R155	82 ohm; similar to Panasonic ERJ6GEYJ820V
R156	91 ohm; similar to Panasonic ERJ6GEYJ910V
R157	100k ohm; similar to Panasonic ERJ2GEJ104X
R158	100k ohm; similar to Panasonic ERJ2GEJ104X
R159	0 ohm; similar to Panasonic ERJ2GE0R00X
R160	1k ohm; similar to Panasonic ERJ2GEJ102X
R161	100k ohm; similar to Panasonic ERJ2GEJ104X
R162	100k ohm; similar to Panasonic ERJ2GEJ104X
R163	1.5k ohm; similar to Panasonic ERJ2GEJ152X
R164	27k ohm; similar to Panasonic ERJ2GEJ273X
R165	100 ohm; similar to Panasonic ERJ2GEJ101X
R166	3.9k ohm; similar to Panasonic ERJ2GEJ392X
R167	1k ohm; similar to Panasonic ERJ2GEJ102X
R168	4.7k ohm; similar to Panasonic ERJ2GEJ472X
R169	820 ohm; similar to Panasonic ERJ2GEJ821X
R170	4.7k ohm; similar to Panasonic ERJ2GEJ472X
R171	56k ohm; similar to Panasonic ERJ2GEJ563X
R172	0 ohm; similar to Panasonic ERJ2GE0R00X
R174	0 ohm; similar to Panasonic ERJ2GE0R00X
R175	10k ohm; similar to Panasonic ERJ2GEJ103X
R181	8.2k ohm; similar to Panasonic ERJ2GEJ822X
R182	1.2k ohm; similar to Panasonic ERJ2GEJ122X
R185	8.2k ohm; similar to Panasonic ERJ2GEJ822X
R186	1.2k ohm; similar to Panasonic ERJ2GEJ122X

SYMBOL	DESCRIPTION
R187	10k ohm; similar to Panasonic ERJ2GEJ103X
R188	2.2k ohm; similar to Panasonic ERJ2GEJ222X
R189	47k ohm; similar to Panasonic ERJ2GEJ473X
R190	1.5k ohm; similar to Panasonic ERJ2GEJ152X
R191	1.5k ohm; similar to Panasonic ERJ2GEJ152X
R192	560 ohm; similar to Panasonic ERJ2GEJ561X
R193	2.2k ohm; similar to Panasonic ERJ2GEJ222X
R194	2.2k ohm; similar to Panasonic ERJ2GEJ222X
R195	560 ohm; similar to Panasonic ERJ2GEJ561X
R196	150 ohm; similar to Panasonic ERJ2GEJ151X
R197	0 ohm; similar to Panasonic ERJ2GE0R00X
R198	560 ohm; similar to Panasonic ERJ2GEJ561X
R201	56k ohm; similar to Panasonic ERJ2GEJ563X
R202	1.5k ohm; similar to Panasonic ERJ2GEJ152X
R203	3.3k ohm; similar to Panasonic ERJ2GEJ332X
R204	56k ohm; similar to Panasonic ERJ2GEJ563X
R205	3.3k ohm; similar to Panasonic ERJ2GEJ332X
R206	1k ohm; similar to Panasonic ERJ2GEJ102X
R207	10 ohm; similar to Panasonic ERJ2GEJ100X
R208	1k ohm; similar to Panasonic ERJ2GEJ102X
R209	18 ohm; similar to Panasonic ERJ6GEYJ180V
R211	470 ohm; similar to Panasonic ERJ2GEJ471X
R212	470 ohm; similar to Panasonic ERJ2GEJ471X
R213	12 ohm; similar to Panasonic ERJ2GEJ120X
R214	3.3k ohm; similar to Panasonic ERJ2GEJ332X
R215	1.5k ohm; similar to Panasonic ERJ2GEJ152X
R216	56k ohm; similar to Panasonic ERJ2GEJ563X
R217	100K ohm; similar to Panasonic ERJ2GEJ104X
R218	100K ohm; similar to Panasonic ERJ2GEJ104X
R219	1.5K ohm; similar to Panasonic ERJ2GEJ152X
R220	3.3K ohm; similar to Panasonic ERJ2GEJ332X
R221	33 ohm; similar to Panasonic ERJ2GEJ330X
R222	1.5K ohm; similar to Panasonic ERJ2GEJ152X
R223	470 ohm; similar to Panasonic ERJ2GEJ471X
R224	10 ohm; similar to Panasonic ERJ8GEYJ100V
R227	470 ohm; similar to Panasonic ERJ2GEJ471X
R228	0 ohm; similar to Panasonic ERJ2GE0R00X
R229	10 ohm; similar to Panasonic ERJ8GEYJ100V
R231	33 ohm; similar to Panasonic ERJ2GEJ330X
R232	3.9K ohm; similar to Panasonic ERJ2GEJ392X
R233	3.9K ohm; similar to Panasonic ERJ2GEJ392X

SYMBOL	DESCRIPTION
R234	560 ohm; similar to Panasonic ERJ8GEYJ561V
R236	3.3K ohm; similar to Panasonic ERJ2GEJ332X
R237	1.5K ohm; similar to Panasonic ERJ2GEJ152X
R238	100K ohm; similar to Panasonic ERJ2GEJ104X
R239	100K ohm; similar to Panasonic ERJ2GEJ104X
R240	56K ohm; similar to Panasonic ERJ2GEJ563X
R241	1.5K ohm; similar to Panasonic ERJ2GEJ152X
R242	3.3K ohm; similar to Panasonic ERJ2GEJ332X
R243	470 ohm; similar to Panasonic ERJ2GEJ471X
R244	470 ohm; similar to Panasonic ERJ2GEJ471X
R245	12 ohm; similar to Panasonic ERJ8GEYJ120V
R246	270 ohm; similar to Panasonic ERJ2GEJ271X
R248	270 ohm; similar to Panasonic ERJ2GEJ271X
R249	18 ohm; similar to Panasonic ERJ2GEJ180X
R301	56 ohm; similar to Panasonic ERJ2GEJ560X
R302	10 ohm; similar to Panasonic ERJ2GEJ100X
R303	1.2K ohm; similar to Panasonic ERJ2GEJ122X
R304	1.8K ohm; similar to Panasonic ERJ2GEJ182X
R305	1.8K ohm; similar to Panasonic ERJ2GEJ182X
R306	330 ohm; similar to Panasonic ERJ2GEJ331X
R307	1.8K ohm; similar to Panasonic ERJ2GEJ182X
R308	330k ohm; similar to Panasonic ERJ2GEJ334X
R310	330 ohm; similar to Panasonic ERJ2GEJ331X
R311	560 ohm; similar to Panasonic ERJ2GEJ561X
R312	10 ohm; similar to Panasonic ERJ2GEJ100X
R315	330k ohm; similar to Panasonic ERJ2GEJ334X
R317	330 ohm; similar to Panasonic ERJ2GEJ331X
R318	220 ohm; similar to Panasonic ERJ2GEJ221X
R319	10 ohm; similar to Panasonic ERJ2GEJ100X
R321	82 ohm; similar to Panasonic ERJ2GEJ820X
R322	82 ohm; similar to Panasonic ERJ2GEJ820X
R323	100 ohm; similar to Panasonic ERJ2GEJ101X
R324	560 ohm; similar to Panasonic ERJ2GEJ561X
R325	390 ohm; similar to Panasonic ERJ2GEJ391X
R326	2.2k ohm; similar to Panasonic ERJ2GEJ222X
R327	2.2k ohm; similar to Panasonic ERJ2GEJ222X
R328	680 ohm; similar to Panasonic ERJ2GEJ681X
R329	2.2k ohm; similar to Panasonic ERJ2GEJ222X
R330	560 ohm; similar to Panasonic ERJ2GEJ561X
R331	18 ohm; similar to Panasonic ERJ2GEJ180X
R332	18 ohm; similar to Panasonic ERJ2GEJ180X

SYMBOL	DESCRIPTION
R333	39 ohm; similar to Panasonic ERJ2GEJ390X
R335	47 ohm; similar to Panasonic ERJ2GEJ470X
R337	10k ohm; similar to Panasonic ERJ2GEJ103X
R338	1.5K ohm; similar to Panasonic ERJ2GEJ152X
R339	12k ohm; similar to Panasonic ERJ2GEJ123X
R340	1k ohm; similar to Panasonic ERJ2GEJ102X
R341	68 ohm; similar to Panasonic ERJ2GEJ680X
R342	22k ohm; similar to Panasonic ERJ2GEJ223X
R345	47 ohm; similar to Panasonic ERJ2GEJ470X
R348	100K ohm; similar to Panasonic ERJ2GEJ104X
R349	47 ohm; similar to Panasonic ERJ2GEJ470X
R351	2.2k ohm; similar to Panasonic ERJ2GEJ222X
R352	1k ohm; similar to Panasonic ERJ2GEJ102X
R353	820 ohm; similar to Panasonic ERJ2GEJ821X
R354	22k ohm; similar to Panasonic ERJ2GEJ223X
R357	82 ohm; similar to Panasonic ERJ2GEJ820X
R358	33 ohm; similar to Panasonic ERJ2GEJ330X
R359	33 ohm; similar to Panasonic ERJ2GEJ330X
R360	33 ohm; similar to Panasonic ERJ2GEJ330X
R362	47 ohm; similar to Panasonic ERJ2GEJ470X
R363	100K ohm; similar to Panasonic ERJ2GEJ104X
R365	1.5K; similar to Panasonic ERJ2GEJ152X
R366	1k ohm; similar to Panasonic ERJ2GEJ102X
R367	820 ohm; similar to Panasonic ERJ2GEJ821X
R368	1k ohm; similar to Panasonic ERJ2GEJ102X
R401	6.8k ohm; similar to KOA RN731ETTP6801F50
R402	2.2k ohm; similar to KOA RN731ETTP2201F50
R403	82 ohm; similar to KOA RN731ETTP82R0F50
R404	6.8k ohm; similar to KOA RN731ETTP6801F50
R405	2.2k ohm; similar to KOA RN731ETTP2201F50
R406	100 ohm; similar to KOA RN731ETTP1000F50
R407	3.9k ohm; similar to Panasonic ERJ2GEJ392X
R408	5.6K ohm; similar to Panasonic ERJ2GEJ562X
R409	1.5K ohm; similar to Panasonic ERJ2GEJ152X
R410	100 ohm; similar to Panasonic ERJ2GEJ101X
R411	18 ohm; similar to Panasonic ERJ2GEJ180X
R412	18 ohm; similar to Panasonic ERJ2GEJ180X
R413	39 ohm; similar to Panasonic ERJ2GEJ390X
R414	4.7k ohm; similar to Panasonic ERJ2GEJ472X
R415	4.7k ohm; similar to Panasonic ERJ2GEJ472X
R416	220 ohm; similar to Panasonic ERJ2GEJ221X

SYMBOL	DESCRIPTION
R417	22 ohm; similar to Panasonic ERJ2GEJ220X
R418	18 ohm; similar to Panasonic ERJ2GEJ180X
R419	6.8k ohm; similar to Panasonic ERJ2GEJ682X
R420	3.3K ohm; similar to Panasonic ERJ2GEJ332X
R421	1k ohm; similar to Panasonic ERJ2GEJ102X
R422	18 ohm; similar to Panasonic ERJ2GEJ180X
R423	47 ohm; similar to Panasonic ERJ6GEYJ470V
R428	4.7k ohm; similar to Panasonic ERJ2GEJ472X
R429	560 ohm; similar to Panasonic ERJ8GEYJ561V
R430	0 ohm; similar to Panasonic ERJ2GE0R00X
R431	4.7k ohm; similar to Panasonic ERJ2GEJ472X
R432	560 ohm; similar to Panasonic ERJ8GEYJ561V
R434	4.7k ohm; similar to Panasonic ERJ2GEJ472X
R435	560 ohm; similar to Panasonic ERJ8GEYJ561V
R437	4.7k ohm; similar to Panasonic ERJ2GEJ472X
R438	560 ohm; similar to Panasonic ERJ8GEYJ561V
R440	4.7k ohm; similar to Panasonic ERJ2GEJ472X
R441	560 ohm; similar to Panasonic ERJ8GEYJ561V
R443	4.7k ohm; similar to Panasonic ERJ2GEJ472X
R444	560 ohm; similar to Panasonic ERJ8GEYJ561V
R451	1.8k ohm; similar to KOA RN731ETTP1801F50
R452	2.2k ohm; similar to KOA RN731ETTP2201F50
R453	270 ohm; similar to KOA RN731ETTP2700F50
R454	5.6K ohm; similar to Panasonic ERJ2GEJ562X
R455	1.5K ohm; similar to Panasonic ERJ2GEJ152X
R456	100 ohm; similar to Panasonic ERJ2GEJ101X
R457	18 ohm; similar to Panasonic ERJ2GEJ180X
R458	18 ohm; similar to Panasonic ERJ2GEJ180X
R459	47 ohm; similar to Panasonic ERJ2GEJ470X
R460	330 ohm; similar to Panasonic ERJ14YJ331U
R461	330 ohm; similar to Panasonic ERJ14YJ331U
R502	27K ohm; similar to Panasonic ERJ2GEJ273X
R503	4.7k ohm; similar to Panasonic ERJ2GEJ472X
R504	22 ohm; similar to Panasonic ERJ2GEJ220X
R505	2.2k ohm; similar to Panasonic ERJ2GEJ222X
R506	1k ohm; similar to Panasonic ERJ2GEJ102X
R507	820 ohm; similar to Panasonic ERJ2GEJ821X
R508	330 ohm; similar to Panasonic ERJ12YJ331U
R509	47 ohm; similar to Panasonic ERJ2GEJ470X
R510	470 ohm; similar to Panasonic ERJ2GEJ471X
R511	2.2k ohm; similar to Panasonic ERJ2GEJ222X

SYMBOL	DESCRIPTION
R512	1M ohm; similar to Panasonic ERJ2GEJ105X
R513	180 ohm; similar to Panasonic ERJ2GEJ181X
R514	150k ohm; similar to Panasonic ERJ2GEJ154X
R515	8.2k ohm; similar to Panasonic ERJ2GEJ822X
R516	180 ohm; similar to Panasonic ERJ2GEJ181X
R517	1k ohm; similar to Panasonic ERJ2GEJ102X
R518	0 ohm; similar to Panasonic ERJ2GE0R00X
R519	0 ohm; similar to Panasonic ERJ2GE0R00X
R521	150k ohm; similar to Panasonic ERJ2GEJ154X
R523	470 ohm; similar to Panasonic ERJ2GEJ471X
R524	47 ohm; similar to Panasonic ERJ2GEJ470X
R525	47 ohm; similar to Panasonic ERJ2GEJ470X
R528	0 ohm; similar to Panasonic ERJ2GE0R00X
R529	10 ohm; similar to Panasonic ERJ6GEYJ100V
R530	120K ohm; similar to Panasonic ERJ2GEJ124X
R531	27 ohm; similar to Panasonic ERJ2GEJ270X
R532	82 ohm; similar to Panasonic ERJ2GEJ820X
R533	120 ohm; similar to Panasonic ERJ2GEJ121X
R535	27K ohm; similar to Panasonic ERJ2GEJ273X
R536	4.7k ohm; similar to Panasonic ERJ2GEJ472X
R537	22 ohm; similar to Panasonic ERJ2GEJ220X
R538	2.2k ohm; similar to Panasonic ERJ2GEJ222X
R539	1k ohm; similar to Panasonic ERJ2GEJ102X
R540	820 ohm; similar to Panasonic ERJ2GEJ821X
R541	330 ohm; similar to Panasonic ERJ12YJ331U
R542	2.2k ohm; similar to Panasonic ERJ2GEJ222X
R543	470 ohm; similar to Panasonic ERJ2GEJ471X
R544	47 ohm; similar to Panasonic ERJ2GEJ470X
R545	1M ohm; similar to Panasonic ERJ2GEJ105X
R546	180 ohm; similar to Panasonic ERJ2GEJ181X
R547	180k ohm; similar to Panasonic ERJ2GEJ184X
R548	6.8k ohm; similar to Panasonic ERJ2GEJ682X
R549	180 ohm; similar to Panasonic ERJ2GEJ181X
R550	1k ohm; similar to Panasonic ERJ2GEJ102X
R551	0 ohm; similar to Panasonic ERJ2GE0R00X
R552	47 ohm; similar to Panasonic ERJ2GEJ470X
R555	0 ohm; similar to Panasonic ERJ2GE0R00X
R556	2.7k ohm; similar to Panasonic ERJ6GEYJ272V
R557	270K ohm; similar to Panasonic ERJ2GEJ274X
R558	39 ohm; similar to Panasonic ERJ2GEJ390X
R559	220 ohm; similar to Panasonic ERJ2GEJ221X

SYMBOL	DESCRIPTION
R560	27 ohm; similar to Panasonic ERJ2GEJ270X
R561	0 ohm; similar to Panasonic ERJ2GE0R00X
R562	0 ohm; similar to Panasonic ERJ2GE0R00X
R563	0 ohm; similar to Panasonic ERJ2GE0R00X
R564	0 ohm; similar to Panasonic ERJ2GE0R00X
R601	10k ohm; similar to Panasonic ERJ2GEJ103X
R602	10k ohm; similar to Panasonic ERJ2GEJ103X
R603	10k ohm; similar to Panasonic ERJ2GEJ103X
R604	10k ohm; similar to Panasonic ERJ2GEJ103X
R605	10k ohm; similar to Panasonic ERJ2GEJ103X
R606	10k ohm; similar to Panasonic ERJ2GEJ103X
R607	15K ohm; similar to Panasonic ERJ2GEJ153X
R608	10k ohm; similar to Panasonic ERJ2GEJ103X
R609	15K ohm; similar to Panasonic ERJ2GEJ153X
R610	10k ohm; similar to Panasonic ERJ2GEJ103X
R611	18k ohm; similar to Panasonic ERJ2GEJ183X
R612	18k ohm; similar to Panasonic ERJ2GEJ183X
R613	18k ohm; similar to Panasonic ERJ2GEJ183X
R617	1k ohm; similar to Panasonic ERJ2GEJ102X
R618	1k ohm; similar to Panasonic ERJ2GEJ102X
R621	2.2k ohm; similar to Panasonic ERJ2RKF222X
R622	2.7k ohm; similar to Panasonic ERJ2RKF272X
R623	18k ohm; similar to Panasonic ERJ2RKF183X
R624	10k ohm; similar to Panasonic ERJ2RKF103X
R625	10k ohm; similar to Panasonic ERJ2RKF103X
R626	3.3k ohm; similar to Panasonic ERJ2RKF332X
R627	1.2k ohm; similar to Panasonic ERJ2RKF122X
R628	10k ohm; similar to Panasonic ERJ2GEJ103X
R629	10k ohm; similar to Panasonic ERJ2RKF103X
R630	10k ohm; similar to Panasonic ERJ2RKF103X
R631	2.2k ohm; similar to Panasonic ERJ2RKF222X
R632	2.7k ohm; similar to Panasonic ERJ2RKF272X
R633	18k ohm; similar to Panasonic ERJ2RKF183X
R634	10k ohm; similar to Panasonic ERJ2RKF103X
R635	10k ohm; similar to Panasonic ERJ2RKF103X
R636	3.3k ohm; similar to Panasonic ERJ2RKF332X
R637	1.2k ohm; similar to Panasonic ERJ2RKF122X
R638	56k ohm; similar to Panasonic ERJ2RKF563X
R639	2.2k ohm; similar to Panasonic ERJ2RKF222X
R640	2.7k ohm; similar to Panasonic ERJ2RKF272X
R641	18k ohm; similar to Panasonic ERJ2RKF183X

SYMBOL	DESCRIPTION
R642	10k ohm; similar to Panasonic ERJ2RKF103X
R643	10k ohm; similar to Panasonic ERJ2RKF103X
R644	3.3k ohm; similar to Panasonic ERJ2RKF332X
R645	1.2k ohm; similar to Panasonic ERJ2RKF122X
R646	10k ohm; similar to Panasonic ERJ2GEJ103X
R647	10k ohm; similar to Panasonic ERJ2RKF103X
R648	10k ohm; similar to Panasonic ERJ2RKF103X
R649	2.2k ohm; similar to Panasonic ERJ2RKF222X
R650	2.7k ohm; similar to Panasonic ERJ2RKF272X
R651	18k ohm; similar to Panasonic ERJ2RKF183X
R652	10k ohm; similar to Panasonic ERJ2RKF103X
R653	10k ohm; similar to Panasonic ERJ2RKF103X
R654	3.3k ohm; similar to Panasonic ERJ2RKF332X
R655	1.2k ohm; similar to Panasonic ERJ2RKF122X
R656	56k ohm; similar to Panasonic ERJ2RKF563X
R657	270 ohm; similar to Panasonic ERJ2GEJ271X
R658	18 ohm; similar to Panasonic ERJ2GEJ180X
R659	270 ohm; similar to Panasonic ERJ2GEJ271X
R701	33K ohm; similar to Panasonic ERJ2GEJ333X
R702	33K ohm; similar to Panasonic ERJ2GEJ333X
R703	10k ohm; similar to Panasonic ERJ2GEJ103X
R704	22k ohm; similar to Panasonic EXB28V223JX
R708	22k ohm; similar to Panasonic ERJ2GEJ223X
R709	22k ohm; similar to Panasonic ERJ2GEJ223X
R710	22k ohm; similar to Panasonic ERJ2GEJ223X
R714	1.5K ohm; similar to Panasonic ERJ2GEJ152X
R715	47K ohm; similar to Panasonic ERJ2GEJ473X
R716	47K ohm; similar to Panasonic ERJ2GEJ473X
R717	12k ohm; similar to Panasonic ERJ2GEJ123X
R718	22k ohm; similar to Panasonic ERJ2GEJ223X
R719	22k ohm; similar to Panasonic ERJ2GEJ223X
R720	22k ohm; similar to Panasonic ERJ2GEJ223X
R721	22k ohm; similar to Panasonic EXB28V223JX
R726	33 ohm; similar to Panasonic ERJ2GEJ330X
R727	33 ohm; similar to Panasonic ERJ2GEJ330X
R728	0 ohm; similar to Panasonic ERJ2GE0R00X
R730	0 ohm; similar to Panasonic ERJ2GE0R00X
R731	10k ohm; similar to Panasonic ERJ2GEJ103X
R732	10k ohm; similar to Panasonic ERJ2GEJ103X
R733	10k ohm; similar to Panasonic EXB28V103JX
R737	10k ohm; similar to Panasonic ERJ2GEJ103X

SYMBOL	DESCRIPTION
R738	0 ohm; similar to Panasonic ERJ2GE0R00X
R739	0 ohm; similar to Panasonic ERJ2GE0R00X
R744	10k ohm; similar to Panasonic ERJ2GEJ103X
R745	27K ohm; similar to Panasonic ERJ2GEJ273X
R746	2.2 ohm; similar to Panasonic ERJ2GEJ2R2X
R747	51k ohm; similar to Panasonic ERJ2RKF513X
R748	47k ohm; similar to Panasonic ERJ2RKF473X
R749	51k ohm; similar to Panasonic ERJ2RKF513X
R750	27k ohm; similar to Panasonic ERJ2RKF273X
R751	51k ohm; similar to Panasonic ERJ2RKF513X
R752	10k ohm; similar to Panasonic ERJ2RKF103X
R753	51k ohm; similar to Panasonic ERJ2RKF513X
R754	10k ohm; similar to Panasonic ERJ2RKF103X
R755	200k ohm; similar to Panasonic ERJ2RKF204X
R756	27k ohm; similar to Panasonic ERJ2RKF273X
R801	27 ohm; similar to Panasonic ERJ1TYJ270U
R802	27 ohm; similar to Panasonic ERJ1TYJ270U
R1301	15K ohm; similar to Panasonic ERJ2GEJ153X
R1302	12k ohm; similar to Panasonic ERJ2GEJ123X
R1303	5.6K ohm; similar to Panasonic ERJ2GEJ562X
R1304	2.7K ohm; similar to Panasonic ERJ2GEJ272X
R1305	2.7k ohm; similar to KOA RN731ETTP2701F50
R1306	2.2k ohm; similar to KOA RN731ETTP2201F50
R1307	820 ohm; similar to KOA RN731ETTP8200F50
R1308	82K ohm; similar to Panasonic ERJ2GEJ823X
R1310	680 ohm; similar to Panasonic ERJ2GEJ681X
R1312	0 ohm; similar to Panasonic ERJ2GE0R00X
R1313	3.3K ohm; similar to Panasonic ERJ2GEJ332X
R1314	5.6K ohm; similar to Panasonic ERJ2GEJ562X
R1315	47 ohm; similar to Panasonic ERJ2GEJ470X
R1316	18 ohm; similar to Panasonic ERJ2GEJ180X
R1317	470 ohm; similar to Panasonic ERJ2GEJ471X
R1318	100 ohm; similar to Panasonic ERJ2GEJ101X
R1319	100 ohm; similar to Panasonic ERJ2GEJ101X
R1320	68 ohm; similar to Panasonic ERJ2GEJ680X
R1321	330 ohm; similar to Panasonic ERJ14YJ331U
R1322	560 ohm; similar to Panasonic ERJ8GEYJ561V
R1323	10k ohm; similar to Panasonic ERJ2GEJ103X
RT101	Thermistor with Positive Temperature Coefficient; similar to Murata PTFM04BD222Q2N34B0
-----INTEGRATED CIRCUITS-----	
HC201	Similar to Mini Circuits ADE-1HW-3+-TR

SYMBOL	DESCRIPTION
IC101	Module, VHF RF PA; similar to Mitsubishi RA60H1317M1A-238
IC102	Similar to NJRC NJG1533KB2(TE1)-#ZZZB
IC103	Similar to NJRC NJM2125F-TE1-#ZZZB
IC104	Similar to TOSHIBA TC4W66FU(TE12L,F)
IC301	Similar to Analog Devices AD9864BCPZRL
IC302	Similar to Linear Technology LTC5507ES6#TRPBF
IC303	Similar to NJRC NJM2125F-TE1-#ZZZB
IC501	Similar to ASAHIKASEI AK1541-L
IC502	Similar to NJRC NJM3404AM(TE1)-#ZZZB
IC503	Similar to NJRC NJM2125F-TE1-#ZZZB
IC504	Similar to ASAHIKASEI AK1541-L
IC505	Similar to NJRC NJM3404AM(TE1)-#ZZZB
IC506	Similar to NJRC NJM2125F-TE1-#ZZZB
IC602	Similar to CYPRESS CY22050FZXIT
IC603	Similar to Toshiba TC74VHC74FK(EL,K)
IC605	Similar to Toshiba TC74VHC4040FK(EL,K)
IC606	Similar to ASAHIKASEI AK4386VT-E2
IC607	Similar to NJRC NJM3404AV(TE1)-#ZZZB
IC608	Similar to Analog Devices AD5304ARMZ-REEL7
IC610	Similar to NJRC NJM2746RB1(TE1)-#ZZZB
IC611	Similar to NJRC NJM2746RB1(TE1)-#ZZZB
IC612	Similar to NJRC NJM2746RB1(TE1)-#ZZZB
IC613	Similar to Analog Devices ADL5385ACPZ-R7

SYMBOL	DESCRIPTION
IC701	Similar to SILICON LAB C8051F022-GQ
IC702	Similar to Toshiba TC7S04FU(TE85L,F)
IC703	Similar to NJRC NJM2125F-TE1-#ZZZB
IC704	Similar to Toshiba TC74VHC125FT-EL
IC705	Similar to NJRC NJM2741F3(TE1)-#ZZZB
IC802	Similar to ROHM BA09FP-E2
IC803	Similar to ROHM BA09FP-E2
IC804	Similar to ROHM BA09FP-E2
IC805	Similar to NJRC NJM7805DL1A-TE1-#ZZZB
IC806	Similar to ROHM BA09FP-E2
IC807	5V 0.1A; similar to NJRC NJM78L05UA(TE1)-#ZZZB
IC808	Similar to TOKO TK11233CUCB-G
IC809	5V 0.1A; similar to NJRC NJM78L05UA(TE1)-#ZZZB
IC810	Similar to ROHM BA09FP-E2
IC811	Similar to Richo R1114D301B-TR-F
	----- JUMPER -----
W101	Similar to Midori H-7ZCPD0269
	----- OSCILLATOR -----
X501	Similar to NDK H-7XNPD0004
	----- SURGE ABSORBERS -----
Z701	Similar to Panasonic ERZCF2MK220
Z780	Similar to KOA NV73A2ATTE22

## **17 PRODUCTION CHANGES**

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

### **50-Watt M7300 Mobile Radio, 136 – 174 MHz (RU-144750-041)**

**Rev. –** Initial release.

**Rev. A** To improve receiver operation, changed the following components on the RF Processor Board: Changed C334 from 10 pF to 33 pF, deleted C764 (was 15 pF), changed L310 from 0.82  $\mu$ H to 0.47  $\mu$ H, added L317 at 0.39  $\mu$ H, and changed R357 from 33 ohms to 82 ohms. See sheet 2 of the RF Processor Board’s schematic diagram.

To improve reliability during vehicle engine starting, changed the following components on the PK Board: Changed 5-volt regulator IC907 from NJU7223DL1-50 to TA58M05, and changed C890 at the regulator’s output from 0.1  $\mu$ F to 22  $\mu$ F. See sheet 3 of the PK Board’s schematic diagram.

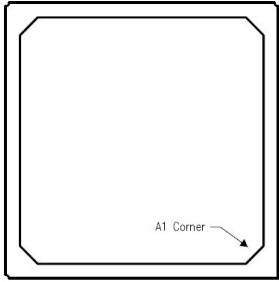
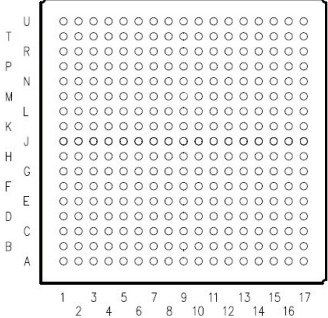
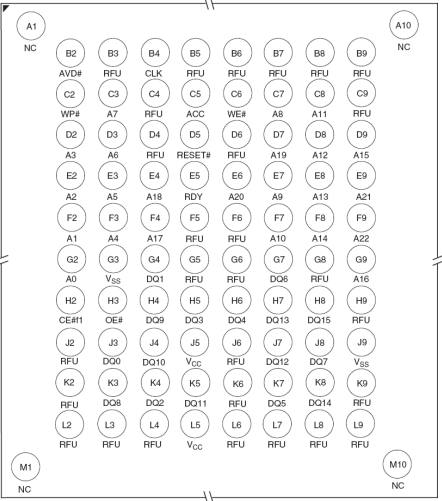
**Rev. B** Incorporated 5-volt regulator IC907 change into PK Board artwork/assembly. New board assembly is CMC-1294E Rev. B.


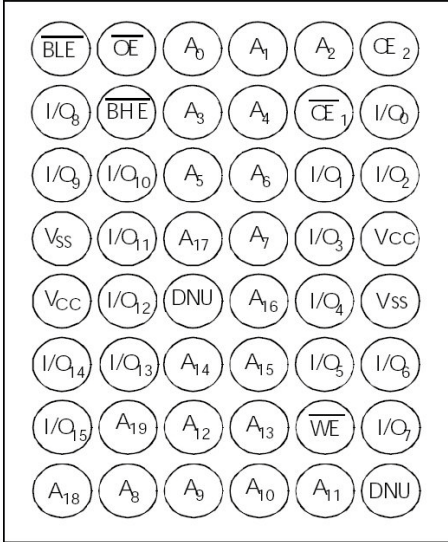
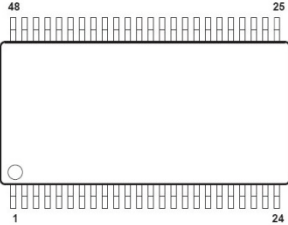
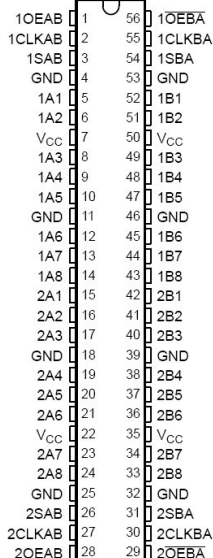
To improve reliability of CAN connections, changed connectors from Conxall part number M9037R to Conxall part number M9037R-BR.

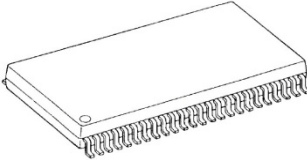
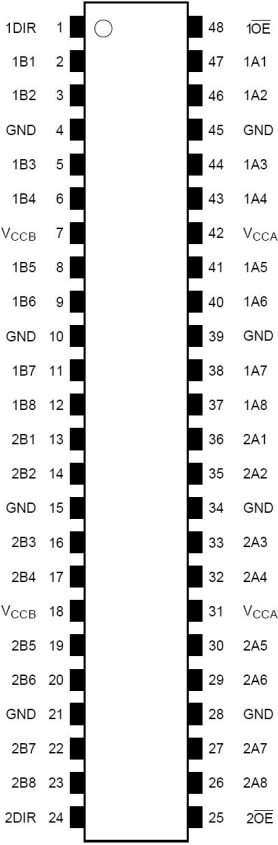
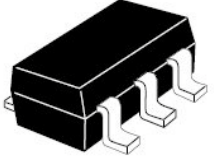
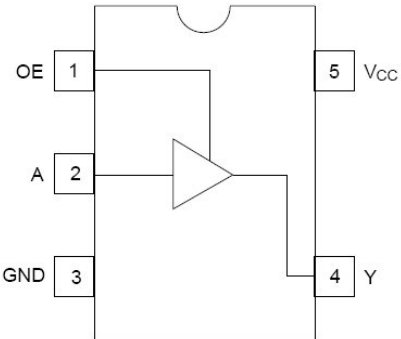
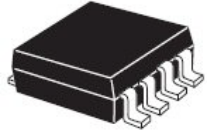
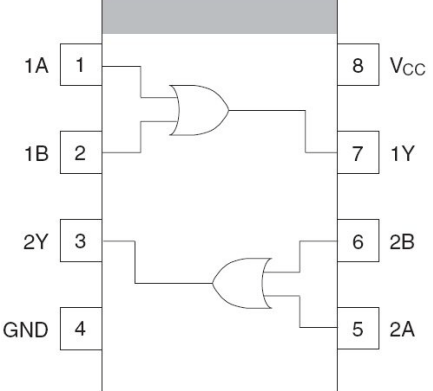
**Rev. C** To improve RF Processor Board’s receive and transmit synthesizer operation, changed transistors TR402, TR403, TR406 and TR423 from RN1301 to RN1305, and changed R407 from 10k ohms to 3.9k ohms. See sheet 4 of the RF Processor Board’s schematic diagram. New board assembly is CMN-6831 Rev. C.

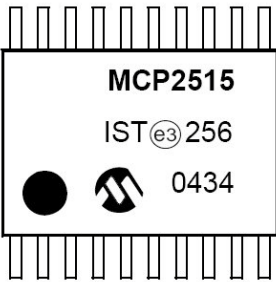
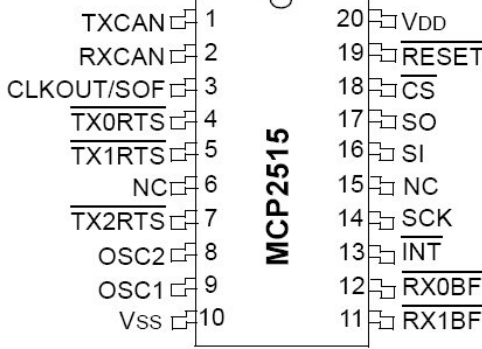

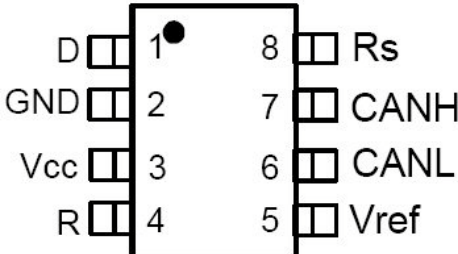
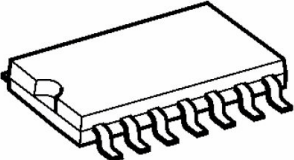
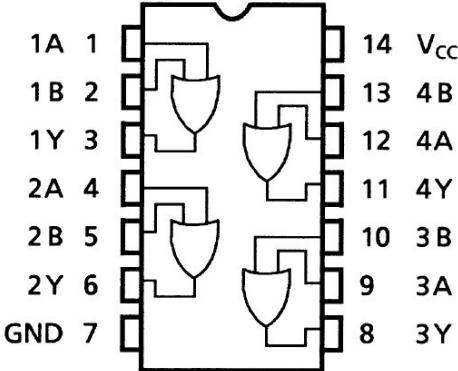
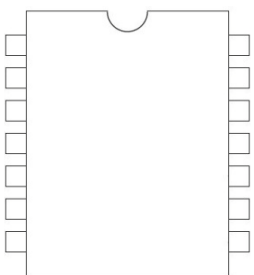
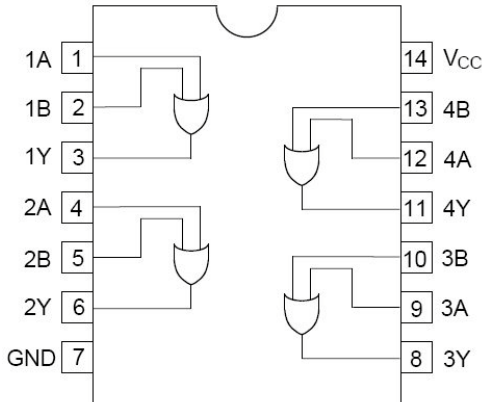
## 18 IC DATA

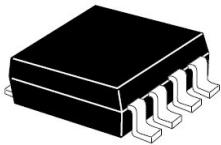
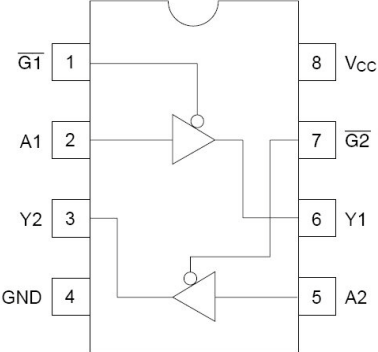
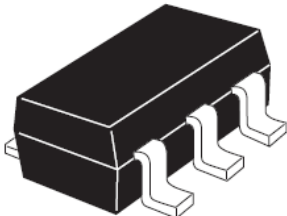
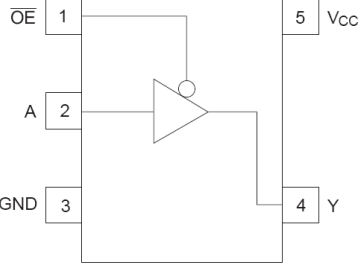
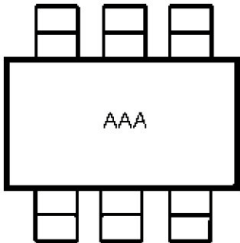
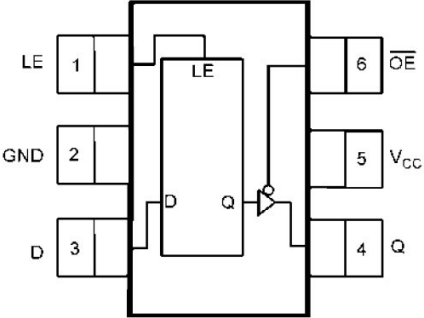
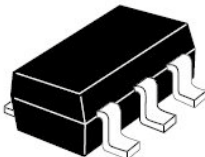
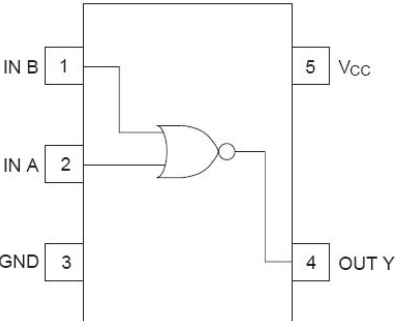
### 18.1 PK BOARD

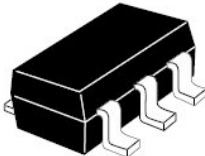
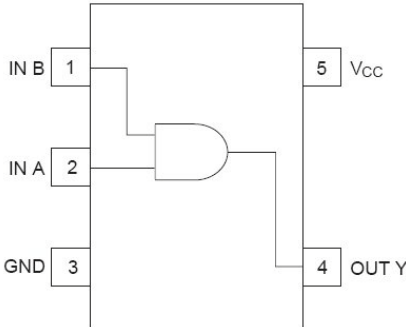
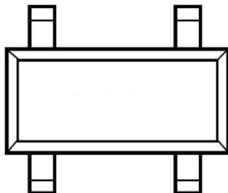
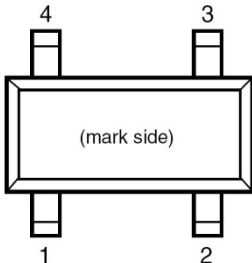
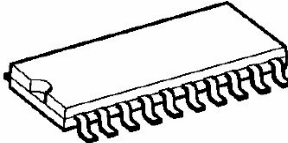
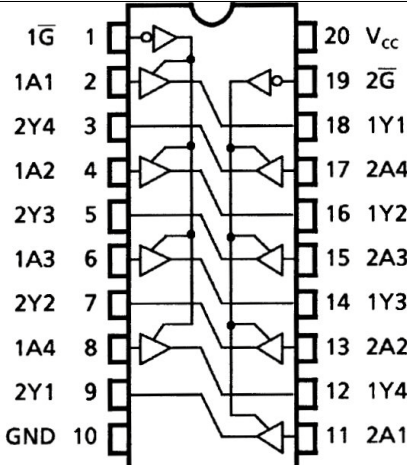
Base Diagram	Description	Reference Designator	Pin-Out
	Dual-Core Processor Similar to Texas Instruments OMAP5910JZDY2	U801	
Base diagram not available.	256 Mb Flash Similar to Spansion S29WS128J0PBFW000A	IC802	 <p> Amax-A0 = Address inputs  DQ15-DQ0 = Data input/output  CE# = Chip Enable input. Asynchronous relative to CLK for the Burst mode.  OE# = Output Enable input. Asynchronous relative to CLK for the Burst mode.  WE# = Write Enable input.  V<sub>CC</sub> = Device Power Supply (1.65 – 1.95 V).  V<sub>SS</sub> = Ground  NC = No Connect; not connected internally  RDY = Ready output;  In Synchronous Mode, indicates the status of the Burst read.  Low = data not valid at expected time. High = data valid.  In Asynchronous Mode, indicates the status of the internal program and erase function.  Low = program/erase in progress.  High Impedance = program/erase completed.  CLK = CLK is not required in asynchronous mode. In burst mode, after the initial word is output, subsequent active edges of CLK increment the internal address counter.  AVD# = Address Valid input. Indicates to device that the valid address is present on the address inputs (Amax-A0).  Low = for asynchronous mode, indicates valid address; for burst mode, causes starting address to be latched.  High = device ignores address inputs  RESET# = Hardware reset input. Low = device resets and returns to reading array data  WP# = Hardware write protect input. At V<sub>IL</sub>, disables program and erase functions in the four outermost sectors. Should be at V<sub>IH</sub> for all other conditions.  ACC = At V<sub>IH</sub>, accelerates programming; automatically places device in unlock bypass mode. At V<sub>IL</sub>, locks all sectors. Should be at V<sub>IH</sub> for all other conditions. </p>


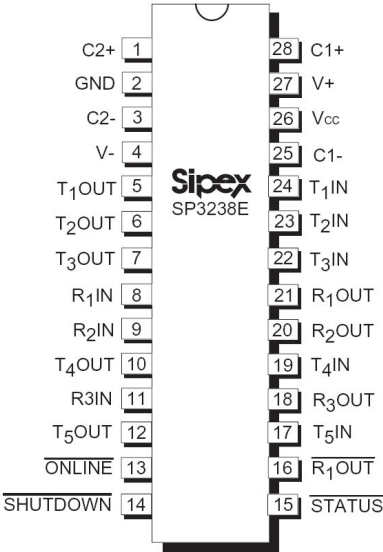
Base Diagram	Description	Reference Designator	Pin-Out
	16M Static RAM Similar to Cypress CY62167DV18LL- 55BVXIT	IC803	Top View 
			Note: DNU pins are to be connected to V <sub>SS</sub> or left open.
	16-BIT Bus transceiver Similar to Texas Instruments SN74LVCH16652ADGGR	IC804	


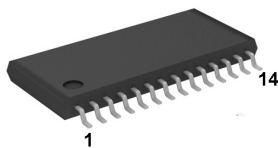
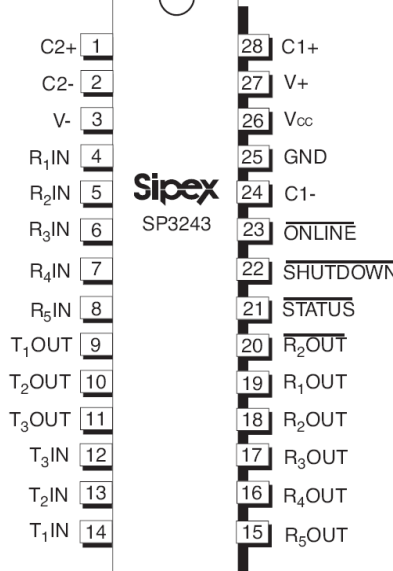
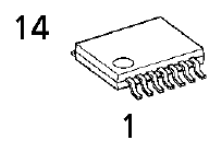
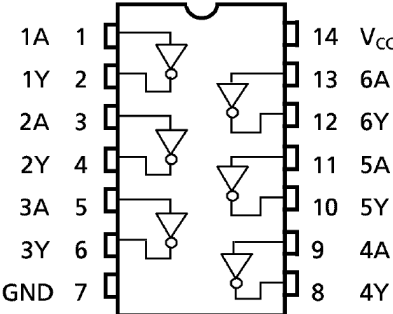
Base Diagram	Description	Reference Designator	Pin-Out
	16-Bit Dual Supply Bus Transceiver Similar to TOSHIBA TC74VCX164245	IC805	
	Bus Buffer Gate with 3-state Output Similar to Renesas HD74LV1G126ACME-E	IC806	
	Dual 2-input OR Gates Similar to Renesas HD74LV2G32AUSE-E	IC807	

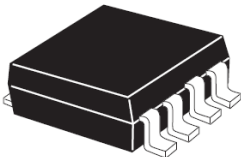
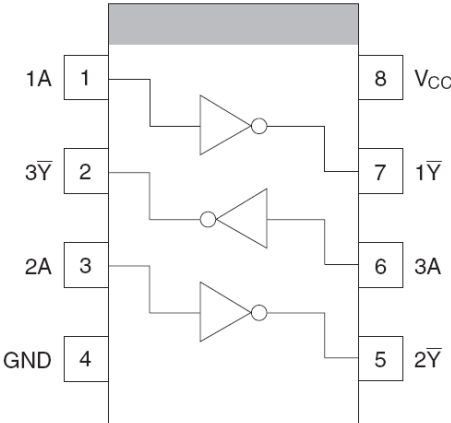
Base Diagram	Description	Reference Designator	Pin-Out
	Stand-Alone CAN Controller Similar to Microchip MCP2515T-I/ST	IC808	
	CAN Transceiver Similar to Texas Instruments SN65HVD251DR	IC809	
	Quad 2-Input OR Gate Similar to Toshiba TC74HCT32AF	IC810	
	Quad 2-input OR Gate Similar to Renesas HD74LVC32FPEL	IC811	


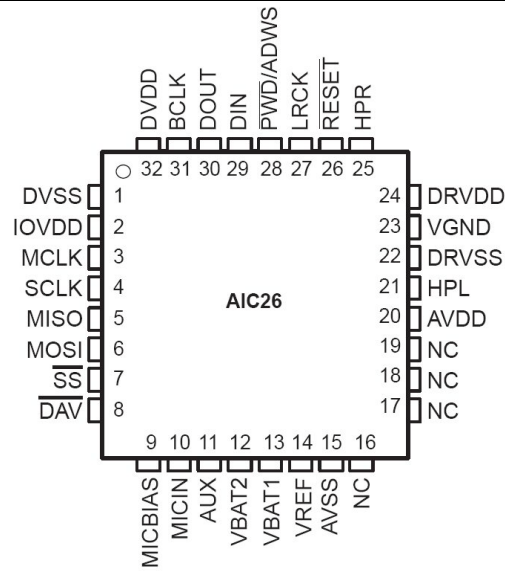
Base Diagram	Description	Reference Designator	Pin-Out															
	Dual Bus Buffer with 3-state Output Similar to Renesas HD74LV2G125AUSE-E	IC812	 <table><thead><tr><th colspan="2">Inputs</th><th>Output Y</th></tr><tr><th>OE</th><th>A</th><th></th></tr></thead><tbody><tr><td>L</td><td>H</td><td>H</td></tr><tr><td>L</td><td>L</td><td>L</td></tr><tr><td>H</td><td>X</td><td>Z</td></tr></tbody></table> <p>H : High level L : Low level X : Immaterial Z : High impedance</p>	Inputs		Output Y	OE	A		L	H	H	L	L	L	H	X	Z
Inputs		Output Y																
OE	A																	
L	H	H																
L	L	L																
H	X	Z																
	Bus Buffer Gate with 3-state Output Similar to Renesas HD74LV1G125ACME	IC813, IC815	 <table><thead><tr><th colspan="2">Inputs</th><th>Output Y</th></tr><tr><th>OE</th><th>A</th><th></th></tr></thead><tbody><tr><td>L</td><td>H</td><td>H</td></tr><tr><td>L</td><td>L</td><td>L</td></tr><tr><td>H</td><td>X</td><td>Z</td></tr></tbody></table> <p>H : High level L : Low level X : Immaterial Z : High impedance</p>	Inputs		Output Y	OE	A		L	H	H	L	L	L	H	X	Z
Inputs		Output Y																
OE	A																	
L	H	H																
L	L	L																
H	X	Z																
 PIN 1	UHS D-Type Latch with 3-STATE Output Similar to Fairchild NC7SZ373P6X	IC814																
	2-input NOR Gate Similar to Renesas HD74LV1G02ACME	IC817																

Base Diagram	Description	Reference Designator	Pin-Out															
	2-input AND Gate Similar to Renesas HD74LV1G08ACME	IC818																
	Low voltage detector with output delay Similar to Richoh R3112Q441C-TR-F	IC819	<div><table><tr><th>Pin No.</th><th>Symbol</th><th>Description</th></tr><tr><td>1</td><td>V<sub>DD</sub></td><td>Voltage Supply Pin</td></tr><tr><td>2</td><td>GND</td><td>Ground Pin</td></tr><tr><td>3</td><td>C<sub>0</sub></td><td>Pin for External Capacitor (for setting output delay)</td></tr><tr><td>4</td><td>OUT</td><td>Output Pin(Output "L" at detector threshold, Output "H" at released voltage)</td></tr></table></div>	Pin No.	Symbol	Description	1	V <sub>DD</sub>	Voltage Supply Pin	2	GND	Ground Pin	3	C <sub>0</sub>	Pin for External Capacitor (for setting output delay)	4	OUT	Output Pin(Output "L" at detector threshold, Output "H" at released voltage)
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4	OUT	Output Pin(Output "L" at detector threshold, Output "H" at released voltage)																
	Non-Inverted, 3-State Output Octal Bus Buffer Similar to Toshiba TC74HC244AF	IC820																


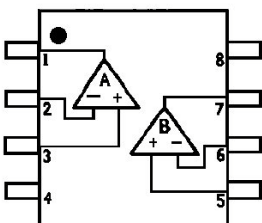
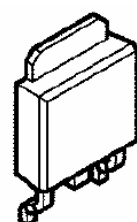
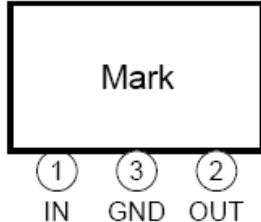
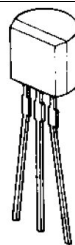

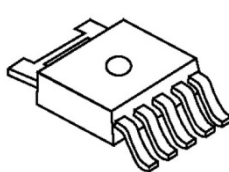
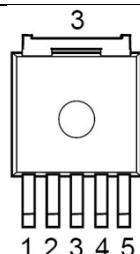
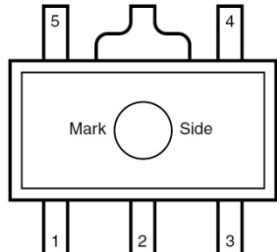
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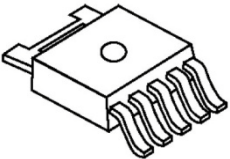
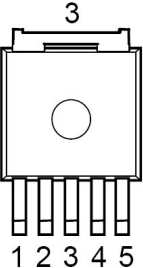
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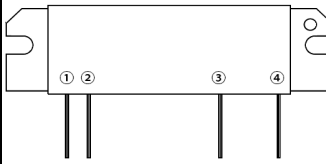
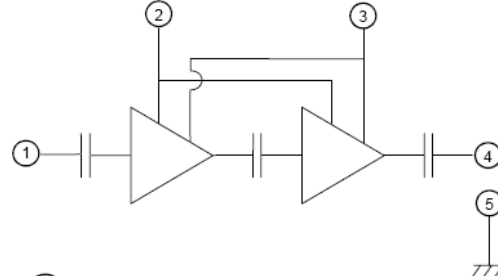

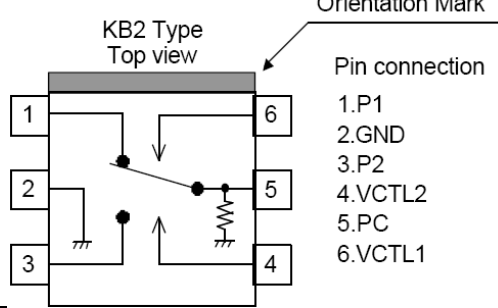

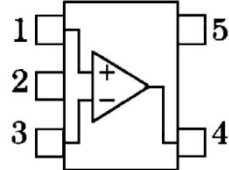
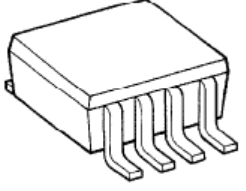
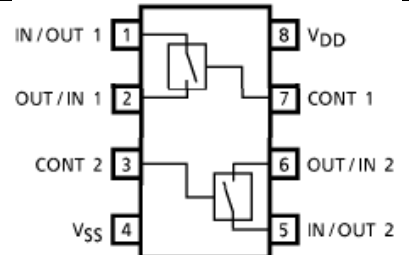
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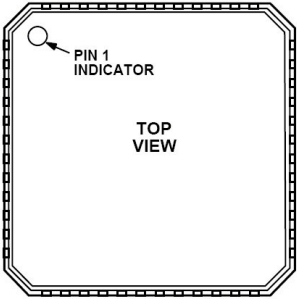
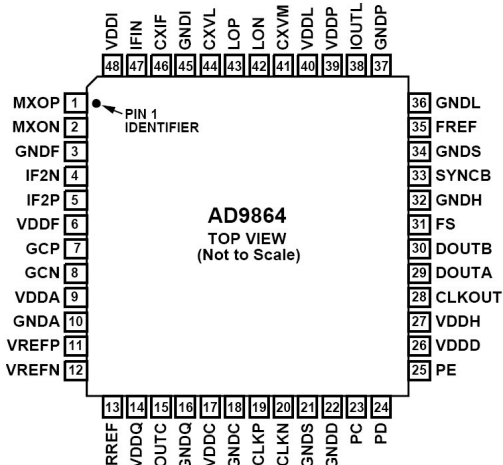
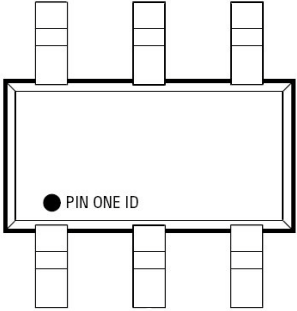
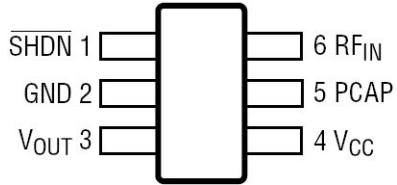

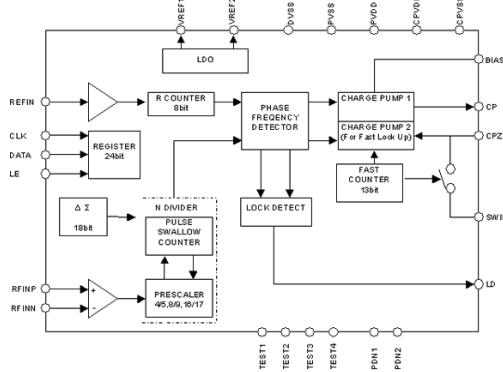
Base Diagram	Description	Reference Designator	Pin-Out
	Single-Supply Dual Op Amplifier Similar to JRC NJM3404AV	IC902	<p><b>PIN FUNCTION</b></p> <p>1.A OUTPUT 2.A -INPUT 3.A +INPUT 4.V<sup>-</sup> 5.B +INPUT 6.B -INPUT 7.B OUTPUT 8.V<sup>+</sup></p>
	Single-Supply Quad Op Amp Similar to JRC NJM3403AV(TE1)	IC903	<p><b>PIN FUNCTION</b></p> <p>1.A OUTPUT 2.A -INPUT 3.A +INPUT 4.V<sup>-</sup> 5.B +INPUT 6.B -INPUT 7.B OUTPUT 8.C OUTPUT 9.C -INPUT 10.C +INPUT 11.V<sup>-</sup> 12.D +INPUT 13.D -INPUT 14.D OUTPUT</p>
	Bilateral Switch Similar to Toshiba TC7S66FU(TE85L)	IC904	<p>IN / OUT 1 OUT / IN 2 GND 3 VCC 5 CONT 4</p>
	35W BRIDGE class AB audio power amplifier Similar to STMicroelectronics TDA7391	IC905	<p>11 MUTE 10 SYNC 9 +V<sub>S</sub> 8 STAND-BY 7 OUT+ 6 GND 5 OUT- 4 CD 3 +V<sub>S</sub> 2 IN+ 1 IN- TAB CONNECTED TO PIN 6</p>


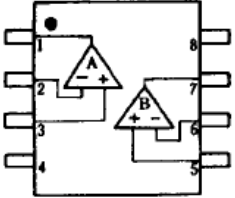
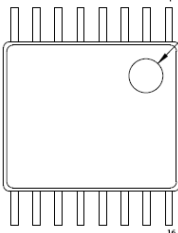
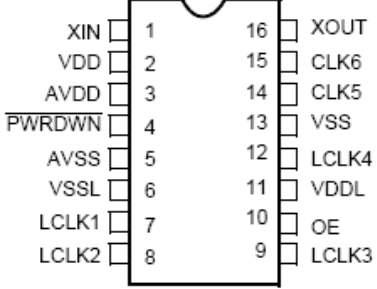

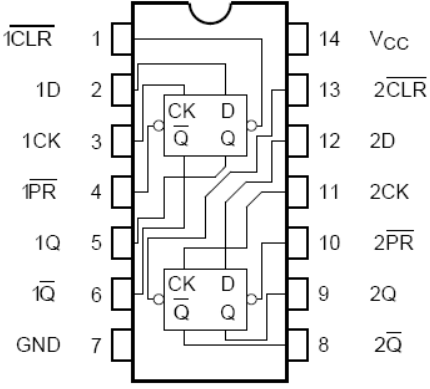

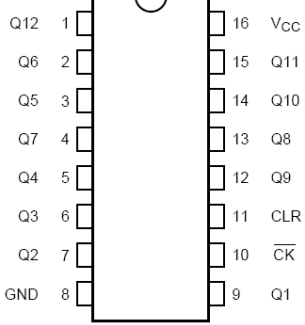
Base Diagram	Description	Reference Designator	Pin-Out												
	Single-Supply Dual Op Amp Similar to JRC NJM3404AV(TE1)	IC906	 <p><b>PIN FUNCTION</b> 1.A OUTPUT 2.A -INPUT 3.A +INPUT 4.V<sup>-</sup> 5.B +INPUT 6.B -INPUT 7.B OUTPUT 8.V<sup>+</sup></p>												
 HSOP3-P-2.30D	500 mA Low-Dropout Voltage Regulator Similar to JRC TA58M05	IC907	 <table><tr><th>Pin No.</th><th>Symbol</th><th>Description</th></tr><tr><td>1</td><td>IN</td><td>Input terminal. Connected by capacitor (C<sub>IN</sub>) to GND.</td></tr><tr><td>3</td><td>GND</td><td>Ground terminal</td></tr><tr><td>2</td><td>OUT</td><td>Output terminal. Connected by capacitor (C<sub>OUT</sub>) to GND.</td></tr></table>	Pin No.	Symbol	Description	1	IN	Input terminal. Connected by capacitor (C <sub>IN</sub> ) to GND.	3	GND	Ground terminal	2	OUT	Output terminal. Connected by capacitor (C <sub>OUT</sub> ) to GND.
Pin No.	Symbol	Description													
1	IN	Input terminal. Connected by capacitor (C <sub>IN</sub> ) to GND.													
3	GND	Ground terminal													
2	OUT	Output terminal. Connected by capacitor (C <sub>OUT</sub> ) to GND.													
	Positive Voltage Regulator Similar to JRC NJM7805FA	IC908	 <p>1. OUT 2. GND 3. IN</p>												
	Adjustable Low Dropout Voltage Regulator Similar to JRC NJM2887DL3	IC909	 <p><b>PIN FUNCTION</b> 1.CONTROL 2. V<sub>IN</sub> 3.GND 4.V<sub>OUT</sub> 5.V<sub>ADJ</sub></p>												
Base diagram not available.	300 mA LDO Regulator Similar to Ricoh R1130H181B-T1	IC910													

Base Diagram	Description	Reference Designator	Pin-Out
	Adjustable Low Dropout Voltage Regulator Similar to JRC NJM2887DL3	IC911	 <p>PIN FUNCTION 1.CONTROL 2. <math>V_{IN}</math> 3.GND 4. <math>V_{OUT}</math> 5. <math>V_{ADJ}</math></p>

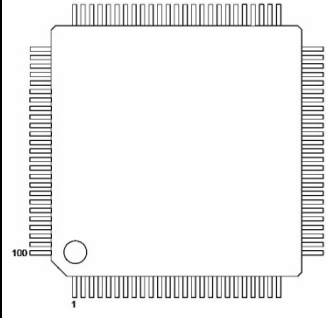
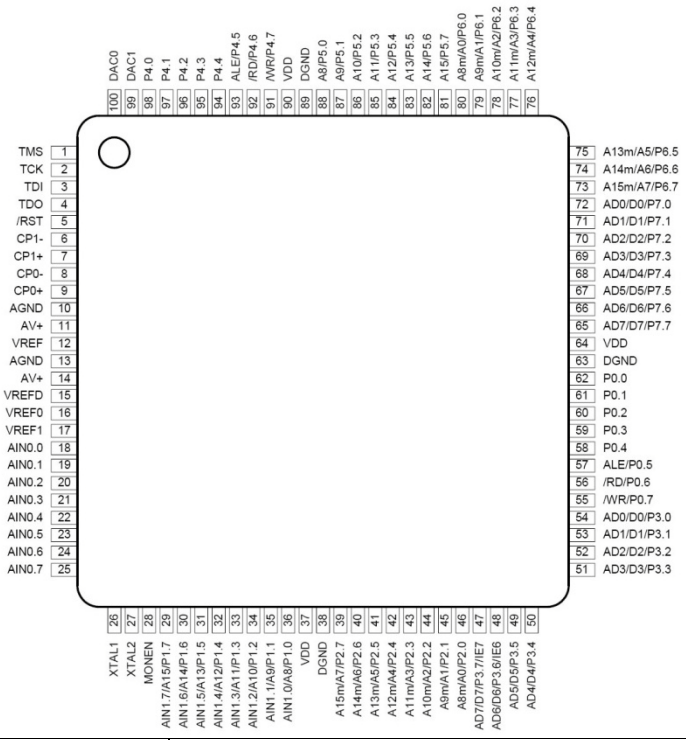
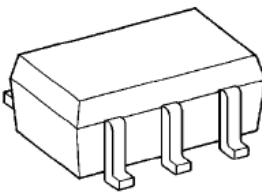
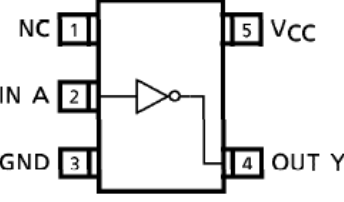
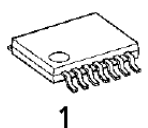
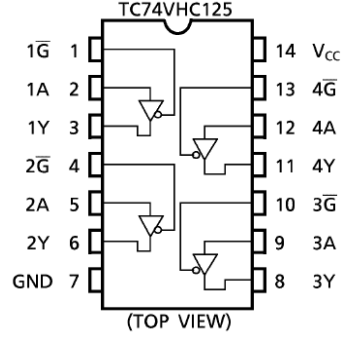
## 18.2 RF PROCESSOR BOARD

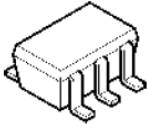
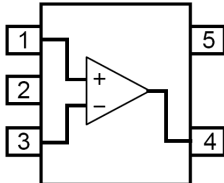
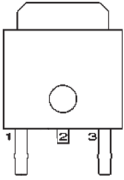
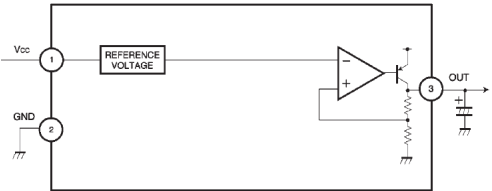

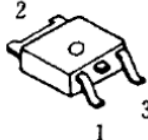
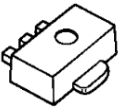
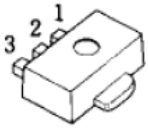
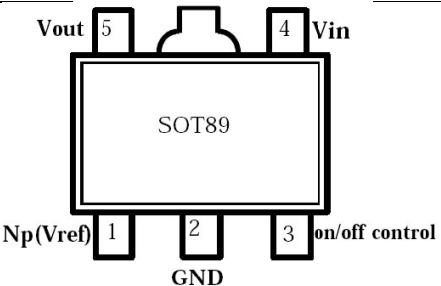
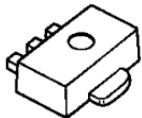
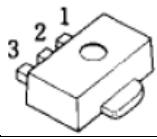

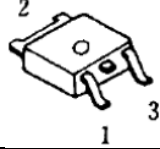
Base Diagram	Description	Reference Designator	Pin-Out
	PA Module Similar to Mitsubishi RA60H1317M1A-238	IC101	 <p>           ① RF Input (<math>P_{in}</math>)            ② Gate Voltage (<math>V_{GG}</math>), Power Control            ③ Drain Voltage (<math>V_{DD}</math>), Battery            ④ RF Output (<math>P_{out}</math>)            ⑤ RF Ground (<math>F_{IN}</math>)         </p>
	SPDT SWITCH Similar to NJRC NJG1533KB2	IC102	 <p>KB2 Type Top view</p> <p>Orientation Mark</p> <p>Pin connection</p> <p>1.P1 2.GND 3.P2 4.VCTL2 5.PC 6.VCTL1</p>
	Single-Supply Operational Amplifier Similar to JRC NJM2125F-TE1	IC103, IC303, IC503, IC506, IC703	 <p><b>PIN FUNCTION</b></p> <p>1.+INPUT 2.GND 3.-INPUT 4.OUTPUT 5.V<sup>+</sup></p>
	Dual Bilateral Switch Similar to Toshiba TC4W66FU	IC104	 <p>IN / OUT 1 1 8 V<sub>DD</sub> OUT / IN 1 2 7 CONT 1 CONT 2 3 6 OUT / IN 2 V<sub>SS</sub> 4 5 IN / OUT 2</p>

Base Diagram	Description	Reference Designator	Pin-Out
	IF Digitizing Subsystem Similar to Analog Devices AD9864BCPZRL	IC301	
	100 kHz to 1 GHz RF Power Detector Similar to Linear Technology LTC5507ES6	IC302	
	Fractional-N Frequency Synthesizer Similar to ASAHI-KASEI AK1541-L	IC501, IC504	

Base Diagram	Description	Reference Designator	Pin-Out
	Dual Operational Amplifier Similar to NJM3404AM(TE1)	IC502, IC505	 <p><b>PIN FUNCTION</b>  <b>1.A OUTPUT</b>  <b>2.A -INPUT</b>  <b>3.A +INPUT</b>  <b>4.V<sup>-</sup></b>  <b>5.B +INPUT</b>  <b>6.B -INPUT</b>  <b>7.B OUTPUT</b>  <b>8.V<sup>+</sup></b></p>
 PIN 1 ID	One-PLL General Purpose Flash Programmable Clock Generator Similar to Cypress H-7DLPD0023B	IC602	
	Dual D-Type Flip-Flop Similar to Toshiba TC74VHC74FK(EL,K)	IC603	 <p>(top view)</p>
	12-Stage Ripple Carry Binary Counter Similar to Toshiba TC74VHC4040FK	IC605	 <p>(top view)</p>

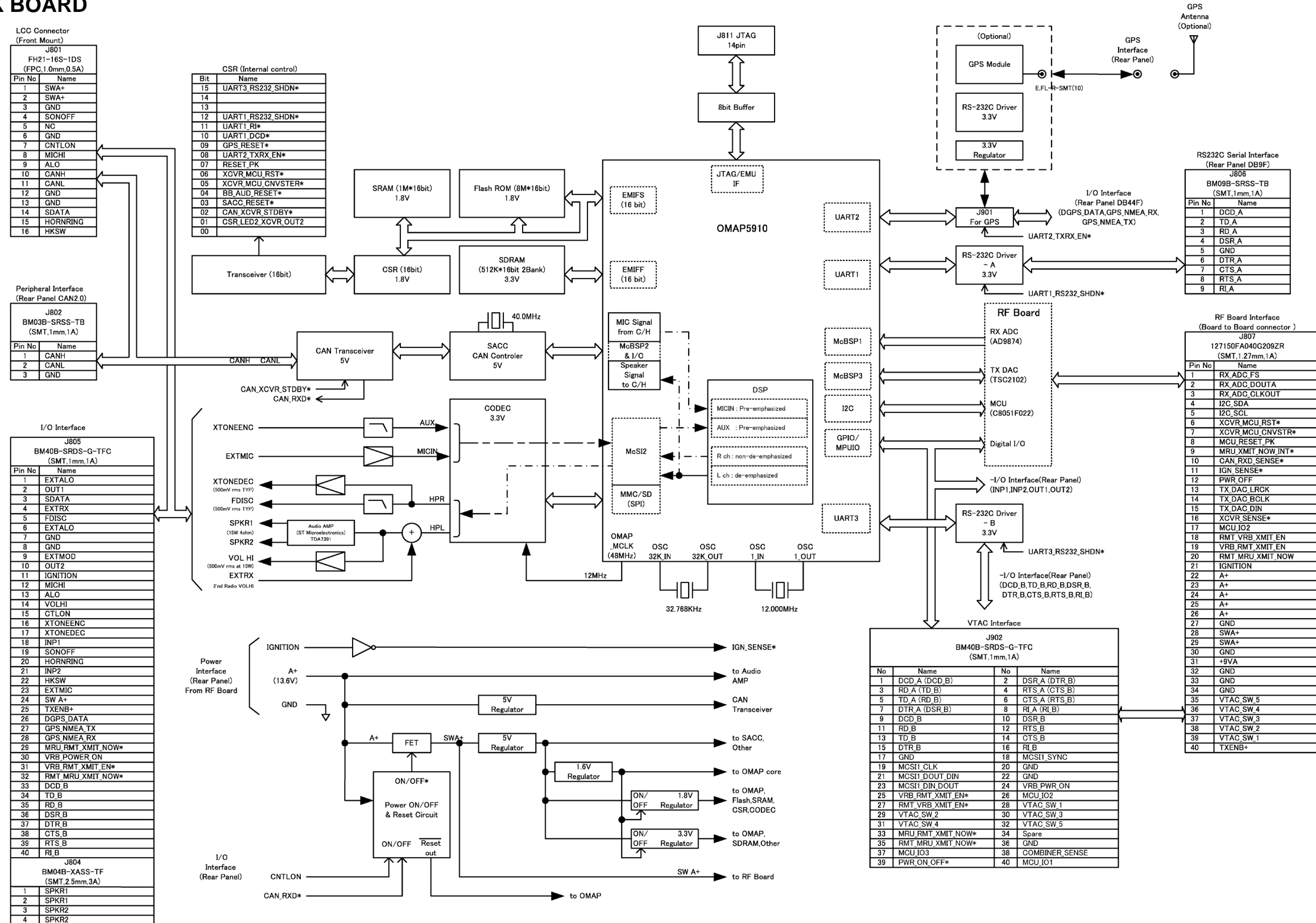
Base Diagram	Description	Reference Designator	Pin-Out
	DAC Similar to ASAHIKASEI AK4386VT-E2	IC606	<p>Top View</p> <p>MCLK 1 BICK 2 SDTI 3 LRCK 4 PDN 5 DFS0 6 DFS1 7 DEM 8</p> <p>16 TEST 15 DIF1 14 VDD 13 VSS 12 VCOM 11 LOUT 10 ROUT 9 DIF0</p>
	Dual Operational Amplifier Similar to NJRC NJM3404AV(TE1)	IC607	<p><b>PIN FUNCTION</b></p> <p>1.A OUTPUT 2.A -INPUT 3.A +INPUT 4.V<sup>-</sup> 5.B +INPUT 6.B -INPUT 7.B OUTPUT 8.V<sup>+</sup></p>
	DAC Similar to Analog Devices AD5304ARMZ-REEL7	IC608	<p><b>AD5304/ AD5314/ AD5324 TOP VIEW (Not to Scale)</b></p> <p>V<sub>DD</sub> 1 V<sub>OUTA</sub> 2 V<sub>OUTB</sub> 3 V<sub>OUTC</sub> 4 REFIN 5</p> <p>10 SYNC 9 SCLK 8 DIN 7 GND 6 V<sub>OUTD</sub></p>
	Dual Operational Amplifier Similar to NJRC NJM2746RB1(TE1)	IC610, IC611, IC612	<p><b>PIN FUNCTION</b></p> <p>1.A OUTPUT 2.A -INPUT 3.A +INPUT 4. GND 5. B +INPUT 6. B -INPUT 7. B OUTPUT 8. V<sup>+</sup></p>
	Quadrature Modulator Similar to Analog Devices ADL5385ACPZ-R7	IC613	<p><b>PIN 1 INDICATOR</b></p> <p>24 VPS3 23 VPS3 22 LOIN 21 LOIP 20 COM3 19 COM3</p> <p>NC 1 NC 2 NC 3 COM1 4 COM1 5 COM1 6</p> <p>18 QBBP 17 QBBN 16 COM2 15 COM2 14 IBBN 13 IBBP</p> <p>7 VOUT 8 VPS1 9 VPS1 10 TEMP 11 VPS2 12 ENBL</p> <p>EXPOSED PADDLE</p>

Base Diagram	Description	Reference Designator	Pin-Out
	<p>8K ISP FLASH MCU Similar to Silicon Laboratories C8051F022-GQ</p>	<p>IC701</p> 	
	<p>Inverter Similar to Toshiba TC7S04FU(TE85L,F)</p>	<p>IC702</p> 	
<p>14</p>  <p>1</p>	<p>Buffer Similar to Toshiba TC74VHC125FT-EL</p>	<p>IC704</p>  <p>(TOP VIEW)</p>	

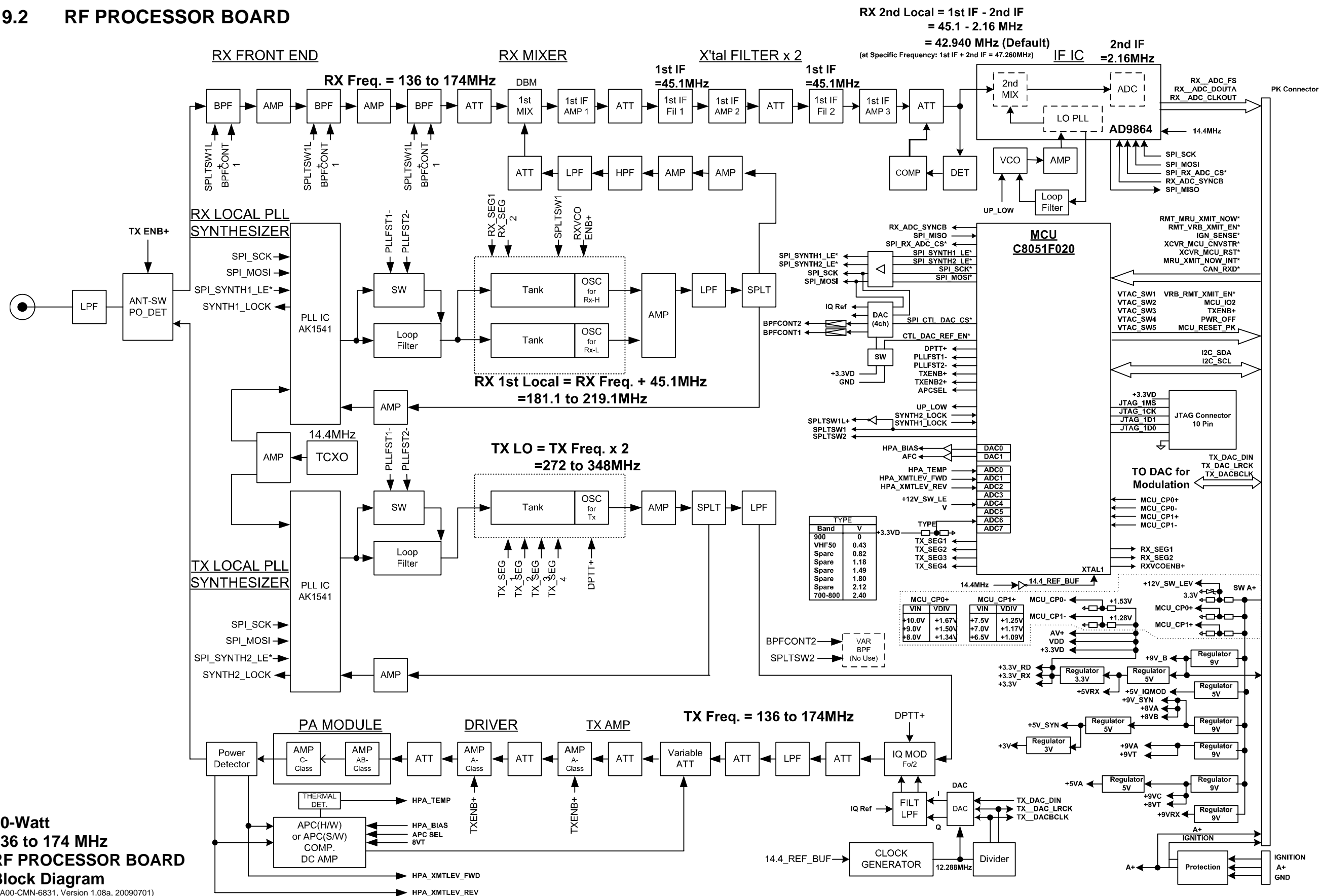
Base Diagram	Description	Reference Designator	Pin-Out
	Low Supply Voltage Operational Amplifier Similar to JRC NJM2741F3(TE1)	IC705	 <p><b>PIN FUNCTION</b></p> <ol style="list-style-type: none"> <li>1. +INPUT</li> <li>2. GND</li> <li>3. -INPUT</li> <li>4. OUTPUT</li> <li>5. <math>V^+</math></li> </ol>
	Voltage Regulator Similar to ROHM BA09FP-E2	IC802, IC803, IC804, IC806, IC810	
	Voltage Regulator Similar to NJRC NJM7805DL1A-TE1	IC805	 <ol style="list-style-type: none"> <li>1. IN</li> <li>2. GND</li> <li>3. OUT</li> </ol>
	3-Terminal Positive Voltage Regulator Similar to NJRC NJM78L05UA(TE1)	IC807	 <ol style="list-style-type: none"> <li>1. OUT</li> <li>2. GND</li> <li>3. IN</li> </ol>
Base diagram not available	LDO Regulator with On/Off switch Similar to TOKO TK11233CUCB-G	IC808	
	3-Terminal Positive Voltage Regulator Similar to NJRC NJM78L05UA(TE1)	IC809	 <ol style="list-style-type: none"> <li>1. OUT</li> <li>2. GND</li> <li>3. IN</li> </ol>
	Low Noise 150 mA LDO Regulator Similar to RICHIO R1114D301B-TR-F	IC811	 <ol style="list-style-type: none"> <li>1. IN</li> <li>2. GND</li> <li>3. OUT</li> </ol>

## 19 BLOCK DIAGRAMS

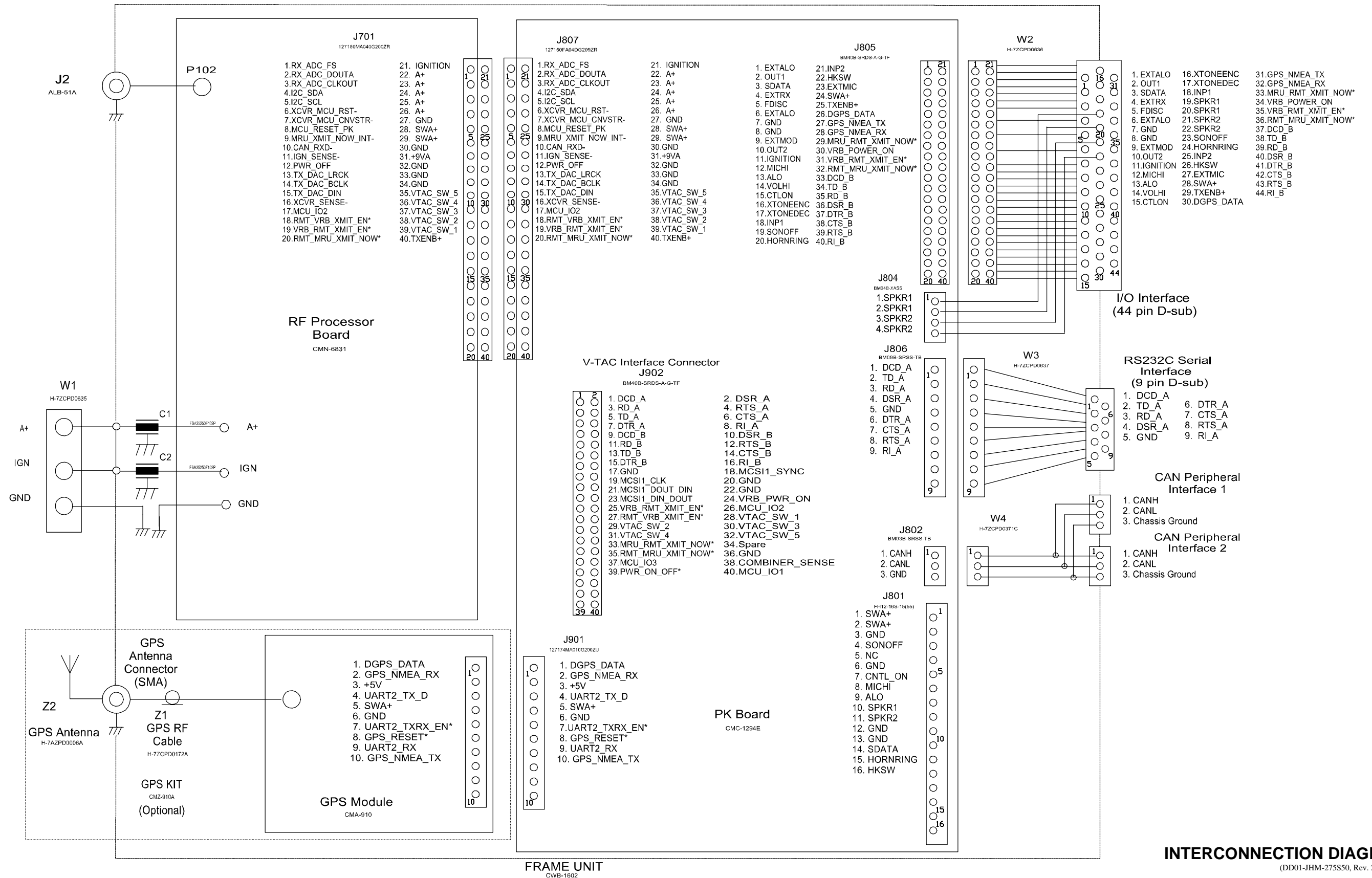
## 19.1 PK BOARD



## 50-Watt 136 to 174 MHz RF PROCESSOR BOARD Block Diagram



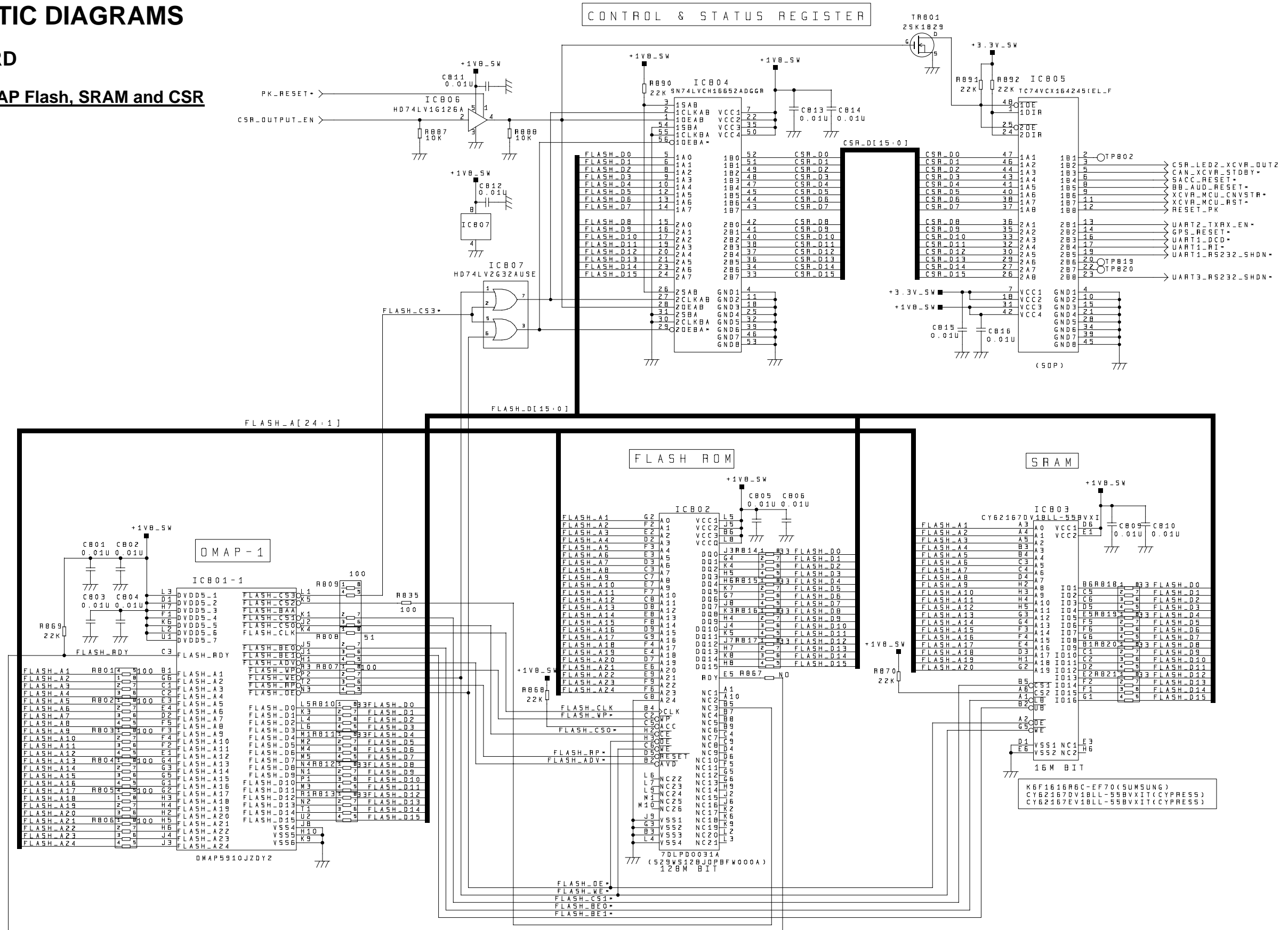
## 20 INTERCONNECTION DIAGRAM



## INTERCONNECTION DIAGRAM

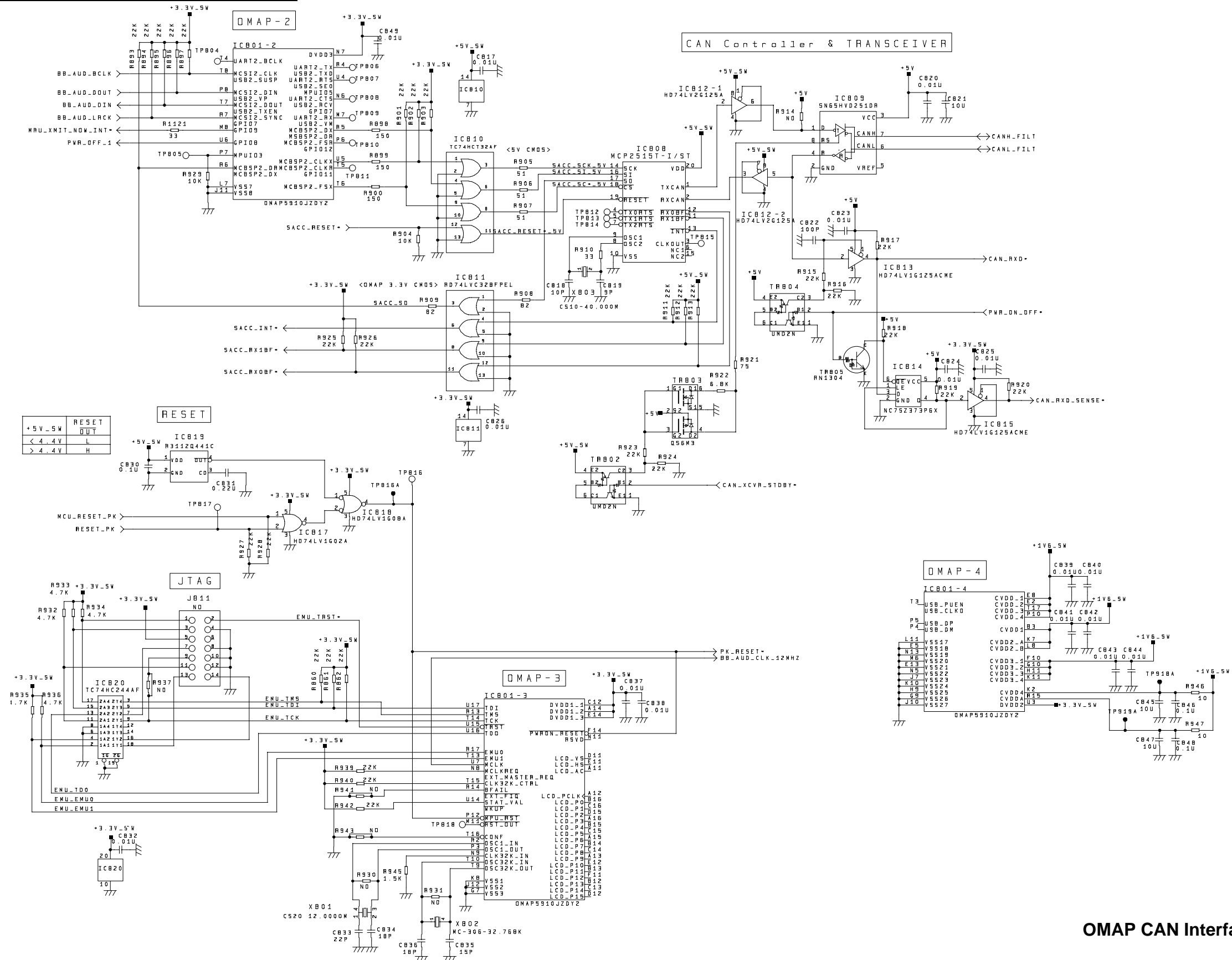
(DD01-JHM-275S50, Rev. 20110311)

### 21.1.1 OMAP Flash, SRAM and CSR



## OMAP Flash, SRAM and CSR

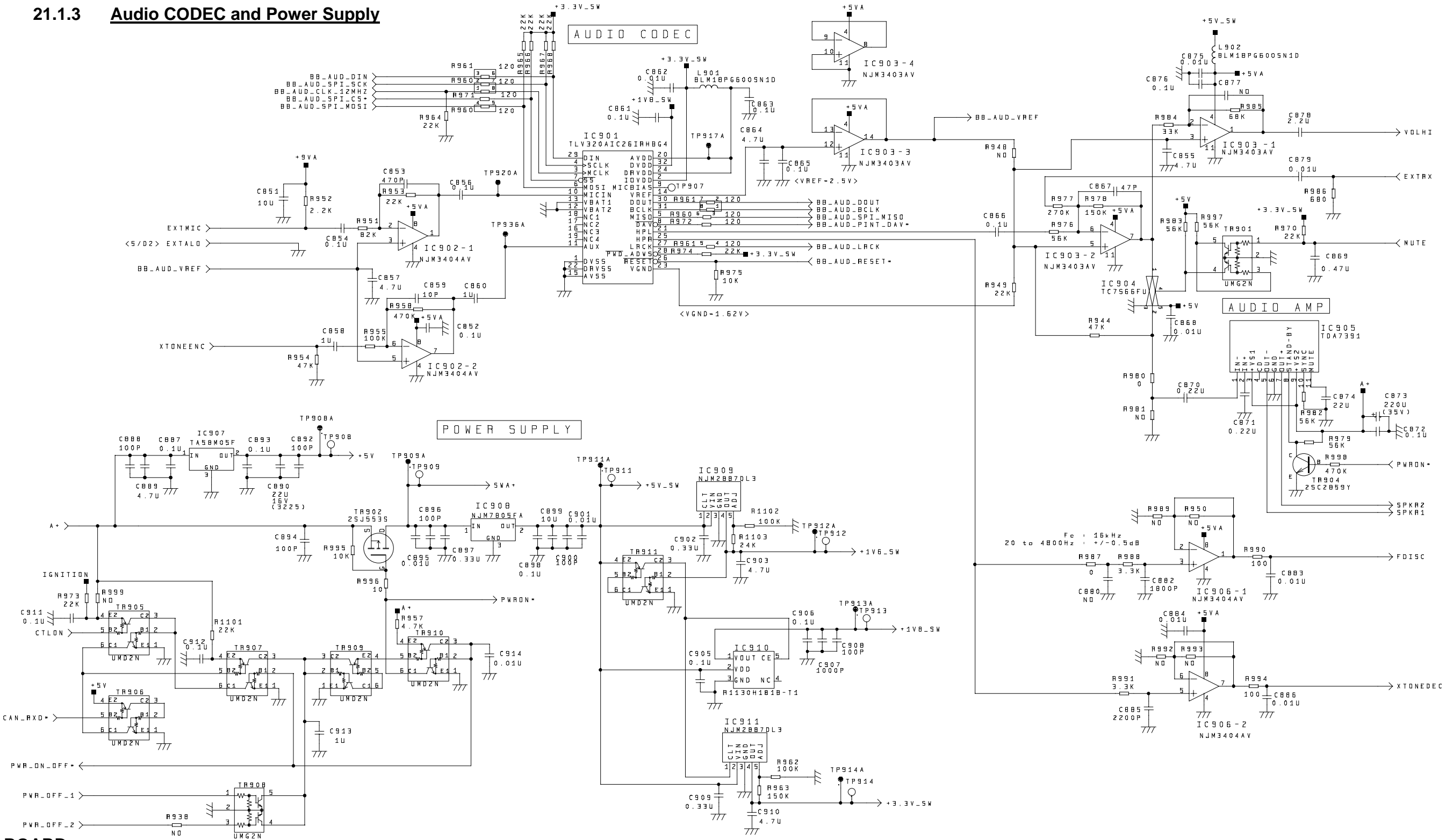
### 21.1.2 OMAP CAN Interface, JTAG and Reset



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

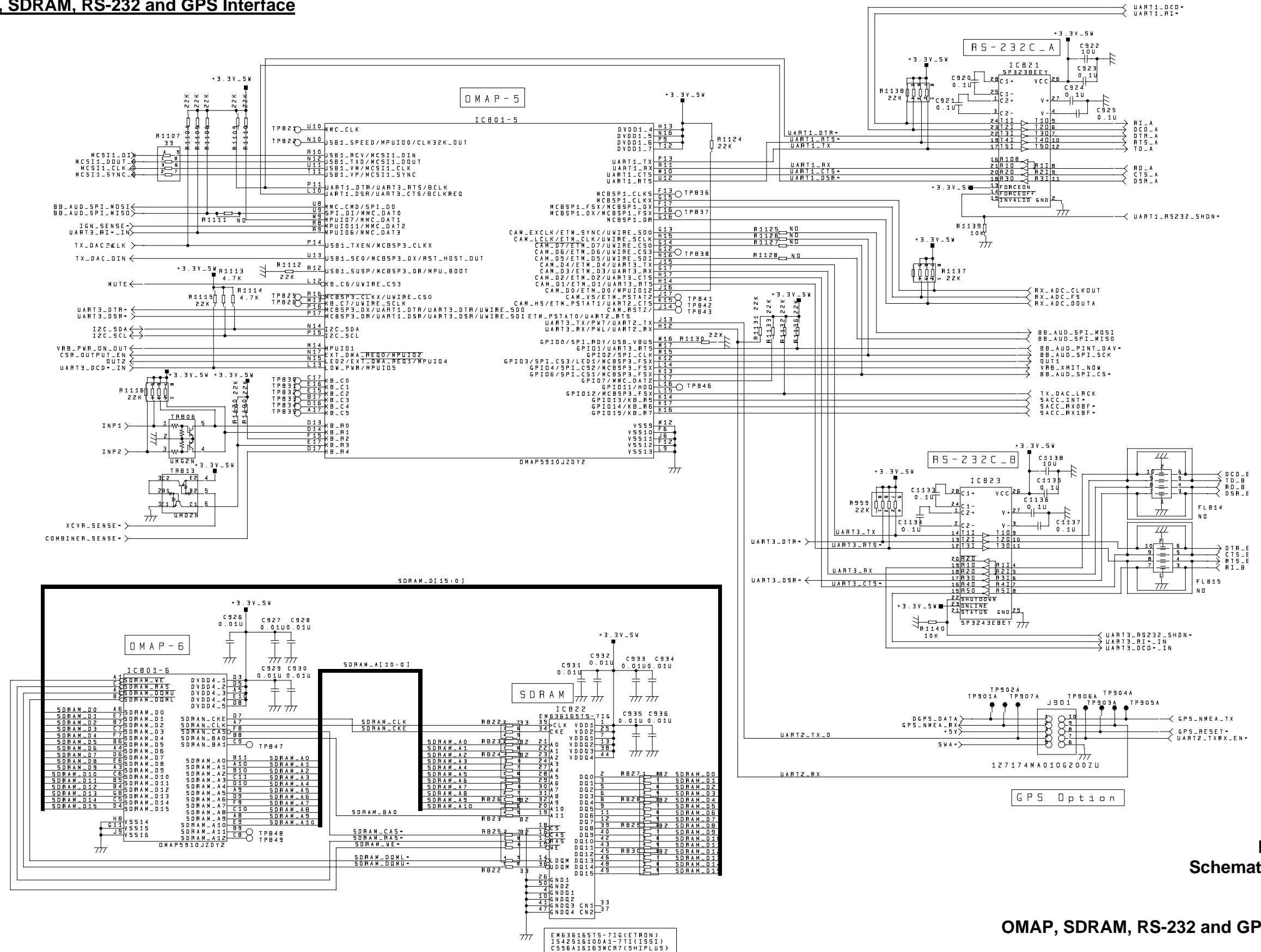
## OMAP CAN Interface, JTAG and Reset

21.1.3 Audio CODEC and Power Supply



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

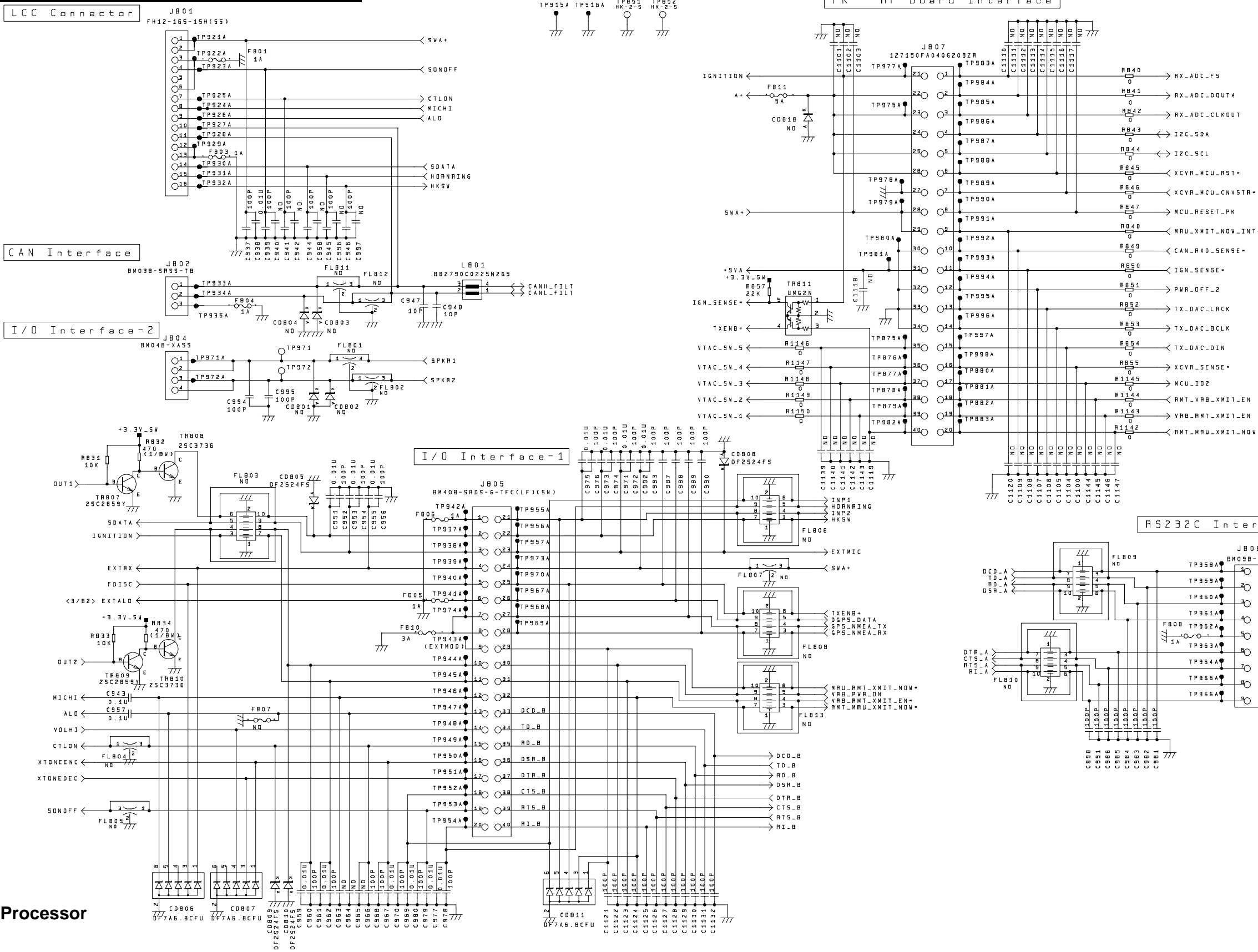
**Audio CODEC and Power Supply**  
(DD02-CMC-1294E)



**PK BOARD**  
**Schematic Diagram**  
Sheet 4 of 6

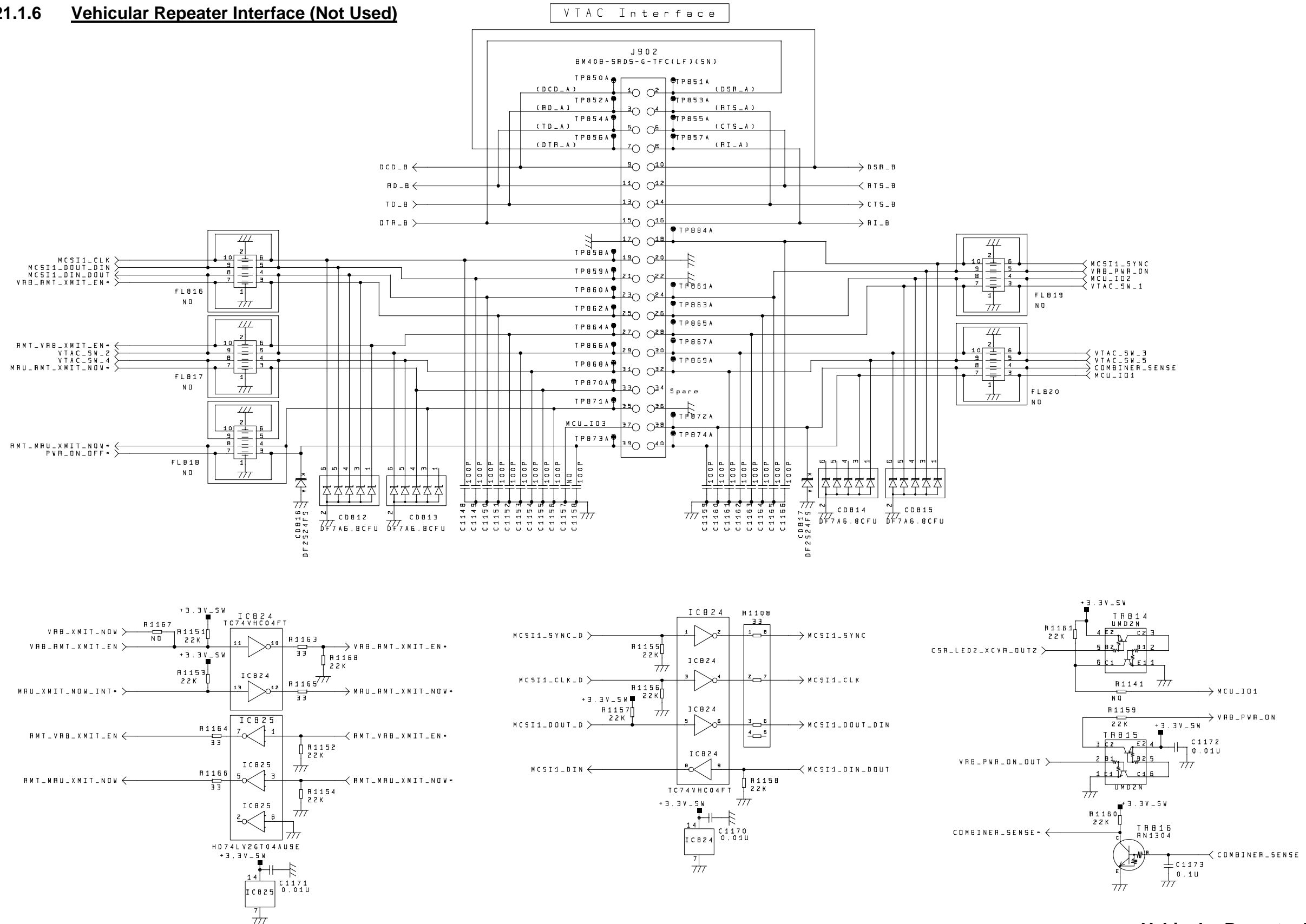
## OMAP, SDRAM, RS-232 and GPS Interface

## LCC Connector



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

(DD02-CMC-1294E)

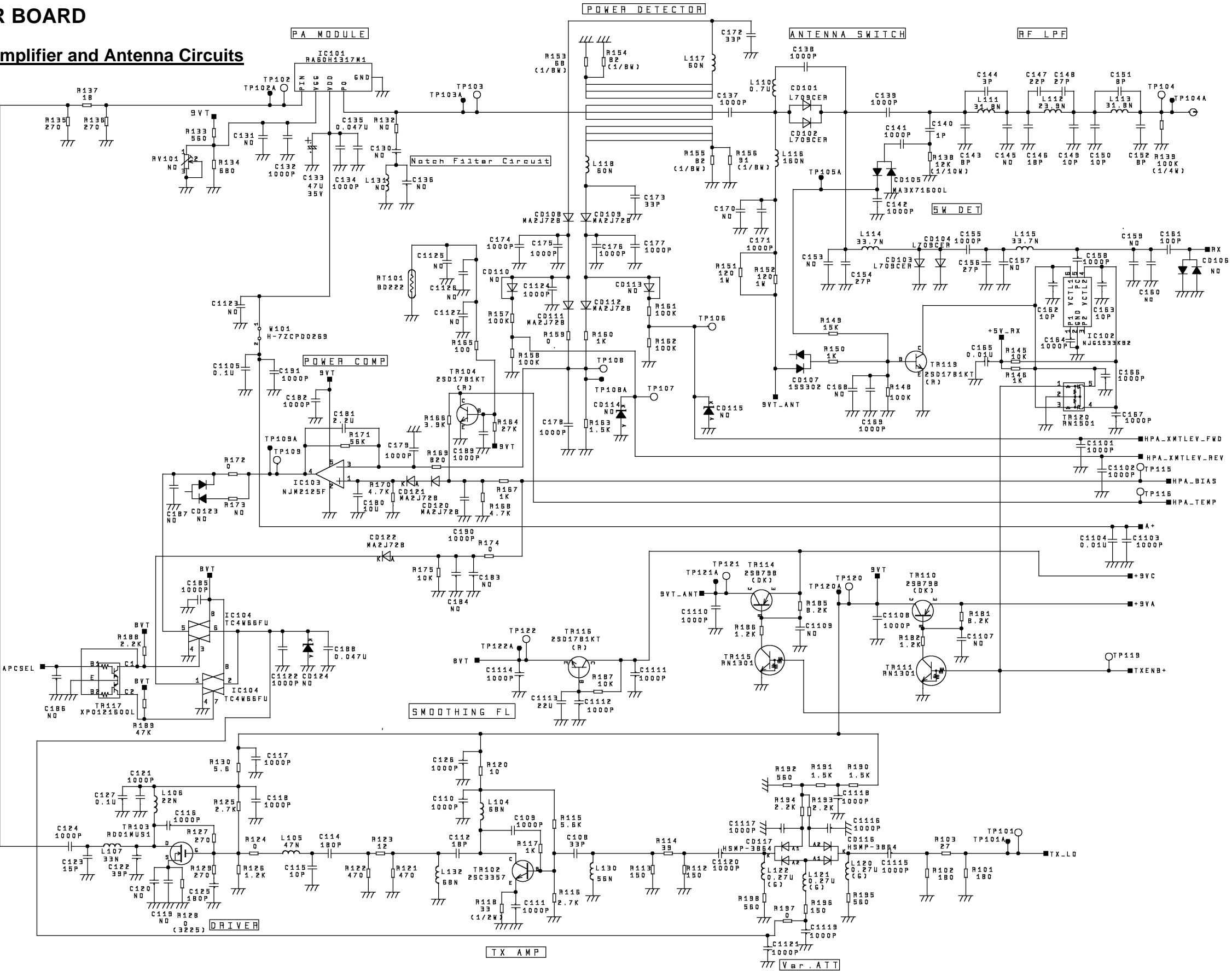
21.1.6 Vehicular Repeater Interface (Not Used)

## Vehicular Repeater Interface (Not Used)

(DD02-CMC-1294E)

**21.2 RF PROCESSOR BOARD**

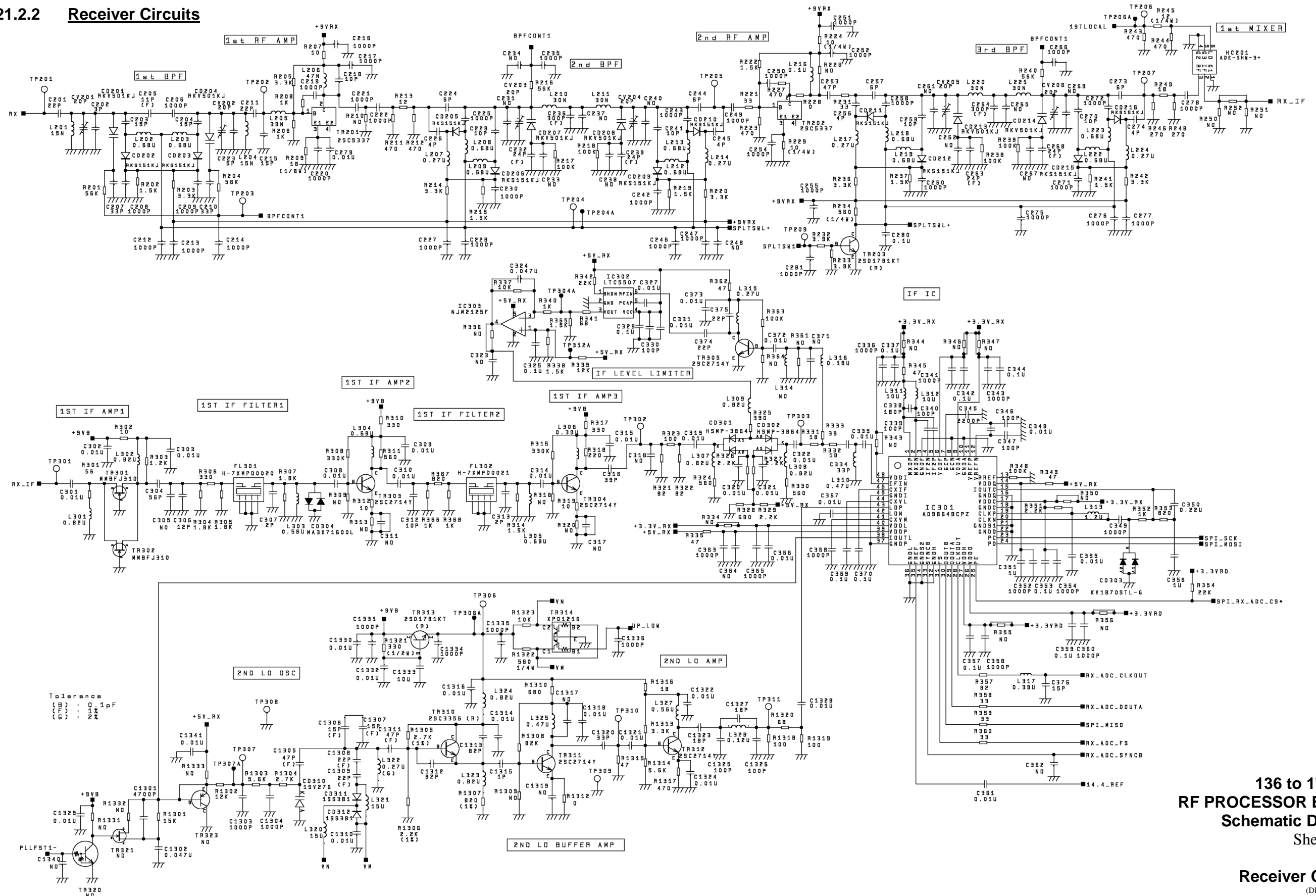
**21.2.1 RF Power Amplifier and Antenna Circuits**



**136 to 174 MHz  
RF PROCESSOR BOARD  
Schematic Diagram**  
Sheet 1 of 6

**RF Power Amplifier  
and Antenna Circuits**  
(DD03-CMN-6831)

## 21.2.2 Receiver Circuits

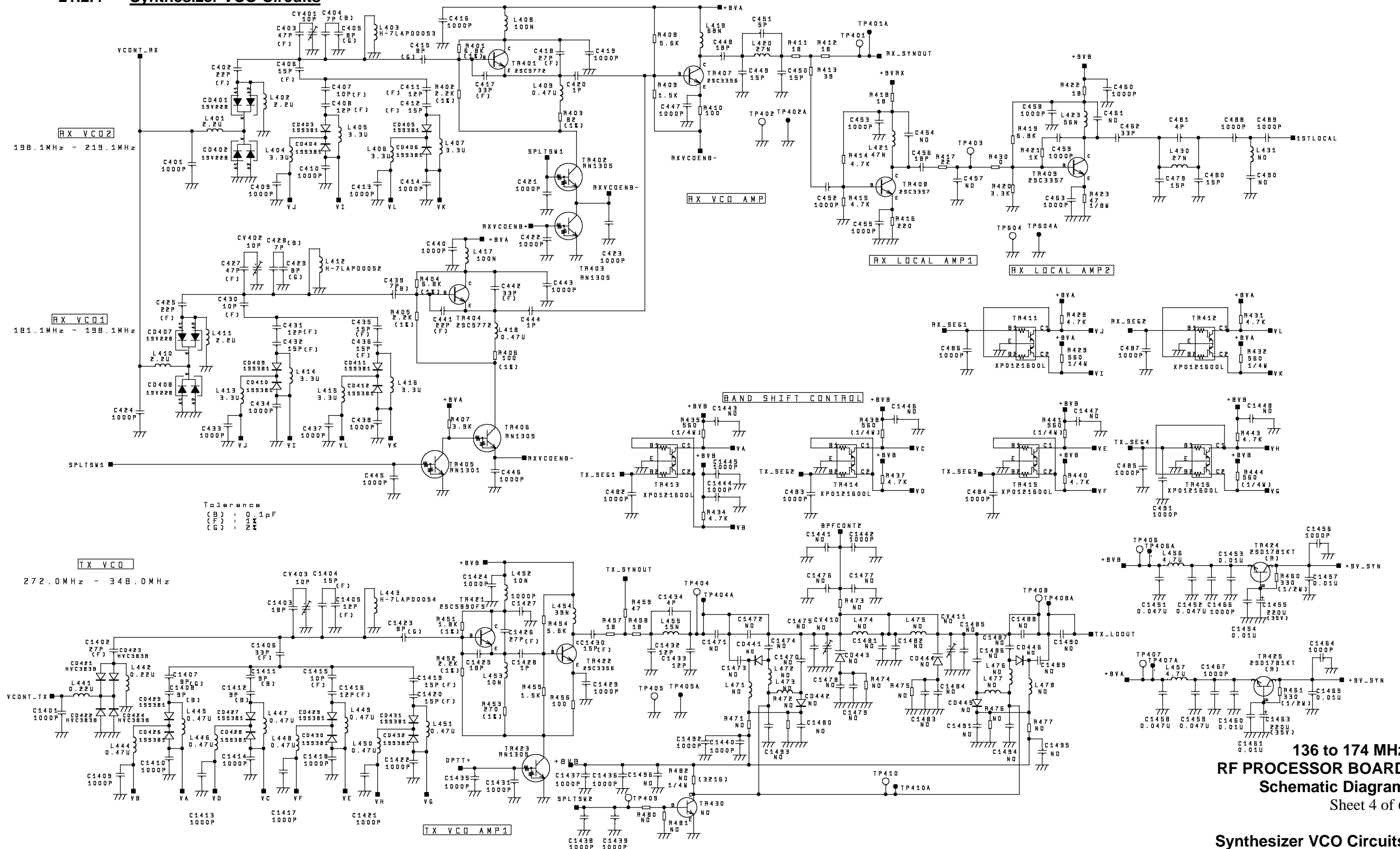


136 to 174 MHz  
RF PROCESSOR BOARD  
Schematic Diagram  
Sheet 2 of 6

## Synthesizer PLL Circuits

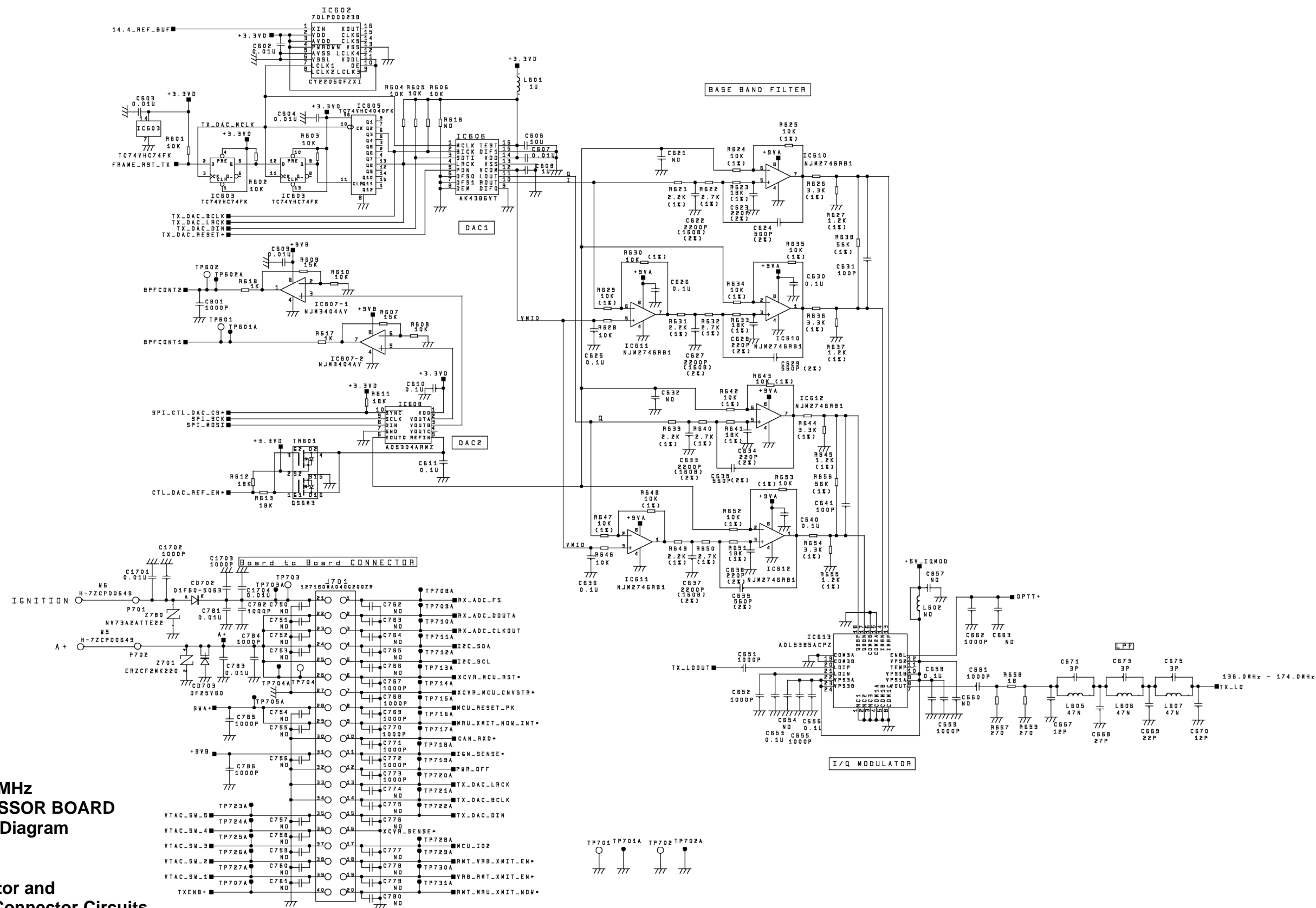


## 21.2.4 Synthesizer VCO Circuits



136 to 174 MHz  
RF PROCESSOR BOARD  
Schematic Diagram  
Sheet 4 of 6

### 21.2.5 I/Q Modulator and PK Board Connector Circuits



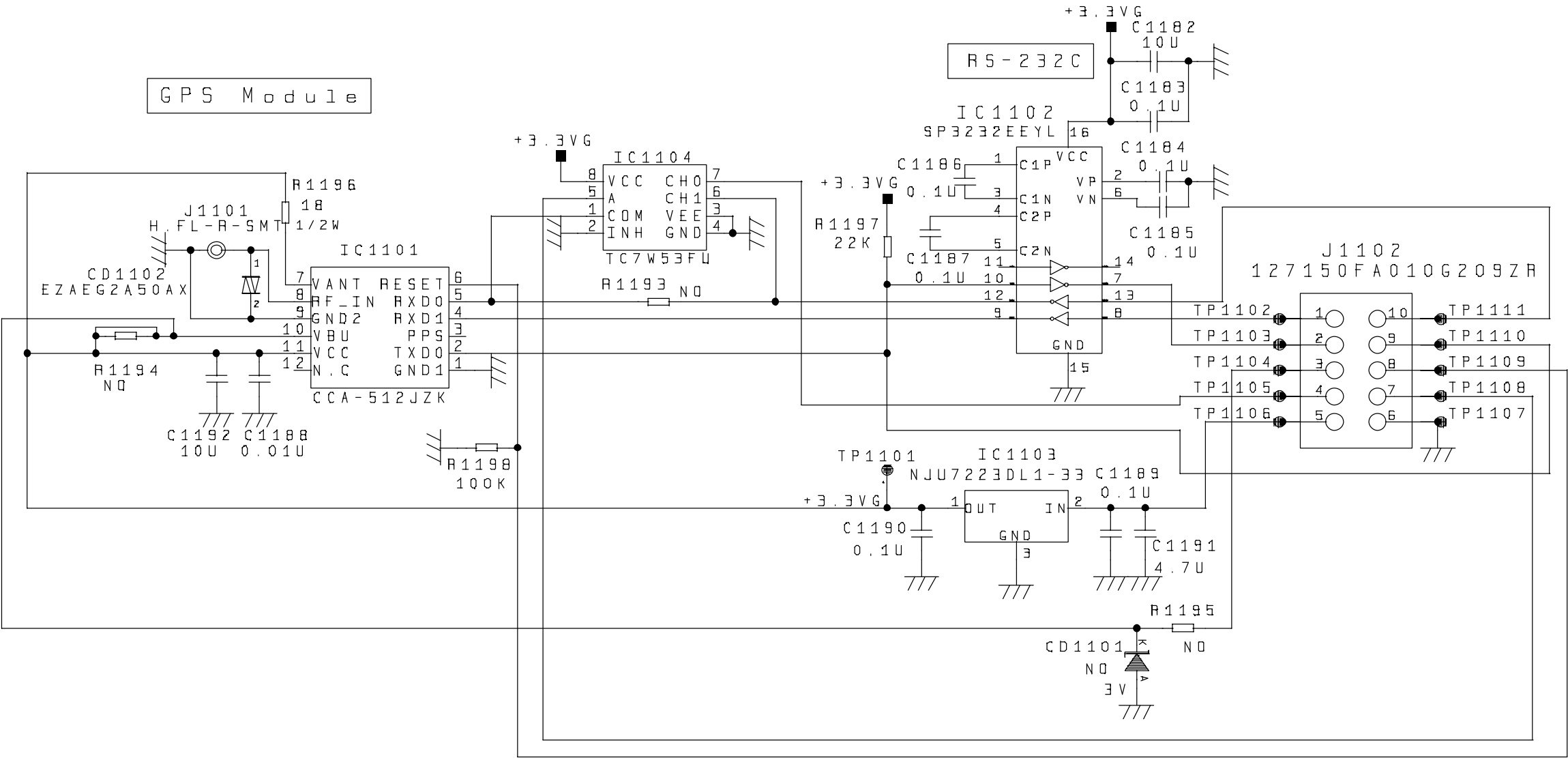
**136 to 174 MHz  
RF PROCESSOR BOARD  
Schematic Diagram**  
Sheet 5 of 6

## I/Q Modulator and PK Board Connector Circuits

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

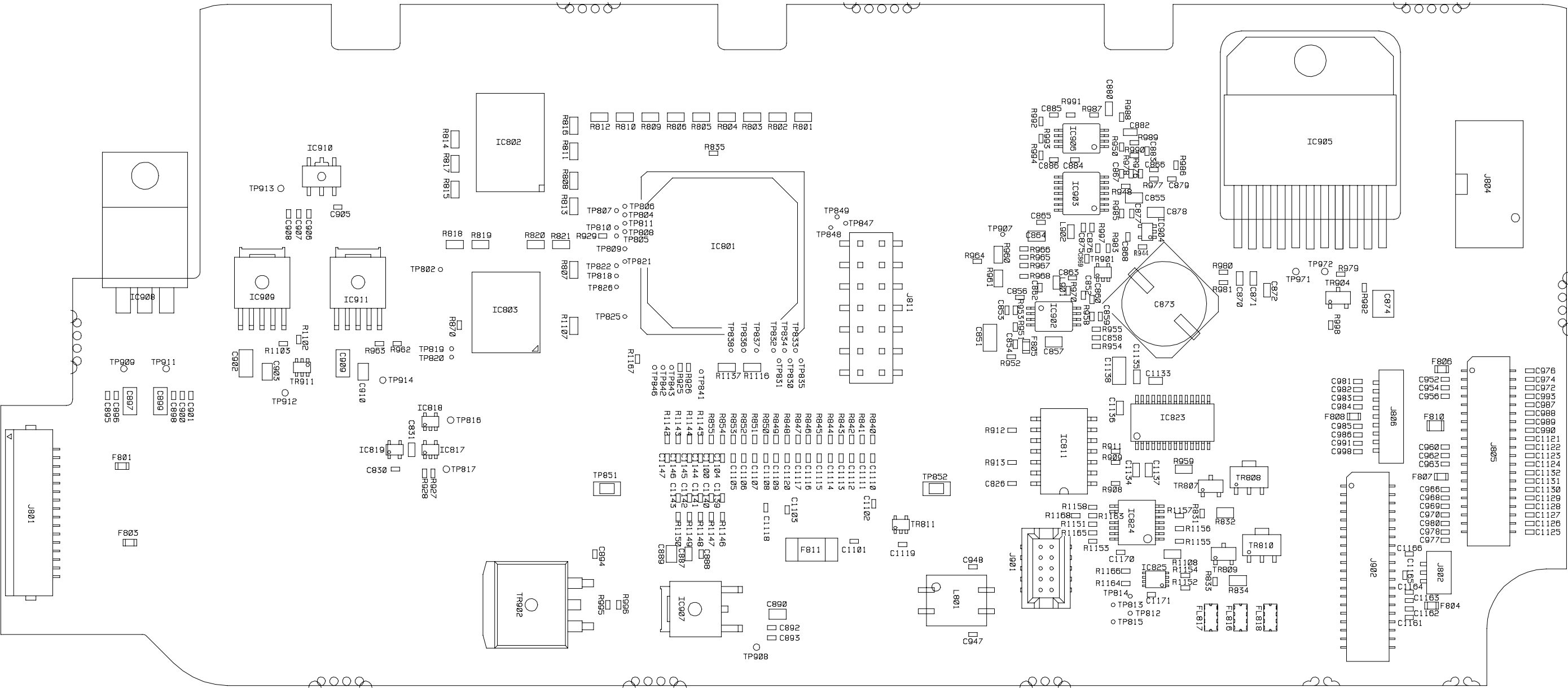


21.3 GPS RECEIVER MODULE

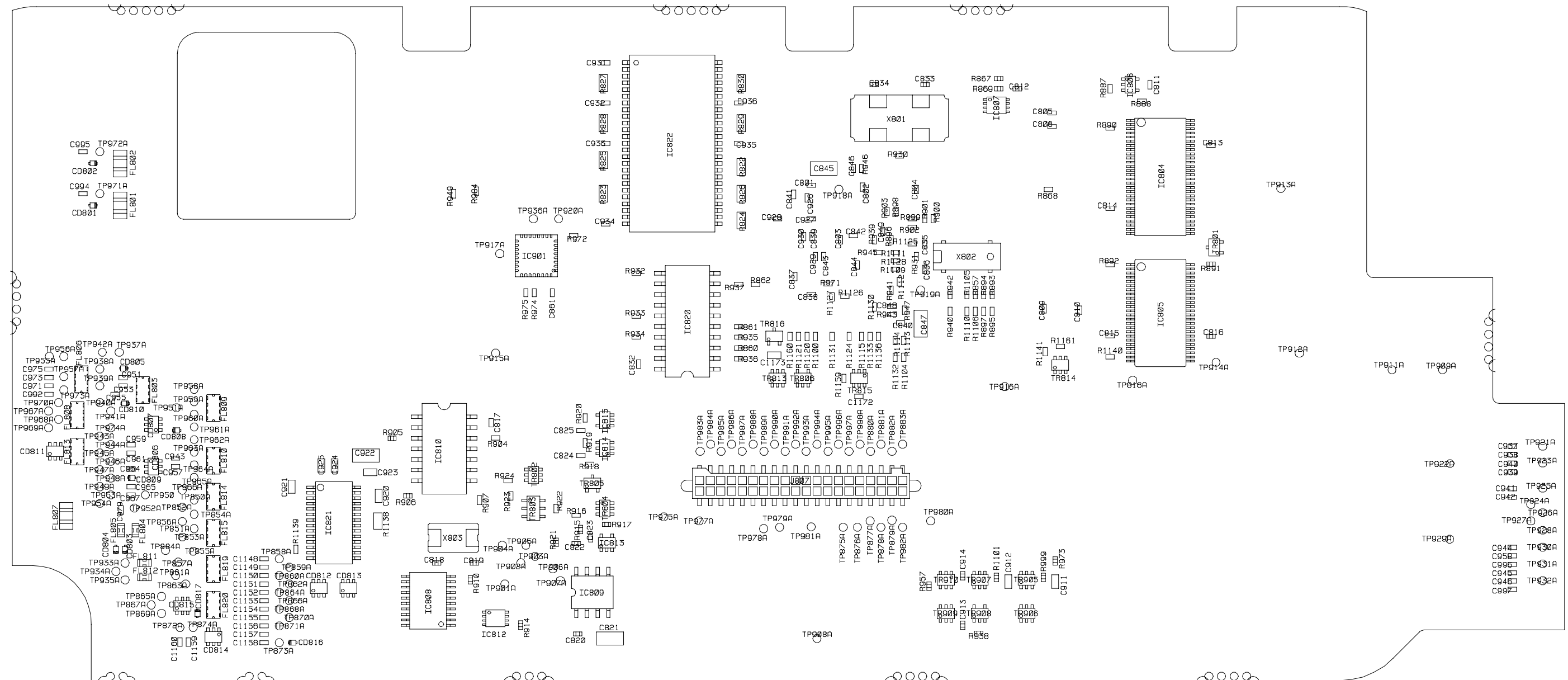


GPS RECEIVER MODULE  
(OPTIONAL)  
Schematic Diagram  
Sheet 1 of 1  
(CMZ/CMA-910 Rev. 20070320)

## 22.1 PK BOARD — PRIMARY SIDE



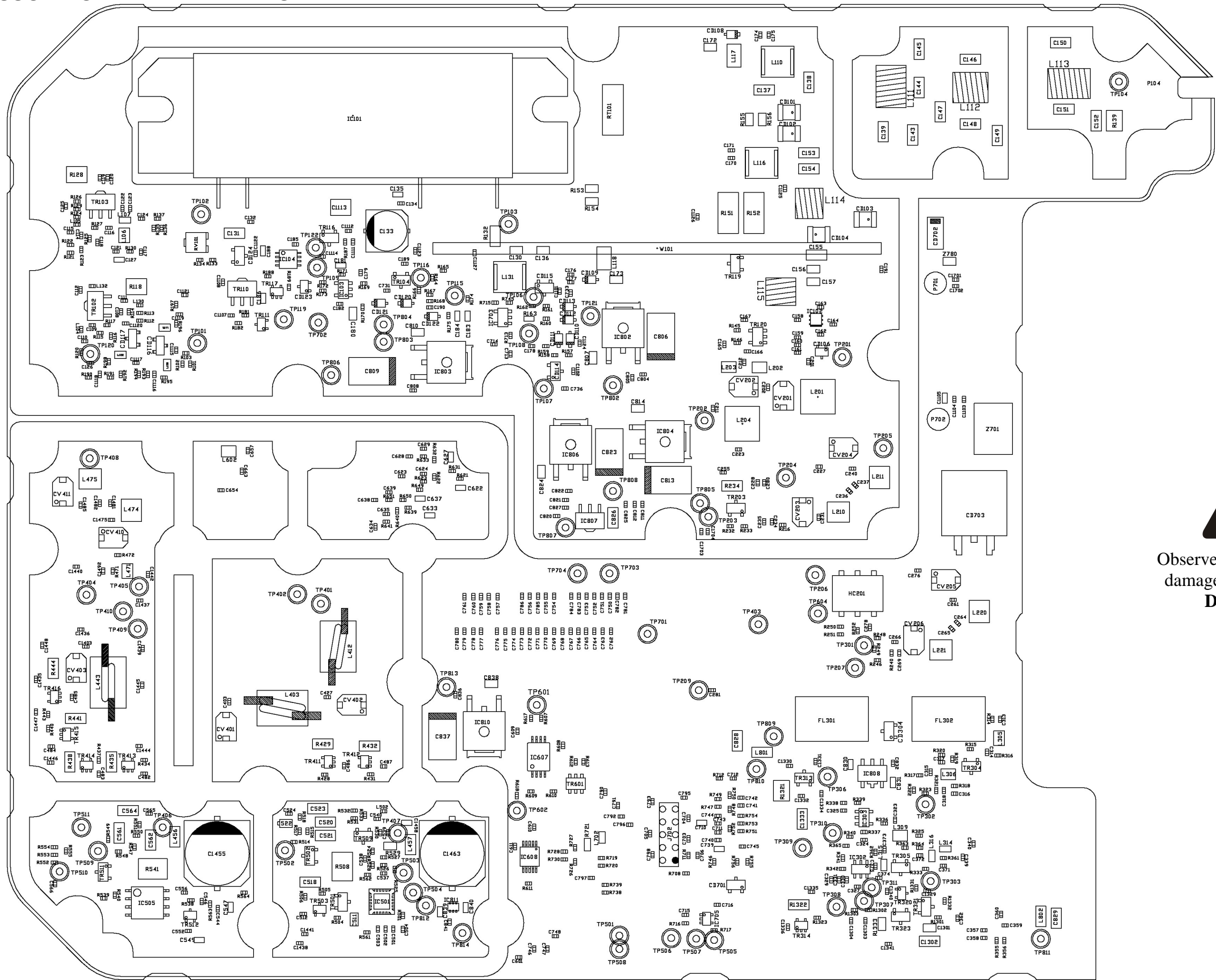
Observe precautions to prevent damage due to **Electro-Static Discharge (ESD)**!



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

(Rev. 8/6/2010)

## 22.3 RF PROCESSOR BOARD — PRIMARY SIDE

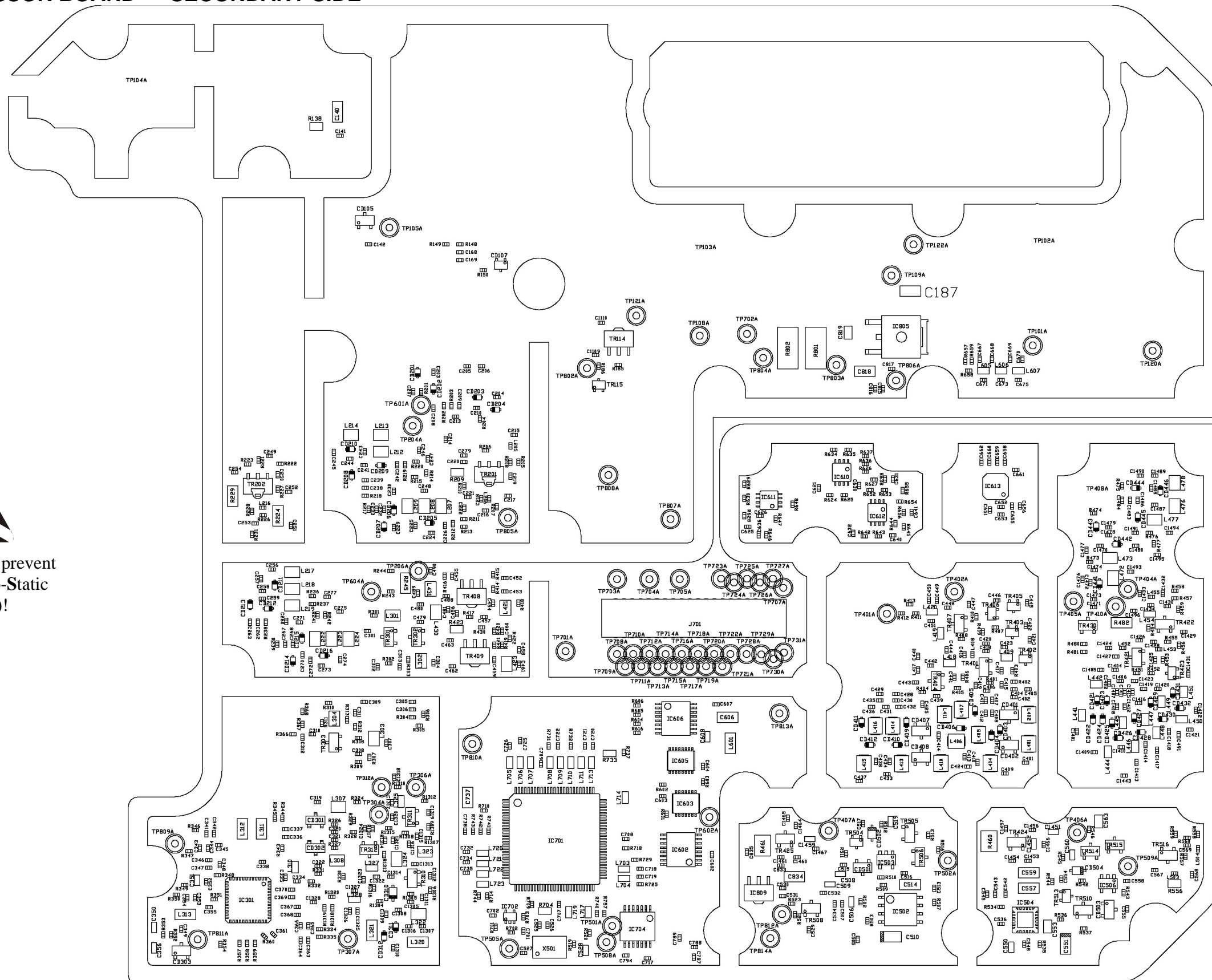
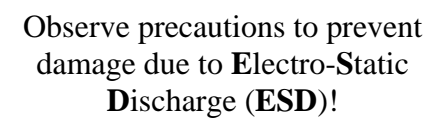


Observe precautions to prevent  
damage due to **Electro-Static  
Discharge (ESD)**!

**136 to 174 MHz  
RF PROCESSOR  
BOARD  
Primary Side**  
(Rev. 7/1/2009)

**136 to 174 MHz  
RF PROCESSOR  
BOARD  
Secondary Side**

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