# SECTION 6 ALIGNMENT PROCEDURE

## *6.1 GENERAL*

### 6.1.1 INTRODUCTION

The following alignment procedure should be performed if repairs are made that could affect the factory alignment or if adjustments may have changed for some other reason. To verify radio operation, the performance tests in Sections 6.5 and 6.6 can be run. To perform transceiver alignment, the following are required:

- PC-compatible computer
- Remote Programming Interface (RPI), Part No. 023-5300-000.
- PCTune software, Part No. 023-9998-499.

All adjustments are set digitally using the computer. Therefore, there is no need to disassemble the transceiver to access adjustment points. In addition, audio test signals are generated internally, so an audio generator is not required. The required test equipment is shown in Figure 6-1.

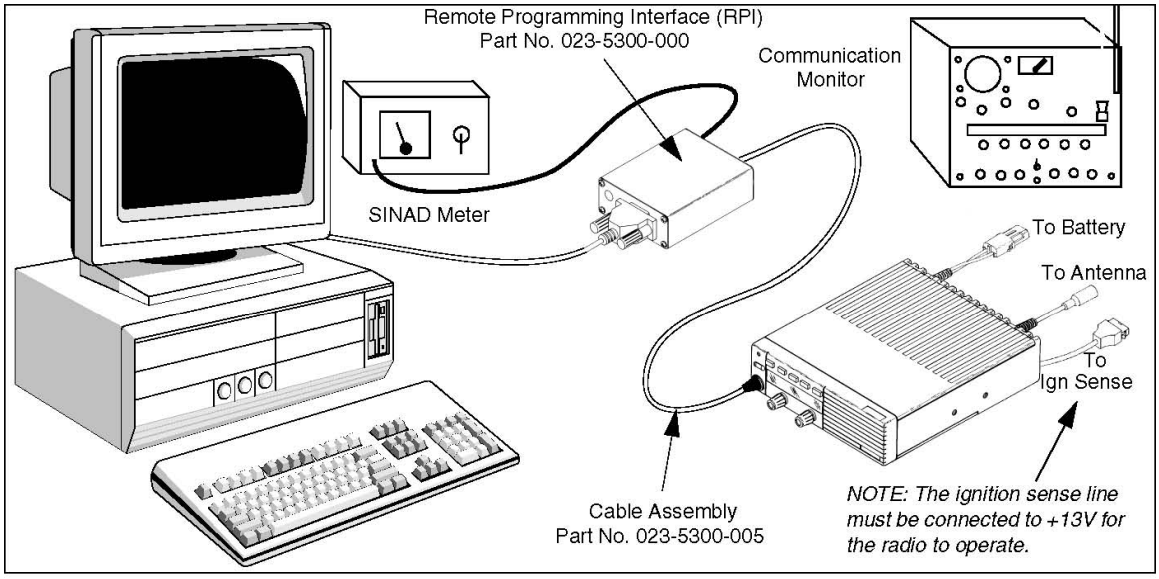



**Figure 6-1 Alignment Setup**

### 6.1.2 TUNE SOFTWARE

General

The PCTune software is a Windows® program. Minimum software and hardware requirements are as follows:

- Windows® 95/98/NT/2000 (3.1 cannot be used)
- Pentium® processor or equivalent
- 16 MB of RAM
- A hard disk drive with at least 3 MB of free space
- A CD-ROM drive
- An available serial port

Software Installation

Proceed as follows to install this software:

1. Close all applications that are currently running (other than Windows).

2. Insert the CD-ROM containing the PCTune software into the drive.

3. From the Windows taskbar, choose RUN and open SETUP.EXE on the drive being used. Alternatively, use File Explorer and double click SETUP.EXE.

4. Follow the instructions on the screen. The program is automatically loaded on the hard drive and startup shortcuts or groups are created.

Starting PCTune

Select Start in the taskbar, then Programs > PCTune > PCTune.

Exiting PCTune

Select File > Exit or click the button.

Online Help

Online help is not available.

### 6.1.3 PCTUNE VERSION REQUIRED

PCTune, Version 2.0.0 or later is required to tune the RF board. The version number can be displayed by selecting the Help > About menu.

## *6.2 MAIN SCREEN*

The main PCTune screen is shown in Figure 6-2. Information on the various parts of this screen follows:

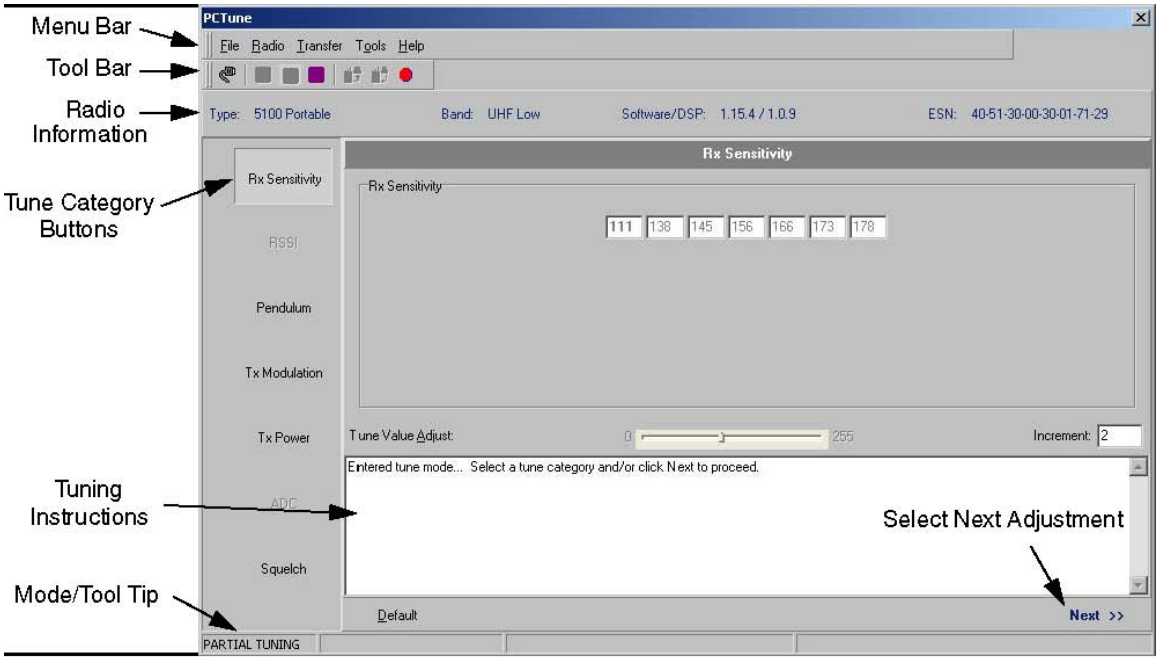



**Figure 6-2 PCTune Main Screen**

**Menu Bar -** Used to select the menus described in Sections 6.3.1-6.3.5.

**Tool Bar -** These buttons are used to quickly select functions as follows:

 - Displays the screen used to set serial port parameters (see Section 6.3.3).

 - Selects the Partial Tune mode the same as the Transfer > Tune Partial menu (see Section 6.3.3) This mode allows manual selection of the desired Tune Category and then automatically steps through the various settings for that adjustment.

 - Selects the Edit Mode which allows parameters in the selected screen to be changed without stepping through each adjustment.

 - Reads and displays the current parameters programmed in the radio the same as the Radio > Read Tune Parameters menu (see Section 6.3.3).

 - Writes the current tune parameters to the radio the same as the Transfer > Write Tune Parameters menu (see Section 6.3.3). This occurs automatically when a Partial Tune adjustment is completed.

 - Exits the current Tune Category without writing parameters to the radio.

**Radio Information**

When tuning parameters are read from a radio by clicking the  button or selecting the Transfer > Read Parameters menu, the following information is displayed in the top part of the screen:

Type - The Radio Series selected by the Radio menu (see Section 6.3.2). The correct series must

be selected for communication with the radio to occur.

Band - The radio frequency band of the radio displayed after information is read from radio. Do not select the band using Tools > Set Band (Section 6.3.4) because this may make the radio nonfunctional.

Software DSP - The first number is the version number of the radio firmware (Flash/operating code), and the second number is the version number of the DSP software.

ESN - The Electronic Serial Number electronically stored in the radio.

**Tuning Categories**

These buttons select the tuning adjustment to be performed. Different functions are displayed for the 51xx and 53xx. If the Partial tune mode is selected, these buttons select the particular adjustment that is performed.

**Mode/Tool Tip**

Information on the bottom line of the screen indicates the current tune mode and information on the selected button on other information.

## *6.3 MENU BAR DESCRIPTION*

### 6.3.1 FILE MENU

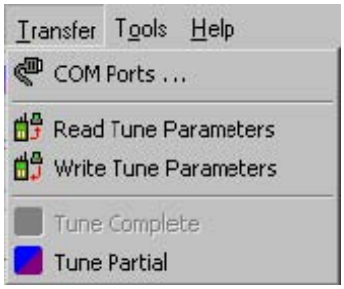
Selecting File > Exit closes the PCTune program.

### 6.3.2 RADIO MENU

[Insert 4300 radio menu]

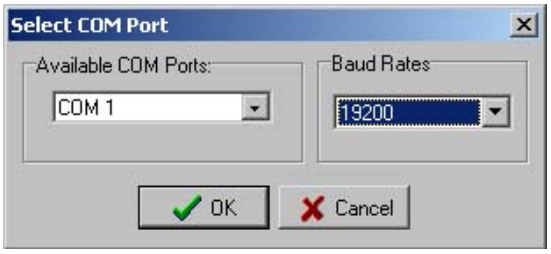
The Radio menu shown above selects the radio type. [Insert correct selections for 4300] The correct radio type must be selected for communication with the radio to occur.

### 6.3.3 TRANSFER MENU




**COM Ports -** Displays the following screen which selects the serial port (1-12) and baud rate

(9600/ 19200) used for communication with the radio. Select the computer port to which the test cable is connected (see Section 6.4.1), and 19200 baud is normally selected. These parameters default to the last selected condition the next time the program is started.




**Read Tune Parameters -** Selecting this function or clicking the  button reads the tune parameters currently programmed in the transceiver and displays them in the various screens.

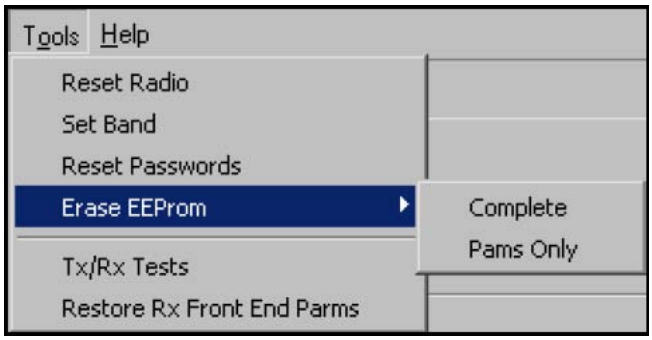
*NOTE: Values in the various screens are for reference only and adjustments should be done only by using the Partial Tune function.*

**Write Tune Parameters -** Selecting this function or clicking the  button writes the current tune parameters to the radio. This occurs automatically when a Partial Tune adjustment is completed.

**Tune Complete –** Not available. This function automatically steps through all the tests required to tune the radio.

**Tune Partial -** Selecting this function or clicking the  button selects the Partial Tune mode. This mode automatically steps through all the adjustments of the currently selected Tune Category.

## 6.3.4 TOOLS MENU




**Reset Radio -** Resets the radio control logic similar to cycling power. This can be used, for example, to change the radio series or band or exit an adjustment before it is complete.

**Set Band -** Selects the operating band of the radio. All tuning values are reset to the factory defaults.

***CAUTION:*** *Do not select this function because it can make the radio non-functional.*

**Reset Passwords -** Erases all password information contained in the radio. This function can be used, for example, to allow reprogramming of passwords if they are lost. *NOTE: Radio personality information is not erased by this function.*

**Erase EEPROM**

***CAUTION:*** *This function erases important radio programming information as described below.*

Complete -Erases all EEPROM information, including factory programmed parameters.

***CAUTION:*** *Do not select this function because the radio must be returned to the factory to make it operational again.*

Parms Only - Erases all personality information.
*NOTE: The radio must be reprogrammed after this function is selected.*

**Tx/Rx Tests -** Selects a screen which is used to check digital (Project 25) receive and transmit performance. Refer to Section 6.5 for more information.

**Restore Rx Front End Parameters -** Programs the radio with default receive front end tune parameters. Other parameters remain unchanged.

### 6.3.5 HELP MENU

Displays the version number of the PCTune software and other information.

## *6.4 TUNING PROCEDURE*

### 6.4.1 CONNECTING TEST SETUP

1. With transceiver power turned off, connect the RPI to an unused serial port of the computer using a suitable cable (see Section 4.1.3).

2. Connect the RPI to the microphone jack of the transceiver using programming cable, Part No. 023-5300-005 (see Figure 6-1).

3. If the receiver squelch adjustment will be made, connect a SINAD meter to the Speaker Audio Out jack on the RPI (see Figure 6-3). This is a low level fixed audio output, and a 2.6 mm (3/32") phone jack is used.

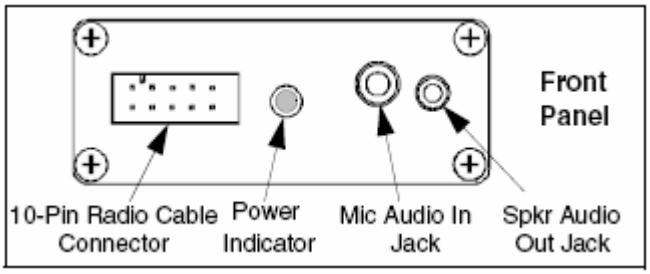



**Figure 6-3 RPI Front Panel**

4. Connect a wattmeter and a suitable load to the antenna jack of the transceiver for the transmitter tests. For the receiver tests, connect the signal generator to the antenna jack through a 6 dB or greater isolation pad.

### 6.4.2 STARTING AND CONFIGURING PCTUNE

1. Start the program as described in Section 6.1.2 and turn transceiver power on. Select Transfer > COM Port and make sure that the correct serial port and the 19200 baud rate are selected (see Section 6.3.3).

2. Select the Radio menu and make sure the correct radio series (43xx) is selected [What is the correct menu selection?] (see Section 6.3.2).

3. Select Transfer > Partial Tune and click the button for the desired Test Category.

4. Follow the instructions displayed on the screen to complete the various adjustments required for a particular setting. Then repeat for other applicable Test Categories.

## *6.5 DIGITAL PERFORMANCE TESTS*

### 6.5.1 GENERAL

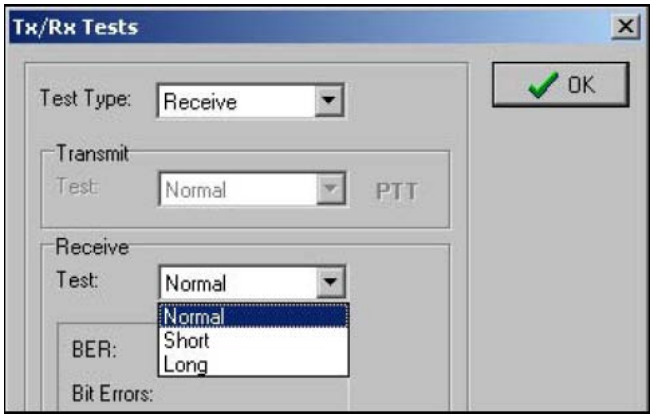
This section describes how to check the performance of the radio on digital Project 25 channels. The PCTune software includes a Tools > Tx/Rx Tests menu that displays the screen used for these tests.

- To perform these tests, a Digital Communication Analyzer such as Motorola R2670 or IFR 2975 is required.
- These tests follow the TIA-102-CAAA-A “Digital C4FM/CQPSK Transceiver Measurement Methods” specification. Refer to that document for more information.
- A P25 conventional channel preprogrammed by the PCConfigure software is used for testing. The PCTune software does not select a specific test channel. The test channel must be programmed with the following options:

**NAC -** 293 (hex)
**TGID (Talk Group ID) -**1
**Frequency -** Any frequency in radio operating band

## 6.5.2 RECEIVE TEST SETUP

1. Connect the test setup and start and configure the PCTune software as described in Section 6.4. Select the Tools > Tx/Rx Tests menu to display the Tx/Rx Tests screen. Then in the Test Type drop-down list select Receive to display the following screen.




2. Connect the Digital Communication Monitor to the antenna jack using a 6 dB or greater isolation pad. Set the Monitor output for the "1011" test pattern.

## 6.5.3 RECEIVE SENSITIVITY TEST

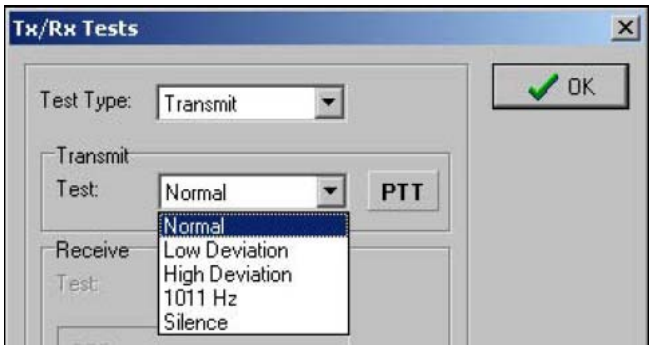
1. A tone should be heard from the radio speaker if the analyzer is set properly. Select the "Short" or "Long" test in the Test drop down list and the radio should mute.

2. Set the analyzer output level for 0.35 µV (–116 dBm) at the receiver antenna jack. The Bit Error Rate (BER) should be 5% or less. (This is a ratio of the receive bit errors to the total number of bits transmitted.)

3. Increase the analyzer output level to 1000 µV (–47 dBm). The BER rate should be less than 0.01%. This is the BER Rate Floor.

## 6.5.4 TRANSMITTER TESTS

1. If applicable select the Tools > Tx/Rx Tests menu to display the Tx/Rx Tests screen. Then in the Test Type drop-down list select Transmit to display the following screen. Connect a dummy load to the radio antenna jack. Monitor the transmit signal with the Digital Communication Monitor.




2. Select the **Low Deviation** test and set the analyzer as required to measure transmitter deviation. This test generates continuous repetitions of bits 10100000. Deviation should be 848-1037 Hz.
3. Click the "PTT" button to transmit the tone. When finished, click that button again to turn the transmitter off.
4. Select the "**High Deviation**" test which transmits a standard transmitter test pattern. Deviation should be 2544-3111 Hz.
5. The "**1011 Hz**" test transmits a standard 1011 Hz tone similar to that used for the receiver test. This tone can be used to check the operation of other radios.
6. The "**Silence**" test transmits a standard silence test pattern which produces no receive audio output by the receiving radio. This tone can also be used to test other radios.
7. Select "**Normal**" to transmit a standard voice signal by speaking into the radio microphone.

## *6.6 ANALOG PERFORMANCE TESTS*

### 6.6.1 GENERAL

The PCTune software is not used for analog channel performance testing. Simply program the desired channels using the PCConfigure software as described in Section 4. The RPI is still required to monitor the audio output signal from the radio.

Depending on the application, 12.5 kHz and 25 kHz test channels may need to be programmed. Also, test channels programmed with or without Call Guard® (CTCSS/DCS) squelch control may be required.

### 6.6.2 RECEIVER PERFORMANCE TESTS

1. Connect a signal generator to the antenna jack using a 6 dB or greater pad. Set the output for the channel frequency, modulated with 1 kHz at the following deviation:
   **12.5 kHz Channels -** 1.5 kHz
   **25 kHz Channels -** 3.0 kHz

2. Connect a SINAD meter to the receive audio jack of the RPI (see Figure 6-3) This is a low level fixed audio output.

SINAD Sensitivity

3. Set the signal generator output level for 1000 µV (–47 dBm) at the antenna jack.

4. Decrease the signal generator output to obtain 12 dB SINAD. The signal generator output should be 0.35 µV (–116 dBm) or less for 25 kHz channels, or 0.50 µV (–113 dBm) or less for 12.5 kHz channels.

Audio Power Output and Distortion

5. Connect a distortion meter across the speaker load. Return the generator output to 1000 µV. Distortion should be 3% or less.

Squelch Sensitivity

6. Increase the signal generator output from zero and note the SINAD when unsquelching occurs. It should be approximately 8 dB.

## 6.6.3 TRANSMITTER PERFORMANCE TESTS

1. Connect a wattmeter and dummy load to the antenna jack. Monitor the transmit signal with a communication monitor.

Transmit Frequency

2. Monitor the transmit frequency and at room temperature it should ±100 Hz. At other temperatures [–22° to +140° F (–30° to +60° C)], it must be within 2.5 PPM. This also checks the receive frequency.

Transmit Power

3. Transmit power should be in the following ranges. High and low levels can be preset anywhere in this range by PCTune. The factory default for high power is the maximum shown below, and low power is half that value.
   **Standard Models -**10-50 Watts

Transmit Modulation

4. Monitor the transmit modulation with a modulation meter. Speak into the microphone with a normal voice. Modulation should be approximately as follows with no CTCSS/DCS signaling present:
   **12.5 kHz Channels -** 1.4 kHz
   **25 kHz Channels -** 3.4 kHz

5. Select a channel programmed with Call Guard (CTCSS/DCS) signaling. Maximum total Call Guard and voice modulation should be approximately as follows:
   **12.5 kHz Channels - 2.3 kHz**
   **25 kHz Channels - 4.7 kHz**