

SECTION 6 ALIGNMENT PROCEDURE

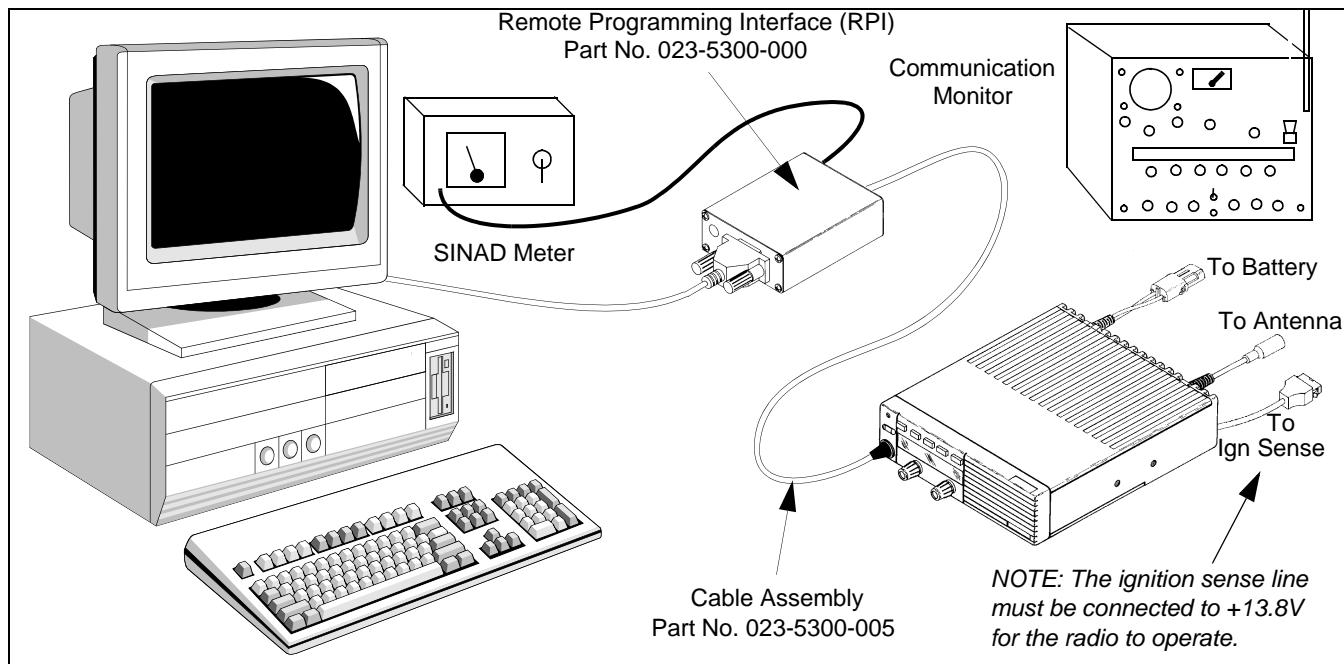


Figure 6-1 Alignment Setup

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. Earlier RPIs, such as Part No. 023-9800-000 or 023-9750-000, cannot be used. Refer to Section 4.1.3 for more RPI information.
- PCTune software, Part No. 023-9998-499. Early units (indicated by an eighth digit of 242 P.N. = "1") require PCTune, Part No. 023-5000-093.

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.

NOTE: PC Tune, Version 1.0.8.9 or later, is required to tune 380-470 MHz and revised logic PC board models (see Section 1.2.5).

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

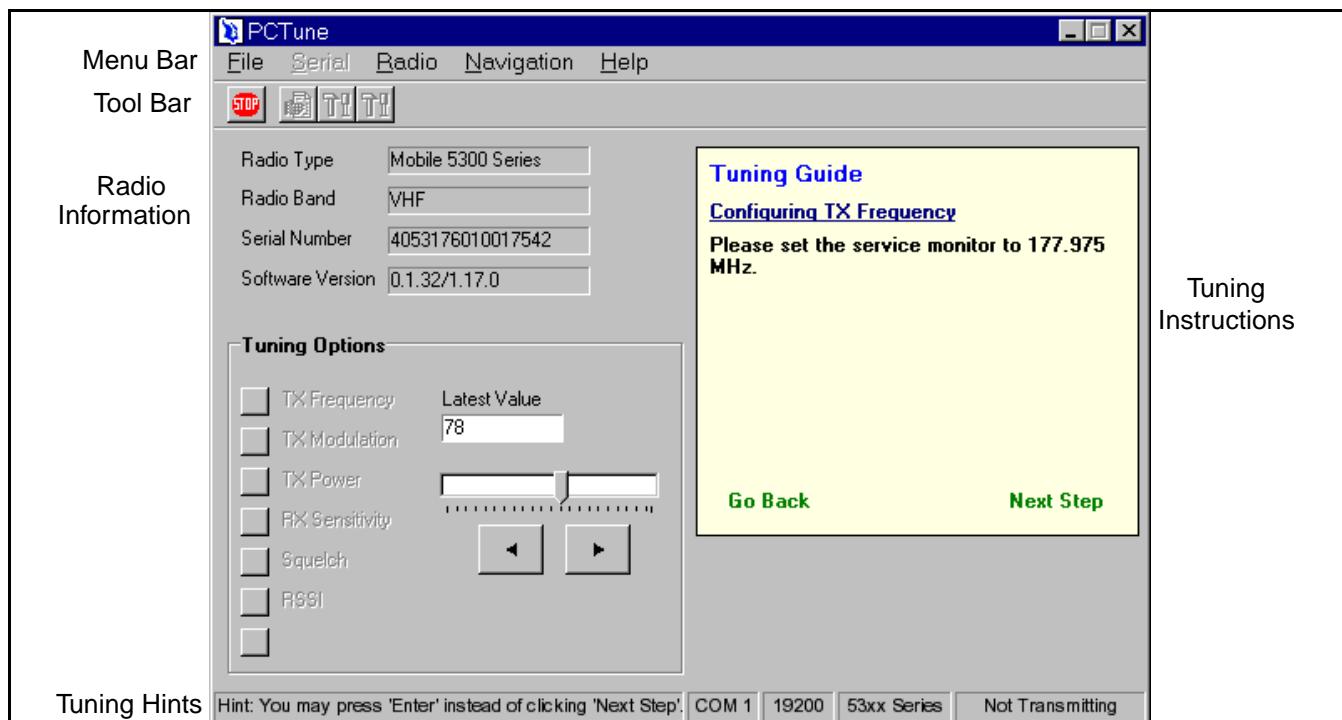


Figure 6-2 PCTune Main Screen

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 or button.

On-Line Help

On-line help is currently not available.

6.2 MAIN SCREEN

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

Menu Bar - Used to select the menus described in Sections 6.3.1-6.3.4.

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

- Exits the program same as File > Exit.

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

- Selects the complete radio tune mode the same as Radio > Tune > Complete.

- Selects the partial radio tune mode which allows manual selection of each adjustment same as Radio > Tune > Partial.

Radio Information

Radio Type - The Radio Series selected by the Radio > Series menu function (see Section 6.3.3).

Radio Band - The radio frequency band of the radio displayed after information is read from radio. Do not set using Radio > Set Band (Section 6.3.3).

Serial Number - The serial number electronically stored by the radio.

Software Version - The first number is the version number of the radio DSP software, and the second number is the version number of the main radio operating (ARM) software.

Tuning Options

When the tuning mode has been enabled by Radio > Tune Complete/Partial, this part of the screen displays the current adjustment value and up/down buttons for changing the value.

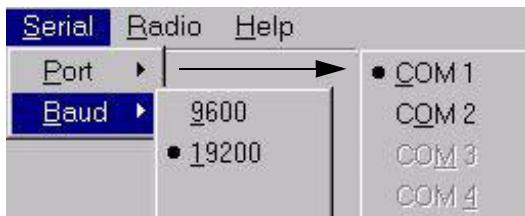
In addition, when “Partial” is selected, adjustments can be individually selected by clicking the applicable button (see Section 6.3.3).

6.3 MENU BAR DESCRIPTION

6.3.1 FILE MENU

Selecting File > Exit closes the PCTune program.

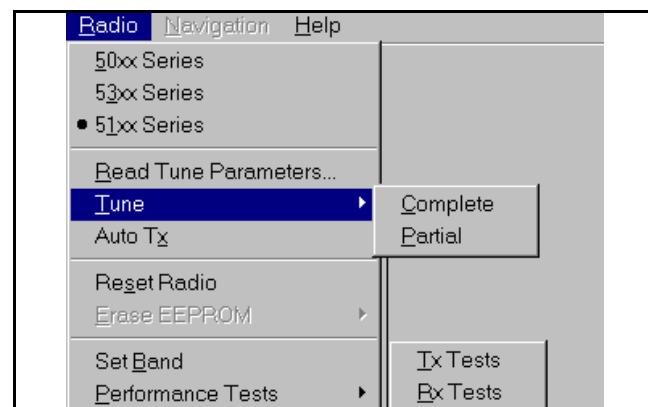
6.3.2 SERIAL MENU



Port - Selects the serial port to which the test cable is connected (see Section 6.4.1). These parameters default to the last selected condition the next time the program is started.

Baud - Selects the data rate used for communication with the radio. Select “19200” as shown above.

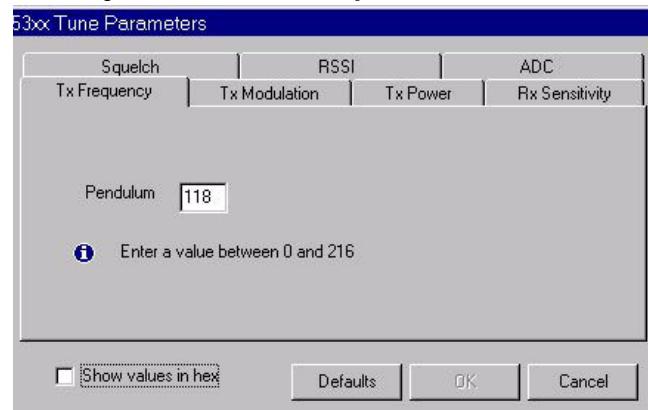
6.3.3 RADIO MENU



Series - Selects the particular radio being tuned. For this radio, select “53xx Series”.

Read Tune Parameters - Selecting this function or clicking the  button reads the tune parameters currently programmed in the transceiver and displays them in the following screen

NOTE: This Read Tune Parameters screen should be used for reference only. Adjustment of values in this screen should be done only by using the Complete or Partial Tune functions.



Read Tune Parameters Screen

Click the tab on top to display the desired parameters. Checking the box on the bottom displays the values as hexadecimal instead of decimal.

Parameters can be changed by entering a value in the appropriate box. Clicking “Default” programs default values, clicking “OK” closes the screen and saves the values entered, and clicking “Cancel” closes the screen without saving any values.

Tune - Selecting “Complete” or clicking the  button automatically steps through all tuning steps. Selecting “Partial” or clicking the  button allows the tuning steps to be selected manually in the “Tuning Options” box.

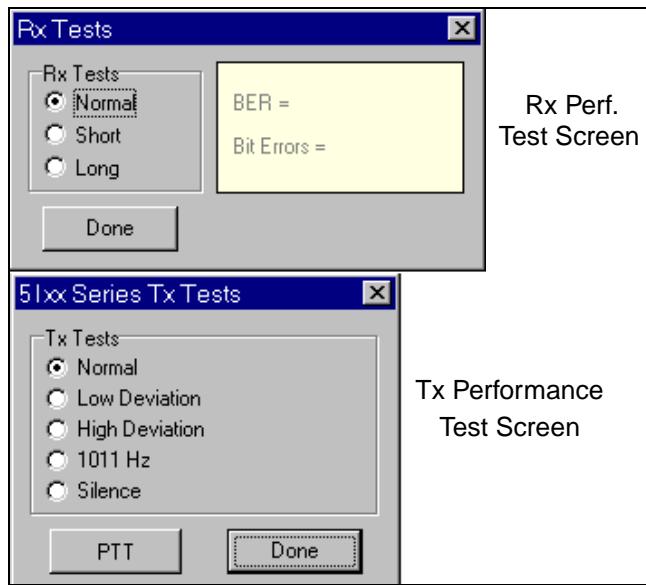
Auto Tx - Selecting this parameter causes the transmitter to automatically key and unkey as required for the various tests. If it is not selected, the transmitter must be manually keyed by pressing the spacebar.

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

Erase EEPROM - If available, this deletes the parameters that are programmed by PCConfigure described in Section 4. *NOTE: Reprogramming is required if this parameter is selected.*

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 leave the radio non-functional.

Performance Tests - Selects the following screens which are used to check digital (P25) receive and transmit performance. Refer to Section 6.5 for more information.



Performance Tests Screens

6.3.4 HELP MENU

Displays the version number of the PCTune software.

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.
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.

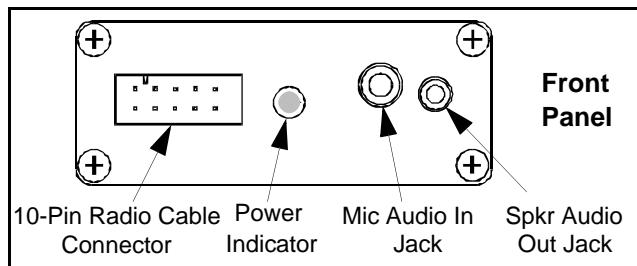


Figure 6-3 RPI Front Panel

6.4.2 STARTING AND CONFIGURING PCTUNE

1. Start the program as described in Section 6.1.2 and turn transceiver power on. Select Serial > Port and make sure that the correct serial port is selected. Likewise, select Serial > Baud and make sure “19200” is selected (see Section 6.3.2). These parameters default to the last selected condition the next time the program is started.
2. Select the Radio menu and make sure the correct radio series (53xx) is selected.

3. Select Radio > Tune > Partial if manually selecting each adjustment or select Complete to have the program automatically step through all adjustments.
4. Follow the instructions displayed on the screen to complete the various transceiver adjustments.

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 Performance Tests menu that is 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:

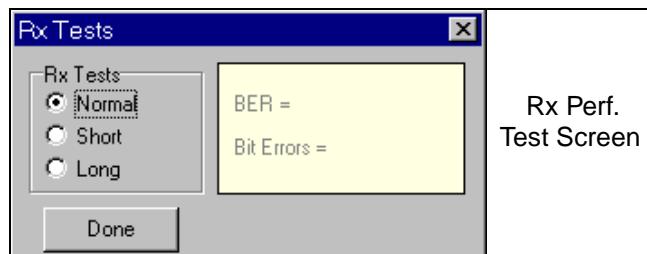
NAC - 293 (hex)

TGID (Talk Group ID) - 1

Frequency - Any freq 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 following Radio > Performance Tests > Rx Tests screen.



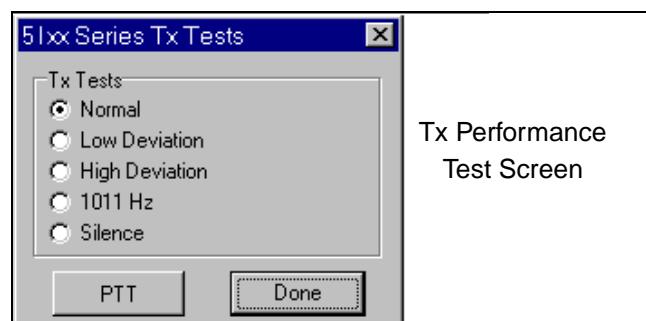
2. Connect the Digital Communication Monitor to the antenna jack using a 6 dB or greater isolation pad. Set the Monitor output for the “1011” test pattern.

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 PCTune Rx Tests screen. After this is selected, the radio audio mutes.
2. Set the analyzer output level for 0.35 μ V (-116 dBm) at the receiver antenna jack. The BER (Bit Error Rate) 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 μ V (-47 dBm). The BER rate should be less than 0.01%. This is the BER Rate Floor.

6.5.4 TRANSMITTER TESTS

1. Connect a dummy load to the radio antenna jack. Monitor the transmit signal with the Digital Communication Monitor.
2. Select the following PCTune Radio Performance Tests > Tx Tests screen.



3. 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.
4. Click the “PTT” button on the screen to transmit the tone. When finished, click the “Done” button.

5. Select the “**High Deviation**” test which transmits a standard transmitter test pattern. Deviation should be 2544-3111 Hz.
6. 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.
7. 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.
8. 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, 25 kHz, and (800 MHz) NPSPAC 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

800 MHz NPSPAC Channels - 2.4 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 μ V (-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 μ V (-116 dBm) or less for 25 kHz channels, or 0.50 μ V (-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 μ V. 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 (-30 to +60° C), it must be within 2.5 PPM (VHF/UHF) or 1.5 PPM (800 MHz). 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.

VHF Standard - 10-50 watts

VHF 100W - 50-100 watts

UHF - 7-15 watts

800 MHz - 10-35 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

800 MHz NPSPAC Channels - 2.5 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

800 MHz NPSPAC Chan - 3.8 kHz