GENERAL DYNAMICS
SATCOM Technologies

# AutoTune™

for Vertex Standard VX-P820/P920

# USER'S GUIDE

General Dynamics SATCOM Technologies
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CG-1345 Rev. C

## AUTOTUNE™ SOFTWARE LICENSE AGREEMENT

The software license agreement governing use of the AutoTune™ for VX-P820/P920 software may be found on the installation CD in the license folder in License_Agreement.rtf.

## TRADEMARKS

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# 1. Introduction

The Vertex Standard VX-P820/P920 are VHF/UHF P25 portable radios providing analog FM and digital P25 reception and transmission of voice and data in the VHF/UHF frequency bands used in land mobile environments. The General Dynamics AutoTune™ application is designed to provide an automated test and alignment solution for Vertex Standard VX-P820/P920 radios. AutoTune™ supports the R2600 family of Communications Systems Analyzer.

# 2. Scope

This document is intended to provide information regarding the operation of the AutoTune™ software application with the Vertex Standard VX-P820/P920. This document encompasses radio information specific to the Vertex Standard VX-P820/P920 radios only. Any references to other test equipment appearing in this document are for illustration purposes only, unless otherwise noted.

# 3. Requirements

## *3.1. Firmware*

Before attempting to align or test a VX-P820/P920 radio, the radio's firmware ***must*** be version **1.29** or later. This firmware version is required to support the AutoTune™ alignment and test capabilities.

On models equipped with an LCD, the radio firmware version may be viewed by pressing and holding the side LAMP Button key while turning the radio on. After radio power-on and self test, the radio will enter the screen test/version view mode. Subsequent LAMP Button presses will cycle through the following screens, in this order:

- Icon test
- Character test
- Serial number
- Firmware version/band
- DSP version

On the Firmware version/band screen, the firmware version is the 4 character value on the left.

For models without an LCD, the radio firmware version may be obtained by using Vertex Standard CE76 software. With the radio connected to a PC, select the Radio > Upload command from the main menu bar. Once the radio's information has been uploaded, the firmware version number is displayed in the "FW Version" field.

## *3.2. Analyzer*

Because of the P25 nature of Vertex Standard VX-P820/P920 radios, a P25-equipped R2600 series Communications System Analyzer is necessary for full use of AutoTune™ for VX-P820/P920 radios. However, a R2600 series analyzer without the P25 option will perform all alignments and tests except for Maximum Deviation. If Maximum Deviation is selected for performance and the R2600 series analyzer in use is not P25 equipped, the user will be notified and the Maximum Deviation test will be marked as Fail.

The analyzer must contain the following PROJ 25/ASTRO/SNET software version to perform correctly:

**6.04.B00** or later

Software issues in some previous versions of the PROJ 25/ASTRO/SNET firmware may prevent correct monitor frequency configuration. Please refer to the analyzer's Operator's Manual for information on how to upgrade the analyzer firmware if necessary.

# 4. Radio Alignment Test Setup

In order to perform the alignment procedures, the VX-P820/P920 must be connected to both the PC and the communications analyzer as shown in the figure(s) below.


Please make certain that the radio under test is configured as described in Figure 4-1 **before** attempting to perform the indicated alignment or test. Failure to do so may result in poor radio performance and/or damage to the communications analyzer or radio equipment under test.

## *4.1. Setup Recommendations*

In the absence of a battery eliminator, it is highly recommended to use a fully charged battery when performing radio alignments or tests, and to perform alignments or tests with the radio under test **out** of the battery charger. Failure to do so may result in poor alignment performance and/or random radio resets, especially during high power tests or alignments such as TX Power.

As electronic parts generally exhibit their best typical performance at normal operating temperatures, it is recommended that the radio under test be allowed to warm-up for 60 seconds after power-on and before beginning an alignment or test. This waiting period allows the radio's internal electrical components to achieve proper operating temperature, resulting in more accurate test results.

**Analyzer Setup:** Adjust the SQUELCH knob on the analyzer fully clockwise until rotation stops and then adjust it counter-clockwise until the squelch indicator light comes on **before** beginning any tests or alignments. Some radio tests or alignments may not perform accurately without this analyzer adjustment.

## *4.2. VX-P820/P920 Test Setup*

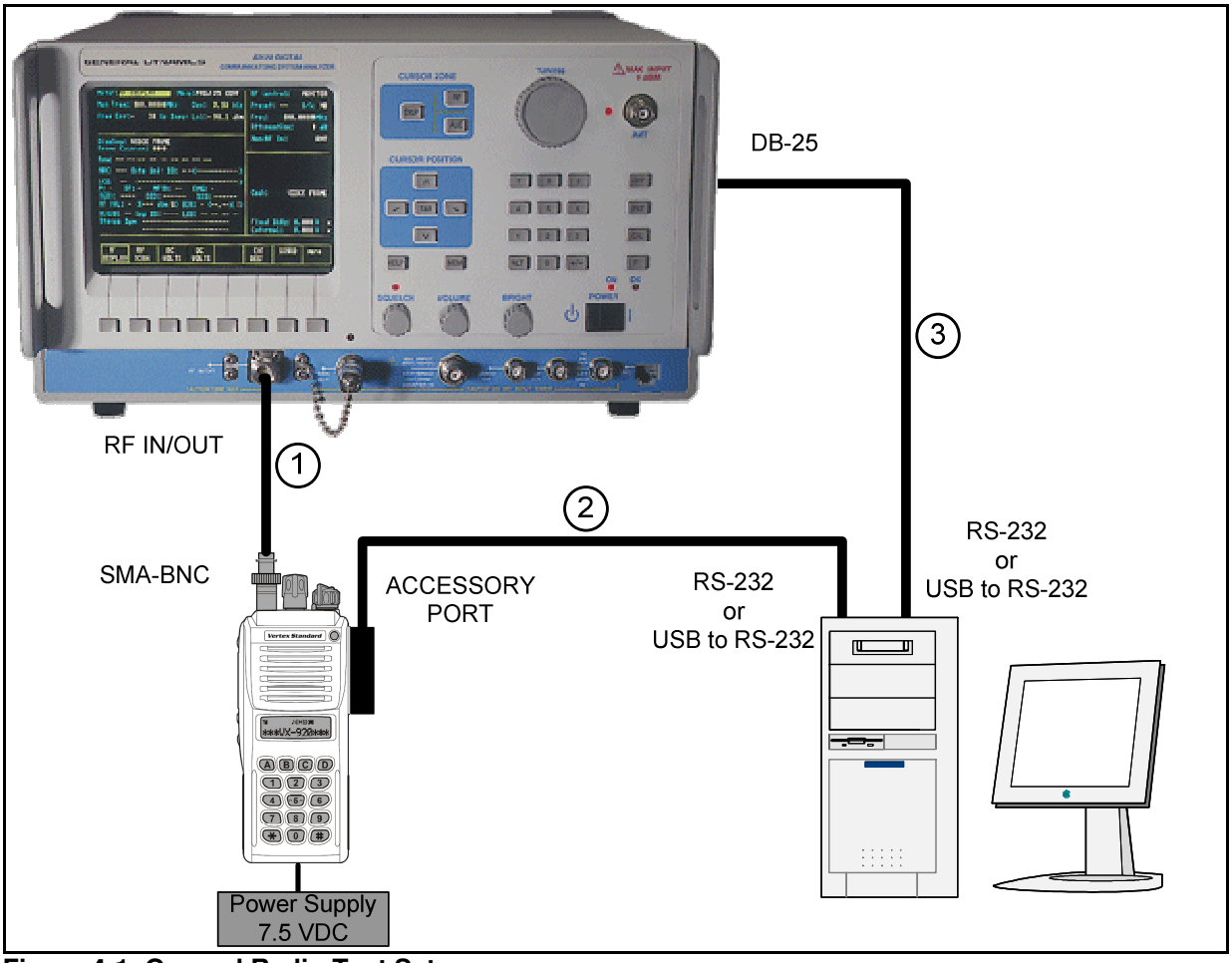


**Figure 4-1. General Radio Test Setup**

| Cable | Connections | Cable Description |
|---|---|---|
| 1 | VX-P820/P920 Antenna port to R2670 RF IN/OUT port | Coaxial BNC Cable |
| 2 | PC COM port OR USB to Serial Adapter to VX-P820/P920 Accessory Port | Vertex Standard Part Number CT-109 and (optional) USB to Serial adapter. |
| 3 | PC COM port OR USB to Serial Adapter to R2670 RS-232 Port | See APPENDIX B. |

**Table 4-1. Radio Test Setup Connections.**

**Note**: For Cable 2 in Table 4-1, the Accessory Port connector *must* be configured as described in Figure 4-1, with the cable wire leading to the PC pointing in the same direction as the radio antenna connector. Incorrect orientation of Cable 2 will result in no radio power-up or radio communication failure.

## *4.3. Radio Test Set*

A radio test set is a service aid which provides a means of injecting signals into and sampling audio output from a radio under test for purposes of performance verification. It generally connects to the radio's universal/accessory port, to a PC, and to other test equipment, such as the R2670. For example, to determine the radio receiver's sensitivity to incoming signals, a SINAD test may be performed. A radio test set can be used to route the radio's audio output to a SINAD meter for measurement.

Currently, Vertex Standard does not market a radio test set for VX-P820/P920 radios. However, a test set may be constructed using the schematic provided in the radio's Service Manual. This schematic is also included in Appendix A of this document.

Though not critical for AutoTune™ performance, a radio test set may be used to verify certain receiver alignments supported within AutoTune™, such as RX Tune and SQL Sensitivity. Because of the lack of a standardized test set, AutoTune™ currently does not directly support a RX Tune or SQL Sensitivity test. If such verification is desired and a radio test set is available, configure the R2600 and radio channels as described for RX Tune and SQL Sensitivity in sections 5.2 and 5.3, respectively. Using the R2600, sample the appropriate SINAD and squelch measurements and compare against Vertex Standard VX-P820/P920 published tolerances for acceptance.

# 5. Alignment and Test Descriptions

Table 5-1 provides the channel configuration for each Test Channel referenced throughout this section. Note that to find the channel operating frequency for a particular radio, the radio operating band must be known. The band designation can usually be located on a sticker underneath the radio's battery.

| | VHF | UHF-A (G6) | UHF-H (G8) | UHF-D (G7) | Channel Space | Band | Signaling |
|---|---|---|---|---|---|---|---|
| **CH 01** | 154.1MHz | 435.1MHz | 415.1MHz | 485.1MHz | Wide | Center | --- |
| **CH 02** | 134.1MHz | 400.1MHz | 380.1MHz | 450.1MHz | Wide | Low | --- |
| **CH 03** | 173.9MHz | 469.9MHz | 449.9MHz | 519.9MHz | Wide | High | --- |
| **CH 04** | 154.1MHz | 435.1MHz | 415.1MHz | 485.1MHz | Wide | Center | CTCSS |
| **CH 05** | 154.1MHz | 435.1MHz | 415.1MHz | 485.1MHz | Wide | Center | DCS |
| **CH 06** | 154.1MHz | 435.1MHz | 415.1MHz | 485.1MHz | Narrow | Center | --- |
| **CH 07** | 154.1MHz | 435.1MHz | 415.1MHz | 485.1MHz | Narrow | Center | CTCSS |
| **CH 08** | 154.1MHz | 435.1MHz | 415.1MHz | 485.1MHz | Narrow | Center | DCS |
| **CH 09** | 154.1MHz | 435.1MHz | 415.1MHz | 485.1MHz | Digital | Center | Digital |

**Table 5-1. Test Channel Configuration**

## *5.1. Frequency*

| Monitor Mode | RF Control | Port | Frequency | Modulation | Attenuation |
|---|---|---|---|---|---|
| Standard | Monitor | RF I/O | Test Channel 06 | FM | 20 dB |

**Table 5-2. Analyzer Configuration for Frequency Alignment and Test**

### 5.1.1. Alignment

The radio is set to Test Channel 6 and commanded to transmit by the software. Using a best linear fit algorithm, several frequency error samples are taken with the analyzer and used to determine the radio softpot value with a frequency error closest to the alignment target value found in APPENDIX C. Once the measurement closest to the target value is found, the corresponding softpot is programmed into the radio.

The following radio test report results are returned for the Frequency alignment:

| Name | Description |
|---|---|
| Result | Pass or Fail. This indicates whether the alignment succeeded in bringing the radio parameter into alignment limits as specified in the limits file. |
| Frequency | Band center frequency for the radio under test. |
| Max Limit | Maximum passable frequency error, inclusive, as specified in the limits file. |
| Freq Error | Measured frequency error after alignment |
| Min Limit | Minimum passable frequency error, inclusive, as specified in the limits file. |
| Old Softpot | Radio parameter softpot value before alignment. |
| New Softpot | Radio parameter softpot value after alignment. |

**Table 5-3. Frequency Alignment Results**

### 5.1.2. Test

The radio is set to Test Channel 6 and commanded to transmit by the software. The analyzer then samples the radio's frequency error. If the sampled frequency error falls within the Frequency test limit range described in APPENDIX C, the test is marked as pass. Otherwise, the test is marked as fail.

The following radio test report results are returned for the Frequency test:

| Name | Description |
|---|---|
| Result | Pass or Fail. This indicates whether the radio's sampled Frequency error fell within the test limits as specified in the limits file. |
| Frequency | Band center frequency for the radio under test. |
| Max Limit | Maximum passable frequency error, inclusive, as specified in the limits file. |
| Freq Error | Measured frequency error after alignment |
| Min Limit | Minimum passable frequency error, inclusive, as specified in the limits file. |
| Softpot | Current radio parameter softpot value. |

**Table 5-4. Frequency Test Results**

## *5.2. RX Tune*

| Monitor Mode | RF Control | Port | Frequency | Modulation | Output Level |
|---|---|---|---|---|---|
| Standard | Generate | RF I/O | Test Channel 01 | 1 kHz @ 3 kHz dev. | -103 dBm |
| Standard | Generate | RF I/O | Test Channel 02 | 1 kHz @ 3 kHz dev. | -103 dBm |
| Standard | Generate | RF I/O | Test Channel 03 | 1 kHz @ 3 kHz dev. | -103 dBm |

**Table 5-5. Analyzer Configuration for RX Tune Alignment**

### 5.2.1. Alignment

The radio is set to receive at Test Channel 1. After setting up the analyzer according to Table 5-5, the radio's RSSI softpot is sequentially incremented across the Low (CH 02), Center (CH 01) and High (CH 03) portions of the radio band. The software uses the Peak RSSI values it locates at each of these points to calculate appropriate softpot

values for the respective portions of the band. These softpot values are then programmed into the radio. Each configured channel's RX Tune value is then updated to reflect these new radio softpot values.

The following radio test report results are returned for the RX Tune alignment:

| Name | Description |
|---|---|
| Result | Pass or Fail. This indicates whether the alignment succeeded. |
| Frequency | Band Center frequency for the radio under test. |
| Low Old | Band Low slope softpot setting before alignment. |
| Low New | Band Low slope softpot setting after alignment. |
| Center Old | Band Center softpot setting before alignment. |
| Center New | Band Center softpot setting after alignment. |
| High Old | Band High slope softpot setting before alignment. |
| High New | Band High slope softpot setting after alignment. |

**Table 5-6. RX Tune Alignment Results**

## *5.3. SQL Sensitivity*

| Monitor Mode | SQL Point | Frequency | Output Level | Modulation |
|---|---|---|---|---|
| Standard | TI NSQ W | Test Channel 01 | -103 dBm | 1 kHz @ 3 kHz dev. |
| " " | TH NSQ W | Test Channel 01 | " " | 1 kHz @ 3 kHz dev. |
| " " | RSSI SQL W | Test Channel 01 | " " | None |
| " " | TX SAVE W | Test Channel 01 | " " | None |
| " " | TI NSQ N | Test Channel 06 | " " | 1 kHz @ 1.5 kHz dev. |
| " " | TH NSQ N | Test Channel 06 | " " | 1 kHz @ 1.5 kHz dev. |
| " " | RSSI SQL N | Test Channel 06 | " " | None |
| " " | TX SAVE N | Test Channel 06 | " " | None |

**Table 5-7. Analyzer Configuration for SQL Sensitivity Alignment**

### 5.3.1. Alignment

The radio is set to receive at Test Channel 1 and the Audio Frequency volume is changed by the software to an adequate level for receiver testing. After setting up the analyzer according to Table 5-7, the radio's first squelch point is sampled repeatedly, averaged, and the result is programmed into the radio as the new squelch point softpot. This process is repeated for each row in Table 5-7.

The following radio test report results are returned for the SQL Sensitivity alignment:

| Name | Description |
|---|---|
| Result | Pass or Fail. This indicates whether the alignment succeeded. |
| Name | Squelch point title. |
| Frequency | Band Center frequency for the radio under test. |
| Power Level | Signal generator output level for aligning this squelch point. |
| Old Softpot | Old squelch point softpot setting before alignment. |
| New Softpot | New squelch point softpot setting after alignment. |

**Table 5-8. SQL Sensitivity Alignment Results**

## *5.4. TX Power*

| Monitor Mode | RF Control | Port | Frequency | Modulation | Attenuation |
|---|---|---|---|---|---|
| Standard | Monitor | RF I/O | Test Channel 06 | FM | 20 dB |

**Table 5-9. Analyzer Configuration for TX Power Alignment and Test**

### 5.4.1. Alignment

The radio is set to Test Channel 6 and commanded to transmit by the software. Using a best linear fit algorithm, several power measurements are taken with the analyzer and used to determine the radio softpot value with a TX power closest to the alignment target value found in APPENDIX C. Once the measurement closest to the target value is found, the corresponding softpot is programmed into the radio. This process is repeated for each TX Power point, including High (5 W), Low-High (2.5 W), Low-Mid (1 W), and E-Low (.25 W).

The following radio test report results are returned for the TX Power alignment:

| Name | Description |
|---|---|
| Result | Pass or Fail. This indicates whether the alignment succeeded in bringing the radio parameter into alignment limits as specified in the limits file. |
| Name | TX Power point under test. |
| Frequency | Band center frequency for the radio under test. |
| Max Limit | Maximum passable power, inclusive, as specified in the limits file. |
| Power | Measured power after alignment. |
| Min Limit | Minimum passable power, inclusive, as specified in the limits file. |
| Old Softpot | Radio parameter softpot value before alignment. |
| New Softpot | Radio parameter softpot value after alignment. |

**Table 5-10. TX Power Alignment Results.**

### 5.4.2. Test

The radio is set to Test Channel 6 and commanded to transmit by the software. The analyzer then samples the radio's TX power. If the sampled TX power falls within the TX Power test limit range for the power point under test as described in APPENDIX C, the test is marked as pass. Otherwise, the test is marked as fail.

The following radio test report results are returned for the TX Power test:

| Name | Description |
|---|---|
| Result | Pass or Fail. This indicates whether the alignment succeeded in bringing the radio parameter into alignment limits as specified in the limits file. |
| Name | TX Power point under test. |

| | |
|---|---|
| Frequency | Band center frequency for the radio under test. |
| Max Limit | Maximum passable power, inclusive, as specified in the limits file. |
| Power | Measured power after alignment. |
| Min Limit | Minimum passable power, inclusive, as specified in the limits file. |
| Softpot | Current radio parameter softpot value. |

**Table 5-11. TX Power Test Results.**

## *5.5. Maximum Deviation*

| Monitor Mode | RF Control | Port | Attenuation | Name | Frequency |
|---|---|---|---|---|---|
| P25 Conventional | Monitor | RF I/O | 20 dB | Wide | Test Channel 01 |
| P25 Conventional | Monitor | RF I/O | 20 dB | Narrow | Test Channel 06 |
| P25 Conventional | Monitor | RF I/O | 20 dB | Digital | Test Channel 09 |

**Table 5-12. Analyzer Configuration for Maximum Deviation Alignment and Test**

### 5.5.1. Alignment

The radio is set to Test Channel 1 and commanded to transmit by the software. Using a best linear fit algorithm, several deviation measurements are taken with the analyzer and used to determine the radio softpot value with a deviation closest to the alignment target value found in APPENDIX C. Once the measurement closest to the target value is found, the corresponding softpot is programmed into the radio. This process is performed for each Maximum Deviation point in Table 5-12: Wide (CH 01), Narrow (CH 06), and Digital (CH 09).

The following radio test report results are returned for Maximum Deviation alignment:

| Name | Description |
|---|---|
| Result | Pass or Fail. This indicates whether the alignment succeeded in bringing the radio parameter into alignment limits as specified in the limits file. |
| Name | Maximum Deviation point under test. |
| Frequency | Band center frequency for the radio under test. |
| Max Limit | Maximum passable deviation, inclusive, as specified in the limits file. |
| Deviation | Measured deviation after alignment. |
| Min Limit | Minimum passable deviation, inclusive, as specified in the limits file. |
| Old Softpot | Radio parameter softpot value before alignment. |
| New Softpot | Radio parameter softpot value after alignment. |

**Table 5-13. Maximum Deviation Alignment Results.**

### 5.5.2. Test

The radio is set to Test Channel 1 and commanded to transmit by the software. The analyzer then samples the radio's maximum deviation. If the sampled deviation falls within the Maximum Deviation test limit range for the deviation point under test as

described in APPENDIX C, the test is marked as pass. Otherwise, the test is marked as fail.

The following radio test report results are returned for the Maximum Deviation test:

| Name | Description |
|---|---|
| Result | Pass or Fail. This indicates whether the alignment succeeded in bringing the radio parameter into alignment limits as specified in the limits file. |
| Name | Maximum Deviation point under test. |
| Frequency | Band center frequency for the radio under test. |
| Max Limit | Maximum passable deviation, inclusive, as specified in the limits file. |
| Deviation | Measured deviation after alignment. |
| Min Limit | Minimum passable deviation, inclusive, as specified in the limits file. |
| Softpot | Current radio parameter softpot value. |

**Table 5-14. Maximum Deviation Test Results.**

## *5.6. Sub Audio Deviation*

| Monitor Mode | RF Control | Port | Modulation | Attenuation | Name | Frequency |
|---|---|---|---|---|---|---|
| Standard | Monitor | RF I/O | FM | 20 dB | CTCSS Wide | Test Channel 04 |
| Standard | Monitor | RF I/O | FM | 20 dB | CTCSS Narrow | Test Channel 05 |
| Standard | Monitor | RF I/O | FM | 20 dB | DCS Wide | Test Channel 07 |
| Standard | Monitor | RF I/O | FM | 20 dB | DCS Narrow | Test Channel 08 |

**Table 5-15. Analyzer Configuration for Sub Audio Deviation Alignment and Test.**

### 5.6.1. Alignment

The radio is set to Test Channel 4 and commanded to transmit by the software. Using a best linear fit algorithm, several deviation measurements are taken with the analyzer and used to determine the radio softpot value with a deviation closest to the target value found in APPENDIX C. Once the measurement closest to the alignment target value is found, the corresponding softpot is programmed into the radio. This process is performed for each Sub Audio Deviation point in Table 5-15: CTCSS Wide (CH 04), CTCSS Narrow (CH 05), DCS Wide (CH 07) and DCS Narrow (CH 08).

The following radio test report results are returned for Sub Audio Deviation alignment:

| Name | Description |
|---|---|
| Result | Pass or Fail. This indicates whether the alignment succeeded in bringing the radio parameter into alignment limits as specified in the limits file. |
| Name | Sub Audio Deviation point under test. |
| Frequency | Band center frequency for the radio under test. |
| Max Limit | Maximum passable sub audio deviation, inclusive, as specified in the limits file. |
| Deviation | Measured deviation after alignment. |
| Min Limit | Minimum passable sub audio deviation, inclusive, as specified in the limits file. |
| Old Softpot | Radio parameter softpot value before alignment. |
| New Softpot | Radio parameter softpot value after alignment. |

**Table 5-16. Sub Audio Deviation Alignment Results.**

### 5.6.2. Test

The radio is set to Test Channel 4 and commanded to transmit by the software. The analyzer then samples the radio's sub audio deviation. If the sampled deviation falls within the Sub Audio Deviation test limit range for the deviation point under test as described in APPENDIX C, the test is marked as pass. Otherwise, the test is marked as fail.

The following radio test report results are returned for the Sub Audio Deviation test:

| Name | Description |
|---|---|
| Result | Pass or Fail. This indicates whether the alignment succeeded in bringing the radio parameter into alignment limits as specified in the limits file. |
| Name | Maximum Deviation point under test. |
| Frequency | Band center frequency for the radio under test. |
| Max Limit | Maximum passable deviation, inclusive, as specified in the limits file. |
| Deviation | Measured deviation after alignment. |
| Min Limit | Minimum passable deviation, inclusive, as specified in the limits file. |
| Softpot | Current radio parameter softpot value. |

**Table 5-17. Sub Audio Deviation Test Results.**

# 6. Basic Troubleshooting

## *6.1. Firmware*

The radio firmware must be version **1.29** or later to be tested or aligned by the AutoTune software.

| Symptom | Possible Cause | Solution |
|---|---|---|
| AutoTune software fails to put radio into test mode. | Incompatible radio firmware. | Before beginning a test or alignment, the radio under test must be placed into test mode. Successful entry into test mode can be observed on LCD-equipped models when "AUTO TEST" is displayed on the radio's LCD screen. If repeated unsuccessful attempts have been made to place the radio into test mode using the AutoTune software, please verify that the radio's firmware meets the above requirement. See section *3.1 Firmware* for more information. |

**Table 6-1. Firmware.**

## *6.2. Power-Up Error Codes*

When powered on, the radio performs some initial self test routines to ensure firmware and hardware integrity. If a problem is detected during these routines, an error message below may be displayed to the radio's LCD screen.

| Message | Description | Corrective Action |
|---|---|---|
| ERROR 1 | EEPROM Checksum Non-Fatal Error | Use AutoTune™ or CE 76 to realign/retest the radio. This action calculates and programs the EEPROM checksum. |
| ERROR 2 | EEPROM Checksum Fatal Error | Send radio to depot |
| ERROR 3 | FLASH ROM Checksum Fatal Error | Send radio to depot |

**Table 6-2. Power-Up Error Codes.**

## *6.3. Alignment and Test Troubleshooting*

| Symptom | Possible Cause | Solution |
|---|---|---|
| RX Tune Low, High Old results are slightly different than the New results from previous alignment. | None. | This seeming error is caused by storing calculated floating-point values as integers in the radio's FLASH ROM. Since some loss of precision will occur, the calculated previous RX Tune Low, High Old values may vary slightly from |

| | | |
|---|---|---|
| | | alignment to alignment. This variance does not affect the radio's sensitivity in any way. |
| Test or Alignment failure | Analyzer measurement. | Occasionally, an alignment or test may fail because a poor measurement was received from the analyzer. When this occurs, first attempt to realign or retest the radio for the failed item. If an analyzer measurement was indeed the reason for the failure, a subsequent test or alignment should be successful. |
| Maximum Deviation test or alignment fails repeatedly | Mistuned Modulation Balance parameter | The Modulation Balance parameter may affect the Maximum Deviation parameter. Use Vertex Standard CE76 tuning software to properly align the Modulation Balance parameter. Please see the CE76 Help for instructions on how to adjust this parameter. |
| Radio left in AutoTest mode after test or alignment. | Radio communication error. | Turn the radio off, then back on. |

**Table 6-3. Alignment and Test Troubleshooting Chart.**

# 7. Support Information

## *7.1. Technical Support*

Telephone: 480.441.0664
Fax: 480.441.4535
Email: CTE@gdsatcom.com

## *7.2. Sales Support*

Telephone: 903-381-4131
Fax: 903-295-1479
Mobile: 847-878-2274
Email: CTE@gdsatcom.com

# 8. References

VX-P920 Series UHF Band Service Manual. Part# EC033U95A. Cypress, CA: Vertex Standard CO., LTD., 2005.

VX-P920 Series VHF Band Service Manual. Part# EC033N95A. Cypress, CA: Vertex Standard CO., LTD., 2005.

## APPENDIX A. Test Set

The figure below depicts the test set schematic necessary to perform several manual VX-P820/P920 receiver alignments and tests. This schematic is provided courtesy of Vertex Standard USA, Inc.

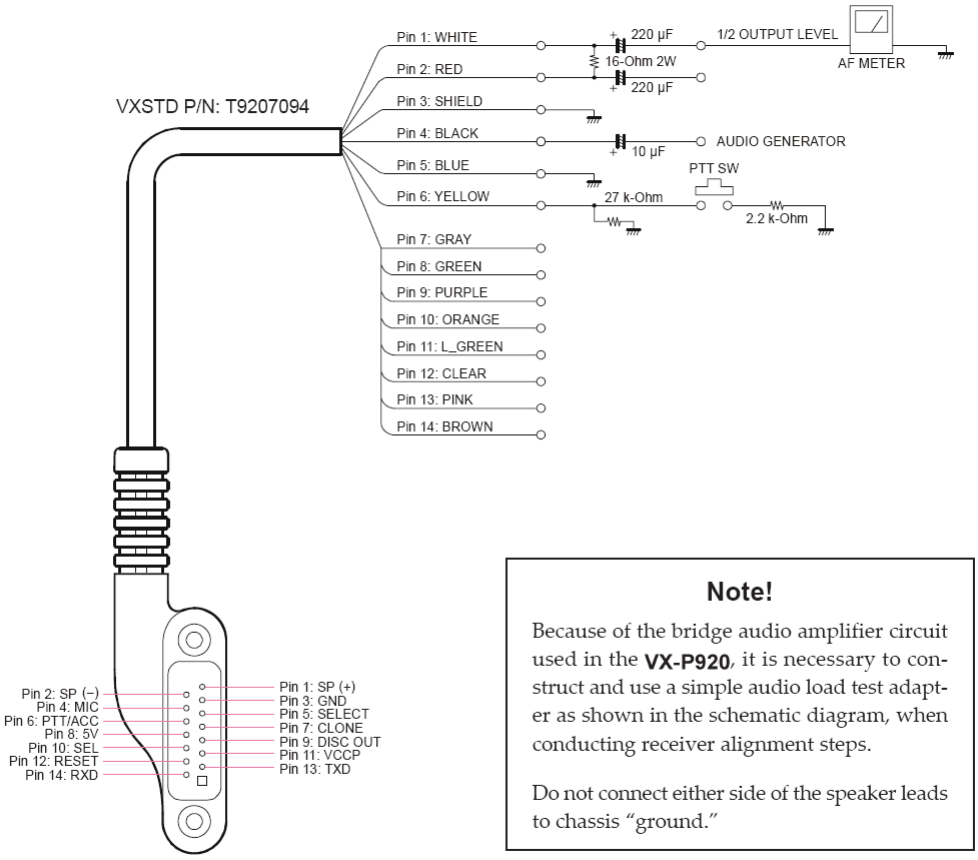


**Figure A-1. Test Set Schematic**

*Source: EC033U95A, VX-P920 Series UHF Band Service Manual, ©2005, Vertex Standard CO., LTD.*

# APPENDIX B. Analyzer Interface Specifications

| DB-25 (M) Analyzer | Cable Wiring | DB-9 (F) Computer |
|---|---|---|
| TxD 2 | | 2 RxD |
| RxD 3 | | 3 TxD |
| RTS 4 | | 7 RTS |
| CTS 5<br>DSR 6 | | 4 DTR |
| DCD 8 | | 1 DCD |
| DTR 20 | | 8 CTS<br>6 DSR |
| GND 7 | | 5 GND |

**Table B-1. Analyzer to PC Serial Cable**

## APPENDIX C. Limits

The limits used to determine whether a test or alignment passes or fails are stored in Vertex Standard.VX-P820/P920.Limits.ini. This file contains the default limits as defined by the radio manufacturer and generally should not be modified.

However, in the event that the limits must be modified because of extenuating circumstances, the limits file may be accessed from the main screen by first selecting a radio from the **Radio Make and Model** list box and then selecting the **Tools** > **Radio** > **Test Limits** menu item. The limits file can be edited with a standard text editor, such as Notepad.


Modify the test and alignment limits with care. Improper use of the test and alignment limits can adversely affect radio test results. It is recommended to back up the limits file before modifications are made.

The limits file is partitioned into various sections. Generally, each section corresponds to a specific alignment or test, or to a specific point in an alignment or test. For instance, the TX Power High point is in its own section, even though it's part of the more comprehensive TX Power alignment.

When editing the limits file, make sure the format:

```
Name=limit
```

is followed precisely, with no embedded spaces between the equals sign and the test limit. Any improper editing may cause AutoTune™ to incorrectly test or align a radio.

The following tables list the default test limits and alignment targets by model for Vertex Standard VX-P820/P920 radios.

| Section | Name | Point | VHF | UHF A (G6) | UHF H (G8) | UHF D (G7) |
|---|---|---|---|---|---|---|
| **5.1** | **Frequency** | | +/- 300 Hz | | | |
| **5.2** | **RX Tune** | | -103 dBm | | | |
| **5.3** | **SQL Sensitivity** | TI NSQ Wide | Min: -113 dBm; Max: -119 dBm | | | |
| | | TH NSQ W | Min: -119 dBm; Max: -125 dBm | | | |
| | | RSSI SQL W | Min: -111 dBm; Max: -117 dBm | | | |
| | | TX SAVE W | Min: -95 dBm; Max: -101 dBm | | | |
| | | TI NSQ N | Min: -113 dBm; Max: -119 dBm | | | |
| | | TH NSQ N | Min: -121 dBm; Max: -124 dBm | | | |
| | | RSSI SQL N | Min: -114 dBm; Max: -117 dBm | | | |
| | | TX SAVE N | Min: -95 dBm; Max: -101 dBm | | | |
| **5.4** | **TX Power** | High | Min: 4.5 W; Max: 5.5 W | | | |
| | | Low-High | Min: 2.1 W; Max: 2.9 W | | | |
| | | Low-Mid | Min: 0.7 W; Max: 1.4 W | | | |
| | | E-Low | Min: 0.1 W; Max: 0.4 W | | | |
| **5.5** | **Maximum Deviation** | Wide | Min: 3.7 kHz; Max: 4.7 kHz | | | |
| | | Narrow | Min: 1.7 kHz; Max: 2.5 kHz | | | |
| | | Digital | Min: 3.0 kHz; Max: 3.9 kHz | | | |
| **5.6** | **Sub Audio Deviation** | CTCSS Wide | Min: 0.5 kHz; Max: 0.8 kHz | | | |
| | | CTCSS Narrow | Min: 0.2 kHz; Max: 0.55 kHz | | | |
| | | DCS Wide | Min: 0.5 kHz; Max: 0.8 kHz | | | |
| | | DCS Narrow | Min: 0.2 kHz; Max: 0.55 kHz | | | |

**Table C-1. Default Vertex Standard VX-P820 Test Limits**

| Section | Name | Point | VHF | UHF A (G6) | UHF H (G8) | UHF D (G7) |
|---|---|---|---|---|---|---|
| **5.1** | **Frequency** | | 0 Hz | | | |
| **5.2** | **RX Tune** | | -103 dBm | | | |
| **5.3** | **SQL Sensitivity** | TI NSQ Wide | -116 dBm | | | |
| | | TH NSQ W | -122 dBm | | | |
| | | RSSI SQL W | -114 dBm | | | |
| | | TX SAVE W | -98 dBm | | | |
| | | TI NSQ N | -116 dBm | | | |
| | | TH NSQ N | -121 dBm | | | |
| | | RSSI SQL N | -114 dBm | | | |
| | | TX SAVE N | -98 dBm | | | |
| **5.4** | **TX Power** | High | 5.0 W | | | |
| | | Low-High | 2.5 W | | | |
| | | Low-Mid | 1.0 W | | | |
| | | E-Low | 0.25 W | | | |
| **5.5** | **Maximum Deviation** | Wide | 4.2 kHz | | | |
| | | Narrow | 2.1 kHz | | | |
| | | Digital | 3.4 kHz | | | |
| **5.6** | **Sub Audio Deviation** | CTCSS Wide | 0.6 kHz | | | |
| | | CTCSS Narrow | 0.3 kHz | | | |
| | | DCS Wide | 0.6 kHz | | | |
| | | DCS Narrow | 0.3 kHz | | | |

**Table C-2. Default Vertex Standard VX-P820 Alignment Targets**

| Section | Name | Point | VHF | UHF A (G6) | UHF H (G8) | UHF D (G7) |
|---|---|---|---|---|---|---|
| **5.1** | **Frequency** | | +/- 300 Hz | +/- 500 Hz | | |
| **5.2** | **RX Tune** | | -103 dBm | | | |
| **5.3** | **SQL Sensitivity** | TI NSQ Wide | Min: -110 dBm; Max: -116 dBm | | | |
| | | TH NSQ W | Min: -119 dBm; Max: -125 dBm | | | |
| | | RSSI SQL W | Min: -110 dBm; Max: -116 dBm | | | |
| | | TX SAVE W | Min: -95 dBm; Max: -101 dBm | | | |
| | | TI NSQ N | Min: -111 dBm; Max: -117 dBm | | | |
| | | TH NSQ N | Min: -119 dBm; Max: -125 dBm | | | |
| | | RSSI SQL N | Min: -111 dBm; Max: -117 dBm | | | |
| | | TX SAVE N | Min: -95 dBm; Max: -101 dBm | | | |
| **5.4** | **TX Power** | High | 4.3 W – 5.7 W | Min: 4.4 W; Max: 5.8 W | | |
| | | Low-High | 2.1 W – 2.9 W | Min: 2.1 W; Max: 2.9 W | | |
| | | Low-Mid | 0.7 W – 1.4 W | Min: 0.7 W; Max: 1.4 W | | |
| | | E-Low | 0.1 W – 0.4 W | Min: 0.2 W; Max: 0.6 W | | |
| **5.5** | **Maximum Deviation** | Wide | Min: 3.7 kHz; Max: 4.7 kHz | | | |
| | | Narrow | Min: 1.7 kHz; Max: 2.5 kHz | | | |
| | | Digital | Min: 3.0 kHz; Max: 3.9 kHz | | | |
| **5.6** | **Sub Audio Deviation** | CTCSS Wide | Min: 0.5 kHz; Max: 0.8 kHz | | | |
| | | CTCSS Narrow | Min: 0.2 kHz; Max: 0.55 kHz | | | |
| | | DCS Wide | Min: 0.5 kHz; Max: 0.8 kHz | | | |
| | | DCS Narrow | Min: 0.2 kHz; Max: 0.55 kHz | | | |

**Table C-3. Default Vertex Standard VX-P920 Test Limits.**

| Section | Name | Point | VHF | UHF A (G6) | UHF H (G8) | UHF D (G7) |
|---|---|---|---|---|---|---|
| **5.1** | **Frequency** | | 0 Hz | | | |
| **5.2** | **RX Tune** | | -103 dBm | | | |
| **5.3** | **SQL Sensitivity** | TI NSQ Wide | Min: -110 dBm; Max: -116 dBm | | | |
| | | TH NSQ W | Min: -119 dBm; Max: -125 dBm | | | |
| | | RSSI SQL W | Min: -110 dBm; Max: -116 dBm | | | |
| | | TX SAVE W | Min: -95 dBm; Max: -101 dBm | | | |
| | | TI NSQ N | Min: -111 dBm; Max: -117 dBm | | | |
| | | TH NSQ N | Min: -119 dBm; Max: -125 dBm | | | |
| | | RSSI SQL N | Min: -111 dBm; Max: -117 dBm | | | |
| | | TX SAVE N | Min: -95 dBm; Max: -101 dBm | | | |
| **5.4** | **TX Power** | High | 5.0 W | | | |
| | | Low-High | 2.5 W | | | |
| | | Low-Mid | 1.0 W | | | |
| | | E-Low | 0.25 W | | | |
| **5.5** | **Maximum Deviation** | Wide | 4.2 kHz | | | |
| | | Narrow | 2.1 kHz | | | |
| | | Digital | 3.4 kHz | | | |
| **5.6** | **Sub Audio Deviation** | CTCSS Wide | 0.6 kHz | | | |
| | | CTCSS Narrow | 0.3 kHz | | | |
| | | DCS Wide | 0.6 kHz | | | |
| | | DCS Narrow | 0.3 kHz | | | |

**Table C-4. Default Vertex Standard VX-P920 Alignment Targets.**

# APPENDIX D. Sample Test Result Report

Test Result Report

Model #: VX-P924 Date/Time: 7/16/2007 9:13 AM
Serial #: 6K160004 Operator ID: mm

Comments: Testing total typical alignment time on P929.

Frequency Alignment

| Result | Frequency | Old Softpot | New Softpot | Freq Error | Min Limit | Max Limit |
|---|---|---|---|---|---|---|
| Pass | 485.100 MHz | 74 | 68 | -48 Hz | -500 Hz | 500 Hz |

RX Tune

| Result | Frequency | Low Old | Low New | Center Old | Center New | High Old | High New |
|---|---|---|---|---|---|---|---|
| Pass | 485.100 MHz | 22 | 21 | [illegible] | [illegible] | 116 | 116 |

Squelch Sensitivity

| Result | Name | Frequency | Power | Old Softpot | New Softpot |
|---|---|---|---|---|---|
| Pass | TI NSQ W | [illegible] | [illegible] | 89 | 86 |
| Pass | TH NSQ W | [illegible] | [illegible] | 141 | 136 |
| Pass | RSSI SQL W | [illegible] | [illegible] dBm | 53 | 55 |
| Pass | TX SAVE W | [illegible] | -98.0 dBm | 78 | 80 |
| Pass | TI NSQ N | [illegible] | -114.0 dBm | 90 | 83 |
| Pass | TH NSQ N | [illegible] | -122.0 dBm | 131 | 128 |
| Pass | RSSI SQL N | 485.100 MHz | -114.0 dBm | 46 | 48 |
| Pass | TX SAVE N | 485.100 MHz | -98.0 dBm | 78 | 80 |

TX Power

| Result | Name | Frequency | Max Limit | Power | Min Limit | Old Softpot | New Softpot |
|---|---|---|---|---|---|---|---|
| Pass | High | 485.100 MHz | 5.800 W | 4.931 W | 4.400 W | 166 | 170 |
| Pass | Low-High | 485.100 MHz | 2.900 W | 2.477 W | 2.100 W | 112 | 112 |
| Pass | Low-Mid | 485.100 MHz | 1.400 W | 1.013 W | 0.700 W | 70 | 70 |
| Pass | E-Low | 485.100 MHz | 0.600 W | 0.257 W | 0.200 W | 38 | 39 |

T:\cvs\Autotune\Results\VX-P820_P920_6K160004.csv



**Figure D-1. Sample Test Result Report**