



# R8000 SERIES COMMUNICATIONS SYSTEM ANALYZER

## AUTOTUNE USER GUIDE

Kenwood Viking Portable Radios  
Kenwood Viking Mobile Radios

Astronics Test Systems  
12700 Ingenuity Dr. Orlando, FL 32826

Copyright © 2022 Astronics Test Systems  
All Rights Reserved  
Printed in U.S.A.

FCT-1383A

## **AUTOTUNE™ SOFTWARE LICENSE AGREEMENT**

The software license agreement governing use of the R8000 Series Communications System Analyzer AutoTune™ software is located in FCT-1365 R8000 Series Communications System Analyzer Operator's Manual.

## **TRADEMARKS**

The Astronics Test Systems logo is a registered ® trademarks of Astronics Test Systems, Inc.

NXDN™ is a trademark of Icom America, Inc. and JVCKenwood Corporation.

### OpenG License

Copyright (c) 2002, Cal-Bay Systems, Inc. <info@calbay.com>  
Copyright (c) 2002, Jean-Pierre Drolet <drolet\_jp@hotmail.com>  
Copyright (c) 2002-2007, Jim Kring <jim@jimkring.com>  
Copyright (c) 2002-2005, Rolf Kalbermatter <rolf.kalbermatter@citeng.com>  
Copyright (c) 2003-2004, Paul F. Sullivan <Paul@SULLutions.com>  
Copyright (c) 2004, Enrique Vargas <vargas@visecurity.com>  
Copyright (c) 2004, Heiko Fettig <heiko.fettig@gmx.net>  
Copyright (c) 2004, Michael C. Ashe <michael.ashe@imaginatics.com>  
Copyright (c) 2005-2006, MKS Instruments, Inc., author: Doug Femec <doug\_femec@mkinst.com>, IM dafemec  
Copyright (c) 2006, JKI <info@jameskring.com>  
Copyright (c) 2006, JKI <info@jameskring.com>; Authors: Jim Kring <jim@jimkring.com>, Philippe Guerit <pjm\_labview@yahoo.com>  
Copyright (c) 2007, JKI <info@jameskring.com> (Author: Jim Kring <jim.kring@jameskring.com>)  
Copyright (c) 2008, Ton Plomp <t.c.plomp@gmail.com>

All rights reserved.

Redistribution and use in source and binary forms, with or without modification, are permitted provided that the following conditions are met:

- Redistributions of source code must retain the above copyright notice, this list of conditions and the following disclaimer.
- Redistributions in binary form must reproduce the above copyright notice, this list of conditions and the following disclaimer in the documentation and/or other materials provided with the distribution.
- Neither the name of the SciWare, James Kring, Inc., nor the names of its contributors may be used to endorse or promote products derived from this software without specific prior written permission.

THIS SOFTWARE IS PROVIDED BY THE COPYRIGHT HOLDERS AND CONTRIBUTORS "AS IS" AND ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE DISCLAIMED. IN NO EVENT SHALL THE COPYRIGHT HOLDER OR CONTRIBUTORS BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

MGI License

Copyright (c) 2010-2013, Moore Good Ideas, inc.

All rights reserved.

Redistribution and use in source and binary forms, with or without modification, are permitted provided that the following conditions are met:

- Redistributions of source code must retain the above copyright notice, this list of conditions and the following disclaimer.
- Redistributions in binary form must reproduce the above copyright notice, this list of conditions and the following disclaimer in the documentation and/or other materials provided with the distribution.
- Neither the name of Moore Good Ideas, Inc., nor the names of its contributors may be used to endorse or promote products derived from this software without specific prior written permission.

THIS SOFTWARE IS PROVIDED BY THE COPYRIGHT HOLDERS AND CONTRIBUTORS "AS IS" AND ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE DISCLAIMED. IN NO EVENT SHALL THE COPYRIGHT HOLDER OR CONTRIBUTORS BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

# TABLE OF CONTENTS

1.	Introduction.....	1
2.	Scope .....	1
2.1.	Supported Models.....	1
2.2.	Firmware Versions.....	1
3.	Conventions.....	2
3.1.	PPM.....	2
4.	Kenwood Viking Portable Radio Test Setup .....	3
4.1.	Cable Sweep .....	3
4.2.	Battery Eliminator .....	3
4.3.	Viking Portable Test Setup .....	3
5.	Kenwood Viking Portable Alignment and Test Descriptions .....	5
5.1.	Assist.....	5
5.2.	Ramp Offset.....	6
5.3.	Rx Filters.....	7
5.4.	TCXO Frequency.....	8
5.5.	Tx Modulation (Balance).....	9
5.6.	Tx Power.....	11
5.7.	Squelch.....	12
5.8.	Rx Sensitivity .....	13
5.9.	P25 Tx Tests.....	14
5.10.	Sensitivity (P25 BER) .....	15
6.	Kenwood Viking Mobile Radio Test Setup.....	16
6.1.	Cable Sweep .....	16
6.2.	Viking Mobile Test Setup .....	16
6.3.	Kenwood Viking Mobile USB Cables .....	18
7.	Kenwood Viking Mobile Alignment and Test Descriptions .....	20
7.1.	Tx Max Power.....	20
8.	Basic Troubleshooting .....	22
9.	Support Information .....	23
9.1.	Technical Support.....	23
9.2.	Sales.....	23
APPENDIX A.	Test Limits .....	A-1
APPENDIX B.	Sample Test Result Report.....	B-1
APPENDIX C.	Revision History.....	C-1

# LIST OF FIGURES

Figure 4-1. Viking Portable Test Setup Diagram with Astronics 203012-01 Cable.....	4
Figure 6-1. Viking Mobile Test Setup Diagram with 203013-01 Audio Interface Box.....	17
Figure 6-2. Viking Mobile Test Setup Diagram with Astronics 203014-01 Cable. ....	18
Figure B-1. Sample Test Result Report .....	B-3

# LIST OF TABLES

Table 5-1. Assist Voltage alignment results .....	5
Table 5-2. Ramp Offset alignment results.....	6
Table 5-3. Analyzer Configuration for Rx Filters .....	7
Table 5-4. Rx Filters Sensitivity (SINAD) alignment results .....	7
Table 5-5. Rx Filters Sensitivity (RSSI) alignment results.....	7
Table 5-6. Analyzer Configuration for TCXO Frequency.....	8
Table 5-7. TCXO Frequency alignment results .....	8
Table 5-8. TCXO Frequency test results.....	8
Table 5-9. Analyzer Configuration for Tx Modulations alignment.....	9
Table 5-10. Tx Modulation alignment results .....	9
Table 5-11. Tx Modulation Fine Tune alignment results .....	9
Table 5-12. Analyzer Configuration for Tx Power .....	11
Table 5-13. Tx Power alignment results.....	11
Table 5-14. Tx Power test results .....	11
Table 5-15. Analyzer Configuration for Squelch .....	12
Table 5-16. Squelch alignment results.....	12
Table 5-17. Analyzer Configuration for Rx Sensitivity test .....	13
Table 5-18. Rx Sensitivity test results.....	13
Table 5-19. Analyzer Configuration for P25 Tx Tests .....	14
Table 5-20. Tx P25 Modulation Fidelity results .....	14
Table 5-21. Tx P25 Symbol Deviation results .....	14
Table 5-22. Analyzer Configuration for Sensitivity (P25 BER) test .....	15
Table 5-23. Sensitivity (P25 BER) test results .....	15
Table 7-1. Analyzer Configuration for Tx Max Power.....	20
Table 7-2. Kenwood Viking Mobile specified target max power.....	20
Table 7-3. Tx Max Power alignment results.....	21
Table 8-1. Kenwood Viking Series Troubleshooting Chart.....	22

## 1. Introduction

The Astronics Test Systems R8000 Series Communications System Analyzer AutoTune™ (hereafter “AutoTune”) provides an automated test and alignment solution for supported two-way radios.

## 2. Scope

This document includes information regarding the tests and alignments performed for supported radios by AutoTune. This document is restricted to radio-specific information for Kenwood Viking Portable and Viking Mobile radios.

Please refer to the R8000 Series Communications System Analyzer Owner’s Manual (FCT-1365) for an overview and basic operating instructions for AutoTune itself.

### 2.1. Supported Models

The following Kenwood Viking models are supported:

- VP5230
- VP5330
- VP5430
- VP6230
- VP6330
- VP6430
- VM5730
- VM5830
- VM5930
- VM6730
- VM6830
- VM6930
- VM7630H
- VM7730
- VM7730H
- VM7830
- VM7930

### 2.2. Firmware Versions

To perform AutoTune servicing, a Viking radio should be running **8.34.xx** or later firmware. If a Viking radio is running **8.32.xx** or earlier firmware, the radio **must** have an analog channel available in its codeplug and this channel must be selected prior to starting AutoTune servicing. There are various edge cases where not being on an analog conventional channel with **8.32.xx** or earlier Viking firmware prevent the radio from entering tune mode successfully.

If the Viking radio is running **8.32.xx** or earlier firmware and not on an analog conventional channel, an AutoTune warning message will appear, and radio servicing will stop.

### **3. Conventions**

#### **3.1. PPM**

“ppm” is “parts per million”. This specification is generally limited to frequency-related measurements. If the frequency units are in MHz, then the ppm specification is in Hz. For example, a 169.075 MHz frequency with a  $\pm 1.5$  ppm specification is allowed to vary by  $1.5 * 169.075$  MHz, or about  $\pm 254$  Hz.



## 4. Kenwood Viking Portable Radio Test Setup

In order to perform the test and alignment procedures, the Viking Portable radio must be connected to the R8000 Communications System Analyzer as shown in the figure below.



Make certain that the radio under test is configured as described in the corresponding diagram **before** attempting to perform an alignment or test. Failure to do so may result in poor radio performance and/or damage to the analyzer or radio equipment under test.

### 4.1. Cable Sweep

Every RF cable connected between a radio under test and the analyzer attenuates the signal propagating through it. The amount of attenuation varies by several factors such as operating frequency, cable length, and cable type. Ensuring this attenuation is accounted for by the analyzer is important to the accuracy of several tests and alignments, primarily power tests.

Sweep the RF cable used between the Radio and Analyzer, label the RF cable with the stored cable sweep name, and enable the Cable Sweep feature in the analyzer System, System Settings... menu. Refer to [Application Note FCT-1017 Utilizing Cable Sweep on the Astronics Communications System Analyzer](#) for instructions on how to perform a cable sweep.

### 4.2. Battery Eliminator

Battery eliminators interface portable radios to DC power supplies. They're needed because batteries cannot produce consistent voltage/current when the radio is keyed for extended time periods, as it will be during an alignment. Attempting to use even a nominally good battery will eventually result in power alignment failures. A battery eliminator should **always** be used while performing radio alignments and tests with AutoTune to achieve consistent alignment performance.

For Viking Portable models, use the following Kenwood battery eliminator part. For more information, see the applicable Kenwood radio service manual.

Viking Portable battery jig

- Kenwood Part Number: **W3F-0001-00**

### 4.3. Viking Portable Test Setup

Refer to the diagram below for the proper test setup.

**Note:** For reliable radio communication with the analyzer, use an externally powered USB hub from a reputable vendor as shown in the diagram.

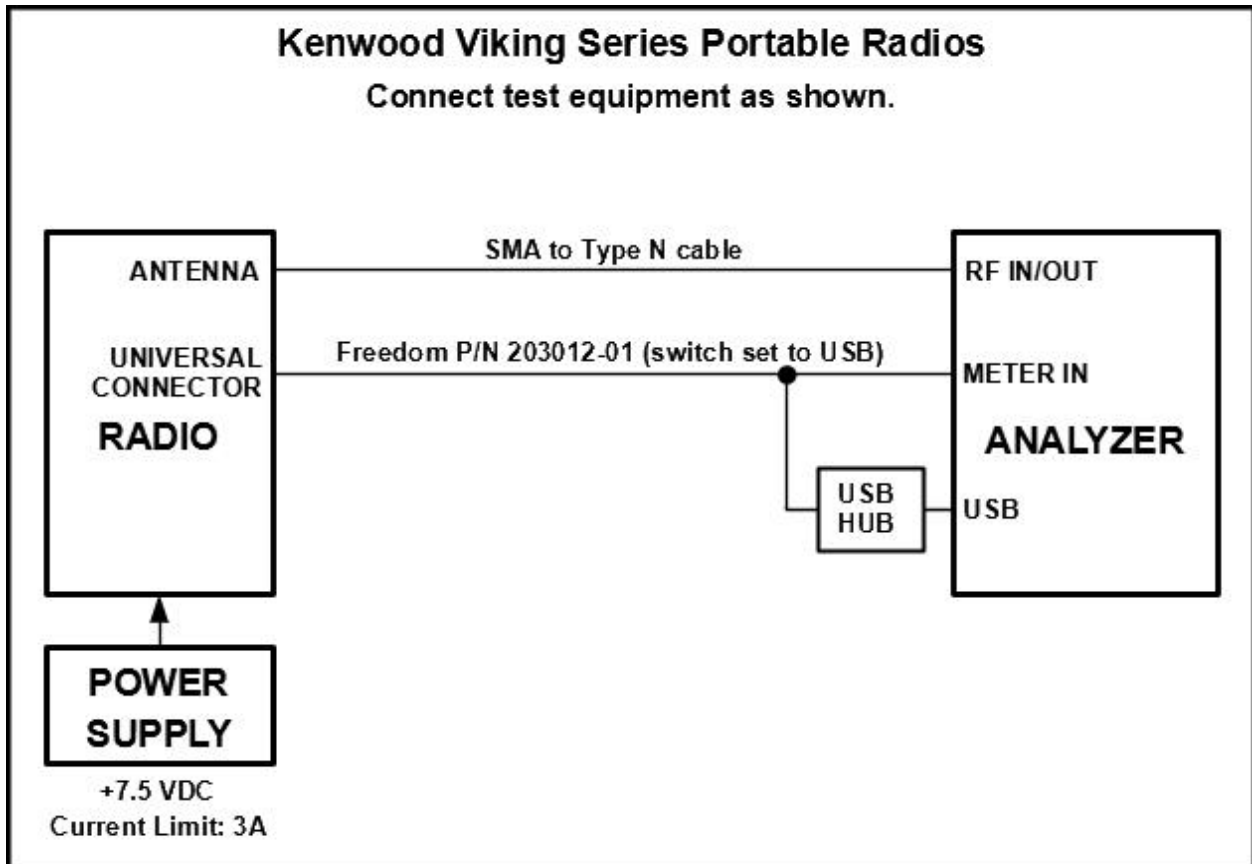


Figure 4-1. Viking Portable Test Setup Diagram with Astronics 203012-01 Cable.

**Note:** When using the Astronics programming cable (which is a modified Kenwood KPG-36X cable), the switch on the cable must be set to “USB” in order for the Analyzer to communicate with the radio.

## 5. Kenwood Viking Portable Alignment and Test Descriptions

**Note:** Throughout this section are references to Test Frequency. Test Frequencies are band- and mode -specific. A table of the frequencies used by each band may be found in the respective radio service manual.

**Note:** All analyzer Mode settings are Standard unless otherwise indicated.

### 5.1. Assist

#### 5.1.1. Alignment

The Assist alignments helps ensure fast VCO lock time. The radio is placed into Test Mode and its VCO lock voltage is adjusted at several Rx and Tx Test Frequency points. The new softpot values for the voltages are then programmed into the radio.

Name	Description
Result	Pass or Fail. Pass as long as no radio error detected.
Frequency	Test Frequency
Old Param	Radio softpot before alignment
New Param	Radio softpot after alignment
Target	Target voltage
Meas	Measured voltage
Diff	Difference between Target and Measured values

**Table 5-1. Assist Voltage alignment results**

#### 5.1.2. Test

There is no Assist test.

## 5.2. Ramp Offset

### 5.2.1. Alignment

The radio is placed into Test Mode and its ramp voltage is optimized. This is an internal radio adjustment which requires no analyzer setup or measurements. The new softpot values for the voltages are then programmed into the radio.

Name	Description
Result	Pass or Fail. Pass as long as no radio error detected.
Meas	Measured value (from radio)
Target	Target value
Up Old	Ramp Up softpot before alignment
Up New	Ramp Up softpot after alignment
Down Old	Ramp Down softpot before alignment
Down New	Ramp Down softpot after alignment

**Table 5-2. Ramp Offset alignment results**

### 5.2.2. Test

There is no Ramp Offset test.

### 5.3. Rx Filters

RF Control	Port	Frequency	Modulation	Output Level
Generate	RF IN/OUT	Test Frequency	FM	SINAD: -120 dBm Portable / -118.5 dBm Mobile RSSI: -100 dBm

**Table 5-3. Analyzer Configuration for Rx Filters**

Note: For portables, only the UHF 380 band models support Rx Filters alignment. For mobiles, all models support the Rx Filters alignment except 700/800 MHz band models. If this alignment is selected for a model that does not support the alignment, the test report will indicate the Rx Filters alignment is not applicable.

#### 5.3.1. Alignment

The radio is placed into Test Mode and its Rx filters are adjusted. For mobiles with VHF, VHF Low, or VHF 110 bands, a Sensitivity (RSSI) alignment is performed. For all other models (portable and mobile) a Sensitivity (SINAD) alignment is performed. Using the Output Level indicated in Table 5-3, the softpots are adjusted to obtain 12 dB SINAD, or RSSI value greater than a minimum value. The new softpot values are then programmed into the radio.

Name	Description
Result	Pass or Fail. Pass if no radio error detected.
Frequency	Test Frequency
Old Softpot	Radio softpot before alignment
New Softpot	Radio softpot after alignment
SINAD	SINAD value measured
Target (12 dB)	Difference between Target and measured SINAD values

**Table 5-4. Rx Filters Sensitivity (SINAD) alignment results**

Name	Description
Result	Pass or Fail. RSSI above Min Limit
Frequency	Test Frequency
Old Softpot	Radio softpot before alignment
New Softpot	Radio softpot after alignment
RSSI	RSSI value measured
Min Limit	Minimum Limit (inclusive) for RSSI

**Table 5-5. Rx Filters Sensitivity (RSSI) alignment results**

#### 5.3.2. Test

There is no Rx Filters test.

## 5.4. TCXO Frequency

RF Control	Port	Frequency	Modulation	Attenuation
Monitor	RF IN/OUT	Test Frequency	FM	30 dB

Table 5-6. Analyzer Configuration for TCXO Frequency

### 5.4.1. Alignment

The radio is placed into Test Mode at a Tx Test Frequency. The analyzer is placed into Monitor mode at the radio Tx Test Frequency and nominal attenuation. The radio is set to transmit a signal at the Test Frequency. The analyzer measures the Frequency error of the signal and adjusts the pendulum softpot to obtain the least amount of frequency error. The new softpot value for the pendulum is then programmed into the radio.

The frequency error is compared against test limits and the results written to the log file.

Name	Description
Result	Pass or Fail. Frequency Error within Max Limit, Min Limit
Frequency	Test Frequency
Min Limit	Minimum Limit (inclusive) for Frequency Error
Max Limit	Maximum Limit (inclusive) for Frequency Error
Freq Error	Frequency Error measured
Pendulum Old	Pendulum softpot before alignment
Pendulum New	Pendulum softpot after alignment

Table 5-7. TCXO Frequency alignment results

### 5.4.2. Test

The radio is placed into Test Mode at a Tx Test Frequency and commanded to transmit. The frequency error is measured by the analyzer and compared to test limits. The results are written to the log file.

Name	Description
Result	Pass or Fail. Frequency Error within Max Limit, Min Limit
Frequency	Test Frequency
Min Limit	Minimum Limit (inclusive) for Frequency Error
Max Limit	Maximum Limit (inclusive) for Frequency Error
Freq Error	Frequency Error measured
Pendulum	Pendulum softpot

Table 5-8. TCXO Frequency test results

## 5.5. Tx Modulation (Balance)

RF Control	Port	Frequency	Modulation	Attenuation	Averaging
Monitor	RF IN/OUT	Test Frequency	FM	30 dB	+/- Peak / 2

Table 5-9. Analyzer Configuration for Tx Modulations alignment

### 5.5.1. Tx Modulation Alignment

The radio is placed into Test Mode at low power at the first TX Test Frequency and commanded to transmit. The radio generates a Mod 2 (TXCO) modulation tone and the  $\pm$ Peak/2-averaged deviation of this tone is measured with the analyzer. Mod 2 softpot is adjusted until tone deviation is between Mod 2 Min, Max test limits. The radio then generates a Mod 1 (VCO) modulation tone and the  $\pm$ Peak/2-averaged deviation of this tone is measured with the analyzer. The Mod 1 softpot is adjusted until the tone deviation is between Mod 1 Min, Max test limits. Mobile and UHF radios only, the radio is set to generate a fine tune modulation tone using the previously found Mod 2 and Mod 1 softpot. Mod 1 and Mod 2 are adjusted by the same percentage until the tone deviation is between the fine tune modulation Min, Max test limits. This adjustment is performed for each TX Test Frequency. The results for each TX Test Frequency are written to the log file.

Name	Description
Result	Pass or Fail
Frequency	Test Frequency
Dev	Measured deviation
Dev Min	Minimum passable deviation (inclusive)
Dev Max	Minimum passable deviation (inclusive)
Mod 2/Mod 1 Old	Mod 2 or Mod 1 softpot before alignment
Mod 2/Mod 1 New	Mod 2 or Mod 1 softpot after alignment

Table 5-10. Tx Modulation alignment results

Name	Description
Result	Pass or Fail.
Frequency	Test Frequency
Fine Tune Dev	Measured deviation
Fine Tune Dev Min	Minimum passable deviation (inclusive)
Fine Tune Dev Max	Minimum passable deviation (inclusive)
Mod 1 Old	Mod1 softpot before alignment
Mod 1 New	Mod1 softpot after alignment
Mod 2 Old	Mod2 softpot before alignment
Mod 2 New	Mod2 softpot after alignment

Table 5-11. Tx Modulation Fine Tune alignment results

#### 5.5.2. Tx Modulation Test

There is no Tx Modulation test.



## 5.6. Tx Power

RF Control	Port	Frequency	Modulation	Attenuation
Monitor	RF IN/OUT	Test Frequency	FM	40 dB

**Table 5-12. Analyzer Configuration for Tx Power**

### 5.6.1. Alignment

The Tx Power Out alignment aligns the power output level of the radio at both High and Low power levels. The radio is placed into Test Mode and commanded to transmit at the first Test Frequency and the Low power setting. For each test frequency, the output level is measured and then adjusted until near to a band-specific output level. This process is repeated for the High power settings. The results are written to the log file.

Name	Description
Result	Pass or Fail. Power Out within manufacturer limits
Frequency	Test Frequency
Power	Measured radio output level
Min	Minimum Limit (inclusive) for Power Out
Max	Maximum Limit (inclusive) for Power Out
Old	Original radio softpot setting
New	Radio softpot after alignment

**Table 5-13. Tx Power alignment results**

### 5.6.2. Test

The radio is placed into Test Mode and commanded to transmit. Beginning at the first Tx Test Frequency, the output level is measured at each Tx Test Frequency, for Low Power and High Power, and compared against test limits. The results are written to the log file.

Name	Description
Result	Pass or Fail. Power Out within Max Limit, Min Limit
Frequency	Test Frequency
Power	Measured radio output level
Min	Minimum Limit (inclusive) for Power Out
Max	Maximum Limit (inclusive) for Power Out
Softpot	Current radio softpot setting

**Table 5-14. Tx Power test results**

## 5.7. Squelch

RF Control	Port	Frequency	Modulation	Level
Generate	RF IN/OUT	Test Freq	<b>Analog:</b> Wide: 1 kHz @ 3 kHz Narrow: 1 kHz @ 1.5 kHz	Varies

**Table 5-15. Analyzer Configuration for Squelch**

### 5.7.1. Alignment

The analyzer is setup by applying the Modulation signal in Table 5-15 to the radio and then setting radio volume level. The radio is placed into Test Mode at the analog wide channel spacing and Rx Test Frequency. The output level of the analyzer is then adjusted until the radio audio signal's SINAD level measures about 10 dB. The radio Unsquench threshold values are then queried and programmed into radio. The output level of the analyzer is then adjusted until the radio audio signal's SINAD level measures about 6 dB. The radio Squelch threshold values are then queried and programmed into radio. The results are written to the log file. This process is repeated for narrow channel spacing.

**Note:** For UHF 380 band portables, an EU squelch alignment is performed after the normal squelch alignment. For the EU squelch alignment, the radio is commanded to use European sensitivity voltage parameters and then to start EU squelch tuning.

Name	Description
Result	Pass or Fail. Difference within Max Limit, Min Limit
Frequency	Test Frequency
Squelch Type	One of: Wideband Squelch or Unsquench, or Narrowband Squelch or Unsquench
Output Level	Analyzer output level used to generate squelch level
SINAD	SINAD level (in dB) when Squelch/Unsquench occurs
Threshold	Measured radio squelch, unsquench levels

**Table 5-16. Squelch alignment results**

### 5.7.2. Test

No test is currently available.

## 5.8. Rx Sensitivity

RF Control	Port	Frequency	Modulation	Level
Generate	RF IN/OUT	Test Freq	Narrow: 1 kHz @ 1.5 kHz	Model specific

**Table 5-17. Analyzer Configuration for Rx Sensitivity test**

### 5.8.1. Test

The analyzer is setup by applying the Modulation signal in Table 5-17 to the radio and then setting radio volume. The radio is placed into Test Mode at the first Rx Test Frequency. The output level of the analyzer is then adjusted until the radio audio signal's SINAD level measures about 12 dB. The current analyzer output level is then compared against test limits. The results are written to the log file. This process is repeated for each Rx Test Frequency.

Name	Description
Result	Pass or Fail. Sensitivity (SINAD) level within Max Limit
Frequency	Test Frequency
SINAD	SINAD level measured
Output Level	Analyzer output level at which the radio SINAD level measures about 12 dB
Max Level	Maximum Limit (inclusive) for Rx Sensitivity to Pass

**Table 5-18. Rx Sensitivity test results**

## 5.9. P25 Tx Tests

RF Control	Port	Frequency	Modulation	Attenuation
Monitor	RF IN/OUT	Test Frequency	C4FM	40 dB

Table 5-19. Analyzer Configuration for P25 Tx Tests

### 5.9.1. Test

The radio is set to a digital channel at low power at the first Tx Test Frequency and commanded to transmit a P25 deviation pattern. The modulation fidelity and symbol deviation of this tone is measured with the analyzer. This process is repeated for each Test Frequency. The test results are written to the log file.

Name	Description
Result	Pass or Fail. Pass is modulation fidelity is below Max Limit
Frequency	Test Frequency
Measured	Measured P25 Modulation Fidelity
Max	Maximum passable Modulation Fidelity level (inclusive)

Table 5-20. Tx P25 Modulation Fidelity results

Name	Description
Result	Pass or Fail. Pass is symbol deviation is between Min and Max Limits
Frequency	Test Frequency
Measured	Measured P25 Symbol Deviation
Min	Minimum Symbol Deviation (inclusive)
Max	Maximum Symbol Deviation (inclusive)

Table 5-21. Tx P25 Symbol Deviation results

## 5.10. Sensitivity (P25 BER)

RF Control	Port	Frequency	Modulation	Level
Generate	RF IN/OUT	Test Freq	<b>Digital:</b> P25 Phase 1:1011 Hz test pattern	-117 dBm

**Table 5-22. Analyzer Configuration for Sensitivity (P25 BER) test**

### 5.10.1. Test

The analyzer is setup by applying the Modulation signal in Table 5-22 to the radio. The radio is placed into Test Mode at the first Rx Test Frequency. The analyzer retrieves the radio's BER level measured. The BER level is then compared against test limits. The results are written to the log file. This process is repeated for each Rx Test Frequency.

Name	Description
Result	Pass or Fail. Sensitivity (P25 BER) level less than Max Limit
Frequency	Test Frequency
Bit Error	Number of bit errors in two superframes
BER	Radio's BER measurement
Max	Maximum BER level (inclusive) allowed for test to Pass

**Table 5-23. Sensitivity (P25 BER) test results**

## 6. Kenwood Viking Mobile Radio Test Setup

In order to perform the test and alignment procedures, the Viking Mobile radio must be connected to the R8000 Communications System Analyzer as shown in the figure below.



Make certain that the radio under test is configured as described in the corresponding diagram **before** attempting to perform the indicated alignment or test. Failure to do so may result in poor radio performance and/or damage to the analyzer or radio equipment under test.

### 6.1. Cable Sweep

Every RF cable connected between a radio under test and the analyzer attenuates the signal propagating through it. The amount of attenuation varies by several factors such as operating frequency, cable length, and cable type. Ensuring this attenuation is accounted for by the analyzer is important to the accuracy of several tests and alignments, primarily power tests.

Sweep the RF cable used between the Radio and Analyzer, label the RF cable with the stored cable sweep name, and enable the Cable Sweep feature in the analyzer System, System Settings... menu. Refer to [Application Note FCT-1017 Utilizing Cable Sweep on the Astronics Communications System Analyzer](#) for instructions on how to perform a cable sweep.

### 6.2. Viking Mobile Test Setup

Refer to the diagram below for the proper test setup.

**Note:** For reliable radio communication with the analyzer, use an externally powered USB hub from a reputable vendor as shown in the diagram.

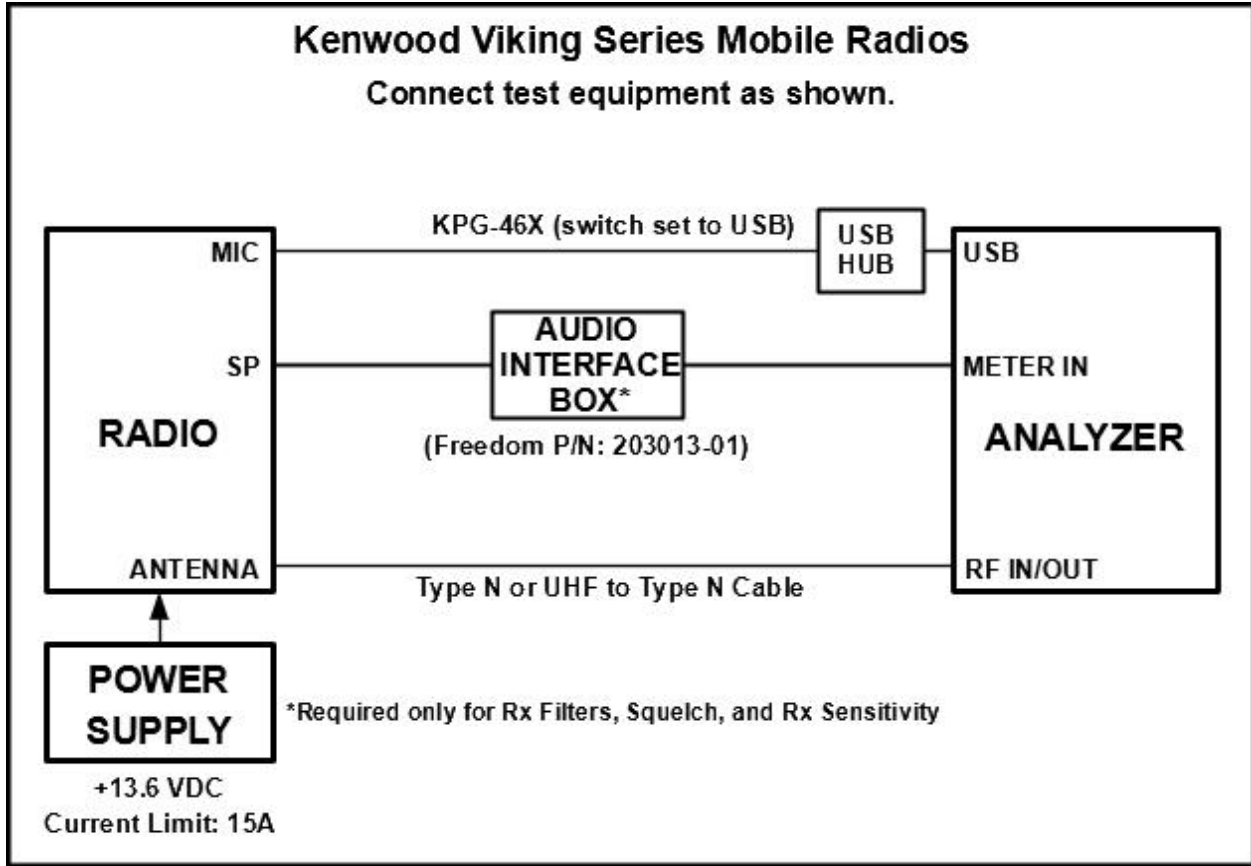


Figure 6-1. Viking Mobile Test Setup Diagram with 203013-01 Audio Interface Box.

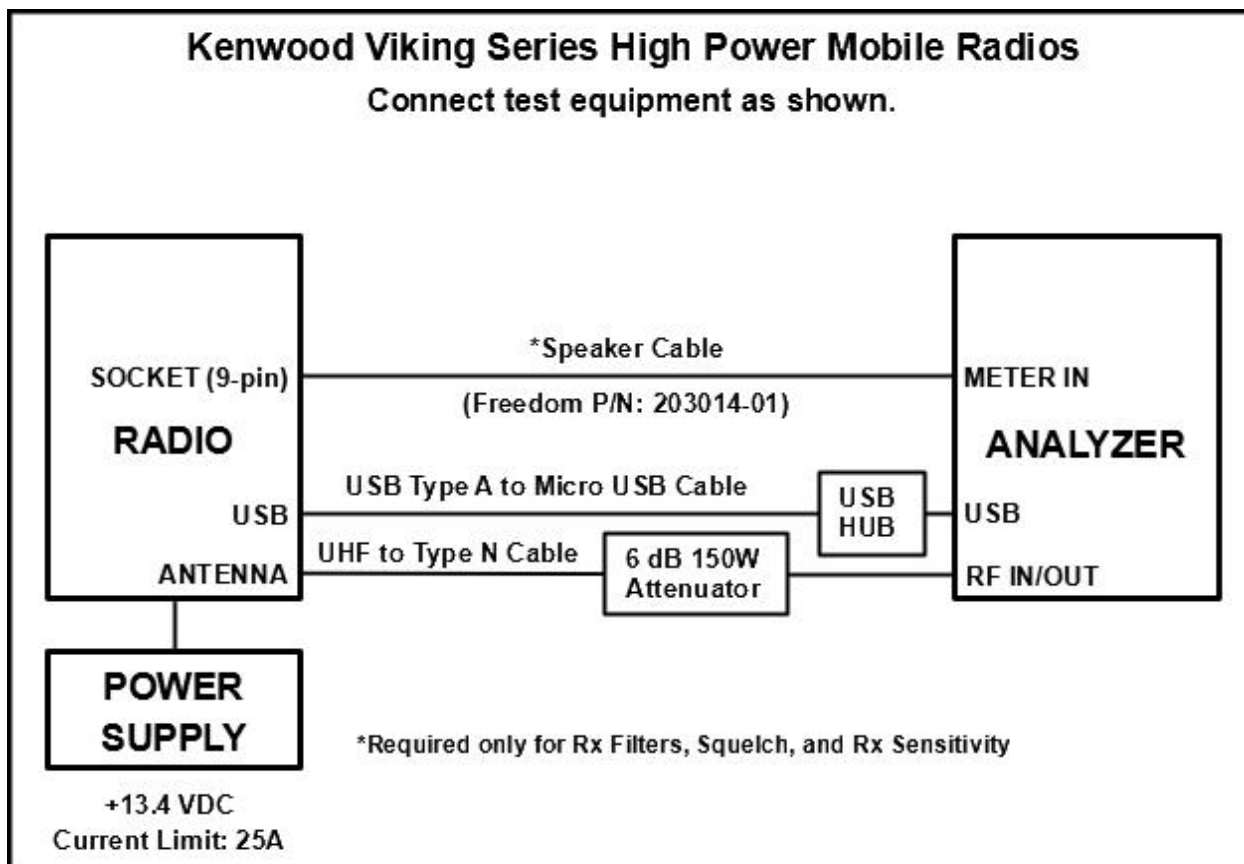


Figure 6-2. Viking Mobile Test Setup Diagram with Astronics 203014-01 Cable.

### 6.3. Kenwood Viking Mobile USB Cables

For mid-power mobiles, the Astronics Audio Interface Box is used to route the radio 3.5mm speaker output to the analyzer Meter In port. This box allows all alignments and tests to be performed.

For high power mobiles, the Astronics Speaker Cable routes the radio speaker connector output to the analyzer Meter In port. This cable allows all alignments and tests to be performed.

When using a Kenwood USB cable without an Audio Interface Box (mid-power mobiles) or speaker cable (high power mobiles), radio audio signals cannot be routed to the Analyzer for measurement. The USB programming cables do not route radio audio signals. The following tests cannot be run without an Audio Interface Box (mid-power mobiles) or speaker cable (high power mobiles) to connect the Radio directly to the Analyzer:

- Rx Filters
- Squelch
- Rx Sensitivity



## Kenwood Viking Series AutoTune™ User Guide

**Note:** When using the KPG-46X cable, the switch on the cable must be set to “USB” in order for the Analyzer to communicate with the radio.

## 7. Kenwood Viking Mobile Alignment and Test Descriptions

**Note:** Throughout this section are references to Test Frequency that are band- and mode -specific. A table of the frequencies used by each band may be found in the respective radio service manual.

A Tx Max Power alignment is added for the Kenwood Viking Mobile radios. For all other mobile alignments and tests, see section Kenwood Viking Portable Alignment and Test Descriptions for details - the alignments and tests are identical.

For Low Band VHF Mobile radios, the Ramp Offset alignment is moved in the function order to follow the Tx Max Power alignment.

### 7.1. Tx Max Power

RF Control	Port	Frequency	Modulation	Attenuation
Monitor	RF IN/OUT	Test Frequency	FM	40 dB

**Table 7-1. Analyzer Configuration for Tx Max Power**

#### 7.1.1. Alignment

The Tx Max Power alignment aligns the power output level of the mobile radio at its maximum power level. The radio is placed into Test Mode and commanded to transmit at the first Test Frequency and the Maximum power setting. For each test frequency, the output level is measured and then adjusted until near to a band-specific output level defined by the respective Kenwood Viking Portable radio service manuals.

Model	High Power Limits(W)
Low Band VHF	115 – 135
VHF 110W	123 – 127
700 MHz	43 – 47
800 MHz	38 – 42
All other models	53 – 57

**Table 7-2. Kenwood Viking Mobile specified target max power**

The results are written to the log file.

<b>Name</b>	<b>Description</b>
Result	Pass or Fail. Power Out within manufacturer limits
Frequency	Test Frequency
Power	Measured radio output level
Min Limit	Minimum Limit (inclusive) for Power Out
Max Limit	Maximum Limit (inclusive) for Power Out
Old Softpot	Original radio softpot setting
New Softpot	Radio softpot after alignment

**Table 7-3. Tx Max Power alignment results**

#### 7.1.2. Test

There is no Tx Max Power test.

## 8. Basic Troubleshooting

Symptom	Possible Cause	Possible Solution
Analyzer consistently fails to communicate with radio	<ul style="list-style-type: none"> <li>• Incorrect setting on cable.</li> </ul>	<ul style="list-style-type: none"> <li>• Verify programming cable KPG-46X is set to USB or AStronics cable 203012-01 is set to USB. See the respective radio test setup sections for more information.</li> </ul>
Alignment or test intermittently stops after partial performance.	<ul style="list-style-type: none"> <li>• USB hub not present.</li> </ul>	<ul style="list-style-type: none"> <li>• Use an externally powered USB hub to connect radio programming cable to analyzer.</li> </ul>
Tx Max Power or Tx Power alignment or test failure	<ul style="list-style-type: none"> <li>• Cable Sweep not enabled.</li> <li>• Power supply voltage level not set to level specified on test setup diagram.</li> <li>• Radio duty cycle too high</li> </ul>	<ul style="list-style-type: none"> <li>• Enable Cable Sweep (Settings &gt; System Settings... &gt; Cable Sweep Table...) and sweep RF cable in use so the analyzer can account for its cable loss. Note Cable Sweep feature is available on analyzer with system software <b>3.8.0.0</b> or later.</li> <li>• Refer to test setup diagram for proper DC power supply voltage level. Confirm this level with a calibrated multimeter.</li> <li>• Wait 1 hour between consecutive full alignment sequences to allow the radio to cool down (while powered on and idling). If the interval is less than an hour between full alignment sequences on the same radio, power alignment failures may occur.</li> </ul>

Table 8-1. Kenwood Viking Series Troubleshooting Chart

## **9. Support Information**

### **9.1. Technical Support**

Telephone/Fax: 407-531-7240

Email: [ATS.LMR-Customer.Support@astronics.com](mailto:ATS.LMR-Customer.Support@astronics.com)

Web: <http://freedomcte.com/support/>

### **9.2. Sales**

Telephone/Fax:407-531-7240

Email: [LMRsales@astronics.com](mailto:LMRsales@astronics.com)

Web: <http://freedomcte.com/sales/>

## **APPENDIX A. Test Limits**

The factory limits contain the default limits as defined by the radio manufacturer and generally should not be modified. AutoTune supports modifying these limits if extenuating circumstances require it. Refer to the R8000 Series Communications System Analyzer Owner's Manual (FCT-1365) for modification instructions.

<https://freedomcte.com/library/>

For the recommended test limits for each Kenwood Viking Portable or Mobile radio model supported by AutoTune, see the respective Kenwood radio service manual available from your Kenwood dealer.

# Kenwood Viking Series AutoTune™ User Guide

## APPENDIX B. Sample Test Result Report

```

=====
                        Test Result Report
=====
Date/Time: 6/1/2022 4:22 PM                      Operator ID: MM
Info
-----
Analyzer
-----
Model #:      R8100
Serial #:     810LSJ0011
Ref Clock Mode: Output
Application:  4.4
RF Level Offset: Off
RF In/Out Offset: 0.0 dB
RF Gen Out Offset: 0.0 dB
Cable Sweep: On
Selected File: RF_ORANGE_N2N
100 MHz Attenuation: -0.201 dB
1 GHz Attenuation: -0.688 dB

Radio
-----
Model #:      VMx830
Serial #:     FO-83-00-00-00-03-84
Band:        UHF 380
Firmware Version: 8.32.10
Bootloader Version: 32.9
DSP Version:  5.32.9
-----

Tx Assist
=====
Result  Frequency  Old Param  New Param  Target  Meas  Diff
-----
Pass    380.1000 MHz  768        770        128     128   0
Pass    385.6000 MHz  874        874        128     128   0
Pass    391.1000 MHz  971        974        128     127   -1
Pass    396.6000 MHz  1069       1069       128     127   -1
Pass    402.6000 MHz  1169       1172       128     127   -1
Pass    408.1000 MHz  1266       1266       128     128   0
Pass    413.6000 MHz  1361       1361       128     128   0
Pass    419.1000 MHz  1458       1458       128     129   1
Pass    425.1000 MHz  1567       1570       128     127   -1
Pass    430.6000 MHz  1670       1672       128     128   0
Pass    436.1000 MHz  1779       1779       128     129   1
Pass    441.6000 MHz  1892       1892       128     128   0
Pass    447.6000 MHz  2017       2017       128     129   1
Pass    453.1000 MHz  2134       2136       128     128   0
Pass    458.6000 MHz  2257       2257       128     129   1
Pass    464.1000 MHz  2382       2385       128     127   -1
Pass    469.9000 MHz  2520       2520       128     129   1

Rx Assist
=====
Result  Frequency  Old Param  New Param  Target  Meas  Diff
-----
Pass    380.0500 MHz  790        790        128     128   0
Pass    385.5500 MHz  909        909        128     129   1
Pass    391.0500 MHz  1023       1023       128     128   0
Pass    396.5500 MHz  1131       1134       128     127   -1
Pass    402.5500 MHz  1249       1249       128     129   1
Pass    408.0500 MHz  1358       1358       128     129   1
Pass    413.5500 MHz  1469       1469       128     128   0
Pass    419.0500 MHz  1580       1580       128     129   1
Pass    425.0500 MHz  1708       1708       128     128   0
Pass    430.5500 MHz  1827       1827       128     129   1
Pass    436.0500 MHz  1949       1952       128     128   0
Pass    441.5500 MHz  2077       2077       128     129   1
Pass    447.5500 MHz  2217       2220       128     127   -1
Pass    453.0500 MHz  2351       2351       128     129   1
Pass    458.5500 MHz  2488       2488       128     129   1
Pass    464.0500 MHz  2628       2628       128     129   1
Pass    469.9500 MHz  2784       2784       128     129   1

Ramp Offset Align
=====
Result  Meas  Target  Up Old  Up New  Down Old  Down New
-----
Pass    50    50      622    622    342      342

Rx Filters
=====
Result  Frequency  Old Softpot  New Softpot  SINAD  Target (12 dB)
-----
Pass    380.0500 MHz  184          183          9.4 dB  Diff: 2.62 dB
Pass    402.5500 MHz  160          160          11.3 dB  Diff: 0.75 dB
Pass    425.0500 MHz  133          134          11.8 dB  Diff: 0.22 dB
Pass    447.5500 MHz  106          104          10.6 dB  Diff: 1.42 dB
Pass    469.9500 MHz  73           71           11.7 dB  Diff: 0.31 dB

TCXO Frequency Align
=====
Result  Frequency  Min Limit  Max Limit  Freq Error  Pendulum Old  Pendulum New
-----
Pass    402.5000 MHz  -3 Hz     3 Hz      2 Hz      -3005        -3005

Tx Modulation Align - Fine Tune
=====
Result  Frequency  Dev      Dev Min  Dev Max  Mod1 Old  Mod1 New  Mod2 Old  Mod2 New
-----
Pass    380.00000 MHz  3129 Hz  3103 Hz  3203 Hz  2002      2002      -4500     -4500
Pass    387.50000 MHz  3158 Hz  3103 Hz  3203 Hz  2057      2057      -4492     -4492

```

# Kenwood Viking Series AutoTune™ User Guide

Pass	395.00000	MHz	3172	Hz	3103	Hz	3203	Hz	2111	2111	-4549	-4549
Pass	402.50000	MHz	3156	Hz	3103	Hz	3203	Hz	2157	2157	-4544	-4544
Pass	410.00000	MHz	3152	Hz	3103	Hz	3203	Hz	2205	2205	-4434	-4434
Pass	417.50000	MHz	3129	Hz	3103	Hz	3203	Hz	2244	2244	-4488	-4488
Pass	425.00000	MHz	3135	Hz	3103	Hz	3203	Hz	2300	2300	-4459	-4459
Pass	432.50000	MHz	3142	Hz	3103	Hz	3203	Hz	2366	2366	-4465	-4465
Pass	440.00000	MHz	3152	Hz	3103	Hz	3203	Hz	2431	2431	-4474	-4474
Pass	447.50000	MHz	3145	Hz	3103	Hz	3203	Hz	2488	2488	-4477	-4477
Pass	455.00000	MHz	3135	Hz	3103	Hz	3203	Hz	2539	2539	-4485	-4485
Pass	462.50000	MHz	3129	Hz	3103	Hz	3203	Hz	2596	2596	-4482	-4482
Pass	470.00000	MHz	3149	Hz	3103	Hz	3203	Hz	2660	2660	-4467	-4467

## Tx Max Power Align

Result	Frequency	Power	Min Limit	Max Limit	Old	Softpot	New	Softpot
Pass	380.0000	MHz 56.6 w	53.0 w	57.0 w	190		207	
Pass	387.5000	MHz 54.3 w	53.0 w	57.0 w	170		181	
Pass	395.0000	MHz 54.7 w	53.0 w	57.0 w	169		169	
Pass	402.5002	MHz 55.1 w	53.0 w	57.0 w	158		183	
Pass	410.0005	MHz 53.5 w	53.0 w	57.0 w	173		173	
Pass	417.5000	MHz 54.7 w	53.0 w	57.0 w	182		182	
Pass	425.0000	MHz 53.0 w	53.0 w	57.0 w	161		161	
Pass	432.5000	MHz 55.0 w	53.0 w	57.0 w	159		183	
Pass	440.0007	MHz 53.2 w	53.0 w	57.0 w	172		172	
Pass	447.5005	MHz 54.3 w	53.0 w	57.0 w	171		192	
Pass	455.0005	MHz 57.0 w	53.0 w	57.0 w	179		217	
Pass	462.5005	MHz 54.8 w	53.0 w	57.0 w	190		190	
Pass	470.0000	MHz 54.3 w	53.0 w	57.0 w	177		177	

## Tx Power Align - Low Power

Result	Frequency	Power	Min	Max	Old	New
Pass	380.00000	MHz 4.95 w	4.50 w	5.50 w	3130	3130
Pass	387.50000	MHz 4.86 w	4.50 w	5.50 w	3136	3136
Pass	395.00000	MHz 4.77 w	4.50 w	5.50 w	3136	3136
Pass	402.50000	MHz 4.76 w	4.50 w	5.50 w	3136	3136
Pass	410.00000	MHz 4.74 w	4.50 w	5.50 w	3136	3136
Pass	417.50000	MHz 4.73 w	4.50 w	5.50 w	3136	3136
Pass	425.00000	MHz 4.70 w	4.50 w	5.50 w	3136	3136
Pass	432.50000	MHz 4.69 w	4.50 w	5.50 w	3136	3136
Pass	440.00000	MHz 4.57 w	4.50 w	5.50 w	3136	3136
Pass	447.50000	MHz 4.52 w	4.50 w	5.50 w	3136	3136
Pass	455.00000	MHz 4.99 w	4.50 w	5.50 w	3170	3170
Pass	462.50000	MHz 4.91 w	4.50 w	5.50 w	3173	3173
Pass	470.00000	MHz 4.91 w	4.50 w	5.50 w	3180	3180

## Tx Power Align - High Power

Result	Frequency	Power	Min	Max	Old	New
Pass	380.00000	MHz 39.92 w	36.00 w	44.00 w	3791	3791
Pass	387.50000	MHz 39.57 w	36.00 w	44.00 w	3799	3799
Pass	395.00000	MHz 39.52 w	36.00 w	44.00 w	3804	3804
Pass	402.50000	MHz 39.79 w	36.00 w	44.00 w	3808	3808
Pass	410.00000	MHz 39.59 w	36.00 w	44.00 w	3809	3809
Pass	417.50000	MHz 40.17 w	36.00 w	44.00 w	3776	3816
Pass	425.00000	MHz 39.89 w	36.00 w	44.00 w	3815	3815
Pass	432.50000	MHz 37.87 w	36.00 w	44.00 w	3800	3800
Pass	440.00000	MHz 37.18 w	36.00 w	44.00 w	3800	3800
Pass	447.50000	MHz 36.72 w	36.00 w	44.00 w	3800	3800
Pass	455.00000	MHz 40.82 w	36.00 w	44.00 w	3840	3840
Pass	462.50000	MHz 39.61 w	36.00 w	44.00 w	3840	3840
Pass	470.00000	MHz 38.91 w	36.00 w	44.00 w	3840	3840

## Squelch

Result	Frequency	Squelch Type	Output Level	SINAD	Threshold
Pass	428.3625	MHz wideband Squelch	-119.0 dBm	8.8 dB	60137
Pass	428.3625	MHz wideband Unsquelch	-119.7 dBm	6.3 dB	58953
Pass	428.3625	MHz Narrowband Squelch	-119.0 dBm	9.6 dB	58905
Pass	428.3625	MHz Narrowband Unsquelch	-120.4 dBm	6.2 dB	56354

## Rx Sensitivity

Result	Frequency	SINAD	Output Level	Max Level
Pass	380.0500	MHz 11.9 dB	-118.5 dBm	-117.0 dBm
Pass	425.0500	MHz 11.6 dB	-117.8 dBm	-117.0 dBm
Pass	469.9500	MHz 11.9 dB	-119.4 dBm	-117.0 dBm

## P25 Tx Tests - Modulation Fidelity

Result	Frequency	Measured	Max
Pass	380.00000	MHz 0.9 %	5.0 %
Pass	402.50000	MHz 1.0 %	5.0 %
Pass	425.00000	MHz 1.1 %	5.0 %
Pass	447.50000	MHz 1.1 %	5.0 %
Pass	470.00000	MHz 1.3 %	5.0 %

## P25 Tx Tests - Symbol Deviation

Result	Frequency	Measured	Min	Max
Pass	380.00000	MHz 1786 Hz	1620 Hz	1980 Hz
Pass	402.50000	MHz 1798 Hz	1620 Hz	1980 Hz
Pass	425.00000	MHz 1782 Hz	1620 Hz	1980 Hz
Pass	447.50000	MHz 1790 Hz	1620 Hz	1980 Hz
Pass	470.00000	MHz 1787 Hz	1620 Hz	1980 Hz

## Sensitivity (P25 BER)

Result	Frequency	Bit Error	BER	Max
Pass	380.05000	MHz 147	2.34 %	5.00 %



# Kenwood Viking Series AutoTune™ User Guide

Pass	402.55000 MHz	230	3.67 %	5.00 %
Pass	419.05000 MHz	301	4.80 %	5.00 %
Pass	441.55000 MHz	217	3.46 %	5.00 %
Pass	469.95000 MHz	140	2.23 %	5.00 %

Tests performed by AutoTune © 2022 Freedom Communication Technologies, Inc. All Rights Reserved.

## Figure B-1. Sample Test Result Report

**APPENDIX C.      Revision History**

A – Initial	T.John	M. Mullins	7/14/22	0403
Revision – Change	Requested By	Approved By	Rel. Date	ECO#