FREEDOM
Communication Technologies

R8000 SERIES
COMMUNICATIONS SYSTEM ANALYZER

AUTOTUNE USER GUIDE

Kenwood NX Portable Radios
Kenwood NX Mobile Radios

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FCT-1375D

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

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1. Introduction

The Freedom Communication Technologies 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 NX Portable and NX 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 NX series models are supported:

- NX-200[G|S]
- NX-210[G]
- NX-300[G|S]
- NX-320
- NX-410
- NX-411
- NX-700[H]
- NX-706
- NX-800[H]
- NX-806
- NX-820[H|HG]
- NX-900
- NX-901

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 ±1.5 ppm specification is allowed to vary by 1.5 * 169.075 MHz, or about ±254 Hz.

3.2. Rated Audio

Rated audio voltage target is approximately 630 mVrms for Kenwood NX Portable and 2.83 Vrms for Kenwood NX Mobile radios across a 4 Ω speaker.

4. Kenwood NX Portable Radio Test Setup

In order to perform the test and alignment procedures, the NX 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. NX Portable Test Setup

Refer to the diagram below for the proper test setup. Note that the correct setting for each test set switch is listed in TEST SET SETTINGS.

Note: Approved USB to serial adapters for connecting the R8000 analyzer to the Kenwood NX series radio under test include any adapters which utilize an FTDI FT232_USB to serial UART interface. See http://www.ftdichip.com/Products/ICs/FT232R.htm for more detail.

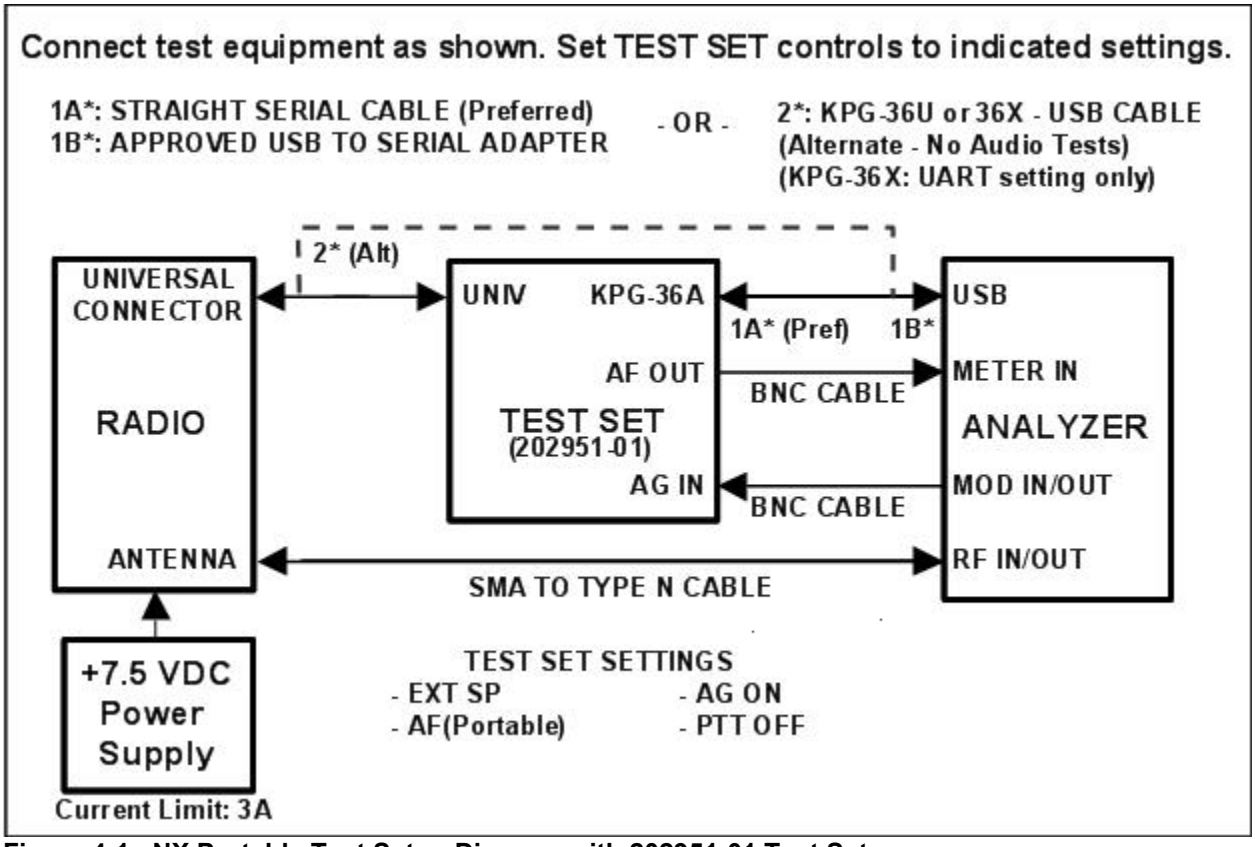

Figure 4-1. NX Portable Test Setup Diagram with 202951-01 Test Set.

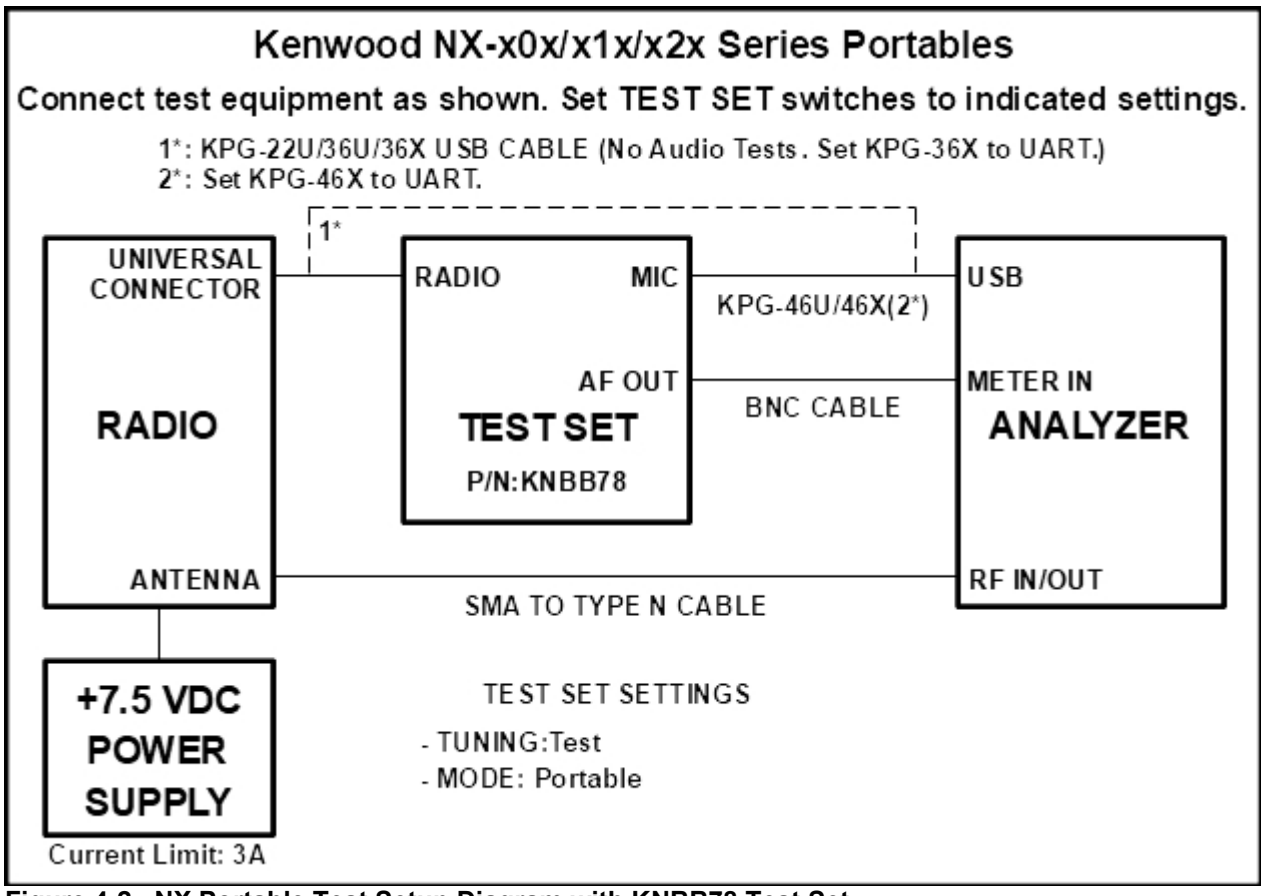

Figure 4-2. NX Portable Test Setup Diagram with KNBB78 Test Set.

4.2. Kenwood NX Portable USB Cables

R8000 system software version 3.1.0.0 and later supports Kenwood USB cables for testing NX portables. When a Kenwood USB cable connects the Radio directly to the Analyzer, the Test Set is bypassed as shown. The Kenwood USB cables do not route radio audio signals. Therefore, the following tests cannot be run when using a Kenwood USB cable:

- TX VOX
- RX Sensitivity
- RX Squelch
- RX RSSI

When a Kenwood NX Portable is selected as the radio to be tested, a new display group appears below the Activity Group (Test Only, Test and Align). This new group displays the current selection for the NX radio interface cable - either Serial, or USB. Use the “Serial or USB Cable” softkey on the right side of the screen to select the cable being used. The list of tests available will update depending on the selection of the cable and the test Activity.

Note: When using the KPG-36X cable, the switch on the cable must be set to “UART” in order for the Analyzer to communicate with the radio. The cable selection on the Analyzer must still be set to “USB”, because the audio tests are not supported when using either the 36U or 36X cables.

5. Kenwood NX 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 Voltage

5.1.1. Alignment

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.
Softpot	Radio softpot after alignment

Table 5-1. Reference Frequency alignment results

5.1.2. Test

There is no Assist Voltage test.

5.2. Reference Frequency

RF Control	Port	Frequency	Modulation	Output Level
Generate	RF IN/OUT	Test Frequency	FM	-30 dBm

Table 5-2. Analyzer Configuration for Reference Frequency

5.2.1. Alignment

The radio is placed into Test Mode at a TX Test Frequency and commanded to transmit. Using a best linear fit algorithm, two frequency error measurements are taken at two different radio softpot values. These frequency error measurements are used to calculate the softpot value which minimizes frequency error. After programming this new softpot value into the radio, the radio softpot is fine tuned until minimum frequency error is detected. The frequency error is compared against test limits and the final results written to the log file.

Name	Description
Result	Pass or Fail. Pass as long as no radio error returned
Frequency	Test Frequency
New Softpot	Radio softpot after alignment
Temp (23 - 27° C)	Internal radio temperature, in Celsius. Ideal temperature is between 23 and 27 degrees Celsius.

Table 5-3. Reference Frequency alignment results

5.2.2. 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 final results are written to the log file.

Name	Description
Result	Pass or Fail. Frequency Error within Max Limit, Min Limit
Frequency	Test Frequency
Freq Error	Measured frequency error
Min Limit	Minimum Limit (inclusive) for frequency error
Max Limit	Maximum Limit (inclusive) for frequency error
Temp (23 - 27° C)	Internal radio temperature, in Celsius. Ideal temperature is between 23 and 27 degrees Celsius.

Table 5-4. Reference Frequency test results

5.3. TX Power

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

Table 5-5. Analyzer Configuration for TX Power

5.3.1. 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 High 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 NX Portable radio service manuals.

Model	High Power Limits(W)	Low Power Limits(W)
NX-410 (800 MHz)	2.8 - 3.2	0.9 - 1.1
NX-411 (900 MHz)	2.3 - 2.7	0.9 - 1.1
All other models	4.8 - 5.2	0.7 - 0.9

Table 5-6. Kenwood NX Portable specified target power

This process is repeated for the Low Power setting. The final results are written to the log file.

Name	Description
Result	Pass or Fail. Power Out within manufacturer limits
Frequency	Test Frequency
Power Out	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 5-7. TX Power alignment results

5.3.2. 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 High Power and Low Power, and compared against test limits. The final results are written to the log file.

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

Table 5-8. TX Power test results

5.4. TX Modulation

The TX Modulation alignment and test includes both TX Balance alignment/test as well as TX Maximum Deviation alignment/test.

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

Table 5-9. Analyzer Configuration for Modulation Balance test, alignment

5.4.1. TX Balance 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 Low modulation tone and the ±Peak/2-averaged deviation of this tone is measured with the analyzer. The radio then generates a High modulation tone and the ±Peak/2-averaged deviation of this tone is measured with the analyzer. The radio softpot is adjusted until the deviation difference between the first and second tones is within test limits. This adjustment is performed for each TX Test Frequency. The results for each TX Test Frequency are written to the log file.

The Variance is calculated as: $Variance(\%) = \left(\frac{Deviation_{LOW} - Deviation_{HIGH}}{Deviation_{LOW}} * 100 \right)$

Name	Description
Result	Pass or Fail. Calculated difference between Low and High tone deviation less than or equal to Dev Ratio.
Frequency	Test Frequency
Variance	Calculated difference, in %, between Low and High tone deviation
Max Limit	Maximum passable % difference (inclusive) between low and high tone deviation.
Old Softpot	Original radio softpot setting
New Softpot	Radio softpot setting after alignment

Table 5-10. TX Balance alignment results

5.4.2. TX Balance Test

The radio is placed into Test Mode at the first TX Test Frequency and commanded to transmit. The radio generates a Low modulation tone and the ±Peak/2-averaged deviation of this tone is measured with the analyzer. The radio then generates a High modulation tone and the ±Peak/2-averaged deviation of this tone is measured with the analyzer. The percent difference is compared against test limits and written to the log file. This test is performed for each remaining TX Test Frequency.

Name	Description
Result	Pass or Fail. Deviation is less than or equal to Max Limit.
Frequency	Test Frequency
Low Tone	Measured low tone deviation level.
High Tone	Measured high tone deviation level.
Variance	Calculated difference, in %, between Low and High tone deviation
Max Limit	Maximum passable deviation (inclusive)
Softpot	Radio softpot which yields Variance

Table 5-11. TX Balance test results

5.4.3. TX Maximum Deviation Alignment

The radio is placed into Test Mode at low power at the first bandwidth, first TX Test Frequency and commanded to transmit. The radio generates a modulation tone and the ±Peak/2-averaged deviation of this tone is measured with the analyzer. The radio softpot is adjusted until the deviation is within 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. Calculated difference between Low and High tone deviation less than or equal to Dev Ratio.
Frequency	Test Frequency
Deviation	Measured maximum deviation level
Min Limit	Minimum passable deviation level
Max Limit	Maximum passable deviation level
Old Softpot	Original radio softpot setting
New Softpot	Radio softpot setting after alignment

Table 5-12. TX Maximum Deviation alignment results

5.4.4. TX Maximum Deviation Test

The radio is placed into Test Mode at low power at the first TX Test Frequency and commanded to transmit. The radio generates a modulation tone and the ±Peak/2-averaged deviation of this tone is measured with the analyzer. This test is performed for each TX Test Frequency. The test results for each TX Test Frequency are written to the log file.

Name	Description
Result	Pass or Fail. Deviation is less than or equal to Max Limit.
Frequency	Test Frequency
Deviation	Measured maximum deviation level
Min Limit	Minimum passable deviation level
Max Limit	Maximum passable deviation level
Softpot	Radio softpot which yields Deviation

Table 5-13. TX Maximum Deviation test results

5.5. TX Signaling

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

Table 5-14. Analyzer Configuration for TX Signaling test, alignment

5.5.1. TX Signaling Alignment

The radio is placed into Test Mode at low power at the first bandwidth and first TX Test Frequency and commanded to transmit. The radio modulates the Test Frequency using the modulation types in Table 5-15 in sequence. The ±Peak/2-averaged modulation deviation is measured with the analyzer. The radio softpot is adjusted until the deviation is within test limits. This adjustment is performed for each TX Test Frequency. The results for each TX Test Frequency are written to the log file.

Modulation	Description
QT	Quiet Talk
DQT	Digital Quiet Talk
LTR	Logic Trunked Radio
DTMF	Dual-tone multi-frequency
Single Tone	Single modulation frequency
MSK	Minimum-shift keying
CWID	Continuous Wave Identification

Table 5-15. TX Signaling modulation types

Name	Description
Result	Pass or Fail. Calculated difference between Low and High tone deviation less than or equal to Dev Ratio.
Frequency	Test Frequency
Deviation	Measured modulation deviation level
Min Limit	Minimum passable deviation (inclusive)
Max Limit	Maximum passable deviation (inclusive)
Old Softpot	Original radio softpot setting
New Softpot	Radio softpot setting after alignment

Table 5-16. TX Signaling alignment results

5.5.2. TX Signaling Test

The radio is placed into Test Mode at the first bandwidth and first TX Test Frequency and commanded to transmit. The radio generates a Low modulation tone and the ±Peak/2-averaged deviation of this tone is measured with the analyzer. The radio then generates a High modulation tone and the ±Peak/2-averaged deviation of this tone is measured with the analyzer. The deviation is compared against test limits and written to the log file. This test is performed for each remaining TX Test Frequency.

Name	Description
Result	Pass or Fail. Deviation is less than or equal to Max Limit.
Frequency	Test Frequency
Deviation	Measured modulation deviation level
Min Limit	Minimum passable deviation (inclusive)
Max Limit	Maximum passable deviation (inclusive)
Softpot	Radio softpot which yields Deviation

Table 5-17. TX Signaling test results

5.6. TX VOX

NOTE: The TX VOX alignment is only applicable to NX Portable radios.

Mode	Audio Frequency	Amplitude
VOX1	1 kHz	45 mV_{RMS} (64 mV_{pk})
VOX10	1 kHz	3 mV_{RMS} (4 mV_{pk})

Table 5-18. Analyzer Configuration for TX VOX1/10 alignment

5.6.1. TX VOX Alignment

The radio is placed into Test Mode. The VOX sensitivity is measured for both VOX 1 and VOX 10 levels. New VOX1 and VOX 10 levels are set using these sensitivity measurements. The results for each VOX level are written to the log file.

Name	Description
Result	Pass or Fail. Pass unless a radio error occurs.
VOX1 Softpot	New programmed softpot based on VOX1 sensitivity level
Audio Voltage	VOX1 audio voltage level
VOX10 Softpot	New programmed softpot based on VOX10 sensitivity level
Audio Voltage	VOX10 audio voltage level

Table 5-19. TX VOX1/10 alignment results

5.6.2. TX VOX Test

There is no TX VOX test.

5.7. RX Sensitivity

NOTE: This test requires an analyzer with NXDN test mode (R8-NXDN or R8-NXDNTYPC option) capability.

RF Control	Port	Frequency	Modulation	Level
Generate	RF IN/OUT	Test Freq	**Analog**: Wide(5k): 1 kHz @ 3 kHz Wide(4k): 1 kHz @ 2.4 kHz Narrow: 1 kHz @ 1.5 kHz **Digital**: FSW+PN9 test pattern	Model-specific

Table 5-20. Analyzer Configuration for RX Sensitivity test

5.7.1. Alignment

Alignment not currently available.

5.7.2. Test (Analog)

The analyzer is setup by applying the Modulation signal in Table 5-20 to the radio and then adjusting radio volume for Rated Audio. The radio is placed into Test Mode at the first bandwidth and 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 final results are written to the log file. This process is repeated for each bandwidth and each RX Test Frequency.

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

Table 5-21. RX Sensitivity test results

5.7.3. Test (Digital)

The analyzer is setup by applying the Modulation signal in Table 5-20 to the radio. The radio is placed into Test Mode at the first bandwidth and first RX Test Frequency. The output level of the analyzer is then adjusted until the radio's BER level measures about 3%. The current analyzer output level is then compared against test limits. The final results are written to the log file. This process is repeated for each bandwidth and each RX Test Frequency.

Name	Description
Result	Pass or Fail. Sensitivity (SINAD) level within Max Limit
Frequency	Test Frequency
3% BER	Analyzer output level at which the radio Bit Error Rate (BER) level measures about 3%
Max Limit	Maximum Limit (inclusive) for Sensitivity (SINAD) to Pass

Table 5-22. RX Sensitivity test results

5.8. RX Squelch

RF Control	Port	Frequency	Modulation	Level
Generate	RF IN/OUT	Test Freq	**Analog:** Wide(5k): 1 kHz @ 3 kHz Wide(4k): 1 kHz @ 2.4 kHz Narrow: 1 kHz @ 1.5 kHz **Digital:** Very Narrow: 0.4 kHz @ 1.1 kHz	Model-specific

Table 5-23. Analyzer Configuration for RX Squelch test

5.8.1. Alignment

The analyzer is setup by applying the Modulation signal in Table 5-23 to the radio and then adjusting radio volume for Rated Audio. The radio is placed into Test Mode at the first bandwidth and 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 final results are written to the log file. This process is repeated for each bandwidth and each RX Test Frequency.

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

Table 5-24. RX Squelch sensitivity results

The analyzer is then setup by applying the Modulation signal in Table 5-23 to the radio. The radio is placed into Test Mode at the first bandwidth and first RX Test Frequency. The output level of the analyzer is then adjusted to the 12 dB output level achieved in the previous step in this section. The radio squelch level is requested and then written to radio. The final results are written to the log file. This process is repeated for each bandwidth, RX Test Frequency, and both squelch types (Open and Tight).

Name	Description
Result	Pass or Fail. Pass unless radio error detected.
Frequency	Test Frequency
Output Level	Analyzer output level used to generate squelch level. Same as 12dB SINAD level in previous step on this section.
Old Softpot	Original radio softpot setting
New Softpot	Radio softpot setting after alignment

Table 5-25. RX Squelch alignment results

The analyzer is then setup by applying the Modulation signal in Table 5-23 to the radio. The radio is placed into Test Mode at the first bandwidth and first RX Test Frequency. The output level of the analyzer is then adjusted to the 12 dB output level achieved in the previous step in this section. The radio squelch level is requested and compared to the current squelch level programmed into the radio. The final results are written to the log file. This process is repeated for each bandwidth, RX Test Frequency, and both squelch types (Open and Tight).

Name	Description
Result	Pass or Fail. Difference within Max Limit, Min Limit
Frequency	Test Frequency
Output Level	Analyzer output level used to generate squelch level. Same as 12dB SINAD level in previous step on this section.
Softpot	Current programmed squelch softpot value
Squelch Level	Measured radio squelch level
Min Limit	Minimum Limit (inclusive) for RX Squelch to Pass
Difference	Difference between Softpot and Squelch Level
Max Limit	Maximum Limit (inclusive) for RX Squelch to Pass

Table 5-26. RX Squelch alignment results

5.8.2. Test

The analyzer is setup by applying the Modulation signal in Table 5-23 to the radio and then adjusting radio volume for Rated Audio. The radio is placed into Test Mode at the first bandwidth and 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 final results are written to the log file. This process is repeated for each bandwidth and each RX Test Frequency.

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

Table 5-27. RX Squelch sensitivity test results

The analyzer is then setup by applying the Modulation signal in Table 5-23 to the radio. The radio is placed into Test Mode at the first bandwidth and first RX Test Frequency. The output level of the analyzer is then adjusted to the 12 dB output level achieved in the previous step in this section. The radio squelch level is requested and compared to the current squelch level programmed into the radio. The final results are written to the log file. This process is repeated for each bandwidth, RX Test Frequency, and both squelch types (Open and Tight).

Name	Description
Result	Pass or Fail. Difference within Max Limit, Min Limit
Frequency	Test Frequency
Output Level	Analyzer output level used to generate squelch level. Same as 12dB SINAD level in previous step on this section.
Softpot	Current programmed squelch softpot value
Squelch Level	Measured radio squelch level
Min Limit	Minimum Limit (inclusive) for RX Squelch to Pass
Difference	Difference between Softpot and Squelch Level
Max Limit	Maximum Limit (inclusive) for RX Squelch to Pass

Table 5-28. RX Squelch test results

5.9. RX RSSI

RF Control	Port	Frequency	Modulation	Level
Generate	RF IN/OUT	Test Freq	**Analog**: Wide(5k): 1 kHz @ 3 kHz Wide(4k): 1 kHz @ 2.4 kHz Narrow: 1 kHz @ 1.5 kHz **Digital**: Narrow: 1 kHz @ 3 kHz Very Narrow: 1 kHz @ 1.1 kHz	Model-specific

Table 5-29. Analyzer Configuration for RX RSSI test

5.9.1. Alignment

Note: This alignment depends upon the 12 dB SINAD output levels discovered in either the RX Sensitivity or RX Squelch sections. If either of these two items are run prior to RX RSSI alignment, the 12 dB SINAD output level points are reused. If neither RX Sensitivity nor RX Squelch is run prior to RX RSSI alignment, then the 12 dB SINAD test parts of RX Sensitivity are performed. See the RX Sensitivity section for details on how the 12 dB SINAD output level points are generated.

The analyzer is setup by applying the appropriate Modulation signal in Table 5-29 to the radio and then adjusting radio volume for Rated Audio. The radio is placed into Test Mode at the first bandwidth and 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 plus a fixed offset. The radio RSSI level is requested from and then applied to the radio. The final results are written to the log file. This process is repeated for each bandwidth, each RX Test Frequency, and each RSSI type (Reference, Low, and High).

Name	Description
Result	Pass or Fail. Pass if 12 dB SINAD level within Max Limit
Frequency	Test Frequency
Output Level	Analyzer output level at which the radio SINAD level measures about 12 dB, plus a fixed offset for RSSI measurements
Old Softpot	Original radio softpot setting
New Softpot	Radio softpot setting after alignment

Table 5-30. RX RSSI sensitivity results

The analyzer is then setup by applying the appropriate Modulation signal in Table 5-29 to the radio. The radio is placed into Test Mode at the first bandwidth and first RX Test Frequency. The output level of the analyzer is then adjusted to the 12 dB output level achieved in the previous step in this section. The radio squelch level is requested and then written to radio. The final results are written to the log file. This process is repeated for each bandwidth, RX Test Frequency, and both squelch types (Open and Tight).

Name	Description
Result	Pass or Fail. Pass unless radio error detected.
Frequency	Test Frequency
Output Level	Analyzer output level used to generate squelch level. Same as 12dB SINAD level in previous step on this section.
Old Softpot	Original radio softpot setting
New Softpot	Radio softpot setting after alignment

Table 5-31. RX Squelch alignment results

The analyzer is then setup by applying the appropriate Modulation signal in Table 5-29 to the radio. The radio is placed into Test Mode at the first bandwidth and first RX Test Frequency. The output level of the analyzer is then adjusted to the 12 dB output level achieved in the previous step in this section. The radio squelch level is requested and compared to the current squelch level programmed into the radio. The final results are written to the log file. This process is repeated for each bandwidth, RX Test Frequency, and both squelch types (Open and Tight).

Name	Description
Result	Pass or Fail. Difference within Max Limit, Min Limit
Frequency	Test Frequency
Output Level	Analyzer output level used to generate squelch level. Same as 12dB SINAD level in previous step on this section.
Softpot	Current programmed squelch softpot value
Squelch Level	Measured radio squelch level
Min Limit	Minimum Limit (inclusive) for RX Squelch to Pass
Difference	Difference between Softpot and Squelch Level
Max Limit	Maximum Limit (inclusive) for RX Squelch to Pass

Table 5-32. RX Squelch alignment results

5.9.2. Test

No test is currently available.

6. Kenwood NX Mobile Radio Test Setup

In order to perform the test and alignment procedures, the NX 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. NX Mobile Test Setup

Refer to the diagram below for the proper test setup.

Note: Approved USB to serial adapters for connecting the R8000 analyzer to the Kenwood NX series radio under test include any adapters which utilize an FTDI FT232_USB to serial UART interface. See http://www.ftdichip.com/Products/ICs/FT232R.htm for more detail.

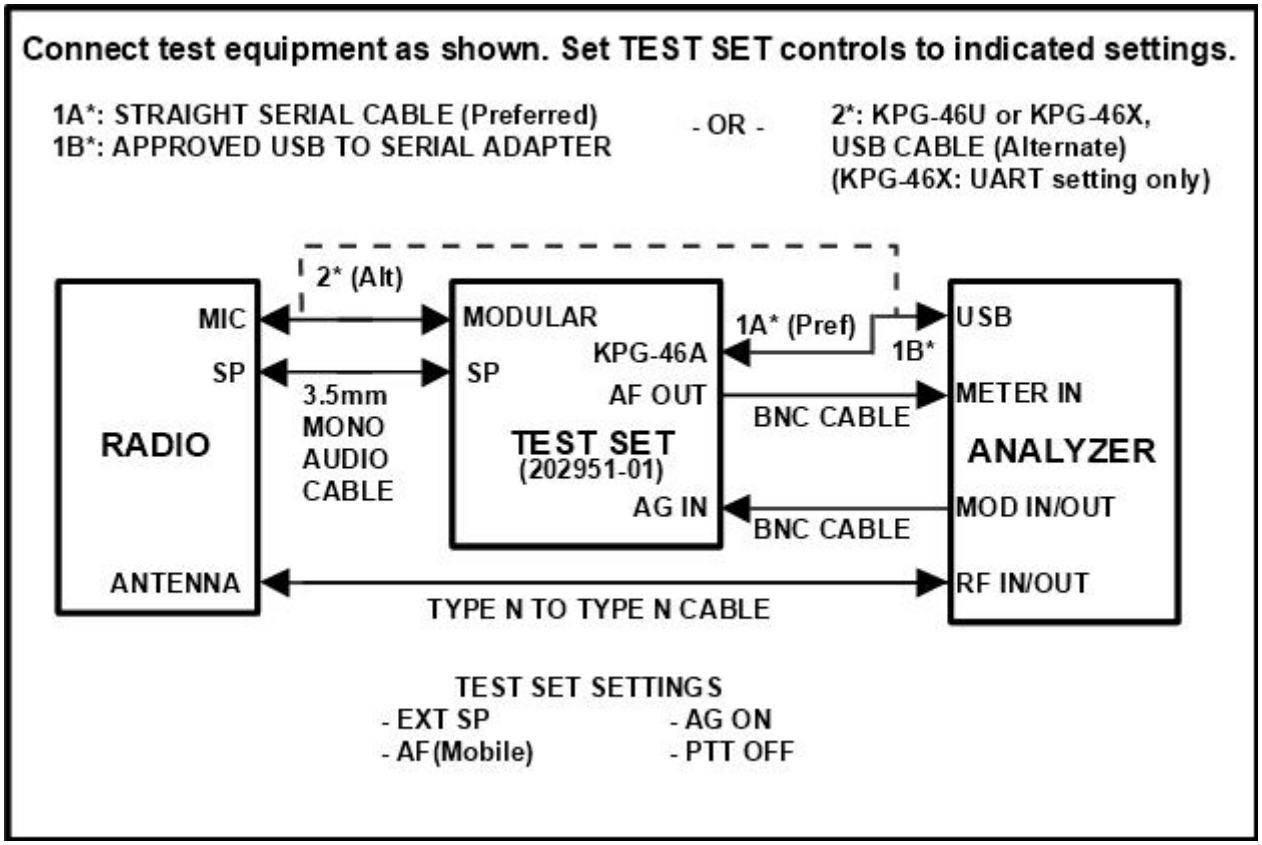

Figure 6-1. NX Mobile Test Setup Diagram with 202951-01 Test Set.

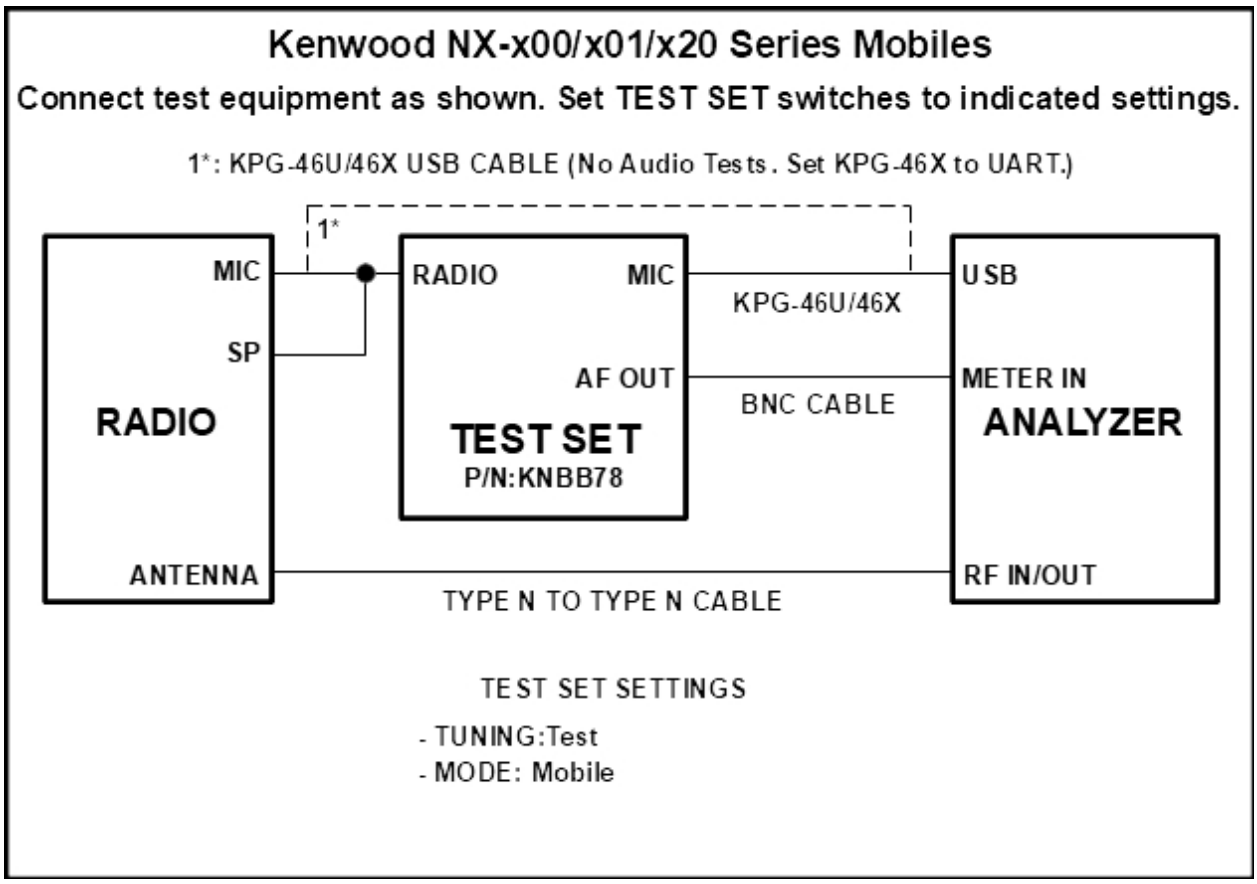

Figure 6-2. NX Mobile Test Setup Diagram with KNBB78 Test Set.

6.2. Kenwood NX Mobile USB Cables

R8000 system software version 3.1.0.0 and later supports Kenwood KPG-46U and KPG-46X USB cables for testing NX mobiles. When using a Kenwood USB cable with the 202951-01 Test Set, a 3.5mm mono audio cable is still used for routing audio signals. Unlike the NX Portable, when used with the 202951-01 Test Set a NX Mobile radio with the USB cable can still run all tests.

When using a Kenwood USB cable without a Test Set, radio audio signals cannot be routed to the Analyzer for measurement. The Kenwood USB cables do not route radio audio signals. The following tests cannot be run when using only a Kenwood USB cable (KPG-46U/46X) to connect the Radio directly to the Analyzer:

- RX Sensitivity
- RX Squelch
- RX RSSI

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

7. Kenwood NX 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.

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

7.1. Assist Voltage

7.1.1. Alignment

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.
Softpot	Radio softpot after alignment

Table 7-1. Reference Frequency alignment results

7.1.2. Test

There is no Assist Voltage test.

7.2. Frequency

RF Control	Port	Frequency	Modulation	Output Level
Generate	RF IN/OUT	Test Frequency	FM	-30 dBm

Table 7-2. Analyzer Configuration for Reference Frequency

7.2.1. Alignment

The radio is placed into Test Mode at a TX Test Frequency and commanded to transmit. Using a best linear fit algorithm, two frequency error measurements are taken at two different radio softpot values. These frequency error measurements are used to calculate the softpot value which minimizes frequency error. After programming this new softpot value into the radio, the radio softpot is fine tuned until minimum frequency error is detected. The frequency error is compared against test limits and the final results written to the log file.

Name	Description
Result	Pass or Fail. Pass as long as no radio error returned
Frequency	Test Frequency
New Softpot	Radio softpot after alignment
Temp (23 - 27° C)	Internal radio temperature, in Celsius. Ideal temperature is between 23 and 27 degrees Celsius.

Table 7-3. Reference Frequency alignment results

7.2.2. 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 final results are written to the log file.

Name	Description
Result	Pass or Fail. Frequency Error within Max Limit, Min Limit
Frequency	Test Frequency
Freq Error	Measured frequency error
Min Limit	Minimum Limit (inclusive) for frequency error
Max Limit	Maximum Limit (inclusive) for frequency error
Temp (23 - 27° C)	Internal radio temperature, in Celsius. Ideal temperature is between 23 and 27 degrees Celsius.

Table 7-4. Reference Frequency test results

7.3. TX Power

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

Table 7-5. Analyzer Configuration for TX Power

The TX Power alignment aligns both the power output level limit and power output level of the radio at both High and Low power levels.

7.3.1. TX Power Limit Alignment

The radio is placed into Test Mode and commanded to transmit at the first Test Frequency and the High Transmit Power Limit 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 NX Mobile radio service manuals.

This process is repeated for the Low Transmit Power Limit setting. The final results are written to the log file.

Name	Description
Result	Pass or Fail. Power Out within manufacturer limits
Frequency	Test Frequency
Power Out	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 7-6. TX Power Limit alignment results

7.3.2. TX Power Alignment

The radio is placed into Test Mode and commanded to transmit at the first Test Frequency and the High Transmit 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 NX Mobile radio service manuals.

This process is repeated for the Low Transmit Power setting. The final results are written to the log file.

Name	Description
Result	Pass or Fail. Power Out within manufacturer limits
Frequency	Test Frequency
Power Out	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 7-7. TX Power alignment results

7.3.3. 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 High Transmit Power and Low Transmit Power, and compared against test limits. The final results are written to the log file.

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

Table 7-8. TX Power test results

7.4. TX Modulation

The TX Modulation alignment and test includes both TX Balance alignment/test as well as TX Maximum Deviation alignment/test.

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

Table 7-9. Analyzer Configuration for TX Modulation test, alignment

7.4.1. TX Balance 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 Low modulation tone and the ±Peak/2-averaged deviation of this tone is measured with the analyzer. The radio then generates a High modulation tone and the ±Peak/2-averaged deviation of this tone is measured with the analyzer. The radio softpot is adjusted until the deviation difference between the first and second tones is within test limits. This adjustment is performed for each TX Test Frequency. The results for each TX Test Frequency are written to the log file.

The Variance is calculated as: $Variance(\%) = \left(\frac{Deviation_{LOW} - Deviation_{HIGH}}{Deviation_{LOW}} * 100 \right)$

Name	Description
Result	Pass or Fail. Calculated difference between Low and High tone deviation less than or equal to Dev Ratio.
Frequency	Test Frequency
Variance	Calculated difference, in %, between Low and High tone deviation
Max Limit	Maximum passable % difference (inclusive) between low and high tone deviation.
Old Softpot	Original radio softpot setting
New Softpot	Radio softpot setting after alignment

Table 7-10. TX Balance alignment results

7.4.2. TX Balance Test

The radio is placed into Test Mode at the first TX Test Frequency and commanded to transmit. The radio generates a Low modulation tone and the ±Peak/2-averaged deviation of this tone is measured with the analyzer. The radio then generates a High modulation tone and the ±Peak/2-averaged deviation of this tone is measured with the analyzer. The percent difference is compared against test limits and written to the log file. This test is performed for each remaining TX Test Frequency.

Name	Description
Result	Pass or Fail. Deviation is less than or equal to Max Limit.
Frequency	Test Frequency
Low Tone	Measured low tone deviation level.
High Tone	Measured high tone deviation level.
Variance	Calculated difference, in %, between Low and High tone deviation
Max Limit	Maximum passable deviation (inclusive)
Softpot	Radio softpot which yields Variance

Table 7-11. TX Balance test results

7.4.3. TX Maximum Deviation Alignment

The radio is placed into Test Mode at low power at the first bandwidth, first TX Test Frequency and commanded to transmit. The radio generates a modulation tone and the ±Peak/2-averaged deviation of this tone is measured with the analyzer. The radio softpot is adjusted until the deviation is within 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. Calculated difference between Low and High tone deviation less than or equal to Dev Ratio.
Frequency	Test Frequency
Deviation	Measured maximum deviation level
Min Limit	Minimum passable deviation level
Max Limit	Maximum passable deviation level
Old Softpot	Original radio softpot setting
New Softpot	Radio softpot setting after alignment

Table 7-12. TX Maximum Deviation alignment results

7.4.4. TX Maximum Deviation Test

The radio is placed into Test Mode at low power at the first TX Test Frequency and commanded to transmit. The radio generates a modulation tone and the ±Peak/2-averaged deviation of this tone is measured with the analyzer. This test is performed for each TX Test Frequency. The test results for each TX Test Frequency are written to the log file.

Name	Description
Result	Pass or Fail. Deviation is less than or equal to Max Limit.
Frequency	Test Frequency
Deviation	Measured maximum deviation level
Min Limit	Minimum passable deviation level
Max Limit	Maximum passable deviation level
Softpot	Radio softpot which yields Deviation

Table 7-13. TX Maximum Deviation test results

7.5. TX Signaling

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

Table 7-14. Analyzer Configuration for TX Signaling test, alignment

7.5.1. TX Signaling Alignment

The radio is placed into Test Mode at low power at the first bandwidth and first TX Test Frequency and commanded to transmit. The radio modulates the Test Frequency using the modulation types in Table 7-15 in sequence. The ±Peak/2-averaged modulation deviation is measured with the analyzer. The radio softpot is adjusted until the deviation is within test limits. This adjustment is performed for each TX Test Frequency. The results for each TX Test Frequency are written to the log file.

Modulation	Description
QT	Quiet Talk
DQT	Digital Quiet Talk
LTR	Logic Trunked Radio
DTMF	Dual-tone multi-frequency
Single Tone	Single modulation frequency
MSK	Minimum-shift keying
CWID	Continuous Wave Identification

Table 7-15. TX Signaling modulation types

Name	Description
Result	Pass or Fail. Calculated difference between Low and High tone deviation less than or equal to Dev Ratio.
Frequency	Test Frequency
Deviation	Measured modulation deviation level
Min Limit	Minimum passable deviation (inclusive)
Max Limit	Maximum passable deviation (inclusive)
Old Softpot	Original radio softpot setting
New Softpot	Radio softpot setting after alignment

Table 7-16. TX Signaling alignment results

7.5.2. TX Signaling Test

The radio is placed into Test Mode at the first bandwidth and first TX Test Frequency and commanded to transmit. The radio generates a Low modulation tone and the ±Peak/2-averaged deviation of this tone is measured with the analyzer. The radio then generates a High modulation tone and the ±Peak/2-averaged deviation of this tone is measured with the analyzer. The deviation is compared against test limits and written to the log file. This test is performed for each remaining TX Test Frequency.

Name	Description
Result	Pass or Fail. Deviation is less than or equal to Max Limit.
Frequency	Test Frequency
Deviation	Measured modulation deviation level
Min Limit	Minimum passable deviation (inclusive)
Max Limit	Maximum passable deviation (inclusive)
Softpot	Radio softpot which yields Deviation

Table 7-17. TX Signaling test results

7.6. RX Sensitivity

NOTE: This test requires an analyzer with NXDN test mode (R8-NXDN or R8-NXDNTYPC option) capability.

RF Control	Port	Frequency	Modulation	Level
Generate	RF IN/OUT	Test Freq	**Analog**: Wide(5k): 1 kHz @ 3 kHz Wide(4k): 1 kHz @ 2.4 kHz Narrow: 1 kHz @ 1.5 kHz **Digital**: FSW+PN9 test pattern	Model-specific

Table 7-18. Analyzer Configuration for RX Sensitivity test

7.6.1. Alignment

Alignment not currently available.

7.6.2. Test (Analog)

The analyzer is setup by applying the Modulation signal in Table 7-18 to the radio and then adjusting radio volume for Rated Audio. The radio is placed into Test Mode at the first bandwidth and 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 final results are written to the log file. This process is repeated for each bandwidth and each RX Test Frequency.

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

Table 7-19. RX Sensitivity (Analog) test results

7.6.3. Test (Digital)

The analyzer is setup by applying the Modulation signal in Table 7-18 to the radio. The radio is placed into Test Mode at the first bandwidth and first RX Test Frequency. The output level of the analyzer is then adjusted until the radio's BER level measures about 3%. The current analyzer output level is then compared against test limits. The final results are written to the log file. This process is repeated for each bandwidth and each RX Test Frequency.

Name	Description
Result	Pass or Fail. Sensitivity (SINAD) level within Max Limit
Frequency	Test Frequency
3% BER	Analyzer output level at which the radio Bit Error Rate (BER) level measures about 3%
Max Limit	Maximum Limit (inclusive) for Sensitivity (SINAD) to Pass

Table 7-20. RX Sensitivity (Digital) test results

7.7. RX Squelch

RF Control	Port	Frequency	Modulation	Level
Generate	RF IN/OUT	Test Freq	**Analog:** Wide(5k): 1 kHz @ 3 kHz Wide(4k): 1 kHz @ 2.4 kHz Narrow: 1 kHz @ 1.5 kHz **Digital:** Narrow: 1 kHz @ 3 kHz Very Narrow: 1 kHz @ 1.5 kHz	Model-specific

Table 7-21. Analyzer Configuration for RX Squelch test

7.7.1. Alignment

The analyzer is setup by applying the Modulation signal in Table 7-21 to the radio and then adjusting radio volume for Rated Audio. The radio is placed into Test Mode at the first bandwidth and 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 final results are written to the log file. This process is repeated for each bandwidth and each RX Test Frequency.

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

Table 7-22. RX Squelch sensitivity results

The analyzer is then setup by applying the Modulation signal in Table 7-21 to the radio. The radio is placed into Test Mode at the first bandwidth and first RX Test Frequency. The output level of the analyzer is then adjusted to the 12 dB output level achieved in the previous step in this section. The radio squelch level is requested and then written to radio. The final results are written to the log file. This process is repeated for each bandwidth, RX Test Frequency, and both squelch types (Open and Tight).

Name	Description
Result	Pass or Fail. Pass unless radio error detected.
Frequency	Test Frequency
Output Level	Analyzer output level used to generate squelch level. Same as 12dB SINAD level in previous step on this section.
Old Softpot	Original radio softpot setting
New Softpot	Radio softpot setting after alignment

Table 7-23. RX Squelch alignment results

The analyzer is then setup by applying the Modulation signal in Table 7-21 to the radio. The radio is placed into Test Mode at the first bandwidth and first RX Test Frequency. The output level of the analyzer is then adjusted to the 12 dB output level achieved in the previous step in this section. The radio squelch level is requested and compared to the current squelch level programmed into the radio. The final results are written to the log file. This process is repeated for each bandwidth, RX Test Frequency, and both squelch types (Open and Tight).

Name	Description
Result	Pass or Fail. Difference within Max Limit, Min Limit
Frequency	Test Frequency
Output Level	Analyzer output level used to generate squelch level. Same as 12dB SINAD level in previous step on this section.
Softpot	Current programmed squelch softpot value
Squelch Level	Measured radio squelch level
Min Limit	Minimum Limit (inclusive) for RX Squelch to Pass
Difference	Difference between Softpot and Squelch Level
Max Limit	Maximum Limit (inclusive) for RX Squelch to Pass

Table 7-24. RX Squelch alignment results

7.7.2. Test

The analyzer is setup by applying the Modulation signal in Table 7-21 to the radio and then adjusting radio volume for Rated Audio. The radio is placed into Test Mode at the first bandwidth and 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 final results are written to the log file. This process is repeated for each bandwidth and each RX Test Frequency.

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

Table 7-25. RX Squelch sensitivity test results

The analyzer is then setup by applying the Modulation signal in Table 5-23 to the radio. The radio is placed into Test Mode at the first bandwidth and first RX Test Frequency. The output level of the analyzer is then adjusted to the 12 dB output level achieved in the previous step in this section. The radio squelch level is requested and compared to the current squelch level programmed into the radio. The final results are written to the log file. This process is repeated for each bandwidth, RX Test Frequency, and both squelch types (Open and Tight).

Name	Description
Result	Pass or Fail. Difference within Max Limit, Min Limit
Frequency	Test Frequency
Output Level	Analyzer output level used to generate squelch level. Same as 12dB SINAD level in previous step on this section.
Softpot	Current programmed squelch softpot value
Squelch Level	Measured radio squelch level
Min Limit	Minimum Limit (inclusive) for RX Squelch to Pass
Difference	Difference between Softpot and Squelch Level
Max Limit	Maximum Limit (inclusive) for RX Squelch to Pass

Table 7-26. RX Squelch test results

7.8. RX RSSI

RF Control	Port	Frequency	Modulation	Level
Generate	RF IN/OUT	Test Freq	**Analog**: Wide(5k): 1 kHz @ 3 kHz Wide(4k): 1 kHz @ 2.4 kHz Narrow: 1 kHz @ 1.5 kHz **Digital**: Narrow: 1 kHz @ 3 kHz Very Narrow: 1 kHz @ 1.1 kHz	Model-specific

Table 7-27. Analyzer Configuration for RX RSSI test

7.8.1. Alignment

Note: This alignment depends upon the 12 dB SINAD output levels discovered in either the RX Sensitivity or RX Squelch sections. If either of these two items are run prior to RX RSSI alignment, the 12 dB SINAD output level points are reused. If neither RX Sensitivity nor RX Squelch is run prior to RX RSSI alignment, then the 12 dB SINAD test parts of RX Sensitivity are performed. See the RX Sensitivity section for details on how the 12 dB SINAD output level points are generated.

The analyzer is setup by applying the appropriate Modulation signal in Table 7-27 to the radio and then adjusting radio volume for Rated Audio. The radio is placed into Test Mode at the first bandwidth and 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 plus a fixed offset. The radio RSSI level is requested from and then applied to the radio. The final results are written to the log file. This process is repeated for each bandwidth, each RX Test Frequency, and each RSSI type (Reference, Low, and High).

Name	Description
Result	Pass or Fail. Pass if 12 dB SINAD level within Max Limit
Frequency	Test Frequency
Output Level	Analyzer output level at which the radio SINAD level measures about 12 dB, plus a fixed offset for RSSI measurements
Old Softpot	Original radio softpot setting
New Softpot	Radio softpot setting after alignment

Table 7-28. RX RSSI sensitivity results

The analyzer is then setup by applying the appropriate Modulation signal in Table 7-27 to the radio. The radio is placed into Test Mode at the first bandwidth and first RX Test Frequency. The output level of the analyzer is then adjusted to the 12 dB output level achieved in the previous step in this section. The radio squelch level is requested and then written to radio. The final results are written to the log file. This process is repeated for each bandwidth, RX Test Frequency, and both squelch types (Open and Tight).

Name	Description
Result	Pass or Fail. Pass unless radio error detected.
Frequency	Test Frequency
Output Level	Analyzer output level used to generate squelch level. Same as 12dB SINAD level in previous step on this section.
Old Softpot	Original radio softpot setting
New Softpot	Radio softpot setting after alignment

Table 7-29. RX RSSI alignment results

The analyzer is then setup by applying the appropriate Modulation signal in Table 7-27 to the radio. The radio is placed into Test Mode at the first bandwidth and first RX Test Frequency. The output level of the analyzer is then adjusted to the 12 dB output level achieved in the previous step in this section. The radio squelch level is requested and compared to the current squelch level programmed into the radio. The final results are written to the log file. This process is repeated for each bandwidth, RX Test Frequency, and both squelch types (Open and Tight).

Name	Description
Result	Pass or Fail. Difference within Max Limit, Min Limit
Frequency	Test Frequency
Output Level	Analyzer output level used to generate squelch level. Same as 12dB SINAD level in previous step on this section.
Softpot	Current programmed squelch softpot value
Squelch Level	Measured radio squelch level
Min Limit	Minimum Limit (inclusive) for RX Squelch to Pass
Difference	Difference between Softpot and Squelch Level
Max Limit	Maximum Limit (inclusive) for RX Squelch to Pass

Table 7-30. RX RSSI alignment results

7.8.2. Test

7.9. No test is currently available.

Basic Troubleshooting

Symptom	Possible Cause	Possible Solution
Analyzer consistently fails to communicate with radio	• Incorrect KPG-144AT port connection	• Verify programming cable is connected to the correct KPG-144AT test set serial connector. See the respective radio test setup sections for more information.
RX Sensitivity test consistently fails one or more points.	• Sensitivity needs alignment	• Using the KPG-111D software, perform a manual Sensitivity alignment.

Table 7-31. Kenwood NX Series Troubleshooting Chart

8. Support Information

8.1. Technical Support

Telephone/Fax: 844.903.7333
Email: service@freedomcte.com
Web: http://freedomcte.com/support/

8.2. Sales

Telephone/Fax: 844.903.7333
Email: sales@freedomcte.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. However, if extenuating circumstances cause a need to modify the limits this is accommodated by AutoTune. Refer to the R8000 Series Communications System Analyzer Owner's Manual (FCT-1365) for modification instructions.

The following tables list the default test limits for each Kenwood NX Series radio model supported by AutoTune.

Section	Test Name	Limit	Default Value
5.1	Frequency	Frequency	Min= -1 ppm Max= 1 ppm
5.3	TX Power High	TX Power High NX-200	Min = 4.8 W Max = 5.2 W
		TX Power High NX-200S	Min = 4.8 W Max = 5.2 W
		TX Power High NX-210	Min = 4.8 W Max = 5.2 W
		TX Power High NX-300	Min = 4.8 W Max = 5.2 W
		TX Power High NX-300S	Min = 4.8 W Max = 5.2 W
		TX Power High NX-410	Min = 2.8 W Max = 3.2 W
		TX Power High NX-411	Min= 2.3 W Max= 2.7 W
5.3	TX Power Low	TX Power High NX-200	Min= 0.7 W Max= 0.9 W
		TX Power High NX-200S	Min= 0.7 W Max= 0.9 W
		TX Power High NX-210	Min= 0.7 W Max= 0.9 W
		TX Power High NX-300	Min= 0.7 W Max= 0.9 W
		TX Power High NX-300S	Min= 0.7 W Max= 0.9 W
		TX Power High NX-410	Min= 0.9 W Max= 1.1 W
		TX Power High NX-411	Min= 0.9 W Max= 1.1 W
5.4	TX Modulation	TX Modulation Balance	Min = -1.0% Max = 1.0%
5.4	TX Modulation	TX Maximum Deviation (Wide5k)	Min=3200 Hz Max=5000 Hz
		TX Maximum Deviation (Wide5k) NX-410	Min=3500 Hz Max=5000 Hz
		TX Maximum Deviation (Wide4k)	Min=2500 Hz Max=4000 Hz
		TX Maximum Deviation (Narrow)	Min=1600 Hz Max=2500 Hz
		TX Maximum Deviation (Narrow) NX-410	Min=1700 Hz Max=2500 Hz
		TX Maximum Deviation (Narrow) NX-411	Min=1700 Hz Max=2500 Hz
		TX Maximum Deviation (NXDN Narrow)	Min=2750 Hz Max=3362 Hz
		TX Maximum Deviation (NXDN Very Narrow)	Min=1203 Hz Max=1471 Hz
5.5	TX Signaling	QT Deviation (Wide5k)	Min=500 Hz Max=1000 Hz
		QT Deviation (Wide4k)	Min=400 Hz Max=800 Hz
		QT Deviation (Narrow)	Min=250 Hz

			Max=450 Hz
		DQT Deviation (Wide5k)	Min=500 Hz Max=1000 Hz
		DQT Deviation (Wide4k)	Min=400 Hz Max=800 Hz
		DQT Deviation (Narrow)	Min=250 Hz Max=450 Hz
		LTR Deviation (Wide5k)	Min=750 Hz Max=1250 Hz
		LTR Deviation (Wide4k)	Min=670 Hz Max=1130 Hz
		LTR Deviation (Narrow)	Min=500 Hz Max=1000 Hz
		DTMF Deviation (Wide5k)	Min=2000 Hz Max=3000 Hz
		DTMF Deviation (Wide4k)	Min=1600 Hz Max=2400 Hz
		DTMF Deviation (Wide4k) NX-410	Min=1600 Hz Max=2500 Hz
		DTMF Deviation (Narrow)	Min=950 Hz Max=1600 Hz
		Single Tone Deviation (Wide5k)	Min=2500 Hz Max=3500 Hz
		Single Tone Deviation (Wide4k)	Min=1900 Hz Max=2900 Hz
		Single Tone Deviation (Narrow)	Min=1000 Hz Max=2000 Hz
		MSK Deviation (Wide5k)	Min=2500 Hz Max=3500 Hz
		MSK Deviation (Wide4k)	Min=1900 Hz Max=2900 Hz
		MSK Deviation (Narrow)	Min=1000 Hz Max=2000 Hz
		CWID Deviation (NXDN Very Narrow)	Min=750 Hz Max=1250 Hz
5.6	TX VOX	VOX1	Max=45 mVrms
		VOX10	Max=3 mVrms
5.7	RX Sensitivity(Analog)	Sensitivity (Wide5k) NX-200 K	Max=-117 dBm
		Sensitivity (Wide5k) NX-200 K2	Max=-117 dBm
		Sensitivity (Wide5k) NX-210 K2	Max=-117 dBm
		Sensitivity (Wide5k) NX-200 E	Max=-116 dBm
		Sensitivity (Wide5k) NX-200 E3	Max=-116 dBm
		Sensitivity (Wide5k) NX-200 C	Max=-116 dBm
		Sensitivity (Wide5k) NX-200S	Max=-116 dBm
		Sensitivity (Wide5k) NX-300 K	Max=-117 dBm
		Sensitivity (Wide5k) NX-300 K2	Max=-117 dBm
		Sensitivity (Wide5k) NX-300 K3	Max=-117 dBm
		Sensitivity (Wide5k) NX-300 K4	Max=-117 dBm
		Sensitivity (Wide5k) NX-300 K5	Max=-117 dBm
		Sensitivity (Wide5k) NX-300 K6	Max=-117 dBm
		Sensitivity (Wide5k) NX-300 E	Max=-116 dBm
		Sensitivity (Wide5k) NX-300S	Max=-116 dBm
		Sensitivity (Wide5k) NX-300 C	Max=-116 dBm

		Sensitivity (Wide5k) NX-410 K2	Max=-117 dBm
		Sensitivity (Wide4k) NX-200 E	Max=-116 dBm
		Sensitivity (Wide4k) NX-200 E3	Max=-116 dBm
		Sensitivity (Wide4k) NX-200S	Max=-116 dBm
		Sensitivity (Wide4k) NX-300 E	Max=-116 dBm
		Sensitivity (Wide4k) NX-300 E4	Max=-116 dBm
		Sensitivity (Wide4k) NX-300S	Max=-116 dBm
		Sensitivity (Wide4k) NX-410 K2	Max=-117 dBm
		Sensitivity (Narrow) NX-200 K	Max=-117 dBm
		Sensitivity (Narrow) NX-200 K2	Max=-117 dBm
		Sensitivity (Narrow) NX-210 K2	Max=-117 dBm
		Sensitivity (Narrow) NX-200 E	Max=-116 dBm
		Sensitivity (Narrow) NX-200 E3	Max=-116 dBm
		Sensitivity (Narrow) NX-200 C	Max=-116 dBm
		Sensitivity (Narrow) NX-200S	Max=-116 dBm
		Sensitivity (Narrow) NX-300 K	Max=-117 dBm
		Sensitivity (Narrow) NX-300 K2	Max=-117 dBm
		Sensitivity (Narrow) NX-300 K3	Max=-117 dBm
		Sensitivity (Narrow) NX-300 K4	Max=-117 dBm
		Sensitivity (Narrow) NX-300 K5	Max=-117 dBm
		Sensitivity (Narrow) NX-300 K6	Max=-117 dBm
		Sensitivity (Narrow) NX-300 E	Max=-116 dBm
		Sensitivity (Narrow) NX-300 E4	Max=-116 dBm
		Sensitivity (Narrow) NX-300S	Max=-116 dBm
		Sensitivity (Narrow) NX-300 C	Max=-116 dBm
		Sensitivity (Narrow) NX-410 K2	Max=-117 dBm
		Sensitivity (Narrow) NX-411 K2	Max=-117 dBm
	RX Sensitivity(Digital)	Sensitivity (NXDN Narrow) NX-200 K	Max=-117 dBm
		Sensitivity (NXDN Narrow) NX-200 K2	Max=-117 dBm
		Sensitivity (NXDN Narrow) NX-210 K2	Max=-117 dBm
		Sensitivity (NXDN Narrow) NX-200 E	Max=-112 dBm
		Sensitivity (NXDN Narrow) NX-200 E3	Max=-112 dBm
		Sensitivity (NXDN Narrow) NX-200 C	Max=-112 dBm
		Sensitivity (NXDN Narrow) NX-200S	Max=-112 dBm
		Sensitivity (NXDN Narrow) NX-300 K	Max=-117 dBm
		Sensitivity (NXDN Narrow) NX-300 K2	Max=-117 dBm
		Sensitivity (NXDN Narrow) NX-300 K3	Max=-117 dBm
		Sensitivity (NXDN Narrow) NX-300 K4	Max=-117 dBm
		Sensitivity (NXDN Narrow) NX-300 K5	Max=-117 dBm
		Sensitivity (NXDN Narrow) NX-300 K6	Max=-117 dBm
		Sensitivity (NXDN Narrow) NX-300 E	Max=-112 dBm
		Sensitivity (NXDN Narrow) NX-300 E4	Max=-112 dBm
		Sensitivity (NXDN Narrow) NX-300S	Max=-112 dBm
		Sensitivity (NXDN Narrow) NX-300 C	Max=-112 dBm
		Sensitivity (NXDN Narrow) NX-410 K2	Max=-117 dBm
		Sensitivity (NXDN Narrow) NX-411 K2	Max=-117 dBm
		Sensitivity (NXDN Very Narrow) NX-200 K	Max=-119 dBm
		Sensitivity (NXDN Very Narrow) NX-200 K2	Max=-119 dBm
		Sensitivity (NXDN Very Narrow) NX-210 K2	Max=-119 dBm
		Sensitivity (NXDN Very Narrow) NX-	Max=-116 dBm

		200 E	
		Sensitivity (NXDN Very Narrow) NX-200 E3	Max=-116 dBm
		Sensitivity (NXDN Very Narrow) NX-200 C	Max=-116 dBm
		Sensitivity (NXDN Very Narrow) NX-200S	Max=-116 dBm
		Sensitivity (NXDN Very Narrow) NX-300 K	Max=-119 dBm
		Sensitivity (NXDN Very Narrow) NX-300 K2	Max=-119 dBm
		Sensitivity (NXDN Very Narrow) NX-300 K3	Max=-119 dBm
		Sensitivity (NXDN Very Narrow) NX-300 K4	Max=-119 dBm
		Sensitivity (NXDN Very Narrow) NX-300 K5	Max=-119 dBm
		Sensitivity (NXDN Very Narrow) NX-300 K6	Max=-119 dBm
		Sensitivity (NXDN Very Narrow) NX-300 E	Max=-116 dBm
		Sensitivity (NXDN Very Narrow) NX-300 E4	Max=-116 dBm
		Sensitivity (NXDN Very Narrow) NX-300S	Max=-116 dBm
		Sensitivity (NXDN Very Narrow) NX-300 C	Max=-116 dBm
		Sensitivity (NXDN Very Narrow) NX-410 K2	Max=-119 dBm
		Sensitivity (NXDN Very Narrow) NX-411 K2	Max=-119 dBm
5.8	RX Squelch	Squelch Open	Min=-15 Max=15
		Squelch Tight	Min=-15 Max=15

Table A-1. Default Kenwood NX Portable Limits

Section	Test Name	Limit	Default Value
7.2	Frequency	Frequency	Min= -1 ppm Max= 1 ppm
7.3	TX Power Limit High	TX Power Limit High NX-700 C	Min=25.0 W Max=31.0 W
		TX Power Limit High NX-700 E	Min=25.0 W Max=31.0 W
		TX Power Limit High NX-700 K	Min=30.0 W Max=36.0 W
		TX Power Limit High NX-700H K	Min=50.0 W Max=56.0 W
		TX Power Limit High NX-800 E	Min=25.0 W Max=31.0 W
		TX Power Limit High NX-800 K Low	Min=30.0 W Max=36.0 W
		TX Power Limit High NX-800 K High'	Min=25.0 W Max=31.0 W
		TX Power Limit High NX-800 K2	Min=30.0 W Max=36.0 W
		TX Power Limit High NX-800H K Low	Min=45.0 W Max=51.0 W
		TX Power Limit High NX-800H K High'	Min=40.0 W Max=46.0 W
		TX Power Limit High NX-800H K High	Min=35.0 W Max=41.0 W
		TX Power Limit High NX-800H K2	Min=45.0 W Max=51.0 W
		TX Power Limit High NX-800H K3	Min=45.0 W Max=51.0 W
		TX Power Limit High NX-900	Min=17.0 W Max=18.0 W
		TX Power Limit High NX-901	Min=16.0 W Max=17.0 W
	TX Power Limit Low	TX Power Limit Low NX-700 C	Min=9.0 W Max=11.0 W
		TX Power Limit Low NX-700 E	Min=9.0 W Max=11.0 W
		TX Power Limit Low NX-700 K	Min=14.0 W Max=16.0 W
		TX Power Limit Low NX-700H K	Min=24.0 W Max=26.0 W
		TX Power Limit Low NX-800 E	Min=9.0 W Max=11.0 W
		TX Power Limit Low NX-800 K	Min=14.0 W Max=16.0 W
		TX Power Limit Low NX-800 K2	Min=14.0 W Max=16.0 W
		TX Power Limit Low NX-800H K	Min=24.0 W Max=26.0 W
		TX Power Limit Low NX-800H K2	Min=24.0 W Max=26.0 W
		TX Power Limit Low NX-800H K3	Min=24.0 W Max=26.0 W
		TX Power Limit Low NX-900	Min=7.0 W

			Max=8.0 W
		TX Power Limit Low NX-901	Min=7.0 W Max=8.0 W
	TX Power High	TX Power High NX-700 C	Min=24.0 W Max=26.0 W
		TX Power High NX-700 E	Min=24.0 W Max=26.0 W
		TX Power High NX-700 K	Min=29.0 W Max=31.0 W
		TX Power High NX-700H K	Min=49.0 W Max=51.0 W
		TX Power High NX-800 E	Min=24.0 W Max=26.0 W
		TX Power High NX-800 K Low	Min=29.0 W Max=31.0 W
		TX Power High NX-800 K High'	Min=24.0 W Max=26.0 W
		TX Power High NX-800 K2	Min=29.0 W Max=31.0 W
		TX Power High NX-800H K Low	Min=44.0 W Max=46.0 W
		TX Power High NX-800H K High'	Min=39.0 W Max=41.0 W
		TX Power High NX-800H K High	Min=34.0 W Max=36.0 W
		TX Power High NX-800H K2	Min=44.0 W Max=46.0 W
		TX Power High NX-800H K3	Min=44.0 W Max=46.0 W
		TX Power High NX-900	Min=14.0 W Max=16.0 W
		TX Power High NX-901	Min=14.0 W Max=16.0 W
	TX Power Low	TX Power Low NX-700 C	Min=4.5 W Max=5.5 W
		TX Power Low NX-700 E	Min=4.5 W Max=5.5 W
		TX Power Low NX-700 K	Min=4.5 W Max=5.5 W
		TX Power Low NX-700H K	Min=9.0 W Max=11.0 W
		TX Power Low NX-800 E	Min=4.5 W Max=5.5 W
		TX Power Low NX-800 K	Min=4.5 W Max=5.5 W
		TX Power Low NX-800 K2	Min=4.5 W Max=5.5 W
		TX Power Low NX-800H K	Min=9.0 W Max=11.0 W
		TX Power Low NX-800H K2	Min=9.0 W Max=11.0 W
		TX Power Low NX-800H K3	Min=9.0 W Max=11.0 W
		TX Power Low NX-900	Min=4.0 W

			Max=6.0 W
		TX Power Low NX-901	Min=4.0 W Max=6.0 W
7.4	TX Modulation Balance	TX Modulation Balance	Min = -1.0% Max = 1.0%
7.4	TX Maximum Deviation	TX Maximum Deviation (Wide5k)	Min=3900 Hz Max=4500 Hz
		TX Maximum Deviation (Wide4k) NX-700	Min=3120 Hz Max=3600 Hz
		TX Maximum Deviation (Wide4k) NX-800	Min=3120 Hz Max=3600 Hz
		TX Maximum Deviation (Wide4k) NX-900	Min=2500 Hz Max=4000 Hz
		TX Maximum Deviation (Narrow)	Min=1950 Hz Max=2250 Hz
		TX Maximum Deviation (NXDN Narrow)	Min=2750 Hz Max=3362 Hz
		TX Maximum Deviation (NXDN Narrow) NX-900	Min=2750 Hz Max=3200 Hz
		TX Maximum Deviation (NXDN Narrow) NX-901	Min=2750 Hz Max=3200 Hz
		TX Maximum Deviation (NXDN Very Narrow)	Min=1203 Hz Max=1471 Hz
7.5	TX Signaling	QT Deviation (Wide5k)	Min=500 Hz Max=1000 Hz
		QT Deviation (Wide4k)	Min=400 Hz Max=800 Hz
		QT Deviation (Narrow)	Min=250 Hz Max=450 Hz
		DQT Deviation (Wide5k)	Min=500 Hz Max=1000 Hz
		DQT Deviation (Wide4k)	Min=400 Hz Max=800 Hz
		DQT Deviation (Narrow)	Min=250 Hz Max=450 Hz
		LTR Deviation (Wide5k)	Min=750 Hz Max=1250 Hz
		LTR Deviation (Wide4k)	Min=670 Hz Max=1130 Hz
		LTR Deviation (Narrow)	Min=500 Hz Max=1000 Hz
		DTMF Deviation (Wide5k)	Min=2500 Hz Max=3500 Hz
		DTMF Deviation (Wide4k)	Min=1900 Hz Max=2900 Hz
		DTMF Deviation (Narrow)	Min=1000 Hz Max=2000 Hz
		Single Tone Deviation (Wide5k)	Min=2500 Hz Max=3500 Hz
		Single Tone Deviation (Wide4k)	Min=1900 Hz Max=2900 Hz
		Single Tone Deviation (Narrow)	Min=1000 Hz Max=2000 Hz
		MSK Deviation (Wide5k)	Min=2500 Hz

			Max=3500 Hz
		MSK Deviation (Wide4k)	Min=1900 Hz Max=2900 Hz
		MSK Deviation (Narrow)	Min=1000 Hz Max=2000 Hz
		CWID Deviation (NXDN Very Narrow)	Min=750 Hz Max=1250 Hz
7.6	RX Sensitivity(Analog)	All bandwidths	Max=-117 dBm
	RX Sensitivity(Digital)	Sensitivity (NXDN Narrow)	Max=-115 dBm
		Sensitivity (NXDN Very Narrow)	Max=-119 dBm
7.7	RX Squelch	Squelch Open	Min=-15 Max=15
		Squelch Tight	Min=-15 Max=15

Table A-2. Default Kenwood NX Mobile Limits

APPENDIX B. Sample Test Result Report

```
================================================================================
                                Test Result Report
================================================================================
Model #:  NX-410:K2                     Date/Time:     8/11/2016 10:14 PM
Serial #: B1200043                      Operator ID:   1

Comments:

Rx Assist Voltage ( Low ) - 851.100 MHz
=======================================
Result    Softpot
------    -------
Pass      1556

Rx Assist Voltage ( High ) - 869.900 MHz
========================================
Result    Softpot
------    -------
Pass      2468

Tx Assist Voltage ( Low ) - 806.000 MHz
=======================================
Result    Softpot
------    -------
Pass      2172

Tx Assist Voltage ( High ) - 825.000 MHz
========================================
Result    Softpot
------    -------
Pass      3044

Tx Assist Voltage ( Low for TA mode ) - 851.000 MHz
===================================================
Result    Softpot
------    -------
Pass      2189

Tx Assist Voltage ( High for TA mode ) - 870.000 MHz
====================================================
Result    Softpot
------    -------
Pass      2840

Frequency Align
===============
Result    Frequency      New Softpot    Temp (23 - 27° C)
------    ---------      -----------    -----------------
Pass      851.050 MHz    2178           25.8 C

Frequency Test
==============
Result    Frequency      Freq Error     Min Limit      Max Limit      Temp (23 - 27° C)
------    ---------      ----------     ---------      ---------      -----------------
Pass      851.050 MHz    0.06 ppm       -1.00 ppm      1.00 ppm       25.8 C

High Transmit Power Align
=========================
Result    Frequency      Power Out      Min Limit      Max Limit      Old Softpot    New Softpot
------    ---------      ---------      ---------      ---------      -----------    -----------
Pass      806.000 MHz    2.8 W          2.8 W          3.2 W          373            413
Pass      825.000 MHz    3.1 W          2.8 W          3.2 W          376            416
Pass      851.000 MHz    3.1 W          2.8 W          3.2 W          420            400
Pass      870.000 MHz    2.9 W          2.8 W          3.2 W          427            387

Low Transmit Power Align
========================
Result    Frequency      Power Out      Min Limit      Max Limit      Old Softpot    New Softpot
------    ---------      ---------      ---------      ---------      -----------    -----------
Pass      806.000 MHz    1.0 W          0.9 W          1.1 W          254            274
Pass      825.000 MHz    1.0 W          0.9 W          1.1 W          246            266
Pass      851.000 MHz    1.0 W          0.9 W          1.1 W          276            256
Pass      870.000 MHz    1.0 W          0.9 W          1.1 W          282            252

Tx Balance Align
================
Result    Frequency      Variance       Max Limit      Old Softpot    New Softpot
------    ---------      --------       ---------      -----------    -----------
Pass      806.0000 MHz    -0.7 %        +/-1.0 %       60             60
Pass      825.0000 MHz     0.4 %        +/-1.0 %       61             61
Pass      851.0000 MHz     0.4 %        +/-1.0 %       67             67
Pass      870.0000 MHz     0.2 %        +/-1.0 %       69             69

TX Maximum Deviation Align Analog Wide 5k
=========================================
Result    Frequency      Deviation      Min Limit      Max Limit      Old Softpot    New Softpot
------    ---------      ---------      ---------      ---------      -----------    -----------
Pass      806.000 MHz    3992 Hz        3200 Hz        5000 Hz        482            482
Pass      825.000 MHz    4073 Hz        3200 Hz        5000 Hz        498            498
Pass      851.000 MHz    4098 Hz        3200 Hz        5000 Hz        498            498
Pass      870.000 MHz    4113 Hz        3200 Hz        5000 Hz        498            498

TX Maximum Deviation Align Analog Wide 4k
=========================================
Result    Frequency      Deviation      Min Limit      Max Limit      Old Softpot    New Softpot
------    ---------      ---------      ---------      ---------      -----------    -----------
Pass      806.000 MHz    3191 Hz        2500 Hz        4000 Hz        482            482
Pass      825.000 MHz    3064 Hz        2500 Hz        4000 Hz        466            466
Pass      851.000 MHz    3072 Hz        2500 Hz        4000 Hz        466            466
Pass      870.000 MHz    3088 Hz        2500 Hz        4000 Hz        466            466

TX Maximum Deviation Align Analog Narrow
========================================
```

Result	Frequency	Deviation	Min Limit	Max Limit	Old Softpot	New Softpot
Pass	806.000 MHz	1977 Hz	1700 Hz	2500 Hz	482	482
Pass	825.000 MHz	2010 Hz	1700 Hz	2500 Hz	498	498
Pass	851.000 MHz	2030 Hz	1700 Hz	2500 Hz	498	498
Pass	870.000 MHz	2038 Hz	1700 Hz	2500 Hz	498	498

TX Maximum Deviation Align NXDN Narrow

Result	Frequency	Deviation	Min Limit	Max Limit	Old Softpot	New Softpot
Pass	806.000 MHz	2964 Hz	2750 Hz	3362 Hz	501	501
Pass	825.000 MHz	2928 Hz	2750 Hz	3362 Hz	501	501
Pass	851.000 MHz	2935 Hz	2750 Hz	3362 Hz	501	501
Pass	870.000 MHz	2945 Hz	2750 Hz	3362 Hz	501	501

TX Maximum Deviation Align NXDN Very Narrow

Result	Frequency	Deviation	Min Limit	Max Limit	Old Softpot	New Softpot
Pass	806.000 MHz	1291 Hz	1203 Hz	1471 Hz	501	501
Pass	825.000 MHz	1275 Hz	1203 Hz	1471 Hz	501	501
Pass	851.000 MHz	1286 Hz	1203 Hz	1471 Hz	501	501
Pass	870.000 MHz	1289 Hz	1203 Hz	1471 Hz	501	501

QT Deviation (Wide5k) Align

Result	Frequency	Deviation	Min Limit	Max Limit	Old Softpot	New Softpot
Pass	825.000 MHz	760 Hz	500 Hz	1000 Hz	539	539
Pass	870.000 MHz	782 Hz	500 Hz	1000 Hz	539	539

QT Deviation (Wide4k) Align

Result	Frequency	Deviation	Min Limit	Max Limit	Old Softpot	New Softpot
Pass	825.000 MHz	568 Hz	400 Hz	800 Hz	533	533
Pass	870.000 MHz	579 Hz	400 Hz	800 Hz	533	533

QT Deviation (Narrow) Align

Result	Frequency	Deviation	Min Limit	Max Limit	Old Softpot	New Softpot
Pass	825.000 MHz	346 Hz	250 Hz	450 Hz	520	520
Pass	870.000 MHz	340 Hz	250 Hz	450 Hz	500	500

DQT Deviation (Wide5k) Align

Result	Frequency	Deviation	Min Limit	Max Limit	Old Softpot	New Softpot
Pass	825.000 MHz	673 Hz	500 Hz	1000 Hz	415	415
Pass	870.000 MHz	679 Hz	500 Hz	1000 Hz	415	415

DQT Deviation (Wide4k) Align

Result	Frequency	Deviation	Min Limit	Max Limit	Old Softpot	New Softpot
Pass	825.000 MHz	540 Hz	400 Hz	800 Hz	447	447
Pass	870.000 MHz	546 Hz	400 Hz	800 Hz	447	447

DQT Deviation (Narrow) Align

Result	Frequency	Deviation	Min Limit	Max Limit	Old Softpot	New Softpot
Pass	825.000 MHz	306 Hz	250 Hz	450 Hz	415	415
Pass	870.000 MHz	313 Hz	250 Hz	450 Hz	415	415

LTR Deviation (Wide5k) Align

Result	Frequency	Deviation	Min Limit	Max Limit	Old Softpot	New Softpot
Pass	825.000 MHz	926 Hz	750 Hz	1250 Hz	465	465
Pass	870.000 MHz	939 Hz	750 Hz	1250 Hz	465	465

LTR Deviation (Wide4k) Align

Result	Frequency	Deviation	Min Limit	Max Limit	Old Softpot	New Softpot
Pass	825.000 MHz	922 Hz	670 Hz	1130 Hz	620	620
Pass	870.000 MHz	897 Hz	670 Hz	1130 Hz	594	594

LTR Deviation (Narrow) Align

Result	Frequency	Deviation	Min Limit	Max Limit	Old Softpot	New Softpot
Pass	825.000 MHz	691 Hz	500 Hz	1000 Hz	465	465
Pass	870.000 MHz	695 Hz	500 Hz	1000 Hz	465	465

DTMF Deviation (Wide5k) Align

Result	Frequency	Deviation	Min Limit	Max Limit	Old Softpot	New Softpot
Pass	825.000 MHz	2276 Hz	2000 Hz	3000 Hz	508	508
Pass	870.000 MHz	2272 Hz	2000 Hz	3000 Hz	508	508

DTMF Deviation (Wide4k) Align

Result	Frequency	Deviation	Min Limit	Max Limit	Old Softpot	New Softpot
Pass	825.000 MHz	1924 Hz	1600 Hz	2500 Hz	572	572
Pass	870.000 MHz	1919 Hz	1600 Hz	2500 Hz	572	572

DTMF Deviation (Narrow) Align

Result	Frequency	Deviation	Min Limit	Max Limit	Old Softpot	New Softpot
Pass	825.000 MHz	1195 Hz	950 Hz	1600 Hz	540	540
Pass	870.000 MHz	1193 Hz	950 Hz	1600 Hz	540	540

MSK Deviation (Wide5k) Align

Result	Frequency	Deviation	Min Limit	Max Limit	Old Softpot	New Softpot
Pass	825.000 MHz	2956 Hz	2500 Hz	3500 Hz	513	513
Pass	870.000 MHz	2766 Hz	2500 Hz	3500 Hz	481	481

MSK Deviation (Wide4k) Align

Result	Frequency	Deviation	Min Limit	Max Limit	Old Softpot	New Softpot
Pass	825.000 MHz	2218 Hz	1900 Hz	2900 Hz	513	513
Pass	870.000 MHz	2206 Hz	1900 Hz	2900 Hz	513	513

MSK Deviation (Narrow) Align

Result	Frequency	Deviation	Min Limit	Max Limit	Old Softpot	New Softpot
Pass	825.000 MHz	1447 Hz	1000 Hz	2000 Hz	513	513
Pass	870.000 MHz	1442 Hz	1000 Hz	2000 Hz	513	513

CWID Deviation (NXDN Very Narrow) Align

Result	Frequency	Deviation	Min Limit	Max Limit	Old Softpot	New Softpot
Pass	806.050 MHz	1017 Hz	750 Hz	1250 Hz	376	376

TX VOX

Result	VOX1 Softpot	Audio Voltage	VOX10 Softpot	Audio Voltage
Pass	190	64.000 mVpk	30	4.000 mVpk

Rx Sensitivity Test Analog Wide 5k

Result	Frequency	12dB SINAD	Max Limit
Pass	851.0500 MHz	-120.6 dBm	-117.0 dBm
Pass	860.0500 MHz	-121.3 dBm	-117.0 dBm
Pass	869.9500 MHz	-119.9 dBm	-117.0 dBm
Pass	851.5500 MHz	-120.1 dBm	-117.0 dBm
Pass	860.5500 MHz	-121.2 dBm	-117.0 dBm
Pass	869.4500 MHz	-121.0 dBm	-117.0 dBm

Rx Sensitivity Test Analog Wide 4k

Result	Frequency	12dB SINAD	Max Limit
Pass	851.0500 MHz	-120.3 dBm	-117.0 dBm
Pass	860.0500 MHz	-121.0 dBm	-117.0 dBm
Pass	869.9500 MHz	-119.5 dBm	-117.0 dBm
Pass	851.5500 MHz	-120.1 dBm	-117.0 dBm
Pass	860.5500 MHz	-121.1 dBm	-117.0 dBm
Pass	869.4500 MHz	-120.6 dBm	-117.0 dBm

Rx Sensitivity Test Analog Narrow

Result	Frequency	12dB SINAD	Max Limit
Pass	851.0500 MHz	-119.7 dBm	-117.0 dBm
Pass	860.0500 MHz	-120.3 dBm	-117.0 dBm
Pass	869.9500 MHz	-119.0 dBm	-117.0 dBm
Pass	851.5500 MHz	-119.6 dBm	-117.0 dBm
Pass	860.5500 MHz	-120.3 dBm	-117.0 dBm
Pass	869.4500 MHz	-120.0 dBm	-117.0 dBm

Rx Digital Sensitivity Test NXDN Narrow

Result	Frequency	3% BER	Max Limit
Pass	851.0500 MHz	-119.7 dBm	-117.0 dBm
Pass	860.0500 MHz	-120.3 dBm	-117.0 dBm
Pass	869.9500 MHz	-119.0 dBm	-117.0 dBm
Pass	851.5500 MHz	-118.8 dBm	-117.0 dBm
Pass	860.5500 MHz	-120.6 dBm	-117.0 dBm
Pass	869.4500 MHz	-120.2 dBm	-117.0 dBm

Rx Digital Sensitivity Test NXDN Very Narrow

Result	Frequency	3% BER	Max Limit
Pass	851.0500 MHz	-122.4 dBm	-119.0 dBm
Pass	860.0500 MHz	-123.0 dBm	-119.0 dBm
Pass	869.9500 MHz	-120.8 dBm	-119.0 dBm
Pass	851.5500 MHz	-122.7 dBm	-119.0 dBm
Pass	860.5500 MHz	-122.9 dBm	-119.0 dBm
Pass	869.4500 MHz	-122.8 dBm	-119.0 dBm

Rx Sensitivity Test Analog Wide 5k

Result	Frequency	12dB SINAD	Max Limit
Pass	851.1000 MHz	-120.4 dBm	-117.0 dBm
Pass	859.9000 MHz	-121.2 dBm	-117.0 dBm
Pass	869.9000 MHz	-120.0 dBm	-117.0 dBm

Rx Sensitivity Test Analog Wide 4k

Result	Frequency	12dB SINAD	Max Limit
Pass	851.1000 MHz	-120.4 dBm	-117.0 dBm
Pass	859.9000 MHz	-120.6 dBm	-117.0 dBm
Pass	869.9000 MHz	-120.0 dBm	-117.0 dBm

Rx Sensitivity Test Analog Narrow

Result	Frequency	12dB SINAD	Max Limit

```
------    ---------     ----------     ---------
Pass      851.1000 MHz   -119.7 dBm     -117.0 dBm
Pass      859.9000 MHz   -120.0 dBm     -117.0 dBm
Pass      869.9000 MHz   -119.3 dBm     -117.0 dBm

Squelch Open Analog Wide 5k Align
=================================
Result    Frequency      Output Level   Old Softpot    New Softpot
------    ---------      ------------   -----------    -----------
Pass      851.1000 MHz   -120.4 dBm     104            106
Pass      859.9000 MHz   -121.2 dBm     99             98
Pass      869.9000 MHz   -120.0 dBm     103            105

Squelch Open Analog Wide 4k Align
=================================
Result    Frequency      Output Level   Old Softpot    New Softpot
------    ---------      ------------   -----------    -----------
Pass      851.1000 MHz   -120.4 dBm     118            119
Pass      859.9000 MHz   -120.6 dBm     119            130
Pass      869.9000 MHz   -120.0 dBm     117            117

Squelch Open Analog Narrow Align
================================
Result    Frequency      Output Level   Old Softpot    New Softpot
------    ---------      ------------   -----------    -----------
Pass      851.1000 MHz   -119.7 dBm     82             79
Pass      859.9000 MHz   -120.0 dBm     79             86
Pass      869.9000 MHz   -119.3 dBm     84             82

Squelch Open NXDN Very Narrow Align
===================================
Result    Frequency      Output Level   Old Softpot    New Softpot
------    ---------      ------------   -----------    -----------
Pass      851.1000 MHz   -123.7 dBm     197            189
Pass      859.9000 MHz   -124.0 dBm     196            198
Pass      869.9000 MHz   -123.3 dBm     196            180

Squelch Tight Analog Wide 5k Align
=================================
Result    Frequency      Output Level   Old Softpot    New Softpot
------    ---------      ------------   -----------    -----------
Pass      851.1000 MHz   -115.4 dBm     217            219
Pass      859.9000 MHz   -116.2 dBm     216            218
Pass      869.9000 MHz   -115.0 dBm     217            221

Squelch Tight Analog Wide 4k Align
==================================
Result    Frequency      Output Level   Old Softpot    New Softpot
------    ---------      ------------   -----------    -----------
Pass      851.1000 MHz   -115.4 dBm     231            230
Pass      859.9000 MHz   -115.6 dBm     231            235
Pass      869.9000 MHz   -115.0 dBm     228            233

Squelch Tight Analog Narrow Align
================================
Result    Frequency      Output Level   Old Softpot    New Softpot
------    ---------      ------------   -----------    -----------
Pass      851.1000 MHz   -114.7 dBm     202            200
Pass      859.9000 MHz   -115.0 dBm     191            204
Pass      869.9000 MHz   -114.3 dBm     200            200

Squelch Open Analog Wide 5k Test
================================
Result    Frequency      Output Level   Softpot        Squlech Level  Min Limit      Difference     Max Limit
------    ---------      ------------   -------        -------------  ---------      ----------     ---------
Pass      851.1000 MHz   -120.4 dBm     106            102            -15            -4             15
Pass      859.9000 MHz   -121.2 dBm     98             96             -15            -2             15
Fail      869.9000 MHz   -120.0 dBm     105            83             -15            -22            15

Squelch Open Analog Wide 4k Test
================================
Result    Frequency      Output Level   Softpot        Squlech Level  Min Limit      Difference     Max Limit
------    ---------      ------------   -------        -------------  ---------      ----------     ---------
Pass      851.1000 MHz   -120.4 dBm     119            122            -15            3              15
Pass      859.9000 MHz   -120.6 dBm     130            129            -15            -1             15
Pass      869.9000 MHz   -120.0 dBm     117            118            -15            1              15

Squelch Open Analog Narrow Test
================================
Result    Frequency      Output Level   Softpot        Squlech Level  Min Limit      Difference     Max Limit
------    ---------      ------------   -------        -------------  ---------      ----------     ---------
Pass      851.1000 MHz   -119.7 dBm     79             82             -15            3              15
Pass      859.9000 MHz   -120.0 dBm     86             86             -15            0              15
Pass      869.9000 MHz   -119.3 dBm     82             77             -15            -5             15

Squelch Tight Analog Wide 5k Test
=================================
Result    Frequency      Output Level   Softpot        Squlech Level  Min Limit      Difference     Max Limit
------    ---------      ------------   -------        -------------  ---------      ----------     ---------
Pass      851.1000 MHz   -115.4 dBm     219            218            -15            -1             15
Pass      859.9000 MHz   -116.2 dBm     218            215            -15            -3             15
Pass      869.9000 MHz   -115.0 dBm     221            206            -15            -15            15

Squelch Tight Analog Wide 4k Test
=================================
Result    Frequency      Output Level   Softpot        Squlech Level  Min Limit      Difference     Max Limit
------    ---------      ------------   -------        -------------  ---------      ----------     ---------
Pass      851.1000 MHz   -115.4 dBm     230            231            -15            1              15
Pass      859.9000 MHz   -115.6 dBm     235            235            -15            0              15
Pass      869.9000 MHz   -115.0 dBm     233            224            -15            -9             15

Squelch Tight Analog Narrow Test
================================
Result    Frequency      Output Level   Softpot        Squlech Level  Min Limit      Difference     Max Limit
------    ---------      ------------   -------        -------------  ---------      ----------     ---------
Pass      851.1000 MHz   -114.7 dBm     200            199            -15            -1             15
Pass      859.9000 MHz   -115.0 dBm     204            204            -15            0              15
Pass      869.9000 MHz   -114.3 dBm     200            194            -15            -6             15
```

RSSI Reference Analog Wide 5k Align

Result	Frequency	Output Level	Old Softpot	New Softpot
Pass	851.1000 MHz	-123.4 dBm	13	14
Pass	859.9000 MHz	-124.2 dBm	13	16
Pass	869.9000 MHz	-123.0 dBm	16	16

RSSI Reference Analog Wide 4k Align

Result	Frequency	Output Level	Old Softpot	New Softpot
Pass	851.1000 MHz	-123.4 dBm	15	13
Pass	859.9000 MHz	-123.6 dBm	13	17
Pass	869.9000 MHz	-123.0 dBm	15	18

RSSI Reference Analog Narrow Align

Result	Frequency	Output Level	Old Softpot	New Softpot
Pass	851.1000 MHz	-122.7 dBm	16	17
Pass	859.9000 MHz	-123.0 dBm	16	15
Pass	869.9000 MHz	-122.3 dBm	16	19

RSSI Reference NXDN Very Narrow Align

Result	Frequency	Output Level	Old Softpot	New Softpot
Pass	851.1000 MHz	-122.7 dBm	16	17
Pass	859.9000 MHz	-123.0 dBm	16	17
Pass	869.9000 MHz	-122.3 dBm	17	19

RSSI Low Analog Wide 5k Align

Result	Frequency	Output Level	Old Softpot	New Softpot
Pass	851.1000 MHz	-118.0 dBm	25	23
Pass	859.9000 MHz	-118.0 dBm	28	30
Pass	869.9000 MHz	-118.0 dBm	27	25

RSSI Low Analog Wide 4k Align

Result	Frequency	Output Level	Old Softpot	New Softpot
Pass	851.1000 MHz	-118.0 dBm	25	23
Pass	859.9000 MHz	-118.0 dBm	27	30
Pass	869.9000 MHz	-118.0 dBm	24	24

RSSI Low Analog Narrow Align

Result	Frequency	Output Level	Old Softpot	New Softpot
Pass	851.1000 MHz	-118.0 dBm	25	27
Pass	859.9000 MHz	-118.0 dBm	27	29
Pass	869.9000 MHz	-118.0 dBm	27	29

RSSI Low NXDN Very Narrow Align

Result	Frequency	Output Level	Old Softpot	New Softpot
Pass	851.1000 MHz	-118.0 dBm	25	27
Pass	859.9000 MHz	-118.0 dBm	27	24
Pass	869.9000 MHz	-118.0 dBm	28	26

RSSI High Analog Wide 5k Align

Result	Frequency	Output Level	Old Softpot	New Softpot
Pass	851.1000 MHz	-80.0 dBm	96	171
Pass	859.9000 MHz	-80.0 dBm	130	173
Pass	869.9000 MHz	-80.0 dBm	170	131

RSSI High Analog Wide 4k Align

Result	Frequency	Output Level	Old Softpot	New Softpot
Pass	851.1000 MHz	-80.0 dBm	167	130
Pass	859.9000 MHz	-80.0 dBm	170	173
Pass	869.9000 MHz	-80.0 dBm	170	172

RSSI High Analog Narrow Align

Result	Frequency	Output Level	Old Softpot	New Softpot
Pass	851.1000 MHz	-80.0 dBm	167	170
Pass	859.9000 MHz	-80.0 dBm	100	173
Pass	869.9000 MHz	-80.0 dBm	170	100

RSSI High NXDN Very Narrow Align

Result	Frequency	Output Level	Old Softpot	New Softpot
Pass	851.1000 MHz	-80.0 dBm	167	99
Pass	859.9000 MHz	-80.0 dBm	170	132
Pass	869.9000 MHz	-80.0 dBm	170	173

Figure B-1. Sample Test Result Report

APPENDIX C. Alternate Test Set

A custom test set jig may be constructed for performing AutoTune tests and alignments in place of the 202951-01 Test Set supplied by Freedom Communication Technologies. For required programming cable and audio connections, please see the radio service manual for the model under test.

For Kenwood NX Portable radios, a custom test jig interface requires the Kenwood KPG-36 or KPG-36A interface cable modified to tap into the audio wires.

For Kenwood NX Mobile radios, a custom test jig interface requires the Kenwood adapter cable E30-3383-05, which brings out the audio wires used for injecting audio into the transceiver.

Refer to Figure 4-1. NX Portable Test Setup Diagram and/or Figure 6-1. NX Mobile Test Setup Diagram for general connector information.

Note: Approved USB to serial adapters for connecting the R8000 analyzer to the Kenwood NX series radio under test include any adapters which utilize an FTDI FT232_USB to serial UART interface. See http://www.ftdichip.com/Products/ICs/FT232R.htm for more detail.

APPENDIX D. Revision History

Revision – Change	Requested By	Approved By	Rel. Date	ECO#
D- Auto Tune User Guide	M. Mullins	M. Humphries	1/21/21	0331
C – Kenwood USB Cables	T.John	M.Humphries	3/12/18	0177*
B – from CG1375A	S.Hill	M.Mullins	6/30/15	-