FREEDOM
Communication Technologies

R8000 SERIES
COMMUNICATIONS SYSTEM ANALYZER

AUTOTUNE USER GUIDE

Harris XL-200 Portable

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Kilgore, Texas 75662

FCT-1201A

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.

CREDITS

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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 Harris XL-200 Portable series 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.

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.

4. Important Notes

4.1. Required firmware

Harris XL-200P series radios must be running **XLP R02D01** firmware or later for AutoTune to successfully run. **XLP R03C09** firmware or later is required for AutoTune to successfully run the RSSI align.

4.2. Conventional channel selection

The radio must have a conventional channel selected before AutoTune servicing begins. A trunked channel if selected is known to cause radio communication initialization failures.

4.3. Supported models

The following Harris XL-200 series models are supported by AutoTune:

- XL-200P

5. Harris XL-200 Portable Radio Test Setup

In order to perform the test and alignment procedures, the XL-200 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 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.

5.1. XL-200 Portable Test Setup

Refer to the diagrams below for proper test setup.

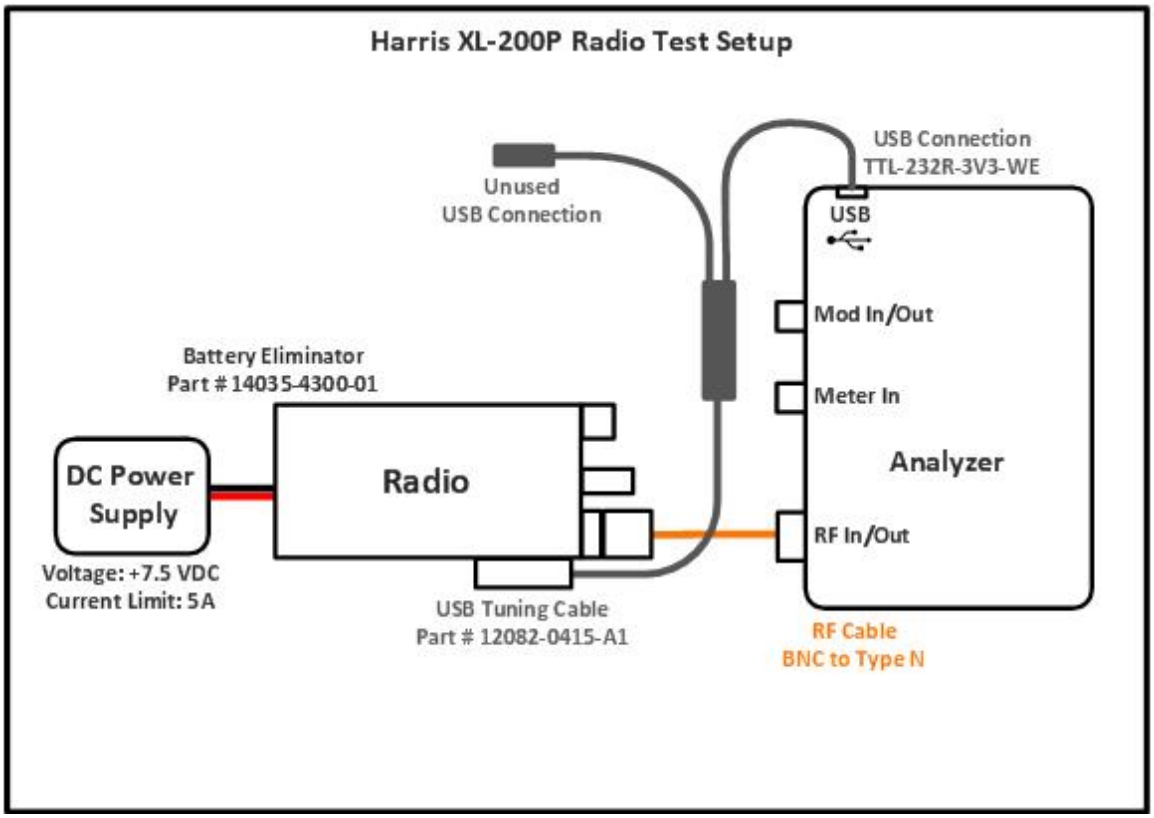

Figure 5-1. XL-200 Portable Test Setup Diagram

6. Harris XL-200 Portable 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.

6.1. Synthesizer Performance Test

The Synthesizer Performance test checks the lock range of the synthesizer circuits.

6.1.1. Test

The radio is set to the first Rx test frequency at the lower end of the first Rx RF Band. The user will be asked to check the radio display for an alarm message. If no alarm message is display, the synthesizer circuit is locked. All ends of the Rx RF Bands are tested. Next, the radio is set to the first Tx test frequency at the lower end of the first Tx RF Band. The radio is keyed for 2 seconds. The user will be asked to check the radio display for an alarm message. If no alarm message is display, the synthesizer circuit is locked. All ends of the Tx RF Bands are tested.

Name	Description
Result	Pass or Fail. Synthesizer circuit locked
Frequency	Test Frequency
Synth Lock	Synthesizer circuit locked

Table 6-1. Synthesizer Performance test results

6.2. TCXO Frequency

RF Control	Port	Frequency	Modulation	Output Level / Attenuation
Generate	RF IN/OUT	Test Frequency	FM	-70 dBm
Monitor	RF IN/OUT	Test Frequency	FM	30 dB

Table 6-2. Analyzer Configuration for TCXO Frequency

6.2.1. Alignment

The radio is placed into Test Mode at the first Rx Test Frequency, and the analyzer is set to generate as listed in Table 6-2. The radio is queried to tune the TCXO softpot and returns the new softpot value. The new softpot radio is written to the radio. After programming the new softpot value, the radio is set to the first Tx Test Frequency and commanded to transmit. The analyzer is set to measure as listed in Table 6-2. The frequency error is measured by the analyzer and compared to the 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 alignment
Max Limit	Maximum Limit (inclusive) for frequency error alignment
Old Softpot	Radio softpot before alignment
New Softpot	Radio softpot after alignment

Table 6-3. TCXO Frequency alignment results

6.2.2. Test

The radio is placed into Test Mode at the first Tx Test Frequency and commanded to transmit. The analyzer is set to measure as listed Table 6-2. The frequency error is measured by the analyzer and compared to the test limits. This process is repeated for each Test Frequency. 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
Softpot	Radio softpot producing the frequency error

Table 6-4. TCXO Frequency test results

6.3. RSSI

RF Control	Port	Frequency	Modulation	Output Level / Attenuation
Generate	RF IN/OUT	Test Freq	None	-95 dBm

Table 6-5. Analyzer Configuration for RSSI

6.3.1. Alignment

The radio is placed into Test Mode at the first Rx Test Frequency, and the analyzer is set to generate as listed in Table 6-5. The radio RSSI level is checked without a carrier signal for interference. If interference is detected, the radio Rx frequency and the analyzer frequency are changed by 75kHz until there is no interference. The analyzer RF signal is turned on. The RSSI level is measured by the radio at the RSSI softpot limits. These RSSI measurements are used to calculate the softpot value which matches the RSSI level to the output level of the analyzer, and the calculated softpot is saved to the radio. The RSSI level is measured by the radio and compared to the test limits. This process is repeated for each Test Frequency. The final results are written to the log file.

Name	Description
Result	Pass or Fail. RSSI within Max Limit, Min Limit.
Frequency	Test Frequency
Old Softpot	Radio softpot before alignment
New Softpot	Radio softpot after alignment
RSSI	Measured frequency error
Min Limit	Minimum Limit (inclusive) for RSSI alignment
Max Limit	Maximum Limit (inclusive) for RSSI alignment

Table 6-6. RSSI alignment results

6.3.2. Test

The radio is placed into Test Mode at a Rx Test Frequency, and the analyzer is set to generate as listed Table 6-5. The radio RSSI level is check without a carrier signal for interference. If interference is detected, the rest of the test is skipped, and results are written to the log file. The analyzer RF signal is turned on. The RSSI level is measured by the radio and compared to the test limits. This process is repeated for each Test Frequency. 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
RSSI Intrf	Measured RSSI level to check for interference with no RF signal
RSSI	Measured RSSI level
Min Limit	Minimum Limit (inclusive) for RSSI
Max Limit	Maximum Limit (inclusive) for RSSI
Softpot	Radio softpot producing the RSSI

Table 6-7. RSSI test results

6.4. TX Power

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

Table 6-8. Analyzer Configuration for TX Power

6.4.1. Test

The radio is commanded to transmit. Beginning at the first Tx Test Frequency, the output level is measured at each TX Test Frequency, for Low and High Power, and compared to the 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

Table 6-9. TX Power test results

6.5. Tx CTCSS/CDCSS Modulation and Composite Deviation

The Tx CTCSS/CDCSS Modulation test measures the radio's CTCSS or CDCSS deviation levels and tone or code accuracy for each test frequency.

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

Table 6-10. Analyzer Configuration for Tx CTCSS/CDCSS Modulation test

6.5.1. Test

For each test frequency and bandwidth (Wide, Narrow, NPSPAC) supported, the radio transmits CTCSS tones and CDCSS codes at rated deviation levels. The ±Peak / 2-averaged deviations of these individual tones/codes and the composite levels are measured with the analyzer for CTCSS tone or CDCSS code accuracy. The test results are written to the log file.

Name	Description
Result	Pass or Fail. CTCSS or CDCSS deviation levels are within limits, and CTCSS tone/CDCSS code is accurate.
Frequency	Test Frequency
CTCSS Dev	Measured CTCSS or CDCSS deviation level
Min Dev	Minimum CTCSS or CDCSS deviation level (inclusive)
Max Dev	Maximum CTCSS or CDCSS deviation level (inclusive)
Meas Tone|Meas Code	Measured CTCSS tone frequency or CDCSS code

Table 6-11. Tx CTCSS/CDCSS Modulation test results

6.6. P25 Phase 1 Tx Tests (C4FM)

The Tx P25 Phase 1 Tx Tests (C4FM) measures the radio's P25 Phase 1 C4FM modulation fidelity level and symbol deviation at multiply test frequencies with a random pattern.

RF Control	Port	Frequency	Modulation	Attenuation	Dev Avg
Monitor	RF IN/OUT	Test Frequency	C4FM	30 dB	Peak Avg

Table 6-12. Analyzer Configuration for P25 Phase 1 Tx Tests (C4FM)

6.6.1. Test

The radio is set to a digital channel at low power at the first Tx Test Frequency and commanded to transmit a random 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. Modulation fidelity is between Min Limit and Max Limit.
Frequency	Test Frequency
Meas Mod Fidelity	Measured P25 Phase 1 C4FM modulation fidelity
Min Mod Fidelity	Minimum passable modulation fidelity level
Max Mod Fidelity	Maximum passable modulation fidelity level

Table 6-13. Tx P25 Phase 1 Modulation Fidelity (C4FM) results

Name	Description
Result	Pass or Fail. Symbol deviation is between Min Limit and Max Limit.
Frequency	Test Frequency
Meas Sym Deviation	Measured P25 Phase 1 C4FM symbol deviation
Min Sym Deviation	Minimum symbol deviation fidelity level
Max Sym Deviation	Maximum symbol deviation fidelity level

Table 6-14. Tx P25 Phase 1 Symbol Deviation (C4FM) results

6.7. P25 Phase 1 Tx Deviation (C4FM) Test

The Tx P25 Phase 1 Tx Deviation (C4FM) test measures the radio's P25 Phase 1 C4FM deviation level at specific test frequencies for both High and Low Patterns.

RF Control	Port	Frequency	Modulation	Attenuation	Dev Avg
Monitor	RF IN/OUT	Test Frequency	C4FM	30 dB	Peak Avg

Table 6-15. Analyzer Configuration for P25 Phase 1 Tx Deviation (C4FM) test

6.7.1. Test

The radio is set to a digital channel at low power at the first Tx Test Frequency and commanded to transmit a pattern. The Peak-averaged deviation of this tone is measured with the analyzer. This process is repeated for each Test Frequency and High and Low patterns. The test results are written to the log file.

Name	Description
Result	Pass or Fail. Deviation is between Min Limit and Max Limit.
Frequency	Test Frequency
Meas Dev	Measured P25 Phase 1 C4FM deviation
Min Dev	Minimum passable deviation level
Max Dev	Maximum passable deviation level

Table 6-16. Tx P25 Phase 1 Deviation (C4FM) test results

6.8. P25 Phase 1 Rx Sensitivity (C4FM) Test

The P25 Phase 1 Rx Sensitivity (C4FM) test measures the radio's P25 Phase 1 C4FM sensitivity level at several Rx test frequencies.

RF Control	Port	Frequency	Modulation	Output Level
Generate	RF IN/OUT	Test Frequency	C4FM	-117 dBm

Table 6-17. Analyzer Configuration for P25 Phase 1 Rx Sensitivity (C4FM) test

6.8.1. Test

The analyzer is setup by applying the Modulation signal in Table 6-17 to the radio. The radio is set to a digital zone and the first Rx test frequency. The radio's reported C4FM BER level is measured and compared against the test limits. This process is repeated for each Test Frequency. The final results are written to the log file.

Name	Description
Result	Pass or Fail. BER level within Max Limit
Frequency	Test Frequency
BER	Radio Bit Error Rate (BER) level
Max Limit	Maximum Limit (inclusive) for Bit Error Rate (BER)
Min Limit	Minimum Limit (exclusive) for Bit Error Rate (BER)

Table 6-18. P25 Phase 1 Rx Sensitivity (C4FM) test results

6.9. P25 Phase 2 Rx Sensitivity (TDMA) Test

The P25 Phase 2 Rx Sensitivity (TDMA) test measures the radio's P25 Phase 2 TDMA sensitivity level at several Rx test frequencies.

RF Control	Port	Frequency	Modulation	Output Level
Generate	RF IN/OUT	Test Frequency	TDMA	-117 dBm

Table 6-19. Analyzer Configuration for P25 Phase 2 Rx Sensitivity (TDMA) test

6.9.1. Test

The analyzer is setup by applying the Modulation signal in Table 6-19 to the radio. The radio is set to a digital zone at the first RX Test Frequency. The radio's reported TDMA BER level is measured and compared against the test limits. This process is repeated for each Test Frequency. The final results are written to the log file.

Name	Description
Result	Pass or Fail. BER level within Max Limit
Frequency	Test Frequency
BER	Radio Bit Error Rate (BER) level
Max Limit	Maximum Limit (inclusive) for Bit Error Rate (BER)
Min Limit	Minimum Limit (exclusive) for Bit Error Rate (BER)

Table 6-20. P25 Phase 2 Rx Sensitivity (TDMA) test results

Basic Troubleshooting

Symptom	Possible Cause	Possible Solution
Analyzer consistently fails to communicate with radio	• Radio on a trunking channel	• Change radio channel to a conventional channel. Trunking channel mode can prevent AutoTune from placing radio into test mode.
Analyzer consistently fails to communicate with radio and radio display softkeys are blank.	• Current mission plan corrupted while setting mission plan to test mode.	• Boot radio into “Wifi programming mode” by pressing the PTT and Bottom Side Button and powering up the radio. Wait 5 seconds. Connect the radio to RPM and re-flash or overwrite the radio personality.
Analyzer occasionally fails to communicate with radio	• USB hub in use	• USB hubs are known to occasionally prevent or drop radio communication. Connect the radio programming cable directly to an analyzer USB port.
Tx Power test power output levels are lower than expected.	• Cable Sweep not enabled	• Enable Settings > System Settings… > Cable Sweep > Cable Sweep. Change cable attenuation values to correspond with the RF cable in use. For example, if 0.5 dB of loss expected at 100 MHz and 1.5 dB of loss is expected at 1 GHz, enter “-0.5 dB” as the 100 MHz loss value and –“1.5 dB” as the 1 GHz loss value. Cable losses are entered as negative values.

Table 6-21. Harris XL-200 Portable Series Troubleshooting Chart

7. Support Information

7.1. Technical Support

Telephone/Fax: 903.985.8999
Email: service@freedomcte.com
Web: http://freedomcte.com/support/

7.2. Sales

Telephone/Fax: 903.985.8999
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 Harris XL-200 Portable radio model supported by AutoTune.

Section	Test Name	Limit	Default Value
6.2	TCXO Frequency	Reference Oscillator Align	Min = -0.05 ppm Max = 0.05 ppm
		Reference Oscillator Test	Min = -0.4 ppm Max = 0.4 ppm
6.3	RSSI	RSSI Align	Min = -3.0 dBm Max = 3.0 dBm
		RSSI Test	Min = -3.0 dBm Max = 3.0 dBm
		RSSI Level	Max = -95 dBm
		RSSI Interference Threshold	Max = -115 dBm
6.4	TX Power (Test)	TX Power Test VHF Low	Min = 0.7 W Max = 1.3 W
		TX Power Test UHF Low	Min = 0.70 W Max = 1.3 W
		TX Power Test 700MHz Low	Min = 0.2 W Max = 0.8 W
		TX Power Test 800MHz Low	Min = 0.2 W Max = 0.8 W
		TX Power Test VHF High	Min = 5.6 W Max = 7.6 W
		TX Power Test UHF High	Min = 4.7 W Max = 6.3 W
		TX Power Test 700MHz High	Min = 2.2 W Max = 3.2 W
		TX Power Test 800MHz High	Min = 2.8 W Max = 3.8 W
6.5	Tx CTCSS/CDCSS Modulation and Composite Deviation	Tx CTCSS/CDCSS Modulation Deviation Wide	Min = 0.5 kHz Max = 1.0 kHz
		Tx CTCSS/CDCSS Modulation Deviation Narrow	Min = 0.315 kHz Max = 0.465 kHz
		Tx CTCSS/CDCSS Modulation Deviation NPSPAC	Min = 0.4 kHz Max = 0.8 kHz
6.6	P25 Phase1 Tx Tests C4FM	P25 Phase1 Tx Modulation Fidelity C4FM	Min = 0.0 % Max = 0.5 %
		P25 Phase1 Tx Symbol Deviation C4FM	Min = 1.620 kHz Max = 1.980 kHz
6.7	P25 Phase2 Tx Modulation TDMA	P25 Phase1 Tx Modulation C4FM High Pattern	Min = 2.544 kHz Max = 3.110 kHz
		P25 Phase1 Tx Modulation C4FM Low Pattern	Min = 0.849 kHz Max = 1.037 kHz
6.8	P25 Phase1 Rx Sensitivity (C4FM)	P25 Phase1 Rx Sensitivity C4FM	Min = 0 % Max = 5 %
6.9	P25 Phase2 Rx Sensitivity (TDMA)	P25 Phase2 Rx Sensitivity TDMA	Min = 0 % Max = 5 %

Table A-1. Default Harris XL-200 Portable Limits

APPENDIX B. Sample Test Result Report

Note: Results shown below are representative of actual results. Actual results and report format may vary.

```
================================================================================
                              Test Result Report
================================================================================
Model #:  Harris XL-200 Portable        Date/Time:     7/11/2017 2:10 PM
Serial #: A40300003218                  Operator ID:   6

Info: FLASH Version: R03D09

TCXO Frequency Align
====================
Result  Frequency     Freq Error  Min Limit  Max Limit  Old Softpot  New Softpot
------  ------------  ----------  ---------  ---------  -----------  -----------
Pass    136.0000 MHz  -2 Hz       -7 Hz      7 Hz       463          461

TCXO Frequency Test
===================
Result  Frequency     Freq Error  Min Limit  Max Limit  Softpot
------  ------------  ----------  ---------  ---------  -------
Pass    136.0000 MHz  -1 Hz       -54 Hz     54 Hz      461
Pass    174.0000 MHz  -2 Hz       -70 Hz     70 Hz      461
Pass    378.0000 MHz  -9 Hz       -151 Hz    151 Hz     461
Pass    522.0000 MHz  -14 Hz      -209 Hz    209 Hz     461
Pass    776.0000 MHz  -27 Hz      -310 Hz    310 Hz     461
Pass    798.0000 MHz  -26 Hz      -319 Hz    319 Hz     461
Pass    816.0000 MHz  -27 Hz      -326 Hz    326 Hz     461
Pass    861.0000 MHz  -24 Hz      -344 Hz    344 Hz     461

RSSI Align
==========
Result  Frequency     Old Softpot  New Softpot  RSSI      Max Limit  Min Limit
------  ------------  -----------  -----------  --------  ---------  ---------
Pass    136.0000 MHz  175          175          0.0 dBm   3.0 dBm    -3.0 dBm
Pass    139.8000 MHz  175          175          0.0 dBm   3.0 dBm    -3.0 dBm
Pass    143.6000 MHz  175          175          0.0 dBm   3.0 dBm    -3.0 dBm
Pass    147.7000 MHz  175          175          0.0 dBm   3.0 dBm    -3.0 dBm
Pass    151.2000 MHz  175          175          0.0 dBm   3.0 dBm    -3.0 dBm
Pass    155.0000 MHz  175          175          0.0 dBm   3.0 dBm    -3.0 dBm
Pass    158.8000 MHz  175          175          0.0 dBm   3.0 dBm    -3.0 dBm
Pass    162.6000 MHz  175          175          0.0 dBm   3.0 dBm    -3.0 dBm
Pass    166.4000 MHz  175          175          0.0 dBm   3.0 dBm    -3.0 dBm
Pass    170.2000 MHz  175          175          0.0 dBm   3.0 dBm    -3.0 dBm
Pass    174.0000 MHz  174          175          0.0 dBm   3.0 dBm    -3.0 dBm
Pass    378.0000 MHz  173          173          0.0 dBm   3.0 dBm    -3.0 dBm
Pass    394.0000 MHz  173          173          0.0 dBm   3.0 dBm    -3.0 dBm
Pass    408.0000 MHz  174          174          0.0 dBm   3.0 dBm    -3.0 dBm
Pass    422.0000 MHz  174          174          0.0 dBm   3.0 dBm    -3.0 dBm
Pass    436.0000 MHz  174          174          0.0 dBm   3.0 dBm    -3.0 dBm
Pass    450.0000 MHz  174          174          0.0 dBm   3.0 dBm    -3.0 dBm
Pass    464.0000 MHz  173          173          1.0 dBm   3.0 dBm    -3.0 dBm
Pass    478.0000 MHz  173          173          0.0 dBm   3.0 dBm    -3.0 dBm
Pass    492.0000 MHz  173          173          0.0 dBm   3.0 dBm    -3.0 dBm
Pass    506.0000 MHz  173          173          -1.0 dBm  3.0 dBm    -3.0 dBm
Pass    522.0000 MHz  172          172          0.0 dBm   3.0 dBm    -3.0 dBm
Pass    768.0000 MHz  172          172          0.0 dBm   3.0 dBm    -3.0 dBm
Pass    769.6000 MHz  172          172          0.0 dBm   3.0 dBm    -3.0 dBm
Pass    771.2000 MHz  171          171          0.0 dBm   3.0 dBm    -3.0 dBm
Pass    772.8000 MHz  170          171          0.0 dBm   3.0 dBm    -3.0 dBm
Pass    774.4000 MHz  170          171          0.0 dBm   3.0 dBm    -3.0 dBm
Pass    776.0000 MHz  171          171          0.0 dBm   3.0 dBm    -3.0 dBm
Pass    851.0000 MHz  169          169          0.0 dBm   3.0 dBm    -3.0 dBm
Pass    852.9000 MHz  169          169          0.0 dBm   3.0 dBm    -3.0 dBm
Pass    856.7000 MHz  171          171          0.0 dBm   3.0 dBm    -3.0 dBm
Pass    861.0000 MHz  168          168          0.0 dBm   3.0 dBm    -3.0 dBm

TX Power Test - Low Power
=========================
Result  Frequency     Power Out  Min Limit  Max Limit
------  ------------  ---------  ---------  ---------
Pass    136.0000 MHz  1.08 W     0.70 W     1.30 W
Pass    174.0000 MHz  1.09 W     0.70 W     1.30 W
Pass    378.0000 MHz  1.01 W     0.70 W     1.30 W
Pass    522.0000 MHz  1.03 W     0.70 W     1.30 W
Pass    776.0000 MHz  0.47 W     0.20 W     0.80 W
Pass    798.0000 MHz  0.46 W     0.20 W     0.80 W
Pass    816.0000 MHz  0.49 W     0.20 W     0.80 W
Pass    861.0000 MHz  0.49 W     0.20 W     0.80 W

TX Power Test - High Power
==========================
Result  Frequency     Power Out  Min Limit  Max Limit
------  ------------  ---------  ---------  ---------
Pass    136.0000 MHz  6.49 W     5.60 W     7.60 W
Pass    174.0000 MHz  6.54 W     5.60 W     7.60 W
Pass    378.0000 MHz  4.97 W     4.70 W     6.30 W
Pass    522.0000 MHz  5.03 W     4.70 W     6.30 W
Pass    776.0000 MHz  2.50 W     2.20 W     3.20 W
Pass    798.0000 MHz  2.47 W     2.20 W     3.20 W
Pass    816.0000 MHz  2.97 W     2.80 W     3.80 W
Pass    861.0000 MHz  2.93 W     2.80 W     3.80 W

Tx CTCSS (156.7 Hz) Modulation Wide
===================================
Result  Frequency     CTCSS Dev  Min Limit  Max Limit  Meas Tone
------  ------------  ---------  ---------  ---------  ---------
Pass    174.0000 MHz  0.677 kHz  0.5 kHz    1.0 kHz    156.8 Hz
Pass    816.0000 MHz  0.677 kHz  0.5 kHz    1.0 kHz    156.7 Hz
Pass    861.0000 MHz  0.677 kHz  0.5 kHz    1.0 kHz    156.8 Hz

Tx CDCSS (627) Modulation Wide
==============================
Result  Frequency     CDCSS Dev  Min Limit  Max Limit  Meas Code
------  ------------  ---------  ---------  ---------  ---------
Pass    174.0000 MHz  0.629 kHz  0.5 kHz    1.0 kHz    627
Pass    816.0000 MHz  0.637 kHz  0.5 kHz    1.0 kHz    627
Pass    861.0000 MHz  0.624 kHz  0.5 kHz    1.0 kHz    627

Tx CTCSS (156.7 Hz) Modulation Narrow
=====================================
Result  Frequency     CTCSS Dev  Min Limit  Max Limit  Meas Tone
------  ------------  ---------  ---------  ---------  ---------
Pass    174.0000 MHz  0.383 kHz  0.315 kHz  0.465 kHz  156.7 Hz
Pass    522.0000 MHz  0.383 kHz  0.315 kHz  0.465 kHz  156.8 Hz
Pass    776.0000 MHz  0.383 kHz  0.315 kHz  0.465 kHz  156.7 Hz
Pass    798.0000 MHz  0.383 kHz  0.315 kHz  0.465 kHz  156.8 Hz

Tx CDCSS (627) Modulation Narrow
================================
Result  Frequency     CDCSS Dev  Min Limit  Max Limit  Meas Code
```

Pass	174.0000 MHz	0.348 kHz	0.315 kHz	0.465 kHz	627
Pass	522.0000 MHz	0.354 kHz	0.315 kHz	0.465 kHz	627
Pass	776.0000 MHz	0.352 kHz	0.315 kHz	0.465 kHz	627
Pass	798.0000 MHz	0.350 kHz	0.315 kHz	0.465 kHz	627

Tx CTCSS (156.7 Hz) Modulation NPSPAC

Result	Frequency	CTCSS Dev	Min Limit	Max Limit	Meas Tone
Pass	816.0000 MHz	0.535 kHz	0.4 kHz	0.8 kHz	156.7 Hz
Pass	861.0000 MHz	0.535 kHz	0.4 kHz	0.8 kHz	156.8 Hz

P25 Phase 1 Tx Modulation Fidelity C4FM

Result	Frequency	Mod Fidelity	Max Limit
Pass	136.0000 MHz	0.422 %	5.000 %
Pass	174.0000 MHz	0.438 %	5.000 %
Pass	378.0000 MHz	0.549 %	5.000 %
Pass	522.0000 MHz	0.580 %	5.000 %
Pass	776.0000 MHz	0.706 %	5.000 %
Pass	798.0000 MHz	0.639 %	5.000 %
Pass	816.0000 MHz	0.641 %	5.000 %
Pass	861.0000 MHz	0.665 %	5.000 %

P25 Phase 1 Tx Symbol Deviation C4FM

Result	Frequency	Symbol Dev	Min Limit	Max Limit
Pass	136.0000 MHz	1.823 kHz	1.620 kHz	1.980 kHz
Pass	174.0000 MHz	1.821 kHz	1.620 kHz	1.980 kHz
Pass	378.0000 MHz	1.822 kHz	1.620 kHz	1.980 kHz
Pass	522.0000 MHz	1.823 kHz	1.620 kHz	1.980 kHz
Pass	776.0000 MHz	1.824 kHz	1.620 kHz	1.980 kHz
Pass	798.0000 MHz	1.823 kHz	1.620 kHz	1.980 kHz
Pass	816.0000 MHz	1.822 kHz	1.620 kHz	1.980 kHz
Pass	861.0000 MHz	1.821 kHz	1.620 kHz	1.980 kHz

P25 Phase 1 Tx Deviation C4FM High Pattern

Result	Frequency	Meas Dev	Min Dev	Max Dev
Pass	136.0000 MHz	2.880 kHz	2.544 kHz	3.110 kHz
Pass	174.0000 MHz	2.871 kHz	2.544 kHz	3.110 kHz
Pass	378.0000 MHz	2.876 kHz	2.544 kHz	3.110 kHz
Pass	522.0000 MHz	2.878 kHz	2.544 kHz	3.110 kHz
Pass	776.0000 MHz	2.873 kHz	2.544 kHz	3.110 kHz
Pass	798.0000 MHz	2.878 kHz	2.544 kHz	3.110 kHz
Pass	816.0000 MHz	2.880 kHz	2.544 kHz	3.110 kHz
Pass	861.0000 MHz	2.879 kHz	2.544 kHz	3.110 kHz

P25 Phase 1 Tx Deviation C4FM Low Pattern

Result	Frequency	Meas Dev	Min Dev	Max Dev
Pass	136.0000 MHz	0.963 kHz	0.849 kHz	1.037 kHz
Pass	174.0000 MHz	0.964 kHz	0.849 kHz	1.037 kHz
Pass	378.0000 MHz	0.970 kHz	0.849 kHz	1.037 kHz
Pass	522.0000 MHz	0.971 kHz	0.849 kHz	1.037 kHz
Pass	776.0000 MHz	0.974 kHz	0.849 kHz	1.037 kHz
Pass	798.0000 MHz	0.972 kHz	0.849 kHz	1.037 kHz
Pass	816.0000 MHz	0.970 kHz	0.849 kHz	1.037 kHz
Pass	861.0000 MHz	0.974 kHz	0.849 kHz	1.037 kHz

P25 Rx Sensitivity BER (C4FM)

Result	Frequency	BER	Min Limit	Max Limit
Pass	136.0000 MHz	0.631 %	0.0 %	5.1 %
Pass	174.0000 MHz	0.609 %	0.0 %	5.1 %
Pass	378.0000 MHz	0.935 %	0.0 %	5.1 %
Pass	522.0000 MHz	1.261 %	0.0 %	5.1 %
Pass	768.0000 MHz	1.421 %	0.0 %	5.1 %
Pass	776.0000 MHz	1.805 %	0.0 %	5.1 %
Pass	851.0000 MHz	2.327 %	0.0 %	5.1 %
Pass	861.0000 MHz	3.125 %	0.0 %	5.1 %

P25 Phase2 Rx Sensitivity (TDMA)

Result	Frequency	BER	Min Limit	Max Limit
Pass	136.0000 MHz	0.059 %	0.0 %	5.1 %
Pass	174.0000 MHz	0.026 %	0.0 %	5.1 %
Pass	378.0000 MHz	0.206 %	0.0 %	5.1 %
Pass	522.0000 MHz	0.376 %	0.0 %	5.1 %
Pass	768.0000 MHz	0.342 %	0.0 %	5.1 %
Pass	776.0000 MHz	0.650 %	0.0 %	5.1 %
Pass	851.0000 MHz	1.157 %	0.0 %	5.1 %
Pass	861.0000 MHz	1.720 %	0.0 %	5.1 %

APP Version 2.3.3.310

Figure B-1. Sample Test Result Report

APPENDIX C. Revision History

A – Original Release	M. Hammer	W.Black	12/17/17	0160
Revision – Change	Requested By	Approved By	Rel. Date	ECO#