NVLAP Lab Code 200087-0

APPLICATION SUBMITTAL REPORT

FOR
FCC And INDUSTRY CANADA
GRANT OF CERTIFICATION

FOR

Model: RM024
2400.7-2470.9 MHz
FHSS Transmission System

FCC ID: KQL-RM024
IC: 2268C-RM024

FOR

Laird Technologies
11160 Thompson Avenue
Lenexa KS 66219

Test Report Number: 120924

Authorized Signatory: Scot D Rogers
Scot D. Rogers

NVLAP Lab Code 200087-0

ROGERS LABS, INC.

4405 West 259th Terrace
Louisburg, KS 66053
Phone / Fax (913) 837-3214

Engineering Test Report
For Application Submittal for
Grant of Certification

FOR

CFR 47, PART 15C - Intentional Radiators Paragraph 15.247 and
Industry Canada, RSS-210
License Exempt Intentional Radiator

For

Laird Technologies

11160 Thompson Avenue
Lenexa KS 66219

Model: RM024
FHSS Transmission System
Frequency Range 2400.7-2470.9 MHz
FCC ID#: KQL-RM024
IC: 2268C-RM024

Test Date: September 24, 2012

Certifying Engineer: Scot D Rogers

Scot D. Rogers
Rogers Labs, Inc.
4405 West 259th Terrace
Louisburg, KS 66053
Telephone/Facsimile: (913) 837-3214

Table Of Contents

TABLE OF CONTENTS 3

REVISIONS 5

FORWARD 6

OPINION / INTERPRETATION OF RESULTS 6

STATEMENT OF MODIFICATIONS AND DEVIATIONS 6

EQUIPMENT TESTED 7

EQUIPMENT FUNCTION AND CONFIGURATION 7

Equipment Configuration 7

APPLICATION FOR CERTIFICATION 8

APPLICABLE STANDARDS & TEST PROCEDURES 9

EQUIPMENT TESTING PROCEDURES 9

AC Line Conducted Emission Test Procedure 9

Diagram 1 Test arrangement for Conducted emissions 10

Radiated Emission Test Procedure 11

Diagram 2 Test arrangement for radiated emissions of tabletop equipment 11

Diagram 3 Test arrangement for radiated emissions tested on Open Area Test Site (OATS) 12

LIST OF TEST EQUIPMENT 13

ENVIRONMENTAL CONDITIONS 14

TEST SITE LOCATIONS 14

UNITS OF MEASUREMENTS 14

INTENTIONAL RADIATORS 14

Antenna Requirements 15

Restricted Bands of Operation 15

Table 1 Radiated Emissions in Restricted Bands Data (General all antennas) 15
Table 2 Radiated Emissions in Restricted Bands Data (2 dBi Chip Antenna) 16
Table 3 Radiated Emissions in Restricted Bands Data (1 dBi NZH Dipole Antenna) 17
Table 4 Radiated Emissions in Restricted Bands Data (5 dBi Dipole Antenna) 18
Table 5 Radiated Emissions in Restricted Bands Data (6 dBi Omni Antenna) 19
Table 6 Radiated Emissions in Restricted Bands Data (9 dBi Panel Antenna) 20

Summary of Results for Radiated Emissions in Restricted Bands 20

AC Line Conducted Emissions Procedure 21

Figure One AC Line Conducted Emissions Line 1 22
Figure Two AC Line Conducted Emissions Line 2 22
Table 7 AC Line Conducted Emissions Data (7 Highest Emissions) 23

Summary of Results for AC Line Conducted Emissions 23

General Radiated EMI Testing Procedure 24

Table 8 General Radiated Emissions Data (worst-case all antennas) 25

Summary of Results for General Radiated Emissions 25

Operation in the Band 2400 – 2483.5 MHz 26

Figure Three of Antenna Port Conducted Emissions (43 Hop set) 26
Figure Four of Antenna Port Conducted Emissions (43 Hop set) 27
Figure Five of Antenna Port Conducted Emissions (43 Hop set) 27
Figure Six of Antenna Port Conducted Emissions (43 Hop set) 28
Figure Seven of Antenna Port Conducted Emissions (43 Hop set) 28
Figure Eight of Antenna Port Conducted Emissions (43 Hop set) 29
Figure Nine of Antenna Port Conducted Emissions (79 Hop set) 29
Figure Ten of Antenna Port Conducted Emissions (79 Hop set) 30
Figure Eleven of Antenna Port Conducted Emissions (79 Hop set) 30
Figure Twelve of Antenna Port Conducted Emissions (79 Hop set) 31
Figure Thirteen of Antenna Port Conducted Emissions (79 Hop set) 31
Figure Fourteen of Antenna Port Conducted Emissions (79 Hop set) 32
Figure Fifteen Plot of Output Across Operational Band (43 Hop set) 32
Figure Sixteen Plot of 20-dB Occupied Bandwidth (Low Channel) (43 Hop set) 33
Figure Seventeen Plot of 20-dB Occupied Bandwidth (Middle Channel) (43 Hop set) 33
Figure Eighteen Plot of 20-dB Occupied Bandwidth (High Channel) (43 Hop set) 34
Figure Nineteen Plot Channel Spacing (43 Hop set) 34
Figure Twenty Plot of Dwell time on Channel (43 Hop set) 35
Figure Twenty-0ne Plot Channel Occupancy (43 Hop set) 35
Figure Twenty-Two Plot of Low Band Edge (43 Hop set) 36
Figure Twenty-Three Plot of High Band Edge (43 Hop set) 36

Figure Twenty-Four Plot of Output Across Operational Band (79 Hop set) 37
Figure Twenty-Five Plot of 20-dB Occupied Bandwidth (Low Channel) (79 Hop set) 37
Figure Twenty-Six Plot of 20-dB Occupied Bandwidth (Middle Channel) (79 Hop set) 38
Figure Twenty-Seven Plot of 20-dB Occupied Bandwidth (High Channel) (79 Hop set) 38
Figure Twenty-Eight Plot Channel Spacing (79 Hop set) 39
Figure Twenty-Nine Plot of Dwell time on Channel (79 Hop set) 39
Figure Thirty Plot Channel Occupancy (79 Hop set) 40
Figure Thirty-One Plot of Low Band Edge (79 Hop set) 40
Figure Thirty -Two Plot of High Band Edge (79 Hop set) 41

Transmitter Emissions Data 41

Table 9 Transmitter Antenna Conducted Emissions Data 41
Table 10 Transmitter Radiated Emission Data (2 dBi Chip Antenna) 42
Table 11 Transmitter Radiated Emission Data (1 dBi NZH PCB Dipole Antenna) 43
Table 12 Transmitter Radiated Emission Data (5 dBi Dipole Antenna) 44
Table 13 Transmitter Radiated Emission Data (6 dBi Omni Antenna) 45
Table 14 Transmitter Radiated Emission Data (9 dBi Panel Antenna) 46

Summary of Results for Radiated Emissions of Intentional Radiator 47

ANNEX 48

Annex A Measurement Uncertainty Calculations 49

Annex B Rogers Labs Test Equipment List 50

Annex C Rogers Qualifications 51

Annex D FCC Site Registration Letter 52

Annex E Industry Canada Site Registration Letter 53

Revisions

Revision 1, Report Issued October 15, 2012

Forward

The following information is submitted for consideration in obtaining Grant of Certification for License Exempt FHSS Intentional Radiator operating under CFR 47 Paragraph 15.247 and Industry Canada RSS-210.

Name of Applicant: Laird Technologies
11160 Thompson Avenue
Lenexa KS 66219

Model: RM024

FCC I.D.: KQL-RM024 IC: 2268C-RM024

Frequency Range: 2400.7-2470.9 MHz

Operating Power: 20.4 dBm, 110 mW (antenna port conducted) (0.11 Watts), Occupied Bandwidth 841.3 kHz (79 hop set) or 1.07 MHz (43 hop set), Antennas supported (Integral chip 2 dBi, PCB Dipole 1 dBi, Dipole 5 dBi, Omni 6 dBi, Panel 9 dBi)

Opinion / Interpretation of Results

Test Performed	Minimum Margin (dB)	Results
Antenna requirement per CFR 47 15.203	N/A	Complies
Restricted Bands (General Emissions) from Support Equipment (* Note1)	-4.8*	Complies
Restricted Bands (Tx) Emissions as per CFR 47 15.205 and RSS-210	-22.0	Complies
AC Line Conducted Emissions as per CFR 47 15.207	-28.0	Complies
Radiated Emissions as per CFR 47 15.209 and RSS-210 (* Note 1)	-4.8*	Complies
Radiated Emissions per CFR 47 15.247 and RSS-210 (harmonics)	-24.1	Complies

*Note 1) General Radiated emissions emanated from test setup support computer system presented highest general radiated emission and lowest radiated emission margin as presented.

Statement of Modifications and Deviations

No modifications to the EUT were required for the unit to demonstrate compliance with the CFR47 Part 15C or RSS-210 emissions requirements. There were no deviations or exceptions to the specifications.

Equipment Tested

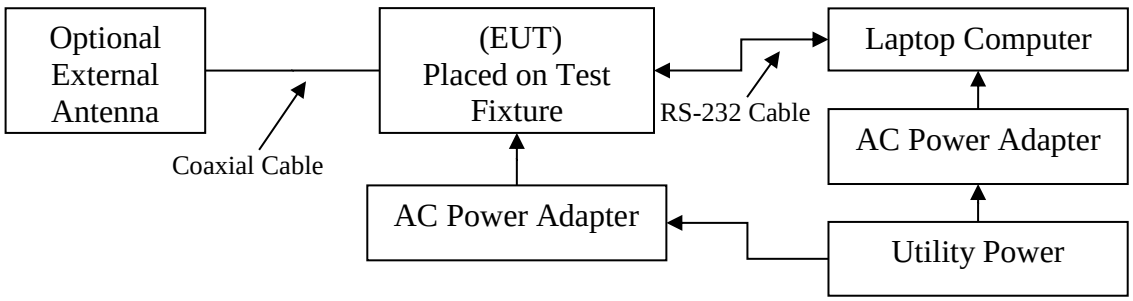
Equipment	Model	FCC I.D. #
EUT	RM024	KQL-RM024
CPU	HP CRVSA-02T1-75	TW24416178
2 dBi Chip	WIC2450A	N/A
1 dBi PCB Dipole	NZH2400-MMCX	N/A
5 dBi Dipole	S151-6-PX-2450S	N/A
6 dBi Omni	IG2450-RS36	N/A
9 dBi Panel	ID2450-RS36	N/A

Antennas (2 dBi Integral chip, 6 dBi Omni, 9dBi Panel, 5dBi Dipole, 1 dBi PCB Dipole)

Equipment Function and Configuration

The EUT is a 2400.7-2470.9 MHz Frequency Hopping Spread Spectrum Transceiver Module used to transmit data in applications offering wireless connectivity. The design offer operation in either 43 hop set or 79 hop set mode. The equipment is marketed for use to incorporate a wireless link to exchange data information from one point to another. The design offers two antenna options (PCB mounted chip antenna and u.fl connection). For testing purposes the RM024 transceiver was connected to the manufacturer supplied test fixture, AC/DC power adapter, and communicating to the laptop computer allowing for data communications and operational control of the transmitter. The RM024 received power from the test fixture and offers no other provision for connection to I/O or utility power systems. Preliminary investigation was performed for all channel bandwidths and modes of operation. Testing of the RM024 and support equipment was performed with the EUT placed on the test fixture, powered from the AC/DC power adapter, and set to transmit in all available data modes and channels.

Equipment Configuration



Application for Certification

(1) Manufacturer: Laird Technologies
11160 Thompson Avenue
Lenexa KS 66219

(2) Identification: Model: RM024
FCC I.D.: KQL-RM024
IC: 2268C-RM024

(3) Instruction Book:

Refer to Exhibit for Instruction Manual.

(4) Description of Circuit Functions:

Refer to Exhibit of Operational Description.

(5) Block Diagram with Frequencies:

Refer to Exhibit of Operational Description.

(6) Report of Measurements:

Report of measurements follows in this Report.

(7) Photographs: Construction, Component Placement, etc.:

Refer to Exhibit for photographs of equipment.

(8) List of Peripheral Equipment Necessary for operation. The equipment operates from power received from support circuitry. The module was placed on the support development board and communications to CPU through the RS-232 interface of the laptop computer during testing. Antenna configurations as documented were tested for Certification Five antenna configurations were tested and data included for authorization purposes.

(9) Transition Provisions of 15.37 are not being requested.

(10) Not Applicable. The unit is not a scanning receiver.

(11) Not Applicable. The EUT does not operate in the 59 – 64 GHz frequency band.

(12) The equipment is not software defined and this section is not applicable.

Applicable Standards & Test Procedures

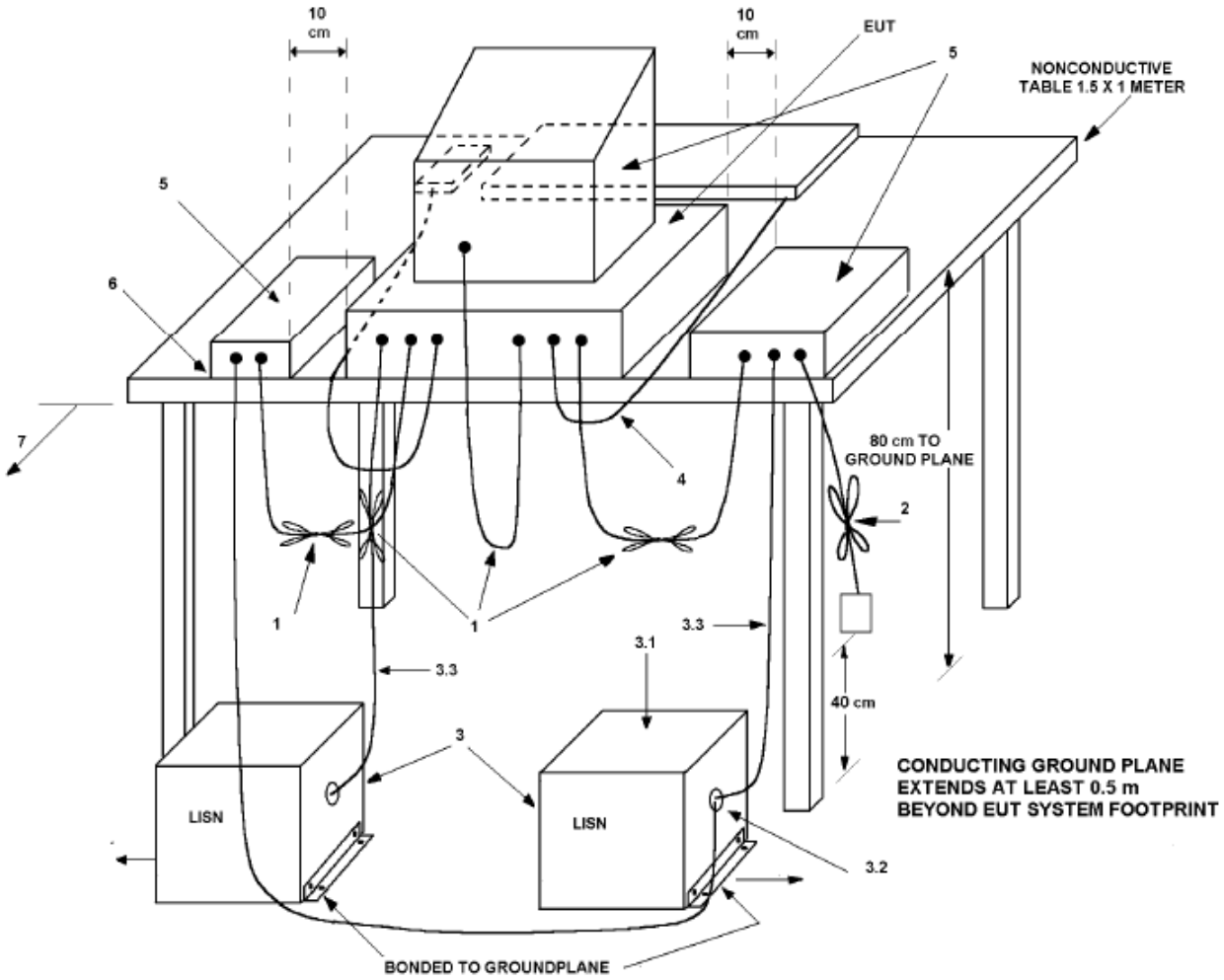
In accordance with the Federal Communications Code of Federal Regulations, dated October 1, 2011, Part 2, Subpart J, Paragraphs 2.907, 2.911, 2.913, 2.925, 2.926, 2.1031 through 2.1057, and applicable parts of paragraph 15, Part 15C Paragraph 15.247 and Industry Canada standard RSS-210 Issue 8 the following information is submitted. Test procedures used are the established Methods of Measurement of Radio-Noise Emissions as described in the ANSI C63.4-2009, FCC documents KDB 996369, DA00-1407, and DA00-705 and/or TIA/EIA 603-1. Testing for the AC line-conducted emissions were performed as defined in sections 7 and 13.1.3, testing of the radiated emissions was performed as defined in sections 8 and 13.1.4 of ANSI C63.4-2009. Testing of the intentional radiated emissions was performed as defined in section 13 of ANSI C63.4-2009.

Equipment Testing Procedures

AC Line Conducted Emission Test Procedure

The EUT operates from DC power only received from host support equipment and must be connected to supporting circuitry for power and interface communications. For testing purposes the EUT was placed on the development support board (test fixture) and communicating to the computer allowing for operational control of the transmitter and communications. For testing purposes, the manufacturer supplied AC/DC power adapter was used to power the test fixture and system. The EUT operates from DC power only and must be connected to an approved AC/DC adapter for operation. For testing purposes, the manufacturer supplied AC/DC power adapter was used to power the EUT. Testing for the AC line-conducted emissions testing was performed as defined in sections 7 and 13.1.3 of ANSI C63.4-2009. The test setup including the EUT was arranged in typical equipment configurations and placed on a 1 x 1.5-meter wooden bench, 0.8 meters high located in a screen room. The power lines of the system were isolated from the power source using a standard LISN with a 50-µHy choke. EMI was coupled to the spectrum analyzer through a 0.1 µF capacitor internal to the LISN. The LISN was positioned on the floor beneath the wooden bench supporting the EUT. The power lines and cables were draped over the back edge of the table. Refer to diagram 1 showing typical test arrangement and photographs in the test setup exhibits for specific EUT placement during testing. Refer to photographs in the test setup exhibits for EUT placement during testing.

Diagram 1 Test arrangement for Conducted emissions



1. Interconnecting cables that hang closer than 40 cm to the ground plane were folded back and forth in the center forming a bundle 30 cm to 40 cm long.
2. Input/output (I/O) cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.
3. EUT connected to one LISN. Unused LISN measuring port connectors are terminated into 50 Ω loads. LISN is placed on top of and bonded to reference ground plane.

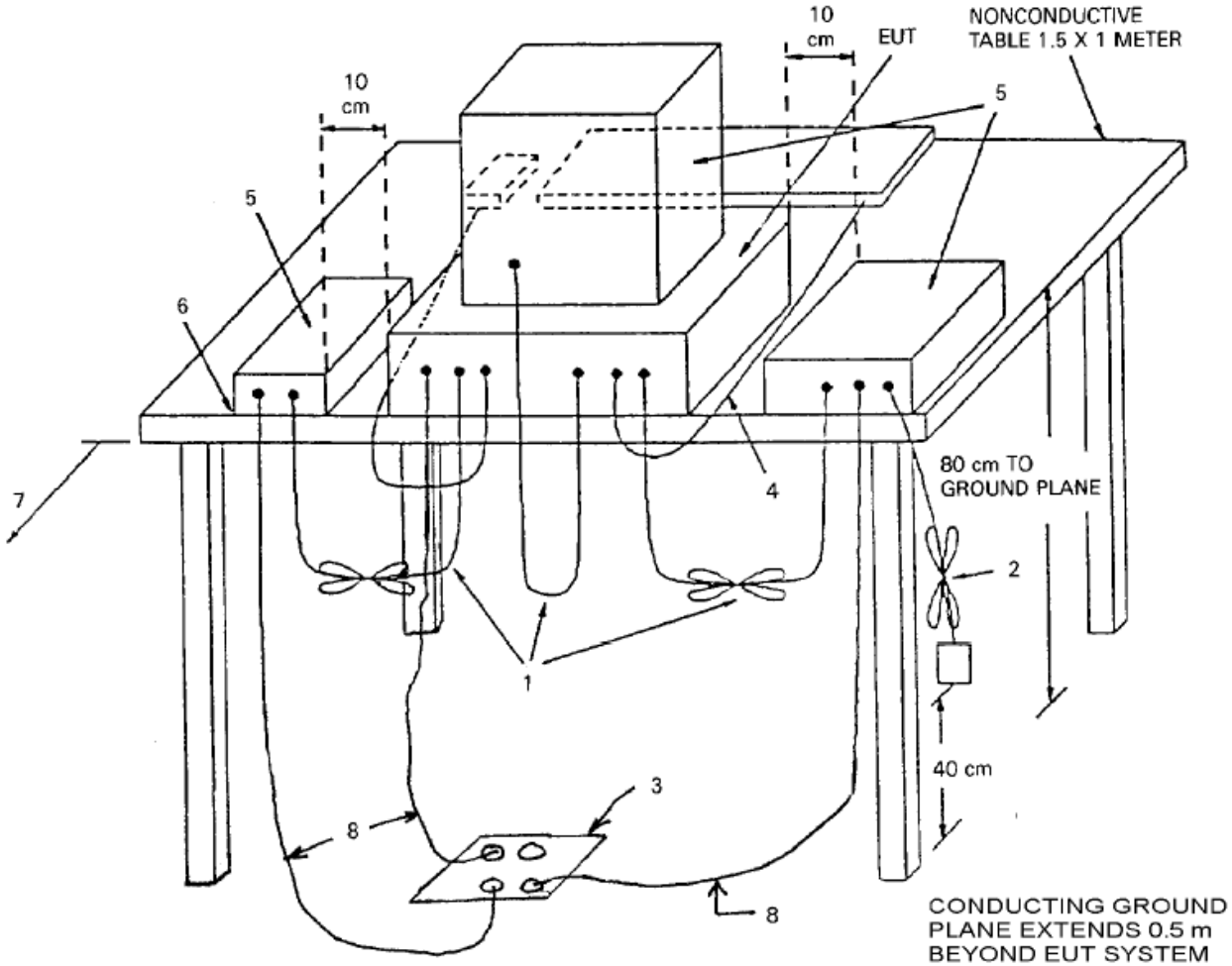
3.1 All other equipment powered from additional LISN(s).
3.2 Multiple outlet strips can be used for multiple power cords of non-EUT equipment.
3.3 LISN is positioned at least 80 cm from nearest part of EUT chassis.

4. Cables of hand-operated devices, such as keyboards, mice, and so on, shall be placed as for normal use.
5. Non-EUT components of EUT system being tested.
6. Rear of EUT, including peripherals, shall all be aligned and flush with rear of tabletop.
7. Rear of tabletop shall be 40 cm removed from a vertical conducting plane that is bonded to the ground plane (see 5.2.2 for options).

Radiated Emission Test Procedure

The EUT was placed on a rotating 1 x 1.5-meter wooden platform, 0.8 meters above the ground plane at a distance of 3 meters from the FSM antenna. Testing for the radiated emissions was performed as required by CFR47 15, RSS-210 and specified in sections 8 and 13.1.4 of ANSI C63.4-2009. EMI energy was maximized by equipment placement, raising and lowering the FSM antenna, changing the antenna polarization, and by rotating the turntable. Each emission was maximized before data was taken using a spectrum analyzer. The frequency spectrum from 9 kHz to 25,000 MHz was searched for during preliminary investigation. Refer to diagrams 2 and 3 showing typical test arrangement and photographs in the test setup exhibits for specific EUT placement during testing.

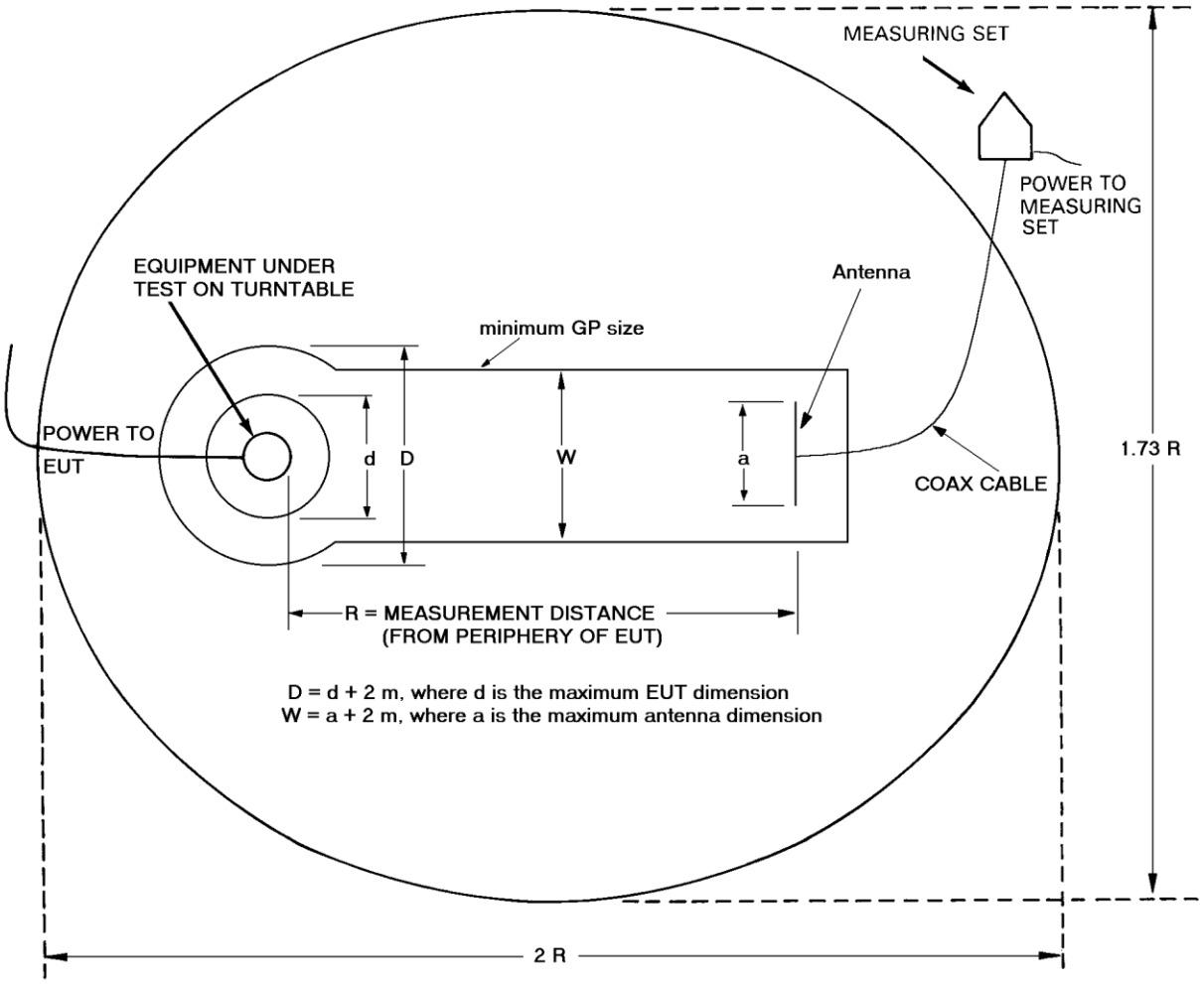
Diagram 2 Test arrangement for radiated emissions of tabletop equipment



1. Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center, forming a bundle 30 cm to 40 cm long.

2. I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated if required using the correct terminating impedance. The total length shall not exceed 1 m.
3. If LISNs are kept in the test setup for radiated emissions, it is preferred that they be installed under the ground plane with the receptacle flush with the ground plane.
4. Cables of hand-operated devices, such as keyboards, mice, and so on, shall be placed as for normal use.
5. Non-EUT components of EUT system being tested.
6. Rear of EUT, including peripherals, shall all be aligned and flush with rear of tabletop (possibly center of table for transmitter equipment).
7. No vertical conducting plane used.
8. Power cords drape to the floor and are routed over to receptacle.

Diagram 3 Test arrangement for radiated emissions tested on Open Area Test Site (OATS)



AREA DIMENSIONS =	R = 3m	R = 10 m	R = 30 m
	6 m x 5.2 m	20 m x 17.3 m	60 m x 52 m

List of Test Equipment

A Rohde and Schwarz ESU40 and/or Hewlett Packard 8591EM was used as the measuring device for the emissions testing of frequencies below 1 GHz. A Rohde and Schwarz ESU40 and/or Hewlett Packard 8562A Spectrum Analyzer was used as the measuring device for testing the emissions at frequencies above 1 GHz. The analyzer settings used are described in the following table. Refer to the appendix for a complete list of test equipment.

AC Line Conducted Emissions (0.150 -30 MHz)		
RBW	AVG. BW	Detector Function
9 kHz	30 kHz	Peak / Quasi Peak
Emissions (30-1000 MHz)		
RBW	AVG. BW	Detector Function
120 kHz	300 kHz	Peak / Quasi Peak
Emissions (Above 1000 MHz)		
RBW	Video BW	Detector Function
100 kHz	100 kHz	Peak
1 MHz	1 MHz	Peak / Average

Equipment	Manufacturer	Model	Band	Cal Date	Due
☒ LISN	Comp. Design	FCC-LISN-2-MOD.CD	.15-30MHz	10/11	10/12
☒ Antenna	ARA	BCD-235-B	20-350MHz	10/11	10/12
☒ Antenna	EMCO	3147	200-1000MHz	10/11	10/12
☒ Antenna	Com Power	AH-118	1-18 GHz	10/11	10/12
☒ Antenna	Com Power	AH-840	18-40 GHz	10/11	10/12
☒ Antenna	Standard	FXRY638A	10-18 GHz	3/12	5/13
☒ Antenna	EMCO	6509	.001-30 MHz	2/12	2/13
☐ Antenna	EMCO	3143	20-1200 MHz	5/12	5/13
☒ Antenna	Sunol	JB-6	30-1000 MHz	5/12	5/13
☐ Analyzer	HP	8591EM	9kHz-1.8GHz	5/12	5/13
☐ Analyzer	HP	8562A	9kHz-110GHz	5/12	5/13
☒ Analyzer	Rohde & Schwarz	ESU40	20Hz-40GHz	5/12	5/13
☒ Amplifier	Com-Power	PA-010	100Hz-30MHz	10/11	10/12
☒ Amplifier	Com-Power	CPPA-102	1-1000 MHz	10/11	10/12
☒ Amplifier	Com-Power	PA-22	0.5-22 GHz	10/11	10/12

Environmental Conditions

Ambient Temperature	23.4° C
Relative Humidity	38%
Atmospheric Pressure	1015.5 mb

Test Site Locations

Conducted EMI	The AC power line conducted emissions testing performed in a shielded screen room located at Rogers Labs, Inc., 4405 W. 259th Terrace, Louisburg, KS
Radiated EMI	The radiated emissions tests were performed at the 3 meters, Open Area Test Site (OATS) located at Rogers Labs, Inc., 4405 W. 259th Terrace, Louisburg, KS
Site Registration	Refer to Annex for Site Registration Letters
NVLAP Accreditation	Lab code 200087-0

Units of Measurements

Conducted EMI	Data is in dBµV; dB referenced to one microvolt
Radiated EMI	Data is in dBµV/m; dB/m referenced to one microvolt per meter

Sample Calculation:

RFS = Radiated Field Strength, FSM = Field Strength Measured

A.F. = Receive antenna factor, Gain = amplification gains and/or cable losses

RFS (dBµV/m @ 3m) = FSM (dBµV) + A.F. (dB/m) - Gain (dB)

Intentional Radiators

As per CFR47, Subpart C, paragraph 15.247 and RSS-210 the following information is submitted.

Antenna Requirements

The product is produced with U.FL antenna connector to be used with approved antenna structures or PCB mounted Chip antenna as described in accompanying documentation. The antenna connection point complies with the unique antenna connection requirements. The requirements are fulfilled and there are no deviations or exceptions to the specification.

Restricted Bands of Operation

Spurious emissions falling in the restricted frequency bands of operation were measured at a distance of three meters on the OATS. The EUT utilizes frequency, determining circuitry, which generates harmonics falling in the restricted bands. Emissions were measured at the OATS, using appropriate antennas or pyramidal horns, amplification stages, and a spectrum analyzer. Emissions emanating from the support computer system in the restricted bands of operation are presented in Table 1. Emissions emanating from the transmitter module in restricted bands of operation are presented in Tables 2 through 6. Emissions No other significant emission was observed which fell into the restricted bands of operation.

Table 1 Radiated Emissions in Restricted Bands Data (General all antennas)

Frequency in MHz	Horizontal Peak (dBµV/m)	Horizontal Quasi-Peak (dBµV/m)	Horizontal Average (dBµV/m)	Vertical Peak (dBµV/m)	Vertical Quasi-Peak (dBµV/m)	Vertical Average (dBµV/m)	Limit @ 3m (dBµV/m)
111.7	35.6	28.9	N/A	42.1	36.5	N/A	43.5
114.6	32.9	26.7	N/A	39.0	34.8	N/A	43.5
115.2	33.7	26.5	N/A	38.5	34.0	N/A	43.5
132.1	36.1	32.9	N/A	38.6	35.0	N/A	43.5
165.3	30.2	24.7	N/A	35.1	29.8	N/A	43.5
250.0	42.3	41.2	N/A	39.4	38.2	N/A	46.0
263.8	40.4	37.2	N/A	40.1	36.7	N/A	46.0
325.5	41.1	37.7	N/A	42.5	39.2	N/A	46.0

Other emissions present had amplitudes at least 20 dB below the limit.
Quasi-Peak amplitude emissions are recorded above for frequency range of 30-1000 MHz.
Average amplitude emissions are recorded above for frequency range above 1000 MHz.

Table 2 Radiated Emissions in Restricted Bands Data (2 dBi Chip Antenna)

Frequency in MHz	Horizontal Peak (dBµV/m)	Horizontal Quasi-Peak (dBµV/m)	Horizontal Average (dBµV/m)	Vertical Peak (dBµV/m)	Vertical Quasi-Peak (dBµV/m)	Vertical Average (dBµV/m)	Limit @ 3m (dBµV/m)
2390.0	30.8	N/A	14.6	31.5	N/A	16.9	54.0
2483.5	32.0	N/A	18.5	38.1	N/A	24.5	54.0
4801.4	33.0	N/A	20.7	36.3	N/A	26.2	54.0
4871.6	32.9	N/A	20.5	35.6	N/A	25.2	54.0
4941.8	32.7	N/A	20.2	34.4	N/A	23.1	54.0
7202.1	29.6	N/A	16.9	30.6	N/A	17.7	54.0
7307.4	29.3	N/A	16.7	30.4	N/A	19.0	54.0
7412.7	28.4	N/A	15.4	30.7	N/A	19.4	54.0
12003.5	33.5	N/A	20.8	32.6	N/A	20.2	54.0
12179.0	32.8	N/A	20.5	31.3	N/A	18.5	54.0
12354.5	31.8	N/A	19.6	32.5	N/A	18.9	54.0
14404.2	35.2	N/A	22.2	34.7	N/A	22.2	54.0

Other emissions present had amplitudes at least 20 dB below the limit. Quasi-Peak amplitude emissions are recorded above for frequency range of 30-1000 MHz. Average amplitude emissions are recorded above for frequency range above 1000 MHz.

Table 3 Radiated Emissions in Restricted Bands Data (1 dBi NZH Dipole Antenna)

Frequency in MHz	Horizontal Peak (dBµV/m)	Horizontal Quasi-Peak (dBµV/m)	Horizontal Average (dBµV/m)	Vertical Peak (dBµV/m)	Vertical Quasi-Peak (dBµV/m)	Vertical Average (dBµV/m)	Limit @ 3m (dBµV/m)
2390.0	33.4	N/A	18.3	30.5	N/A	15.1	54.0
2483.5	39.4	N/A	25.9	34.7	N/A	21.2	54.0
4801.4	32.3	N/A	19.9	33.9	N/A	22.5	54.0
4871.6	32.0	N/A	19.5	33.1	N/A	21.3	54.0
4941.8	32.4	N/A	19.4	34.0	N/A	21.2	54.0
7202.1	30.7	N/A	18.0	33.5	N/A	22.2	54.0
7307.4	30.6	N/A	17.8	32.5	N/A	20.3	54.0
7412.7	28.8	N/A	16.6	29.7	N/A	17.4	54.0
12003.5	33.4	N/A	20.4	35.4	N/A	23.4	54.0
12179.0	30.9	N/A	18.1	30.8	N/A	18.4	54.0
12354.5	31.5	N/A	18.8	32.7	N/A	20.2	54.0
14404.2	35.1	N/A	22.4	35.5	N/A	22.8	54.0

Other emissions present had amplitudes at least 20 dB below the limit. Quasi-Peak amplitude emissions are recorded above for frequency range of 30-1000 MHz. Average amplitude emissions are recorded above for frequency range above 1000 MHz.

Table 4 Radiated Emissions in Restricted Bands Data (5 dBi Dipole Antenna)

Frequency in MHz	Horizontal Peak (dBµV/m)	Horizontal Quasi-Peak (dBµV/m)	Horizontal Average (dBµV/m)	Vertical Peak (dBµV/m)	Vertical Quasi-Peak (dBµV/m)	Vertical Average (dBµV/m)	Limit @ 3m (dBµV/m)
2390.0	28.0	N/A	14.2	34.3	N/A	19.1	54.0
2483.5	33.9	N/A	21.0	43.0	N/A	29.1	54.0
4801.4	33.1	N/A	21.0	36.3	N/A	25.4	54.0
4871.6	32.2	N/A	19.9	34.3	N/A	23.4	54.0
4941.8	33.5	N/A	20.7	35.9	N/A	25.2	54.0
7202.1	30.7	N/A	17.2	32.0	N/A	20.5	54.0
7307.4	31.2	N/A	18.8	30.5	N/A	17.7	54.0
7412.7	29.5	N/A	17.2	29.7	N/A	17.6	54.0
12003.5	33.4	N/A	20.8	36.6	N/A	24.2	54.0
12179.0	30.4	N/A	18.3	35.3	N/A	23.5	54.0
12354.5	33.2	N/A	19.9	35.3	N/A	23.9	54.0
14404.2	35.5	N/A	22.4	35.1	N/A	22.5	54.0

Other emissions present had amplitudes at least 20 dB below the limit. Quasi-Peak amplitude emissions are recorded above for frequency range of 30-1000 MHz. Average amplitude emissions are recorded above for frequency range above 1000 MHz.

Table 5 Radiated Emissions in Restricted Bands Data (6 dBi Omni Antenna)

Frequency in MHz	Horizontal Peak (dBµV/m)	Horizontal Quasi-Peak (dBµV/m)	Horizontal Average (dBµV/m)	Vertical Peak (dBµV/m)	Vertical Quasi-Peak (dBµV/m)	Vertical Average (dBµV/m)	Limit @ 3m (dBµV/m)
2390.0	27.0	N/A	12.9	40.0	N/A	20.4	54.0
2483.5	28.0	N/A	14.5	28.5	N/A	14.5	54.0
4801.4	32.5	N/A	20.2	35.3	N/A	25.2	54.0
4871.6	32.4	N/A	20.3	33.6	N/A	21.9	54.0
4941.8	32.8	N/A	20.7	34.4	N/A	23.0	54.0
7202.1	29.7	N/A	17.4	31.3	N/A	19.2	54.0
7307.4	27.5	N/A	15.4	29.2	N/A	16.7	54.0
7412.7	27.3	N/A	14.8	28.0	N/A	14.7	54.0
12003.5	32.9	N/A	20.2	34.8	N/A	22.9	54.0
12179.0	32.3	N/A	19.1	31.3	N/A	19.1	54.0
12354.5	30.8	N/A	18.8	33.4	N/A	20.2	54.0
14404.2	35.1	N/A	22.2	34.9	N/A	22.5	54.0

Other emissions present had amplitudes at least 20 dB below the limit. Quasi-Peak amplitude emissions are recorded above for frequency range of 30-1000 MHz. Average amplitude emissions are recorded above for frequency range above 1000 MHz.

Table 6 Radiated Emissions in Restricted Bands Data (9 dBi Panel Antenna)

Frequency in MHz	Horizontal Peak (dBµV/m)	Horizontal Quasi-Peak (dBµV/m)	Horizontal Average (dBµV/m)	Vertical Peak (dBµV/m)	Vertical Quasi-Peak (dBµV/m)	Vertical Average (dBµV/m)	Limit @ 3m (dBµV/m)
2390.0	28.7	N/A	14.7	39.9	N/A	24.1	54.0
2483.5	34.0	N/A	21.2	45.4	N/A	32.0	54.0
4801.4	32.4	N/A	20.3	35.3	N/A	23.8	54.0
4871.6	32.4	N/A	20.0	33.3	N/A	21.3	54.0
4941.8	32.1	N/A	19.8	32.7	N/A	19.9	54.0
7202.1	30.0	N/A	17.4	32.0	N/A	17.6	54.0
7307.4	34.1	N/A	17.5	30.2	N/A	18.0	54.0
7412.7	28.7	N/A	16.4	30.5	N/A	17.0	54.0
12003.5	32.8	N/A	20.3	34.2	N/A	21.5	54.0
12179.0	31.8	N/A	19.1	33.4	N/A	20.5	54.0
12354.5	31.3	N/A	18.6	30.6	N/A	18.1	54.0
14404.2	36.1	N/A	22.3	35.1	N/A	22.5	54.0

Other emissions present had amplitudes at least 20 dB below the limit. Quasi-Peak amplitude emissions are recorded above for frequency range of 30-1000 MHz. Average amplitude emissions are recorded above for frequency range above 1000 MHz.

Summary of Results for Radiated Emissions in Restricted Bands

The EUT demonstrated compliance with the radiated emissions requirements of CFR 47 Part 15C and RSS-210 Intentional Radiators. The EUT transmitter demonstrated a minimum margin of –22.0 dB below the requirements. The EUT support computer system demonstrated a minimum margin of -4.8 dB below the requirements. Peak, Quasi-peak, and average amplitudes were checked for compliance with the regulations. Worst-case emissions are reported with other emissions found in the restricted frequency bands at least 20 dB below the requirements.

AC Line Conducted Emissions Procedure

The EUT was arranged in a typical equipment configuration and placed on a 1 x 1.5-meter wooden bench 80 cm above the conducting ground plane, floor of a screen room. The bench was positioned 40 cm away from the wall of the screen room. The LISN was positioned on the floor of the screen room 80-cm from the rear of the EUT. The manufacturer supplied AC power adapter for the EUT test fixture was connected to the LISN. A second LISN was positioned on the floor of the screen room 80-cm from the rear of the supporting equipment of the EUT. All power cords except the EUT were then powered from the second LISN. EMI was coupled to the spectrum analyzer through a 0.1 μF capacitor, internal to the LISN. Power line conducted emissions testing were carried out individually for each current carrying conductor of the EUT. The excess length of lead between the system and the LISN receptacle was folded back and forth to form a bundle not exceeding 40 cm in length. The screen room, conducting ground plane, analyzer, and LISN were bonded together to the protective earth ground. Preliminary testing was performed to identify the frequency of each radio frequency emission displaying the highest amplitude. The cables were repositioned to obtain maximum amplitude of measured EMI level. Once the worst-case configuration was identified, plots were made of the EMI from 0.15 MHz to 30 MHz then the data was recorded with maximum conducted emissions levels. Refer to figures one and two for plots of the EUT test fixture AC Power Line conducted emissions.

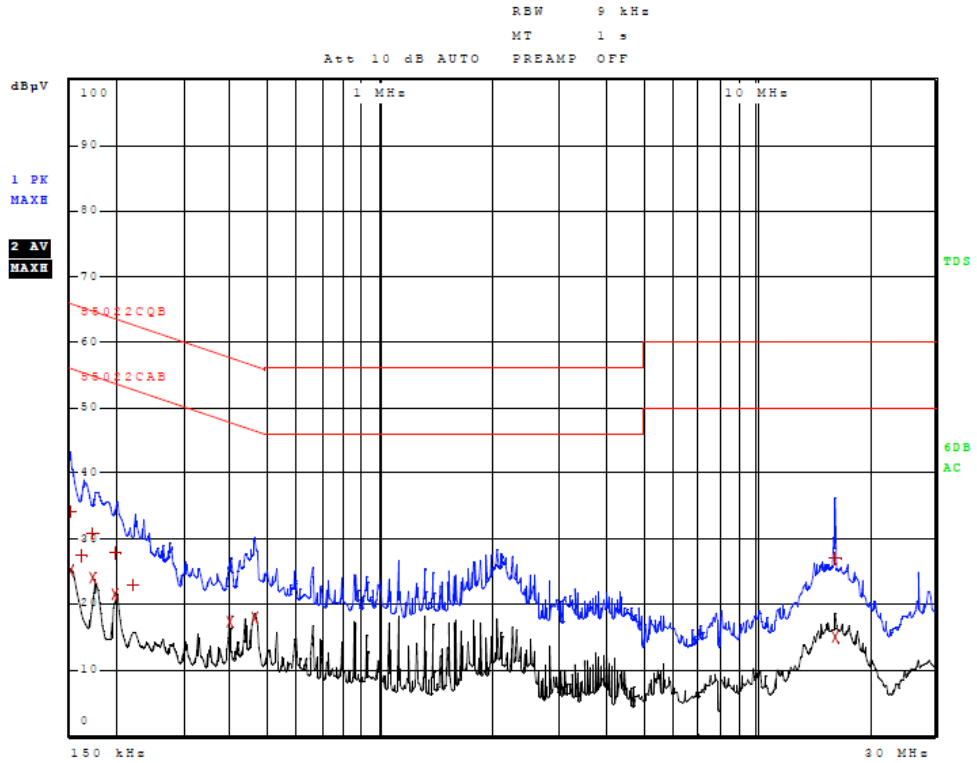


Figure One AC Line Conducted Emissions Line 1

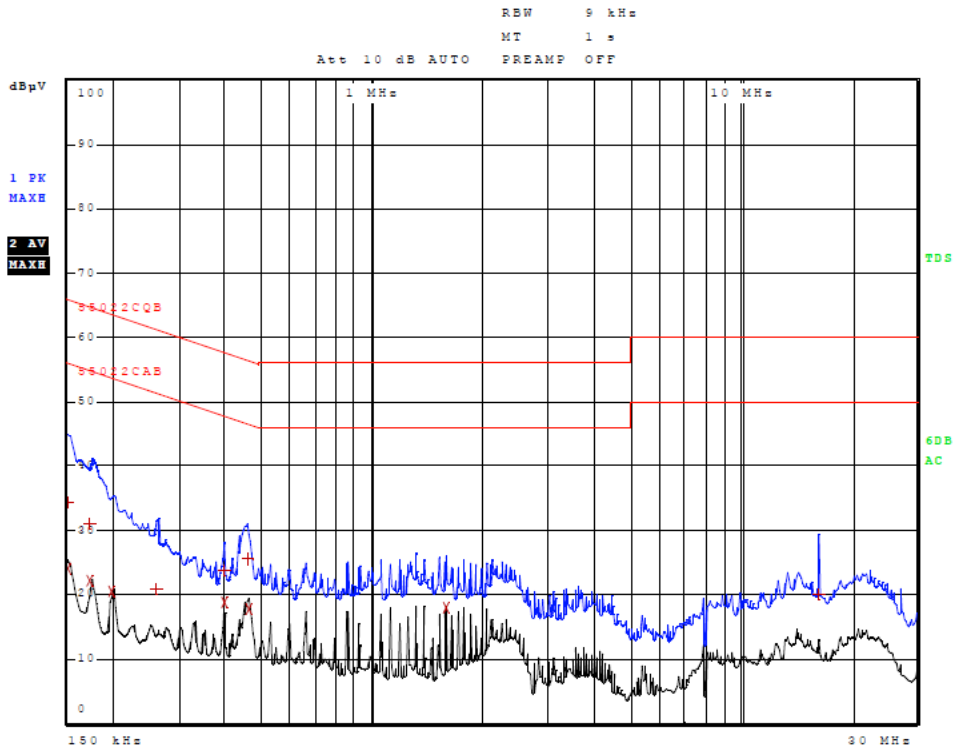


Figure Two AC Line Conducted Emissions Line 2

Table 7 AC Line Conducted Emissions Data (7 Highest Emissions)

Line 1

Trace	Frequency	Level (dBµV)	Detector	Delta Limit/dB
2	150.000000000 kHz	25.07	Average	-30.93
1	150.000000000 kHz	34.24	Quasi Peak	-31.76
1	162.000000000 kHz	27.49	Quasi Peak	-37.87
2	174.000000000 kHz	24.04	Average	-30.72
1	174.000000000 kHz	30.78	Quasi Peak	-33.99
2	198.000000000 kHz	21.59	Average	-32.11
1	198.000000000 kHz	27.83	Quasi Peak	-35.86
1	222.000000000 kHz	22.96	Quasi Peak	-39.79
2	394.000000000 kHz	17.34	Average	-30.64
2	462.000000000 kHz	18.00	Average	-28.66
1	16.260000000 MHz	27.00	Quasi Peak	-33.00
2	16.296000000 MHz	15.02	Average	-34.98

Line 2

Trace	Frequency	Level (dBµV)	Detector	Delta Limit/dB
2	150.000000000 kHz	23.97	Average	-32.03
1	150.000000000 kHz	34.42	Quasi Peak	-31.58
2	174.000000000 kHz	22.16	Average	-32.61
1	174.000000000 kHz	30.88	Quasi Peak	-33.88
2	198.000000000 kHz	20.51	Average	-33.18
1	262.000000000 kHz	20.83	Quasi Peak	-40.54
2	394.000000000 kHz	18.74	Average	-29.23
1	394.000000000 kHz	23.75	Quasi Peak	-34.23
1	458.000000000 kHz	25.50	Quasi Peak	-31.23
2	462.000000000 kHz	17.79	Average	-28.86
2	1.582000000 MHz	17.92	Average	-28.08
1	16.256000000 MHz	20.16	Quasi Peak	-39.84

Other emissions present had amplitudes at least 20 dB below the limit.

Summary of Results for AC Line Conducted Emissions

The EUT demonstrated compliance with the conducted emissions requirements of CFR47 Part 15C and RSS-210 equipment. The EUT demonstrated minimum margin of -28.0 dB below the limit. Measurements were taken using the peak, quasi peak, and average, measurement function for each emissions amplitude and were below the limits stated in the specification. Other emissions were present with recorded data representing worst-case amplitudes.

General Radiated EMI Testing Procedure

The EUT was arranged in the test fixture emulating worst-case equipment configuration and operated through all available modes with worst-case data recorded. Preliminary testing was performed in a screen room with the EUT positioned 1 meter from the FSM. Investigations were performed to identify the frequencies, which produced the highest radiated emissions. Radiated emission investigations were performed from 9 kHz to 25,000 MHz with the EUT positioned in three orthogonal axes per regulations. Frequencies of interest were recorded for use during testing on the OATS. Each investigated emission was then maximized at the OATS site before final radiated emissions measurements were performed. Final data was taken with the EUT located at the open area test site at a distance of 3 meters between the EUT and the receiving antenna. Test procedures of ANSI C63.4-2009 paragraphs 13.1 and 8.3.1.2 were used during radiated emissions testing. Peak and average amplitudes of frequencies above 1000 MHz were compared to the required limits with worst-case data presented below. Measured emission levels were maximized by EUT placement on the table, changing cable location, rotating the turntable through 360 degrees, varying the antenna height between 1 and 4 meters above the ground plane and changing antenna polarization between horizontal and vertical. Antennas used were Loop from 0.09 to 30 MHz, Broadband Biconical from 30 MHz to 200 MHz, Log Periodic from 200 MHz to 1 GHz, and/or Biconilog from 30 MHz to 1000 MHz, Double-Ridge, and/or Pyramidal Horns from 1 GHz to 25 GHz, and amplification stages.

Table 8 General Radiated Emissions Data (worst-case all antennas)

Frequency in MHz	Horizontal Peak (dBµV/m)	Horizontal Quasi-Peak (dBµV/m)	Horizontal Average (dBµV/m)	Vertical Peak (dBµV/m)	Vertical Quasi-Peak (dBµV/m)	Vertical Average (dBµV/m)	Limit @ 3m (dBµV/m)
48.8	37.1	32.0	N/A	35.4	27.6	N/A	40.0
97.6	38.2	34.1	N/A	39.3	37.1	N/A	43.5
102.4	36.6	28.6	N/A	40.9	37.5	N/A	43.5
105.0	37.6	33.7	N/A	34.5	31.7	N/A	43.5
111.7	35.6	28.9	N/A	42.1	36.5	N/A	43.5
114.6	32.9	26.7	N/A	39.0	34.8	N/A	43.5
115.2	33.7	26.5	N/A	38.5	34.0	N/A	43.5
132.1	36.1	32.9	N/A	38.6	35.0	N/A	43.5
165.3	30.2	24.7	N/A	35.1	29.8	N/A	43.5
250.0	42.3	41.2	N/A	39.4	38.2	N/A	46.0
263.8	40.4	37.2	N/A	40.1	36.7	N/A	46.0
325.5	41.1	37.7	N/A	42.5	39.2	N/A	46.0
396.3	44.7	39.6	N/A	43.6	39.3	N/A	46.0
455.7	42.7	40.3	N/A	42.3	39.4	N/A	46.0
660.0	42.2	38.5	N/A	44.4	39.2	N/A	46.0
666.0	46.2	40.6	N/A	45.3	39.9	N/A	46.0
927.3	47.6	39.2	N/A	43.5	37.2	N/A	46.0
932.0	47.6	40.8	N/A	43.9	39.6	N/A	46.0

Other emissions present had amplitudes at least 20 dB below the limit.
Quasi-Peak amplitude emissions are recorded above for frequency range of 30-1000 MHz.
Average amplitude emissions are recorded above for frequency range above 1000 MHz.

Summary of Results for General Radiated Emissions

The EUT demonstrated compliance with the general radiated emissions requirements of CFR47 Part 15.247 and RSS-210. The EUT demonstrated a minimum margin of -4.8 dB below general radiated emissions requirements. There are no other significantly measurable emissions in the restricted bands other than those recorded in this report. Other emissions were present with amplitudes at least 20 dB below the requirements.

Operation in the Band 2400 – 2483.5 MHz

The power output was measured both at the antenna connection port and at the open area test site at a three-meter distance with the authorized antenna systems. Harmonic emissions measurement data presented in tables 10 through 14 include Duty Cycle correction Factor (DCF) reduction of -17.7 dB (as authorized in 47 CFR paragraph 15.35(b) and RSS –GEN paragraph 4.5). The DCF was calculated using the absolute maximum transmitter on time (13 mS) over a 100 millisecond period (20log[13/100] = -17.7). Figures three through fourteen represent antenna conducted emissions across the frequency spectrum for both the 43 and 79 hopping modes. Figures fifteen through twenty-three demonstrate compliance of the 43 hop set mode with the FHSS requirements of 15.247(c) and RSS-210. Figures twenty-four through thirty-two demonstrate compliance of the 79 hop set mode with the FHSS requirements of 15.247(c) and RSS-210.

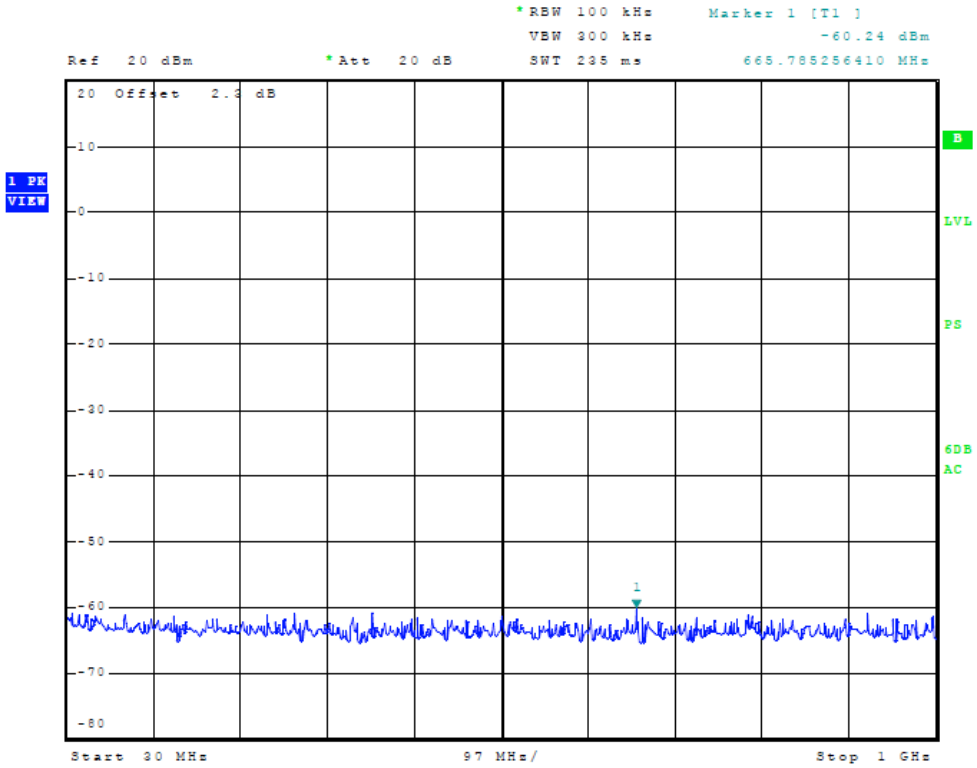


Figure Three of Antenna Port Conducted Emissions (43 Hop set)

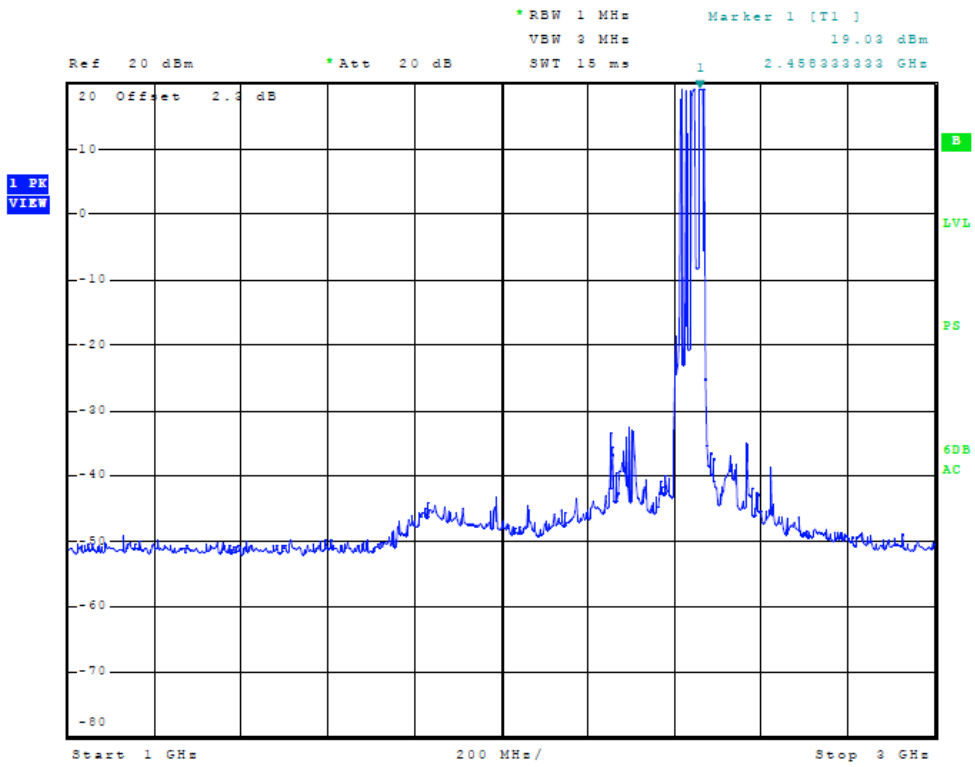


Figure Four of Antenna Port Conducted Emissions (43 Hop set)

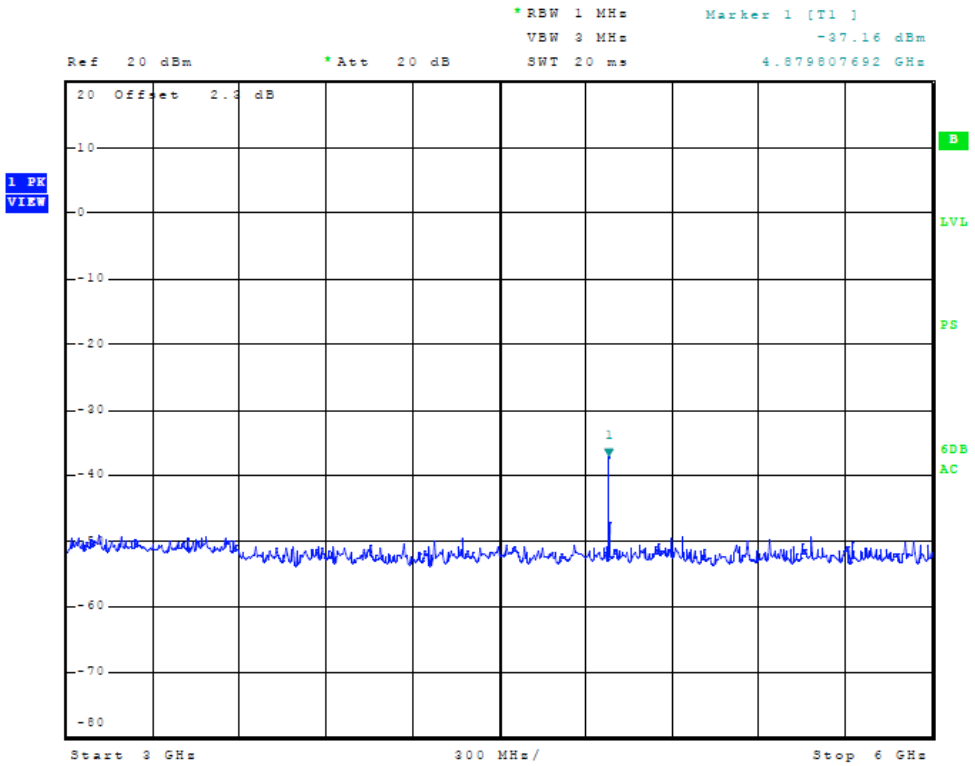


Figure Five of Antenna Port Conducted Emissions (43 Hop set)

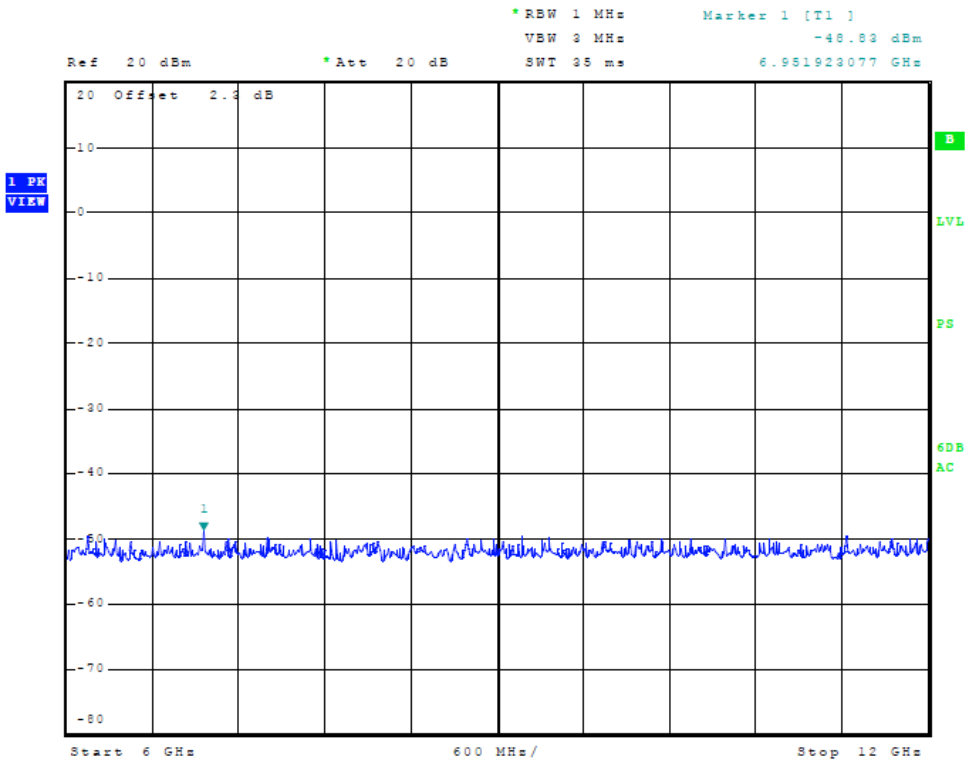


Figure Six of Antenna Port Conducted Emissions (43 Hop set)

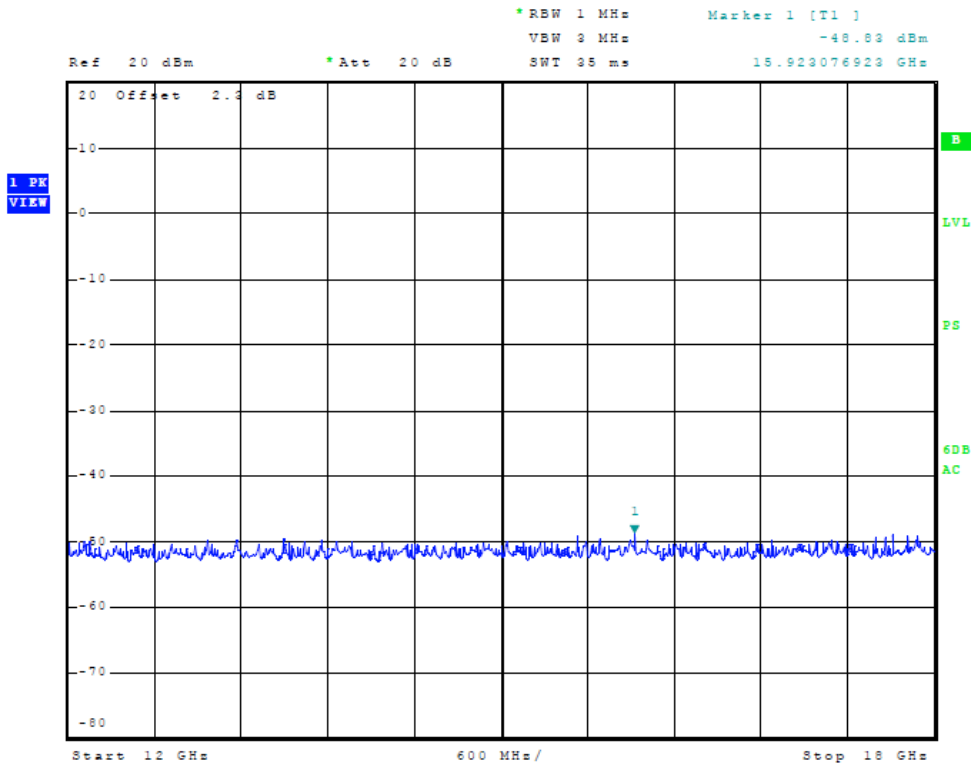


Figure Seven of Antenna Port Conducted Emissions (43 Hop set)

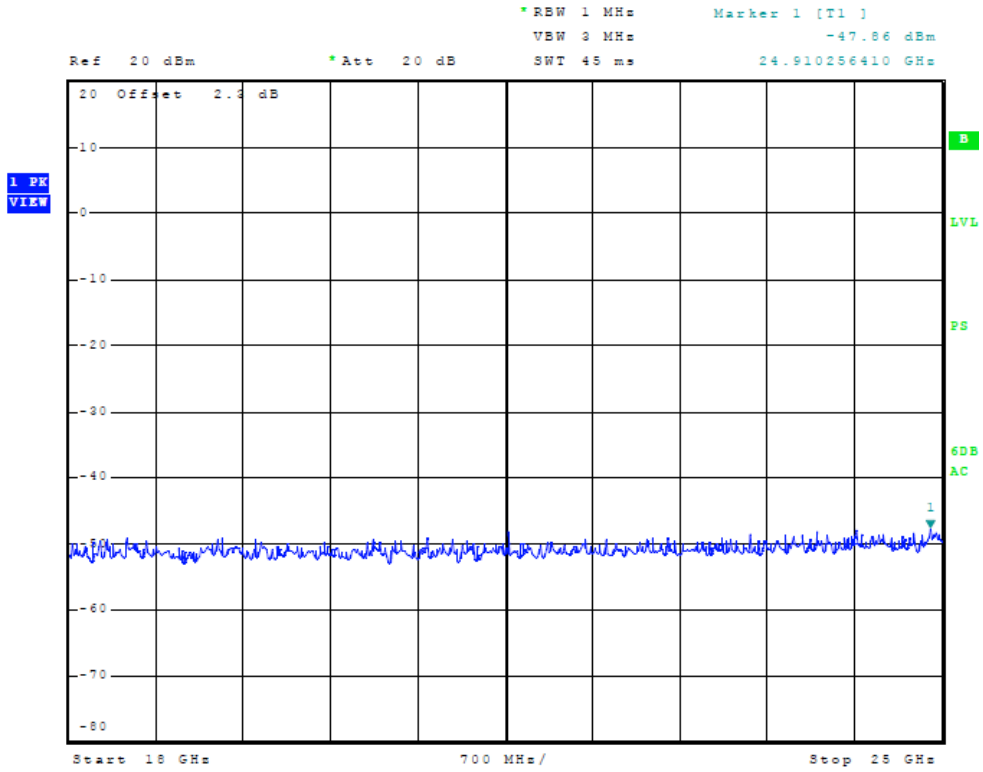


Figure Eight of Antenna Port Conducted Emissions (43 Hop set)

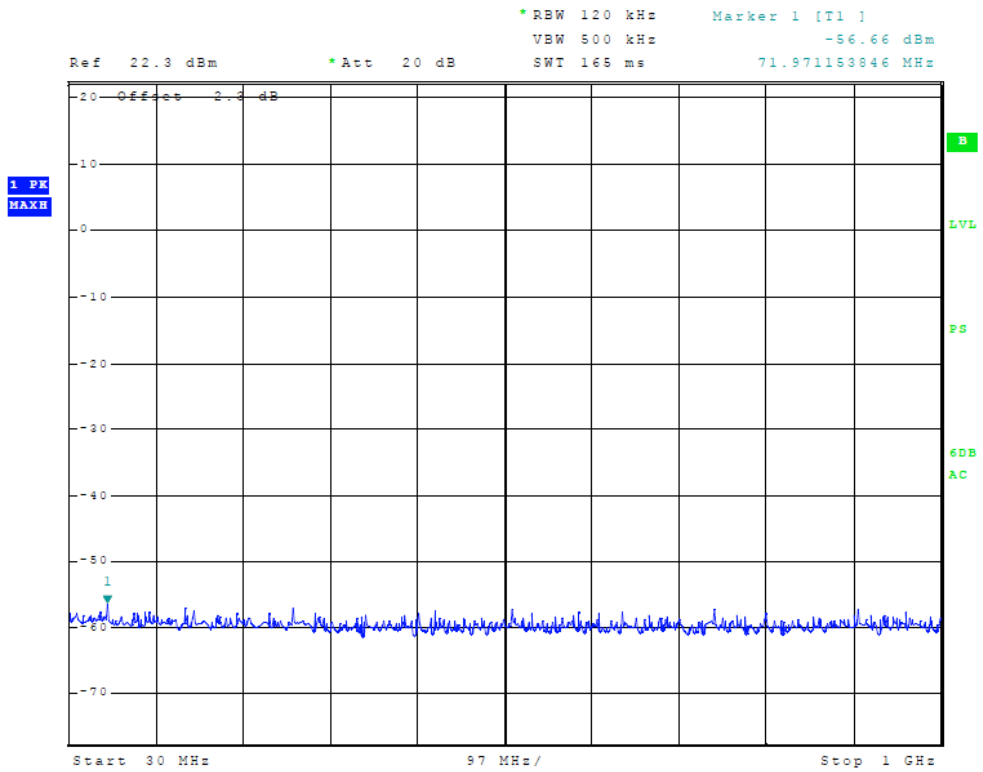


Figure Nine of Antenna Port Conducted Emissions (79 Hop set)

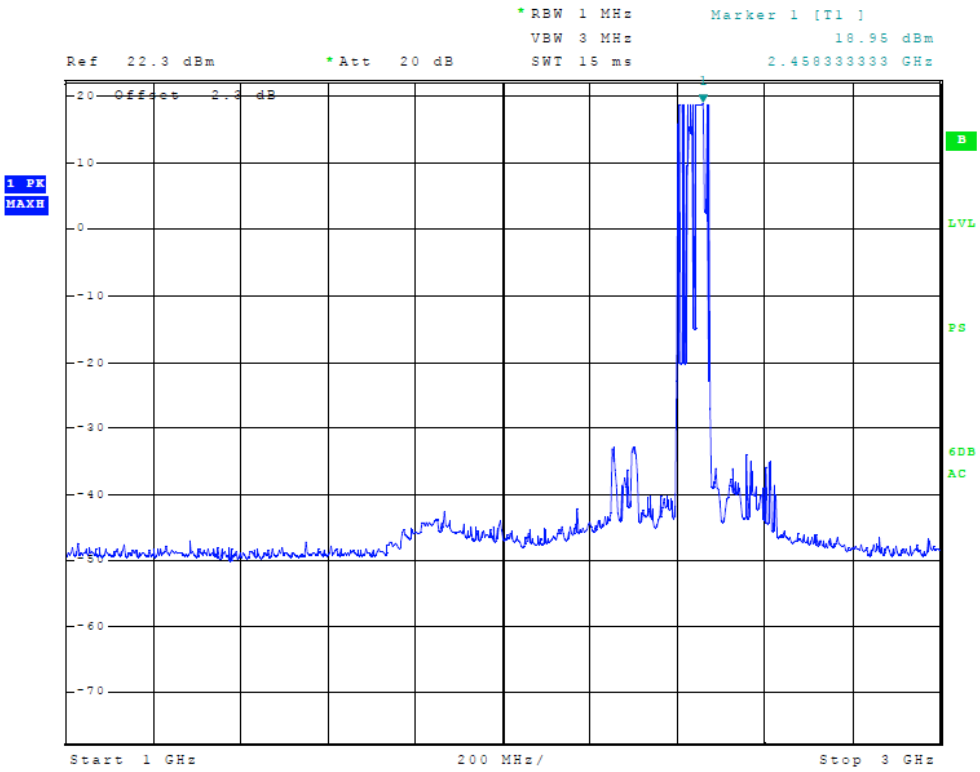


Figure Ten of Antenna Port Conducted Emissions (79 Hop set)

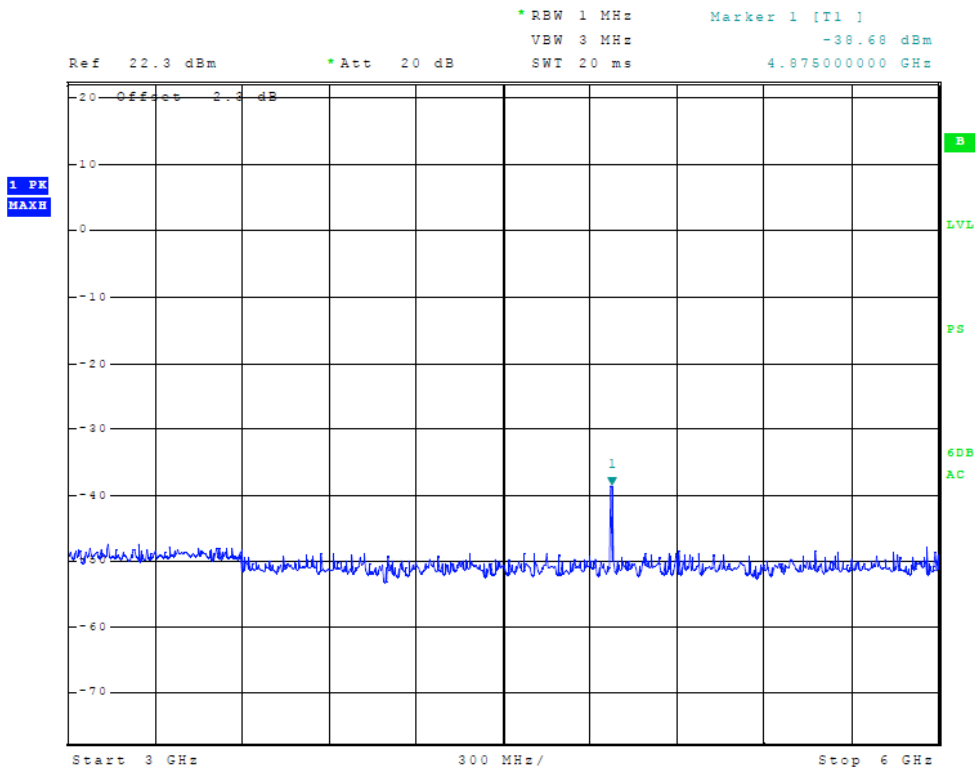


Figure Eleven of Antenna Port Conducted Emissions (79 Hop set)

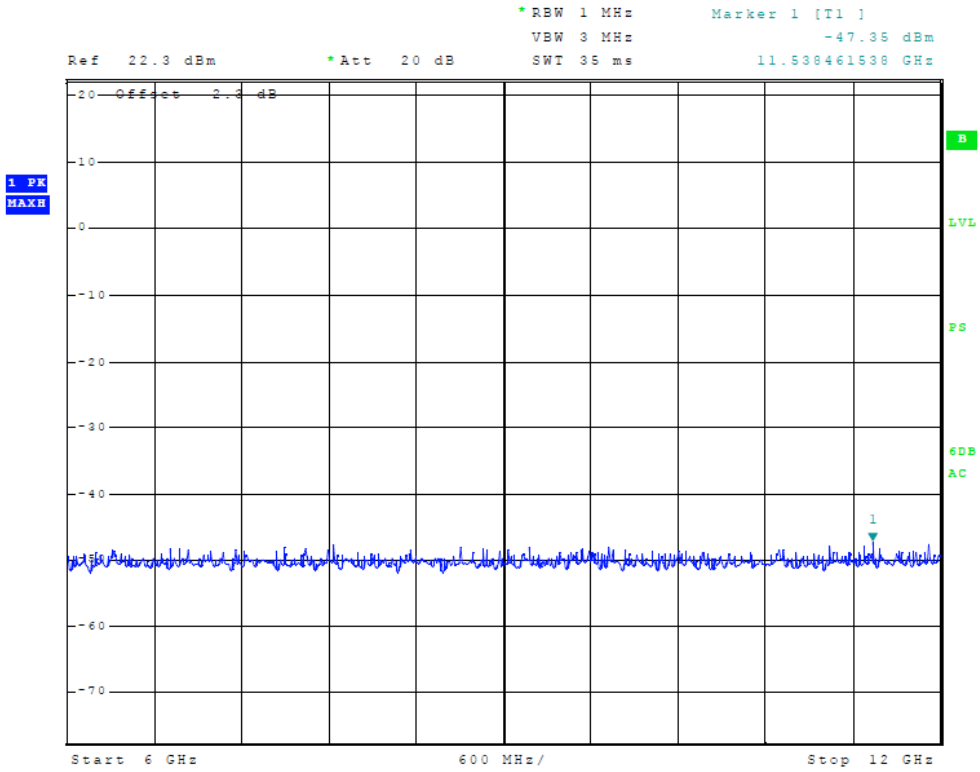


Figure Twelve of Antenna Port Conducted Emissions (79 Hop set)

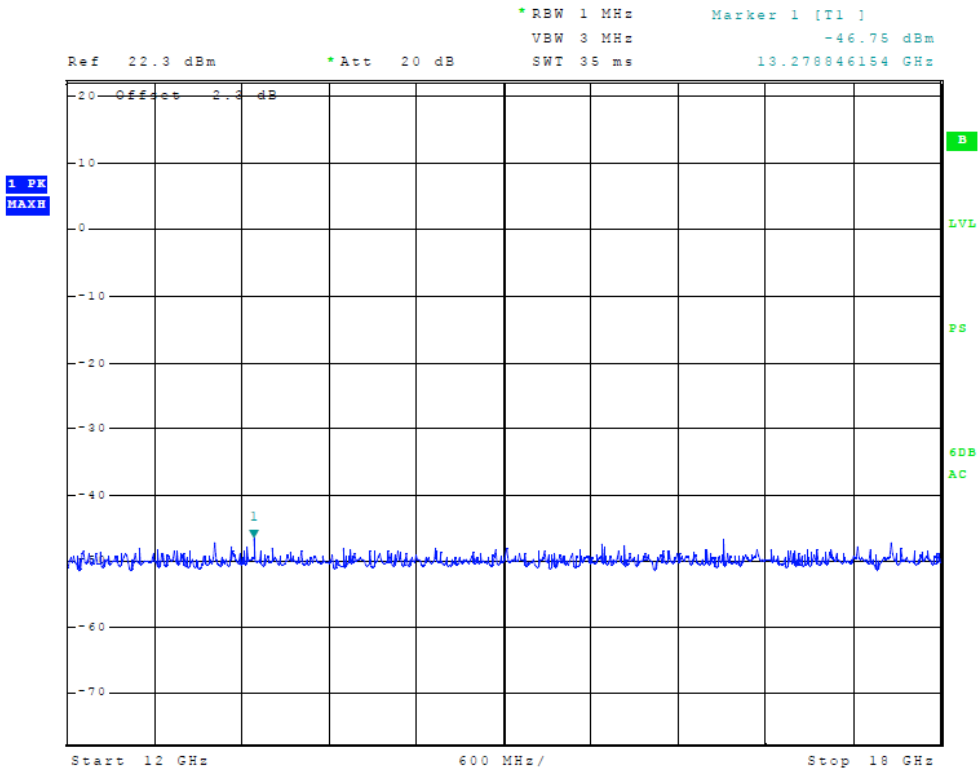


Figure Thirteen of Antenna Port Conducted Emissions (79 Hop set)

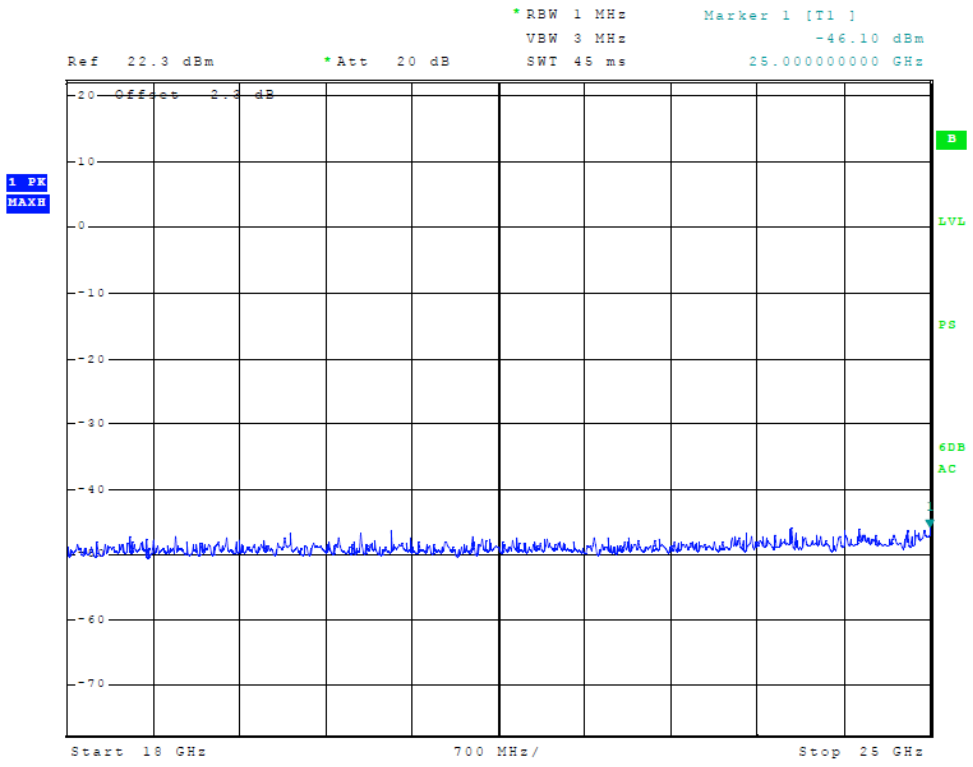


Figure Fourteen of Antenna Port Conducted Emissions (79 Hop set)

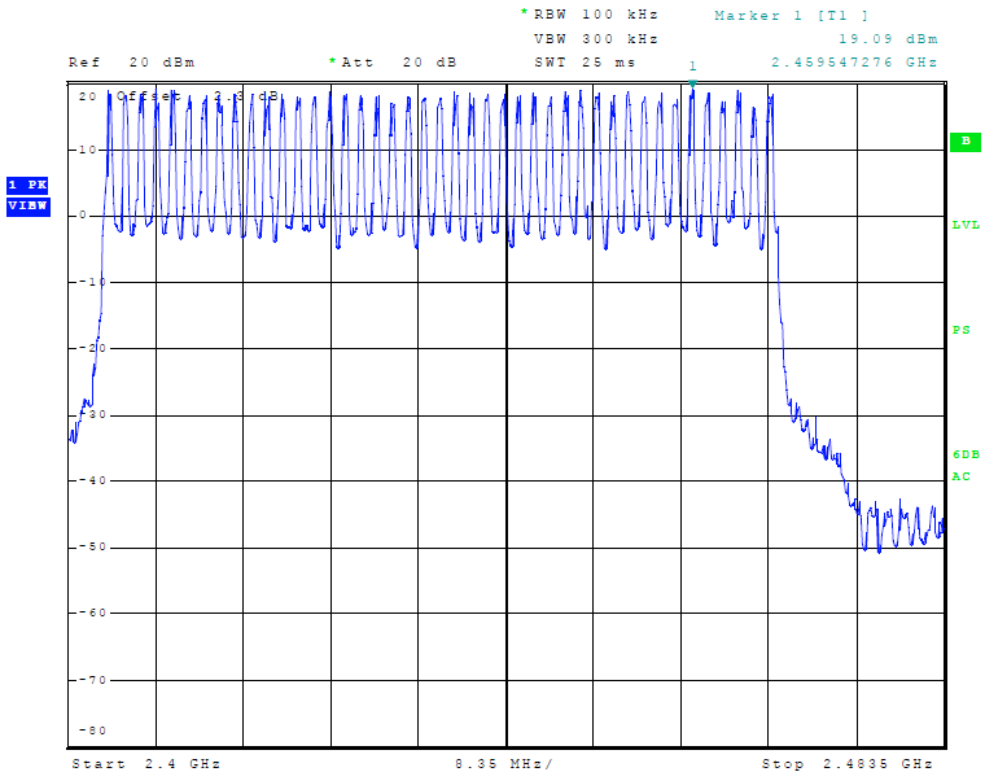


Figure Fifteen Plot of Output Across Operational Band (43 Hop set)

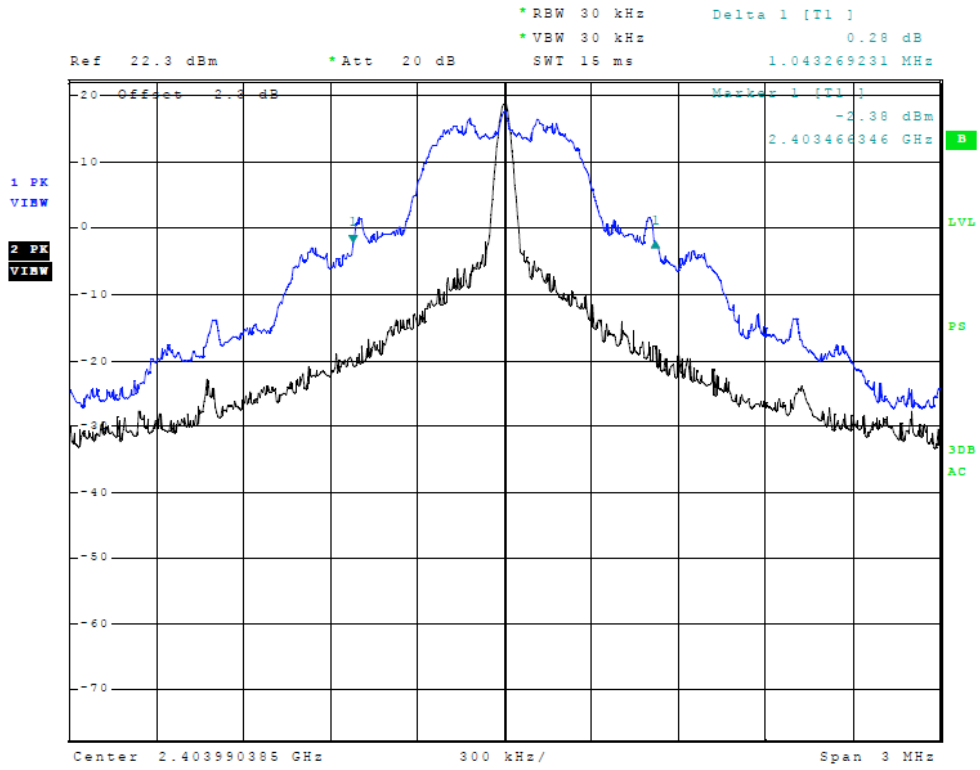


Figure Sixteen Plot of 20-dB Occupied Bandwidth (Low Channel) (43 Hop set)

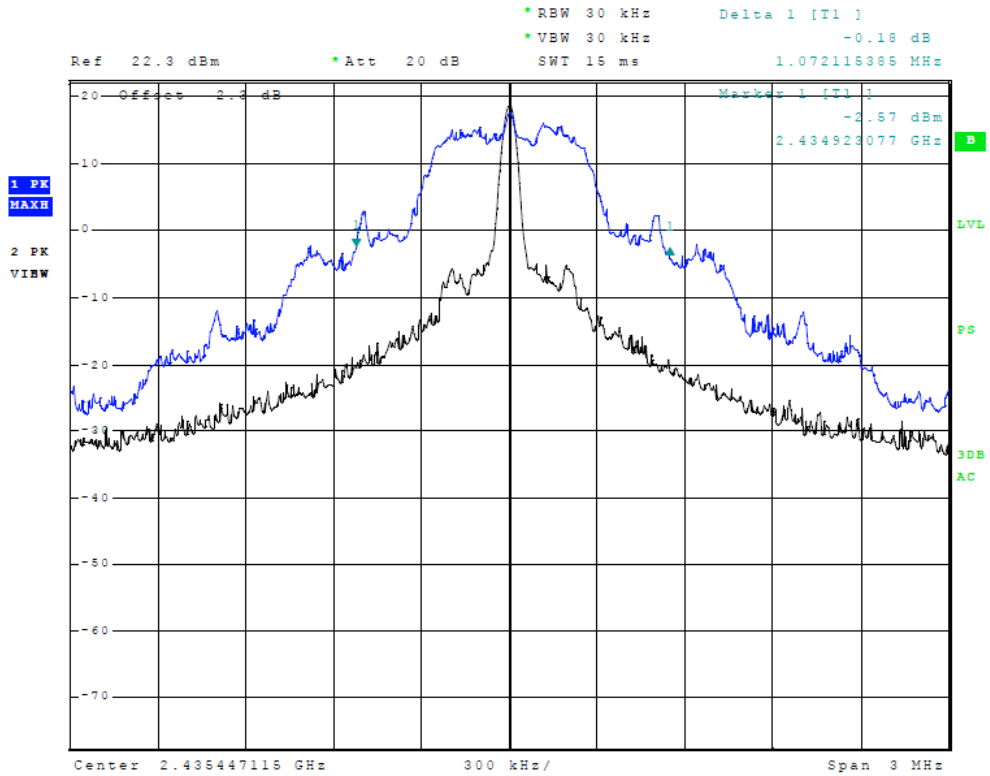


Figure Seventeen Plot of 20-dB Occupied Bandwidth (Middle Channel) (43 Hop set)

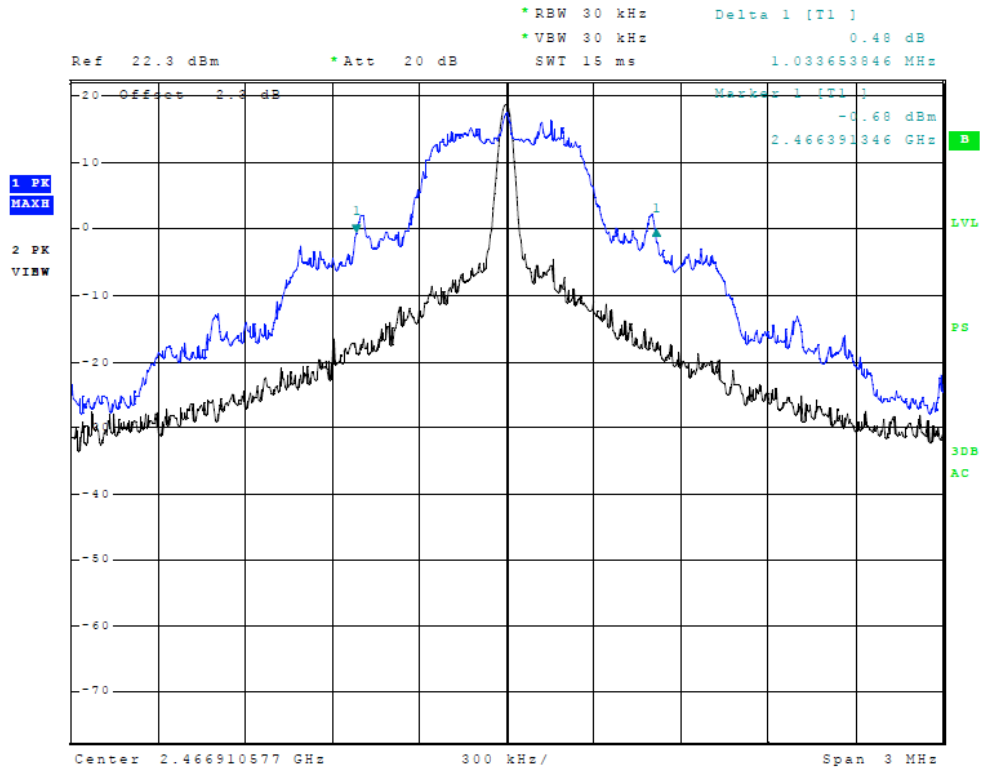


Figure Eighteen Plot of 20-dB Occupied Bandwidth (High Channel) (43 Hop set)

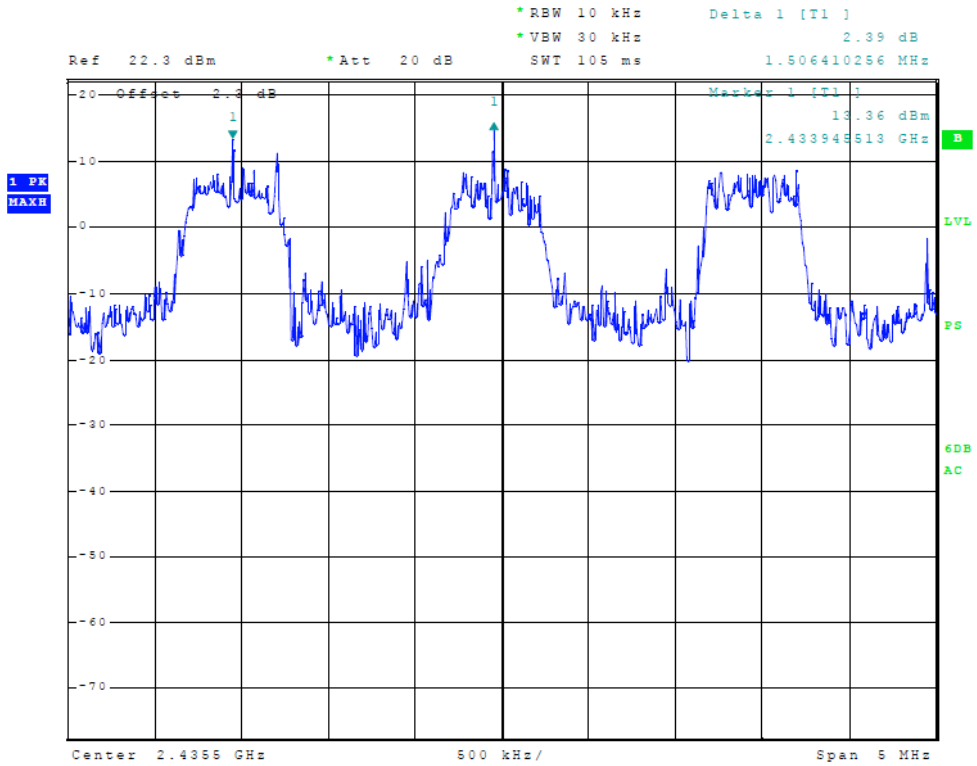


Figure Nineteen Plot Channel Spacing (43 Hop set)

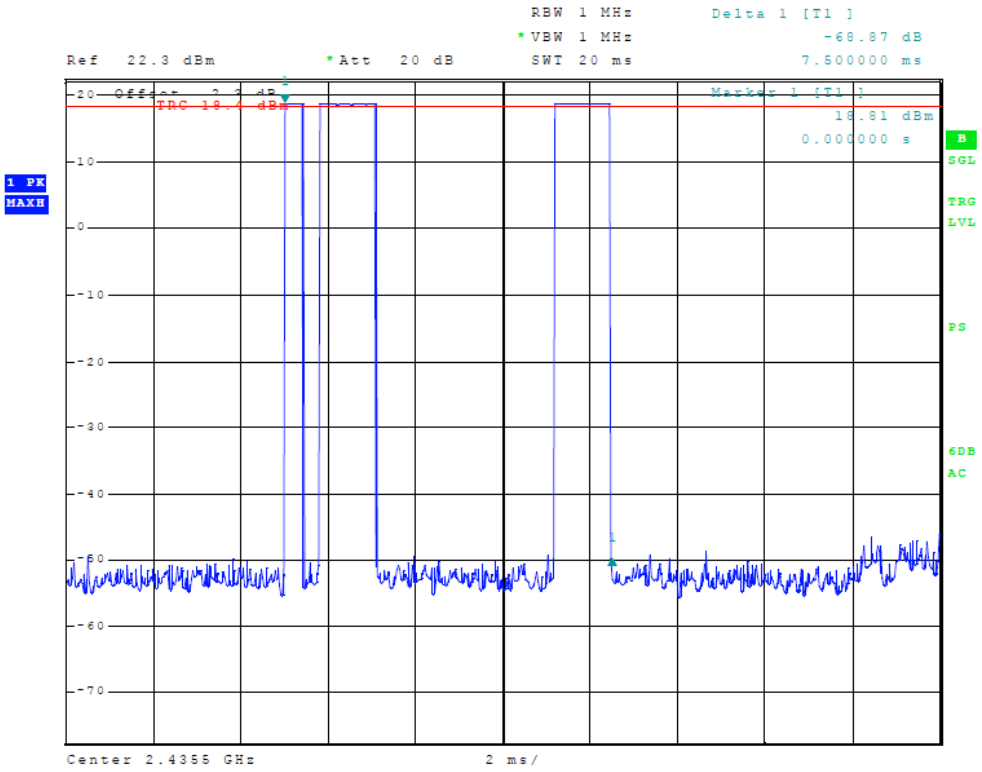


Figure Twenty Plot of Dwell time on Channel (43 Hop set)

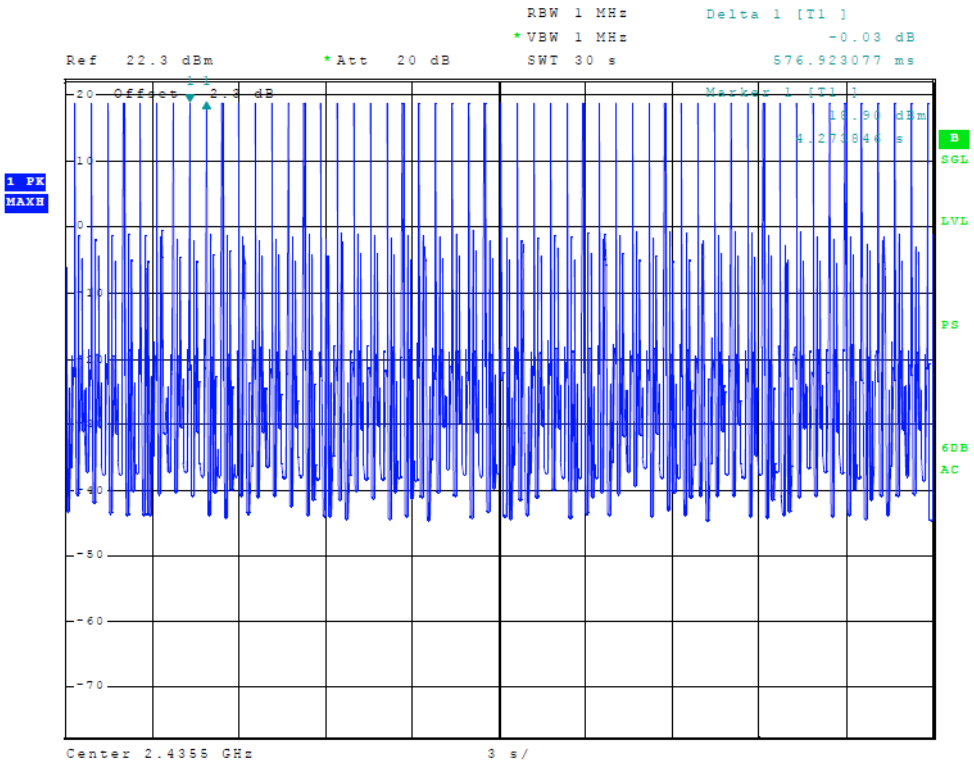


Figure Twenty-0ne Plot Channel Occupancy (43 Hop set)

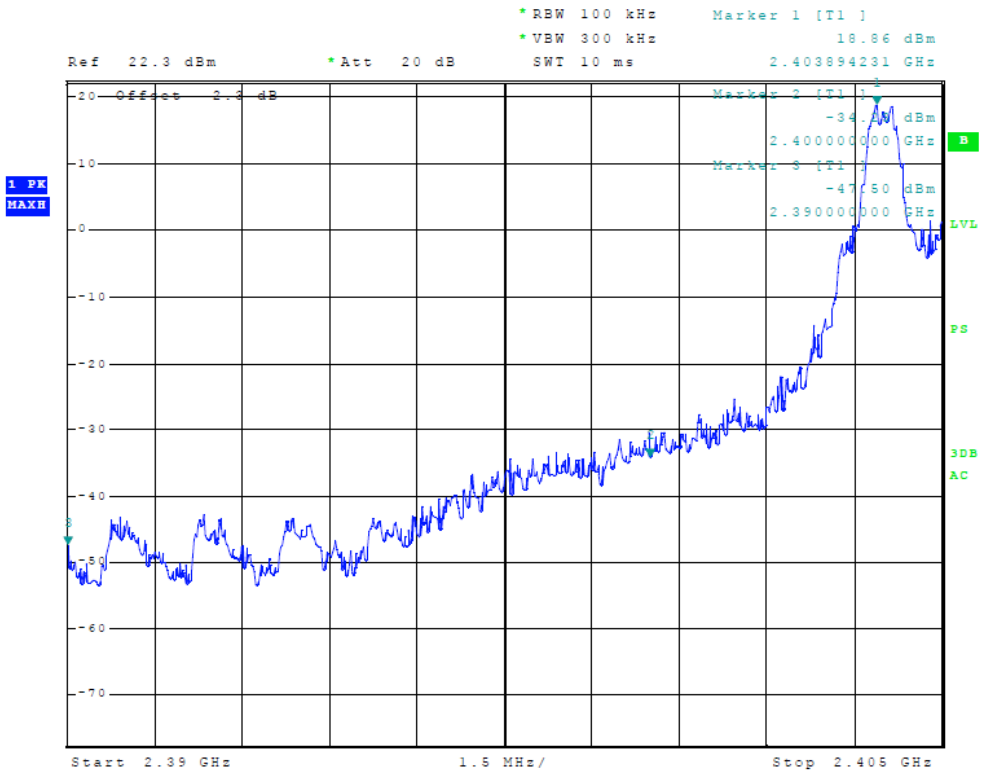


Figure Twenty-Two Plot of Low Band Edge (43 Hop set)

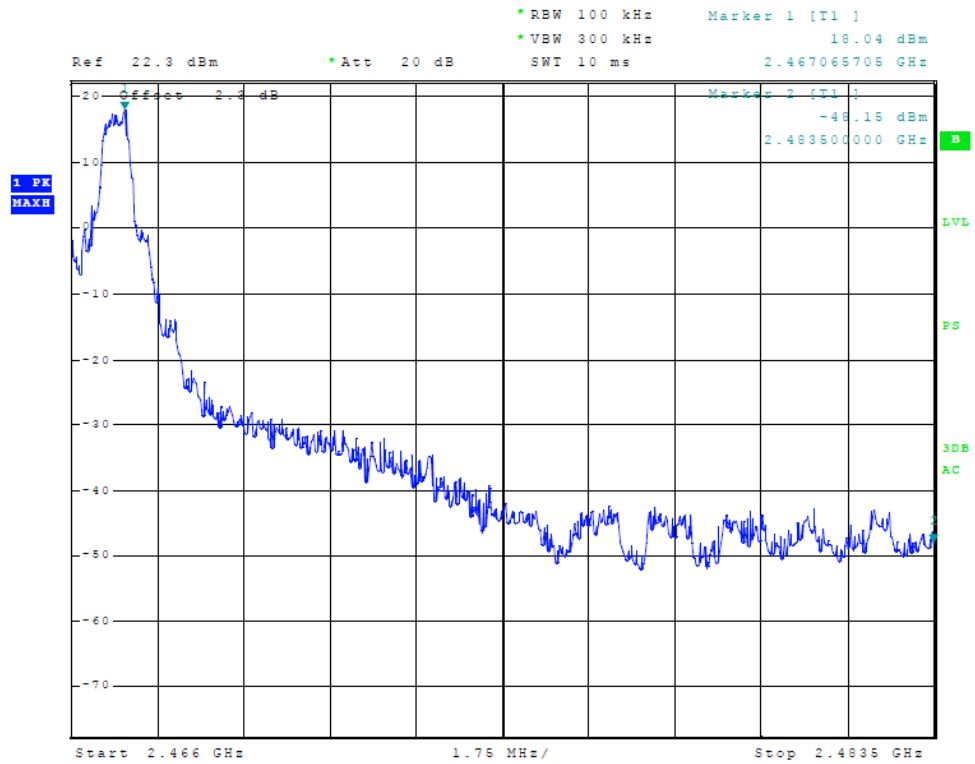


Figure Twenty-Three Plot of High Band Edge (43 Hop set)

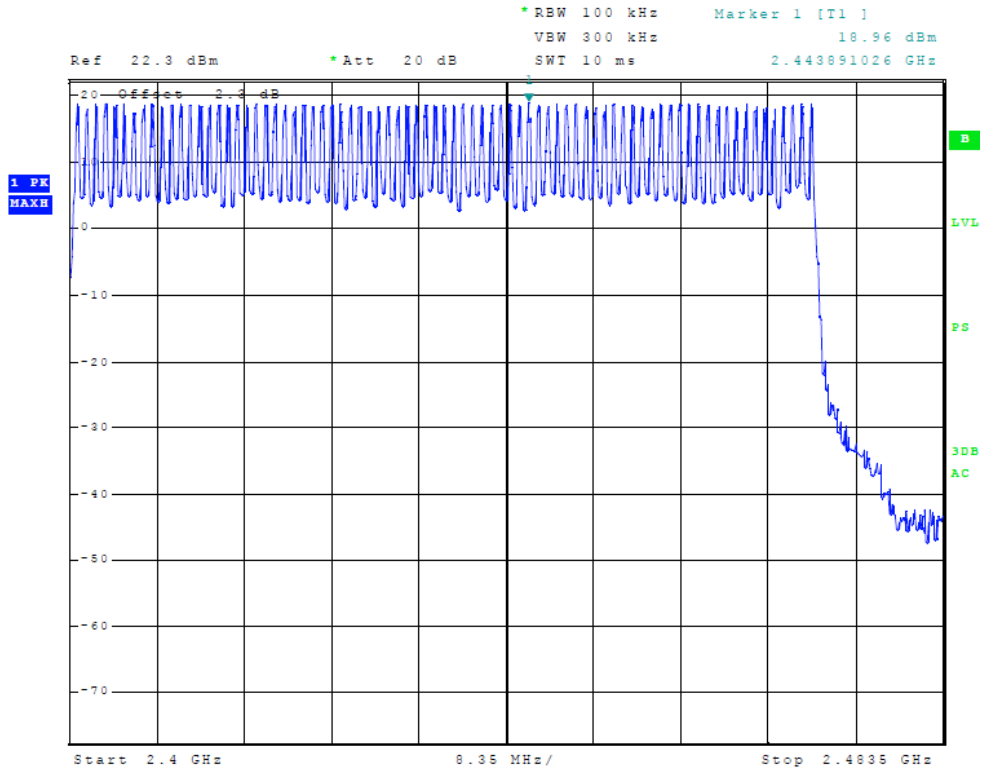


Figure Twenty-Four Plot of Output Across Operational Band (79 Hop set)

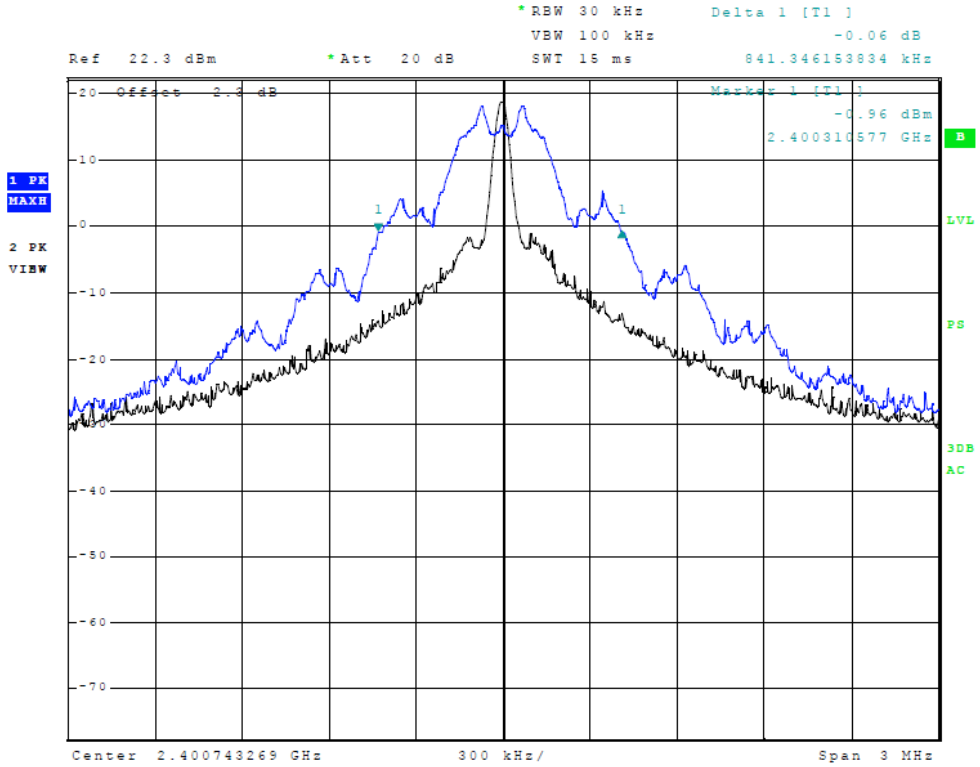


Figure Twenty-Five Plot of 20-dB Occupied Bandwidth (Low Channel) (79 Hop set)

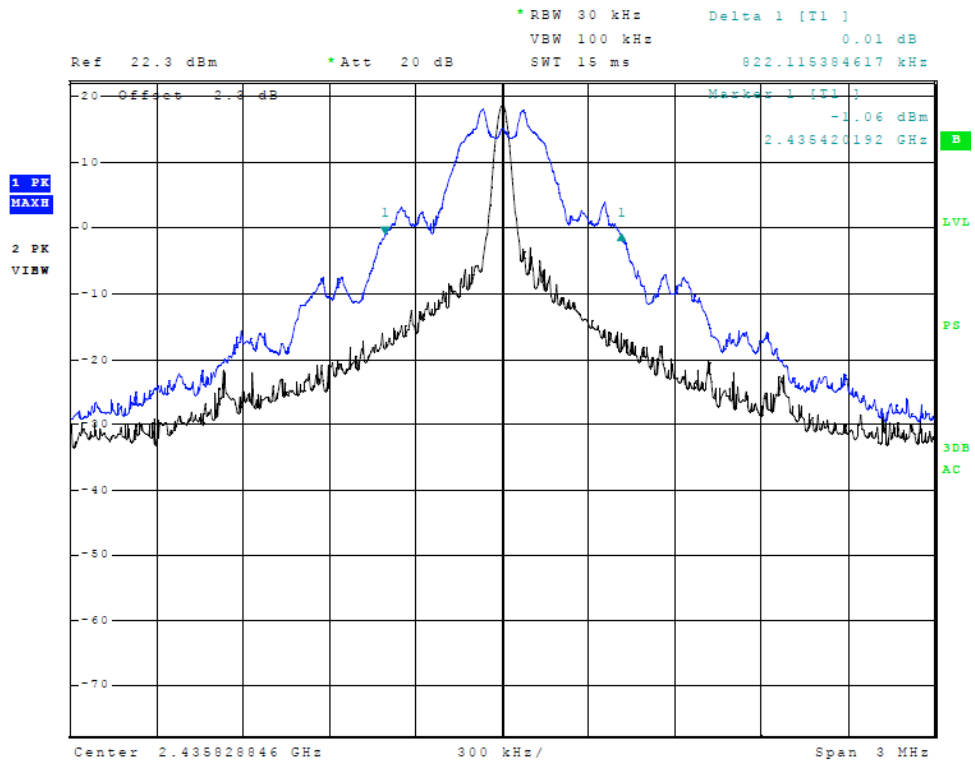


Figure Twenty-Six Plot of 20-dB Occupied Bandwidth (Middle Channel) (79 Hop set)

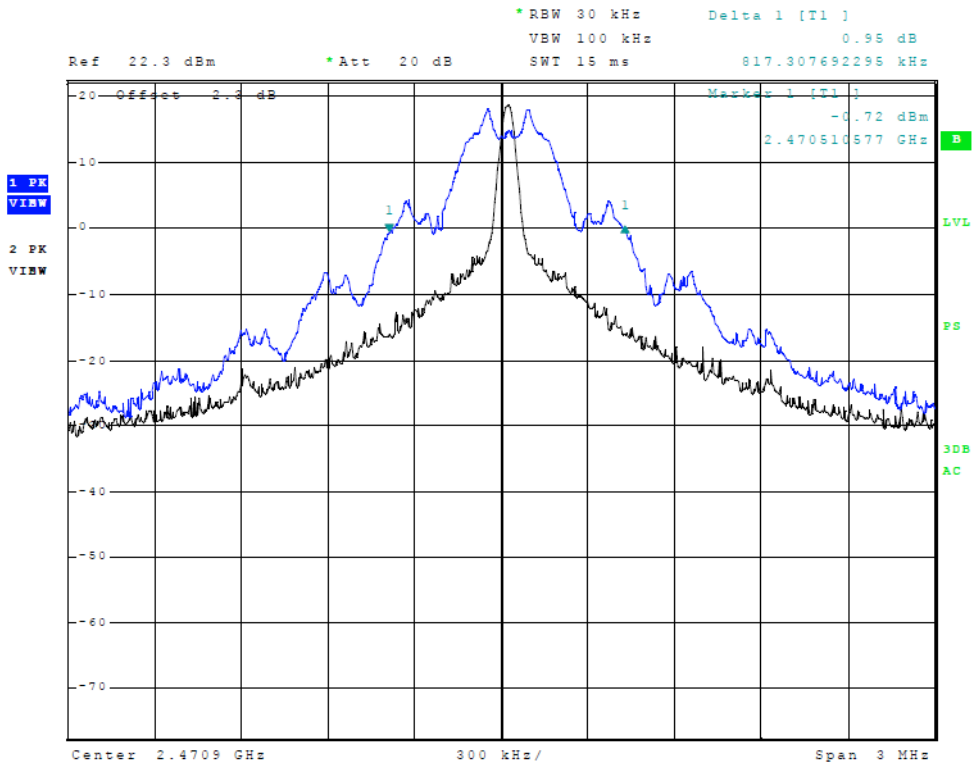


Figure Twenty-Seven Plot of 20-dB Occupied Bandwidth (High Channel) (79 Hop set)

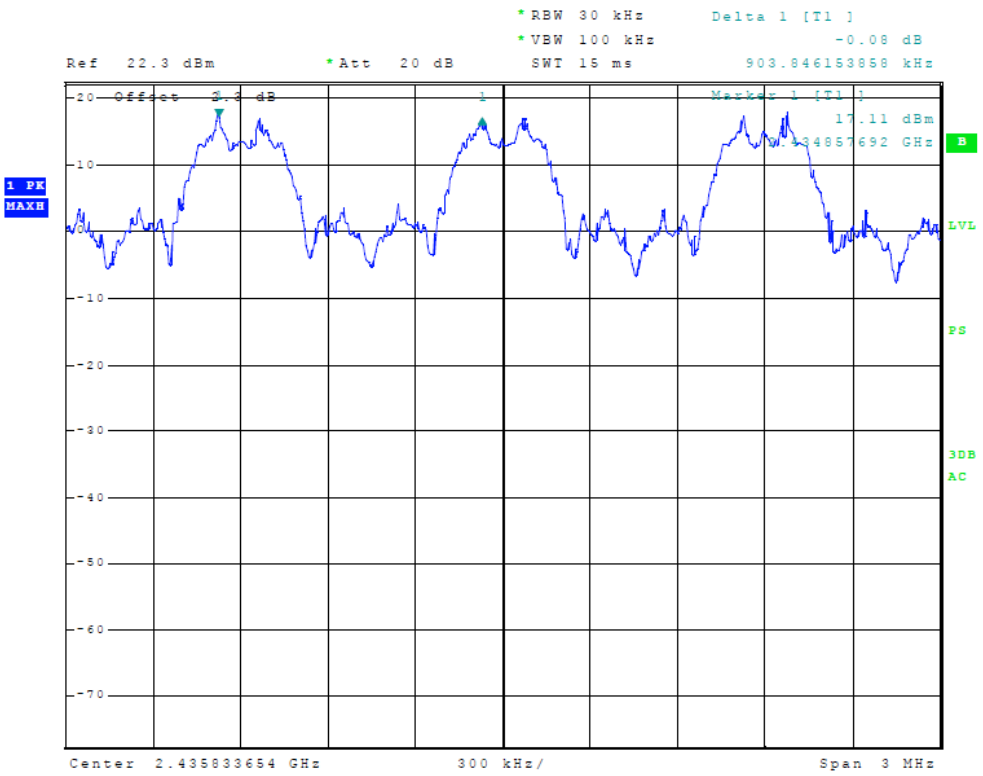


Figure Twenty-Eight Plot Channel Spacing (79 Hop set)

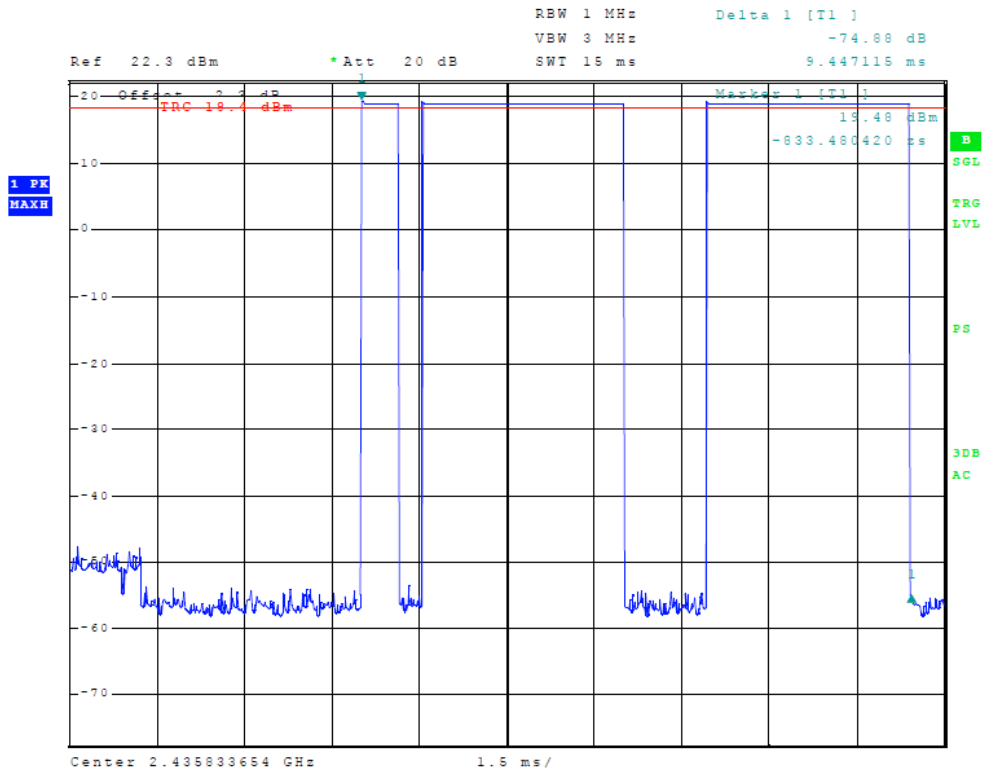


Figure Twenty-Nine Plot of Dwell time on Channel (79 Hop set)

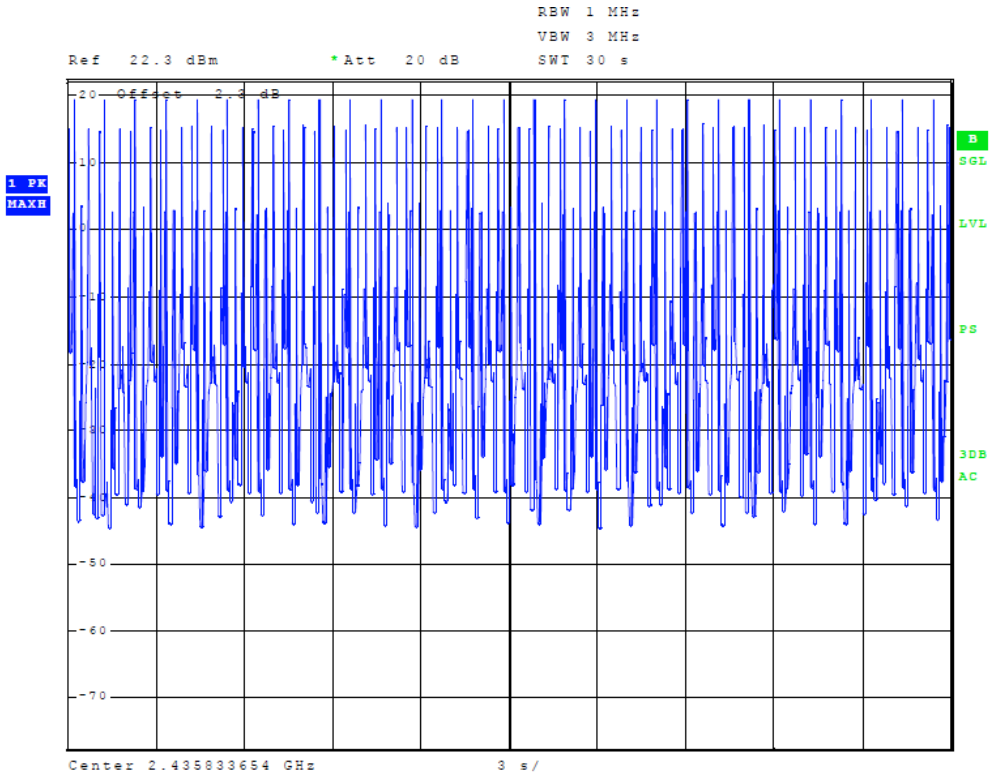


Figure Thirty Plot Channel Occupancy (79 Hop set)

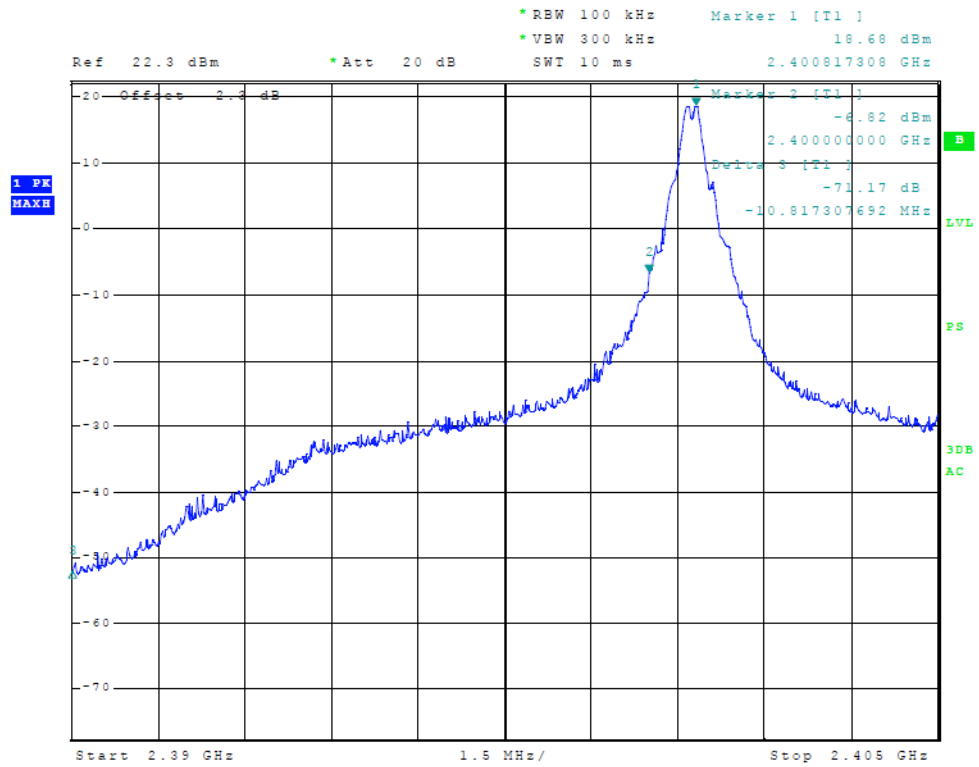


Figure Thirty-One Plot of Low Band Edge (79 Hop set)

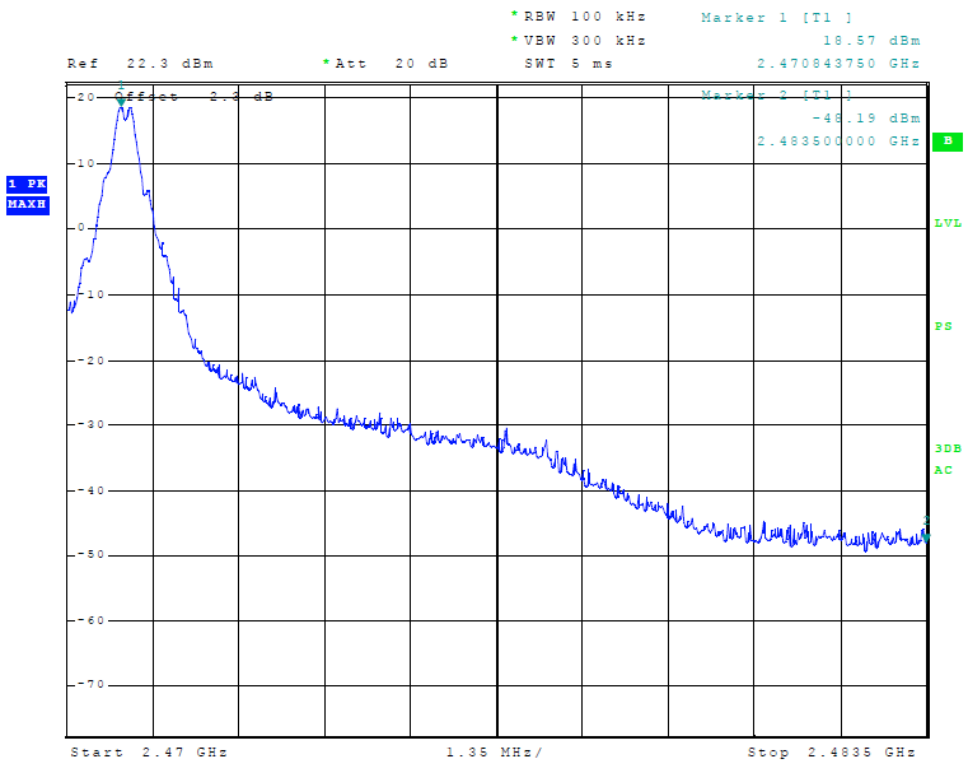


Figure Thirty -Two Plot of High Band Edge (79 Hop set)

Transmitter Emissions Data

Table 9 Transmitter Antenna Conducted Emissions Data

The antenna conducted output power and 20-dB bandwidth were measured while operating in available modes for the lowest, middle and highest available channels. The data reported below represents the worst-case operational conditions.

Operational Mode	Frequency MHz	Antenna Conducted Output Power dBm	Antenna Conducted Output Power mW	Occupied Bandwidth kHz
43 Hop Set	2404.00	20.33	107.9	1,043.3
43 Hop Set	2435.47	20.23	105.4	1,072.1
43 Hop Set	2466.93	20.28	106.7	1,033.6
79 Hop Set	2400.76	20.38	109.1	841.3
79 Hop Set	2435.85	20.24	105.7	822.1
79 Hop Set	2479.94	20.27	106.4	817.4

Table 10 Transmitter Radiated Emission Data (2 dBi Chip Antenna)

Frequency in MHz	Horizontal Peak (dBµV/m)	Horizontal Quasi-Peak (dBµV/m)	Horizontal Average (dBµV/m)	Vertical Peak (dBµV/m)	Vertical Quasi-Peak (dBµV/m)	Vertical Average (dBµV/m)	Limit @ 3m (dBµV/m)
2400.7	105.6	N/A	99.5	111.8	N/A	106.6	--
4801.4	33.0	N/A	20.7	36.3	N/A	26.2	54
7202.1	29.6	N/A	16.9	30.6	N/A	17.7	54
9602.8	36.7	N/A	27.3	34.3	N/A	24.4	54
12003.5	33.5	N/A	20.8	32.6	N/A	20.2	54
14404.2	35.2	N/A	22.2	34.7	N/A	22.2	54
16804.9	33.4	N/A	20.8	33.4	N/A	20.8	54
2435.8	104.9	N/A	99.6	112.1	N/A	106.0	--
4871.6	32.9	N/A	20.5	35.6	N/A	25.2	54
7307.4	29.3	N/A	16.7	30.4	N/A	19.0	54
9743.2	36.8	N/A	27.5	33.5	N/A	22.9	54
12179.0	32.8	N/A	20.5	31.3	N/A	18.5	54
14614.8	33.7	N/A	21.4	33.9	N/A	21.4	54
17050.6	34.7	N/A	21.1	34.7	N/A	21.2	54
2470.9	104.2	N/A	98.9	111.9	N/A	106.7	--
4941.8	32.7	N/A	20.2	34.4	N/A	23.1	54
7412.7	28.4	N/A	15.4	30.7	N/A	19.4	54
9883.6	36.9	N/A	27.2	35.6	N/A	25.9	54
12354.5	31.8	N/A	19.6	32.5	N/A	18.9	54
14825.4	35.7	N/A	22.9	35.7	N/A	22.7	54
17296.3	33.4	N/A	21.3	34.0	N/A	21.3	54

Other emissions present had amplitudes at least 20 dB below the limit.
Quasi-Peak amplitude emissions are recorded above for frequency range of 30-1000 MHz.
Average amplitude emissions are recorded above for frequency range above 1000 MHz.

Table 11 Transmitter Radiated Emission Data (1 dBi NZH PCB Dipole Antenna)

Frequency in MHz	Horizontal Peak (dBµV/m)	Horizontal Quasi-Peak (dBµV/m)	Horizontal Average (dBµV/m)	Vertical Peak (dBµV/m)	Vertical Quasi-Peak (dBµV/m)	Vertical Average (dBµV/m)	Limit @ 3m (dBµV/m)
2400.7	113.5	N/A	108.3	107.5	N/A	102.2	--
4801.4	32.3	N/A	19.9	33.9	N/A	22.5	54
7202.1	30.7	N/A	18.0	33.5	N/A	22.2	54
9602.8	37.1	N/A	26.0	37.2	N/A	27.9	54
12003.5	33.4	N/A	20.4	35.4	N/A	23.4	54
14404.2	35.1	N/A	22.4	35.5	N/A	22.8	54
16804.9	34.7	N/A	21.0	33.6	N/A	21.1	54
2435.8	113.5	N/A	108.3	107.0	N/A	101.7	--
4871.6	32.0	N/A	19.5	33.1	N/A	21.3	54
7307.4	30.6	N/A	17.8	32.5	N/A	20.3	54
9743.2	30.2	N/A	17.4	35.9	N/A	25.0	54
12179.0	30.9	N/A	18.1	30.8	N/A	18.4	54
14614.8	34.7	N/A	21.4	34.1	N/A	21.2	54
17050.6	34.6	N/A	21.1	33.8	N/A	21.1	54
2470.9	113.9	N/A	108.5	105.9	N/A	100.6	--
4941.8	32.4	N/A	19.4	34.0	N/A	21.2	54
7412.7	28.8	N/A	16.6	29.7	N/A	17.4	54
9883.6	31.7	N/A	18.2	33.3	N/A	21.5	54
12354.5	31.5	N/A	18.8	32.7	N/A	20.2	54
14825.4	35.1	N/A	22.5	35.0	N/A	22.6	54
17296.3	33.6	N/A	21.3	33.9	N/A	21.3	54

Other emissions present had amplitudes at least 20 dB below the limit.
Quasi-Peak amplitude emissions are recorded above for frequency range of 30-1000 MHz.
Average amplitude emissions are recorded above for frequency range above 1000 MHz.

Table 12 Transmitter Radiated Emission Data (5 dBi Dipole Antenna)

Frequency in MHz	Horizontal Peak (dBµV/m)	Horizontal Quasi-Peak (dBµV/m)	Horizontal Average (dBµV/m)	Vertical Peak (dBµV/m)	Vertical Quasi-Peak (dBµV/m)	Vertical Average (dBµV/m)	Limit @ 3m (dBµV/m)
2400.7	106.6	N/A	101.4	115.4	N/A	110.2	--
4801.4	33.1	N/A	21.0	36.3	N/A	25.4	54
7202.1	30.7	N/A	17.2	32.0	N/A	20.5	54
9602.8	35.7	N/A	23.7	39.0	N/A	29.9	54
12003.5	33.4	N/A	20.8	36.6	N/A	24.2	54
14404.2	35.5	N/A	22.4	35.1	N/A	22.5	54
16804.9	33.3	N/A	21.1	33.3	N/A	21.1	54
2435.8	107.2	N/A	102.0	116.0	N/A	110.8	--
4871.6	32.2	N/A	19.9	34.3	N/A	23.4	54
7307.4	31.2	N/A	18.8	30.5	N/A	17.7	54
9743.2	37.1	N/A	24.3	35.6	N/A	23.8	54
12179.0	30.4	N/A	18.3	35.3	N/A	23.5	54
14614.8	34.0	N/A	21.4	35.4	N/A	22.5	54
17050.6	34.2	N/A	21.0	33.2	N/A	21.0	54
2470.9	107.5	N/A	102.2	116.5	N/A	111.2	--
4941.8	33.5	N/A	20.7	35.9	N/A	25.2	54
7412.7	29.5	N/A	17.2	29.7	N/A	17.6	54
9883.6	33.9	N/A	21.4	35.3	N/A	23.3	54
12354.5	33.2	N/A	19.9	35.3	N/A	23.9	54
14825.4	35.6	N/A	22.7	35.2	N/A	22.9	54
17296.3	34.5	N/A	21.2	34.2	N/A	21.3	54

Other emissions present had amplitudes at least 20 dB below the limit.
Quasi-Peak amplitude emissions are recorded above for frequency range of 30-1000 MHz.
Average amplitude emissions are recorded above for frequency range above 1000 MHz.

Table 13 Transmitter Radiated Emission Data (6 dBi Omni Antenna)

Frequency in MHz	Horizontal Peak (dBµV/m)	Horizontal Quasi-Peak (dBµV/m)	Horizontal Average (dBµV/m)	Vertical Peak (dBµV/m)	Vertical Quasi-Peak (dBµV/m)	Vertical Average (dBµV/m)	Limit @ 3m (dBµV/m)
2400.7	98.4	N/A	93.2	117.0	N/A	111.9	--
4801.4	32.5	N/A	20.2	35.3	N/A	25.2	54
7202.1	29.7	N/A	17.4	31.3	N/A	19.2	54
9602.8	36.4	N/A	23.9	36.4	N/A	25.9	54
12003.5	32.9	N/A	20.2	34.8	N/A	22.9	54
14404.2	35.1	N/A	22.2	34.9	N/A	22.5	54
16804.9	33.8	N/A	21.0	34.4	N/A	21.0	54
2435.8	96.4	N/A	90.9	117.5	N/A	112.3	--
4871.6	32.4	N/A	20.3	33.6	N/A	21.9	54
7307.4	27.5	N/A	15.4	29.2	N/A	16.7	54
9743.2	33.7	N/A	20.9	37.7	N/A	25.3	54
12179.0	32.3	N/A	19.1	31.3	N/A	19.1	54
14614.8	34.6	N/A	21.3	34.2	N/A	21.2	54
17050.6	33.6	N/A	21.1	34.1	N/A	21.1	54
2470.9	96.0	N/A	90.8	117.4	N/A	111.9	--
4941.8	32.8	N/A	20.7	34.4	N/A	23.0	54
7412.7	27.3	N/A	14.8	28.0	N/A	14.7	54
9883.6	32.7	N/A	20.0	38.4	N/A	27.5	54
12354.5	30.8	N/A	18.8	33.4	N/A	20.2	54
14825.4	35.7	N/A	22.6	34.6	N/A	22.6	54
17296.3	34.1	N/A	21.2	34.3	N/A	21.2	54

Other emissions present had amplitudes at least 20 dB below the limit.
Quasi-Peak amplitude emissions are recorded above for frequency range of 30-1000 MHz.
Average amplitude emissions are recorded above for frequency range above 1000 MHz.

Table 14 Transmitter Radiated Emission Data (9 dBi Panel Antenna)

Frequency in MHz	Horizontal Peak (dBµV/m)	Horizontal Quasi-Peak (dBµV/m)	Horizontal Average (dBµV/m)	Vertical Peak (dBµV/m)	Vertical Quasi-Peak (dBµV/m)	Vertical Average (dBµV/m)	Limit @ 3m (dBµV/m)
2400.7	106.2	N/A	100.7	120.8	N/A	115.6	--
4801.4	32.4	N/A	20.3	35.3	N/A	23.8	54
7202.1	30.0	N/A	17.4	32.0	N/A	17.6	54
9602.8	33.5	N/A	20.5	37.5	N/A	27.0	54
12003.5	32.8	N/A	20.3	34.2	N/A	21.5	54
14404.2	36.1	N/A	22.3	35.1	N/A	22.5	54
16804.9	33.4	N/A	21.1	33.5	N/A	21.0	54
2435.8	106.8	N/A	101.6	121.4	N/A	116.2	--
4871.6	32.4	N/A	20.0	33.3	N/A	21.3	54
7307.4	34.1	N/A	17.5	30.2	N/A	18.0	54
9743.2	35.6	N/A	24.1	37.9	N/A	28.3	54
12179.0	31.8	N/A	19.1	33.4	N/A	20.5	54
14614.8	33.4	N/A	21.3	33.8	N/A	21.3	54
17050.6	33.5	N/A	21.0	33.0	N/A	21.0	54
2470.9	107.9	N/A	102.3	120.8	N/A	115.7	--
4941.8	32.1	N/A	19.8	32.7	N/A	19.9	54
7412.7	28.7	N/A	16.4	30.5	N/A	17.0	54
9883.6	34.2	N/A	21.8	38.1	N/A	28.2	54
12354.5	31.3	N/A	18.6	30.6	N/A	18.1	54
14825.4	35.2	N/A	22.7	35.3	N/A	22.6	54
17296.3	34.0	N/A	21.3	33.9	N/A	21.3	54

Other emissions present had amplitudes at least 20 dB below the limit.
Quasi-Peak amplitude emissions are recorded above for frequency range of 30-1000 MHz.
Average amplitude emissions are recorded above for frequency range above 1000 MHz.

Summary of Results for Radiated Emissions of Intentional Radiator

The EUT demonstrated antenna conducted output power of 109.1 Milliwatts (0.11 Watts) at antenna port. The EUT presented in compliance with the radiated emissions requirements of CFR47 Part 15.247 and RSS-210 with highest radiated emission level measured of 116.2 dBµV/m. The EUT demonstrated a minimum margin of -24.1 dB below the harmonic emissions requirements. The EUT demonstrated a minimum margin of -22.0 dB below the emissions requirements for restricted bands (transmitter emissions). The EUT support equipment demonstrated a minimum margin of -4.8 dB below the emissions requirements for restricted bands (general emissions of support equipment). The EUT tested was observed in compliance with the radiated emissions requirements of CFR47 Part 15.247 and RSS-210 Intentional Radiators. There were no other significantly measurable emissions observed in restricted bands other than those recorded in this report. Other emissions were present with amplitudes at least 20 dB below the requirements. The EUT demonstrated compliance with the specifications of CFR47 15.247 and RSS-210. There were no deviations or exceptions to the requirements.

Annex

- Annex A Measurement Uncertainty Calculations
- Annex B Rogers Labs Test Equipment List
- Annex C Rogers Qualifications
- Annex D FCC Site Registration Letter
- Annex E Industry Canada Site Registration Letter

Annex A Measurement Uncertainty Calculations

Measurement uncertainty calculations were made for the laboratory. Result of measurement uncertainty calculations are recorded below for AC line conducted and radiated emission measurements.

Measurement Uncertainty	$U_{(E)}$	$U_{(lab)}$
3 Meter Horizontal 30-200 MHz Measurements	2.08	4.16
3 Meter Vertical 30-200 MHz Measurements	2.16	4.33
3 Meter Vertical Measurements 200-1000 MHz	2.99	5.97
10 Meter Horizontal Measurements 30-200 MHz	2.07	4.15
10 Meter Vertical Measurements 30-200 MHz	2.06	4.13
10 Meter Horizontal Measurements 200-1000 MHz	2.32	4.64
10 Meter Vertical Measurements 200-1000 MHz	2.33	4.66
3 Meter Measurements 1-6 GHz	2.57	5.14
3 Meter Measurements 6-18 GHz	2.58	5.16
AC Line Conducted	1.72	3.43

Annex B Rogers Labs Test Equipment List

The test equipment is maintained in calibration and good operating condition. Use of this calibrated equipment ensures measurements are traceable to national standards.

List of Test Equipment	Calibration Date
Spectrum Analyzer: Rohde & Schwarz ESU40	5/12
Spectrum Analyzer: HP 8562A, HP Adapters: 11518, 11519, and 11520 Mixers: 11517A, 11970A, 11970K, 11970U, 11970V, 11970W	5/12
Spectrum Analyzer: HP 8591EM	5/12
Antenna: EMCO Biconilog Model: 3143	5/12
Antenna: Sunol Biconilog Model: JB6	10/11
Antenna: EMCO Log Periodic Model: 3147	10/11
Antenna: Antenna Research Biconical Model: BCD 235	10/11
LISN: Compliance Design Model: FCC-LISN-2.Mod.cd, 50 µHy/50 ohm/0.1 µf	10/11
R.F. Preamp CPPA-102	10/11
Attenuator: HP Model: HP11509A	10/11
Attenuator: Mini Circuits Model: CAT-3	10/11
Attenuator: Mini Circuits Model: CAT-3	10/11
Cable: Belden RG-58 (L1)	10/11
Cable: Belden RG-58 (L2)	10/11
Cable: Belden 8268 (L3)	10/11
Cable: Time Microwave: 4M-750HF290-750	10/11
Cable: Time Microwave: 10M-750HF290-750	10/11
Frequency Counter: Leader LDC825	2/12
Oscilloscope Scope: Tektronix 2230	2/12
Wattmeter: Bird 43 with Load Bird 8085	2/12
Power Supplies: Sorensen SRL 20-25, SRL 40-25, DCR 150, DCR 140	2/12
R.F. Generators: HP 606A, HP 8614A, HP 8640B	2/12
R.F. Power Amp 65W Model: 470-A-1010	2/12
R.F. Power Amp 50W M185- 10-501	2/12
R.F. Power Amp A.R. Model: 10W 1010M7	2/12
R.F. Power Amp EIN Model: A301	2/12
LISN: Compliance Eng. Model 240/20	2/12
LISN: Fischer Custom Communications Model: FCC-LISN-50-16-2-08	2/12
Antenna: EMCO Dipole Set 3121C	2/12
Antenna: C.D. B-101	2/12
Antenna: Solar 9229-1 & 9230-1	2/12
Antenna: EMCO 6509	2/12
Audio Oscillator: H.P. 201CD	2/12
Peavey Power Amp Model: IPS 801	2/12
ELGAR Model: 1751	2/12
ELGAR Model: TG 704A-3D	2/12
ESD Test Set 2010i	2/12
Fast Transient Burst Generator Model: EFT/B-101	2/12
Field Intensity Meter: EFM-018	2/12
KEYTEK Ecat Surge Generator	2/12
Shielded Room 5 M x 3 M x 3.0 M	

Annex C Rogers Qualifications

Scot D. Rogers, Engineer

Rogers Labs, Inc.

Mr. Rogers has approximately 17 years' experience in the field of electronics. Engineering experience includes six years in the automated controls industry and remaining years working with the design, development and testing of radio communications and electronic equipment.

Positions Held

Systems Engineer:	A/C Controls Mfg. Co., Inc.	6 Years
Electrical Engineer:	Rogers Consulting Labs, Inc.	5 Years
Electrical Engineer:	Rogers Labs, Inc.	Current

Educational Background

1) Bachelor of Science Degree in Electrical Engineering from Kansas State University.

2) Bachelor of Science Degree in Business Administration Kansas State University.

3) Several Specialized Training courses and seminars pertaining to Microprocessors and Software programming.

Scot D Rogers

Scot D. Rogers

NVLAP Lab Code 200087-0

Annex D FCC Site Registration Letter

FEDERAL COMMUNICATIONS COMMISSION

Laboratory Division
7435 Oakland Mills Road
Columbia, MD 21046

November 01, 2011

Registration Number: 90910

Rogers Labs, Inc.
4405 West 259th Terrace,
Louisburg, KS 66053

Attention: Scot Rogers,

Re: Measurement facility located at Louisburg
3 & 10 meter site
Date of Renewal: November 01, 2011

Dear Sir or Madam:

Your request for renewal of the registration of the subject measurement facility has been received. The information submitted has been placed in your file and the registration has been renewed. The name of your organization will remain on the list of facilities whose measurement data will be accepted in conjunction with applications for Certification under Parts 15 or 18 of the Commission's Rules. Please note that the file must be updated for any changes made to the facility and the registration must be renewed at least every three years.

Measurement facilities that have indicated that they are available to the public to perform measurement services on a fee basis may be found on the FCC website www.fcc.gov under E-Filing, OET Equipment Authorization Electronic Filing, Test Firms.

Sincerely,

Phyllis Parrish
Industry Analyst

NVLAP Lab Code 200087-0

Annex E Industry Canada Site Registration Letter

Industry Canada Industrie Canada

December 28, 2011

OUR FILE: 46405-3041
Submission No: 152685

Rogers Labs Inc.
4405 West 259th Terrance
Louisburg, KS, 66053
USA

Attention: Mr. Scot D. Rogers

Dear Sir/Madame:

The Bureau has received your application for the renewal of 3/10m OATS. Be advised that the information received was satisfactory to Industry Canada. The following number(s) is now associated to the site(s) for which registration / renewal was sought **(Site# 3041A-1).** Please reference the appropriate site number in the body of test reports containing measurements performed on the site. In addition, please keep for your records the following information;

- The company address code associated to the site(s) located at the above address is: **3041A**

Furthermore, to obtain or renew a unique site number, the applicant shall demonstrate that the site has been accredited to ANSI C63.4-2003 or later. A scope of accreditation indicating the accreditation by a recognized accreditation body to ANSI C63.4-2003 or later shall be accepted. Please indicate in a letter the previous assigned site number if applicable and the type of site (example: 3 metre OATS or 3 metre chamber). If the test facility is not accredited to ANSI C63.4-2003 or later, the test facility shall submit test data demonstrating full compliance with the ANSI standard. The Bureau will evaluate the filing to determine if recognition shall be granted.

The frequency for re-validation of the test site and the information that is required to be filed or retained by the testing party shall comply with the requirements established by the accrediting organization. However, in all cases, test site re-validation shall occur on an interval not to **exceed three years**. There is no fee or form associated with an OATS filing. OATS submissions are encouraged to be submitted electronically to the Bureau using the following URL;
http://strategis.ic.gc.ca/epic/internet/inceb-bhst.nsf/en/h_tt00052e.html.

If you have any questions, you may contact the Bureau by e-mail at certification.bureau@ic.gc.ca Please reference our file and submission number above for all correspondence.

Yours sincerely,

Dalwinder Gill
For: Wireless Laboratory Manager
Certification and Engineering Bureau
3701 Carling Ave., Building 94
P.O. Box 11490, Station "H"
Ottawa, Ontario K2H 8S2
Email: dalwinder.gill@ic.gc.ca
Tel. No. (613) 998-8363
Fax. No. (613) 990-4752