SUBMITTAL APPLICATION REPORT

FOR

GRANT OF CERTIFICATION

FOR

Model: WISM PLUS
Part number: WLM400
2412-2462 MHz
Broadband Digital Transmission System

FOR

LAIRD TECHNOLOGIES

11160 Thompson Avenue
Lenexa KS 66219

Test Report Number: 100122

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
Application for Grant of Certification

FOR

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

For

LAIRD TECHNOLOGIES

11160 Thompson Avenue
Lenexa KS 66219

Broadband Digital Transmission System
Model: WISM PLUS
Part number: WLM400
Frequency Range 2412-2462 MHz
FCC ID#: KQL-WISMP
IC: 2268C-WISMP

Test Date: January 22, 2010

Certifying Engineer: Scot D Rogers

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

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The following information is submitted for consideration in obtaining a Grant of Certification for License Exempt 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: WISM PLUS Part Number: WLM400

FCC I.D.: KQL-WISMP FRN: 0006 3090 82 IC: 2268C-WISMP
Frequency Range: 2412-2462 MHz

Operating Power: 0.062 Watt antenna port conducted power, 94.0 dBμV/m @ 3-meters (3-meter radiated measurement 2.5 dBi Dipole), Occupied Bandwidth 16.83 MHz

Opinion / Interpretation of Results

Tests Performed	Results
Emissions Tests	
Emissions as per CFR 47 paragraphs 2 and 15.205	Complies
Emissions as per CFR 47 paragraphs 2 and 15.207	Complies
Emissions as per CFR 47 paragraphs 2 and 15.209	Complies
Emissions as per CFR 47 paragraphs 2 and 15.247	Complies
Emissions as per RSS-210 Issue 7, Dated June 2007	Complies

Environmental Conditions

Ambient Temperature	21.6° C
Relative Humidity	27%
Atmospheric Pressure	1020.4 mb

Equipment Tested

Equipment	Model	FCC I.D.# /SN
EUT	WISM PLUS	KQL-WISMP / ENG1
CPU	IBM 2686	N/A / L3-BG732
AC Adapter	WR9QC2000LCP-N-NA	N/A / N/A
Antenna (2 dBi dipole)		

Application for Certification

(1) Manufacturer: LAIRD TECHNOLOGIES
11160 Thompson Avenue
Lenexa KS 66219

(2) Identification: Model: WISM PLUS

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

(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 the support circuitry. The module was placed on the support development board and communications to CPU through the USB interface of the laptop computer during testing. Antenna configurations as documented were tested for Certification.

(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, 2009, 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 RSS-210 the following information is submitted.

Test procedures used are the established Methods of Measurement of Radio-Noise Emissions as described in the ANSI 63.4-2003 Document FCC, documents 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. Testing of the intentional radiated emissions was performed as defined in section 13 of ANSI C63.4.

Equipment Function and Testing Procedures

The EUT is a 2412-2462 MHz transmitter module used to transmit data in applications offering broadband wireless connectivity. The equipment is marketed for use to incorporate a wireless link to exchange data information from one point to another. For testing purposes the WISM PLUS transceiver was connected to the support development board and communicating to the laptop computer allowing for operational control of the transmitter and communications. The WISM PLUS receives power form the support circuitry and offers no provision to connect to utility AC power systems. No other interfacing options are provided on the design. For testing purposes the WISM PLUS and support equipment were powered from the AC power adapter supply of the support development board and set to transmit in all modes available. The device is marketed as a modular solution for incorporation into OEM designed systems and used with approved antennas only. The design complies with the unique antenna connection requirements.

Equipment and Cable Configurations

AC Line Conducted Emission Test Procedure

The EUT operates from DC power only and must be connected to an approved AC adapter for operation. For testing purposes, the manufacturer supplied AC power adapter for the support development board was used to power the system. Testing for the AC line-conducted emissions testing was performed as defined in sections 7 and 13.1.3 of ANSI C63.4. The test setup including the EUT was arranged in a typical equipment configuration 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.

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 defined in sections 8 and 13.1.4 of ANSI C63.4. 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. Refer to photographs in the test setup exhibits for EUT placement during testing.

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

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 Approval — Refer to Annex for FCC and Industry Canada Site Registration Letters

NVLAP — Lab code 200087-0

List of Test Equipment

A Rhodes & Schwarz ESU40 and or Hewlett Packard 8591EM Spectrum Analyzer was used as the measuring device for the emissions testing of frequencies below 1 GHz. A Rhodes & 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.

Analyzer Settings		
Conducted Emissions		
RBW	AVG. BW	Detector Function
9 kHz	30 kHz	Peak / Quasi Peak
Radiated Emissions below 1000 MHz		
RBW	AVG. BW	Detector Function
120 kHz	300 kHz	Peak / Quasi Peak
Radiated Emissions above 1000 MHz		
RBW	Video BW	Detector Function
100 kHz	100 kHz	Peak
1 MHz	1 MHz	Peak / Average

Equipment	Manufacturer	Model	Calibration Date	Due
LISN	Comp. Design	FCC-LISN-2-MOD.CD	10/09	10/10
LISN	Comp. Design	1762	2/09	2/10
Antenna	ARA	BCD-235-B	10/09	10/10
Antenna	EMCO	3147	10/09	10/10
Antenna	EMCO	3143	5/09	5/10
Analyzer	Rohde s & Schwarz	ESU40	2/09	2/10
Analyzer	HP	8591EM	5/09	5/10
Analyzer	HP	8562A	5/09	5/10

Intentional Radiators

As per CFR 47, 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. The antenna connection point complies with the unique antenna connection requirements. The requirements of 15.203 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 at 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. No other significant emission was observed which fell into the restricted bands of operation.

Sample Calculations:

RFS (dBμV/m @ 3m) = FSM(dBμV) + A.F.(dB) - Gain(dB)
= 17.8 + 32.9 -25
= 25.7

Radiated Emissions in Restricted Bands Data (worst-case)

Frequency in MHz	FSM Horz. (dBµV)	FSM Vert. (dBµV)	A.F. (dB/m)	Amp. Gain (dB)	RFS Horz. @ 3m (dBµV/m)	RFS Vert. @ 3m (dBµV/m)	FCC Class B Limit @ 3m (dBµV/m)
2390.0	17.8	21.2	32.9	25.0	25.7	29.1	54.0
2400.0	18.0	25.7	32.9	25.0	25.9	33.6	54.0
2483.5	17.9	18.5	33.3	25.0	26.2	26.8	54.0
4824.0	17.7	19.2	32.9	25.0	25.6	27.1	54.0
4884.0	17.3	20.7	32.9	25.0	25.2	28.6	54.0
4924.0	17.2	20.7	32.9	25.0	16.6	28.6	54.0
7236.0	15.6	15.7	36.4	25.0	27.0	27.1	54.0
7326.0	15.4	15.2	36.4	25.0	26.8	26.6	54.0
7386.0	14.7	14.8	36.7	25.0	16.6	26.5	54.0
12060.0	12.4	12.4	40.0	25.0	27.4	27.4	54.0
12210.0	12.5	12.5	40.2	25.0	27.7	27.7	54.0
12310.0	12.4	12.4	40.4	25.0	16.6	27.8	54.0

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

Summary of Results for Radiated Emissions in Restricted Bands

The EUT demonstrated compliance with the radiated emissions requirements of RSS-210 and CFR 47 Part 15C Intentional Radiators. The EUT demonstrated a minimum margin of 20.4 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.

Statement of Modifications and Deviations

No modifications to the EUT were required for the unit to demonstrate compliance with the RSS-210 and CFR 47 Part 15C paragraph 15.205 emissions requirements. There were no deviations or exceptions to the specifications.

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 support development board 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 AC Line conducted emissions.

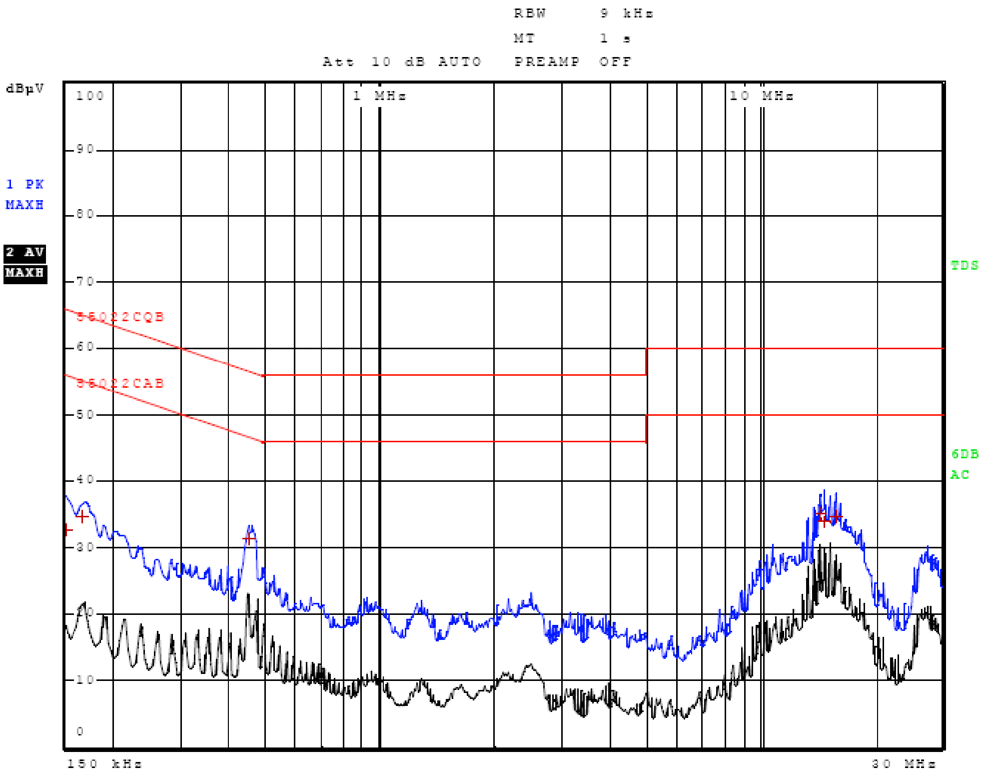

Figure One AC Line Conducted Emissions Line 1

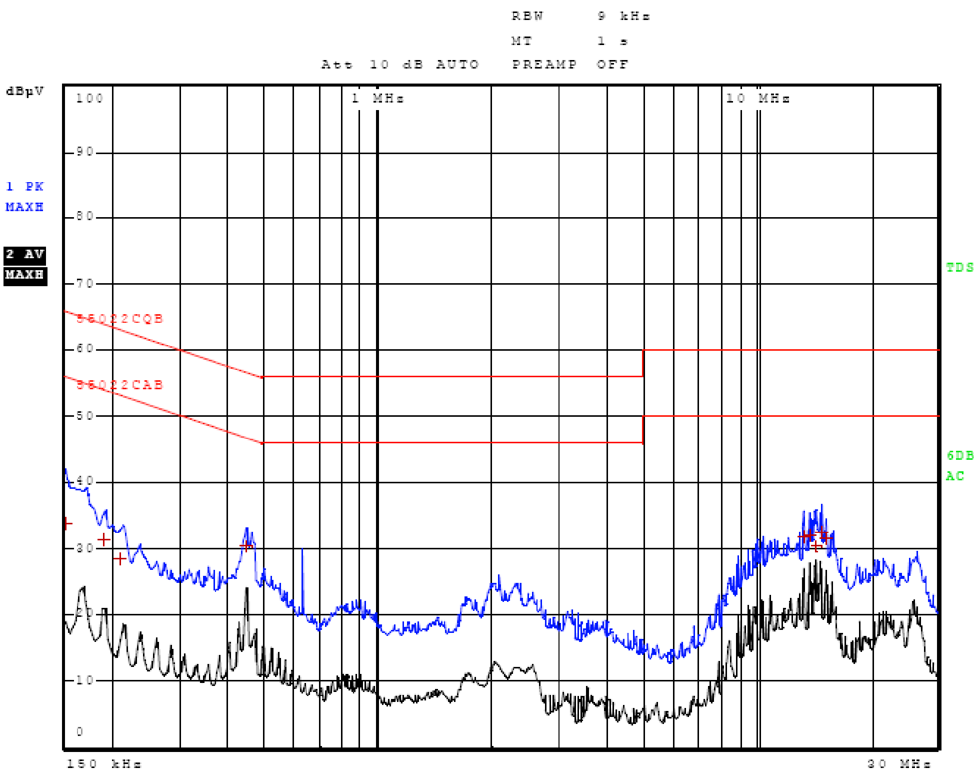

Figure Two AC Line Conducted Emissions Line 2

AC Line Conducted Emissions Data

Line 1

Trace	Frequency	Level (dBµV)	Detector	Delta Limit/dB
1	150.000000000 kHz	32.65	Quasi Peak	-33.35
1	166.000000000 kHz	34.77	Quasi Peak	-30.39
1	450.000000000 kHz	31.33	Quasi Peak	-25.55
1	14.284000000 MHz	35.21	Quasi Peak	-24.79
1	14.684000000 MHz	33.99	Quasi Peak	-26.01
1	15.768000000 MHz	34.71	Quasi Peak	-25.29

Line 2

Trace	Frequency	Level (dBµV)	Detector	Delta Limit/dB
1	150.000000000 kHz	33.64	Quasi Peak	-32.36
1	190.000000000 kHz	31.40	Quasi Peak	-32.63
1	210.000000000 kHz	28.43	Quasi Peak	-34.77
1	446.000000000 kHz	30.27	Quasi Peak	-26.68
1	13.288000000 MHz	31.80	Quasi Peak	-28.20
1	13.700000000 MHz	32.09	Quasi Peak	-27.91
1	14.276000000 MHz	30.36	Quasi Peak	-29.64
1	14.776000000 MHz	32.46	Quasi Peak	-27.54
1	15.176000000 MHz	31.71	Quasi Peak	-28.29

Other emissions present had amplitudes at least 10 dB below the limit.

Summary of Results for AC Line Conducted Emissions

The EUT demonstrated compliance with the conducted emissions requirements for CISPR 22, RSS-210 and CFR 47 Part 15C equipment. The EUT demonstrated minimum margin of 24.8 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 Emissions Procedure

The EUT was arranged in a typical 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. Radiated emissions measurements were performed to identify the frequencies, which produced the highest emissions. Plots were made of the radiated frequency spectrum from 30 MHz to 25,000 MHz for the preliminary testing. Refer to figures three through nine for plots of the general radiated emissions spectrum taken in a screen room. The highest radiated emission was then re-maximized at the OATS location before final radiated emissions measurements were performed. Final data was taken with the EUT located at the OATS at a distance of 3 meters between the EUT and the receiving antenna. The frequency spectrum from 30 MHz to 25,000 MHz was searched for general radiated emissions. Measured emission levels were maximized by EUT placement on the table, rotating the turntable through 360 degrees, varying the antenna height between 1 and 4 meters above the ground plane and changing antenna position between horizontal and vertical polarization. Antennas used were Broadband Biconical from 30 to 200 MHz, Biconilog from 30 to 1000 MHz, Log Periodic from 200 MHz to 5 GHz and or, pyramidal horns and mixers from 4 GHz to 30 GHz, notch filters and appropriate amplifiers were utilized.

Sample Calculations:

RFS = Radiated Field Strength

dBµV/m @ 3m = dBµV + A.F. - Amplifier Gain

dBµV/m @ 3m = 43.4 + 7.0 - 30

= 20.4

Figure Three General Radiated Emissions taken at 1 meter in screen room

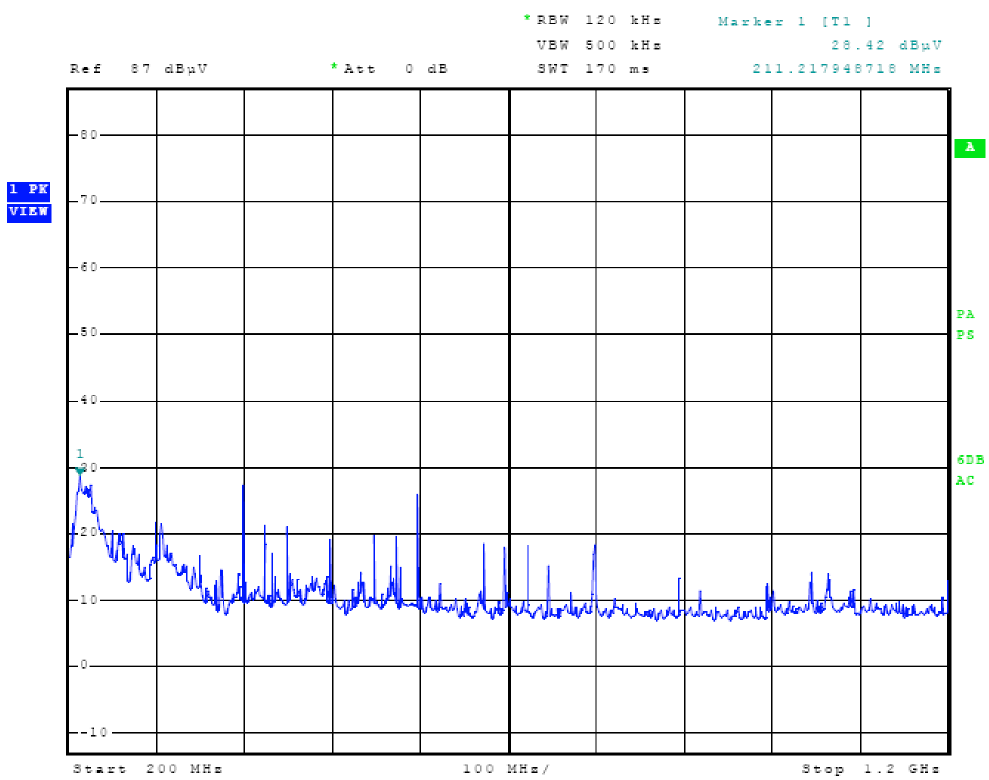

Figure Four General Radiated Emissions taken at 1 meter in screen room

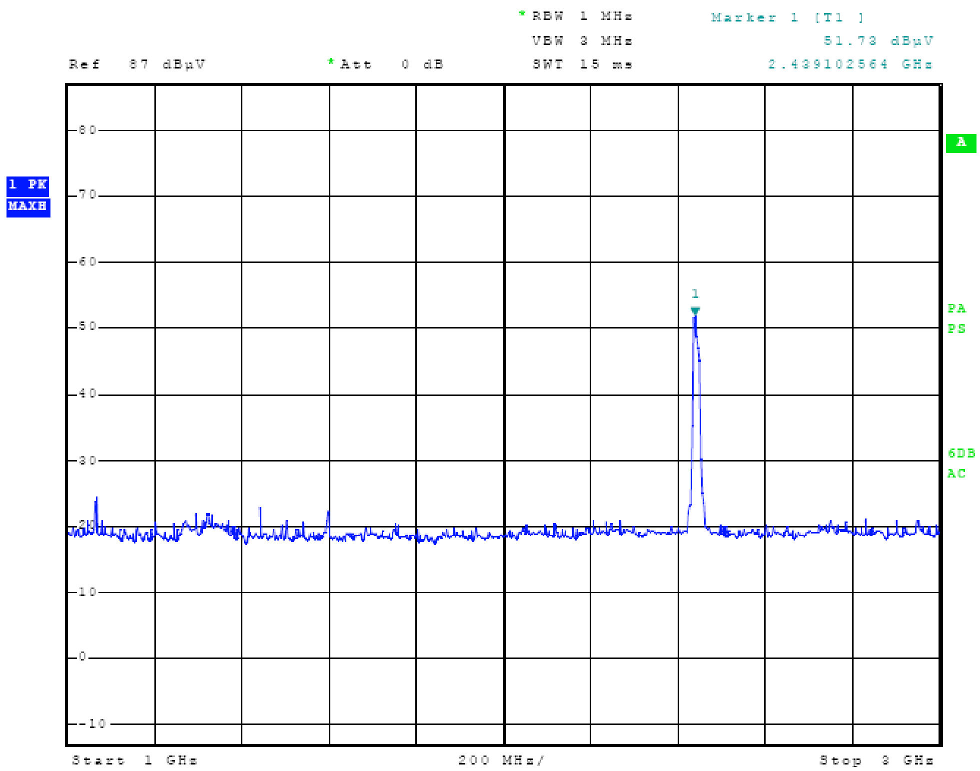

Figure Five General Radiated Emissions taken at 1 meter in screen room

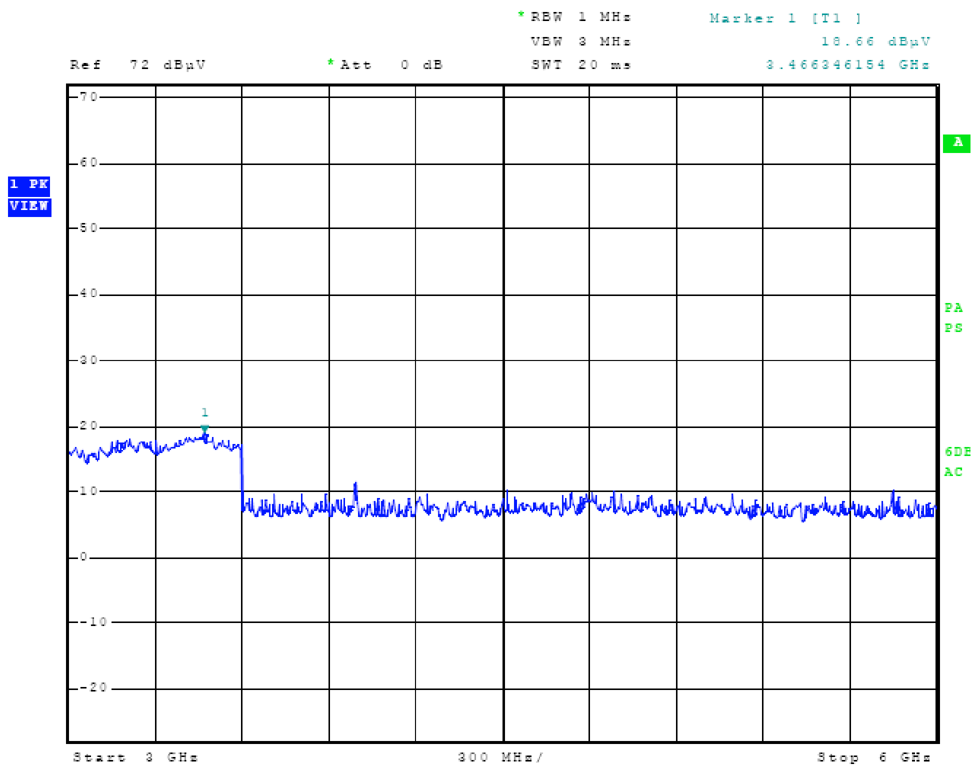

Figure Six General Radiated Emissions taken at 1 meter in screen room

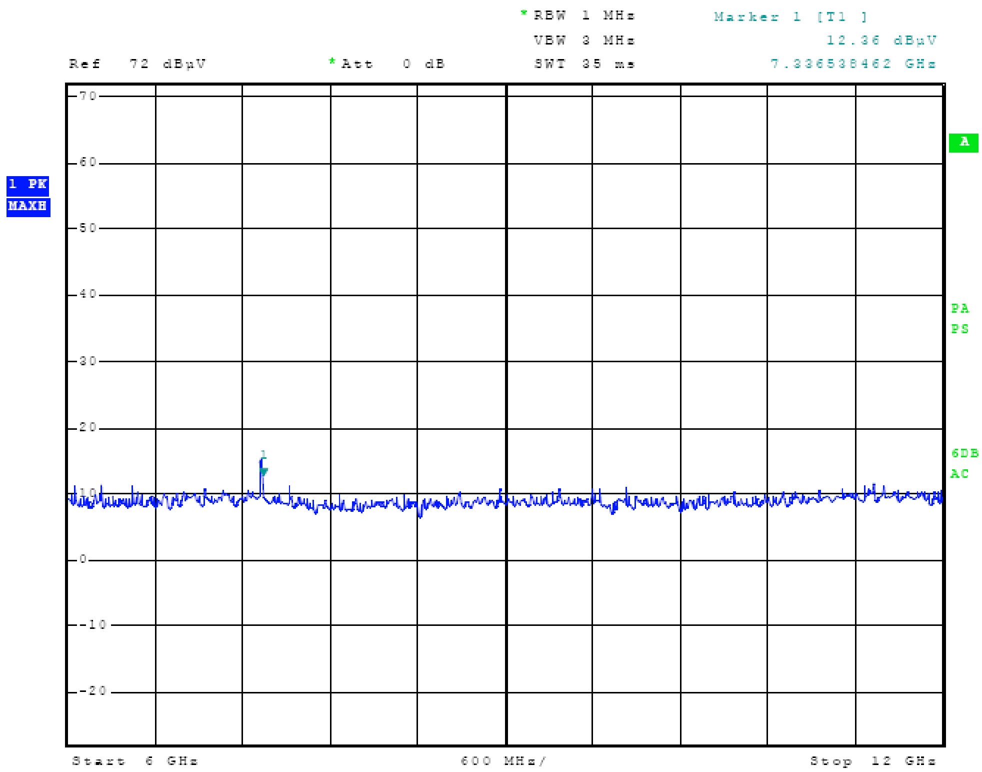

Figure Seven General Radiated Emissions taken at 1 meter in screen room

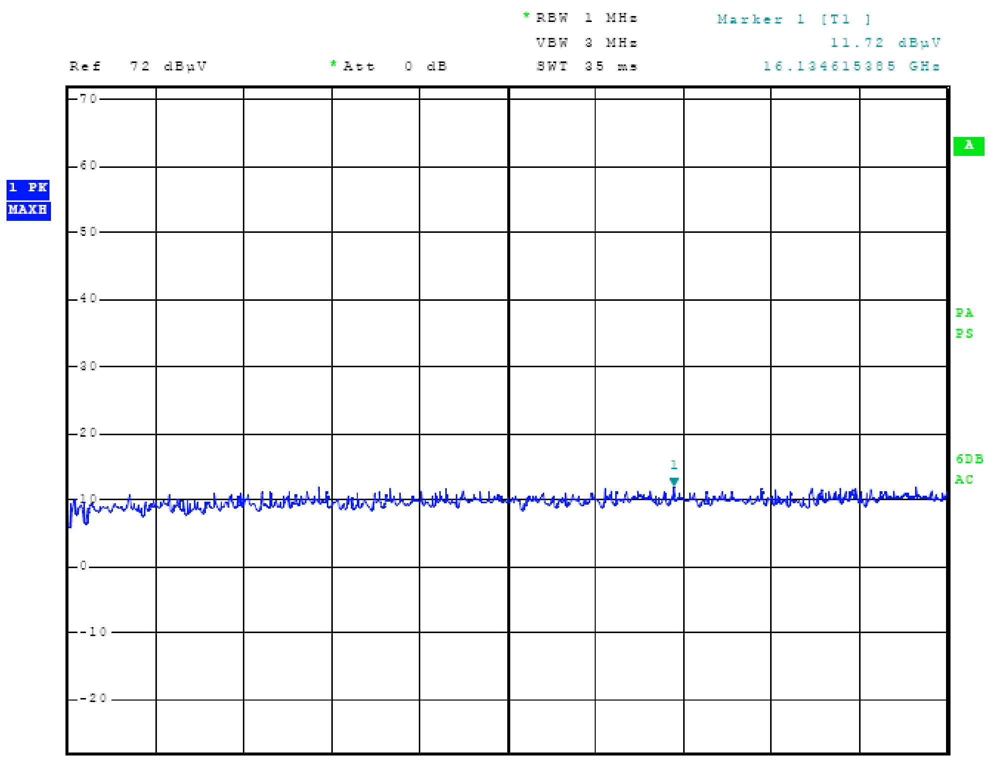

Figure Eight General Radiated Emissions taken at 1 meter in screen room

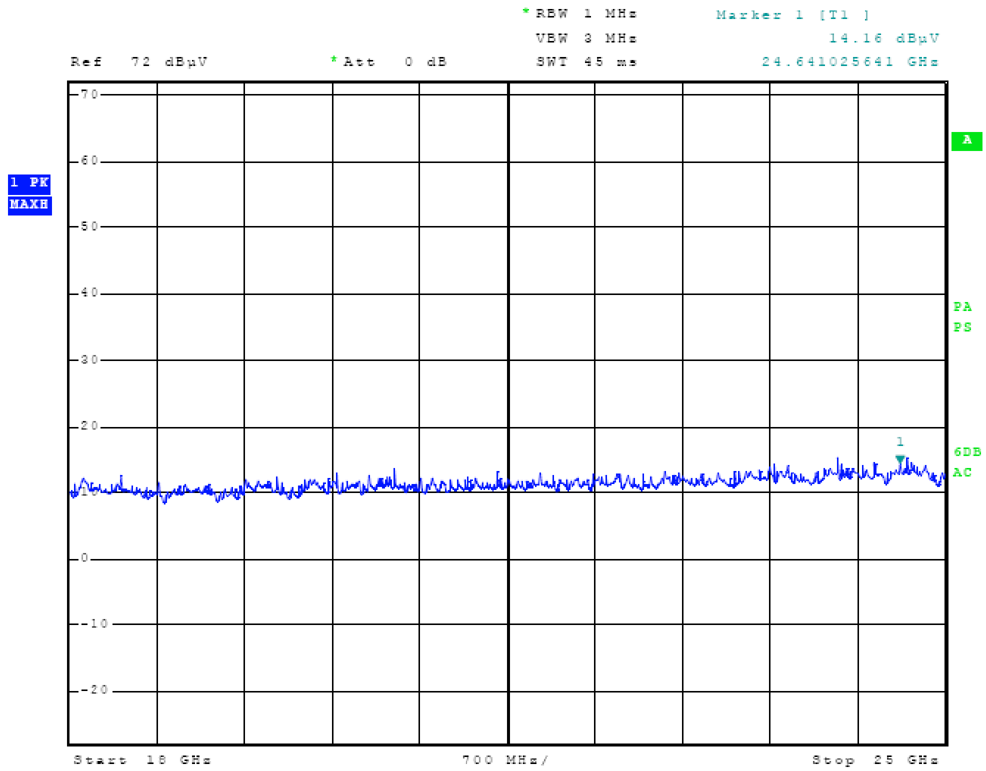

Figure Nine General Radiated Emissions taken at 1 meter in screen room

Radiated Emissions from EUT Data (Highest Emissions)

Frequency in MHz	FSM Horz. (dBµV)	FSM Vert. (dBµV)	A.F. (dB/m)	Amp. Gain (dB)	RFS Horz. @ 3m (dBµV/m)	RFS Vert. @ 3m (dBµV/m)	Limit @ 3m (dBµV/m)
107.7	43.4	45.4	7.0	30	20.4	22.4	43.5
120.7	37.7	48.8	7.1	30	14.8	25.9	43.5
182.2	44.4	46.7	9.2	30	23.6	25.9	43.5
208.2	41.4	47.0	11.0	30	22.4	28.0	43.5
211.5	39.3	48.3	11.0	30	20.3	29.3	43.5
298.0	39.6	42.1	13.9	30	23.5	26.0	46.0
397.3	45.8	43.3	16.5	30	32.3	29.8	46.0
595.9	39.0	39.9	19.4	30	28.4	29.3	46.0

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

Summary of Results for General Radiated Emissions

The EUT demonstrated compliance with the radiated emissions requirements of RSS-210 and CFR 47 Part 15C paragraph 15.209 Intentional Radiators. The EUT demonstrated a minimum margin of 13.7 dB below the requirements. Other emissions were present with amplitudes at least 20 dB below the Limits.

Statement of Modifications and Deviations

No modifications to the EUT were required for the equipment to demonstrate compliance with the CISPR 22, RSS-210 or CFR 47 emissions requirements. There were no deviations or exceptions to the specifications.

Antenna Power Conduction Limits for Receivers

Receivers which provide terminals for the connection of an external receiving antenna may be tested to demonstrate compliance with the provisions of CFR 47 15.109 with the antenna terminals shielded and terminated with a termination equal to the impedance specified for the antenna, provided these receivers also comply with the following: With the receiver antenna terminal connected to a resistive termination equal to the impedance specified or employed for the antenna, the power at the antenna terminal at any frequency within the range of measurements specified in 15.33 shall not exceed 2.0 nanowatts. The EUT incorporates a unique antenna connection for use with authorized antenna system. The antenna port was connected to a spectrum analyzer for testing the antenna-conducted emissions. The antenna connection under test was connected to the spectrum analyzer through a short coaxial cable. The spectrum analyzer provided the 50-ohm load for the antenna port. The frequency spectrum was investigated at the antenna port with the worst case data presented. Compliance to antenna port conducted emission requirements are demonstrated in radiated emissions test data as tested at 3 meter OATS with data presented elsewhere in this report.

Antenna Conducted Emissions Data

Frequency (MHz)	Emission Level (dBm)	Limit (dBm)	Margin (dB)
2442.0	-79.48	-57.0	-22.5
4884.0	-81.08	-57.0	-24.1
7326.0	-81.15	-57.0	-24.2
9768.0	-81.52	-57.0	-24.5
12210.0	-81.37	-57.0	-24.4
14652.0	-80.56	-57.0	-23.6
17094.0	-80.66	-57.0	-23.7
19536.0	-80.18	-57.0	-23.2
21978.0	-79.40	-57.0	-22.4

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

Receiver Radiated Emissions Data

Emission Freq. (MHz)	FSM Horz. (dBμV)	FSM Vert. (dBμV)	Ant. Factor (dB)	Amp. Gain (dB)	RFS Horz. @ 3m (dBμV/m)	RFS Vert. @ 3m (dBμV/m)	Limit @ 3m (dBμV/m)
2442.0	15.5	15.4	32.9	25	23.4	23.3	54.0
4884.0	14.7	15.3	32.9	25	22.6	23.2	54.0
7326.0	14.6	15.8	36.4	25	26.0	27.2	54.0
9768.0	13.5	13.4	38.2	25	26.7	26.6	54.0
12210.0	12.5	12.3	40.2	25	27.7	27.5	54.0

Other emissions were present with amplitudes at least 20 dB below limits.

Summary of Results for Antenna Conducted Emissions

The EUT demonstrated compliance with the antenna conducted emissions requirements of CFR 47 Part 15B and RSS-GEN with a minimum 22.4 dB margin below the limit. The EUT demonstrated compliance with the receiver radiated emissions requirements of CFR 47 Part 15B and RSS-GEN with a minimum 26.3 dB margin below the limit. Other emissions were present with amplitudes at least 20 dB below the CFR 47 15B and RSS-GEN limits.

Operation in the Band 2400-2483.5 MHz

The power output was measured both at the antenna connection port offered for testing and at the open area test site at a three-meter distance with the authorized antenna systems. Figures ten through fifteen demonstrate worst-case antenna conducted emissions and compliance with the requirements of 15.247(c) for emission limitations. Figures sixteen and seventeen demonstrate compliance with maximum output power requirements across the operational frequency band. Figures eighteen through twenty-three demonstrate compliance with the minimum 6 db bandwidth requirements. Figures twenty-four through twenty-nine demonstrate compliance to power spectral density requirements. Compliance to band edge requirements per 15.209 and 15.247 are demonstrated in radiated emissions tables.

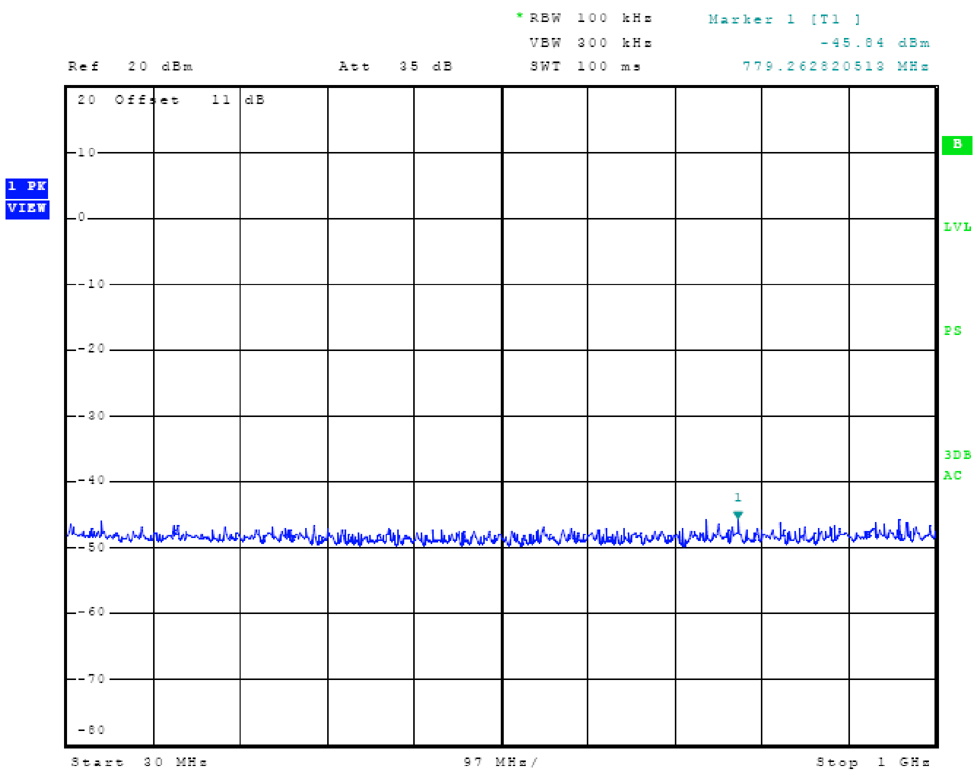

Figure Ten Plot of Antenna Port Conducted Emissions

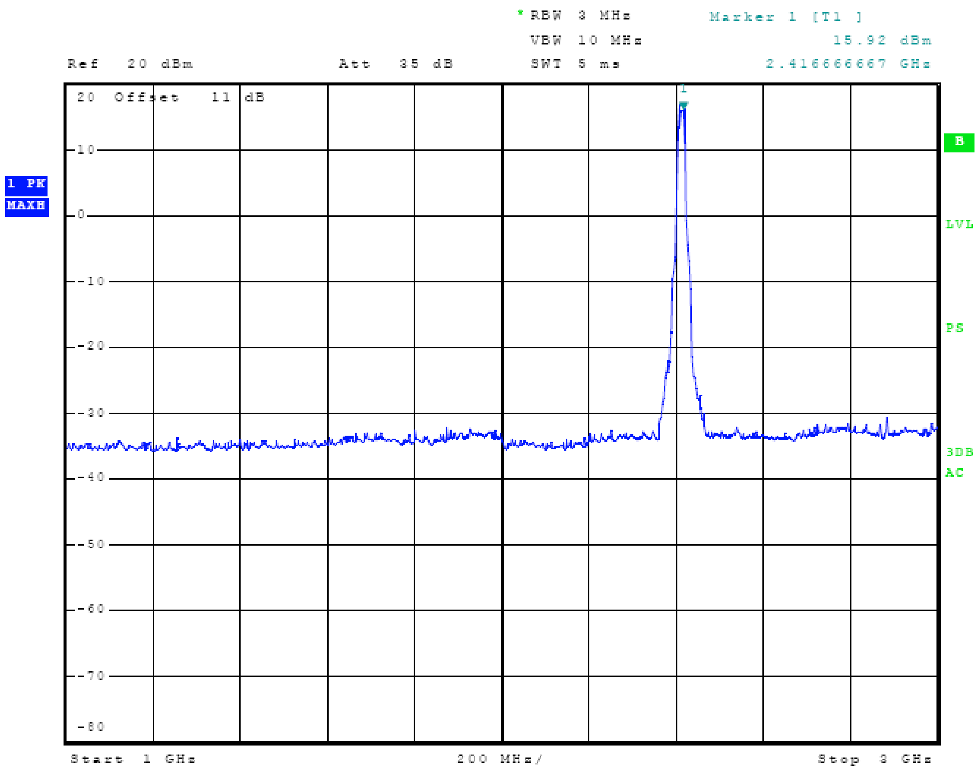

Figure Eleven Plot of Antenna Port Conducted Emissions

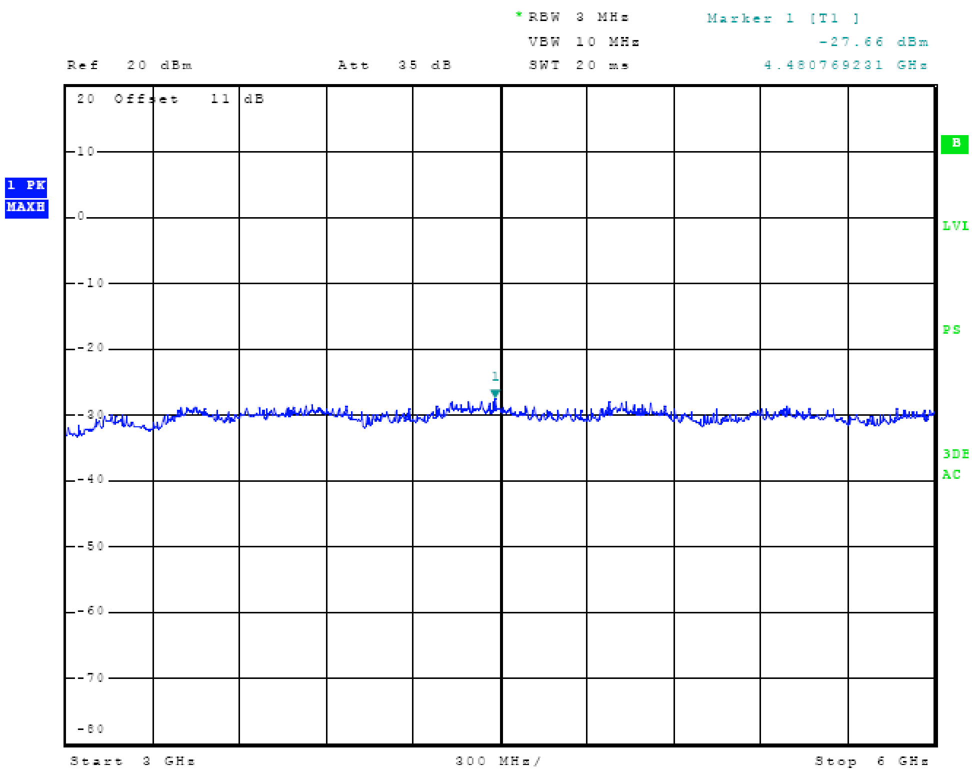

Figure Twelve Plot of Antenna Port Conducted Emissions

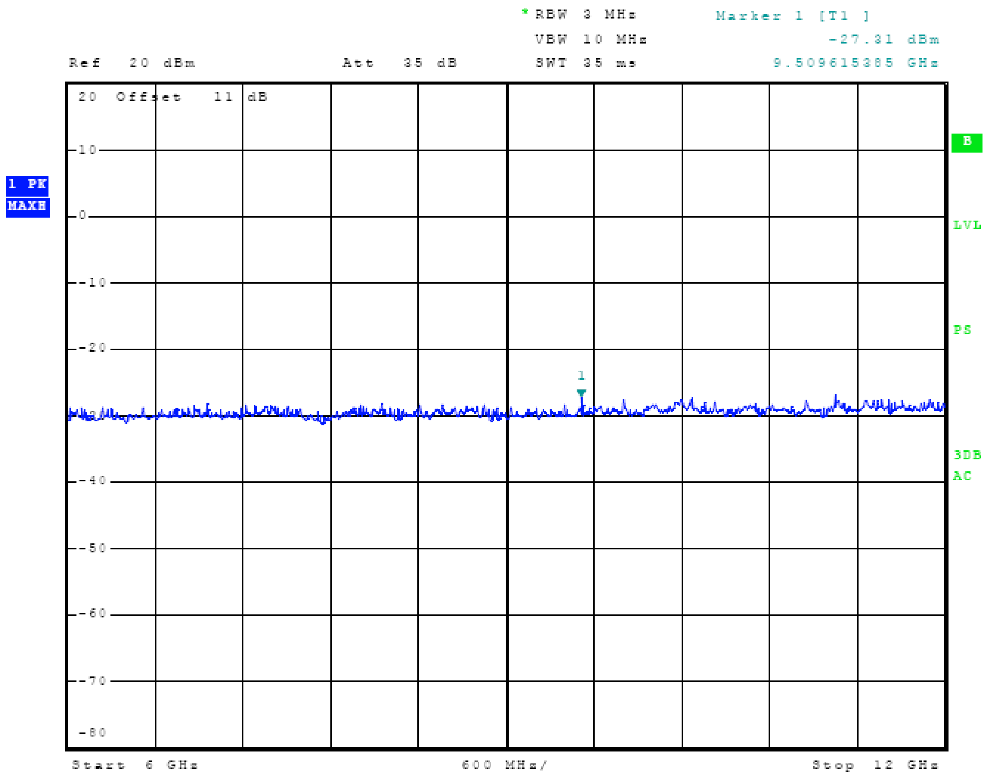

Figure Thirteen Plot of Antenna Port Conducted Emissions

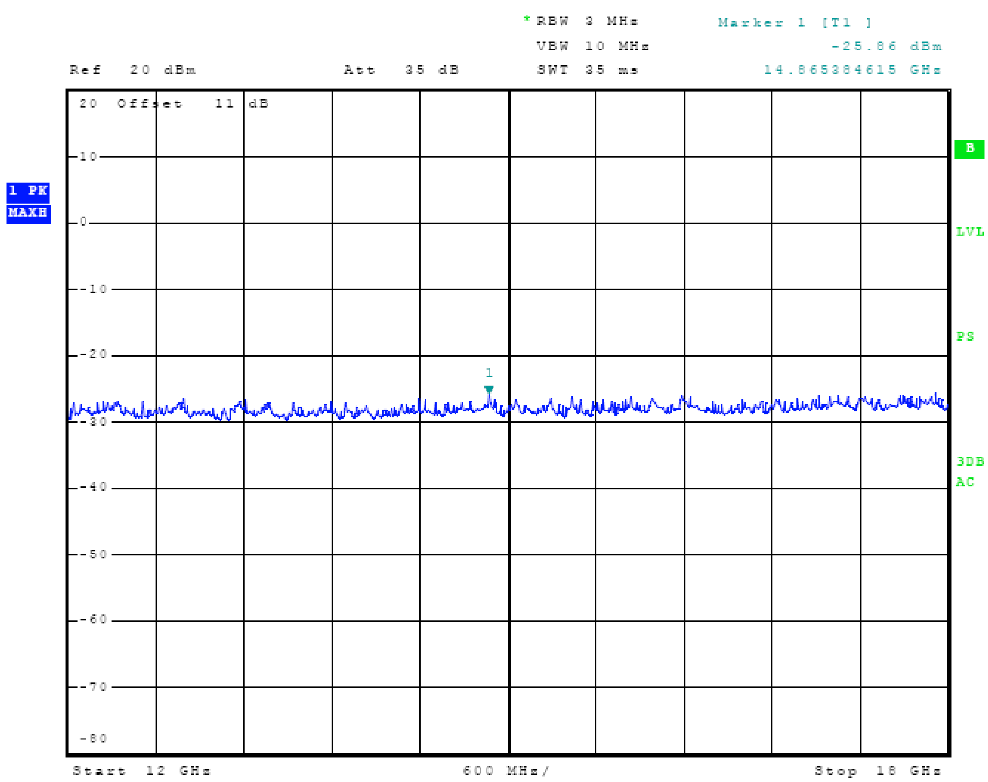

Figure Fourteen Plot of Antenna Port Conducted Emissions

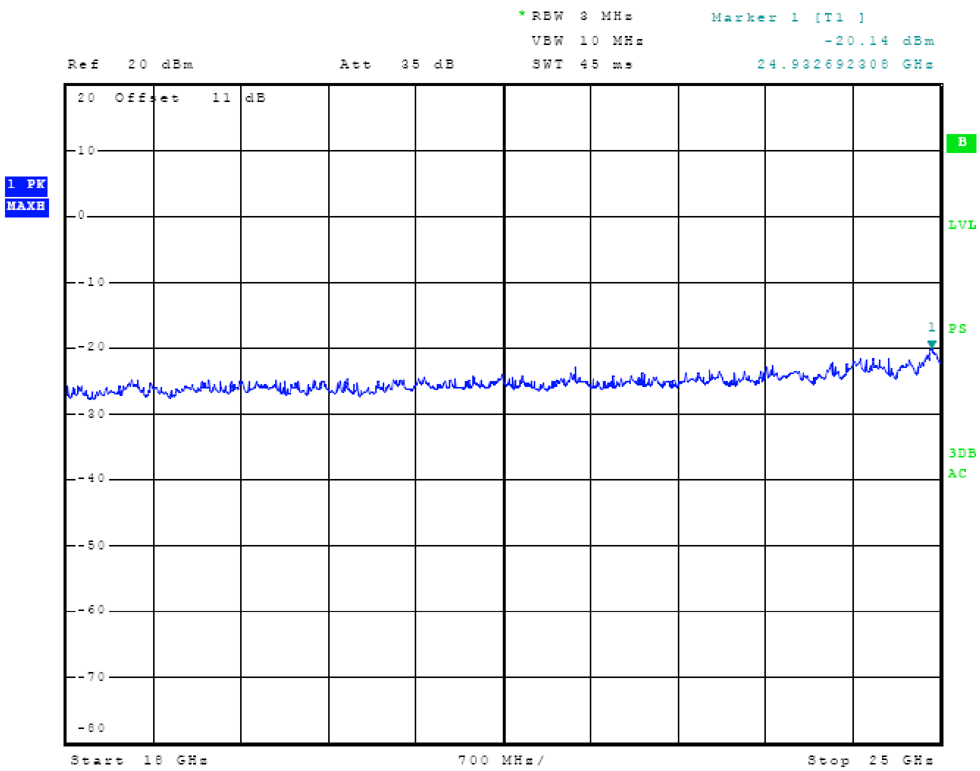

Figure Fifteen Plot of Antenna Port Conducted Emissions

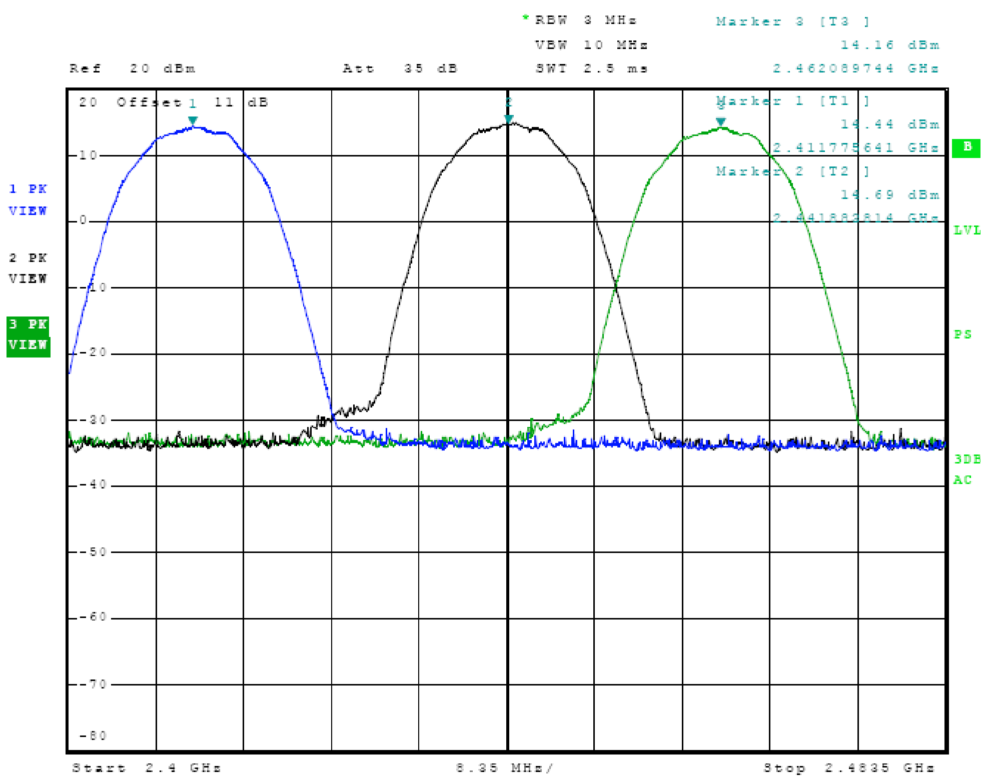

Figure Sixteen Plot of Power Output Across Operational Band (802.11b)

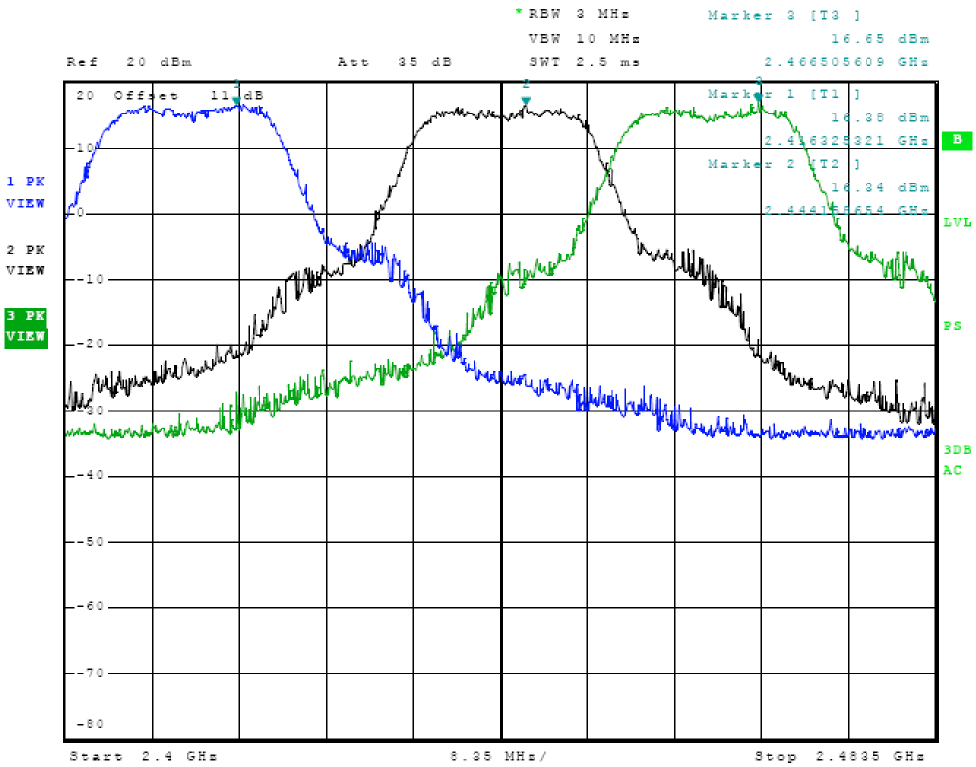

Figure Seventeen Plot of Power Output Across Operational Band (802.11g)

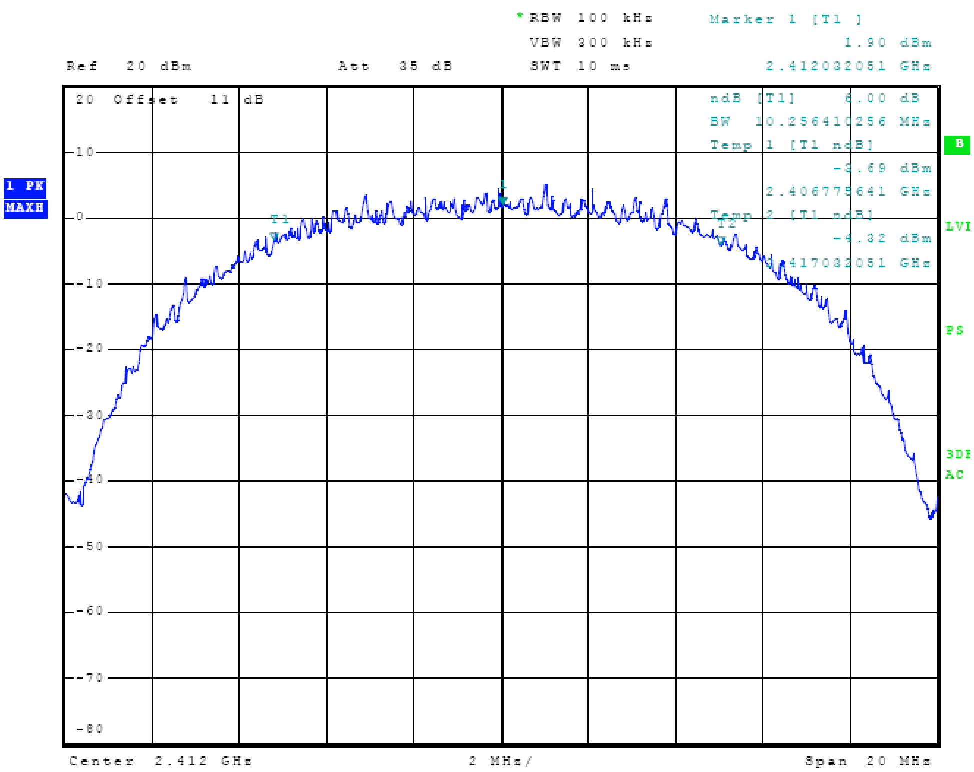

Figure Eighteen Plot of 6dB Band width (802.11b)

NVLAP Lab Code 200087-0

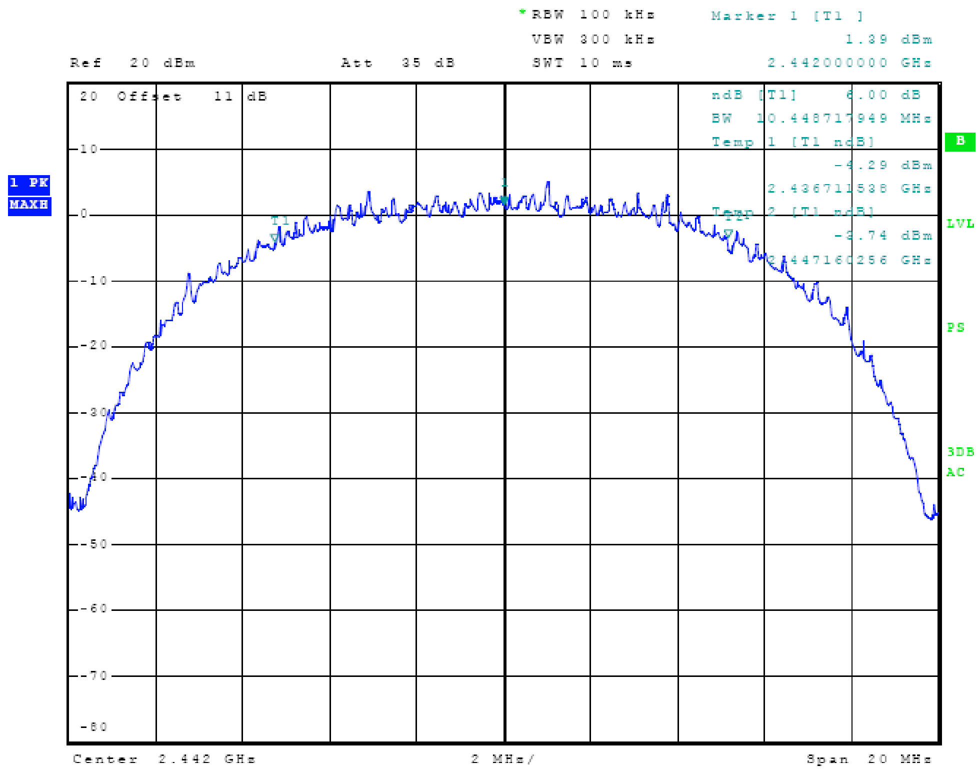

Figure Nineteen Plot of 6dB Band width (802.11b)

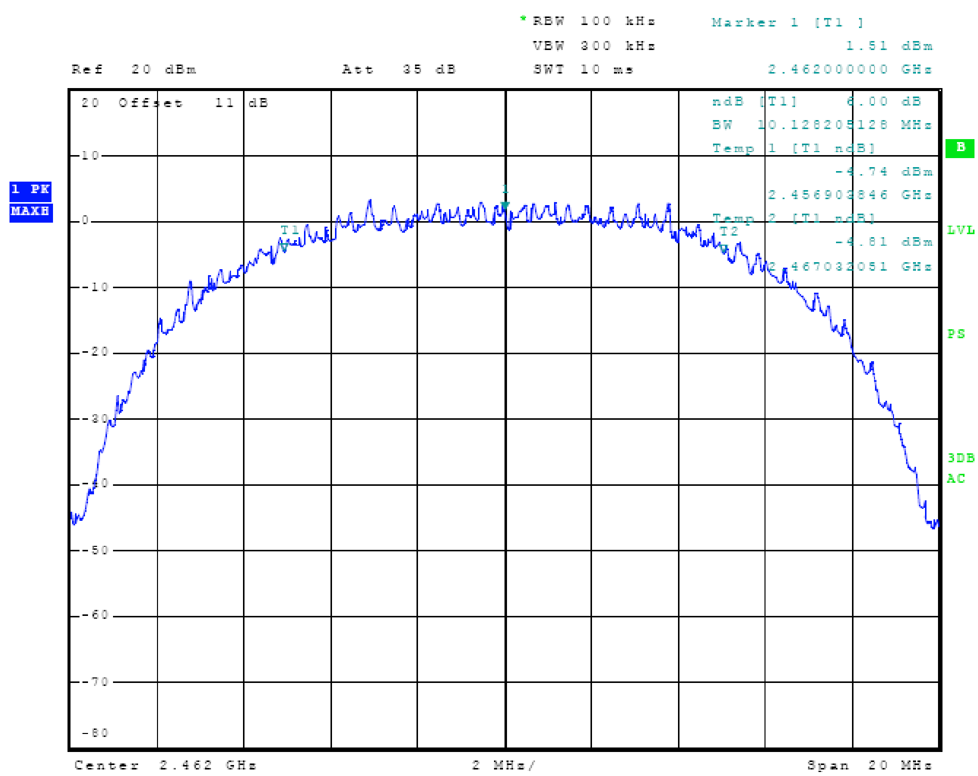

Figure Twenty Plot of 6dB Band width (802.11b)

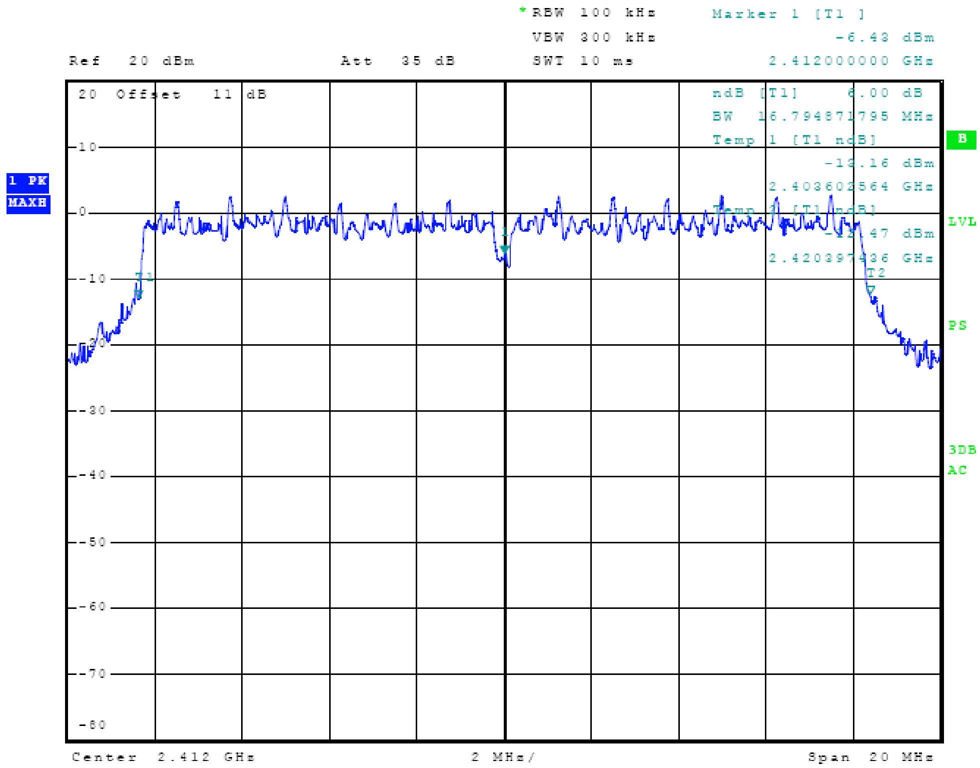

Figure Twenty-one Plot of 6dB Band width (802.11g)

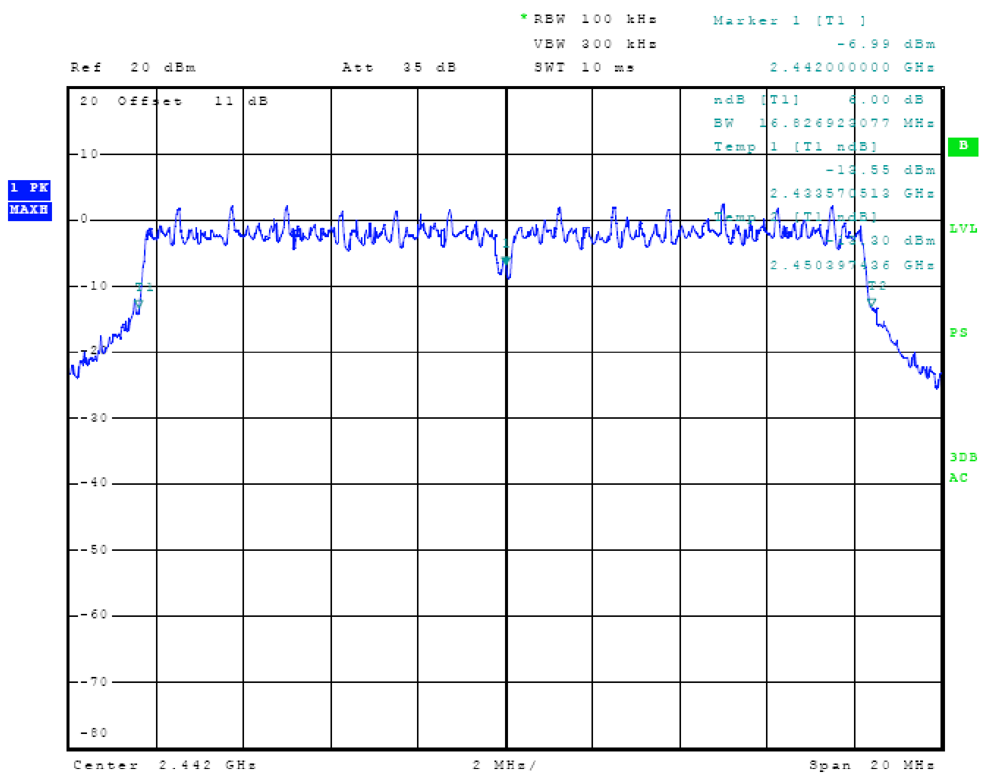

Figure Twenty-two Plot of 6dB Band width (802.11g)

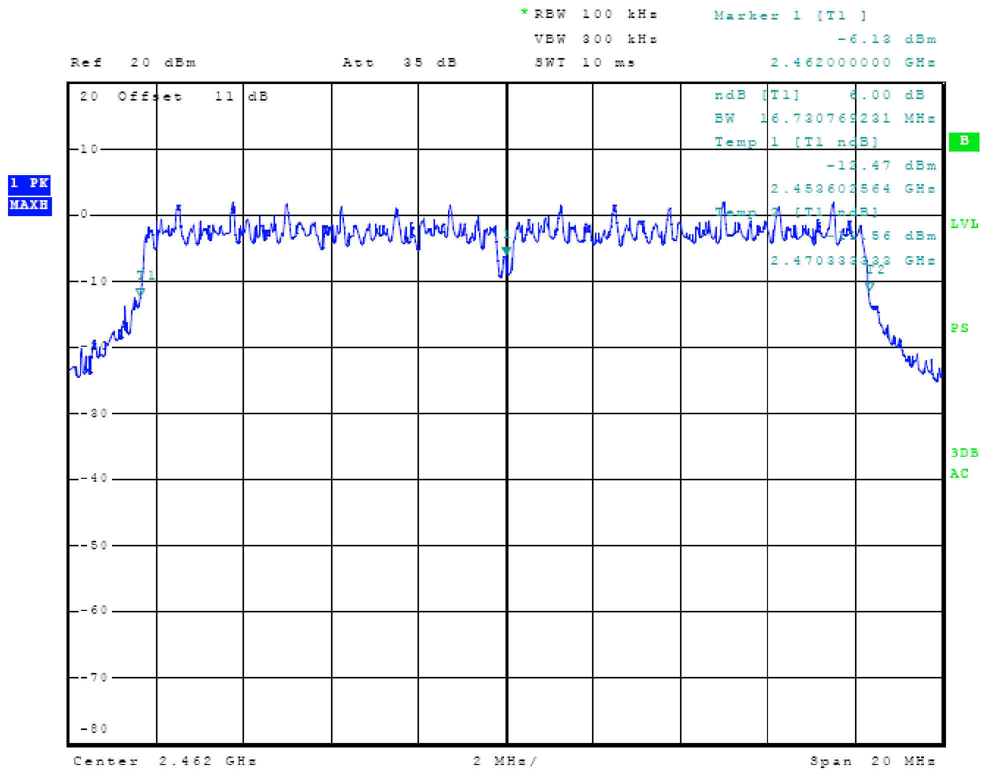

Figure Twenty-three Plot of 6dB Band width (802.11g)

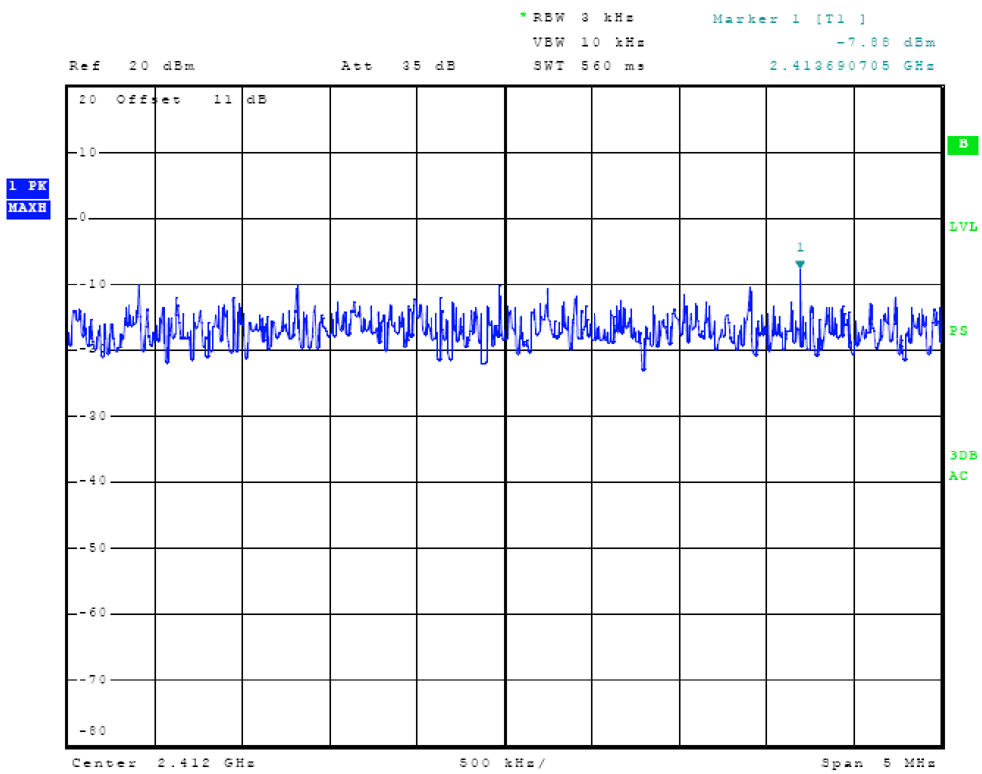

Figure Twenty-four Plot of Power Spectral Density (802.11b)

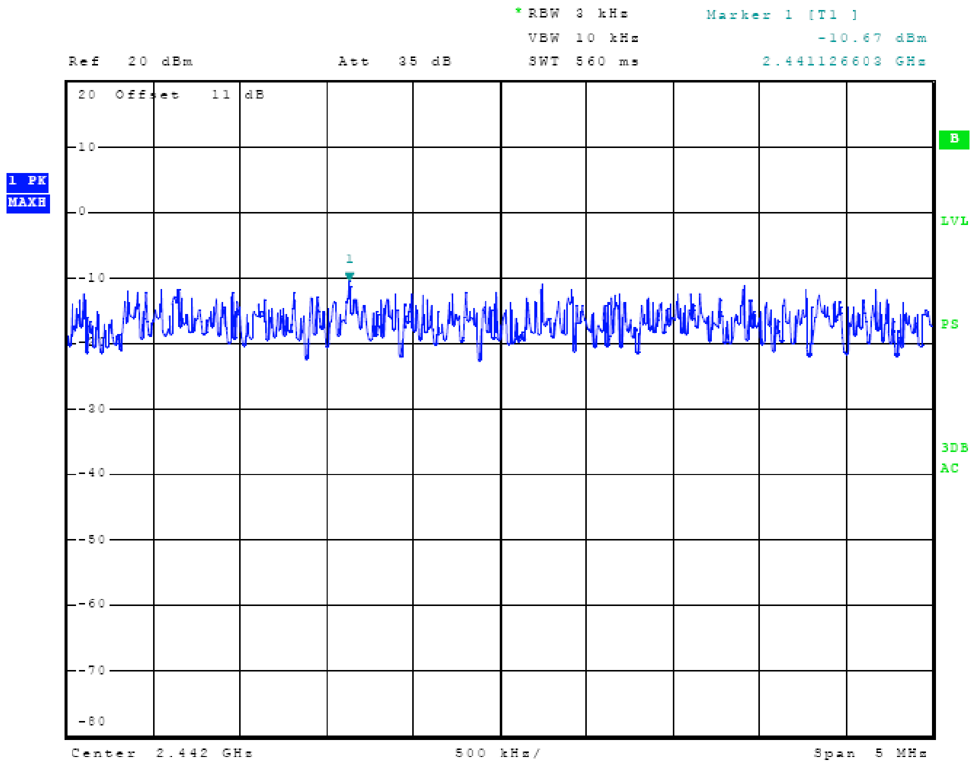

Figure Twenty-five Plot of Power Spectral Density (802.11b)

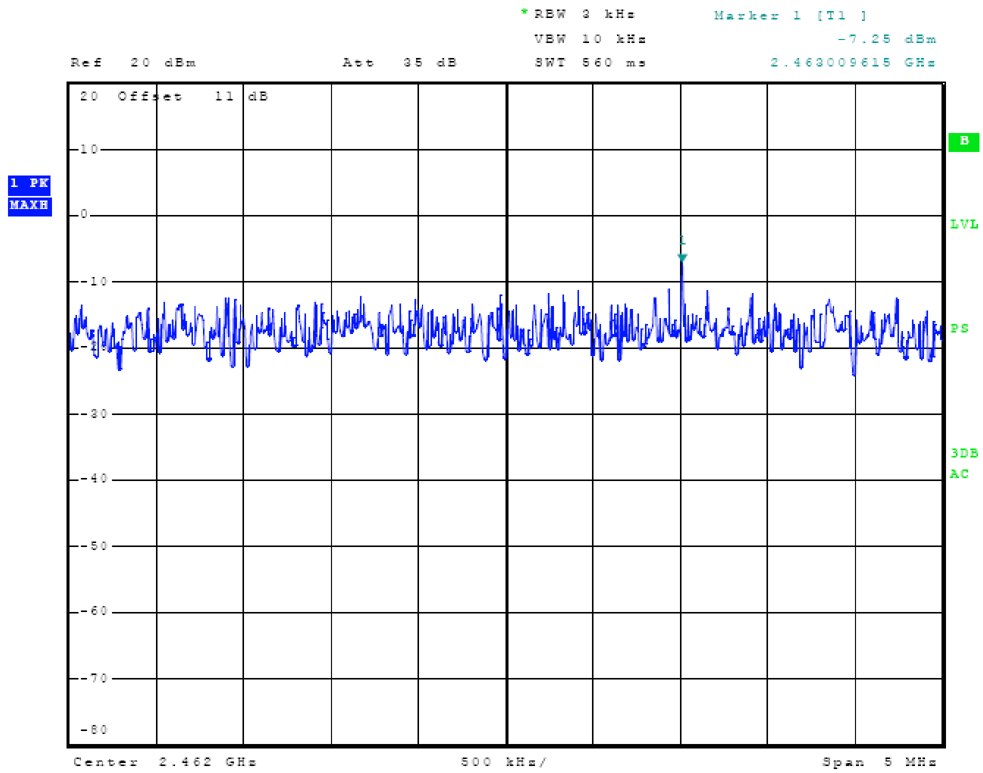

Figure Twenty-six Plot of Power Spectral Density (802.11b)

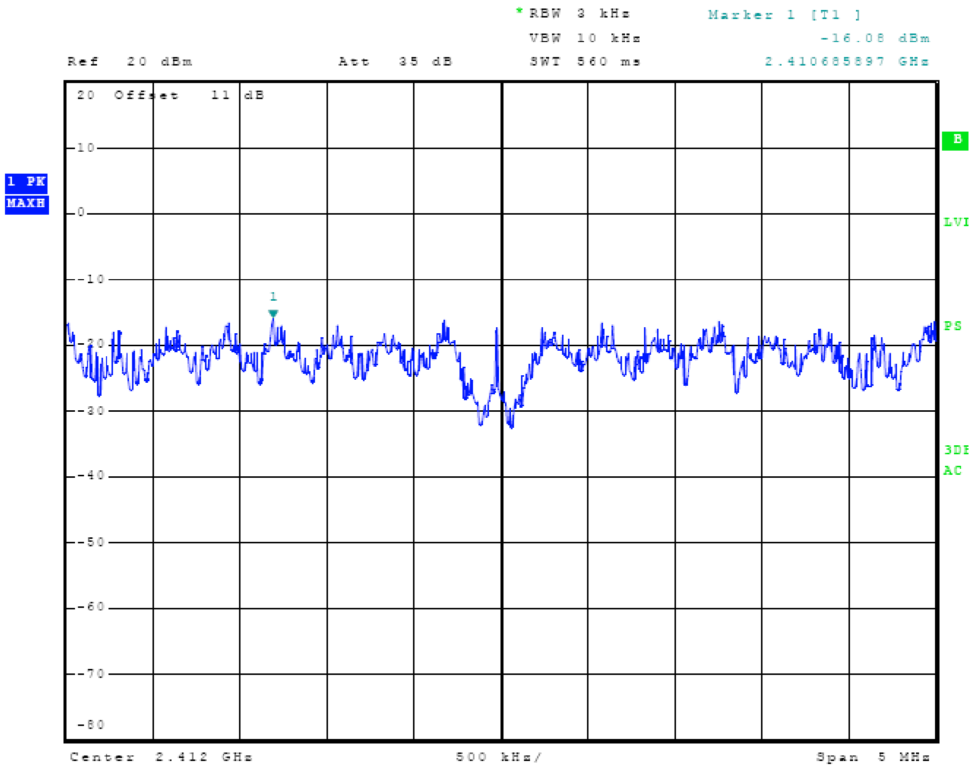

Figure Twenty-seven Plot of Power Spectral Density (802.11g)

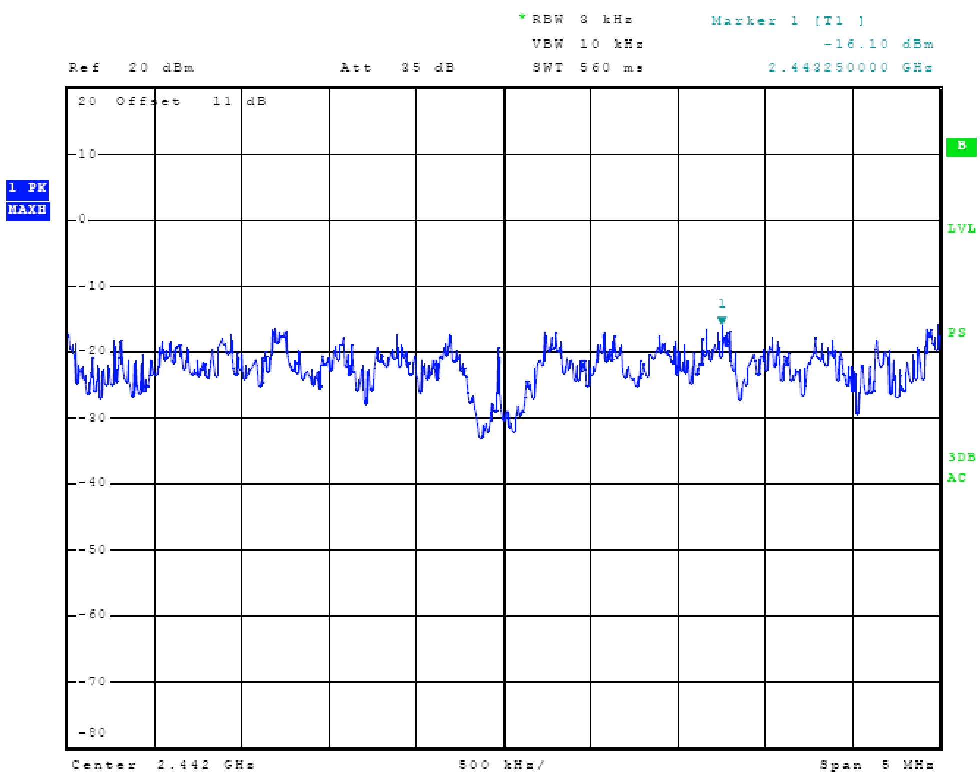

Figure Twenty-eight Plot of Power Spectral Density (802.11g)

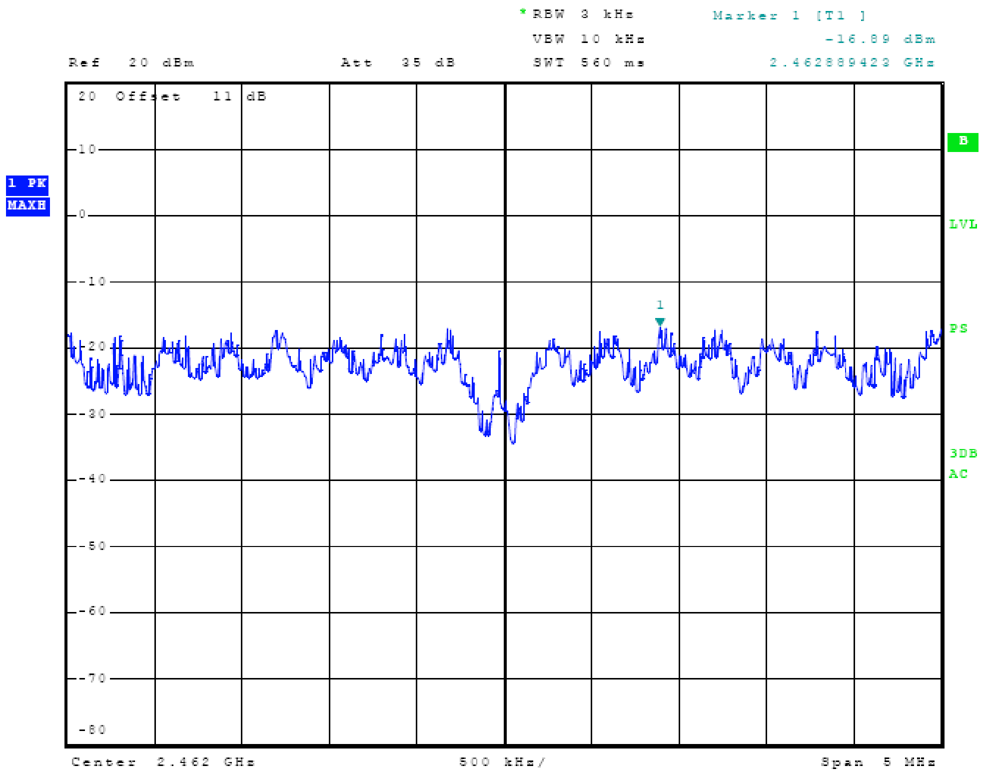

Figure Twenty-nine Plot of Power Spectral Density (802.11g)

Transmitter Emissions Data

The antenna conducted output power, power spectral density, and 6-dB bandwidth were measured while operating in available modes. The data reported below represents the worst-case operational conditions.

Transmitter Antenna Port Conducted Emissions Data

Frequency MHz	Antenna Conducted Output Power dBm	Occupied Bandwidth MHz	Power Spectral Density dBm
Mode 802.11b			
2412	17.90	10.25	-7.88
2442	17.51	10.45	-10.67
2462	17.78	10.48	-7.25
Mode 802.11g			
2412	17.92	16.79	-16.79
2442	17.59	16.83	-16.82
2462	17.76	17.73	-16.73

Transmitter Radiated Emissions Data 802.11b Mode with 2.5 dBi Dipole Antenna

Frequency in MHz	FSM Horz. (dBµV)	FSM Vert. (dBµV)	A.F. (dB/m)	Amp. Gain (dB)	RFS Horz. @ 3m (dBµV/m)	RFS Vert. @ 3m (dBµV/m)	Limit @ 3m (dBµV/m)
Mode 802.11b							
2412.0	79.8	85.2	32.9	25	87.7	93.1	--
4824.0	17.7	19.2	32.9	25	25.6	27.1	54.0
7236.0	15.6	15.7	36.4	25	27.0	27.1	54.0
9648.0	15.7	15.8	38.1	25	28.8	28.9	54.0
12060.0	12.4	12.4	40.0	25	27.4	27.4	54.0
2442.0	81.2	86.1	32.9	25	89.1	94.0	--
4884.0	17.3	20.7	32.9	25	25.2	28.6	54.0
7326.0	15.4	15.2	36.4	25	26.8	26.6	54.0
9768.0	15.1	15.2	38.2	25	28.3	28.4	54.0
12210.0	12.5	12.5	40.2	25	27.7	27.7	54.0
2462.0	79.0	85.3	32.9	25	86.9	93.2	--
4924.0	17.2	20.7	32.9	25	25.1	28.6	54.0
7386.0	14.7	14.8	36.7	25	26.4	26.5	54.0
9848.0	14.9	14.9	38.4	25	28.3	28.3	54.0
12310.0	12.4	12.4	40.4	25	27.8	27.8	54.0
Band Edge Compliance							
2390.0	17.8	21.2	32.9	25	25.7	29.1	54.0
2400.0	18.0	25.7	32.9	25	25.9	33.6	54.0
2483.5	17.9	18.5	33.3	25	26.2	26.8	54.0

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

Transmitter Radiated Emissions Data 802.11g Mode with 2.5 dBi Dipole Antenna

Frequency in MHz	FSM Horz. (dBµV)	FSM Vert. (dBµV)	A.F. (dB/m)	Amp. Gain (dB)	RFS Horz. @ 3m (dBµV/m)	RFS Vert. @ 3m (dBµV/m)	Limit @ 3m (dBµV/m)
Mode 802.11g							
2412.0	78.4	82.9	32.9	25	86.3	90.8	--
4824.0	17.5	17.6	32.9	25	25.4	25.5	54.0
7236.0	15.7	15.7	36.4	25	27.1	27.1	54.0
9648.0	15.6	15.7	38.1	25	28.7	28.8	54.0
12060.0	12.3	12.4	40.0	25	27.3	27.4	54.0
2442.0	77.4	82.2	32.9	25	85.3	90.1	--
4884.0	17.3	17.4	32.9	25	25.2	25.3	54.0
7326.0	15.2	15.3	36.4	25	26.6	26.7	54.0
9768.0	15.0	15.1	38.2	25	28.2	28.3	54.0
12210.0	12.4	12.4	40.2	25	27.6	27.6	54.0
2462.0	78.6	82.5	32.9	25	86.5	90.4	--
4924.0	17.3	17.0	32.9	25	25.2	24.9	54.0
7386.0	14.7	14.7	36.7	25	26.4	26.4	54.0
9848.0	14.8	14.8	38.4	25	28.2	28.2	54.0
12310.0	12.3	12.3	40.4	25	27.7	27.7	54.0
Band Edge Compliance							
2390.0	17.8	21.2	32.9	25	25.7	29.1	54.0
2400.0	18.0	25.7	32.9	25	25.9	33.6	54.0
2483.5	17.9	18.5	33.3	25	26.2	26.8	54.0

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

Summary of Results for Radiated Emissions of Intentional Radiator

The EUT demonstrated antenna conducted output power of 62 milliwatt (at antenna port). The EUT demonstrated compliance with the radiated emissions requirements of CFR 47 Part 15.247 and RSS-210 with highest average emission level measured of 94.0 dBμV/m (2 dBi dipole) at 3 meters. The EUT demonstrated a worst-case margin below the harmonic emissions requirements of 25.1 dB below the limit. The EUT demonstrated compliance with the radiated emissions requirements of RSS-210 and CFR 47 Part 15.247 Intentional Radiators. There are no 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. The specifications of RSS-210 and CFR 47 15.247 were met; there are no deviations or exceptions to the requirements.

Statement of Modifications and Deviations

No modifications to the EUT were required for the unit to demonstrate compliance with the RSS-210 and CFR 47 Part 15C emissions standards. There were no deviations to the specifications.

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

Radiated Emissions Measurement Uncertainty Calculation

Measurement of vertically polarized radiated field strength over the frequency range 30 MHz to 1 GHz on an open area test site at 3m and 10m includes following uncertainty:

Contribution	Probability Distribution	Uncertainty (dB)
Antenna factor calibration	normal (k = 2)	±0.58
Cable loss calibration	normal (k = 2)	±0.2
Receiver specification	rectangular	±1.0
Antenna directivity	rectangular	±0.1
Antenna factor variation with height	rectangular	±2.0
Antenna factor frequency interpolation	rectangular	±0.1
Measurement distance variation	rectangular	±0.2
Site Imperfections	rectangular	±1.5

Combined standard uncertainty $u_c(y)$ is

$$U_c(y) = \pm \sqrt{\left[\frac{1.0}{2}\right]^2 + \left[\frac{0.2}{2}\right]^2 + \left[\frac{1.0^2 + 0.1^2 + 2.0^2 + 0.1^2 + 0.2^2 + 1.5^2}{3}\right]}$$

$U_c(y) = \pm$ 1.6 dB

It is probable that $u_c(y) / s(q_k) > 3$, where $s(q_k)$ is estimated standard deviation from a sample of n readings unless the repeatability of the EUT is particularly poor, and a coverage factor of k = 2 will ensure that the level of confidence will be approximately 95%, therefore:

$$s(q_k) = \sqrt{\frac{1}{(n-1)} \sum_{k-1}^{n} (q_k - \bar{q})^2}$$

$U = 2\ U_c(y) = 2 \times \pm 1.6$ dB $= \pm$ 3.2 dB

Notes:

1.1 Uncertainties for the antenna and cable were estimated, based on a normal probability distribution with k = 2.

1.2 The receiver uncertainty was obtained from the manufacturer's specification for which a rectangular distribution was assumed.

1.3 The antenna factor uncertainty does not take account of antenna directivity.

1.4 The antenna factor varies with height and since the height was not always the same in use as when the antenna was calibrated an additional uncertainty is added.

1.5 The uncertainty in the measurement distance is relatively small but has some effect on the received signal strength. The increase in measurement distance as the antenna height is increased is an inevitable consequence of the test method and is therefore not considered a contribution to uncertainty.

1.6 Site imperfections are difficult to quantify but may include the following contributions:
-Unwanted reflections from adjacent objects.
-Ground plane imperfections: reflection coefficient, flatness, and edge effects.
-Losses or reflections from "transparent" cabins for the EUT or site coverings.
-Earth currents in antenna cable (mainly effect biconical antennas).

The specified limits for the difference between measured site attenuation and the theoretical value (± 4 dB) were not included in total since the measurement of site attenuation includes uncertainty contributions already allowed for in this budget, such as antenna factor.

Conducted Measurements Uncertainty Calculation

Measurement of conducted emissions over the frequency range 9 kHz to 30 MHz includes following uncertainty:

Contribution	Probability Distribution	Uncertainty (dB)
Receiver specification	rectangular	±1.5
LISN coupling specification	rectangular	±1.5
Cable and input attenuator calibration	normal (k=2)	±0.5

Combined standard uncertainty $u_c(y)$ is

$$U_c(y) = \pm \sqrt{\left[\frac{0.5}{2}\right]^2 + \frac{1.5^2 + 1.5^2}{3}}$$

$U_c(y) = \pm 1.2$ dB

As with radiated field strength uncertainty, it is probable that $u_c(y) / s(q_k) > 3$ and a coverage factor of k = 2 will suffice, therefore:

$U = 2\ U_c(y) = 2 \times \pm 1.2$ dB $= \pm 2.4$ dB

Annex B Rogers Labs Test Equipment List

The test equipment used 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
Oscilloscope Scope: Tektronix 2230	2/09
Wattmeter: Bird 43 with Load Bird 8085	2/09
Power Supplies: Sorensen SRL 20-25, SRL 40-25, DCR 150, DCR 140	2/09
H/V Power Supply: Fluke Model: 408B (SN: 573)	2/09
R.F. Generator: HP 606A	2/09
R.F. Generator: HP 8614A	2/09
R.F. Generator: HP 8640B	2/09
Spectrum Analyzer: Rhodes & Schwarz ESU 40	2/09
Spectrum Analyzer: HP 8562A,	5/09
Mixers: 11517A, 11970A, 11970K, 11970U, 11970V, 11970W	
HP Adapters: 11518, 11519, 11520	
Spectrum Analyzer: HP 8591EM	5/09
Frequency Counter: Leader LDC825	2/09
Antenna: EMCO Biconilog Model: 3143	5/09
Antenna: EMCO Log Periodic Model: 3147	10/09
Antenna: Antenna Research Biconical Model: BCD 235	10/09
Antenna: EMCO Dipole Set 3121C	2/09
Antenna: C.D. B-101	2/09
Antenna: Solar 9229-1 & 9230-1	2/09
Antenna: EMCO 6509	2/09
Audio Oscillator: H.P. 201CD	2/09
R.F. Power Amp 65W Model: 470-A-1010	2/09
R.F. Power Amp 50W M185- 10-501	2/09
R.F. PreAmp CPPA-102	2/09
LISN 50 μHy/50 ohm/0.1 μf	10/09
LISN Compliance Eng. 240/20	2/09
LISN Fischer Custom Communications FCC-LISN-50-16-2-08	2/09
Peavey Power Amp Model: IPS 801	2/09
Power Amp A.R. Model: 10W 1010M7	2/09
Power Amp EIN Model: A301	2/09
ELGAR Model: 1751	2/09
ELGAR Model: TG 704A-3D	2/09
ESD Test Set 2010i	2/09
Fast Transient Burst Generator Model: EFT/B-101	2/09
Current Probe: Singer CP-105	2/09
Current Probe: Solar 9108-1N	2/09
Field Intensity Meter: EFM-018	2/09
KEYTEK Ecat Surge Generator	2/09

Annex C Rogers Qualifications

Scot D. Rogers, Engineer

Rogers Labs, Inc.

Mr. Rogers has approximately 17 years experience in the field of electronics. Six years working in the automated controls industry and 6 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

Bachelor of Science Degree in Electrical Engineering from Kansas State University

Bachelor of Science Degree in Business Administration Kansas State University

Several Specialized Training courses and seminars pertaining to Microprocessors and Software programming

Scot D Rogers

Scot D. Rogers

Annex D FCC Site Registration Letter

FEDERAL COMMUNICATIONS COMMISSION

Laboratory Division
7435 Oakland Mills Road
Columbia, MD 21046

June 18, 2008

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: June 18, 2008

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

Annex E Industry Canada Site Registration Letter

Industry Canada Industrie Canada

July 29th, 2008

OUR FILE: 46405-3041
Submission No: 127059

Rogers Labs Inc.
4405 West 259th Terrace
Louisburg KY 66053
USA

Attention: Scot D. Rogers

Dear Sir/Madame:

The Bureau has received your application for the registration / renewal of a 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 **(3040A-1).** Please reference the appropriate site number in the body of test reports containing measurements performed on the site. In addition, please be informed that the Bureau is now utilizing a **new site numbering scheme** in order to simplify the electronic filing process. Our goal is to reduce the number of secondary codes associated to one particular company. The following changes have been made to your records.

Your primary code is: **3041**
The company number associated to the site(s) located at the above address is: **3041A**
The table below is a summary of the changes made to the unique site registration number(s):

New Site Number	Obsolete Site Number	Description of Site	Expiry Date (YYYY-MM-DD)
3041A-1	3041-1	3 / 10m OATS	2010-07-29

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 shall be accepted. Please indicate in a letter the previous assigned site number if applicable and the type of site (example: 3 meter OATS or 3 meter 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 two 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;

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,

S. Proulx Wireless Laboratory
Manager Certification and
Engineering Bureau Industry Canada
3701 Carling Ave., Building 94
Ottawa, Ontario K2H 8S2
Canada

Canada