Excellence in Compliance Testing

Certification Test Report

FCC ID: HSW-WSN802G
IC: 4492A-WSN802G

FCC Rule Part: 15.247
IC Radio Standards Specification: RSS-210

ACS Report Number: 09-0120 – 15C

Manufacturer: **RFM / Cirronet Inc.**
Model(s): **WSN802GC, WSN802GP**

Test Begin Date: April 23, 2009
Test End Date: May 4, 2009

Report Issue Date: **May 12, 2009**

FOR THE SCOPE OF ACCREDITATION UNDER LAB Code 200612-0

This report is not be used to claim certification, approval, or endorsement by NVLAP, NIST or any government agency.

Prepared by: Ken Rivers

Ken Rivers
Wireless Certifications Technician
ACS, Inc.

Reviewed by: _____

Kirby Munroe
Director, Wireless Certifications
ACS, Inc.

This report contains 25 pages

Table of Contents

1.0 General 3
1.1 Purpose 3
1.2 Product Description 3
1.2.1 General 3
1.2.2 Intended Use 3
1.3 Test Methodology and Considerations 3
2.0 Test Facilities 4
2.1 Location 4
2.2 Laboratory Accreditations/Recognitions/Certifications 4
2.3 Radiated Emissions Test Site Description 5
2.3.1 Semi-Anechoic Chamber Test Site 5
2.3.2 Open Area Tests Site (OATS) 6
2.4 Conducted Emissions Test Site Description 7
3.0 Applicable Standards and References 7
4.0 List of Test Equipment 8
5.0 Support Equipment 9
6.0 EUT Setup Block Diagram 9
7.0 Summary of Tests 10
7.1 Antenna Requirement 10
7.2 Power Line Conducted Emissions 10
7.2.1 Test Methodology 10
7.2.2 Test Results 10
7.3 Radiated Emissions (Unintentional Radiation) 14
7.3.1 Test Methodology 14
7.3.2 Test Results 14
7.4 6dB / 99% Bandwidth 14
7.4.1 Test Methodology 14
7.4.2 Test Results 14
7.5 Peak Output Power 17
7.5.1 Test Methodology 17
7.5.2 Test Results 17
7.6 Band-Edge Compliance and Spurious Emissions 17
7.6.1 Band-Edge Compliance 17
7.6.1.1 Test Methodology 17
7.6.1.2 Test Results 17
7.6.2 Conducted Spurious Emissions 19
7.6.2.1 Test Methodology 19
7.6.2.2 Test Results 19
7.6.3 Radiated Spurious Emissions 22
7.6.3.1 Test Methodology 22
7.6.3.2 Test Results 22
7.6.3.3 Sample Calculation 23
7.7 Power Spectral Density 23
7.7.1 Test Methodology 23
7.7.2 Test Results 23
8.0 CONCLUSION 25

Additional Exhibits Included In Filing

Internal Photographs
External Photographs
Test Setup Photographs
Product Labeling
RF Exposure – MPE Calculations
Installation/Users Guide
Theory of Operation
System Block Diagram
Schematics

1.0 GENERAL

1.1 Purpose

The purpose of this report is to demonstrate compliance with Part 15 Subpart C of the FCC's Code of Federal Regulations and Industry Canada's Radio Standards Specification RSS-210.

1.2 Product Description

1.2.1 General

The WSN802G transceiver module is a low cost, robust solution for IEEE 802.11g sensor networks. The WSN802G module includes analog, digital and serial I/O, providing the flexibility and versatility needed to serve a wide range of sensor network applications. The WSN802G module is easy to integrate and is compatible with standard IEEE 802.11b/g access points.

Manufacturer Information:
RFM/Cirronet, Inc.
3079 Premiere Parkway, Suite 140
Duluth, GA 30097

Test Sample Serial Number(s):
Z100144

Antenna Information:
9dBi Dipole Antenna: Mobile Mark Communications, Model OD9-2400, SN: 0405
12dBi Patch Antenna: Cirronet, Model 800484, SN: NA

1.2.2 Intended Use

The WSN802G provides highly reliable wireless connectivity for either point-to-point or point-to-multipoint applications.

1.3 Test Methodology and Considerations

A test evaluation board was utilized to supply power and program the EUT for test modes. See Section 5.0 – 6.0 for additional details.

The WSN802G was tested in the following modes/data rates which represent worst case:
Conducted Power, Bandwidth, Spurious Emissions: 1Mbps
Power Spectral Density: 2Mbps

2.0 TEST FACILITIES

2.1 Location

The radiated and conducted emissions test sites are located at the following address:

Advanced Compliance Solutions
5015 B.U. Bowman Drive
Buford, GA 30518
Phone: (770) 831-8048
Fax: (770) 831-8598

2.2 Laboratory Accreditations/Recognitions/Certifications

The Semi-Anechoic Chamber Test Site, Open Area Test Site (OATS) and Conducted Emissions Site have been fully described, submitted to, and accepted by the FCC, Industry Canada and the Japanese Voluntary Control Council for Interference by information technology equipment. In addition, ACS is compliant to ISO/IEC 17025 as certified by the National Institute of Standards and Technology under their National Voluntary Laboratory Accreditation Program. The following certification numbers have been issued in recognition of these accreditations and certifications:

FCC Registration Number: 894540
Industry Canada Lab Code: IC 4175
VCCI Member Number: 1831

- VCCI OATS Registration Number R-1526
- VCCI Conducted Emissions Site Registration Number: C-1608

NVLAP Lab Code: 200612-0

2.3 Radiated Emissions Test Site Description

2.3.1 Semi-Anechoic Chamber Test Site

The Semi-Anechoic Chamber Test Site consists of a 20' x 30' x 18' shielded enclosure. The chamber is lined with Toyo Ferrite Grid Absorber, model number FFG-1000. The ferrite tile grid is 101 x 101 x 19mm thick and weighs approximately 550 grams. These tiles are mounted on steel panels and installed directly on the inner walls of the chamber.

The turntable is 150cm in diameter and is located 160cm from the back wall of the chamber. The chamber is grounded via 1 - 8' copper ground rod, installed at the center of the back wall, it is bound to the ground plane using 3/4" stainless steel braided cable.

The turntable is all steel, flush mounted table installed in an all steel frame. The table is remotely operated from inside the control room located 25' from the range. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane during operation.

Behind the turntable is a 3' x 6' x 4' deep shielded pit used for support equipment if necessary. The pit is equipped with 1 - 4" PVC chases from the turntable to the pit that allow for cabling to the EUT if necessary. The underside of the turntable can be accessed from the pit so cables can be supplied to the EUT from the pit.

A diagram of the Semi-Anechoic Chamber Test Site is shown in Figure 2.3-1 below:

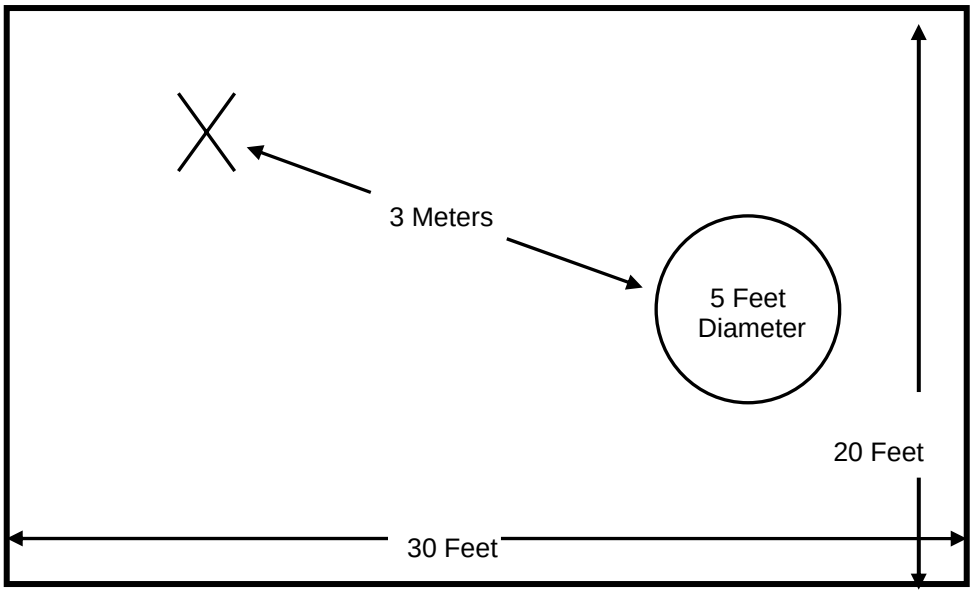

Figure 2.3-1: Semi-Anechoic Chamber Test Site

2.3.2 Open Area Tests Site (OATS)

The open area test site consists of a 40' x 66' concrete pad covered with a perforated electro-plated galvanized sheet metal. The perforations in the sheet metal are 1/8" holes that are staggered every 3/16". The individual sheets are placed to overlap each other by 1/4" and are riveted together to provide a continuous seam. Rivets are spaced every 3" in a 3 x 20 meter perimeter around the antenna mast and EUT area. Rivets in the remaining area are spaced as necessary to properly secure the ground plane and maintain the electrical continuity.

The entire ground plane extends 12' beyond the turntable edge and 16' beyond the antenna mast when set to a 10 meter measurement distance. The ground plane is grounded via 4 - 8' copper ground rods, each installed at a corner of the ground plane and bound to the ground plane using 3/4" stainless steel braided cable.

The turntable is an all aluminum 10' flush mounted table installed in an all aluminum frame. The table is remotely operated from inside the control room located 40' from the range. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane during operation.

Adjacent to the turntable is a 7' x 7' square and 4' deep concrete pit used for support equipment if necessary. The pit is equipped with 5 - 4" PVC chases from the pit to the control room that allow for cabling to the EUT if necessary. The underside of the turntable can be accessed from the pit so cables can be supplied to the EUT from the pit. The pit is covered with 2 sheets of 1/4" diamond style re-enforced steel sheets. The sheets are painted to match the perforated steel ground plane; however the underside edges have been masked off to maintain the electrical continuity of the ground plane. All reflecting objects are located outside of the ellipse defined in ANSI C63.4.

A diagram of the Open Area Test Site is shown in Figure 2.3-2 below:

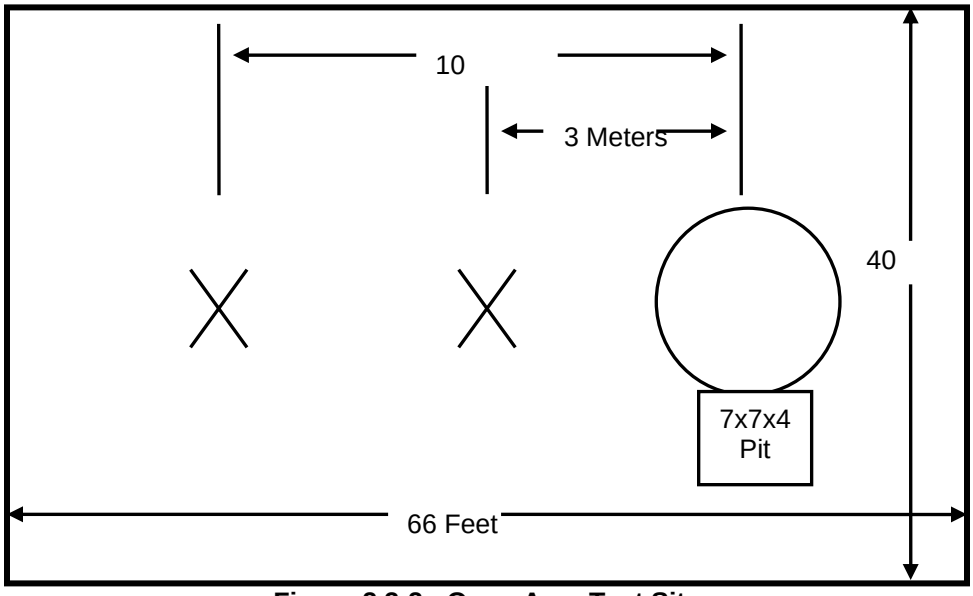

Figure 2.3-2: Open Area Test Site

2.4 Conducted Emissions Test Site Description

The AC mains conducted EMI site is located in the main EMC lab. It consists of an 8' x 8' solid aluminum horizontal group reference plane (GRP) bonded every 3" to an 8' X 8' vertical ground plane.

The site is of sufficient size to test table top and floor standing equipment in accordance with section 6.1.4 of ANSI C63.4.

A diagram of the room is shown below in figure 4.1.3-1:

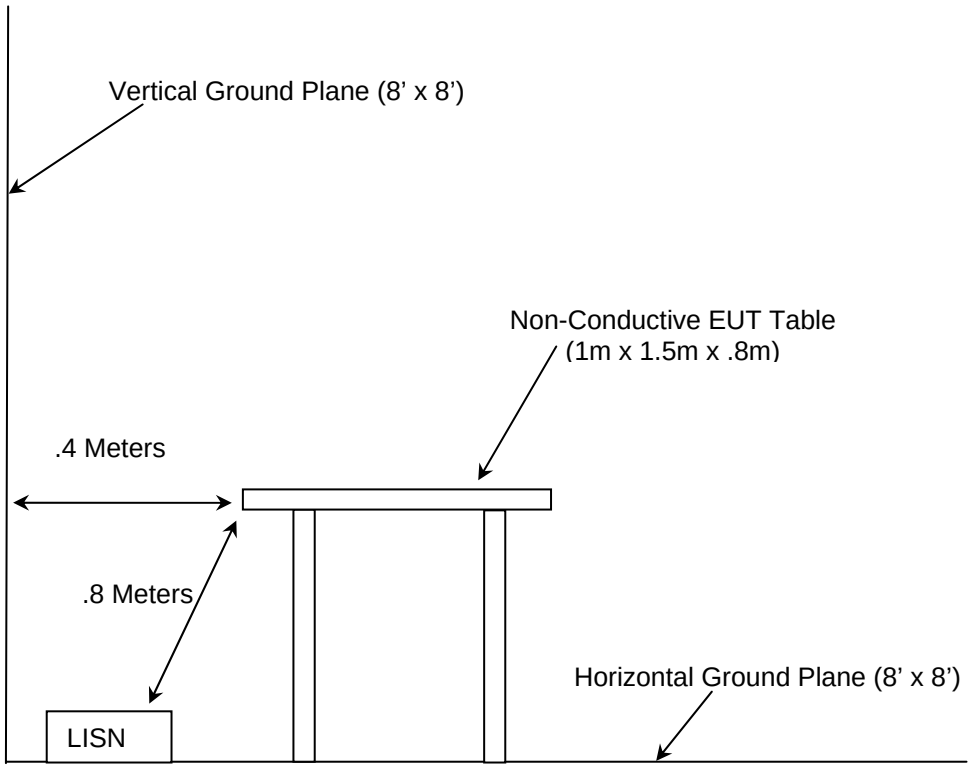

Figure 2.4-1: AC Mains Conducted EMI Site

3.0 APPLICABLE STANDARD REFERENCES

The following standards were used:

- ANSI C63.4-2003: Method of Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the 9KHz to 40GHz
- US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures, 2008
- US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2008
- FCC OET Bulletin 65 Appendix C - Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields, 2001
- FCC KDB Publication No. 558074 - Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247), March 2005
- Industry Canada Radio Standards Specification: RSS-210 - Low-power License-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment, Issue 7 June 2007
- Industry Canada Radio Standards Specification: RSS-Gen – General Requirements and Information for the Certification of Radiocommunication Equipment, Issue2, June 2007.

4.0 LIST OF TEST EQUIPMENT

The calibration interval of test equipment is annually or the manufacturer's recommendations. Where the calibration interval deviates from the annual cycle based on the instrument manufacturer's recommendations, it shall be stated below.

Table 4-1: Test Equipment

Equipment Calibration Information					
ACS#	**Mfg.**	**Eq. type**	**Model**	**S/N**	**Cal. Due**
1	Rohde & Schwarz	Spectrum Analyzers	ESMI - Display	833771/007	09/19/2009
2	Rohde & Schwarz	Spectrum Analyzers	ESMI- Receiver	839587/003	09/19/2009
3	Rohde & Schwarz	Spectrum Analyzers	ESMI - Display	839379/011	02/02/2010
4	Rohde & Schwarz	Spectrum Analyzers	ESMI - Receiver	833827/003	02/02/2010
22	Agilent	Amplifiers	8449B	3008A00526	10/22/2009
25	Chase	Antennas	CBL6111	1043	08/22/2009
153	EMCO	LISN	3825/2	9411-2268	01/27/2010
167	ACS	Cable Set	Chamber EMI Cable Set	167	02/06/2010 (Note1)
168	Hewlett Packard	Attenuators	11947A	44829	02/10/2010 (Note2)
267	Agilent	Meters	N1911A	MY45100129	11/06/2009
268	Agilent	Sensors	N1921A	MY45240184	11/06/2009
283	Rohde & Schwarz	Spectrum Analyzers	FSP40	1000033	09/19/2009
291	Florida RF Cables	Cables	SMRE-200W-12.0-SMRE	None	11/24/2009 (Note1)
292	Florida RF Cables	Cables	SMR-290AW-480.0-SMR	None	11/24/2009 (Note1)
321	Hewlett Packard	Amplifiers	HPC 8447D	1937A02809	10/08/2009
324	ACS	Cables	Belden	8214	07/28/2009 (Note1)
329	A.H.Systems	Antennas	SAS-571	721	08/06/2009
338	Hewlett Packard	Amplifiers	8449B	3008A01111	10/22/2009
340	Aeroflex/Weinschel	Attenuators	AS-20	7136	10/22/2009 (Note2)
362	Microwave Circuits	Filter	H18G26G1	210078	11/05/2009 (Note1)
422	Florida RF	Cables	SMS-200AW-72.0-SMR	805	02/05/2010 (Note1)
432	Microwave Circuits	Filter	H3G020G4	264066	07/17/2009 (Note1)

Note1: Items characterized on an annual cycle. The date shown indicates the next characterization due date.
Note2: Items verified on an annual cycle. The date shown indicates the next verification due date.

5.0 SUPPORT EQUIPMENT

Table 5-1: Support Equipment

Item #	Manufacturer	Equipment Type	Model Number	Serial Number
1	Globtek, Inc.	AC-DC Adapter	WR9QD1700KC P-N-KIT	NA
2	RFM/Cirronet	Developers Kit Eval Board	800972 Rev A	NA
3	Mobile Mark Communications	9dBi Dipole Antenna	OD9-2400	0405
4	Cirronet	12dBi Patch Antenna	800484	NA

6.0 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

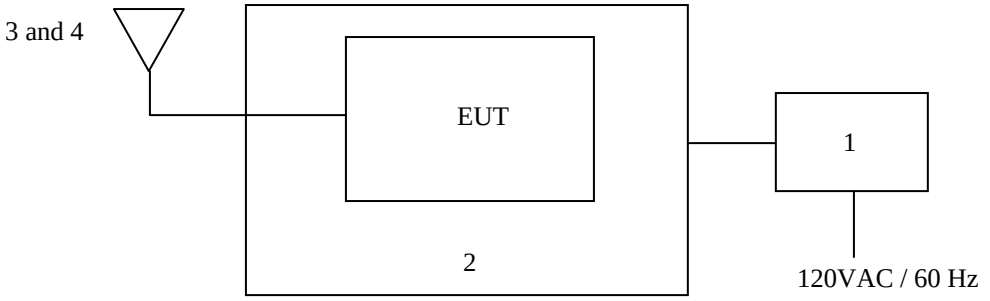

Figure 1: Radiated Emissions Setup

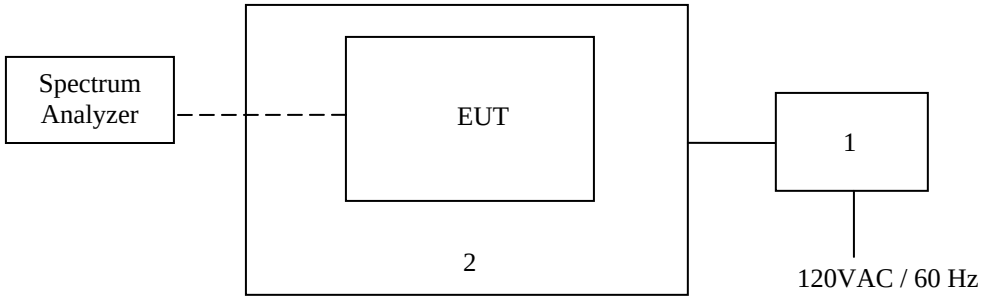

Figure 2: RF Conducted Setup

Figure 6-1: EUT Test Setup

*See Test Setup photographs for additional detail.

7.0 SUMMARY OF TESTS

Along with the tabular data shown below, plots were taken of all signals deemed important enough to document.

7.1 Antenna Requirement – FCC: Section 15.203

The WSN802G utilizes a U.FL antenna connector which satisfies the unique coupling requirements of Part 15.203.

7.2 Power Line Conducted Emissions – FCC: Section 15.207 IC: RSS-Gen 7.2.2

7.2.1 Test Methodology

ANSI C63.4 sections 6 and 7 were the guiding documents for this evaluation. Conducted emissions were performed from 150kHz to 30MHz with the spectrum analyzer's resolution bandwidth set to 9kHz and the video bandwidth set to 30kHz. The calculation for the conducted emissions is as follows:

Corrected Reading = Analyzer Reading + LISN Loss + Cable Loss
Margin = Applicable Limit - Corrected Reading

7.2.2 Test Results

Results of the test are shown below in Tables 7.2.2-1 to 7.2.2-8 and Figures 7.2.2-1 to 7.2.2-4.

Table 7.2.2-1: Conducted EMI Results – Quasi-Peak Line 1 – Dipole

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Line	PE
0.168000	39.10	9.9	65	25.9	L1	FLO
0.450000	20.80	10.0	57	36.1	L1	FLO
0.660000	14.10	10.0	56	41.9	L1	FLO
0.714000	21.20	10.1	56	34.8	L1	FLO
2.142000	22.60	10.0	56	33.4	L1	FLO
2.232000	20.50	10.0	56	35.5	L1	FLO
4.518000	15.90	10.0	56	40.1	L1	FLO
6.768000	13.60	10.0	60	46.4	L1	FLO
17.172000	10.00	9.8	60	50.0	L1	FLO
17.994000	10.30	9.8	60	49.7	L1	FLO

Table 7.2.2-2: Conducted EMI Results – Average Line 1 - Dipole

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Line	PE
0.228000	9.20	9.9	53	43.3	L1	FLO
0.450000	15.70	10.0	47	31.1	L1	FLO
0.624000	14.80	10.0	46	31.2	L1	FLO
0.750000	9.90	10.1	46	36.1	L1	FLO
2.154000	17.60	10.0	46	28.4	L1	FLO
2.166000	17.40	10.0	46	28.6	L1	FLO
4.506000	11.80	10.0	46	34.2	L1	FLO
6.852000	9.30	10.0	50	40.7	L1	FLO
17.358000	7.40	9.8	50	42.6	L1	FLO
17.652000	6.60	9.8	50	43.4	L1	FLO

Table 7.2.2-3: Conducted EMI Results – Quasi-Peak Line 2 - Dipole

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Line	PE
0.168000	39.30	9.9	65	25.8	L2	FLO
0.456000	22.40	10.0	57	34.4	L2	FLO
0.480000	16.50	10.0	56	39.8	L2	FLO
0.792000	19.20	10.1	56	36.8	L2	FLO
1.254000	17.70	10.0	56	38.3	L2	FLO
2.250000	19.90	10.0	56	36.1	L2	FLO
4.938000	14.60	10.0	56	41.4	L2	FLO
10.188000	10.80	9.9	60	49.2	L2	FLO
14.574000	10.70	9.8	60	49.3	L2	FLO
26.850000	10.40	9.4	60	49.6	L2	FLO

Table 7.2.2-4: Conducted EMI Results – Average Line 2 - Dipole

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Line	PE
0.198000	14.50	9.9	54	39.2	L2	FLO
0.462000	10.30	10.0	47	36.4	L2	FLO
0.486000	8.00	10.0	46	38.3	L2	FLO
0.756000	11.10	10.1	46	34.9	L2	FLO
1.272000	13.20	10.0	46	32.8	L2	FLO
2.208000	15.70	10.0	46	30.3	L2	FLO
4.902000	10.60	10.0	46	35.4	L2	FLO
10.170000	7.80	9.9	50	42.2	L2	FLO
14.700000	7.70	9.8	50	42.3	L2	FLO
26.820000	7.30	9.4	50	42.7	L2	FLO

Table 7.2.2-5: Conducted EMI Results – Quasi-Peak Line 1 – Patch

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Line	PE
0.168000	39.20	9.9	65	25.8	L1	FLO
0.462000	13.30	10.0	57	43.3	L1	FLO
0.474000	21.50	10.0	56	34.9	L1	FLO
0.918000	12.00	10.0	56	44.0	L1	FLO
1.884000	15.80	10.0	56	40.2	L1	FLO
2.436000	21.80	10.0	56	34.2	L1	FLO
4.764000	14.30	10.0	56	41.7	L1	FLO
7.608000	13.20	10.0	60	46.8	L1	FLO
11.148000	10.00	9.9	60	50.0	L1	FLO
22.632000	9.20	9.4	60	50.9	L1	FLO

Table 7.2.2-6: Conducted EMI Results – Average Line 1 - Patch

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Line	PE
0.228000	9.70	9.9	53	42.9	L1	FLO
0.456000	16.30	10.0	47	30.5	L1	FLO
0.474000	17.30	10.0	46	29.1	L1	FLO
0.930000	11.20	10.0	46	34.8	L1	FLO
1.842000	12.70	10.0	46	33.3	L1	FLO
2.496000	14.60	10.0	46	31.4	L1	FLO
4.812000	11.80	10.0	46	34.2	L1	FLO
7.686000	9.00	10.0	50	41.0	L1	FLO
11.082000	7.50	9.9	50	42.5	L1	FLO
22.404000	6.80	9.4	50	43.2	L1	FLO

Table 7.2.2-7: Conducted EMI Results – Quasi-Peak Line 2 - Patch

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Line	PE
0.168000	39.20	9.9	65	25.8	L2	FLO
0.432000	32.40	10.0	57	24.8	L2	FLO
0.480000	16.80	10.0	56	39.6	L2	FLO
1.086000	17.10	10.0	56	38.9	L2	FLO
2.076000	17.40	10.0	56	38.6	L2	FLO
2.232000	21.10	10.0	56	34.9	L2	FLO
4.518000	14.00	10.0	56	42.0	L2	FLO
8.316000	10.70	9.9	60	49.3	L2	FLO
14.052000	10.60	9.8	60	49.4	L2	FLO
28.746000	10.60	9.2	60	49.4	L2	FLO

Table 7.2.2-8: Conducted EMI Results – Average Line 2 - Patch

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Line	PE
0.228000	9.30	9.9	53	43.2	L2	FLO
0.462000	9.90	10.0	47	36.8	L2	FLO
0.492000	7.90	10.0	46	38.3	L2	FLO
1.092000	14.70	10.0	46	31.3	L2	FLO
2.142000	15.90	10.0	46	30.1	L2	FLO
2.244000	16.10	10.0	46	29.9	L2	FLO
4.560000	9.70	10.0	46	36.3	L2	FLO
8.406000	7.10	9.9	50	42.9	L2	FLO
14.064000	7.50	9.8	50	42.5	L2	FLO
28.908000	8.00	9.2	50	42.0	L2	FLO

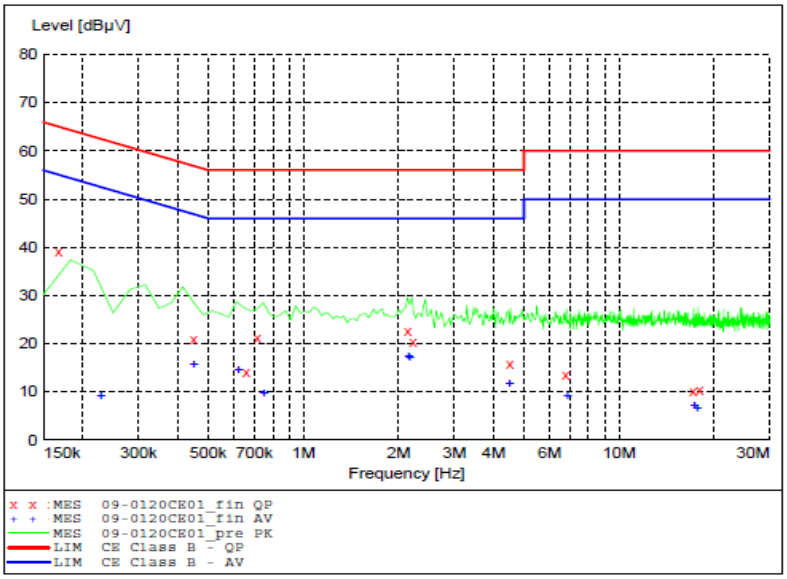

Figure 7.2.2-1: Conducted EMI Results – Line 1 - Dipole

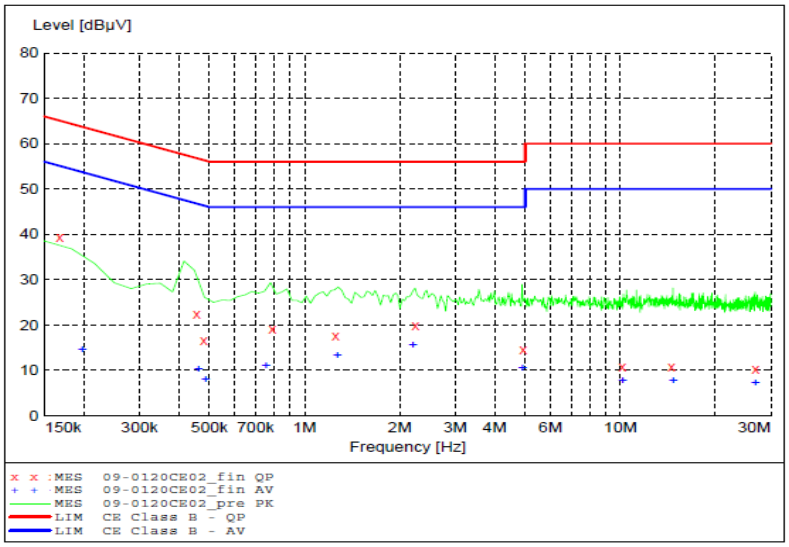

Figure 7.2.2-2: Conducted EMI Results – Line 2 - Dipole

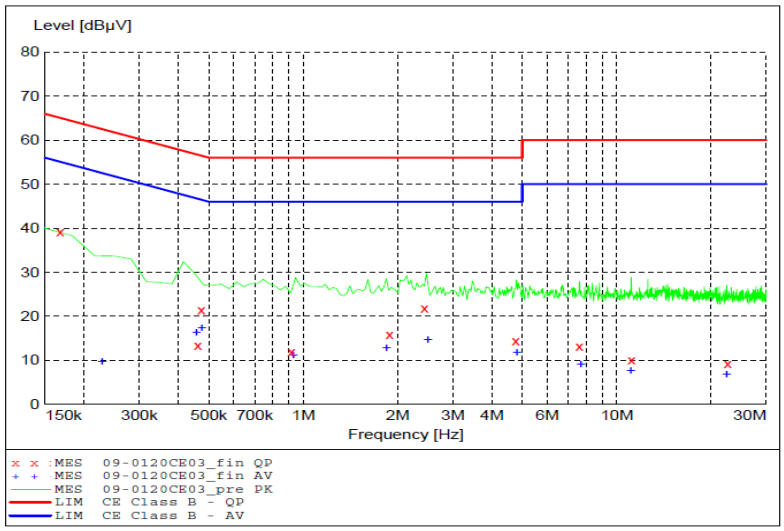

Figure 7.2.2-3: Conducted EMI Results – Line 1 - Patch

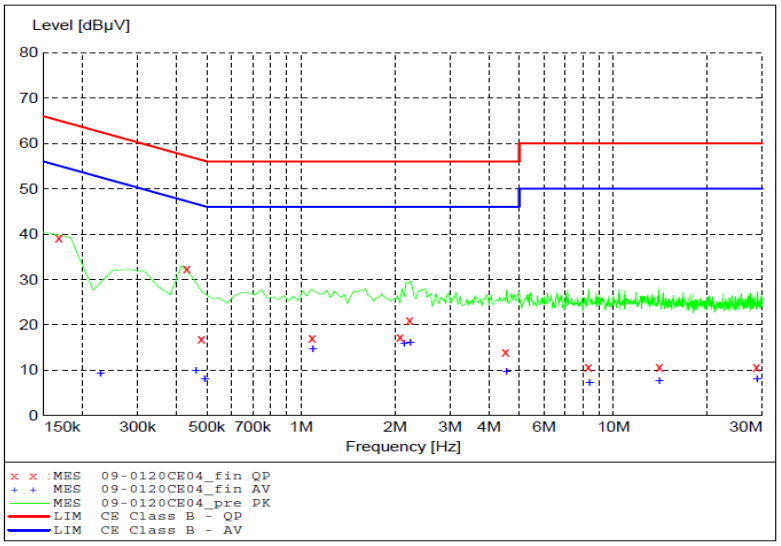

Figure 7.2.2-4: Conducted EMI Results – Line 2 - Patch

7.3 Radiated Emissions – FCC: Section 15.109(Unintentional Radiation) IC: RSS-210 2.6

7.3.1 Test Methodology

Radiated emissions tests were performed over the frequency range of 30MHz to 12.5 GHz. Measurements of the radiated field strength were made at a distance of 3m from the boundary of the equipment under test (EUT) and the receiving antenna. The antenna height was varied from 1m to 4m so that the maximum radiated emissions level would be detected. Radiated measurements above 30MHz and below 1GHz were made with the Spectrum Analyzer's resolution bandwidth set to 120 KHz using a Quasi-peak detector. Above 1GHz, peak and average measurements are taken with the RBW and VBW were set to 1MHz and 3MHz respectively.

The WSN802G was evaluated with both the 9dBi dipole and 12 dBi patch antenna. Final data was collected using the dipole antenna which represents worst case.

7.3.2 Test Results

Results of the test are given in Table 7.3.2-1 below:

Table 7.3.2-1: Radiated Emissions Tabulated Data

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Correction Factors	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg	(H/V)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
38.622	---------	19.29	H	-10.98	---------	8.31	--------	40.0	---------	31.69
109.755	---------	32.76	V	-13.01	---------	19.75	--------	43.5	---------	23.75
148.555	---------	42.15	V	-13.43	---------	28.72	--------	43.5	---------	14.78
189.5111	---------	41.83	V	-15.22	---------	26.61	--------	43.5	---------	16.89
343.633	---------	34.79	V	-9.59	---------	25.20	--------	46.0	---------	20.80
957.967	---------	20.07	H	3.04	---------	23.11	--------	46.0	---------	22.89

* Note: All emissions above 957.967 MHz were attenuated below the permissible limit.

7.4 6dB / 99% Bandwidth – FCC: Section 15.247(a)(2) IC: RSS-210 A8.2(a)

7.4.1 Test Methodology

The 6dB bandwidth was measured in accordance with the FCC KDB Publication No. 558074 "Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247)". The RBW of the spectrum analyzer was set to 100 kHz and VBW 300 kHz. Span was set large enough to capture the entire emissions and >> RBW.

The 99% occupied bandwidth was also measured in accordance to the measurement guidelines provided by Industry Canada (The Measurement of Occupied Bandwidth).

7.4.2 Test Results

Results are shown below in table 7.4.2-1 and figures 7.4.2-1 to 7.4.2-6:

Table 7.4.2-1: 6dB Bandwidth 802.11b

Frequency (MHz)	6dB Bandwidth (MHz)	99% Bandwidth (MHz)
2412	10.152	14.796
2437	10.152	14.868
2462	10.152	14.940

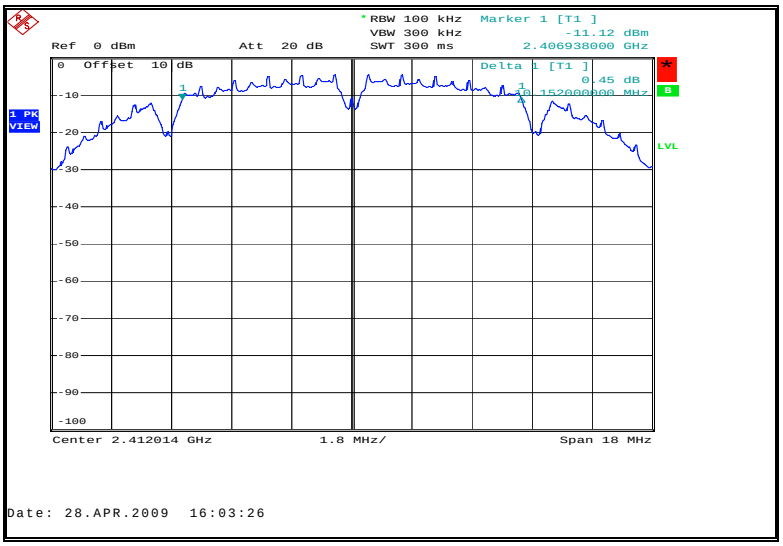

Figure 7.4.2-1: 6dB Bandwidth Plot – Low Channel

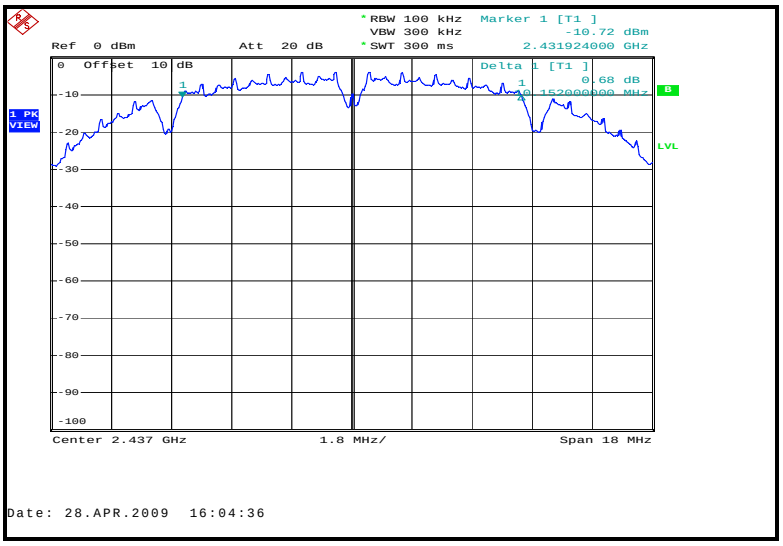

Figure 7.4.2-2: 6dB Bandwidth Plot – Mid Channel

Figure 7.4.2-3: 6dB Bandwidth Plot – High Channel

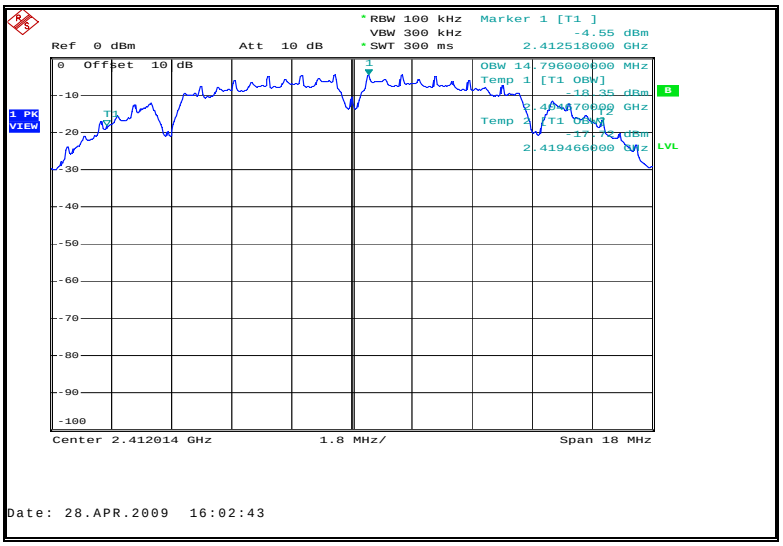

Figure 7.4.2-4: 99% Bandwidth Plot – Low Channel

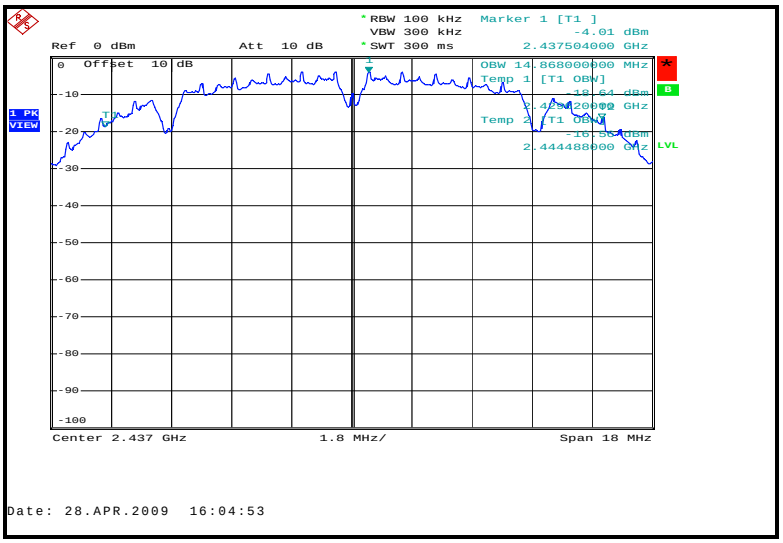

Figure 7.4.2-5: 99% Bandwidth Plot – Mid Channel

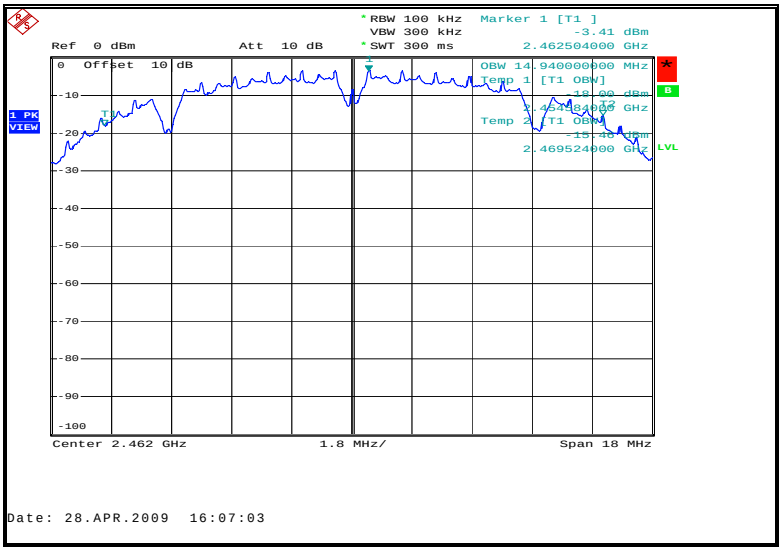

Figure 7.4.2-6: 99% Bandwidth Plot – High Channel

7.5 Peak Output Power Requirement - FCC Section 15.247(b)(3) IC: RSS-210 A8.4(4)

7.5.1 Test Methodology

The Peak Output Power was measured in accordance with the FCC KDB Publication No. 558074 "Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247)" Power Option 1. The RF output of the equipment under test was directly connected to the input of the wideband power meter.

Data was collected with the EUT operating at maximum power. All modes of operation and data rates were evaluated. Worst case data presented in section 7.5.2 below.

7.5.2 Test Results

Results are shown below in Table 7.5.2-1.

Table 7.5.2-1: Peak Output Power

Frequency (MHz)	Output Power (dBm)
2412	9.36
2437	9.80
2462	10.18

7.6 Band-Edge Compliance and Spurious Emissions - FCC Section 15.247(d) IC: RSS-210 2.6, A8.5

7.6.1 Band-Edge Compliance of RF Emissions

7.6.1.1 Test Methodology

The EUT was investigated at the low and high channels of operation to determine band-edge compliance. All antenna types were evaluated. Because the upper band-edge coincides with a restricted band, band-edge compliance for the upper band-edge was determined using the radiated mark-delta method as outlined in FCC DA 00-705. The radiated field strength of the fundamental emission was first determined and then the mark-delta method was used to determine the field strength of the band-edge emissions.

The lower band-edge compliance was determined using the marker-delta method in which the radio frequency power that is produced by the EUT is at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of desired power.

7.6.1.2 Test Results

Band-edge compliance is displayed in Table 7.6.1.2-1 to 7.6.1.2-2 and Figure 7.6.1.2-1 – 7.6.1.2-3.

Table 7.6.1.2-1: Upper Band-edge Marker Delta Method – Dipole Antenna

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Correction Factors	Fundamental Field Strength (dBuV/m)		Delta-Marker (dB)	Band-edge Field Strength (dBuV/m)		Margin to Limit (dBuV/m) 74	54
	pk	avg	(H/V)	(dB)	pk	avg		pk	avg	pk	avg
Fundamental Frequency											
2462	105.30	98.09	V	0.95	106.25	99.04	46.65	59.60	52.39	14.40	1.61

Table 7.6.1.2-2: Upper Band-edge Marker Delta Method – Patch Antenna

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Correction Factors	Fundamental Field Strength (dBuV/m)		Delta-Marker (dB)	Band-edge Field Strength (dBuV/m)		Margin to Limit (dBuV/m) 74	54
	pk	avg	(H/V)	(dB)	pk	avg		pk	avg	pk	avg
Fundamental Frequency											
2462	106.54	97.84	V	0.95	107.49	98.79	44.16	63.33	53.97	10.67	0.03

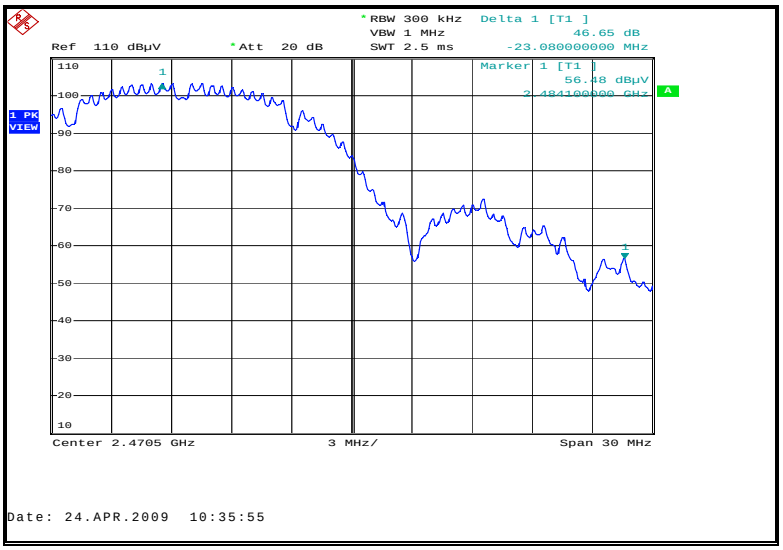

Figure 7.6.1.2-1: Upper Band-edge (Radiated) - Dipole

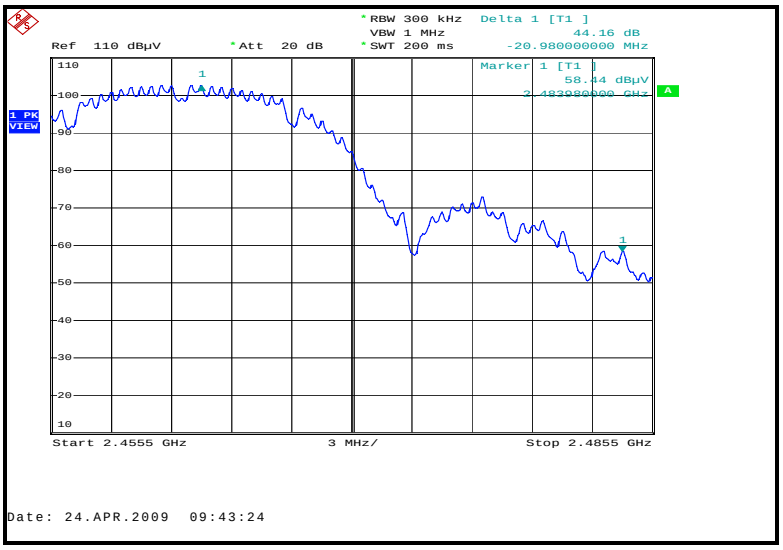

Figure 7.6.1.2-2: Upper Band-edge (Radiated) – Patch

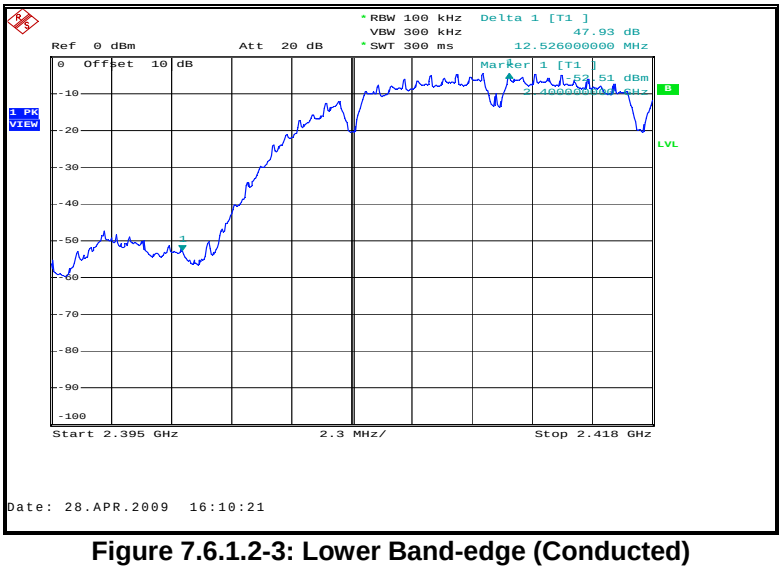

Figure 7.6.1.2-3: Lower Band-edge (Conducted)

7.6.2 RF Conducted Spurious Emissions

The RF Conducted Spurious Emissions were measured in accordance with the FCC KDB Publication No. 558074 "Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247)". The RF output of the equipment under test was directly connected to the input of the Spectrum Analyzer. The EUT was investigated for conducted spurious emissions from 30MHz to 25GHz, 10 times the highest fundamental frequency. For each measurement, the spectrum analyzer's RBW was set to 100 kHz and the VBW was set to 300 kHz. The peak detector and Max Hold function of the analyzer were utilized.

7.6.2.2 Test Results

In a 100 kHz bandwidth, the radio frequency power that was produced by the EUT emissions is at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of desired power. RF Conducted Emissions are displayed in Figures 7.6.2.2-1 through 7.6.2.2-9.

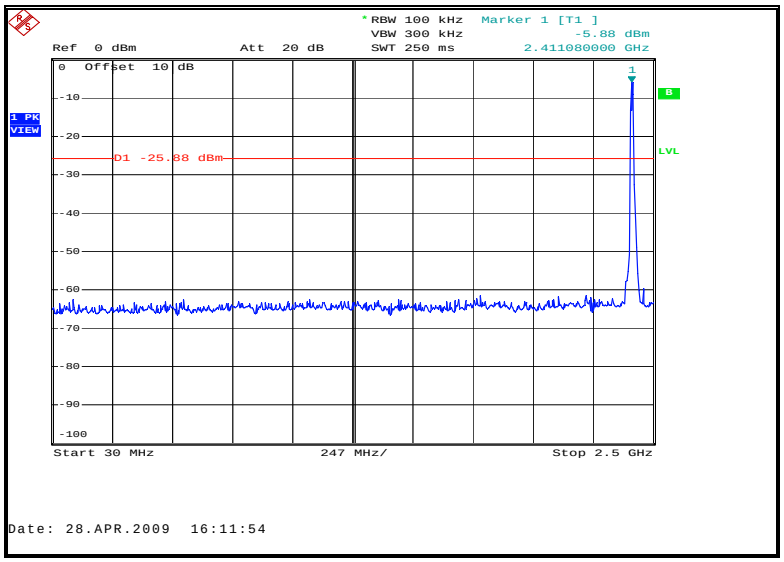

Figure 7.6.2.2-1: 30 MHz – 2.5 GHz – Low Channel

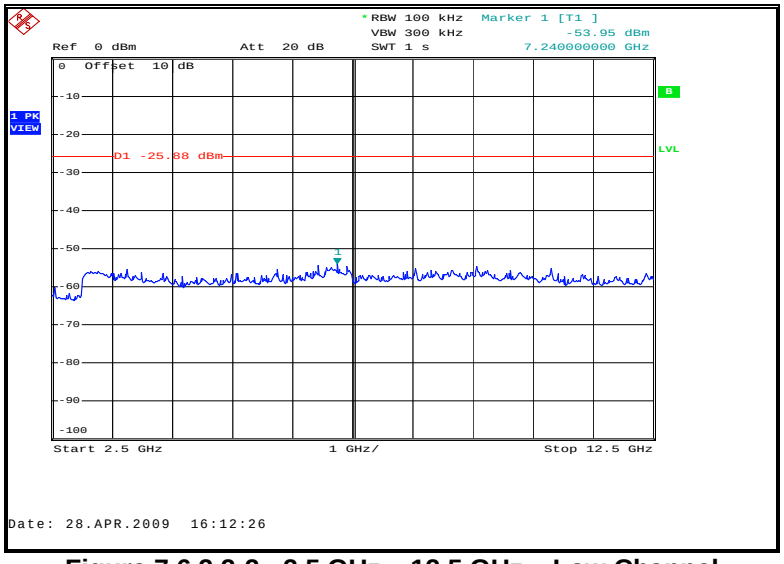

Figure 7.6.2.2-2: 2.5 GHz – 12.5 GHz – Low Channel

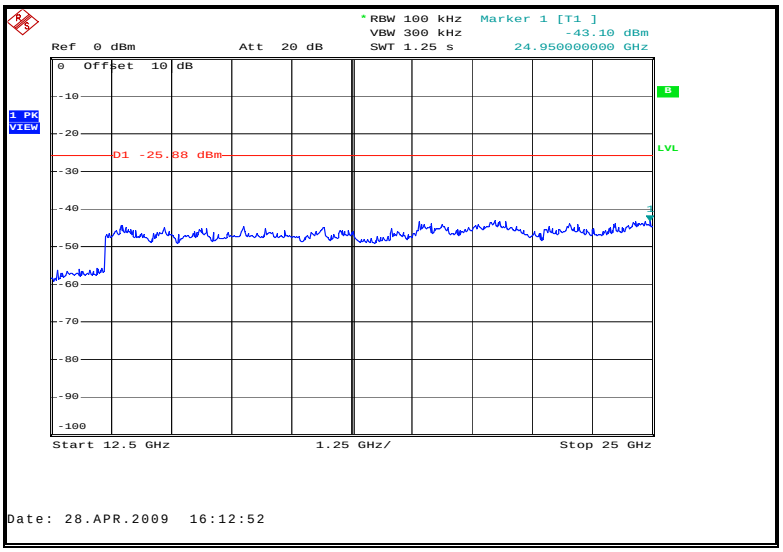

Figure 7.6.2.2-3: 12.5 GHz – 25 GHz – Low Channel

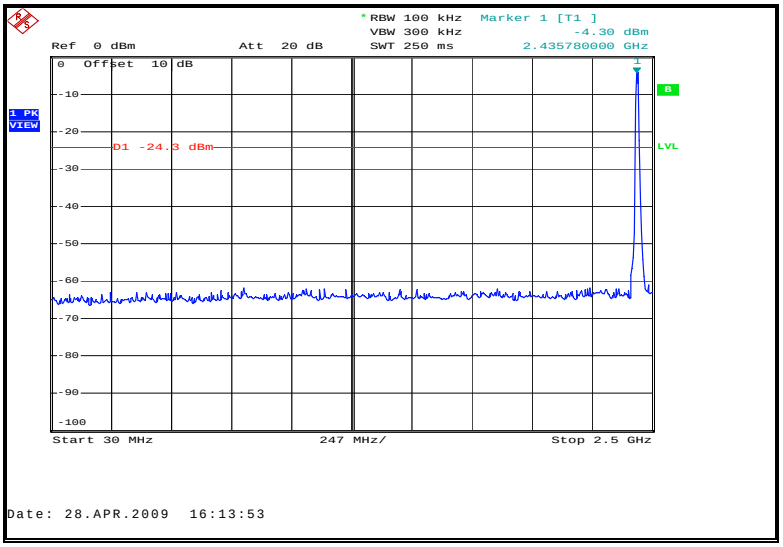

Figure 7.6.2.2-4: 30 MHz – 2.5 GHz –Mid Channel

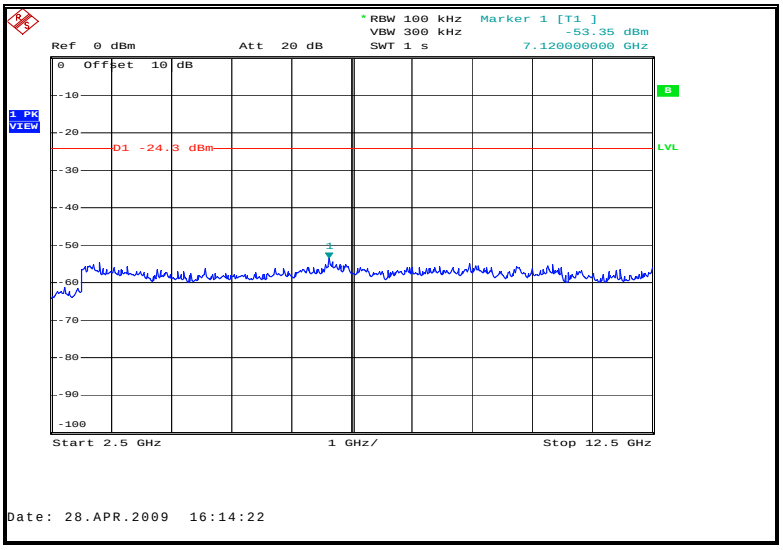

Figure 7.6.2.2-5: 2.5 GHz – 12.5 GHz – Mid Channel

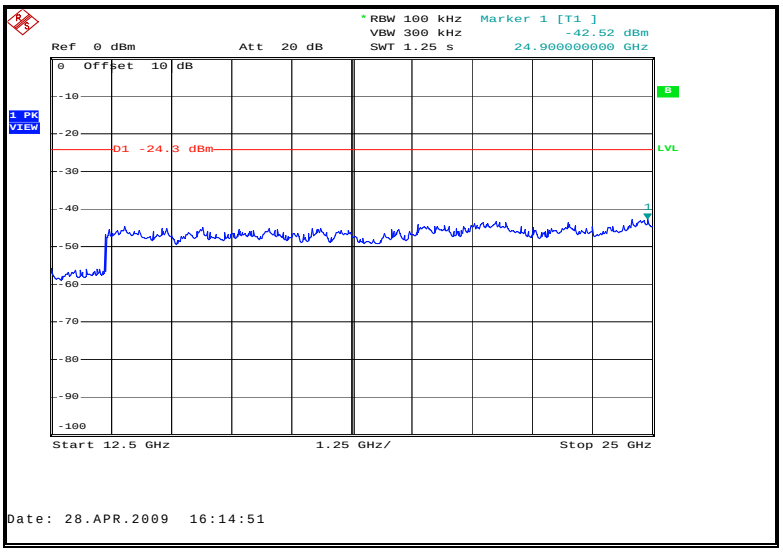

Figure 7.6.2.2-6: 12.5 GHz – 25 GHz – Mid Channel

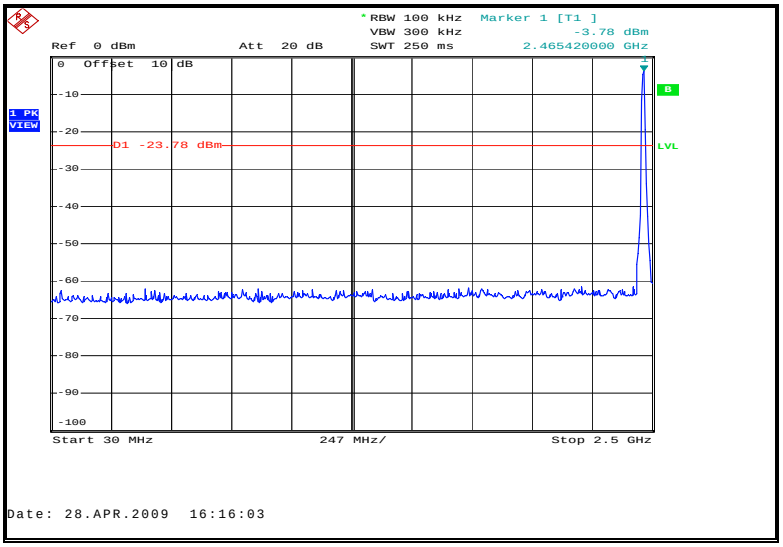

Figure 7.6.2.2-7: 30 MHz – 2.5 GHz – High Channel

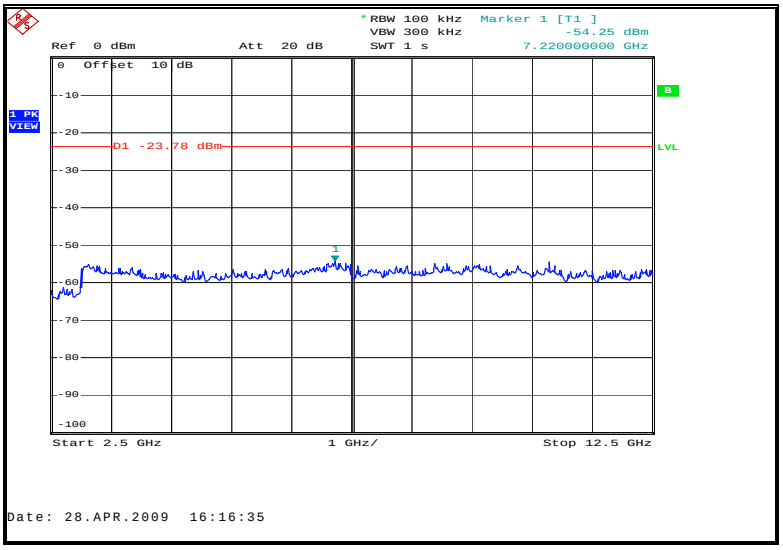

Figure 7.6.2.2-8: 2.5 GHz – 12.5 GHz –High Channel

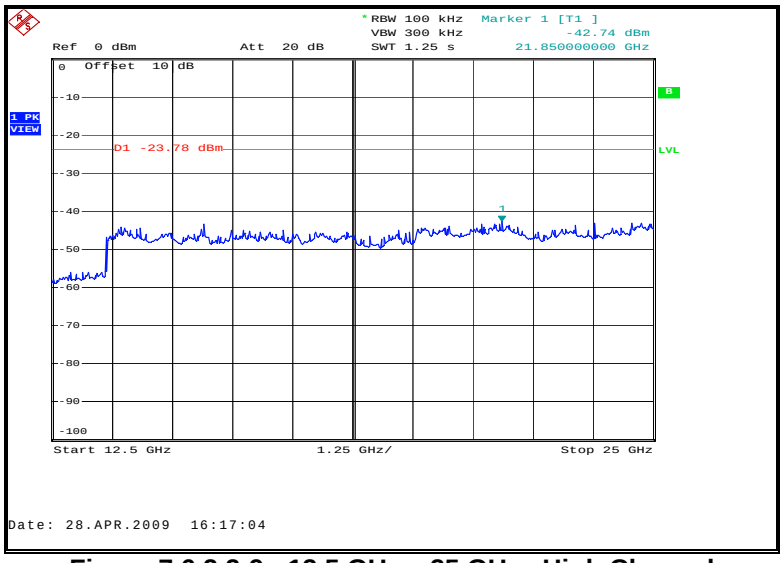

Figure 7.6.2.2-9: 12.5 GHz – 25 GHz –High Channel

7.6.3 Radiated Spurious Emissions (Restricted Bands) - FCC Section 15.205 IC: RSS-210 2.6

7.6.3.1 Test Methodology

Radiated emissions tests were made over the frequency range of 30MHz to 25GHz, 10 times the highest fundamental frequency.

The EUT was rotated through 360° and the receive antenna height was varied from 1m to 4m so that the maximum radiated emissions level would be detected. For frequencies below 1000MHz, quasi-peak measurements were made using a resolution bandwidth RBW of 120 kHz and a video bandwidth VBW of 300 kHz. For frequencies above 1000MHz, peak measurements made with RBW and VBW of 1 MHz. Average measurements were made with RBW of 1MHz and a VBW of 10Hz. The average emissions were further corrected by applying the duty cycle correction of the EUT to the average measurements for comparison to the average limit.

7.6.3.2 Test Results

Using the procedures set forth in the FCC KDB Publication No. 558074 “Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247)”, radiated spurious emissions found in the band of 30MHz to 25GHz are reported in Table 7.6.3.2-1 to 7.6.3.2-2. Each emission found to be in a restricted band as defined by section 15.205, was compared to the radiated emission limits as defined in section 15.209.

Table 7.6.3.2-1: Radiated Spurious Emissions – Dipole Antenna

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Correction Factors	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg	(H/V)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Low Channel										
4824	42.77	33.05	H	8.62	51.39	41.67	74.0	54.0	22.61	12.33
4824	44.02	35.81	V	8.72	52.74	44.53	74.0	54.0	21.26	9.47
Mid Channel										
4874	44.11	33.27	H	8.82	52.93	42.09	74.0	54.0	21.07	11.91
4874	39.80	35.72	V	8.92	48.72	44.64	74.0	54.0	25.28	9.36
High Channel										
4924	44.94	36.22	H	9.01	53.95	45.23	74.0	54.0	20.05	8.77
4924	45.13	37.54	V	9.11	54.24	46.65	74.0	54.0	19.76	7.35

Table 7.6.3.2-2: Radiated Spurious Emissions – Patch Antenna

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Correction Factors	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg	(H/V)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Low Channel										
4824			H	8.62	---------	---------	74.0	54.0	---------	---------
4824	44.07	35.86	V	8.72	52.79	44.58	74.0	54.0	21.21	9.42
Mid Channel										
4874			H	8.82	---------	---------	74.0	54.0	---------	---------
4874	44.78	36.65	V	8.92	53.70	45.57	74.0	54.0	20.30	8.43
High Channel										
4924			H	9.01	---------	---------	74.0	54.0	---------	---------
4924	45.11	37.84	V	9.11	54.22	46.95	74.0	54.0	19.78	7.05

7.6.3.3 Sample Calculation:

$R_C = R_U + CF_T$

Where:

CF_T = Total Correction Factor (AF+CA+AG)-DC (Average Measurements Only)
R_U = Uncorrected Reading
R_C = Corrected Level
AF = Antenna Factor
CA = Cable Attenuation
AG = Amplifier Gain
DC = Duty Cycle Correction Factor

Example Calculation: Peak
Corrected Level: 42.77 + 8.62 = 51.39dBuV/m
Margin: 74dBuV/m – 51.39dBuV/m = 22.61dB

Example Calculation: Average
Corrected Level: 33.05 + 8.62 - 0= 41.67dBuV
Margin: 54dBuV – 41.67dBuV = 12.33dB

7.7 Peak Power Spectral Density- FCC Section 15.247(d) IC: RSS-210 A8.2(b)

7.7.1 Test Methodology

The power spectral density was measured in accordance with the FCC KDB Publication No. 558074 "Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247)". The emission peaks within the pass band were located and zoomed in on. The spectrum analyzer RBW was set to 3 kHz and VBW 10 kHz. Span was adjusted to 500 kHz and the sweep time was calculated to be 168s (Span/3 kHz).

7.7.2 Test Results

Results are shown below in table 7.7.2-1 and figures 7.7.2-1 – 7.7.2-3:

Table 7.7.2-1: Peak Power Spectral Density

Frequency (MHz)	PSD Level (dBm)
2412	-15.29
2437	-15.63
2462	-14.76

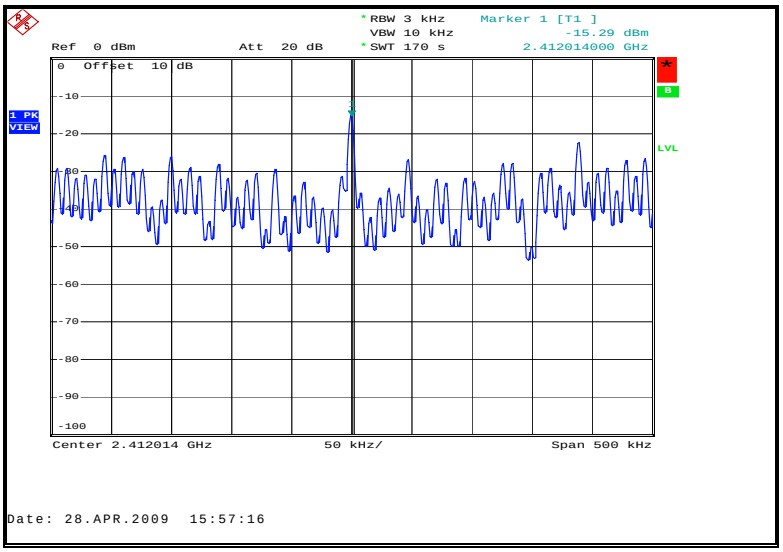

Figure 7.7.2-1: Power Spectral Density Plot – Low Channel

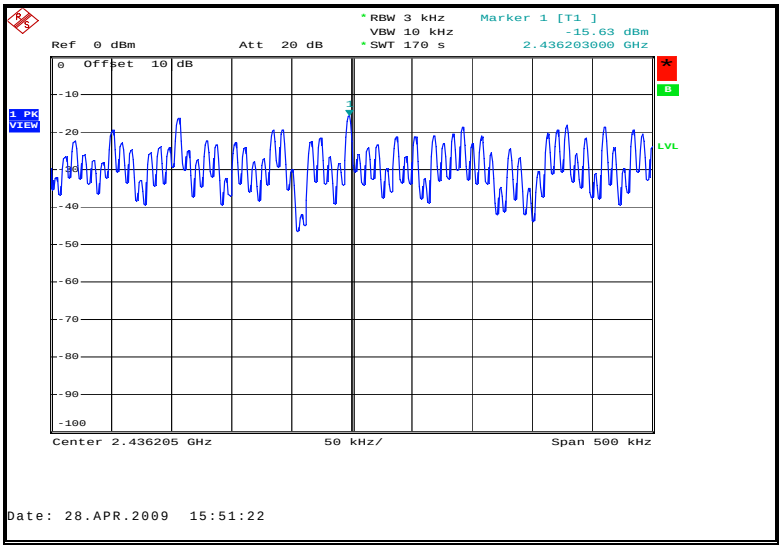

Figure 7.7.2-2: Power Spectral Density Plot – Mid Channel

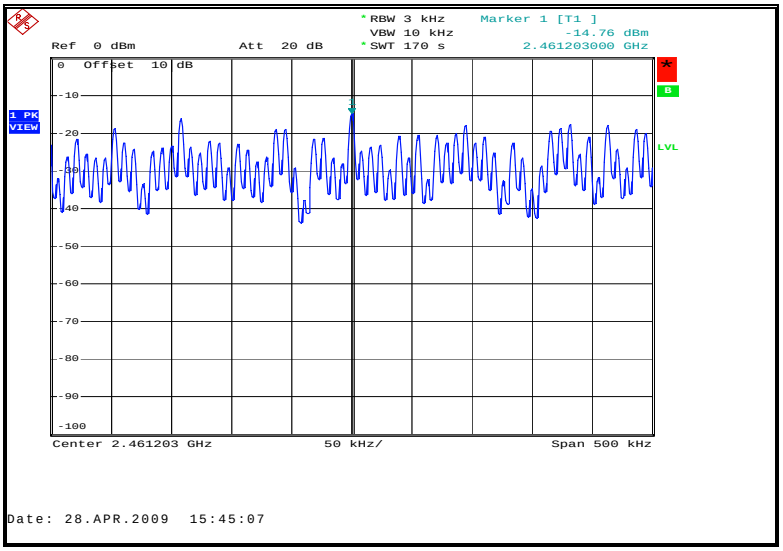

Figure 7.7.2-3: Power Spectral Density Plot – High Channel

8.0 CONCLUSION

In the opinion of ACS, Inc., models WSN802GC, and WSN802GP manufactured by RFM / Cirronet Inc. meets the requirements of FCC Part 15 subpart C and Industry Canada's Radio Standards Specification RSS-210.

END REPORT