Test Report

Product Name	802.11n 1x1 MIMO Half Mini Card
Model No	BCM4313
FCC ID.	RK9-BCM4313N1T1R

Applicant	CastleNet Technology Inc.
Address	No.64,Chung-Shan Rd. Tu-Cheng Ciy, Taipei 236 Taiwan

Date of Receipt	Nov. 02, 2010
Issue Date	Nov. 22, 2010
Report No.	10B125R-RFUSP42V01
Report Version	V1.0

Test Report Certification

Issue Date: Nov. 22, 2010
Report No.: 10B125R-RFUSP42V01

Accredited by NIST (NVLAP)
NVLAP Lab Code: 200533-0

Product Name	802.11n 1x1 MIMO Half Mini Card
Applicant	CastleNet Technology Inc.
Address	No.64,Chung-Shan Rd. Tu-Cheng Ciy, Taipei 236 Taiwan
Manufacturer	CastleNet Technology Inc.
Model No.	BCM4313
FCC ID.	RK9-BCM4313N1T1R
EUT Rated Voltage	DC 3.3V
EUT Test Voltage	AC 120V/60Hz
Trade Name	CastleNet
Applicable Standard	FCC CFR Title 47 Part 15 Subpart C: 2009 ANSI C63.4: 2003
Test Result	Complied

NVLAP Lab Code: 200533-0

The test results relate only to the samples tested.
The test report shall not be reproduced except in full without the written approval of QuieTek Corporation.
This report must not be used to claim product endorsement by NVLAP any agency of the U.S. Government

Documented By : Leven Huang
(Senior Adm. Specialist / Leven Huang)

Tested By : Eason Hung
(Engineer / Eason Hung)

Approved By :
(Manager / Vincent Lin)

Testing Laboratory
0914

TABLE OF CONTENTS

	Description	Page
1.	**GENERAL INFORMATION**	**5**
1.1.	EUT Description	5
1.2.	Operational Description	7
1.3.	Tested System Details	8
1.4.	Configuration of Tested System	9
1.5.	EUT Exercise Software	9
1.6.	Test Facility	10
2.	**Conducted Emission**	**11**
2.1.	Test Equipment	11
2.2.	Test Setup	11
2.3.	Limits	12
2.4.	Test Procedure	12
2.5.	Uncertainty	12
2.6.	Test Result of Conducted Emission	13
3.	**Peak Power Output**	**17**
3.1.	Test Equipment	17
3.2.	Test Setup	17
3.3.	Limits	17
3.4.	Test Procedure	17
3.5.	Uncertainty	17
3.6.	Test Result of Peak Power Output	18
4.	**Radiated Emission**	**21**
4.1.	Test Equipment	21
4.2.	Test Setup	22
4.3.	Limits	23
4.4.	Test Procedure	24
4.5.	Uncertainty	24
4.6.	Test Result of Radiated Emission	25
5.	**RF antenna conducted test**	**49**
5.1.	Test Equipment	49
5.2.	Test Setup	49
5.3.	Limits	49
5.4.	Test Procedure	50
5.5.	Uncertainty	50
5.6.	Test Result of RF antenna conducted test	51
6.	**Band Edge**	**57**
6.1.	Test Equipment	57
6.2.	Test Setup	58
6.3.	Limits	58
6.4.	Test Procedure	59
6.5.	Uncertainty	59
6.6.	Test Result of Band Edge	60

7. Occupied Bandwidth 84

7.1. Test Equipment 84
7.2. Test Setup 84
7.3. Limits 84
7.4. Test Procedure 84
7.5. Uncertainty 84
7.6. Test Result of Occupied Bandwidth 85

8. Power Density 94

8.1. Test Equipment 94
8.2. Test Setup 94
8.3. Limits 94
8.4. Test Procedure 94
8.5. Uncertainty 94
8.6. Test Result of Power Density 95

9. EMI Reduction Method During Compliance Testing 104

Attachment 1: EUT Test Photographs
Attachment 2: EUT Detailed Photographs

1. GENERAL INFORMATION

1.1. EUT Description

Product Name	802.11n 1x1 MIMO Half Mini Card
Trade Name	CastleNet
Model No.	BCM4313
FCC ID.	RK9-BCM4313N1T1R
Frequency Range	2412-2462MHz
Number of Channels	802.11b/g/n-20MHz: 11
Data Speed	802.11b: 1-11Mbps, 802.11g: 6-54Mbps, 802.11n: 7.2-72.2bps
Type of Modulation	802.11b:DSSS (DBPSK, DQPSK, CCK) 802.11g/n:OFDM (BPSK, QPSK, 16QAM, 64QAM)
Antenna Type	Dipole, PIFA
Antenna Gain	Refer to the table “Antenna List”
Channel Control	Auto

Antenna List

No.	Manufacturer	Part No.	Antenna Type	Peak Gain
1	KINSUN	6602113033-150	Dipole array	2.28dBi for 2.4GHz
2	KINSUN	6602113093-290	Dipole array	1.76dBi for 2.4GHz
3	KINSUN	6602113053-230	Dipole array	2.24dBi for 2.4GHz
4	KINSUN	6602103081-000	Dipole array	1.97dBi for 2.4GHz
5	KINSUN	6602100033-090	Dipole array	2.39dBi for 2.4GHz
6	KINSUN	6602100053-290	Dipole array	1.76dBi for 2.4GHz
7	KINSUN	6602113051-230	Dipole array	2.24dBi for 2.4GHz
8	KINSUN	6602113053-300	Dipole array	1.62dBi for 2.4GHz
9	KINSUN	6602113051-090	Dipole array	2.39dBi for 2.4GHz
10	YONGSHUN	L22-XY30201	PIFA	2dBi for 2.4GHz
11	MAG. LAYERS	MSA-2005-2G4C1-A1	PIFA	4.98dBi for 2.4GHz

Note: The antenna of EUT is conform to FCC 15.203(Antenna uses an "I-Pex" antenna coupler).
The final test are use antenna of KINSUN (Part No. 6602113051-090) and
antenna of MAG. LAYERS (Part No. MSA-2005-2G4C1-A1).

802.11b/g/n-20MHz Center Frequency of Each Channel:

Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
Channel 01:	2412 MHz	Channel 02:	2417 MHz	Channel 03:	2422 MHz	Channel 04:	2427 MHz
Channel 05:	2432 MHz	Channel 06:	2437 MHz	Channel 07:	2442 MHz	Channel 08:	2447 MHz
Channel 09:	2452 MHz	Channel 10:	2457 MHz	Channel 11:	2462 MHz		

Note:

1. The EUT is a 802.11n 1x1 MIMO Half Mini Card, Contains WiFi function.
2. Regarding to the operation frequency, the lowest, middle and highest frequency are selected to perform the test.
3. Lowest and highest data rates are tested in each mode. Only worst case is shown in the report. (802.11b is 1Mbps 、802.11g is 6Mbps、802.11n(20M-BW) is 7.2Mbps)
4. These tests are conducted on a sample for the purpose of demonstrating compliance of 802.11b/g/n transmitter with Part 15 Subpart C Paragraph 15.247 of spread spectrum devices

1.2. Operational Description

The EUT is an 802.11n 1x1 MIMO Half Mini Card, This device provided four kinds of transmitting speed 1, 2, 5.5 and 11Mbps and the device of RF carrier is DBPSK, DQPSK and CCK (IEEE 802.11b). The device provided of eight kinds of transmitting speed 6, 9, 12, 18, 24, 36, 48 and 54Mbps the device of RF carrier is BPSK, QPSK, 16QAM and 64QAM (IEEE 802.11g).

The device provided of eight kinds of transmitting speed 7.2,14.4,21.7,28.9,43.3,57.8,65 and 72.2Mbps in 802.11n(20M-BW) mode the device of RF carrier is BPSK, QPSK, 16QAM and 64QAM (IEEE 802.11n), The IEEE 802.11n is Multiple In, Single Out" (MISO) technology and two antennas to support 1(Transmit) * 1(Receive) MISO technology.

This 802.11n 1x1 MIMO Half Mini Card, compliant with IEEE 802.11b and IEEE 802.11g/n, is a high-efficiency Wireless LAN adapter. It allows your computer to connect to a wireless network and to share resources, such as files or printers without being bound to the network wires. Operation in 2.4GHz Direst Sequence Spread Spectrum (DSSS) and Orthogonal Frequency Division Multiplexing (OFDM) radio transmission, the 802.11n 1x1 MIMO Half Mini Card Wired Equivalent Protection (WEP) algorithm is used. In addition, its standard compliance ensures that it can communicate with any IEEE 802.11b and IEEE 802.11g/n network.

Test Mode:	Mode 1: Transmit (802.11b 1Mbps)
	Mode 2: Transmit (802.11g 6Mbps)
	Mode 3: Transmit (802.11n MCS0 7.2Mbps 20M-BW)

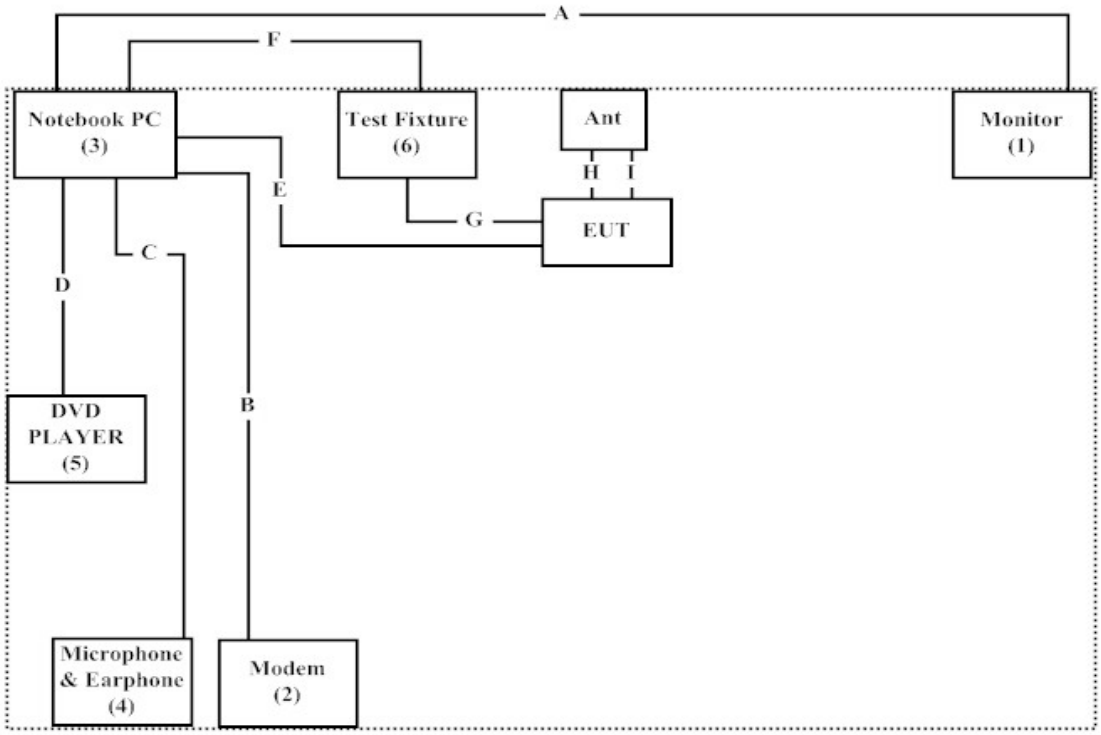
1.3. Tested System Details

The types for all equipment, plus descriptions of all cables used in the tested system (including inserted cards) are:

Product		Manufacturer	Model No.	Serial No.	FCC ID	Power Cord
1	Monitor	LG	W2261VT	907YHED07356	DoC	Non-Shielded, 1.8m
2	Modem	ACEEX	DM-1414	0102027559	IFAXDM1414	Non-Shielded, 1.8m
3	Notebook PC	DELL	PPT	N/A		Non-Shielded, 0.8m
4	Microphone & Earphone	Lobos	LB-EW020	N/A	N/A	N/A
5	DVD PLAYER	DELL	PD01S	N/A	N/A	N/A
6	Test Fixture	CastleNet	N/A	N/A	N/A	N/A

Signal Cable Type		Signal cable Description
A	VGA Cable	Shielded, 1.8m ,with two ferrite cores bonded.
B	Modem Cable	Shielded,1.2m
C	Microphone & Earphone Cable	Non-Shielded, 2m
D	DVD Cable	Non-Shielded, 0.6m
E	RJ-45 Cable	Non-Shielded, 0.8m
F	USB Cable	Non-Shielded, 1.2m
G	Fixture Cable	Non-Shielded, 0.3m, four PCS.
H	Ant Cable	Shielded, 0.1m
I	Ant Cable	Shielded, 0.1m

1.4. Configuration of Tested System



1.5. EUT Exercise Software

(1) Setup the EUT as shown in Section 1.4.

(2) Execute “Hyper terminal” on the Notebook Pc.

(3) Configure the test mode, the test channel, and the data rate.

(4) Press “OK” to start the continuous Transmit.

(5) Verify that the EUT works properly.

1.6. Test Facility

Ambient conditions in the laboratory:

Items	Required (IEC 68-1)	Actual
Temperature (°C)	15-35	20-35
Humidity (%RH)	25-75	50-65
Barometric pressure (mbar)	860-1060	950-1000

The related certificate for our laboratories about the test site and management system can be downloaded from QuieTek Corporation's Web Site: http://www.quietek.com/tw/ctg/cts/accreditations.htm
The address and introduction of QuieTek Corporation's laboratories can be founded in our Web site: http://www.quietek.com/

Site Description: File on
Federal Communications Commission
FCC Engineering Laboratory
7435 Oakland Mills Road
Columbia, MD 21046
Registration Number: 92195

Accreditation on NVLAP
NVLAP Lab Code: 200533-0

Site Name: Quietek Corporation
Site Address: No. 5-22, Ruei-Shu Valley, Ruei-Ping Tsuen,
Lin-Kou Shiang, Taipei,
Taiwan, R.O.C.
TEL: 886-2-8601-3788 / FAX : 886-2-8601-3789
E-Mail : service@quietek.com

FCC Accreditation Number: TW1014

Testing Laboratory
0914

2. Conducted Emission

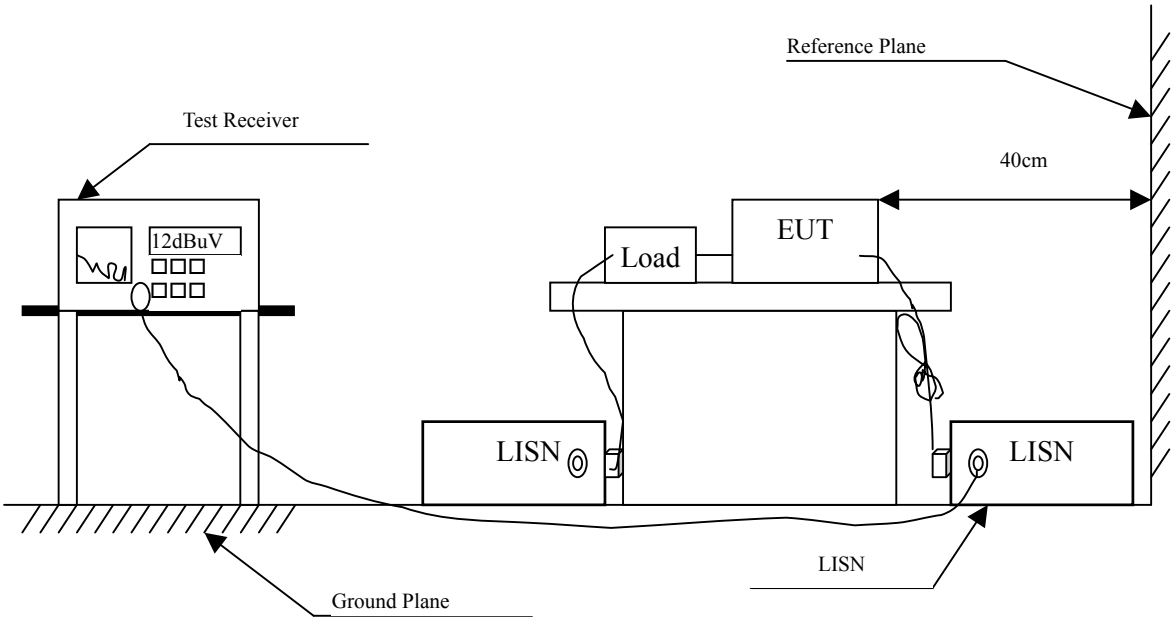
2.1. Test Equipment

The following test equipment are used during the conducted emission test:

Item	Instrument	Manufacturer	Type No./Serial No	Last Cal.	Remark
1	Test Receiver	R & S	ESCS 30/825442/17	May, 2010	
2	L.I.S.N.	R & S	ESH3-Z5/825016/6	May, 2010	EUT
3	L.I.S.N.	Kyoritsu	KNW-407/8-1420-3	May, 2010	Peripherals
4	Pulse Limiter	R & S	ESH3-Z2	May, 2010	
5	No.1 Shielded Room			N/A	

Note: All instruments are calibrated every one year.

2.2. Test Setup



2.3. Limits

FCC Part 15 Subpart C Paragraph 15.207 (dBuV) Limit		
Frequency MHz	Limits	
	QP	AVG
0.15 - 0.50	66-56	56-46
0.50-5.0	56	46
5.0 - 30	60	50

2.4. Test Procedure

The EUT and simulators are connected to the main power through a line impedance stabilization network (L.I.S.N.). This provides a 50 ohm /50uH coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN that provides a 50ohm /50uH coupling impedance with 50ohm termination. (Please refers to the block diagram of the test setup and photographs.)

Both sides of A.C. line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.4: 2003 on conducted measurement.

Conducted emissions were invested over the frequency range from 0.15MHz to 30MHz using a receiver bandwidth of 9kHz.

2.5. Uncertainty

± 2.26 dB

2.6. Test Result of Conducted Emission

Product : 802.11n 1x1 MIMO Half Mini Card
Test Item : Conducted Emission Test
Power Line : Line 1
Test Mode : Mode 3: Transmit (802.11n MCS0 7.2Mbps 20M-BW) (2437MHz) (Dipole Antenna)

Frequency	Correct Factor	Reading Level	Measurement Level	Margin	Limit
MHz	dB	dBuV	dBuV	dB	dBuV
Line 1					
Quasi-Peak					
0.162	9.750	48.180	57.930	-7.727	65.657
0.220	9.693	33.730	43.423	-20.577	64.000
0.271	9.662	32.490	42.152	-20.391	62.543
0.326	9.650	30.620	40.270	-20.701	60.971
14.853	9.990	23.050	33.040	-26.960	60.000
24.130	10.070	25.750	35.820	-24.180	60.000
Average					
0.162	9.750	40.650	50.400	-5.257	55.657
0.220	9.693	26.960	36.653	-17.347	54.000
0.271	9.662	26.010	35.672	-16.871	52.543
0.326	9.650	28.410	38.060	-12.911	50.971
14.853	9.990	14.500	24.490	-25.510	50.000
24.130	10.070	22.480	32.550	-17.450	50.000

Note:

1. All Reading Levels are Quasi-Peak and average value.
2. " " means the worst emission level.
3. Measurement Level = Reading Level + Correct Factor

Product : 802.11n 1x1 MIMO Half Mini Card
Test Item : Conducted Emission Test
Power Line : Line 2
Test Mode : Mode 3: Transmit (802.11n MCS0 7.2Mbps 20M-BW) (2437MHz) (Dipole Antenna)

Frequency	Correct Factor	Reading Level	Measurement Level	Margin	Limit
MHz	dB	dBuV	dBuV	dB	dBuV
Line 2					
Quasi-Peak					
0.162	9.751	47.760	57.511	-8.146	65.657
0.216	9.706	38.910	48.616	-15.498	64.114
0.271	9.672	31.500	41.172	-21.371	62.543
0.322	9.660	31.630	41.290	-19.796	61.086
14.088	9.960	27.130	37.090	-22.910	60.000
24.130	10.070	26.600	36.670	-23.330	60.000
Average					
0.162	9.751	40.360	50.111	-5.546	55.657
0.216	9.706	30.990	40.696	-13.418	54.114
0.271	9.672	24.540	34.212	-18.331	52.543
0.322	9.660	27.630	37.290	-13.796	51.086
14.088	9.960	18.500	28.460	-21.540	50.000
24.130	10.070	23.490	33.560	-16.440	50.000

Note:

1. All Reading Levels are Quasi-Peak and average value.
2. " " means the worst emission level.
3. Measurement Level = Reading Level + Correct Factor

Product : 802.11n 1x1 MIMO Half Mini Card
Test Item : Conducted Emission Test
Power Line : Line 1
Test Mode : Mode 3: Transmit (802.11n MCS0 7.2Mbps 20M-BW) (2437MHz) (PIFA Antenna)

Frequency	Correct Factor	Reading Level	Measurement Level	Margin	Limit
MHz	dB	dBuV	dBuV	dB	dBuV
Line 1					
Quasi-Peak					
0.162	9.750	50.930	60.680	-4.977	65.657
0.173	9.734	33.270	43.005	-22.338	65.343
0.212	9.698	39.620	49.318	-14.911	64.229
0.271	9.662	34.500	44.162	-18.381	62.543
0.322	9.650	30.130	39.780	-21.306	61.086
23.130	9.970	29.360	39.330	-20.670	60.000
Average					
0.162	9.750	42.790	52.540	-3.117	55.657
0.173	9.734	12.270	22.005	-33.338	55.343
0.212	9.698	31.690	41.388	-12.841	54.229
0.271	9.662	27.240	36.902	-15.641	52.543
0.322	9.650	26.380	36.030	-15.056	51.086
23.130	9.970	24.200	34.170	-15.830	50.000

Note:

1. All Reading Levels are Quasi-Peak and average value.
2. " " means the worst emission level.
3. Measurement Level = Reading Level + Correct Factor

Product : 802.11n 1x1 MIMO Half Mini Card
Test Item : Conducted Emission Test
Power Line : Line 2
Test Mode : Mode 3: Transmit (802.11n MCS0 7.2Mbps 20M-BW) (2437MHz) (PIFA Antenna)

Frequency	Correct Factor	Reading Level	Measurement Level	Margin	Limit
MHz	dB	dBuV	dBuV	dB	dBuV
Line 2					
Quasi-Peak					
0.162	9.751	49.840	59.591	-6.066	65.657
0.216	9.706	41.040	50.746	-13.368	64.114
0.267	9.675	31.950	41.625	-21.032	62.657
0.326	9.660	31.270	40.930	-20.041	60.971
0.377	9.650	27.440	37.090	-22.424	59.514
24.005	10.060	32.890	42.950	-17.050	60.000
Average					
0.162	9.751	42.060	51.811	-3.846	55.657
0.216	9.706	32.840	42.546	-11.568	54.114
0.267	9.675	24.260	33.935	-18.722	52.657
0.326	9.660	25.370	35.030	-15.941	50.971
0.377	9.650	22.850	32.500	-17.014	49.514
24.005	10.060	30.410	40.470	-9.530	50.000

Note:

1. All Reading Levels are Quasi-Peak and average value.
2. " " means the worst emission level.
3. Measurement Level = Reading Level + Correct Factor

3. Peak Power Output

3.1. Test Equipment

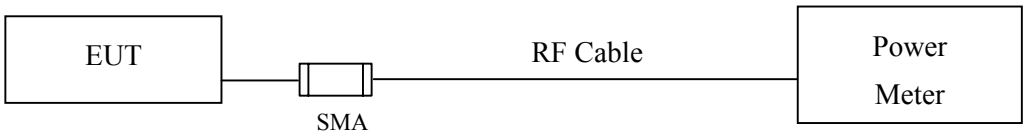
	Equipment	Manufacturer	Model No./Serial No.	Last Cal.
X	Power Meter	Anritsu	ML2495A/6K00003357	May, 2010
X	Power Sensor	Anritsu	MA2411B/0738448	Jun, 2010
	8-WAY Power Divider	JFW	50PD-647 / 526770 0916	Apr., 2010

Note:

1. All equipments are calibrated with traceable calibrations. Each calibration is traceable to the national or international standards.
2. The test instruments marked with "X" are used to measure the final test results.
3. The power combiner is used for measure 11n mode.

3.2. Test Setup

Conducted Measurement



3.3. Limits

The maximum peak power shall be less 1 Watt.

3.4. Test Procedure

The EUT was tested according to DTS test procedure of Mar. 2005 KDB558074 for compliance to FCC 47CFR 15.247 requirements.

3.5. Uncertainty

± 1.27 dB

3.6. Test Result of Peak Power Output

Product : 802.11n 1x1 MIMO Half Mini Card
Test Item : Peak Power Output Data
Test Site : No.3 OATS
Test Mode : Mode 1: Transmit (802.11b 1Mbps)

Channel No	Frequency (MHz)	Average Power For different Data Rate (Mbps)				Peak Power	Required Limit	Result
		1	2	5.5	11	1		
		Measurement Level (dBm)						
01	2412	15.92	--	--	--	18.32	<30dBm	Pass
06	2437	16.02	15.96	15.51	15.62	18.59	<30dBm	Pass
11	2462	15.79	--	--	--	18.43	<30dBm	Pass

Note: Peak Power Output Value =Reading value on peak power meter + cable loss

Product : 802.11n 1x1 MIMO Half Mini Card
Test Item : Peak Power Output Data
Test Site : No.3 OATS
Test Mode : Mode 2: Transmit (802.11g 6Mbps)

Channel No	Frequency (MHz)	Average Power For different Data Rate (Mbps)								Peak Power	Required Limit	Result
		6	9	12	18	24	36	48	54	6		
		Measurement Level (dBm)										
01	2412	12.89	12.77	12.71	12.81	12.62	12.72	12.6	12.7	20.14	<30dBm	Pass
06	2437	12.72	--	--	--	--	--	--	--	20.36	<30dBm	Pass
11	2462	12.79	--	--	--	--	--	--	--	20.29	<30dBm	Pass

Note: Peak Power Output Value =Reading value on peak power meter + cable loss

Product : 802.11n 1x1 MIMO Half Mini Card
Test Item : Peak Power Output Data
Test Site : No.3 OATS
Test Mode : Mode 3: Transmit (802.11n MCS0 7.2Mbps 20M-BW)

Channel No	Frequency (MHz)	Average Power For different Data Rate (Mbps)								Peak Power	Required Limit	Result
		7.2	14.4	21.7	28.9	43.3	57.8	65	72.2	7.2		
		Measurement Level (dBm)										
01	2412	13.89	13.29	13.15	13.15	12.98	12.85	12.8	12.79	20.5	<30dBm	Pass
06	2437	12.92	--	--	--	--	--	--	--	20.17	<30dBm	Pass
11	2462	12.78	--	--	--	--	--	--	--	20.62	<30dBm	Pass

Note: Peak Power Output Value =Reading value on peak power meter + cable loss

4. Radiated Emission

4.1. Test Equipment

The following test equipment are used during the radiated emission test:

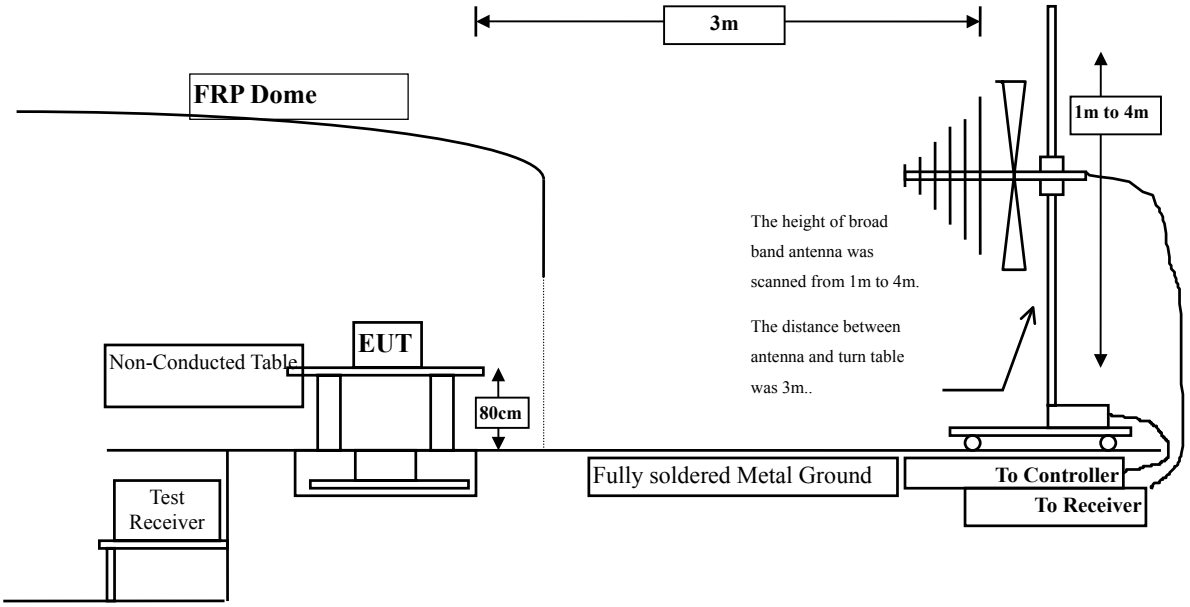
Test Site	Equipment		Manufacturer	Model No./Serial No.	Last Cal.
☒Site # 3	X	Bilog Antenna	Schaffner Chase	CBL6112B/2673	Sep., 2010
	X	Horn Antenna	Schwarzbeck	BBHA9120D/D305	Sep., 2010
	X	Horn Antenna	Schwarzbeck	BBHA9170/208	Jul., 2010
	X	Pre-Amplifier	Agilent	8447D/2944A09549	Sep., 2010
	X	Spectrum Analyzer	Agilent	E4407B / US39440758	May, 2010
	X	Test Receiver	R & S	ESCS 30/ 825442/018	Sep., 2010
	X	Coaxial Cable	QuieTek	QTK-CABLE/ CAB5	Feb., 2010
	X	Controller	QuieTek	QTK-CONTROLLER/ CTRL3	N/A
	X	Coaxial Switch	Anritsu	MP59B/6200265729	N/A

Note: 1. All equipments are calibrated with traceable calibrations. Each calibration is traceable to the national or international standards.

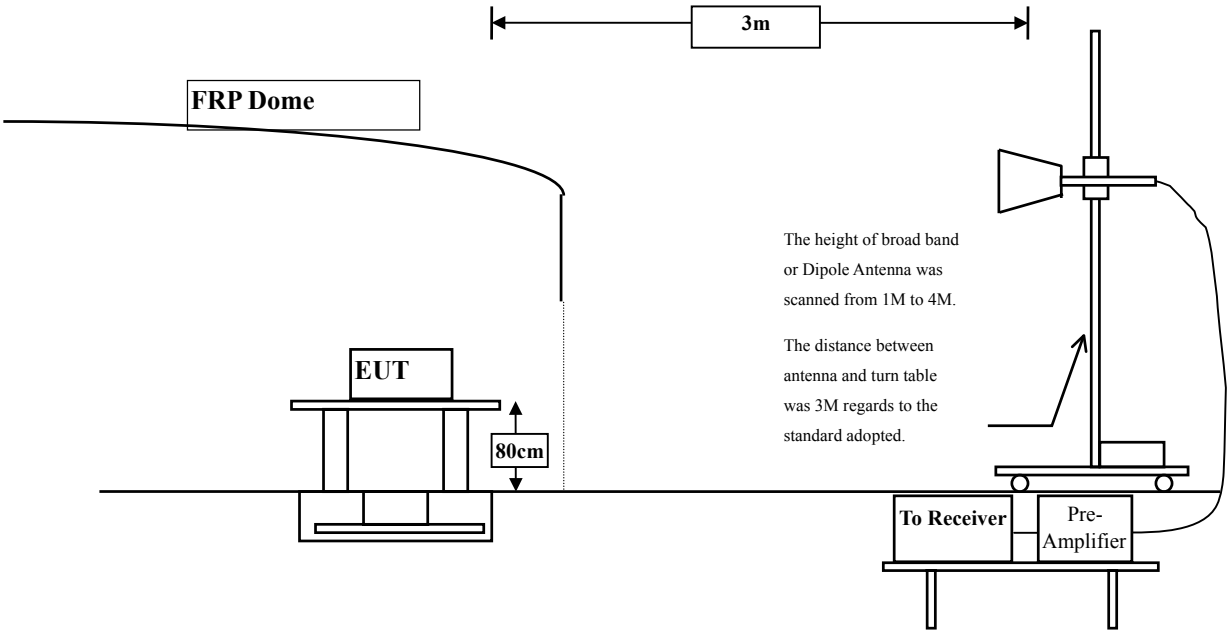
2. The test instruments marked with "X" are used to measure the final test results.

4.2. Test Setup

Radiated Emission Below 1GHz



Radiated Emission Above 1GHz



4.3. Limits

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 20dB below the level of the fundamental or to the general radiated emission limits in paragraph 15.209, whichever is the lesser attenuation.

FCC Part 15 Subpart C Paragraph 15.209(a) Limits		
Frequency MHz	uV/m @3m	dBuV/m@3m
30-88	100	40
88-216	150	43.5
216-960	200	46
Above 960	500	54

Remarks: E field strength (dBuV/m) = 20 log E field strength (uV/m)

4.4. Test Procedure

The EUT was setup according to ANSI C63.4, 2003 and tested according to DTS test procedure of Mar. 2005 KDB558074 for compliance to FCC 47CFR 15.247 requirements.
The EUT is placed on a turn table which is 0.8 meter above ground. The turn table is rotated 360 degrees to determine the position of the maximum emission level. The EUT was positioned such that the distance from antenna to the EUT was 3 meters.
The antenna is scanned between 1 meter and 4 meters to find out the maximum emission level. This is repeated for both horizontal and vertical polarization of the antenna. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.4:2003 on radiated measurement.
The resolution bandwidth below 1GHz setting on the field strength meter is 120 kHz and above 1GHz is 1MHz.
Radiated emission measurements below 1GHz are made using broadband Bilog antenna and above 1GHz are made using Horn Antennas.
The measurement is divided into the Preliminary Measurement and the Final Measurement.
The suspected frequencies are searched for in Preliminary Measurement with the measurement antenna kept pointed at the source of the emission both in azimuth and elevation, with the polarization of the antenna oriented for maximum response. The antenna is pointed at an angle towards the source of the emission, and the EUT is rotated in both height and polarization to maximize the measured emission. The emission is kept within the illumination area of the 3 dB bandwidth of the antenna.
The worst radiated emission is measured in the Open Area Test Site on the Final Measurement.
The frequency range from 30MHz to 10th harminics is checked.

4.5. Uncertainty

± 3.9 dB above 1GHz
± 3.8 dB below 1GHz

4.6. Test Result of Radiated Emission

Product : 802.11n 1x1 MIMO Half Mini Card
Test Item : Harmonic Radiated Emission Data
Test Site : No.3 OATS
Test Mode : Mode 1: Transmit (802.11b 1Mbps) (2412MHz) (Dipole Antenna)

Frequency	Correct Factor	Reading Level	Measurement Level	Margin	Limit
MHz	dB	dBuV	dBuV/m	dB	dBuV/m
Horizontal					
Peak Detector:					
4824.000	3.261	43.782	47.043	-26.957	74.000
7236.000	10.650	43.174	53.824	-20.176	74.000
9648.000	13.337	44.151	57.487	-16.513	74.000
Average Detector:					
9648.000	13.337	30.334	43.670	-10.330	54.000
Vertical					
Peak Detector:					
4824.000	6.421	44.473	50.894	-23.106	74.000
7236.000	11.495	43.456	54.951	-19.049	74.000
9648.000	13.807	43.950	57.756	-16.244	74.000
Average Detector:					
7236.000	11.495	29.229	40.724	-13.276	54.000
9648.000	13.807	30.342	44.148	-9.852	54.000

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Average measurements: RBW = 1MHz, VBW = 10 Hz, Sweep: Auto.
4. Measurement Level = Reading Level + Correct Factor.
5. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
6. The average measurement was not performed when the peak measured data under the limit of average detection.
7. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product : 802.11n 1x1 MIMO Half Mini Card
Test Item : Harmonic Radiated Emission Data
Test Site : No.3 OATS
Test Mode : Mode 1: Transmit (802.11b 1Mbps) (2437 MHz) (Dipole Antenna)

Frequency	Correct Factor	Reading Level	Measurement Level	Margin	Limit
MHz	dB	dBuV	dBuV/m	dB	dBuV/m
Horizontal					
Peak Detector:					
4874.000	3.038	43.434	46.471	-27.529	74.000
7311.000	11.795	43.024	54.818	-19.182	74.000
9748.000	12.635	43.734	56.369	-17.631	74.000
Average					
Detector:					
7311.000	11.795	29.104	40.898	-13.102	54.000
9748.000	12.635	29.722	42.357	-11.643	54.000
Vertical					
Peak Detector:					
4874.000	5.812	45.990	51.801	-22.199	74.000
7311.000	12.630	43.934	56.563	-17.437	74.000
9748.000	13.126	44.741	57.867	-16.133	74.000
Average					
Detector:					
7311.000	12.630	29.160	41.789	-12.211	54.000
9748.000	13.126	30.193	43.319	-10.681	54.000

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Average measurements: RBW = 1MHz, VBW = 10 Hz, Sweep: Auto.
4. Measurement Level = Reading Level + Correct Factor.
5. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
6. The average measurement was not performed when the peak measured data under the limit of average detection.
7. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product : 802.11n 1x1 MIMO Half Mini Card
Test Item : Harmonic Radiated Emission Data
Test Site : No.3 OATS
Test Mode : Mode 1: Transmit (802.11b 1Mbps) (2462 MHz) (Dipole Antenna)

Frequency	Correct Factor	Reading Level	Measurement Level	Margin	Limit
MHz	dB	dBuV	dBuV/m	dB	dBuV/m
Horizontal					
Peak Detector:					
4924.000	2.858	43.698	46.555	-27.445	74.000
7386.000	12.127	42.706	54.834	-19.166	74.000
9848.000	12.852	44.033	56.886	-17.114	74.000
Average Detector:					
7386.000	12.127	29.161	41.289	-12.711	54.000
9848.000	12.852	29.633	42.486	-11.514	54.000
Vertical					
Peak Detector:					
4924.000	5.521	45.474	50.994	-23.006	74.000
7386.000	13.254	42.789	56.043	-17.957	74.000
9848.000	13.367	43.851	57.218	-16.782	74.000
Average Detector:					
7386.000	13.254	29.178	42.432	-11.568	54.000
9848.000	13.367	29.816	43.183	-10.817	54.000

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Average measurements: RBW = 1MHz, VBW = 10 Hz, Sweep: Auto.
4. Measurement Level = Reading Level + Correct Factor.
5. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
6. The average measurement was not performed when the peak measured data under the limit of average detection.
7. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product : 802.11n 1x1 MIMO Half Mini Card
Test Item : Harmonic Radiated Emission Data
Test Site : No.3 OATS
Test Mode : Mode 2: Transmit (802.11g 6Mbps) (2412MHz) (Dipole Antenna)

Frequency	Correct Factor	Reading Level	Measurement Level	Margin	Limit
MHz	dB	dBuV	dBuV/m	dB	dBuV/m
Horizontal					
Peak Detector:					
4824.000	3.261	43.537	46.798	-27.202	74.000
7236.000	10.650	43.335	53.985	-20.015	74.000
9648.000	13.337	44.713	58.049	-15.951	74.000
Average					
Detector:					
9648.000	13.337	30.264	43.600	-10.400	54.000
Vertical					
Peak Detector:					
4824.000	6.421	42.796	49.217	-24.783	74.000
7236.000	11.495	42.999	54.494	-19.506	74.000
9648.000	13.807	43.986	57.792	-16.208	74.000
Average					
Detector:					
7236.000	11.495	28.748	40.243	-13.757	54.000
9648.000	13.807	30.041	43.847	-10.153	54.000

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Average measurements: RBW = 1MHz, VBW = 10 Hz, Sweep: Auto.
4. Measurement Level = Reading Level + Correct Factor.
5. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
6. The average measurement was not performed when the peak measured data under the limit of average detection.
7. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product : 802.11n 1x1 MIMO Half Mini Card
Test Item : Harmonic Radiated Emission Data
Test Site : No.3 OATS
Test Mode : Mode 2: Transmit (802.11g 6Mbps) (2437 MHz) (Dipole Antenna)

Frequency	Correct Factor	Reading Level	Measurement Level	Margin	Limit
MHz	dB	dBuV	dBuV/m	dB	dBuV/m
Horizontal					
Peak Detector:					
4874.000	3.038	43.933	46.970	-27.030	74.000
7311.000	11.795	43.213	55.007	-18.993	74.000
9748.000	12.635	43.610	56.245	-17.755	74.000
Average					
Detector:					
7311.000	11.795	29.093	40.887	-13.113	54.000
9748.000	12.635	29.738	42.373	-11.627	54.000
Vertical					
Peak Detector:					
4874.000	5.812	43.893	49.704	-24.296	74.000
7311.000	12.630	43.828	56.457	-17.543	74.000
9748.000	13.126	44.097	57.223	-16.777	74.000
Average					
Detector:					
7311.000	12.630	29.027	41.656	-12.344	54.000
9748.000	13.126	29.759	42.885	-11.115	54.000

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Average measurements: RBW = 1MHz, VBW = 10 Hz, Sweep: Auto.
4. Measurement Level = Reading Level + Correct Factor.
5. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
6. The average measurement was not performed when the peak measured data under the limit of average detection.
7. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product : 802.11n 1x1 MIMO Half Mini Card
Test Item : Harmonic Radiated Emission Data
Test Site : No.3 OATS
Test Mode : Mode 2: Transmit (802.11g 6Mbps) (2462 MHz) (Dipole Antenna)

Frequency	Correct Factor	Reading Level	Measurement Level	Margin	Limit
MHz	dB	dBuV	dBuV/m	dB	dBuV/m
Horizontal					
Peak Detector:					
4924.000	2.858	44.057	46.914	-27.086	74.000
7386.000	12.127	42.975	55.103	-18.897	74.000
9848.000	12.852	43.686	56.539	-17.461	74.000
Average Detector:					
7386.000	12.127	29.054	41.182	-12.818	54.000
9848.000	12.852	29.532	42.385	-11.615	54.000
Vertical					
Peak Detector:					
4924.000	5.521	43.727	49.247	-24.753	74.000
7386.000	13.254	43.554	56.808	-17.192	74.000
9848.000	13.367	43.554	56.921	-17.079	74.000
Average Detector:					
7386.000	13.254	29.078	42.332	-11.668	54.000
9848.000	13.367	29.506	42.873	-11.127	54.000

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Average measurements: RBW = 1MHz, VBW = 10 Hz, Sweep: Auto.
4. Measurement Level = Reading Level + Correct Factor.
5. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
6. The average measurement was not performed when the peak measured data under the limit of average detection.
7. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product : 802.11n 1x1 MIMO Half Mini Card
Test Item : Harmonic Radiated Emission Data
Test Site : No.3 OATS
Test Mode : Mode 3: Transmit (802.11n MCS0 7.2Mbps 20M-BW)(2412MHz)
(Dipole Antenna)

Frequency	Correct Factor	Reading Level	Measurement Level	Margin	Limit
MHz	dB	dBuV	dBuV/m	dB	dBuV/m
Horizontal					
Peak Detector:					
4824.000	3.261	43.666	46.927	-27.073	74.000
7236.000	10.650	43.835	54.485	-19.515	74.000
9648.000	13.337	44.807	58.143	-15.857	74.000
Average					
Detector:					
7236.000	10.650	29.218	39.868	-14.132	54.000
9648.000	13.337	30.319	43.655	-10.345	54.000
Vertical					
Peak Detector:					
4824.000	6.421	43.944	50.365	-23.635	74.000
7236.000	11.495	43.536	55.031	-18.969	74.000
9648.000	13.807	44.659	58.465	-15.535	74.000
Average					
Detector:					
7236.000	11.495	29.385	40.880	-13.120	54.000
9648.000	13.807	30.253	44.059	-9.941	54.000

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Average measurements: RBW = 1MHz, VBW = 10 Hz, Sweep: Auto.
4. Measurement Level = Reading Level + Correct Factor.
5. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
6. The average measurement was not performed when the peak measured data under the limit of average detection.
7. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product : 802.11n 1x1 MIMO Half Mini Card
Test Item : Harmonic Radiated Emission Data
Test Site : No.3 OATS
Test Mode : Mode 3: Transmit (802.11n MCS0 7.2Mbps 20M-BW) (2437 MHz) (Dipole Antenna)

Frequency	Correct Factor	Reading Level	Measurement Level	Margin	Limit
MHz	dB	dBuV	dBuV/m	dB	dBuV/m
Horizontal					
Peak Detector:					
4874.000	3.038	44.050	47.087	-26.913	74.000
7311.000	11.795	43.350	55.144	-18.856	74.000
9748.000	12.635	43.550	56.185	-17.815	74.000
Average Detector:					
7311.000	11.795	29.860	41.654	-12.346	54.000
9748.000	12.635	29.740	42.375	-11.625	54.000
Vertical					
Peak Detector:					
4874.000	5.812	43.920	49.731	-24.269	74.000
7311.000	12.630	43.970	56.599	-17.401	74.000
9748.000	13.126	44.190	57.316	-16.684	74.000
Average Detector:					
7311.000	12.630	29.050	41.679	-12.321	54.000
9748.000	13.126	29.800	42.926	-11.074	54.000

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Average measurements: RBW = 1MHz, VBW = 10 Hz, Sweep: Auto.
4. Measurement Level = Reading Level + Correct Factor.
5. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
6. The average measurement was not performed when the peak measured data under the limit of average detection.
7. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product : 802.11n 1x1 MIMO Half Mini Card
Test Item : Harmonic Radiated Emission Data
Test Site : No.3 OATS
Test Mode : Mode 3: Transmit (802.11n MCS0 7.2Mbps 20M-BW) (2462 MHz) (Dipole Antenna)

Frequency	Correct Factor	Reading Level	Measurement Level	Margin	Limit
MHz	dB	dBuV	dBuV/m	dB	dBuV/m
Horizontal					
Peak Detector:					
4924.000	2.858	44.510	47.367	-26.633	74.000
7386.000	12.127	42.930	55.058	-18.942	74.000
9848.000	12.852	43.610	56.463	-17.537	74.000
Average					
Detector:					
7386.000	12.127	28.980	41.108	-12.892	54.000
9848.000	12.852	29.000	41.853	-12.147	54.000
Vertical					
Peak Detector:					
4924.000	5.521	42.850	48.370	-25.630	74.000
7386.000	13.254	43.060	56.314	-17.686	74.000
9848.000	13.367	44.510	57.877	-16.123	74.000
Average					
Detector:					
7386.000	13.254	29.110	42.364	-11.636	54.000
9848.000	13.367	29.610	42.977	-11.023	54.000

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Average measurements: RBW = 1MHz, VBW = 10 Hz, Sweep: Auto.
4. Measurement Level = Reading Level + Correct Factor.
5. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
6. The average measurement was not performed when the peak measured data under the limit of average detection.
7. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product : 802.11n 1x1 MIMO Half Mini Card
Test Item : Harmonic Radiated Emission Data
Test Site : No.3 OATS
Test Mode : Mode 1: Transmit (802.11b 1Mbps) (2412MHz) (PIFA Antenna)

Frequency	Correct Factor	Reading Level	Measurement Level	Margin	Limit
MHz	dB	dBuV	dBuV/m	dB	dBuV/m
Horizontal					
Peak Detector:					
4824.000	3.261	42.277	45.538	-28.462	74.000
7236.000	10.650	36.770	47.420	-26.580	74.000
9648.000	13.337	39.913	53.249	-20.751	74.000
Average Detector:					
--					
Vertical					
Peak Detector:					
4824.000	6.421	45.097	51.518	-22.482	74.000
7236.000	11.495	36.779	48.274	-25.726	74.000
9648.000	13.807	38.906	52.712	-21.288	74.000
Average Detector:					
--					

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Average measurements: RBW = 1MHz, VBW = 10 Hz, Sweep: Auto.
4. Measurement Level = Reading Level + Correct Factor.
5. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
6. The average measurement was not performed when the peak measured data under the limit of average detection.
7. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product : 802.11n 1x1 MIMO Half Mini Card
Test Item : Harmonic Radiated Emission Data
Test Site : No.3 OATS
Test Mode : Mode 1: Transmit (802.11b 1Mbps) (2437 MHz) (PIFA Antenna)

Frequency	Correct Factor	Reading Level	Measurement Level	Margin	Limit
MHz	dB	dBuV	dBuV/m	dB	dBuV/m
Horizontal					
Peak Detector:					
4874.000	3.038	43.242	46.279	-27.721	74.000
7311.000	11.795	40.645	52.439	-21.561	74.000
9748.000	12.635	38.232	50.867	-23.133	74.000
Average					
Detector:					
--					
Vertical					
Peak Detector:					
4874.000	5.812	45.410	51.221	-22.779	74.000
7311.000	12.630	38.489	51.118	-22.882	74.000
9748.000	13.126	36.638	49.764	-24.236	74.000
Average					
Detector:					
--					

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Average measurements: RBW = 1MHz, VBW = 10 Hz, Sweep: Auto.
4. Measurement Level = Reading Level + Correct Factor.
5. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
6. The average measurement was not performed when the peak measured data under the limit of average detection.
7. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product : 802.11n 1x1 MIMO Half Mini Card
Test Item : Harmonic Radiated Emission Data
Test Site : No.3 OATS
Test Mode : Mode 1: Transmit (802.11b 1Mbps) (2462 MHz) (PIFA Antenna)

Frequency	Correct Factor	Reading Level	Measurement Level	Margin	Limit
MHz	dB	dBuV	dBuV/m	dB	dBuV/m
Horizontal					
Peak Detector:					
4924.000	2.858	43.579	46.436	-27.564	74.000
7386.000	12.127	38.970	51.098	-22.902	74.000
9848.000	12.852	39.170	52.023	-21.977	74.000
Average Detector:					
--					
Vertical					
Peak Detector:					
4924.000	5.521	47.617	53.137	-20.863	74.000
7386.000	13.254	38.270	51.524	-22.476	74.000
9848.000	13.367	39.728	53.095	-20.905	74.000
Average Detector:					
--					

Note:
1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Average measurements: RBW = 1MHz, VBW = 10 Hz, Sweep: Auto.
4. Measurement Level = Reading Level + Correct Factor.
5. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
6. The average measurement was not performed when the peak measured data under the limit of average detection.
7. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product : 802.11n 1x1 MIMO Half Mini Card
Test Item : Harmonic Radiated Emission Data
Test Site : No.3 OATS
Test Mode : Mode 2: Transmit (802.11g 6Mbps) (2412MHz) (PIFA Antenna)

Frequency	Correct Factor	Reading Level	Measurement Level	Margin	Limit
MHz	dB	dBuV	dBuV/m	dB	dBuV/m
Horizontal					
Peak Detector:					
4824.000	3.261	37.660	40.921	-33.079	74.000
7236.000	10.650	35.780	46.430	-27.570	74.000
9648.000	13.337	35.530	48.866	-25.134	74.000
Average Detector:					
--					
Vertical					
Peak Detector:					
4824.000	6.421	39.770	46.191	-27.809	74.000
7236.000	11.495	36.640	48.135	-25.865	74.000
9648.000	13.807	35.850	49.656	-24.344	74.000
Average Detector:					
--					

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Average measurements: RBW = 1MHz, VBW = 10 Hz, Sweep: Auto.
4. Measurement Level = Reading Level + Correct Factor.
5. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
6. The average measurement was not performed when the peak measured data under the limit of average detection.
7. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product : 802.11n 1x1 MIMO Half Mini Card
Test Item : Harmonic Radiated Emission Data
Test Site : No.3 OATS
Test Mode : Mode 2: Transmit (802.11g 6Mbps) (2437 MHz) (PIFA Antenna)

Frequency	Correct Factor	Reading Level	Measurement Level	Margin	Limit
MHz	dB	dBuV	dBuV/m	dB	dBuV/m
Horizontal					
Peak Detector:					
4874.000	3.038	37.330	40.367	-33.633	74.000
7311.000	11.795	35.980	47.774	-26.226	74.000
9748.000	12.635	35.850	48.485	-25.515	74.000
Average					
Detector:					
--					
Vertical					
Peak Detector:					
4874.000	5.812	40.570	46.381	-27.619	74.000
7311.000	12.630	35.110	47.739	-26.261	74.000
9748.000	13.126	35.630	48.756	-25.244	74.000
Average					
Detector:					
--					

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Average measurements: RBW = 1MHz, VBW = 10 Hz, Sweep: Auto.
4. Measurement Level = Reading Level + Correct Factor.
5. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
6. The average measurement was not performed when the peak measured data under the limit of average detection.
7. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product : 802.11n 1x1 MIMO Half Mini Card
Test Item : Harmonic Radiated Emission Data
Test Site : No.3 OATS
Test Mode : Mode 2: Transmit (802.11g 6Mbps) (2462 MHz) (PIFA Antenna)

Frequency	Correct Factor	Reading Level	Measurement Level	Margin	Limit
MHz	dB	dBuV	dBuV/m	dB	dBuV/m
Horizontal					
Peak Detector:					
4924.000	2.858	38.040	40.897	-33.103	74.000
7386.000	12.127	38.340	50.468	-23.532	74.000
9848.000	12.852	35.580	48.433	-25.567	74.000
Average Detector:					
--					
Vertical					
Peak Detector:					
4924.000	5.521	42.750	48.270	-25.730	74.000
7386.000	13.254	38.390	51.644	-22.356	74.000
9848.000	13.367	35.920	49.287	-24.713	74.000
Average Detector:					
--					

Note:
1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Average measurements: RBW = 1MHz, VBW = 10 Hz, Sweep: Auto.
4. Measurement Level = Reading Level + Correct Factor.
5. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
6. The average measurement was not performed when the peak measured data under the limit of average detection.
7. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product : 802.11n 1x1 MIMO Half Mini Card
Test Item : Harmonic Radiated Emission Data
Test Site : No.3 OATS
Test Mode : Mode 3: Transmit (802.11n MCS0 7.2Mbps 20M-BW)(2412MHz)
(PIFA Antenna)

Frequency	Correct Factor	Reading Level	Measurement Level	Margin	Limit
MHz	dB	dBuV	dBuV/m	dB	dBuV/m
Horizontal					
Peak Detector:					
4824.000	3.261	37.520	40.781	-33.219	74.000
7236.000	10.650	35.570	46.220	-27.780	74.000
9648.000	13.337	37.710	51.046	-22.954	74.000
Average					
Detector:					
--					
Vertical					
Peak Detector:					
4824.000	6.421	39.570	45.991	-28.009	74.000
7236.000	11.495	36.490	47.985	-26.015	74.000
9648.000	13.807	36.150	49.956	-24.044	74.000
Average					
Detector:					
--					

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Average measurements: RBW = 1MHz, VBW = 10 Hz, Sweep: Auto.
4. Measurement Level = Reading Level + Correct Factor.
5. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
6. The average measurement was not performed when the peak measured data under the limit of average detection.
7. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product : 802.11n 1x1 MIMO Half Mini Card
Test Item : Harmonic Radiated Emission Data
Test Site : No.3 OATS
Test Mode : Mode 3: Transmit (802.11n MCS0 7.2Mbps 20M-BW) (2437 MHz) (PIFA Antenna)

Frequency	Correct Factor	Reading Level	Measurement Level	Margin	Limit
MHz	dB	dBuV	dBuV/m	dB	dBuV/m
Horizontal					
Peak Detector:					
4874.000	3.038	37.330	40.367	-33.633	74.000
7311.000	11.795	35.160	46.954	-27.046	74.000
9748.000	12.635	36.430	49.065	-24.935	74.000
Average Detector:					
--					
Vertical					
Peak Detector:					
4874.000	5.812	40.510	46.321	-27.679	74.000
7311.000	12.630	37.800	50.429	-23.571	74.000
9748.000	13.126	36.210	49.336	-24.664	74.000
Average Detector:					
--					

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Average measurements: RBW = 1MHz, VBW = 10 Hz, Sweep: Auto.
4. Measurement Level = Reading Level + Correct Factor.
5. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
6. The average measurement was not performed when the peak measured data under the limit of average detection.
7. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product : 802.11n 1x1 MIMO Half Mini Card
Test Item : Harmonic Radiated Emission Data
Test Site : No.3 OATS
Test Mode : Mode 3: Transmit (802.11n MCS0 7.2Mbps 20M-BW) (2462 MHz) (PIFA Antenna)

Frequency	Correct Factor	Reading Level	Measurement Level	Margin	Limit
MHz	dB	dBuV	dBuV/m	dB	dBuV/m
Horizontal					
Peak Detector:					
4924.000	2.858	38.640	41.497	-32.503	74.000
7386.000	12.127	38.310	50.438	-23.562	74.000
9848.000	12.852	36.440	49.293	-24.707	74.000
Average Detector:					
--					
Vertical					
Peak Detector:					
4924.000	5.521	42.970	48.490	-25.510	74.000
7386.000	13.254	46.970	60.224	-13.776	74.000
9848.000	13.367	36.930	50.297	-23.703	74.000
Average Detector:					
7386.000	13.254	30.260	43.514	-10.486	54.000

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Average measurements: RBW = 1MHz, VBW = 10 Hz, Sweep: Auto.
4. Measurement Level = Reading Level + Correct Factor.
5. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
6. The average measurement was not performed when the peak measured data under the limit of average detection.
7. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product : 802.11n 1x1 MIMO Half Mini Card
Test Item : General Radiated Emission Data
Test Site : No.3 OATS
Test Mode : Mode 1: Transmit (802.11b 1Mbps)(2437 MHz) (Dipole Antenna)

Frequency	Correct Factor	Reading Level	Measurement Level	Margin	Limit
MHz	dB	dBuV	dBuV/m	dB	dBuV/m
Horizontal					
142.520	-7.627	39.568	31.941	-11.559	43.500
499.480	1.991	35.694	37.684	-8.316	46.000
666.320	1.879	34.355	36.234	-9.766	46.000
749.740	3.963	36.521	40.484	-5.516	46.000
800.180	6.417	28.515	34.932	-11.068	46.000
1000.000	9.564	28.188	37.752	-16.248	54.000
Vertical					
30.000	-3.010	34.555	31.545	-8.455	40.000
92.080	-5.373	35.716	30.343	-13.157	43.500
332.640	-2.255	31.670	29.415	-16.585	46.000
499.480	-0.199	36.559	36.359	-9.641	46.000
749.740	2.023	37.180	39.203	-6.797	46.000
901.060	1.858	27.770	29.628	-16.372	46.000

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Average measurements: RBW = 1MHz, VBW = 10 Hz, Sweep: Auto.
4. Measurement Level = Reading Level + Correct Factor.
5. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
6. The average measurement was not performed when the peak measured data under the limit of average detection.
7. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product : 802.11n 1x1 MIMO Half Mini Card
Test Item : General Radiated Emission Data
Test Site : No.3 OATS
Test Mode : Mode 2: Transmit (802.11g 6Mbps)(2437 MHz) (Dipole Antenna)

Frequency	Correct Factor	Reading Level	Measurement Level	Margin	Limit
MHz	dB	dBuV	dBuV/m	dB	dBuV/m
Horizontal					
146.400	-7.756	40.603	32.847	-10.653	43.500
499.480	1.991	36.095	38.085	-7.915	46.000
666.320	1.879	34.295	36.174	-9.826	46.000
749.740	3.963	36.263	40.226	-5.774	46.000
800.180	6.417	28.448	34.865	-11.135	46.000
1000.000	9.564	28.035	37.599	-16.401	54.000
Vertical					
30.000	-3.010	34.334	31.324	-8.676	40.000
90.140	-4.175	34.874	30.699	-12.801	43.500
332.640	-2.255	32.123	29.868	-16.132	46.000
499.480	-0.199	36.400	36.200	-9.800	46.000
677.960	0.840	28.929	29.769	-16.231	46.000
749.740	2.023	37.066	39.089	-6.911	46.000

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Average measurements: RBW = 1MHz, VBW = 10 Hz, Sweep: Auto.
4. Measurement Level = Reading Level + Correct Factor.
5. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
6. The average measurement was not performed when the peak measured data under the limit of average detection.
7. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product : 802.11n 1x1 MIMO Half Mini Card
Test Item : General Radiated Emission Data
Test Site : No.3 OATS
Test Mode : Mode 3: Transmit (802.11n MCS0 7.2Mbps 20M-BW)(2437 MHz)
(Dipole Antenna)

Frequency	Correct Factor	Reading Level	Measurement Level	Margin	Limit
MHz	dB	dBuV	dBuV/m	dB	dBuV/m
Horizontal					
30.000	-0.150	29.162	29.012	-10.988	40.000
146.400	-7.756	40.935	33.179	-10.321	43.500
499.480	1.991	35.498	37.488	-8.512	46.000
666.320	1.879	34.300	36.179	-9.821	46.000
749.740	3.963	35.842	39.805	-6.195	46.000
1000.000	9.564	28.247	37.811	-16.189	54.000
Vertical					
30.000	-3.010	35.168	32.158	-7.842	40.000
94.020	-6.580	39.031	32.451	-11.049	43.500
332.640	-2.255	31.804	29.549	-16.451	46.000
499.480	-0.199	36.915	36.715	-9.285	46.000
749.740	2.023	37.149	39.172	-6.828	46.000
1000.000	-1.166	28.839	27.673	-26.327	54.000

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Average measurements: RBW = 1MHz, VBW = 10 Hz, Sweep: Auto.
4. Measurement Level = Reading Level + Correct Factor.
5. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
6. The average measurement was not performed when the peak measured data under the limit of average detection.
7. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product : 802.11n 1x1 MIMO Half Mini Card
Test Item : General Radiated Emission Data
Test Site : No.3 OATS
Test Mode : Mode 1: Transmit (802.11b 1Mbps)(2437 MHz) (PIFA Antenna)

Frequency	Correct Factor	Reading Level	Measurement Level	Margin	Limit
MHz	dB	dBuV	dBuV/m	dB	dBuV/m
Horizontal					
148.340	-7.806	40.221	32.415	-11.085	43.500
400.540	0.942	35.383	36.325	-9.675	46.000
499.480	1.991	35.757	37.747	-8.253	46.000
666.320	1.879	33.421	35.300	-10.700	46.000
749.740	3.963	34.070	38.033	-7.967	46.000
1000.000	9.564	27.580	37.144	-16.856	54.000
Vertical					
30.000	-3.010	35.578	32.568	-7.432	40.000
84.320	-4.204	34.814	30.610	-9.390	40.000
332.640	-2.255	34.332	32.077	-13.923	46.000
400.540	-2.868	31.740	28.872	-17.128	46.000
499.480	-0.199	36.480	36.280	-9.720	46.000
749.740	2.023	34.247	36.270	-9.730	46.000

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Average measurements: RBW = 1MHz, VBW = 10 Hz, Sweep: Auto.
4. Measurement Level = Reading Level + Correct Factor.
5. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
6. The average measurement was not performed when the peak measured data under the limit of average detection.
7. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product : 802.11n 1x1 MIMO Half Mini Card
Test Item : General Radiated Emission Data
Test Site : No.3 OATS
Test Mode : Mode 2: Transmit (802.11g 6Mbps)(2437 MHz) (PIFA Antenna)

Frequency	Correct Factor	Reading Level	Measurement Level	Margin	Limit
MHz	dB	dBuV	dBuV/m	dB	dBuV/m
Horizontal					
152.220	-7.926	39.178	31.252	-12.248	43.500
332.640	-3.895	35.898	32.003	-13.997	46.000
400.540	0.942	35.468	36.410	-9.590	46.000
499.480	1.991	35.535	37.525	-8.475	46.000
666.320	1.879	33.516	35.395	-10.605	46.000
749.740	3.963	33.754	37.717	-8.283	46.000
Vertical					
30.000	-3.010	33.841	30.831	-9.169	40.000
113.420	-3.709	33.884	30.175	-13.325	43.500
332.640	-2.255	33.646	31.391	-14.609	46.000
400.540	-2.868	31.157	28.289	-17.711	46.000
499.480	-0.199	37.200	37.000	-9.000	46.000
749.740	2.023	33.941	35.964	-10.036	46.000

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Average measurements: RBW = 1MHz, VBW = 10 Hz, Sweep: Auto.
4. Measurement Level = Reading Level + Correct Factor.
5. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
6. The average measurement was not performed when the peak measured data under the limit of average detection.
7. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product : 802.11n 1x1 MIMO Half Mini Card
Test Item : General Radiated Emission Data
Test Site : No.3 OATS
Test Mode : Mode 3: Transmit (802.11n MCS0 7.2Mbps 20M-BW)(2437 MHz)
(PIFA Antenna)

Frequency	Correct Factor	Reading Level	Measurement Level	Margin	Limit
MHz	dB	dBuV	dBuV/m	dB	dBuV/m
Horizontal					
144.460	-7.703	40.978	33.275	-10.225	43.500
400.540	0.942	35.762	36.704	-9.296	46.000
499.480	1.991	35.264	37.254	-8.746	46.000
666.320	1.879	33.839	35.718	-10.282	46.000
749.740	3.963	34.242	38.205	-7.795	46.000
1000.000	9.564	27.272	36.836	-17.164	54.000
Vertical					
30.000	-3.010	35.323	32.313	-7.687	40.000
90.140	-4.175	34.425	30.250	-13.250	43.500
332.640	-2.255	33.816	31.561	-14.439	46.000
400.540	-2.868	30.939	28.071	-17.929	46.000
499.480	-0.199	35.987	35.787	-10.213	46.000
749.740	2.023	33.928	35.951	-10.049	46.000

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Average measurements: RBW = 1MHz, VBW = 10 Hz, Sweep: Auto.
4. Measurement Level = Reading Level + Correct Factor.
5. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
6. The average measurement was not performed when the peak measured data under the limit of average detection.
7. The emission levels of other frequencies are very lower than the limit and not show in test report.

5. RF antenna conducted test

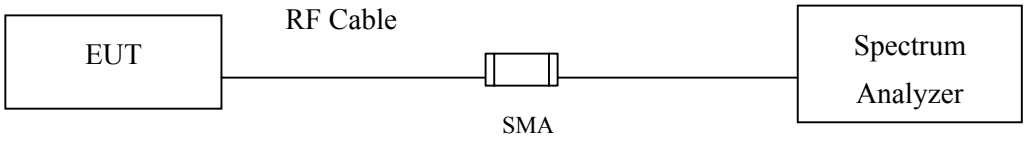
5.1. Test Equipment

	Equipment	Manufacturer	Model No./Serial No.	Last Cal.
	Spectrum Analyzer	R&S	FSP40 / 100170	Jun, 2010
	Spectrum Analyzer	Agilent	E4407B / US39440758	Jun, 2010
X	Spectrum Analyzer	Agilent	N9010A / MY48030495	Apr., 2010
	8-WAY Power Divider	JFW	50PD-647 / 526770 0916	Apr., 2010

Note: 1. All equipments are calibrated with traceable calibrations. Each calibration is traceable to the national or international standards.
2. The test instruments marked with "X" are used to measure the final test results.
3. The power combiner is used for measure 11n mode.

5.2. Test Setup

RF antenna Conducted Measurement:



5.3. Limits

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

5.4. Test Procedure

The EUT was tested according to DTS test procedure of Mar. 2005 KDB558074 for compliance to FCC 47CFR 15.247 requirements.
Set RBW = 100 kHz, Set VBW> RBW, scan up through 10th harmonic.

5.5. Uncertainty

The measurement uncertainty
Conducted is defined as ± 1.27dB

5.6. Test Result of RF antenna conducted test

Product : 802.11n 1x1 MIMO Half Mini Card
Test Item : RF antenna conducted test
Test Site : No.3 OATS
Test Mode : Mode 1: Transmit (802.11b 1Mbps)

Channel 01 (2412MHz) 30-25GHz

Channel 06 (2437MHz) 30-25GHz

Channel 11 (2462MHz) 30-25GHz

Product : 802.11n 1x1 MIMO Half Mini Card
Test Item : RF Antenna Conducted Spurious
Test Site : No.3 OATS
Test Mode : Mode 2: Transmit (802.11g 6Mbps)

Channel 01 (2412MHz) 30-25GHz

Channel 06 (2437MHz) 30-25GHz

Channel 11 (2462MHz) 30-25GHz

Product : 802.11n 1x1 MIMO Half Mini Card
Test Item : RF Antenna Conducted Spurious
Test Site : No.3 OATS
Test Mode : Mode 3: Transmit (802.11n MCS0 7.2Mbps 20M-BW)

Channel 01 (2412MHz) 30-25GHz

Channel 06 (2437MHz) 30-25GHz

Channel 11 (2462MHz) 30-25GHz

6. Band Edge

6.1. Test Equipment

RF Conducted Measurement

The following test equipments are used during the band edge tests:

	Equipment	Manufacturer	Model No./Serial No.	Last Cal.
	Spectrum Analyzer	R&S	FSP40 / 100170	Jun, 2010
	Spectrum Analyzer	Agilent	E4407B / US39440758	Jun, 2010
X	Spectrum Analyzer	Agilent	N9010A / MY48030495	Apr., 2010
	8-WAY Power Divider	JFW	50PD-647 / 526770 0916	Apr., 2010

Note:

1. All equipments are calibrated with traceable calibrations. Each calibration is traceable to the national or international standards.
2. The test instruments marked with "X" are used to measure the final test results.
3. The power combiner is used for measure 11n mode.

RF Radiated Measurement:

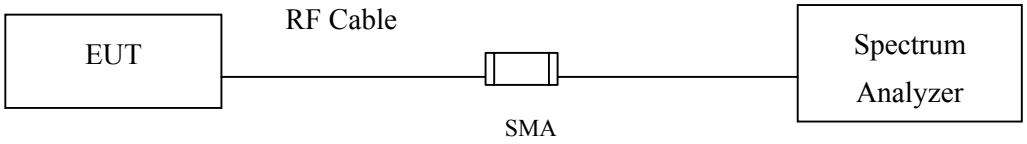
The following test equipments are used during the band edge tests:

Test Site		Equipment	Manufacturer	Model No./Serial No.	Last Cal.
☒Site # 3		Bilog Antenna	Schaffner Chase	CBL6112B/2673	Sep., 2010
	X	Horn Antenna	Schwarzbeck	BBHA9120D/D305	Sep., 2010
		Horn Antenna	Schwarzbeck	BBHA9170/208	Jul., 2010
	X	Pre-Amplifier	Agilent	8447D/2944A09549	Sep., 2010
	X	Spectrum Analyzer	Agilent	E4407B / US39440758	May, 2010
		Test Receiver	R & S	ESCS 30/ 825442/018	Sep., 2010
	X	Coaxial Cable	QuieTek	QTK-CABLE/ CAB5	Feb., 2010
	X	Controller	QuieTek	QTK-CONTROLLER/ CTRL3	N/A
	X	Coaxial Switch	Anritsu	MP59B/6200265729	N/A

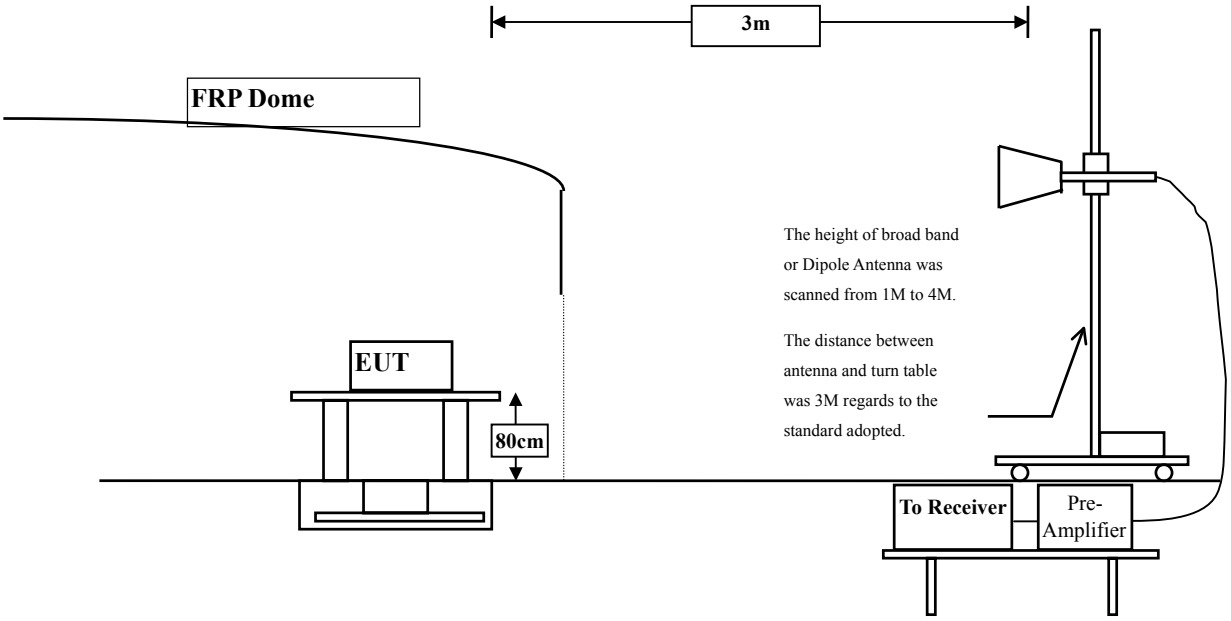
Note: 1. All instruments are calibrated every one year.
2. The test instruments marked by "X" are used to measure the final test results.

6.2. Test Setup

RF Conducted Measurement



RF Radiated Measurement:



6.3. Limits

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 20dB below the level of the fundamental or to the general radiated emission limits in paragraph 15.209, whichever is the lesser attenuation.

6.4. Test Procedure

The EUT was setup according to ANSI C63.4, 2003 and tested according to DTS test procedure of Mar. 2005 KDB558074 for compliance to FCC 47CFR 15.247 requirements.
The EUT is placed on a turn table which is 0.8 meter above ground. The turn table is rotated 360 degrees to determine the position of the maximum emission level. The EUT was positioned such that the distance from antenna to the EUT was 3 meters.
The antenna is scanned from 1 meter to 4 meters to find out the maximum emission level. This is repeated for both horizontal and vertical polarization of the antenna. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.4:2003 on radiated measurement.

6.5. Uncertainty

± 3.9 dB above 1GHz
± 3.8 dB below 1GHz

6.6. Test Result of Band Edge

Product : 802.11n 1x1 MIMO Half Mini Card
Test Item : Band Edge Data
Test Site : No.3 OATS
Test Mode : Mode 1: Transmit (802.11b 1Mbps) (Dipole Antenna)

Fundamental Filed Strength

Antenna Pole	Frequency [MHz]	Correction Factor [dB/m]	Reading Level [dBuV]	Emission Level [dBuV/m]	Detector
Horizontal	2412	31.639	58.54	90.178	Peak
Horizontal	2412	31.639	55.17	86.808	Average
Vertical	2412	30.95	70.76	101.709	Peak
Vertical	2412	30.95	67.95	98.899	Average

Note: 1: Spectrum Analyzer setting:

Peak detector: RBW=1MHz, VBW=1MHz

Average detector: RBW=1MHz, VBW=10Hz

Band Edge Test Data

Antenna Pole	Test Frequency (MHz)	Fundamental (dBuV/m)	Δ (dB)	Band Edge Field Strength (dBuV/m)	Detector
Horizontal	2390	90.178	48.754	41.424	Peak
Horizontal	2390	86.808	57.84	28.968	Average
Vertical	2390	101.709	48.754	52.955	Peak
Vertical	2390	98.899	57.84	41.059	Average

Note:

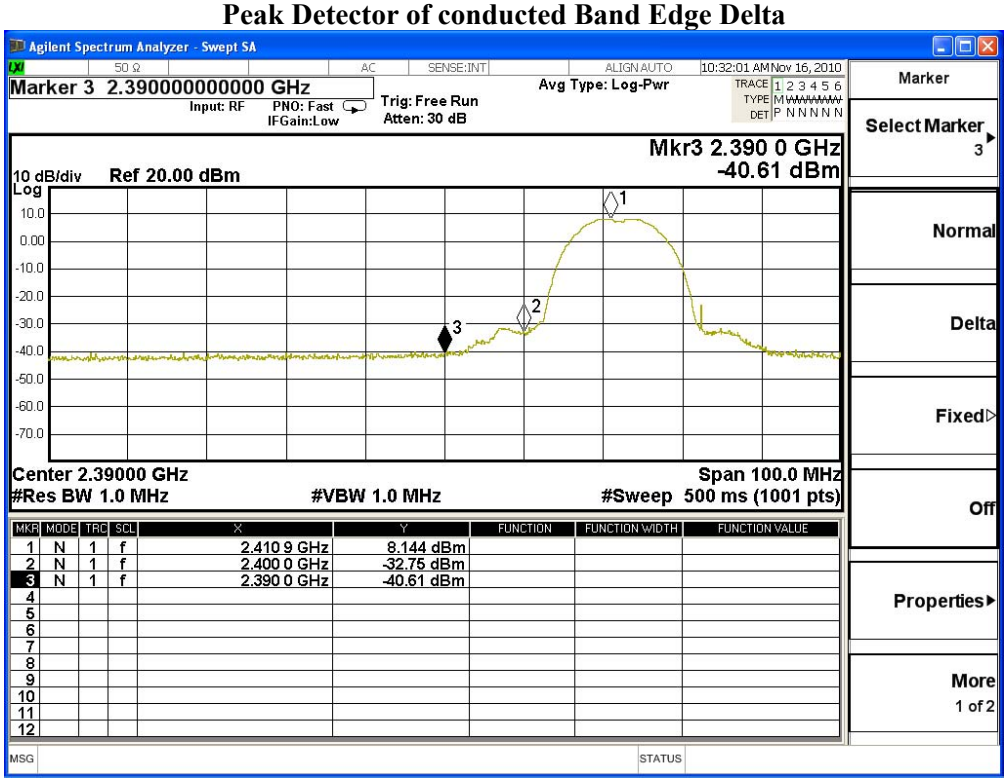
The Band Edge Field Strength was calculated using the Fundamental and Conducted Band Edge measurements per the Marker-Delta Method with the following formula:

Band Edge field Strength = F - Δ

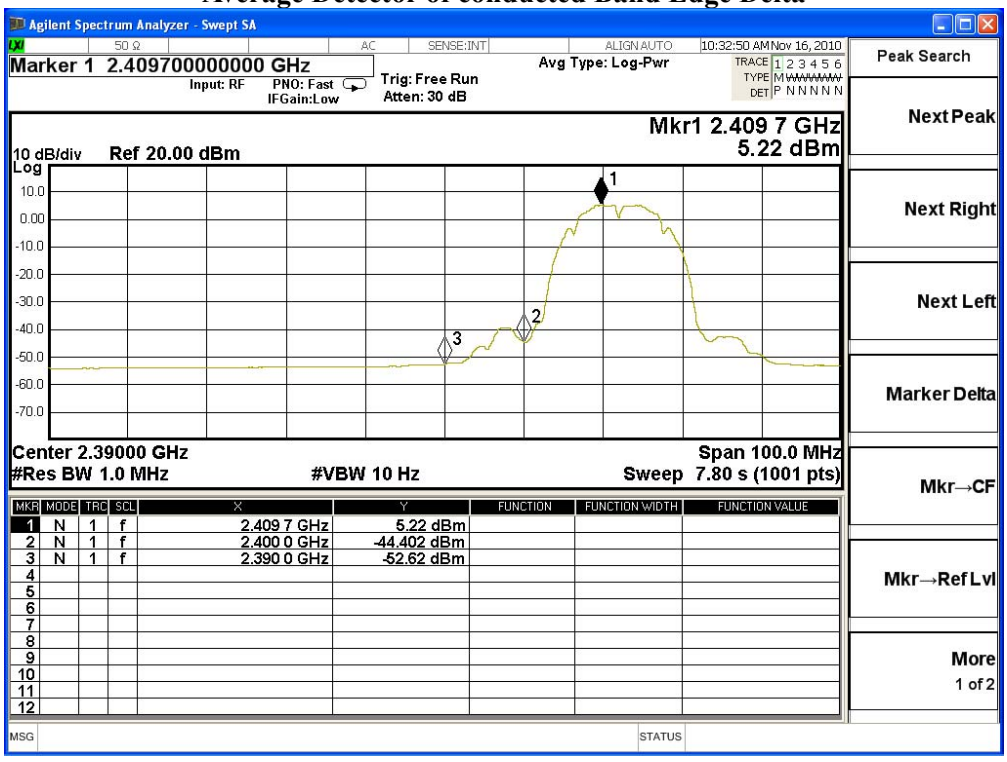
F = Fundamental field Strength (Peak or Average)

Δ = Conducted Band Edge Delta (Peak or Average)

Peak Detector of conducted Band Edge Delta



Average Detector of conducted Band Edge Delta



Product : 802.11n 1x1 MIMO Half Mini Card
Test Item : Band Edge Data
Test Site : No.3 OATS
Test Mode : Mode 1: Transmit (802.11b 1Mbps) (Dipole Antenna)

Fundamental Filed Strength

Antenna Pole	Frequency [MHz]	Correction Factor [dB/m]	Reading Level [dBuV]	Emission Level [dBuV/m]	Detector
Horizontal	2462	32.019	62.14	94.159	Peak
Horizontal	2462	32.019	58.82	90.839	Average
Vertical	2462	31.29	70.27	101.56	Peak
Vertical	2462	31.29	67.37	98.66	Average

Note: 1: Spectrum Analyzer setting:

Peak detector: RBW=1MHz, VBW=1MHz

Average detector: RBW=1MHz, VBW=10Hz

Band Edge Test Data

Antenna Pole	Test Frequency (MHz)	Fundamental (dBuV/m)	Δ (dB)	Band Edge Field Strength (dBuV/m)	Detector
Horizontal	2499.8	94.159	45.24	48.919	Peak
Horizontal	2500.0	90.839	49.17	41.669	Average
Vertical	2499.8	101.56	45.24	56.32	Peak
Vertical	2500.0	98.66	49.17	49.49	Average

Note:

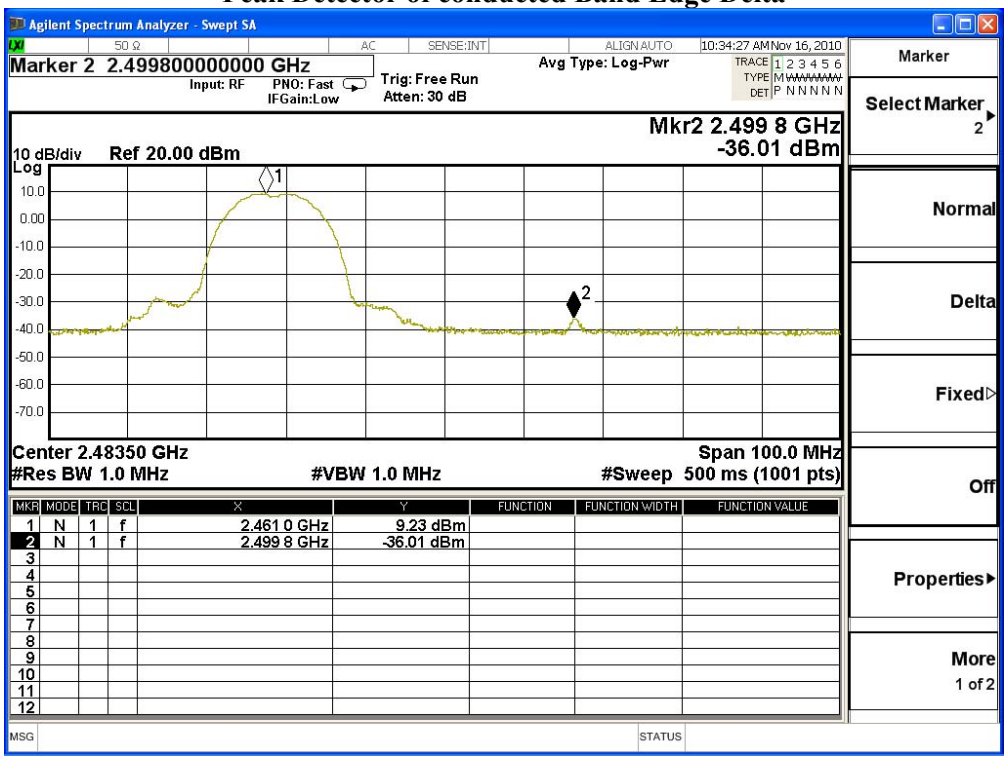
The Band Edge Field Strength was calculated using the Fundamental and Conducted Band Edge measurements per the Marker-Delta Method with the following formula:

Band Edge field Strength = F - Δ

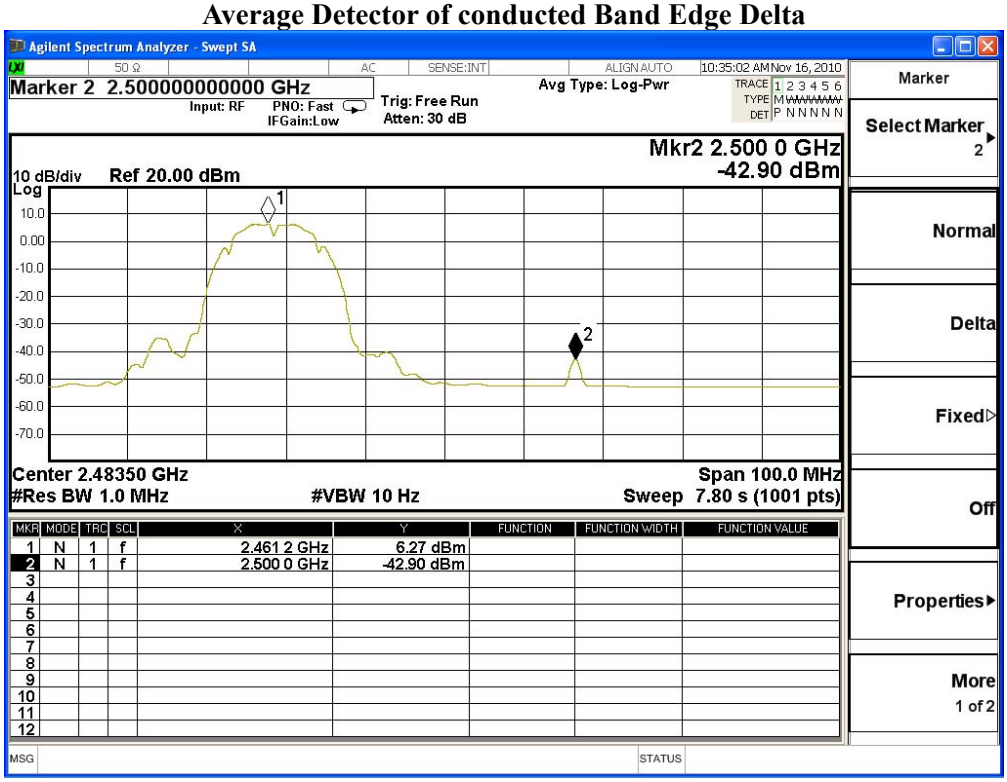
F = Fundamental field Strength (Peak or Average)

Δ = Conducted Band Edge Delta (Peak or Average)

Peak Detector of conducted Band Edge Delta



Average Detector of conducted Band Edge Delta



Product : 802.11n 1x1 MIMO Half Mini Card
Test Item : Band Edge Data
Test Site : No.3 OATS
Test Mode : Mode 2: Transmit (802.11g 6Mbps) (Dipole Antenna)

Fundamental Filed Strength

Antenna Pole	Frequency [MHz]	Correction Factor [dB/m]	Reading Level [dBuV]	Emission Level [dBuV/m]	Detector
Horizontal	2412	31.639	61.92	93.558	Peak
Horizontal	2412	31.639	51.94	83.578	Average
Vertical	2412	30.95	74.35	105.299	Peak
Vertical	2412	30.95	63.68	94.629	Average

Note: 1:Spectrum Analyzer setting:

Peak detector: RBW=1MHz, VBW=1MHz

Average detector: RBW=1MHz, VBW=10Hz

Band Edge Test Data

Antenna Pole	Test Frequency (MHz)	Fundamental (dBuV/m)	Δ (dB)	Band Edge Field Strength (dBuV/m)	Detector
Horizontal	2389.9	93.558	37.25	56.308	Peak
Horizontal	2389.9	83.578	43.135	40.443	Average
Vertical	2389.9	105.299	37.25	68.049	Peak
Vertical	2389.9	94.629	43.135	51.494	Average

Note:

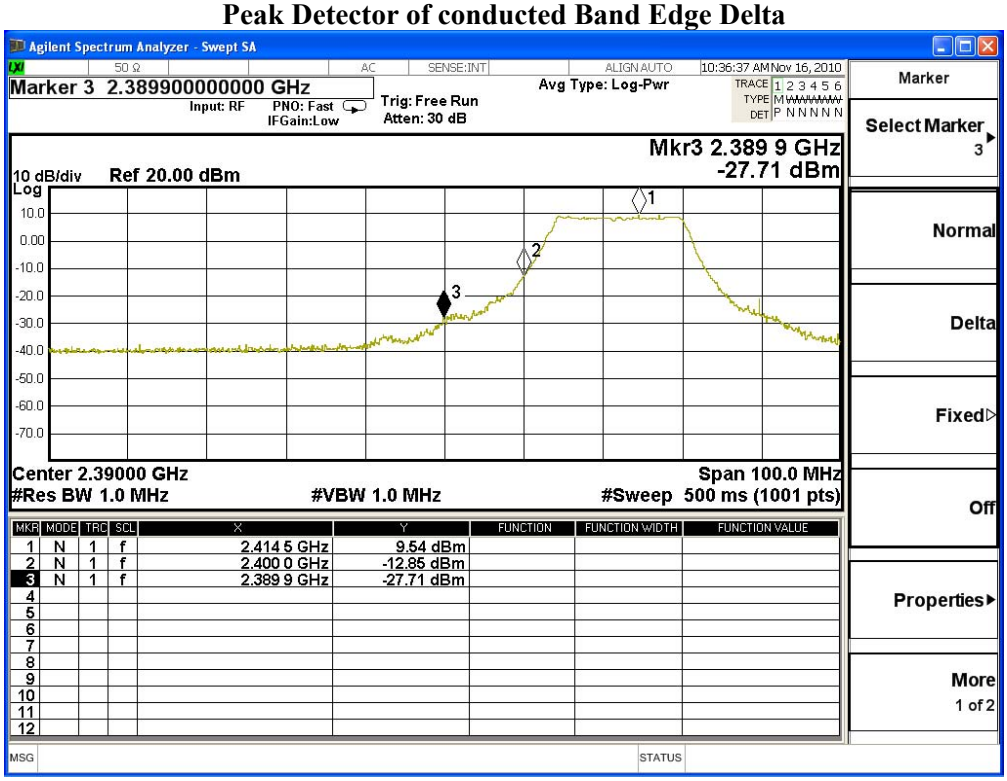
The Band Edge Field Strength was calculated using the Fundamental and Conducted Band Edge measurements per the Marker-Delta Method with the following formula:

Band Edge field Strength = F - Δ

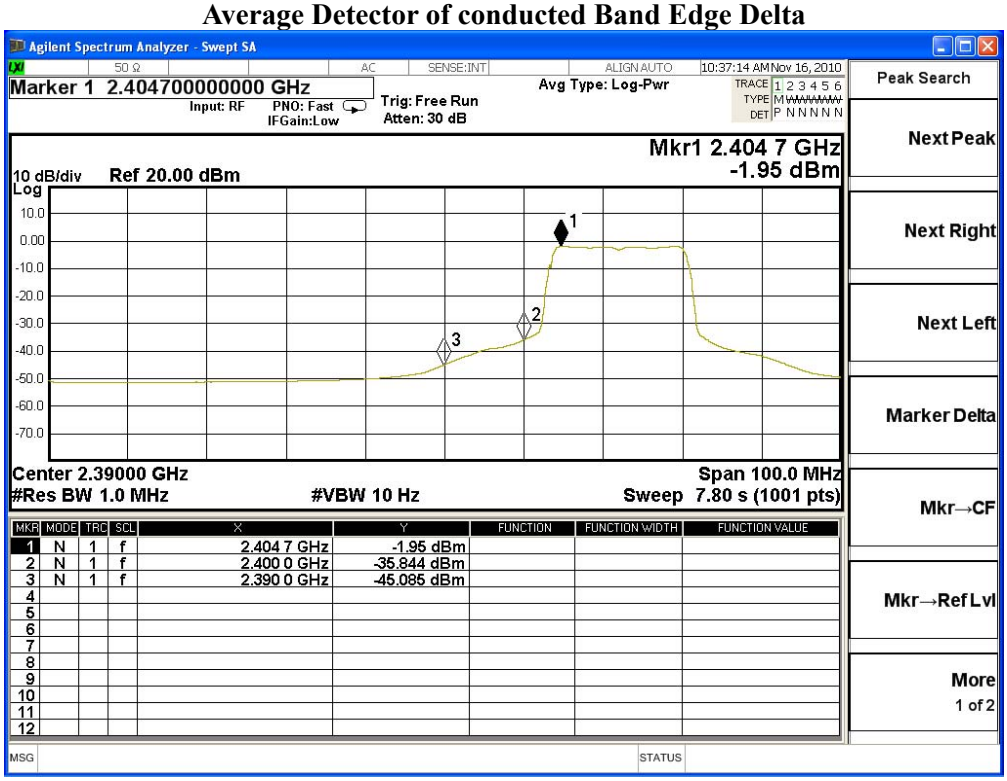
F = Fundamental field Strength (Peak or Average)

Δ = Conducted Band Edge Delta (Peak or Average)

Peak Detector of conducted Band Edge Delta



Average Detector of conducted Band Edge Delta



Product : 802.11n 1x1 MIMO Half Mini Card
Test Item : Band Edge Data
Test Site : No.3 OATS
Test Mode : Mode 2: Transmit (802.11g 6Mbps) (Dipole Antenna)

Fundamental Filed Strength

Antenna Pole	Frequency [MHz]	Correction Factor [dB/m]	Reading Level [dBuV]	Emission Level [dBuV/m]	Detector
Horizontal	2462	32.019	59.21	91.229	Peak
Horizontal	2462	32.019	49.44	81.459	Average
Vertical	2462	31.29	71.79	103.08	Peak
Vertical	2462	31.29	61.28	92.57	Average

Note: 1:Spectrum Analyzer setting:

Peak detector: RBW=1MHz, VBW=1MHz

Average detector: RBW=1MHz, VBW=10Hz

Band Edge Test Data

Antenna Pole	Test Frequency (MHz)	Fundamental (dBuV/m)	Δ (dB)	Band Edge Field Strength (dBuV/m)	Detector
Horizontal	2483.5	91.229	38.27	52.959	Peak
Horizontal	2500	81.459	41.08	40.379	Average
Vertical	2485.2	103.08	38.27	64.81	Peak
Vertical	2500	92.57	41.08	51.49	Average

Note:

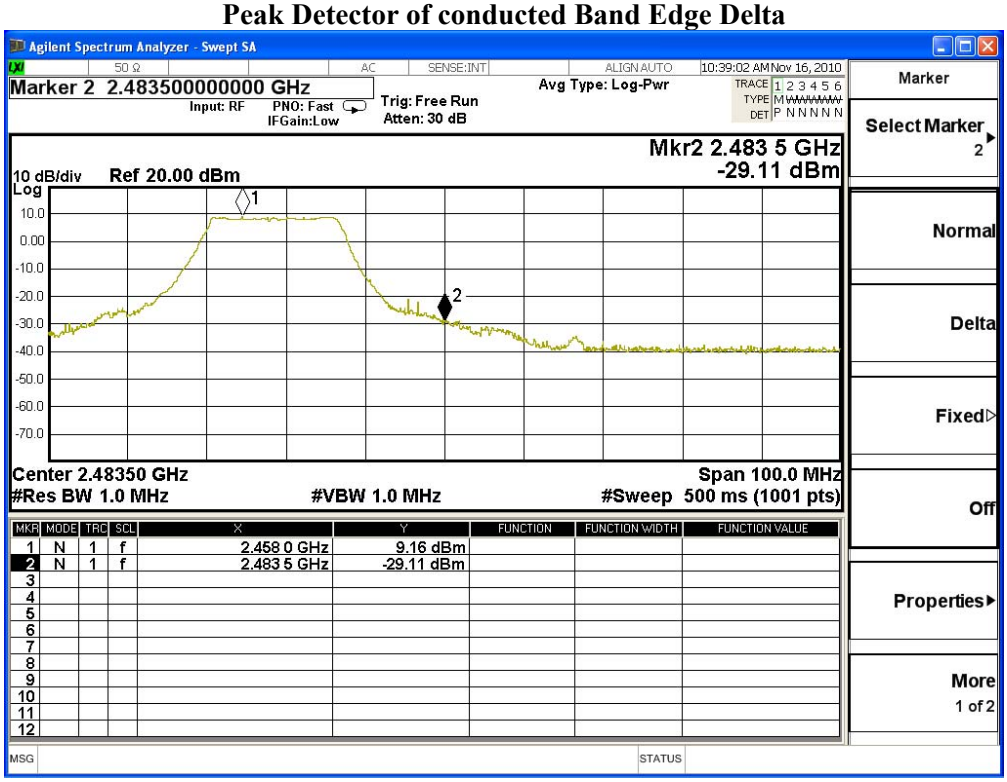
The Band Edge Field Strength was calculated using the Fundamental and Conducted Band Edge measurements per the Marker-Delta Method with the following formula:

Band Edge field Strength = F - Δ

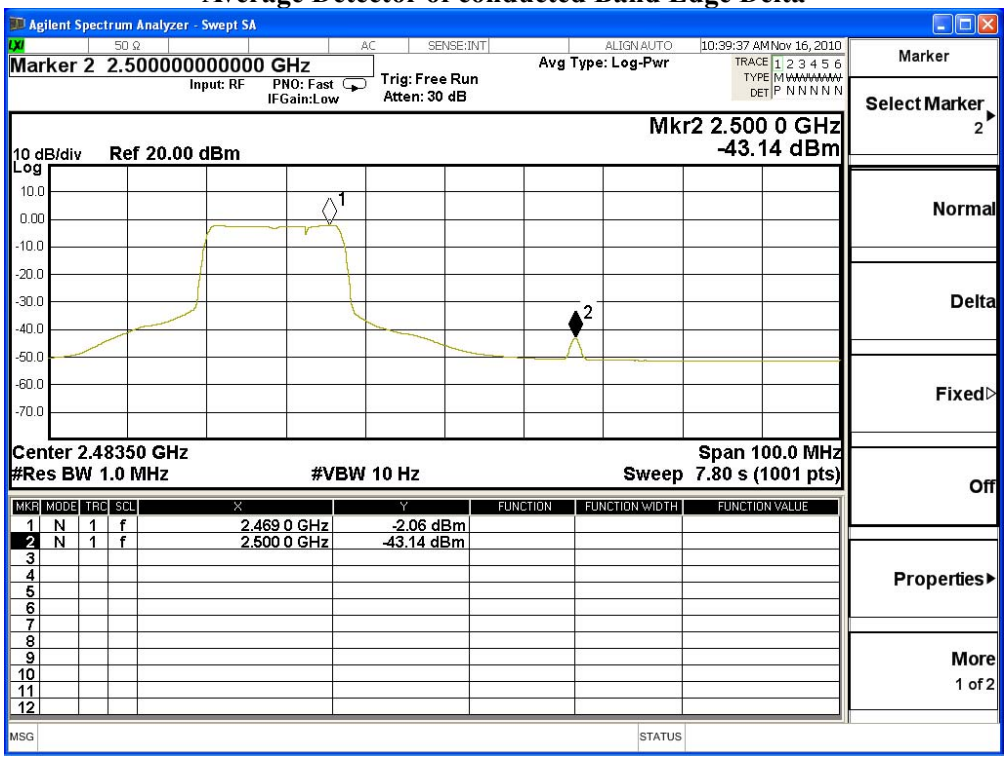
F = Fundamental field Strength (Peak or Average)

Δ = Conducted Band Edge Delta (Peak or Average)

Peak Detector of conducted Band Edge Delta



Average Detector of conducted Band Edge Delta



Product : 802.11n 1x1 MIMO Half Mini Card
Test Item : Band Edge Data
Test Site : No.3 OATS
Test Mode : Mode 3: Transmit (802.11n MCS0 7.2Mbps 20M-BW) (Dipole Antenna)

Fundamental Filed Strength

Antenna Pole	Frequency [MHz]	Correction Factor [dB/m]	Reading Level [dBuV]	Emission Level [dBuV/m]	Detector
Horizontal	2412	31.639	65.48	97.118	Peak
Horizontal	2412	31.639	55.31	86.948	Average
Vertical	2412	30.95	78.67	109.619	Peak
Vertical	2412	30.95	64.02	94.969	Average

Note: 1:Spectrum Analyzer setting:

Peak detector: RBW=1MHz, VBW=1MHz

Average detector: RBW=1MHz, VBW=10Hz

Band Edge Test Data

Antenna Pole	Test Frequency (MHz)	Fundamental (dBuV/m)	Δ (dB)	Band Edge Field Strength (dBuV/m)	Detector
Horizontal	2390	97.118	36.99	60.128	Peak
Horizontal	2390	86.948	43.058	43.89	Average
Vertical	2390	109.619	36.99	72.629	Peak
Vertical	2390	94.969	43.058	51.911	Average

Note:

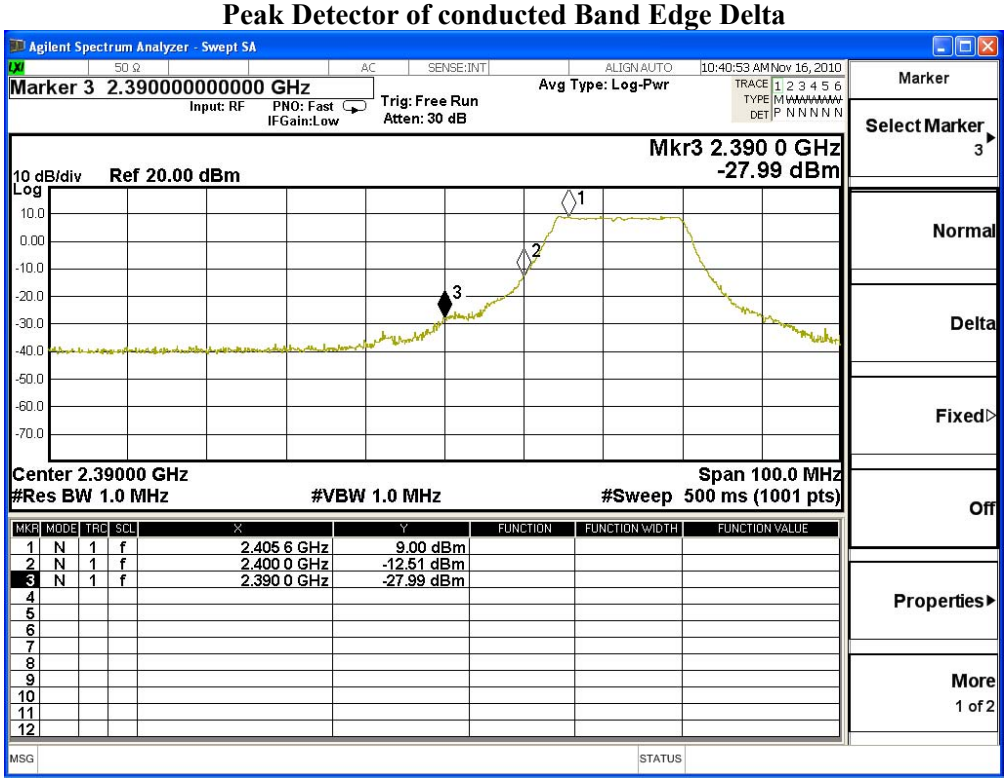
The Band Edge Field Strength was calculated using the Fundamental and Conducted Band Edge measurements per the Marker-Delta Method with the following formula:

Band Edge field Strength = F - Δ

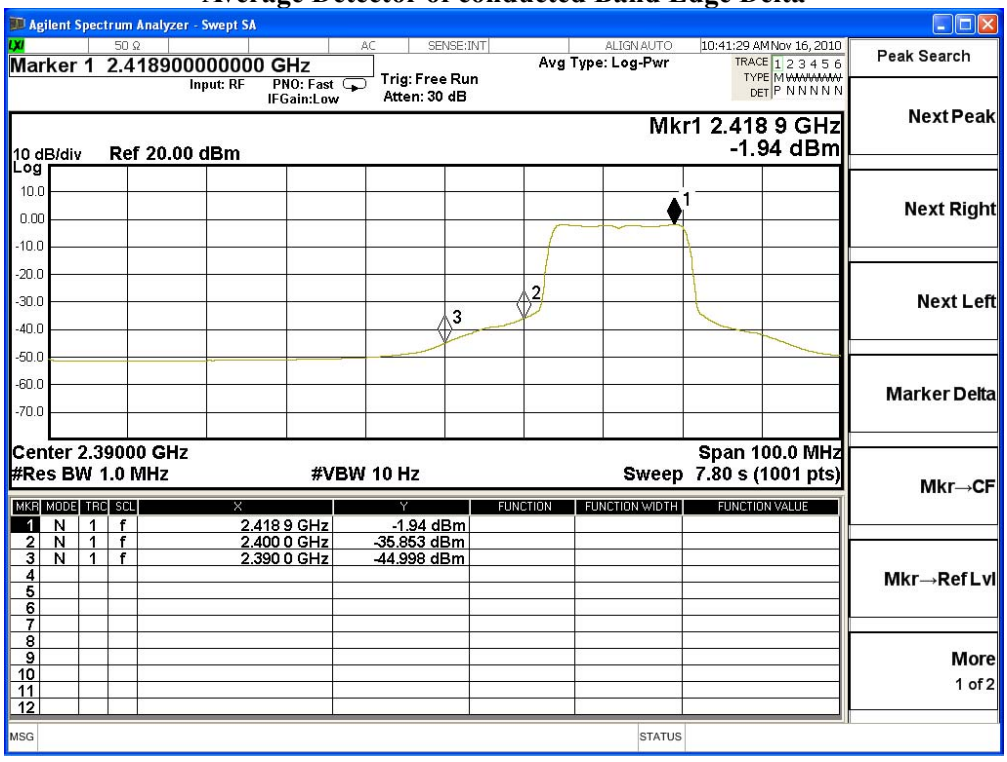
F = Fundamental field Strength (Peak or Average)

Δ = Conducted Band Edge Delta (Peak or Average)

Peak Detector of conducted Band Edge Delta



Average Detector of conducted Band Edge Delta



Product : 802.11n 1x1 MIMO Half Mini Card
Test Item : Band Edge Data
Test Site : No.3 OATS
Test Mode : Mode 3: Transmit (802.11n MCS0 7.2Mbps 20M-BW) (Dipole Antenna)

Fundamental Filed Strength

Antenna Pole	Frequency [MHz]	Correction Factor [dB/m]	Reading Level [dBuV]	Emission Level [dBuV/m]	Detector
Horizontal	2462	32.019	63.06	95.079	Peak
Horizontal	2462	32.019	52.25	84.269	Average
Vertical	2462	31.29	72.03	103.32	Peak
Vertical	2462	31.29	61.13	92.42	Average

Note: 1:Spectrum Analyzer setting:

Peak detector: RBW=1MHz, VBW=1MHz

Average detector: RBW=1MHz, VBW=10Hz

Band Edge Test Data

Antenna Pole	Test Frequency (MHz)	Fundamental (dBuV/m)	Δ (dB)	Band Edge Field Strength (dBuV/m)	Detector
Horizontal	2483.5	95.079	38.115	56.964	Peak
Horizontal	2500	84.269	41.2	43.069	Average
Vertical	2483.5	103.32	38.115	65.205	Peak
Vertical	2500	92.42	41.2	51.22	Average

Note:

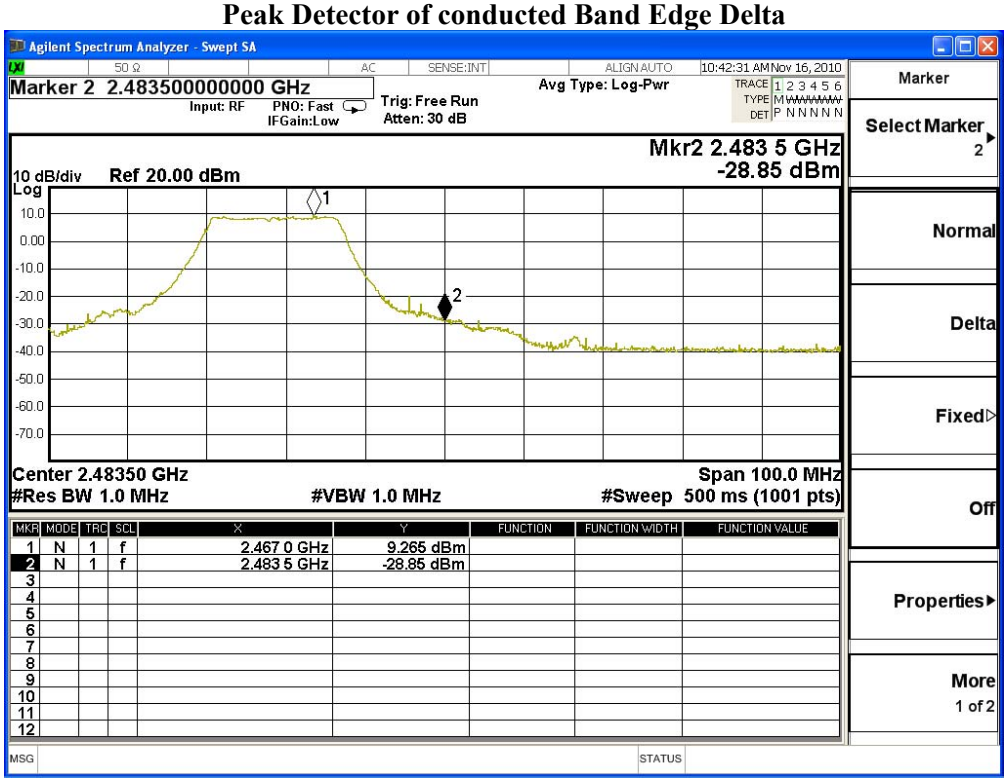
The Band Edge Field Strength was calculated using the Fundamental and Conducted Band Edge measurements per the Marker-Delta Method with the following formula:

Band Edge field Strength = F - Δ

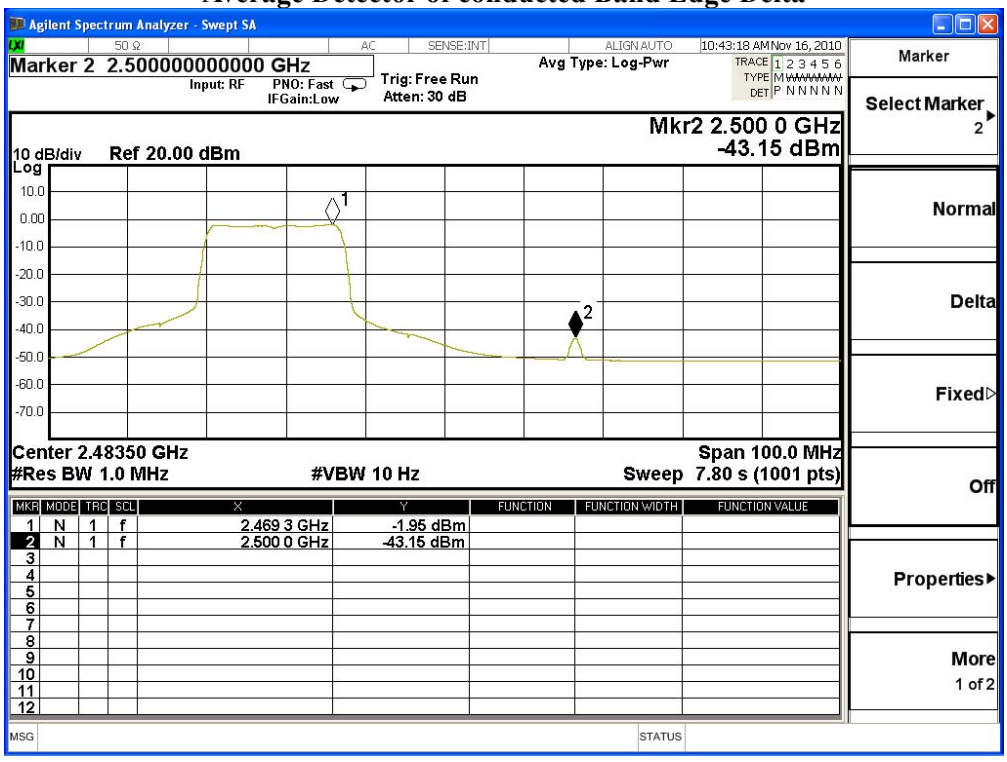
F = Fundamental field Strength (Peak or Average)

Δ = Conducted Band Edge Delta (Peak or Average)

Peak Detector of conducted Band Edge Delta



Average Detector of conducted Band Edge Delta



Product : 802.11n 1x1 MIMO Half Mini Card
Test Item : Band Edge Data
Test Site : No.3 OATS
Test Mode : Mode 1: Transmit (802.11b 1Mbps) (PIFA Antenna)

Fundamental Filed Strength

Antenna Pole	Frequency [MHz]	Correction Factor [dB/m]	Reading Level [dBuV]	Emission Level [dBuV/m]	Detector
Horizontal	2412	31.639	58.96	90.598	Peak
Horizontal	2412	31.639	55.79	87.428	Average
Vertical	2412	30.95	70.05	100.999	Peak
Vertical	2412	30.95	66.82	97.769	Average

Note: 1:Spectrum Analyzer setting:

Peak detector: RBW=1MHz, VBW=1MHz

Average detector: RBW=1MHz, VBW=10Hz

Band Edge Test Data

Antenna Pole	Test Frequency (MHz)	Fundamental (dBuV/m)	Δ (dB)	Band Edge Field Strength (dBuV/m)	Detector
Horizontal	2390	90.598	48.754	41.844	Peak
Horizontal	2390	87.428	57.84	29.588	Average
Vertical	2390	100.999	48.754	52.245	Peak
Vertical	2390	97.769	57.84	39.929	Average

Note:

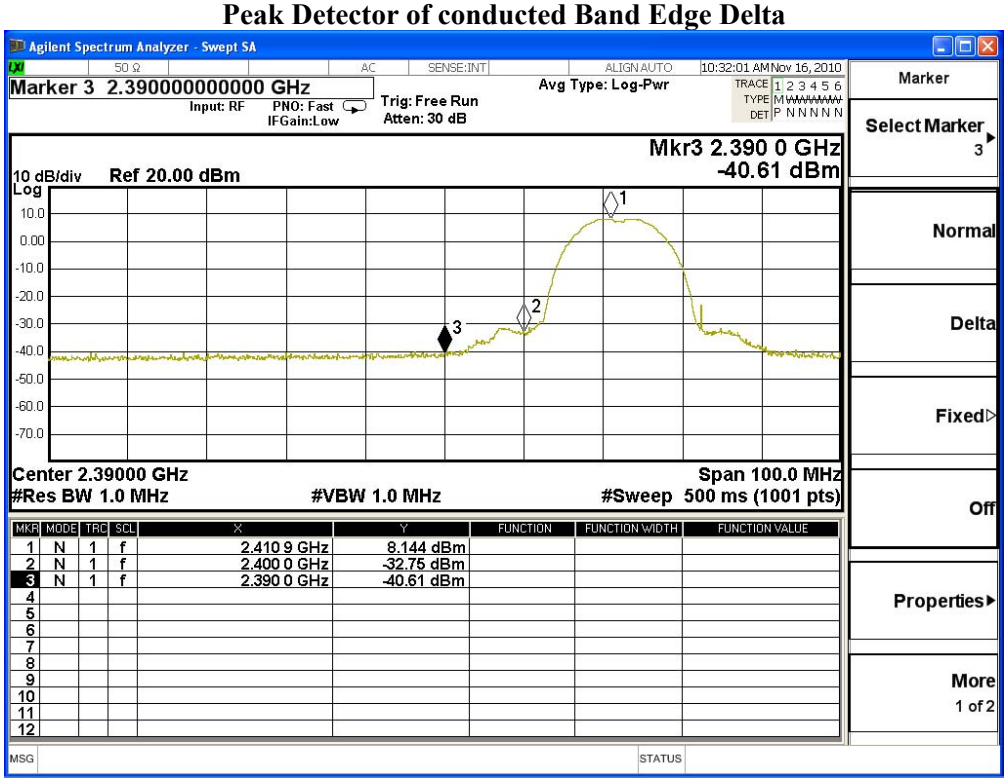
The Band Edge Field Strength was calculated using the Fundamental and Conducted Band Edge measurements per the Marker-Delta Method with the following formula:

Band Edge field Strength = F - Δ

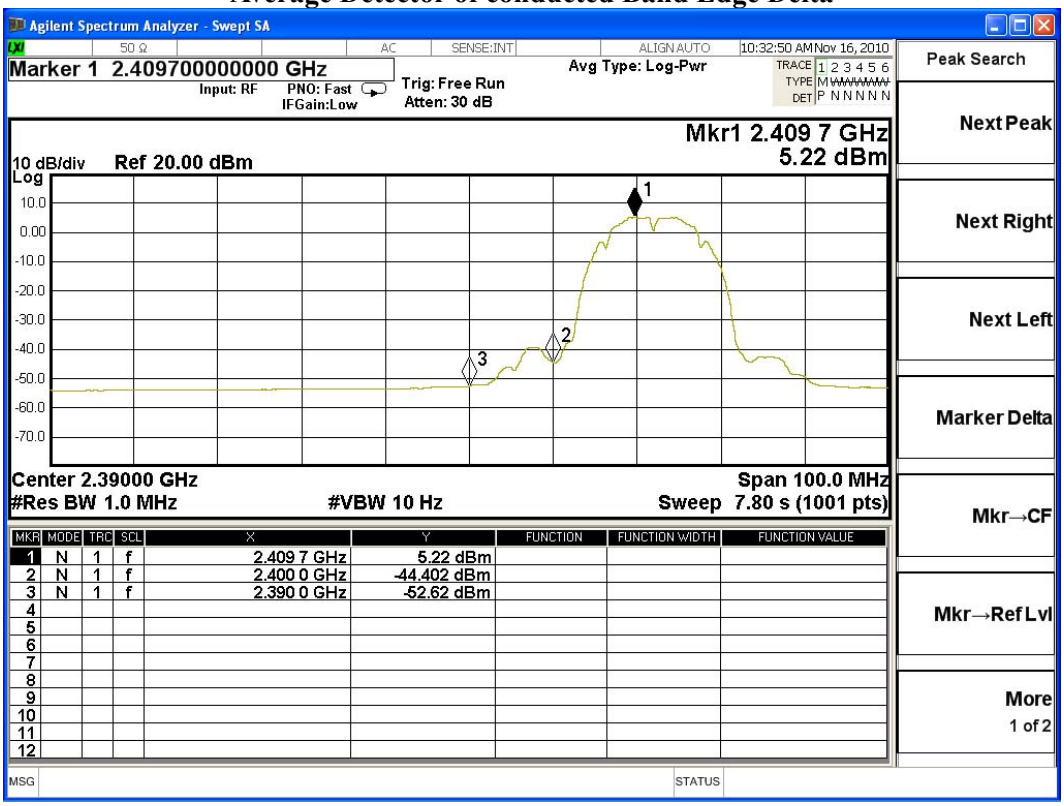
F = Fundamental field Strength (Peak or Average)

Δ = Conducted Band Edge Delta (Peak or Average)

Peak Detector of conducted Band Edge Delta



Average Detector of conducted Band Edge Delta



Product : 802.11n 1x1 MIMO Half Mini Card
Test Item : Band Edge Data
Test Site : No.3 OATS
Test Mode : Mode 1: Transmit (802.11b 1Mbps) (PIFA Antenna)

Fundamental Filed Strength

Antenna Pole	Frequency [MHz]	Correction Factor [dB/m]	Reading Level [dBuV]	Emission Level [dBuV/m]	Detector
Horizontal	2462	32.019	62.56	94.579	Peak
Horizontal	2462	32.019	59.64	91.659	Average
Vertical	2462	31.29	71.77	103.06	Peak
Vertical	2462	31.29	67.9	99.19	Average

Note: 1:Spectrum Analyzer setting:

Peak detector: RBW=1MHz, VBW=1MHz

Average detector: RBW=1MHz, VBW=10Hz

Band Edge Test Data

Antenna Pole	Test Frequency (MHz)	Fundamental (dBuV/m)	Δ (dB)	Band Edge Field Strength (dBuV/m)	Detector
Horizontal	2499.8	94.579	45.24	49.339	Peak
Horizontal	2500.0	91.659	49.17	42.489	Average
Vertical	2499.8	103.06	45.24	57.82	Peak
Vertical	2500.0	99.19	49.17	50.02	Average

Note:

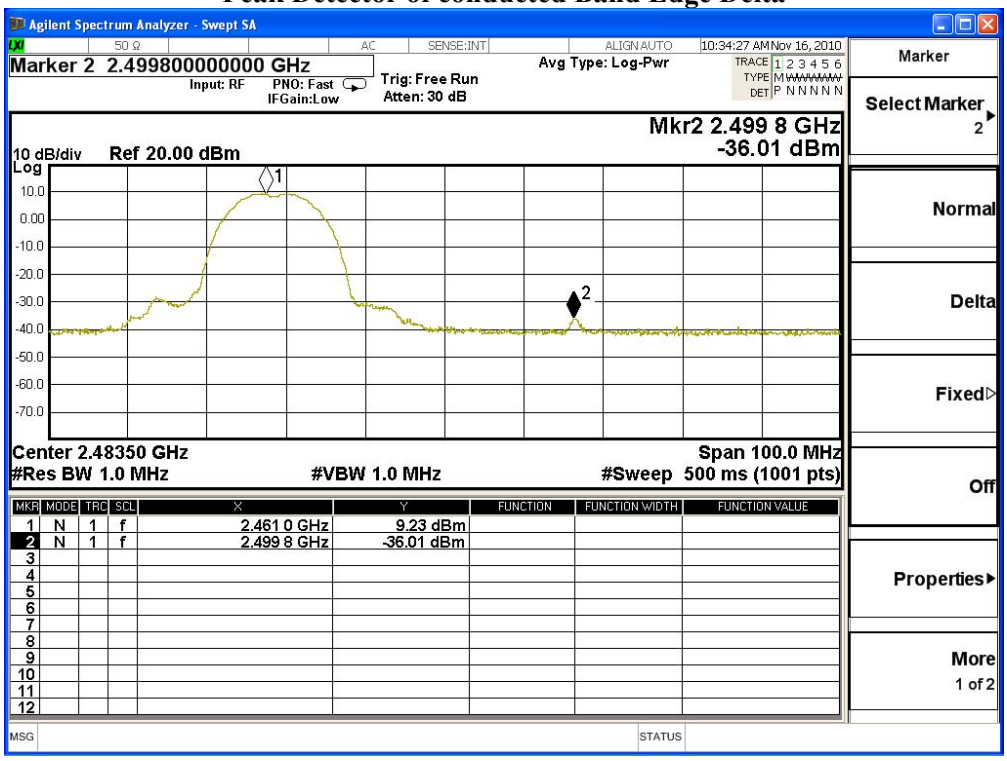
The Band Edge Field Strength was calculated using the Fundamental and Conducted Band Edge measurements per the Marker-Delta Method with the following formula:

Band Edge field Strength = F - Δ

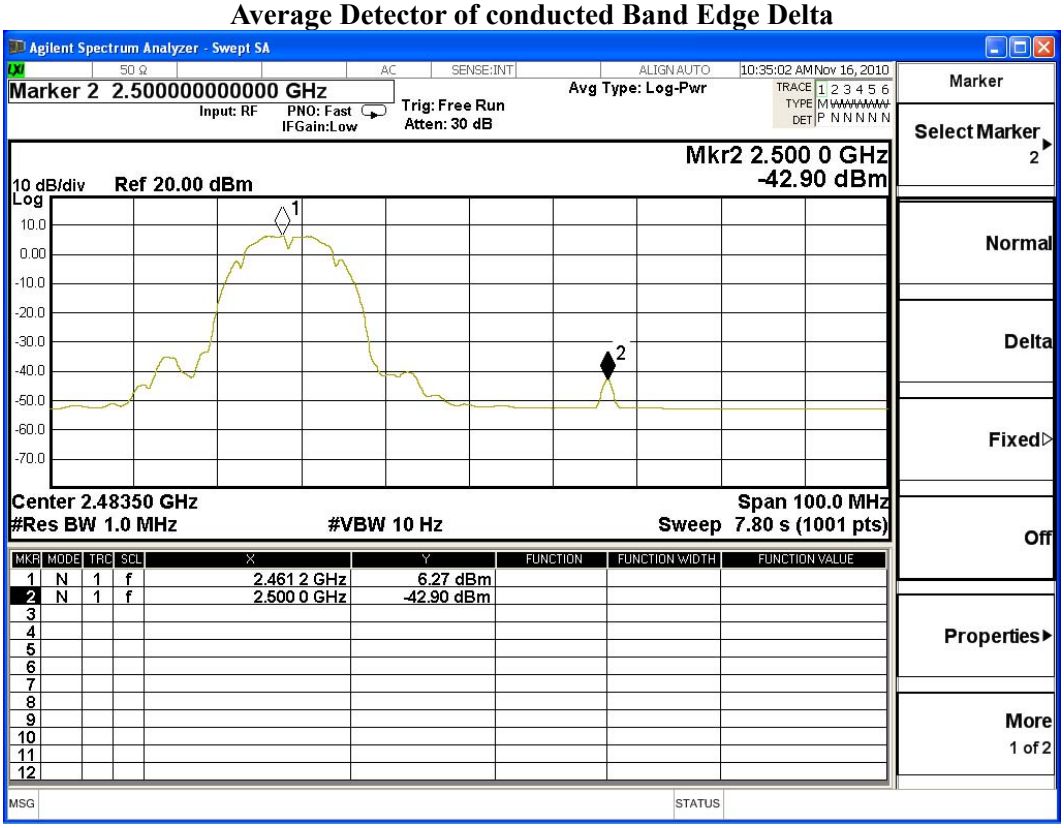
F = Fundamental field Strength (Peak or Average)

Δ = Conducted Band Edge Delta (Peak or Average)

Peak Detector of conducted Band Edge Delta



Average Detector of conducted Band Edge Delta



Product : 802.11n 1x1 MIMO Half Mini Card
Test Item : Band Edge Data
Test Site : No.3 OATS
Test Mode : Mode 2: Transmit (802.11g 6Mbps) (PIFA Antenna)

Fundamental Filed Strength

Antenna Pole	Frequency [MHz]	Correction Factor [dB/m]	Reading Level [dBuV]	Emission Level [dBuV/m]	Detector
Horizontal	2412	31.639	68.82	100.458	Peak
Horizontal	2412	31.639	57.4	89.038	Average
Vertical	2412	30.95	73.67	104.619	Peak
Vertical	2412	30.95	61.92	92.869	Average

Note: 1:Spectrum Analyzer setting:

Peak detector: RBW=1MHz, VBW=1MHz

Average detector: RBW=1MHz, VBW=10Hz

Band Edge Test Data

Antenna Pole	Test Frequency (MHz)	Fundamental (dBuV/m)	Δ (dB)	Band Edge Field Strength (dBuV/m)	Detector
Horizontal	2389.9	100.458	37.25	63.208	Peak
Horizontal	2389.9	89.038	43.135	45.903	Average
Vertical	2389.9	104.619	37.25	67.369	Peak
Vertical	2389.9	92.869	43.135	49.734	Average

Note:

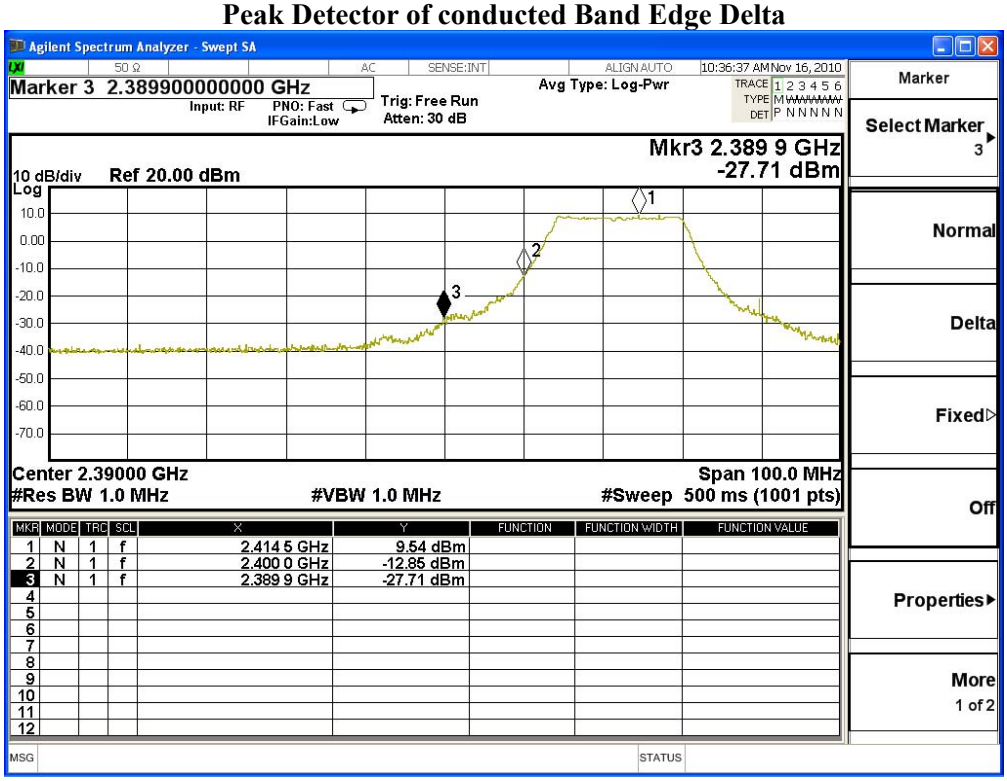
The Band Edge Field Strength was calculated using the Fundamental and Conducted Band Edge measurements per the Marker-Delta Method with the following formula:

Band Edge field Strength = F - Δ

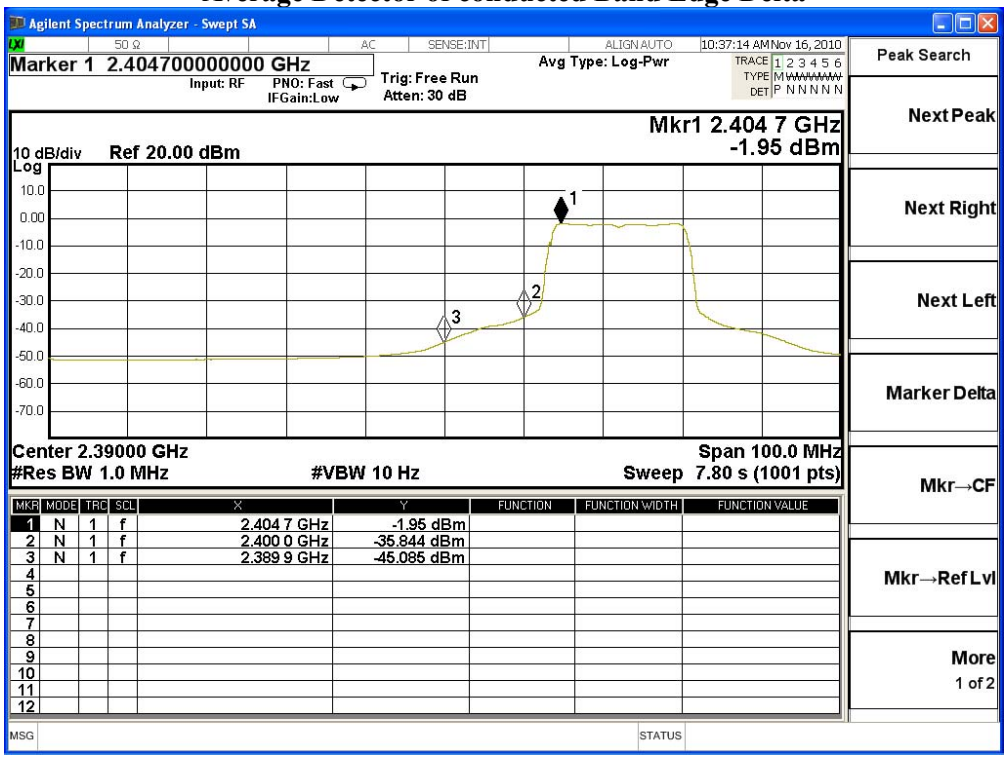
F = Fundamental field Strength (Peak or Average)

Δ = Conducted Band Edge Delta (Peak or Average)

Peak Detector of conducted Band Edge Delta



Average Detector of conducted Band Edge Delta



Product : 802.11n 1x1 MIMO Half Mini Card
Test Item : Band Edge Data
Test Site : No.3 OATS
Test Mode : Mode 2: Transmit (802.11g 6Mbps) (PIFA Antenna)

Fundamental Filed Strength

Antenna Pole	Frequency [MHz]	Correction Factor [dB/m]	Reading Level [dBuV]	Emission Level [dBuV/m]	Detector
Horizontal	2462	32.019	71.05	103.069	Peak
Horizontal	2462	32.019	59.53	91.549	Average
Vertical	2462	31.29	74.96	106.25	Peak
Vertical	2462	31.29	62.88	93.17	Average

Note: 1:Spectrum Analyzer setting:

Peak detector: RBW=1MHz, VBW=1MHz

Average detector: RBW=1MHz, VBW=10Hz

Band Edge Test Data

Antenna Pole	Test Frequency (MHz)	Fundamental (dBuV/m)	Δ (dB)	Band Edge Field Strength (dBuV/m)	Detector
Horizontal	2483.5	103.069	38.27	64.799	Peak
Horizontal	2500	91.549	41.08	50.469	Average
Vertical	2485.2	106.25	38.27	67.98	Peak
Vertical	2500	93.17	41.08	52.09	Average

Note:

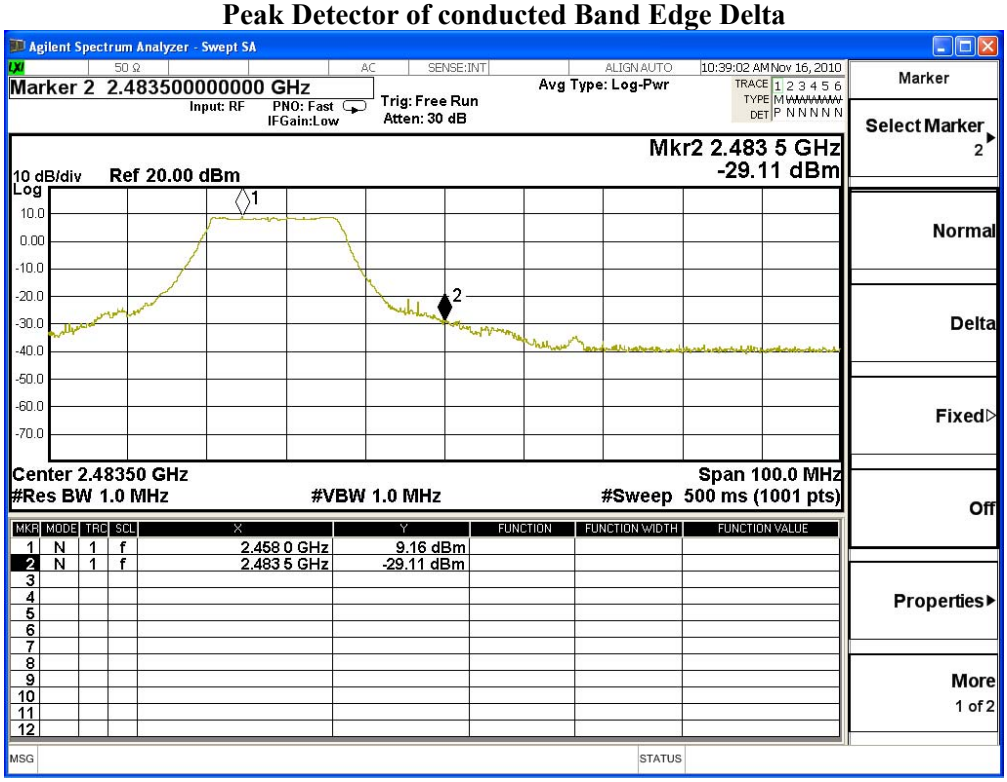
The Band Edge Field Strength was calculated using the Fundamental and Conducted Band Edge measurements per the Marker-Delta Method with the following formula:

Band Edge field Strength = F - Δ

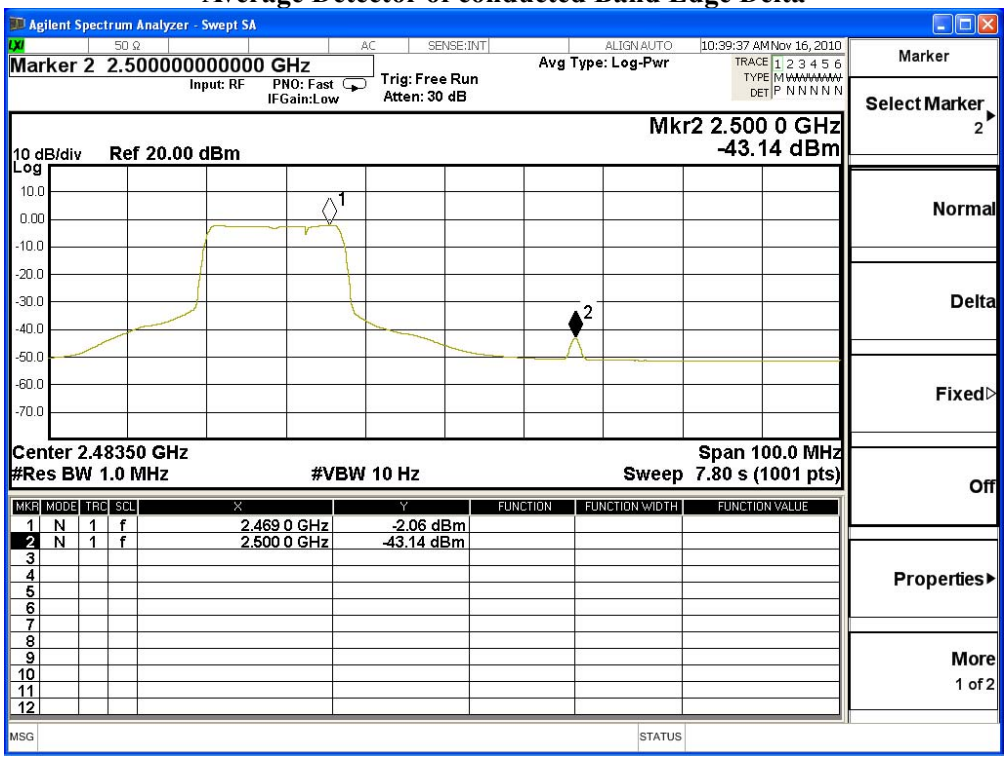
F = Fundamental field Strength (Peak or Average)

Δ = Conducted Band Edge Delta (Peak or Average)

Peak Detector of conducted Band Edge Delta



Average Detector of conducted Band Edge Delta



Product : 802.11n 1x1 MIMO Half Mini Card
Test Item : Band Edge Data
Test Site : No.3 OATS
Test Mode : Mode 3: Transmit (802.11n MCS0 7.2Mbps 20M-BW) (PIFA Antenna)

Fundamental Filed Strength

Antenna Pole	Frequency [MHz]	Correction Factor [dB/m]	Reading Level [dBuV]	Emission Level [dBuV/m]	Detector
Horizontal	2412	31.639	69.24	100.878	Peak
Horizontal	2412	31.639	57.94	89.578	Average
Vertical	2412	30.95	74.49	105.439	Peak
Vertical	2412	30.95	61.95	92.899	Average

Note: 1:Spectrum Analyzer setting:

Peak detector: RBW=1MHz, VBW=1MHz

Average detector: RBW=1MHz, VBW=10Hz

Band Edge Test Data

Antenna Pole	Test Frequency (MHz)	Fundamental (dBuV/m)	Δ (dB)	Band Edge Field Strength (dBuV/m)	Detector
Horizontal	2390	100.878	36.99	63.888	Peak
Horizontal	2390	89.578	43.058	46.52	Average
Vertical	2390	105.439	36.99	68.449	Peak
Vertical	2390	92.899	43.058	49.841	Average

Note:

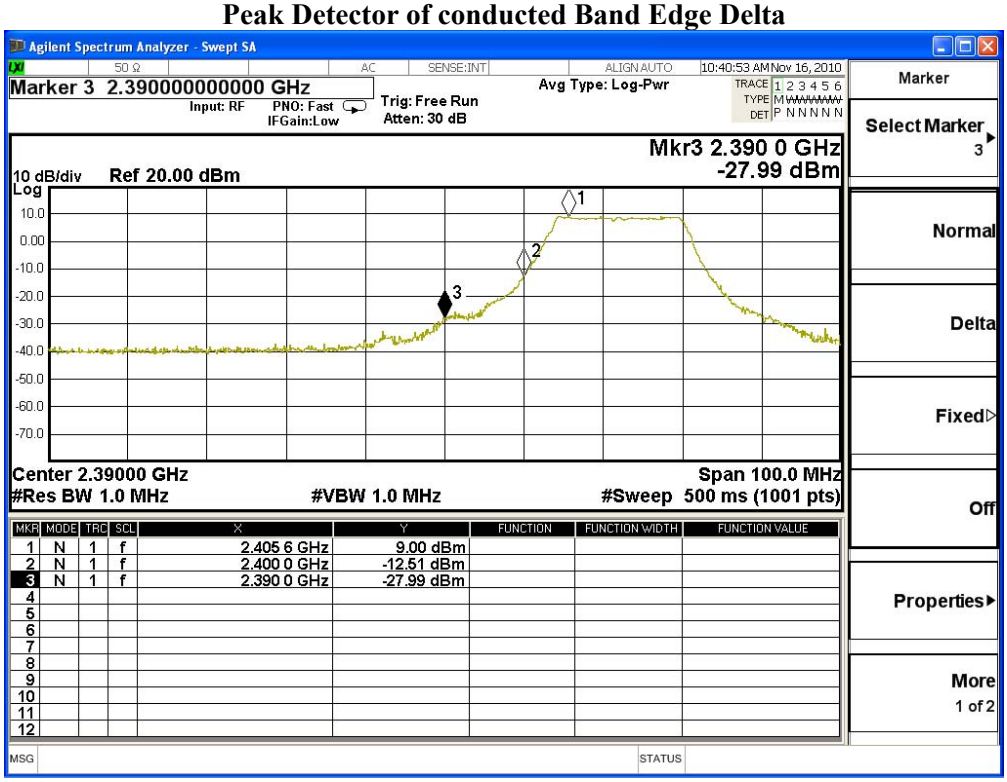
The Band Edge Field Strength was calculated using the Fundamental and Conducted Band Edge measurements per the Marker-Delta Method with the following formula:

Band Edge field Strength = F - Δ

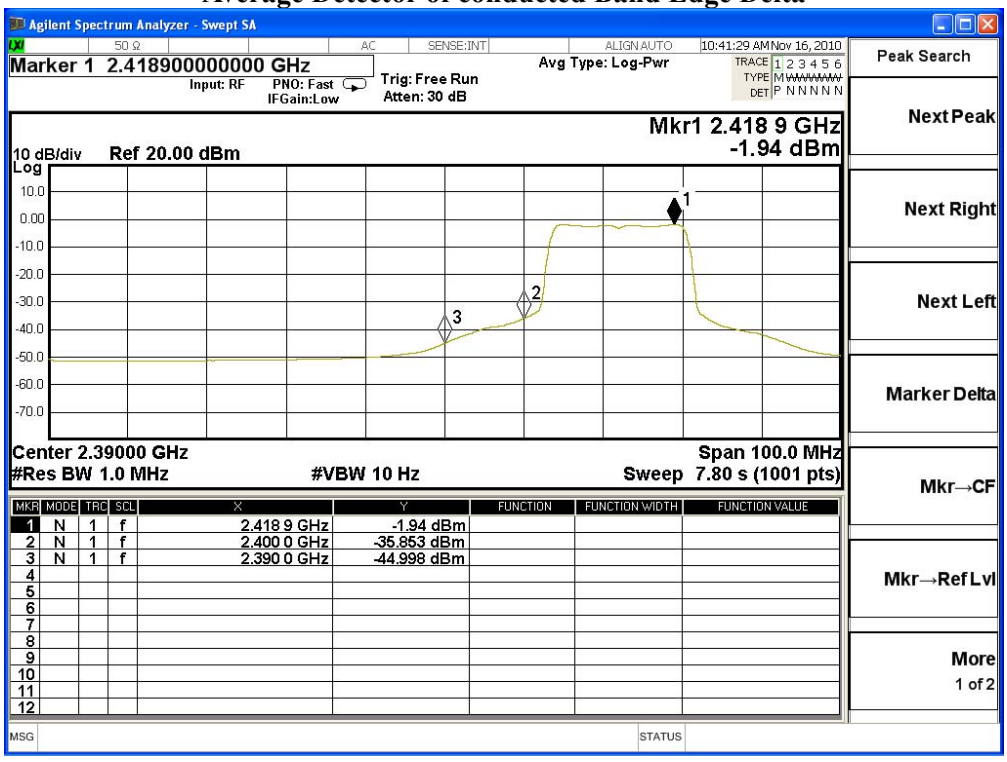
F = Fundamental field Strength (Peak or Average)

Δ = Conducted Band Edge Delta (Peak or Average)

Peak Detector of conducted Band Edge Delta



Average Detector of conducted Band Edge Delta



Product : 802.11n 1x1 MIMO Half Mini Card
Test Item : Band Edge Data
Test Site : No.3 OATS
Test Mode : Mode 3: Transmit (802.11n MCS0 7.2Mbps 20M-BW) (PIFA Antenna)

Fundamental Filed Strength

Antenna Pole	Frequency [MHz]	Correction Factor [dB/m]	Reading Level [dBuV]	Emission Level [dBuV/m]	Detector
Horizontal	2462	32.019	70.96	102.979	Peak
Horizontal	2462	32.019	59.46	91.479	Average
Vertical	2462	31.29	75.01	106.3	Peak
Vertical	2462	31.29	61.93	93.22	Average

Note: 1:Spectrum Analyzer setting:

Peak detector: RBW=1MHz, VBW=1MHz

Average detector: RBW=1MHz, VBW=10Hz

Band Edge Test Data

Antenna Pole	Test Frequency (MHz)	Fundamental (dBuV/m)	Δ (dB)	Band Edge Field Strength (dBuV/m)	Detector
Horizontal	2483.5	102.979	38.115	64.864	Peak
Horizontal	2500	91.479	41.2	50.279	Average
Vertical	2483.5	106.3	38.115	68.185	Peak
Vertical	2500	93.22	41.2	52.02	Average

Note:

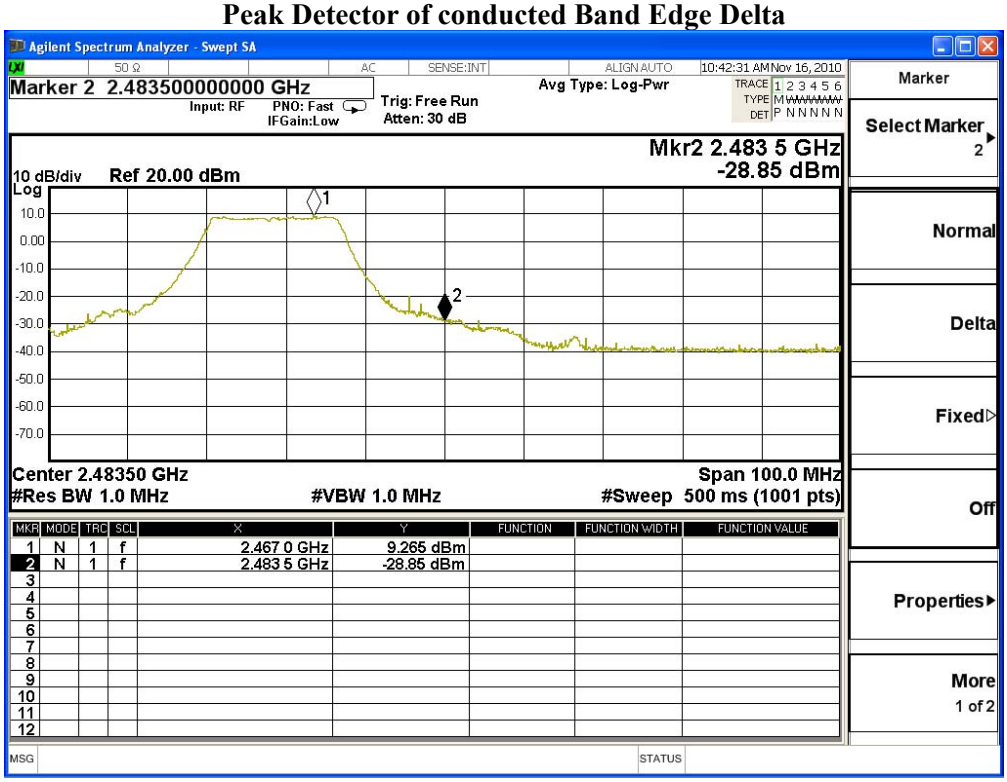
The Band Edge Field Strength was calculated using the Fundamental and Conducted Band Edge measurements per the Marker-Delta Method with the following formula:

Band Edge field Strength = F - Δ

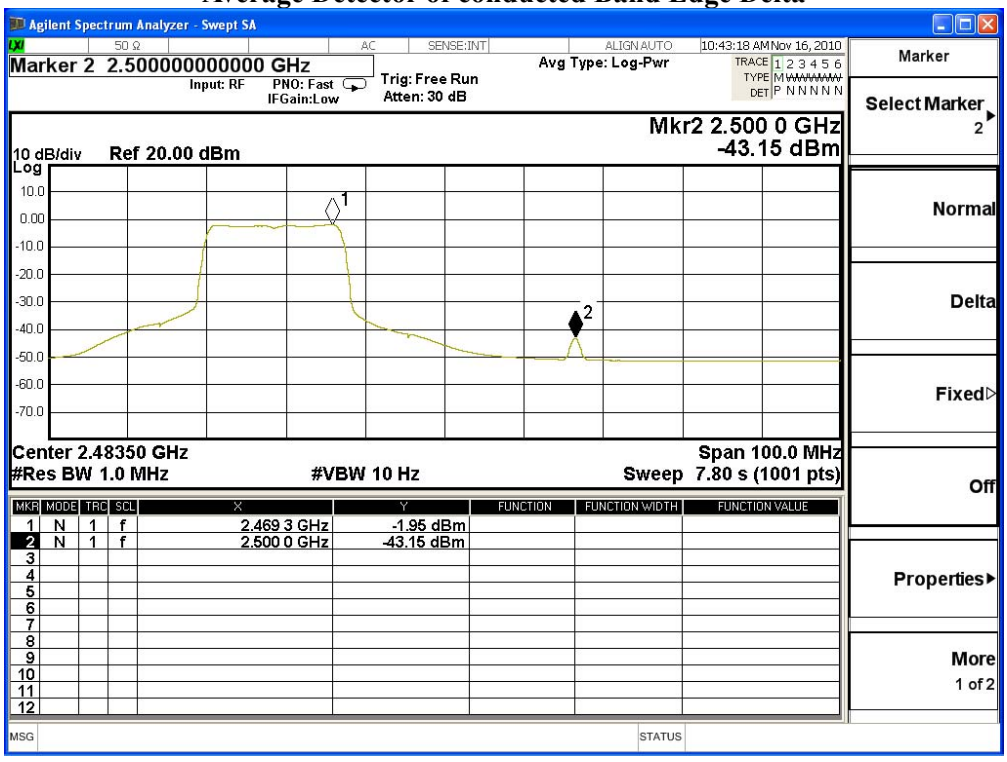
F = Fundamental field Strength (Peak or Average)

Δ = Conducted Band Edge Delta (Peak or Average)

Peak Detector of conducted Band Edge Delta



Average Detector of conducted Band Edge Delta



7. Occupied Bandwidth

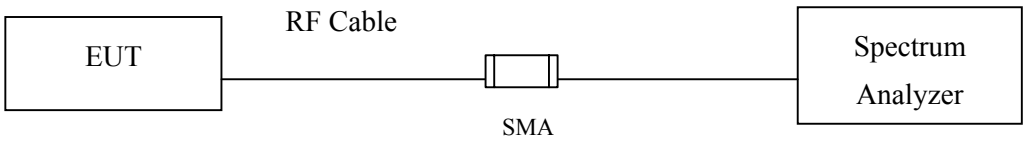
7.1. Test Equipment

	Equipment	Manufacturer	Model No./Serial No.	Last Cal.
	Spectrum Analyzer	R&S	FSP40 / 100170	Jun, 2010
	Spectrum Analyzer	Agilent	E4407B / US39440758	Jun, 2010
X	Spectrum Analyzer	Agilent	N9010A / MY48030495	Apr., 2010
	8-WAY Power Divider	JFW	50PD-647 / 526770 0916	Apr., 2010

Note:

1. All equipments are calibrated with traceable calibrations. Each calibration is traceable to the national or international standards.
2. The test instruments marked with "X" are used to measure the final test results.
3. The power combiner is used for measure 11n mode.

7.2. Test Setup



7.3. Limits

The minimum bandwidth shall be at least 500 kHz.

7.4. Test Procedure

The EUT was setup according to ANSI C63.4, 2003; tested according to DTS test procedure of Mar. 2005 KDB558074 for compliance to FCC 47CFR 15.247 requirements.

Set RBW = 100 kHz, Span greater than RBW.

7.5. Uncertainty

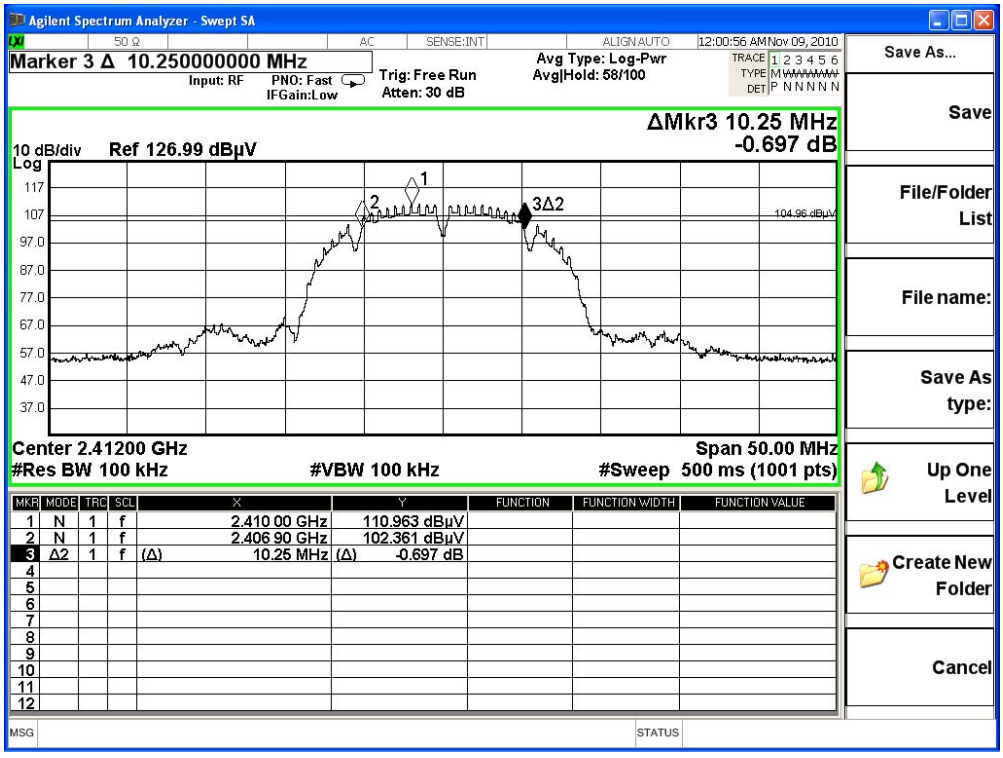
± 150Hz

7.6. Test Result of Occupied Bandwidth

Product : 802.11n 1x1 MIMO Half Mini Card
Test Item : Occupied Bandwidth Data
Test Site : No.3 OATS
Test Mode : Mode 1: Transmit (802.11b 1Mbps) (2412MHz)

Channel No.	Frequency (MHz)	Measurement Level (kHz)	Required Limit (kHz)	Result
1	2412.00	10250	>500	Pass

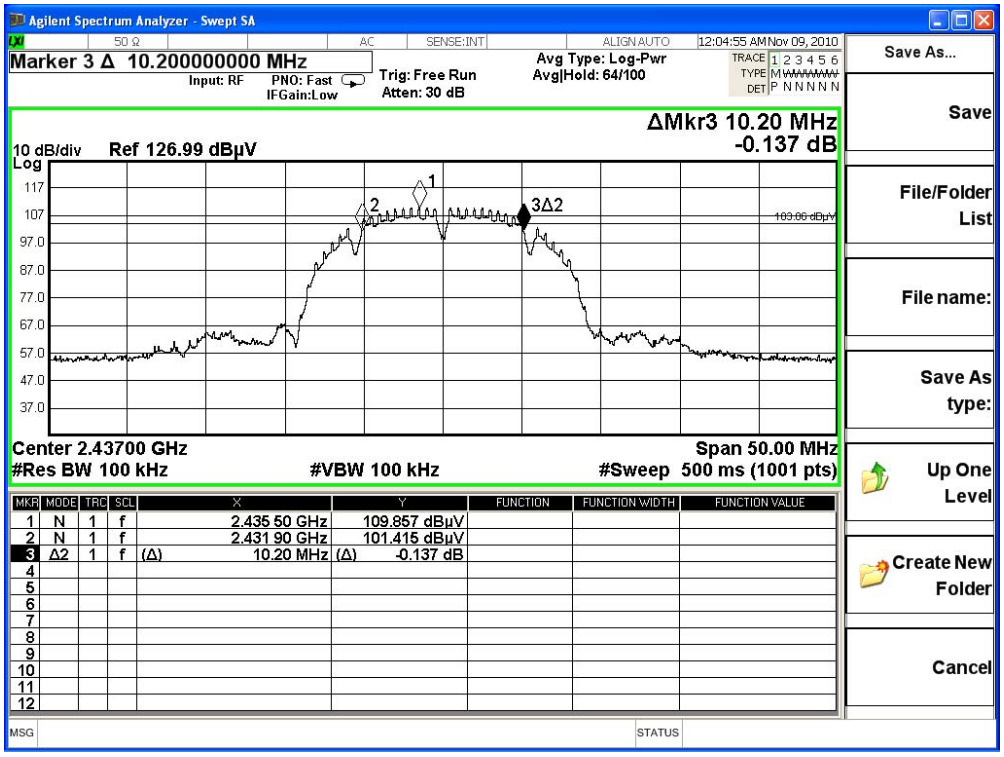
Figure Channel 1:



Product : 802.11n 1x1 MIMO Half Mini Card
Test Item : Occupied Bandwidth Data
Test Site : No.3 OATS
Test Mode : Mode 1: Transmit (802.11b 1Mbps) (2437MHz)

Channel No.	Frequency (MHz)	Measurement Level (kHz)	Required Limit (kHz)	Result
6	2437.00	10200	>500	Pass

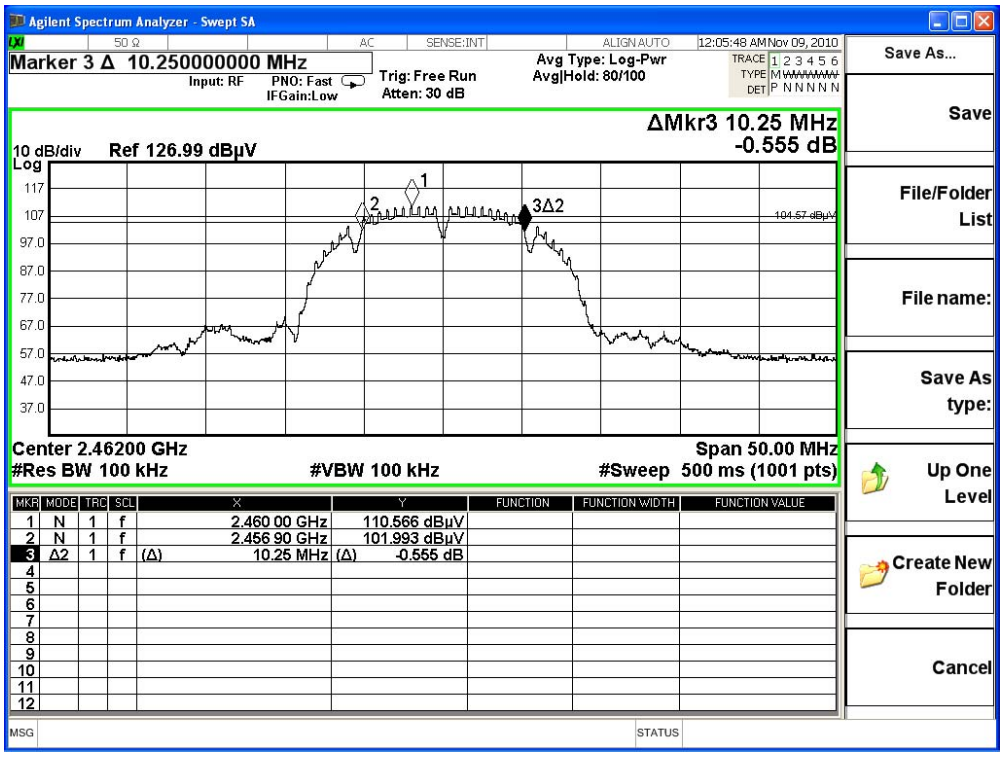
Figure Channel 6:



Product : 802.11n 1x1 MIMO Half Mini Card
Test Item : Occupied Bandwidth Data
Test Site : No.3 OATS
Test Mode : Mode 1: Transmit (802.11b 1Mbps) (2462MHz)

Channel No.	Frequency (MHz)	Measurement Level (kHz)	Required Limit (kHz)	Result
11	2462.00	10250	>500	Pass

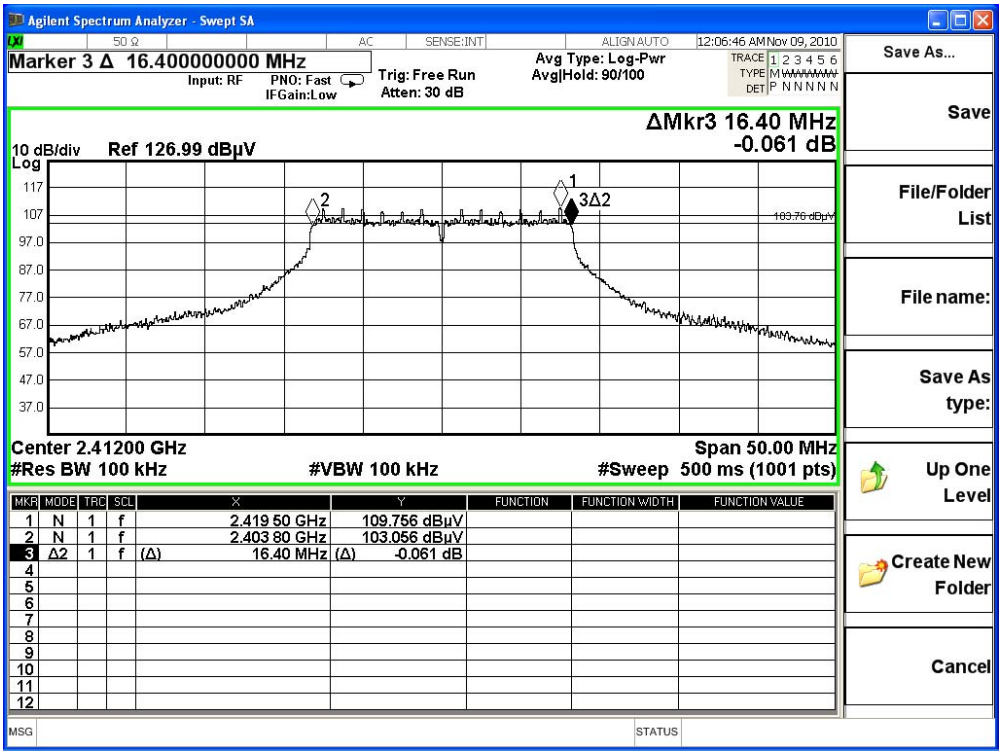
Figure Channel 11:



Product : 802.11n 1x1 MIMO Half Mini Card
Test Item : Occupied Bandwidth Data
Test Site : No.3 OATS
Test Mode : Mode 2: Transmit (802.11g 6Mbps) (2412MHz)

Channel No.	Frequency (MHz)	Measurement Level (kHz)	Required Limit (kHz)	Result
1	2412.00	16400	>500	Pass

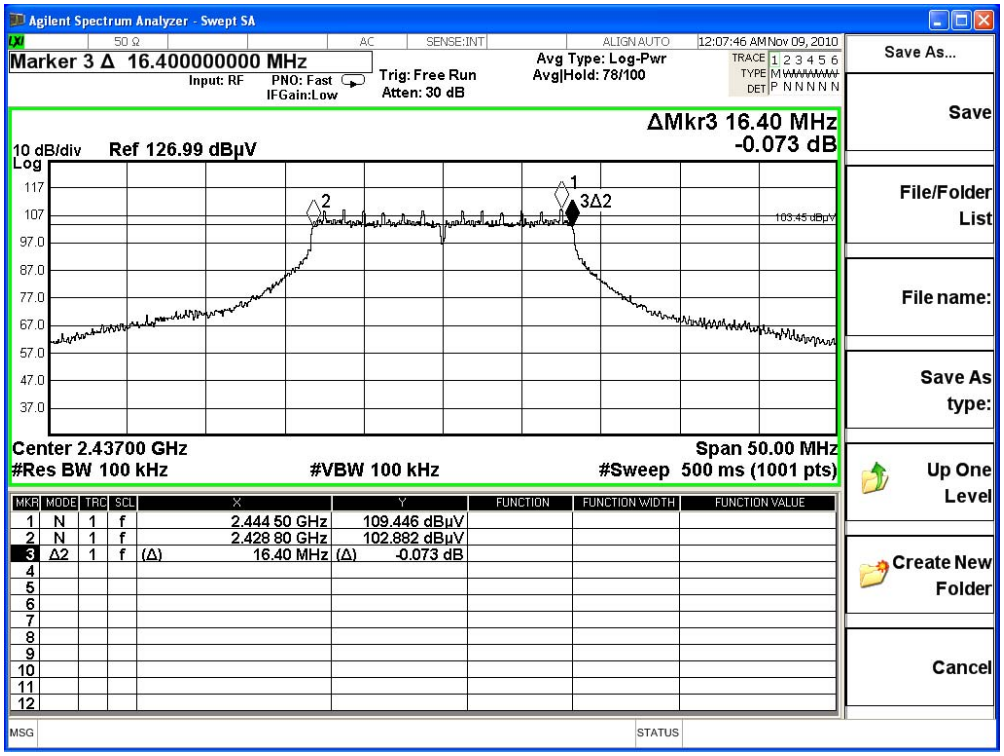
Figure Channel 1:



Product : 802.11n 1x1 MIMO Half Mini Card
Test Item : Occupied Bandwidth Data
Test Site : No.3 OATS
Test Mode : Mode 2: Transmit (802.11g 6Mbps) (2437MHz)

Channel No.	Frequency (MHz)	Measurement Level (kHz)	Required Limit (kHz)	Result
6	2437.00	16400	>500	Pass

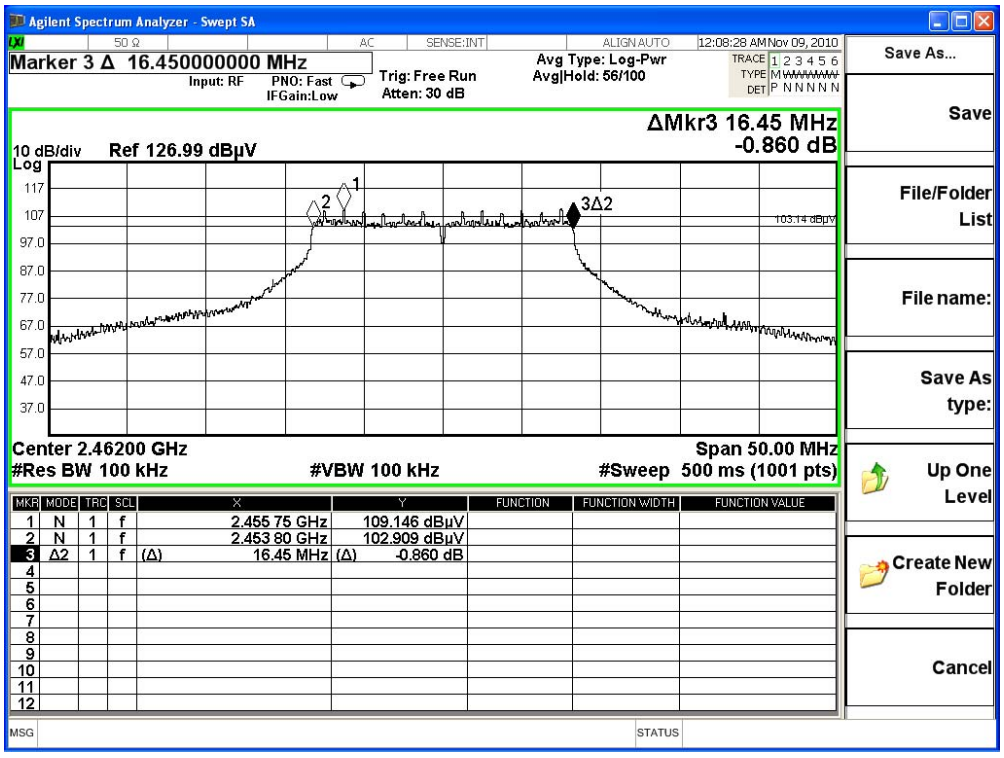
Figure Channel 6:



Product : 802.11n 1x1 MIMO Half Mini Card
Test Item : Occupied Bandwidth Data
Test Site : No.3 OATS
Test Mode : Mode 2: Transmit (802.11g 6Mbps) (2462MHz)

Channel No.	Frequency (MHz)	Measurement Level (kHz)	Required Limit (kHz)	Result
11	2462.00	16450	>500	Pass

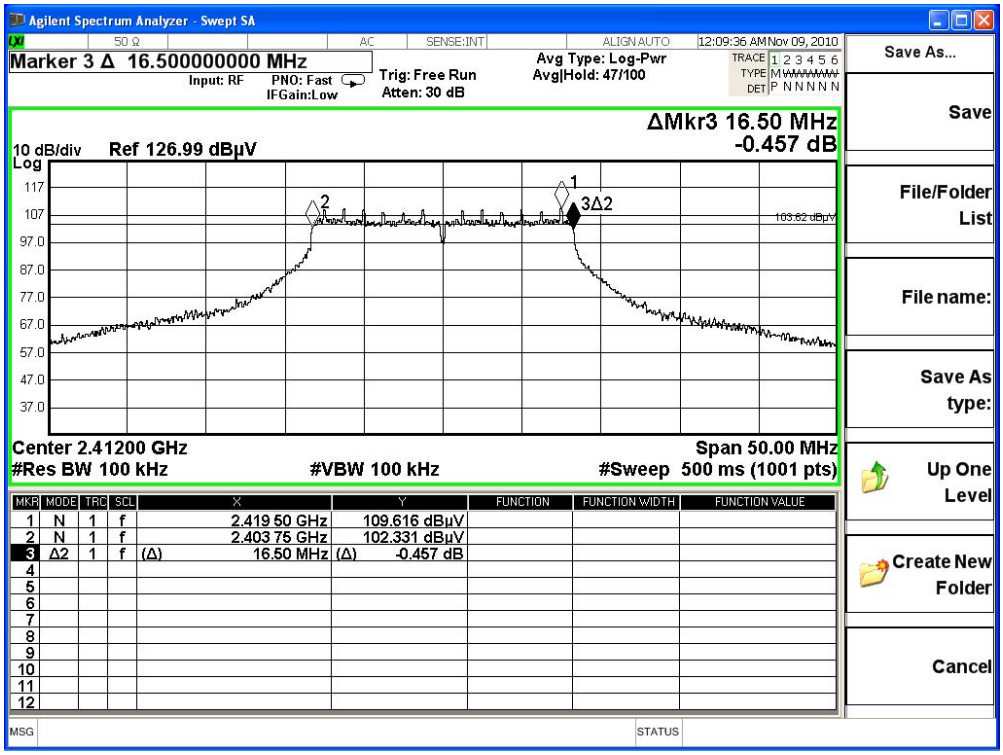
Figure Channel 11:



Product : 802.11n 1x1 MIMO Half Mini Card
Test Item : Occupied Bandwidth Data
Test Site : No.3 OATS
Test Mode : Mode 3: Transmit (802.11n MCS0 7.2Mbps 20M-BW) (2412MHz)

Channel No.	Frequency (MHz)	Measurement Level (kHz)	Required Limit (kHz)	Result
1	2412.00	16500	>500	Pass

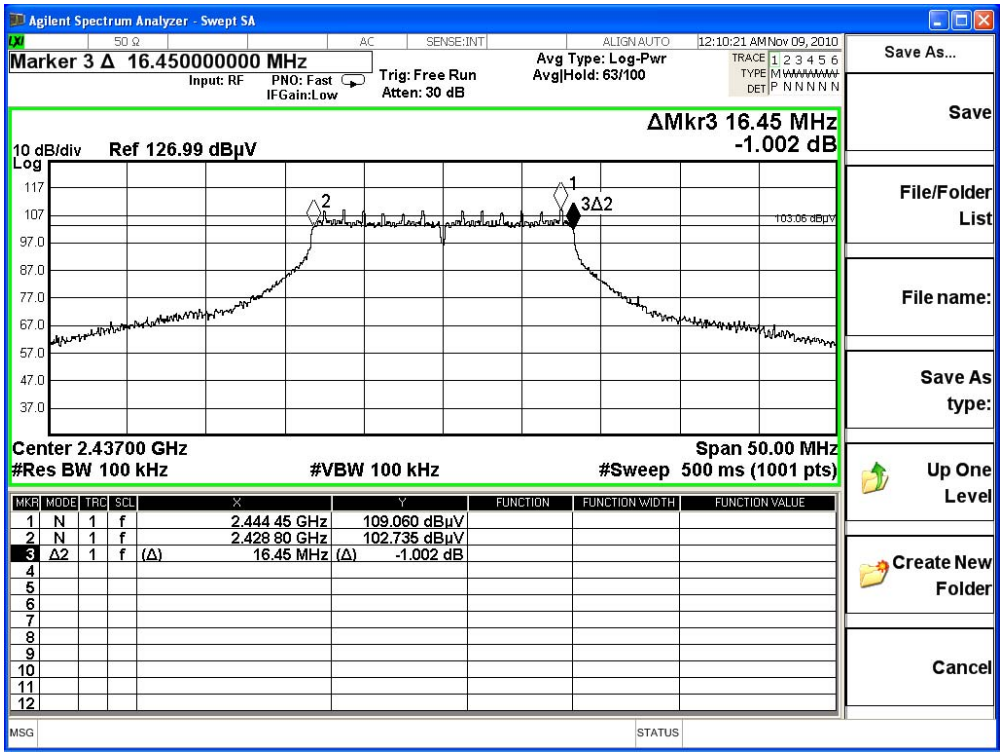
Figure Channel 1:



Product : 802.11n 1x1 MIMO Half Mini Card
Test Item : Occupied Bandwidth Data
Test Site : No.3 OATS
Test Mode : Mode 3: Transmit (802.11n MCS0 7.2Mbps 20M-BW) (2437MHz)

Channel No.	Frequency (MHz)	Measurement Level (kHz)	Required Limit (kHz)	Result
6	2437.00	16450	>500	Pass

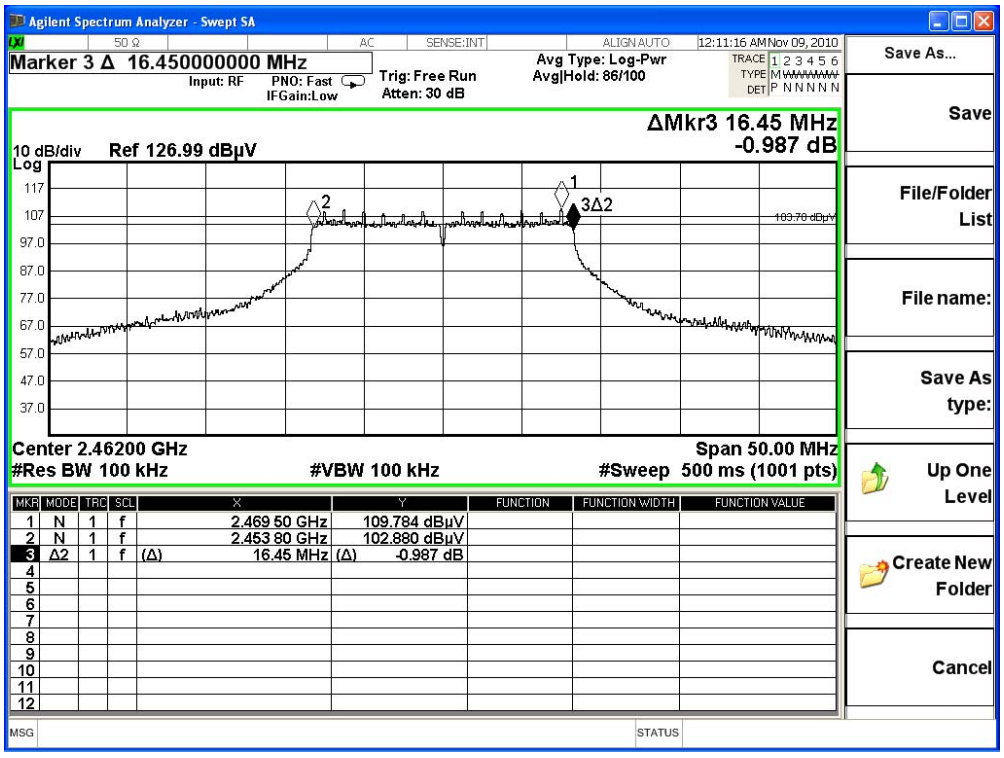
Figure Channel 6:



Product : 802.11n 1x1 MIMO Half Mini Card
Test Item : Occupied Bandwidth Data
Test Site : No.3 OATS
Test Mode : Mode 3: Transmit (802.11n MCS0 7.2Mbps 20M-BW) (2462MHz)

Channel No.	Frequency (MHz)	Measurement Level (kHz)	Required Limit (kHz)	Result
11	2462.00	16450	>500	Pass

Figure Channel 11:



8. Power Density

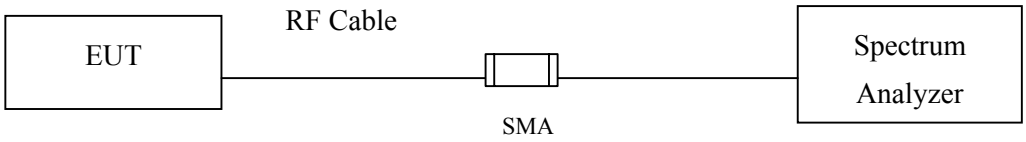
8.1. Test Equipment

	Equipment	Manufacturer	Model No./Serial No.	Last Cal.
	Spectrum Analyzer	R&S	FSP40 / 100170	Jun, 2010
	Spectrum Analyzer	Agilent	E4407B / US39440758	Jun, 2010
X	Spectrum Analyzer	Agilent	N9010A / MY48030495	Apr., 2010
	8-WAY Power Divider	JFW	50PD-647 / 526770 0916	Apr., 2010

Note:

1. All equipments are calibrated with traceable calibrations. Each calibration is traceable to the national or international standards.
2. The test instruments marked with "X" are used to measure the final test results.
3. The power combiner is used for measure 11n mode.

8.2. Test Setup



8.3. Limits

The transmitted power density averaged over any 1 second interval shall not be greater +8dBm in any 3kHz bandwidth.

8.4. Test Procedure

The EUT was setup according to ANSI C63.4, 2003; tested according to DTS test procedure of Mar. 2005 KDB558074 for compliance to FCC 47CFR 15.247 requirements.
Set RBW= 3 kHz, VBW=10KHz, Sweep time=(SPAN/3KHz), detector=Peak detector

8.5. Uncertainty

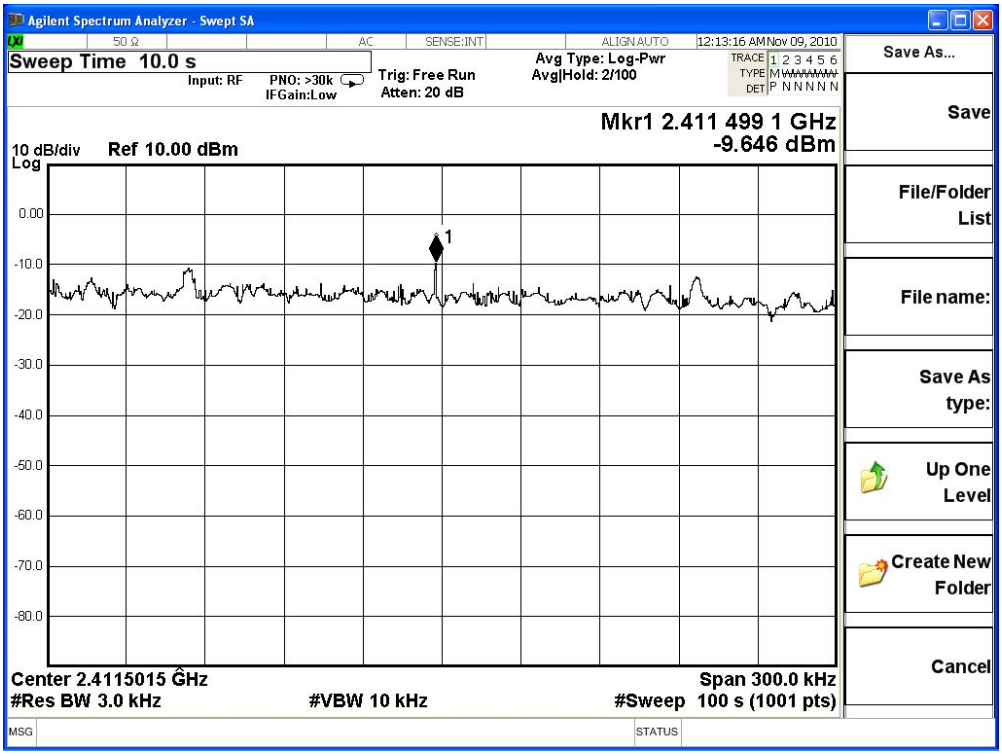
± 1.27 dB

8.6. Test Result of Power Density

Product : 802.11n 1x1 MIMO Half Mini Card
Test Item : Power Density Data
Test Site : No.3 OATS
Test Mode : Mode 1: Transmit (802.11b 1Mbps) (2412MHz)

Channel No.	Frequency (MHz)	Measure Level (dBm)	Limit (dBm)	Result
1	2412.00	-9.646	< 8dBm	Pass

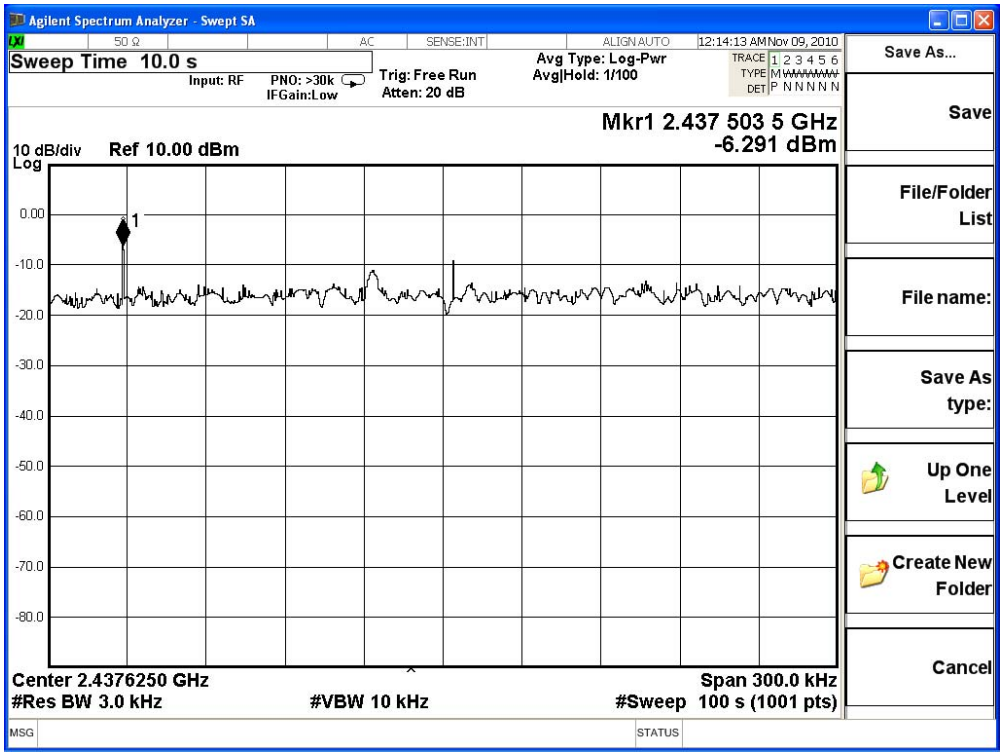
Figure Channel 1:



Product : 802.11n 1x1 MIMO Half Mini Card
Test Item : Power Density Data
Test Site : No.3OATS
Test Mode : Mode 1: Transmit (802.11b 1Mbps) (2437MHz)

Channel No.	Frequency (MHz)	Measurement Level (dBm)	Required Limit (dBm)	Result
6	2437.000	-6.291	< 8dBm	Pass

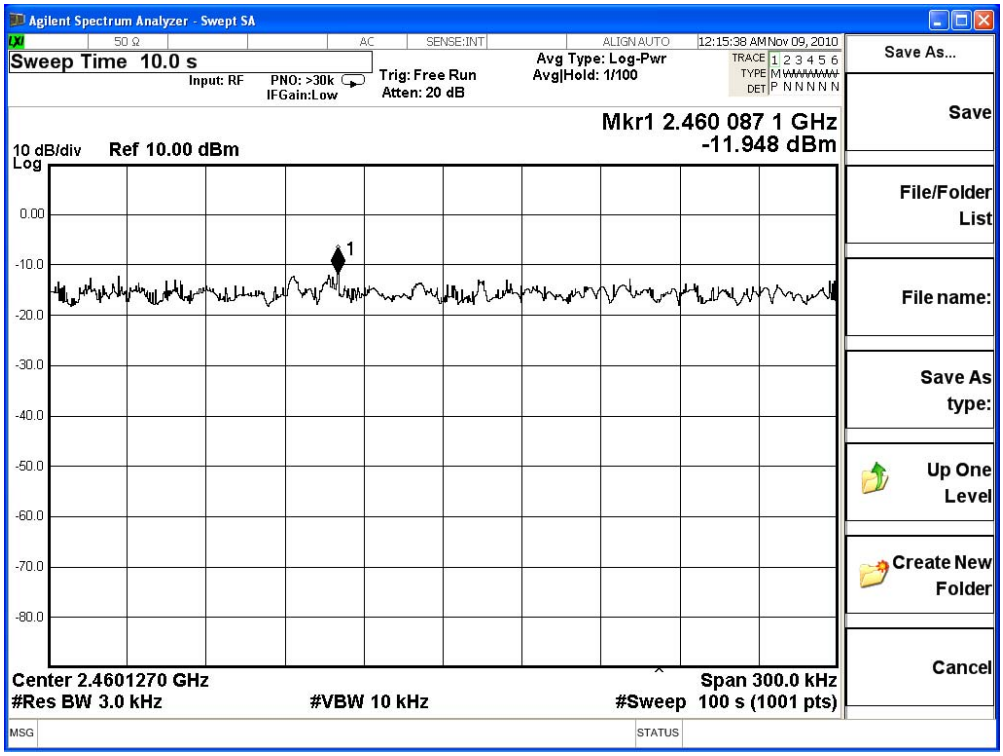
Figure Channel 6:



Product : 802.11n 1x1 MIMO Half Mini Card
Test Item : Power Density Data
Test Site : No.3 OATS
Test Mode : Mode 1: Transmit (802.11b 1Mbps) (2462MHz)

Channel No.	Frequency (MHz)	Measurement Level (dBm)	Required Limit (dBm)	Result
11	2462.00	-11.948	< 8dBm	Pass

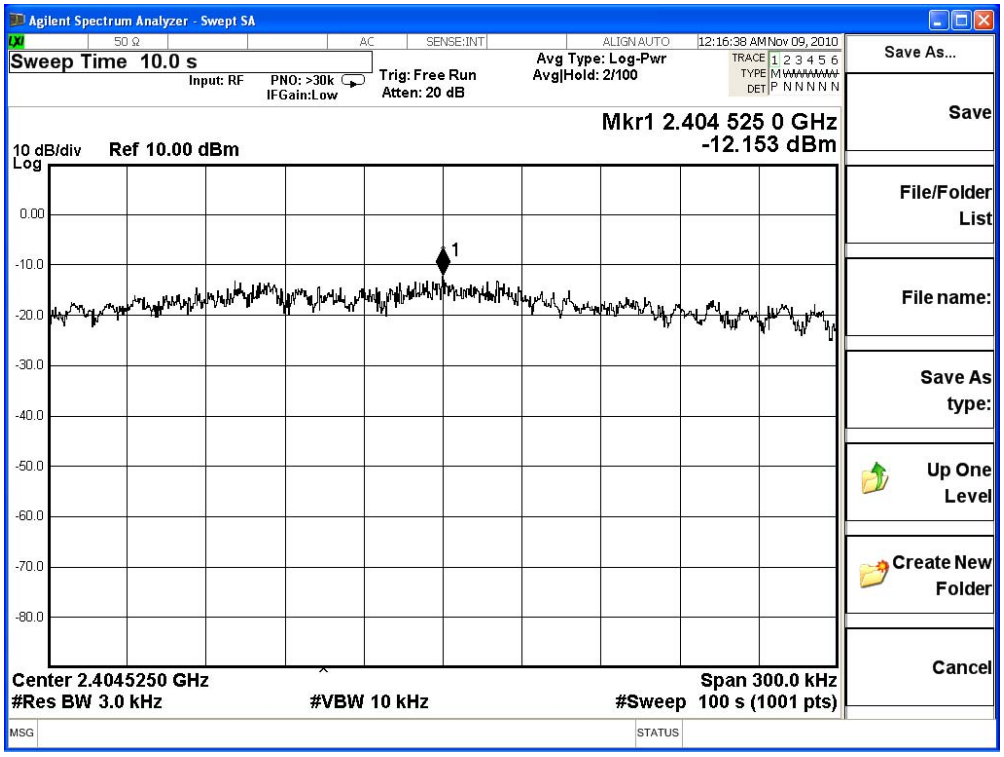
Figure Channel 11:



Product : 802.11n 1x1 MIMO Half Mini Card
Test Item : Power Density Data
Test Site : No.3 OATS
Test Mode : Mode 2: Transmit (802.11g 6Mbps) (2412MHz)

Channel No.	Frequency (MHz)	Measure Level (dBm)	Limit (dBm)	Result
1	2412.00	-12.153	< 8dBm	Pass

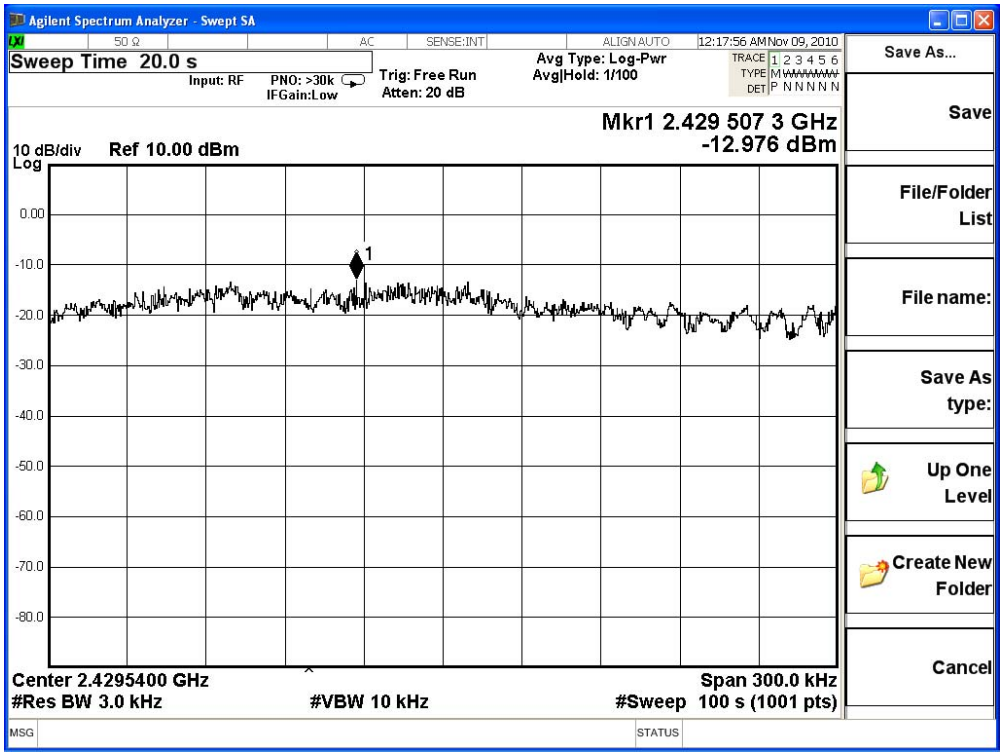
Figure Channel 1:



Product : 802.11n 1x1 MIMO Half Mini Card
Test Item : Power Density Data
Test Site : No.3OATS
Test Mode : Mode 2: Transmit (802.11g 6Mbps) (2437MHz)

Channel No.	Frequency (MHz)	Measurement Level (dBm)	Required Limit (dBm)	Result
6	2437.000	-12.976	< 8dBm	Pass

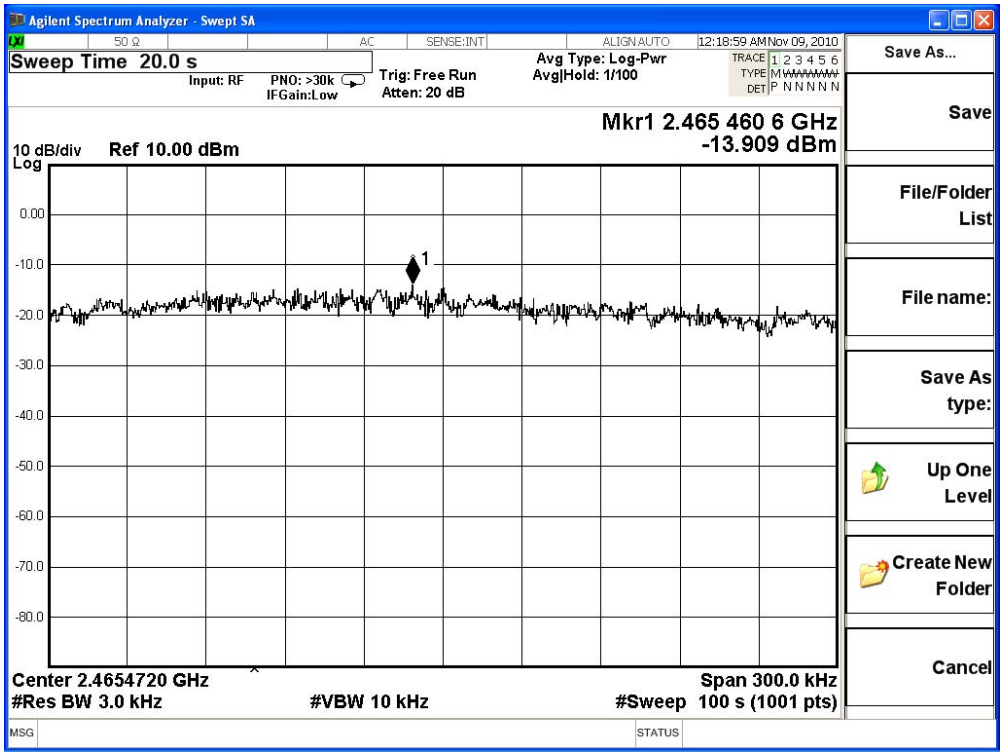
Figure Channel 6:



Product : 802.11n 1x1 MIMO Half Mini Card
Test Item : Power Density Data
Test Site : No.3 OATS
Test Mode : Mode 2: Transmit (802.11g 6Mbps) (2462MHz)

Channel No.	Frequency (MHz)	Measurement Level (dBm)	Required Limit (dBm)	Result
11	2462.00	-13.909	< 8dBm	Pass

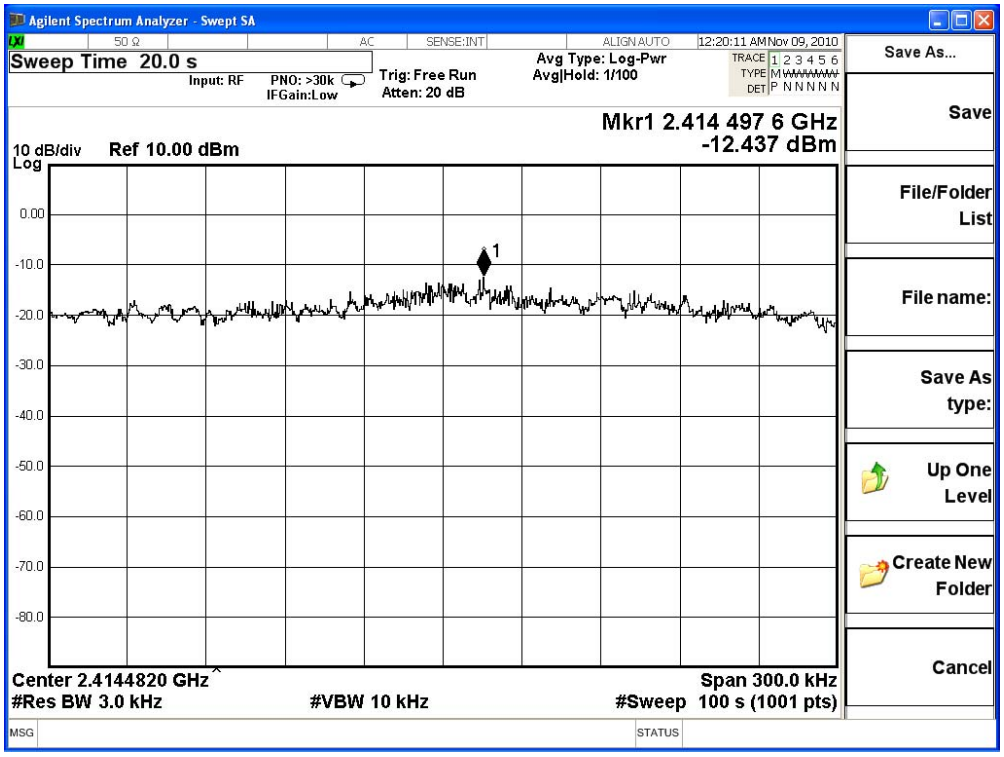
Figure Channel 11:



Product : 802.11n 1x1 MIMO Half Mini Card
Test Item : Power Density Data
Test Site : No.3 OATS
Test Mode : Mode 3: Transmit (802.11n MCS0 7.2Mbps 20M-BW) (2412MHz)

Channel No.	Frequency (MHz)	Measure Level (dBm)	Limit (dBm)	Result
1	2412.00	-12.437	< 8dBm	Pass

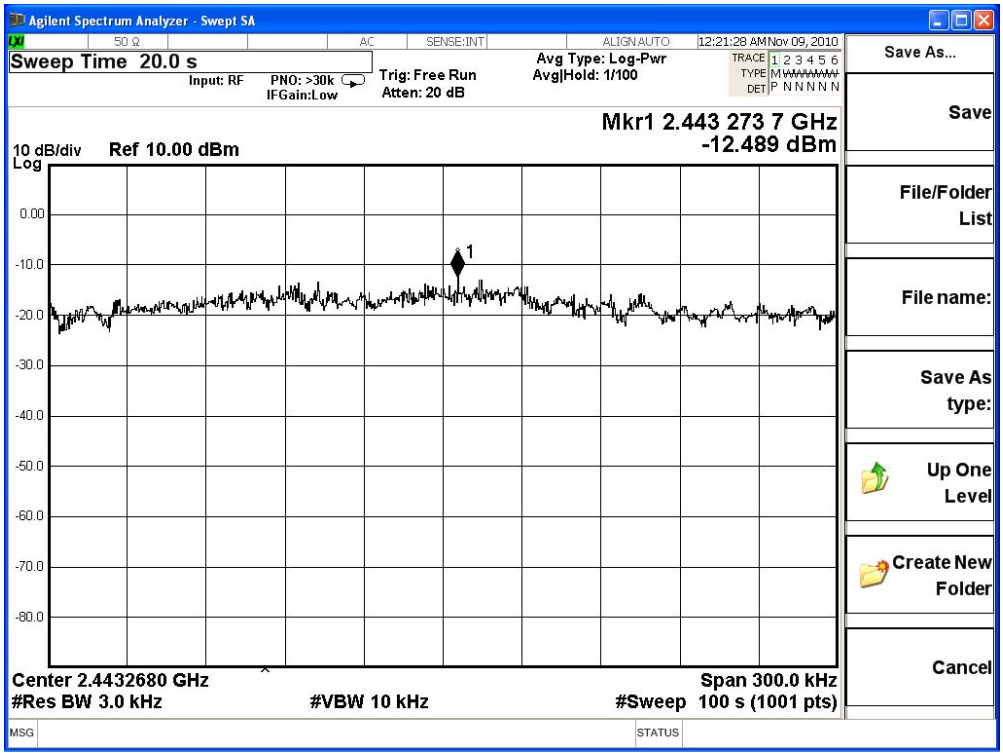
Figure Channel 1:



Product : 802.11n 1x1 MIMO Half Mini Card
Test Item : Power Density Data
Test Site : No.3OATS
Test Mode : Mode 3: Transmit (802.11n MCS0 7.2Mbps 20M-BW) (2437MHz)

Channel No.	Frequency (MHz)	Measurement Level (dBm)	Required Limit (dBm)	Result
6	2437.000	-12.489	< 8dBm	Pass

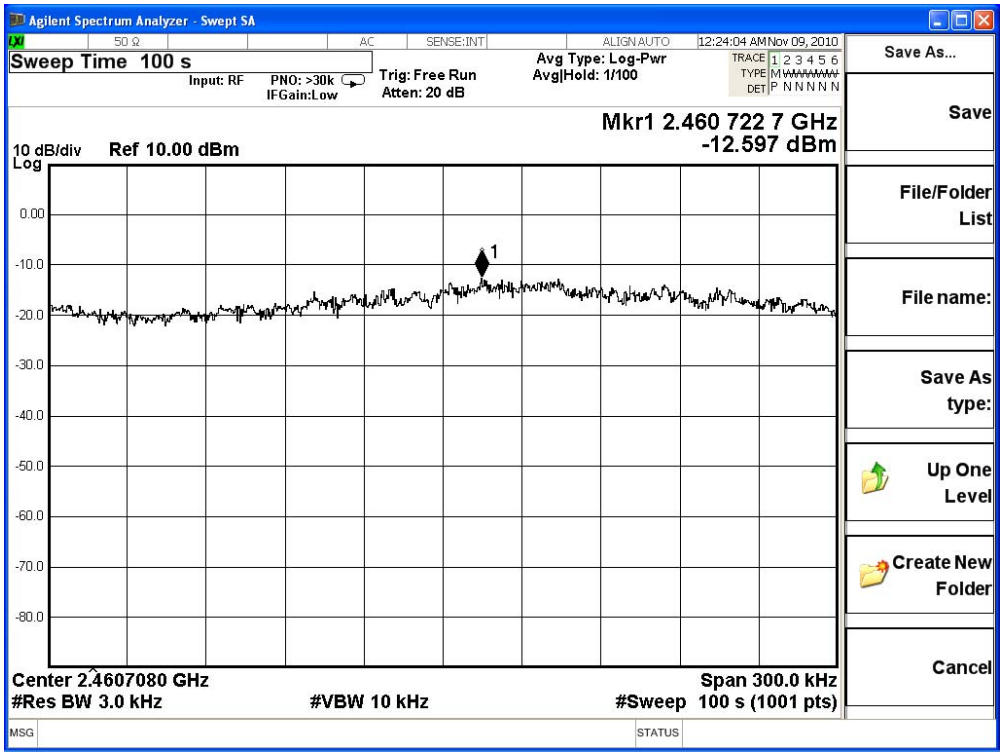
Figure Channel 6:



Product : 802.11n 1x1 MIMO Half Mini Card
Test Item : Power Density Data
Test Site : No.3 OATS
Test Mode : Mode 3: Transmit (802.11n MCS0 7.2Mbps 20M-BW) (2462MHz)

Channel No.	Frequency (MHz)	Measurement Level (dBm)	Required Limit (dBm)	Result
11	2462.00	-12.597	< 8dBm	Pass

Figure Channel 11:



9. EMI Reduction Method During Compliance Testing

No modification was made during testing.