FCC PART 15, SUBPART C
IC RSS-210, ISSUE 8, DECEMBER 2010

TEST AND MEASUREMENT REPORT

For

GainSpan Corporation

3590 North First Street, Suite 300, San Jose, CA 95134, USA

FCC ID: YOPGS2011MIZ
IC: 9154A-GS2011MIZ

Report Type:	**Product Type:**
Original Report	Low Power Wi-Fi Module with 802.11b/g/n

Prepared By: Ken Bai

Report Number: R1402134-247 Rev A

Report Date: 2014-04-21

Reviewed By: Bo Li
Test Engineer

Bay Area Compliance Laboratories Corp.
1274 Anvilwood Avenue,
Sunnyvale, CA 94089, USA
Tel: (408) 732-9162
Fax: (408) 732-9164

TABLE OF CONTENTS

`

DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1402134-247	Original Report	2014-04-07
1	R1402134-247 Rev A	Revised report with updated model number and serial number	2014-04-21

1 General Description

1.1 Product Description for Equipment Under Test (EUT)

This test and measurement report was prepared on behalf of *GainSpan Corporation*, and their product model: *GS2011MIZ, FCC ID: YOPGS2011MIZ, IC: 9154A-GS2011MIZ* or the "EUT" as referred to in this report. The EUT is Low Power Wi-Fi Module with 802.11 b/g/n.

1.2 Mechanical Description of EUT

The EUT measures approximately 3.25 cm (L) x 2.28 cm (W) x 0.363 cm (H) and weighs 22 g.

The test data gathered are from typical production sample, serial number: 001DC900297D assigned by Client.

1.3 Objective

This report is prepared on behalf of *GainSpan Corporation* in accordance with Part 2, Subpart J, and Part 15, Subparts B and C of the Federal Communication Commissions rules and IC RSS-210 Issue 8, Dec 2010.

The objective is to determine compliance with FCC Part 15.247 and IC RSS-210 rules for Output Power, Antenna Requirements, 6 dB Bandwidth, and power spectral density, 100 kHz Bandwidth of Band Edges Measurement, Spurious Emissions, Conducted and Radiated Spurious Emissions.

1.4 Related Submittal(s)/Grant(s)

N/A

1.5 Test Methodology

All measurements contained in this report were conducted in accordance with ANSI C63.4-2009, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz and FCC KDB 558074 D01 DTS Meas Guidance v03r01: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247

1.6 Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in the field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system repeatability.

The following calculation follows the procedures as set forth in clause 7.2.3, ETSI TR 100 028-1 V1.4.1 (2001-12), the expression of Uncertainty in Radiated RF Testing is in accordance to ISO/IEC 17025 and TR 100 028-1 V1.4.1 (2001-12).

The expanded Measurement Uncertainty value having a confidence factor of 95%, is within a range of 5.48 dB.

This means that the value of conducted RF carrier power test will be within +/- 2.74 dB of the measuring radiated emissions power versus the expected value.

The expected value is defined as the power at the antenna of the Transmitter under Test.

1.7 Test Facility

Bay area compliance Laboratories Corp. (BACL) is:
1- An independent Commercial Test Laboratory accredited to **ISO 17025: 2005** by **A2LA**, in the fields of: Electromagnetic Compatibility & Telecommunications covering Emissions, Immunity, Radio, RF Exposure, Safety and Telecom. This includes NEBS (Network Equipment Building System), Wireless RF, Telecommunications Terminal Equipment (TTE); Network Equipment; Information Technology Equipment (ITE); Medical Electrical Equipment; Industrial, Commercial, and Medical Test Equipment; Professional Audio and Video Equipment; Electronic (Digital) Products; Industrial and Scientific Instruments; Cabled Distribution Systems and Energy Efficiency Lighting.

2- An ENERGY STAR Recognized Laboratory, for the LM80 Testing, a wide variety of Luminares and Computers.

3- A NIST Designated Phase-I and Phase-II CAB including: ACMA (Australian Communication and Media Authority), BSMI (Bureau of Standards, Metrology and Inspection of Taiwan), IDA (Infocomm Development Authority of Singapore), IC(Industry Canada), Korea (Ministry of Communications Radio Research Laboratory), NCC (Formerly DGT; Directorate General of Telecommunication of Chinese Taipei) OFTA (Office of the Telecommunications Authority of Hong Kong), Vietnam, VCCI - Voluntary Control Council for Interference of Japan and a designated EU CAB (Conformity Assessment Body) (Notified Body) for the EMC and R&TTE Directives.

4- A Product Certification Body accredited to **ISO Guide 65: 1996** by **A2LA** to certify:
1- Unlicensed, Licensed radio frequency devices and Telephone Terminal Equipment for the FCC. Scope A1, A2, A3, A4, B1, B2, B3, B4 & C.
2. Radio Standards Specifications (RSS) in the Category I Equipment Standards List and All Broadcasting Technical Standards (BETS) in Category I Equipment Standards List for Industry Canada.
3. Radio Communication Equipment for Singapore.
4. Radio Equipment Specifications, GMDSS Marine Radio Equipment Specifications, and Fixed Network Equipment Specifications for Hong Kong.
5. Japan MIC Telecommunication Business Law (A1, A2) and Radio Law (B1, B2 and B3).
6. Audio/Video, Battery Charging Systems, Computers, Displays, Enterprise Servers, Imaging Equipment, Set-Top Boxes, Telephony, Televisions, Ceiling Fans, CFLs (Including GU24s),Decorative Light Strings, Integral LED Lamps, Luminaires, Residential Ventilating Fans.

The test site used by BACL Corp. to collect radiated and conducted emissions measurement data is located at its facility in Sunnyvale, California, USA.

The test site at BACL Corp. has been fully described in reports submitted to the Federal Communication Commission (FCC) and Voluntary Control Council for Interference (VCCI). The details of these reports have been found to be in compliance with the requirements of Section 2.948 of the FCC Rules on February 11 and December 10, 1997, and Article 8 of the VCCI regulations on December 25, 1997. The test site also complies with the test methods and procedures set forth in CISPR 22:2008 §10.4 for measurements below 1 GHz and §10.6 for measurements above 1 GHz as well as ANSI C63.4-2009, ANSI C63.4-2009, TIA/EIA-603 & CISPR 24:2010.

The Federal Communications Commission and Voluntary Control Council for Interference have the reports on file and they are listed under FCC registration number: 90464 and VCCI Registration No.: A-0027. The test site has been approved by the FCC and VCCI for public use and is listed in the FCC Public Access Link (PAL) database.

Additionally, BACL Corp. is an American Association for Laboratory Accreditation (A2LA) accredited laboratory (Lab Code 3297-02). The current scope of accreditations can be found at

http://www.a2la.org/scopepdf/3297-02.pdf?CFID=1132286&CFTOKEN=e42a3240dac3f6ba-6DE17DCB-1851-9E57-477422F667031258&jsessionid=8430d44f1f47cf2996124343c704b367816b

2 System Test Configuration

2.1 Justification

The EUT was configured for testing according to ANSI C63.4-2009 and FCC KDB 558074 D01 DTS Meas Guidance v03r01.

The EUT was tested in a testing mode to represent worst-case results during the final qualification test.

The worst-case data rates are determined to be as follows for each mode based upon investigation by measuring the average power, peak power and PPSD across all data rates bandwidths, and modulations.

2.2 EUT Exercise Software

The test utility used was *Tera Term* was provided by GainSpan Corporation., and was verified *Ken Bai* to comply with the standard requirements being tested against.

2.3 Special Equipment

There were no special accessories were required, included, or intended for use with EUT during these tests.

2.4 Equipment Modifications

No modifications were made to the EUT.

2.5 Local Support Equipment

Manufacturer	Description	Model	Serial Number
Dell	Laptop	Latitude E5420	-

2.6 EUT Internal Configuration Details

Manufacturer	Description	Model	Serial Number
GainSpan	Motherboard	GS_Module-Daughter Card Rev2	-
GainSpan	Wifi-Module	Gainspan GS2011MIZ Rev 3.1	-

2.7 Interface Ports and Cables

Cable Description	Length (m)	To	From
RF Cable	<1.0	PSA	EUT

2.8 Power Supply List and Details

Manufacturer	Description	Model	Part Number
GainSpan	Power Supply cord	PSA05R-033	-

3 Summary of Test Results

Results reported relate only to the product tested.

FCC & IC Rules	Description of Test	Results
FCC §15.247(i), §2.1091 IC RSS-102	RF Exposure	Compliant
FCC §15.203 IC RSS-Gen §7.1.2	Antenna Requirement	Compliant
FCC §15.207(a) IC RSS-Gen §7.2.4	AC Line Conducted Emissions	Compliant
FCC §15.247 (d) IC RSS-210 §A8.5	Spurious Emissions at Antenna Port	Compliant
FCC §15.205 IC RSS-210 §2.2	Restricted Bands	Compliant
FCC §15.209, §15.247 (d) IC RSS-210 §A8.5	Radiated Spurious Emissions	Compliant
FCC §15.247(a)(2) IC RSS-210 §A8.2	6 dB Emission Bandwidth	Compliant
FCC §15.247(b)(3) IC RSS-210 §A8.4	Maximum Peak Output Power	Compliant
FCC §15.247(d) IC RSS-210 §A8.5	100 kHz Bandwidth of Frequency Band Edge	Compliant
FCC §15.247(e) IC RSS-210 §A8.2(b)	Power Spectral Density	Compliant
IC RSS-210 §2.3 & RSS-Gen §4.10	Receiver Spurious Emission	Compliant

4 FCC §15.247 (i), §2.1091 & IC RSS-102 – RF Exposure

4.1 Applicable Standard

According to FCC §15.247(i) and §1.1307(b)(1), systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

Limits for General Population/Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Averaging Time (minutes)
Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	* (100)	30
1.34-30	824/f	2.19/f	* ($180/f^2$)	30
30-300	27.5	0.073	0.2	30
300-1500	/	/	f/1500	30
1500-100,000	/	/	1.0	30

f = frequency in MHz
* = Plane-wave equivalent power density

Before equipment certification is granted, the procedure of IC RSS-102 must be followed concerning the exposure of humans to RF fields.

According to IC RSS-102 Issue 2 section 4.1, RF limits used for general public will be applied to the EUT.

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m^2)	Time Averaging (min)
0.003 - 1	280	2.19	-	6
1 - 10	280/f	2.19/f	-	6
10 - 30	28	2.19/f	-	6
30 – 300	28	0.073	2*	6
300 – 1 500	$1.585\ f^{0.5}$	$0.0042f^{0.5}$	f / 150	6
1 500 – 15 000	61.4	0.163	10	6
15 000 – 150 000	61.4	0.163	10	$616000/f^{1.2}$
150 000- 300 000	$0.158\ f^{0.5}$	$4.21 \times 10^{-4}\ f^{0.5}$	$6.67 \times 10^{-5}\ f$	$616000/f^{1.2}$

Note: *f* is frequency in MHz
* = Power density limit is applicable at frequencies greater than 100 MHz

4.2 MPE Prediction

Predication of MPE limit at a given distance, Equation from OET Bulletin 65, Edition 97-01

$$S = PG/4\pi R^2$$

Where: S = power density
P = power input to antenna
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna

4.3 MPE Results

Maximum peak output power at antenna input terminal (dBm):	19.80
Maximum peak output power at antenna input terminal (mW):	95.499
Prediction distance (cm):	20
Prediction frequency (MHz):	2412
Maximum Antenna Gain, typical (dBi):	0
Maximum Antenna Gain (numeric):	1
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.018999
Power density of prediction frequency at 20.0 cm (W/m^2):	0.18999
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1.0
MPE limit for uncontrolled exposure at prediction frequency (W/m^2):	10

The device is compliant with the requirement MPE limit for uncontrolled exposure. The maximum power density at the distance of 20 cm is 0.019 mW/cm^2 (0.19 W/m^2).

5 FCC §15.203 & IC RSS-Gen §7.1.2 – Antenna Requirements

5.1 Applicable Standard

According to FCC §15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

And according to FCC §15.247 (b) (4), if transmitting antennas of directional gain greater than 6 dBi are used the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

According to IC RSS-Gen §7.1.2: Transmitter Antenna

A transmitter can only be sold or operated with antennas with which it was certified. A transmitter may be certified with multiple antenna types. An antenna type comprises antennas having similar in-band and out-of-band radiation patterns. Testing shall be performed using the highest-gain antenna of each combination of transmitter and antenna type for which certification is being sought, with the transmitter output power set at the maximum level. Any antenna of the same type and having equal or lesser gain as an antenna that had been successfully tested for certification with the transmitter, will also be considered certified with the transmitter, and may be used and marketed with the transmitter. The manufacturer shall include with the application for certification a list of acceptable antenna types to be used with the transmitter.

When a measurement at the antenna connector is used to determine RF output power, the effective gain of the device's antenna shall be stated, based on measurement or on data from the antenna manufacturer. Any antenna gain in excess of 6 dBi (6 dB above isotropic gain) shall be added to the measured RF output power before using the power limits specified in RSS-210 or RSS-310 for devices of RF output powers of 10 mW or less. For devices of output powers greater than 10 mW, except devices subject to RSS-210 Annex 8 (Frequency Hopping and Digital Modulation Systems Operating in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz Bands) or RSS-210 Annex 9 (Local Area Network Devices), the total antenna gain shall be added to the measured RF output power before using the specified power limits. For devices subject to RSS-210 Annex 8 or Annex 9, the antenna gain shall not be added.

5.2 Antenna List

Manufacturers	Antenna Type/Pattern	Antenna Gain (dBi) @ 2.4 GHz
GainSpan	Ceramic Chip	0

Note: The power setting was controlled by manufacture with different antenna configuration. The power setting of the different antenna will be set with the corresponded value and no more then the level reported.

The antenna consists of non-standard (UFL) connectors with less 6 dBi gain; therefore, it complies with the antenna requirement. Please refer to the internal photos.

6 FCC §15.207 & IC RSS-Gen §7.2.4 – AC Line Conducted Emissions

6.1 Applicable Standards

As per FCC §15.207 and IC RSS-Gen §7.2.4 Conducted limits:

For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequencies ranges.

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-Peak	Average
0.15-0.5	66 to 56 *	56 to 46 *
0.5-5	56	46
5-30	60	50

**Decreases with the logarithm of the frequency.*

6.2 Test Setup

The measurement was performed at shield room, using the setup per ANSI C63.4-2009 measurement procedure. The specification used was FCC §15.207 and IC RSS-Gen §7.2.4 limits.

External I/O cables were draped along the edge of the test table and bundle when necessary.

The AC/DC power adapter of the EUT was connected with LISN-1 which provided 120 V / 60 Hz AC power.

6.3 Test Procedure

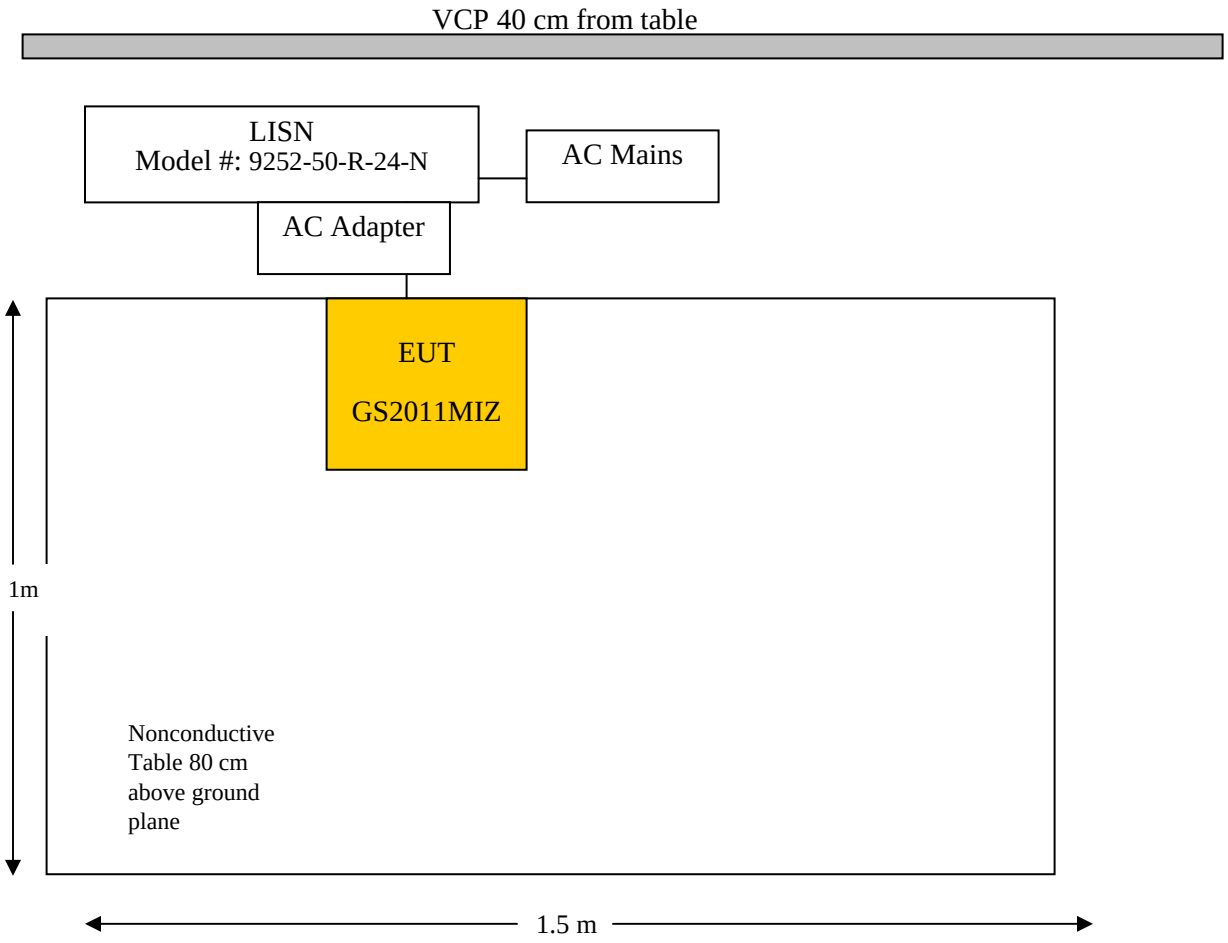
During the conducted emissions test, the power cord of the EUT host system was connected to the mains outlet of the LISN-2.

Maximizing procedure was performed on the six (6) highest emissions of the EUT.

All data was recorded in the peak detection mode, quasi-peak and average. Quasi-Peak readings are distinguished with a “QP.” Average readings are distinguished with an “Ave”.

6.4 Test Setup Block Diagram

AC/DC Adaptor:



6.5 Corrected Amplitude & Margin Calculation

The Corrected Amplitude (CA) is calculated by adding the Cable Loss (CL), the Attenuator Factor (Atten) to indicated Amplitude (Ai) reading. The basic equation is as follows:

CA = Ai + CL + Atten

For example, a corrected amplitude of 46.2 dBuV = Indicated Reading (32.5 dBuV) + Cable Loss (3.7 dB) + Attenuator (10 dB)

The "**Margin**" column of the following data tables indicates the degree of compliance within the applicable limit. For example, a margin of -7 dB means the emission is 7 dB below the maximum limit. The equation for margin calculation is as follows:

Margin = Corrected Amplitude - Limit

6.6 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Rohde & Schwarz	EMI Test Receiver	ESCI 1166.5950K03	100337	2013-03-28	1 year
Solar Electronics	LISN	9252-50-R-24-N	511205	2013-06-25	1 year
TTE	Filter, High Pass	H9962-150K-50-21378	K7133	2013-05-30	1 year

Statement of Traceability: BACL Corp. *attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.*

6.7 Test Environmental Conditions

Temperature:	22º C
Relative Humidity:	52 %
ATM Pressure:	101.89 kPa

The testing was performed by Ken Bai on 2014-02-26 in 5 m chamber 2.

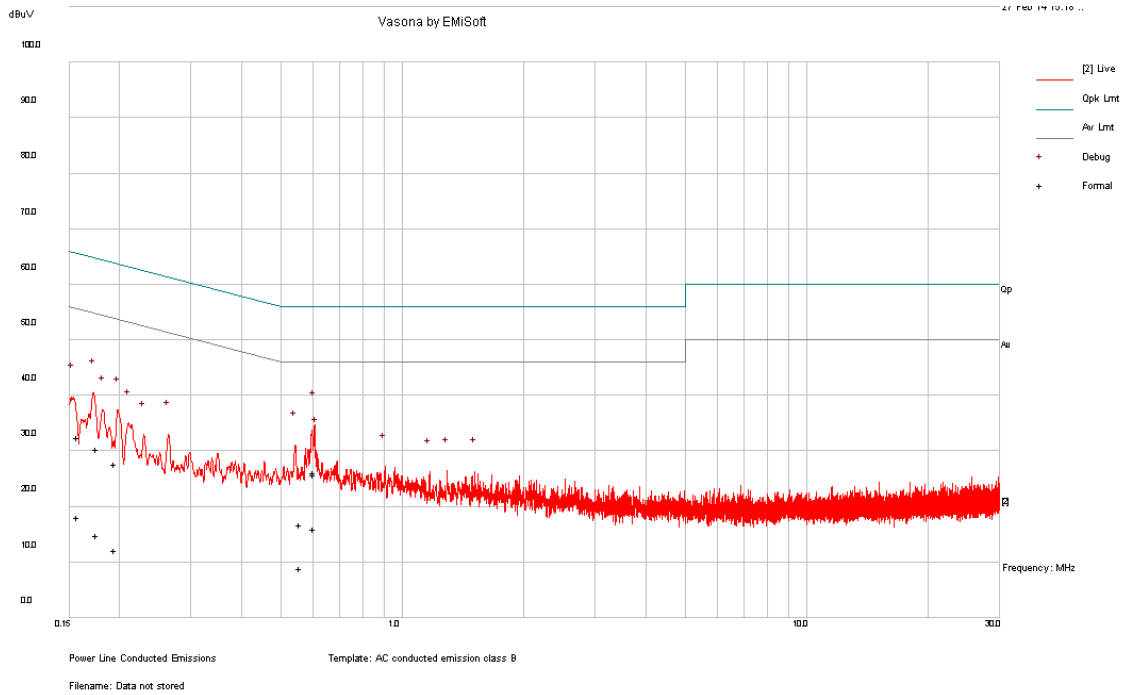
6.8 Summary of Test Results

According to the recorded data in following table, the EUT complied with the FCC standard's conducted emissions limits, with the margin reading of:

Connection: AC/DC adapter connected to 120 V/60 Hz, AC			
Margin (dB)	**Frequency (MHz)**	**Conductor Mode (Line/Neutral)**	**Range (MHz)**
-20.21	0.182487	Neutral	0.15 to 30 MHz

6.9 Conducted Emissions Test Plots and Data

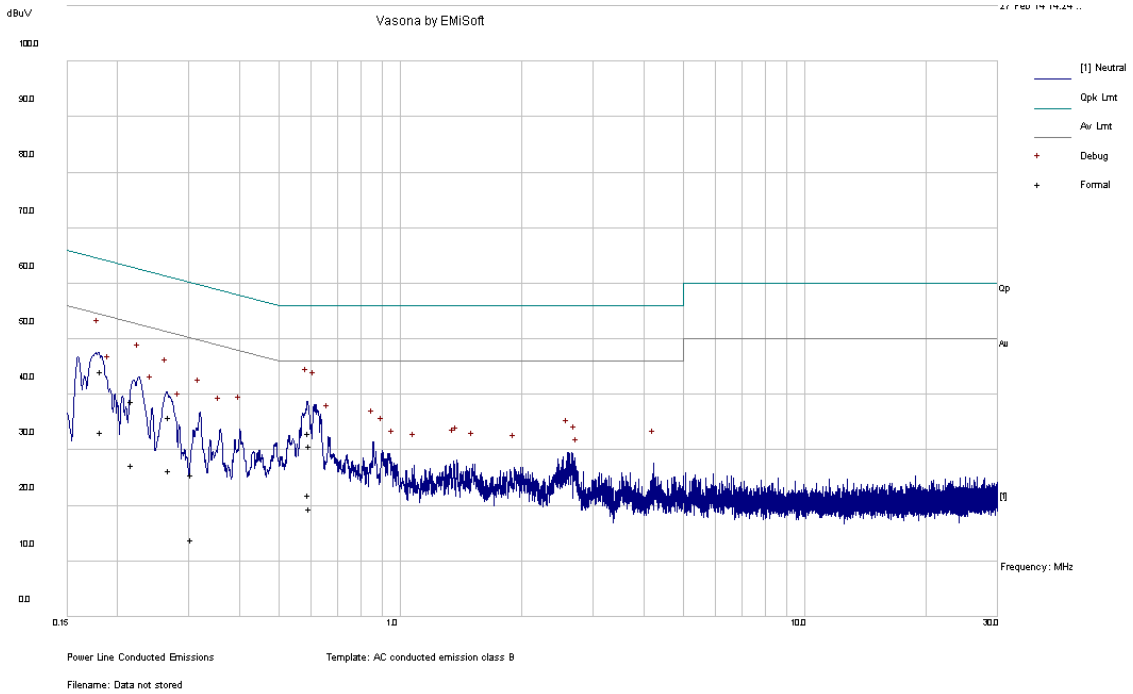
120 V, 60 Hz – Line, AC/DC Adaptor



Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)	Detector (QP/Ave.)
0.604418	26.2	Line	56	-29.80	QP
0.604743	25.82	Line	56	-30.18	QP
0.157838	32.54	Line	65.58	-33.03	QP
0.175776	30.36	Line	64.68	-34.32	QP
0.195512	27.73	Line	63.8	-36.07	QP
0.558542	16.83	Line	56	-39.17	QP

Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)	Detector (QP/Ave.)
0.604418	16.05	Line	46	-29.95	Ave.
0.604743	16.04	Line	46	-29.96	Ave.
0.558542	8.85	Line	46	-37.15	Ave.
0.157838	18.2	Line	55.58	-37.38	Ave.
0.175776	14.88	Line	54.68	-39.80	Ave.
0.195512	12.17	Line	53.8	-41.63	Ave.

120 V, 60 Hz – Neutral, AC/DC Adaptor



Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)	Detector (QP/Ave.)
0.182487	44.17	Neutral	64.37	-20.21	QP
0.593496	33.06	Neutral	56	-22.94	QP
0.217403	38.89	Neutral	62.92	-24.03	QP
0.268721	35.98	Neutral	61.16	-25.18	QP
0.597455	30.8	Neutral	56	-25.20	QP
0.304796	25.65	Neutral	60.11	-34.46	QP

Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)	Detector (QP/Ave.)
0.182487	33.18	Neutral	54.37	-21.19	Ave.
0.593496	21.92	Neutral	46	-24.08	Ave.
0.268721	26.41	Neutral	51.16	-24.75	Ave.
0.217403	27.34	Neutral	52.92	-25.58	Ave.
0.597455	19.37	Neutral	46	-26.63	Ave.
0.304796	13.87	Neutral	50.11	-36.24	Ave.

7 FCC §2.1051, §15.247(d) & IC RSS-210 §A8.5 – Spurious Emissions at Antenna Terminals

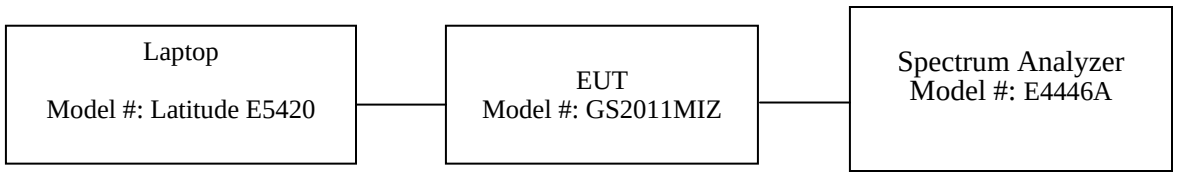
7.1 Applicable Standard

For FCC §15.247(d) and IC RSS-210 §A8.5 in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated 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, provided the transmitter demonstrates compliance with the peak conducted power limits.

7.2 Measurement Procedure

The measurements are base on FCC KDB 558074 D01 DTS Meas Guidance v03r01: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 section 11: Emissions in non-restricted frequency bands and section 12: Emissions in restricted frequency bands.

7.3 Test Setup Block Diagram



7.4 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Cycle
Agilent	Spectrum Analyzer	E4446A	MY48250238	2013-08-29	1 year

Statement of Traceability: BACL Corp. *attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.*

7.5 Test Environmental Conditions

Temperature:	22-24° C
Relative Humidity:	42-45 %
ATM Pressure:	101-102 kPa

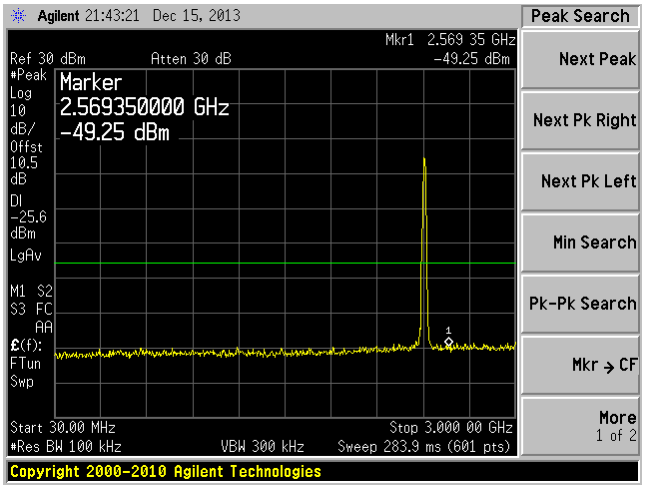
The testing was performed by Ken Bai from 2014-2-22 to 2014-2-26 at RF site.

7.6 Test Results

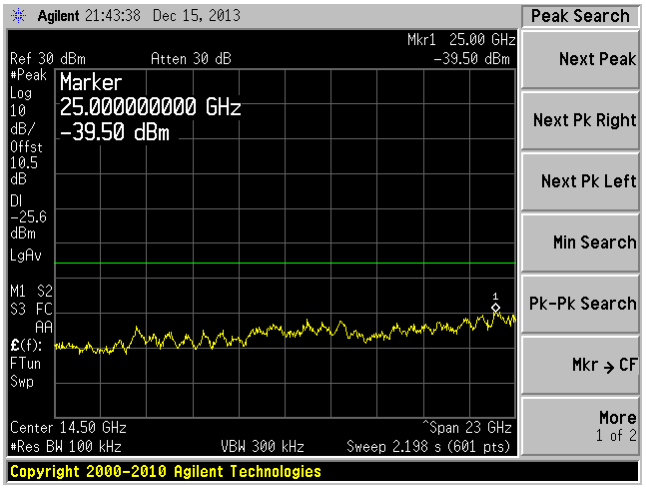
Please refer to following plots of spurious emissions.

802.11b, Low Channel, 2412 MHz

Plot: 30 MHz – 3 GHz

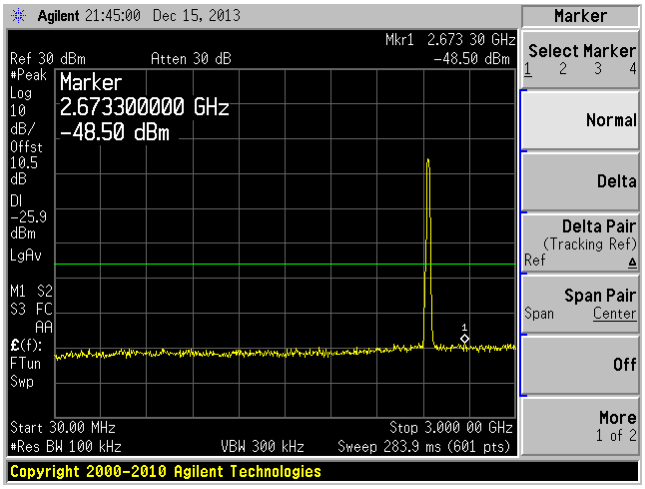


Plot: 3 GHz – 25 GHz

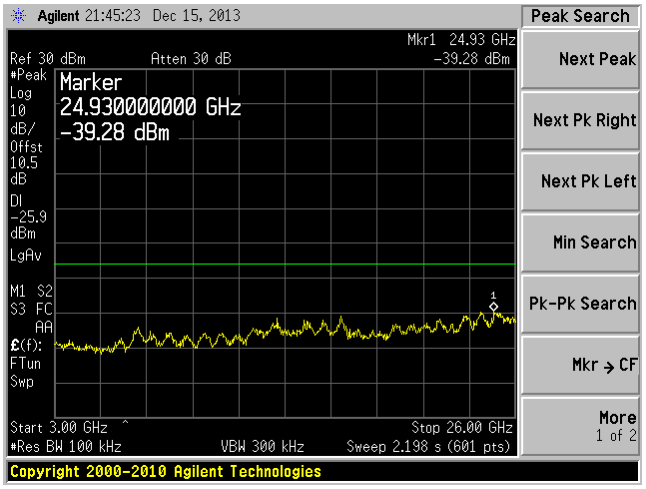


802.11b, Middle Channel, 2437 MHz

Plot: 30 MHz – 3 GHz

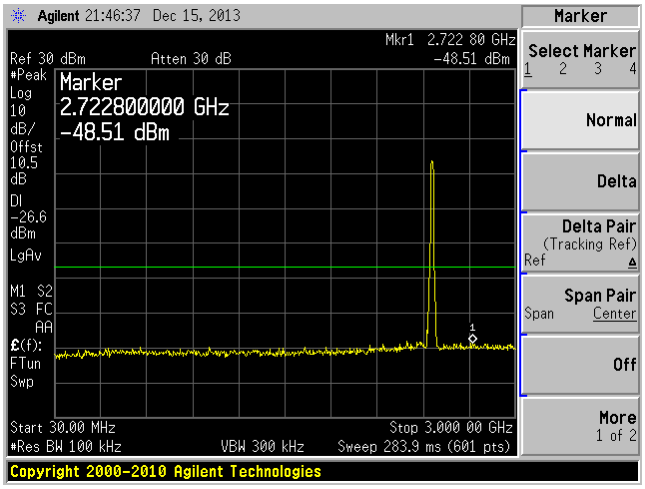


Plot: 3 GHz – 25 GHz

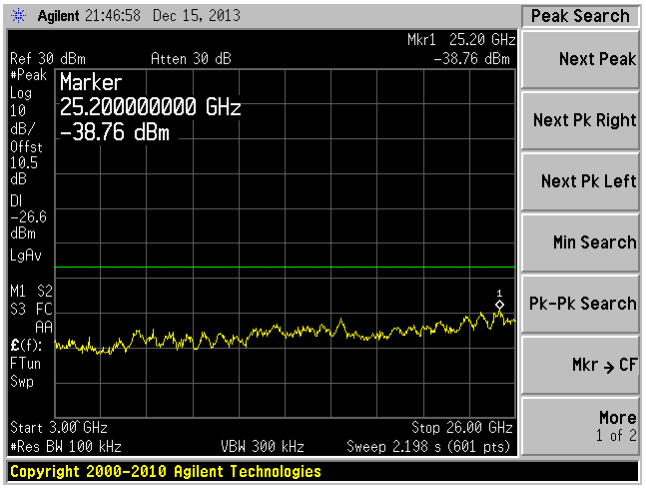


802.11b, High Channel, 2462 MHz

Plot: 30 MHz – 3 GHz

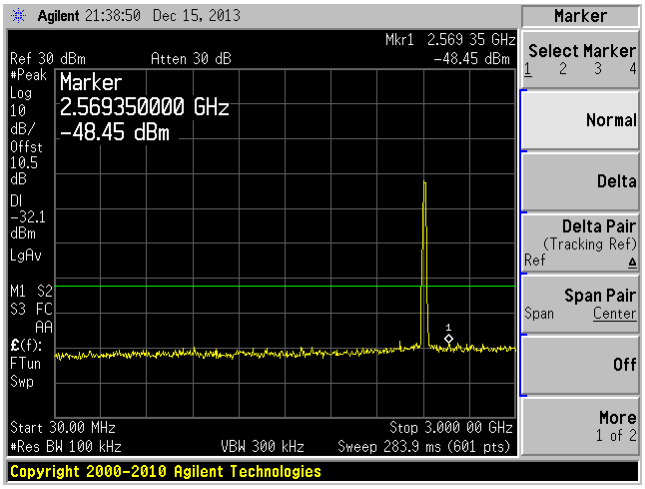


Plot: 3 GHz – 25 GHz

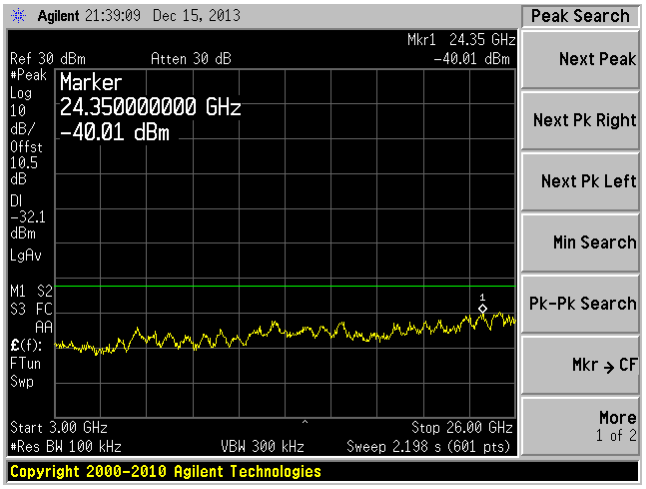


802.11g, Low Channel 2412 MHz

Plot: 30 MHz – 3 GHz

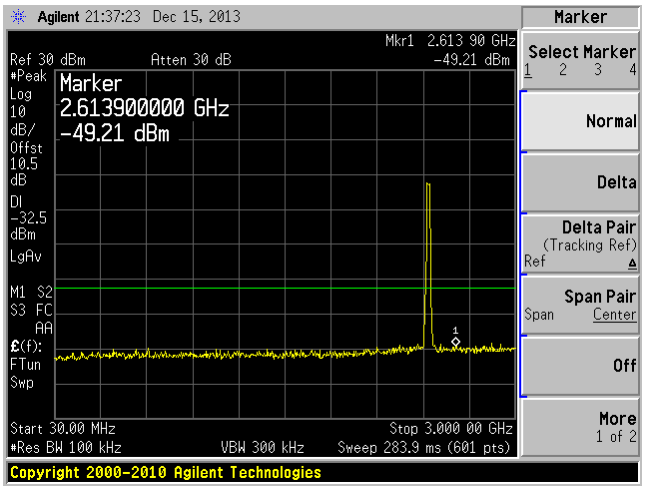


Plot: 3 GHz – 25 GHz

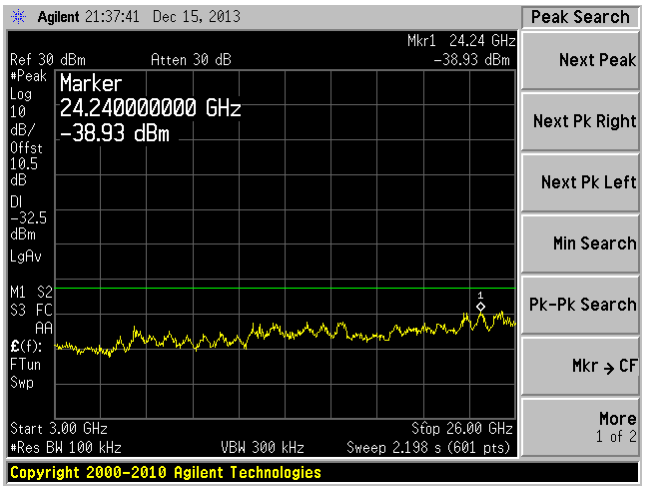


802.11g, Middle Channel 2437 MHz

Plot: 30 MHz – 3 GHz

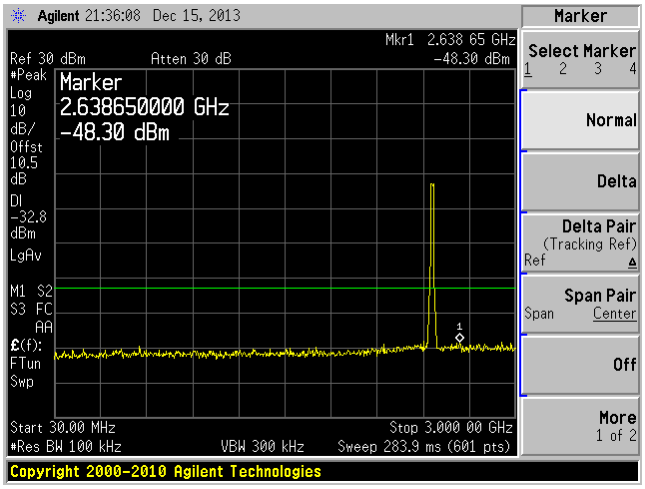


Plot: 3 GHz – 25 GHz

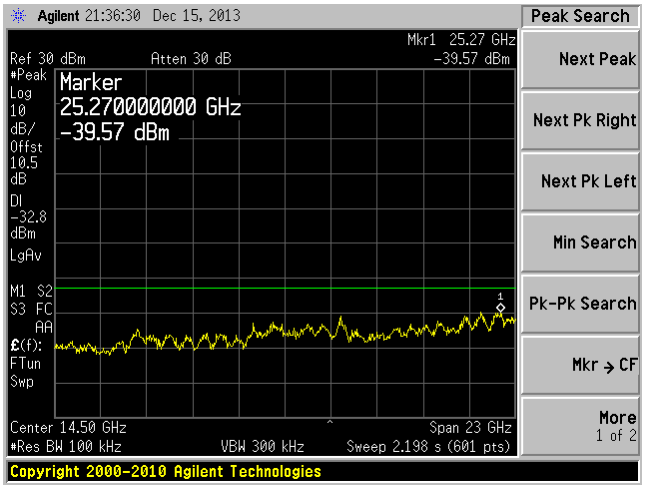


802.11g, High Channel 2462 MHz

Plot: 30 MHz – 3 GHz

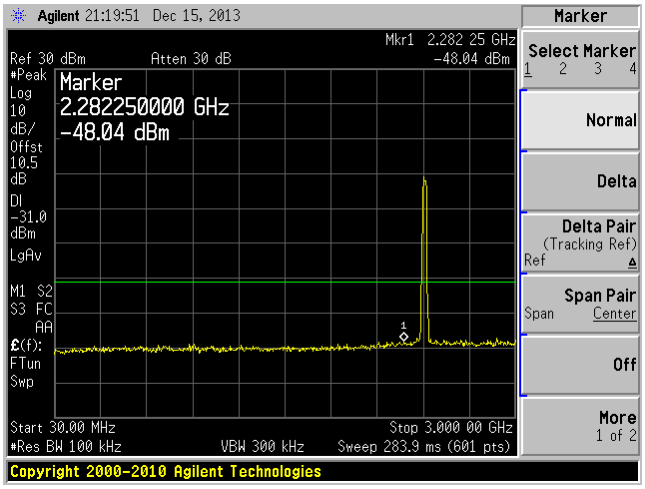


Plot: 3 GHz – 25 GHz

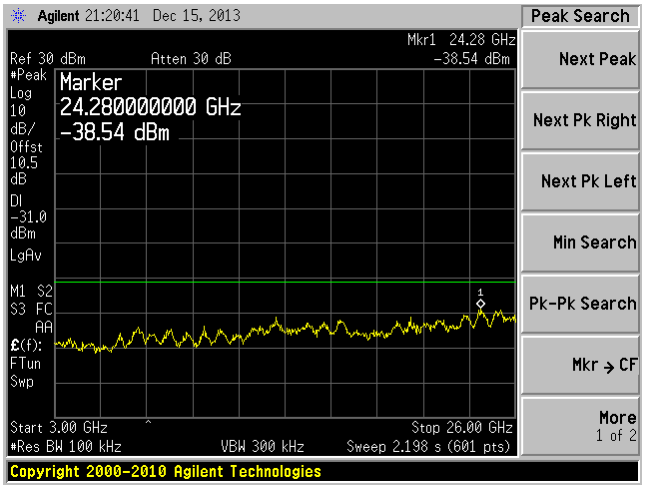


802.11n-HT20, Low Channel 2412 MHz

Plot: 30 MHz – 3 GHz

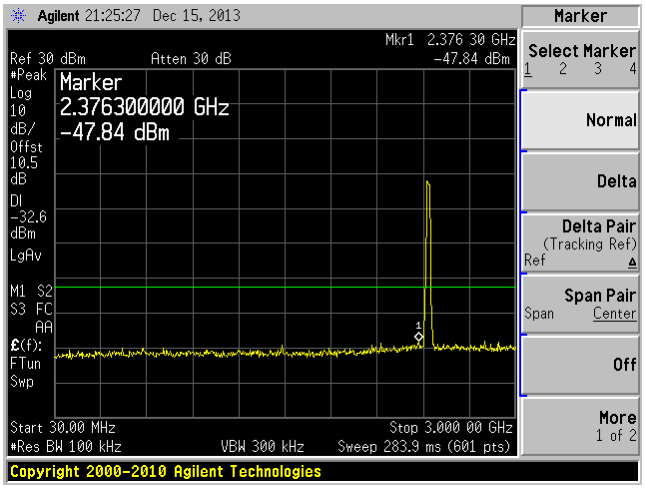


Plot: 3 GHz – 25 GHz

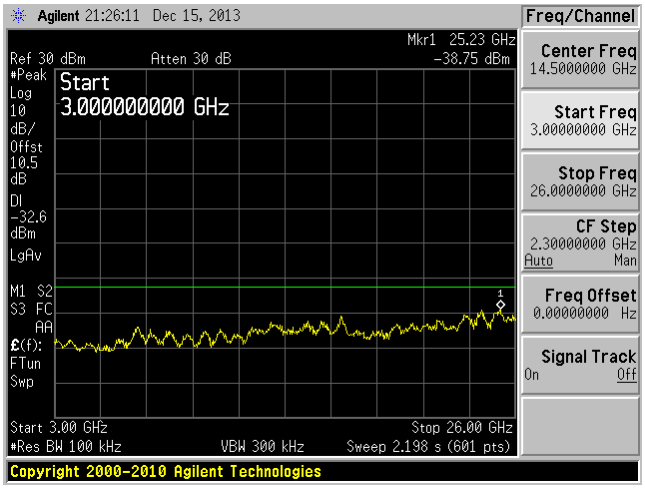


802.11n-HT20, Middle Channel 2437 MHz

Plot: 30 MHz – 3 GHz

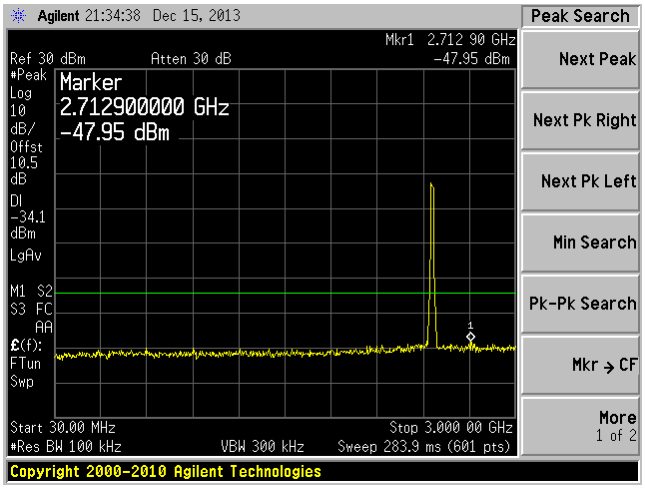


Plot: 3 GHz – 25 GHz

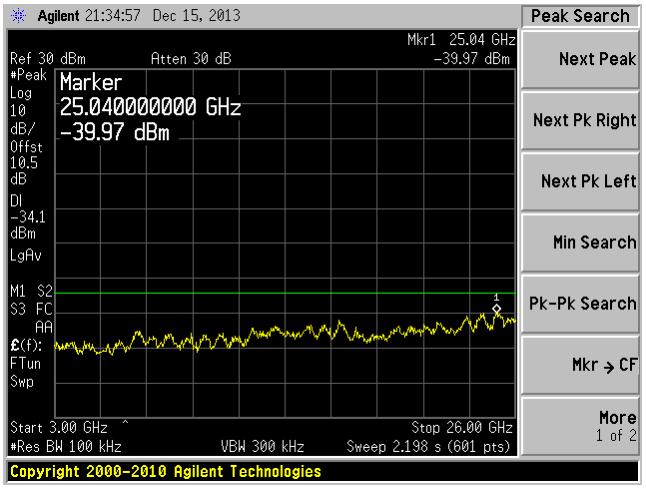


802.11n-HT20, High Channel 2462 MHz

Plot: 30 MHz – 3 GHz



Plot: 3 GHz – 25 GHz



8 FCC §15.205, §15.209 & §15.247(d) & IC RSS-210 §A8.5 – Spurious Radiated Emissions

8.1 Applicable Standard

As per FCC §15.35(d): Unless otherwise specified, on any frequency or frequencies above 1000 MHz, the radiated emission limits are based on the use of measurement instrumentation employing an average detector function. Unless otherwise specified, measurements above 1000 MHz shall be performed using a minimum resolution bandwidth of 1 MHz.

As per FCC §15.209(a) and RSS-210: Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table

Frequency (MHz)	Field Strength (micro volts/meter)	Measurement Distance (meters)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100**	3
88 - 216	150**	3
216 - 960	200**	3
Above 960	500	3

** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

As Per FCC §15.205(a) except as show in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 – 0.110	16.42 – 16.423	960 – 1240	4. 5 – 5. 15
0.495 – 0.505	16.69475 – 16.69525	1300 – 1427	5. 35 – 5. 46
2.1735 – 2.1905	25.5 – 25.67	1435 – 1626.5	7.25 – 7.75
4.125 – 4.128	37.5 – 38.25	1645.5 – 1646.5	8.025 – 8.5
4.17725 – 4.17775	73 – 74.6	1660 – 1710	9.0 – 9.2
4.20725 – 4.20775	74.8 – 75.2	1718.8 – 1722.2	9.3 – 9.5
6.215 – 6.218	108 – 121.94	2200 – 2300	10.6 – 12.7
6.26775 – 6.26825	123 – 138	2310 – 2390	13.25 – 13.4
6.31175 – 6.31225	149.9 – 150.05	2483.5 – 2500	14.47 – 14.5
8.291 – 8.294	156.52475 – 156.52525	2690 – 2900	15.35 – 16.2
8.362 – 8.366	156.7 – 156.9	3260 – 3267	17.7 – 21.4
8.37625 – 8.38675	162.0125 –167.17	3.332 – 3.339	22.01 – 23.12
8.41425 – 8.41475	167.72 – 173.2	3 3458 – 3 358	23.6 – 24.0
12.29 – 12.293	240 – 285	3.600 – 4.400	31.2 – 31.8
12.51975 – 12.52025	322 – 335.4		36.43 – 36.5
12.57675 – 12.57725	399.9 – 410		Above 38.6
13.36 – 13.41	608 – 614		

As per FCC §15.247 (d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated 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, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c).

As per IC RSS-210 A8.5 Out-of-band Emissions, In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section A8.4 (4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

8.2 Test Setup

The radiated emissions tests were performed in the 5-meter Chamber, using the setup in accordance with ANSI C63.4-2009. The specification used was the FCC 15 Subpart C and IC RSS-210 limits.

The spacing between the peripherals was 10 centimeters.

External I/O cables were draped along the edge of the test table and bundle when necessary.

8.3 Test Procedure

The measurements are based on FCC KDB 558074 D01 DTS Meas Guidance v03r01: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 section 11: Emissions in non-restricted frequency bands and section 12: Emissions in restricted frequency bands. As well as ANSI C63.4: 2009 as described below:

For the radiated emissions test, the EUT host, and all support equipment power cords was connected to the AC floor outlet.

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

The EUT is set 3 meter away from the testing antenna, which is varied from 1-4 meter, and the EUT is placed on a turntable, which is 0.8 meter above ground plane, the table shall be rotated for 360 degrees to find out the highest emission. The receiving antenna should be changed the polarization both of horizontal and vertical.

The spectrum analyzer or receiver is set as:

Below 1000 MHz:

RBW = 100 kHz / VBW = 300 kHz / Sweep = Auto

Above 1000 MHz:

(1) Peak: RBW = 1MHz / VBW = 1MHz / Sweep = Auto
(2) Average: RBW = 1MHz / VBW = 10Hz / Sweep = Auto

8.4 Corrected Amplitude & Margin Calculation

The Corrected Amplitude (CA) is calculated by adding the Antenna Factor (AF), the Cable Loss (CL), the Attenuator Factor (Atten) and subtracting the Amplifier Gain (Ga) to indicated Amplitude (Ai) reading. The basic equation is as follows:

CA = Ai + AF + CL + Atten – Ga

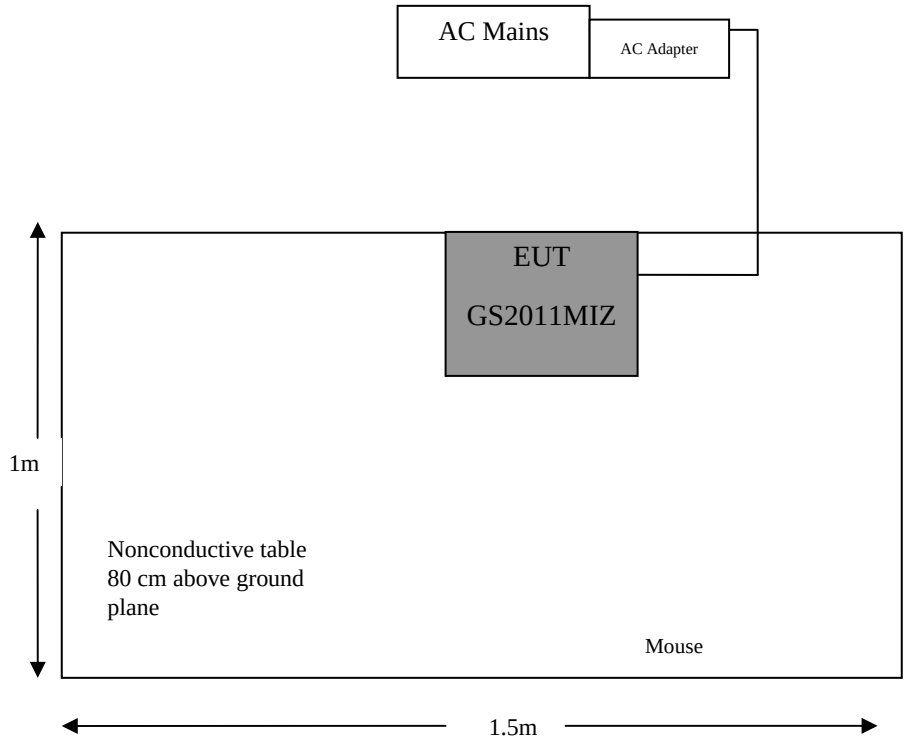
For example, a corrected amplitude of 40.3 dBuV/m = Indicated Reading (32.5 dBuV) + Antenna Factor (+23.5dB) + Cable Loss (3.7 dB) + Attenuator (10 dB) - Amplifier Gain (29.4 dB)

The "**Margin**" column of the following data tables indicates the degree of compliance within the applicable limit. For example, a margin of -7 dB means the emission is 7 dB below the maximum limit. The equation for margin calculation is as follows:

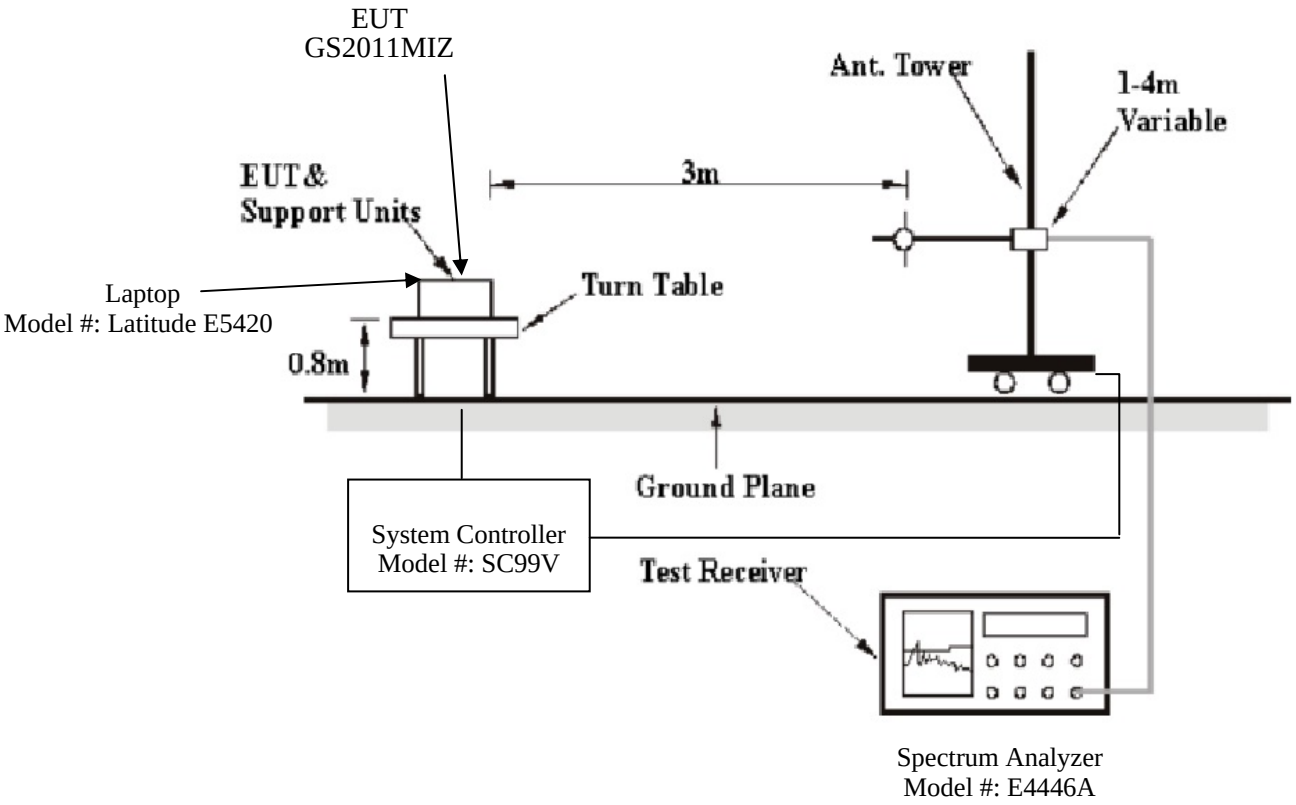
Margin = Corrected Amplitude - Limit

8.5 Test Setup Block Diagram

Block Diagram #1



Block Diagram #2



8.6 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Cycle
Agilent	Spectrum Analyzer	E4446A	MY48250238	2013-08-29	1 year
Sunol Science Corp	System Controller	SC99V	122303-1	N/R	N/R
Sunol Science Corp	Combination Antenna	JB3	A020106-3	2013-07-11	1 Year
Hewlett Packard	Pre-amplifier	8447D	2944A06639	2013-06-09	1 Year
EMCO	Horn antenna	3115	9511-4627	2014-1-7	1 Year
Mini-Circuits	Pre Amplifier	ZVA-183-S	570400946	2013-05-09	1 Year

Statement of Traceability: BACL *attests that all calibrations have been performed per the A2LA requirements, traceable to NIST.*

8.7 Test Environmental Conditions

Temperature:	22º C
Relative Humidity:	52 %
ATM Pressure:	101.89 kPa

The testing was performed by Ken Bai on 2014-02-26 and 2014-02-28 in 5 m chamber 3 and 5 m chamber2.

8.8 Summary of Test Results

According to the data hereinafter, the EUT complied with the FCC Title 47, Part 15C and IC RSS-210 standard's radiated emissions limits, and had the worst margin of:

30-1000 MHz:

Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Mode, Channel**
-8.84	31.5645	Vertical	802.11b, Low CH

1-25 GHz:

Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Mode, Channel**
-4.824	2390	Horizontal	802.11n-HT20, Low CH

Please refer to the following table and plots for specific test result details

8.9 Radiated Emissions Test Data

1) 30 MHz-1 GHz, Measured at 3 meters, Quasi-Peak Measurements

802.11b mode

Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)
31.5645	31.16	99	V	226	40	-8.84
64.58	27.94	102	V	82	40	-12.06
119.8913	28.17	111	V	76	43.5	-15.33
37.273	23.62	149	V	350	40	-16.38

802.11g mode

Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)
31.6295	30.02	102	V	342	40	-9.98
64.19825	28.93	132	V	90	40	-11.07
37.33725	24.31	117	V	254	40	-15.69
119.7658	26.24	138	H	351	43.5	-17.26

802.11n-HT20 mode

Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)
31.631	29.24	125	V	258	40	-10.76
64.60775	26.75	145	V	61	40	-13.25
36.495	23.87	149	H	157	40	-16.13
713.0123	15.88	293	V	281	46	-30.12
706.342	15.77	208	V	360	46	-30.23

In 30-1000 MHz range, all spurious are digital, other emissions are on the noise floor level. The worst case result was reported.

2) 1–25 GHz, Measured at 3 meters

802.11b mode

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/IC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 2412 MHz, measured at 3 meters											
2412	68.45	202	100	V	28.956	3.12	0	100.526	N/A	N/A	Peak
2412	67.96	199	100	H	28.956	3.12	0	100.036	N/A	N/A	Peak
2412	64.36	202	100	V	28.956	3.12	0	96.436	N/A	N/A	Ave
2412	64.21	199	100	H	28.956	3.12	0	96.286	N/A	N/A	Ave
2390	26.75	0	100	V	28.956	3.12	0	58.826	74	-15.174	Peak
2390	26.46	0	100	H	28.956	3.12	0	58.536	74	-15.464	Peak
2390	12.9	0	100	V	28.956	3.12	0	44.976	54	-9.024	Ave
2390	12.67	0	100	H	28.956	3.12	0	44.746	54	-9.254	Ave
4824	33.87	0	100	V	33.097	4.56	27.7	43.827	74	-30.173	Peak
4824	33.13	0	100	H	33.097	4.56	27.7	43.087	74	-30.913	Peak
4824	27.19	0	100	V	33.097	4.56	27.7	37.147	54	-16.853	Ave
4824	26.64	0	100	H	33.097	4.56	27.7	36.597	54	-17.403	Ave
7236	32.25	0	100	V	35.928	5.49	27.58	46.088	80.526	-34.438	Peak
7236	31.8	0	100	H	35.928	5.49	27.58	45.638	80.036	-34.398	Peak
7236	17.74	0	100	V	35.928	5.49	27.58	31.578	76.436	-44.858	Ave
7236	17.73	0	100	H	35.928	5.49	27.58	31.568	76.286	-44.718	Ave
Middle Channel 2437 MHz, measured at 3 meters											
2437	67.83	209	100	V	28.956	3.12	0	99.906	N/A	N/A	Peak
2437	68.75	115	100	H	28.956	3.12	0	100.826	N/A	N/A	Peak
2437	64.44	209	100	V	28.956	3.12	0	96.516	N/A	N/A	Ave
2437	64.69	115	100	H	28.956	3.12	0	96.766	N/A	N/A	Ave
4874	33.77	307	100	V	33.327	4.54	27.76	43.877	74	-30.123	Peak
4874	32.04	0	100	H	33.327	4.54	27.76	42.147	74	-31.853	Peak
4874	27.63	307	100	V	33.327	4.54	27.76	37.737	54	-16.263	Ave
4874	26.26	0	100	H	33.327	4.54	27.76	36.367	54	-17.633	Ave
7311	31.1	0	100	V	36.369	5.57	27.51	45.529	74	-28.471	Peak
7311	30.99	0	100	H	36.369	5.57	27.51	45.419	74	-28.581	Peak
7311	18.04	0	100	V	36.369	5.57	27.51	32.469	54	-21.531	Ave
7311	17.97	0	100	H	36.369	5.57	27.51	32.399	54	-21.601	Ave

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/IC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
High Channel 2462 MHz, measured at 3 meters											
2462	66.51	216	100	V	29.155	3.25	0	98.915	N/A	N/A	Peak
2462	67.87	260	100	H	29.155	3.25	0	100.275	N/A	N/A	Peak
2462	62.15	216	100	V	29.155	3.25	0	94.555	N/A	N/A	Ave
2462	63.36	260	100	H	29.155	3.25	0	95.765	N/A	N/A	Ave
2483.5	27.3	0	100	V	29.155	3.25	0	59.705	74	-14.295	Peak
2483.5	28.16	117	100	H	29.155	3.25	0	60.565	74	-13.435	Peak
2483.5	13.14	0	100	V	29.155	3.25	0	45.545	54	-8.455	Ave
2483.5	13.57	117	100	H	29.155	3.25	0	45.975	54	-8.025	Ave
4924	34.47	307	100	V	33.327	4.52	27.75	44.567	74	-29.433	Peak
4924	33.72	0	100	H	33.327	4.52	27.75	43.817	74	-30.183	Peak
4924	29.56	307	100	V	33.327	4.52	27.75	39.657	54	-14.343	Ave
4924	28.19	0	100	H	33.327	4.52	27.75	38.287	54	-15.713	Ave
7386	31.29	0	100	V	36.565	5.62	27.51	45.965	74	-28.035	Peak
7386	30.6	0	100	H	36.565	5.62	27.51	45.275	74	-28.725	Peak
7386	17.99	0	100	V	36.565	5.62	27.51	32.665	54	-21.335	Ave
7386	17.95	0	100	H	36.565	5.62	27.51	32.625	54	-21.375	Ave

802.11g mode

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/IC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 2412 MHz, measured at 3 meters											
2412	67.64	222	100	V	28.956	3.12	0	99.716	N/A	N/A	Peak
2412	70.59	149	100	H	28.956	3.12	0	102.666	N/A	N/A	Peak
2412	57.5	222	100	V	28.956	3.12	0	89.576	N/A	N/A	Ave
2412	61.06	149	100	H	28.956	3.12	0	93.136	N/A	N/A	Ave
2390	30.52	213	100	V	28.956	3.12	0	62.596	74	-11.404	Peak
2390	32.05	139	100	H	28.956	3.12	0	64.126	74	-9.874	Peak
2390	14.5	213	100	V	28.956	3.12	0	46.576	54	-7.424	Ave
2390	15.7	139	100	H	28.956	3.12	0	47.776	54	-6.224	Ave
4824	33.45	97	100	V	33.097	4.56	27.7	43.407	74	-30.593	Peak
4824	33.71	0	100	H	33.097	4.56	27.7	43.667	74	-30.333	Peak
4824	25.59	97	100	V	33.097	4.56	27.7	35.547	54	-18.453	Ave
4824	26.08	0	100	H	33.097	4.56	27.7	36.037	54	-17.963	Ave
7236	30.63	0	100	V	35.928	5.49	27.58	44.468	74	-29.532	Peak
7236	30.23	0	100	H	35.928	5.49	27.58	44.068	74	-29.932	Peak
7236	17.81	0	100	V	35.928	5.49	27.58	31.648	54	-22.352	Ave
7236	17.77	0	100	H	35.928	5.49	27.58	31.608	54	-22.392	Ave
Middle Channel 2437 MHz, measured at 3 meters											
2437	67.06	216	100	V	28.956	3.12	0	99.136	N/A	N/A	Peak
2437	69.82	152	100	H	28.956	3.12	0	101.896	N/A	N/A	Peak
2437	56.06	216	100	V	28.956	3.12	0	88.136	N/A	N/A	Ave
2437	59.46	152	100	H	28.956	3.12	0	91.536	N/A	N/A	Ave
4874	34.01	310	100	V	33.327	4.54	27.76	44.117	74	-29.883	Peak
4874	33.6	0	100	H	33.327	4.54	27.76	43.707	74	-30.293	Peak
4874	26.92	310	100	V	33.327	4.54	27.76	37.027	54	-16.973	Ave
4874	27.33	0	100	H	33.327	4.54	27.76	37.437	54	-16.563	Ave
7311	31.86	0	100	V	36.369	5.57	27.51	46.289	74	-27.711	Peak
7311	31.8	0	100	H	36.369	5.57	27.51	46.229	74	-27.771	Peak
7311	18.13	0	100	V	36.369	5.57	27.51	32.559	54	-21.441	Ave
7311	17.96	0	100	H	36.369	5.57	27.51	32.389	54	-21.611	Ave

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/IC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
High Channel 2462 MHz, measured at 3 meters											
2462	67.57	223	100	V	29.155	3.25	0	99.975	N/A	N/A	Peak
2462	68.67	137	100	H	29.155	3.25	0	101.075	N/A	N/A	Peak
2462	57.56	223	100	V	29.155	3.25	0	89.965	N/A	N/A	Ave
2462	57.75	137	100	H	29.155	3.25	0	90.155	N/A	N/A	Ave
2483.5	33.7	219	100	V	29.155	3.25	0	66.105	74	-7.895	Peak
2483.5	33.8	151	100	H	29.155	3.25	0	66.205	74	-7.795	Peak
2483.5	15.7	219	100	V	29.155	3.25	0	48.105	54	-5.895	Ave
2483.5	15.84	151	100	H	29.155	3.25	0	48.245	54	-5.755	Ave
4924	35.08	309	100	V	33.327	4.52	27.75	45.177	74	-28.823	Peak
4924	34.13	0	100	H	33.327	4.52	27.75	44.227	74	-29.773	Peak
4924	29.84	309	100	V	33.327	4.52	27.75	39.937	54	-14.063	Ave
4924	27.25	0	100	H	33.327	4.52	27.75	37.347	54	-16.653	Ave
7386	30.52	0	100	V	36.565	5.62	27.51	45.195	74	-28.805	Peak
7386	29.83	0	100	H	36.565	5.62	27.51	44.505	74	-29.495	Peak
7386	18.02	0	100	V	36.565	5.62	27.51	32.695	54	-21.305	Ave
7386	17.83	0	100	H	36.565	5.62	27.51	32.505	54	-21.495	Ave

802.11n-HT20 mode

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/IC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 2412 MHz, measured at 3 meters											
2412	67.18	227	100	V	28.956	3.12	0	99.256	N/A	N/A	Peak
2412	70.01	148	100	H	28.956	3.12	0	102.086	N/A	N/A	Peak
2412	56.9	227	100	V	28.956	3.12	0	88.976	N/A	N/A	Ave
2412	60.04	148	100	H	28.956	3.12	0	92.116	N/A	N/A	Ave
2390	35.41	221	100	V	28.956	3.12	0	67.486	74	-6.514	Peak
2390	37.67	152	100	H	28.956	3.12	0	69.746	74	-4.254	Peak
2390	15.36	221	100	V	28.956	3.12	0	47.436	54	-6.564	Ave
2390	17.1	152	100	H	28.956	3.12	0	49.176	54	-4.824	Ave
4824	34.47	323	100	V	33.097	4.56	27.7	44.427	74	-29.573	Peak
4824	34.76	319	100	H	33.097	4.56	27.7	44.717	74	-29.283	Peak
4824	29.36	323	100	V	33.097	4.56	27.7	39.317	54	-14.683	Ave
4824	28.47	319	100	H	33.097	4.56	27.7	38.427	54	-15.573	Ave
7236	31.48	0	100	V	35.928	5.49	27.58	45.318	74	-28.682	Peak
7236	30.86	0	100	H	35.928	5.49	27.58	44.698	74	-29.302	Peak
7236	17.92	0	100	V	35.928	5.49	27.58	31.758	54	-22.242	Ave
7236	17.87	0	100	H	35.928	5.49	27.58	31.708	54	-22.292	Ave
Middle Channel 2437 MHz, measured at 3 meters											
2437	66.06	207	100	V	28.956	3.12	0	98.136	N/A	N/A	Peak
2437	68.7	148	100	H	28.956	3.12	0	100.776	N/A	N/A	Peak
2437	56.23	207	100	V	28.956	3.12	0	88.306	N/A	N/A	Ave
2437	58.53	148	100	H	28.956	3.12	0	90.606	N/A	N/A	Ave
4874	36.19	219	100	V	33.327	4.54	27.76	46.297	74	-27.703	Peak
4874	34.15	31	100	H	33.327	4.54	27.76	44.257	74	-29.743	Peak
4874	29.95	219	100	V	33.327	4.54	27.76	40.057	54	-13.943	Ave
4874	27.42	31	100	H	33.327	4.54	27.76	37.527	54	-16.473	Ave
7311	32.05	0	100	V	36.369	5.57	27.51	46.479	74	-27.521	Peak
7311	32.91	0	100	H	36.369	5.57	27.51	47.339	74	-26.661	Peak
7311	17.84	0	100	V	36.369	5.57	27.51	32.269	54	-21.731	Ave
7311	18.09	0	100	H	36.369	5.57	27.51	32.519	54	-21.481	Ave

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/IC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
High Channel 2462 MHz, measured at 3 meters											
2462	67.22	227	100	V	29.155	3.25	0	99.625	N/A	N/A	Peak
2462	68.09	151	100	H	29.155	3.25	0	100.495	N/A	N/A	Peak
2462	56.03	227	100	V	29.155	3.25	0	88.435	N/A	N/A	Ave
2462	58	151	100	H	29.155	3.25	0	90.405	N/A	N/A	Ave
2483.5	35.37	212	100	V	29.155	3.25	0	67.775	74	-6.225	Peak
2483.5	34.62	156	100	H	29.155	3.25	0	67.025	74	-6.975	Peak
2483.5	16.32	212	100	V	29.155	3.25	0	48.725	54	-5.275	Ave
2483.5	16.22	156	100	H	29.155	3.25	0	48.625	54	-5.375	Ave
4924	35.61	224	100	V	33.327	4.52	27.75	45.707	74	-28.293	Peak
4924	33.56	167	100	H	33.327	4.52	27.75	43.657	74	-30.343	Peak
4924	29.37	224	100	V	33.327	4.52	27.75	39.467	54	-14.533	Ave
4924	26.7	167	100	H	33.327	4.52	27.75	36.797	54	-17.203	Ave
7386	30.45	0	100	V	36.565	5.62	27.51	45.125	74	-28.875	Peak
7386	30.39	0	100	H	36.565	5.62	27.51	45.065	74	-28.935	Peak
7386	18.18	0	100	V	36.565	5.62	27.51	32.855	54	-21.145	Ave
7386	18.21	0	100	H	36.565	5.62	27.51	32.885	54	-21.115	Ave

9 FCC§15.247(a)(2) & IC RSS-210 §A8.2 – 6 dB & 99% Emission Bandwidth

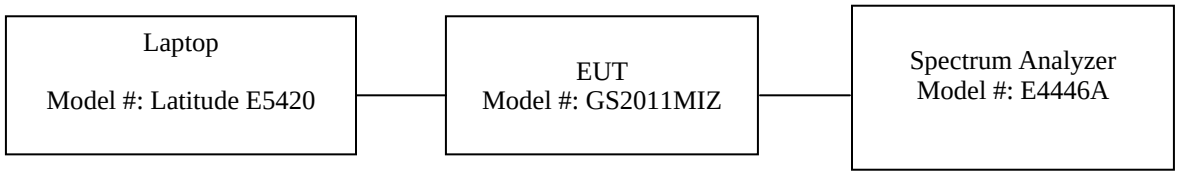
9.1 Applicable Standard

According to FCC §15.247(a)(2) and IC RSS-210 A8.2 (a), systems using digital modulation techniques may operate in the 902~928 MHz, 2400~2483.5 MHz, and 5725~5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz

9.2 Measurement Procedure

The measurements are base on FCC KDB 558074 D01 DTS Meas Guidance v03r01: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 section 8: DTS bandwidth

9.3 Test Setup Block Diagram



9.4 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Cycle
Agilent	Spectrum Analyzer	E4446A	MY48250238	2013-08-29	1 year

Statement of Traceability: BACL Corp. *attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.*

9.5 Test Environmental Conditions

Temperature:	22-24° C
Relative Humidity:	42-45 %
ATM Pressure:	101-102 kPa

The testing was performed by Ken Bai from 2014-2-22 and 2014-2-26 at RF site.

9.6 Test Results

802.11 b mode

Channel	Frequency (MHz)	6 dB OBW (MHz)	99% OBW (MHz)	Limit (MHz)	Results
Low	2412	13.160	16.549	> 0.5	Compliant
Middle	2437	13.157	16.483	> 0.5	Compliant
High	2462	13.136	16.452	> 0.5	Compliant

802.11 g mode

Channel	Frequency (MHz)	6 dB OBW (MHz)	99% OBW (MHz)	Limit (MHz)	Results
Low	2412	16.468	16.428	> 0.5	Compliant
Middle	2437	16.485	16.413	> 0.5	Compliant
High	2462	16.528	16.426	> 0.5	Compliant

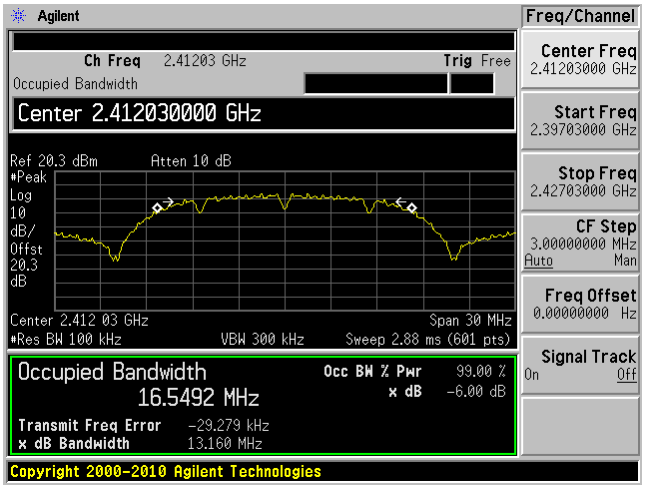
802.11n-HT20 mode

Channel	Frequency (MHz)	6 dB OBW (MHz)	99% OBW (MHz)	Limit (MHz)	Results
Low	2412	17.622	17.515	> 0.5	Compliant
Middle	2437	17.560	17.511	> 0.5	Compliant
High	2462	17.586	17.495	> 0.5	Compliant

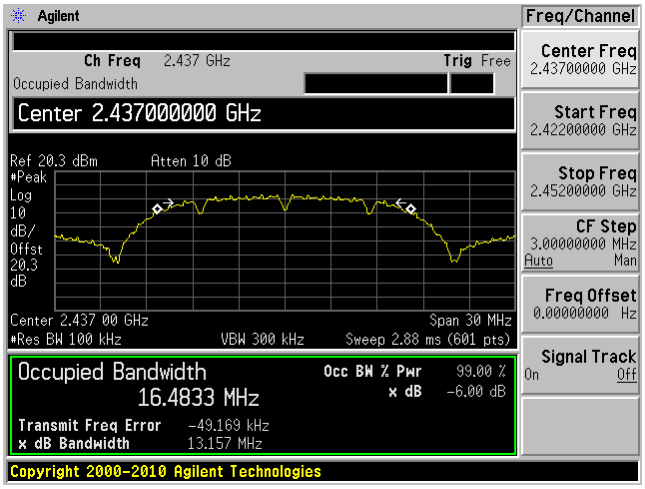
Please refer to the following plots for detailed test results

802.11b mode

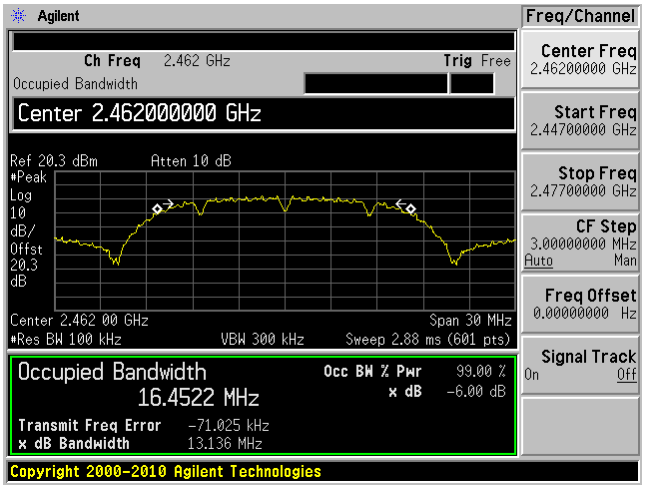
Low channel: 2412 MHz



Middle channel: 2437 MHz

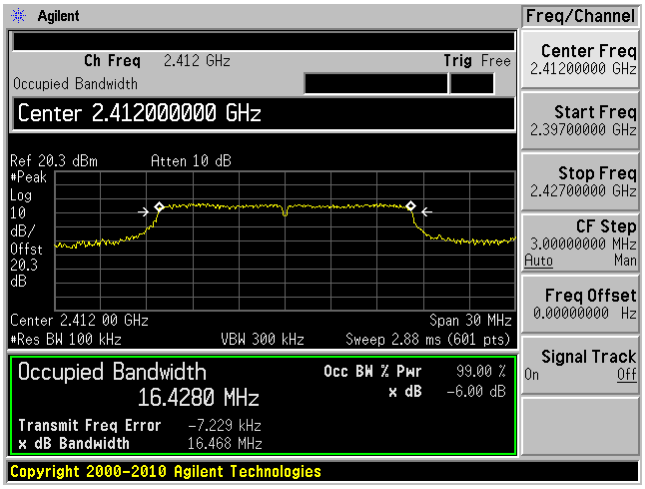


High channel: 2462 MHz

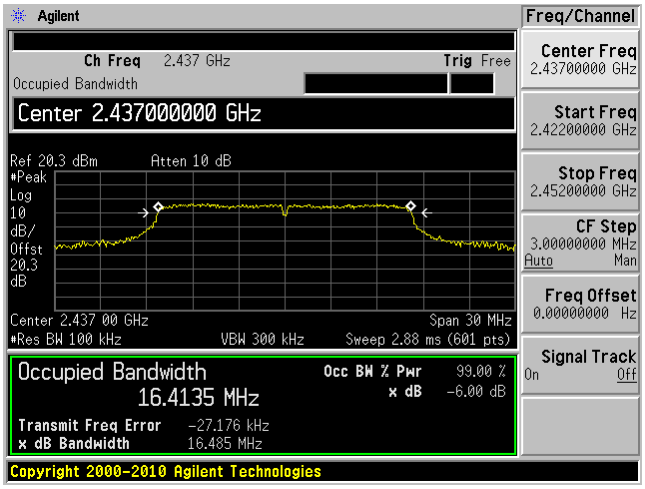


802.11g mode

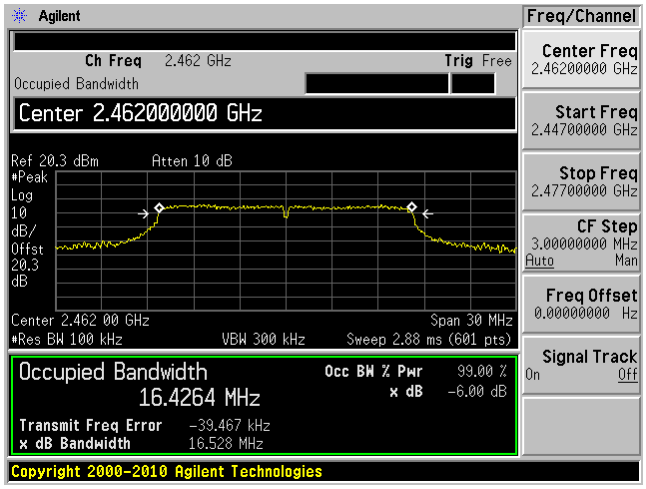
Low channel: 2412 MHz



Middle channel: 2437 MHz

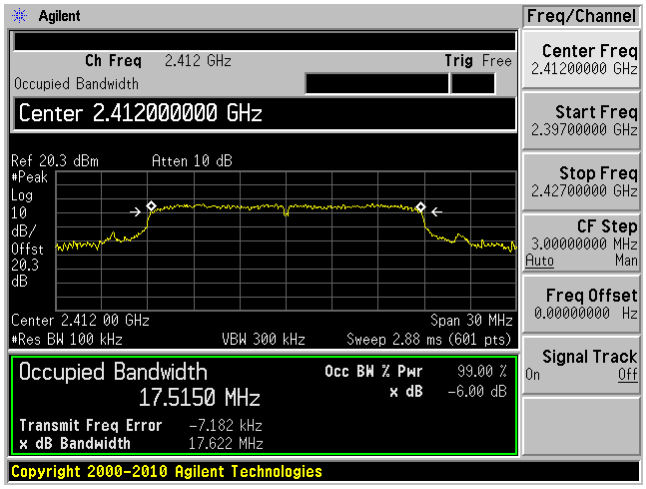


High channel: 2462 MHz

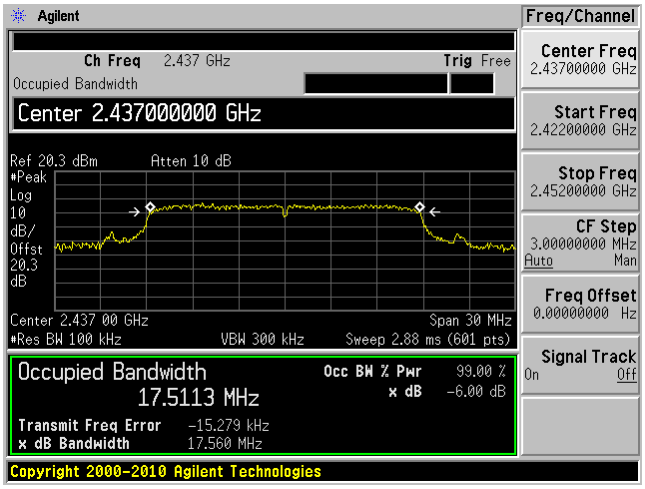


802.11n-HT20 mode

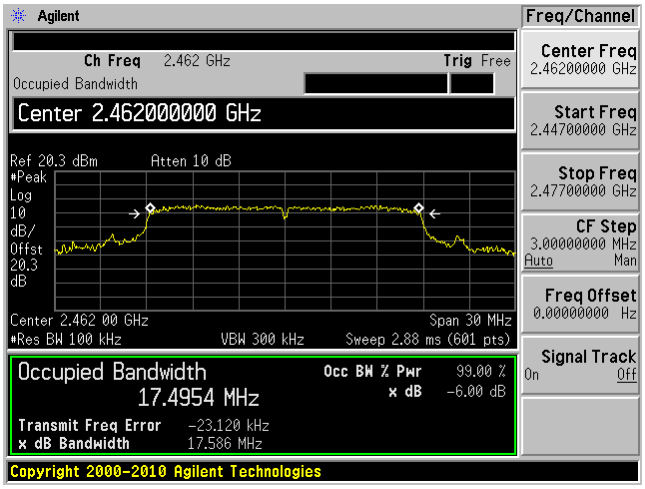
Low channel: 2412 MHz



Middle channel: 2437 MHz



High channel: 2462 MHz



10 FCC §15.247(b) & IC RSS-210 §A8.4 – Peak Output Power Measurement

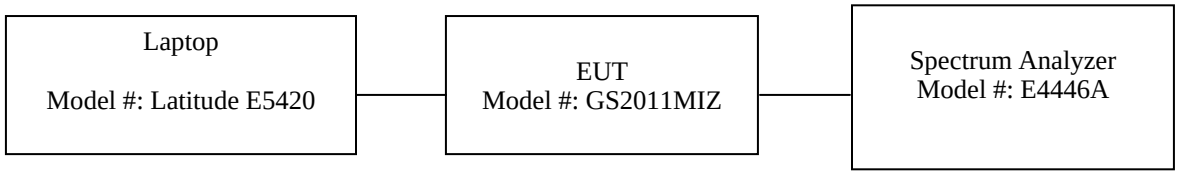
10.1 Applicable Standard

According to FCC §15.247(b) and IC RSS-210 §A8.4 (4) for systems using digital modulation in the 902~928 MHz, 2400~2483.5 MHz, and 5725~5850 MHz bands: 1 Watt.

10.2 Measurement Procedure

The measurements are base on FCC KDB 558074 D01 DTS Meas Guidance v03r01: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 section 9: Fundamental emission output power

10.3 Test Setup Block Diagram



10.4 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Cycle
Agilent	Spectrum Analyzer	E4446A	MY48250238	2013-08-29	1 year

Statement of Traceability: BACL Corp. *attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.*

10.5 Test Environmental Conditions

Temperature:	22-24° C
Relative Humidity:	42-45 %
ATM Pressure:	101-102 kPa

The testing was performed by Ken Bai from 2014-2-22 and 2014-2-26 at RF site.

10.6 Test Results

802.11b mode

Channel	Frequency (MHz)	Conducted Output Power (dBm)	Limit (dBm)	Margin (dB)	Power Setting
Low	2412	19.13	30	-10.87	20
Middle	2437	18.61	30	-11.39	20
High	2462	17.83	30	-12.17	20

802.11g mode

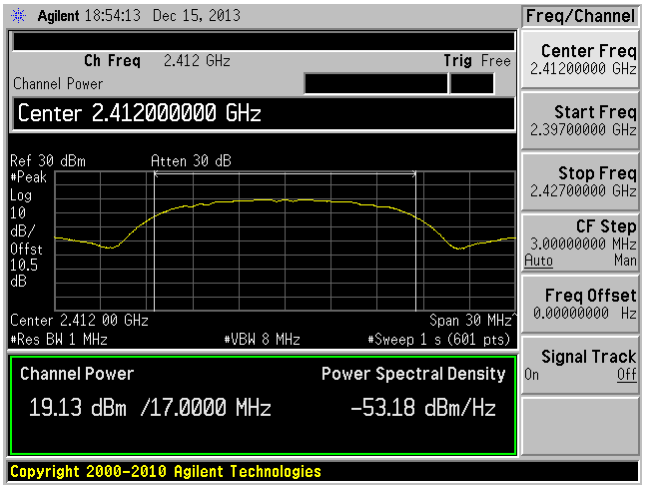
Channel	Frequency (MHz)	Conducted Output Power (dBm)	Limit (dBm)	Margin (dB)	Power Setting
Low	2412	19.8	30	-10.2	24
Middle	2437	19.4	30	-10.6	24
High	2462	18.59	30	-11.41	24

802.11n-HT20 mode

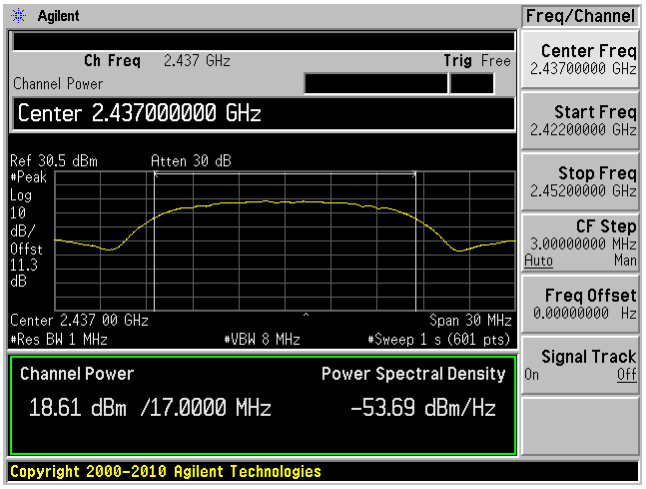
Channel	Frequency (MHz)	Conducted Output Power (dBm)	Limit (dBm)	Margin (dB)	Power Setting
Low	2412	19.61	30	-10.39	24
Middle	2437	19.24	30	-10.76	24
High	2462	18.61	30	-11.39	24

802.11b mode

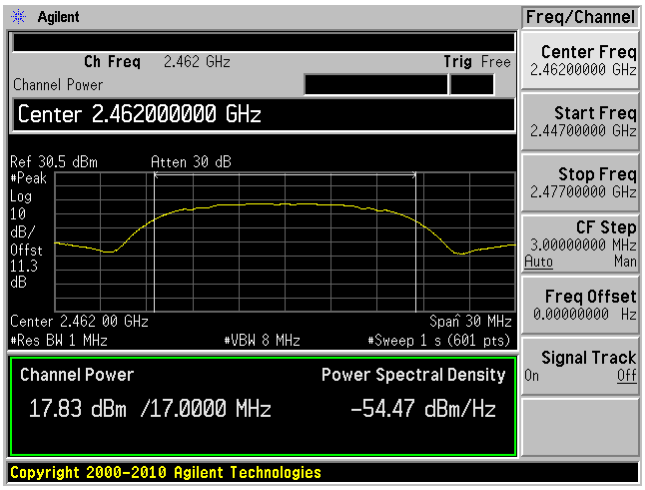
Low channel: 2412 MHz



Middle channel: 2437 MHz

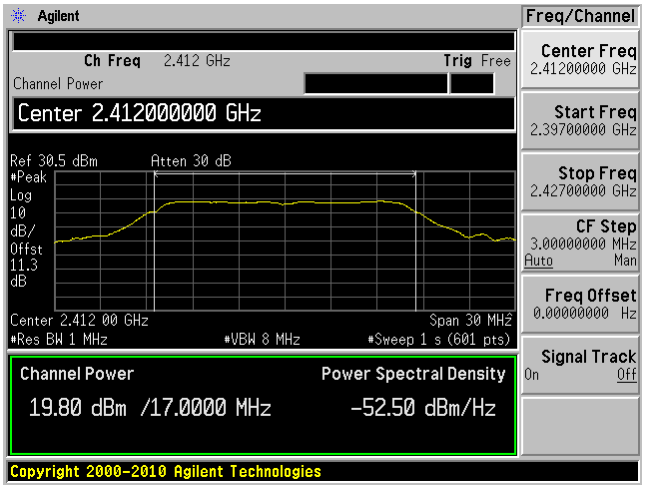


High channel: 2462 MHz

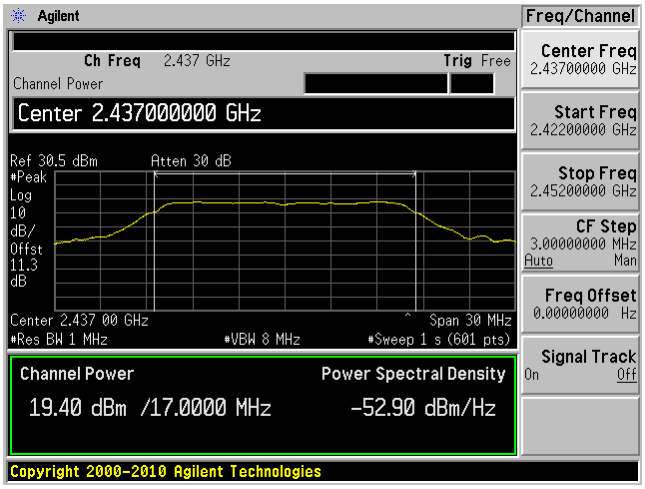


802.11g mode

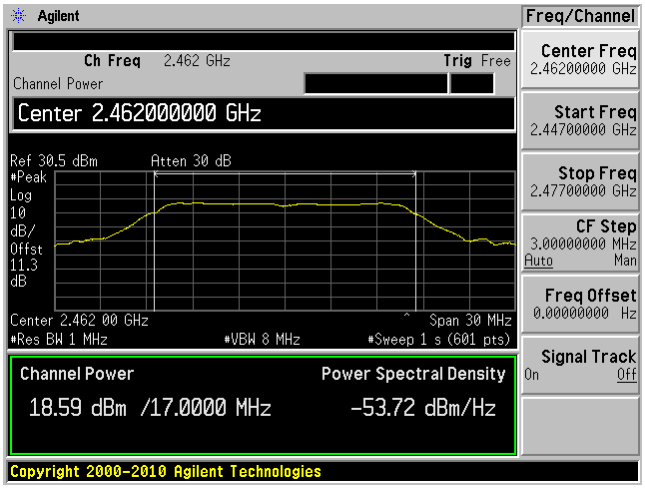
Low channel: 2412 MHz



Middle channel: 2437 MHz

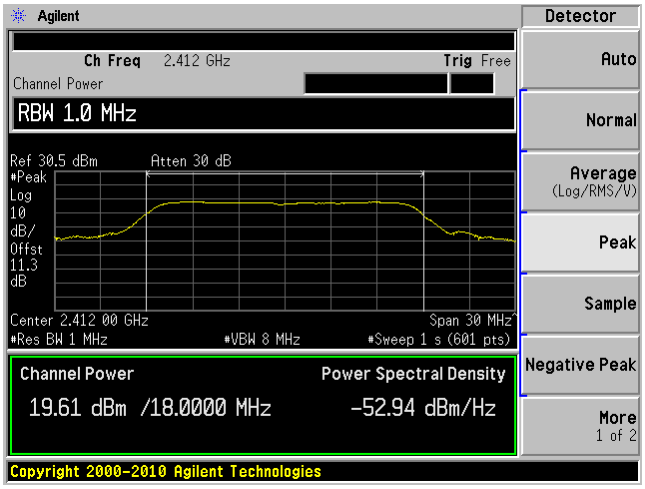


High channel: 2462 MHz

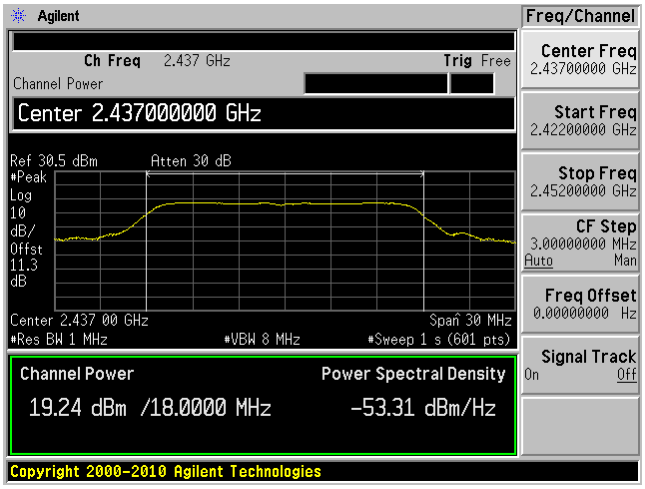


802.11n-HT20 mode

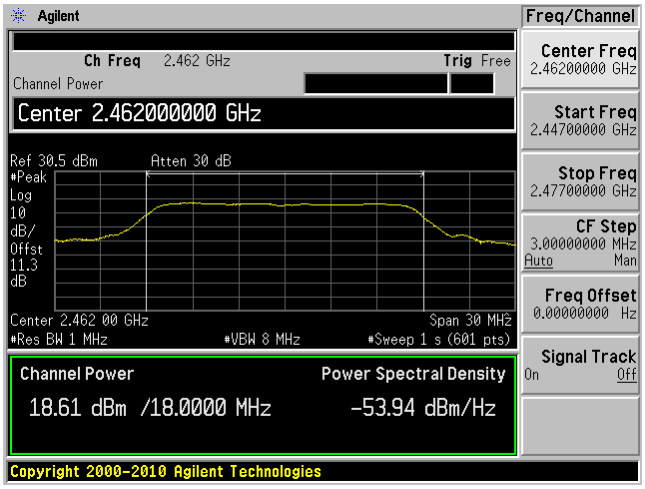
Low channel: 2412 MHz



Middle channel: 2437 MHz



High channel: 2462 MHz



11 FCC §15.247(d) & IC RSS-210 §A8.5 – 100 kHz Bandwidth of Band Edges

11.1 Applicable Standard

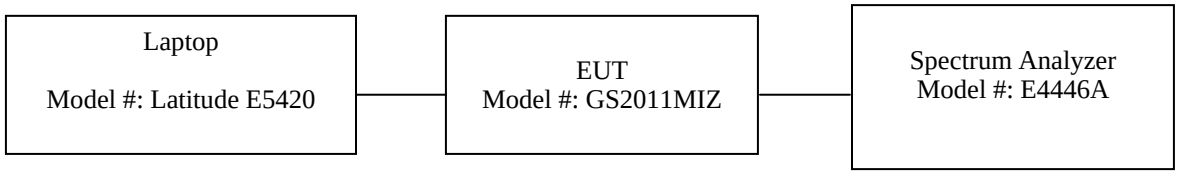
According to FCC §15.247(d), in any 100 kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emissions limits specified in §15.209(a) see §15.205(c).

According to IC Rss-210 §A8.5, in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the radio frequency power that is produced 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, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under section A8.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Tables 2 and 3 is not required.

11.2 Measurement Procedure

The measurements are base on FCC KDB 558074 D01 DTS Meas Guidance v03r01: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 section 13: Band-edge measurements

11.3 Test Setup Block Diagram



11.4 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Cycle
Agilent	Spectrum Analyzer	E4446A	MY48250238	2013-08-29	1 year

Statement of Traceability: BACL Corp. *attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.*

11.5 Test Environmental Conditions

Temperature:	22-24° C
Relative Humidity:	42-45 %
ATM Pressure:	101-102 kPa

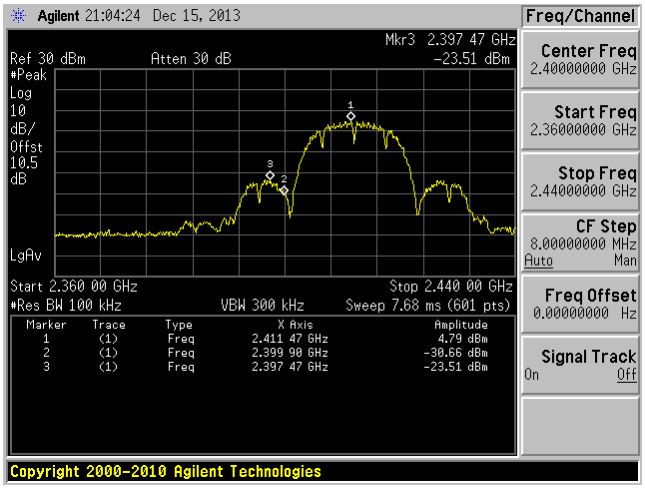
The testing was performed by Ken Bai from 2014-2-22 and 2014-2-26 at RF site.

11.6 Test Results

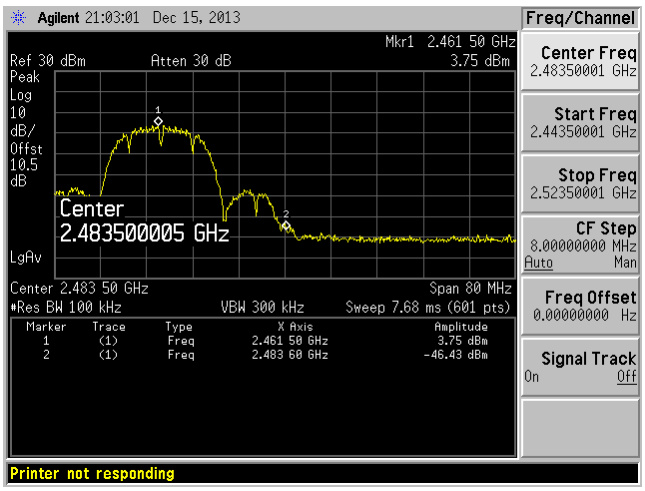
Please refer to following plots.

802.11b mode

802.11b, Low Band Edge

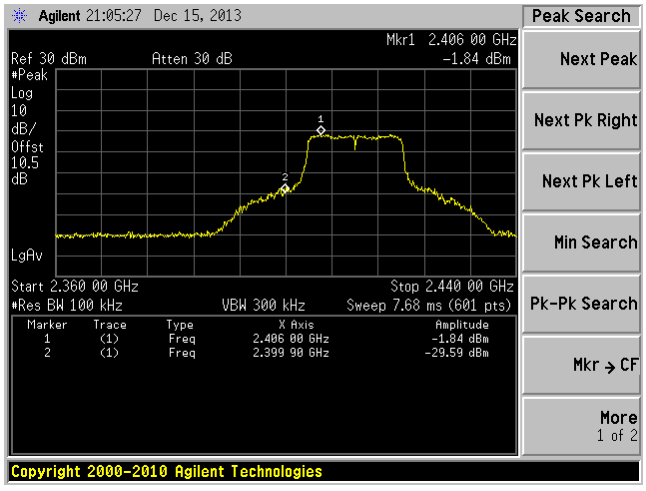


802.11b, High Band Edge

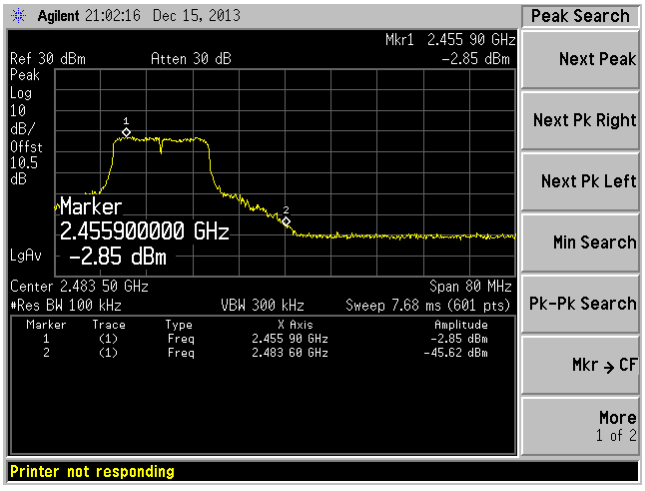


802.11g mode

802.11g, Low Band Edge

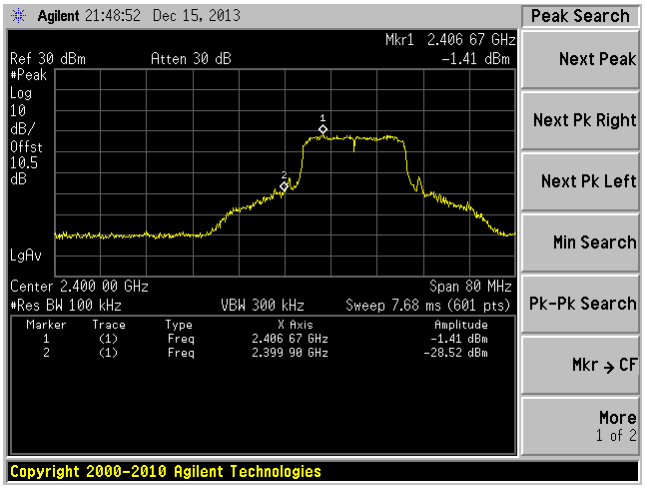


802.11g, High Band Edge

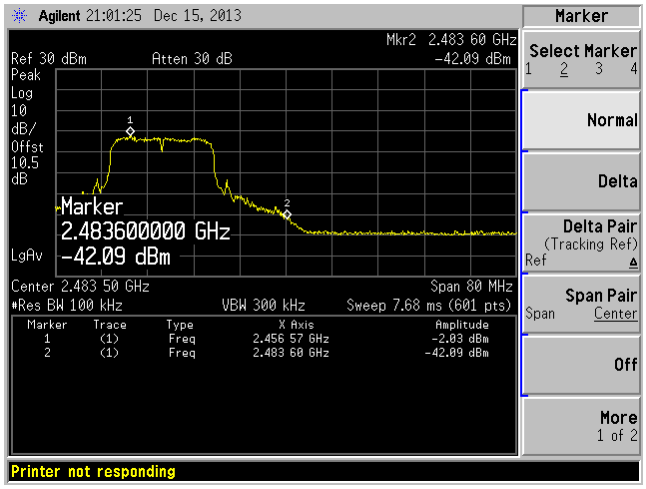


802.11n-HT20 mode

802.11n-HT20, Low Band Edge



802.11n-HT20, Chain J1 High Band Edge



12 FCC §15.247(e) & IC RSS-210 §A8.2 (b) – Power Spectral Density

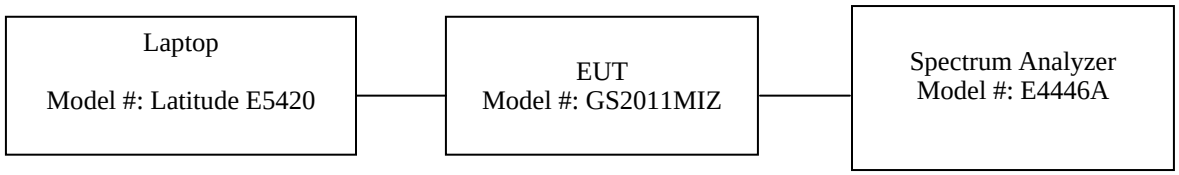
12.1 Applicable Standard

According to FCC §15.247(e) and RSS-210 §A8.2 (b) , for digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

12.2 Measurement Procedure

The measurements are base on FCC KDB 558074 D01 DTS Meas Guidance v03r01: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 section 10: Maximum power spectral density level in the fundamental emission

12.3 Test Setup Block Diagram



12.4 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Cycle
Agilent	Spectrum Analyzer	E4446A	MY48250238	2013-08-29	1 year

Statement of Traceability: BACL Corp. *attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.*

12.5 Test Environmental Conditions

Temperature:	22-24° C
Relative Humidity:	42-45 %
ATM Pressure:	101-102 kPa

The testing was performed by Ken Bai from 2014-2-22 and 2014-2-26 at RF site.

12.6 Test Results

802.11b mode

Channel	Frequency (MHz)	PSD (dBm)	Limit (dBm)	Margin (dB)
Low	2412	-13.26	8	-21.26
Middle	2437	-13.86	8	-21.86
High	2462	-14.61	8	-22.61

802.11g mode

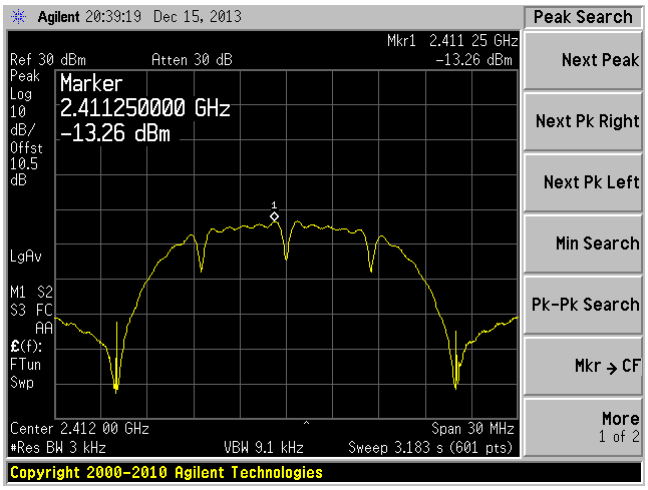
Channel	Frequency (MHz)	PSD (dBm)	Limit (dBm)	Margin (dB)
Low	2412	-15.52	8	-23.52
Middle	2437	-16.14	8	-24.14
High	2462	-16.31	8	-24.31

802.11n-HT20 mode

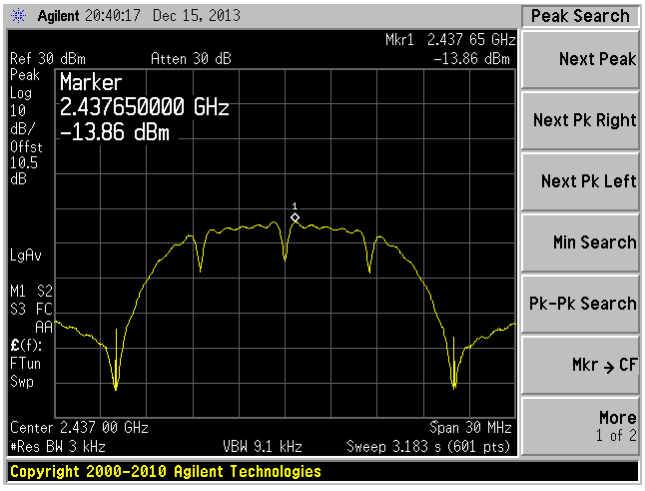
Channel	Frequency (MHz)	PSD (dBm)	Limit (dBm)	Margin (dB)
Low	2412	-15.14	8	-23.14
Middle	2437	-15.81	8	-23.81
High	2462	-16.37	8	-24.37

802.11b mode

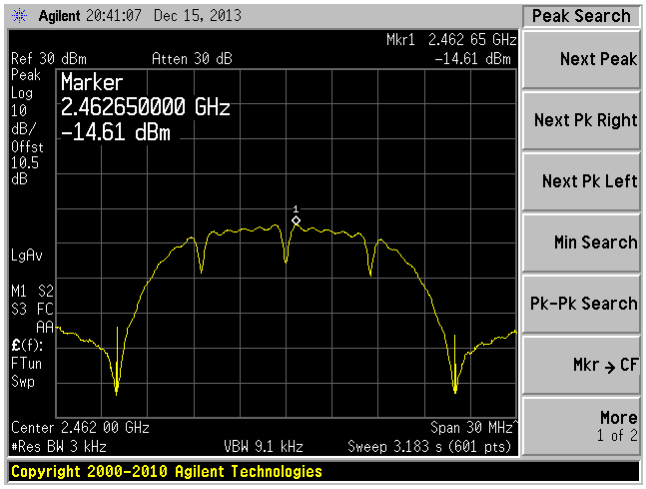
Low channel: 2412 MHz



Middle channel: 2437 MHz

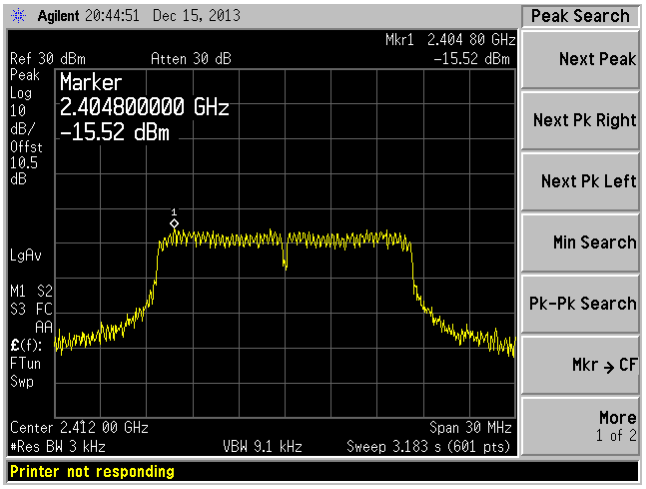


High channel: 2462 MHz

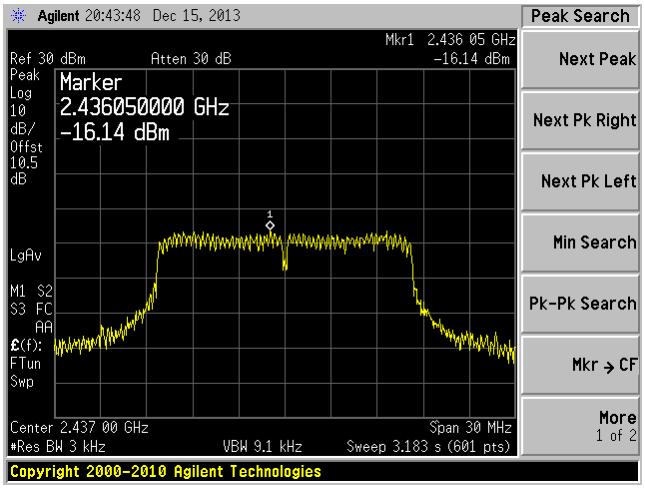


802.11g mode

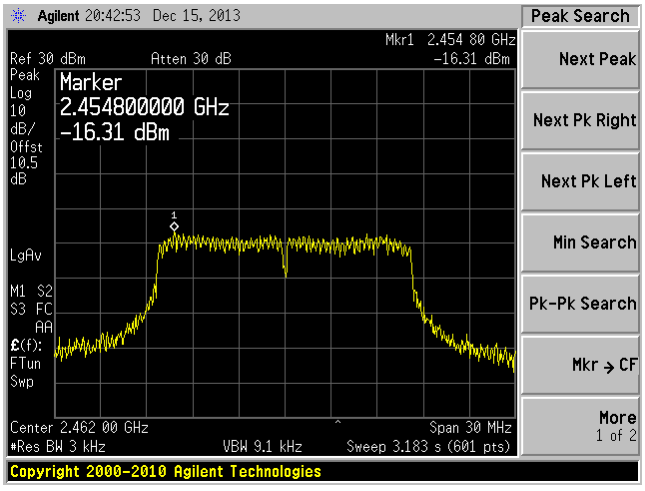
Low channel: 2412 MHz



Middle channel: 2437 MHz

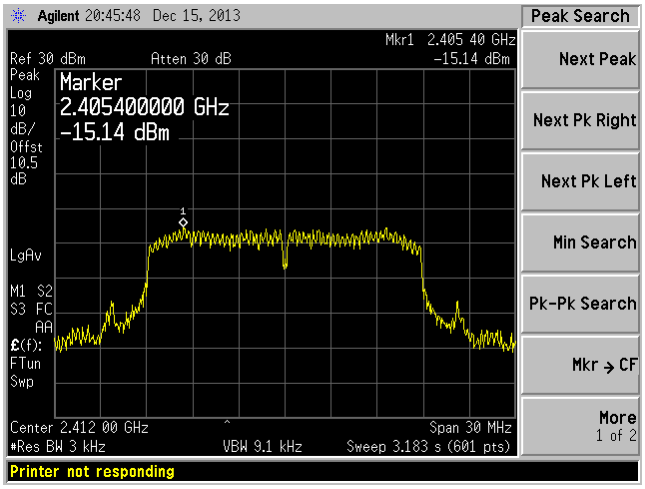


High channel: 2462 MHz

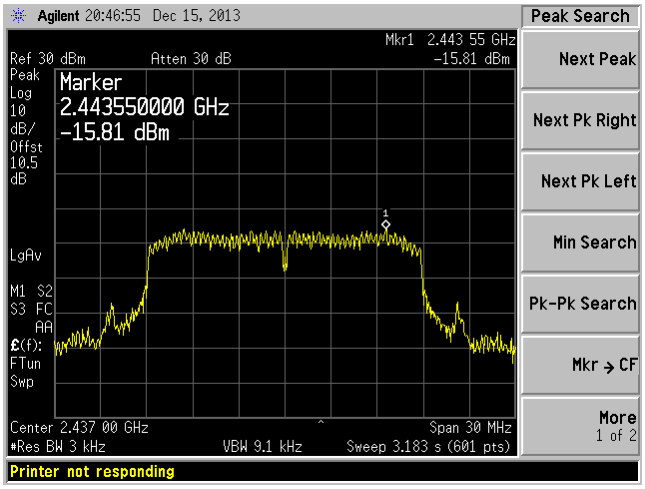


802.11n-HT20 mode

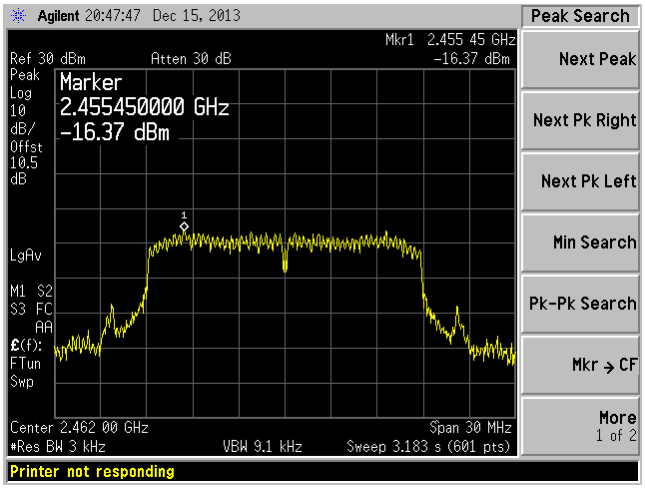
Low channel: 2412 MHz



Middle channel: 2437 MHz



High channel: 2462 MHz



13 IC RSS-210 §2.3 & RSS-Gen §4.10 – Receiver Spurious Radiated Emissions

13.1 Applicable Standard

According to IC RSS-Gen §4.10, the receiver shall be operated in the normal receive mode near the mid-point of the band over which the receiver is designed to operate.

Unless otherwise specified in the applicable RSS, the radiated emission measurement is the standard measurement method (with the device's antenna in place) to measure receiver spurious emissions.

Radiated emission measurements are to be performed using a calibrated open-area test site.

For either method, the search for spurious emissions shall be from the lowest frequency internally generated or used in the receiver (e.g. local oscillator, intermediate or carrier frequency), or 30 MHz, whichever is the higher, to at least 3 times the highest tuneable or local oscillator frequency, whichever is the higher, without exceeding 40 GHz.

For emissions below 1 GHz, measurements shall be performed using a CISPR quasi-peak detector and the related measurement bandwidth. As an alternative to CISPR quasi-peak measurement, compliance with the emission limit can be demonstrated using measuring equipment employing a peak detector with the same measurement bandwidth as that for CISPR quasi-peak measurements. Above 1 GHz, measurements shall be performed using an average detector and a resolution bandwidth of 300 kHz to 1 MHz.

According to RSS-Gen §6.1, Tables 2 show the general field strength limits of receiver spurious emissions

Table 2: Radiated Limits of Receiver Spurious Emissions

Frequency (MHz)	Field Strength (Microvolts/m at 3 meters)
30-88	100
88-216	150
216-960	200
Above 960	500

13.2 EUT Setup

The radiated emissions tests were performed in the 3 meter chamber, using the setup in accordance with ANSI C63.4-2009.

13.3 Test Procedure

Maximizing procedure was performed on the six (6) highest emissions to ensure EUT compliance is with all installation combinations.

All data were recorded in the peak detection mode. Quasi-peak readings was performed only when an emissions was found to be marginal (within -4 dB of specification limits), and are distinguished with a "**QP**" in the data table.

13.4 Corrected Amplitude & Margin Calculation

The Corrected Amplitude (CA) is calculated by adding the Antenna Factor (AF), the Cable Loss (CL), the Attenuator Factor (Atten) and subtracting the Amplifier Gain (Ga) to indicated Amplitude (Ai) reading. The basic equation is as follows:

CA = Ai + AF + CL + Atten – Ga

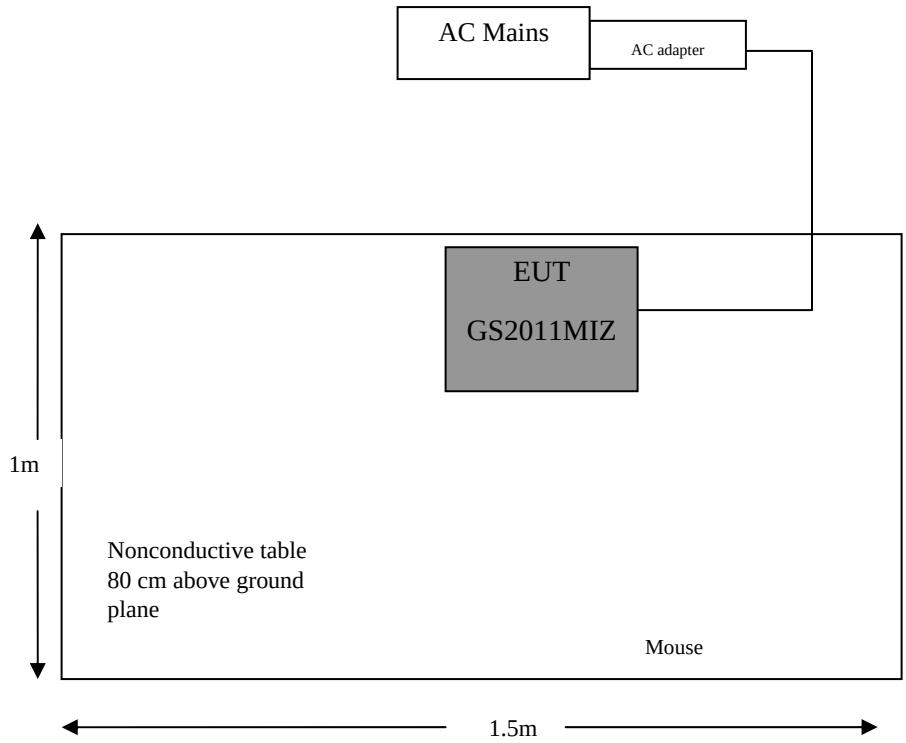
For example, a corrected amplitude of 40.3 dBuV/m = Indicated Reading (32.5 dBuV) + Antenna Factor (+23.5dB) + Cable Loss (3.7 dB) + Attenuator (10 dB) - Amplifier Gain (29.4 dB)

The "**Margin**" column of the following data tables indicates the degree of compliance within the applicable limit. For example, a margin of -7 dB means the emission is 7 dB below the maximum limit. The equation for margin calculation is as follows:

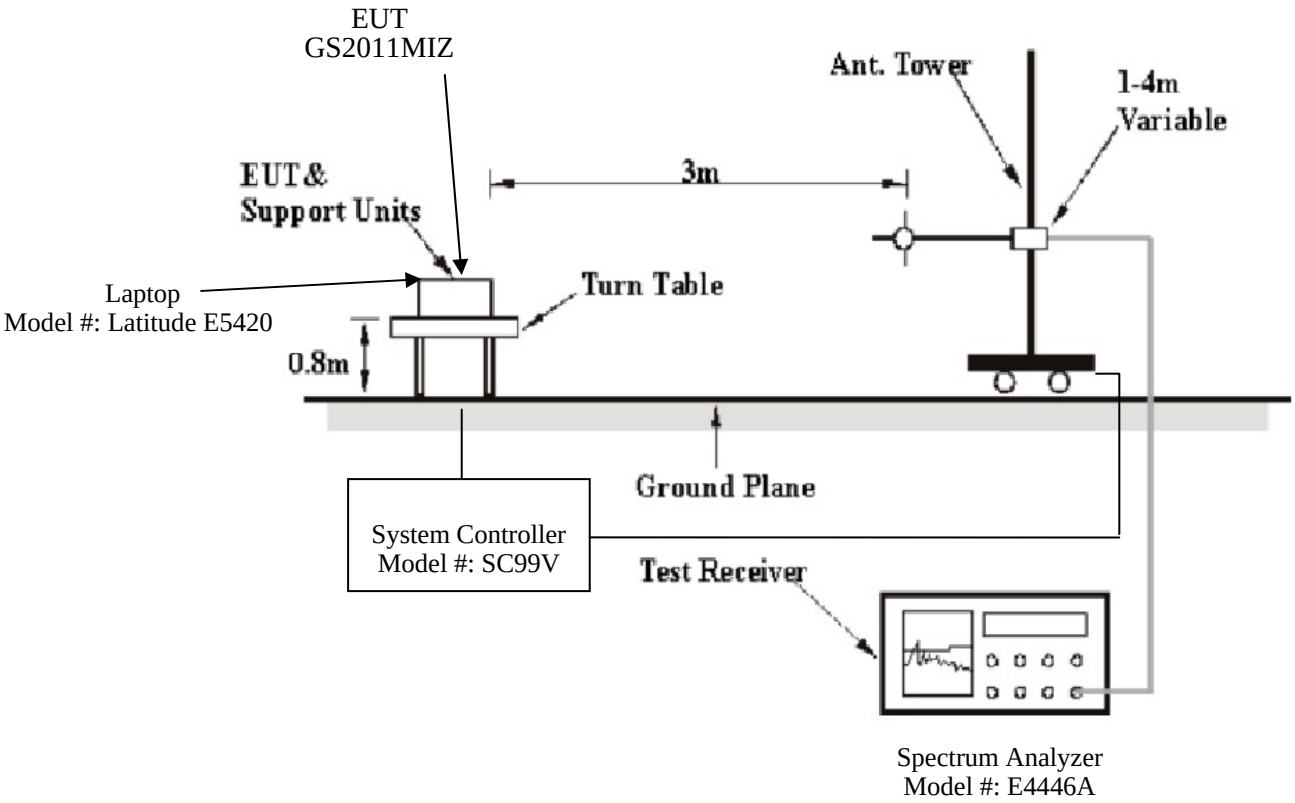
Margin = Corrected Amplitude - Limit

13.5 Test Setup Block Diagram

Block Diagram #1



Block Diagram #2



13.6 Test Equipment Lists and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Cycle
Agilent	Spectrum Analyzer	E4446A	MY48250238	2013-08-29	1 Year
Sunol Science Corp	System Controller	SC99V	122303-1	N/R	N/R
Sunol Science Corp	Combination Antenna	JB3	A020106-3	2013-07-11	1 Year
Hewlett Packard	Pre-amplifier	8447D	2944A10187	2013-03-08	1 Year
EMCO	Horn antenna	3115	9511-4627	2014-01-07	1 Year
Mini-Circuits	Pre Amplifier	ZVA-183-S	570400946	2013-05-09	1 Year

Statement of Traceability: *BACL attests that all calibrations have been performed per the A2LA requirements, traceable to NIST.*

13.7 Test Environmental Conditions

Temperature:	22° C
Relative Humidity:	47 %
ATM Pressure:	102.1 kPa

The testing was performed by Ken Bai from 2014-2-28 at 5 meter

13.8 Summary of Test Results

According to the test data, the EUT complied with the RSS-210, with the closest margins from the limit listed below:

30MHz-1GHz

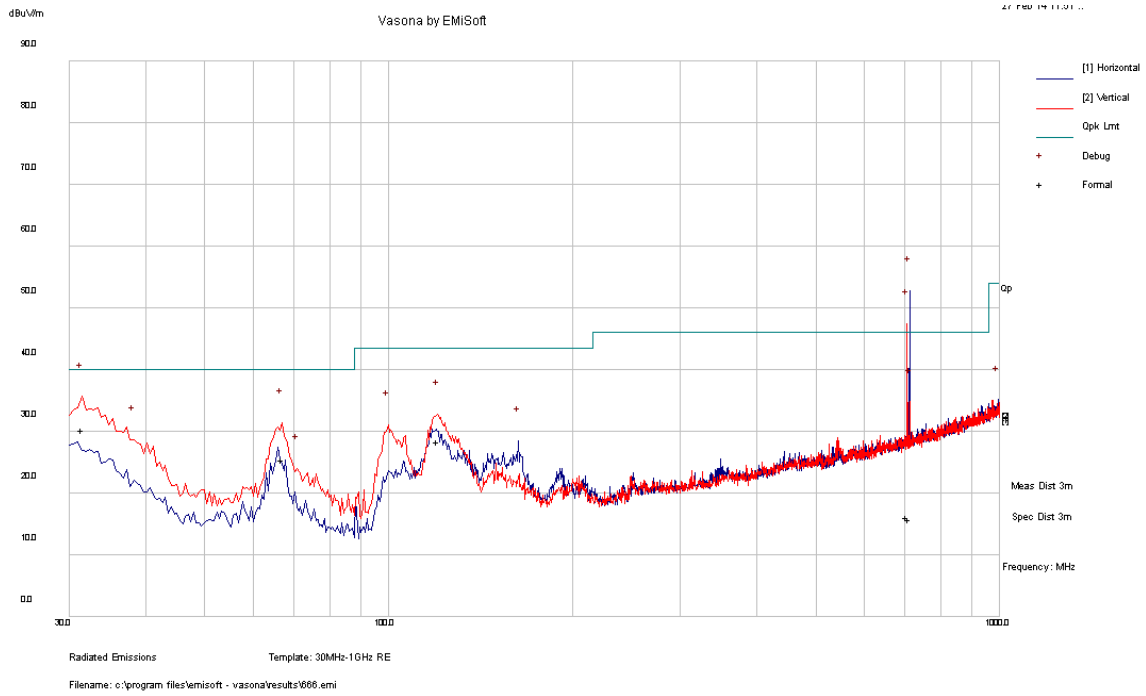
Mode: Receiving			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Range (MHz)**
-9.74	31.51975	Horizontal	30-1000

Above 1 GHz

Mode: Receiving			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Range (MHz)**
-12.187	13720	Vertical	Above 1 GHz

13.9 Test Results and Plots

1) 30-1000 MHz, Measured at 3 meters



Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Detector (QP/Ave.)
31.51975	30.26	99	H	288	40	-9.74	QP
66.94025	25.46	99	V	167	40	-14.54	QP
120.378	28.3	99	H	118	43.5	-15.20	QP
704.9153	16.04	203	V	213	46	-29.96	QP
711.79	15.82	180	V	318	46	-30.18	QP

2) Above 1 GHz Measured at 3 meters

Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Comment
1200	35.591	100	V	40	74	-38.409	Peak
1200	35.375	100	H	81	74	-38.625	Peak
1200	22.121	100	V	40	54	-31.879	Ave
1200	22.005	100	H	81	54	-31.995	Ave
3120	38.688	100	V	0	74	-35.312	Peak
3120	38.306	100	H	0	74	-35.694	Peak
3120	25.338	100	V	0	54	-28.662	Ave
3120	25.356	100	H	0	54	-28.644	Ave
13720	54.513	100	V	0	74	-19.487	Peak
13720	54.415	100	H	0	74	-19.585	Peak
13720	41.813	100	V	0	54	-12.187	Ave
13720	41.775	100	H	0	54	-12.225	Ave