



FCC PART 15, SUBPART C
IC RSS-247, ISSUE 1, MAY 2015

TEST AND MEASUREMENT REPORT

For

Venstar Inc.

9250 Owensmouth Ave.,

Chatsworth, CA 91311, USA

FCC ID: MUH-SKYPOR4
IC: 12547A-SKYPOR4

Report Type: Original Report	Product Type: Wi-Fi module, for use with a thermostat
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Report Date: 2016-02-17	
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Note: This test report is prepared for the customer shown above and for the device described herein. It may not be duplicated or used in part without prior written consent from Bay Area Compliance Laboratories Corp. This report **must not** be used by the customer to claim product certification, approval, or endorsement by A2LA*, NIST, or any agency of the Federal Government.

* This report may contain data that are not covered by the A2LA accreditation and are marked with an asterisk “*” (Rev.12)

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1509235-247	Original Report	2016-02-17

1 General Description

1.1 Product Description for Equipment Under Test (EUT)

This test and measurement report has been compiled on behalf of *Venstar Inc.*, and their product, FCC ID: MUH-SKYPORT4; IC: 12547A- SKYPORT4, model number: *TSTATGAC-VWF*, which henceforth is referred to as the EUT (Equipment Under Test.), The EUT is a 2.4 GHz Wi-Fi module which can be used with a thermostat.

1.2 Mechanical Description of EUT

The EUT measures approximately 2.2 cm (L) x 1.3 cm (W) x 0.4 cm (H) and weighs approximately 300 g.

The data gathered are from a typical production sample provided by the manufacturer with serial number: R1509235-1.

1.3 Objective

This report is prepared on behalf of *Venstar Inc.* in accordance with Part 2, Subpart J, and Part 15, Subparts B and C of the Federal Communication Commission's rules and IC RSS-247 Issue 1, May 2015.

The objective is to determine compliance with FCC Part 15.247 and IC RSS-247 rules for Output Power, Antenna Requirements, 6 dB Bandwidth, Power spectral density, 100 kHz Bandwidth of Band Edges Measurement, 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 C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices and FCC KDB 558074 D01 DTS Meas Guidance v03r03: 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.

Based on CISPR16-4-2:2011, The Treatment of Uncertainty in EMC Measurements, the values ranging from ± 2.0 dB for Conducted Emissions tests and ± 4.0 dB for Radiated Emissions tests are the most accurate estimates pertaining to uncertainty of EMC measurements at BACL Corp.

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 Luminaires 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:
 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 C63.10-2013.

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

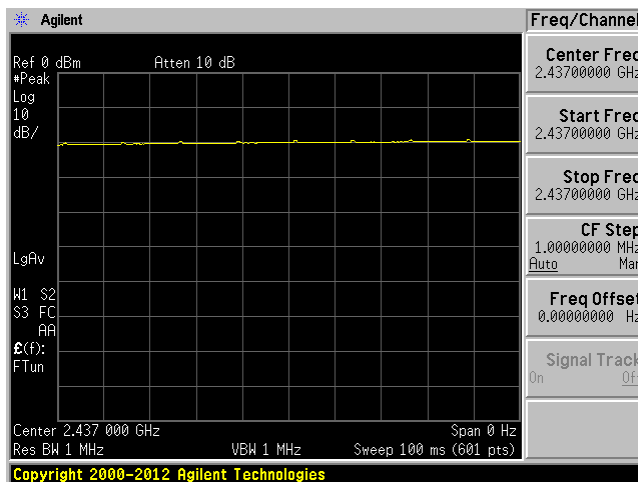
The worst-case data rates are determined to be as follows for each mode based upon investigation by measuring the average power, peak power and PSD across all data rates bandwidths, and modulations.

2.2 EUT Exercise Software

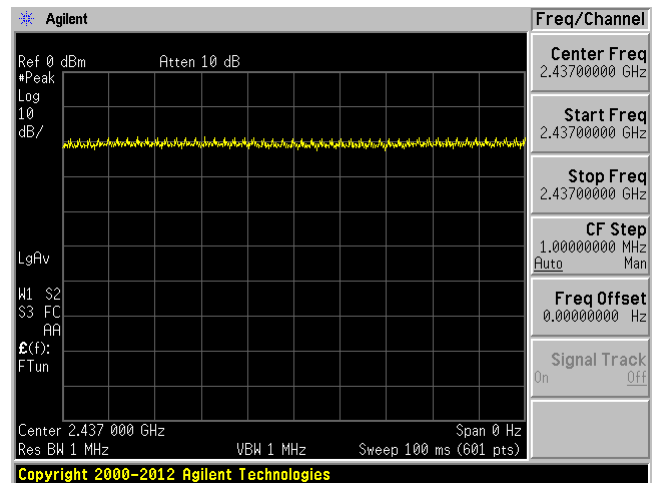
The software “RadioToolIGU v1.1.5540.33372” is provided by customer.

Duty Cycle: 100%

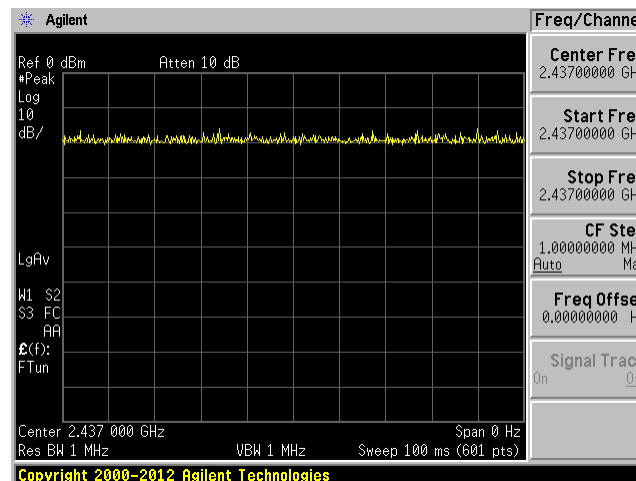
802.11b mode



802.11g mode



802.11n20 mode



2.3 Equipment Modifications

No modifications were made to the EUT.

2.4 Local Support Equipment

Manufacturer	Description	Model No.	Serial No.
DELL	Laptop	Inspiron 1545	25840163269
Venstar Inc.	Wi-Fi Programming Adapter Board	Rev_0	CN3

2.5 EUT Internal Configuration Details

Manufacturer	Description	Model No.	Serial Number
Venstar Inc.	Wi-Fi module	E353931	1715
Venstar Inc.	Main Board	T005V0 94v-0 E78017	1531

2.6 Power Supply and Line Filters

Manufacturer	Description	Model	Part Number
Power Supply EUC	Power Adapter	MKA-412400200	050VPP

2.7 Interface Ports and Cabling

Cable Description	Length (m)	To	From
USB Cable	1	Laptop	EUT
RF Cable	1	EUT	PSA

3 Summary of Test Results

Results reported relate only to the product tested.

FCC & IC Rules	Description of Test	Results
FCC §15.203 IC RSS-Gen §8.3	Antenna Requirement	Compliant
FCC §15.207(a) IC RSS-Gen §8.8	AC Line Conducted Emissions	Compliant
FCC §15.247(i) IC RSS-102	RF Exposure	Compliant
FCC §15.247(d) IC RSS-247 §5.5	Spurious Emissions at Antenna Port	Compliant
FCC §15.205 IC RSS-Gen §8.10	Restricted Bands	Compliant
FCC §15.209, §15.247(d) IC RSS-247 §5.5 IC RSS-Gen §8.9	Radiated Spurious Emissions	Compliant
FCC §15.247(a)(2) IC RSS-247 §5.2 IC RSS-Gen §6.6	6 dB&99% Emission Bandwidth	Compliant
FCC §15.247(b)(3) IC RSS-247 §5.4	Maximum Peak Output Power	Compliant
FCC §15.247(d) IC RSS-247 §5.5	100 kHz Bandwidth of Frequency Band Edge	Compliant
FCC §15.247(e) IC RSS-247 §5.2	Power Spectral Density	Compliant

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

4.1 Applicable Standards

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 field

According to IC RSS-102 Issue 5:

2.5.2 Exemption Limits for Routine Evaluation – RF Exposure Evaluation

RF exposure evaluation is required if the separation distance between the user and/or bystander and the device's radiating element is greater than 20 cm, except when the device operates as follows:

- below 20 MHz⁶ and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 1 W (adjusted for tune-up tolerance);
- at or above 20 MHz and below 48 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $4.49/f^{0.5}$ W (adjusted for tune-up tolerance), where f is in MHz;
- at or above 48 MHz and below 300 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 0.6 W (adjusted for tune-up tolerance);
- at or above 300 MHz and below 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $1.31 \times 10^{-2} f^{0.6834}$ W (adjusted for tune-up tolerance), where f is in MHz;
- at or above 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 5 W (adjusted for tune-up tolerance).

In these cases, the information contained in the RF exposure technical brief may be limited to information that demonstrates how the e.i.r.p. was derived.

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

<u>Maximum peak output power at antenna input terminal (dBm):</u>	<u>13.18</u>
<u>Maximum peak output power at antenna input terminal (mW):</u>	<u>20.797</u>
<u>Prediction distance (cm):</u>	<u>20</u>
<u>Prediction frequency (MHz):</u>	<u>2437</u>
<u>Maximum Antenna Gain, typical (dBi):</u>	<u>1.9</u>
<u>Maximum Antenna Gain (numeric):</u>	<u>1.55</u>
<u>Power density of prediction frequency at 20.0 cm (mW/cm²):</u>	<u>0.0068</u>
<u>FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm²):</u>	<u>1.0</u>

The device is compliant with the requirement MPE limit for uncontrolled exposure. The maximum power density at the distance of 20 cm is 0.006 mW/cm². Limit is 1.0 mW/cm².

4.4 RF exposure evaluation exemption for IC

Maximum EIRP power = 13.18 dBm + 1.9 dBi = 15.08 dBm which is lesser than $1.31 \times 10^{-2} f^{0.6834} = 2.703 \text{ W} = 34.318 \text{ dBm}$

Therefore the RF exposure calculation is not required.

5 FCC §15.203 & IC RSS-Gen §8.3 - Antenna Requirements

5.1 Applicable Standards

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 §8.3: Transmitter Antenna

The applicant for equipment certification, as per RSP-100, must provide a list of all antenna types that may be used with the licence-exempt transmitter, indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna.

Licence-exempt transmitters that have received equipment certification may operate with different types of antennas. However, it is not permissible to exceed the maximum equivalent isotropically radiated power (e.i.r.p.) limits specified in the applicable standard (RSS) for the licence-exempt apparatus.

Testing shall be performed using the highest gain antenna of each combination of licence-exempt transmitter and antenna type, with the transmitter output power set at the maximum level. 9 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 a measurement or on data from the antenna manufacturer.

User manuals for transmitters equipped with detachable antennas shall also contain the following notice in a conspicuous location:

This radio transmitter (identify the device by certification number) has been approved by Industry Canada to operate with the antenna types listed below with the maximum permissible gain indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Immediately following the above notice, the manufacturer shall provide a list of all antenna types approved for use with the transmitter, indicating the maximum permissible antenna gain (in dBi).

5.2 Antenna Description

Antenna Type	Antenna Gain (dBi) @ 2.4 GHz
Omni-directional	1.9

6 FCC §15.207 & IC RSS-Gen §8.8 - AC Line Conducted Emissions

6.1 Applicable Standards

As per FCC §15.207 and IC RSS-Gen §8.8 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 μ H/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 ^{Note}	56 to 46 ^{Note}
0.5-5	56	46
5-30	60	50

Note: Decreases with the logarithm of the frequency.

6.2 Test Setup

The measurement was performed at shield room, using the setup per ANSI C63.4-2014 measurement procedure. The specification used was FCC §15.207 and IC RSS-Gen §8.8 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 host was connected with LISN-1 which provided 120 V/60 Hz AC power.

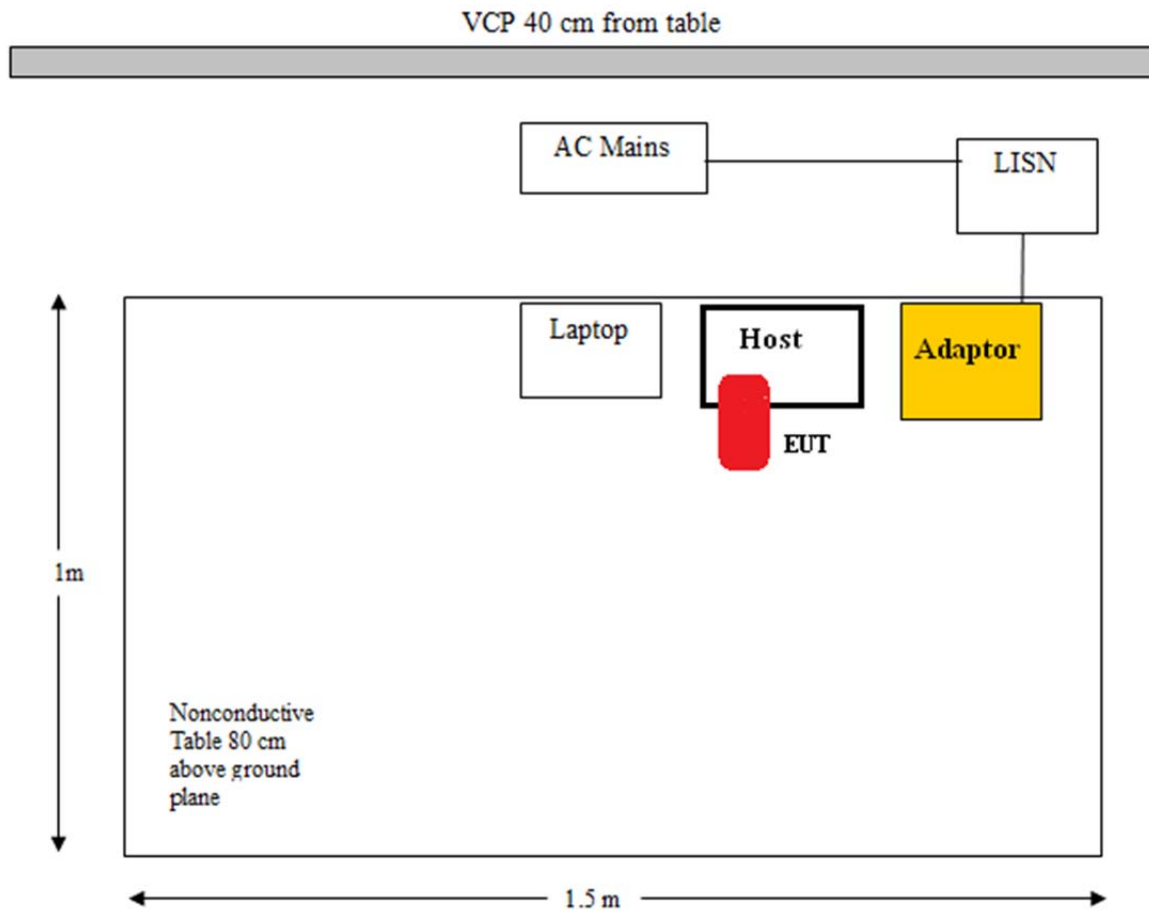
6.3 Test Procedure

During the conducted emissions test, the power cord of the EUT host system was connected to the mains outlet of the LISN-1 and the power cord of the support equipment was connected to 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



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:

$$CA = A_i + CL + \text{Atten}$$

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:

$$\text{Margin} = \text{Corrected Amplitude} - \text{Limit}$$

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	2015-09-28	1 year
FCC	LISN	FCC-LISN-50-25-2-10-CISPR16	160129	2015-04-17	1 year
TTE	Filter, High Pass	H962-150k-50-21378	K7133	2015-01-30	1 year
Suirong	30 ft conductive emission cable	LMR 400	-	2015-03-05	1 year
Hewlett-Packard	5 ft RF cable	-	1268	2015-07-29	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:	24° C
Relative Humidity:	43 %
ATM Pressure:	102.5 kPa

The testing was performed by Zhisen Qian on 2015-10-25 in 5m chamber2.

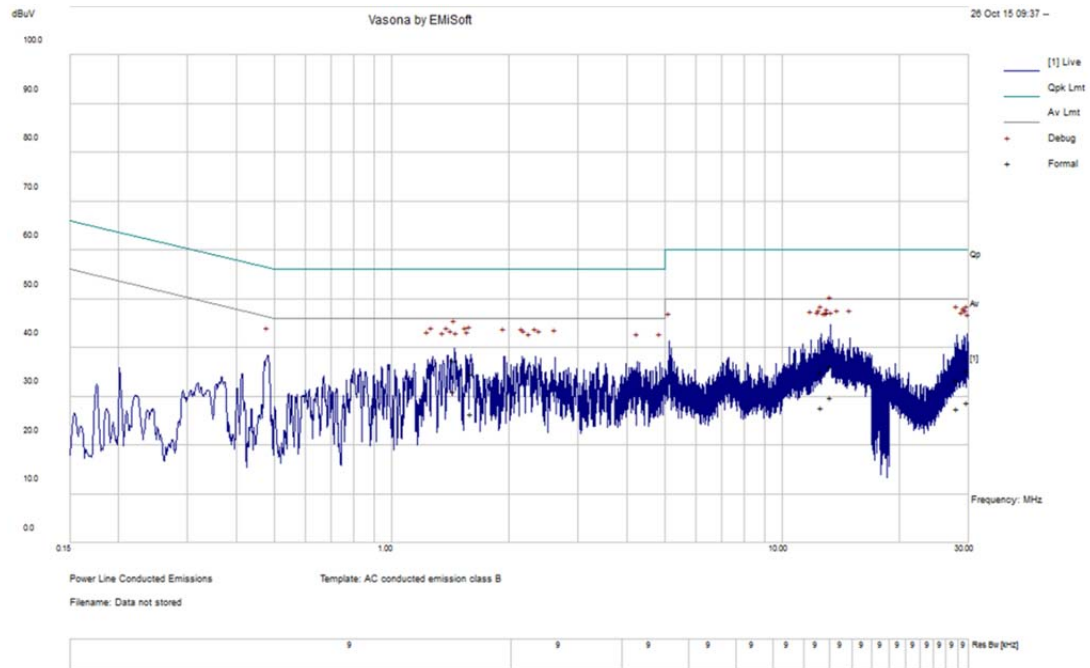
6.8 Summary of Test Results

According to the recorded data in following table, the EUT complied with the FCC 15C and IC RSS-Gen 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)
-14.88	1.444125	Line	0.15-30

6.9 Conducted Emissions Test Plots and Data

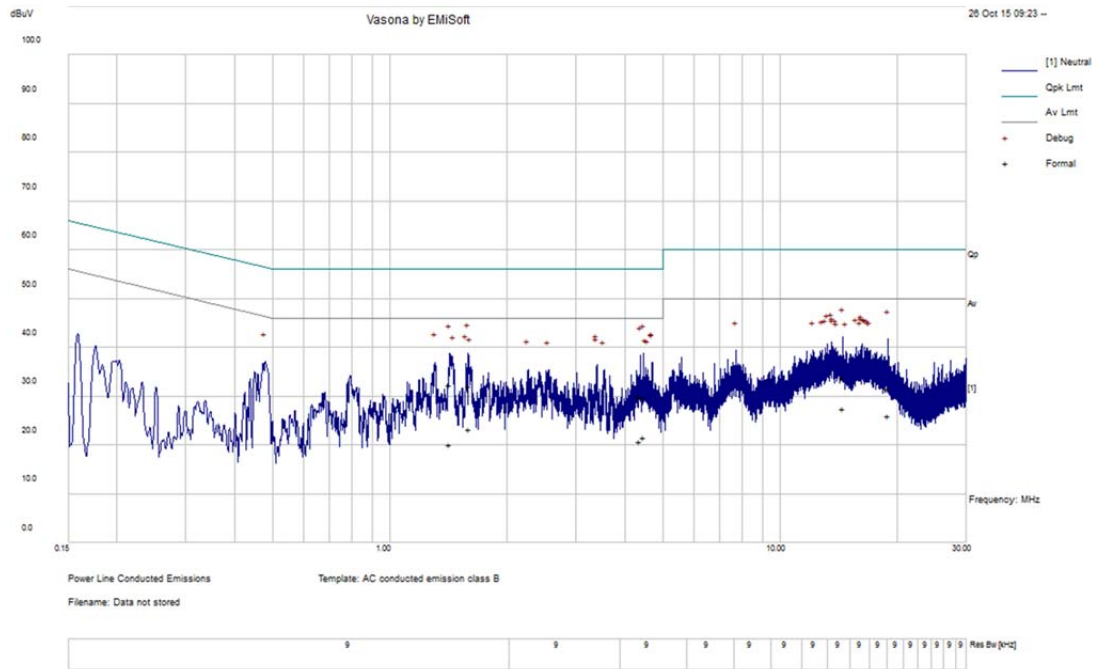
120 V, 60 Hz – Line



Frequency (MHz)	Corrected Amplitude (dBμV)	Conductor (Line/Neutral)	Limit (dBμV)	Margin (dB)	Detector (QP/Ave.)
13.32234	36.15	Line	60	-23.85	QP
1.444125	37.55	Line	56	-18.45	QP
12.58326	35.07	Line	60	-24.93	QP
29.75018	35.29	Line	60	-24.71	QP
28.02236	33.53	Line	60	-26.47	QP
1.597428	34.79	Line	56	-21.21	QP

Frequency (MHz)	Corrected Amplitude (dBμV)	Conductor (Line/Neutral)	Limit (dBμV)	Margin (dB)	Detector (QP/Ave.)
13.32234	29.81	Line	50	-20.19	Ave.
1.444125	31.12	Line	46	-14.88	Ave.
12.58326	27.85	Line	50	-22.15	Ave.
29.75018	28.79	Line	50	-21.21	Ave.
28.02236	27.55	Line	50	-22.45	Ave.
1.597428	26.45	Line	46	-19.55	Ave.

120 V, 60 Hz – Neutral



Frequency (MHz)	Corrected Amplitude (dBμV)	Conductor (Line/Neutral)	Limit (dBμV)	Margin (dB)	Detector (QP/Ave.)
1.592574	32.3	Neutral	56	-23.7	QP
4.483922	29.9	Neutral	56	-26.1	QP
1.422465	32.42	Neutral	56	-23.58	QP
4.373027	30.14	Neutral	56	-25.86	QP
14.49673	33.84	Neutral	60	-26.16	QP
18.881	31.68	Neutral	60	-28.32	QP

Frequency (MHz)	Corrected Amplitude (dBμV)	Conductor (Line/Neutral)	Limit (dBμV)	Margin (dB)	Detector (QP/Ave.)
1.592574	23.45	Neutral	46	-22.55	Ave.
4.483922	21.69	Neutral	46	-24.31	Ave.
1.422465	20.15	Neutral	46	-25.85	Ave.
4.373027	20.75	Neutral	46	-25.25	Ave.
14.49673	27.58	Neutral	50	-22.42	Ave.
18.881	26.18	Neutral	50	-23.82	Ave.

7 FCC §15.247(d) & IC RSS-247 §5.5 - Spurious Emissions at Antenna Terminals

7.1 Applicable Standards

For 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.

According to IC RSS-247 §5.5. 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 5.4(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.

7.2 Measurement Procedure

The RF output of the EUT was connected to a spectrum analyzer through appropriate attenuation. The resolution bandwidth of the spectrum analyzer was set at 100 kHz. Sufficient scans were taken to show any out of band emissions up to 10th harmonic.

7.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4440A	MY44303352	2015-10-16	1 year
R & S	Spectrum Analyzer	FSQ	1155.5001.26	2015-03-09	1 year
Mini Circuit	Precision Fixed Attenuator, 20 dB	BW-S20W5	-	Each Time1	N/A
-	SMA cable	-	C0002	Each time1	N/A

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

7.4 Test Environmental Conditions

Temperature:	24° C
Relative Humidity:	43 %
ATM Pressure:	102.5 kPa

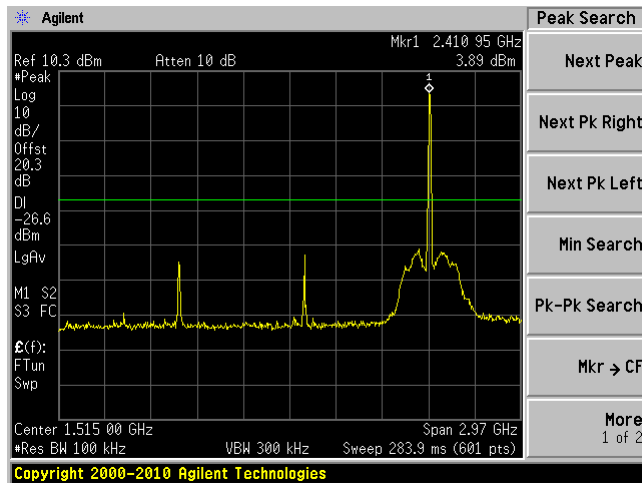
The testing was performed by Zhisen Qian on 2015-10-22 at RF site.

7.5 Test Results

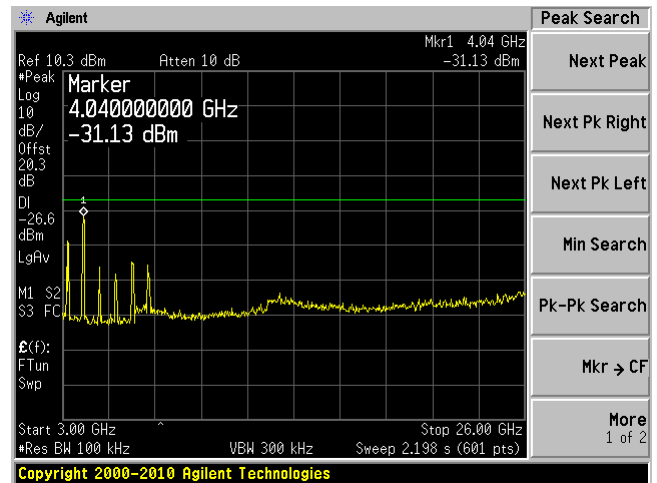
Please refer to following plots of spurious emissions.

802.11b, Low Channel, 2412 MHz

Plot: 30 MHz – 3 GHz

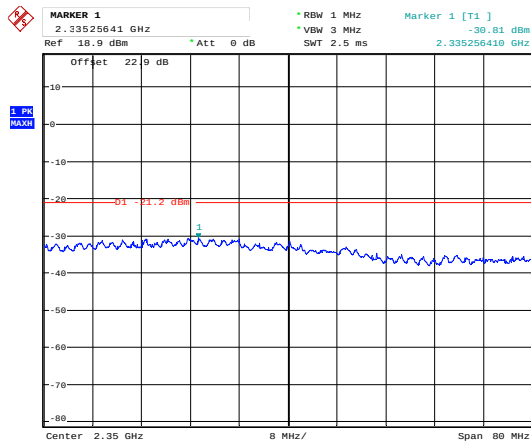


Plot: 3 GHz – 26 GHz



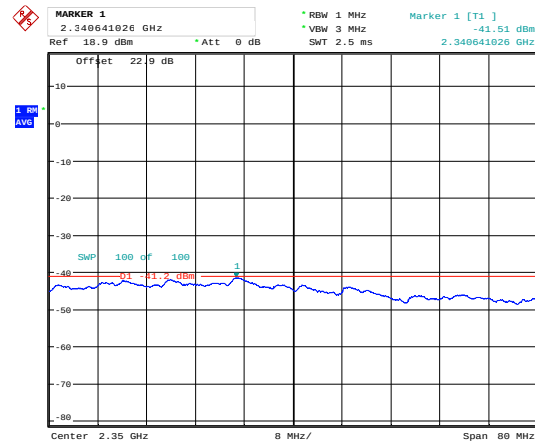
Plot: 2.31 GHz – 2.39 GHz (restrict Band)

Peak



Plot: 2.31 GHz – 2.39 GHz (restrict band)

Ave

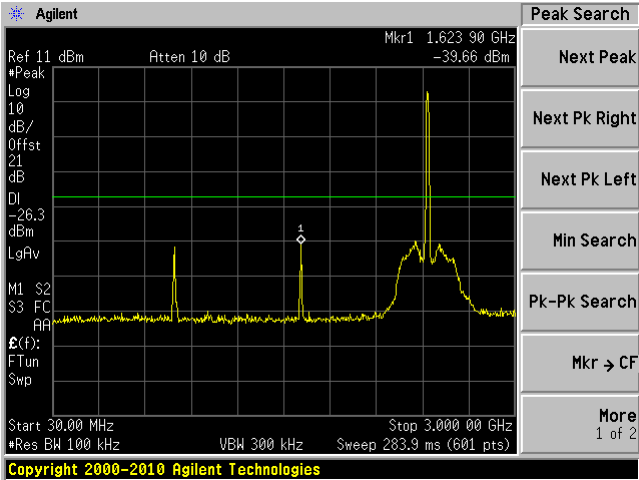


Date: 23.OCT.2015 15:13:27

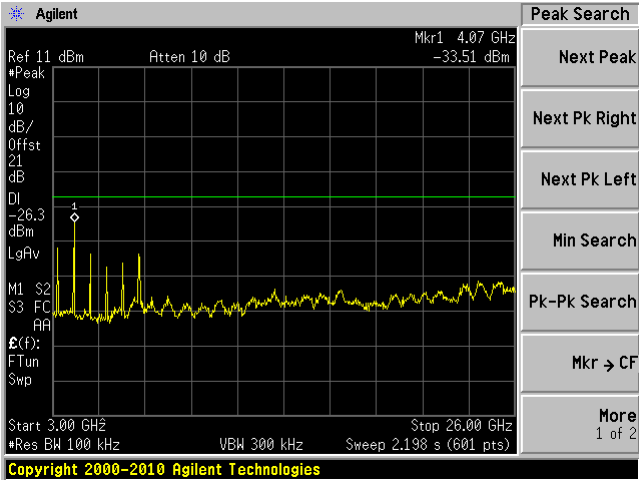
Date: 23.OCT.2015 15:08:50

802.11b, Middle Channel, 2437 MHz

Plot: 30 MHz – 3 GHz

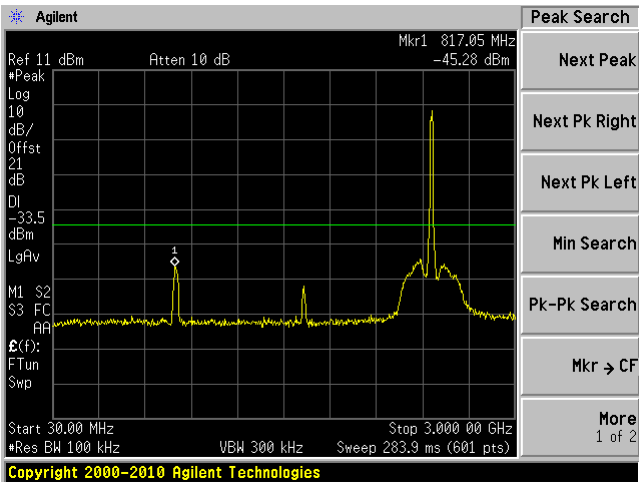


Plot: 3 GHz – 26 GHz

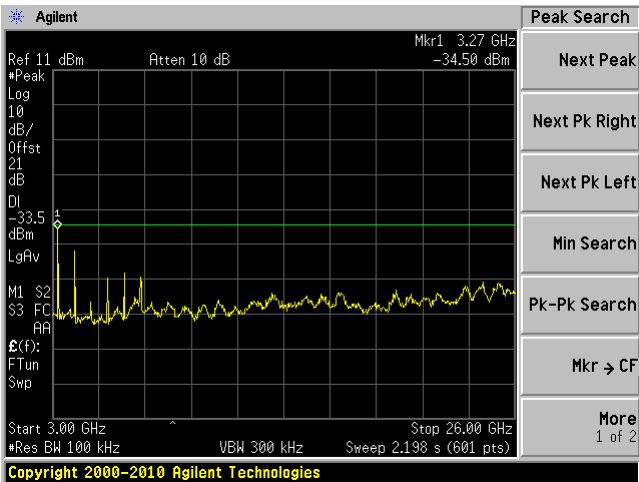


802.11b, High Channel, 2462 MHz

Plot: 30 MHz – 3 GHz



Plot: 3 GHz – 26 GHz

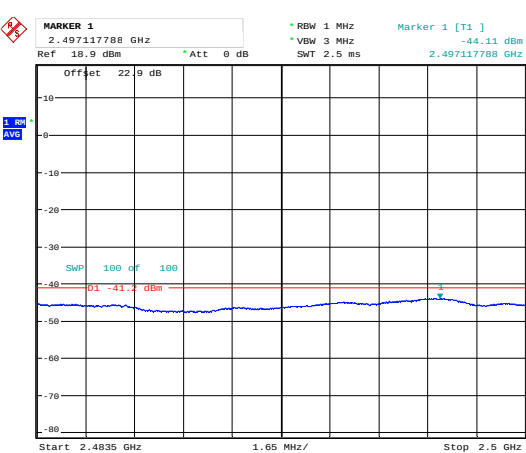
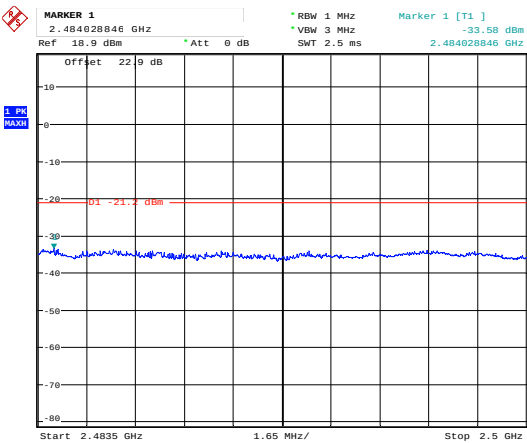


Plot: 2.4835 GHz – 2.5 GHz (restrict Band)

Plot: 2.4835 GHz – 2.5 GHz (restrict band)

Peak

Ave



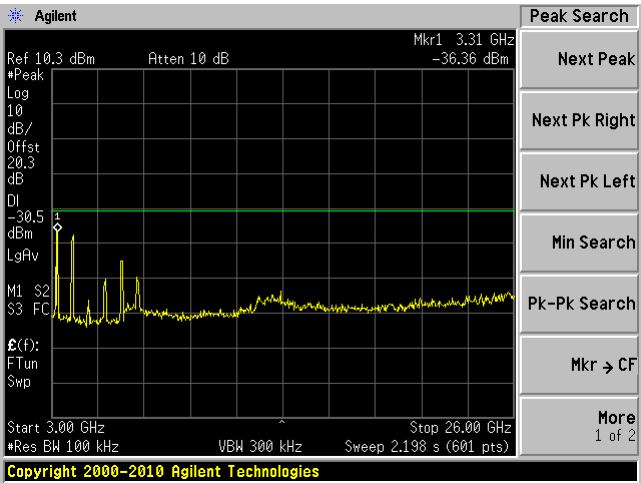
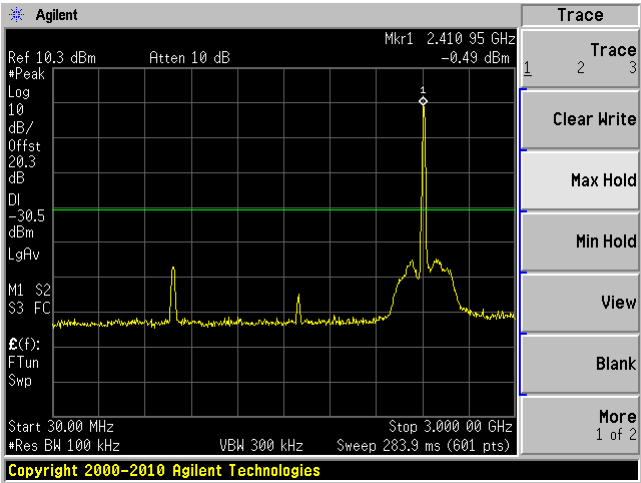
Date: 23.OCT.2015 15:27:06

Date: 23.OCT.2015 15:23:19

802.11g, Low Channel 2412 MHz

Plot: 30 MHz – 3 GHz

Plot: 3 GHz – 26 GHz

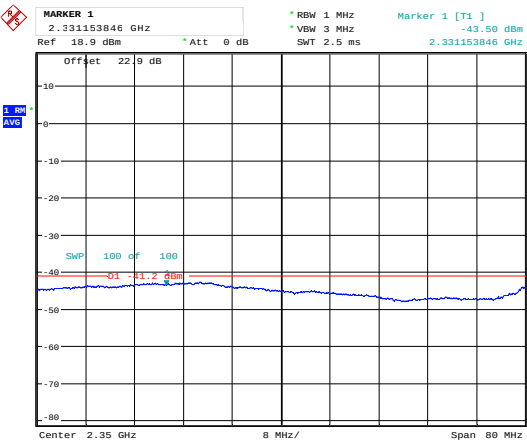
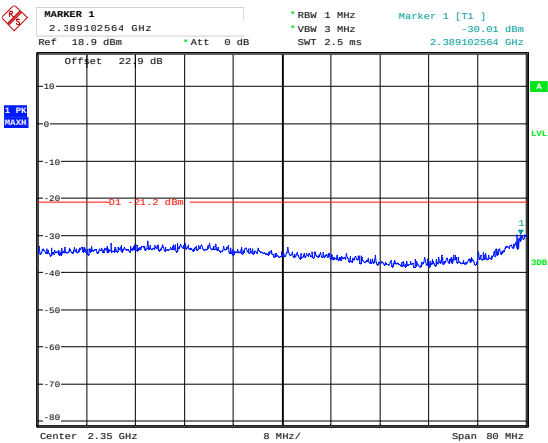


Plot: 2.31 GHz – 2.39 GHz (restrict Band)

Plot: 2.31 GHz – 2.39 GHz (restrict band)

Peak

Ave



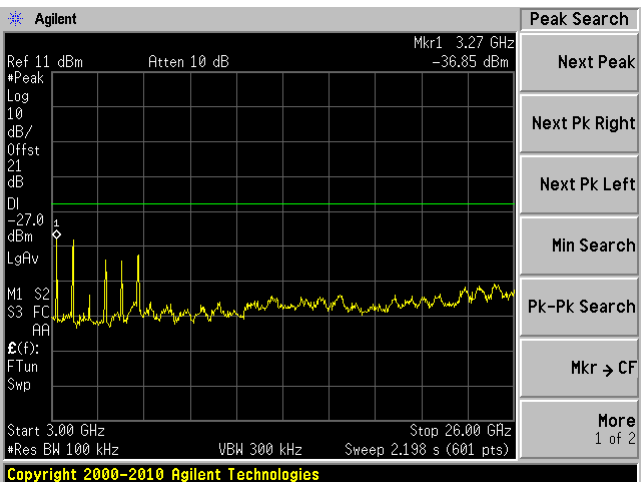
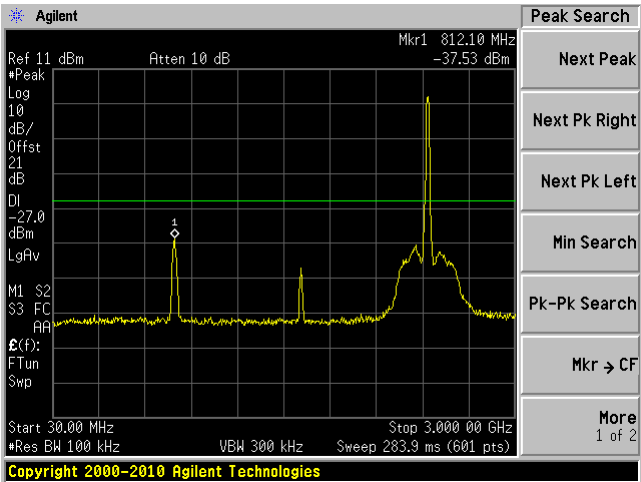
Date: 23.OCT.2015 15:12:44

Date: 23.OCT.2015 15:07:29

802.11g, Middle Channel 2437 MHz

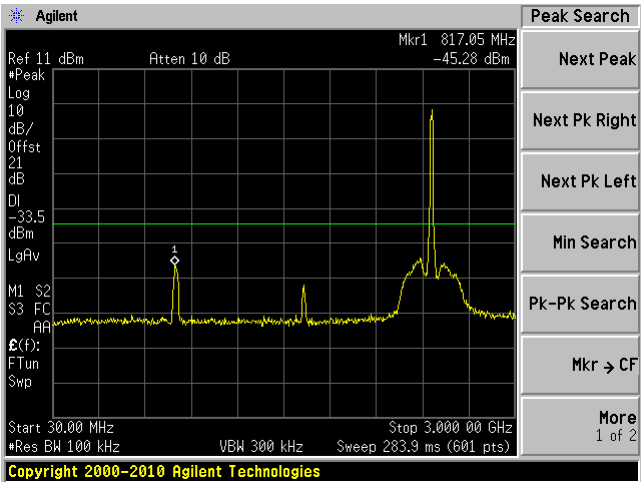
Plot: 30 MHz – 3 GHz

Plot: 3 GHz – 26 GHz

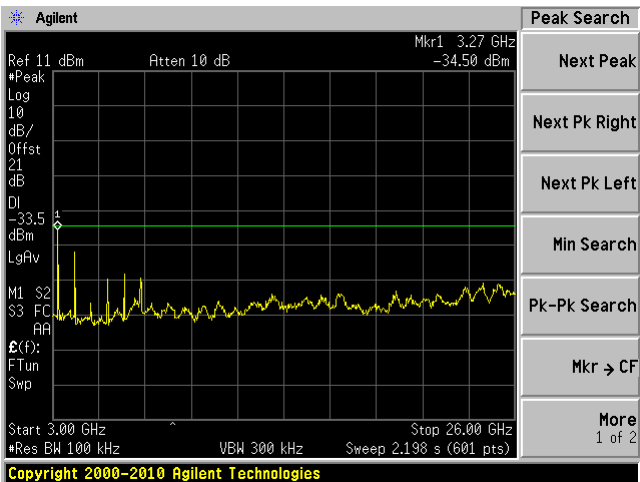


802.11g, High Channel 2462 MHz

Plot: 30 MHz – 3 GHz

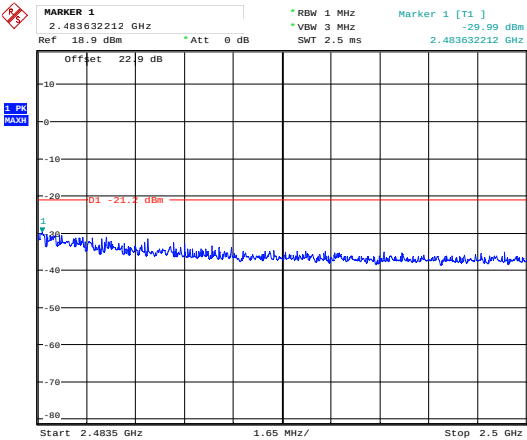


Plot: 3 GHz – 26 GHz



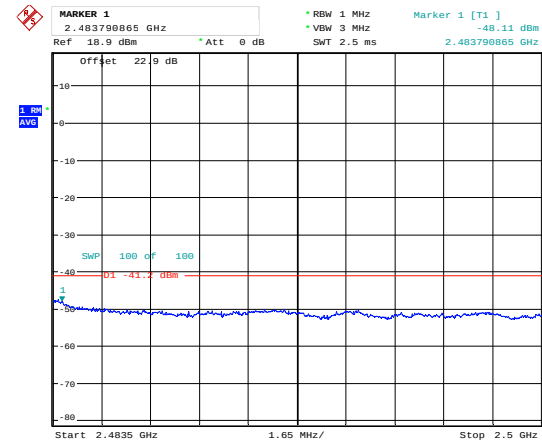
Plot: 2.4835 GHz – 2.5 GHz (restrict Band)

Peak



Plot: 2.4835 GHz – 2.5 GHz (restrict band)

Ave

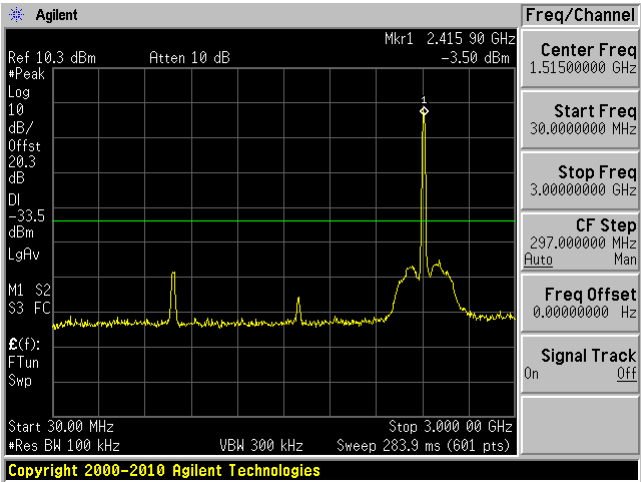


Date: 23.OCT.2015 15:26:25

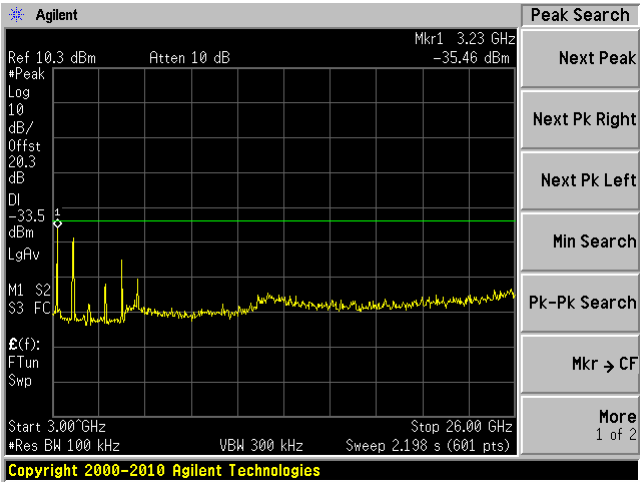
Date: 23.OCT.2015 15:24:16

802.11n HT20, Low Channel 2412 MHz

Plot: 30 MHz – 3 GHz

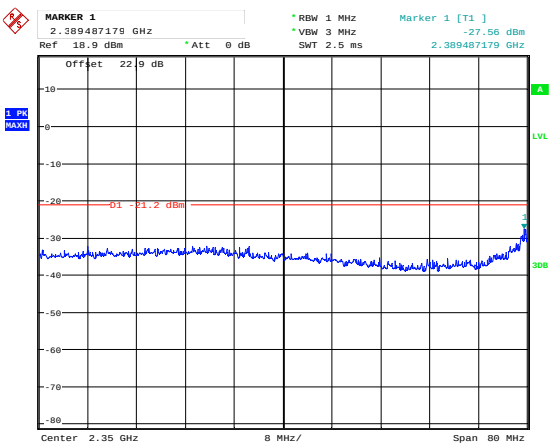


Plot: 3 GHz – 26 GHz



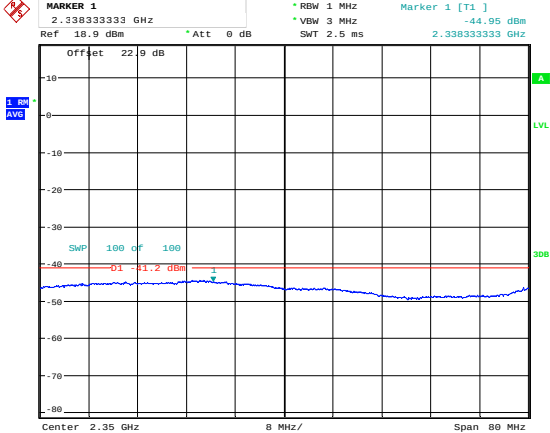
Plot: 2.31 GHz – 2.39 GHz (restrict Band)

Peak



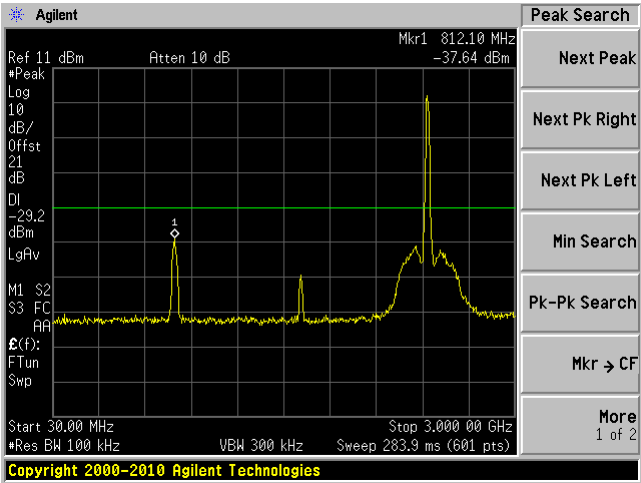
Plot: 2.31 GHz – 2.39 GHz (restrict band)

Ave

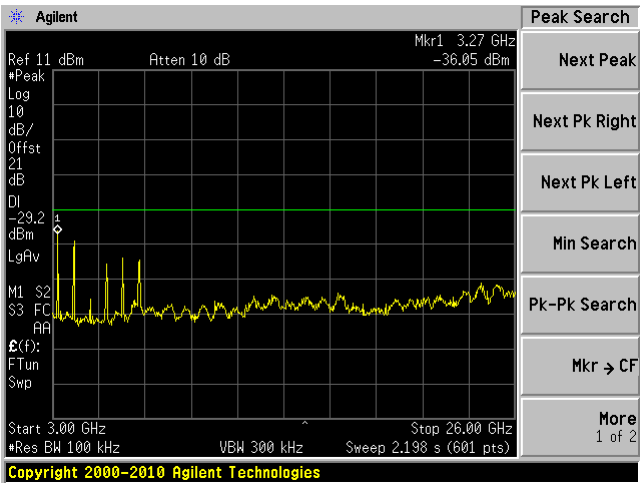


802.11n HT20, Middle Channel 2437 MHz

Plot: 30 MHz – 3 GHz

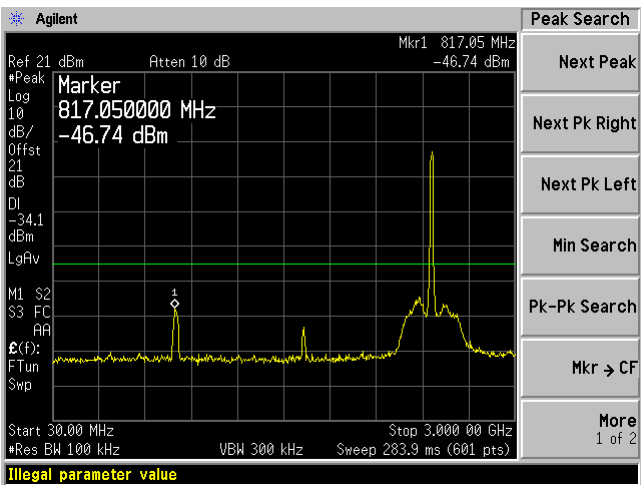


Plot: 3 GHz – 26 GHz

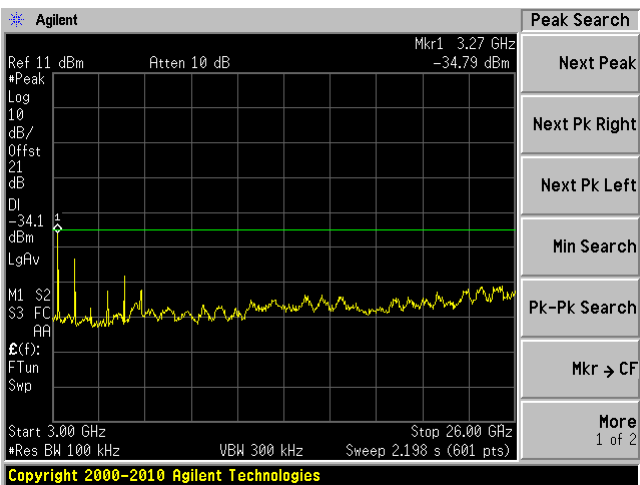


802.11n HT20, High Channel 2462 MHz

Plot: 30 MHz – 3 GHz



Plot: 3 GHz – 26 GHz

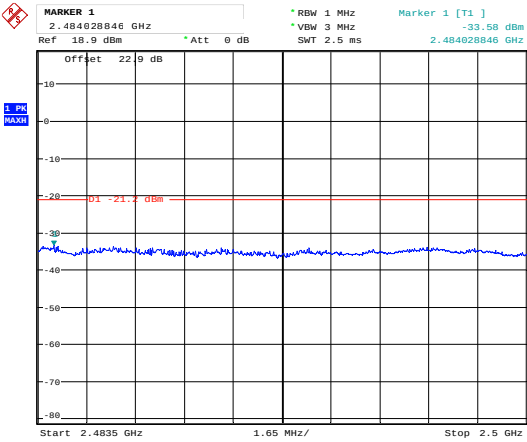


Plot: 2.4835 GHz – 2.5 GHz (restrict Band)

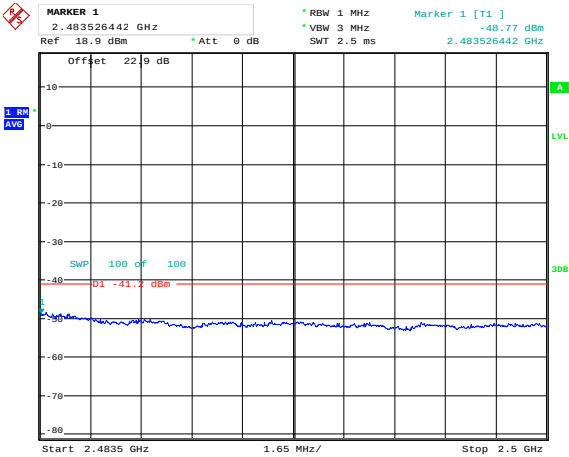
Plot: 2.4835 GHz – 2.5 GHz (restrict band)

Peak

Ave



Date: 23.OCT.2015 15:27:06



Date: 23.OCT.2015 15:24:50

8 FCC §15.209, §15.247(d) & IC RSS-247 §5.5, RSS-GEN §8.9 – Spurious Radiated Emissions

8.1 Applicable Standards

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): 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-Gen 8.9,

Except when the requirements applicable to a given device state otherwise, emissions from licence-exempt transmitters shall comply with the field strength limits shown in Table 4 or Table 5 below. Additionally, the level of any transmitter emission shall not exceed the level of the transmitter's fundamental emission.

Table 4 – General Field Strength Limits for Licence-Exempt Transmitters at Frequencies Above 30 MHz

Frequency (MHz)	Field Strength ($\mu\text{V/m}$ at 3 metres)
30-88	100
88-216	150
216-960	200
Above 960*	500

* Unless otherwise specified, for all frequencies greater than 1 GHz, the radiated emission limits for licence-exempt radio apparatus stated in applicable RSSs (including RSS-Gen) are based on measurements using a linear average detector function having a minimum resolution bandwidth of 1 MHz. If an average limit is specified for the EUT, then the peak emission shall also be measured with instrumentation properly adjusted for such factors as pulse desensitization to ensure the peak emission is less than 20 dB above the average limit.

Note: Transmitting devices are not permitted in restricted frequency bands unless stated otherwise in the specific RSS.

As per IC RSS-247 §5.5, 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 5.4(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 C63.10-2013. The specification used was the FCC 15 Subpart C and IC RSS-247 limits.

The spacing between the peripherals was 3 centimeters.

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

8.3 Test Procedure

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:

$$\text{RBW} = 100 \text{ kHz} / \text{VBW} = 300 \text{ kHz} / \text{Sweep} = \text{Auto}$$

Above 1000 MHz:

- (1) Peak: $\text{RBW} = 1\text{MHz} / \text{VBW} = 1\text{MHz} / \text{Sweep} = \text{Auto}$
- (2) Average: $\text{RBW} = 1\text{MHz} / \text{VBW} = 10\text{Hz} / \text{Sweep} = \text{Auto}$

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:

$$\text{CA} = \text{Ai} + \text{AF} + \text{CL} + \text{Atten} - \text{Ga}$$

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:

$$\text{Margin} = \text{Corrected Amplitude} - \text{Limit}$$

8.5 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Rohde & Schwarz	EMI Test Receiver	ESCI 1166.5950K03	100337	2015-06-18	1 year
Agilent	Spectrum Analyzer	E4440A	MY44303352	2015-10-16	1 year
Sunol Science Corp	System Controller	SC99V	011003-1	N/R	N/R
Sunol Science Corp	Combination Antenna	JB3	A020106-2	2015-07-11	2 year
EMCO	Horn Antenna	3115	9511-4627	2015-10-17	1 year
Hewlett Packard	Pre-amplifier	8447D	2944A10187	2015-03-20	1 year
WiseWave	Horn Antenna	ARH-4223-02	10555-01	2014-08-09	3 Years
Suirong	30 ft conductive emission cable	LMR 400	-	2015-03-05	1 year
-	SMA cable	-	C0002	Each time ¹	N/A
IW Microwave	AOBOR Hi frequency Co AX Cable	DC 1531	KPS-1501A3960K PS	2015-08-10	1 year
Hewlett-Packard	5 ft N-type RF cable	-	1268	2015-05-15	1 year
Agilent	Pre-Amplifier	8449B	3008A01978	2015-03-11	1year

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

8.6 Test Environmental Conditions

Temperature:	24° C
Relative Humidity:	43 %
ATM Pressure:	102.5 KPa

The testing was performed by Zhisen Qian on 2015-10-25 in 5m chamber2.

8.7 Summary of Test Results

According to the data hereinafter, the EUT complied with the FCC Title 47, Part 15C and IC RSS-247 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
-3.86	32.6675	Vertical	802.11g Mid CH

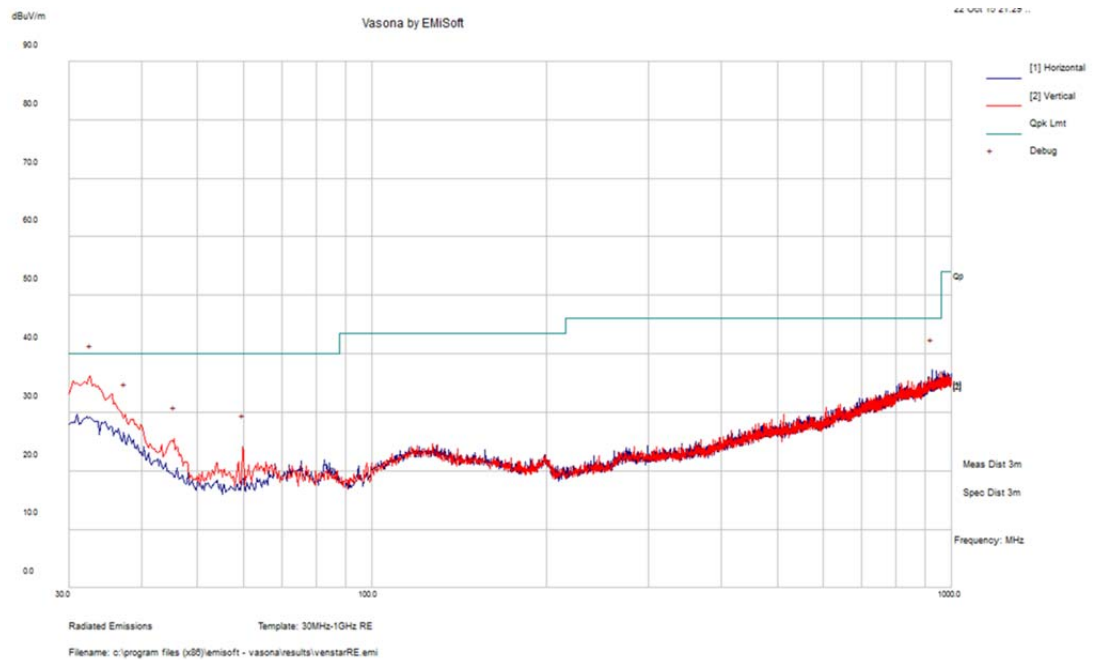
1 – 25 GHz:

Mode: Transmitting			
Margin (dB)	Frequency (MHz)	Polarization (Horizontal/Vertical)	Mode, Channel
-2.75	4824	Horizontal	802.11b Low CH

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

8.8 Radiated Emissions Test Data and Plots

30 MHz – 1 GHz



Frequency (MHz)	Corrected Amplitude (dBμV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBμV/m)	Margin (dB)	Detector (PK/QP/Ave)
32.6675	31.81	100	V	0	40	-3.86	QP
923.37	27.63	300	H	0	46	-8.77	QP
37.5175	28.34	100	V	0	40	-10.44	QP
45.52	29.96	100	V	0	40	-14.46	QP
59.8275	30.59	100	V	0	40	-15.88	QP

Note: Worst case, 802.11g mode, Middle Channel

1-25 GHz

2.4 GHz Band, 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											
4824	53.51	219	242	V	33.12	5.357	34.62	57.37	74.00	-16.63	Peak
4824	56.52	23	153	H	33.18	5.357	34.62	60.44	74.00	-13.56	Peak
4824	44.26	219	242	V	33.12	5.357	34.62	48.12	54.00	-5.88	Ave
4824	47.33	23	153	H	33.18	5.357	34.62	51.25	54.00	-2.75	Ave
7236	50.33	340	265	V	37.44	6.925	34.44	60.26	74.00	-13.74	Peak
7236	50.71	14	121	H	37.44	6.925	34.44	60.64	74.00	-13.36	Peak
7236	39.49	340	265	V	37.44	6.925	34.44	49.42	54.00	-4.58	Ave
7236	39.65	14	121	H	37.44	6.925	34.44	49.58	54.00	-4.42	Ave
9648	43.59	0	150	V	38.83	10.204	32.66	59.96	74.00	-14.04	Peak
9648	43.92	0	150	H	38.83	10.204	32.66	60.30	74.00	-13.70	Peak
9648	29.06	0	150	V	38.83	10.204	32.66	45.43	54.00	-8.57	Ave
9648	29.01	0	150	H	38.83	10.204	32.66	45.39	54.00	-8.61	Ave
Middle Channel 2437 MHz											
4874	54.55	208	232	V	33.32	5.375	34.61	58.64	74.00	-15.36	Peak
4874	57.02	134	114	H	33.35	5.375	34.61	61.14	74.00	-12.86	Peak
4874	45.29	208	232	V	33.32	5.375	34.61	49.38	54.00	-4.62	Ave
4874	47.8	134	114	H	33.35	5.375	34.61	51.92	54.00	-2.08	Ave
7311	48.25	321	143	V	37.324	6.925	34.52	57.98	74.00	-16.02	Peak
7311	49.37	47	111	H	37.356	6.925	34.52	59.13	74.00	-14.87	Peak
7311	36.67	321	143	V	37.324	6.925	34.52	46.40	54.00	-7.60	Ave
7311	38.77	47	111	H	37.356	6.925	34.52	48.53	54.00	-5.47	Ave
9748	42.93	0	150	V	38.908	10.650	33.14	59.35	74.00	-14.65	Peak
9748	43.6	0	150	H	38.953	10.650	33.14	60.06	74.00	-13.94	Peak
9748	28.57	0	150	V	38.908	10.650	33.14	44.99	54.00	-9.01	Ave
9748	28.71	0	150	H	38.953	10.650	33.14	45.17	54.00	-8.83	Ave
High Channel 2462 MHz											
4924	49.93	208	247	V	33.32	6.340	34.61	54.98	74.00	-19.02	Peak
4924	51.17	283	174	H	33.35	6.340	34.61	56.25	74.00	-17.75	Peak
4924	41.02	208	247	V	33.32	6.340	34.61	46.07	54.00	-7.93	Ave
4924	42.18	283	174	H	33.35	6.340	34.61	47.26	54.00	-6.74	Ave
7386	48.87	331	204	V	37.24	7.310	34.62	58.80	74.00	-15.20	Peak
7386	51.12	47	100	H	37.24	7.310	34.62	61.05	74.00	-12.95	Peak
7386	37.84	331	204	V	37.24	7.310	34.62	47.77	54.00	-6.23	Ave
7386	40.37	47	100	H	37.24	7.310	34.62	50.30	54.00	-3.70	Ave
9848	41.92	0	150	V	38.92	10.65	33.46	58.03	74.00	-15.97	Peak
9848	41.99	0	150	H	38.91	10.65	33.46	58.09	74.00	-15.91	Peak
9848	28.78	0	150	V	38.92	10.65	33.46	44.89	54.00	-9.11	Ave
9848	29.04	0	150	H	38.91	10.65	33.46	45.14	54.00	-8.86	Ave

2.4 GHz Band, 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											
4824	51.04	219	193	V	33.12	5.357	34.62	54.90	74.00	-19.10	Peak
4824	52.81	89	153	H	33.18	5.357	34.62	56.73	74.00	-17.27	Peak
4824	31.18	219	193	V	33.12	5.357	34.62	35.04	54.00	-18.96	Ave
4824	31.79	89	153	H	33.18	5.357	34.62	35.71	54.00	-18.29	Ave
7236	50.38	340	179	V	37.44	6.925	34.44	60.31	74.00	-13.69	Peak
7236	51.71	12	100	H	37.44	6.925	34.44	61.64	74.00	-12.36	Peak
7236	31.02	340	179	V	37.44	6.925	34.44	40.95	54.00	-13.05	Ave
7236	31.17	12	100	H	37.44	6.925	34.44	41.10	54.00	-12.90	Ave
9648	43.37	0	150	V	38.83	10.20	32.66	59.74	74.00	-14.26	Peak
9648	42.79	0	150	H	38.83	10.20	32.66	59.17	74.00	-14.83	Peak
9648	28.5	0	150	V	38.83	10.20	32.66	44.87	54.00	-9.13	Ave
9648	28.33	0	150	H	38.83	10.20	32.66	44.71	54.00	-9.29	Ave
Middle Channel 2437 MHz											
4874	53.11	250	100	V	33.32	5.375	34.6	57.20	74.00	-16.80	Peak
4874	55.83	21	124	H	33.35	5.375	34.6	59.95	74.00	-14.05	Peak
4874	32.59	250	100	V	33.32	5.375	34.6	36.68	54.00	-17.32	Ave
4874	33.41	21	124	H	33.35	5.375	34.6	37.53	54.00	-16.47	Ave
7311	51.95	327	150	V	37.324	6.925	34.5	61.68	74.00	-12.32	Peak
7311	54.85	11	100	H	37.356	6.925	34.5	64.61	74.00	-9.39	Peak
7311	31.29	327	150	V	37.324	6.925	34.5	41.02	54.00	-12.98	Ave
7311	32.17	11	100	H	37.356	6.925	34.5	41.93	54.00	-12.07	Ave
9748	41.83	0	150	V	38.908	10.65	33.1	58.25	74.00	-15.75	Peak
9748	42.65	0	150	H	38.953	10.65	33.1	59.11	74.00	-14.89	Peak
9748	28.49	0	150	V	38.908	10.65	33.1	44.91	54.00	-9.09	Ave
9748	28.69	0	150	H	38.953	10.65	33.1	45.15	54.00	-8.85	Ave
High Channel 2462 MHz											
4924	45.43	235	125	V	33.32	6.340	34.61	50.48	74.00	-23.52	Peak
4924	47.9	128	123	H	33.35	6.340	34.61	52.98	74.00	-21.02	Peak
4924	29.97	235	125	V	33.32	6.340	34.61	35.02	54.00	-18.98	Ave
4924	30.52	128	123	H	33.35	6.340	34.61	35.60	54.00	-18.40	Ave
7386	47.95	323	224	V	37.24	7.310	34.62	57.88	74.00	-16.12	Peak
7386	52.17	50	100	H	37.24	7.310	34.62	62.10	74.00	-11.90	Peak
7386	29.9	323	224	V	37.24	7.310	34.62	39.83	54.00	-14.17	Ave
7386	30.92	50	100	H	37.24	7.310	34.62	40.85	54.00	-13.15	Ave
9848	43.06	0	150	V	38.92	10.65	33.46	59.17	74.00	-14.83	Peak
9848	42.46	0	150	H	38.91	10.65	33.46	58.56	74.00	-15.44	Peak
9848	28.52	0	150	V	38.92	10.65	33.46	44.63	54.00	-9.37	Ave
9848	28.65	0	150	H	38.91	10.65	33.46	44.75	54.00	-9.25	Ave

2.4 GHz Band, 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											
4824	51.64	248	270	V	33.12	5.357	34.62	55.50	74.00	-18.50	Peak
4824	52.49	15	178	H	33.18	5.357	34.62	56.41	74.00	-17.59	Peak
4824	30.86	248	270	V	33.12	5.357	34.62	34.72	54.00	-19.28	Ave
4824	31.23	15	178	H	33.18	5.357	34.62	35.15	54.00	-18.85	Ave
7236	50.66	338	220	V	37.44	6.925	34.44	60.59	74.00	-13.41	Peak
7236	50.65	9	100	H	37.44	6.925	34.44	60.58	74.00	-13.42	Peak
7236	30.48	338	220	V	37.44	6.925	34.44	40.41	54.00	-13.59	Ave
7236	30.19	9	100	H	37.44	6.925	34.44	40.12	54.00	-13.88	Ave
9648	42.39	0	150	V	38.83	10.20	32.66	58.76	74.00	-15.24	Peak
9648	42.66	0	150	H	38.83	10.20	32.66	59.04	74.00	-14.96	Peak
9648	28.49	0	150	V	38.83	10.20	32.66	44.86	54.00	-9.14	Ave
9648	28.39	0	150	H	38.83	10.20	32.66	44.77	54.00	-9.23	Ave
Middle Channel 2437 MHz											
4874	53.18	249	240	V	33.32	5.375	34.6	57.27	74.00	-16.73	Peak
4874	55.61	133	112	H	33.35	5.375	34.6	59.73	74.00	-14.27	Peak
4874	31.93	249	240	V	33.32	5.375	34.6	36.02	54.00	-17.98	Ave
4874	32.49	133	112	H	33.35	5.375	34.6	36.61	54.00	-17.39	Ave
7311	51.01	320	255	V	37.324	6.925	34.5	60.74	74.00	-13.26	Peak
7311	53.78	9	103	H	37.356	6.925	34.5	63.54	74.00	-10.46	Peak
7311	30.42	320	255	V	37.324	6.925	34.5	40.15	54.00	-13.85	Ave
7311	31.14	9	103	H	37.356	6.925	34.5	40.90	54.00	-13.10	Ave
9748	43.34	0	150	V	38.908	10.65	33.1	59.76	74.00	-14.24	Peak
9748	42.5	0	150	H	38.953	10.65	33.1	58.96	74.00	-15.04	Peak
9748	29.02	0	150	V	38.908	10.65	33.1	45.44	54.00	-8.56	Ave
9748	29.06	0	150	H	38.953	10.65	33.1	45.52	54.00	-8.48	Ave
High Channel 2462 MHz											
4924	47.62	210	243	V	33.32	6.340	34.61	52.67	74.00	-21.33	Peak
4924	47.31	135	293	H	33.35	6.340	34.61	52.39	74.00	-21.61	Peak
4924	30.15	210	243	V	33.32	6.340	34.61	35.20	54.00	-18.80	Ave
4924	30.21	135	293	H	33.35	6.340	34.61	35.29	54.00	-18.71	Ave
7386	48.86	330	190	V	37.24	7.310	34.62	58.79	74.00	-15.21	Peak
7386	51.49	9	114	H	37.24	7.310	34.62	61.42	74.00	-12.58	Peak
7386	29.57	330	190	V	37.24	7.310	34.62	39.50	54.00	-14.50	Ave
7386	30.62	9	114	H	37.24	7.310	34.62	40.55	54.00	-13.45	Ave
9848	42.52	0	150	V	38.92	10.65	33.46	58.63	74.00	-15.37	Peak
9848	42.77	0	150	H	38.91	10.65	33.46	58.87	74.00	-15.13	Peak
9848	29.09	0	150	V	38.92	10.65	33.46	45.20	54.00	-8.80	Ave
9848	28.95	0	150	H	38.91	10.65	33.46	45.05	54.00	-8.95	Ave

9 FCC§15.247(a)(2) & IC RSS-247 §5.2 - 6 dB & 99% Emission Bandwidth

9.1 Applicable Standards

According to FCC §15.247(a)(2), 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

According to IC RSS-237 §5.2 DTSs include systems that employ digital modulation techniques resulting in spectral characteristics similar to direct sequence systems. The following applies to the bands 902-928 MHz and 2400-2483.5 MHz:

1. The minimum 6 dB bandwidth shall be 500 kHz.

9.2 Measurement Procedure

The measurements are based on FCC KDB 558074 D01 DTS Meas Guidance v03r03: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 section 8: DTS bandwidth

9.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	US44300386	2015-09-29	1 year
Mini Circuit	Precision Fixed Attenuator, 20 dB	BW-S20W5	-	Each Time1	N/A
-	SMA cable	-	C0002	Each time1	N/A

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

9.4 Test Environmental Conditions

Temperature:	24° C
Relative Humidity:	43 %
ATM Pressure:	102.5 kPa

The testing was performed by Zhisen Qian on 2015-10-22 at RF site.

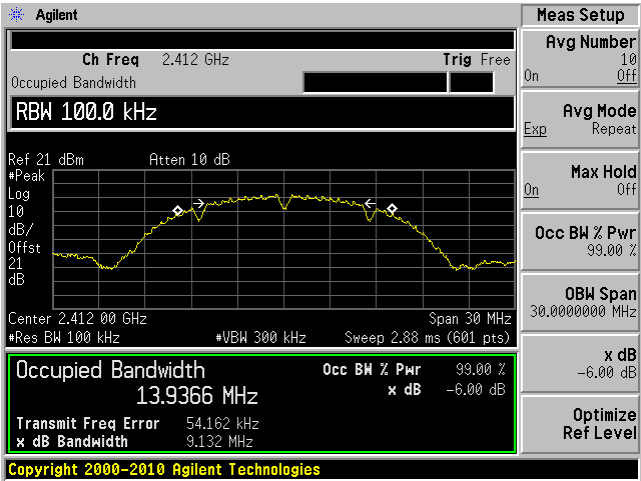
9.5 Test Results

Channel	Frequency (MHz)	6 dB OBW (MHz)	99% OBW (MHz)	Limit (MHz)	Results
802.11b mode					
Low	2412	9.132	13.9366	> 0.5	Compliant
Middle	2437	8.633	13.9868	> 0.5	Compliant
High	2462	9.148	14.0364	> 0.5	Compliant
802.11g mode					
Low	2412	13.021	16.2993	> 0.5	Compliant
Middle	2437	14.174	16.5820	> 0.5	Compliant
High	2462	12.831	16.2917	> 0.5	Compliant
802.11n HT20 mode					
Low	2412	15.115	17.4310	> 0.5	Compliant
Middle	2437	13.913	17.6508	> 0.5	Compliant
High	2462	13.875	17.4186	> 0.5	Compliant

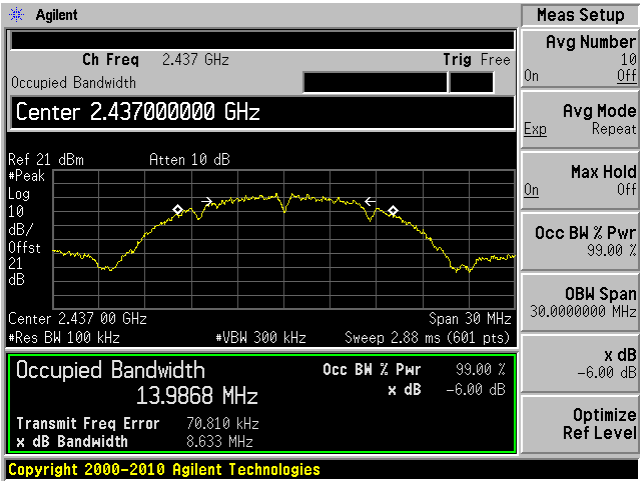
Please refer to the following plots for detailed test results

802.11b mode

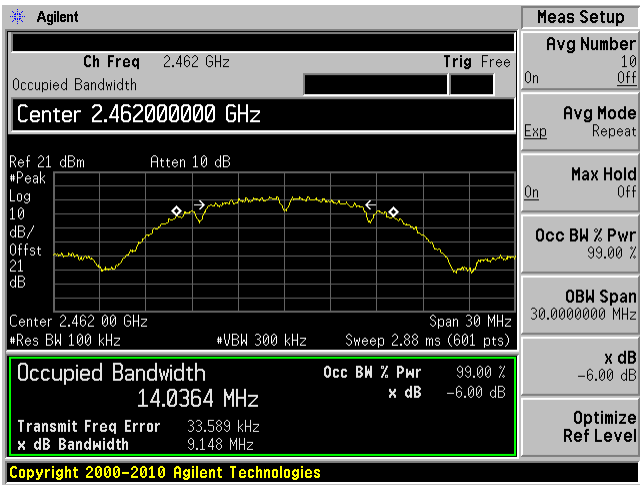
Low channel: 2412 MHz



Middle channel: 2437 MHz

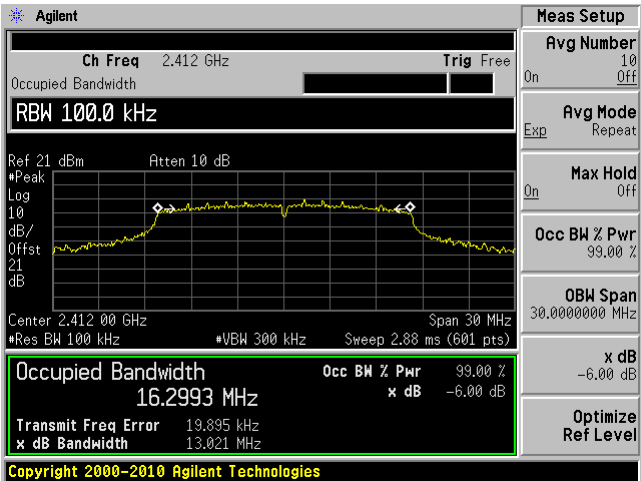


High channel: 2462 MHz

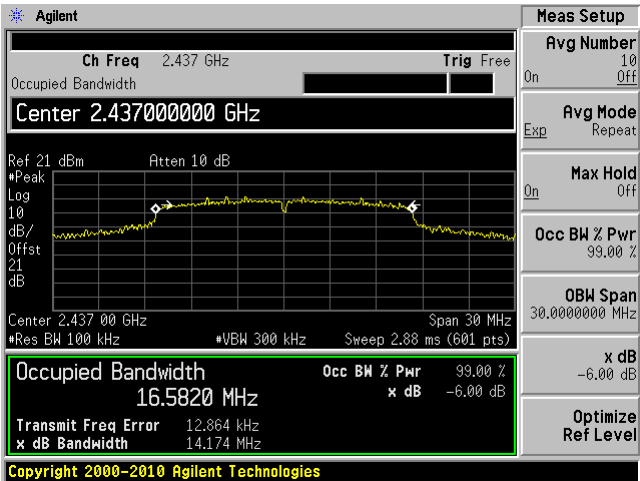


802.11g mode

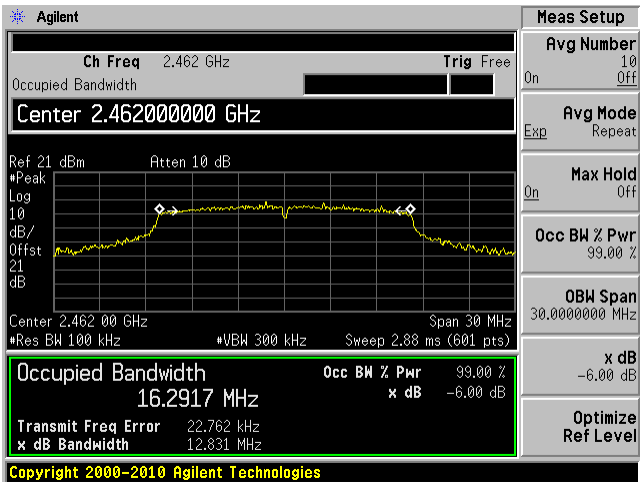
Low channel: 2412 MHz



Middle channel: 2437 MHz

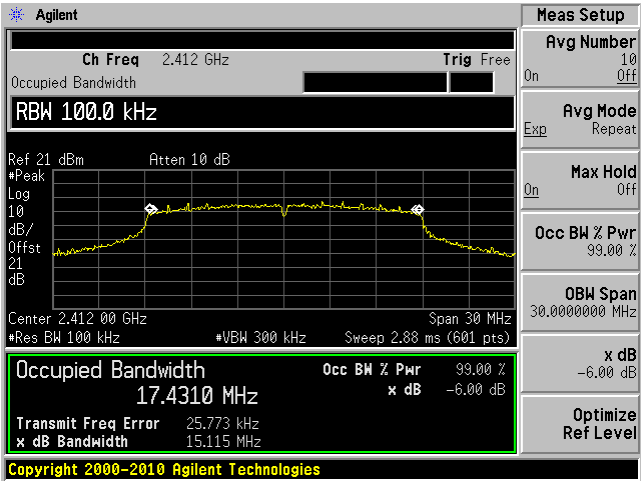


High channel: 2462 MHz

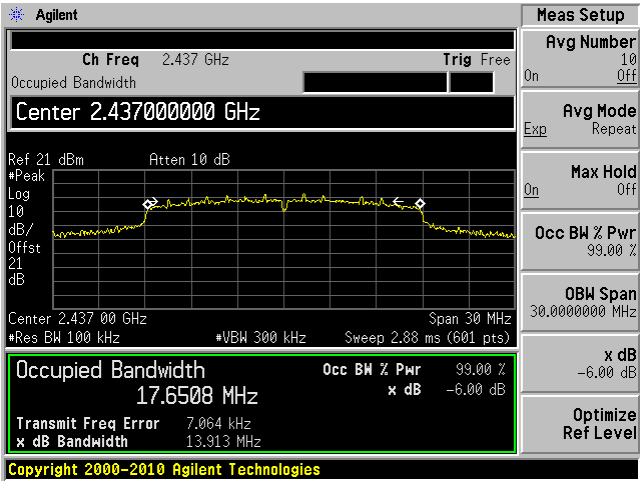


802.11n HT20 mode

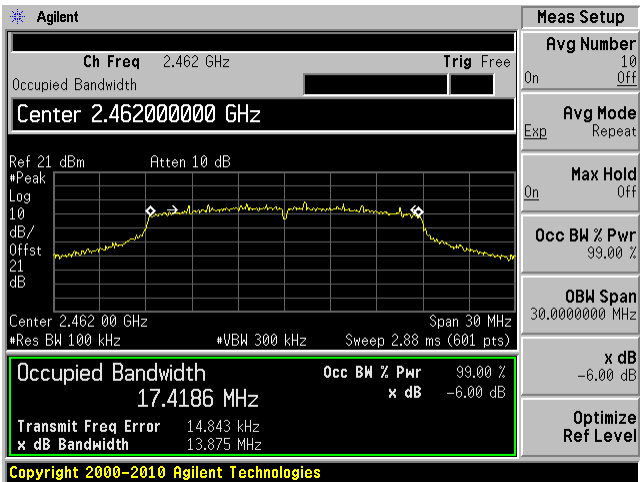
Low channel: 2412 MHz



Middle channel: 2437 MHz



High channel: 2462 MHz



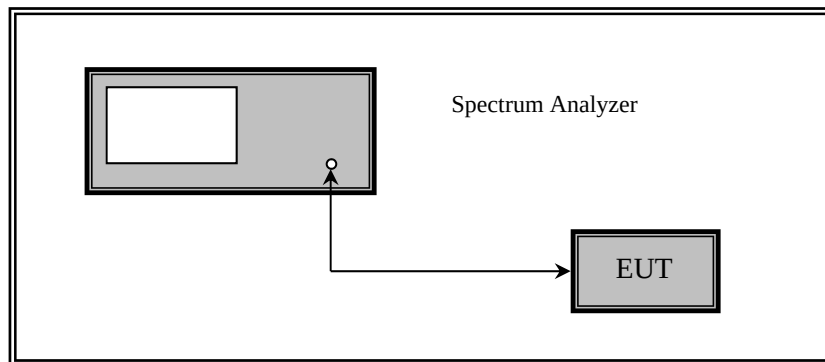
10 FCC §15.247(b)(3) & IC RSS-247 §5.4 - Output Power

10.1 Applicable Standards

According to FCC §15.247(b) and IC RSS-247 §5.4 (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 based on FCC KDB 558074 D01 DTS Meas Guidance v03r03: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 section 9: Fundamental emission output power



10.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Rohde & Schwarz	Spectrum Analyzer	FSQ	1155.5001.26	2015-03-09	1 year
Mini Circuit	Precision Fixed Attenuator, 20 dB	BW-S20W5	-	Each Time1	N/A
-	SMA cable	-	C0002	Each time1	N/A

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

10.4 Test Environmental Conditions

Temperature:	24 °C
Relative Humidity:	43 %
ATM Pressure:	102.5 kPa

The testing was performed by Zhisen Qian on 2015-10-22 at RF site.

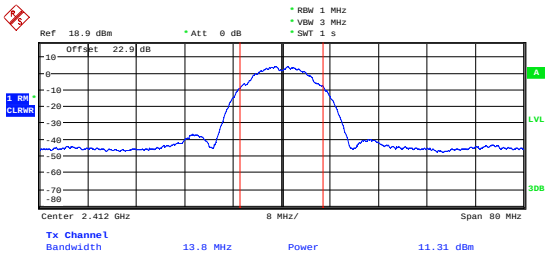
10.5 Test Results

Channel	Frequency (MHz)	Conducted Output Power (dBm)	Limit (dBm)	Results
802.11b mode				
Low	2412	11.31	30	Compliant
Middle	2437	12.85	30	Compliant
High	2462	12.40	30	Compliant
802.11g mode				
Low	2412	10.26	30	Compliant
Middle	2437	13.18	30	Compliant
High	2462	10.86	30	Compliant
802.11n HT20 mode				
Low	2412	9.43	30	Compliant
Middle	2437	13.18	30	Compliant
High	2462	9.06	30	Compliant

Please refer to the following plots for detailed test results

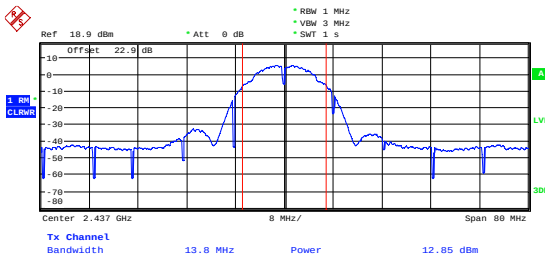
802.11b mode

Low channel: 2412 MHz



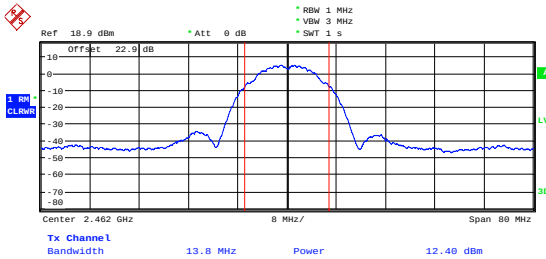
Date: 23.OCT.2015 16:18:22

Middle channel: 2437 MHz



Date: 23.OCT.2015 16:19:38

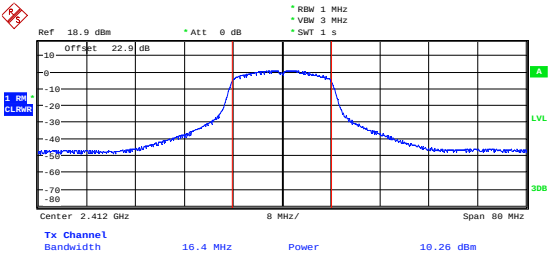
High channel: 2462 MHz



Date: 23.OCT.2015 16:18:56

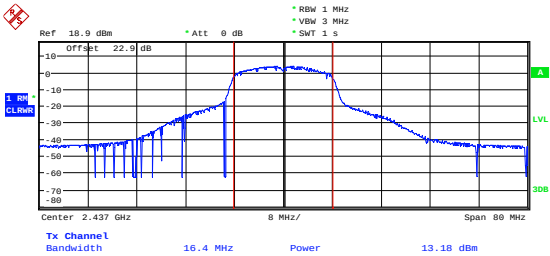
802.11g mode

Low channel: 2412 MHz



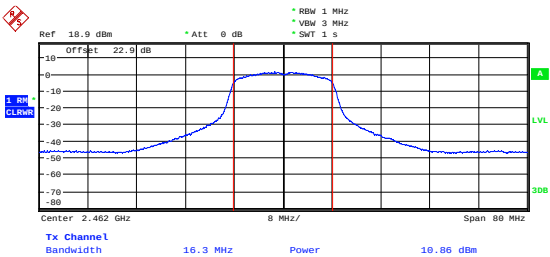
Date: 23.OCT.2015 16:04:07

Middle channel: 2437 MHz



Date: 23.OCT.2015 16:03:35

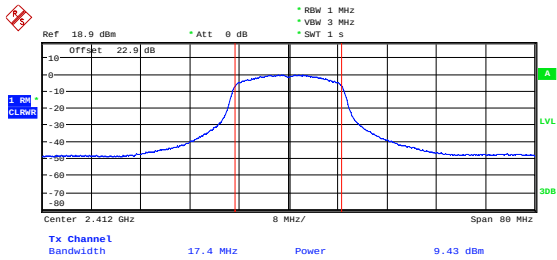
High channel: 2462 MHz



Date: 23.OCT.2015 15:54:33

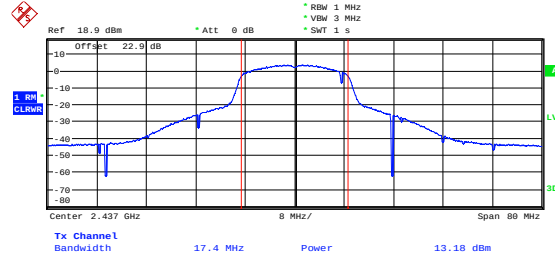
802.11n HT20 mode

Low channel: 2412 MHz



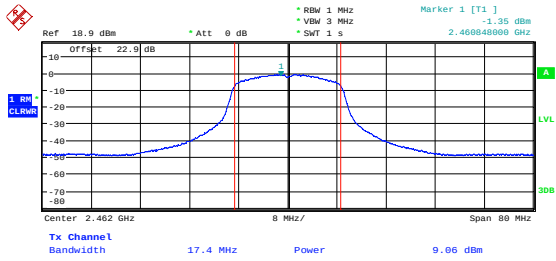
Date: 23.OCT.2015 16:08:02

Middle channel: 2437 MHz



Date: 23.OCT.2015 16:08:43

High channel: 2462 MHz



Date: 23.OCT.2015 16:08:59

11 FCC §15.247(d) & IC RSS-247 §5.5 - 100 kHz Bandwidth of Band Edges

11.1 Applicable Standards

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-247 §5.5. 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 5.4(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.

11.2 Measurement Procedure

The measurements are based on FCC KDB 558074 D01 DTS Meas Guidance v03r03: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 section 13: Band-edge measurements

11.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	US44300386	2015-09-29	1 year
Mini Circuit	Precision Fixed Attenuator, 20 dB	BW-S20W5	-	Each Time1	N/A
-	SMA cable	-	C0002	Each time1	N/A

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

11.4 Test Environmental Conditions

Temperature:	24° C
Relative Humidity:	43 %
ATM Pressure:	102.5 KPa

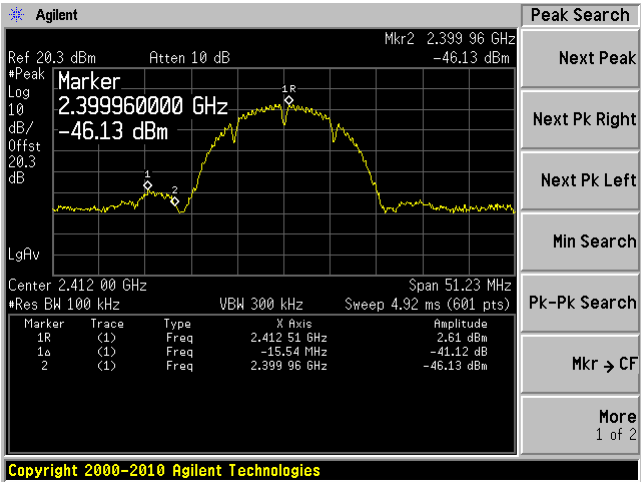
The testing was performed by Zhisen Qian on 2015-10-22 at RF site.

11.5 Test Results

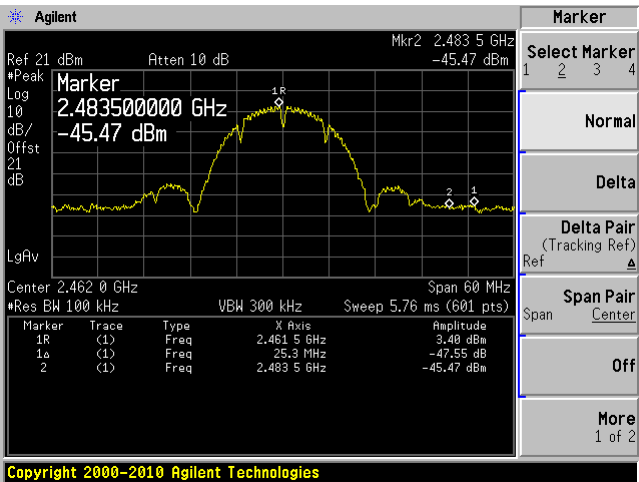
Please refer to following pages for plots of band edge.

802.11b mode

802.11b, Low Band Edge

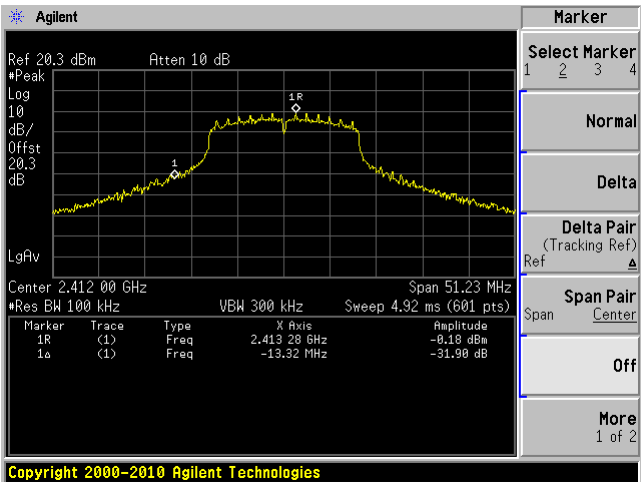


802.11b, High Band Edge

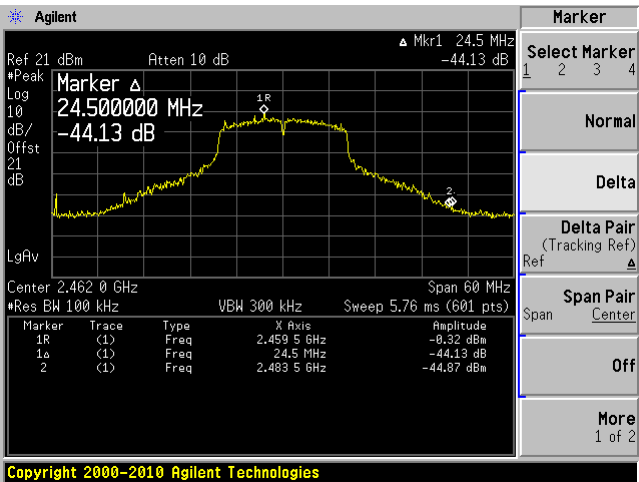


802.11g mode

802.11g, Low Band Edge

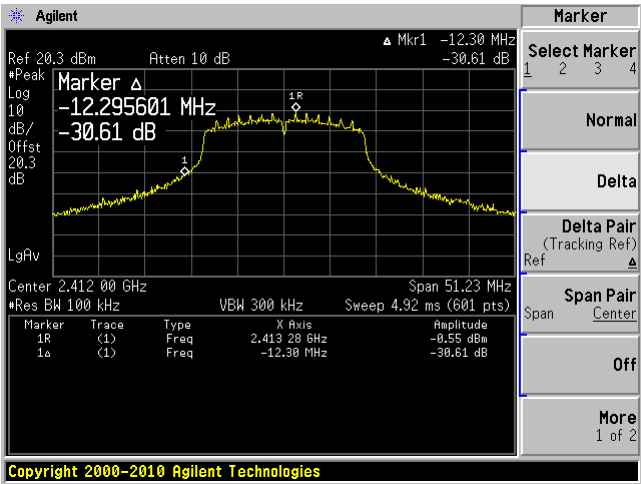


802.11g, High Band Edge

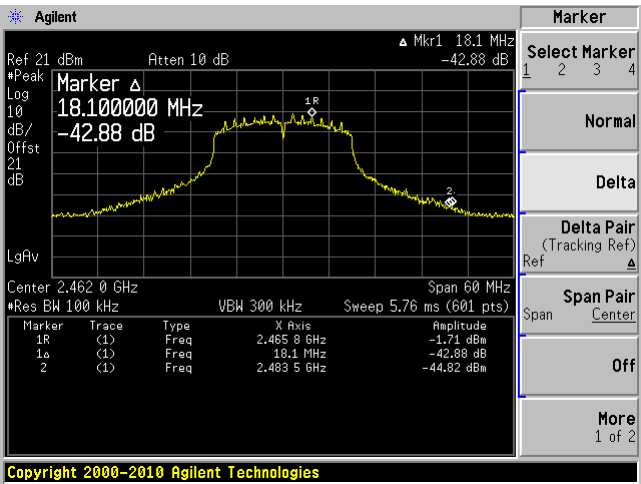


802.11n HT20 mode

802.11n HT20, Low Band Edge



802.11n HT20, High Band Edge



12 FCC §15.247(e) & IC RSS-247 §5.2 (b) - Power Spectral Density

12.1 Applicable Standards

According to FCC §15.247(e) and RSS-247 §5.2 (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 based on FCC KDB 558074 D01 DTS Meas Guidance v03r03: 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 Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	US44300386	2015-09-29	1 year
Mini Circuit	Precision Fixed Attenuator, 20 dB	BW-S20W5	-	Each Time1	N/A
-	SMA cable	-	C0002	Each time1	N/A

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

12.4 Test Environmental Conditions

Temperature:	24 °C
Relative Humidity:	43 %
ATM Pressure:	102.5 kPa

The testing was performed by Zhisen Qian on 2015-10-22 at RF site.

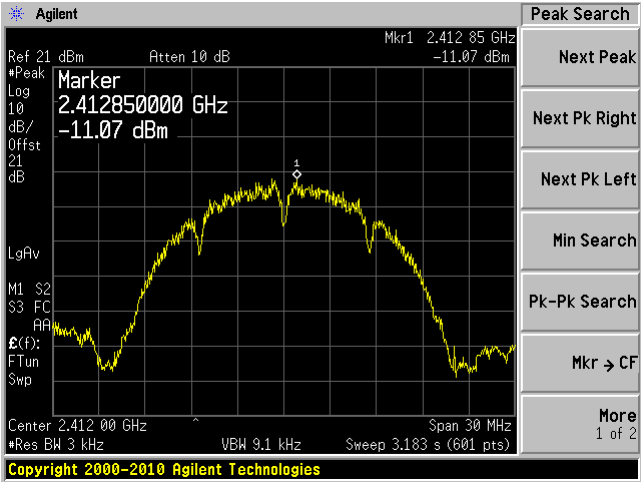
12.5 Test Results

Channel	Frequency (MHz)	Power Spectral Density (dBm)	Limit (dBm)	Results
802.11b mode				
Low	2412	-11.07	8	Compliant
Middle	2437	-9.87	8	Compliant
High	2462	-11.74	8	Compliant
802.11g mode				
Low	2412	-17.11	8	Compliant
Middle	2437	-12.71	8	Compliant
High	2462	-17.50	8	Compliant
802.11n HT20 mode				
Low	2412	-17.96	8	Compliant
Middle	2437	-13.57	8	Compliant
High	2462	-16.76	8	Compliant

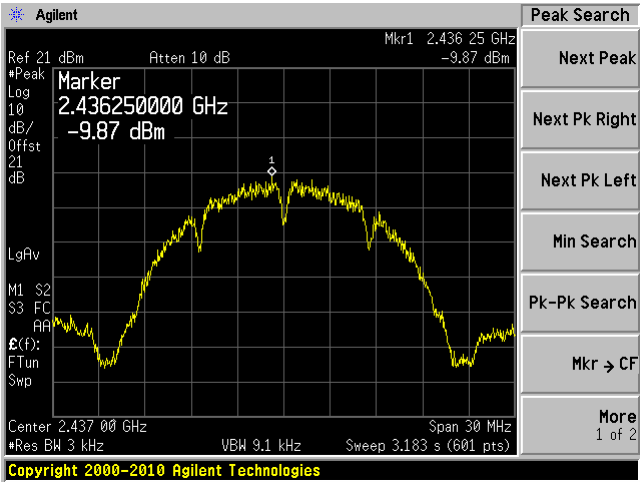
Please refer to the following plots for detailed test results

802.11b mode

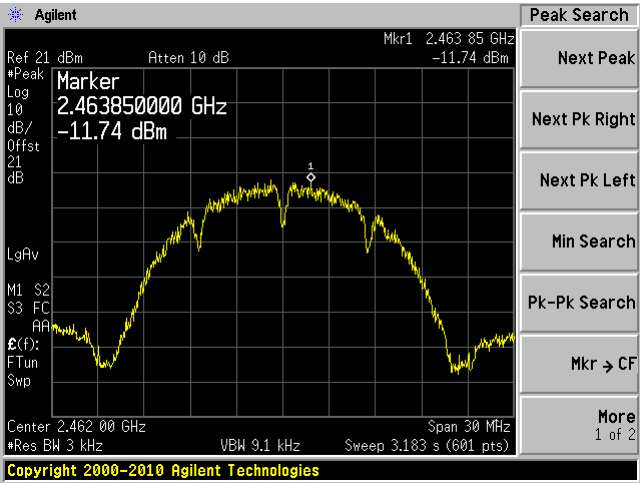
Low channel: 2412 MHz



Middle channel: 2437 MHz

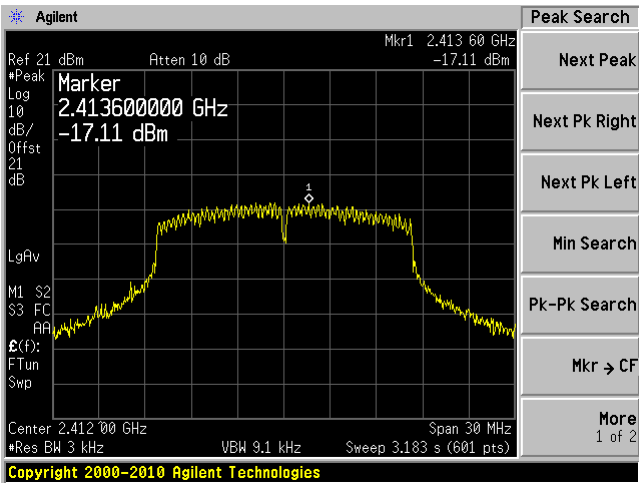


High channel: 2462 MHz

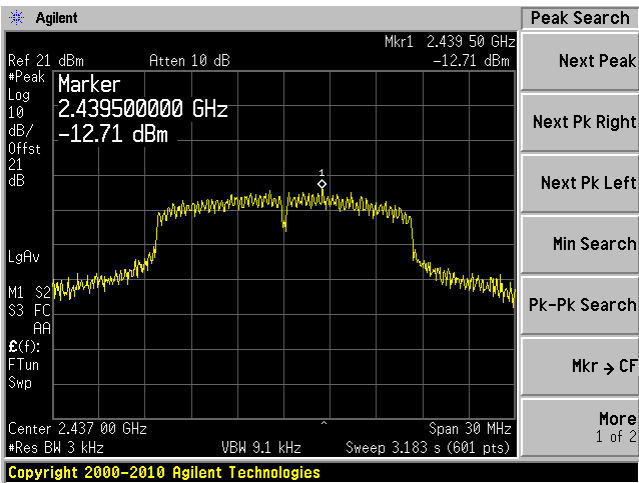


802.11g mode

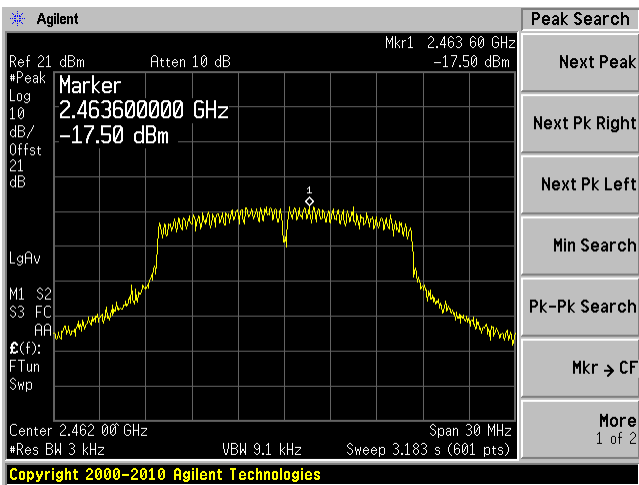
Low channel: 2412 MHz



Middle channel: 2437 MHz



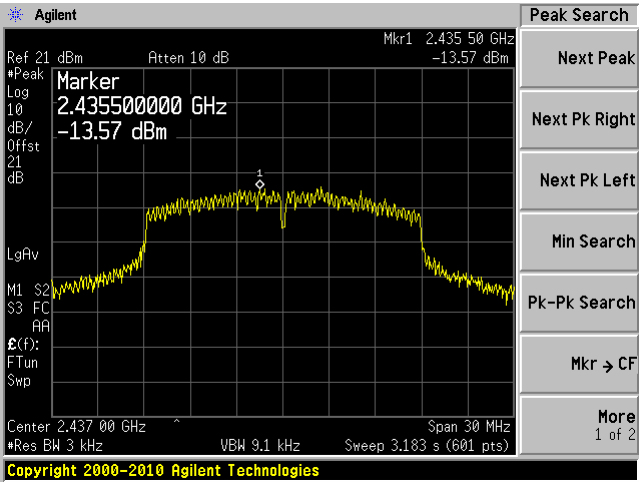
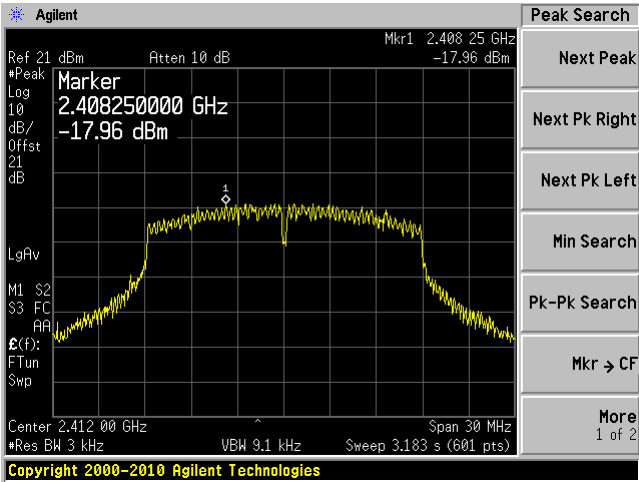
High channel: 2462 MHz



802.11n HT20 mode

Low channel: 2412 MHz

Middle channel: 2437 MHz



High channel: 2462 MHz

