FCC PART 15, SUBPART C
ISEDC RSS-247, ISSUE 2, FEBRUARY 2017

TEST REPORT

For

Roost, Inc.

1250 Borregas Ave.,

Sunnyvale, CA 94089 USA

FCC ID: 2AE5A-RSW200A
IC: 20891-RSW200A

Report Type:	**Product Type:**
Original Report	Wi-Fi Module

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Report Number:	R1707202-247
Report Date:	2018-01-23
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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1707202-247	Original Report	2017-10-26
1	R1707202-247	Model name changed	2018-01-23

1 General Description

1.1 Product Description for Equipment Under Test (EUT)

This test and measurement report was prepared on behalf of *Roost, Inc.*, and their product model: *RSW200A*, FCC ID: 2AE5A-RSW200A, IC: 20891-RSW200A or the "EUT" as referred to in this report. It is a 2.4 GHz Wi-Fi module.

1.2 Mechanical Description of EUT

The EUT measures approximately 15 mm (L) x 25 mm (W) x 1 mm (H) and weighs approximately 0.69 g.

The test data gathered are from typical production sample, serial number: R1707202-01 assigned by BACL.

1.3 Objective

This report is prepared on behalf of *Roost, Inc.*, in accordance with Part 2, Subpart J, and Part 15, Subparts B and C of the Federal Communication Commission's rules and ISEDC RSS-247 Issue 2, February 2017.

The objective is to determine compliance with FCC Part 15.247 and ISEDC 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 v04: 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.

Parameter	Measurement uncertainty
Occupied Channel Bandwidth	±5 %
RF output power, conducted	±0.57 dB
Power Spectral Density, conducted	±1.48dB
Unwanted Emissions, conducted	±1.57dB
All emissions, radiated	±4.0 dB
AC power line Conducted Emission	±2.0 dB
Temperature	±2 ° C
Humidity	±5 %
DC and low frequency voltages	±1.0 %
Time	±2 %
Duty Cycle	±3 %

1.7 Test Facility Registrations

BACLs test facilities that are used to perform Radiated and Conducted Emissions tests are currently recognized by the Federal Communications Commission as Accredited with NIST Designation Number US1129.

BACL's test facilities that are used to perform Radiated and Conducted Emissions tests are currently registered with Industry Canada under Registration Numbers: 3062A-1, 3062A-2, and 3062A-3.

BACL is a Chinese Taipei Bureau of Standards Metrology and Inspection (BSMI) validated Conformity Assessment Body (CAB), under Appendix B, Phase I Procedures of the APEC Mutual Recognition Arrangement (MRA). BACL's BSMI Lab Code Number is: SL2-IN-E-1002R

BACL's test facilities that are used to perform AC Line Conducted Emissions, Telecommunications Line Conducted Emissions, Radiated Emissions from 30 MHz to 1 GHz, and Radiated Emissions from 1 GHz to 6 GHz are currently recognized as Accredited in accordance with the Voluntary Control Council for Interference [VCCI] Article 15 procedures under Registration Number A-0027.

1.8 Test Facility Accreditations

Bay Area Compliance Laboratories Corp. (BACL) is:

A- ***An independent, 3rd-Party, Commercial Test Laboratory accredited to ISO/IEC 17025:2005 by A2LA (Test Laboratory Accreditation Certificate Number 3279.02),*** in the fields of: Electromagnetic Compatibility and Telecommunications. Unless noted by an Asterisk (*) in the Compliance Matrix (See Section 3 of this Test Report), BACL's ISO/IEC 17025:2005 Scope of Accreditation includes all of the Test Method Standards and/or the Product Family Standards detailed in this Test Report..

BACL's ISO/IEC 17025:2005 Scope of Accreditation includes a comprehensive suite of EMC Emissions, EMC Immunity, Radio, RF Exposure, Safety and wireline Telecommunications test methods applicable to a wide range of product categories. These product categories include Central Office Telecommunications Equipment

[including NEBS - Network Equipment Building Systems], Unlicensed and Licensed Wireless and RF devices, Information Technology Equipment (ITE); Telecommunications Terminal Equipment (TTE); Medical Electrical Equipment; Industrial, Scientific and Medical Test Equipment; Professional Audio and Video Equipment; Industrial and Scientific Instruments and Laboratory Apparatus; Cable Distribution Systems, and Energy Efficient Lighting.

B- ***A Product Certification Body accredited to ISO/IEC 17065:2012 by A2LA (Product Certification Body Accreditation Certificate Number 3279.03)*** to certify

- For the USA (Federal Communications Commission):
  - 1- All Unlicensed radio frequency devices within FCC Scopes A1, A2, A3, and A4;
  - 2- All Licensed radio frequency devices within FCC Scopes B1, B2, B3, and B4;
  - 3- All Telephone Terminal Equipment within FCC Scope C.
- For the Canada (Industry Canada):
  - 1 All Scope 1-Licence-Exempt Radio Frequency Devices;
  - 2 All Scope 2-Licensed Personal Mobile Radio Services;
  - 3 All Scope 3-Licensed General Mobile and Fixed Radio Services;
  - 4 All Scope 4-Licensed Maritime and Aviation Radio Services;
  - 5 All Scope 5-Licensed Fixed Microwave Radio Services
  - 6 All Broadcasting Technical Standards (BETS) in the Category I Equipment Standards List.
- For Singapore (Info-Communications Development Authority (IDA)):
  - 1 All Line Terminal Equipment: All Technical Specifications for Line Terminal Equipment – Table 1 of IDA MRA Recognition Scheme: 2011, Annex 2
  - 2. All Radio-Communication Equipment: All Technical Specifications for Radio-Communication Equipment – Table 2 of IDA MRA Recognition Scheme: 2011, Annex 2
- For the Hong Kong Special Administrative Region:
  - 1 All Radio Equipment, per KHCA 10XX-series Specifications;
  - 2 All GMDSS Marine Radio Equipment, per HKCA 12XX-series Specifications;
  - 3 All Fixed Network Equipment, per HKCA 20XX-series Specifications.
- For Japan:
  - 1 MIC Telecommunication Business Law (Terminal Equipment):
    - All Scope A1 - Terminal Equipment for the Purpose of Calls;
    - All Scope A2 - Other Terminal Equipment
  - 2 Radio Law (Radio Equipment):
    - All Scope B1 - Specified Radio Equipment specified in Article 38-2-2, paragraph 1, item 1 of the Radio Law
    - All Scope B2 - Specified Radio Equipment specified in Article 38-2-2, paragraph 1, item 2 of the Radio Law
    - All Scope B3 - Specified Radio Equipment specified in Article 38-2-2, paragraph 1, item 3 of the Radio Law

C- ***A Product Certification Body accredited to ISO/IEC 17065:2012 by A2LA (Product Certification Body Accreditation Certificate Number 3279.01)*** to certify Products to USA's Environmental Protection Agency (EPA) ENERGY STAR Product Specifications for:

1 Electronics and Office Equipment:
- for Telephony (ver. 3.0)
- for Audio/Video (ver. 3.0)
- for Battery Charging Systems (ver. 1.1)
- for Set-top Boxes and Cable Boxes (ver. 4.1)
- for Televisions (ver. 6.1)
- for Computers (ver. 6.0)
- for Displays (ver. 6.0)
- for Imaging Equipment (ver. 2.0)

- for Computer Servers (ver. 2.0)

2 Commercial Food Service Equipment
- for Commercial Dishwashers (ver. 2.0)
- for Commercial Ice Machines (ver. 2.0)
- for Commercial Ovens (ver. 2.1)
- for Commercial Refrigerators and Freezers

3 Lighting Products
- For Decorative Light Strings (ver. 1.5)
- For Luminaires (including sub-components) and Lamps (ver. 1.2)
- For Compact Fluorescent Lamps (CFLs) (ver. 4.3)
- For Integral LED Lamps (ver. 1.4)

4 Heating, Ventilation, and AC Products
- for Residential Ceiling Fans (ver. 3.0)
- for Residential Ventilating Fans (ver. 3.2)

5 Other
- For Water Coolers (ver. 3.0)

D- ***A NIST Designated Phase-I and Phase-II Conformity Assessment Body (CAB) for the following economies and regulatory authorities under the terms of the stated MRAs/Treaties:***

- Australia: ACMA (Australian Communication and Media Authority) – APEC Tel MRA -Phase I;
- Canada: (Industry Canada - ISEDC) Foreign Certification Body – FCB – APEC Tel MRA -Phase I and Phase II;
- Chinese Taipei (Republic of China – Taiwan):
  - BSMI (Bureau of Standards, Metrology and Inspection) APEC Tel MRA -Phase I;
  - NCC (National Communications Commission) APEC Tel MRA -Phase I;
- European Union:
  - EMC Directive 2004/108/EC US-EU EMC and Telecom MRA CAB
  - Radio and Teleterminal Equipment (RandTTE) Directive 1995/5/EC US -EU EMC and Telecom MRA CAB
- Hong Kong Special Administrative Region: (Office of the Telecommunications Authority – OFTA) APEC Tel MRA -Phase I and Phase II
- Israel – US-Israel MRA Phase I
- Republic of Korea (Ministry of Communications - Radio Research Laboratory) APEC Tel MRA -Phase I
- Singapore: (Infocomm Development Authority - IDA) APEC Tel MRA -Phase I and Phase II;
- Japan: VCCI - Voluntary Control Council for Interference US-Japan Telecom Treaty VCCI Side Letter-
- USA:
  - ENERGY STAR Recognized Test Laboratory – US EPA
  - Telecommunications Certification Body (TCB) – US FCC;
- Vietnam: APEC Tel MRA -Phase I;

2 System Test Configuration

2.1 Justification

The EUT was configured for testing according to ANSI C63.10-2013 and FCC KDB 558074 D01 DTS Meas Guidance v04.

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 firmware used was ATMEL GUI 'WINC1500_GUI.exe' provided by *Roost, Inc.*, the software is compliant with the standard requirements being tested against.

Modulation	Frequency (MHz)	Digital Gain (Power Setting)
802.11b	2412	-10
	2437	-9
	2462	-10
802.11g	2412	-11
	2437	-7
	2462	-9
802.11n20	2412	-12
	2437	-7
	2462	-10

2.3 Duty Cycle Correction Factor

According to KDB 558074 D01 DTS Meas Guidance v04 section 6.0:

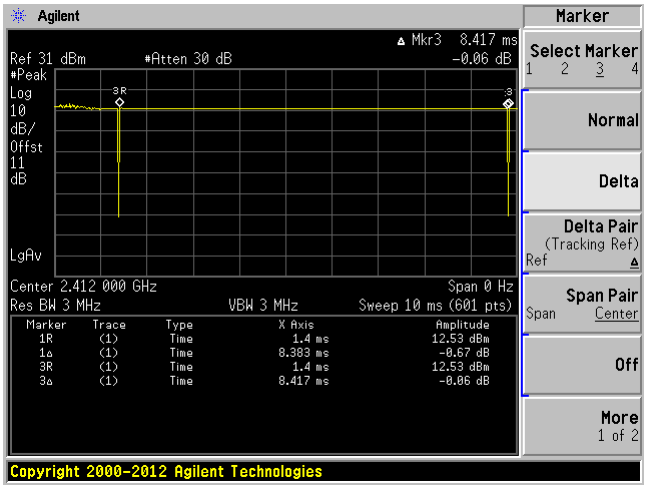
Preferably, all measurements of maximum conducted (average) output power will be performed with the EUT transmitting continuously (i.e., with a duty cycle of greater than or equal to 98%). When continuous operation cannot be realized, then the use of sweep triggering/signal gating techniques can be utilized to ensure that measurements are made only during transmissions at the maximum power control level. Such sweep triggering/signal gating techniques will require knowledge of the minimum transmission duration (T) over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation. Sweep triggering/signal gating techniques can then be used if the measurement/sweep time of the analyzer can be set such that it does not exceed T at any time that data is being acquired (i.e., no transmitter off-time is to be considered).

Radio Mode	On Time (ms)	Period (ms)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)
802.11b	8.383	8.417	99.596	0.01758
802.11g	1.387	1.437	96.52	0.1538
802.11n20	1.3	1.35	96.296	0.164

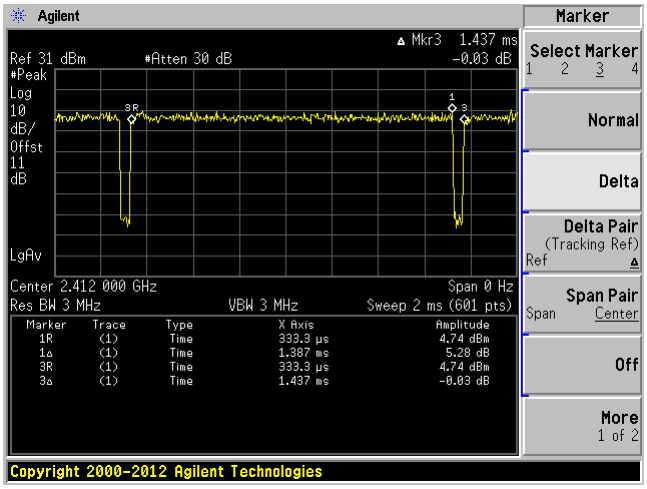
Duty Cycle = On Time (ms)/ Period (ms)
Duty Cycle Correction Factor (dB) = 10*log(1/Duty Cycle)

Please refer to the following plots.

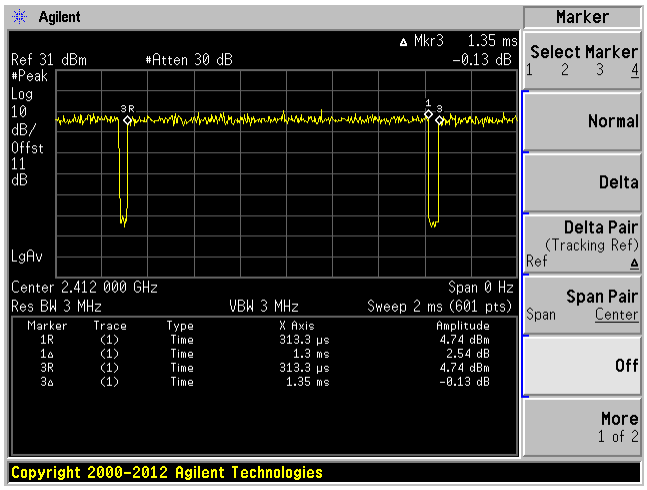
802.11b mode



802.11g mode



802.11n20 mode



2.4 Equipment Modifications

N/A

2.5 Local Support Equipment

Manufacturer	Description	Model
Dell	Laptop	Latitude E7450
HP	DC Power Supply	E3630
Pomona	Banana Plug Patch Cord, Stackable, RED & BLACK	B-36-2

2.6 Support Equipment

Manufacturer	Description	Model
HP	Laptop	V6GT0ULA
TOTAL PHASE	Aardvark I2C/SPI Host Adapter	TP240141

2.7 Interface Ports and Cabling

Cable Description	Length (m)	To	From
USB Cable	< 2 m	Laptop	UUT
RF Cable (SMA Pigtail)	< 1 m	UUT	PSA

3 Summary of Test Results

Results reported relate only to the product tested.

FCC & ISEDC Rules	Description of Test	Results
FCC §15.203 ISEDC RSS-Gen §8.3	Antenna Requirement	Compliant
FCC §15.207 ISEDC RSS-Gen §8.8	AC Line Conducted Emissions	Compliant
FCC §2.1091, §15.247(i) ISEDC RSS-102	RF Exposure	Compliant
FCC §2.1051, §15.247 (d) ISEDC RSS-247 §5.5	Spurious Emissions at Antenna Port	Compliant
FCC §2.1053, §15.209, §15.247 (d) ISEDC RSS-247 §5.5 RSS-Gen §8.9 and §8.10	Radiated Spurious Emissions	Compliant
FCC §15.247(a)(2) ISEDC RSS-247 §5.2 (1)	6 dB and 99% Emission Bandwidth	Compliant
FCC §15.247(b)(3) ISEDC RSS-247 §5.4 (4)	Maximum Peak Output Power	Compliant
FCC §15.247(d) ISEDC RSS-247 §5.5	100 kHz Bandwidth of Frequency Band Edge	Compliant
FCC §15.247(e) ISEDC RSS-247 §5.2 (2)	Power Spectral Density	Compliant

4 FCC §15.203 & ISEDC RSS-Gen §8.3 - Antenna Requirements

4.1 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 ISEDC 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 license-exempt transmitter, indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna.

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

Testing shall be performed using the highest gain antenna of each combination of license-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).

4.2 Antenna Description

The antennas used by the EUT are permanent attached antennas.

Antenna usage	Frequency Range (MHz)	Maximum Gain (dBi)
Wi-Fi	2412-2462	-6.7

5 FCC §2.1091, §15.247(i) & ISEDC RSS-102 - RF Exposure

5.1 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

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 MHz[6] 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.

5.2 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

5.3 MPE Results

Maximum peak output power at antenna input terminal (dBm):	16.1
Maximum peak output power at antenna input terminal (mW):	40.73
Prediction distance (cm):	20
Prediction frequency (MHz):	2437
Maximum Antenna Gain, typical (dBi):	-6.7
Maximum Antenna Gain (numeric):	0.21
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.0017
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1.0

The device is compliant with the requirement MPE limit for uncontrolled exposure. The maximum power density at the distance of 20 cm is 0.0017 mW/cm^2. Limit is 1.0 mW/cm^2.

5.4 RF exposure evaluation exemption for IC

16.1 + (-6.7) dBi = 9.4 dBm < $1.31\times10^{-2}f^{0.6834}$ = 2.68 W = 34.29 dBm

Therefore the RF exposure is not required.

Note: Tune-up tolerance 1 dB has been considered into the evaluation. So the output power at antenna input terminal is 15.1+1=16.1 dBm

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

6.1 Applicable Standards

As per FCC §15.207 and ISEDC 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 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 Note1	56 to 46 Note2
0.5-5	56	46
5-30	60	50

Note1: Decreases with the logarithm of the frequency.
Note2: A linear average detector is required

6.2 Test Setup

The measurement was performed at shield room, using the setup per ANSI C63.10-2013 measurement procedure. The specification used were FCC §15.207 and ISEDC 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 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-1 and the power cords of support equipment were connected to LISN-2.

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

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

6.4 Corrected Amplitude and 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:

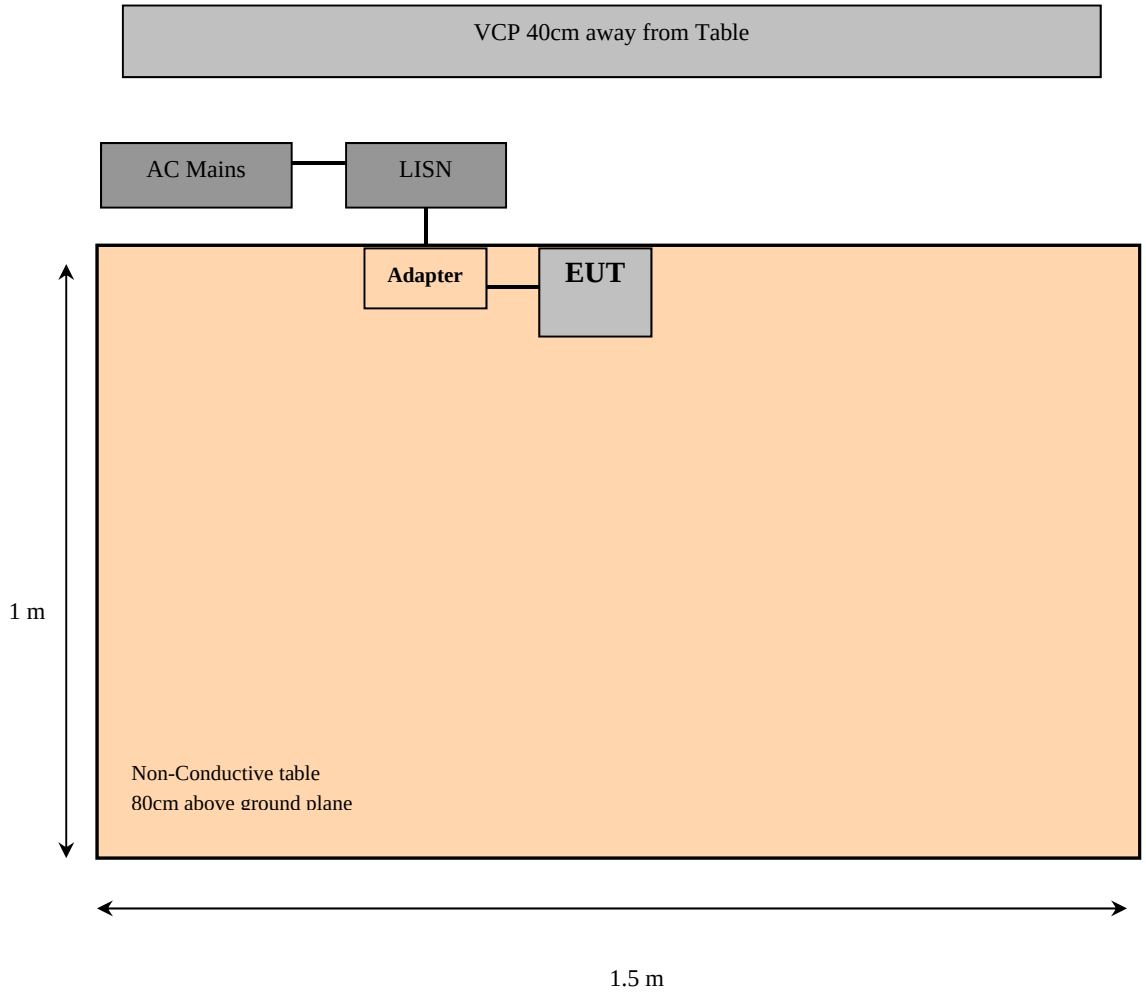
CA = Ai + CL + Atten

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

6.5 Test Setup Block Diagram



6.6 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Rohde and Schwarz	Receiver, EMI Test	ESCI 1166.5950K03	100338	2016-02-04	2 years
Rohde and Schwarz	Impulse Limiter	ESH3-Z2	101964	2017-07-22	1 year
Keysight Technologies	RF Limiter	11867A	MY42242931	2017-01-12	1 year
Solar Electronics Company	High Pass Filter	Type 7930-100	7930150204	2017-03-13	1 year
Suirong	30 ft conductive emission cable	LMR 400	-	N/R	N/A
FCC	LISN	FCC-LISN-50-25-2-10-CISPR16	160129	2017-04-24	1 year
Vasona	Test software	V6.0 build 11	10400213	N/R	N/R

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:	23º C
Relative Humidity:	42 %
ATM Pressure:	101.31 kPa

The testing was performed by Troy Pandhumsoporn on 2017-09-02 at RF site.

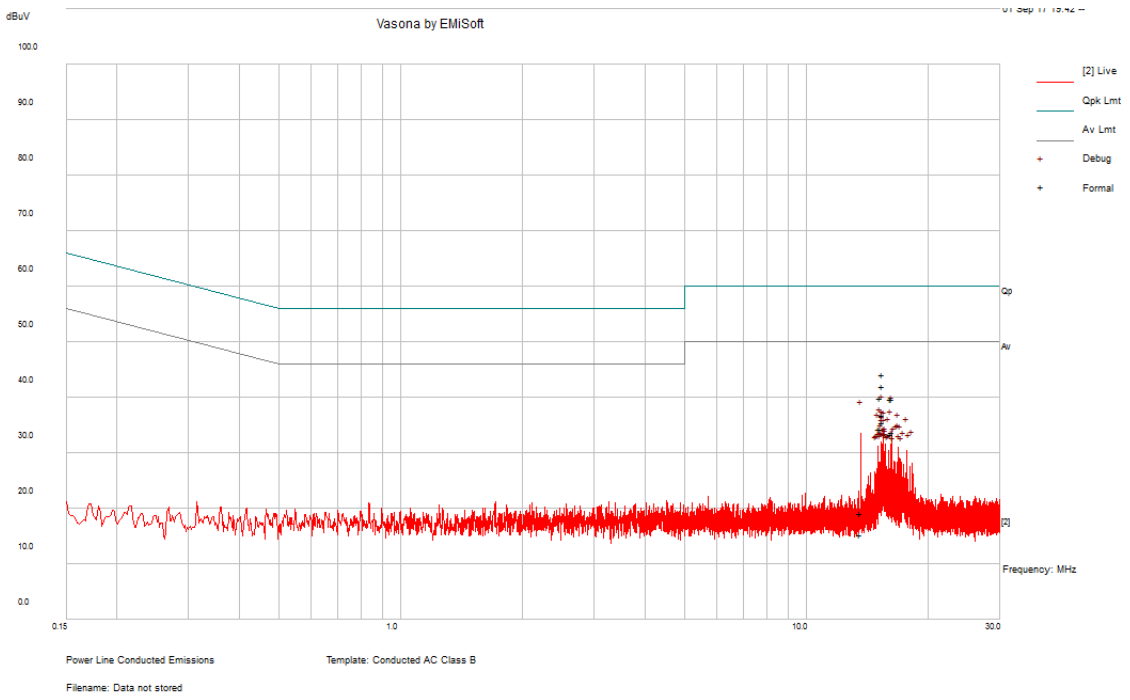
6.8 Summary of Test Results

According to the recorded data in following table, the EUT complied with the FCC 15C and ISEDC 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)**
-11.51	15.37441	Neutral	0.15-30

6.9 Conducted Emissions Test Plots and Data

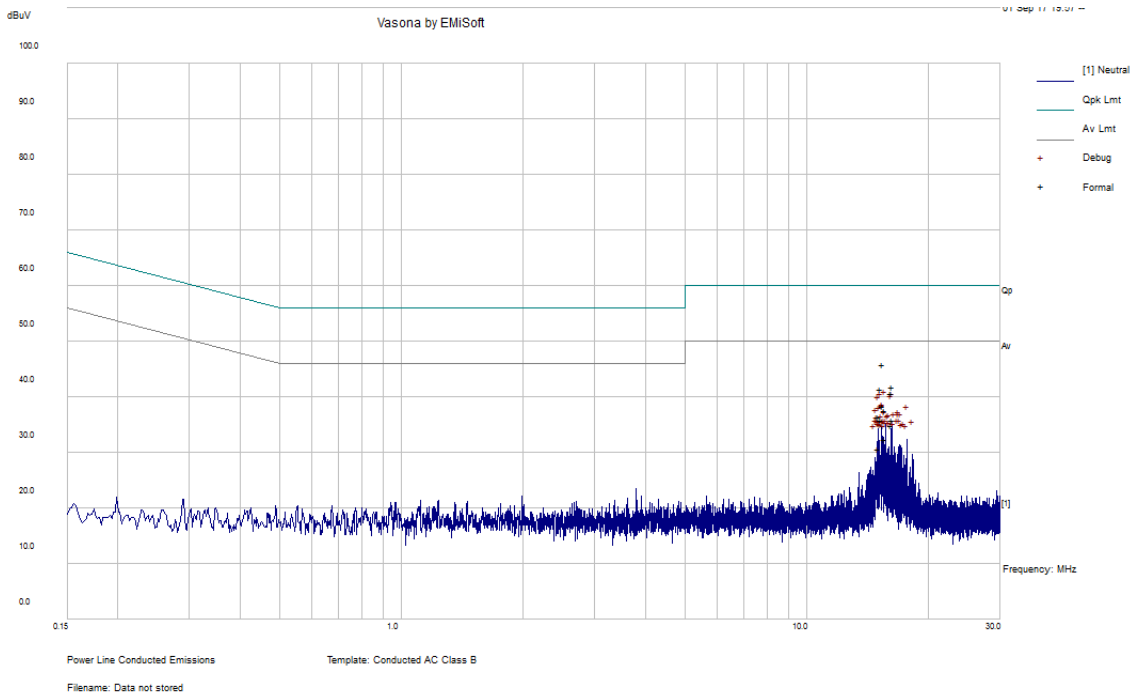
120 V, 60 Hz – Line



Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
15.43402	42.05	Line	60	-17.95	QP
16.23032	39.83	Line	60	-20.17	QP
13.60146	19.19	Line	60	-40.81	QP
15.25123	39.98	Line	60	-20.02	QP
16.16653	39.67	Line	60	-20.33	QP
15.37434	44.17	Line	60	-15.83	QP

Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
15.43402	35.6	Line	50	-14.4	Ave.
16.23032	33.79	Line	50	-16.21	Ave.
13.60146	15.33	Line	50	-34.67	Ave.
15.25123	34.4	Line	50	-15.6	Ave.
16.16653	33.32	Line	50	-16.68	Ave.
15.37434	36.89	Line	50	-13.11	Ave.

120 V, 60 Hz – Neutral



Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
15.61961	37.66	Neutral	60	-22.34	QP
16.22961	41.89	Neutral	60	-18.11	QP
15.25295	41.4	Neutral	60	-18.6	QP
16.16775	40.78	Neutral	60	-19.22	QP
15.00845	36.39	Neutral	60	-23.61	QP
15.37441	45.85	Neutral	60	-14.15	QP

Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
15.61961	32.35	Neutral	50	-17.65	Ave.
16.22961	35.91	Neutral	50	-14.09	Ave.
15.25295	35.96	Neutral	50	-14.04	Ave.
16.16775	35	Neutral	50	-15	Ave.
15.00845	30.68	Neutral	50	-19.32	Ave.
15.37441	38.49	Neutral	50	**-11.51**	Ave.

7 FCC §15.209, §15.247(d) & ISEDC RSS-247 §5.5, RSS-Gen §8.9, §8.10 - Spurious Radiated Emissions

7.1 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 §15.205(a) and RSS-Gen 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 0.495 – 0.505 2.1735 – 2.1905 4.125 – 4.128 4.17725 – 4.17775 4.20725 – 4.20775 6.215 – 6.218 6.26775 – 6.26825 6.31175 – 6.31225 8.291 – 8.294 8.362 – 8.366 8.37625 – 8.38675 8.41425 – 8.41475 12.29 – 12.293 12.51975 – 12.52025 12.57675 – 12.57725 13.36 – 13.41	16.42 – 16.423 16.69475 – 16.69525 25.5 – 25.67 37.5 – 38.25 73 – 74.6 74.8 – 75.2 108 – 121.94 123 – 138 149.9 – 150.05 156.52475 – 156.52525 156.7 – 156.9 162.0125 –167.17 167.72 – 173.2 240 – 285 322 – 335.4 399.9 – 410 608 – 614	960 – 1240 1300 – 1427 1435 – 1626.5 1645.5 – 1646.5 1660 – 1710 1718.8 – 1722.2 2200 – 2300 2310 – 2390 2483.5 – 2500 2690 – 2900 3260 – 3267 3.332 – 3.339 3 3458 – 3 358 3.600 – 4.400	4. 5 – 5. 15 5. 35 – 5. 46 7.25 – 7.75 8.025 – 8.5 9.0 – 9.2 9.3 – 9.5 10.6 – 12.7 13.25 – 13.4 14.47 – 14.5 15.35 – 16.2 17.7 – 21.4 22.01 – 23.12 23.6 – 24.0 31.2 – 31.8 36.43 – 36.5 Above 38.6

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 §15.247 (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 ISEDC 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 (µv/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 license-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 ISEDC 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 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 ISEDC RSS-247 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.

7.3 Test Procedure

For the radiated emissions test, the EUT host, and all support equipment power cords were 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 was set 3 meter away from the testing antenna, which was varied from 1-4 meter, and the EUT was placed on a turntable, which was 0.8 meter and 1.5 meter above the ground plane for below and above 1000 MHz measurements, the table shall be rotated for 360 degrees to find out the highest emission. The receiving antenna's polarity should be changed between horizontal and vertical.

The spectrum analyzer or receiver was 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

7.4 Corrected Amplitude and 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

0For 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

7.5 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Rohde and Schwarz	Receiver, EMI Test	ESCI 1166.5950K03	100338	2016-02-04	2 years
Agilent	Analyzer, Spectrum	E4440A	US44300386	2017-04-20	1 year
Sunol Sciences	System Controller	SC99V	011003-1	N/R	N/A
Sunol Sciences	Antenna, Biconi-Log	JB1	A013105-3	2015-07-11	26 Months
EMCO	Antenna, Horn	3115	9511-4627	2016-01-28	2 years
Agilent	Amplifier, Pre	8447D	2944A06639	2017-03-13	1 year
IW	AOBOR Hi frequency Co AX Cable	DC 1531	KPS-1501A3960KPS	2017-08-05	1 year
-	SMA cable	-	C0002	Each time[1]	N/A
-	N-Type Cable	-	C00012	Each time[1]	N/A
-	N-Type Cable	-	C00014	Each time[1]	N/A
Agilent	Pre-Amplifier	8449B	3008A01978	2016-10-06	1 year
Sunol Sciences	Antenna, Horn	DRH-118	A052704	2017-03-27	2 years
A.R.A.	Antenna, Horn	DRG-118/A	1132	2015-09-21	2 years
Vasona	Test software	V6.0 build 11	10400213	N/R	N/R

Note[1]: cable and attenuator included in the test set-up will be checked each time before testing.
Statement of Traceability: BACL *attests that all calibrations have been performed per the A2LA requirements, traceable to NIST.*

7.6 Test Environmental Conditions

Temperature:	20-22 ºC
Relative Humidity:	42-50 %
ATM Pressure:	102.7 kPa

The testing was performed by Candi Li and Troy Pandhumsoporn on 2017-08-22 and 2017-08-31 respectively in 5m chamber 3.

7.7 Summary of Test Results

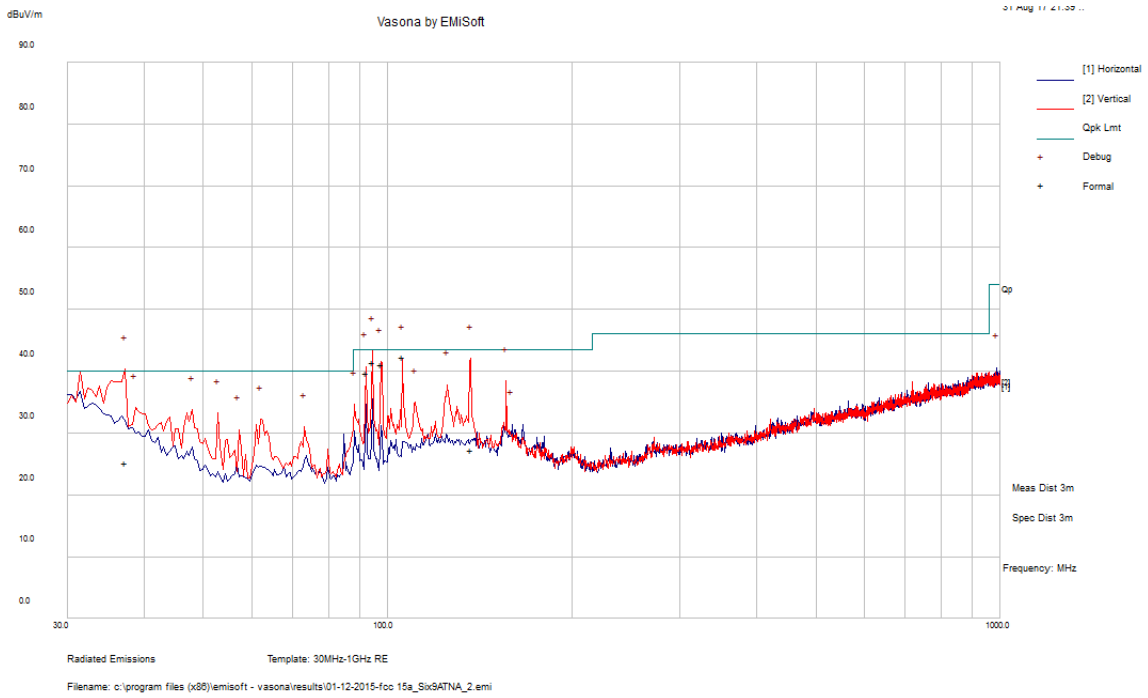
According to the data hereinafter, the EUT complied with FCC Title 47, Part 15C and ISEDC RSS-247 standard's radiated emissions limits, and had the worst margin of:

Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Mode, channel**
-0.63	4824	Vertical	802.11b mode, low channel

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

7.8 Radiated Emissions Test Results

1) 30 MHz – 1 GHz Worst Case, Measured at 3 meters



802.11b, Middle Channel

Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Comment
37.2645	25.25	103	V	304	40	-14.75	QP
94.4365	41.55	130	V	350	43.5	-1.95	QP
136.7185	27.37	106	V	299	43.5	-16.13	QP
105.661	42.3	123	V	336	43.5	-1.2	QP
97.6405	41.15	131	V	180	43.5	-2.35	QP
92.323	39.71	102	V	220	43.5	-3.79	QP

Note: Other emissions were 20 dB below the limit.

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/ISEDC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 2412 MHz											
2412	53.59	157	292	H	28.94	6.29	0	88.82	-	-	PK
2412	50.57	157	292	H	28.94	6.29	0	85.80	-	-	AV
2412	56.29	174	263	V	28.93	6.29	0	91.51	-	-	PK
2412	53.50	174	263	V	28.93	6.29	0	88.72	-	-	AV
2390	24.23	157	292	H	28.94	6.24	0	59.41	74.00	-14.59	PK
2390	15.20	157	292	H	28.94	6.24	0	50.38	54.00	-3.62	AV
2390	25.13	174	263	V	28.93	6.24	0	60.30	74.00	-13.70	PK
2390	15.25	174	263	V	28.93	6.24	0	50.42	54.00	-3.58	AV
4824	51.52	223	289	V	32.56	9.62	36.38	57.32	74.00	-16.68	PK
4824	47.57	223	289	V	32.56	9.62	36.38	53.37	54.00	**-0.63**	AV
7236	44.38	20	106	V	37.81	13.82	36.43	59.58	74.00	-14.42	PK
7236	33.23	20	106	V	37.81	13.82	36.43	48.43	54.00	-5.57	AV
Middle Channel 2437 MHz											
2437	53.09	157	289	H	29.19	6.29	0.00	88.57	-	-	PK
2437	50.17	157	289	H	29.19	6.29	0.00	85.65	-	-	AV
2437	55.01	180	297	V	29.19	6.29	0.00	90.49	-	-	PK
2437	52.27	180	297	V	29.19	6.29	0.00	87.75	-	-	AV
4874	45.43	215	240	H	32.79	9.42	36.327	51.31	74.00	-22.69	PK
4874	36.63	215	240	H	32.79	9.42	36.327	42.51	54.00	-11.49	AV
7311	44.73	125	286	H	37.82	12.92	36.45	59.01	74.00	-14.99	PK
7311	33.47	125	286	H	37.82	12.92	36.45	47.75	54.00	-6.25	AV
High Channel 2462 MHz											
2462	51.67	160	280	H	29.15	6.35	0.00	87.17	-	-	PK
2462	48.84	160	280	H	29.15	6.35	0.00	84.34	-	-	AV
2462	54.06	175	243	V	29.19	6.35	0.00	89.59	-	-	PK
2462	51.25	175	243	V	29.19	6.35	0.00	86.78	-	-	AV
2483.5	25.56	160	280	H	29.25	6.22	0.00	61.03	74.00	-12.97	PK
2483.5	15.43	160	280	H	29.25	6.22	0.00	50.90	54.00	-3.10	AV
2483.5	24.76	175	243	V	29.18	6.22	0.00	60.16	74.00	-13.84	PK
2483.5	15.49	175	243	V	29.18	6.22	0.00	50.89	54.00	-3.11	AV
4924	47.18	221	290	V	32.70	8.58	36.41	52.05	74.00	-21.95	PK
4924	40.66	221	290	V	32.70	8.58	36.41	45.53	54.00	-8.47	AV
7386	45.19	104	259	V	37.98	13.76	36.45	60.48	74.00	-13.52	PK
7386	32.95	104	259	V	37.98	13.76	36.45	48.24	54.00	-5.76	AV

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/ISEDC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 2412 MHz											
2412	53.32	153	294	H	28.94	6.29	0	88.55	-	-	PK
2412	44.53	153	294	H	28.94	6.29	0	79.76	-	-	AV
2412	55.94	185	300	V	28.93	6.29	0	91.16	-	-	PK
2412	47.22	185	300	V	28.93	6.29	0	82.44	-	-	AV
2390	25.49	153	294	H	28.94	6.24	0	60.67	74.00	-13.33	PK
2390	15.21	153	294	H	28.94	6.24	0	50.39	54.00	-3.61	AV
2390	26.66	185	300	V	28.93	6.24	0	61.83	74.00	-12.17	PK
2390	15.43	185	300	V	28.93	6.24	0	50.60	54.00	-3.40	AV
4824	45.19	200	288	H	32.53	9.62	36.36	50.98	74.00	-23.02	PK
4824	34.77	200	288	H	32.53	9.62	36.36	40.56	54.00	-13.44	AV
7236	44.76	175	278	H	37.81	13.82	36.43	59.96	74.00	-14.04	PK
7236	33.37	175	278	H	37.81	13.82	36.43	48.57	54.00	-5.43	AV
Middle Channel 2437 MHz											
2437	55.16	155	234	H	29.19	6.29	0.00	90.64	-	-	PK
2437	47.38	155	234	H	29.19	6.29	0.00	82.86	-	-	AV
2437	58.76	185	296	V	29.19	6.29	0.00	94.24	-	-	PK
2437	50.80	185	296	V	29.19	6.29	0.00	86.28	-	-	AV
4874	47.12	241	279	V	32.53	9.42	36.40	52.67	74.00	-21.34	PK
4874	37.06	241	279	V	32.53	9.42	36.40	42.61	54.00	-11.40	AV
7311	44.58	340	281	V	37.82	12.92	36.45	58.86	74.00	-15.14	PK
7311	34.26	340	281	V	37.82	12.92	36.45	48.54	54.00	-5.46	AV
High Channel 2462 MHz											
2462	51.92	162	276	H	29.15	6.35	0.00	87.42	-	-	PK
2462	44.16	162	276	H	29.15	6.35	0.00	79.66	-	-	AV
2462	54.95	182	283	V	29.19	6.35	0.00	90.48	-	-	PK
2462	46.74	182	283	V	29.19	6.35	0.00	82.27	-	-	AV
2483.5	25.69	162	276	H	29.25	6.22	0.00	61.16	74.00	-12.84	PK
2483.5	15.56	162	276	H	29.25	6.22	0.00	51.03	54.00	-2.97	AV
2483.5	25.47	182	283	V	29.18	6.22	0.00	60.87	74.00	-13.13	PK
2483.5	16.18	182	283	V	29.18	6.22	0.00	51.58	54.00	-2.42	AV
4924	46.09	82	284	V	32.70	8.58	36.41	50.96	74.00	-23.04	PK
4924	34.56	82	284	V	32.70	8.58	36.41	39.43	54.00	-14.57	AV
7386	44.70	360	276	V	37.98	13.76	36.45	59.99	74.00	-14.01	PK
7386	33.05	360	276	V	37.98	13.76	36.45	48.34	54.00	-5.66	AV

802.11n20 mode

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/ISEDC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 2412 MHz											
2412	52.35	160	291	H	28.94	6.29	0	87.58	-	-	PK
2412	43.74	160	291	H	28.94	6.29	0	78.97	-	-	AV
2412	54.94	183	297	V	28.93	6.29	0	90.16	-	-	PK
2412	46.57	183	297	V	28.93	6.29	0	81.79	-	-	AV
2390	25.30	160	291	H	28.94	6.24	0	60.48	74.00	-13.52	PK
2390	15.87	160	291	H	28.94	6.24	0	51.05	54.00	-2.95	AV
2390	25.70	183	297	V	28.93	6.24	0	60.87	74.00	-13.13	PK
2390	16.13	183	297	V	28.93	6.24	0	51.30	54.00	-2.70	AV
4824	45.29	167	276	H	32.53	9.62	36.36	51.08	74.00	-22.92	PK
4824	35.54	167	276	H	32.53	9.62	36.36	41.33	54.00	-12.67	AV
7236	44.97	180	268	H	37.81	13.82	36.43	60.17	74.00	-13.83	PK
7236	33.85	180	268	H	37.81	13.82	36.43	49.05	54.00	-4.95	AV
Middle Channel 2437 MHz											
2437	57.07	160	290	H	29.19	6.29	0.00	92.55	-	-	PK
2437	48.14	160	290	H	29.19	6.29	0.00	83.62	-	-	AV
2437	59.11	175	231	V	29.19	6.29	0.00	94.59	-	-	PK
2437	51.57	175	231	V	29.19	6.29	0.00	87.05	-	-	AV
4874	46.94	180	273	V	32.53	9.42	36.40	52.49	74.00	-21.52	PK
4874	33.62	180	273	V	32.53	9.42	36.40	39.17	54.00	-14.84	AV
7311	45.04	0	280	V	37.82	12.92	36.45	59.32	74.00	-14.68	PK
7311	33.62	0	280	V	37.82	12.92	36.45	47.90	54.00	-6.10	AV
High Channel 2462 MHz											
2462	50.84	159	281	H	29.15	6.35	0.00	86.34	-	-	PK
2462	42.81	159	281	H	29.15	6.35	0.00	78.31	-	-	AV
2462	54.30	174	289	V	29.19	6.35	0.00	89.83	-	-	PK
2462	46.06	174	289	V	29.19	6.35	0.00	81.59	-	-	AV
2483.5	25.41	159	281	H	29.25	6.22	0.00	60.88	74.00	-13.12	PK
2483.5	15.39	159	281	H	29.25	6.22	0.00	50.86	54.00	-3.14	AV
2483.5	25.61	174	289	V	29.18	6.22	0.00	61.01	74.00	-12.99	PK
2483.5	15.78	174	289	V	29.18	6.22	0.00	51.18	54.00	-2.82	AV
4924	44.92	169	283	V	32.70	8.58	36.41	49.79	74.00	-24.21	PK
4924	35.21	169	283	V	32.70	8.58	36.41	40.08	54.00	-13.92	AV
7386	44.64	154	278	V	37.98	13.76	36.45	59.93	74.00	-14.07	PK
7386	34.38	154	278	V	37.98	13.76	36.45	49.67	54.00	-4.33	AV

Note: Duty Cycle Correction Factor has been added to the measurements.

8 FCC §15.247(a) (2) & ISEDC RSS-247 §5.2 -Emission Bandwidth

8.1 Applicable Standards

According to ECFR §15.247(a) (2) and ISEDC RSS-247 §5.2, 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

8.2 Measurement Procedure

The measurements are based on FCC KDB 558074 D01 DTS Meas Guidance v04: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 section 8: DTS bandwidth

8.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Analyzer, Spectrum	E4440A	US45303156	2017-02-24	1 year
-	RF cable	-	-	Each time[1]	N/A
-	10 dB attenuator	-	-	Each time[1]	N/A

Note[1]: cable and attenuator included in the test set-up will be checked each time before testing.
Statement of Traceability: BACL Corp. *attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.*

8.4 Test Environmental Conditions

Temperature:	23º C
Relative Humidity:	42 %
ATM Pressure:	102.7 KPa

The testing was performed by Frank Wang on 2017-08-18 in RF site.

8.5 Test Results

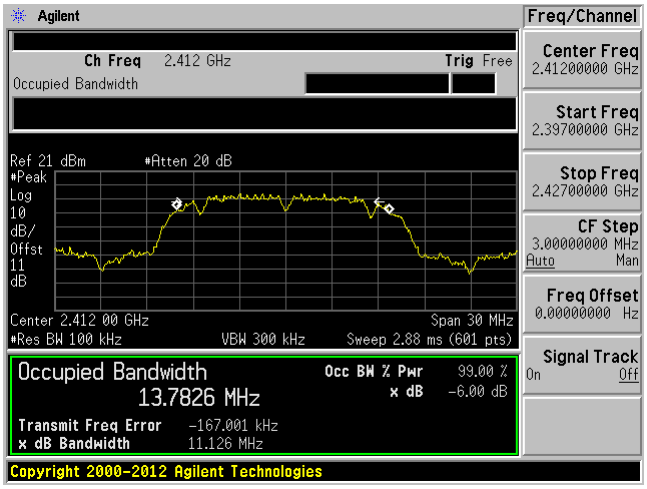
Channel	Frequency (MHz)	99% OBW (MHz)	6 dB BW (kHz)	6 dB OBW limit (kHz)
802.11b mode				
Low	2412	13.9690	11126	500
Middle	2437	13.9589	11079	500
High	2462	13.9411	11121	500
802.11g mode				
Low	2412	16.6593	16473	500
Middle	2437	16.7053	16059	500
High	2462	16.6623	16412	500
802.11n20 mode				
Low	2412	17.7164	16327	500
Middle	2437	17.7705	17302	500
High	2462	17.7004	14217	500

Please refer to the following plots for detailed test results.

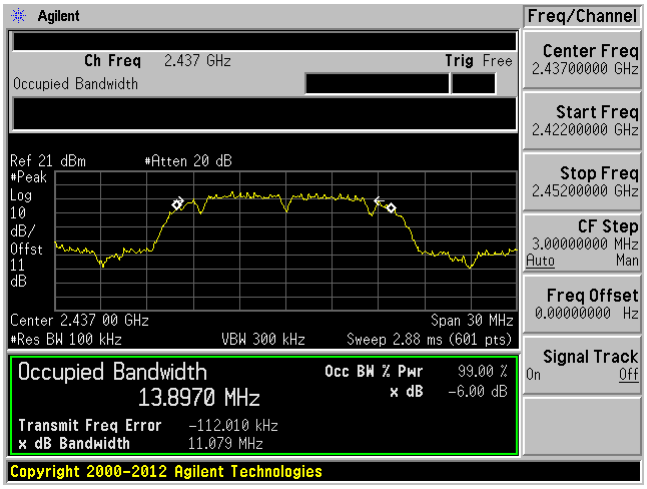
6 dB Emission Bandwidth

802.11b mode

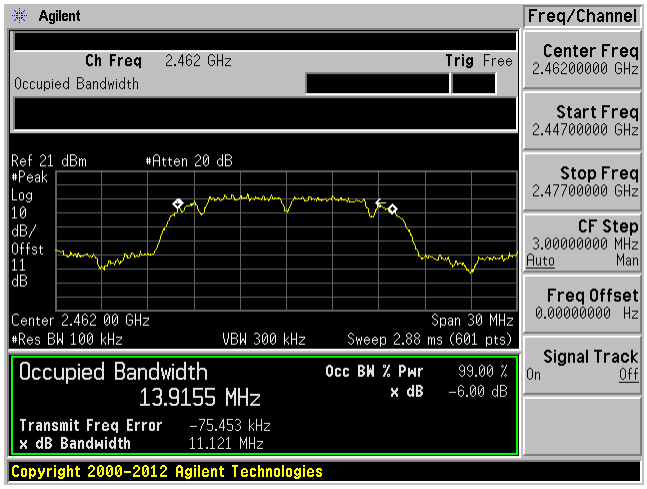
Low Channel 2412 MHz



Middle Channel 2437 MHz

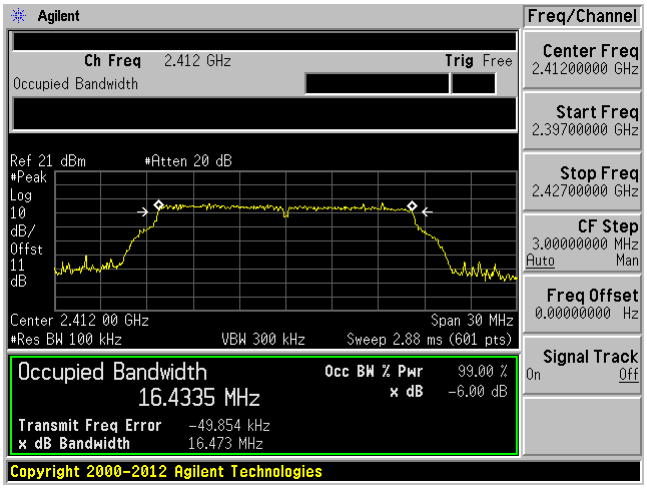


High Channel 2462 MHz

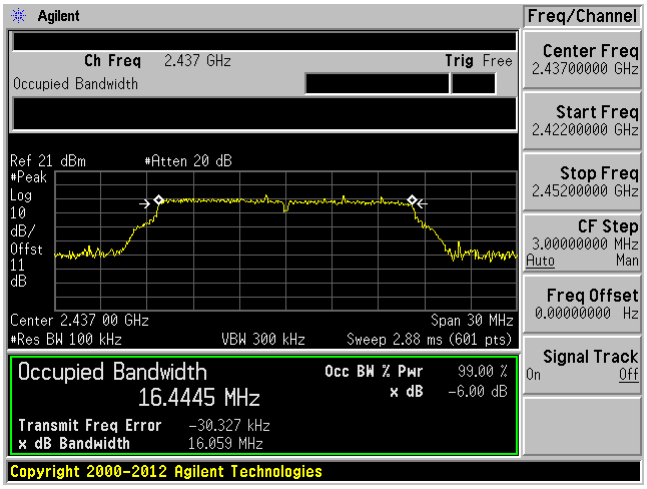


802.11g mode

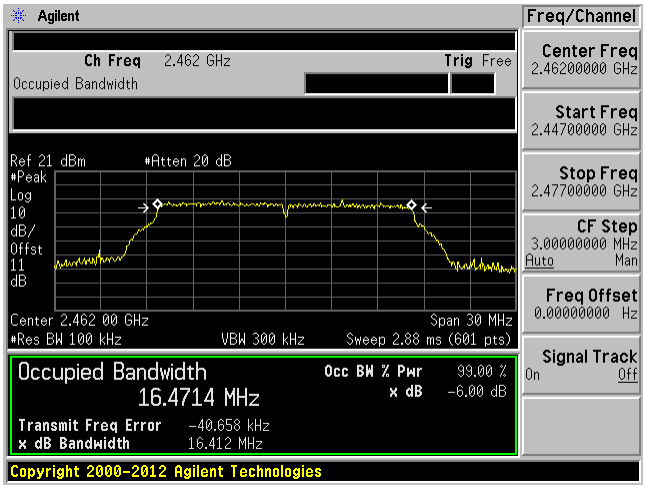
Low Channel 2412 MHz



Middle Channel 2437 MHz

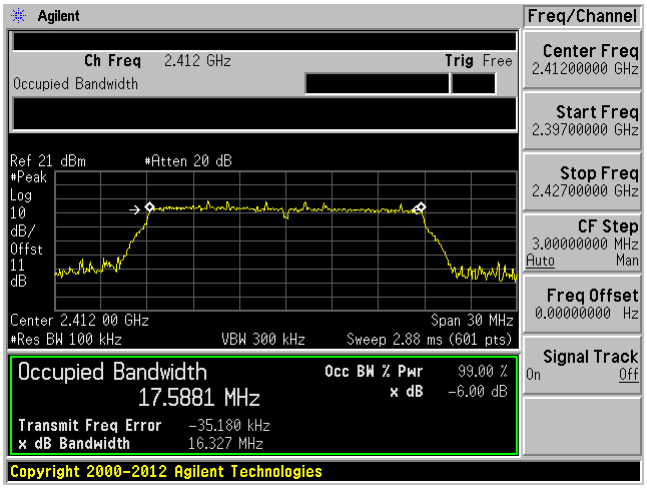


High Channel 2462 MHz

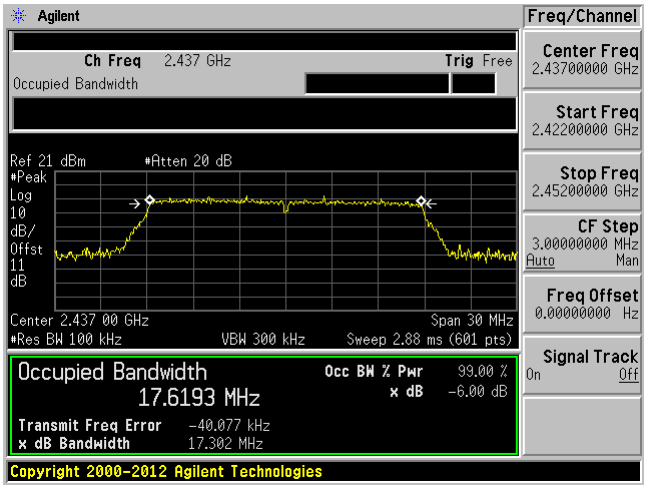


802.11n20 mode

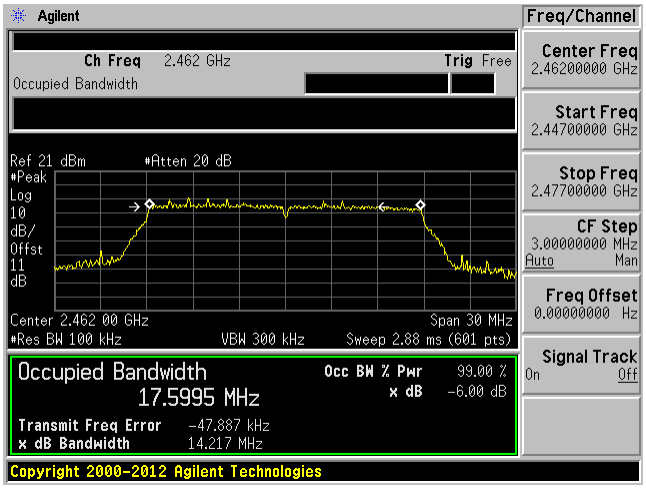
Low Channel 2412 MHz



Middle Channel 2437 MHz



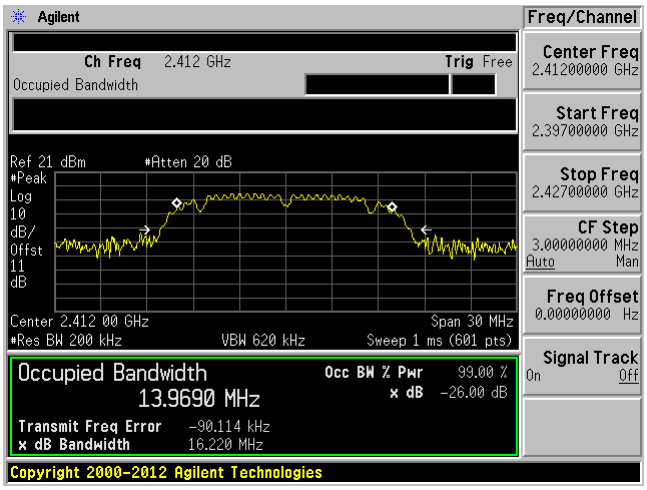
High Channel 2462 MHz



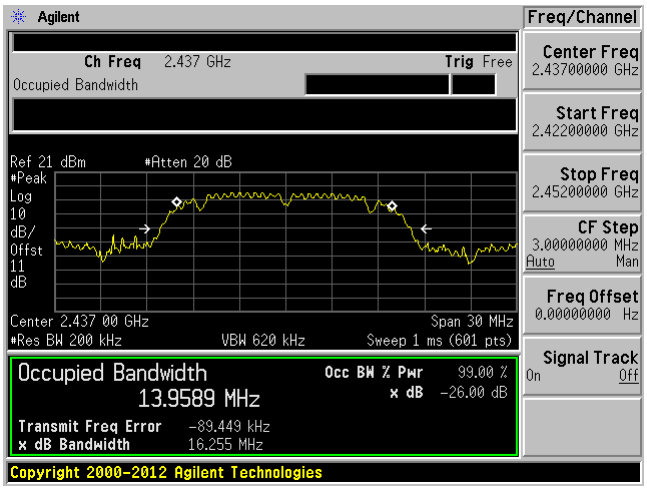
99% Occupied Bandwidth

802.11b mode

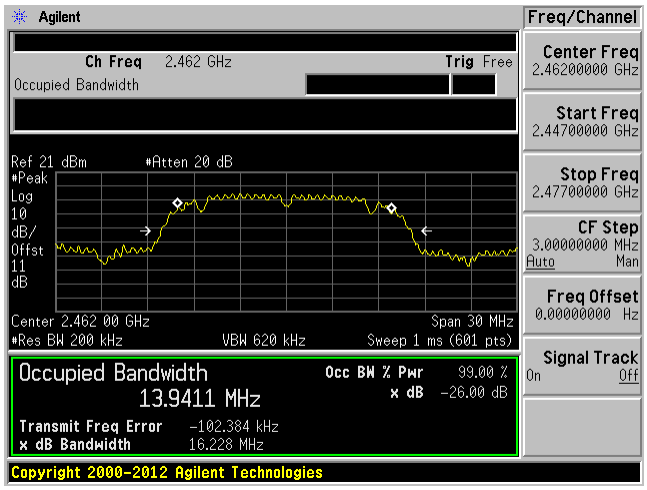
Low Channel 2412 MHz



Middle Channel 2437 MHz

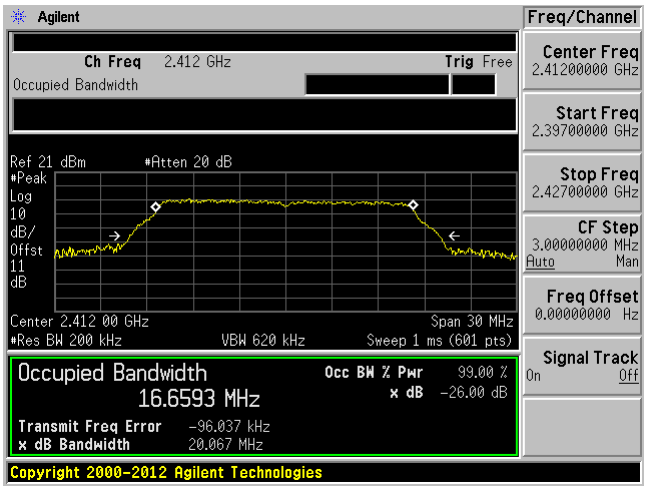


High Channel 2462 MHz

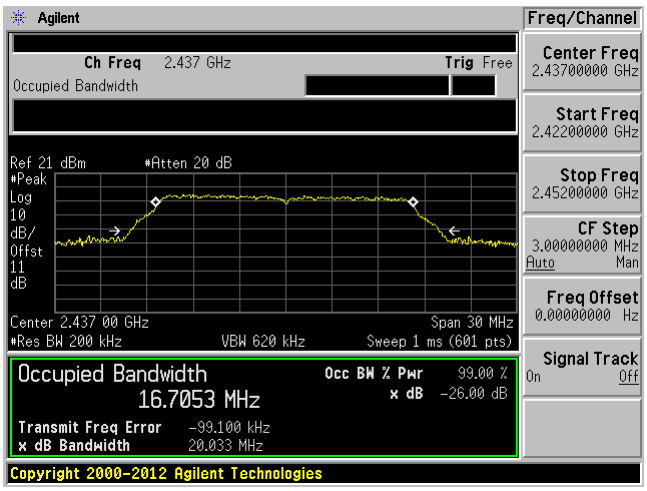


802.11g mode

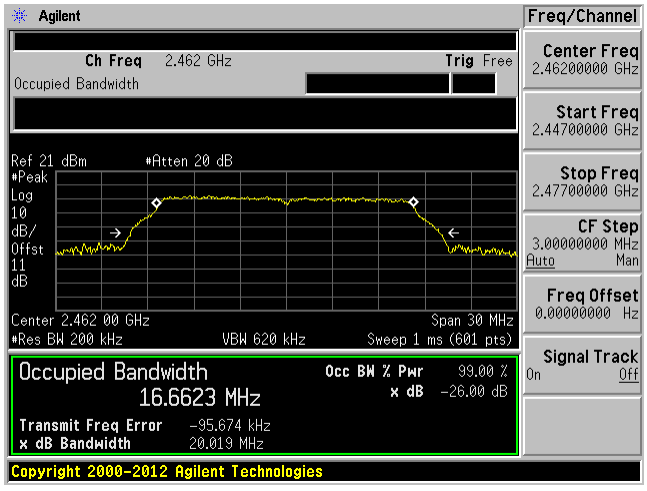
Low Channel 2412 MHz



Middle Channel 2437 MHz

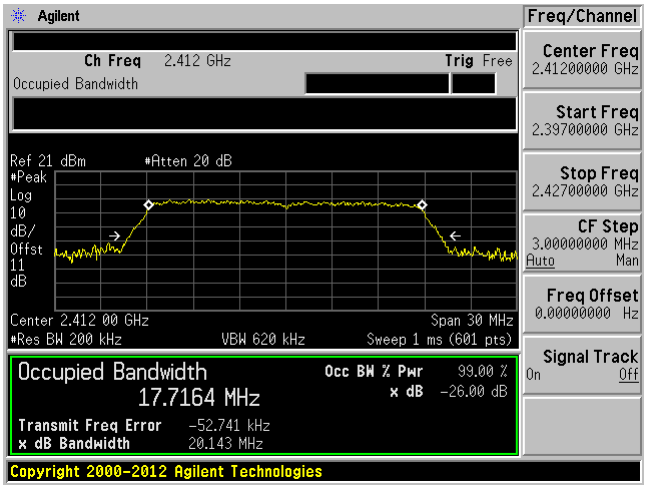


High Channel 2462 MHz

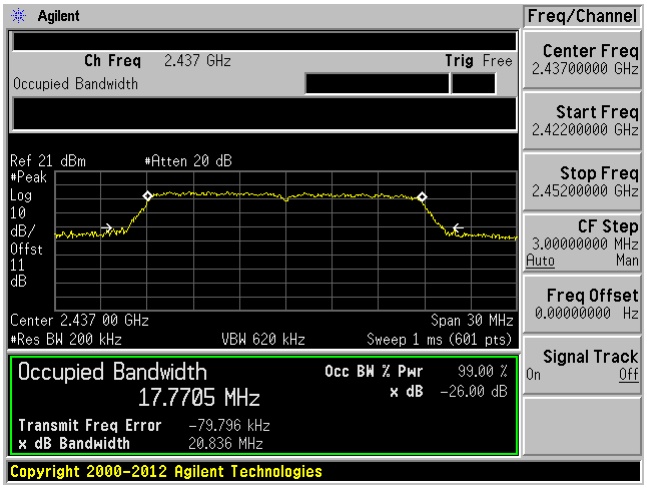


802.11n20 mode

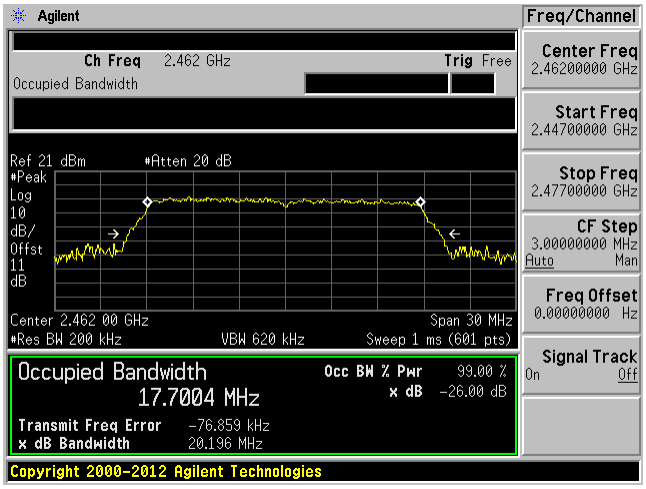
Low Channel 2412 MHz



Middle Channel 2437 MHz



High Channel 2462 MHz



9 FCC §15.247(b) (3) & ISEDC RSS-247 §5.4 (4) - Output Power Measurement

9.1 Applicable Standards

According to ECFR §15.247(b) (3) and ISEDC 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.

9.2 Measurement Procedure

The measurements are based on FCC KDB 558074 D01 DTS Meas Guidance v04: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 section 9: Fundamental emission output power

9.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
ETS- Lingerin	Power Sensor	7002-006	160097	2016-12-05	2 years
-	RF Cable	-	-	Each time[1]	N/A
-	10dB attenuator	-	-	Each time[1]	N/A

Note[1]: cable and attenuator included in the test set-up will be checked each time before testing.
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:	23º C
Relative Humidity:	42 %
ATM Pressure:	102.7 KPa

The testing was performed by Troy Pandhumsoporn on 2017-08-24 in RF site.

9.5 Test Results

Channel	Frequency (MHz)	Conducted Average Output Power (dBm)	FCC/ISEDC Limit (dBm)
802.11b mode			
1	2412	14.91	30
6	2437	15.1	30
11	2462	14.23	30
802.11g mode			
1	2412	11.18	30
6	2437	14.67	30
11	2462	12.38	30
802.11n-HT20 mode			
1	2412	10.2	30
6	2437	14.78	30
11	2462	11.3	30

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

10.1 Applicable Standards

According to ECFR §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 ISEDC 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.

10.2 Measurement Procedure

The measurements are based on FCC KDB 558074 D01 DTS Meas Guidance v04: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 section 13: Band-edge measurements

10.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Analyzer, Spectrum	E4440A	US45303156	2017-02-24	1 year
-	RF cable	-	-	Each time[1]	N/A
-	10dB attenuator	-	-	Each time[1]	N/A

Note[1]: cable and attenuator included in the test set-up will be checked each time before testing.
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:	23º C
Relative Humidity:	42 %
ATM Pressure:	102.7 KPa

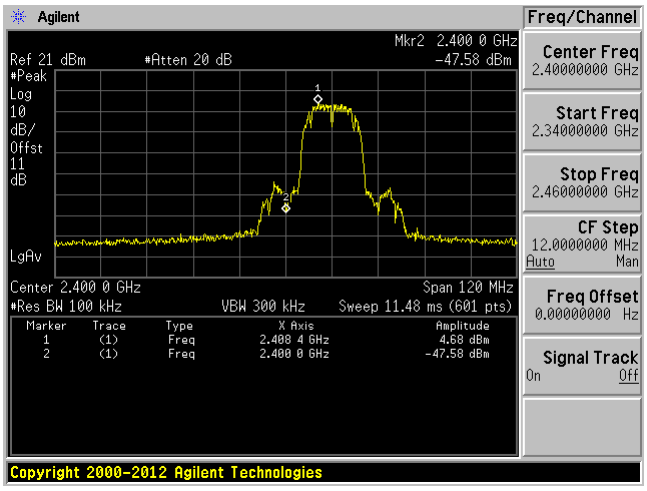
The testing was performed by Frank Wang on 2017-08-18 in RF site.

10.5 Test Results

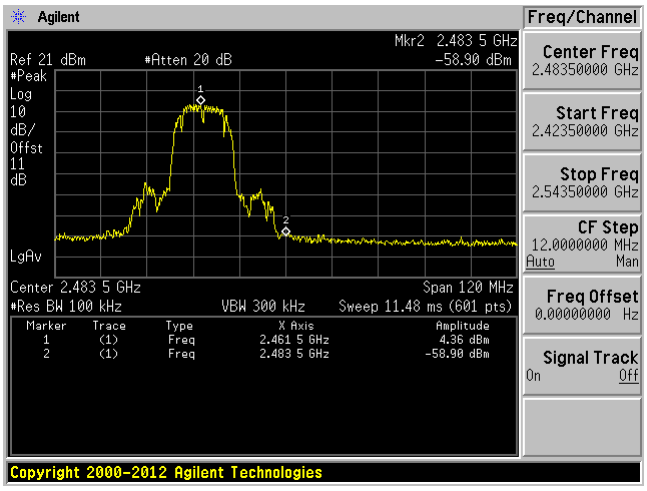
Please refer to the following plots.

802.11b mode

Low Channel 2412 MHz

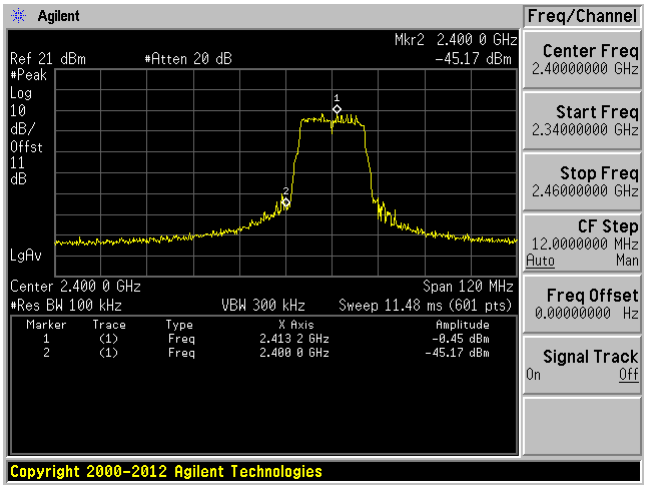


High Channel 2462 MHz

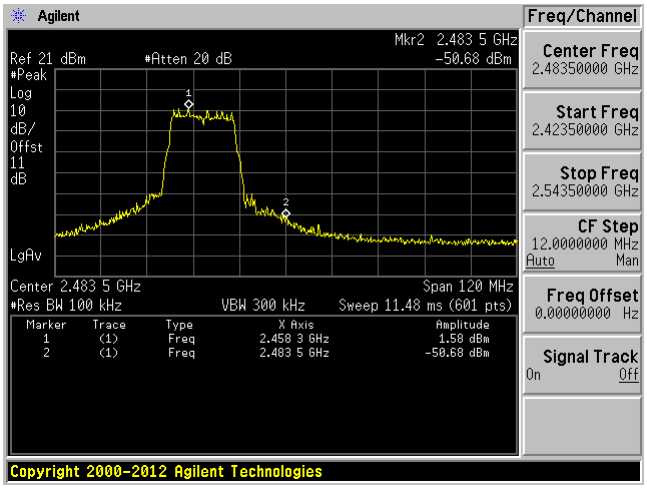


802.11g mode

Low Channel 2412 MHz

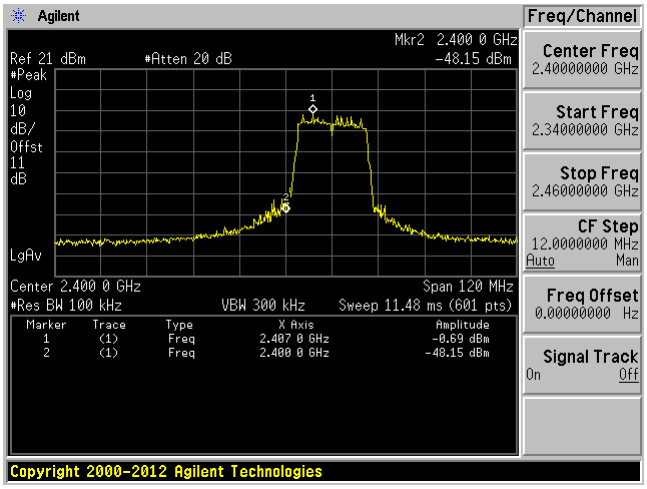


High Channel 2462 MHz

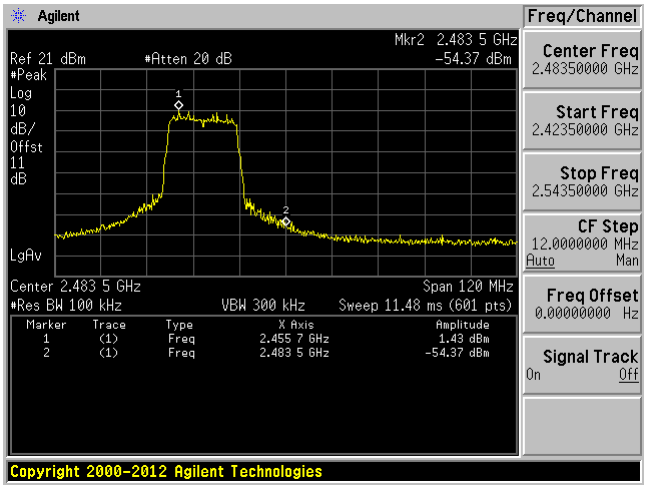


802.11n20 mode

Low Channel 2412 MHz



High Channel 2462 MHz



11 FCC §15.247(e) & ISEDC RSS-247 §5.2(2) - Power Spectral Density

11.1 Applicable Standards

According to ECFR §15.247(e) and RSS-247 §5.2 (2) , 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.

11.2 Measurement Procedure

The measurements are based on FCC KDB 558074 D01 DTS Meas Guidance v04: 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.

11.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Analyzer, Spectrum	E4446A	US44300386	2017-04-20	1 year
-	RF Cable	-	-	Each time[1]	N/A
-	10dB attenuator	-	-	Each time[1]	N/A

Note[1]: cable and attenuator included in the test set-up will be checked each time before testing.
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:	23º C
Relative Humidity:	42 %
ATM Pressure:	102.7 KPa

The testing was performed by Frank Wang on 2017-08-18 in RF site.

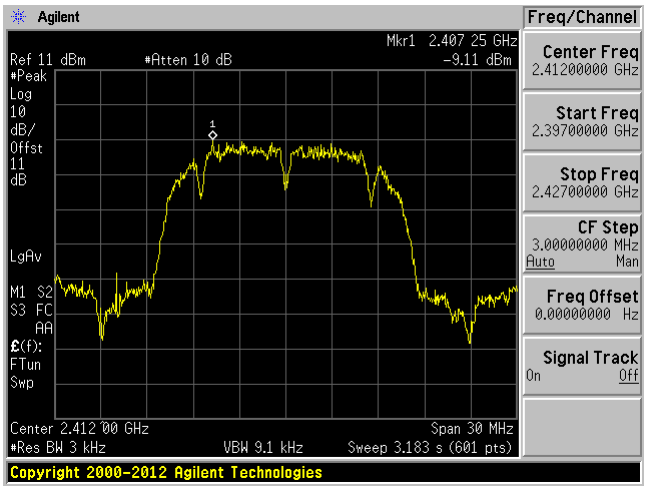
11.5 Test Results

Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)
802.11b mode			
Low	2412	-9.11	8
Middle	2437	-8.80	8
High	2462	-10.06	8
802.11g mode			
Low	2412	-13.60	8
Middle	2437	-10.70	8
High	2462	-12.30	8
802.11n20 mode			
Low	2412	-14.87	8
Middle	2437	-10.20	8
High	2462	-13.56	8

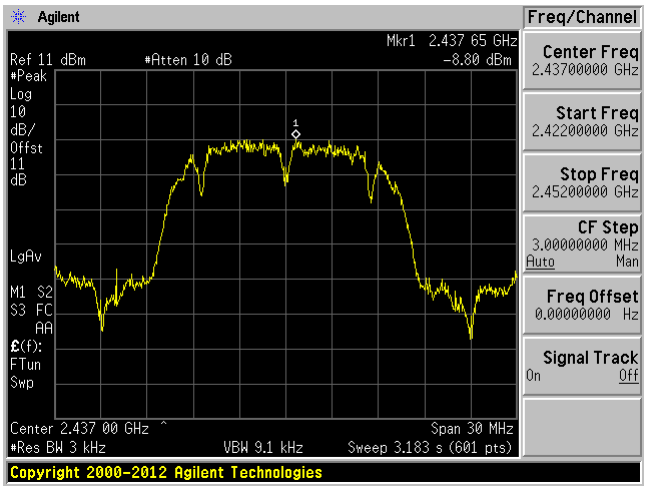
Please refer to the following plots for detailed test results

802.11b mode

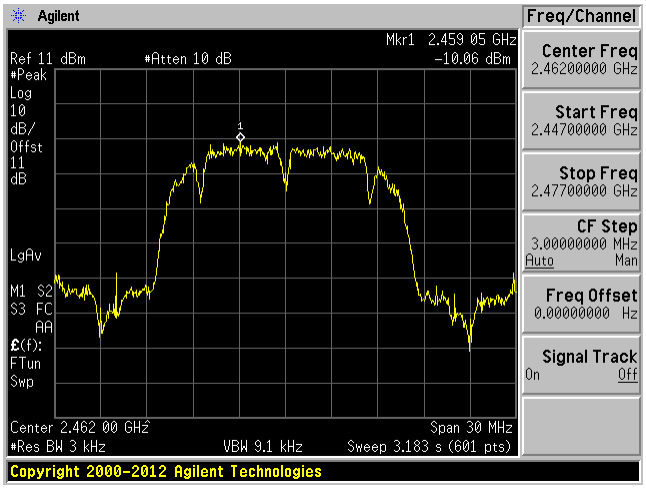
Low Channel 2412 MHz



Middle Channel 2437 MHz

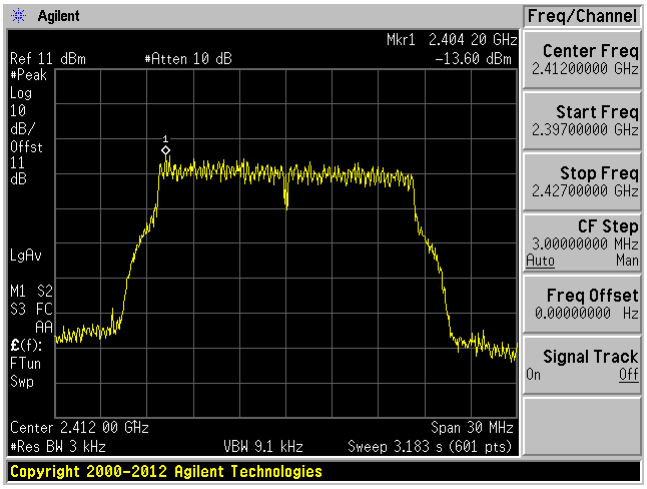


High Channel 2462 MHz

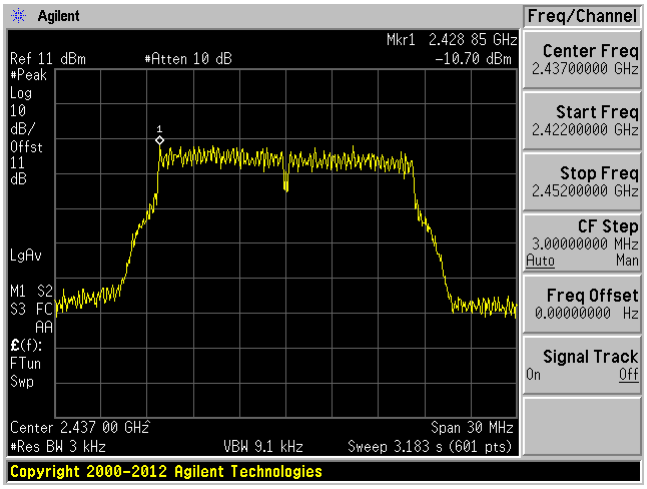


802.11g mode

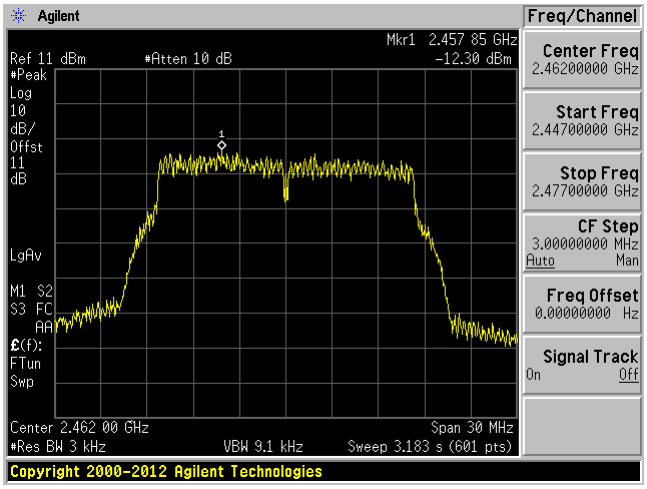
Low Channel 2412 MHz



Middle Channel 2437 MHz

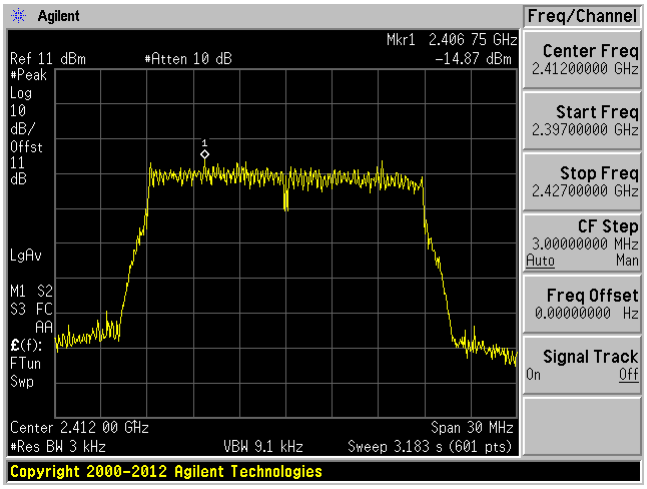


High Channel 2462 MHz

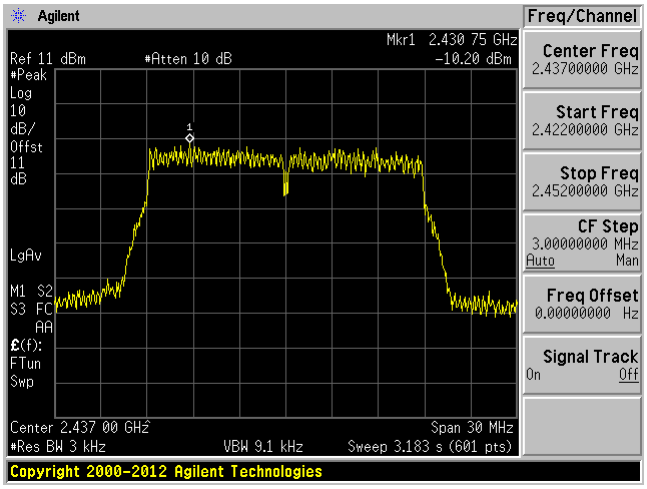


802.11n20 mode

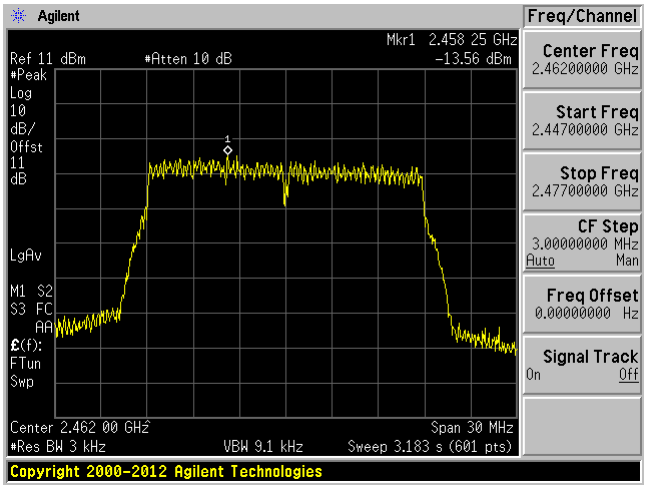
Low Channel 2412 MHz



Middle Channel 2437 MHz



High Channel 2462 MHz



12 FCC §15.247(d) & ISEDC RSS-247 §5.5, RSS-GEN §8.9 - Spurious Emissions at Antenna Terminals

12.1 Applicable Standards

For ECFR §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 ISEDC 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.

12.2 Test 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.

12.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Analyzer, Spectrum	E4440A	US45303156	2017-02-24	1 year
-	RF cable	-	-	Each time[1]	N/A
-	10dB attenuator	-	-	Each time[1]	N/A

Note[1]: cable and attenuator included in the test set-up will be checked each time before testing.
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:	23º C
Relative Humidity:	42 %
ATM Pressure:	102.7 KPa

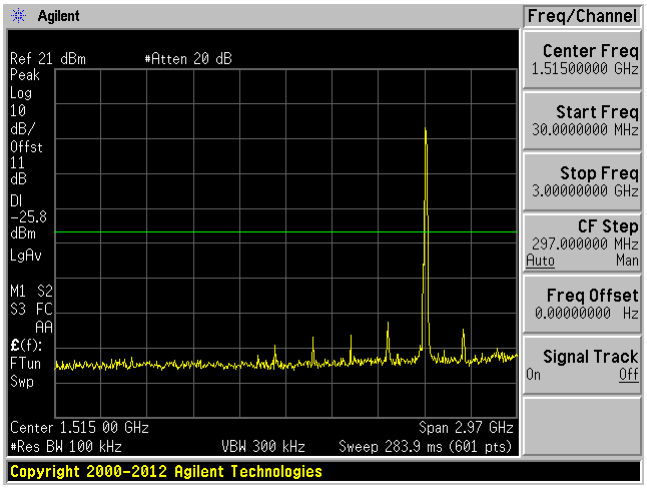
The testing was performed by Frank Wang on 2017-08-18 in RF site.

12.5 Test Results

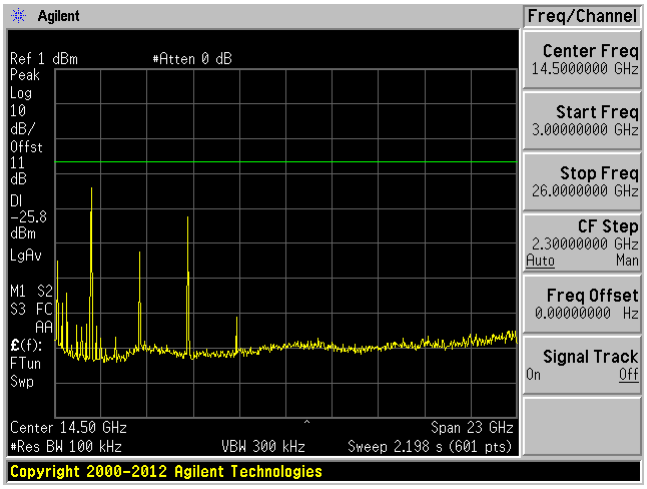
Please refer to following plots.

802.11b mode

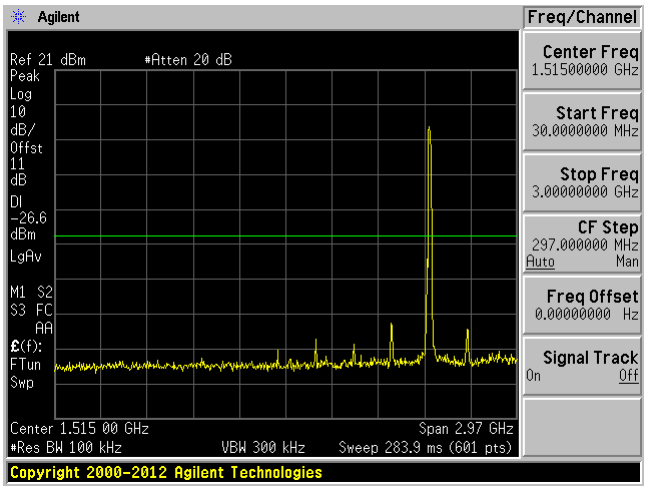
Low Channel 30MHz – 3 GHz



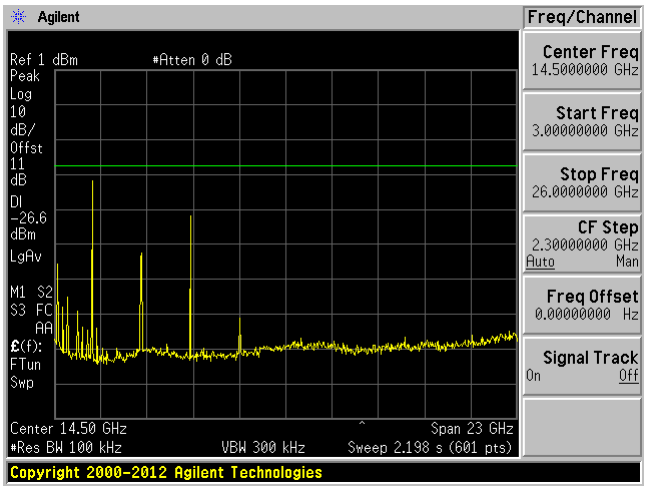
Low Channel 3 GHz – 26 GHz



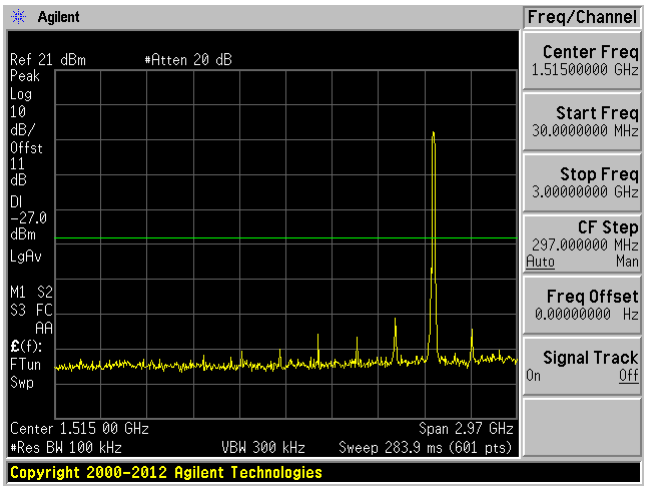
Middle Channel 30 MHz – 3 GHz



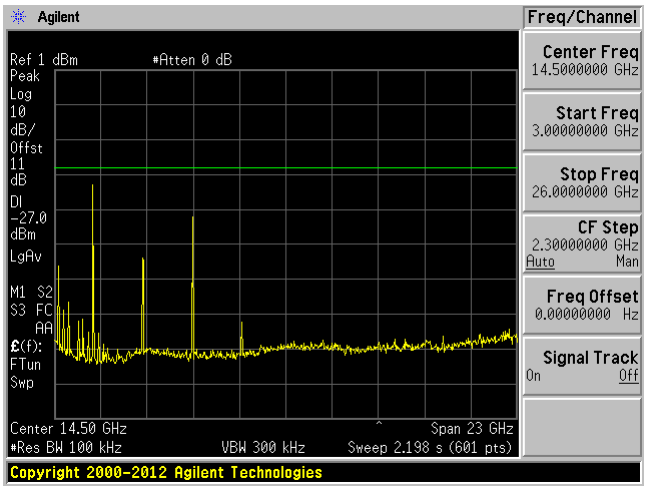
Middle Channel 3 GHz – 26 GHz



High Channel 30 MHz – 3 GHz

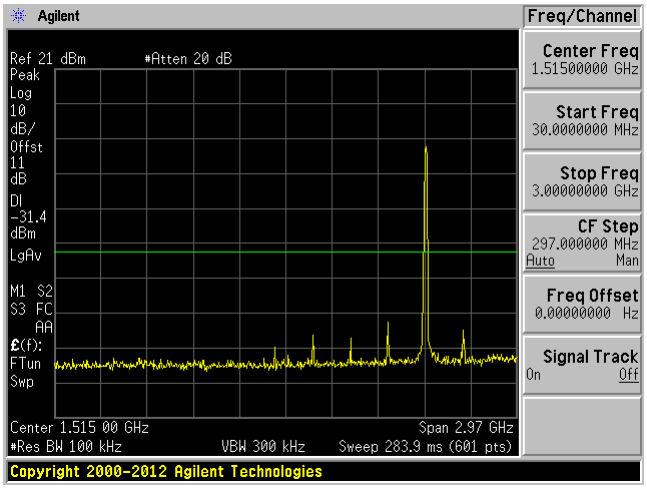


High Channel 3 GHz – 26 GHz

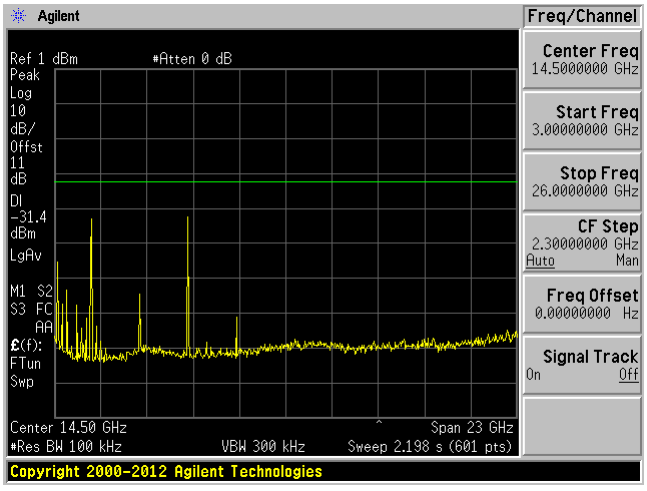


802.11g mode

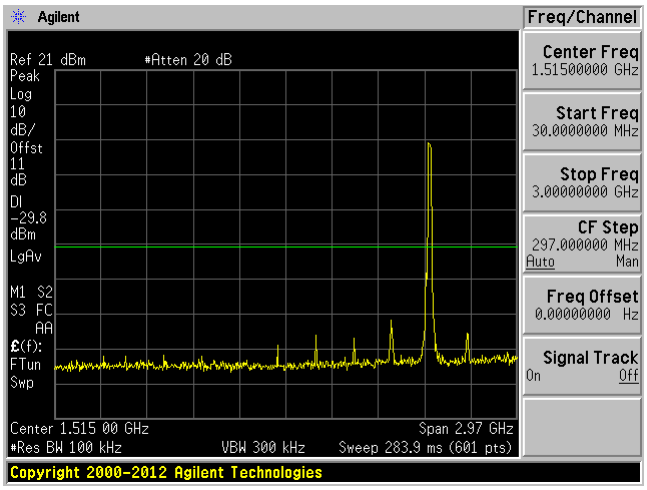
Low Channel 30 MHz – 3 GHz



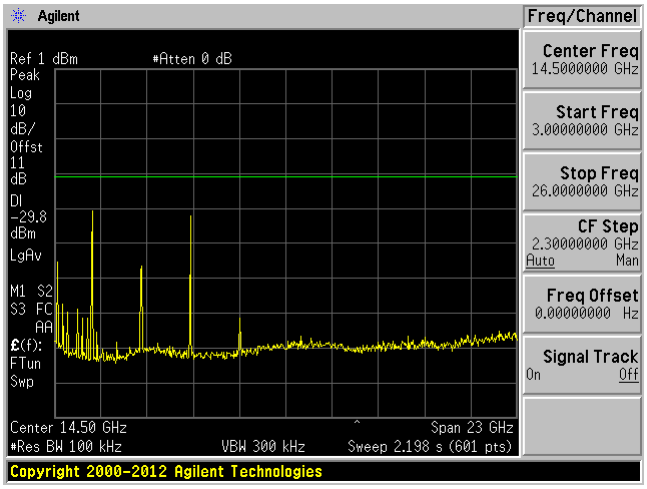
Low Channel 3 GHz – 26 GHz



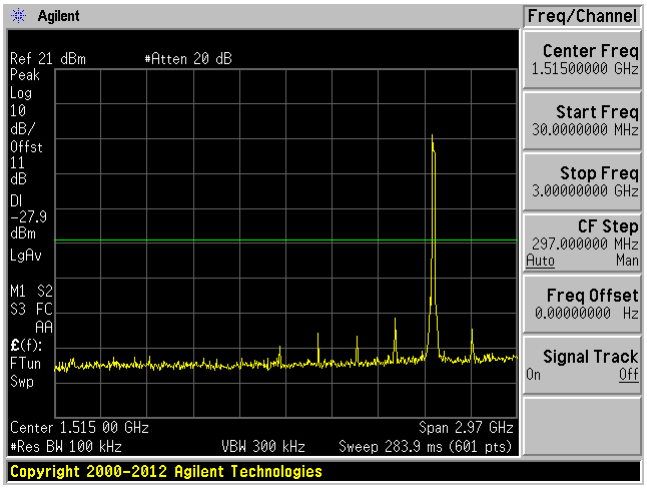
Middle Channel 30 MHz – 3 GHz



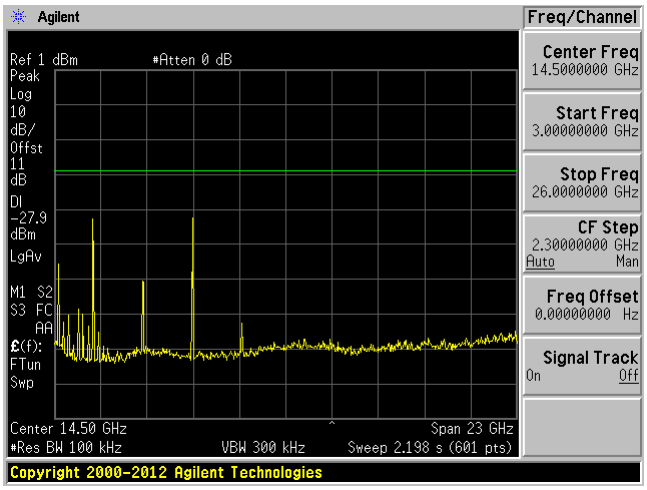
Middle Channel 3 GHz – 26 GHz



High Channel 30 MHz – 3 GHz

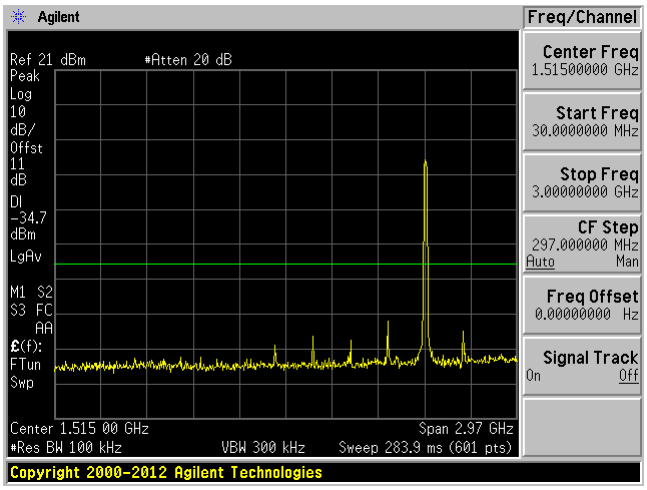


High Channel 3 GHz – 26 GHz

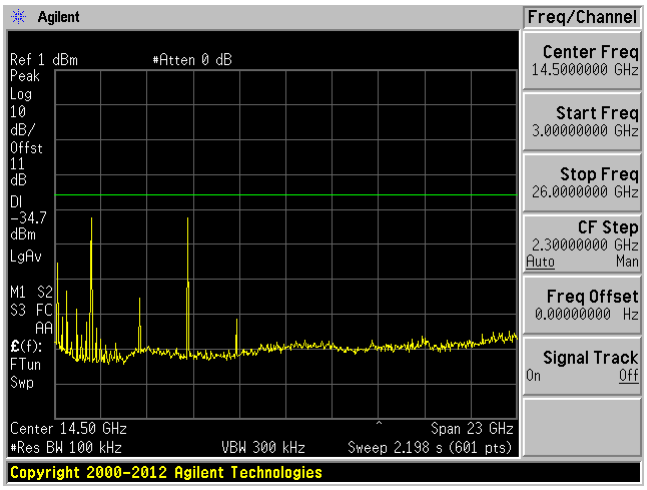


802.11n20 mode

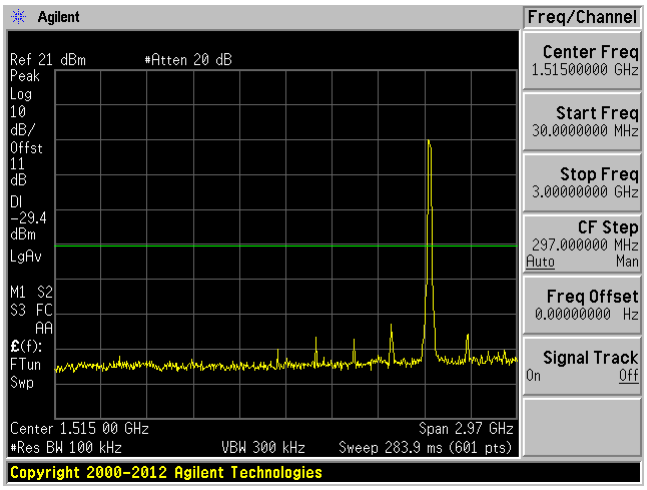
Low Channel 30 MHz – 3 GHz



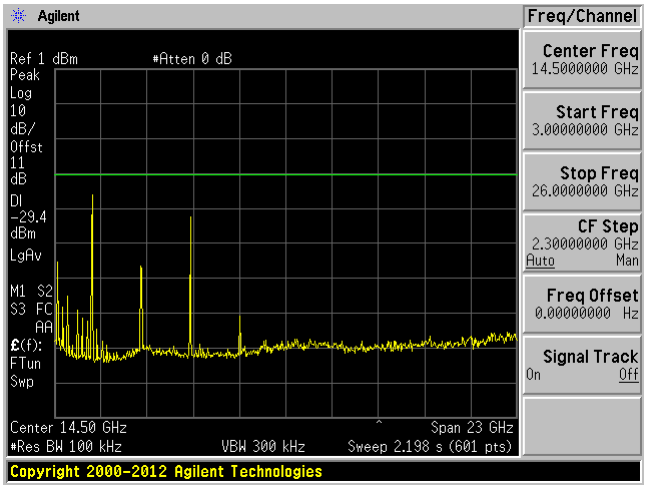
Low Channel 3 GHz – 26 GHz



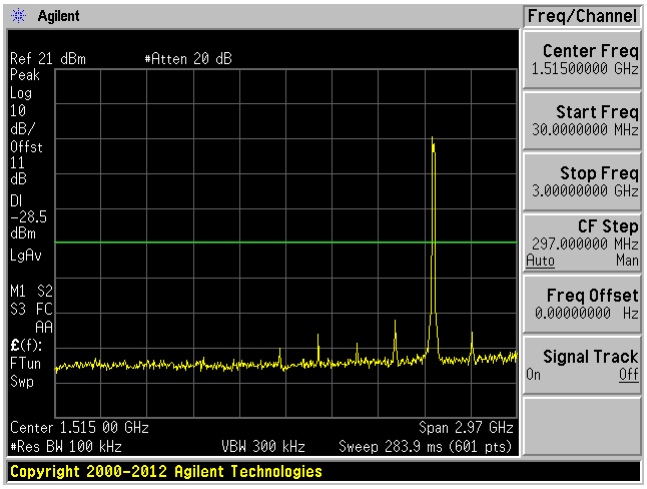
Middle Channel 30 MHz – 3 GHz



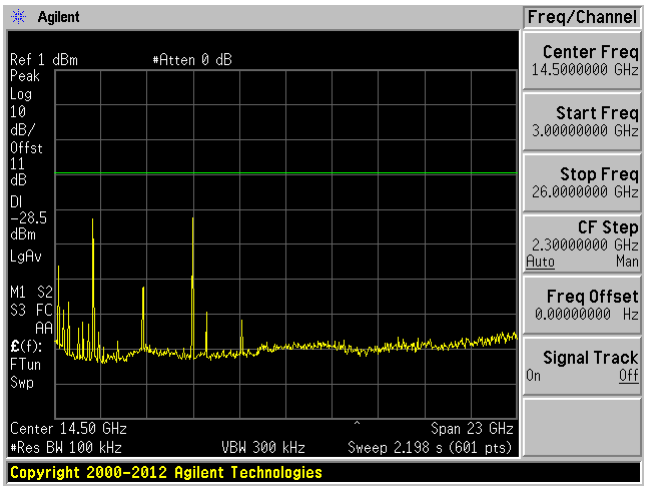
Middle Channel 3 GHz – 26 GHz



High Channel 30 MHz – 3 GHz



High Channel 3 GHz – 26 GHz



13 Annexes

Please see attachment

Annex A-Labeling requirement
Annex B-Setup photo
Annex C-External photo

--- END OF REPORT ---