



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

TEST REPORT

For

Wi2Wi, Inc.

2107 N 1st Street, Suite 680,
San Jose, CA 95131, USA

FCC ID: U9RWM825
IC: 7089A-WM825

Report Type: Original Report	Product Type: Wi-Fi Module 802.11b/g/n 20MHz only, 1x1 SISO, with Integrated Antenna and Antenna Diversity
Prepared By: Xiao Lin Test Engineer	
Report Number: R1611092-247 DTS	
Report Date: 2017-01-23	
Reviewed By: Bo Li RF Supervisor	
Bay Area Compliance Laboratories Corp. 1274 Anvilwood Avenue, Sunnyvale, CA 94089, USA Tel: (408) 732-9162 Fax: (408) 732-9164	

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 “*”

TABLE OF CONTENTS

1 General Description.....	5
1.1 Product Description for Equipment Under Test (EUT)	5
1.2 Mechanical Description of EUT	5
1.3 Objective.....	5
1.4 Related Submittal(s)/Grant(s)	5
1.5 Test Methodology	5
1.6 Measurement Uncertainty	6
1.7 Test Facility Registrations	6
1.8 Test Facility Accreditations	7
2 System Test Configuration.....	9
2.1 Justification.....	9
2.2 EUT Exercise Software.....	9
2.3 Duty Cycle Correction Factor	9
2.4 Equipment Modifications.....	10
2.5 Local Support Equipment	10
2.6 Support Equipment	11
2.7 Interface Ports and Cabling.....	11
3 Summary of Test Results	12
4 FCC §15.203 & ISED RSS-Gen §8.3 - Antenna Requirements	13
4.1 Applicable Standards	13
4.2 Antenna Description	13
5 FCC §15.247(i) & ISED RSS-102 - RF Exposure	14
5.1 Applicable Standards	14
5.2 MPE Prediction.....	15
5.3 MPE Results	15
5.4 RF exposure evaluation exemption for IC	15
6 FCC §15.207 & ISED RSS-Gen §8.8 - AC Line Conducted Emissions.....	16
6.1 Applicable Standards	16
6.2 Test Setup	16
6.3 Test Procedure	16
6.4 Corrected Amplitude & Margin Calculation.....	17
6.5 Test Setup Block Diagram	17
6.6 Test Equipment List and Details.....	18
6.7 Test Environmental Conditions	18
6.8 Summary of Test Results	18
6.9 Conducted Emissions Test Plots and Data.....	19
7 FCC §15.209, §15.247(d) & ISED RSS-247 §5.5, RSS-Gen §8.9, §8.10 - Spurious Radiated Emissions.....	21
7.1 Applicable Standards	21
7.2 Test Setup	23
7.3 Test Procedure	23
7.4 Corrected Amplitude & Margin Calculation.....	23
7.5 Test Equipment List and Details.....	24
7.6 Test Environmental Conditions	24
7.7 Summary of Test Results	25
7.8 Radiated Emissions Test Results	26
8 FCC §15.247(a) (2) & ISED RSS-247 §5.2 - Emission Bandwidth	33
8.1 Applicable Standards	33
8.2 Measurement Procedure.....	33
8.3 Test Equipment List and Details.....	33
8.4 Test Environmental Conditions	33

8.5	Test Results.....	34
9	FCC §15.247(b) (3) & ISED RSS-247 §5.4 (4) - Output Power Measurement	38
9.1	Applicable Standards	38
9.2	Measurement Procedure.....	38
9.3	Test Equipment List and Details.....	38
9.4	Test Environmental Conditions	38
9.5	Test Results.....	39
10	FCC §15.247(d) & ISED RSS-247 §5.5 - 100 kHz Bandwidth of Band Edges	40
10.1	Applicable Standards	40
10.2	Measurement Procedure.....	40
10.3	Test Equipment List and Details.....	40
10.4	Test Environmental Conditions	40
10.5	Test Results.....	41
11	FCC §15.247(e) & ISED RSS-247 §5.2(2) - Power Spectral Density	43
11.1	Applicable Standards	43
11.2	Measurement Procedure.....	43
11.3	Test Equipment List and Details.....	43
11.4	Test Environmental Conditions	43
11.5	Test Results.....	44
12	FCC §15.247(d) & ISED RSS-247 §5.5 & ISED RSS-GEN §8.9 – Spurious Emissions at Antenna Terminals..	48
12.1	Applicable Standards	48
12.2	Test Procedure	48
12.3	Test Equipment List and Details.....	48
12.4	Test Environmental Conditions	49
12.5	Test Results.....	49
13	Annex A (Informative) - A2LA Electrical Testing Certificate.....	55
14	Annex B (Normative) - FCC & ISED Equipment Labeling Requirements.....	56
14.1	FCC ID Label Requirements	56
14.2	ISED Label Requirements	56
14.3	FCC ID & ISED Label Contents and Location.....	57
15	Annex C (Normative) - Test Setup Photographs	58
15.1	Radiated Emission below 1 GHz Front View	58
15.2	Radiated Emission below 1 GHz Rear View	58
15.3	Radiated Emission above 1 GHz Front View	59
15.4	Radiated Emission above 1 GHz Rear View	59
15.5	AC Conducted Emissions Front View	60
15.6	AC Conducted Emissions Side View.....	60
16	Annex D (Normative) - EUT Photographs	61
16.1	EUT Top View.....	61
16.2	EUT Bottom View	61
16.3	EUT without Shielding Top View	62
16.4	EUT with Supported Board Top View	62
16.5	EUT with Supported Board Bottom View	63

DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1611092-247 DTS	Original Report	2017-01-23

1 General Description

1.1 Product Description for Equipment Under Test (EUT)

This test and measurement report was prepared on behalf of *Wi2Wi Inc.*, and their product model: *WM825B00*, FCC ID: U9RWM825, IC: 7089A-WM825 or the “EUT” as referred to in this report. It is a module with Wi-Fi function. It operates in the 2.4 GHz band.

1.2 Mechanical Description of EUT

The EUT measures approximately 16 mm (L) x 12.5 mm (W) x 1.76 mm (H).

The test data gathered are from typical production sample, serial number: B2, B7 and B8 assigned by Wi2Wi, Inc.

1.3 Objective

This report is prepared on behalf of *Wi2Wi, Inc.*, in accordance with Part 2, Subpart J, and Part 15, Subparts B and C of the Federal Communication Commission’s rules and ISSED RSS-247 Issue 1, MAY 2015.

The objective is to determine compliance with FCC Part 15.247 and ISSED 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 v03r05: 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	$\pm 5 \%$
RF output power, conducted	$\pm 0.57 \text{ dB}$
Power Spectral Density, conducted	$\pm 1.48 \text{ dB}$
Unwanted Emissions, conducted	$\pm 1.57 \text{ dB}$
All emissions, radiated	$\pm 4.0 \text{ dB}$
AC power line Conducted Emission	$\pm 2.0 \text{ dB}$
Temperature	$\pm 2 \text{ }^{\circ} \text{C}$
Humidity	$\pm 5 \%$
DC and low frequency voltages	$\pm 1.0 \%$
Time	$\pm 2 \%$
Duty Cycle	$\pm 3 \%$

1.7 Test Facility Registrations

BACL's 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 3297.02), 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 3297.03) 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 & Fixed Radio Services;
- 4 All Scope 4-Licensed Maritime & 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 3297.01) 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 & 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 - IC) Foreign Certification Body – FCB – APEC Tel MRA -Phase I & Phase II;
- Chinese Taipei (Republic of China – Taiwan):
 - o BSMI (Bureau of Standards, Metrology and Inspection) APEC Tel MRA -Phase I;
 - o NCC (National Communications Commission) APEC Tel MRA -Phase I;
- European Union:
 - o EMC Directive 2014/30/EC US-EU EMC & Telecom MRA CAB
 - o Radio & Teleterminal Equipment (R&TTE) Directive 1995/5/EC
US -EU EMC & Telecom MRA CAB
- Hong Kong Special Administrative Region: (Office of the Telecommunications Authority – OFTA)
APEC Tel MRA -Phase I & 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 & Phase II;
- Japan: VCCI - Voluntary Control Council for Interference US-Japan Telecom Treaty VCCI Side Letter-
- USA:
 - o ENERGY STAR Recognized Test Laboratory – US EPA
 - o 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 v03r05.

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 DutApiWiFi8801BrdigeEth.exe and firmware files provided by *Wi2Wi, Inc.*, the software is comply with the standard requirements being tested against.

2.3 Duty Cycle Correction Factor

According to KDB 558074 D01 DTS Meas Guidance v03r05 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).

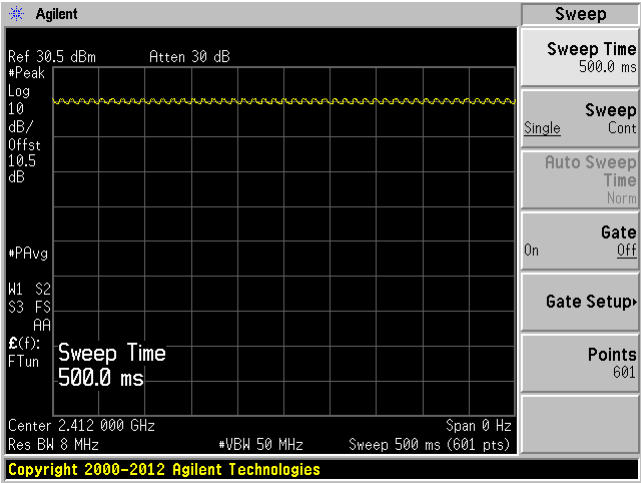
Radio Mode	On Time (ms)	Period (ms)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)
802.11b	500	500	100	N/A
802.11g	500	500	100	N/A
802.11n20	500	500	100	N/A

Duty Cycle = On Time (ms)/ Period (ms)

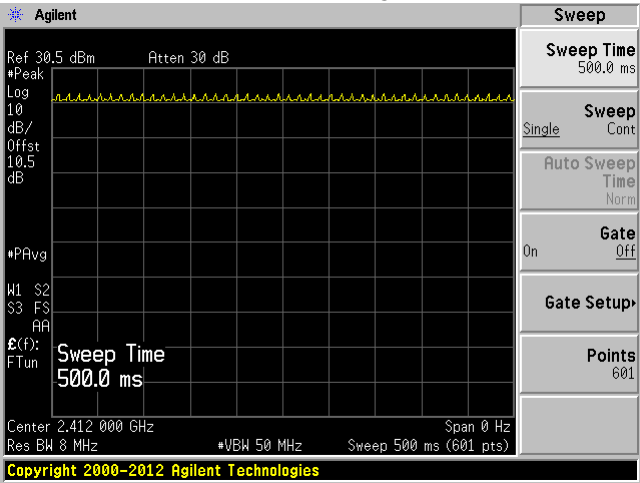
Duty Cycle Correction Factor (dB) = $10 \cdot \log(1/\text{Duty Cycle})$

Please refer to the following plots.

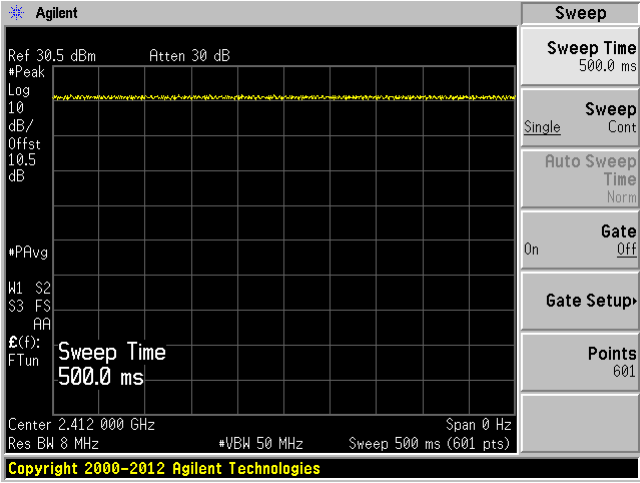
802.11b mode



802.11g mode



802.11n20 mode



2.4 Equipment Modifications

N/A

2.5 Local Support Equipment

Manufacturer/Product Type	Description	Model No.	Serial No.
IBM	Linux Laptop	-	-
IBM	Windows Laptop	-	-

2.6 Support Equipment

There was no support equipment included, or intended for use with EUT during these tests.

2.7 Interface Ports and Cabling

Cable Description	Length (m)	To	From
RJ45	< 1 m	Linux Laptop	Windows Laptop
RF Cable	< 1 m	PSA	EUT

3 Summary of Test Results

Results reported relate only to the product tested.

FCC & IC Rules	Description of Test	Results
FCC §15.203 ISED RSS-Gen §8.3	Antenna Requirement	Compliant
FCC §15.207 ISED RSS-Gen §8.8	AC Line Conducted Emissions	Compliant
FCC §2.1093, §15.247(i) ISED RSS-102	RF Exposure	Compliant
FCC §2.1051, §15.247 (d) ISED RSS-247 §5.5	Spurious Emissions at Antenna Port	Compliant
FCC §2.1053, §15.205, §15.209, §15.247 (d) ISED RSS-247 §5.5 ISED RSS-Gen §8.9 & §8.10	Radiated Spurious Emissions	Compliant
FCC §15.247(a)(2) ISED RSS-247 §5.2 (1)	6 dB & 99% Emission Bandwidth	Compliant
FCC §15.247(b)(3) ISED RSS-247 §5.4 (4)	Maximum Peak Output Power	Compliant
FCC §15.247(d) ISED RSS-247 §5.5	100 kHz Bandwidth of Frequency Band Edge	Compliant
FCC §15.247(e) ISED RSS-247 §5.2 (2)	Power Spectral Density	Compliant

4 FCC §15.203 & ISED 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 ISED 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 isotropically 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 Antenna Gain (dBi)
Wi-Fi	2400-2500	0.2

5 FCC §15.247(i) & ISSED RSS-102 - RF Exposure

5.1 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 ISSED 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.

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

<u>Maximum peak output power at antenna input terminal (dBm):</u>	<u>24.93</u>
<u>Maximum peak output power at antenna input terminal (mW):</u>	<u>311.172</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>0.2</u>
<u>Maximum Antenna Gain (numeric):</u>	<u>1.047</u>
<u>Power density of prediction frequency at 20.0 cm (mW/cm²):</u>	<u>0.0648</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 0.0648 mW/cm². Limit is 1.0 mW/cm².

5.4 RF exposure evaluation exemption for IC

$$24.93 + 0.2 \text{ dBi} = 25.13 \text{ dBm} < 1.31 \times 10^{-2} f^{0.6834} = 2.703 \text{ W} = 34.318 \text{ dBm}$$

Therefore the RF exposure is not required.

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

6.1 Applicable Standards

As per FCC §15.207 and ISED 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 ^{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 ISED 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 adapters of the support laptops were connected with LISNs 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 & 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:

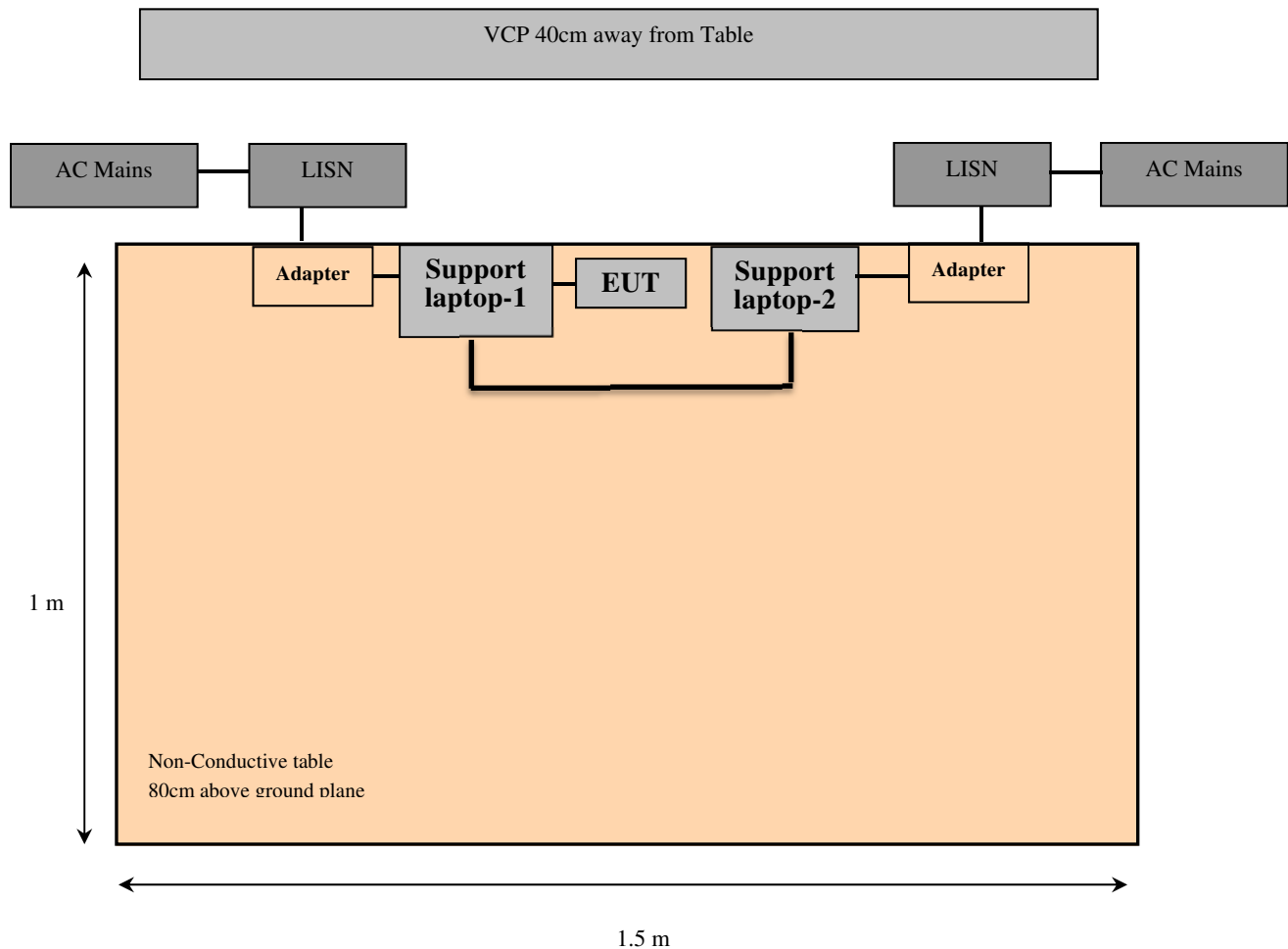
$$CA = Ai + CL + Atten$$

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:

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

6.5 Test Setup Block Diagram



6.6 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Rohde & Schwarz	Receiver, EMI Test	ESCI 1166.5950K03	100338	2016-02-04	2 years
Rohde & Schwarz	Impulse Limiter	ESH3-Z2	101964	2016-07-22	1 year
Solar Electronics Company	High Pass Filter	Type 7930-100	7930150204	2016-03-09	1 Year
Suirong	30 ft conductive emission cable	LMR 400	-	2016-03-05	1 year
FCC	LISN	FCC-LISN-50-25-2-10-CISPR16	160131	2016-04-25	1year
Vasona	Test software	V6.0 build 11	10400213	N/R	N/R

Statement of Traceability: BACL Corp. attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with A2LA Policy P102 (dated 9 June 2016) "A2LA Policy on Metrological Traceability".

6.7 Test Environmental Conditions

Temperature:	22° C
Relative Humidity:	42 %
ATM Pressure:	102 kPa

The testing was performed by Xiao Lin on 2016-12-14 in RF site.

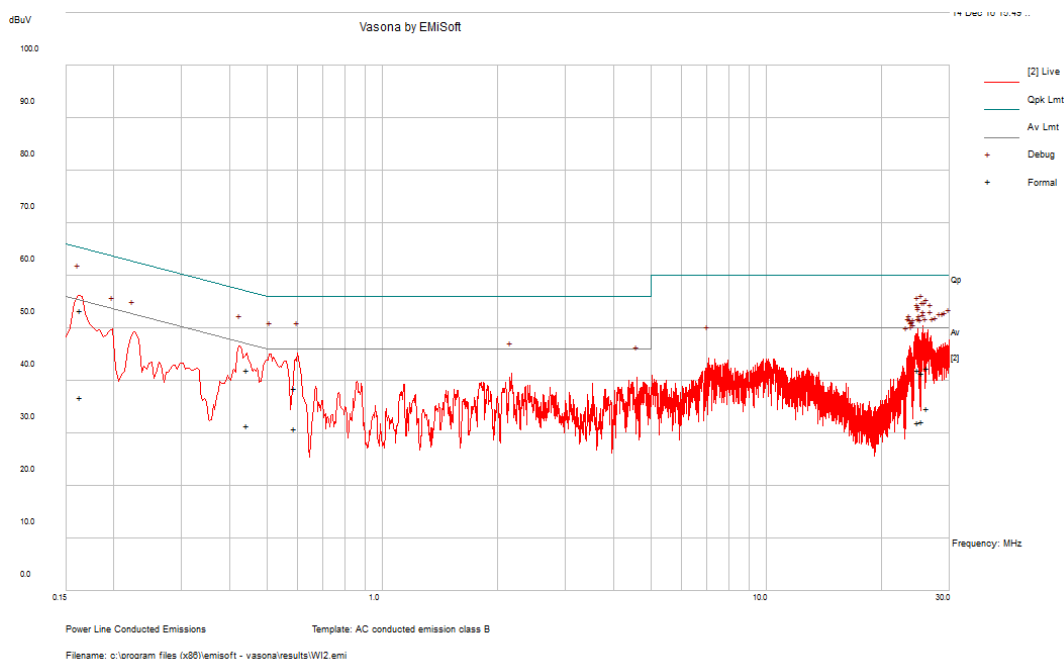
6.8 Summary of Test Results

According to the recorded data in following table, the EUT complied with the FCC 15C and ISSED 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)
-3.43	0.602485	Neutral	0.15-30

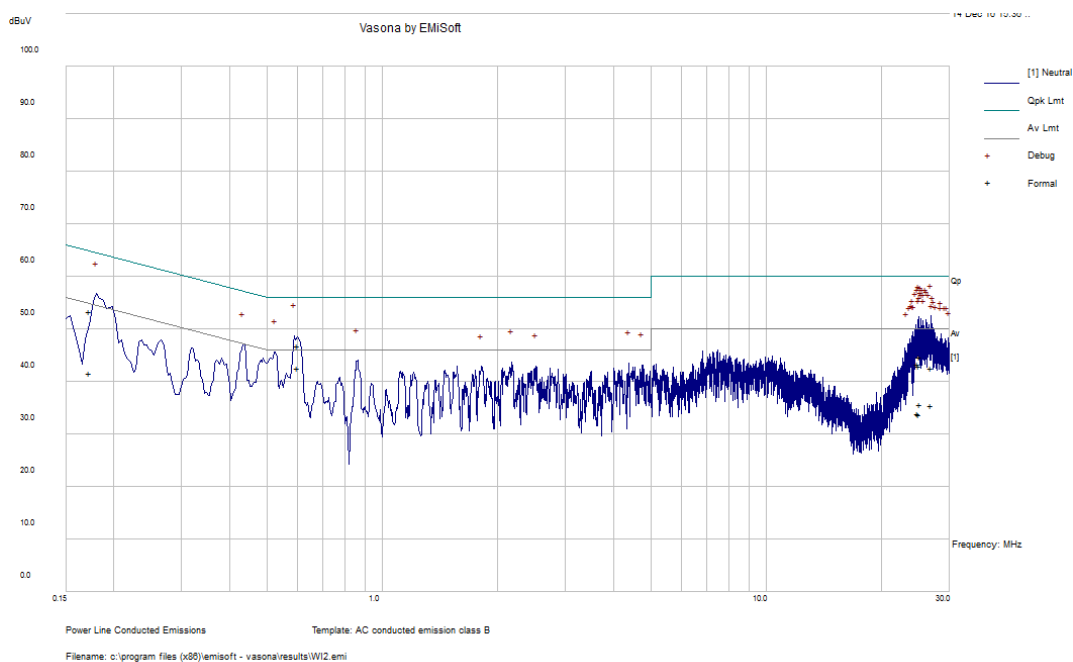
6.9 Conducted Emissions Test Plots and Data

120 V, 60 Hz – Line



Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
0.163643	53.3	Line	65.28	-11.97	QP
25.52547	41.53	Line	60	-18.47	QP
24.80992	41.99	Line	60	-18.01	QP
26.26357	42.37	Line	60	-17.63	QP
0.443753	42.04	Line	56.99	-14.95	QP
0.591918	38.5	Line	56	-17.5	QP

Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
0.163643	36.94	Line	55.28	-18.34	Ave.
25.52547	32.21	Line	50	-17.79	Ave.
24.80992	31.98	Line	50	-18.02	Ave.
26.26357	34.75	Line	50	-15.25	Ave.
0.443753	31.48	Line	46.99	-15.51	Ave.
0.591918	30.92	Line	46	-15.08	Ave.

120 V, 60 Hz – Neutral

Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
0.602485	46.93	Neutral	56	-9.07	QP
26.92616	42.53	Neutral	60	-17.47	QP
0.172562	53.47	Neutral	64.84	-11.37	QP
24.99319	43.06	Neutral	60	-16.94	QP
25.2253	44.68	Neutral	60	-15.32	QP
24.81434	43.32	Neutral	60	-16.68	QP

Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
0.602485	42.57	Neutral	46	-3.43	Ave.
26.92616	35.59	Neutral	50	-14.41	Ave.
0.172562	41.66	Neutral	54.84	-13.18	Ave.
24.99319	33.76	Neutral	50	-16.24	Ave.
25.2253	35.66	Neutral	50	-14.34	Ave.
24.81434	33.89	Neutral	50	-16.11	Ave.

7 FCC §15.209, §15.247(d) & ISSED 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	16.42 – 16.423		4.5 – 5.15
0.495 – 0.505	16.69475 – 16.69525	960 – 1240	5.35 – 5.46
2.1735 – 2.1905	25.5 – 25.67	1300 – 1427	7.25 – 7.75
4.125 – 4.128	37.5 – 38.25	1435 – 1626.5	8.025 – 8.5
4.17725 – 4.17775	73 – 74.6	1645.5 – 1646.5	9.0 – 9.2
4.20725 – 4.20775	74.8 – 75.2	1660 – 1710	9.3 – 9.5
6.215 – 6.218	108 – 121.94	1718.8 – 1722.2	10.6 – 12.7
6.26775 – 6.26825	123 – 138	2200 – 2300	13.25 – 13.4
6.31175 – 6.31225	149.9 – 150.05	2310 – 2390	14.47 – 14.5
8.291 – 8.294	156.52475 – 156.52525	2483.5 – 2500	15.35 – 16.2
8.362 – 8.366	156.7 – 156.9	2690 – 2900	17.7 – 21.4
8.37625 – 8.38675	162.0125 – 167.17	3260 – 3267	22.01 – 23.12
8.41425 – 8.41475	167.72 – 173.2	3.332 – 3.339	23.6 – 24.0
12.29 – 12.293	240 – 285	3.3458 – 3.358	31.2 – 31.8
12.51975 – 12.52025	322 – 335.4	3.600 – 4.400	36.43 – 36.5
12.57675 – 12.57725	399.9 – 410		Above 38.6
13.36 – 13.41	608 – 614		

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 ISED 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 ($\mu\text{V}/\text{m}$ 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 ISED 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 ISSED 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:

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

Above 1000 MHz:

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

7.4 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:

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

7.5 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Rohde & Schwarz	Receiver, EMI Test	ESCI 1166.5950K03	100338	2016-02-04	2 year
Agilent	Analyzer, Spectrum	E4440A	US45303156	2016-01-19	1 year
Sunol Science Corp	System Controller	SC99V	011003-1	N/R	N/R
Sunol Sciences	Antenna, Biconi-Log	JB3	A020106-2	2015-07-11	2 Years
EMCO	Antenna, Horn	3115	9511-4627	2016-01-28	2 years
HP	Amplifier, Pre	8449B	3147A00400	2016-03-30	1 year
IW	Armored High Frequency Cable	DC 1531	KPS- 1501A3960K PS	2016-08-05	1 Year
-	SMA cable	-	C0002	Each time ¹	N/A
-	N-Type Cable	-	C00013	2016-04-28	1 year
-	N-Type Cable	-	C00014	2016-05-28	1 year
HP	Pre-Amplifier	8447D	2443A04374	2016-06-28	1year
Wisewave	Antenna, Horn	ARH-4223-02	10555-01	2015-10-22	2 years
Wisewave	Amplifier, Low Noise	ALN-22093530-01	12263-01	2016-05-16	1 year
Vasona	Test software	V6.0 build 11	10400213	N/R	N/R

Note¹: cable and attenuator included in the test set-up will be checked each time before testing.

Statement of Traceability: BACL Corp. attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with A2LA Policy P102 (dated 9 June 2016) “A2LA Policy on Metrological Traceability”.

7.6 Test Environmental Conditions

Temperature:	20-22° C
Relative Humidity:	42-46 %
ATM Pressure:	102 kPa

The testing was performed by Xiao Lin from 2016-12-13 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 ISED RSS-247 standard's radiated emissions limits, and had the worst margin of:

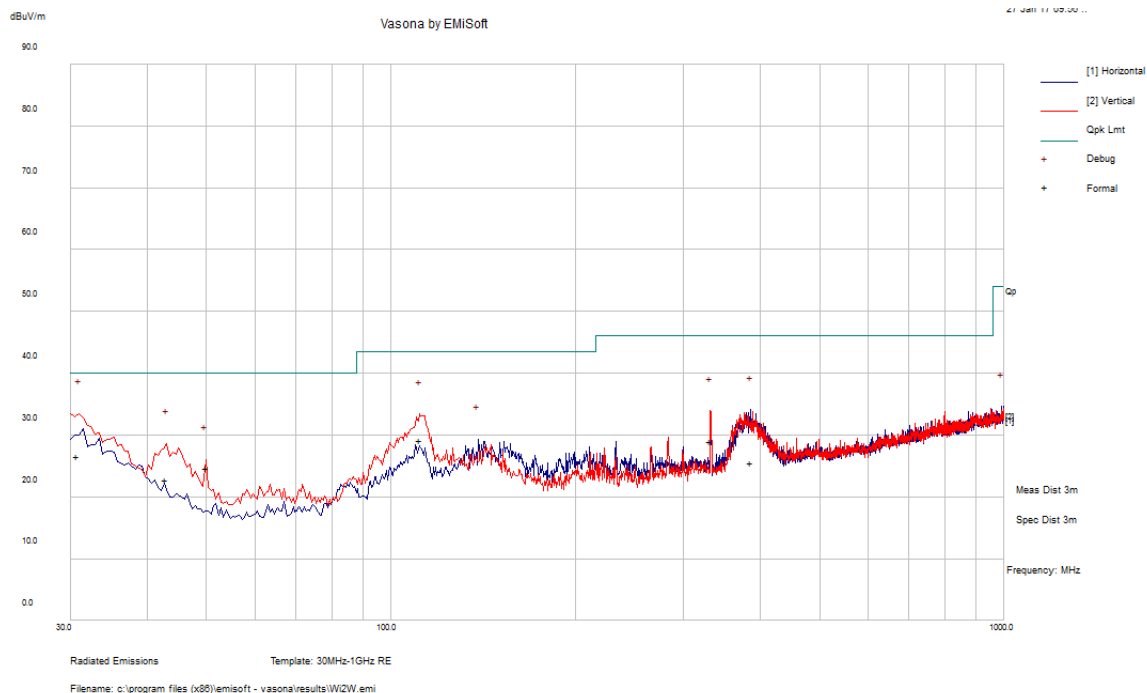
2.4 GHz Wi-Fi

Mode: Transmitting			
Margin (dB)	Frequency (MHz)	Polarization (Horizontal/Vertical)	Mode, channel
-2.11	2483.5	Horizontal	n20 mode, high 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



Frequency (MHz)	Corrected Amplitude (dBμV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBμV/m)	Margin (dB)	Comment
30.82725	26.64	123	V	257	40	-13.36	QP
111.4638	29.16	101	V	227	43.5	-14.34	QP
42.9525	22.77	107	V	76	40	-17.23	QP
386.1893	25.64	159	H	197	46	-20.36	QP
331.895	28.96	126	V	315	46	-17.04	QP
50.07825	24.67	101	V	0	40	-15.33	QP

2) 1–25 GHz Measured at 3 meters

802.11b mode

Frequency (MHz)	S.A. Reading (dBμV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre- Amp. (dB)	Cord. Reading (dBμV/m)	FCC/IC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBμV/m)	Margin (dB)	
Low Channel 2412 MHz											
2412	55.61	94	295	H	29.04	5.19	0	89.84	-	-	PK
2412	53.03	94	295	H	29.04	5.19	0	87.26	-	-	AV
2412	48.03	306	100	V	29.04	5.19	0	82.26	-	-	PK
2412	45.02	306	100	V	29.04	5.19	0	79.25	-	-	AV
2390	26.19	94	295	H	29.04	5.19	0	60.42	74.00	-13.58	PK
2390	14.71	94	295	H	29.04	5.19	0	48.94	54.00	-5.06	AV
2390	26.00	306	100	V	29.04	5.19	0	60.23	74.00	-13.77	PK
2390	14.72	306	100	V	29.04	5.19	0	48.95	54.00	-5.05	AV
4824	48.42	92	100	H	32.47	8.93	38.56	51.26	74.00	-22.74	PK
4824	38.67	92	100	H	32.47	8.93	38.56	41.51	54.00	-12.49	AV
7236	47.16	0	100	H	36.69	11.48	37.9	57.43	74.00	-16.57	PK
7236	35.03	0	100	H	36.39	11.48	37.9	45.00	54.00	-9.00	AV
9648	47.88	0	100	H	37.77	13.82	38.29	61.18	74.00	-12.82	PK
9648	35.41	0	100	H	37.77	13.82	38.29	48.71	54.00	-5.29	AV
Middle Channel 2437 MHz											
2437	57.11	101	249	H	29.04	5.19	0.00	91.34	-	-	PK
2437	54.59	101	249	H	29.04	5.19	0.00	88.82	-	-	AV
2437	51.75	261	276	V	29.04	5.19	0.00	85.98	-	-	PK
2437	49.24	261	276	V	29.04	5.19	0.00	83.47	-	-	AV
4874	47.67	89	245	H	32.64	8.83	38.54	50.60	74.00	-23.40	PK
4874	38.99	89	245	H	32.64	8.83	38.54	41.92	54.00	-12.08	AV
7311	45.90	0	100	H	37.15	12.01	37.90	57.16	74.00	-16.84	PK
7311	34.56	0	100	H	37.15	12.01	37.90	45.82	54.00	-8.18	AV
9748	46.16	0	100	H	37.92	13.70	38.29	59.49	74.00	-14.51	PK
9748	35.08	0	100	H	37.92	13.70	38.29	48.41	54.00	-5.59	AV

Frequency (MHz)	S.A. Reading (dBμV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre- Amp. (dB)	Cord. Reading (dBμV/m)	FCC/IC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBμV/m)	Margin (dB)	
High Channel 2462 MHz											
2462	56.46	98	243	H	29.41	5.19	0.00	91.06	-	-	PK
2462	53.76	98	243	H	29.41	5.19	0.00	88.36	-	-	AV
2462	49.46	304	100	V	29.41	5.19	0.00	84.06	-	-	PK
2462	46.33	304	100	V	29.41	5.19	0.00	80.93	-	-	AV
2483.5	26.33	98	243	H	29.41	5.19	0.00	60.93	74.00	-13.07	PK
2483.5	14.99	98	243	H	29.41	5.19	0.00	49.59	54.00	-4.41	AV
2483.5	27.48	304	100	V	29.41	5.19	0.00	62.08	74.00	-11.92	PK
2483.5	14.98	304	100	V	29.41	5.19	0.00	49.58	54.00	-4.42	AV
4924	48.12	91	276	H	32.64	8.70	38.54	50.92	74.00	-23.08	PK
4924	39.42	91	276	H	32.64	8.70	38.54	42.22	54.00	-11.78	AV
7386	45.79	0	100	H	37.14	11.96	37.89	57.00	74.00	-17.00	PK
7386	34.40	0	100	H	37.14	11.96	37.89	45.61	54.00	-8.39	AV
9848	45.62	0	100	H	37.99	14.31	38.33	59.59	74.00	-14.41	PK
9848	34.49	0	100	H	37.99	14.31	38.33	48.46	54.00	-5.54	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/IC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBμV/m)	Margin (dB)	
Low Channel 2412 MHz											
2412	54.24	236	100	H	29.04	5.19	0	88.47	-	-	PK
2412	46.34	236	100	H	29.04	5.19	0	80.57	-	-	AV
2412	48.17	111	107	V	29.04	5.19	0	82.40	-	-	PK
2412	40.36	111	107	V	29.04	5.19	0	74.59	-	-	AV
2390	26.20	236	100	H	29.04	5.19	0	60.43	74.00	-13.57	PK
2390	14.70	236	100	H	29.04	5.19	0	48.93	54.00	-5.07	AV
2390	26.17	111	107	V	29.04	5.19	0	60.40	74.00	-13.60	PK
2390	14.64	111	107	V	29.04	5.19	0	48.87	54.00	-5.13	AV
4824	47.64	88	100	H	32.47	8.93	38.56	50.48	74.00	-23.52	PK
4824	35.57	88	100	H	32.47	8.93	38.56	38.41	54.00	-15.59	AV
7236	47.19	0	100	H	36.69	11.48	37.9	57.46	74.00	-16.54	PK
7236	35.16	0	100	H	36.39	11.48	37.9	45.13	54.00	-8.87	AV
9648	47.56	0	100	H	37.77	13.82	38.29	60.86	74.00	-13.14	PK
9648	35.33	0	100	H	37.77	13.82	38.29	48.63	54.00	-5.37	AV
Middle Channel 2437 MHz											
2437	56.02	116	224	H	29.04	5.19	0.00	90.25	-	-	PK
2437	48.50	116	224	H	29.04	5.19	0.00	82.73	-	-	AV
2437	54.83	276	264	V	29.04	5.19	0.00	89.06	-	-	PK
2437	47.41	276	264	V	29.04	5.19	0.00	81.64	-	-	AV
4874	47.58	92	100	H	32.64	8.83	38.54	50.51	74.00	-23.49	PK
4874	35.67	92	100	H	32.64	8.83	38.54	38.60	54.00	-15.40	AV
7311	46.03	0	100	H	37.15	12.01	37.90	57.29	74.00	-16.71	PK
7311	34.77	0	100	H	37.15	12.01	37.90	46.03	54.00	-7.97	AV
9748	46.01	0	100	H	37.92	13.70	38.29	59.34	74.00	-14.66	PK
9748	35.41	0	100	H	37.92	13.70	38.29	48.74	54.00	-5.26	AV

Frequency (MHz)	S.A. Reading (dBμV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre- Amp. (dB)	Cord. Reading (dBμV/m)	FCC/IC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBμV/m)	Margin (dB)	
High Channel 2462 MHz											
2462	57.71	249	181	H	29.41	5.19	0.00	92.31	-	-	PK
2462	50.21	249	181	H	29.41	5.19	0.00	84.81	-	-	AV
2462	49.03	247	279	V	29.41	5.19	0.00	83.63	-	-	PK
2462	41.40	247	279	V	29.41	5.19	0.00	76.00	-	-	AV
2483.5	28.15	249	181	H	29.41	5.19	0.00	62.75	74.00	-11.25	PK
2483.5	15.99	249	181	H	29.41	5.19	0.00	50.59	54.00	-3.41	AV
2483.5	26.44	247	279	V	29.41	5.19	0.00	61.04	74.00	-12.96	PK
2483.5	15.15	247	279	V	29.41	5.19	0.00	49.75	54.00	-4.25	AV
4924	47.44	101	100	H	32.64	8.70	38.54	50.24	74.00	-23.76	PK
4924	39.01	101	100	H	32.64	8.70	38.54	41.81	54.00	-12.19	AV
7386	47.35	0	100	H	37.14	11.96	37.89	58.56	74.00	-15.44	PK
7386	35.18	0	100	H	37.14	11.96	37.89	46.39	54.00	-7.61	AV
9848	47.11	0	100	H	37.99	14.31	38.33	61.08	74.00	-12.92	PK
9848	35.21	0	100	H	37.99	14.31	38.33	49.18	54.00	-4.82	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/IC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBμV/m)	Margin (dB)	
Low Channel 2412 MHz											
2412	54.10	111	217	H	29.04	5.19	0	88.33	-	-	PK
2412	46.04	111	217	H	29.04	5.19	0	80.27	-	-	AV
2412	50.74	271	300	V	29.04	5.19	0	84.97	-	-	PK
2412	42.78	271	300	V	29.04	5.19	0	77.01	-	-	AV
2390	27.83	111	217	H	29.04	5.19	0	62.06	74.00	-11.94	PK
2390	16.58	111	217	H	29.04	5.19	0	50.81	54.00	-3.19	AV
2390	27.77	271	300	V	29.04	5.19	0	62.00	74.00	-12.00	PK
2390	16.56	271	300	V	29.04	5.19	0	50.79	54.00	-3.21	AV
4824	48.89	92	100	H	32.47	8.93	38.56	51.73	74.00	-22.27	PK
4824	36.02	92	100	H	32.47	8.93	38.56	38.86	54.00	-15.14	AV
7236	46.53	0	100	H	36.69	11.48	37.9	56.80	74.00	-17.20	PK
7236	34.97	0	100	H	36.39	11.48	37.9	44.94	54.00	-9.06	AV
9648	46.99	0	100	H	37.77	13.82	38.29	60.29	74.00	-13.71	PK
9648	35.51	0	100	H	37.77	13.82	38.29	48.81	54.00	-5.19	AV
Middle Channel 2437 MHz											
2437	53.48	108	138	H	29.04	5.19	0.00	87.71	-	-	PK
2437	45.41	108	138	H	29.04	5.19	0.00	79.64	-	-	AV
2437	48.84	180	287	V	29.04	5.19	0.00	83.07	-	-	PK
2437	40.84	180	287	V	29.04	5.19	0.00	75.07	-	-	AV
4874	48.11	82	100	H	32.64	8.83	38.54	51.04	74.00	-22.96	PK
4874	36.71	82	100	H	32.64	8.83	38.54	39.64	54.00	-14.36	AV
7311	46.29	0	100	H	37.15	12.01	37.90	57.55	74.00	-16.45	PK
7311	35.01	0	100	H	37.15	12.01	37.90	46.27	54.00	-7.73	AV
9748	46.87	0	100	H	37.92	13.70	38.29	60.20	74.00	-13.80	PK
9748	36.78	0	100	H	37.92	13.70	38.29	50.11	54.00	-3.89	AV

Frequency (MHz)	S.A. Reading (dBμV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre- Amp. (dB)	Cord. Reading (dBμV/m)	FCC/IC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBμV/m)	Margin (dB)	
High Channel 2462 MHz											
2462	54.62	110	212	H	29.41	5.19	0.00	89.22	-	-	PK
2462	47.03	110	212	H	29.41	5.19	0.00	81.63	-	-	AV
2462	53.24	267	288	V	29.41	5.19	0.00	87.84	-	-	PK
2462	45.74	267	288	V	29.41	5.19	0.00	80.34	-	-	AV
2483.5	29.72	110	212	H	29.41	5.19	0.00	64.32	74.00	-9.68	PK
2483.5	17.29	110	212	H	29.41	5.19	0.00	51.89	54.00	-2.11	AV
2483.5	29.55	267	288	V	29.41	5.19	0.00	64.15	74.00	-9.85	PK
2483.5	17.11	267	288	V	29.41	5.19	0.00	51.71	54.00	-2.29	AV
4924	48.49	115	100	H	32.64	8.70	38.54	51.29	74.00	-22.71	PK
4924	39.55	115	100	H	32.64	8.70	38.54	42.35	54.00	-11.65	AV
7386	47.10	0	100	H	37.14	11.96	37.89	58.31	74.00	-15.69	PK
7386	35.83	0	100	H	37.14	11.96	37.89	47.04	54.00	-6.96	AV
9848	47.69	0	100	H	37.99	14.31	38.33	61.66	74.00	-12.34	PK
9848	36.08	0	100	H	37.99	14.31	38.33	50.05	54.00	-3.95	AV

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

8.1 Applicable Standards

According to FCC §15.247(a) (2) and ISSED 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 v03r05: 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	2016-01-19	1 year
-	RF cable	-	-	Each time ¹	N/A
-	10dB attenuator	-	-	Each time ¹	N/A

Note¹: cable and attenuator included in the test set-up will be checked each time before testing.

Statement of Traceability: BACL Corp. attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with A2LA Policy P102 (dated 9 June 2016) "A2LA Policy on Metrological Traceability".

8.4 Test Environmental Conditions

Temperature:	23° C
Relative Humidity:	42 %
ATM Pressure:	102.5 KPa

The testing was performed by Xiao Lin on 2016-11-29 in RF site.

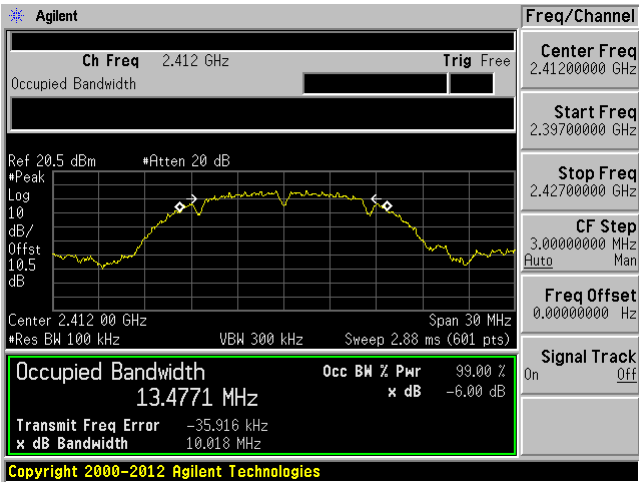
8.5 Test Results

Channel	Frequency (MHz)	99% OBW (kHz)	6 dB OBW (kHz)	6 dB OBW Limit (kHz)
802.11b mode				
Low	2412	13477.1	10018	500
Middle	2437	13518.6	9930	500
High	2462	13541	10012	500
802.11g mode				
Low	2412	16458.3	16570	500
Middle	2437	16452	16581	500
High	2462	16452.6	16581	500
802.11n-HT20 mode				
Low	2412	17675.5	17826	500
Middle	2437	17686.8	17860	500
High	2462	17705.9	17850	500

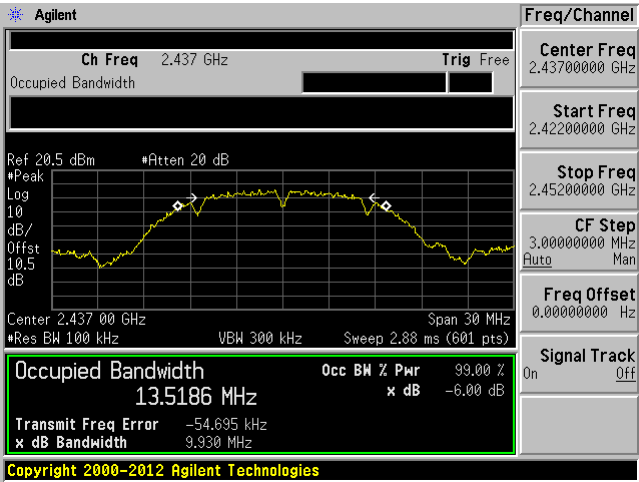
Please refer to the following plots for detailed test results.

802.11b mode

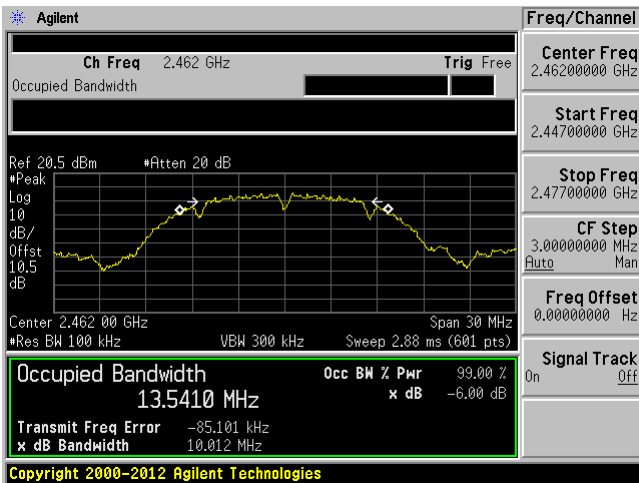
Low Channel 2412 MHz



Middle Channel 2437 MHz

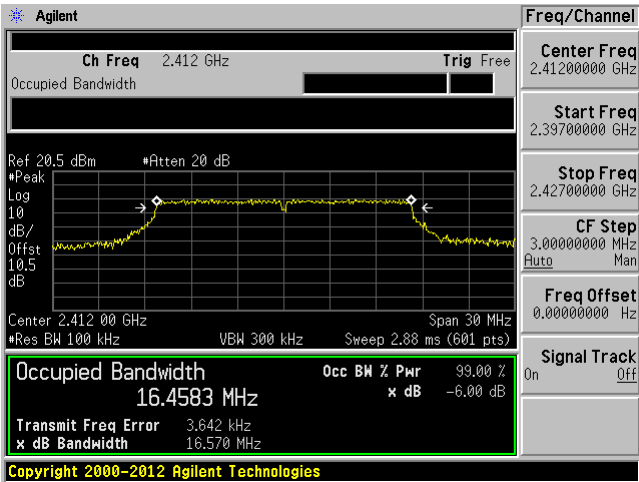


High Channel 2462 MHz

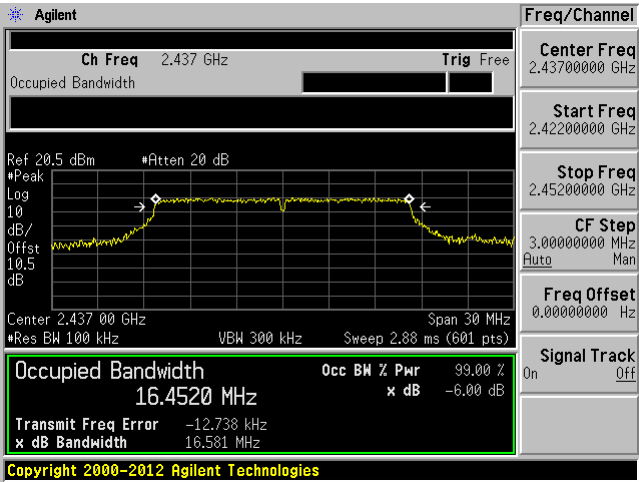


802.11g mode

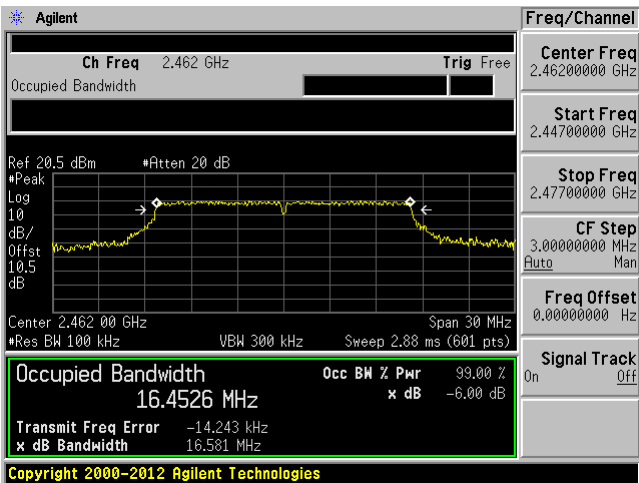
Low Channel 2412 MHz



Middle Channel 2437 MHz

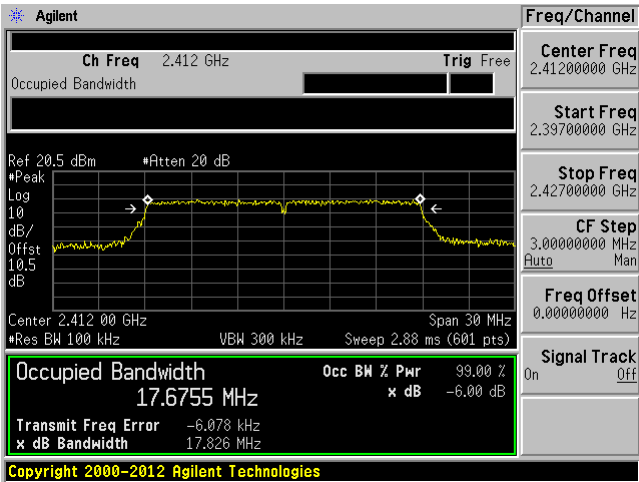


High Channel 2462 MHz

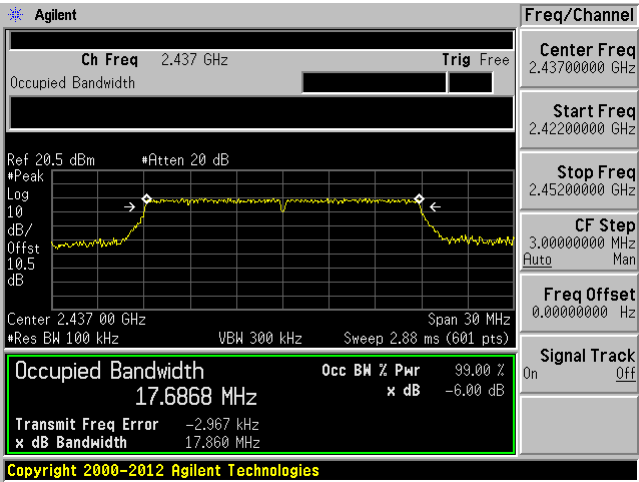


802.11n20 mode

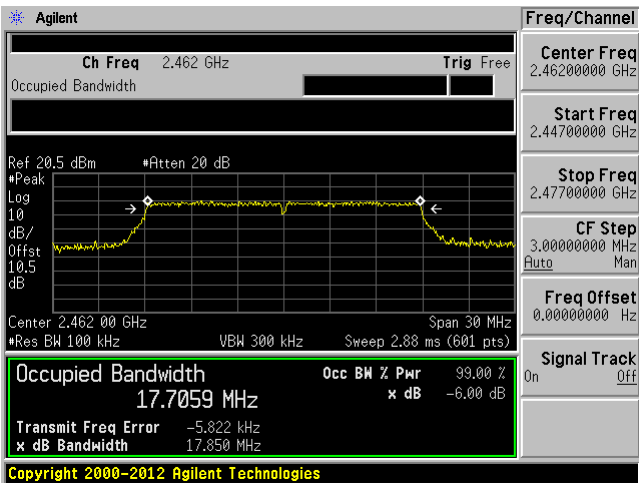
Low Channel 2412 MHz



Middle Channel 2437 MHz



High Channel 2462 MHz



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

9.1 Applicable Standards

According to FCC §15.247(b) (3) and ISSED 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 v03r05: 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
Agilent	Power Sensor	N1921A	MY54210024	2016-11-17	1 year
Agilent	Power Meter	N1912A	MY5000492	2016-11-17	1 year
WEINSCHTEL	10dB attenuator	5328	-	2016-06-18	1 year
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

Note¹: cable and attenuator included in the test set-up will be checked each time before testing.

Statement of Traceability: BACL Corp. attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with A2LA Policy P102 (dated 9 June 2016) "A2LA Policy on Metrological Traceability".

9.4 Test Environmental Conditions

Temperature:	23° C
Relative Humidity:	42 %
ATM Pressure:	102.5 KPa

The testing was performed by Xiao Lin on 2016-12-13 in RF site.

9.5 Test Results

Channel	Frequency (MHz)	Conducted Output Power (dBm)		Limit (dBm)
		Average	Peak	
802.11b mode				
1	2412	17.39	19.89	30
6	2437	17.64	19.58	30
11	2462	17.3	19.66	30
802.11g mode				
1	2412	15.3	24.86	30
6	2437	15.65	24.93	30
11	2462	15.7	24.9	30
802.11n-HT20 mode				
1	2412	15.39	24.27	30
6	2437	15.67	24.61	30
11	2462	15.86	24.37	30

Note: Duty Cycle correction factor has already been added to the measurement.

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

10.1 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 ISSED 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 v03r05: 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	2016-01-19	1 year
-	RF Cable	-	-	Each time ¹	N/A
-	10dB attenuator	-	-	Each time ¹	N/A

Note¹: cable and attenuator included in the test set-up will be checked each time before testing.

Statement of Traceability: BACL Corp. attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with A2LA Policy P102 (dated 9 June 2016) "A2LA Policy on Metrological Traceability".

10.4 Test Environmental Conditions

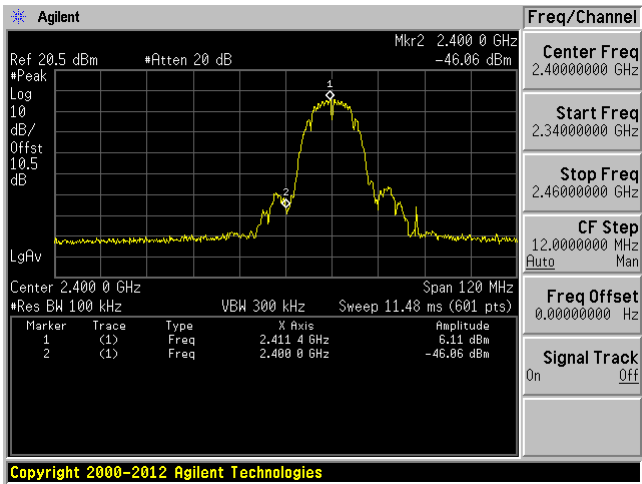
Temperature:	23° C
Relative Humidity:	42 %
ATM Pressure:	102.5 KPa

The testing was performed by Xiao Lin on 2016-11-29 in RF site.

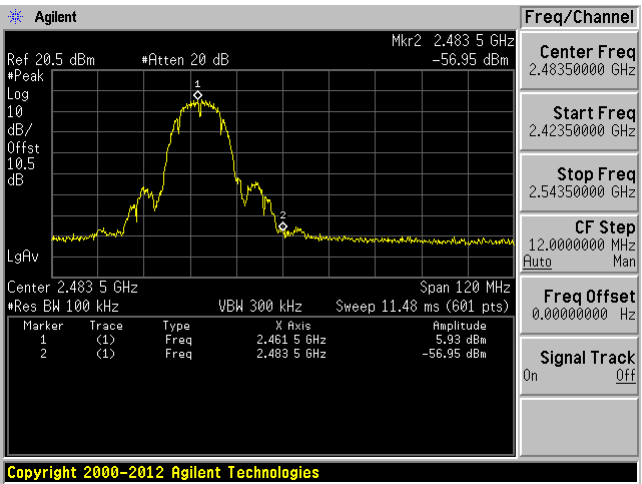
10.5 Test Results

802.11b mode

Low Channel 2412 MHz

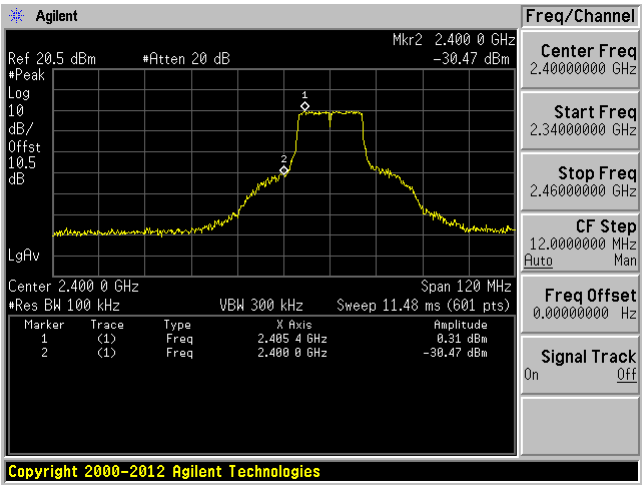


High Channel 2462 MHz

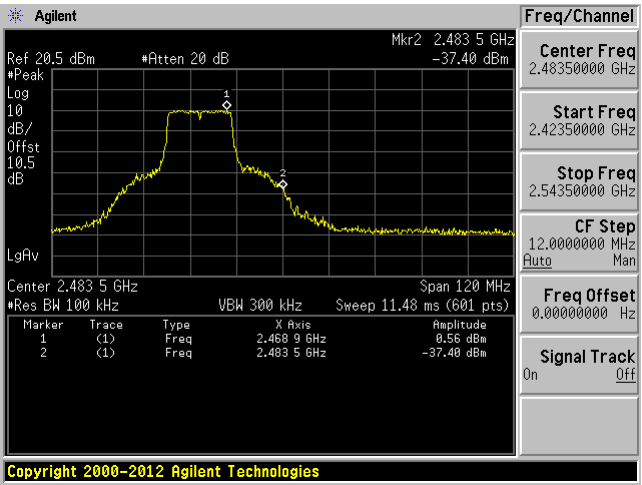


802.11g mode

Low Channel 2412 MHz

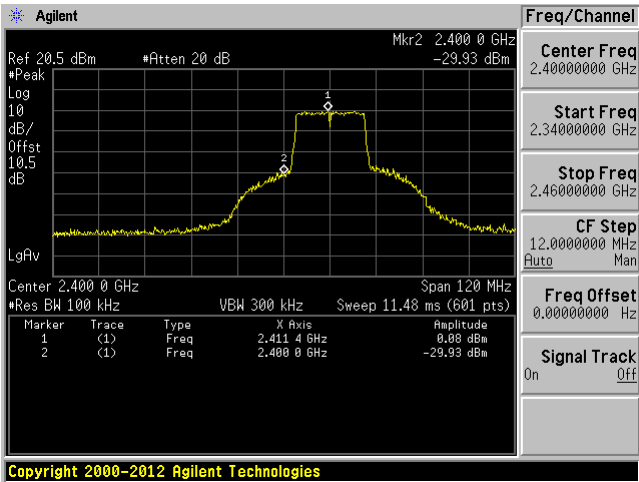


High Channel 2462 MHz

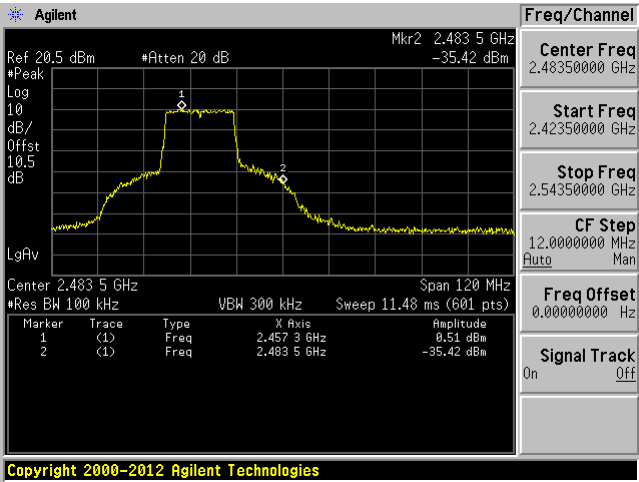


802.11n20 mode

Low Channel 2412 MHz



High Channel 2462 MHz



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

11.1 Applicable Standards

According to FCC §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 v03r05: 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	E4440A	US45303156	2016-01-19	1 year
-	RF Cable	-	-	Each time ¹	N/A
-	10dB attenuator	-	-	Each time ¹	N/A

Note¹: cable and attenuator included in the test set-up will be checked each time before testing.

Statement of Traceability: BACL Corp. attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with A2LA Policy P102 (dated 9 June 2016) “A2LA Policy on Metrological Traceability”.

11.4 Test Environmental Conditions

Temperature:	23° C
Relative Humidity:	42 %
ATM Pressure:	102.5 KPa

The testing was performed by Xiao Lin on 2016-11-29 in RF site.

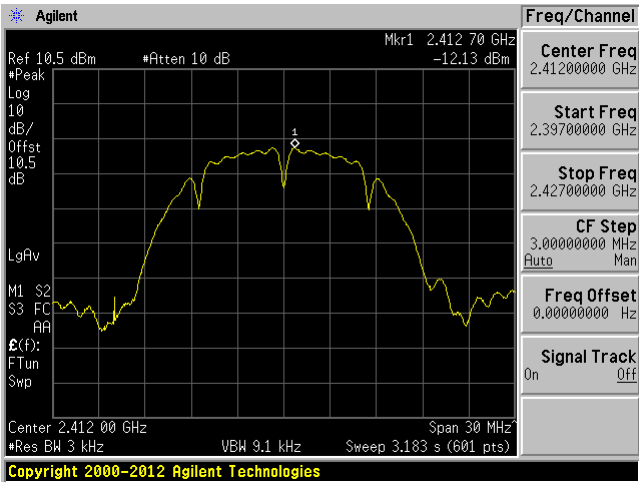
11.5 Test Results

Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)
802.11b mode			
Low	2412	-12.13	8
Middle	2437	-12.14	8
High	2462	-12.42	8
802.11g mode			
Low	2412	-13.86	8
Middle	2437	-13.49	8
High	2462	-13.3	8
802.11n-HT20 mode			
Low	2412	-11.62	8
Middle	2437	-11.2	8
High	2462	-11.66	8

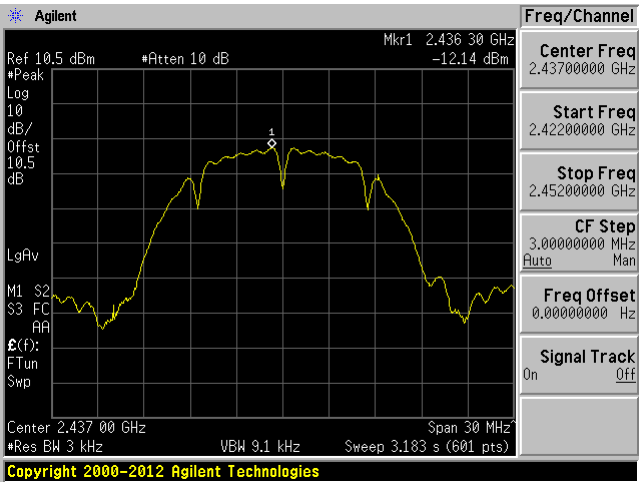
Please refer to the following plots for detailed test results

802.11b mode

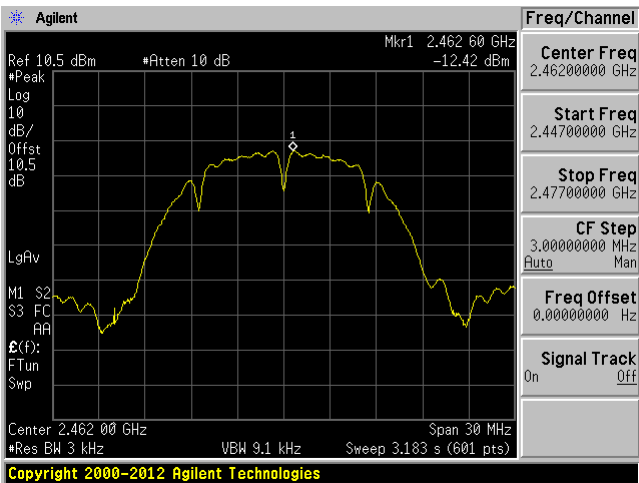
Low Channel 2412 MHz



Middle Channel 2437 MHz

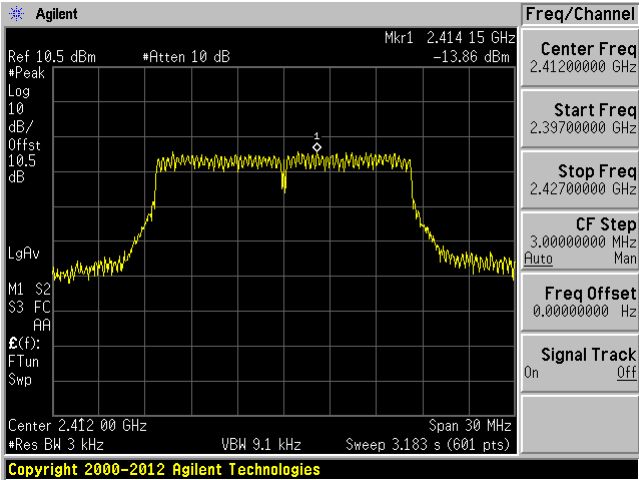


High Channel 2462 MHz

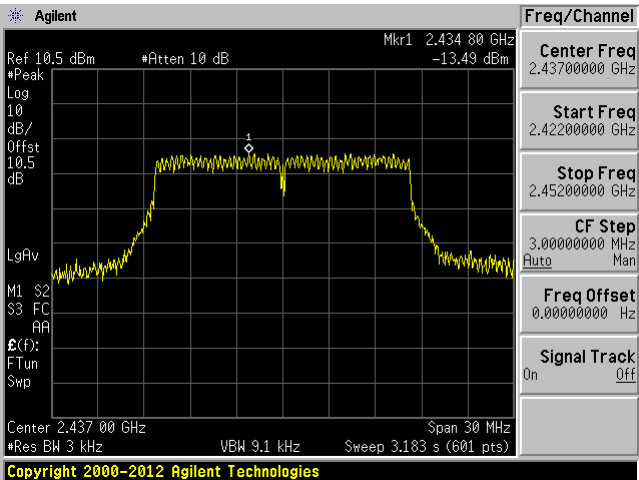


802.11g mode

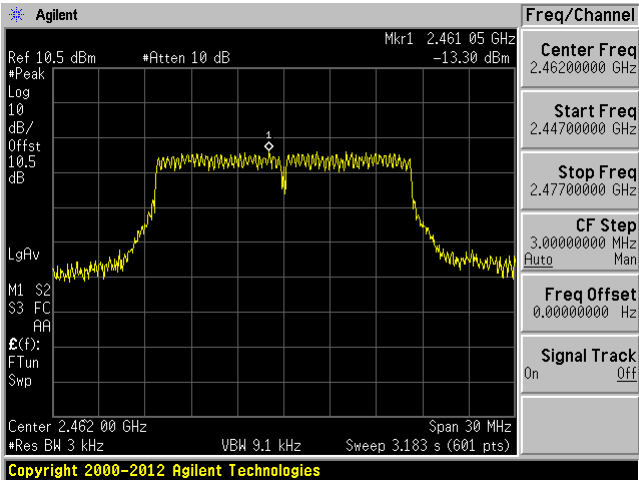
Low Channel 2412 MHz



Middle Channel 2437 MHz

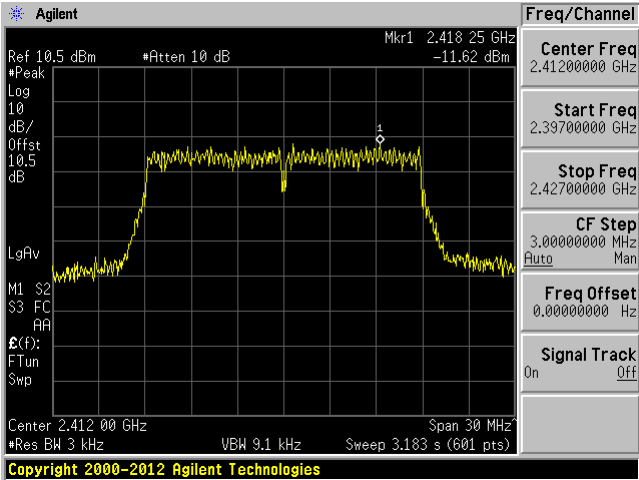


High Channel 2462 MHz

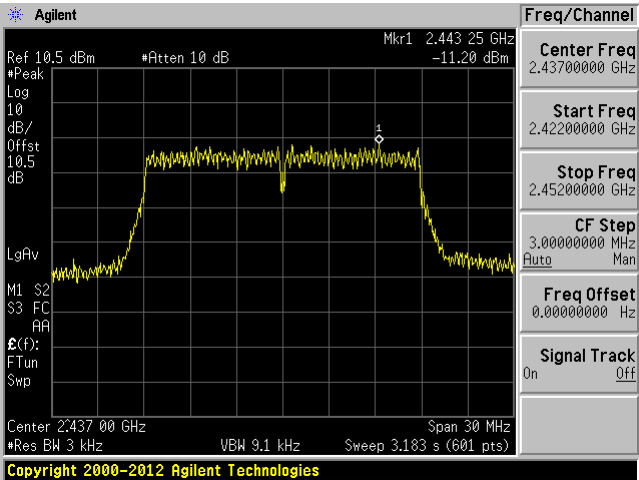


802.11n20 mode

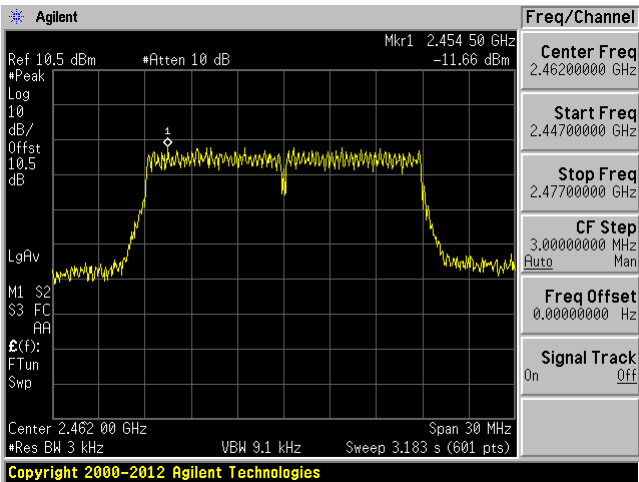
Low Channel 2412 MHz



Middle Channel 2437 MHz



High Channel 2462 MHz



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

12.1 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. 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 ISED 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	2016-01-19	1 year
-	RF Cable	-	-	Each time ¹	N/A
-	10dB attenuator	-	-	Each time ¹	N/A

Note¹: cable and attenuator included in the test set-up will be checked each time before testing.

Statement of Traceability: BACL Corp. attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with A2LA Policy P102 (dated 9 June 2016) “A2LA Policy on Metrological Traceability”.

12.4 Test Environmental Conditions

Temperature:	23° C
Relative Humidity:	42 %
ATM Pressure:	102.5 KPa

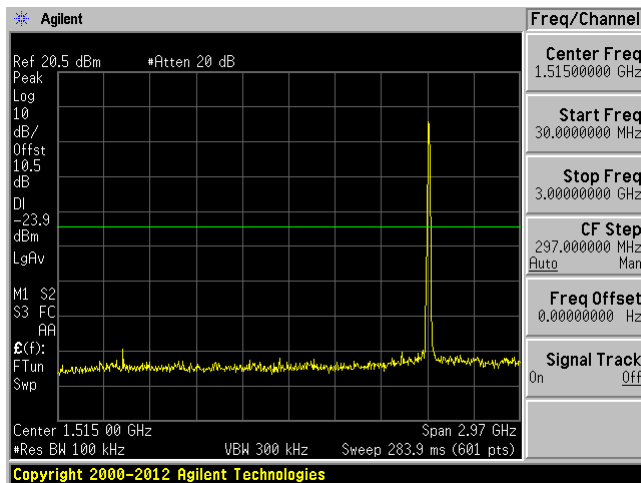
The testing was performed by Xiao Lin on 2016-11-29 in RF site.

12.5 Test Results

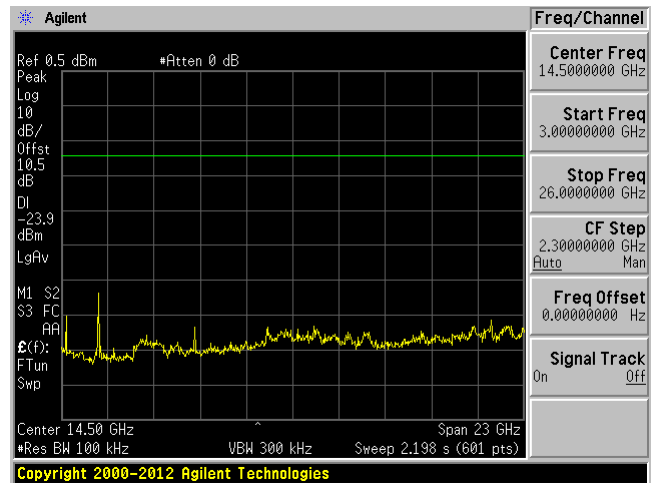
Please refer to following plots.

802.11b mode

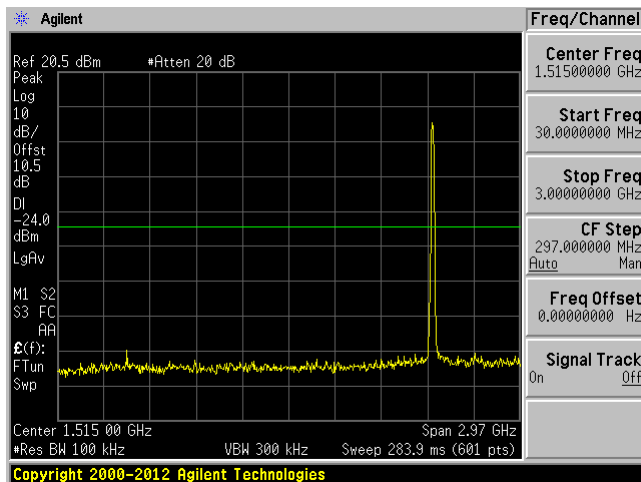
Low Channel 30MHz – 3 GHz



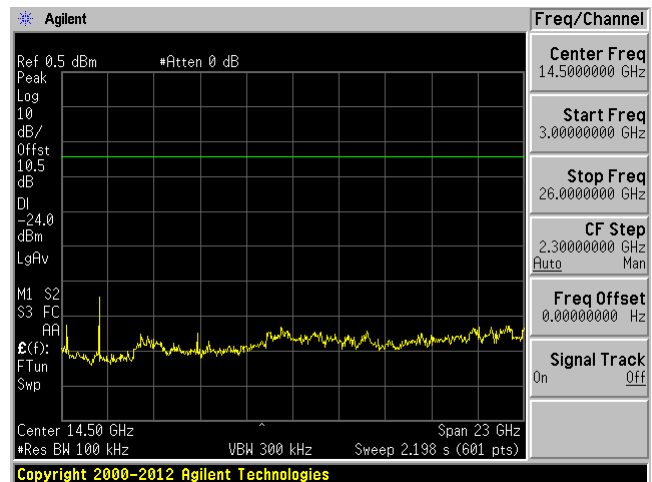
Low Channel 3 GHz – 26 GHz



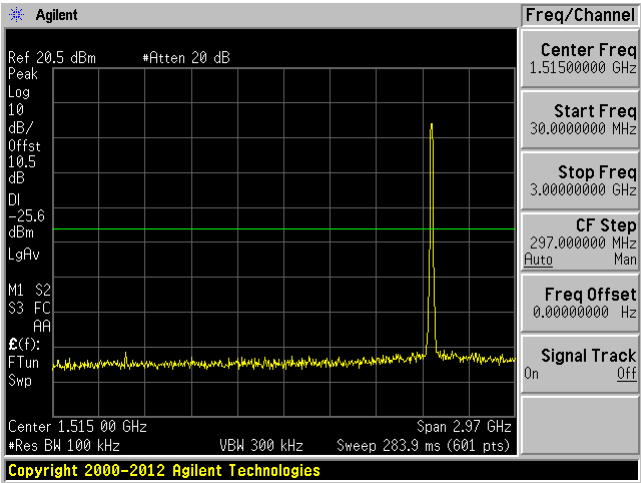
Middle Channel 30 MHz – 3 GHz



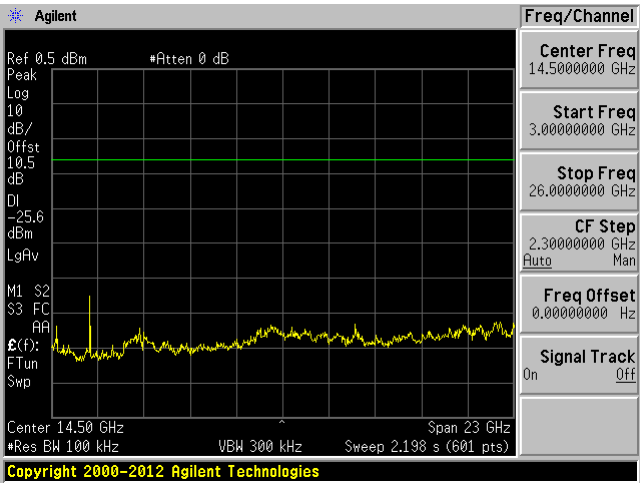
Middle Channel 3 GHz – 26 GHz



High Channel 30 MHz – 3 GHz

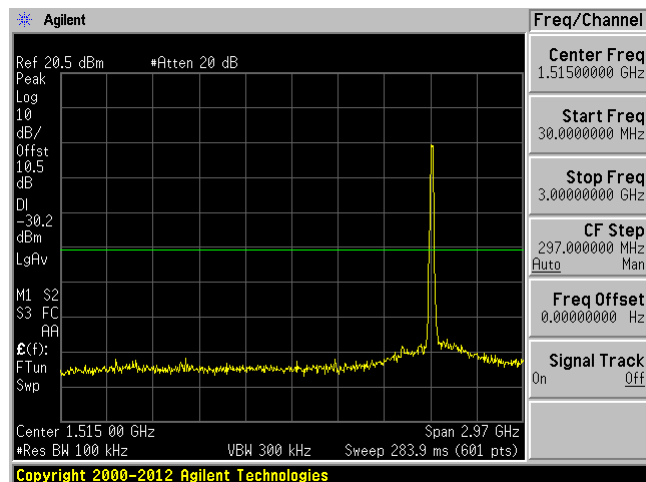


High Channel 3 GHz – 26 GHz

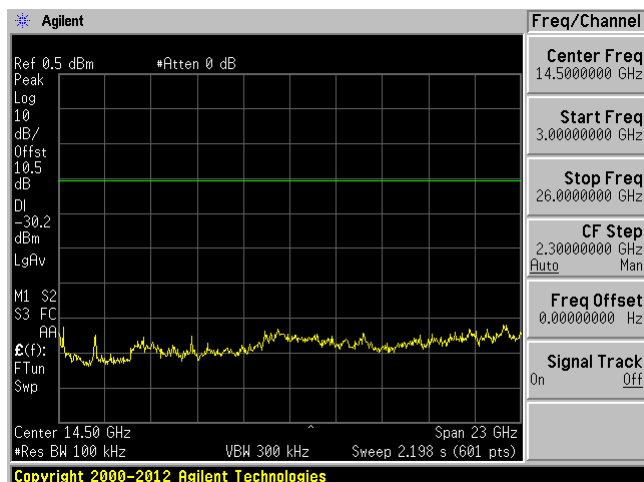


802.11g mode

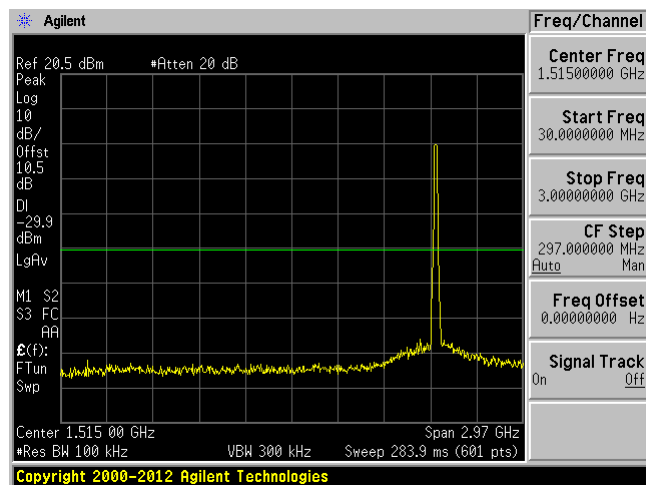
Low Channel 30 MHz – 3 GHz



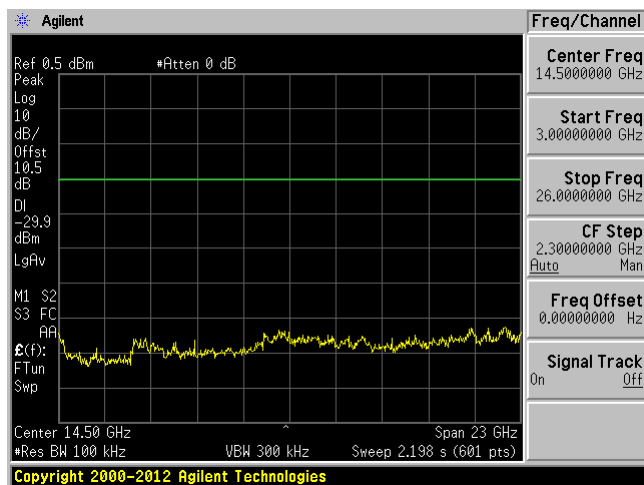
Low Channel 3 GHz – 26 GHz



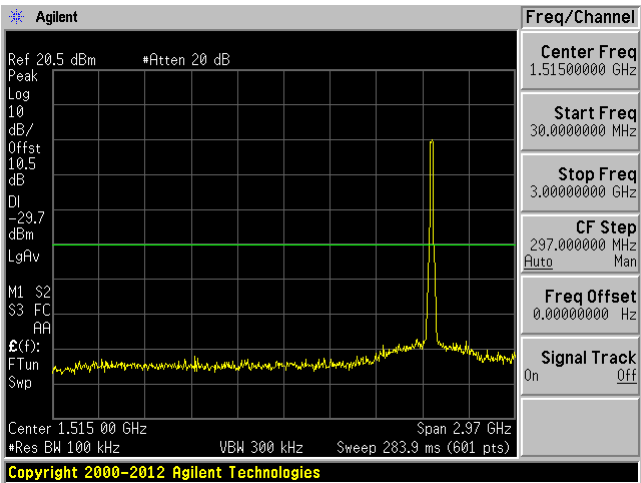
Middle Channel 30 MHz – 3 GHz



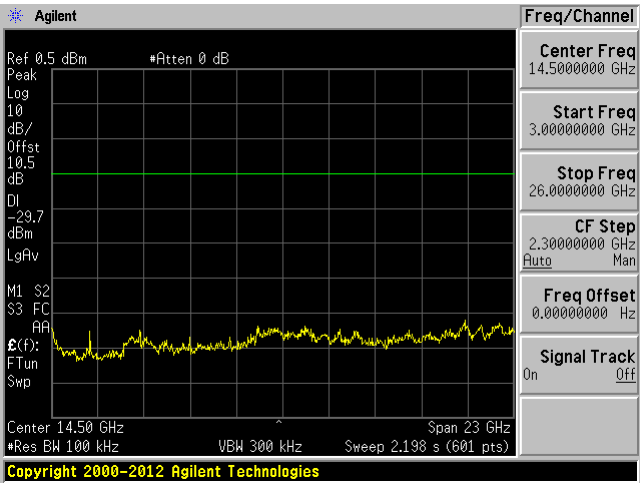
Middle Channel 3 GHz – 26 GHz



High Channel 30 MHz – 3 GHz

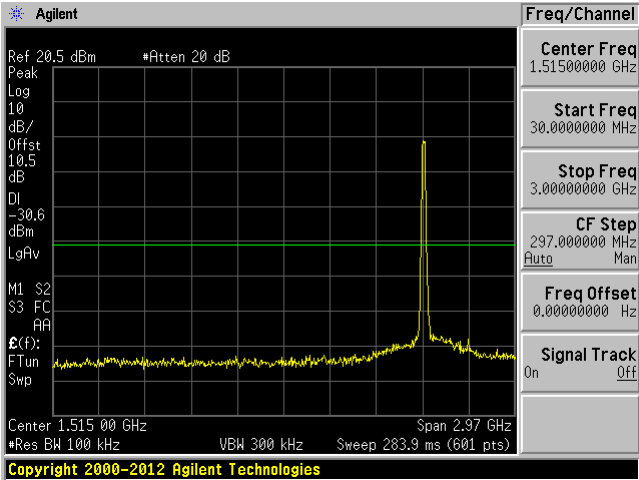


High Channel 3 GHz – 26 GHz

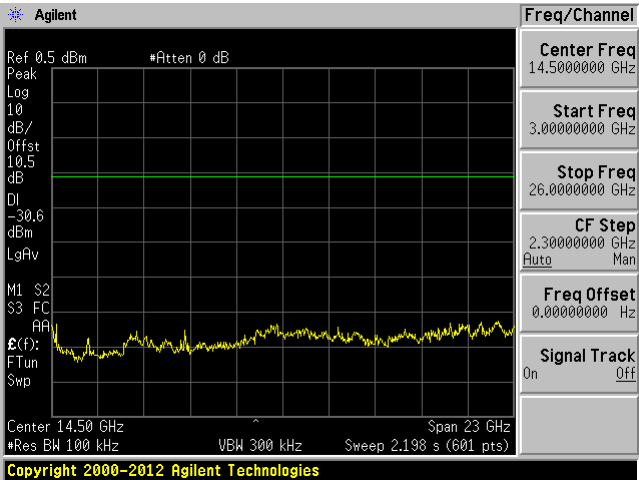


802.11n20 mode

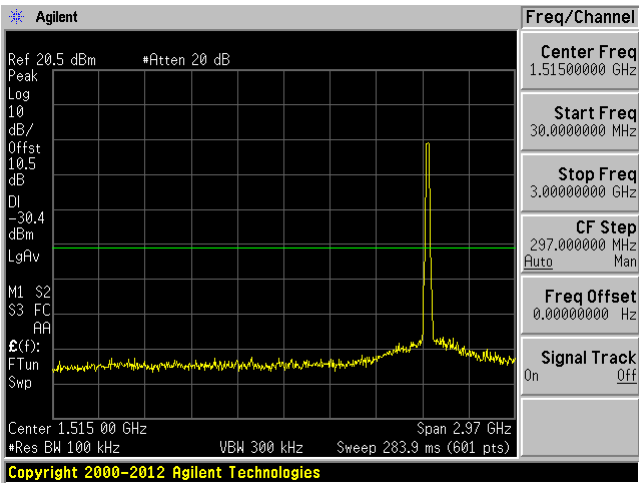
Low Channel 30 MHz – 3 GHz



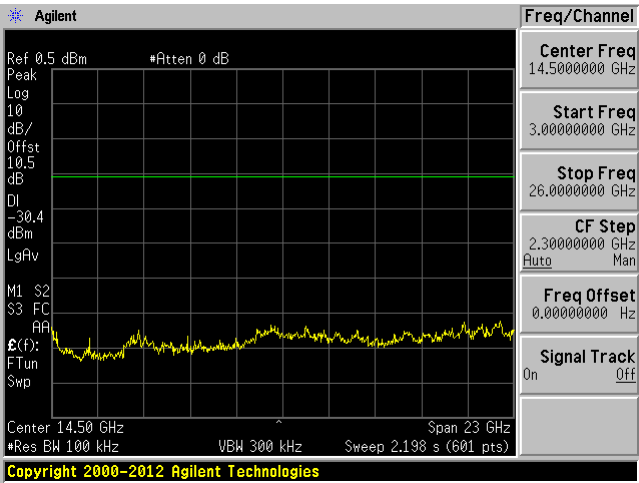
Low Channel 3 GHz – 26 GHz



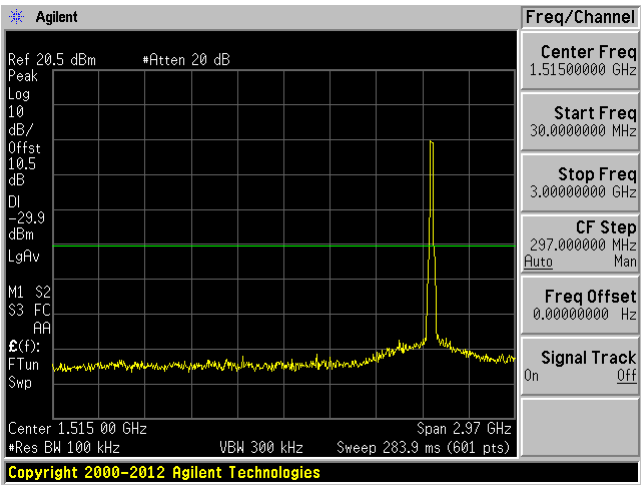
Middle Channel 30 MHz – 3 GHz



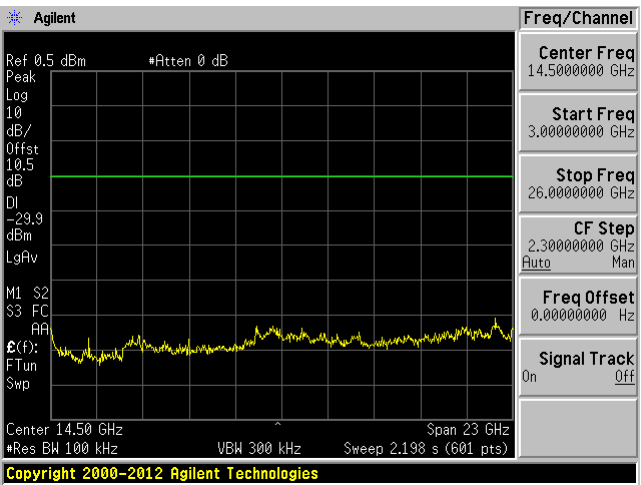
Middle Channel 3 GHz – 26 GHz



High Channel 30 MHz – 3 GHz



High Channel 3 GHz – 26 GHz



13 Annex A (Informative) - A2LA Electrical Testing Certificate



Accredited Laboratory

A2LA has accredited

BAY AREA COMPLIANCE LABORATORIES CORP.

Sunnyvale, CA

for technical competence in the field of

Electrical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 General requirements for the competence of testing and calibration laboratories. This laboratory also meets the requirements of any additional program requirements in the Electrical field. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009).



Presented this 30th day of August 2016.

President and CEO
For the Accreditation Council
Certificate Number 3297.02
Valid to September 30, 2018
Revised November 14, 2016

For the tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.

