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

TEST REPORT

For

Tyto Life LLC

411 Borel Avenue, Suite 100

San Mateo, CA 94402, USA

FCC ID: 2ALVS-OB100
IC: 22669-OB100

Report Type:	**Product Type:**
Original Report	Wireless Door Lock

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Report Number:	R1706221-247
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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1706221-247	Original Report	2017-08-17

1 General Description

1.1 Product Description for Equipment Under Test (EUT)

This test and measurement report was prepared on behalf of *Tyto Life LLC*, and their product model: *OB100,* FCC ID: 2ALVS-OB100, IC: 22669-OB100 or the "EUT" as referred to in this report. It is a wireless-enabled Door Lock with Wi-Fi, two Bluetooth Low Energy functions, and 5.8 GHz radar.

1.2 Mechanical Description of EUT

The EUT measures approximately 7 cm (L) x 10 cm (W) including locking mechanism (or 6.5 cm for cylinder width) x 10 cm (H) and weight 0.835 kg.

The test data gathered are from sample, serial number: R1706221-01 and R1706221-02 assigned by BACL.

1.3 Objective

This report is prepared on behalf of *Tyto Life LLC* 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: Antenna Requirements, RF Exposure, 6 dB and 99% Bandwidth, Output Power, Power Spectral Density, 100 kHz Bandwidth of Band Edges Measurement, Conducted TX Spurious Emissions and Radiated Spurious Emissions.

1.4 Related Submittal(s)/Grant(s)

FCC Part 15, Subpart C, Equipment DXX with FCC ID: 2ALVS-OB100; IC: 22669-OB100, Report number: R1706221-249

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 the CoolTerm serial terminal and Texas Instruments's BTool provided by *Tyto Life LLC,* the software is compliant with the standard requirements being tested against.

Modulation	Frequency (MHz)	Power Setting
b	2412	60
	2437	60
	2462	60
g	2412	60
	2437	60
	2462	60
n20	2412	60
	2437	60
	2462	56
INNER-BLE	2402	default
	2440	default
	2480	default
OUTER-BLE	2402	default
	2440	default
	2480	default

2.3 Duty Cycle Correction Factor

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

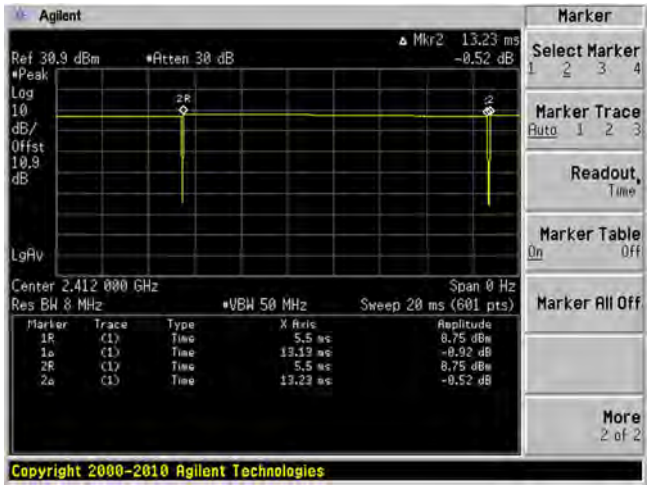
Preferably, all measurements of maximum conducted (average) output power will be performed with the EUT transmitting continuously (i.e., with a duty cycle of greater than or equal to 98%). When continuous operation cannot be realized, then the use of sweep triggering/signal gating techniques can be utilized 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	13.13	13.23	99.24	0.033
802.11g	2.158	2.283	94.52	0.24
802.11n20	0.235	0.3367	69.79	1.56
INNER-BLE	0.2863	0.6283	45.56	3.41
OUTER-BLE	0.2837	0.6232	45.53	3.34

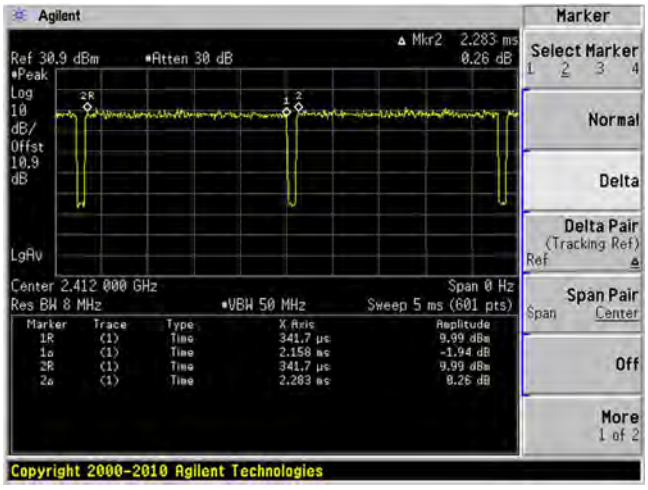
Duty Cycle = On Time (ms)/ Period (ms)
Duty Cycle Correction Factor (dB) = 10*log(1/Duty Cycle)

Please refer to the following plots.

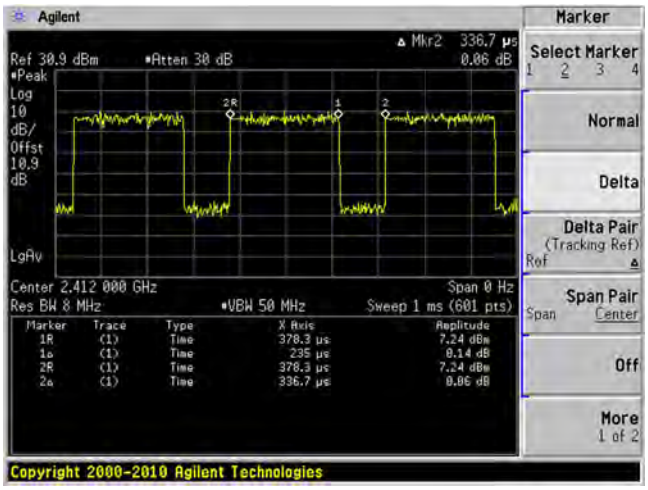
802.11b mode



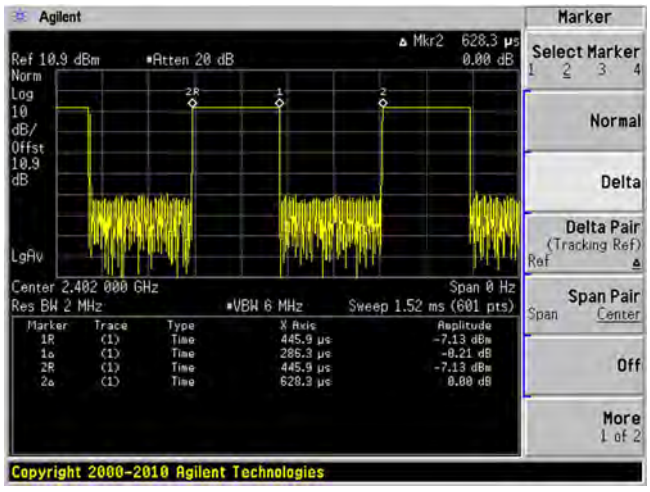
802.11g mode



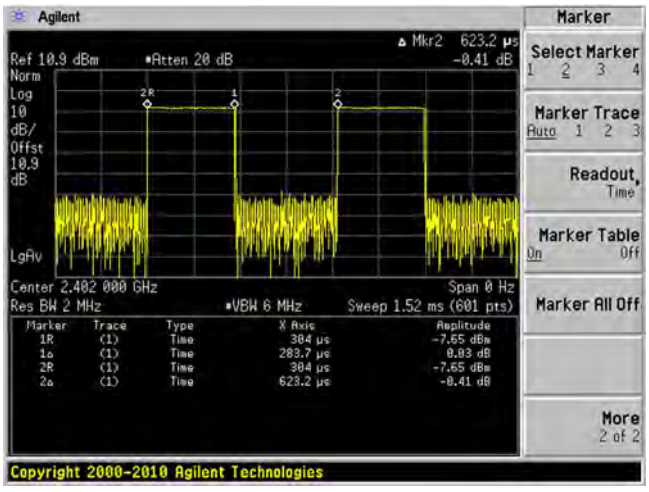
802.11n20 mode



INNER-BLE



OUTER-BLE



2.4 Equipment Modifications

The radiated sample was fastened with masking tape to turn on the device for testing. (No permanent modifications made to the EUT.)

2.5 Local Support Equipment

Manufacturer	Description	Model	Serial Number
BK Precision	DC Power Supply	1740	26502000233
Hewlett-Packard	DC Power Supply	E3630A	KR64309342

2.6 Support Equipment

Manufacturer	Description	Model
ASUS	Laptop	X556UAM Signature Edition

2.7 Interface Ports and Cabling

Cable Description	Length (m)	To	From
Segger J-Link CortexM Adapter	< 1 m	Laptop	EUT
RF Cable Assembly (WFL-WFL) 70mm ultra	< 1 m	EUT	PSA
TRIPP-LITE Keyspan USB Serial Adapter + TLL Converter	< 1m	Laptop	EUT
Standard USB Adapter (2x)	< 1m	Laptop	EUT

3 Summary of Test Results

Results reported relate only to the product tested.

FCC and ISEDC Rules	Description of Test	Results
FCC §15.203 ISEDC RSS-Gen §8.3	Antenna Requirement	Compliant
FCC §2.1093, §15.247(i) ISEDC RSS-102	RF Exposure	Compliant
FCC §15.207 ISEDC RSS-Gen §8.8	AC Power Line Conducted Emissions	N/A*
FCC §2.1051, §15.247 (d) ISEDC RSS-247 §5.5, §6.2.4.2	Spurious Emissions at Antenna Port	Compliant
FCC §2.1053, §15.205, §15.209, §15.247 (d) ISEDC RSS-247 §5.5 ISEDC RSS-Gen §8.9 and §8.10	Radiated Spurious Emissions	Compliant
FCC §15.247(a)(2) ISEDC RSS-247 §5.2 (a), §6.2.4.1	6 dB and 99% Emission Bandwidth	Compliant
FCC §15.247(b)(3) ISEDC RSS-247 §5.4 (d), §6.2.4.1	Maximum Peak Output Power	Compliant
FCC §15.247(d) ISEDC RSS-247 §5.5, §6.2.4.2	100 kHz Bandwidth of Frequency Band Edge	Compliant
FCC §15.247(e) ISEDC RSS-247 §5.2 (b), §6.2.4.1	Power Spectral Density	Compliant

Note: Because the EUT uses CR123A battery, AC Power Line Conducted Emissions test is not required.

4 FCC §15.203 and 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 Antenna Gain (dBi)
Wi-Fi	2412-2462	3.10
Inner BLE	2402-2480	3.10
Outer BLE	2402-2480	3.94

5 FCC §2.1093, §15.247(i) & ISED RSS-102 – RF Exposure

5.1 Applicable Standards

According to FCC KDB 447498 D01 General RF Exposure Guidance v06 Section 4.3.1, Unless specifically required by the published RF exposure KDB procedures, standalone 1-g head or body and 10-g extremity SAR evaluation for general population exposure conditions, by measurement or numerical simulation, is not required when the corresponding SAR Test Exclusion Threshold condition, listed below, is satisfied. These test exclusion conditions are based on source-based time-averaged maximum conducted output power of the RF channel requiring evaluation, adjusted for tune-up tolerance, and the minimum test separation distance required for the exposure conditions. The minimum test separation distance is determined by the smallest distance from the antenna and radiating structures or outer surface of the device, according to the host form factor, exposure conditions and platform requirements, to any part of the body or extremity of a user or bystander (see 5) of section 4.1). To qualify for SAR test exclusion, the test separation distances applied must be fully explained and justified by the operating configurations and exposure conditions of the transmitter and applicable host platform requirements, typically in the SAR measurement or SAR analysis report, according to the required published RF exposure KDB procedures. When no other RF exposure testing or reporting is required, a statement of justification and compliance must be included in the equipment approval, in lieu of the SAR report, to qualify for the SAR test exclusion. When required, the device specific conditions described in the other published RF exposure KDB procedures must be satisfied before applying these SAR test exclusion provisions; for example, handheld PTT two-way radios, handsets, laptops & tablets etc.

1) The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:

   [(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] · [√f(GHz)] ≤ 3.0 for 1-g SAR and ≤ 7.5 for 10-g extremity SAR, where

   • f(GHz) is the RF channel transmit frequency in GHz
   • Power and distance are rounded to the nearest mW and mm before calculation
   • The result is rounded to one decimal place for comparison
   • 3.0 and 7.5 are referred to as the numeric thresholds in the step 2 below

   The test exclusions are applicable only when the minimum test separation distance is ≤ 50 mm and for transmission frequencies between 100 MHz and 6 GHz. When the minimum test separation distance is < 5 mm, a distance of 5 mm according to 5) in section 4.1 is applied to determine SAR test exclusion.

2) At 100 MHz to 6 GHz and for test separation distances > 50 mm, the SAR test exclusion threshold is determined according to the following, and as illustrated in Appendix B:

   a) [Power allowed at numeric threshold for 50 mm in step 1) + (test separation distance - 50 mm)·(f(MHz)/150)] mW, at 100 MHz to 1500 MHz
   b) [Power allowed at numeric threshold for 50 mm in step 1) + (test separation distance - 50 mm)· 10] mW at > 1500 MHz and ≤ 6 GHz

3) At frequencies below 100 MHz, the following may be considered for SAR test exclusion, and as illustrated in Appendix C:

   a) The power threshold at the corresponding test separation distance at 100 MHz in step 2) is multiplied by [1 + log(100/f(MHz))] for test separation distances > 50 mm and < 200 mm
   b) The power threshold determined by the equation in a) for 50 mm and 100 MHz is multiplied by ½ for test separation distances ≤ 50 mm
   c) SAR measurement procedures are not established below 100 MHz. When SAR test exclusion cannot be applied, a KDB inquiry is required to determine SAR evaluation requirements for any test results to be acceptable.

Estimated SAR: According to FCC KDB 447498 Section 4.3.2 b), when an antenna qualifies for the standalone SAR test exclusion of 4.3.1 and also transmits simultaneously with other antennas, the standalone SAR value must be estimated according to the following to determine the simultaneous transmission SAR test exclusion criteria:

1) [(max. power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm)] · [$\sqrt{f_{(GHz)}}$/x] W/kg, for test separation distance ≤ 50 mm;

Where x = 7.5 for 1-g SAR and x = 18.75 for 10-g SAR

2) 0.4 W/kg for 1-g SAR and 1.0 W/kg for 10-g SAR, when the test separation distance is > 50 mm.

According to ISED RSS-102 Issue 5 §2.5.1,

SAR evaluation is required if the separation distance between the user and/or bystander and the antenna and/or radiating element of the device is less than or equal to 20 cm, except when the device operates at or below the applicable output power level (adjusted for tune-up tolerance) for the specified separation distance defined in Table 1.

Table 1: SAR evaluation – Exemption limits for routine evaluation based on frequency and separation distance

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of ≤ 5 mm	At separation distance of 10 mm	At separation distance of 15 mm	At separation distance of 20 mm	At separation distance of 25 mm
≤ 300	71	101	132	162	193
450	52	70	88	106	123
835	17	30	42	55	67
1900	7	10	18	34	60
2450	4	7	15	30	52
3500	2	6	16	32	55
5800	1	6	15	27	41

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of 30 mm	At separation distance of 35 mm	At separation distance of 40 mm	At separation distance of 45 mm	At separation distance of ≥ 50 mm
≤ 300	223	254	284	315	345
450	141	159	177	195	213
835	80	92	105	117	130
1900	99	153	225	316	431
2450	83	123	173	235	309
3500	86	124	170	225	290
5800	56	71	85	97	106

Output power level shall be the higher of the maximum conducted or equivalent isotropically radiated power (e.i.r.p.) source-based, time-averaged output power. For controlled use devices where the 8 W/kg for 1 gram of tissue applies, the exemption limits for routine evaluation in Table 1 are multiplied by a factor of 5. For limb-worn devices where the 10 gram value applies, the exemption limits for routine evaluation in Table 1 are multiplied by a factor of 2.5. If the operating frequency of the device is between two frequencies located in Table 1, linear interpolation shall be applied for the applicable separation distance. For test separation distance less than 5 mm, the exemption limits for a separation distance of 5 mm can be applied to determine if a routine evaluation is required. For medical implants devices, the exemption limit for routine evaluation is set at 1 mW.

The output power of a medical implants device is defined as the higher of the conducted or e.i.r.p to determine whether the device is exempt from the SAR evaluation.

5.2 RF Exposure Evaluation Results

FCC Standalone:

Based on the customer declaration, the EUT will work less than 5mm distance from human hands in the normal operating condition.

Based on the [(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] · [√f(GHz)] ≤ 3.0 for 1-g SAR and ≤ 7.5 for 10-g extremity SAR

Based on the Grantee declaration, the OB100 firmware will limit the transmission duty cycle under 10% for Wi-Fi in normal operation. Thus, the Wi-Fi time-averaged output power in normal operation was calculated by subtracting duty cycle factor (10 dB) from the measured output power.

Mode	Frequency (MHz)	Measured Power (dBm)	Time-average Power (dBm)	Time-average Power (mW)	Exclusion Threshold	Limit	Result
Wi-Fi (802.11b)	2412	14.89	4.89	3.0831	0.9577	<7.5	Exclude

Mode	Frequency (MHz)	Measured Peak Power (dBm)	Measured Peak Power (mW)	Exclusion Threshold	Limit	Result
BLE (Inner)	2440	4.61	2.8907	0.9031	<7.5	Exclude
BLE (Outer)	2402	4.52	2.8314	0.8776	<7.5	Exclude

ISED Standalone:

Mode	Frequency (MHz)	Measured e.i.r.p (dBm)	Time-average e.i.r.p (dBm)	Time-average e.i.r.p (mW)	Exemption Limits (mW)	Result
Wi-Fi (802.11b)	2412	17.99	7.99	6.2951	10	Exempt

Mode	Frequency (MHz)	Peak e.i.r.p (dBm)	Peak e.i.r.p (mW)	Exemption Limits (mW)	Result
BLE (Inner)	2440	7.71	5.902	10	Exempt
BLE (Outer)	2402	8.46	7.015	10	Exempt

Note[1]: we used 2450 MHz Exemption limit @<5mm as worst case.
Note[2]: the power level is the higher of the maximum conducted or e.i.r.p.

Conclusion:
Standalone SAR was exempted for this device.

Simultaneous Transmit:

According to KDB 447498 the estimated SAR should be:
[(max. power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm)] · [$\sqrt{f_{(GHz)}}$/x] W/kg, for test separation distance ≤ 50 mm;

Where x = 7.5 for 1-g SAR and x = 18.75 for 10-g SAR

Mode	Frequency (MHz)	Time-average Power (dBm)	Time-average Power (mW)	Separation Distance (mm)	Estimated SAR (W/kg)
802.11b	2412	4.89	3.0831	<5	0.0511
BLE(Inner)	2440	4.61	2.8907	<5	0.0482
BLE(Outer)	2402	4.52	2.8314	<5	0.0468
Radar	5785	-13.07	0.0493	<5	0.0013

Radio	Estimated Standalone SAR (W/kg)	Sum of SAR (W/kg)	Limit[3] (W/kg)	Results
Configuration #1				
2.4 GHz Wi-Fi	0.0511	0.0992	4	Pass
BLE(Outer)	0.0468			
Radar	0.0013			
Configuration #2				
BLE(Inner)	0.0482	0.0963	4	Pass
BLE(Outer)	0.0468			
Radar	0.0013			

Note[1]: Wi-Fi radio and Inner BLE cannot transmit simultaneously.
Note[2]: The conducted power of Radar is calculated from the field strength of radar and antenna gain which can be referred to the test report R1706221-249.
Note[3]: The EUT was a door lock and the normal operational configuration of this device would be hand extremity exposure condition. Thus, the extremity SAR limit was applied.

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 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 Note 1	56 to 46 Note 2
0.5-5	56	46
5-30	60	50

Note 1: Decreases with the logarithm of the frequency.
Note 2: A linear average detector is required

6.2 Summary of Test Results

The EUT uses CR123A batteries, so AC conducted emissions were not required.

7 FCC §15.209, §15.247(d) and 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:

$$CA = Ai + AF + CL + Atten - Ga$$

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

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

Margin = Corrected Amplitude - Limit

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	E4446A	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	2016-07-11	2 years
EMCO	Antenna, Horn	3115	9511-4627	2016-01-28	2 years
Agilent	Amplifier, Pre	8447D	2944A06639	2017-06-28	1 year
IW	AOBOR Hi frequency Co AX Cable	DC 1531	KPS-1501A3960KPS	2016-08-05	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 Frank Wang and Troy Pandhumsoporn 2017-07-03 to 2017-07-12 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:

2.4 GHz Wi-Fi

Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Mode, channel**
-0.376	2390	Vertical	n20 mode, low channel

INNER-BLE

Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**channel**
-1.10	2483.5	Vertical	high channel

OUTER-BLE

Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**channel**
-2.53	4804	Vertical	low channel

Co-Location: Outer-Inner-BLE, RADAR

Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**channel**
-9.23	9920	Horizontal	Outer: ch39, Inner: ch20

Co-Location: Wi-Fi, Outer-BLE, RADAR

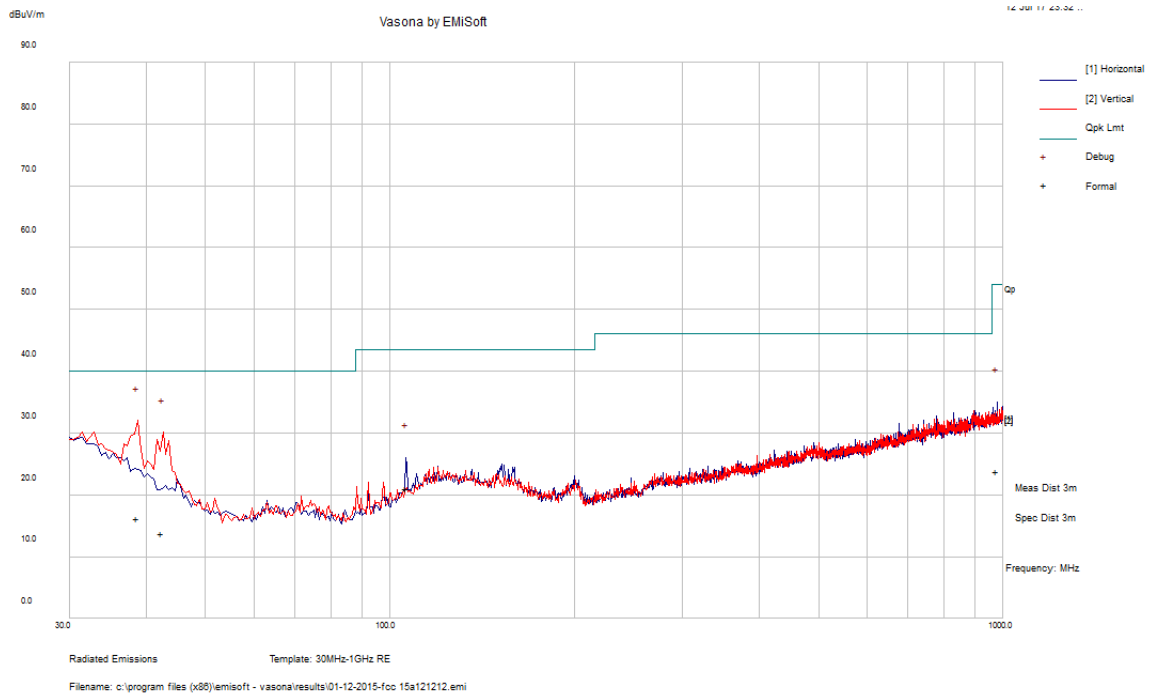
Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**channel**
-8.10	9920	Horizontal	Outer: ch39

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

7.8 Radiated Emissions Test Results

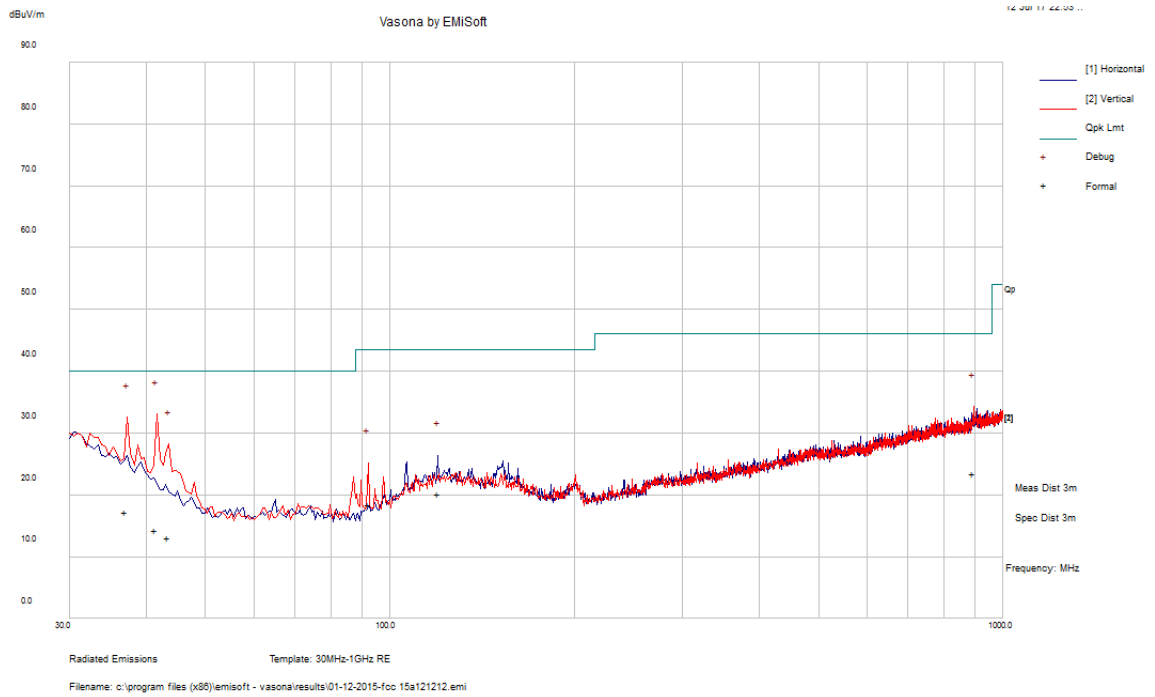
1) 30 MHz – 1 GHz Worst Case, Measured at 3 meters

2.4 GHz Wi-Fi, 2.4 GHz Outer-BLE, 5.8 GHz Radar Co-Location Testing



Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Comment
38.71325	16.3	312	V	173	40	-23.7	QP
42.38575	13.82	392	V	4	40	-26.18	QP
106.3935	21.01	124	H	232	43.5	-22.49	QP
977.432	23.9	388	H	32	54	-30.1	QP

2.4 GHz Inner-BLE, 2.4 GHz Outer-BLE, 5.8 GHz Radar Co-Location Testing



Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Comment
41.42725	14.38	355	V	252	40	-25.62	QP
37.06775	17.29	233	V	34	40	-22.71	QP
894.7388	23.55	144	V	257	46	-22.45	QP
43.402	13.05	351	V	20	40	-26.95	QP
119.9728	20.27	188	H	241	43.5	-23.23	QP
92.29875	18.54	126	V	159	43.5	-24.96	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/ISEDC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 2412 MHz											
2412	67.36	61	300	H	29.042	6.29	0	102.692	-	-	PK
2412	64.54	58	300	H	29.042	6.29	0	99.872	-	-	AV
2412	68.51	55	119	V	29.042	6.29	0	103.842	-	-	PK
2412	64.84	55	119	V	29.042	6.29	0	100.172	-	-	AV
2390	27.67	0	100	H	29.042	6.29	0	63.002	74	-10.998	PK
2390	12.78	0	100	H	29.042	6.29	0	48.112	54	-5.888	AV
2390	28.65	0	100	V	29.042	6.29	0	63.982	74	-10.018	PK
2390	17.69	54	100	V	29.042	6.29	0	53.022	54	-0.978	AV
4824	45.53	0	100	V	32.472	8.416	38.56	47.858	74	-26.142	PK
4824	31.81	0	100	V	32.472	8.416	38.56	34.138	54	-19.862	AV
7236	44.46	0	100	V	36.69	10.211	37.9	53.461	74	-20.539	PK
7236	30.42	0	100	V	36.39	10.211	37.9	39.121	54	-14.879	AV
9648	44.54	0	100	V	37.77	11.621	38.29	55.641	74	-18.359	PK
9648	30.26	0	200	V	37.77	11.621	38.29	41.361	54	-12.639	AV
Middle Channel 2437 MHz											
2437	66.98	61	178	H	29.042	6.29	0	102.312	-	-	PK
2437	64.63	58	200	H	29.042	6.29	0	99.962	-	-	AV
2437	72.53	56	135	V	29.042	6.29	0	107.862	-	-	PK
2437	63.23	57	135	V	29.042	6.29	0	98.562	-	-	AV
4874	45.87	0	100	V	32.64	8.416	38.54	48.386	74	-25.614	PK
4874	31.97	0	100	V	32.64	8.416	38.54	34.486	54	-19.514	AV
7311	44.65	0	100	V	37.148	10.211	37.9	54.109	74	-19.891	PK
7311	29.814	0	100	V	37.148	10.211	37.9	39.273	54	-14.727	AV
9748	44.388	0	100	V	37.92	11.621	38.29	55.639	74	-18.361	PK
9748	30.071	0	100	V	37.92	11.621	38.29	41.322	54	-12.678	AV

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)	
High Channel 2462 MHz											
2462	68.24	62	202	H	29.413	6.29	0	103.943	-	-	PK
2462	66.01	61	202	H	29.413	6.29	0	101.713	-	-	AV
2462	68.1	56	123	V	29.413	6.29	0	103.803	-	-	PK
2462	65.03	56	123	V	29.413	6.29	0	100.733	-	-	AV
2483.5	27.6	0	100	H	29.413	6.29	0	63.303	74	-10.697	PK
2483.5	15.76	0	100	H	29.413	6.29	0	51.463	54	-2.537	AV
2483.5	27.74	0	100	V	29.413	6.29	0	63.443	74	-10.557	PK
2483.5	15.69	0	100	V	29.413	6.29	0	51.393	54	-2.607	AV
4924	46.47	0	100	H	32.64	8.416	38.54	48.986	74	-25.014	PK
4924	31.55	0	100	H	32.64	8.416	38.54	34.066	54	-19.934	AV
7386	46.2	0	100	H	37.139	10.211	37.89	55.66	74	-18.34	PK
7386	31.58	0	100	H	37.139	10.211	37.89	41.04	54	-12.96	AV
9848	45.87	0	100	H	37.99	11.621	38.33	57.151	74	-16.849	PK
9848	31.46	0	100	H	37.99	11.621	38.33	42.741	54	-11.259	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	71.13	61	211	H	29.042	6.29	0	106.462	-	-	PK
2412	60.56	61	211	H	29.042	6.29	0	95.892	-	-	AV
2412	72.84	201	276	V	29.042	6.29	0	108.172	-	-	PK
2412	61.17	201	276	V	29.042	6.29	0	96.502	-	-	AV
2390	68.84	0	300	H	29.042	6.29	36.587	67.584	74	-6.415	PK
2390	53.68	0	300	H	29.042	6.29	36.587	52.424	54	-1.575	AV
2390	70.56	88	300	V	29.042	6.29	36.587	69.304	74	-4.695	PK
2390	54.5	88	300	V	29.042	6.29	36.587	53.244	54	-0.755	AV
4824	46.26	0	100	V	32.472	8.416	38.56	48.588	74	-25.412	PK
4824	32.53	0	100	V	32.472	8.416	38.56	34.858	54	-19.142	AV
7236	44.48	0	100	V	36.69	10.211	37.9	53.481	74	-20.519	PK
7236	31.189	0	100	V	36.39	10.211	37.9	39.89	54	-14.11	AV
9648	45.24	0	100	V	37.77	11.621	38.29	56.341	74	-17.659	PK
9648	30.29	0	100	V	37.77	11.621	38.29	41.391	54	-12.609	AV
Middle Channel 2437 MHz											
2437	72.45	0	300	H	29.042	6.29	0	107.782	-	-	PK
2437	63.02	0	300	H	29.042	6.29	0	98.352	-	-	AV
2437	70.63	55	130	V	29.042	6.29	0	105.962	-	-	PK
2437	60	55	130	V	29.042	6.29	0	95.332	-	-	AV
4874	46.2	0	100	H	32.64	8.416	38.54	48.716	74	-25.284	PK
4874	34.51	0	100	H	32.64	8.416	38.54	37.026	54	-16.974	AV
7311	43.99	0	100	H	37.148	10.211	37.9	53.449	74	-20.551	PK
7311	32.89	0	100	H	37.148	10.211	37.9	42.349	54	-11.651	AV
9748	39.57	0	100	H	37.92	11.621	38.29	50.821	74	-23.179	PK
9748	27.99	0	100	H	37.92	11.621	38.29	39.241	54	-14.759	AV

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)	
High Channel 2462 MHz											
2462	70.29	37	283	H	29.413	6.29	0	105.993	-	-	PK
2462	61.79	37	283	H	29.413	6.29	0	97.493	-	-	AV
2462	72.92	65	138	V	29.413	6.29	0	108.623	-	-	PK
2462	64.42	63	138	V	29.413	6.29	0	100.123	-	-	AV
2483.5	27.58	0	100	H	29.413	6.29	0	63.283	74	-10.717	PK
2483.5	15.99	0	100	H	29.413	6.29	0	51.693	54	-2.307	AV
2483.5	27.71	0	100	V	29.413	6.29	0	63.413	74	-10.587	PK
2483.5	15.92	0	100	V	29.413	6.29	0	51.623	54	-2.377	AV
4924	45.22	0	100	V	32.64	8.416	38.54	47.736	74	-26.264	PK
4924	33.55	0	100	V	32.64	8.416	38.54	36.066	54	-17.934	AV
7386	44.63	0	100	V	37.139	10.211	37.89	54.09	74	-19.91	PK
7386	32.63	0	100	V	37.139	10.211	37.89	42.09	54	-11.91	AV
9848	44.5	0	100	V	37.99	11.621	38.33	55.781	74	-18.219	PK
9848	32.55	0	100	V	37.99	11.621	38.33	43.831	54	-10.169	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	68.2	37	125	H	29.042	6.29	0	103.532	-	-	PK
2412	59.93	35	125	H	29.042	6.29	0	95.262	-	-	AV
2412	73.21	63	140	V	29.042	6.29	0	108.542	-	-	PK
2412	63.82	63	140	V	29.042	6.29	0	99.152	-	-	AV
2390	70.27	0	300	H	29.042	6.29	36.588	69.014	74	-4.986	PK
2390	54.49	0	300	H	29.042	6.29	36.588	53.234	54	-0.766	AV
2390	69.24	309	300	V	29.042	6.29	36.588	67.984	74	-6.016	PK
2390	54.88	309	300	V	29.042	6.29	36.588	53.624	54	**-0.376**	AV
4824	44.57	0	100	V	32.472	8.416	38.56	46.898	74	-27.102	PK
4824	33.23	0	100	V	32.472	8.416	38.56	35.558	54	-18.442	AV
7236	44.11	0	100	V	36.69	10.211	37.9	53.111	74	-20.889	PK
7236	33.45	0	100	V	36.39	10.211	37.9	42.151	54	-11.849	AV
9648	44.1	0	100	V	37.77	11.621	38.29	55.201	74	-18.799	PK
9648	33.02	0	100	V	37.77	11.621	38.29	44.121	54	-9.879	AV
Middle Channel 2437 MHz											
2437	72.21	32	157	H	29.042	6.29	0	107.542	-	-	PK
2437	63.13	32	157	H	29.042	6.29	0	98.462	-	-	AV
2437	70.52	76	258	V	29.042	6.29	0	105.852	-	-	PK
2437	62.41	73	258	V	29.042	6.29	0	97.742	-	-	AV
4874	45.19	0	100	V	32.64	8.416	38.54	47.706	74	-26.294	PK
4874	34.82	0	100	V	32.64	8.416	38.54	37.336	54	-16.664	AV
7311	44.73	0	100	V	37.148	10.211	37.9	54.189	74	-19.811	PK
7311	33.78	0	100	V	37.148	10.211	37.9	43.239	54	-10.761	AV
9748	44.61	0	100	V	37.92	11.621	38.29	55.861	74	-18.139	PK
9748	34.51	0	100	V	37.92	11.621	38.29	45.761	54	-8.239	AV

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)	
High Channel 2462 MHz											
2462	70.8	35	115	H	29.413	6.29	0	106.503	-	-	PK
2462	60.6	35	115	H	29.413	6.29	0	96.303	-	-	AV
2462	70	58	100	V	29.413	6.29	0	105.703	-	-	PK
2462	61.5	68	100	V	29.413	6.29	0	97.203	-	-	AV
2483.5	67.58	57	194	H	29.413	6.29	36.589	66.694	74	-7.306	PK
2483.5	52.83	57	194	H	29.413	6.29	36.589	51.944	54	-2.056	AV
2483.5	69.32	58	100	V	29.413	6.29	36.589	68.434	74	-5.566	PK
2483.5	54.38	61	100	V	29.413	6.29	36.589	53.494	54	-0.506	AV
4924	45.08	0	100	H	32.64	8.42	38.54	47.60	74.00	-26.40	PK
4924	34.10	0	100	H	32.64	8.42	38.54	36.62	54.00	-17.38	AV
7386	45.27	0	100	H	37.14	10.21	37.89	54.73	74.00	-19.27	PK
7386	33.60	0	100	H	37.14	10.21	37.89	43.06	54.00	-10.94	AV
9848	45.26	0	100	H	37.99	11.62	38.33	56.54	74.00	-17.46	PK
9848	34.73	0	100	H	37.99	11.62	38.33	46.01	54.00	-7.99	AV

INNER-BLE

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 2402 MHz											
2402	57.86	54	0	H	29.04	5.19	0	92.09	-	-	PK
2402	54.53	54	0	H	29.04	5.19	0	88.76	-	-	AV
2402	61.95	56	135	V	29.04	5.19	0	96.18	-	-	PK
2402	58.22	56	135	V	29.04	5.19	0	92.45	-	-	AV
2390	28.67	0	100	H	29.04	5.19	0	62.90	74.00	-11.10	PK
2390	13.53	0	100	H	29.04	5.19	0	47.76	54.00	-6.24	AV
2390	31.16	56	157	V	29.04	5.19	0	65.39	74.00	-8.61	PK
2390	13.50	57	157	V	29.04	5.19	0	47.73	54.00	-6.27	AV
4804	45.86	0	100	V	32.47	8.71	38.56	48.48	74.00	-25.52	PK
4804	32.44	0	100	V	32.47	8.71	38.56	35.06	54.00	-18.94	AV
7206	44.57	0	100	V	36.69	11.17	37.9	54.53	74.00	-19.47	PK
7206	31.30	0	100	V	36.39	11.17	37.9	40.96	54.00	-13.04	AV
9608	41.83	0	100	V	37.77	13.41	38.29	54.72	74.00	-19.28	PK
9608	28.90	0	100	V	37.77	13.41	38.29	41.79	54.00	-12.21	AV
Middle Channel 2440 MHz											
2440	60.60	55	292	H	29.04	5.19	0.00	94.83	-	-	PK
2440	57.17	55	292	H	29.04	5.19	0.00	91.40	-	-	AV
2440	63.36	57	110	V	29.04	5.19	0.00	97.59	-	-	PK
2440	59.65	57	110	V	29.04	5.19	0.00	93.88	-	-	AV
4880	46.05	0	100	V	32.64	8.71	38.54	48.86	74.00	-25.14	PK
4880	32.75	0	100	V	32.64	8.71	38.54	35.56	54.00	-18.44	AV
7320	45.38	0	100	V	37.15	11.17	37.90	55.80	74.00	-18.20	PK
7320	31.21	0	100	V	37.15	11.17	37.90	41.63	54.00	-12.37	AV
9760	44.24	0	100	V	37.92	13.41	38.29	57.28	74.00	-16.72	PK
9760	29.64	0	100	V	37.92	13.41	38.29	42.68	54.00	-11.32	AV

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)	
High Channel 2480 MHz											
2480	63.51	188	300	H	29.41	5.19	0.00	98.11	-	-	PK
2480	58.34	188	300	H	29.41	5.19	0.00	92.94	-	-	AV
2480	62.33	98	300	V	29.41	5.19	0.00	96.93	-	-	PK
2480	57.60	98	300	V	29.41	5.19	0.00	92.20	-	-	AV
2483.5	74.79	16	300	H	29.41	5.19	36.589	72.80	74.00	-1.20	PK
2483.5	35.70	16	300	H	29.41	5.19	36.589	33.71	54.00	-20.29	AV
2483.5	74.89	306	300	V	29.41	5.19	36.589	72.90	74.00	**-1.10**	PK
2483.5	36.93	306	300	V	29.41	5.19	36.589	34.94	54.00	-19.06	AV
4960	46.42	0	100	H	32.64	8.71	38.54	49.23	74.00	-24.77	PK
4960	31.62	0	100	H	32.64	8.71	38.54	34.43	54.00	-19.57	AV
7440	45.00	0	100	H	37.14	11.17	37.89	55.42	74.00	-18.58	PK
7440	31.00	0	100	H	37.14	11.17	37.89	41.42	54.00	-12.58	AV
9920	41.64	0	100	H	37.99	13.41	38.33	54.71	74.00	-19.29	PK
9920	27.85	0	100	H	37.99	13.41	38.33	40.92	54.00	-13.08	AV

OUTER-BLE

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 2402 MHz											
2402	55.96	207	300	H	29.04	5.19	0	90.19	-	-	PK
2402	51.70	207	300	H	29.04	5.19	0	85.93	-	-	AV
2402	57.77	127	290	V	29.04	5.19	0	92.00	-	-	PK
2402	54.70	127	290	V	29.04	5.19	0	88.93	-	-	AV
2390	29.20	217	300	H	29.04	5.19	0	63.43	74.00	-10.57	PK
2390	13.43	217	300	H	29.04	5.19	0	47.66	54.00	-6.34	AV
2390	30.13	126	300	V	29.04	5.19	0	64.36	74.00	-9.64	PK
2390	13.27	126	300	V	29.04	5.19	0	47.50	54.00	-6.50	AV
4804	54.33	193	120	V	32.47	8.71	38.56	56.95	74.00	-17.05	PK
4804	48.85	193	120	V	32.47	8.71	38.56	51.47	54.00	**-2.53**	AV
7206	44.97	0	100	V	36.69	11.17	37.9	54.93	74.00	-19.07	PK
7206	31.08	0	100	V	36.39	11.17	37.9	40.74	54.00	-13.26	AV
9608	42.33	0	100	V	37.77	13.41	38.29	55.22	74.00	-18.78	PK
9608	28.60	0	100	V	37.77	13.41	38.29	41.49	54.00	-12.51	AV
Middle Channel 2440 MHz											
2440	58.75	181	300	H	29.04	5.19	0.00	92.98	-	-	PK
2440	55.45	181	300	H	29.04	5.19	0.00	89.68	-	-	AV
2440	56.76	333	300	V	29.04	5.19	0.00	90.99	-	-	PK
2440	53.55	333	300	V	29.04	5.19	0.00	87.78	-	-	AV
4880	47.23	194	300	H	32.64	8.71	38.54	50.04	74.00	-23.96	PK
4880	36.52	194	300	H	32.64	8.71	38.54	39.33	54.00	-14.67	AV
7320	44.58	0	100	H	37.15	11.17	37.90	55.00	74.00	-19.00	PK
7320	31.04	0	100	H	37.15	11.17	37.90	41.46	54.00	-12.54	AV
9760	44.32	0	100	H	37.92	13.41	38.29	57.36	74.00	-16.64	PK
9760	30.20	0	100	H	37.92	13.41	38.29	43.24	54.00	-10.76	AV

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)	
High Channel 2480 MHz											
2480	57.75	43	300	H	29.41	5.19	0.00	92.35	-	-	PK
2480	53.27	43	300	H	29.41	5.19	0.00	87.87	-	-	AV
2480	58.87	134	300	V	29.41	5.19	0.00	93.47	-	-	PK
2480	54.10	134	300	V	29.41	5.19	0.00	88.70	-	-	AV
2483.5	35.57	241	100	H	29.41	5.19	0.00	70.17	74.00	-3.83	PK
2483.5	13.86	241	100	H	29.41	5.19	0.00	48.46	54.00	-5.54	AV
2483.5	35.31	352	100	V	29.41	5.19	0.00	69.91	74.00	-4.09	PK
2483.5	13.61	352	100	V	29.41	5.19	0.00	48.21	54.00	-5.79	AV
4960	51.00	180	100	V	32.64	8.71	38.54	53.81	74.00	-20.19	PK
4960	43.40	180	100	V	32.64	8.71	38.54	46.21	54.00	-7.79	AV
7440	44.92	0	100	V	37.14	11.17	37.89	55.34	74.00	-18.66	PK
7440	30.88	0	100	V	37.14	11.17	37.89	41.30	54.00	-12.70	AV
9920	41.24	0	100	V	37.99	13.41	38.33	54.31	74.00	-19.69	PK
9920	27.84	0	100	V	37.99	13.41	38.33	40.91	54.00	-13.09	AV

CO-LOCATION: Outer-Inner-BLE, RADAR

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)	
4960	45.28	0	100	H	32.64	8.71	38.54	48.09	74.00	-25.91	PK
4960	31.80	0	100	H	32.64	8.71	38.54	34.61	54.00	-19.39	AV
4960	44.99	0	100	V	32.64	8.71	38.54	47.80	74.00	-26.20	PK
4960	32.60	74	154	V	32.64	8.71	38.54	35.41	54.00	-18.59	AV
7440	45.61	0	100	H	37.14	11.17	37.89	56.03	74.00	-17.97	PK
7440	31.61	0	100	H	37.14	11.17	37.89	42.03	54.00	-11.97	AV
7440	45.02	0	100	V	37.14	11.17	37.89	55.44	74.00	-18.56	PK
7440	31.66	0	100	V	37.14	11.17	37.89	42.08	54.00	-11.92	AV
9920	44.69	0	100	H	37.99	13.41	38.33	57.76	74.00	-16.24	PK
9920	31.70	0	100	H	37.99	13.41	38.33	44.77	54.00	**-9.23**	AV
9920	44.88	0	100	V	37.99	13.41	38.33	57.95	74.00	-16.05	PK
9920	31.22	0	100	V	37.99	13.41	38.33	44.29	54.00	-9.71	AV
11624	42.89	0	100	H	35.16	16.12	38.21	55.96	74.00	-18.04	PK
11624	29.04	0	100	H	35.16	16.12	38.21	42.11	54.00	-11.89	AV
11624	42.78	0	100	V	35.16	16.12	38.21	55.85	74.00	-18.15	PK
11624	27.72	0	100	V	35.16	16.12	38.21	40.79	54.00	-13.21	AV
17436	43.12	0	100	H	32.88	19.45	38.21	57.24	74.00	-16.76	PK
17436	27.52	0	100	H	32.88	19.45	36.99	42.86	54.00	-11.14	AV
17436	42.37	0	100	V	32.88	19.45	38.21	56.49	74.00	-17.51	PK
17436	27.51	0	100	V	32.88	19.45	36.99	42.85	54.00	-11.15	AV

CO-LOCATION: Wi-Fi, Outer-BLE, RADAR

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)	
4874	46.21	0	100	H	32.64	8.416	38.54	48.726	74	-25.274	PK
4874	32.56	0	100	H	32.64	8.416	38.54	35.076	54	-18.924	AV
4874	46.45	0	100	V	32.64	8.416	38.54	48.966	74	-25.034	PK
4874	32.52	0	100	V	32.64	8.416	38.54	35.036	54	-18.964	AV
7311	44.74	0	100	H	37.148	10.211	37.9	54.199	74	-19.801	PK
7311	31.72	0	100	H	37.148	10.211	37.9	41.179	54	-12.821	AV
7311	44.92	0	100	V	37.148	10.211	37.9	54.379	74	-19.621	PK
7311	32.66	0	100	V	37.148	10.211	37.9	42.119	54	-11.881	AV
9748	46.4	0	100	H	37.92	11.621	38.29	57.651	74	-16.349	PK
9748	32.61	0	100	H	37.92	11.621	38.29	43.861	54	-10.139	AV
9748	46.44	0	100	V	37.92	11.621	38.29	57.691	74	-16.309	PK
9748	32.59	0	100	V	37.92	11.621	38.29	43.841	54	-10.159	AV
4960	45.81	0	100	H	32.64	8.71	38.54	48.62	74.00	-25.38	PK
4960	31.60	0	100	H	32.64	8.71	38.54	34.41	54.00	-19.59	AV
4960	45.25	0	100	V	32.64	8.71	38.54	48.06	74.00	-25.94	PK
4960	31.62	0	100	V	32.64	8.71	38.54	34.43	54.00	-19.57	AV
7440	45.07	0	100	H	37.14	11.17	37.89	55.49	74.00	-18.51	PK
7440	31.61	0	100	H	37.14	11.17	37.89	42.03	54.00	-11.97	AV
7440	45.04	0	100	V	37.14	11.17	37.89	55.46	74.00	-18.54	PK
7440	31.55	0	100	V	37.14	11.17	37.89	41.97	54.00	-12.03	AV
9920	44.84	0	100	H	37.99	13.41	38.33	57.91	74.00	-16.09	PK
9920	32.83	0	100	H	37.99	13.41	38.33	45.90	54.00	**-8.10**	AV
9920	44.62	0	100	V	37.99	13.41	38.33	57.69	74.00	-16.31	PK
9920	31.38	0	100	V	37.99	13.41	38.33	44.45	54.00	-9.55	AV
11624	42.54	0	100	H	35.16	16.12	38.21	55.61	74.00	-18.39	PK
11624	30.81	0	100	H	35.16	16.12	38.21	43.88	54.00	-10.12	AV
11624	42.58	0	100	V	35.16	16.12	38.21	55.65	74.00	-18.35	PK
11624	30.83	0	100	V	35.16	16.12	38.21	43.90	54.00	-10.10	AV
17436	42.26	0	100	H	32.88	19.45	38.21	56.38	74.00	-17.62	PK
17436	28.45	0	100	H	32.88	19.45	36.99	43.79	54.00	-10.21	AV
17436	43.04	0	100	V	32.88	19.45	38.21	57.16	74.00	-16.84	PK
17436	30.38	0	100	V	32.88	19.45	36.99	45.72	54.00	-8.28	AV

Note: the duty cycle correction factor has ready be considered in the results above.

8 FCC §15.247(a) (2) and ISEDC RSS-247 §5.2, §6.2.4.1 -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	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.*

8.4 Test Environmental Conditions

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

The testing was performed by Troy Pandhumsoporn on 2017-06-29 to 2017-06-30 and 2017-07-12 in RF site.

8.5 Test Results

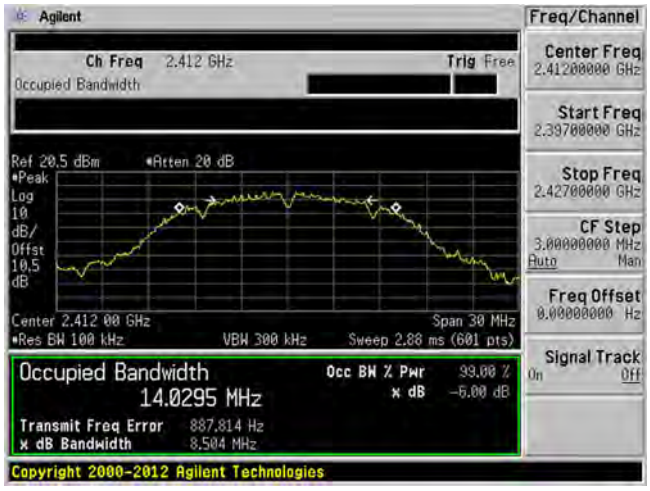
Channel	Frequency (MHz)	99% OBW (kHz)	6 dB BW (kHz)	6 dB OBW limit (kHz)
802.11b mode				
Low	2412	14063.2	8504	500
Middle	2437	14053.9	7611	500
High	2462	14038.6	8565	500
802.11g mode				
Low	2412	16335.7	14785	500
Middle	2437	16311.4	14671	500
High	2462	16318.5	12934	500
802.11n-20 mode				
Low	2412	17481.4	15142	500
Middle	2437	17484.4	15165	500
High	2462	17464.6	14510	500
INNER-BLE				
Low	2402	1019.5	715.617	500
Middle	2440	1002.8	655.921	500
High	2480	1017.7	721.691	500
OUTER-BLE				
Low	2402	1173.5	682.494	500
Middle	2440	1078.2	712.559	500
High	2480	1019.7	732.224	500

Please refer to the following plots for detailed test results.

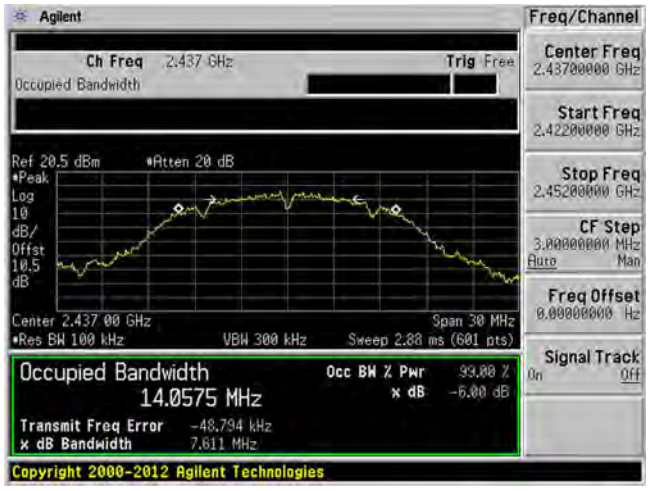
6 dB Bandwidth

802.11b mode

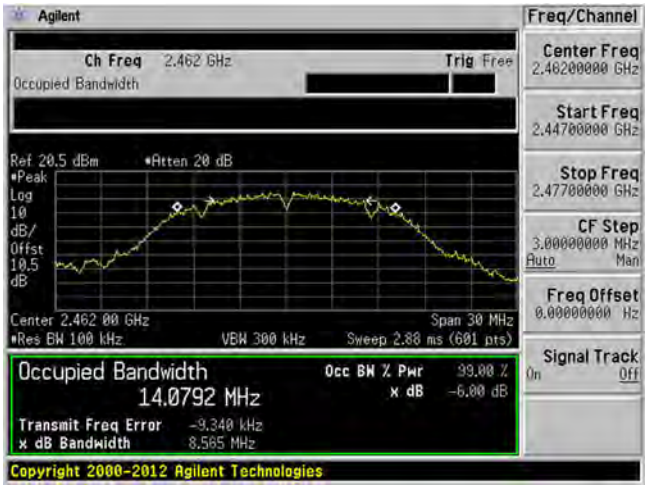
Low Channel 2412 MHz



Middle Channel 2437 MHz

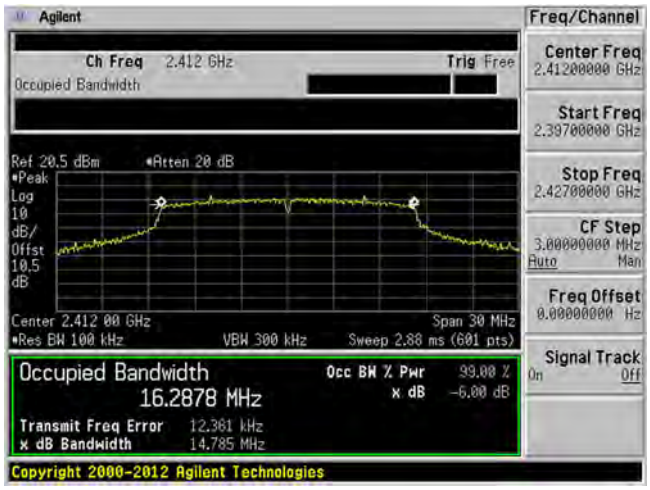


High Channel 2462 MHz

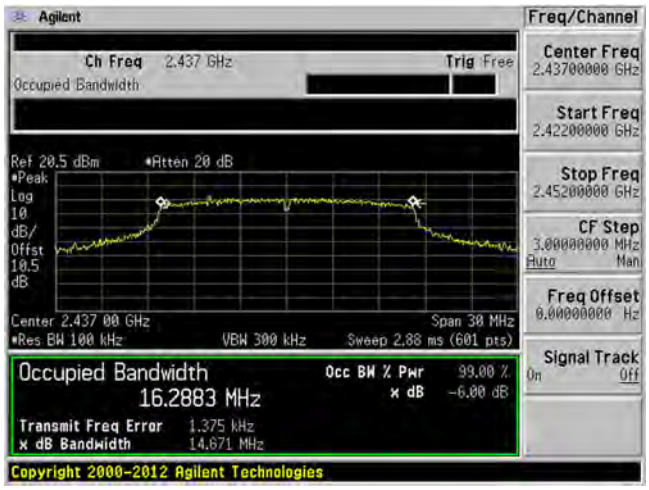


802.11g mode

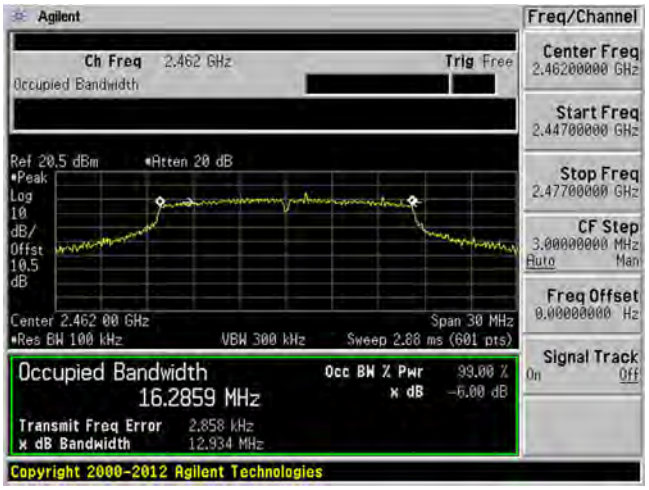
Low Channel 2412 MHz



Middle Channel 2437 MHz

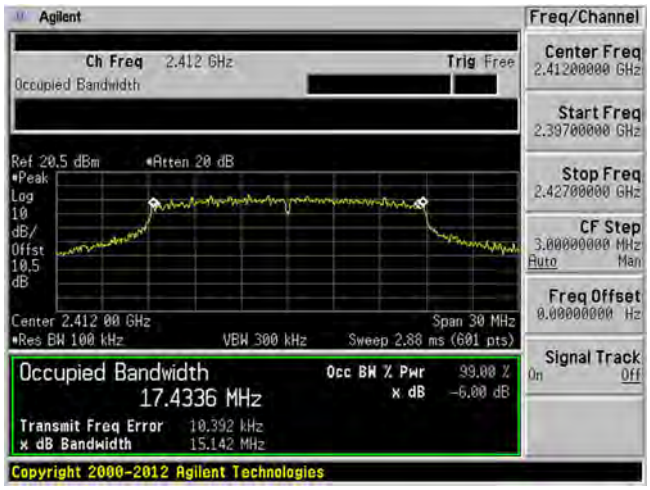


High Channel 2462 MHz

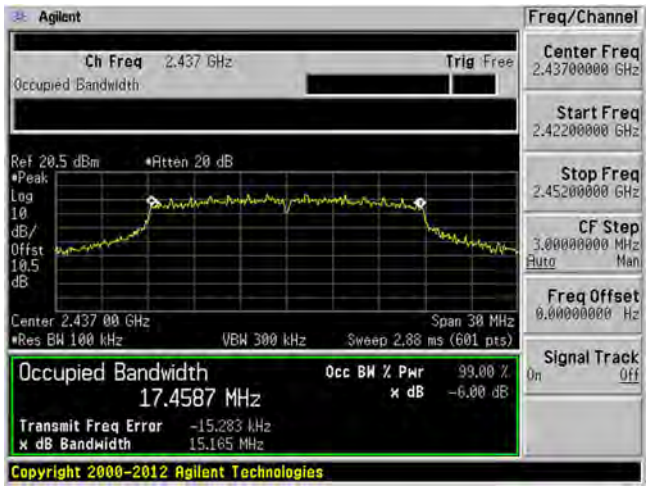


802.11n20 mode

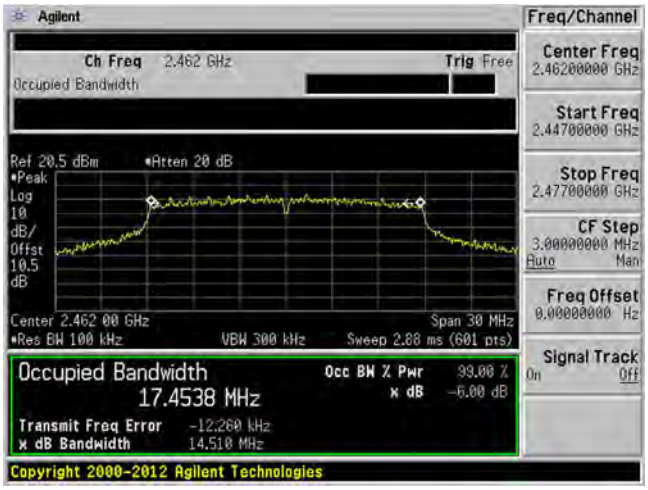
Low Channel 2412 MHz



Middle Channel 2437 MHz

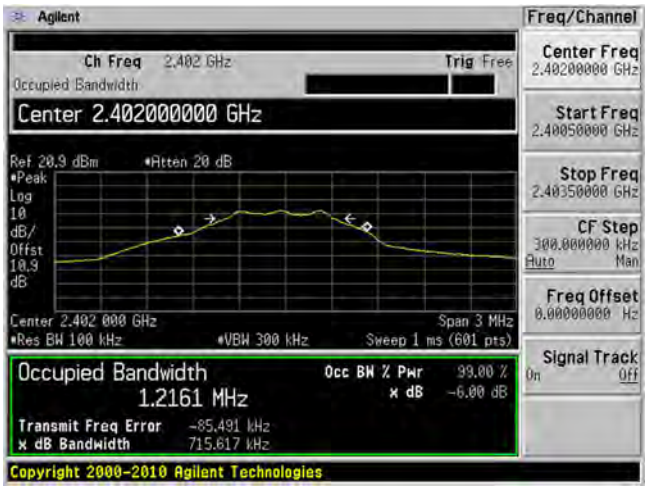


High Channel 2462 MHz

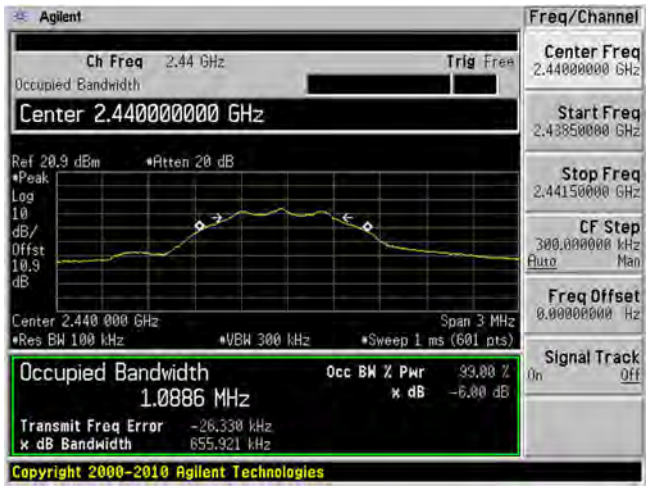


INNER-BLE

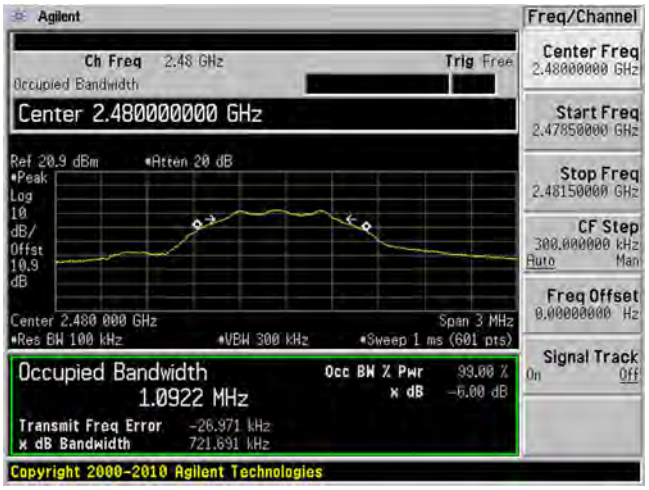
Low Channel 2402 MHz



Middle Channel 2440 MHz

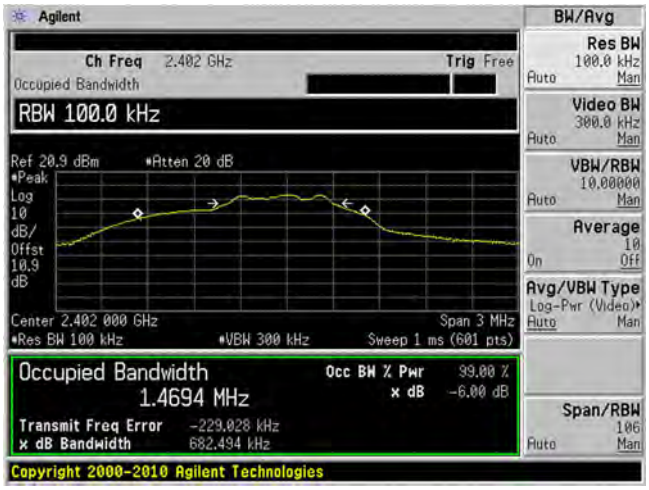


High Channel 2480 MHz

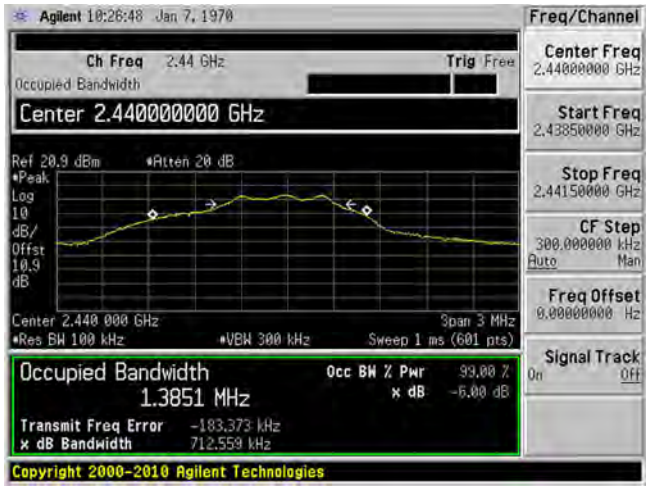


OUTER-BLE

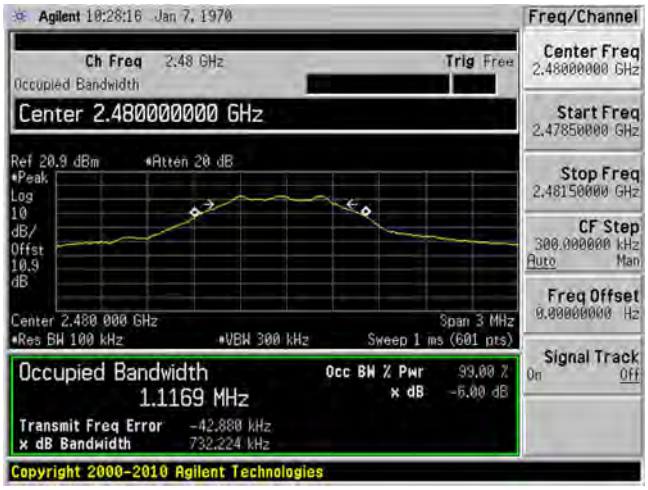
Low Channel 2402 MHz



Middle Channel 2440 MHz



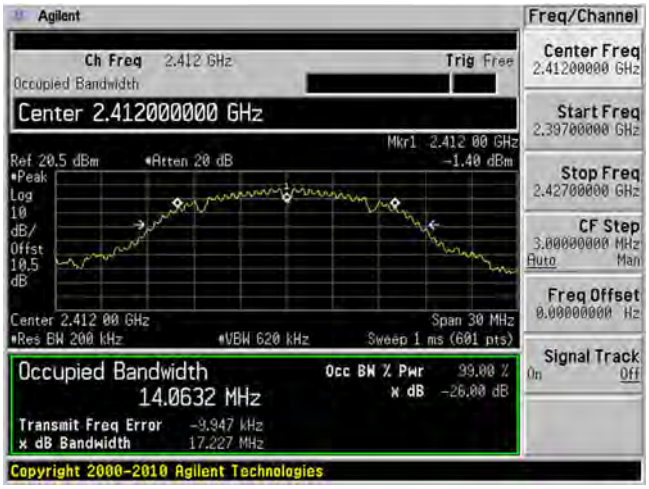
High Channel 2480 MHz



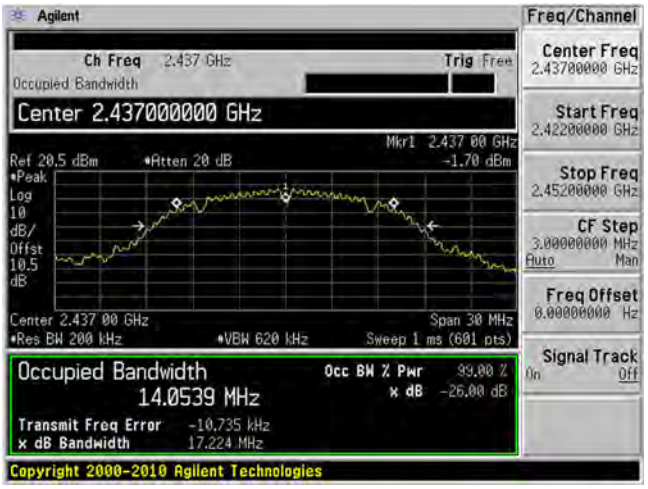
99% Occupied Bandwidth

802.11b mode

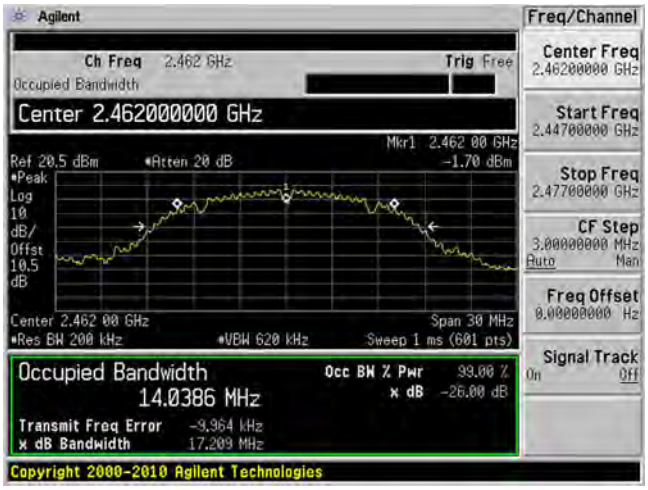
Low Channel 2412 MHz



Middle Channel 2437 MHz

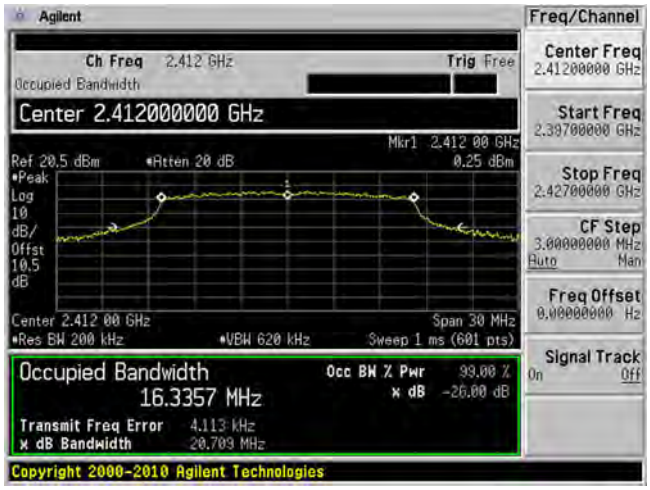


High Channel 2462 MHz

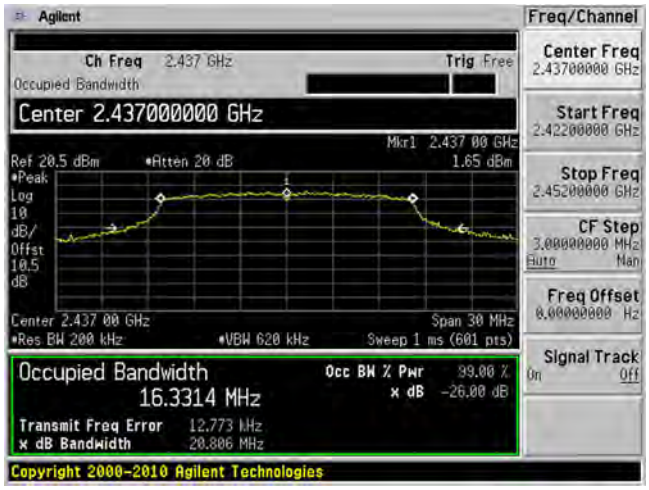


802.11g mode

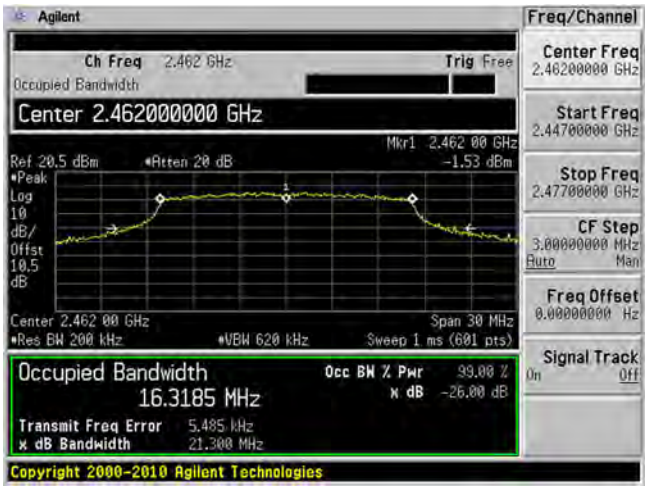
Low Channel 2412 MHz



Middle Channel 2437 MHz

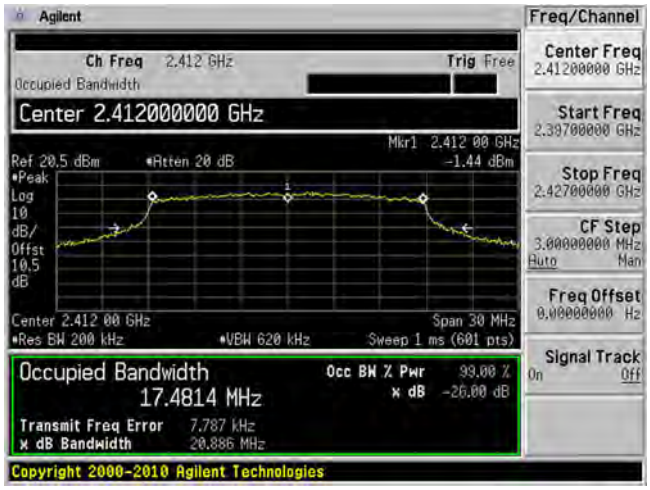


High Channel 2462 MHz

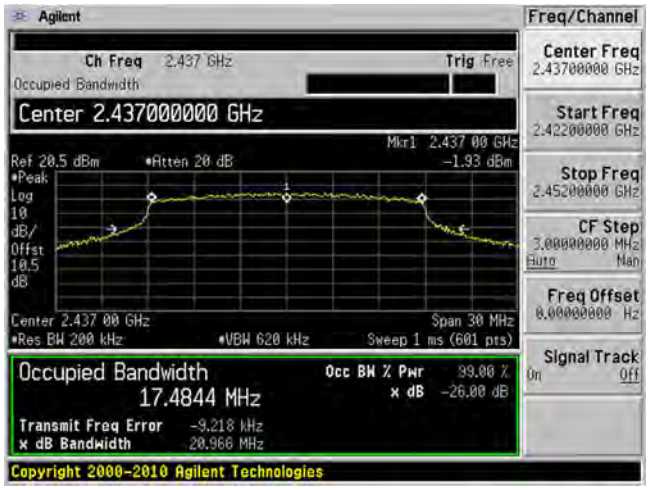


802.11n20 mode

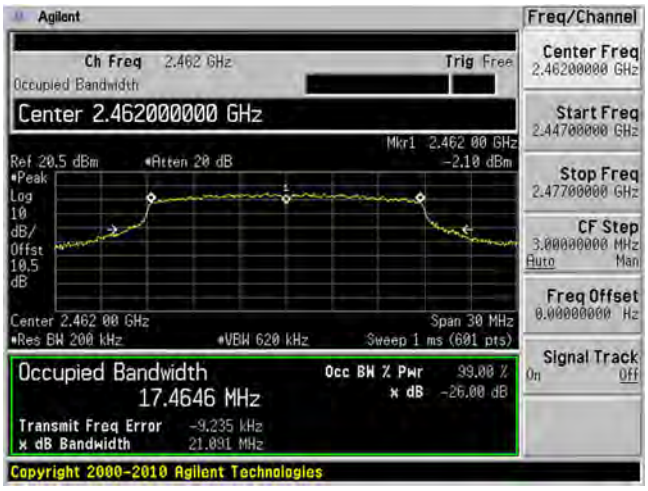
Low Channel 2412 MHz



Middle Channel 2437 MHz

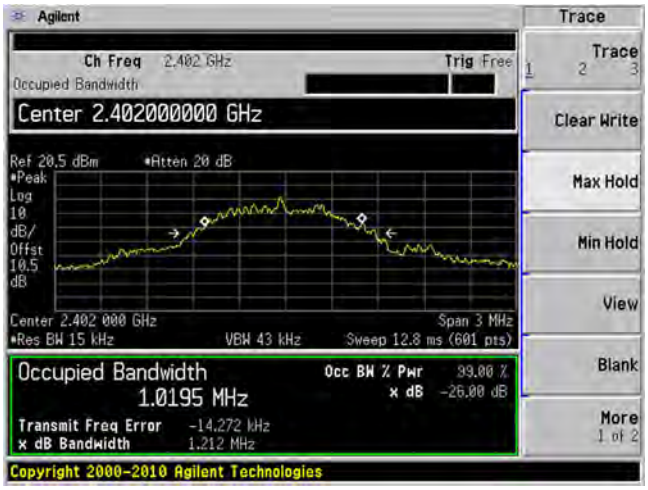


High Channel 2462 MHz

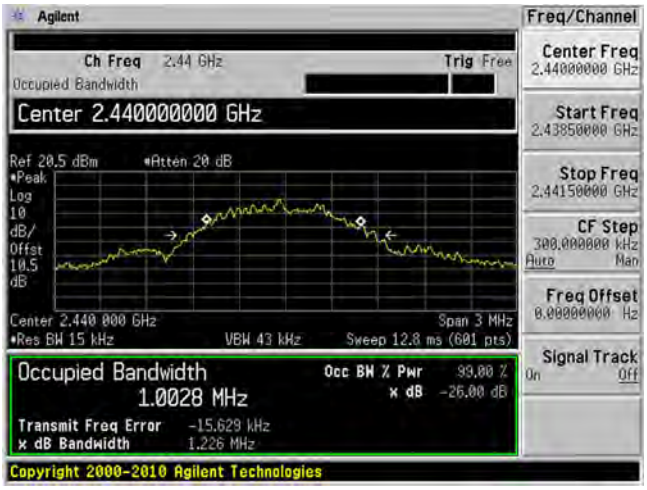


INNER-BLE

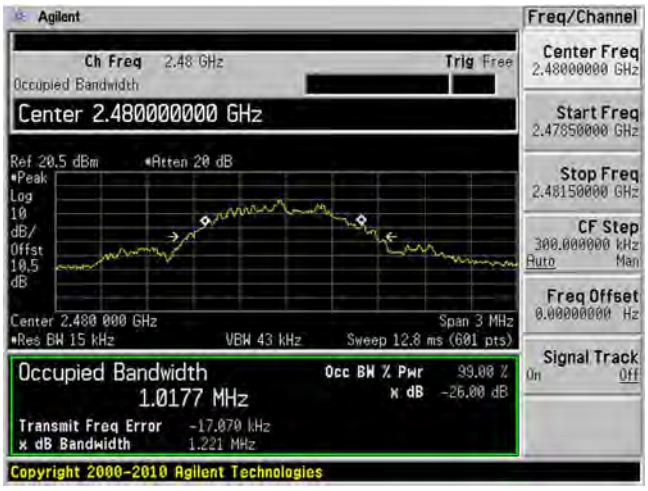
Low Channel 2402 MHz



Middle Channel 2440 MHz

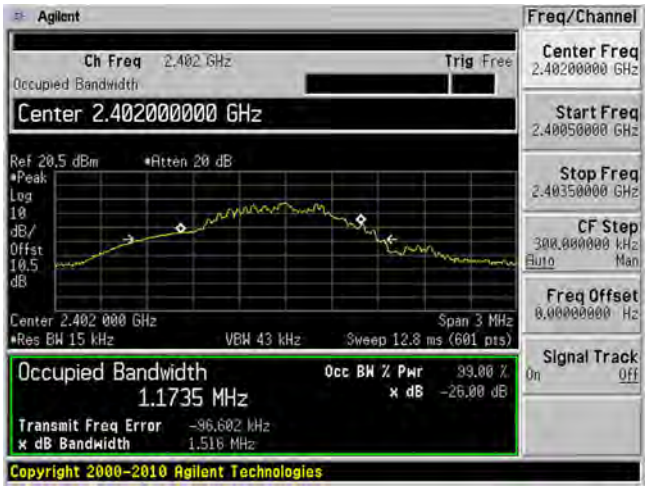


High Channel 2480 MHz

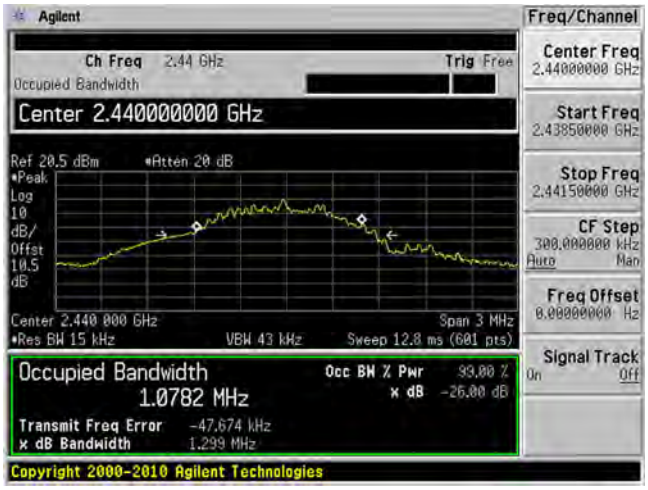


OUTER-BLE

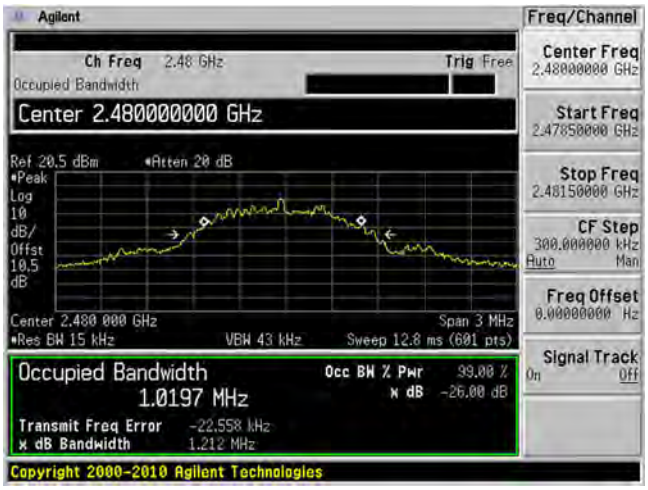
Low Channel 2402 MHz



Middle Channel 2440 MHz



High Channel 2480 MHz



9 FCC §15.247(b) (3) and ISEDC RSS-247 §5.4 (d), §6.2.4.1- Output Power Measurement

9.1 Applicable Standards

According to ECFR §15.247(b) (3) and ISEDC RSS-247 §5.4 (d) for systems using digital modulation in the 902~928 MHz, 2400~2483.5 MHz, and 5725~5850 MHz bands: 1 Watt.

As per ISEDC RSS-247 §6.2.4.1, the maximum conducted output power shall not exceed 1 W. The output power spectral density shall not exceed 30 dBm in any 500 kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the output power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

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
Agilent	Analyzer, Spectrum	E4446A	US44300386	2017-04-20	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

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 2017-06-29 to 2017-06-30 in RF site.

9.5 Test Results

Average Output Power

Channel	Frequency (MHz)	Ave Power (dBm)	Limit (dBm)
802.11b mode			
1	2412	14.89	30
6	2437	14.56	30
11	2462	14.45	30
802.11g mode			
1	2412	14.82	30
6	2437	14.63	30
11	2462	14.23	30
802.11n-HT20 mode			
1	2412	14.21	30
6	2437	14.18	30
11	2462	13.9	30

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

Peak Output Power

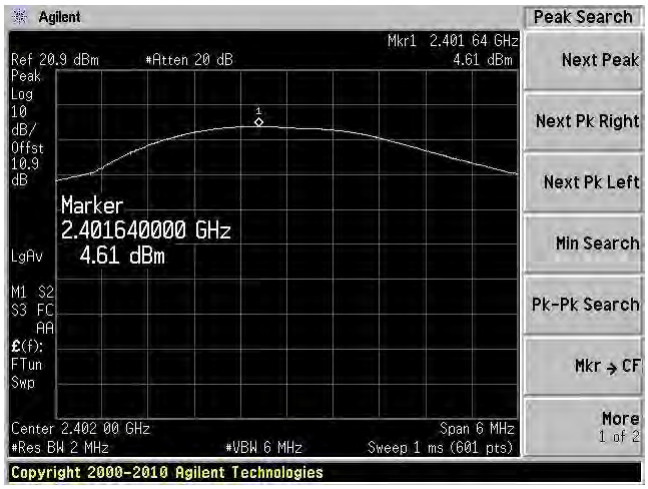
Channel	Frequency (MHz)	Peak Power (dBm)	Limit (dBm)
INNER-BLE			
Low	2402	4.61	30
Middle	2440	4.50	30
High	2480	4.35	30

Channel	Frequency (MHz)	Peak Power (dBm)	Limit (dBm)
OUTER-BLE			
Low	2402	4.52	30
Middle	2440	4.34	30
High	2480	4.08	30

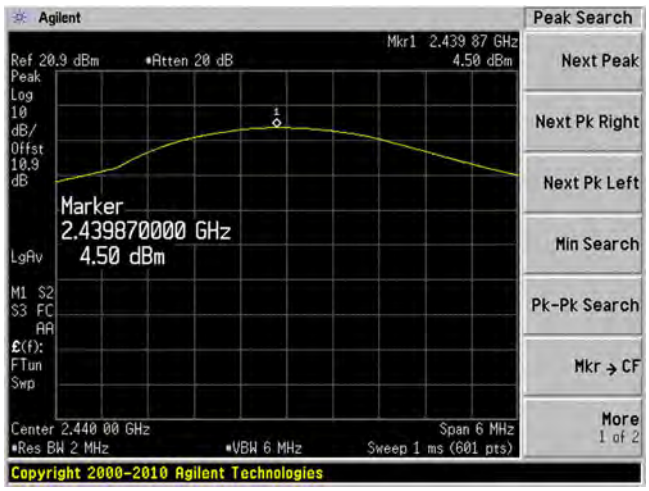
Please refer to the following plots for detailed test results.

INNER-BLE

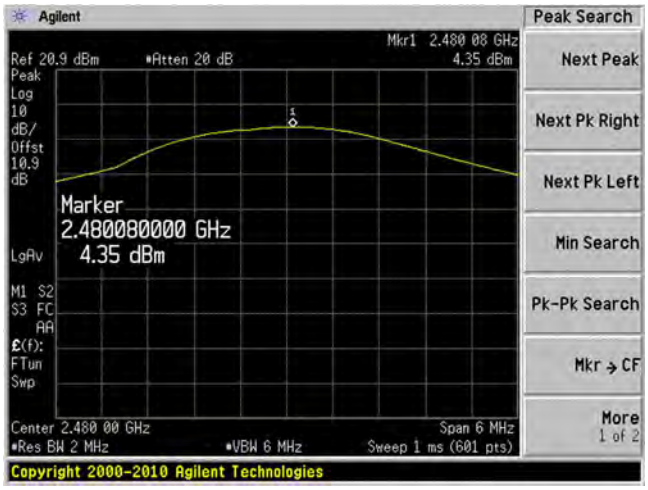
Low Channel 2402 MHz



Middle Channel 2440 MHz

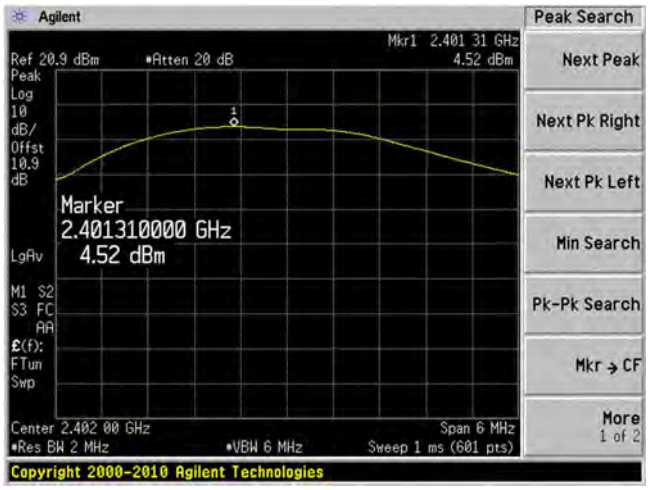


High Channel 2480 MHz

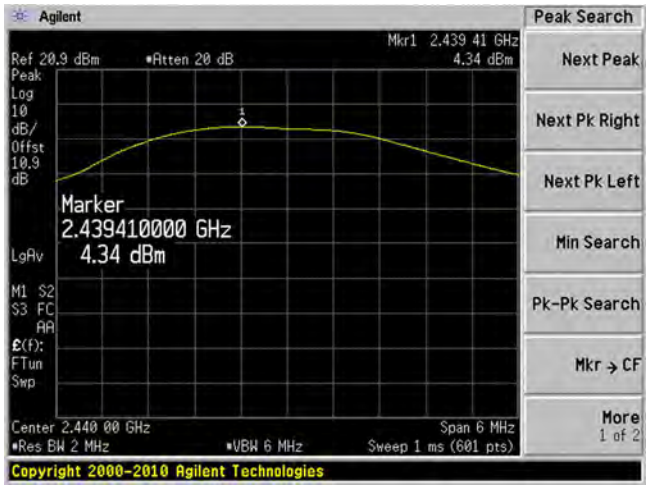


OUTER-BLE

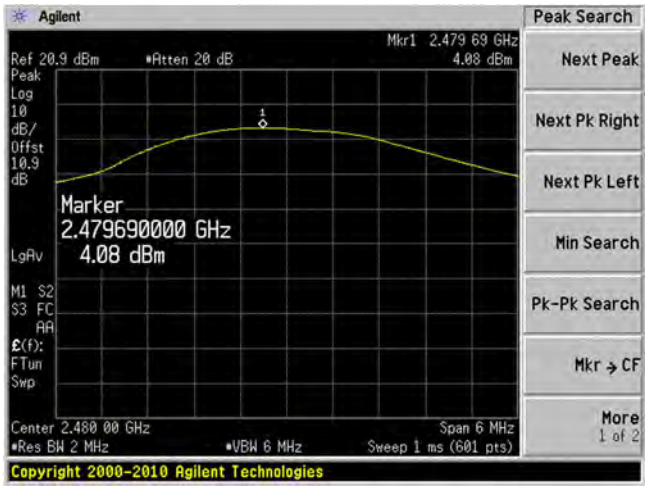
Low Channel 2402 MHz



Middle Channel 2440 MHz



High Channel 2480 MHz



10 FCC §15.247(d) and ISEDC RSS-247 §5.5, §6.2.4.2 –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(d), 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 & FCC KDB 789033 D02 General U-NII Test Procedure.

10.3 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.*

10.4 Test Environmental Conditions

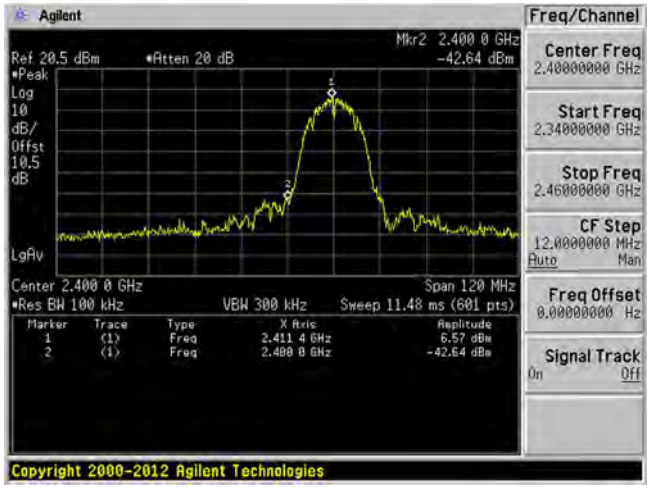
Temperature:	23° C
Relative Humidity:	42 %
ATM Pressure:	102.7 KPa

The testing was performed by Troy Pandhumsoporn on 2017-06-29 and 2017-06-30 in RF site.

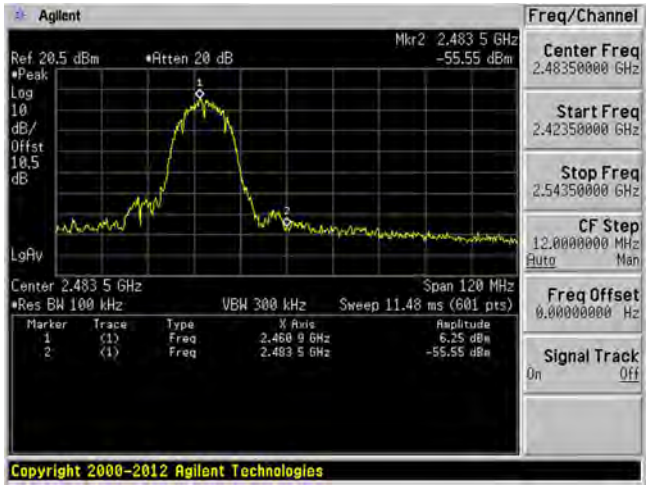
10.5 Test Results

802.11b mode

Low Channel 2412 MHz

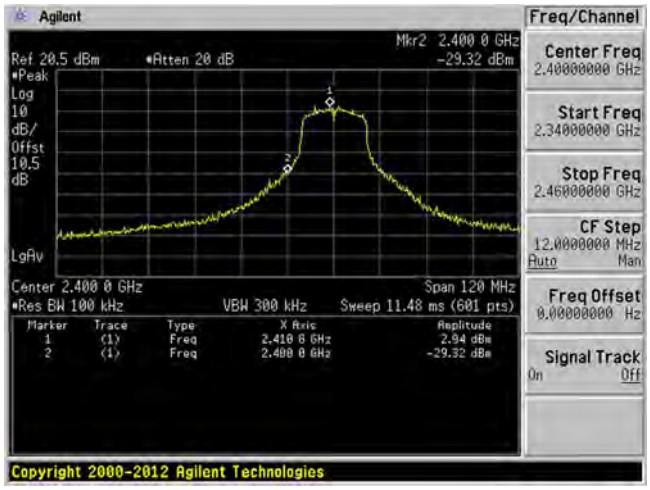


High Channel 2462 MHz

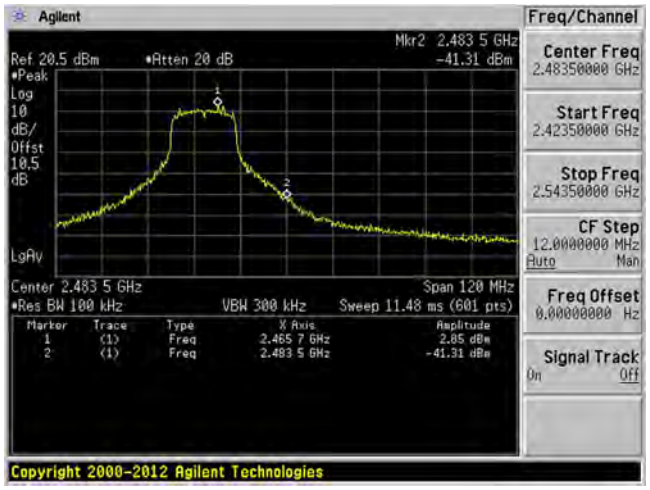


802.11g mode

Low Channel 2412 MHz

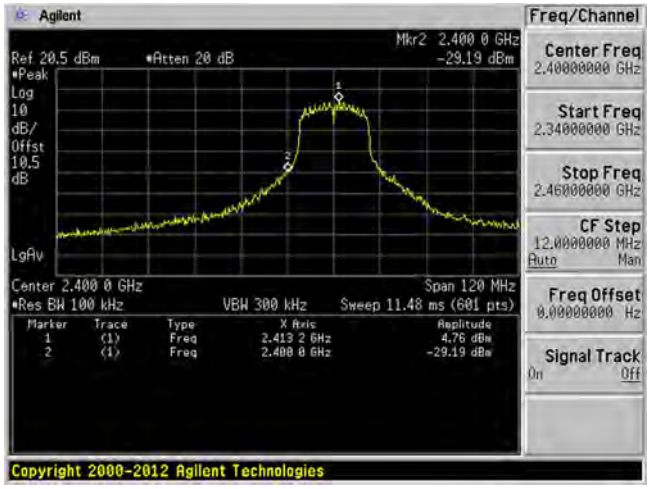


High Channel 2462 MHz

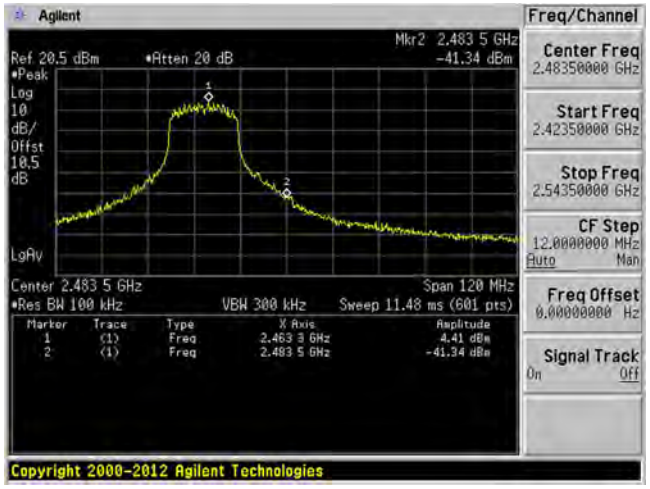


802.11n20 mode

Low Channel 2412 MHz

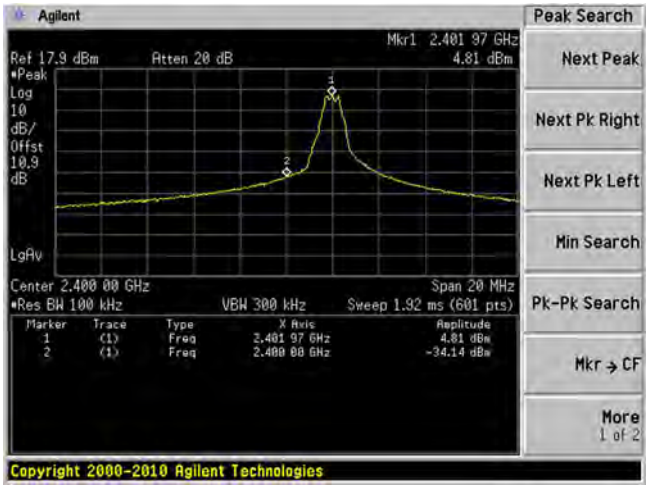


High Channel 2462 MHz

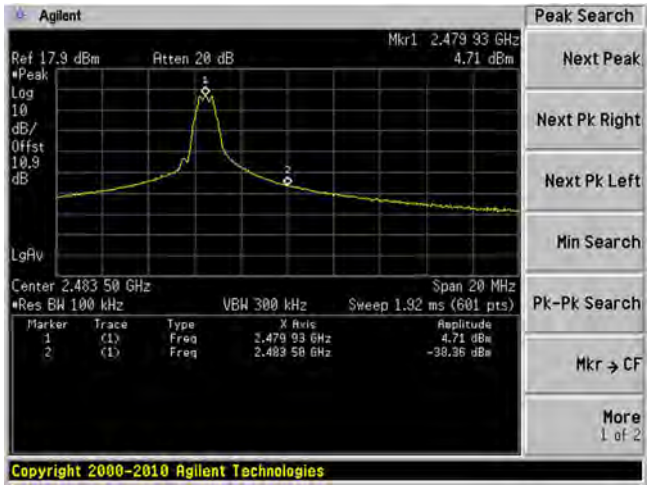


INNER-BLE

Low Channel 2402 MHz

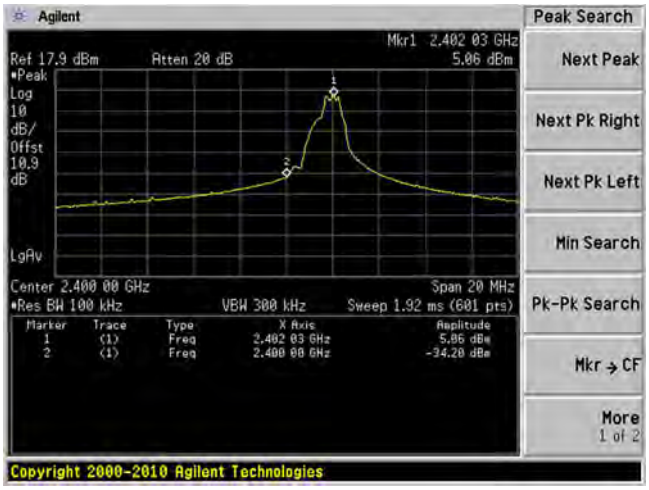


High Channel 2480 MHz

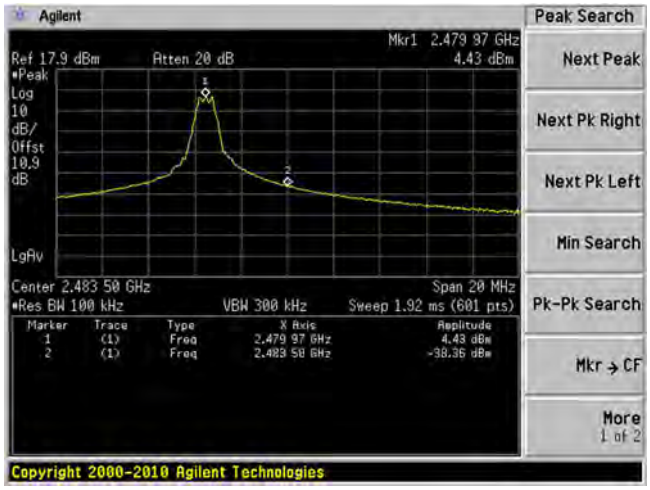


OUTER-BLE

Low Channel 2402 MHz



High Channel 2480 MHz



11 FCC §15.247(e) and ISEDC RSS-247 §5.2(b), §6.2.4.1 – Power Spectral Density

11.1 Applicable Standards

According to ECFR §15.247(e) and RSS-247 §5.2 (b) , for digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

According to RSS-247 §6.2.4.1, The maximum conducted output power shall not exceed 1 W. The output power spectral density shall not exceed 30 dBm in any 500 kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the output power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

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 Troy Pandhumsoporn on 2017-06-30 in RF site.

11.5 Test Results

Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)
802.11b mode			
Low	2412	-7.88	8
Middle	2437	-7.8	8
High	2462	-7.58	8
802.11g mode			
Low	2412	-10.04	8
Middle	2437	-9.21	8
High	2462	-10.54	8
802.11n-HT20 mode			
Low	2412	-10.92	8
Middle	2437	-9.47	8
High	2462	-11.98	8

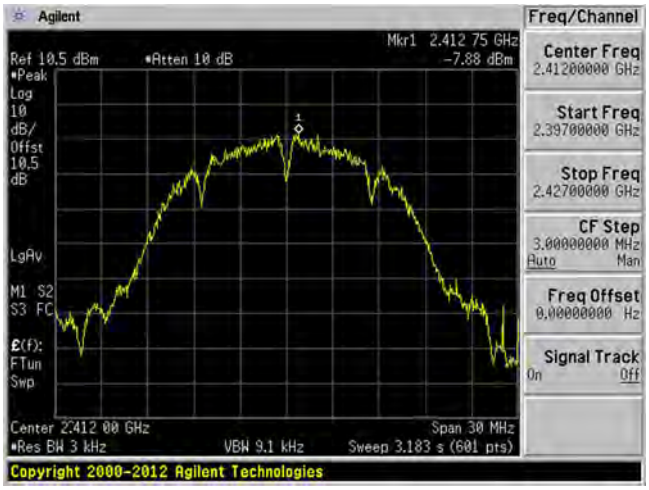
Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)
INNER-BLE			
Low	2402	-9.06	8
Middle	2440	-10.9	8
High	2480	-10.84	8

Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)
OUTER-BLE			
Low	2402	-11.65	8
Middle	2440	-12.31	8
High	2480	-10.4	8

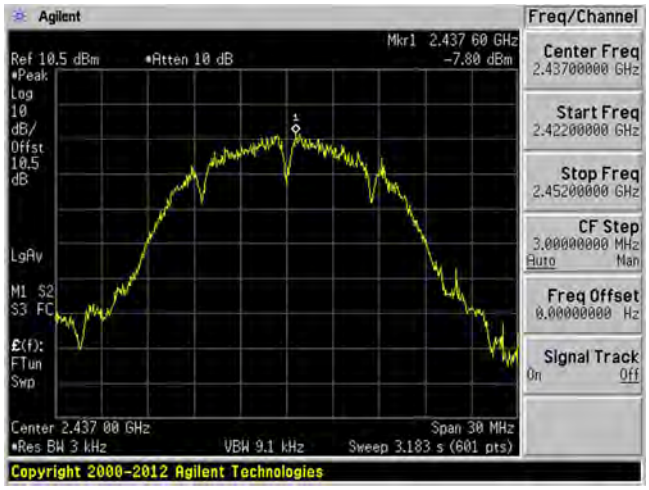
Please refer to the following plots for detailed test results

802.11b mode

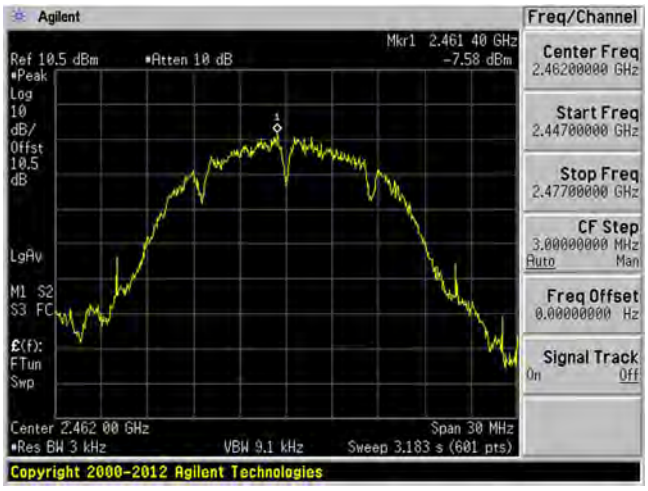
Low Channel 2412 MHz



Middle Channel 2437 MHz

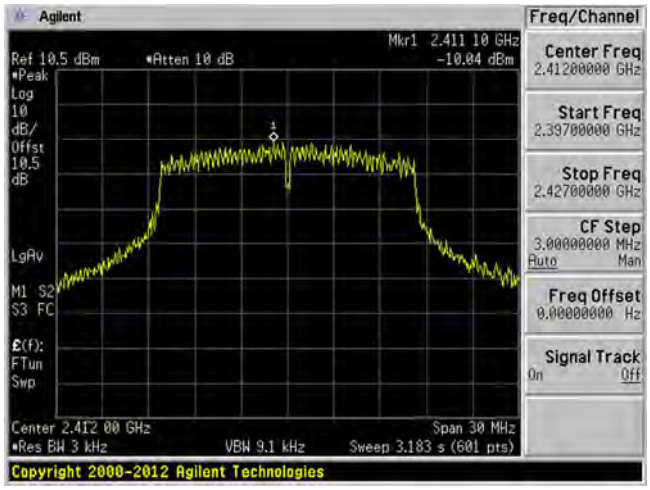


High Channel 2462 MHz

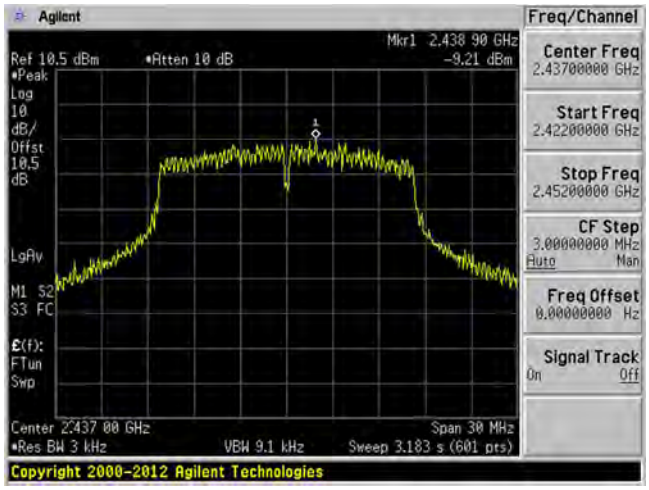


802.11g mode

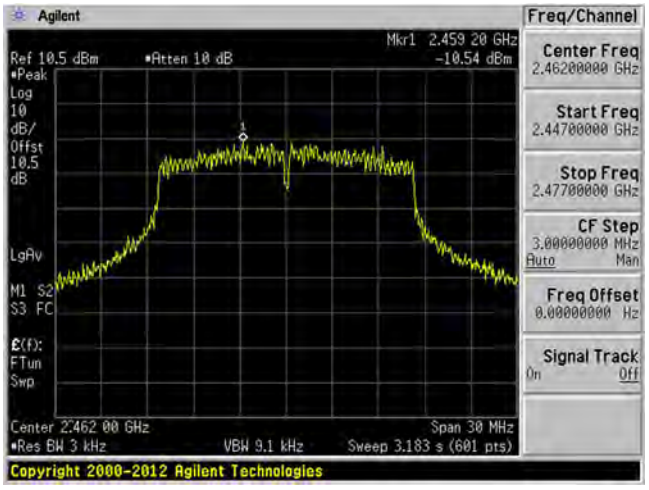
Low Channel 2412 MHz



Middle Channel 2437 MHz

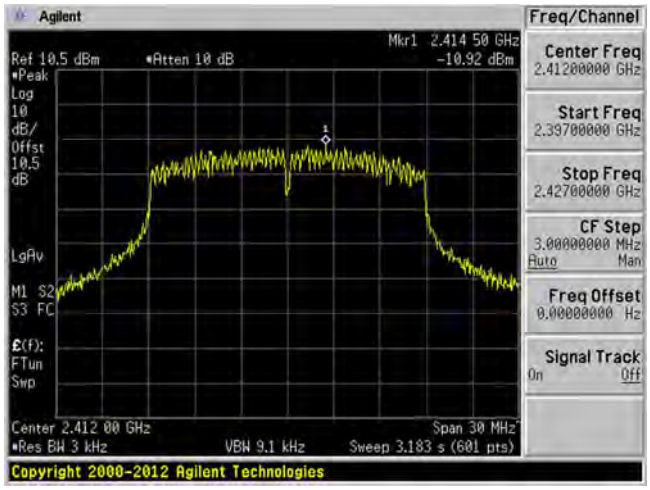


High Channel 2462 MHz

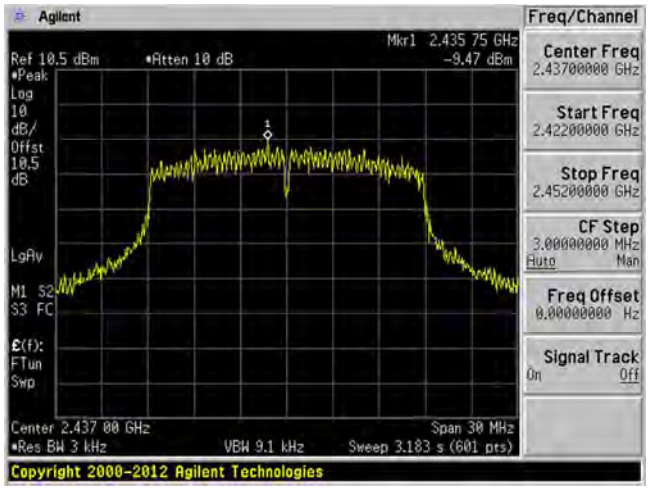


802.11n20 mode

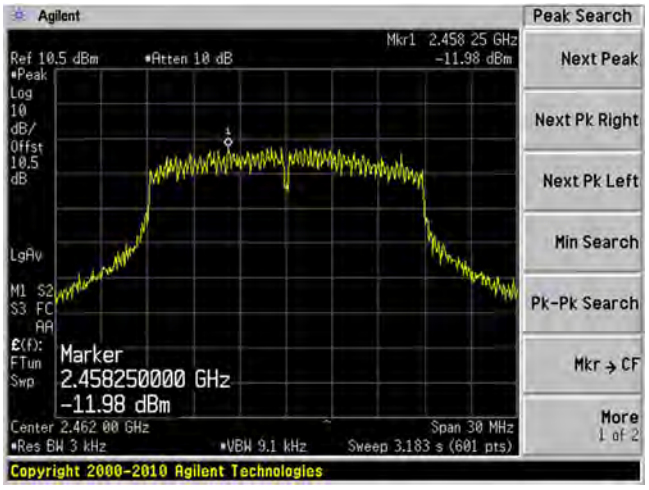
Low Channel 2412 MHz



Middle Channel 2437 MHz

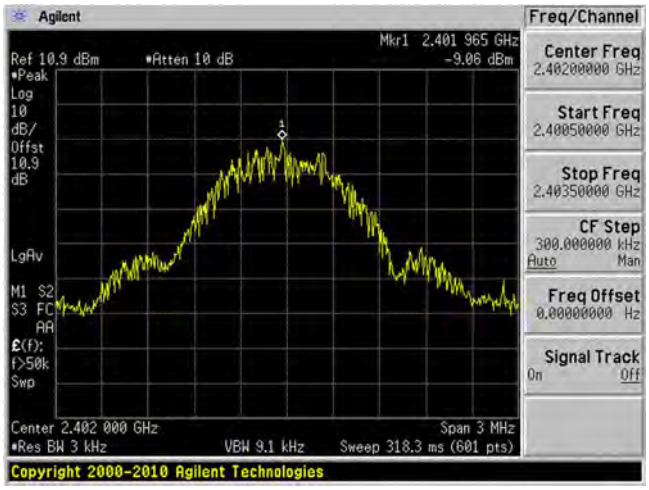


High Channel 2462 MHz

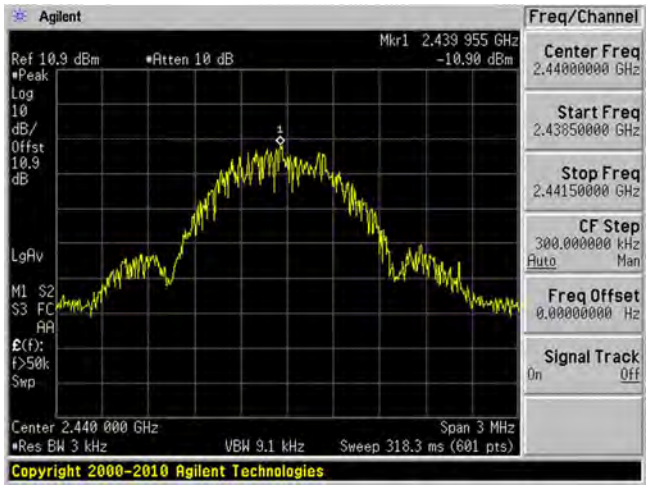


INNER-BLE

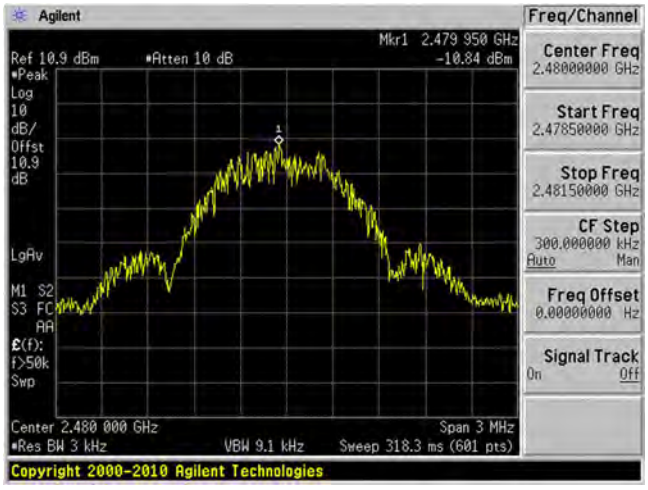
Low Channel 2402 MHz



Middle Channel 2440 MHz

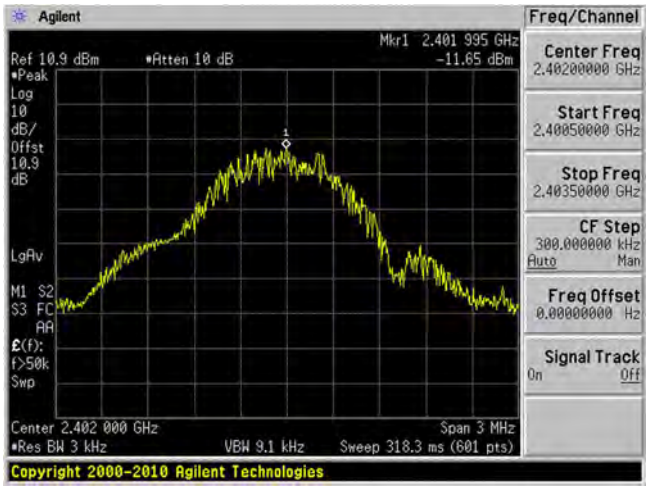


High Channel 2480 MHz

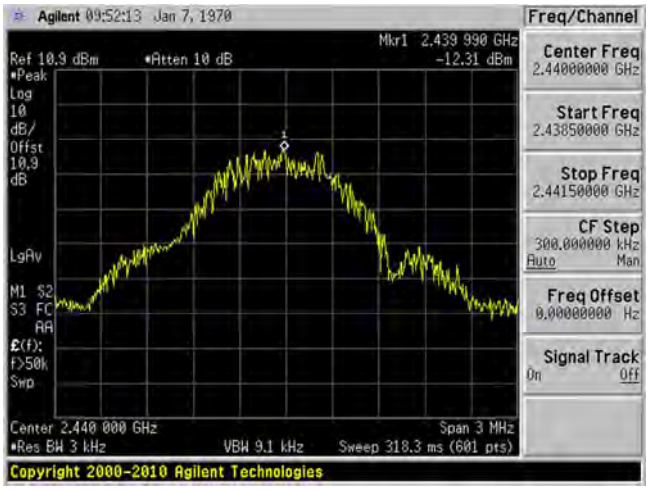


OUTER-BLE

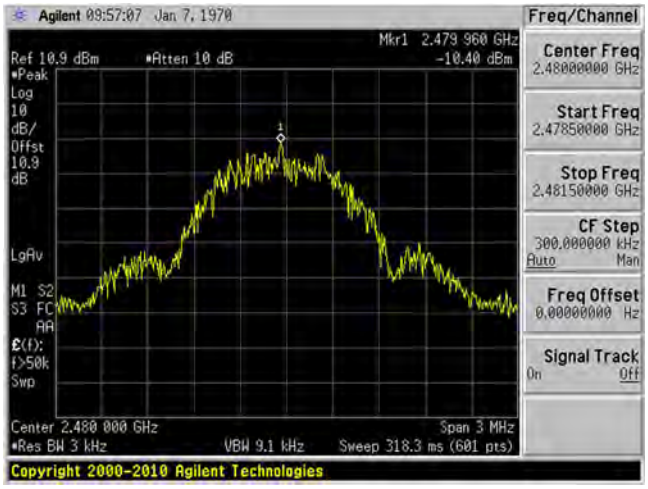
Low Channel 2402 MHz



Middle Channel 2440 MHz



High Channel 2480 MHz



12 FCC §15.247(d) and ISEDC RSS-247 §5.5, §6.2.4.2 and ISEDC 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.

As per ISEDC RSS-247 § 6.2.4.2, Devices operating in the band 5725-5850 MHz with antenna gain greater than 10 dBi can have unwanted emissions that comply with either the limits in this section or in section 5.5 until six (6) months after the publication date of this standard for certification. Certified devices that do not comply with emission limits in this section shall not be manufactured, imported, distributed, leased, offered for sale or sold after April 1, 2018.

Devices operating in the band 5725-5850 MHz with antenna gain of 10 dBi or less can have unwanted emissions that comply with either the limits in this section or in section 5.5 until April 1, 2018 for certification. Certified devices that do not comply with emission limits in this section shall not be manufactured, imported, distributed, leased, offered for sale or sold after April 1, 2020.

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	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.*

12.4 Test Environmental Conditions

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

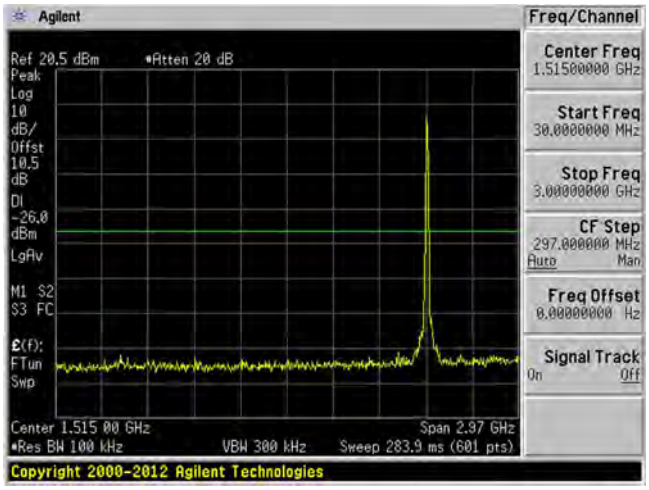
The testing was performed by Troy Pandhumsoporn on 2017-06-29 to 2017-06-30 in RF site.

12.5 Test Results

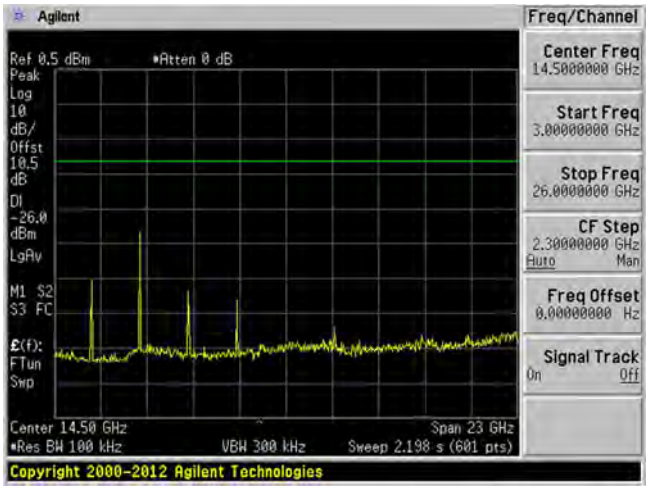
Please refer to following plots.

802.11b mode

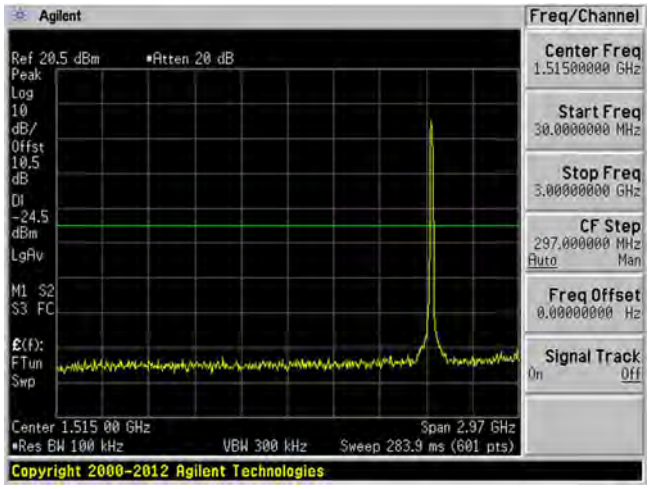
Low Channel 30MHz – 3 GHz



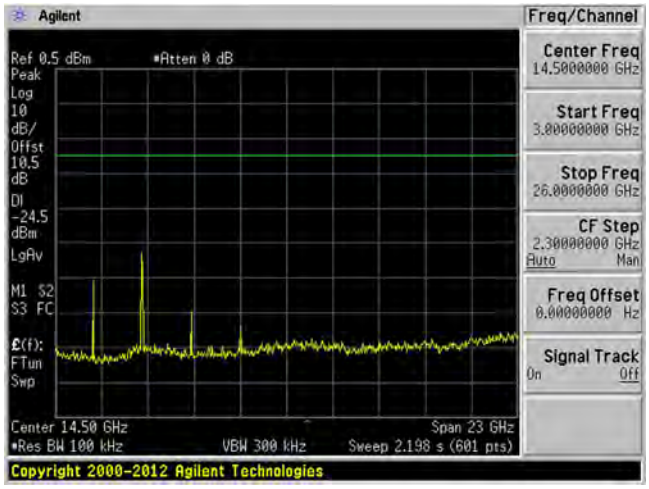
Low Channel 3 GHz – 26 GHz



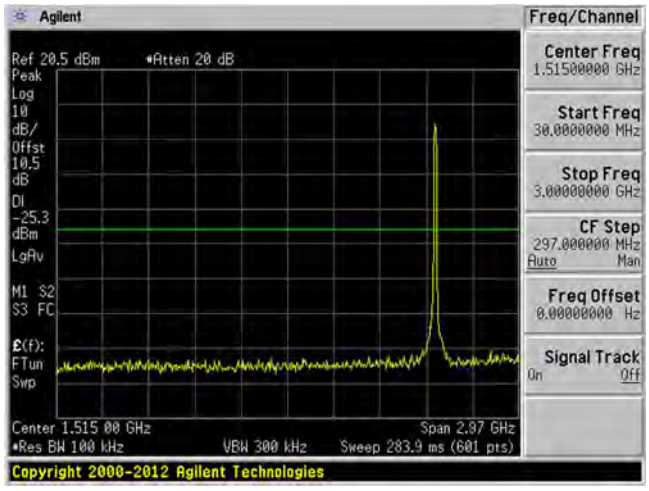
Middle Channel 30 MHz – 3 GHz



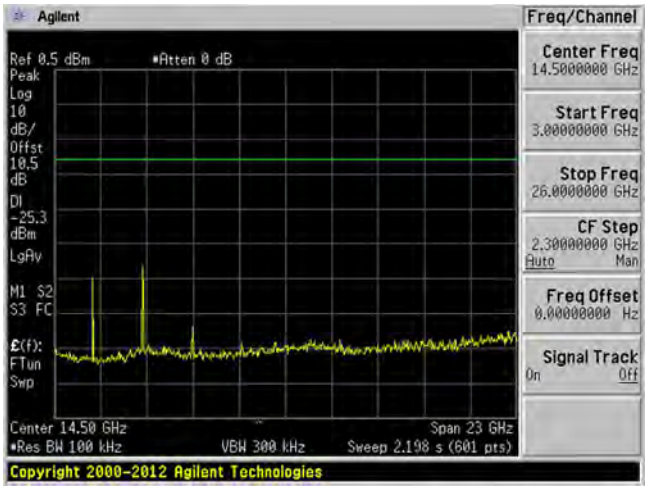
Middle Channel 3 GHz – 26 GHz



High Channel 30 MHz – 3 GHz

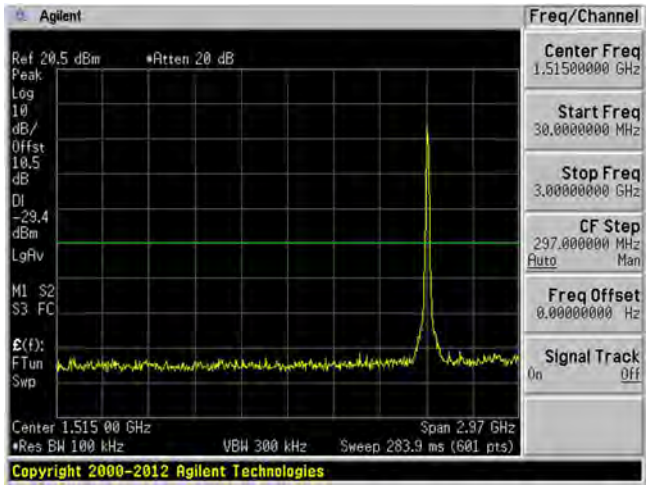


High Channel 3 GHz – 26 GHz

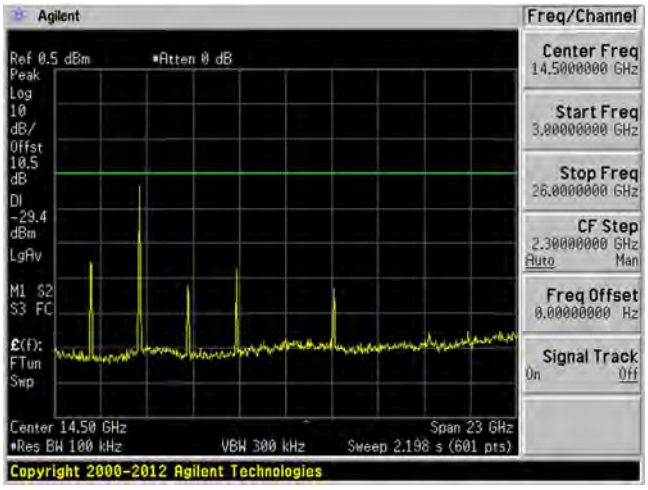


802.11g mode

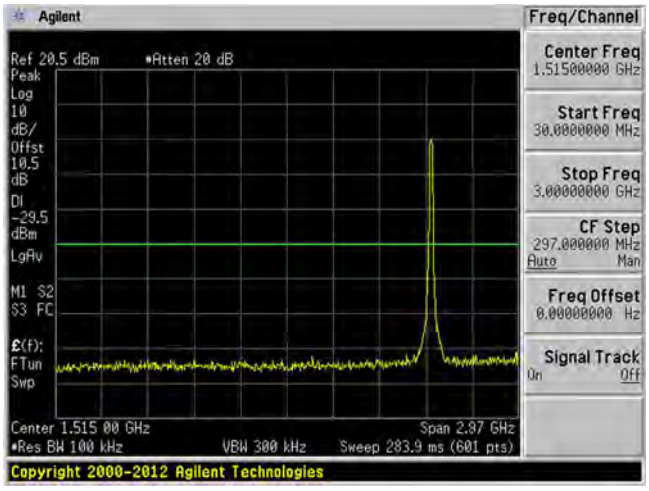
Low Channel 30 MHz – 3 GHz



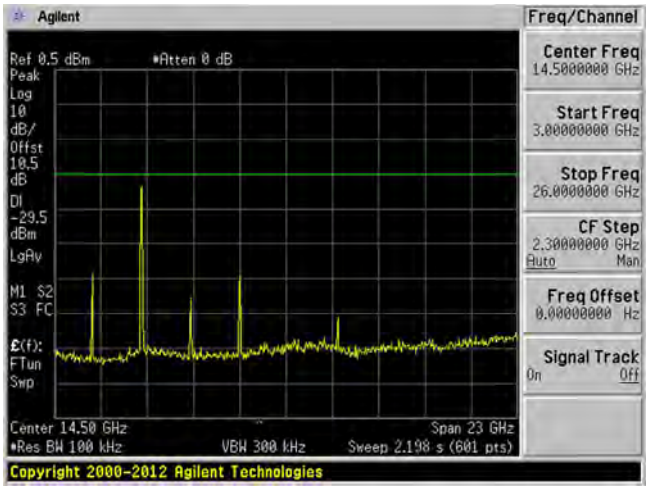
Low Channel 3 GHz – 26 GHz



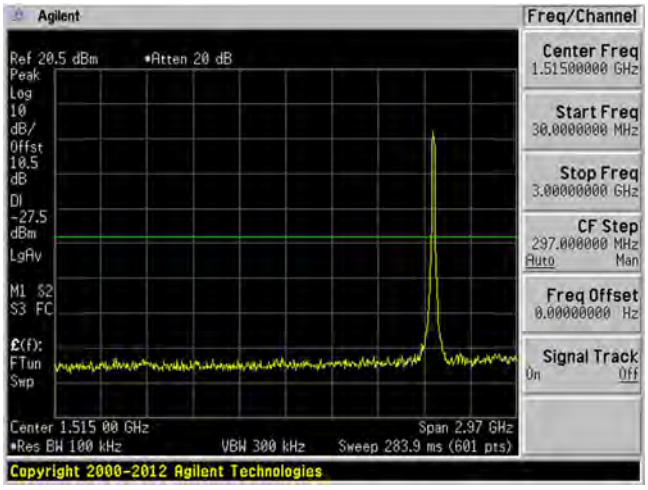
Middle Channel 30 MHz – 3 GHz



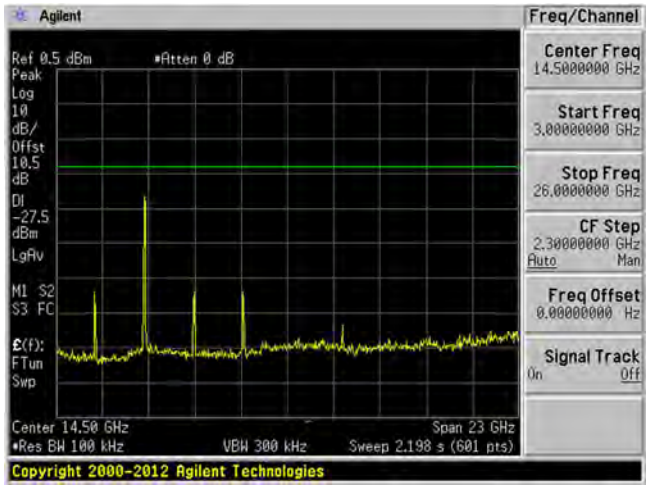
Middle Channel 3 GHz – 26 GHz



High Channel 30 MHz – 3 GHz

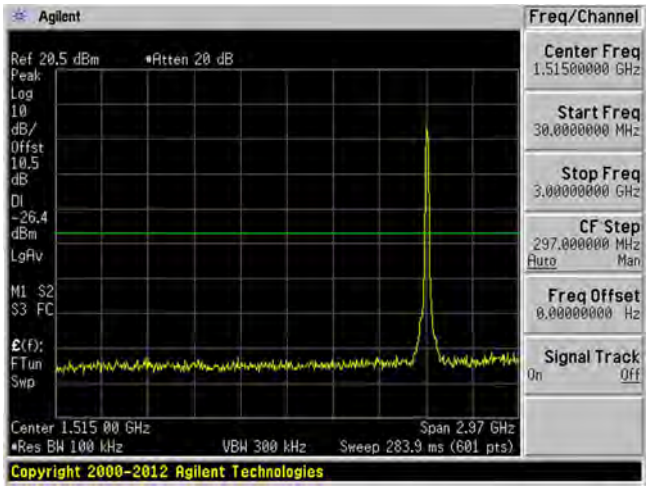


High Channel 3 GHz – 26 GHz

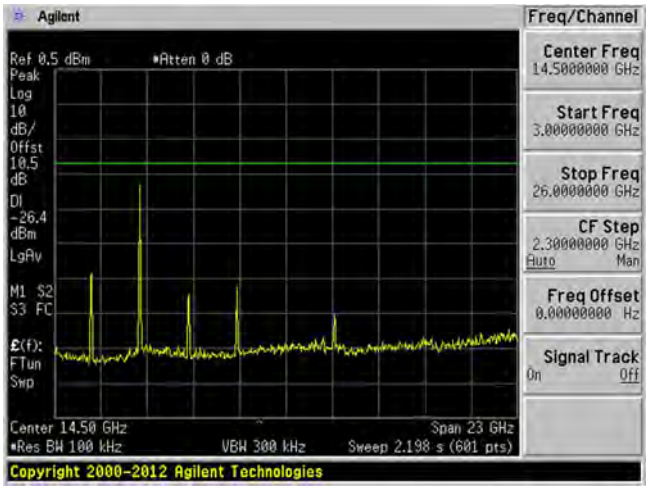


802.11n20 mode

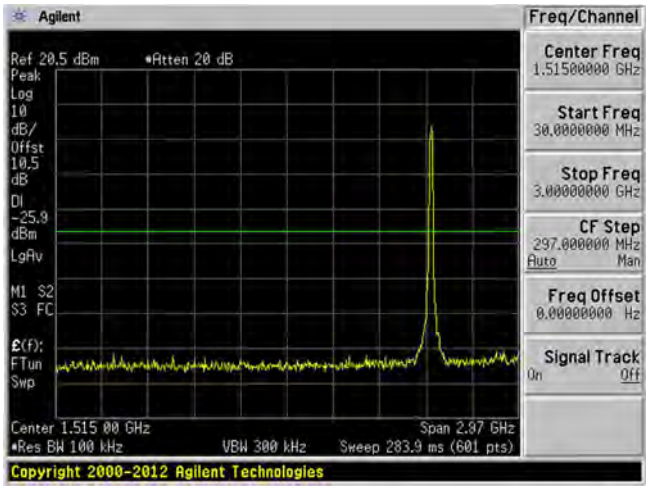
Low Channel 30 MHz – 3 GHz



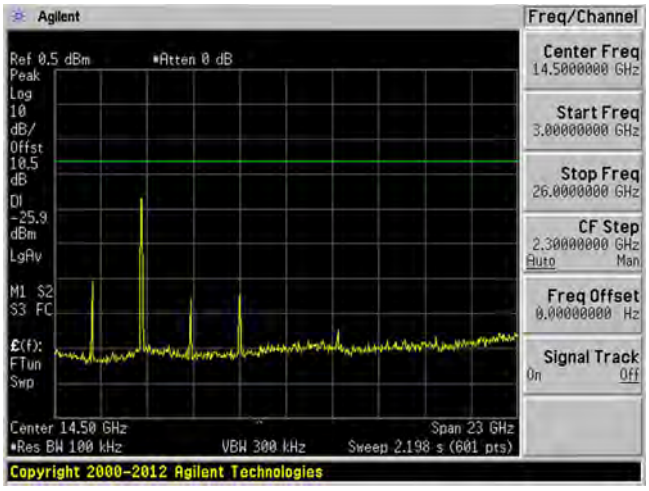
Low Channel 3 GHz – 26 GHz



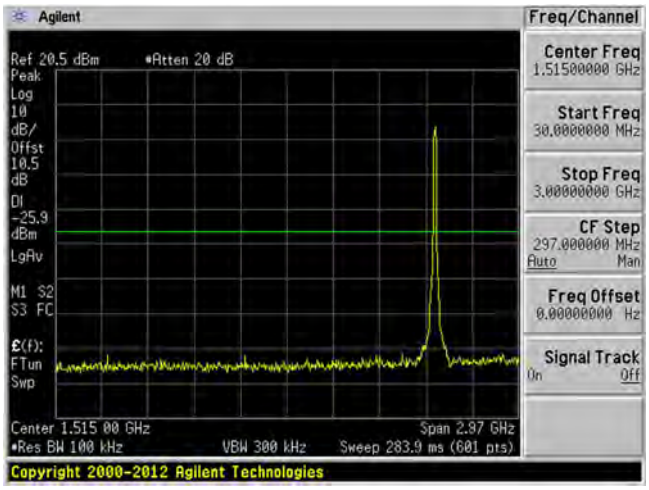
Middle Channel 30 MHz – 3 GHz



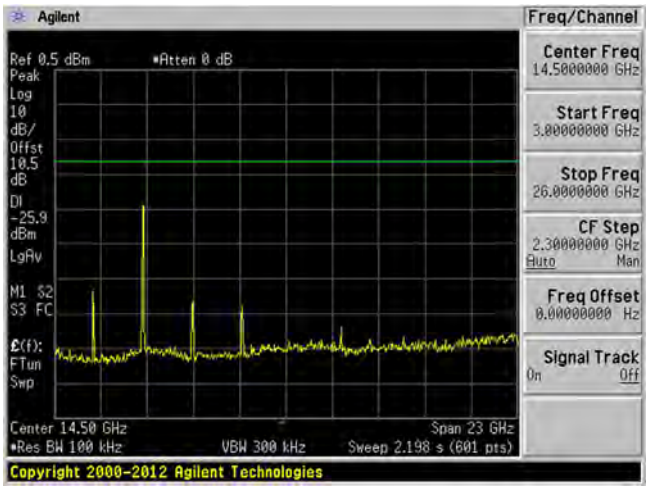
Middle Channel 3 GHz – 26 GHz



High Channel 30 MHz – 3 GHz

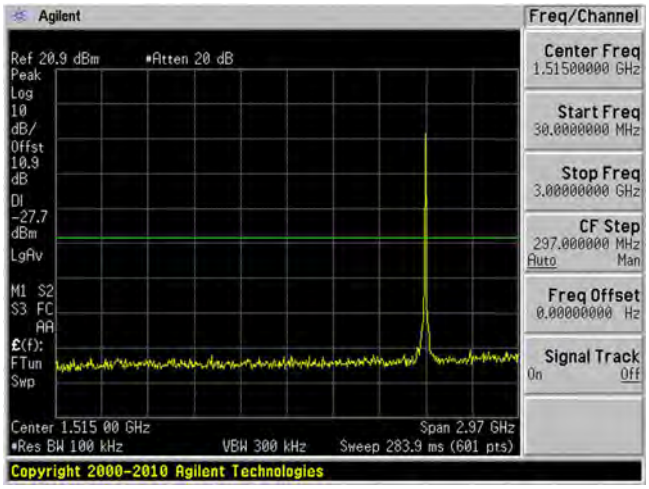


High Channel 3 GHz – 26 GHz

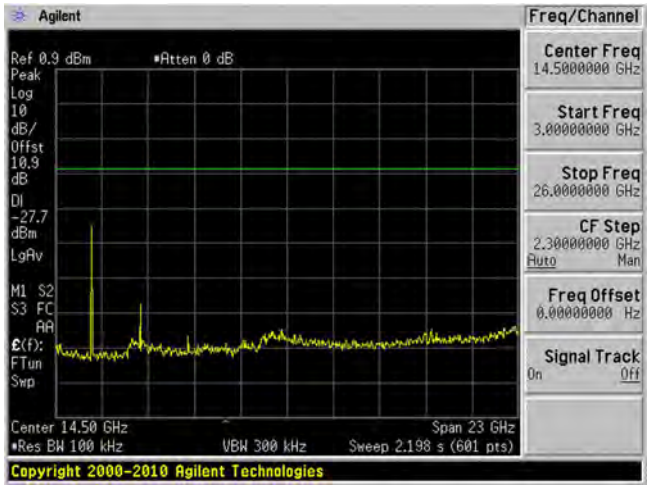


INNER-BLE

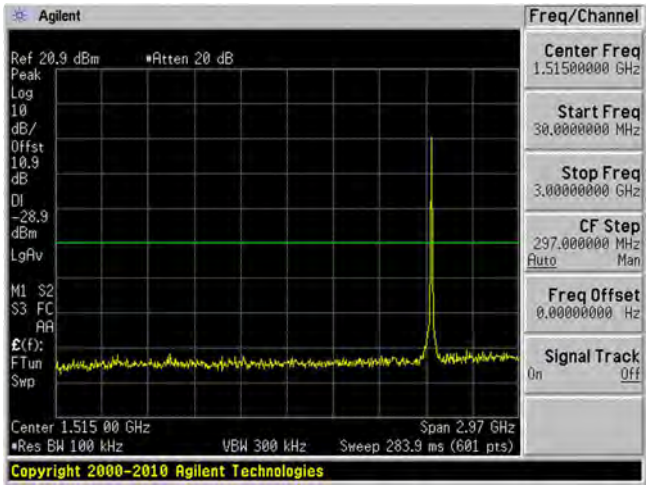
Low Channel 30 MHz – 3 GHz



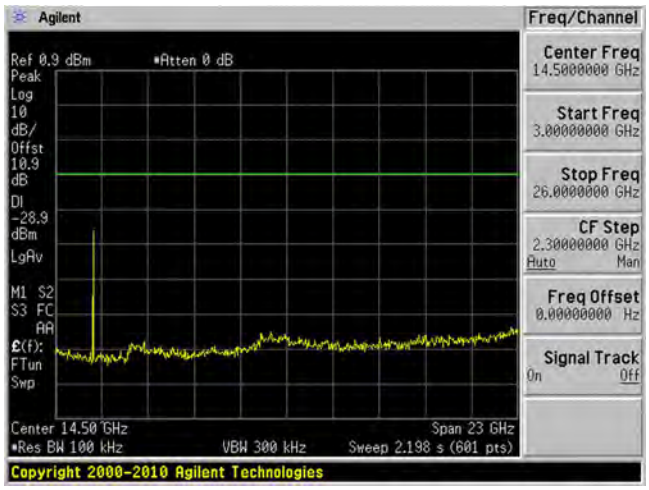
Low Channel 3 GHz – 26 GHz



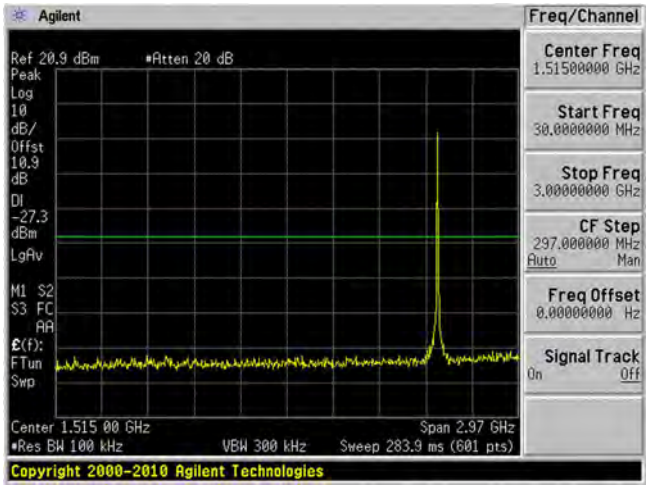
Middle Channel 30 MHz – 3 GHz



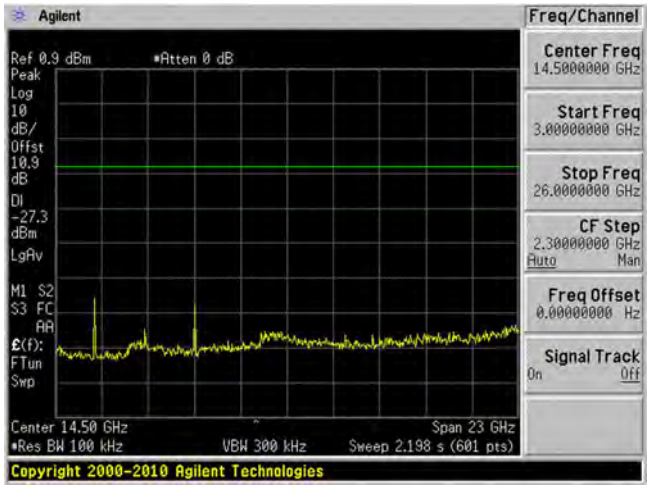
Middle Channel 3 GHz – 26 GHz



High Channel 30 MHz – 3 GHz

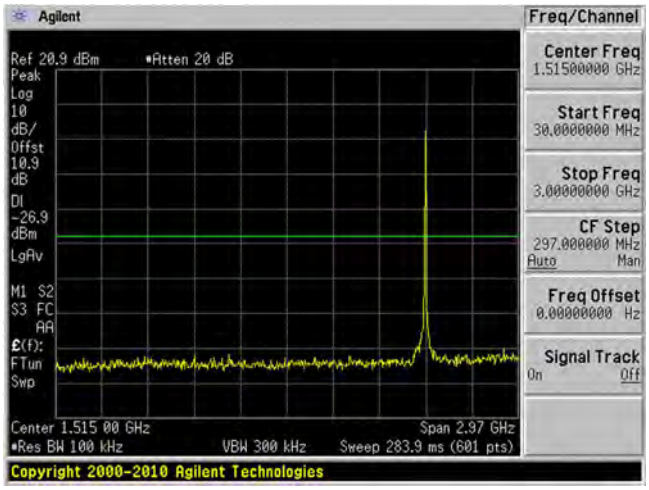


High Channel 3 GHz – 26 GHz

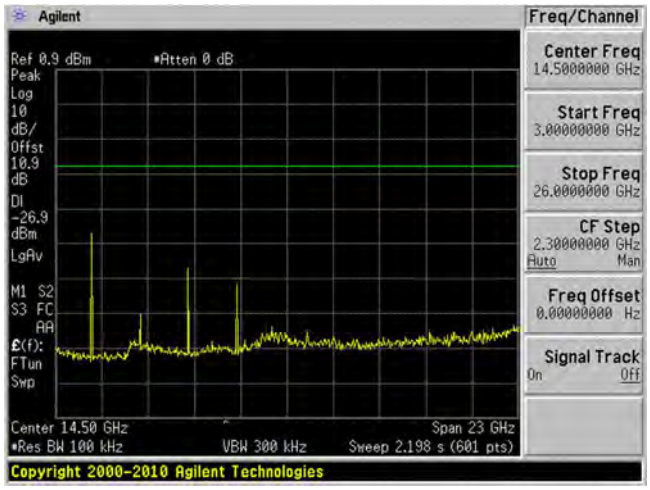


OUTER-BLE

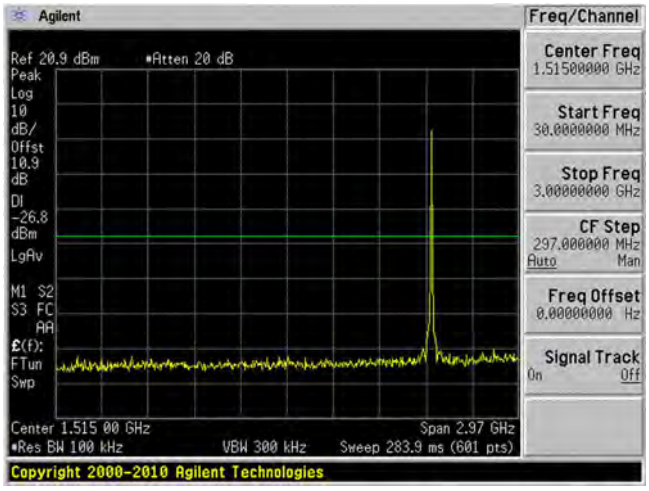
Low Channel 30 MHz – 3 GHz



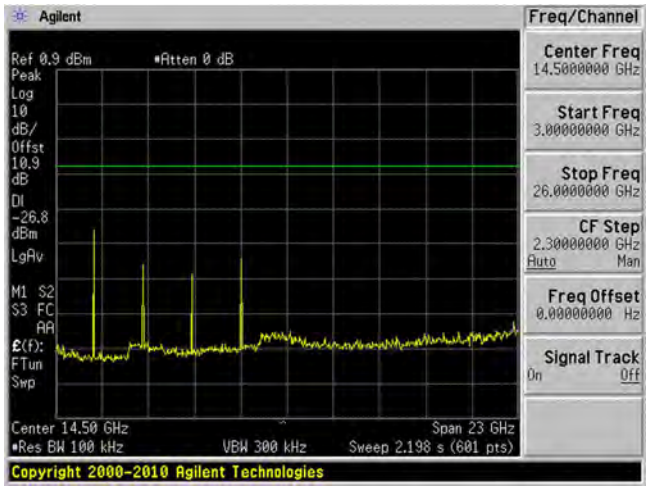
Low Channel 3 GHz – 26 GHz



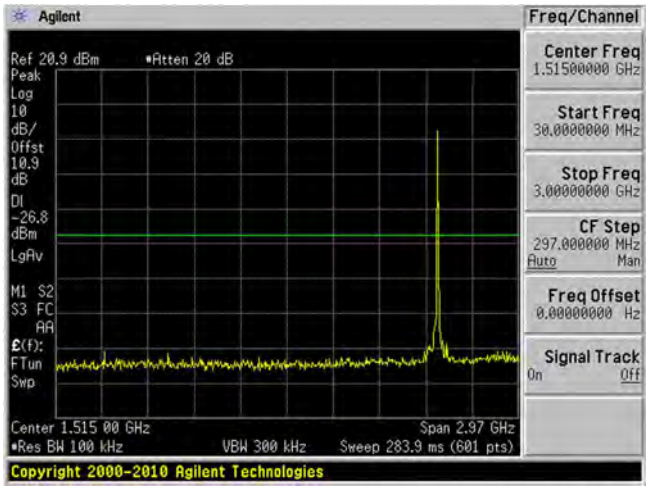
Middle Channel 30 MHz – 3 GHz



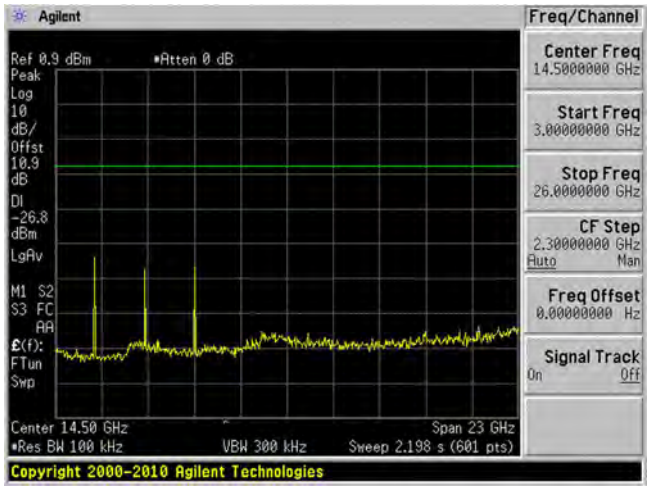
Middle Channel 3 GHz – 26 GHz



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 A2LA *R222 - Specific Requirements - EPA ENERGY STAR Accreditation Program*. 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.

Senior Director of Quality & Communications
For the Accreditation Council
Certificate Number 3297.02
Valid to September 30, 2018

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