FCC PART 15, SUBPART C

TEST REPORT

For

ClearCaptions, LLC

3001 Lava Ridge Ct #100,

Roseville, CA 95661, USA

FCC ID: 2ARIOCC0031

Report Type:	Product Type:
Original Report	Captioning Telephone

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Report Number:	R1809245-247 DTS
Report Date:	2018-12-13
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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1809245-247 DTS	Original Report	2018-12-13

1 General Description

1.1 Product Description for Equipment Under Test (EUT)

This test and measurement report was prepared on behalf of *ClearCaptions, LLC,* and their product models: *BLUE,* FCC ID: 2ARIOCC0031 or the "EUT" as referred to in this report. The EUT is a Captioning Telephone.

1.2 Objective

This report is prepared on behalf of *ClearCaptions, LLC,* in accordance with Part 2, Subpart J, and Part 15, Subparts B and C of the Federal Communication Commission's rules and.

The objective is to determine compliance with FCC Part 15.247 rules for Output Power, Antenna Requirements, 6 dB Bandwidth, and Power Spectral Density, 100 kHz Bandwidth of Band Edges Measurement, Conducted and Radiated Spurious Emissions.

1.3 Related Submittal(s)/Grant(s)

FCC 15.247 Report: R1809245-247 DSS

1.4 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.

1.5 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 º C
Humidity	±5 %
DC and low frequency voltages	±1.0 %
Time	±2 %
Duty Cycle	±3 %

1.6 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.

1.7 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 & Fixed Radio Services;
  - 4 All Scope 4-Licensed Maritime & Aviation Radio Services;
  - 5 All Scope 5-Licensed Fixed Microwave Radio Services
  - 6 All Broadcasting Technical Standards (BETS) in the Category I Equipment Standards List.
- For Singapore (Info-Communications Development Authority (IDA)):
  - 1 All Line Terminal Equipment: All Technical Specifications for Line Terminal Equipment – Table 1 of IDA MRA Recognition Scheme: 2011, Annex 2

2. All Radio-Communication Equipment: All Technical Specifications for Radio-Communication Equipment – Table 2 of IDA MRA Recognition Scheme: 2011, Annex 2

- For the Hong Kong Special Administrative Region:
  1 All Radio Equipment, per KHCA 10XX-series Specifications;
  2 All GMDSS Marine Radio Equipment, per HKCA 12XX-series Specifications;
  3 All Fixed Network Equipment, per HKCA 20XX-series Specifications.
- For Japan:
  1 MIC Telecommunication Business Law (Terminal Equipment):
  - All Scope A1 - Terminal Equipment for the Purpose of Calls;
  - All Scope A2 - Other Terminal Equipment
  2 Radio Law (Radio Equipment):
  - All Scope B1 - Specified Radio Equipment specified in Article 38-2-2, paragraph 1, item 1 of the Radio Law
  - All Scope B2 - Specified Radio Equipment specified in Article 38-2-2, paragraph 1, item 2 of the Radio Law
  - All Scope B3 - Specified Radio Equipment specified in Article 38-2-2, paragraph 1, item 3 of the Radio Law

C- ***A Product Certification Body accredited to ISO/IEC 17065:2012 by A2LA (Product Certification Body Accreditation Certificate Number 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 & 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: (Innovation, Science and Economic development Canada - ISEDC) Foreign Certification Body – FCB – APEC Tel MRA -Phase I & 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 2014/30/EU US-EU EMC & Telecom MRA CAB (NB)
  - Radio Equipment (RE) Directive 2014/53/EU US-EU EMC & Telecom MRA CAB (NB)
  - Low Voltage Directive (LVD) 2014/35/EU
- Hong Kong Special Administrative Region: (Office of the Telecommunications Authority – OFTA) APEC Tel MRA -Phase I & Phase II
- Israel – US-Israel MRA Phase I
- Republic of Korea (Ministry of Communications - Radio Research Laboratory) APEC Tel MRA -Phase I
- Singapore: (Infocomm Media Development Authority - IMDA) APEC Tel MRA -Phase I & 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;
  - Nationally Recognized Test Laboratory (NRTL) – US OSHA
- 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 was used by android ADB and WLAN Test application, provided by *ClearCaptions, LLC,* and the software is compliant with the standard requirements being tested against.

Modulation	Frequency (MHz)	Power Setting
802.11b	2412	44
	2437	44
	2462	44
8002.11g	2412	50
	2437	56
	2462	50
802.11n20	2412	48
	2437	56
	2462	49
802.11n40	2422	50
	2437	54
	2452	46
BLE	2402	Default
	2440	Default
	2480	Default

Data Rates Tested:
802.11b mode: 1Mbps
802.11g mode: 6Mbps
802.11n HT20 mode: MCS0
802.11n HT40 mode: MCS0
BLE: 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	Duty Cycle (%)	Duty Cycle Correction Factor (dB)
802.11b	99.845	0.0155
802.11g	94.895	0.2276
802.11n20	93.194	0.30612
802.11n40	85.886	0.66080
BLE	23.387	6.31026

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

2.4 Equipment Modifications

N/A

2.5 Local Support Equipment

Manufacturer	Description	Model	Serial Number
Dell	Laptop	Latitude E6410	3CKRAQ1

2.6 Support Equipment

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

2.7 Power Supply/Adapter

Manufacturer	Description	Model
Adapter Tech.	AC adapter	ATS018T-W120U

2.8 Interface Ports and Cabling

Description	Length (m)	To	From
Cat5e	< 1 m	Router	EUT
RJ11	< 1 m	POTS Line	EUT
RJ9	< 1 m	Handset	EUT
U.FL to SMA	< 1 m	PSA	EUT

3 Summary of Test Results

Results reported relate only to the product tested.

FCC Rules	Description of Test	Results
FCC §15.203	Antenna Requirement	Compliant
FCC §15.207	AC Line Conducted Emissions	Compliant
FCC §2.1091, §15.247(i)	RF Exposure	Compliant
FCC §2.1051, §15.247 (d)	Spurious Emissions at Antenna Port	Compliant
FCC §2.1053, §15.205, §15.209, §15.247 (d)	Radiated Spurious Emissions	Compliant
FCC §15.247(a)(2)	6 dB and 99% Emission Bandwidth	Compliant
FCC §15.247(b)(3)	Output Power	Compliant
FCC §15.247(d)	100 kHz Bandwidth of Frequency Band Edge	Compliant
FCC §15.247(e)	Power Spectral Density	Compliant

4 FCC §15.203 - 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.

4.2 Antenna Description

The antennas used by the EUT have IPEX MHF Connector.

Frequency Range (MHz)	External/ Internal/ Integral	Antenna Type/ Pattern	Maximum Antenna Gain (dBi)
2402-2480	Internal	Omnidirectional	2.0

5 FCC §2.1091 & §15.247(i) - RF Exposure

5.1 Applicable Standards

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

Limits for General Population/Uncontrolled Exposure

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

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

5.2 MPE Prediction

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

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

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

5.3 MPE Results

Note: Client declares that Bluetooth and 2.4 GHz Wi-Fi cannot transmit simultaneously.

2.4 GHz Wi-Fi

Maximum output power at antenna input terminal (dBm):	14.95
Maximum output power at antenna input terminal (mW):	31.261
Prediction distance (cm):	20
Prediction frequency (MHz):	2437
Maximum Antenna Gain, typical (dBi):	2.0
Maximum Antenna Gain (numeric):	1.585
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.0099
FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1.0

The device is compliant with the requirement MPE limit for uncontrolled exposure. The maximum power density at the distance of 20 cm is 0.0099 mW/cm^2. Limit is 1.0 mW/cm^2.

BLE

Maximum peak output power at antenna input terminal (dBm):	10.26
Maximum peak output power at antenna input terminal (mW):	10.616
Prediction distance (cm):	20
Prediction frequency (MHz):	2440
Maximum Antenna Gain, typical (dBi):	2.0
Maximum Antenna Gain (numeric):	1.585
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.0033
FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1.0

The device is compliant with the requirement MPE limit for uncontrolled exposure. The maximum power density at the distance of 20 cm is 0.0033 mW/cm^2. Limit is 1.0 mW/cm^2.

6 FCC §15.207 - AC Line Conducted Emissions

6.1 Applicable Standards

As per FCC §15.207 Conducted limits:

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

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-Peak	Average
0.15-0.5	66 to 56 Note1	56 to 46 Note2
0.5-5	56	46
5-30	60	50

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

6.2 Test Setup

The measurement was performed at shield room, using the setup per ANSI C63.10-2013 measurement procedure. The specification used were FCC §15.207.

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

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

6.3 Test Procedure

During the conducted emissions test, the power cord of the EUT host system was connected to the mains outlet of the LISN-1 and the power cords of support equipment were connected to LISN-2.

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

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

6.4 Corrected Amplitude and Margin Calculation

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

CA = Ai + CL + Atten

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

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

Margin = Corrected Amplitude – Limit

6.5 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Rohde and Schwarz	Receiver, EMI Test	ESCI 1166.5950K03	100337	2017-07-15	2 years
Rohde and Schwarz	Impulse Limiter	ESH3-Z2	101964	2018-07-27	1 year
Solar Electronics Company	High Pass Filter	Type 7930-100	7930150203	2018-02-28	1 year
Suirong	30 ft conductive emission cable	LMR 400	-	N/R	N/A
FCC	LISN	FCC-LISN-50-25-2-10-CISPR16	160129	2018-04-04	1 year
Vasona	Test software	V6.0 build 11	10400213	N/R	N/R

Statement of Traceability: BACL Corp. *attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with A2LA Policy P102 (dated 09 June 2016) "A2LA Policy on Metrological Traceability".*

6.6 Test Environmental Conditions

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

The testing was performed by Frank Wang on 2018-12-06 in Ground Test Site.

6.7 Summary of Test Results

According to the recorded data in following table, the EUT complied with the FCC 15C standard's conducted emissions limits, with the margin reading of:

2.4 GHz Wi-Fi

Connection: AC/DC adapter connected to 120 V/60 Hz, AC			
Margin (dB)	**Frequency (MHz)**	**Conductor Mode (Line/Neutral)**	**Range (MHz)**
-14.48	0.385551	Line	0.15-30

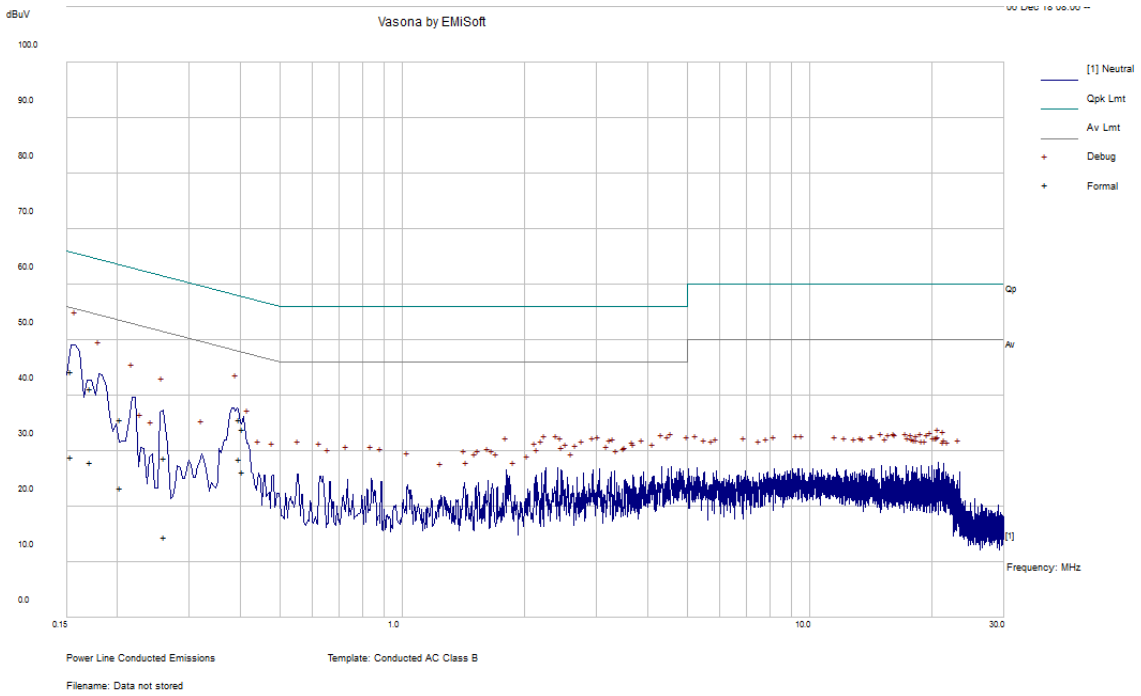
BLE

Connection: AC/DC adapter connected to 120 V/60 Hz, AC			
Margin (dB)	**Frequency (MHz)**	**Conductor Mode (Line/Neutral)**	**Range (MHz)**
-12.46	0.397318	Line	0.15-30

6.8 Conducted Emissions Test Plots and Data

2.4 GHz Wi-Fi, g mode (2437 MHz)

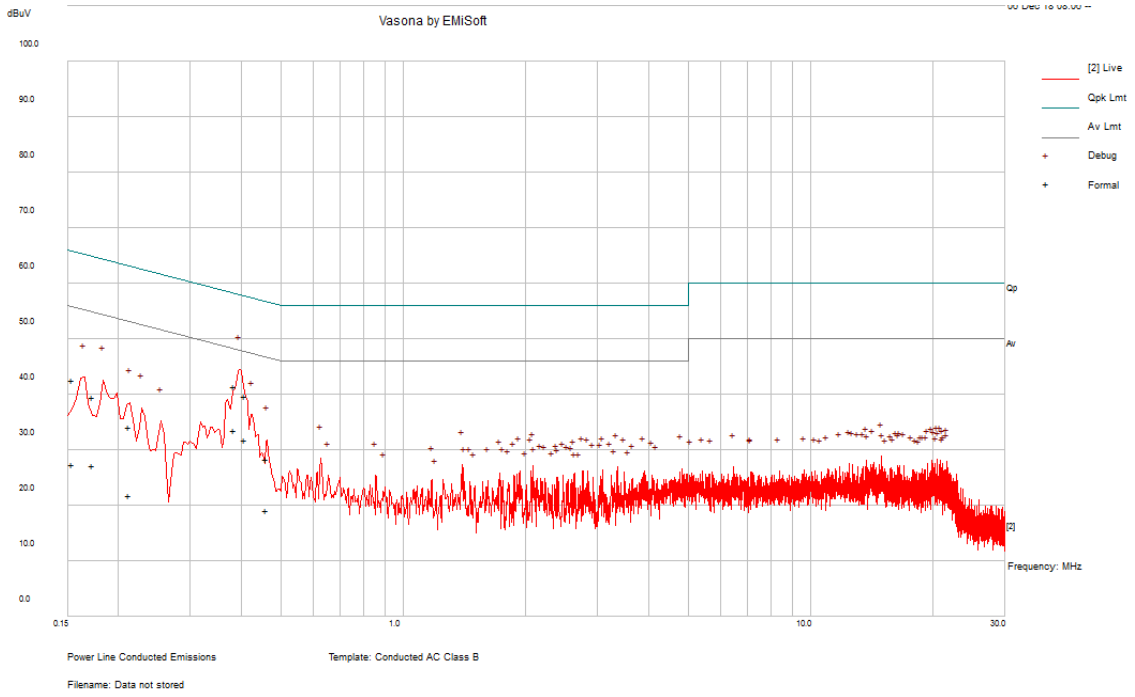
120 V, 60 Hz – Neutral



Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)	Detector (QP/Ave.)
0.153845	44.42	Neutral	65.79	-21.37	QP
0.397768	35.72	Neutral	57.9	-22.18	QP
0.172148	41.3	Neutral	64.86	-23.55	QP
0.203163	35.64	Neutral	63.48	-27.85	QP
0.26041	28.75	Neutral	61.42	-32.67	QP
0.40641	34.07	Neutral	57.72	-23.65	QP

Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)	Detector (QP/Ave.)
0.153845	28.92	Neutral	55.79	-26.87	Ave.
0.397768	28.63	Neutral	47.9	-19.27	Ave.
0.172148	27.98	Neutral	54.86	-26.88	Ave.
0.203163	23.43	Neutral	53.48	-30.05	Ave.
0.26041	14.51	Neutral	51.42	-36.91	Ave.
0.40641	26.37	Neutral	47.72	-21.35	Ave.

120 V, 60 Hz – Line

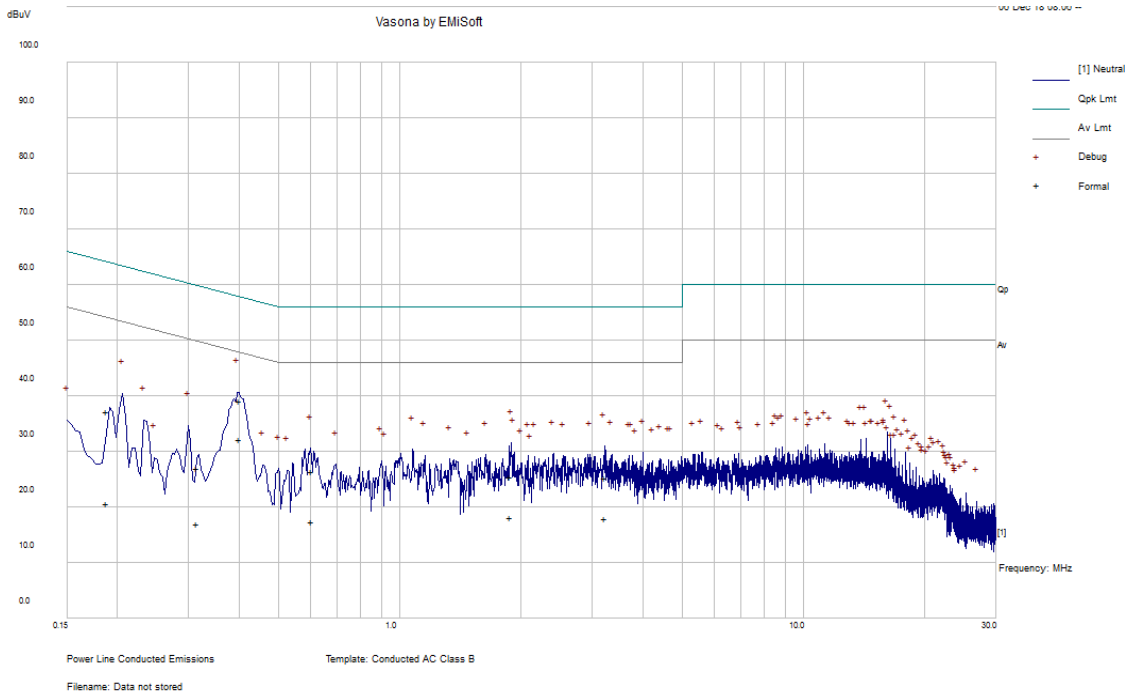


Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)	Detector (QP/Ave.)
0.385551	41.49	Line	58.16	-16.67	QP
0.408275	39.72	Line	57.68	-17.96	QP
0.17309	39.52	Line	64.81	-25.29	QP
0.154432	42.61	Line	65.76	-23.15	QP
0.212158	34.09	Line	63.12	-29.03	QP
0.46035	28.41	Line	56.69	-28.27	QP

Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)	Detector (QP/Ave.)
0.385551	33.68	Line	48.16	-14.48	Ave.
0.408275	31.92	Line	47.68	-15.76	Ave.
0.17309	27.24	Line	54.81	-27.57	Ave.
0.154432	27.44	Line	55.76	-28.31	Ave.
0.212158	21.83	Line	53.12	-31.29	Ave.
0.46035	19.12	Line	46.69	-27.57	Ave.

BLE (2440 MHz)

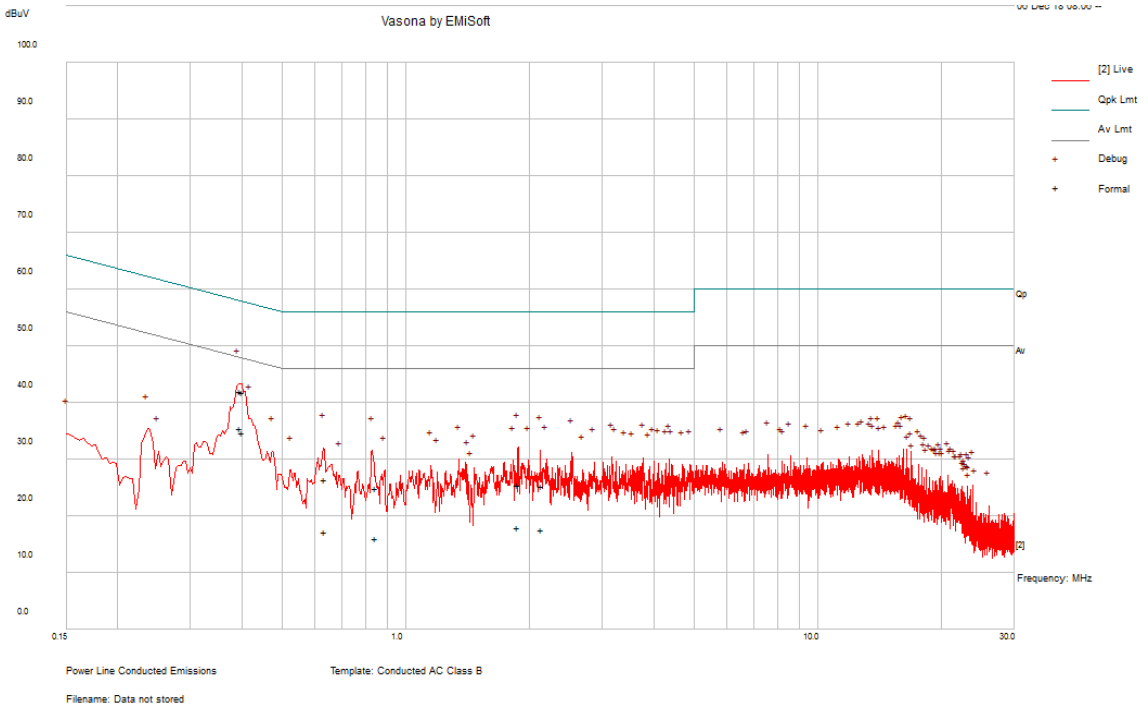
120 V, 60 Hz – Neutral



Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)	Detector (QP/Ave.)
0.400077	39.19	Neutral	57.85	-18.66	QP
0.188441	37.26	Neutral	64.11	-26.85	QP
1.883305	25.43	Neutral	56	-30.57	QP
3.223924	25.26	Neutral	56	-30.74	QP
0.605022	26.54	Neutral	56	-29.46	QP
0.314038	27.13	Neutral	59.86	-32.73	QP

Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)	Detector (QP/Ave.)
0.400077	32.2	Neutral	47.85	-15.65	Ave.
0.188441	20.62	Neutral	54.11	-33.48	Ave.
1.883305	18.28	Neutral	46	-27.72	Ave.
3.223924	17.98	Neutral	46	-28.02	Ave.
0.605022	17.54	Neutral	46	-28.46	Ave.
0.314038	17.08	Neutral	49.86	-32.78	Ave.

120 V, 60 Hz – Line



Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)	Detector (QP/Ave.)
0.397318	42.01	Line	57.91	-15.9	QP
0.400668	41.89	Line	57.84	-15.95	QP
1.872819	25.47	Line	56	-30.53	QP
0.634514	26.53	Line	56	-29.47	QP
2.137404	25.32	Line	56	-30.68	QP
0.846359	24.96	Line	56	-31.04	QP

Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)	Detector (QP/Ave.)
0.397318	35.45	Line	47.91	-12.46	Ave.
0.400668	34.74	Line	47.84	-13.1	Ave.
1.872819	17.97	Line	46	-28.03	Ave.
0.634514	17.28	Line	46	-28.72	Ave.
2.137404	17.68	Line	46	-28.32	Ave.
0.846359	16.18	Line	46	-29.82	Ave.

7 FCC §15.209 & §15.247(d) - 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) 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).

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 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 = 3MHz / Sweep = 100 ms
(2) Average: RBW = 1 / T / 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/m) + 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 & Schwarz	Receiver, EMI Test	ESCI 1166.5950.03	100338	2018-07-05	2 year
Agilent	Analyzer, Spectrum	E4446A	US44300386	2018-06-01	1 year
Sunol Science Corp	System Controller	SC99V	011003-1	N/R	N/R
Sunol Sciences	Antenna, Biconi-Log	JB1	A013105-3	2018-02-26	2 years
Wisewave	Antenna, Horn	ARH-4223-02	10555-02	2017-12-15	2 years
Agilent	Amplifier, Pre	8447D	2944A10187	2018-04-02	1 year
Insulated Wire INC	2.92mm (M) X2, 1501 Armor Neoprene, 396"	KPS-1501AN-3960-KPS	DC 1807	2018-03-13	1 year
-	SMA cable	-	C00011	Each time[1]	N/A
-	N-Type Cable	-	C00012	Each time[1]	N/A
-	N-Type Cable	-	C00014	Each time[1]	N/A
HP	Pre-Amplifier	8449B	3147A00400	2018-02-02	1 year
Sunol Sciences	Antenna, Horn	DRH-118	A052704	2017-03-27	2 years
Vasona	Test software	V6.0 build 11	10400213	N/R	N/R

Note[1]: cables included in the test set-up will be checked each time before testing.
Statement of Traceability: BACL Corp. *attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with A2LA Policy P102 (dated 09 June 2016) "A2LA Policy on Metrological Traceability".*

7.6 Test Environmental Conditions

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

The testing was performed by Harry Zhao on 2018-11-05 in 5m chamber 3.

7.7 Summary of Test Results

According to the data hereinafter, the EUT complied with FCC Title 47, Part 15C 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**
-1.18	2483.5	Horizontal	n20 mode, 2462 MHz

BLE

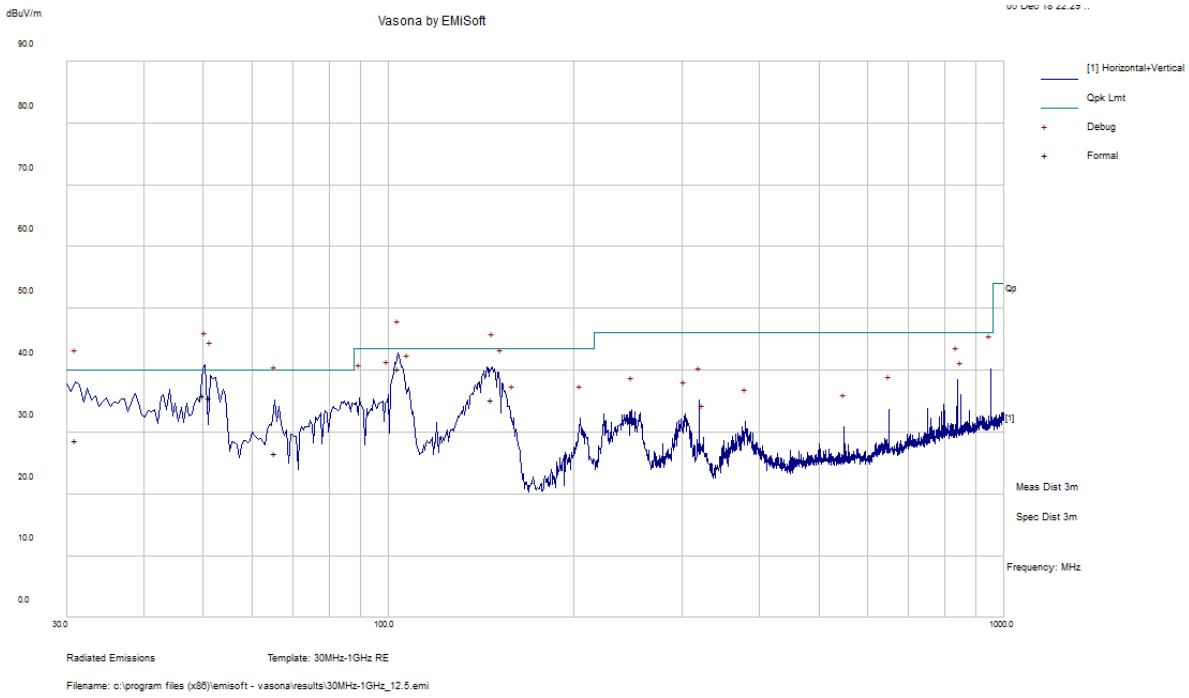
Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Mode**
-2	50.69025	Vertical	BLE, 2440 MHz

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

7.8 Radiated Emissions Test Results

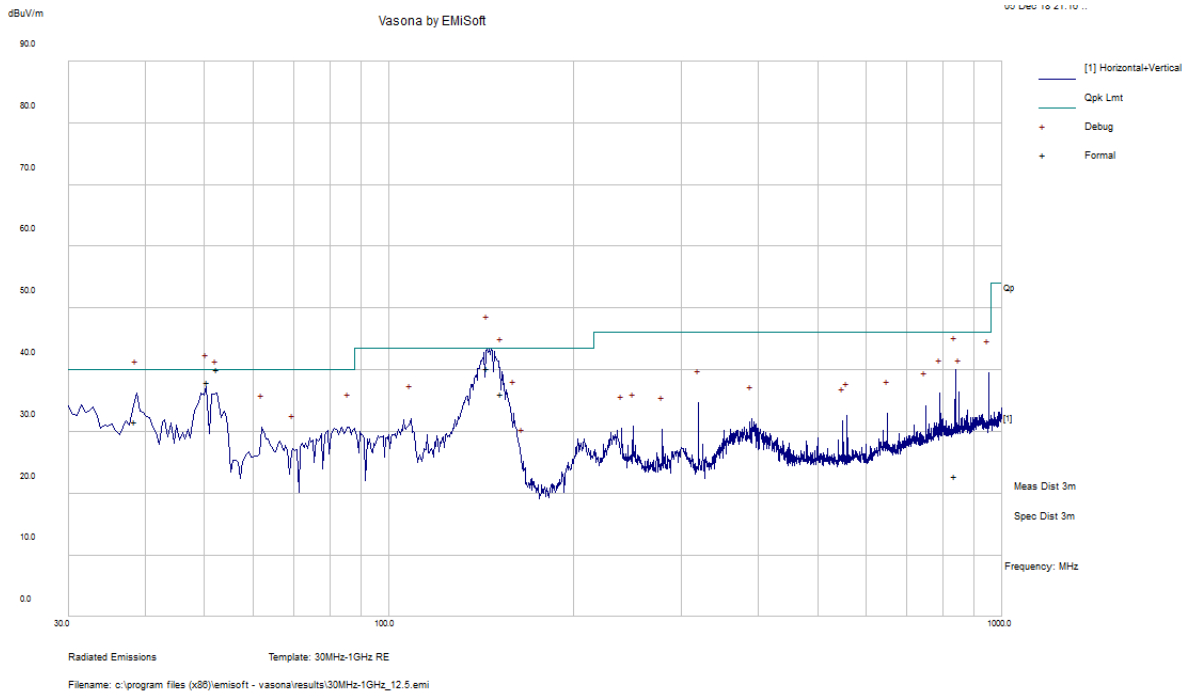
1) 30 MHz – 1 GHz Worst Case, Measured at 3 meters

2.4 GHz Wi-Fi, g mode (2437 MHz)



Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Comment
50.06525	35.99	99	V	347	40	-4.01	QP
103.8658	40.34	298	H	38	43.5	-3.16	QP
51.29325	35.61	101	V	0	40	-4.39	QP
30.97325	28.76	176	V	246	40	-11.24	QP
147.077	35.19	269	H	107	43.5	-8.31	QP
65.52625	26.53	120	V	354	40	-13.47	QP

BLE (2440 MHz)



Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Comment
144.5403	40.31	155	H	91	43.5	-3.19	QP
50.69025	38	125	V	141	40	-2	QP
152.6333	36.12	115	H	52	43.5	-7.38	QP
38.494	31.62	103	V	50	40	-8.38	QP
839.165	22.87	161	V	245	46	-23.13	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		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 2412 MHz											
2390	28.04	0	100	H	28.94	5.083	0	62.07	74.00	-11.93	PK
2390	17.41	0	100	H	28.94	5.083	0	51.44	54.00	-2.56	AV
2390	28.20	0	100	V	28.93	5.083	0	62.22	74.00	-11.78	PK
2390	17.41	0	100	V	28.93	5.083	0	51.43	54.00	-2.57	AV
4824	45.86	0	100	H	32.54	7.427	33.15	52.68	74.00	-21.32	PK
4824	37.41	0	100	H	32.54	7.427	33.15	44.23	54.00	-9.77	AV
4824	45.15	0	100	V	32.56	7.427	33.15	51.99	74.00	-22.01	PK
4824	33.98	0	100	V	32.56	7.427	33.15	40.82	54.00	-13.18	AV
Middle Channel 2437 MHz											
4874	44.86	6	159	H	32.79	7.427	33.15	51.92	74.00	-22.08	PK
4874	36.06	6	159	H	32.79	7.427	33.15	43.12	54.00	-10.88	AV
4874	44.91	0	100	V	32.53	7.427	33.15	51.71	74.00	-22.29	PK
4874	34.74	0	100	V	32.53	7.427	33.15	41.54	54.00	-12.46	AV
High Channel 2462 MHz											
2483.5	29.38	0	100	H	29.18	5.083	0	63.64	74.00	-10.36	PK
2483.5	17.53	0	100	H	29.18	5.083	0	51.79	54.00	-2.21	AV
2483.5	28.39	0	100	V	29.18	5.083	0	62.65	74.00	-11.35	PK
2483.5	17.35	0	100	V	29.18	5.083	0	51.61	54.00	-2.39	AV
4924	45.23	0	100	H	32.81	7.600	33.15	52.49	74.00	-21.51	PK
4924	35.54	0	100	H	32.81	7.600	33.15	42.80	54.00	-11.20	AV
4924	45.68	0	100	V	32.70	7.600	33.15	52.83	74.00	-21.18	PK
4924	33.53	0	100	V	32.70	7.600	33.15	40.68	54.00	-13.33	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		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 2412 MHz											
2390	28.33	0	100	H	28.94	5.083	0	62.36	74.00	-11.64	PK
2390	17.92	0	100	H	28.94	5.083	0	51.95	54.00	-2.05	AV
2390	28.30	0	100	V	28.93	5.083	0	62.32	74.00	-11.68	PK
2390	17.97	0	100	V	28.93	5.083	0	51.99	54.00	-2.01	AV
4824	45.40	0	100	H	32.54	7.427	33.15	52.22	74.00	-21.78	PK
4824	34.83	0	100	H	32.54	7.427	33.15	41.65	54.00	-12.35	AV
4824	45.44	0	100	V	32.56	7.427	33.15	52.28	74.00	-21.72	PK
4824	34.71	0	100	V	32.56	7.427	33.15	41.55	54.00	-12.45	AV
Middle Channel 2437 MHz											
4874	45.23	0	100	H	32.79	7.427	32.993	52.45	74.00	-21.55	PK
4874	34.44	0	100	H	32.79	7.427	32.993	41.66	54.00	-12.34	AV
4874	44.98	0	100	V	32.53	7.427	32.993	51.94	74.00	-22.06	PK
4874	34.35	0	100	V	32.53	7.427	32.993	41.31	54.00	-12.69	AV
High Channel 2462 MHz											
2483.5	28.94	0	100	H	29.18	5.083	0	63.20	74.00	-10.80	PK
2483.5	18.16	0	100	H	29.18	5.083	0	52.42	54.00	-1.58	AV
2483.5	28.65	0	100	V	29.18	5.083	0	62.91	74.00	-11.09	PK
2483.5	17.84	0	100	V	29.18	5.083	0	52.10	54.00	-1.90	AV
4924	45.19	0	100	H	32.81	7.600	32.993	52.60	74.00	-21.40	PK
4924	34.37	0	100	H	32.81	7.600	32.993	41.78	54.00	-12.22	AV
4924	45.56	0	100	V	32.70	7.600	32.993	52.86	74.00	-21.14	PK
4924	34.28	0	100	V	32.70	7.600	32.993	41.58	54.00	-12.42	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		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 2412 MHz											
2390	29.68	0	100	H	28.94	5.083	0	63.71	74.00	-10.29	PK
2390	18.07	0	100	H	28.94	5.083	0	52.10	54.00	-1.90	AV
2390	29.66	0	100	V	28.93	5.083	0	63.68	74.00	-10.32	PK
2390	18.01	0	100	V	28.93	5.083	0	52.03	54.00	-1.97	AV
4824	45.85	0	100	H	32.54	7.427	33.15	52.67	74.00	-21.33	PK
4824	35.23	0	100	H	32.54	7.427	33.15	42.05	54.00	-11.95	AV
4824	45.88	0	100	V	32.56	7.427	33.15	52.72	74.00	-21.28	PK
4824	35.17	0	100	V	32.56	7.427	33.15	42.01	54.00	-11.99	AV
Middle Channel 2437 MHz											
4874	45.79	0	100	H	32.79	7.427	32.993	53.01	74.00	-20.99	PK
4874	34.76	0	100	H	32.79	7.427	32.993	41.98	54.00	-12.02	AV
4874	46.08	0	100	V	32.53	7.427	32.993	53.04	74.00	-20.96	PK
4874	34.61	0	100	V	32.53	7.427	32.993	41.57	54.00	-12.43	AV
High Channel 2462 MHz											
2483.5	29.05	0	100	H	29.18	5.083	0	63.31	74.00	-10.69	PK
2483.5	18.56	0	100	H	29.18	5.083	0	52.82	54.00	-1.18	AV
2483.5	29.32	0	100	V	29.18	5.083	0	63.58	74.00	-10.42	PK
2483.5	18.07	0	100	V	29.18	5.083	0	52.33	54.00	-1.67	AV
4924	45.64	0	100	H	32.81	7.600	32.993	53.05	74.00	-20.95	PK
4924	34.75	0	100	H	32.81	7.600	32.993	42.16	54.00	-11.84	AV
4924	46.04	0	100	V	32.70	7.600	32.993	53.34	74.00	-20.66	PK
4924	34.77	0	100	V	32.70	7.600	32.993	42.07	54.00	-11.93	AV

802.11n40 mode

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 2422 MHz											
2390	29.87	0	100	H	28.94	5.083	0	63.90	74.00	-10.10	PK
2390	18.36	0	100	H	28.94	5.083	0	52.39	54.00	-1.61	AV
2390	29.08	0	100	V	28.93	5.083	0	63.10	74.00	-10.90	PK
2390	18.39	0	100	V	28.93	5.083	0	52.41	54.00	-1.59	AV
4844	44.90	0	100	H	32.54	7.427	33.15	51.72	74.00	-22.28	PK
4844	35.10	0	100	H	32.54	7.427	33.15	41.92	54.00	-12.08	AV
4844	45.13	0	100	V	32.56	7.427	33.15	51.97	74.00	-22.03	PK
4844	35.04	0	100	V	32.56	7.427	33.15	41.88	54.00	-12.12	AV
Middle Channel 2437 MHz											
4874	45.37	0	100	H	32.79	7.427	32.993	52.59	74.00	-21.41	PK
4874	35.13	0	100	H	32.79	7.427	32.993	42.35	54.00	-11.65	AV
4874	44.64	0	100	V	32.53	7.427	32.993	51.60	74.00	-22.40	PK
4874	35.11	0	100	V	32.53	7.427	32.993	42.07	54.00	-11.93	AV
High Channel 2452 MHz											
2483.5	28.08	0	100	H	29.18	5.083	0	62.34	74.00	-11.66	PK
2483.5	18.33	0	100	H	29.18	5.083	0	52.59	54.00	-1.41	AV
2483.5	28.70	0	100	V	29.18	5.083	0	62.96	74.00	-11.04	PK
2483.5	18.25	0	100	V	29.18	5.083	0	52.51	54.00	-1.49	AV
4904	45.65	0	100	H	32.81	7.600	32.993	53.06	74.00	-20.94	PK
4904	35.25	0	100	H	32.81	7.600	32.993	42.66	54.00	-11.34	AV
4904	45.13	0	100	V	32.70	7.600	32.993	52.43	74.00	-21.57	PK
4904	35.23	0	100	V	32.70	7.600	32.993	42.53	54.00	-11.47	AV

BLE

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 2402 MHz											
2390	28.39	0	100	H	28.94	5.083	0	62.42	74.00	-11.58	PK
2390	14.85	0	100	H	28.94	5.083	0	48.88	54.00	-5.12	AV
2390	28.54	0	100	V	28.93	5.083	0	62.56	74.00	-11.44	PK
2390	14.92	0	100	V	28.93	5.083	0	48.94	54.00	-5.06	AV
4804	46.60	0	100	H	32.54	7.427	33.15	53.42	74.00	-20.58	PK
4804	32.76	0	100	H	32.54	7.427	33.15	39.58	54.00	-14.42	AV
4804	47.01	0	100	V	32.56	7.427	33.15	53.85	74.00	-20.15	PK
4804	32.86	0	100	V	32.56	7.427	33.15	39.70	54.00	-14.30	AV
Middle Channel 2440 MHz											
4880	46.88	0	100	H	32.79	7.427	33.15	53.94	74.00	-20.06	PK
4880	32.76	0	100	H	32.79	7.427	33.15	39.82	54.00	-14.18	AV
4880	46.50	0	100	V	32.53	7.427	33.15	53.30	74.00	-20.70	PK
4880	32.75	0	100	V	32.53	7.427	33.15	39.55	54.00	-14.45	AV
High Channel 2480 MHz											
2483.5	28.43	0	100	H	29.18	5.083	0	62.69	74.00	-11.31	PK
2483.5	15.21	0	100	H	29.18	5.083	0	49.47	54.00	-4.53	AV
2483.5	28.25	0	100	V	29.18	5.083	0	62.51	74.00	-11.49	PK
2483.5	15.42	0	100	V	29.18	5.083	0	49.68	54.00	-4.32	AV
4960	45.81	0	100	H	32.81	7.600	33.15	53.07	74.00	-20.93	PK
4960	32.26	0	100	H	32.81	7.600	33.15	39.52	54.00	-14.48	AV
4960	46.81	0	100	V	32.70	7.600	33.15	53.96	74.00	-20.05	PK
4960	32.35	0	100	V	32.70	7.600	33.15	39.50	54.00	-14.51	AV

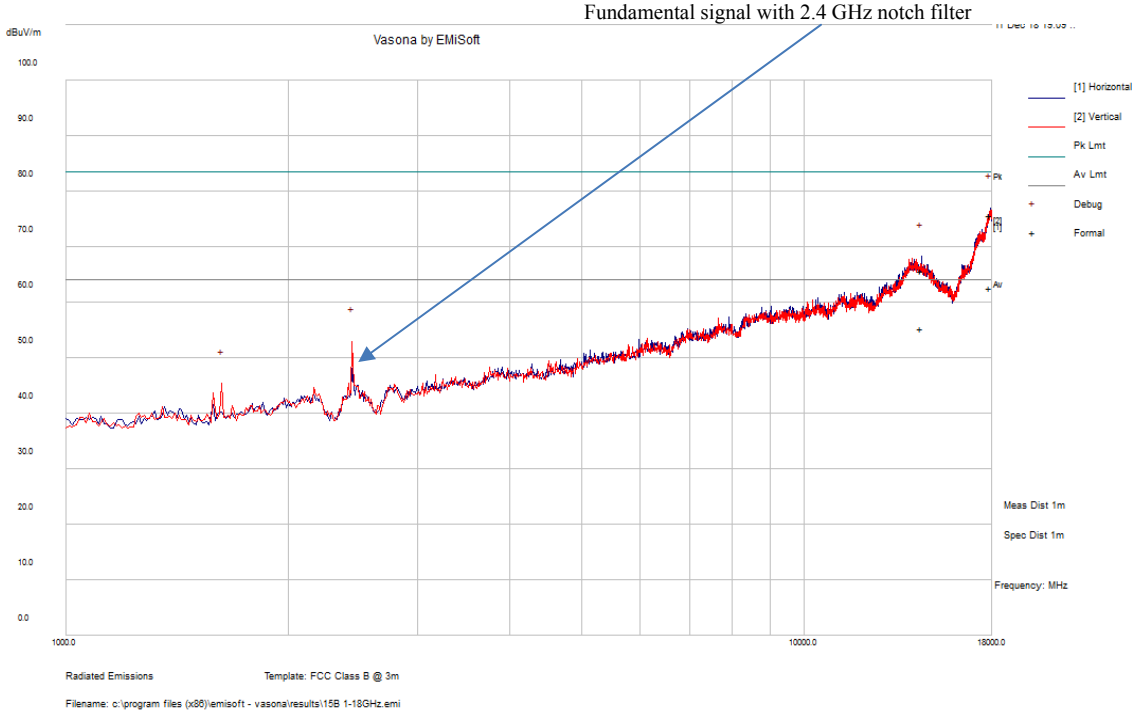
Note: Any Emission above the second harmonic is due to noise floor.

Worst Case Plots, Measured at 1 meter

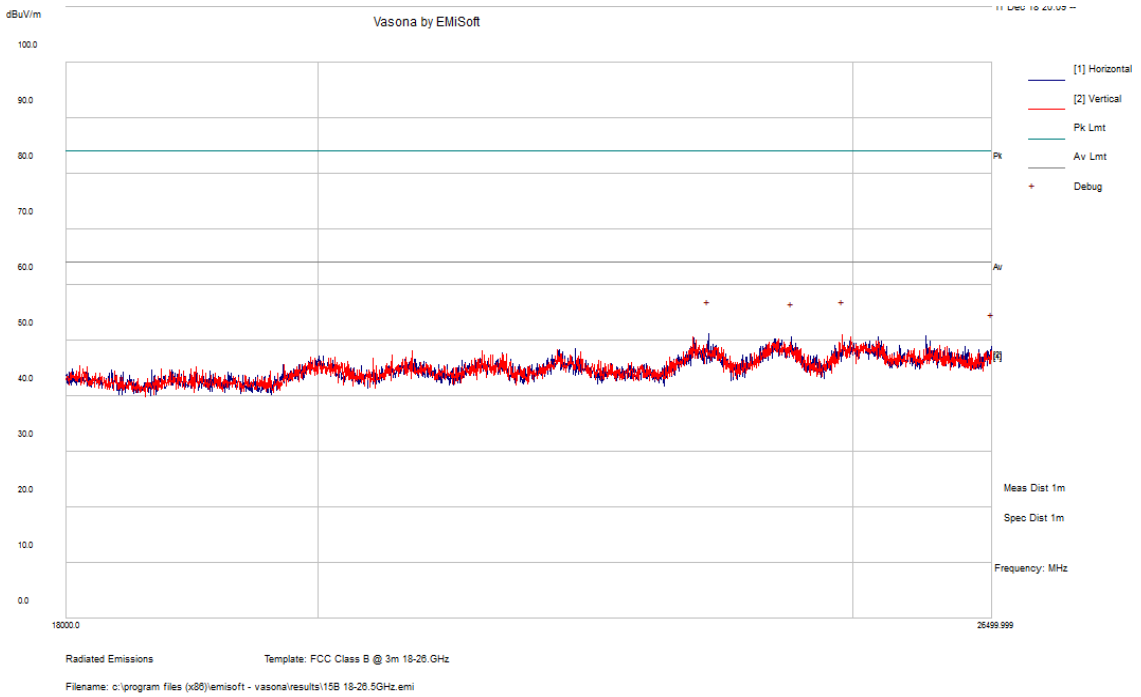
2.4 GHz Wi-Fi, g mode (2437 MHz)

1-18 GHz

Fundamental signal with 2.4 GHz notch filter



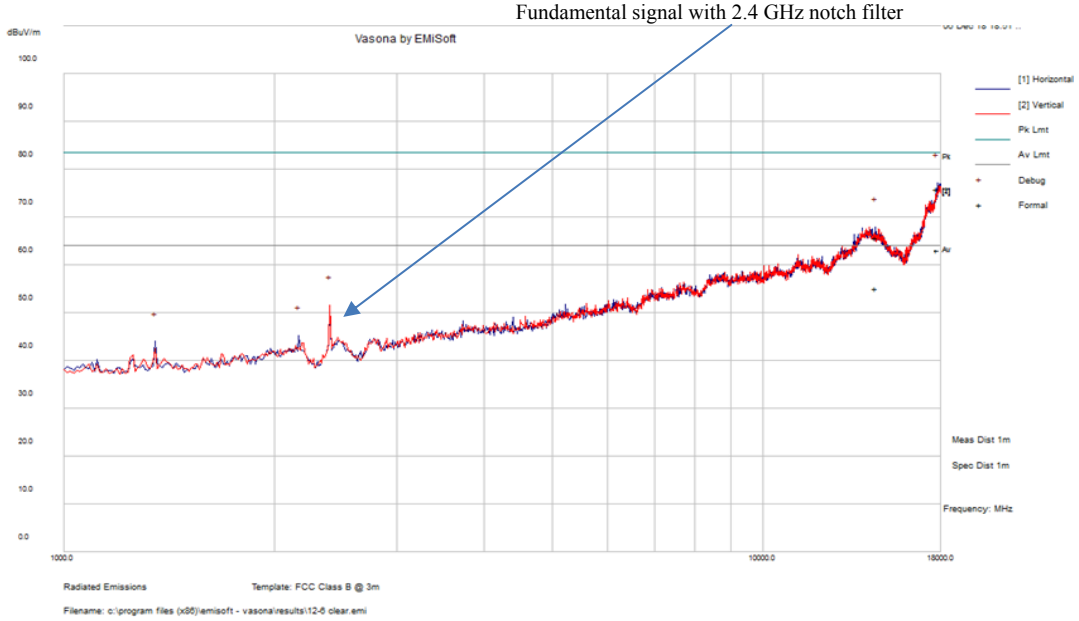
18-26.5 GHz



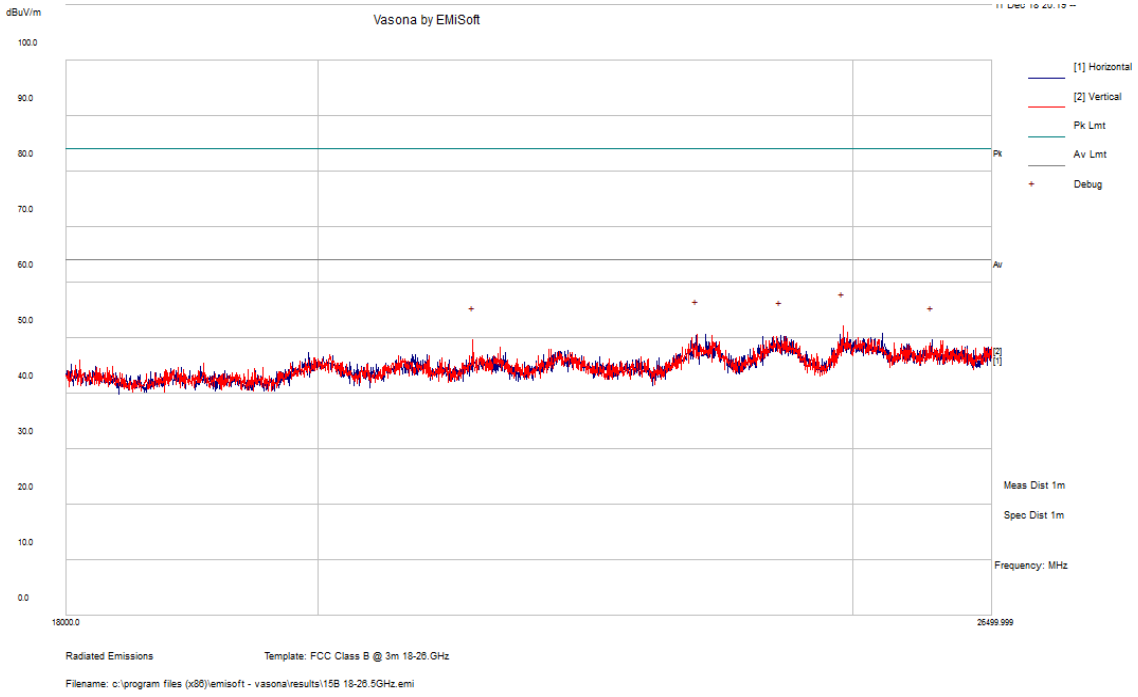
BLE (2440 MHz)

1-18 GHz

Fundamental signal with 2.4 GHz notch filter



18-26.5 GHz



8 FCC §15.247(a) (2) -Emission Bandwidth

8.1 Applicable Standards

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

8.2 Measurement Procedure

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

8.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Analyzer, Spectrum	E4440A	US45303156	2018-02-26	1 year
-	RF cable	-	-	Each time[1]	N/A
-	20dB 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 of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with A2LA Policy P102 (dated 09 June 2016) "A2LA Policy on Metrological Traceability".*

8.4 Test Environmental Conditions

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

The testing was performed by Harry Zhao on 2018-11-02 and Frank Wang on 2018-12-03 in RF site.

8.5 Test Results

99% and 6 dB Bandwidth

2.4 GHz Wi-Fi

Channel	Frequency (MHz)	99% OBW (kHz)	6 dB BW (kHz)	6 dB OBW limit (kHz)
802.11b mode				
Low	2412	15048.4	10030	>500
Middle	2437	15033.2	10068	>500
High	2462	15034.4	10066	>500
802.11g mode				
Low	2412	16737.3	16385	>500
Middle	2437	16794.1	16386	>500
High	2462	16657.4	16402	>500
802.11n20 mode				
Low	2412	17767.2	17608	>500
Middle	2437	17812.7	17568	>500
High	2462	17827.1	17609	>500
802.11n40 mode				
Low	2422	36223.6	35736	>500
Middle	2437	36179.0	35467	>500
High	2452	36115.7	35383	>500

BLE

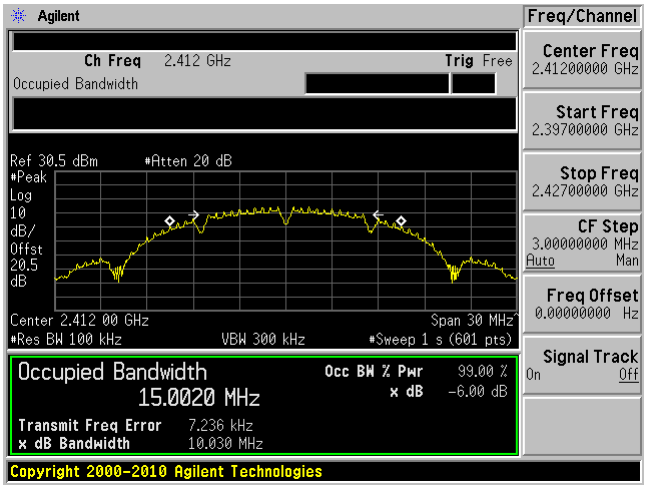
Channel	Frequency (MHz)	99% OBW (kHz)	6 dB BW (kHz)	6 dB OBW limit (kHz)
BLE				
Low	2402	1035.8	536.828	>500
Middle	2440	1035.7	536.758	>500
High	2480	1035.7	532.312	>500

Please refer to the following plots for detailed test results.

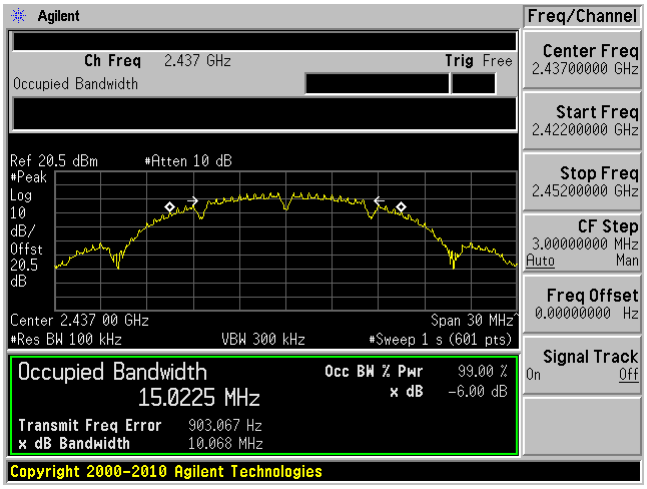
6 dB Emission Bandwidth

802.11b mode

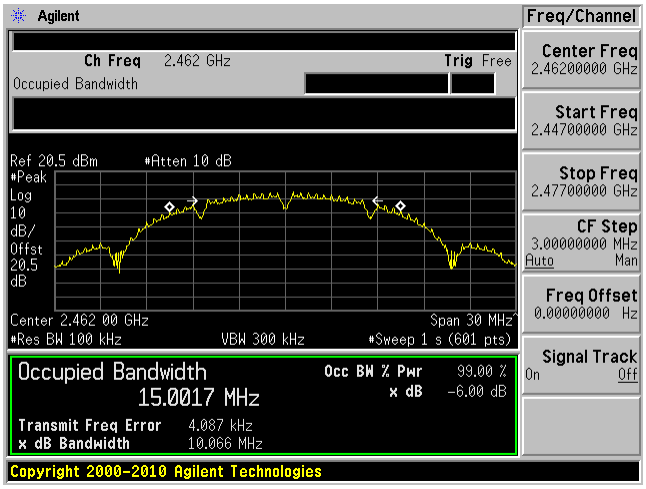
Low Channel 2412 MHz



Middle Channel 2437 MHz

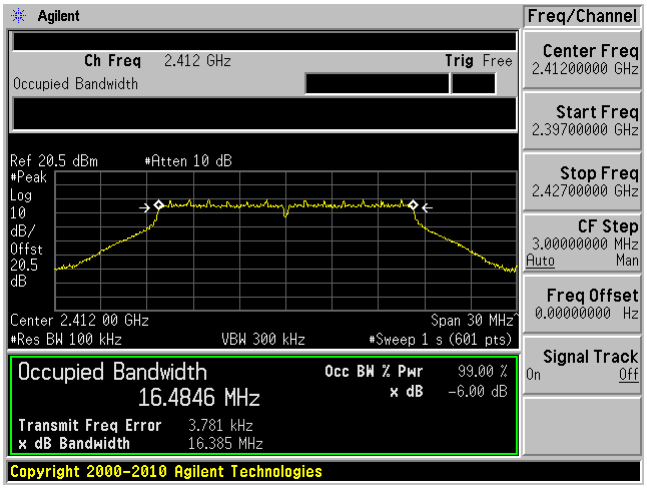


High Channel 2462 MHz

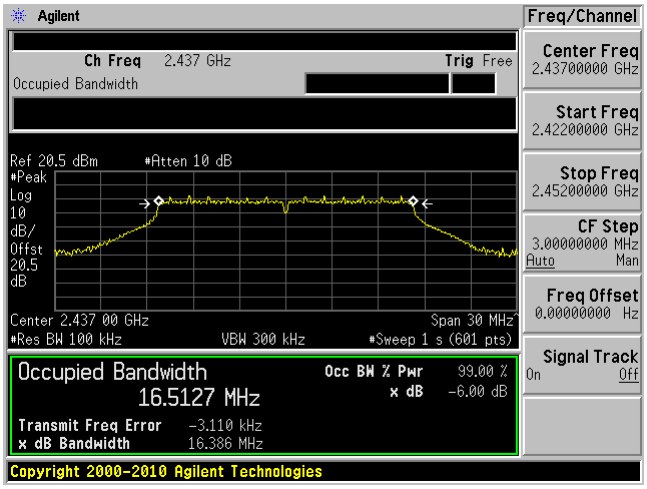


802.11g mode

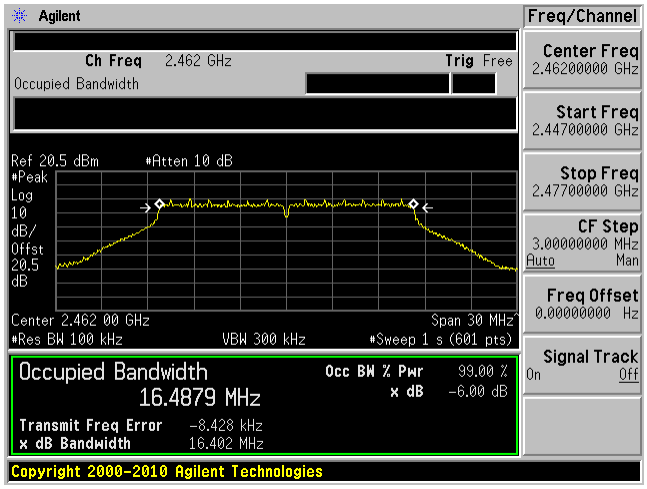
Low Channel 2412 MHz



Middle Channel 2437 MHz

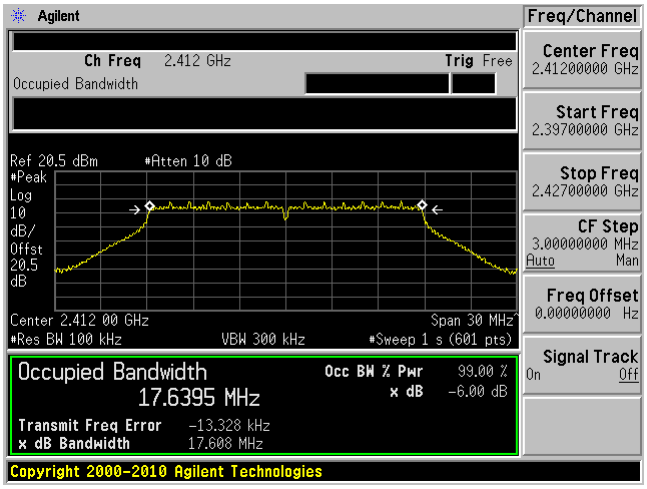


High Channel 2462 MHz

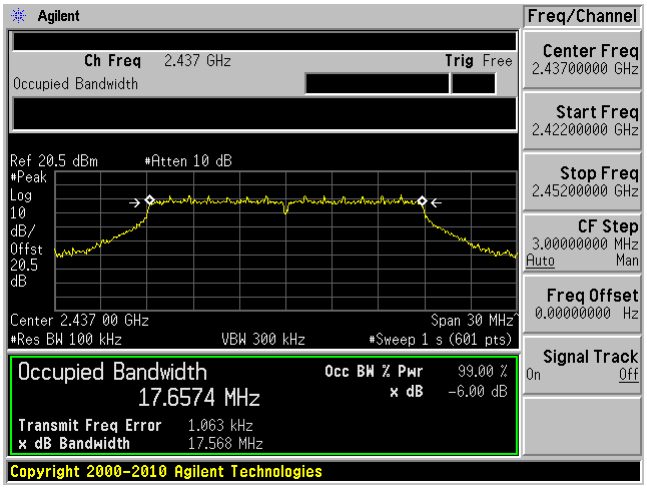


802.11n20 mode

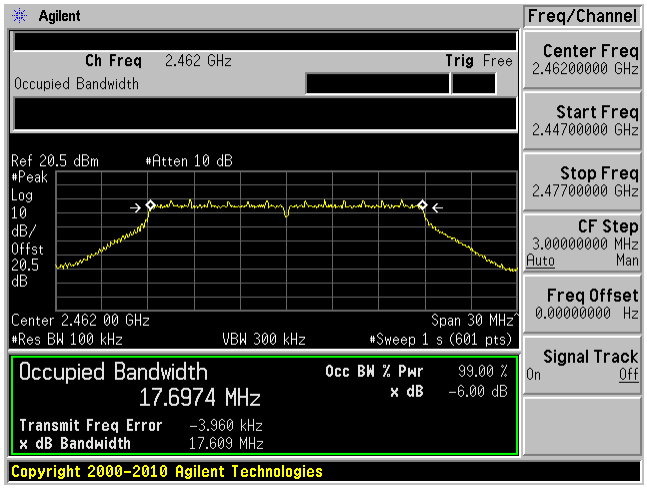
Low Channel 2412 MHz



Middle Channel 2437 MHz

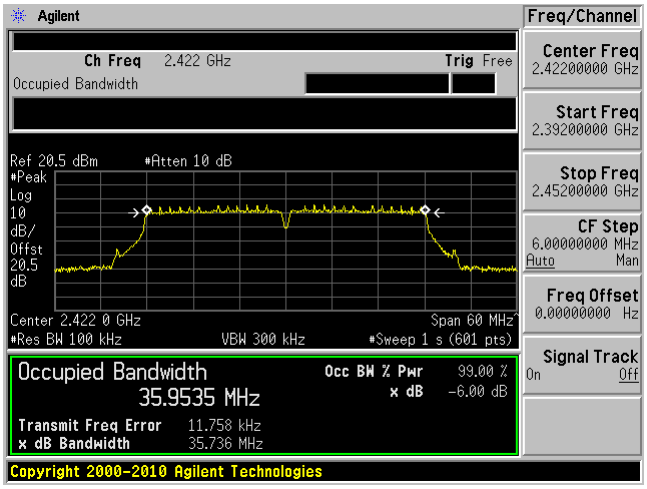


High Channel 2462 MHz

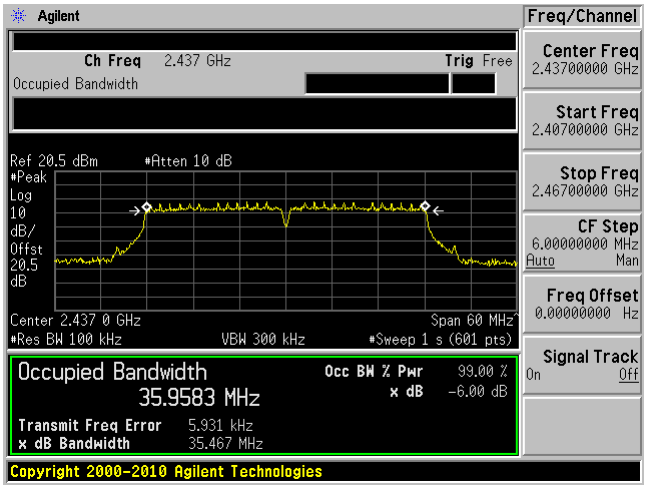


802.11n40 mode

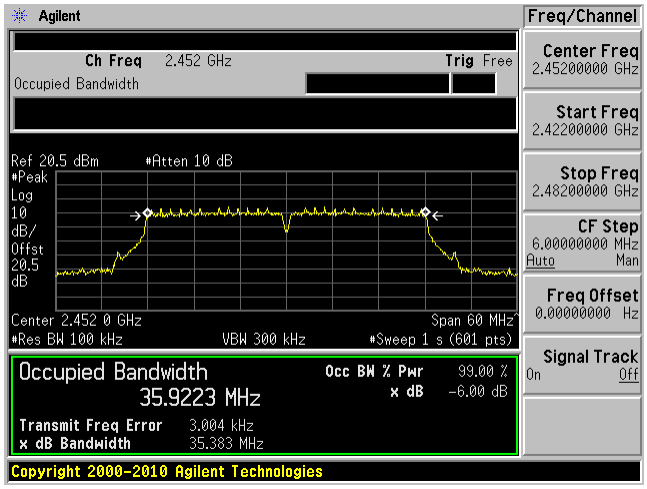
Low Channel 2422 MHz



Middle Channel 2437 MHz

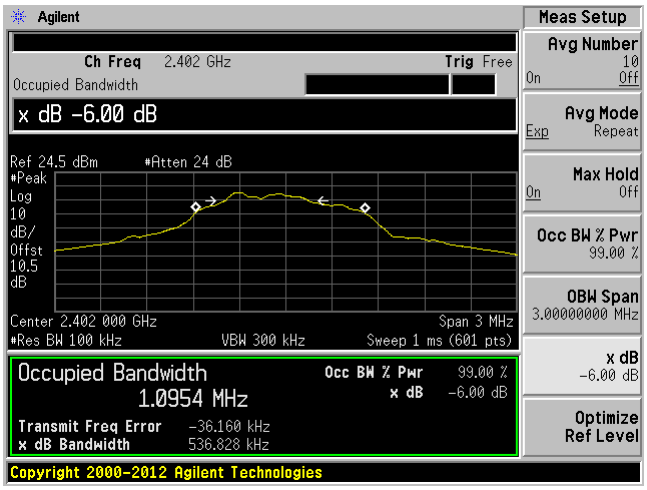


High Channel 2452 MHz

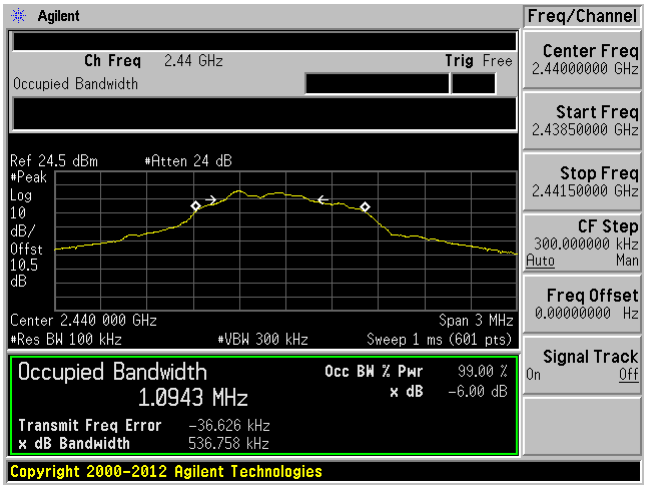


BLE

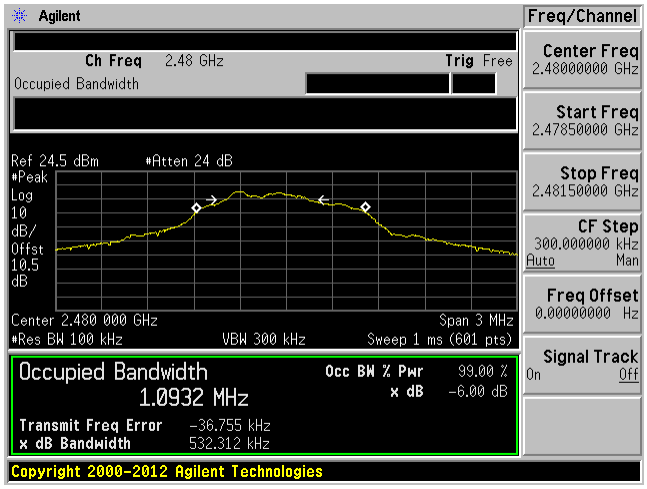
Low Channel 2402 MHz



Middle Channel 2440 MHz



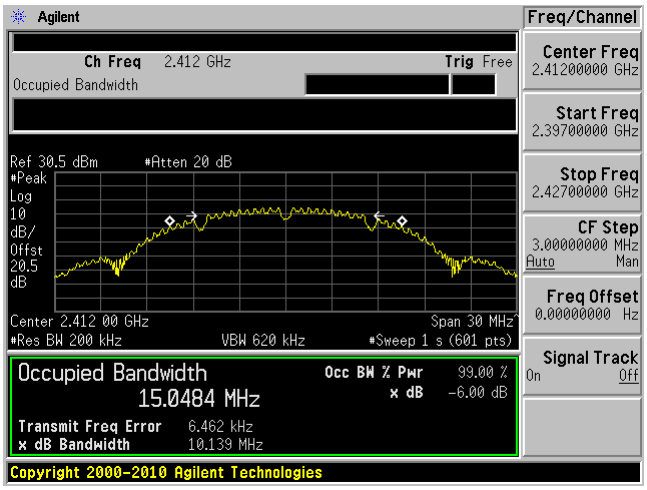
High Channel 2480 MHz



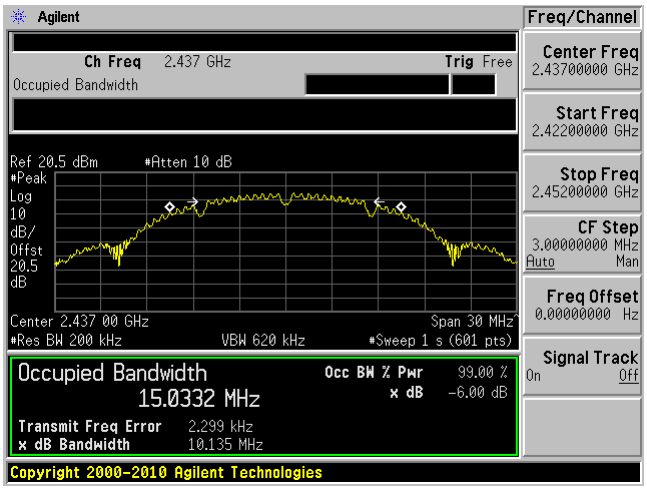
99% Emission Bandwidth

802.11b mode

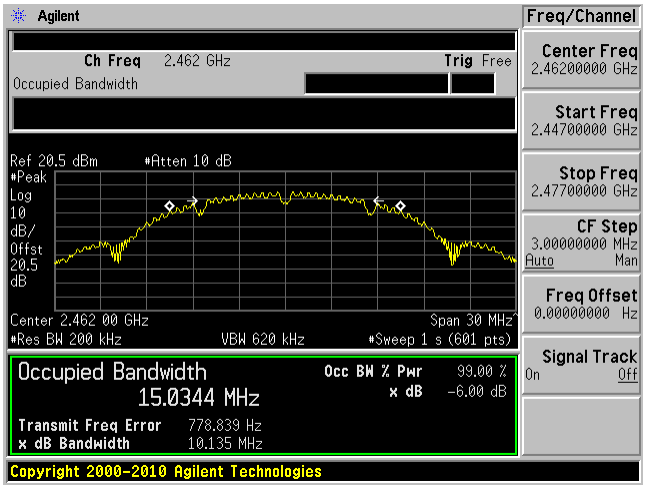
Low Channel 2412 MHz



Middle Channel 2437 MHz

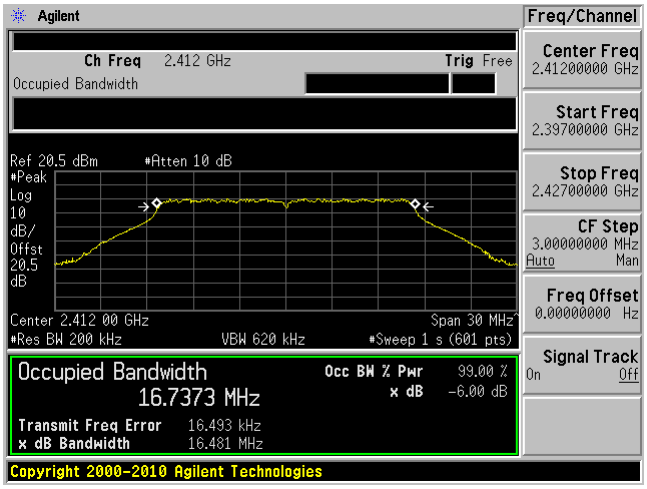


High Channel 2462 MHz

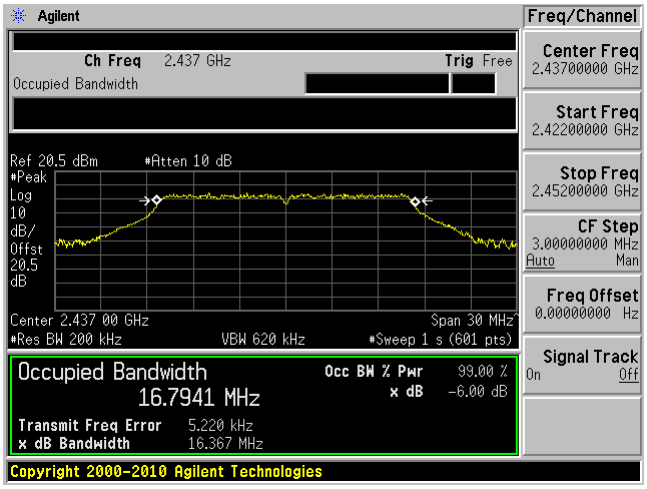


802.11g mode

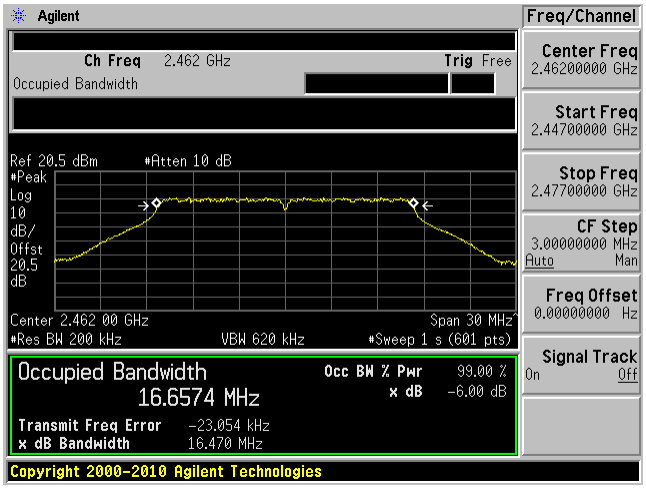
Low Channel 2412 MHz



Middle Channel 2437 MHz

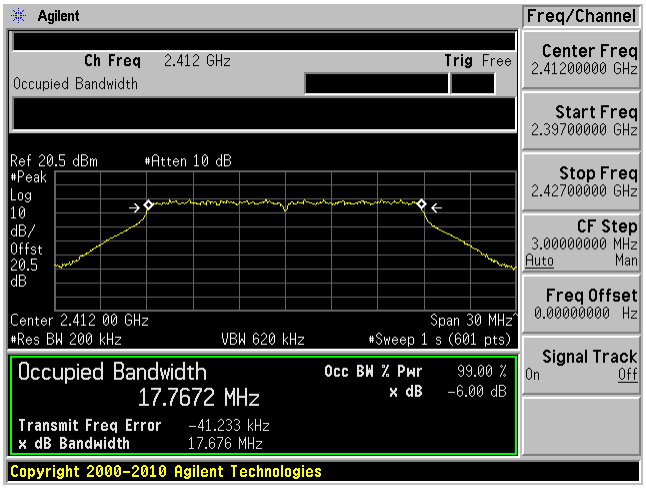


High Channel 2462 MHz

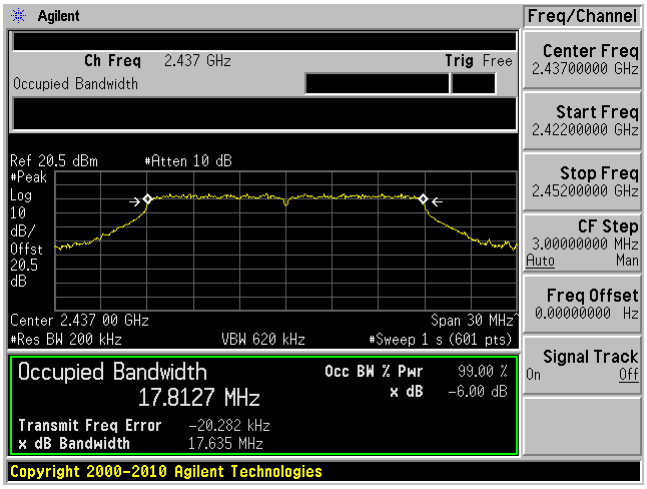


802.11n20 mode

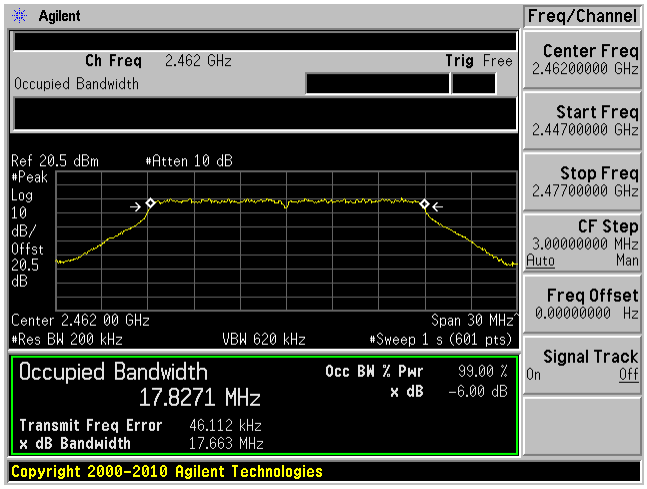
Low Channel 2412 MHz



Middle Channel 2437 MHz

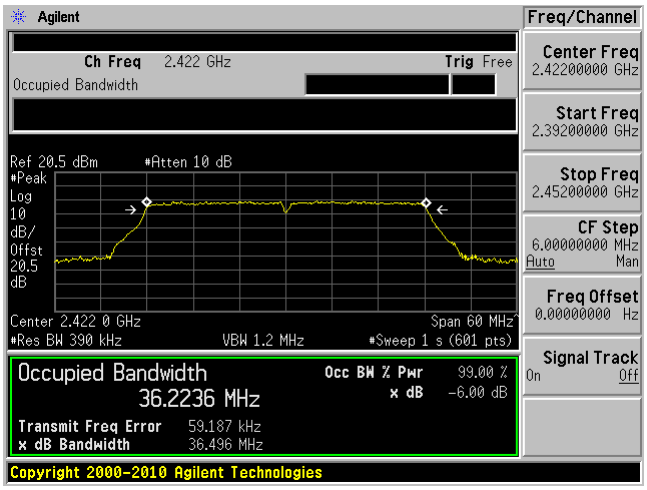


High Channel 2462 MHz

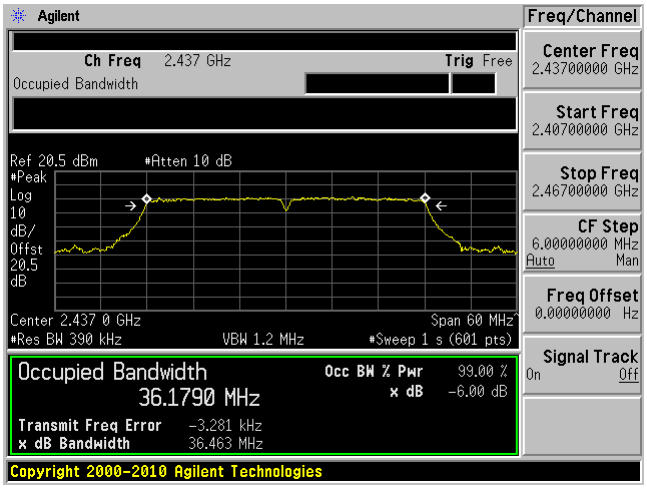


802.11n40 mode

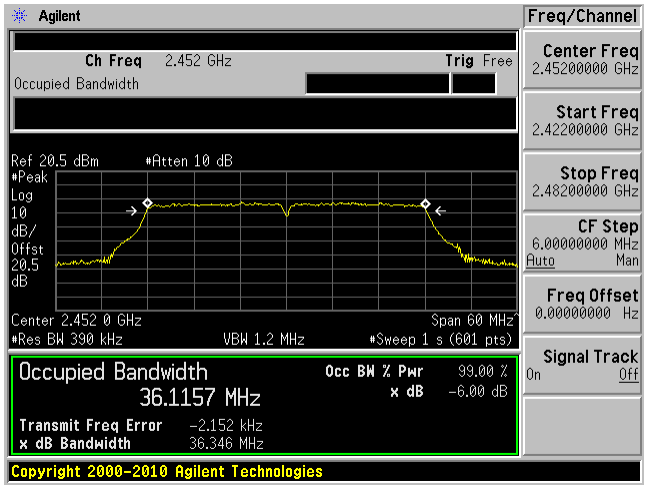
Low Channel 2422 MHz



Middle Channel 2437 MHz

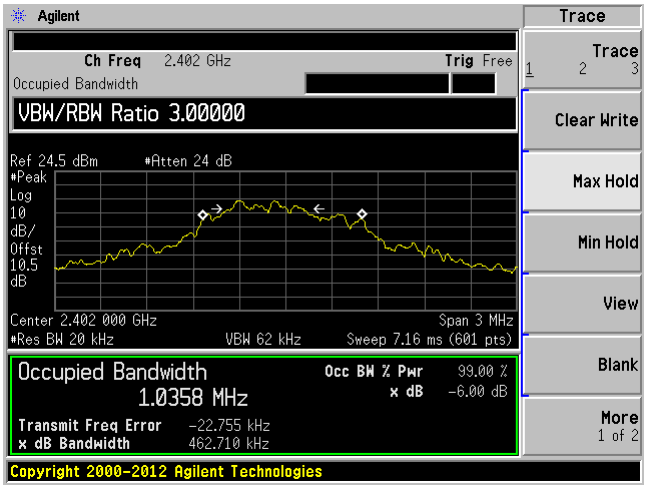


High Channel 2452 MHz

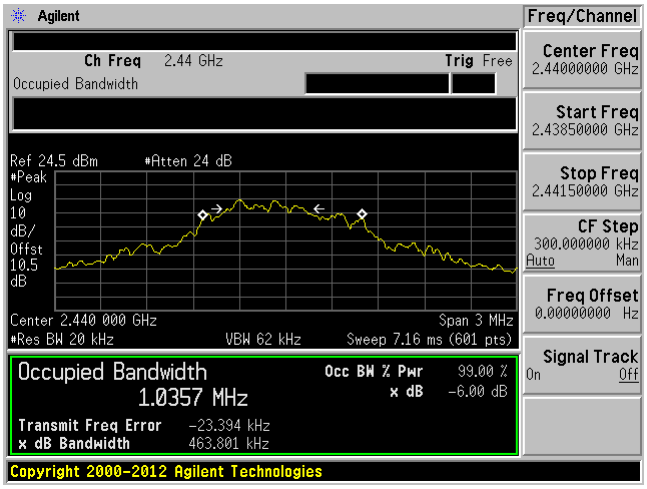


BLE

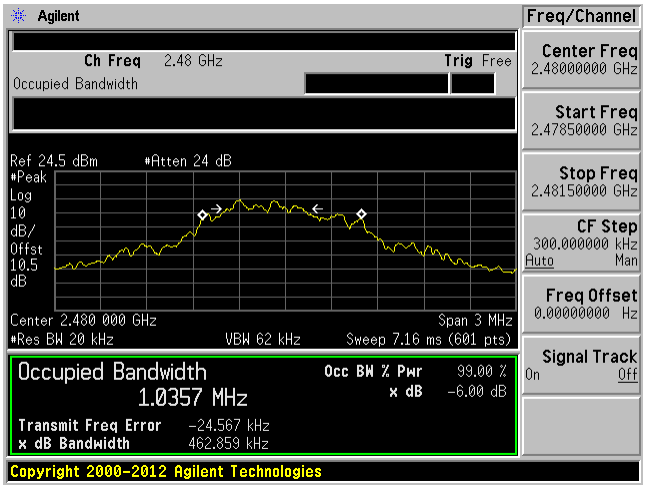
Low Channel 2402 MHz



Middle Channel 2440 MHz



High Channel 2480 MHz



9 FCC §15.247(b) (3) - Output Power Measurement

9.1 Applicable Standards

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

9.2 Measurement Procedure

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

9.2.2.6 Method AVGSA-3 (RMS detection across on- and off-times of the EUT with max hold)

a) Set span to at least 1.5 × OBW.
b) Set sweep trigger to "free run".
c) Set RBW = 1 % to 5 % of the OBW, not to exceed 1 MHz.
d) Set VBW ≥ 3 × RBW
e) Number of points in sweep ≥ 2 × span / RBW. (This gives bin-to-bin spacing ≤ RBW/2, so that narrowband signals are not lost between frequency bins.)
f) Sweep time ≤ (number of points in sweep) × T, where T is defined in Section 6.0. If this gives a sweep time less than the auto sweep time of the instrument, Method AVGSA-3 shall not be used (use AVGSA-3 Alternative). The purpose of this step is so that averaging time in each bin is less than or equal to the minimum time of a transmission.
g) Detector = RMS.
h) Trace mode = max hold.
i) Allow max hold to run for at least 60 s, or longer as needed to allow the trace to stabilize.
j) Compute power by integrating the spectrum across the OBW of the signal using the instrument's band power measurement function with band limits set equal to the OBW band edges. If the instrument does not have a band power function, sum the spectrum levels (in power units) at intervals equal to the RBW extending across the entire OBW.

9.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Analyzer, Spectrum	E4440A	US45303156	2018-02-26	1 year
ETS-LINDGREN	Power Sensor	7002-006	160097	2016-12-05	2 years
-	RF cable	-	-	Each time[1]	N/A
-	10dB attenuator	-	-	Each time[1]	N/A
-	20dB 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 of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with A2LA Policy P102 (dated 09 June 2016) "A2LA Policy on Metrological Traceability".*

9.4 Test Environmental Conditions

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

The testing was performed by Harry Zhao on 2018-11-02 and Frank Wang on 2018-12-03 in RF site.

9.5 Test Results

Output Power 2.4 GHz Wi-Fi

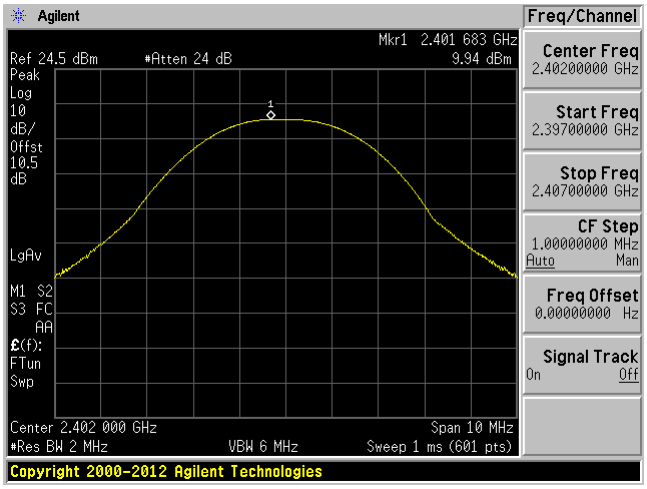
Channel	Frequency (MHz)	Average Output Power (dBm)	Limit (dBm)
802.11b mode			
Low	2412	14.12	30
Middle	2437	14.37	30
High	2462	14.59	30
802.11g mode			
Low	2412	11.84	30
Middle	2437	14.95	30
High	2462	12.38	30
802.11n20 mode			
Low	2412	10.87	30
Middle	2437	14.87	30
High	2462	11.68	30
802.11n40 mode			
Low	2422	10.94	30
Middle	2437	12.91	30
High	2452	8.92	30

BLE

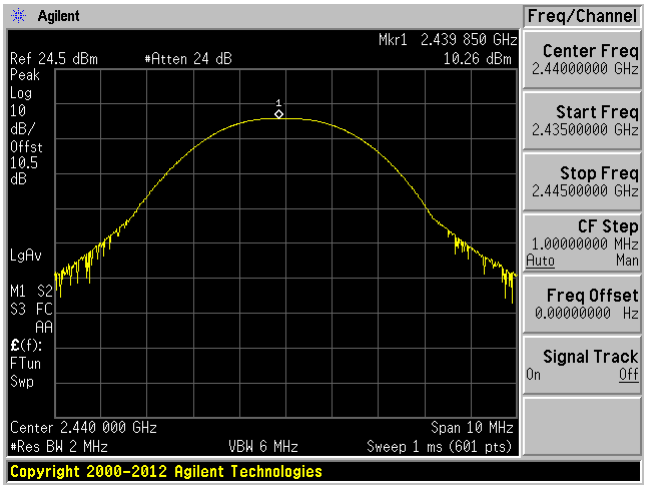
Channel	Frequency (MHz)	Peak Output Power (dBm)	Limit (dBm)
BLE			
Low	2402	9.94	30
Middle	2440	10.26	30
High	2480	10.15	30

BLE

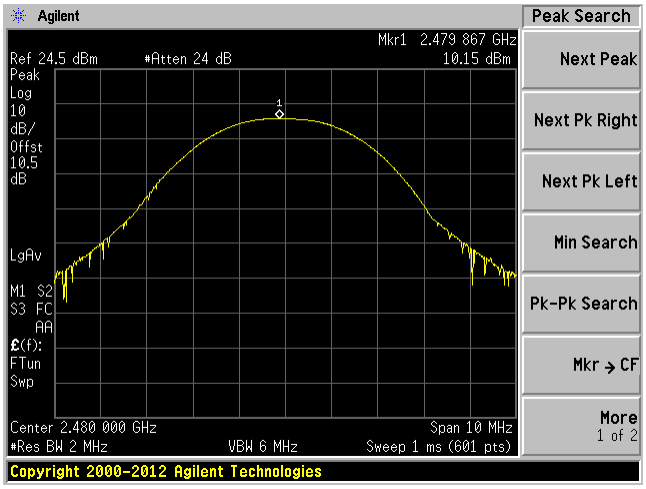
Low Channel 2402 MHz



Middle Channel 2440 MHz



High Channel 2480 MHz



10 FCC §15.247(d) - 100 kHz Bandwidth of Band Edges

10.1 Applicable Standards

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

10.2 Measurement Procedure

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

10.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Analyzer, Spectrum	E4440A	US45303156	2018-02-26	1 year
-	RF cable	-	-	Each time[1]	N/A
-	10dB attenuator	-	-	Each time[1]	N/A
-	20dB 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 of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with A2LA Policy P102 (dated 09 June 2016) "A2LA Policy on Metrological Traceability".*

10.4 Test Environmental Conditions

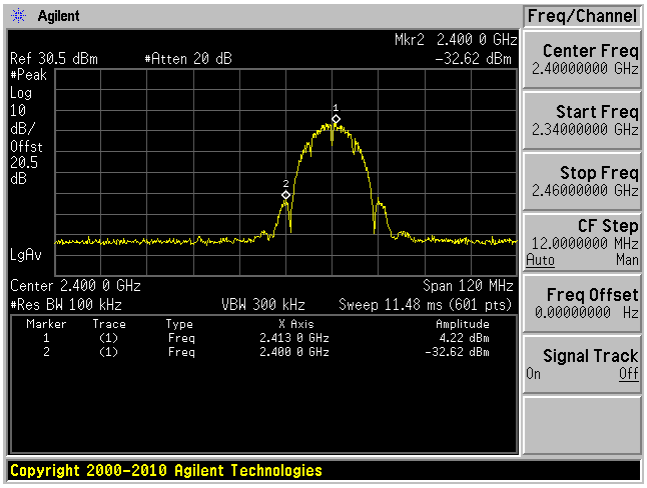
Temperature:	23º C
Relative Humidity:	42 %
ATM Pressure:	102.7 KPa

The testing was performed by Harry Zhao on 2018-11-02 and Frank Wang on 2018-12-03 in RF site.

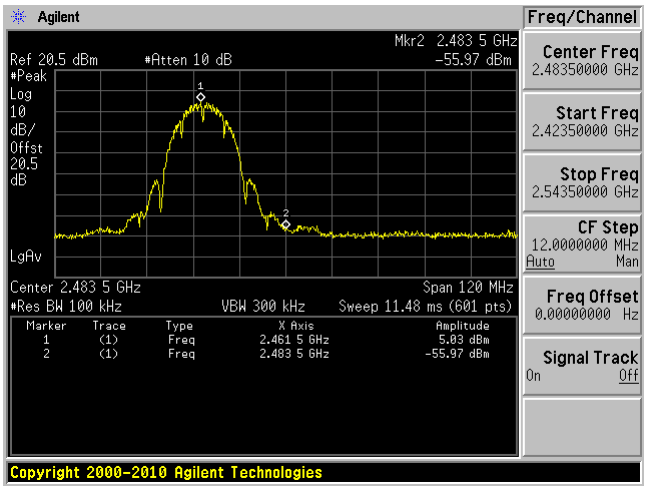
10.5 Test Results

802.11b mode

Low Channel 2412 MHz

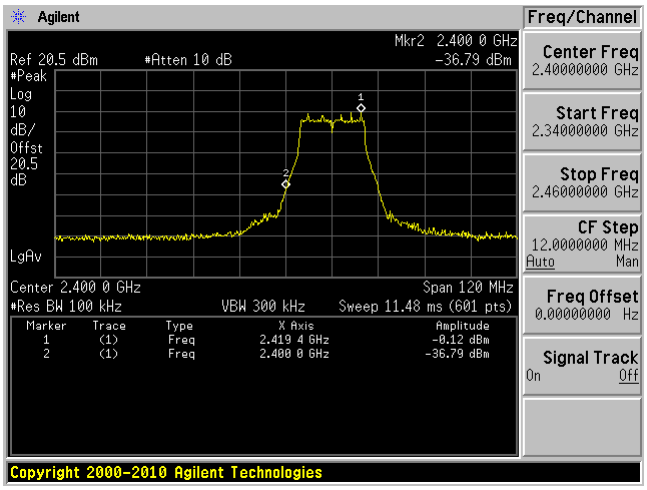


High Channel 2462 MHz

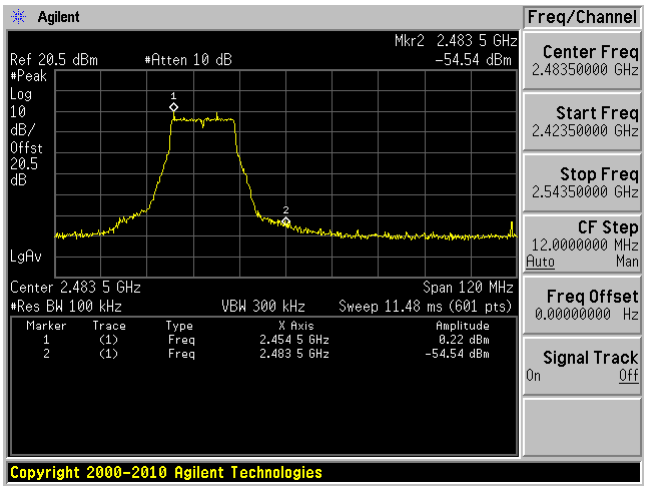


802.11g mode

Low Channel 2412 MHz

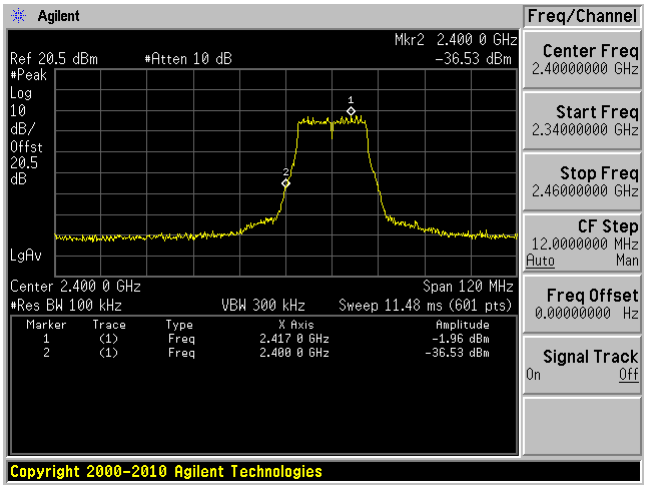


High Channel 2462 MHz

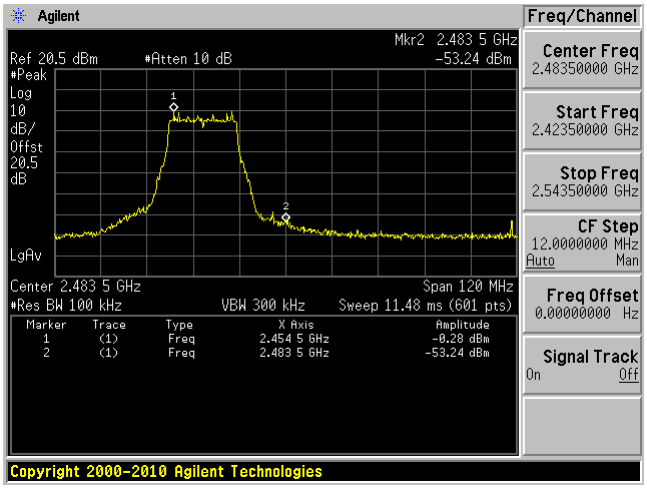


802.11n20 mode

Low Channel 2412 MHz

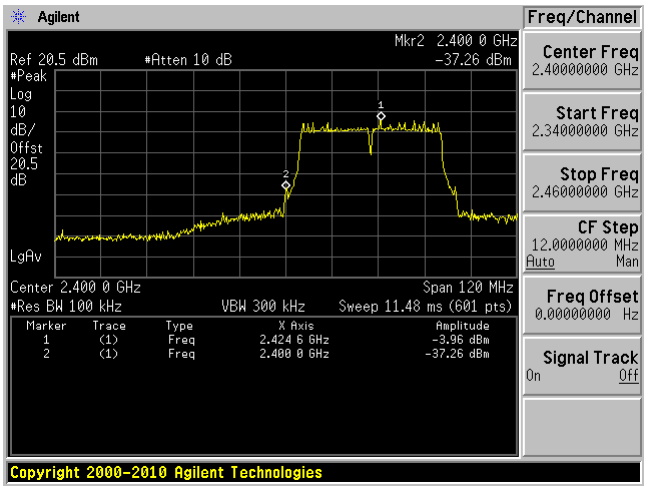


High Channel 2462 MHz

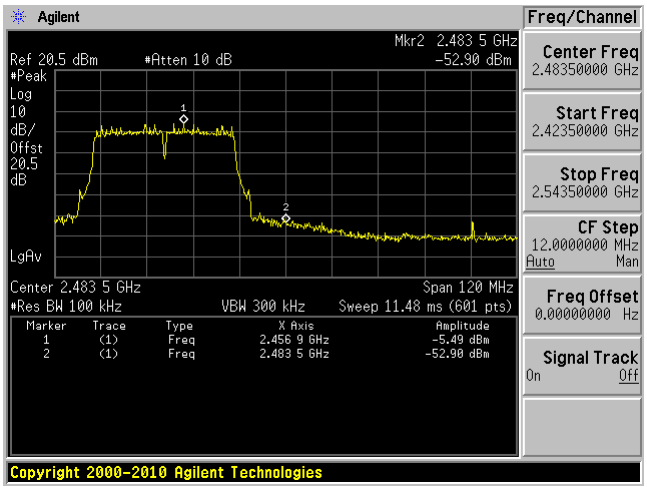


802.11n40 mode

Low Channel 2412 MHz

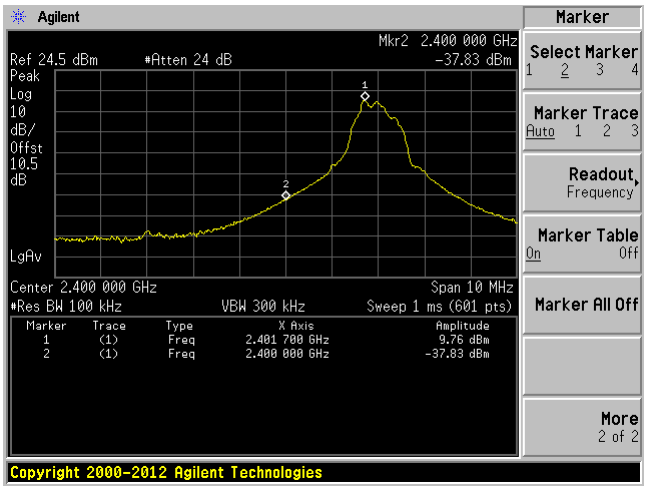


High Channel 2462 MHz

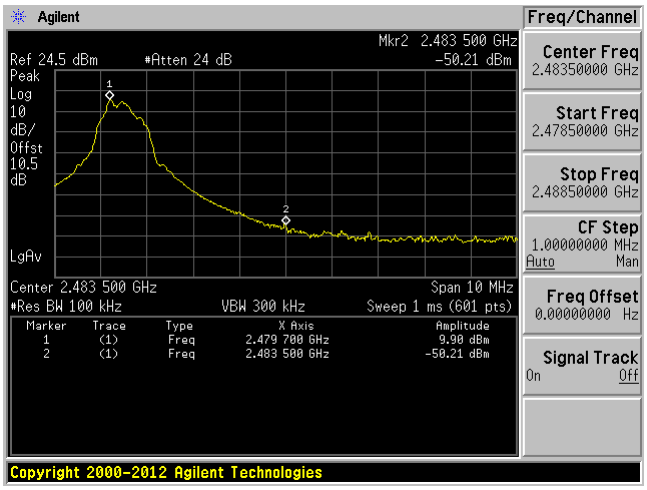


BLE

Low Channel 2402 MHz



High Channel 2480 MHz



11 FCC §15.247(e) - Power Spectral Density

11.1 Applicable Standards

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

11.2 Measurement Procedure

The measurements are based on FCC KDB 558074 D01 DTS Meas Guidance v04: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 section 10: Maximum power spectral density level in the fundamental emission.

11.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Analyzer, Spectrum	E4440A	US45303156	2018-02-26	1 year
-	RF cable	-	-	Each time[1]	N/A
-	10dB attenuator	-	-	Each time[1]	N/A
-	20dB 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 of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with A2LA Policy P102 (dated 09 June 2016) "A2LA Policy on Metrological Traceability".*

11.4 Test Environmental Conditions

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

The testing was performed by Harry Zhao on 2018-11-02 and Frank Wang on 2018-12-03 in RF site.

11.5 Test Results

2.4 GHz Wi-Fi

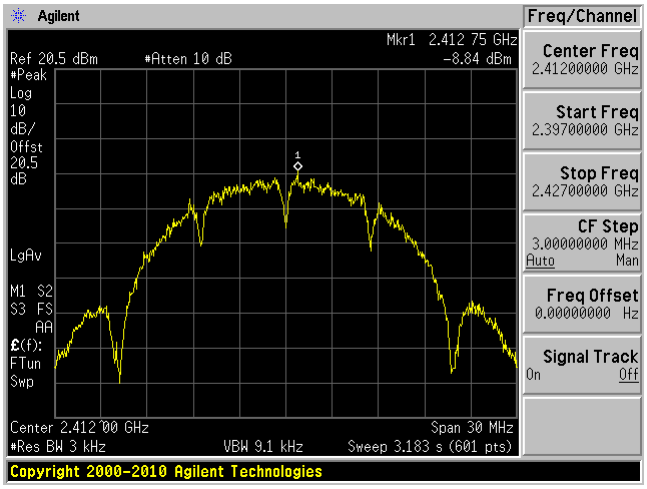
Channel	Frequency (MHz)	Power Spectral Density (dBm/3kHz)	Limit (dBm/3kHz)
802.11b mode			
Low	2412	-8.84	8
Middle	2437	-8.88	8
High	2462	-9.81	8
802.11g mode			
Low	2412	-14.30	8
Middle	2437	-11.66	8
High	2462	-13.41	8
802.11n20 mode			
Low	2412	-15.60	8
Middle	2437	-12.40	8
High	2462	-14.51	8
802.11n40 mode			
Low	2422	-17.91	8
Middle	2437	-16.56	8
High	2452	-20.79	8

BLE

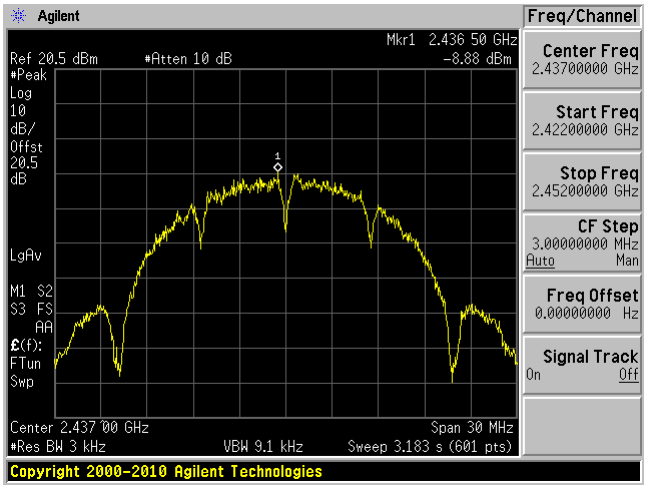
Channel	Frequency (MHz)	Power Spectral Density (dBm/3kHz)	Limit (dBm/3kHz)
BLE			
Low	2402	-7.48	8
Middle	2440	-7.19	8
High	2480	-7.34	8

802.11b mode

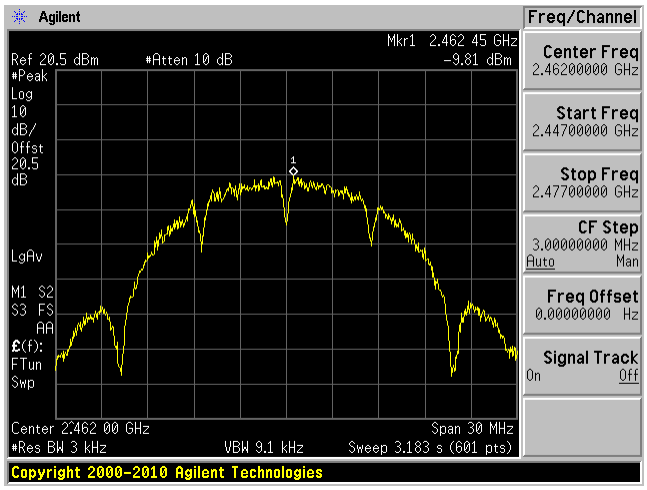
Low Channel 2412 MHz



Middle Channel 2437 MHz

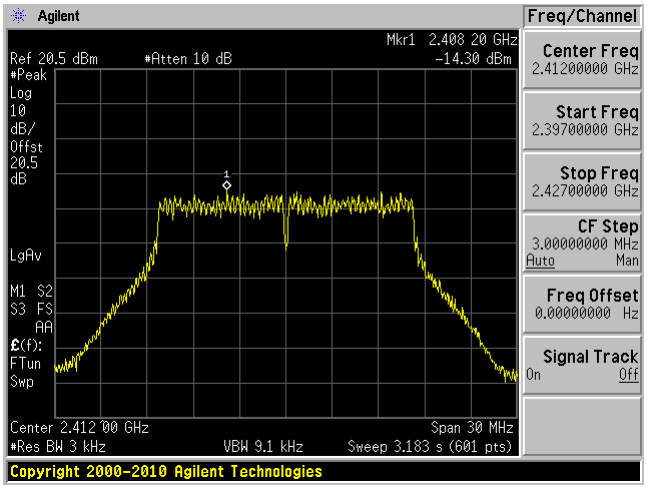


High Channel 2462 MHz

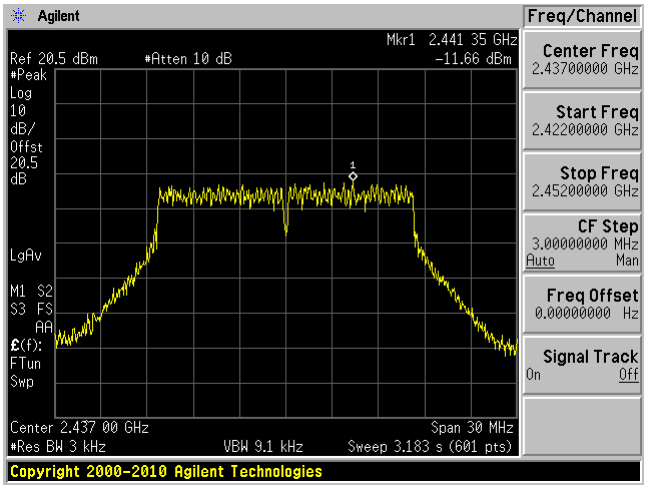


802.11g mode

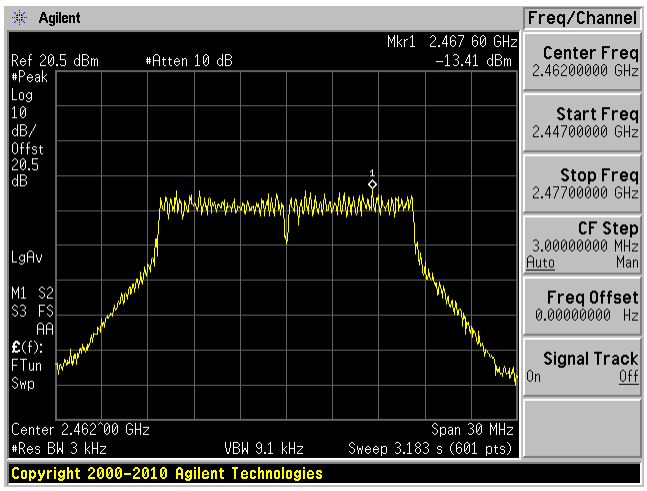
Low Channel 2412 MHz



Middle Channel 2437 MHz

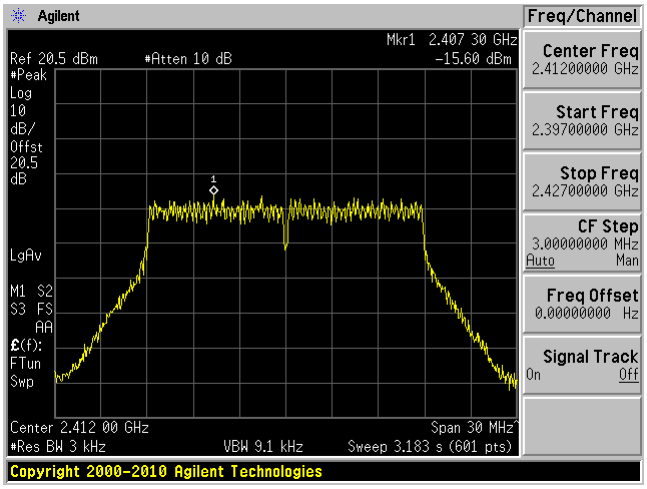


High Channel 2462 MHz

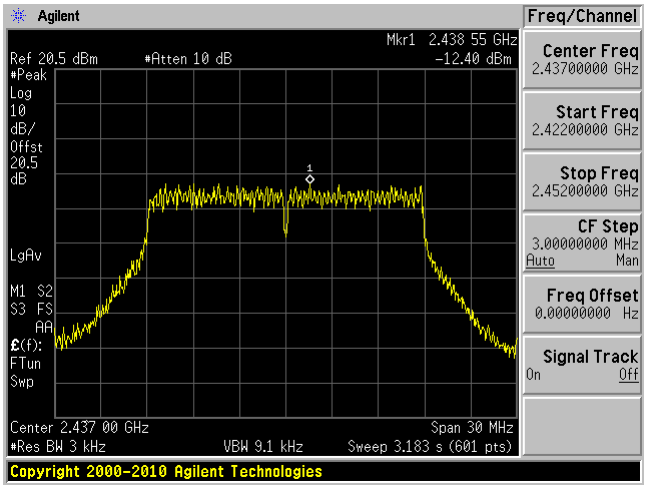


802.11n20 mode

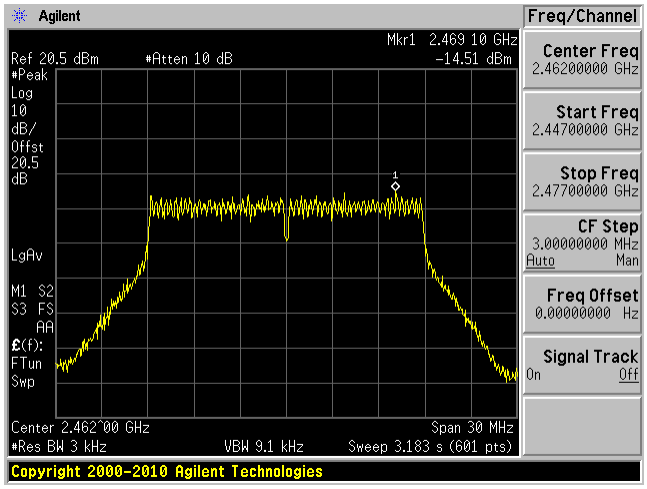
Low Channel 2412 MHz



Middle Channel 2437 MHz

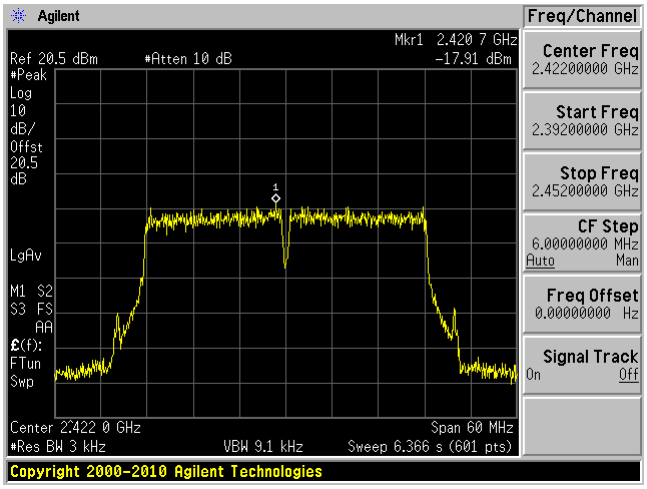


High Channel 2462 MHz

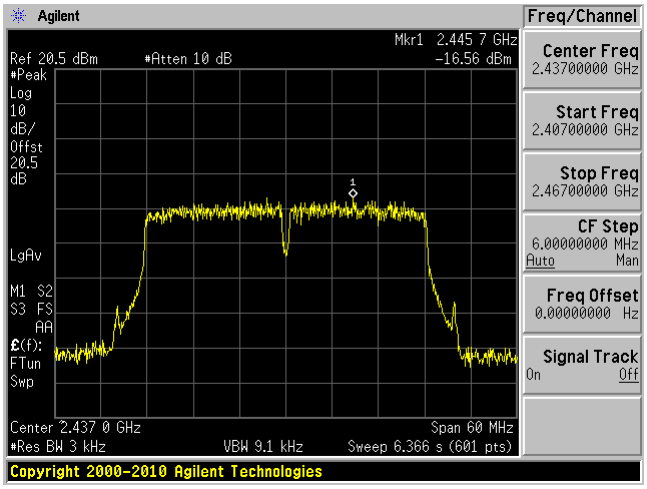


802.11n40 mode

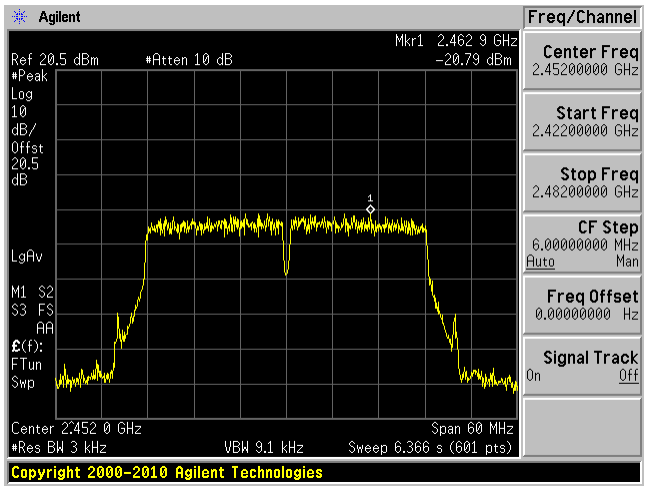
Low Channel 2422 MHz



Middle Channel 2437 MHz

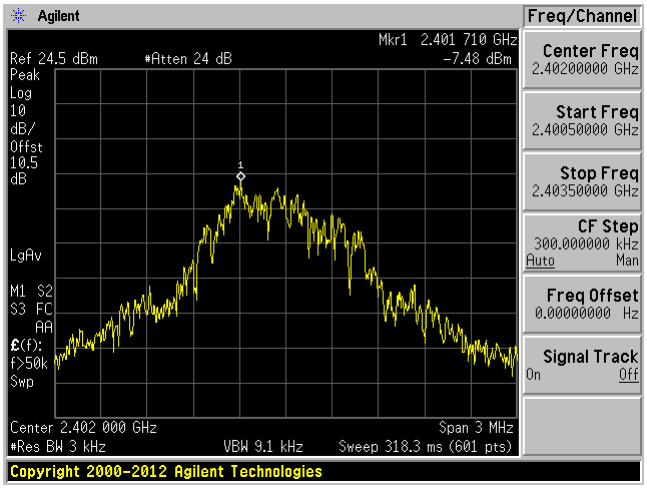


High Channel 2452 MHz

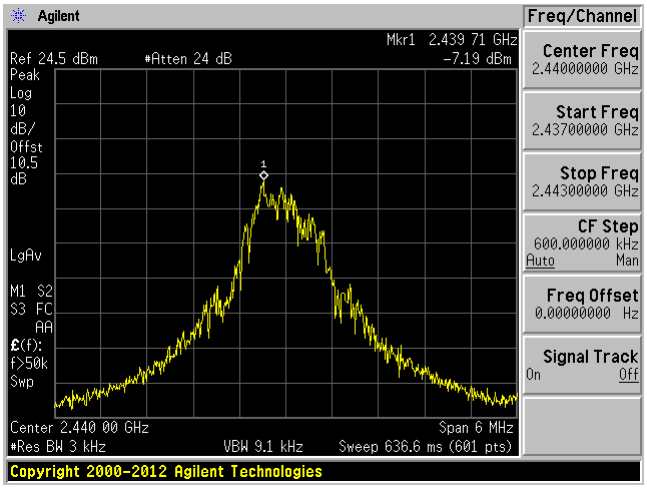


BLE

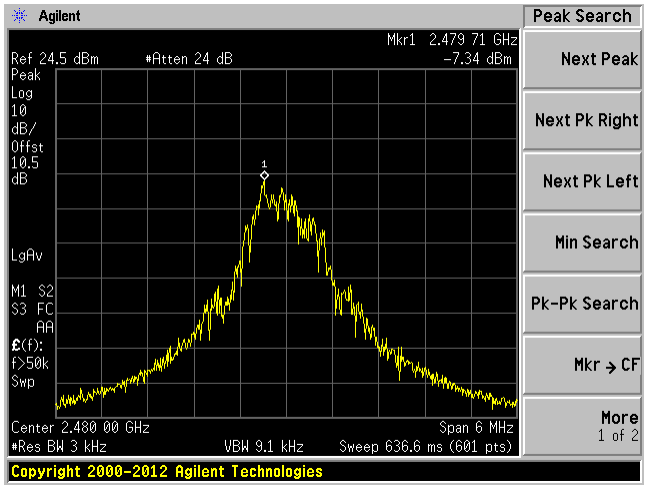
Low Channel 2402 MHz



Middle Channel 2440 MHz



High Channel 2480 MHz



12 FCC §15.247(d) - Spurious Emissions at Antenna Terminals

12.1Applicable 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)).

12.2Test 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.

12.3Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Analyzer, Spectrum	E4440A	US45303156	2018-02-26	1 year
-	RF cable	-	-	Each time[1]	N/A
-	10dB attenuator	-	-	Each time[1]	N/A
-	20dB 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 of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with A2LA Policy P102 (dated 09 June 2016) "A2LA Policy on Metrological Traceability".*

12.4Test Environmental Conditions

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

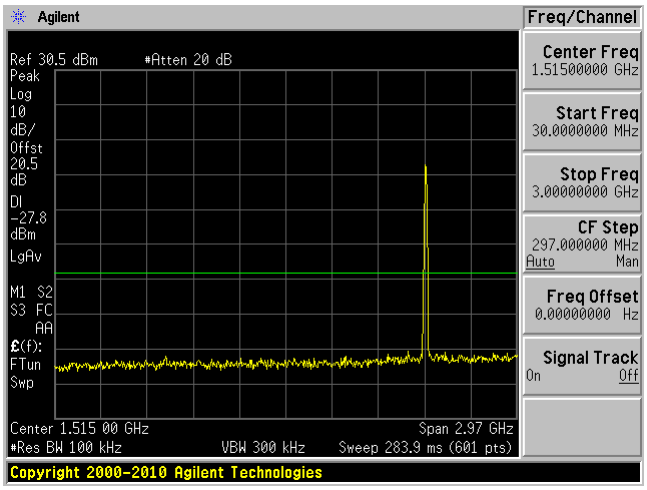
The testing was performed by Harry Zhao on 2018-11-02 and Frank Wang on 2018-12-03 in RF site.

12.5 Test Results

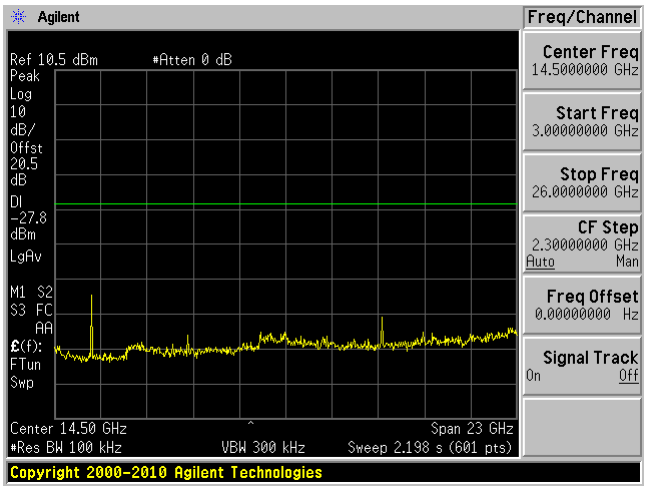
Please refer to following plots.

802.11b mode

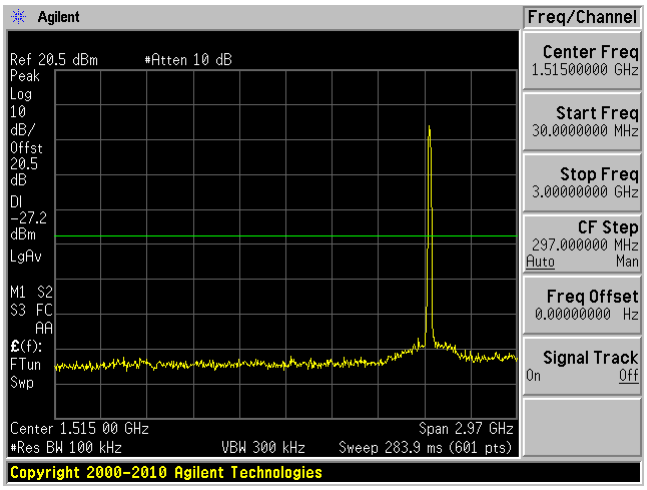
Low Channel 30MHz – 3 GHz



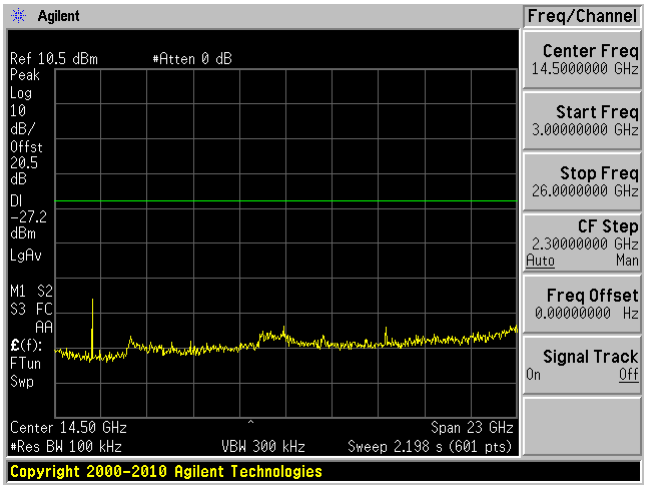
Low Channel 3 GHz – 26 GHz



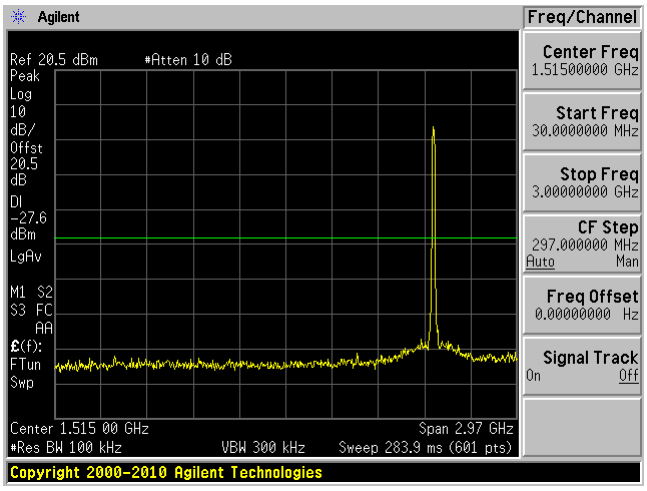
Middle Channel 30 MHz – 3 GHz



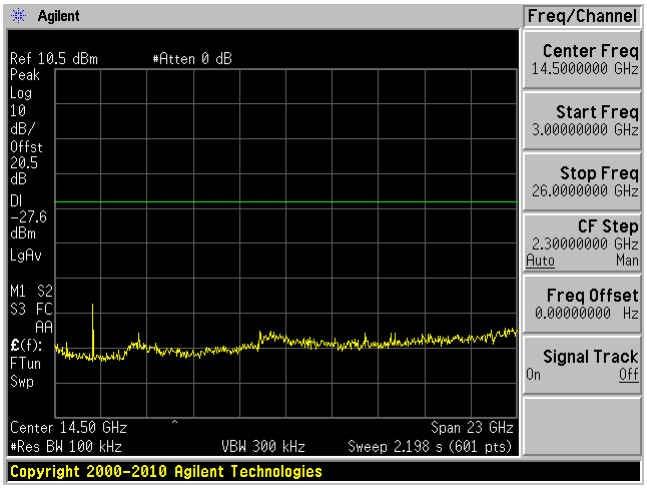
Middle Channel 3 GHz – 26 GHz



High Channel 30 MHz – 3 GHz

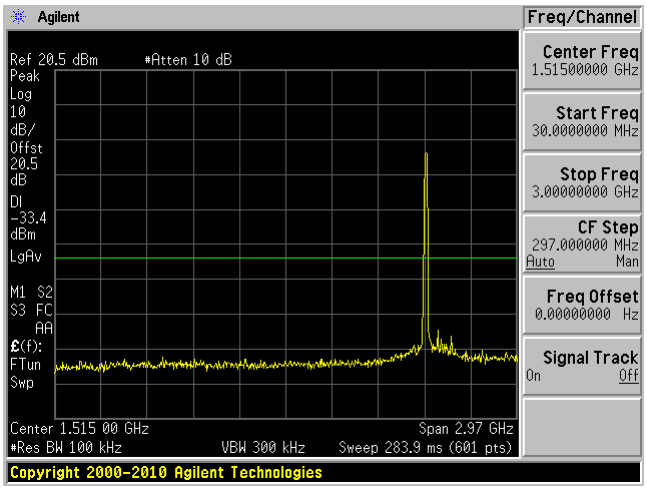


High Channel 3 GHz – 26 GHz

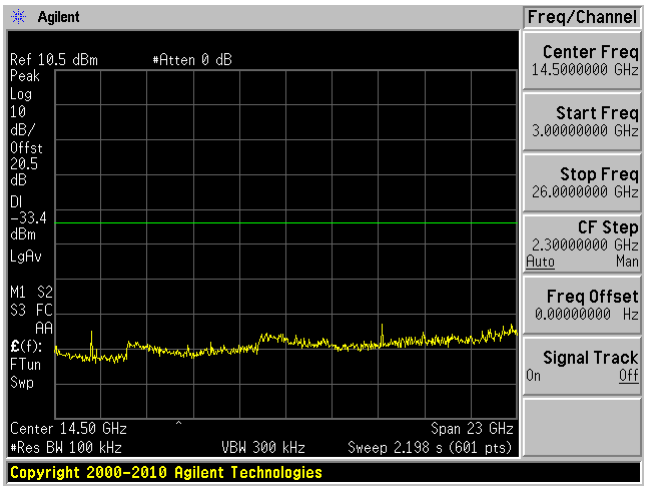


802.11g mode

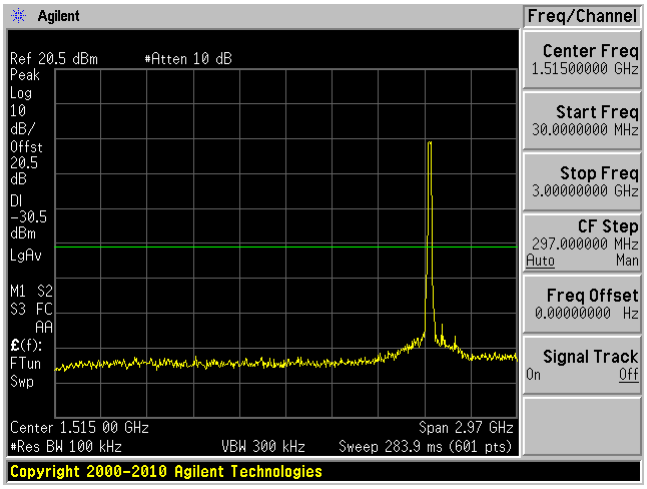
Low Channel 30MHz – 3 GHz



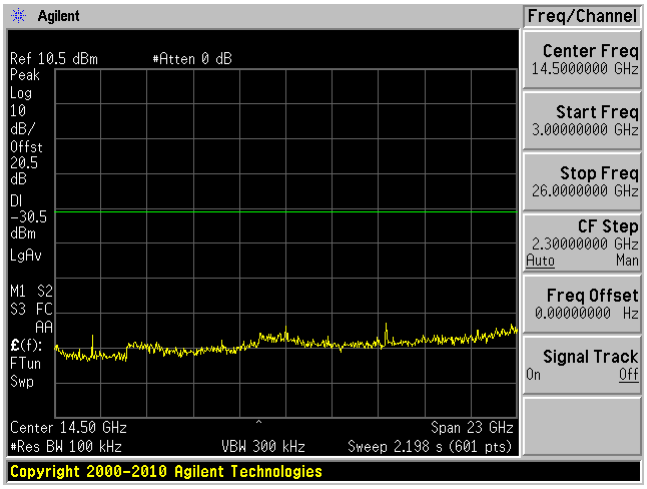
Low Channel 3 GHz – 26 GHz



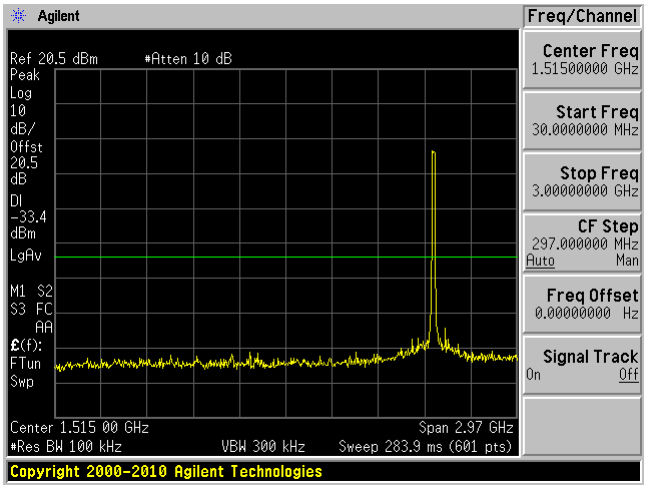
Middle Channel 30 MHz – 3 GHz



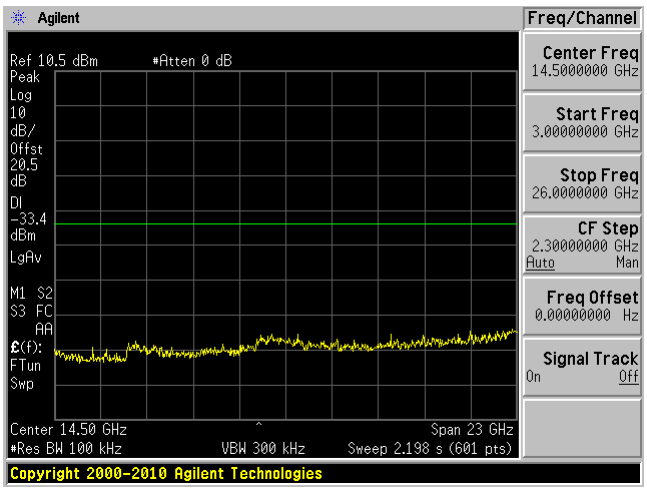
Middle Channel 3 GHz – 26 GHz



High Channel 30 MHz – 3 GHz

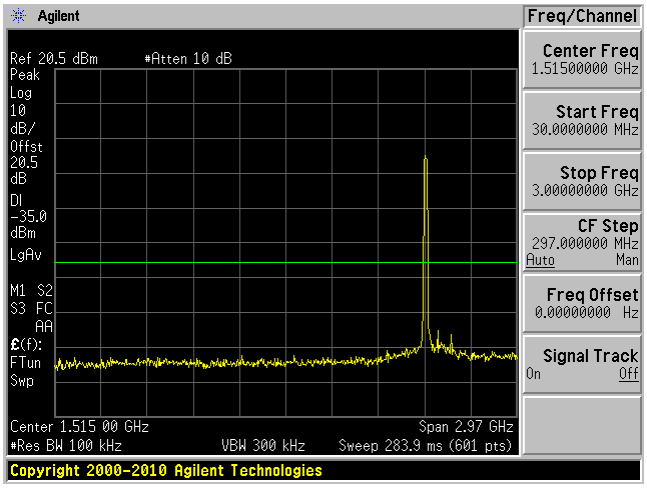


High Channel 3 GHz – 26 GHz

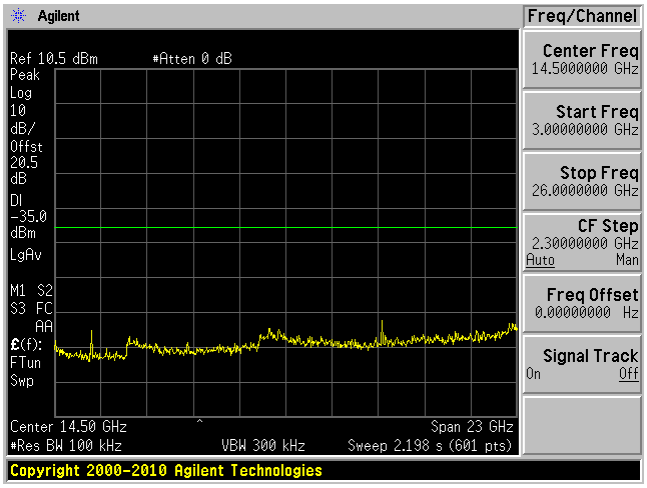


802.11n20 mode

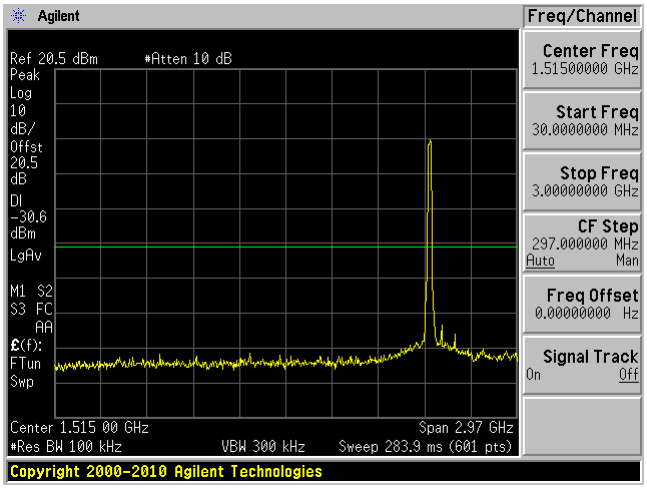
Low Channel 30MHz – 3 GHz



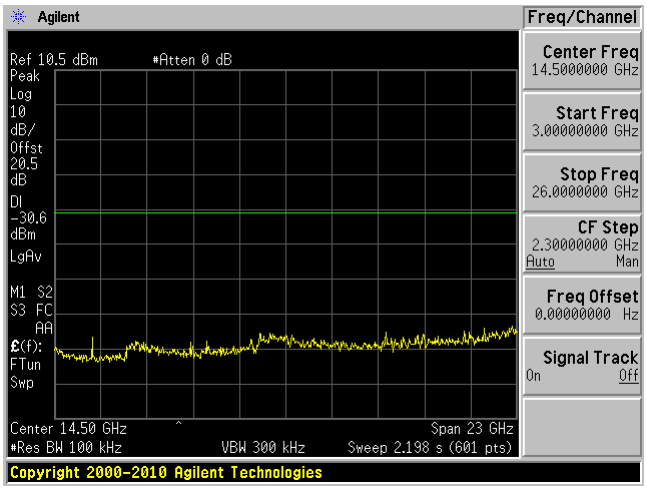
Low Channel 3 GHz – 26 GHz



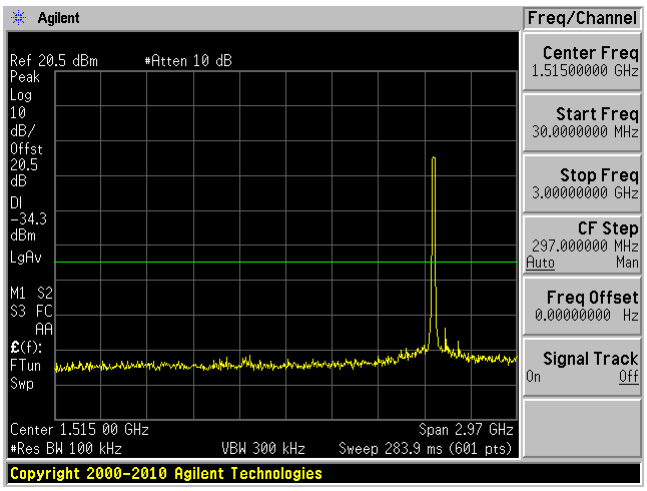
Middle Channel 30 MHz – 3 GHz



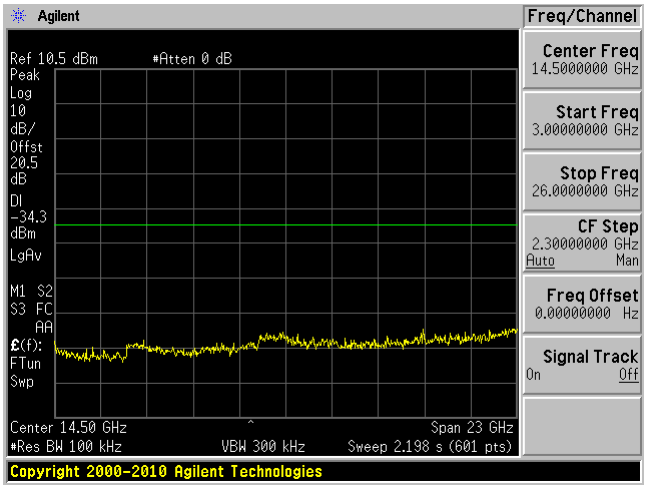
Middle Channel 3 GHz – 26 GHz



High Channel 30 MHz – 3 GHz

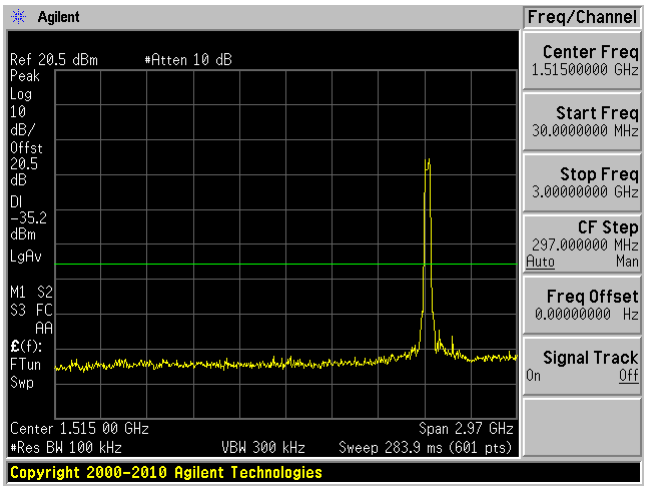


High Channel 3 GHz – 26 GHz

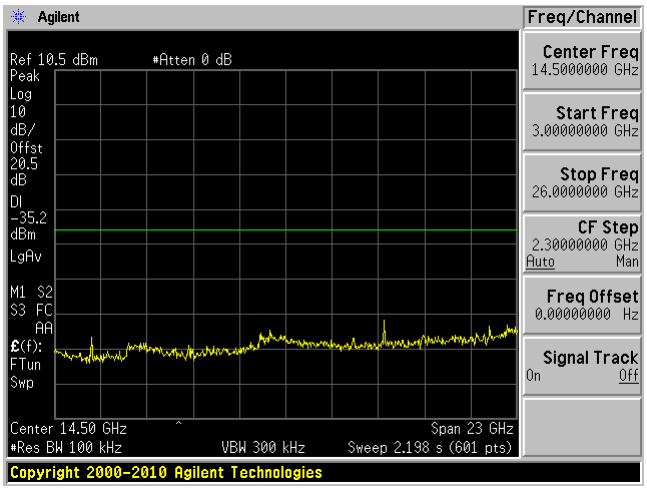


802.11n40 mode

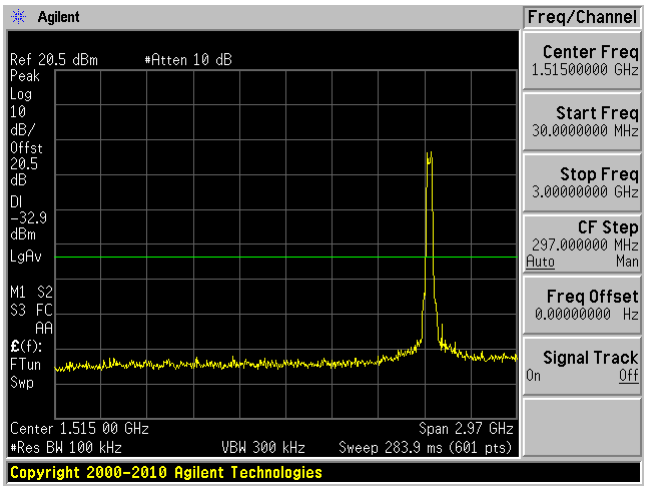
Low Channel 30 MHz – 3 GHz



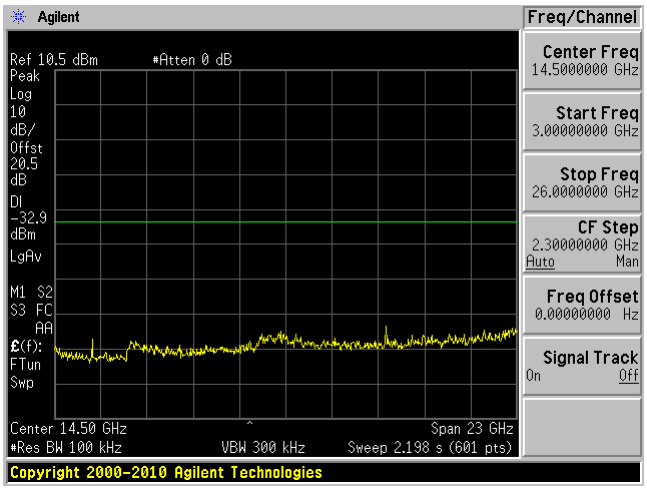
Low Channel 3 GHz – 26 GHz



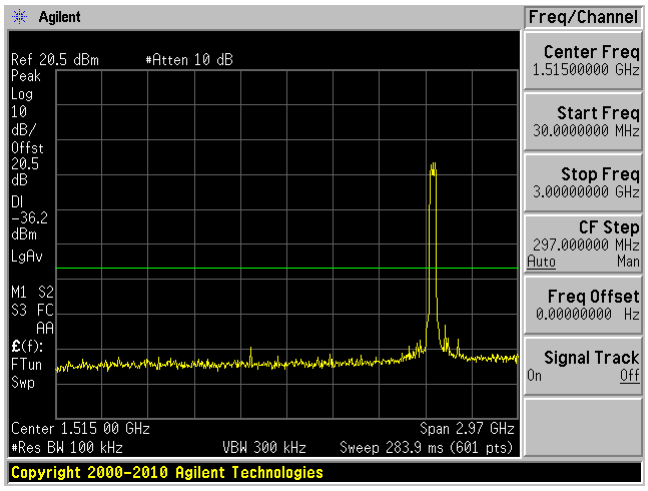
Middle Channel 30 MHz – 3 GHz



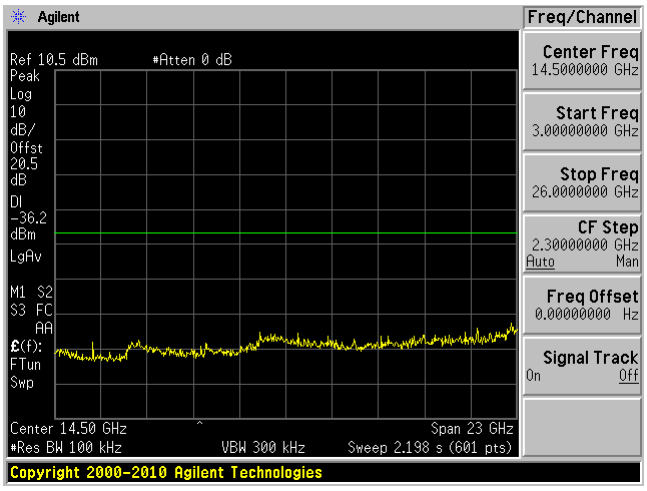
Middle Channel 3 GHz – 26 GHz



High Channel 30 MHz – 3 GHz

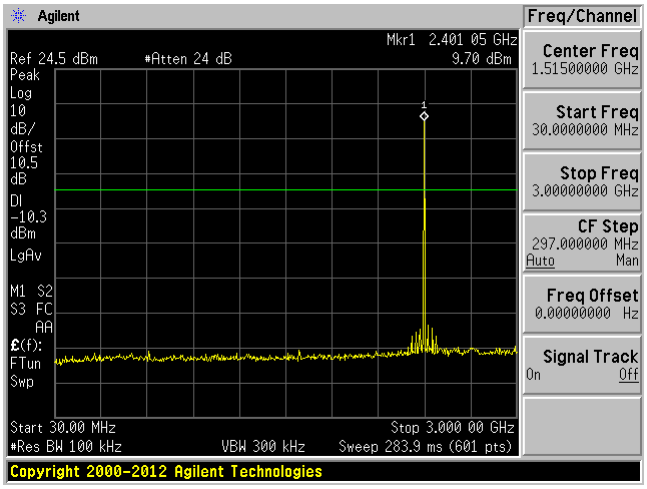


High Channel 3 GHz – 26 GHz

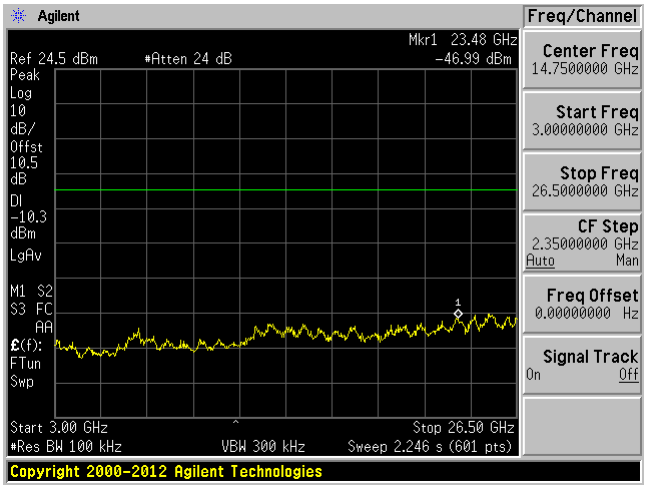


BLE

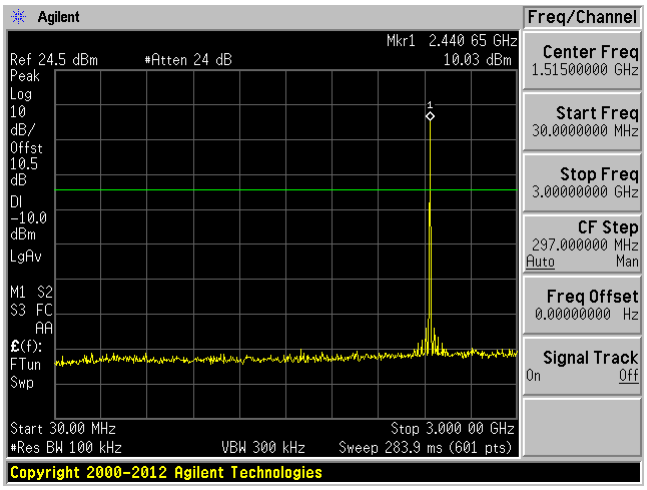
Low Channel 30 MHz – 3 GHz



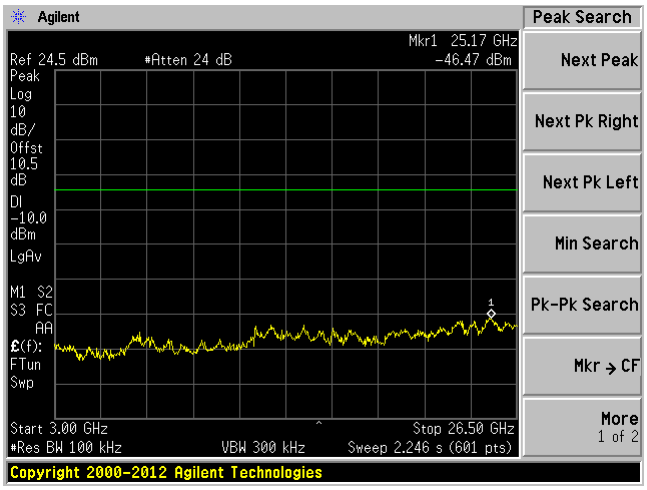
Low Channel 3 GHz – 26 GHz



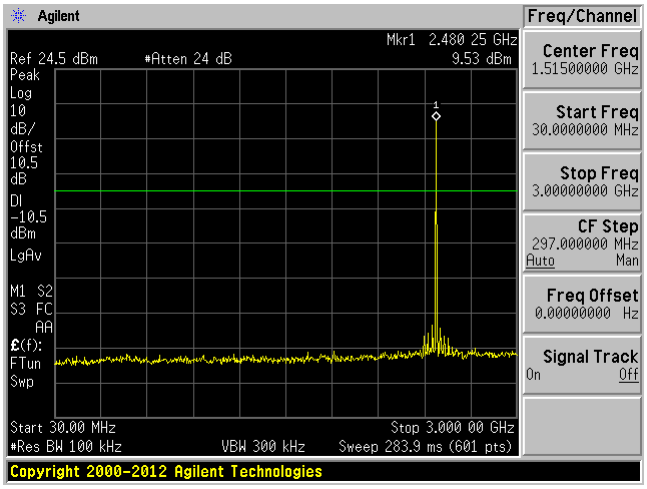
Middle Channel 30 MHz – 3 GHz



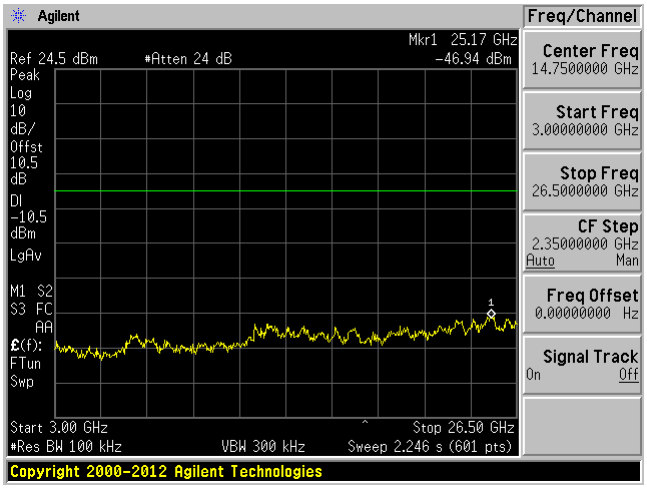
Middle Channel 3 GHz – 26 GHz



High Channel 30 MHz – 3 GHz



High Channel 3 GHz – 26 GHz



13 Exhibit A - FCC Equipment Labeling Requirements

13.1 FCC ID Label Requirements

As per FCC §2.925,

(a) Each equipment covered in an application for equipment authorization shall bear a nameplate or label listing the following:

(1) FCC Identifier consisting of the two elements in the exact order specified in §2.926. The FCC Identifier shall be preceded by the term FCC ID in capital letters on a single line, and shall be of a type size large enough to be legible without the aid of magnification.

Example: FCC ID: XXX123

Where: XXX—Grantee Code, 123—Equipment Product Code

As per FCC §15.19,

(a) In addition to the requirements in part 2 of this chapter, a device subject to certification, or verification shall be labeled as follows:

(3) All other devices shall bear the following statement in a conspicuous location on the device:
This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

(4) Where a device is constructed in two or more sections connected by wires and marketed together, the statement specified above is required to be affixed only to the main control unit. If the EUT is integrated within another device then a label affixed to the host shall also state, "Contains FCC ID: XXXXXX"

(5) When the device is so small or for such use that it is not practicable to place the statement specified under paragraph (a) of this section on it, the information required by this paragraph shall be placed in a prominent location in the instruction manual or pamphlet supplied to the user or, alternatively, shall be placed on the container in which the device is marketed. However, the FCC identifier or the unique identifier, as appropriate, must be displayed on the device.

12.3 Recommended Label Contents and Location

Bottom Side of EUT

14 Appendix A (Normative) - EUT Test Setup Photographs

Please see attachment.

15 Appendix B (Normative) – EUT External Photographs

Please see attachment.

16 Appendix C (Normative) – EUT Internal Photographs

Please see attachment.

16 Appendix D (Normative) - 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 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 April 2017*).

Presented this 2nd day of October 2018.

President and CEO
For the Accreditation Council
Certificate Number 3297.02
Valid to September 30, 2020

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

----- END OF REPORT -----