FCC PART 15, SUBPART C

TEST REPORT

For

SunPower Corporation

1414 Harbour Way South, Ste 1901,

Richmond, CA 94804

FCC ID: YAW523917

Report Type:	**Model:**
Original Report	SunPower STAC (523917)

Prepared By:	Vincent Licata Test Engineer
Report Number:	R1707273-247
Report Date:	2017-09-15
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TABLE OF CONTENTS

DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1707273-247	Original Report	-

1 General Description

1.1 Product Description for Equipment Under Test (EUT)

This test and measurement report was prepared on behalf of *SunPower Corporation* and their product model: SunPower STAC, Serial number: 523917 FCC ID: YAW523917 or the "EUT" as referred to in this report

1.2 Objective

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

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

1.3 Related Submittal(s)/Grant(s)

N/A

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 ° 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***
- - 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: (Industry Canada - IC) 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 & Teleterminal Equipment (R&TTE) Directive 1995/5/EC 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 Development Authority - IDA) APEC Tel MRA -Phase I & Phase II;
- Japan: VCCI - Voluntary Control Council for Interference US-Japan Telecom Treaty VCCI Side Letter
- USA:
  - 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 used was Putty provided by *SunPower Corporation*, the software is compliant with the standard requirements being tested against.

Modulation	Frequency (MHz)	Power Setting
802.11b	2412	18
	2437	18
	2462	18
802.11g	2412	11
	2437	11
	2462	11
802.11n20	2412	11
	2437	11
	2462	11
802.11n40	2422	10
	2437	10
	2452	10

Data Rates Tested:
802.11b mode: 1 Mbps
802.11g mode: 6 Mbps
802.11n HT20 mode: 6.5 Mbps
802.11n HT40 mode: 13.5 Mbps

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).

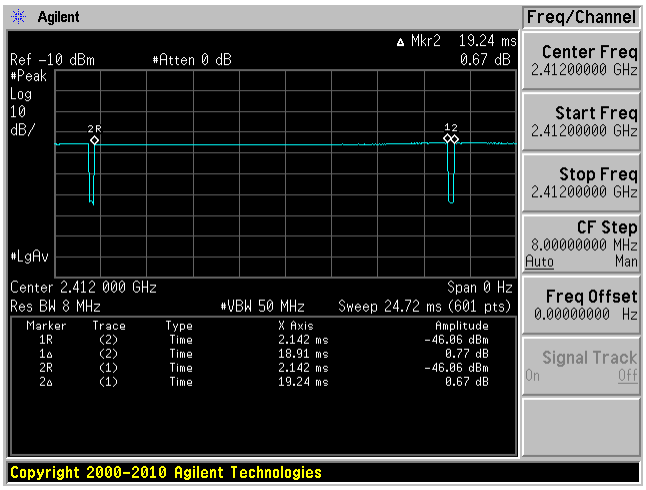
Radio Mode	On Time (ms)	Period (ms)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)
802.11b	18.91	19.24	98.28%	0.08
802.11g	3.13	10.01	31.27%	5.05
802.11n20	2.93	10.05	29.15%	5.35
802.11n40	1.442	10.05	14.35%	8.43

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

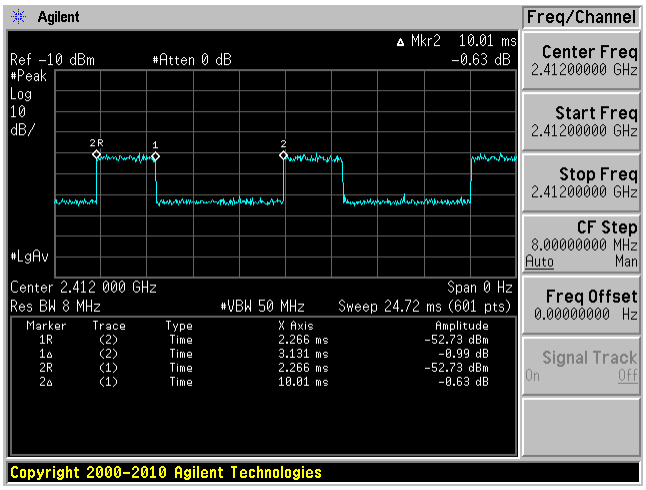
Please refer to the following plots.

Antenna Port J20

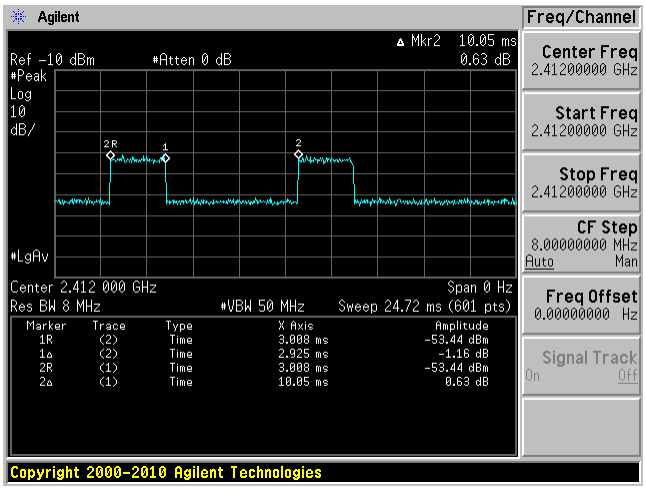
802.11b mode



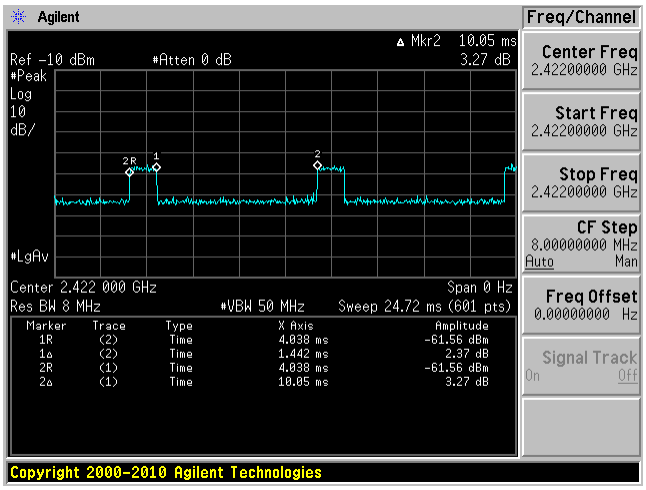
802.11g mode



802.11n20 mode



802.11 n40 mode



2.4 Equipment Modifications

No equipment modifications are made to the EUT

2.5 Local Support Equipment

Manufacturer	Description	Model
Dell	Laptop	Latitude E6410

2.6 Support Equipment

Manufacturer	Description	Model	Serial Number
AMETEK	DC Power Supply	Sorensen XHR 600-1.7	1118A03471

2.7 Interface Ports and Cabling

Cable Description	Length (m)	To	From
Micro USB to USB	< 1 m	Laptop	EUT
RF Cable	< 1 m	EUT	PSA
Power Supply Cables	6.5 m	EUT	Power Supply

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)	Maximum Peak 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 apply unique reverse SMA connectors.

Note[1]: See Annex C – EUT Photographs for visual of antenna attachment.

Antenna usage	Frequency Range (MHz)	Maximum Antenna Gain (dBi)
Wi-Fi	2400	0.8

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

Maximum peak output power at antenna input terminal (dBm):	16.89
Maximum peak output power at antenna input terminal (mW):	48.865
Prediction distance (cm):	20
Prediction frequency (MHz):	2412
Maximum Antenna Gain, typical (dBi):	0.8
Maximum Antenna Gain (numeric):	1.202
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.0117
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 0.0117 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 limits.

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

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

6.3 Test Procedure

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

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

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

6.4 Corrected Amplitude and Margin Calculation

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

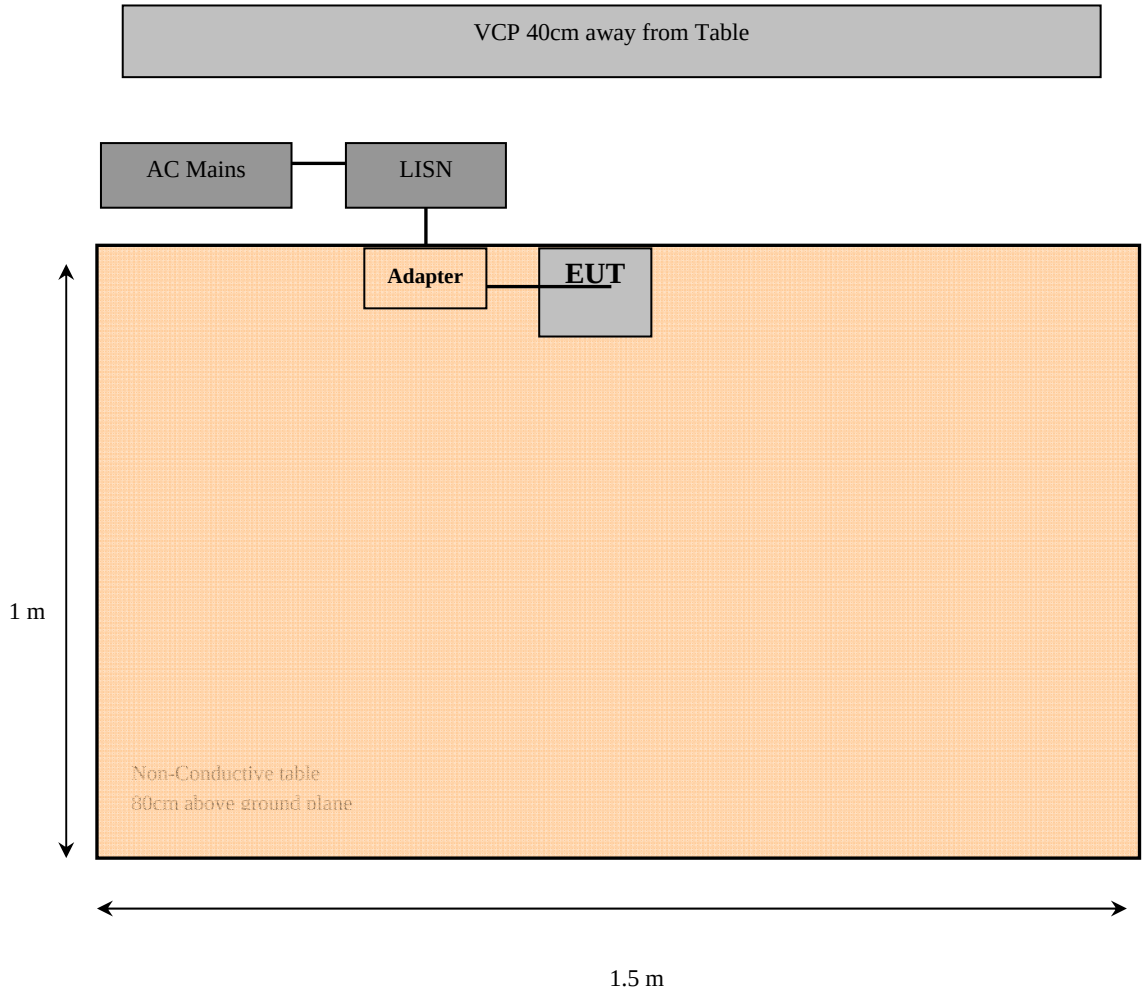
CA = Ai + CL + Atten

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

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

Margin = Corrected Amplitude – Limit

6.5 Test Setup Block Diagram



6.6 Test Equipment List and Details

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

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

6.7 Test Environmental Conditions

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

The testing was performed by Vincent Licata on 2017-08-31 in 5 chamber 3.

6.8 Summary of Test Results

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

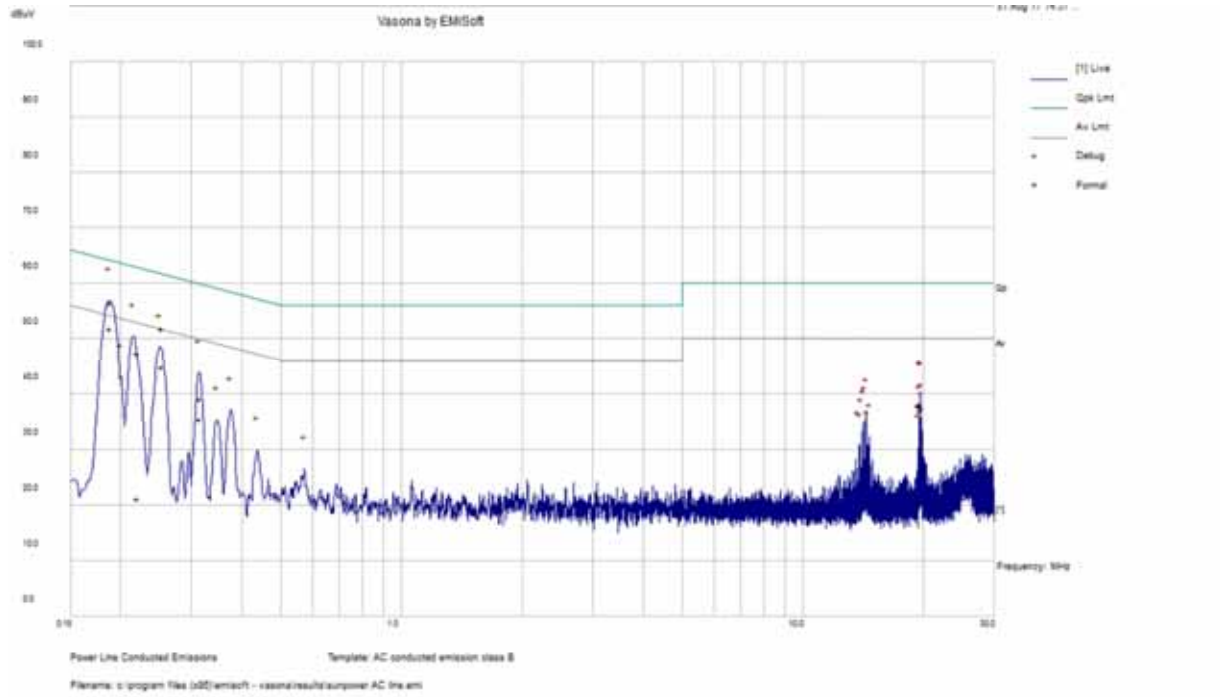
2.4 GHz Wi-Fi

Connection: AC/DC adapter connected to 120 V/60 Hz, AC			
Margin (dB)	**Frequency (MHz)**	**Conductor Mode (Line/Neutral)**	**Range (MHz)**
-2.26	0.187832	Line	0.15-30

6.9 Conducted Emissions Test Plots and Data

2.4 GHz Wi-Fi

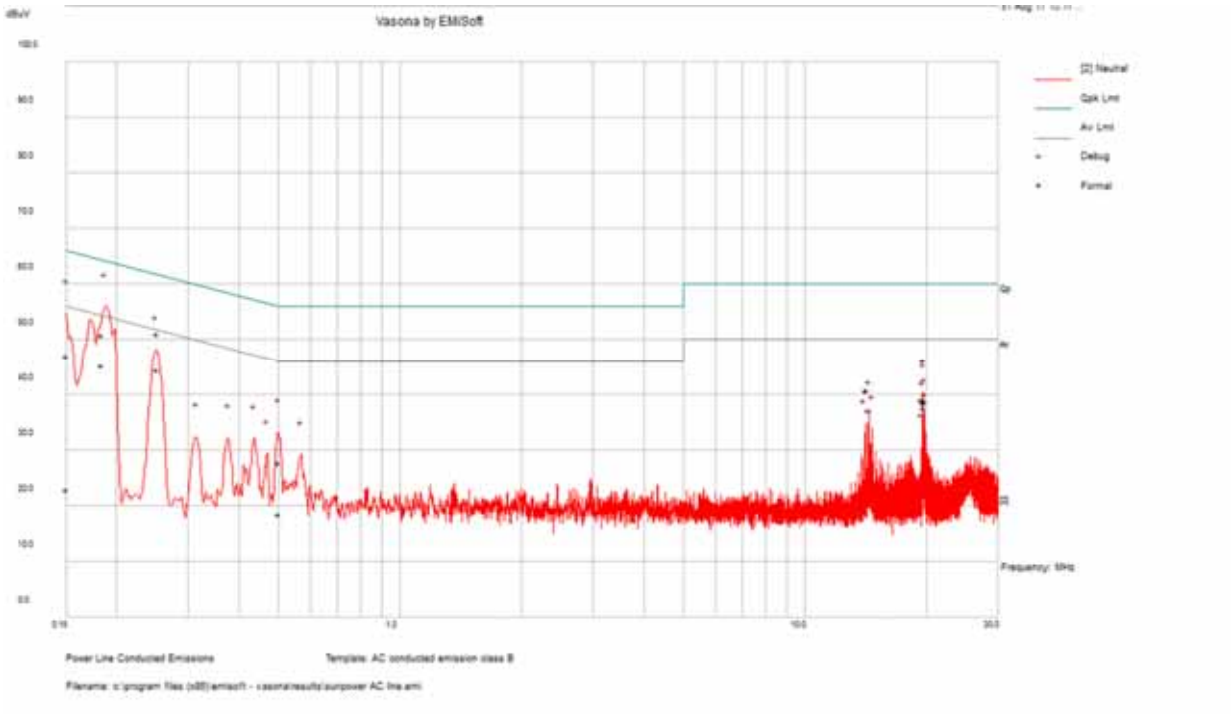
120 V, 60 Hz – Line



Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
0.187832	56.37	Line	64.13	-7.77	QP
0.220297	47.34	Line	62.81	-15.47	QP
0.252915	51.75	Line	61.66	-9.91	QP
0.313901	39.07	Line	59.87	-20.8	QP
19.63093	37.93	Line	60	-22.07	QP
19.56867	38.23	Line	60	-21.77	QP

Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
0.187832	51.87	Line	54.13	-2.26	Ave.
0.220297	21.33	Line	52.81	-31.48	Ave.
0.252915	44.88	Line	51.66	-6.78	Ave.
0.313901	35.56	Line	49.87	-14.3	Ave.
19.63093	37.09	Line	50	-12.91	Ave.
19.56867	37.78	Line	50	-12.22	Ave.

120 V, 60 Hz – Neutral



Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
0.18398	50.85	Neutral	64.3	-13.45	QP
0.150182	47.11	Neutral	65.99	-18.88	QP
0.252141	51.16	Neutral	61.69	-10.53	QP
19.56973	39.23	Neutral	60	-20.77	QP
19.63174	38.5	Neutral	60	-21.5	QP
0.50156	27.75	Neutral	56	-28.25	QP

Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
0.18398	45.37	Neutral	54.3	-8.93	Ave.
0.150182	23.09	Neutral	55.99	-32.9	Ave.
0.252141	44.64	Neutral	51.69	-7.05	Ave.
19.56973	38.75	Neutral	50	-11.25	Ave.
19.63174	37.62	Neutral	50	-12.38	Ave.
0.50156	18.69	Neutral	46	-27.31	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) 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).

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.

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 = 1/Period / 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	JB3	A020106-2	2015-07-11	26 Months
EMCO	Antenna, Horn	3115	9511-4627	2016-01-28	2 years
Agilent	Amplifier, Pre	8447D	2944A10187	2017-03-13	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	3147A00400	2017-06-15	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:	20-23 ºC
Relative Humidity:	42-50 %
ATM Pressure:	102.7 kPa

The testing was performed by Vincent Licata 2017-08-31 to 2017-09-11 in 5m chamber 3 and 10m chamber 1[1].

Note[1]: Radiated emissions from 30 MHz to 1 GHz were performed in the 10m chamber 1 because the EUT needed to be grounded and the power supply put under ground in order to simulate normal conditions.

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:

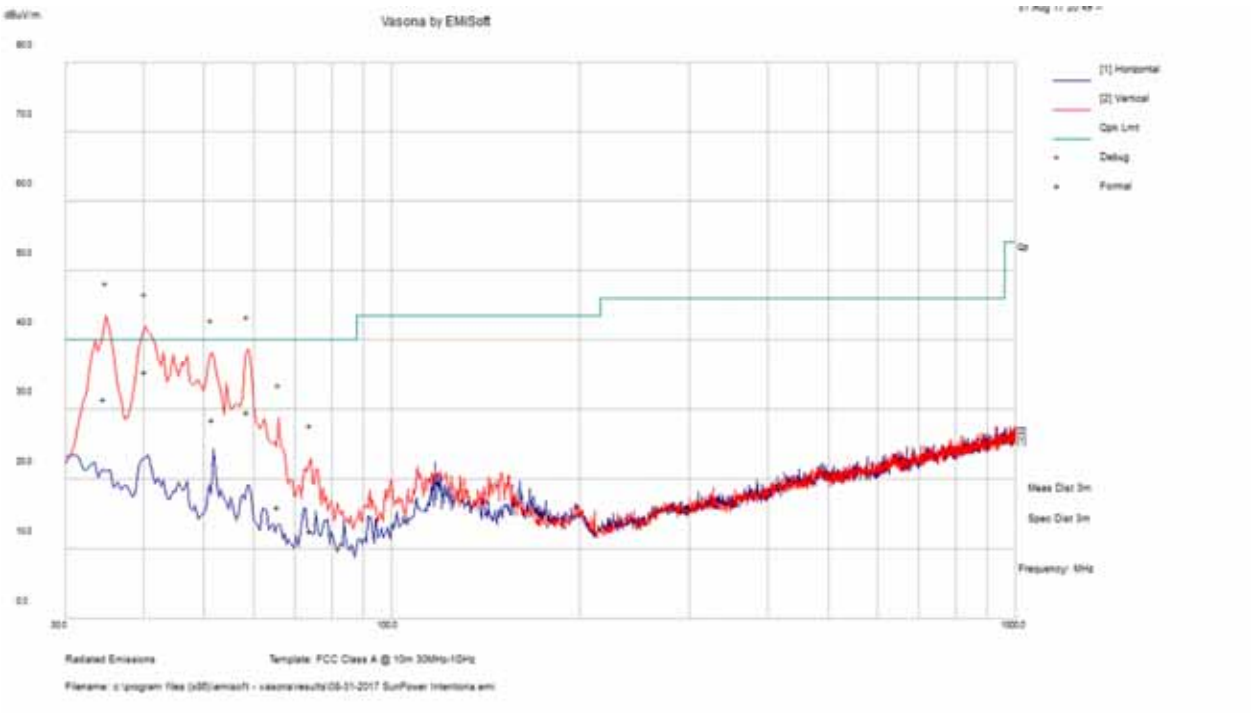
2.4 GHz Wi-Fi

Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Mode, channel**
-0.67	2390	Vertical	g, low channel

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

7.8 Radiated Emissions Test Results

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



2.4 GHz Wi-Fi

Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Comment
34.62725	31.42	102	V	79	40	-8.58	Pass
40.2055	35.46	207	V	12	40	-4.54	Pass
58.60025	29.66	120	V	318	40	-10.34	Pass
51.54675	28.53	204	V	295	40	-11.47	Pass
65.76675	15.92	323	V	166	40	-24.08	Pass
74.17825	12.52	178	V	227	40	-27.48	Pass

Note: Only 6 emissions were present because the other emissions were 20 dB below the limit.

2) 1–25 GHz Measured at 3 meters

Note: After the pre-scan, the worst case for each mode has been selected for the formal tested as below,

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											
2412	69.30	259	181	H	28.94	6.29	0	104.53	-	-	PK
2412	66.67	259	181	H	28.94	6.29	0	101.90	-	-	AV
2412	66.35	181	100	V	28.93	6.29	0	101.57	-	-	PK
2412	63.86	181	100	V	28.93	6.29	0	99.08	-	-	AV
2390	29.60	0	100	H	28.94	6.24	0	64.78	74.00	-9.22	PK
2390	17.24	0	100	H	28.94	6.24	0	52.42	54.00	-1.58	AV
2390	29.49	0	100	V	28.93	6.24	0	64.66	74.00	-9.34	PK
2390	17.22	0	100	V	28.93	6.24	0	52.39	54.00	-1.61	AV
4824	49.30	162	300	H	32.53	9.62	36.36	55.09	74.00	-18.91	PK
4824	41.72	162	300	H	32.53	9.62	36.36	47.51	54.00	-6.49	AV
4824	50.10	11	300	V	32.53	9.62	36.36	55.89	74.00	-18.11	PK
4824	42.16	11	300	V	32.53	9.62	36.36	47.95	54.00	-6.05	AV
7236	46.58	0	100	H	36.88	12.21	36.38	59.29	74.00	-14.71	PK
7236	34.01	0	100	H	36.88	12.21	36.38	46.72	54.00	-7.28	AV
9648	48.15	0	100	H	37.81	13.82	36.43	63.35	74.00	-10.65	PK
9648	35.54	0	100	H	37.81	13.82	36.43	50.74	54.00	-3.26	AV
Middle Channel 2437 MHz											
2437	69.73	65	100	H	29.19	6.29	0.00	105.21	-	-	PK
2437	67.09	65	100	H	29.19	6.29	0.00	102.57	-	-	AV
2437	69.93	186	100	V	29.19	6.29	0.00	105.41	-	-	PK
2437	67.34	186	100	V	29.19	6.29	0.00	102.82	-	-	AV
4874	49.31	272	300	H	32.70	9.42	36.327	55.09	74.00	-18.91	PK
4874	40.34	272	300	H	32.70	9.42	36.327	46.12	54.00	-7.88	PK
4874	50.19	12	300	V	32.70	9.42	36.327	55.97	74.00	-18.03	PK
4874	43.55	12	300	V	32.70	9.42	36.327	49.33	54.00	-4.67	AV
7311	44.76	0	100	H	36.99	11.68	36.40	57.03	74.00	-16.97	PK
7311	33.52	0	100	H	36.99	11.68	36.40	45.79	54.00	-8.21	AV
9748	47.55	0	100	H	37.82	13.21	36.45	62.12	74.00	-11.88	PK
9748	35.27	0	100	H	37.82	13.21	36.45	49.84	54.00	-4.16	AV

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)	
High Channel 2462 MHz											
2462	73.57	68	134	H	29.15	6.35	0.00	109.07	-	-	PK
2462	70.96	68	134	H	29.15	6.35	0.00	106.46	-	-	AV
2462	72.56	186	100	V	29.19	6.35	0.00	108.09	-	-	PK
2462	69.86	186	100	V	29.19	6.35	0.00	105.39	-	-	AV
2483.5	30.18	0	100	H	29.25	6.22	0.00	65.65	74.00	-8.35	PK
2483.5	17.62	0	100	H	29.25	6.22	0.00	53.09	54.00	-0.91	AV
2483.5	29.80	0	100	V	29.18	6.22	0.00	65.20	74.00	-8.80	PK
2483.5	17.60	0	100	V	29.18	6.22	0.00	53.00	54.00	-1.00	AV
4924	48.50	0	300	H	32.70	8.58	36.33	53.45	74.00	-20.55	PK
4924	41.64	0	300	H	32.70	8.58	36.33	46.59	54.00	-7.41	AV
4924	50.52	64	300	V	32.70	8.58	36.33	55.47	74.00	-18.53	PK
4924	43.96	64	300	V	32.70	8.58	36.33	48.91	54.00	-5.09	AV
7386	46.13	0	100	H	37.10	12.30	36.41	59.12	74.00	-14.88	PK
7386	34.29	0	100	H	37.10	12.30	36.41	47.28	54.00	-6.72	AV
9848	47.36	0	100	H	37.98	13.76	36.45	62.65	74.00	-11.35	PK
9848	35.18	0	100	H	37.98	13.76	36.45	50.47	54.00	-3.53	AV

Note: Emissions past the third harmonic are all noise floor.

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											
2412	65.90	259	177	H	28.94	6.29	0	101.13	-	-	PK
2412	56.25	259	177	H	28.94	6.29	0	91.48	-	-	AV
2412	64.29	180	100	V	28.93	6.29	0	99.51	-	-	PK
2412	54.79	180	100	V	28.93	6.29	0	90.01	-	-	AV
2390	70.67	73	100	H	28.94	6.76	36.59	69.78	74.00	-4.23	PK
2390	54.08	73	100	H	28.94	6.76	36.59	53.19	54.00	-0.82	AV
2390	70.14	192	100	V	28.93	6.76	36.59	69.24	74.00	-4.77	PK
2390	**54.24**	**192**	**100**	**V**	**28.93**	**6.76**	**36.59**	**53.34**	**54.00**	**-0.67**	**AV**
4824	47.72	0	100	H	32.53	9.62	36.36	53.51	74.00	-20.49	PK
4824	35.61	0	100	H	32.53	9.62	36.36	41.40	54.00	-12.60	AV
4824	47.18	0	100	V	32.53	9.62	36.36	52.97	74.00	-21.03	PK
4824	35.24	0	100	V	32.53	9.62	36.36	41.03	54.00	-12.97	AV
7236	45.74	0	100	H	36.88	12.21	36.38	58.45	74.00	-15.55	PK
7236	34.01	0	100	H	36.88	12.21	36.38	46.72	54.00	-7.28	AV
9648	47.35	0	100	H	37.81	13.82	36.43	62.55	74.00	-11.45	PK
9648	35.54	0	100	H	37.81	13.82	36.43	50.74	54.00	-3.26	AV
Low Channel 2437 MHz											
2437	63.73	84	100	H	29.19	6.29	0.00	99.21	-	-	PK
2437	54.83	84	100	H	29.19	6.29	0.00	90.31	-	-	AV
2437	63.43	180	100	V	29.19	6.29	0.00	98.91	-	-	PK
2437	54.47	180	100	V	29.19	6.29	0.00	89.95	-	-	AV
4874	47.14	0	100	H	32.70	9.42	36.327	52.92	74.00	-21.08	PK
4874	35.52	0	100	H	32.70	9.42	36.327	41.30	54.00	-12.70	PK
4874	46.89	0	100	V	32.70	9.42	36.327	52.67	74.00	-21.33	PK
4874	35.49	0	100	V	32.70	9.42	36.327	41.27	54.00	-12.73	AV
7311	45.14	0	100	H	36.99	11.68	36.40	57.41	74.00	-16.59	PK
7311	33.68	0	100	H	36.99	11.68	36.40	45.95	54.00	-8.05	AV
9748	46.88	0	100	H	37.82	13.21	36.45	61.45	74.00	-12.55	PK
9748	35.40	0	100	H	37.82	13.21	36.45	49.97	54.00	-4.03	AV

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)	
High Channel 2462 MHz											
2462	67.40	81	179	H	29.15	6.35	0.00	102.9	-	-	PK
2462	57.87	81	179	H	29.15	6.35	0.00	93.37	-	-	AV
2462	67.02	178	100	V	29.19	6.35	0.00	102.5	-	-	PK
2462	57.38	178	100	V	29.19	6.35	0.00	92.91	-	-	AV
2483.5	70.87	74	100	H	29.25	6.84	36.59	70.37	74.00	-3.63	PK
2483.5	53.24	74	100	H	29.25	6.84	36.59	52.74	54.00	-1.26	AV
2483.5	68.55	171	100	V	29.18	6.84	36.59	67.98	74.00	-6.02	PK
2483.5	50.94	171	100	V	29.18	6.84	36.59	50.37	54.00	-3.63	AV
4924	47.02	0	100	H	32.70	8.58	36.33	51.97	74.00	-22.03	PK
4924	35.25	0	100	H	32.70	8.58	36.33	40.20	54.00	-13.80	AV
4924	47.25	0	100	V	32.70	8.58	36.33	52.20	74.00	-21.80	PK
4924	35.27	0	100	V	32.70	8.58	36.33	40.22	54.00	-13.78	AV
7386	45.63	0	100	H	37.10	12.30	36.41	58.62	74.00	-15.38	PK
7386	34.19	0	100	H	37.10	12.30	36.41	47.18	54.00	-6.82	AV
9848	46.80	0	100	H	37.98	13.76	36.45	62.09	74.00	-11.91	PK
9848	35.24	0	100	H	37.98	13.76	36.45	50.53	54.00	-3.47	AV

Note: Emissions past the third harmonic are all noise floor.

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											
2412	64.88	85	100	H	28.94	6.29	0	100.11	-	-	PK
2412	55.45	85	100	H	28.94	6.29	0	90.68	-	-	AV
2412	63.48	182	100	V	28.93	6.29	0	98.70	-	-	PK
2412	54.51	182	100	V	28.93	6.29	0	89.73	-	-	AV
2390	63.18	64	128	H	28.94	6.76	36.59	62.29	74.00	-11.72	PK
2390	46.09	64	128	H	28.94	6.76	36.59	45.20	54.00	-8.81	AV
2390	61.94	194	100	V	28.93	6.76	36.59	61.04	74.00	-12.97	PK
2390	44.66	194	100	V	28.93	6.76	36.59	43.76	54.00	-10.25	AV
4824	47.82	0	100	H	32.53	9.62	36.36	53.61	74.00	-20.39	PK
4824	35.68	0	100	H	32.53	9.62	36.36	41.47	54.00	-12.53	AV
4824	47.48	0	100	V	32.53	9.62	36.36	53.27	74.00	-20.73	PK
4824	35.64	0	100	V	32.53	9.62	36.36	41.43	54.00	-12.57	AV
7236	45.83	0	100	H	36.88	12.21	36.38	58.54	74.00	-15.46	PK
7236	34.44	0	100	H	36.88	12.21	36.38	47.15	54.00	-6.85	AV
9648	47.66	0	100	H	37.81	13.82	36.43	62.86	74.00	-11.14	PK
9648	35.62	0	100	H	37.81	13.82	36.43	50.82	54.00	-3.18	AV
Middle Channel 2437 MHz											
2437	64.32	85	100	H	29.19	6.29	0.00	99.80	-	-	PK
2437	55.18	85	100	H	29.19	6.29	0.00	90.66	-	-	AV
2437	64.16	186	100	V	29.19	6.29	0.00	99.64	-	-	PK
2437	55.07	186	100	V	29.19	6.29	0.00	90.55	-	-	AV
4874	48.14	0	100	H	32.70	9.42	36.327	53.92	74.00	-20.08	PK
4874	35.67	0	100	H	32.70	9.42	36.327	41.45	54.00	-12.55	PK
4874	48.61	0	100	V	32.70	9.42	36.327	54.39	74.00	-19.61	PK
4874	35.71	0	100	V	32.70	9.42	36.327	41.49	54.00	-12.51	AV
7311	45.39	0	100	H	36.99	11.68	36.40	57.66	74.00	-16.34	PK
7311	34.17	0	100	H	36.99	11.68	36.40	46.44	54.00	-7.56	AV
9748	47.24	0	100	H	37.82	13.21	36.45	61.81	74.00	-12.19	PK
9748	35.56	0	100	H	37.82	13.21	36.45	50.13	54.00	-3.87	AV

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)	
High Channel 2462 MHz											
2462	66.98	82	100	H	29.15	6.35	0.00	102.48	-	-	PK
2462	57.61	82	100	H	29.15	6.35	0.00	93.11	-	-	AV
2462	66.75	178	100	V	29.19	6.35	0.00	102.28	-	-	PK
2462	57.11	178	100	V	29.19	6.35	0.00	92.64	-	-	AV
2483.5	71.66	73	100	H	29.25	6.84	36.59	71.16	74.00	-2.84	PK
2483.5	53.82	73	100	H	29.25	6.84	36.59	53.32	54.00	-0.68	AV
2483.5	70.54	185	100	V	29.18	6.84	36.59	69.97	74.00	-4.03	PK
2483.5	51.95	185	100	V	29.18	6.84	36.59	51.38	54.00	-2.62	AV
4924	47.32	0	100	H	32.70	8.58	36.33	52.27	74.00	-21.73	PK
4924	35.18	0	100	H	32.70	8.58	36.33	40.13	54.00	-13.87	AV
4924	47.31	0	100	V	32.70	8.58	36.33	52.26	74.00	-21.74	PK
4924	35.16	0	100	V	32.70	8.58	36.33	40.11	54.00	-13.89	AV
7386	46.16	0	100	H	37.10	12.30	36.41	59.15	74.00	-14.85	PK
7386	34.10	0	100	H	37.10	12.30	36.41	47.09	54.00	-6.91	AV
9848	47.31	0	100	H	37.98	13.76	36.45	62.60	74.00	-11.40	PK
9848	34.96	0	100	H	37.98	13.76	36.45	50.25	54.00	-3.75	AV

Note: Emissions past the third harmonic are all noise floor.

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											
2422	61.25	85	100	H	28.94	6.29	0	96.48	-	-	PK
2422	50.37	85	100	H	28.94	6.29	0	85.60	-	-	AV
2422	60.66	176	100	V	28.93	6.29	0	95.88	-	-	PK
2422	49.68	176	100	V	28.93	6.29	0	84.90	-	-	AV
2390	69.07	67	100	H	28.94	6.76	36.59	68.18	74.00	-5.83	PK
2390	52.76	67	100	H	28.94	6.76	36.59	51.87	54.00	-2.14	AV
2390	68.70	195	100	V	28.93	6.76	36.59	67.80	74.00	-6.21	PK
2390	53.03	195	100	V	28.93	6.76	36.59	52.13	54.00	-1.88	AV
4844	47.66	0	100	H	32.53	9.62	36.36	53.45	74.00	-20.55	PK
4844	35.38	0	100	H	32.53	9.62	36.36	41.17	54.00	-12.83	AV
4844	47.61	0	100	V	32.53	9.62	36.36	53.40	74.00	-20.60	PK
4844	35.34	0	100	V	32.53	9.62	36.36	41.13	54.00	-12.87	AV
7266	46.48	0	100	H	36.88	12.21	36.38	59.19	74.00	-14.81	PK
7266	34.27	0	100	H	36.88	12.21	36.38	46.98	54.00	-7.02	AV
9688	47.93	0	100	H	37.81	13.82	36.43	63.13	74.00	-10.87	PK
9688	35.61	0	100	H	37.81	13.82	36.43	50.81	54.00	-3.19	AV
Middle Channel 2437 MHz											
2437	61.33	86	100	H	29.19	6.29	0.00	96.81	-	-	PK
2437	50.46	86	100	H	29.19	6.29	0.00	85.94	-	-	AV
2437	60.83	179	100	V	29.19	6.29	0.00	96.31	-	-	PK
2437	49.81	179	100	V	29.19	6.29	0.00	85.29	-	-	AV
4874	47.79	0	100	H	32.70	9.42	36.327	53.57	74.00	-20.43	PK
4874	35.61	0	100	H	32.70	9.42	36.327	41.39	54.00	-12.61	PK
4874	47.62	0	100	V	32.70	9.42	36.327	53.40	74.00	-20.60	PK
4874	35.57	0	100	V	32.70	9.42	36.327	41.35	54.00	-12.65	AV
7311	45.14	0	100	H	36.99	11.68	36.40	57.41	74.00	-16.59	PK
7311	33.49	0	100	H	36.99	11.68	36.40	45.76	54.00	-8.24	AV
9748	47.16	0	100	H	37.82	13.21	36.45	61.73	74.00	-12.27	PK
9748	34.66	0	100	H	37.82	13.21	36.45	49.23	54.00	-4.77	AV

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)	
High Channel 2452 MHz											
2452	61.89	85	100	H	29.15	6.35	0.00	97.39	-	-	PK
2452	50.81	85	100	H	29.15	6.35	0.00	86.31	-	-	AV
2452	61.22	177	100	V	29.19	6.35	0.00	96.75	-	-	PK
2452	50.42	177	100	V	29.19	6.35	0.00	85.95	-	-	AV
2483.5	68.99	75	100	H	29.25	6.84	36.59	68.49	74.00	-5.51	PK
2483.5	52.84	75	100	H	29.25	6.84	36.59	52.34	54.00	-1.66	AV
2483.5	68.37	184	100	V	29.18	6.84	36.59	67.80	74.00	-6.20	PK
2483.5	51.90	184	100	V	29.18	6.84	36.59	51.33	54.00	-2.67	AV
4904	47.35	0	100	H	32.70	8.58	36.33	52.30	74.00	-21.70	PK
4904	35.40	0	100	H	32.70	8.58	36.33	40.35	54.00	-13.65	AV
4904	47.46	0	100	V	32.70	8.58	36.33	52.41	74.00	-21.59	PK
4904	35.62	0	100	V	32.70	8.58	36.33	40.57	54.00	-13.43	AV
7356	45.53	0	100	H	37.10	12.30	36.41	58.52	74.00	-15.48	PK
7356	33.43	0	100	H	37.10	12.30	36.41	46.42	54.00	-7.58	AV
9808	46.45	0	100	H	37.98	13.76	36.45	61.74	74.00	-12.26	PK
9808	34.68	0	100	H	37.98	13.76	36.45	49.97	54.00	-4.03	AV

Note: Emissions past the third harmonic are all noise floor.

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	E4446A	MY48250238	2017-02-24	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 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 Vincent Licata on 2017-09-1 in RF site.

8.5 Test Results

6dB Bandwidth

Antenna Port J20

Channel	Frequency (MHz)	99% OBW (kHz)	6 dB BW (kHz)	6 dB OBW limit (kHz)
802.11b mode				
Low	2412	13687	7586	500
Middle	2437	13562	8053	500
High	2462	13352	6599	500
802.11g mode				
Low	2412	16486	16362	500
Middle	2437	16497	16384	500
High	2462	16463	16494	500
802.11n-20 mode				
Low	2412	17664	17623	500
Middle	2437	17632	17022	500
High	2462	17617	17764	500
802.11n-40 mode				
Low	2422	35963	31443	500
Middle	2437	35942	34046	500
High	2452	35937	34363	500

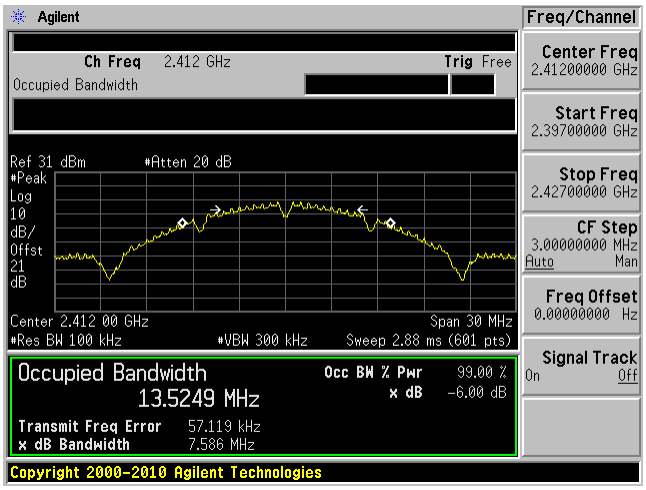
Note: Worst case antenna data is shown.

Please refer to the following plots for detailed test results.

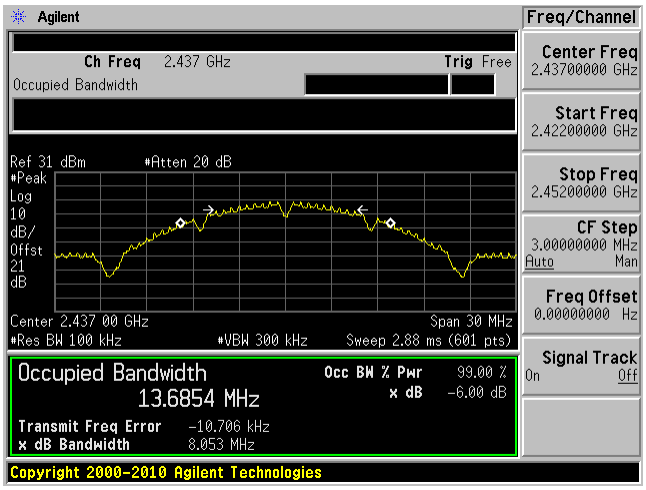
6dB Bandwidth

802.11b mode (Port J20)

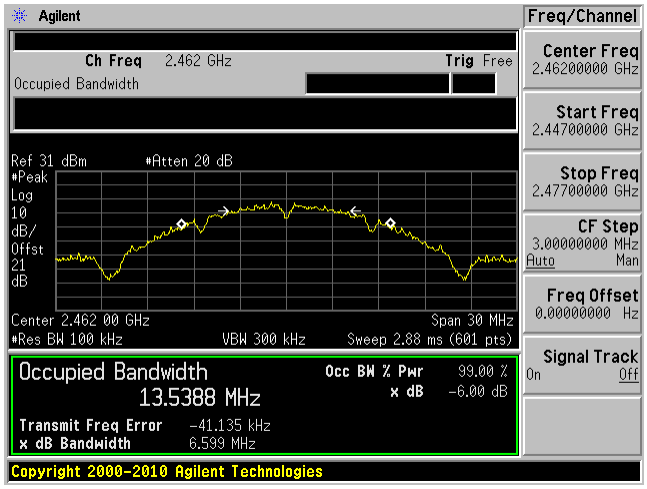
Low Channel 2412 MHz



Middle Channel 2437 MHz

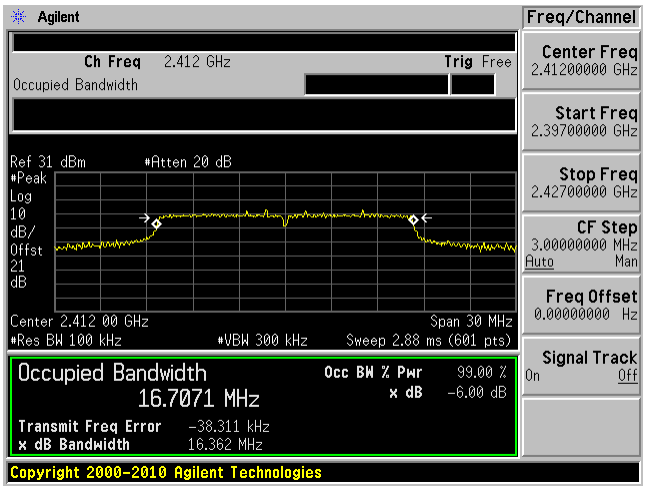


High Channel 2462 MHz

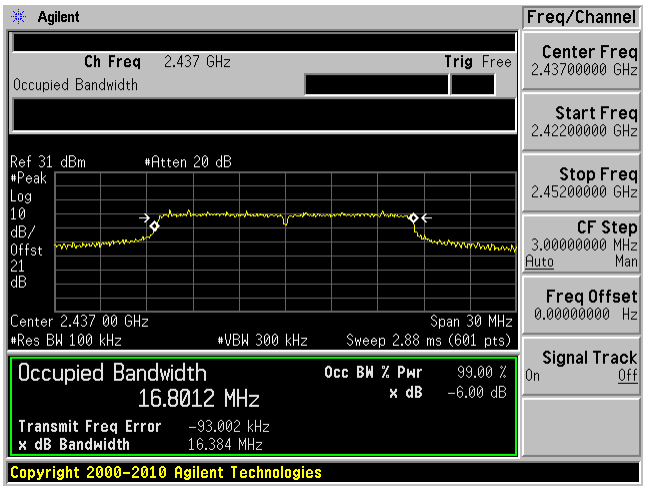


802.11g mode (Port J20)

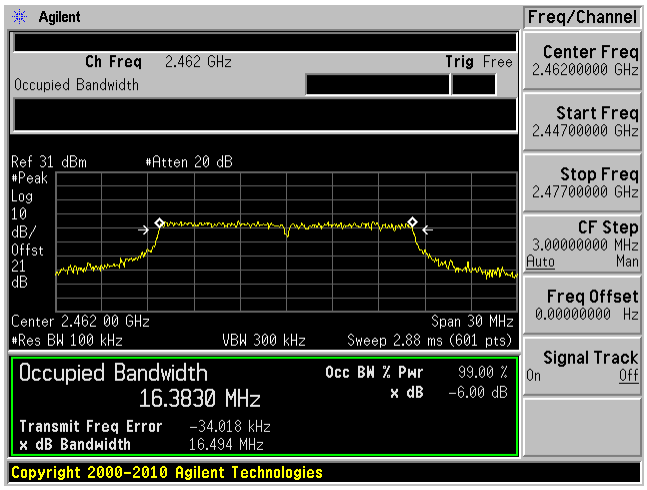
Low Channel 2412 MHz



Middle Channel 2437 MHz

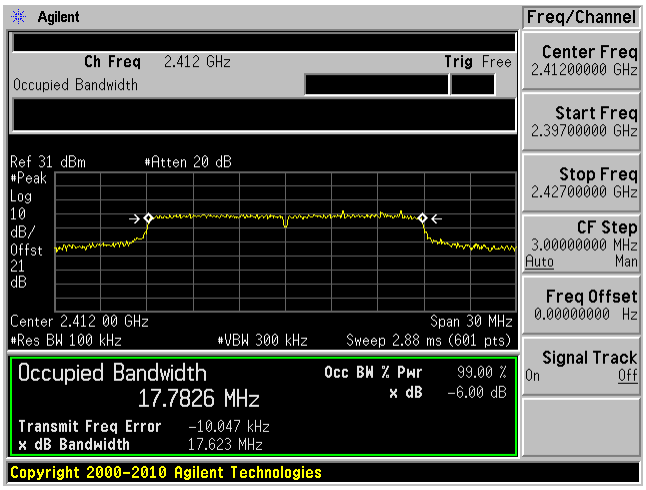


High Channel 2462 MHz

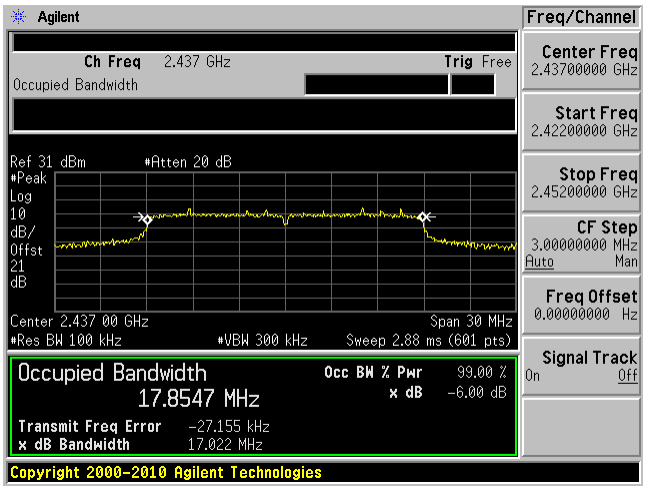


802.11n20 mode (Port J20)

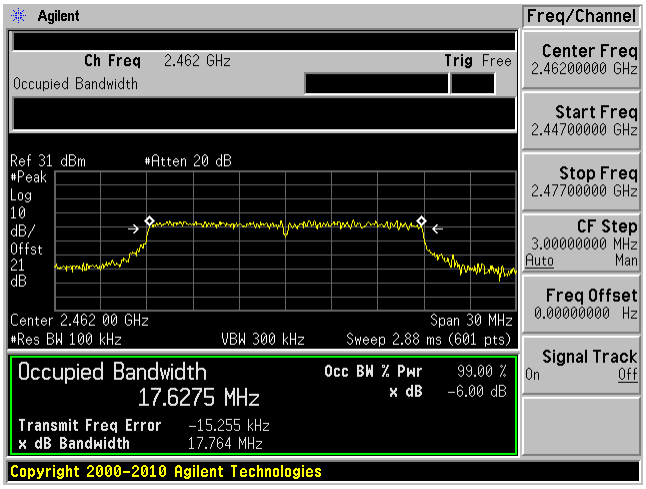
Low Channel 2412 MHz



Middle Channel 2437 MHz

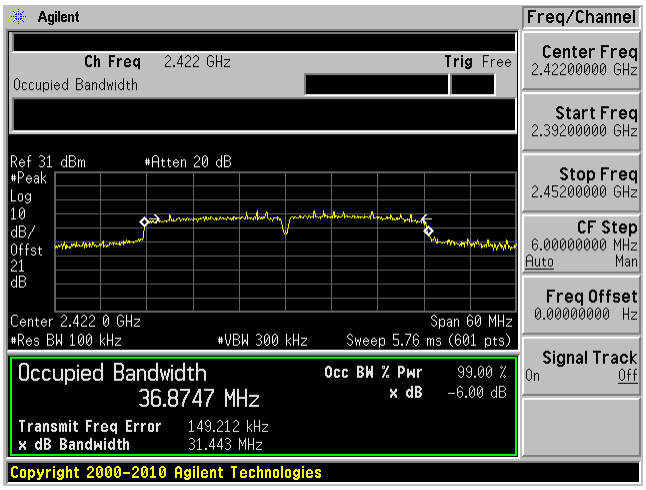


High Channel 2462 MHz

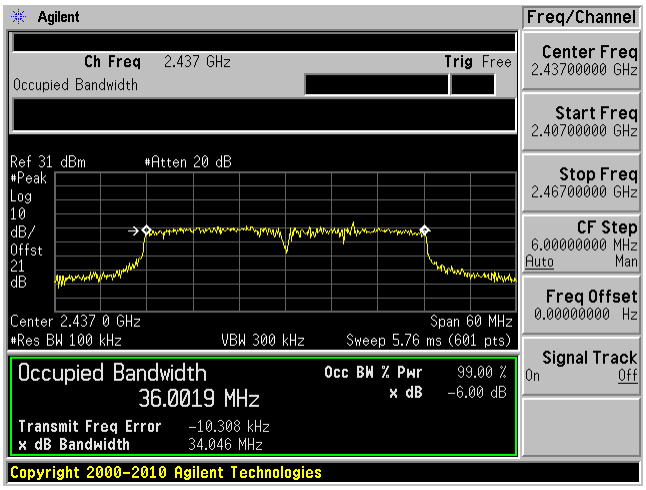


802.11n40 mode (Port J20)

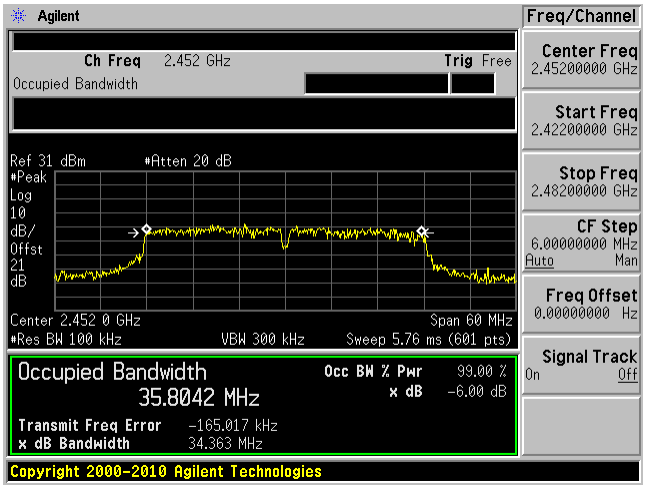
Low Channel 2422 MHz



Middle Channel 2437 MHz



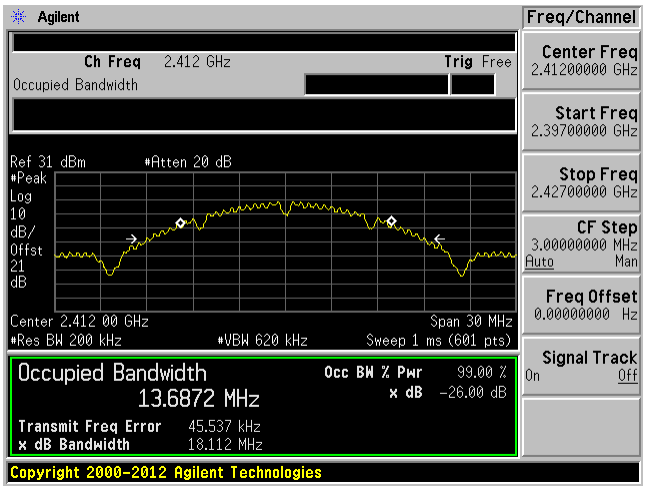
High Channel 2452 MHz



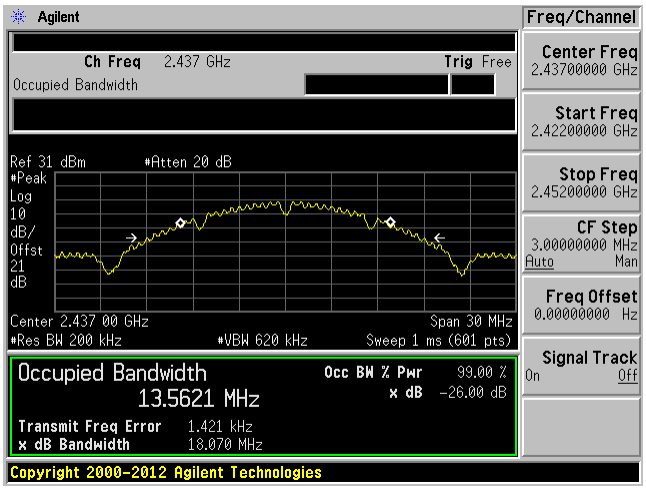
99% OBW

802.11b mode (Port J20)

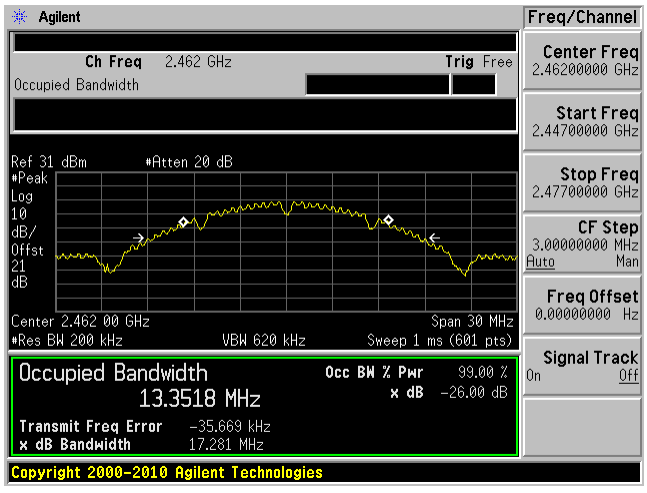
Low Channel 2412 MHz



Middle Channel 2437 MHz

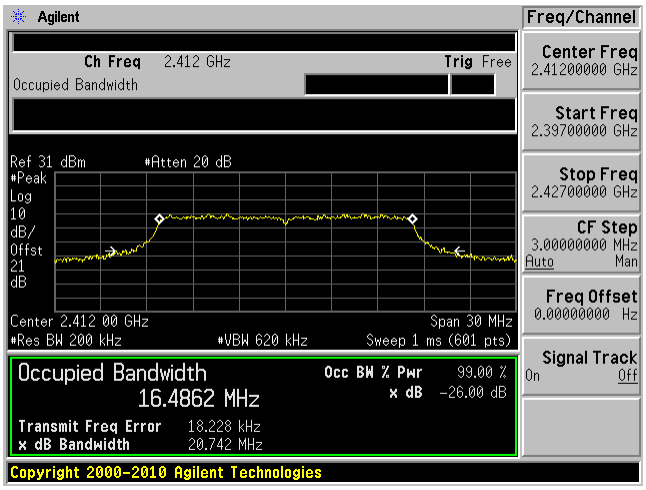


High Channel 2462 MHz

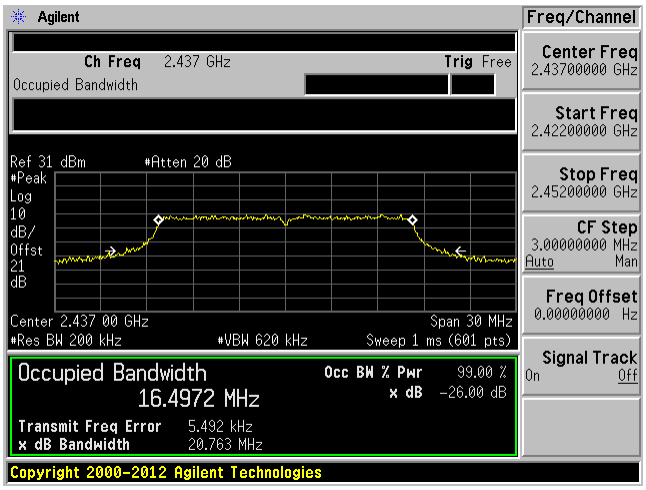


802.11g mode (Port J20)

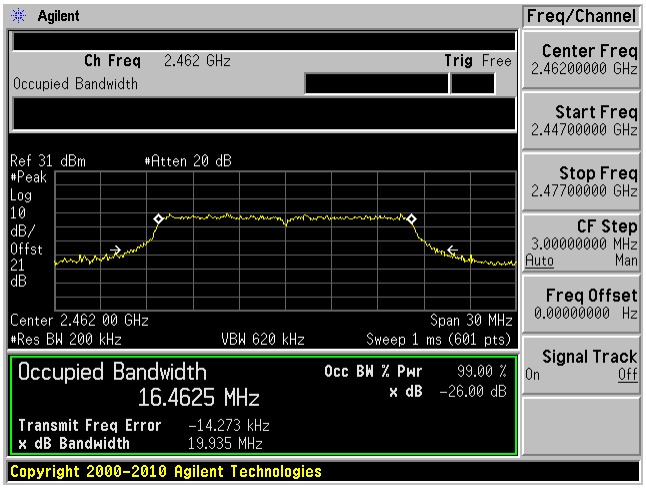
Low Channel 2412 MHz



Middle Channel 2437 MHz

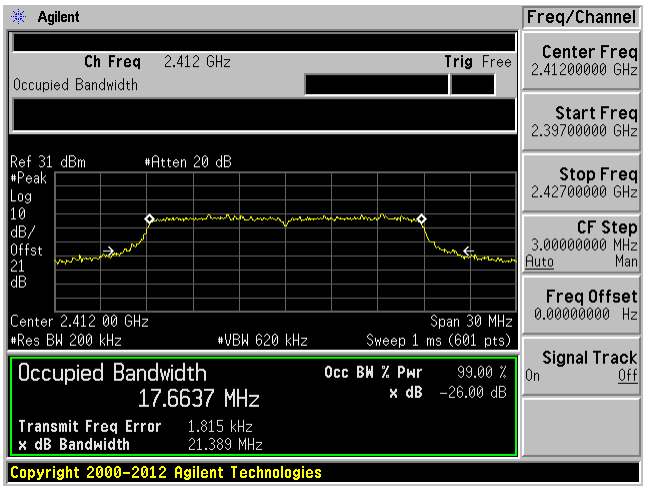


High Channel 2462 MHz

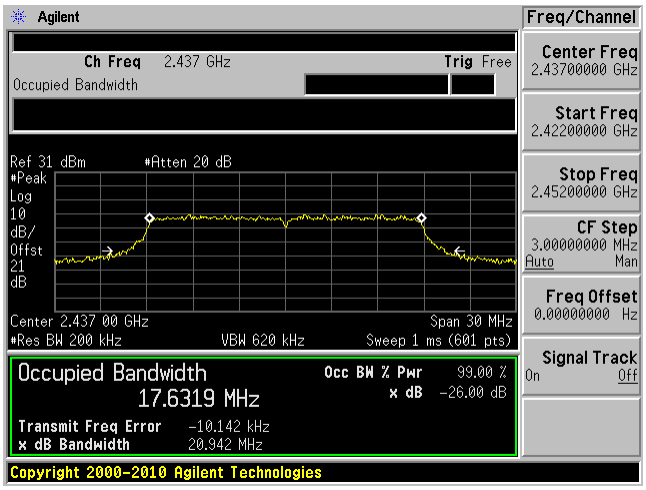


802.11n20 mode (Port J20)

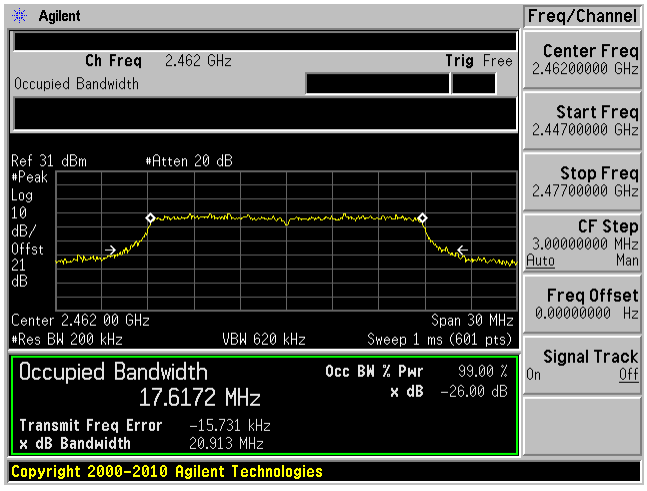
Low Channel 2412 MHz



Middle Channel 2437 MHz

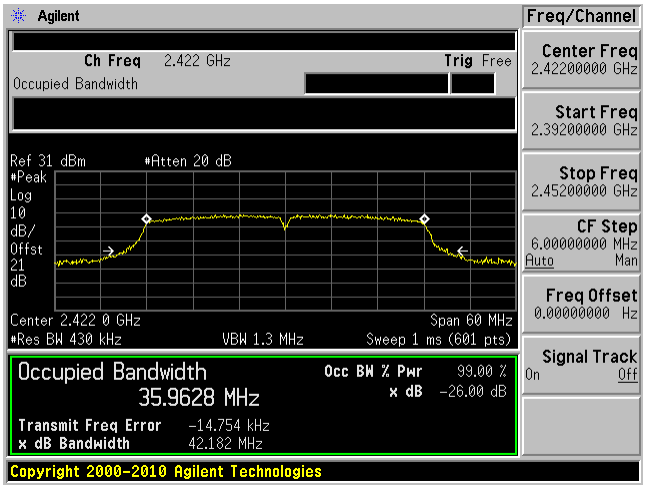


High Channel 2462 MHz

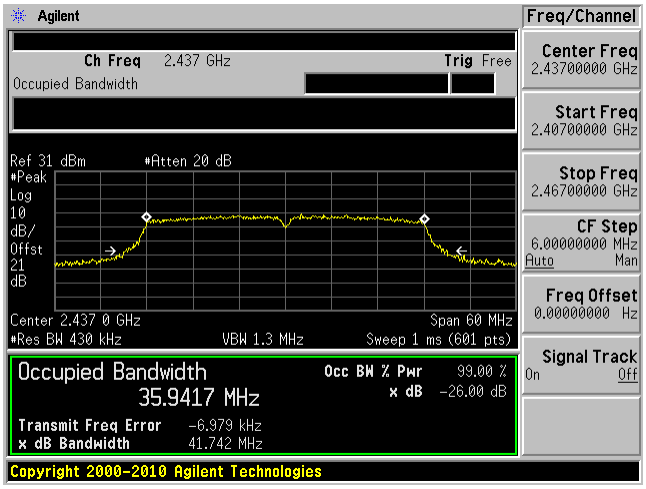


802.11n40 mode (Port J20)

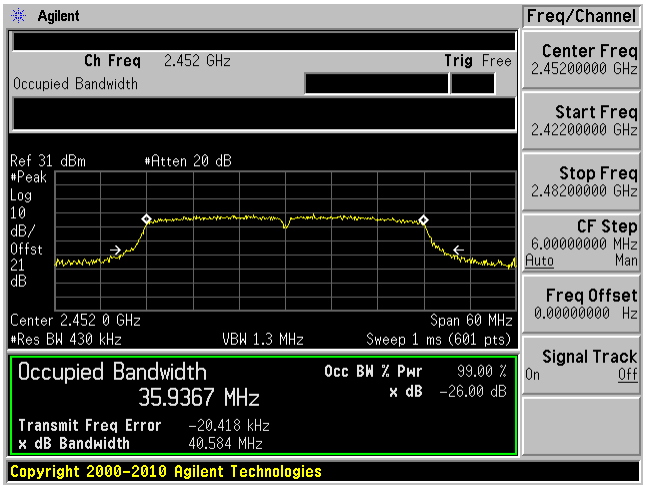
Low Channel 2422 MHz



Middle Channel 2437 MHz



High Channel 2452 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

9.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
ETS- Lingerin	Power Sensor	7002-006	160097	2016-12-05	2 years
-	RF Cable	-	-	Each time[1]	N/A
-	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 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 Vincent Licata on 2017-09-1 in RF site.

9.5 Test Results

Average Output Power

Antenna Port	Channel	Frequency (MHz)	Average Power (dBm)	Limit (dBm)
802.11b mode				
J19	1	2412	14.02	30
	6	2437	14.19	30
	11	2462	14.54	30
J20	1	2412	16.89	30
	6	2437	16.50	30
	11	2462	16.28	30
802.11g mode				
J19	1	2412	7.37	30
	6	2437	7.68	30
	11	2462	7.33	30
J20	1	2412	10.93	30
	6	2437	10.78	30
	11	2462	10.99	30
802.11n20 mode				
J19	1	2412	7.23	30
	6	2437	7.31	30
	11	2462	7.34	30
J20	1	2412	11.05	30
	6	2437	10.79	30
	11	2462	10.39	30
802.11n40 mode				
J19	3	2422	6.14	30
	6	2437	6.27	30
	9	2452	6.44	30
J20	3	2422	9.96	30
	6	2437	9.87	30
	9	2452	9.72	30

Note 1: Duty Cycle correction factor has already been added to the measurement.

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

10.1 Applicable Standards

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

10.2 Measurement Procedure

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

10.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Analyzer, Spectrum	E4440A	US45303156	2017-02-24	1 year
-	RF Cable	-	-	Each time[1]	N/A
-	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 calibrations have been performed per the A2LA requirements, traceable to the NIST.*

10.4 Test Environmental Conditions

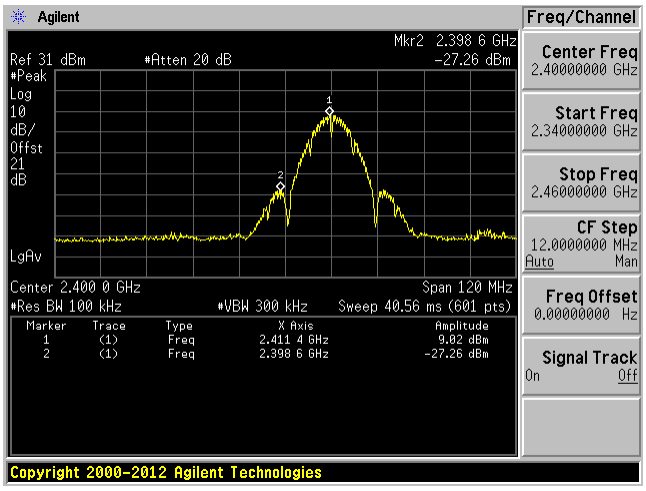
Temperature:	23º C
Relative Humidity:	42 %
ATM Pressure:	102.7 KPa

The testing was performed by Vincent Licata on 2017-09-1 in RF site.

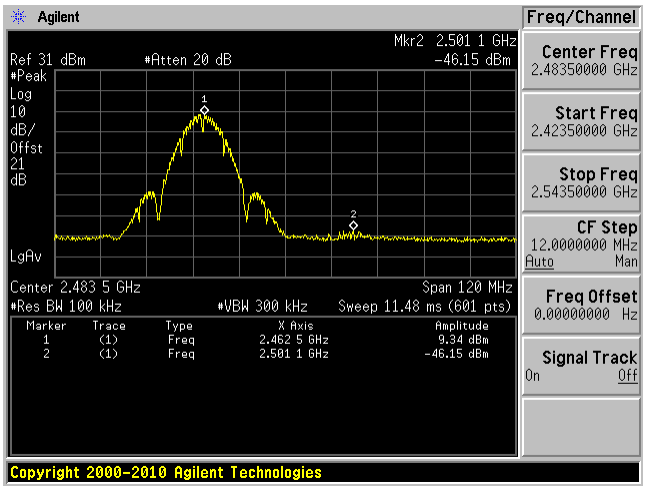
10.5 Test Results

802.11b mode (Port J20)

Low Channel 2412 MHz

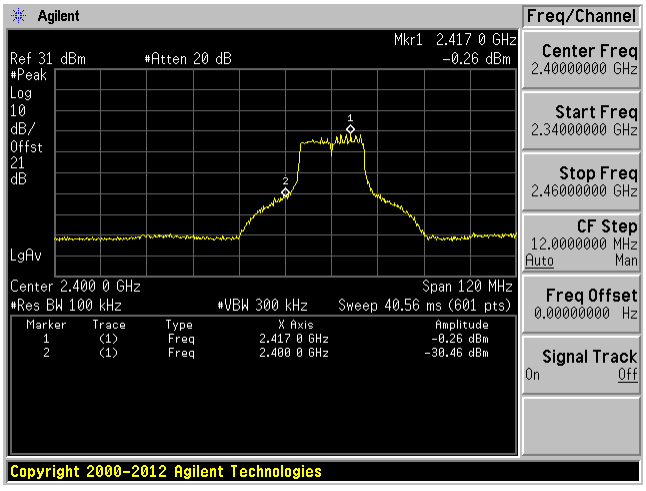


High Channel 2462 MHz

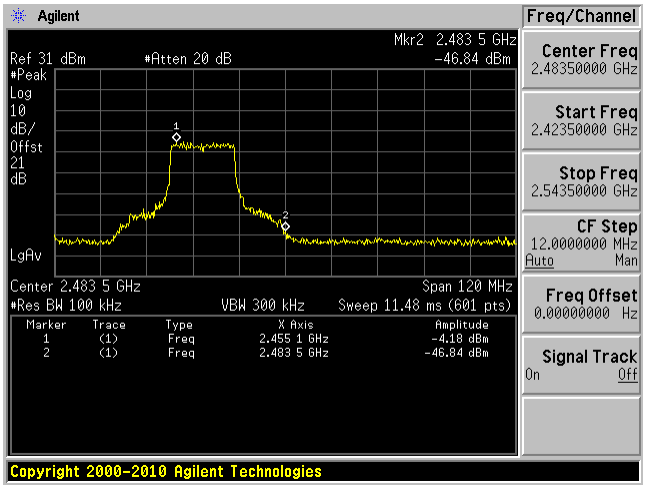


802.11g mode (Port J20)

Low Channel 2412 MHz

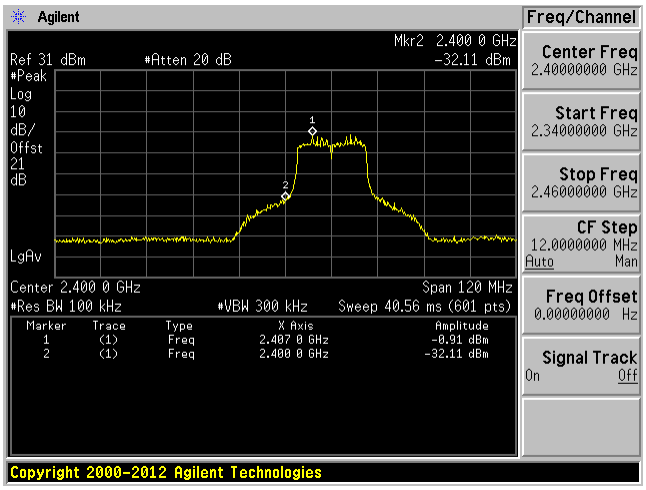


High Channel 2462 MHz

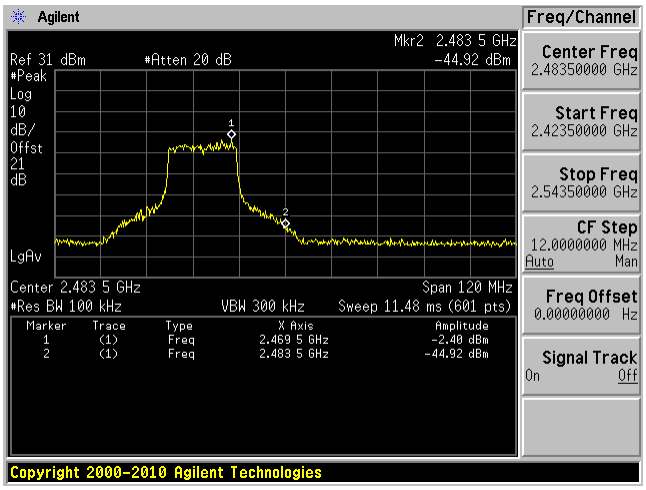


802.11n20 mode (Port J20)

Low Channel 2412 MHz

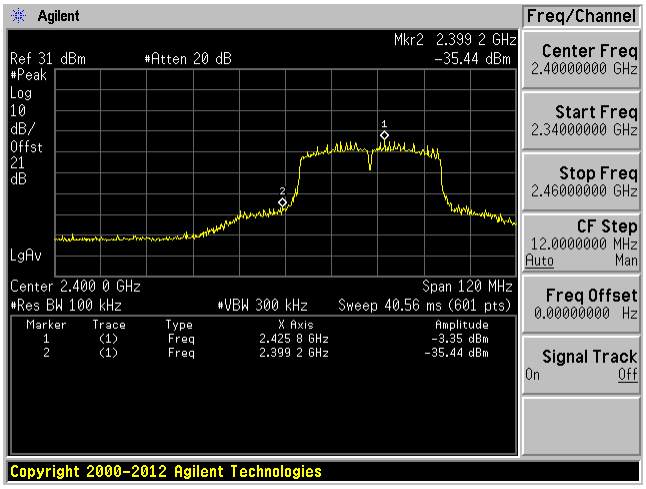


High Channel 2462 MHz

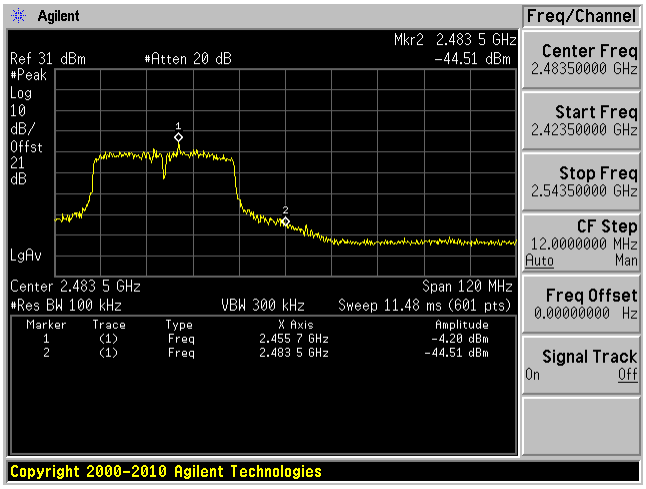


802.11n40 mode (Port J20)

Low Channel 2422 MHz

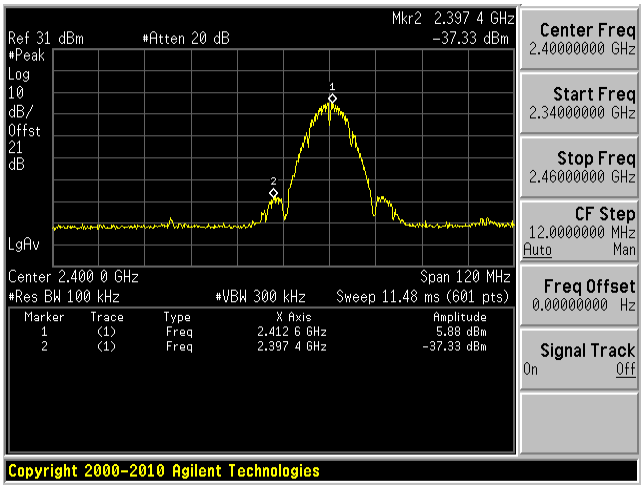


High Channel 2452 MHz

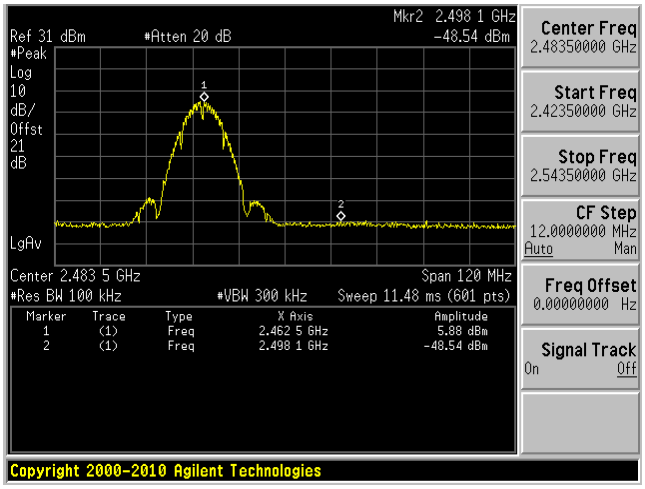


802.11b mode (Port J19)

Low Channel 2412 MHz

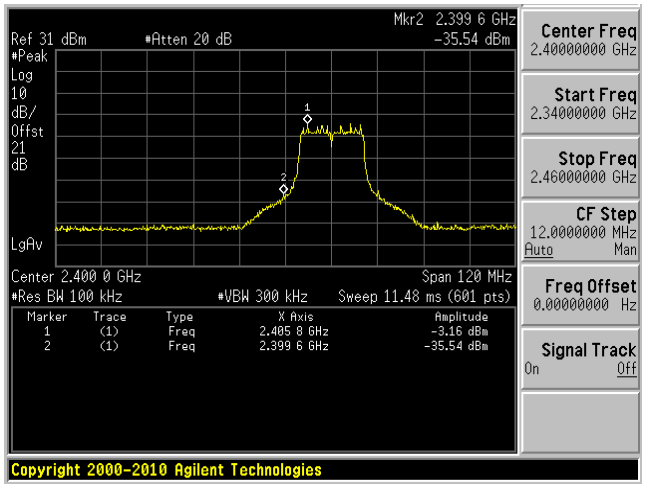


High Channel 2462 MHz

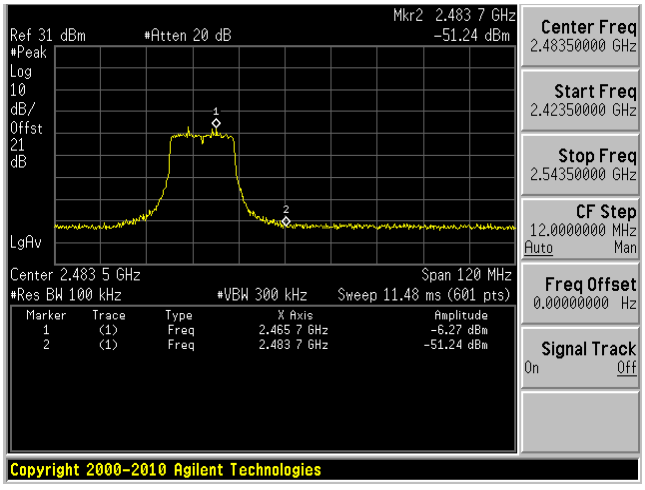


802.11g mode (Port J19)

Low Channel 2412 MHz

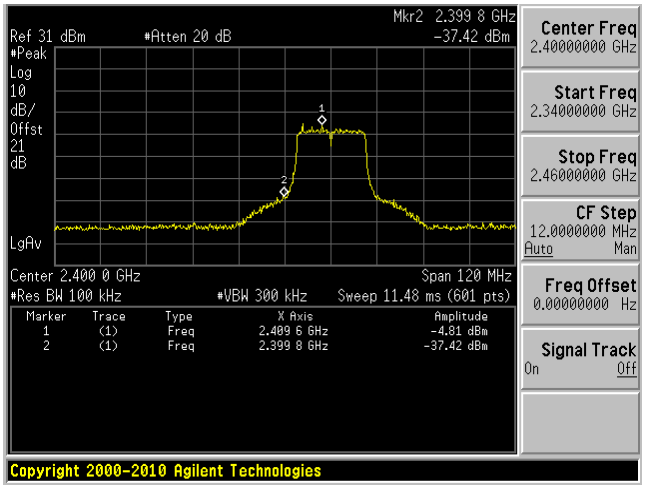


High Channel 2462 MHz

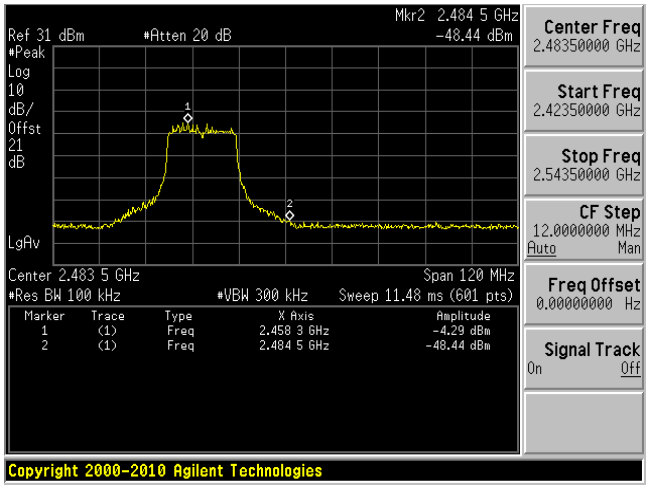


802.11n20 mode (Port J19)

Low Channel 2412 MHz

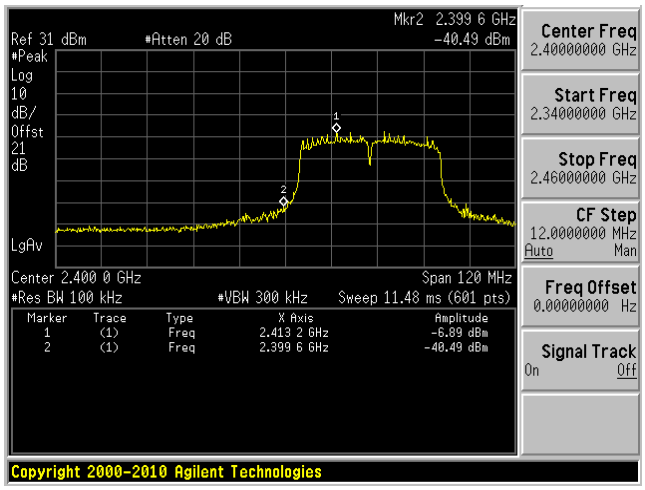


High Channel 2462 MHz

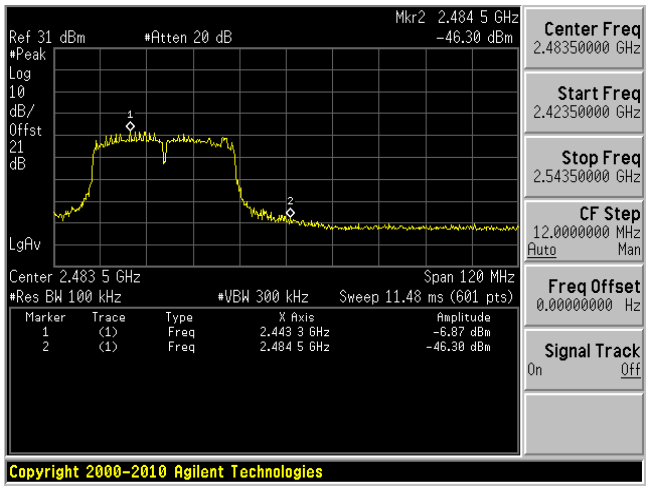


802.11n40 mode (Port J19)

Low Channel 2422 MHz



High Channel 2452 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	E4446A	MY48250238	2017-02-24	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 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 Vincent Licata on 2017-09-1 in RF site.

11.5 Test Results

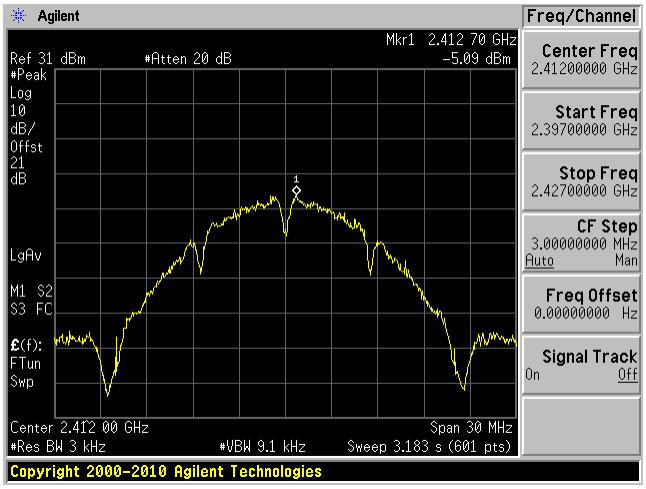
Antenna Port	Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)
802.11b mode				
J20	Low	2412	-5.09	8
	Middle	2437	-5.55	8
	High	2462	-5.08	8
802.11g mode				
J20	Low	2412	-14.83	8
	Middle	2437	-15.36	8
	High	2462	-14.99	8
802.11n20 mode				
J20	Low	2412	-14.47	8
	Middle	2437	-14.93	8
	High	2462	-16.30	8
802.11n40 mode				
J20	Low	2422	-18.02	8
	Middle	2437	-19.32	8
	High	2452	-18.96	8

Note: Worst case antenna data is shown.

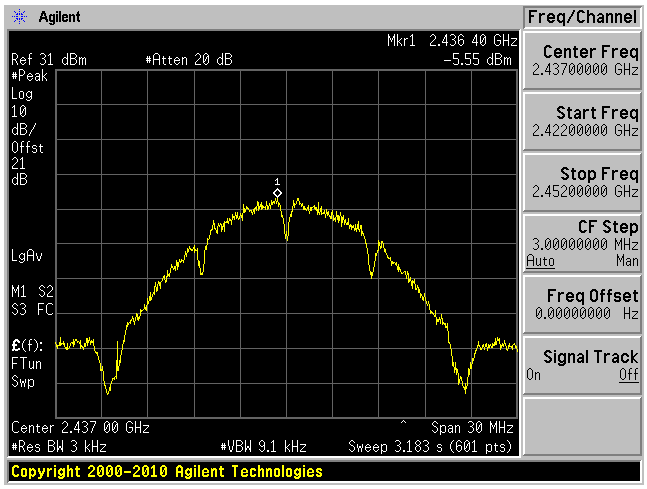
Please refer to the following plots for detailed test results

802.11b mode (Port J20)

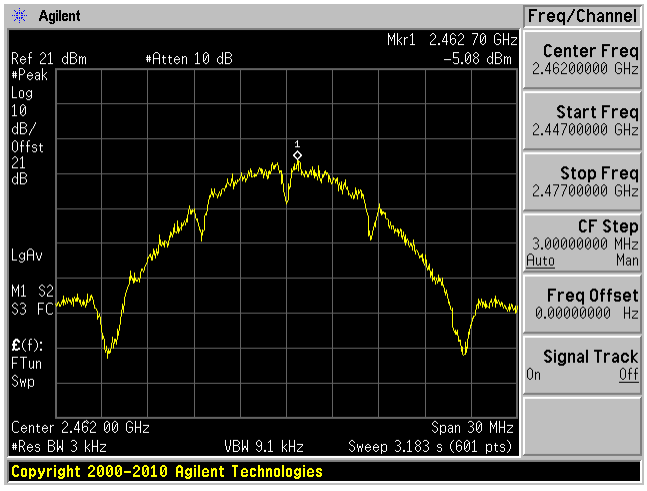
Low Channel 2412 MHz



Middle Channel 2437 MHz

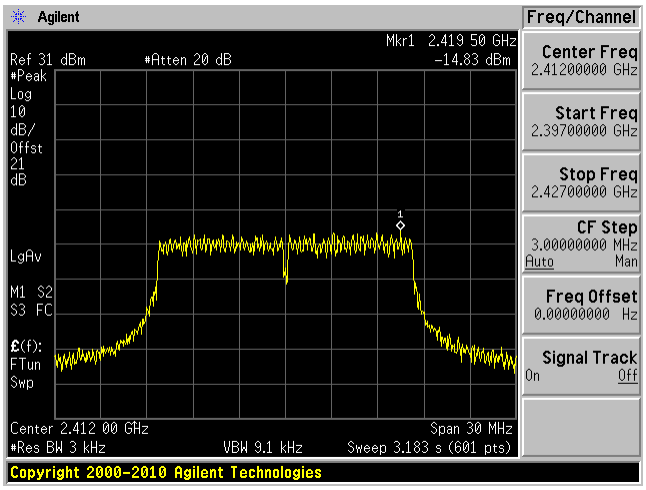


High Channel 2462 MHz

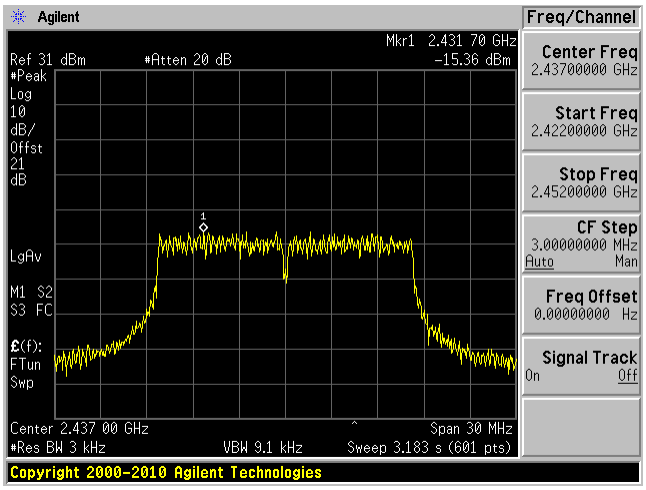


802.11g mode (Port J20)

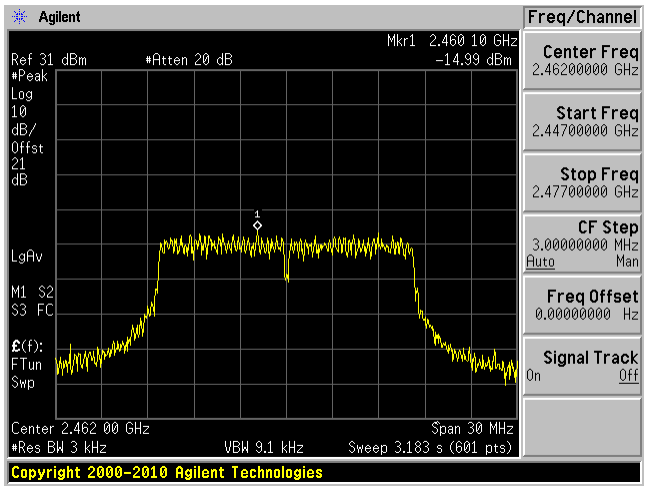
Low Channel 2412 MHz



Middle Channel 2437 MHz

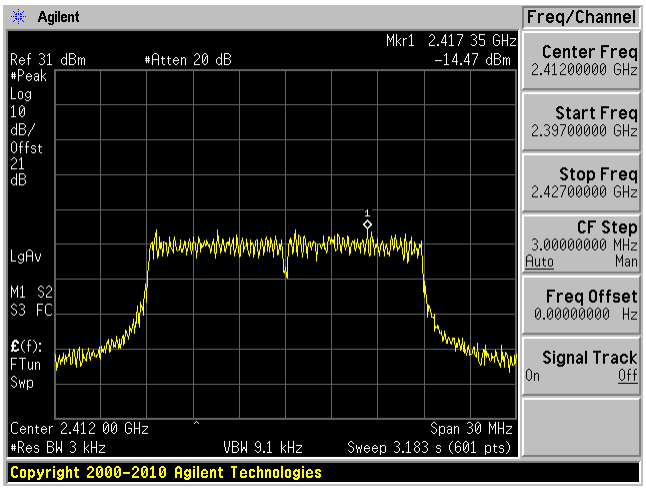


High Channel 2462 MHz

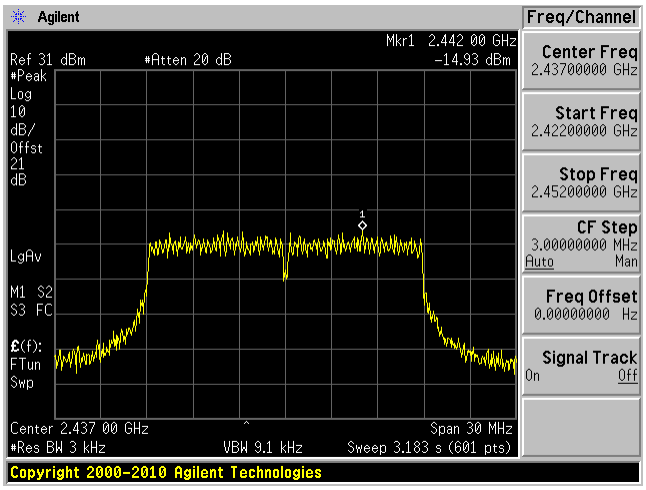


802.11n20 mode (Port J20)

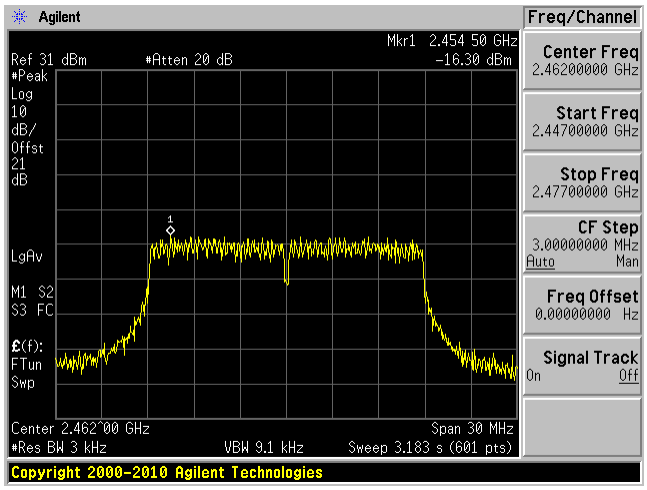
Low Channel 2412 MHz



Middle Channel 2437 MHz

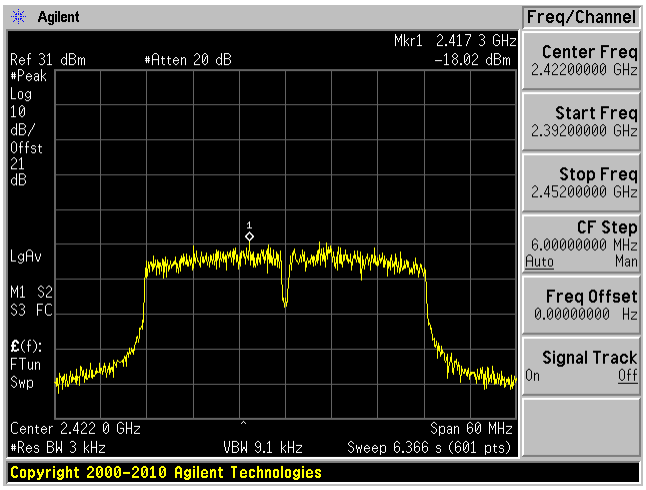


High Channel 2462 MHz

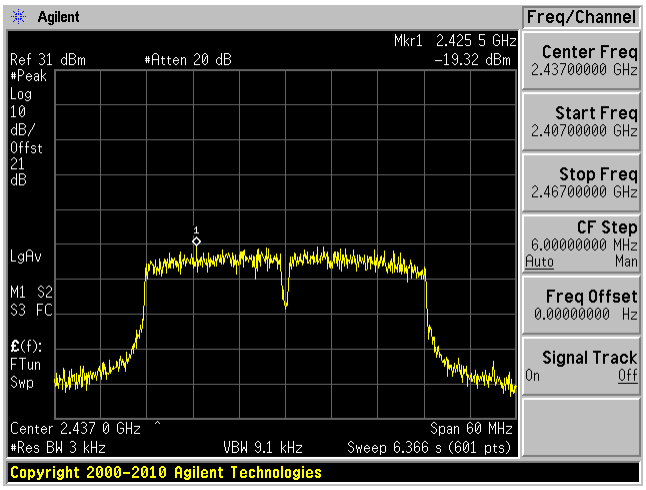


802.11n40 mode (Port J20)

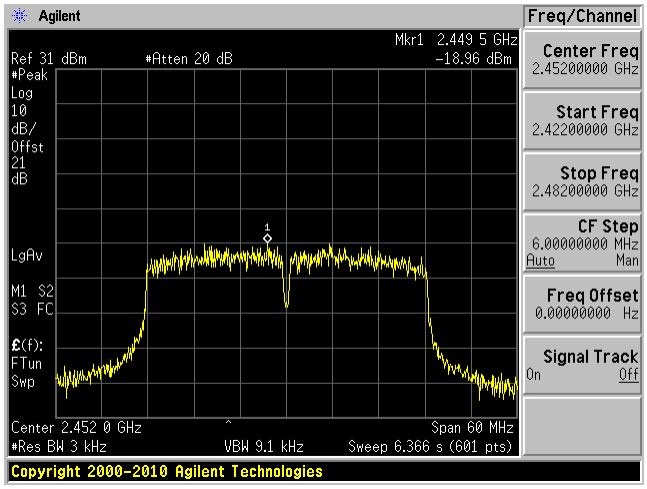
Low Channel 2422 MHz



Middle Channel 2437 MHz



High Channel 2452 MHz



12 FCC §15.247(d)– 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)).

12.2 Test Procedure

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

12.3 Test Equipment List and Details

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

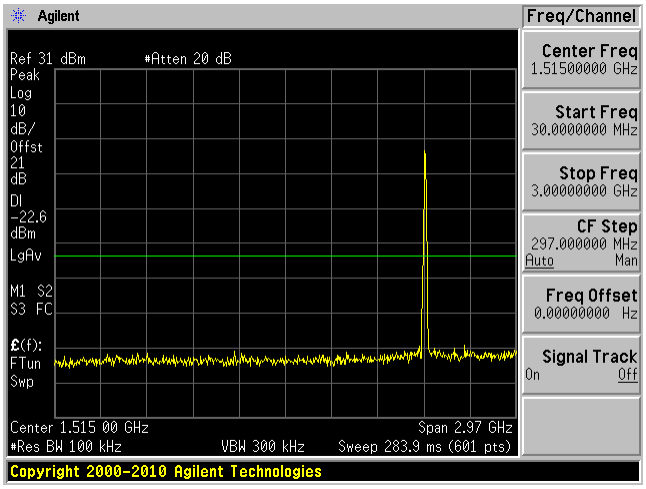
The testing was performed by Chin Ming Lui on 2017-09-1 in RF site.

12.5 Test Results

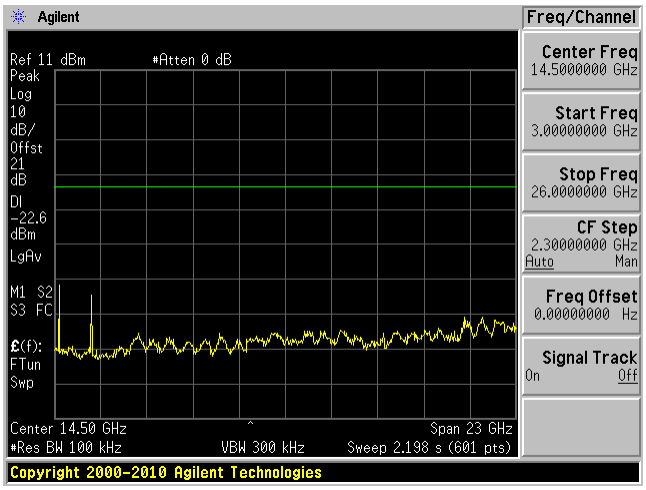
Please refer to following plots.

802.11b mode (Port J20)

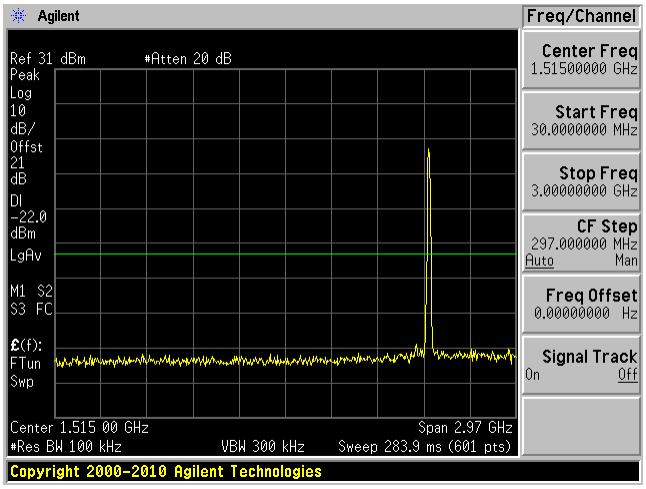
Low Channel 30MHz – 3 GHz



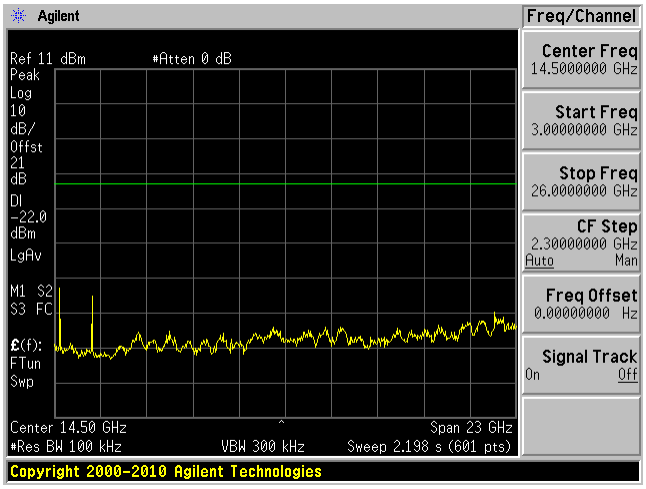
Low Channel 3 GHz – 26 GHz



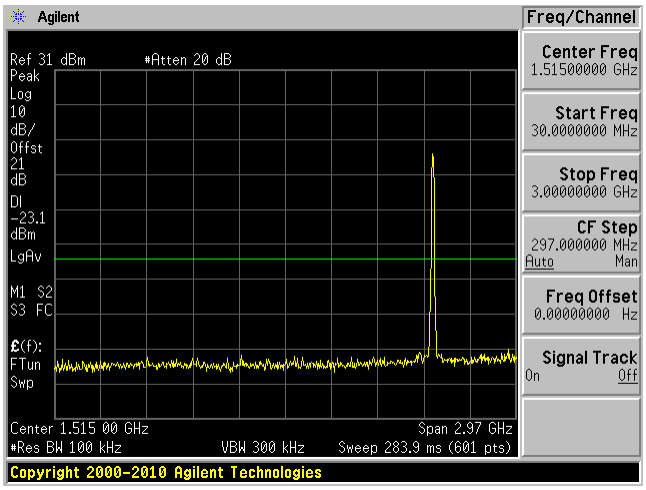
Middle Channel 30 MHz – 3 GHz



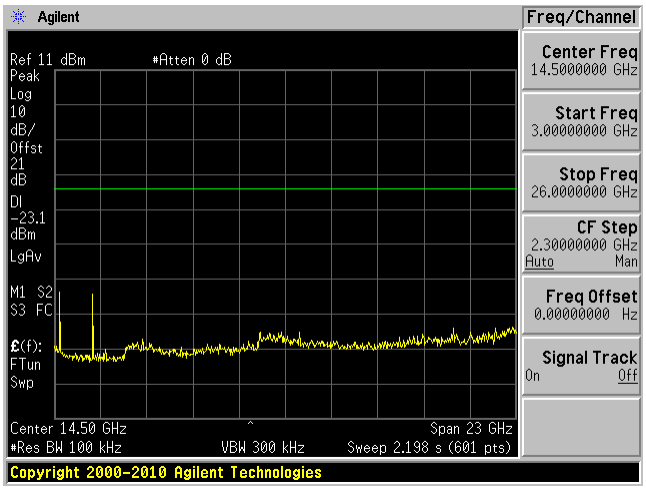
Middle Channel 3 GHz – 26 GHz



High Channel 30 MHz – 3 GHz

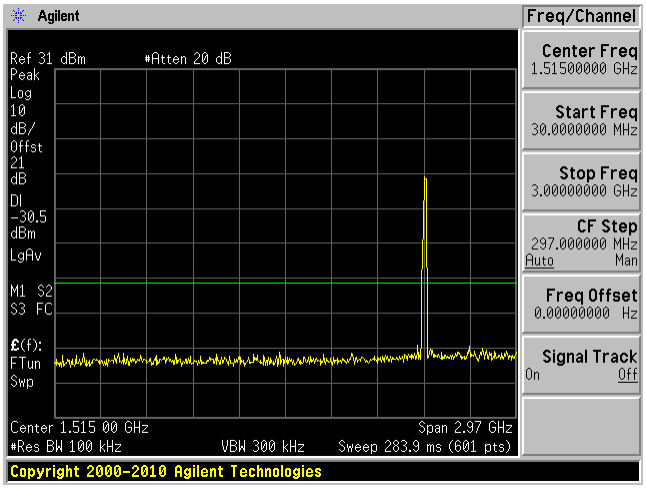


High Channel 3 GHz – 26 GHz

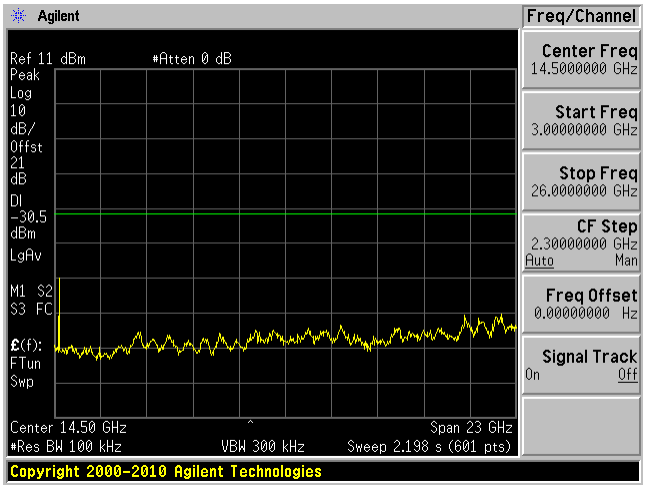


802.11g mode (Port J20)

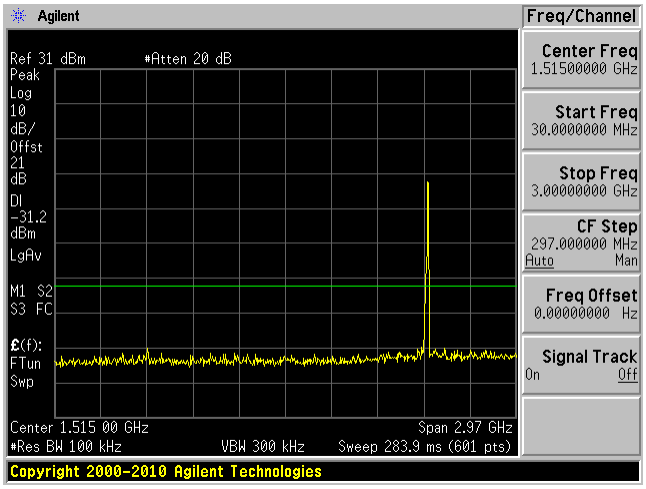
Low Channel 30 MHz – 3 GHz



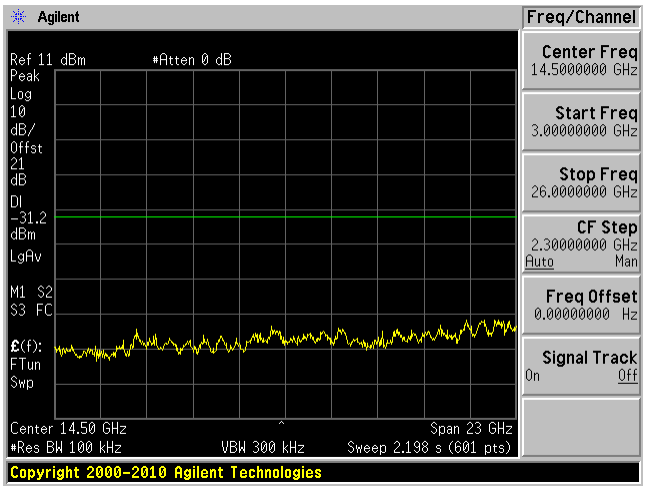
Low Channel 3 GHz – 26 GHz



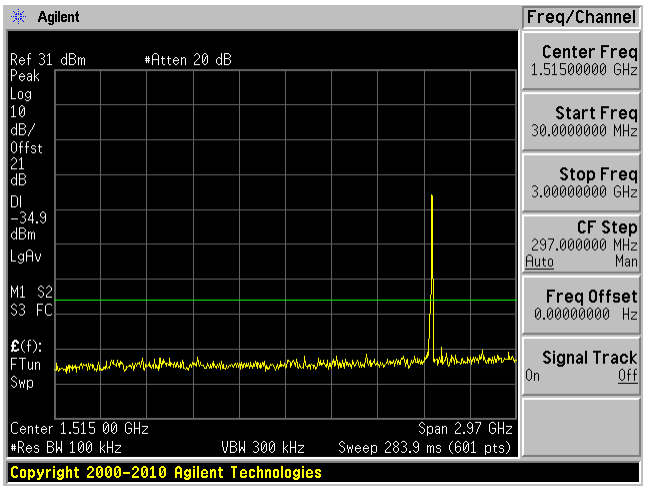
Middle Channel 30 MHz – 3 GHz



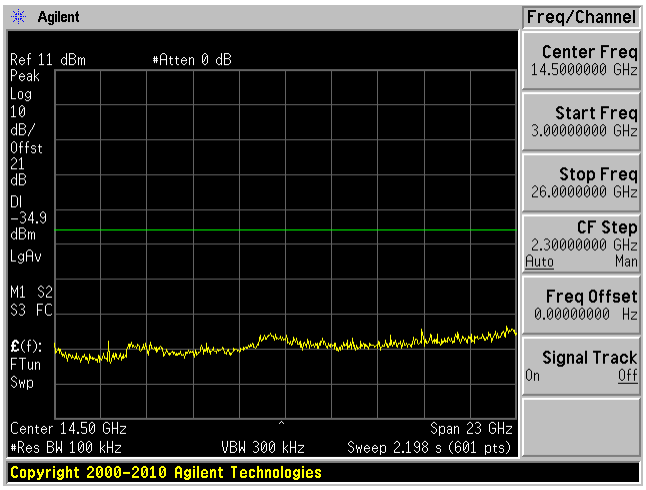
Middle Channel 3 GHz – 26 GHz



High Channel 30 MHz – 3 GHz

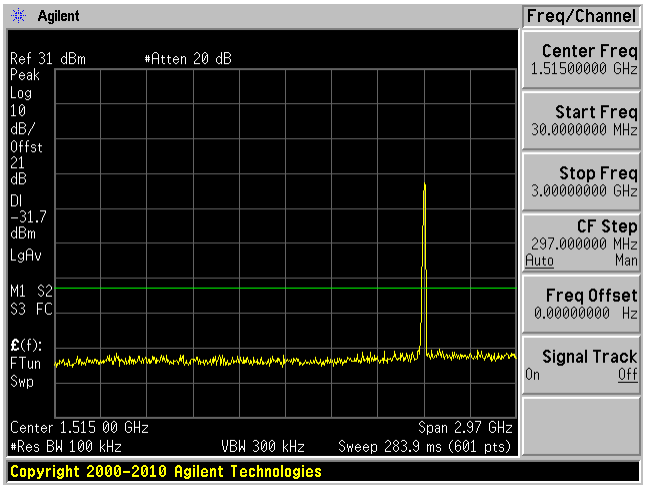


High Channel 3 GHz – 26 GHz

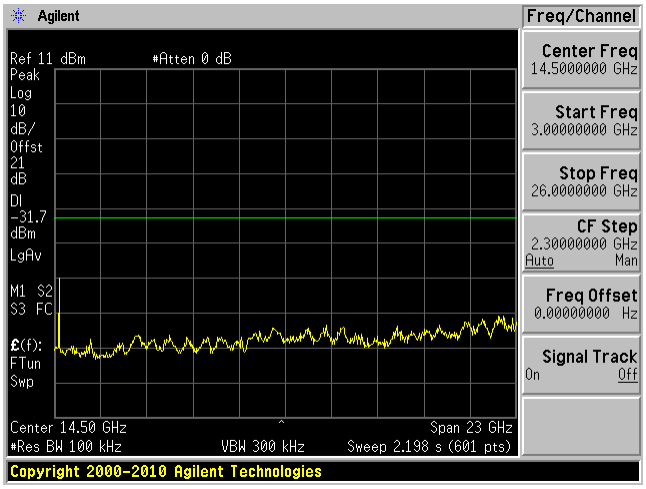


802.11n20 mode (Port J20)

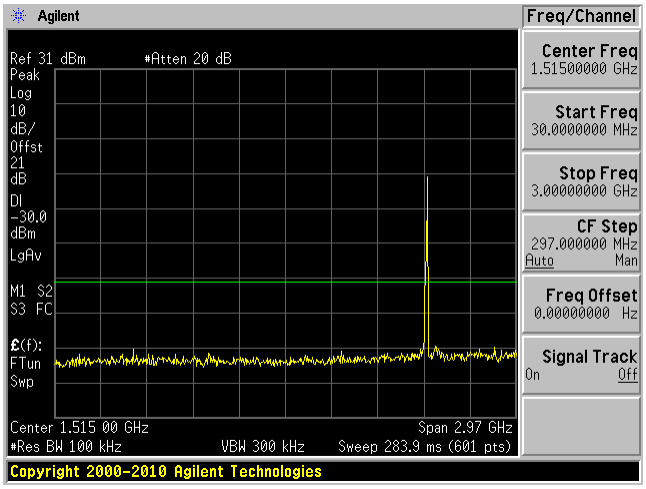
Low Channel 30 MHz – 3 GHz



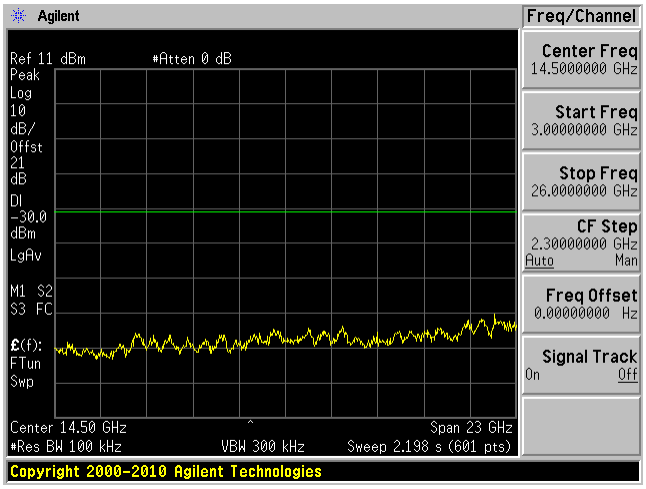
Low Channel 3 GHz – 26 GHz



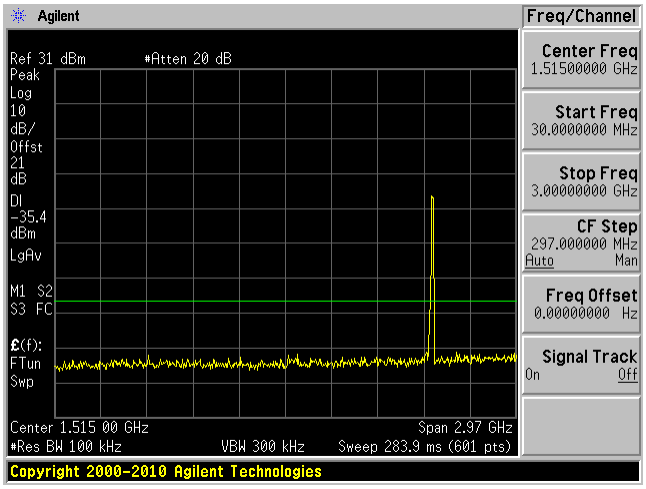
Middle Channel 30 MHz – 3 GHz



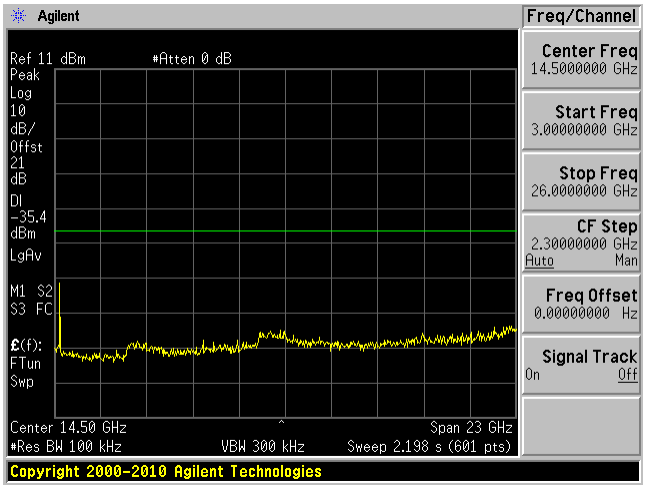
Middle Channel 3 GHz – 26 GHz



High Channel 30 MHz – 3 GHz

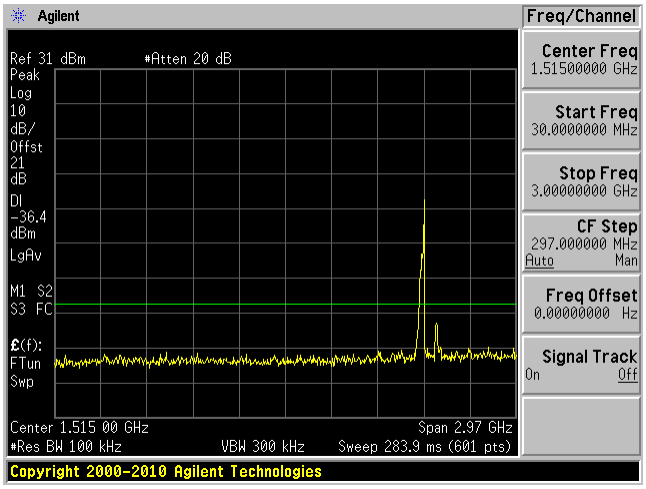


High Channel 3 GHz – 26 GHz

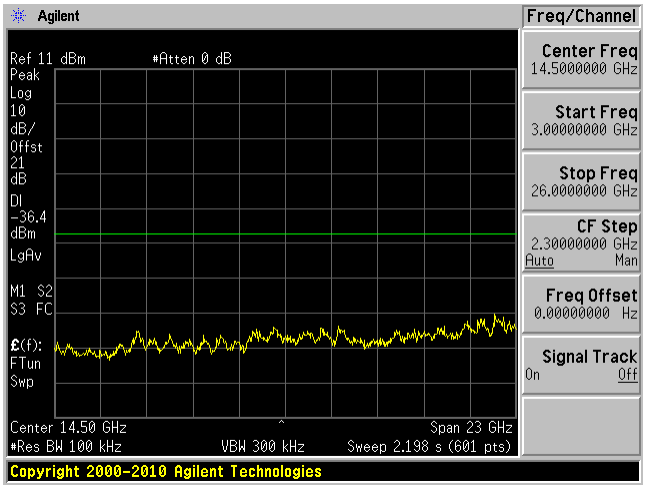


802.11n40 mode (Port J20)

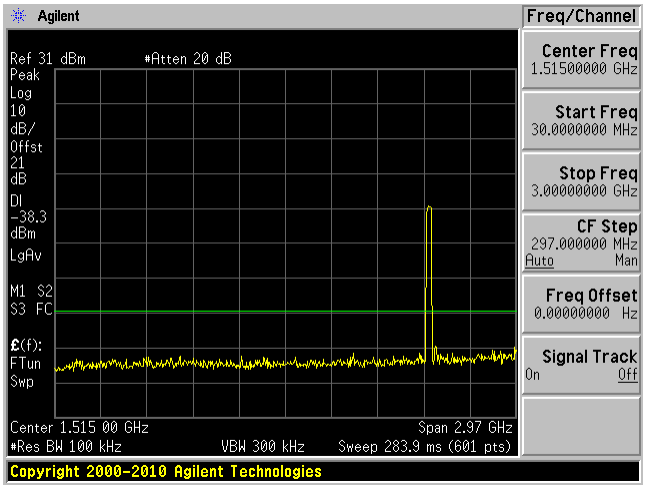
Low Channel 30 MHz – 3 GHz



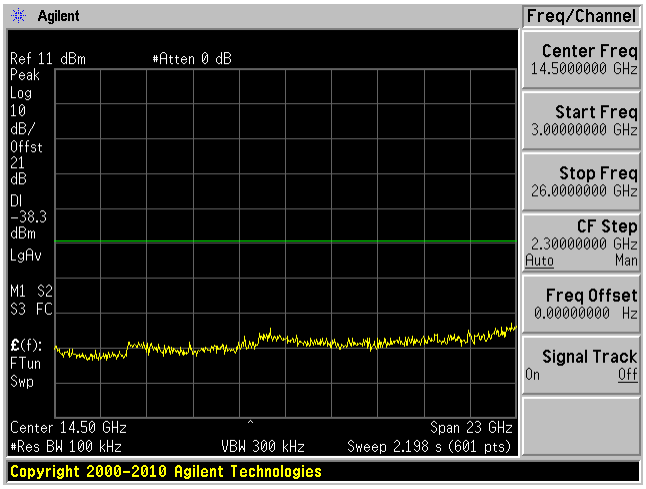
Low Channel 3 GHz – 26 GHz



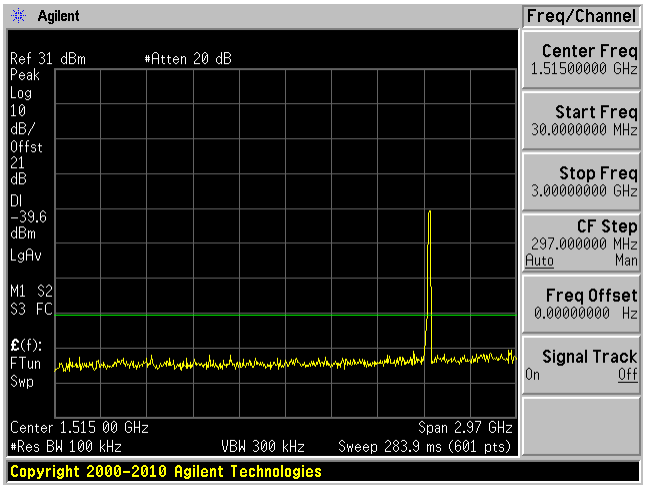
Middle Channel 30 MHz – 3 GHz



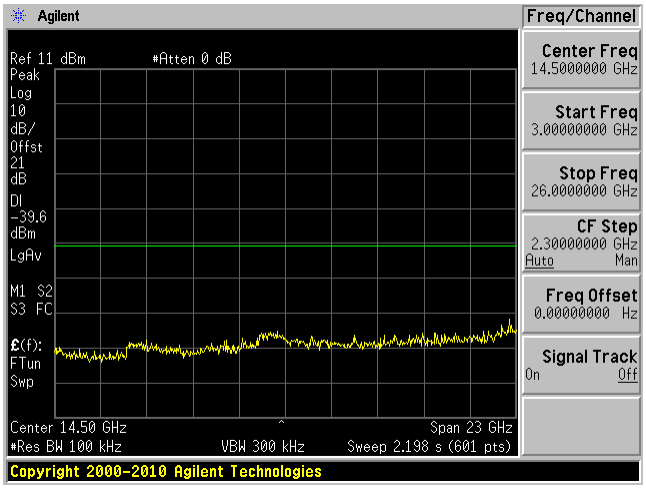
Middle Channel 3 GHz – 26 GHz



High Channel 30 MHz – 3 GHz



High Channel 3 GHz – 26 GHz



13 Annex D (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.

---END OF REPORT ---