FCC PART 15, SUBPART C

TEST AND MEASUREMENT REPORT

For

The Procter & Gamble Company

One P&G Plaza,

Cincinnati, OH 45201-0599, USA

FCC ID: 2AG9A416010

Report Type:	**Product Type:**
Original Report	Smart Air Freshener

Prepared By:	Jin Yang Test Engineer
Report Number:	R1604282-247
Report Date:	2016-05-17
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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1604282-247	Original Report	2016-05-17

1 General Description

1.1 Product Description for Equipment Under Test (EUT)

This test and measurement report was prepared on behalf of *The Procter & Gamble Company,* and their product model: *4E-100,* FCC ID: 2AG9A416010 or the "EUT" as referred to in this report. It is a Smart air freshener with Wi-Fi and ZigBee functions. It operates in the 2.4 GHz.

1.2 Mechanical Description of EUT

The EUT measures approximately 78 mm (L) x 94 mm (W) x 11.4 mm (H) and weight 100 g.

The test data gathered are from typical production sample, serial number: 1604282-1 assigned by BACL.

1.3 Objective

This report is prepared on behalf of *The Procter & Gamble Company,* 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 for Output Power, Antenna Requirements, 6 dB Bandwidth, and Power Spectral Density, 100 kHz Bandwidth of Band Edges Measurement, Conducted and Radiated Spurious Emissions.

1.4 Related Submittal(s)/Grant(s)

N/A

1.5 Test Methodology

All measurements contained in this report were conducted in accordance with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices and FCC KDB 558074 D01 DTS Meas Guidance v03r03: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247.

1.6 Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in the field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system repeatability.

Based on CISPR16-4-2:2011, The Treatment of Uncertainty in EMC Measurements, the values ranging from $\pm$2.0 dB for Conducted Emissions tests and $\pm$4.0 dB for Radiated Emissions tests are the most accurate estimates pertaining to uncertainty of EMC measurements at BACL Corp.

1.7 Test Facility

Bay area compliance Laboratories Corp. (BACL) is:
1- An independent Commercial Test Laboratory accredited to **ISO 17025: 2005** by **A2LA**, in the fields of: Electromagnetic Compatibility & Telecommunications covering Emissions, Immunity, Radio, RF Exposure, Safety and Telecom. This includes NEBS (Network Equipment Building System), Wireless RF, Telecommunications Terminal Equipment (TTE); Network Equipment; Information Technology Equipment (ITE); Medical Electrical Equipment; Industrial, Commercial, and Medical Test Equipment; Professional Audio and Video Equipment; Electronic (Digital) Products; Industrial and Scientific Instruments; Cabled Distribution Systems and Energy Efficiency Lighting.

2- An ENERGY STAR Recognized Laboratory, for the LM80 Testing, a wide variety of Luminares and Computers.

3- A NIST Designated Phase-I and Phase-II CAB including: ACMA (Australian Communication and Media Authority), BSMI (Bureau of Standards, Metrology and Inspection of Taiwan), IDA (Infocomm Development Authority of Singapore), IC(Industry Canada), Korea (Ministry of Communications Radio Research Laboratory), NCC (Formerly DGT; Directorate General of Telecommunication of Chinese Taipei) OFTA (Office of the Telecommunications Authority of Hong Kong), Vietnam, VCCI - Voluntary Control Council for Interference of Japan and a designated EU CAB (Conformity Assessment Body) (Notified Body) for the EMC and R&TTE Directives.

4- A Product Certification Body accredited to **ISO 17065: 2012** by **A2LA** to certify:
2. Radio Standards Specifications (RSS) in the Category I Equipment Standards List and All Broadcasting Technical Standards (BETS) in Category I Equipment Standards List for Industry Canada.
3. Radio Communication Equipment for Singapore.
4. Radio Equipment Specifications, GMDSS Marine Radio Equipment Specifications, and Fixed Network Equipment Specifications for Hong Kong.
5. Japan MIC Telecommunication Business Law (A1, A2) and Radio Law (B1, B2 and B3).
6. Audio/Video, Battery Charging Systems, Computers, Displays, Enterprise Servers, Imaging Equipment, Set-Top Boxes, Telephony, Televisions, Ceiling Fans, CFLs (Including GU24s),Decorative Light Strings, Integral LED Lamps, Luminaires, Residential Ventilating Fans.

The test site used by BACL Corp. to collect radiated and conducted emissions measurement data is located at its facility in Sunnyvale, California, USA.

The test site at BACL Corp. has been fully described in reports submitted to the Federal Communication Commission (FCC) and Voluntary Control Council for Interference (VCCI). The details of these reports have been found to be in compliance with the requirements of Section 2.948 of the FCC Rules on February 11 and December 10, 1997, and Article 8 of the VCCI regulations on December 25, 1997. The test site also complies with the test methods and procedures set forth in CISPR 22:2008 §10.4 for measurements below 1 GHz and §10.6 for measurements above 1 GHz as well as ANSI C63.10-2013, ANSI C63.4-2014, TIA/EIA-603 & CISPR 24:2010.

The Federal Communications Commission and Voluntary Control Council for Interference have the reports on file and they are listed under FCC registration number: 90464 and VCCI Registration No.: A-0027. The test site has been approved by the FCC and VCCI for public use and is listed in the FCC Public Access Link (PAL) database.

Additionally, BACL Corp. is an American Association for Laboratory Accreditation (A2LA) accredited laboratory (Lab Code 3297-02). The current scope of accreditations can be found at

http://www.a2la.org/scopepdf/3297-02.pdf?CFID=1132286&CFTOKEN=e42a3240dac3f6ba-6DE17DCB-1851-9E57-477422F667031258&jsessionid=8430d44f1f47cf2996124343c704b367816b

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 v03r04.

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 utility used was by *The Procter & Gamble Company,* the software was verified by *Jin Yang* to comply with the standard requirements being tested against.

2.3 Duty Cycle Correction

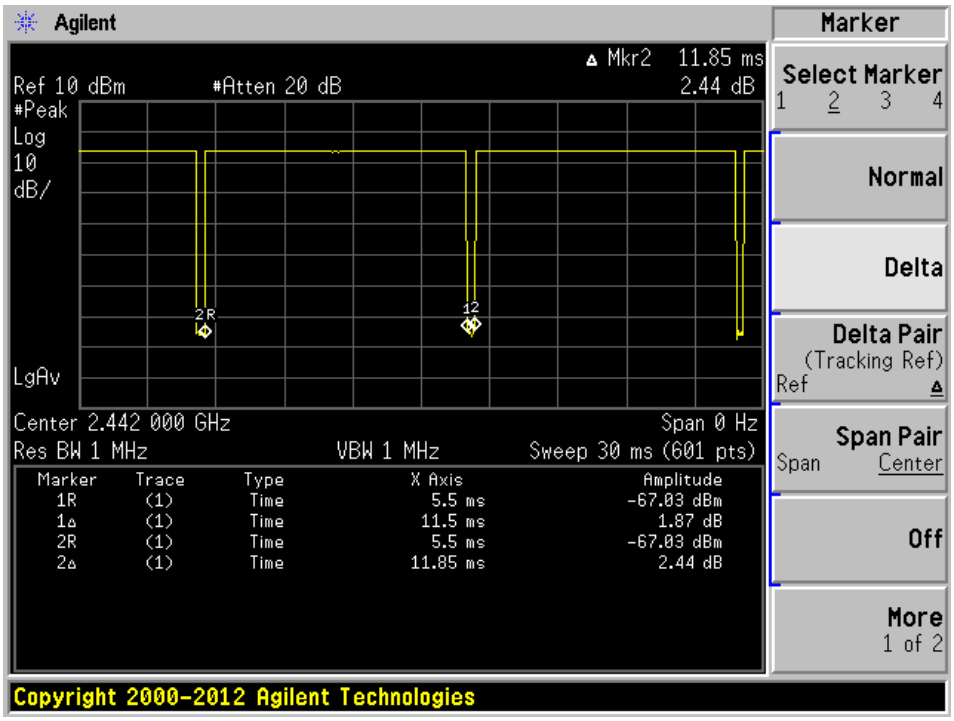
Radio Mode	On Time (ms)	Period (ms)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)
802.11b	11.5	11.85	97.05	0.13
802.11g	1.92	2.04	94.12	0.26
802.11n20	1.8	1.933	93.12	0.31
ZigBee	1000	1000	1000	0

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

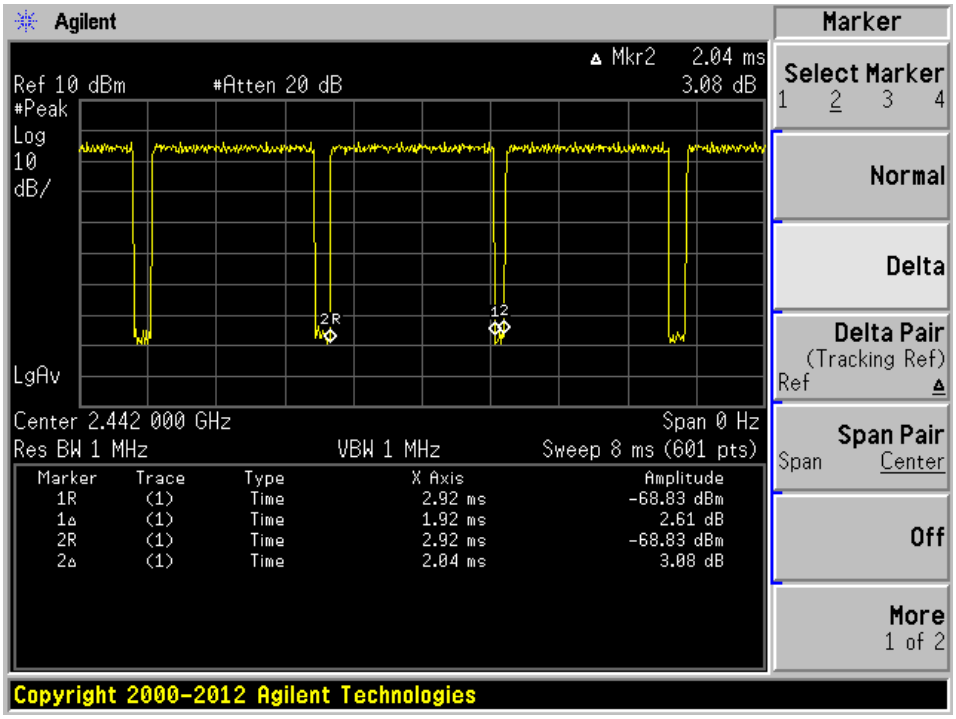
Duty Cycle Correction Factor (dB) = 10*log(1/Duty Cycle)

Please refer to the following plots.

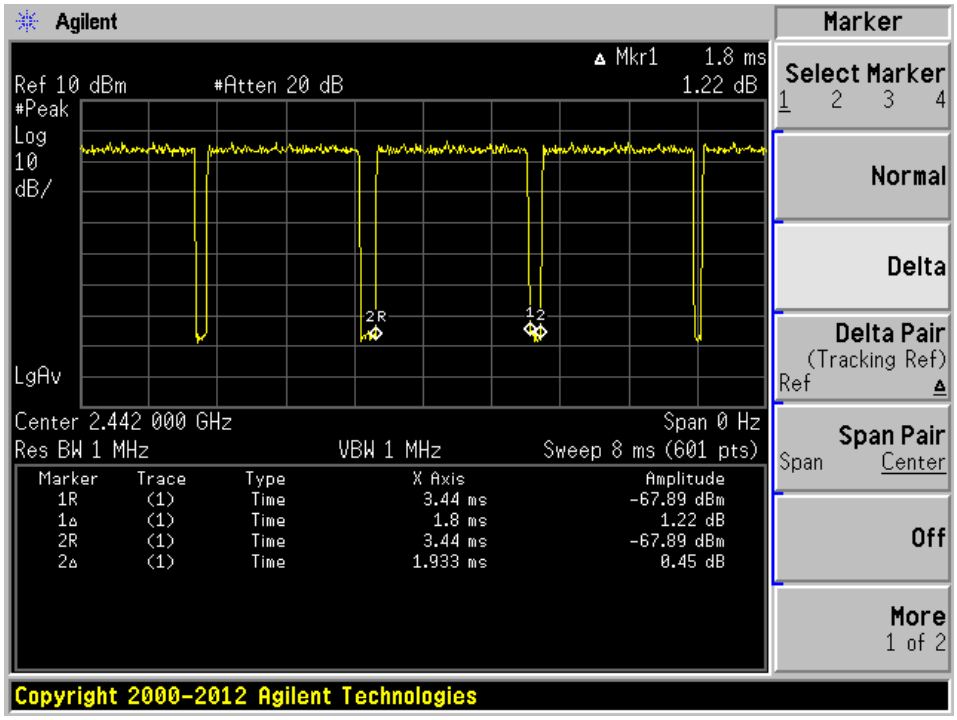
802.11b mode



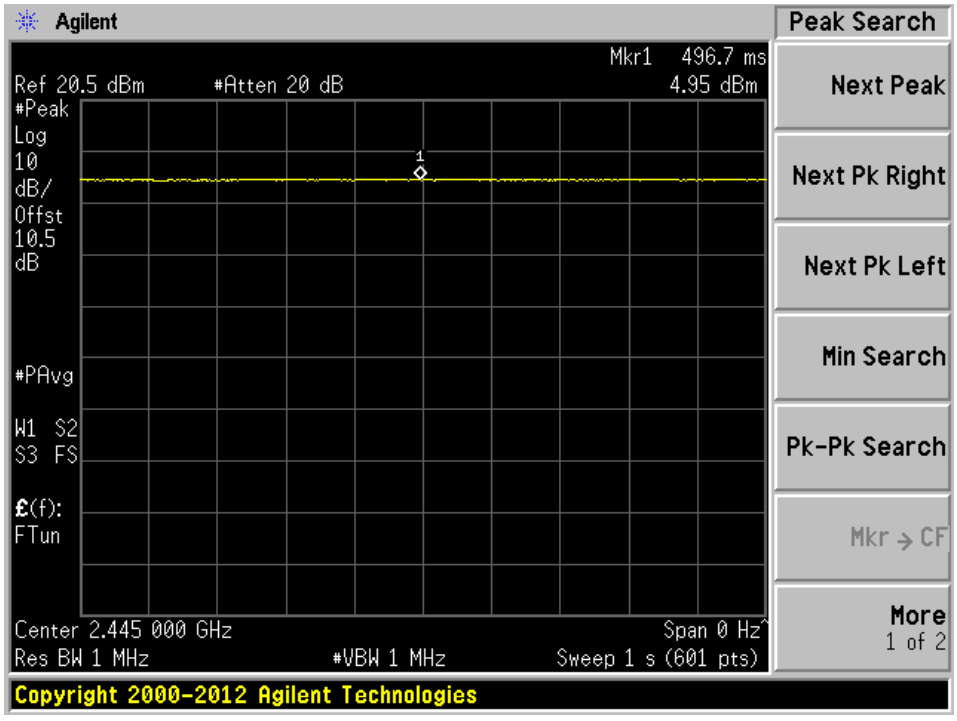
802.11g mode



802.11n20 mode



ZigBee mode



2.4 Equipment Modifications

A hole was cut in the back of the EUT to access the antenna ports.

2.5 Local Support Equipment

Manufacturer	Description	Model
Dell	Laptop	Latitude D630

2.6 Support Equipment

Manufacturer	Description	Model
/	/	/

2.7 Interface Ports and Cabling

Cable Description	Length (m)	To	From
/	/	/	/

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 & 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 are permanent attached patch and PCB antennas.

Antenna Type	Maximum Antenna Gain (dBi) @ 2.4 GHz
Chip (Wi-Fi)	1.9
PCB (ZigBee)	3.0

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

Maximum output power at antenna input terminal (dBm):	20.55
Maximum output power at antenna input terminal (mW):	113.50
Prediction distance (cm):	20
Prediction frequency (MHz):	2442
Maximum Antenna Gain, typical (dBi):	1.9
Maximum Antenna Gain (numeric):	1.55
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.0350
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 $0.0327mW/cm^2$, limit is $1.0mW/cm^2$.

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 & 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:

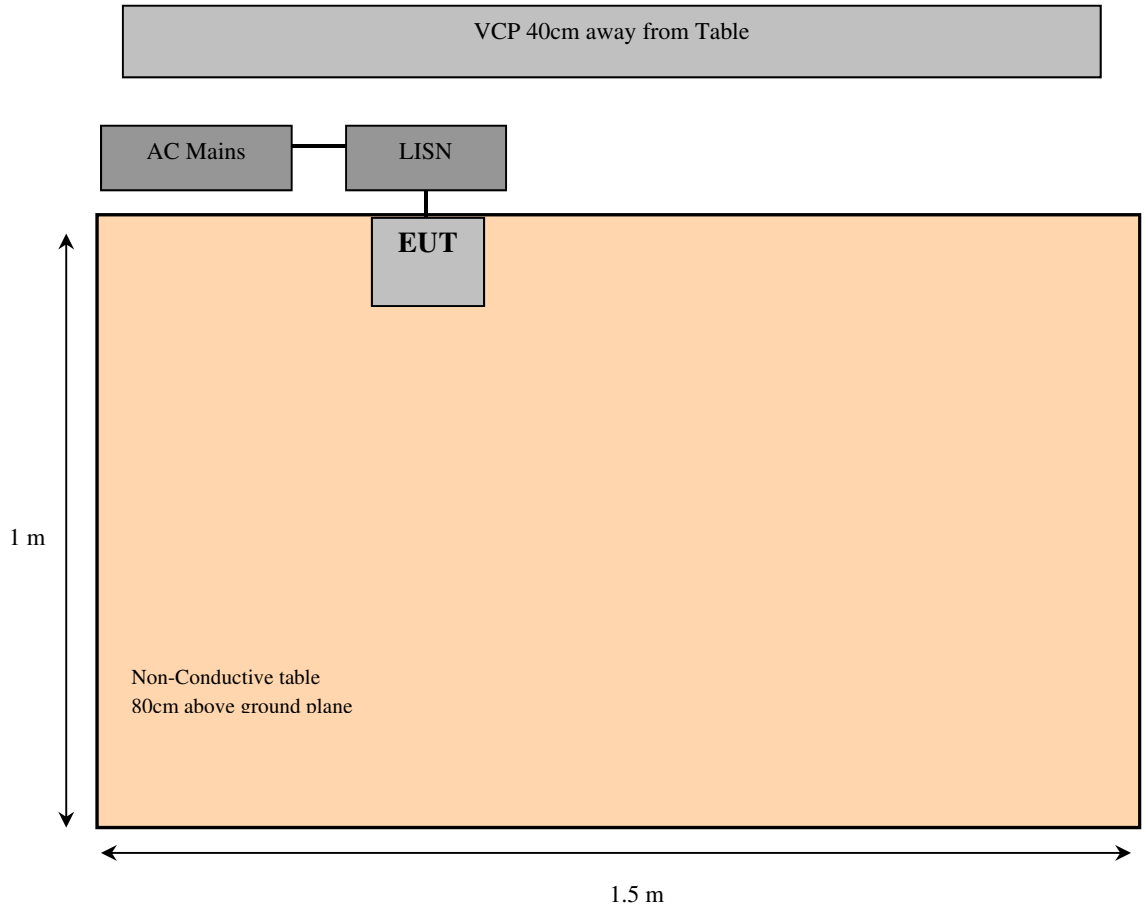
CA = Ai + CL + Atten

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 & Schwarz	Receiver, EMI Test	ESCI 1166.5950K03	100044	2015-07-23	1 year
Rohde & Schwarz	Impulse Limiter	ESH3-Z2	101963	2015-07-15	1year
Keysight Technologies	RF Limiter	11867A	MY42242931	2015-12-15	1year
Solar Electronics Company	High Pass Filter	Type 7930-100	7930150204	2016-03-16	1 year
Suirong	30 ft conductive emission cable	LMR 400	-	2015-07-02	1 year
FCC	LISN	FCC-LISN-50-25-2-10-CISPR16	160129	2016-04-11	1year

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:	15º C
Relative Humidity:	42 %
ATM Pressure:	101.31 kPa

The testing was performed by Jin Yang on 2016-05-12.

6.8 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: EUT connected to 120 V/60 Hz, AC			
Margin (dB)	**Frequency (MHz)**	**Conductor Mode (Live/Neutral)**	**Range (MHz)**
-6.24	0.312461	Neutral	0.15-30

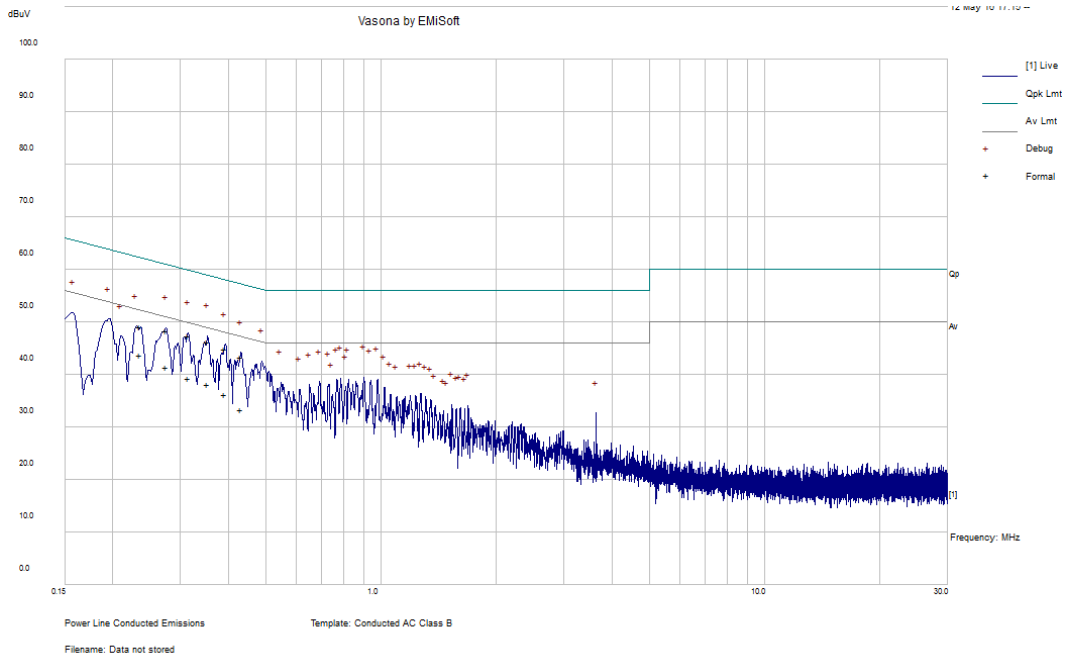
ZigBee

Connection: EUT connected to 120 V/60 Hz, AC			
Margin (dB)	**Frequency (MHz)**	**Conductor Mode (Live/Neutral)**	**Range (MHz)**
-7.44	0.381664	Live	0.15-30

6.9 Conducted Emissions Test Plots and Data

2.4 GHz Wi-Fi

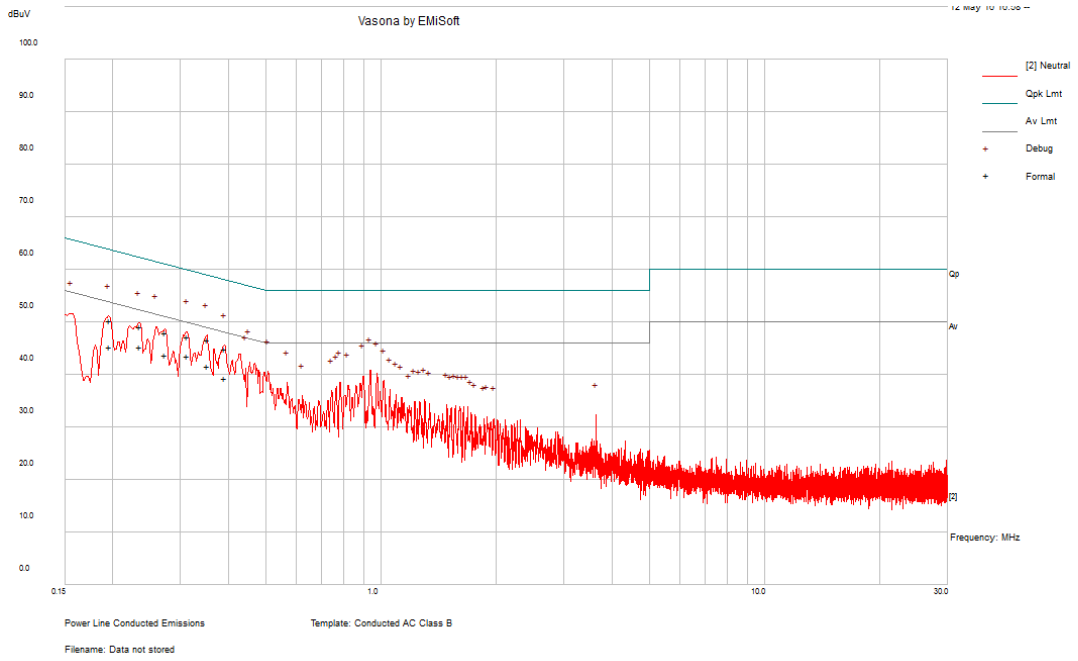
120 V, 60 Hz – Line



Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
0.352854	46.31	Line	58.9	-12.58	QP
0.31456	47.41	Line	59.85	-12.44	QP
0.275151	48.32	Line	60.96	-12.64	QP
0.392497	45.02	Line	58.01	-12.99	QP
0.432537	43.43	Line	57.2	-13.78	QP
0.235347	49.16	Line	62.26	-13.1	QP

Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
0.352854	38.23	Line	48.9	-10.66	Ave.
0.31456	39.35	Line	49.85	-10.49	Ave.
0.275151	41.38	Line	50.96	-9.59	Ave.
0.392497	36.28	Line	48.01	-11.73	Ave.
0.432537	33.48	Line	47.2	-13.72	Ave.
0.235347	43.82	Line	52.26	-8.44	Ave.

120 V, 60 Hz – Neutral

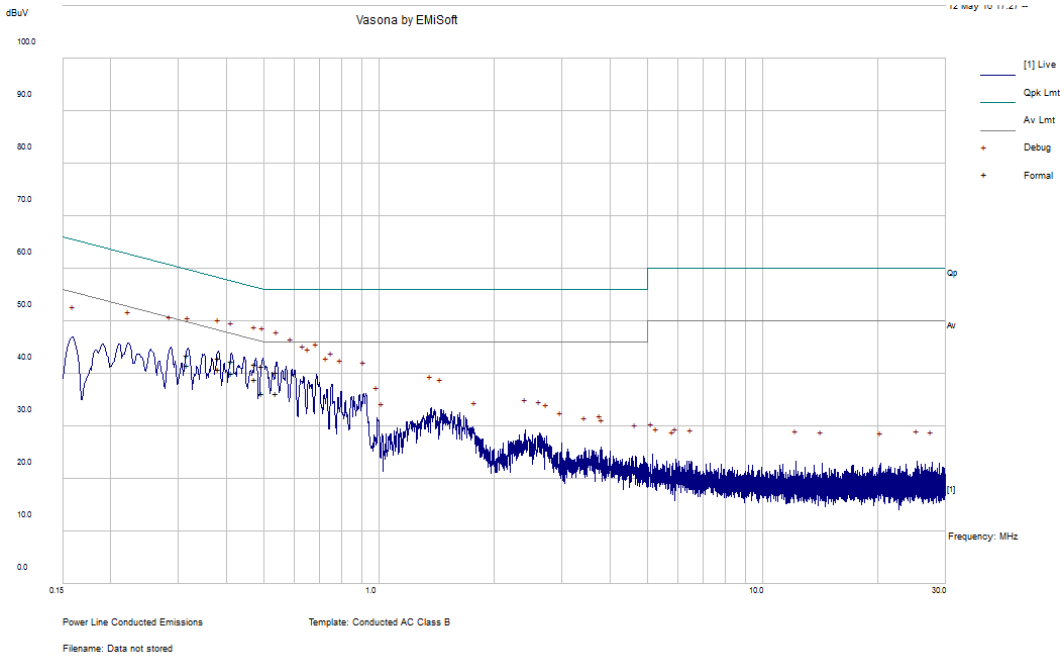


Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
0.352266	46.65	Neutral	58.91	-12.26	QP
0.312461	47.3	Neutral	59.9	-12.6	QP
0.274555	47.95	Neutral	60.98	-13.03	QP
0.39209	44.91	Neutral	58.02	-13.11	QP
0.235352	49.1	Neutral	62.26	-13.16	QP
0.196212	50.27	Neutral	63.77	-13.5	QP

Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
0.352266	41.66	Neutral	48.91	-7.25	Ave.
0.312461	43.66	Neutral	49.9	-6.24	Ave.
0.274555	43.76	Neutral	50.98	-7.22	Ave.
0.39209	39.43	Neutral	48.02	-8.59	Ave.
0.235352	45.32	Neutral	52.26	-6.94	Ave.
0.196212	45.41	Neutral	53.77	-8.36	Ave.

ZigBee

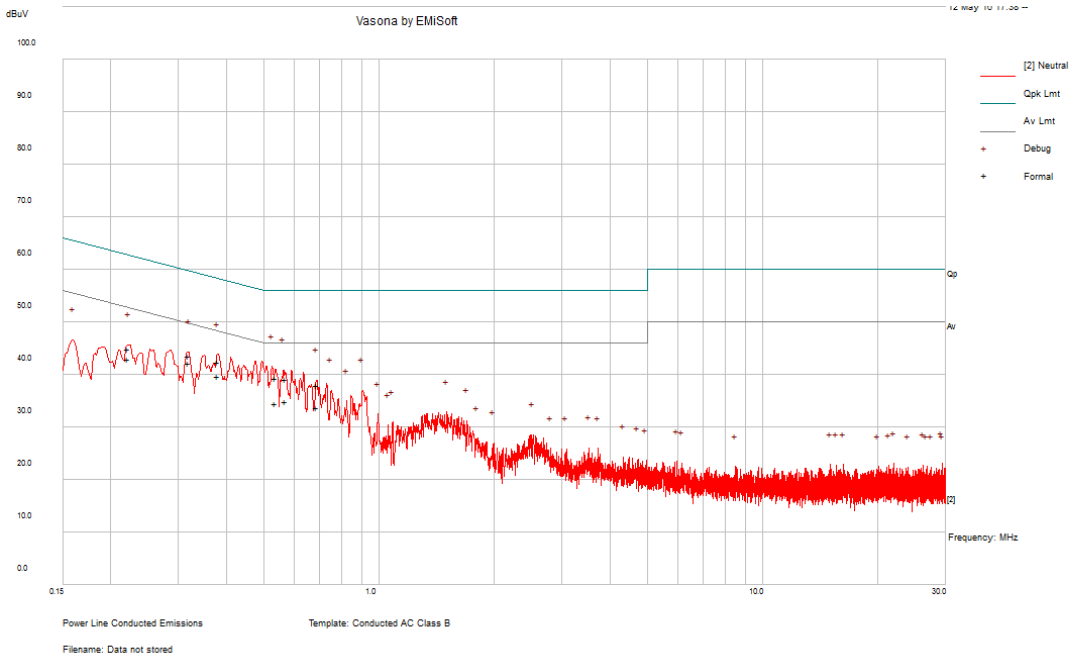
120 V, 60 Hz – Line



Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
0.495987	41.38	Line	56.07	-14.69	QP
0.476121	41.82	Line	56.41	-14.58	QP
0.41291	42.37	Line	57.59	-15.22	QP
0.540081	40.35	Line	56	-15.65	QP
0.381664	42.94	Line	58.24	-15.3	QP
0.316311	43.49	Line	59.8	-16.31	QP

Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
0.495987	36.29	Line	46.07	-9.78	Ave.
0.476121	38.91	Line	46.41	-7.5	Ave.
0.41291	40.14	Line	47.59	-7.45	Ave.
0.540081	36.32	Line	46	-9.68	Ave.
0.381664	40.8	Line	48.24	-7.44	Ave.
0.316311	41.75	Line	49.8	-8.06	Ave.

120 V, 60 Hz – Neutral



Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
0.379655	42.48	Neutral	58.29	-15.81	QP
0.537397	39.3	Neutral	56	-16.7	QP
0.571485	39.21	Neutral	56	-16.79	QP
0.318087	43.56	Neutral	59.76	-16.2	QP
0.687282	38.05	Neutral	56	-17.95	QP
0.221585	44.85	Neutral	62.76	-17.91	QP

Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
0.379655	39.65	Neutral	48.29	-8.64	Ave.
0.537397	34.52	Neutral	46	-11.48	Ave.
0.571485	35.03	Neutral	46	-10.97	Ave.
0.318087	42.16	Neutral	49.76	-7.6	Ave.
0.687282	33.71	Neutral	46	-12.29	Ave.
0.221585	42.94	Neutral	52.76	-9.82	Ave.

7 FCC §15.205, §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 limits.

The spacing between the peripherals was 10 centimeters.

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

7.3 Test Procedure

For the radiated emissions test, the EUT host, and all support equipment power cords were connected to the AC floor outlet.

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

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

The spectrum analyzer or receiver was set as:

Below 1000 MHz:

RBW = 100 kHz / VBW = 300 kHz / Sweep = Auto

Above 1000 MHz:

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

7.4 Corrected Amplitude & 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 & Schwarz	Receiver, EMI Test	ESCI 1166.5950K03	100044	2015-07-23	1 year
Agilent	Analyzer, Spectrum	E4440A	MY44303352	2015-06-22	1 year
Sunol Science Corp	System Controller	SC99V	011003-1	N/R	N/R
Sunol Sciences	Antenna, Biconi-Log	JB3	A020106-2	2015-07-11	2 years
EMCO	Antenna, Horn	3115	9511-4627	2016-01-28	1 year
Agilent	Amplifier, Pre	8447D	2944A10187	2016-03-23	1 year
Suirong	30 ft conductive emission cable	LMR 400	-	2015-07-02	1 year
IW Microwave	High Frequency Cable	DC-1438	SPS-2303-3840-SPS	2016-01-18	1 year
Hewlett-Packard	5 ft N-type RF cable	-	1268	2015-05-15	1 year
Hewlett	Pre-Amplifier	8449B	3008A01978	2015-09-02	1year

Note[1]: 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:	20-22º C
Relative Humidity:	42-50 %
ATM Pressure:	102.7 kPa

The testing was performed by Jin Yang from 2016-05-10 to 2016-05-11 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, channel**
-0.47	4924	Horizontal	b mode, channel 11

ZigBee

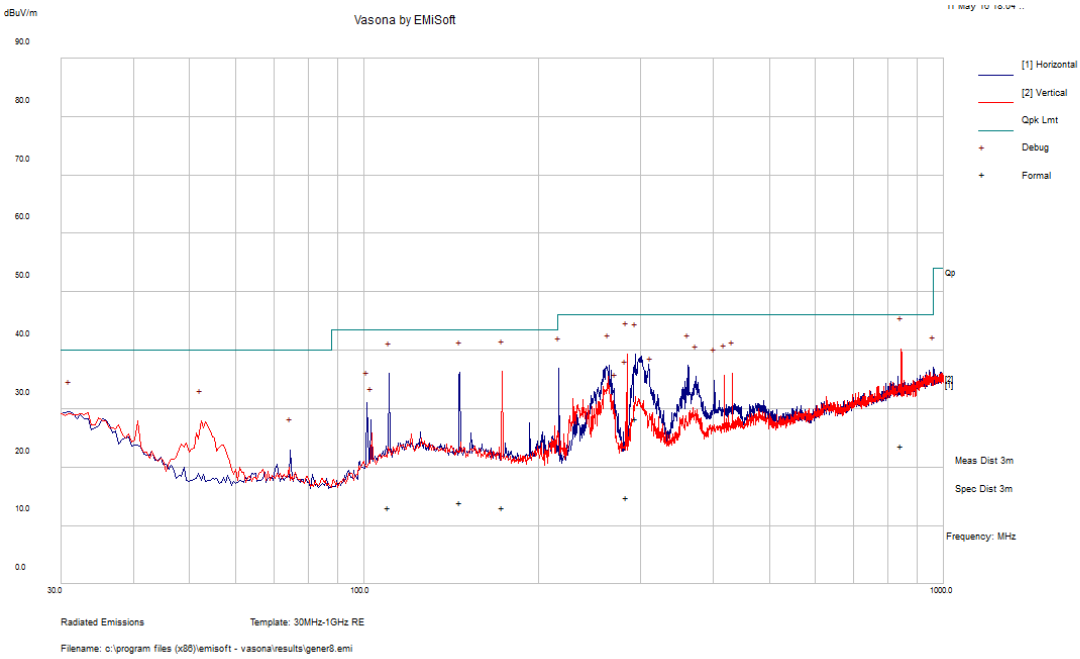
Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**channel**
-0.13	2483.5	Horizontal	High channel

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

7.8 Radiated Emissions Test Results

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

Worst Case: Transmitting 802.11g, 2442MHz



Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Detector (PK/QP/Ave)
845.2623	23.62	237	V	55	46	-22.38	QP
284.117	14.8	156	V	206	46	-31.2	QP
293.8895	28.32	163	H	226	46	-17.68	QP
173.2285	13.05	255	V	186	43.5	-30.45	QP
146.4298	13.96	205	H	267	43.5	-29.54	QP
110.287	13.03	153	H	138	43.5	-30.47	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, power setting 0											
2412	60.15	146	229	H	29.09	5.23	0.00	94.47	N/A	N/A	Peak
2412	57.42	146	229	H	29.09	5.23	0.00	91.74	N/A	N/A	Ave
2412	61.13	273	241	V	29.09	5.23	0.00	95.45	N/A	N/A	Peak
2412	58.52	273	241	V	29.09	5.23	0.00	92.84	N/A	N/A	Ave
2390	26.39	273	241	V	28.98	5.20	0.00	60.57	74.00	-13.43	Peak
2390	15.68	273	241	V	28.98	5.20	0.00	49.86	54.00	-4.14	Ave
4824	54.84	226	100	H	32.51	7.77	37.83	57.29	74.00	-16.71	Peak
4824	50.98	226	100	H	32.51	7.77	37.83	53.43	54.00	-0.57	Ave
7236	46.04	0	150	H	36.86	9.74	37.50	55.14	74.00	-18.86	Peak
7236	34.64	0	150	H	36.86	9.74	37.50	43.74	54.00	-10.26	Ave
9648	46.57	360	150	H	37.80	11.39	38.09	57.67	74.00	-16.33	Peak
9648	34.84	360	150	H	37.80	11.39	38.09	45.94	54.00	-8.06	Ave
Middle Channel 2442 MHz, power setting 3											
2442	60.19	231	217	H	29.20	5.26	0.00	94.65	N/A	N/A	Peak
2442	57.35	231	217	H	29.20	5.26	0.00	91.81	N/A	N/A	Ave
2442	60.76	275	190	V	29.20	5.26	0.00	95.22	N/A	N/A	Peak
2442	57.7	275	190	V	29.20	5.26	0.00	92.16	N/A	N/A	Ave
4884	54.34	227	121	H	32.61	7.83	37.77	57.01	74.00	-16.99	Peak
4884	50.36	227	121	H	32.61	7.83	37.77	53.03	54.00	-0.97	Ave
7326	45.67	0	150	H	37.15	9.80	37.52	55.10	74.00	-18.90	Peak
7326	34.17	0	150	H	37.15	9.80	37.52	43.60	54.00	-10.40	Ave
9768	47.01	360	150	H	37.90	11.46	38.16	58.21	74.00	-15.79	Peak
9768	35.06	360	150	H	37.90	11.46	38.16	46.26	54.00	-7.74	Ave
CH11: 2462 MHz, power setting 2											
2462	61.61	232	248	H	29.27	5.29	0.00	96.17	N/A	N/A	Peak
2462	58.89	232	248	H	29.27	5.29	0.00	93.45	N/A	N/A	Ave
2462	62.39	271	186	V	29.27	5.29	0.00	96.95	N/A	N/A	Peak
2462	59.78	271	186	V	29.27	5.29	0.00	94.34	N/A	N/A	Ave
2483.5	28.92	271	186	V	29.35	5.32	0.00	63.59	74.00	-10.41	Peak
2483.5	17.86	271	186	V	29.35	5.32	0.00	52.53	54.00	-1.47	Ave
4924	54.48	150	255	H	32.72	7.86	37.73	57.33	74.00	-16.67	Peak
4924	50.68	150	255	H	32.72	7.86	37.73	53.53	54.00	-0.47	Ave
7386	45.94	0	150	H	37.14	9.84	37.53	55.39	74.00	-18.61	Peak
7386	34.43	0	150	H	37.14	9.84	37.53	43.88	54.00	-10.12	Ave
9848	48	360	150	H	37.95	11.51	38.17	59.29	74.00	-14.71	Peak
9848	35.77	360	150	H	37.95	11.51	38.17	47.06	54.00	-6.94	Ave

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 2472 MHz, power setting 4											
2472	58.55	232	248	H	29.31	5.30	0.00	93.16	N/A	N/A	Peak
2472	55.92	232	248	H	29.31	5.30	0.00	90.53	N/A	N/A	Ave
2472	59.81	271	186	V	29.31	5.30	0.00	94.42	N/A	N/A	Peak
2472	57.12	271	186	V	29.31	5.30	0.00	91.73	N/A	N/A	Ave
2483.5	27.53	271	186	V	29.35	5.32	0.00	62.20	74.00	-11.80	Peak
2483.5	16.59	271	186	V	29.35	5.32	0.00	51.26	54.00	-2.74	Ave

Note: The power setting of CH 12 (2467 MHz) is same as High Channel, so tested High Channel as the worst case.

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, power setting 0											
2412	60.97	146	229	H	29.09	5.23	0.00	95.29	N/A	N/A	Peak
2412	53.19	146	229	H	29.09	5.23	0.00	87.51	N/A	N/A	Ave
2412	62.04	273	241	V	29.09	5.23	0.00	96.36	N/A	N/A	Peak
2412	54.23	273	241	V	29.09	5.23	0.00	88.55	N/A	N/A	Ave
2390	27.05	273	241	V	28.98	5.20	0.00	61.23	74.00	-12.77	Peak
2390	15.95	273	241	V	28.98	5.20	0.00	50.13	54.00	-3.87	Ave
4824	53.08	226	100	H	32.51	7.77	37.83	55.53	74.00	-18.47	Peak
4824	40.81	226	100	H	32.51	7.77	37.83	43.26	54.00	-10.74	Ave
7236	46.26	0	150	H	36.86	9.74	37.50	55.36	74.00	-18.64	Peak
7236	34.59	0	150	H	36.86	9.74	37.50	43.69	54.00	-10.31	Ave
9648	46.78	360	150	H	37.80	11.39	38.09	57.88	74.00	-16.12	Peak
9648	34.92	360	150	H	37.80	11.39	38.09	46.02	54.00	-7.98	Ave
Middle Channel 2442 MHz, power setting 0											
2442	64.5	231	217	H	29.20	5.26	0.00	98.96	N/A	N/A	Peak
2442	56.45	231	217	H	29.20	5.26	0.00	90.91	N/A	N/A	Ave
2442	66.01	275	190	V	29.20	5.26	0.00	100.47	N/A	N/A	Peak
2442	57.4	275	190	V	29.20	5.26	0.00	91.86	N/A	N/A	Ave
4884	58.47	227	121	H	32.61	7.83	37.77	61.14	74.00	-12.86	Peak
4884	46.16	227	121	H	32.61	7.83	37.77	48.83	54.00	-5.17	Ave
7326	46.39	0	150	H	37.15	9.80	37.52	55.82	74.00	-18.18	Peak
7326	34.22	0	150	H	37.15	9.80	37.52	43.65	54.00	-10.35	Ave
9768	47.16	360	150	H	37.90	11.46	38.16	58.36	74.00	-15.64	Peak
9768	35.18	360	150	H	37.90	11.46	38.16	46.38	54.00	-7.62	Ave
CH 11: 2462 MHz, power setting 0											
2462	63.01	232	248	H	29.27	5.29	0.00	97.57	N/A	N/A	Peak
2462	54.96	232	248	H	29.27	5.29	0.00	89.52	N/A	N/A	Ave
2462	63.93	271	186	V	29.27	5.29	0.00	98.49	N/A	N/A	Peak
2462	56.69	271	186	V	29.27	5.29	0.00	91.25	N/A	N/A	Ave
2483.5	29.87	271	186	V	29.35	5.32	0.00	64.54	74.00	-9.46	Peak
2483.5	17.57	271	186	V	29.35	5.32	0.00	52.24	54.00	-1.76	Ave
4924	58.97	150	255	H	32.72	7.86	37.73	61.82	74.00	-12.18	Peak
4924	45.76	150	255	H	32.72	7.86	37.73	48.61	54.00	-5.39	Ave
7386	45.83	0	150	H	37.14	9.84	37.53	55.28	74.00	-18.72	Peak
7386	34.19	0	150	H	37.14	9.84	37.53	43.64	54.00	-10.36	Ave
9848	48.06	360	150	H	37.95	11.51	38.17	59.35	74.00	-14.65	Peak
9848	35.85	360	150	H	37.95	11.51	38.17	47.14	54.00	-6.86	Ave

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)	
CH 12: 2467 MHz, power setting 6											
2467	59.43	232	248	H	29.29	5.30	0.00	94.02	N/A	N/A	Peak
2467	51.23	232	248	H	29.29	5.30	0.00	85.82	N/A	N/A	Ave
2467	60.23	271	186	V	29.29	5.30	0.00	94.82	N/A	N/A	Peak
2467	52.44	271	186	V	29.29	5.30	0.00	87.03	N/A	N/A	Ave
2483.5	31.1	271	186	V	29.35	5.32	0.00	65.77	74.00	-8.23	Peak
2483.5	18.43	271	186	V	29.35	5.32	0.00	53.10	54.00	-0.90	Ave
High Channel 2472 MHz, power setting 12											
2472	54.16	40	250	H	29.31	5.30	0.00	88.77	N/A	N/A	Peak
2472	45.51	232	248	H	29.31	5.30	0.00	80.12	N/A	N/A	Ave
2472	55	232	248	V	29.31	5.30	0.00	89.61	N/A	N/A	Peak
2472	46.87	271	186	V	29.31	5.30	0.00	81.48	N/A	N/A	Ave
2483.5	34.27	271	186	V	29.35	5.32	0.00	68.94	74.00	-5.06	Peak
2483.5	18.8	271	186	V	29.35	5.32	0.00	53.47	54.00	-0.53	Ave

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, power setting 0											
2412	60.46	146	229	H	29.09	5.23	0.00	94.78	N/A	N/A	Peak
2412	52.44	146	229	H	29.09	5.23	0.00	86.76	N/A	N/A	Ave
2412	61.29	273	241	V	29.09	5.23	0.00	95.61	N/A	N/A	Peak
2412	53.46	273	241	V	29.09	5.23	0.00	87.78	N/A	N/A	Ave
2390	30.49	273	241	V	28.98	5.20	0.00	64.67	74.00	-9.33	Peak
2390	15.95	273	241	V	28.98	5.20	0.00	50.13	54.00	-3.87	Ave
4824	54.2	226	100	H	32.51	7.77	37.83	56.65	74.00	-17.35	Peak
4824	39.82	226	100	H	32.51	7.77	37.83	42.27	54.00	-11.73	Ave
7236	46.35	0	150	H	36.86	9.74	37.50	55.45	74.00	-18.55	Peak
7236	34.89	0	150	H	36.86	9.74	37.50	43.99	54.00	-10.01	Ave
9648	46.23	360	150	H	37.80	11.39	38.09	57.33	74.00	-16.67	Peak
9648	34.59	360	150	H	37.80	11.39	38.09	45.69	54.00	-8.31	Ave
Middle Channel 2442 MHz, power setting 0											
2442	63.95	231	217	H	29.20	5.26	0.00	98.41	N/A	N/A	Peak
2442	55.72	231	217	H	29.20	5.26	0.00	90.18	N/A	N/A	Ave
2442	64.62	275	190	V	29.20	5.26	0.00	99.08	N/A	N/A	Peak
2442	56.08	275	190	V	29.20	5.26	0.00	90.54	N/A	N/A	Ave
4884	58.91	227	121	H	32.61	7.83	37.77	61.58	74.00	-12.42	Peak
4884	45	227	121	H	32.61	7.83	37.77	47.67	54.00	-6.33	Ave
7326	45.39	0	150	H	37.15	9.80	37.52	54.82	74.00	-19.18	Peak
7326	34.05	0	150	H	37.15	9.80	37.52	43.48	54.00	-10.52	Ave
9768	46.89	360	150	H	37.90	11.46	38.16	58.09	74.00	-15.91	Peak
9768	35.01	360	150	H	37.90	11.46	38.16	46.21	54.00	-7.79	Ave
CH 11: 2462 MHz, power setting 0											
2462	62.17	232	248	H	29.27	5.29	0.00	96.73	N/A	N/A	Peak
2462	54.15	232	248	H	29.27	5.29	0.00	88.71	N/A	N/A	Ave
2462	63.18	271	186	V	29.27	5.29	0.00	97.74	N/A	N/A	Peak
2462	54.84	271	186	V	29.27	5.29	0.00	89.40	N/A	N/A	Ave
2483.5	31.62	271	186	V	29.35	5.32	0.00	66.29	74.00	-7.71	Peak
2483.5	16.9	271	186	V	29.35	5.32	0.00	51.57	54.00	-2.43	Ave
4924	58.95	150	255	H	32.72	7.86	37.73	61.80	74.00	-12.20	Peak
4924	44.33	150	255	H	32.72	7.86	37.73	47.18	54.00	-6.82	Ave
7386	45.93	0	150	H	37.14	9.84	37.53	55.38	74.00	-18.62	Peak
7386	34.26	0	150	H	37.14	9.84	37.53	43.71	54.00	-10.29	Ave
9848	48.26	360	150	H	37.95	11.51	38.17	59.55	74.00	-14.45	Peak
9848	35.81	360	150	H	37.95	11.51	38.17	47.10	54.00	-6.90	Ave

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)	
CH 12: 2467 MHz, power setting 5											
2467	59.16	232	248	H	29.29	5.30	0.00	93.75	N/A	N/A	Peak
2467	51.1	232	248	H	29.29	5.30	0.00	85.69	N/A	N/A	Ave
2467	59.93	271	186	V	29.29	5.30	0.00	94.52	N/A	N/A	Peak
2467	52.1	271	186	V	29.29	5.30	0.00	86.69	N/A	N/A	Ave
2483.5	32.75	271	186	V	29.35	5.32	0.00	67.42	74.00	-6.58	Peak
2483.5	18.3	271	186	V	29.35	5.32	0.00	52.97	54.00	-1.03	Ave
High Channel 2472 MHz, power setting 12											
2472	52.78	232	248	H	29.31	5.30	0.00	87.39	N/A	N/A	Peak
2472	44.05	232	248	H	29.31	5.30	0.00	78.66	N/A	N/A	Ave
2472	53.49	271	186	V	29.31	5.30	0.00	88.10	N/A	N/A	Peak
2472	45.4	271	186	V	29.31	5.30	0.00	80.01	N/A	N/A	Ave
2483.5	33.75	271	186	V	29.35	5.32	0.00	68.42	74.00	-5.58	Peak
2483.5	18.64	271	186	V	29.35	5.32	0.00	53.31	54.00	-0.69	Ave

ZigBee 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 2405 MHz, power setting 31											
2405	68.2	35	146	H	29.06	5.22	0.00	102.48	N/A	N/A	Peak
2405	65.96	35	146	H	29.06	5.22	0.00	100.24	N/A	N/A	Ave
2405	66.19	48	287	V	29.06	5.22	0.00	100.47	N/A	N/A	Peak
2405	63.94	48	287	V	29.06	5.22	0.00	98.22	N/A	N/A	Ave
2390	27.08	35	146	H	28.98	5.20	0.00	61.26	74.00	-12.74	Peak
2390	15.96	35	146	H	28.98	5.20	0.00	50.14	54.00	-3.86	Ave
4810	51.43	40	123	V	32.49	7.76	37.84	53.84	74.00	-20.16	Peak
4810	41.5	40	123	V	32.49	7.76	37.84	43.91	54.00	-10.09	Ave
7215	52.24	53	228	H	36.76	9.72	37.50	61.22	74.00	-12.78	Peak
7215	43.82	53	228	H	36.76	9.72	37.50	52.80	54.00	-1.20	Ave
9620	46.7	360	150	H	37.78	11.38	38.07	57.79	74.00	-16.21	Peak
9620	33.97	360	150	H	37.78	11.38	38.07	45.06	54.00	-8.94	Ave
Middle Channel 2445 MHz, power setting 26											
2445	66.1	40	285	H	29.21	5.27	0.00	100.58	N/A	N/A	Peak
2445	63.94	40	285	H	29.21	5.27	0.00	98.42	N/A	N/A	Ave
2445	62.98	41	309	V	29.21	5.27	0.00	97.46	N/A	N/A	Peak
2445	61.34	41	309	V	29.21	5.27	0.00	95.82	N/A	N/A	Ave
4890	56.81	328	226	V	32.62	7.83	37.76	59.50	74.00	-14.50	Peak
4890	50.92	328	226	V	32.62	7.83	37.76	53.61	54.00	-0.39	Ave
7335	47.1	0	150	H	37.14	9.81	37.52	56.53	74.00	-17.47	Peak
7335	34.52	0	150	H	37.14	9.81	37.52	43.95	54.00	-10.05	Ave
9780	46.62	360	150	H	37.91	11.47	38.16	57.84	74.00	-16.16	Peak
9780	34.4	360	150	H	37.91	11.47	38.16	45.62	54.00	-8.38	Ave
CH 25: 2475 MHz, power setting 27											
2475	67.78	40	108	H	29.32	5.31	0.00	102.41	N/A	N/A	Peak
2475	66.07	40	108	H	29.32	5.31	0.00	100.70	N/A	N/A	Ave
2475	62.97	21	299	V	29.32	5.31	0.00	97.60	N/A	N/A	Peak
2475	61.14	21	299	V	29.32	5.31	0.00	95.77	N/A	N/A	Ave
2483.5	29.17	40	108	H	29.35	5.32	0.00	63.84	74.00	-10.16	Peak
2483.5	18.77	40	108	H	29.35	5.32	0.00	53.44	54.00	-0.56	Ave
4950	56.34	187	126	V	32.81	7.89	37.71	59.33	74.00	-14.67	Peak
4950	50.2	187	126	V	32.81	7.89	37.71	53.19	54.00	-0.81	Ave
7425	47.28	0	150	H	37.08	9.87	37.54	56.69	74.00	-17.31	Peak
7425	34.97	0	150	H	37.08	9.87	37.54	44.38	54.00	-9.62	Ave
9900	47.84	360	150	H	37.99	11.53	38.18	59.18	74.00	-14.82	Peak
9900	34.66	360	150	H	37.99	11.53	38.18	46.00	54.00	-8.00	Ave

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 2480 MHz, power setting 19											
2480	54.08	40	108	H	29.34	5.31	0.00	88.73	N/A	N/A	Peak
2480	52.01	40	108	H	29.34	5.31	0.00	86.66	N/A	N/A	Ave
2480	50.41	21	299	V	29.34	5.31	0.00	85.06	N/A	N/A	Peak
2480	48.33	21	299	V	29.34	5.31	0.00	82.98	N/A	N/A	Ave
2483.5	29.17	40	108	H	29.35	5.32	0.00	63.84	74.00	-10.16	Peak
2483.5	19.2	40	108	H	29.35	5.32	0.00	53.87	54.00	-0.13	Ave

Note: Duty cycle correction factor has been considered for all average reading of spurious emissions.

8 FCC §15.247(a) (2) – 6 dB & 99% Occupied Bandwidth

8.1 Applicable Standards

According to FCC §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 v03r04: 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	MY44303352	2015-06-22	1 year
-	U. FL to SMA pigtail	-	-	Each time[1]	N/A
-	10dB attenuator	-	-	Each time[1]	N/A

Note[1]: cable and attenuator included in the test set-up will be checked each time before testing.

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

8.4 Test Environmental Conditions

Temperature:	22º C
Relative Humidity:	42 %
ATM Pressure:	102.7 KPa

The testing was performed by Jin Yang on 2016-05-11 in RF site.

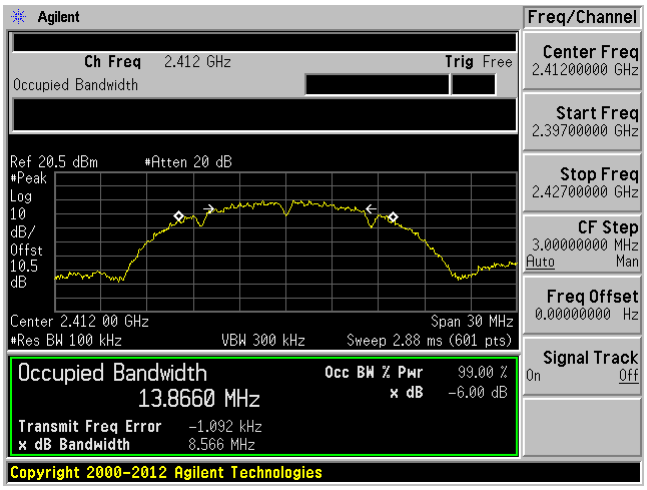
8.5 Test Results

Channel	Frequency (MHz)	99% OBW (kHz)	6 dB OBW (kHz)	6 dB OBW Limit (kHz)
802.11 b mode				
Low	2412	13866	8566	500
Middle	2442	13981.9	9092	500
High	2472	14027.9	9109	500
802.11 g mode				
Low	2412	16305.9	13821	500
Middle	2442	16368.7	15093	500
High	2472	16266.5	14999	500
802.11n-HT20 mode				
Low	2412	174812	13862	500
Middle	2442	17553.5	15089	500
High	2472	17435.4	12211	500
ZigBee				
Low	2405	2362.9	1594	500
Middle	2445	23367	1579	500
High	2480	2416.7	1619	500

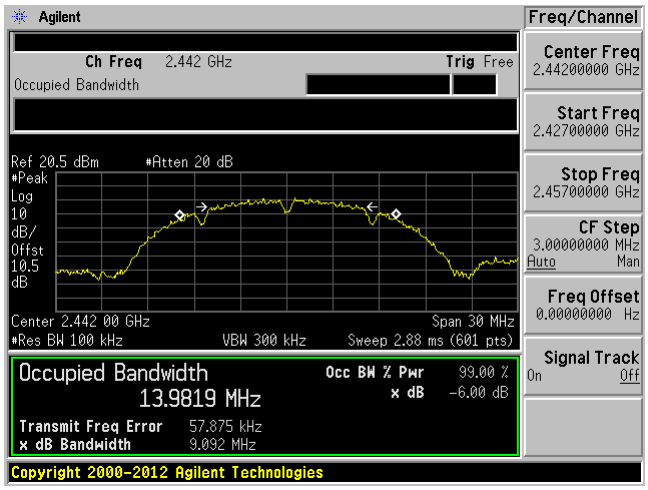
Please refer to the following plots for detailed test results.

802.11b mode

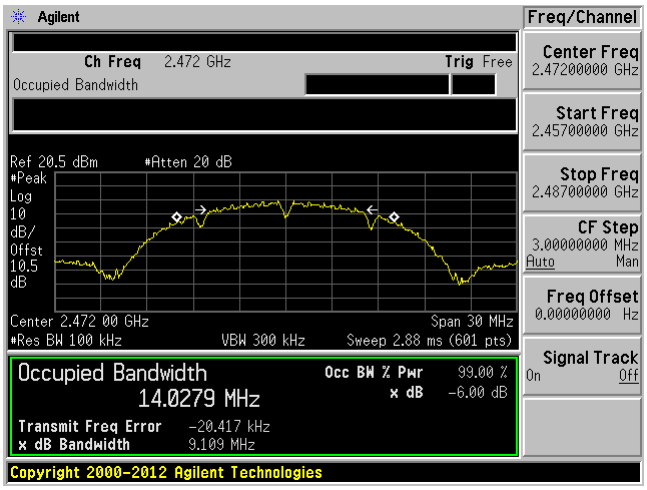
Low Channel 2412 MHz



Middle Channel 2442 MHz

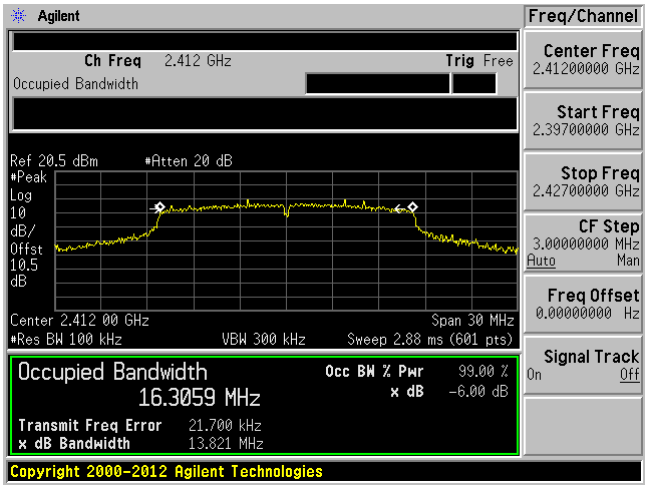


High Channel 2472 MHz

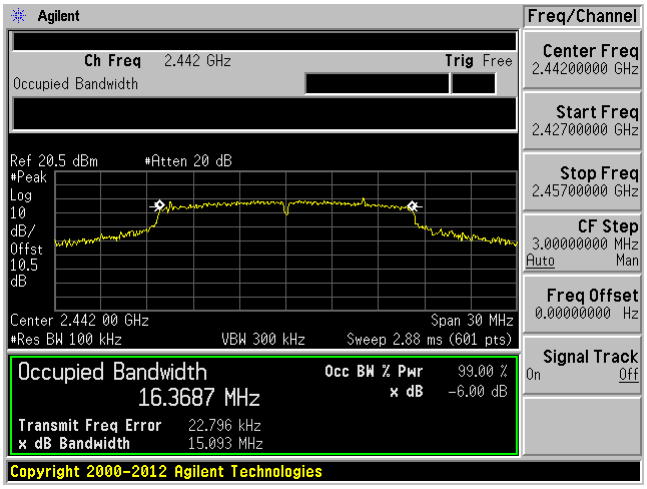


802.11g mode

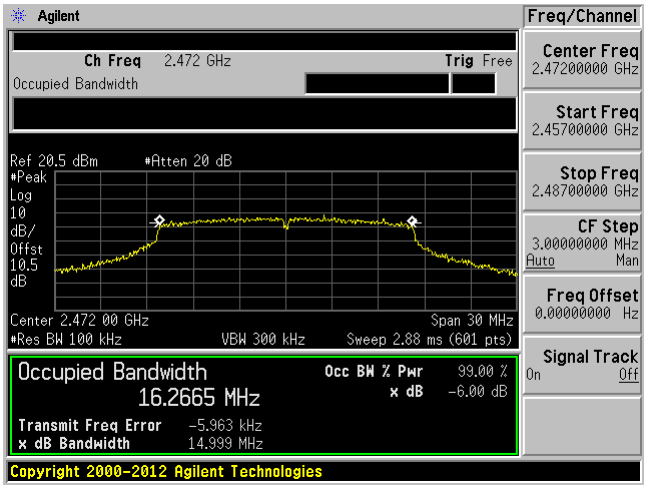
Low Channel 2412 MHz



Middle Channel 2442 MHz

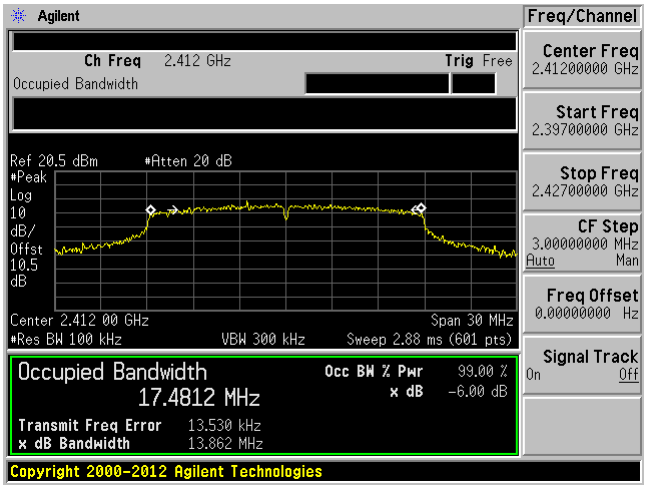


High Channel 2472 MHz

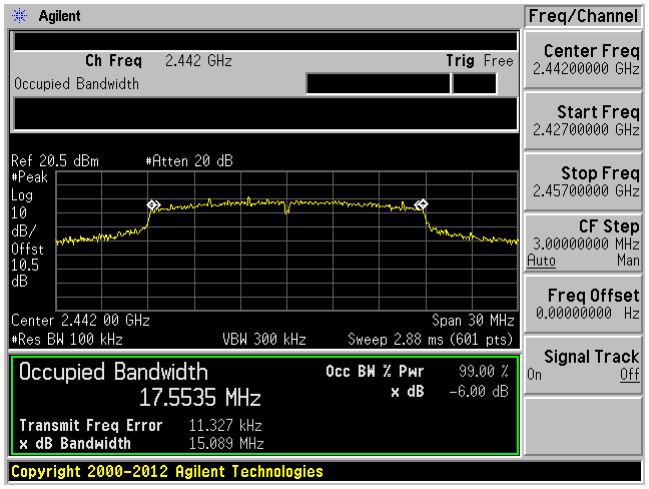


802.11n20 mode

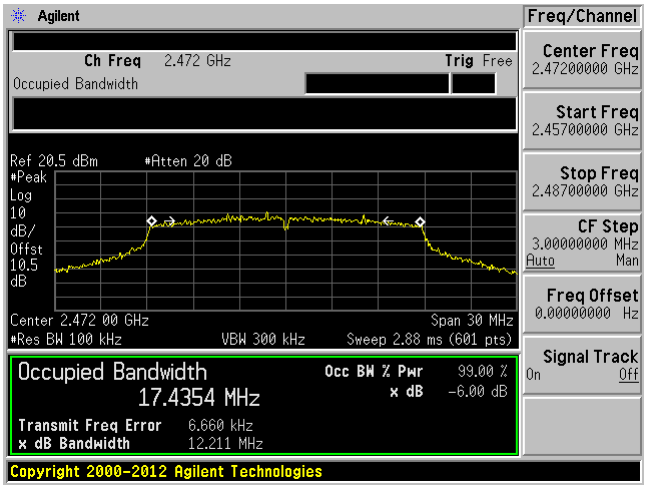
Low Channel 2412 MHz



Middle Channel 2442 MHz

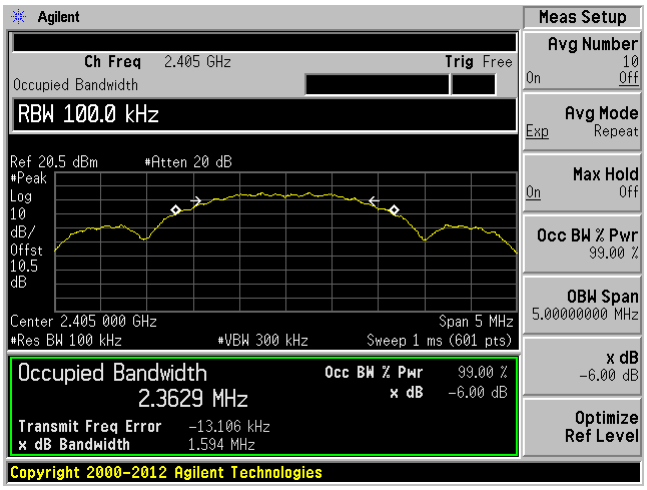


High Channel 2472 MHz

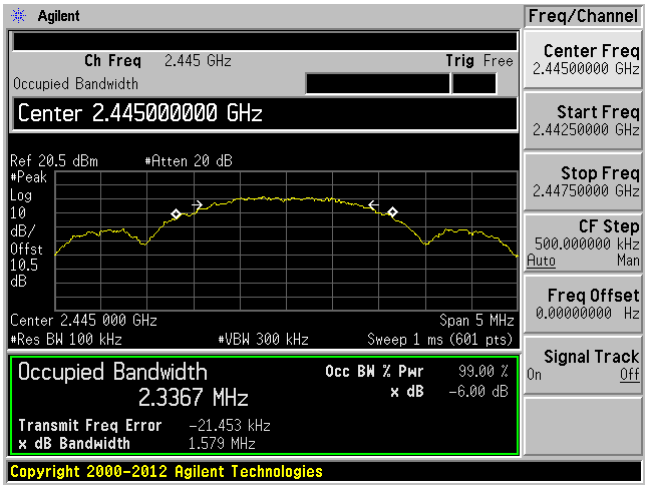


ZigBee

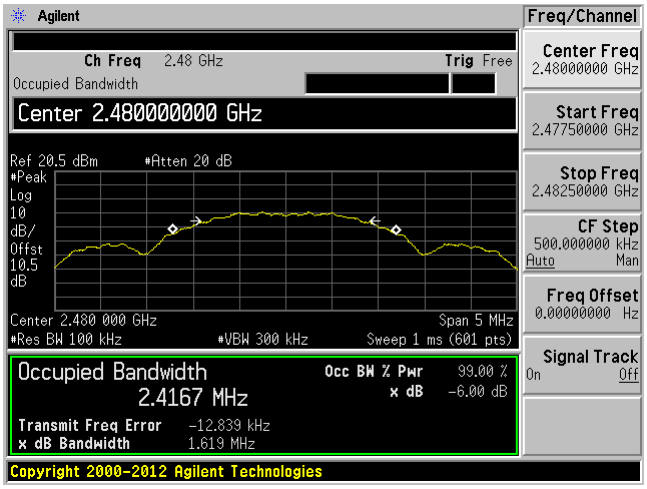
Low Channel 2405 MHz



Middle Channel 2445 MHz



High Channel 2480 MHz



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

9.1 Applicable Standards

According to FCC §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 v03r04: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 section 9: Fundamental emission output power

9.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Analyzer, Spectrum	E4440A	MY44303352	2015-06-22	1 year
Rohde & Schwarz	Signal Analyzer	FSQ26	200749	2016-03-24	1 year
-	U. FL to SMA pigtail	-	-	Each time[1]	N/A
-	10dB attenuator	-	-	Each time[1]	N/A

Note[1]: cable and attenuator included in the test set-up will be checked each time before testing.

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

9.4 Test Environmental Conditions

Temperature:	22º C
Relative Humidity:	42 %
ATM Pressure:	102.7 KPa

The testing was performed by Jin Yang on 2016-05-11 to 2016-05-19 in RF site.

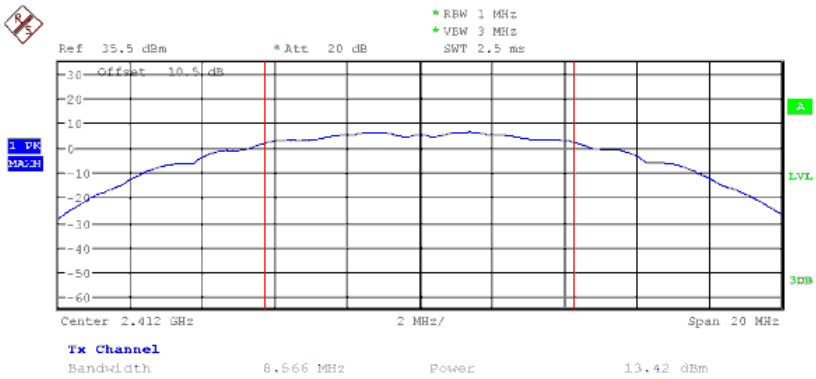
9.5 Test Results

Channel	Frequency (MHz)	Conducted Output Power (dBm)	Limit (dBm)
802.11b mode			
Low	2412	13.42	30
Middle	2442	14.24	30
11	2462	14.75	30
12	2467	12.38	30
High	2472	12.13	30
802.11g mode			
Low	2412	18.01	30
Middle	2442	20.55	30
11	2462	19.56	30
12	2467	16.08	30
High	2472	9.4	30
802.11n-HT20 mode			
Low	2412	17.21	30
Middle	2442	20.29	30
11	2462	18.81	30
12	2467	15.45	30
High	2472	8.42	30
ZigBee			
Low	2405	8.76	30
Middle	2445	5.78	30
25	2475	7.11	30
High	2480	-5.62	30

Please refer to the following plots for detailed test results.

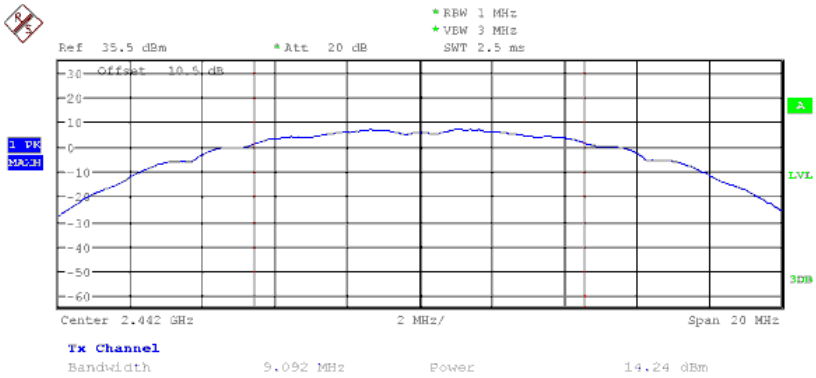
802.11b

Low Channel 2412 MHz



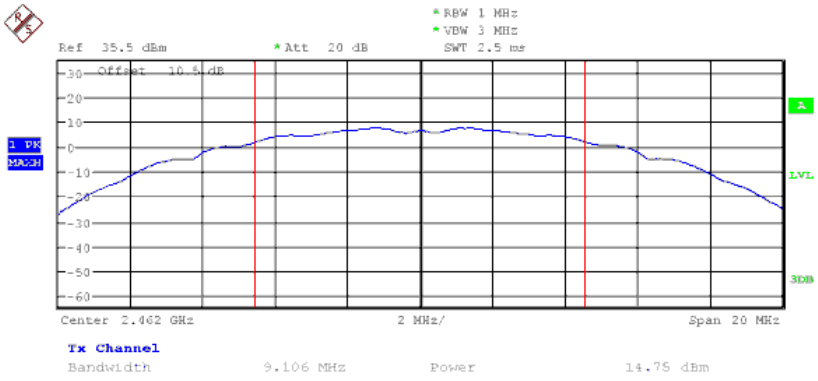
Date: 19.MAY.2016 11:47:43

Middle Channel 2442 MHz



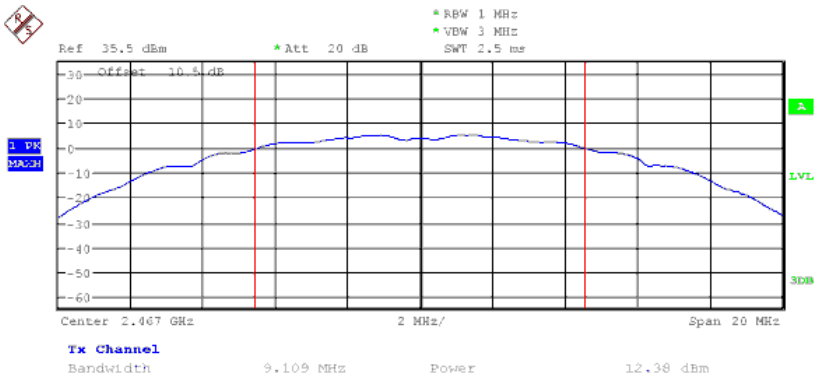
Date: 19.MAY.2016 11:50:27

CH 11: 2462MHz



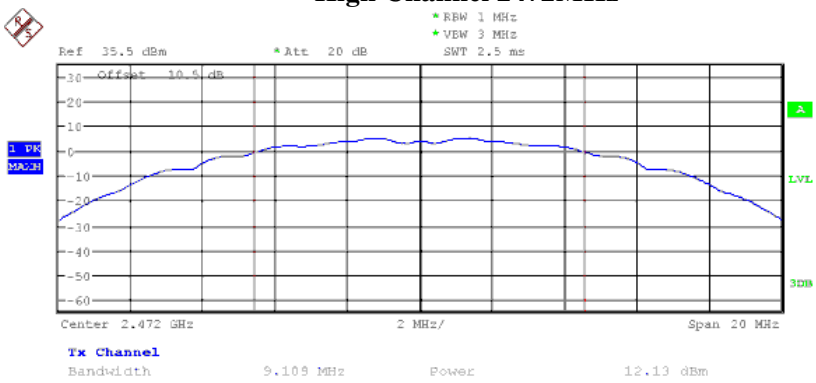
Date: 19.MAY.2016 11:49:39

CH 12: 2467MHz



Date: 19.MAY.2016 11:51:07

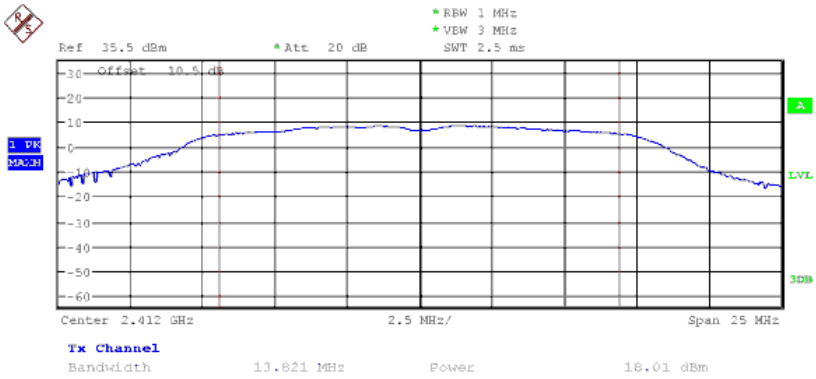
High Channel 2472MHz



Date: 19.MAY.2016 11:51:28

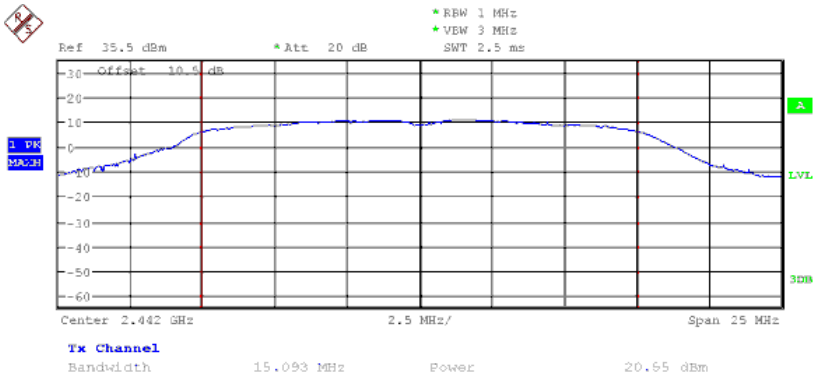
802.11g

Low Channel 2412 MHz



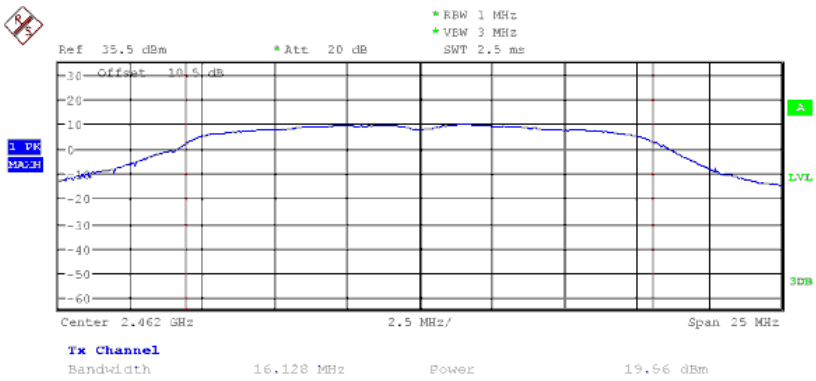
Date: 19.MAY.2016 11:55:00

Middle Channel 2442 MHz



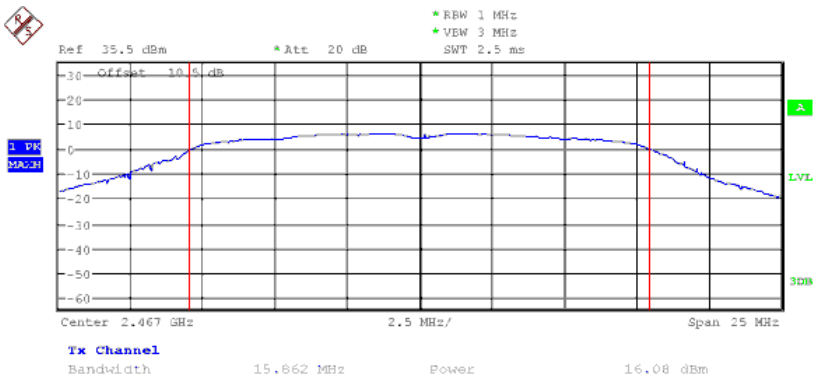
Date: 19.MAY.2016 11:54:32

CH 11: 2462MHz



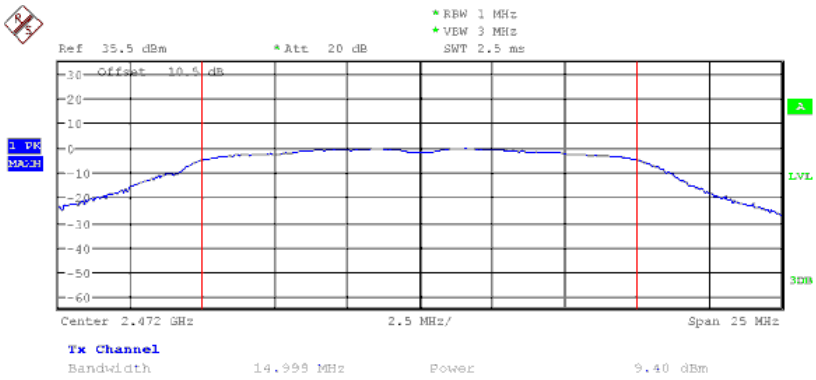
Date: 19.MAY.2016 11:53:57

CH 12: 2467MHz



Date: 19.MAY.2016 11:53:09

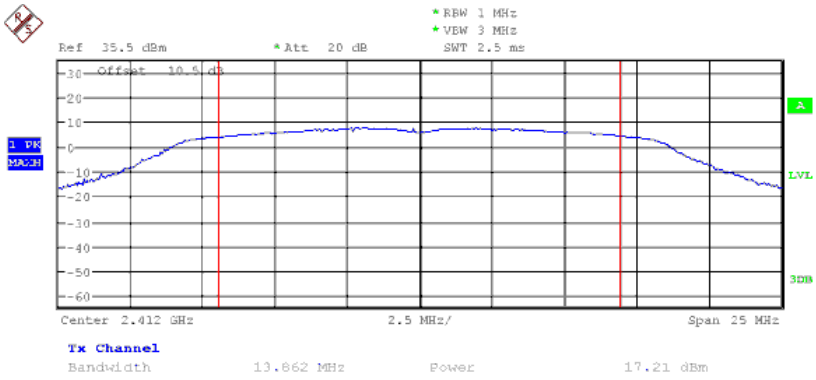
High Channel 2472MHz



Date: 19.MAY.2016 11:52:31

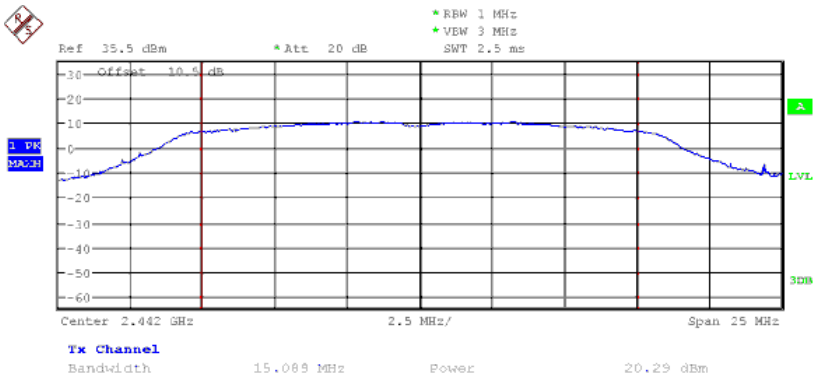
802.11n20

Low Channel 2412 MHz



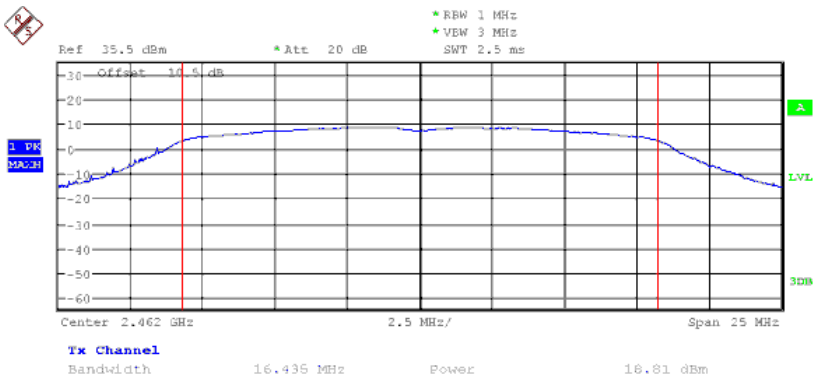
Date: 19.MAY.2016 11:55:43

Middle Channel 2442 MHz



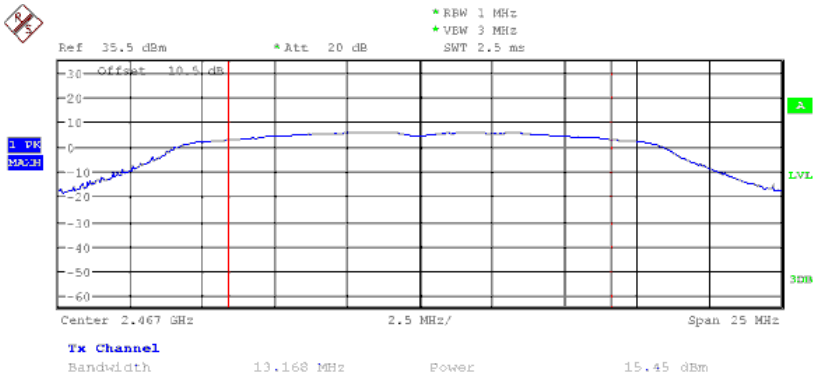
Date: 19.MAY.2016 11:56:15

CH 11: 2462MHz



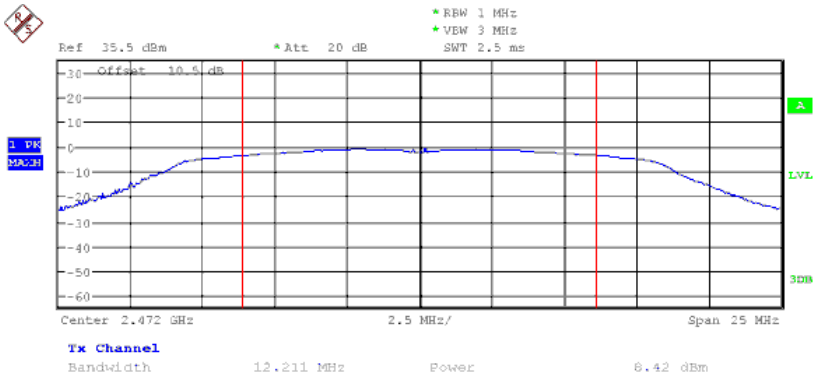
Date: 19.MAY.2016 11:56:47

CH 12: 2467MHz



Date: 19.MAY.2016 11:57:42

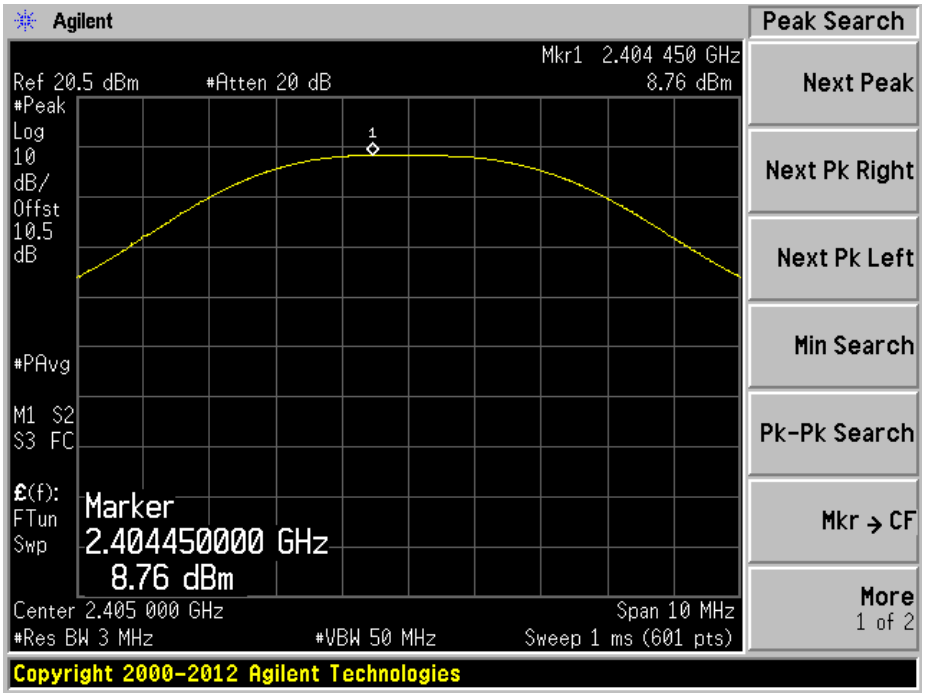
High Channel 2472MHz



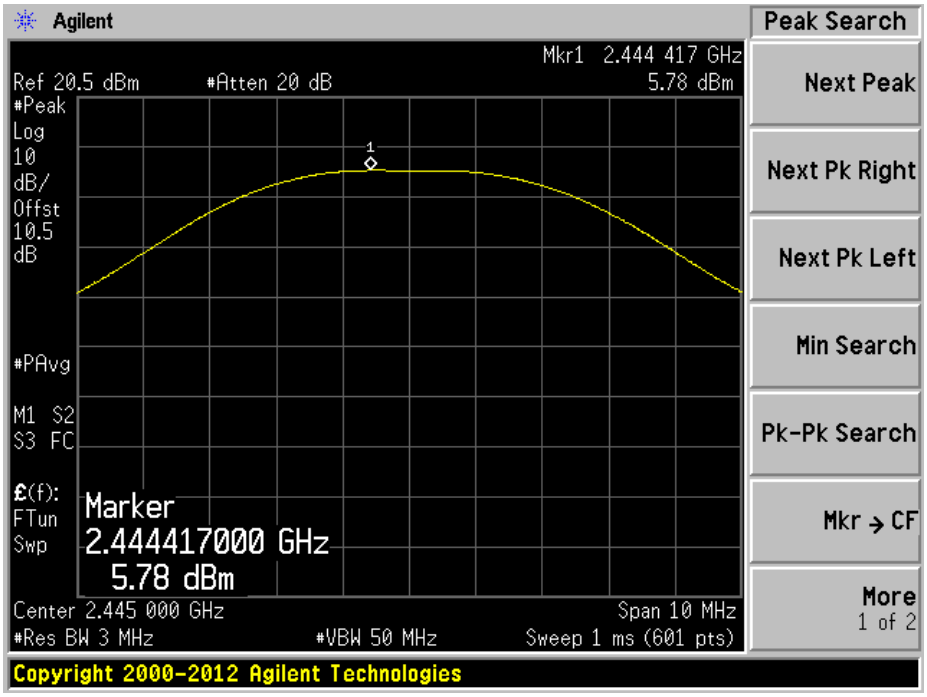
Date: 19.MAY.2016 11:50:40

ZigBee

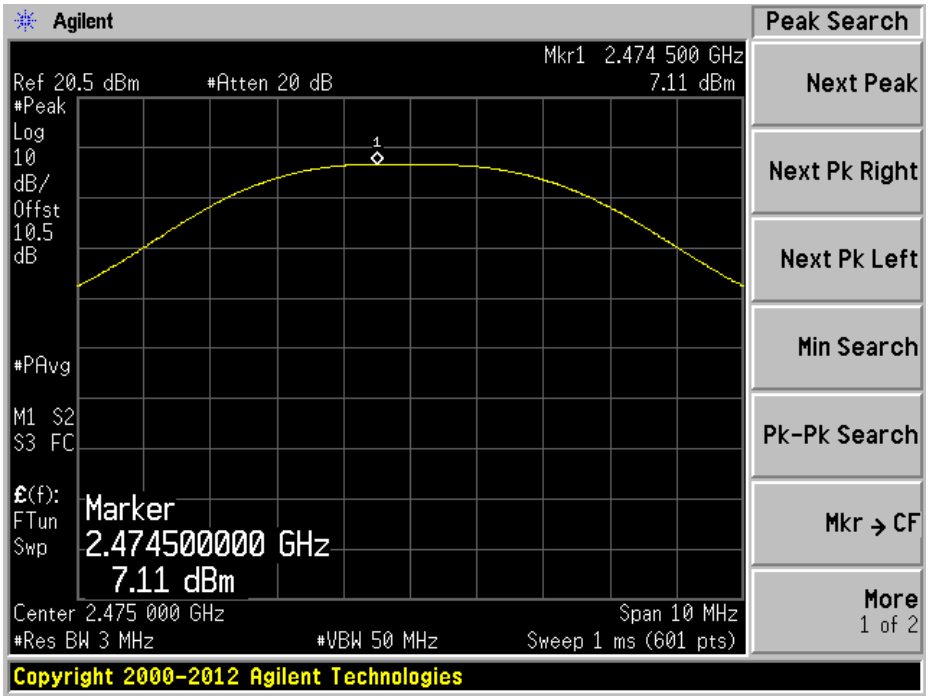
Low Channel 2405 MHz



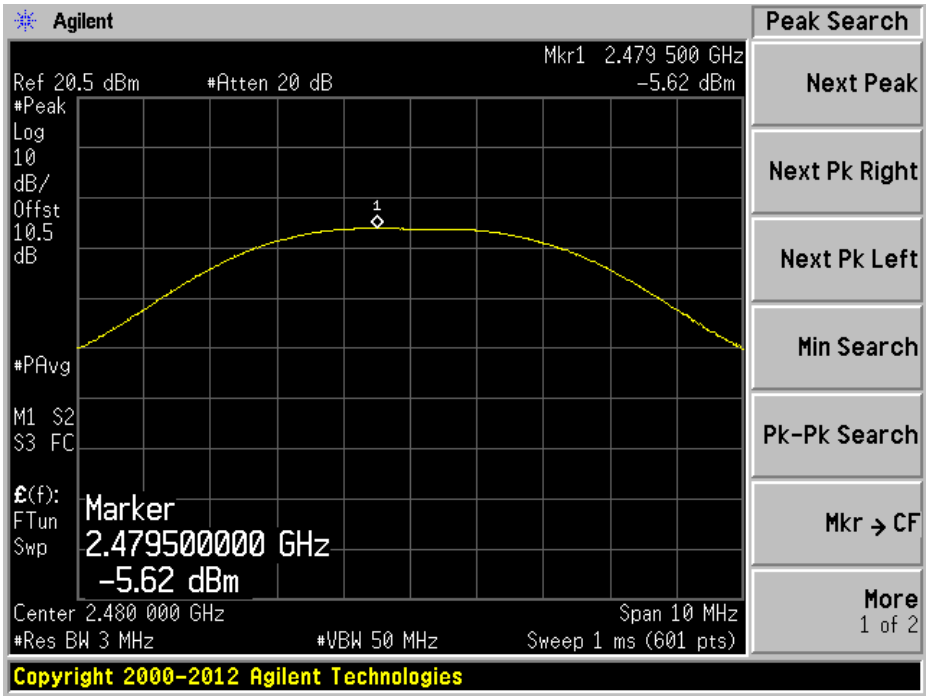
Middle Channel 2445 MHz



CH 25: 2475MHz



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 v03r04: 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	MY44303352	2015-06-22	1 year
-	U. FL to SMA pigtail	-	-	Each time[1]	N/A
-	10dB attenuator	-	-	Each time[1]	N/A

Note[1]: cable and attenuator included in the test set-up will be checked each time before testing.

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

10.4 Test Environmental Conditions

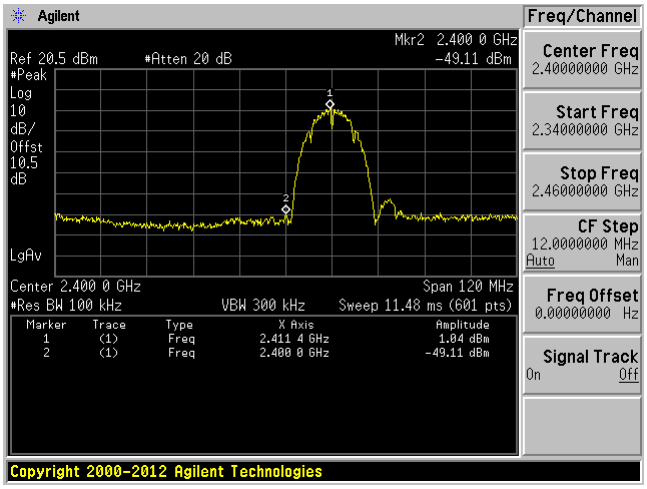
Temperature:	22º C
Relative Humidity:	42 %
ATM Pressure:	102.7 KPa

The testing was performed by Jin Yang on 2016-05-11 in RF site.

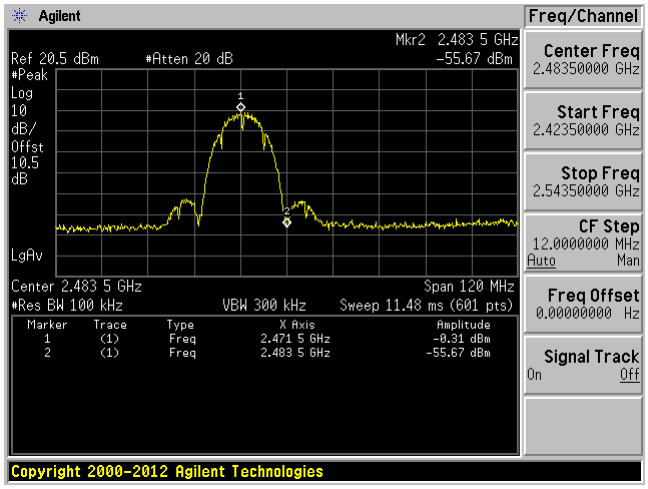
10.5 Test Results

802.11b mode

Low Channel 2412 MHz

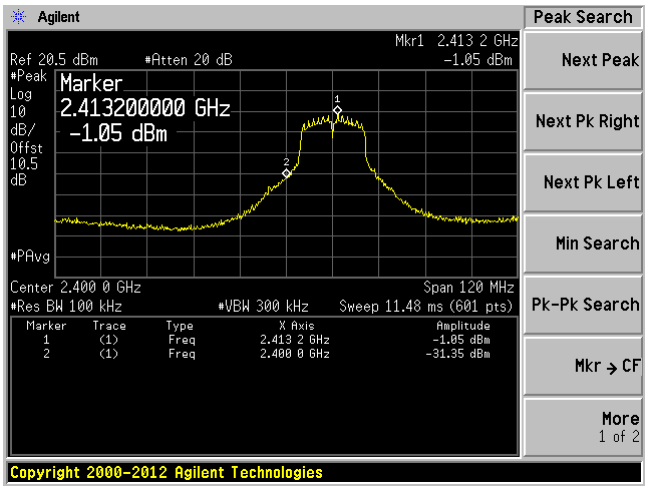


High Channel 2472 MHz

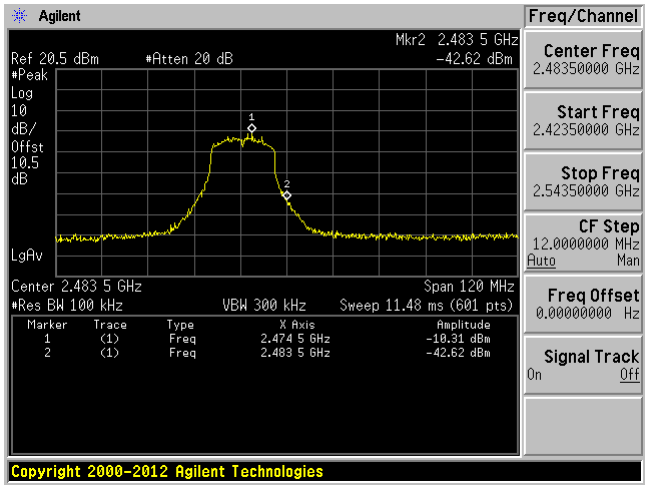


802.11g mode

Low Channel 2412 MHz

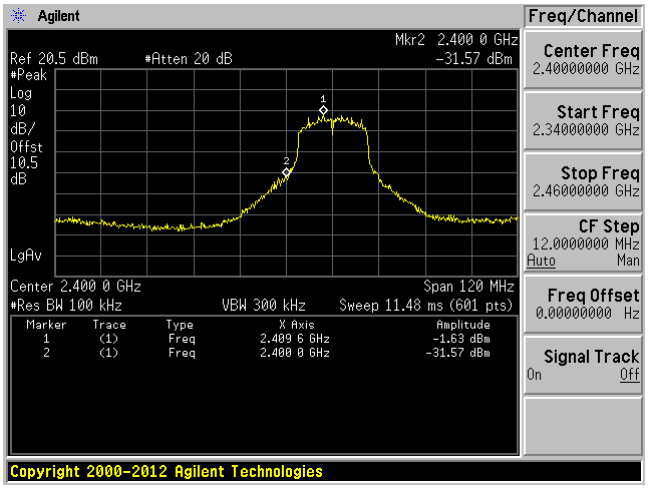


High Channel 2472 MHz

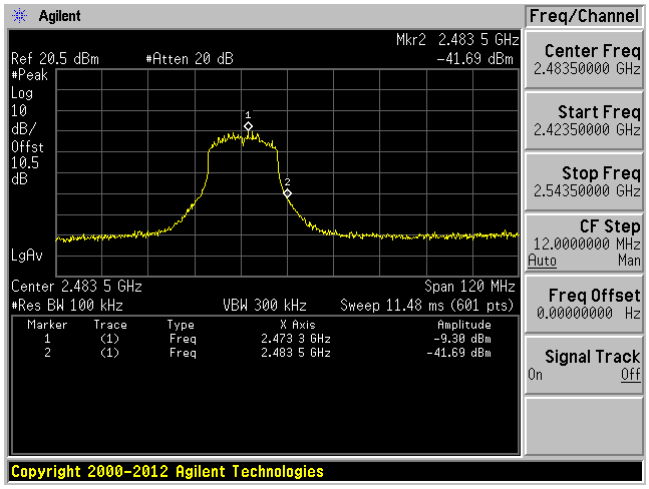


802.11n20 mode

Low Channel 2412 MHz

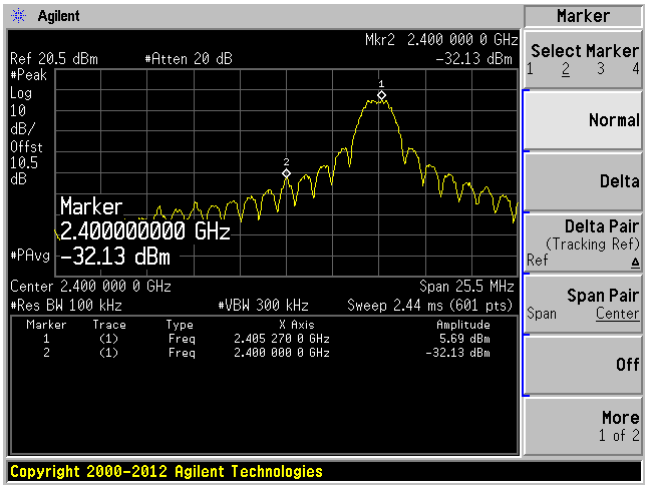


High Channel 2472 MHz

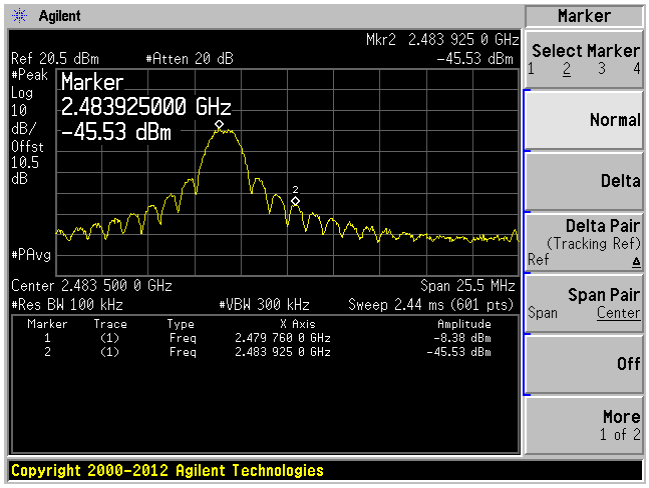


ZigBee

Low Channel 2405 MHz



High Channel 2480 MHz



11 FCC §15.247(e) – Power Spectral Density

11.1 Applicable Standards

According to FCC §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 v03r04: 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	MY44303352	2015-06-22	1 year
Rohde & Schwarz	Signal Analyzer	FSQ26	200749	2016-03-24	1 year
-	U. FL to SMA pigtail	-	-	Each time[1]	N/A
-	10dB attenuator	-	-	Each time[1]	N/A

Note[1]: cable and attenuator included in the test set-up will be checked each time before testing.

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

11.4 Test Environmental Conditions

Temperature:	22º C
Relative Humidity:	42 %
ATM Pressure:	102.7 KPa

The testing was performed by Jin Yang on 2016-05-11 to 2016-05-19 in RF site.

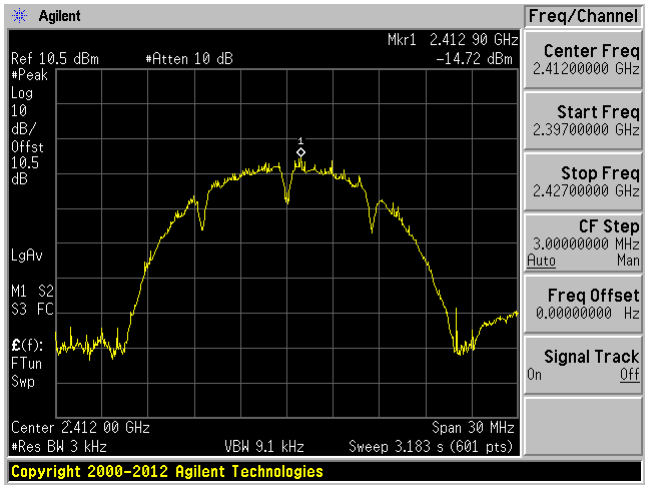
11.5 Test Results

Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)
802.11b mode			
Low	2412	-14.72	8
Middle	2442	-14.28	8
11	2462	-13.12	8
12	2467	-16.14	8
High	2472	-17.01	8
802.11g mode			
Low	2412	-16.53	8
Middle	2442	-14.16	8
11	2462	-15.4	8
12	2467	-19.82	8
High	2472	-25.34	8
802.11n-HT20 mode			
Low	2412	-16.93	8
Middle	2442	-14.3	8
11	2462	-15.69	8
12	2467	-19.02	8
High	2472	-25.7	8
ZigBee			
Low	2405	-5.98	8
Middle	2445	-8.99	8
25	2475	-7.77	8
High	2480	-20.15	8

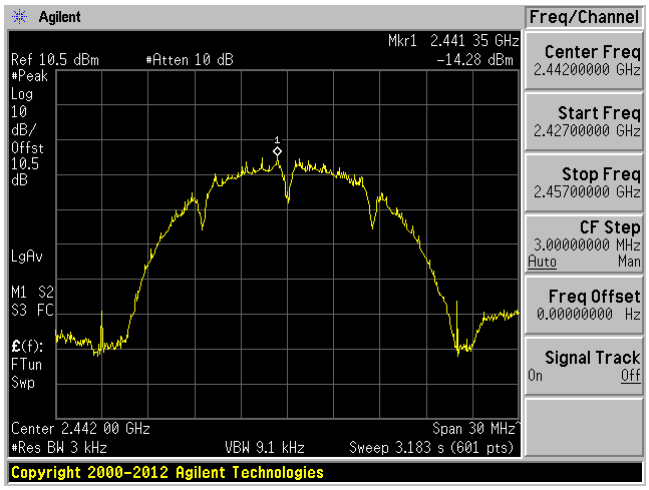
Please refer to the following plots for detailed test results

802.11b mode

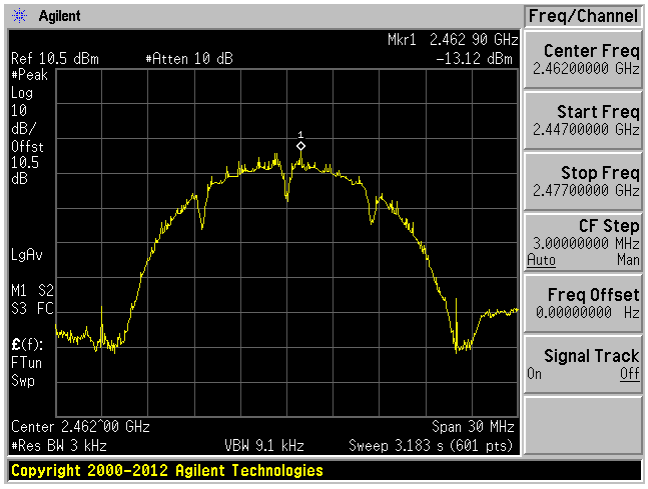
Low Channel 2412 MHz



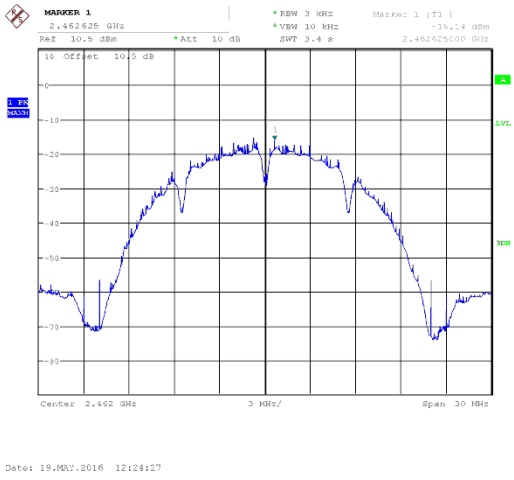
Middle Channel 2442 MHz



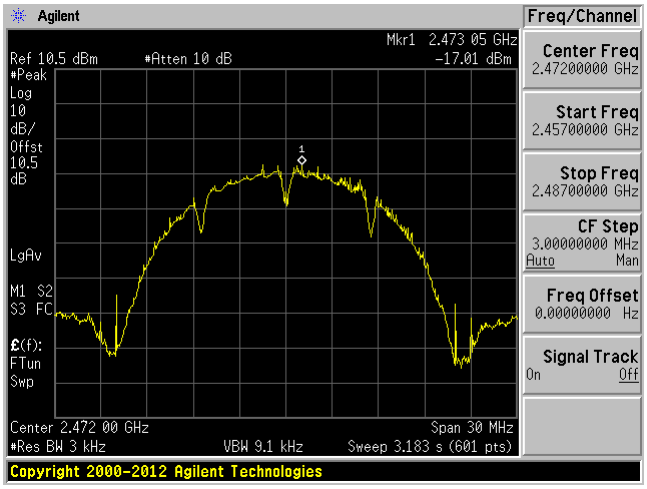
CH 11: 2462MHz



CH 12: 2467MHz

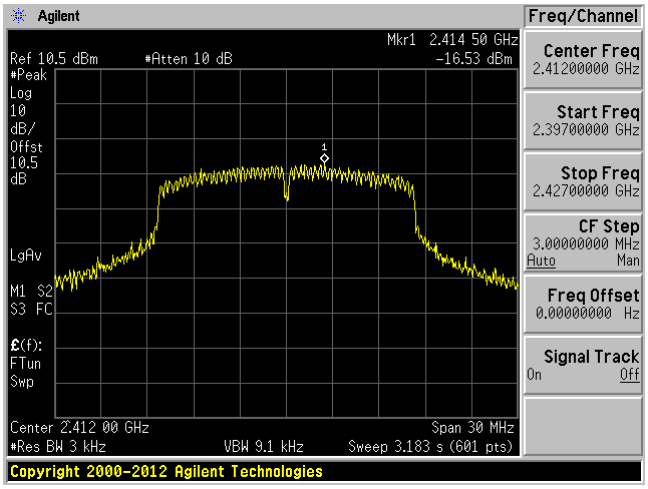


High Channel 2472 MHz

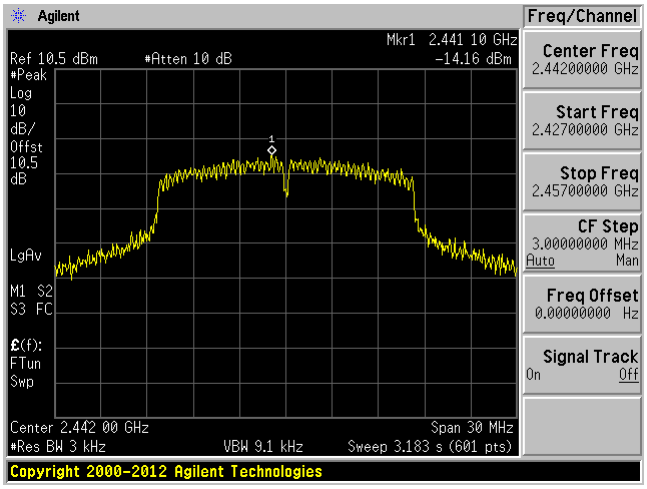


802.11g mode

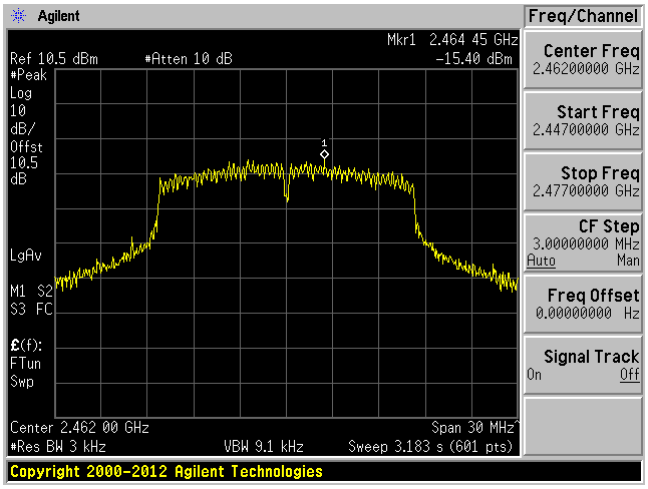
Low Channel 2412 MHz



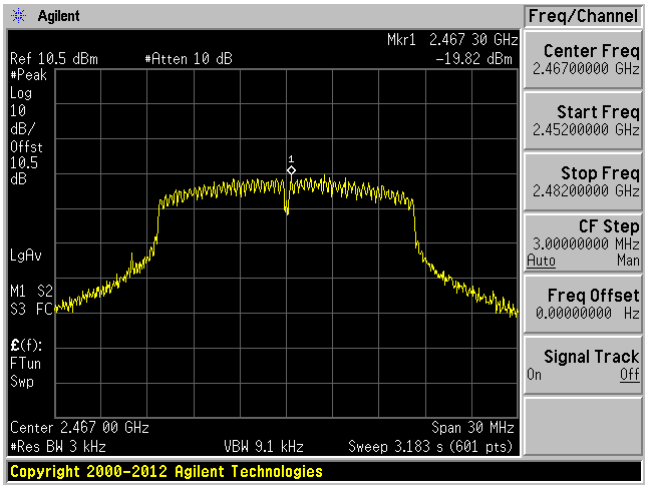
Middle Channel 2442 MHz



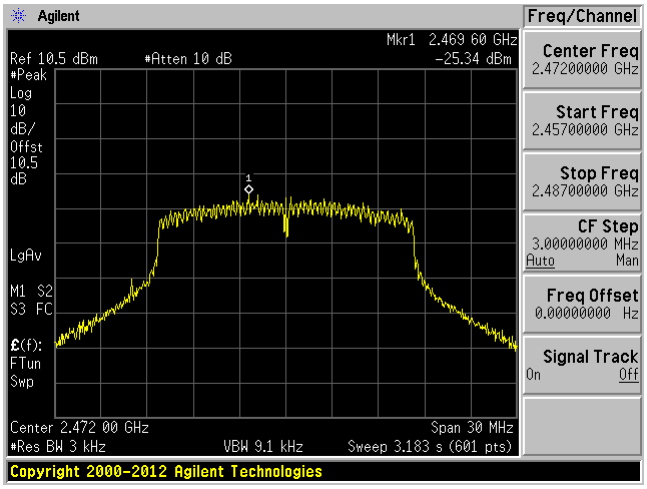
CH 11: 2462 MHz



CH 12: 2467MHz

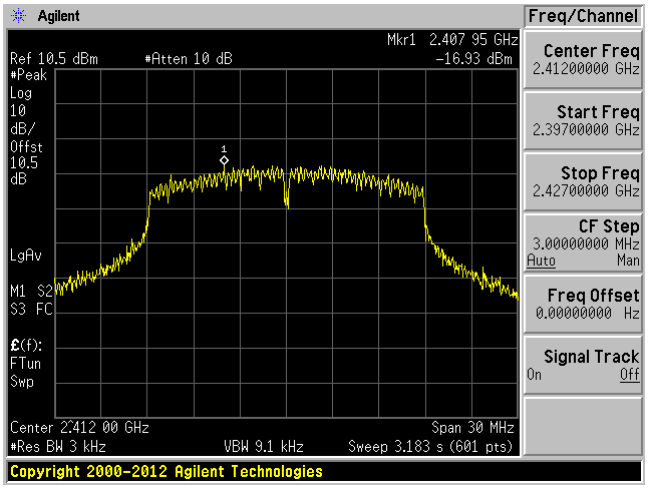


High Channel 2472MHz

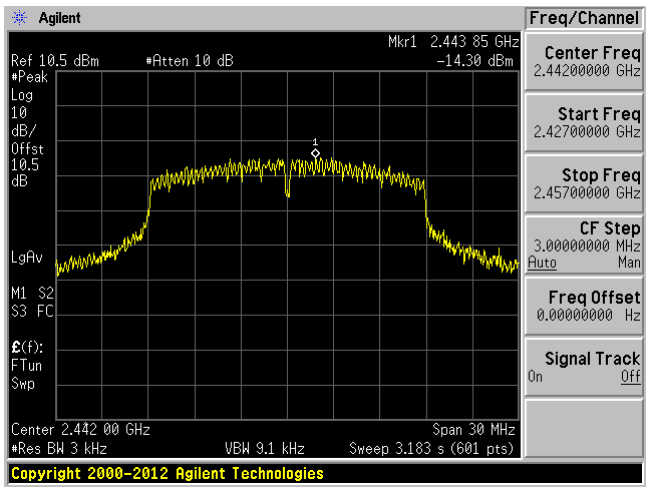


802.11n20 mode

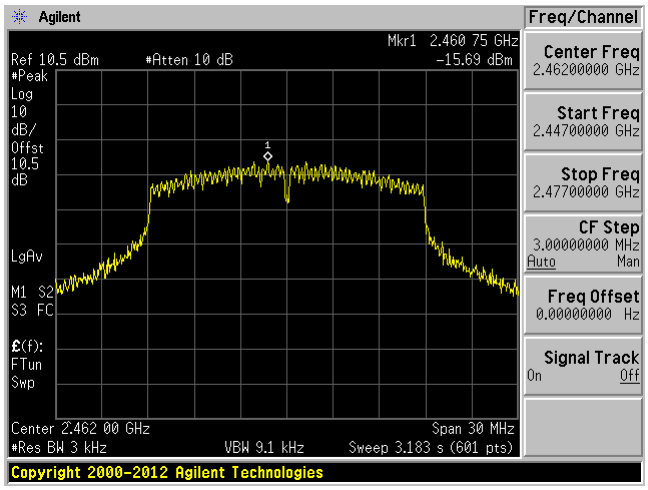
Low Channel 2412 MHz



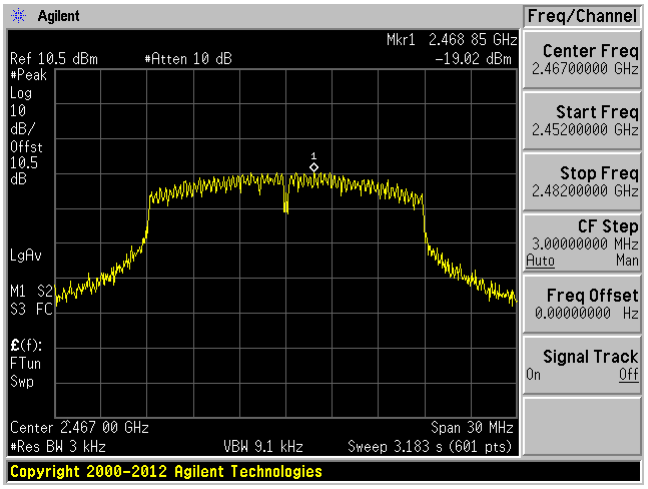
Middle Channel 2442 MHz



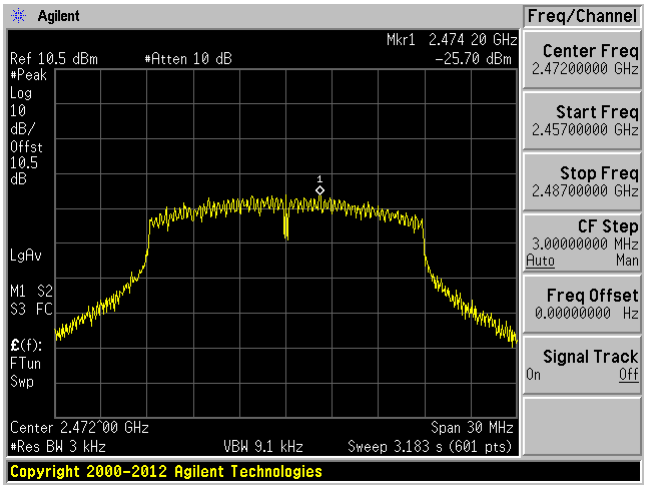
CH 11: 2462MHz



CH 12:2467MHz

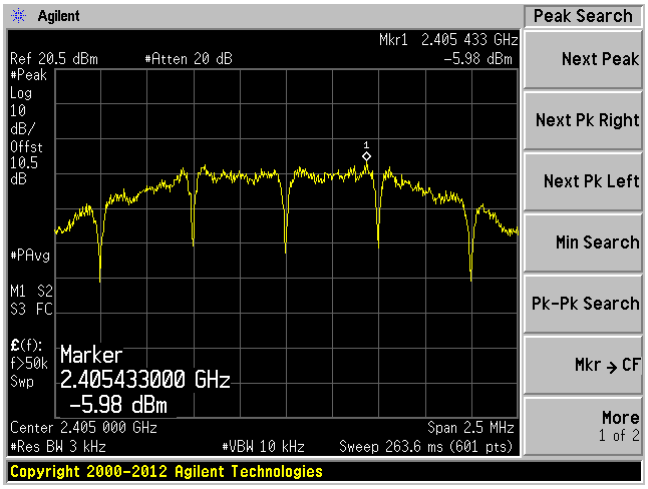


High Channel 2472MHz

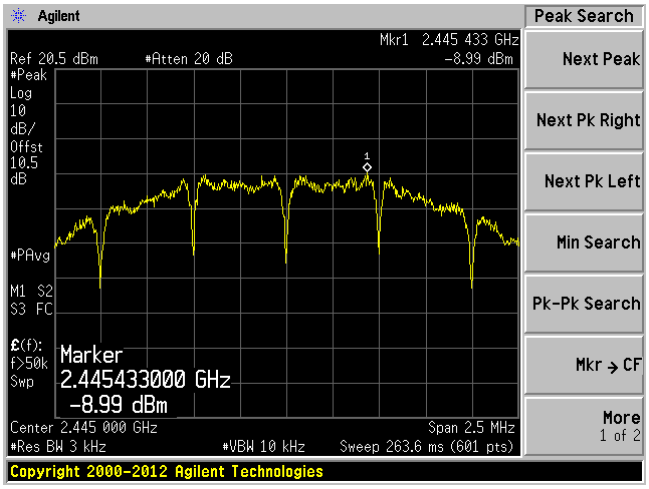


ZigBee

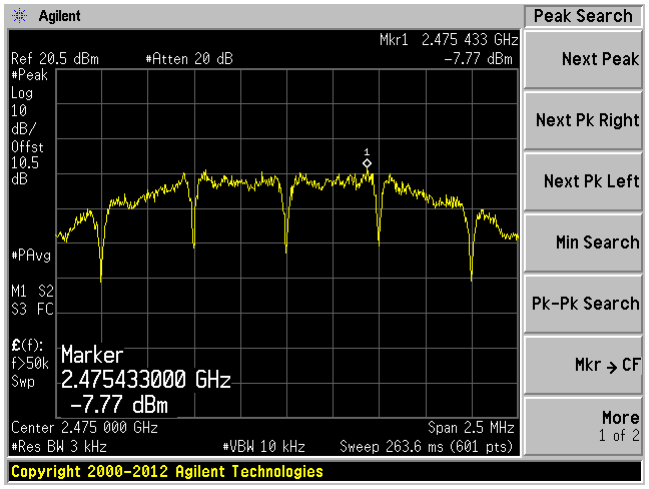
Low Channel 2405 MHz



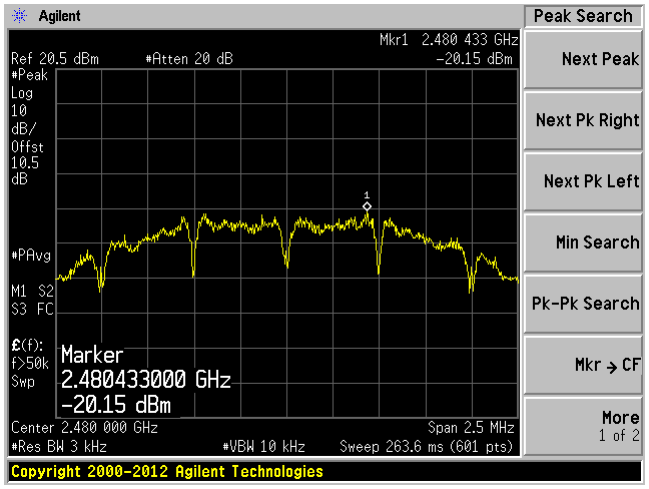
Middle Channel 2445 MHz



CH 25: 2475MHz



High Channel 2480 MHz



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

12.1 Applicable Standards

For FCC §15.247(d) in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

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	MY44303352	2015-06-22	1 year
-	U. FL to SMA pigtail	-	-	Each time[1]	N/A
-	10dB attenuator	-	-	Each time[1]	N/A

Note[1]: cable and attenuator included in the test set-up will be checked each time before testing.

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

12.4 Test Environmental Conditions

Temperature:	22º C
Relative Humidity:	42 %
ATM Pressure:	102.7 KPa

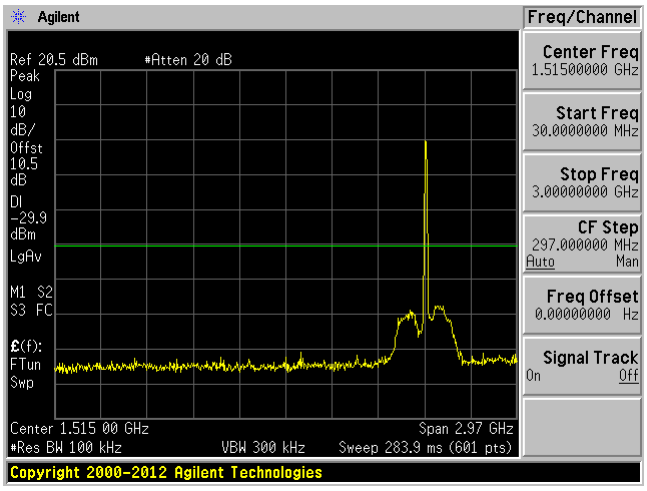
The testing was performed by Jin Yang on 2016-05-11 in RF site.

12.5 Test Results

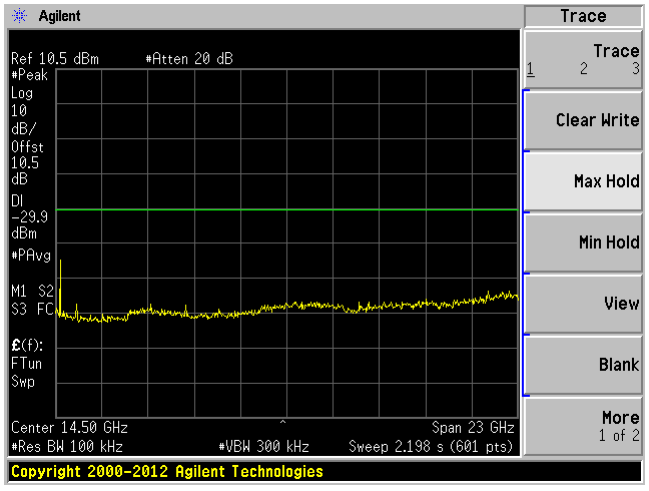
Please refer to following plots.

802.11b mode

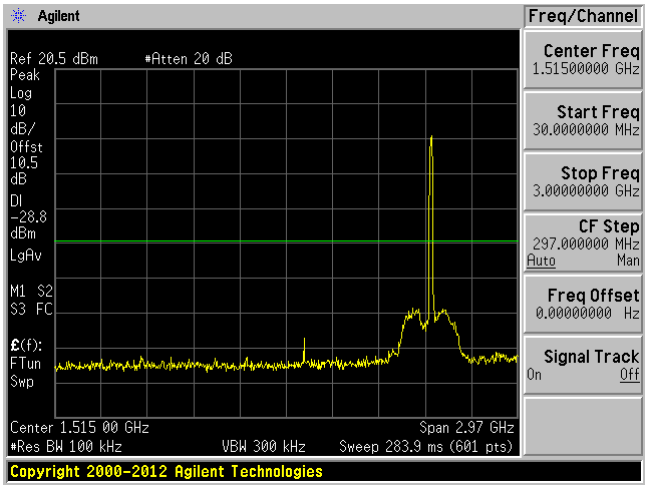
Low Channel 30MHz – 3 GHz



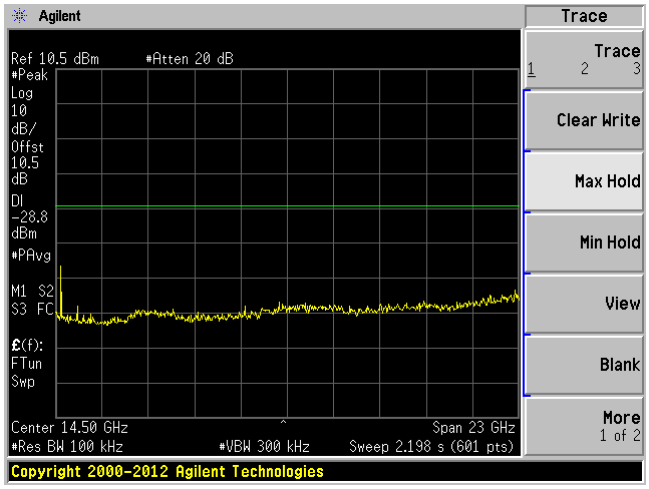
Low Channel 3 GHz – 26 GHz



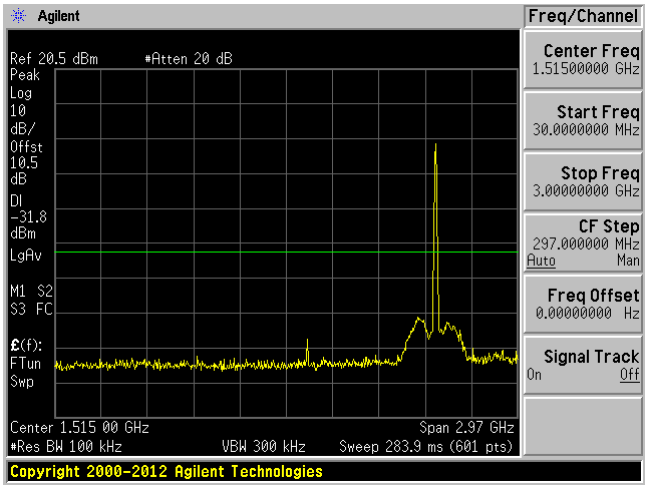
Middle Channel 30 MHz – 3 GHz



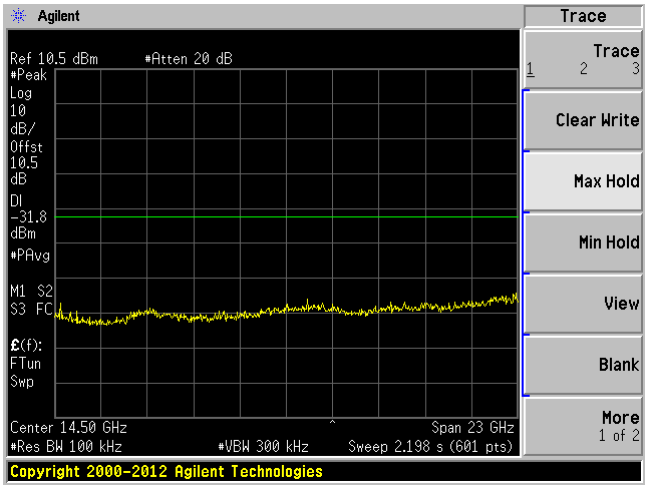
Middle Channel 3 GHz – 26 GHz



High Channel 30 MHz – 3 GHz

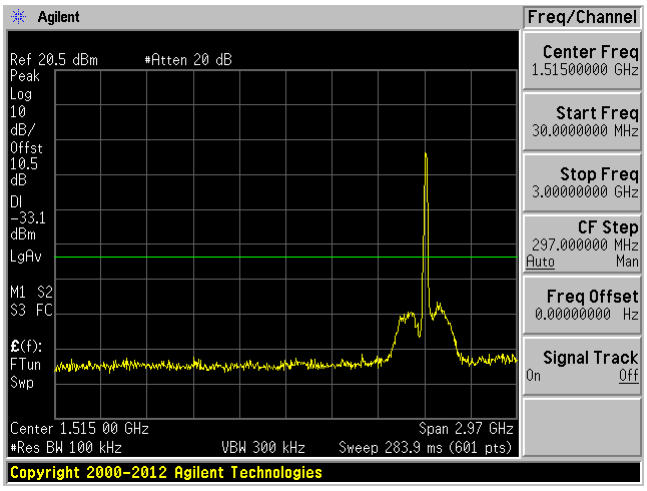


High Channel 3 GHz – 26 GHz

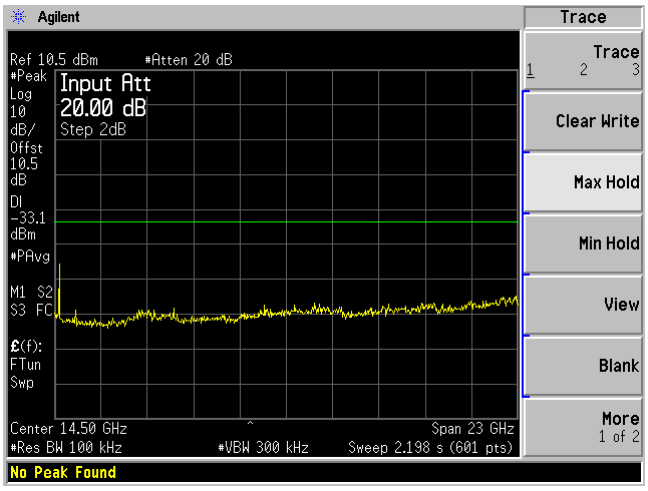


802.11g mode

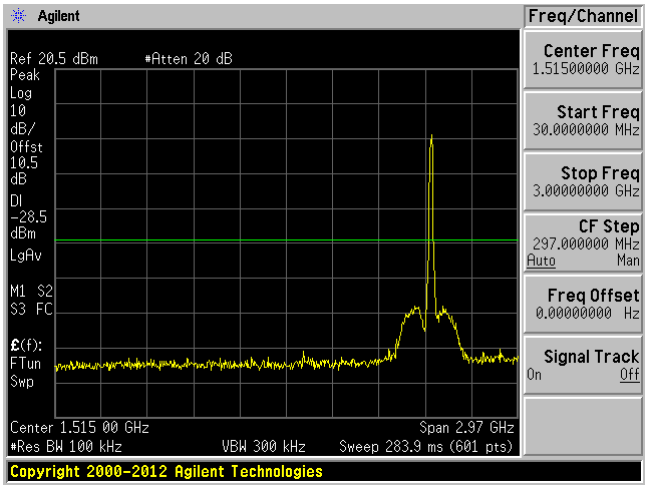
Low Channel 30 MHz – 3 GHz



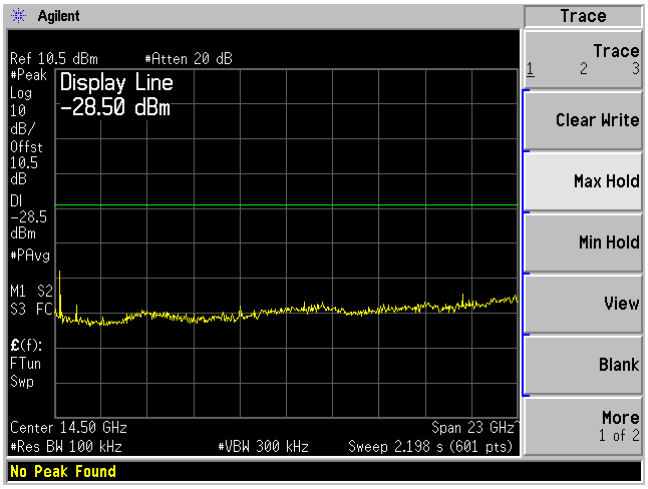
Low Channel 3 GHz – 26 GHz



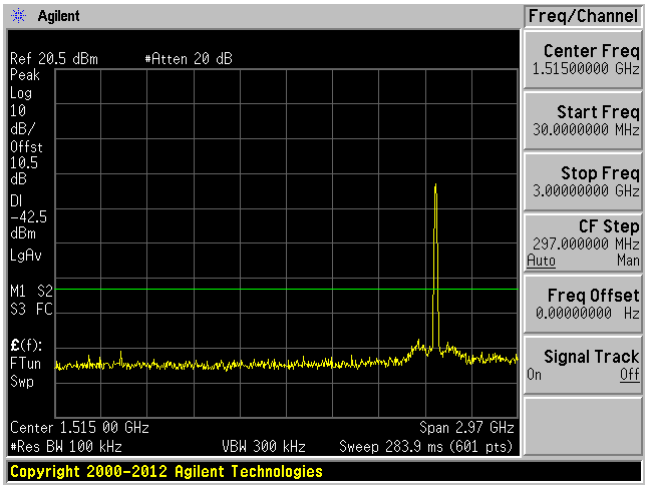
Middle Channel 30 MHz – 3 GHz



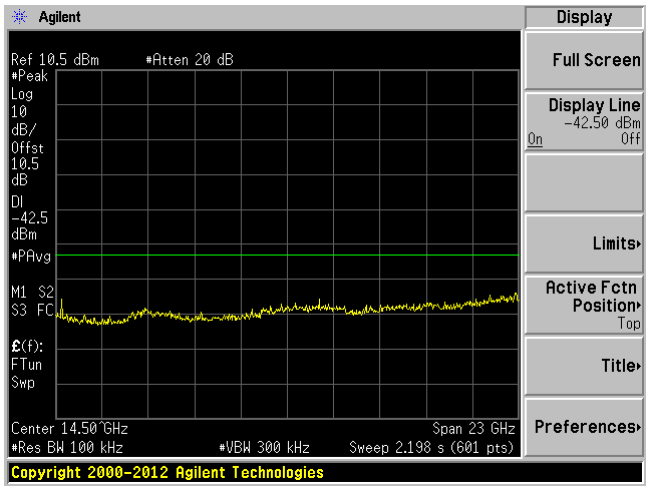
Middle Channel 3 GHz – 26 GHz



High Channel 30 MHz – 3 GHz

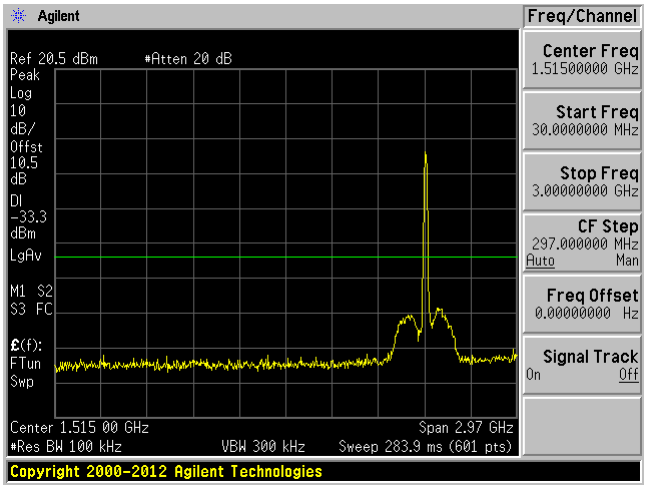


High Channel 3 GHz – 26 GHz

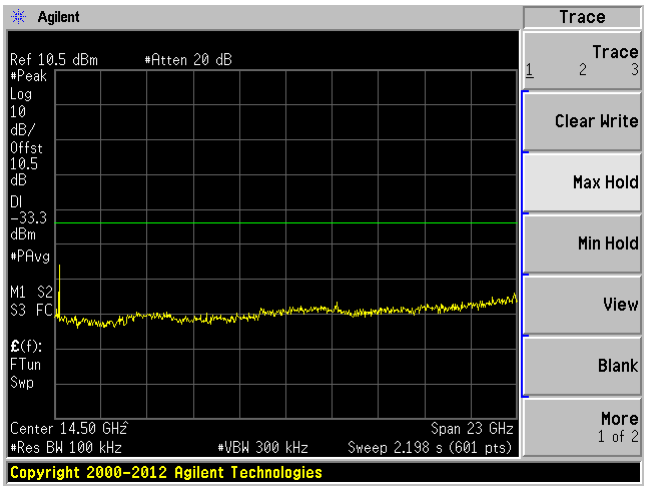


802.11n20 mode

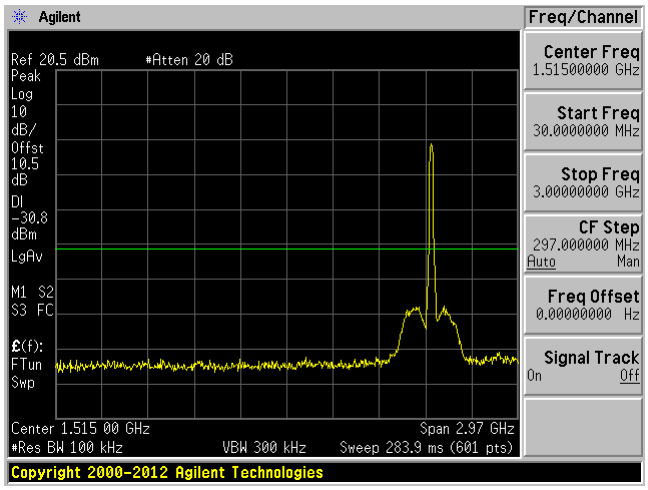
Low Channel 30 MHz – 3 GHz



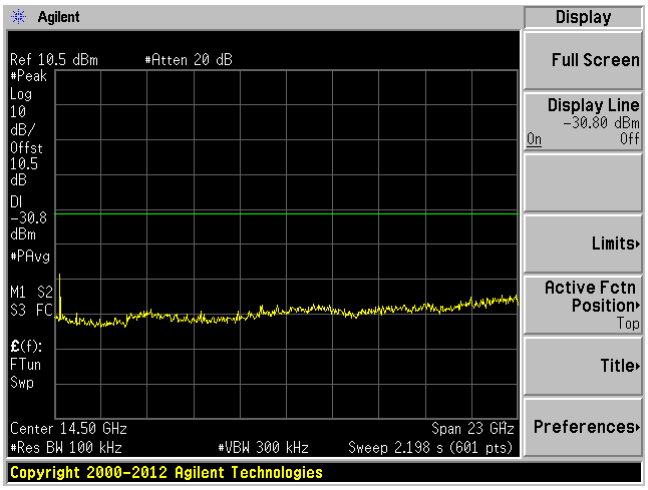
Low Channels 3 GHz – 26 GHz



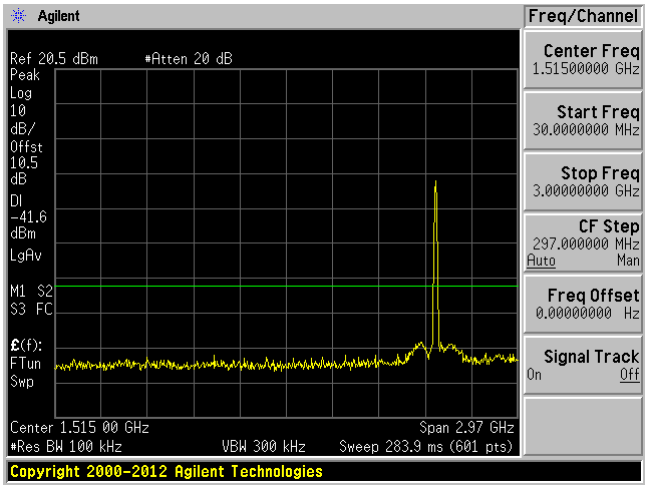
Middle Channel 30 MHz – 3 GHz



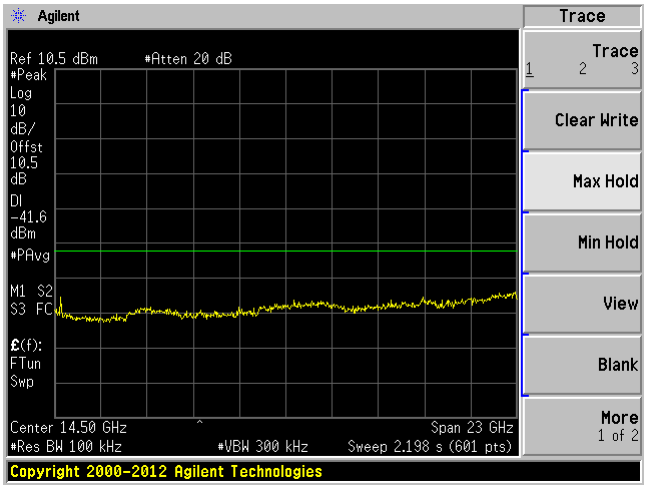
Middle Channels 3 GHz – 26 GHz



High Channel 30 MHz – 3 GHz

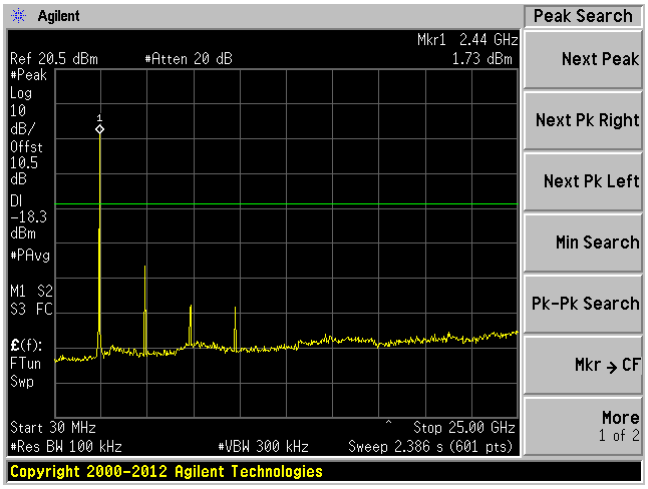


High Channel 3 GHz – 26 GHz

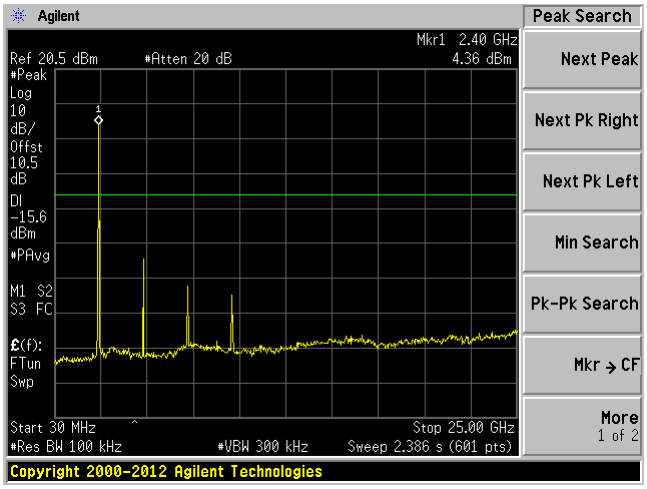


ZigBee

Low Channel 30 MHz – 25 GHz



Middle Channel 30 MHz – 25 GHz



High Channel 30 MHz – 25 GHz