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

TEST AND MEASUREMENT REPORT

For

Venstar, Inc.

9250 Owensmouth Ave.,

Chatsworth, CA 91311, USA

FCC ID: MUH-SEN6
IC: 12547A-SEN6

Report Type:	**Product Type:**
Original Report	Wi-Fi Temperature Sensor

Prepared By:	Leonard Gray Associate Engineer
Report Number:	R1511094-247
Report Date:	2016-02-05
Reviewed By:	Bo Li RF Leader

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1511094-247	Original Report	2016-02-05

1 General Description

1.1 Product Description for Equipment Under Test (EUT)

This test and measurement report has been compiled on behalf of *Venstar, Inc.* and their product FCC ID: MUH-SEN6. IC: 12547A-SEN6 model number: *ACC-TSENWIFI*, which henceforth is referred to as the EUT (Equipment under Test). The EUT is a temperature sensor with Wi-Fi technology, 24AC or battery powered.

1.2 Mechanical Description of EUT

The EUT measures approximately 11cm (L), 6.5cm (W), 1.5cm (H), and weighs approximately 0.05 kg.

The data gathered are from a typical production sample provided by the manufacturer with serial number: R1511094-01, assigned by BACL.

1.3 Objective

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

The objective is to determine compliance with FCC Part 15.247 rules and with IC RSS-247 rules for Output Power, Antenna Requirements, 6 dB Bandwidth, power spectral density, 100 kHz Bandwidth of Band Edges Measurement, Spurious Emissions, 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 Guide 65: 1996** 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 C63.3-2013, 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 v03r03.

The EUT was tested in a testing mode to represent worst-case results during the final qualification test.

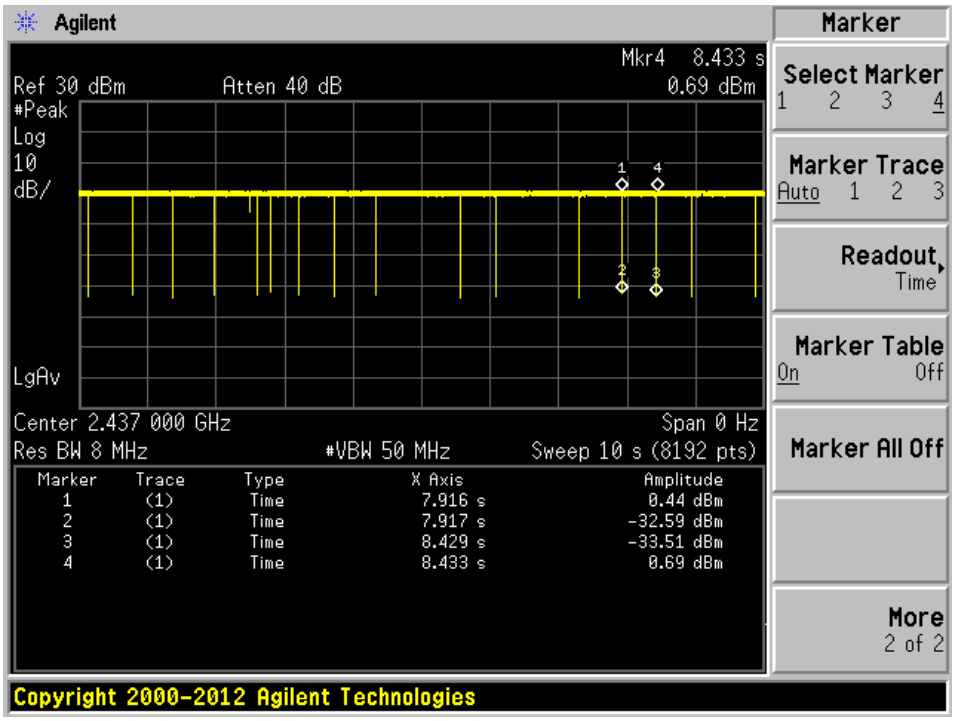
The worst-case data rates are determined to be as follows for each mode based upon investigation by measuring the average power, peak power and PPSD across all data rates bandwidths, and modulations.

2.2 EUT Exercise Software

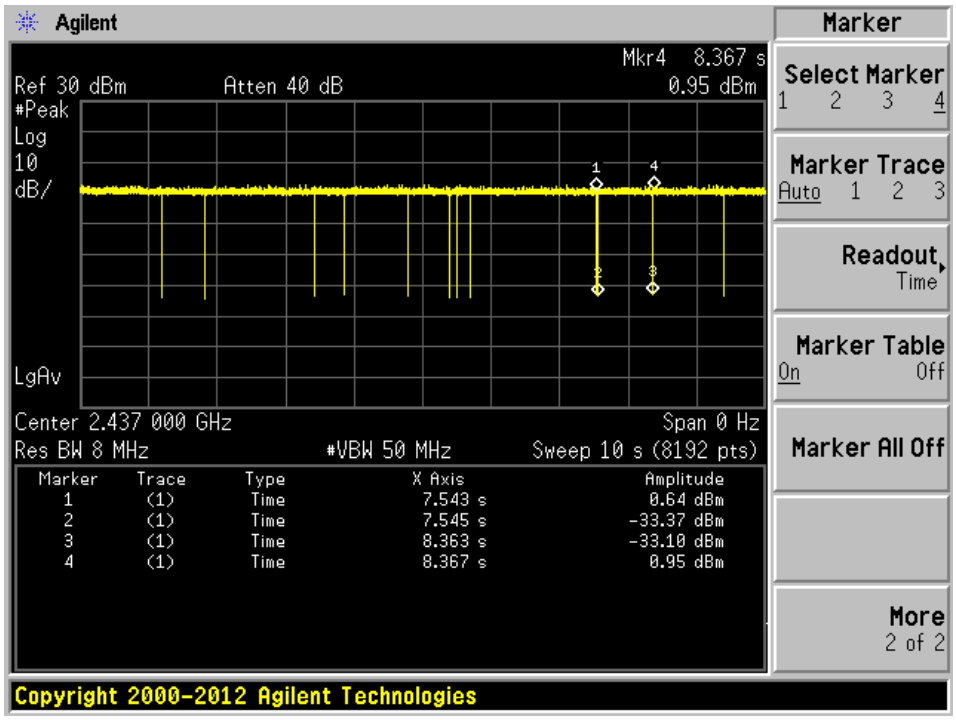
The software "CC3100/CC3200 Radio Tool v1.1.5686.29375" was provided by customer.

The Duty cycle for the EUT was greater than 99%

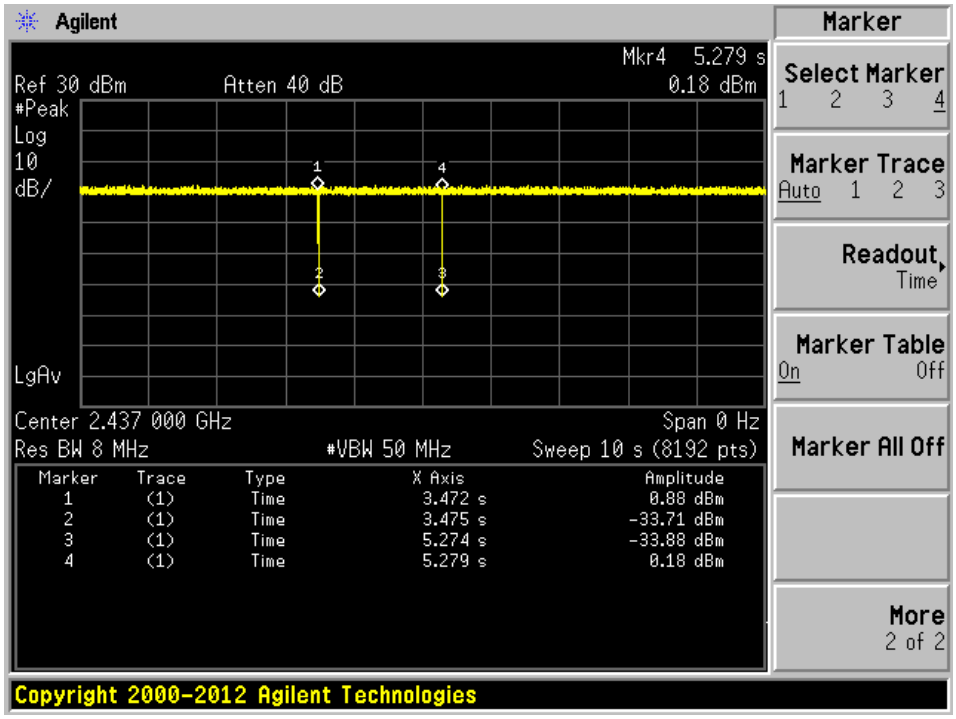
802.11b Duty Cycle



802.11g Duty Cycle



802.11n20 Duty Cycle



2.3 Equipment Modifications

No modifications were made to the EUT.

2.4 Local Support Equipment

Manufacturer	Description	Model No.	Serial No.
DELL	Laptop	Latitude D630	-
Venstar Inc.	WiFi Programming Adapter Board	Rev_0	CN3

2.5 EUT Internal Configuration Details

Manufacturer/Product Type	Description	Model No.	Serial No.
Venstar Inc.	PCB	00708 BA	-
Venstar Inc.	PCA	00707 rev BA	-

2.6 Power Supply and Line Filter

Manufacturer	Description	Model	Part Number
Power Supply EUC	Power Adapter	MKA-412400200	050VPP

2.7 Interface Ports and Cabling

Cable Description	Length (m)	To	From
RF Cable	< 1m	PSA	EUT
USB Cable	<1m	EUT	Laptop

3 Summary of Test Results

Results reported relate only to the product tested.

FCC & IC Rules	Description of Test	Results
FCC §15.203 IC RSS-Gen §8.3	Antenna Requirement	Compliant
FCC §15.207(a) IC RSS-Gen §8.8	AC Line Conducted Emissions	Compliant
FCC §15.247(i) IC RSS-102	RF Exposure	Compliant
FCC §15.247(d) IC RSS-247 §5.5	Spurious Emissions at Antenna Port	Compliant
FCC §15.205 IC RSS-Gen §8.10	Restricted Bands	Compliant
FCC §15.209, §15.247(d) IC RSS-247 §5.5 IC RSS-Gen §8.9	Radiated Spurious Emissions	Compliant
FCC §15.247(a)(2) IC RSS-247 §5.2 IC RSS-Gen §6.6	6 dB&99% Emission Bandwidth	Compliant
FCC §15.247(b)(3) IC RSS-247 §5.4	Maximum Peak Output Power	Compliant
FCC §15.247(d) IC RSS-247 §5.5	100 kHz Bandwidth of Frequency Band Edge	Compliant
FCC §15.247(e) IC RSS-247 §5.2	Power Spectral Density	Compliant

4 FCC §15.247(i) & IC RSS §102 - RF Exposure

4.1 Applicable Standards

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

Limits for General Population/Uncontrolled Exposure

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

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

Before equipment certification is granted, the procedure of IC RSS-102 must be followed concerning the exposure of humans to RF field

According to IC RSS-102 Issue 5:

2.5.2 Exemption Limits for Routine Evaluation – RF Exposure Evaluation

RF exposure evaluation is required if the separation distance between the user and/or bystander and the device's radiating element is greater than 20 cm, except when the device operates as follows:

- below 20 MHz[6] and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 1 W (adjusted for tune-up tolerance);
- at or above 20 MHz and below 48 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $4.49/f^{0.5}$ W (adjusted for tune-up tolerance), where f is in MHz;
- at or above 48 MHz and below 300 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 0.6 W (adjusted for tune-up tolerance);
- at or above 300 MHz and below 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $1.31 \times 10^{-2} f^{0.6834}$ W (adjusted for tune-up tolerance), where f is in MHz;
- at or above 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 5 W (adjusted for tune-up tolerance).

In these cases, the information contained in the RF exposure technical brief may be limited to information that demonstrates how the e.i.r.p. was derived.

4.2 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

4.3 MPE Results for FCC

Maximum peak output power at antenna input terminal (dBm):	17.57
Maximum peak output power at antenna input terminal (mW):	57.14786
Prediction distance (cm):	20
Prediction frequency (MHz):	2437
Maximum Antenna Gain, typical (dBi):	1.9
Maximum Antenna Gain (numeric):	1.548817
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.0176
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 0.0176 mW/cm^2. Limit is 1.0 mW/cm^2.

4.4 RF exposure evaluation exemption for IC

Maximum EIRP power = 17.57 dBm + 1.9 dBi = 19.47 dBm which is lesser than $1.31\times10^{-2}f^{0.6834}$ = 2.703 W = 34.318 dBm

Therefore the RF exposure calculation is not required.

5 FCC §15.203 &IC RSS-Gen §8.3 - Antenna Requirements

5.1 Applicable Standards

According to FCC §15.203:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

And according to FCC §15.247 (b) (4), if transmitting antennas of directional gain greater than 6 dBi are used the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

According to IC RSS-Gen §8.3: Transmitter Antenna

The applicant for equipment certification, as per RSP-100, must provide a list of all antenna types that may be used with the license-exempt transmitter, indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna.

License-exempt transmitters that have received equipment certification may operate with different types of antennas. However, it is not permissible to exceed the maximum equivalent isotropically radiated power (e.i.r.p.) limits specified in the applicable standard (RSS) for the license-exempt apparatus.

Testing shall be performed using the highest gain antenna of each combination of license-exempt transmitter and antenna type, with the transmitter output power set at the maximum level. 9 When a measurement at the antenna connector is used to determine RF output power, the effective gain of the device's antenna shall be stated, based on a measurement or on data from the antenna manufacturer.

User manuals for transmitters equipped with detachable antennas shall also contain the following notice in a conspicuous location:

This radio transmitter (identify the device by certification number) has been approved by Industry Canada to operate with the antenna types listed below with the maximum permissible gain indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Immediately following the above notice, the manufacturer shall provide a list of all antenna types approved for use with the transmitter, indicating the maximum permissible antenna gain (in dBi).

5.2 Antenna List and Details

Antenna Type	Antenna Gain (dBi) @ 2.4 GHz
Omni-directional	1.9

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

6.1 Applicable Standards

As per FCC §15.207 and IC RSS-Gen Conducted limits:

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

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

Note: Decreases with the logarithm of the frequency.

6.2 Test Setup

The measurement was performed at shield room, using the setup per ANSI C63.4-2014 measurement procedure. The specification used was FCC §15.207 and IC RSS-Gen §8.8 limits.

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

The 24 V AC/AC power adapter of the EUT was connected with LISN-1 which provided 120 V/60 Hz AC power.

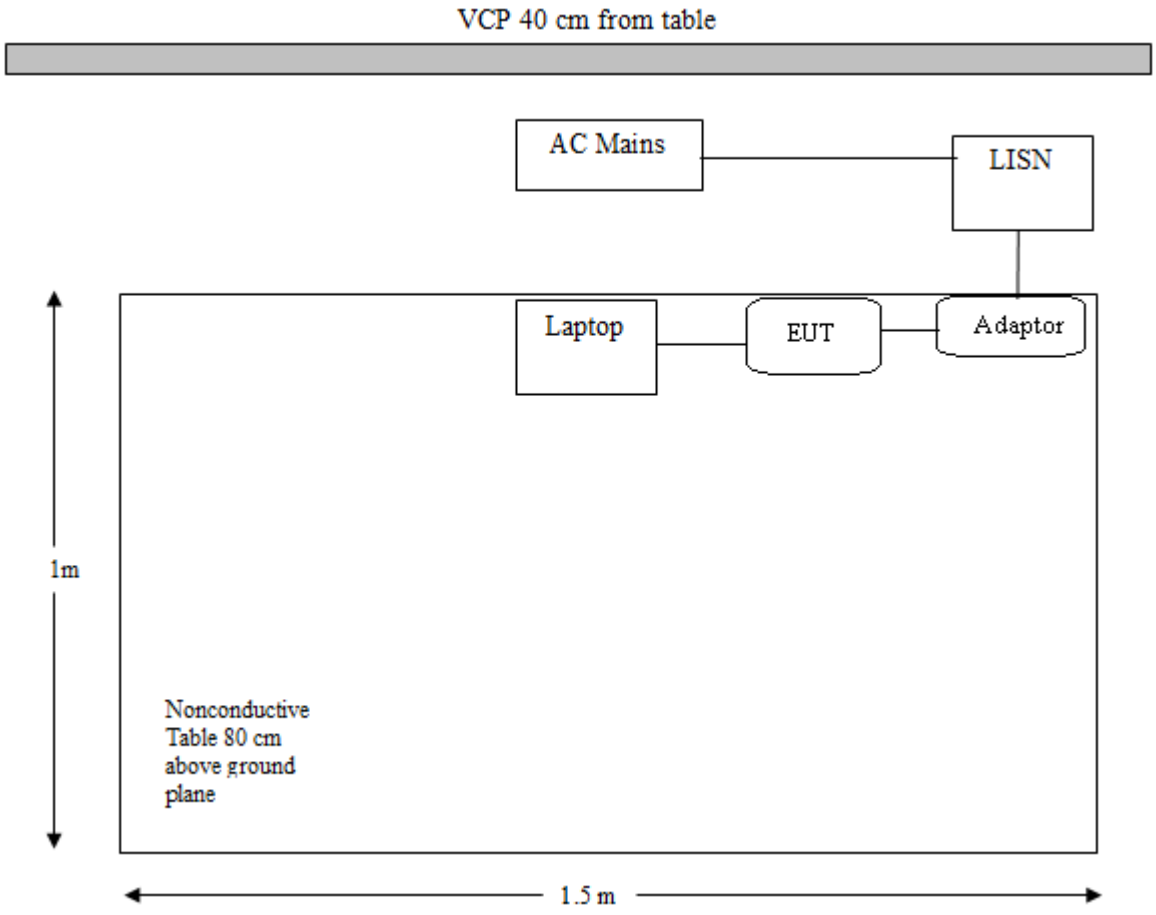
6.3 Test Procedure

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 cord of the support equipment was connected to LISN-2.

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

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

6.4 Test Setup Block Diagram



6.5 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

6.6 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Rohde & Schwarz	EMI Test Receiver	ESCI 1166.5950K03	100337	2015-09-28	1 year
FCC	LISN	FCC-LISN-50-25-2-10-CISPR16	160129	2015-04-17	1 year
TTE	Filter, High Pass	H962-150k-50-21378	K7133	2015-01-30	1 year
Suirong	30 ft conductive emission cable	LMR 400	-	2015-03-05	1 year
Hewlett-Packard	5 ft RF cable	-	1268	2015-07-29	1 year

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:	24º C
Relative Humidity:	43 %
ATM Pressure:	102.5 kPa

The testing was performed by Leonard Gray on 2015-12-09 in 5m chamber2.

6.8 Summary of Test Results

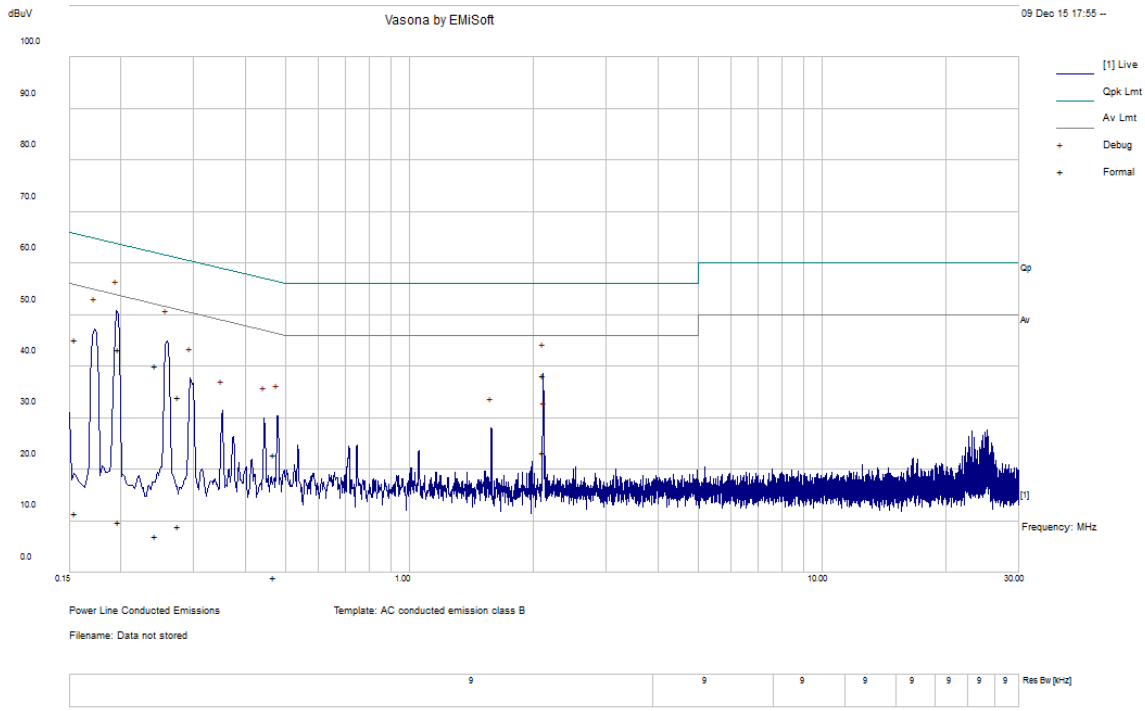
According to the recorded data in following table, the EUT complied with the FCC 15C and IC RSS-Gen standard's conducted emissions limits, with the margin reading of:

Worst Case was transmitted during testing: 802.11b, 2437 MHz

Connection: 24 V AC/AC adapter connected to 120 V/60 Hz, AC			
Margin (dB)	**Frequency (MHz)**	**Conductor Mode (Line/Neutral)**	**Range (MHz)**
-17.63	2.107486	Line	0.15-30

6.9 Conducted Emissions Test Plots and Data

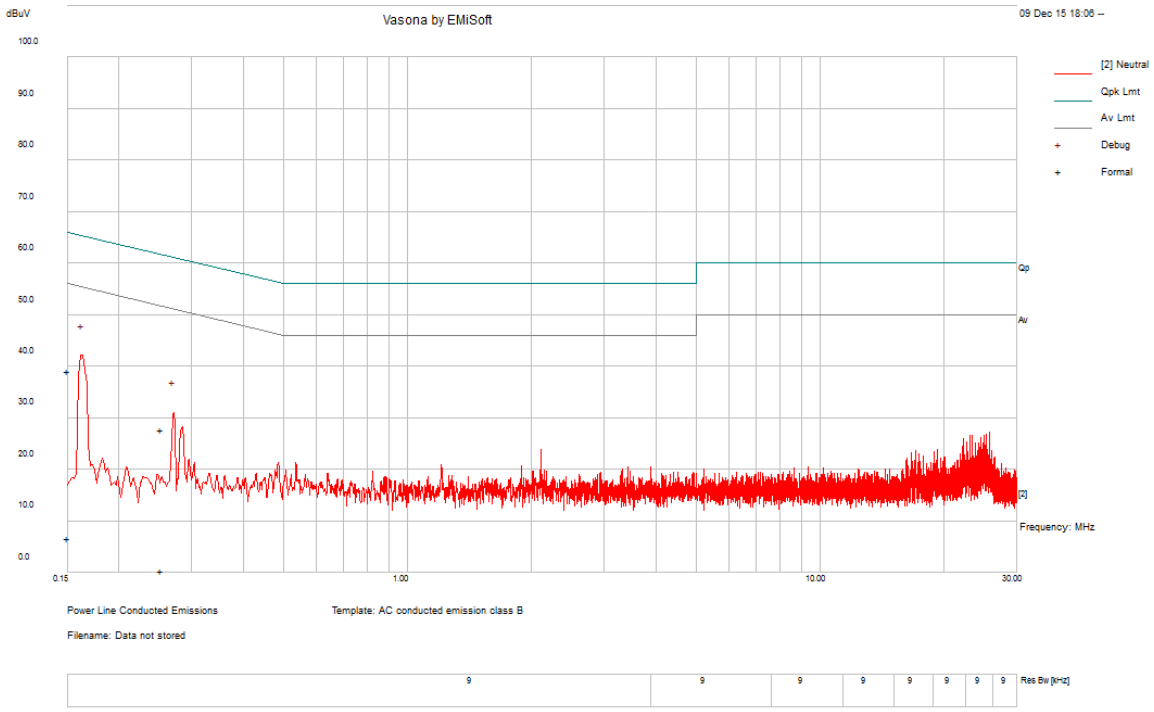
120 V, 60 Hz – Line



Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)	Detector (QP/Ave.)
2.107486	38.37	Line	56	-17.63	QP
0.469796	22.99	Line	56.52	-33.53	QP
0.275932	34.19	Line	60.94	-26.74	QP
0.242179	40.14	Line	62.02	-21.88	QP
0.197508	43.46	Line	63.71	-20.25	QP
0.154854	45.22	Line	65.74	-20.52	QP

Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)	Detector (QP/Ave.)
0.197508	9.96	Line	53.71	-43.76	Ave.
0.242179	7.22	Line	52.02	-44.8	Ave.
2.107486	23.38	Line	46	-22.62	Ave.
0.154854	11.54	Line	55.74	-44.2	Ave.
0.275932	9.13	Line	50.94	-41.81	Ave.
0.469796	-0.8	Line	46.52	-47.32	Ave.

120 V, 60 Hz – Neutral



Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)	Detector (QP/Ave.)
0.150117	39.28	Neutral	65.99	-26.71	QP
0.253852	27.72	Neutral	61.63	-33.91	QP
-	-	Neutral	-	-	-
-	-	Neutral	-	-	-
-	-	Neutral	-	-	-
-	-	Neutral	-	-	-

Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)	Detector (QP/Ave.)
0.150117	6.68	Neutral	55.99	-49.32	Ave.
0.253852	0.51	Neutral	51.63	-51.12	Ave.
-	-	Neutral	-	-	-
-	-	Neutral	-	-	-
-	-	Neutral	-	-	-
-	-	Neutral	-	-	-
-	-	Neutral	-	-	-

Note: “-“noise floor

7 FCC §15.209, §15.247(d) & IC RSS-247 §5.5, RSS-Gen §8.9, §8.10 - Spurious Radiated Emissions

7.1 Applicable Standards

As per FCC §15.35(d): Unless otherwise specified, on any frequency or frequencies above 1000 MHz, the radiated emission limits are based on the use of measurement instrumentation employing an average detector function. Unless otherwise specified, measurements above 1000 MHz shall be performed using a minimum resolution bandwidth of 1 MHz.

As per FCC §15.209(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 §15.205(a) except as show in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 – 0.110 0.495 – 0.505 2.1735 – 2.1905 4.125 – 4.128 4.17725 – 4.17775 4.20725 – 4.20775 6.215 – 6.218 6.26775 – 6.26825 6.31175 – 6.31225 8.291 – 8.294 8.362 – 8.366 8.37625 – 8.38675 8.41425 – 8.41475 12.29 – 12.293 12.51975 – 12.52025 12.57675 – 12.57725 13.36 – 13.41	16.42 – 16.423 16.69475 – 16.69525 25.5 – 25.67 37.5 – 38.25 73 – 74.6 74.8 – 75.2 108 – 121.94 123 – 138 149.9 – 150.05 156.52475 – 156.52525 156.7 – 156.9 162.0125 –167.17 167.72 – 173.2 240 – 285 322 – 335.4 399.9 – 410 608 – 614	960 – 1240 1300 – 1427 1435 – 1626.5 1645.5 – 1646.5 1660 – 1710 1718.8 – 1722.2 2200 – 2300 2310 – 2390 2483.5 – 2500 2690 – 2900 3260 – 3267 3.332 – 3.339 3 3458 – 3 358 3.600 – 4.400	4. 5 – 5. 15 5. 35 – 5. 46 7.25 – 7.75 8.025 – 8.5 9.0 – 9.2 9.3 – 9.5 10.6 – 12.7 13.25 – 13.4 14.47 – 14.5 15.35 – 16.2 17.7 – 21.4 22.01 – 23.12 23.6 – 24.0 31.2 – 31.8 36.43 – 36.5 Above 38.6

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

As per IC RSS-Gen 8.9,

> Except when the requirements applicable to a given device state otherwise, emissions from licence-exempt transmitters shall comply with the field strength limits shown in Table 4 or Table 5 below. Additionally, the level of any transmitter emission shall not exceed the level of the transmitter's fundamental emission.

Table 4 – General Field Strength Limits for Licence-Exempt Transmitters at Frequencies Above 30 MHz

Frequency (MHz)	Field Strength (µv/m at 3 metres)
30-88	100
88-216	150
216-960	200
Above 960*	500

* Unless otherwise specified, for all frequencies greater than 1 GHz, the radiated emission limits for licence-exempt radio apparatus stated in applicable RSSs (including RSS-Gen) are based on measurements using a linear average detector function having a minimum resolution bandwidth of 1 MHz. If an average limit is specified for the EUT, then the peak emission shall also be measured with instrumentation properly adjusted for such factors as pulse desensitization to ensure the peak emission is less than 20 dB above the average limit.

Note: Transmitting devices are not permitted in restricted frequency bands unless stated otherwise in the specific RSS.

As per IC RSS-247 5.5, in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

As per IC RSS-Gen 8.10, Restricted bands, identified in Table 6, are designated primarily for safety-of-life services (distress calling and certain aeronautical bands), certain satellite downlinks, radio astronomy and some government uses. Except where otherwise indicated, the following restrictions apply: (a) Fundamental components of modulation of licence-exempt radio apparatus shall not fall within the restricted bands of Table 6 except for apparatus complying under RSS-287; (b) Unwanted emissions that fall into restricted bands of Table 6 shall comply with the limits specified in RSS-Gen; and (c) Unwanted emissions that do not fall within the restricted frequency bands of Table 6 shall comply either with the limits specified in the applicable RSS or with those specified in this RSS-Gen.

Table 6 – Restricted Frequency Bands*

MHz
0.090-0.110
2.1735-2.1905
3.020-3.026
4.125-4.128
4.17725-4.17775
4.20725-4.20775
5.677-5.683
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
16.80425-16.80475
25.5-25.67
37.5-38.25
73-74.6
74.8-75.2
108-138
156.52475-156.52525
156.7-156.9

MHz
240-285
322-335.4
399.9-410
608-614
960-1427
1435-1626.5
1645.5-1646.5
1660-1710
1718.8-1722.2
2200-2300
2310-2390
2655-2900
3260-3267
3332-3339
3345.8-3358
3500-4400
4500-5150
5350-5460
7250-7750
8025-8500

GHz
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

* Certain frequency bands listed in Table 6 and in bands above 38.6 GHz are designated for licence-exempt applications. These frequency bands and the requirements that apply to the devices are set out in the 200- and 300-series of RSSs, such as RSS-210 and RSS-310, which contain the requirements that apply to licence-exempt radio apparatus.

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/IC RSS-247 limits.

The spacing between the peripherals was 10 centimeters.

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

7.3 Test Procedure

For the radiated emissions test, the EUT host, and all support equipment power cords was 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 is set 3 meter away from the testing antenna, which is varied from 1-4 meter, and the EUT is placed on a turntable, which is 0.8 meter above ground plane, the table shall be rotated for 360 degrees to find out the highest emission. The receiving antenna should be changed the polarization both of horizontal and vertical.

The spectrum analyzer or receiver is 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	EMI Test Receiver	ESCI 1166.5950K03	100338	2014-01-20	2 year
Agilent	Spectrum Analyzer	E4440A	MY44303352	2015-06-22	1 year
Sunol Science Corp	System Controller	SC99V	011003-1	Calibration Not Required	Calibration Not Required
Sunol Sciences	Antenna, Biconi-Log	JB1	A013105-3	2015-07-11	2 year
A.R.A	Antenna, Horn	DRG-118/A	1132	2015-09-21	2 year
HP	Pre-Amplifier	8447D	2944A06639	2015-06-08	1 year
Suirong	30 ft conductive emission cable	LMR 400	-	2015-03-05	1 year
-	SMA cable	-	C0001	Each time[1]	N/A
IW Microwave	High Frequency Cable	DC-1531	KPS-1501A3960KPS	2015-08-10	1 year
Agilent	Pre-Amplifier	8449B	3008A01978	2015-09-02	1year

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:	20-25º C
Relative Humidity:	40-45 %
ATM Pressure:	101.2-103.5 kPa

The testing was performed by Leonard Gray on 2015-12-02 in 5m chamber3.

7.7 Summary of Test Results

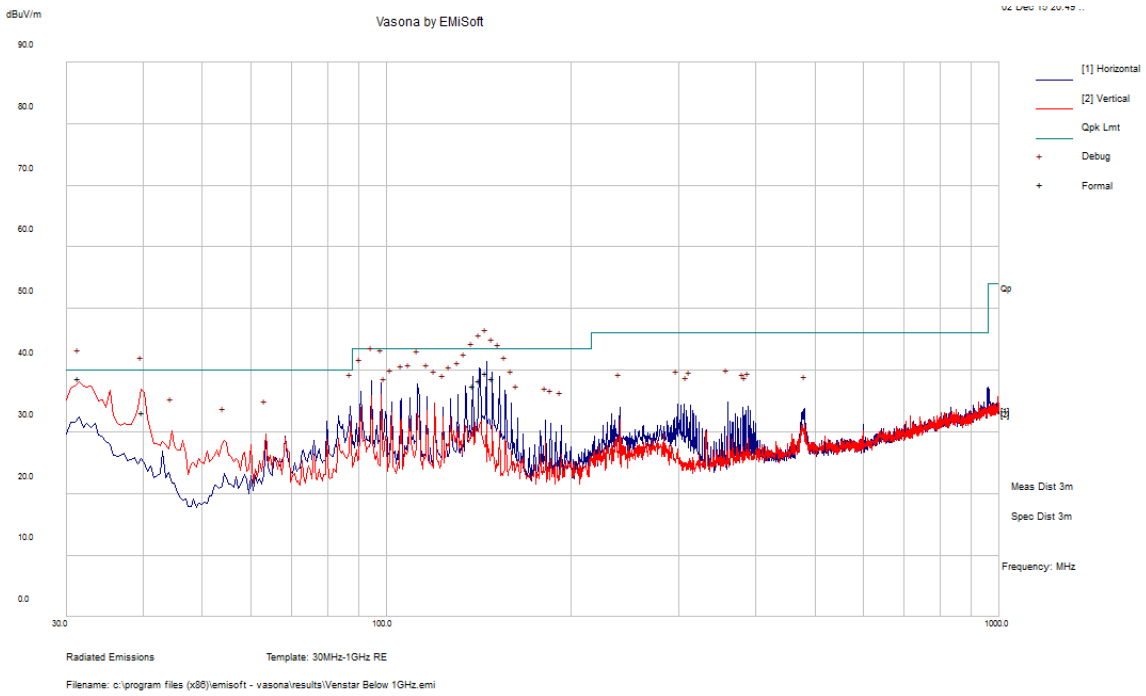
According to the data hereinafter, the EUT complied with the FCC Title 47, Part 15C and IC RSS-247 standard's radiated emissions limits, and had the worst margin of:

Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Mode, Channel**
-1.37	31.37525	Vertical	802.11b Middle Channel

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

7.8 Radiated Emissions Test Data and Plots

1) 30 MHz – 1 GHz



Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Comments (PK/QP/Ave.)
31.37525	38.63	100	V	217	40	-1.37	QP
145.4523	39.61	201	H	212	43.5	-3.89	QP
149.074	38.72	214	H	10	43.5	-4.78	QP
141.7928	38.31	198	H	10	43.5	-5.19	QP
138.2033	37.56	209	H	26	43.5	-5.94	QP
39.94725	33.14	116	V	1	40	-6.86	QP

Note: Worst Case, 802.11b, 2437 MHz.

2) 1 – 25 GHz

802.11b Mode

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/IC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 2412 MHz											
4824	50.72	39	100	V	32.89	4.297	35.86	52.05	74.00	-21.95	Peak
4824	49.78	73	100	H	32.74	4.297	35.86	50.96	74.00	-23.04	Peak
4824	41.23	39	100	V	32.89	4.297	35.86	42.56	54.00	-11.44	Ave
4824	40.71	73	100	H	32.74	4.297	35.86	41.89	54.00	-12.11	Ave
7236	44.68	0	100	V	36.25	5.675	36.01	50.60	74.00	-23.40	Peak
7236	45.44	0	100	H	36.14	5.675	36.01	51.24	74.00	-22.76	Peak
7236	30.86	0	100	V	36.25	5.675	36.01	36.78	54.00	-17.22	Ave
7236	30.22	0	100	H	36.14	5.675	36.01	36.02	54.00	-17.98	Ave
9648	45.44	0	100	V	38.00	8.704	36.04	56.10	74.00	-17.90	Peak
9648	45.72	0	100	H	37.92	8.704	36.04	56.30	74.00	-17.70	Peak
9648	31.3	0	100	V	38.00	8.704	36.04	41.96	54.00	-12.04	Ave
9648	30.87	0	100	H	37.92	8.704	36.04	41.45	54.00	-12.55	Ave
Middle Channel 2437 MHz											
4874	52.66	316	249	V	33.295	4.404	35.90	54.46	74.00	-19.54	Peak
4874	50.69	73	291	H	32.932	4.404	35.90	52.13	74.00	-21.87	Peak
4874	43.38	316	249	V	33.295	4.404	35.90	45.18	54.00	-8.82	Ave
4874	41.02	73	291	H	32.932	4.404	35.90	42.46	54.00	-11.54	Ave
7311	45.34	0	100	V	36.694	5.788	35.96	51.86	74.00	-22.14	Peak
7311	44.84	0	100	H	36.575	5.788	35.96	51.25	74.00	-22.75	Peak
7311	30.66	0	100	V	36.694	5.788	35.96	37.18	54.00	-16.82	Ave
7311	30.18	0	100	H	36.575	5.788	35.96	36.59	54.00	-17.41	Ave
9748	45.07	0	100	V	38.128	8.157	36.03	55.32	74.00	-18.68	Peak
9748	45.49	0	100	H	37.896	8.157	36.03	55.51	74.00	-18.49	Peak
9748	30.62	0	100	V	38.128	8.157	36.03	40.87	54.00	-13.13	Ave
9748	30.19	0	100	H	37.896	8.157	36.03	40.21	54.00	-13.79	Ave
High Channel 2462 MHz											
4924	49.26	306	100	V	33.32	4.485	35.91	51.15	74.00	-22.85	Peak
4924	47.7	162	100	H	33.24	4.485	35.91	49.52	74.00	-24.48	Peak
4924	38.49	306	100	V	33.32	4.485	35.91	40.38	54.00	-13.62	Ave
4924	37.1	162	100	H	33.24	4.485	35.91	38.92	54.00	-15.08	Ave
7386	45.77	0	100	V	36.88	5.869	35.96	52.56	74.00	-21.44	Peak
7386	45.7	0	100	H	36.76	5.869	35.96	52.36	74.00	-21.64	Peak
7386	30.96	0	100	V	36.88	5.869	35.96	37.75	54.00	-16.25	Ave
7386	30.83	0	100	H	36.76	5.869	35.96	37.49	54.00	-16.51	Ave
9848	43.67	0	100	V	38.36	7.444	35.98	53.50	74.00	-20.50	Peak
9848	44.79	0	100	H	38.37	7.444	35.98	54.63	74.00	-19.37	Peak
9848	30.48	0	100	V	38.36	7.444	35.98	40.31	54.00	-13.69	Ave
9848	30.45	0	100	H	38.37	7.444	35.98	40.29	54.00	-13.71	Ave

802.11g Mode

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/IC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 2412 MHz											
4824	52.19	120	146	V	32.89	4.297	35.86	53.52	74.00	-20.48	Peak
4824	50.17	78	147	H	32.74	4.297	35.86	51.35	74.00	-22.65	Peak
4824	32.25	120	146	V	32.89	4.297	35.86	33.58	54.00	-20.42	Ave
4824	32.22	78	147	H	32.74	4.297	35.86	33.40	54.00	-20.60	Ave
7236	44.78	0	100	V	36.25	5.675	36.01	50.70	74.00	-23.30	Peak
7236	44.6	0	100	H	36.14	5.675	36.01	50.40	74.00	-23.60	Peak
7236	30.39	0	100	V	36.25	5.675	36.01	36.31	54.00	-17.69	Ave
7236	30.44	0	100	H	36.14	5.675	36.01	36.24	54.00	-17.76	Ave
9648	40.74	0	100	V	38.00	8.704	36.04	51.40	74.00	-22.60	Peak
9648	40.58	0	100	H	37.92	8.704	36.04	51.16	74.00	-22.84	Peak
9648	25.83	0	100	V	38.00	8.704	36.04	36.49	54.00	-17.51	Ave
9648	26.28	0	100	H	37.92	8.704	36.04	36.86	54.00	-17.14	Ave
Middle Channel 2437 MHz											
4874	51.17	100	100	V	33.295	4.404	35.90	52.97	74.00	-21.03	Peak
4874	49.16	241	100	H	32.932	4.404	35.90	50.60	74.00	-23.40	Peak
4874	31.82	100	100	V	33.295	4.404	35.90	33.62	54.00	-20.38	Ave
4874	31.47	241	100	H	32.932	4.404	35.90	32.91	54.00	-21.09	Ave
7311	43.49	0	100	V	36.694	5.788	35.96	50.01	74.00	-23.99	Peak
7311	44.74	0	100	H	36.575	5.788	35.96	51.15	74.00	-22.85	Peak
7311	30.32	0	100	V	36.694	5.788	35.96	36.84	54.00	-17.16	Ave
7311	30.35	0	100	H	36.575	5.788	35.96	36.76	54.00	-17.24	Ave
9748	38.6	0	100	V	38.128	8.157	36.03	48.85	74.00	-25.15	Peak
9748	38.27	0	100	H	37.896	8.157	36.03	48.29	74.00	-25.71	Peak
9748	24.86	0	100	V	38.128	8.157	36.03	35.11	54.00	-18.89	Ave
9748	24.84	0	100	H	37.896	8.157	36.03	34.86	54.00	-19.14	Ave
High Channel 2462 MHz											
4924	50.66	148	231	V	33.32	4.485	35.91	52.55	74.00	-21.45	Peak
4924	46.94	244	100	H	33.24	4.485	35.91	48.76	74.00	-25.24	Peak
4924	31.62	148	231	V	33.32	4.485	35.91	33.51	54.00	-20.49	Ave
4924	30.76	244	100	H	33.24	4.485	35.91	32.58	54.00	-21.42	Ave
7386	48.78	165	100	V	36.88	5.869	35.96	55.57	74.00	-18.43	Peak
7386	45.74	0	100	H	36.76	5.869	35.96	52.40	74.00	-21.60	Peak
7386	30.71	165	100	V	36.88	5.869	35.96	37.50	54.00	-16.50	Ave
7386	29.9	0	100	H	36.76	5.869	35.96	36.56	54.00	-17.44	Ave
9848	40.43	0	100	V	38.36	7.444	35.98	50.26	74.00	-23.74	Peak
9848	40.2	0	100	H	38.37	7.444	35.98	50.04	74.00	-23.96	Peak
9848	25.3	0	100	V	38.36	7.444	35.98	35.13	54.00	-18.87	Ave
9848	25.329	0	100	H	38.37	7.444	35.98	35.17	54.00	-18.83	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/IC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 2412 MHz											
4824	51.81	105	100	V	32.89	4.297	35.86	53.14	74.00	-20.86	Peak
4824	47.71	240	100	H	32.74	4.297	35.86	48.89	74.00	-25.11	Peak
4824	30.53	105	100	V	32.89	4.297	35.86	31.86	54.00	-22.14	Ave
4824	29.8	240	100	H	32.74	4.297	35.86	30.98	54.00	-23.02	Ave
7236	44.71	0	100	V	36.25	5.675	36.01	50.63	74.00	-23.37	Peak
7236	44.35	0	100	H	36.14	5.675	36.01	50.15	74.00	-23.85	Peak
7236	29.56	0	100	V	36.25	5.675	36.01	35.48	54.00	-18.52	Ave
7236	29.57	0	100	H	36.14	5.675	36.01	35.37	54.00	-18.63	Ave
9648	42.39	0	100	V	38.00	8.704	36.04	53.05	74.00	-20.95	Peak
9648	42.06	0	100	H	37.92	8.704	36.04	52.64	74.00	-21.36	Peak
9648	27.35	0	100	V	38.00	8.704	36.04	38.01	54.00	-15.99	Ave
9648	27.33	0	100	H	37.92	8.704	36.04	37.91	54.00	-16.09	Ave
Middle Channel 2437 MHz											
9748	40.33	0	100	V	38.128	8.157	36.03	50.58	74.00	-23.42	Peak
9748	40.54	0	100	H	37.896	8.157	36.03	50.56	74.00	-23.44	Peak
9748	25.88	0	100	V	38.128	8.157	36.03	36.13	54.00	-17.87	Ave
9748	25.92	0	100	H	37.896	8.157	36.03	35.94	54.00	-18.06	Ave
9748	40.33	0	100	V	38.128	8.157	36.03	50.58	74.00	-23.42	Peak
9748	40.54	0	100	H	37.896	8.157	36.03	50.56	74.00	-23.44	Peak
9748	25.88	0	100	V	38.128	8.157	36.03	36.13	54.00	-17.87	Ave
9748	25.92	0	100	H	37.896	8.157	36.03	35.94	54.00	-18.06	Ave
9748	40.33	0	100	V	38.128	8.157	36.03	50.58	74.00	-23.42	Peak
9748	40.54	0	100	H	37.896	8.157	36.03	50.56	74.00	-23.44	Peak
9748	25.88	0	100	V	38.128	8.157	36.03	36.13	54.00	-17.87	Ave
9748	25.92	0	100	H	37.896	8.157	36.03	35.94	54.00	-18.06	Ave
High Channel 2462 MHz											
4924	48.5	98	100	V	33.32	4.485	35.91	50.39	74.00	-23.61	Peak
4924	46.07	246	100	H	33.24	4.485	35.91	47.89	74.00	-26.11	Peak
4924	31.34	98	100	V	33.32	4.485	35.91	33.23	54.00	-20.77	Ave
4924	30.43	246	100	H	33.24	4.485	35.91	32.25	54.00	-21.75	Ave
7386	48.66	164	100	V	36.88	5.869	35.96	55.45	74.00	-18.55	Peak
7386	44.88	0	100	H	36.76	5.869	35.96	51.54	74.00	-22.46	Peak
7386	30.96	164	100	V	36.88	5.869	35.96	37.75	54.00	-16.25	Ave
7386	29.86	0	100	H	36.76	5.869	35.96	36.52	54.00	-17.48	Ave
9848	39.55	0	100	V	38.36	7.444	35.98	49.38	74.00	-24.62	Peak
9848	39.69	0	100	H	38.37	7.444	35.98	49.53	74.00	-24.47	Peak
9848	25.55	0	100	V	38.36	7.444	35.98	35.38	54.00	-18.62	Ave
9848	25.56	0	100	H	38.37	7.444	35.98	35.40	54.00	-18.60	Ave

8 FCC §15.247(a)(2) & IC RSS-247 §5.2 - 6 dB & 99% Emission 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

According to IC RSS-247 5.2 (1), DTSs include systems that employ digital modulation techniques resulting in spectral characteristics similar to direct sequence systems. The minimum 6 dB bandwidth shall be 500 kHz for bands 902 -928 MHz and 2400 – 2483.5 MHz.

8.2 Measurement Procedure

The measurements are based on FCC KDB 558074 D01 DTS Meas Guidance v03r03: 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	Spectrum Analyzer	E4440A	US42221851	2015-06-23	1 year
-	SMA Cable	-	C0001	Each Time[1]	N/A
Mini-Circuits	Attenuator	BW-S20W5	1430	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:	22 ºC
Relative Humidity:	42 %
ATM Pressure:	102.7 kPa

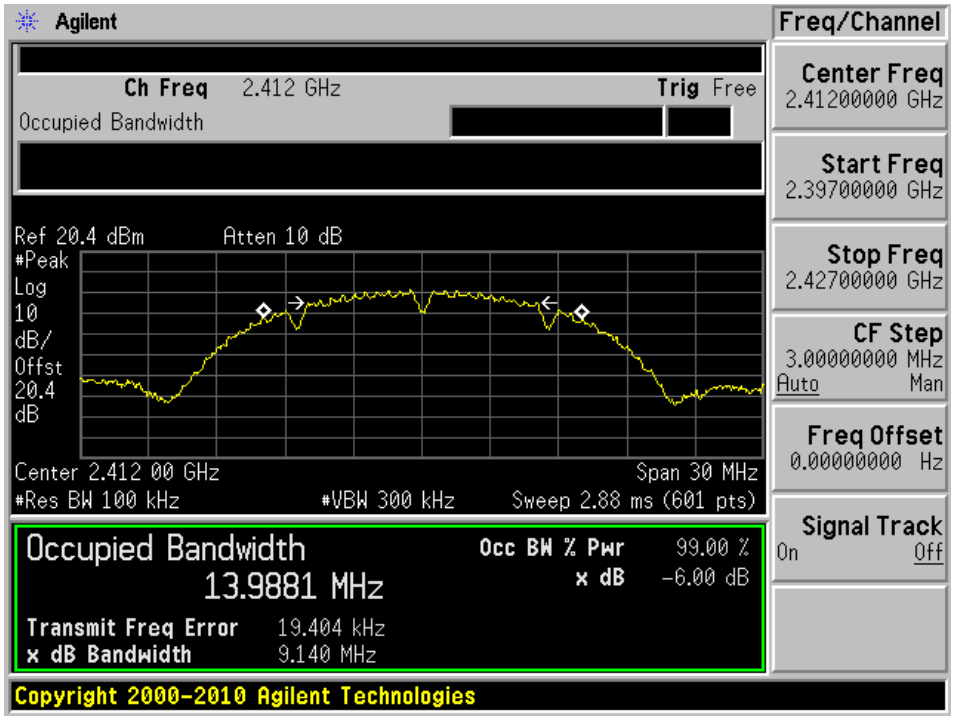
The testing was performed by Leonard Gray on 2015-12-01 in RF site.

8.5 Test Results

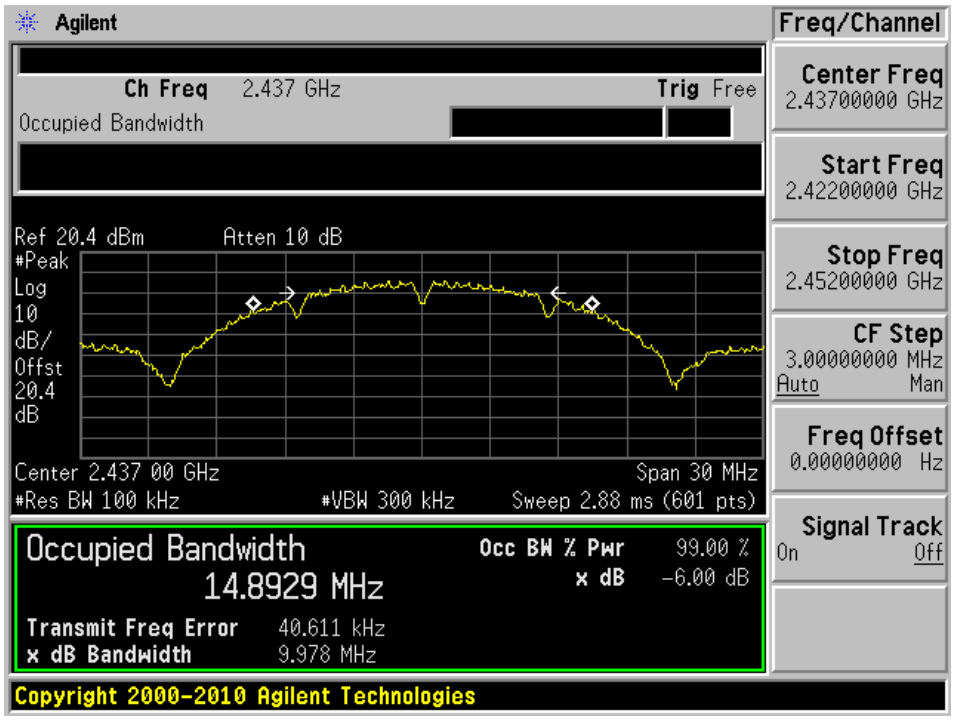
Channel	Frequency (MHz)	99 % OBW (MHz)	6 dB OBW (MHz)	6 dB OBW Limit (kHz)	Result
802.11b mode					
Low	2412	13.9881	9.140	≥ 500	Pass
Middle	2437	14.8929	9.978	≥ 500	Pass
High	2462	14.5200	10.061	≥ 500	Pass
802.11g mode					
Low	2412	16.4564	15.137	≥ 500	Pass
Middle	2437	16.3477	15.137	≥ 500	Pass
High	2462	16.4683	15.147	≥ 500	Pass
802.11n20 mode					
Low	2412	17.4162	15.132	≥ 500	Pass
Middle	2437	17.4353	15.170	≥ 500	Pass
High	2462	17.5108	14.789	≥ 500	Pass

Please refer to the following plots for detailed test results

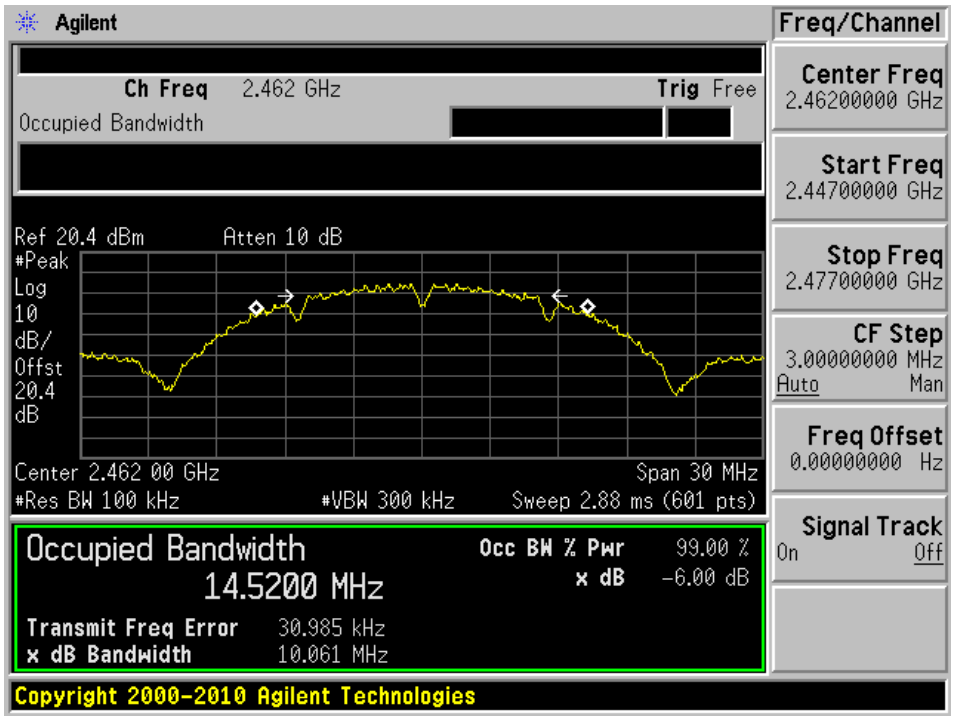
802.11b - 2412 MHz



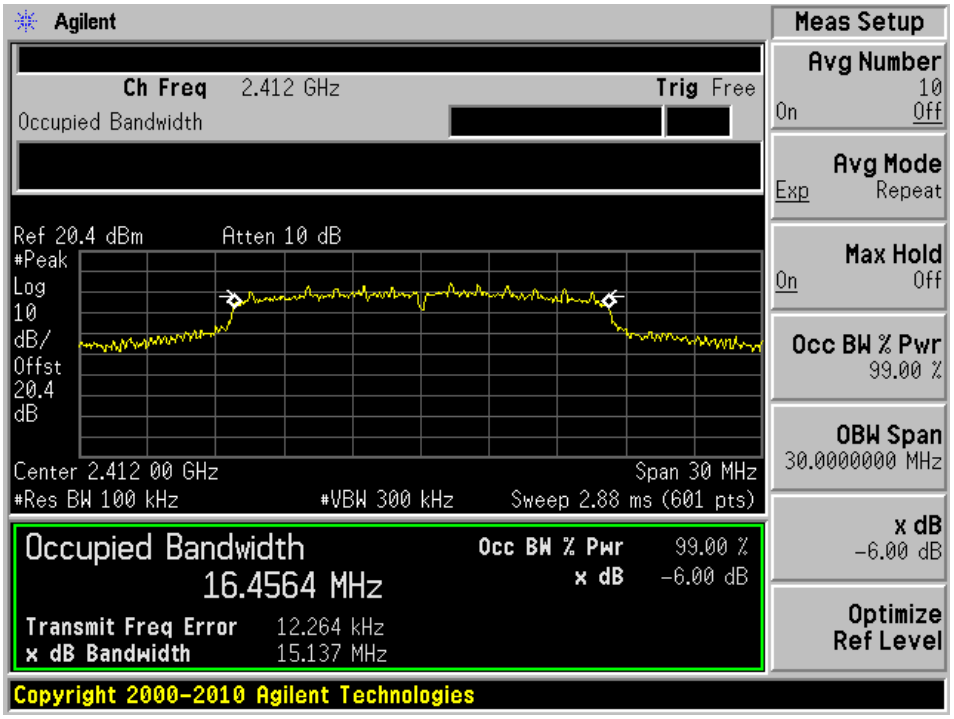
802.11b - 2437 MHz



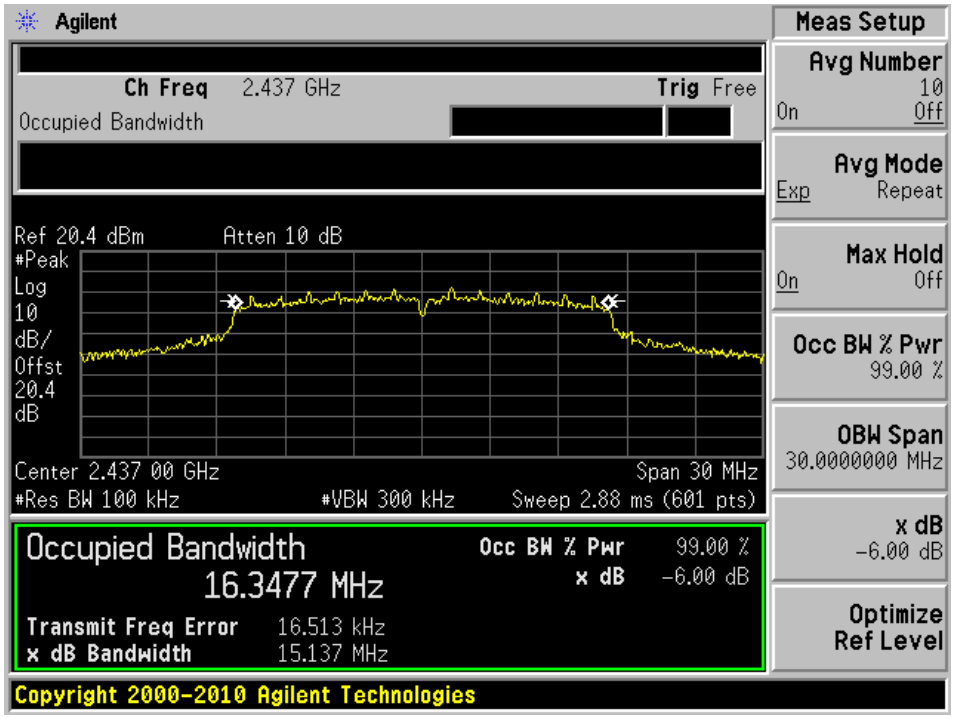
802.11b - 2462 MHz



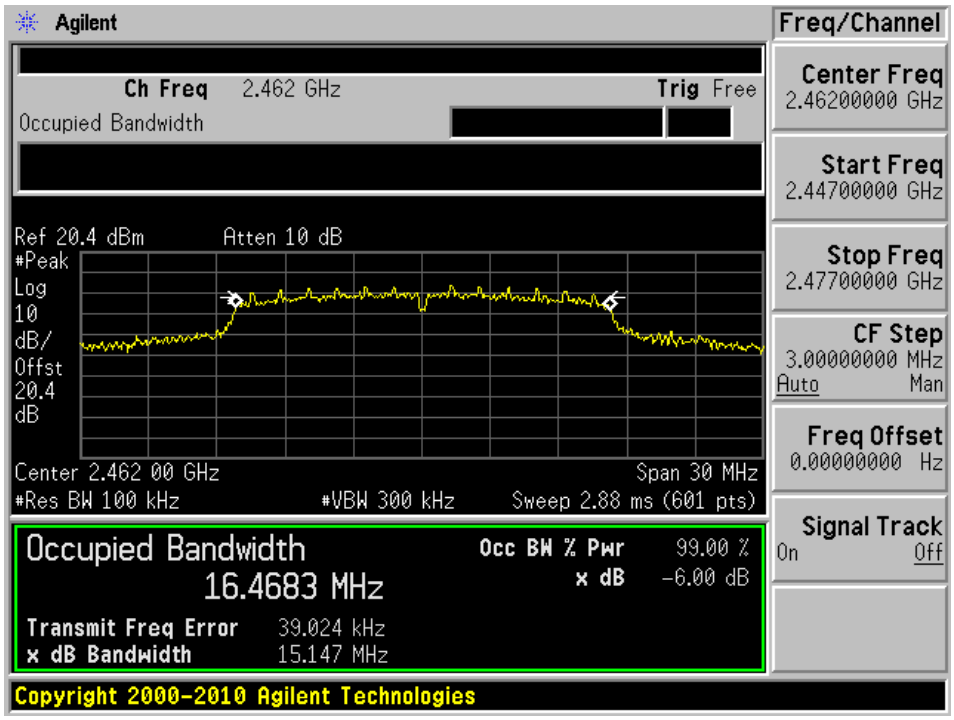
802.11g - 2412 MHz



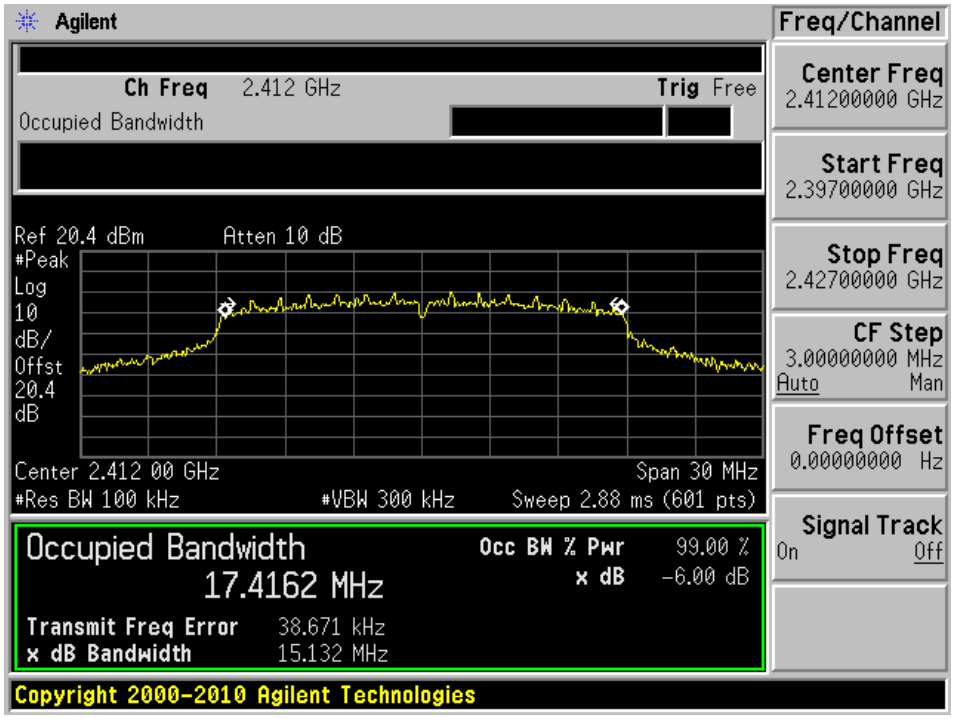
802.11g - 2437 MHz



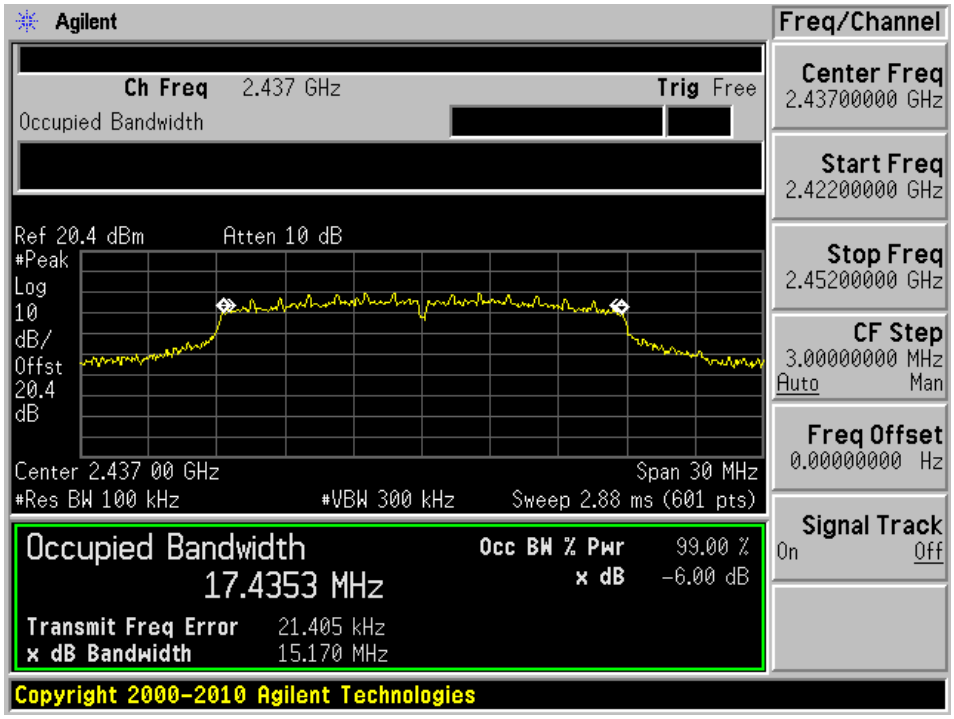
802.11g - 2462 MHz



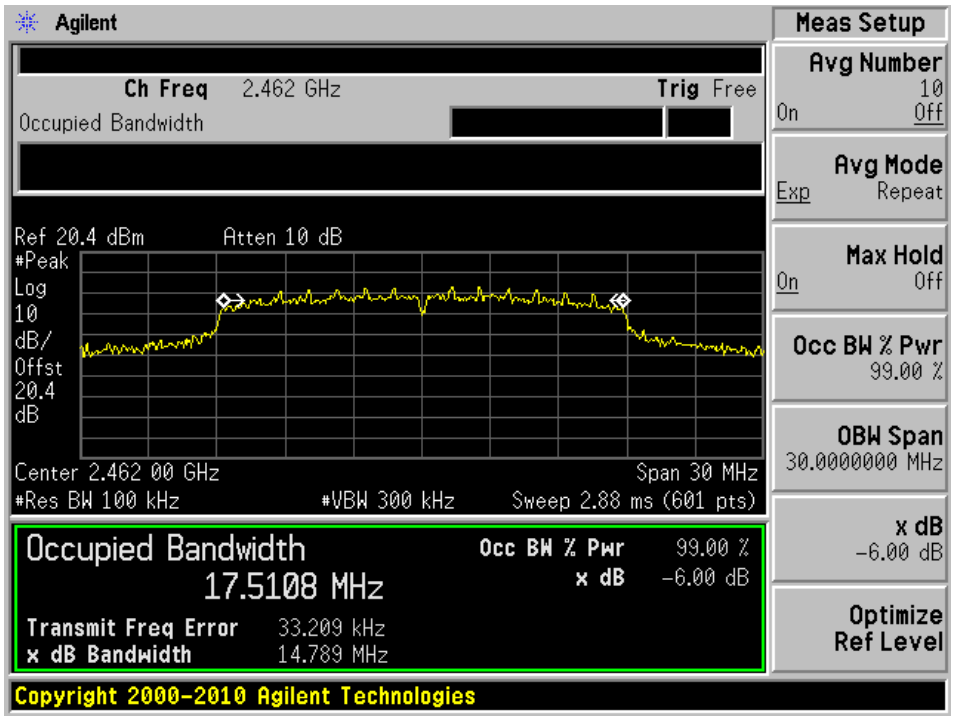
802.11n20 - 2412 MHz



802.11n20 - 2437 MHz



802.11n20 - 2462 MHz



9 FCC §15.247(b) & IC RSS-247 §5.4 - Output Power Measurement

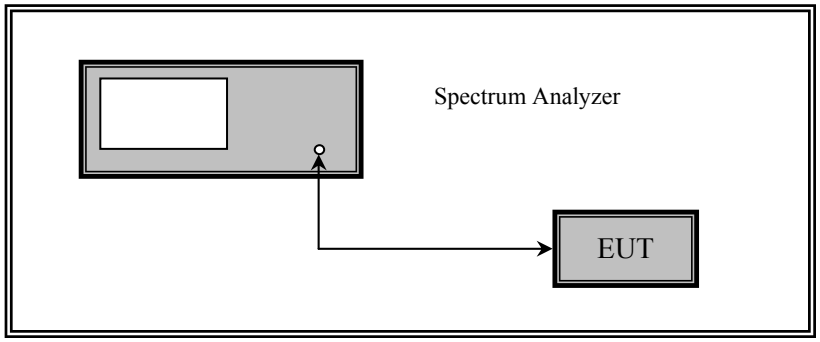
9.1 Applicable Standards

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

According to IC RSS-247 §5.4 (4), for DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1W. Except as provided in Section 5.4(5), the e.i.r.p. shall not exceed 4 W.

9.2 Measurement Procedure

The measurements are based on FCC KDB 558074 D01 DTS Meas Guidance v03r03: 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	Spectrum Analyzer	E4440A	US42221851	2015-06-23	1 year
-	SMA Cable	-	C0001	Each Time[1]	N/A
Mini-Circuits	Attenuator	BW-S20W5	1430	Each Time[1]	N/A

[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:	21-24º C
Relative Humidity:	40-44 %
ATM Pressure:	102.1-103.5 kPa

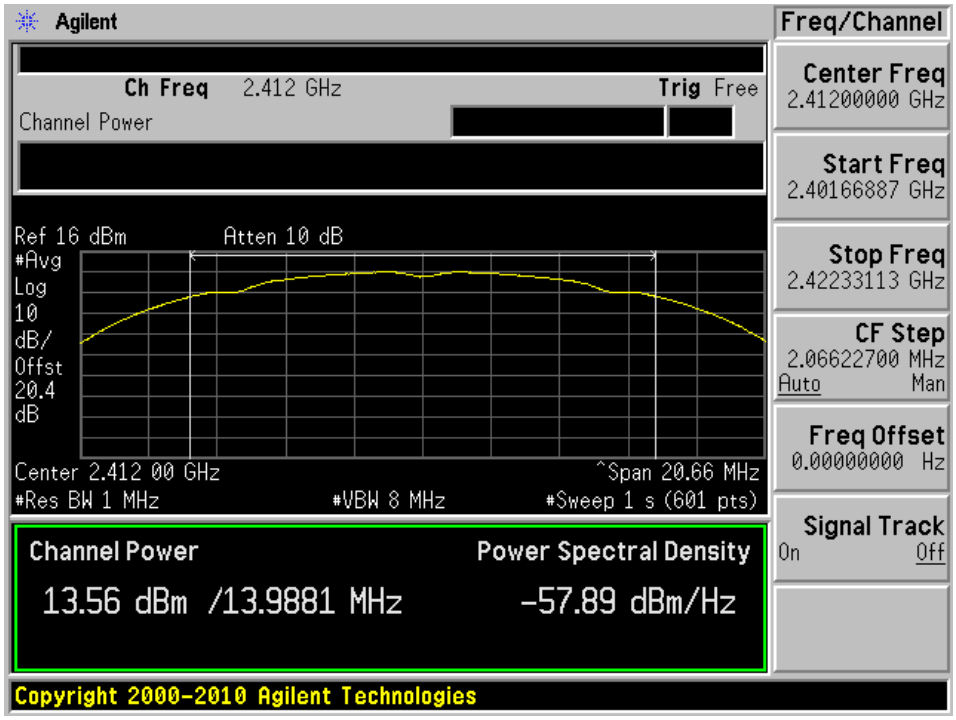
The testing was performed by Leonard Gray on 2015-12-02 in RF site.

9.5 Test Results

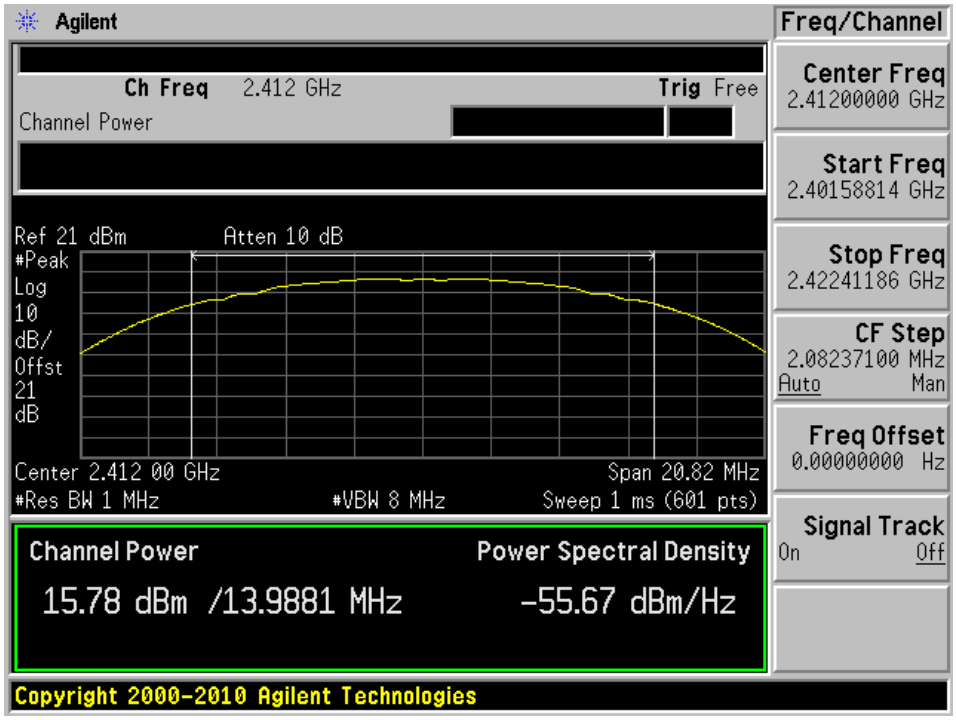
Channel	Frequency (MHz)	Conducted Output Power (dBm)		Limit (dBm)	Result
		Average	Peak		
802.11b					
Low	2412	13.56	15.78	30	Pass
Middle	2437	15.19	17.57	30	Pass
High	2462	13.19	16.80	30	Pass
802.11g					
Low	2412	9.83	14.13	30	Pass
Middle	2437	10.97	15.08	30	Pass
High	2462	9.03	14.35	30	Pass
802.11n20					
Low	2412	9.37	13.42	30	Pass
Middle	2437	10.91	14.32	30	Pass
High	2462	8.47	12.97	30	Pass

Please refer to the follow plots.

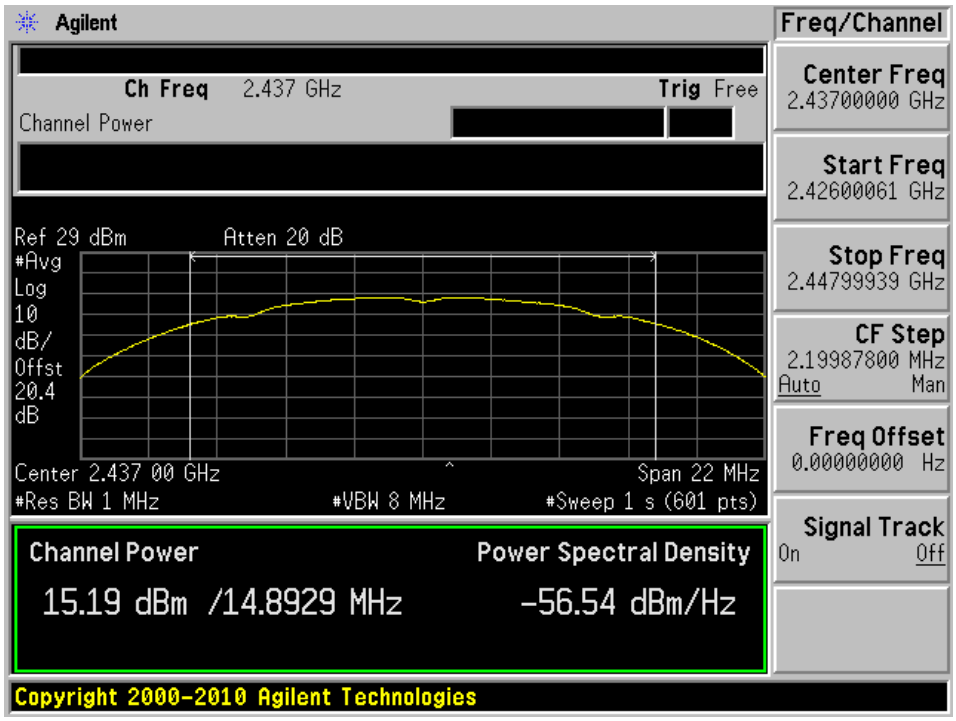
802.11b 2412 MHz, Average



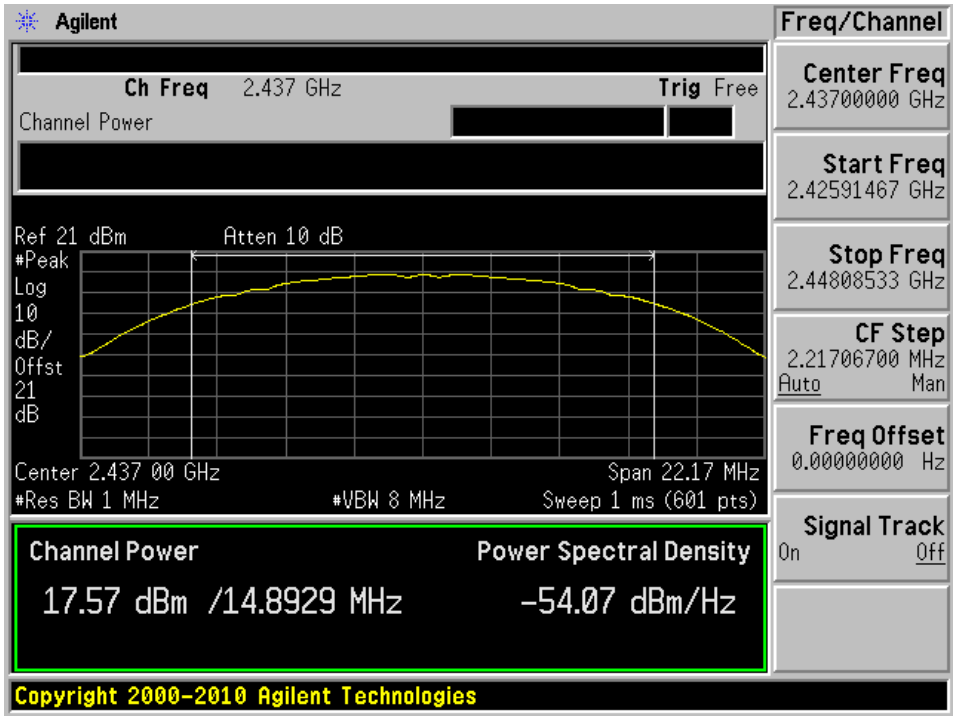
802.11b 2412 MHz, Peak



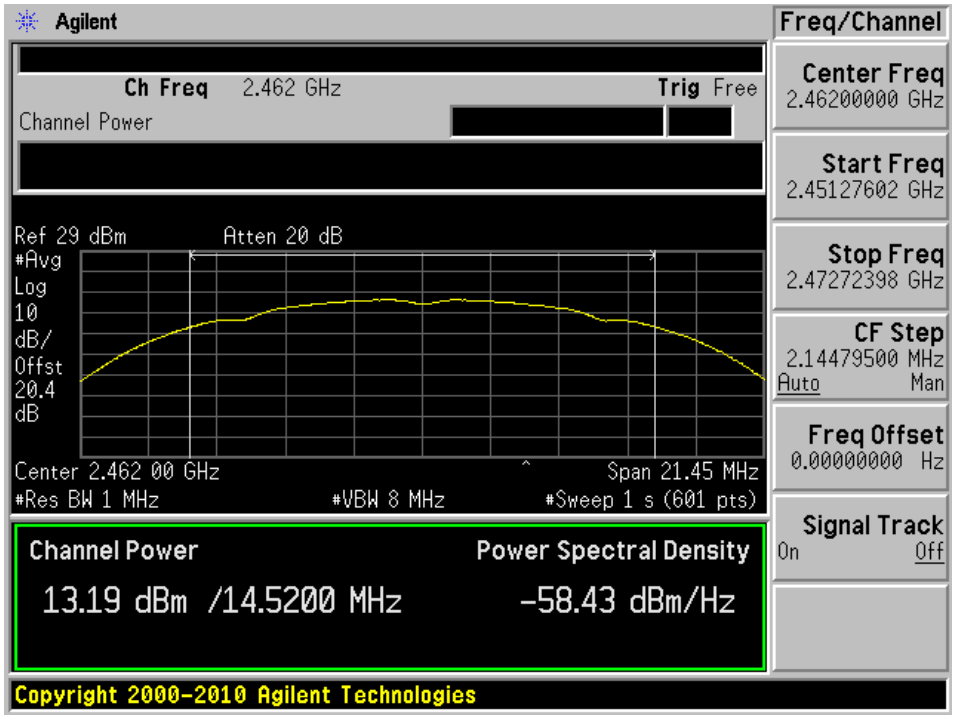
802.11b 2437 MHz, Average



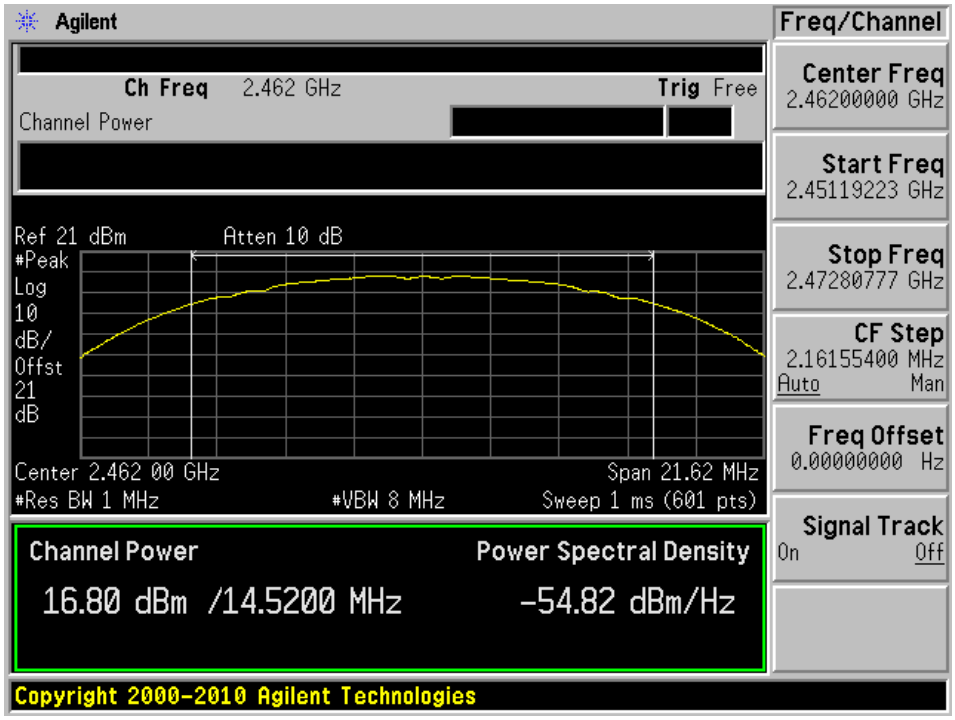
802.11b 2437 MHz, Peak



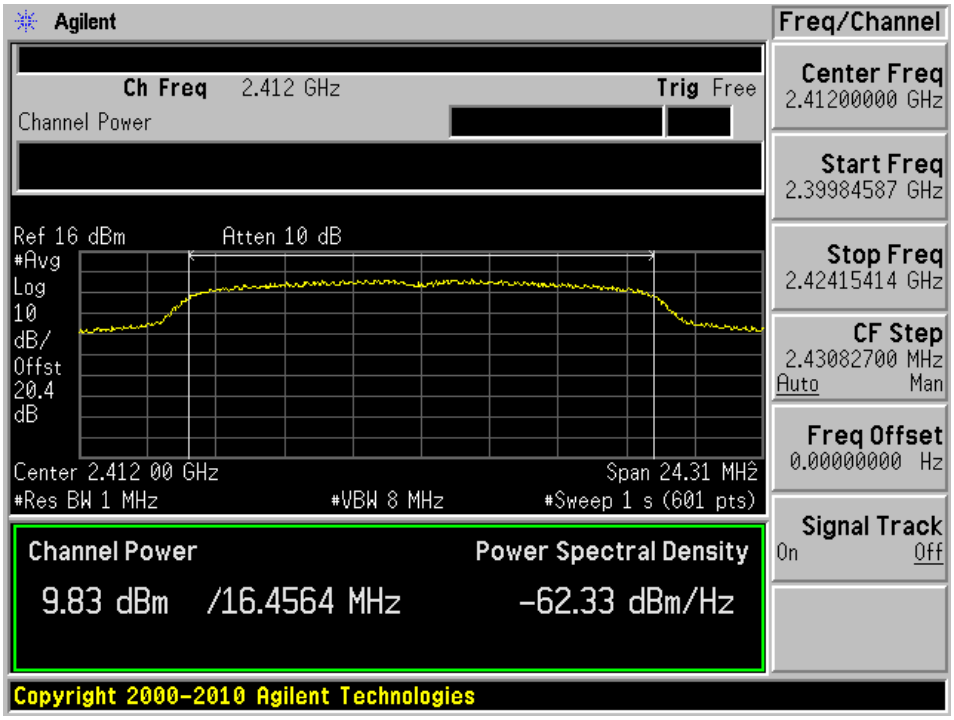
802.11b 2462 MHz, Average



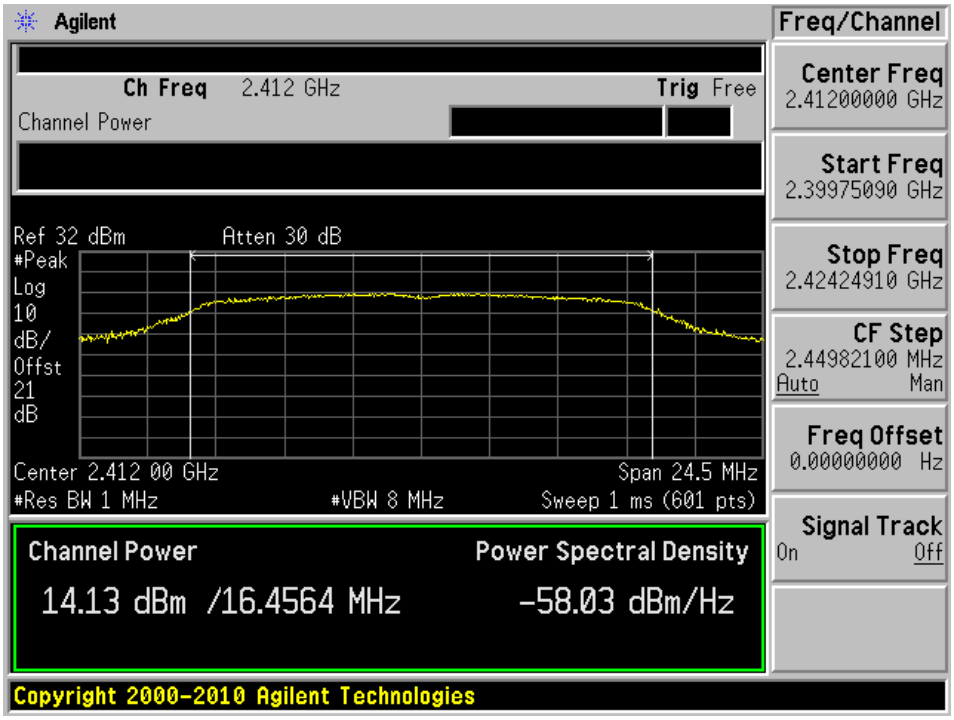
802.11b 2462 MHz, Peak



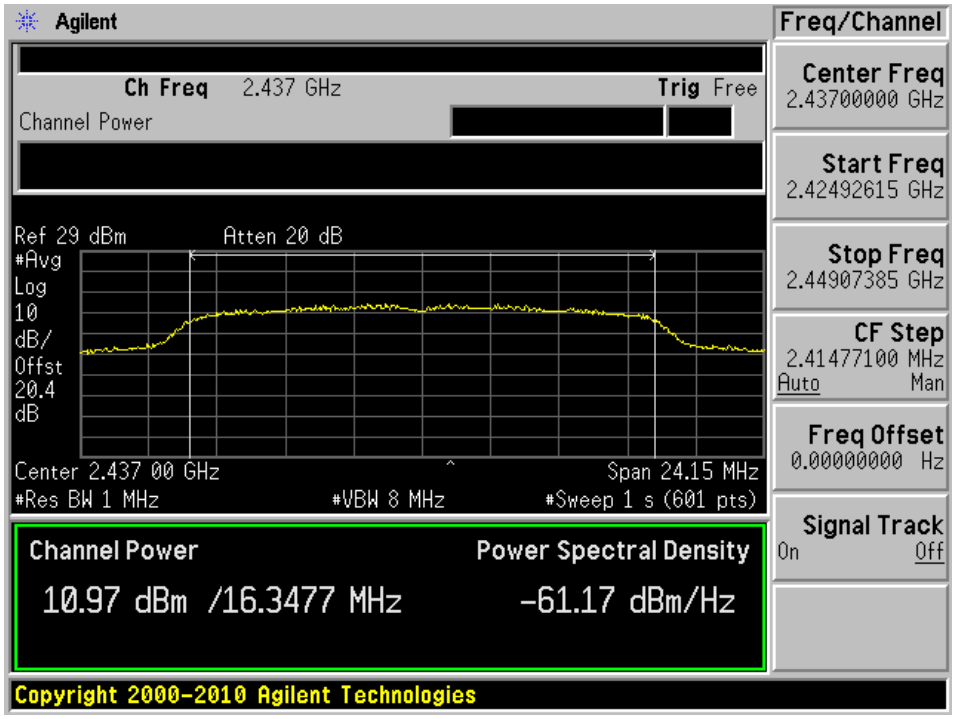
802.11g 2412 MHz, Average



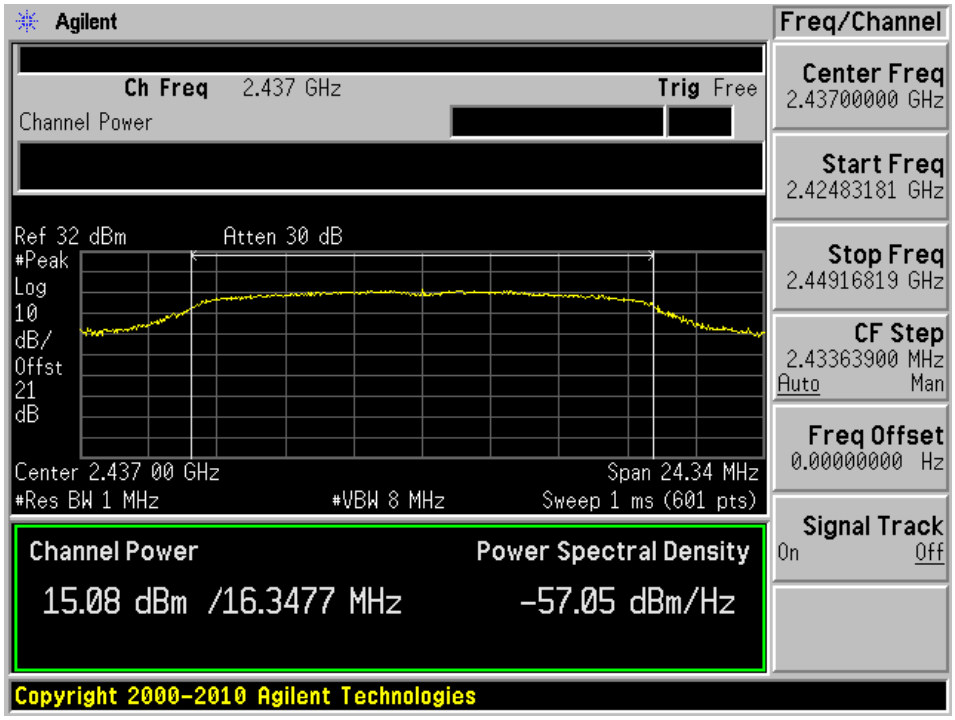
802.11g 2412 MHz, Peak



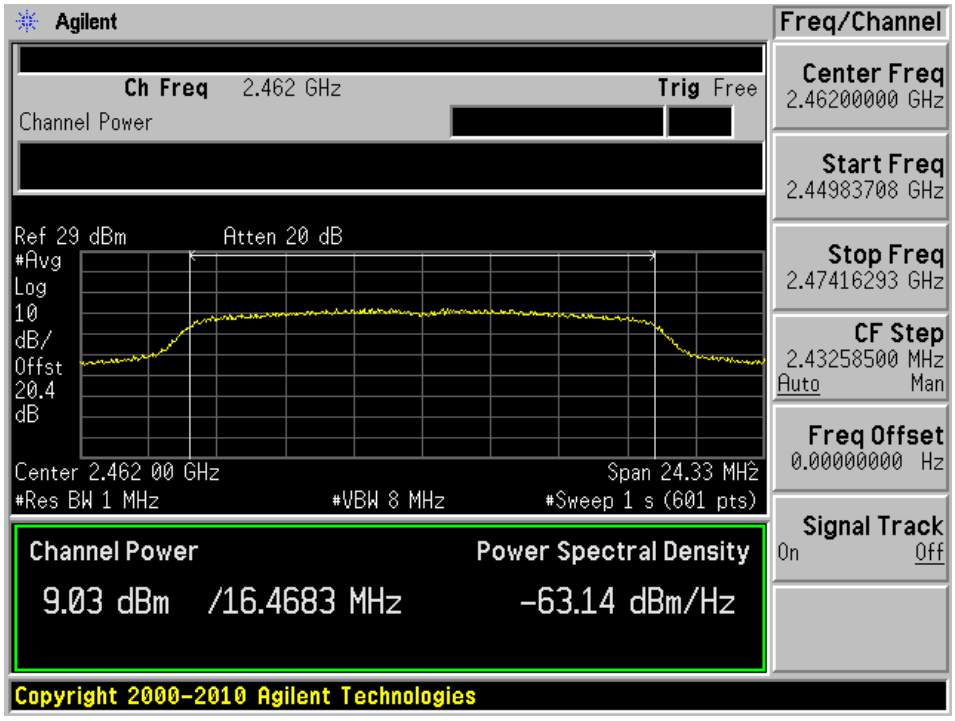
802.11g 2437 MHz, Average



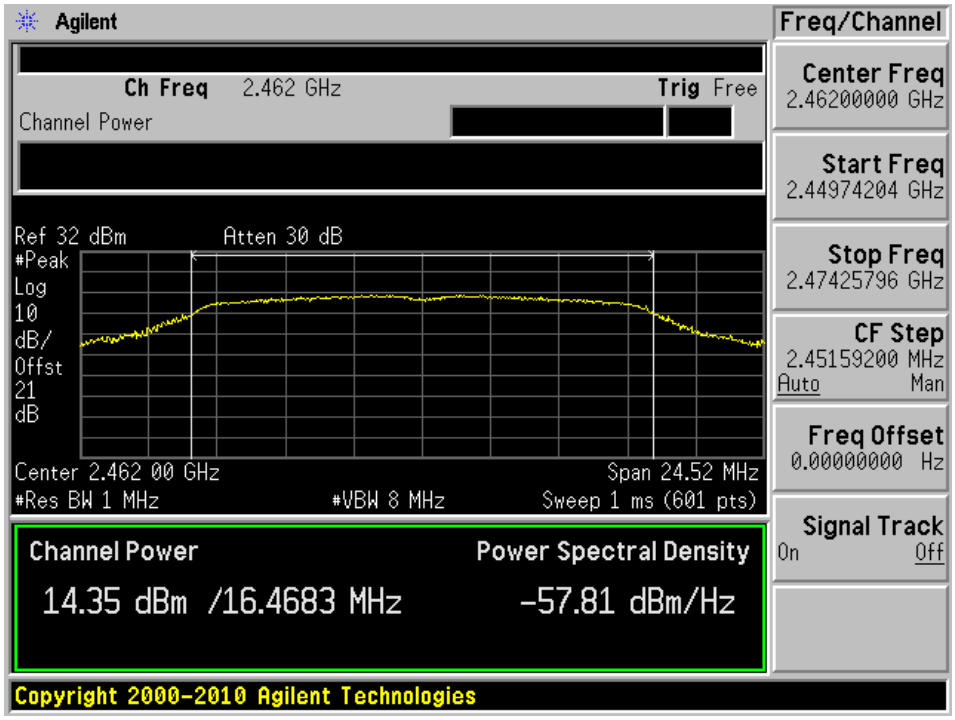
802.11g 2437 MHz, Peak



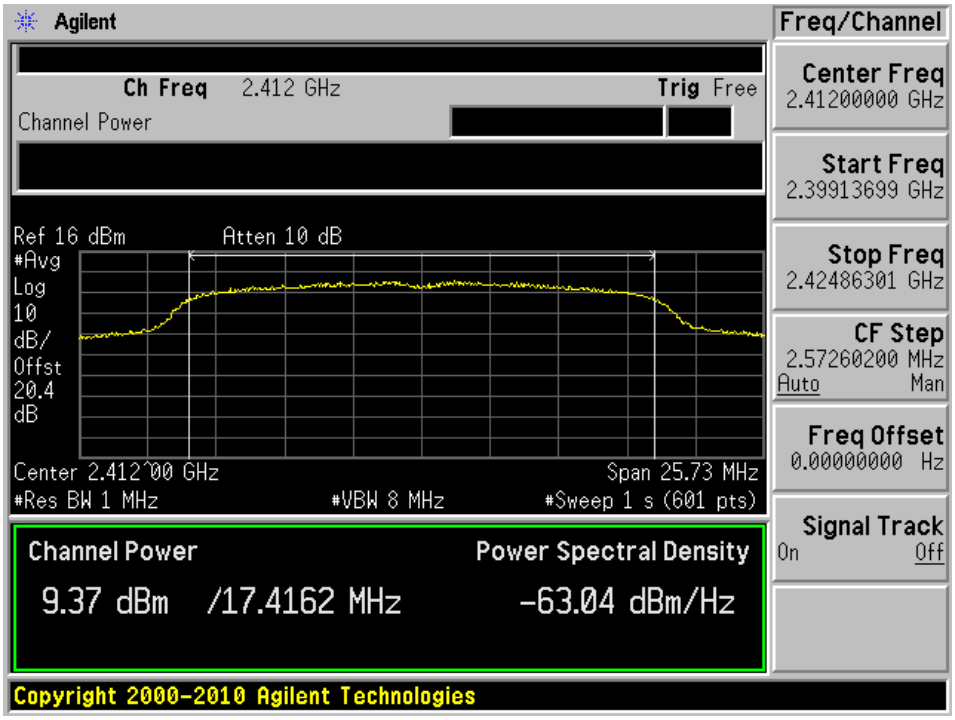
802.11g 2462 MHz, Average



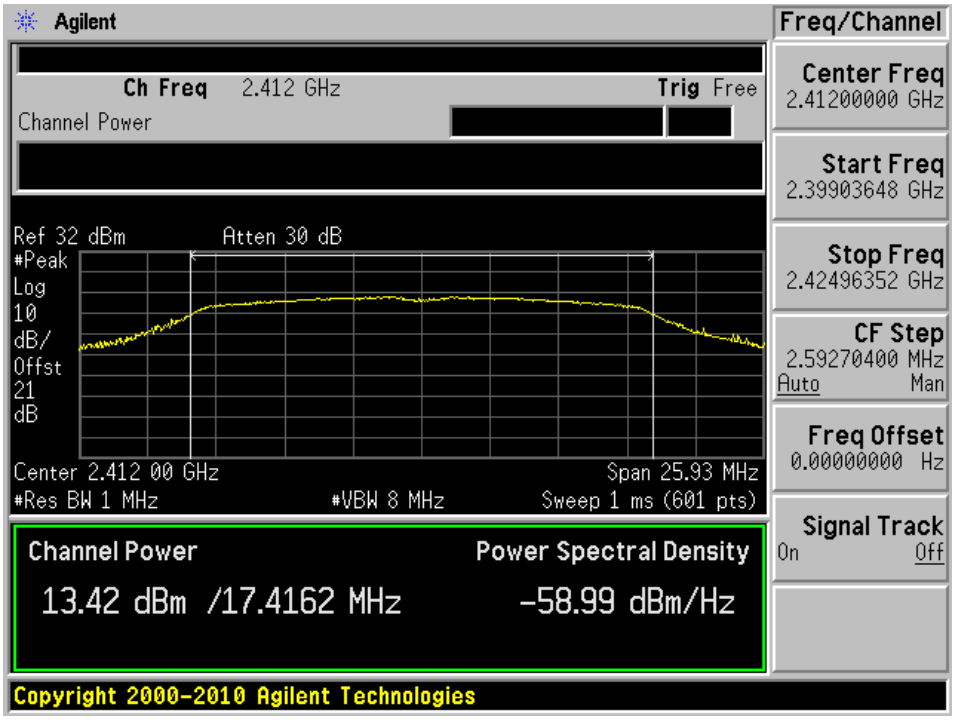
802.11g 2462 MHz, Peak



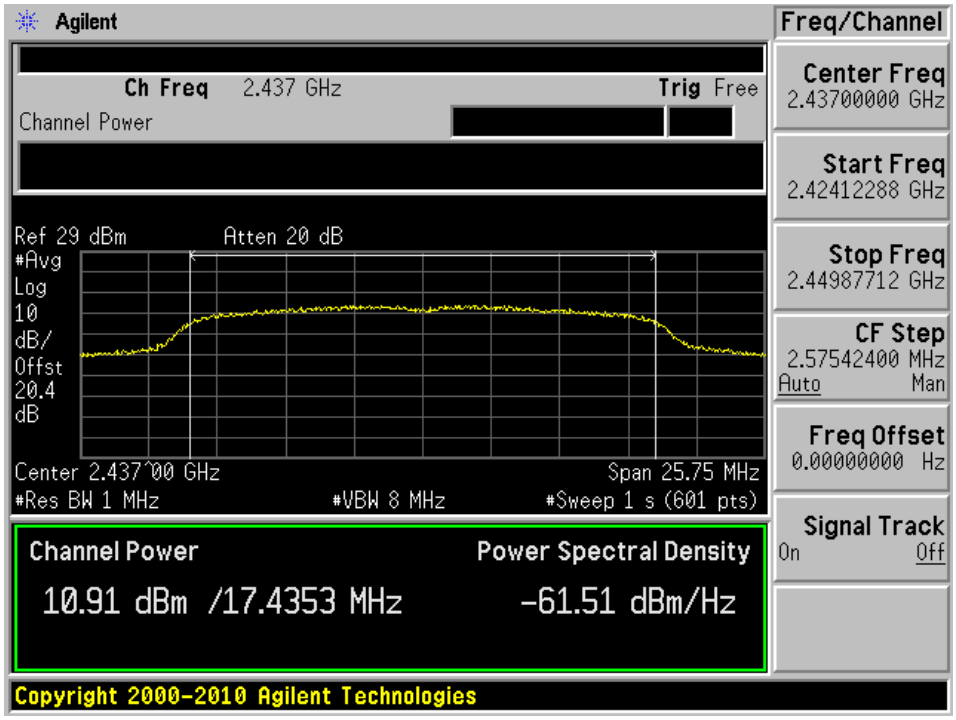
802.11n20 2412 MHz, Average



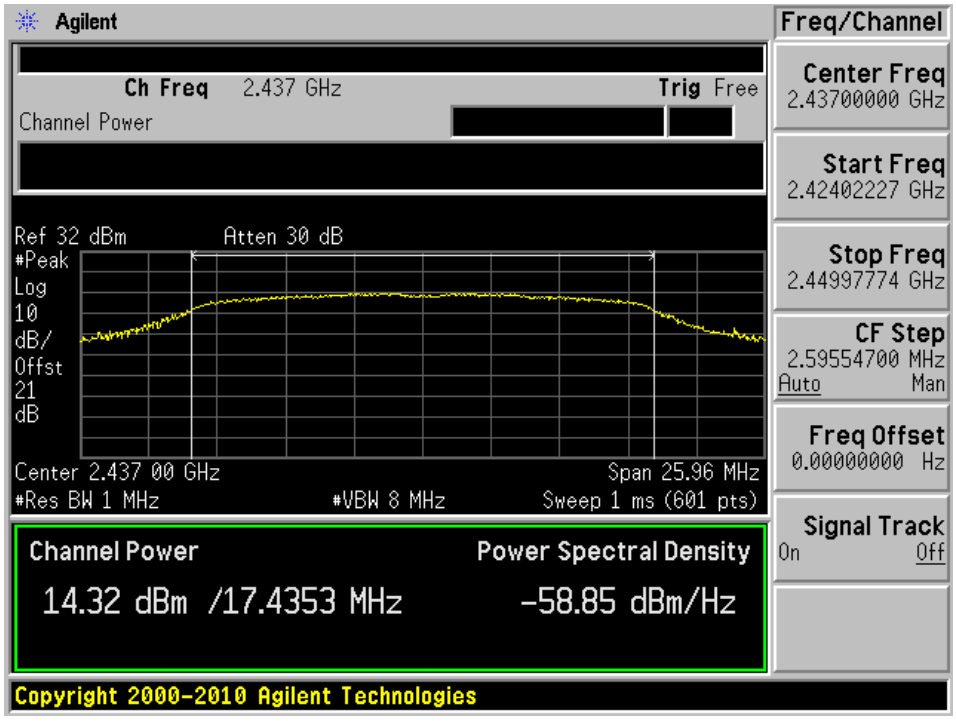
802.11n20 2412 MHz, Peak



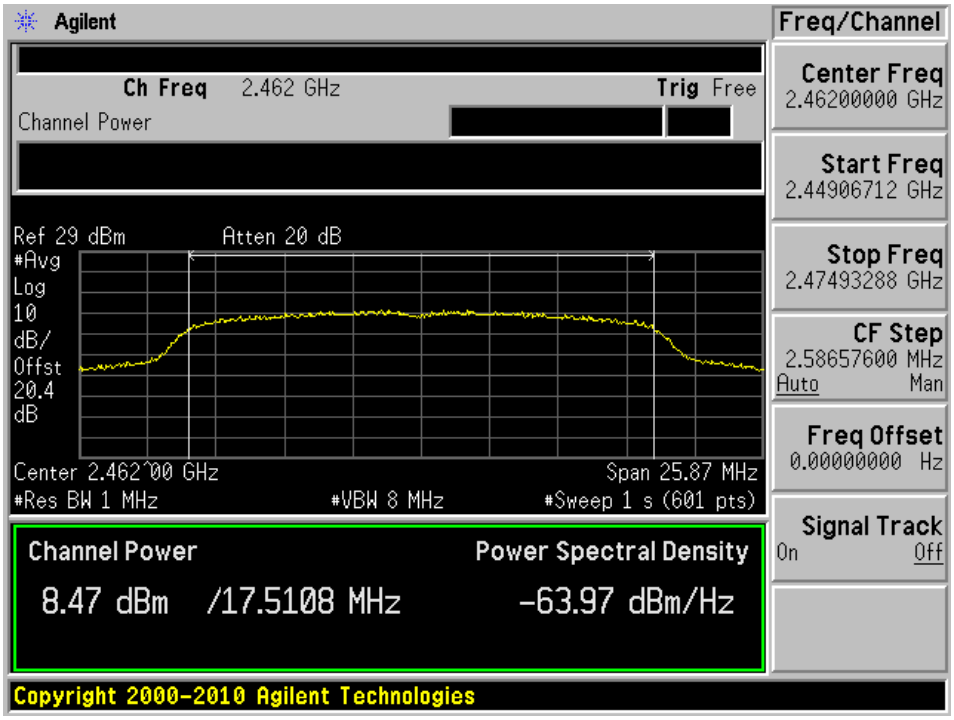
802.11n20 2437 MHz, Average



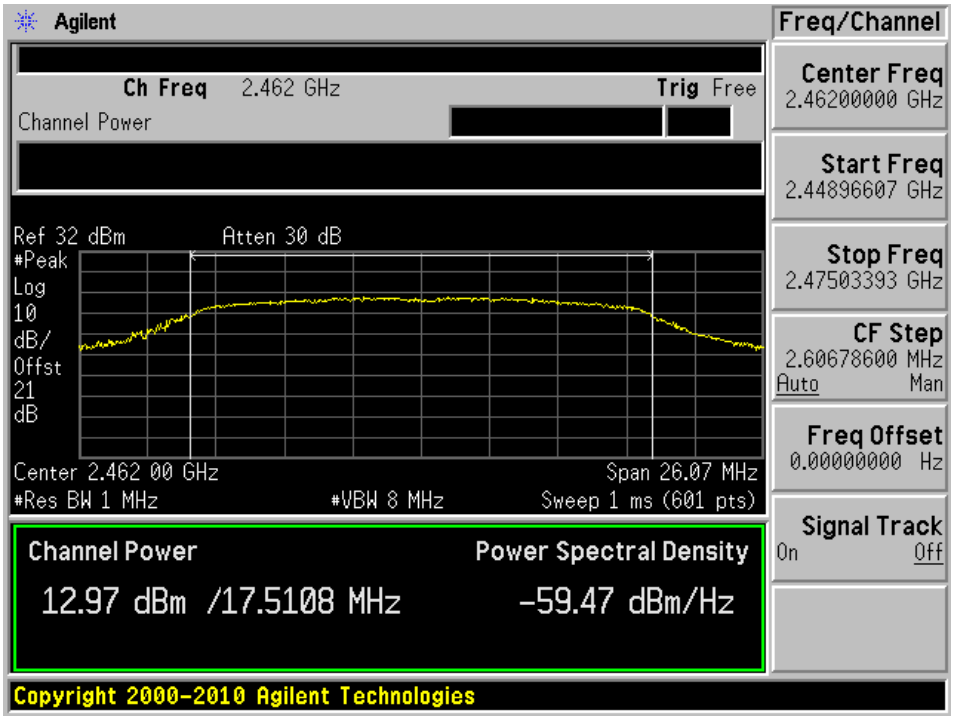
802.11n20 2437 MHz, Peak



802.11n20 2462 MHz, Average



802.11n20 2462 MHz, Peak



10 FCC §15.247(d) & IC RSS-247 §5.5 - Spurious Emissions at Antenna Port and Band Edges

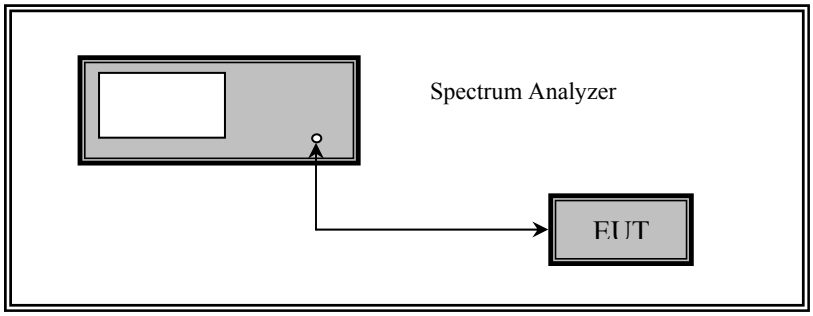
10.1 Applicable Standards

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).

For IC RSS-247 §5.5, in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

10.2 Measurement Procedure

The measurements are based on FCC KDB 558074 D01 DTS Meas Guidance v03r03: 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
Rohde & Schwarz	Spectrum Analyzer	FSQ	1155.5001.26	2015-03-09	1 year
Agilent	Spectrum Analyzer	E4440A	US42221851	2015-06-23	1 year
-	SMA Cable	-	C0001	Each Time[1]	N/A
Mini-Circuits	Attenuator	BW-S20W5	1430	Each Time[1]	N/A

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

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

10.4 Test Environmental Conditions

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

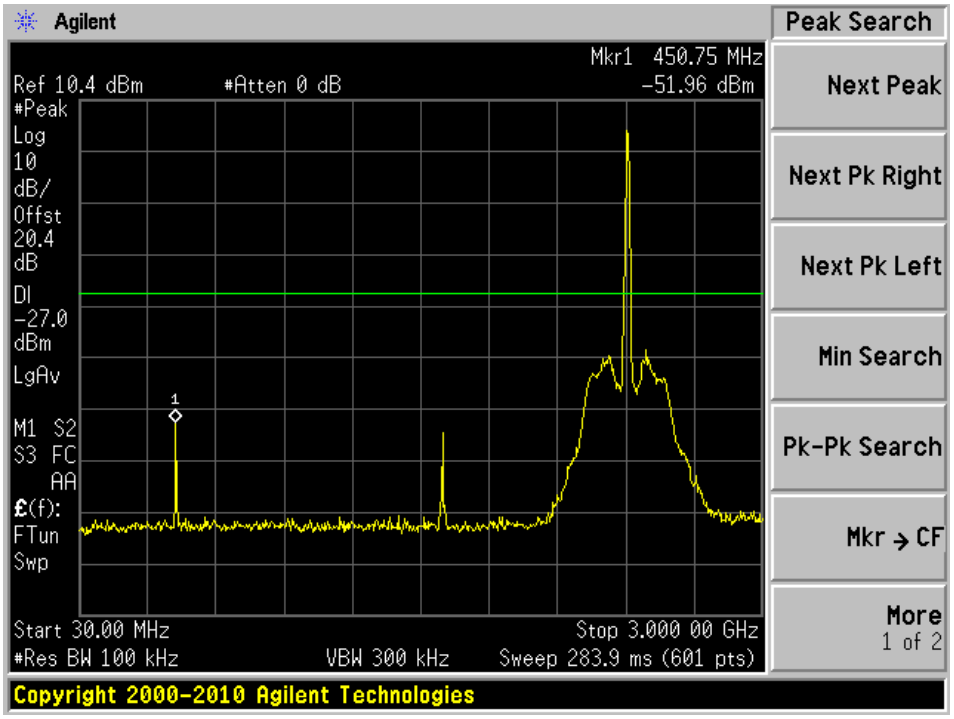
The testing was performed by Leonard Gray on 2015-12-02 in RF site.

10.5 Test Results

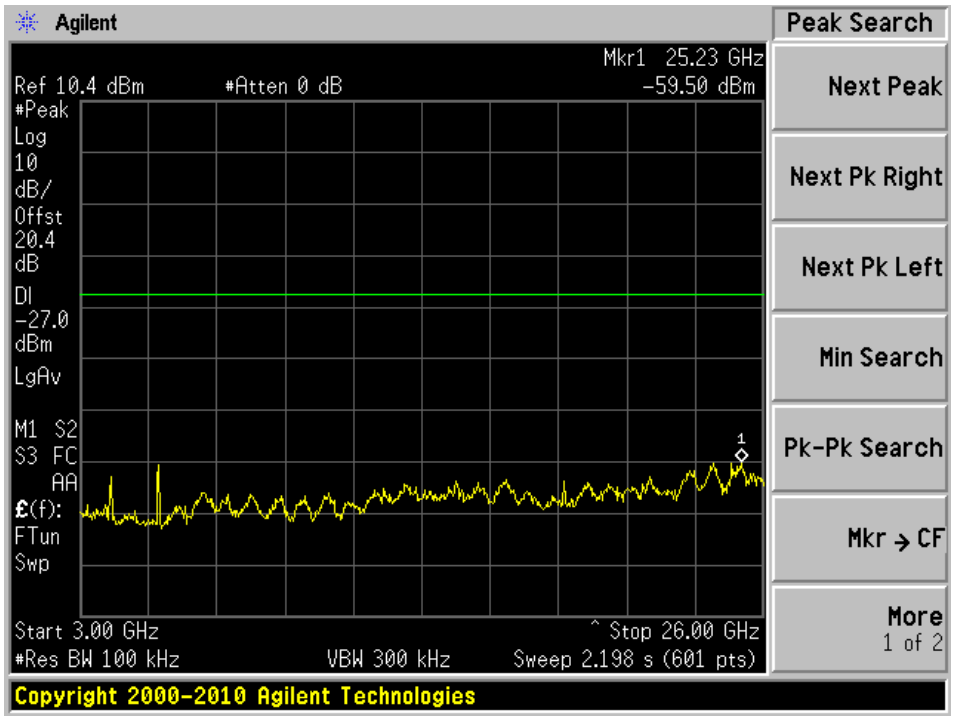
Please refer to the following plots.

Spurious Emissions

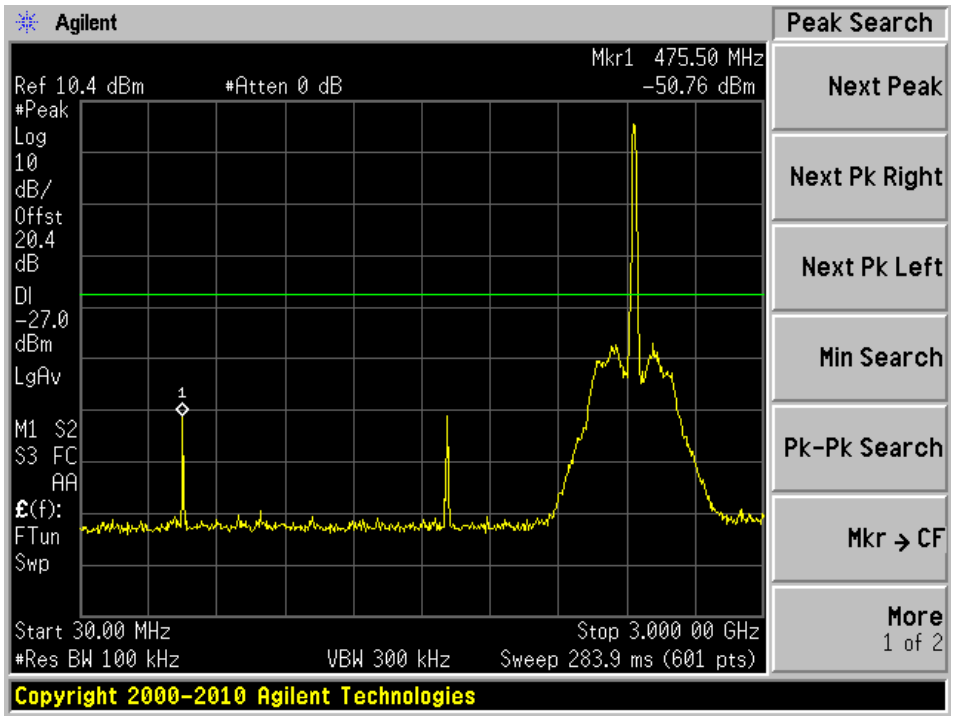
802.11b-2412 MHz (30 MHz-3 GHz)



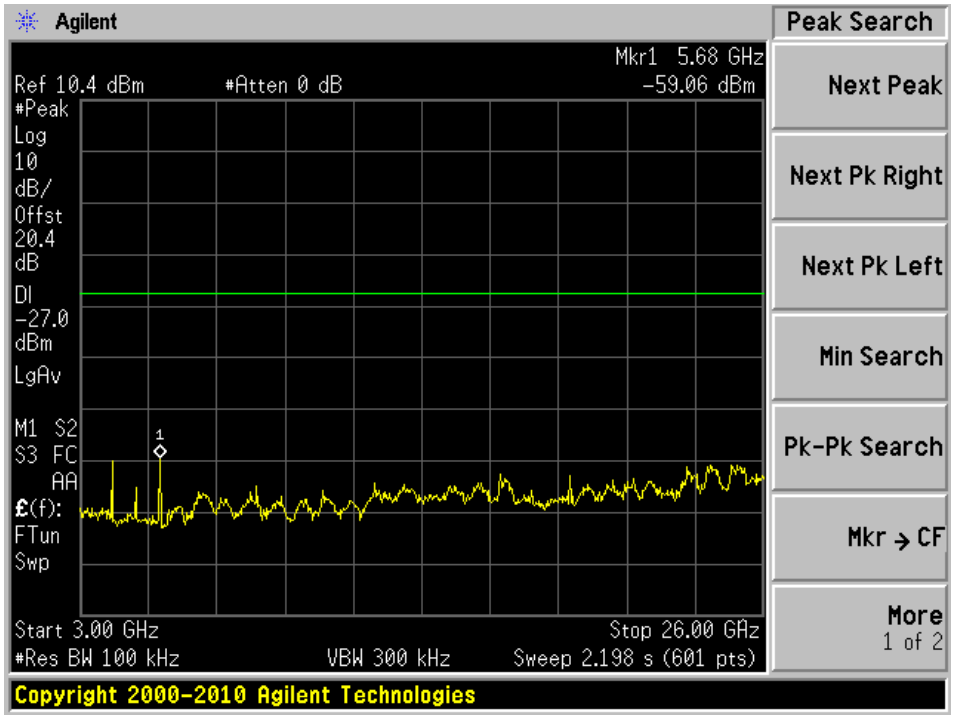
802.11b-2412 MHz (3-26 GHz)



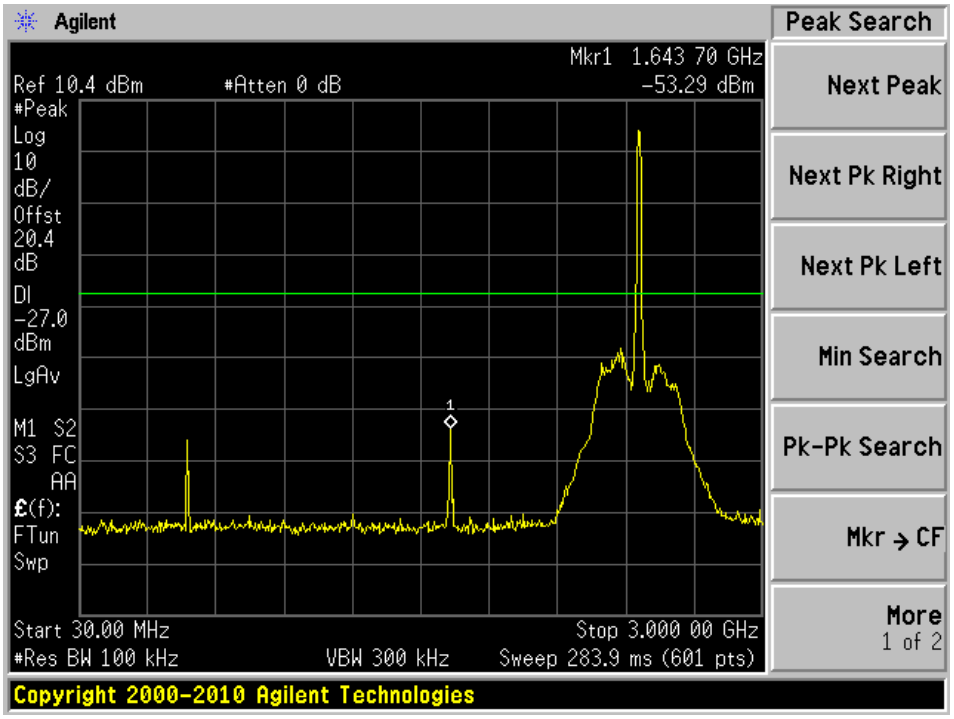
802.11b-2437 MHz (30 MHz-3 GHz)



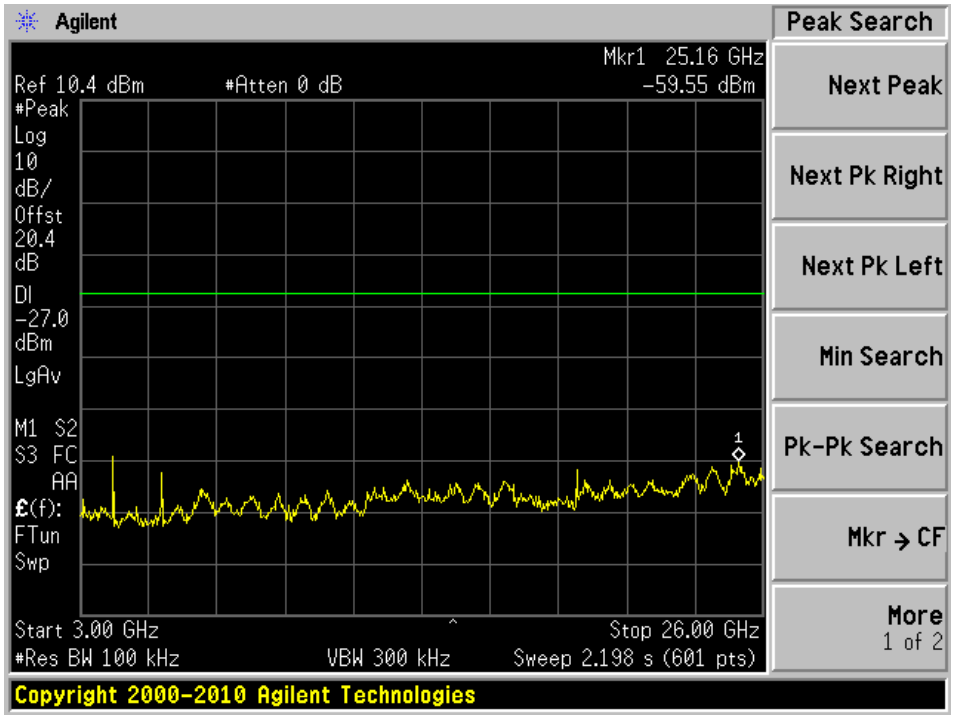
802.11b-2437 MHz (3-26 GHz)



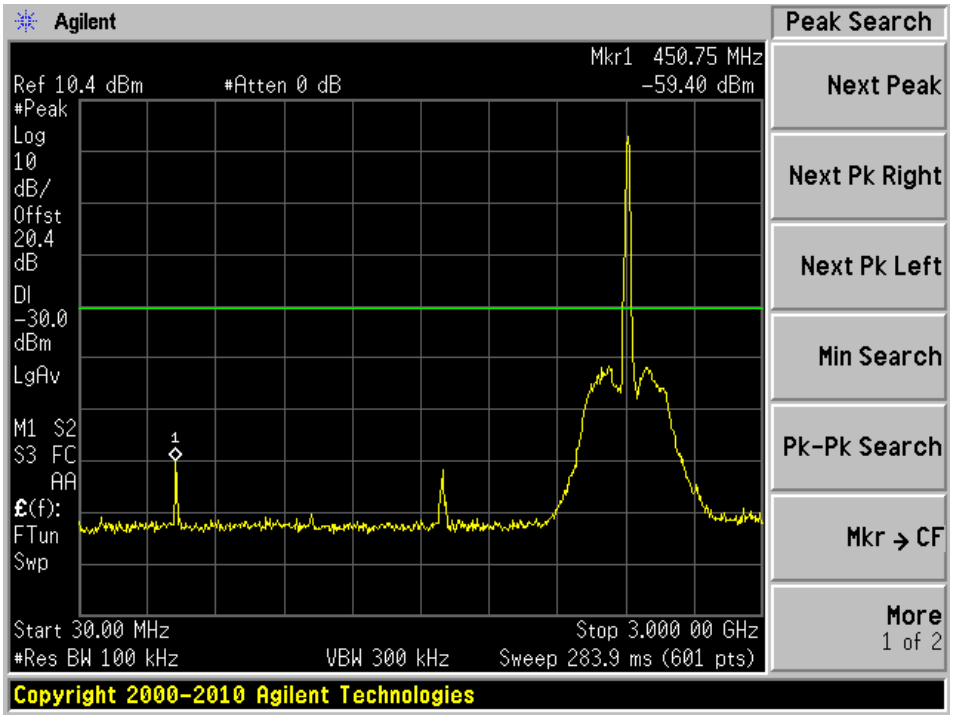
802.11b-2462 MHz (30 MHz-3 GHz)



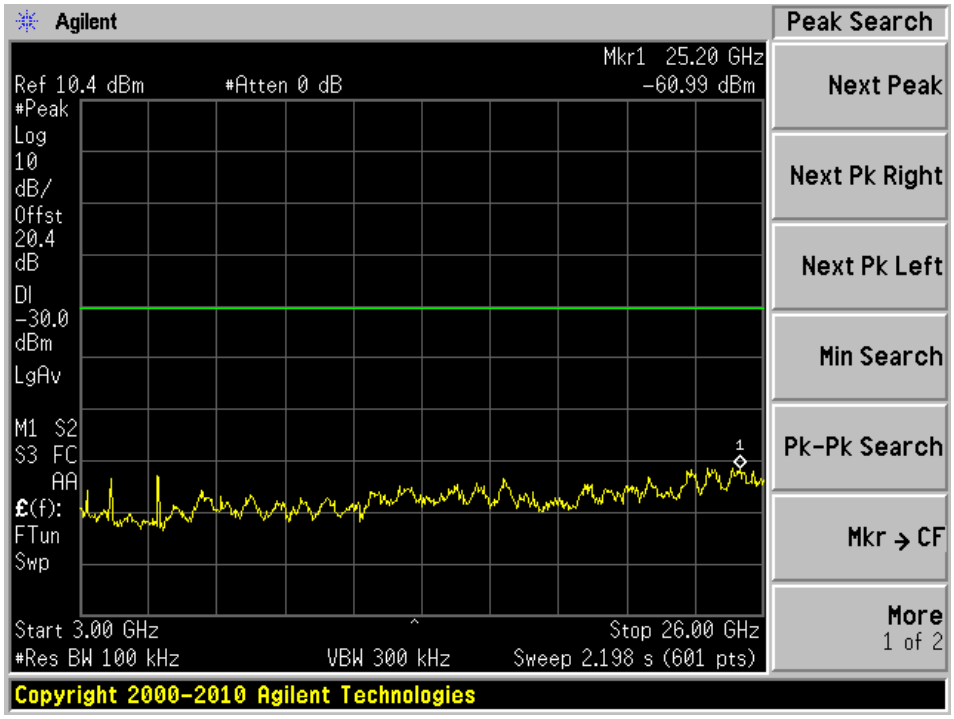
802.11b-2462 MHz (3-26 GHz)



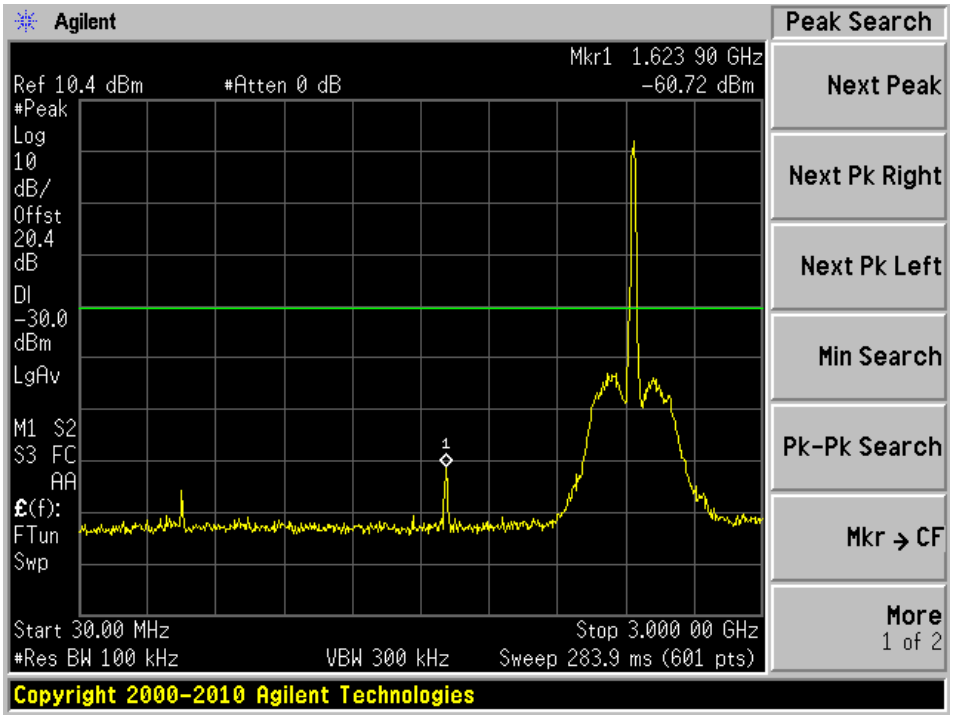
802.11g-2412 MHz (30 MHz-3 GHz)



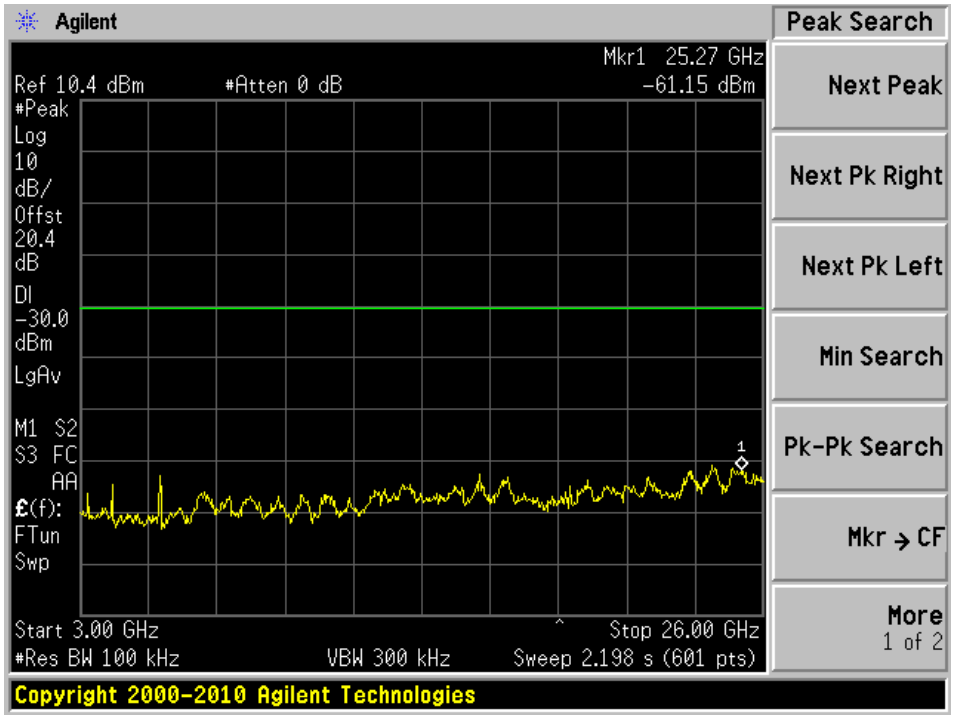
802.11g-2412 MHz (3-26 GHz)



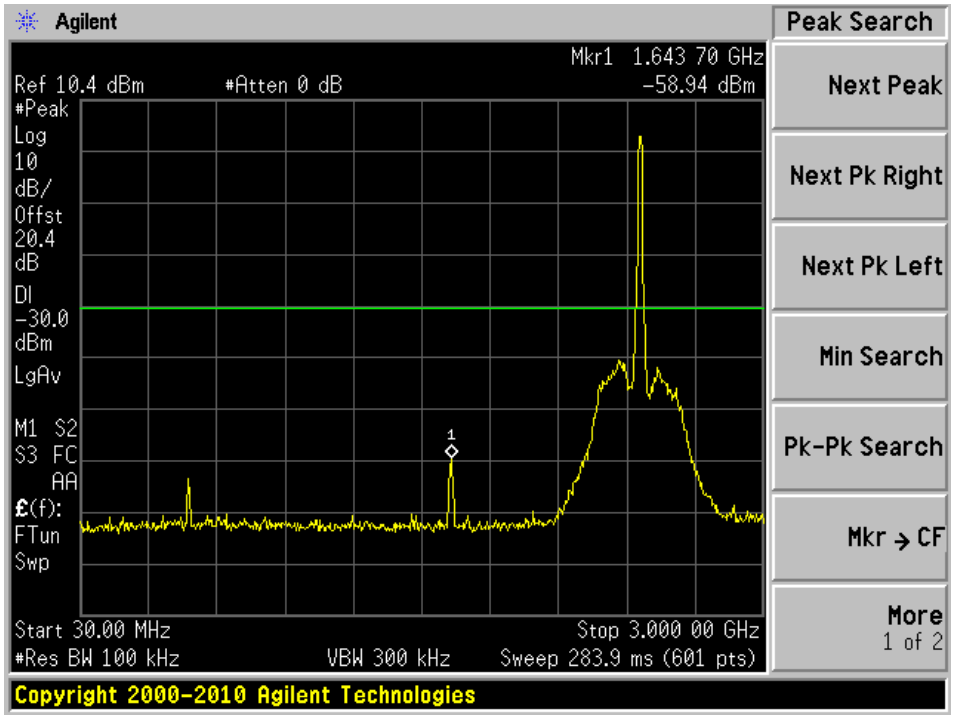
802.11g-2437 MHz (30 MHz-3 GHz)



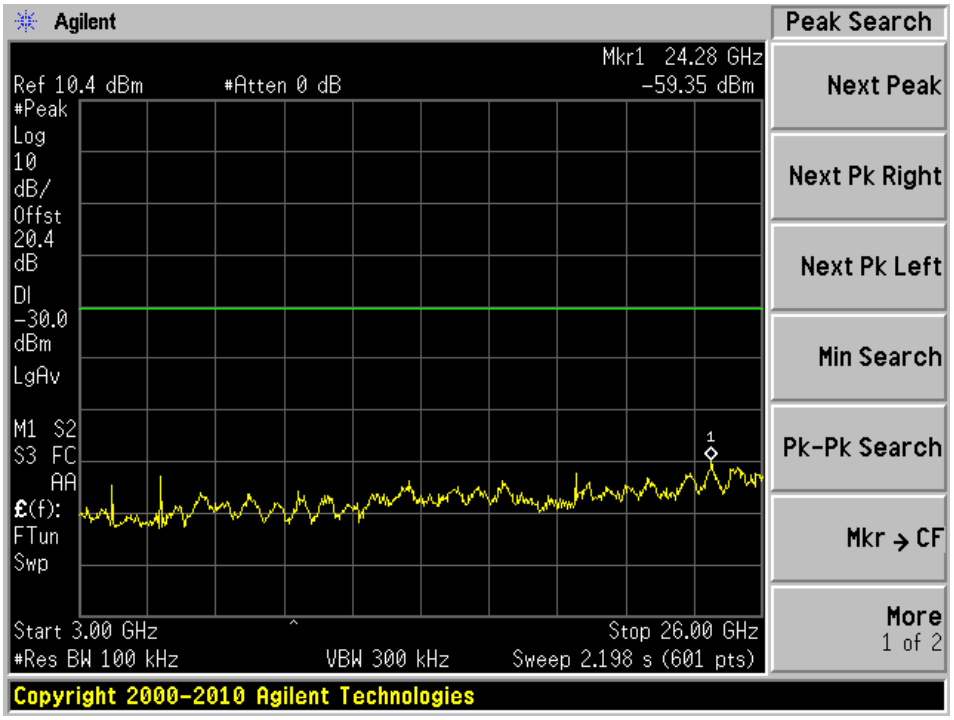
802.11g-2437 MHz (3-26 GHz)



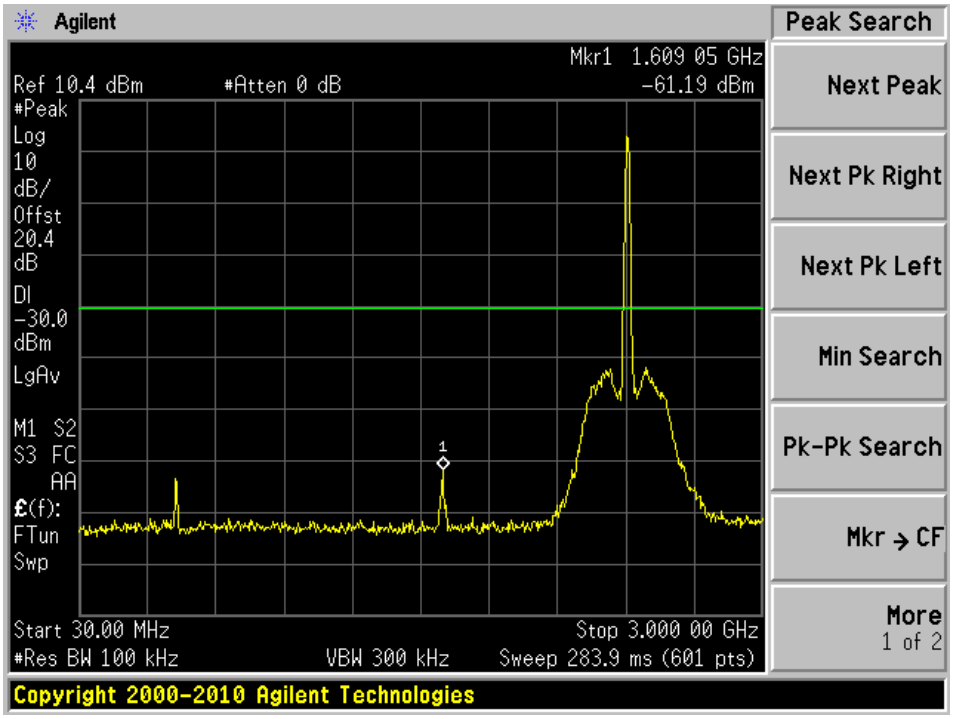
802.11g-2462 MHz (30 MHz-3 GHz)



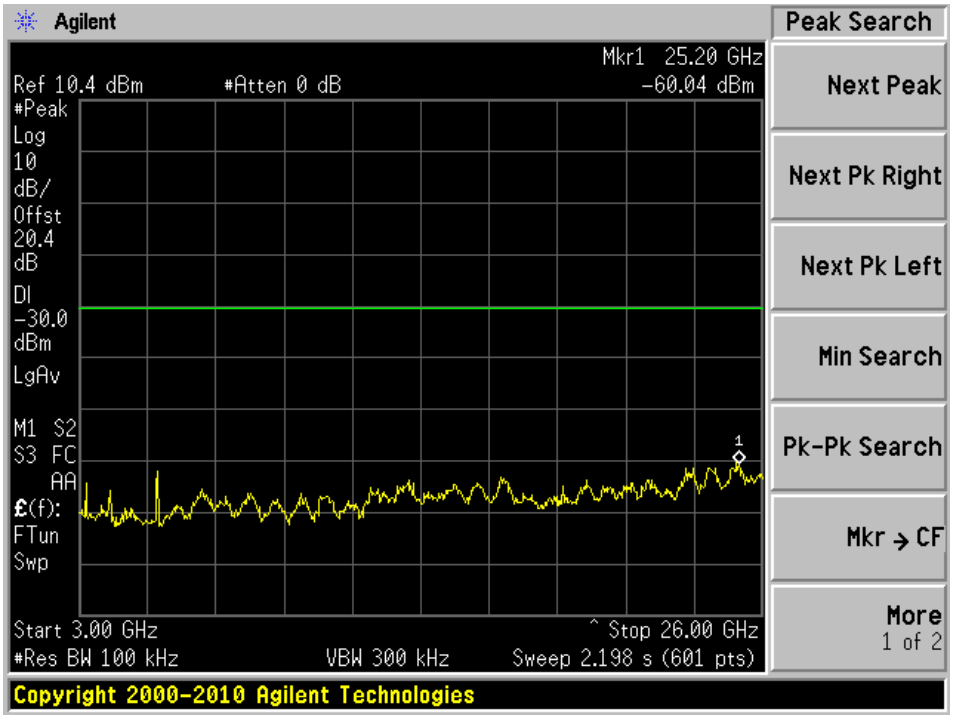
802.11g-2462 MHz (3-26 GHz)



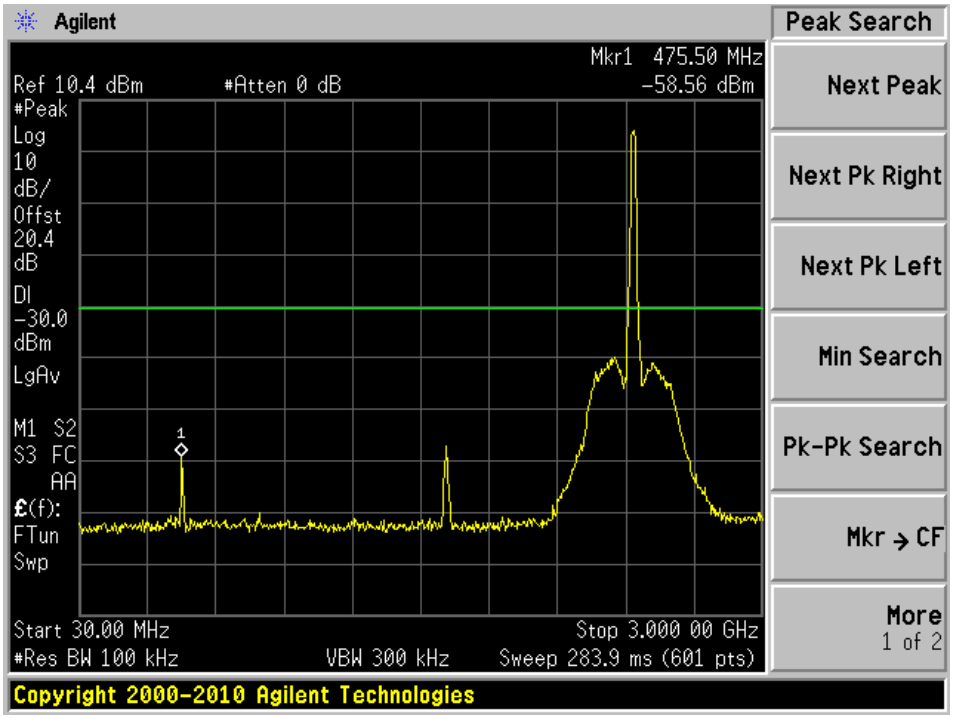
802.11n20-2412 MHz (30 MHz-3 GHz)



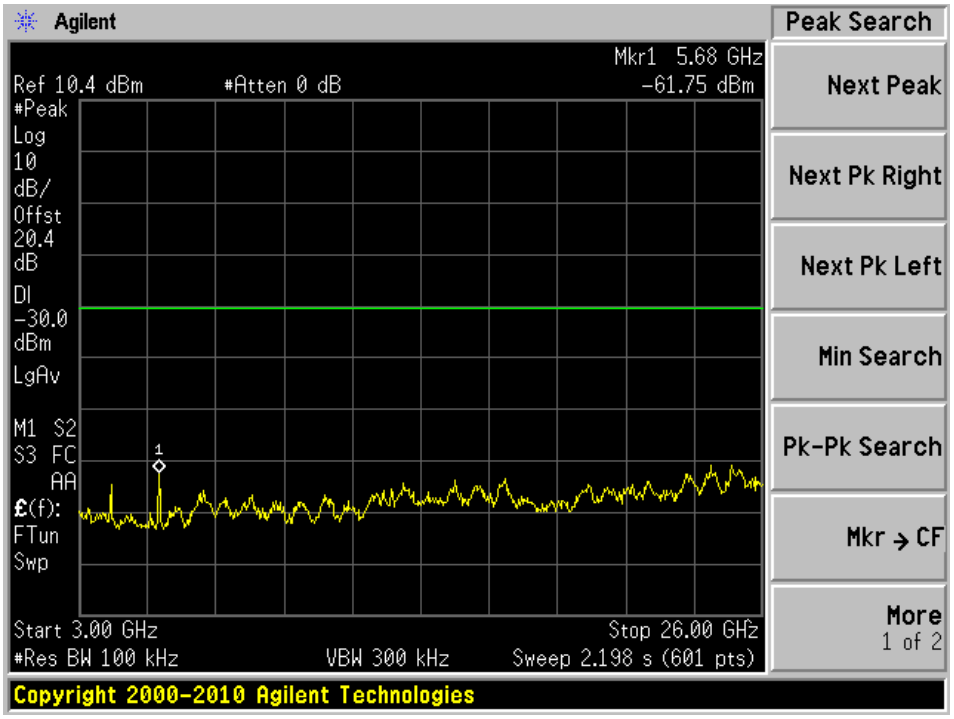
802.11n20-2412 MHz (3-26 GHz)



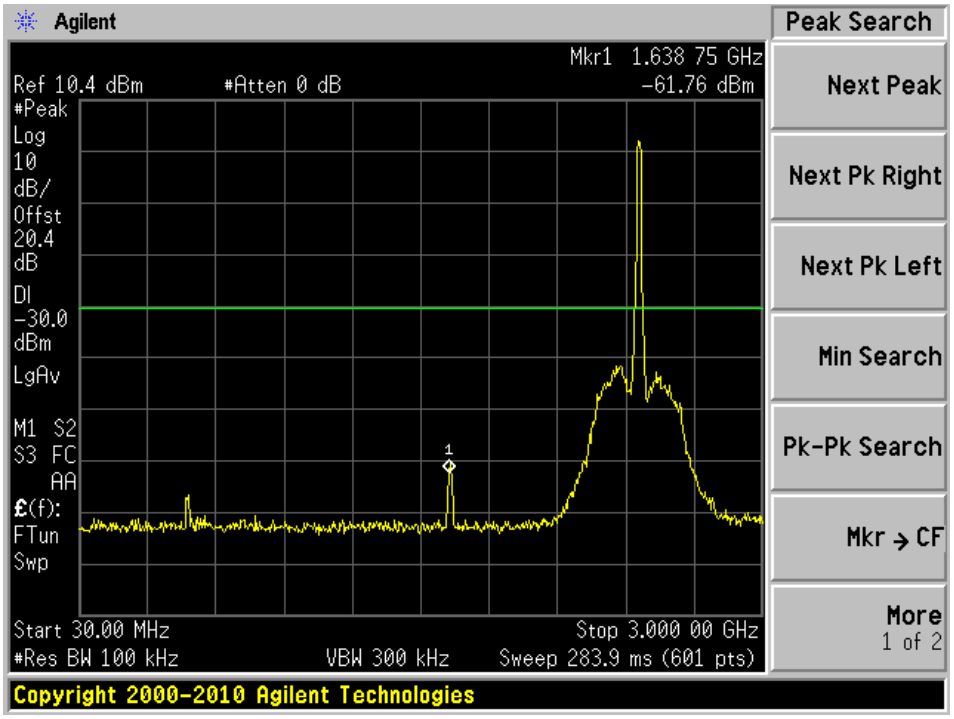
802.11n20-2437 MHz (30 MHz-3 GHz)



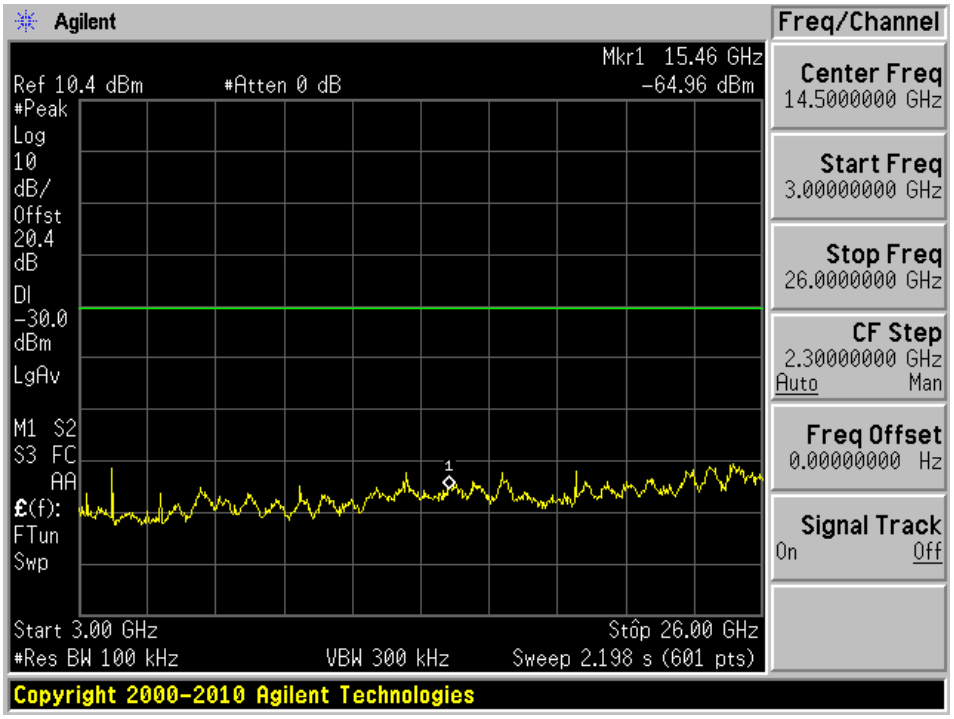
802.11n20-2437 MHz (3-26 GHz)



802.11n20-2462 MHz (30 MHz-3 GHz)

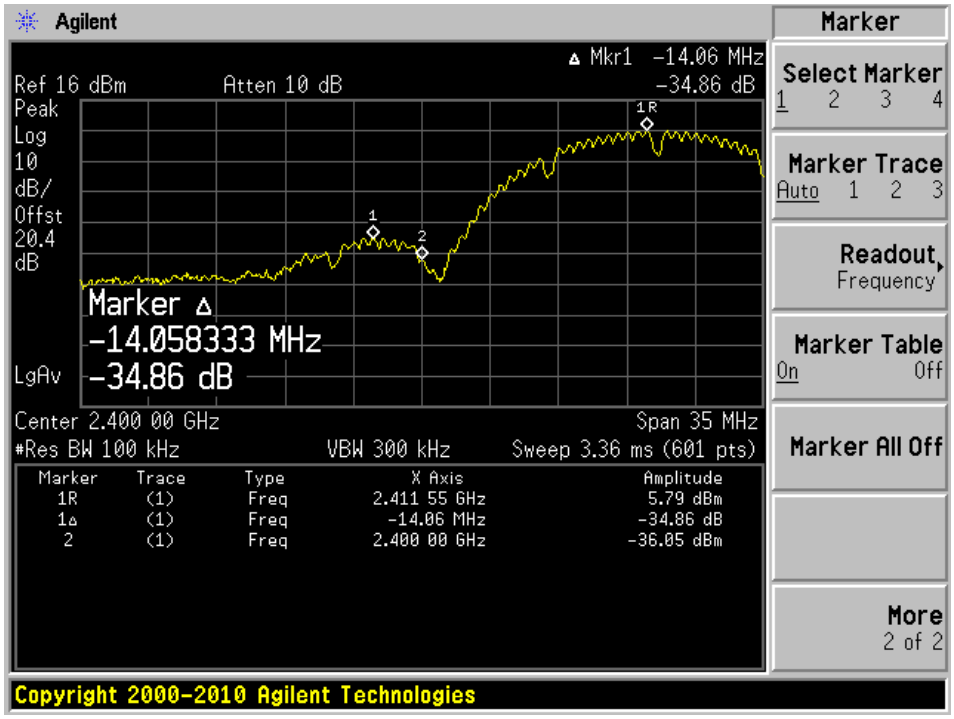


802.11n20-2462 MHz (3-26 GHz)

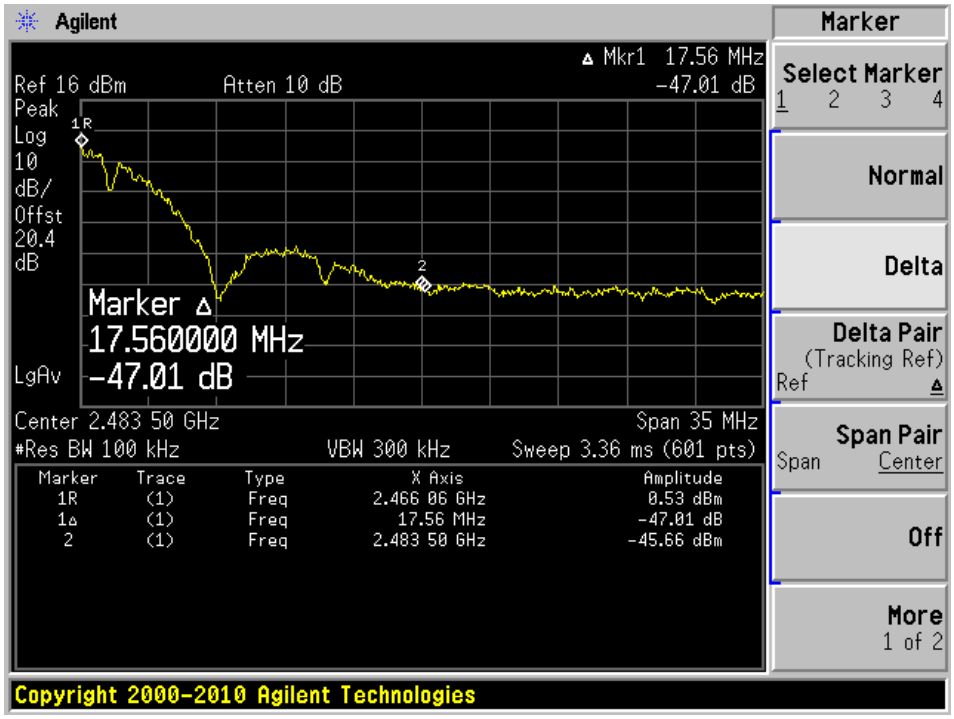


Band Edge

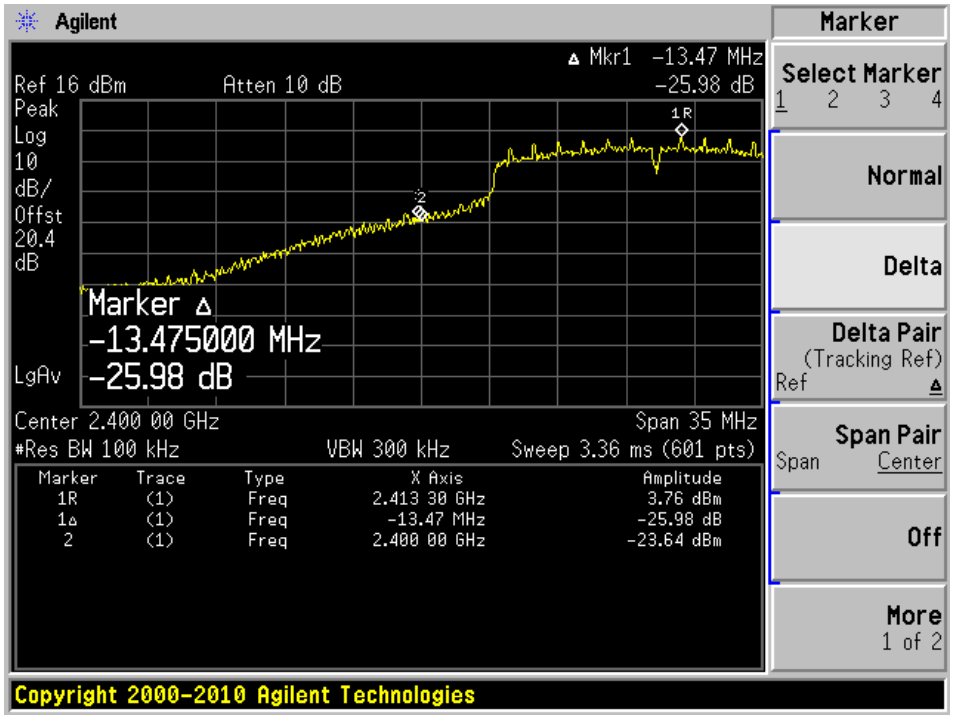
802.11b - Low Band Edge



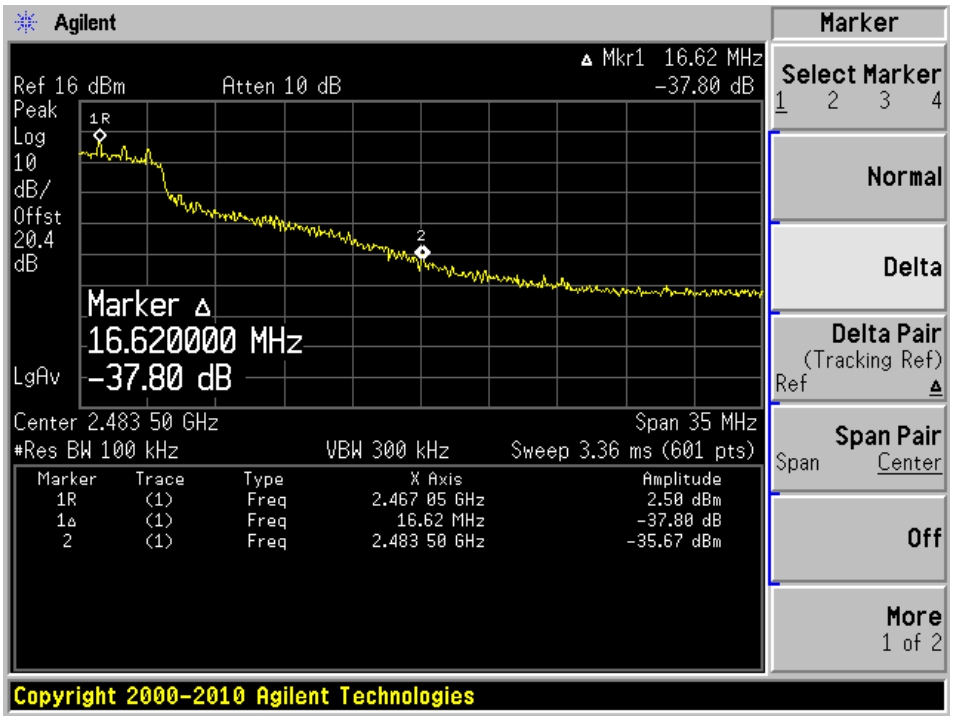
802.11b - High Band Edge



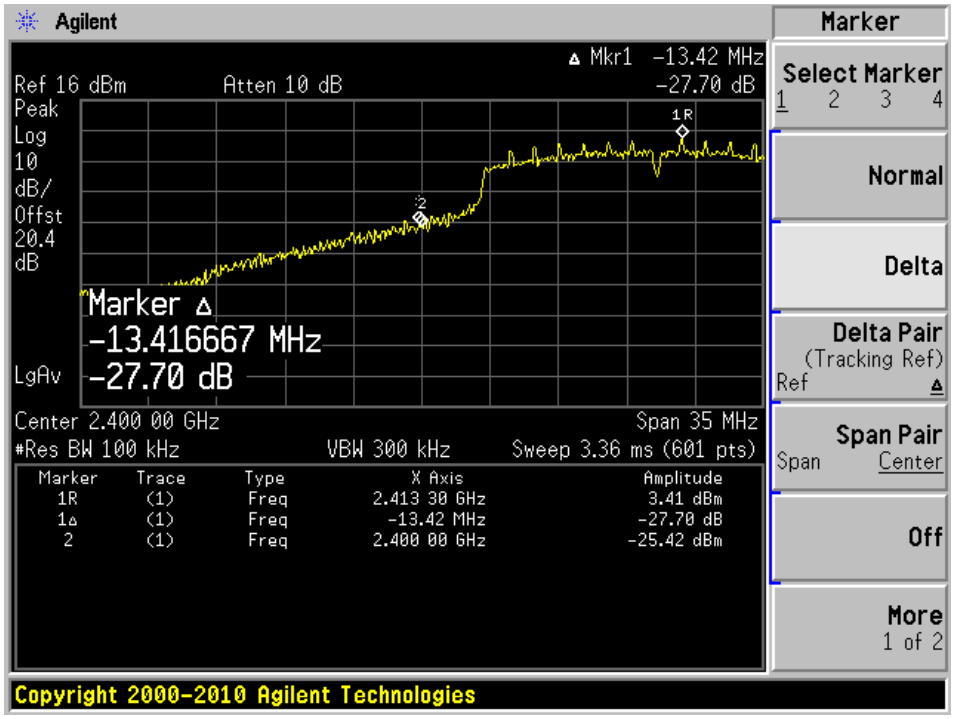
802.11g - Low Band Edge



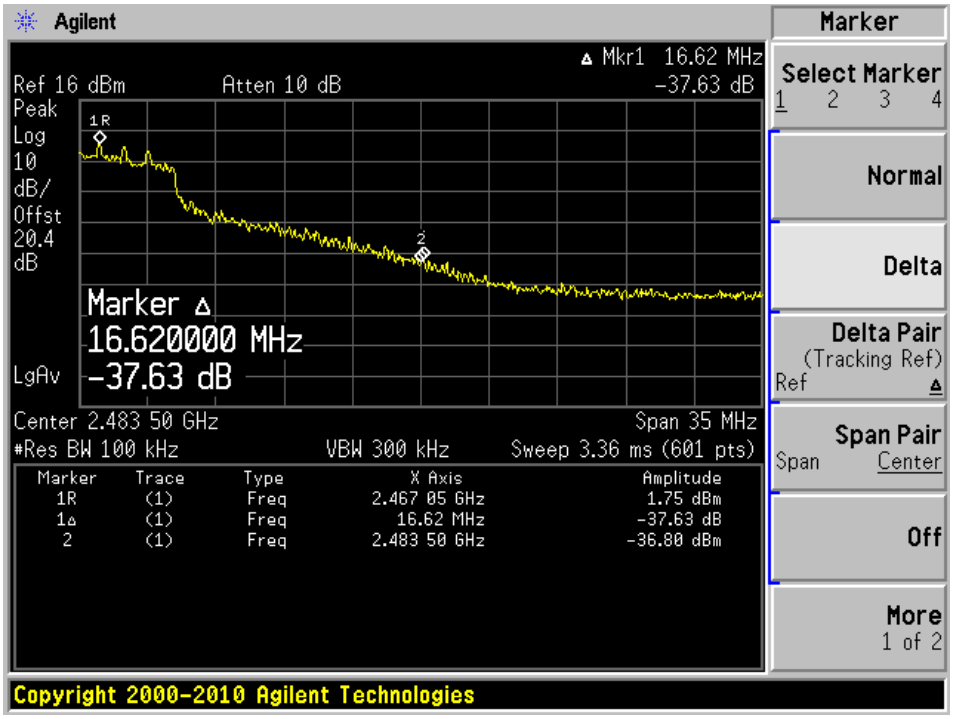
802.11g - High Band Edge



802.11n20 - Low Band Edge



802.11n20 - High Band Edge



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

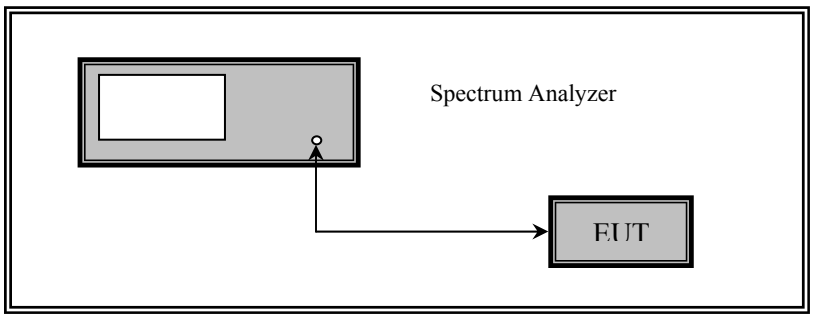
11.1 Applicable Standards

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.

According to RSS-247 §5.2(2) , DTSs include systems that employ digital modulation techniques resulting in spectral characteristics similar to direct sequence systems. The following applies to the bands 902-928 MHz and 2400- 2483.5 MHz1 : The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of Section 5.4(4), (i.e. the power spectral density shall be determined using the same method as is used to determine the conducted output power).

11.2 Measurement Procedure

The measurements are based on FCC KDB 558074 D01 DTS Meas Guidance v03r03: 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
Rohde & Schwarz	Spectrum Analyzer	FSQ	1155.5001.26	2015-03-09	1 year
Agilent	Spectrum Analyzer	E4440A	US42221851	2015-06-23	1 year
-	SMA Cable	-	C0001	Each Time[1]	N/A
Mini-Circuits	Attenuator	BW-S20W5	1430	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:	21-25 ºC
Relative Humidity:	42-45 %
ATM Pressure:	102.1-103.7 kPa

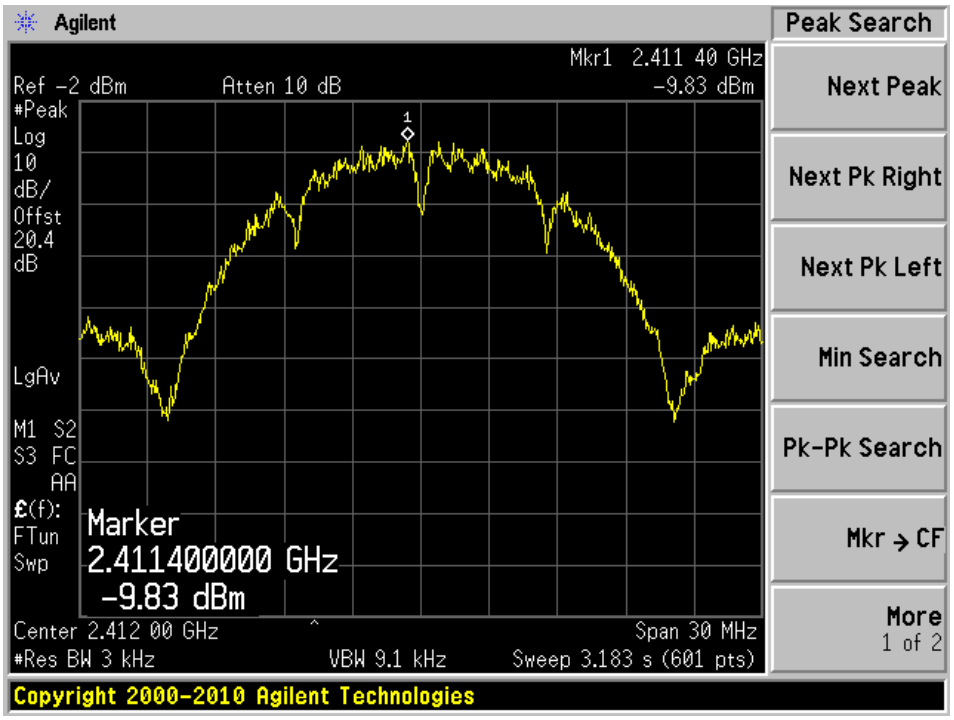
The testing was performed by Leonard Gray on 2015-12-02 in RF site.

11.5 Test Results

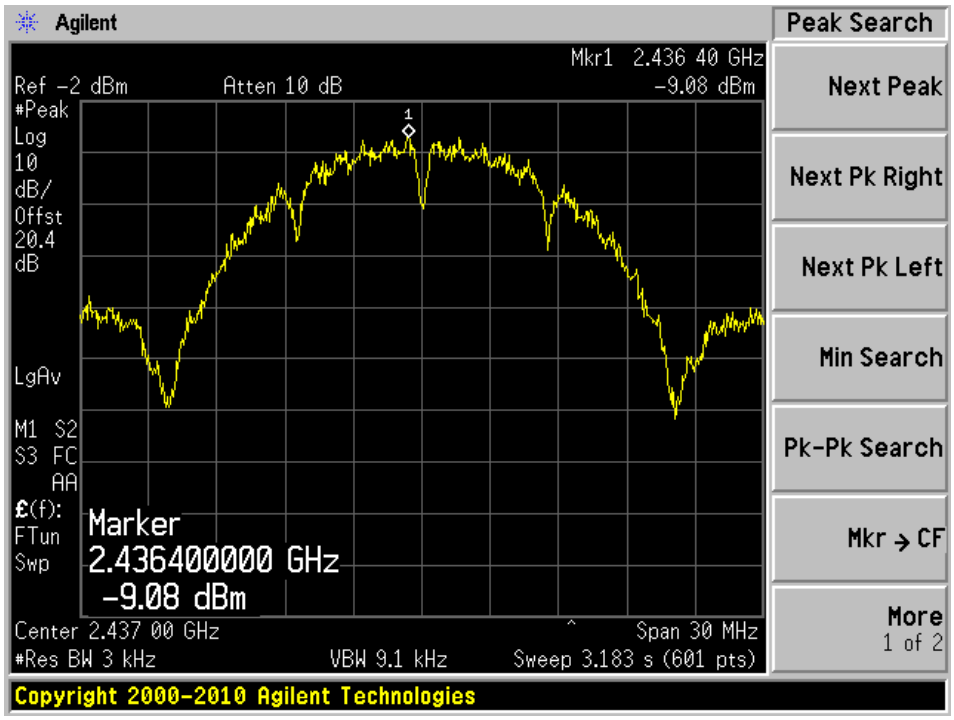
Channel	Frequency (MHz)	Power Spectral Density (dBm/3 kHz)	Limit (dBm/3 kHz)
802.11b mode			
Low	2412	-9.83	8
Middle	2437	-9.08	8
High	2462	-10.66	8
802.11g mode			
Low	2412	-12.23	8
Middle	2437	-10.59	8
High	2462	-14.01	8
802.11n20 mode			
Low	2412	-16.39	8
Middle	2437	-11.76	8
High	2462	-14.52	8

Please refer to the following plots.

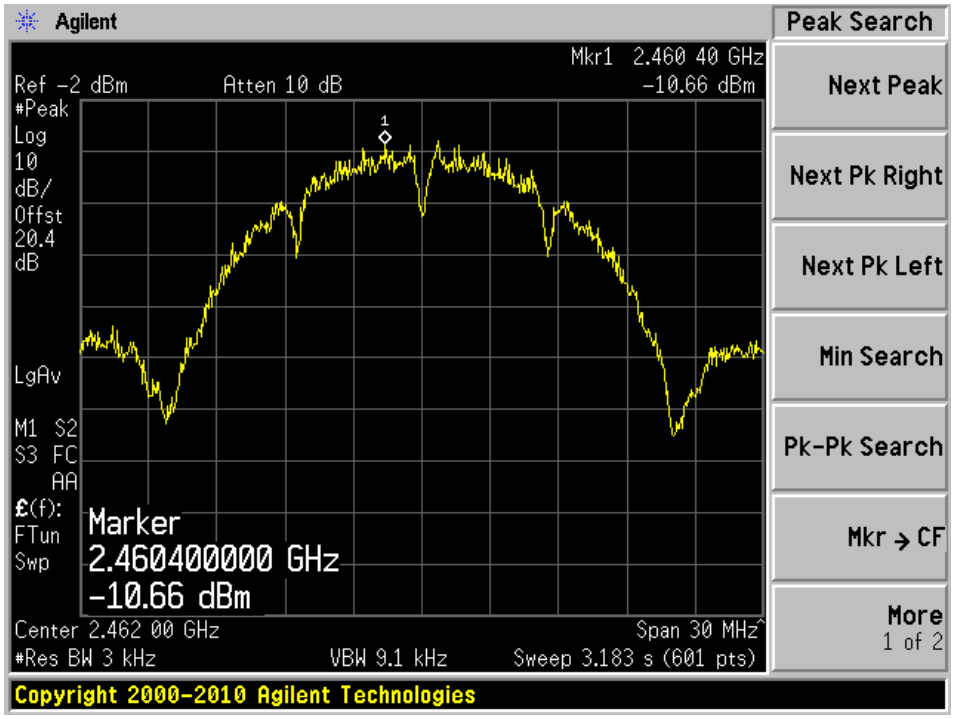
802.11b-2412 MHz



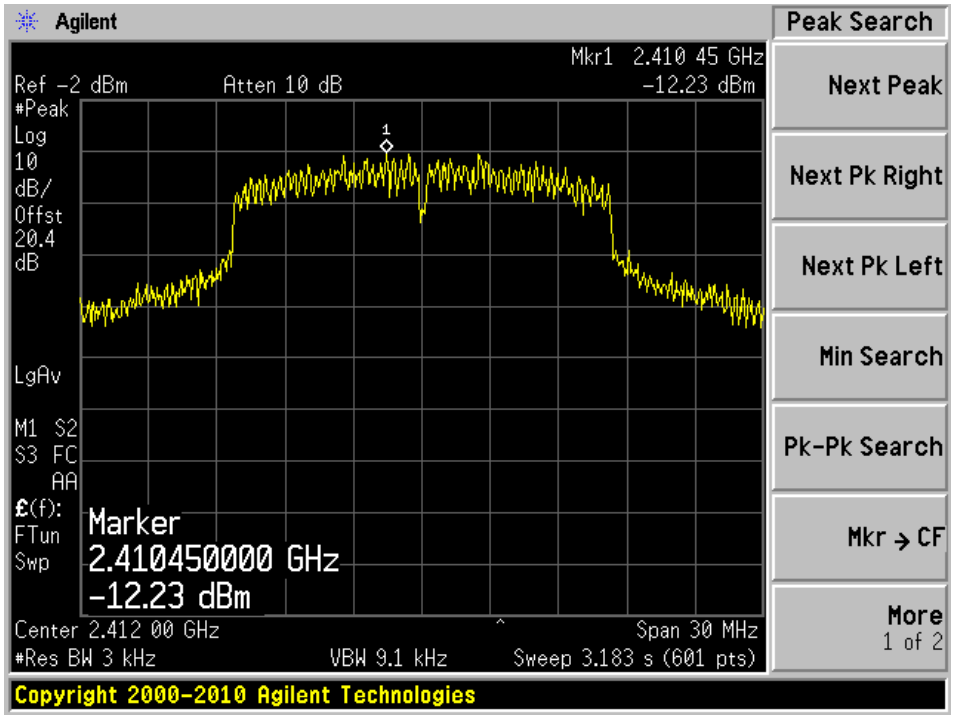
802.11b-2437 MHz



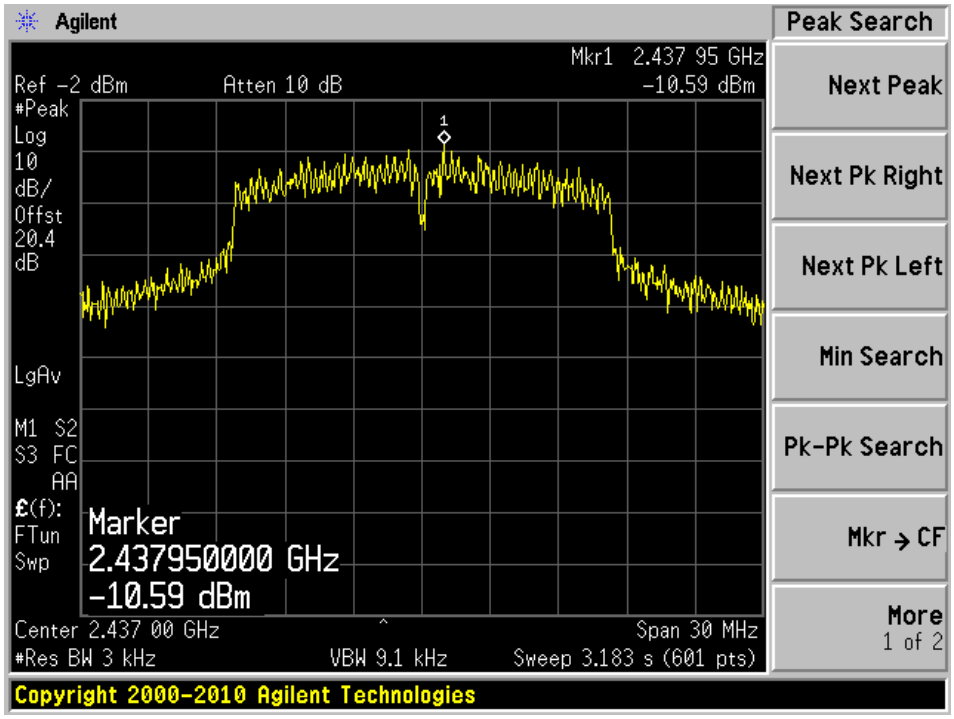
802.11b-2462 MHz



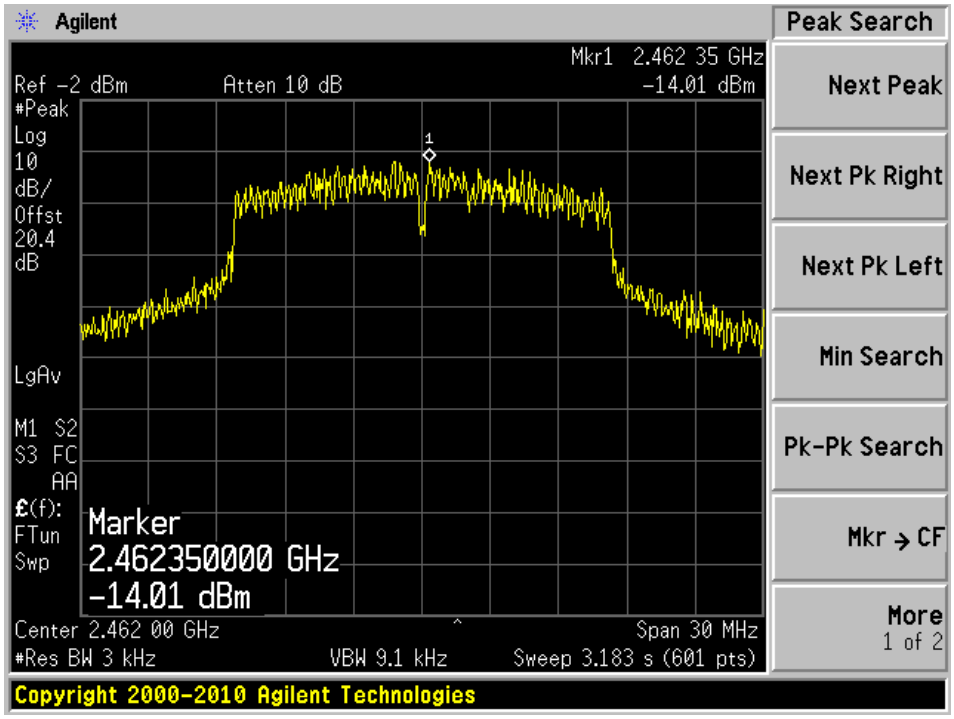
802.11g-2412 MHz



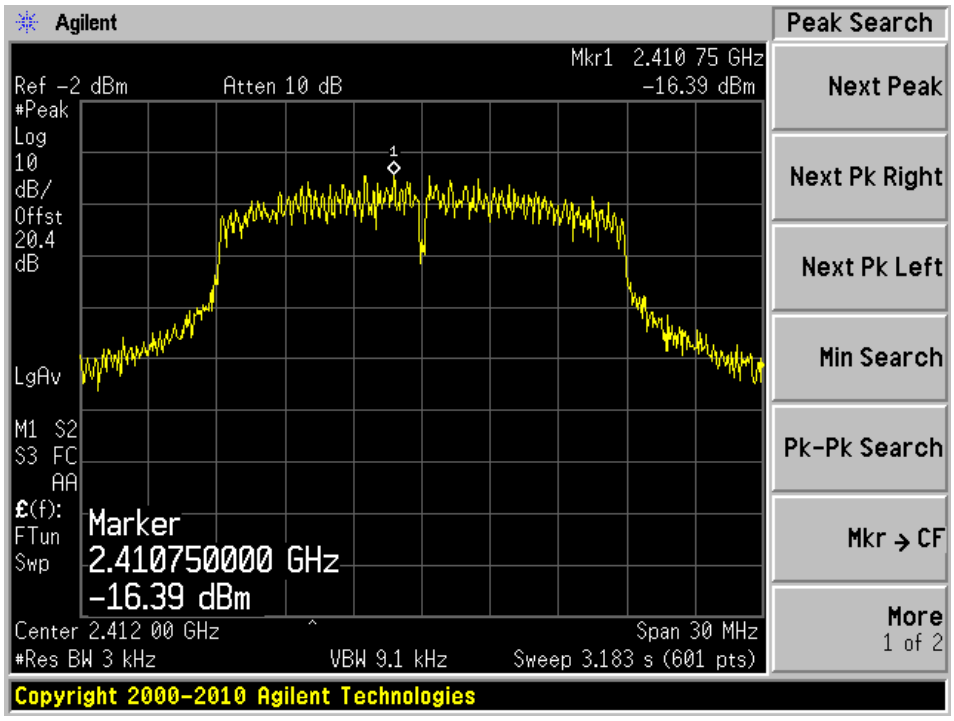
802.11g-2437 MHz



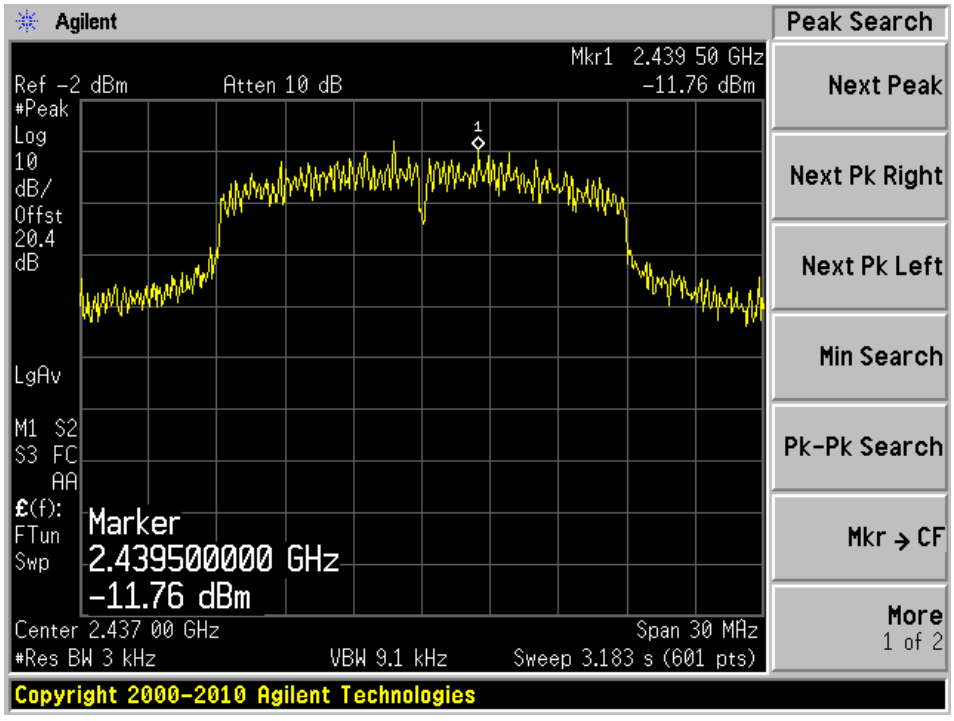
802.11g-2462 MHz



802.11n20-2412 MHz



802.11n20-2437 MHz



802.11n20-2462 MHz