# FCC PART 15, SUBPART C
# IC RSS-210, ISSUE 8, DECEMBER 2010

# TEST AND MEASUREMENT REPORT

For

## Rezolt Corporation

1248 Reamwood Avenue,

Sunnyvale, CA 94089, USA

**FCC ID: O2R-226MS**
**IC: 10363A-226MS**

| **Report Type:** | **Product Type:** |
|---|---|
| Original Report | 802.11 b/g/n Module |

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# DOCUMENT REVISION HISTORY

| Revision Number | Report Number | Description of Revision | Date of Revision |
|---|---|---|---|
| 0 | R1304094-247 | Original Report | 2014-01-23 |

# 1 General Description

## 1.1 Product Description for Equipment Under Test (EUT)

This test and measurement report was prepared on behalf of *Rezolt Corporation*, and their product FCC ID: O2R-226MS, IC: 10363A-226MS, model: *RZ226MS* or the "EUT" as referred on this report is an 802.11 b/g/n module operates in 2.4 GHz band.

## 1.2 Mechanical Description

The EUT measures approximately 1.95cm (L) x 1.85cm (W) x 0.43 cm (H) and weighs approximately 4 g.

*The data gathered are from a production sample, serial number: 1C7Z18 assigned by BACL.*

## 1.3 Objective

This report is prepared on behalf of *ReZolt Corporation* in accordance with Part 2, Subpart J, and Part 15, Subparts B and C of the Federal Communication Commission's rules and IC RSS-210 Issue 8, Dec 2010.

The objective is to determine compliance with FCC Part 15.247 and IC RSS-210 rules for Output Power, Antenna Requirements, 6 dB Bandwidth, and 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 C63.4-2009, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz and FCC KDB 558074 D01 DTS Meas Guidance v03r01: 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:
1- Unlicensed, Licensed radio frequency devices and Telephone Terminal Equipment for the FCC. Scope A1, A2, A3, A4, B1, B2, B3, B4 & C.
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 C63.4-2009, ANSI C63.4-2009, 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 C63.4-2009 and FCC KDB 558074 D01 DTS Meas Guidance v03r01.

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.

The EUT had been tested with the following data rate settings (worst case):

| Radio Mode | Bandwidth (MHz) | Frequency/Data Rate | | |
|---|---|---|---|---|
| | | Low CH (MHz/Mbps) | Mid CH (MHz/Mbps) | High CH (MHz/Mbps) |
| 802.11 b | 20 | 2412/1 | 2437/1 | 2462/1 |
| 802.11 g | 20 | 2412/6 | 2437/6 | 2462/6 |
| 802.11 n20 | 20 | 2412/6.5 | 2437/6.5 | 2462/6.5 |

## 2.2 EUT Exercise Software

The test utility used was wl.exe was provided by Rezolt Corporation and was verified Jeffrey Wu to comply with the standard requirements being tested against.

## 2.3 Special Equipment

There were no special accessories were required, included, or intended for use with EUT during these tests.

## 2.4 Equipment Modifications

No modifications were made to the EUT.

## 2.5 Local Support Equipment

| Manufacturers | Descriptions | Model Number | Serial Number |
|---|---|---|---|
| IMB | Laptop | T40 | - |
| Rezolt Corp. | Supporting Board 1 | 211-1135-040 Rev 2 | - |
| Rezolt Corp. | Supporting Board 2 | MB786/STM324 C-04 | 213020135 |

## 2.6 EUT Internal Configuration Details

| Manufacturers | Descriptions | Model Number | Serial Number |
|---|---|---|---|
| Rezolt Corp. | Main Module | RZ226MS | 32612000127G2 |

## 2.7 External I/O Cabling List and Details

| Cable Descriptions | Length (m) | From | To |
|---|---|---|---|
| USB Cable | < 1m | Supporting Board | Laptop |
| RF Cable | < 1m | EUT | PSA |

## 2.8 Power Supply List and Details

N/A

# 3 Summary of Test Results

Results reported relate only to the product tested.

| FCC & IC Rules | Description of Test | Results |
|---|---|---|
| FCC §15.247(i), §2.1091<br>IC RSS-102 | RF Exposure | Compliant |
| FCC §15.203<br>IC RSS-Gen §7.1.2 | Antenna Requirement | Compliant |
| FCC §15.207(a)<br>IC RSS-Gen §7.2.4 | AC Line Conducted Emissions | Compliant |
| FCC §15.247 (d)<br>IC RSS-210 §A8.5 | Spurious Emissions at Antenna Port | Compliant |
| FCC §15.205<br>IC RSS-210 §2.2 | Restricted Bands | Compliant |
| FCC §15.209, §15.247 (d)<br>IC RSS-210 §A8.5 | Radiated Spurious Emissions | Compliant |
| FCC §15.247(a)(2)<br>IC RSS-210 §A8.2 | 6 dB Emission Bandwidth | Compliant |
| FCC §15.247(b)(3)<br>IC RSS-210 §A8.4 | Maximum Peak Output Power | Compliant |
| FCC §15.247(d)<br>IC RSS-210 §A8.5 | 100 kHz Bandwidth of Frequency Band Edge | Compliant |
| FCC §15.247(e)<br>IC RSS-210 §A8.2(b) | Power Spectral Density | Compliant |
| IC RSS-210 §2.3<br>& RSS-Gen §4.10 | Receiver Spurious Emission | Compliant |

# 4 FCC §15.247 (i), §2.1091 & IC RSS-102 – RF Exposure

## 4.1 Applicable Standard

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 fields.

According to IC RSS-102 Issue 2 section 4.1, RF limits used for general public will be applied to the EUT.

| Frequency Range (MHz) | Electric Field (V/m rms) | Magnetic Field (A/m rms) | Power Density ($W/m^2$) | Time Averaging (min) |
|---|---|---|---|---|
| 0.003 - 1 | 280 | 2.19 | - | 6 |
| 1 - 10 | 280 / f | 2.19 / f | - | 6 |
| 10 - 30 | 28 | 2.19 / f | - | 6 |
| 30 – 300 | 28 | 0.073 | 2* | 6 |
| 300 – 1 500 | $1.585\ f^{0.5}$ | $0.0042\ f^{0.5}$ | f / 150 | 6 |
| 1 500 – 15 000 | 61.4 | 0.163 | 10 | 6 |
| 15 000 – 150 000 | 61.4 | 0.163 | 10 | $616000 / f^{1.2}$ |
| 150 000- 300 000 | $0.158\ f^{0.5}$ | $4.21 \times 10\ -4\ f^{0.5}$ | $6.67 \times 10^{-5}\ f$ | $616000 / f^{1.2}$ |

**Note:** *f* is frequency in MHz
* = Power density limit is applicable at frequencies greater than 100 MHz

## 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

| | |
|---|---|
| Maximum peak output power at antenna input terminal (dBm): | 17.39 |
| Maximum peak output power at antenna input terminal (mW): | 54.828 |
| Prediction distance (cm): | 20 |
| Prediction frequency (MHz): | 2462 |
| Maximum Antenna Gain, typical (dBi): | 0 |
| Maximum Antenna Gain (numeric): | 1 |
| Power density of prediction frequency at 20.0 cm ($mW/cm^2$): | 0.0109 |
| Power density of prediction frequency at 20.0 cm ($W/m^2$): | 0.109 |
| MPE limit for uncontrolled exposure at prediction frequency ($mW/cm^2$): | 1.0 |
| MPE limit for uncontrolled exposure at prediction frequency ($W/m^2$): | 10 |

The device is compliant with the requirement MPE limit for uncontrolled exposure. The maximum power density at the distance of 20 cm is 0.011 $mW/cm^2$ (0.11$W/m^2$). Limit is1 $mW/cm^2$ (10$W/m^2$).

# 5 FCC §15.203 & IC RSS-Gen §7.1.2 – Antenna Requirements

## 5.1 Applicable Standard

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 §7.1.2: Transmitter Antenna

A transmitter can only be sold or operated with antennas with which it was certified. A transmitter may be certified with multiple antenna types. An antenna type comprises antennas having similar in-band and out-of-band radiation patterns. Testing shall be performed using the highest-gain antenna of each combination of transmitter and antenna type for which certification is being sought, with the transmitter output power set at the maximum level. Any antenna of the same type and having equal or lesser gain as an antenna that had been successfully tested for certification with the transmitter, will also be considered certified with the transmitter, and may be used and marketed with the transmitter. The manufacturer shall include with the application for certification a list of acceptable antenna types to be used with the transmitter.

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 measurement or on data from the antenna manufacturer. Any antenna gain in excess of 6 dBi (6 dB above isotropic gain) shall be added to the measured RF output power before using the power limits specified in RSS-210 or RSS-310 for devices of RF output powers of 10 mW or less. For devices of output powers greater than 10 mW, except devices subject to RSS-210 Annex 8 (Frequency Hopping and Digital Modulation Systems Operating in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz Bands) or RSS-210 Annex 9 (Local Area Network Devices), the total antenna gain shall be added to the measured RF output power before using the specified power limits. For devices subject to RSS-210 Annex 8 or Annex 9, the antenna gain shall not be added.

## 5.2 Antenna List

| Manufacturers | Models/Part Number | Antenna Gain (dBi) @ 2.4 GHz |
|---|---|---|
| Johanson Technology | 2450AT42B100E | 0 |

Note: The power setting was controlled by manufacture with different antenna configuration. The power setting of the different antenna will be set with the corresponded value and no more than the level reported.

The EUT's antenna has the maximum gain of 0 dBi and permanently attached to the PCB; which complies with sections FCC Part §15.203 and IC RSS-Gen §7.1.2 Please refer to the internal photos.

# 6 FCC §15.207 & IC RSS-Gen §7.2.4 – AC Line Conducted Emissions

## 6.1 Applicable Standards

As per FCC §15.207 and IC RSS-Gen §7.2.4 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 * | 56 to 46 * |
| 0.5-5 | 56 | 46 |
| 5-30 | 60 | 50 |

**Decreases with the logarithm of the frequency.*

## 6.2 Test Setup

The measurement was performed at shield room, using the setup per ANSI C63.4-2009 measurement procedure. The specification used was FCC §15.207 and IC RSS-Gen §7.2.4 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.

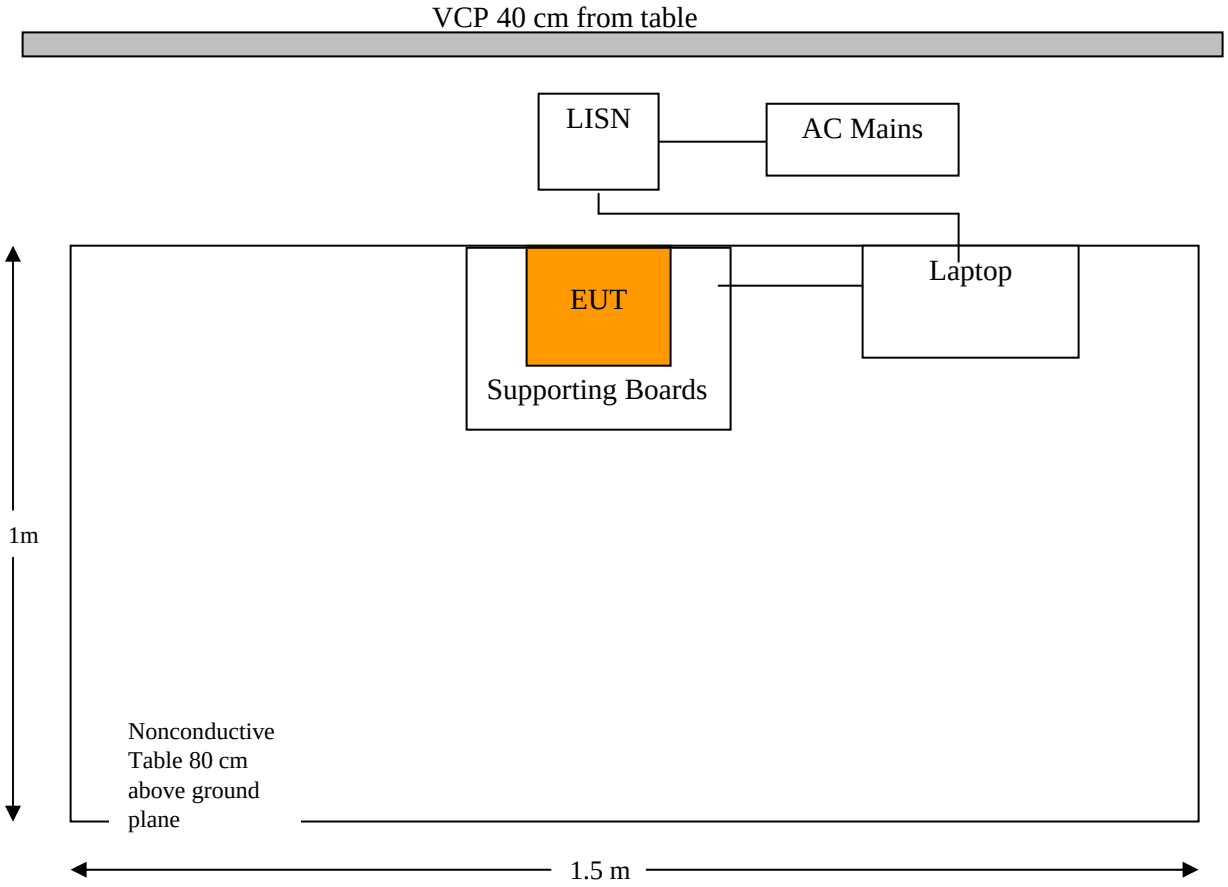
## 6.3 Test Procedure

During the conducted emissions test, the power cord of the EUT host system was connected to the mains outlet of the LISN-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 | 2013-03-28 | 1 Year |
| Solar Electronics | LISN | 9252-R-24-BNC | 511213 | 2013-06-25 | 1 Year |
| TTE | Filter, High Pass | H9962-150K-50-21378 | K7133 | 2013-05-30 | 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:** | 21 ºC |
| **Relative Humidity:** | 33 % |
| **ATM Pressure:** | 102.2 kPa |

*Testing was performed by Jeffrey Wu on 2013-12-26 in chamber 5m3.*

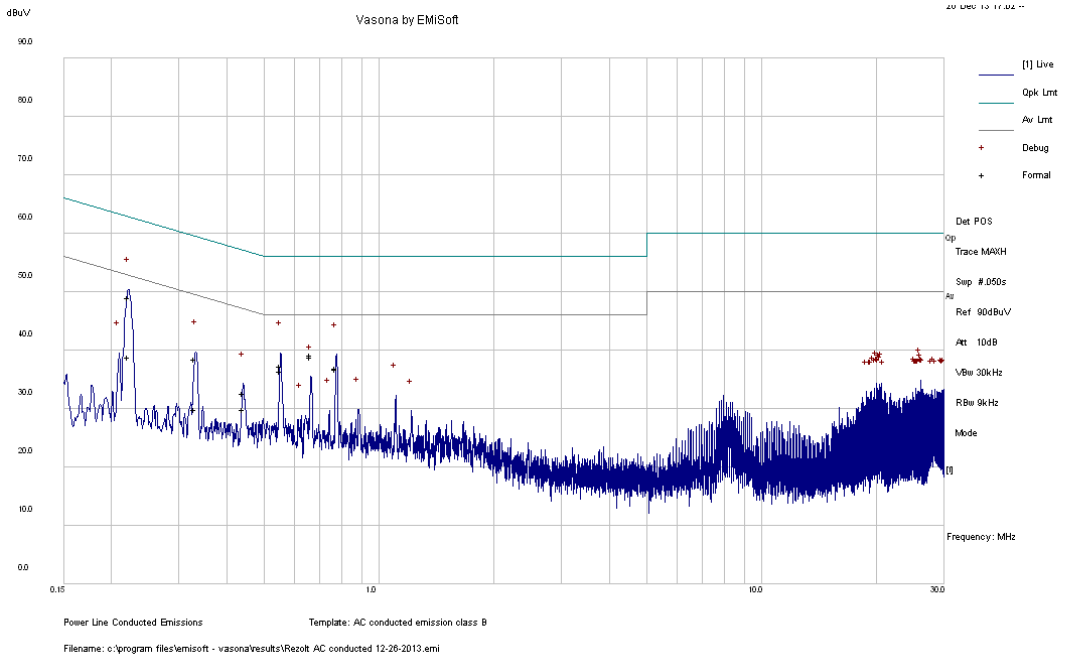
## 6.8 Summary of Test Results

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

| **Connection: AC/DC adapter connected to 120 V/60 Hz, AC** | | | |
|---|---|---|---|
| **Margin (dB)** | **Frequency (MHz)** | **Conductor Mode (Line/Neutral)** | **Range (MHz)** |
| -7.13 | 0.663726 | Line | 0.15-30 |

## 6.9 Conducted Emissions Test Plots and Data

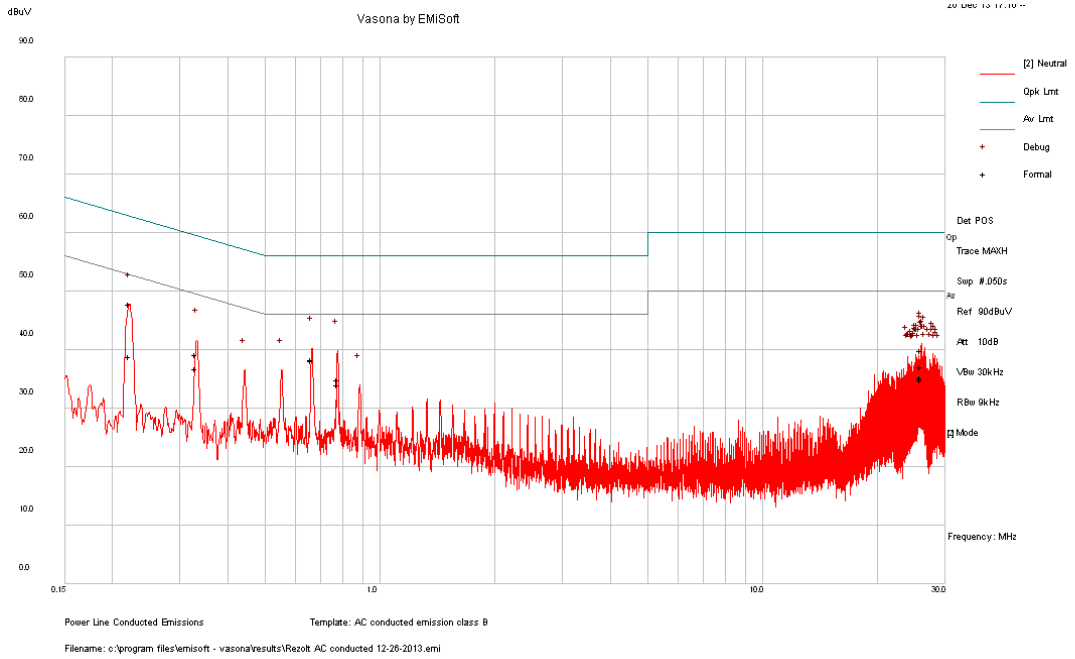
**120 V, 60 Hz – Line, AC/DC Adaptor**




| Frequency (MHz) | Corrected Amplitude (dBuV) | Conductor (L/N) | Limit (dBuV) | Margin (dB) | Detector (QP/Ave.) |
|---|---|---|---|---|---|
| 0.221484 | 49.1 | L | 62.76 | -13.66 | QP |
| 0.663726 | 39.16 | L | 56 | -16.84 | QP |
| 0.551652 | 37.41 | L | 56 | -18.59 | QP |
| 0.772539 | 36.96 | L | 56 | -19.04 | QP |
| 0.330081 | 38.59 | L | 59.45 | -20.86 | QP |
| 0.442191 | 32.77 | L | 57.02 | -24.25 | QP |

| Frequency (MHz) | Corrected Amplitude (dBuV) | Conductor (L/N) | Limit (dBuV) | Margin (dB) | Detector (QP/Ave.) |
|---|---|---|---|---|---|
| 0.663726 | 38.87 | L | 46 | -7.13 | Ave. |
| 0.772539 | 36.76 | L | 46 | -9.24 | Ave. |
| 0.551652 | 36.52 | L | 46 | -9.48 | Ave. |
| 0.221484 | 38.86 | L | 52.76 | -13.91 | Ave. |
| 0.442191 | 29.88 | L | 47.02 | -17.14 | Ave. |
| 0.330081 | 29.88 | L | 49.45 | -19.57 | Ave. |

## 120 V, 60 Hz – Neutral, AC/DC Adaptor




| Frequency (MHz) | Corrected Amplitude (dBuV) | Conductor (L/N) | Limit (dBuV) | Margin (dB) | Detector (QP/Ave.) |
|---|---|---|---|---|---|
| 0.22125 | 47.92 | N | 62.77 | -14.86 | QP |
| 0.662877 | 38.40 | N | 56 | -17.60 | QP |
| 25.8612 | 39.97 | N | 60 | -20.03 | QP |
| 0.331215 | 39.21 | N | 59.42 | -20.21 | QP |
| 0.774897 | 34.97 | N | 56 | -21.03 | QP |
| 25.97045 | 37.22 | N | 60 | -22.78 | QP |

| Frequency (MHz) | Corrected Amplitude (dBuV) | Conductor (L/N) | Limit (dBuV) | Margin (dB) | Detector (QP/Ave.) |
|---|---|---|---|---|---|
| 0.662877 | 38.13 | N | 46 | -7.87 | Ave. |
| 0.774897 | 34.14 | N | 46 | -11.86 | Ave. |
| 0.331215 | 36.8 | N | 49.42 | -12.62 | Ave. |
| 0.22125 | 38.89 | N | 52.77 | -13.88 | Ave. |
| 25.8612 | 35.32 | N | 50 | -14.68 | Ave. |
| 25.97045 | 34.97 | N | 50 | -15.03 | Ave. |

# 7 FCC §2.1051, §15.247(d) & IC RSS-210 §A8.5 – Spurious Emissions at Antenna Terminals

## 7.1 Applicable Standard

For FCC §15.247(d) and IC RSS-210 §A8.5 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.

## 7.2 Measurement Procedure

The measurements are base on FCC KDB 558074 D01 DTS Meas Guidance v03r01: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 section 11: Emissions in non-restricted frequency bands and section 12: Emissions in restricted frequency bands.

## 7.3 Test Equipment List and Details

| Manufacturer | Description | Model No. | Serial No. | Calibration Date | Calibration Interval |
|---|---|---|---|---|---|
| Agilent | Spectrum Analyzer | E4446A | US44300386 | 2013-10-22 | 1 Year |

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

## 7.4 Test Environmental Conditions

| | |
|---|---|
| **Temperature:** | 21 ºC |
| **Relative Humidity:** | 38 % |
| **ATM Pressure:** | 102.2 kPa |

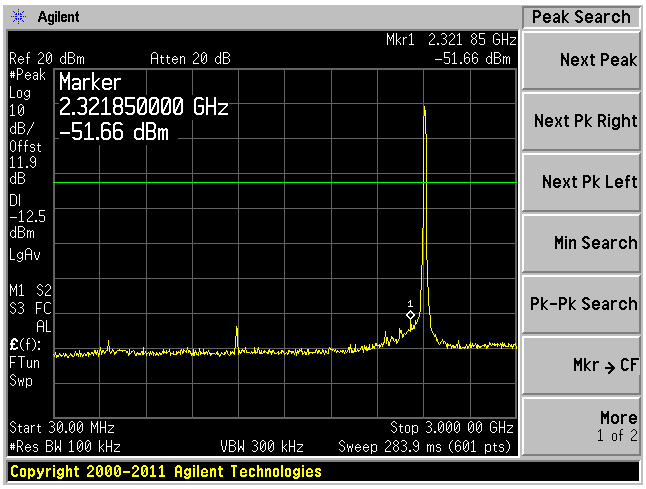
*Testing was performed by Jeffrey Wu from 2014-01-03 to 2014-01-05 in in RF Site.*

## 7.5 Test Results

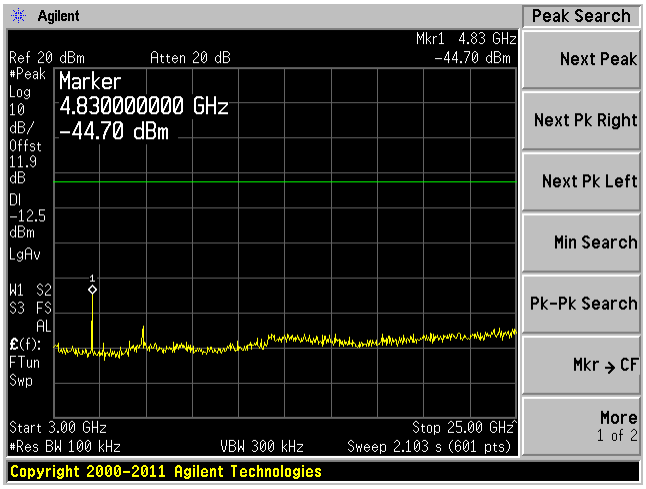
Please refer to following plots of spurious emissions.

## 802.11b, Low Channel, 2412 MHz

30 MHz to 3 GHz

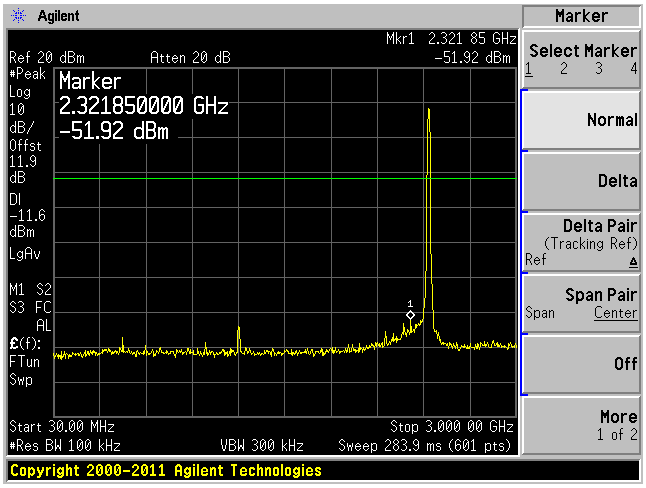



3 GHz to 25 GHz

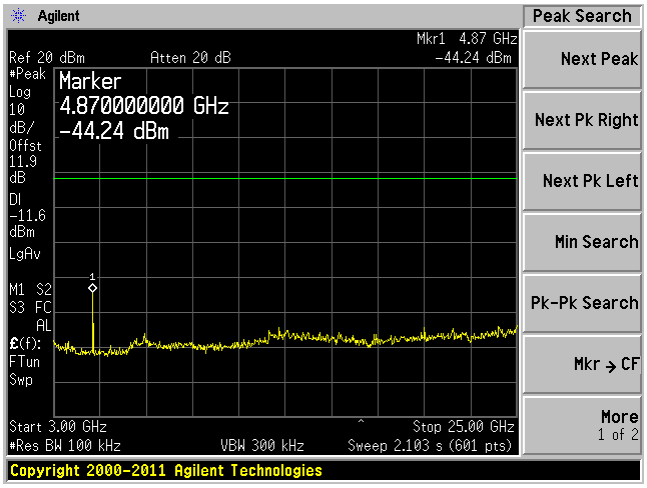



## 802.11b, Middle Channel, 2437 MHz

30 MHz to 3 GHz

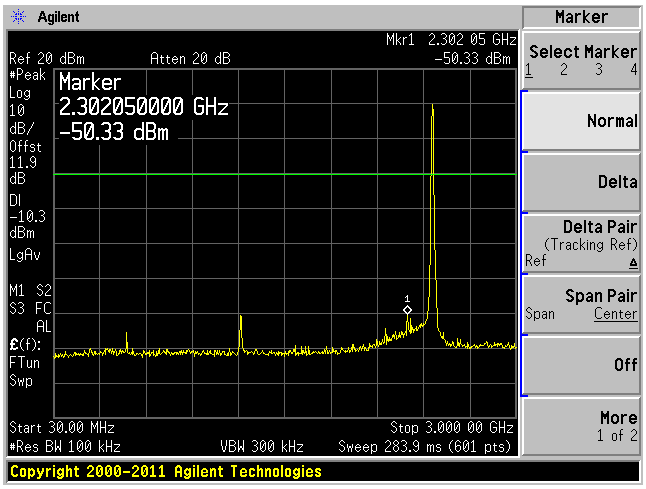



3 GHz to 25 GHz

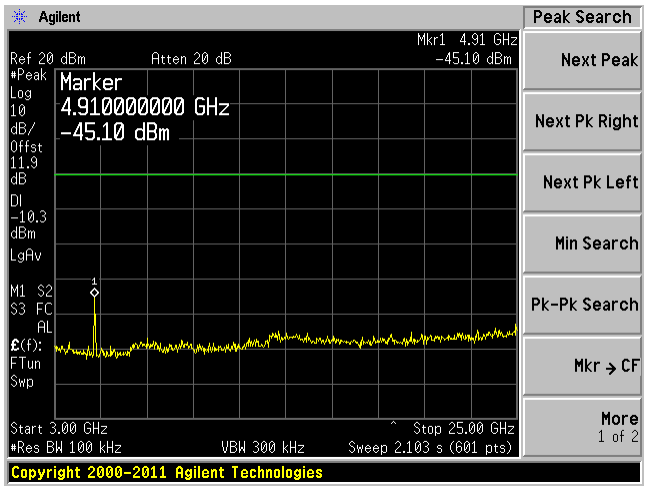


## 802.11b, High Channel, 2462 MHz

30 MHz to 3 GHz

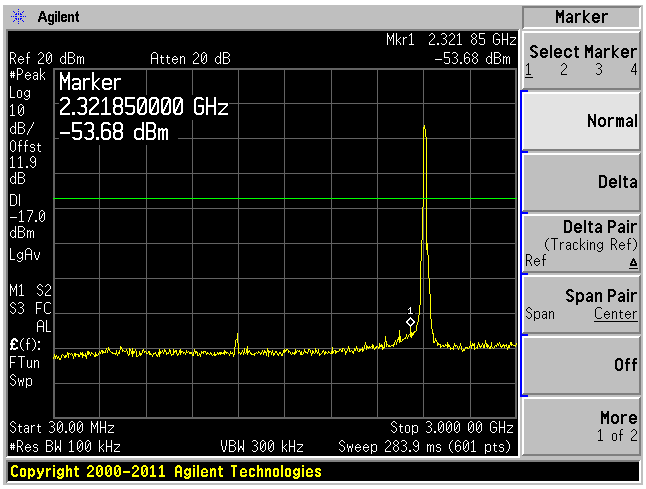



3 GHz to 25 GHz

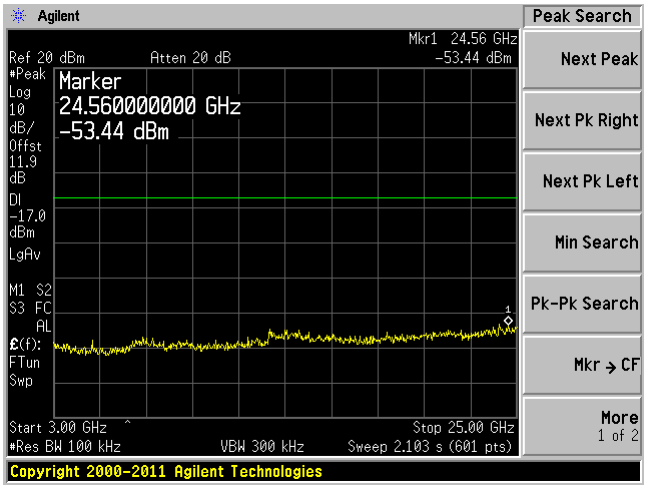



## 802.11g, Low Channel 2412 MHz

30 MHz to 3 GHz

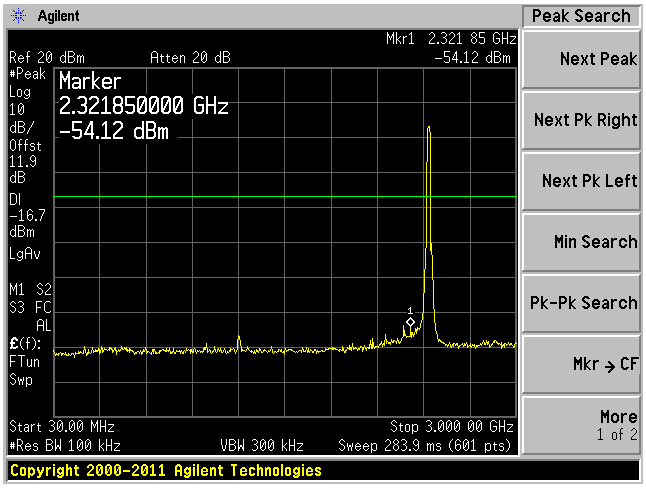



3 GHz to 25 GHz

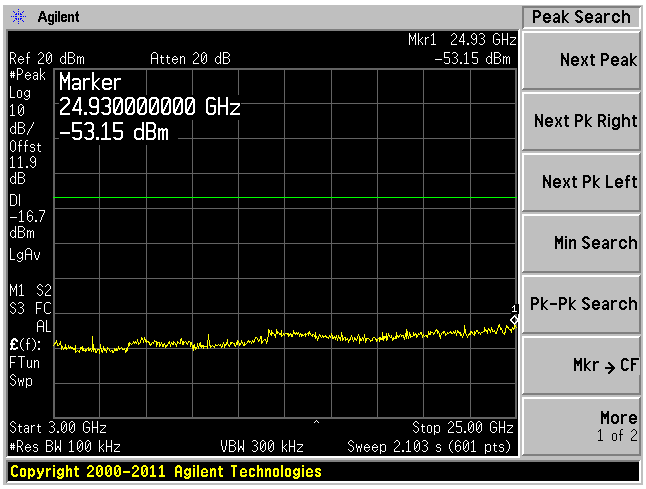


## 802.11g, Middle Channel 2437 MHz

30 MHz to 3 GHz

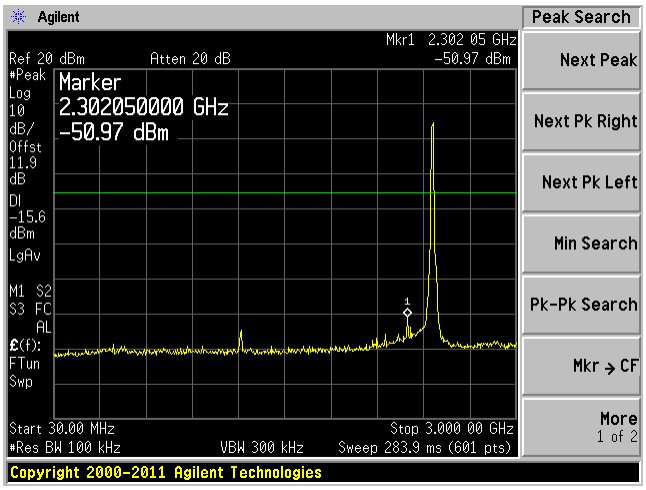



3 GHz to 25 GHz

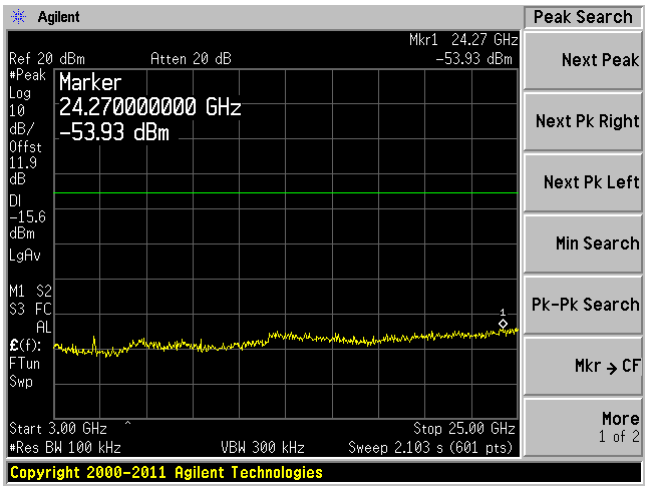



## 802.11g, High Channel 2462 MHz

30 MHz to 3 GHz

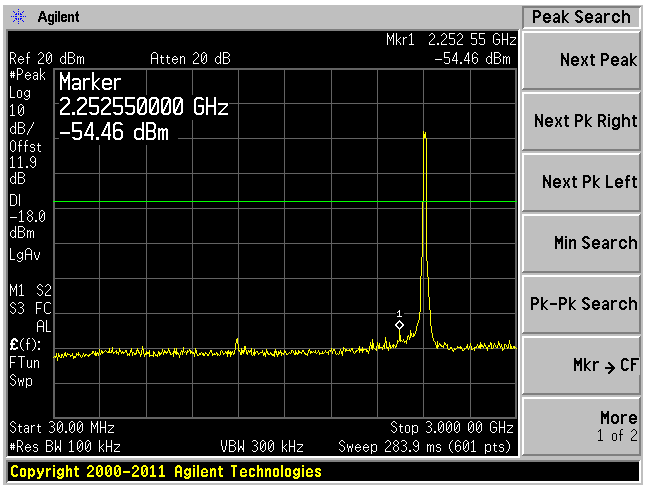



3 GHz to 25 GHz

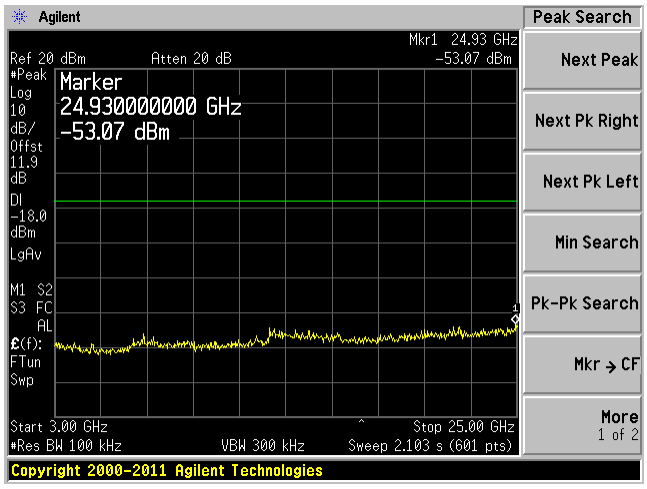


## 802.11n-HT20, Low Channel 2412 MHz

30 MHz to 3 GHz

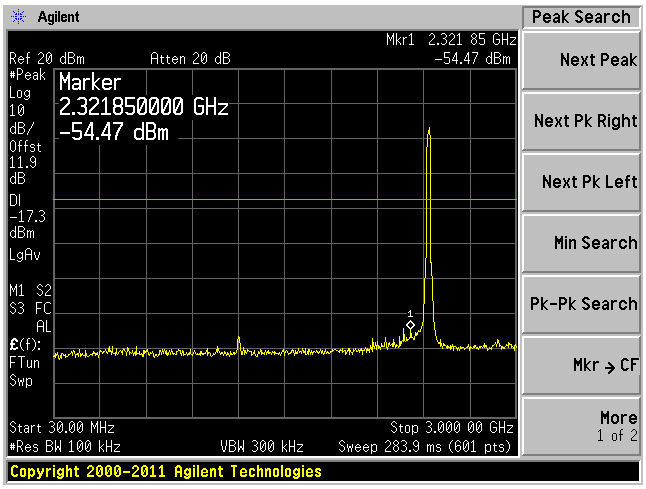



3 GHz to 25 GHz

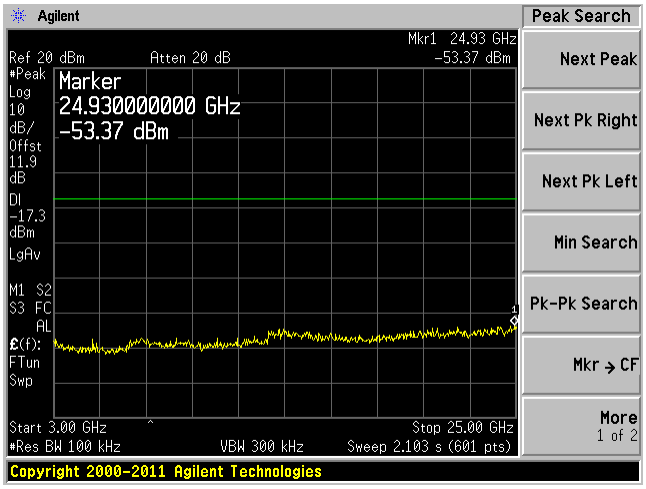



## 802.11n-HT20, Middle Channel 2437 MHz

30 MHz to 3 GHz

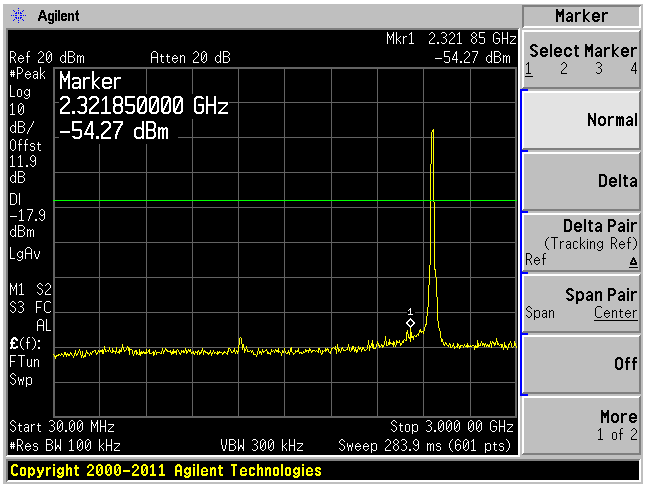



3 GHz to 25 GHz

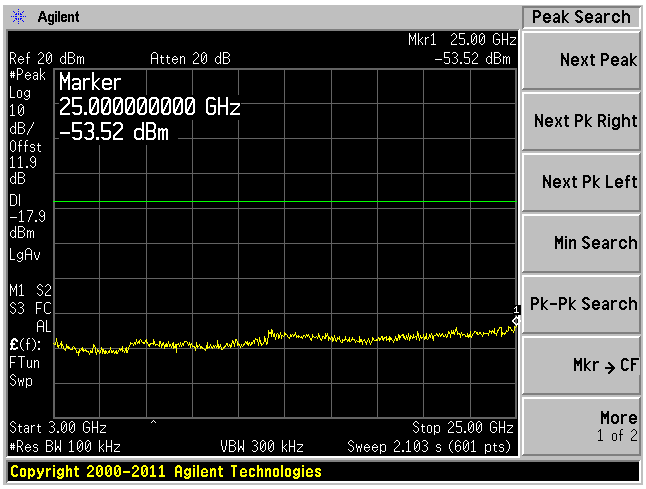


## 802.11n-HT20, High Channel 2462 MHz

30 MHz to 3 GHz




3 GHz to 25 GHz

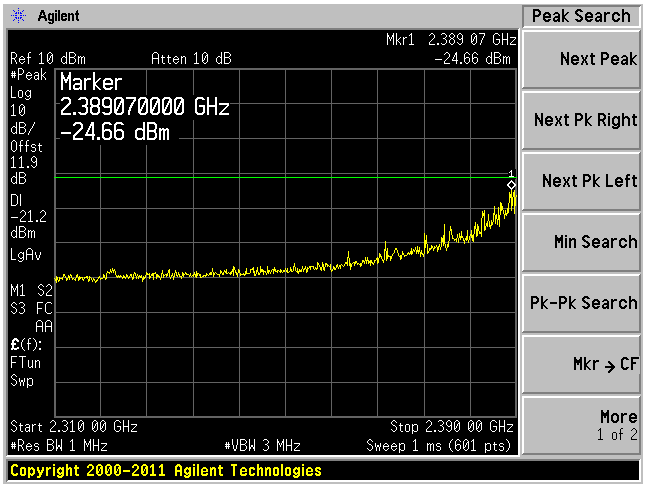


**Restricted Band:**

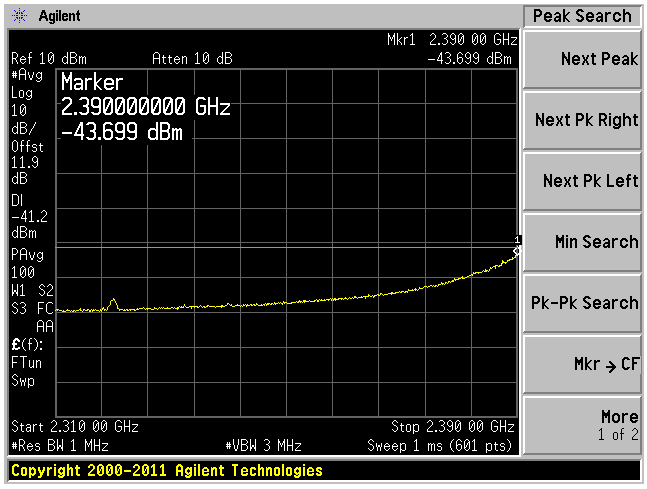
**2310 to 2390 MHz**

**802.11b, Low Channel, 2412 MHz**

Peak, Peak Limit

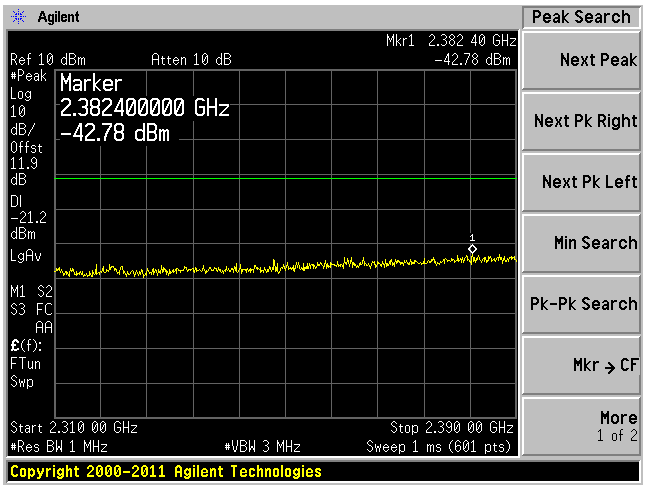



Average, Average Limit

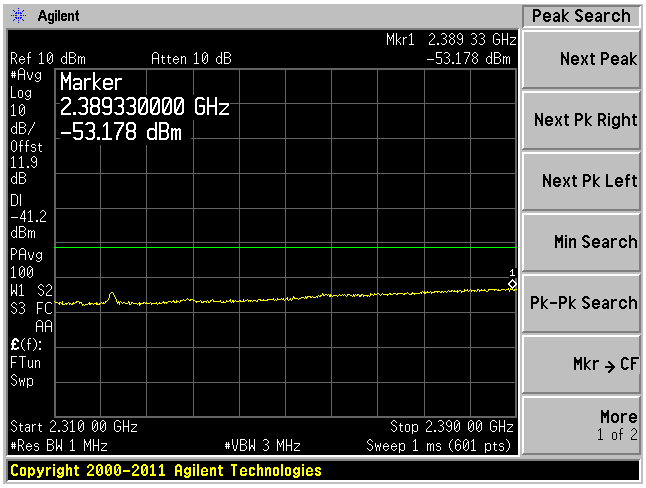



**802.11b, Middle Channel, 2437 MHz**

Peak, Peak Limit

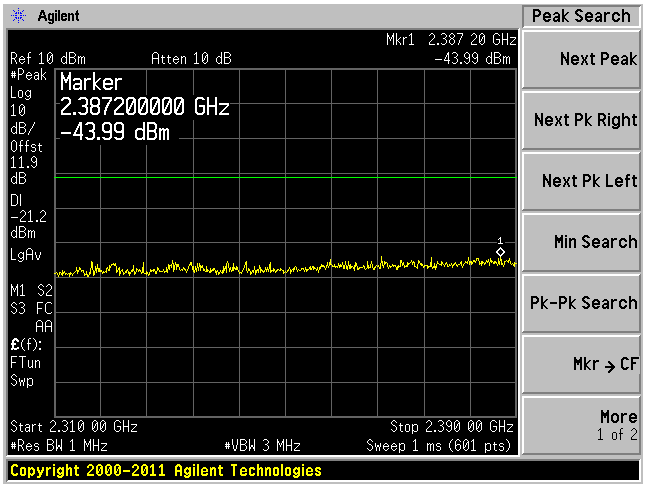



Average, Average Limit

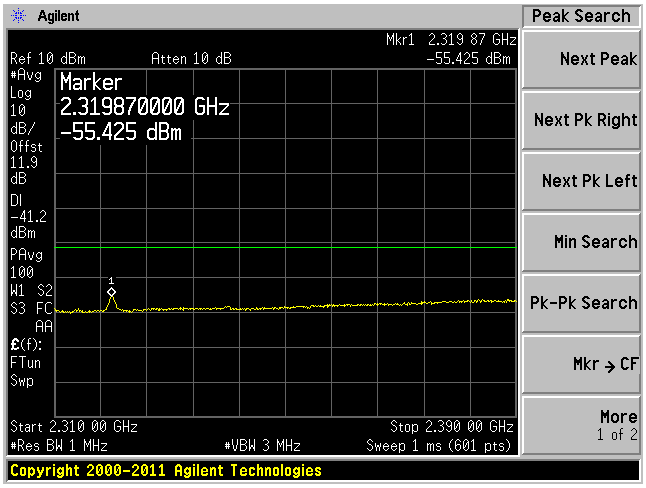


## 802.11b, High Channel, 2462 MHz

Peak Detector, Peak, Peak Limit

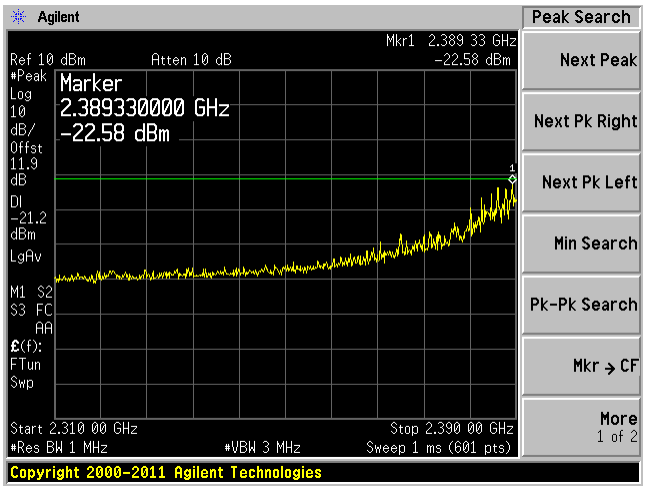



Average, Average Limit

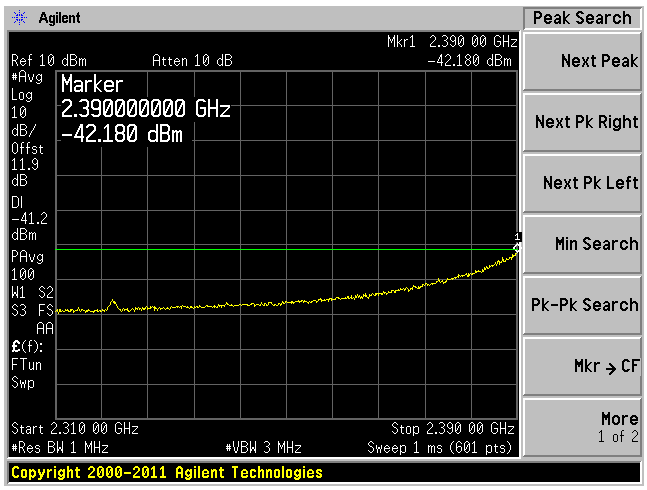



## 802.11g, Low Channel 2412 MHz

Peak, Peak Limit

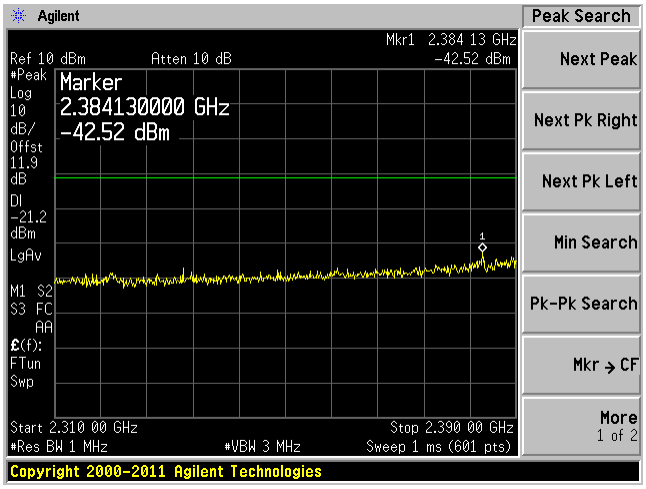



Average, Average Limit

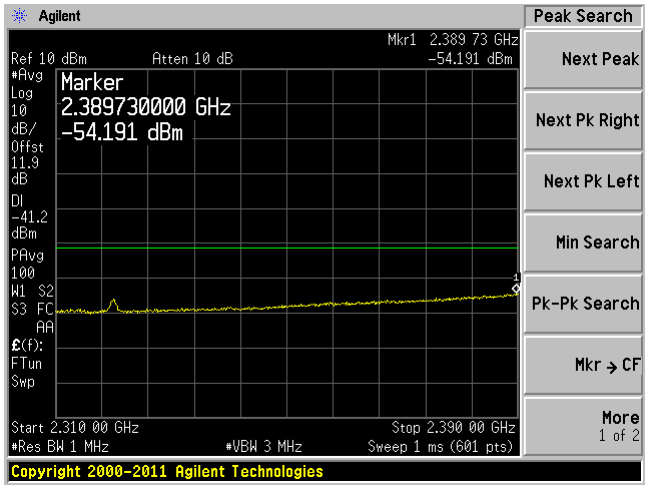


## 802.11g, Middle Channel 2437 MHz

Peak, Peak Limit

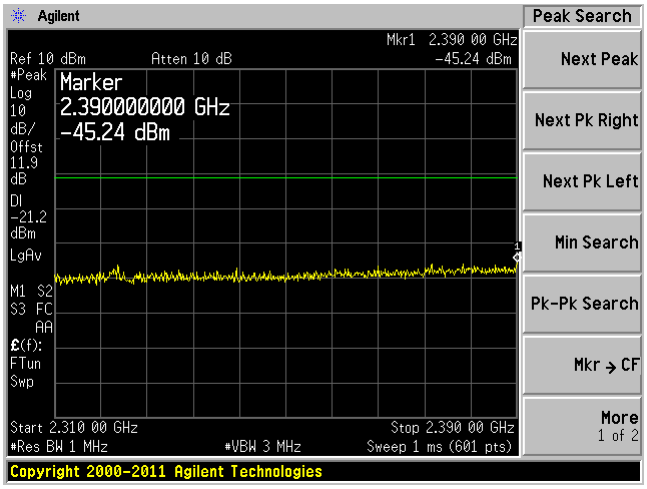



Average, Average Limit

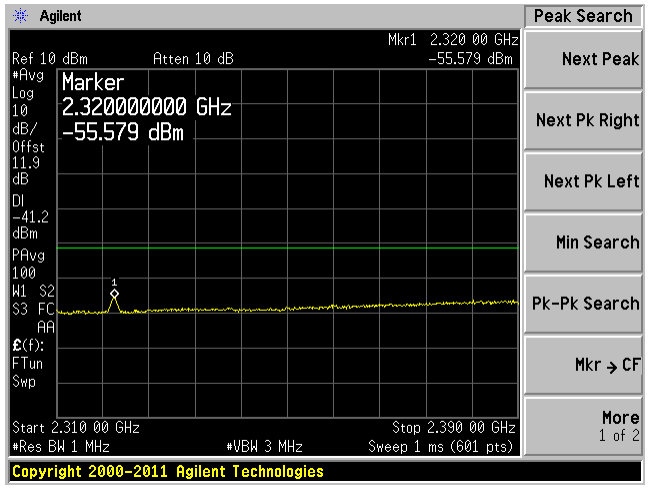



## 802.11g, High Channel 2462 MHz

Peak, Peak Limit

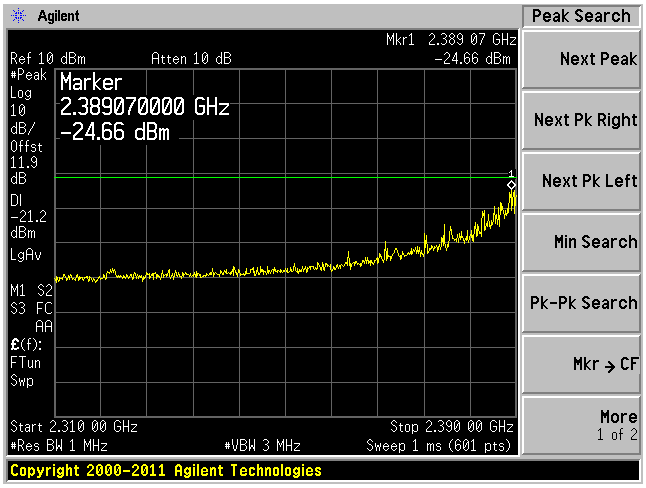



Average, Average Limit

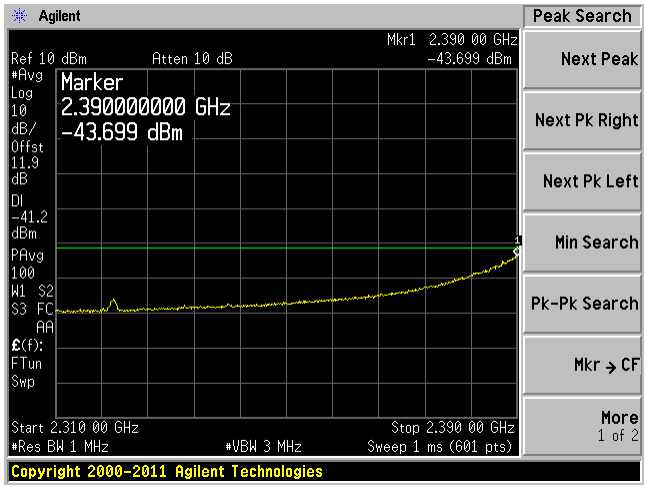


## 802.11n-HT20, Low Channel 2412 MHz

Peak, Peak Limit

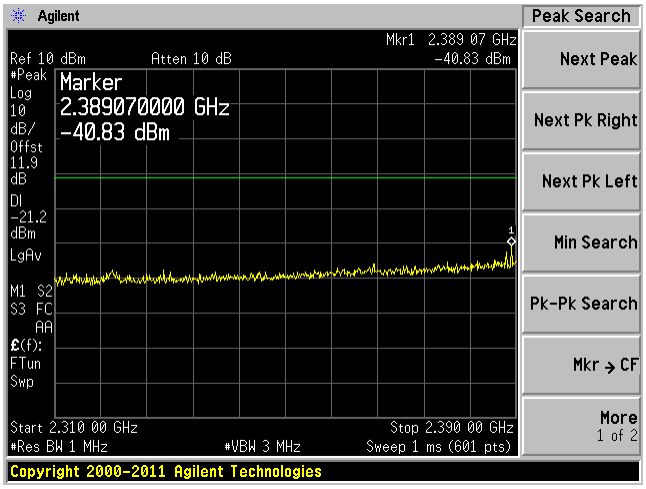



Average, Average Limit

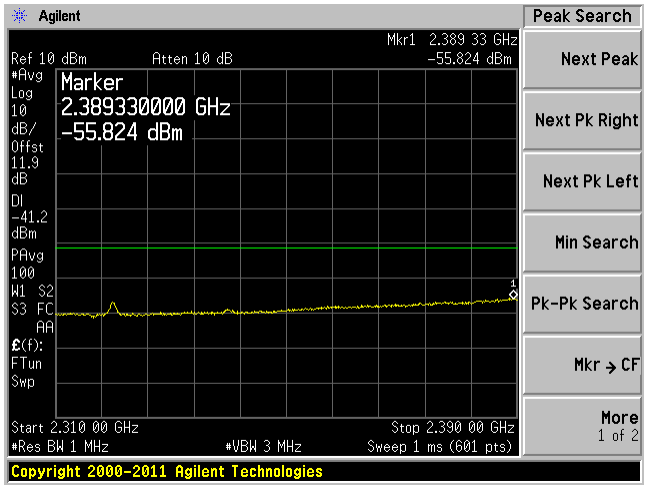



## 802.11n-HT20, Middle Channel 2437 MHz

Peak, Peak Limit

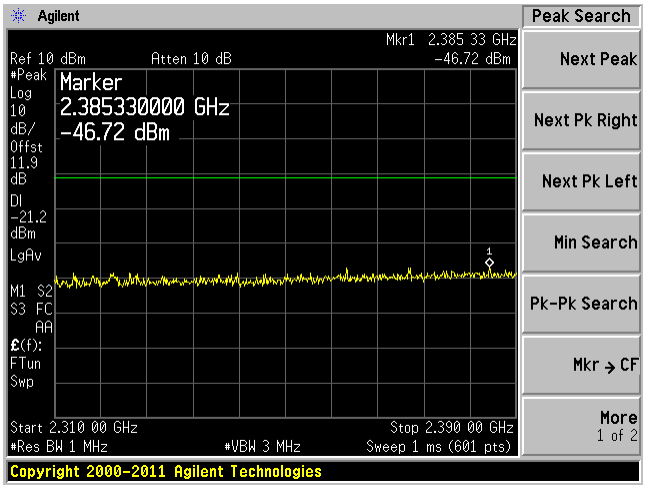



Average, Average Limit

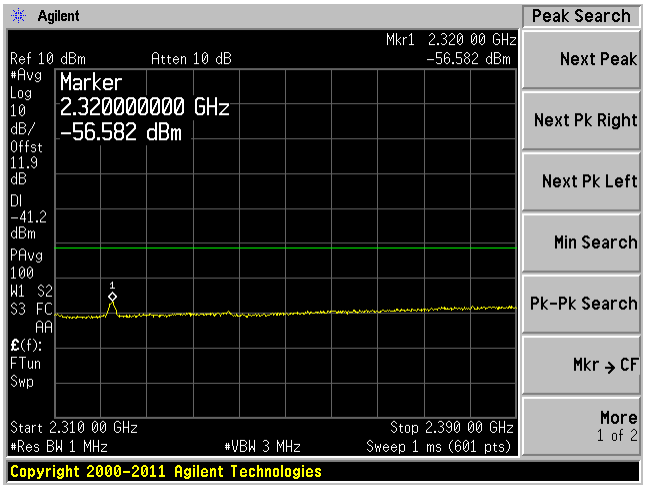


## 802.11n-HT20, High Channel 2462 MHz

Peak, Peak Limit



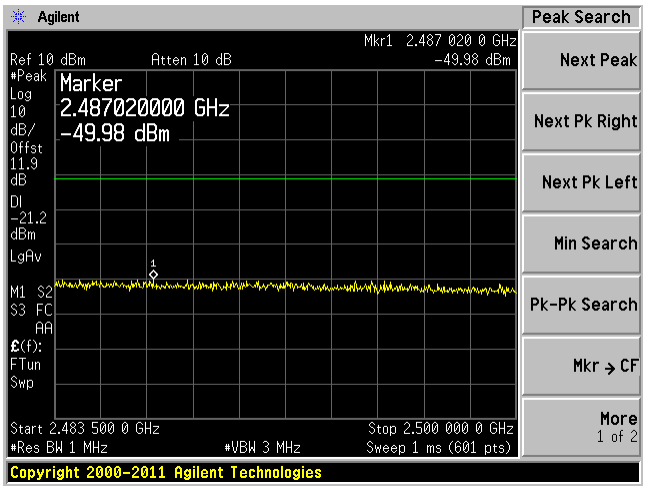

Average, Average Limit



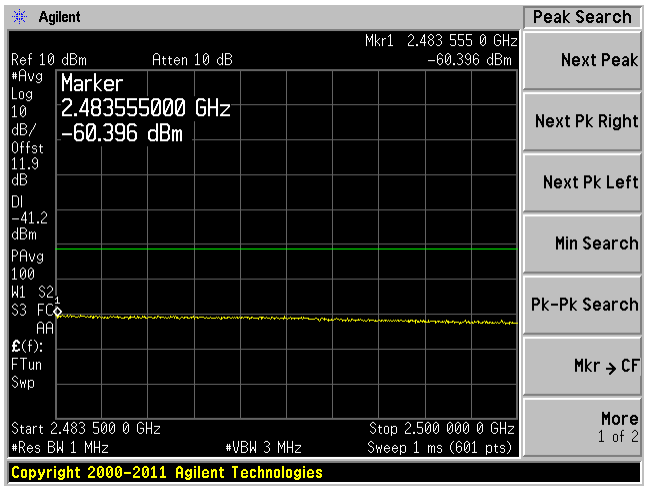
**2483.5 to 2500 MHz**

**802.11b, Low Channel, 2412 MHz**

Peak, Peak Limit

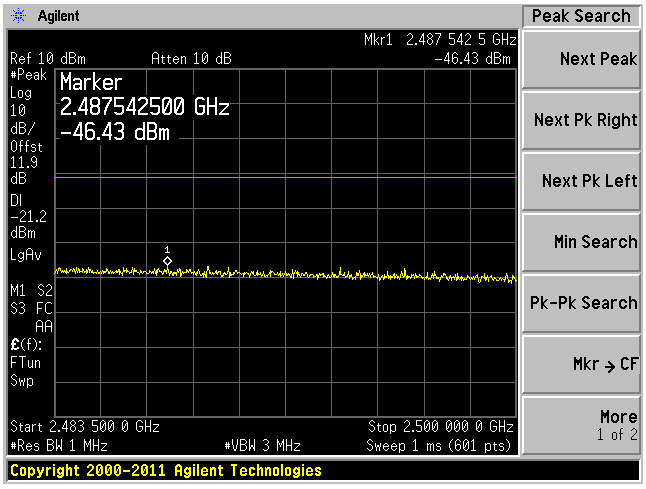



Average, Average Limit

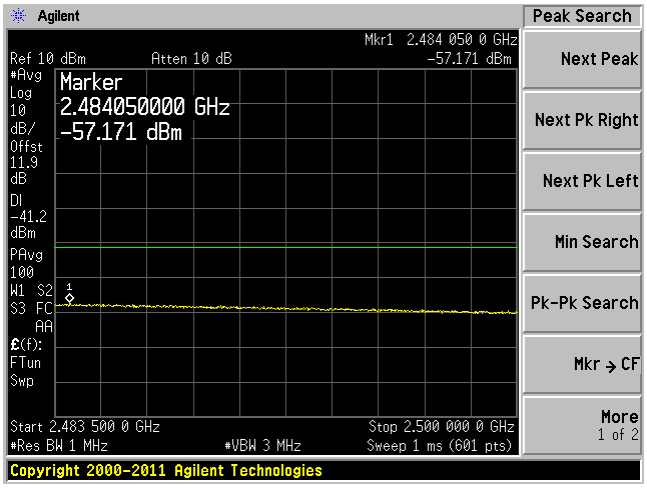



**802.11b, Middle Channel, 2437 MHz**

Peak, Peak Limit

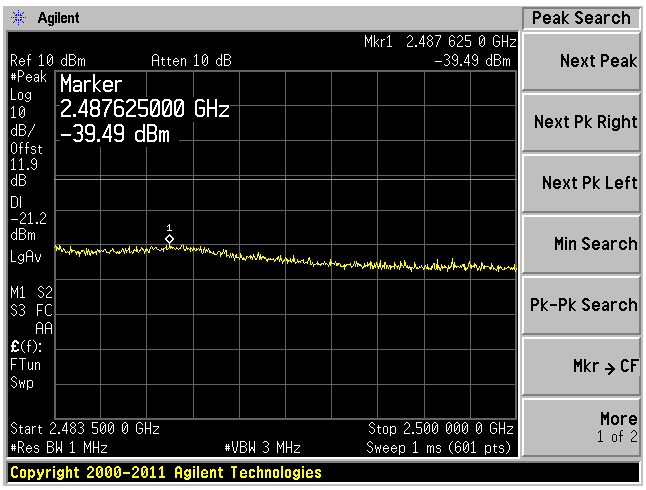



Average, Average Limit

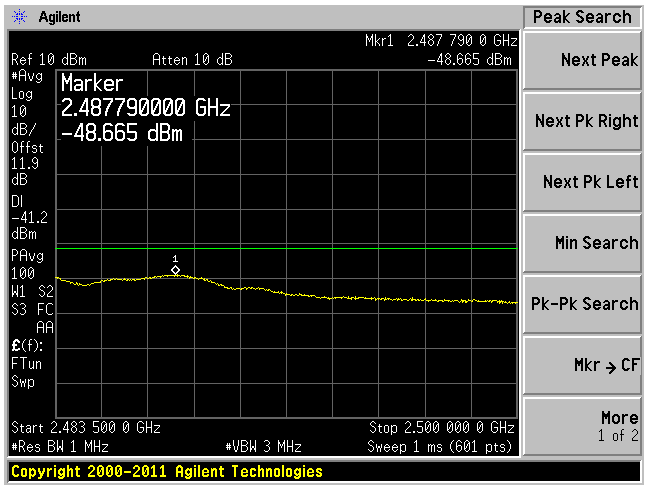


## 802.11b, High Channel, 2462 MHz

Peak, Peak Limit

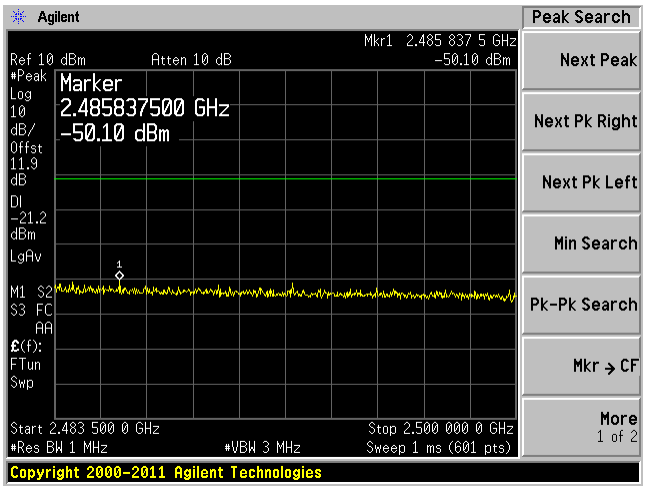



Average, Average Limit

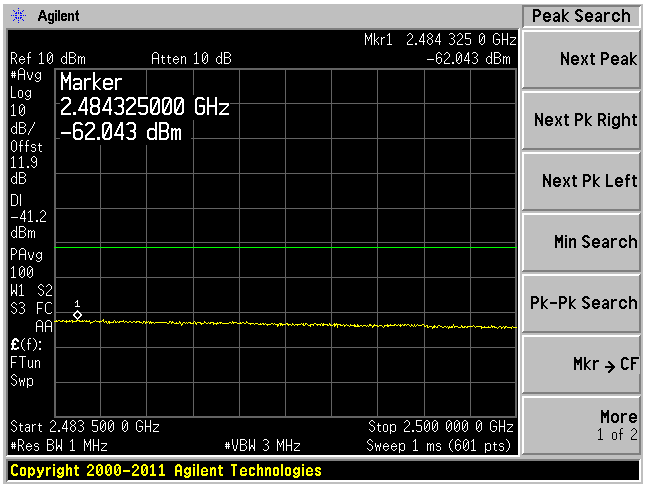



## 802.11g, Low Channel 2412 MHz

Peak, Peak Limit

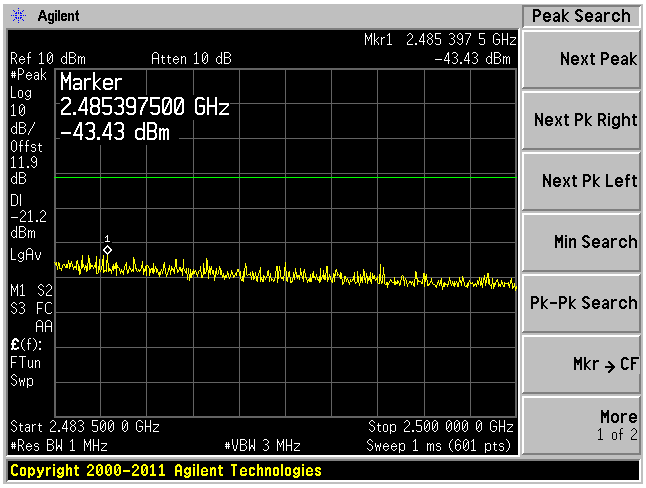



Average, Average Limit

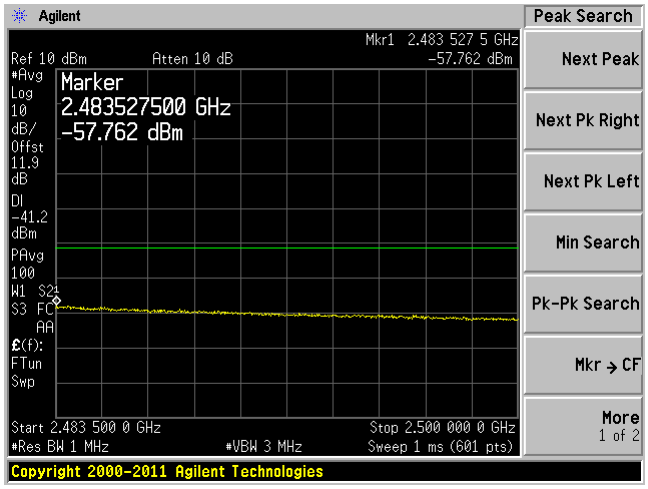


## 802.11g, Middle Channel 2437 MHz

Peak, Peak Limit

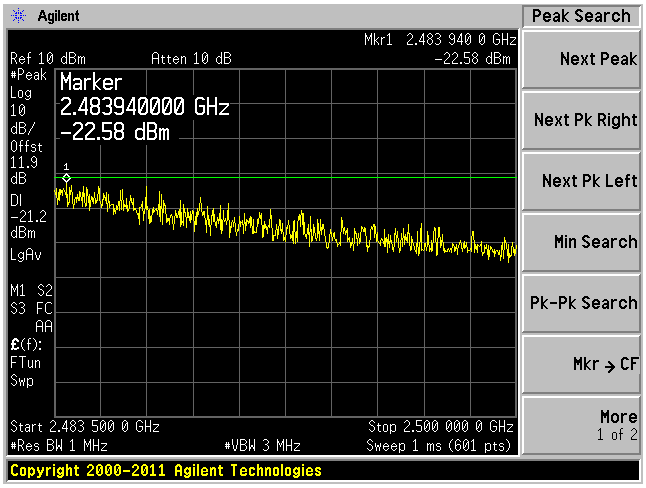



Average, Average Limit

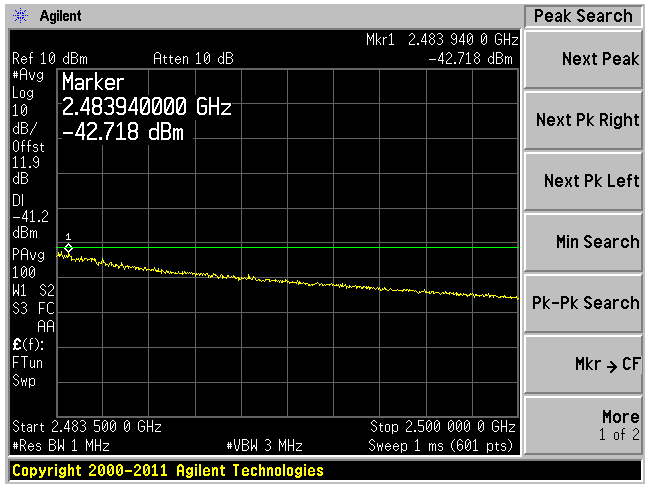



## 802.11g, High Channel 2462 MHz

Peak, Peak Limit

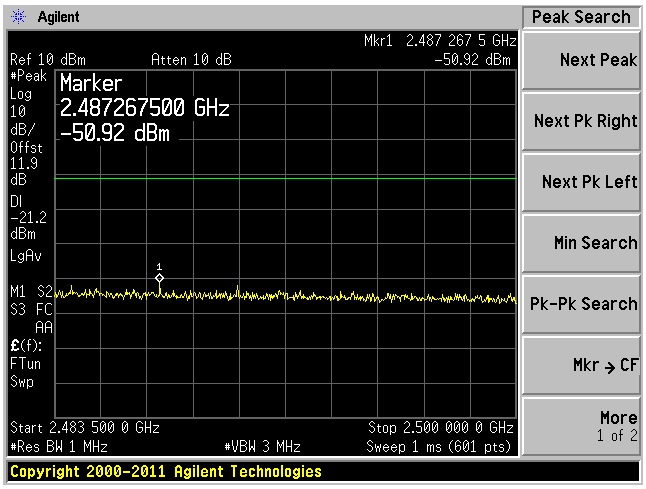



Average, Average Limit

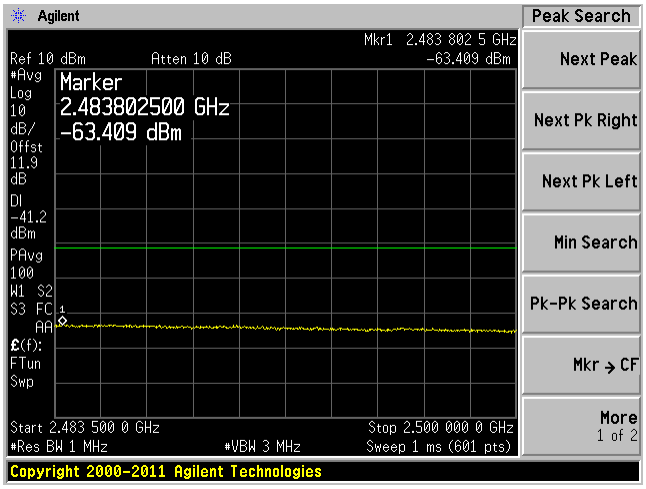


## 802.11n-HT20, Low Channel 2412 MHz

Peak, Peak Limit

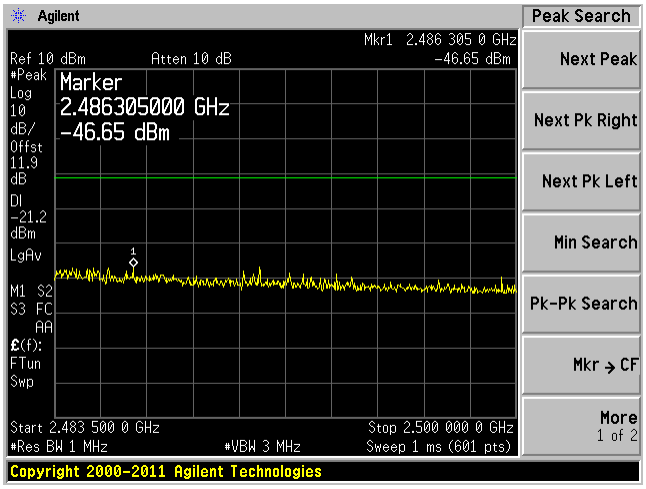



Average, Average Limit

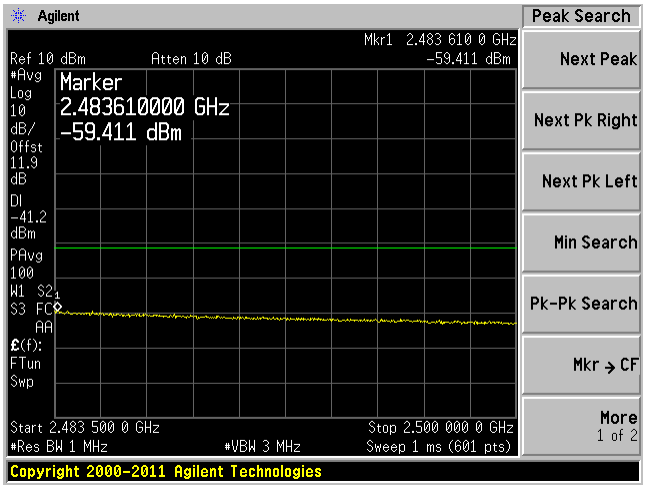



## 802.11n-HT20, Middle Channel 2437 MHz

Peak, Peak Limit

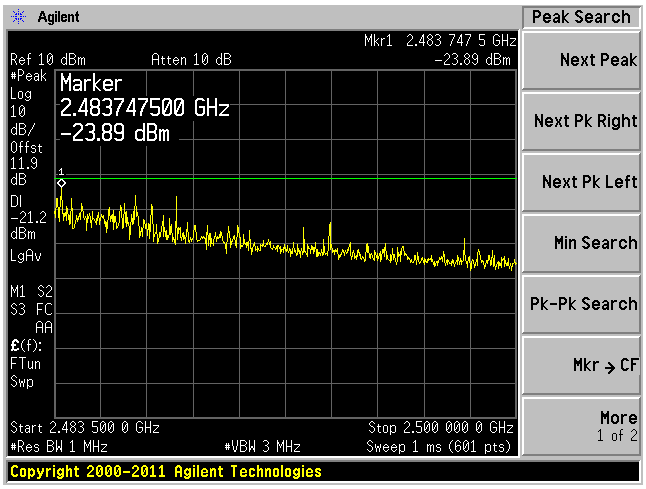



Average, Average Limit

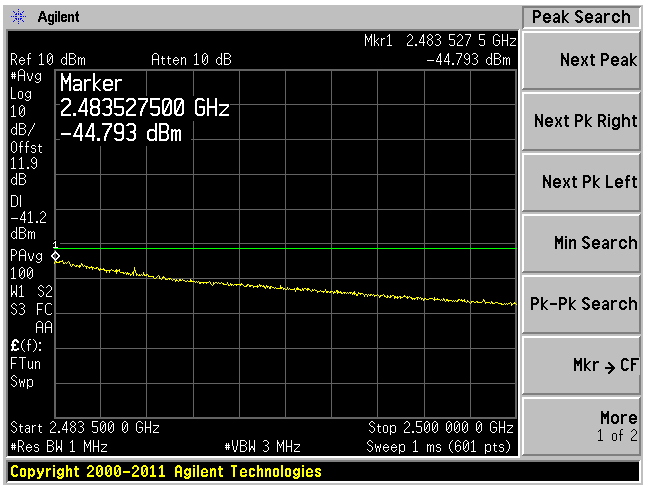


## 802.11n-HT20, High Channel 2462 MHz

Peak, Peak Limit




Average, Average Limit

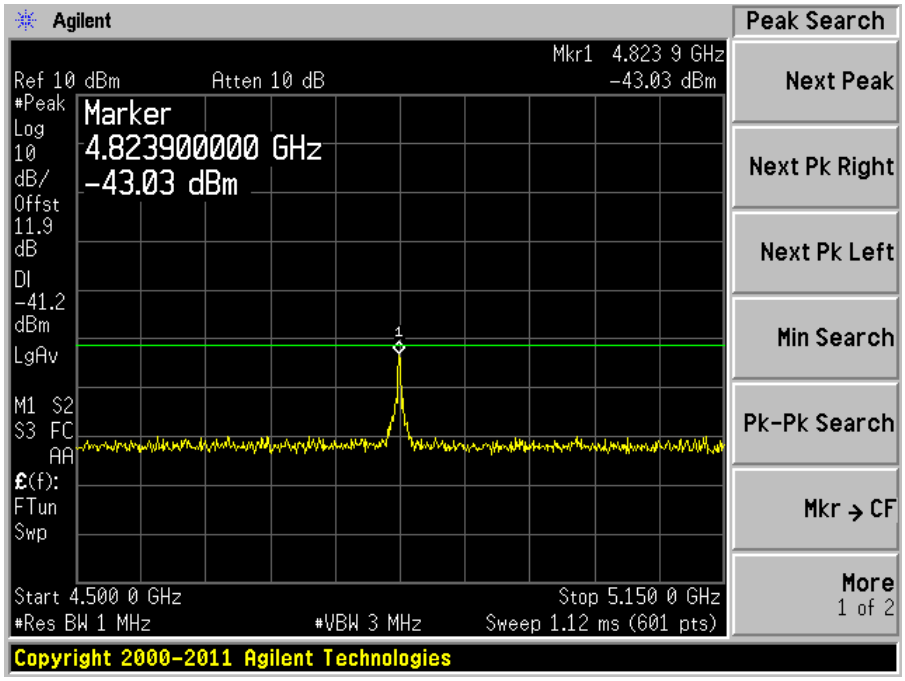


**4500 to 5150 MHz**

Note: The data was collected with Peak Detector, Average Limit; Average Detector, Average Limit data was not collected.

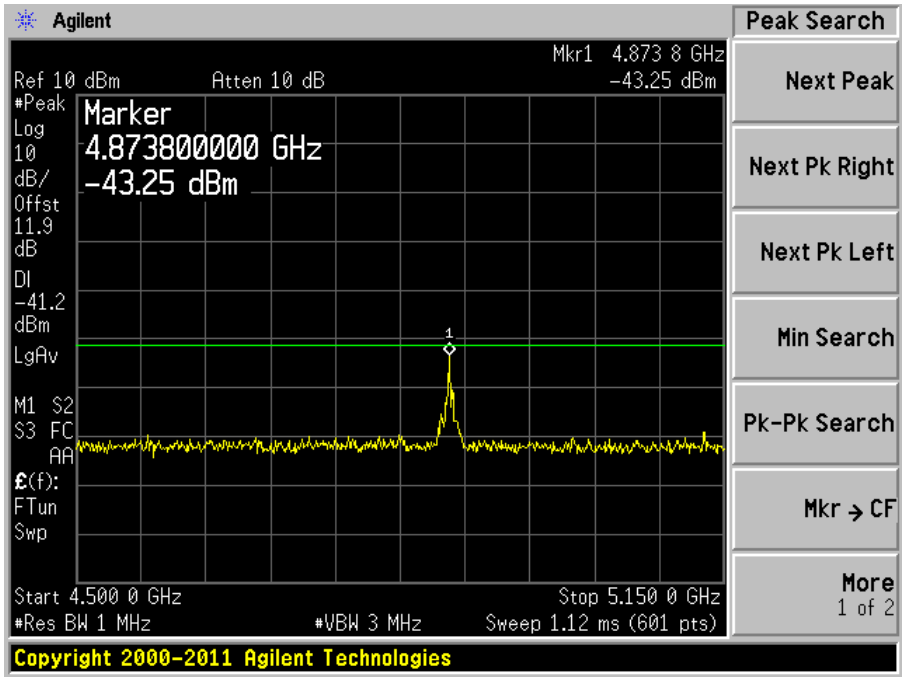
**802.11b, Low Channel, 2412 MHz**

Peak, Average Limit



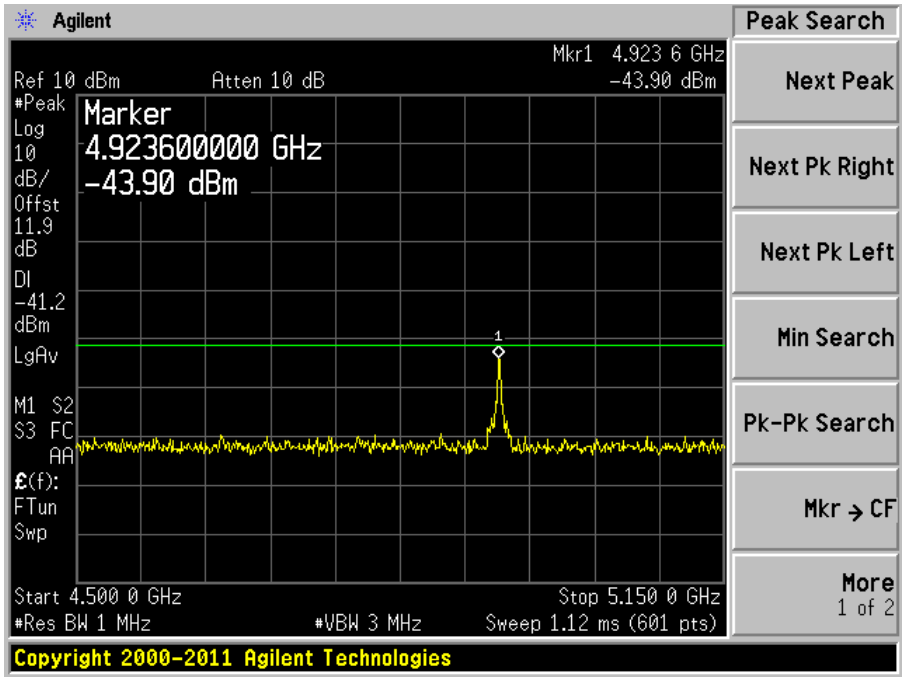

**802.11b, Middle Channel, 2437 MHz**

Peak, Average Limit



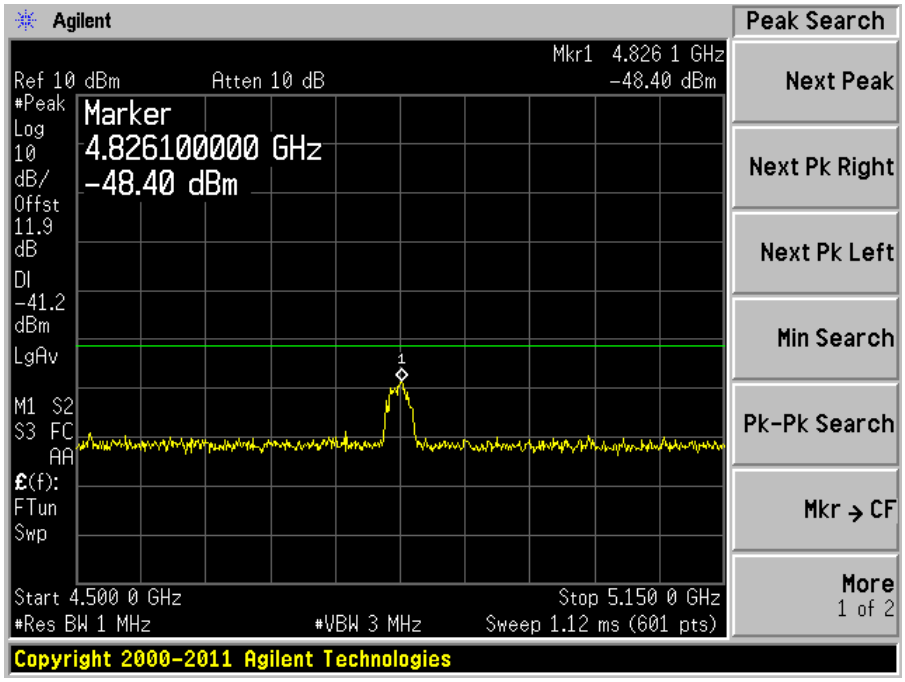
**802.11b, High Channel, 2462 MHz**

Peak, Average Limit



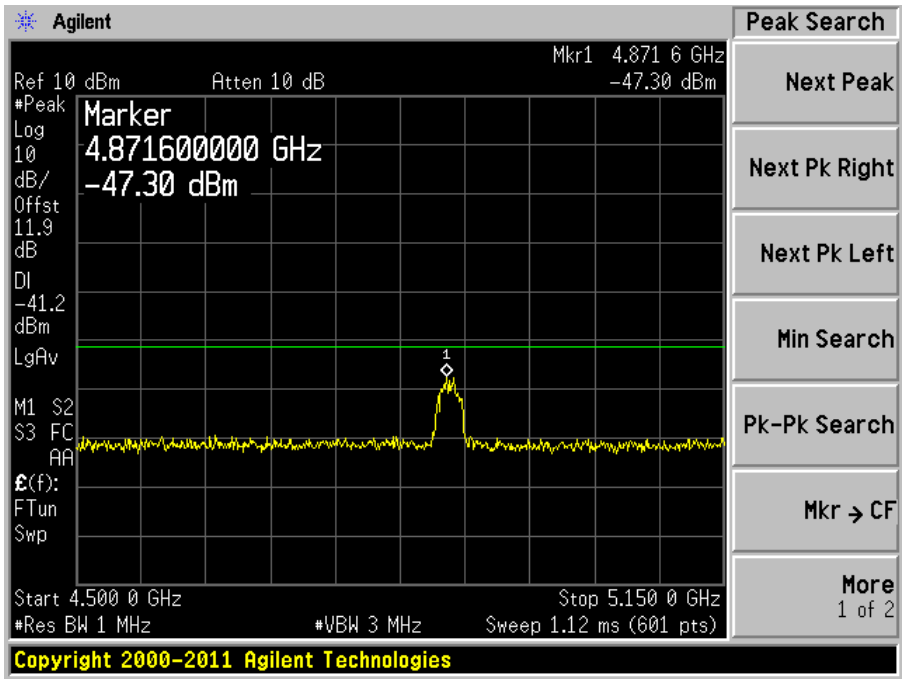

**802.11g, Low Channel 2412 MHz**

Peak, Average Limit



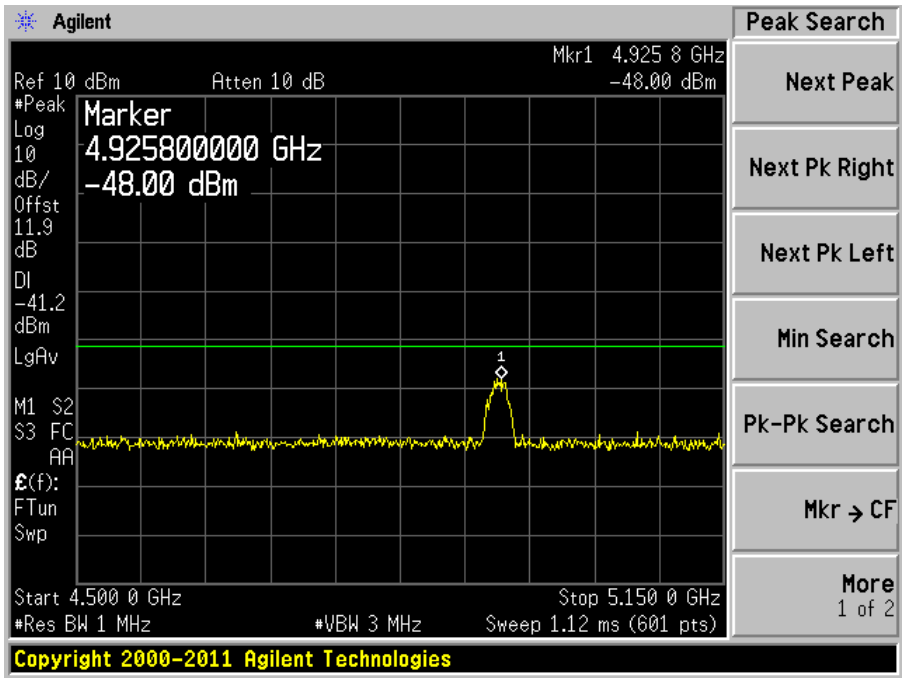
**802.11g, Middle Channel 2437 MHz**

Peak, Average Limit



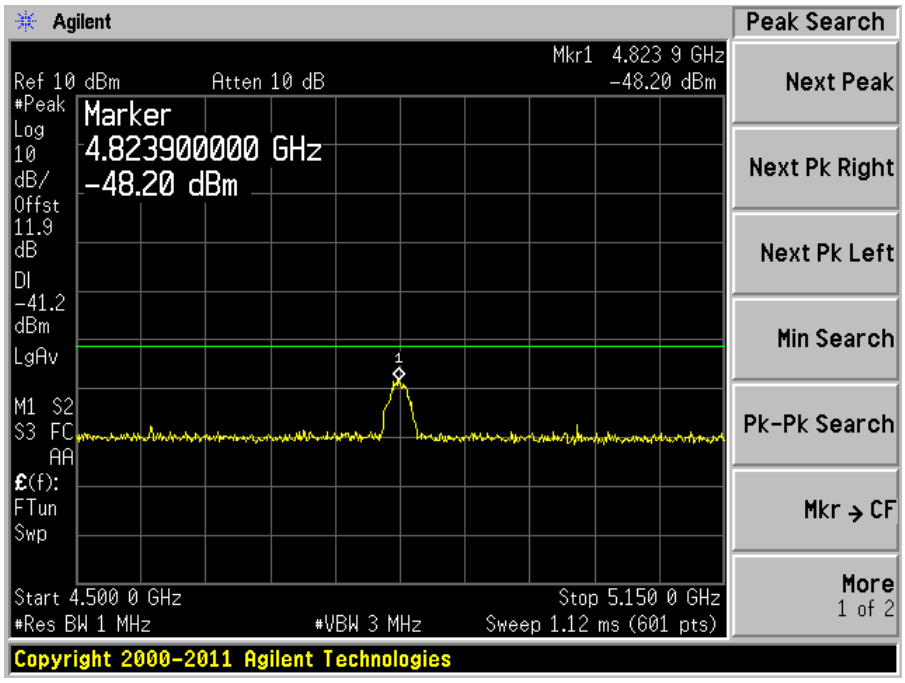

**802.11g, High Channel 2462 MHz**

Peak, Average Limit



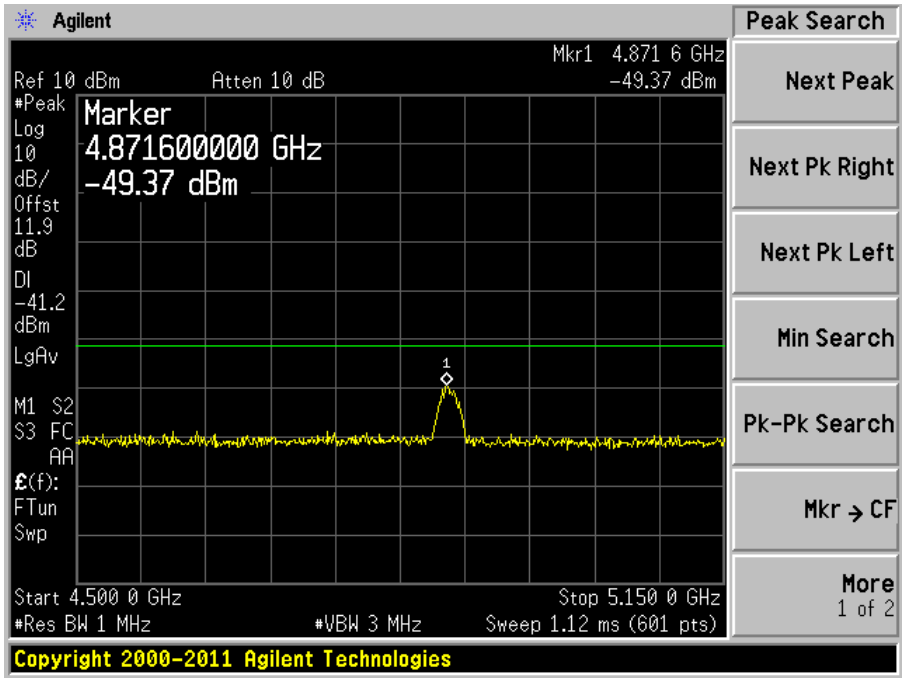
**802.11n-HT20, Low Channel 2412 MHz**

Peak, Average Limit



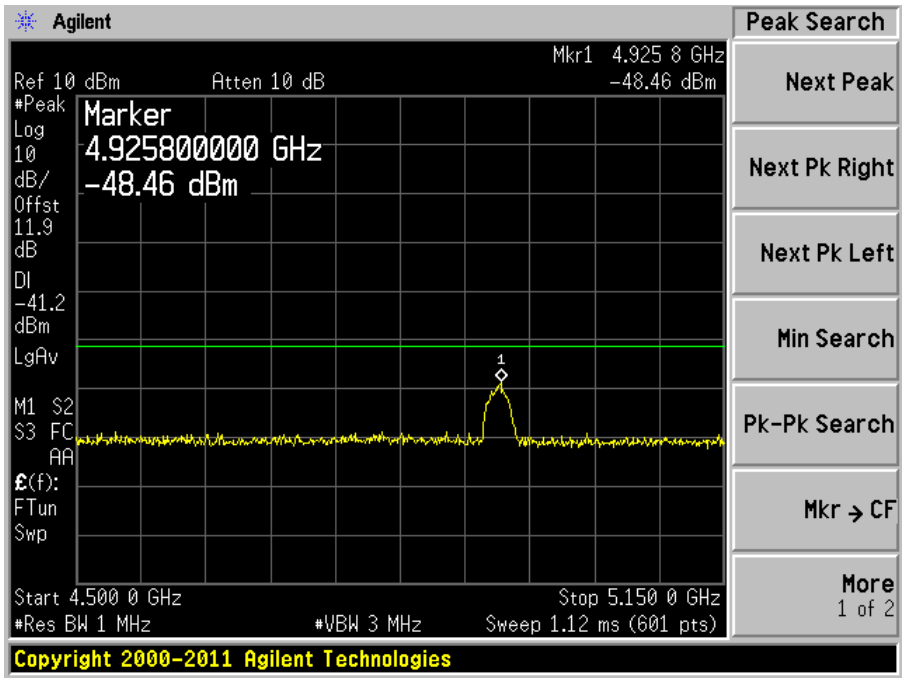

**802.11n-HT20, Middle Channel 2437 MHz**

Peak, Average Limit



**802.11n-HT20, High Channel 2462 MHz**

Peak, Average Limit



# 8 FCC §15.205, §15.209 & §15.247(d) & IC RSS-210 §A8.5 – Spurious Radiated Emissions

## 8.1 Applicable Standard

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) and RSS-210: 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 | 16.42 – 16.423 | 960 – 1240 | 4. 5 – 5. 15 |
| 0.495 – 0.505 | 16.69475 – 16.69525 | 1300 – 1427 | 5. 35 – 5. 46 |
| 2.1735 – 2.1905 | 25.5 – 25.67 | 1435 – 1626.5 | 7.25 – 7.75 |
| 4.125 – 4.128 | 37.5 – 38.25 | 1645.5 – 1646.5 | 8.025 – 8.5 |
| 4.17725 – 4.17775 | 73 – 74.6 | 1660 – 1710 | 9.0 – 9.2 |
| 4.20725 – 4.20775 | 74.8 – 75.2 | 1718.8 – 1722.2 | 9.3 – 9.5 |
| 6.215 – 6.218 | 108 – 121.94 | 2200 – 2300 | 10.6 – 12.7 |
| 6.26775 – 6.26825 | 123 – 138 | 2310 – 2390 | 13.25 – 13.4 |
| 6.31175 – 6.31225 | 149.9 – 150.05 | 2483.5 – 2500 | 14.47 – 14.5 |
| 8.291 – 8.294 | 156.52475 – 156.52525 | 2690 – 2900 | 15.35 – 16.2 |
| 8.362 – 8.366 | 156.7 – 156.9 | 3260 – 3267 | 17.7 – 21.4 |
| 8.37625 – 8.38675 | 162.0125 –167.17 | 3.332 – 3.339 | 22.01 – 23.12 |
| 8.41425 – 8.41475 | 167.72 – 173.2 | 3 3458 – 3 358 | 23.6 – 24.0 |
| 12.29 – 12.293 | 240 – 285 | 3.600 – 4.400 | 31.2 – 31.8 |
| 12.51975 – 12.52025 | 322 – 335.4 | | 36.43 – 36.5 |
| 12.57675 – 12.57725 | 399.9 – 410 | | Above 38.6 |
| 13.36 – 13.41 | 608 – 614 | | |

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-210 A8.5 Out-of-band Emissions, 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 A8.4 (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.

## 8.2 Test Setup

The radiated emissions tests were performed in the 5-meter Chamber, using the setup in accordance with ANSI C63.4-2009. The specification used was the FCC 15 Subpart C and IC RSS-210 limits.

The spacing between the peripherals was 3 centimeters.

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

## 8.3 Test Procedure

The measurements are base on FCC KDB 558074 D01 DTS Meas Guidance v03r01: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 section 11: Emissions in non-restricted frequency bands and section 12: Emissions in restricted frequency bands. As well as ANSI C63.4: 2009 as described below:

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

## 8.4 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

## 8.5 Test Equipment List and Details

| Manufacturer | Description | Model No. | Serial No. | Calibration Date | Calibration Interval |
|---|---|---|---|---|---|
| Agilent | Spectrum Analyzer | E4446A | US44300386 | 2013-10-22 | 1 Year |
| Sounol Sciences | Horn Antenna | DRH-118 | A052704 | 2013-03-07 | 1 Year |
| Mini-Circuits | Pre-amplifier | ZVA-183-S | 570400946 | 2013-05-09 | 1 Year |
| Rohde & Schwarz | Test Receiver | ESCI 1166.5950K03 | 100337 | 2013-03-28 | 1 Year |
| Sunol Sciences | Biconi-Log Antenna | JB3 | A020106-2 | 2013-08-12 | 1 Year |
| Agilent | Pre-amplifier | 8447D | 2944A10187 | 2013-03-08 | 1 Year |
| Sunol Sciences | System Controller | SC104V | 113005-1 | N/A | N/A |

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

## 8.6 Test Environmental Conditions

| | |
|---|---|
| **Temperature:** | 21-22 ºC |
| **Relative Humidity:** | 25-30 % |
| **ATM Pressure:** | 101-102 kPa |

*Testing was performed by Jeffrey Wu from 2013-12-20 to2013-12-23 in chamber 5m3.*

## 8.7 Summary of Test Results

According to the data hereinafter, the EUT complied with the FCC Title 47, Part 15C and IC RSS-210 standard's radiated emissions limits, and had the worst margin of:

30-1000 MHz:

| Mode: Transmitting | | | |
|---|---|---|---|
| **Margin (dB)** | **Frequency (MHz)** | **Polarization (Horizontal/Vertical)** | **Mode** |
| -3.45 | 276.9013 | Horizontal | B mode |

1-25 GHz:

| Mode: Transmitting | | | |
|---|---|---|---|
| **Margin (dB)** | **Frequency (MHz)** | **Polarization (Horizontal/Vertical)** | **Mode** |
| -0.131 | 2483.5 | Horizontal | G mode |

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

## 8.8 Radiated Emissions Test Data and Plots

### 1) 30 MHz – 1 GHz, Measured at 3 meters, EUT antenna port was terminated

**2.4 GHz Band, Quasi-Peak Measurements**

802.11b mode

| Frequency (MHz) | Corrected Amplitude (dBµV/m) | Antenna Height (cm) | Antenna Polarity (H/V) | Turntable Azimuth (degrees) | Limit (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|
| 35.4855 | 32.78 | 130 | V | 267 | 40 | -7.22 |
| 277.0728 | 34.5 | 128 | H | 234 | 46 | -11.5 |

802.11g mode

| Frequency (MHz) | Corrected Amplitude (dBµV/m) | Antenna Height (cm) | Antenna Polarity (H/V) | Turntable Azimuth (degrees) | Limit (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|
| 39.26375 | 31.63 | 100 | V | 140 | 40 | -8.37 |
| 276.9013 | 42.55 | 149 | H | 280 | 46 | -3.45 |

802.11n-HT20 mode

| Frequency (MHz) | Corrected Amplitude (dBµV/m) | Antenna Height (cm) | Antenna Polarity (H/V) | Turntable Azimuth (degrees) | Limit (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|
| 59.6695 | 24.6 | 115 | V | 320 | 40 | -15.4 |
| 165.8323 | 39.54 | 256 | H | 255 | 43.5 | -3.96 |
| 215.9933 | 38.36 | 107 | V | 111 | 43.5 | -5.14 |

All 30 MHz-1 GHz spurious are digital, other emissions are on the noise floor level. The worst case result was reported.

**2) 1–25 GHz, Measured at 3 meters, EUT antenna port was terminated**

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 CH, 2412 MHz, measured at 3 meters | | | | | | | | | | | |
| 2412 | 73.7 | 175 | 100 | V | 28.73 | 3.12 | 0 | 105.547 | - | Fund. | Peak |
| 2412 | 74.73 | 94 | 100 | H | 28.73 | 3.12 | 0 | 106.577 | - | Fund. | Peak |
| 2412 | 70.90 | 175 | 100 | V | 28.73 | 3.12 | 0 | 102.747 | - | Fund. | Ave |
| 2412 | 70.898 | 94 | 100 | H | 28.73 | 3.12 | 0 | 102.745 | - | Fund. | Ave |
| 2390 | 26.68 | 175 | 100 | V | 28.73 | 3.12 | 0 | 58.527 | 74 | -15.473 | Peak |
| 2390 | 26.78 | 94 | 100 | H | 28.73 | 3.12 | 0 | 58.627 | 74 | -15.373 | Peak |
| 2390 | 13.88 | 175 | 100 | V | 28.73 | 3.12 | 0 | 45.727 | 54 | -8.273 | Ave |
| 2390 | 14.2 | 94 | 100 | H | 28.7 | 3.12 | 0 | 46.047 | 54 | -7.953 | Ave |
| 4824 | 43.85 | 291 | 110 | V | 32.55 | 4.06 | 27.91 | 52.547 | 74 | -21.453 | Peak |
| 4828 | 42.99 | 55 | 103 | H | 32.55 | 4.06 | 27.91 | 51.687 | 74 | -22.313 | Peak |
| 4828 | 41.55 | 291 | 100 | V | 32.55 | 4.06 | 27.91 | 50.247 | 54 | -3.753 | Ave |
| 4828 | 40.12 | 55 | 103 | H | 32.55 | 4.06 | 27.91 | 48.817 | 54 | -5.183 | Ave |
| 7236 | 37.36 | 94 | 129 | V | 36.37 | 4.93 | 27.65 | 51.013 | 85.547 | -34.534 | Peak |
| 7236 | 33.86 | 252 | 135 | H | 36.37 | 4.93 | 27.65 | 47.513 | 86.577 | -39.064 | Peak |
| 7236 | 28.4 | 94 | 129 | V | 36.37 | 4.93 | 27.65 | 42.053 | 82.747 | -40.694 | Ave |
| 7236 | 22.2 | 252 | 135 | H | 36.37 | 4.93 | 27.65 | 35.853 | 82.745 | -46.892 | Ave |
| 9648* | 30.24 | 0 | 100 | V | 37.26 | 5.82 | 27.21 | 46.113 | 85.547 | -39.434 | Peak |
| 9648* | 30.33 | 0 | 100 | H | 37.26 | 5.82 | 27.21 | 46.203 | 86.577 | -40.374 | Peak |
| 9648* | 15.05 | 0 | 100 | V | 37.26 | 5.82 | 27.21 | 30.923 | 82.747 | -51.824 | Ave |
| 9648* | 15.1 | 0 | 100 | H | 37.26 | 5.82 | 27.21 | 30.973 | 82.745 | -51.772 | Ave |

** Data was collected as noise floor*

| 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) | |
| Middle CH 2437 MHz, measured at 3 meters | | | | | | | | | | | |
| 2437 | 73.62 | 195 | 100 | V | 28.73 | 3.25 | 0 | 105.597 | - | Fund. | Peak |
| 2437 | 74.96 | 91 | 100 | H | 28.73 | 3.25 | 0 | 106.937 | - | Fund. | Peak |
| 2437 | 69.87 | 195 | 100 | V | 28.73 | 3.25 | 0 | 101.847 | - | Fund. | Ave |
| 2437 | 70.94 | 91 | 100 | H | 28.73 | 3.25 | 0 | 102.917 | - | Fund. | Ave |
| 4874 | 41.39 | 284 | 115 | V | 32.77 | 4.06 | 27.76 | 50.457 | 74 | -23.543 | Peak |
| 4874 | 42.29 | 63 | 113 | H | 32.77 | 4.06 | 27.76 | 51.357 | 74 | -22.643 | Peak |
| 4874 | 38.5 | 284 | 115 | V | 32.77 | 4.06 | 27.76 | 47.567 | 54 | -6.433 | Ave |
| 4874 | 38.02 | 63 | 113 | H | 32.77 | 4.06 | 27.76 | 47.087 | 54 | -6.913 | Ave |
| 7311 | 35.4 | 84 | 122 | V | 36.59 | 4.88 | 27.67 | 49.203 | 85.597 | -36.394 | Peak |
| 7311 | 33.22 | 0 | 100 | H | 36.59 | 4.88 | 27.67 | 47.023 | 86.937 | -39.914 | Peak |
| 7311 | 24.864 | 84 | 122 | V | 36.59 | 4.88 | 27.67 | 38.667 | 81.847 | -43.180 | Ave |
| 7311 | 17.57 | 0 | 100 | H | 36.59 | 4.88 | 27.67 | 31.373 | 82.917 | -51.544 | Ave |
| 9748* | 29.09 | 0 | 100 | V | 37.15 | 5.77 | 27.16 | 44.853 | 85.597 | -40.744 | Peak |
| 9748* | 28.94 | 0 | 100 | H | 37.15 | 5.77 | 27.16 | 44.703 | 86.937 | -42.234 | Peak |
| 9748* | 15.31 | 0 | 100 | V | 37.15 | 5.77 | 27.16 | 31.073 | 81.847 | -50.774 | Ave |
| 9748* | 15.29 | 0 | 100 | H | 37.15 | 5.77 | 27.16 | 31.053 | 82.917 | -51.864 | Ave |
| High CH 2462 MHz, measured at 3 meters | | | | | | | | | | | |
| 2462 | 73.79 | 194 | 100 | V | 28.97 | 3.25 | 0 | 106.009 | - | Fund. | Peak |
| 2462 | 74.45 | 92 | 100 | H | 28.97 | 3.25 | 0 | 106.669 | - | Fund. | Peak |
| 2462 | 70.72 | 194 | 100 | V | 28.97 | 3.25 | 0 | 102.939 | - | Fund. | Ave |
| 2462 | 70.82 | 92 | 100 | H | 28.97 | 3.25 | 0 | 103.039 | - | Fund. | Ave |
| 2483.5 | 26.29 | 0 | 100 | V | 28.97 | 3.25 | 0 | 58.509 | 74 | -15.491 | Peak |
| 2483.5 | 25.75 | 0 | 100 | H | 28.97 | 3.25 | 0 | 57.969 | 74 | -16.031 | Peak |
| 2483.5 | 12.18 | 0 | 100 | V | 28.97 | 3.25 | 0 | 44.399 | 54 | -9.601 | Ave |
| 2483.5 | 12.25 | 0 | 100 | H | 28.97 | 3.25 | 0 | 44.469 | 54 | -9.531 | Ave |
| 4924 | 38.06 | 290 | 116 | V | 32.77 | 4.10 | 27.81 | 47.117 | 74 | -26.883 | Peak |
| 4924 | 37.99 | 0 | 131 | H | 32.77 | 4.10 | 27.81 | 47.047 | 74 | -26.953 | Peak |
| 4924 | 32.88 | 290 | 116 | V | 32.77 | 4.10 | 27.81 | 41.937 | 54 | -12.063 | Ave |
| 4924 | 33.04 | 0 | 131 | H | 32.77 | 4.10 | 27.81 | 42.097 | 54 | -11.903 | Ave |
| 7386* | 33.05 | 0 | 100 | V | 36.58 | 4.89 | 27.82 | 46.697 | 74 | -27.303 | Peak |
| 7386* | 32.67 | 0 | 100 | H | 36.58 | 4.89 | 27.82 | 46.317 | 74 | -27.683 | Peak |
| 7386* | 20.13 | 0 | 100 | V | 36.58 | 4.89 | 27.82 | 33.777 | 54 | -20.223 | Ave |
| 7386* | 17.63 | 0 | 100 | H | 36.58 | 4.89 | 27.82 | 31.277 | 54 | -22.723 | Ave |
| 9848* | 31.05 | 0 | 100 | V | 37.27 | 5.77 | 27.27 | 46.822 | 86.009 | -39.187 | Peak |
| 9848* | 31.25 | 0 | 100 | H | 37.27 | 5.77 | 27.27 | 47.022 | 86.669 | -39.647 | Peak |
| 9848* | 16.62 | 0 | 100 | V | 37.27 | 5.77 | 27.27 | 32.392 | 82.939 | -50.547 | Ave |
| 9848* | 16.54 | 0 | 100 | H | 37.27 | 5.77 | 27.27 | 32.312 | 83.039 | -50.727 | Ave |

** Data was collected as noise floor*

802.11g mode

| Frequency (MHz) | S.A. Reading (dBµV) | Turntable Azimuth (degrees) | Test Antenna | | | Cable Loss (dB) | Pre-Amp. (dB) | Cord. Reading (dBµV/m) | FCC/IC | | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Height (cm) | Polarity (H/V) | Factor (dB/m) | | | | Limit (dBµV/m) | Margin (dB) | |
| Low CH 2412 MHz, measured at 3 meters | | | | | | | | | | | |
| 2412 | 75.67 | 177 | 100 | V | 28.73 | 3.12 | 0 | 107.517 | - | Fund. | Peak |
| 2412 | 76.69 | 94 | 100 | H | 28.73 | 3.12 | 0 | 108.537 | - | Fund. | Peak |
| 2412 | 62.48 | 177 | 100 | V | 28.73 | 3.12 | 0 | 94.327 | - | Fund. | Ave |
| 2412 | 63.67 | 94 | 100 | H | 28.73 | 3.12 | 0 | 95.517 | - | Fund. | Ave |
| 2390 | 39.17 | 177 | 100 | V | 28.7 | 3.12 | 0 | 71.017 | 74 | -2.983 | Peak |
| 2390 | 40.49 | 94 | 100 | H | 28.7 | 3.12 | 0 | 72.337 | 74 | -1.663 | Peak |
| 2390 | 16.36 | 177 | 100 | V | 28.7 | 3.12 | 0 | 48.207 | 54 | -5.793 | Ave |
| 2390 | 17.04 | 94 | 100 | H | 28.7 | 3.12 | 0 | 48.887 | 54 | -5.113 | Ave |
| 4824 | 40.67 | 294 | 119 | V | 32.55 | 4.06 | 27.91 | 49.367 | 74 | -24.633 | Peak |
| 4828 | 37.72 | 332 | 121 | H | 32.55 | 4.06 | 27.91 | 46.417 | 74 | -27.583 | Peak |
| 4828 | 24.51 | 294 | 119 | V | 32.55 | 4.06 | 27.91 | 33.207 | 54 | -20.793 | Ave |
| 4828 | 22.61 | 332 | 121 | H | 32.55 | 4.06 | 27.91 | 31.307 | 54 | -22.693 | Ave |
| 7236* | 33.03 | 0 | 100 | V | 36.37 | 4.93 | 27.65 | 46.683 | 87.517 | -40.834 | Peak |
| 7236* | 33.03 | 0 | 100 | H | 36.37 | 4.93 | 27.65 | 46.683 | 88.537 | -41.854 | Peak |
| 7236* | 17.57 | 0 | 100 | V | 36.37 | 4.93 | 27.65 | 31.223 | 74.327 | -43.104 | Ave |
| 7236* | 17.49 | 0 | 100 | H | 36.37 | 4.93 | 27.65 | 31.143 | 75.517 | -44.374 | Ave |
| 9648* | 33.41 | 0 | 100 | V | 37.26 | 5.82 | 27.21 | 49.283 | 87.517 | -38.234 | Peak |
| 9648* | 32.95 | 0 | 100 | H | 37.26 | 5.82 | 27.21 | 48.823 | 88.537 | -39.714 | Peak |
| 9648* | 17.59 | 0 | 100 | V | 37.26 | 5.82 | 27.21 | 33.463 | 74.327 | -40.864 | Ave |
| 9648* | 17.63 | 0 | 100 | H | 37.26 | 5.82 | 27.21 | 33.503 | 75.517 | -42.014 | Ave |
| Middle CH 2437 MHz, measured at 3 meters | | | | | | | | | | | |
| 2437 | 74.86 | 197 | 100 | V | 28.73 | 3.25 | 0 | 106.837 | - | Fund. | Peak |
| 2437 | 75.46 | 91 | 100 | H | 28.73 | 3.25 | 0 | 107.437 | - | Fund. | Peak |
| 2437 | 61.84 | 197 | 100 | V | 28.73 | 3.25 | 0 | 93.817 | - | Fund. | Ave |
| 2437 | 63.14 | 91 | 100 | H | 28.73 | 3.25 | 0 | 95.117 | - | Fund. | Ave |
| 4874 | 37.9 | 290 | 111 | V | 32.77 | 4.06 | 27.76 | 46.967 | 74 | -27.033 | Peak |
| 4874 | 35.84 | 126 | 117 | H | 32.77 | 4.06 | 27.76 | 44.907 | 74 | -29.093 | Peak |
| 4874 | 22.14 | 290 | 111 | V | 32.77 | 4.06 | 27.76 | 31.207 | 54 | -22.793 | Ave |
| 4874 | 21.34 | 126 | 117 | H | 32.77 | 4.06 | 27.76 | 30.407 | 54 | -23.593 | Ave |
| 7311* | 31.57 | 0 | 100 | V | 36.59 | 4.88 | 27.67 | 45.373 | 86.837 | -41.464 | Peak |
| 7311* | 31.71 | 0 | 100 | H | 36.59 | 4.88 | 27.67 | 45.513 | 87.437 | -41.924 | Peak |
| 7311* | 17.56 | 0 | 100 | V | 36.59 | 4.88 | 27.67 | 31.363 | 73.817 | -42.454 | Ave |
| 7311* | 17.58 | 0 | 100 | H | 36.59 | 4.88 | 27.67 | 31.383 | 75.117 | -43.734 | Ave |
| 9748* | 30.51 | 0 | 100 | V | 37.15 | 5.77 | 27.16 | 46.273 | 86.837 | -40.564 | Peak |
| 9748* | 30.47 | 0 | 100 | H | 37.15 | 5.77 | 27.16 | 46.233 | 87.437 | -41.204 | Peak |
| 9748* | 17.62 | 0 | 100 | V | 37.15 | 5.77 | 27.16 | 33.383 | 73.817 | -40.434 | Ave |
| 9748* | 17.68 | 0 | 100 | H | 37.15 | 5.77 | 27.16 | 33.443 | 75.117 | -41.674 | Ave |

** Data was collected as noise floor*

| 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) | |
| High CH 2462 MHz, measured at 3 meters | | | | | | | | | | | |
| 2462 | 76.49 | 184 | 100 | V | 28.97 | 3.25 | 0 | 108.709 | - | Fund. | Peak |
| 2462 | 76.77 | 58 | 100 | H | 28.97 | 3.25 | 0 | 108.989 | - | Fund. | Peak |
| 2462 | 63.47 | 184 | 100 | V | 28.97 | 3.25 | 0 | 95.689 | - | Fund. | Ave |
| 2462 | 64.03 | 58 | 100 | H | 28.97 | 3.25 | 0 | 96.249 | - | Fund. | Ave |
| 2483.5 | 41.63 | 184 | 100 | V | 28.969 | 3.25 | 0 | 73.849 | 74 | -0.151 | Peak |
| 2483.5 | 41.65 | 58 | 100 | H | 28.969 | 3.25 | 0 | 73.869 | 74 | -0.131 | Peak |
| 2483.5 | 18.6 | 184 | 100 | V | 28.969 | 3.25 | 0 | 50.819 | 54 | -3.181 | Ave |
| 2483.5 | 19.01 | 58 | 100 | H | 28.969 | 3.25 | 0 | 51.229 | 54 | -2.771 | Ave |
| 4924 | 34.57 | 265 | 113 | V | 32.77 | 4.10 | 27.81 | 43.627 | 74 | -30.373 | Peak |
| 4924 | 36.82 | 18 | 125 | H | 32.77 | 4.10 | 27.81 | 45.877 | 74 | -28.123 | Peak |
| 4924 | 18.05 | 265 | 113 | V | 32.77 | 4.10 | 27.81 | 27.107 | 54 | -26.893 | Ave |
| 4924 | 20.81 | 18 | 125 | H | 32.77 | 4.10 | 27.81 | 29.867 | 54 | -24.133 | Ave |
| 7386* | 30.79 | 0 | 100 | V | 36.58 | 4.89 | 27.82 | 44.437 | 74 | -29.563 | Peak |
| 7386* | 31.82 | 0 | 100 | H | 36.58 | 4.89 | 27.82 | 45.467 | 74 | -28.533 | Peak |
| 7386* | 17.37 | 0 | 100 | V | 36.58 | 4.89 | 27.82 | 31.017 | 54 | -22.983 | Ave |
| 7386* | 17.45 | 0 | 100 | H | 36.58 | 4.89 | 27.82 | 31.097 | 54 | -22.903 | Ave |
| 9848* | 31.25 | 0 | 100 | V | 37.27 | 5.77 | 27.27 | 47.022 | 88.709 | -41.687 | Peak |
| 9848* | 31.4 | 0 | 100 | H | 37.27 | 5.77 | 27.27 | 47.172 | 88.989 | -41.817 | Peak |
| 9848* | 17.38 | 0 | 100 | V | 37.27 | 5.77 | 27.27 | 33.152 | 75.689 | -42.537 | Ave |
| 9848* | 17.61 | 0 | 100 | H | 37.27 | 5.77 | 27.27 | 33.382 | 76.249 | -42.867 | Ave |

** Data was collected as noise floor*

802.11n-HT20 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 CH 2412 MHz, measured at 3 meters | | | | | | | | | | | |
| 2412 | 72.61 | 187 | 100 | V | 28.73 | 3.12 | 0 | 104.457 | - | Fund. | Peak |
| 2412 | 74.13 | 52 | 100 | H | 28.73 | 3.12 | 0 | 105.977 | - | Fund. | Peak |
| 2412 | 59.87 | 187 | 100 | V | 28.73 | 3.12 | 0 | 91.717 | - | Fund. | Ave |
| 2412 | 61.53 | 52 | 100 | H | 28.73 | 3.12 | 0 | 93.377 | - | Fund. | Ave |
| 2390 | 37.33 | 187 | 100 | V | 28.7 | 3.12 | 0 | 69.177 | 74 | -4.823 | Peak |
| 2390 | 39.45 | 52 | 100 | H | 28.7 | 3.12 | 0 | 71.297 | 74 | -2.703 | Peak |
| 2390 | 14.66 | 187 | 100 | V | 28.7 | 3.12 | 0 | 46.507 | 54 | -7.493 | Ave |
| 2390 | 15.53 | 52 | 100 | H | 28.7 | 3.12 | 0 | 47.377 | 54 | -6.623 | Ave |
| 4824 | 39.09 | 290 | 100 | V | 32.55 | 4.06 | 27.91 | 47.787 | 74 | -26.213 | Peak |
| 4828 | 36.24 | 127 | 114 | H | 32.55 | 4.06 | 27.91 | 44.937 | 74 | -29.063 | Peak |
| 4828 | 23.23 | 290 | 100 | V | 32.55 | 4.06 | 27.91 | 31.927 | 54 | -22.073 | Ave |
| 4828 | 21.34 | 127 | 114 | H | 32.55 | 4.06 | 27.91 | 30.037 | 54 | -23.963 | Ave |
| 7236* | 31.59 | 0 | 100 | V | 36.37 | 4.93 | 27.65 | 45.243 | 84.457 | -39.214 | Peak |
| 7236* | 31.64 | 0 | 100 | H | 36.37 | 4.93 | 27.65 | 45.293 | 85.977 | -40.684 | Peak |
| 7236* | 17.42 | 0 | 100 | V | 36.37 | 4.93 | 27.65 | 31.073 | 71.717 | -40.644 | Ave |
| 7236* | 17.46 | 0 | 100 | H | 36.37 | 4.93 | 27.65 | 31.113 | 73.377 | -42.264 | Ave |
| Middle CH 2437 MHz, measured at 3 meters | | | | | | | | | | | |
| 2437 | 73.1 | 197 | 100 | V | 28.73 | 3.25 | 0 | 105.077 | - | Fund. | Peak |
| 2437 | 72.8 | 51 | 100 | H | 28.73 | 3.25 | 0 | 104.777 | - | Fund. | Peak |
| 2437 | 60.49 | 197 | 100 | V | 28.73 | 3.25 | 0 | 92.467 | - | Fund. | Ave |
| 2437 | 60.45 | 51 | 100 | H | 28.73 | 3.25 | 0 | 92.427 | - | Fund. | Ave |
| 4874 | 37.09 | 96 | 115 | V | 32.77 | 4.06 | 27.76 | 46.157 | 74 | -27.843 | Peak |
| 4874 | 39.53 | 64 | 115 | H | 32.77 | 4.06 | 27.76 | 48.597 | 74 | -25.403 | Peak |
| 4874 | 19.59 | 96 | 115 | V | 32.77 | 4.06 | 27.76 | 28.657 | 54 | -25.343 | Ave |
| 4874 | 23.01 | 64 | 115 | H | 32.77 | 4.06 | 27.76 | 32.077 | 54 | -21.923 | Ave |
| 7311* | 31.00 | 0 | 100 | V | 36.59 | 4.88 | 27.67 | 44.803 | 85.077 | -40.274 | Peak |
| 7311* | 32.11 | 0 | 100 | H | 36.59 | 4.88 | 27.67 | 45.913 | 84.777 | -38.864 | Peak |
| 7311* | 17.46 | 0 | 100 | V | 36.59 | 4.88 | 27.67 | 31.263 | 72.467 | -41.204 | Ave |
| 7311* | 17.53 | 0 | 100 | H | 36.59 | 4.88 | 27.67 | 31.333 | 72.427 | -41.094 | Ave |
| 9748* | 30.85 | 0 | 100 | V | 37.15 | 5.77 | 27.16 | 46.613 | 85.077 | -38.464 | Peak |
| 9748* | 30.47 | 0 | 100 | H | 37.15 | 5.77 | 27.16 | 46.233 | 84.777 | -38.544 | Peak |
| 9748* | 17.12 | 0 | 100 | V | 37.15 | 5.77 | 27.16 | 32.883 | 72.467 | -39.584 | Ave |
| 9748* | 17.09 | 0 | 100 | H | 37.15 | 5.77 | 27.16 | 32.853 | 72.427 | -39.574 | Ave |

** Data was collected as noise floor*

| 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) | |
| High CH 2462 MHz, measured at 3 meters | | | | | | | | | | | |
| 2462 | 73.16 | 193 | 100 | V | 28.97 | 3.25 | 0 | 105.379 | - | Fund. | Peak |
| 2462 | 74.21 | 108 | 100 | H | 28.97 | 3.25 | 0 | 106.429 | - | Fund. | Peak |
| 2462 | 61.38 | 193 | 100 | V | 28.97 | 3.25 | 0 | 93.599 | - | Fund. | Ave |
| 2462 | 63.78 | 108 | 100 | H | 28.97 | 3.25 | 0 | 95.999 | - | Fund. | Ave |
| 2483.5 | 40.99 | 193 | 100 | V | 28.969 | 3.25 | 0 | 73.209 | 74 | -0.791 | Peak |
| 2483.5 | 41.01 | 108 | 100 | H | 28.969 | 3.25 | 0 | 73.229 | 74 | -0.771 | Peak |
| 2483.5 | 16.4 | 193 | 100 | V | 28.969 | 3.25 | 0 | 48.619 | 54 | -5.381 | Ave |
| 2483.5 | 17.07 | 108 | 100 | H | 28.969 | 3.25 | 0 | 49.289 | 54 | -4.711 | Ave |
| 4924 | 32.23 | 0 | 100 | V | 32.77 | 4.10 | 27.81 | 41.287 | 74 | -32.713 | Peak |
| 4924 | 32.39 | 0 | 100 | H | 32.77 | 4.10 | 27.81 | 41.447 | 74 | -32.553 | Peak |
| 4924 | 17.62 | 0 | 100 | V | 32.77 | 4.10 | 27.81 | 26.677 | 54 | -27.323 | Ave |
| 4924 | 18.24 | 0 | 100 | H | 32.77 | 4.10 | 27.81 | 27.297 | 54 | -26.703 | Ave |
| 7386 | 32.51 | 0 | 100 | V | 36.58 | 4.89 | 27.82 | 46.157 | 74 | -27.843 | Peak |
| 7386 | 32.19 | 0 | 100 | H | 36.58 | 4.89 | 27.82 | 45.837 | 74 | -28.163 | Peak |
| 7386 | 17.4 | 0 | 100 | V | 36.58 | 4.89 | 27.82 | 31.047 | 54 | -22.953 | Ave |
| 7386 | 17.34 | 0 | 100 | H | 36.58 | 4.89 | 27.82 | 30.987 | 54 | -23.013 | Ave |
| 9848 | 30.85 | 0 | 100 | V | 37.27 | 5.77 | 27.27 | 46.622 | 85.379 | -38.757 | Peak |
| 9848 | 30.72 | 0 | 100 | H | 37.27 | 5.77 | 27.27 | 46.492 | 86.429 | -39.937 | Peak |
| 9848 | 16.94 | 0 | 100 | V | 37.27 | 5.77 | 27.27 | 32.712 | 73.599 | -40.887 | Ave |
| 9848 | 16.86 | 0 | 100 | H | 37.27 | 5.77 | 27.27 | 32.632 | 75.999 | -43.367 | Ave |

** Data was collected as noise floor*

# 9 FCC§15.247(a)(2) & IC RSS-210 §A8.2 – 6 dB & 99% Emission Bandwidth

## 9.1 Applicable Standard

According to FCC §15.247(a)(2) and IC RSS-210 A8.2 (a), 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

## 9.2 Measurement Procedure

The measurements are base on FCC KDB 558074 D01 DTS Meas Guidance v03r01: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 section 8: DTS bandwidth

## 9.3 Test Equipment List and Details

| Manufacturer | Description | Model No. | Serial No. | Calibration Date | Calibration Interval |
|---|---|---|---|---|---|
| Agilent | Spectrum Analyzer | E4446A | US44300386 | 2013-10-22 | 1 Year |

***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:** | 22 ºC |
| **Relative Humidity:** | 39 % |
| **ATM Pressure:** | 102.2 kPa |

*Testing was performed by Jeffrey Wu on 2014-01-02 in RF Site.*

## 9.5 Test Results

802.11 b mode:

| Channel | Frequency (MHz) | 6 dB Emission Bandwidth (MHz) | 99% Emission Bandwidth (MHz) | Limit (MHz) | Results |
|---|---|---|---|---|---|
| Low | 2412 | 8.591 | 12.9184 | >0.5 | Compliant |
| Middle | 2437 | 8.094 | 12.9276 | >0.5 | Compliant |
| High | 2462 | 8.549 | 12.9601 | >0.5 | Compliant |

802.11 g mode:

| Channel | Frequency (MHz) | 6 dB Emission Bandwidth (MHz) | 99% Emission Bandwidth (MHz) | Limit (MHz) | Results |
|---|---|---|---|---|---|
| Low | 2412 | 15.358 | 16.3118 | >0.5 | Compliant |
| Middle | 2437 | 15.156 | 16.2996 | >0.5 | Compliant |
| High | 2462 | 15.333 | 16.2853 | >0.5 | Compliant |

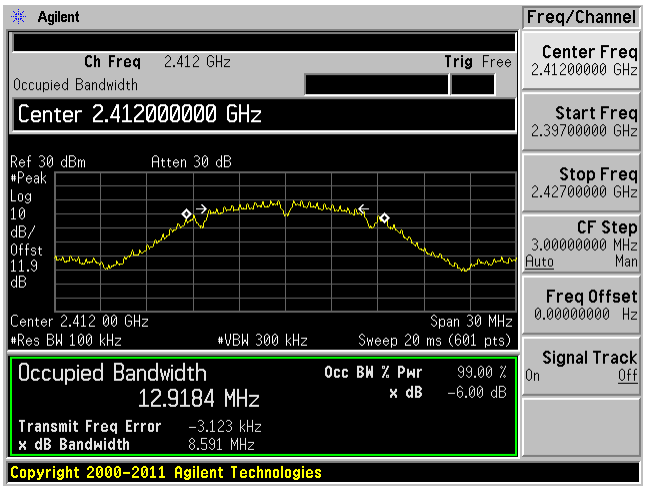
802.11n HT20 mode:

| Channel | Frequency (MHz) | 6 dB Emission Bandwidth (MHz) | 99% Emission Bandwidth (MHz) | Limit (MHz) | Results |
|---|---|---|---|---|---|
| Low | 2412 | 16.089 | 17.4564 | >0.5 | Compliant |
| Middle | 2437 | 16.090 | 17.4508 | >0.5 | Compliant |
| High | 2462 | 15.984 | 17.4570 | >0.5 | Compliant |

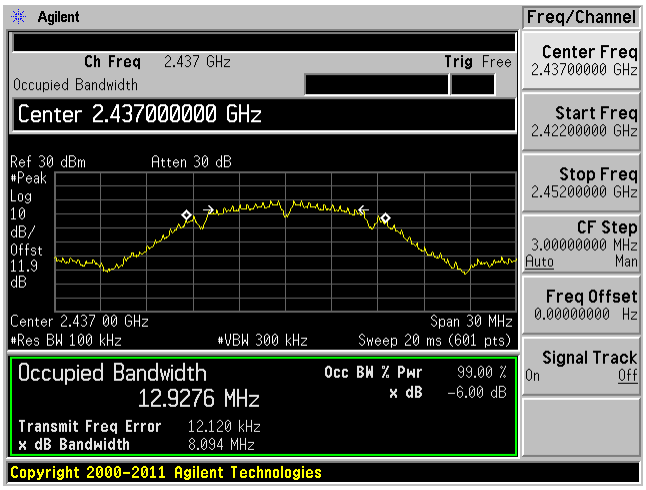
Please refer to the following plots for detailed test results

**802.11 b mode**

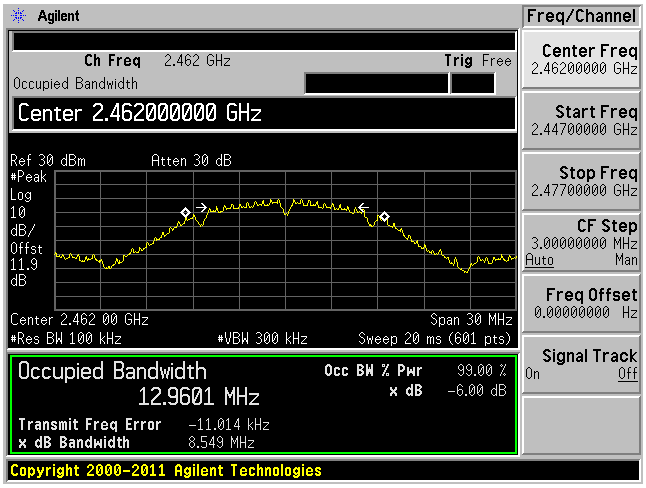
Low Channel, 2412 MHz




Middle Channel, 2437 MHz

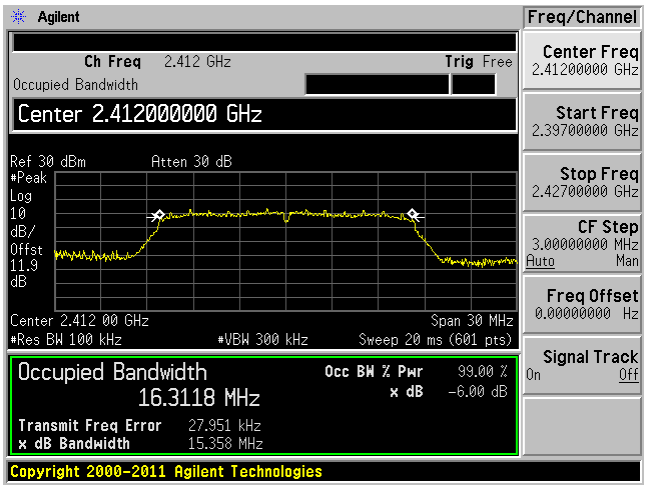



High Channel, 2462 MHz

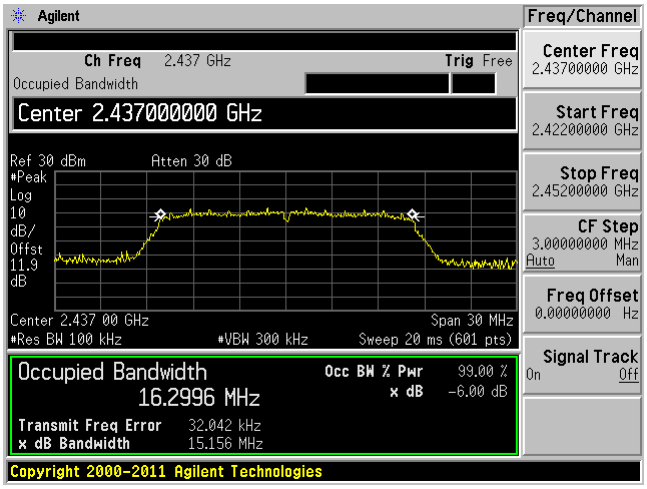


**802.11 g mode**

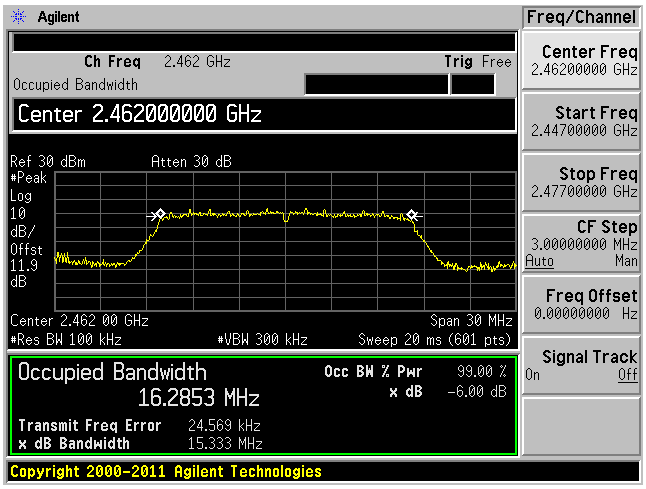
Low Channel, 2412 MHz




Middle Channel, 2437 MHz

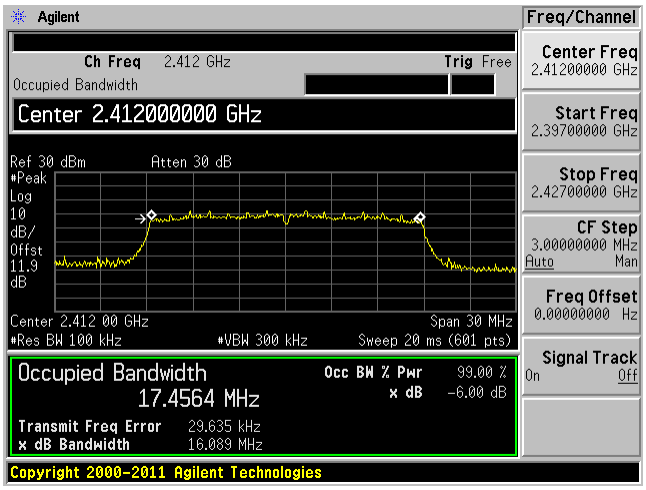



High Channel, 2462 MHz

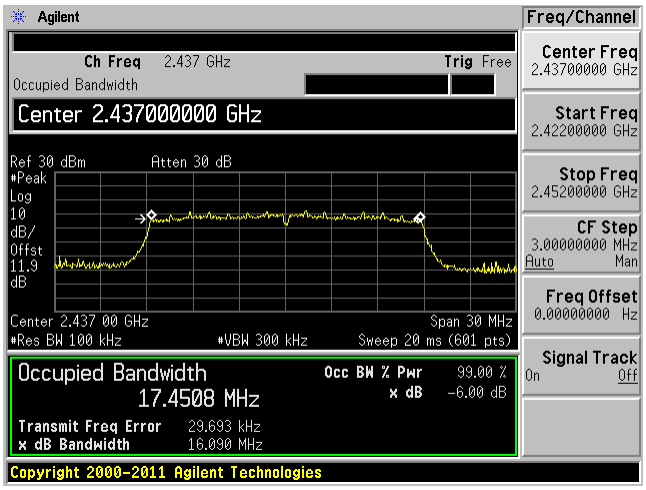


**802.11n-HT20 mode**

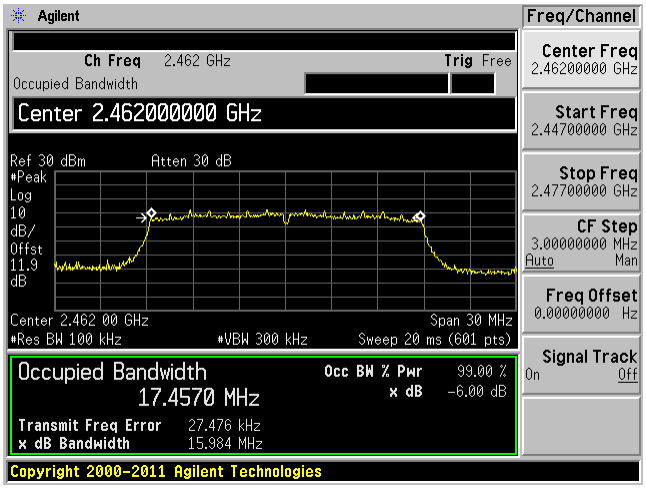
Low Channel, 2412 MHz




Middle Channel, 2437 MHz




High Channel, 2462 MHz



# 10 FCC §15.247(b) & IC RSS-210 §A8.4 – Peak Output Power Measurement

## 10.1 Applicable Standard

According to FCC §15.247(b) and IC RSS-210 §A8.4 (4) for systems using digital modulation in the 902~928 MHz, 2400~2483.5 MHz, and 5725~5850 MHz bands: 1 Watt.

## 10.2 Measurement Procedure

The measurements are base on FCC KDB 558074 D01 DTS Meas Guidance v03r01: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 section 9: Fundamental emission output power

## 10.3 Test Equipment List and Details

| Manufacturer | Description | Model No. | Serial No. | Calibration Date | Calibration Interval |
|---|---|---|---|---|---|
| Agilent | Spectrum Analyzer | E4446A | US44300386 | 2013-10-22 | 1 Year |

***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:** | 39 % |
| **ATM Pressure:** | 102.2 kPa |

*Testing was performed by Jeffrey Wu on 2014-01-02 in RF Site.*

## 10.5 Test Results

802.11b mode

| Channel | Frequency (MHz) | Conducted Output Power (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|
| Low | 2412 | 17.29 | 30 | -12.71 |
| Middle | 2437 | 17.12 | 30 | -12.88 |
| High | 2462 | 17.39 | 30 | -12.61 |

802.11g mode

| Channel | Frequency (MHz) | Conducted Output Power (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|
| Low | 2412 | 14.26 | 30 | -15.74 |
| Middle | 2437 | 14.35 | 30 | -15.65 |
| High | 2462 | 14.40 | 30 | -15.60 |

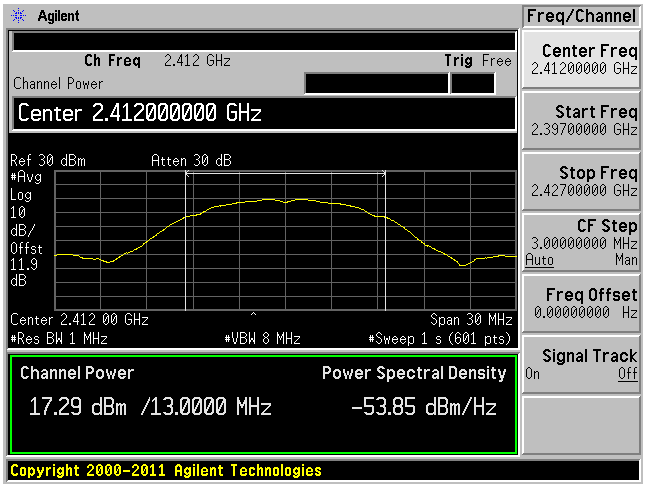
802.11n-HT20 mode

| Channel | Frequency (MHz) | Conducted Output Power (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|
| Low | 2412 | 12.97 | 30 | -17.03 |
| Middle | 2437 | 13.01 | 30 | -16.99 |
| High | 2462 | 13.39 | 30 | -16.61 |

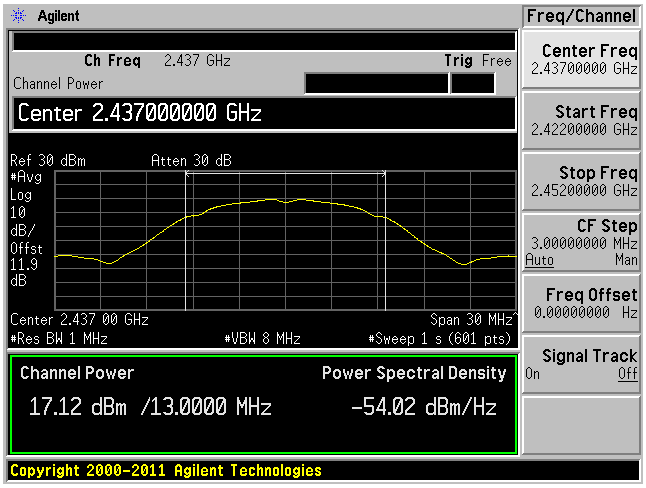
Please refer to the following plots for detailed test results

**802.11 b mode**

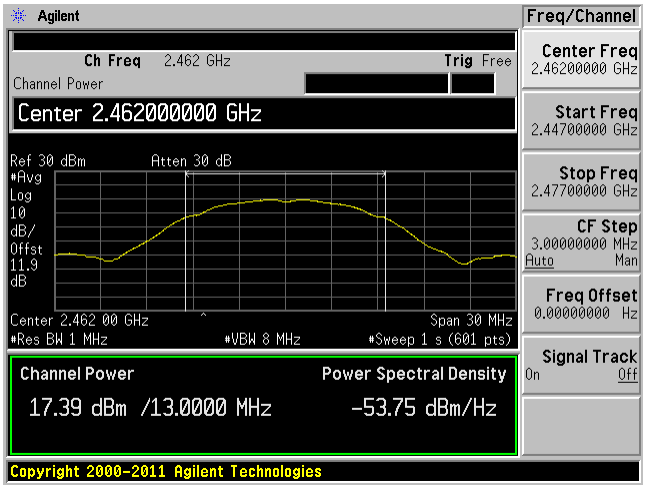
Low Channel, 2412 MHz




Middle Channel, 2437 MHz

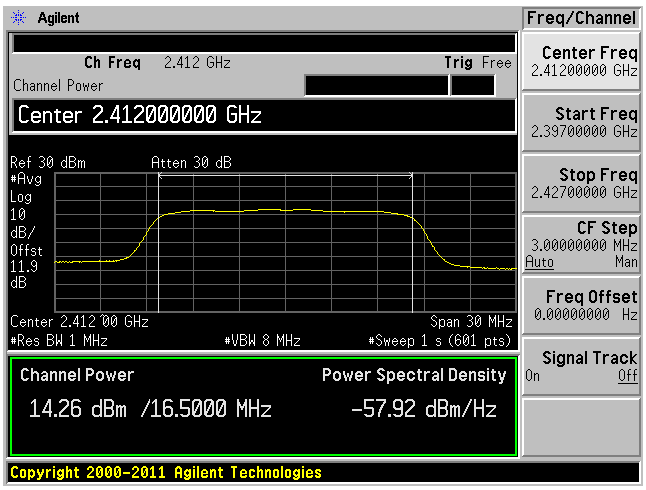



High Channel, 2462 MHz

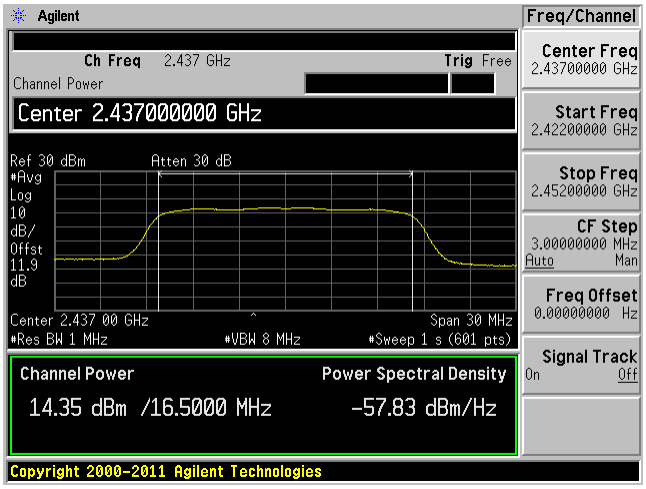


**802.11 g mode**

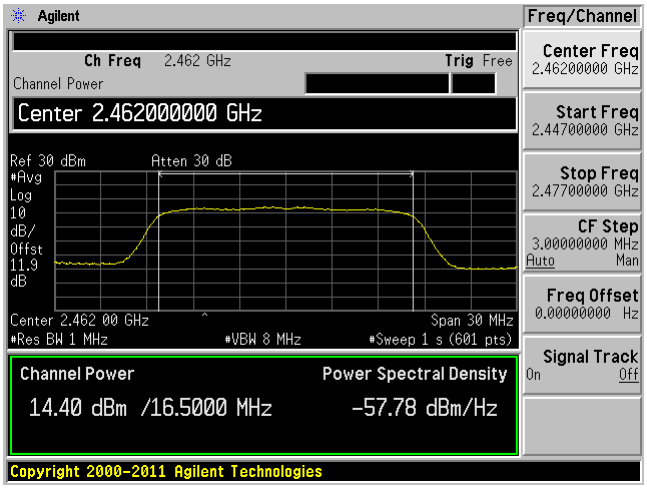
Low Channel, 2412 MHz




Middle Channel, 2437 MHz

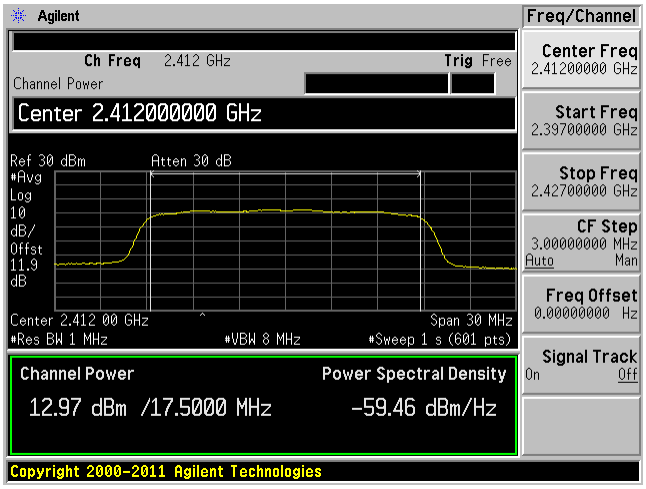



High Channel, 2462 MHz

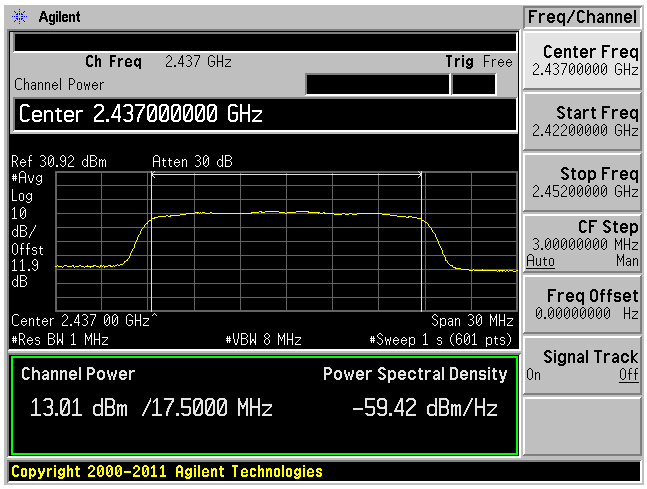


**802.11n-HT20 mode**

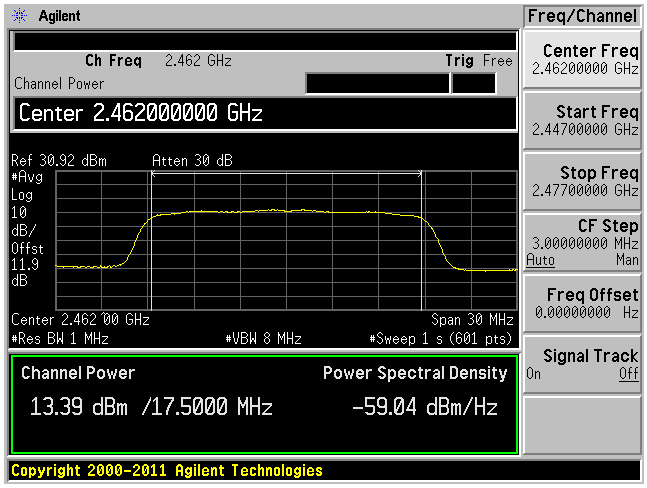
Low Channel, 2412 MHz




Middle Channel, 2437 MHz




High Channel, 2462 MHz



# 11 FCC §15.247(d) & IC RSS-210 §A8.5 – 100 kHz Bandwidth of Band Edges

## 11.1 Applicable Standard

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).

According to IC Rss-210 §A8.5, in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the radio frequency 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 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 section A8.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Tables 2 and 3 is not required.

## 11.2 Measurement Procedure

The measurements are base on FCC KDB 558074 D01 DTS Meas Guidance v03r01: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 section 13: Band-edge measurements

## 11.3 Test Equipment List and Details

| Manufacturer | Description | Model No. | Serial No. | Calibration Date | Calibration Interval |
|---|---|---|---|---|---|
| Agilent | Spectrum Analyzer | E4446A | US44300386 | 2013-10-22 | 1 Year |

***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:** | 22 ºC |
| **Relative Humidity:** | 39 % |
| **ATM Pressure:** | 102.2 kPa |

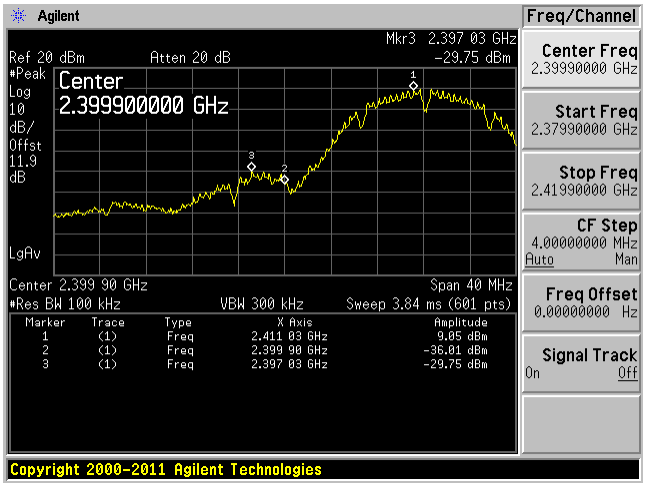
*Testing was performed by Jeffrey Wu on 2014-01-02 in RF Site.*

## 11.5 Test Results

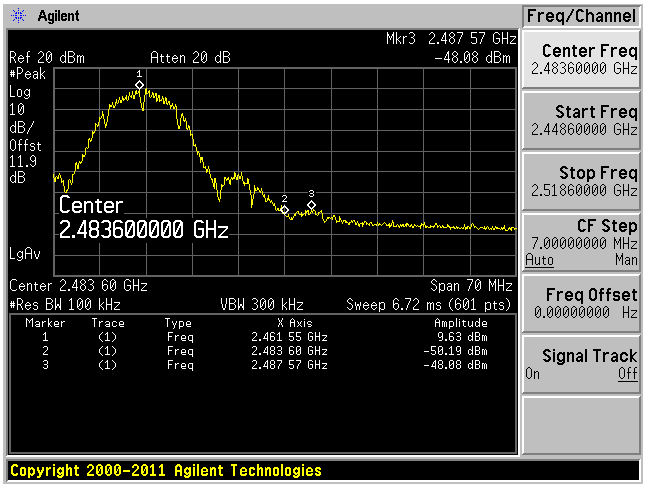
Please refer to following pages for plots of band edge.

## 802.11b mode

Lower Edge

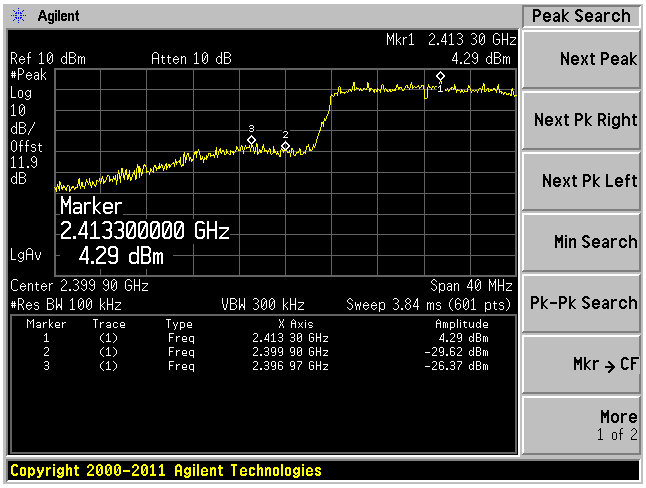



Higher Edge

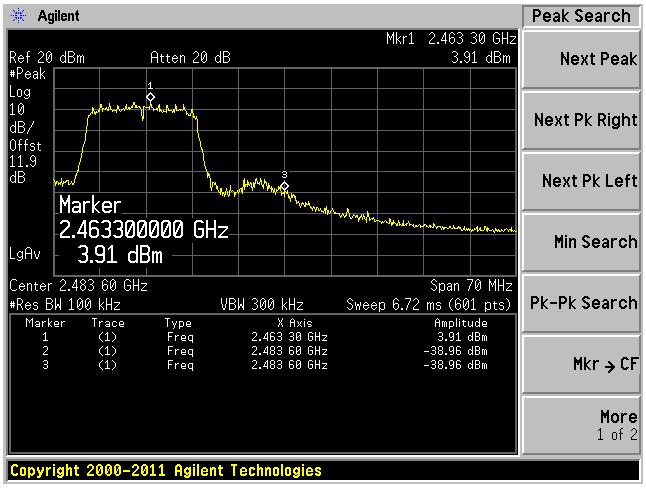



## 802.11g mode

Lower Edge

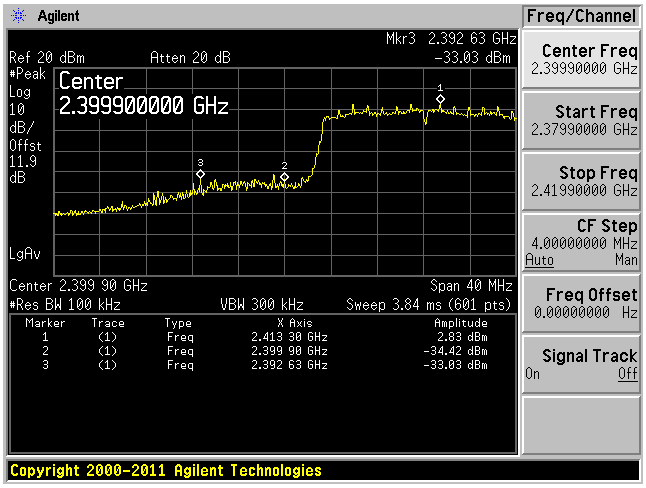



Higher Edge

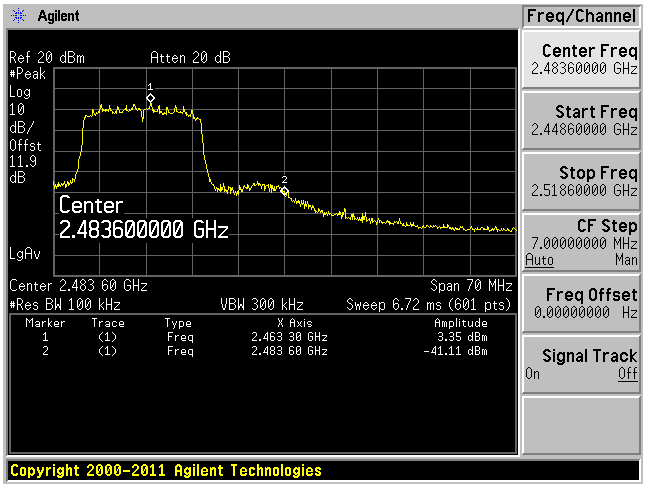


**802.11n-HT20 mode**

Lower Edge




Higher Edge



# 12 FCC §15.247(e) & IC RSS-210 §A8.2 (b) – Power Spectral Density

## 12.1 Applicable Standard

According to FCC §15.247(e) and RSS-210 §A8.2 ( b) , for digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

## 12.2 Measurement Procedure

The measurements are base on FCC KDB 558074 D01 DTS Meas Guidance v03r01: 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

## 12.3 Test Equipment List and Details

| Manufacturer | Description | Model No. | Serial No. | Calibration Date | Calibration Interval |
|---|---|---|---|---|---|
| Agilent | Spectrum Analyzer | E4446A | US44300386 | 2013-10-22 | 1 Year |

***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:** | 22 ºC |
| **Relative Humidity:** | 39 % |
| **ATM Pressure:** | 102.2 kPa |

*Testing was performed by Jeffrey Wu on 2014-01-02 in RF Site.*

## 12.5 Test Results

802.11b mode

| Channel | Frequency (MHz) | Conducted PSD (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|
| Low | 2412 | -3.56 | 8 | -11.56 |
| Middle | 2437 | -5.44 | 8 | -13.44 |
| High | 2462 | -4.22 | 8 | -12.22 |

802.11g mode

| Channel | Frequency (MHz) | Conducted PSD (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|
| Low | 2412 | -10.07 | 8 | -18.07 |
| Middle | 2437 | -9.12 | 8 | -17.12 |
| High | 2462 | -8.85 | 8 | -16.85 |

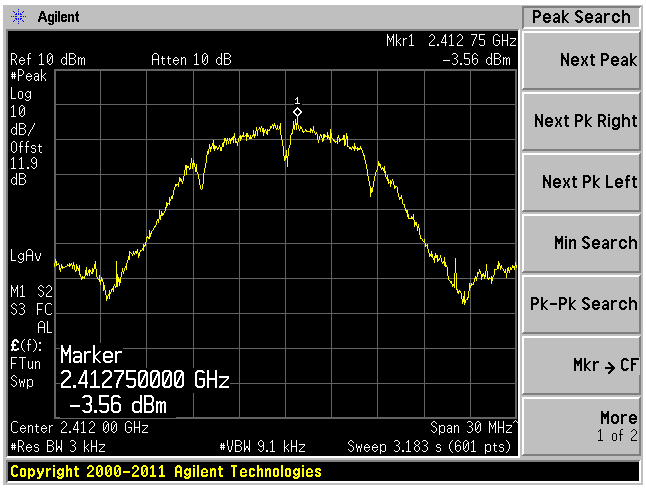
802.11n-HT20 mode

| Channel | Frequency (MHz) | Conducted PSD (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|
| Low | 2412 | -9.57 | 8 | -17.57 |
| Middle | 2437 | -10.88 | 8 | -18.88 |
| High | 2462 | -9.95 | 8 | -17.95 |

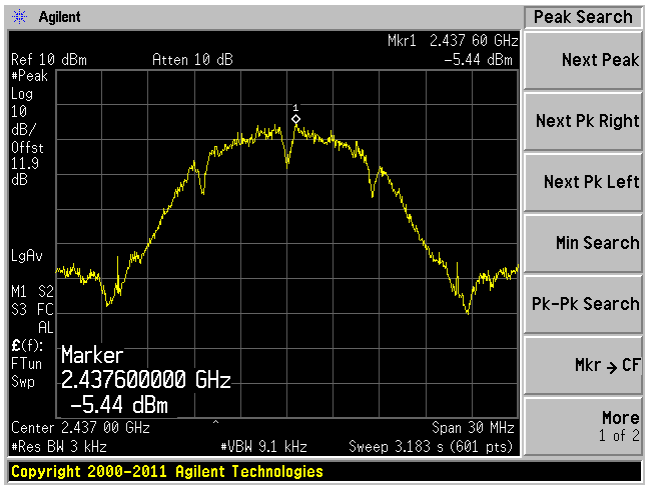
Please refer to the following plots for detailed test results

**802.11 b mode**

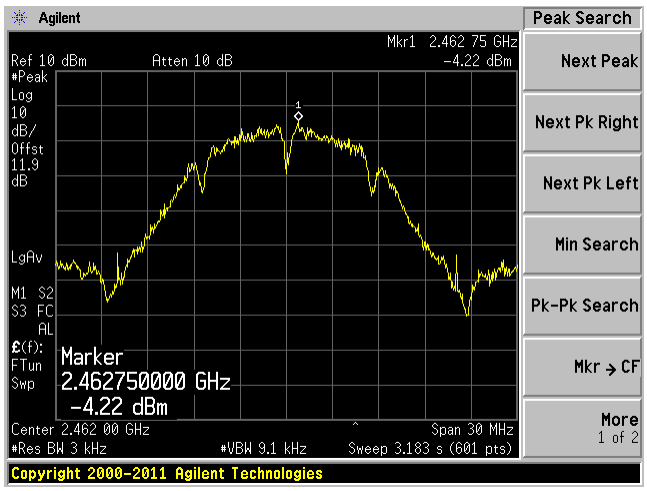
Low Channel, 2412 MHz




Middle Channel, 2437 MHz

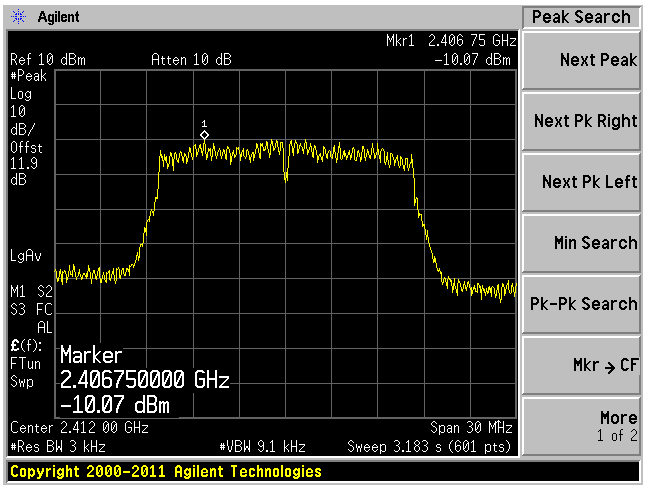



High Channel, 2462 MHz

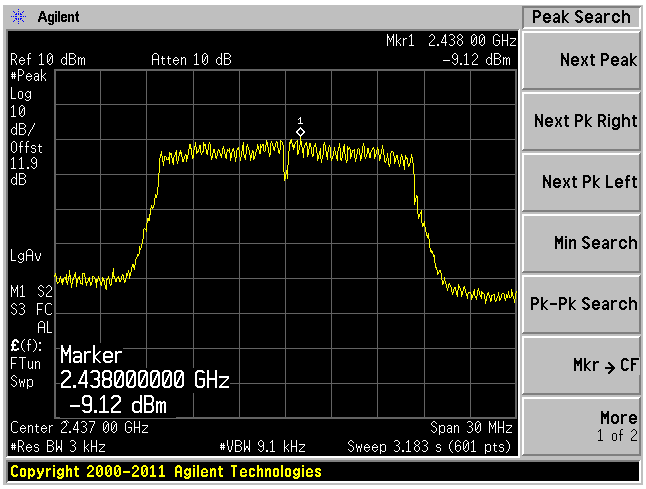


**802.11 g mode**

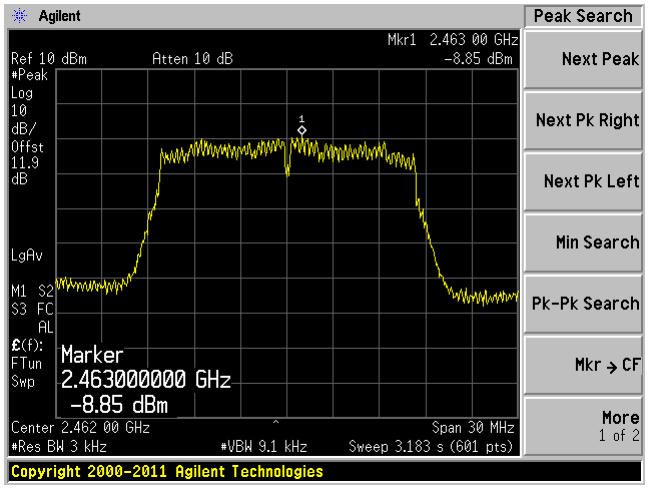
Low Channel, 2412 MHz




Middle Channel, 2437 MHz

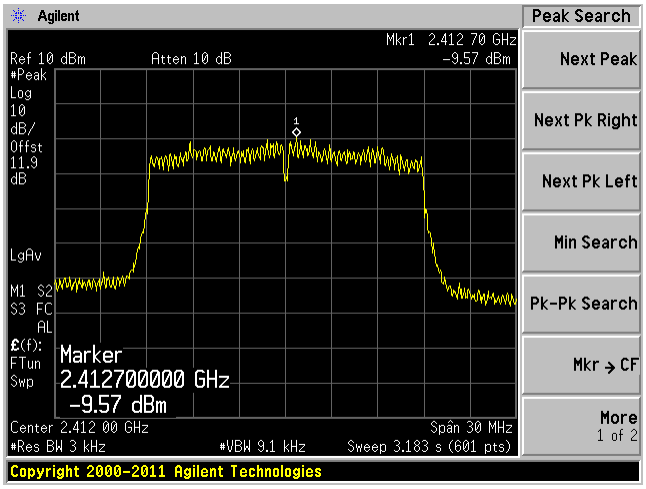



High Channel, 2462 MHz

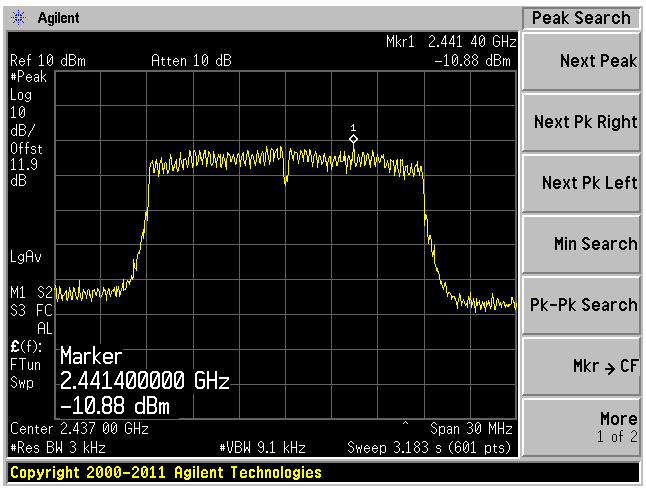


**802.11n-HT20 mode**

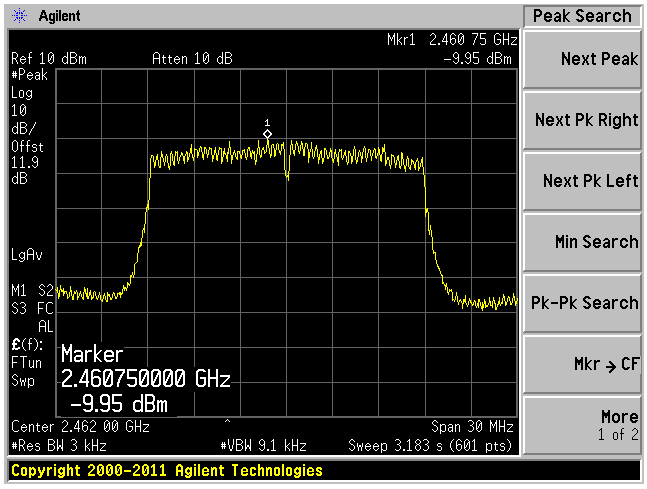
Low Channel, 2412 MHz




Middle Channel, 2437 MHz




High Channel, 2462 MHz



# 13 IC RSS-210 §2.3 & RSS-Gen §4.10 – Receiver Spurious Radiated Emissions

## 13.1 Applicable Standard

According to IC RSS-Gen §4.10, the receiver shall be operated in the normal receive mode near the mid-point of the band over which the receiver is designed to operate.

Unless otherwise specified in the applicable RSS, the radiated emission measurement is the standard measurement method (with the device's antenna in place) to measure receiver spurious emissions.

Radiated emission measurements are to be performed using a calibrated open-area test site.

For either method, the search for spurious emissions shall be from the lowest frequency internally generated or used in the receiver (e.g. local oscillator, intermediate or carrier frequency), or 30 MHz, whichever is the higher, to at least 3 times the highest tuneable or local oscillator frequency, whichever is the higher, without exceeding 40 GHz.

For emissions below 1 GHz, measurements shall be performed using a CISPR quasi-peak detector and the related measurement bandwidth. As an alternative to CISPR quasi-peak measurement, compliance with the emission limit can be demonstrated using measuring equipment employing a peak detector with the same measurement bandwidth as that for CISPR quasi-peak measurements. Above 1 GHz, measurements shall be performed using an average detector and a resolution bandwidth of 300 kHz to 1 MHz.

According to RSS-Gen §6.1, Tables 2 show the general field strength limits of receiver spurious emissions

Table 2: Radiated Limits of Receiver Spurious Emissions

| Frequency (MHz) | Field Strength (Microvolts/m at 3 meters) |
|---|---|
| 30-88 | 100 |
| 88-216 | 150 |
| 216-960 | 200 |
| Above 960 | 500 |

## 13.2 EUT Setup

The radiated emissions tests were performed in the 3 meter chamber, using the setup in accordance with ANSI C63.4-2009.

## 13.3 Test Procedure

Maximizing procedure was performed on the six (6) highest emissions to ensure EUT compliance is with all installation combinations.

All data were recorded in the peak detection mode. Quasi-peak readings was performed only when an emissions was found to be marginal (within -4 dB of specification limits), and are distinguished with a "**QP**" in the data table.

## 13.4 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 the indicated Amplitude (Ai) reading. The basic equation is as follows:

CA = Ai + AF + CL + Atten – Ga

For example, the Corrected Amplitude (CA) of 40.3 dBuV/m = indicated Amplitude reading (Ai) 32.5 dBuV + Antenna Factor (AF) 23.5dB + Cable Loss (CL) 3.7 dB + Attenuator (Atten) 10 dB - Amplifier Gain (Ga) 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 for Class A. The equation for margin calculation is as follows:

Margin (dB) = Corrected Amplitude (dBuV/m) - Limit (dBuV/m)

## 13.5 Test Equipment Lists and Details

| Manufacturer | Description | Model No. | Serial No. | Calibration Date | Calibration Interval |
|---|---|---|---|---|---|
| Agilent | Spectrum Analyzer | E4446A | US44300386 | 2013-10-22 | 1 Year |
| Sounol Sciences | Horn Antenna | DRH-118 | A052704 | 2013-03-07 | 1 Year |
| Mini-Circuits | Pre-amplifier | ZVA-183-S | 570400946 | 2013-05-09 | 1 Year |
| Rohde & Schwarz | Test Receiver | ESCI 1166.5950K03 | 100337 | 2013-03-28 | 1 Year |
| Sunol Sciences | Biconi-Log Antenna | JB3 | A020106-2 | 2013-08-12 | 1 Year |
| Agilent | Pre-amplifier | 8447D | 2944A10187 | 2013-03-08 | 1 Year |
| Sunol Sciences | System Controller | SC104V | 113005-1 | N/A | N/A |

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

## 13.6 Test Environmental Conditions

| | |
|---|---|
| **Temperature:** | 21 º C |
| **Relative Humidity:** | 33 % |
| **ATM Pressure:** | 102.2 kPa |

*Testing was performed by Jeffrey Wu on 2013-12-26 in chamber 5m3.*

## 13.7 Summary of Test Results

According to the test data, the EUT complied with the RSS-210, with the closest margins from the limit listed below:

**30 MHz-1 GHz**

| Mode: Receiving | | | |
|---|---|---|---|
| **Margin (dB)** | **Frequency (MHz)** | **Polarization (Horizontal/Vertical)** | **Range (MHz)** |
| -5.15 | 780.0455 | Horizontal | 30-1000 |

**1-12.75 GHz**

| Mode: Receiving | | | |
|---|---|---|---|
| **Margin (dB)** | **Frequency (MHz)** | **Polarization (Horizontal/Vertical)** | **Range (MHz)** |
| -9.423 | 2437 | Vertical | 1000-12750 |

## 13.8 Test Results

1) 30-1000 MHz, Measured at 3 meters

| Frequency (MHz) | Corrected Amplitude (dBµV/m) | Antenna Height (cm) | Antenna Polarity (H/V) | Turntable Azimuth (degrees) | Limit (dBµV/m) | Margin (dB) | Comment |
|---|---|---|---|---|---|---|---|
| 59.828 | 19.99 | 196 | V | 231 | 40 | -20.01 | QP |
| 196.6043 | 35.82 | 100 | V | 360 | 43.5 | -7.68 | QP |
| 504.8248 | 27.98 | 133 | H | 0 | 46 | -18.02 | QP |
| 593.1698 | 30.67 | 174 | H | 78 | 46 | -15.33 | QP |
| 729.457 | 22.35 | 100 | V | 11 | 46 | -23.65 | QP |
| 780.0455 | 40.85 | 102 | H | 242 | 46 | -5.15 | QP |

2) Above 1 GHz Measured at 3 meters

| Frequency (MHz) | Corrected Amplitude (dBµV/m) | Antenna Height (cm) | Antenna Polarity (H/V) | Turntable Azimuth (degrees) | Limit (dBµV/m) | Margin (dB) | Comment |
|---|---|---|---|---|---|---|---|
| 2437 | 43.72 | 111 | V | 180 | 74 | -26.613 | Peak |
| 2437 | 42.62 | 124 | H | 317 | 74 | -27.713 | Peak |
| 2437 | 40.91 | 111 | V | 180 | 54 | -9.423 | Ave |
| 2437 | 39.48 | 124 | H | 317 | 54 | -10.853 | Ave |

# 14 Exhibit A – FCC & IC Equipment Labeling Requirements

## 14.1 FCC ID Label Requirements

**As per FCC §2.925,**

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

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

Example: FCC ID: XXX123

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

**As per FCC §15.19**,

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

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

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

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

## 14.2 IC Label Requirements

As per IC RSS-Gen §5.2, the certification number shall appear as follows:

IC: XXXXXX-YYYYYYYY

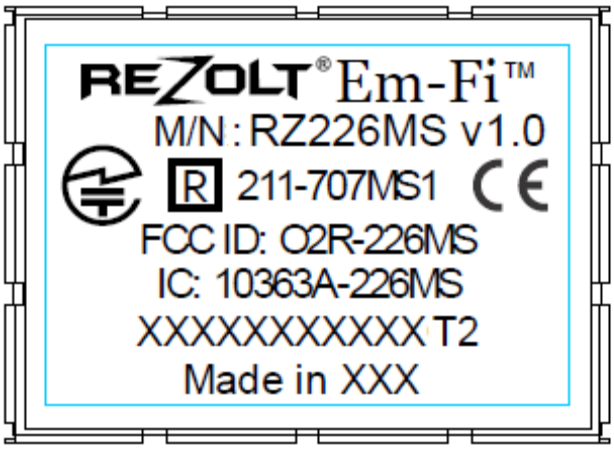
Where:

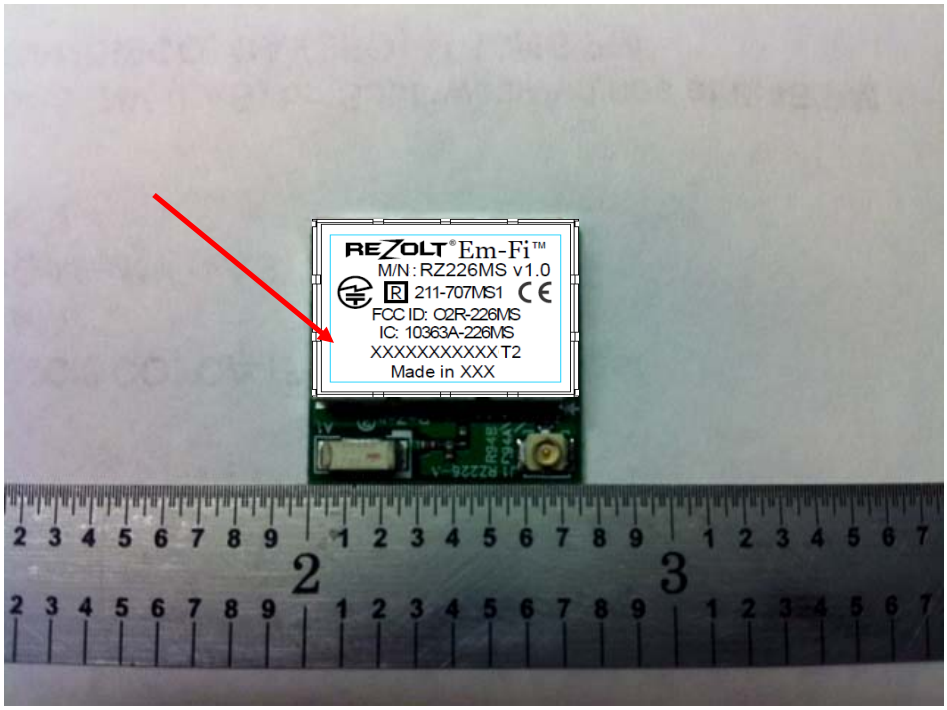
- "XXXXXX-YYYYYYYY" is the certification number
- "XXXXXX" is the Certificate Holder Number (CHN), made of at most 6 alphanumeric characters (A-Z, 0-9), assigned by Industry Canada; and
- "YYYYYYYY" is the Unique Product Number (UPN), made of at most 11 alphanumeric characters (A-Z, 0-9) assigned by the applicant.
- Note 1: The term "IC" before the equipment certification number only signifies that the Industry Canada technical specifications were met.
- Note 2: Note 1 shall be conspicuously placed in the equipment user manual.
- Note 3: Permitted alphanumeric characters used in the CHN and UPN are limited to capital letters (A-Z) and digits (0-9). Other characters, such as "#", "/" or "-", shall not be used.

**As per RSS-Gen §5.2 Equipment Labeling:**

Equipment subject to certification under the applicable RSS, shall be permanently labeled on each item, or as an inseparable combination. The label must contain the following information for full compliance:
(a) the certification number, prefixed by the term "IC:";
(b) the manufacturer's name, trade name or brand name; and
(c) a model name or number.
Equipment for which a certificate has been issued is not considered certified if it is not properly labeled.
The information on the Canadian label can be combined with the manufacturer's other labeling requirements.
If the device size is too small to put a label, the label can be included in the user's manual, upon agreement with Industry Canada.

## 14.3 FCC ID & IC Label Contents and Location

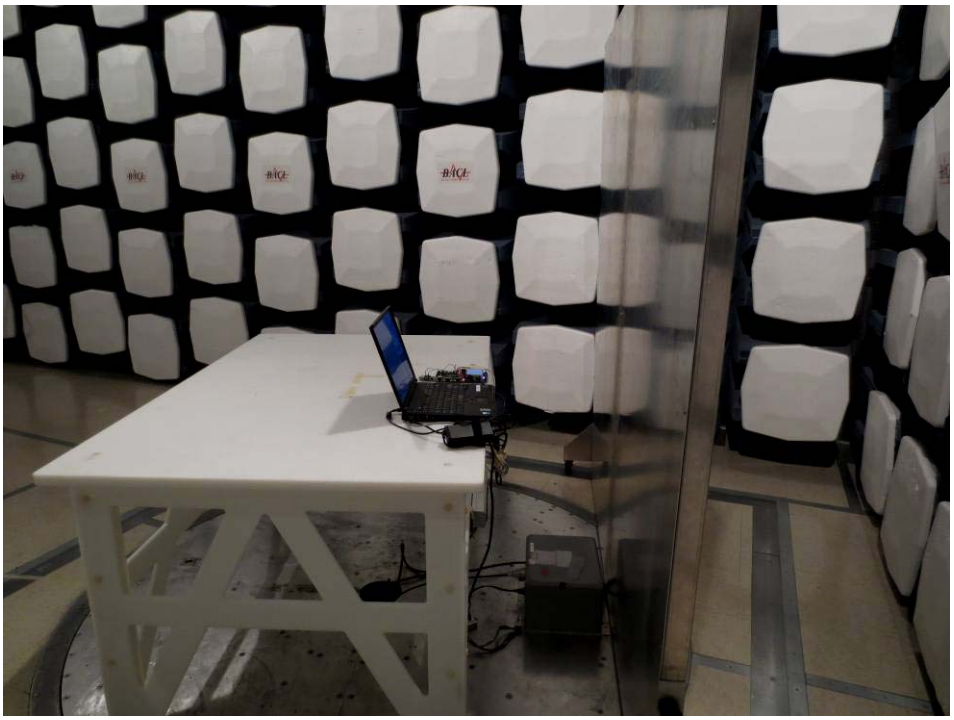


# 15 Exhibit B – Test Setup Photographs

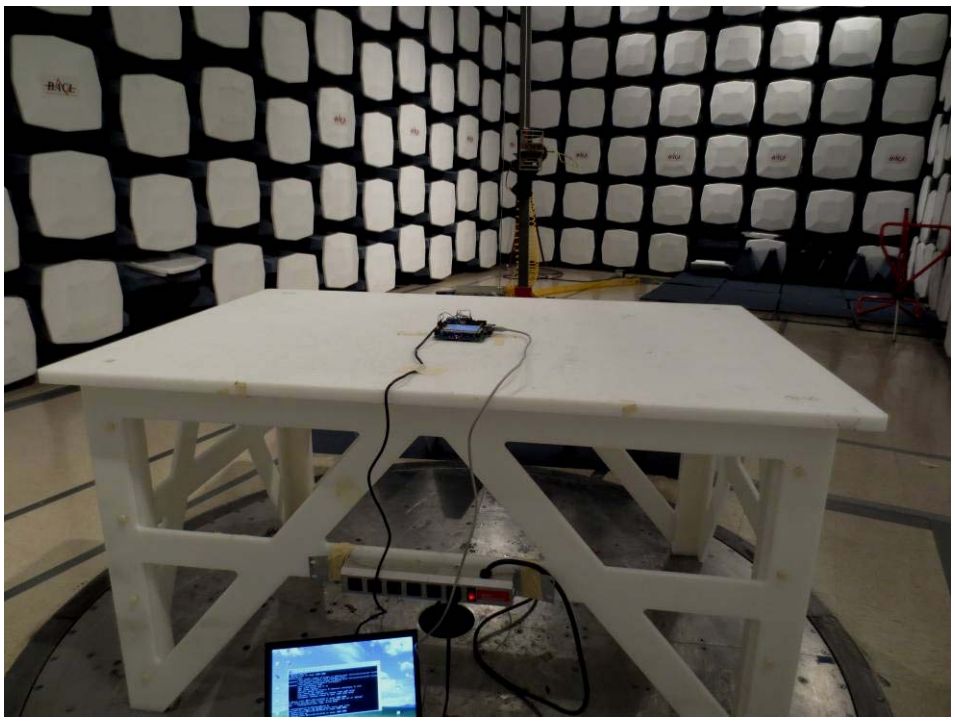
## 15.1 Conducted Emissions - Front View

## 15.2 Conducted Emissions - Side View

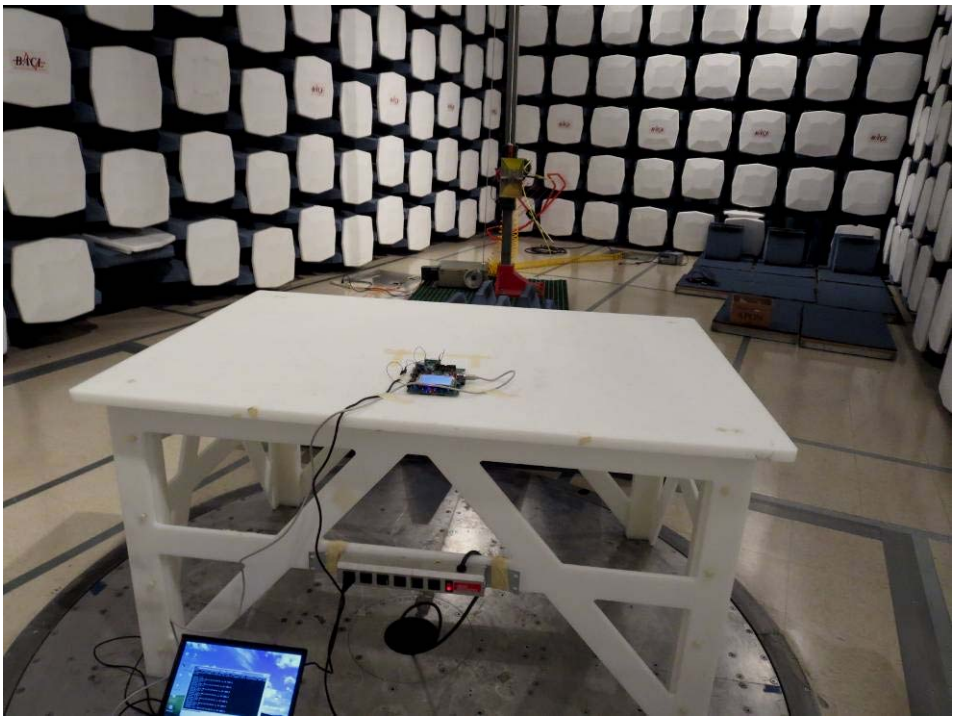


## 15.3 Radiated Emission Front View at 3 Meter

## 15.4 Radiated Emission below 1 GHz Rear View at 3 Meter

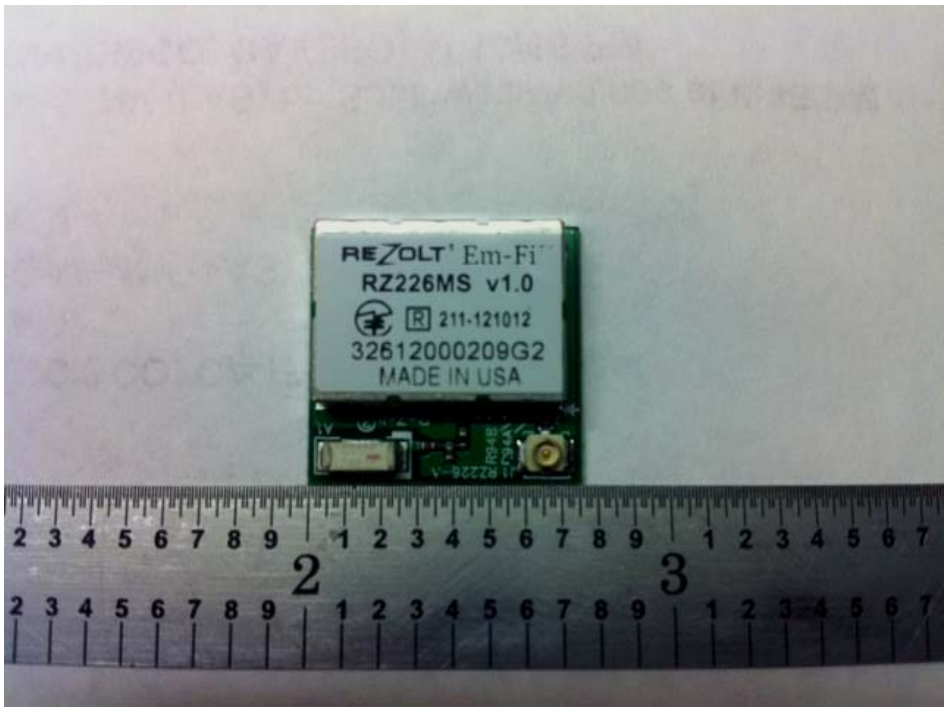


## 15.5 Radiated Emission above 1 GHz Rear View at 3 Meter

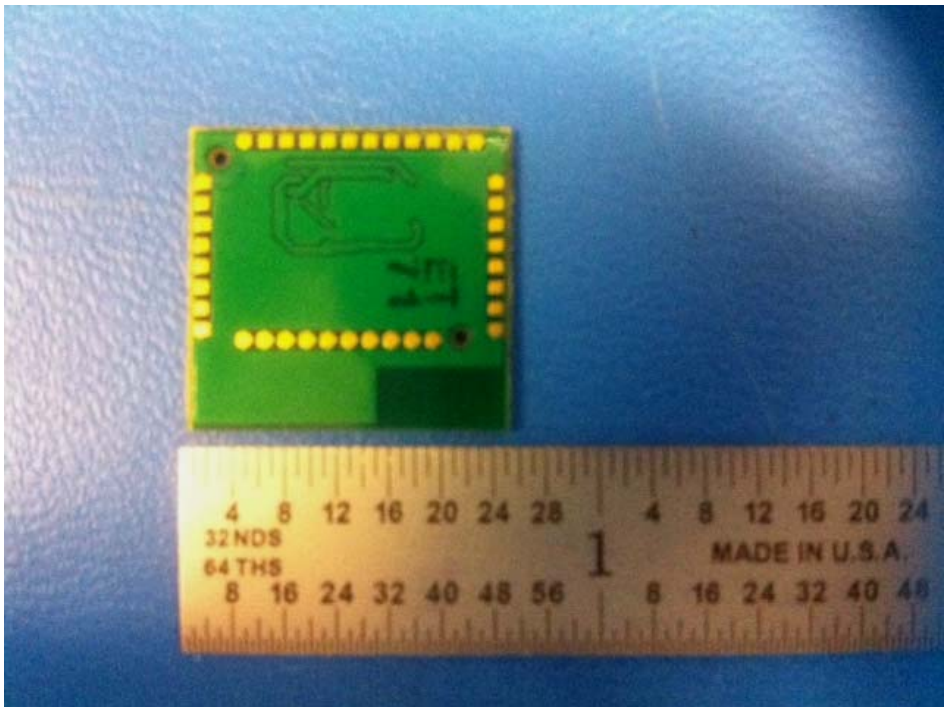


# 16 Exhibit C – EUT Photographs

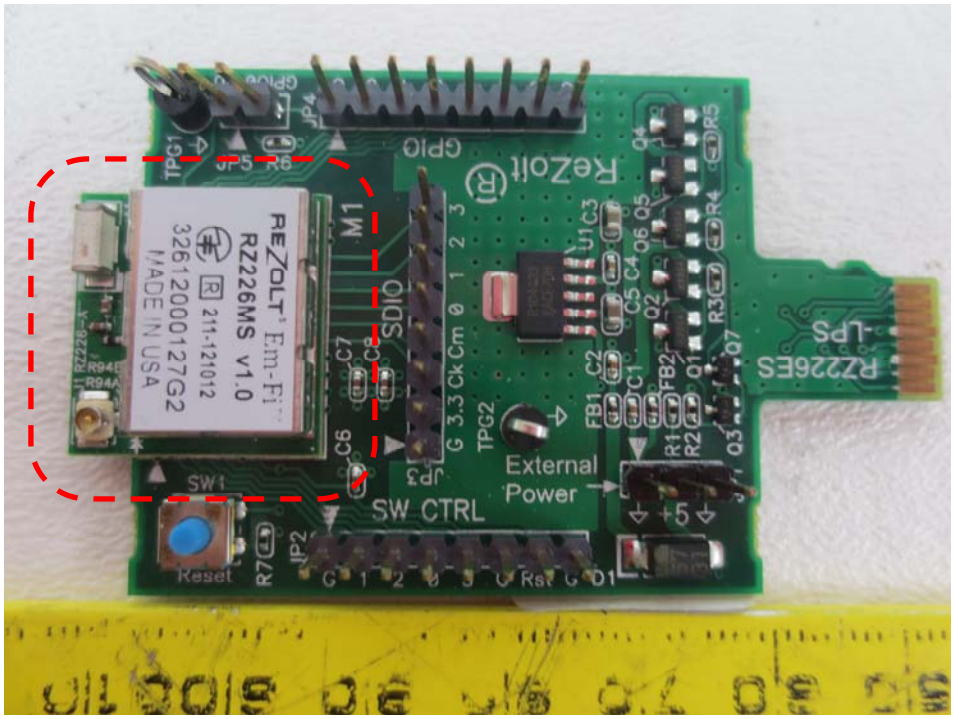
## 16.1 EUT Front View



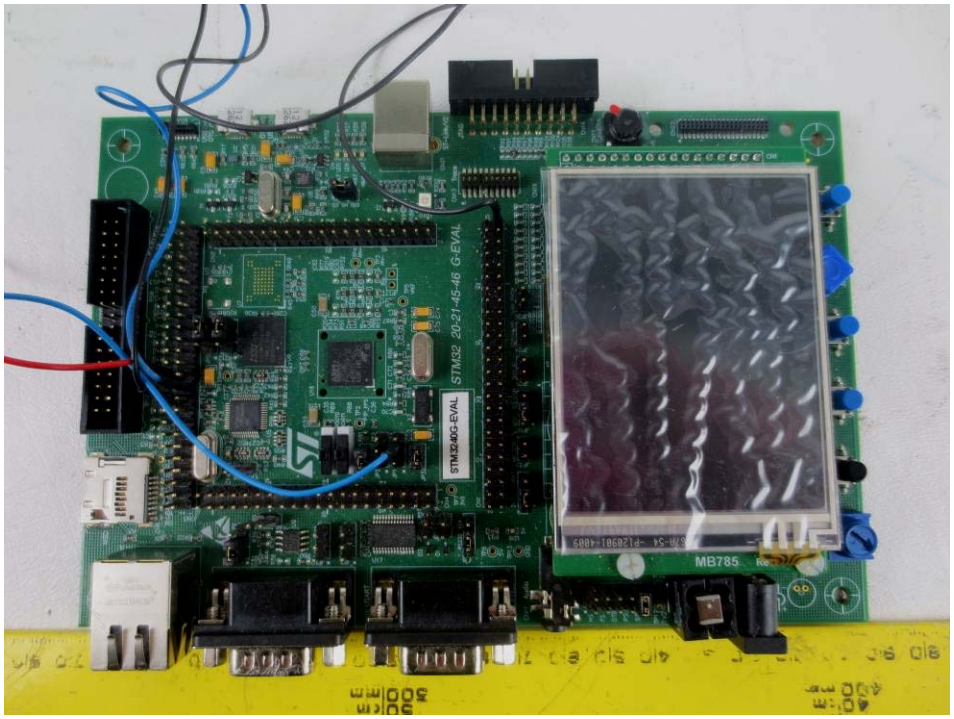

## 16.2 EUT Back View



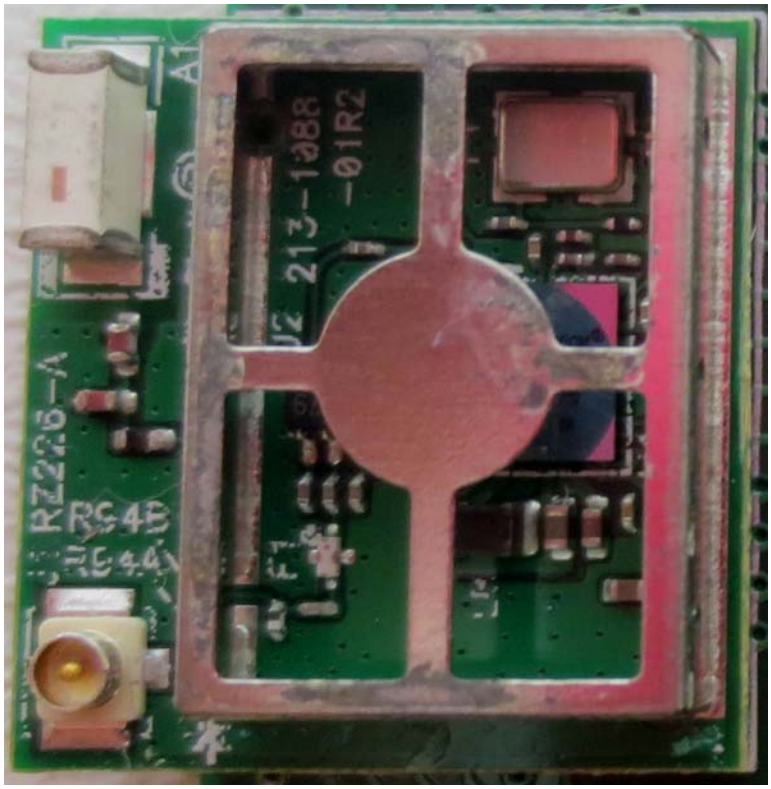
## 16.3 EUT on the Support Board 1 View




## 16.4 Support Board 2 View



## 16.5 EUT Shielding off View

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