Excellence in Compliance Testing

# Certification Test Report

## FCC ID: VRA-SG9011098

## FCC Rule Part: 15.247
## IC Radio Standards Specification: RSS-210

## ACS Report Number: 11-2058.W03.12.C

Manufacturer: Sagrad
Model: SG901-1098

Test Begin Date: **June 29, 2011**
Test End Date: **October 21, 2011**

Report Issue Date: October 28, 2011

ACCREDITED
TESTING

FOR THE SCOPE OF ACCREDITATION UNDER CERTIFICATE NUMBER AT-1533

This report must not be used by the client to claim product certification, approval, or endorsement by ACLASS, ANSI, or any agency of the Federal Government.


**Project Manager:**

**Thierry Jean-Charles**
**EMC Engineer**
**Advanced Compliance Solutions, Inc.**

**Reviewed by:**

**Kirby Munroe**
**Director, Wireless Certifications**
**Advanced Compliance Solutions, Inc.**




**This report contains 53 pages**

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# 1 GENERAL

## 1.1 Purpose

The purpose of this report is to demonstrate compliance with Part 15 Subpart C of the FCC's Code of Federal Regulations and Industry Canada's Radio Standards Specification for modular approval.

## 1.2 Product description

The Sagrad SG901-1098 is a 802.11b/g/n module which is designed to be used with different types of processors and in different types of applications. The module is a fully integrated wireless radio including a RF synthesizer/VCO, high speed data converters, digital baseband processors, power management and power amplifier.

Technical Details:

| | |
|---|---|
| Operating Range: | 2412GHz – 2462MHz |
| Number of Channels: | 11 |
| Modulation: | 802.11b: DSSS (BPSK / QPSK / CCK);<br>802.11g: OFDM (BPSK / QPSK / 16QAM / 64QAM)<br>802.11n: OFDM (BPSK / QPSK / 16QAM / 64QAM) |
| Data Rate: | 802.11b: 11, 5.5, 2, 1 Mbps;<br>802.11g: 54, 48, 36, 24, 18, 12, 9, 6 Mbps;<br>802.11n: 65, 58.5, 52, 39, 26, 19.5, 13, 6.5 Mbps |
| RF Connector: | U-FL. |
| Antenna / Gain: | Sagrad 3.8 dBi SG901-1066 PCB antenna, 2.4 - 2.5 GHz<br>Pulse 3.2 dBi W1037 1/4 dipole antenna, 2.4 - 2.5 GHz<br>Pulse 4.9 dBi W1038 1/4 dipole antenna, 2.4 - 2.5 GHz |
| Input Voltage: | 3.5 VDC |

Manufacturer Information:
Sagrad, Inc.
751 North Drive, Suite 10
Melbourne, FL 32934-9289
Phone: (321) 255-0513

Test Sample Serial Number(s): N/A

Test Sample Condition: The sample provided was in good operating condition with no noticeable physical damage.

### 1.3 Test Methodology and Considerations

The Sagrad SG901-1098 was evaluated for compliance to the radiated and RF conducted emissions requirements at three channels corresponding to the lower, middle and higher channels operating in the 2.4 GHz ISM band for all three available modes of operation. The unit was connected to an evaluation board through a SDIO board.

Additionally, the radiated spurious emissions evaluation was performed with the SG901-1098 in two antenna configurations: W1038 Pulse external antenna and an SG901-1066 Sagrad PCB antenna. The EUT was setup in the orientation of typical installation. The table below reports the EUT configurations leading to the highest emissions.

**Table 1.3-1: EUT Evaluation Configuration**

| Mode of Operation | Channel | Frequency (MHz) | Test Utility Power Setting (dBm) | Data Rates |
|---|---|---|---|---|
| 802.11b | 1 | 2412 | 10 | 1 Mbps |
| | 6 | 2437 | 10 | |
| | 11 | 2462 | 10 | |
| 802.11g | 1 | 2412 | 13 | 6 Mbps |
| | 6 | 2437 | 18 | |
| | 11 | 2462 | 12 | |
| 802.11n | 1 | 2412 | 13 | 6.5 Mbps |
| | 6 | 2437 | 18 | |
| | 11 | 2462 | 12 | |

The unintentional emissions data for the evaluation of the SG902-1098 are reported separately in a verification report.

# 2 TEST FACILITIES

## 2.1 Location

The radiated and conducted emissions test sites are located at the following address:

Advanced Compliance Solutions, Inc.
3998 FAU Blvd, Suite 310
Boca Raton, Florida 33431
Phone: (561) 961-5585
Fax: (561) 961-5587
www.acstestlab.com

FCC Test Firm Registration #: 587595
Industry Canada Lab Code: 4175C

## 2.2 Laboratory Accreditations/Recognitions/Certifications

ACS is accredited to ISO/IEC 17025 by ANSI-ASQ National Accreditation Board under their ACLASS program and has been issued certificate number AT-1533 in recognition of this accreditation. Unless otherwise specified, all test methods described within this report are covered under the ISO/IEC 17025 scope of accreditation.

## 2.3 Radiated & Conducted Emissions Test Site Description

### 2.3.1 Semi-Anechoic Chamber Test Site

The EMC radiated test facility consists of an RF-shielded enclosure. The interior dimensions of the indoor semi-anechoic chamber are approximately 48 feet (14.6 m) long by 36 feet (10.8 m) wide by 24 feet (7.3 m) high and consist of rigid, 1/8 inch (0.32 cm) steel-clad, wood core modular panels with steel framing. In the shielded enclosure, the faces of the panels are galvanized and the chamber is self-supporting. 8-foot RF absorbing cones are installed on 4 walls and the ceiling. The steel-clad ground plane is covered with vinyl floor.

The turntable is driven by pneumatic motor, which is capable of supporting a 2000 lb. load. The turntable is flushed with the chamber floor which it is connected to, around its circumference, with a continuous metallic loaded spring. An EMCO Model 1050 Multi-device Controller controls the turntable position.

A pneumatic motor is used to control antenna polarizations and height relative to the ground. The height information is displayed on the control unit EMCO Model 1050.

The control room is an RF shielded enclosure attached to the semi-anechoic chamber with two bulkhead panels for connecting RF, and control cables. The dimension of the room is 7.3 m x 4.9 m x 3 m high and the entrance doors of both control and conducted rooms are 3 feet (0.91 m) by 7 feet (2.13 m).

A diagram of the Semi-Anechoic Chamber Test Site is shown in Figure 2.3.1-1 below:

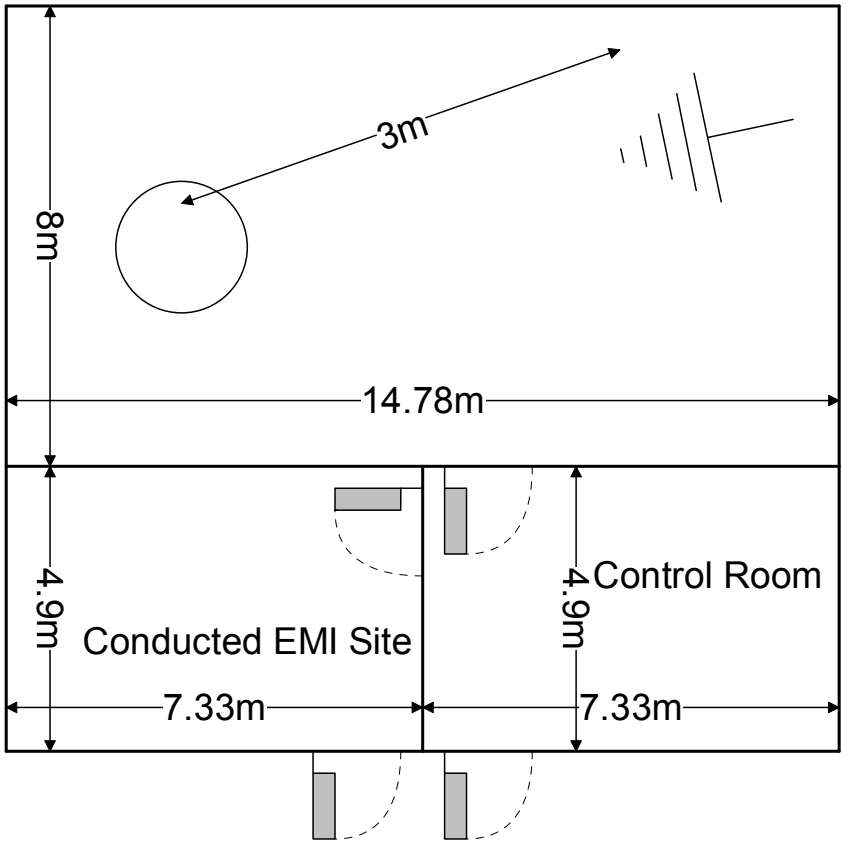



**Figure 2.3.1-1: Semi-Anechoic Chamber Test Site**

### 2.3.2 Conducted Emissions Test Site Description

The dimensions of the shielded conducted room are 7.3 x 4.9 x 3 $m^3$. As per ANSI C63.4 2003 requirements, the data were taken using two LISNs; a Solar Model 8028-50 50 Ω/50 µH and an EMCO Model 3825, which are installed as shown in Photograph 3. For 220 V, 50 Hz, a Polarad LISN (S/N 879341/048) is used in conjunction with a 1 kVA, 50 Hz/220 V EDGAR variable frequency generator, Model 1001B, to filter conducted noise from the generator.

A diagram of the room is shown below in figure 2.3.2-1:

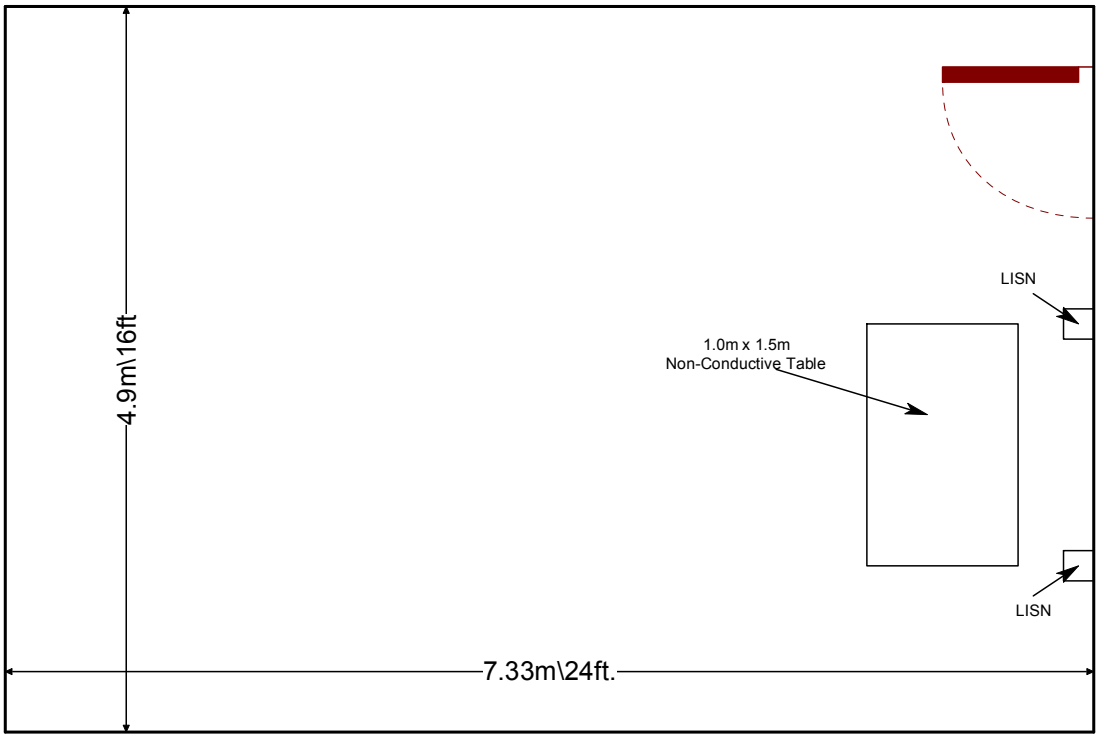



**Figure 2.3.2-1: AC Mains Conducted EMI Site**

## 3 APPLICABLE STANDARD REFERENCES

The following standards were used:

- ANSI C63.4-2003: Method of Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the 9KHz to 40GHz
- US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures, 2011
- US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2011
- KDB Publication No. 558074 - Measurement of Digital Transmission Systems Operating under Section 15.247, March 23, 2005
- Industry Canada Radio Standards Specification: RSS-210 - Low-power License-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment, Issue 8, December 2010.
- Industry Canada Radio Standards Specification: RSS-GEN – General Requirements and Information for the Certification of Radiocommunication Equipment, Issue 3, December 2010.

## 4 LIST OF TEST EQUIPMENT

The calibration interval of test equipment is annually or the manufacturer's recommendations. Where the calibration interval deviates from the annual cycle based on the instrument manufacturer's recommendations, it shall be stated below.

**Table 4-1: Test Equipment**

| AssetID | Manufacturer | Model # | Equipment Type | Serial # | Last Calibration Date | Calibration Due Date |
|---|---|---|---|---|---|---|
| 523 | Agilent | E7405 | Spectrum Analyzers | MY45103293 | 1/5/2011 | 1/5/2013 |
| 524 | Chase | CBL6111 | Antennas | 1138 | 1/7/2011 | 1/7/2013 |
| 2006 | EMCO | 3115 | Antennas | 2573 | 3/2/2011 | 3/2/2013 |
| 2011 | Hewlett-Packard | HP 8447D | Amplifiers | 2443A03952 | 1/3/2011 | 1/3/2012 |
| 2012 | Hewlett-Packard | HP83017A | Amplifiers | 3123A00324 | 2/25/2011 | 2/25/2012 |
| RE586 | Agilent Technologies, Inc. | 83017A | Amplifiers | 3123A00168 | 9/23/2011 | 9/23/2012 |
| 2013 | Hewlett Packard | HP8566B | Spectrum Analyzers | 2407A03233 | 8/5/2010 | 8/5/2012 |
| 2014 | Hewlett Packard | HP 85650A | Quasi Peak Adapter | 2430A00559 | 8/5/2010 | 8/5/2012 |
| 2037 | ACS Boca | Chamber EMI Cable Set | Cable Set | 2037 | 1/7/2011 | 1/7/2012 |
| 2044 | QMI | N/A | Cables | 2044 | 1/7/2011 | 1/7/2012 |
| 2070 | Mini Circuits | VHF-8400+ | Filter | 2070 | 2/3/2011 | 2/3/2012 |
| 2072 | Mini Circuits | VHF-3100+ | Filter | 30737 | 2/3/2011 | 2/3/2012 |
| 2075 | Hewlett Packard | 8495B | Attenuators | 2626A11012 | 12/10/2010 | 12/10/2011 |
| 2082 | Teledyne Storm Products | 90-010-048 | Cables | 2082 | 6/6/2011 | 6/6/2012 |
| 2022 | EMCO | LISN3825/2R | LISN | 1095 | 8/10/2009 | 8/10/2011 |
| 2022 | EMCO | LISN3825/2R | LISN | 1095 | 8/19/2011 | 8/19/2013 |
| 2045 | ACS Boca | Conducted Cable Set | Cable Set | 2045 | 1/6/2011 | 1/6/2012 |
| 2064 | CIR Q-TEL | FHT/22-10K-13/50-3A/3A | Filter | 9 | 1/15/2011 | 1/15/2012 |
| 2008 | COM-Power | AH-826 | Antennas | 81009 | NCR | NCR |

**NCR=No Calibration Required**

The asset 2008 is a standard gain horn antenna. Hence, recurring calibration beyond initial calibration per the manufacturer is not required only in case of damage, suspected deterioration or use at distance closer than $2xa^2/\lambda$, as per ANSI C63.4 requirements.

## 5 SUPPORT EQUIPMENT

**Table 5-1: Support Equipment – (EUT with Dipole Antenna)**

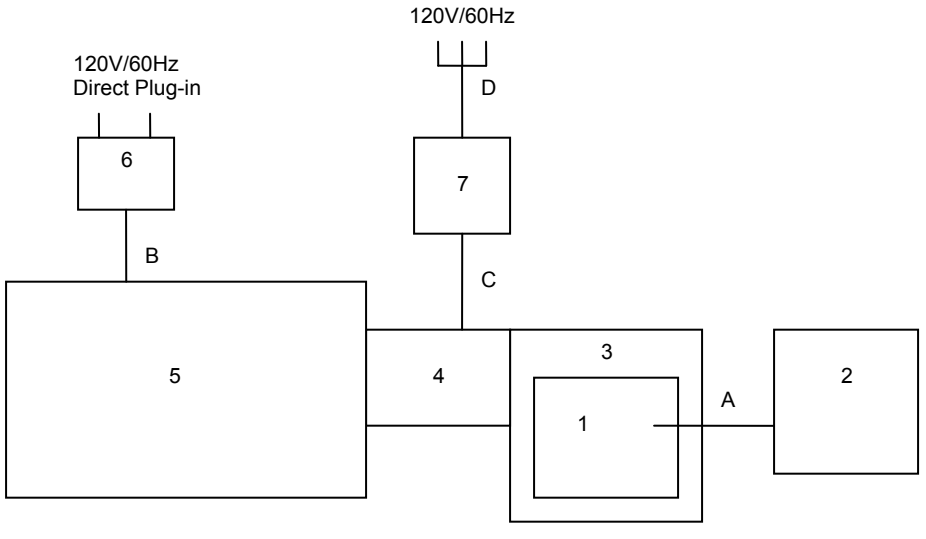
| Item | Equipment Type | Manufacturer | Model Number | Serial Number |
|---|---|---|---|---|
| 1 | EUT | Sagrad | SG901-1098 | N/A |
| 2 | Antenna | Pulse | W1038 | N/A |
| 3 | SDIO Insertion PCB | Sagrad | SG911-0072 | N/A |
| 4 | SDIO Translator PCB | Sagrad | SG909-0032 | N/A |
| 5 | Evaluation Board | Sagrad | MX515 | 700-26203 rev B |
| 6 | 5 VDC Power Supply | V-Infinity | 3A-061WP05 | N/A |
| 7 | DC Power Supply | MPJA | HY5003 | 003700278 |

**Table 5-2: Support Equipment – (EUT with PCB Antenna)**

| Item | Equipment Type | Manufacturer | Model Number | Serial Number |
|---|---|---|---|---|
| 1 | EUT | Sagrad | SG901-1098 | N/A |
| 2 | Antenna | Sagrad | SG901-1066 | N/A |
| 3 | SDIO Insertion PCB | Sagrad | SG911-0072 | N/A |
| 4 | SDIO Translator PCB | Sagrad | SG909-0032 | N/A |
| 5 | Evaluation Board | Sagrad | MX515 | 700-26203 rev B |
| 6 | 5 VDC Power Supply | V-Infinity | 3A-061WP05 | N/A |
| 7 | DC Power Supply | MPJA | HY5003 | 003700278 |

## 6 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

A. Antenna coaxial cable, 0.1m, shielded
B. Power cord, 1.85m, not shielded
C. 2 Wire Conductor, 1.75m, not shielded
D. Power Cord, 1.8m, not shielded




* Note: Item 7 was not used for the power line conducted emissions evaluation. The EUT was powered through the evaluation board.

# 7 SUMMARY OF TESTS

Along with the tabular data shown below, plots were taken of all signals deemed important enough to document.

## 7.1 Antenna Requirement – FCC: Section 15.203

The SG901-1098 provides a U-FL. connector at the antenna port. The module is marketed with three antennas:
Sagrad 3.8 dBi SG901-1066 PCB antenna, 2.4 - 2.5 GHz
Pulse 3.2 dBi W1037 1/4 dipole antenna, 2.4 - 2.5 GHz
Pulse 4.9 dBi W1038 1/4 dipole antenna, 2.4 - 2.5 GHz

## 7.2 6 dB Bandwidth - FCC: Section 15.247(a)(2) IC: RSS-210 A8.2(a)

### 7.2.1 Measurement Procedure

The 6dB bandwidth was measured in accordance with the FCC KDB Publication No. 558074 "Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247)". The RBW of the spectrum analyzer was set to 100 kHz and VBW 300 kHz. Span was set large enough to capture the entire emissions and >> RBW.

### 7.2.2 Measurement Results

Results are shown below in Tables 7.2.2-1 to 7.2.2-3 and Figures 7.2.2-1 to 7.2.2-9.

**Table 7.2.2-1: 6 dB Bandwidth (802.11b)**

| Frequency [MHz] | 6dB Bandwidth [kHz] |
|---|---|
| 2412 | 10150 |
| 2437 | 10150 |
| 2462 | 10200 |

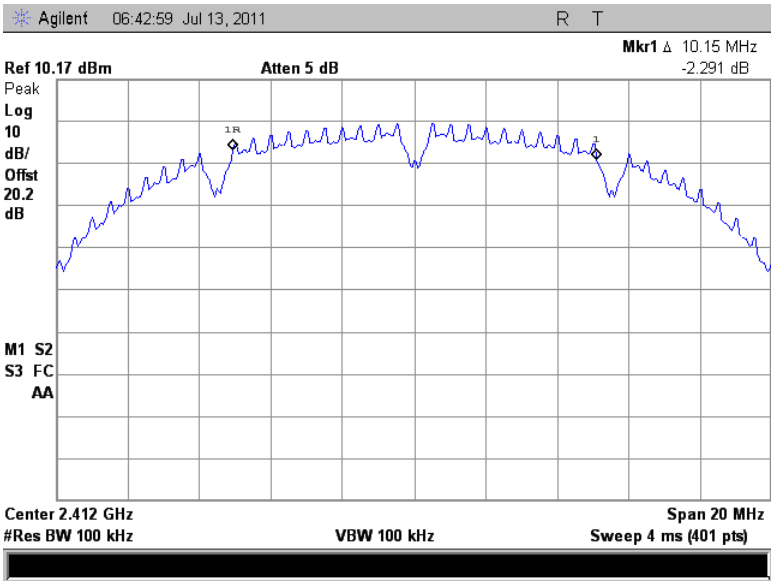



**Figure 7.2.2-1: 6dB BW - Low Channel (802.11b)**

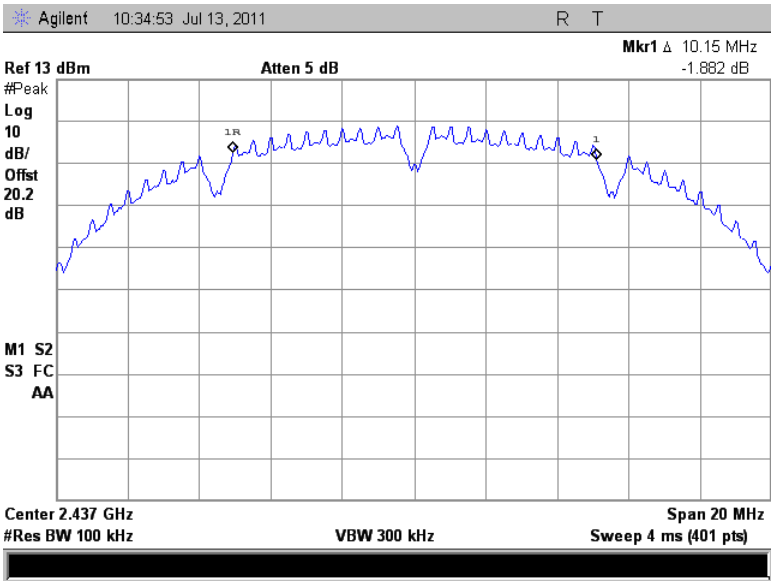



**Figure 7.2.2-2: 6dB BW - Middle Channel (802.11b)**

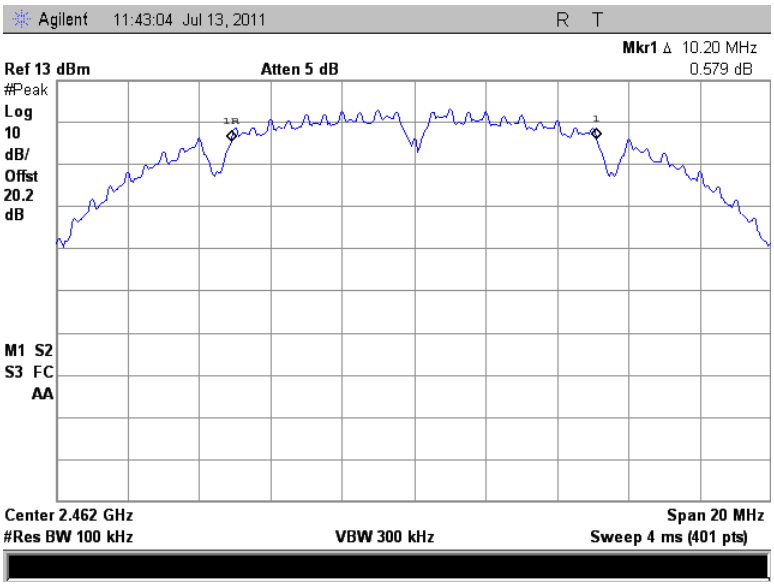



**Figure 7.2.2-3: 6dB BW - High Channel (802.11 b)**

**Table 7.2.2-2: 6 dB Bandwidth (802.11g)**

| Frequency [MHz] | 6dB Bandwidth [kHz] |
|---|---|
| 2412 | 16450 |
| 2437 | 16450 |
| 2462 | 16450 |

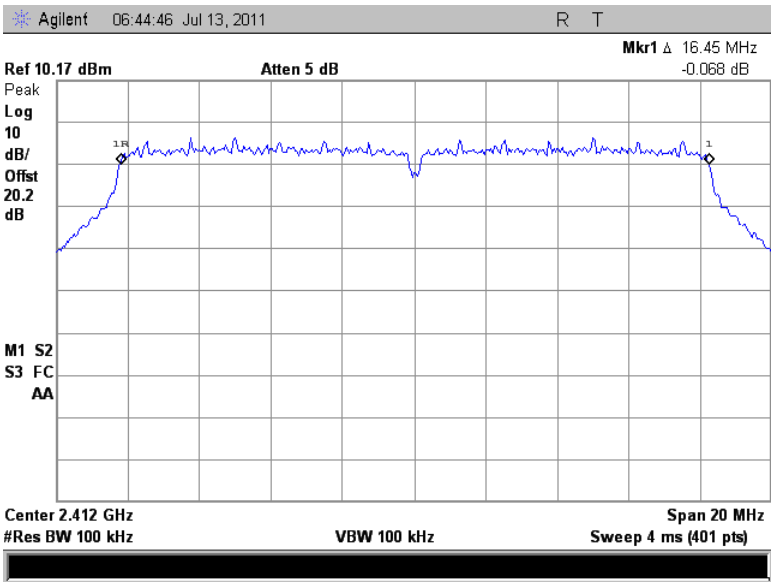



**Figure 7.2.2-4: 6dB BW - Low Channel (802.11g)**

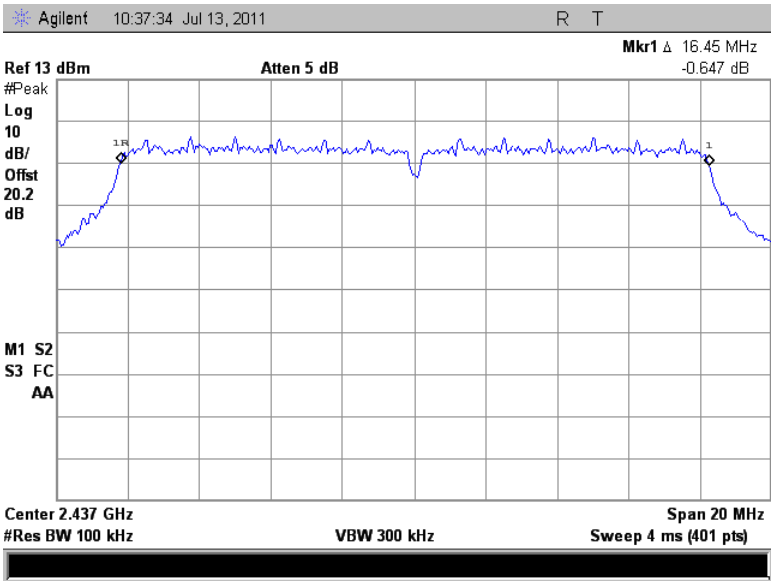



**Figure 7.2.2-5: 6dB BW - Middle Channel (802.11g)**

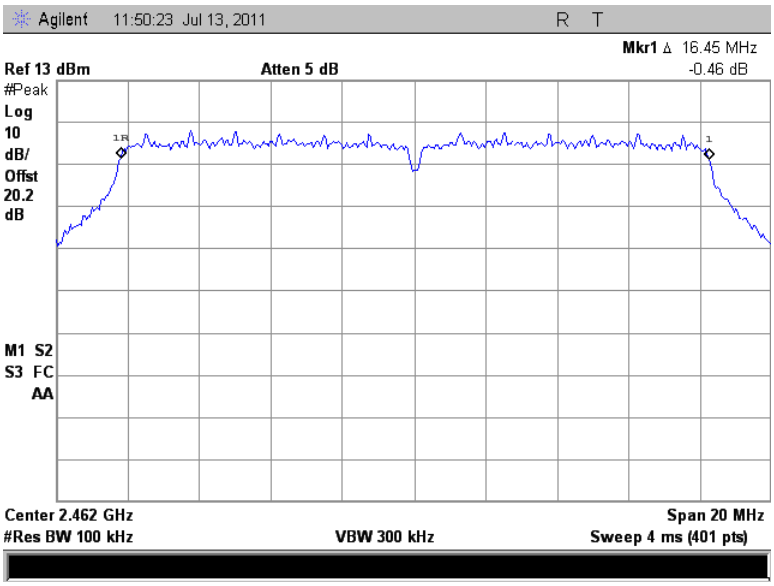



**Figure 7.2.2-6: 6dB BW - High Channel (802.11g)**

**Table 7.2.2-3: 6 dB Bandwidth (802.11n)**

| Frequency [MHz] | 6dB Bandwidth [kHz] |
|---|---|
| 2412 | 17650 |
| 2437 | 17600 |
| 2462 | 17600 |

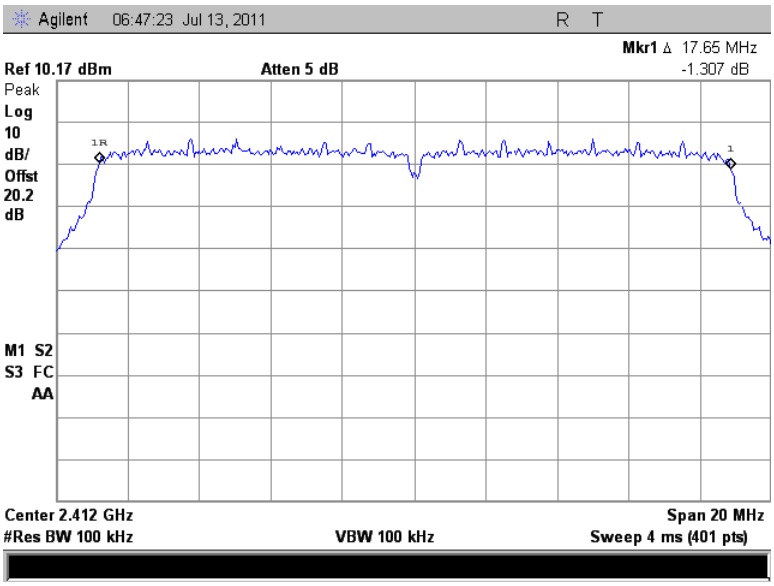



**Figure 7.2.2-7: 6dB BW - Low Channel (802.11n)**

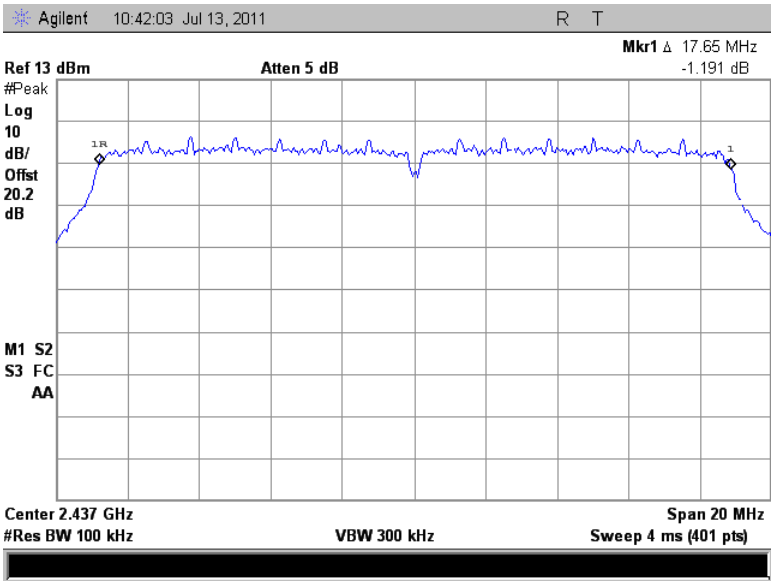



**Figure 7.2.2-8: 6dB BW - Middle Channel (802.11n)**

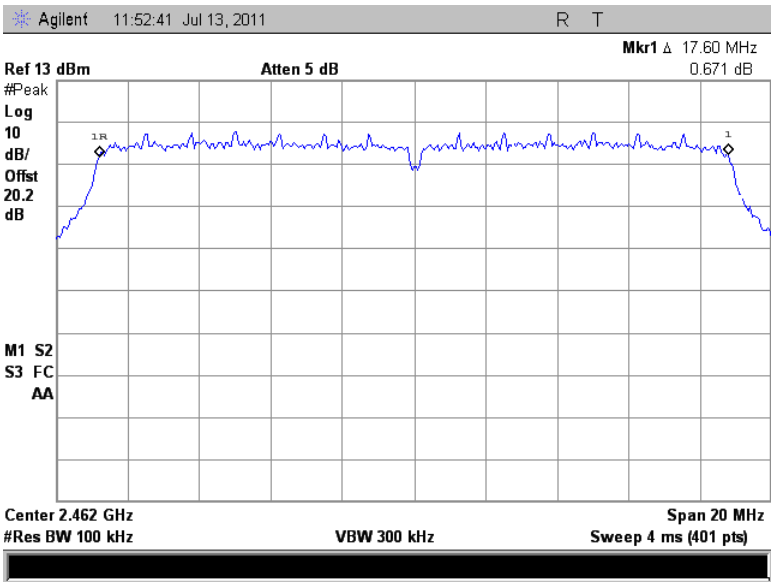



**Figure 7.2.2-9: 6dB BW - High Channel (802.11n)**

## 7.3 Peak Output Power - FCC Section 15.247(b)(3) IC: RSS-210 A8.4(4)

### 7.3.1 Measurement Procedure (Conducted Method)

The Peak Output Power was measured in accordance with the FCC KDB Publication No. 558074 "Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247)" Power Option 2, Method 1. The RF output of the equipment under test was directly connected to the input of the Spectrum Analyzer. Offset values were input for cable and attenuation. Data was collected with the EUT operating at maximum power per channelization.

### 7.3.2 Measurement Results

Results are shown below in Tables 7.3.2-1 to 7.3.2-3 and Figures 7.3.2-1 to 7.3.2-9:

**Table 7.3.2-1: RF Output Power (802.11b)**

| Frequency (MHz) | Power (dBm) |
|---|---|
| 2412 | 13.76 |
| 2437 | 14.88 |
| 2462 | 16.07 |

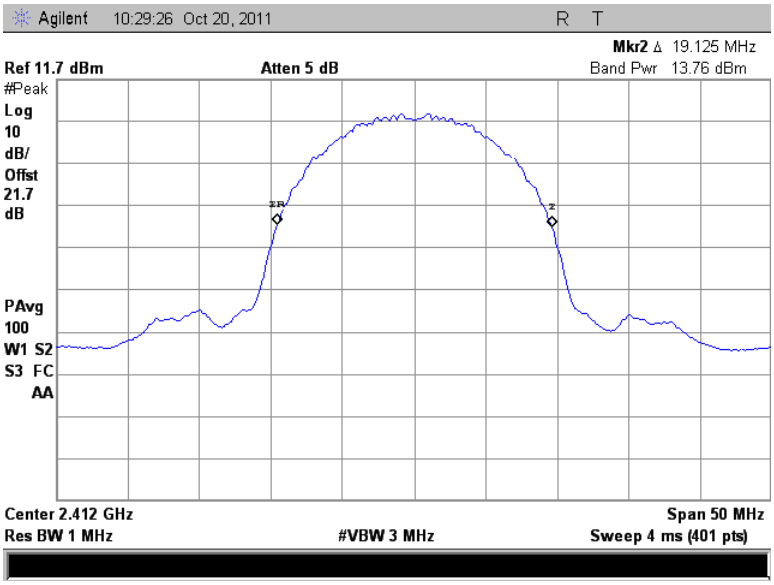



**Figure 7.3.2-1: RF Output Power - Low Channel**

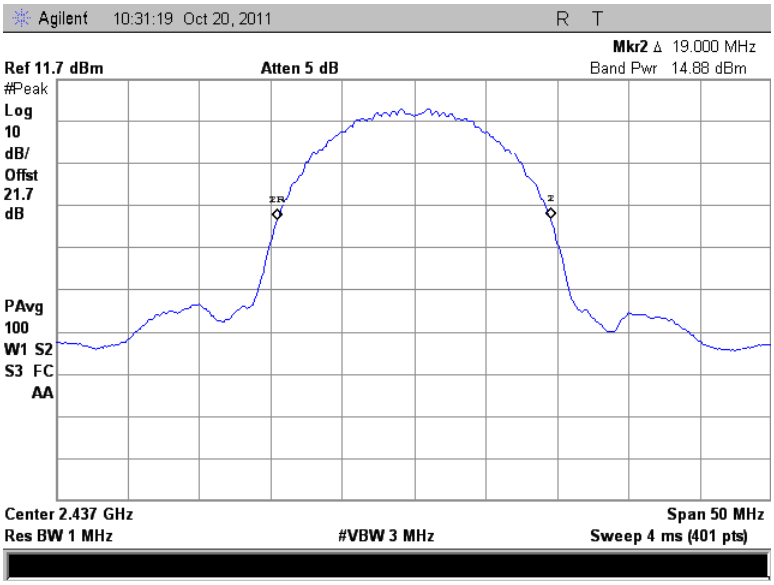



**Figure 7.3.2-2: RF Output Power - Middle Channel**

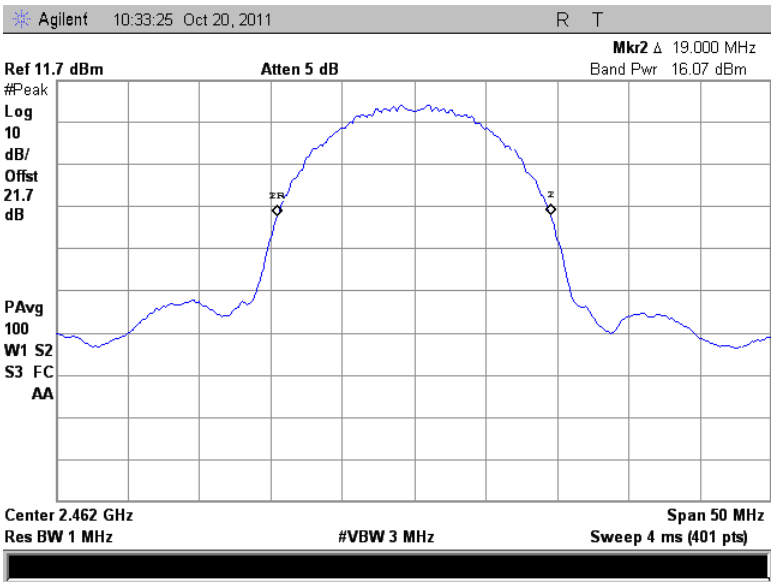



**Figure 7.3.2-3: RF Output Power - High Channel**

**Table 7.3.2-2: RF Output Power (802.11g)**

| Frequency (MHz) | Power (dBm) |
|---|---|
| 2412 | 17.94 |
| 2437 | 23.12 |
| 2462 | 19.67 |

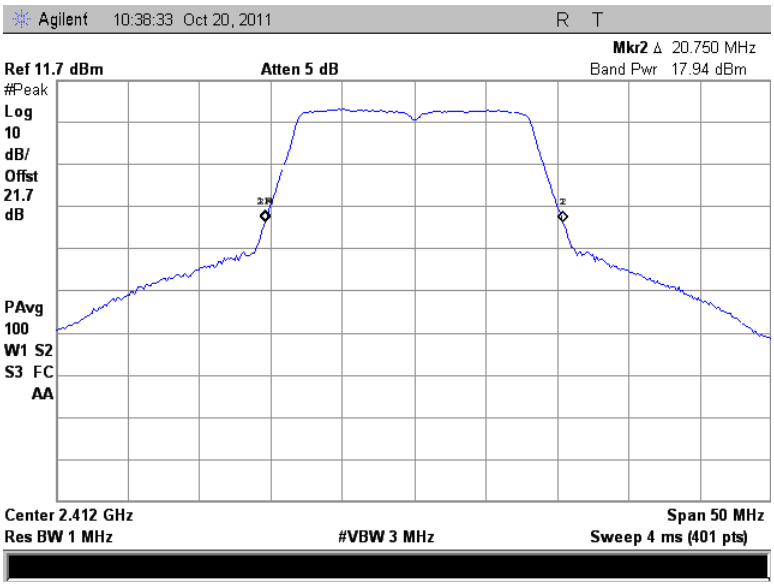



**Figure 7.3.2-4: RF Output Power - Low Channel (802.11g)**

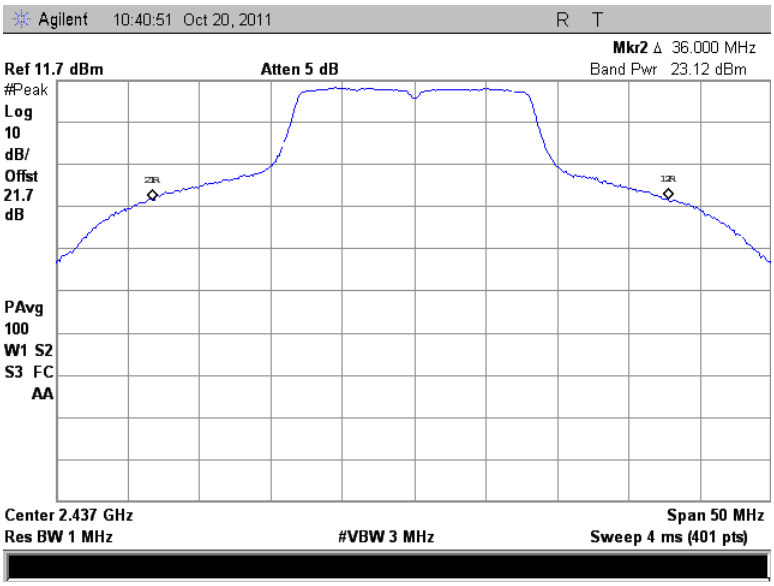



**Figure 7.3.2-5: RF Output Power - Middle Channel (80.211g)**

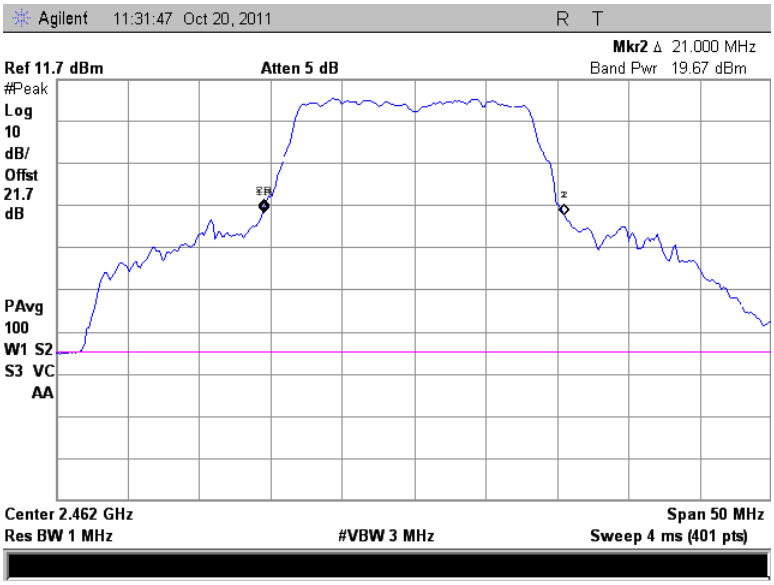



**Figure 7.3.2-6: RF Output Power - High Channel (802.11g)**

**Table 7.3.2-3: RF Output Power (802.11n)**

| Frequency (MHz) | Power (dBm) |
|---|---|
| 2412 | 17.19 |
| 2437 | 23.27 |
| 2462 | 19.50 |

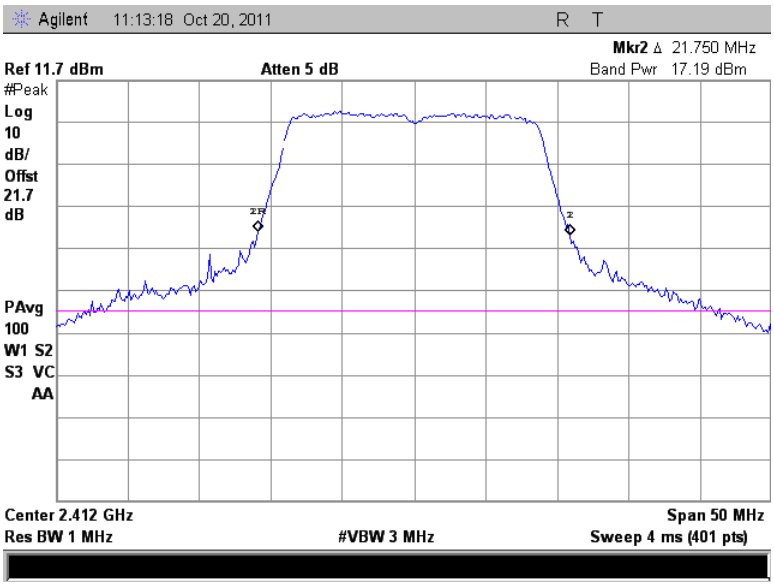



**Figure 7.3.2-7: RF Output Power - Low Channel (802.11n)**

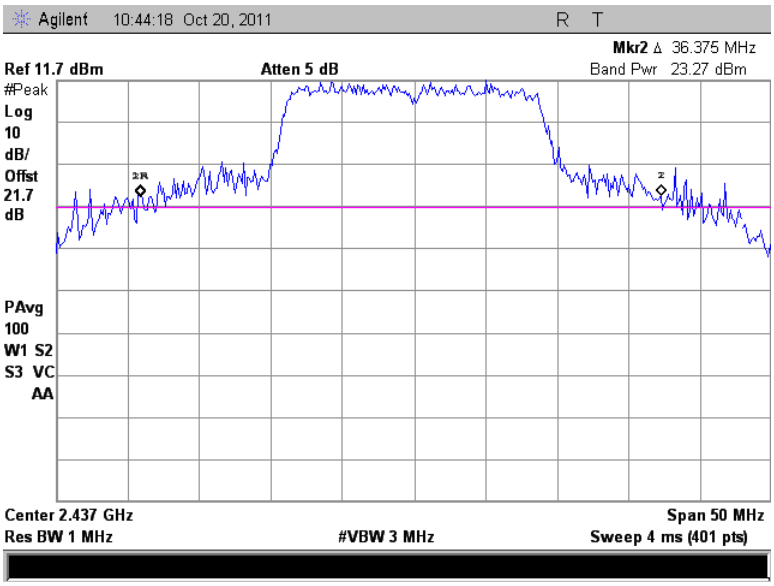



**Figure 7.3.2-8: RF Output Power - Middle Channel (80.211n)**

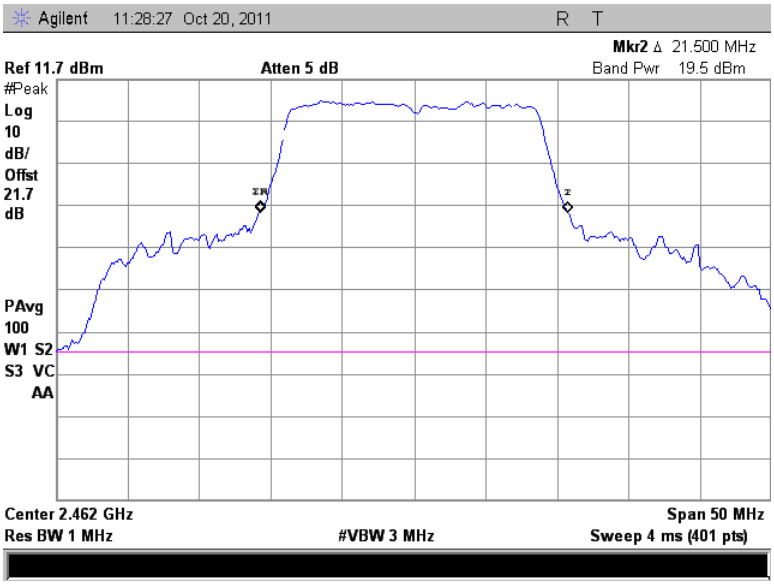



**Figure 7.3.2-9: RF Output Power - High Channel (802.11n)**

## 7.4 Band-Edge Compliance and Spurious Emissions-FCC 15.247(d) IC: RSS-210 A8.5

### 7.4.1 Band-Edge Compliance of RF Conducted Emissions

#### *7.4.1.1* Measurement Procedure

The RF output port of the EUT was directly connected to the input of the spectrum analyzer. The EUT was investigated at the lowest and highest channel available to determine band-edge compliance. For each measurement the spectrum analyzer's RBW was set to 100 kHz, and the VBW was set to 3000 kHz.

#### *7.4.1.2* Measurement Results

Results are shown below in Tables 7.4.1.2-1 to 7.4.1.2-3 and Figures 7.4.1.2-1 to 7.4.1.2-6:

**Table 7.4.1.2-1: Conducted Band Edge – (802.11b)**

| Frequency (MHz) | Measured Level (dBc) | Limit (dBc) | Margin (dB) |
|---|---|---|---|
| **2400.0** | 44.97 | 20 | 24.97 |
| **2483.5** | 55.66 | 20 | 35.66 |

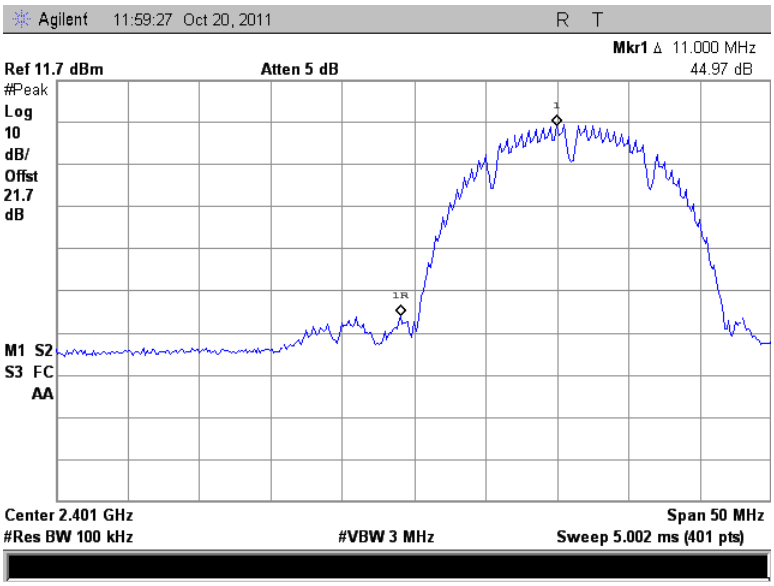



**Figure 7.4.1.2-1: Lower Band-edge (802.11b)**

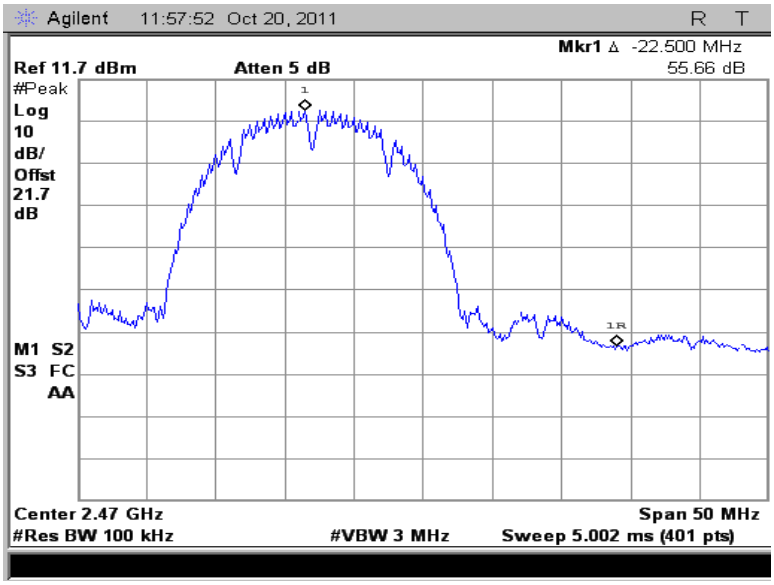



**Figure 7.4.1.2-2: Upper Band-edge (802.11b)**

**Table 7.4.1.2-2: Conducted Band Edge – (802.11g)**

| Frequency (MHz) | Measured Level (dBc) | Limit (dBc) | Margin (dB) |
|---|---|---|---|
| **2400.0** | 31.6 | 20 | 11.6 |
| **2483.5** | 41.82 | 20 | 21.82 |

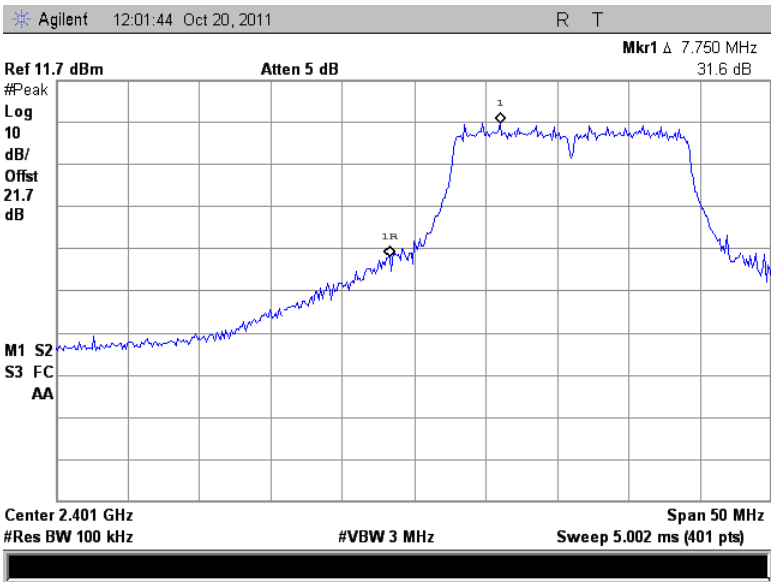



**Figure 7.4.1.2-3: Lower Band-edge (802.11g)**

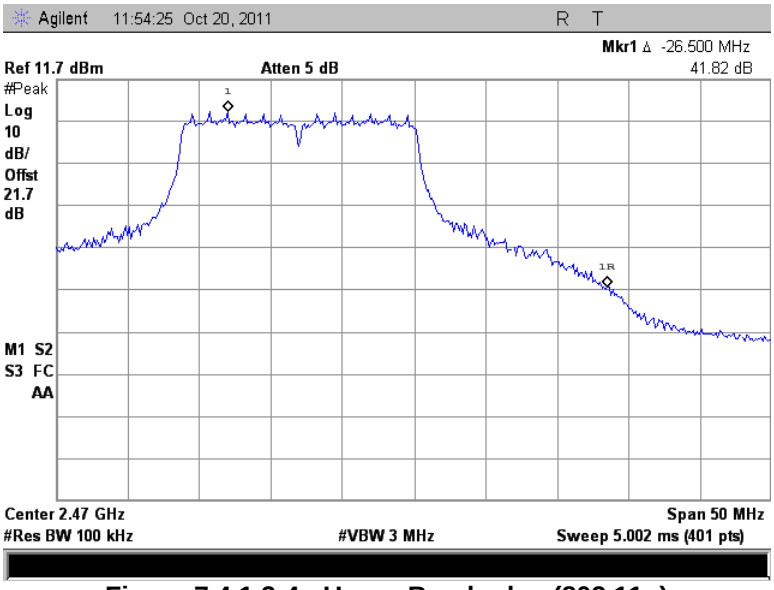



**Figure 7.4.1.2-4: Upper Band-edge (802.11g)**

**Table 7.4.1.2-3: Conducted Band Edge – (802.11n)**

| Frequency (MHz) | Measured Level (dBc) | Limit (dBc) | Margin (dB) |
|---|---|---|---|
| **2400.0** | 33.24 | 20 | 13.24 |
| **2483.5** | 39.71 | 20 | 19.71 |

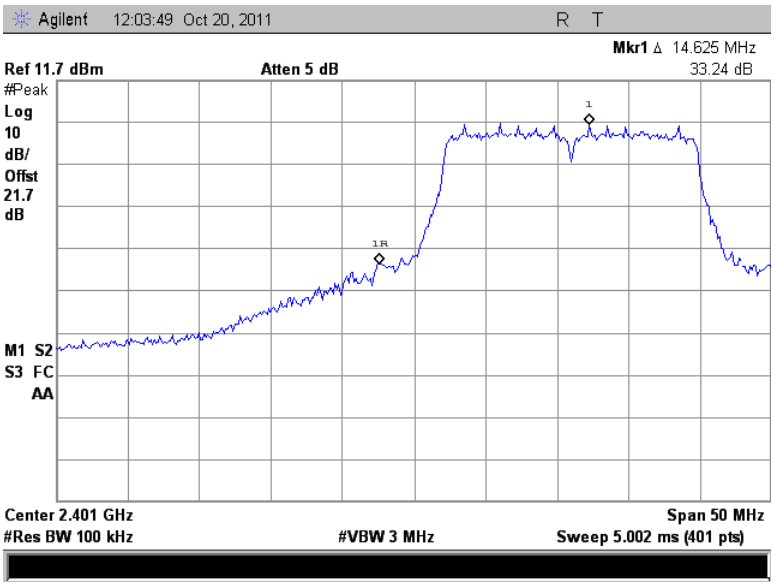



**Figure 7.4.1.2-5: Lower Band-edge (802.11n)**

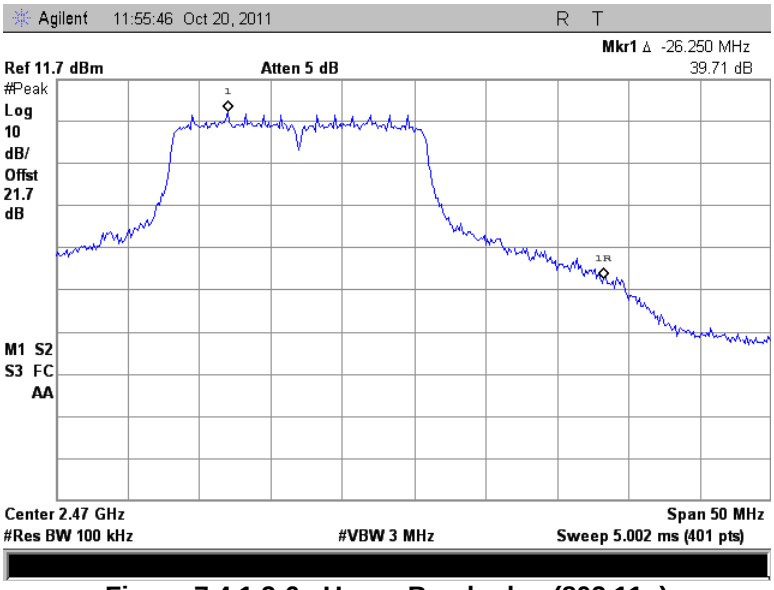



**Figure 7.4.1.2-6: Upper Band-edge (802.11n)**

### 7.4.2 RF Conducted Spurious Emissions

#### *7.4.2.1* Measurement Procedure

The RF Conducted Spurious Emissions were measured in accordance with the FCC KDB Publication No. 558074 "Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247)". The RF output port of the equipment under test was directly connected to the input of the spectrum analyzer. The EUT was investigated for conducted spurious emissions from 30MHz to 26 GHz, 10 times the highest fundamental frequency. Measurements were made at the low, center and high channels of the EUT. For each measurement, the spectrum analyzer's RBW was set to 100 kHz and the VBW was set to 300 kHz. The peak Max Hold function of the analyzer was utilized.

#### *7.4.2.2* Measurement Results

Results are shown below in Figures 7.4.2.2-1 to 7.4.2.2-18:

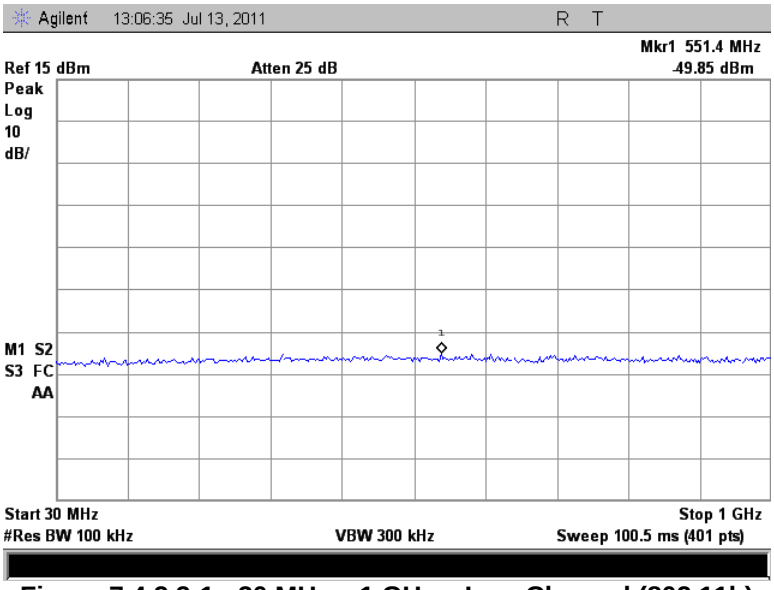



**Figure 7.4.2.2-1: 30 MHz – 1 GHz – Low Channel (802.11b)**

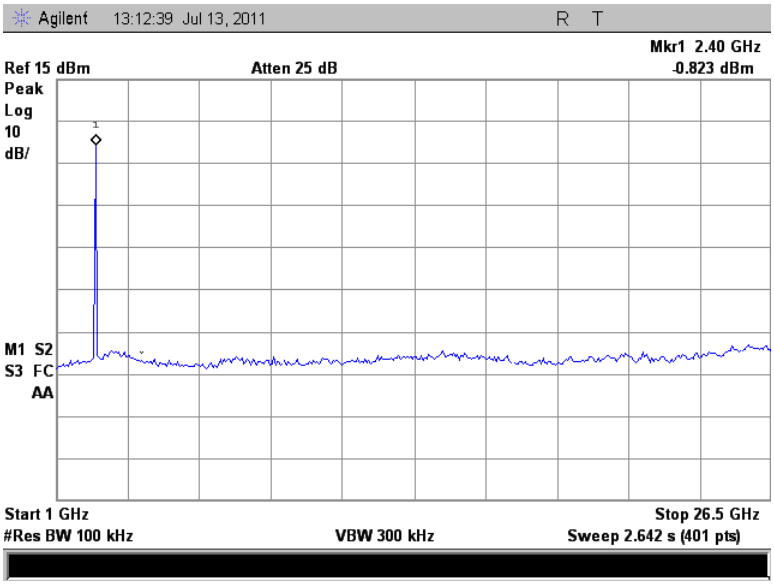



**Figure 7.4.2.2-2: 1 GHz – 26 GHz – Low Channel (802.11b)**

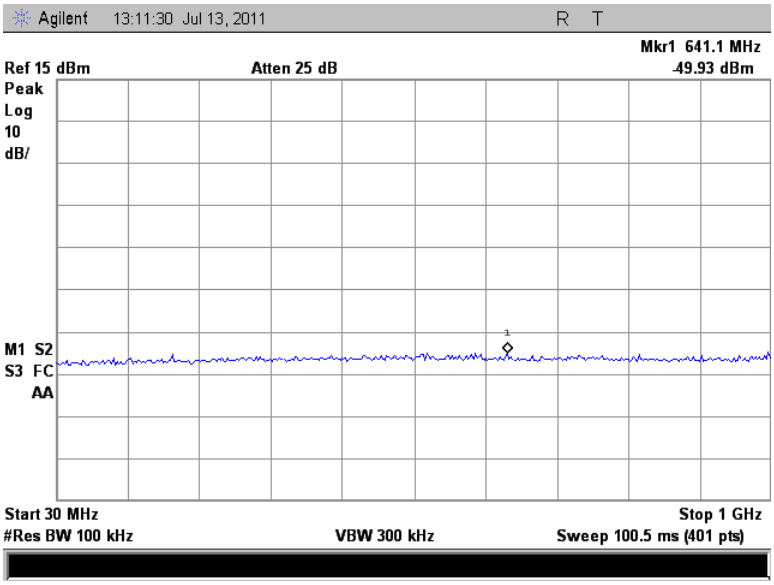



**Figure 7.4.2.2-3: 30 MHz – 1 GHz –Middle Channel (802.11b)**

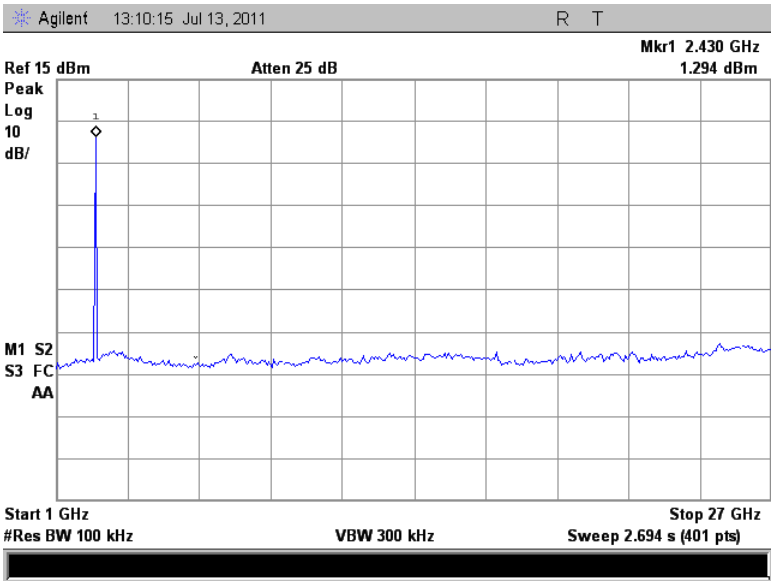



**Figure 7.4.2.2-4: 1 GHz – 26 GHz – Middle Channel (802.11b)**

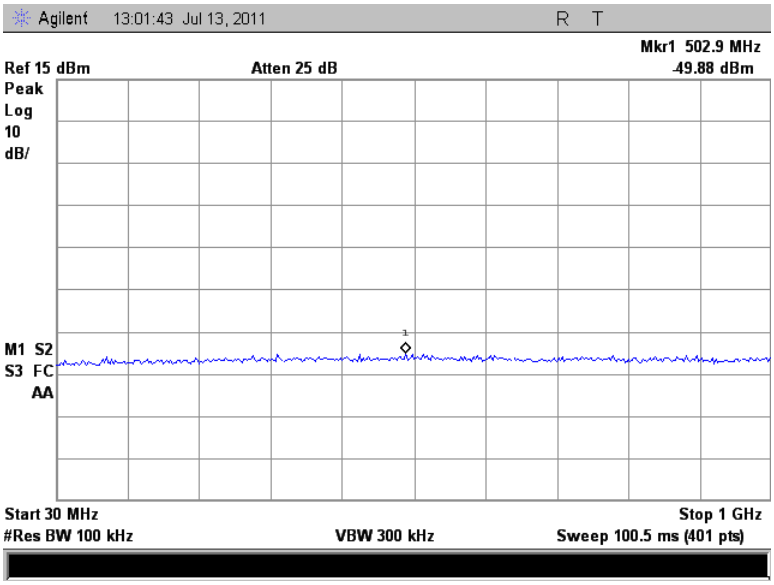



**Figure 7.4.2.2-5: 30 MHz – 1 GHz – High Channel (802.11b)**

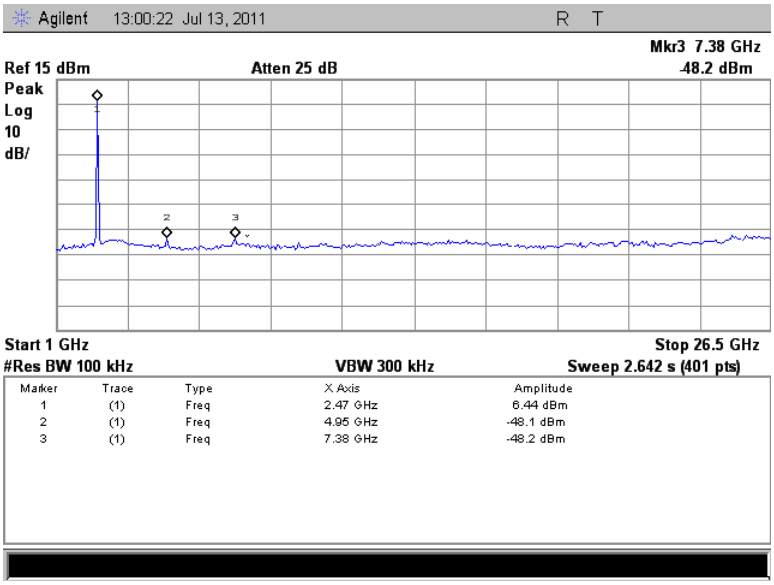



**Figure 7.4.2.2-6: 1 GHz – 26 GHz –High Channel (802.11b)**

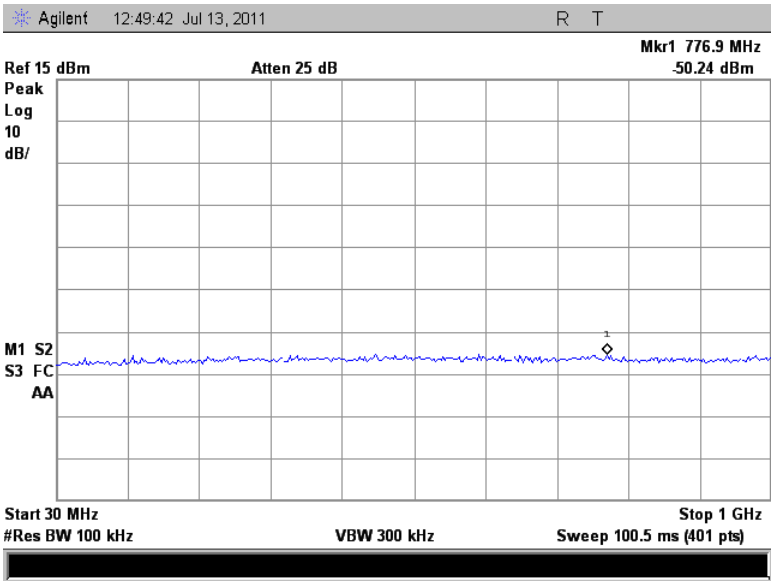



**Figure 7.4.2.2-7: 30 MHz – 1 GHz – Low Channel (802.11g)**

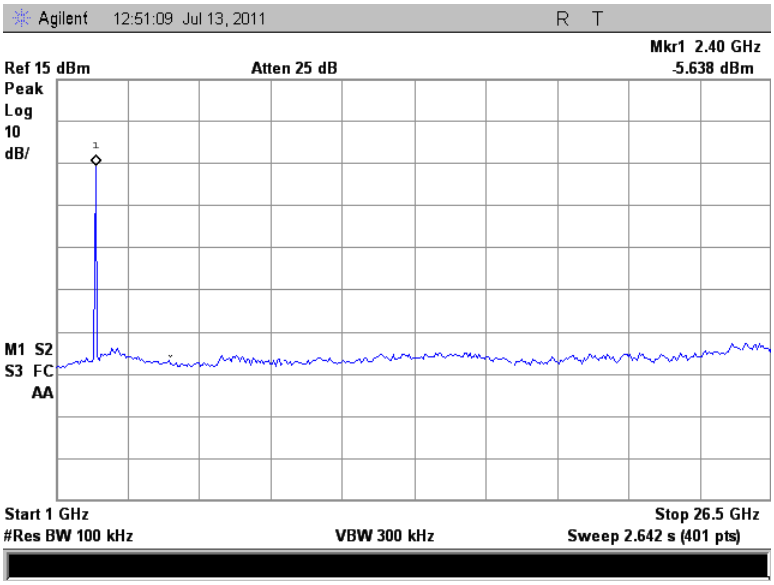



**Figure 7.4.2.2-8: 1 GHz – 26 GHz – Low Channel (802.11g)**

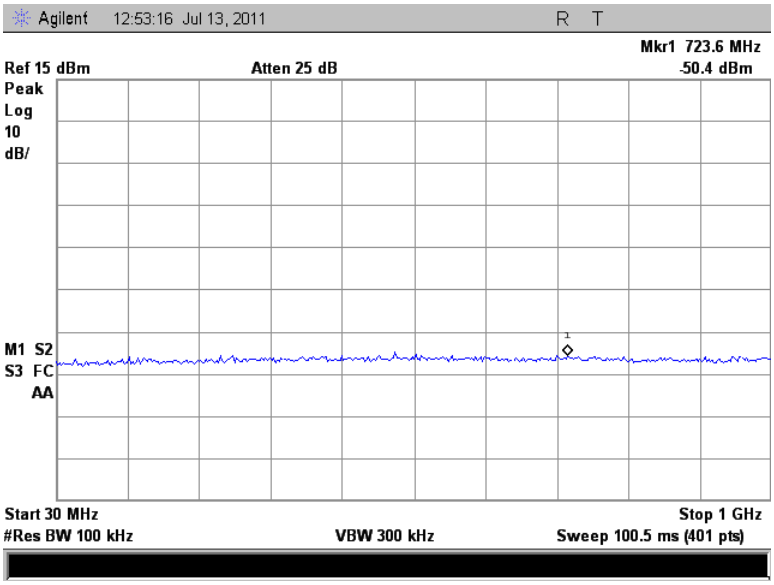



**Figure 7.4.2.2-9: 30 MHz – 1 GHz –Middle Channel (802.11g)**

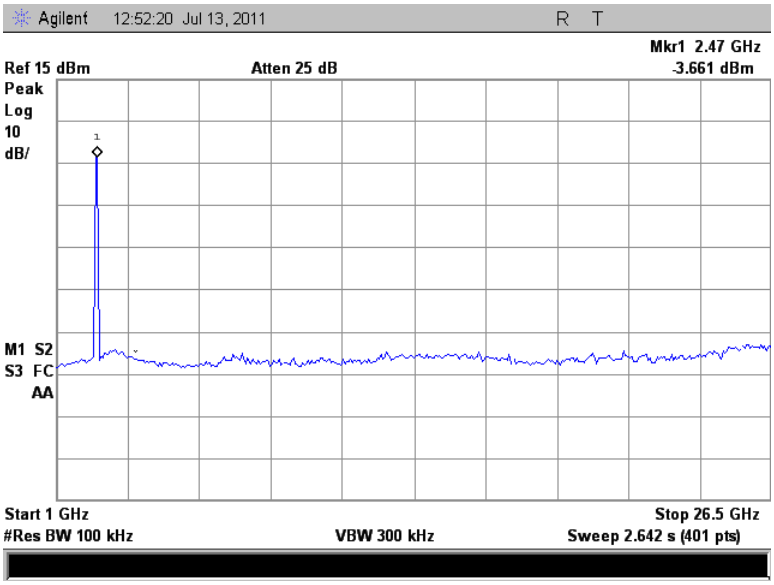



**Figure 7.4.2.2-10: 1 GHz – 26 GHz – Middle Channel (802.11g)**

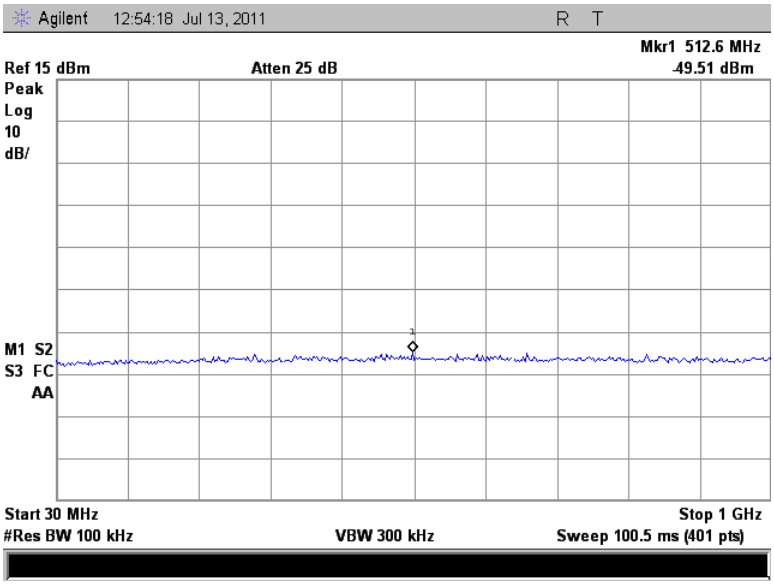



**Figure 7.4.2.2-11: 30 MHz – 1 GHz – High Channel (802.11g)**

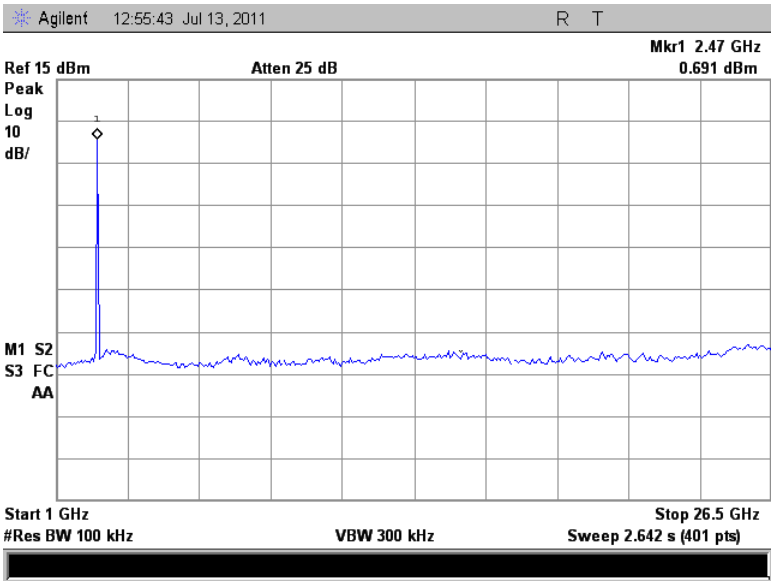



**Figure 7.4.2.2-12: 1 GHz – 26 GHz –High Channel (802.11g)**

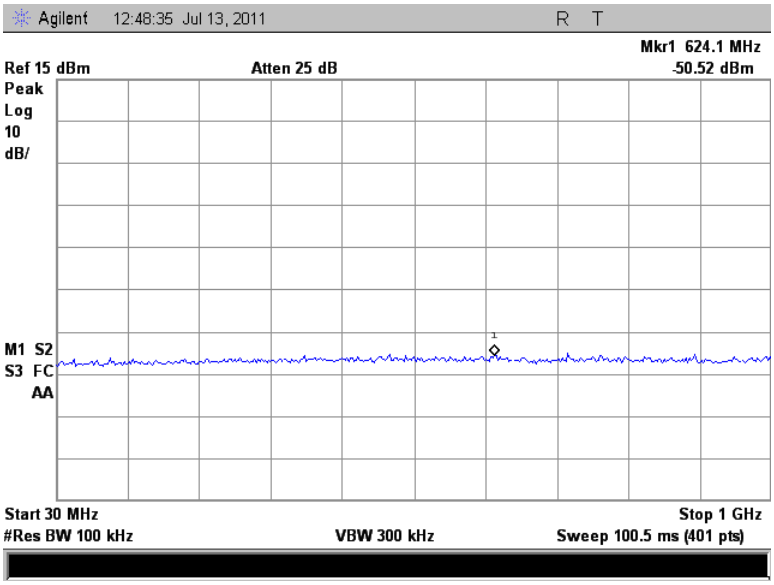



**Figure 7.4.2.2-13: 30 MHz – 1 GHz – Low Channel (802.11n)**

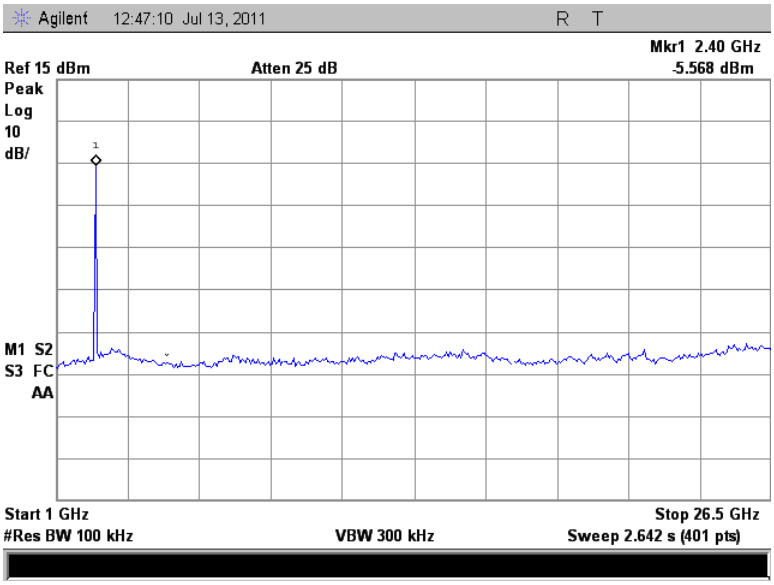



**Figure 7.4.2.2-14: 1 GHz – 26 GHz – Low Channel (802.11n)**

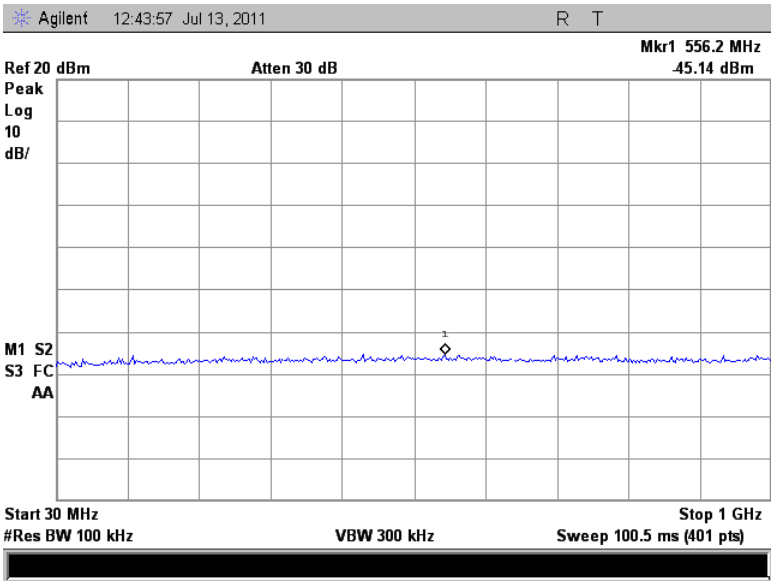



**Figure 7.4.2.2-15: 30 MHz – 1 GHz –Middle Channel (802.11n)**

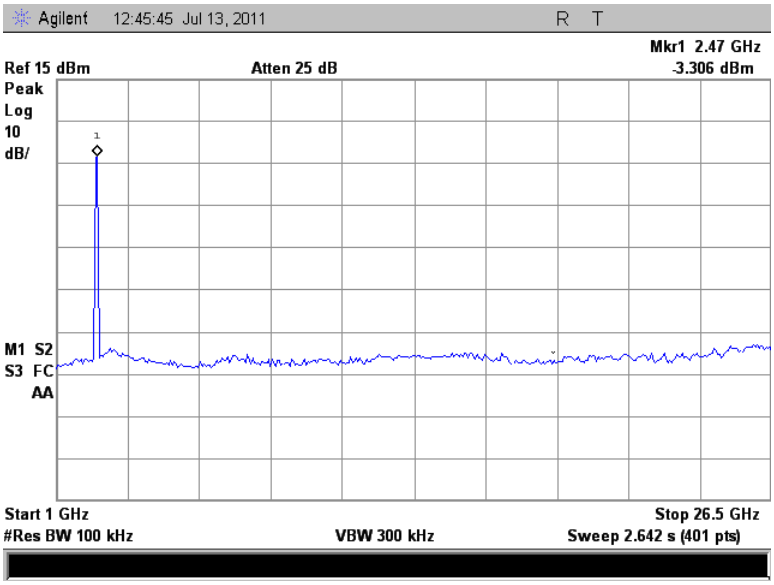



**Figure 7.4.2.2-16: 1 GHz – 26 GHz – Middle Channel (802.11n)**

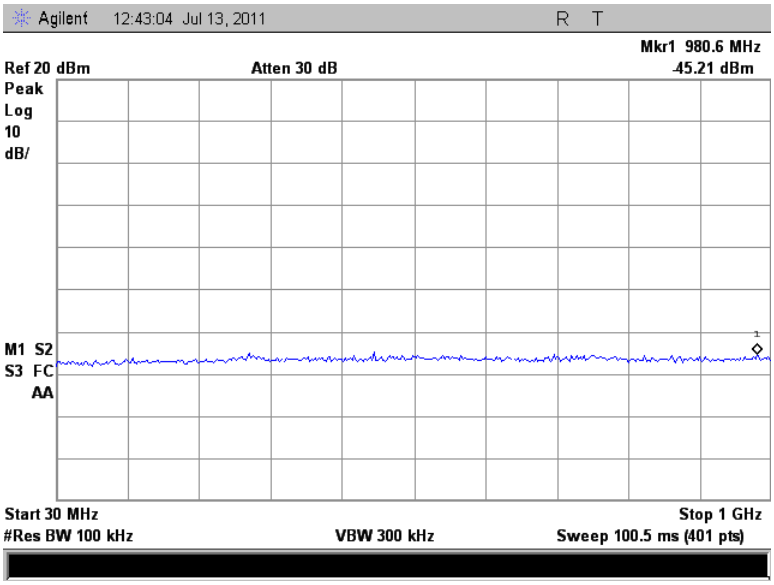



**Figure 7.4.2.2-17: 30 MHz – 1 GHz – High Channel (802.11n)**

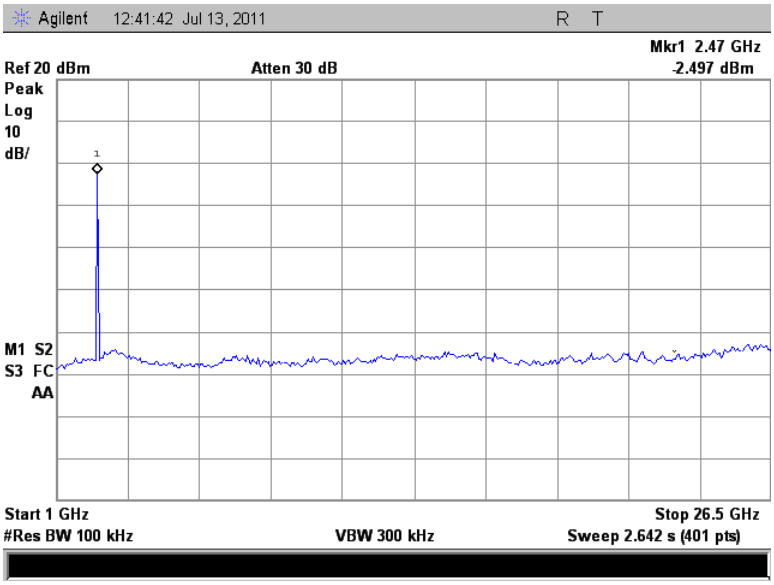



**Figure 7.4.2.2-18: 1 GHz – 26 GHz –High Channel (802.11n)**

### 7.4.3 Radiated Spurious Emissions - FCC Section 15.205 IC: RSS-210 2.2, RSS-GEN 7.2.5

#### *7.4.3.1* Measurement Procedure

Radiated emissions tests were made over the frequency range of 30MHz to 26GHz, 10 times the highest fundamental frequency.

The EUT was rotated through 360° and the receive antenna height was varied from 1m to 4m so that the maximum radiated emissions level would be detected. For frequencies below 1000MHz, quasi-peak measurements were made using a resolution bandwidth RBW of 120 kHz and a video bandwidth VBW of 300 kHz. For frequencies above 1000MHz, peak and average measurements made with RBW of 1 MHz and VBW of 3 MHz and 10 Hz respectively.

**Duty Cycle Correction Factor**

For average radiated measurements, using a 39.17% duty cycle, the measured level was reduced by a factor 8.14dB. The duty cycle correction factor is determined using the formula: 20log (39.17/100) = -8.14dB.

A detailed analysis of the duty cycle timing is provided in the Theory of Operation accompanying this report.

Measurement Results

Radiated spurious emissions found in the band of 30MHz to 26GHz are reported in the Table 7.4.3.2-1 to 7.4.3.2-6 below.

**Table 7.4.3.2-1: Radiated Spurious Emissions Tabulated Data - 802.11b Dipole Antenna**

| Frequency (MHz) | Level (dBuV) | | Antenna Polarity | Correction Factors | Corrected Level (dBuV/m) | | Limit (dBuV/m) | | Margin (dB) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | pk | Qpk/Avg | (H/V) | (dB) | pk | Qpk/Avg | pk | Qpk/Avg | pk | Qpk/Avg |
| **Low Channel 2412 MHz** | | | | | | | | | | |
| **2390** | 49.59 | 36.60 | H | -3.73 | 45.86 | 24.73 | 74.0 | 54.0 | 28.10 | 29.30 |
| **2390** | 49.30 | 36.50 | V | -3.73 | 45.57 | 24.63 | 74.0 | 54.0 | 28.40 | 29.40 |
| **4824** | 45.90 | 40.39 | H | 4.41 | 50.31 | 36.66 | 74.0 | 54.0 | 23.70 | 17.30 |
| **Middle Channel 2437 MHz** | | | | | | | | | | |
| **4874** | 47.89 | 42.51 | H | 4.58 | 52.47 | 38.95 | 74.0 | 54.0 | 21.50 | 15.00 |
| **4874** | 47.88 | 43.06 | V | 4.58 | 52.46 | 39.50 | 74.0 | 54.0 | 21.50 | 14.50 |
| **High Channel 2462 MHz** | | | | | | | | | | |
| **2483.5** | 50.61 | 38.22 | H | -3.38 | 47.23 | 26.70 | 74.0 | 54.0 | 26.80 | 27.30 |
| **2483.5** | 49.20 | 36.40 | V | -3.38 | 45.82 | 24.88 | 74.0 | 54.0 | 28.20 | 29.10 |
| **4924** | 47.87 | 44.10 | H | 4.76 | 52.63 | 40.72 | 74.0 | 54.0 | 21.40 | 13.30 |
| **4924** | 50.25 | 47.50 | V | 4.76 | 55.01 | 44.12 | 74.0 | 54.0 | 19.00 | 9.90 |

*Note:

- All emissions above 4924 MHz were attenuated below the permissible limit.
- A Duty Cycle Correction of 39.17% was applied to the average measurements.

**Table 7.4.3.2-2: Radiated Spurious Emissions Tabulated Data - 802.11g Dipole Antenna**

| Frequency (MHz) | Level (dBuV) | | Antenna Polarity | Correction Factors | Corrected Level (dBuV/m) | | Limit (dBuV/m) | | Margin (dB) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | pk | Qpk/Avg | (H/V) | (dB) | pk | Qpk/Avg | pk | Qpk/Avg | pk | Qpk/Avg |
| **Low Channel 2412 MHz** | | | | | | | | | | |
| **2390** | 59.32 | 43.39 | H | -3.73 | 55.59 | 31.52 | 74.0 | 54.0 | 18.4 | 22.5 |
| **2390** | 56.66 | 40.94 | V | -3.73 | 52.93 | 29.07 | 74.0 | 54.0 | 21.1 | 24.9 |
| **Middle Channel 2437 MHz** | | | | | | | | | | |
| **Noise Floor** | | | | | | | | | | |
| **High Channel 2462 MHz** | | | | | | | | | | |
| **2483.5** | 63.90 | 44.69 | H | -3.38 | 60.52 | 33.17 | 74.0 | 54.0 | 13.5 | 20.8 |
| **2483.5** | 55.41 | 38.20 | V | -3.38 | 52.03 | 26.68 | 74.0 | 54.0 | 22.0 | 27.3 |

*Note:

- All emissions above 2483.5 MHz were attenuated below the permissible limit.
- A Duty Cycle Correction of 39.17% was applied to the average measurements.

**Table 7.4.3.2-3: Radiated Spurious Emissions Tabulated Data - 802.11n Dipole Antenna**

| Frequency (MHz) | Level (dBuV) | | Antenna Polarity | Correction Factors | Corrected Level (dBuV/m) | | Limit (dBuV/m) | | Margin (dB) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | pk | Qpk/Avg | (H/V) | (dB) | pk | Qpk/Avg | pk | Qpk/Avg | pk | Qpk/Avg |
| **Low Channel 2412 MHz** | | | | | | | | | | |
| **2390** | 61.69 | 44.29 | H | -3.73 | 57.96 | 32.42 | 74.0 | 54.0 | 16.0 | 21.6 |
| **2390** | 61.50 | 43.71 | V | -3.73 | 57.77 | 31.84 | 74.0 | 54.0 | 16.2 | 22.2 |
| **Middle Channel 2437 MHz** | | | | | | | | | | |
| **Noise Floor** | | | | | | | | | | |
| **High Channel 2462 MHz** | | | | | | | | | | |
| **2483.5** | 64.64 | 47.39 | H | -3.38 | 61.26 | 35.87 | 74.0 | 54.0 | 12.7 | 18.1 |
| **2483.5** | 58.26 | 40.45 | V | -3.38 | 54.88 | 28.93 | 74.0 | 54.0 | 19.1 | 25.1 |

*Note:

- All emissions above 2483.5 MHz were attenuated below the permissible limit.
- A Duty Cycle Correction of 39.17% was applied to the average measurements.

**Table 7.4.3.2-4: Radiated Spurious Emissions Tabulated Data - 802.11b PCB Antenna**

| Frequency (MHz) | Level (dBuV) | | Antenna Polarity | Correction Factors | Corrected Level (dBuV/m) | | Limit (dBuV/m) | | Margin (dB) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | pk | Qpk/Avg | (H/V) | (dB) | pk | Qpk/Avg | pk | Qpk/Avg | pk | Qpk/Avg |
| **Low Channel 2412 MHz** | | | | | | | | | | |
| **2390** | 66.51 | 59.01 | H | -10.31 | 56.20 | 40.56 | 74.0 | 54.0 | 17.80 | 13.40 |
| **2390** | 59.49 | 51.83 | V | -10.31 | 49.18 | 33.38 | 74.0 | 54.0 | 24.80 | 20.60 |
| **4824** | 58.68 | 55.64 | H | -2.18 | 56.50 | 45.32 | 74.0 | 54.0 | 17.50 | 8.70 |
| **4824** | 57.66 | 54.05 | V | -2.18 | 55.48 | 43.73 | 74.0 | 54.0 | 18.50 | 10.30 |
| **Middle Channel 2437 MHz** | | | | | | | | | | |
| **4874** | 53.85 | 50.11 | H | -2.01 | 51.84 | 39.96 | 74.0 | 54.0 | 22.20 | 14.00 |
| **4874** | 59.22 | 56.83 | V | -2.01 | 57.21 | 46.68 | 74.0 | 54.0 | 16.80 | 7.30 |
| **High Channel 2462 MHz** | | | | | | | | | | |
| **2483.5** | 67.44 | 59.46 | H | -9.92 | 57.52 | 41.39 | 74.0 | 54.0 | 16.50 | 12.60 |
| **2483.5** | 63.38 | 53.91 | V | -9.92 | 53.46 | 35.84 | 74.0 | 54.0 | 20.50 | 18.20 |
| **4924** | 60.46 | 58.62 | H | -1.84 | 58.62 | 48.64 | 74.0 | 54.0 | 15.40 | 5.40 |
| **4924** | 58.10 | 55.94 | V | -1.84 | 56.26 | 45.96 | 74.0 | 54.0 | 17.70 | 8.00 |

*Note:

- All emissions above 4924 MHz were attenuated below the permissible limit.
- A Duty Cycle Correction of 39.17% was applied to the average measurements.

**Table 7.4.3.2-5: Radiated Spurious Emissions Tabulated Data - 802.11g PCB Antenna**

| Frequency (MHz) | Level (dBuV) | | Antenna Polarity | Correction Factors | Corrected Level (dBuV/m) | | Limit (dBuV/m) | | Margin (dB) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | pk | Qpk/Avg | (H/V) | (dB) | pk | Qpk/Avg | pk | Qpk/Avg | pk | Qpk/Avg |
| **Low Channel 2412 MHz** | | | | | | | | | | |
| **2390** | 78.63 | 54.41 | H | -10.31 | 68.32 | 35.96 | 74.0 | 54.0 | 5.7 | 18.0 |
| **2390** | 70.83 | 47.26 | V | -10.31 | 60.52 | 28.81 | 74.0 | 54.0 | 13.5 | 25.2 |
| **Middle Channel 2437 MHz** | | | | | | | | | | |
| **4874** | 53.62 | 36.06 | H | -2.01 | 51.61 | 25.91 | 74.0 | 54.0 | 22.40 | 28.10 |
| **4874** | 51.02 | 35.78 | V | -2.01 | 49.01 | 25.63 | 74.0 | 54.0 | 25.00 | 28.40 |
| **High Channel 2462 MHz** | | | | | | | | | | |
| **2483.5** | 82.61 | 61.82 | H | -9.92 | 72.69 | 43.75 | 74.0 | 54.0 | 1.30 | 10.20 |
| **2483.5** | 78.68 | 57.52 | V | -9.92 | 68.76 | 39.45 | 74.0 | 54.0 | 5.20 | 14.50 |

*Note:

- All emissions above 4874 MHz were attenuated below the permissible limit.
- A Duty Cycle Correction of 39.17% was applied to the average measurements.

**Table 7.4.3.2-6: Radiated Spurious Emissions Tabulated Data - 802.11n PCB Antenna**

| Frequency (MHz) | Level (dBuV) | | Antenna Polarity | Correction Factors | Corrected Level (dBuV/m) | | Limit (dBuV/m) | | Margin (dB) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | pk | Qpk/Avg | (H/V) | (dB) | pk | Qpk/Avg | pk | Qpk/Avg | pk | Qpk/Avg |
| **Low Channel 2412 MHz** | | | | | | | | | | |
| **2390** | 74.86 | 56.13 | H | -10.31 | 64.55 | 37.68 | 74.0 | 54.0 | 9.5 | 16.3 |
| **2390** | 66.95 | 48.53 | V | -10.31 | 56.64 | 30.08 | 74.0 | 54.0 | 17.4 | 23.9 |
| **Middle Channel 2437 MHz** | | | | | | | | | | |
| **4874** | 53.60 | 38.95 | H | -2.01 | 51.59 | 28.80 | 74.0 | 54.0 | 22.40 | 25.20 |
| **4874** | 50.35 | 35.68 | V | -2.01 | 48.34 | 25.53 | 74.0 | 54.0 | 25.70 | 28.50 |
| **High Channel 2462 MHz** | | | | | | | | | | |
| **2483.5** | 82.53 | 63.10 | H | -9.92 | 72.61 | 45.03 | 74.0 | 54.0 | 1.4 | 9.0 |
| **2483.5** | 78.77 | 58.95 | V | -9.92 | 68.85 | 40.88 | 74.0 | 54.0 | 5.2 | 13.1 |

*Note:

- All emissions above 4874 MHz were attenuated below the permissible limit.
- A Duty Cycle Correction of 39.17% was applied to the average measurements.

### *7.4.3.2* Sample Calculation:

$R_C = R_U + CF_T$

Where:

| | | |
|---|---|---|
| $CF_T$ | = | Total Correction Factor (AF+CA+AG)-DC (Average Measurements Only) |
| $R_U$ | = | Uncorrected Reading |
| $R_C$ | = | Corrected Level |
| AF | = | Antenna Factor |
| CA | = | Cable Attenuation |
| AG | = | Amplifier Gain |
| DC | = | Duty Cycle Correction Factor |

**Duty Cycle Correction Factor**
20log (39.17/100) = -9.14dB

**Example Calculation: Peak**
Corrected Level: 49.59 + (-3.73) = 45.86dBµV/m
Margin: 74dBµV/m – 45.86dBµV/m = 28.1dB

**Example Calculation: Average**
Corrected Level: 36.6 + (-3.73) – 8.14= 24.73dBµV/m
Margin: 54dBµV/m – 24.73dBµV/m = 29.3dB

## 7.5 Power Spectral Density - FCC Section 15.247(e) IC: RSS-210 A8.2(b)

### 7.5.1 PSD Measurement Procedure (Conducted Method)

The power spectral density was measured in accordance with the FCC KDB Publication No. 558074 "Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247)" PSD Option 2. The RF output port of the EUT was directly connected to the input of the spectrum analyzer. Offset values were input for cable and attenuation. The spectrum analyzer RBW was set to 3 kHz and VBW >= 10 kHz. The detector was set to peak and the trace was averaged over 100 sweeps.

### 7.5.2 Measurement Results

Results are shown below in Table 7.5.2-1 to 7.5.2-3 and Figures 7.5.2-1 to 7.5.2-9 below:

**Table 7.5.2-1: Power Spectral Density (802.11b)**

| Frequency [MHz] | Level [dBm] |
|---|---|
| 2412 | -16.98 |
| 2437 | -20.06 |
| 2462 | -15.61 |

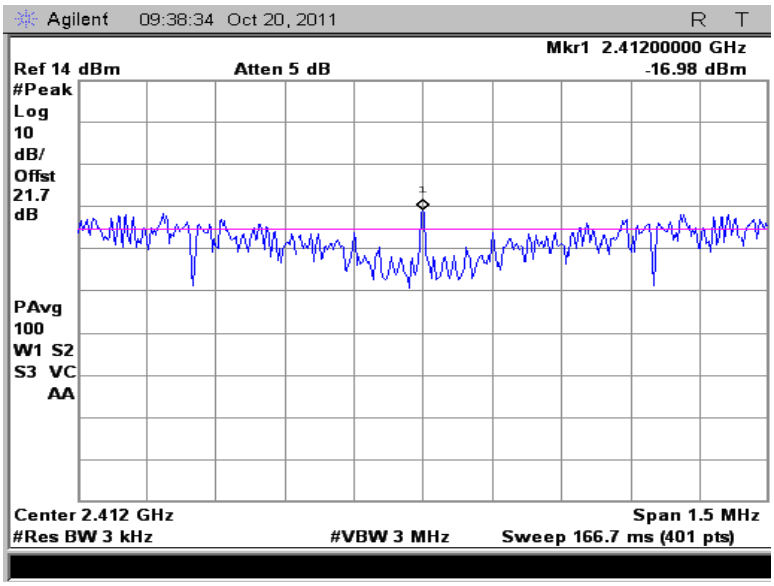



**Figure 7.5.2-1: Power Spectral Density - Low Channel (802.11b)**

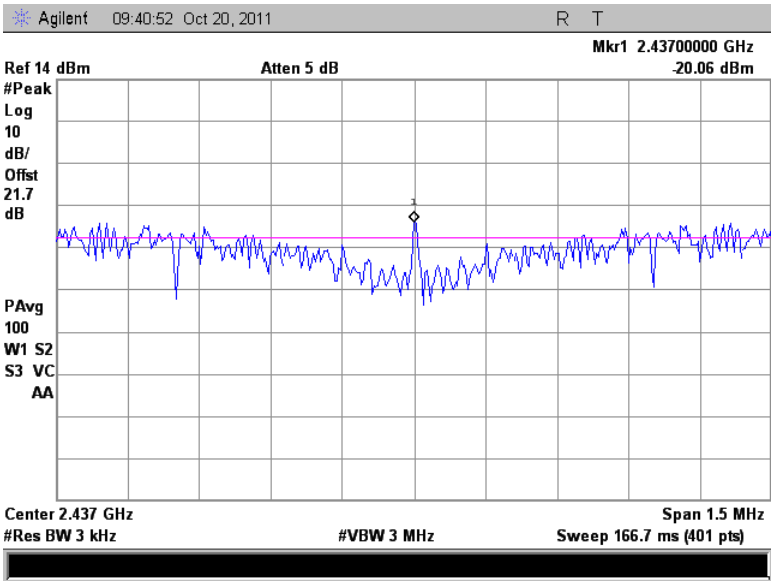



**Figure 7.5.2-2: Power Spectral Density - Middle Channel (802.11b)**

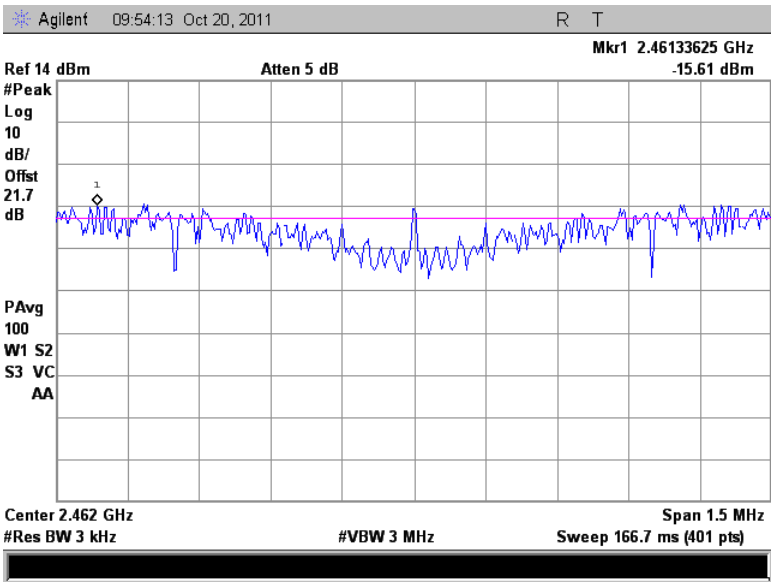



**Figure 7.5.2-3: Power Spectral Density – High Channel (802.11b)**

**Table 7.5.2-2: Power Spectral Density (802.11g)**

| Frequency [MHz] | Level [dBm] |
|---|---|
| 2412 | -14.02 |
| 2437 | -9.782 |
| 2462 | -14.03 |

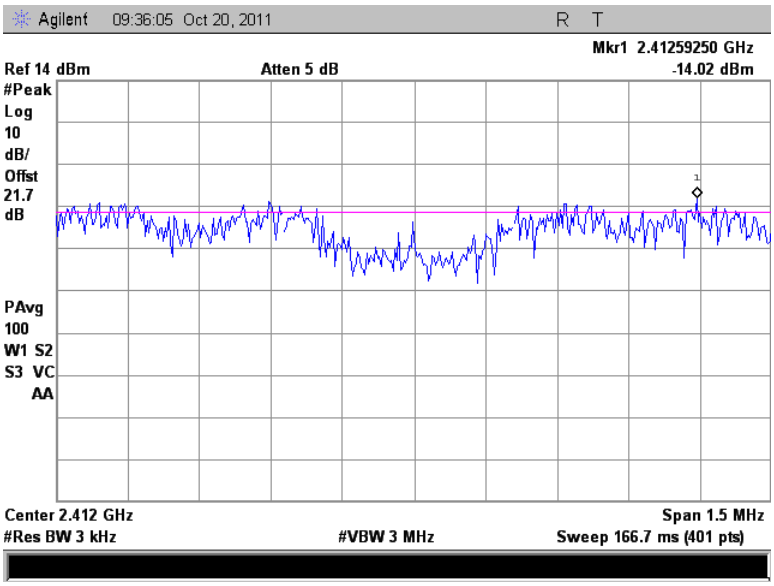



**Figure 7.5.2-4: Power Spectral Density - Low Channel (802.11g)**

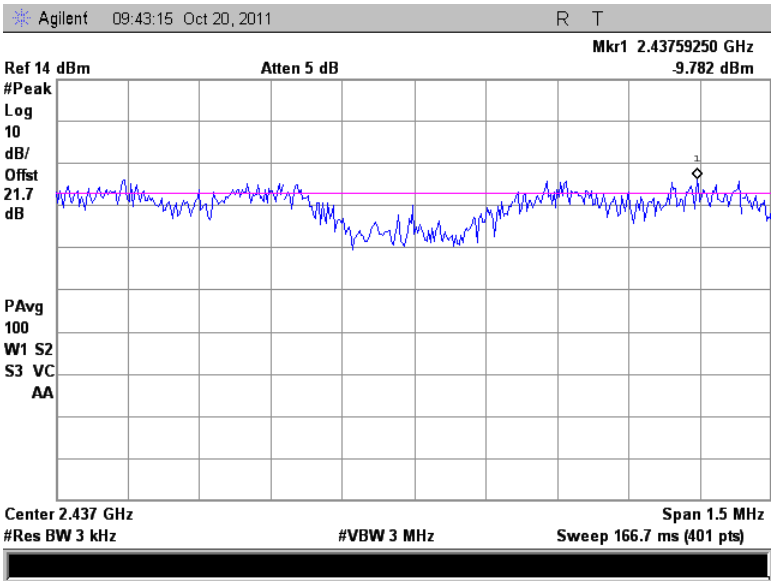



**Figure 7.5.2-5: Power Spectral Density - Middle Channel (802.11g)**

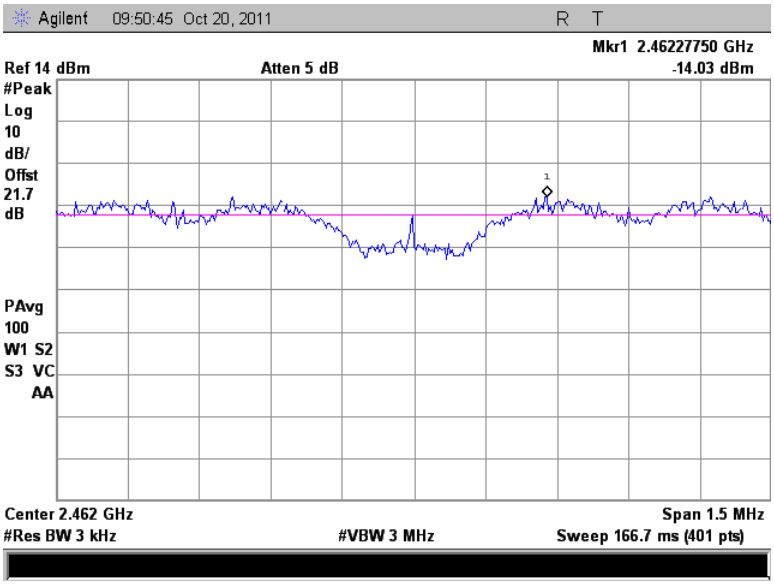



**Figure 7.5.2-6: Power Spectral Density – High Channel (802.11g)**

**Table 7.5.2-3: Power Spectral Density (802.11n)**

| Frequency [MHz] | Level [dBm] |
|---|---|
| 2412 | -12.4 |
| 2437 | -8.67 |
| 2462 | -14.3 |

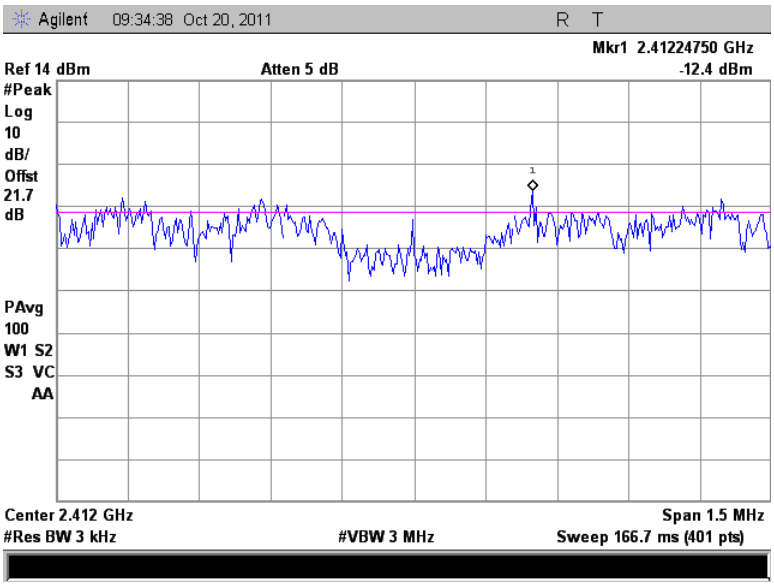



**Figure 7.5.2-7: Power Spectral Density - Low Channel (802.11n)**

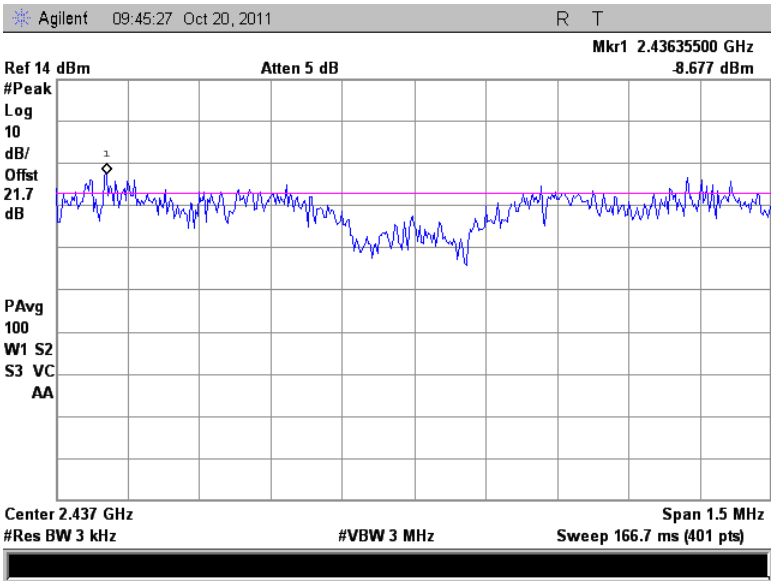



**Figure 7.5.2-8: Power Spectral Density - Middle Channel (802.11n)**

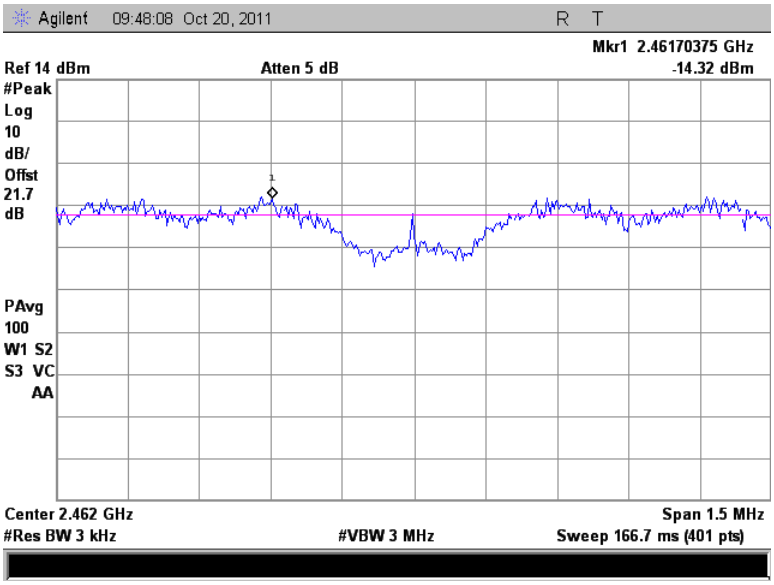



**Figure 7.5.2-9: Power Spectral Density – High Channel (802.11n)**

## 7.6 Power Line Conducted Emissions – FCC: Section 15.207 IC: RSS-Gen 7.2.4

### 7.6.1 Measurement Procedure

ANSI C63.4 sections 6 and 7 were the guiding documents for this evaluation. Conducted emissions were performed from 150 kHz to 30 MHz with the spectrum analyzer's resolution bandwidth set to 9 kHz and the video bandwidth set to 30 kHz. The calculation for the conducted emissions is as follows:

**Corrected Reading = Analyzer Reading + LISN Loss + Cable Loss**
**Margin = Applicable Limit - Corrected Reading**

### 7.6.2 Measurement Results

Results of the test are shown below in Tables 7.6.2-1 to .7.6.2-2 and Figures 7.6.2-1 to 7.6.2-2.

**Table 7.6.2-1: Line 1 Conducted EMI Results**

☒ Line 1
☐ To Ground ☒ Floating
☐ Telecom Port _____
☒ dBµV ☐ dBµA

Plot Number: 11-2058CE04
Power Supply Description:
5 VDC

| Frequency (MHz) | Uncorrected Reading | | Total Correction Factor (dB) | Corrected Level | | Limit | | Margin (dB) | |
|---|---|---|---|---|---|---|---|---|---|
| | Quasi-Peak | Average | | Quasi-Peak | Average | Quasi-Peak | Average | Quasi-Peak | Average |
| Line 1 | | | | | | | | | |
| 0.456613 | 45.643 | 41.077 | 0.60 | 46.24 | 41.67 | 56.75 | 46.75 | 10.5 | 5.1 |
| 0.50985 | 42.407 | 36.706 | 0.53 | 42.94 | 37.24 | 55.84 | 45.84 | 12.9 | 8.6 |
| 0.511312 | 43.24 | 38.296 | 0.53 | 43.77 | 38.83 | 56.00 | 46.00 | 12.2 | 7.2 |
| 0.57045 | 47.397 | 42.767 | 0.53 | 47.93 | 43.30 | 56.00 | 46.00 | 8.1 | 2.7 |
| 0.6272 | 45.627 | 40.663 | 0.52 | 46.14 | 41.18 | 56.00 | 46.00 | 9.9 | 4.8 |
| 0.6798 | 40.684 | 34.936 | 0.51 | 41.20 | 35.45 | 56.00 | 46.00 | 14.8 | 10.5 |
| 1.2539 | 44.178 | 39.798 | 0.50 | 44.68 | 40.30 | 56.00 | 46.00 | 11.3 | 5.7 |
| 1.42359 | 43.126 | 38.351 | 0.50 | 43.63 | 38.86 | 56.00 | 46.00 | 12.4 | 7.1 |
| 1.8243 | 41.431 | 36.313 | 0.50 | 41.94 | 36.82 | 56.00 | 46.00 | 14.1 | 9.2 |
| 2.62119 | 41.48 | 37.03 | 0.51 | 41.99 | 37.54 | 56.00 | 46.00 | 14.0 | 8.5 |

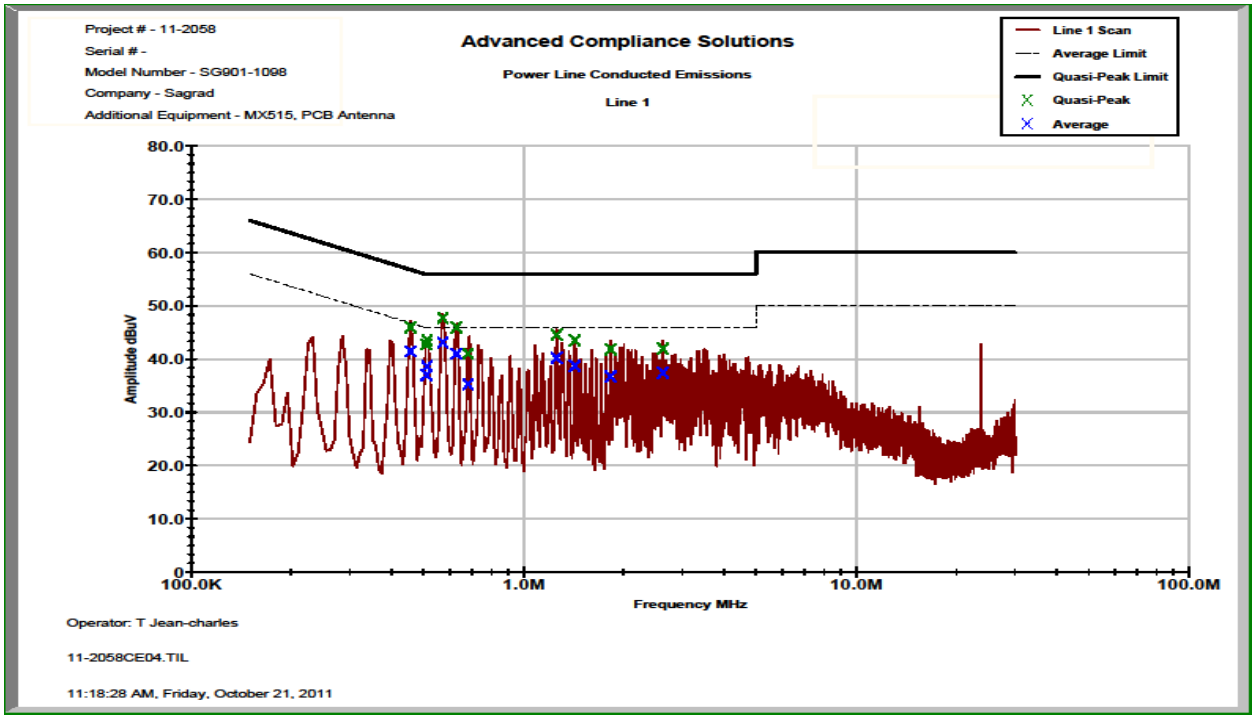



**Figure 7.6.2-1: Line 1 Conducted EMI Results**

**Table 7.6.2-2: Line 2 Conducted EMI Results**

☒ Line 2
☐ To Ground ☒ Floating
☐ Telecom Port ____
☒ dBµV ☐ dBµA

Plot Number: 11-2058CE04
Power Supply Description:
5 VDC

| Frequency (MHz) | Uncorrected Reading | | Total Correction Factor (dB) | Corrected Level | | Limit | | Margin (dB) | |
|---|---|---|---|---|---|---|---|---|---|
| | Quasi-Peak | Average | | Quasi-Peak | Average | Quasi-Peak | Average | Quasi-Peak | Average |
| Line 2 | | | | | | | | | |
| 0.513062 | 41.687 | 36.849 | 0.59 | 42.28 | 37.44 | 56.00 | 46.00 | 13.7 | 8.6 |
| 0.5135 | 41.596 | 36.708 | 0.59 | 42.19 | 37.30 | 56.00 | 46.00 | 13.8 | 8.7 |
| 0.56915 | 42.435 | 38.812 | 0.59 | 43.02 | 39.40 | 56.00 | 46.00 | 13.0 | 6.6 |
| 0.627012 | 44.056 | 39.667 | 0.56 | 44.62 | 40.23 | 56.00 | 46.00 | 11.4 | 5.8 |
| 0.68405 | 40.704 | 36.886 | 0.56 | 41.27 | 37.45 | 56.00 | 46.00 | 14.7 | 8.6 |
| 0.741088 | 42.447 | 38.014 | 0.54 | 42.99 | 38.55 | 56.00 | 46.00 | 13.0 | 7.4 |
| 1.25365 | 38.708 | 32.673 | 0.56 | 39.27 | 33.23 | 56.00 | 46.00 | 16.7 | 12.8 |
| 1.31079 | 40.196 | 34.595 | 0.56 | 40.76 | 35.15 | 56.00 | 46.00 | 15.2 | 10.8 |
| 2.05384 | 37.288 | 31.537 | 0.59 | 37.87 | 32.12 | 56.00 | 46.00 | 18.1 | 13.9 |
| 2.10752 | 37.373 | 31.772 | 0.59 | 37.96 | 32.36 | 56.00 | 46.00 | 18.0 | 13.6 |

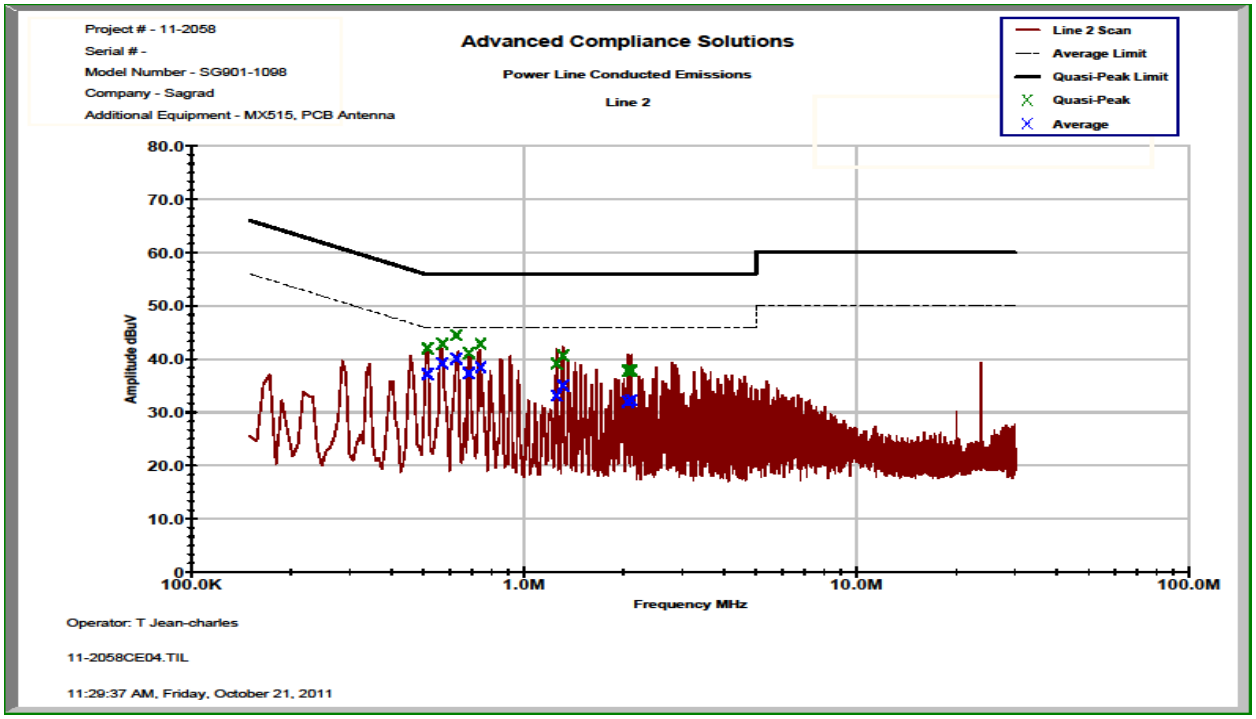



**Figure 7.6.2-2: Line 2 Conducted EMI Results**

## 8 CONCLUSION

In the opinion of ACS, Inc. the SG901-1098, manufactured by Sagrad meets the requirements of FCC Part 15 subpart C and Industry Canada's Radio Standards Specification RSS-210.

# END REPORT