**MET Laboratories, Inc.** *Safety Certification - EMI - Telecom Environmental Simulation*
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3162 BELICK STREET ● SANTA CLARA, CALIFORNIA 95054 ● PHONE (408 748-3585 ● FAX (510) 489-6372

January 5, 2010

Firetide, Inc.
16795 Lark Ave. Suite 200
Los Gatos, CA 95032

Dear Paul Richards,

Enclosed is the EMC Wireless test report for compliance testing of the Firetide, Inc., 7100 Indoor Unit as tested to the requirements of Title 47 of the CFR, Ch. 1 (10-1-06 ed.), Part 15, Subpart B, ICES-003, Issue 4 February 2004 for a Class A Digital Device and FCC Part 15 Subpart C, RSS-210, Issue 7, June 2007 for Intentional Radiators.

Thank you for using the services of MET Laboratories, Inc. If you have any questions regarding these results or if MET can be of further service to you, please feel free to contact me.

Sincerely yours,
MET LABORATORIES, INC.

Jennifer Warnell
Documentation Department

Reference: (\Firetide, Inc.\EMCS81748A-FCC247 Rev. 2)

# Electromagnetic Compatibility Criteria
# Test Report

for the

**Firetide, Inc.**
**7100 Indoor Unit**

**Tested under**
the FCC Certification Rules
contained in
Title 47 of the CFR, Parts 15 Subpart B & ICES-003
for Class A Digital Devices
&
15.247 Subpart C & RSS-210, Issue 7, June 2007
for Intentional Radiators

**MET Report: EMCS81748A-FCC247 Rev. 2**

January 5, 2010

**Prepared For:**

**Firetide, Inc.**
**16795 Lark Ave. Suite 200**
**Los Gatos, CA 95032**

**Prepared By:**
**MET Laboratories, Inc.**
914 W. Patapsco Ave.
Baltimore, MD 21230

  

# Electromagnetic Compatibility Criteria
# Test Report

for the

## Firetide, Inc.
## 7100 Indoor Unit

**Tested under**
the FCC Certification Rules
contained in
Title 47 of the CFR, Parts 15 Subpart B & ICES-003
for Class A Digital Devices
&
15.247 Subpart C & RSS-210, Issue 7, June 2007
for Intentional Radiators

Minh Ly, Project Engineer
Electromagnetic Compatibility Lab

Jennifer Warnell
Documentation Department

**Engineering Statement:** The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of the FCC Rules Parts 15B, 15.247 and Industry Canada standards ICES-003, Issue 4 February 2004, RSS-210, Issue 7, June 2007 under normal use and maintenance.

Shawn McMillen,
Wireless Manager, Electromagnetic Compatibility Lab

  

# Report Status Sheet

| Revision | Report Date | Reason for Revision |
|---|---|---|
| ∅ | October 23, 2009 | Initial Issue. |
| 1 | December 24, 2009 | Revised to correct RF Exposure information. |
| 2 | January 5, 2010 | Correct Harmonics Table Column headers |

  

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# List of Terms and Abbreviations

| | |
|---|---|
| **AC** | **A**lternating **C**urrent |
| **ACF** | **A**ntenna **C**orrection **F**actor |
| **Cal** | **Cal**ibration |
| ***d*** | **M**easurement **D**istance |
| **dB** | **D**eci**b**els |
| **dBµA** | **D**eci**b**els above one **micro**amp |
| **dBµV** | **D**eci**b**els above one **micro**volt |
| **dBµA/m** | **D**eci**b**els above one **micro**amp **per m**eter |
| **dBµV/m** | **D**eci**b**els above one **micro**volt **per m**eter |
| **DC** | **D**irect **C**urrent |
| **E** | **E**lectric Field |
| **DSL** | **D**igital **S**ubscriber **L**ine |
| **ESD** | **E**lectro**s**tatic **D**ischarge |
| **EUT** | **E**quipment **U**nder **T**est |
| ***f*** | **F**requency |
| **FCC** | **F**ederal **C**ommunications **C**ommission |
| **GRP** | **G**round **R**eference **P**lane |
| **H** | Magnetic Field |
| **HCP** | **H**orizontal **C**oupling **P**lane |
| **Hz** | **H**ert**z** |
| **IEC** | **I**nternational **E**lectrotechnical **C**ommission |
| **kHz** | **k**ilo**h**ert**z** |
| **kPa** | **k**ilo**pa**scal |
| **kV** | **k**ilovolt |
| **LISN** | **L**ine **I**mpedance **S**tabilization **N**etwork |
| **MHz** | **M**ega**h**ertz |
| **µH** | **micro**henry |
| µ | **micro**farad |
| **µs** | **micros**econds |
| **NEBS** | **N**etwork **E**quipment-**B**uilding **S**ystem |
| **PRF** | **P**ulse **R**epetition **F**requency |
| **RF** | **R**adio **F**requency |
| **RMS** | **R**oot-**M**ean-**S**quare |
| **TWT** | **T**raveling **W**ave **T**ube |
| **V/m** | **V**olts **per m**eter |
| **VCP** | **V**ertical **C**oupling **P**lane |

# I. Executive Summary

## A. Purpose of Test

An EMC evaluation was performed to determine compliance of the Firetide, Inc. 7100 Indoor Unit, with the requirements of Part 15, §15.247. All references are to the most current version of Title 47 of the Code of Federal Regulations in effect. In accordance with §2.1033, the following data is presented in support of the Certification of the 7100 Indoor Unit. Firetide, Inc. should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the 7100 Indoor Unit, has been **permanently** discontinued.

## B. Executive Summary

The following tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 15, §15.247, in accordance with Firetide, Inc., purchase order number 2475. All tests were conducted using measurement procedure ANSI C63.4-2003.

| FCC Reference | IC Reference | Description | Compliance |
|---|---|---|---|
| 47 CFR Part 15.247:2005 | RSS-210 Issue 7: 2007 | Applicable Standard | Compliant |
| 47 CFR Part 15.107 (a) | RSS-210 Issue 7: 2007 | Conducted Emission Limits for a Class A Digital Device | Compliant |
| 47 CFR Part 15.109 (a) | RSS-210 Issue 7: 2007 | Radiated Emission Limits for a Class A Digital Device | Compliant |
| Title 47 of the CFR, Part 15 §15.203 | N/A | Antenna Requirement | Compliant |
| Title 47 of the CFR, Part 15 §15.207(a) | RSS-210(7.2.2) | Conducted Emission Voltage | Compliant |
| Title 47 of the CFR, Part 15 §15.247(a)(1) | RSS-210(A8.1) | Occupied Bandwidth | Compliant |
| Title 47 of the CFR, Part 15 §15.247(b) | RSS-210(A8.4) | RF Output Power | Compliant |
| Title 47 of the CFR, Part 15 §15.209, §15.247(d) | RSS-210(A8.5) | Radiated Spurious Emissions | Compliant |
| Title 47 of the CFR, Part 15 §15.205 | RSS-210(A8.5) | Emissions at Restricted Band | Compliant |
| Title 47 of the CFR, Part 15 §15.209, §15.247(d) | RSS-210(A8.5) | Conducted Spurious Emissions | Compliant |
| Title 47 of the CFR, Part 15; §15.247(e) | RSS-210(A8.3) | Power Spectral Density | Compliant |
| Title 47 of the CFR, Part 15 §15.247(i) | RSS-Gen(5.5) | Maximum Permissible Exposure | Compliant |
| N/A | RSS-Gen(4.8) | Receiver Spurious Emissions | Compliant |

**Table 1. Executive Summary of EMC Part 15.247 ComplianceTesting**

# II. Equipment Configuration

# A. Overview

MET Laboratories, Inc. was contracted by Firetide, Inc. to perform testing on the 7100 Indoor Unit, under Firetide, Inc.'s purchase order number 2475.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Firetide, Inc., 7100 Indoor Unit.

The results obtained relate only to the item(s) tested.

| | | | |
|---|---|---|---|
| **Model(s) Tested:** | 7100 Indoor Unit | | |
| **Model(s) Covered:** | 7100 Indoor Unit | | |
| **EUT Specifications:** | Primary Power: 12 VDC | | |
| | FCC ID: REP-7100-1<br>IC: 4988A-7100 | | |
| | Type of Modulations: | OFDM (Orthogonal Frequency Division multiplexing) | |
| | Emission Designator: | **2.4 GHz** | **5 GHz** |
| | | 802.11g: 16M31D7D | 802.11a: 16M24D7D |
| | | 802.11n 20MHz: 17M58D7D | 802.11n 20MHz: 17M54D7D |
| | | 802.11n 40MHz: 36M63D7D | 802.11n 40MHz: 36M63D7D |
| | Equipment Code: | DTS | |
| | Peak RF Output Power: | **2.4 GHz** | **5 GHz** |
| | | 802.11g: 26.09 dBm | 802.11a: 29.62 dBm |
| | | 802.11n 20MHz: 24.31 dBm | 802.11n 20MHz: 24.68 dBm |
| | | 802.11n 40MHz: 22.79 dBm | 802.11n 40MHz: 24.90 dBm |
| | EUT Frequency Ranges: | 2412 - 2462MHz &5745– 5825MHz | |
| **Analysis:** | The results obtained relate only to the item(s) tested. | | |
| **Environmental Test Conditions:** | Temperature: 15-35º C | | |
| | Relative Humidity: 30-60% | | |
| | Barometric Pressure: 860-1060 mbar | | |
| **Evaluated by:** | Minh Ly | | |
| **Report Date(s):** | December 24, 2009 | | |

**Table 2. EUT Summary Table**

## B. References

| | |
|---|---|
| **CFR 47, Part 15, Subpart C** | Federal Communication Commission, Code of Federal Regulations, Title 47, Part 15: General Rules and Regulations, Allocation, Assignment, and Use of Radio Frequencies |
| **RSS-210, Issue 7, June 2007** | Low-power Licence-exempt Radiocommunications Devices (All Frequency Bands): Category I Equipment |
| **CFR 47, Part 15, Subpart B** | Electromagnetic Compatibility: Criteria for Radio Frequency Devices |
| **ICES-003, Issue 4 February 2004** | Electromagnetic Compatibility: Criteria for Radio Frequency Devices |
| **ANSI C63.4:2003** | Methods and Measurements of Radio-Noise Emissions from Low-Voltage Electrical And Electronic Equipment in the Range of 9 kHz to 40 GHz |
| **ANSI/NCSL Z540-1-1994** | Calibration Laboratories and Measuring and Test Equipment - General Requirements |
| **ANSI/ISO/IEC 17025:2000** | General Requirements for the Competence of Testing and Calibration Laboratories |

**Table 3. References**

## C. Test Site

All testing was performed at MET Laboratories, Inc., 3162 Belick Street, Santa Clara, CA 95054. All equipment used in making physical determinations is accurate and bears recent traceability to the National Institute of Standards and Technology.

Radiated Emissions measurements were performed in a 5 meter semi-anechoic chamber (equivalent to an Open Area Test Site). In accordance with §2.948(a)(3), a complete site description is contained at MET Laboratories.

## D. Description of Test Sample

The Firetide, Inc. 7100 Indoor Unit, Equipment Under Test (EUT), is a Dual Radio Wireless Mesh Node.


**Photograph 1. Firetide, Inc., 7100 Indoor Unit**

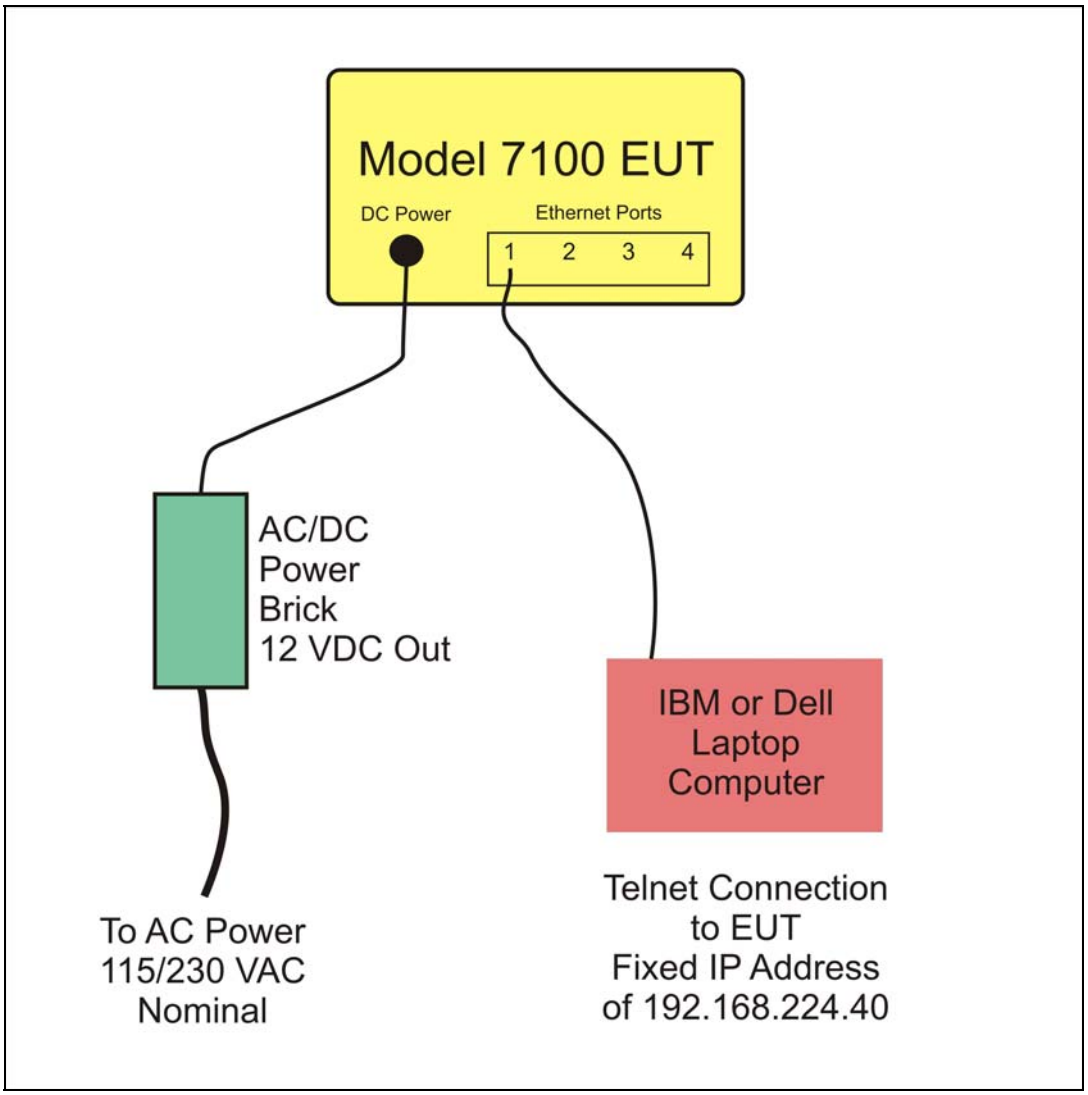



**Figure 1. Block Diagram of Test Configuration**

## E. Equipment Configuration

The EUT was set up as outlined in Figure 1, Block Diagram of Test Setup. All cards, racks, etc., incorporated as part of the EUT is included in the following list.

| Ref. ID | Slot # | Name / Description | Model Number | Part Number | Serial Number | Rev. # |
|---|---|---|---|---|---|---|
| N/A | N/A | HOTPORT INDOOR MESH NODE | 7100 | 7100 | N/A | 1 |

**Table 4. Equipment Configuration**

## F. Support Equipment

Support equipment necessary for the operation and testing of the EUT is included in the following list.

| Ref. ID | Name / Description | Manufacturer | Model Number |
|---|---|---|---|
| N/A | 5DBI OMNI (2.4GHZ) | WHA YU | C812-510010-A |
| N/A | 5DBI OMNI (5GHZ) | WHA YU | C812-510012-A |
| N/A | LAPTOP COMPUTER | IBM | T42 |
| N/A | LAPTOP COMPUTER | DELL | N/A |
| N/A | AC/DC POWER BRICK | FSP GROUPINC. | FSP040-1ADF03A |

**Table 5. Support Equipment**

## G. Ports and Cabling Information

| Ref. ID | Port name on EUT | Cable Description or reason for no cable | Qty. | Length (m) | Shielded (Y/N) | Termination Box ID & Port Name |
|---|---|---|---|---|---|---|
| N/A | PORT 1 | ETHERNET | 1 | 1.5 | N | LAPTOP-RJ45 |
| N/A | PORT 2 – 4 | NOT CONNECTED; ONLY 1 ETHERNET CONNECTION IS NECESSARY TO COMMUNICATE WITH EUT | N/A | N/A | N/A | N/A |
| N/A | POWER | DC POWER IN FROM POWER BRICK; 2.1 MM PLUG | 1 | 1 | N | N/A |
| N/A | USB | NOT USED; DISABLED | N/A | N/A | N/A | N/A |

**Table 6. Ports and Cabling Information**

## H. Mode of Operation

The UUT has the Atheros Radio Test (ART) software loaded. The UUT can be put into continuous TX or RX using ART. The Mesh Node has a default IP address of 192.168.224.150. An external computer can ping this address to verify the Ethernet PHY and processor are running.

## I. Method of Monitoring EUT Operation

An external computer can ping this address to verify the Ethernet PHY and processor are running.

## J. Modifications

### a) Modifications to EUT

No modifications were made to the EUT.

### b) Modifications to Test Standard

No modifications were made to the test standard.

## K. Disposition of EUT

The test sample including all support equipment submitted to the Electro-Magnetic Compatibility Lab for testing was returned to Firetide, Inc. upon completion of testing.

# III. Electromagnetic Compatibility Criteria for Unintentional Radiators

## Electromagnetic Compatibility Criteria

## § 15.107 Conducted Emissions Limits

**Test Requirement(s):**

**15.107 (a)** Except for Class A digital devices, for equipment 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 Table 7. Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminals.

**15.107 (b)** For a Class A digital device 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 Table 7. Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminals. The lower limit applies at the band edges.

**15.207(a)**, Except as shown in paragraphs (b) and (c) of this section*, charging, AC adapters or battery eliminators 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 Table 7, 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 range (MHz) | Class A Conducted Limits (dBµV) | | *Class B Conducted Limits (dBµV) | |
|---|---|---|---|---|
| | Quasi-Peak | Average | Quasi-Peak | Average |
| * 0.15- 0.45 | 79 | 66 | 66 - 56 | 56 - 46 |
| 0.45 - 0.5 | 79 | 66 | 56 | 46 |
| 0.5 - 30 | 73 | 60 | 60 | 50 |
| Note 1 — The lower limit shall apply at the transition frequencies.<br>Note 2 — The limit decreases linearly with the logarithm if the frequency in the range 0.15 MHz to 0.5 MHz.<br>* -- Limits per Subsection 15.207(a). | | | | |

**Table 7. Conducted Limits for Radio Frequency Devices calculated from FCC Part 15 Subsections 15.107(a) (b) and 15.207(a)**

**Test Results:** The EUT was compliant with the Class B requirement(s) of this section. Measured emissions were below applicable limits.

**Test Engineer(s):** Minh Ly

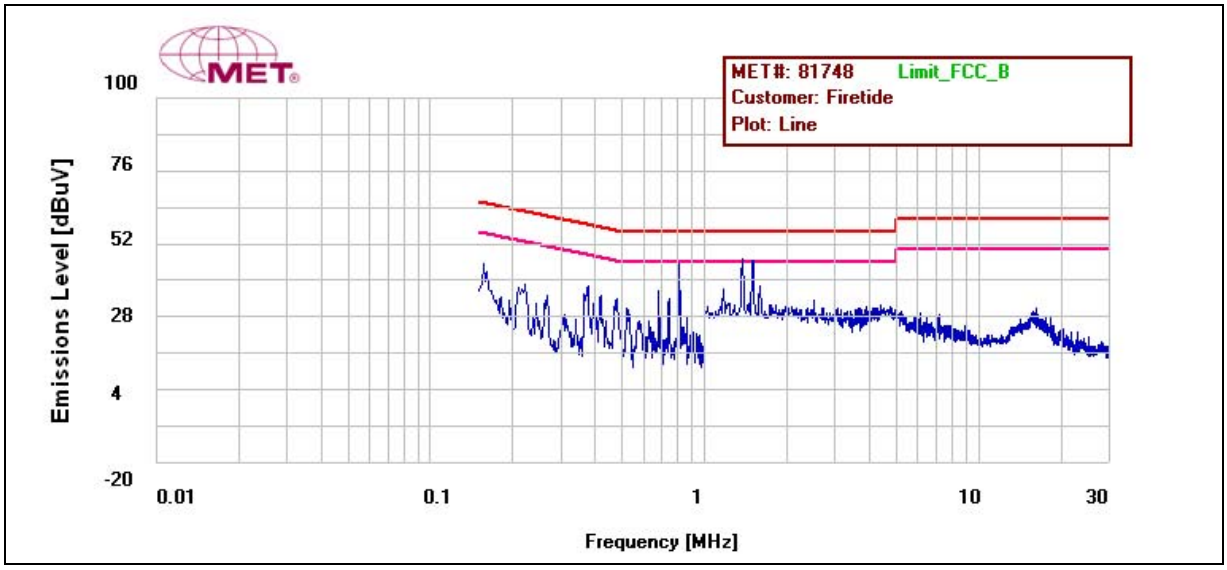
**Test Date(s):** 08/06/09

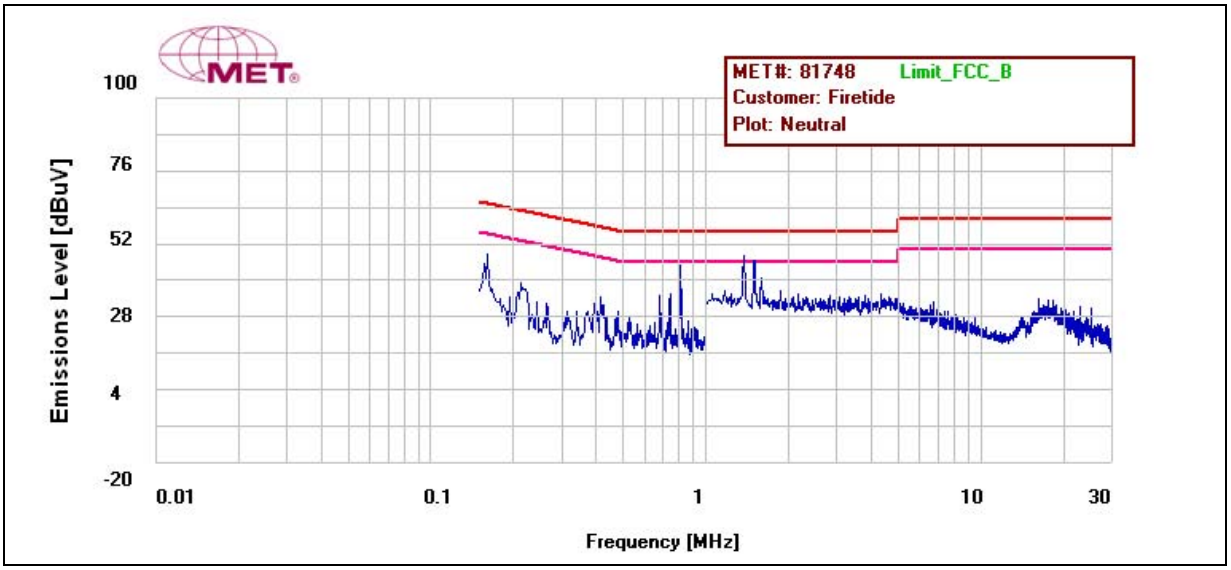
## Conducted Emissions - Voltage, AC Power, (120VAC)

| Line | Freq (MHz) | QP Amplitude | QP Limit | Delta | Pass | Average Amplitude | Average Limit | Delta | Pass |
|---|---|---|---|---|---|---|---|---|---|
| Line | 0.809 | 48.48 | 56 | -7.52 | Pass | 44.48 | 46 | -1.52 | Pass |
| Line | 1.37 | 45.08 | 56 | -10.92 | Pass | 41.72 | 46 | -4.28 | Pass |
| Line | 1.5 | 42.8 | 56 | -13.2 | Pass | 40.39 | 46 | -5.61 | Pass |
| Neutral | 0.810 | 47.88 | 56 | -8.12 | Pass | 44.88 | 46 | -1.12 | Pass |
| Neutral | 1.371 | 45.01 | 56 | -10.99 | Pass | 42.16 | 46 | -3.84 | Pass |
| Neutral | 1.5 | 40.76 | 56 | -15.24 | Pass | 39.93 | 46 | -6.07 | Pass |

**Table 8. Conducted Emissions - Voltage, AC Power, (120VAC)**




**Plot 1. Conducted Emission, Phase Line Plot**

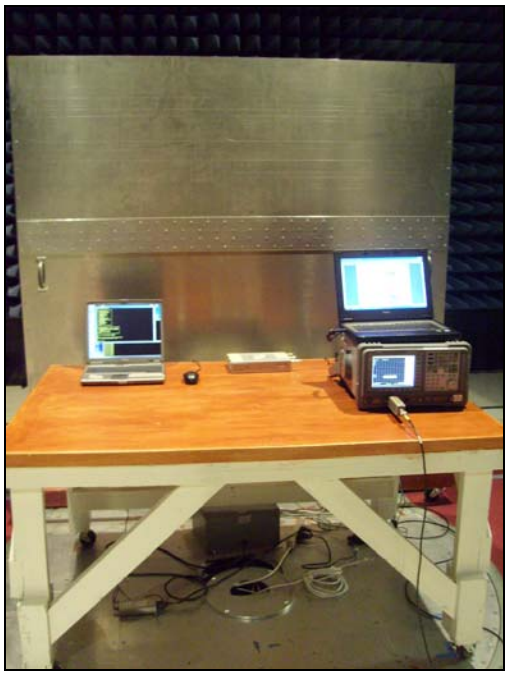



**Plot 2. Conducted Emission, Neutral Line Plot**

## Conducted Emission Limits Test Setup

**Photograph 2. Conducted Emissions, Test Setup. Side View**



**Photograph 3. Conducted Emissions, Test Setup. Front View**

## Radiated Emission Limits

### § 15.109 Radiated Emissions Limits

**Test Requirement(s):** **15.109 (a)** Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the Class B limits expressed in Table 9.

**15.109 (b)** The field strength of radiated emissions from a Class A digital device, as determined at a distance of 10 meters, shall not exceed the Class A limits expressed in Table 9.

| Frequency (MHz) | Field Strength (dBµV/m) | |
|---|---|---|
| | §15.109 (b), Class A Limit (dBµV) @ 10m | §15.109 (a),Class B Limit (dBµV) @ 3m |
| 30 - 88 | 39.00 | 40.00 |
| 88 - 216 | 43.50 | 43.50 |
| 216 - 960 | 46.40 | 46.00 |
| Above 960 | 49.50 | 54.00 |

**Table 9. Radiated Emissions Limits calculated from FCC Part 15, §15.109 (a) (b)**

**Test Procedures:** The EUT was placed on a non-metallic table, 80 cm above the ground plane inside a semi-anechoic chamber. The method of testing and test conditions of ANSI C63.4 were used. An antenna was located 3m from the EUT on an adjustable mast. A pre-scan was first performed in order to find prominent radiated emissions. For final emissions measurements at each frequency of interest, the EUT was rotated and the antenna height was varied between 1 m and 4 m in order to maximize the emission. Measurements in both horizontal and vertical polarities were made and the data was recorded. Unless otherwise specified, measurements were made using a quasi-peak detector with a 120 kHz bandwidth.

**Test Results:** The EUT was compliant with the Class A requirement(s) of this section. Measured emissions were below applicable limits.

**Test Engineer(s):** Minh Ly

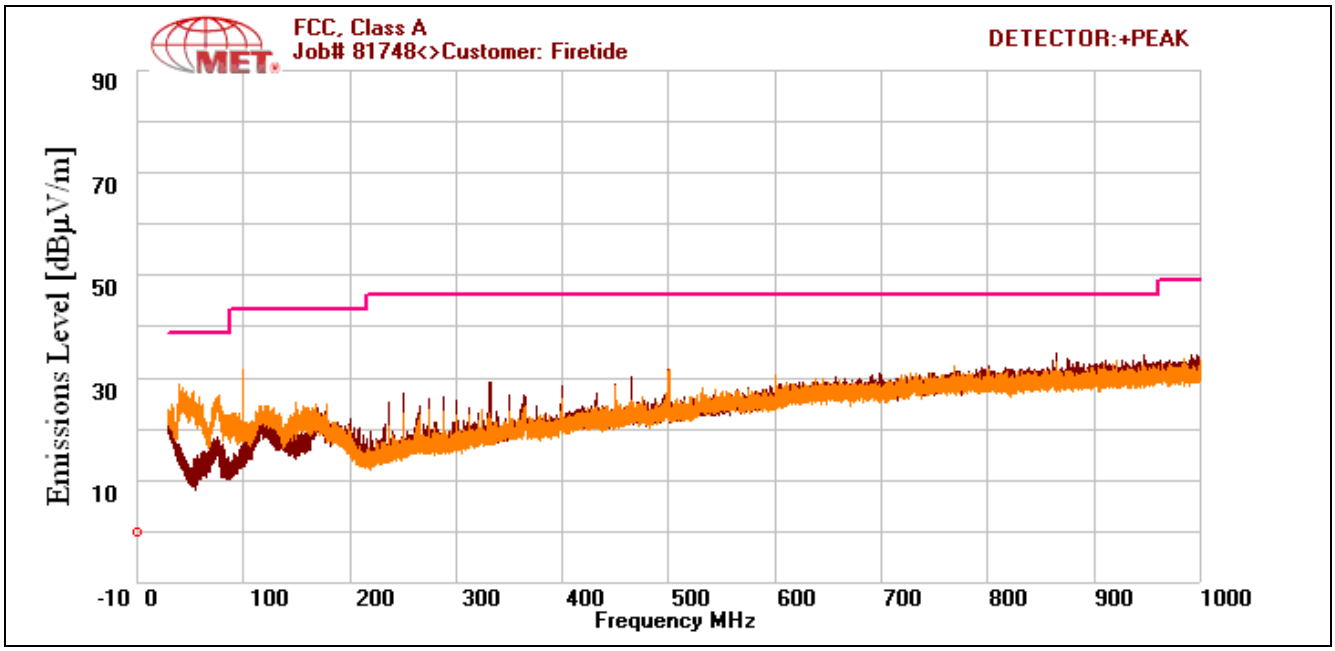
**Test Date(s):** 08/10/09

## Radiated Emissions Limits Test Results, Class A

| Frequency (MHz) | Antenna Polarity | EUT Azimuth (Degrees) | Antenna Height (cm) | Uncorrected Amplitude (dBuV) | ACF (dB/m) | Pre Amp Gain (dB) | CBL (dB) | DCF (dB) | Corrected Amplitude (dBuV/m) | Limit (dBuV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 100 | V | 134 | 100 | 27.52 | 12.7 | 0 | 2.47 | -10.46 | 32.23 | 43.5 | -11.27 |
| 500 | V | 193 | 100 | 19.49 | 17.6 | 0 | 5.74 | -10.46 | 32.37 | 46.4 | -14.03 |
| 42.4 | V | 139 | 100 | 25.2 | 10.7 | 0 | 1.565 | -10.46 | 27.005 | 39 | -11.995 |
| 100 | H | 81 | 253 | 23.3 | 11.1 | 0 | 2.47 | -10.46 | 26.41 | 43.5 | -17.09 |
| 332 | H | 0 | 100 | 18.48 | 14.74 | 0 | 4.636 | -10.46 | 27.396 | 46.4 | -19.004 |
| 500 | H | 197 | 205 | 17.8 | 18 | 0 | 5.74 | -10.46 | 31.08 | 46.4 | -15.32 |

**Table 10. Radiated Emissions Limits, Test Results, FCC Limits, 30 MHz – 1 GHz**

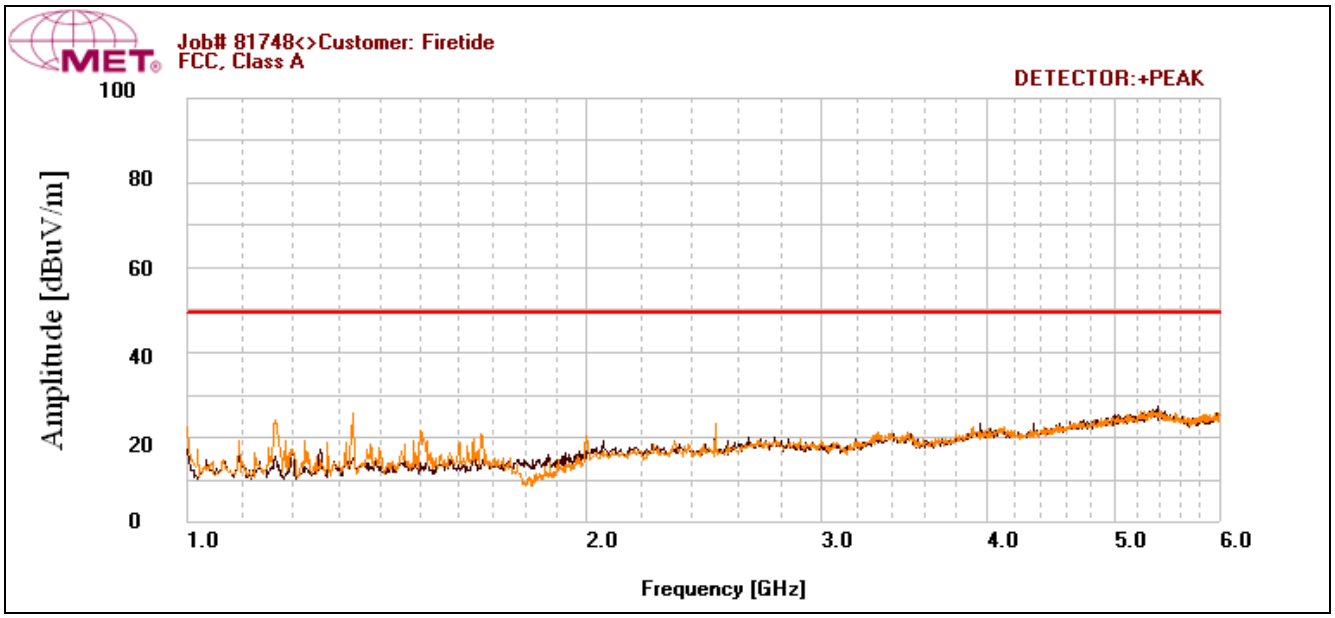



**Plot 3. Radiated Emissions, Pre-Scan, FCC Limits, 30 MHz – 1 GHz**

| Frequency (MHz) | Antenna Polarity | EUT Azimuth (Degrees) | Antenna Height (cm) | Uncorrected Amplitude (dBuV) | ACF (dB/m) | Pre Amp Gain (dB) | CBL (dB) | DCF (dB) | Corrected Amplitude (dBuV/m) | Limit (dBuV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1260 | V | 29 | 100 | 51.53 | -1.552 | 35.258 | 1.686 | -10.46 | 5.946 | 49.5 | -43.554 |
| 1328 | V | 193 | 100 | 59.13 | -1.636 | 35.155 | 1.724 | -10.46 | 13.603 | 49.5 | -35.897 |
| 2250 | H | 91 | 100 | 49.24 | 1.485 | 34.555 | 2.187 | -10.46 | 7.897 | 49.5 | -41.603 |
| 5000 | H | 0 | 100 | 44.36 | 8.299 | 34.415 | 4.13 | -10.46 | 11.914 | 49.5 | -37.586 |
| 5000 | V | 0 | 100 | 45.28 | 8.299 | 34.415 | 4.13 | -10.46 | 12.834 | 49.5 | -36.666 |

**Table 11. Radiated Emissions Limits, Test Results, FCC Limits, 1 GHz – 6 GHz**



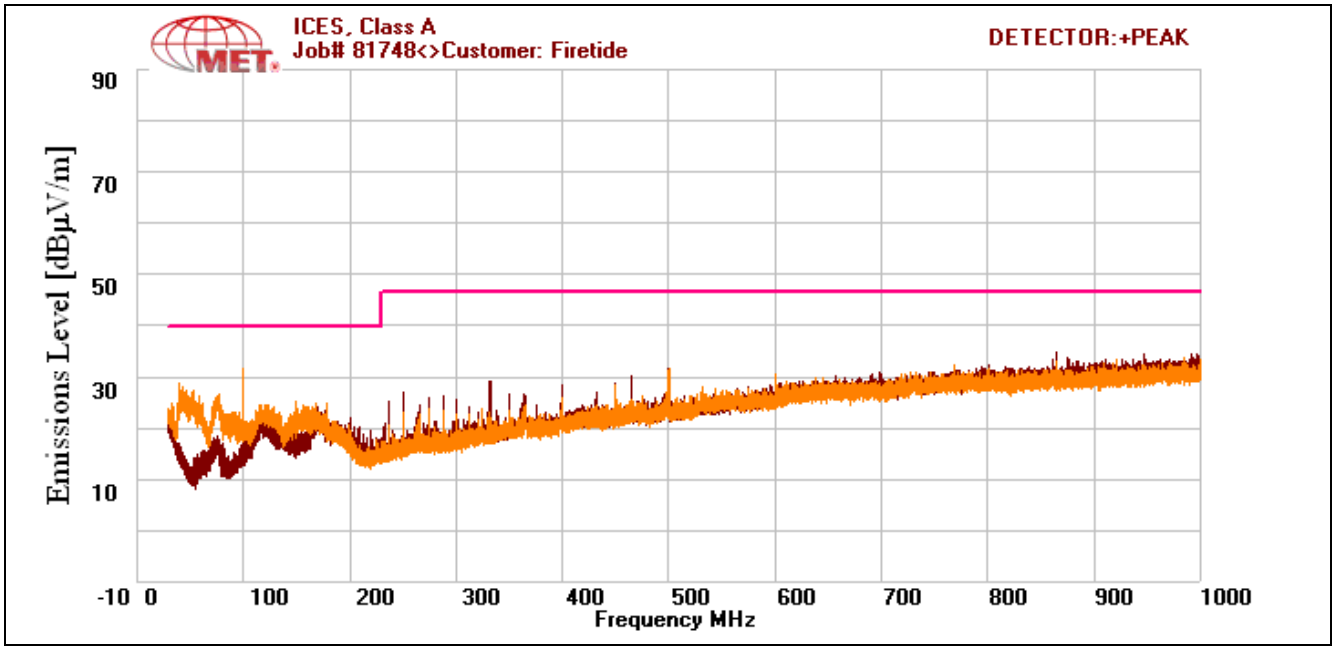

**Plot 4. Radiated Emissions, Pre-Scan, FCC Limits, 1 GHz – 6 GHz**

## Radiated Emissions Limits Test Results, Class A

| Frequency (MHz) | Antenna Polarity | EUT Azimuth (Degrees) | Antenna Height (cm) | Uncorrected Amplitude (dBuV) | ACF (dB/m) | Pre Amp Gain (dB) | CBL (dB) | DCF (dB) | Corrected Amplitude (dBuV/m) | Limit (dBuV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 100 | V | 134 | 100 | 27.52 | 12.7 | 0 | 2.47 | -10.46 | 32.23 | 40 | -7.77 |
| 500 | V | 193 | 100 | 19.49 | 17.6 | 0 | 5.74 | -10.46 | 32.37 | 47 | -14.63 |
| 42.4 | V | 139 | 100 | 25.2 | 10.7 | 0 | 1.565 | -10.46 | 27.005 | 40 | -12.995 |
| 100 | H | 81 | 253 | 23.3 | 11.1 | 0 | 2.47 | -10.46 | 26.41 | 40 | -13.59 |
| 332 | H | 0 | 100 | 18.48 | 14.74 | 0 | 4.636 | -10.46 | 27.396 | 47 | -19.604 |
| 500 | H | 197 | 205 | 17.8 | 18 | 0 | 5.74 | -10.46 | 31.08 | 47 | -15.92 |

**Table 12. Radiated Emissions Limits, Test Results, ICES-003 Limits**

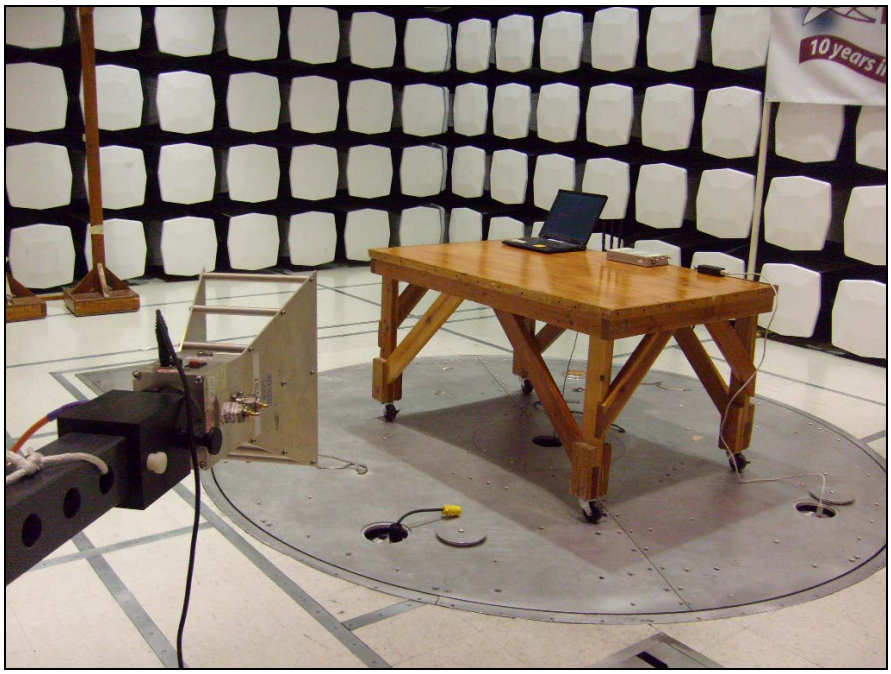



**Plot 5. Radiated Emissions, Pre-Scan, ICES-003 Limits**

## Radiated Emission Limits Test Setup

**Photograph 4. Radiated Emission, Test Setup, 30 MHz – 1 GHz**



**Photograph 5. Radiated Emission, Test Setup, 1 GHz – 6 GHz**

# IV. Electromagnetic Compatibility Criteria for Intentional Radiators

## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.203 Antenna Requirement

**Test Requirement:** **§ 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.

The structure and application of the EUT were analyzed to determine compliance with Section 15.203 of the Rules. Section 15.203 states that the subject device must meet at least one of the following criteria:

a.) Antenna must be permanently attached to the unit.

b.) Antenna must use a unique type of connector to attach to the EUT.

c.) Unit must be professionally installed. Installer shall be responsible for verifying that the correct antenna is employed with the unit.

**Results:** The EUT as tested is compliant the criteria of §15.203 by having a unique type of antenna connector attached to the EUT.

**Test Engineer(s):** Minh Ly

**Test Date(s):** 08/11/09

| Gain/Type | Model | Manufacturer |
|---|---|---|
| 5dBi Omni (2.4GHz) | C812-510010-A | Wha Yu |
| 5dBi Omni (5GHz) | C812-510012-A | Wha Yu |

## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.207 Conducted Emissions Limits

**Test Requirement(s):** **§ 15.207 (a):** 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 30MHz, shall not exceed the limits in the following table, as measured using a 50 μH/50 Ω 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 frequency ranges.

| Frequency range (MHz) | § 15.207(a), Conducted Limit (dBμV) | |
|---|---|---|
| | Quasi-Peak | Average |
| * 0.15- 0.45 | 66 - 56 | 56 - 46 |
| 0.45 - 0.5 | 56 | 46 |
| 0.5 - 30 | 60 | 50 |

**Table 13. Conducted Limits for Intentional Radiators from FCC Part 15 § 15.207(a)**

**Test Procedure:** The EUT was placed on a 0.8 m-high wooden table inside a screen room. The EUT was situated such that the back of the EUT was 0.4 m from one wall of the vertical ground plane, and the remaining sides of the EUT were no closer than 0.8 m from any other conductive surface. The EUT was powered from a 50 Ω/50 μH Line Impedance Stabilization Network (LISN). The EMC receiver scanned the frequency range from 150 kHz to 30 MHz. Conducted Emissions measurements were made in accordance with *ANSI C63.4-2003 "Methods and Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9kHz to 40 GHz"*. The measurements were performed over the frequency range of 0.15 MHz to 30 MHz using a 50 Ω/50 μH LISN as the input transducer to an EMC/field intensity meter. For the purpose of this testing, the transmitter was turned on.

**Test Results:** The EUT was compliant with this requirement.

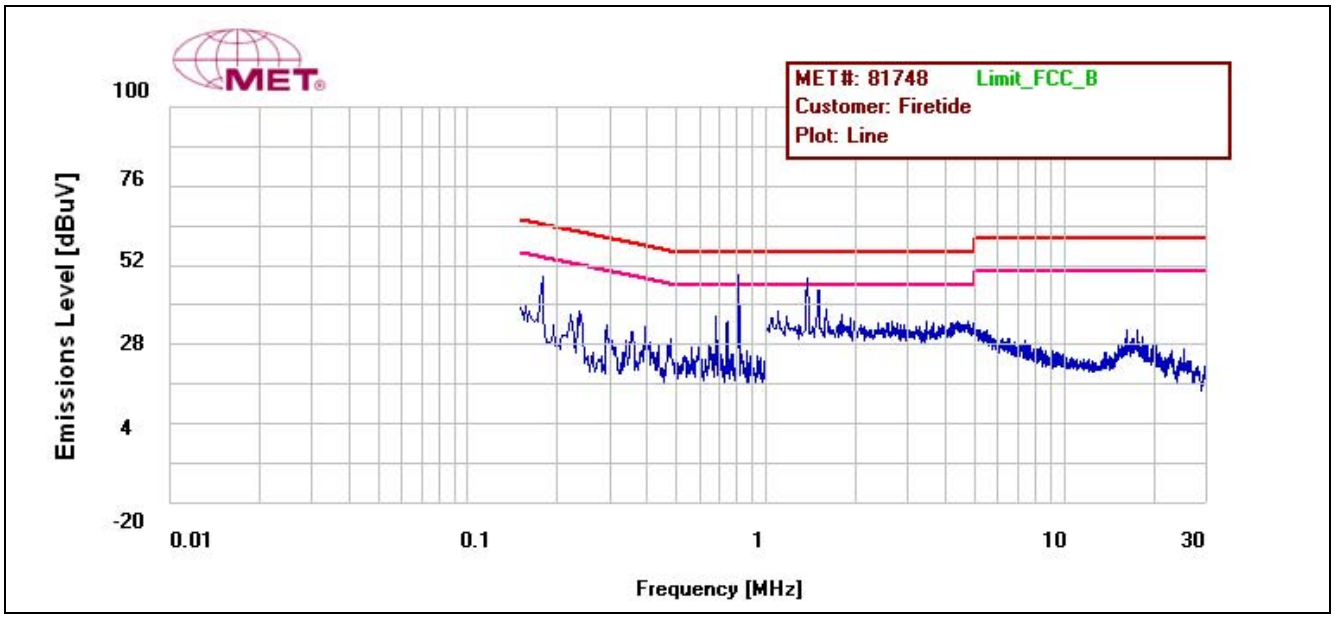
**Test Engineer(s):** Minh Ly

**Test Date(s):** 08/06/09

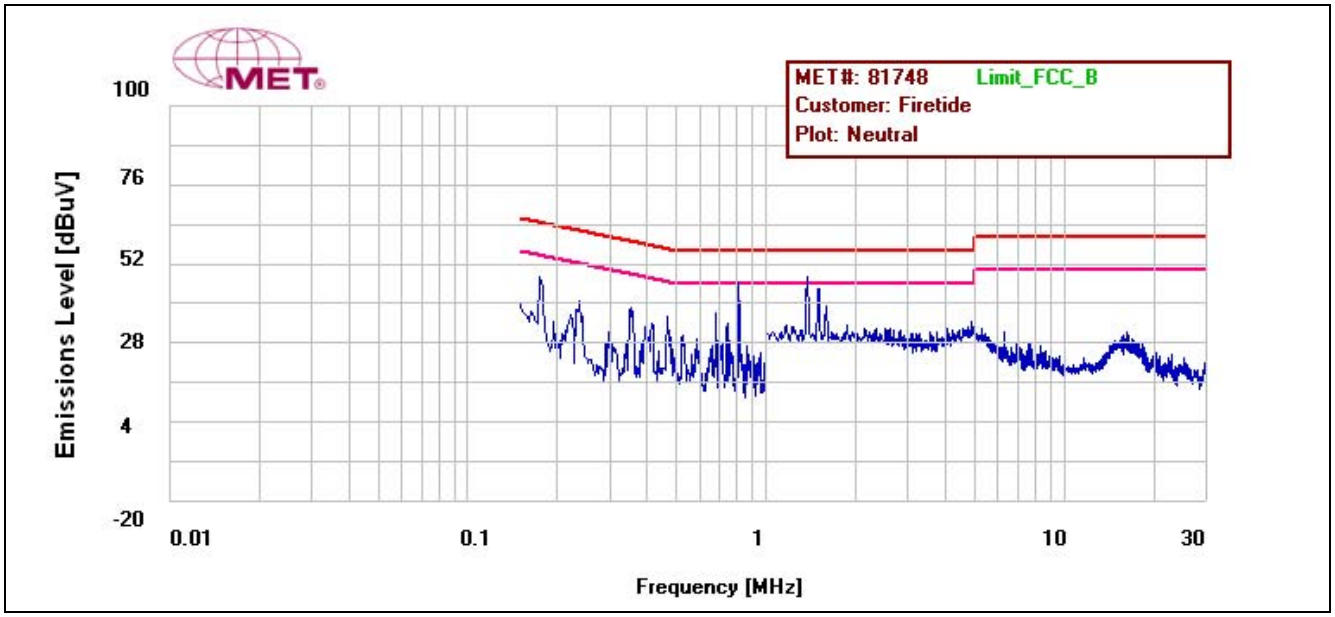
| Line | Freq (MHz) | QP Amplitude | QP Limit | Delta | Pass | Average Amplitude | Average Limit | Delta | Pass |
|---|---|---|---|---|---|---|---|---|---|
| Line | 0.81 | 48.12 | 56 | -7.88 | Pass | 44.49 | 46 | -1.51 | Pass |
| Line | 1.37 | 45.92 | 56 | -10.08 | Pass | 41.87 | 46 | -4.13 | Pass |
| Line | 1.5 | 40.81 | 56 | -15.19 | Pass | 40.63 | 46 | -5.37 | Pass |
| Neutral | 0.809 | 45.55 | 56 | -10.45 | Pass | 43.78 | 46 | -2.22 | Pass |
| Neutral | 1.37 | 46.16 | 56 | -9.84 | Pass | 41.91 | 46 | -4.09 | Pass |
| Neutral | 1.5 | 43.79 | 56 | -12.21 | Pass | 40.02 | 46 | -5.98 | Pass |

**Table 14. Conducted Emissions, 15.207, Test Results**

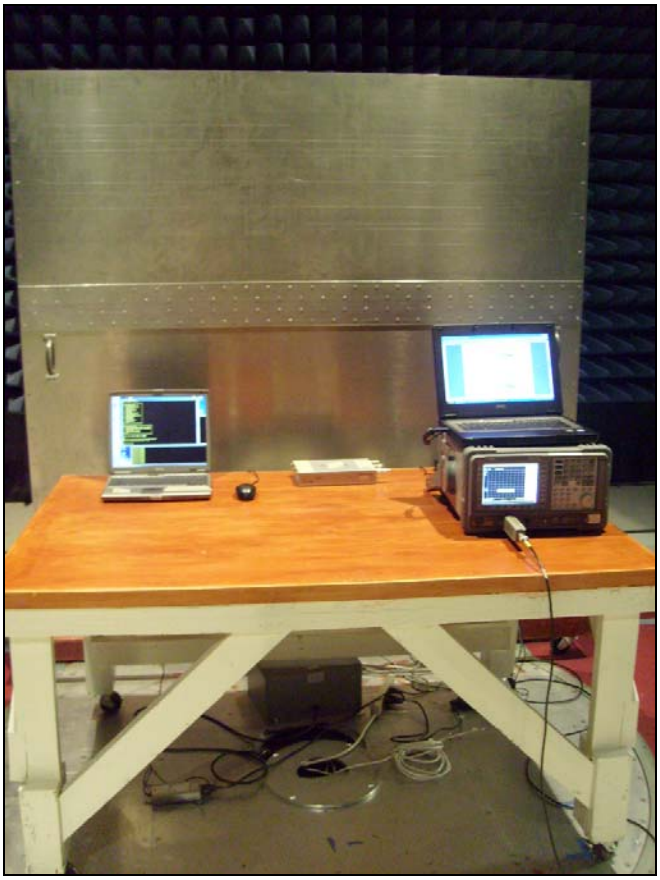



**Plot 6. Conducted Emissions, Phase Line**




**Plot 7. Conducted Emissions, Neutral Line**



**Photograph 6. Conducted Emissions, 15.207, Test Setup**

## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.247(a) 6 dB and 99% Bandwidth

**Test Requirements:** **§ 15.247(a):** Operation under the provisions of this section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

For systems using digital modulation techniques, the EUT may operate in the 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz bands. The minimum 6dB bandwidth shall be at least 500 kHz.

**Test Procedure:** The transmitter was on and transmitting at the highest output power. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using a RBW approximately 1% of the total emission bandwidth, VBW > RBW. The 6 dB Bandwidth was measured and recorded. The measurements were performed on the low, mid and high channels.

**Test Results** The EUT was compliant with § 15.247 (a).

The 6 dB and 99% Bandwidth was determined from the plots on the following pages.

**Test Engineer(s):** Minh Ly

**Test Date(s):** 08/11/09

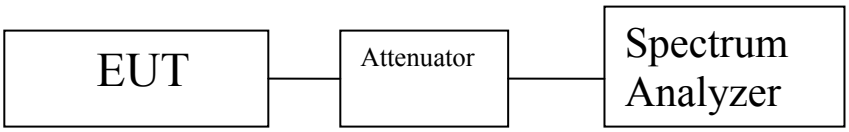



**Figure 2. Block Diagram, Occupied Bandwidth Test Setup**

| Occupied Bandwidth (2.4 GHz), Port 1 | | | | |
|---|---|---|---|---|
| **Mode** | **Carrier Channel** | **Frequency (MHz)** | **Measured 6 dB Bandwidth (MHz)** | **Measured 99% Bandwidth (MHz)** |
| 802.11g | Low | 2412 | 16.301 | 16.7118 |
| | Mid | 2437 | 15.720 | 16.9048 |
| | High | 2462 | 15.960 | 16.5275 |
| 802.11n (20MHz) | Low | 2412 | 17.479 | 17.7502 |
| | Mid | 2437 | 17.576 | 17.8559 |
| | High | 2447 | 17.309 | 17.5549 |
| 802.11n (40MHz) | Mid | 2437 | 36.633 | 36.7035 |

**Table 15. Occupied Bandwidth, Test Results, 2.4 GHz, Port 1**

| Occupied Bandwidth (2.4 GHz), Port 2 | | | | |
|---|---|---|---|---|
| **Mode** | **Carrier Channel** | **Frequency (MHz)** | **Measured 6 dB Bandwidth (MHz)** | **Measured 99% Bandwidth (MHz)** |
| 802.11n (20MHz) | Low | 2412 | 17.573 | 17.7259 |
| | Mid | 2437 | 17.702 | 17.8810 |
| | High | 2462 | 17.278 | 17.8034 |
| 802.11n (40MHz) | Mid | 2437 | 35.855 | 36.4845 |

**Table 16. Occupied Bandwidth, Test Results, 2.4 GHz, Port 2**

| Occupied Bandwidth (2.4 GHz), Port 3 | | | | |
|---|---|---|---|---|
| **Mode** | **Carrier Channel** | **Frequency (MHz)** | **Measured 6 dB Bandwidth (MHz)** | **Measured 99% Bandwidth (MHz)** |
| 802.11n (20MHz) | Low | 2412 | 17.148 | 17.6532 |
| | Mid | 2437 | 16.838 | 17.7236 |
| | High | 2462 | 17.428 | 17.8052 |
| 802.11n (40MHz) | Mid | 2437 | 36.046 | 36.3106 |

**Table 17. Occupied Bandwidth, Test Results, 2.4 GHz, Port 3**

| Occupied Bandwidth (5 GHz), Port 1 | | | | |
|---|---|---|---|---|
| **Mode** | **Carrier Channel** | **Frequency (MHz)** | **Measured 6 dB Bandwidth (MHz)** | **Measured 99% Bandwidth (MHz)** |
| 802.11g | Low | 5745 | 13.473 | 16.2290 |
| | Mid | 5785 | 16.235 | 23.0412 |
| | High | 5825 | 15.746 | 22.3802 |
| 802.11n (20MHz) | Low | 5745 | 17.538 | 17.8341 |
| | Mid | 5785 | 16.925 | 17.6839 |
| | High | 5825 | 17.365 | 17.6673 |
| 802.11n (40MHz) | Low | 5755 | 35.503 | 36.5352 |
| | High | 5795 | 36.628 | 36.6484 |

**Table 18. Occupied Bandwidth, Test Results, 5 GHz, Port 1**

| Occupied Bandwidth (5 GHz), Port 2 | | | | |
|---|---|---|---|---|
| **Mode** | **Carrier Channel** | **Frequency (MHz)** | **Measured 6 dB Bandwidth (MHz)** | **Measured 99% Bandwidth (MHz)** |
| 802.11n (20MHz) | Low | 5745 | 16.800 | 17.6619 |
| | Mid | 5785 | 17.509 | 17.6483 |
| | High | 5825 | 16.070 | 17.6021 |
| 802.11n (40MHz) | Low | 5755 | 36.177 | 36.6398 |
| | High | 5795 | 35.487 | 36.9090 |

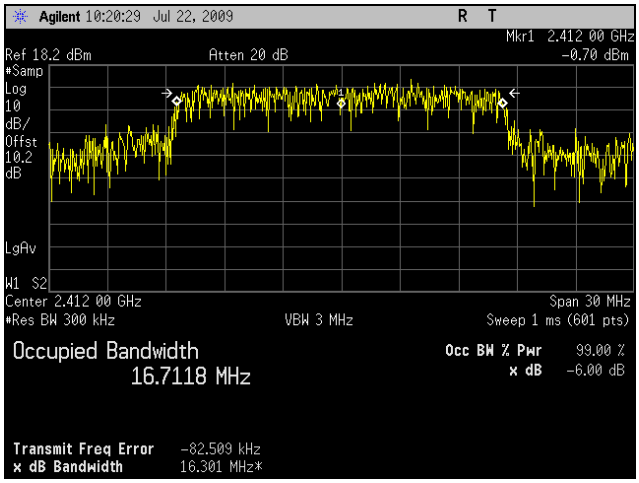
**Table 19. Occupied Bandwidth, Test Results, 5 GHz, Port 2**

| Occupied Bandwidth (5 GHz), Port 2 | | | | |
|---|---|---|---|---|
| **Mode** | **Carrier Channel** | **Frequency (MHz)** | **Measured 6 dB Bandwidth (MHz)** | **Measured 99% Bandwidth (MHz)** |
| 802.11n (20MHz) | Low | 5745 | 17.411 | 17.7486 |
| | Mid | 5785 | 16.671 | 17.6934 |
| | High | 5825 | 16.539 | 17.7542 |
| 802.11n (40MHz) | Low | 5755 | 36.143 | 36.9800 |
| | High | 5795 | 35.934 | 36.4675 |

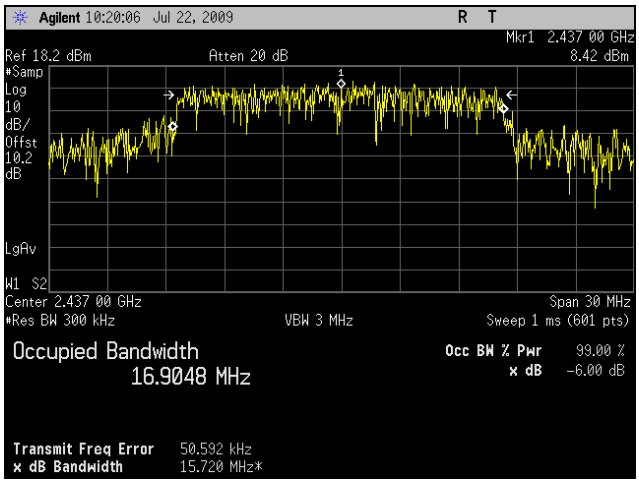
**Table 20. Occupied Bandwidth, Test Results, 5 GHz, Port 3**

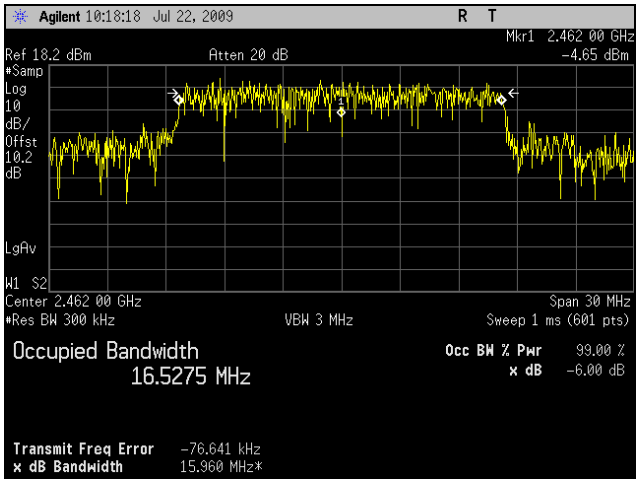
## Occupied Bandwidth, 2.4 GHz, Port 1




**Plot 8. Occupied Band Width, Low Channel, 2.4 GHz, Port 1, 802.11g**

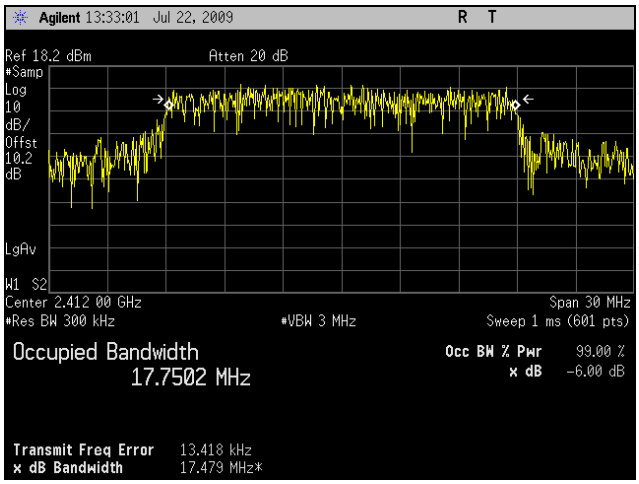



**Plot 9. Occupied Band Width, Mid Channel, 2.4 GHz, Port 1, 802.11g**

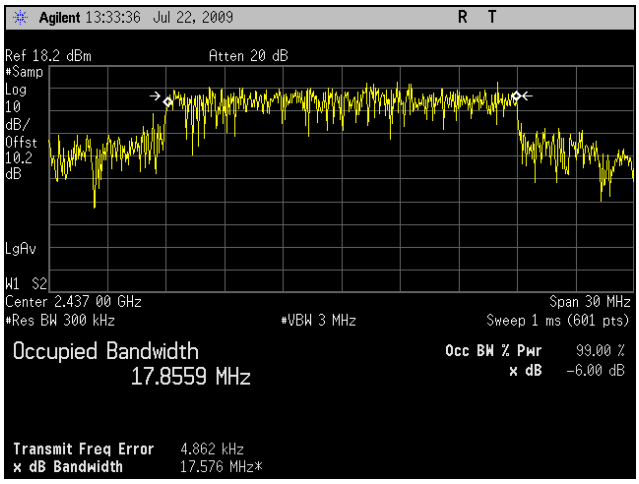



**Plot 10. Occupied Band Width, High Channel, 2.4 GHz, Port 1, 802.11g**

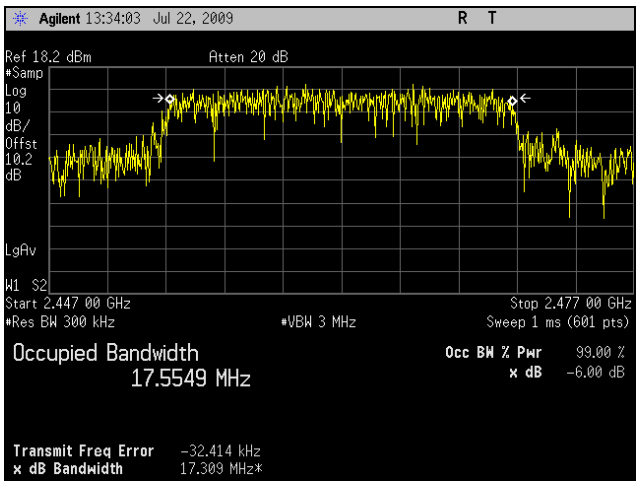
  




**Plot 11. Occupied Band Width, Low Channel, 2.4 GHz, Port 1, 802.11n 20MHz**

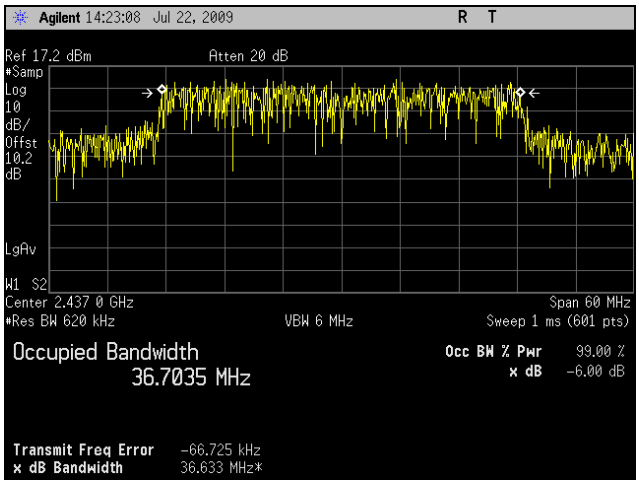



**Plot 12. Occupied Band Width, Mid Channel, 2.4 GHz, Port 1, 802.11n 20MHz**




**Plot 13. Occupied Band Width, High Channel, 2.4 GHz, Port 1, 802.11n 20MHz**

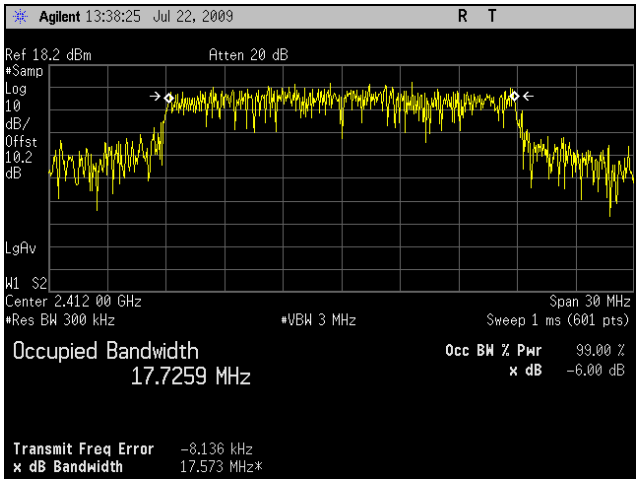
  



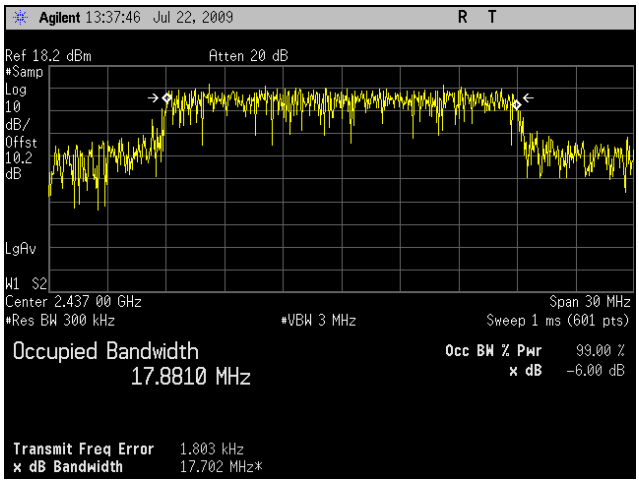

**Plot 14. Occupied Band Width, Mid Channel, 2.4 GHz, Port 1, 802.11n 40MHz**

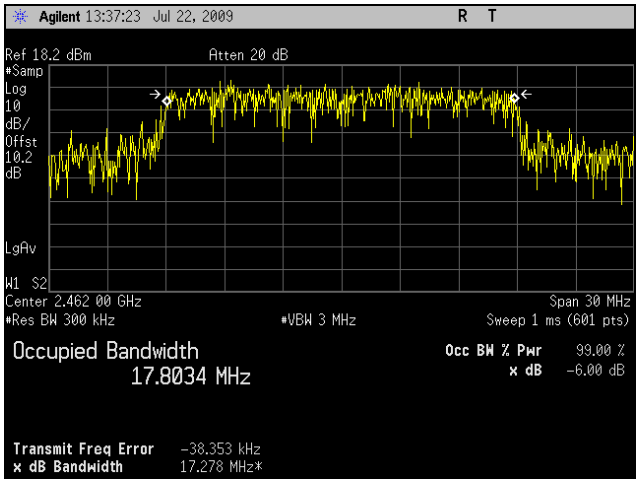
## Occupied Bandwidth, 2.4 GHz, Port 2




**Plot 15. Occupied Band Width, Low Channel, 2.4 GHz, Port 2, 802.11n 20MHz**

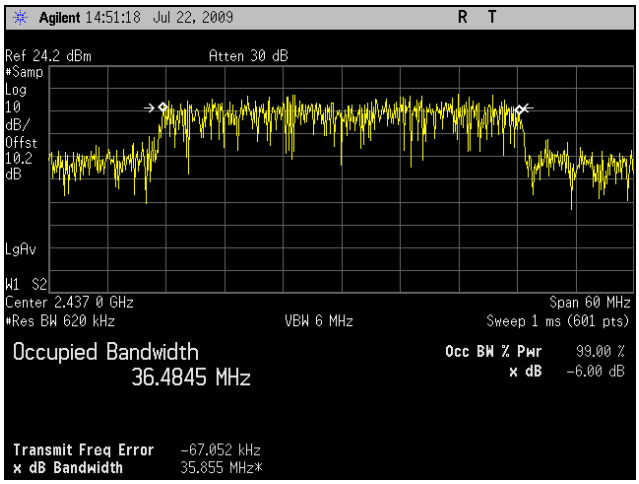



**Plot 16. Occupied Band Width, Mid Channel, 2.4 GHz, Port 2, 802.11n 20MHz**




**Plot 17. Occupied Band Width, High Channel, 2.4 GHz, Port 2, 802.11n 20MHz**

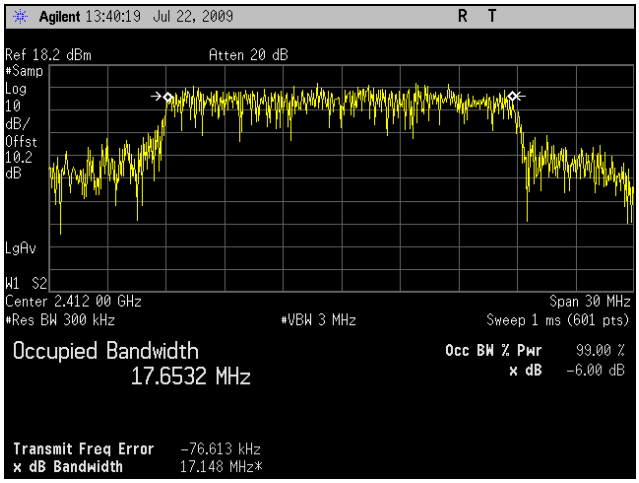
  



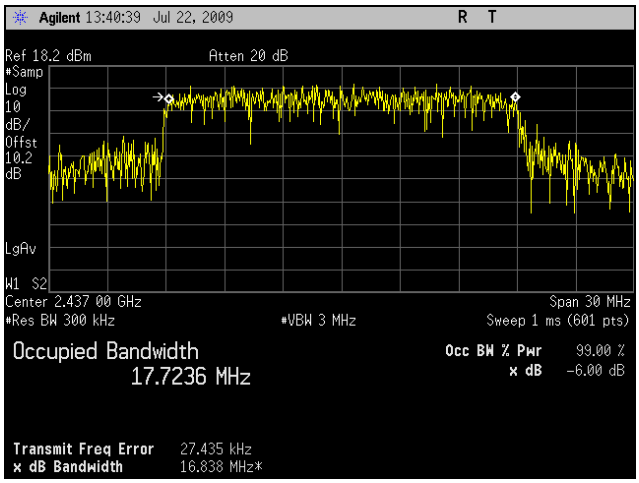

**Plot 18. Occupied Band Width, Mid Channel, 2.4 GHz, Port 2, 802.11n 40MHz**

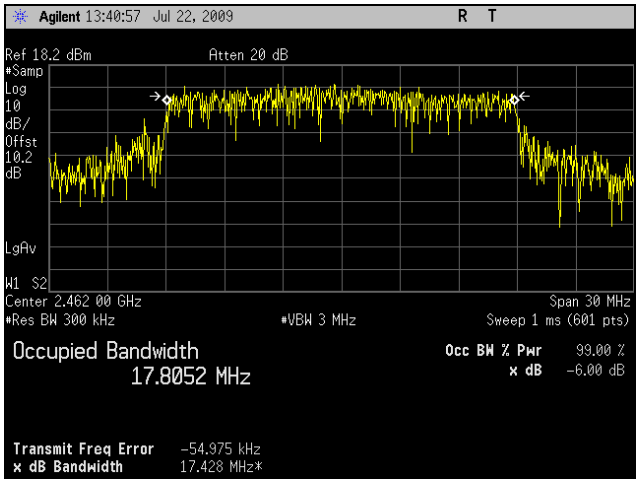
## Occupied Bandwidth, 2.4 GHz, Port 3




**Plot 19. Occupied Band Width, Low Channel, 2.4 GHz, Port 3, 802.11n 20MHz**

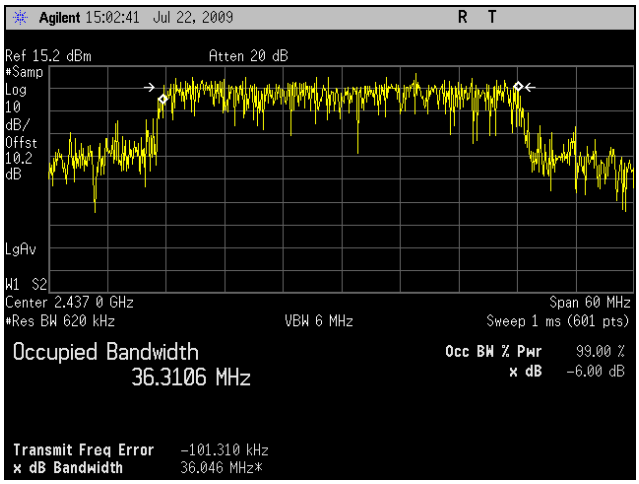



**Plot 20. Occupied Band Width, Mid Channel, 2.4 GHz, Port 3, 802.11n 20MHz**




**Plot 21. Occupied Band Width, High Channel, 2.4 GHz, Port 3, 802.11n 20MHz**

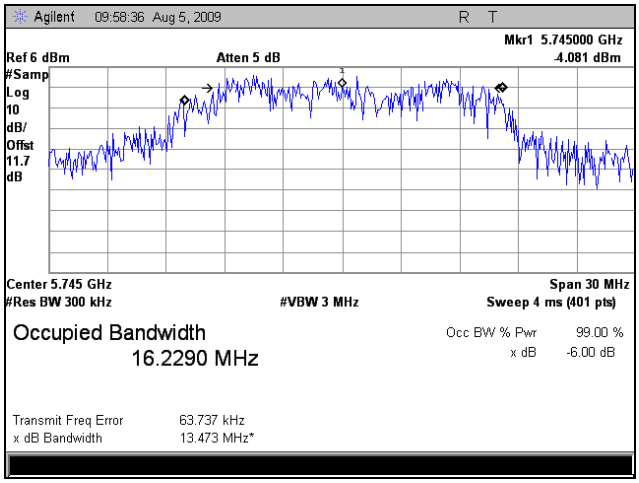
  



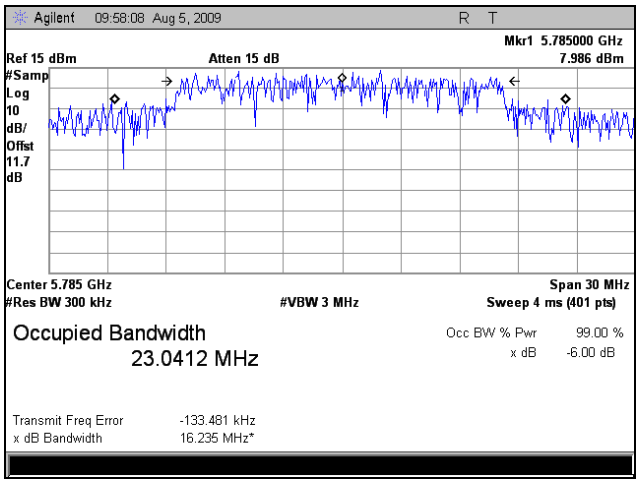

**Plot 22. Occupied Band Width, Mid Channel, 2.4 GHz, Port 3, 802.11n 40MHz**

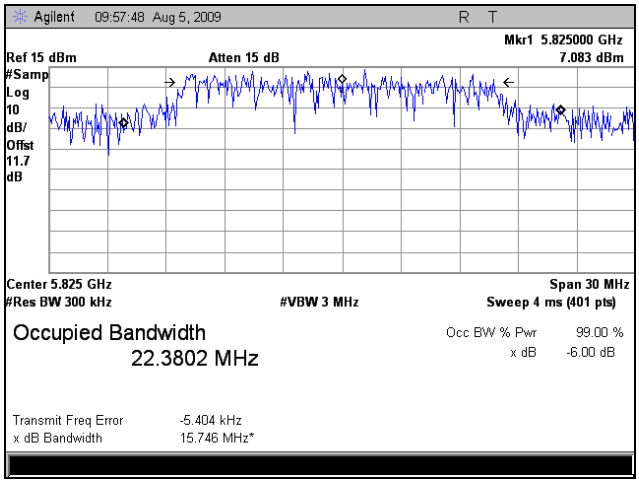
## Occupied Bandwidth, 5 GHz, Port 1




**Plot 23. Occupied Band Width, Low Channel, 5 GHz, Port 1, 802.11a**

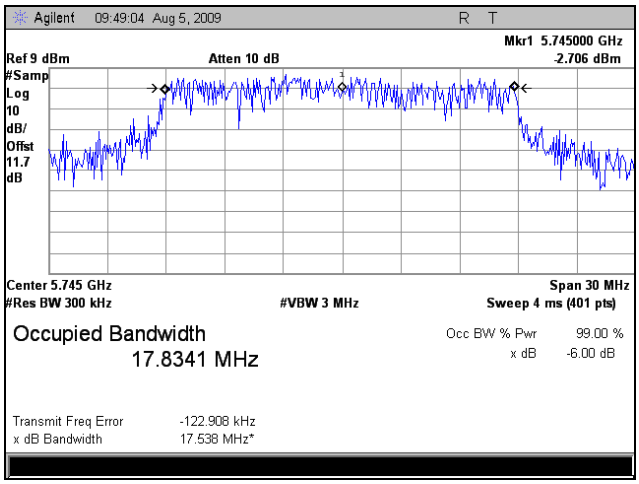



**Plot 24. Occupied Band Width, Mid Channel, 5 GHz, Port 1, 802.11a**

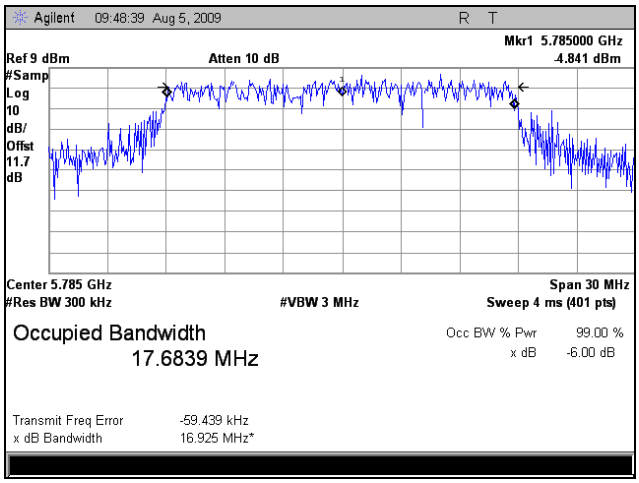



**Plot 25. Occupied Band Width, High Channel, 5 GHz, Port 1, 802.11a**

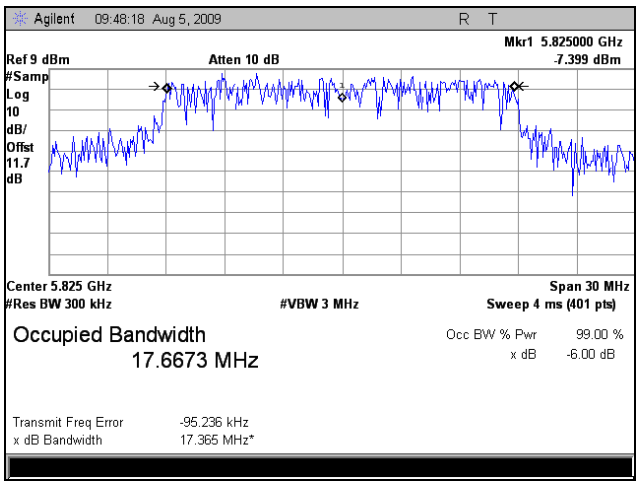
  




**Plot 26. Occupied Band Width, Low Channel, 5 GHz, Port 1, 802.11n 20MHz**

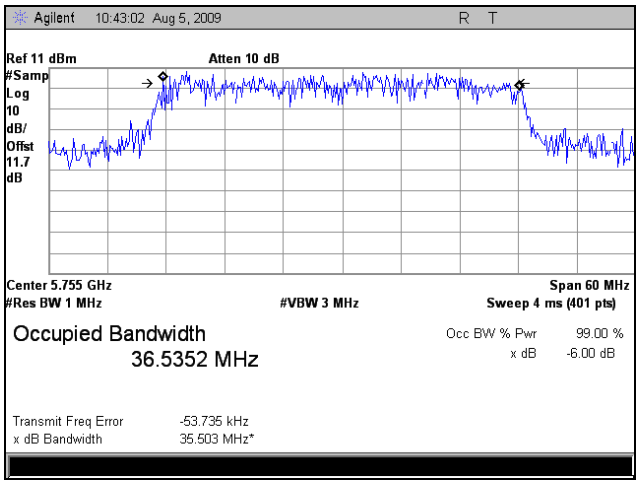



**Plot 27. Occupied Band Width, Mid Channel, 5 GHz, Port 1, 802.11n 20MHz**

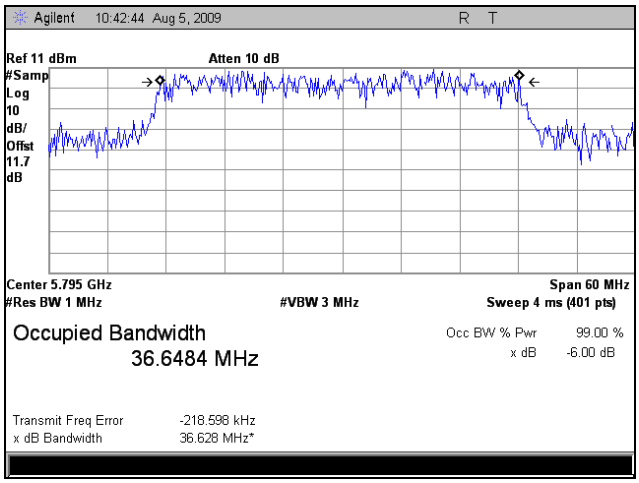



**Plot 28. Occupied Band Width, High Channel, 5 GHz, Port 1, 802.11n 20MHz**



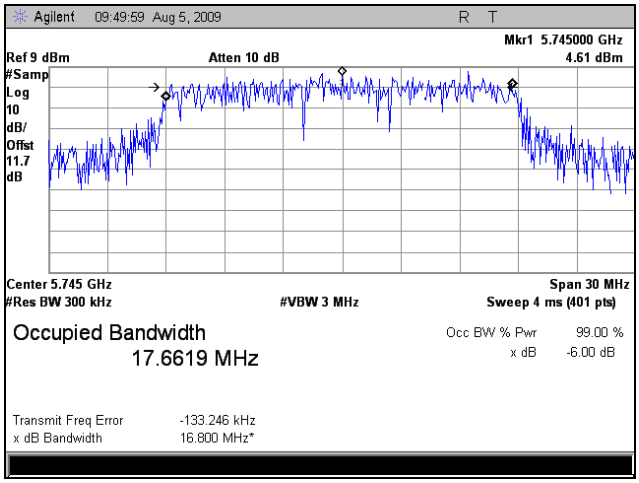

**Plot 29. Occupied Band Width, Low Channel, 5 GHz, Port 1, 802.11n 40MHz**



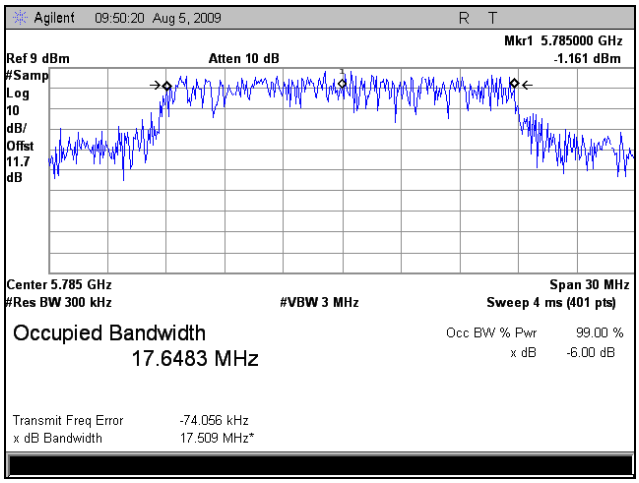

**Plot 30. Occupied Band Width, High Channel, 5 GHz, Port 1, 802.11n 40MHz**

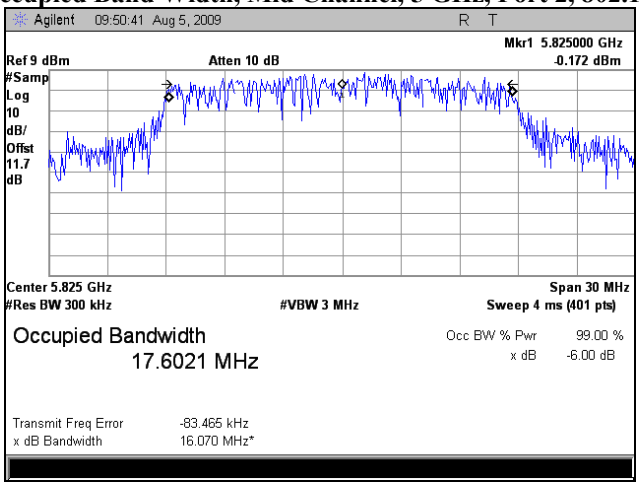
## Occupied Bandwidth, 5 GHz, Port 2




**Plot 31. Occupied Band Width, Low Channel, 5 GHz, Port 2, 802.11n 20MHz**

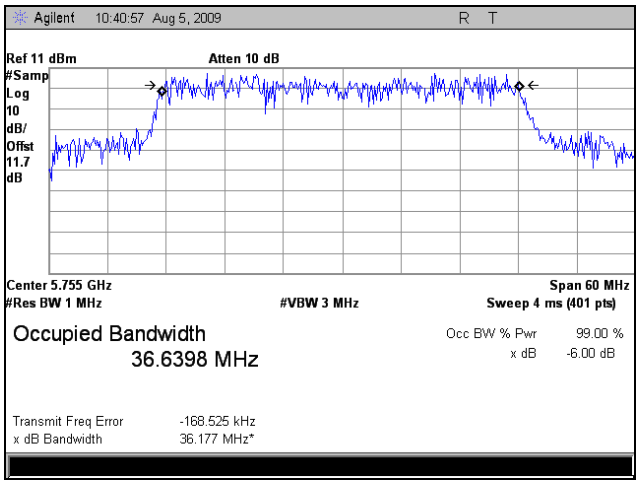



**Plot 32. Occupied Band Width, Mid Channel, 5 GHz, Port 2, 802.11n 20MHz**

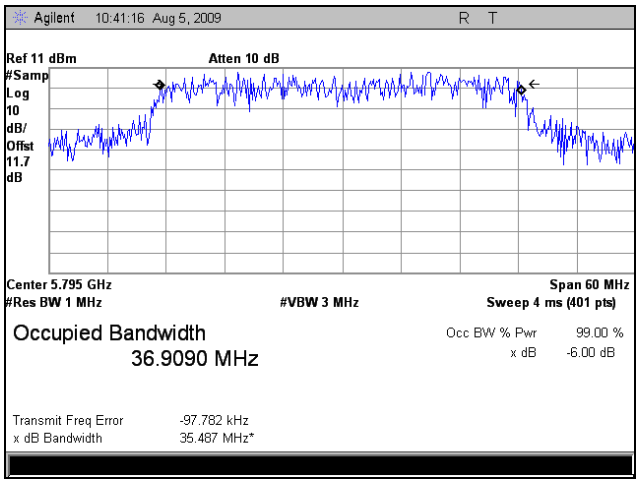



**Plot 33. Occupied Band Width, High Channel, 5 GHz, Port 2, 802.11n 20MHz**



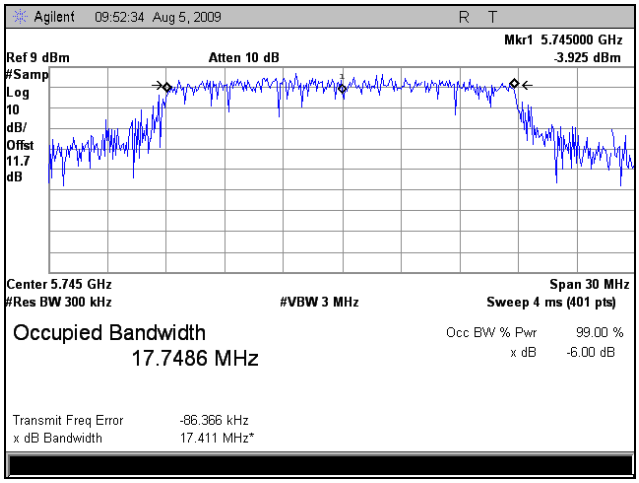

**Plot 34. Occupied Band Width, Low Channel, 5 GHz, Port 2, 802.11n 40MHz**



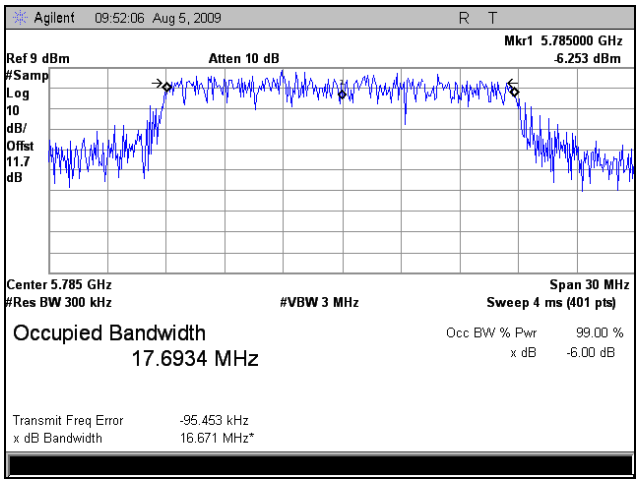

**Plot 35. Occupied Band Width, High Channel, 5 GHz, Port 2, 802.11n 40MHz**

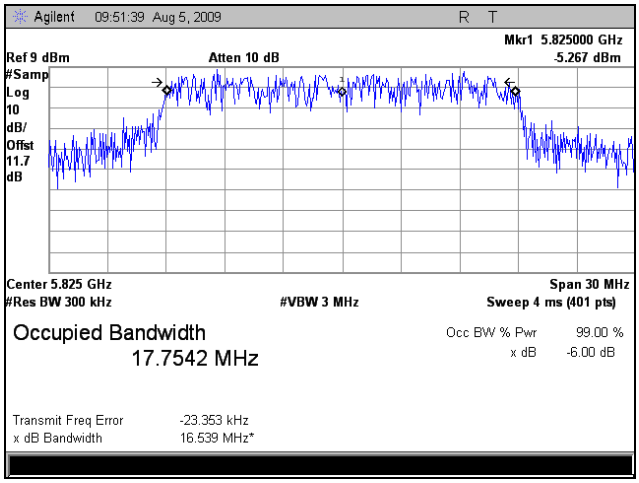
## Occupied Bandwidth, 5 GHz, Port 3




**Plot 36. Occupied Band Width, Low Channel, 5 GHz, Port 3, 802.11n 20MHz**

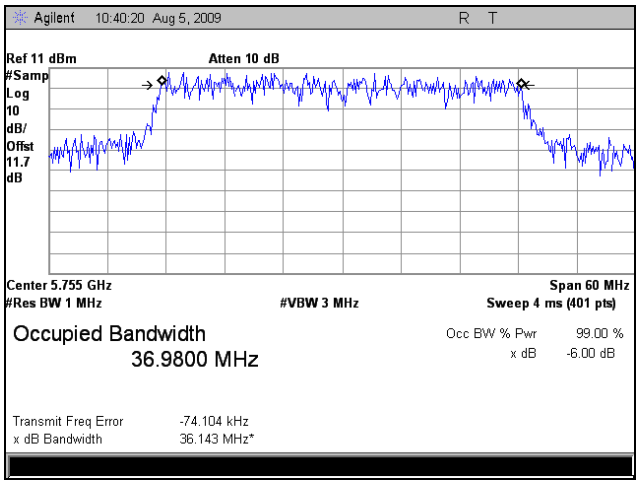



**Plot 37. Occupied Band Width, Mid Channel, 5 GHz, Port 3, 802.11n 20MHz**

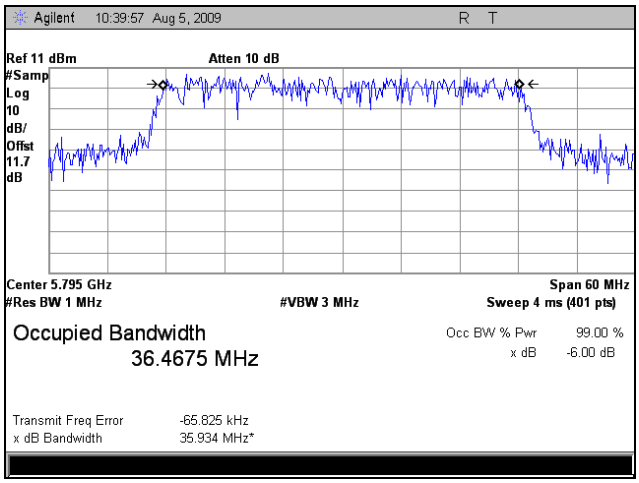



**Plot 38. Occupied Band Width, High Channel, 5 GHz, Port 3, 802.11n 20MHz**




**Plot 39. Occupied Band Width, Low Channel, 5 GHz, Port 3, 802.11n 40MHz**




**Plot 40. Occupied Band Width, High Channel, 5 GHz, Port 3, 802.11n 40MHz**

## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.247(b) Peak Power Output and RF Exposure

**Test Requirements:** **§15.247(b):** The maximum peak output power of the intentional radiator shall not exceed the following:

| Digital Transmission Systems (MHz) | Output Limit (Watts) |
|---|---|
| 902-928 | 1.000 |
| 2400–2483.5 | 1.000 |
| 5725– 5850 | 1.000 |

**Table 21. Output Power Requirements from §15.247**

**§15.247(c):** if transmitting antennas of directional gain greater than 6 dBi are used the peak output power from the intentional radiator shall be reduced below the stated values in the Table 21, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Systems operating in the 2400 – 2483.5 MHz band may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

Systems operating in the 5725 – 5850 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter peak output power.

Fixed, point-to-point operation excludes the use of point-to-multipoint systems, omni-directional applications, and multiple co-located intentional radiators transmitting the same information. The operator of the spread spectrum intentional radiator or, if the equipment is professionally installed, the installer is responsible for ensuring that the system is used exclusively for fixed, point-to-point operations. The instruction manual furnished with the intentional radiator shall contain language in the installation instructions informing the operator and the installer of this responsibility.

**Test Procedure:** The transmitter was connected to a calibrated spectrum analyzer. The EUT was measured at the low, mid and high channels of each band at the maximum power level.

**Test Results:** The EUT was compliant with the Peak Power Output limits of **§15.247(b)**.

**Test Engineer(s):** Minh Ly

**Test Date(s):** 08/11/09

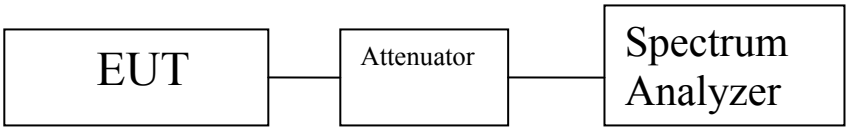



**Figure 3. Block Diagram, Peak Power Output Test Setup**

| Peak Conducted Output Power, 2.4 GHz, Port 1 | | | |
|---|---|---|---|
| Mode/Antenna | Carrier Channel | Frequency (MHz) | Measured Peak Output Power dBm |
| 802.11g | Low | 2412 | 25.98 |
| | Mid | 2437 | 25.71 |
| | High | 2462 | 26.09 |
| 802.11n 20MHz | Low | 2412 | 22.29 |
| | Mid | 2437 | 22.47 |
| | High | 2462 | 23.17 |
| 802.11n 40MHz | Mid | 2437 | 21.48 |

**Table 22. Peak Output Power, Test Results, 2.4 GHz, Port 1**

| Peak Conducted Output Power, 2.4 GHz, Port 2 | | | |
|---|---|---|---|
| Mode/Antenna | Carrier Channel | Frequency (MHz) | Measured Peak Output Power dBm |
| 802.11n 20MHz | Low | 2412 | 24.31 |
| | Mid | 2437 | 22.23 |
| | High | 2462 | 22.62 |
| 802.11n 40MHz | Mid | 2437 | 22.79 |

**Table 23. Peak Output Power, Test Results, 2.4 GHz, Port 2**

| Peak Conducted Output Power, 2.4 GHz, Port 3 | | | |
|---|---|---|---|
| Mode/Antenna | Carrier Channel | Frequency (MHz) | Measured Peak Output Power dBm |
| 802.11n 20MHz | Low | 2412 | 23.27 |
| | Mid | 2437 | 23.83 |
| | High | 2462 | 23.39 |
| 802.11n 40MHz | Mid | 2437 | 22.04 |

**Table 24. Peak Output Power, Test Results, 2.4 GHz, Port 3**

| 802.11n mode (20MHz) | | | | | | |
|---|---|---|---|---|---|---|
| Carrier Channel | Frequency (MHz) | Port 1 (dBm) | Port 2 (dBm) | Port 3 (dBm) | Total (dBm) | Total (W) |
| Low | 2412 | 22.29 | 24.31 | 23.27 | 28.133 | 0.652 |
| Mid | 2437 | 22.47 | 22.23 | 23.83 | 27.673 | 0.586 |
| High | 2462 | 23.17 | 22.62 | 23.39 | 27.833 | 0.608 |

**Table 25. RF Output Power Results – All Ports, 802.11n Mode (20MHz)**

| 802.11n mode (40MHz) | | | | | | |
|---|---|---|---|---|---|---|
| Carrier Channel | Frequency (MHz) | Port 1 (dBm) | Port 2 (dBm) | Port 3 (dBm) | Total (dBm) | Total (W) |
| Mid | 2437 | 21.48 | 22.79 | 22.04 | 26.91 | 0.492 |

**Table 26. RF Output Power Results – All Ports, 802.11n mode (40MHz)**

Note: Total Output Power = Port 1 (10^(Output Power/10)/1000) + Port 2 (10^(Output Power/10)/1000)

| Peak Conducted Output Power, 5 GHz, Port 1 | | | |
|---|---|---|---|
| **Mode** | **Carrier Channel** | **Frequency (MHz)** | **Measured Peak Output Power dBm** |
| 802.11a | Low | 5745 | 29.20 |
| | Mid | 5785 | 29.62 |
| | High | 5825 | 28.53 |
| 802.11n 20MHz | Low | 5745 | 24.70 |
| | Mid | 5785 | 24.59 |
| | High | 5825 | 24.94 |
| 802.11n 40MHz | Low | 5755 | 24.05 |
| | High | 5795 | 23.79 |

**Table 27. Peak Output Power, Test Results, 5 GHz, Port 1**

| Peak Conducted Output Power, 5 GHz, Port 2 | | | |
|---|---|---|---|
| **Mode** | **Carrier Channel** | **Frequency (MHz)** | **Measured Peak Output Power dBm** |
| 802.11n 20MHz | Low | 5745 | 24.86 |
| | Mid | 5785 | 24.27 |
| | High | 5825 | 24.68 |
| 802.11n 40MHz | Low | 5755 | 24.79 |
| | High | 5795 | 24.36 |

**Table 28. Peak Output Power, Test Results, 5 GHz, Port 2**

| Peak Conducted Output Power, 5 GHz, Port 3 | | | |
|---|---|---|---|
| **Mode** | **Carrier Channel** | **Frequency (MHz)** | **Measured Peak Output Power dBm** |
| 802.11n 20MHz | Low | 5745 | 24.85 |
| | Mid | 5785 | 24.90 |
| | High | 5825 | 24.41 |
| 802.11n 40MHz | Low | 5755 | 24.68 |
| | High | 5795 | 24.33 |

**Table 29. Peak Output Power, Test Results, 5 GHz, Port 3**

| 802.11n mode (20MHz) | | | | | | |
|---|---|---|---|---|---|---|
| **Carrier Channel** | **Frequency (MHz)** | **Port 1 (dBm)** | **Port 2 (dBm)** | **Port 3 (dBm)** | **Total (dBm)** | **Total (W)** |
| Low | 5745 | 24.70 | 24.86 | 24.85 | 29.57 | 0.908 |
| Mid | 5785 | 24.59 | 24.27 | 24.90 | 29.35 | 0.864 |
| High | 5825 | 24.94 | 24.68 | 24.41 | 29.45 | 0.883 |

**Table 30. RF Output Power Results – All Ports, 802.11n Mode (20MHz)**

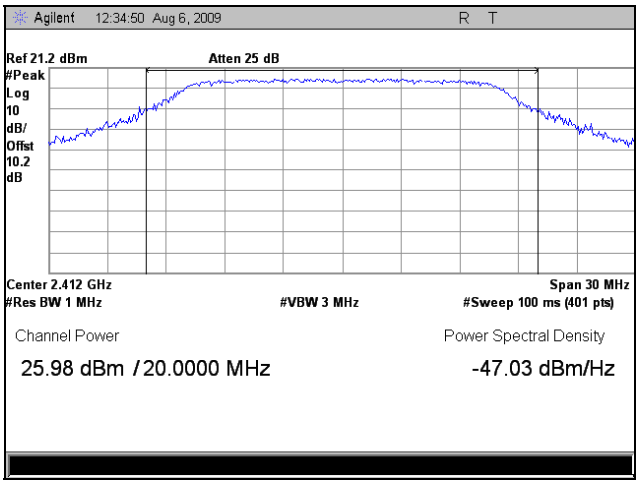
| 802.11n mode (40MHz) | | | | | | |
|---|---|---|---|---|---|---|
| **Carrier Channel** | **Frequency (MHz)** | **Port 1 (dBm)** | **Port 2 (dBm)** | **Port 3 (dBm)** | **Total (dBm)** | **Total (W)** |
| Low | 5755 | 24.05 | 24.79 | 24.68 | 29.28 | 0.850 |
| High | 5795 | 23.79 | 24.36 | 24.33 | 28.93 | 0.784 |

**Table 31. RF Output Power Results – All Ports, 802.11n mode (40MHz)**

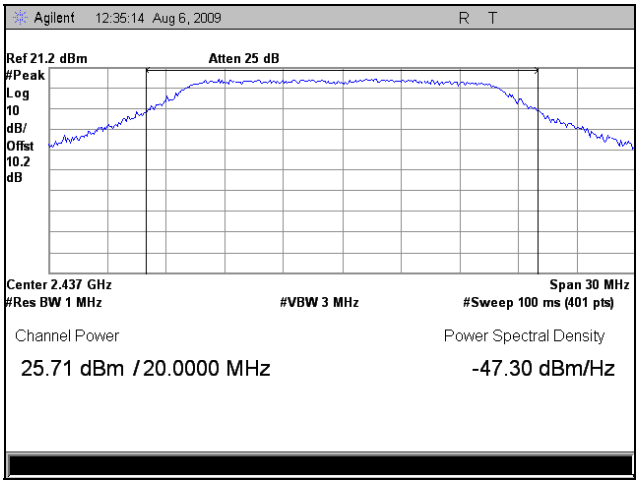
Note: Total Output Power = Port 1 (10^(Output Power/10)/1000) + Port 2 (10^(Output Power/10)/1000)

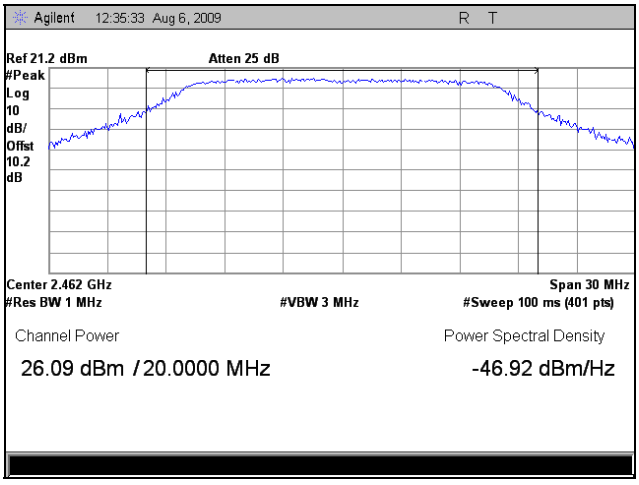
## Peak Power Output, 2.4 GHz, Port 1




**Plot 41. Peak Output Power, Low Channel, 2.4 GHz, Port 1, 802.11g, 5 dBi Omni**

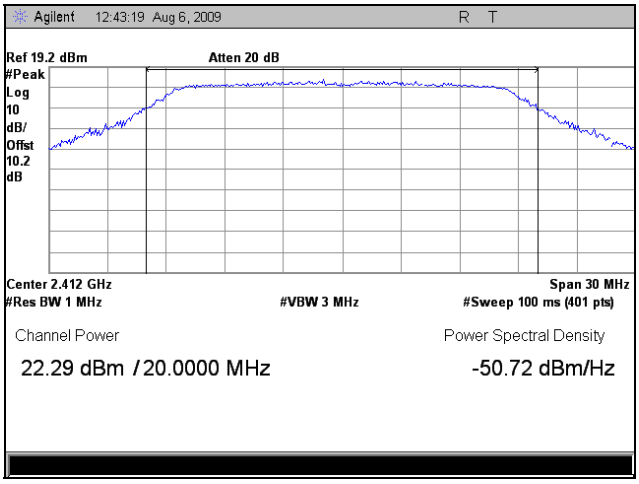



**Plot 42. Peak Output Power, Mid Channel, 2.4 GHz, Port 1, 802.11g, 5 dBi Omni**

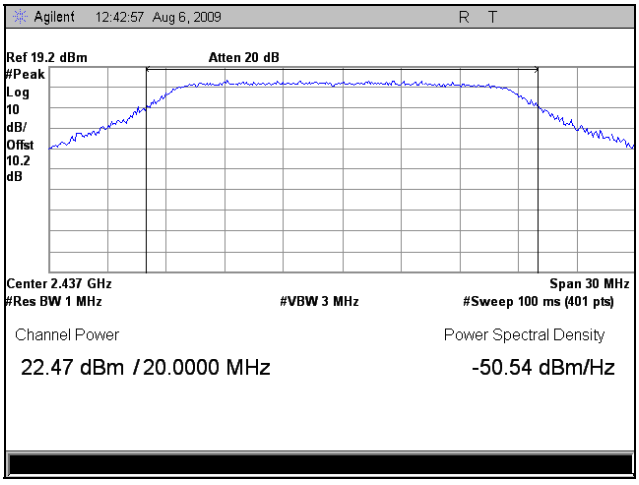



**Plot 43. Peak Output Power, High Channel, 2.4 GHz, Port 1, 802.11g, 5 dBi Omni**

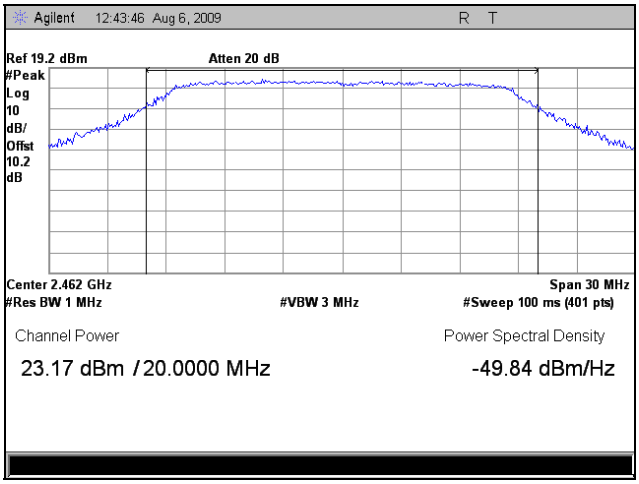
  




**Plot 44. Peak Output Power, Low Channel, 2.4 GHz, Port 1, 802.11n 20MHz, 5 dBi Omni**

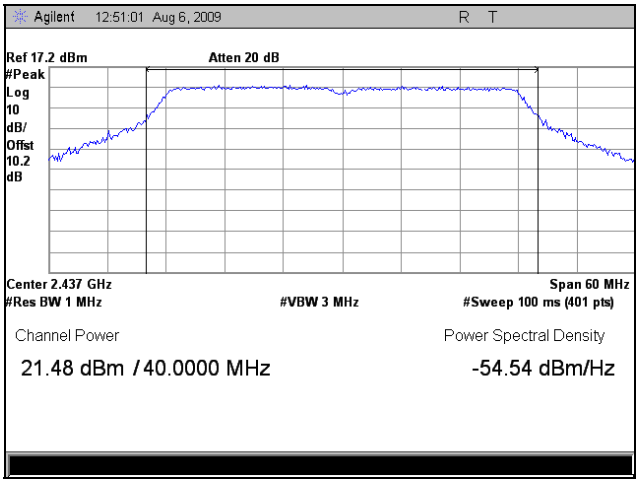



**Plot 45. Peak Output Power, Mid Channel, 2.4 GHz, Port 1, 802.11n 20MHz, 5 dBi Omni**




**Plot 46. Peak Output Power, High Channel, 2.4 GHz, Port 1, 802.11n 20MHz, 5 dBi Omni**

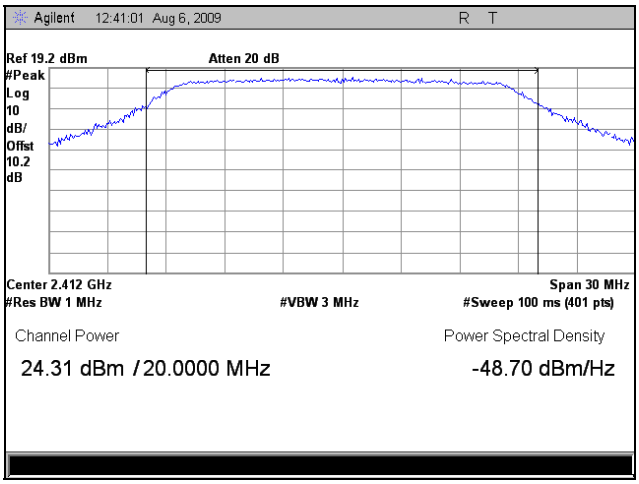
  



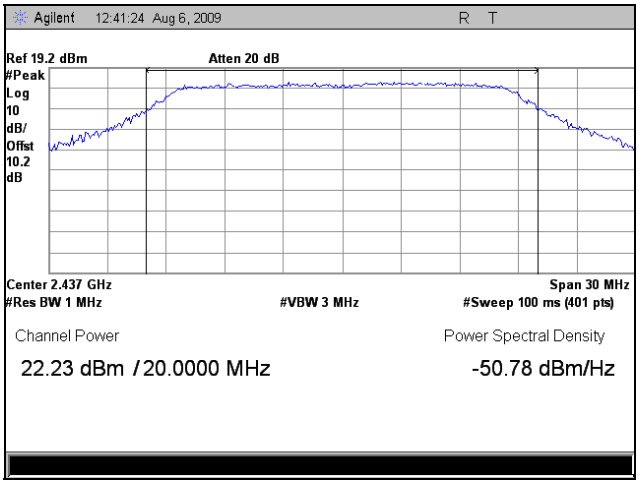

**Plot 47. Peak Output Power, Mid Channel, 2.4 GHz, Port 1, 802.11n 40MHz, 5 dBi Omni**

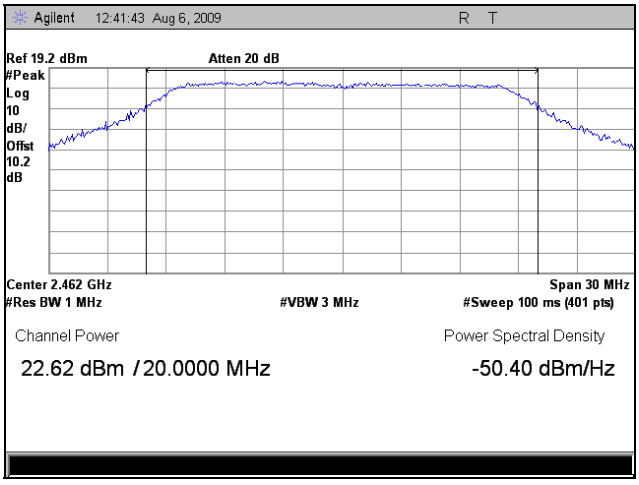
## Peak Power Output, 2.4 GHz, Port 2




**Plot 48. Peak Output Power, Low Channel, 2.4 GHz, Port 2, 802.11n 20MHz, 5 dBi Omni**

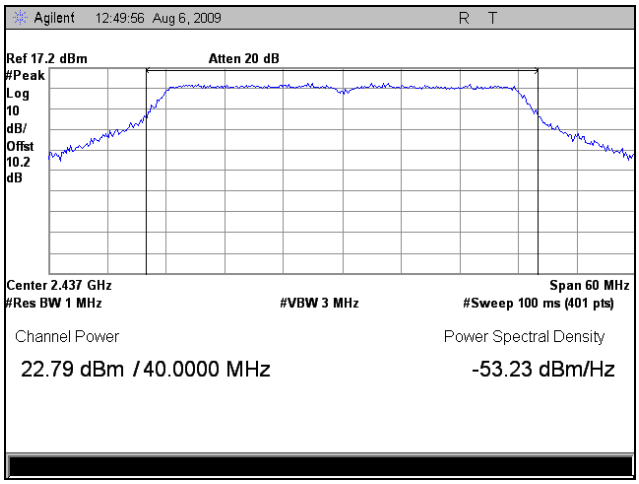



**Plot 49. Peak Output Power, Mid Channel, 2.4 GHz, Port 2, 802.11n 20MHz, 5 dBi Omni**




**Plot 50. Peak Output Power, High Channel, 2.4 GHz, Port 2, 802.11n 20MHz, 5 dBi Omni**

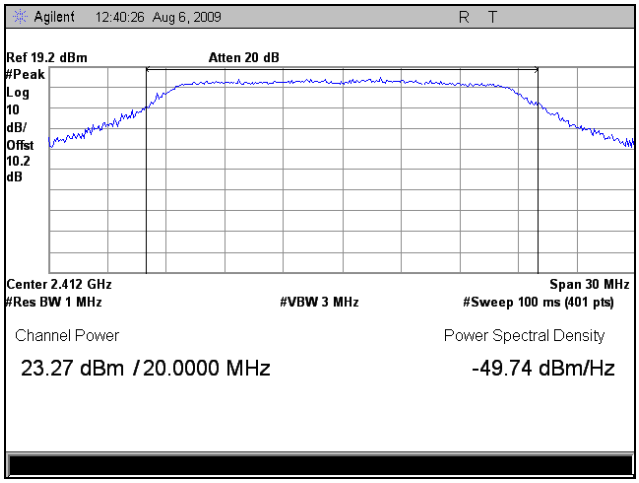
  



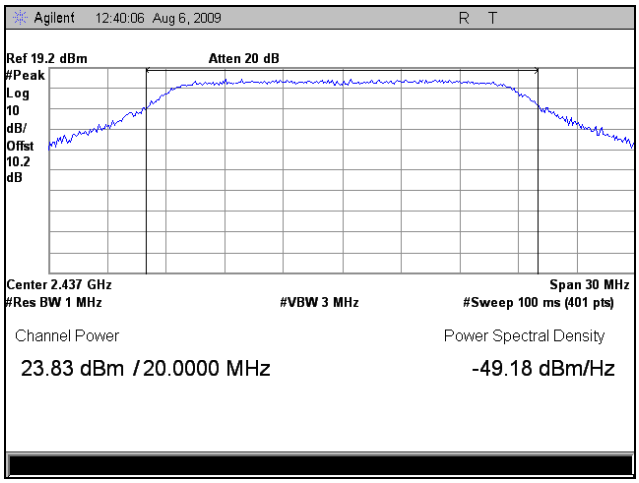

**Plot 51. Peak Output Power, Mid Channel, 2.4 GHz, Port 2, 802.11n 40MHz, 5 dBi Omni**

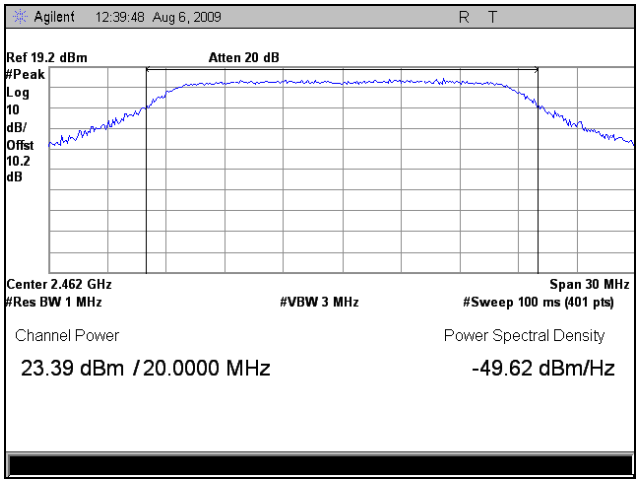
## Peak Power Output, 2.4 GHz, Port 3




**Plot 52. Peak Output Power, Low Channel, 2.4 GHz, Port 3, 802.11n 20MHz, 5 dBi Omni**

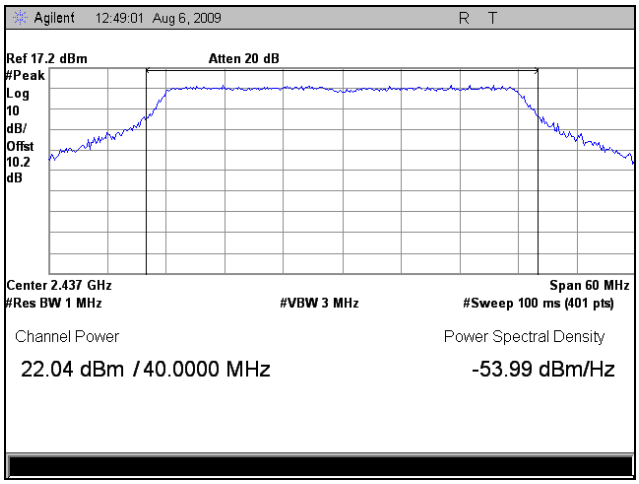



**Plot 53. Peak Output Power, Mid Channel, 2.4 GHz, Port 3, 802.11n 20MHz, 5 dBi Omni**




**Plot 54. Peak Output Power, High Channel, 2.4 GHz, Port 3, 802.11n 20MHz, 5 dBi Omni**

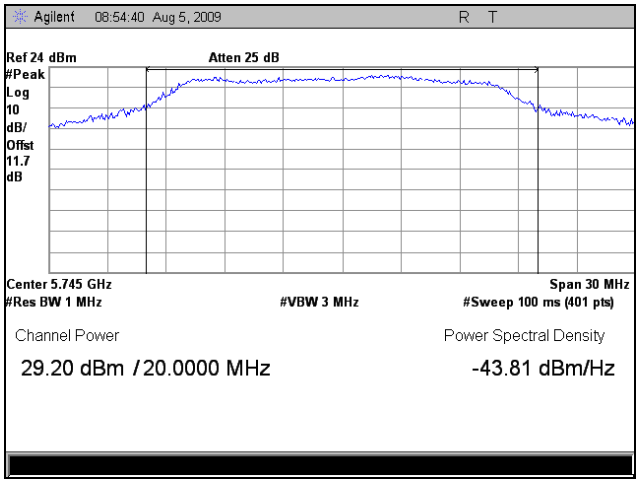
  



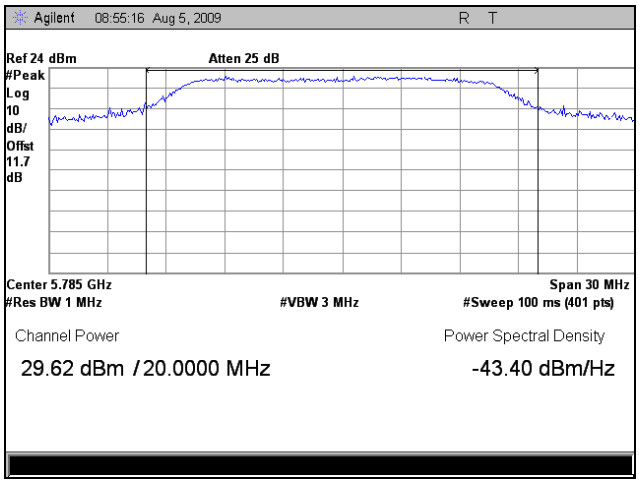

**Plot 55. Peak Output Power, Mid Channel, 2.4 GHz, Port 3, 802.11n 40MHz, 5 dBi Omni**

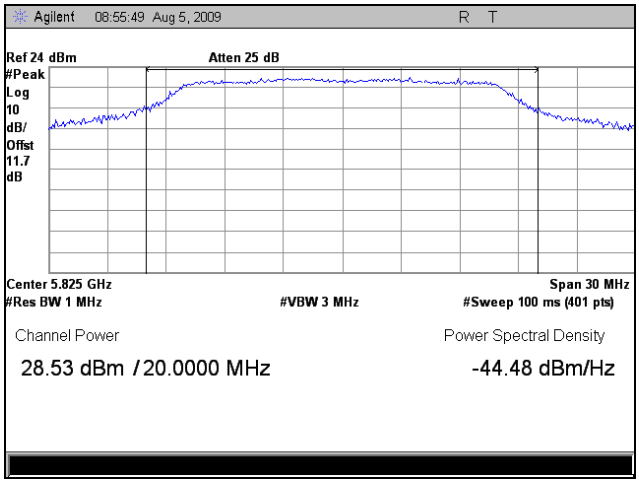
## Peak Power Output, 5 GHz, Port 1




**Plot 56. Peak Output Power, Low Channel, 5 GHz, Port 1, 802.11a, 5 dBi Omni**

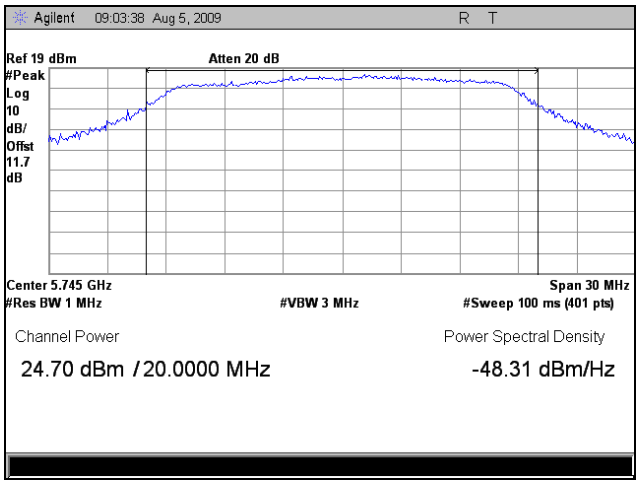



**Plot 57. Peak Output Power, Mid Channel, 5 GHz, Port 1, 802.11a, 5 dBi Omni**

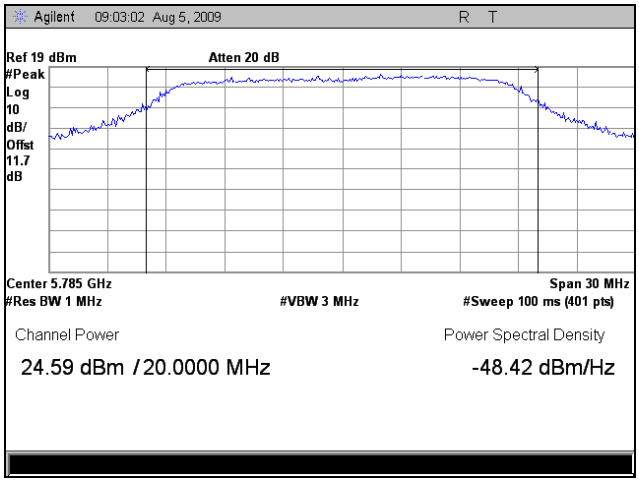



**Plot 58. Peak Output Power, High Channel, 5 GHz, Port 1, 802.11a, 5 dBi Omni**

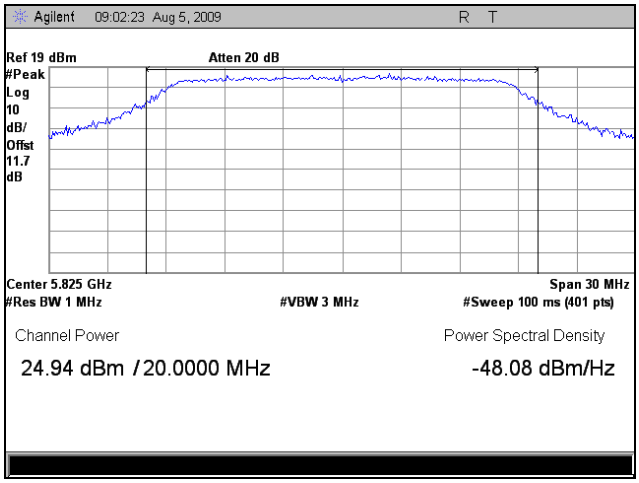
  




**Plot 59. Peak Output Power, Low Channel, 5 GHz, Port 1, 802.11n 20MHz, 5 dBi Omni**

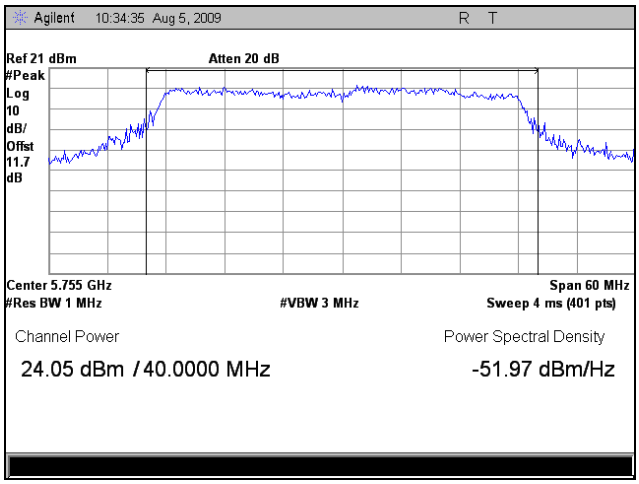



**Plot 60. Peak Output Power, Mid Channel, 5 GHz, Port 1, 802.11n 20MHz, 5 dBi Omni**

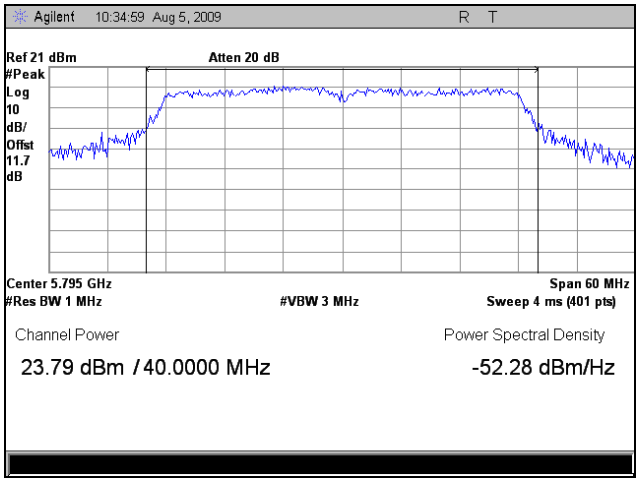



**Plot 61. Peak Output Power, High Channel, 5 GHz, Port 1, 802.11n 20MHz, 5 dBi Omni**



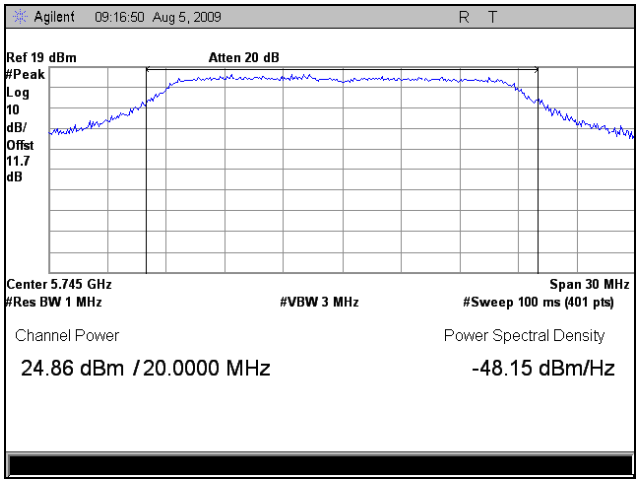

**Plot 62. Peak Output Power, Low Channel, 5 GHz, Port 1, 802.11n 40MHz, 5 dBi Omni**



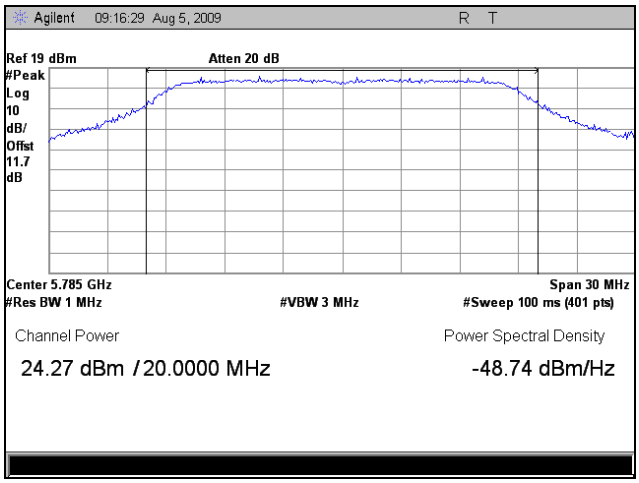

**Plot 63. Peak Output Power, High Channel, 5 GHz, Port 1, 802.11n 40MHz, 5 dBi Omni**

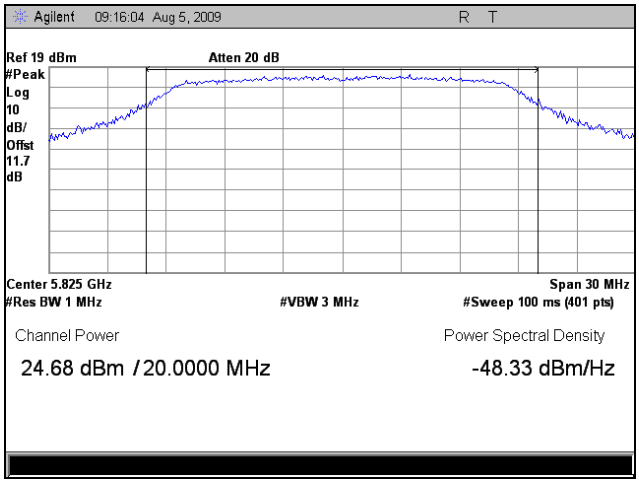
## Peak Power Output, 5 GHz, Port 2




**Plot 64. Peak Output Power, Low Channel, 5 GHz, Port 2, 802.11n 20MHz, 5 dBi Omni**

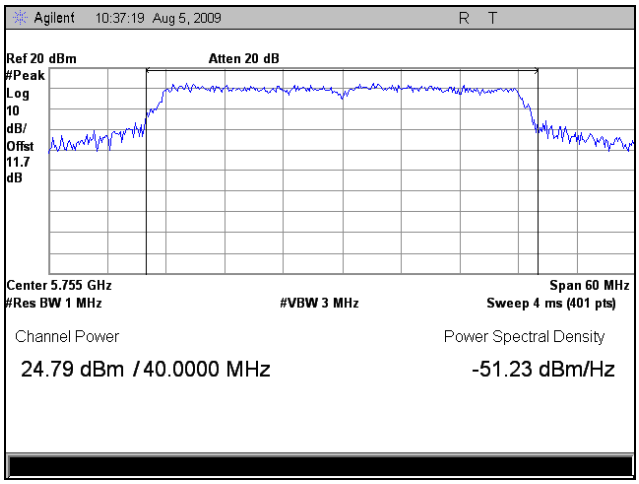



**Plot 65. Peak Output Power, Mid Channel, 5 GHz, Port 2, 802.11n 20MHz, 5 dBi Omni**

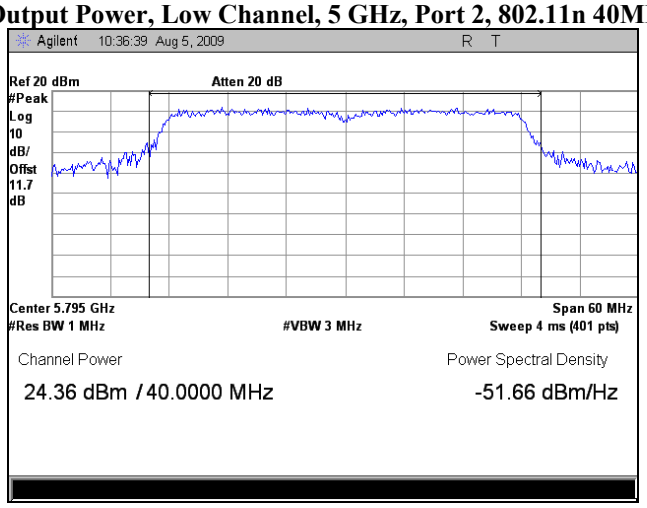



**Plot 66. Peak Output Power, High Channel, 5 GHz, Port 2, 802.11n 20MHz, 5 dBi Omni**



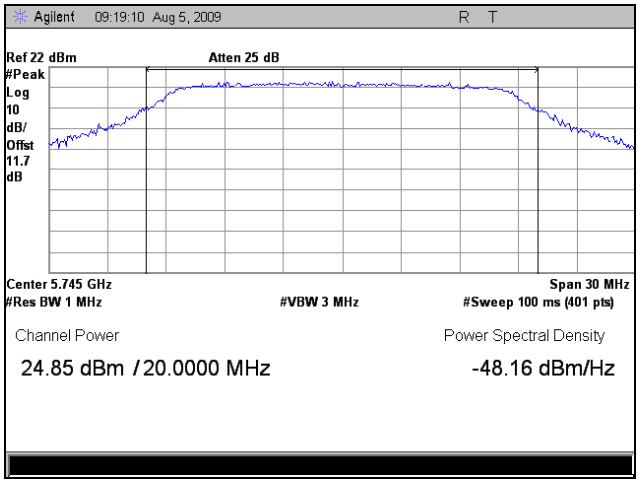

**Plot 67. Peak Output Power, Low Channel, 5 GHz, Port 2, 802.11n 40MHz, 5 dBi Omni**



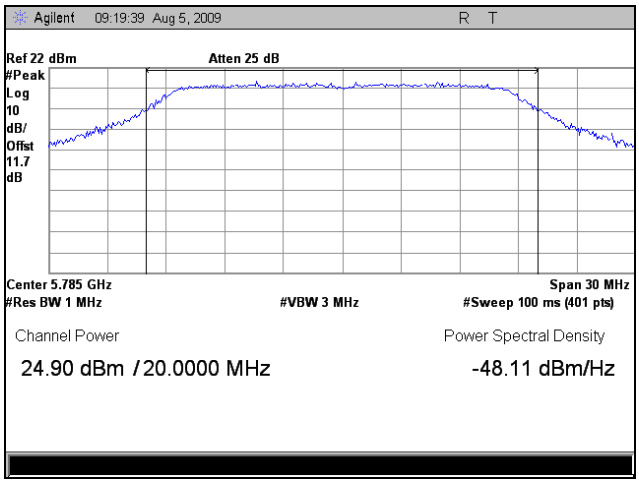

**Plot 68. Peak Output Power, High Channel, 5 GHz, Port 2, 802.11n 40MHz, 5 dBi Omni**

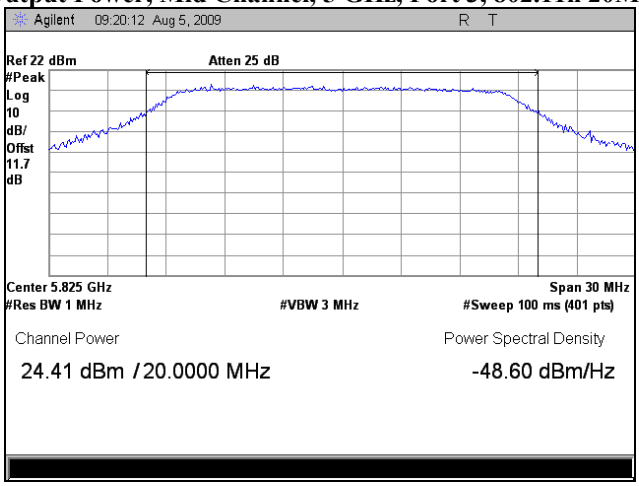
## Peak Power Output, 5 GHz, Port 3




**Plot 69. Peak Output Power, Low Channel, 5 GHz, Port 3, 802.11n 20MHz, 5 dBi Omni**

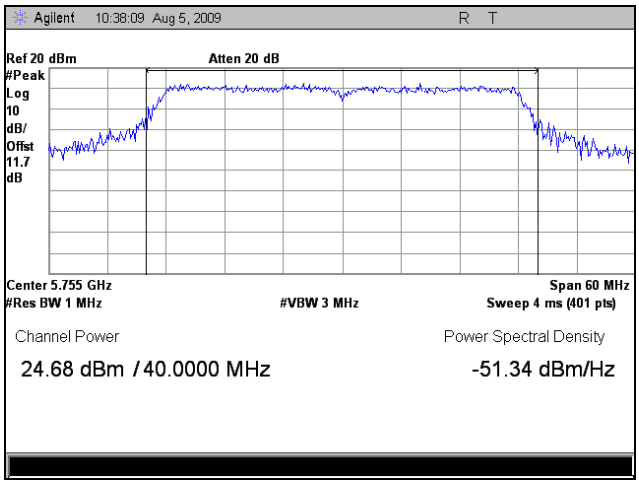



**Plot 70. Peak Output Power, Mid Channel, 5 GHz, Port 3, 802.11n 20MHz, 5 dBi Omni**

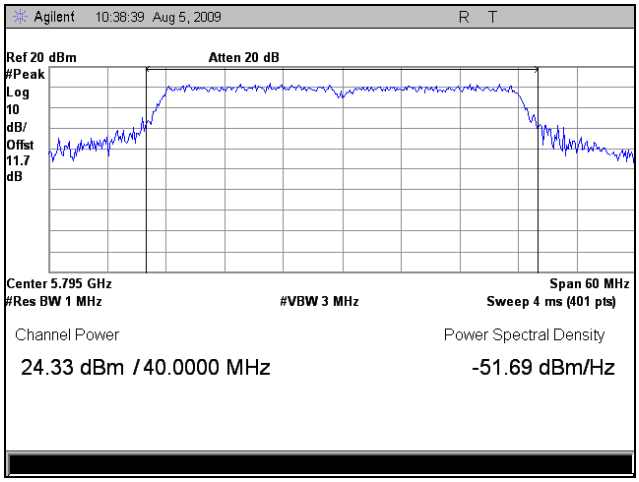



**Plot 71. Peak Output Power, High Channel, 5 GHz, Port 3, 802.11n 20MHz, 5 dBi Omni**




**Plot 72. Peak Output Power, Low Channel, 5 GHz, Port 3, 802.11n 40MHz, 5 dBi Omni**




**Plot 73. Peak Output Power, High Channel, 5 GHz, Port 3, 802.11n 40MHz, 5 dBi Omni**

# Electromagnetic Compatibility Criteria for Intentional Radiators

## § 15.247(b) RF Exposure

**RF Exposure Requirements:** **§1.1307(b)(1) and §1.1307(b)(2):** 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 levels in excess of the Commission's guidelines.

**RF Radiation Exposure Limit:** **§1.1310:** As specified in this section, the Maximum Permissible Exposure (MPE) Limit shall be used to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation as specified in Sec. 1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of Sec. 2.1093 of this chapter.

MPE Limit Calculation: EUT's operating frequencies @ 2412-2462 MHz; highest conducted power = *28.13dBm* (peak) therefore, **Limit for Uncontrolled exposure: 1 mW/cm$^2$ or 10 W/m$^2$**

EUT maximum antenna gain = **5dBi Omni**

Equation from page 18 of OET 65, Edition 97-01

$$S = PG / 4\pi R^2 \quad \text{or} \quad R = \sqrt{PG / 4\pi S}$$

where, S = Power Density (1 mW/cm$^2$)
P = Power Input to antenna (650.13mW)
G = Antenna Gain (3.16 numeric)

S = (650.13*3.16 / 4*3.14*20.0$^2$)= (2055.89/ 5024) = **0.409mW/cm$^2$**@ 20cm separation

MPE Limit Calculation: EUT's operating frequencies @ 5745-5825 MHz; highest conducted power = *29.57dBm* (peak) therefore, **Limit for Uncontrolled exposure: 1 mW/cm$^2$ or 10 W/m$^2$**

EUT maximum antenna gain = **5dBi Omni**

Equation from page 18 of OET 65, Edition 97-01

$$S = PG / 4\pi R^2 \quad \text{or} \quad R = \sqrt{PG / 4\pi S}$$

where, S = Power Density (1 mW/cm$^2$)
P = Power Input to antenna (905.73mW)
G = Antenna Gain (3.16 numeric)

S = (905.73*3.16 / 4*3.14*20.0$^2$)= (2864.17/ 5024) = **0.57 mW/cm$^2$**@ 20cm separation

# Electromagnetic Compatibility Criteria for Intentional Radiators

## § 15.247(d) Radiated Spurious Emissions Requirements and Band Edge

**Test Requirements:** **§15.247(d); §15.205:** Emissions outside the frequency band.

**§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. 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).

**§15.205(a):** Except as shown 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 | 399.9–410 | 4.5–5.15 |
| [1] 0.495–0.505---------- | 16.69475–16.69525 | 608–614 | 5.35–5.46 |
| 2.1735–2.1905---------- | 16.80425–16.80475 | 960–1240 | 7.25–7.75 |
| 4.125–4.128---------- | 25.5–25.67 | 1300–1427 | 8.025–8.5 |
| 4.17725–4.17775---------- | 37.5–38.25 | 1435–1626.5 | 9.0–9.2 |
| 4.20725–4.20775---------- | 73–74.6 | 1645.5–1646.5 | 9.3–9.5 |
| 6.215–6.218---------- | 74.8–75.2 | 1660–1710 | 10.6–12.7 |
| 6.26775–6.26825---------- | 108–121.94 | 1718.8–1722.2 | 13.25–13.4 |
| 6.31175–6.31225---------- | 123–138 | 2200–2300 | 14.47–14.5 |
| 8.291–8.294---------- | 149.9–150.05 | 2310–2390 | 15.35–16.2 |
| 8.362–8.366---------- | 156.52475–156.52525 | 2483.5–2500 | 17.7–21.4 |
| 8.37625–8.38675---------- | 156.7–156.9 | 2655–2900 | 22.01–23.12 |
| 8.41425–8.41475---------- | 162.0125–167.17 | 3260–3267 | 23.6–24.0 |
| 12.29–12.293---------- | 167.72–173.2 | 3332–3339 | 31.2–31.8 |
| 12.51975–12.52025---------- | 240–285 | 3345.8–3358 36. | 43–36.5 |
| 12.57675–12.57725---------- | 322–335.4 | 3600–4400 | ([2]) |

**Table 32. Restricted Bands of Operation**

[1] Until February 1, 1999, this restricted band shall be 0.490 – 0.510 MHz.
[2] Above 38.6

**Test Requirement(s):** **§ 15.209 (a):** Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in Table 33.

| Frequency (MHz) | § 15.209(a),Radiated Emission Limits (dBµV) @ 3m |
|---|---|
| 30 - 88 | 40.00 |
| 88 - 216 | 43.50 |
| 216 - 960 | 46.00 |
| Above 960 | 54.00 |

**Table 33. Radiated Emissions Limits Calculated from FCC Part 15, § 15.209 (a)**

**Test Procedures:** The transmitter was set to the mid channel at the highest output power and placed on a 0.8 m high wooden table inside in a semi-anechoic chamber. Measurements were performed with the EUT rotated 360 degrees and varying the adjustable antenna mast with 1 m to 4 m height to determine worst case orientation for maximum emissions. Measurement were repeated the measurement at the low and highest channels.

For frequencies from 30 MHz to 1 GHz, measurements were made using a quasi-peak detector with a 120 kHz bandwidth.

For intentional radiators with a digital device portion which operates below 10 GHz, the spectrum was investigated as per §15.33(a)(1) and §15.33(a)(4); i.e., the lowest RF signal generated or used in the device up to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

In accordance with §15.35(b) the limit on the radio frequency emissions as measured using instrumentation with a peak detector function shall be 20 dB above the maximum permitted average limit for the frequency being investigated unless a different peak emission limit is otherwise specified in the rules.

EUT Field Strength Final Amplitude = Raw Amplitude – Preamp gain + Antenna Factor + Cable Loss

**Test Results:** The EUT was compliant with the Radiated Spurious Emission limits of **§ 15.247(d)**.

**Test Engineer(s):** Minh Ly

**Test Date(s):** 08/11/09

## Harmonic Emissions Requirements – Radiated, 2.4 GHz, Port 1

| Frequency (MHz) | Antenna Polarity (H/V) | Raw Amp. @ 3m | Pre Amp (dB) | Ant. Cor. Factor (dB) | Cable Loss (dB) | Dist. Cor. Factor (dB) | EUT Field Strength Final Amp. (dBµV/m) | Limit @ 3m (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|
| 4.824 | H | 49.21 | 34.76 | 33.35 | 4.60 | 52.40 | Peak | 74 | -21.60 |
| 4.824 | H | 37.34 | 34.76 | 33.35 | 4.60 | 40.53 | Avg. | 54 | -13.47 |
| 7.236 | H | 44.69 | 35.01 | 35.80 | 10.48 | 55.96 | Peak | 74 | -18.04 |
| 7.236 | H | 31.75 | 35.01 | 35.80 | 10.48 | 43.02 | Avg. | 54 | -10.98 |
| 9.648 | H | 42.76 | 35.58 | 37.95 | 10.80 | 55.93 | Peak | 74 | -18.07 |
| 9.648 | H | 31.59 | 35.58 | 37.95 | 10.80 | 44.76 | Avg. | 54 | -9.24 |

**Table 34. Radiated Harmonic Emissions, Low Channel, 2.4 GHz, Port 1, 802.11g, 5 dBi Omni**

Note: All other emissions were measured at the noise floor of the spectrum analyzer.

| Frequency (MHz) | Antenna Polarity (H/V) | Raw Amp. @ 3m | Pre Amp (dB) | Ant. Cor. Factor (dB) | Cable Loss (dB) | Dist. Cor. Factor (dB) | EUT Field Strength Final Amp. (dBµV/m) | Limit @ 3m (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|
| 4.874 | H | 51.61 | 34.74 | 33.46 | 4.66 | 54.99 | Peak | 74 | -19.01 |
| 4.874 | H | 38.66 | 34.74 | 33.46 | 4.66 | 42.04 | Avg. | 54 | -11.96 |
| 7.311 | H | 43.77 | 35.02 | 35.96 | 10.65 | 55.36 | Peak | 74 | -18.64 |
| 7.311 | H | 31.69 | 35.02 | 35.96 | 10.65 | 43.28 | Avg. | 54 | -10.72 |
| 9.748 | H | 42.64 | 35.55 | 38.07 | 10.88 | 56.04 | Peak | 74 | -17.96 |
| 9.748 | H | 31.49 | 35.55 | 38.07 | 10.88 | 44.89 | Avg. | 54 | -9.11 |

**Table 35. Radiated Harmonic Emissions, Mid Channel, 2.4 GHz, Port 1, 802.11g, 5 dBi Omni**

Note: All other emissions were measured at the noise floor of the spectrum analyzer.

| Frequency (MHz) | Antenna Polarity (H/V) | Raw Amp. @ 3m | Pre Amp (dB) | Ant. Cor. Factor (dB) | Cable Loss (dB) | Dist. Cor. Factor (dB) | EUT Field Strength Final Amp. (dBµV/m) | Limit @ 3m (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|
| 4.924 | H | 52.43 | 34.73 | 33.56 | 4.75 | 56.02 | Peak | 74 | -17.98 |
| 4.924 | H | 40.35 | 34.73 | 33.56 | 4.75 | 43.94 | Avg. | 54 | -10.06 |
| 7.386 | H | 44.69 | 35.05 | 36.11 | 10.80 | 56.55 | Peak | 74 | -17.45 |
| 7.386 | H | 32.24 | 35.05 | 36.11 | 10.80 | 44.10 | Avg. | 54 | -9.90 |
| 9.848 | H | 42.78 | 35.54 | 38.19 | 10.96 | 56.39 | Peak | 74 | -17.61 |
| 9.848 | H | 31.04 | 35.54 | 38.19 | 10.96 | 44.65 | Avg. | 54 | -9.35 |

**Table 36. Radiated Harmonic Emissions, High Channel, 2.4 GHz, Port 1, 802.11g, 5 dBi Omni**

Note: All other emissions were measured at the noise floor of the spectrum analyzer.

## Harmonic Emissions Requirements – Radiated, 2.4 GHz, Combined Ports

| Frequency (MHz) | Antenna Polarity (H/V) | Raw Amp. @ 3m | Pre Amp (dB) | Ant. Cor. Factor (dB) | Cable Loss (dB) | EUT Field Strength Final Amp. (dBµV/m) | Limit Detector Peak / Avg | Limit @ 3m (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|
| 4.824 | H | 45.94 | 34.76 | 33.35 | 4.60 | 49.13 | Peak | 74 | -24.87 |
| 4.824 | H | 34.42 | 34.76 | 33.35 | 4.60 | 37.61 | Avg. | 54 | -16.39 |
| 7.236 | H | 43.31 | 35.01 | 35.80 | 10.48 | 54.58 | Peak | 74 | -19.42 |
| 7.236 | H | 31.37 | 35.01 | 35.80 | 10.48 | 42.64 | Avg. | 54 | -11.36 |
| 9.648 | H | 42.76 | 35.58 | 37.95 | 10.80 | 55.93 | Peak | 74 | -18.07 |
| 9.648 | H | 31.46 | 35.58 | 37.95 | 10.80 | 44.63 | Avg. | 54 | -9.37 |

**Table 37. Radiated Harmonic Emissions, Low Channel, 2.4 GHz, Combined Ports, 802.11n 20MHz, 5 dBi Omni**

Note: All other emissions were measured at the noise floor of the spectrum analyzer.

| Frequency (MHz) | Antenna Polarity (H/V) | Raw Amp. @ 3m | Pre Amp (dB) | Ant. Cor. Factor (dB) | Cable Loss (dB) | EUT Field Strength Final Amp. (dBµV/m) | Limit Detector Peak / Avg | Limit @ 3m (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|
| 4.874 | H | 50.29 | 34.74 | 33.46 | 4.66 | 53.67 | Peak | 74 | -20.33 |
| 4.874 | H | 39.21 | 34.74 | 33.46 | 4.66 | 42.59 | Avg. | 54 | -11.41 |
| 7.311 | H | 43.32 | 35.02 | 35.96 | 10.65 | 54.91 | Peak | 74 | -19.09 |
| 7.311 | H | 31.32 | 35.02 | 35.96 | 10.65 | 42.91 | Avg. | 54 | -11.09 |
| 9.748 | H | 44.42 | 35.55 | 38.07 | 10.88 | 57.82 | Peak | 74 | -16.18 |
| 9.748 | H | 31.52 | 35.55 | 38.07 | 10.88 | 44.92 | Avg. | 54 | -9.08 |

**Table 38. Radiated Harmonic Emissions, Mid Channel, 2.4 GHz, Combined Ports, 802.11n 20MHz, 5 dBi Omni**

Note: All other emissions were measured at the noise floor of the spectrum analyzer.

| Frequency (MHz) | Antenna Polarity (H/V) | Raw Amp. @ 3m | Pre Amp (dB) | Ant. Cor. Factor (dB) | Cable Loss (dB) | EUT Field Strength Final Amp. (dBµV/m) | Limit Detector Peak / Avg | Limit @ 3m (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|
| 4.924 | H | 47.74 | 34.73 | 33.56 | 4.75 | 51.33 | Peak | 74 | -22.67 |
| 4.924 | H | 36.72 | 34.73 | 33.56 | 4.75 | 40.31 | Avg. | 54 | -13.69 |
| 7.386 | H | 43.13 | 35.05 | 36.11 | 10.80 | 54.99 | Peak | 74 | -19.01 |
| 7.386 | H | 31.81 | 35.05 | 36.11 | 10.80 | 43.67 | Avg. | 54 | -10.33 |
| 9.848 | H | 42.53 | 35.54 | 38.19 | 10.96 | 56.14 | Peak | 74 | -17.86 |
| 9.848 | H | 31.05 | 35.54 | 38.19 | 10.96 | 44.66 | Avg. | 54 | -9.34 |

**Table 39. Radiated Harmonic Emissions, High Channel, 2.4 GHz, Combined Ports, 802.11n 20MHz, 5 dBi Omni**

Note: All other emissions were measured at the noise floor of the spectrum analyzer.

| Frequency (MHz) | Antenna Polarity (H/V) | Raw Amp. @ 3m | Pre Amp (dB) | Ant. Cor. Factor (dB) | Cable Loss (dB) | EUT Field Strength Final Amp. (dBµV/m) | Limit Detector Peak / Avg | Limit @ 3m (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|
| 4.874 | H | 48.97 | 34.74 | 33.46 | 4.66 | 52.35 | Peak | 74 | -21.65 |
| 4.874 | H | 36.36 | 34.74 | 33.46 | 4.66 | 39.74 | Avg. | 54 | -14.26 |
| 7.311 | H | 42.28 | 35.02 | 35.96 | 10.65 | 53.87 | Peak | 74 | -20.13 |
| 7.311 | H | 31.16 | 35.02 | 35.96 | 10.65 | 42.75 | Avg. | 54 | -11.25 |
| 9.748 | H | 43.17 | 35.55 | 38.07 | 10.88 | 56.57 | Peak | 74 | -17.43 |
| 9.748 | H | 31.25 | 35.55 | 38.07 | 10.88 | 44.65 | Avg. | 54 | -9.35 |

**Table 40. Radiated Harmonic Emissions, Mid Channel, 2.4 GHz, Combined Ports, 802.11n 40MHz, 5 dBi Omni**

Note: All other emissions were measured at the noise floor of the spectrum analyzer.

## Harmonic Emissions Requirements – Radiated, 5 GHz, Combined Ports

| Frequency (MHz) | Antenna Polarity (H/V) | Raw Amp. @ 3m | Pre Amp (dB) | Ant. Cor. Factor (dB) | Cable Loss (dB) | EUT Field Strength Final Amp. (dBµV/m) | Limit Detector Peak / Avg | Limit @ 3m (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|
| 11.49 | V | 44.26 | 34.86 | 39.79 | 7.68 | 56.87 | Peak | 74 | -17.13 |
| 11.49 | V | 30.62 | 34.86 | 39.79 | 7.68 | 43.23 | Avg. | 54 | -10.77 |
| 17.235 | V | 43.93 | 34.01 | 42.82 | 9.25 | 61.99 | Peak | 74 | -12.01 |
| 17.235 | V | 31.52 | 34.01 | 42.82 | 9.25 | 49.58 | Avg. | 54 | -4.42 |

**Table 41. Radiated Harmonic Emissions, Low Channel, 5 GHz, Combined Ports, 802.11a, 5 dBi Omni**

Note: All other emissions were measured at the noise floor of the spectrum analyzer.

| Frequency (MHz) | Antenna Polarity (H/V) | Raw Amp. @ 3m | Pre Amp (dB) | Ant. Cor. Factor (dB) | Cable Loss (dB) | EUT Field Strength Final Amp. (dBµV/m) | Limit Detector Peak / Avg | Limit @ 3m (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|
| 11.57 | V | 46.46 | 34.91 | 39.88 | 7.55 | 58.98 | Peak | 74 | -15.02 |
| 11.57 | V | 34.55 | 34.91 | 39.88 | 7.55 | 47.07 | Avg. | 54 | -6.93 |
| 17.355 | V | 43.29 | 33.93 | 43.15 | 9.58 | 62.09 | Peak | 74 | -11.91 |
| 17.355 | V | 31.23 | 33.93 | 43.15 | 9.58 | 50.03 | Avg. | 54 | -3.97 |

**Table 42. Radiated Harmonic Emissions, Mid Channel, 5 GHz, Combined Ports, 802.11a, 5 dBi Omni**

Note: All other emissions were measured at the noise floor of the spectrum analyzer.

| Frequency (MHz) | Antenna Polarity (H/V) | Raw Amp. @ 3m | Pre Amp (dB) | Ant. Cor. Factor (dB) | Cable Loss (dB) | EUT Field Strength Final Amp. (dBµV/m) | Limit Detector Peak / Avg | Limit @ 3m (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|
| 11.65 | V | 49.46 | 34.96 | 39.94 | 7.23 | 61.67 | Peak | 74 | -12.33 |
| 11.65 | V | 37.15 | 34.96 | 39.94 | 7.23 | 49.36 | Avg. | 54 | -4.64 |
| 17.475 | V | 43.26 | 33.89 | 43.59 | 10.28 | 63.23 | Peak | 74 | -10.77 |
| 17.475 | V | 31.27 | 33.89 | 43.59 | 10.28 | 51.24 | Avg. | 54 | -2.76 |

**Table 43. Radiated Harmonic Emissions, High Channel, 5 GHz, Combined Ports, 802.11a, 5 dBi Omni**

Note: All other emissions were measured at the noise floor of the spectrum analyzer.

| Frequency (MHz) | Antenna Polarity (H/V) | Raw Amp. @ 3m | Pre Amp (dB) | Ant. Cor. Factor (dB) | Cable Loss (dB) | EUT Field Strength Final Amp. (dBµV/m) | Limit Detector Peak / Avg | Limit @ 3m (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|
| 11.49 | **V** | 46.83 | 34.86 | 39.79 | 7.68 | 59.44 | Peak | 74 | -14.56 |
| 11.49 | **V** | 34.23 | 34.86 | 39.79 | 7.68 | 46.84 | Avg. | 54 | -7.16 |
| 17.235 | **V** | 43.71 | 34.01 | 42.82 | 9.25 | 61.77 | Peak | 74 | -12.23 |
| 17.235 | **V** | 31.17 | 34.01 | 42.82 | 9.25 | 49.23 | Avg. | 54 | -4.77 |

**Table 44. Radiated Harmonic Emissions, Low Channel, 5 GHz, Combined Ports, 802.11n 20MHz, 5 dBi Omni**

Note: All other emissions were measured at the noise floor of the spectrum analyzer.

| Frequency (MHz) | Antenna Polarity (H/V) | Raw Amp. @ 3m | Pre Amp (dB) | Ant. Cor. Factor (dB) | Cable Loss (dB) | EUT Field Strength Final Amp. (dBµV/m) | Limit Detector Peak / Avg | Limit @ 3m (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|
| 11.57 | V | 49.24 | 34.91 | 39.88 | 7.55 | 61.76 | Peak | 74 | -12.24 |
| 11.57 | V | 35.73 | 34.91 | 39.88 | 7.55 | 48.25 | Avg. | 54 | -5.75 |
| 17.355 | V | 42.81 | 33.93 | 43.15 | 9.58 | 61.61 | Peak | 74 | -12.39 |
| 17.355 | V | 31.06 | 33.93 | 43.15 | 9.58 | 49.86 | Avg. | 54 | -4.14 |

**Table 45. Radiated Harmonic Emissions, Mid Channel, 5 GHz, Combined Ports, 802.11n 20MHz, 5 dBi Omni**

Note: All other emissions were measured at the noise floor of the spectrum analyzer.

| Frequency (MHz) | Antenna Polarity (H/V) | Raw Amp. @ 3m | Pre Amp (dB) | Ant. Cor. Factor (dB) | Cable Loss (dB) | EUT Field Strength Final Amp. (dBµV/m) | Limit Detector Peak / Avg | Limit @ 3m (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|
| 11.65 | V | 49.66 | 34.96 | 39.94 | 7.23 | 61.87 | Peak | 74 | -12.13 |
| 11.65 | V | 35.3 | 34.96 | 39.94 | 7.23 | 47.51 | Avg. | 54 | -6.49 |
| 17.475 | V | 43.96 | 33.89 | 43.59 | 10.28 | 63.93 | Peak | 74 | -10.07 |
| 17.475 | V | 31.71 | 33.89 | 43.59 | 10.28 | 51.68 | Avg. | 54 | -2.32 |

**Table 46. Radiated Harmonic Emissions, High Channel, 5 GHz, Combined Ports, 802.11n 20MHz, 5 dBi Omni**

Note: All other emissions were measured at the noise floor of the spectrum analyzer.

| Frequency (MHz) | Antenna Polarity (H/V) | Raw Amp. @ 3m | Pre Amp (dB) | Ant. Cor. Factor (dB) | Cable Loss (dB) | EUT Field Strength Final Amp. (dBµV/m) | Limit Detector Peak / Avg | Limit @ 3m (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|
| 11.51 | V | 45.66 | 34.88 | 39.81 | 7.67 | 58.27 | Peak | 74 | -15.73 |
| 11.51 | V | 31.43 | 34.88 | 39.81 | 7.67 | 44.04 | Avg. | 54 | -9.96 |
| 17.265 | V | 46.15 | 33.98 | 42.90 | 9.30 | 64.36 | Peak | 74 | -9.64 |
| 17.265 | V | 30.65 | 33.98 | 42.90 | 9.30 | 48.86 | Avg. | 54 | -5.14 |

**Table 47. Radiated Harmonic Emissions, Low Channel, 5 GHz, Combined Ports, 802.11n 40MHz, 5 dBi Omni**

Note: All other emissions were measured at the noise floor of the spectrum analyzer.

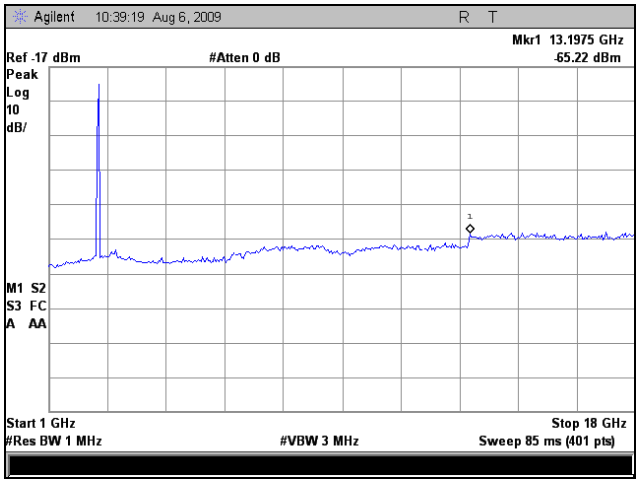
| Frequency (MHz) | Antenna Polarity (H/V) | Raw Amp. @ 3m | Pre Amp (dB) | Ant. Cor. Factor (dB) | Cable Loss (dB) | EUT Field Strength Final Amp. (dBµV/m) | Limit Detector Peak / Avg | Limit @ 3m (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|
| 11.59 | V | 45.23 | 34.92 | 39.89 | 7.49 | 57.69 | Peak | 74 | -16.31 |
| 11.59 | V | 32.06 | 34.92 | 39.89 | 7.49 | 44.52 | Avg. | 54 | -9.48 |
| 17.385 | V | 42.99 | 33.92 | 43.24 | 9.72 | 62.04 | Peak | 74 | -11.96 |
| 17.385 | V | 31.26 | 33.92 | 43.24 | 9.72 | 50.31 | Avg. | 54 | -3.69 |

**Table 48. Radiated Harmonic Emissions, High Channel, 5 GHz, Combined Ports, 802.11n 40MHz, 5 dBi Omni**

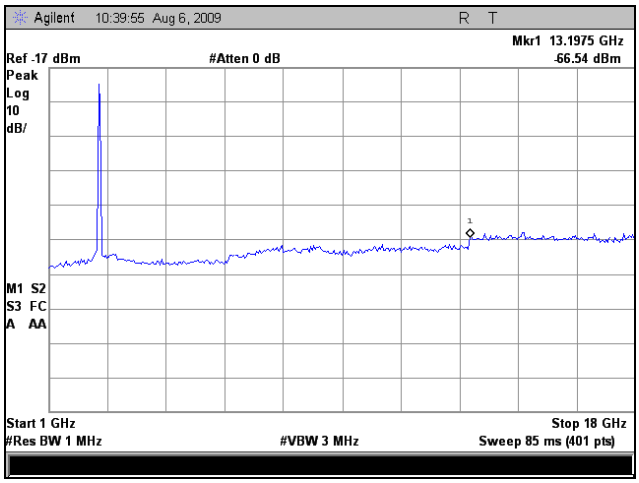
Note: All other emissions were measured at the noise floor of the spectrum analyzer.

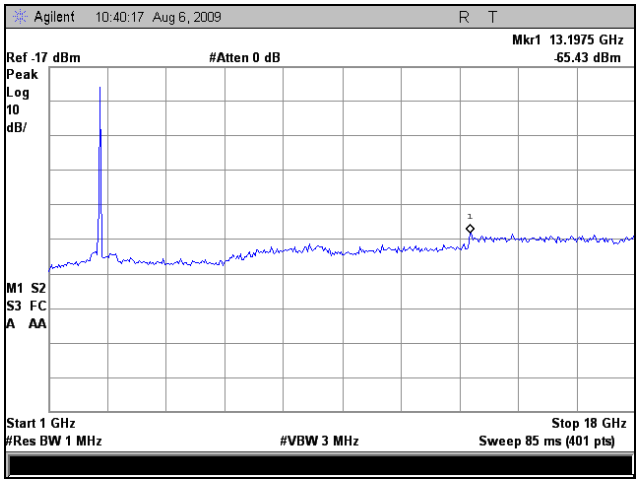
## Radiated Spurious Emissions, 802.11g, 2.4 GHz, Combined Ports




**Plot 74. Radiated Spurious Emissions, Low Channel, 2.4 GHz, 802.11g, 5 dBi Omni**

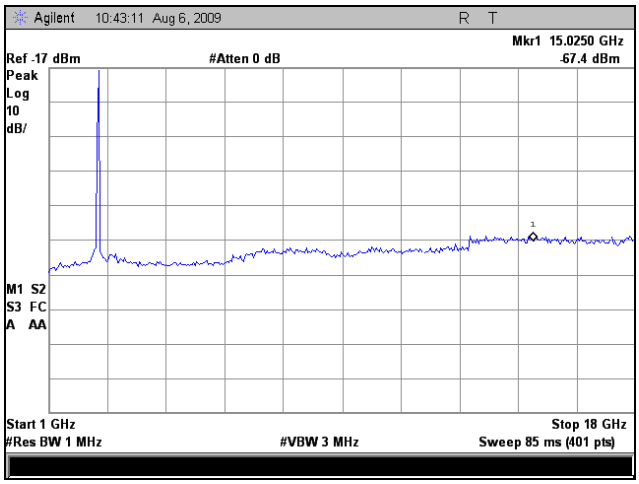



**Plot 75. Radiated Spurious Emissions, Mid Channel, 2.4 GHz, 802.11g, 5 dBi Omni**

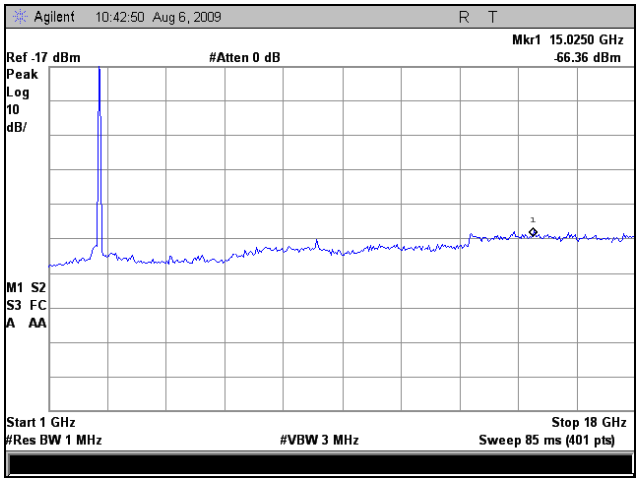



**Plot 76. Radiated Spurious Emissions, High Channel, 2.4 GHz, 802.11g, 5 dBi Omni**

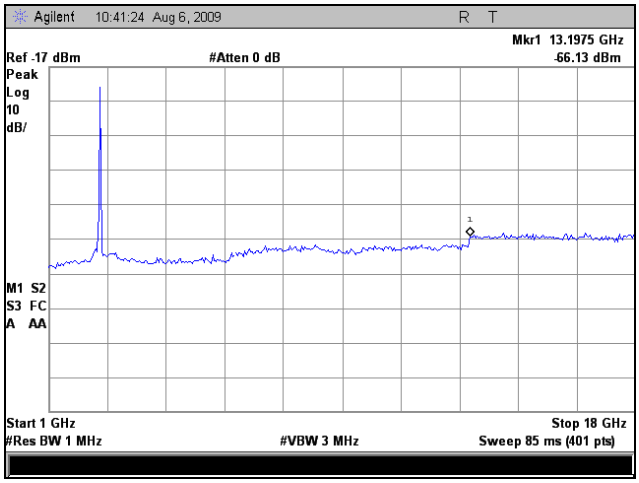
  




**Plot 77. Radiated Spurious Emissions, Low Channel, 2.4 GHz, Combined Ports, 802.11n 20MHz, 5 dBi Omni**

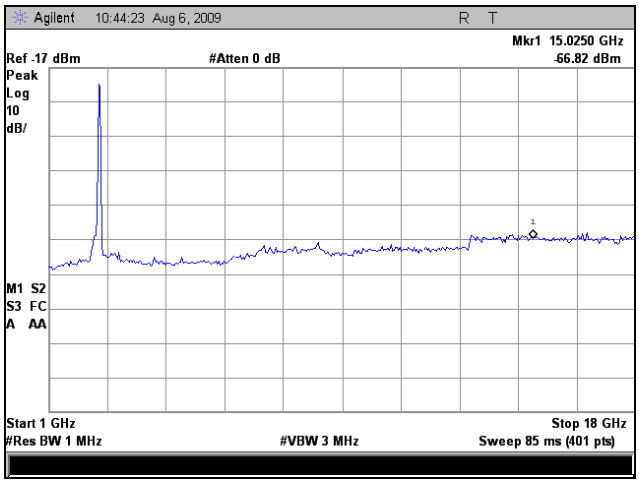



**Plot 78. Radiated Spurious Emissions, Mid Channel, 2.4 GHz, Combined Ports, 802.11n 20MHz, 5 dBi Omni**




**Plot 79. Radiated Spurious Emissions, High Channel, 2.4 GHz, Combined Ports, 802.11n 20MHz, 5 dBi Omni**

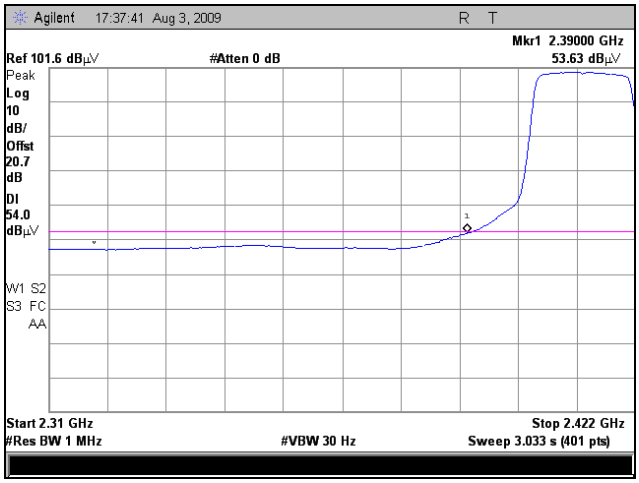
  



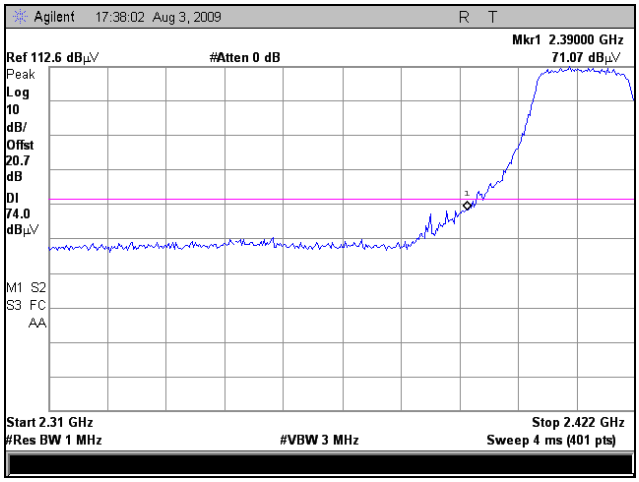

**Plot 80. Radiated Spurious Emissions, Mid Channel, 2.4 GHz, Combined Ports, 802.11n 40MHz, 5 dBi Omni**

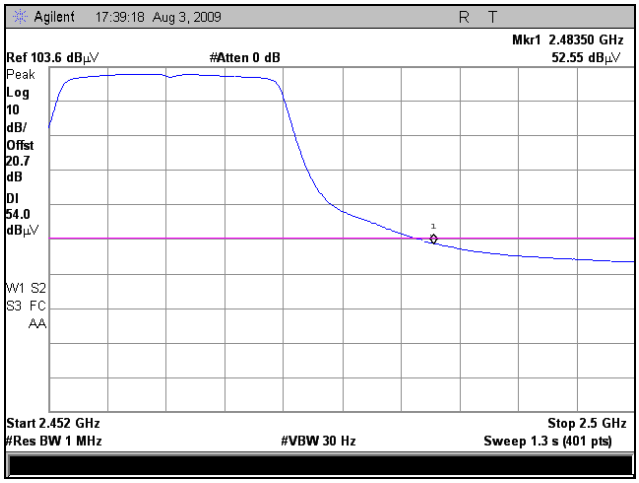
## Radiated Band Edge Measurements, 802.11g, Port 1




**Plot 81. Lower Band Edge, Average, 2.4 GHz, 802.11g 20MHz, Port 1, 5 dBi Omni**

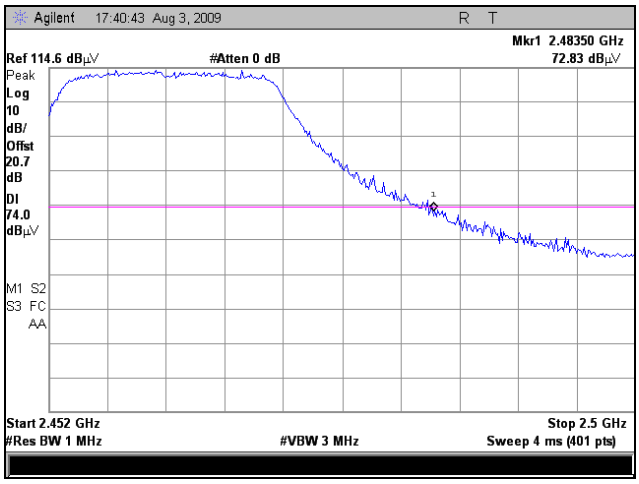



**Plot 82. Lower Band Edge, Peak, 2.4 GHz, 802.11g 20MHz, Port 1, 5 dBi Omni**




**Plot 83. Upper Band Edge, Average, 2.4 GHz, 802.11g 20MHz, Port 1, 5 dBi Omni**

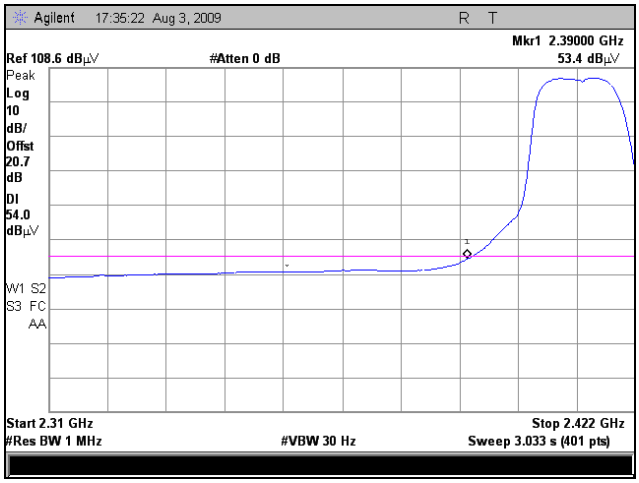
  



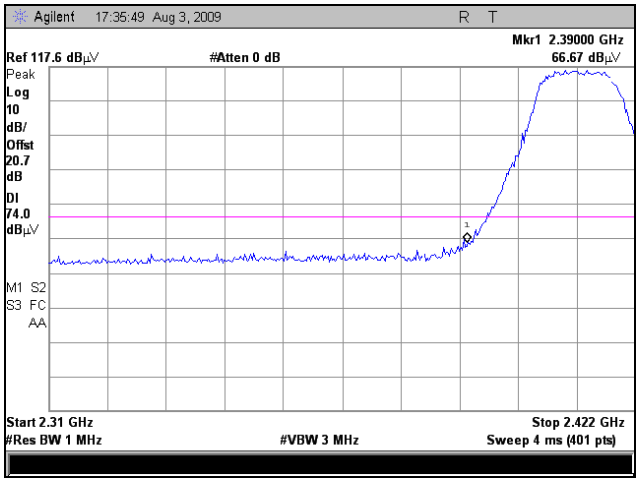

**Plot 84. Upper Band Edge, Peak, 2.4 GHz, 802.11g 20MHz, Port 1, 5 dBi Omni**

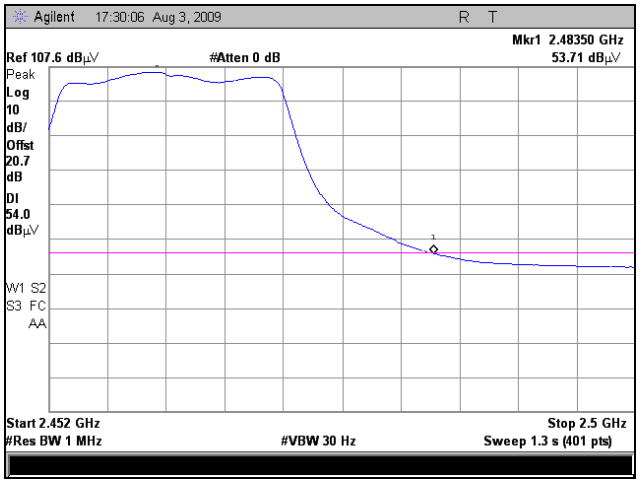
## Radiated Band Edge Measurements, 2.4 GHz, Combined Ports




**Plot 85. Lower Band Edge, Average, 2.4 GHz, Combined Ports, 802.11n 20MHz, 5 dBi Omni**

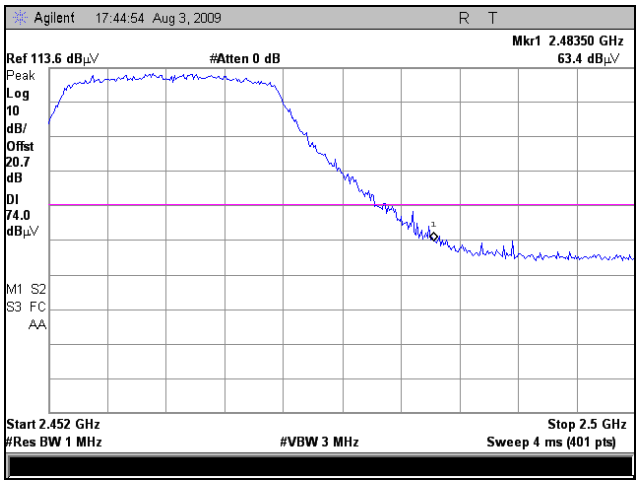



**Plot 86. Lower Band Edge, Peak, 2.4 GHz, Combined Ports, 802.11n 20MHz, 5 dBi Omni**

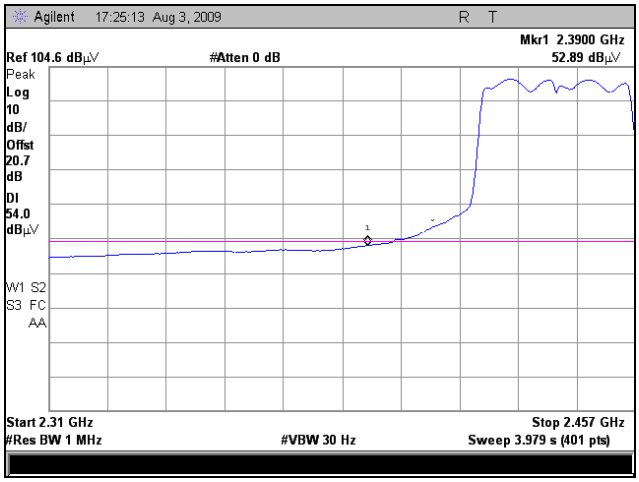



**Plot 87. Upper Band Edge, Average, 2.4 GHz, Combined Ports, 802.11n 20MHz, 5 dBi Omni**

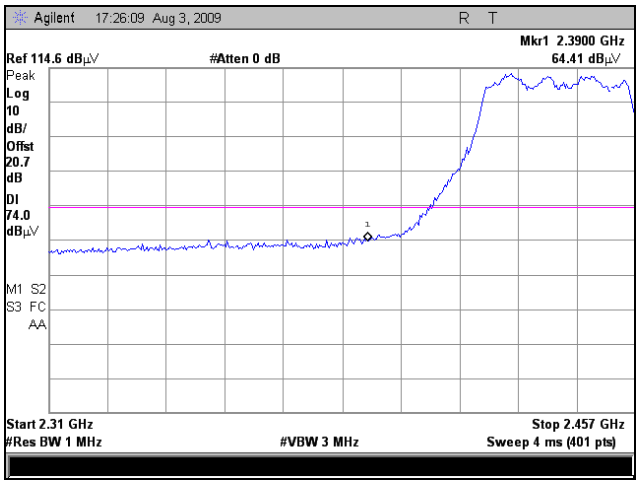
  




**Plot 88. Upper Band Edge, Peak, 2.4 GHz, Combined Ports, 802.11n 20MHz, 5 dBi Omni**

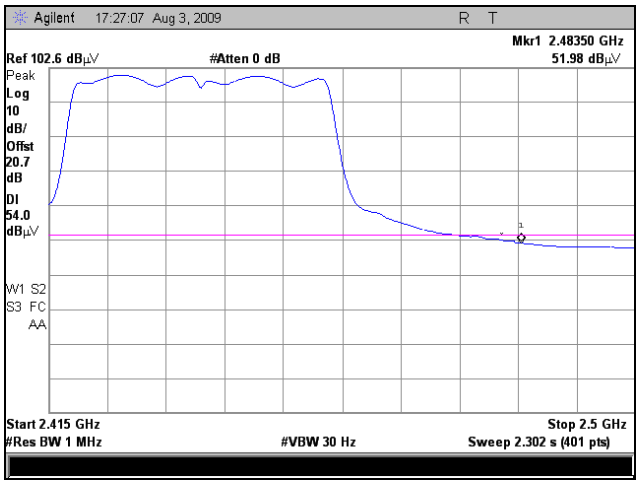



**Plot 89. Lower Band Edge, Average, 2.4 GHz, Combined Ports, 802.11n 40MHz, 5 dBi Omni**

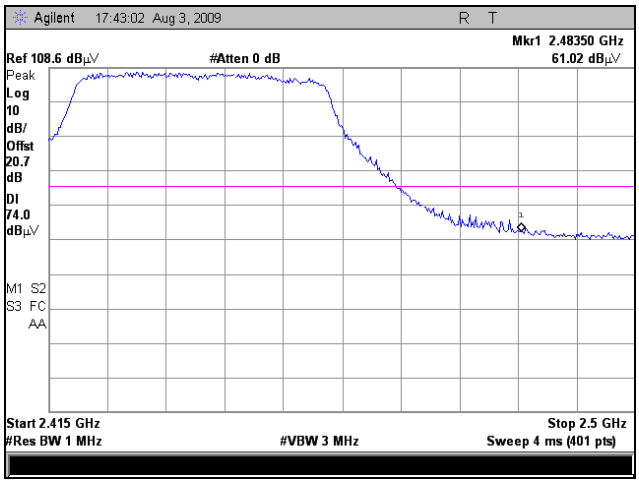



**Plot 90. Lower Band Edge, Peak, 2.4 GHz, Combined Ports, 802.11n 40MHz, 5 dBi Omni**



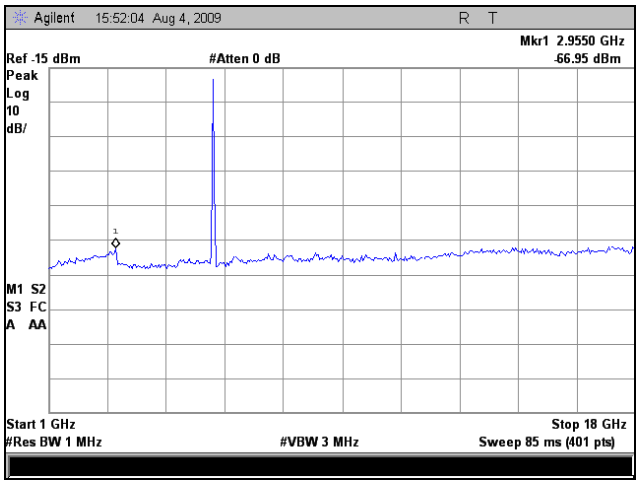

**Plot 91. Upper Band Edge, Average, 2.4 GHz, Combined Ports, 802.11n 40MHz, 5 dBi Omni**



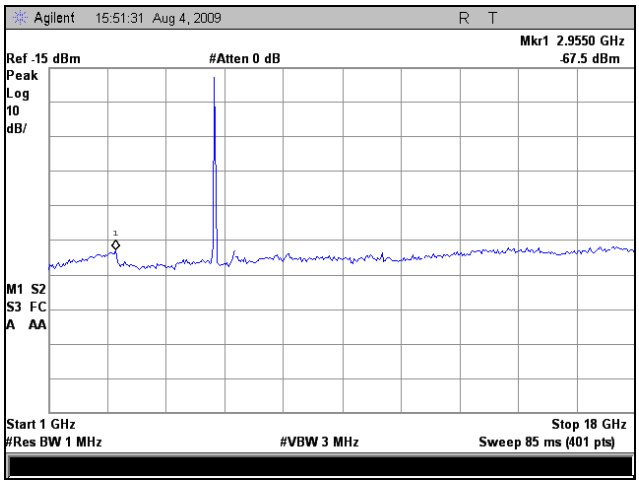

**Plot 92. Upper Band Edge, Peak, 2.4 GHz, Combined Ports, 802.11n 40MHz, 5 dBi Omni**

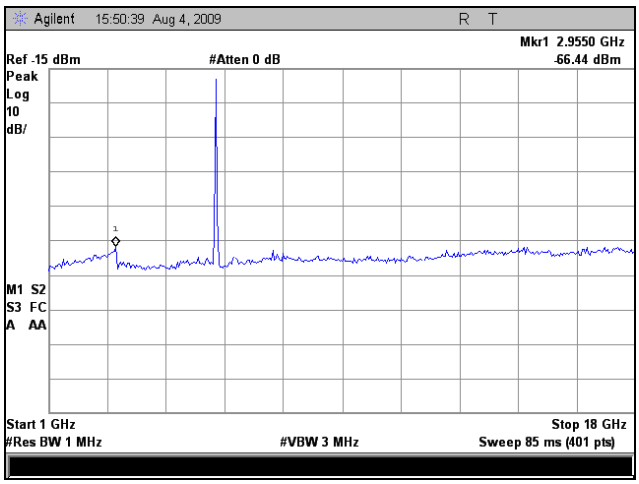
## Radiated Spurious Emissions, 5 GHz, Combined Ports




**Plot 93. Radiated Spurious Emissions, Low Channel, 5 GHz, 802.11a 20MHz, 5 dBi Omni**

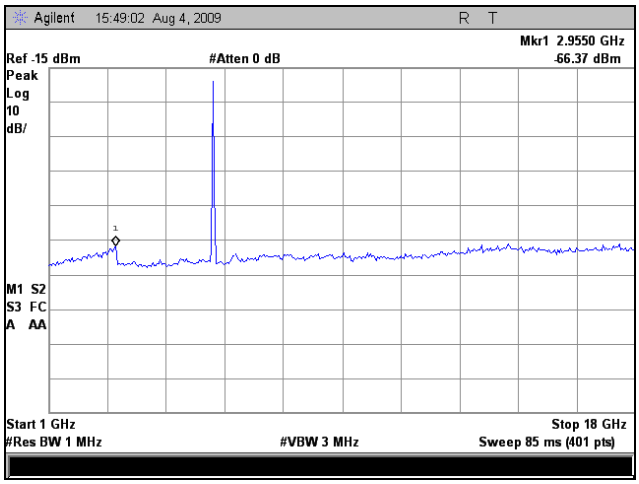



**Plot 94. Radiated Spurious Emissions, Mid Channel, 5 GHz, 802.11a 20MHz, 5 dBi Omni**

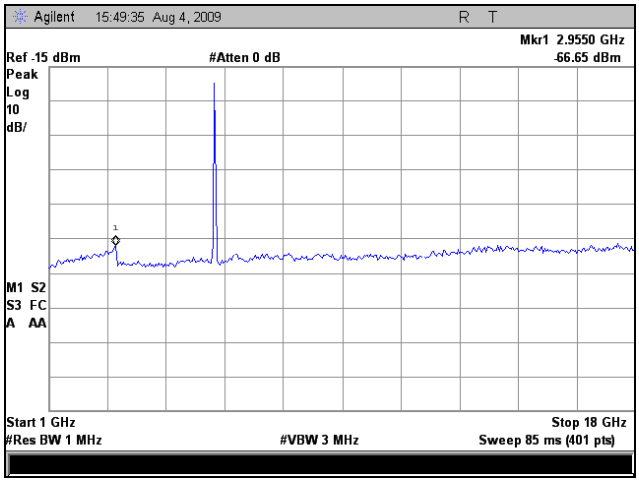



**Plot 95. Radiated Spurious Emissions, High Channel, 5 GHz, 802.11a 20MHz, 5 dBi Omni**

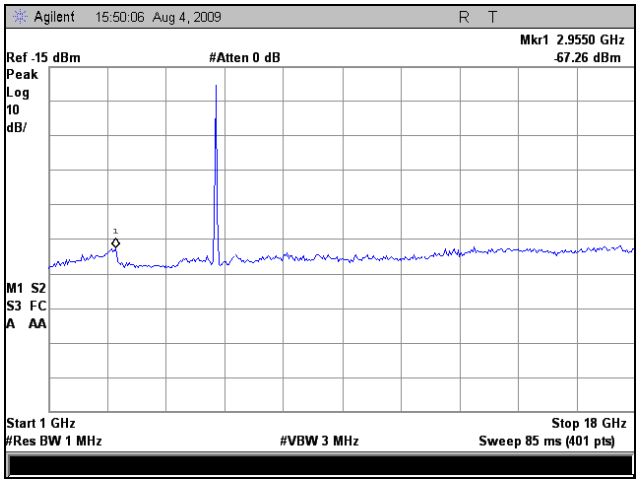
  




**Plot 96. Radiated Spurious Emissions, Low Channel, 5 GHz, Combined Ports, 802.11n 20MHz, 5 dBi Omni**

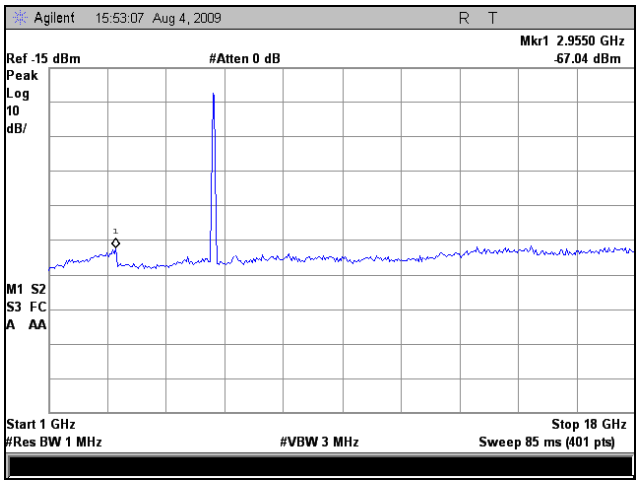



**Plot 97. Radiated Spurious Emissions, Mid Channel, 5 GHz, Combined Ports, 802.11n 20MHz, 5 dBi Omni**

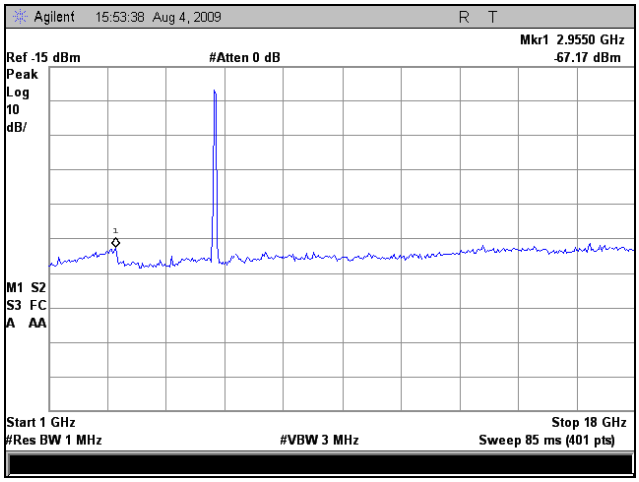



**Plot 98. Radiated Spurious Emissions, High Channel, 5 GHz, Combined Ports, 802.11n 20MHz, 5 dBi Omni**




**Plot 99. Radiated Spurious Emissions, Low Channel, 5 GHz, Combined Ports, 802.11n 40MHz, 5 dBi Omni**




**Plot 100. Radiated Spurious Emissions, High Channel, 5 GHz, Combined Ports, 802.11n 40MHz, 5 dBi Omni**

## Radiated Spurious Emissions – Test Setup Photographs

**Photograph 7. Test Equipment and Setup for Various Radiated Measurements – Combined Omni Antennas**

## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.247(d) RF Conducted Spurious Emissions Requirements and Band Edge

**Test Requirement:** **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 leas 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.

**Test Procedure:** For intentional radiators with a digital device portion which operates below 10 GHz, the spectrum was investigated as per §15.33(a)(1) and §15.33(a)(4); i.e., the lowest RF signal generated or used in the device up to the 10$^{th}$ harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

See following pages for detailed test results with RF Conducted Spurious Emissions.

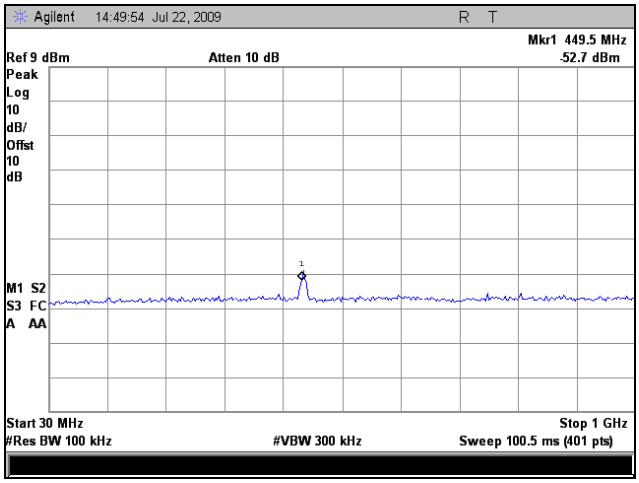
**Test Results:** The EUT was compliant with the Conducted Spurious Emission limits of **§15.247(d)**.

**Test Engineer(s):** Minh Ly

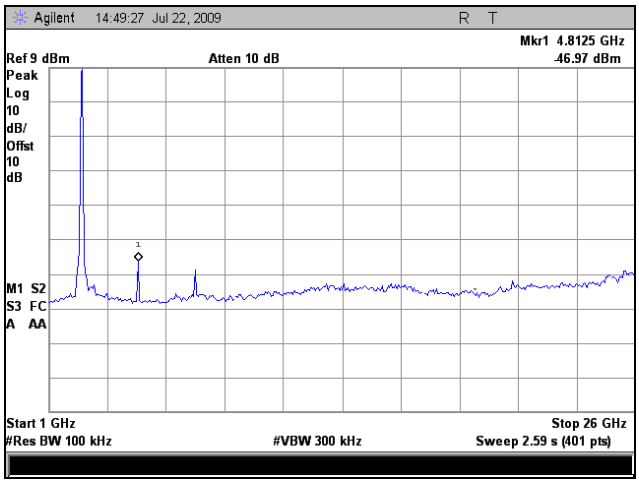
**Test Date(s):** 08/11/09

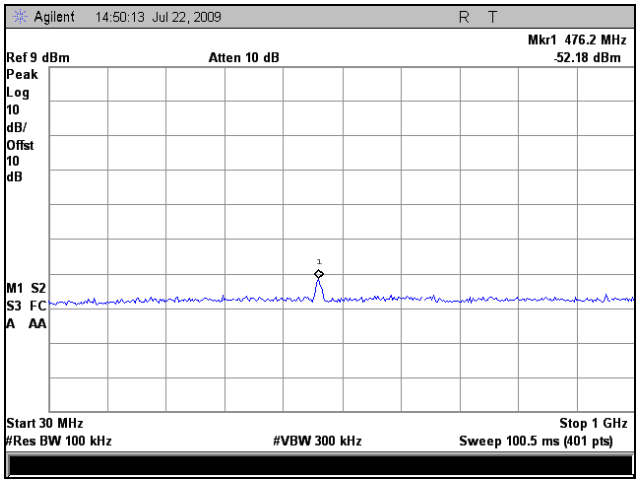
## RF Conducted Spurious Emissions Requirements, 2.4 GHz, 802.11g, Port 1




**Plot 101. Conducted Emissions, Low Channel, 2.4 GHz, 802.11g, Port 1, 30 MHz – 1 GHz**

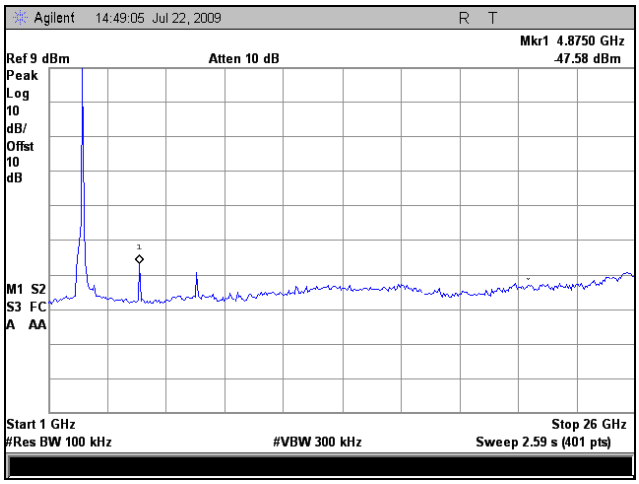



**Plot 102. Conducted Emissions, Low Channel, 2.4 GHz, 802.11g, Port 1, 1 GHz – 26 GHz**

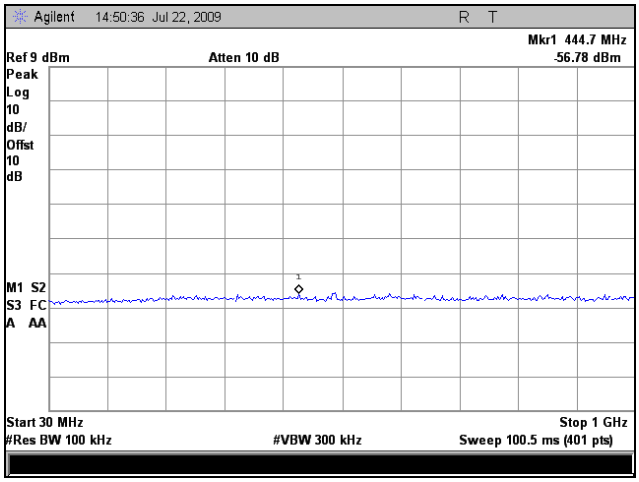



**Plot 103. Conducted Emissions, Mid Channel, 2.4 GHz, 802.11g, Port 1, 30 MHz – 1 GHz**

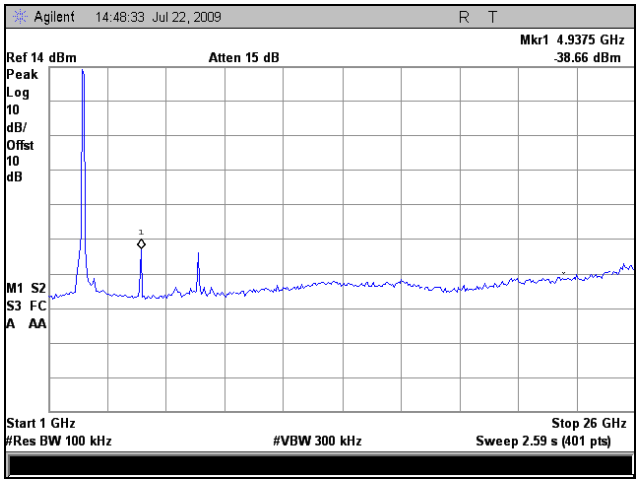
  




**Plot 104. Conducted Emissions, Mid Channel, 2.4 GHz, 802.11g, Port 1, 1 GHz – 26 GHz**

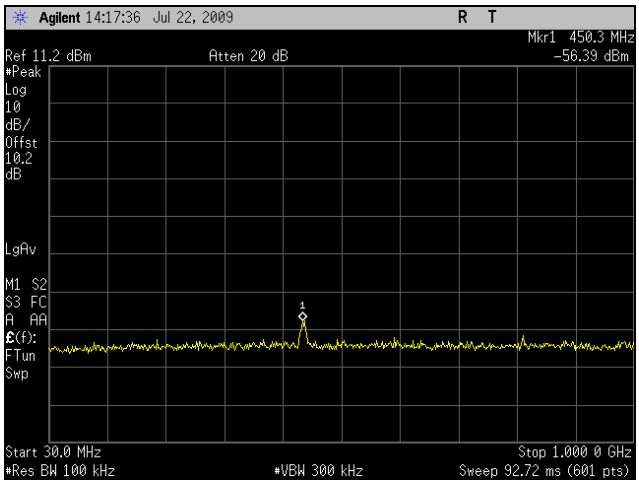



**Plot 105. Conducted Emissions, High Channel, 2.4 GHz, 802.11g, Port 1, 30 MHz – 1 GHz**

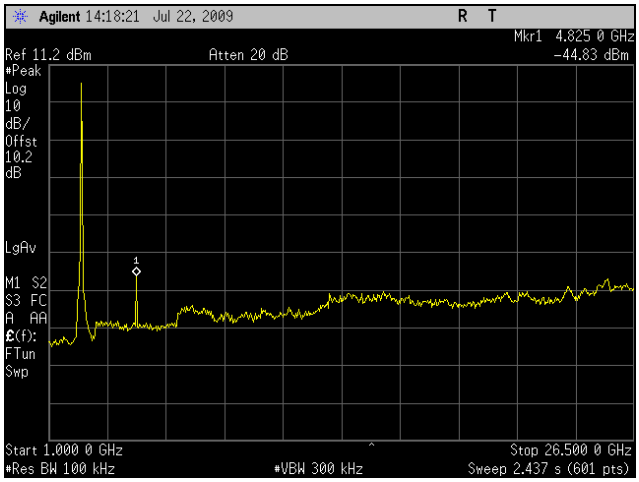



**Plot 106. Conducted Emissions, High Channel, 2.4 GHz, 802.11g, Port 1, 1 GHz – 26 GHz**

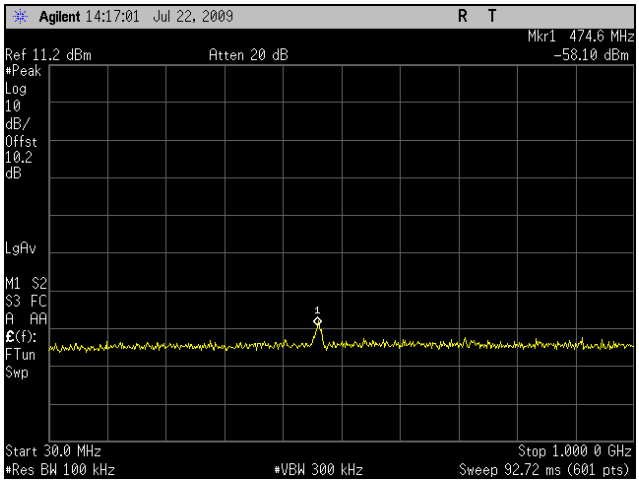
  




**Plot 107. Conducted Emissions, Low Channel, 2.4 GHz, Port 1, 802.11n 20MHz, 30 MHz – 1 GHz**

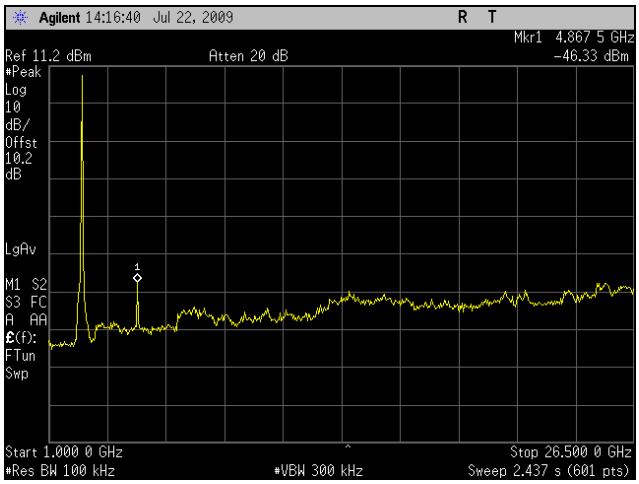



**Plot 108. Conducted Emissions, Low Channel, 2.4 GHz, Port 1, 802.11n 20MHz, 1 GHz – 26.5 GHz**

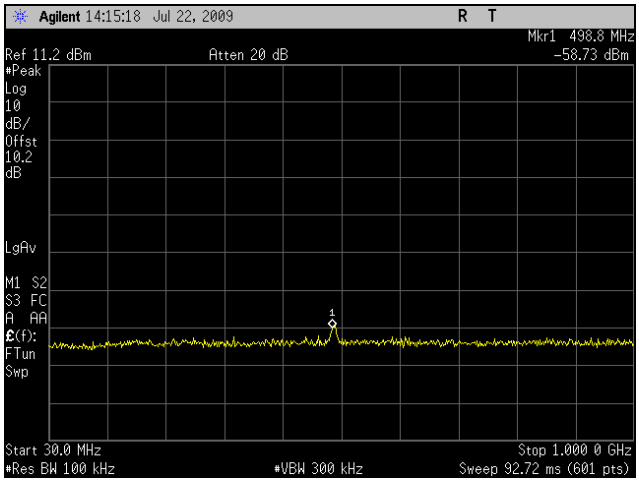



**Plot 109. Conducted Emissions, Mid Channel, 2.4 GHz, Port 1, 802.11n 20MHz, 30 MHz – 1 GHz**

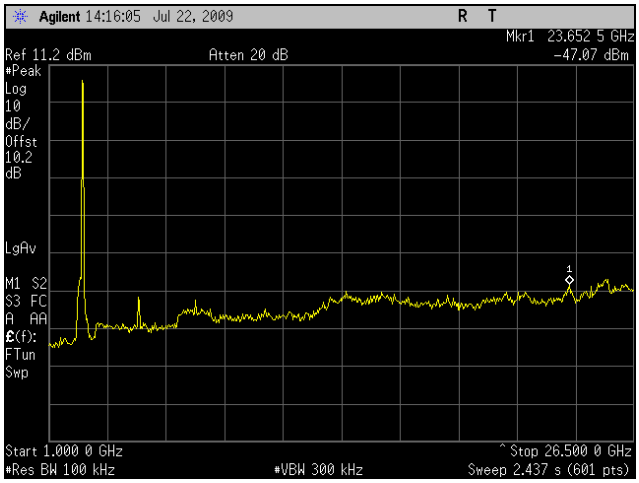
  




**Plot 110. Conducted Emissions, Mid Channel, 2.4 GHz, Port 1, 802.11n 20MHz, 1 GHz – 26.5 GHz**

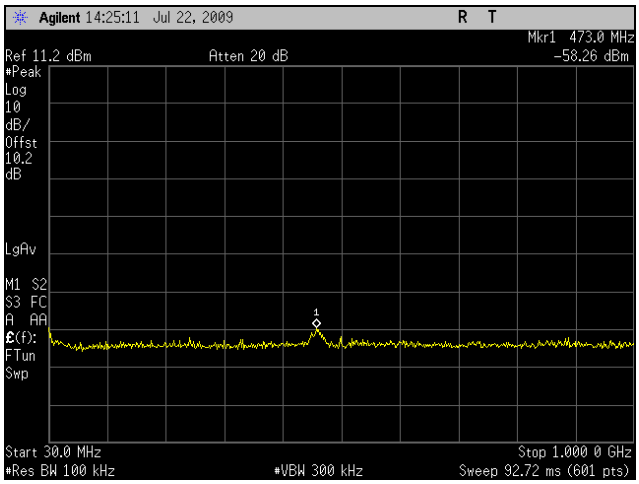



**Plot 111. Conducted Emissions, High Channel, 2.4 GHz, Port 1, 802.11n 20MHz, 30 MHz – 1 GHz**

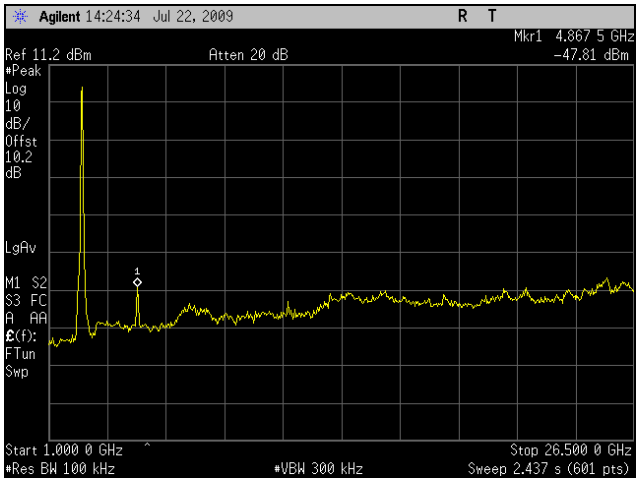



**Plot 112. Conducted Emissions, High Channel, 2.4 GHz, Port 1, 802.11n 20MHz, 1 GHz – 26.5 GHz**



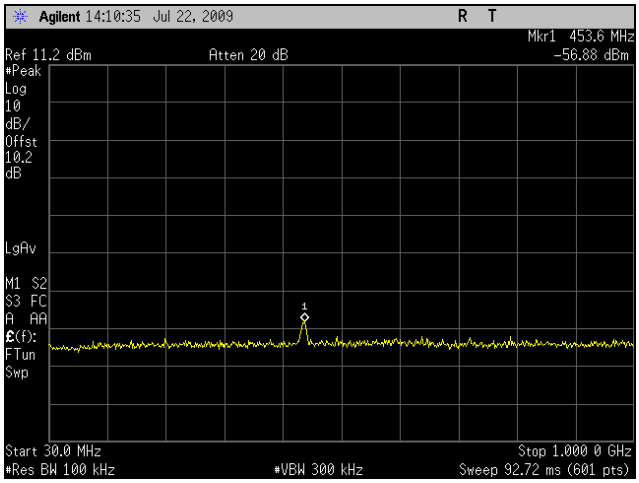

**Plot 113. Conducted Emissions, Mid Channel, 2.4 GHz, Port 1, 802.11n 40MHz, 30 MHz – 1 GHz**



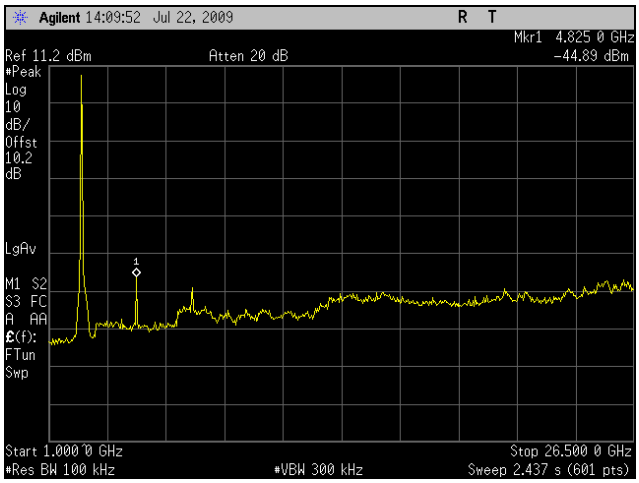

**Plot 114. Conducted Emissions, Mid Channel, 2.4 GHz, Port 1, 802.11n 40MHz, 1 GHz – 26.5 GHz**

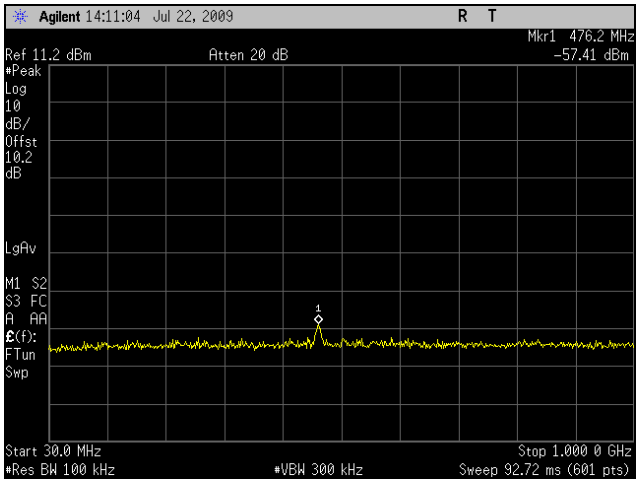
## RF Conducted Spurious Emissions Requirements, 2.4 GHz, Port 2




**Plot 115. Conducted Emissions, Low Channel, 2.4 GHz, Port 2, 802.11n 20MHz, 30 MHz – 1 GHz**

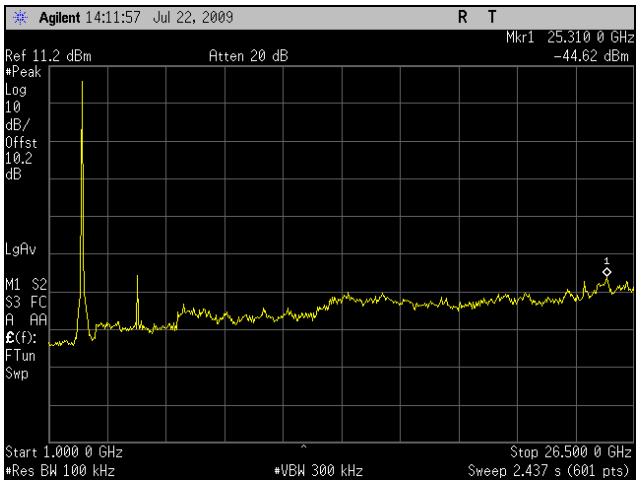



**Plot 116. Conducted Emissions, Low Channel, 2.4 GHz, Port 2, 802.11n 20MHz, 1 GHz – 26.5 GHz**

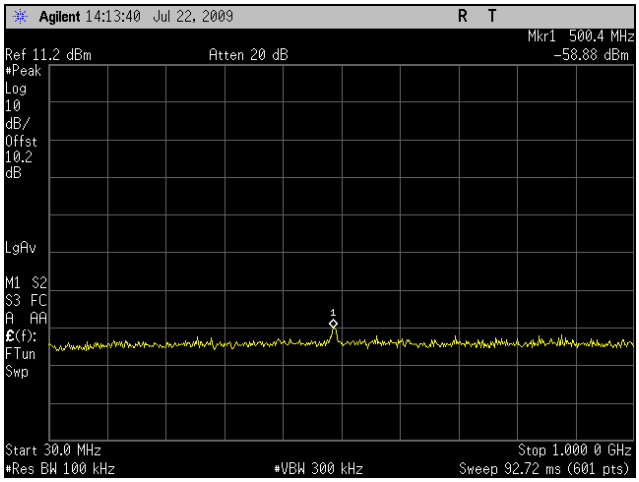



**Plot 117. Conducted Emissions, Mid Channel, 2.4 GHz, Port 2, 802.11n 20MHz, 30 MHz – 1 GHz**

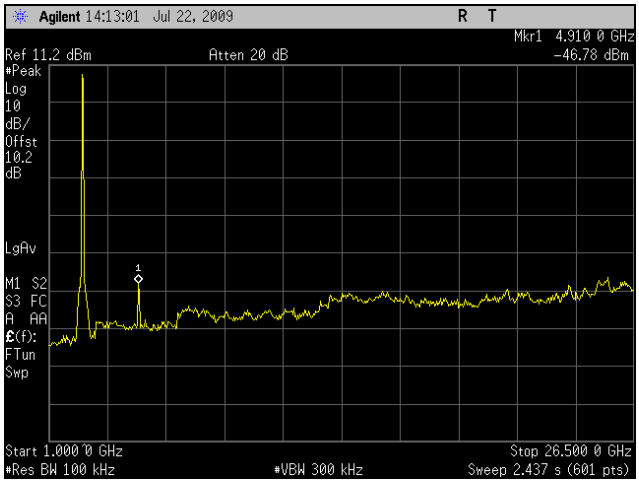
  




**Plot 118. Conducted Emissions, Mid Channel, 2.4 GHz, Port 2, 802.11n 20MHz, 1 GHz – 26.5 GHz**

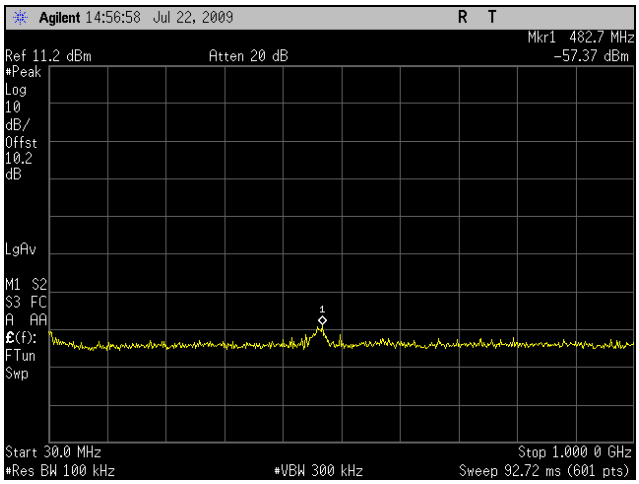



**Plot 119. Conducted Emissions, High Channel, 2.4 GHz, Port 2, 802.11n 20MHz, 30 MHz – 1 GHz**

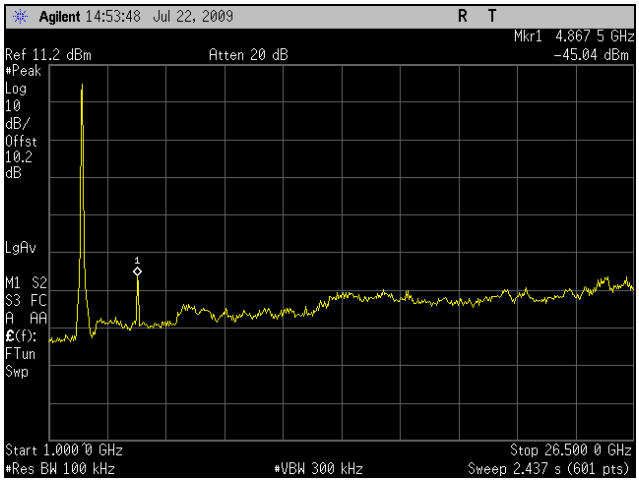



**Plot 120. Conducted Emissions, High Channel, 2.4 GHz, Port 2, 802.11n 20MHz, 1 GHz – 26.5 GHz**



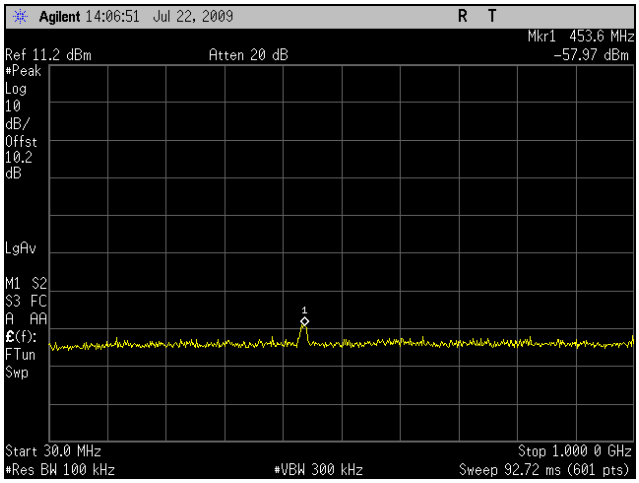

**Plot 121. Conducted Emissions, Mid Channel, 2.4 GHz, Port 2, 802.11n 40MHz, 30 MHz – 1 GHz**



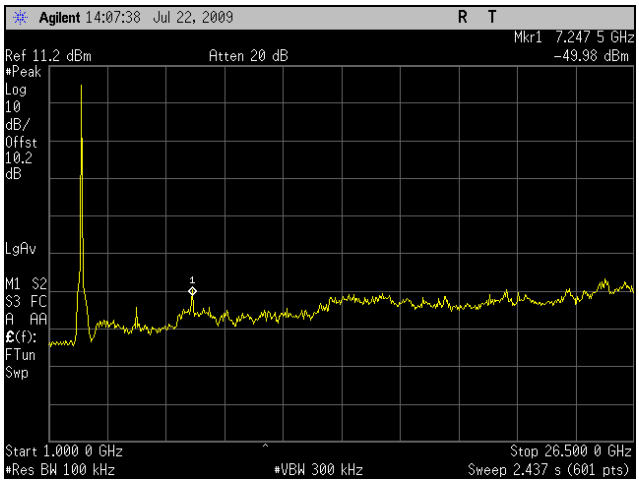

**Plot 122. Conducted Emissions, Mid Channel, 2.4 GHz, Port 2, 802.11n 40MHz, 1 GHz – 26.5 GHz**

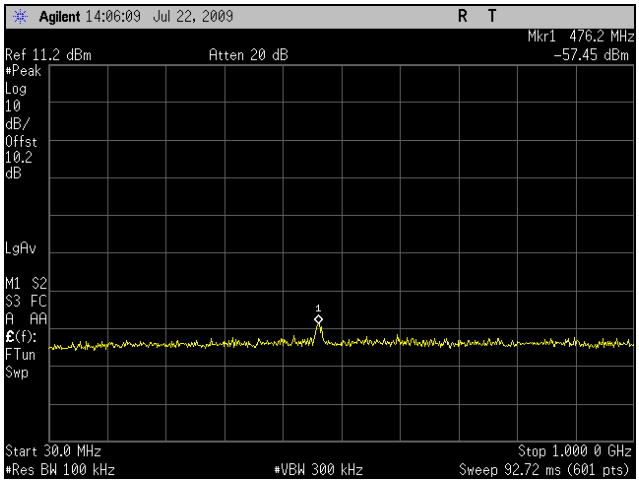
## RF Conducted Spurious Emissions Requirements, 2.4 GHz, Port 3




**Plot 123. Conducted Emissions, Low Channel, 2.4 GHz, Port 3, 802.11n 20MHz, 30 MHz – 1 GHz**

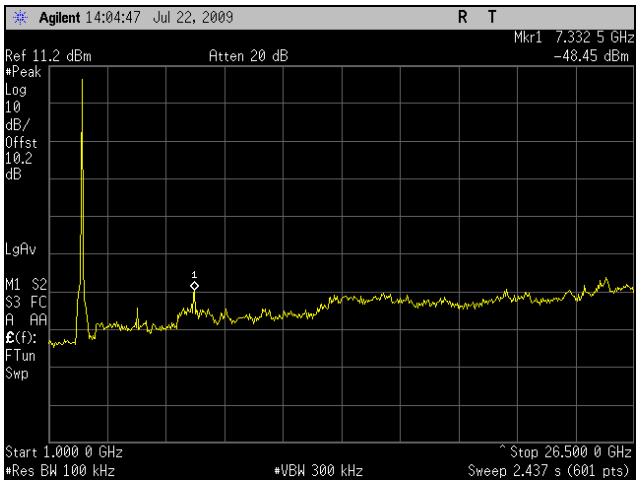



**Plot 124. Conducted Emissions, Low Channel, 2.4 GHz, Port 3, 802.11n 20MHz, 1 GHz – 26.5 GHz**

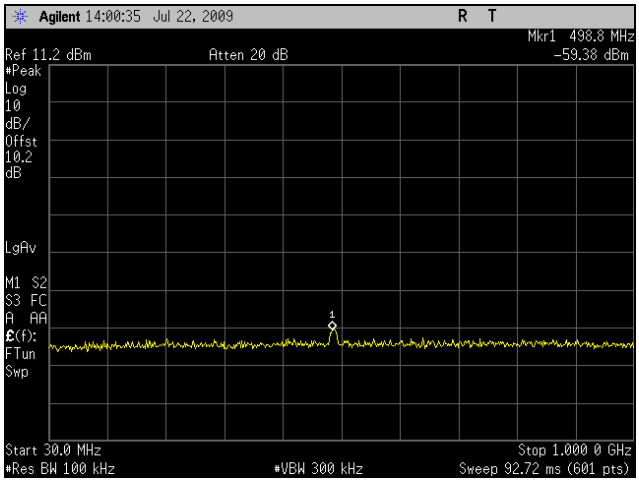



**Plot 125. Conducted Emissions, Mid Channel, 2.4 GHz, Port 3, 802.11n 20MHz, 30 MHz – 1 GHz**

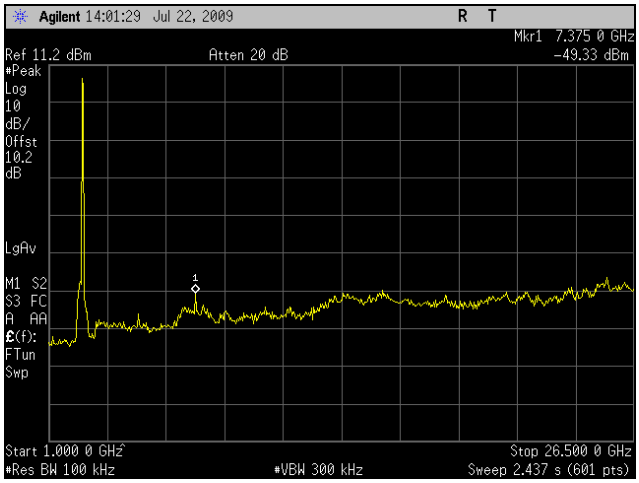
  




**Plot 126. Conducted Emissions, Mid Channel, 2.4 GHz, Port 3, 802.11n 20MHz, 1 GHz – 26.5 GHz**

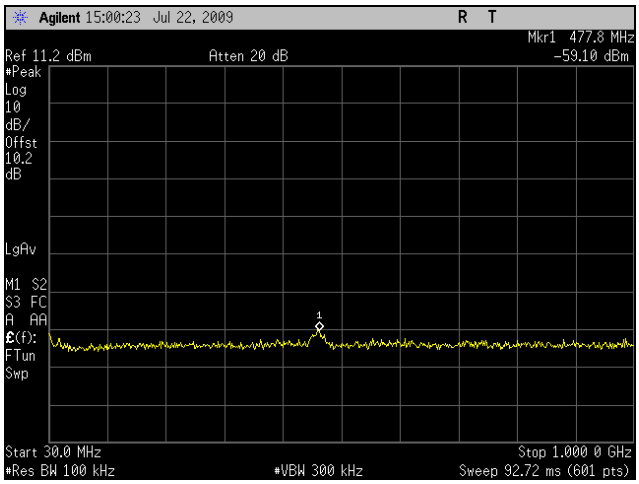



**Plot 127. Conducted Emissions, High Channel, 2.4 GHz, Port 3, 802.11n 20MHz 30 MHz – 1 GHz**

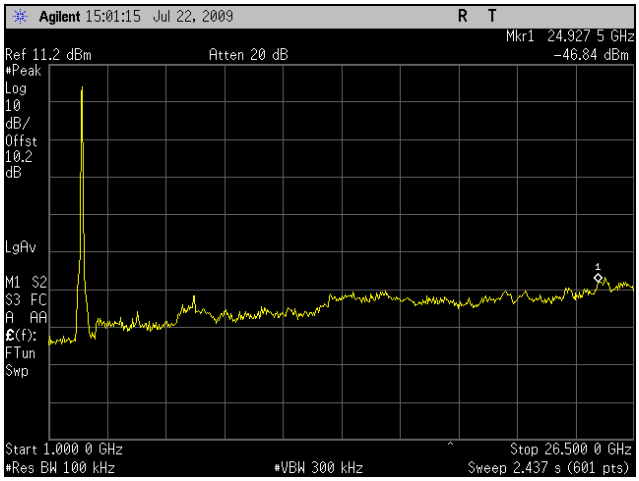



**Plot 128. Conducted Emissions, High Channel, 2.4 GHz, Port 3, 802.11n 20MHz, 1 GHz – 26.5 GHz**



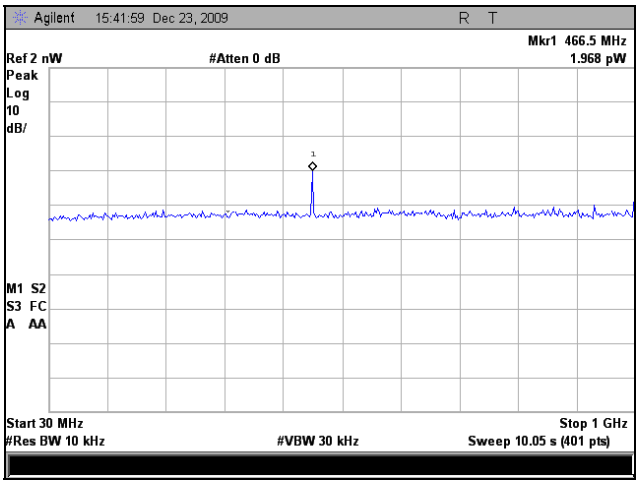

**Plot 129. Conducted Emissions, Mid Channel, 2.4 GHz, Port 3, 802.11n 40MHz, 30 MHz – 1 GHz**



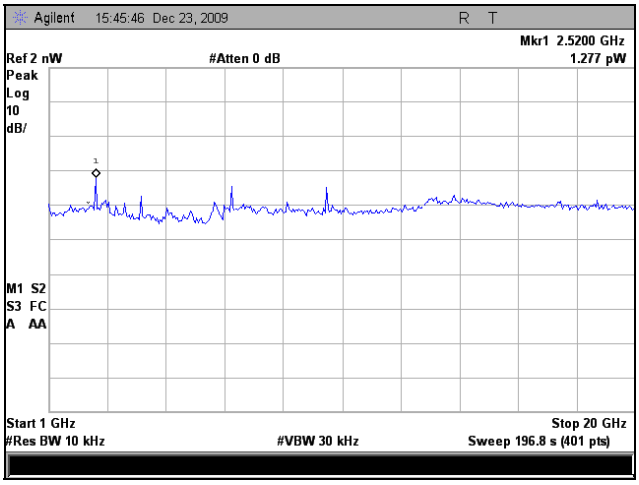

**Plot 130. Conducted Emissions, Mid Channel, 2.4 GHz, Port 3, 802.11n 40MHz, 1 GHz – 26.5 GHz**

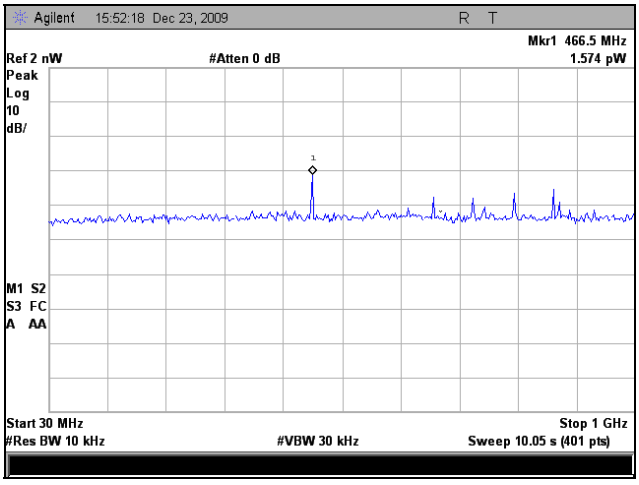
## Receiver Spurious Emissions




**Plot 131. Conducted Spurious Emissions, Port 1, 30 MHz – 1 GHz**

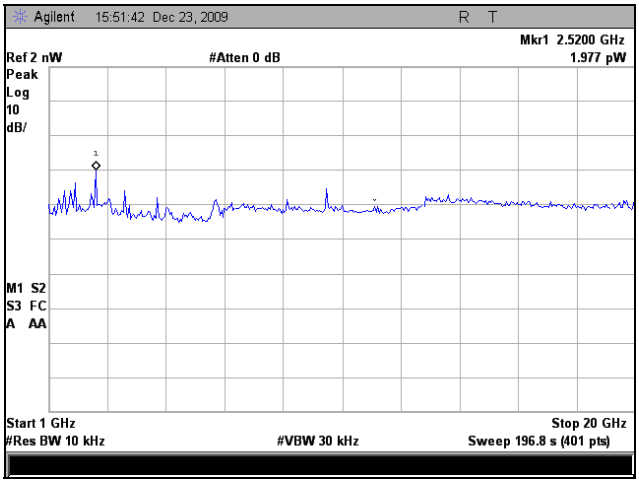



**Plot 132. Conducted Spurious Emissions, Port 1, 1 GHz – 20 GHz**

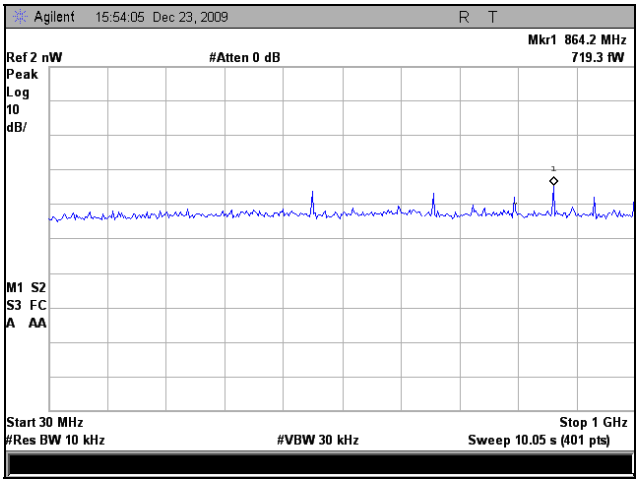



**Plot 133. Conducted Spurious Emissions, Port 2, 30 MHz – 1 GHz**

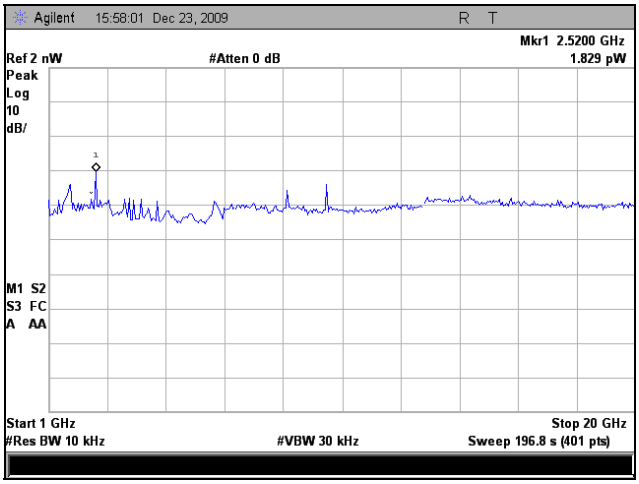
  




**Plot 134. Conducted Spurious Emissions, Port 2, 1 GHz – 20 GHz**



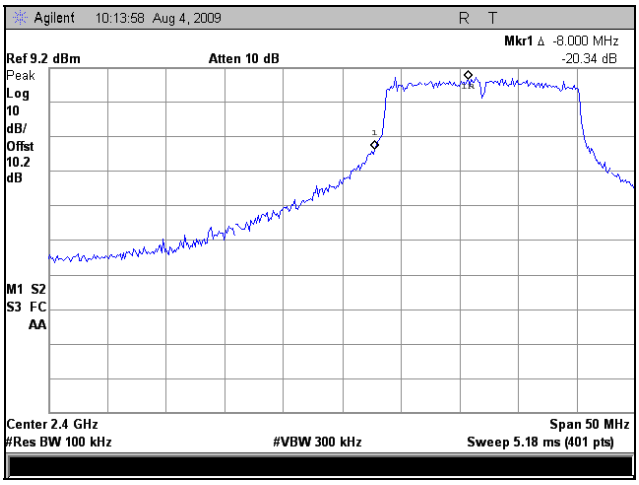

**Plot 135. Conducted Spurious Emissions, Port 3, 30 MHz – 1 GHz**



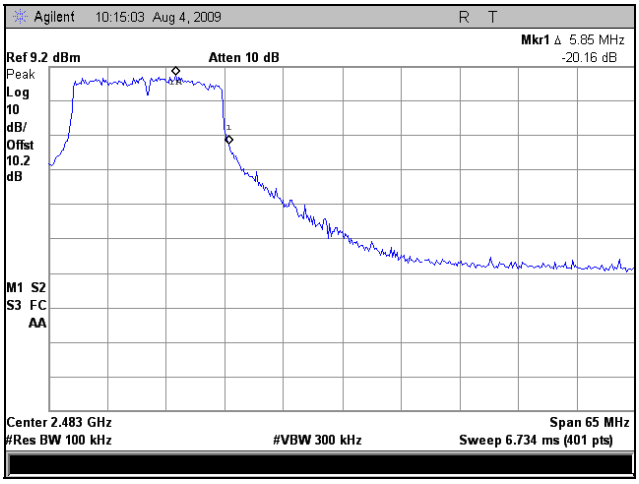

**Plot 136. Conducted Spurious Emissions, Port 3, 1 GHz – 20 GHz**

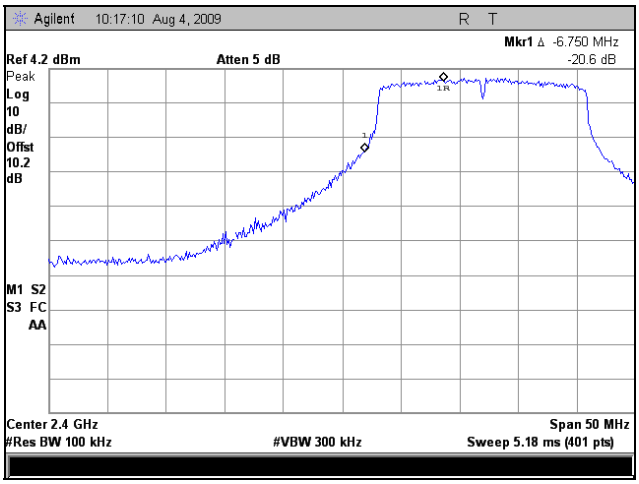
## Conducted Band Edge, 2.4 GHz, Port 1




**Plot 137. Lower Conducted Band Edge, 2.4 GHz, Port 1, 802.11g**

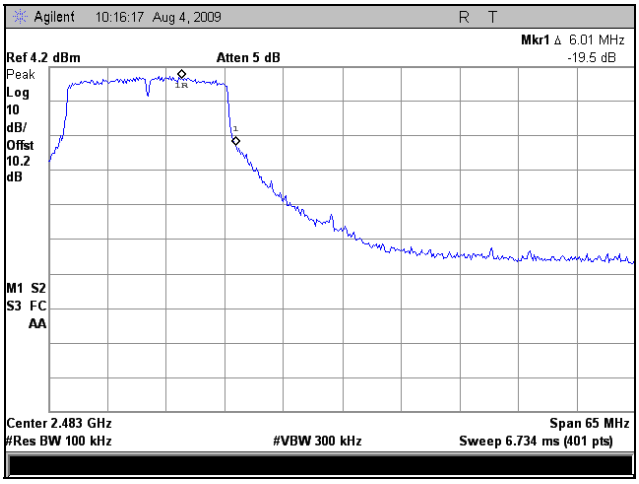



**Plot 138. Upper Conducted Band Edge, 2.4 GHz, Port 1, 802.11g**

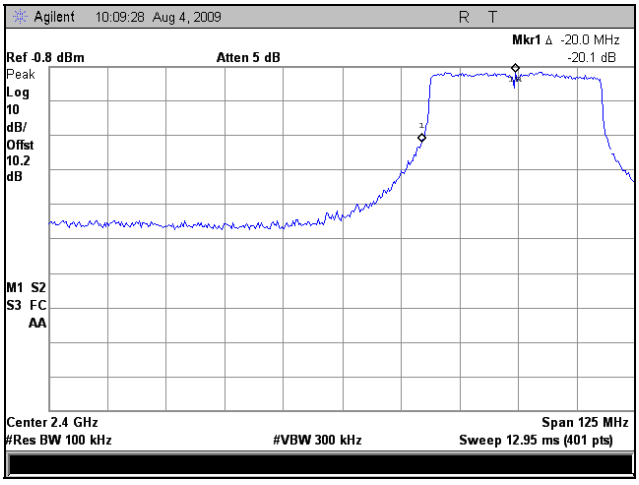



**Plot 139. Lower Conducted Band Edge, 2.4 GHz, Port 1, 802.11n 20MHz**

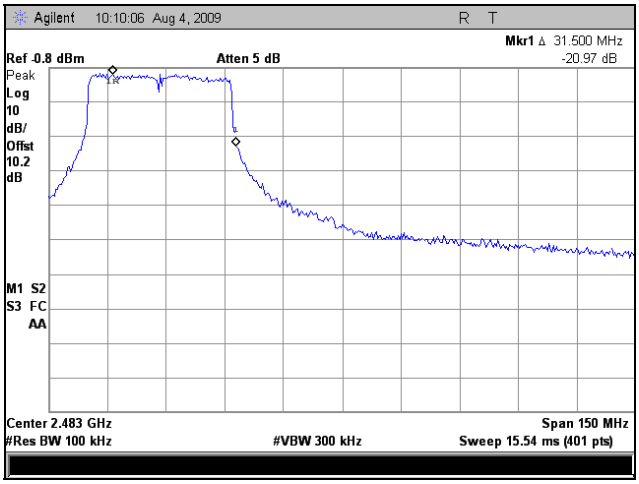
  




**Plot 140. Upper Conducted Band Edge, 2.4 GHz, Port 1, 802.11n 20MHz**



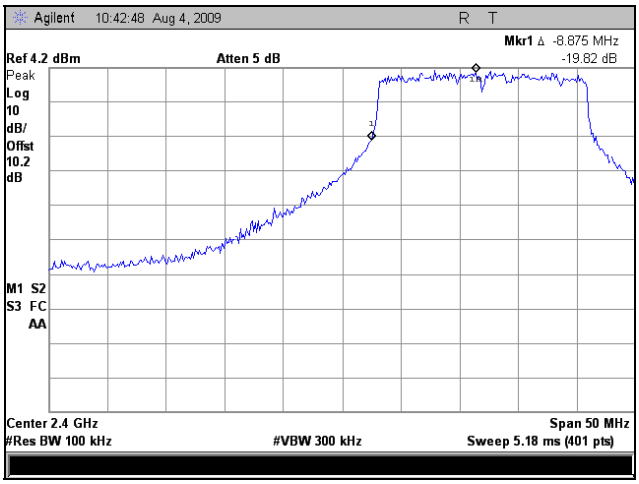

**Plot 141. Lower Conducted Band Edge, 2.4 GHz, Port 1, 802.11n 40MHz**



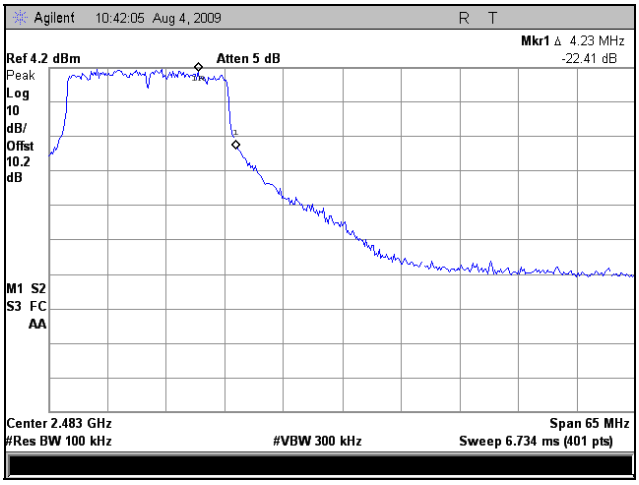

**Plot 142. Lower Conducted Band Edge, 2.4 GHz, Port 1, 802.11n 40MHz**

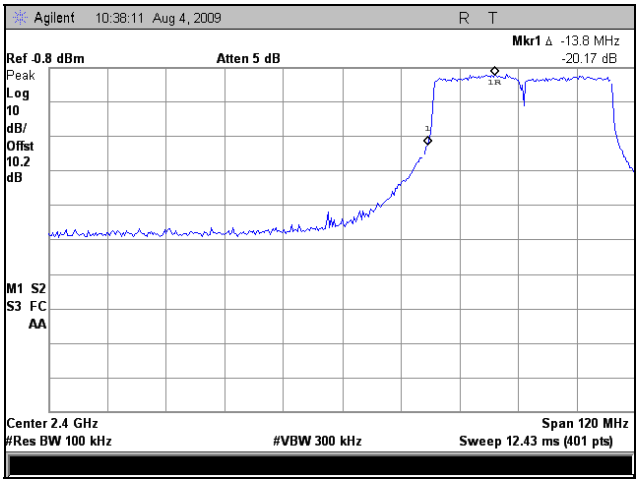
## Conducted Band Edge, 2.4 GHz, Port 2




**Plot 143. Lower Conducted Band Edge, 2.4 GHz, Port 2, 802.11n 20MHz**

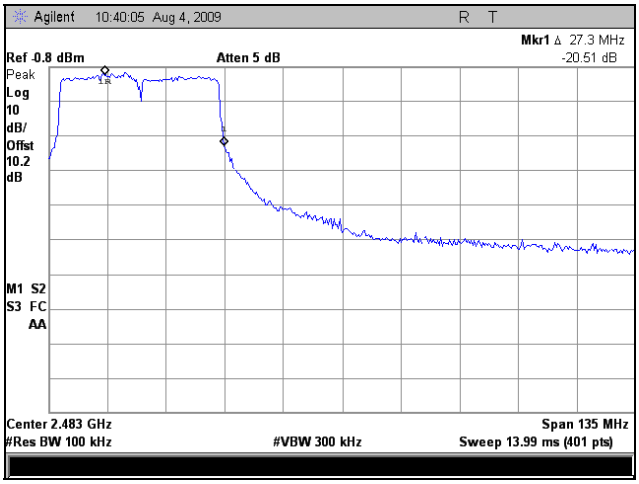



**Plot 144. Upper Conducted Band Edge, 2.4 GHz, Port 2, 802.11n 20MHz**



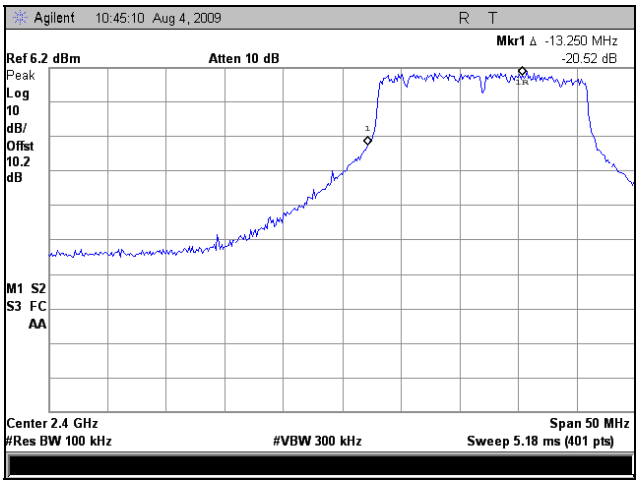

**Plot 145. Lower Conducted Band Edge, 2.4 GHz, Port 2, 802.11n 40MHz**

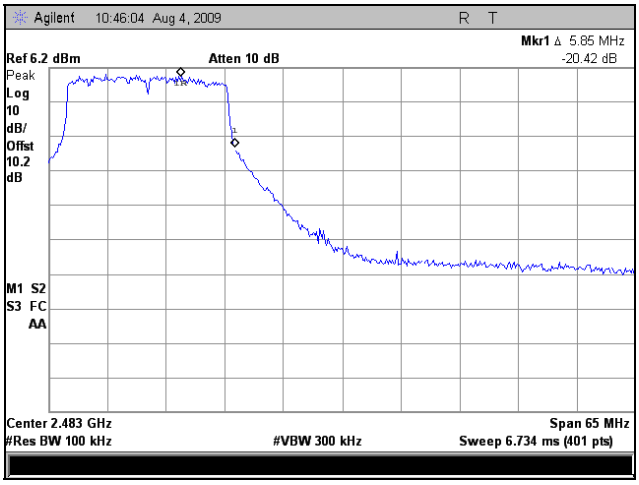



**Plot 146. Upper Conducted Band Edge, 2.4 GHz, Port 2, 802.11n 40MHz**

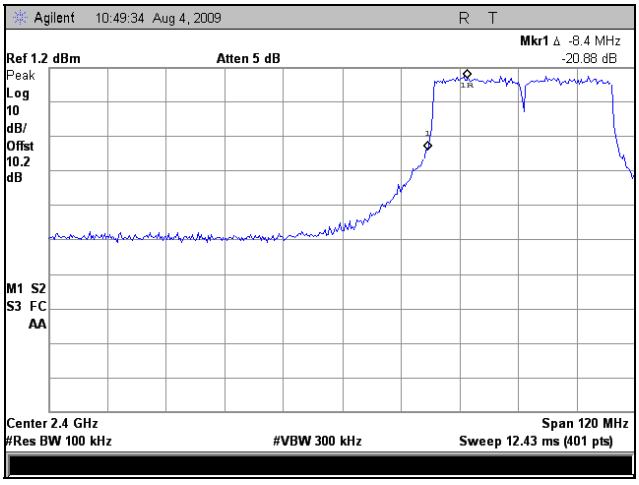
## Conducted Band Edge, 2.4 GHz, Port 3




**Plot 147. Lower Conducted Band Edge, 2.4 GHz, Port 3, 802.11n 20MHz**

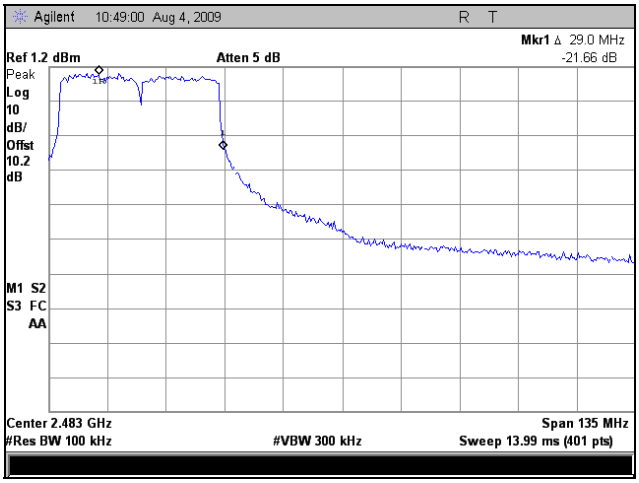



**Plot 148. Upper Conducted Band Edge, 2.4 GHz, Port 3, 802.11n 20MHz**




**Plot 149. Lower Conducted Band Edge, 2.4 GHz, Port 3, 802.11n 40MHz**

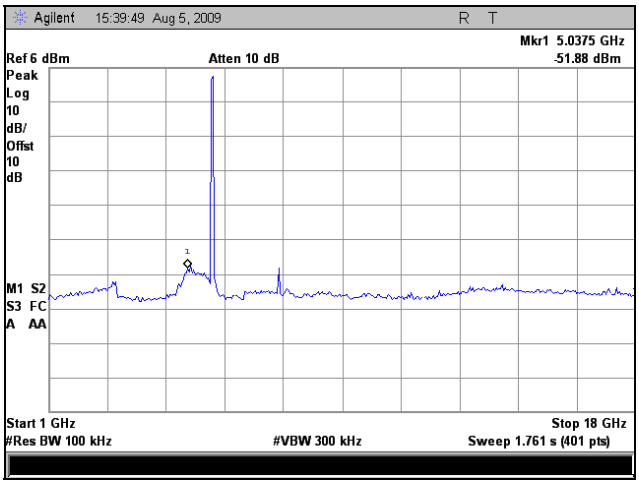
  



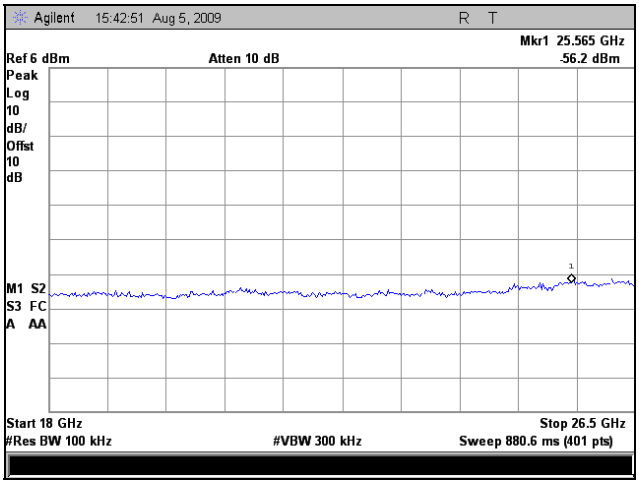

**Plot 150. Upper Conducted Band Edge, 2.4 GHz, Port 3, 802.11n 40MHz**

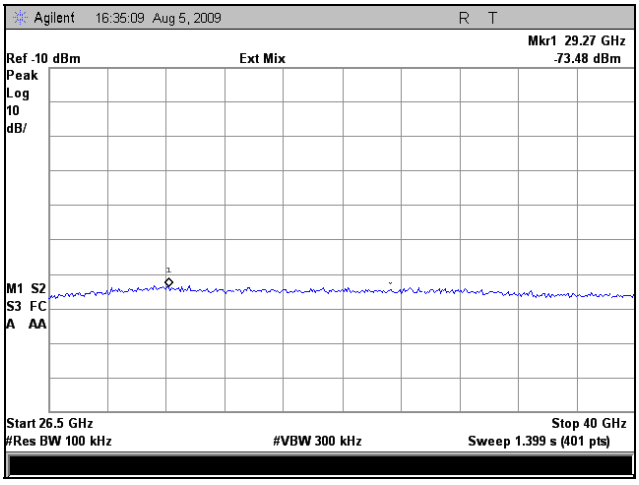
## RF Conducted Spurious Emissions Requirements, 5 GHz, Port 1




**Plot 151. Conducted Emissions, Low Channel, 5 GHz, Port 1, 802.11a, 1 GHz – 18 GHz**

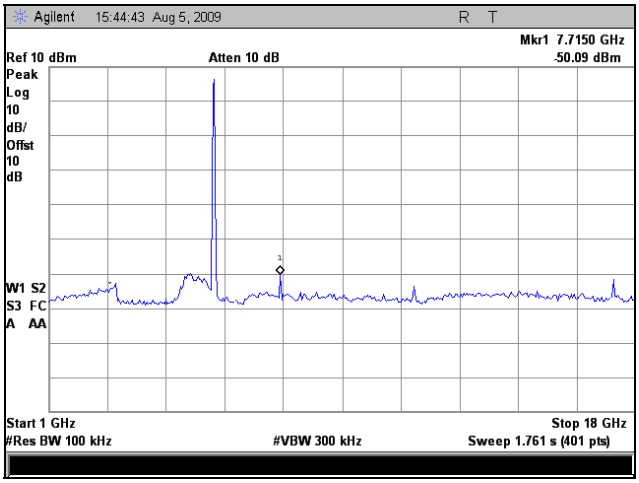



**Plot 152. Conducted Emissions, Low Channel, 5 GHz, Port 1, 802.11a, 18 GHz – 26.5 GHz**

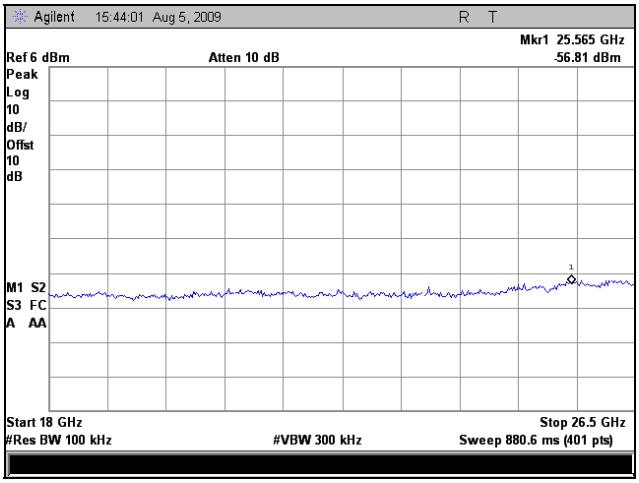



**Plot 153. Conducted Emissions, Low Channel, 5 GHz, Port 1, 802.11a, 26.5 GHz – 40 GHz**

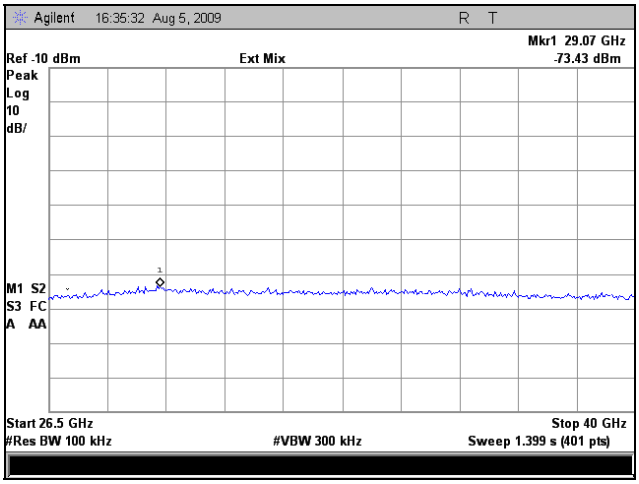
  




**Plot 154. Conducted Emissions, Mid Channel, 5 GHz, Port 1, 802.11a, 1 GHz – 18 GHz**

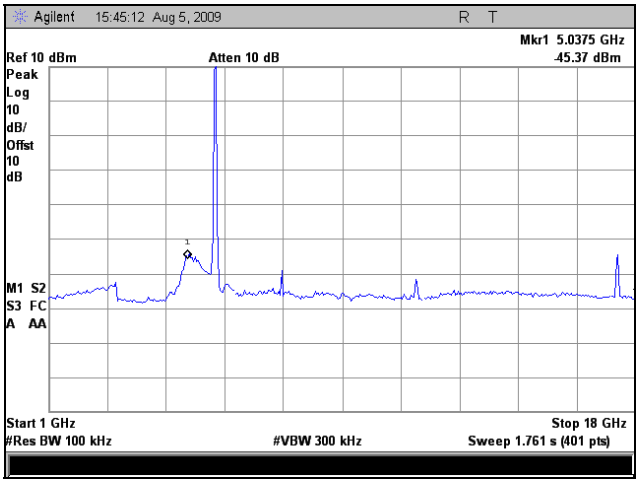



**Plot 155. Conducted Emissions, Mid Channel, 5 GHz, Port 1, 802.11a, 18 GHz – 26 GHz**

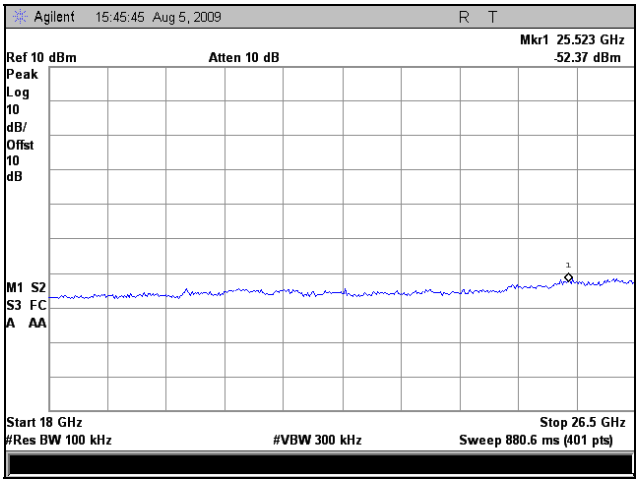



**Plot 156. Conducted Emissions, Mid Channel, 5 GHz, Port 1, 802.11a, 26 GHz – 40 GHz**

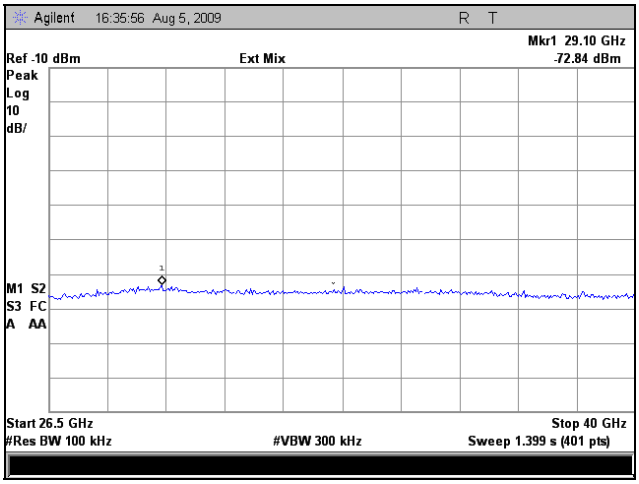
  




**Plot 157. Conducted Emissions, High Channel, 5 GHz, Port 1, 802.11a, 1 GHz – 18 GHz**

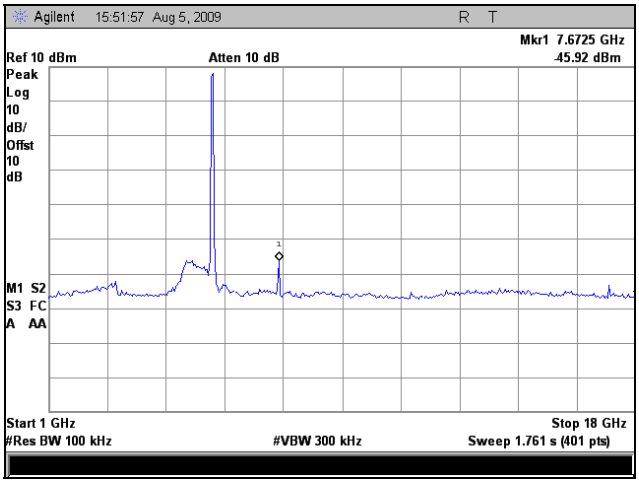



**Plot 158. Conducted Emissions, High Channel, 5 GHz, Port 1, 802.11a, 18 GHz – 26 GHz**

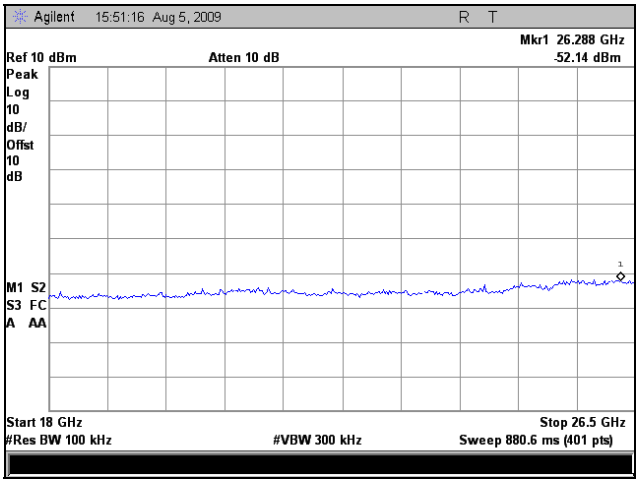



**Plot 159. Conducted Emissions, High Channel, 5 GHz, Port 1, 802.11a, 26 GHz – 40 GHz**

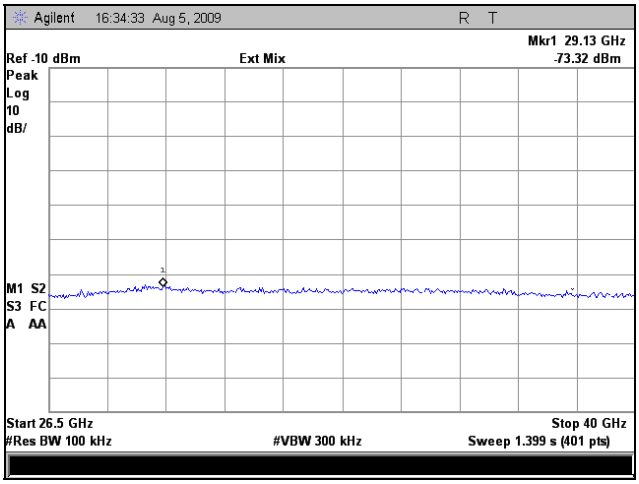
  




**Plot 160. Conducted Emissions, Low Channel, 5 GHz, Port 1, 802.11n 20MHz, 1 GHz – 18 GHz**

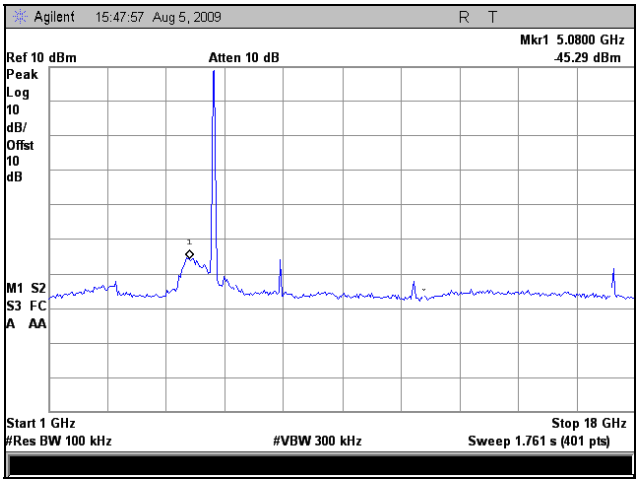



**Plot 161. Conducted Emissions, Low Channel, 5 GHz, Port 1, 802.11n 20MHz, 18 GHz – 26.5 GHz**

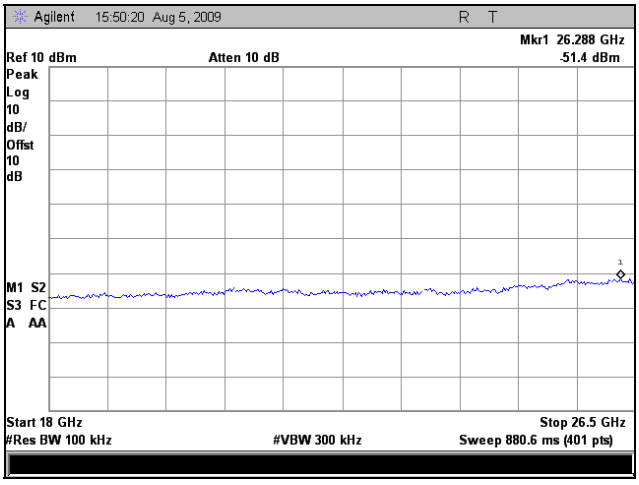



**Plot 162. Conducted Emissions, Low Channel, 5 GHz, Port 1, 802.11n 20MHz, 26.5 GHz – 40 GHz**

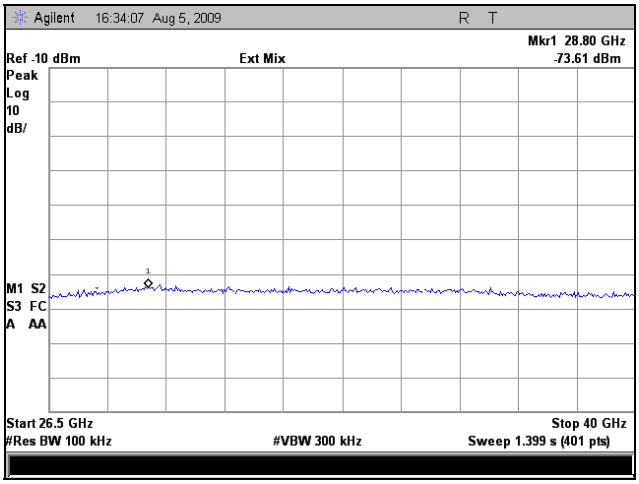
  




**Plot 163. Conducted Emissions, Mid Channel, 5 GHz, Port 1, 802.11n 20MHz, 1 GHz – 18 GHz**

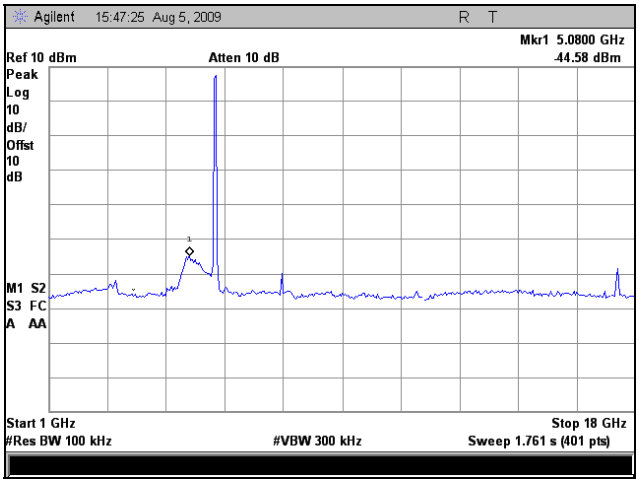



**Plot 164. Conducted Emissions, Mid Channel, 5 GHz, Port 1, 802.11n 20MHz, 18 GHz – 26.5 GHz**

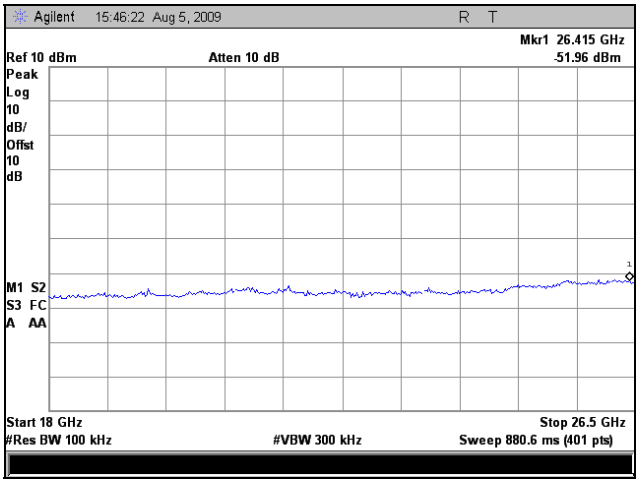



**Plot 165. Conducted Emissions, Mid Channel, 5 GHz, Port 1, 802.11n 20MHz, 26.5 GHz – 40 GHz**

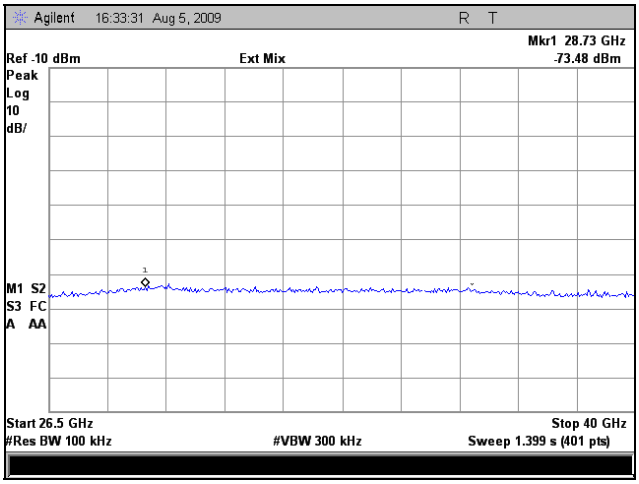
  




**Plot 166. Conducted Emissions, High Channel, 5 GHz, Port 1, 802.11n 20MHz, 1 GHz – 18 GHz**

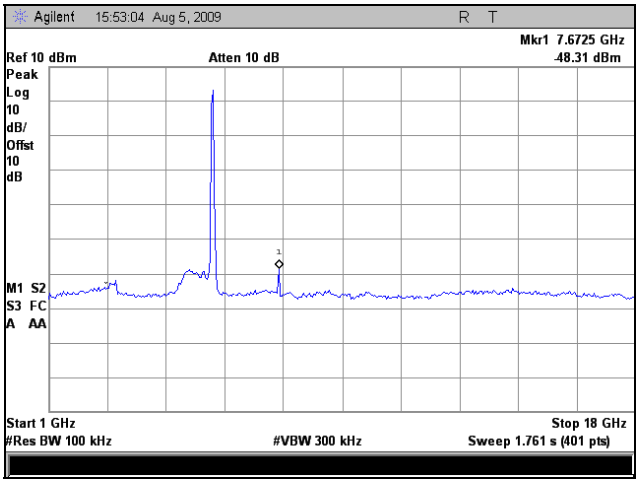



**Plot 167. Conducted Emissions, High Channel, 5 GHz, Port 1, 802.11n 20MHz, 18 GHz – 26.5 GHz**

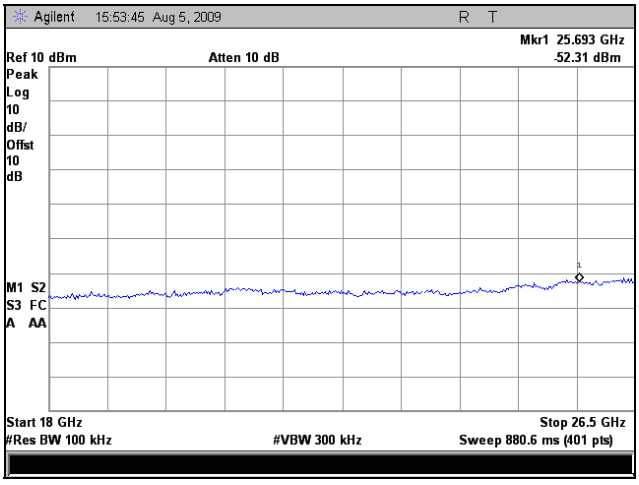



**Plot 168. Conducted Emissions, High Channel, 5 GHz, Port 1, 802.11n 20MHz, 26.5 GHz – 40 GHz**

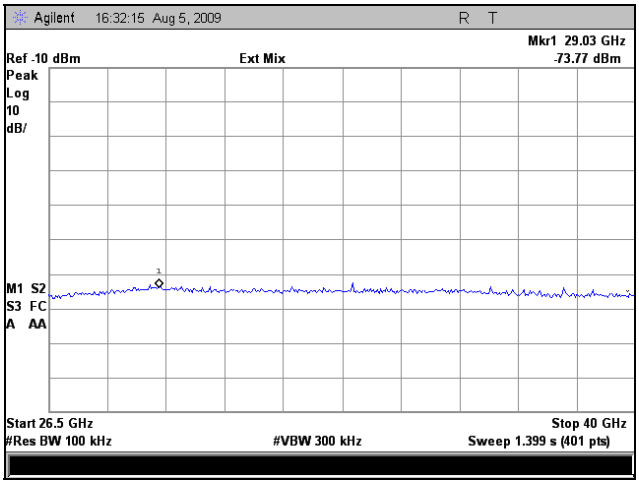
  




**Plot 169. Conducted Emissions, Low Channel, 5 GHz, Port 1, 802.11n 40MHz, 1 GHz – 18 GHz**

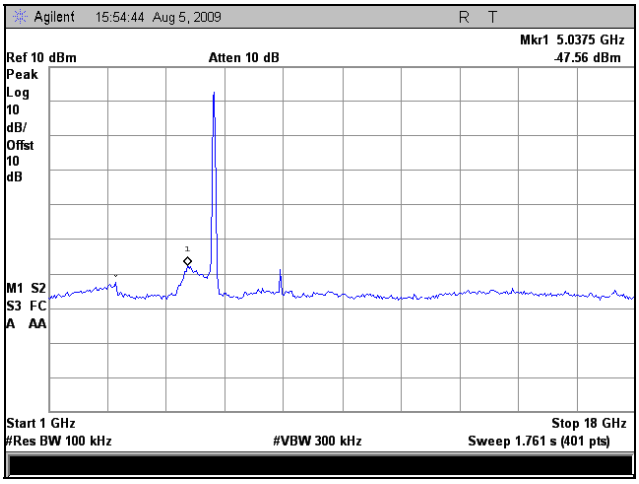



**Plot 170. Conducted Emissions, Low Channel, 5 GHz, Port 1, 802.11n 40MHz, 18 GHz – 26.5 GHz**

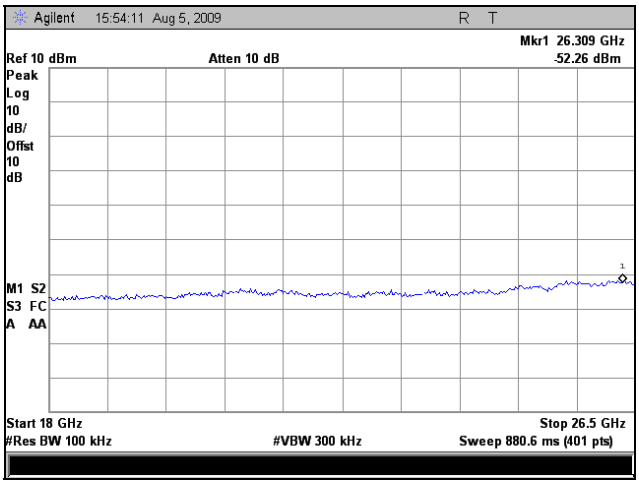



**Plot 171. Conducted Emissions, Low Channel, 5 GHz, Port 1, 802.11n 40MHz, 26.5 GHz – 40 GHz**

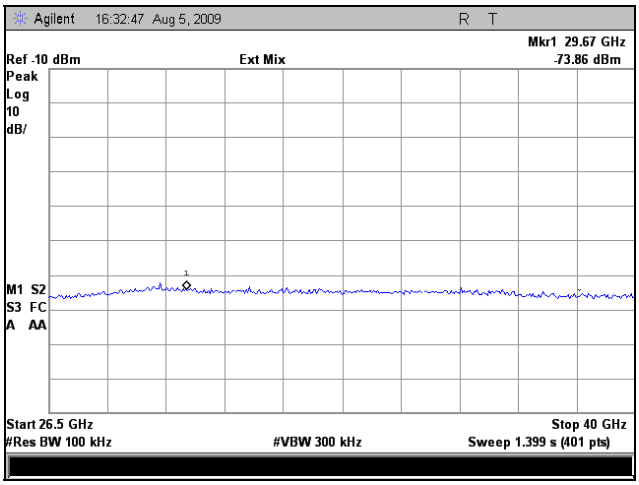
  




**Plot 172. Conducted Emissions, High Channel, 5 GHz, Port 1, 802.11n 40MHz, 1 GHz – 18 GHz**



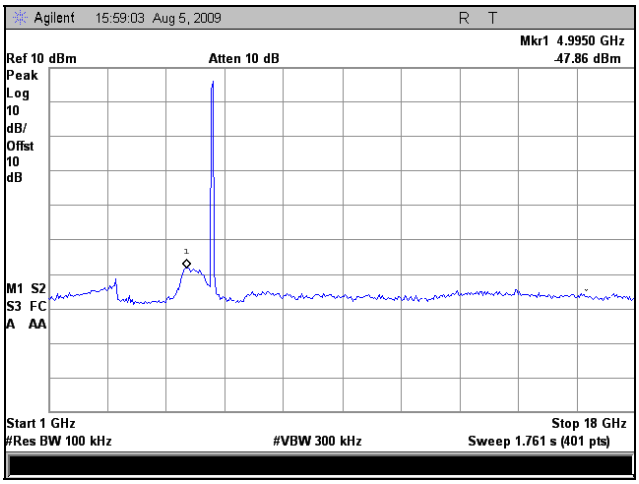

**Plot 173. Conducted Emissions, High Channel, 5 GHz, Port 1, 802.11n 40MHz, 18 GHz – 26.5 GHz**



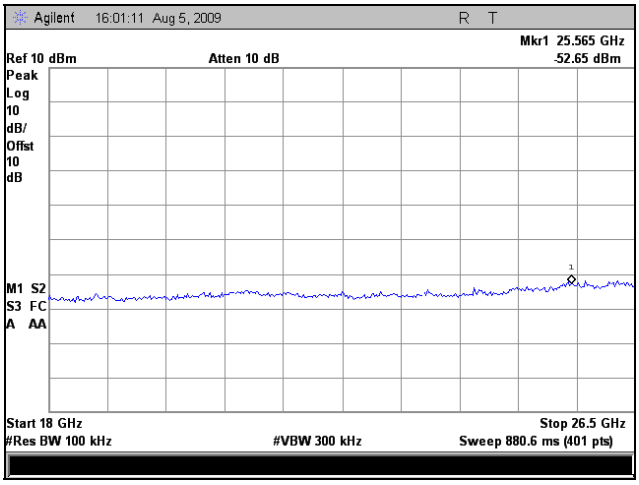

**Plot 174. Conducted Emissions, High Channel, 5 GHz, Port 1, 802.11n 40MHz, 26.5 GHz – 40 GHz**

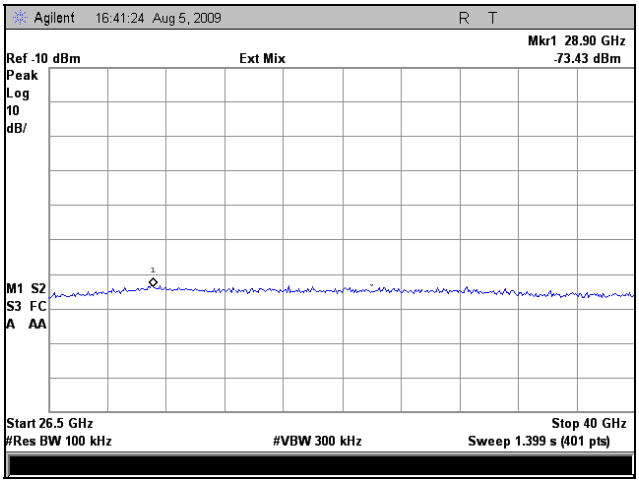
## RF Conducted Spurious Emissions Requirements, 5 GHz, Port 2




**Plot 175. Conducted Emissions, Low Channel, 5 GHz, Port 2, 802.11n 20MHz, 1 GHz – 18 GHz**

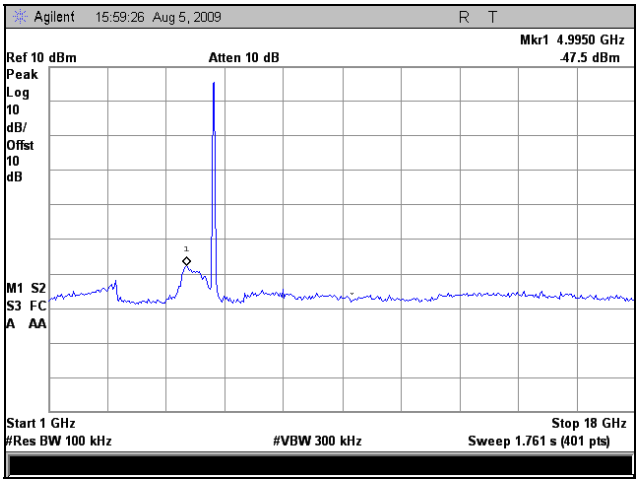



**Plot 176. Conducted Emissions, Low Channel, 5 GHz, Port 2, 802.11n 20MHz, 18 GHz – 26.5 GHz**

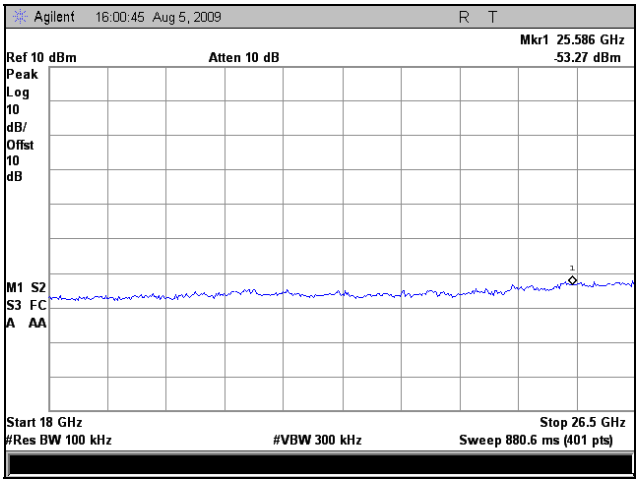



**Plot 177. Conducted Emissions, Low Channel, 5 GHz, Port 2, 802.11n 20MHz, 26.5 GHz – 40 GHz**

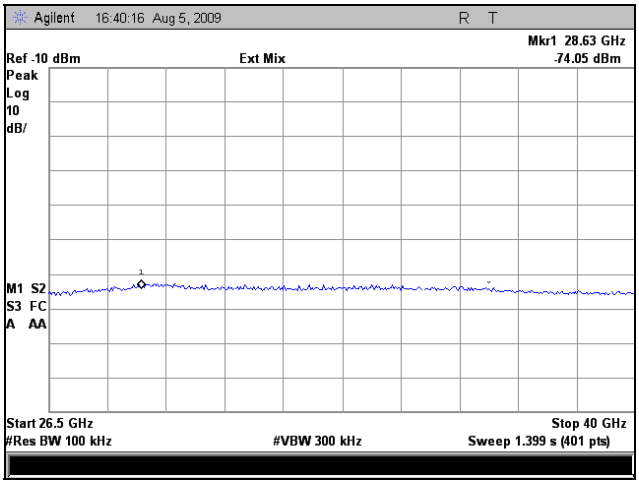
  




**Plot 178. Conducted Emissions, Mid Channel, 5 GHz, Port 2, 802.11n 20MHz, 1 GHz – 18 GHz**

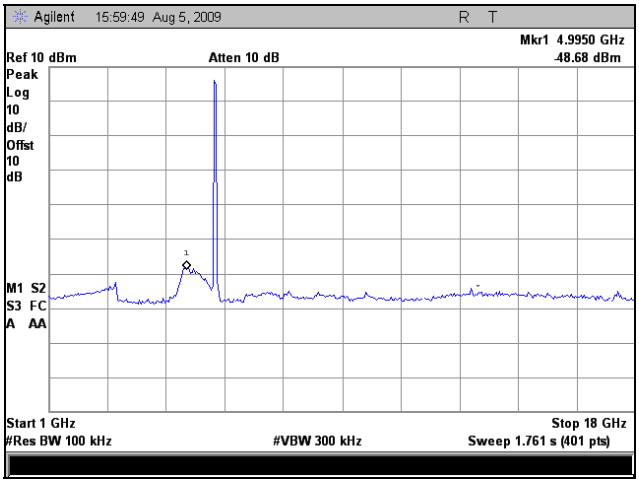



**Plot 179. Conducted Emissions, Mid Channel, 5 GHz, Port 2, 802.11n 20MHz, 18 GHz – 26.5 GHz**

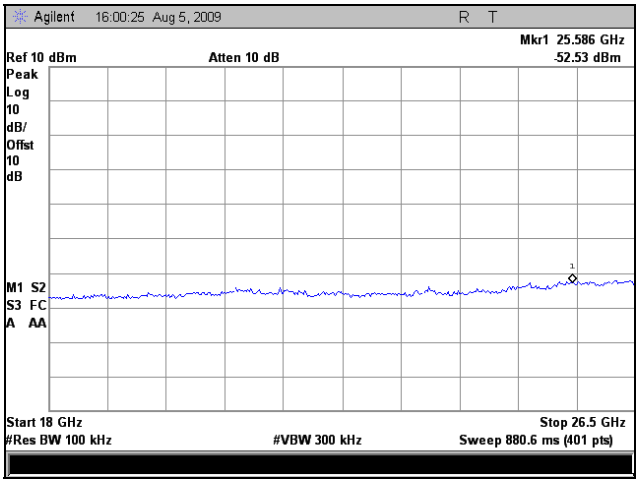



**Plot 180. Conducted Emissions, Mid Channel, 5 GHz, Port 2, 802.11n 20MHz, 26.5 GHz – 40 GHz**

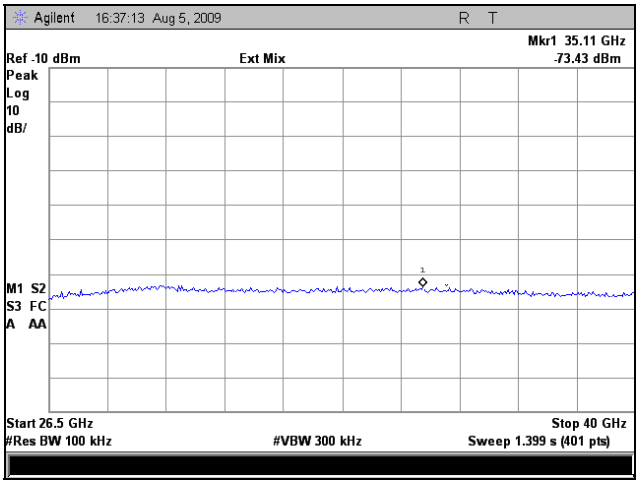
  




**Plot 181. Conducted Emissions, High Channel, 5 GHz, Port 2, 802.11n 20MHz, 1 GHz – 18 GHz**

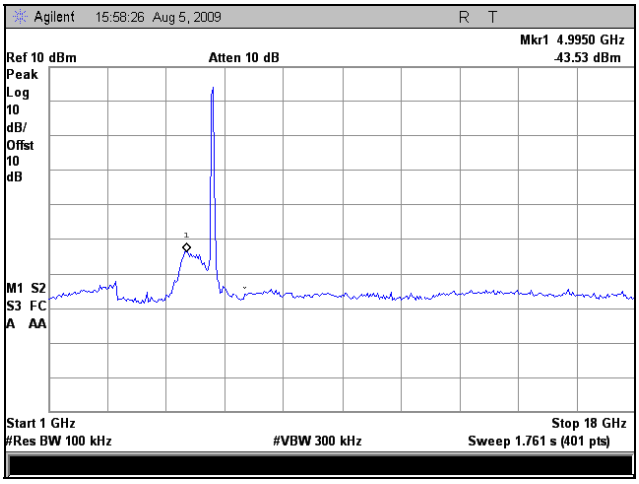



**Plot 182. Conducted Emissions, High Channel, 5 GHz, Port 2, 802.11n 20MHz, 18 GHz – 26.5 GHz**

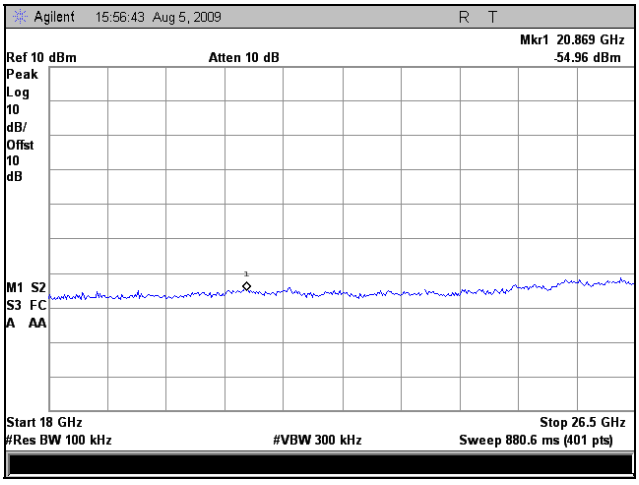



**Plot 183. Conducted Emissions, High Channel, 5 GHz, Port 2, 802.11n 20MHz, 26.5 GHz – 40 GHz**

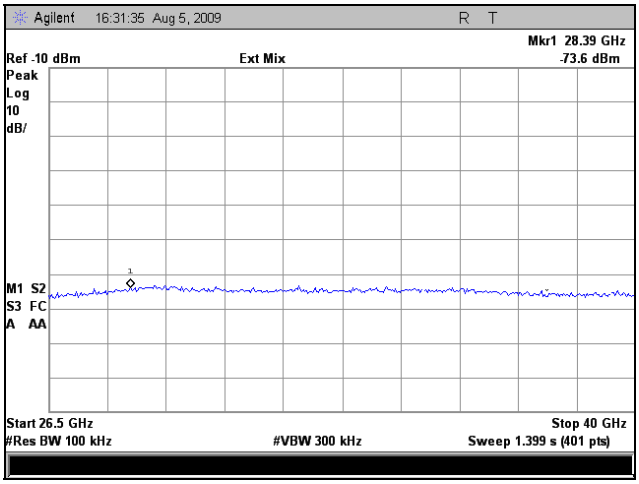
  




**Plot 184. Conducted Emissions, Low Channel, 5 GHz, Port 2, 802.11n 40MHz, 1 GHz – 18 GHz**

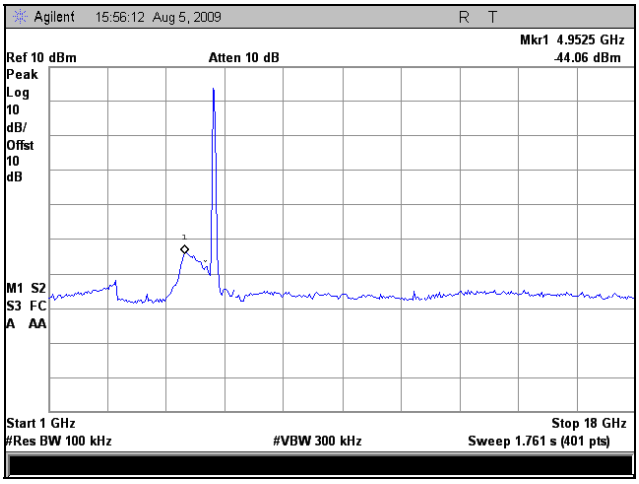



**Plot 185. Conducted Emissions, Low Channel, 5 GHz, Port 2, 802.11n 40MHz, 18 GHz – 26.5 GHz**

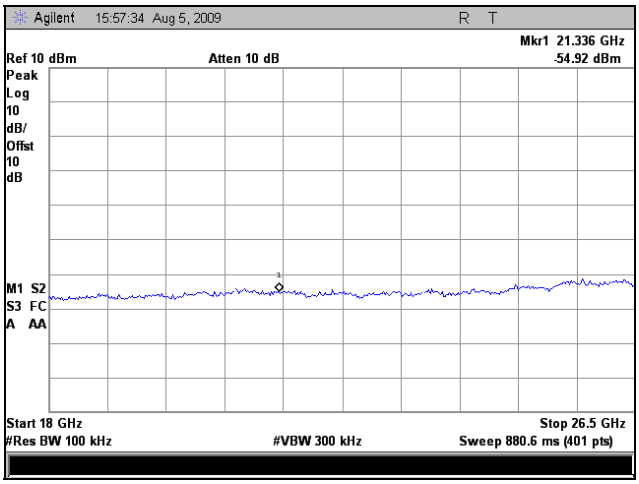



**Plot 186. Conducted Emissions, Low Channel, 5 GHz, Port 2, 802.11n 40MHz, 26.5 GHz – 40 GHz**

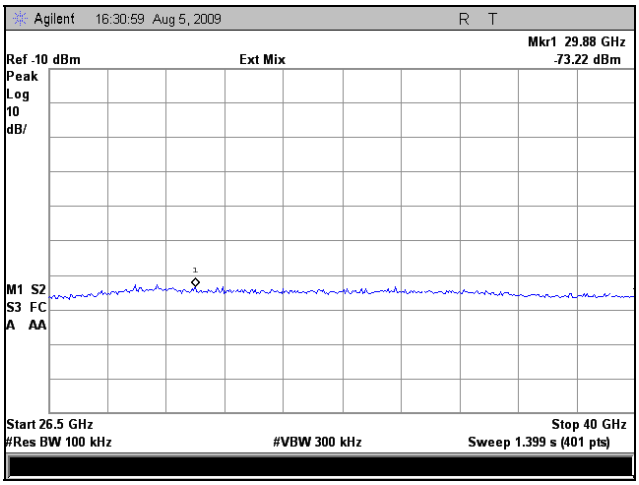
  




**Plot 187. Conducted Emissions, High Channel, 5 GHz, Port 2, 802.11n 40MHz, 1 GHz – 18 GHz**



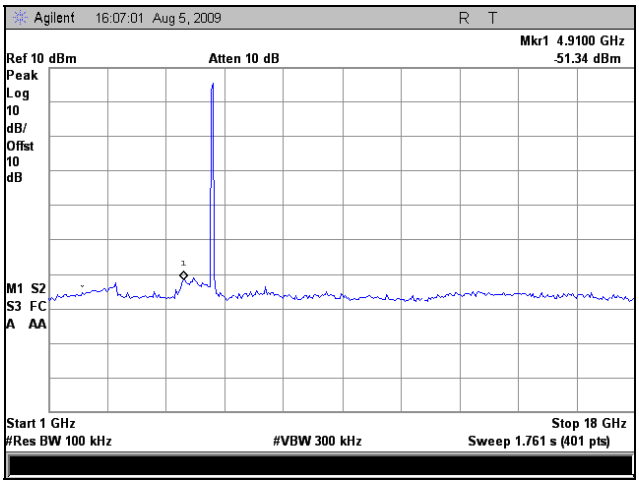

**Plot 188. Conducted Emissions, High Channel, 5 GHz, Port 2, 802.11n 40MHz, 18 GHz – 26.5 GHz**



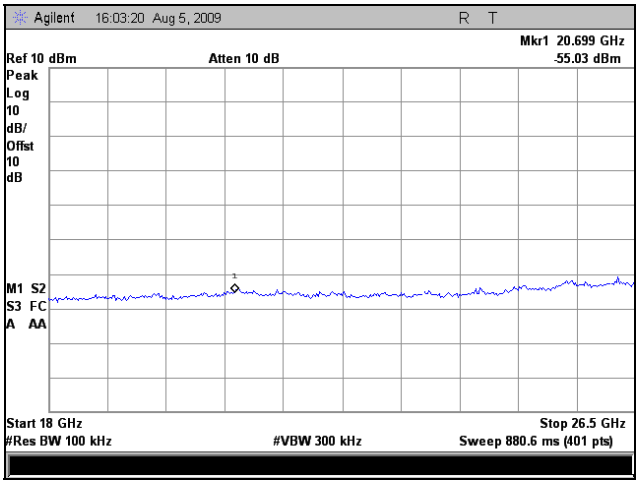

**Plot 189. Conducted Emissions, High Channel, 5 GHz, Port 2, 802.11n 40MHz, 26.5 GHz – 40 GHz**

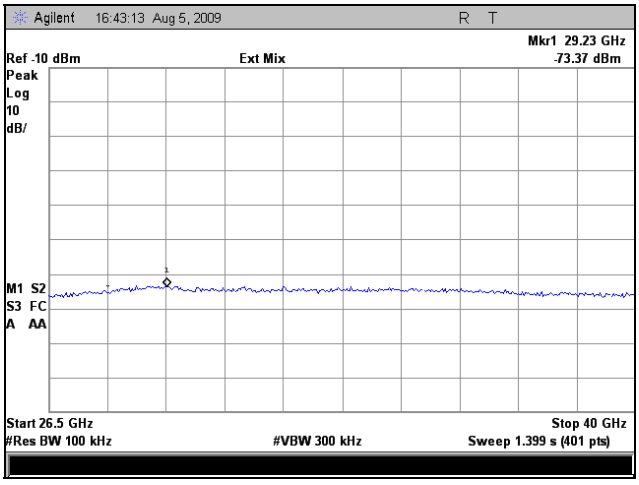
## RF Conducted Spurious Emissions Requirements, 5 GHz, Port 3




**Plot 190. Conducted Emissions, Low Channel, 5 GHz, Port 3, 802.11n 20MHz, 1 GHz – 18 GHz**

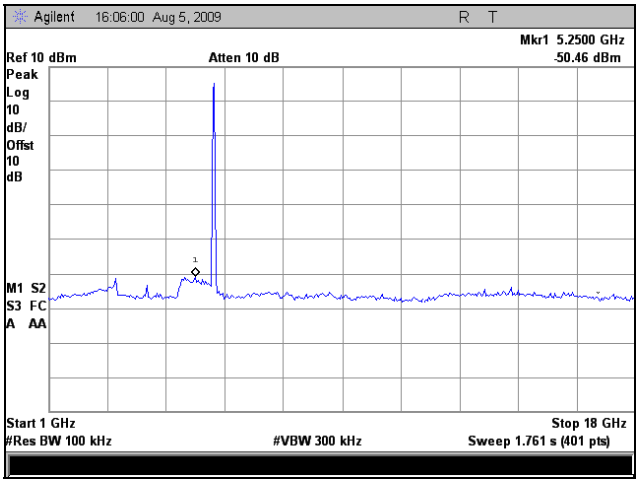



**Plot 191. Conducted Emissions, Low Channel, 5 GHz, Port 3, 802.11n 20MHz, 18 GHz – 26.5 GHz**

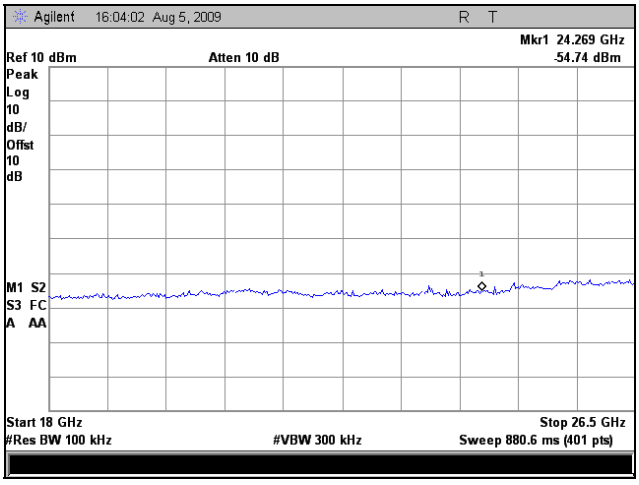



**Plot 192. Conducted Emissions, Low Channel, 5 GHz, Port 3, 802.11n 20MHz, 26.5 GHz – 40 GHz**

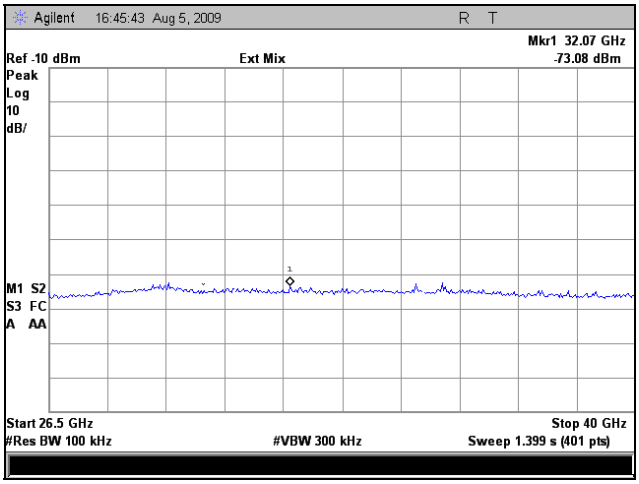
  




**Plot 193. Conducted Emissions, Mid Channel, 5 GHz, Port 3, 802.11n 20MHz, 1 GHz – 18 GHz**

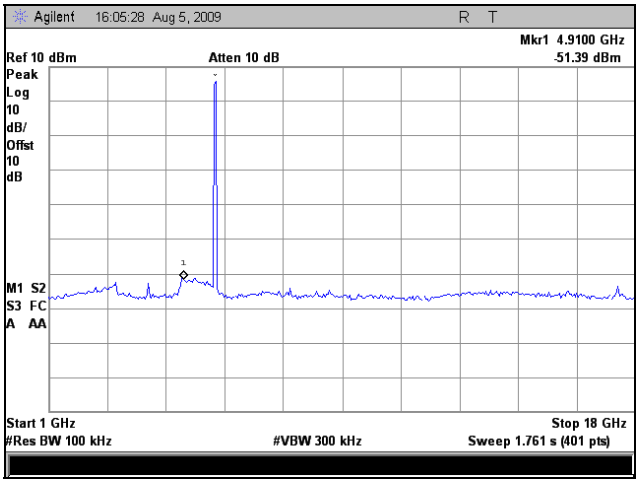



**Plot 194. Conducted Emissions, Mid Channel, 5 GHz, Port 3, 802.11n 20MHz, 18 GHz – 26.5 GHz**

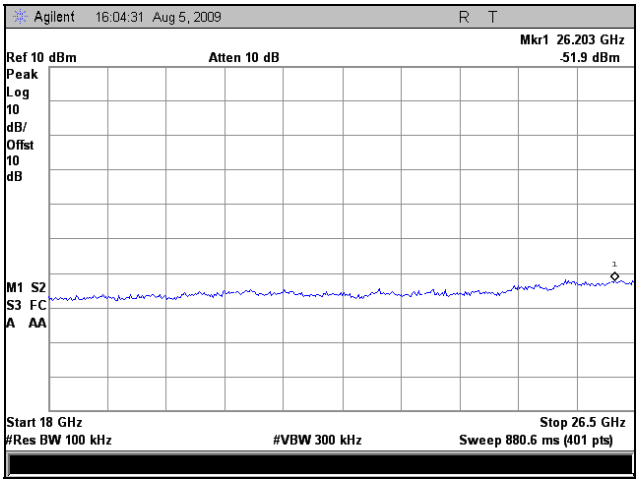



**Plot 195. Conducted Emissions, Mid Channel, 5 GHz, Port 3, 802.11n 20MHz, 26.5 GHz – 40 GHz**

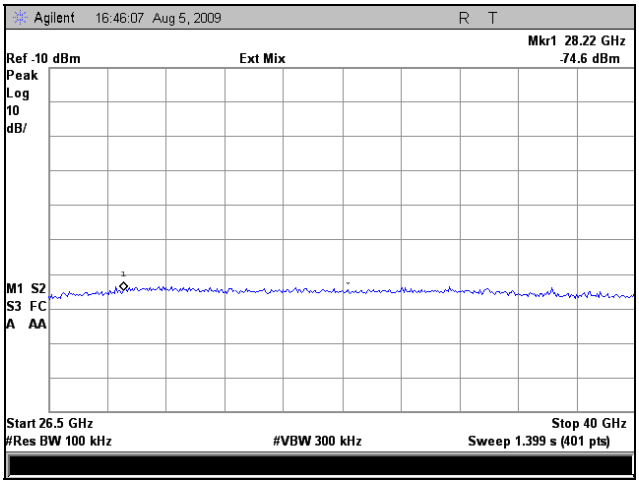
  




**Plot 196. Conducted Emissions, High Channel, 5 GHz, Port 3, 802.11n 20MHz, 1 GHz – 18 GHz**

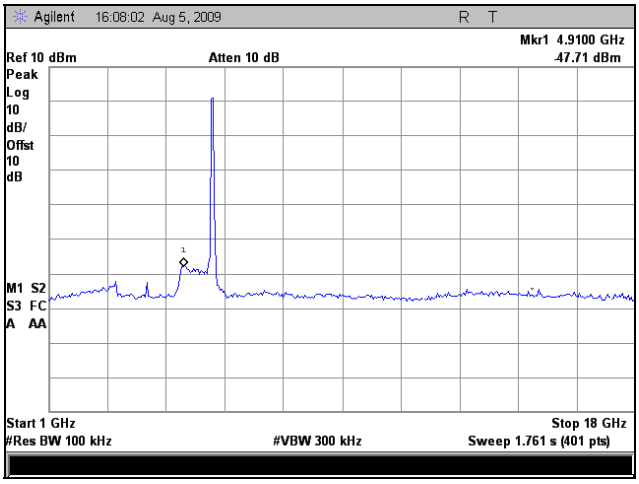



**Plot 197. Conducted Emissions, High Channel, 5 GHz, Port 3, 802.11n 20MHz, 18 GHz – 26.5 GHz**

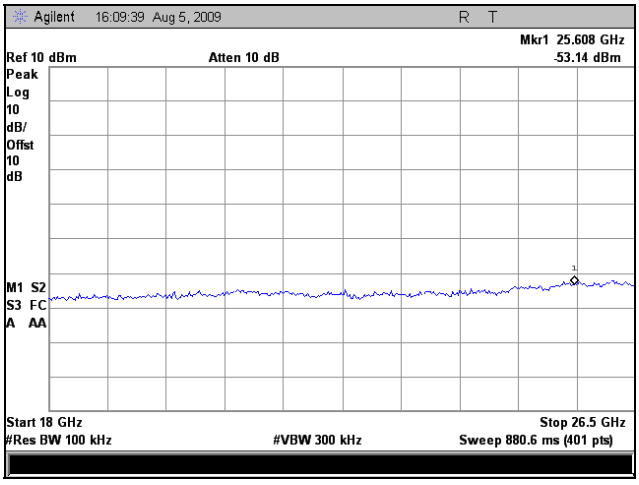



**Plot 198. Conducted Emissions, High Channel, 5 GHz, Port 3, 802.11n 20MHz, 26.5 GHz – 40 GHz**

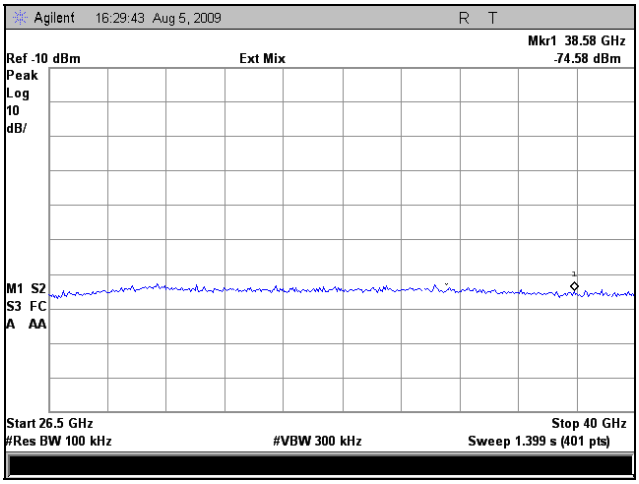
  




**Plot 199. Conducted Emissions, Low Channel, 5 GHz, Port 3, 802.11n 40MHz, 1 GHz – 18 GHz**

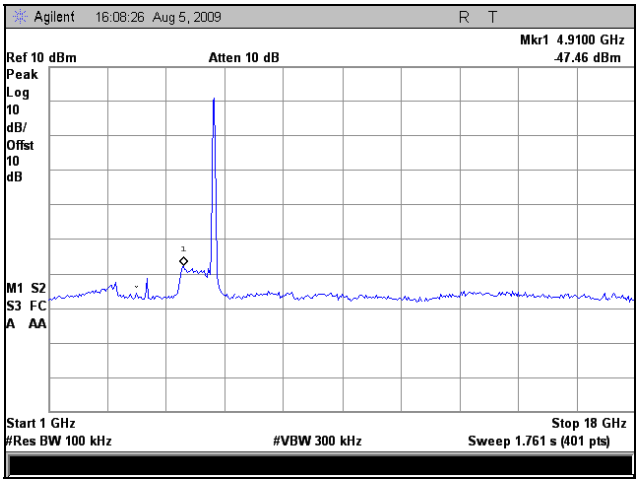



**Plot 200. Conducted Emissions, Low Channel, 5 GHz, Port 3, 802.11n 40MHz, 18 GHz – 26.5 GHz**

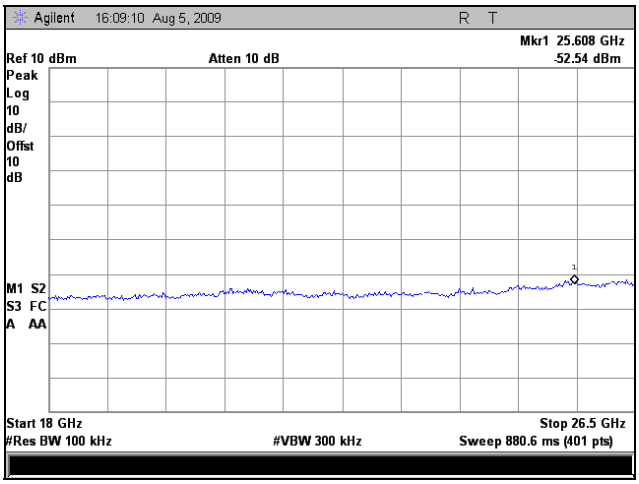



**Plot 201. Conducted Emissions, Low Channel, 5 GHz, Port 3, 802.11n 40MHz, 26.5 GHz – 40 GHz**

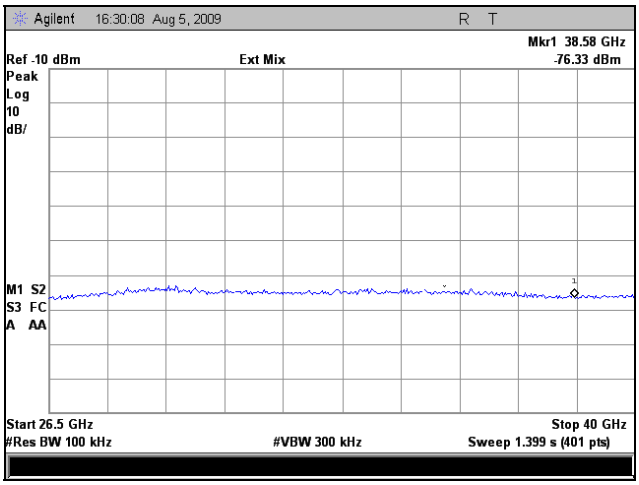
  




**Plot 202. Conducted Emissions, High Channel, 5 GHz, Port 3, 802.11n 40MHz, 1 GHz – 18 GHz**



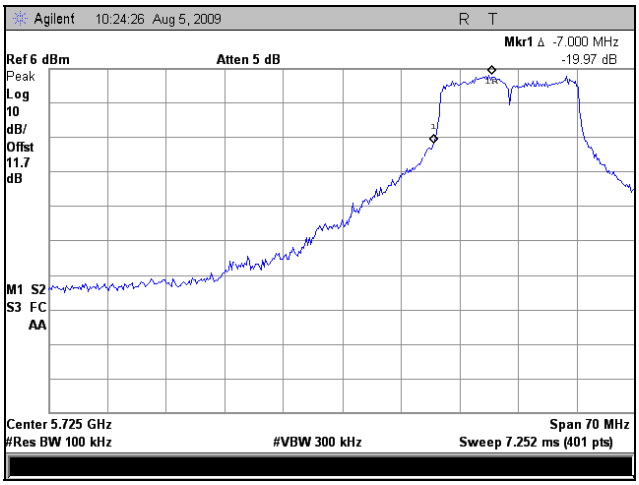

**Plot 203. Conducted Emissions, High Channel, 5 GHz, Port 3, 802.11n 40MHz, 18 GHz – 26.5 GHz**



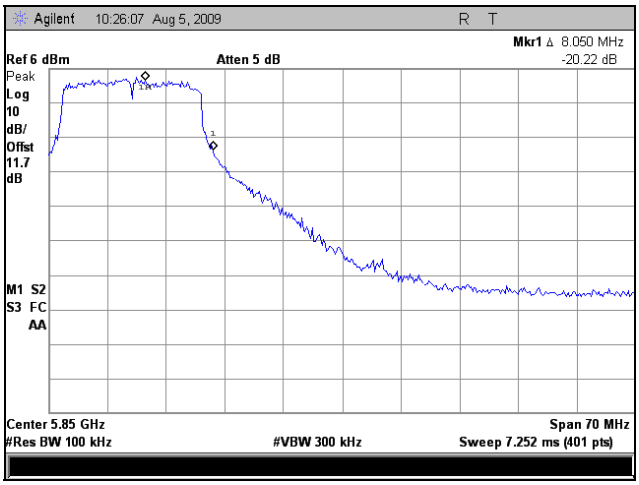

**Plot 204. Conducted Emissions, High Channel, 5 GHz, Port 3, 802.11n 40MHz, 26.5 GHz – 40 GHz**

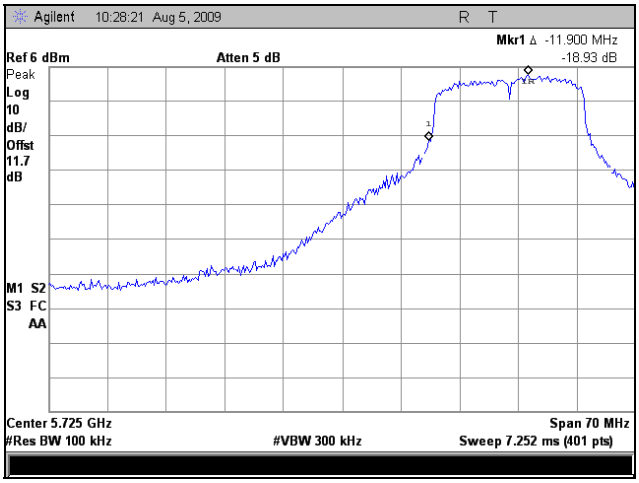
## Conducted Band Edge, 5 GHz, Port 1




**Plot 205. Lower Conducted Band Edge, 5 GHz, Port 1, 802.11a**

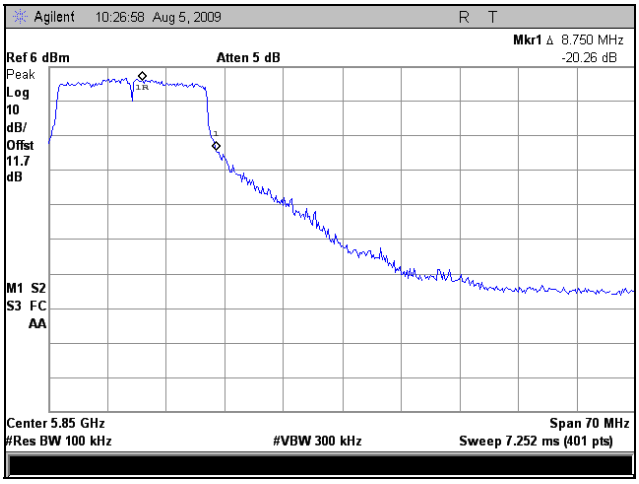



**Plot 206. Upper Conducted Band Edge, 5 GHz, Port 1, 802.11a**

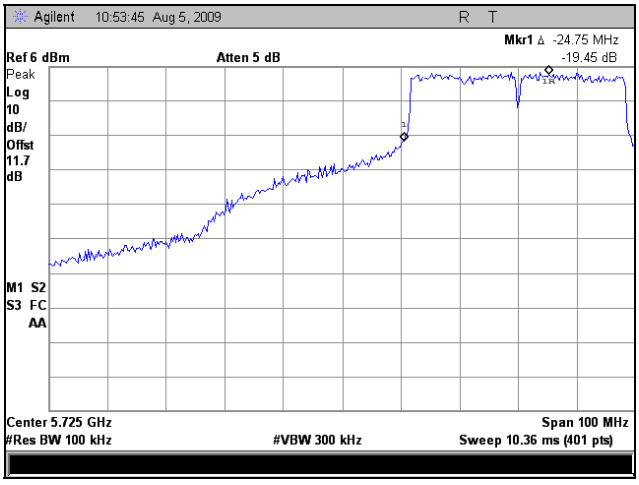



**Plot 207. Lower Conducted Band Edge, 5 GHz, Port 1, 802.11n 20MHz**

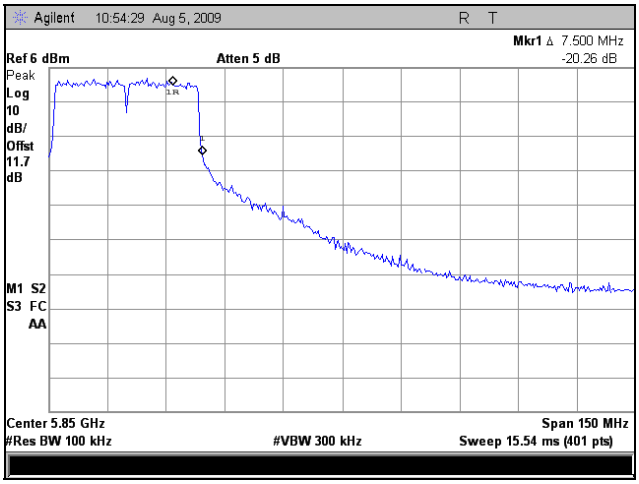
  




**Plot 208. Upper Conducted Band Edge, 5 GHz, Port 1, 802.11n 20MHz**



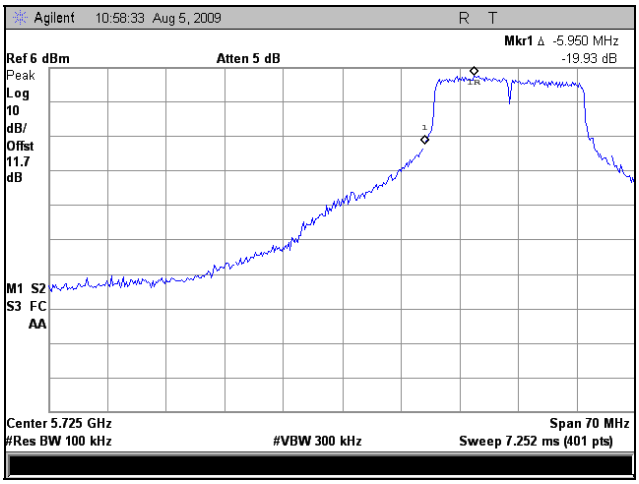

**Plot 209. Lower Conducted Band Edge, 5 GHz, Port 1, 802.11n 40MHz**



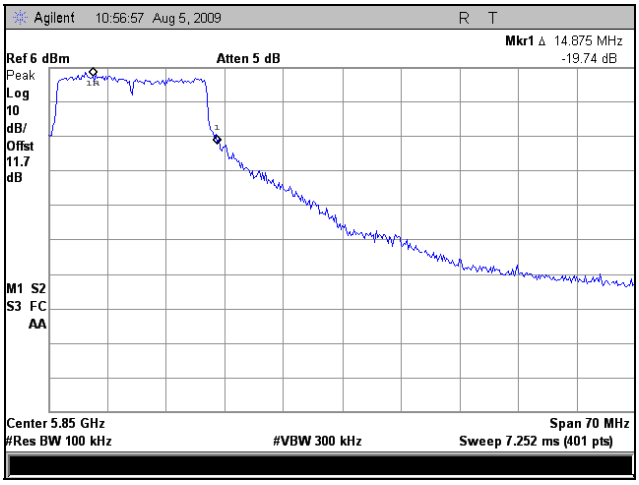

**Plot 210. Lower Conducted Band Edge, 5 GHz, Port 1, 802.11n 40MHz**

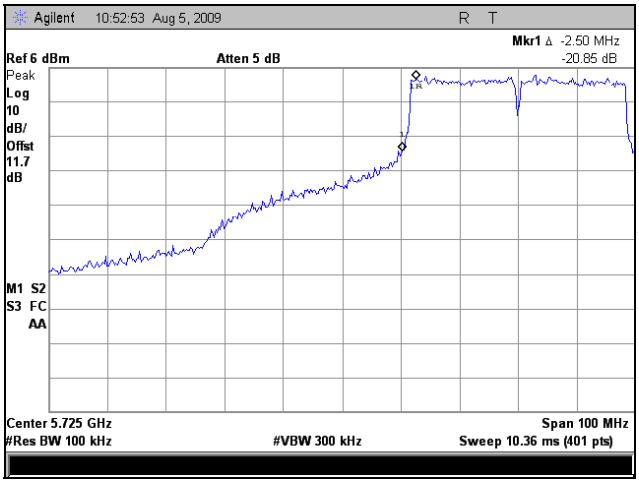
## Conducted Band Edge, 5 GHz, Port 2




**Plot 211. Lower Conducted Band Edge, 5 GHz, Port 2, 802.11n 20MHz**

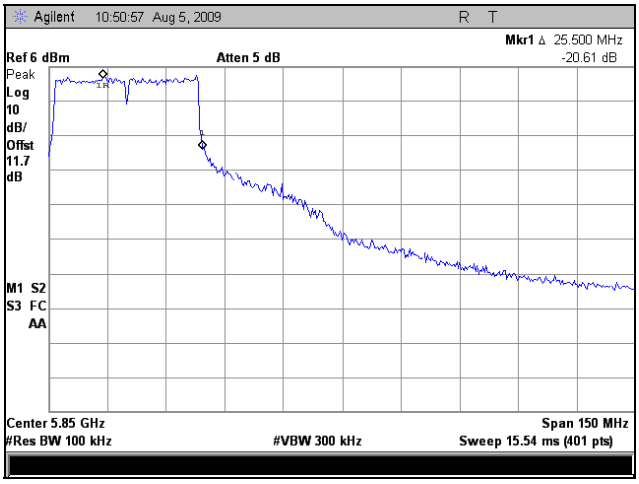



**Plot 212. Upper Conducted Band Edge, 5 GHz, Port 2, 802.11n 20MHz**




**Plot 213. Lower Conducted Band Edge, 5 GHz, Port 2, 802.11n 40MHz**

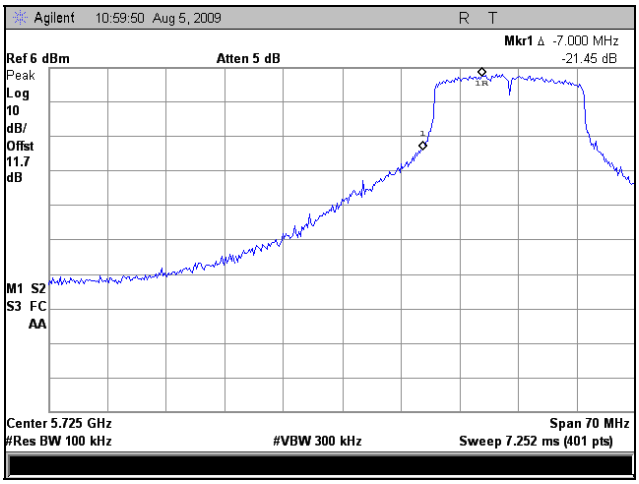
  



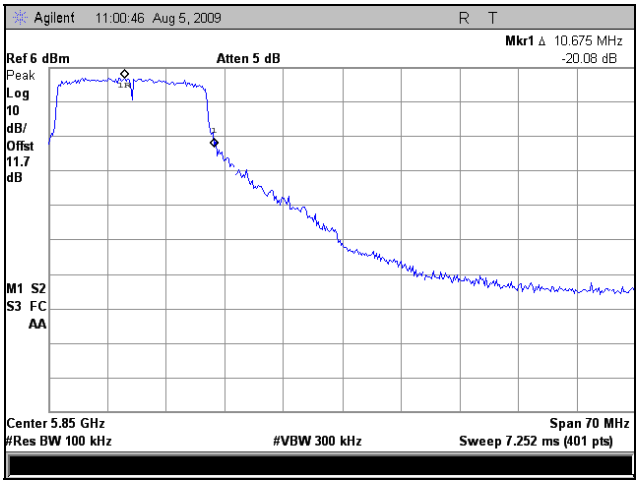

**Plot 214. Upper Conducted Band Edge, 5 GHz, Port 2, 802.11n 40MHz**

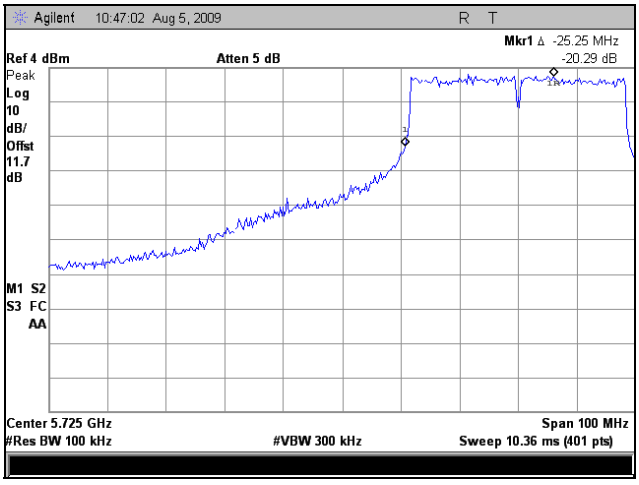
## Conducted Band Edge, 5 GHz, Port 3




**Plot 215. Lower Conducted Band Edge, 5 GHz, Port 3, 802.11n 20MHz**

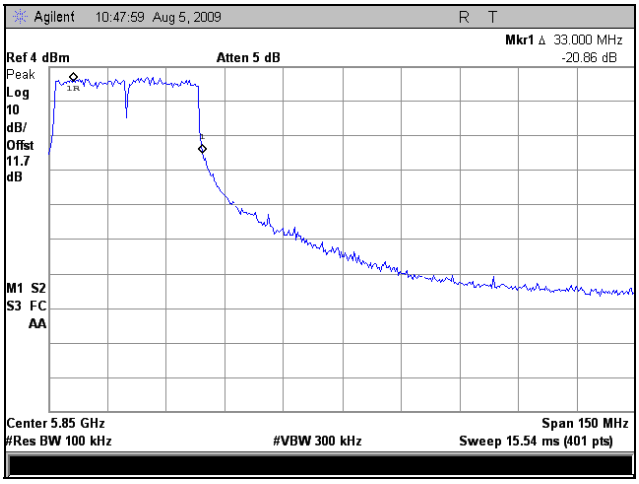



**Plot 216. Upper Conducted Band Edge, 5 GHz, Port 3, 802.11n 20MHz**




**Plot 217. Lower Conducted Band Edge, 5 GHz, Port 3, 802.11n 40MHz**




**Plot 218. Upper Conducted Band Edge, 5 GHz, Port 3, 802.11n 40MHz**

## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.247(e) Peak Power Spectral Density

**Test Requirements:** **§15.247(e):** For digitally modulated systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3 kHz band during any time interval of continuous transmission.

**Test Procedure:** The transmitter was connected directly to a Spectrum Analyzer through an attenuator. The power level was set to the maximum level throughout each of the 100 sweeps of power averaging. The RBW was set to 3 kHz and a VBW set to 9 kHz or greater. The spectrum analyzer was set to an auto sweep time and a peak detector was used. Measurements were carried out at the low, mid and high channels.

**Test Results:** The EUT was compliant with the peak power spectral density limits of **§ 15.247 (e)**.

The peak power spectral density was determined from plots on the following page(s).

**Test Engineer:** Minh Ly

**Test Date:** 08/11/09

| Peak Power Spectral Density, 2.4 GHz, Port 1 | | | | | |
|---|---|---|---|---|---|
| **Mode** | **Carrier Channel** | **Frequency (MHz)** | **Measured PPSD (dBm)** | **Limit (dBm)** | **Margin (dB)** |
| 802.11g | Low | 2412 | -2.275 | 8 | 10.275 |
| | Mid | 2437 | -1.931 | 8 | 9.931 |
| | High | 2462 | -2.119 | 8 | 10.119 |
| 802.11n 20MHz | Low | 2412 | -2.082 | 8 | 10.082 |
| | Mid | 2437 | -1.727 | 8 | 9.727 |
| | High | 2462 | -0.622 | 8 | 8.622 |
| 802.11n 40MHz | Mid | 2412 | -3.58 | 8 | 11.58 |

**Table 49. Peak Power Spectral Density, Test Results, 2.4 GHz, Port 1**

| Peak Power Spectral Density, 2.4 GHz, Port 2 | | | | | |
|---|---|---|---|---|---|
| **Mode** | **Carrier Channel** | **Frequency (MHz)** | **Measured PPSD (dBm)** | **Limit (dBm)** | **Margin (dB)** |
| 802.11n 20MHz | Low | 2412 | -2.695 | 8 | 10.695 |
| | Mid | 2437 | -2.359 | 8 | 10.359 |
| | High | 2462 | -1.526 | 8 | 9.526 |
| 802.11n 4MHz | Mid | 2412 | -3.306 | 8 | 11.306 |

**Table 50. Peak Power Spectral Density, Test Results, 2.4 GHz, Port 2**

| Peak Power Spectral Density, 2.4 GHz, Port 3 | | | | | |
|---|---|---|---|---|---|
| Mode | Carrier Channel | Frequency (MHz) | Measured PPSD (dBm) | Limit (dBm) | Margin (dB) |
| 802.11n 20MHz | Low | 2412 | -2.63 | 8 | 10.63 |
| | Mid | 2437 | -1.18 | 8 | 9.18 |
| | High | 2462 | -0.90 | 8 | 8.90 |
| 802.11n 40MHz | Mid | 2412 | -7.92 | 8 | 15.92 |

**Table 51. Peak Power Spectral Density, Test Results, 2.4 GHz, Port 3**

| Peak Power Spectral Density, 2.4 GHz, Combined Ports | | | | | |
|---|---|---|---|---|---|
| Mode | Carrier Channel | Frequency (MHz) | Measured PPSD (dBm) | Limit (dBm) | Margin (dB) |
| 802.11n 20MHz | Low | 2412 | 3.91 | 8 | 4.09 |
| | Mid | 2437 | 3.68 | 8 | 4.32 |
| | High | 2462 | 3.47 | 8 | 4.53 |
| 802.11n 40MHz | Mid | 2412 | 1.72 | 8 | 6.28 |

**Table 52. Peak Power Spectral Density, Test Results, 2.4 GHz, Combined Ports**

| Peak Power Spectral Density, 5 GHz, Port 1 | | | | | |
|---|---|---|---|---|---|
| Mode | Carrier Channel | Frequency (MHz) | Measured PPSD (dBm) | Limit (dBm) | Margin (dB) |
| 802.11a | Low | 5745 | -8.054 | 8 | 16.054 |
| | Mid | 5785 | -7.195 | 8 | 15.195 |
| | High | 5825 | -6.632 | 8 | 14.632 |
| 802.11n 20MHz | Low | 5745 | -6.409 | 8 | 14.409 |
| | Mid | 5785 | -6.886 | 8 | 14.886 |
| | High | 5825 | -6.471 | 8 | 14.471 |
| 802.11n 40MHz | Low | 5755 | -8.285 | 8 | 16.285 |
| | High | 5795 | -9.881 | 8 | 17.881 |

**Table 53. Peak Power Spectral Density, Test Results, 5 GHz, Port 1**

| Peak Power Spectral Density, 5 GHz, Port 2 | | | | | |
|---|---|---|---|---|---|
| Mode | Carrier Channel | Frequency (MHz) | Measured PPSD (dBm) | Limit (dBm) | Margin (dB) |
| 802.11n 20MHz | Low | 5745 | -7.41 | 8 | 15.41 |
| | Mid | 5785 | -7.445 | 8 | 15.445 |
| | High | 5825 | -6.819 | 8 | 14.819 |
| 802.11n 40Mhz | Low | 5755 | -9.474 | 8 | 17.474 |
| | High | 5795 | -8.649 | 8 | 16.649 |

**Table 54. Peak Power Spectral Density, Test Results, 5 GHz, Port 2**

| Peak Power Spectral Density, 5 GHz, Port 3 | | | | | |
|---|---|---|---|---|---|
| **Mode** | **Carrier Channel** | **Frequency (MHz)** | **Measured PPSD (dBm)** | **Limit (dBm)** | **Margin (dB)** |
| 802.11n 20MHz | Low | 5745 | -7.379 | 8 | 15.379 |
| | Mid | 5785 | -6.757 | 8 | 14.757 |
| | High | 5825 | -7.983 | 8 | 15.983 |
| 802.11n 40MHz | Low | 5755 | -9.001 | 8 | 17.001 |
| | High | 5795 | -8.733 | 8 | 16.733 |

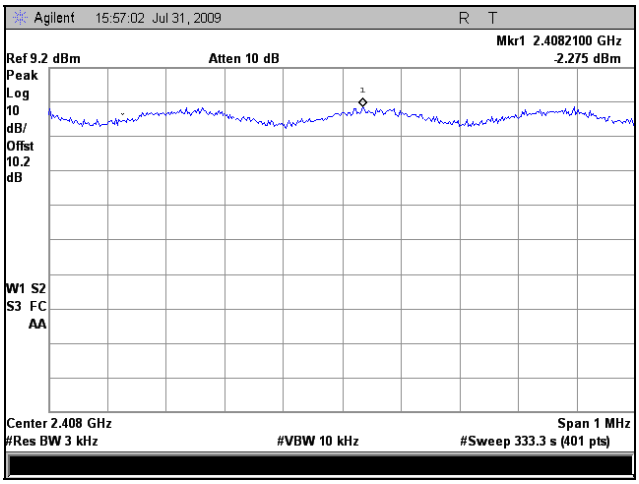
**Table 55. Peak Power Spectral Density, Test Results, 5 GHz, Port 3**

| Peak Power Spectral Density, 5 GHz, Combined Ports | | | | | |
|---|---|---|---|---|---|
| **Mode** | **Carrier Channel** | **Frequency (MHz)** | **Measured PPSD (dBm)** | **Limit (dBm)** | **Margin (dB)** |
| 802.11n 20MHz | Low | 5745 | -1.01 | 8 | 9.01 |
| | Mid | 5785 | -0.63 | 8 | 8.63 |
| | High | 5825 | -0.707 | 8 | 8.707 |
| 802.11n 4MHz | Low | 5755 | -1.885 | 8 | 9.885 |
| | High | 5795 | -2.769 | 8 | 10.769 |

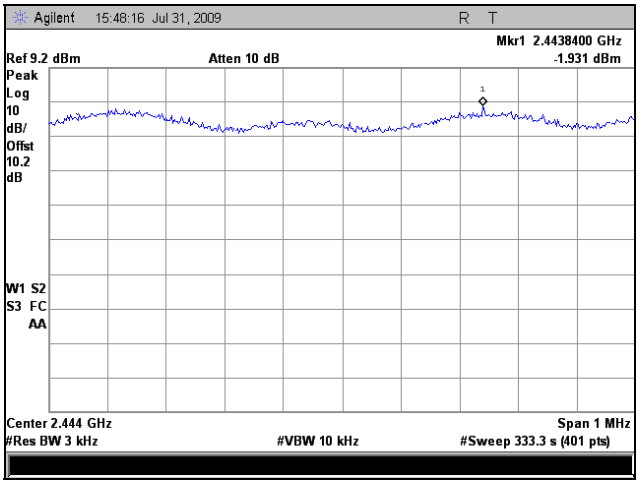
**Table 56. Peak Power Spectral Density, Test Results, 5 GHz, Combined Ports**

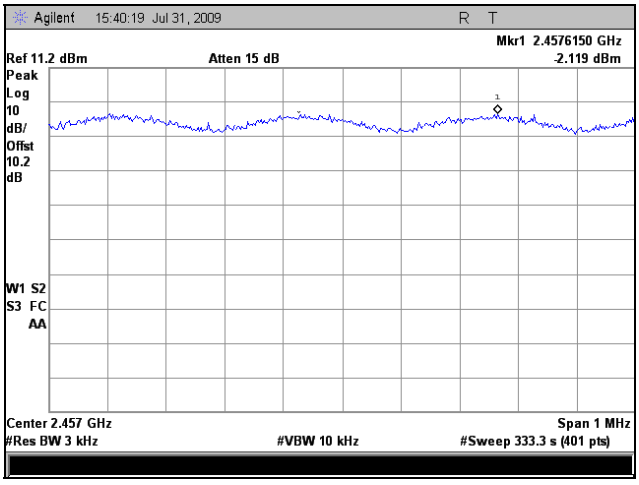
## Peak Power Spectral Density, 2.4 GHz, Port 1




**Plot 219. Peak Power Spectral Density, Low Channel, 2.4 GHz, Port 1, 802.11g**

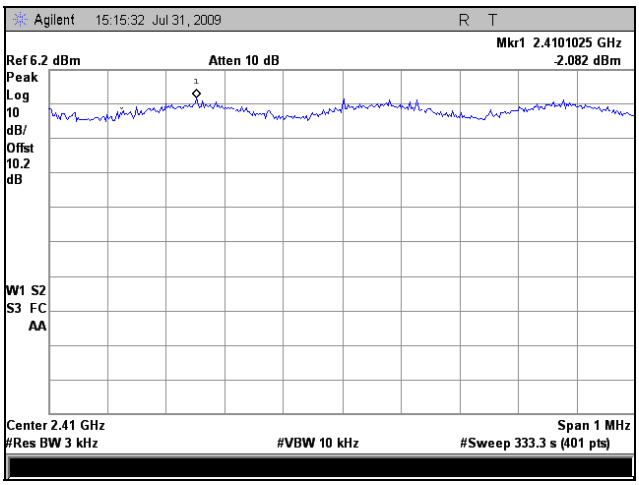



**Plot 220. Peak Power Spectral Density, Mid Channel, 2.4 GHz, Port 1, 802.11g**

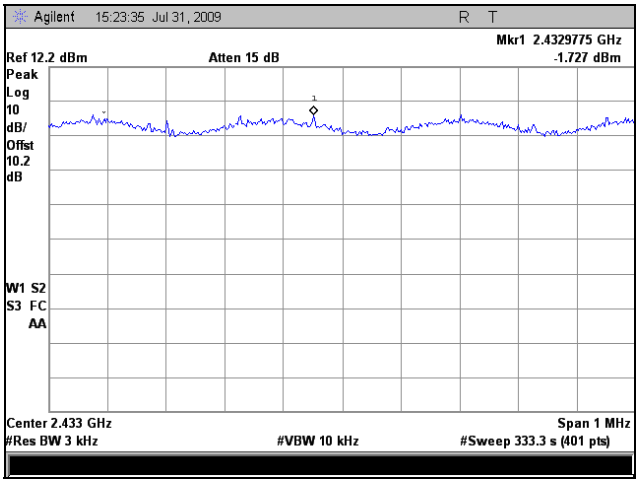



**Plot 221. Peak Power Spectral Density, High Channel, 2.4 GHz, Port 1, 802.11g**

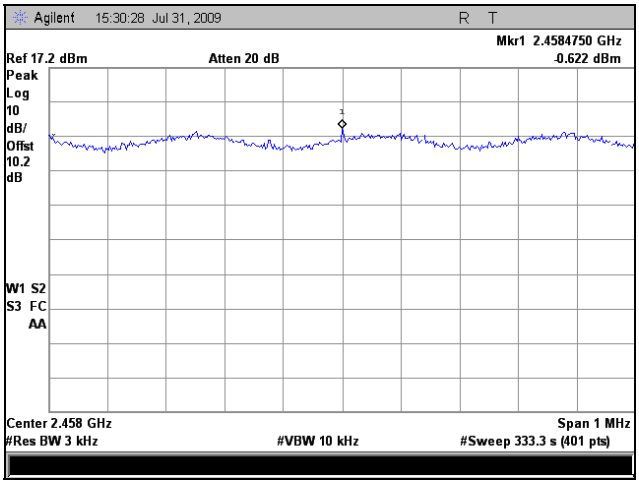
  




**Plot 222. Peak Power Spectral Density, Low Channel, 2.4 GHz, Port 1, 802.11n 20MHz**

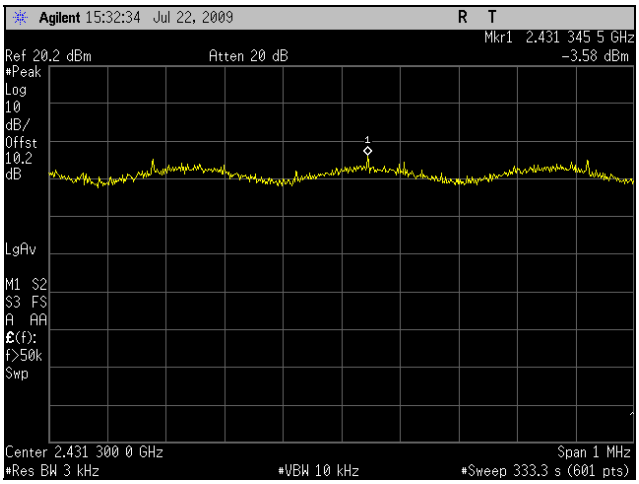



**Plot 223. Peak Power Spectral Density, Mid Channel, 2.4 GHz, Port 1, 802.11n 20MHz**



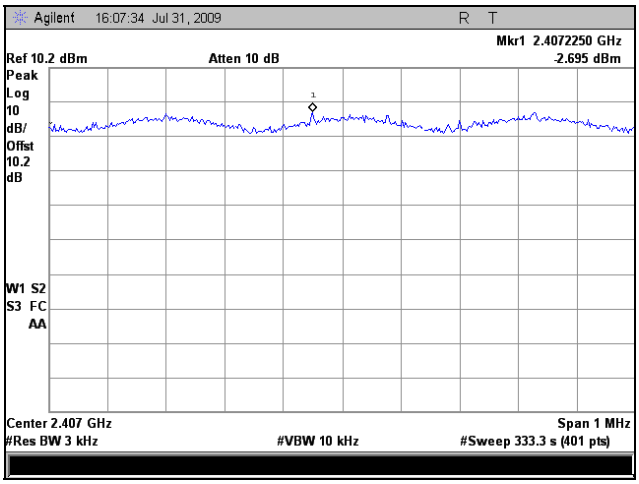

**Plot 224. Peak Power Spectral Density, High Channel, 2.4 GHz, Port 1, 802.11n 20MHz**

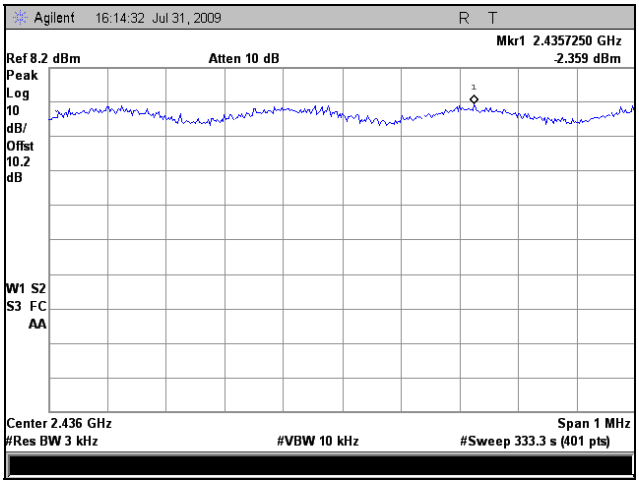



**Plot 225. Peak Power Spectral Density, Mid Channel, 2.4 GHz, Port 1, 802.11n 40MHz**

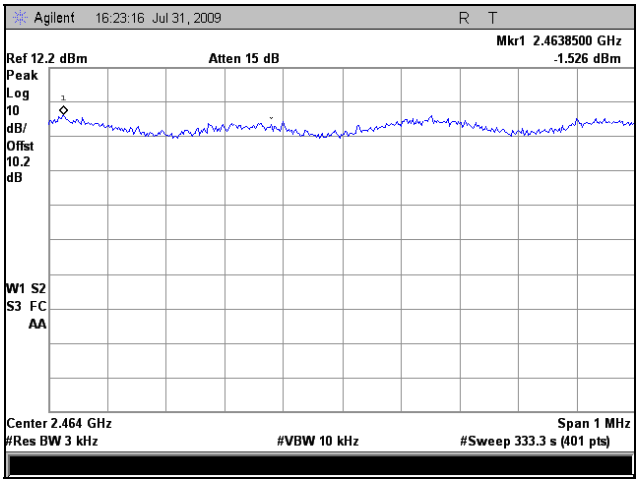
## Peak Power Spectral Density, 2.4 GHz, Port 2




**Plot 226. Peak Power Spectral Density, Low Channel, 2.4 GHz, Port 2, 802.11n 20MHz**

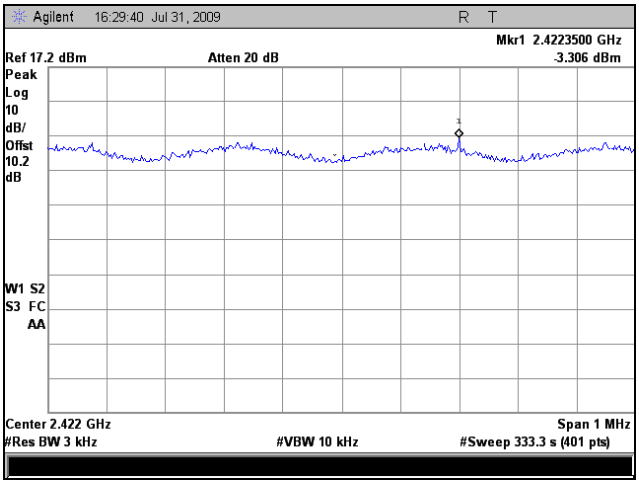



**Plot 227. Peak Power Spectral Density, Mid Channel, 2.4 GHz, Port 2, 802.11n 20MHz**




**Plot 228. Peak Power Spectral Density, High Channel, 2.4 GHz, Port 2, 802.11n 20MHz**

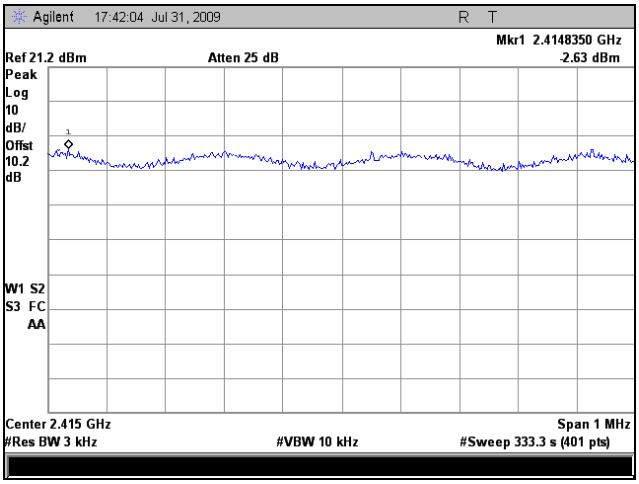
  



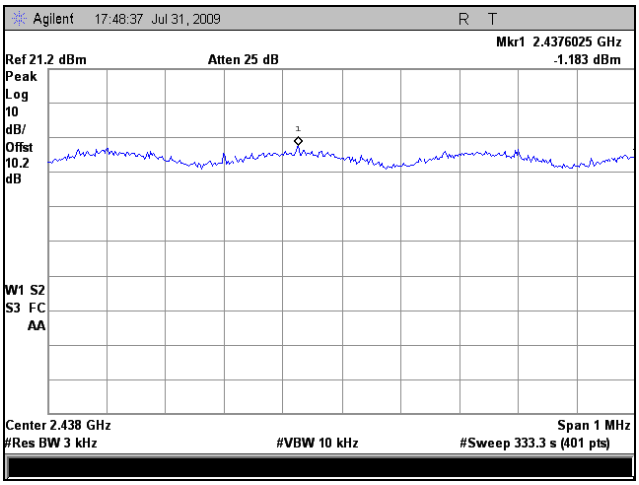

**Plot 229. Peak Power Spectral Density, Mid Channel, 2.4 GHz, Port 2, 802.11n 40MHz**

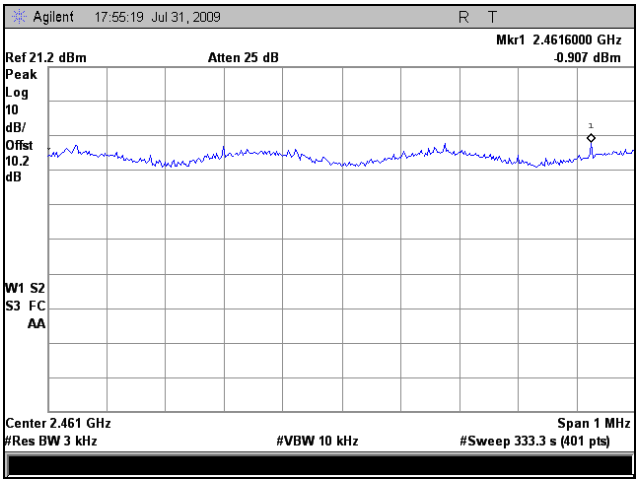
## Peak Power Spectral Density, 2.4 GHz, Port 3




**Plot 230. Peak Power Spectral Density, Low Channel, 2.4 GHz, Port 3, 802.11n 20MHz**

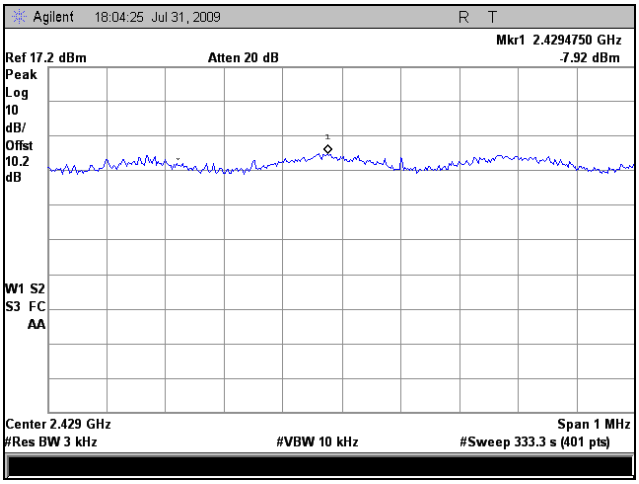



**Plot 231. Peak Power Spectral Density, Mid Channel, 2.4 GHz, Port 3, 802.11n 20MHz**




**Plot 232. Peak Power Spectral Density, High Channel, 2.4 GHz, Port 3, 802.11n 20MHz**

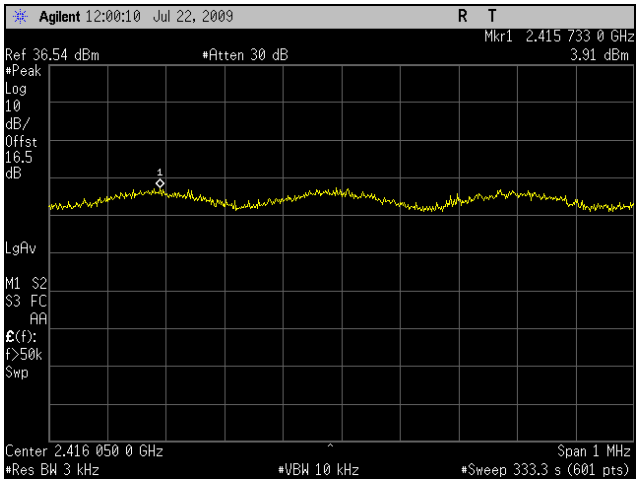
  



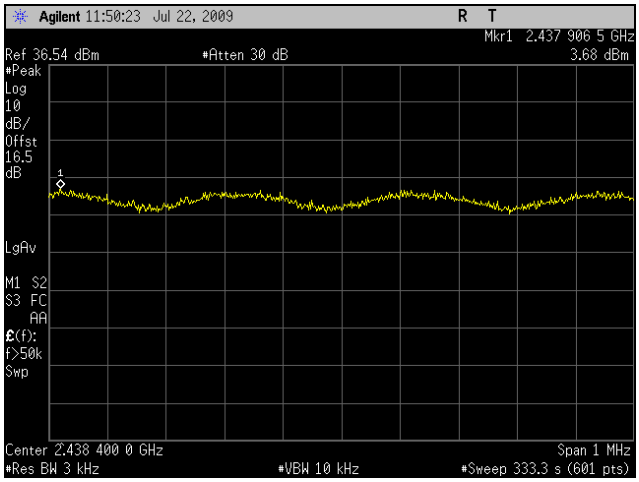

**Plot 233. Peak Power Spectral Density, Mid Channel, 2.4 GHz, Port 3, 802.11n 40MHz**

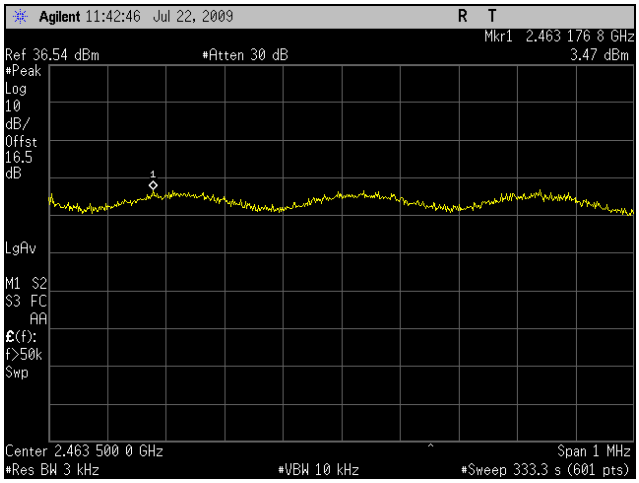
## Peak Power Spectral Density, 2.4 GHz, Combined Ports




**Plot 234. Peak Power Spectral Density, Low Channel, 2.4 GHz, Combined Ports, 802.11n 20MHz**

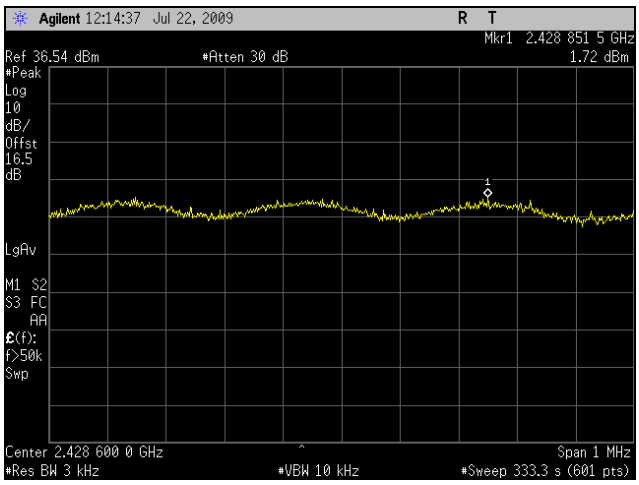



**Plot 235. Peak Power Spectral Density, Mid Channel, 2.4 GHz, Combined Ports, 802.11n 20MHz**




**Plot 236. Peak Power Spectral Density, High Channel, 2.4 GHz, Combined Ports, 802.11n 20MHz**

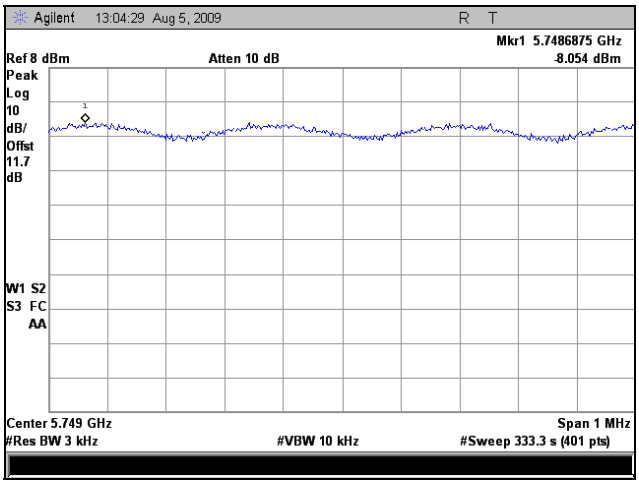
  



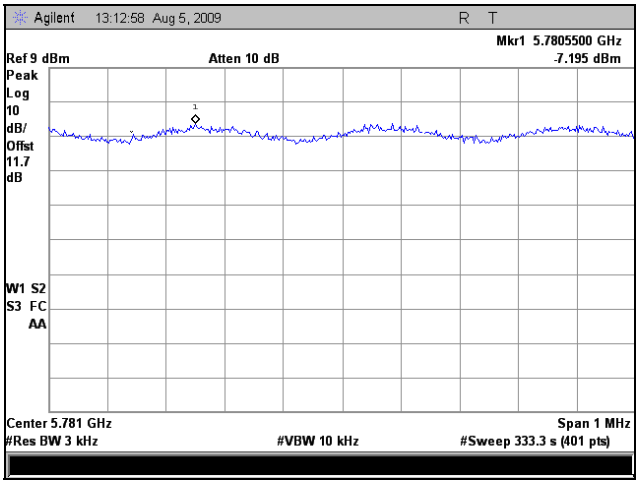

**Plot 237. Peak Power Spectral Density, Mid Channel, 2.4 GHz, Combined Ports, 802.11n 40MHz**

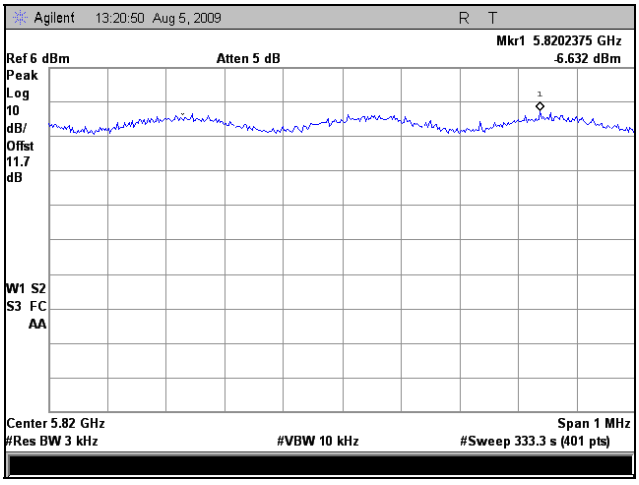
## Peak Power Spectral Density, 5 GHz, Port 1




**Plot 238. Peak Power Spectral Density, Low Channel, 5 GHz, Port 1, 802.11a**

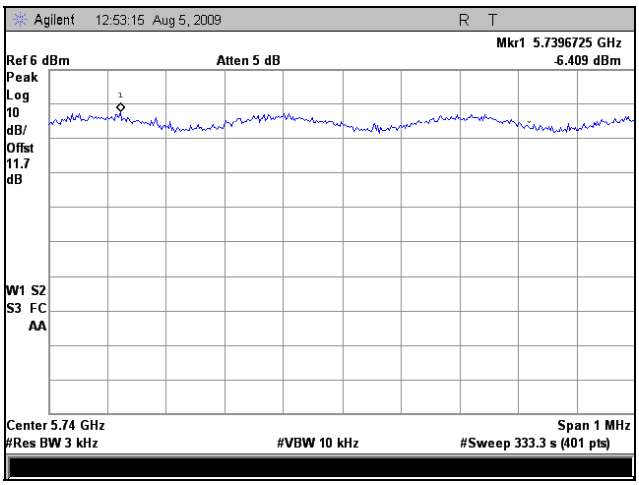



**Plot 239. Peak Power Spectral Density, Mid Channel, 5 GHz, Port 1, 802.11a**

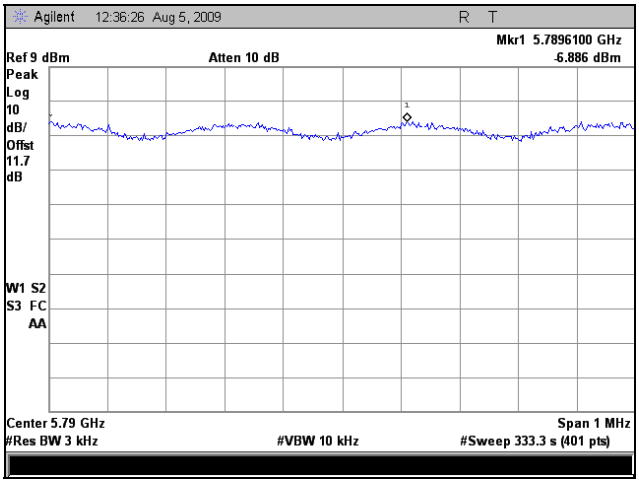



**Plot 240. Peak Power Spectral Density, High Channel, 5 GHz, Port 1, 802.11a**

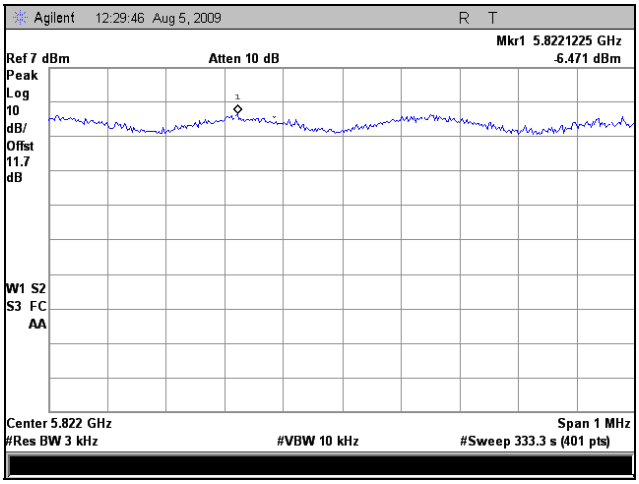
  




**Plot 241. Peak Power Spectral Density, Low Channel, 5 GHz, Port 1, 802.11n 20MHz**

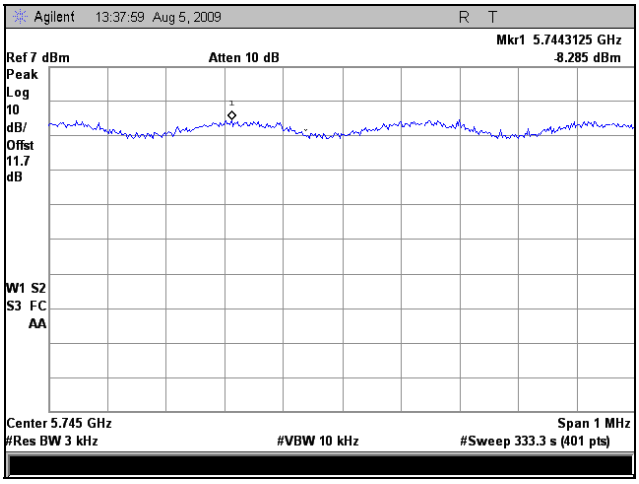



**Plot 242. Peak Power Spectral Density, Mid Channel, 5 GHz, Port 1, 802.11n 20MHz**

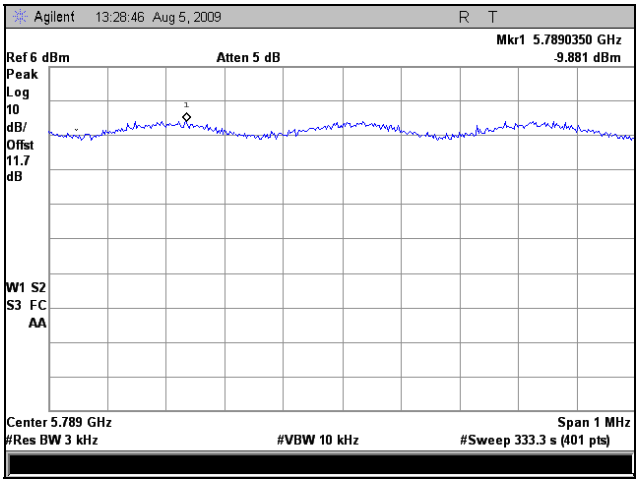



**Plot 243. Peak Power Spectral Density, High Channel, 5 GHz, Port 1, 802.11n 20MHz**



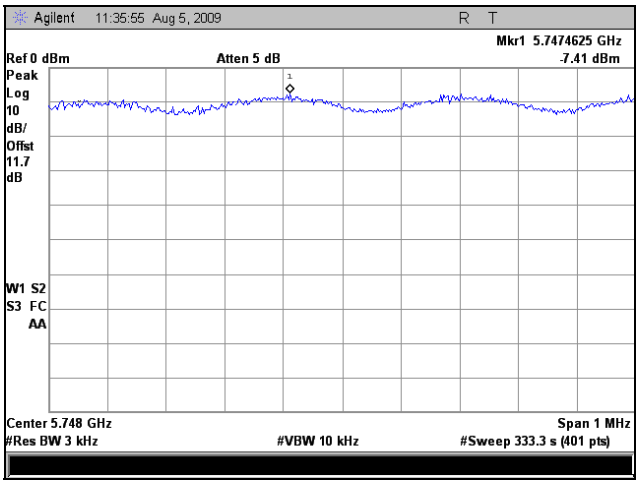

**Plot 244. Peak Power Spectral Density, Low Channel, 5 GHz, Port 1, 802.11n 40MHz**



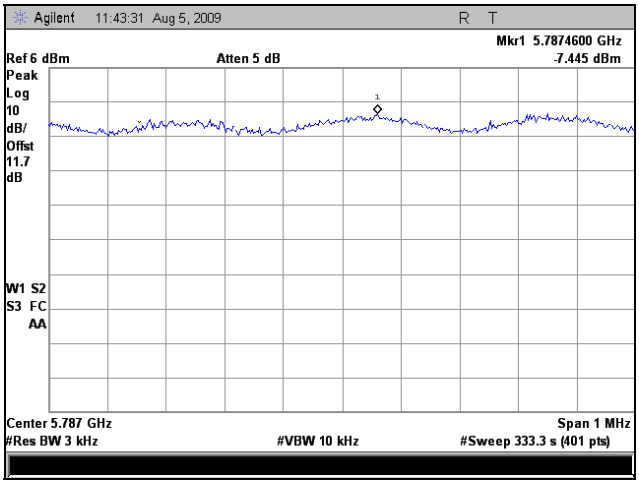

**Plot 245. Peak Power Spectral Density, High Channel, 5 GHz, Port 1, 802.11n 40MHz**

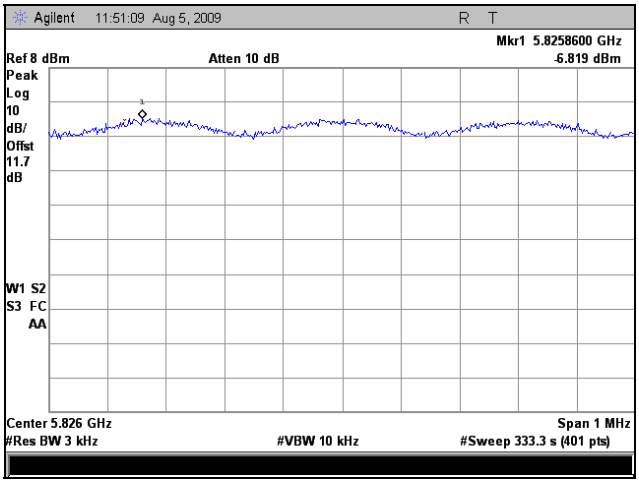
## Peak Power Spectral Density, 5 GHz, Port 2




**Plot 246. Peak Power Spectral Density, Low Channel, 5 GHz, Port 2, 802.11n 20MHz**

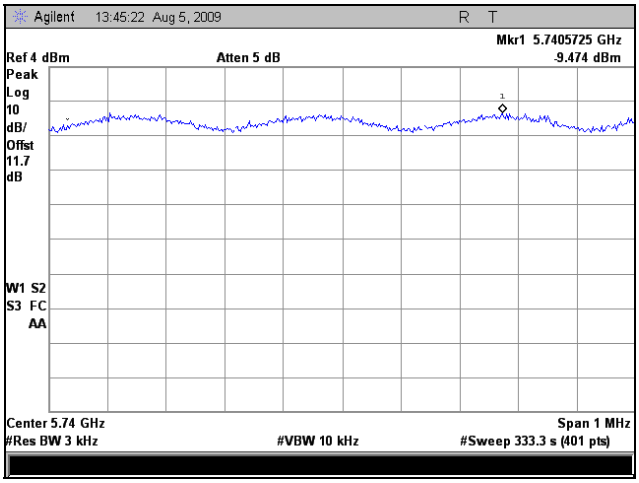



**Plot 247. Peak Power Spectral Density, Mid Channel, 5 GHz, Port 2, 802.11n 20MHz**

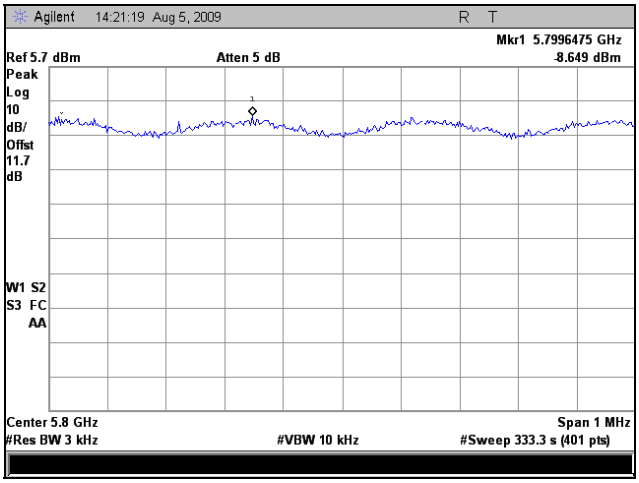



**Plot 248. Peak Power Spectral Density, High Channel, 5 GHz, Port 2, 802.11n 20MHz**



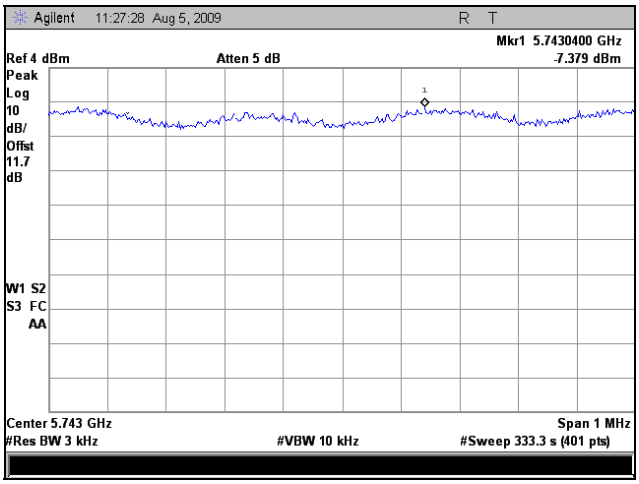

**Plot 249. Peak Power Spectral Density, Low Channel, 5 GHz, Port 2, 802.11n 40MHz**



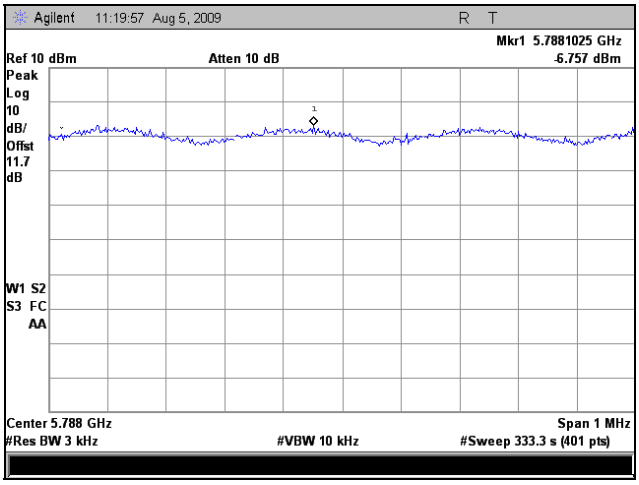

**Plot 250. Peak Power Spectral Density, High Channel, 5 GHz, Port 2, 802.11n 40MHz**

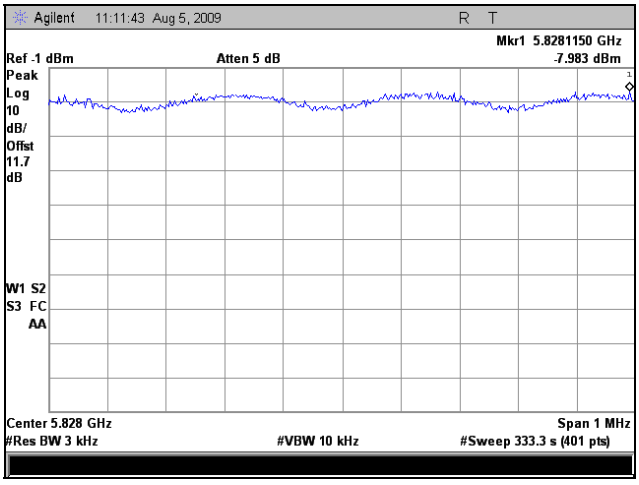
## Peak Power Spectral Density, 5 GHz, Port 3




**Plot 251. Peak Power Spectral Density, Low Channel, 5 GHz, Port 3, 802.11n 20MHz**

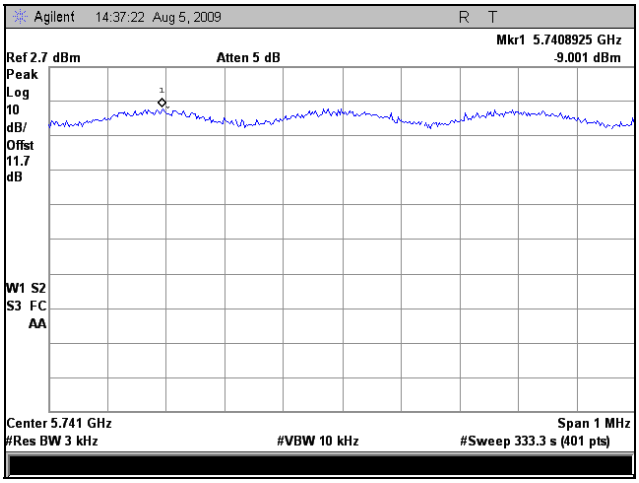



**Plot 252. Peak Power Spectral Density, Mid Channel, 5 GHz, Port 3, 802.11n 20MHz**

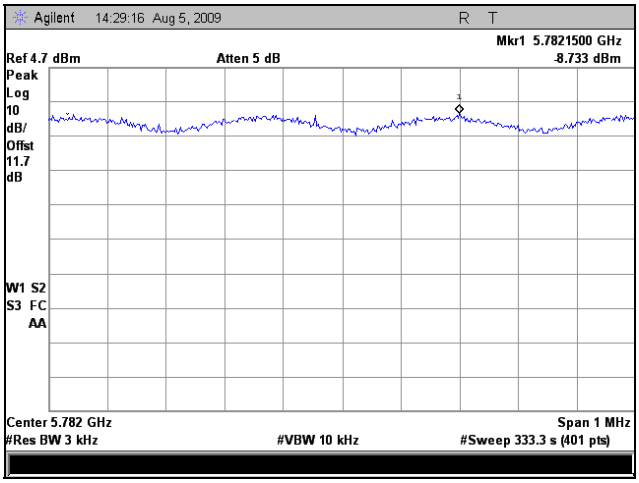



**Plot 253. Peak Power Spectral Density, High Channel, 5 GHz, Port 3, 802.11n 20MHz**



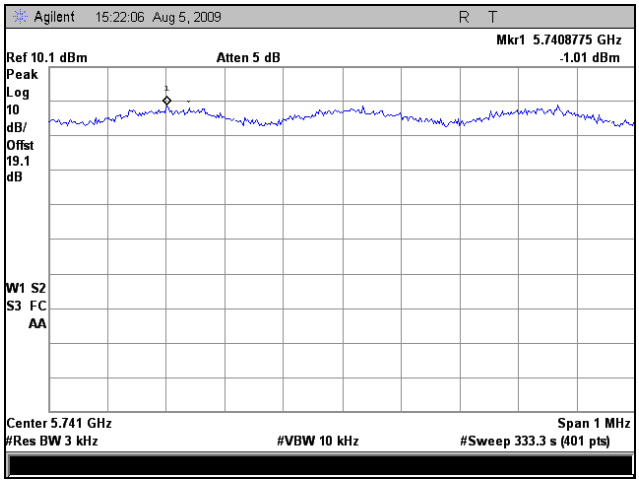

**Plot 254. Peak Power Spectral Density, Low Channel, 5 GHz, Port 3, 802.11n 40MHz**



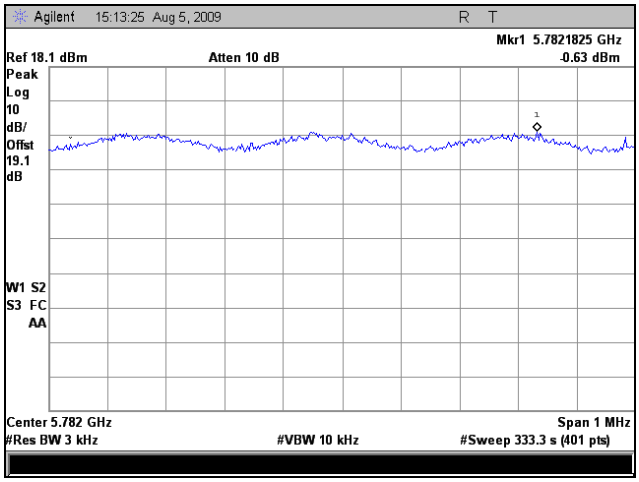

**Plot 255. Peak Power Spectral Density, High Channel, 5 GHz, Port 3, 802.11n 40MHz**

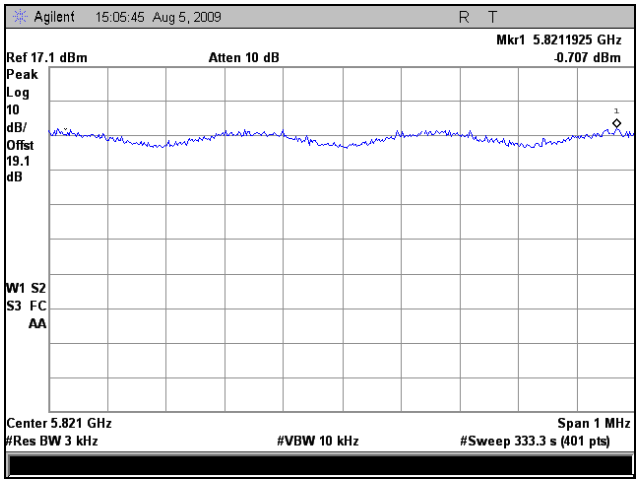
## Peak Power Spectral Density, 5 GHz, Combined Ports




**Plot 256. Peak Power Spectral Density, Low Channel, 5 GHz, Combined Ports, 802.11n 20MHz**

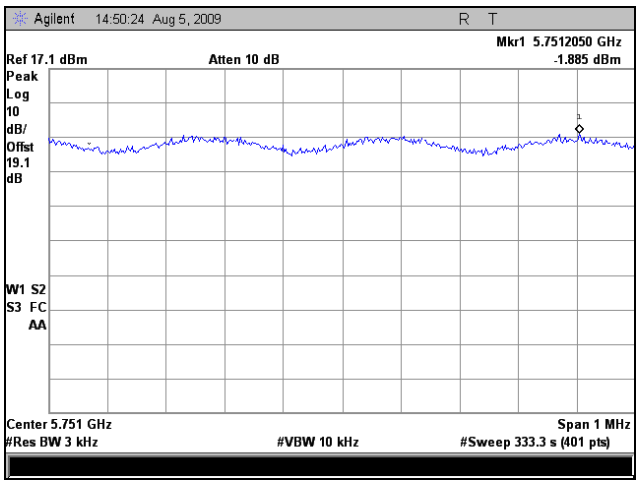



**Plot 257. Peak Power Spectral Density, Mid Channel, 5 GHz, Combined Ports, 802.11n 20MHz**

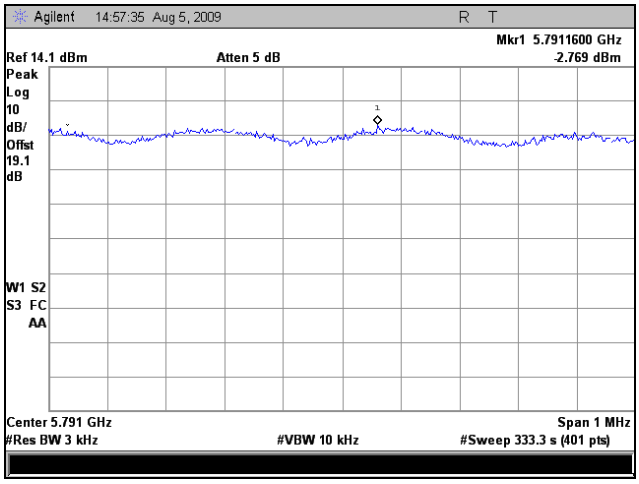



**Plot 258. Peak Power Spectral Density, High Channel, 5 GHz, Combined Ports, 802.11n 20MHz**




**Plot 259. Peak Power Spectral Density, Low Channel, 5 GHz, Combined Ports, 802.11n 40MHz**




**Plot 260. Peak Power Spectral Density, High Channel, 5 GHz, Combined Ports, 802.11n 40MHz**

# IV. Test Equipment

## Test Equipment

Calibrated test equipment utilized during testing was maintained in a current state of calibration per the requirements of ANSI/NCSL Z540-1-1994 and ANSI/ISO/IEC 17025:2000.

| MET Asset # | Equipment | Manufacturer | Model | Last Cal Date | Cal Due Date |
|---|---|---|---|---|---|
| 1S2421 | EMI RECEIVER | ROHDE&SCHWARZ | ESIB 7 | 05/27/2009 | 05/27/2010 |
| 1S2121 | PRE-AMPLIFIER | HEWLETT PACKARD | 8449B | SEE NOTE | |
| 1S2198 | HORN ANTENNA | EMCO | 3115 | 09/10/2008 | 09/10/2009 |
| 1S2202 | ANTENNA, HORN, 1 METER | EMCO | 3116 | 04/10/2007 | 04/10/2010 |
| N/A | HIGH PASS FILTER | MICRO-TRONICS | HPM13146 | SEE NOTE | |
| 1S2481 | CHAMBER, 10 METER | ETS-LINDGREN | DKE 8X8 DBL | 12/26/2008 | 12/26/2009 |
| 1S2041 | COUPLER, BI DIRECTIONALCOAXIAL | NARDA | N/A | SEE NOTE | |
| 1S2460 | ANALYZER, SPECTRUM 9 KHZ-40GHZ | AGILENT | E4407B | 04/14/2009 | 04/14/2010 |
| 1S2034 | COUPLER, DIRECTIONAL 1-20 GHZ | KRYTAR | 101020020 | SEE NOTE | |
| 1S2464 | LISN | SOLAR ELECTRONICS | 9252-50-R24-BNC | 09/26/2008 | 09/26/2009 |
| 1S2512 | TRANSIENT LIMITER | AGILENT | 11947A | SEE NOTE | |
| 1S2520 | THERMO-HYGROMETER | FISHER SCIENTIFIC | 11-661-7D | 11/14/2007 | 11/13/2009 |
| 1S2482 | CHAMBER, 5 METER | PANASHIELD | 641431 | 11/22/2008 | 11/22/2009 |
| 1S2108 | RECIEVER, EMI, RF FILTER SECTION | HP | 85460A | 11/06/2008 | 11/06/2009 |
| 1S2399 | TURNTABLE CONTROLLER | SUNOL SCIENCE | SC99V | SEE NOTE | |
| 1S2485 | BILOG ANTENNA | TESEQ | CBL6112D | 03/20/2009 | 03/20/2010 |
| N/A | 2-6GHZ COMBINER | MINI CIRCUITS | ZN4PD-1-63-S+ | SEE NOTE | |
| 1S2108 | RF FILTER SECTION | HEWLETT PACKARD | 85460A | 11/6/08 | 11/6/09 |
| 1S2041 | COUPLER, BI DIRECTIONALCOAXIAL | NARDA | N/A | SEE NOTE | |
| 1S2128 | HARMONIC MIXER | HEWLETT PACKARD | 11970A | 11/22/2008 | 11/22/2010 |
| 1S2129 | HARMONIC MIXER | HEWLETT PACKARD | 11970K | 11/22/2008 | 11/22/2010 |

Note: Functionally tested equipment is verified using calibrated instrumentation at the time of testing.

# V. Certification & User's Manual Information

# Certification & User's Manual Information

## A. Certification Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 2, Subpart I — Marketing of Radio frequency devices:

**§ 2.801 Radio-frequency device defined.**

As used in this part, a radio-frequency device is any device which in its operation is capable of Emitting radio-frequency energy by radiation, conduction, or other means. Radio- frequency devices include, but are not limited to:

(a) The various types of radio communication transmitting devices described throughout this chapter.

*(b) The incidental, unintentional and intentional radiators defined in Part 15 of this chapter.*

(c) The industrial, scientific, and medical equipment described in Part 18 of this chapter.

(d) Any part or component thereof which in use emits radio-frequency energy by radiation, conduction, or other means.

**§ 2.803 Marketing of radio frequency devices prior to equipment authorization.**

(a) Except as provided elsewhere in this chapter, no person shall sell or lease, or offer for sale or lease (including advertising for sale or lease), or import, ship or distribute for the purpose of selling or leasing or offering for sale or lease, any radio frequency device unless:

(1) In the case of a device subject to certification, such device has been authorized by the Commission in accordance with the rules in this chapter and is properly identified and labeled as required by §2.925 and other relevant sections in this chapter; or

(2) In the case of a device that is not required to have a grant of equipment authorization issued by the Commission, but which must comply with the specified technical standards prior to use, such device also complies with all applicable administrative (including verification of the equipment or authorization under a Declaration of Conformity, where required), technical, labeling and identification requirements specified in this chapter.

(d) Notwithstanding the provisions of paragraph (a) of this section, the offer for sale solely to business, commercial, industrial, scientific or medical users (but not an offer for sale to other parties or to end users located in a residential environment) of a radio frequency device that is in the conceptual, developmental, design or pre-production stage is permitted prior to equipment authorization or, for devices not subject to the equipment authorization requirements, prior to a determination of compliance with the applicable technical requirements *provided* that the prospective buyer is advised in writing at the time of the offer for sale that the equipment is subject to the FCC rules and that the equipment will comply with the appropriate rules before delivery to the buyer or to centers of distribution.

(e)(1) Notwithstanding the provisions of paragraph (a) of this section, prior to equipment authorization or determination of compliance with the applicable technical requirements any radio frequency device may be operated, but not marketed, for the following purposes and under the following conditions:

*(i) Compliance testing;*

(ii) Demonstrations at a trade show provided the notice contained in paragraph (c) of this section is displayed in a conspicuous location on, or immediately adjacent to, the device;

(iii) Demonstrations at an exhibition conducted at a business, commercial, industrial, scientific or medical location, but excluding locations in a residential environment, provided the notice contained in paragraphs (c) or (d) of this section, as appropriate, is displayed in a conspicuous location on, or immediately adjacent to, the device;

(iv) Evaluation of product performance and determination of customer acceptability, provided such operation takes place at the manufacturer's facilities during developmental, design or pre-production states; or

(v) Evaluation of product performance and determination of customer acceptability where customer acceptability of a radio frequency device cannot be determined at the manufacturer's facilities because of size or unique capability of the device, provided the device is operated at a business, commercial, industrial, scientific or medical user's site, but not at a residential site, during the development, design or pre-production stages.

(e)(2) For the purpose of paragraphs (e)(1)(iv) and (e)(1)(v) of this section, the term *manufacturer's facilities* includes the facilities of the party responsible for compliance with the regulations and the manufacturer's premises, as well as the facilities of other entities working under the authorization of the responsible party in connection with the development and manufacture, but not the marketing, of the equipment.

(f) For radio frequency devices subject to verification and sold solely to business, commercial, industrial, scientific and medical users (excluding products sold to other parties or for operation in a residential environment), parties responsible for verification of the devices shall have the option of ensuring compliance with the applicable technical specifications of this chapter at each end user's location after installation, provided that the purchase or lease agreement includes a proviso that such a determination of compliance be made and is the responsibility of the party responsible for verification of the equipment.

## Certification & User's Manual Information

**The following is extracted from Title 47 of the Code of Federal Regulations, Part 2, Subpart J — Equipment Authorization Procedures:**

**§ 2.901 Basis and Purpose**

(a) In order to carry out its responsibilities under the Communications Act and the various treaties and international regulations, and in order to promote efficient use of the radio spectrum, the Commission has developed technical standards for radio frequency equipment and parts or components thereof. The technical standards applicable to individual types of equipment are found in that part of the rules governing the service wherein the equipment is to be operated.[1] *In addition to the technical standards provided, the rules governing the service may require that such equipment be verified by the manufacturer or importer*, be authorized under a Declaration of Conformity, or receive an equipment authorization from the Commission by one of the following procedures: certification or registration.

(b) The following sections describe the verification procedure, the procedure for a Declaration of Conformity, and the procedures to be followed in obtaining certification from the Commission and the conditions attendant to such a grant.

**§ 2.907 Certification.**

(a) Certification is an equipment authorization issued by the Commission, based on representation and test data submitted by the applicant.

(b) Certification attaches to all units subsequently marketed by the grantee which are identical (see Section 2.908) to the sample tested except for permissive changes or other variations authorized by the Commission pursuant to Section 2.1043.

[1] In this case, the equipment is subject to the rules of Part 15. More specifically, the equipment falls under Subpart B (of Part 15), which deals with unintentional radiators.

## Certification & User's Manual Information

### § 2.948 Description of measurement facilities.

(a) Each party making measurements of equipment that is subject to an equipment authorization under Part 15 or Part 18 of this chapter, regardless of whether the measurements are filed with the Commission or kept on file by the party responsible for compliance of equipment marketed within the U.S. or its possessions, shall compile a description of the measurement facilities employed.

(1) If the measured equipment is subject to the verification procedure, the description of the measurement facilities shall be retained by the party responsible for verification of the equipment.

*(i) If the equipment is verified through measurements performed by an independent laboratory, it is acceptable for the party responsible for verification of the equipment to rely upon the description of the measurement facilities retained by or placed on file with the Commission by that laboratory. In this situation, the party responsible for the verification of the equipment is not required to retain a duplicate copy of the description of the measurement facilities.*

(ii) If the equipment is verified based on measurements performed at the installation site of the equipment, no specific site calibration data is required. It is acceptable to retain the description of the measurement facilities at the site at which the measurements were performed.

(2) If the equipment is to be authorized by the Commission under the certification procedure, the description of the measurement facilities shall be filed with the Commission's Laboratory in Columbia, Maryland. The data describing the measurement facilities need only be filed once but must be updated as changes are made to the measurement facilities or as otherwise described in this section. At least every three years, the organization responsible for filing the data with the Commission shall certify that the data on file is current.

# Certification & User's Manual Information

## Label and User's Manual Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 15, Subpart A — General:

**§ 15.19 Labeling requirements.**

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

(1) Receivers associated with the operation of a licensed radio service, e.g., FM broadcast under Part 73 of this chapter, land mobile operation under Part 90, etc., 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 condition that this device does not cause harmful interference.

(2) A stand-alone cable input selector switch, shall bear the following statement in a conspicuous location on the device:

This device is verified to comply with Part 15 of the FCC Rules for use with cable television service.

(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 under paragraph (a) of this section is required to be affixed only to the main control unit.

(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.

**§ 15.21 Information to user.**

The users manual or instruction manual for an intentional or unintentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

## Verification & User's Manual Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 15, Subpart B — Unintentional Radiators:

### § 15.105 Information to the user.

(a) For a Class A digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at own expense.

(b) For a Class B digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a residential environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

– Reorient or relocate the receiving antenna.

– Increase the separation between the equipment and receiver.

– Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

– Consult the dealer or an experienced radio/TV technician for help.

## ICES-003 Procedural & Labeling Requirements

From the Industry Canada Electromagnetic Compatibility Advisory Bulletin entitled, "Implementation and Interpretation of the Interference-Causing Equipment Standard for Digital Apparatus, ICES-003" (EMCAB-3, Issue 2, July 1995):

> "At present, CISPR 22: 2002 and ICES technical requirements are essentially equivalent. Therefore, if you have CISPR 22: 2002 approval by meeting CISPR Publication 22, the only additional requirements are: to attach a note to the report of the test results for compliance, indicating that these results are deemed satisfactory evidence of compliance with ICES-003 of the Canadian Interference-Causing Equipment Regulations; to maintain these records on file for the requisite five year period; and to provide the device with a notice of compliance in accordance with ICES-003."

**Procedural Requirements:**

According to Industry Canada's Interference Causing Equipment Standard for Digital Apparatus ICES-003 Issue 4, February 2004:

Section 6.1: A record of the measurements and results, showing the date that the measurements were completed, shall be retained by the manufacturer or importer for a period of at least five years from the date shown in the record and made available for examination on the request of the Minister.

Section 6.2: A written notice indicating compliance must accompany each unit of digital apparatus to the end user. The notice shall be in the form of a label that is affixed to the apparatus. Where because of insufficient space or other constraints it is not feasible to affix a label to the apparatus, the notice may be in the form of a statement in the user's manual.

**Labeling Requirements:**

The suggested text for the notice, in English and in French, is provided below, from the Annex of ICES-003:

> This Class [2] digital apparatus complies with Canadian ICES-003.
>
> Cet appareil numérique de la classe [1] est conforme à la norme NMB-003 du Canada.

[2] Insert either A or B but not both as appropriate for the equipment requirements.

# End of Report