**MET Laboratories, Inc.** *Safety Certification - EMI - Telecom Environmental Simulation*
914 WEST PATAPSCO AVENUE ● BALTIMORE, MARYLAND 21230-3432 ● PHONE (410) 354-3300 ● FAX (410) 354-3313

November 2, 2006

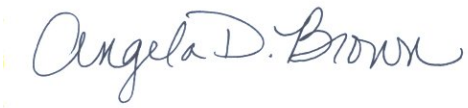
Motorola - Mesh Networks Product Group
485 Keller Rd, Suite 250
Maitland, FL 32751

Dear Daniel DiLuzio,

Enclosed is the EMC test report for compliance testing of the Motorola - Mesh Networks Product Group, HotZone Duo as tested to the requirements of Title 47 of the CFR, Ch. 1 (10-1-03 ed.), Part 15, Subpart C.

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.



Angela D. Brown
Documentation Department

Reference: (\Motorola - Mesh Networks Product Group\EMC19771-FCC247 Rev 1)

# Electromagnetic Compatibility
# Test Report

for the

**Motorola - Mesh Networks Product Group**
**HotZone Duo**

**Verified under**
the FCC Certification Rules
contained in
Title 47 of the CFR, Part 15.247, Subpart C
for Intentional Radiators

**MET Report: EMC19771-FCC247**

November 2, 2006

**Prepared For:**

**Motorola - Mesh Networks Product Group**
**485 Keller Rd, Suite 250**
**Maitland, FL 32751**

**Prepared By:**
**MET Laboratories, Inc.**
914 W. Patapsco Avenue
Baltimore, Maryland 21230

# Electromagnetic Compatibility
# Test Report

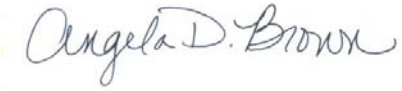
for the

## Motorola - Mesh Networks Product Group
## HotZone Duo

**Tested Under**

the FCC Certification Rules
contained in
Title 47 of the CFR, Part 15.247, Subpart C
for Intentional Radiators

Len Knight, Project Engineer
Electromagnetic Compatibility Lab



Angela D. Brown
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 Part 15.407, of the FCC Rules under normal use and maintenance.

Kevin Mehaffey, Manager
Electromagnetic Compatibility Lab

# Report Status Sheet

| Revision | Report Date | Reason for Revision |
|---|---|---|
| ∅ | September 27, 2006 | Initial Issue. |
| 1 | November 2, 2006 | Addition of Peak Conducted Output Power Data |

# Table of Contents



# List of Tables



# List of Figures



# List of Photographs

# 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 µ |
| **E** | **E**lectric Field |
| **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**ilo**v**olt |
| **LISN** | **L**ine **I**mpedance **S**tabilization **N**etwork |
| **MHz** | **M**ega**h**ertz |
| **µH** | **microh**enry |
| µ | **microf**arad |
| **µs** | **micros**econds |
| **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 Motorola - Mesh Networks Product Group, HotZone Duo, 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 HotZone Duo. Motorola - Mesh Networks Product Group should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the HotZone Duo, 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 Motorola - Mesh Networks Product Group, purchase order number PO-NP2519864. All tests were conducted using measurement procedure ANSI C63.4-2003.

| Reference | Description | Results |
|---|---|---|
| Title 47 of the CFR, Part 15, Subpart C, §15.207 | AC Power Line Conducted Emissions | Compliant |
| Title 47 of the CFR, Part 15, Subpart C, §15.203/15.247(b)(c) | Antenna Requirement | Compliant |
| Title 47 of the CFR, Part 15, Subpart C, §15.205(d) | Band Edge Emissions | Compliant |
| Title 47 of the CFR, Part 15, Subpart C, §15.247(a)(2) | 6dB Occupied Bandwidth | Compliant. |
| Title 47 of the CFR, Part 15, Subpart C, §15.247(b)(3) | Maximum Peak Conducted Output Power | Compliant |
| Title 47 of the CFR, Part 15, Subpart C, §15.247(d) | Spurious Radiated Emissions | Compliant |
| Title 47 of the CFR, Part 15, Subpart C, §15.247(e) | Peak Power Spectral Density | Compliant |

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

# II. Equipment Configuration

# A. Overview

MET Laboratories, Inc. was contracted by Motorola - Mesh Networks Product Group to perform testing on the HotZone Duo, under Motorola - Mesh Networks Product Group's purchase order number PO-NP2519864.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Motorola - Mesh Networks Product Group, HotZone Duo.

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

| | | |
|---|---|---|
| **Model(s) Tested:** | HotZone Duo | |
| **Model(s) Covered:** | HotZone Duo | |
| **EUT Specifications:** | Primary Power: 120VAC, 60Hz | |
| | FCC ID: | |
| | Type of Modulations: | Complementary Code Keying (CCK) and Orthogonal Frequency Division Multiplexing (OFDM) |
| | Emission Designators: | 802.11/b - |
| | | 802.11/g - |
| | Equipment Code: | DTS |
| | Peak RF Conducted Output Power: | 802.11/b – 27.9 dBm |
| | | 802.11/g – 27.97 dBm |
| | EUT TX Frequency Ranges: | 2412 MHz – 2462 MHz |
| **Analysis:** | The results obtained relate only to the item(s) tested. | |
| **Evaluated by:** | Len Knight | |
| **Date(s):** | November 2, 2006 | |

| Channel Number | Frequency (MHz) |
|---|---|
| 1 | 2412 |
| 2 | 2417 |
| 3 | 2422 |
| 4 | 2427 |
| 5 | 2432 |
| 6 | 2437 |
| 7 | 2442 |
| 8 | 2447 |
| 9 | 2452 |
| 10 | 2457 |
| 11 | 2462 |

**Table 2. Frequency Allocation for 802.11/b/g**

## 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 |
| **CFR 47, Part 15, Subpart B** | 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 |

## C. Test Site

All testing was performed at MET Laboratories, Inc., 914 West Patapsco Avenue, Baltimore, MD 21230. 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 semi-anechoic chamber. In accordance with §2.948(a)(3), a complete site description is contained at MET Laboratories. In accordance with §2.948(d), MET Laboratories has been accredited by the National Voluntary Laboratory Accreditation Program (Lab Code: 100273-0).

## D. Description of Test Sample

The HotZone Duo, Equipment Under Test (EUT), is an 802.11 Access Point. The system supports 802.11 a/b/g via an Atheros AP30 chipset.

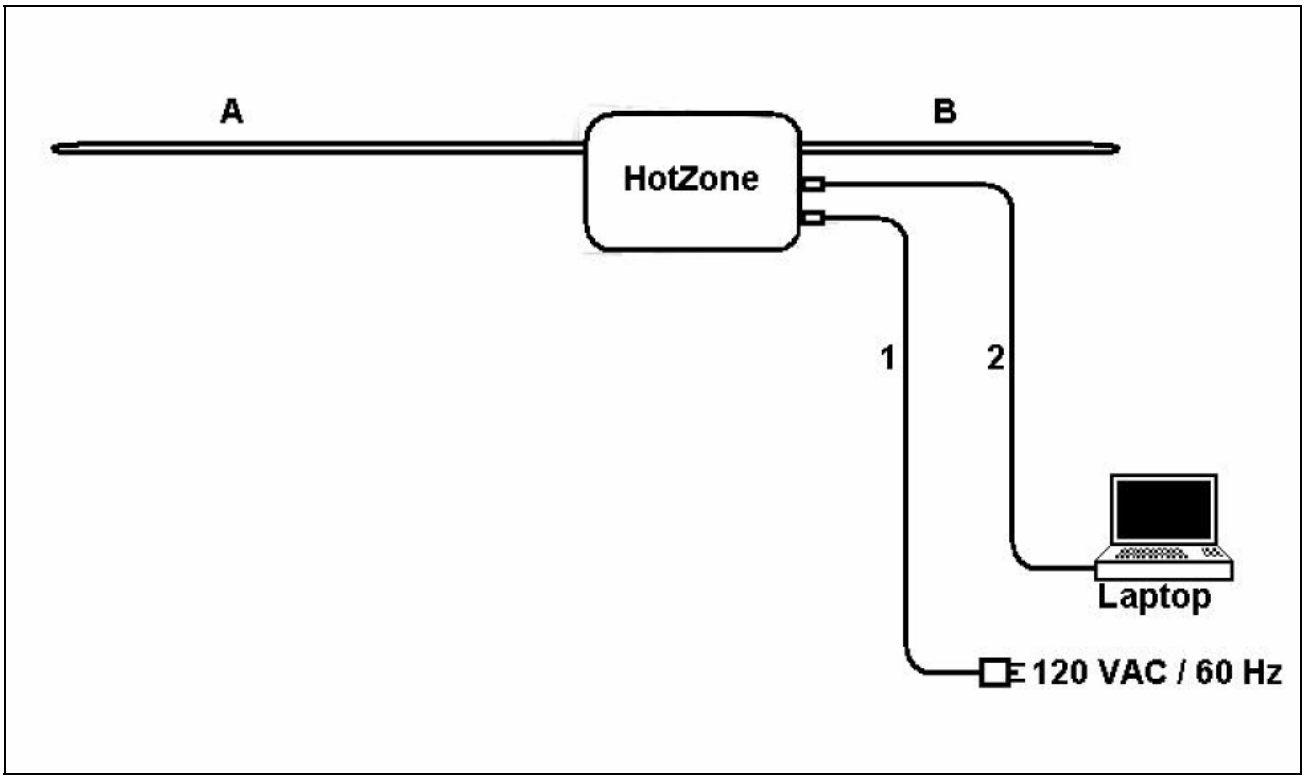



**Figure 1. Block Diagram of Test Configuration (Radiated Emissions)**

## E. Equipment Configuration

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

| Ref. ID | Name / Description | Gain | Manufacturer | Model Number |
|---|---|---|---|---|
| B | 5.725-5.875 GHz Antenna | 10 dBi | Radiall/Larsen | R380700212 |
| A | 2.4-2.5 GHz Antenna | 8 dBi | Radiall/Larsen | R380.500.226 |

**Table 3. Equipment Configuration**

| | Card Name | Card Description |
|---|---|---|
| **Hot Zone** | AP30 – 2.4 | AP30 802.11 b/g 2.4 GHz Radio Module |
| | AP30 – 5.8 | AP30 802.11 a 5.8 GHz Radio Module |

## F. Support Equipment

Motorola - Mesh Networks Product Group supplied support equipment necessary for the operation and testing of the HotZone Duo. All support equipment supplied is listed in the following Support Equipment List.

| Ref. ID | Manufacturer | Model | Serial Number | FCC ID |
|---|---|---|---|---|
| Laptop | Dell | Inspiron 3800 | 33252720049 | LNQUSA-34522-M5-E |

**Table 4. Support Equipment**

## G. Ports and Cabling Information

| Ref. ID | Port Name on EUT | Cable Description | Qty. | Length (m) | Shielded (Y/N) | Termination Point |
|---|---|---|---|---|---|---|
| 1 | Power | 4 cond, 18 ga. | 1 | 3.7 | Yes | AC Power |
| 2 | Ethernet | 4 pair twisted, 24 ga. | 1 | 3.7 | Yes | Laptop |

**Table 5. Ports and Cabling Information**

## H. Mode of Operation

The EUT was operated in the following manner:
The EUT was equipped with diagnostic software. The output power, transmit mode, transmit channel, and data rates could be controlled depending on each test. Output power for each channel was at the highest power which allowed compliance. Transmit mode was [TX100]. If not otherwise noted, for each test, the data rate was at maximum.

## I. Modifications

### a) Modifications to EUT

In order to attain the proper Conducted Power level, the output of the HotZone in 802.11 b mode must be software controlled per channel as follows:

Channel 1 : 27 dBm
Channel 2 : 26 dBm
Channel 3 : 26 dBm
Channel 4 : 26 dBm
Channel 5 : 26 dBm
Channel 6 : 26 dBm
Channel 7 : 26 dBm
Channel 8 : 26 dBm
Channel 9 : 26 dBm
Channel 10 : 26 dBm
Channel 11 : 26 dBm

In order to attain the proper Restricted Band level, the output of the HotZone in 802.11 g mode must be software controlled per channel as follows:

Channel 1 : 24 dBm
Channel 2 : 26 dBm
Channel 3 : 26 dBm
Channel 4 : 27 dBm
Channel 5 : 27 dBm
Channel 6 : 25 dBm
Channel 7 : 24 dBm
Channel 8 : 23 dBm
Channel 9 : 23 dBm
Channel 10 : 22 dBm
Channel 11 : 21 dBm

These are the modifications necessary for compliance to the restricted band emissions:

Band-Edge Corrections.

1.) U15, U16 from a LT6600CS8-20 to a LT6600CS8-10.

2.) U14,U51 from a MDR747F-T to a MDR767F-T.

Noise Floor Corrections.

1.) U13 Short Pins 37,38 and 39 together.

2.) U13 Short Pins 40,41 and 42 together.

3.) C129, C134 from a 1.8pF Capacitor to a 1.5pF Capacitor.

4.) C130 from a 1.8pF Capacitor to a 3.3nH Inductor.

5.) R57 from a 49.9 Ohm Resistor to a 1.0pF Capacitor.

6.) R58 from a DNP to a 1.8nH Inductor.

7.) R59 from a DNP to a 1.8pF Capacitor.

8.) L57 from a 3.3nH Inductor to a DNP.

9.) C296 from a 1.2pF Capacitor to a 3.3pF Capacitor.

10.) L59 from a 1.5nH Inductor to a DNP.

**b) Modifications to Test Standard**

No modifications were made to the test standard.

## J. Disposition of EUT

The test sample including all support equipment submitted to the Electro-Magnetic Compatibility Lab for testing was returned to Motorola - Mesh Networks Product Group upon completion of testing.

# III. 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 meets the criteria of this rule by virtue of being professionally installed. The EUT is therefore compliant with §15.203.

| Name / Description | Gain | Manufacturer | Model Number |
|---|---|---|---|
| 5.725-5.875 GHz Antenna | 10 dBi | Radiall/Larsen | R380700212 |
| 2.4-2.5 GHz Antenna | 8 dBi | Radiall/Larsen | R380.500.226 |

**Test Engineer(s):** Len Knight

**Test Date(s):** July 11, 2006

# Electromagnetic Compatibility Criteria for Intentional Radiators

## § 15.205 Band Edge Emissions

**Test Requirement(s):** **§ 15.205 (a):** Except as shown in paragraph (d) of **15.205 Restricted bands of operation**, only spurious emissions are permitted in any of the frequency bands specified in Table 6:

| MHz | MHz | MHz | GHz |
|---|---|---|---|
| 0.090–0.110 | 16.42–16.423 | 399.9–410 | 4.5–5.15 |
| 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 | Note |
| 13.36–13.41. | | | |
| Note : Above 38.6 | | | |

**Table 6. Restricted Bands of Operation from FCC Part 15, § 15.205**

**Test Procedure:** The EUT was set up at maximum power, first on Channel 1, then on Channel 11. It was verified that the first channel and the last channel were within the band 2400-2480 MHz and not infringing upon the restricted bands. The EUT was tested in both 802.11b and 802.11g modes of operation.

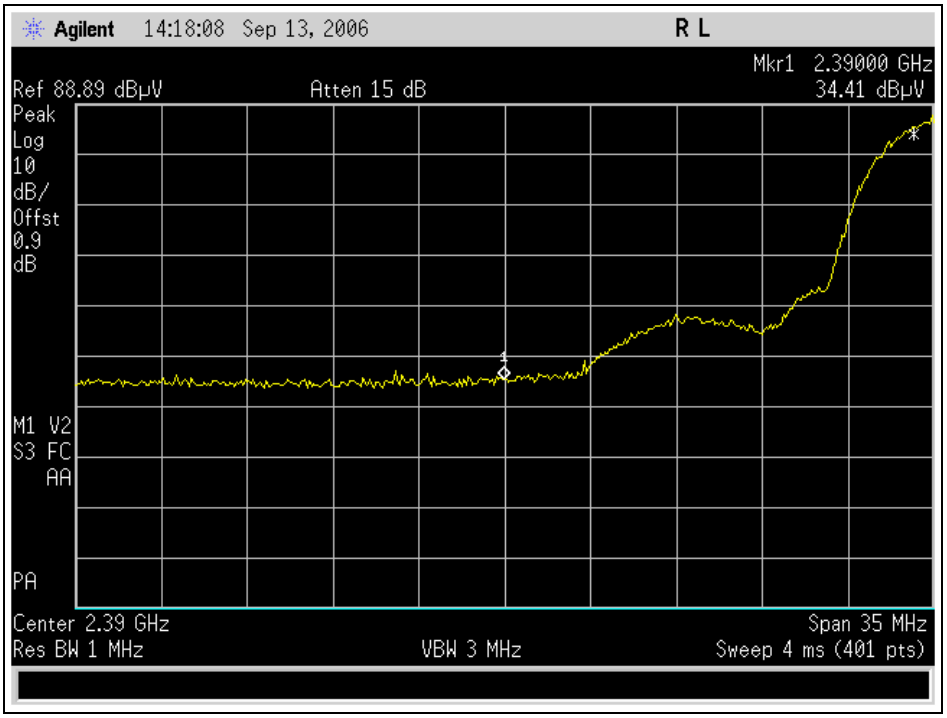
**Test Results:** The EUT was found compliant with the requirements of this section.

**Test Engineer:** Len Knight

**Test Date:** 8/31/2006

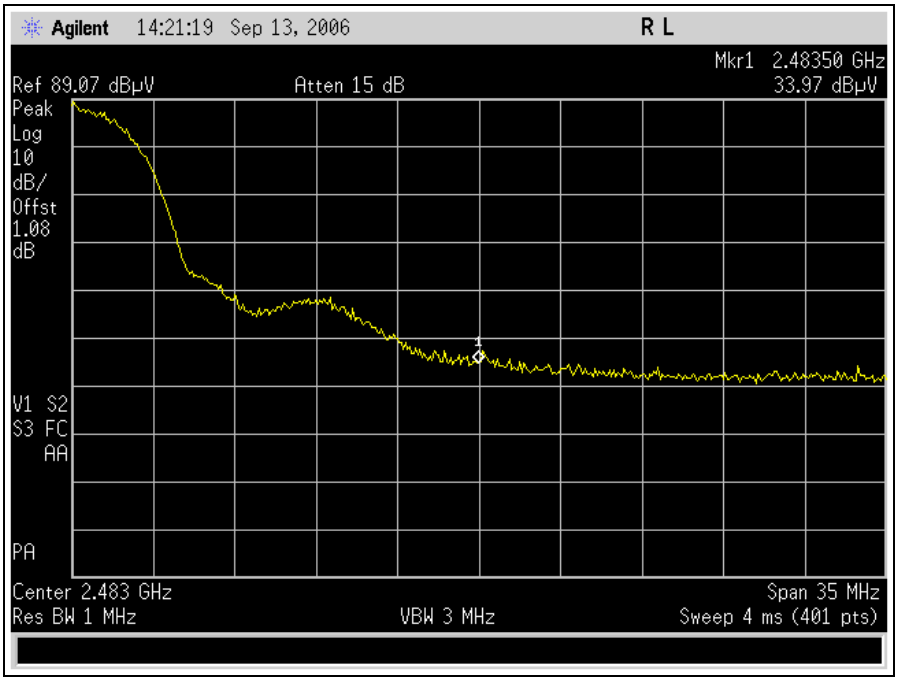
  

## Band Edge Emissions – Test Results




**Plot 1. Band Edge Emissions, Channel 1, 802.11 b**

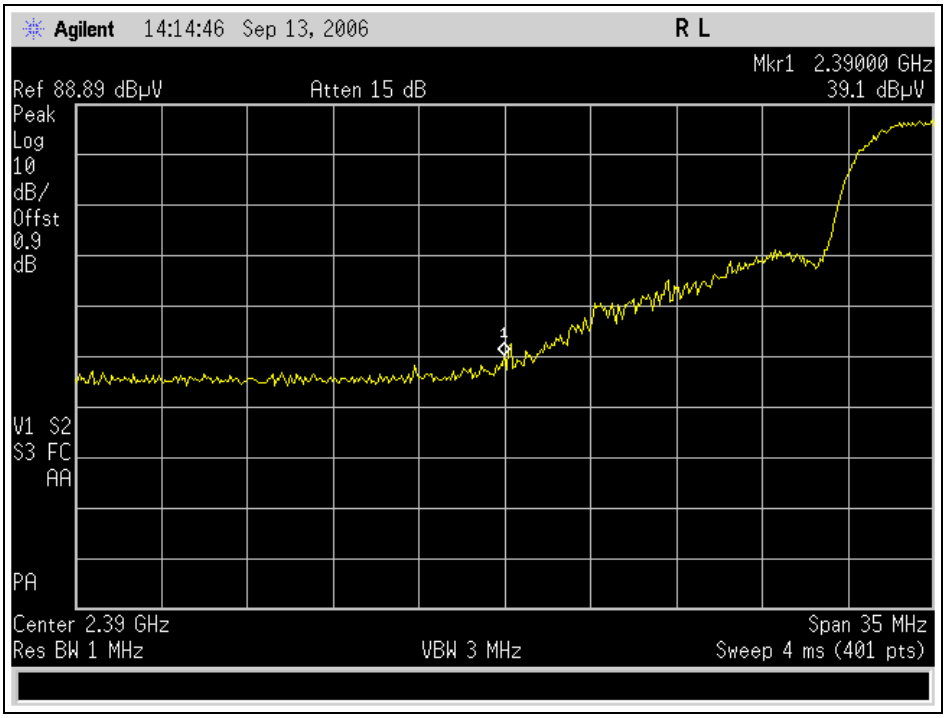
## Band Edge Emissions – Test Results




**Plot 2. Band Edge Emissions Channel 11, 802.11 b**

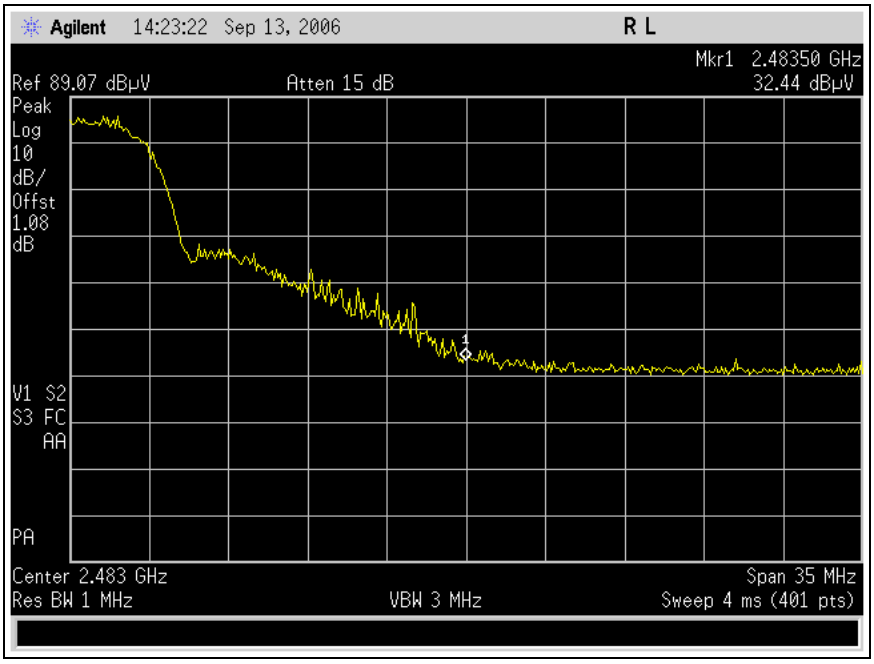
| Frequency (GHz) | EUT Azimuth (Degrees) | Antenna Polarity (H/V) Antenna Height (m) | | Antenna Correction Factor (dB) | Cable Loss/Pre-amp System Gain Correction Factor (dB) | Corrected Measurement (dBuV/m) | | Emissions Limit @ 3m (dBuV/m) | | Margin (dB) | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Peak | Average | | | Peak | Average | Peak | Average | Peak | Average |
| 2.99 | 0 | 34.41 | 21.38 | 28.57 | 1 | 63.98 | 50.95 | 74 | 54 | -10.02 | -3.05 |
| 2.4835 | 0 | 33.97 | 23.28 | 28.76 | 1 | 63.73 | 53.04 | 74 | 54 | -10.27 | -0.96 |

## Band Edge Emissions – Test Results




**Plot 3. Band Edge Emissions Channel 1, 802.11 g**

## Band Edge Emissions – Test Results




**Plot 4. Band Edge Emissions Channel 11, 802.11 g**

| Frequency (GHz) | EUT Azimuth (Degrees) | Antenna Polarity (H/V) Antenna Height (m) | | Antenna Correction Factor (dB) | Cable Loss/Pre-amp System Gain Correction Factor (dB) | Corrected Measurement (dBuV/m) | | Emissions Limit @ 3m (dBuV/m) | | Margin (dB) | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Peak | Average | | | Peak | Average | Peak | Average | Peak | Average |
| 2.39 | 0 | 39.01 | 20.6 | 28.85 | 1 | 68.95 | 50.45 | 74 | 54 | -5.05 | -3.55 |
| 2.4835 | 0 | 32.44 | 21.6 | 29.06 | 1 | 62.5 | 51.66 | 74 | 54 | -11.5 | -2.34 |

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

**Test Procedure:** 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 C63.4-1992 "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. The tests were conducted in a RF-shielded enclosure.

**Test Results:** The EUT was found compliant with the Conducted Emission limits of **§15.207(a)** for Intentional Radiators. See following pages for detailed test results.

**Test Engineer(s):** Len Knight

**Test Date(s):** July 17, 2006

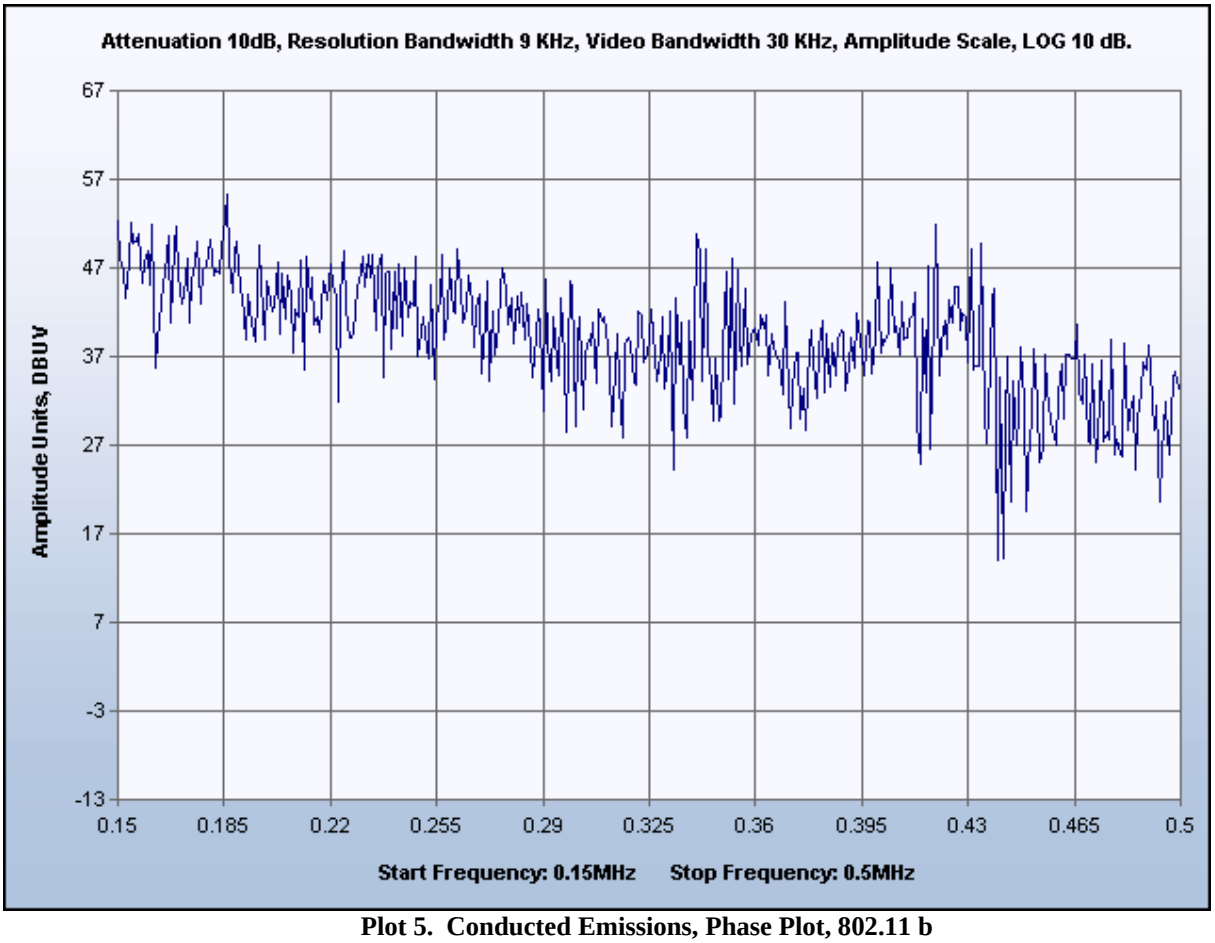
## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.207 Conducted Emissions Limits

### Conducted Emissions - Voltage, Phase (120VAC, 60Hz), 802.11 b

| Frequency (MHz) | Quasi-Peak Amplitude (dBµV) | Quasi-Peak Limit (dBµV) | Quasi-Peak Margin (dBµV) | Average Amplitude (dBµV) | Average Limit (dBµV) | Average Margin (dBµV) |
|---|---|---|---|---|---|---|
| 0.15333 | 42.23 | 79 | -36.77 | 14.98 | 66 | -51.02 |
| 0.16477 | 47.44 | 79 | -31.56 | 40.97 | 66 | -25.03 |
| 0.220137 | 40.9 | 79 | -38.1 | 36.1 | 66 | -29.9 |
| 0.385172 | 38.26 | 79 | -40.74 | 37.56 | 66 | -28.44 |
| 0.386765 | 35.48 | 79 | -43.52 | 34.87 | 66 | -31.13 |
| 0.663353 | 30.3 | 73 | -42.7 | 29.67 | 60 | -30.33 |
| 14.582 | 24.95 | 73 | -48.05 | 10.46 | 60 | -49.54 |

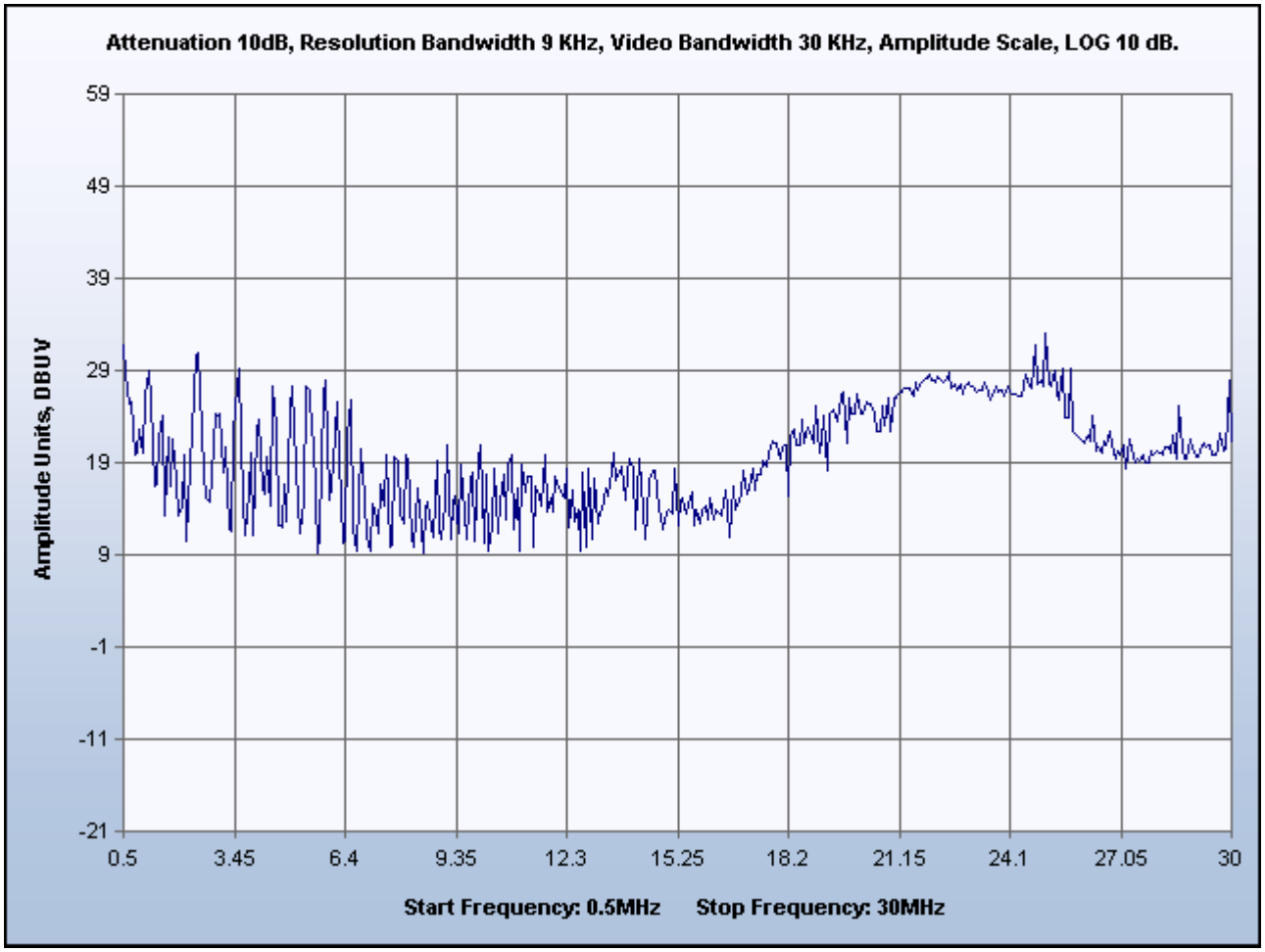
**Table 8. Conducted Emissions - Voltage, Phase (120VAC, 60Hz), 802.11 b**




**Plot 5. Conducted Emissions, Phase Plot, 802.11 b**

## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.207 Conducted Emissions Limits




**Plot 6. Conducted Emission, Phase Line Plot, 802.11 b**

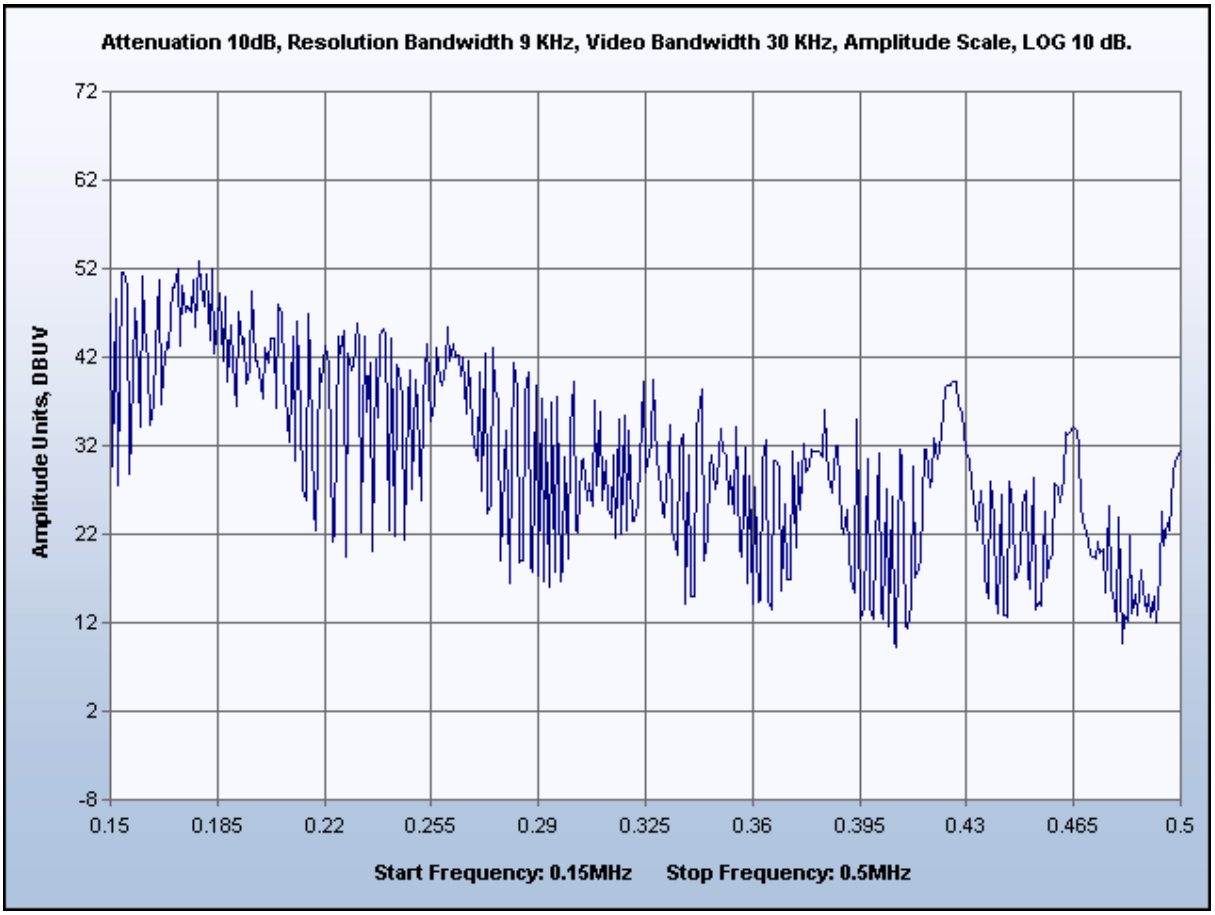
## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.207 Conducted Emissions Limits

### Conducted Emissions - Voltage, Neutral (120VAC, 60Hz), 802.11 b

| Frequency (MHz) | Quasi-Peak Amplitude (dBµV) | Quasi-Peak Limit (dBµV) | Quasi-Peak Margin (dBµV) | Average Amplitude (dBµV) | Average Limit (dBµV) | Average Margin (dBµV) |
|---|---|---|---|---|---|---|
| 0.16445 | 47.12 | 79 | -31.88 | 40.36 | 66 | -25.64 |
| 0.170278 | 42.83 | 79 | -36.17 | 34.87 | 66 | -31.13 |
| 0.331746 | 30.58 | 79 | -48.42 | 29.14 | 66 | -36.86 |
| 0.386126 | 38.19 | 79 | -40.81 | 37.34 | 66 | -28.66 |
| 0.993718 | 34.96 | 73 | -38.04 | 34.15 | 60 | -25.85 |
| 1.09996 | 33.68 | 73 | -39.32 | 29.74 | 60 | -30.26 |
| 6.01666 | 29.94 | 73 | -43.06 | 21.24 | 60 | -38.76 |

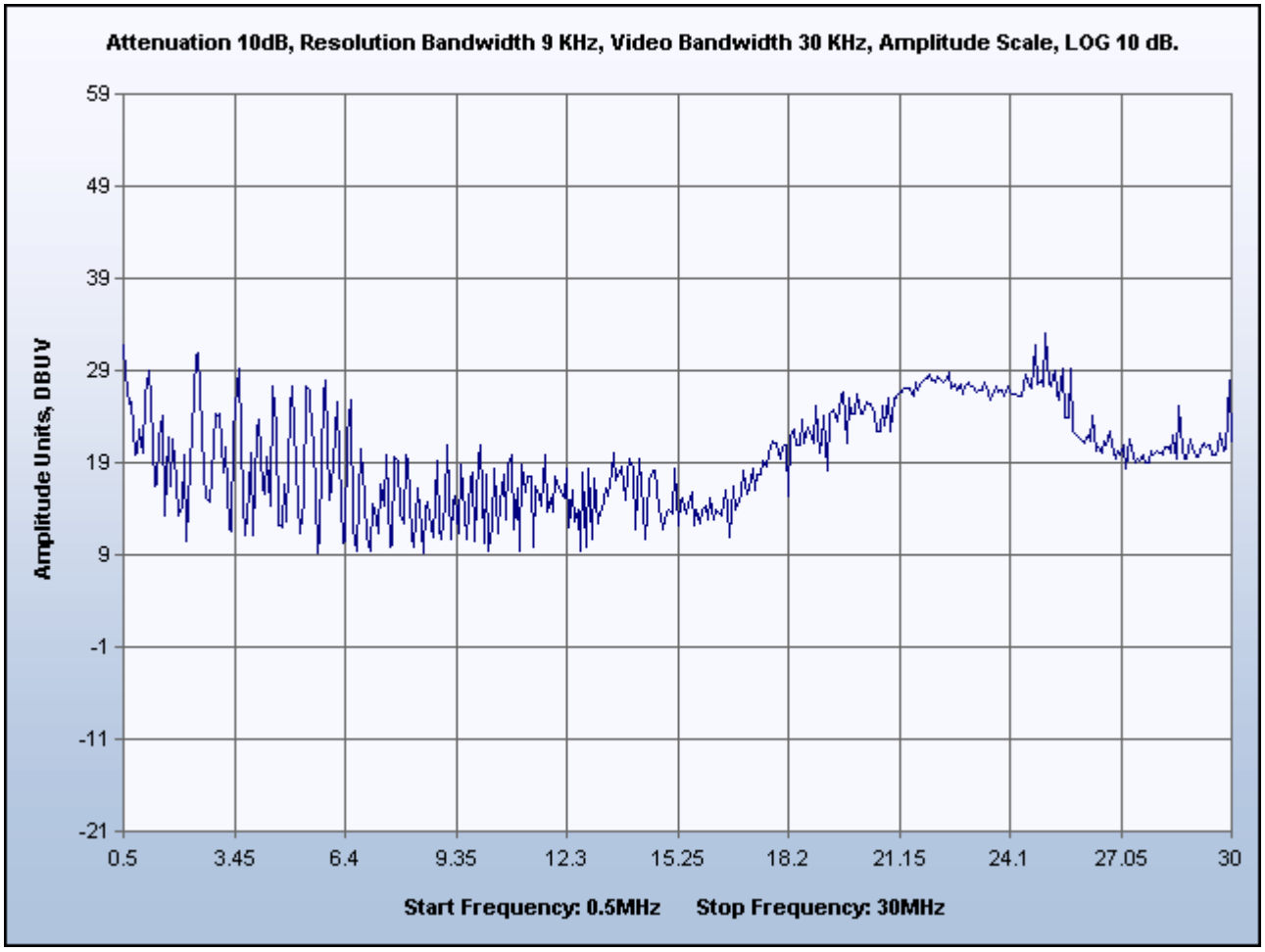
**Table 9. Conducted Emissions - Voltage, Neutral (120VAC, 60Hz), 802.11 b**




**Plot 7. Conducted Emission, Neutral Plot, 802.11 b**

## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.207 Conducted Emissions Limits




**Plot 8. Conducted Emission, Neutral Plot, 802.11 b**

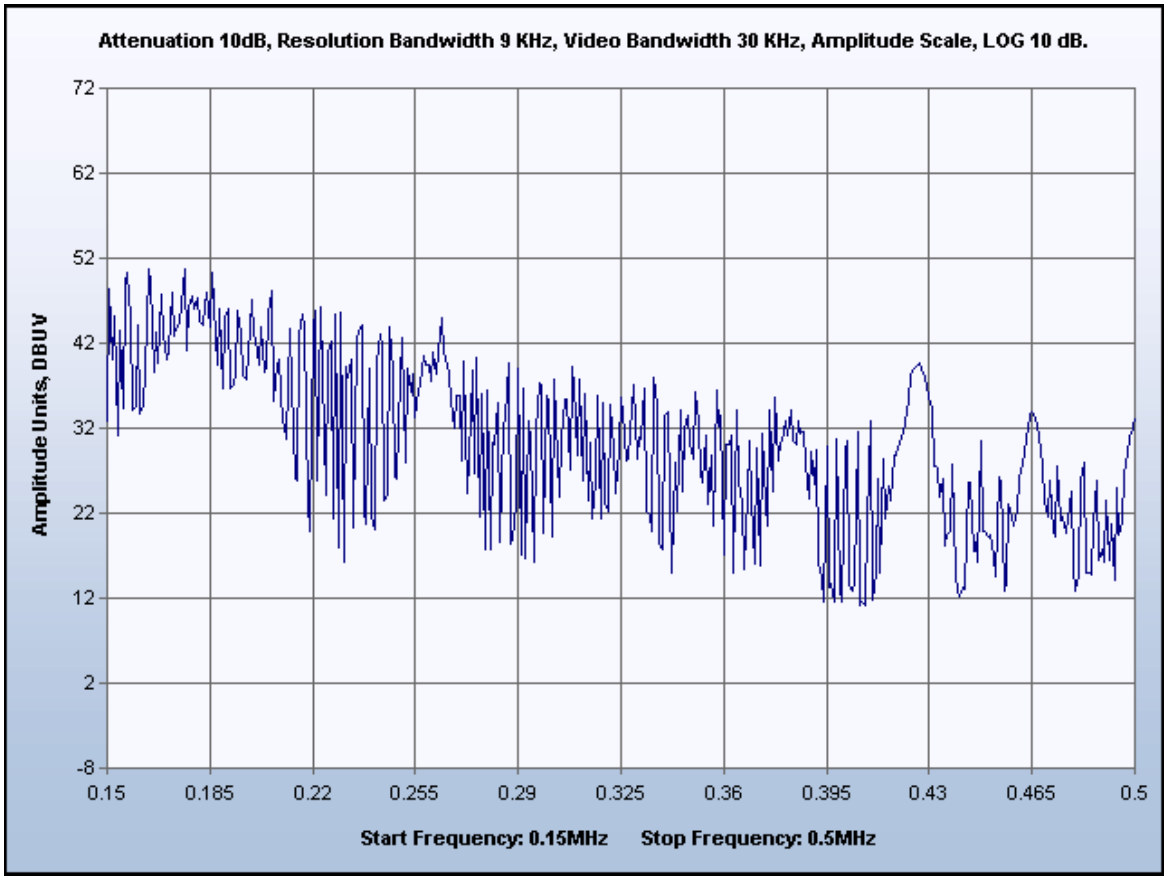
## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.207 Conducted Emissions Limits

### Conducted Emissions - Voltage, Phase (120VAC, 60Hz), 802.11 g

| Frequency (MHz) | Quasi-Peak Amplitude (dBµV) | Quasi-Peak Limit (dBµV) | Quasi-Peak Margin (dBµV) | Average Amplitude (dBµV) | Average Limit (dBµV) | Average Margin (dBµV) |
|---|---|---|---|---|---|---|
| 0.164209 | 45.9 | 79 | -33.1 | 39.43 | 66 | -26.57 |
| 0.222128 | 40.87 | 79 | -38.13 | 35.95 | 66 | -30.05 |
| 0.335 | 29.96 | 79 | -49.04 | 28.02 | 66 | -37.98 |
| 0.387617 | 39.92 | 79 | -39.08 | 39.33 | 66 | -26.67 |
| 0.442144 | 32.93 | 79 | -46.07 | 32.19 | 66 | -33.81 |
| 0.664172 | 30.91 | 73 | -42.09 | 30.2 | 60 | -29.8 |
| 16.001 | 23.45 | 73 | -49.55 | 11.03 | 60 | -48.97 |

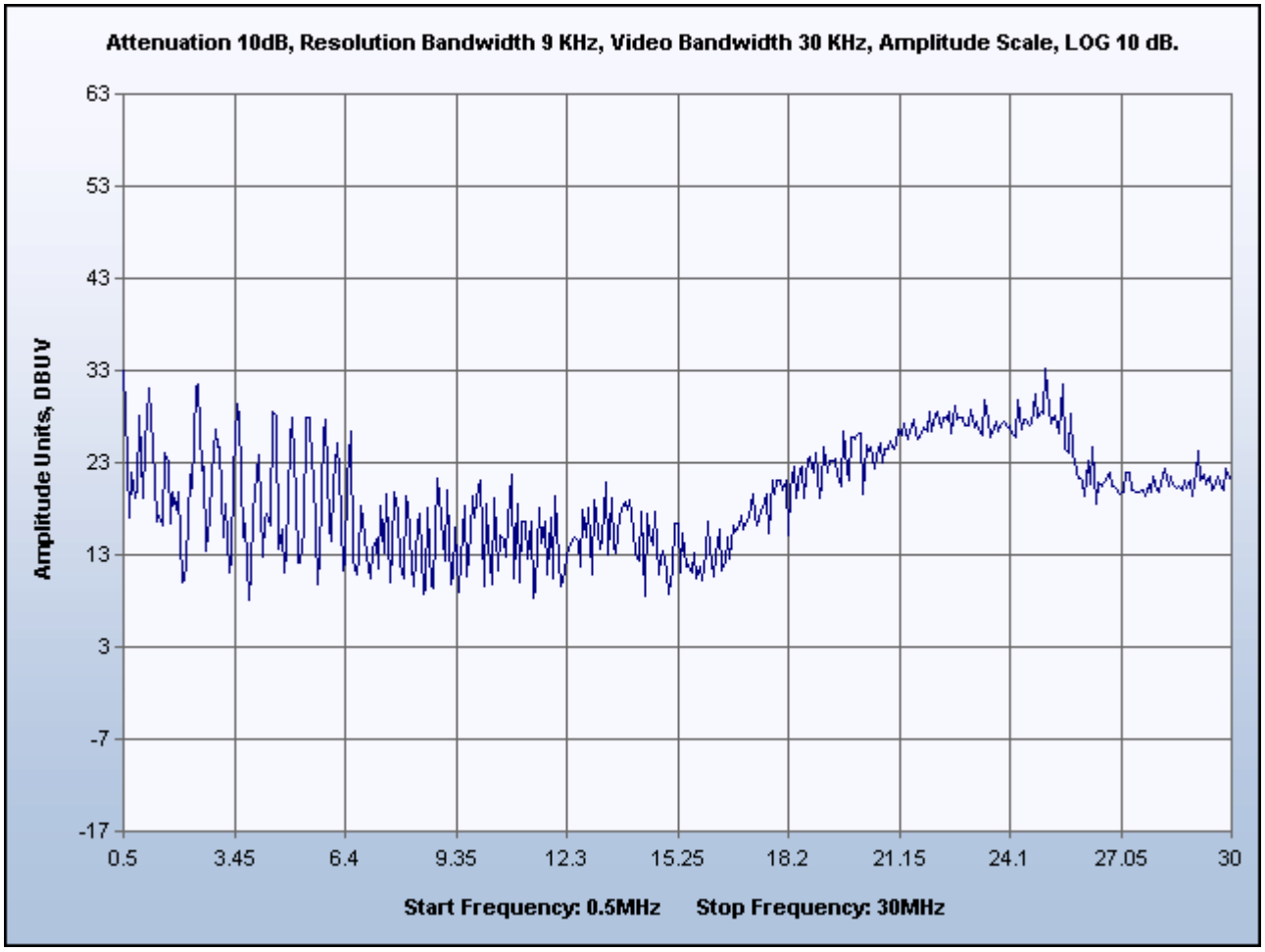
**Table 10. Conducted Emissions - Voltage, Phase (120VAC, 60Hz), 802.11 g**




**Plot 9. Conducted Emission, Phase Plot, 802.11 g**

## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.207 Conducted Emissions Limits




**Plot 10. Conducted Emission, Phase Plot, 802.11 g**

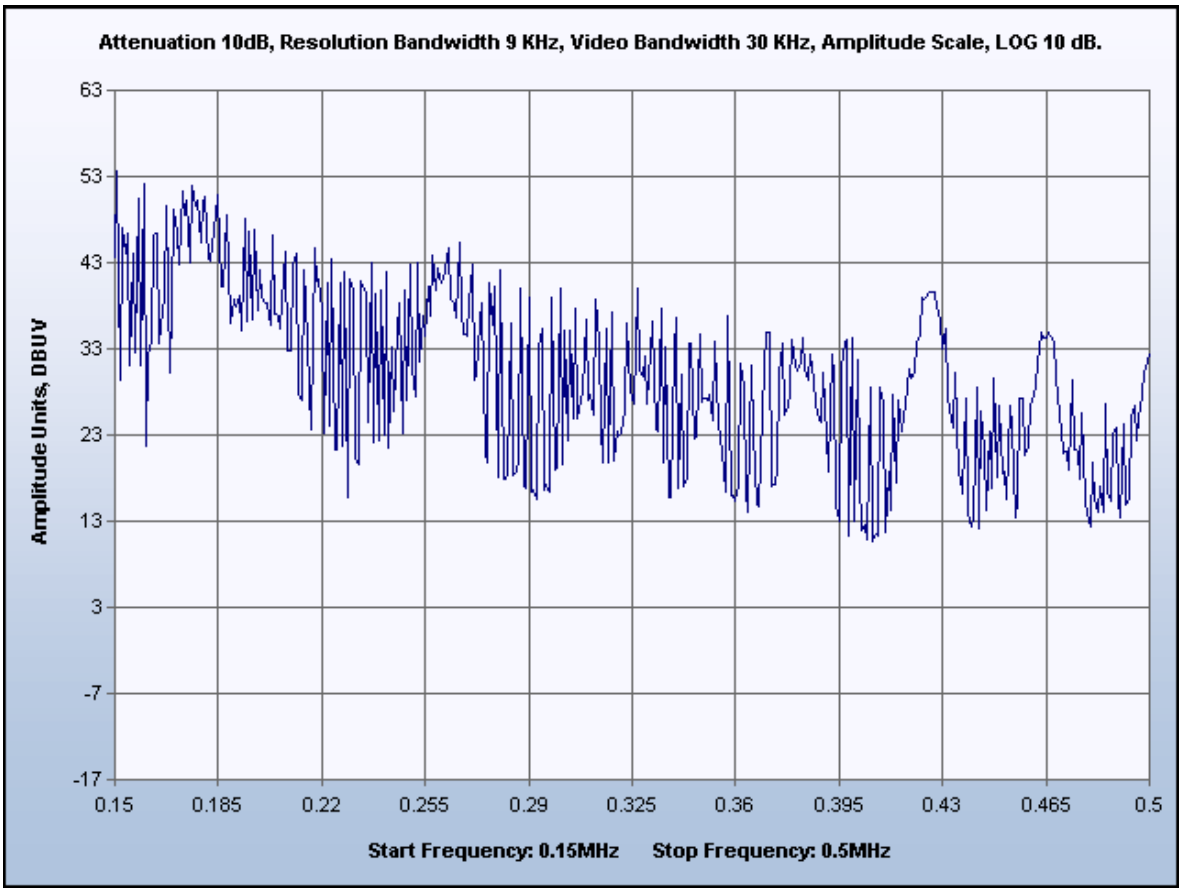
## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.207 Conducted Emissions Limits

## Conducted Emissions - Voltage, Neutral (120VAC, 60Hz), 802.11 g

| Frequency (MHz) | Quasi-Peak Amplitude (dBµV) | Quasi-Peak Limit (dBµV) | Quasi-Peak Margin (dBµV) | Average Amplitude (dBµV) | Average Limit (dBµV) | Average Margin (dBµV) |
|---|---|---|---|---|---|---|
| 0.169751 | 44.96 | 79 | -34.04 | 37.72 | 66 | -28.28 |
| 0.218902 | 40.5 | 79 | -38.5 | 36.07 | 66 | -29.93 |
| 0.385761 | 38.99 | 79 | -40.01 | 38.48 | 66 | -27.52 |
| 0.492106 | 22.34 | 79 | -56.66 | 15.57 | 66 | -50.43 |
| 0.997824 | 35.31 | 73 | -37.69 | 33.76 | 60 | -26.24 |
| 1.2145 | 31.88 | 73 | -41.12 | 30.24 | 60 | -29.76 |
| 6.3465 | 31.87 | 73 | -41.13 | 15.92 | 60 | -44.08 |

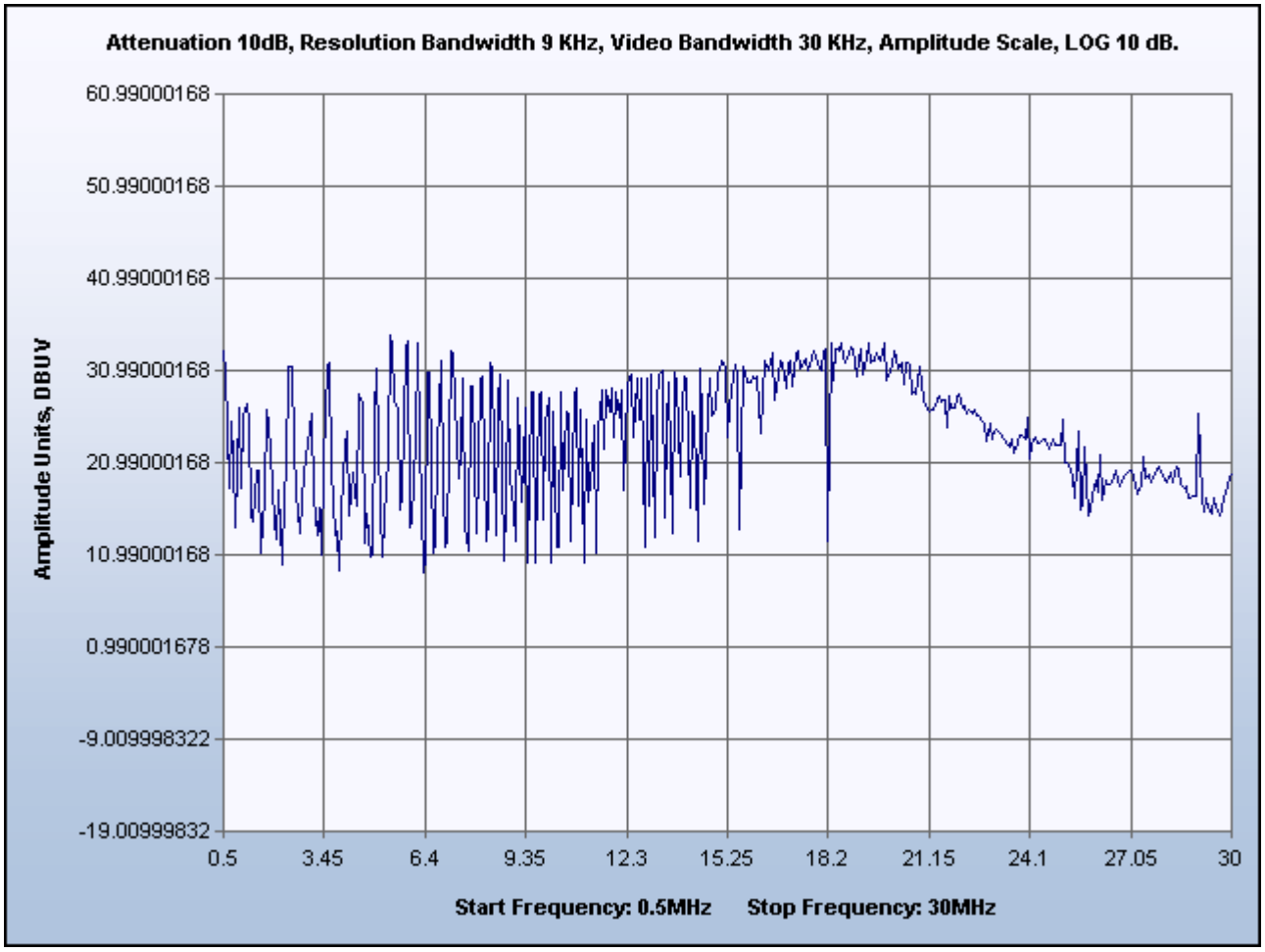
**Table 11. Conducted Emissions - Voltage, Neutral (120VAC, 60Hz), 802.11 g**




**Plot 11. Conducted Emission, Neutral Plot, 802.11 g**

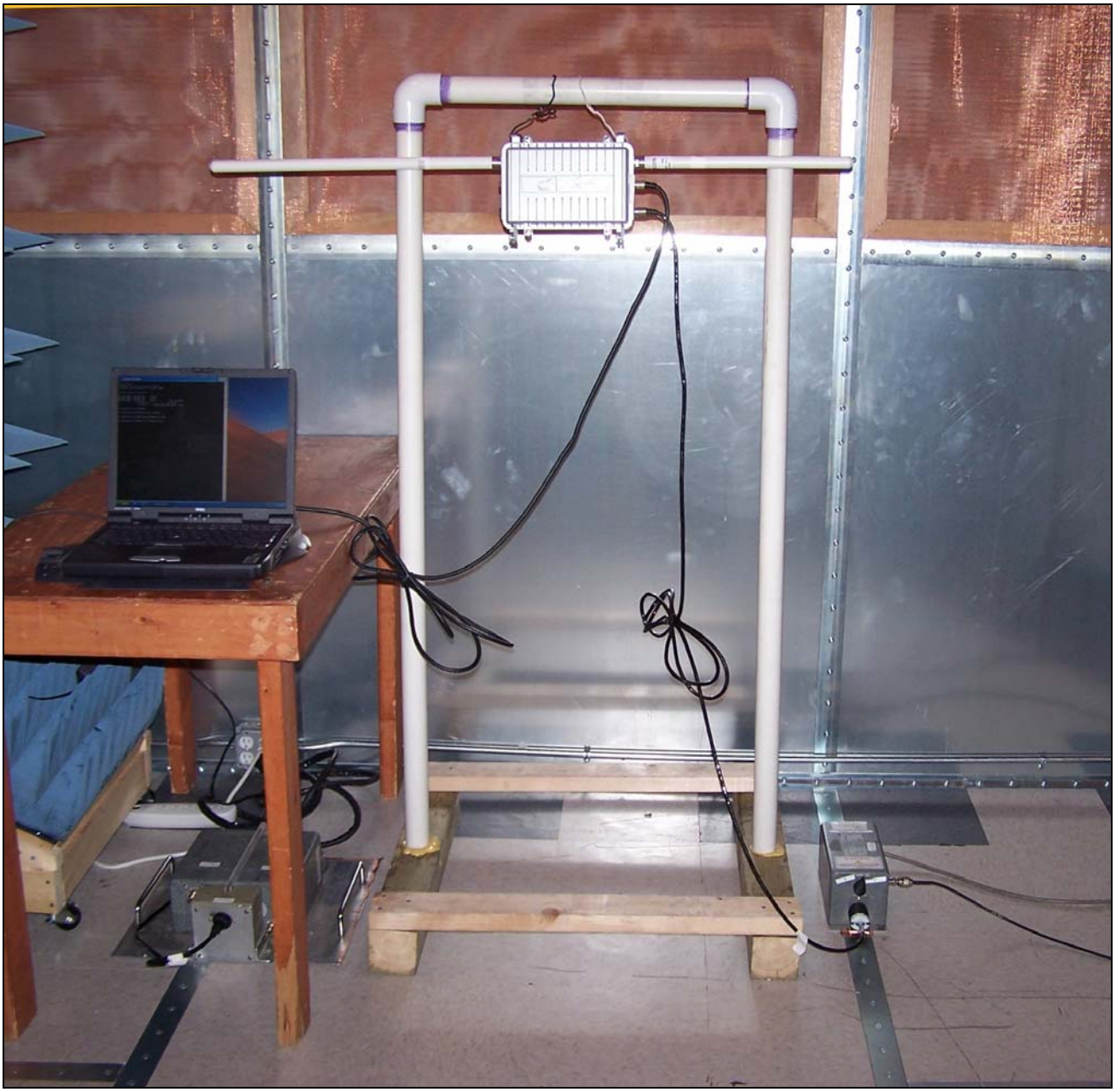
## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.207 Conducted Emissions Limits




**Plot 12. Conducted Emission, Neutral Plot, 802.11 g**

## Conducted Emission Limits Test Setup



**Photograph 1. Conducted Emissions Test Setup**

# Electromagnetic Compatibility Criteria for Intentional Radiators

## § 15.209 Radiated Emissions Limits

**Test Requirement(s):** **§ 15.205 (a):** Except as shown in paragraph (d) of **15.205 Restricted bands of operation**, only spurious emissions are permitted in any of the frequency bands specified in Table 12:

| MHz | MHz | MHz | GHz |
|---|---|---|---|
| 0.090–0.110 | 16.42–16.423 | 399.9–410 | 4.5–5.15 |
| 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 | Note |
| 13.36–13.41. | | | |
| Note: Above 38.6 | | | |

**Table 12. Restricted Bands of Operation from FCC Part 15, § 15.205**

**§ 15.205 (b):** (b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

**§ 15.35 (b):** …When average radiated emission measurements are specified in this part, including emission measurements below 1000 MHz, there also is a limit on the radio frequency emissions, as measured using instrumentation with a peak detector function, corresponding to 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…

| Frequency (MHz) | Field Strength (Microvolts/meter) | Measurement Distance (meters) |
|---|---|---|
| 0.009 – 0.490 | 2400/F (kHz) | 300 |
| 0.490 – 1.705 | 24000/F (kHz) | 30 |
| 1.705 – 30.0 | 30 | 30 |
| 30 - 88 | 100 ** | 3 |
| 88 - 216 | 150 ** | 3 |
| 216 - 960 | 200 ** | 3 |
| Above 960 | 500 | 3 |
| ** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241. | | |

**Table 13. Radiated Emissions Limits from § 15.209 (a)**

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

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

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.

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 found compliant with the requirements of this section.

**Test Engineer(s):** Len Knight and Jeff Hazen

**Test Date(s):** 6/4/2006

### Radiated Emissions Limits Test Results – 30 MHz to 1 GHz, 802.11g

| Frequency (MHz) | EUT Azimuth (Degrees) | Antenna Polarity (H/V) | Antenna HEIGHT (m) | Uncorrected Amplitude (dBuv) | Antenna Correction Factor (dB) (+) | Cable Loss (dB) (+) | Distance Correction Factor (dB) (-) | Corrected Amplitude (dBuv) | Limit (dBuv) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|---|
| 35.259 | 226 | H | 3.69 | 16.48 | 7.96 | 0.45 | 10.46 | 14.43 | 39.00 | -24.57 |
| 35.259 | 331 | V | 1.00 | 17.88 | 7.55 | 0.45 | 10.46 | 15.42 | 39.00 | -23.58 |
| 52.101 | 0 | H | 4.00 | 20.00 | 10.20 | 0.63 | 10.46 | 20.38 | 39.00 | -18.62 |
| 52.101 | 289 | V | 1.00 | 31.52 | 9.23 | 0.63 | 10.46 | 30.93 | 39.00 | -8.07 |
| 52.177 | 360 | H | 4.00 | 19.70 | 10.22 | 0.64 | 10.46 | 20.10 | 39.00 | -18.90 |
| 52.177 | 291 | V | 1.12 | 32.00 | 9.25 | 0.64 | 10.46 | 31.43 | 39.00 | -7.57 |
| 52.485 | 0 | H | 4.00 | 18.24 | 10.30 | 0.64 | 10.46 | 18.71 | 39.00 | -20.29 |
| 52.485 | 310 | V | 1.00 | 27.66 | 9.35 | 0.64 | 10.46 | 27.18 | 39.00 | -11.82 |
| 55.411 | 0 | H | 4.00 | 17.10 | 10.85 | 0.66 | 10.46 | 18.15 | 39.00 | -20.85 |
| 55.411 | 300 | V | 1.00 | 22.28 | 10.11 | 0.66 | 10.46 | 22.59 | 39.00 | -16.41 |
| <950.000 | 0 | H | 4.00 | 16.69 | 23.20 | 2.95 | 10.46 | 32.38 | 46.40 | -14.02 |
| 950.000 | 300 | V | 1.00 | 16.69 | 23.10 | 2.95 | 10.46 | 32.28 | 46.40 | -14.12 |

**Table 14. Radiated Emissions Limits Test Results, 802.11g**

Note 1: The EUT was tested at 3 m. The data has been corrected for comparison with the 10 m limit using the formula: 20log (3 m/10 m) as expressed in the 'Distance Correction' column.

Note 2: Where the less than (<) sign occurs in a row, this indicates that the frequency was investigated according to the pre-scan and emissions were below the measurement system noise floor at 3 m.

### Radiated Emissions Limits Test Results, 15.209 (a) – 802.11b, Channel 1

| Frequency (GHz) | EUT Azimuth (Degrees) | Antenna Polarity (H/V) | Antenna Height (m) | Antenna Correction Factor (dB) | Cable Loss/Pre-amp System Gain Correction Factor (dB) | Measurement Distance Correction Factor (dB) @ 3m | Corrected Measurement (dBuV/m) | | Emissions Limit @ 3m (dBuV/m) | | Margin (dB) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Peak | Average | Peak | Average | Peak | Average |
| 1.991 | 0 | H | 1.25 | 27.87 | 1 | 0 | 45 | 29.8 | 74 | 54 | -29 | -24.2 |
| 4.824 | 0 | H | 1.25 | 33.63 | 1 | 0 | 51.08 | 34.7 | 74 | 54 | -22.92 | -19.3 |
| 14.693 | 0 | H | 1.25 | 40.9 | 1 | 0 | 60.12 | 46.5 | 74 | 54 | -13.88 | -7.5 |
| 13.967 | 0 | H | 1.25 | 41.78 | 1 | 0 | 57.73 | 43.52 | 74 | 54 | -16.27 | -10.48 |
| 12.507 | 0 | H | 1.25 | 39.01 | 1 | 0 | 53.42 | 39.45 | 74 | 54 | -20.58 | -14.55 |
| 10.056 | 0 | H | 1.25 | 38.9 | 1 | 0 | 53.48 | 39.05 | 74 | 54 | -20.52 | -14.95 |

**Table 15. Radiated Emissions Test Results, 802.11b, Channel 1**

**Radiated Emissions Limits Test Results, 15.209 (a) – 802.11b, Channel 6**

| Frequency (GHz) | EUT Azimuth (Degrees) | Antenna Polarity (H/V) | Antenna Height (m) | Antenna Correction Factor (dB) | Cable Loss/Pre-amp System Gain Correction Factor (dB) | Measurement Distance Correction Factor (dB) @ 3m | Corrected Measurement (dBuV/m) | | Emissions Limit @ 3m (dBuV/m) | | Margin (dB) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Peak | Average | Peak | Average | Peak | Average |
| 1.989 | 0 | H | 1.25 | 27.86 | 1 | 0 | 46.27 | 27.93 | 74 | 54 | -27.73 | -26.07 |
| 1.395 | 0 | H | 1.25 | 25.15 | 1 | 0 | 44.44 | 29.46 | 74 | 54 | -29.56 | -24.54 |
| | | V | | | | | | | | | | |
| 1.195 | 0 | H | 1.25 | 24.63 | 1 | 0 | 45.13 | 31.19 | 74 | 54 | -28.87 | -22.81 |
| | | V | | | | | | | | | | |
| 4.874 | 0 | H | 1.25 | 33.78 | 1 | 0 | 51.106 | 34.64 | 74 | 54 | -22.89 | -19.36 |
| | | V | | | | | | | | | | |
| 14.771 | 0 | H | 1.25 | 40.58 | 1 | 0 | 59.11 | 44.99 | 74 | 54 | -14.89 | -9.01 |
| | | V | | | | | | | | | | |
| 13.972 | 0 | H | 1.25 | 41.79 | 1 | 0 | 59 | 43.87 | 74 | 54 | -15 | -10.13 |
| | | V | | | | | | | | | | |

**Table 16. Radiated Emissions Test Results, 802.11b, Channel 6**

**Radiated Emissions Limits Test Results, 15.209 (a) – 802.11b, Channel 11**

| Frequency (GHz) | EUT Azimuth (Degrees) | Antenna Polarity (H/V) | Antenna Height (m) | Antenna Correction Factor (dB) | Cable Loss/Pre-amp System Gain Correction Factor (dB) | Measurement Distance Correction Factor (dB) @ 3m | Corrected Measurement (dBuV/m) | | Emissions Limit @ 3m (dBuV/m) | | Margin (dB) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Peak | Average | Peak | Average | Peak | Average |
| 4.924 | 0 | H | 1.25 | 33.92 | 1 | 0 | 52 | 35.66 | 74 | 54 | -22 | -18.34 |
| 14.747 | 0 | H | 1.25 | 40.68 | 1 | 0 | 59.66 | 45.03 | 74 | 54 | -14.34 | -8.97 |
| 14.005 | 0 | H | 1.25 | 41.8 | 1 | 0 | 55.452 | 42.96 | 74 | 54 | -18.55 | -11.04 |
| 12.51 | 0 | H | 1.25 | 39.01 | 1 | 0 | 53.775 | 39.31 | 74 | 54 | -20.23 | -14.69 |

**Table 17. Radiated Emissions Test Results, 802.11b, Channel 11**

**Radiated Emissions Limits Test Results, 15.209 (a) – 802.11g, Channel 1**

| Frequency (GHz) | EUT Azimuth (Degrees) | Antenna Polarity (H/V) | Antenna Height (m) | Antenna Correction Factor (dB) | Cable Loss/Pre-amp System Gain Correction Factor (dB) | Measurement Distance Correction Factor (dB) @ 3m | Corrected Measurement (dBuV/m) | | Emissions Limit @ 3m (dBuV/m) | | Margin (dB) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Peak | Average | Peak | Average | Peak | Average |
| 14.693 | 0 | H | 1.25 | 40.9 | 2 | 0 | 56.61 | 46.87 | 74 | 54 | -17.39 | -7.13 |
| 14.01 | 0 | H | 1.25 | 41.8 | 2 | 0 | 56.24 | 43.31 | 74 | 54 | -17.76 | -10.69 |
| 12.505 | 0 | H | 1.25 | 39 | 2 | 0 | 51.55 | 41.3 | 74 | 54 | -22.45 | -12.7 |

**Table 18. Radiated Emissions Test Results, 802.11g, Channel 1**

**Radiated Emissions Limits Test Results, 15.209 (a) – 802.11g, Channel 6**

| Frequency (GHz) | EUT Azimuth (Degrees) | Antenna Polarity (H/V) | Antenna Height (m) | Antenna Correction Factor (dB) | Cable Loss/Pre-amp System Gain Correction Factor (dB) | Measurement Distance Correction Factor (dB) @ 3m | Corrected Measurement (dBuV/m) | | Emissions Limit @ 3m (dBuV/m) | | Margin (dB) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Peak | Average | Peak | Average | Peak | Average |
| 4.875 | 0 | H | 1.25 | 33.78 | 1 | 0 | 69.93 | 42.26 | 74 | 54 | -4.07 | -11.74 |
| 13.96 | 0 | H | 1.25 | 41.78 | 1 | 0 | 57.27 | 43.41 | 74 | 54 | -16.73 | -10.59 |
| 12.486 | 0 | H | 1.25 | 38.99 | 1 | 0 | 51.5 | 38.36 | 74 | 54 | -22.5 | -15.64 |
| 10.78 | 0 | H | 1.25 | 38.78 | 1 | 0 | 53.02 | 39.01 | 74 | 54 | -20.98 | -14.99 |
| 10 | 0 | H | 1.25 | 38.9 | 1 | 0 | 54.26 | 39.34 | 74 | 54 | -19.74 | -14.66 |
| 14.687 | 0 | H | 1.25 | 40.92 | 1 | 0 | 60.6 | 46.18 | 74 | 54 | -13.4 | -7.82 |

**Table 19. Radiated Emissions Test Results, 802.11g, Channel 6**

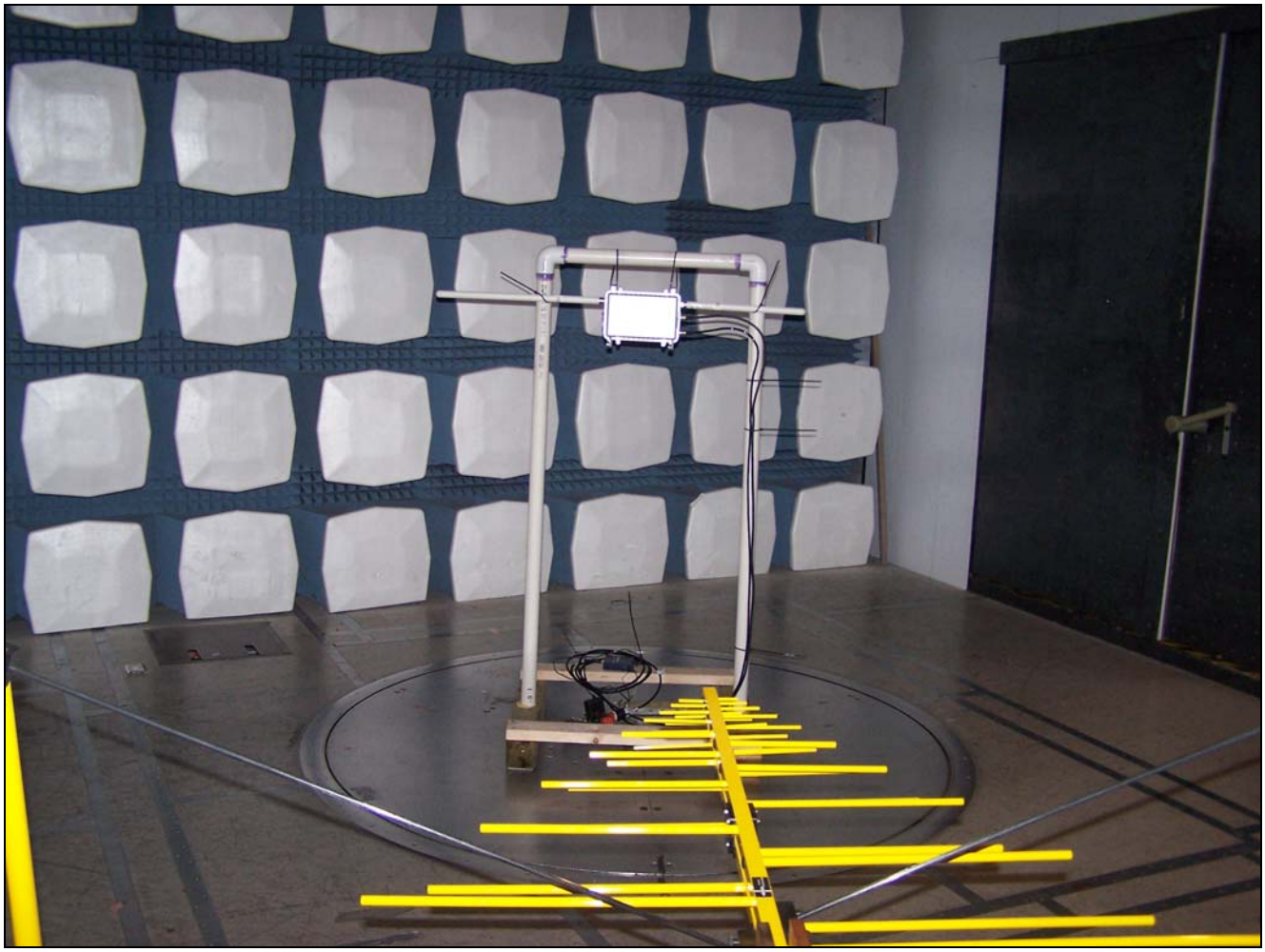
**Radiated Emissions Limits Test Results, 15.209 (a) – 802.11b, Channel 11**

| Frequency (GHz) | EUT Azimuth (Degrees) | Antenna Polarity (H/V) | Antenna Height (m) | Antenna Correction Factor (dB) | Cable Loss/Pre-amp System Gain Correction Factor (dB) | Measurement Distance Correction Factor (dB) @ 3m | Corrected Measurement (dBuV/m) | | Emissions Limit @ 3m (dBuV/m) | | Margin (dB) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Peak | Average | Peak | Average | Peak | Average |
| 4.927 | 0 | H | 1.25 | 33.78 | 1 | 0 | 61.55 | 32.53 | 74 | 54 | -12.45 | -21.47 |
| 14.687 | 0 | H | 1.25 | 41.78 | 1 | 0 | 59.72 | 46.41 | 74 | 54 | -14.28 | -7.59 |
| 13.996 | 0 | H | 1.25 | 38.99 | 1 | 0 | 57.89 | 42.97 | 74 | 54 | -16.11 | -11.03 |
| 12.443 | 0 | H | 1.25 | 38.78 | 1 | 0 | 52.35 | 38.57 | 74 | 54 | -21.65 | -15.43 |
| 10.817 | 0 | H | 1.25 | 38.9 | 1 | 0 | 50.11 | 38.17 | 74 | 54 | -23.89 | -15.83 |
| 10.113 | 0 | H | 1.25 | 40.92 | 1 | 0 | 52.76 | 39.17 | 74 | 54 | -21.24 | -14.83 |

**Table 20. Radiated Emissions Test Results, 802.11g, Channel 11**

## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.209 Radiated Emissions Limits



**Photograph 2. Radiated Emission Test Setup**

## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.247(a) 6 dB a 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:
**§ 15.247(a)(2):** 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 set to the mid channel at the highest output power and connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using a RBW of 100 kHz, VBW > RBW. The 6 dB Bandwidth was measured and recorded. The measurements were repeated at the low and high channels.

**Test Results:** Equipment complies with § 15.247 (a). The 6 dB Bandwidth was determined from the plots on the following pages.

**Test Engineer:** Len Knight

**Test Date:** June 12, 2006

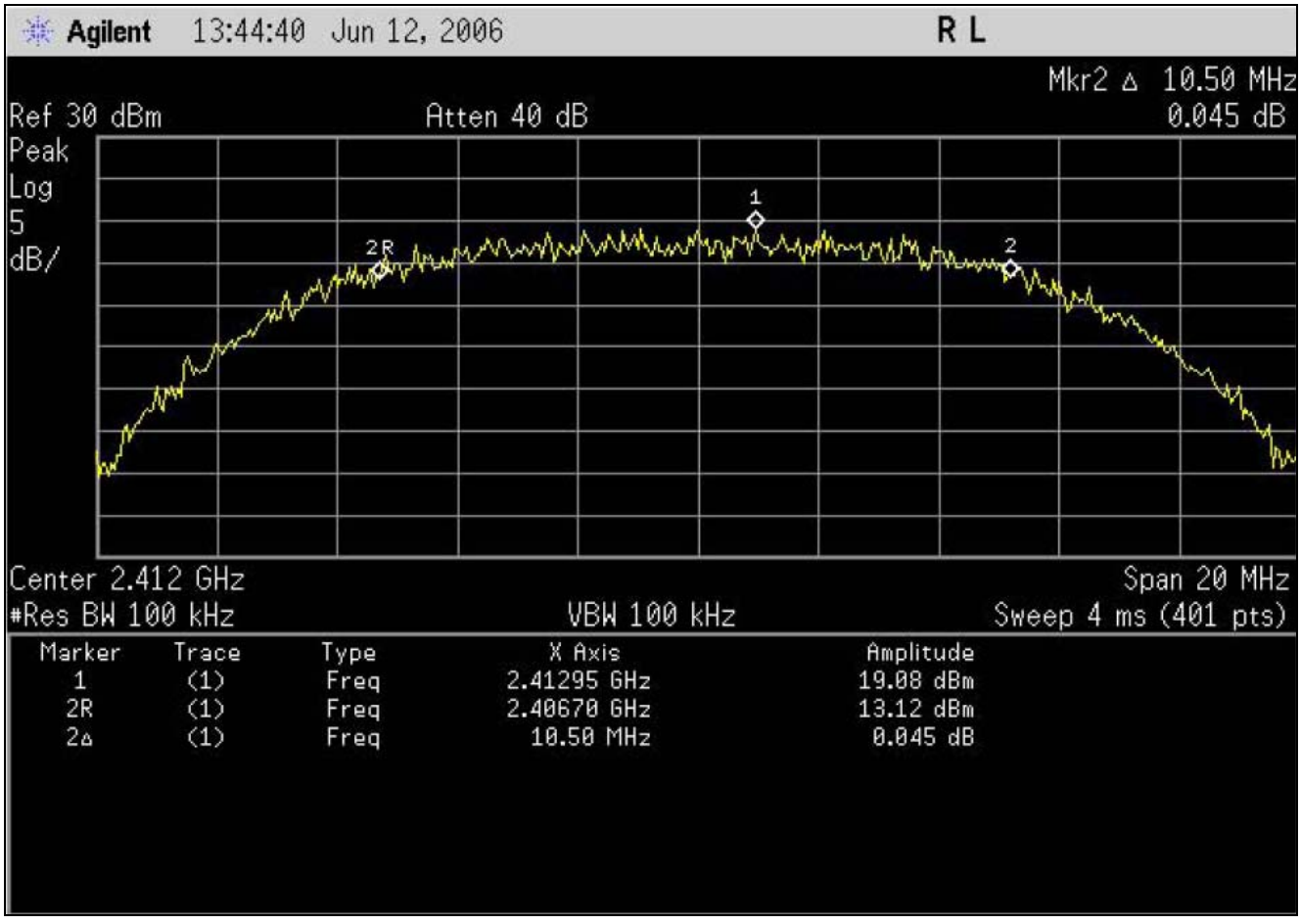
  

## Electromagnetic Compatibility Criteria for Intentional Radiators

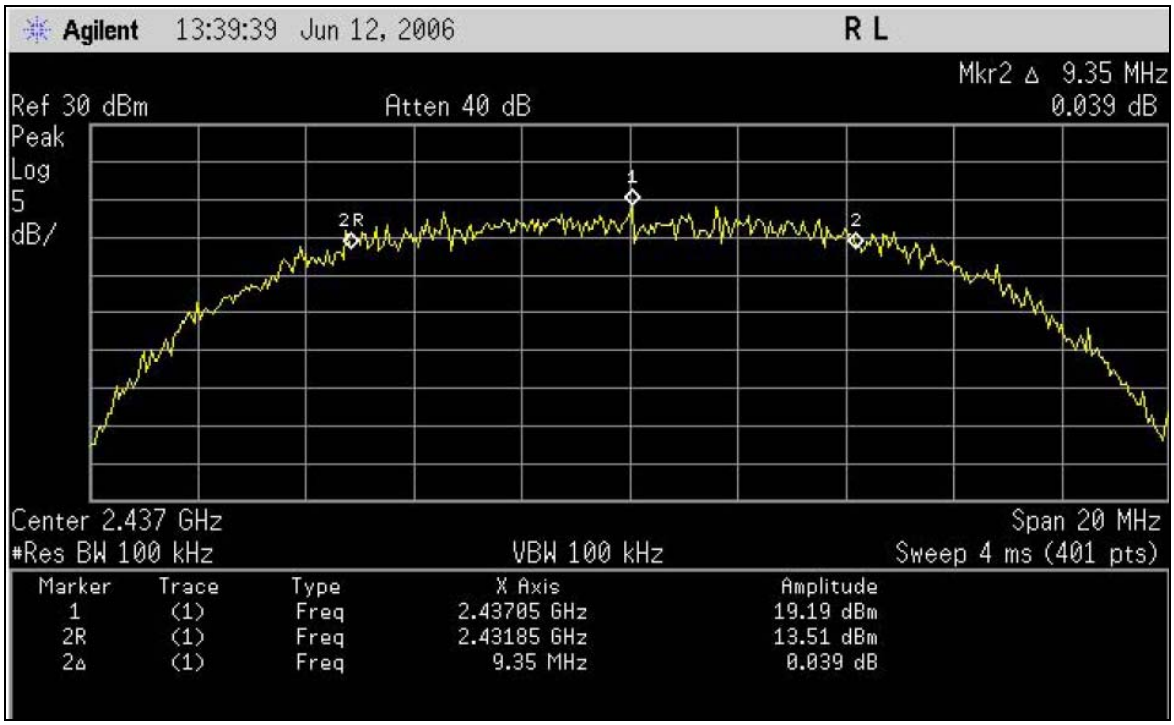
### § 15.247(a) 6 dB Bandwidth

| Band | Frequency | Measured 6dB Bandwidth |
|---|---|---|
| Low | 2.412 GHz | 10.5 MHz |
| Mid | 2.437 GHz | 9.35 MHz |
| High | 2.462 GHz | 10.2 MHz |

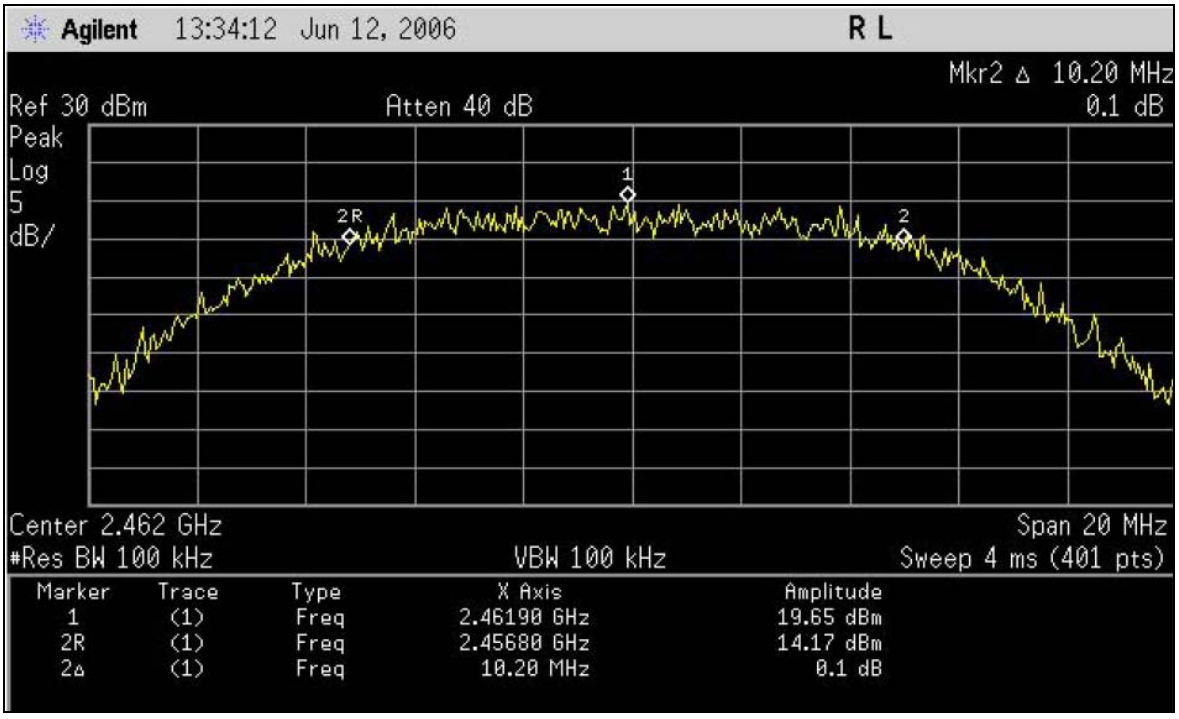
**Table 21. 6 dB Bandwith Test Results, 802.11b Mode**




**Plot 13. 802.11b Mode, Low**




**Plot 14. 802.11b Mode, Mid**



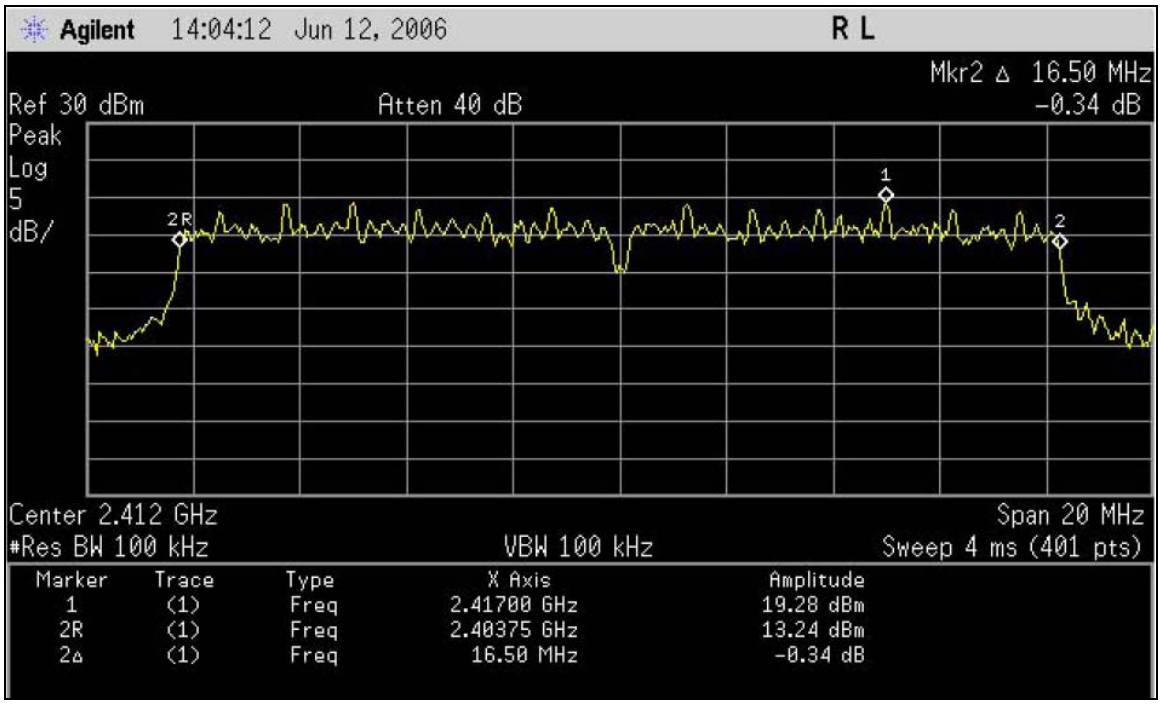

**Plot 15. 802.11b Mode, High**

## Electromagnetic Compatibility Criteria for Intentional Radiators

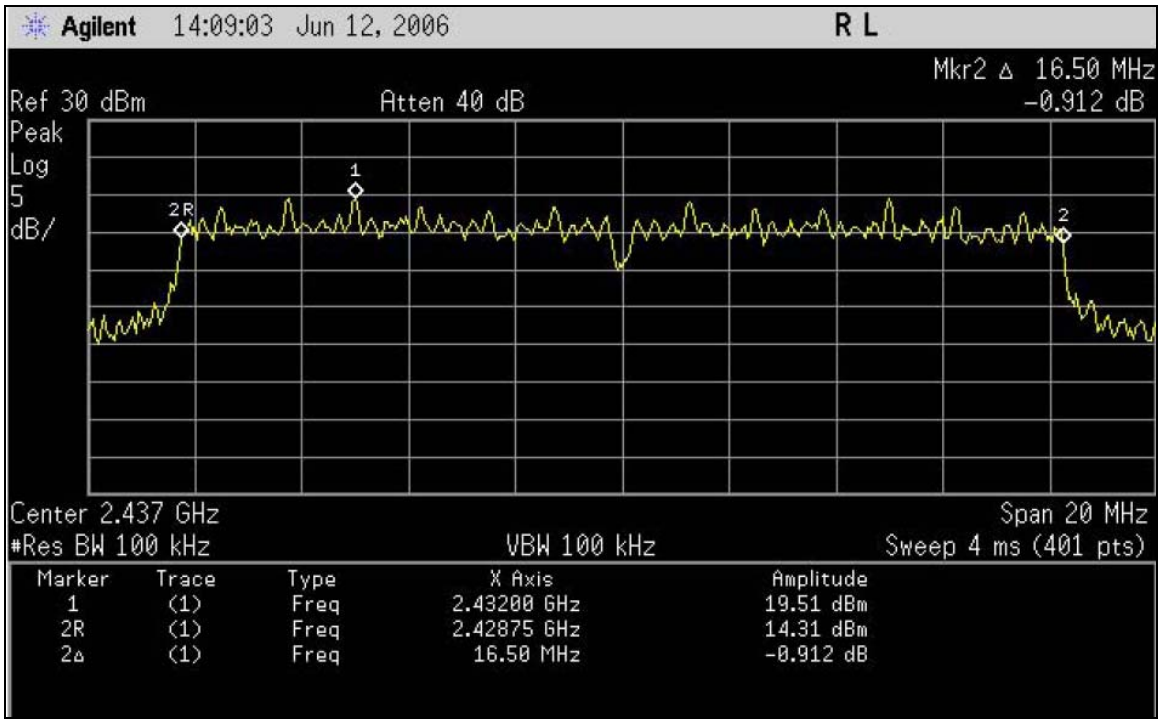
### § 15.247(a) 6 dB Bandwidth

| Band | Frequency | Measured 6dB Bandwidth |
|---|---|---|
| Low | 2.412 GHz | 16.50 MHz |
| Mid | 2.437 GHz | 16.50 MHz |
| High | 2.462 GHz | 16.45 MHz |

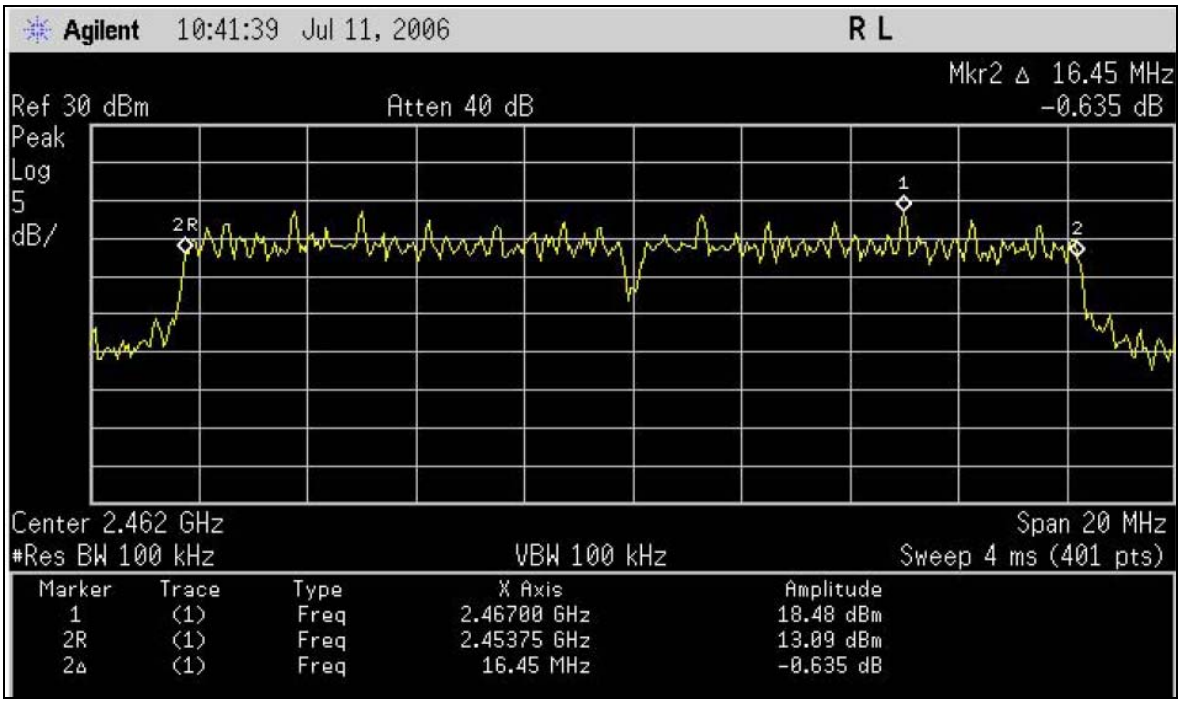
**Table 22. 6 dB Bandwith Test Results, 802.11g Mode**




**Plot 16. 802.11g Mode, Low**



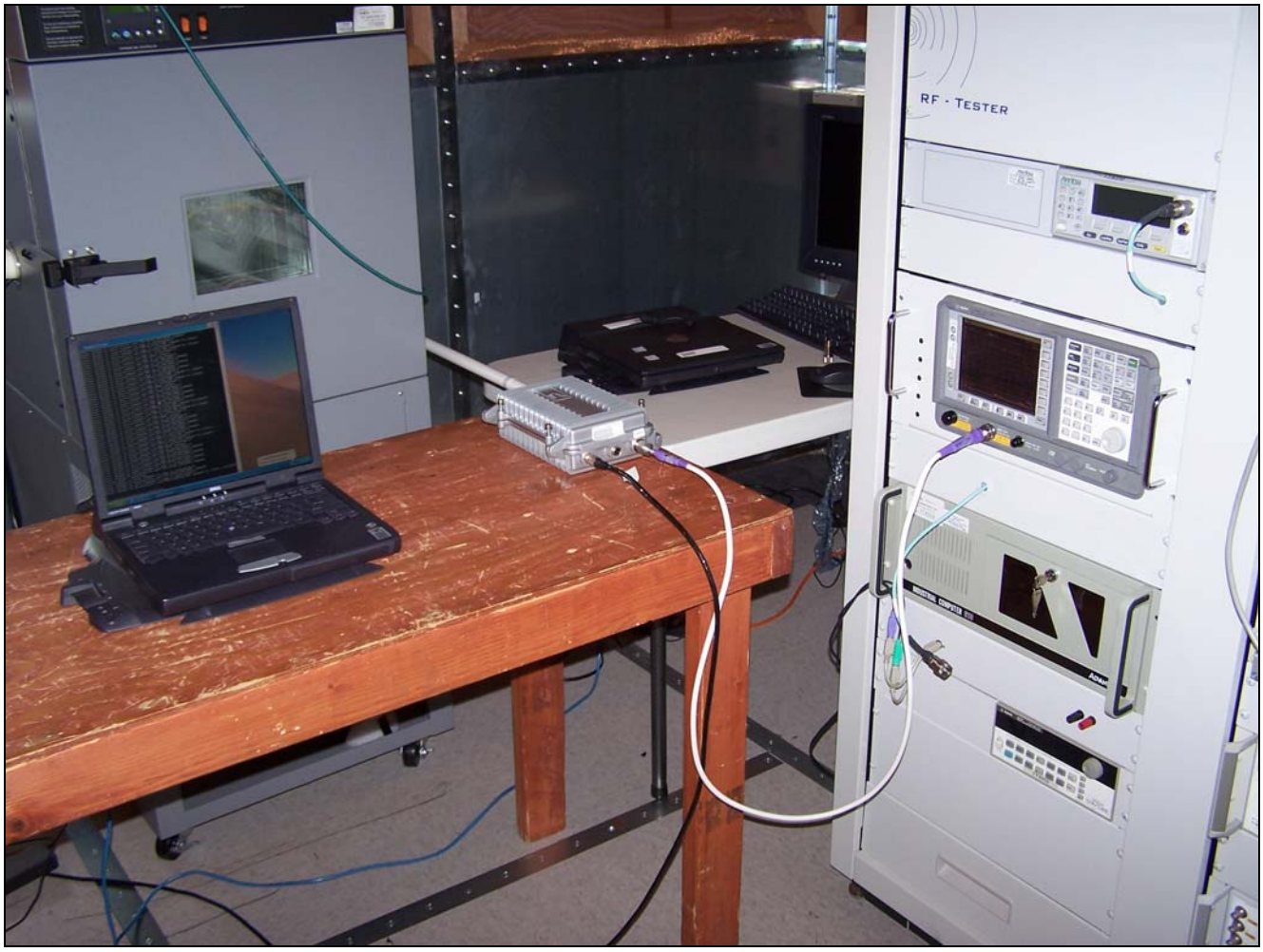

**Plot 17. 802.11g Mode, Mid**




**Plot 18. 802.11g Mode, High**

## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.247(a) 6 dB Bandwidth, Test Setup




**Photograph 3. 6 dB Bandwith, Test Setup**

# 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 23. 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 23, 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.

# Electromagnetic Compatibility Criteria for Intentional Radiators

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

**Test Procedure:** The transmitter was connected to a calibrated PSA Spectrum Analyzer. The EUT was measured at each channel and at multiple data rates. Both 802.11b and 802.11g modes were used.

**Test Results:** Equipment complies with the Peak Power Output limits of **§ 15.247(b)**.

| Channel | Freq | Data Rate | Power |
|---|---|---|---|
| 1 | 2412 | 1 Mbps | 27.89 |
| 1 | 2412 | 11 Mbps | 27.95 |

| Channel | Freq | Data Rate | Power |
|---|---|---|---|
| 2 | 2417 | 1 Mbps | 27.84 |
| 2 | 2417 | 11 Mbps | 27.82 |

| Channel | Freq | Data Rate | Power |
|---|---|---|---|
| 3 | 2422 | 1 Mbps | 27.84 |
| 3 | 2422 | 11 Mbps | 27.27 |

| Channel | Freq | Data Rate | Power |
|---|---|---|---|
| 4 | 2427 | 1 Mbps | 27.4 |
| 4 | 2427 | 11 Mbps | 27.55 |

| Channel | Freq | Data Rate | Power |
|---|---|---|---|
| 5 | 2432 | 1 Mbps | 27.54 |
| 5 | 2432 | 11 Mbps | 27.52 |

| Channel | Freq | Data Rate | Power |
|---|---|---|---|
| 6 | 2437 | 1 Mbps | 27.9 |
| 6 | 2437 | 11 Mbps | 27.6 |

| Channel | Freq | Data Rate | Power |
|---|---|---|---|
| 7 | 2442 | 1 Mbps | 27.77 |
| 7 | 2442 | 11 Mbps | 27.83 |

| Channel | Freq | Data Rate | Power |
|---|---|---|---|
| 8 | 2447 | 1 Mbps | 27.8 |
| 8 | 2447 | 11 Mbps | 27.23 |

| Channel | Freq | Data Rate | Power |
|---|---|---|---|
| 9 | 2452 | 1 Mbps | 27.84 |
| 9 | 2452 | 11 Mbps | 27.26 |

| Channel | Freq | Data Rate | Power |
|---|---|---|---|
| 10 | 2457 | 1 Mbps | 27.7 |
| 10 | 2457 | 11 Mbps | 27.07 |

| Channel | Freq | Data Rate | Power |
|---|---|---|---|
| 11 | 2462 | 1 Mbps | 27.82 |
| 11 | 2462 | 11 Mbps | 26.77 |

**Table 24. Peak Output Power, 802.11b**

| Channel | Freq | Data Rate | Power |
|---|---|---|---|
| 1 | 2412 | 6 Mbps | 23.57 |
| 1 | 2412 | 9 Mbps | 23.73 |
| 1 | 2412 | 12 Mbps | 23.99 |
| 1 | 2412 | 18 Mbps | 23.91 |
| 1 | 2412 | 24 Mbps | 23.81 |
| 1 | 2412 | 36 Mbps | 24.04 |
| 1 | 2412 | 48 Mbps | 24.23 |
| 1 | 2412 | 54 Mbps | 24.27 |

| Channel | Freq | Data Rate | Power |
|---|---|---|---|
| 2 | 2417 | 6 Mbps | 26.01 |
| 2 | 2417 | 9 Mbps | 25.88 |
| 2 | 2417 | 12 Mbps | 25.92 |
| 2 | 2417 | 18 Mbps | 25.91 |
| 2 | 2417 | 24 Mbps | 26.22 |
| 2 | 2417 | 36 Mbps | 26 |
| 2 | 2417 | 48 Mbps | 25.94 |
| 2 | 2417 | 54 Mbps | 25.99 |

| Channel | Freq | Data Rate | Power |
|---|---|---|---|
| 3 | 2422 | 6 Mbps | 25.58 |
| 3 | 2422 | 9 Mbps | 26.12 |
| 3 | 2422 | 12 Mbps | 26.15 |
| 3 | 2422 | 18 Mbps | 26.23 |
| 3 | 2422 | 24 Mbps | 26.02 |
| 3 | 2422 | 36 Mbps | 26.02 |
| 3 | 2422 | 48 Mbps | 26.03 |
| 3 | 2422 | 54 Mbps | 26 |

| Channel | Freq | Data Rate | Power |
|---|---|---|---|
| 4 | 2427 | 6 Mbps | 26.92 |
| 4 | 2427 | 9 Mbps | 27.15 |
| 4 | 2427 | 12 Mbps | 27.62 |
| 4 | 2427 | 18 Mbps | 27.01 |
| 4 | 2427 | 24 Mbps | 27.06 |
| 4 | 2427 | 36 Mbps | 27.28 |
| 4 | 2427 | 48 Mbps | 27.24 |
| 4 | 2427 | 54 Mbps | 27.97 |

| Channel | Freq | Data Rate | Power |
|---|---|---|---|
| 5 | 2432 | 6 Mbps | 26.86 |
| 5 | 2432 | 9 Mbps | 27.28 |
| 5 | 2432 | 12 Mbps | 27.25 |
| 5 | 2432 | 18 Mbps | 27.15 |
| 5 | 2432 | 24 Mbps | 27.07 |
| 5 | 2432 | 36 Mbps | 27.08 |
| 5 | 2432 | 48 Mbps | 27.17 |
| 5 | 2432 | 54 Mbps | 27.29 |

| Channel | Freq | Data Rate | Power |
|---|---|---|---|
| 6 | 2437 | 6 Mbps | 25.46 |
| 6 | 2437 | 9 Mbps | 25.49 |
| 6 | 2437 | 12 Mbps | 25.64 |
| 6 | 2437 | 18 Mbps | 25.29 |
| 6 | 2437 | 24 Mbps | 25.32 |
| 6 | 2437 | 36 Mbps | 25.39 |
| 6 | 2437 | 48 Mbps | 25.81 |
| 6 | 2437 | 54 Mbps | 25.2 |

| Channel | Freq | Data Rate | Power |
|---|---|---|---|
| 7 | 2442 | 6 Mbps | 24.43 |
| 7 | 2442 | 9 Mbps | 24.64 |
| 7 | 2442 | 12 Mbps | 24.48 |
| 7 | 2442 | 18 Mbps | 24.56 |
| 7 | 2442 | 24 Mbps | 24.47 |
| 7 | 2442 | 36 Mbps | 24.42 |
| 7 | 2442 | 48 Mbps | 24.62 |
| 7 | 2442 | 54 Mbps | 24.47 |

| Channel | Freq | Data Rate | Power |
|---|---|---|---|
| 8 | 2447 | 6 Mbps | 23.69 |
| 8 | 2447 | 9 Mbps | 23.48 |
| 8 | 2447 | 12 Mbps | 23.52 |
| 8 | 2447 | 18 Mbps | 23.83 |
| 8 | 2447 | 24 Mbps | 23.68 |
| 8 | 2447 | 36 Mbps | 23.59 |
| 8 | 2447 | 48 Mbps | 23.64 |
| 8 | 2447 | 54 Mbps | 23.87 |

| Channel | Freq | Data Rate | Power |
|---|---|---|---|
| 9 | 2452 | 6 Mbps | 23.6 |
| 9 | 2452 | 9 Mbps | 23.7 |
| 9 | 2452 | 12 Mbps | 23.71 |
| 9 | 2452 | 18 Mbps | 23.77 |
| 9 | 2452 | 24 Mbps | 23.6 |
| 9 | 2452 | 36 Mbps | 23.87 |
| 9 | 2452 | 48 Mbps | 23.64 |
| 9 | 2452 | 54 Mbps | 24.04 |

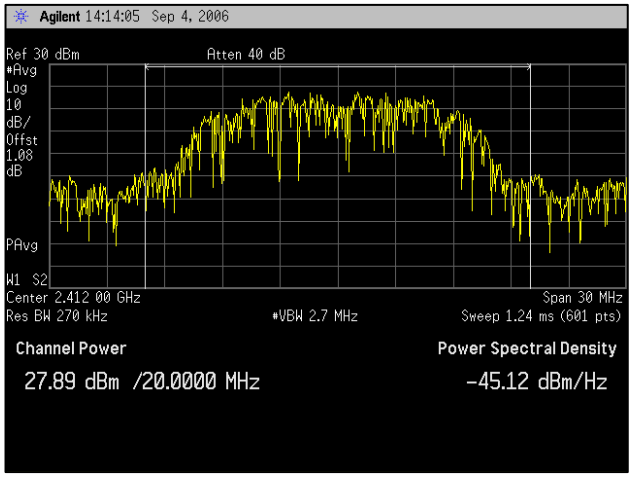
| Channel | Freq | Data Rate | Power |
|---|---|---|---|
| 10 | 2457 | 6 Mbps | 22.31 |
| 10 | 2457 | 9 Mbps | 22.28 |
| 10 | 2457 | 12 Mbps | 22.57 |
| 10 | 2457 | 18 Mbps | 22.27 |
| 10 | 2457 | 24 Mbps | 22.61 |
| 10 | 2457 | 36 Mbps | 22.5 |
| 10 | 2457 | 48 Mbps | 22.91 |
| 10 | 2457 | 54 Mbps | 23 |

| Channel | Freq | Data Rate | Power |
|---|---|---|---|
| 11 | 2462 | 6 Mbps | 20.72 |
| 11 | 2462 | 9 Mbps | 21.17 |
| 11 | 2462 | 12 Mbps | 21.73 |
| 11 | 2462 | 18 Mbps | 21.69 |
| 11 | 2462 | 24 Mbps | 21.61 |
| 11 | 2462 | 36 Mbps | 21.57 |
| 11 | 2462 | 48 Mbps | 21.85 |
| 11 | 2462 | 54 Mbps | 21.68 |

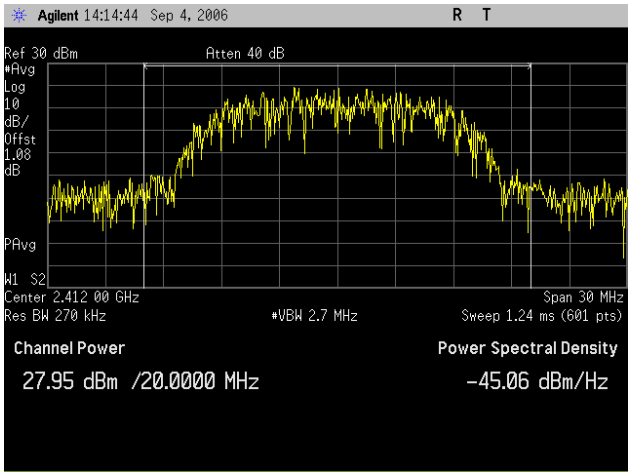
**Table 25. Peak Output Power, 802.11g**

**Test Engineer(s):** Len Knight

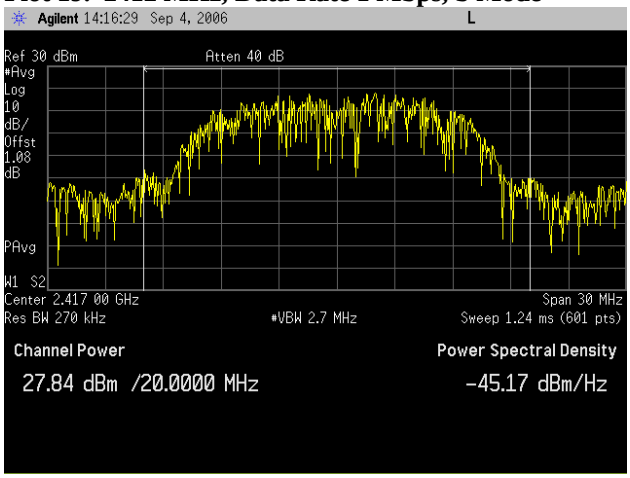
**Test Date(s):** July 12, 2006



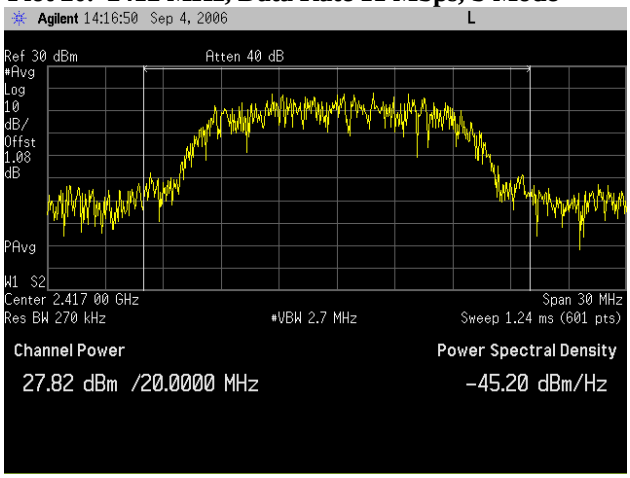

**Plot 19. 2412 MHz, Data Rate 1 Mbps, b Mode**



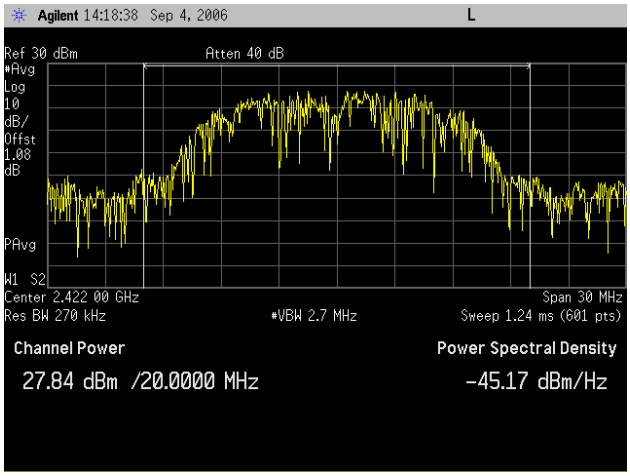

**Plot 20. 2412 MHz, Data Rate 11 Mbps, b Mode**



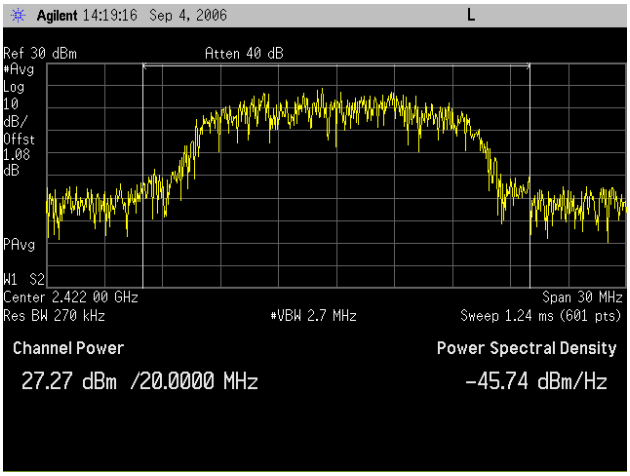

**Plot 21. 2417 MHz, Data Rate 1 Mbps, b Mode**




**Plot 22. 2417 MHz, Data Rate 11 Mbps, b Mode**

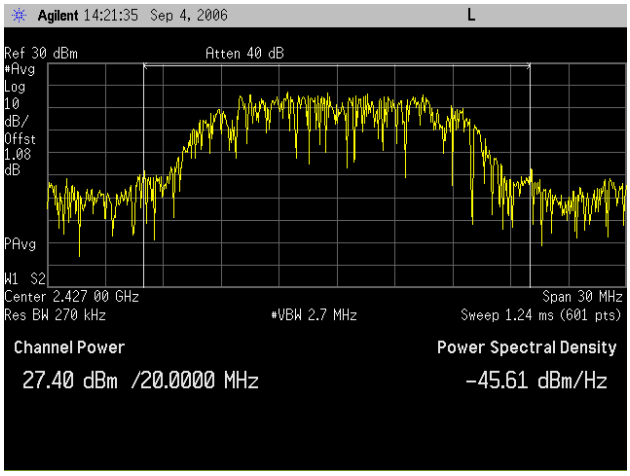



**Plot 23. 2422 MHz, Data Rate 1 Mbps, b Mode**

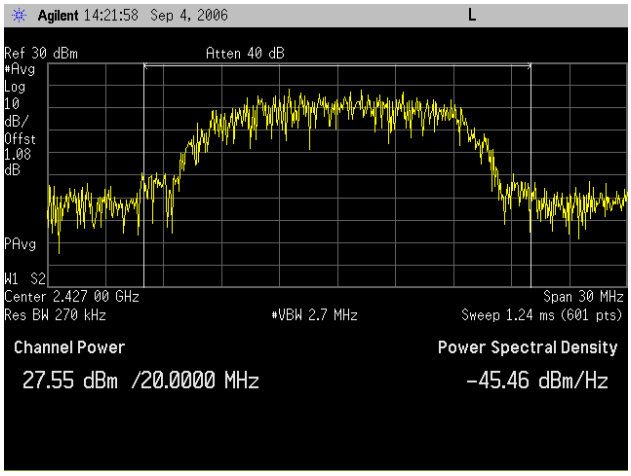



**Plot 24. 2422 MHz, Data Rate 11 Mbps, b Mode**

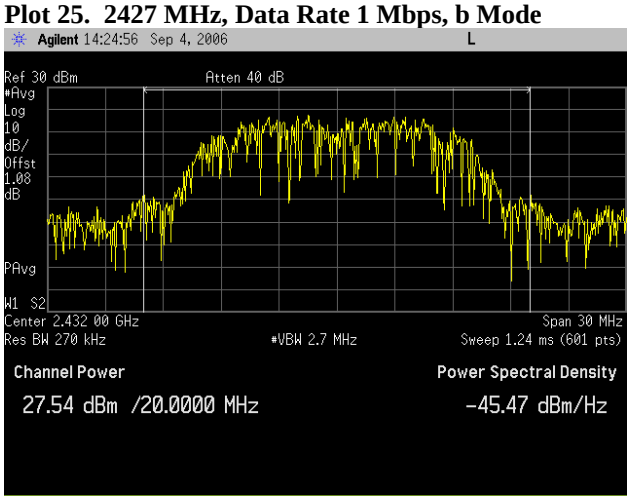
  



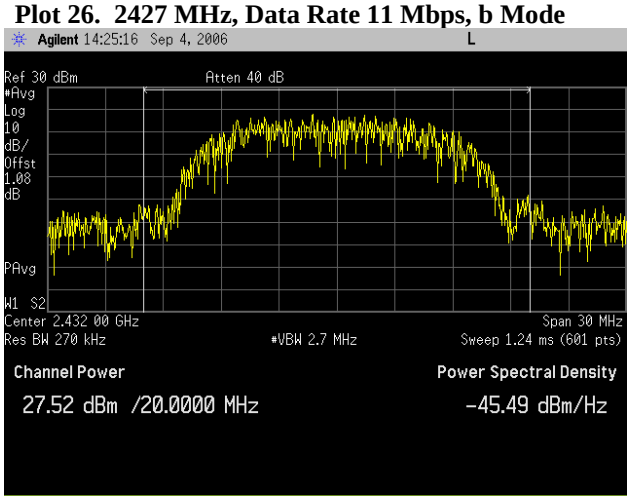

**Plot 25. 2427 MHz, Data Rate 1 Mbps, b Mode**



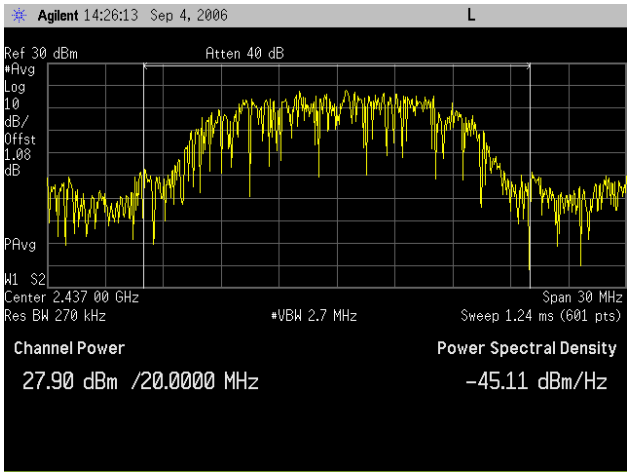

**Plot 26. 2427 MHz, Data Rate 11 Mbps, b Mode**



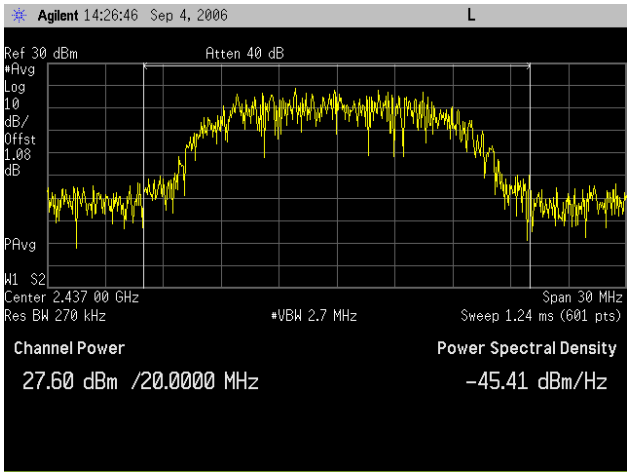

**Plot 27. 2432 MHz, Data Rate 1 Mbps, b Mode**



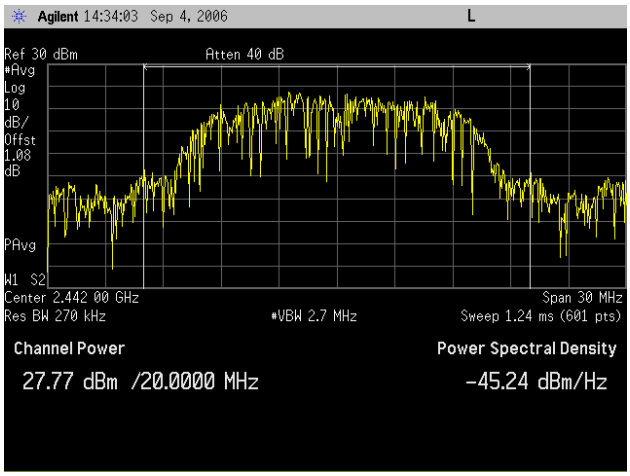

**Plot 28. 2432 MHz, Data Rate 11 Mbps, b Mode**



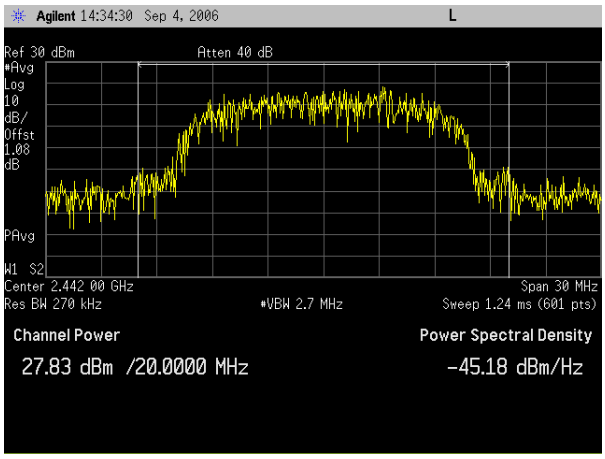

**Plot 29. 2437 MHz, Data Rate 1 Mbps, b Mode**



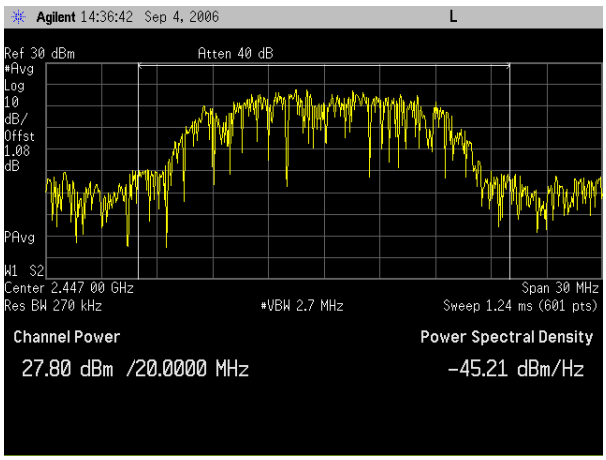

**Plot 30. 2437 MHz, Data Rate 11 Mbps, b Mode**



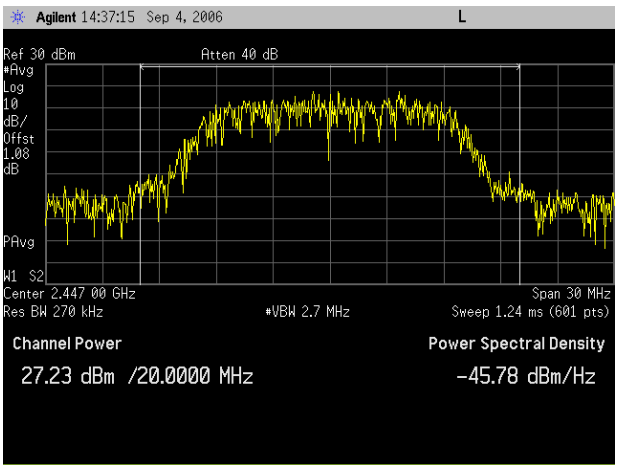

**Plot 31. 2442 MHz, Data Rate 1 Mbps, b Mode**



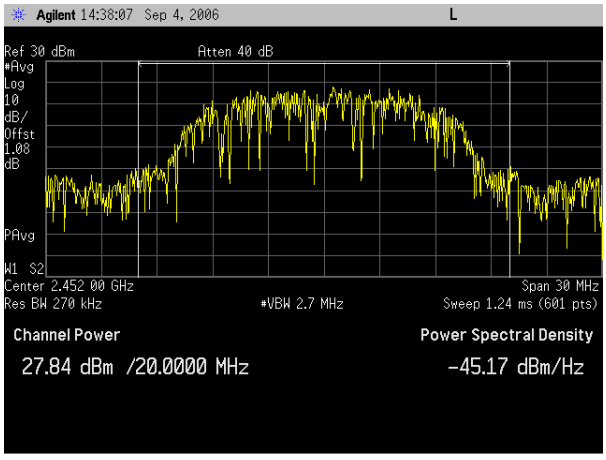

**Plot 32. 2442 MHz, Data Rate 11 Mbps, b Mode**



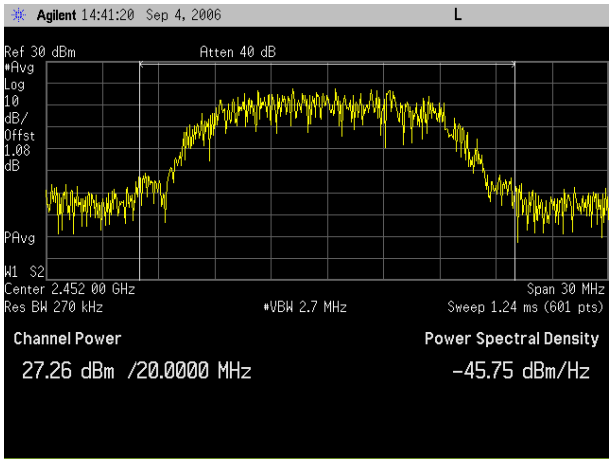

**Plot 33. 2447 MHz, Data Rate 1 Mbps, b Mode**




**Plot 34. 2447 MHz, Data Rate 11 Mbps, b Mode**

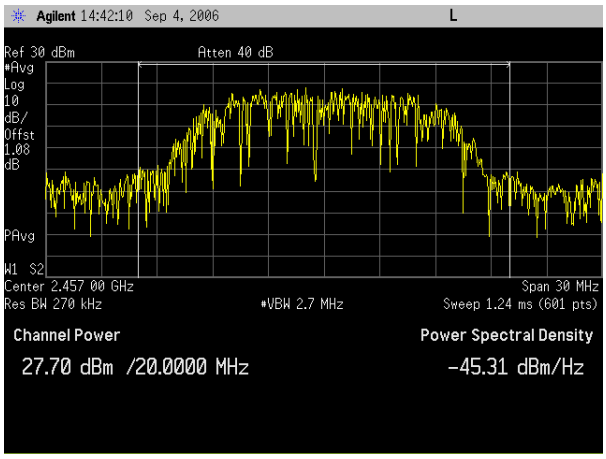



**Plot 35. 2452 MHz, Data Rate 1 Mbps, b Mode**

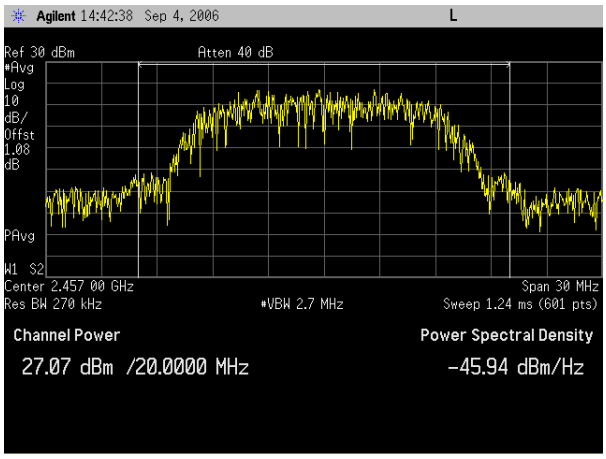



**Plot 36. 2452 MHz, Data Rate 11 Mbps, b Mode**

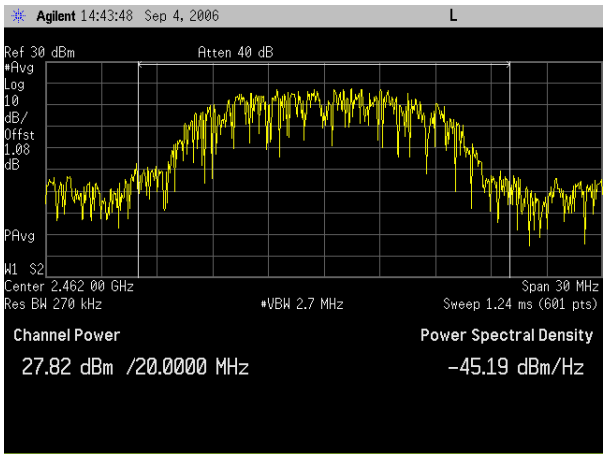
  



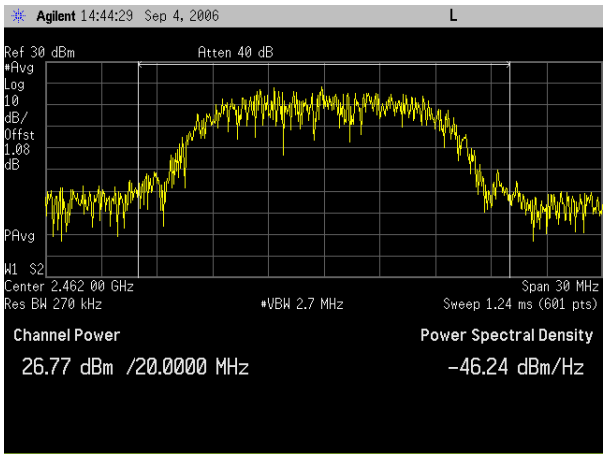

**Plot 37. 2457 MHz, Data Rate 1 Mbps, b Mode**



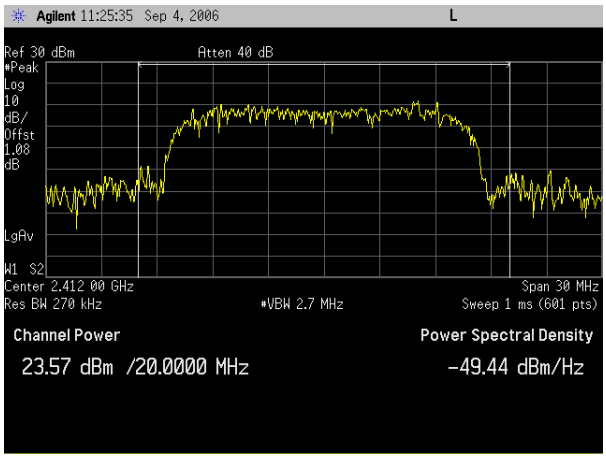

**Plot 38. 2457 MHz, Data Rate 11 Mbps, b Mode**



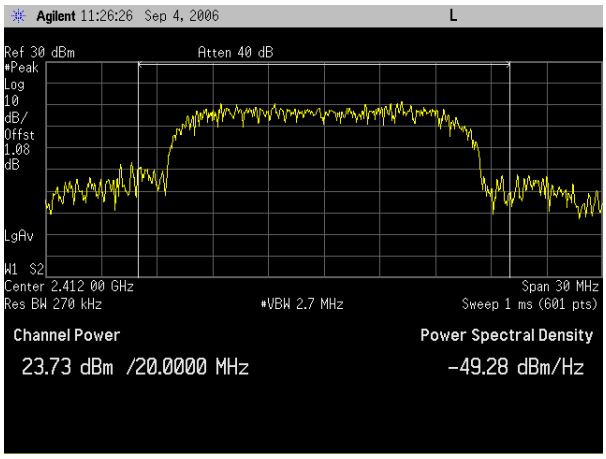

**Plot 39. 2462 MHz, Data Rate 1 Mbps, b Mode**



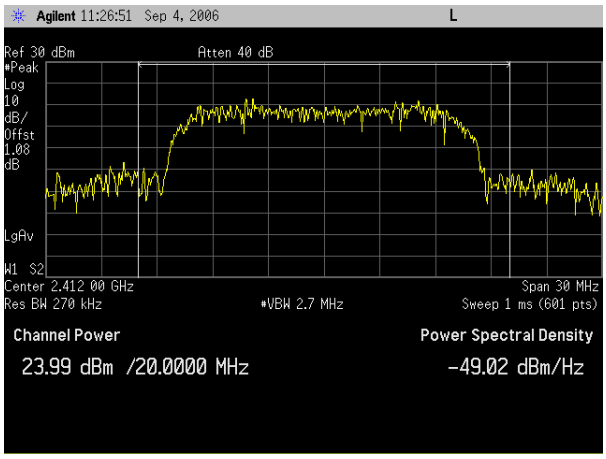

**Plot 40. 2462 MHz, Data Rate 11 Mbps, b Mode**



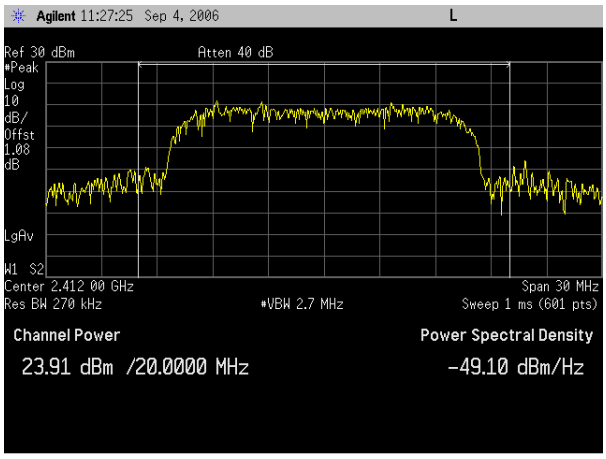

**Plot 41. 2412 MHz, Data Rate 6 Mbps, g Mode**



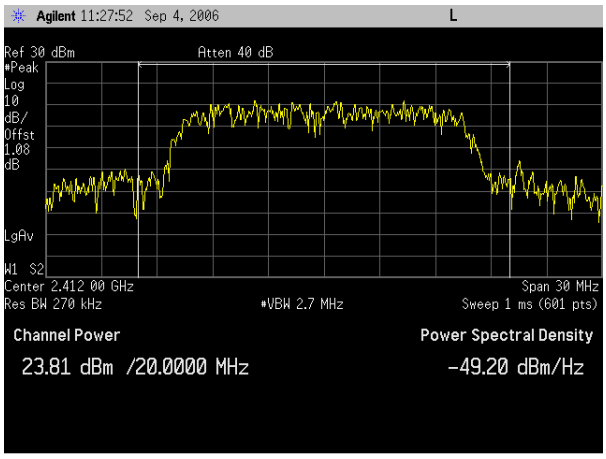

**Plot 42. 2412 MHz, Data Rate 9 Mbps, g Mode**



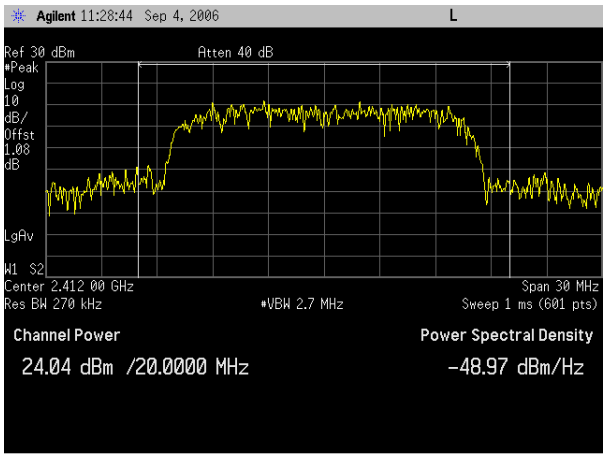

**Plot 43. 2412 MHz, Data Rate 12 Mbps, g Mode**



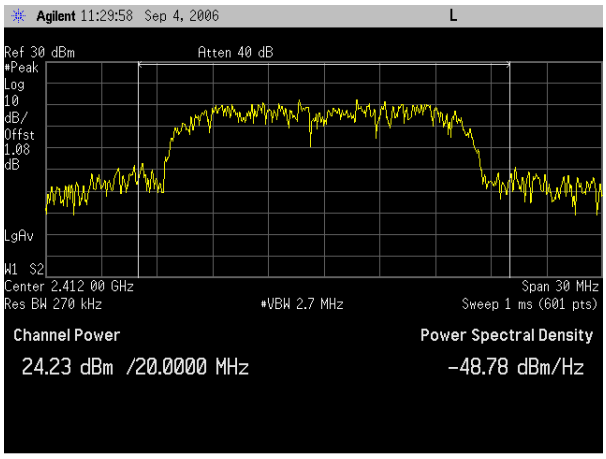

**Plot 44. 2412 MHz, Data Rate 18 Mbps, g Mode**



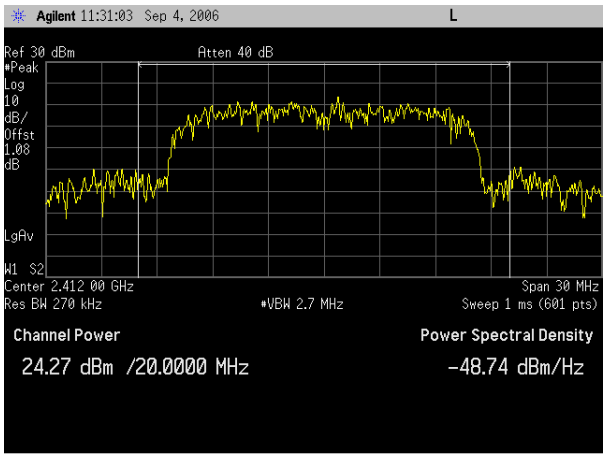

**Plot 45. 2412 MHz, Data Rate 24 Mbps, g Mode**



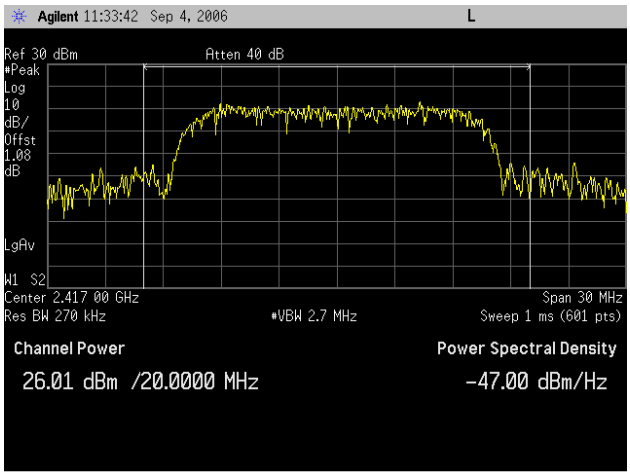

**Plot 46. 2412 MHz, Data Rate 32 Mbps, g Mode**



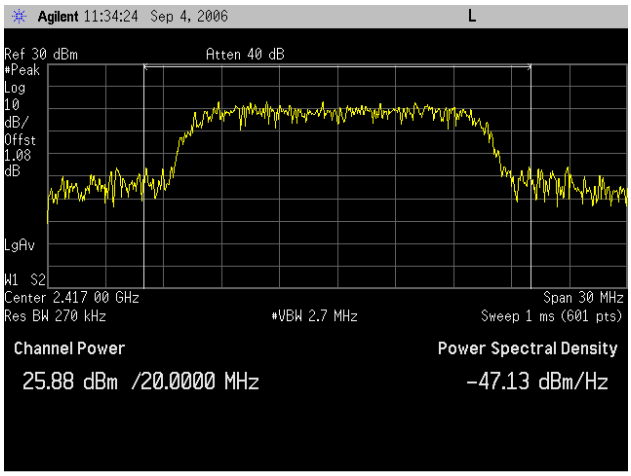

**Plot 47. 2412 MHz, Data Rate 48 Mbps, g Mode**



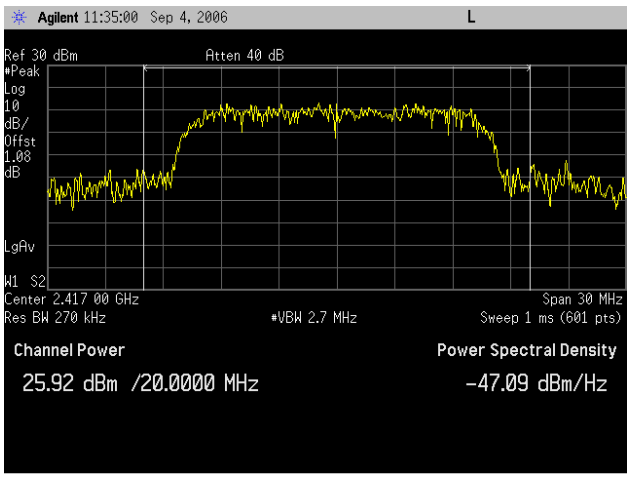

**Plot 48. 2412 MHz, Data Rate 54 Mbps, g Mode**



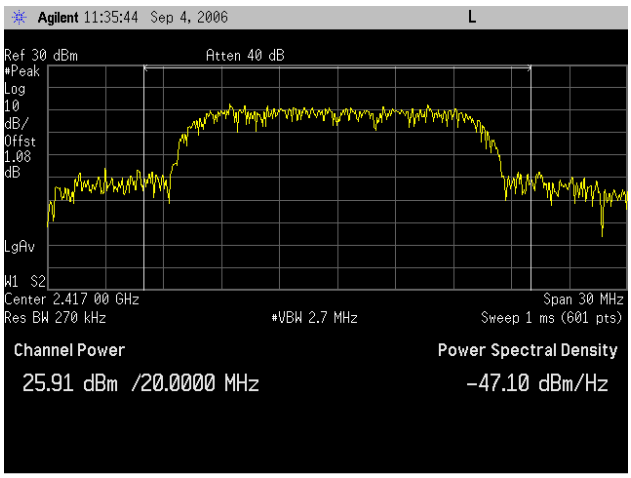

**Plot 49. 2417 MHz, Data Rate 6 Mbps, g Mode**



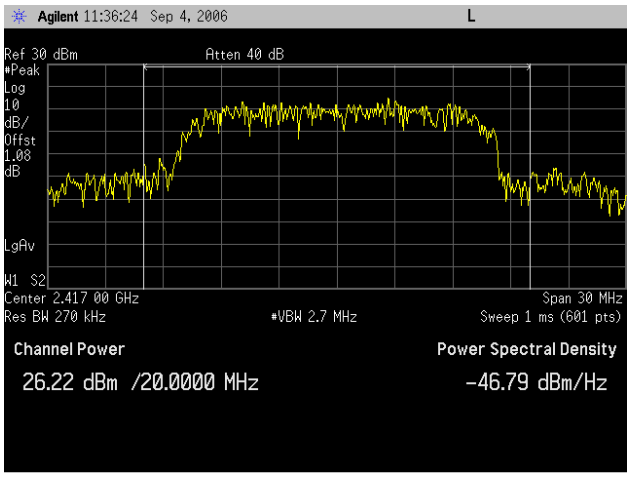

**Plot 50. 2417 MHz, Data Rate 9 Mbps, g Mode**



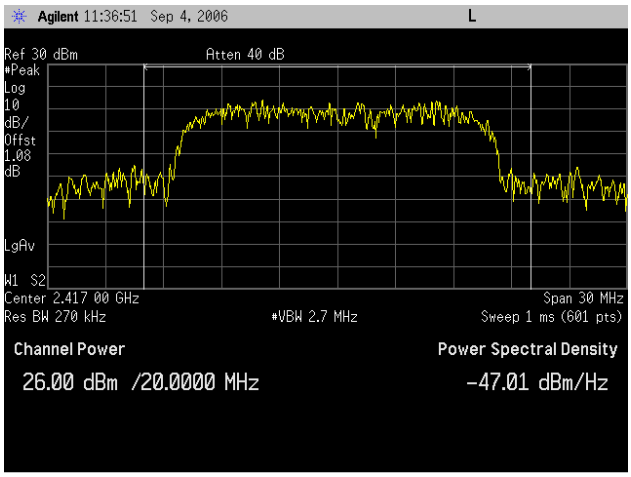

**Plot 51. 2417 MHz, Data Rate 12 Mbps, g Mode**



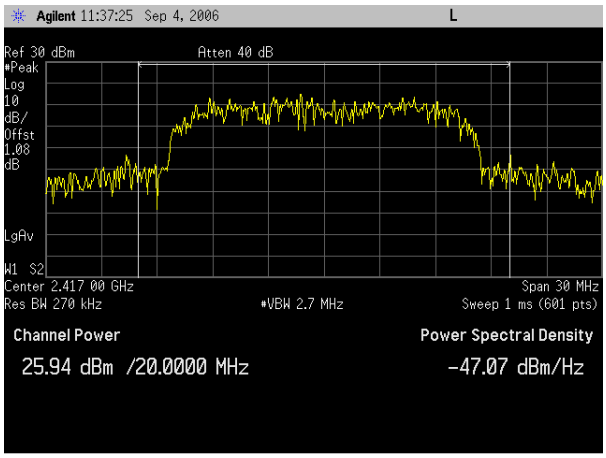

**Plot 52. 2417 MHz, Data Rate 18 Mbps, g Mode**



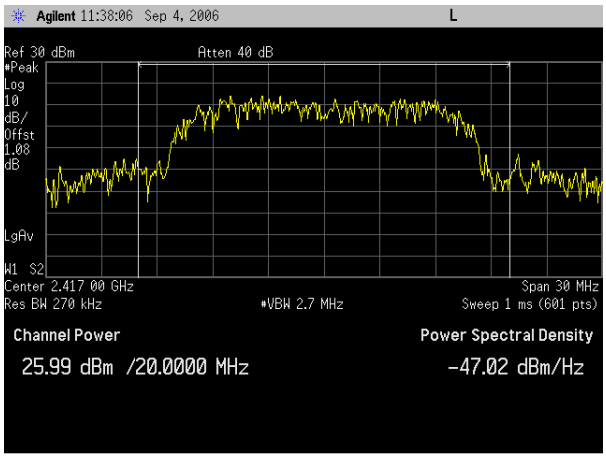

**Plot 53. 2417 MHz, Data Rate 24 Mbps, g Mode**



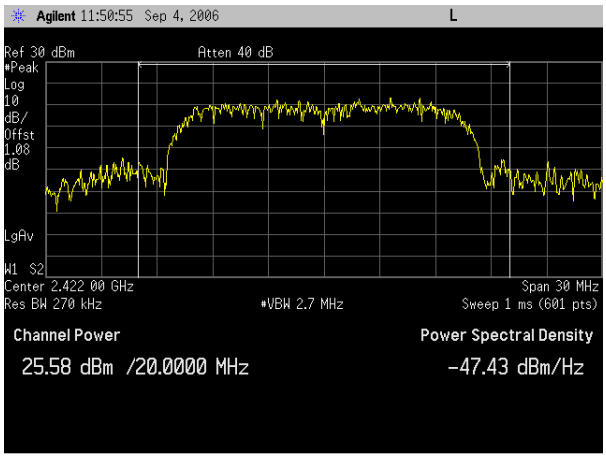

**Plot 54. 2417 MHz, Data Rate 36 Mbps, g Mode**



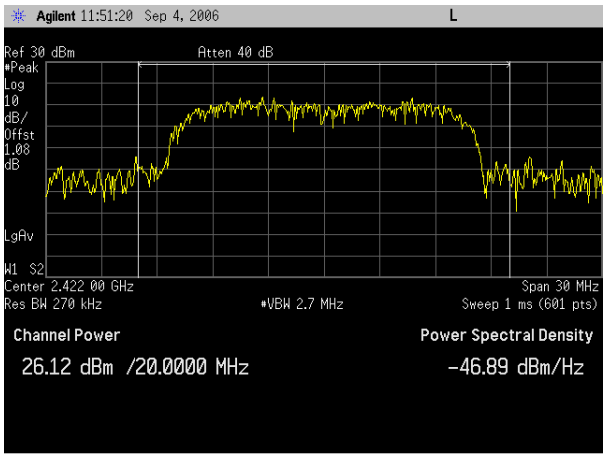

**Plot 55. 2417 MHz, Data Rate 48 Mbps, g Mode**



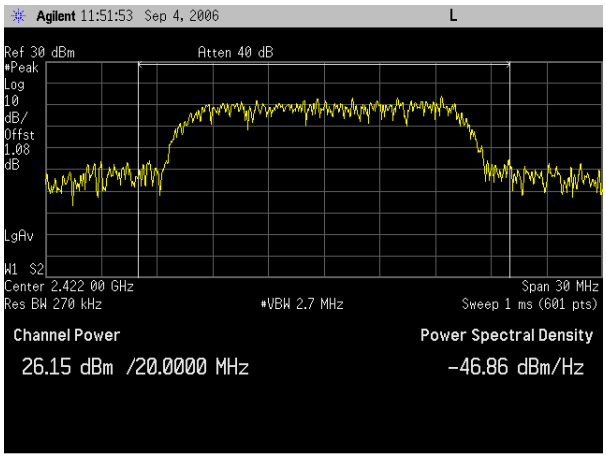

**Plot 56. 2417 MHz, Data Rate 54 Mbps, g Mode**



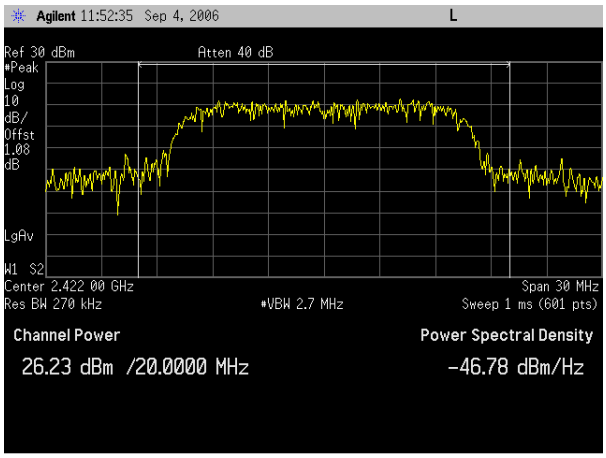

**Plot 57. 2422 MHz, Data Rate 6 Mbps, g Mode**



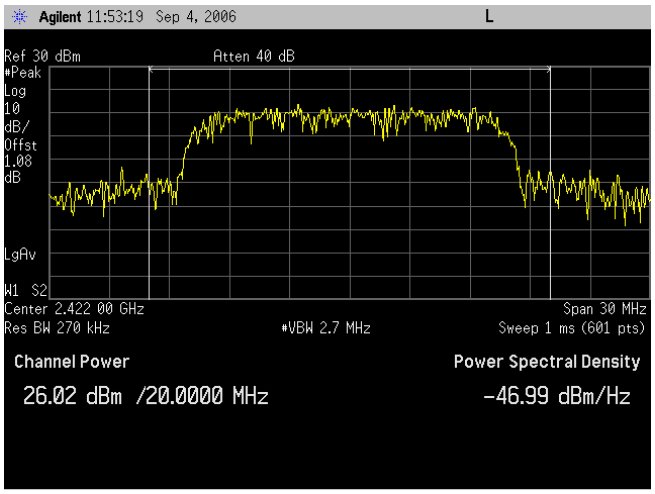

**Plot 58. 2422 MHz, Data Rate 9 Mbps, g Mode**



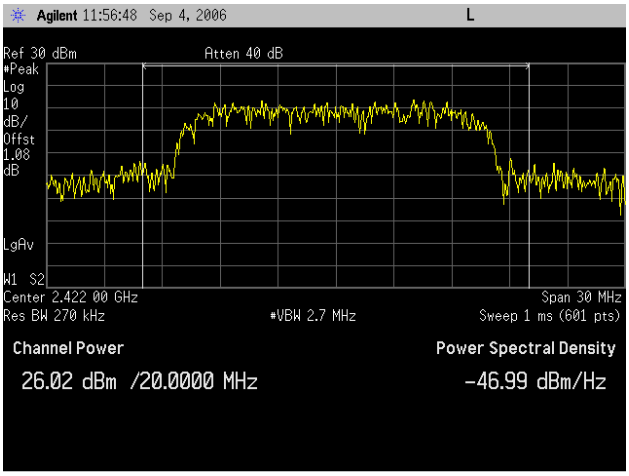

**Plot 59. 2422 MHz, Data Rate 12 Mbps, g Mode**



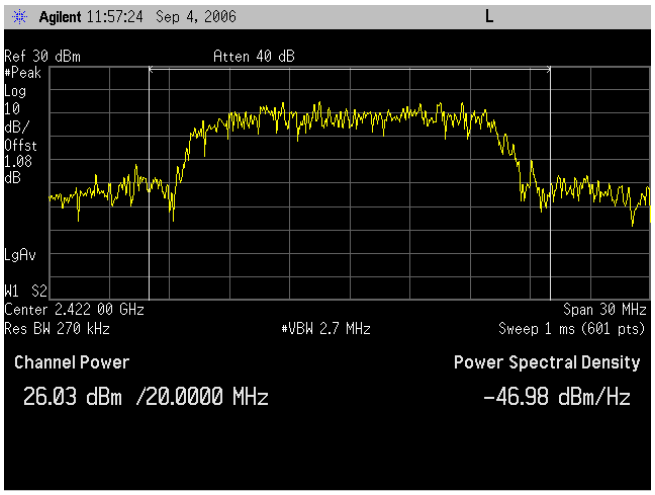

**Plot 60. 2422 MHz, Data Rate 18 Mbps, g Mode**



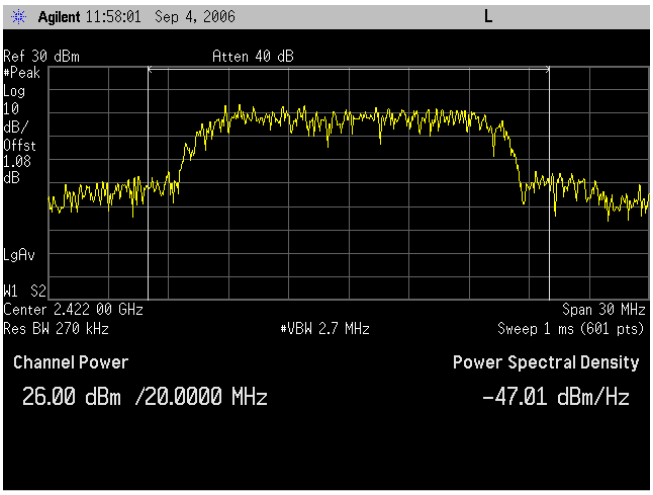

**Plot 61. 2422 MHz, Data Rate 24 Mbps, g Mode**



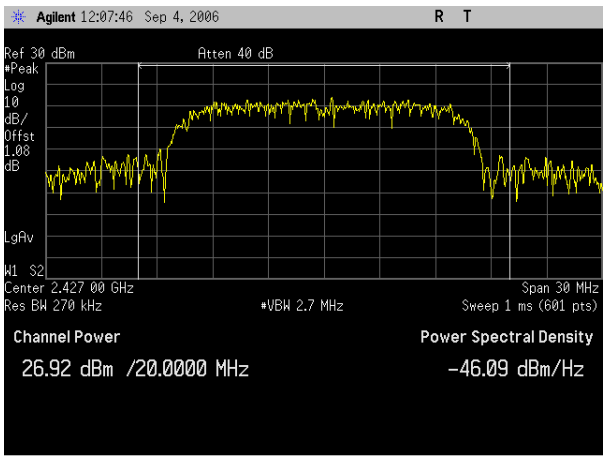

**Plot 62. 2422 MHz, Data Rate 36 Mbps, g Mode**



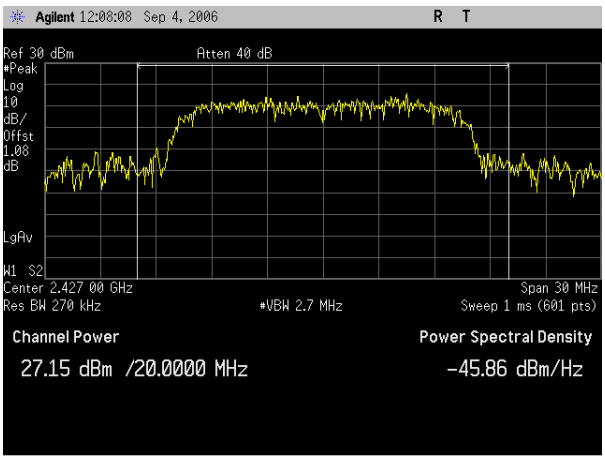

**Plot 63. 2422 MHz, Data Rate 48 Mbps, g Mode**




**Plot 64. 2422 MHz, Data Rate 54 Mbps, g Mode**

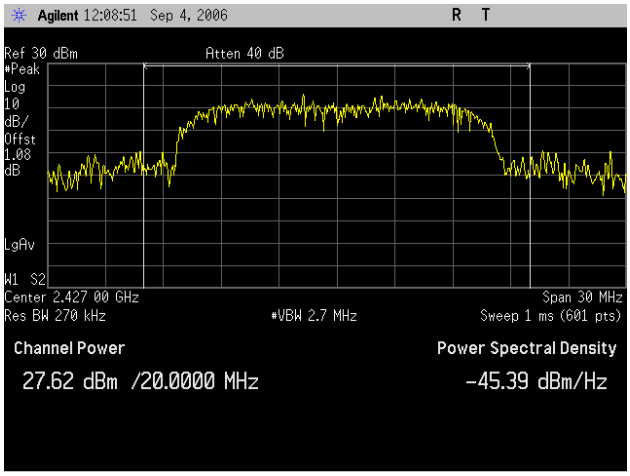



**Plot 65. 2427 MHz, Data Rate 6 Mbps, g Mode**

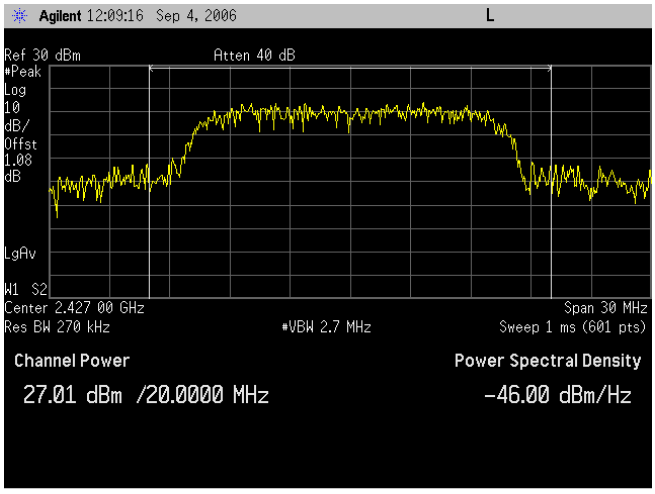



**Plot 66. 2427 MHz, Data Rate 9 Mbps, g Mode**

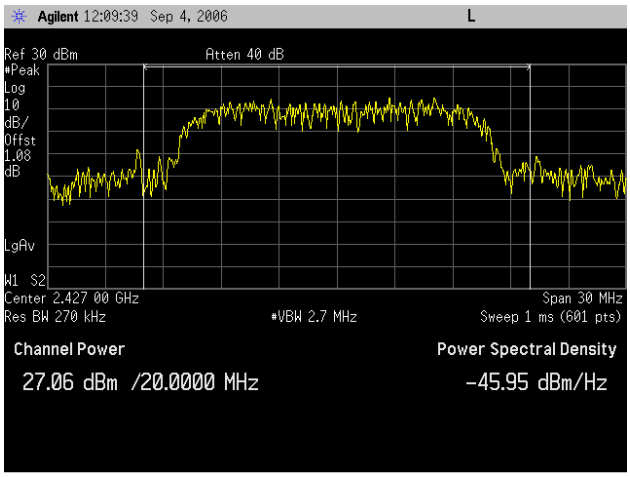
  



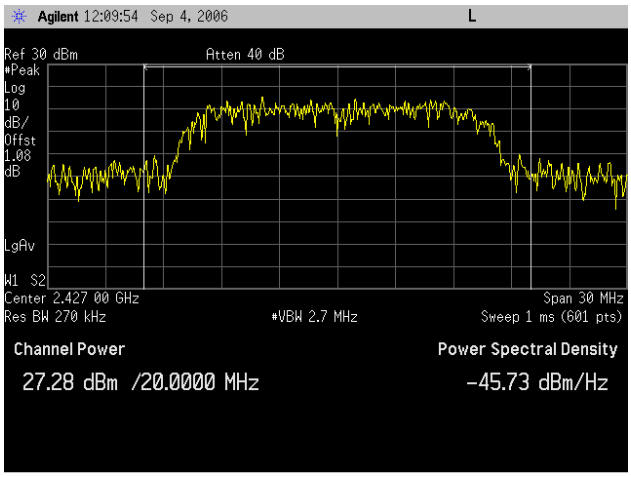

**Plot 67. 2427 MHz, Data Rate 12 Mbps, g Mode**



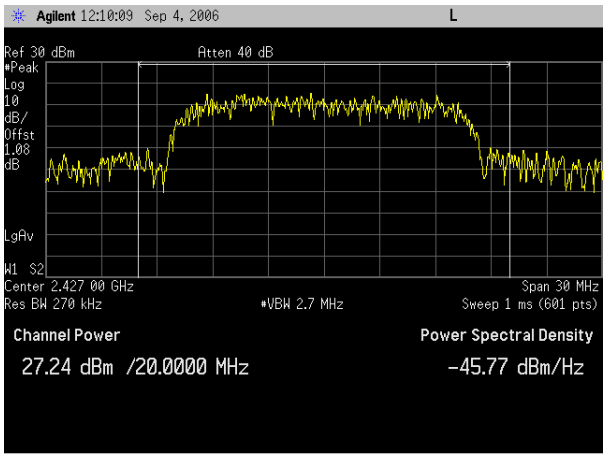

**Plot 68. 2427 MHz, Data Rate 18 Mbps, g Mode**



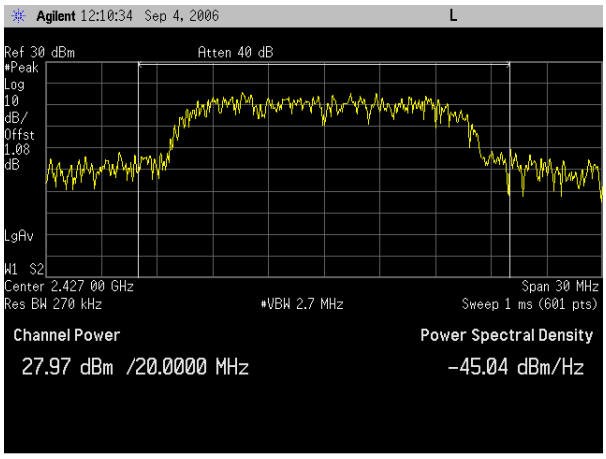

**Plot 69. 2427 MHz, Data Rate 24 Mbps, g Mode**



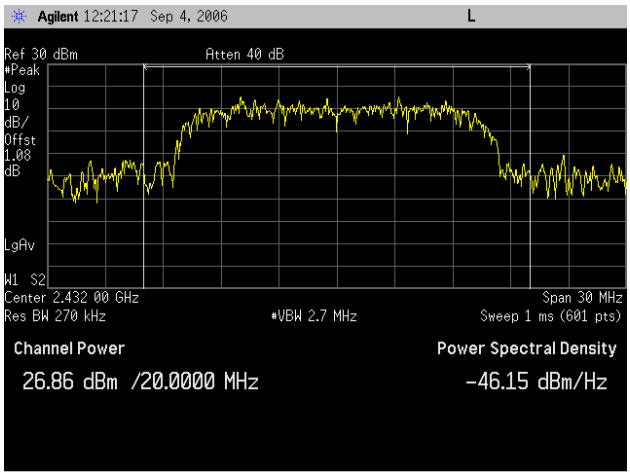

**Plot 70. 2427 MHz, Data Rate 36 Mbps, g Mode**



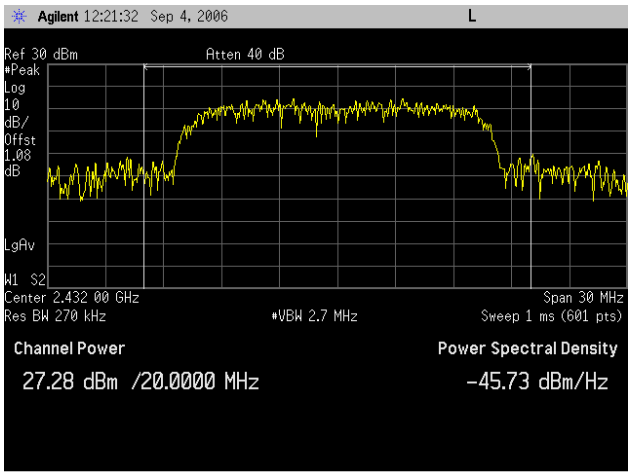

**Plot 71. 2427 MHz, Data Rate 48 Mbps, g Mode**



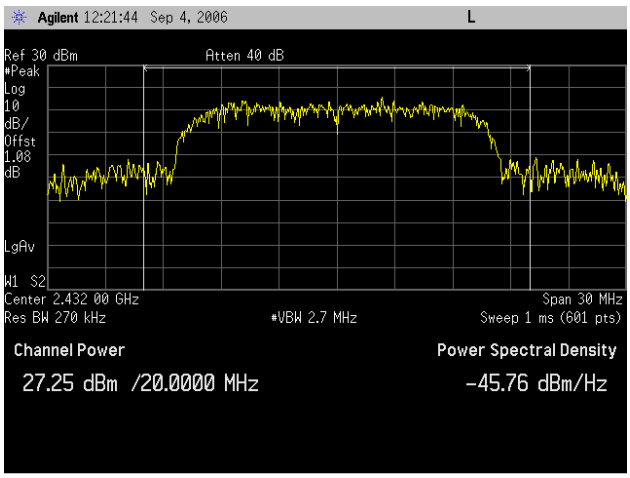

**Plot 72. 2427 MHz, Data Rate 54 Mbps, g Mode**



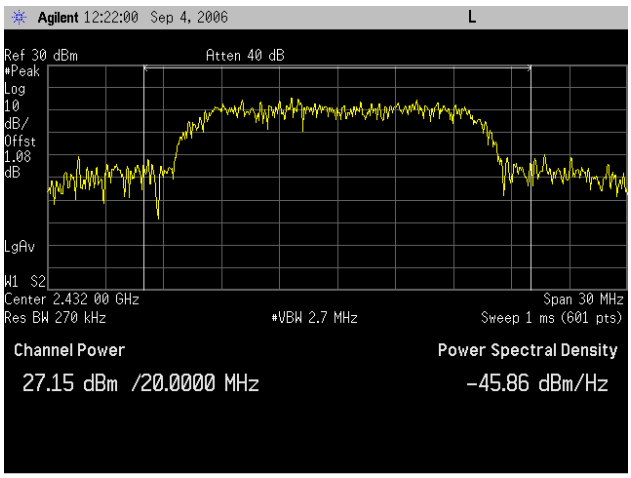

**Plot 73. 2432 MHz, Data Rate 6 Mbps, g Mode**



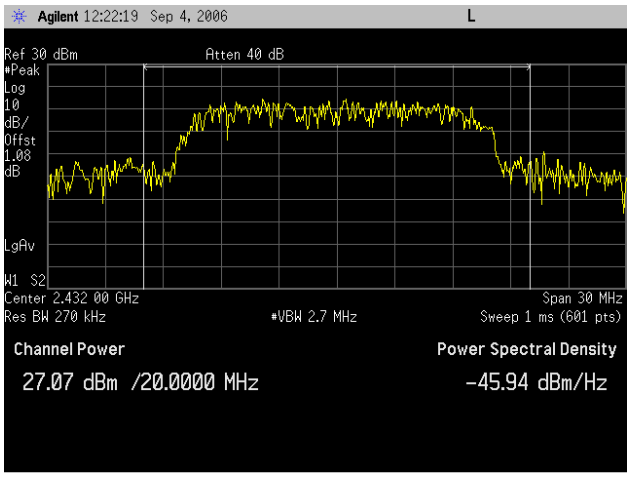

**Plot 74. 2432 MHz, Data Rate 9 Mbps, g Mode**



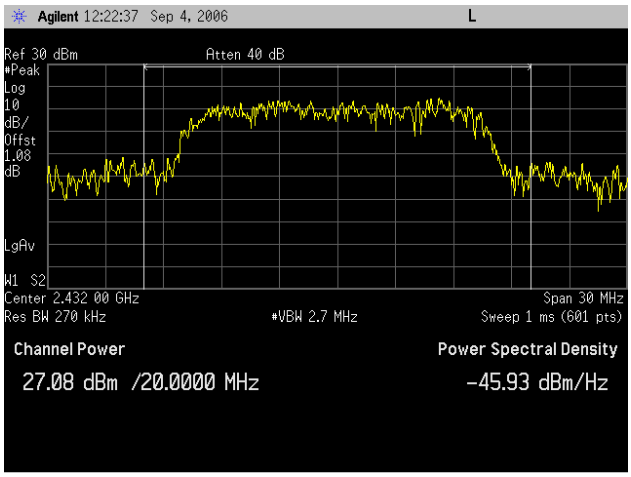

**Plot 75. 2432 MHz, Data Rate 12 Mbps, g Mode**



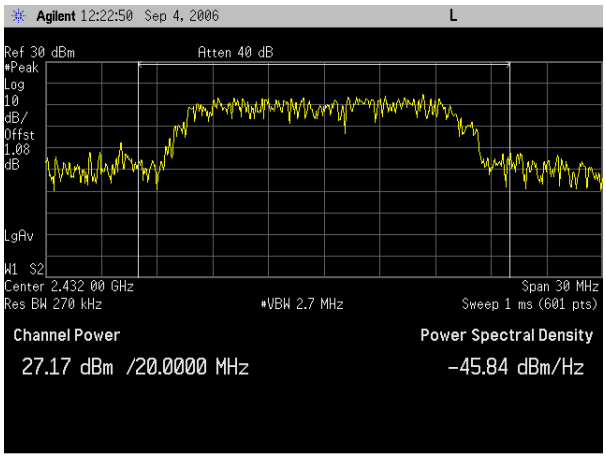

**Plot 76. 2432 MHz, Data Rate 18 Mbps, g Mode**



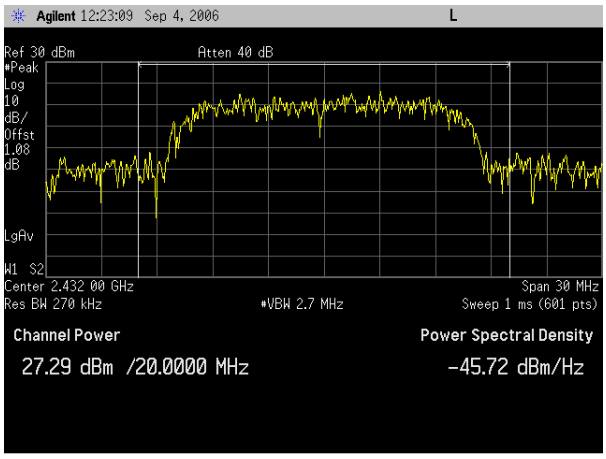

**Plot 77. 2432 MHz, Data Rate 24 Mbps, g Mode**



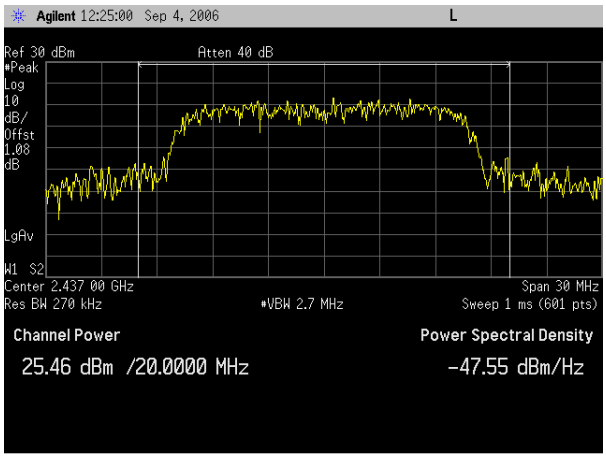

**Plot 78. 2432 MHz, Data Rate 32 Mbps, g Mode**



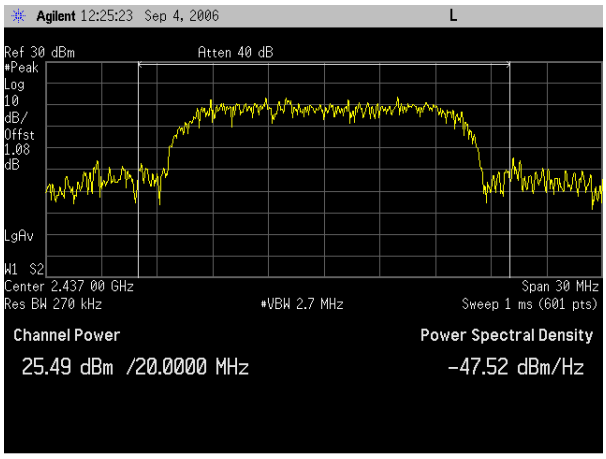

**Plot 79. 2432 MHz, Data Rate 48 Mbps, g Mode**



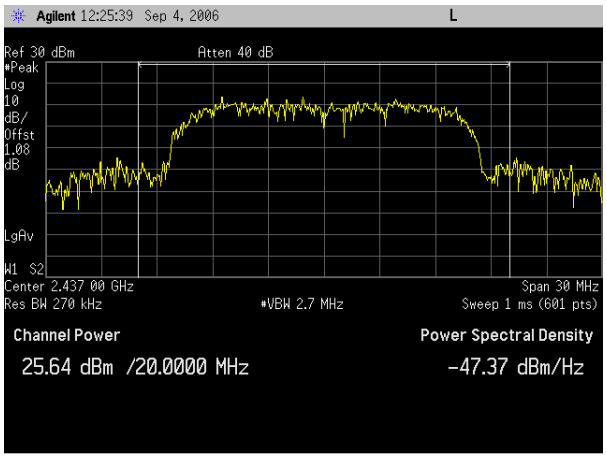

**Plot 80. 2432 MHz, Data Rate 54 Mbps, g Mode**



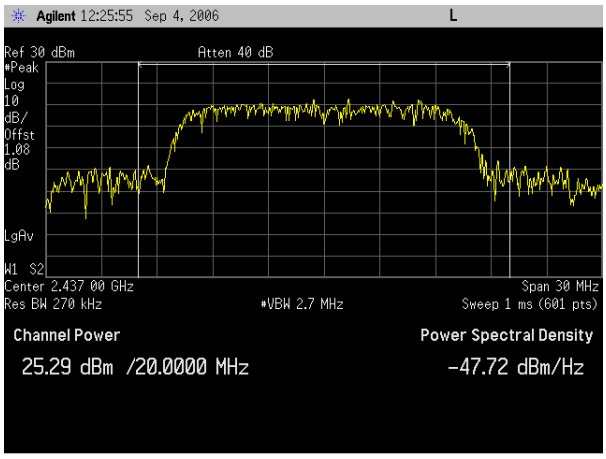

**Plot 81. 2437 MHz, Data Rate 6 Mbps, g Mode**



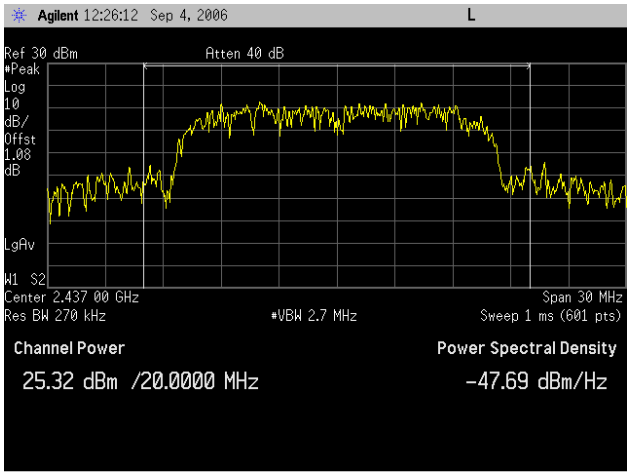

**Plot 82. 2437 MHz, Data Rate 9 Mbps, g Mode**



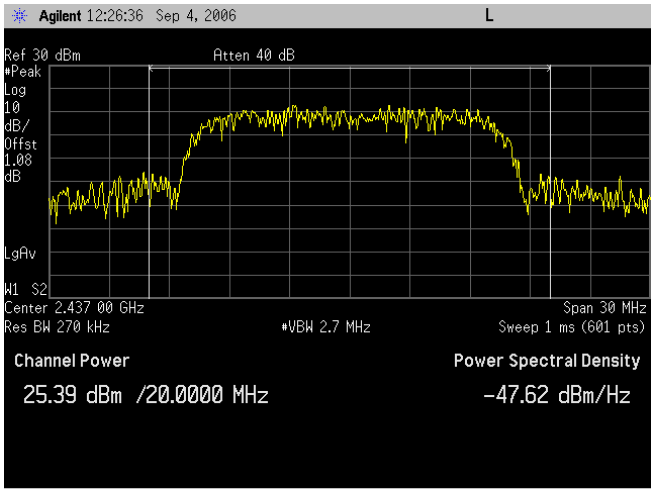

**Plot 83. 2437 MHz, Data Rate 12 Mbps, g Mode**



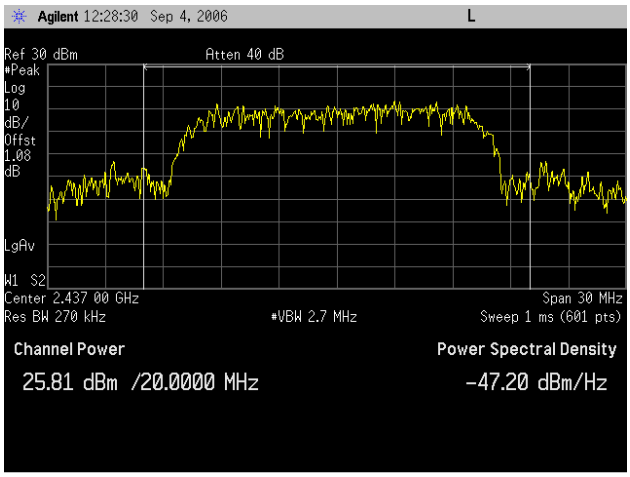

**Plot 84. 2437 MHz, Data Rate 18 Mbps, g Mode**



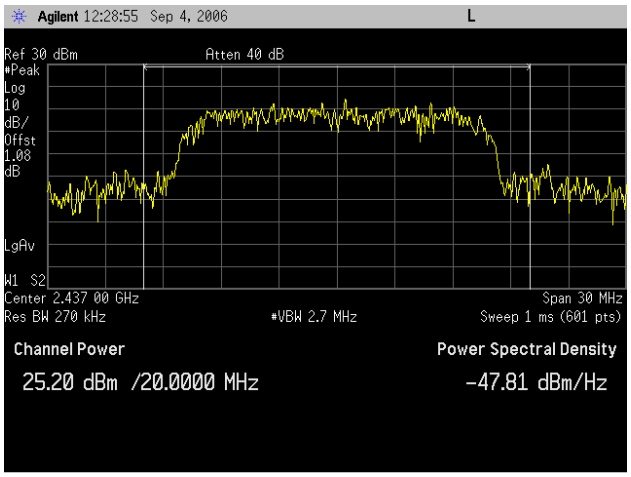

**Plot 85. 2437 MHz, Data Rate 24 Mbps, g Mode**



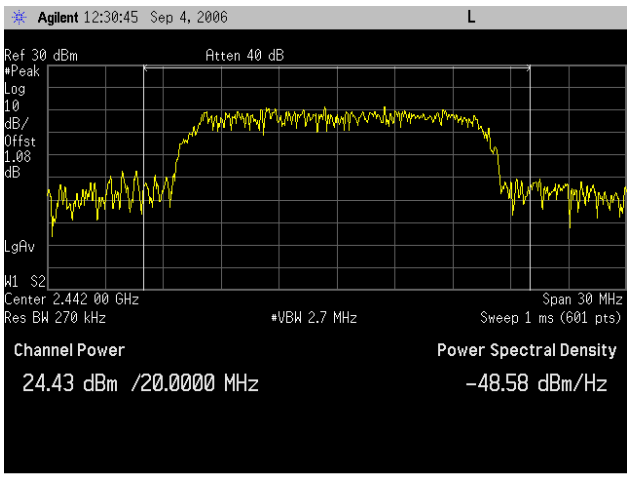

**Plot 86. 2437 MHz, Data Rate 36 Mbps, g Mode**



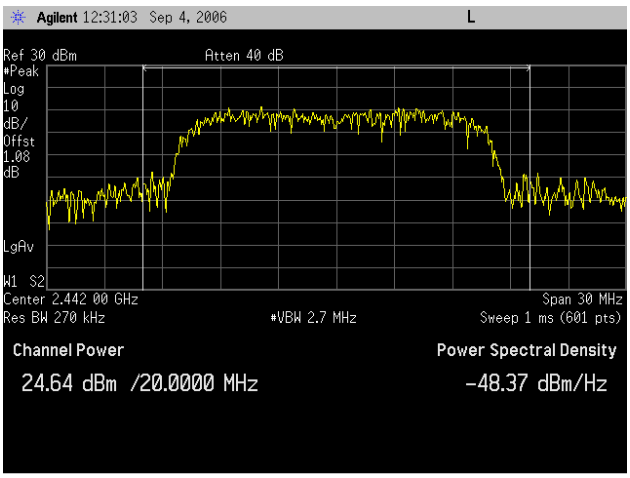

**Plot 87. 2437 MHz, Data Rate 48 Mbps, g Mode**



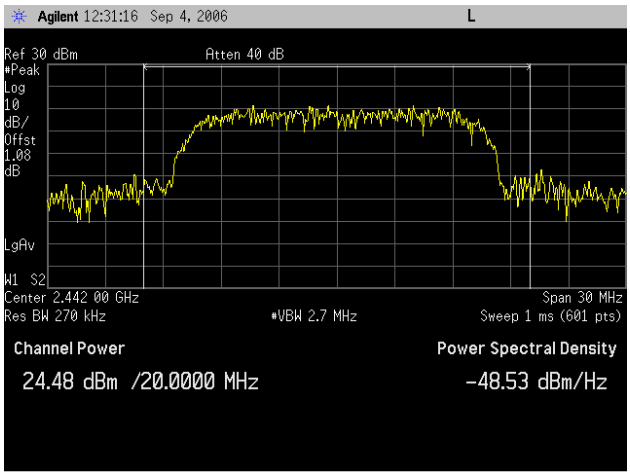

**Plot 88. 2437 MHz, Data Rate 54 Mbps, g Mode**



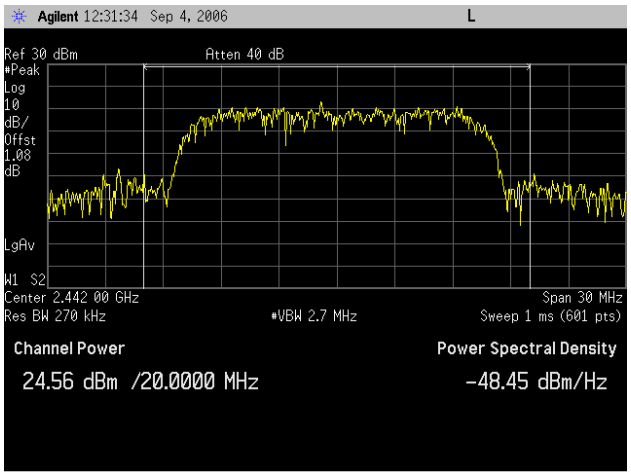

**Plot 89. 2442 MHz, Data Rate 6 Mbps, g Mode**



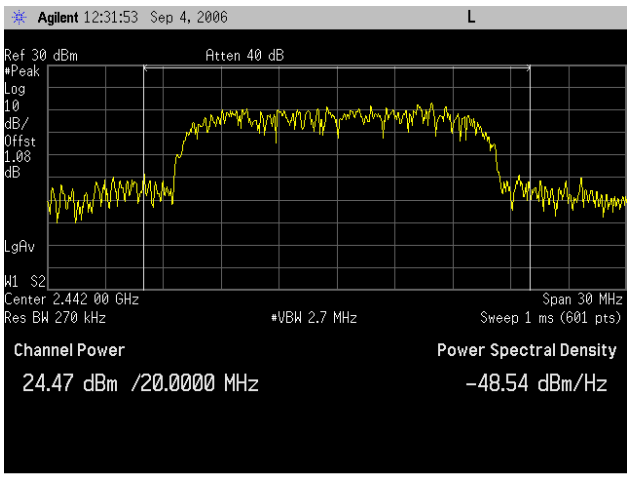

**Plot 90. 2442 MHz, Data Rate 9 Mbps, g Mode**



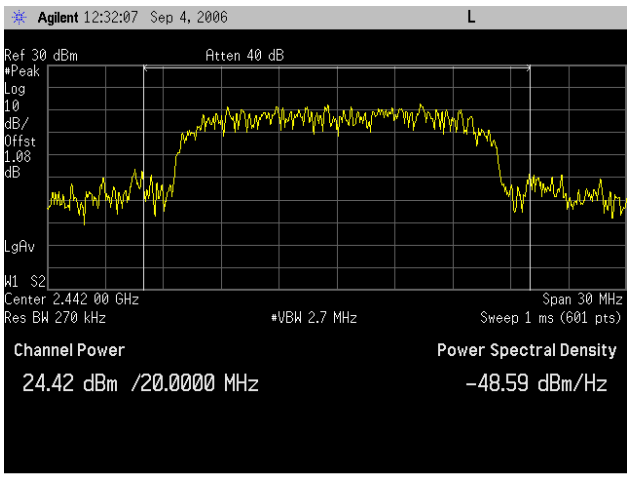

**Plot 91. 2442 MHz, Data Rate 12 Mbps, g Mode**



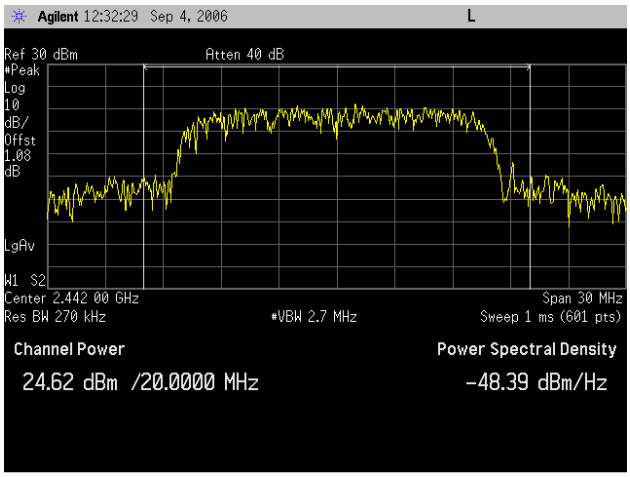

**Plot 92. 2442 MHz, Data Rate 18 Mbps, g Mode**



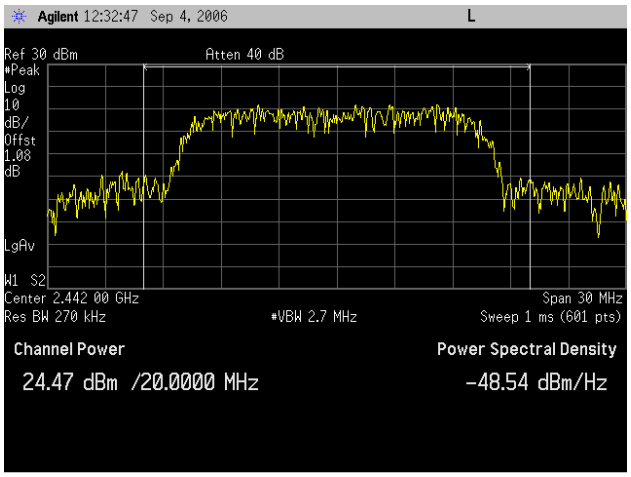

**Plot 93. 2442 MHz, Data Rate 24 Mbps, g Mode**



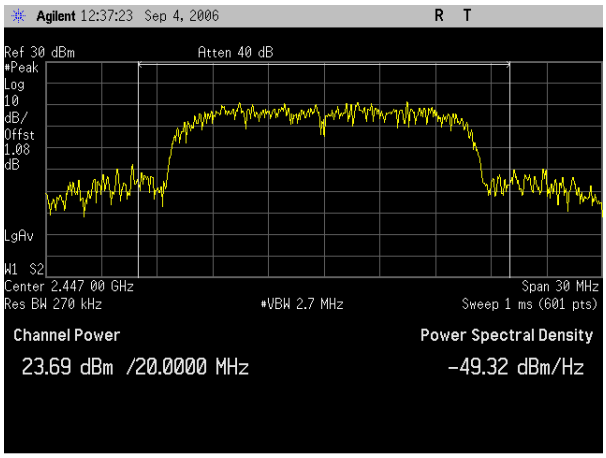

**Plot 94. 2442 MHz, Data Rate 36 Mbps, g Mode**



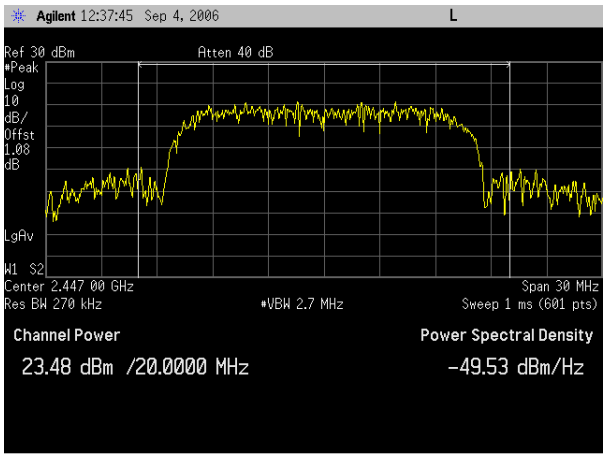

**Plot 95. 2442 MHz, Data Rate 48 Mbps, g Mode**



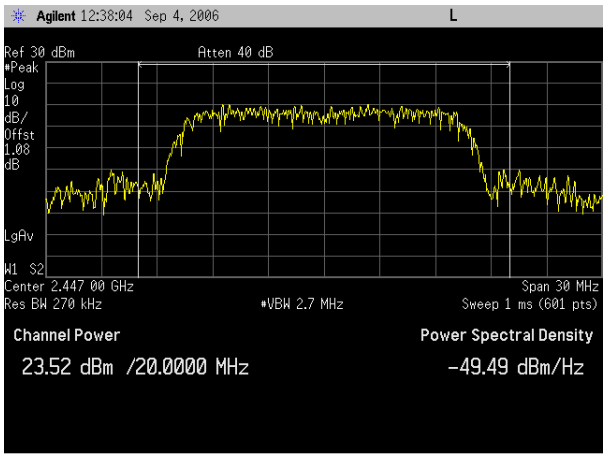

**Plot 96. 2442 MHz, Data Rate 54 Mbps, g Mode**



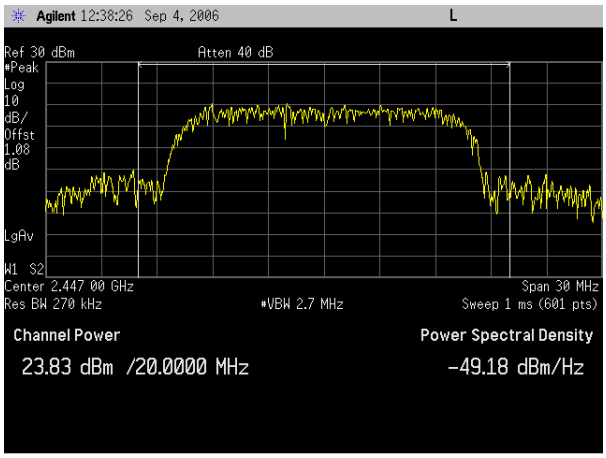

**Plot 97. 2447 MHz, Data Rate 6 Mbps, g Mode**



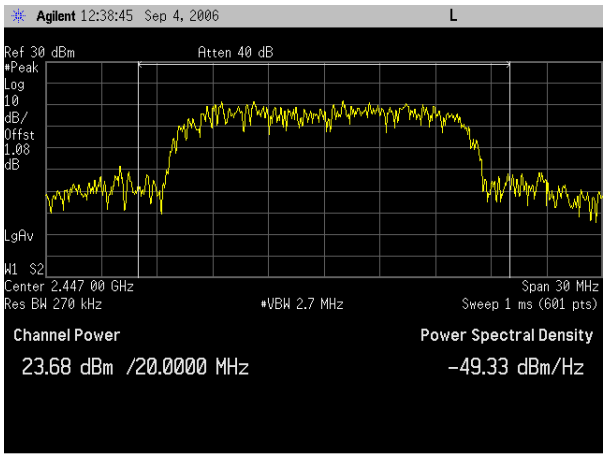

**Plot 98. 2447 MHz, Data Rate 9 Mbps, g Mode**



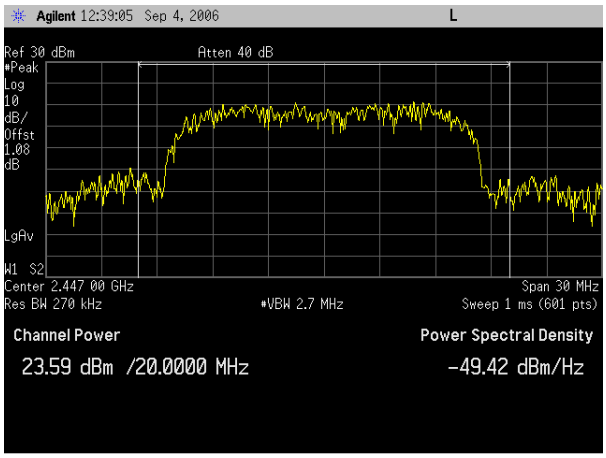

**Plot 99. 2447 MHz, Data Rate 12 Mbps, g Mode**



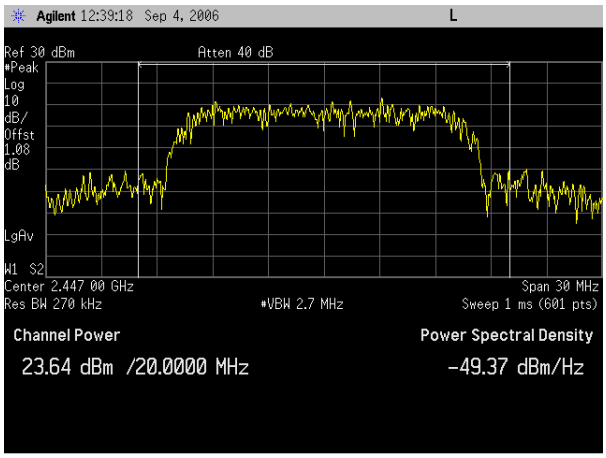

**Plot 100. 2447 MHz, Data Rate 18 Mbps, g Mode**



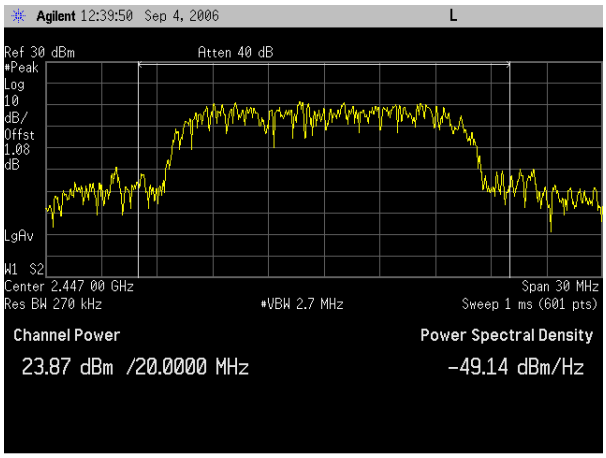

**Plot 101. 2447 MHz, Data Rate 24 Mbps, g Mode**



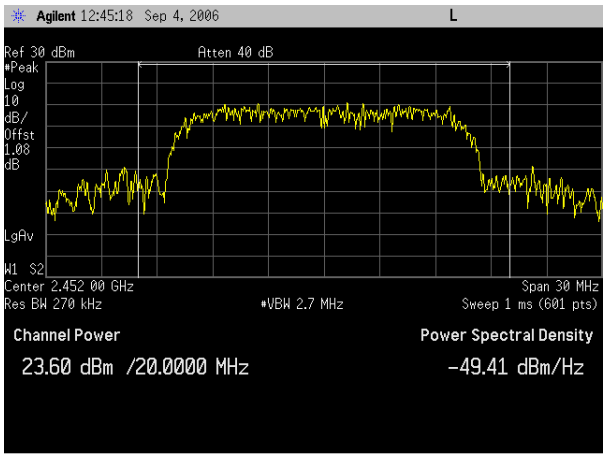

**Plot 102. 2447 MHz, Data Rate 36 Mbps, g Mode**



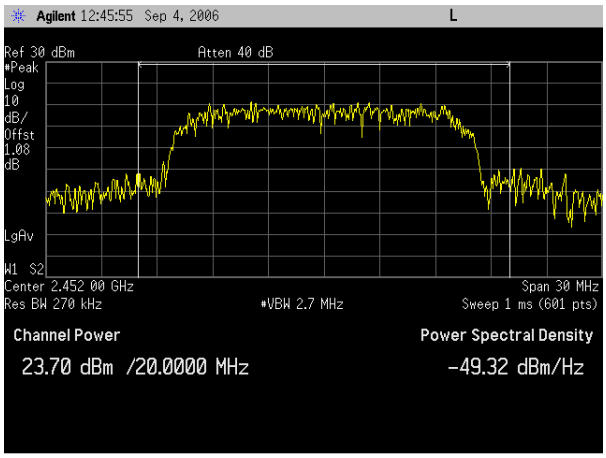

**Plot 103. 2447 MHz, Data Rate 48 Mbps, g Mode**



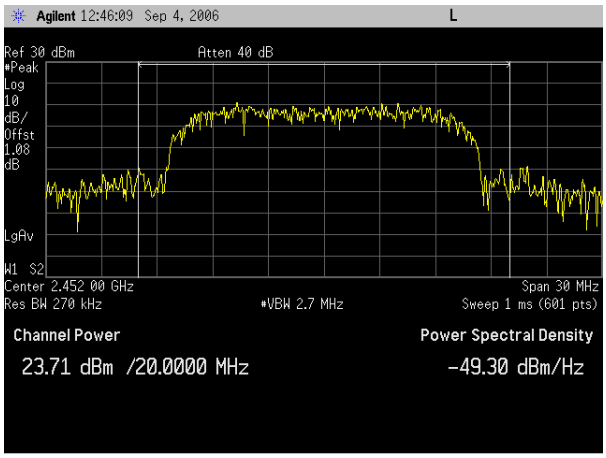

**Plot 104. 2447 MHz, Data Rate 54 Mbps, g Mode**



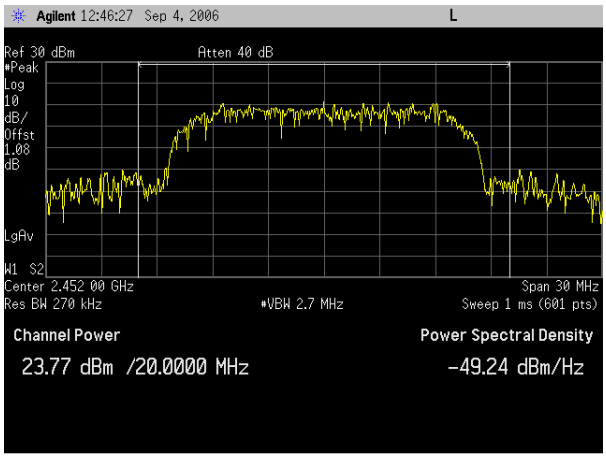

**Plot 105. 2452 MHz, Data Rate 6 Mbps, g Mode**



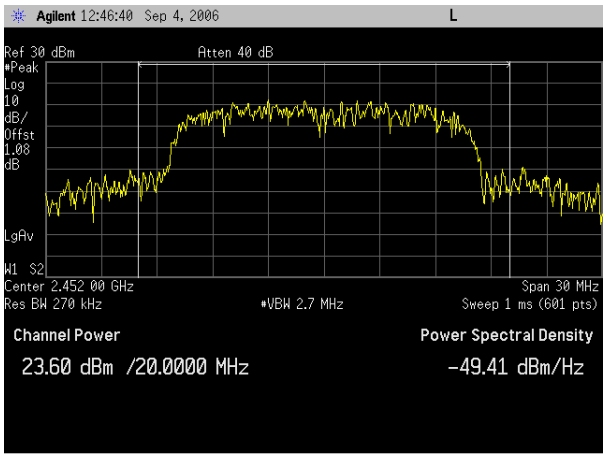

**Plot 106. 2452 MHz, Data Rate 9 Mbps, g Mode**



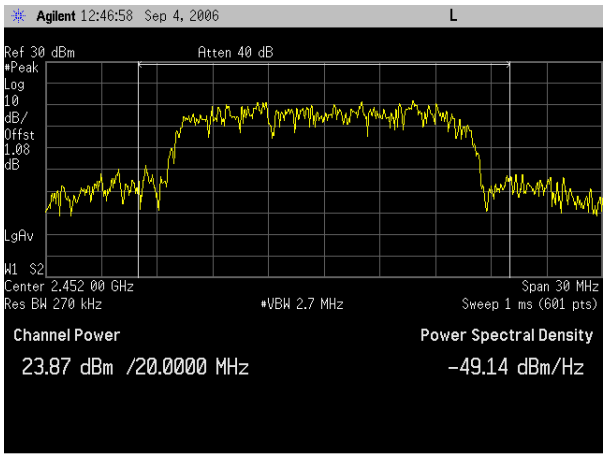

**Plot 107. 2452 MHz, Data Rate 12 Mbps, g Mode**



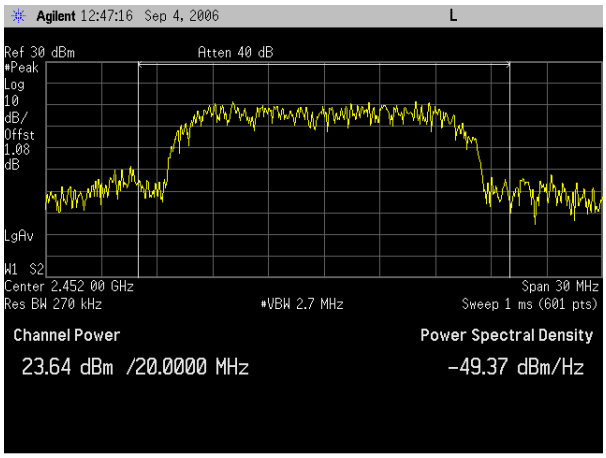

**Plot 108. 2452 MHz, Data Rate 18 Mbps, g Mode**



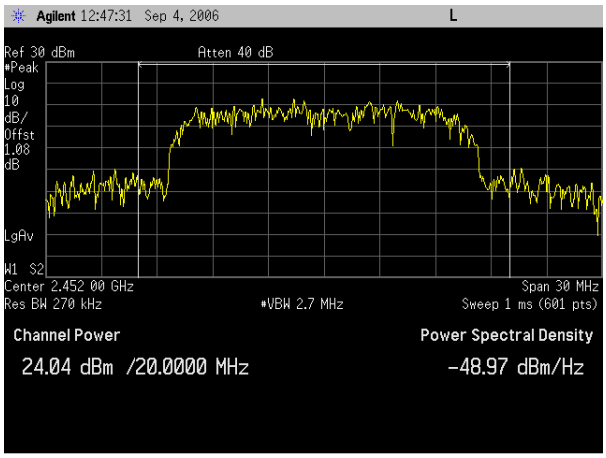

**Plot 109. 2452 MHz, Data Rate 24 Mbps, g Mode**



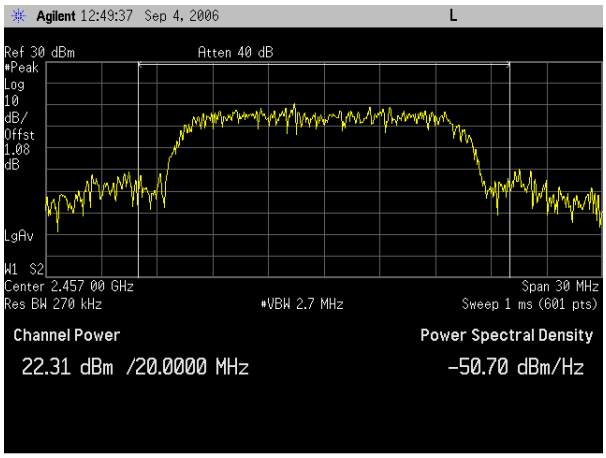

**Plot 110. 2452 MHz, Data Rate 36 Mbps, g Mode**



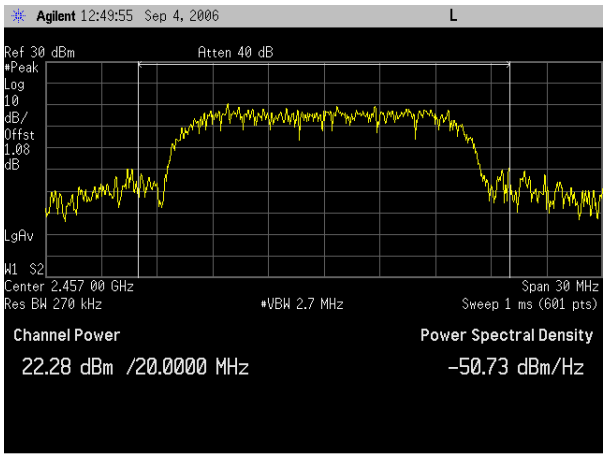

**Plot 111. 2452 MHz, Data Rate 48 Mbps, g Mode**



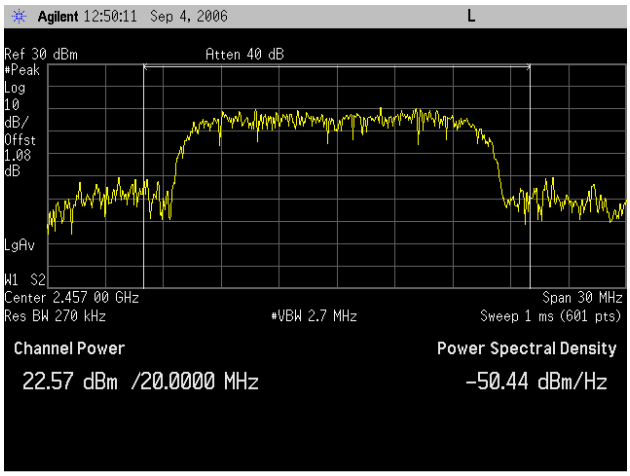

**Plot 112. 2452 MHz, Data Rate 54 Mbps, g Mode**



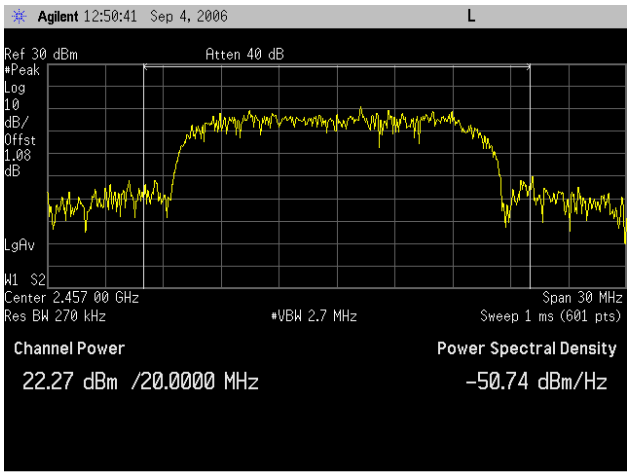

**Plot 113. 2457 MHz, Data Rate 6 Mbps, g Mode**



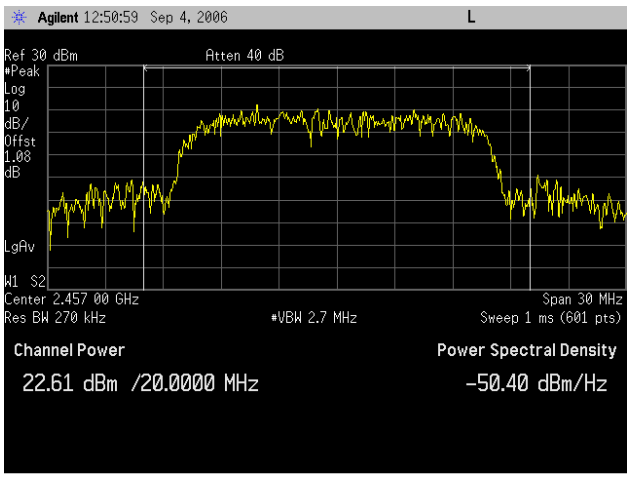

**Plot 114. 2457 MHz, Data Rate 9 Mbps, g Mode**



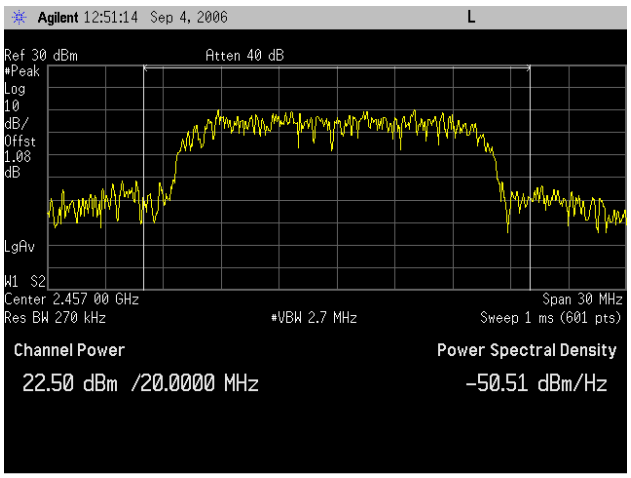

**Plot 115. 2457 MHz, Data Rate 12 Mbps, g Mode**



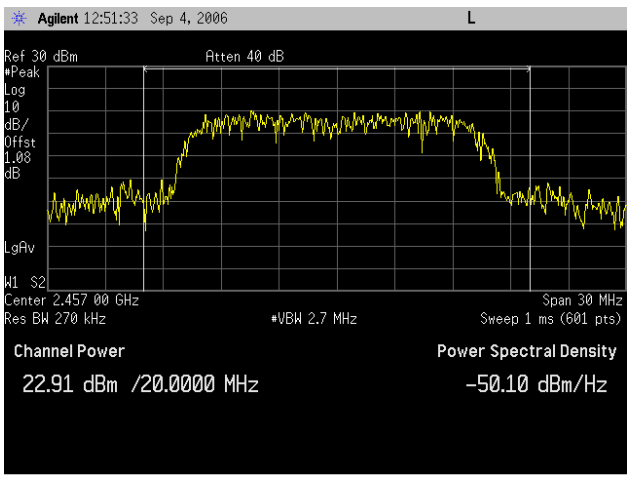

**Plot 116. 2457 MHz, Data Rate 18 Mbps, g Mode**



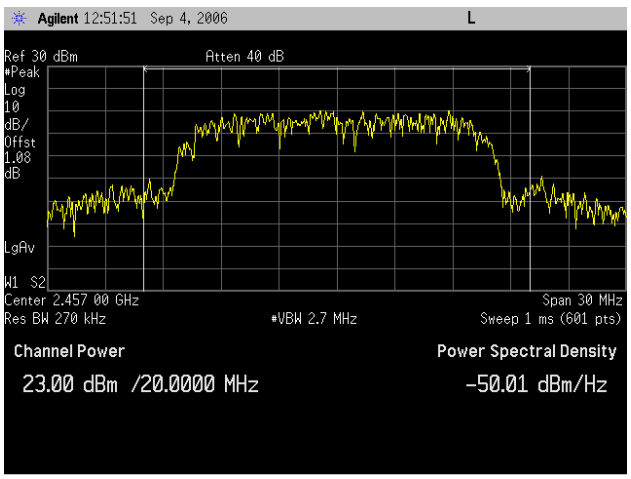

**Plot 117. 2457 MHz, Data Rate 24 Mbps, g Mode**



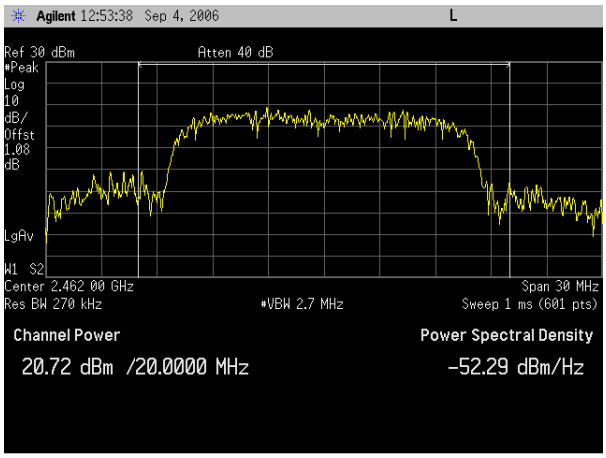

**Plot 118. 2457 MHz, Data Rate 36 Mbps, g Mode**



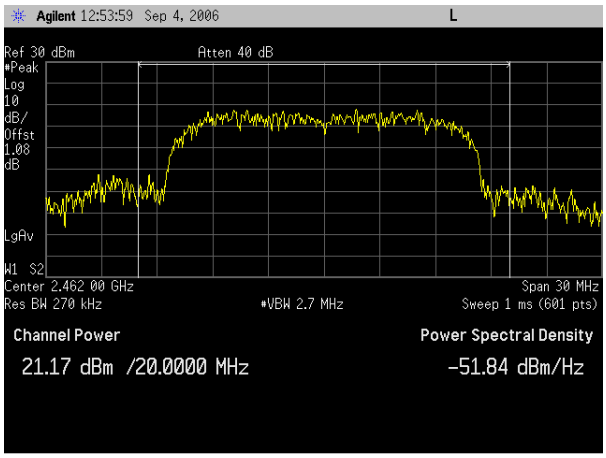

**Plot 119. 2457 MHz, Data Rate 48 Mbps, g Mode**



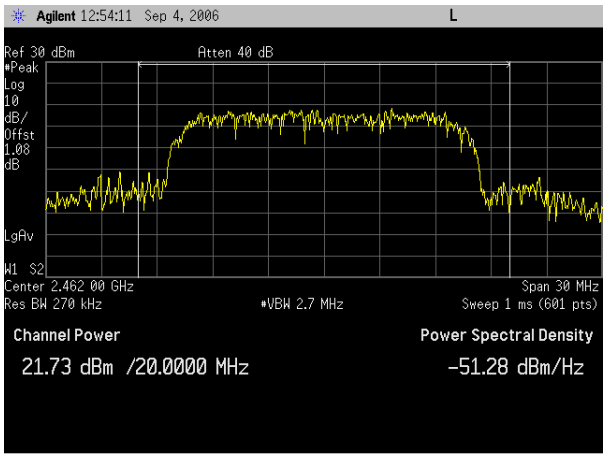

**Plot 120. 2457 MHz, Data Rate 54 Mbps, g Mode**



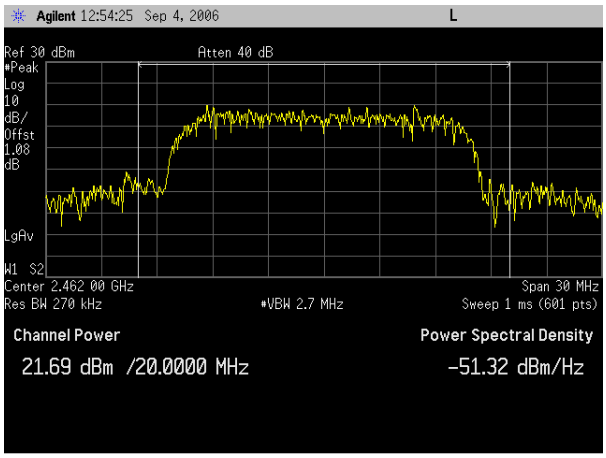

**Plot 121. 2462 MHz, Data Rate 6 Mbps, g Mode**



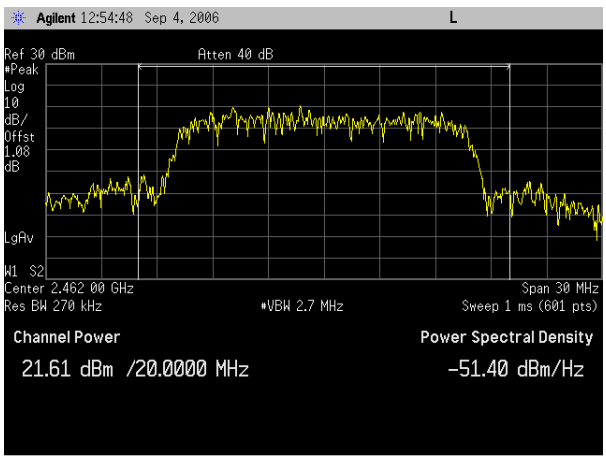

**Plot 122. 2462 MHz, Data Rate 9 Mbps, g Mode**



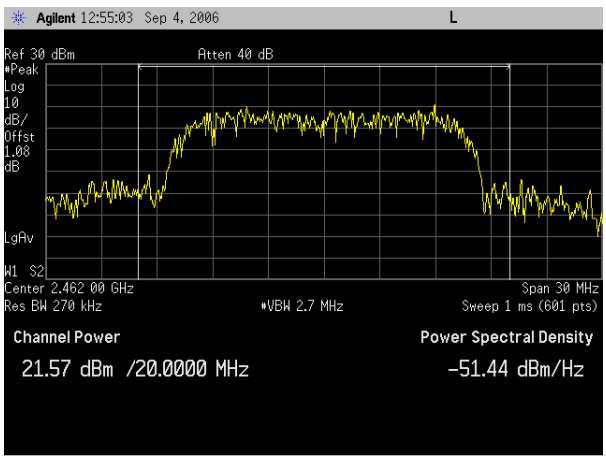

**Plot 123. 2462 MHz, Data Rate 12 Mbps, g Mode**



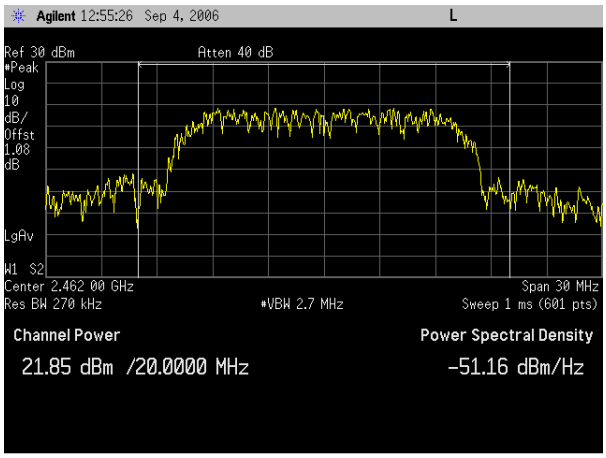

**Plot 124. 2462 MHz, Data Rate 18 Mbps, g Mode**



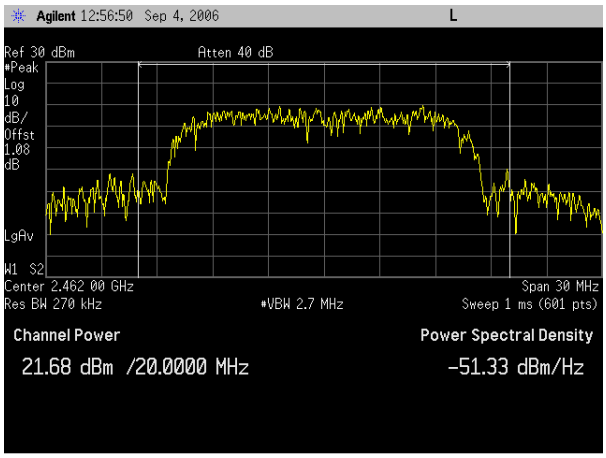

**Plot 125. 2462 MHz, Data Rate 24 Mbps, g Mode**



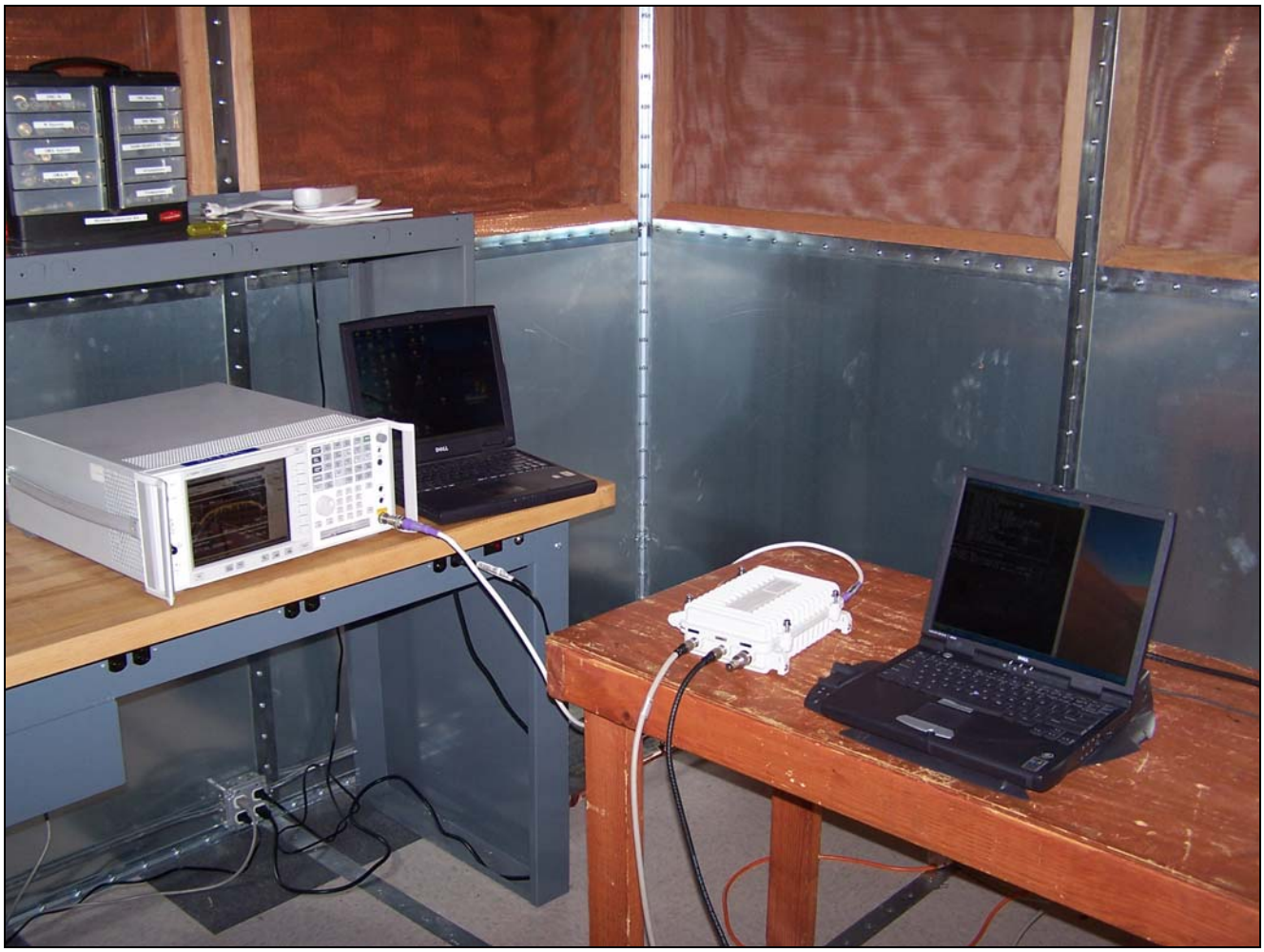

**Plot 126. 2462 MHz, Data Rate 36 Mbps, g Mode**




**Plot 127. 2462 MHz, Data Rate 48 Mbps, g Mode**




**Plot 128. 2462 MHz, Data Rate 54 Mbps, g Mode**



**Photograph 4. Peak Power Output and RF Exposure, Test Setup**

# Electromagnetic Compatibility Criteria for Intentional Radiators

## § 15.247(b) Peak Power Output and 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.

| Frequency Range (MHz) | Electric Field Stretgh (V/m) | Magnetic Field Stregth (A/m) | Power Density ($mW/cm^2$) | Average Time (minutes) |
|---|---|---|---|---|
| **(A) Limits for Occupational/Control Exposures** | | | | |
| 30-300 | 61.4 | 0.163 | 1.0 | 6 |
| 300-1,500 | -- | -- | F/300 | 6 |
| 1,500-100,000 | -- | -- | 5 | 6 |
| **(B) Limits for General Population/Uncontrolled Exposure** | | | | |
| 30-300 | 27.5 | 0.073 | 0.2 | 30 |
| 300-1,500 | -- | -- | F/1,500 | 30 |
| 1,500-100,000 | -- | -- | 1.0 | 30 |

**Table 26. Limits for Maximum Permissible Exposure**

Note: F=Frequency in MHz

MPE Limit Calculation: EUT's operating frequencies @ 2412-2462 MHz; highest conducted power = 27.97dBm (peak) therefore, **Limit for Uncontrolled exposure: 1 $mW/cm^2$.**

EUT maximum antenna gain = 8 dBi.

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

$$S = PG / 4\pi R^2$$

where,

S = Power Density $mW/m^2$
P = Power Input to antenna mili Watts
G = Numeric Antenna Gain
R = Distance to the center of radiation of the antenna (20 cm for Mobile minimum distance)

Antenna Numeric Gain = $10^{dBi/10}$

Power at antenna port = 602.6 mW

Antenna Gain = 8 dBi

Numeric antenna gain = $10^{8/10}$ = 6.31

$S = (602.6)(6.31) / 4(3.1416)(20)^2$

$S = 0.756\ mW/cm^2$

Therefore, EUT meets the Uncontrolled Exposure limit.

## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.247(d) Harmonic Emissions – Radiated and Conducted

**Test Requirements:** **§15.247(c):** 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).

**Test Procedure:** The EUT was configured with the control software to transmit at maximum power. The transmit output was connected to the analyzer through an attenuator. RBW = 100 kHz, VBW $\geq$ RBW. Testing was performed in both 802.11 b and 802.11 g modes of operation. Low, Mid and High channels were tested.

**Test Results:** The EUT was found compliant with the requirements of this section.

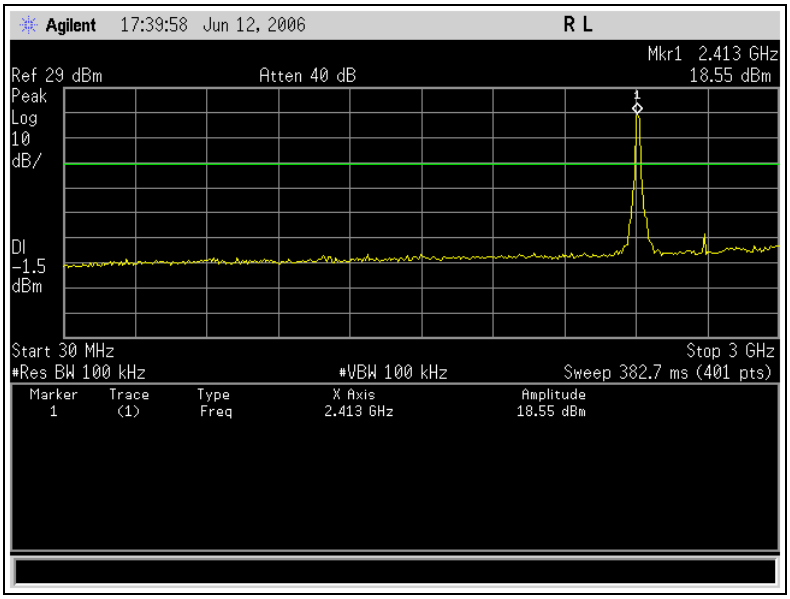
**Test Engineer:** Len Knight

**Test Date:** 6/12/2006

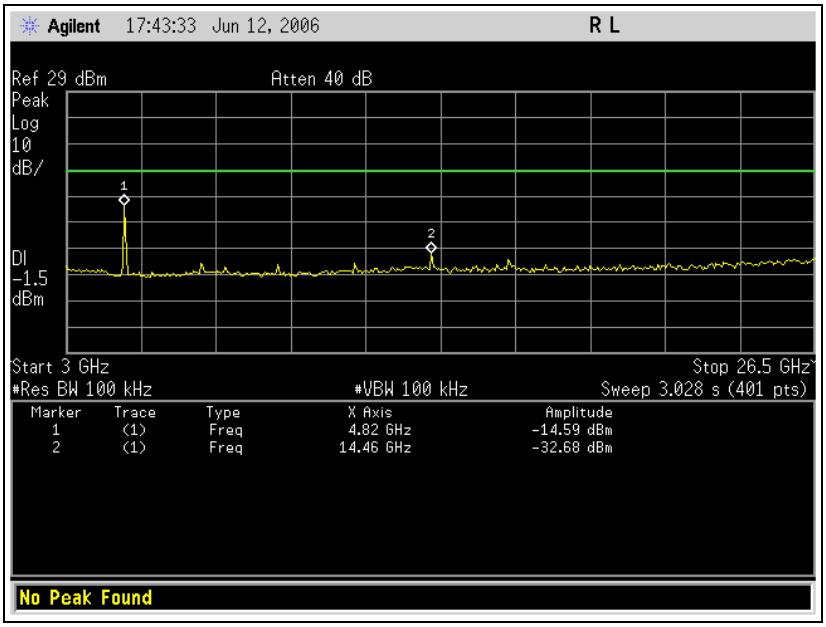
  

## Electromagnetic Compatibility Criteria for Intentional Radiators

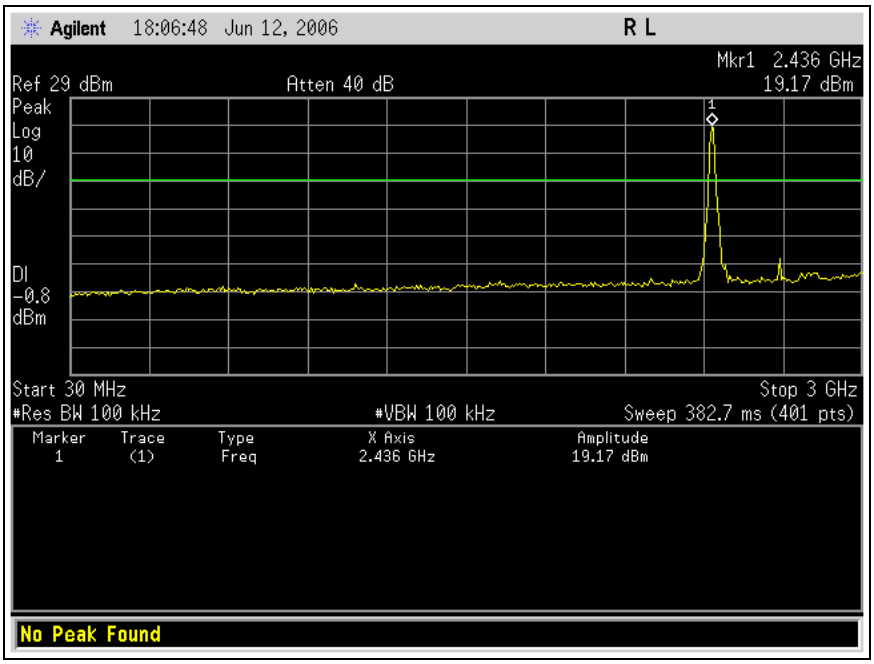
### § 15.247(d) Harmonic Emissions Requirements – Radiated (802.11b)



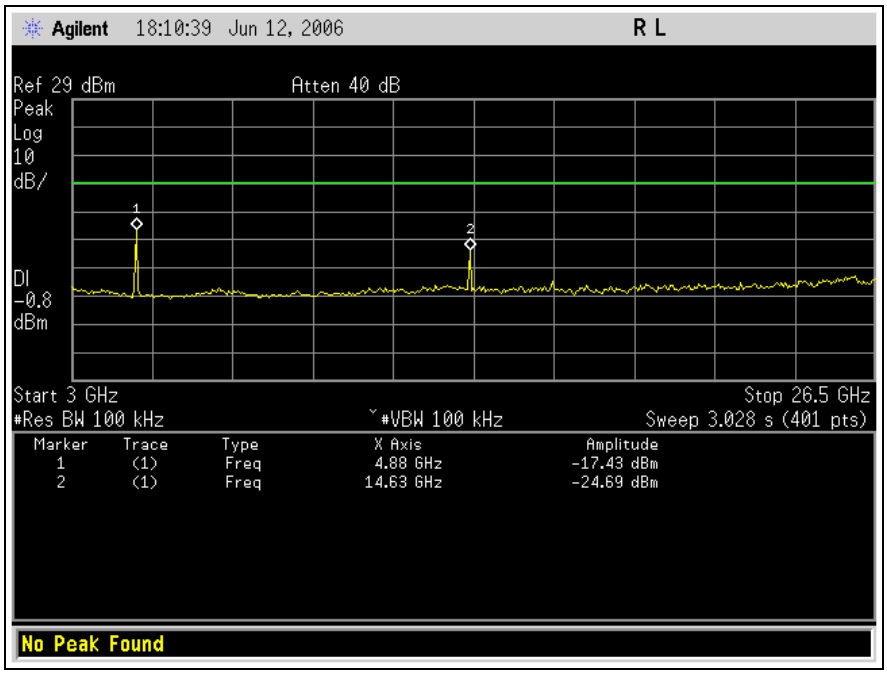

**Plot 129. Spurious Conducted Emission – Low Channel 802.11 b, 30 MHz to 3 GHz**



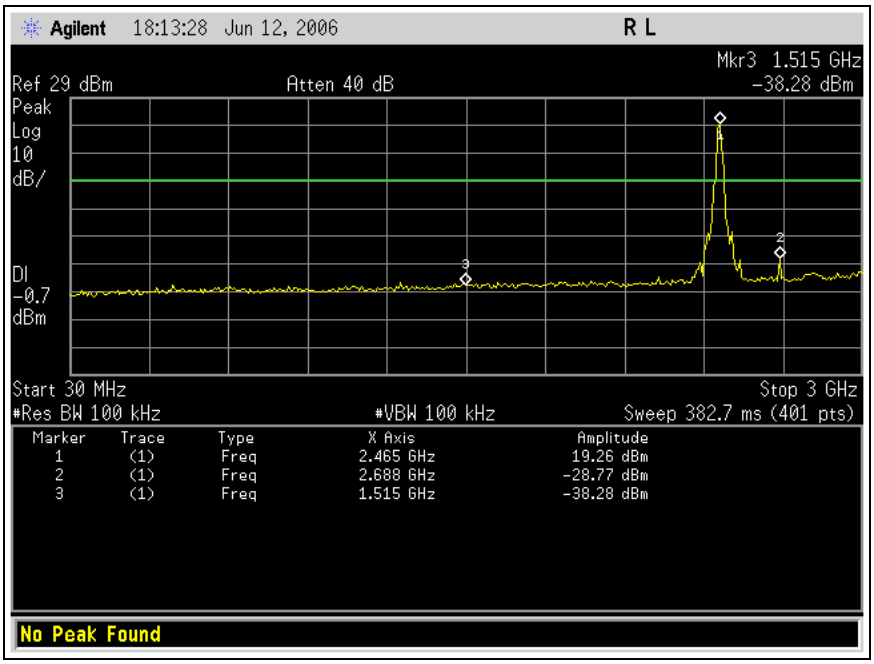

**Plot 130. Surious Conducted Emission – Low Channel 802.11 b, 3 GHz to 26.5 GHz**



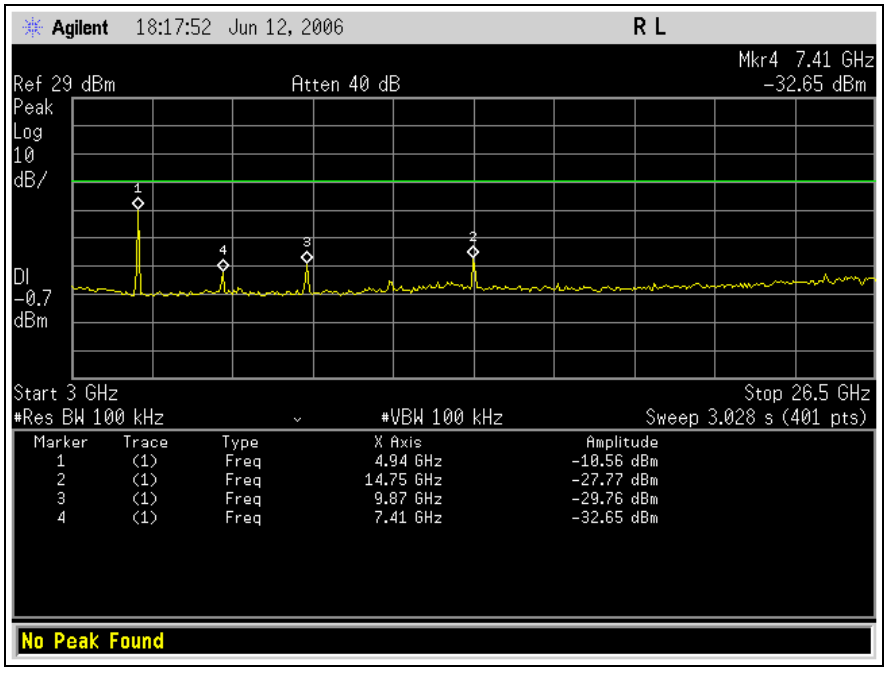

**Plot 131. Spurious Conducted Emission – Mid Channel 802.11 b, 30 MHz to 3 GHz**



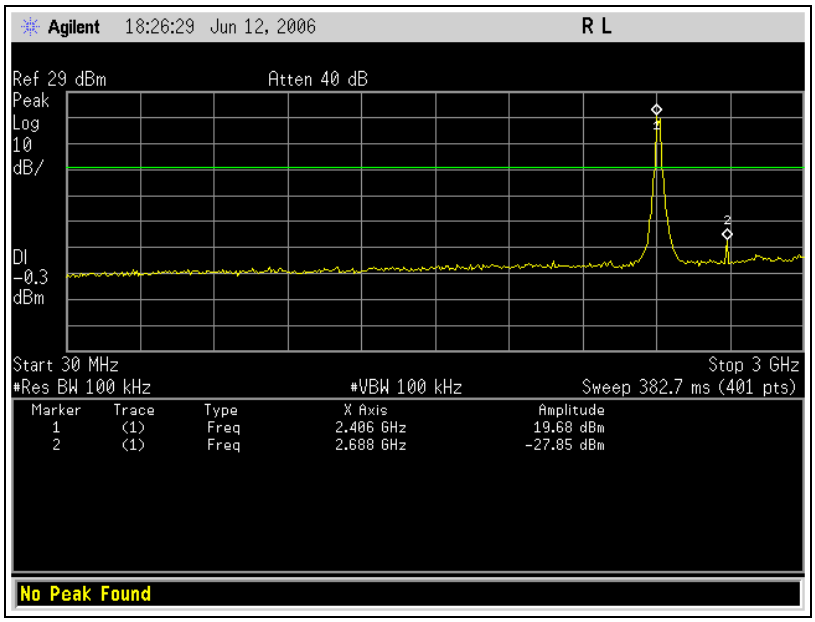

**Plot 132. Spurious Conducted Emission – Mid Channel 802.11 b, 3 GHz to 26.5 GHz**



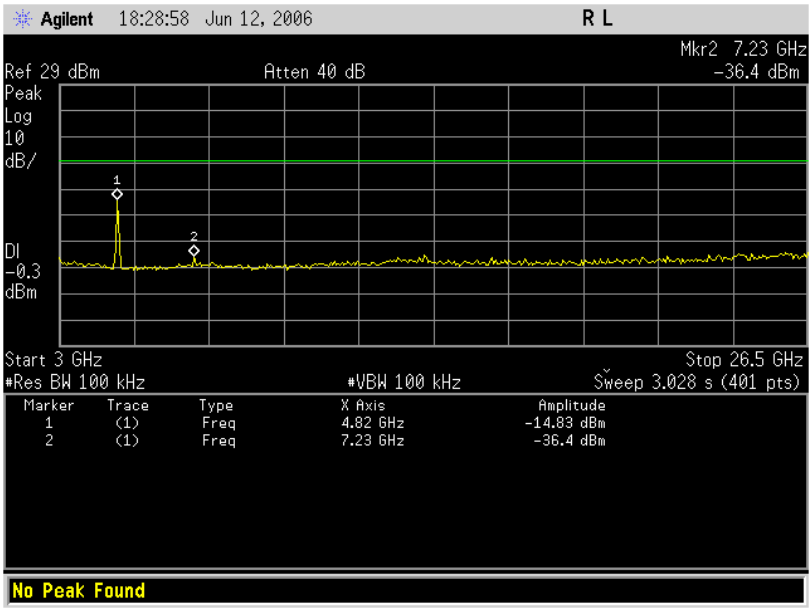

**Plot 133. Spurious Conducted Emission – High Channel 802.11 b, 30 MHz to 3 GHz**



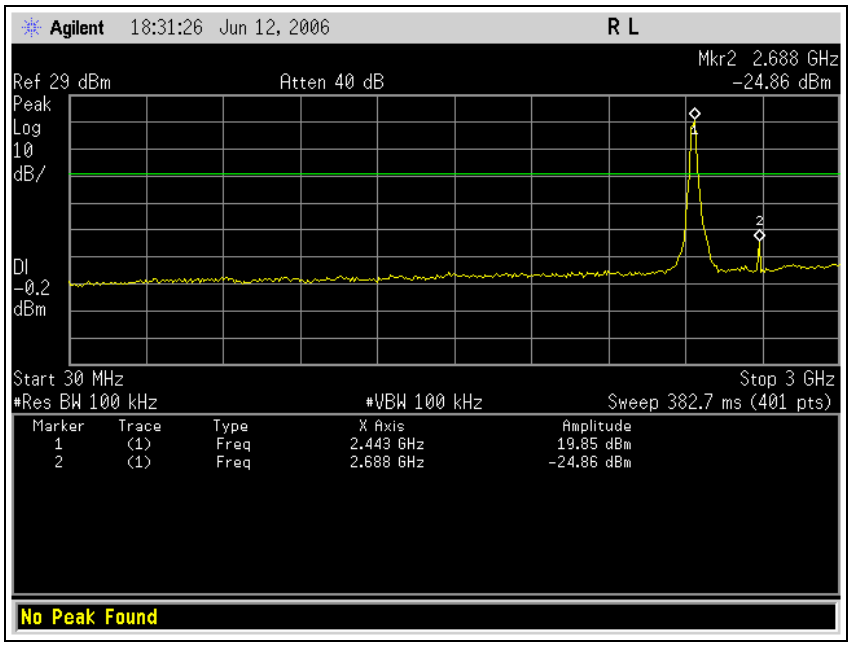

**Plot 134. Spurious Conducted Emission – High Channel 802.11 b, 3 GHz to 26.5 GHz**



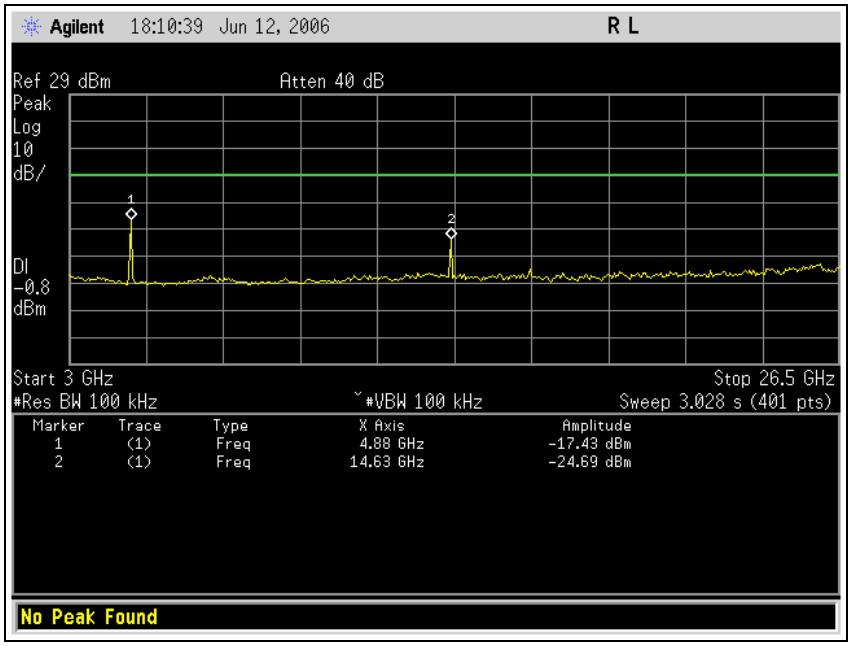

**Plot 135. Spurious Conducted Emission – Low Channel 802.11 g, 30 MHz to 3 GHz**



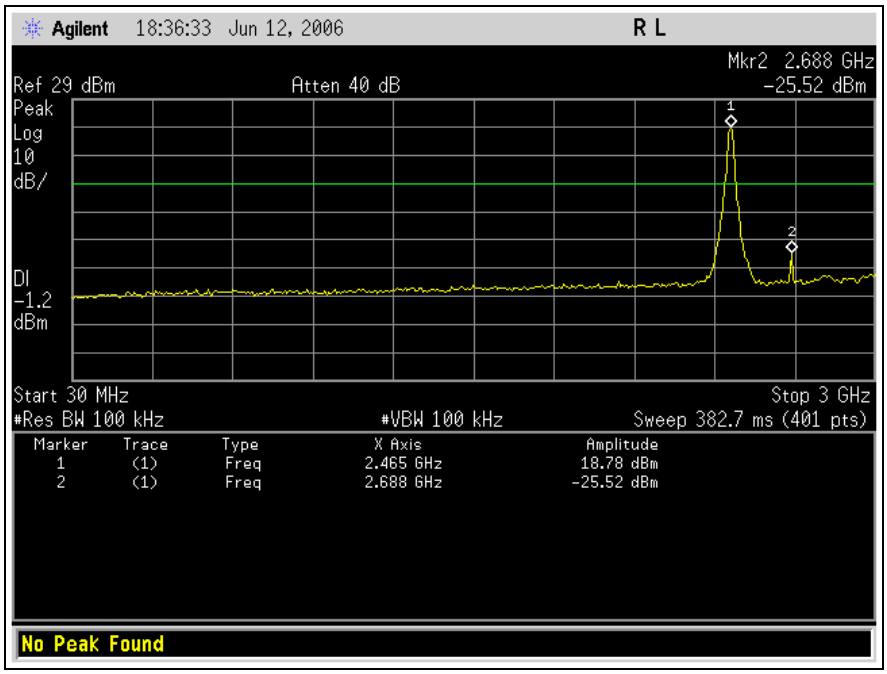

**Plot 136. Surious Conducted Emission – Low Channel 802.11 g, 3 GHz to 26.5 GHz**



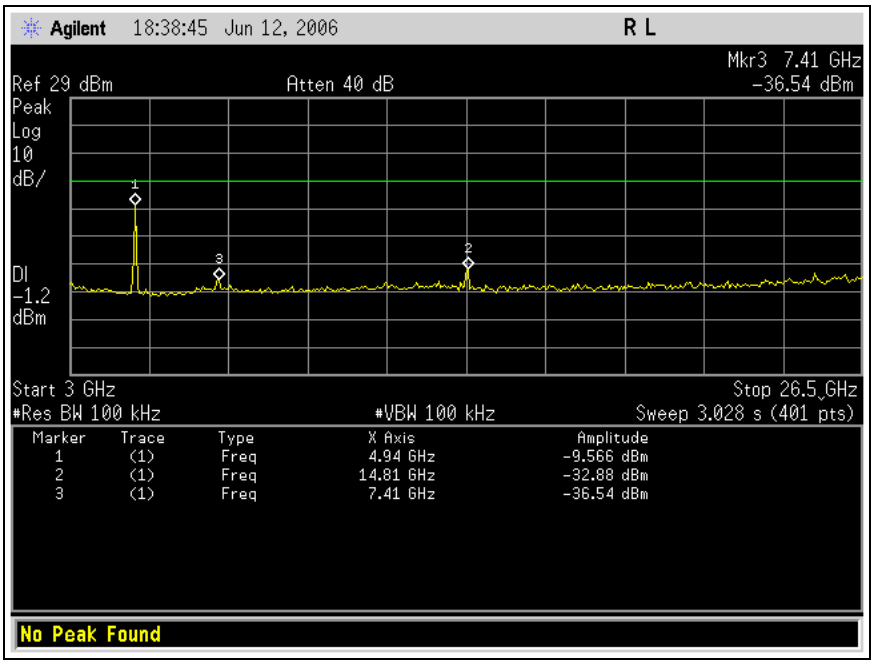

**Plot 137. Spurious Conducted Emission – Mid Channel 802.11 g, 30 MHz to 3 GHz**



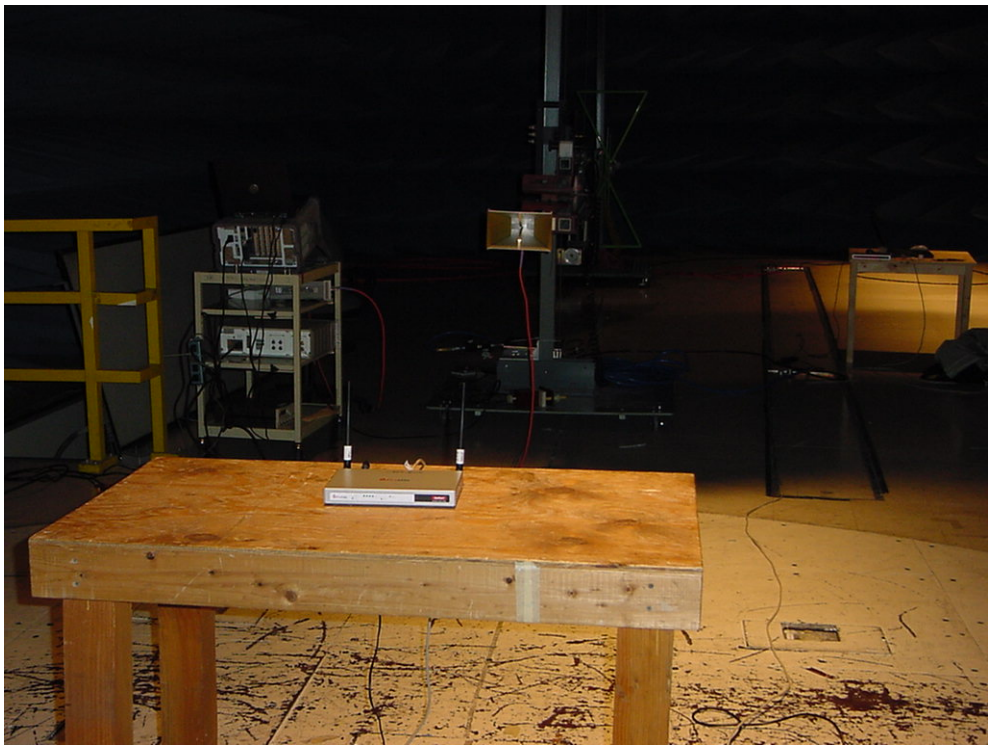

**Plot 138. Spurious Conducted Emission – Mid Channel 802.11 g, 3 GHz to 26.5 GHz**

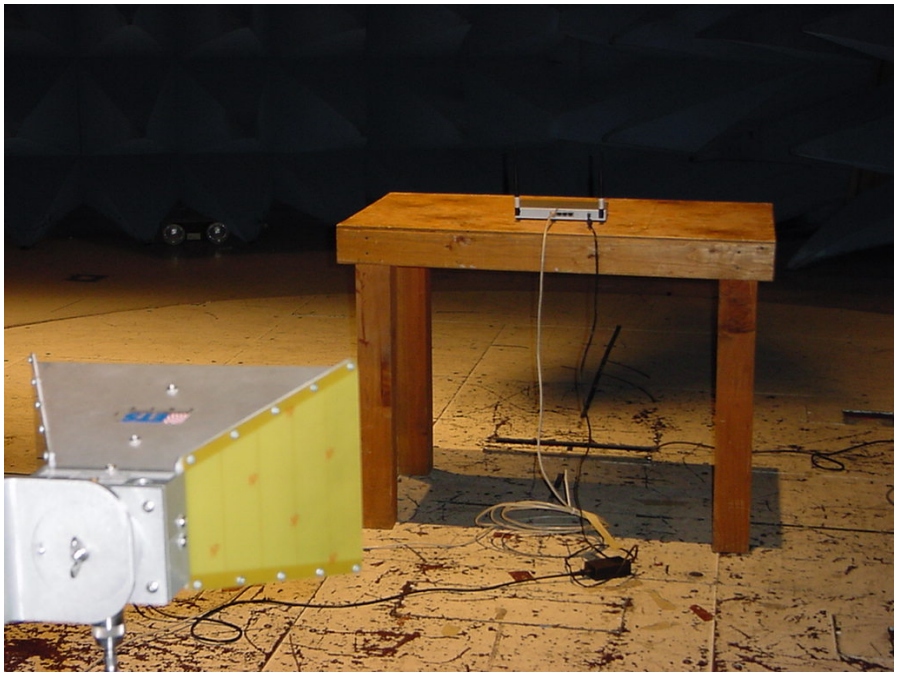



**Plot 139. Spurious Conducted Emission – High Channel 802.11 g, 30 MHz to 3 GHz**




**Plot 140. Spurious Conducted Emission – High Channel 802.11 g, 3 GHz to 26.5 GHz**





**Photograph 5. Test Equipment and setup for various Radiated Measurements**

## Electromagnetic Compatibility Criteria for Intentional Radiators

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

**Test Requirements:** **§15.247(d):** 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. The power level was set to the maximum level.
RBW = 3 kHz, VBW>RBW
Sweep = Span/ 3 kHz

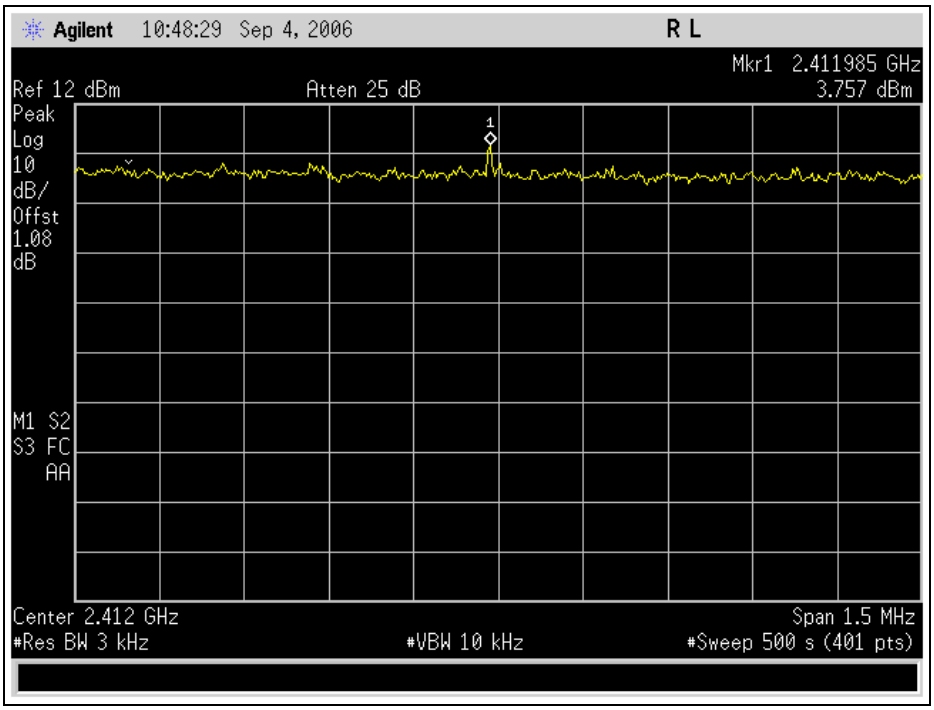
**Test Results:** Equipment complies with the peak power spectral density limits of **§ 15.247 (d)**. The peak power spectral density was determined from plots on the following page(s).

**Test Engineer:** Len Knight

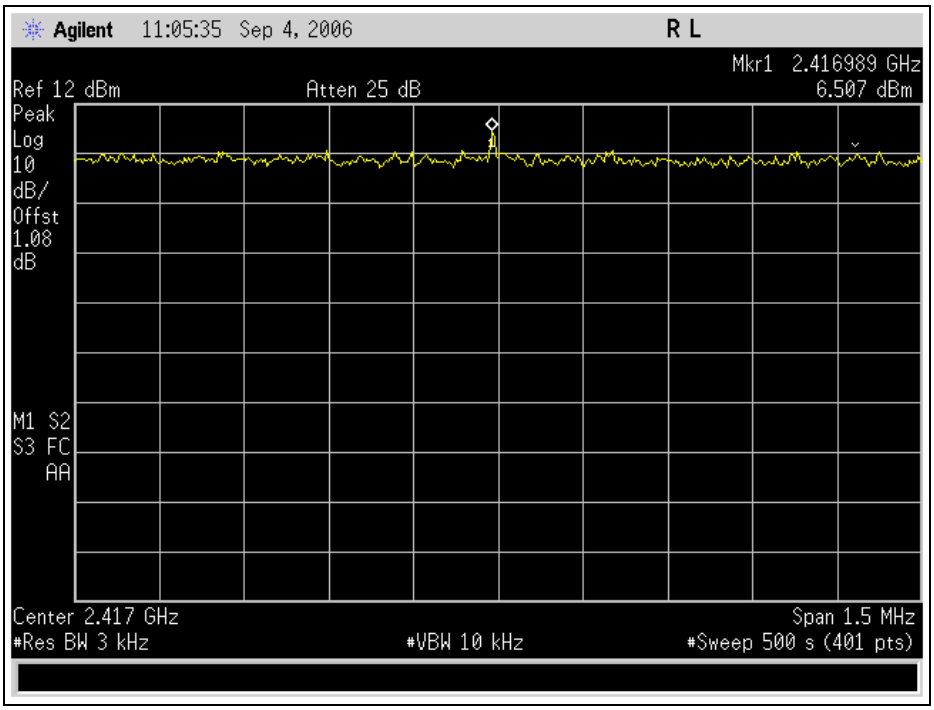
**Test Date:** September 3-4, 2006

| Channel | Frequency | Limit (dBm) | Measured PPSD (dBm) |
|---|---|---|---|
| 1 | 2.412 GHz | 8 | 3.757 |
| 2 | 2.417 GHz | 8 | 6.507 |
| 3 | 2.422 GHz | 8 | 6.067 |
| 4 | 2.427 GHz | 8 | 6.634 |
| 5 | 2.432 GHz | 8 | 5.276 |
| 6 | 2.437 GHz | 8 | 5.443 |
| 7 | 2.442 GHz | 8 | 5.95 |
| 8 | 2.447 GHz | 8 | 5.249 |
| 9 | 2.452 GHz | 8 | 5.054 |
| 10 | 2.457 GHz | 8 | 4.911 |
| 11 | 2.462 GHz | 8 | 3.712 |

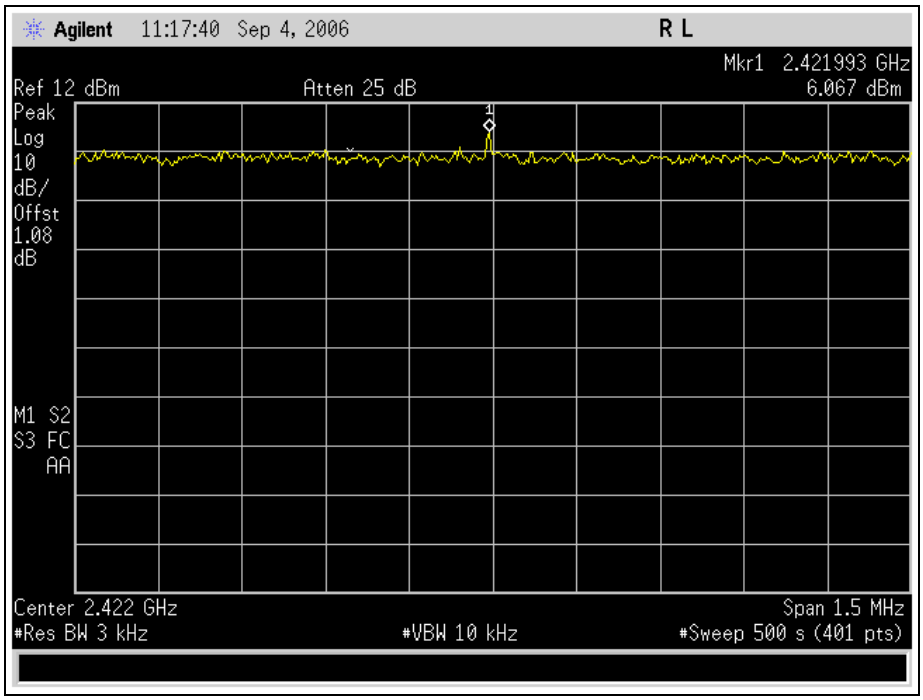
**Table 27. Peak Power Spectral Density Test Results, 802.11b**



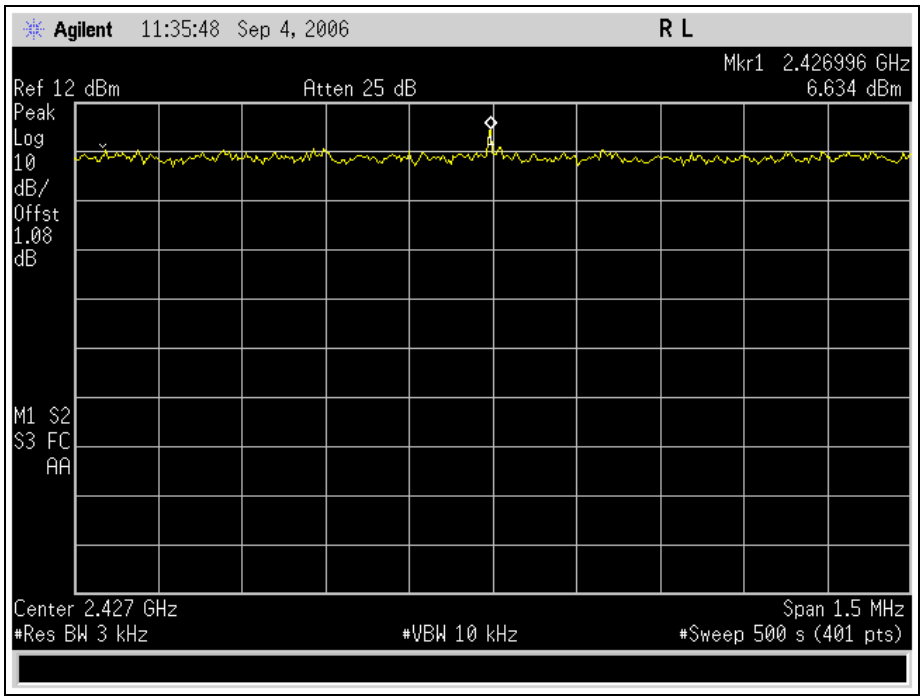

**Plot 141. Peak Power Spectral Density Test Results, 802.11b, Channel 1**



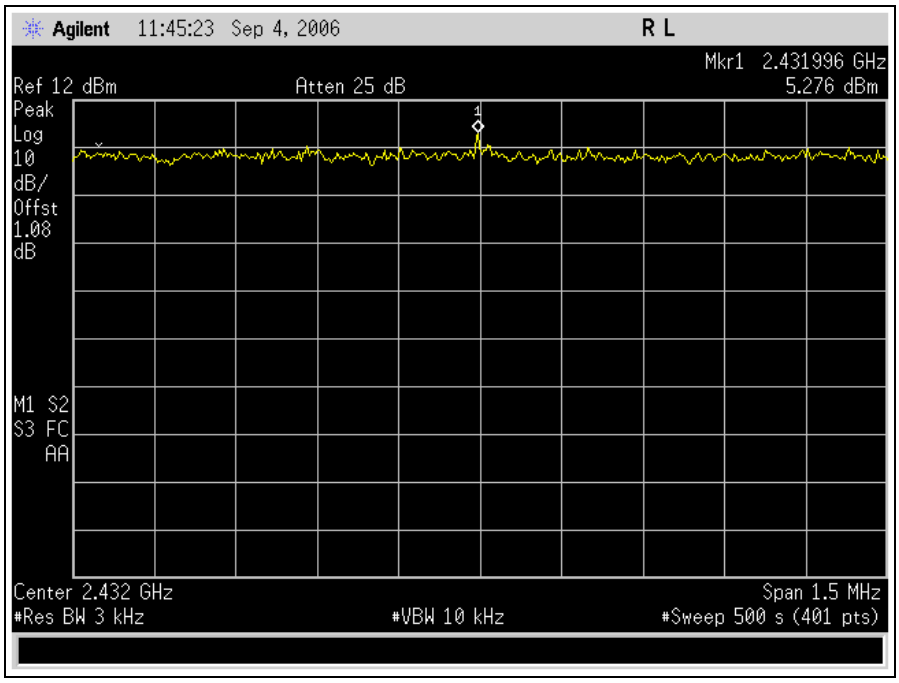

**Plot 142. Peak Power Spectral Density Test Results, 802.11b, Channel 2**



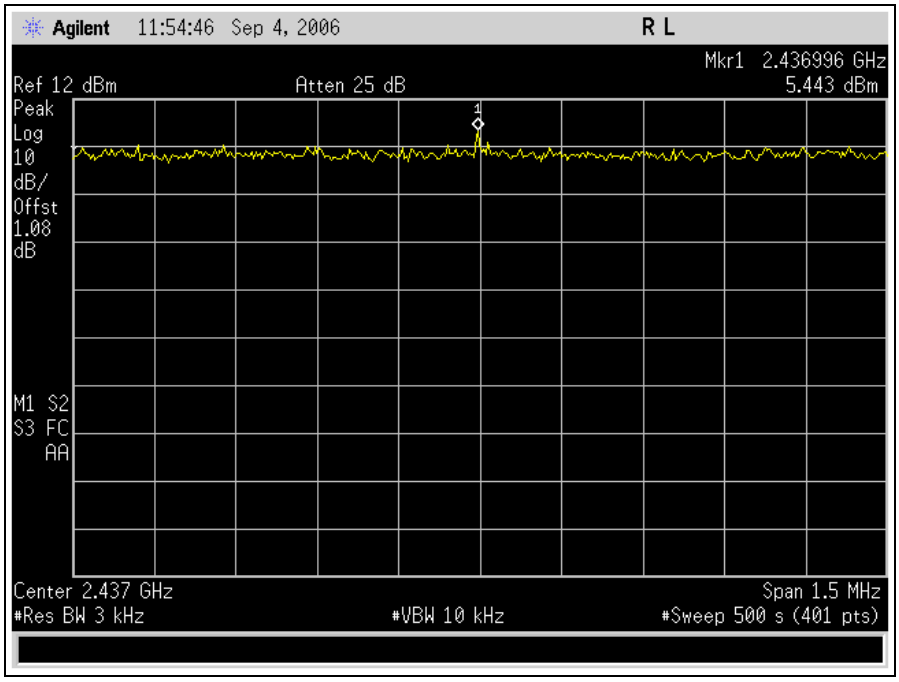

**Plot 143. Peak Power Spectral Density Test Results, 802.11b, Channel 3**



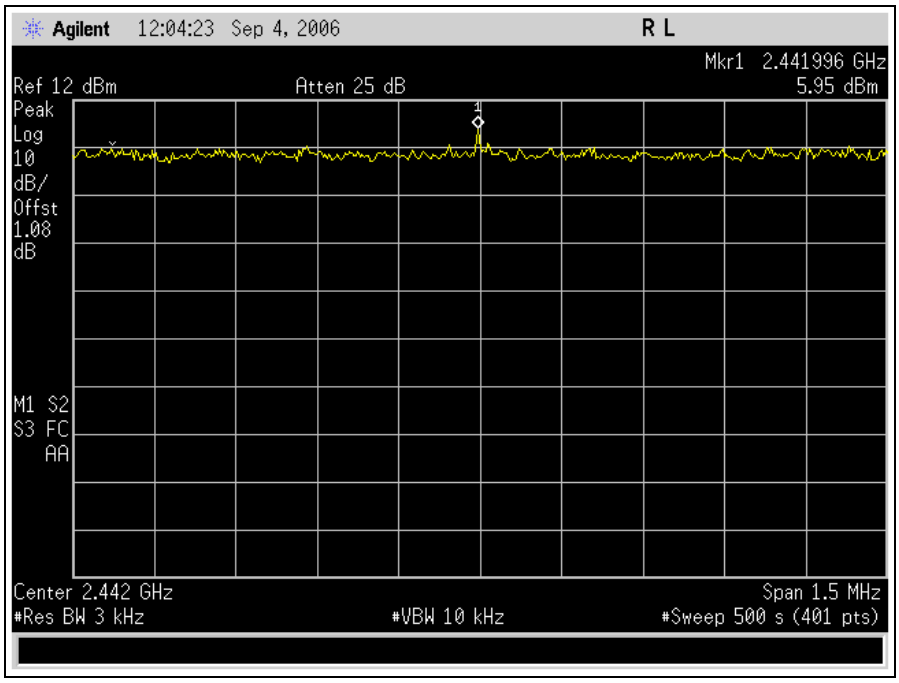

**Plot 144. Peak Power Spectral Density Test Results, 802.11b, Channel 4**



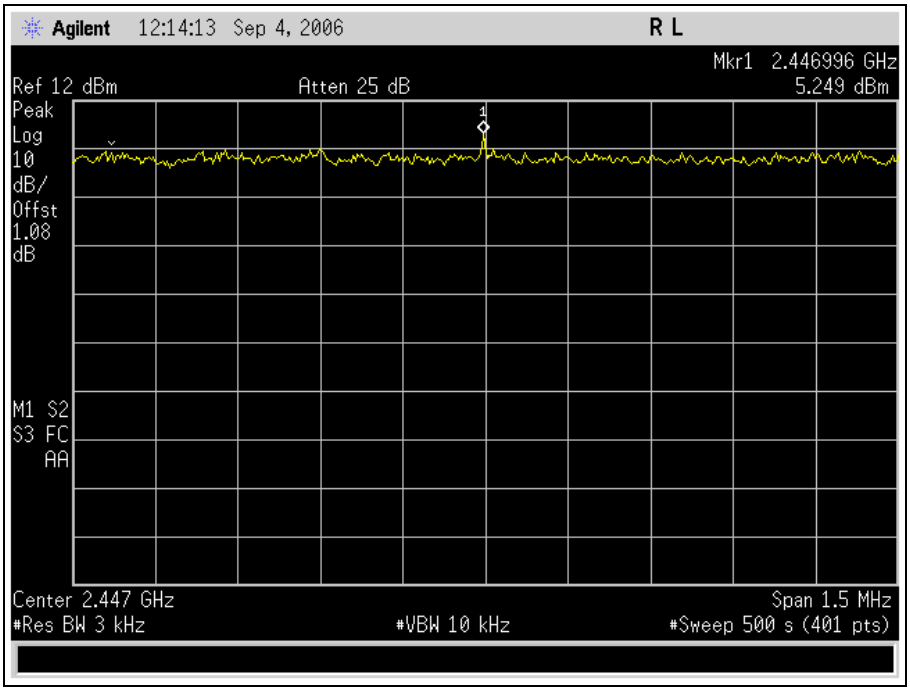

**Plot 145. Peak Power Spectral Density Test Results, 802.11b, Channel 5**



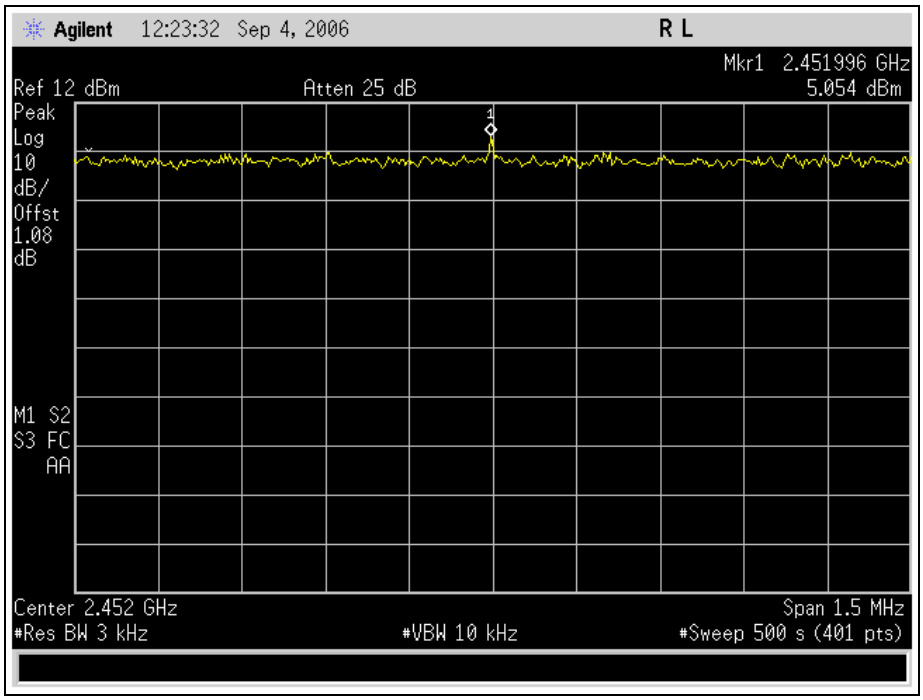

**Plot 146. Peak Power Spectral Density Test Results, 802.11b, Channel 6**



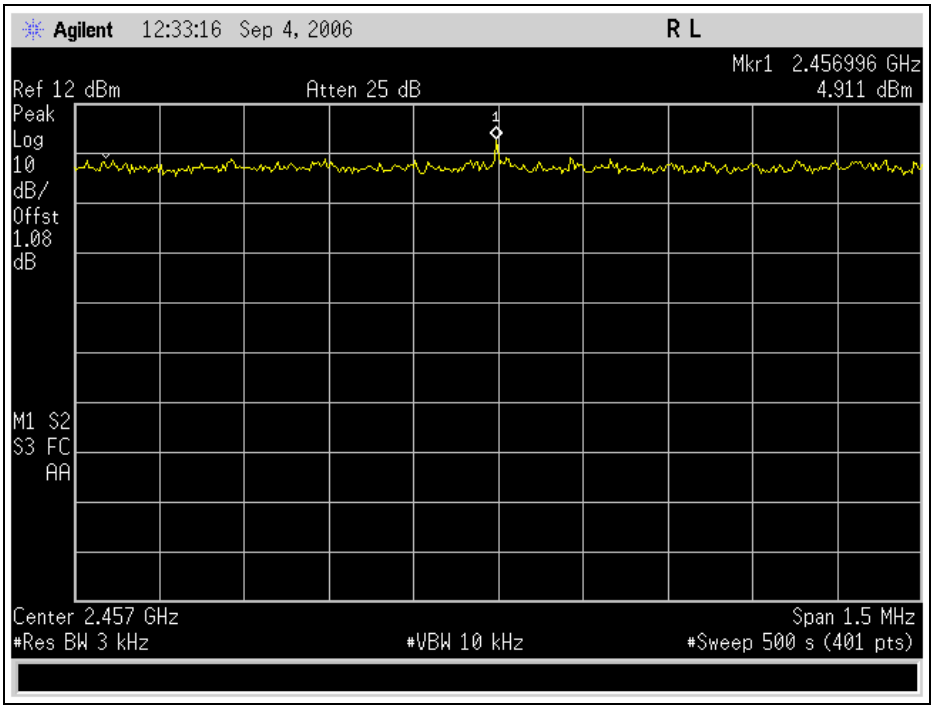

**Plot 147. Peak Power Spectral Density Test Results, 802.11b, Channel 7**



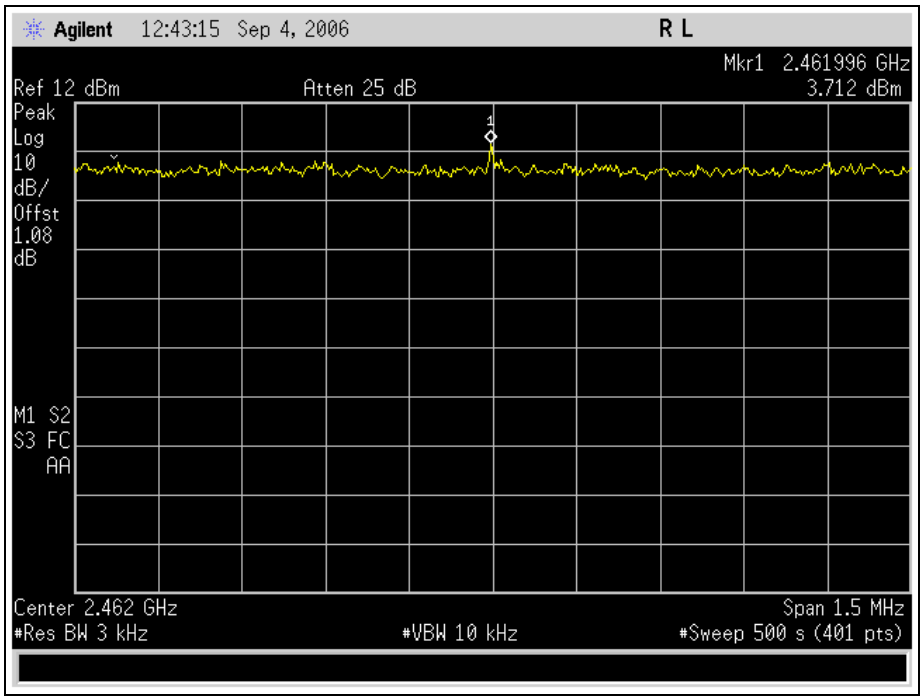

**Plot 148. Peak Power Spectral Density Test Results, 802.11b, Channel 8**




**Plot 149. Peak Power Spectral Density Test Results, 802.11b, Channel 9**



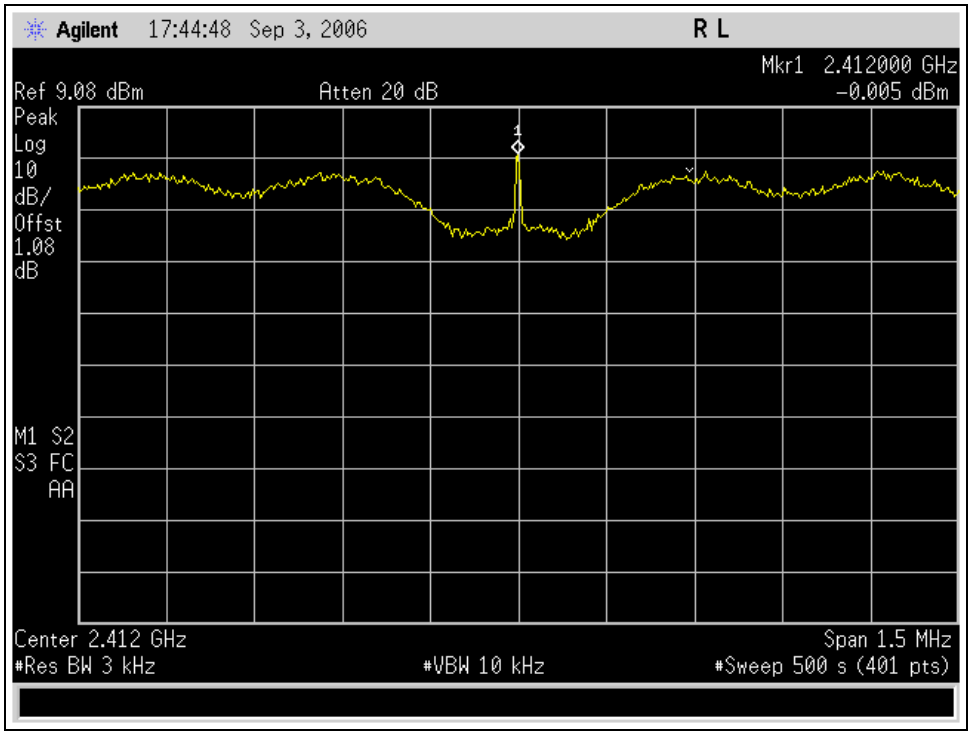

**Plot 150. Peak Power Spectral Density Test Results, 802.11b, Channel 10**



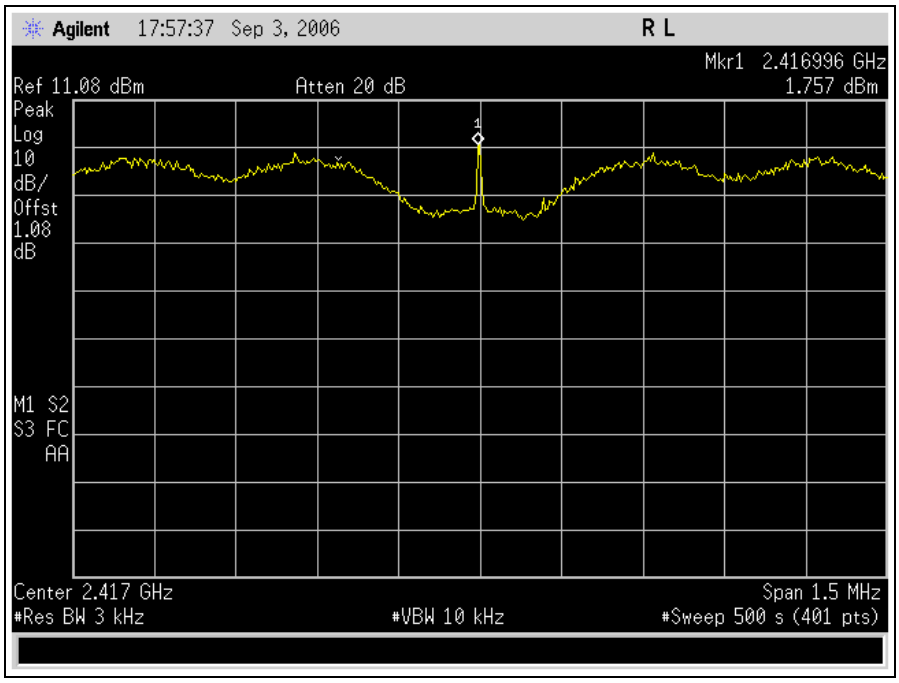

**Plot 151. Peak Power Spectral Density Test Results, 802.11b, Channel 11**

| Channel | Frequency | Limit (dBm) | Measured PPSD (dBm) |
|---|---|---|---|
| 1 | 2.412 GHz | 8 | 0 |
| 2 | 2.417 GHz | 8 | 1.757 |
| 3 | 2.422 GHz | 8 | 2.676 |
| 4 | 2.427 GHz | 8 | 4.678 |
| 5 | 2.432 GHz | 8 | 3.343 |
| 6 | 2.437 GHz | 8 | 2.107 |
| 7 | 2.442 GHz | 8 | 1.48 |
| 8 | 2.447 GHz | 8 | 1.304 |
| 9 | 2.452 GHz | 8 | 1.768 |
| 10 | 2.457 GHz | 8 | -1.507 |
| 11 | 2.462 GHz | 8 | -1.565 |

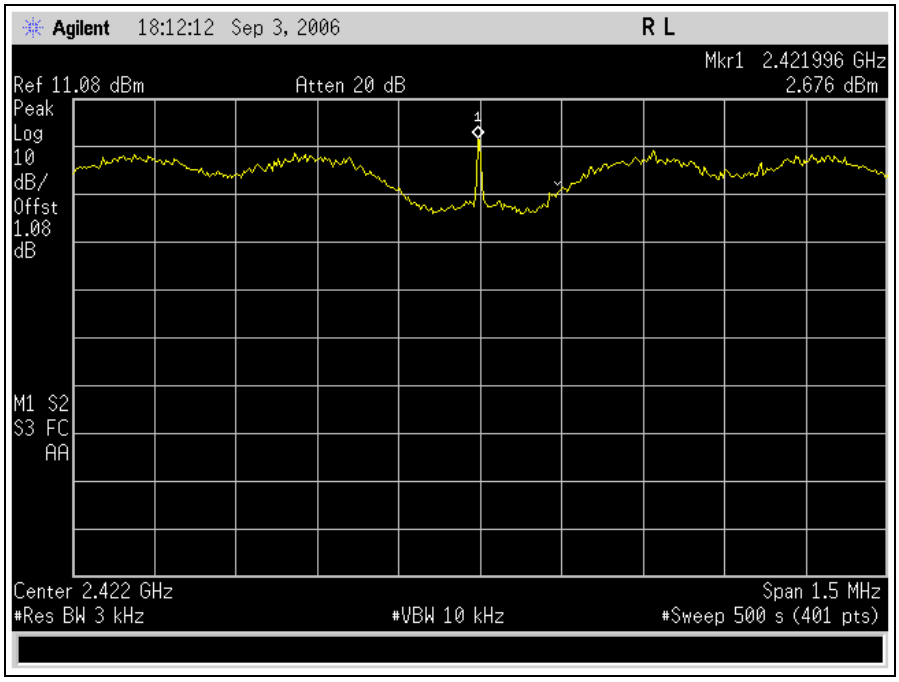
**Table 28. Peak Power Spectral Density Test Results, 802.11g**



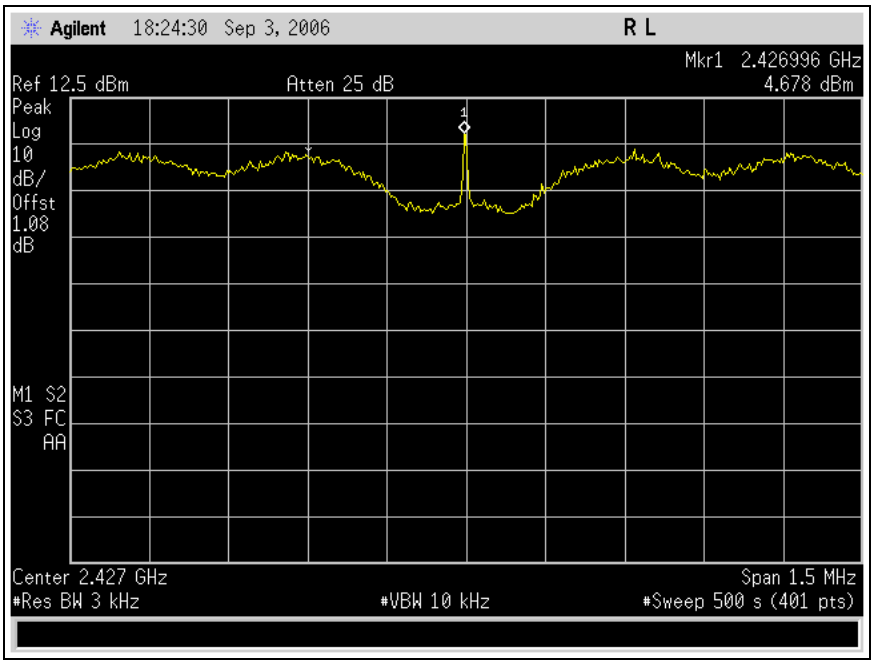

**Plot 152. Peak Power Spectral Density Test Results, 802.11g, Channel 1**



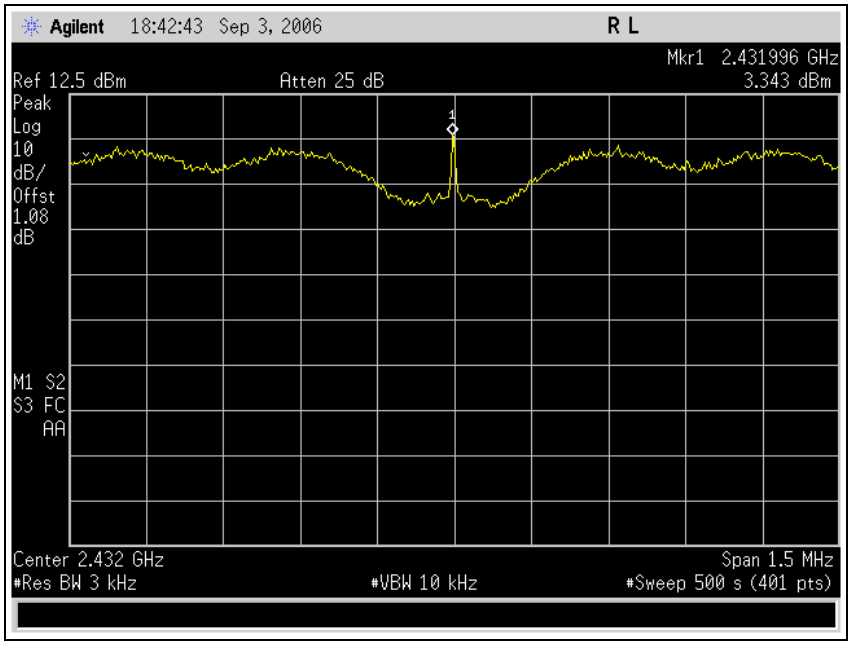

**Plot 153. Peak Power Spectral Density Test Results, 802.11g, Channel 2**



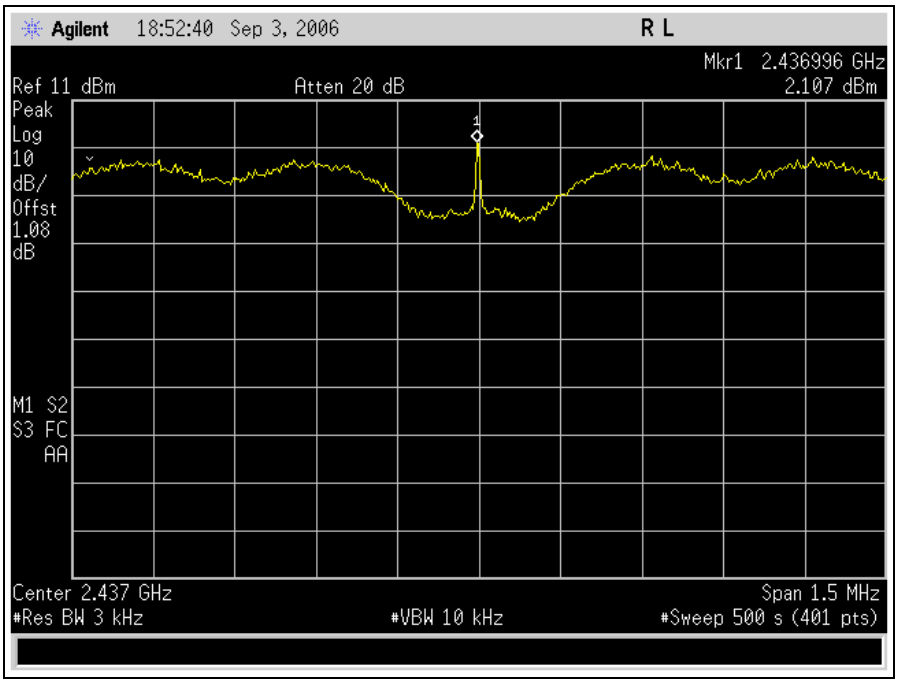

**Plot 154. Peak Power Spectral Density Test Results, 802.11g, Channel 3**



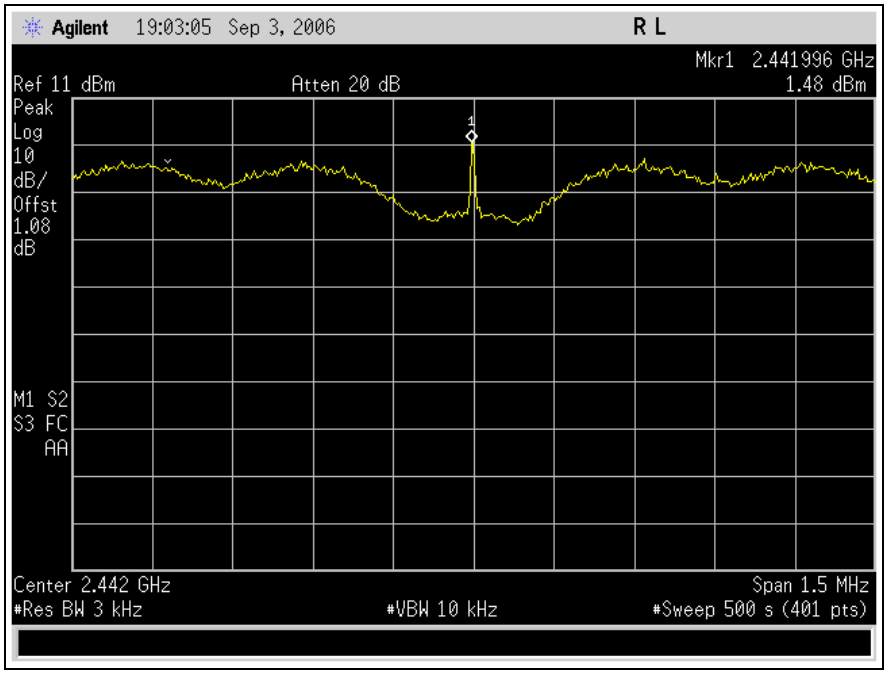

**Plot 155. Peak Power Spectral Density Test Results, 802.11g, Channel 4**



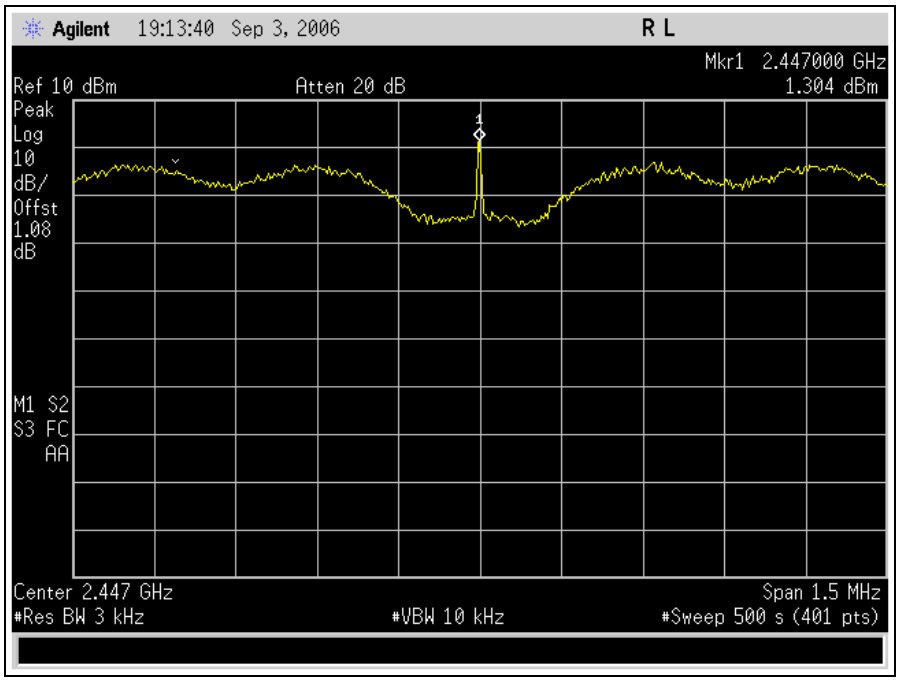

**Plot 156. Peak Power Spectral Density Test Results, 802.11g, Channel 5**



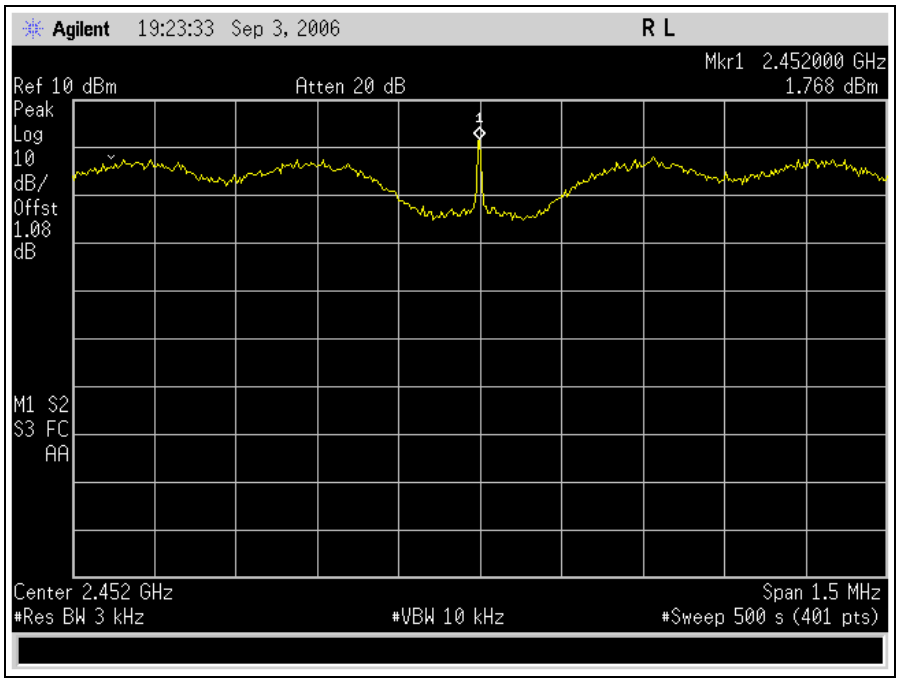

**Plot 157. Peak Power Spectral Density Test Results, 802.11g, Channel 6**



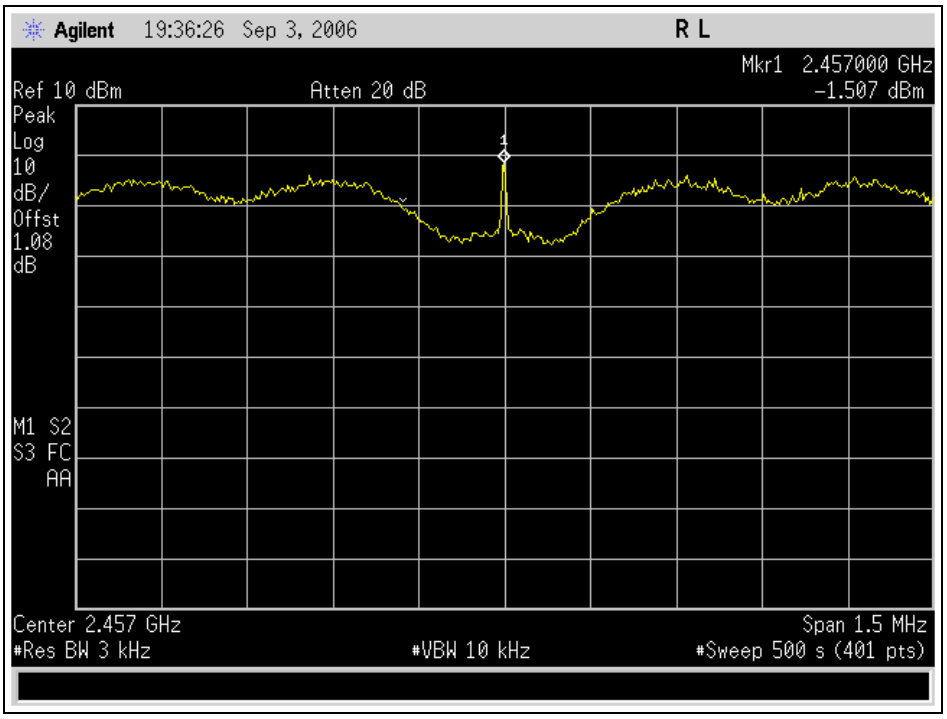

**Plot 158. Peak Power Spectral Density Test Results, 802.11g, Channel 7**



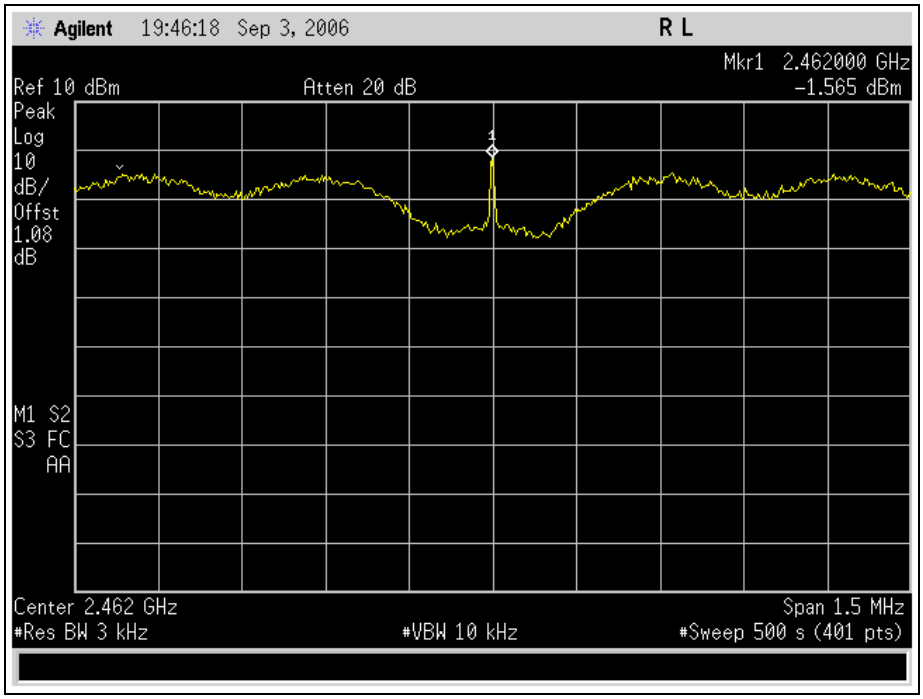

**Plot 159. Peak Power Spectral Density Test Results, 802.11g, Channel 8**




**Plot 160. Peak Power Spectral Density Test Results, 802.11g, Channel 9**




**Plot 161. Peak Power Spectral Density Test Results, 802.11g, Channel 10**




**Plot 162. Peak Power Spectral Density Test Results, 802.11g, Channel 11**

# 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.

**Test Name: Conducted Emissions**

| MET Asset # | Equipment | Manufacturer | Model | Last Cal Date | Cal Due Date |
|---|---|---|---|---|---|
| 1T4302 | EMI Receiver | Hewlett Packard | 8546A | 10/20/2005 | 10/20/2006 |
| 1T4212 | LISN | Solar | 9252-50-R-24-BNC | 12/06/2005 | 12/06/2006 |
| 1T4461 | Weather Station | Fisher | 11-661-7D | 11/08/2005 | 11/08/2006 |
| 1T4146 | Transient Limiter | Hewlett Packard | 11947A | N/A | N/A |
| 1T4404 | Test Room 1 | N/A | N/A | N/A | N/A |
| 1T4351 | EMC Analyzer | Agilent | E7405A | 10/04/2005 | 10/04/2006 |
| 1T4079 | LISN | Solar | 8012-50-R-24-BNC | 03/21/2006 | 03/21/2007 |
| 1T2947 | LISN | Solar | 8028-50-TS-24-BNC | 10/14/2005 | 10/14/2006 |
| 1T2948 | LISN | Solar | 8028-50-TS-24-BNC | 10/14/2005 | 10/14/2006 |

**Test Name: Radiated Emissions**

| MET Asset # | Equipment | Manufacturer | Model | Last Cal Date | Cal Due Date |
|---|---|---|---|---|---|
| 1T4462 | Thermo-Hygrometer | Fisher Scientific | 11-661-7D | 11/08/2004 | 11/08/2006 |
| 1T4480 | Military Chamber 20 x 20 x 12 | ETS Lindgren | Series 80 | See note | |
| 1T2511 | ANTENNA; HORN | EMCO | 3115 | 07/13/2006 | 07/13/2007 |
| 1T4414 | Microwave Pre-Amplifier | AH Systems | PAM-0118 | See note | |
| US42070103 | PSA series Spectrum Analyzer | Agilent | E4448A | 01/12/2006 | 01/12/2007 |
| 1T4288 | SPECTRUM ANALYZER | Hewlett Packard | 8563A | 01/12/2006 | 01/12/2007 |
| 1T4323 | HARMONIC MIXER | Hewlett Packard | 11970K | See note | |

**Test Name: 6 dB Bandwith**

| MET Asset # | Equipment | Manufacturer | Model | Last Cal Date | Cal Due Date |
|---|---|---|---|---|---|
| 1T4351 | EMC Analyzer | Agilent | E7405A | 10/04/2005 | 10/04/2006 |

**Test Name: Peak Power Output**

| MET Asset # | Equipment | Manufacturer | Model | Last Cal Date | Cal Due Date |
|---|---|---|---|---|---|
| 1T4503 | Shielded Room | UNIVERSAL SHIELDING CORP | N/A | 06/01/2006 | 06/01/2007 |
| US42070103 | PSA series Spectrum Analyzer | Agilent | E4448A | 01/12/2006 | 01/12/2007 |

**Test Name: RF Exposure**

| MET Asset # | Equipment | Manufacturer | Model | Last Cal Date | Cal Due Date |
|---|---|---|---|---|---|
| 1T4351 | EMC Analyzer | Agilent | E7405A | 10/04/2005 | 10/04/2006 |

**Test Name: Spurious Emissions**

| MET Asset # | Equipment | Manufacturer | Model | Last Cal Date | Cal Due Date |
|---|---|---|---|---|---|
| 1T4351 | EMC Analyzer | Agilent | E7405A | 10/04/2005 | 10/04/2006 |

**Test Name: Peak Power Spectral Density**

| MET Asset # | Equipment | Manufacturer | Model | Last Cal Date | Cal Due Date |
|---|---|---|---|---|---|
| 1T4351 | EMC Analyzer | Agilent | E7405A | 10/04/2005 | 10/04/2006 |

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 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.

# VI. Exhibits

# Exhibit A, Hopping Capability Requirements

# Exhibit B, Non-Coordination Requirements

# End of Report