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March 2, 2012

Fortress Technologies
2 Technology Park Drive
Westford, MA 01886

Dear John Pacheco,

Enclosed is the EMC Wireless test report for compliance testing of the Fortress Technologies, ES2440 as tested to the requirements of Title 47 of the CFR, Ch. 1 (10-1-06 ed.), Title 47 of the CFR, Part 15, Subpart B, Industry Canada ICES-003 Issue 4 February 2004 for Unintentional Radiators and Part 15.407, Industry Canada RSS-210, Issue 8, December 2010 for Intentional Radiators.

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

Sincerely yours,
MET LABORATORIES, INC.

Jennifer Warnell
Documentation Department

Reference: (\Fortress Technologies\EMC32466A-FCC407 Rev. 1 (UNII3))

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# Electromagnetic Compatibility Criteria Test Report

for the

**Fortress Technologies**
**Model ES2440**

**Tested under**
the Certification Rules
contained in
Title 47 of the CFR, Part 15, Subpart B and
ICES-003 Issue 4 February 2004
for Unintentional Radiators
and
Title 47 of the CFR, Part 15.407 and
Industry Canada RSS-210, Issue 8, December 2010
for Intentional Radiators

**MET Report: EMC32466A-FCC407 Rev. 1 (UNII3)**

March 2, 2012

**Prepared For:**

**Fortress Technologies**
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**Westford, MA 01886**

**Prepared By:**
**MET Laboratories, Inc.**
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# Electromagnetic Compatibility Criteria
# Test Report

for the

## Fortress Technologies
## Model ES2440

the Certification Rules
contained in
Title 47 of the CFR, Part 15, Subpart B and
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and
Title 47 of the CFR, Part 15.407 and
Industry Canada RSS-210, Issue 8, December 2010
for Intentional Radiators

Jeffrey Pratt, Project Engineer
Electromagnetic Compatibility Lab

Jennifer Warnell
Documentation Department

**Engineering Statement:** The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of Parts 15B, 15.407, of the FCC Rules and ICES-003 and RSS-210 of the Industry Canada rules under normal use and maintenance.

Shawn McMillen, Wireless Manager
Electromagnetic Compatibility Lab

  

# Report Status Sheet

| Revision | Report Date | Reason for Revision |
|---|---|---|
| ∅ | January 5, 2012 | Initial Issue. |
| 1 | March 2, 2012 | Revised to reflect engineer corrections. |

  

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# List of Terms and Abbreviations

| | |
|---|---|
| **AC** | **A**lternating **C**urrent |
| **ACF** | **A**ntenna **C**orrection **F**actor |
| **Cal** | **Cal**ibration |
| ***d*** | **M**easurement **D**istance |
| **dB** | **D**eci**b**els |
| **dBµA** | **D**eci**b**els above one **micro**amp |
| **dBµV** | **D**eci**b**els above one **micro**volt |
| **dBµA/m** | **D**eci**b**els above one **micro**amp **per m**eter |
| **dBµV/m** | **D**eci**b**els above one **micro**volt **per m**eter |
| **DC** | **D**irect **C**urrent |
| **E** | **E**lectric Field |
| **DSL** | **D**igital **S**ubscriber **L**ine |
| **ESD** | **E**lectro**s**tatic **D**ischarge |
| **EUT** | **E**quipment **U**nder **T**est |
| ***f*** | **F**requency |
| **FCC** | **F**ederal **C**ommunications **C**ommission |
| **GRP** | **G**round **R**eference **P**lane |
| **H** | Magnetic Field |
| **HCP** | **H**orizontal **C**oupling **P**lane |
| **Hz** | **H**ert**z** |
| **IEC** | **I**nternational **E**lectrotechnical **C**ommission |
| **kHz** | **k**ilo**h**ert**z** |
| **kPa** | **k**ilo**pa**scal |
| **kV** | **k**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 Fortress Technologies ES2440, with the requirements of Part 15, §15.407. 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 ES2440. Fortress Technologies should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the ES2440, 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, §15.407, in accordance with Fortress Technologies, purchase order number 0003235. All tests were conducted using measurement procedure ANSI C63.4-2003.

| FCC Reference | Industry Canada Reference | Description | Results |
|---|---|---|---|
| 15.107 | ICES-003 Issue 4 February 2004 | Conducted Emissions | Compliant |
| 15.109 | | Radiated Emissions | Compliant |
| 15.203 | RSS-GEN 7.1.4 | Antenna Requirements | Compliant |
| 15.205/15.209 | 2.2 | General Field Strength Limits (Restricted Bands and Radiated Emission Limits) | Compliant |
| 15.207 | RSS-GEN 7.2.2; RSS-210 2.2 | AC Conducted Emissions 150KHz – 30MHz | Compliant |
| 15.403 (c) | A8.2 | 26dB Occupied Bandwidth | Compliant |
| 15.407 (a)(1), (2), (3) | A9.2(3) | Conducted Transmitter Output Power | Compliant |
| 15.407 (a)(1), (2), (3), (5) | A9.2(3) | Power Spectral Density | Compliant |
| 15.407 (a)(6) | A8.2 | Peak Excursion | Compliant |
| 15.407 (b)(1), (2), (5), (6) | A9.3(4) | Undesirable Emissions | Compliant |
| 15.407(f) | RSS-GEN | RF Exposure | Compliant |
| 15.407(g) | 2.1 | Frequency Stability | Compliant |

**Table 1. Executive Summary of EMC Part 15.407 ComplianceTesting**

# II. Equipment Configuration

# A. Overview

MET Laboratories, Inc. was contracted by Fortress Technologies to perform testing on the ES2440, under Fortress Technologies's purchase order number 0003235.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Fortress Technologies ES2440.

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

| | | | |
|---|---|---|---|
| **Model(s) Tested:** | ES2440 | | |
| **Model(s) Covered:** | ES2440 | | |
| **EUT Specifications:** | Primary Power: 120 VAC, 60 Hz | | |
| | FCC ID: WYK-ES2440<br>IC: 8190A-ES2440 | | |
| | Type of Modulations: | OFDM | |
| | Equipment Code: | NII | |
| | Peak RF Output Power: | **MHz** | **Power** |
| | | 5745 MHz | 15.57 dBm |
| | EUT Frequency Ranges: | 5745 – 5805 MHz | |
| **Analysis:** | The results obtained relate only to the item(s) tested. | | |
| **Environmental Test Conditions:** | Temperature: 15-35º C | | |
| | Relative Humidity: 30-60% | | |
| | Barometric Pressure: 860-1060 mbar | | |
| **Evaluated by:** | Jeff Pratt | | |
| **Report Date(s):** | March 2, 2012 | | |

**Table 2. EUT Summary**

## B. References

| | |
|---|---|
| **CFR 47, Part 15, Subpart B** | Electromagnetic Compatibility: Criteria for Radio Frequency Devices |
| **CFR 47, Part 15, Subpart E** | Unlicensed National Information Infrastructure Devices (UNII) |
| **RSS-210, Issue 8, December 2010** | Low-power License-exempt Radiocommunications Devices (All Frequency Bands): Category I Equipment |
| **ICES-003, Issue 4 February 2004** | Electromagnetic Compatibility: Criteria for Radio Frequency Devices |
| **ANSI C63.4:2003** | Methods and Measurements of Radio-Noise Emissions from Low-Voltage Electrical And Electronic Equipment in the Range of 9 kHz to 40 GHz |
| **ANSI/NCSL Z540-1-1994** | Calibration Laboratories and Measuring and Test Equipment - General Requirements |
| **ANSI/ISO/IEC 17025:2000** | General Requirements for the Competence of Testing and Calibration Laboratories |

**Table 3. References**

## C. Test Site

All testing was performed at MET Laboratories, Inc., 914 W. Patapsco Ave., 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 3 meter semi-anechoic chamber (equivalent to an Open Area Test Site). In accordance with §2.948(a)(3), a complete site description is contained at MET Laboratories.

## D. Description of Test Sample

The Fortress Technologies ES2440, Equipment Under Test (EUT), is a quad radio access point/bridge. It embeds four COTS high power radios and three Ethernet ports in a ruggedized enclosure. The radios operate in accordance to the 802.11a, 802.11b, 802.11g, and 802.11n standards.

The ES2440 is intended to provided outdoor mobile connectivity in a secure manner both wired and wirelessly.

**Photograph 1. Fortress Technologies ES2440**

## E. Equipment Configuration

| Ref. ID | Name / Description | Model Number | Serial Number |
|---|---|---|---|
| 1 | Fortress High Capacity Infrastructure Mesh Point | ES2440 | 11022261 |

**Table 4. Equipment Configuration**

## F. Support Equipment

Fortress Technologies supplied support equipment necessary for the operation and testing of the ES2440. All support equipment supplied is listed in the following Support Equipment List.

| Ref. ID | Name / Description | Manufacturer | Model Number |
|---|---|---|---|
| 1 | PoE Adapter | Phihong | POE61U-560DG |
| 5 | 5.8GHz Omni Antenna | Ubiquiti | AMO-5G10 |
| 6 | 5.8GHz Sector Antenna | PCTel | SP4959 16XP90 |

**Table 5. Support Equipment**

## G. Ports and Cabling Information

| Ref. ID | Port Name on EUT | Cable Description | Qty. | Length (m) | Shielded (Y/N) | Termination Point |
|---|---|---|---|---|---|---|
| 1 | ANT1A, ANT1B, ANT2A, ANT2B, ANT3A, ANT3B, ANT4A, ANT4B | Antenna | 8 | - | Y | - |
| 2 | DC Power | Provides power | 1 | - | N | - |
| 3 | Ethernet1/WAN/POE<br>Ethernet 2<br>Ethernet 3 | Standard RJ45 CAT5 Ethernet Cable | 3 | - | N | - |
| 4 | Serial | Standard RJ45 serial cable | 1 | - | N | - |
| | GPS | GPS antenna | 1 | - | N | - |

**Table 6. Ports and Cabling Information**

## H. Mode of Operation

The ES2440 can operate in 802.11a, 802.11b, 802.11g, and 802.11n modes. These modes may be configured using the UI of the product. Additionally, these modes may be entered by using ART, the Atheros Radio Test tool. This is a standard tool provide by Atheros for directly manipulating and configuring their chips during testing and manufacturing.

## I. Modifications

### a) Modifications to EUT

No modifications were made to the EUT.

### b) Modifications to Test Standard

No modifications were made to the test standard.

## J. Disposition of EUT

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

# III. Electromagnetic Compatibility Criteria for Unintentional Radiators

## Electromagnetic Compatibility Criteria

### § 15.107 Conducted Emissions Limits

**Test Requirement(s):** **15.107 (a)** Except for Class A digital devices, for equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in Table 7. Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminals.

**15.107 (b)** For a Class A digital device that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in Table 7. Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminals. The lower limit applies at the band edges.

| Frequency range (MHz) | Class A Conducted Limits (dBµV) | | *Class B Conducted Limits (dBµV) | |
|---|---|---|---|---|
| | Quasi-Peak | Average | Quasi-Peak | Average |
| * 0.15- 0.45 | 79 | 66 | 66 - 56 | 56 - 46 |
| 0.45 - 0.5 | 79 | 66 | 56 | 46 |
| 0.5 - 30 | 73 | 60 | 60 | 50 |
| Note 1 — The lower limit shall apply at the transition frequencies.<br>Note 2 — The limit decreases linearly with the logarithm if the frequency in the range 0.15 MHz to 0.5 MHz.<br>* -- Limits per Subsection 15.207(a). | | | | |

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

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

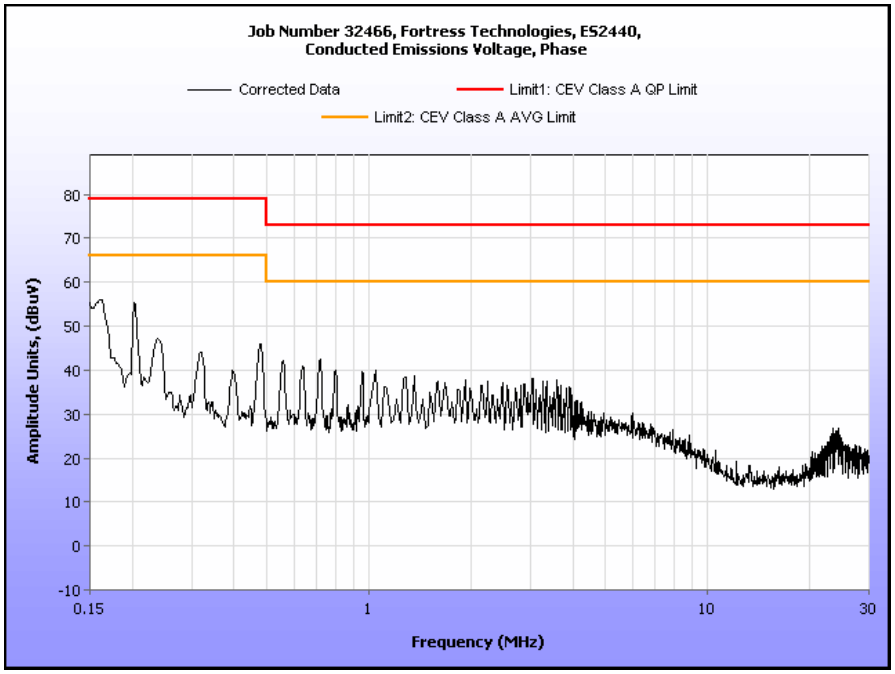
**Test Engineer(s):** Jeff Pratt

**Test Date(s):** 10/26/11

## Conducted Emissions - Voltage, AC Power

| Frequency (MHz) | Uncorrected Meter Reading (dBuV) QP | Cable Loss (dB) | Corrected Measurement (dBuV) QP | Limit (dBuV) QP | Margin (dB) QP | Uncorrected Meter Reading (dBuV) Avg. | Cable Loss (dB) | Corrected Measurement (dBuV) AVG | Limit (dBuV) AVG | Margin (dB) AVG |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.158 | 50.21 | 0 | 50.21 | 79 | -28.79 | 42.13 | 0 | 42.13 | 66 | -23.87 |
| 0.238 | 43.17 | 0.01 | 43.18 | 79 | -35.82 | 37.86 | 0.01 | 37.87 | 66 | -28.13 |
| 0.476 | 42.62 | 0 | 42.62 | 79 | -36.38 | 37.98 | 0 | 37.98 | 66 | -28.02 |
| 0.715 | 38.38 | 0 | 38.38 | 73 | -34.62 | 33.1 | 0 | 33.1 | 60 | -26.9 |
| 0.318 | 39.87 | 0 | 39.87 | 79 | -39.13 | 34.91 | 0 | 34.91 | 66 | -31.09 |
| 0.635 | 37.81 | 0 | 37.81 | 73 | -35.19 | 33.36 | 0 | 33.36 | 60 | -26.64 |

**Table 8. Conducted Emissions - Voltage, AC Power, Phase Line, Test Results**



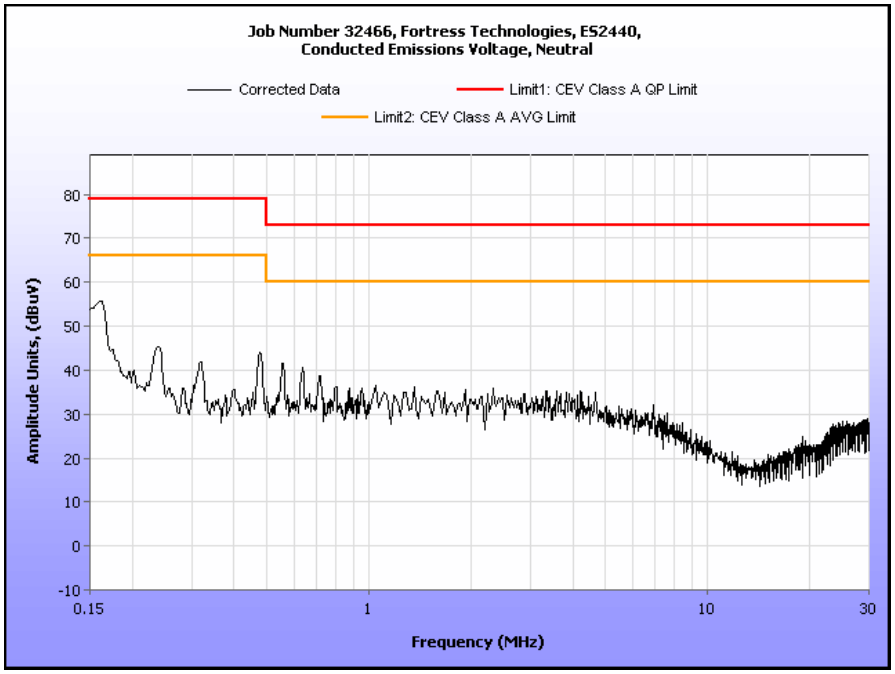

**Plot 1. Conducted Emission, Phase Line Plot**

## Conducted Emissions - Voltage, AC Power

| Frequency (MHz) | Uncorrected Meter Reading (dBuV) QP | Cable Loss (dB) | Corrected Measurement (dBuV) QP | Limit (dBuV) QP | Margin (dB) QP | Uncorrected Meter Reading (dBuV) Avg. | Cable Loss (dB) | Corrected Measurement (dBuV) AVG | Limit (dBuV) AVG | Margin (dB) AVG |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.238 | 41.73 | 0.01 | 41.74 | 79 | -37.26 | 38.52 | 0.01 | 38.53 | 66 | -27.47 |
| 0.477 | 42.14 | 0 | 42.14 | 79 | -36.86 | 41.22 | 0 | 41.22 | 66 | -24.78 |
| 0.158 | 50.36 | 0 | 50.36 | 79 | -28.64 | 43.74 | 0 | 43.74 | 66 | -22.26 |
| 0.557 | 38.85 | 0 | 38.85 | 73 | -34.15 | 37.66 | 0 | 37.66 | 60 | -22.34 |
| 0.634 | 38.48 | 0 | 38.48 | 73 | -34.52 | 37.08 | 0 | 37.08 | 60 | -22.92 |
| 0.318 | 39.36 | 0 | 39.36 | 79 | -39.64 | 37.3 | 0 | 37.3 | 66 | -28.7 |

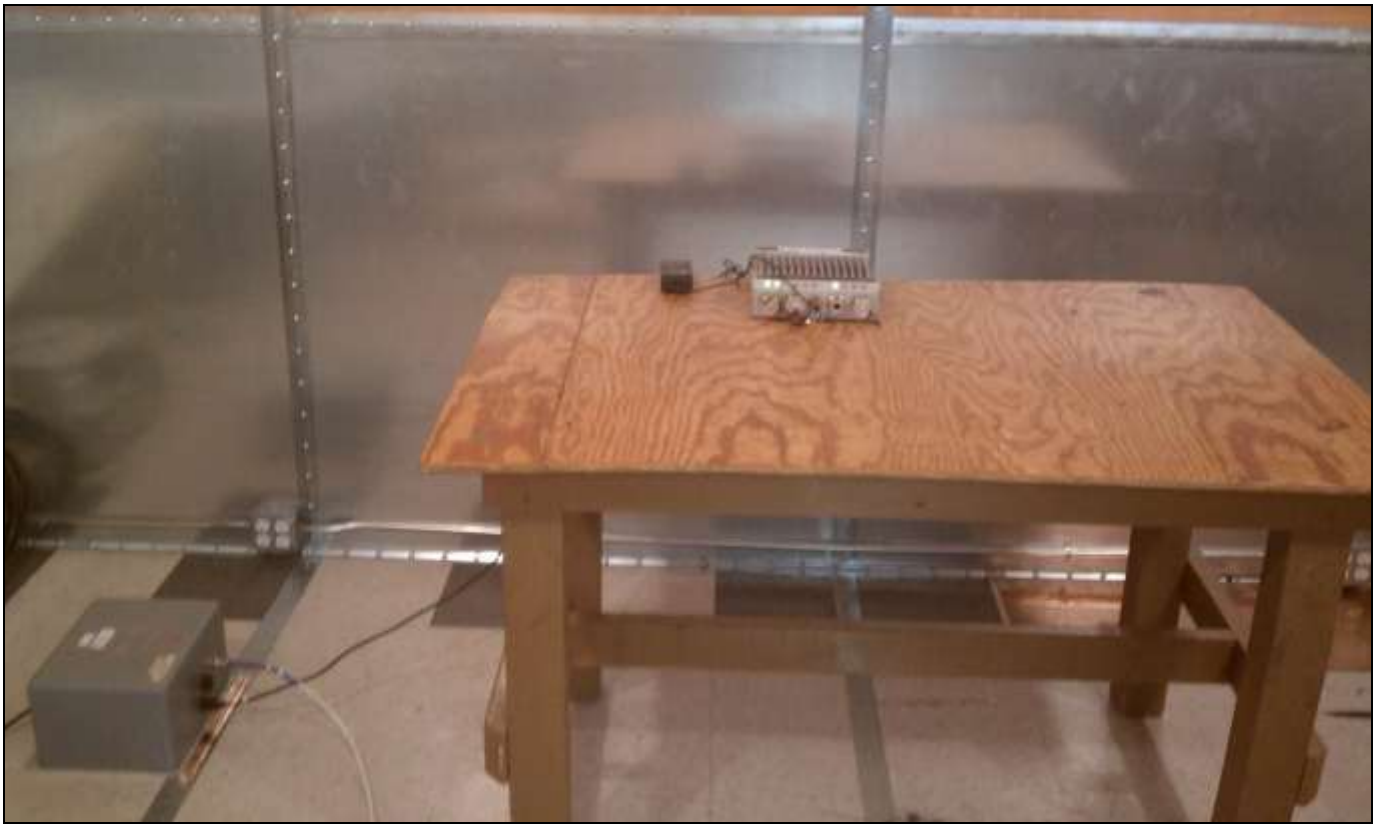
**Table 9. Conducted Emissions - Voltage, AC Power, Neutral Line, Test Results**




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

## Conducted Emission Limits Test Setup



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

## Radiated Emission Limits

### § 15.109 Radiated Emissions Limits

**Test Requirement(s):** **15.109 (a)** Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the Class B limits expressed in Table 10.

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

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

**Table 10. Radiated Emissions Limits calculated from FCC Part 15, §15.109 (a) (b)**

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

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

**Test Engineer(s):** Ben Taylor

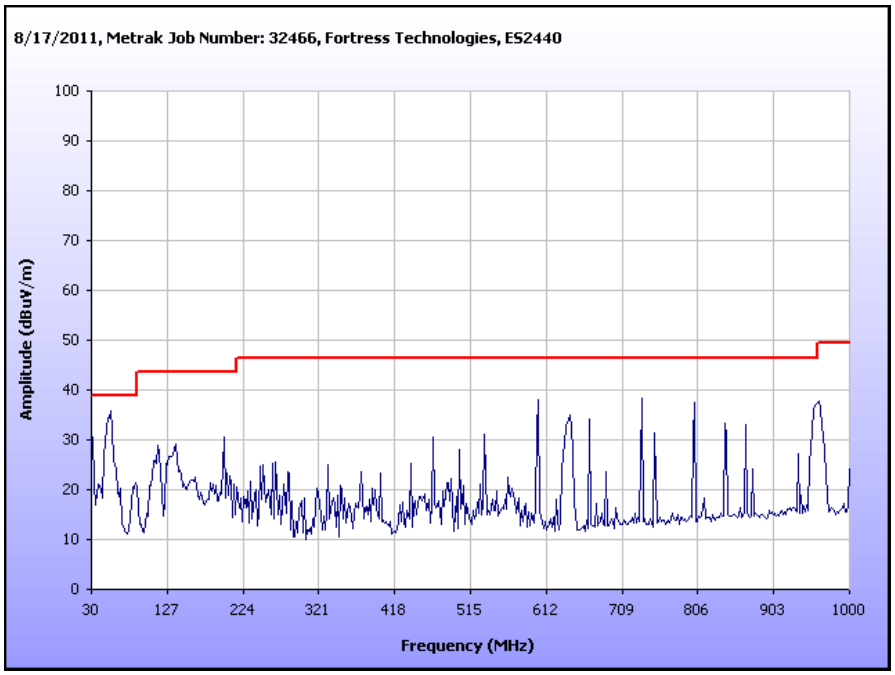
**Test Date(s):** 08/17/11

## Radiated Emissions Limits Test Results, Class A

| 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/m) | Limit (dBuV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|---|
| 55.791583 | 109 | H | 3.17 | 18.18 | 7.44 | 0.23 | 10.46 | 15.39 | 39.00 | -23.61 |
| 55.791583 | 11 | V | 1.02 | 36.23 | 7.44 | 0.23 | 10.46 | 33.44 | 39.00 | -5.56 |
| 200.04008 | 158 | H | 1.39 | 14.54 | 12.99 | 0.23 | 10.46 | 17.30 | 43.50 | -26.20 |
| 200.04008 | 207 | V | 1.06 | 25.18 | 12.99 | 0.23 | 10.46 | 27.94 | 43.50 | -15.56 |
| 600.05078 | 81 | H | 1.17 | 26.84 | 19.50 | 1.17 | 10.46 | 37.05 | 46.40 | -9.35 |
| 600.05078 | 89 | V | 1.05 | 26.07 | 19.50 | 1.17 | 10.46 | 36.28 | 46.40 | -10.12 |
| 639.40882 | 349 | H | 1.45 | 17.26 | 19.99 | 1.17 | 10.46 | 27.96 | 46.40 | -18.44 |
| 639.40882 | 253 | V | 1.05 | 18.79 | 19.99 | 1.17 | 10.46 | 29.49 | 46.40 | -16.91 |
| 733.38482 | 59 | H | 1.34 | 27.58 | 20.90 | 1.50 | 10.46 | 39.52 | 46.40 | -6.88 |
| 733.38482 | 89 | V | 1.02 | 24.75 | 20.90 | 1.50 | 10.46 | 36.69 | 46.40 | -9.71 |
| 957.56513 | 202 | H | 1.01 | 17.42 | 23.10 | 1.72 | 10.46 | 31.78 | 46.40 | -14.62 |
| 957.56513 | 350 | V | 1.05 | 13.38 | 23.10 | 1.72 | 10.46 | 27.74 | 46.40 | -18.66 |

**Table 11. Radiated Emissions, Test Results, FCC Limits, 30 MHz – 1 GHz**




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

| 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/m) | Limit (dBuV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|---|
| 55.791583 | 109 | H | 3.17 | 18.18 | 7.44 | 0.23 | 10.46 | 15.39 | 40.00 | -24.61 |
| 55.791583 | 11 | V | 1.02 | 36.23 | 7.44 | 0.23 | 10.46 | 33.44 | 40.00 | -6.56 |
| 200.04008 | 158 | H | 1.39 | 14.54 | 12.99 | 0.23 | 10.46 | 17.30 | 40.00 | -22.70 |
| 200.04008 | 207 | V | 1.06 | 25.18 | 12.99 | 0.23 | 10.46 | 27.94 | 40.00 | -12.06 |
| 600.05078 | 81 | H | 1.17 | 26.84 | 19.50 | 1.17 | 10.46 | 37.05 | 47.00 | -9.95 |
| 600.05078 | 89 | V | 1.05 | 26.07 | 19.50 | 1.17 | 10.46 | 36.28 | 47.00 | -10.72 |
| 639.40882 | 349 | H | 1.45 | 17.26 | 19.99 | 1.17 | 10.46 | 27.96 | 47.00 | -19.04 |
| 639.40882 | 253 | V | 1.05 | 18.79 | 19.99 | 1.17 | 10.46 | 29.49 | 47.00 | -17.51 |
| 733.38482 | 59 | H | 1.34 | 27.58 | 20.90 | 1.50 | 10.46 | 39.52 | 47.00 | -7.48 |
| 733.38482 | 89 | V | 1.02 | 24.75 | 20.90 | 1.50 | 10.46 | 36.69 | 47.00 | -10.31 |
| 957.56513 | 202 | H | 1.01 | 17.42 | 23.10 | 1.72 | 10.46 | 31.78 | 47.00 | -15.22 |
| 957.56513 | 350 | V | 1.05 | 13.38 | 23.10 | 1.72 | 10.46 | 27.74 | 47.00 | -19.26 |

**Table 12. Radiated Emissions, Test Results, ICES-003 Limits, 30 MHz – 1 GHz**

## Radiated Emission Limits Test Setup

**Photograph 3. Radiated Emission, Test Setup**

# IV. Electromagnetic Compatibility Criteria for Intentional Radiators

# Electromagnetic Compatibility Criteria for Intentional Radiators

## § 15.203 Antenna Requirement

**Test Requirement:** **§ 15.203:** An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

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

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

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

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

**Results:** The EUT as tested is compliant the criteria of §15.203. The unit will be professionally installed.

**Test Engineer(s):** Jeff Pratt

**Test Date(s):** 10/18/11

| Type | Gain | Manufacturer | Model |
|---|---|---|---|
| Omni | 10 dBi | Ubiquiti Networks | AMO-5G10 |
| Sector | 15.5 dBi | PCTEL, Inc. | SP4959-16XP90 |

# Electromagnetic Compatibility Criteria for Intentional Radiators

## § 15.207 Conducted Emissions Limits

**Test Requirement(s):** **§ 15.207 (a):** For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30MHz, shall not exceed the limits in the following table, as measured using a 50 μH/50 Ω line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

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

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

**Test Procedure:** The EUT was placed on a 0.8 m-high wooden table inside a semi-anechoic chamber. 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.

**Test Results:** The EUT was found to comply with the requirement(s) of this section. Measured emissions were below applicable limits.

**Test Engineer(s):** Ben Taylor

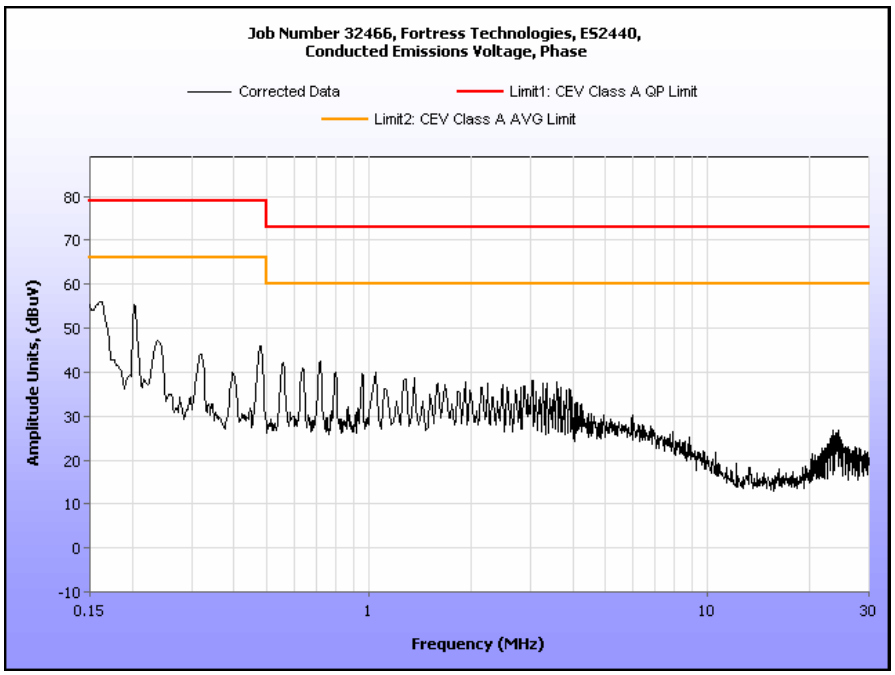
**Test Date(s):** 10/26/11

## Conducted Emissions - Voltage, AC Power

| Frequency (MHz) | Uncorrected Meter Reading (dBuV) QP | Cable Loss (dB) | Corrected Measurement (dBuV) QP | Limit (dBuV) QP | Margin (dB) QP | Uncorrected Meter Reading (dBuV) Avg. | Cable Loss (dB) | Corrected Measurement (dBuV) AVG | Limit (dBuV) AVG | Margin (dB) AVG |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.1569 | 53.36 | 0 | 53.36 | 65.63 | -12.27 | 43.66 | 0 | 43.66 | 55.63 | -11.97 |
| 0.3995 | 43.6 | 0 | 43.6 | 57.86 | -14.26 | 38.08 | 0 | 38.08 | 47.86 | -9.78 |
| 0.5584 | 41 | 0 | 41 | 56 | -15 | 35.6 | 0 | 35.6 | 46 | -10.4 |
| 0.7148 | 39.1 | 0 | 39.1 | 56 | -16.9 | 33.57 | 0 | 33.57 | 46 | -12.43 |
| 3.66 | 42.31 | 0.03 | 42.34 | 56 | -13.66 | 37.52 | 0.03 | 37.55 | 46 | -8.45 |
| 4.475 | 42.82 | 0.08 | 42.9 | 56 | -13.1 | 39.42 | 0.08 | 39.5 | 46 | -6.5 |

**Table 14. Conducted Emissions - Voltage, AC Power, Phase Line, Test Results**

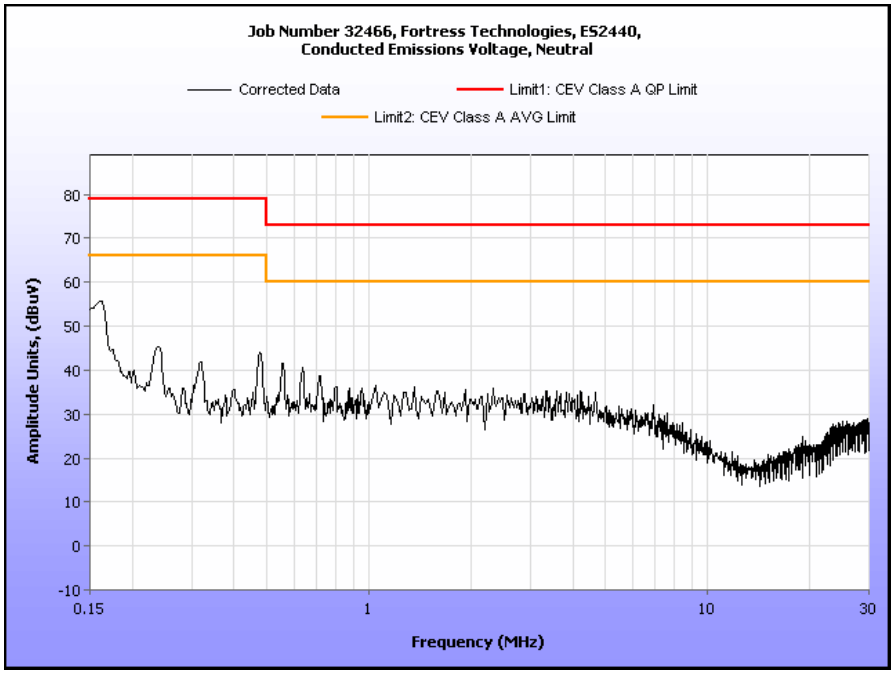



**Plot 4. §15.207 Conducted Emissions, Phase Line Plot**

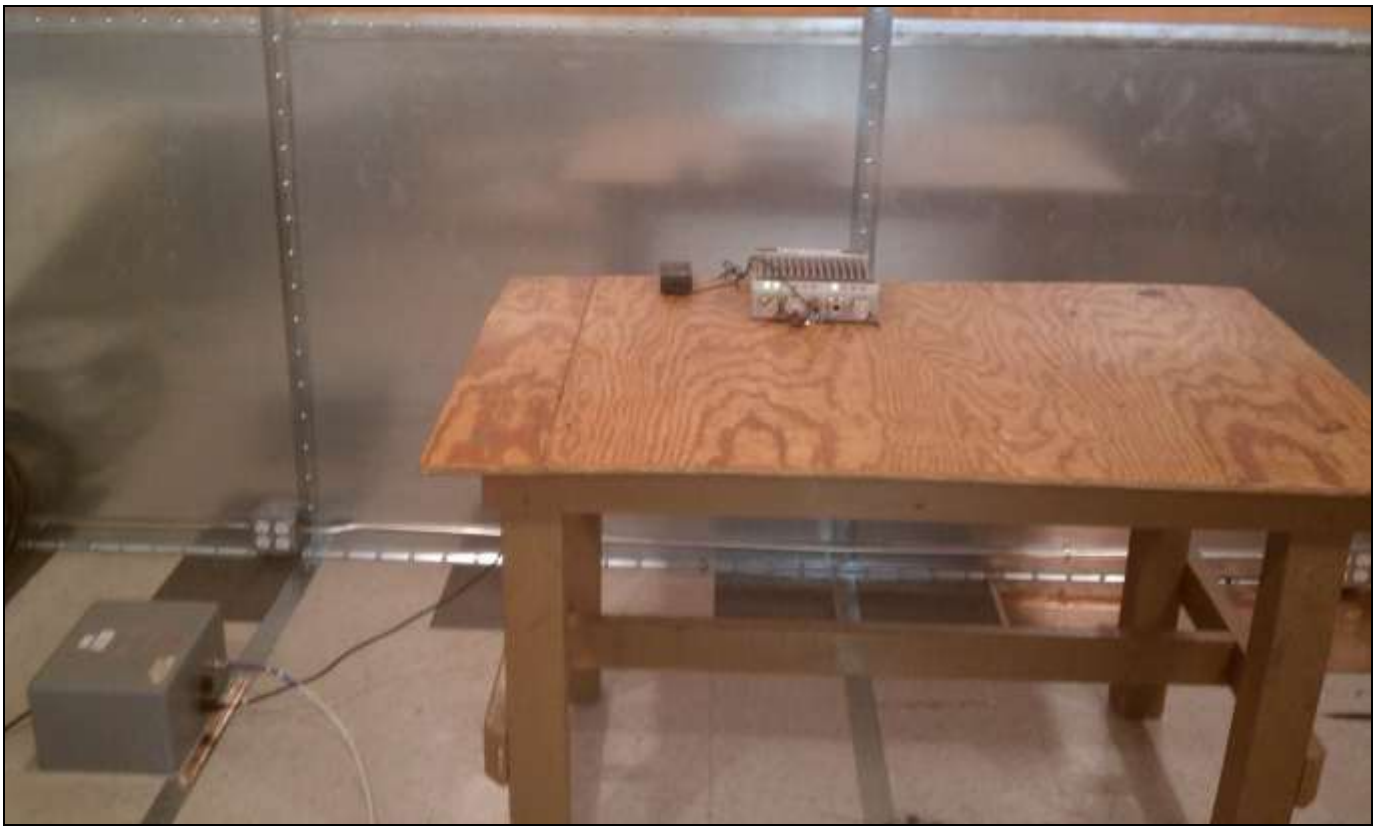
| Frequency (MHz) | Uncorrected Meter Reading (dBuV) QP | Cable Loss (dB) | Corrected Measurement (dBuV) QP | Limit (dBuV) QP | Margin (dB) QP | Uncorrected Meter Reading (dBuV) Avg. | Cable Loss (dB) | Corrected Measurement (dBuV) AVG | Limit (dBuV) AVG | Margin (dB) AVG |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.1584 | 53.42 | 0 | 53.42 | 65.55 | -12.13 | 44.62 | 0 | 44.62 | 55.55 | -10.93 |
| 0.2385 | 44.18 | 0.01 | 44.19 | 62.15 | -17.96 | 38.39 | 0.01 | 38.4 | 52.15 | -13.75 |
| 0.398 | 42.8 | 0 | 42.8 | 57.9 | -15.1 | 41 | 0 | 41 | 47.9 | -6.9 |
| 0.5568 | 39.35 | 0 | 39.35 | 56 | -16.65 | 39.44 | 0 | 39.44 | 46 | -6.56 |
| 3.66 | 43.13 | 0.03 | 43.16 | 56 | -12.84 | 42.03 | 0.03 | 42.06 | 46 | -3.94 |
| 4.881 | 42.25 | 0.1 | 42.35 | 56 | -13.65 | 41.96 | 0.1 | 42.06 | 46 | -3.94 |

**Table 15. Conducted Emissions - Voltage, AC Power, Neutral Line, Test Results**




**Plot 5. §15.207 Conducted Emissions, Neutral Line Plot**



**Photograph 4. §15.207 Conducted Emissions, Test Setup**

## Electromagnetic Compatibility Criteria for Intentional Radiators

## § 15. 403(c) 26dB Bandwidth

**Test Requirements:** **§ 15.403 (c):** Operation under the provisions of this section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

**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 approximately equal to 1% of the total emission bandwidth, VBW > RBW. The 26 dB Bandwidth was measured and recorded. The measurements were repeated at the low and high channels.

**Test Results** Equipment complies with § 15.407 (c). The 26 dB Bandwidth was determined from the plots on the following pages.

**Test Engineer(s):** Jeff Pratt

**Test Date(s):** 09/14/11

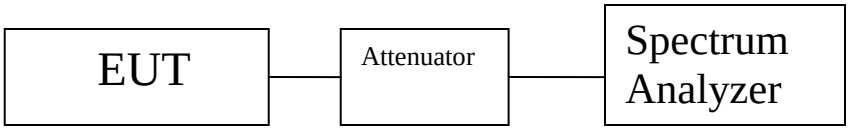



**Figure 1. Occupied Bandwidth Test Setup**

| Occupied Bandwidth | | | |
|---|---|---|---|
| **Mode** | **Frequency (MHz)** | **Measured 26 dB Bandwidth (MHz)** | **99 % Bandwidth (MHz)** |
| **802.11a** | 5745 | 20.711 | 16.6108 |
| | 5785 | 21.231 | 16.6246 |
| | 5805 | 21.224 | 16.4928 |

**Table 16. Occupied Bandwidth, Test Results, 802.11a**

| Occupied Bandwidth | | | |
|---|---|---|---|
| **Mode** | **Frequency (MHz)** | **Measured 26 dB Bandwidth (MHz)** | **99 % Bandwidth (MHz)** |
| **802.11n 20MHz Port A** | 5745 | 21.583 | 17.6900 |
| | 5785 | 21.510 | 17.7500 |
| | 5805 | 21.924 | 17.7108 |
| **802.11n 20MHz Port B** | 5745 | 20.427 | 17.7375 |
| | 5785 | 21.096 | 17.7387 |
| | 5805 | 22.392 | 17.7331 |

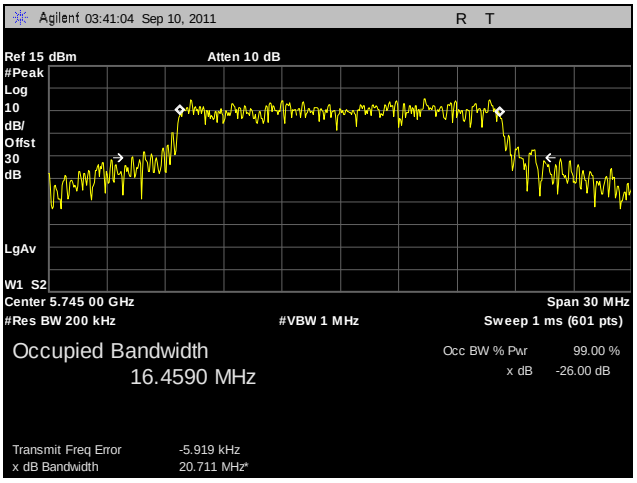
**Table 17. Occupied Bandwidth, Test Results, 802.11n 20 MHz**

| Occupied Bandwidth | | | |
|---|---|---|---|
| **Mode** | **Frequency (MHz)** | **Measured 26 dB Bandwidth (MHz)** | **99 % Bandwidth (MHz)** |
| **802.11n 40MHz Port A** | 5755 | 41.990 | 36.1640 |
| | 5785 | 41.697 | 35.7092 |
| | 5795 | 43.298 | 36.2786 |
| **802.11n 40MHz Port B** | 5755 | 43.609 | 35.9563 |
| | 5785 | 41.973 | 36.2562 |
| | 5795 | 41.346 | 36.1754 |

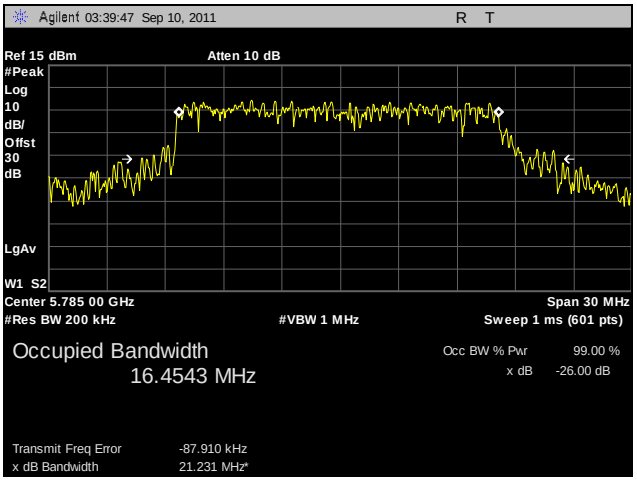
**Table 18. Occupied Bandwidth, Test Results, 802.11n 40 MHz**

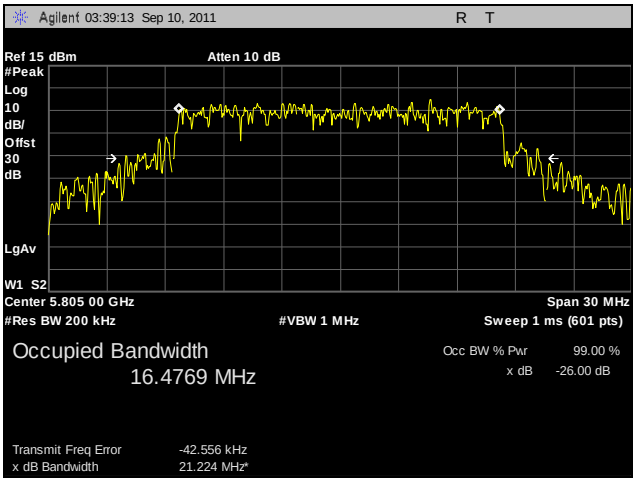
# Occupied Bandwidth, 802.11a




**Plot 6. Occupied Bandwidth, 802.11a, 5745 MHz**



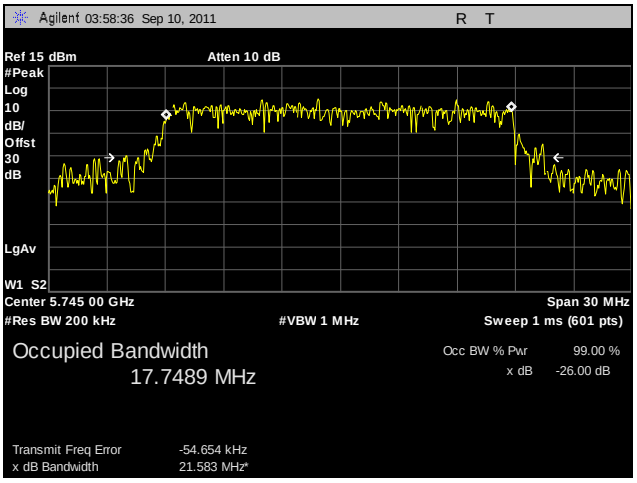

**Plot 7. Occupied Bandwidth, 802.11a, 5785 MHz**



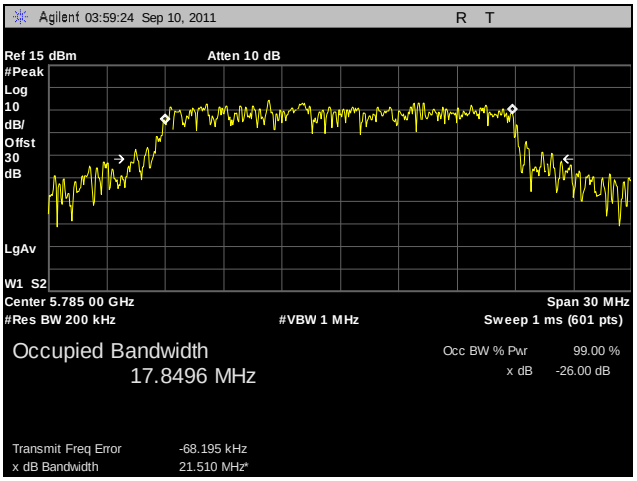

**Plot 8. Occupied Bandwidth, 802.11a, 5805 MHz**

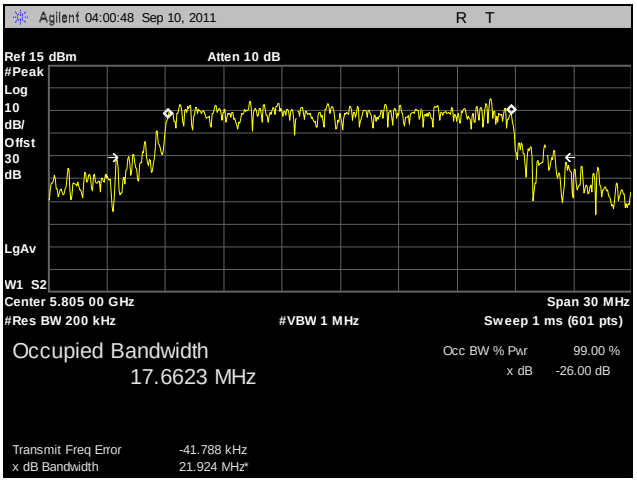
## Occupied Bandwidth, 802.11n 20 MHz, Port A




**Plot 9. Occupied Bandwidth, 802.11n 20 MHz, Port A, 5745 MHz**



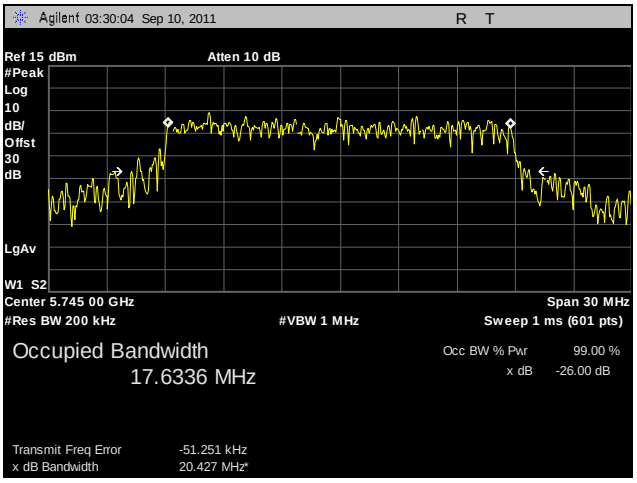

**Plot 10. Occupied Bandwidth, 802.11n 20 MHz, Port A, 5785 MHz**



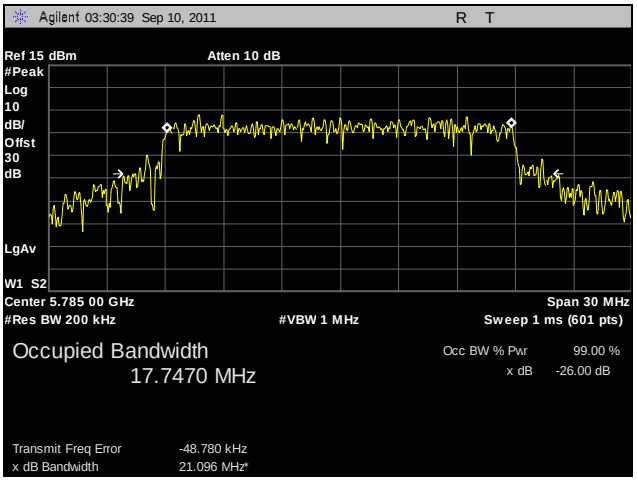

**Plot 11. Occupied Bandwidth, 802.11n 20 MHz, Port A, 5805 MHz**

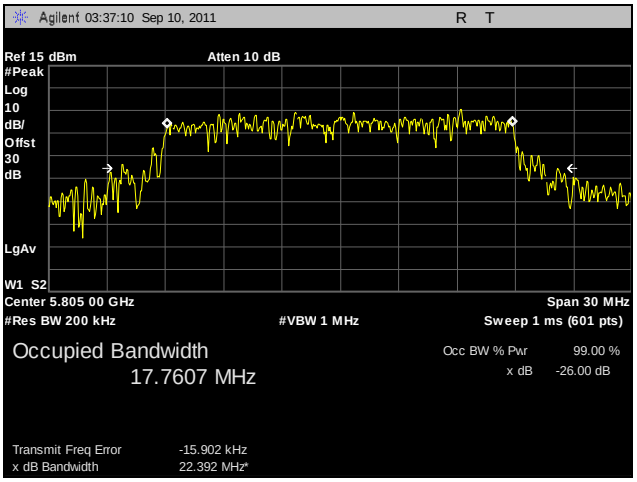
## Occupied Bandwidth, 802.11n 20 MHz, Port B




**Plot 12. Occupied Bandwidth, 802.11n 20 MHz, Port B, 5745 MHz**



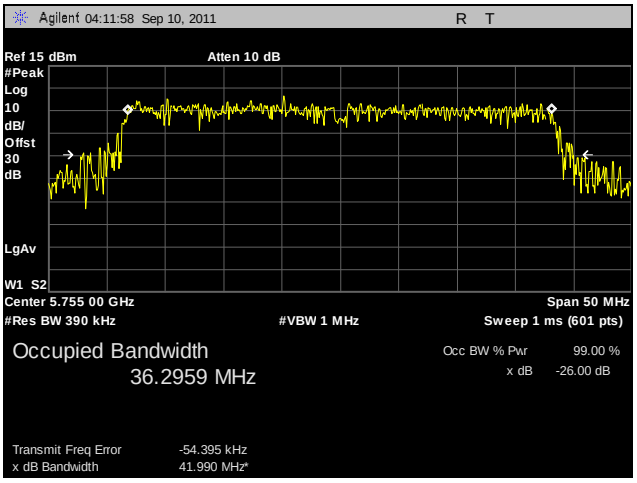

**Plot 13. Occupied Bandwidth, 802.11n 20 MHz, Port B, 5785 MHz**



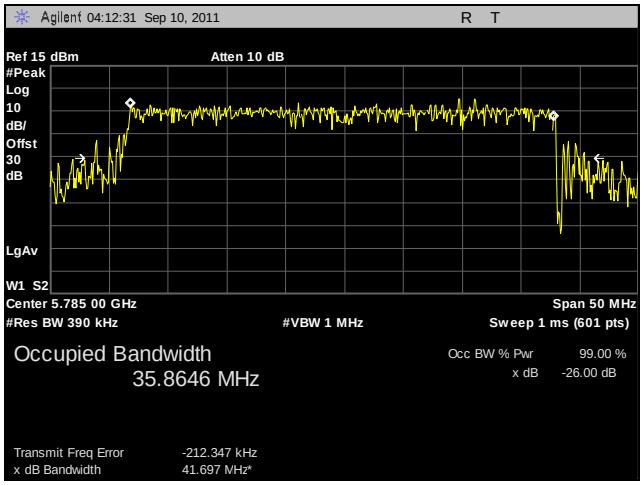

**Plot 14. Occupied Bandwidth, 802.11n 20 MHz, Port B, 5805 MHz**

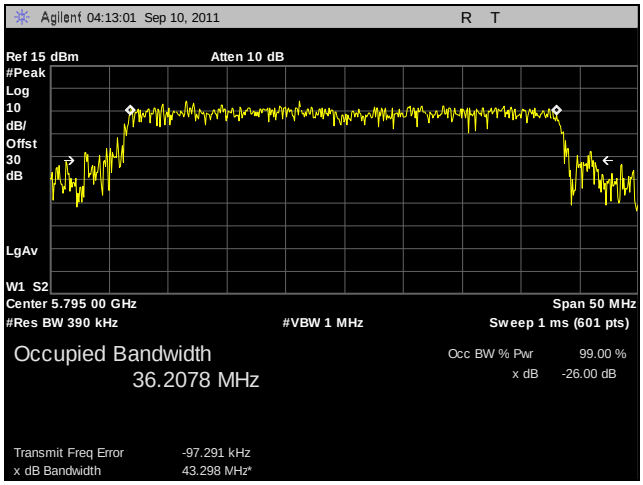
## Occupied Bandwidth, 802.11n 40 MHz, Port A




**Plot 15. Occupied Bandwidth, 802.11n 40 MHz, Port A, 5755 MHz**



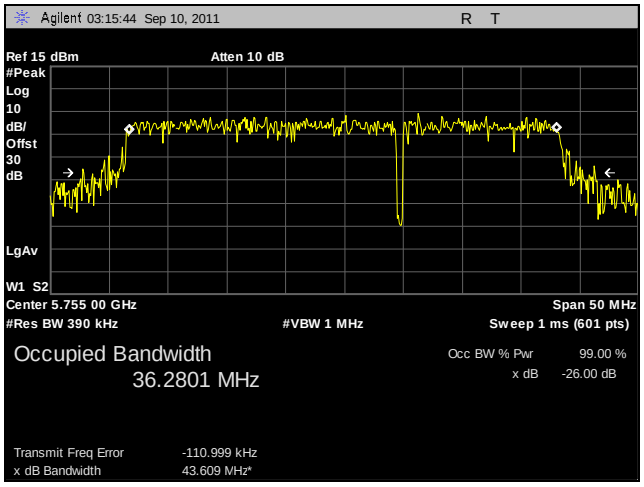

**Plot 16. Occupied Bandwidth, 802.11n 40 MHz, Port A, 5785 MHz**



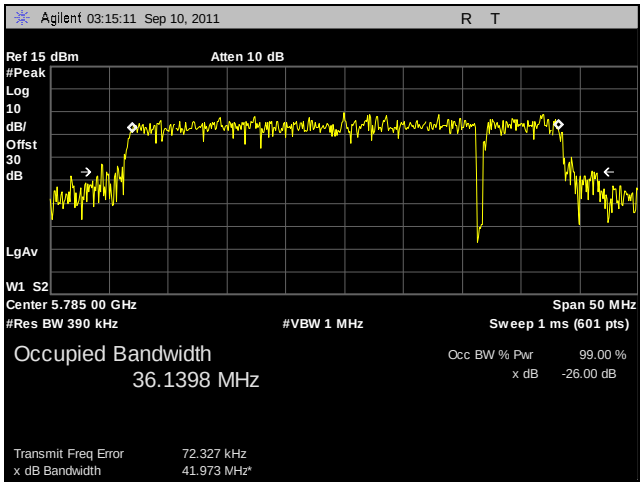

**Plot 17. Occupied Bandwidth, 802.11n 40 MHz, Port A, 5795 MHz**

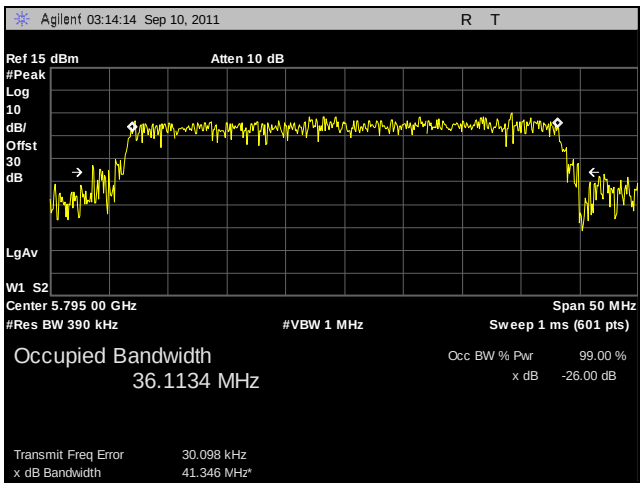
## Occupied Bandwidth, 802.11n 40 MHz, Port B




**Plot 18. Occupied Bandwidth, 802.11n 40 MHz, Port B, 5755 MHz**



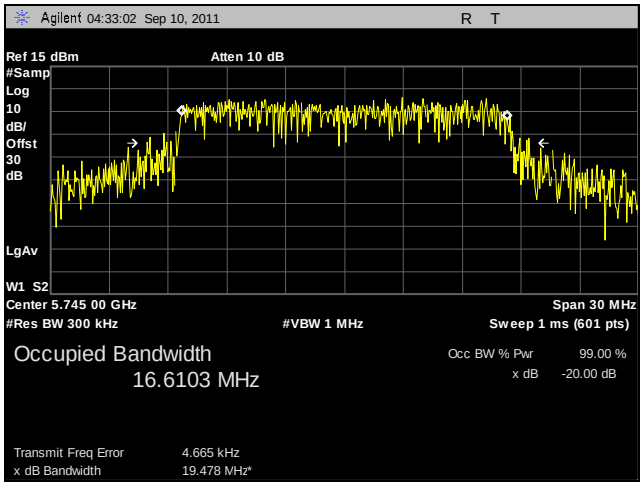

**Plot 19. Occupied Bandwidth, 802.11n 40 MHz, Port B, 5785 MHz**



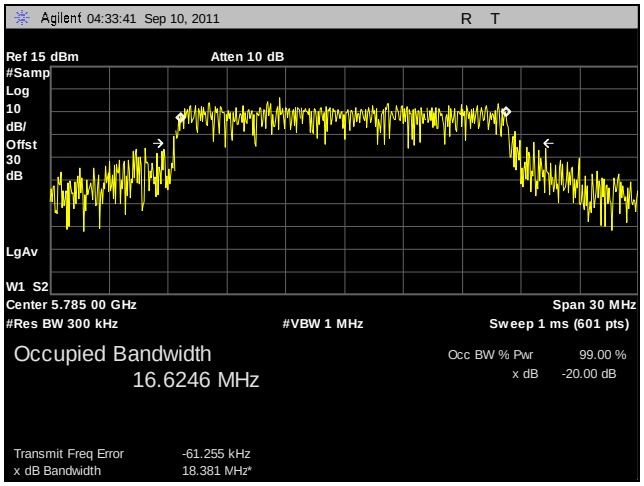

**Plot 20. Occupied Bandwidth, 802.11n 40 MHz, Port B, 5795 MHz**

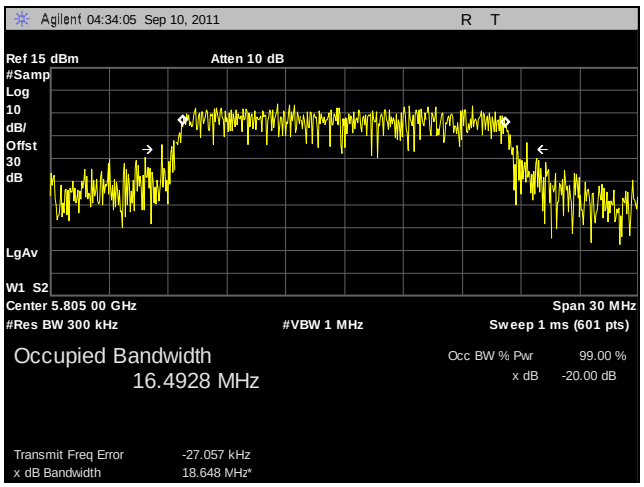
## 99% Occupied Bandwidth, 802.11a




**Plot 21. 99% Occupied Bandwidth, 802.11a, 5745 MHz**



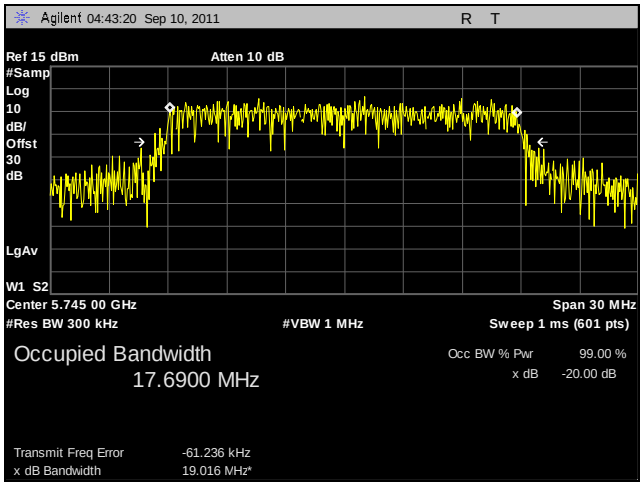

**Plot 22. 99% Occupied Bandwidth, 802.11a, 5785 MHz**



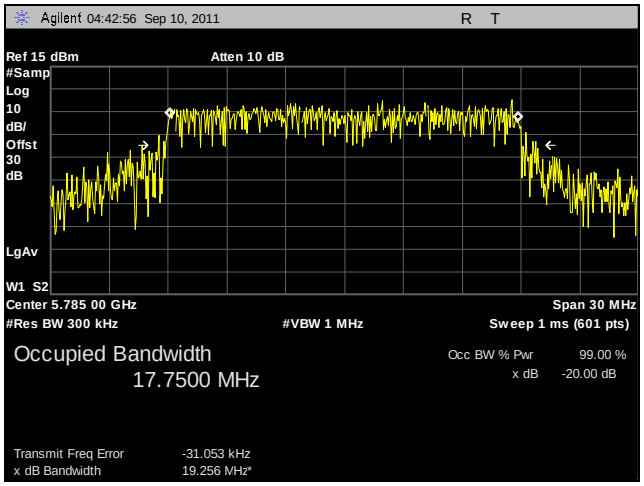

**Plot 23. 99% Occupied Bandwidth, 802.11a, 5805 MHz**

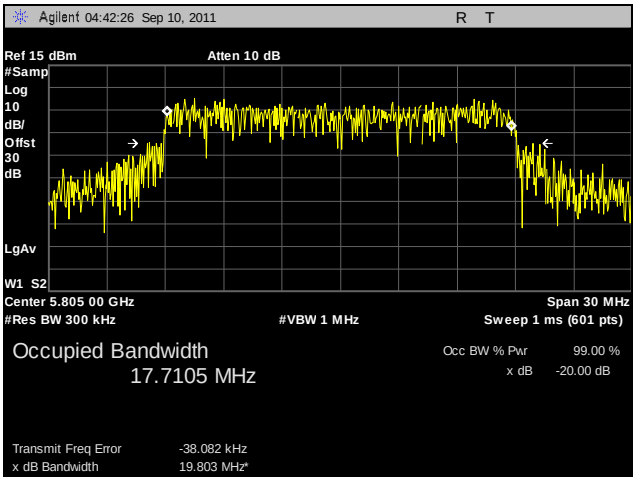
## 99% Occupied Bandwidth, 802.11n 20 MHz, Port A




**Plot 24. 99% Occupied Bandwidth, 802.11n 20 MHz, Port A, 5745 MHz**



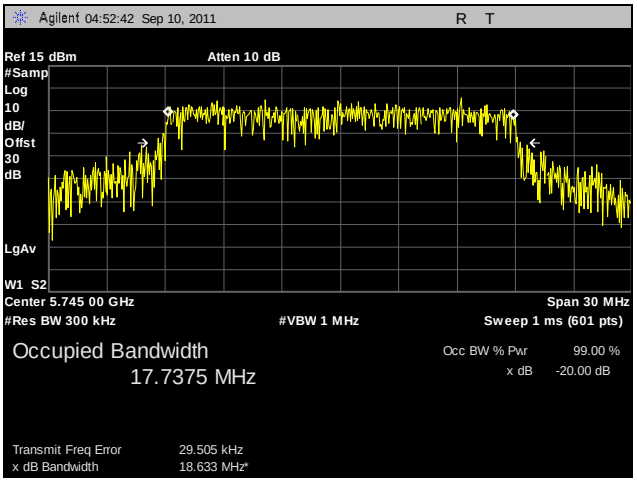

**Plot 25. 99% Occupied Bandwidth, 802.11n 20 MHz, Port A, 5785 MHz**



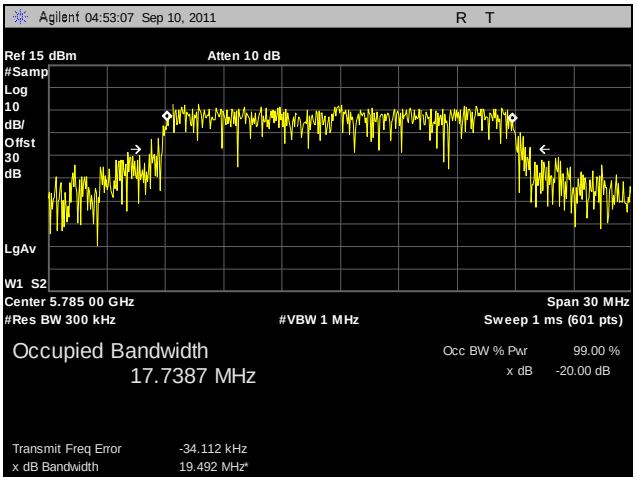

**Plot 26. 99% Occupied Bandwidth, 802.11n 20 MHz, Port A, 5805 MHz**

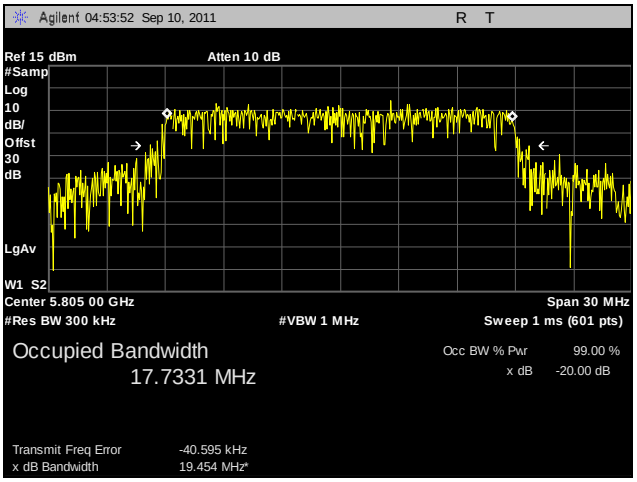
## 99% Occupied Bandwidth, 802.11n 20 MHz, Port B




**Plot 27. 99% Occupied Bandwidth, 802.11n 20 MHz, Port B, 5745 MHz**



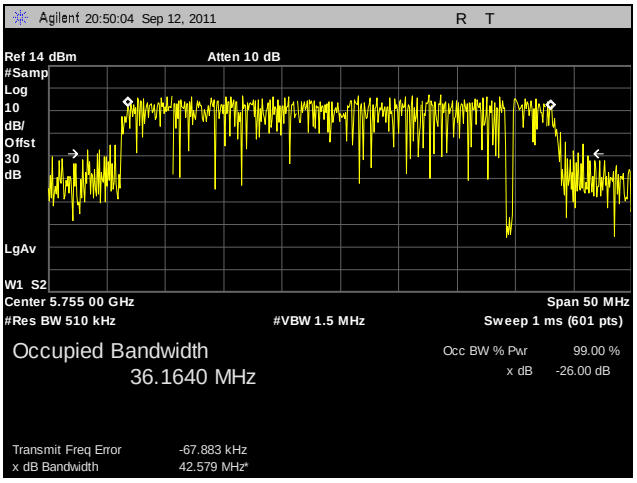

**Plot 28. 99% Occupied Bandwidth, 802.11n 20 MHz, Port B, 5785 MHz**



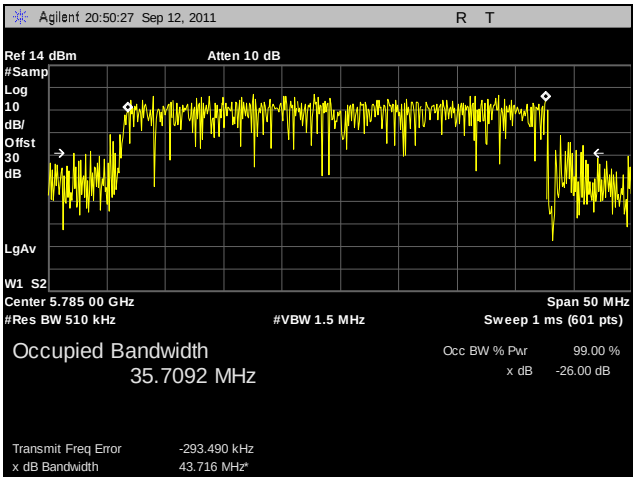

**Plot 29. 99% Occupied Bandwidth, 802.11n 20 MHz, Port B, 5805 MHz**

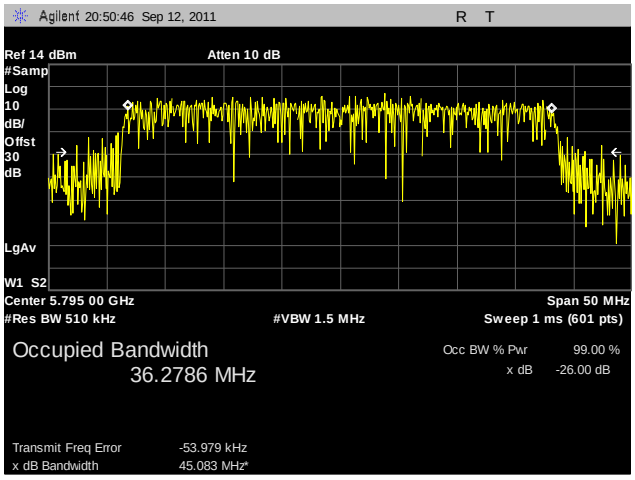
## 99% Occupied Bandwidth, 802.11n 40 MHz, Port A




**Plot 30. 99% Occupied Bandwidth, 802.11n 40 MHz, Port A, 5755 MHz**



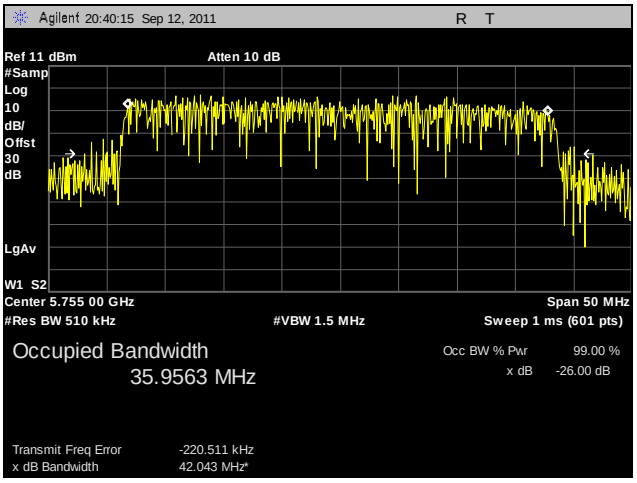

**Plot 31. 99% Occupied Bandwidth, 802.11n 40 MHz, Port A, 5785 MHz**



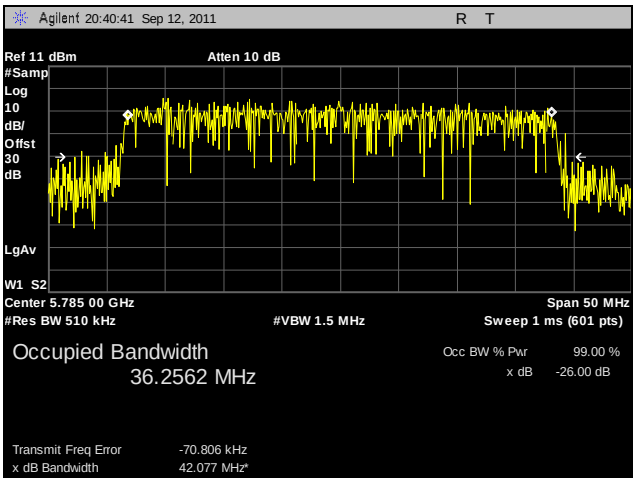

**Plot 32. 99% Occupied Bandwidth, 802.11n 40 MHz, Port A, 5795 MHz**

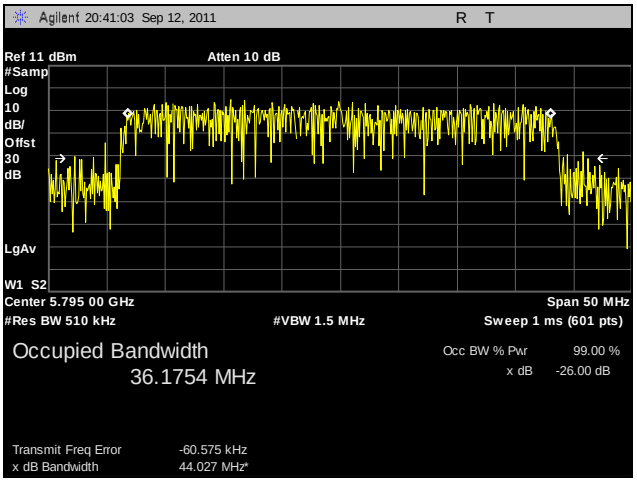
## 99% Occupied Bandwidth, 802.11n 40 MHz, Port B




**Plot 33. 99% Occupied Bandwidth, 802.11n 40 MHz, Port B, 5755 MHz**




**Plot 34. 99% Occupied Bandwidth, 802.11n 40 MHz, Port B, 5785 MHz**




**Plot 35. 99% Occupied Bandwidth, 802.11n 40 MHz, Port B, 5795 MHz**

## Electromagnetic Compatibility Criteria for Intentional Radiators

## § 15. 407(a) (1), (2) RF Power Output

**Test Requirements:** **§15.407(a) (1), (2):** The maximum output power of the intentional radiator shall not exceed the following:

| Digital Transmission Systems (MHz) | Output Limit (mW) |
|---|---|
| 5150-5250 | 50 |
| 5250-5350 | 250 |

**Table 19. Output Power Requirements from §15.407**

**§15.407(a) (3):** For the band 5.725–5.825 GHz, the maximum conducted output power over the frequency band of operation shall not exceed the lesser of 1 W or 17 dBm + 10 log B, where B is the 26-dB emission bandwidth in MHz.

**Test Procedure:** The transmitter was connected to a calibrated Spectrum analyzer. The EUT was measured at the low, mid and high channels of each band with the data rate that produced the highest output power.

**Test Results:** Equipment complies with the Peak Power Output limits of **§ 15.401(a) (2)**

**Test Engineer(s):** Jeff Pratt

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

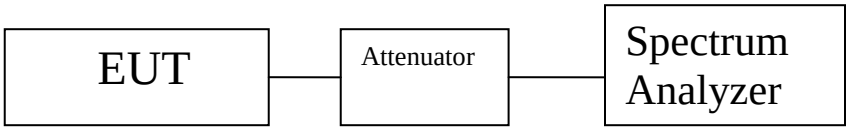



**Figure 2. Peak Power Output Test Setup**

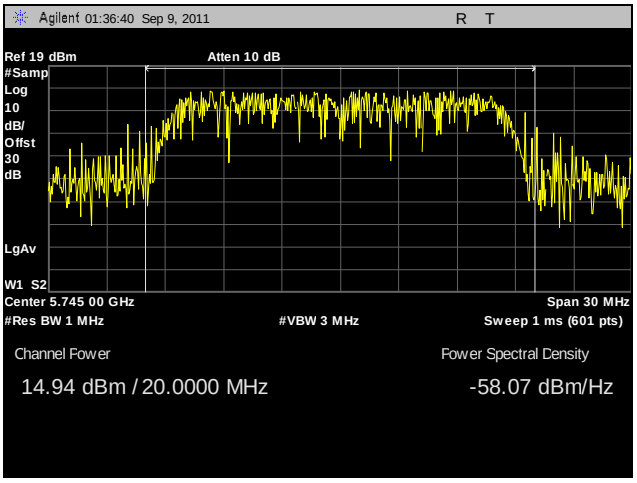
| Channel (MHz) | Mode / Mod. Type | Port 1A Conducted Power (dBm) | Port 1A Conducted Power (mW) | Port 1B Conducted Power (dBm) | Port 1B Conducted Power (mW) | Summed Conducted Power (mW) | Summed Conducted Power (dBm) | Antenna Gain (dBi) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|---|
| 5745 | 802.11a | 14.94 | 31.1888958 | | | 31.188896 | 14.94 | 10 | 26 | -11.06 |
| 5785 | 802.11a | 14.05 | 25.4097271 | | | 25.409727 | 14.05 | 10 | 26 | -11.95 |
| 5805 | 802.11a | 13.4 | 21.8776162 | | | 21.877616 | 13.4 | 10 | 26 | -12.6 |
| 5745 | 802.11n HT20 | 12.73 | 18.7499451 | 12.39 | 17.33804 | 36.087985 | 15.5736263 | 10 | 26 | -10.4263737 |
| 5785 | 802.11n HT20 | 12.29 | 16.943378 | 11.75 | 14.9623566 | 31.905735 | 15.0386875 | 10 | 26 | -10.9613125 |
| 5805 | 802.11n HT20 | 12.22 | 16.6724721 | 11.42 | 13.8675583 | 30.54003 | 14.8486947 | 10 | 26 | -11.1513053 |
| 5755 | 802.11n HT40 | 12.95 | 19.7242274 | 11.85 | 15.3108746 | 35.035102 | 15.4450339 | 10 | 26 | -10.5549661 |
| 5785 | 802.11n HT40 | 11.77 | 15.0314197 | 11.93 | 15.595525 | 30.626945 | 14.8610367 | 10 | 26 | -11.1389633 |
| 5795 | 802.11n HT40 | 10.68 | 11.6949939 | 11.36 | 13.6772883 | 25.372282 | 14.0435953 | 10 | 26 | -11.9564047 |

**Table 20. RF Power Output, Test Results**

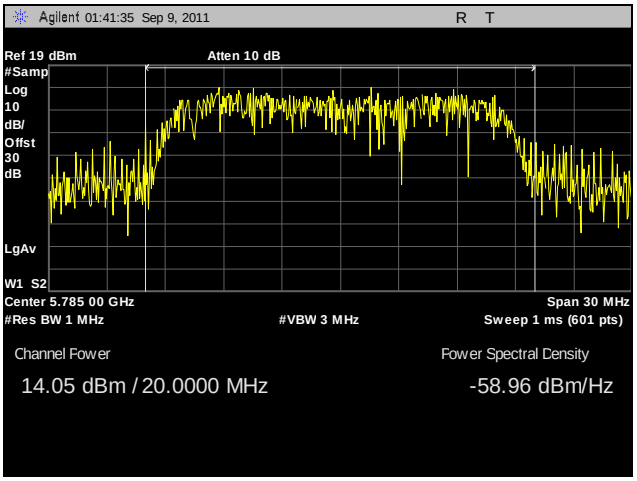
| Channel (MHz) | Mode / Mod. Type | Port 1A Conducted Power (dBm) | Port 1A Conducted Power (mW) | Port 1B Conducted Power (dBm) | Port 1B Conducted Power (mW) | Summed Conducted Power (mW) | Summed Conducted Power (dBm) | Antenna Gain (dBi) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|---|
| 5745 | 802.11a | 14.51 | 28.2487997 | | | 28.2488 | 14.51 | 15.5 | 20.5 | -5.99 |
| 5785 | 802.11a | 13.5 | 22.3872114 | | | 22.387211 | 13.5 | 15.5 | 20.5 | -7 |
| 5805 | 802.11a | 13.41 | 21.9280494 | | | 21.928049 | 13.41 | 15.5 | 20.5 | -7.09 |
| 5745 | 802.11n HT20 | 12.83 | 19.1866874 | 12.11 | 16.2554876 | 35.442175 | 15.4952037 | 15.5 | 20.5 | -5.00479635 |
| 5785 | 802.11n HT20 | 12.59 | 18.1551566 | 11.3 | 13.4896288 | 31.644785 | 15.0030216 | 15.5 | 20.5 | -5.49697844 |
| 5805 | 802.11n HT20 | 11.53 | 14.2232879 | 11.18 | 13.121999 | 27.345287 | 14.3688248 | 15.5 | 20.5 | -6.13117516 |
| 5755 | 802.11n HT40 | 12.04 | 15.9955803 | 11.42 | 13.8675583 | 29.863139 | 14.7513545 | 15.5 | 20.5 | -5.7486455 |
| 5785 | 802.11n HT40 | 11.24 | 13.3045442 | 11.93 | 15.595525 | 28.900069 | 14.6089888 | 15.5 | 20.5 | -5.89101117 |
| 5795 | 802.11n HT40 | 11.3 | 13.4896288 | 10.61 | 11.5080039 | 24.997633 | 13.9789888 | 15.5 | 20.5 | -6.52101117 |

**Table 21. RF Power Output, Test Results, Sector Antenna**

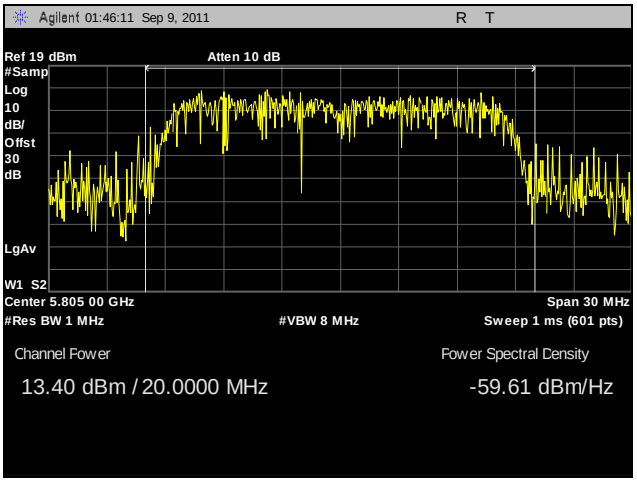
## Conducted Output Power, 802.11a




**Plot 36. Conducted Output Power, 802.11a, 5745 MHz**



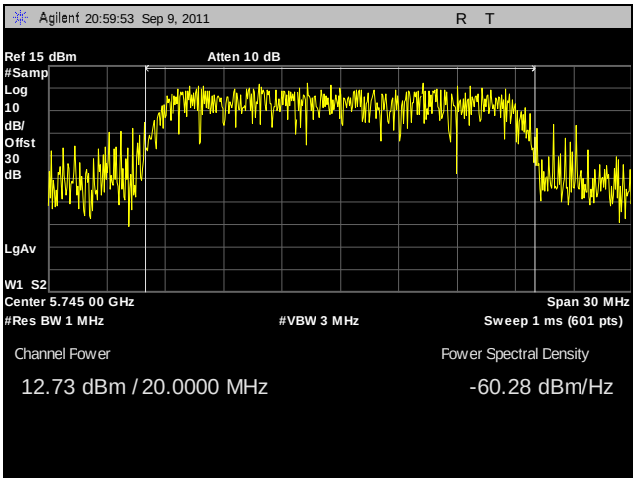

**Plot 37. Conducted Output Power, 802.11a, 5785 MHz**



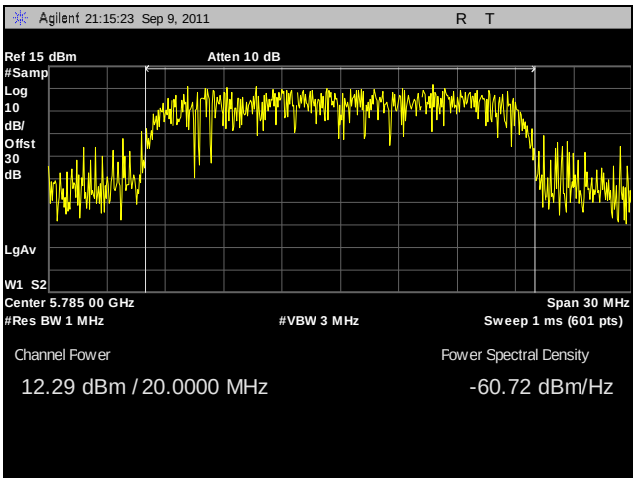

**Plot 38. Conducted Output Power, 802.11a, 5805 MHz**

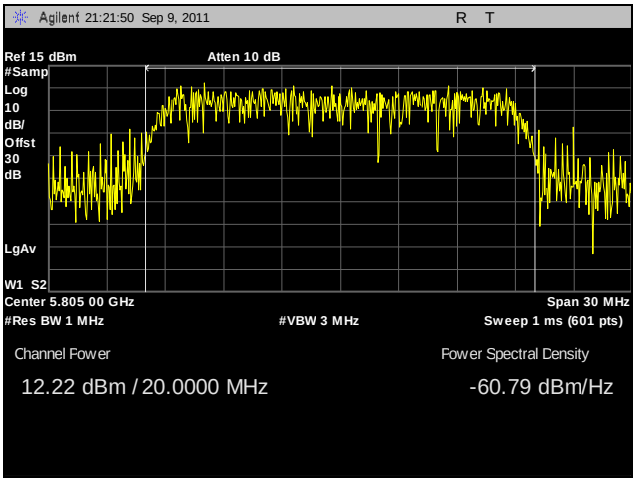
## Conducted Output Power, 802.11n 20 MHz, Port A




**Plot 39. Conducted Output Power, 802.11n 20 MHz, Port A, 5745 MHz**



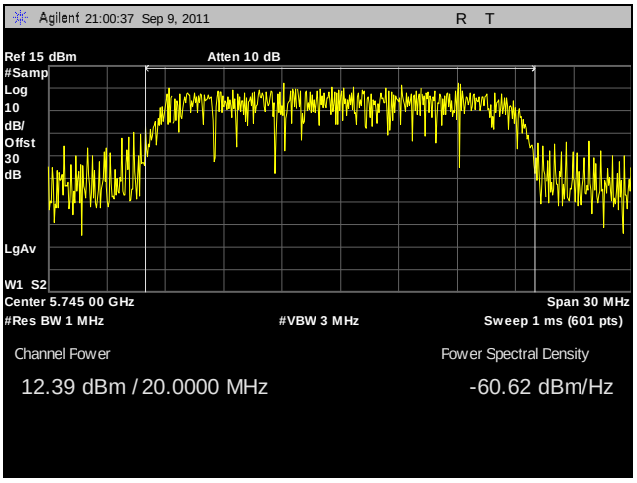

**Plot 40. Conducted Output Power, 802.11n 20 MHz, Port A, 5785 MHz**



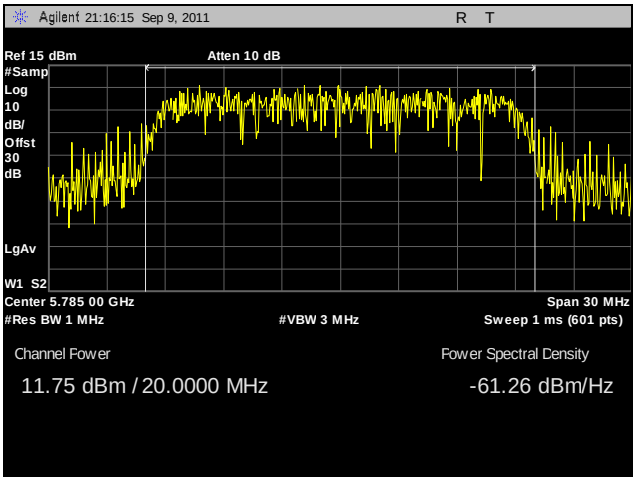

**Plot 41. Conducted Output Power, 802.11n 20 MHz, Port A, 5805 MHz**

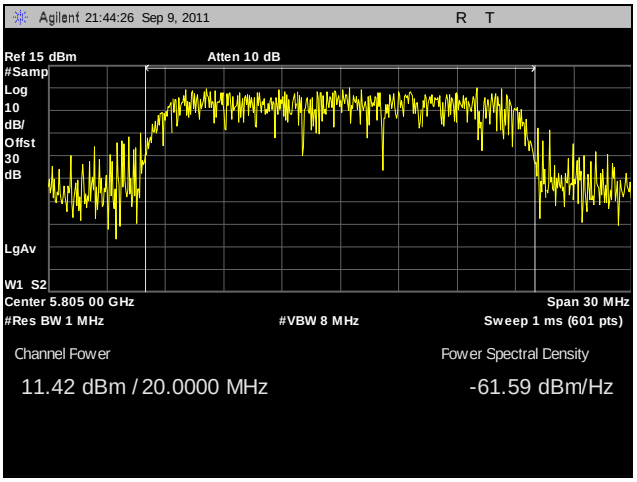
## Conducted Output Power, 802.11n 20 MHz, Port B




**Plot 42. Conducted Output Power, 802.11n 20 MHz, Port B, 5745 MHz**



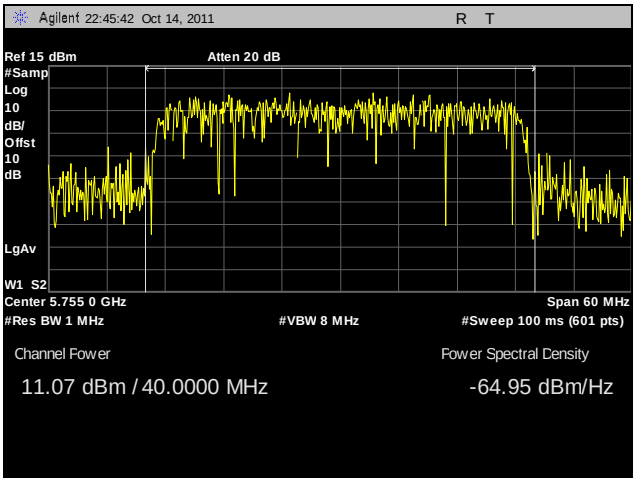

**Plot 43. Conducted Output Power, 802.11n 20 MHz, Port B, 5785 MHz**



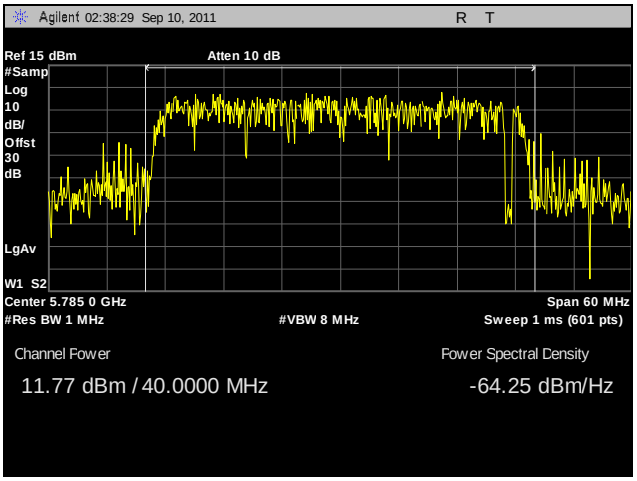

**Plot 44. Conducted Output Power, 802.11n 20 MHz, Port B, 5805 MHz**

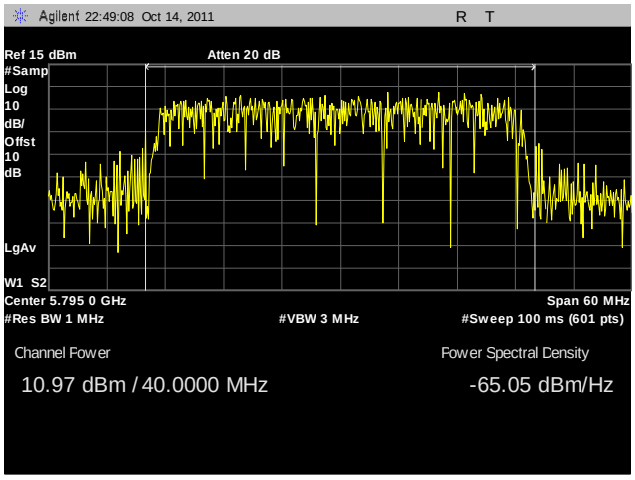
## Conducted Output Power, 802.11n 40 MHz, Port A




**Plot 45. Conducted Output Power, 802.11n 40 MHz, Port A, 5755 MHz**



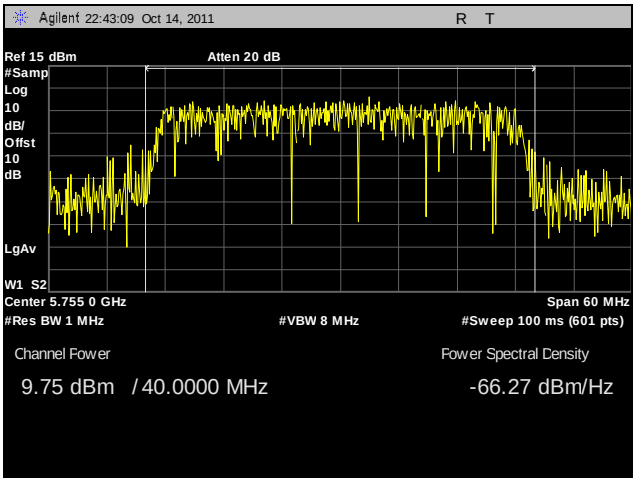

**Plot 46. Conducted Output Power, 802.11n 40 MHz, Port A, 5785 MHz**



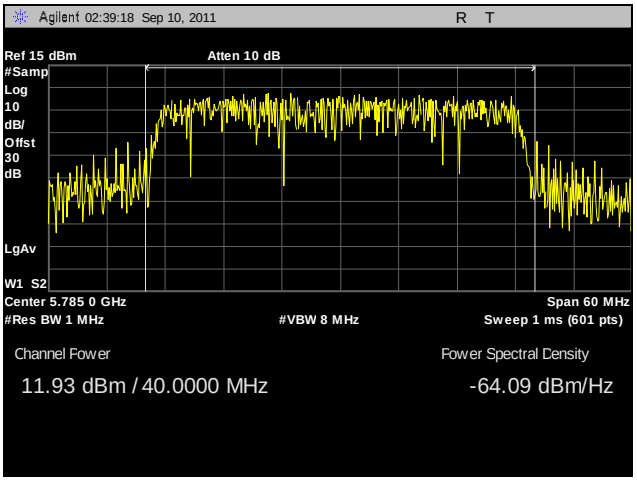

**Plot 47. Conducted Output Power, 802.11n 40 MHz, Port A, 5795 MHz**

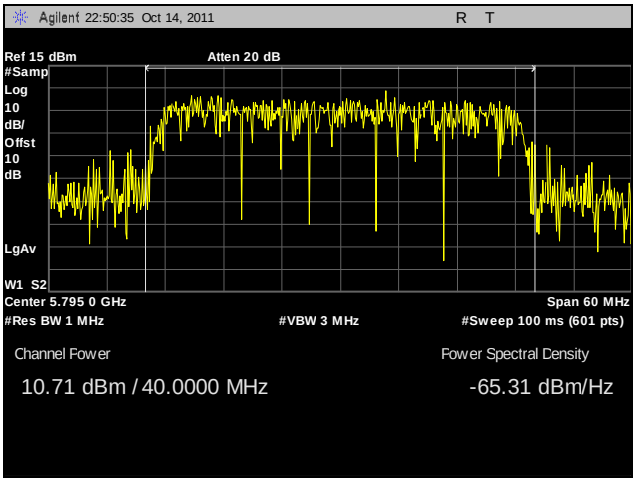
## Conducted Output Power, 802.11n 40 MHz, Port B




**Plot 48. Conducted Output Power, 802.11n 40 MHz, Port B, 5755 MHz**



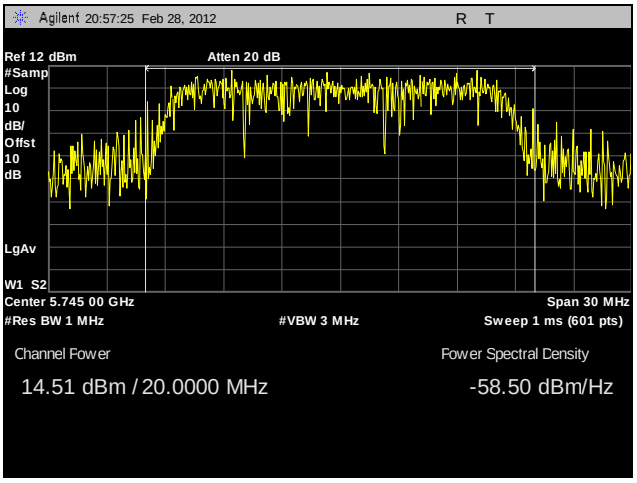

**Plot 49. Conducted Output Power, 802.11n 40 MHz, Port B, 5785 MHz**



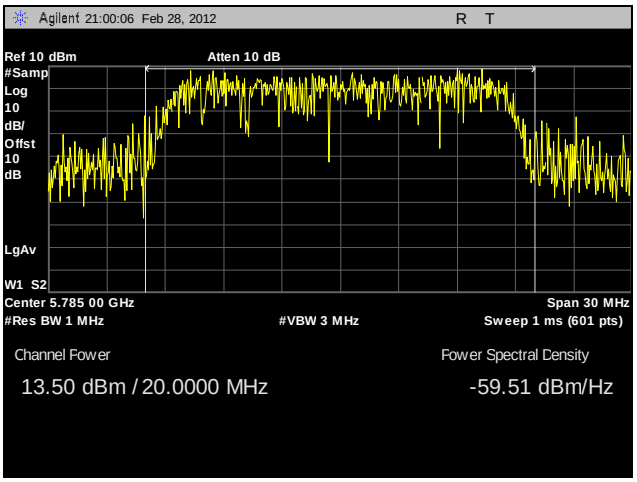

**Plot 50. Conducted Output Power, 802.11n 40 MHz, Port B, 5795 MHz**

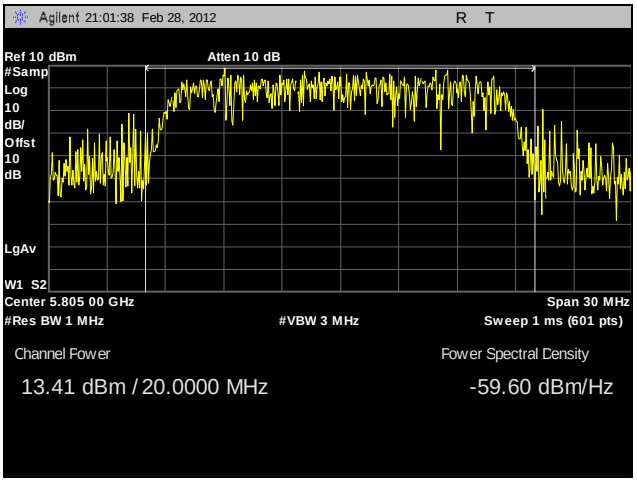
## Conducted Output Power, 802.11a, Sector Antenna




**Plot 51. Conducted Output Power, 802.11a, 5745 MHz, Sector Antenna**



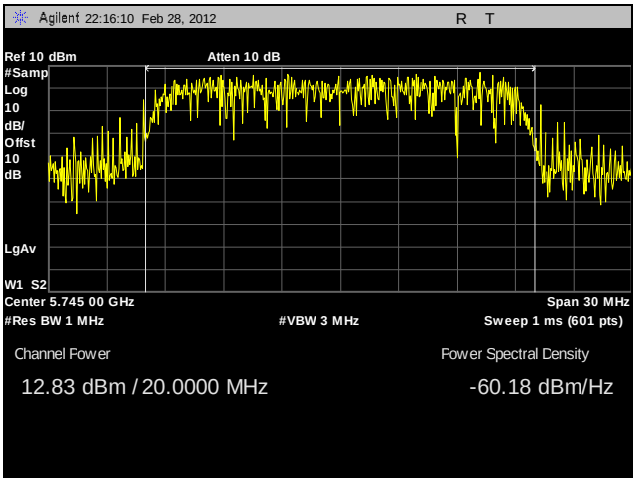

**Plot 52. Conducted Output Power, 802.11a, 5785 MHz, Sector Antenna**



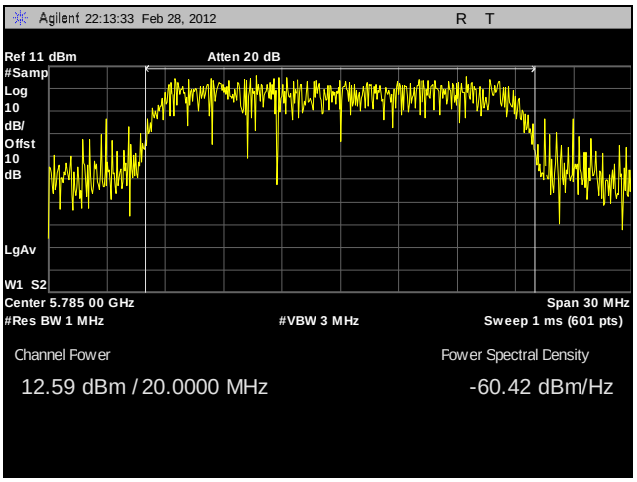

**Plot 53. Conducted Output Power, 802.11a, 5805 MHz, Sector Antenna**

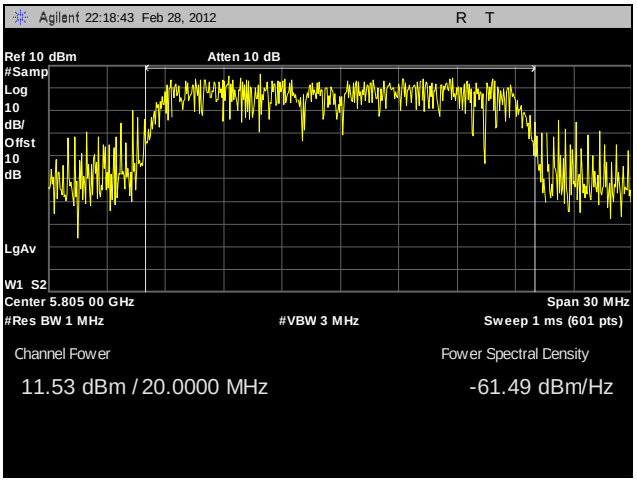
## Conducted Output Power, 802.11n 20 MHz, Port A, Sector Antenna




**Plot 54. Conducted Output Power, 802.11n 20 MHz, Port A, Sector Antenna, 5745 MHz**



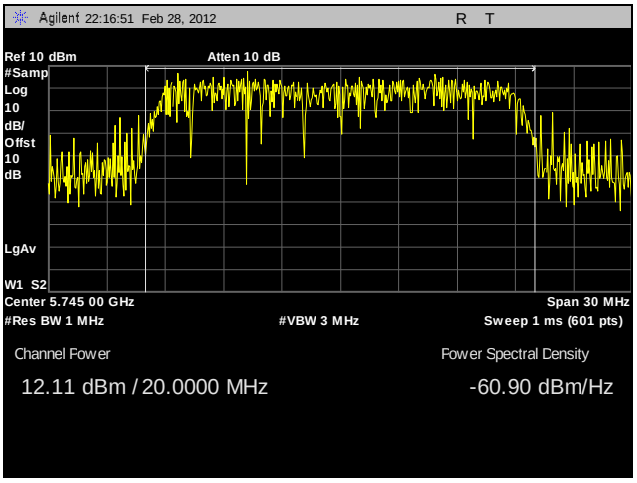

**Plot 55. Conducted Output Power, 802.11n 20 MHz, Port A, Sector Antenna, 5785 MHz**



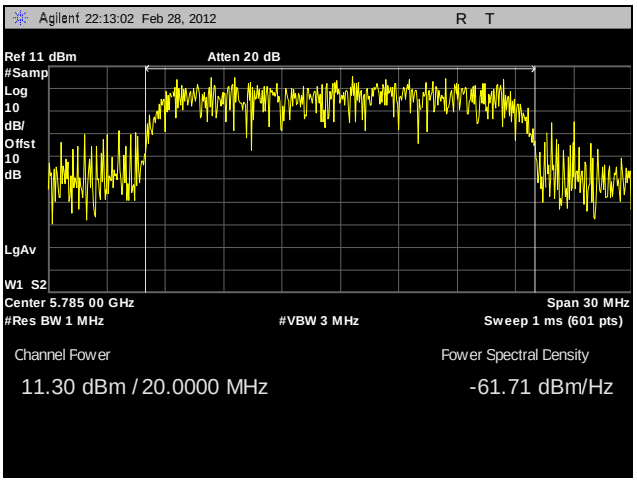

**Plot 56. Conducted Output Power, 802.11n 20 MHz, Port A, Sector Antenna, 5805 MHz**

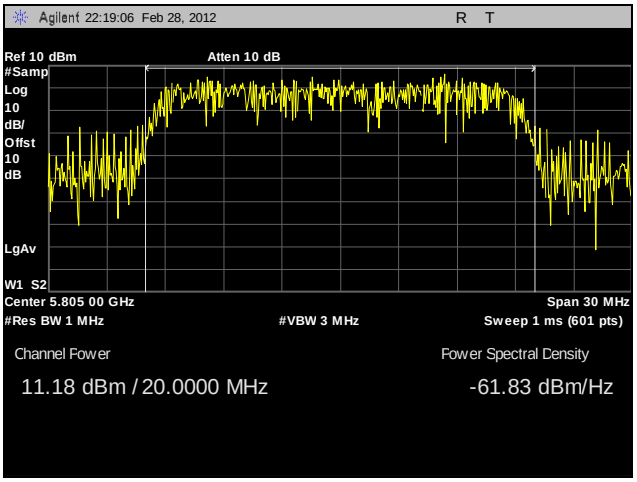
## Conducted Output Power, 802.11n 20 MHz, Port B, Sector Antenna




**Plot 57. Conducted Output Power, 802.11n 20 MHz, Port B, Sector Antenna, 5745 MHz**



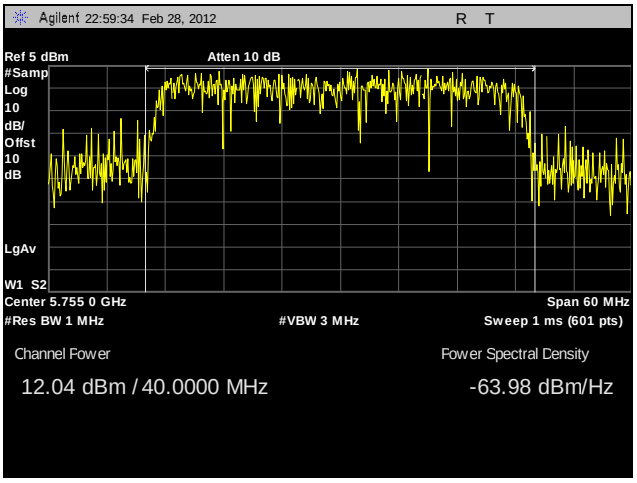

**Plot 58. Conducted Output Power, 802.11n 20 MHz, Port B, Sector Antenna, 5785 MHz**



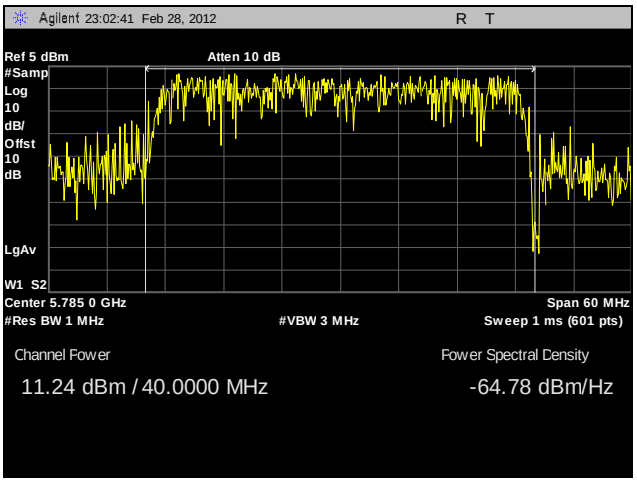

**Plot 59. Conducted Output Power, 802.11n 20 MHz, Port B, Sector Antenna, 5805 MHz**

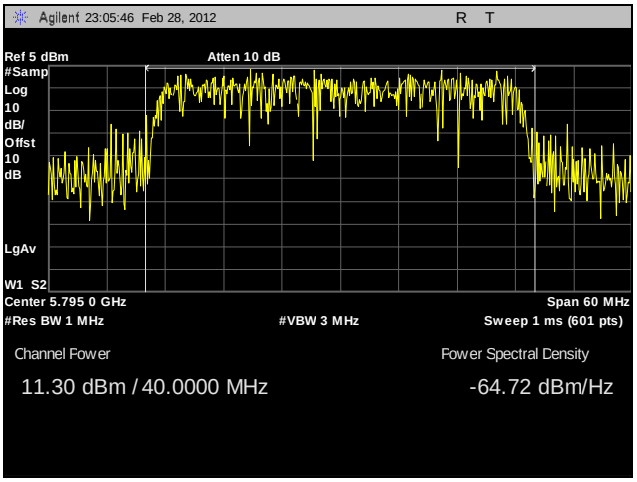
## Conducted Output Power, 802.11n 40 MHz, Port A, Sector Antenna




**Plot 60. Conducted Output Power, 802.11n 40 MHz, Port A, Sector Antenna, 5755 MHz**



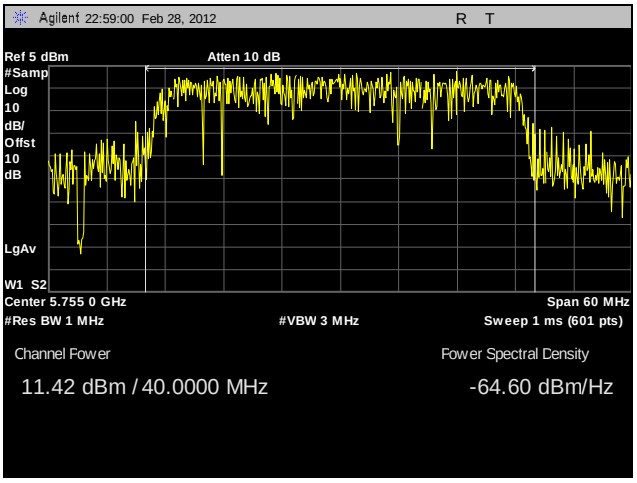

**Plot 61. Conducted Output Power, 802.11n 40 MHz, Port A, Sector Antenna, 5785 MHz**



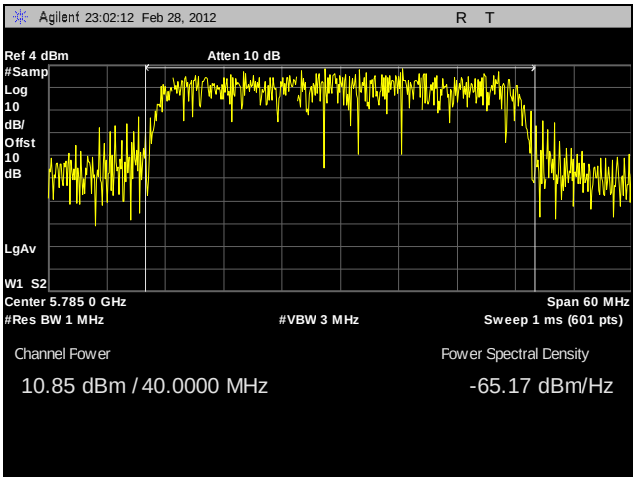

**Plot 62. Conducted Output Power, 802.11n 40 MHz, Port A, Sector Antenna, 5795 MHz**

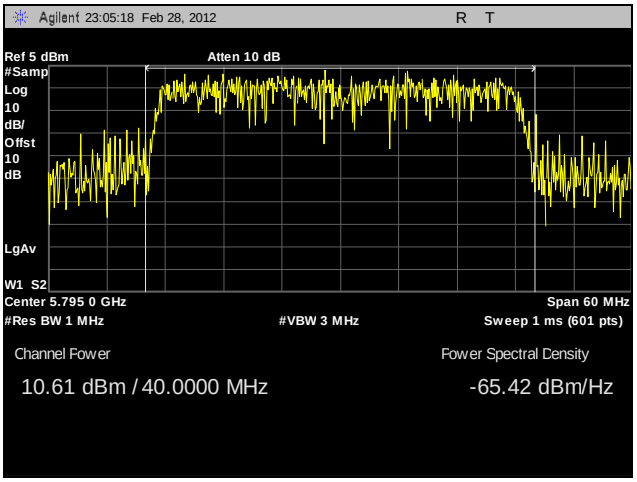
## Conducted Output Power, 802.11n 40 MHz, Port B, Sector Antenna




**Plot 63. Conducted Output Power, 802.11n 40 MHz, Port B, Sector Antenna, 5755 MHz**




**Plot 64. Conducted Output Power, 802.11n 40 MHz, Port B, Sector Antenna, 5785 MHz**




**Plot 65. Conducted Output Power, 802.11n 40 MHz, Port B, Sector Antenna, 5795 MHz**

## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.407(a)(1), (a)(2) Peak Power Spectral Density

**Test Requirements:** **§ 15.407(a)(3), (a)(2):** The peak power spectral density shall not exceed 17 dBm in any 1–MHz band in the frequency band 5.725GHz to 5.825GHz.

**Test Procedure:** The transmitter was connected directly to a Spectrum Analyzer through an attenuator. The power level was set to the maximum level on the EUT. The RBW was set to 1MHz and the VBW was set to 3MHz. The method of measurement SA-1 from 789033 D01 UNII General Test Procedures v01 was used.

**Test Results:** Equipment complies with the peak power spectral density limits of **§ 15.407(a)(1), (a)(2).** The peak power spectral density was determined from plots on the following page(s).

**Test Engineer(s):** Jeff Pratt

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

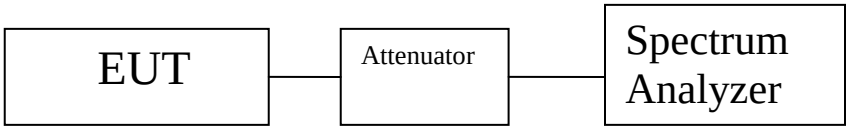



**Figure 3. Peak Power Spectral Density Test Setup**

| Channel (MHz) | Mode/Modulation Type | Port 1A Spectral Density (dBm) | Port 1A Spectral Density (mW) | Port 1B Spectral Density (dBm) | Port 1B Spectral Density (mW) | Summed Spectral Density (mW) | Summed Spectral Density (dBm) | Antenna Gain (dBi) | Limit (dBm) | Margin (dB) | GUI |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5745 | 802.11a | 3.965 | 2.491724 | | | 2.491724 | 3.965 | 10 | 13 | -9.035 | 20 |
| 5785 | 802.11a | 3.248 | 2.112516 | | | 2.112516 | 3.248 | 10 | 13 | -9.752 | 20 |
| 5805 | 802.11a | 2.329 | 1.709622 | | | 1.709622 | 2.329 | 10 | 13 | -10.671 | 20 |
| 5745 | 802.11n HT20 | 1.83 | 1.524053 | 1.227 | 1.326478 | 2.850531 | 4.549257 | 10 | 13 | -8.45074 | 20 |
| 5785 | 802.11n HT20 | 1.168 | 1.308579 | -0.033 | 0.99243 | 2.301009 | 3.619184 | 10 | 13 | -9.38082 | 20 |
| 5805 | 802.11n HT20 | 1.059 | 1.276145 | 0.457 | 1.110964 | 2.387109 | 3.778722 | 10 | 13 | -9.22128 | 20 |
| 5755 | 802.11n HT40 | -1.768 | 0.66558 | -2.233 | 0.597998 | 1.263578 | 1.01602 | 10 | 13 | -11.984 | 20 |
| 5785 | 802.11n HT40 | -2.501 | 0.562212 | -2.44 | 0.570164 | 1.132376 | 0.539907 | 10 | 13 | -12.4601 | 20 |
| 5795 | 802.11n HT40 | -1.801 | 0.660541 | -1.57 | 0.696627 | 1.357168 | 1.326336 | 10 | 13 | -11.6737 | 20 |

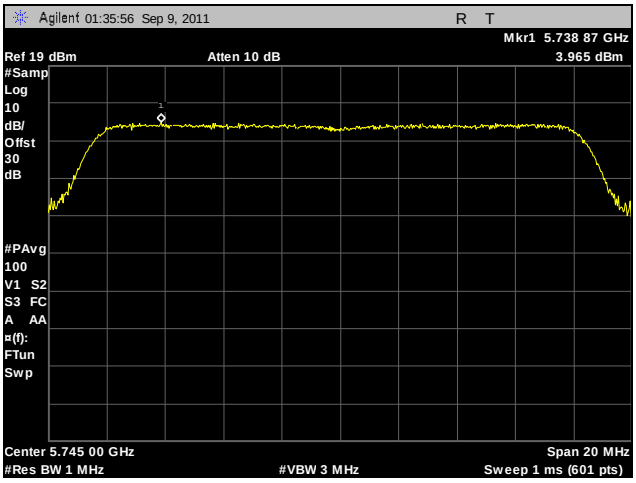
**Table 22. Power Spectral Density, 802.11a, Test Results**

| Channel (MHz) | Mode/Modulation Type | Port 1A Spectral Density (dBm) | Port 1A Spectral Density (mW) | Port 1B Spectral Density (dBm) | Port 1B Spectral Density (mW) | Summed Spectral Density (mW) | Summed Spectral Density (dBm) | Antenna Gain (dBi) | Limit (dBm) | Margin (dB) | GUI |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5745 | 802.11a | 3.034 | 2.010944 | | | 2.010944 | 3.034 | 15.5 | 7.5 | -4.466 | 17 |
| 5785 | 802.11a | 2.803 | 1.906777 | | | 1.906777 | 2.803 | 15.5 | 7.5 | -4.697 | 18 |
| 5805 | 802.11a | 2.079 | 1.613987 | | | 1.613987 | 2.079 | 15.5 | 7.5 | -5.421 | 17 |
| 5745 | 802.11n HT20 | 1.615 | 1.450441 | 1.629 | 1.455124 | 2.905565 | 4.632306 | 15.5 | 7.5 | -2.86769 | 17 |
| 5785 | 802.11n HT20 | 0.687 | 1.171386 | 0.778 | 1.19619 | 2.367575 | 3.743038 | 15.5 | 7.5 | -3.75696 | 17 |
| 5805 | 802.11n HT20 | 0.201 | 1.04737 | -0.488 | 0.893717 | 1.941087 | 2.880449 | 15.5 | 7.5 | -4.61955 | 17 |
| 5755 | 802.11n HT40 | -2.457 | 0.567937 | -2.63 | 0.545758 | 1.113695 | 0.467661 | 15.5 | 7.5 | -7.03234 | 17 |
| 5785 | 802.11n HT40 | -2.777 | 0.527594 | -3.031 | 0.497622 | 1.025217 | 0.108157 | 15.5 | 7.5 | -7.39184 | 18 |
| 5795 | 802.11n HT40 | -2.993 | 0.501996 | -3.409 | 0.456142 | 0.958138 | -0.18572 | 15.5 | 7.5 | -7.68572 | 17 |

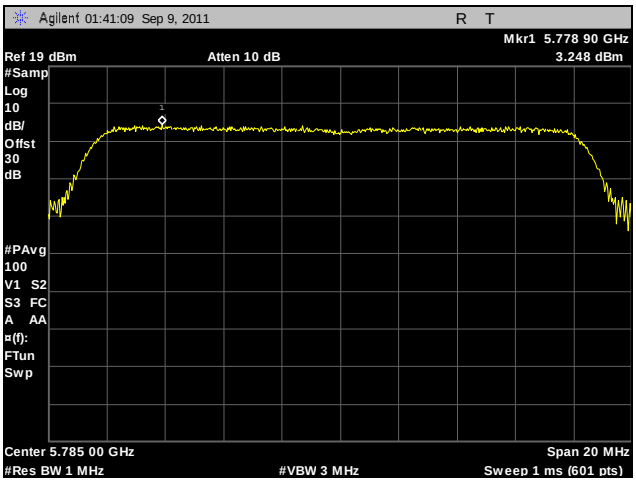
**Table 23. Power Spectral Density, 802.11a, Test Results, Sector Antenna**

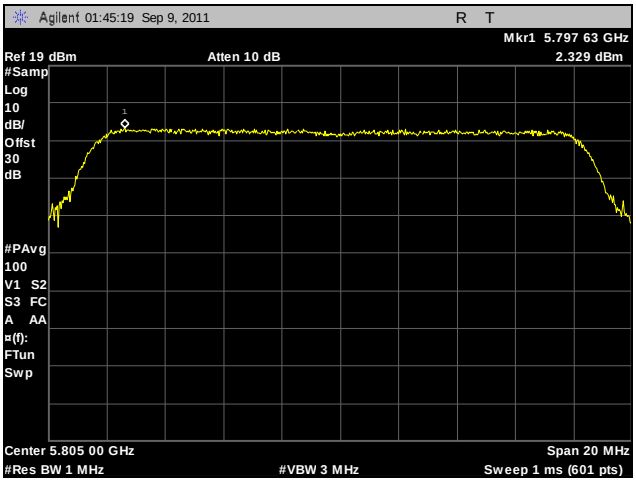
## Peak Power Spectral Density, 802.11a




**Plot 66. Peak Spectral Density, 802.11a, 5745 MHz**



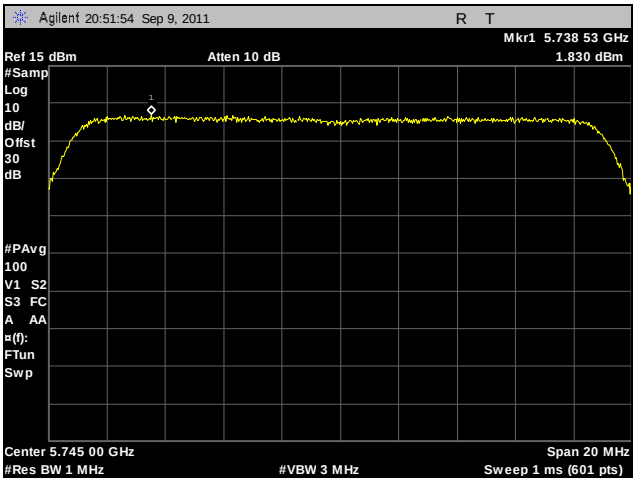

**Plot 67. Peak Spectral Density, 802.11a, 5785 MHz**



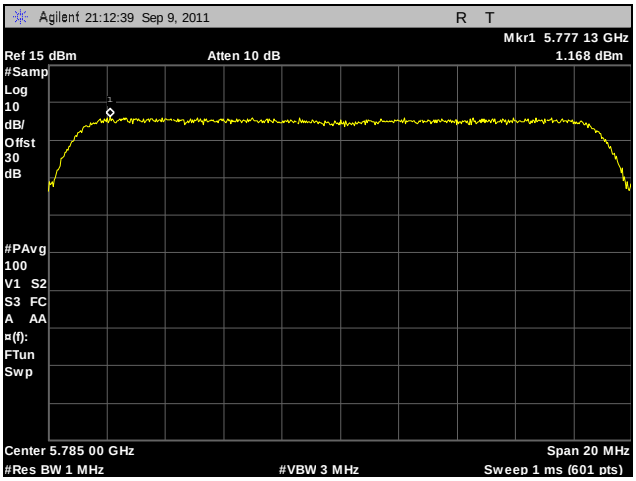

**Plot 68. Peak Spectral Density, 802.11a, 5805 MHz**

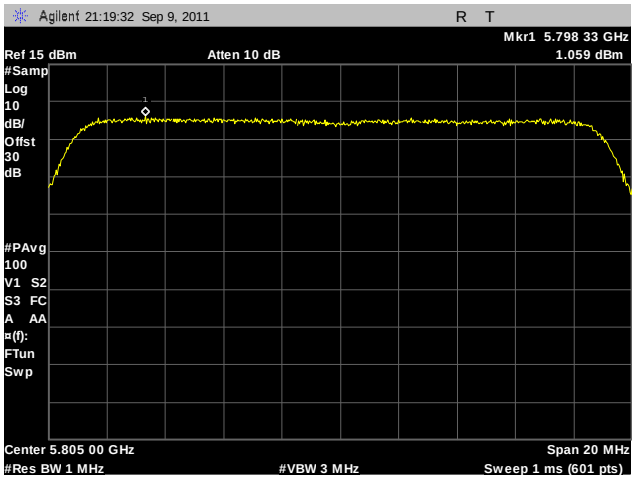
## Peak Power Spectral Density, 802.11n 20 MHz, Port A




**Plot 69. Peak Spectral Density, 802.11n 20 MHz, Port A, 5745 MHz**



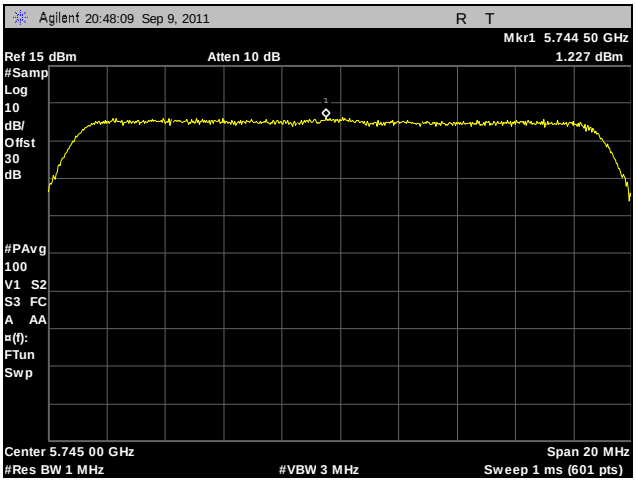

**Plot 70. Peak Spectral Density, 802.11n 20 MHz, Port A, 5785 MHz**



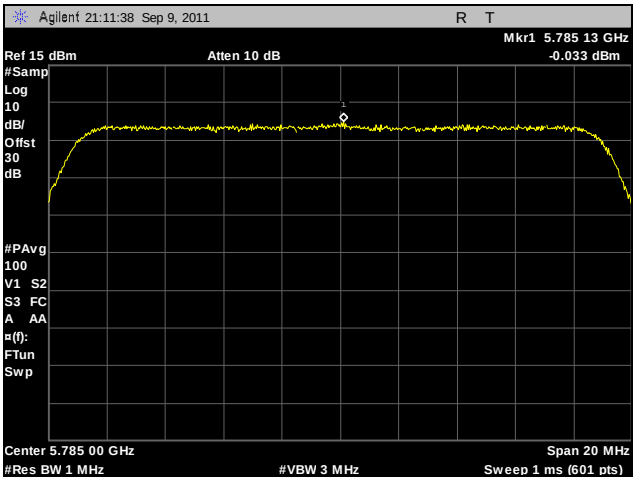

**Plot 71. Peak Spectral Density, 802.11n 20 MHz, Port A, 5805 MHz**

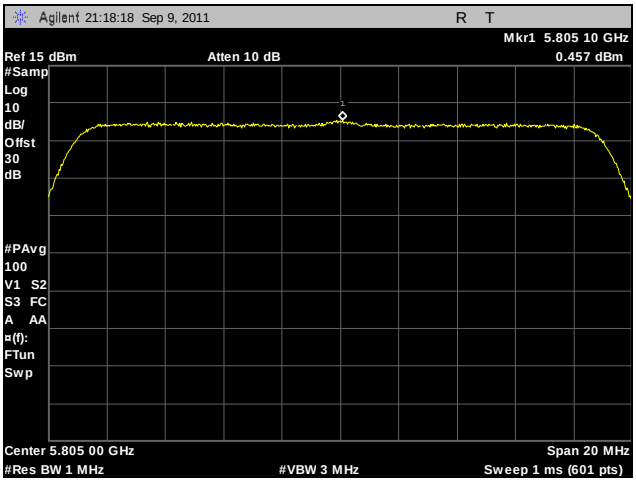
## Peak Power Spectral Density, 802.11n 20 MHz, Port B




**Plot 72. Peak Spectral Density, 802.11n 20 MHz, Port B, 5745 MHz**



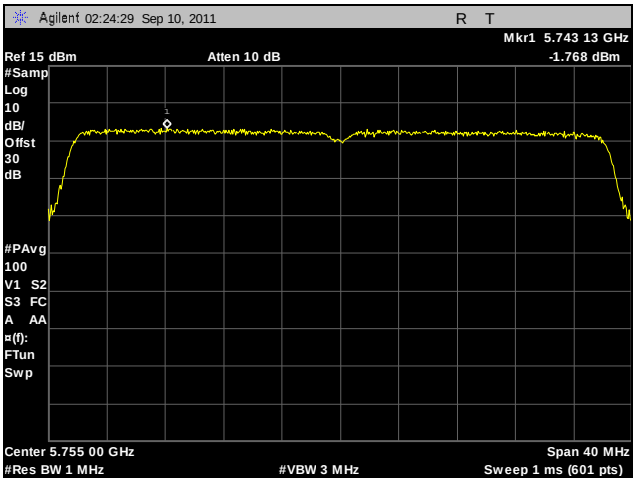

**Plot 73. Peak Spectral Density, 802.11n 20 MHz, Port B, 5785 MHz**



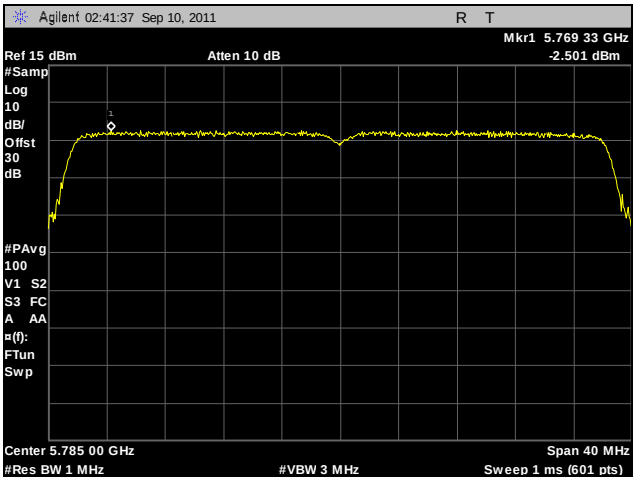

**Plot 74. Peak Spectral Density, 802.11n 20 MHz, Port B, 5805 MHz**

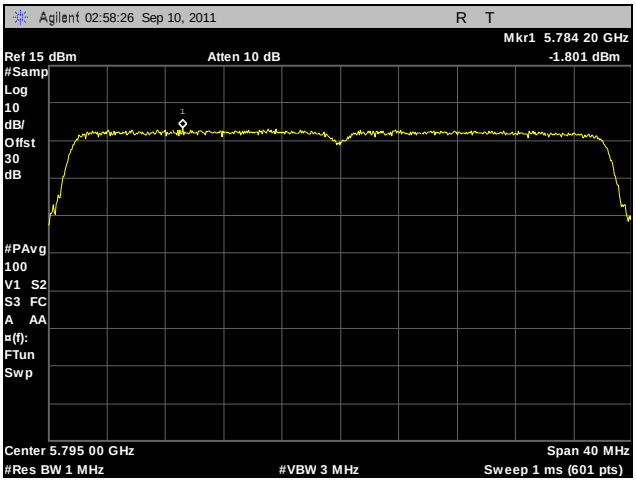
## Peak Power Spectral Density, 802.11n 40 MHz, Port A




**Plot 75. Peak Spectral Density, 802.11n 40 MHz, Port A, 5755 MHz**



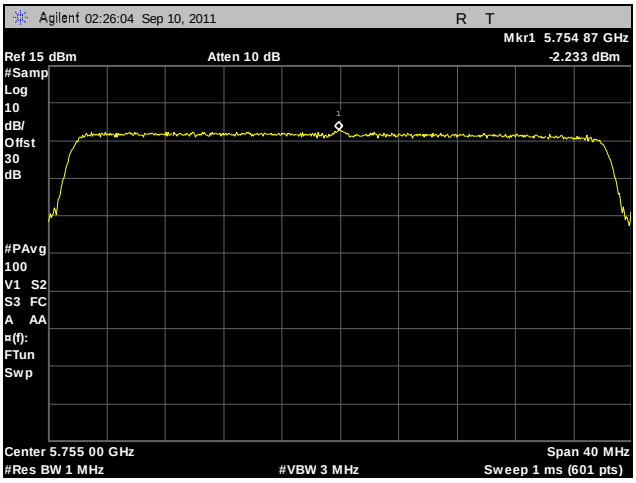

**Plot 76. Peak Spectral Density, 802.11n 40 MHz, Port A, 5785 MHz**



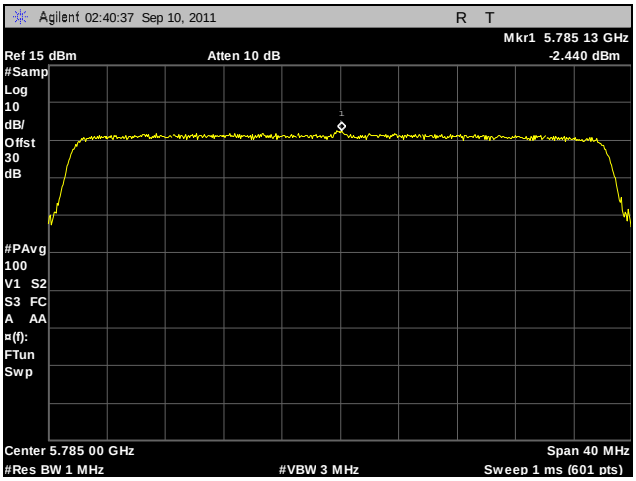

**Plot 77. Peak Spectral Density, 802.11n 40 MHz, Port A, 5795 MHz**

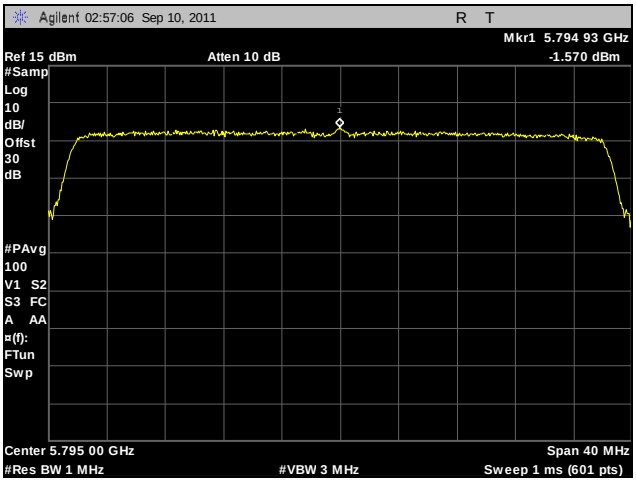
## Peak Power Spectral Density, 802.11n 40 MHz, Port B




**Plot 78. Peak Spectral Density, 802.11n 40 MHz, Port B, 5755 MHz**



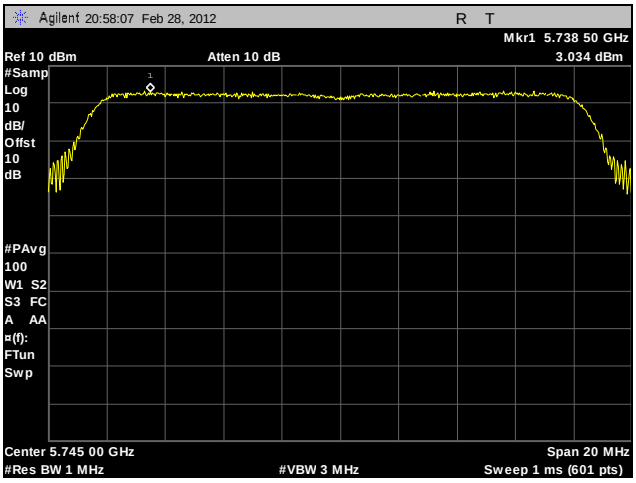

**Plot 79. Peak Spectral Density, 802.11n 40 MHz, Port B, 5785 MHz**



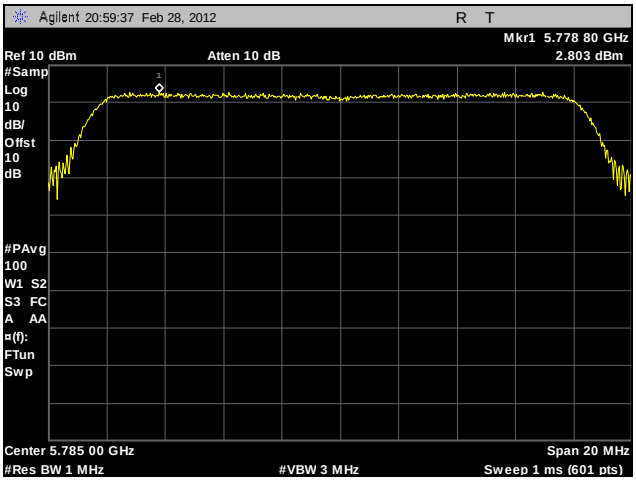

**Plot 80. Peak Spectral Density, 802.11n 40 MHz, Port B, 5795 MHz**

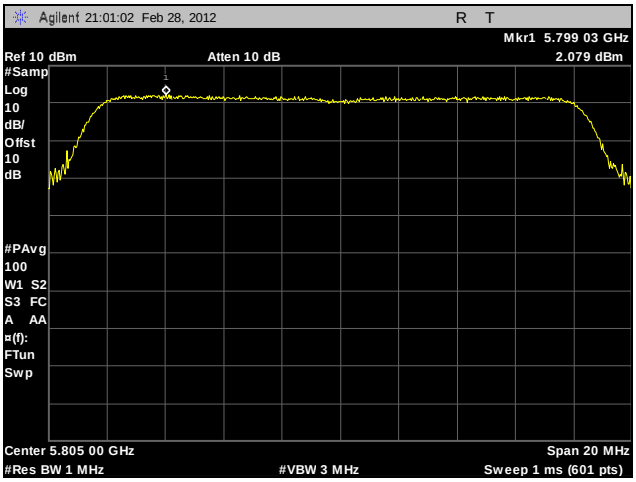
## Peak Power Spectral Density, 802.11a, Sector Antenna




**Plot 81. Peak Spectral Density, 802.11a, 5745 MHz, Sector Antenna**



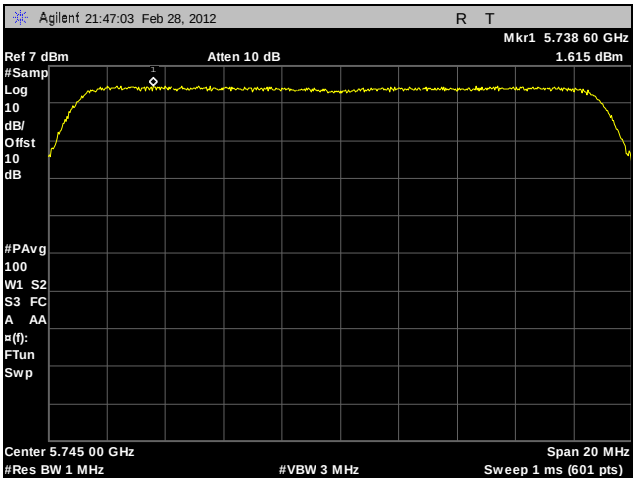

**Plot 82. Peak Spectral Density, 802.11a, 5785 MHz, Sector Antenna**



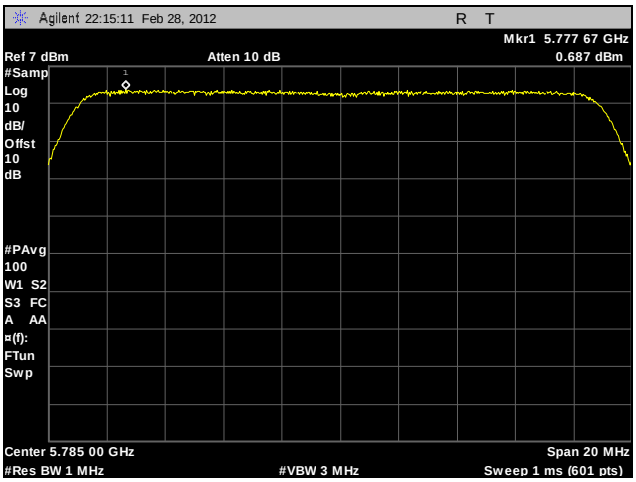

**Plot 83. Peak Spectral Density, 802.11a, 5805 MHz, Sector Antenna**

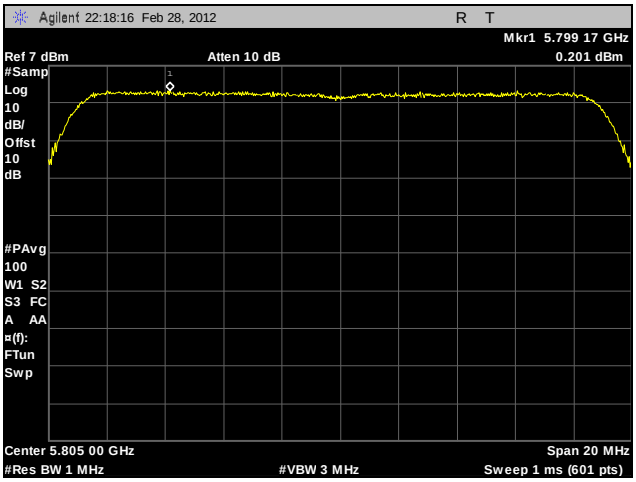
## Peak Power Spectral Density, 802.11n 20 MHz, Port A, Sector Antenna




**Plot 84. Peak Spectral Density, 802.11n 20 MHz, Port A, Sector Antenna, 5745 MHz**



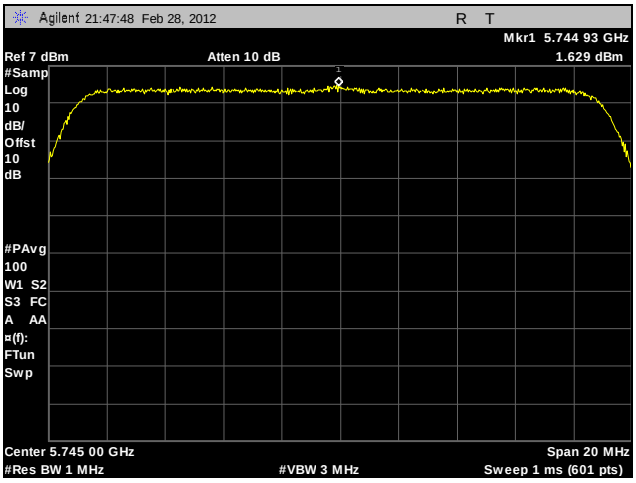

**Plot 85. Peak Spectral Density, 802.11n 20 MHz, Port A, Sector Antenna, 5785 MHz**



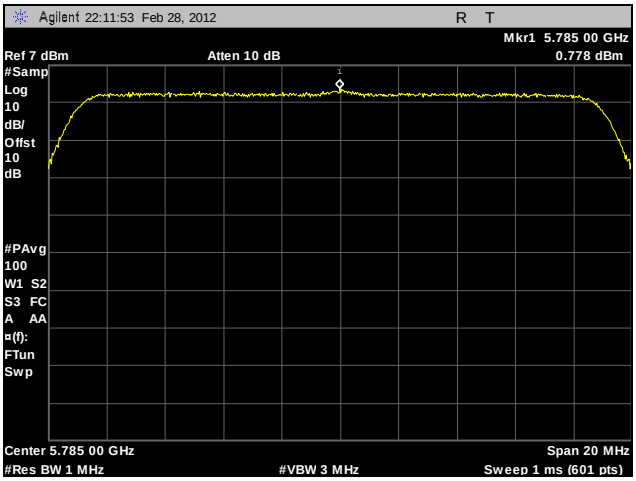

**Plot 86. Peak Spectral Density, 802.11n 20 MHz, Port A, Sector Antenna, 5805 MHz**

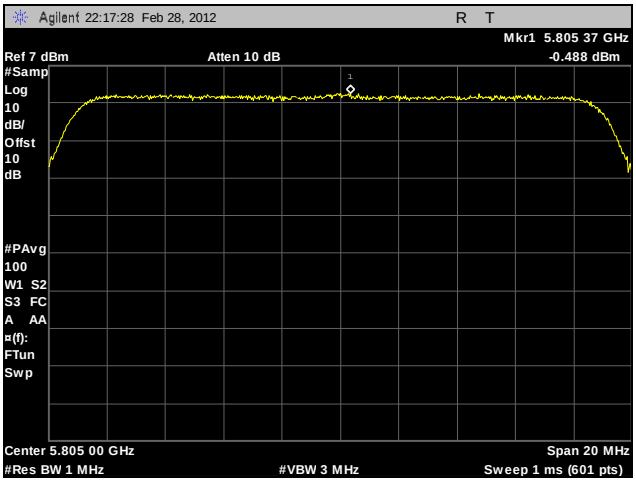
## Peak Power Spectral Density, 802.11n 20 MHz, Port B, Sector Antenna




**Plot 87. Peak Spectral Density, 802.11n 20 MHz, Port B, Sector Antenna, 5745 MHz**



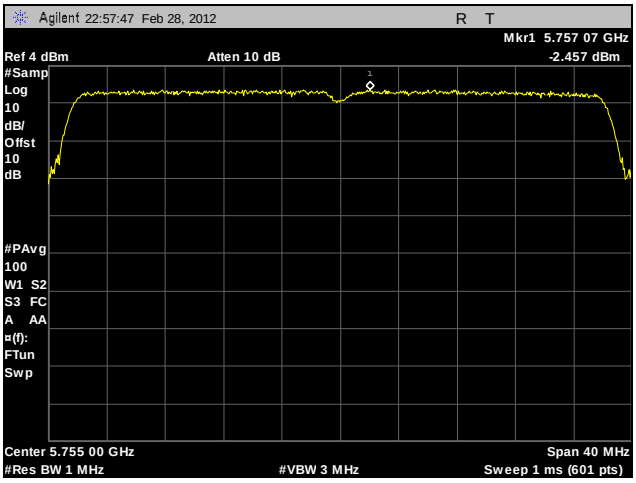

**Plot 88. Peak Spectral Density, 802.11n 20 MHz, Port B, Sector Antenna, 5785 MHz**



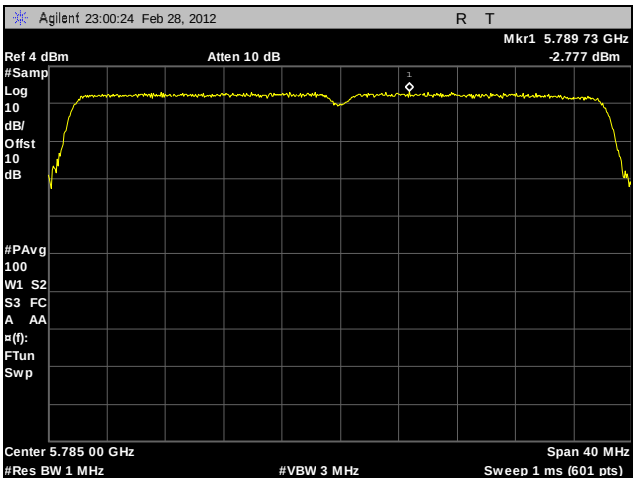

**Plot 89. Peak Spectral Density, 802.11n 20 MHz, Port B, Sector Antenna, 5805 MHz**

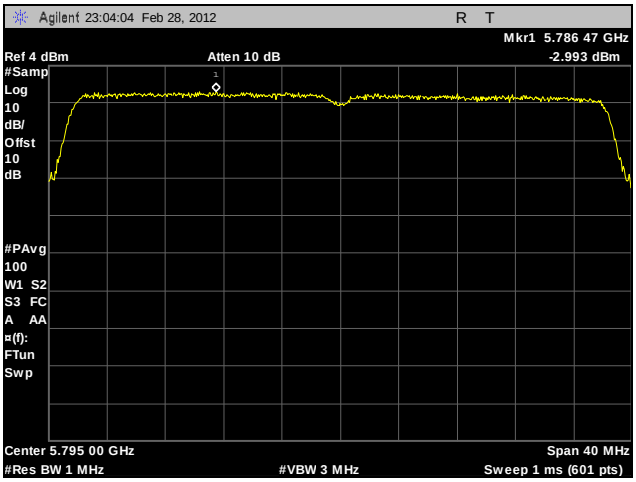
## Peak Power Spectral Density, 802.11n 40 MHz, Port A, Sector Antenna




**Plot 90. Peak Spectral Density, 802.11n 40 MHz, Port A, Sector Antenna, 5755 MHz**



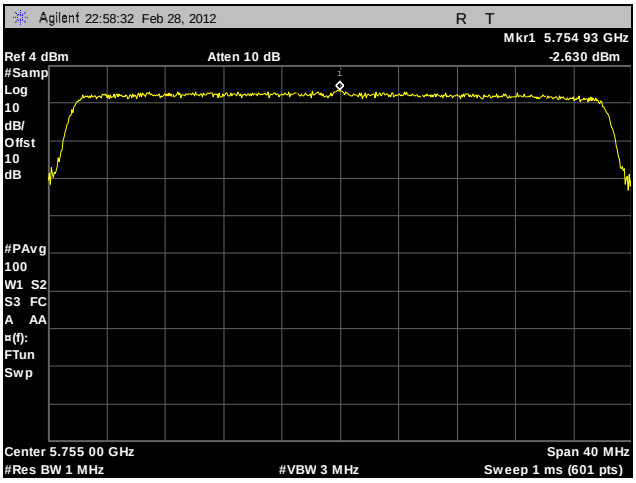

**Plot 91. Peak Spectral Density, 802.11n 40 MHz, Port A, Sector Antenna, 5785 MHz**



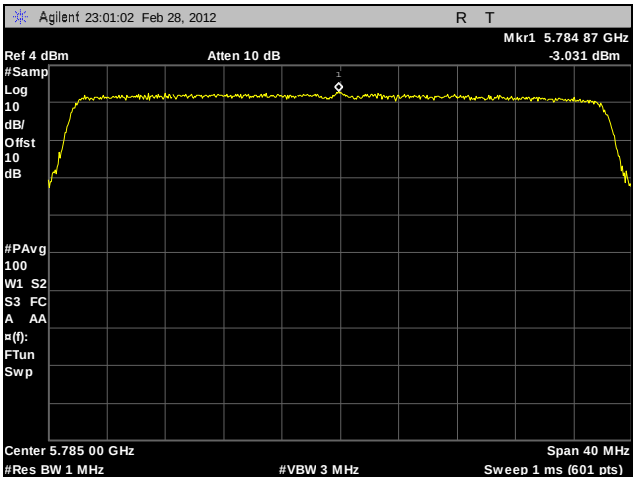

**Plot 92. Peak Spectral Density, 802.11n 40 MHz, Port A, Sector Antenna, 5795 MHz**

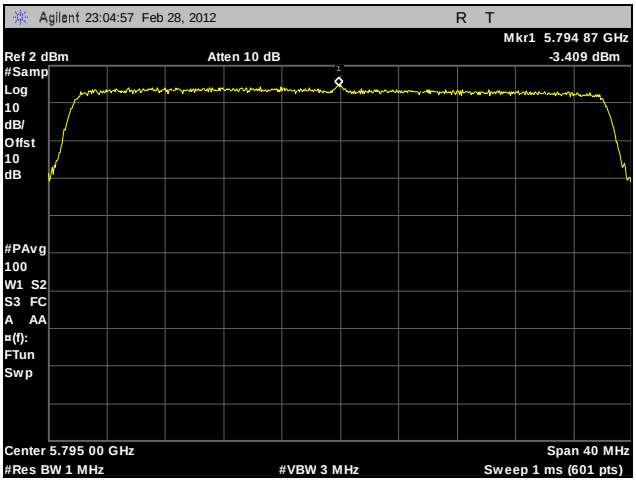
## Peak Power Spectral Density, 802.11n 40 MHz, Port B, Sector Antenna




**Plot 93. Peak Spectral Density, 802.11n 40 MHz, Port B, Sector Antenna, 5755 MHz**




**Plot 94. Peak Spectral Density, 802.11n 40 MHz, Port B, Sector Antenna, 5785 MHz**




**Plot 95. Peak Spectral Density, 802.11n 40 MHz, Port B, Sector Antenna, 5795 MHz**

# Electromagnetic Compatibility Criteria for Intentional Radiators

## § 15.407(a)(6) Peak Excursion Ratio

**Test Requirements:** **§ 15.407(a)(6):** For digitally modulated systems, the peak excursion of the modulation envelope to the peak transmit power shall not exceed 13dB across any 1MHz bandwidth of the emission bandwidth whichever is less.

**Test Procedure:** The method of measurement from 789033 D01 UNII General Test Procedures v01 was used. The EUT was connected directly to the spectrum analyzer through cabling and attenuation. The 1st trace on the spectrum analyzer was set to RBW=1MHz, VBW=3MHz. The peak detector mode was used and the trace max held. The 2nd trace on the spectrum analyzer was set to a RBW=1MHz, VBW=30 KHz. The detector mode was set to sample detector.

The Peak Excursion Ratio was determined from the difference between the maximum found in each trace.

**Test Results:** Equipment complies with the peak excursion ratio limits of **§ 15.407(a)(6).** The peak excursion ratio was determined from plots on the following page(s).

**Test Engineer(s):** Jeff Pratt

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

| Peak Excursion Ration | | | | |
|---|---|---|---|---|
| **Mode** | **Frequency (MHz)** | **Excursion Ratio (dB)** | **Limit (dBm)** | **Margin (dB)** |
| **802.11a** | 5745 | 10.293 | 13 | 2.707 |
| | 5785 | 10.068 | 13 | 2.932 |
| | 5805 | 10.376 | 13 | 2.624 |

**Table 24. Peak Excursion Ration, Test Results, 802.11a**

| Peak Excursion Ration | | | | |
|---|---|---|---|---|
| **Mode** | **Frequency (MHz)** | **Excursion Ratio (dB)** | **Limit (dBm)** | **Margin (dB)** |
| **802.11n 20 MHz Port A** | 5745 | 10.304 | 13 | 2.696 |
| | 5785 | 10.083 | 13 | 2.917 |
| | 5805 | 10.229 | 13 | 2.771 |
| **802.11n 20 MHz Port B** | 5745 | 9.979 | 13 | 3.021 |
| | 5785 | 10.634 | 13 | 2.366 |
| | 5805 | 10.371 | 13 | 2.629 |

**Table 25. Peak Excursion Ration, Test Results, 802.11n 20 MHz**

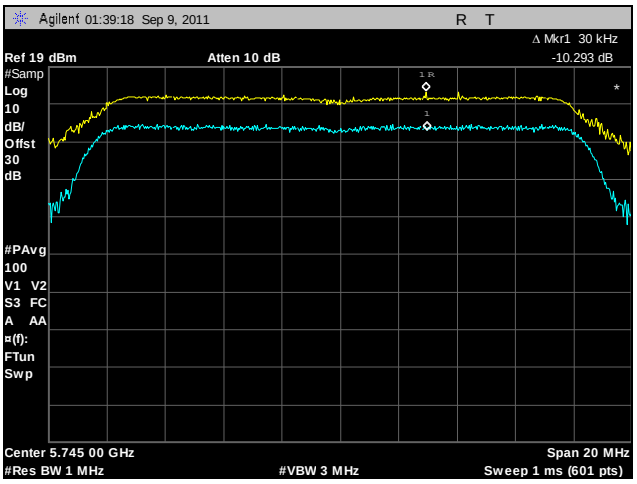
  

| Peak Excursion Ration | | | | |
|---|---|---|---|---|
| **Mode** | **Frequency (MHz)** | **Excursion Ratio (dBm)** | **Limit (dBm)** | **Margin (dB)** |
| **802.11n 40 MHz Port A** | 5755 | 10.440 | 13 | 2.560 |
| | 5785 | 10.375 | 13 | 2.625 |
| | 5795 | 10.490 | 13 | 2.510 |
| **802.11n 40 MHz Port B** | 5755 | 9.756 | 13 | 3.244 |
| | 5785 | 10.622 | 13 | 2.378 |
| | 5795 | 10.728 | 13 | 2.272 |

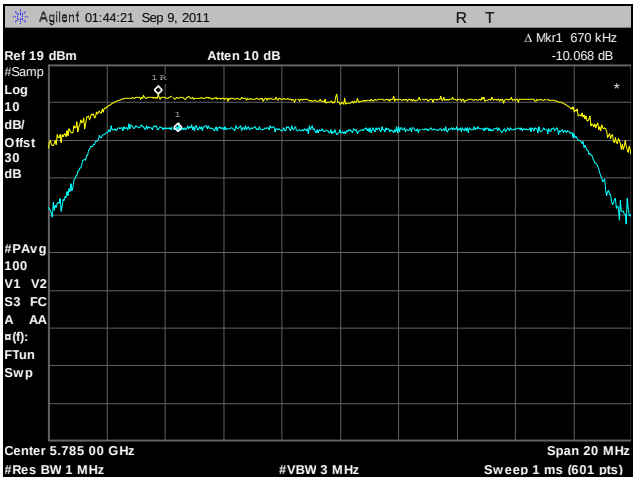
**Table 26. Peak Excursion Ration, Test Results, 802.11n 40 MHz**

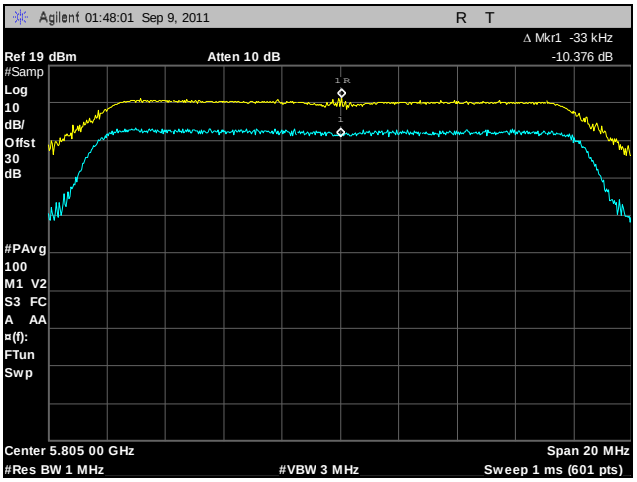
## Peak Excursion Ratio, 802.11a




**Plot 96. Peak Excursion, 802.11a, 5745 MHz**



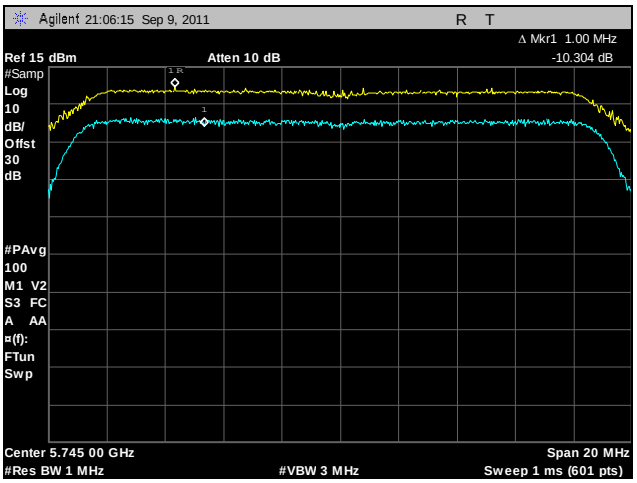

**Plot 97. Peak Excursion, 802.11a, 5785 MHz**



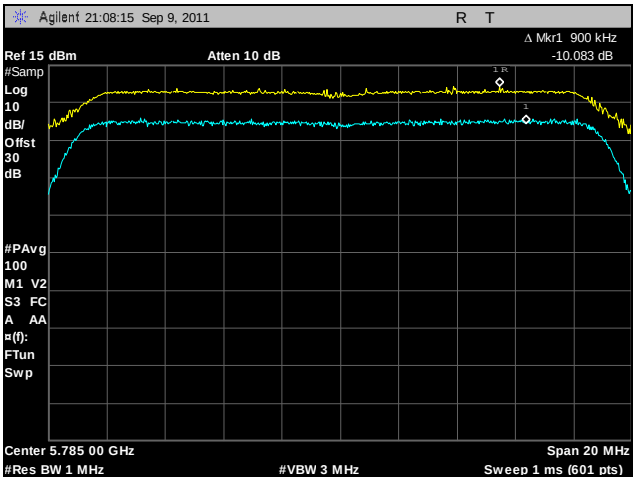

**Plot 98. Peak Excursion, 802.11a, 5805 MHz**

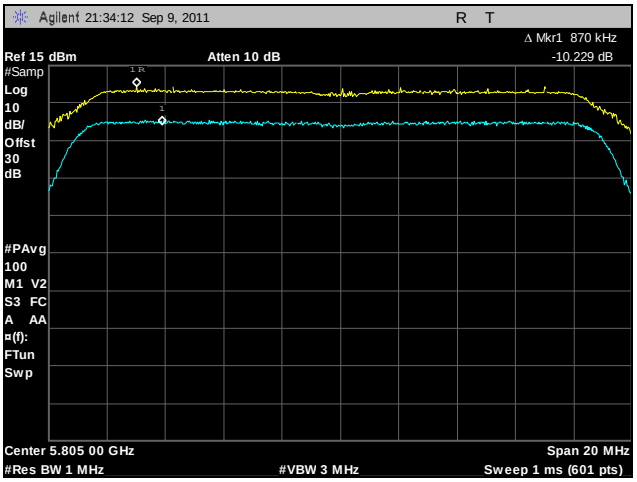
## Peak Excursion Ratio, 802.11n 20 MHz, Port A




**Plot 99. Peak Excursion, 802.11n 20 MHz, Port A, 5745 MHz**



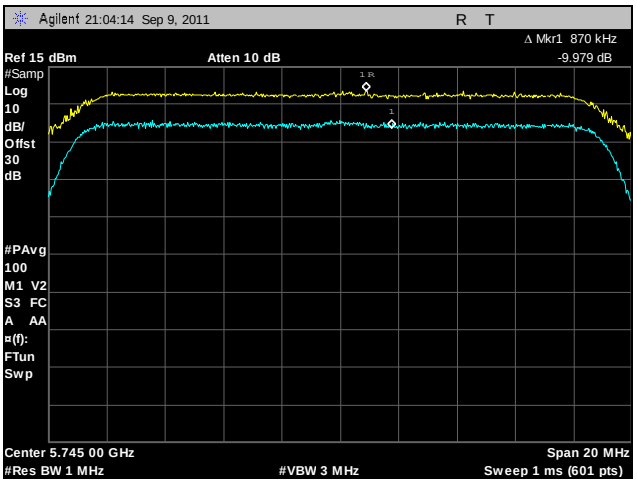

**Plot 100. Peak Excursion, 802.11n 20 MHz, Port A, 5785 MHz**



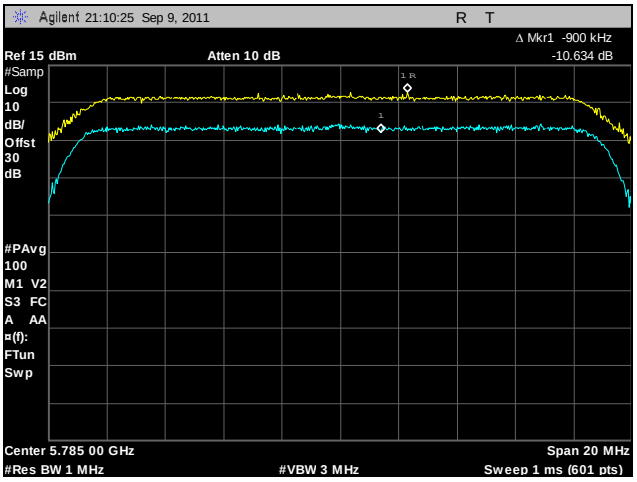

**Plot 101. Peak Excursion, 802.11n 20 MHz, Port A, 5805 MHz**

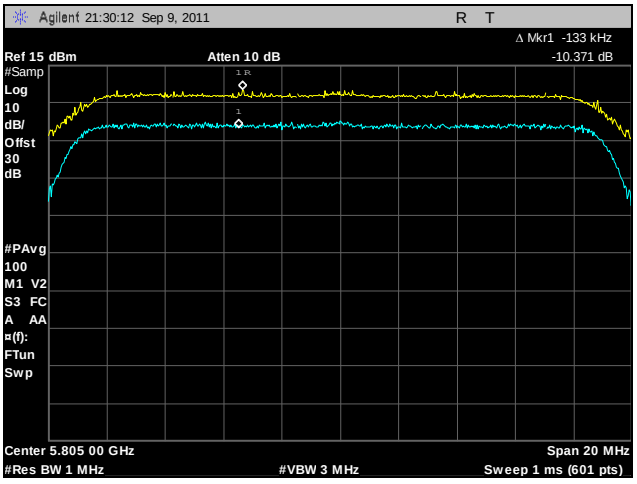
## Peak Excursion Ratio, 802.11n 20 MHz, Port B




**Plot 102. Peak Excursion, 802.11n 20 MHz, Port B, 5745 MHz**



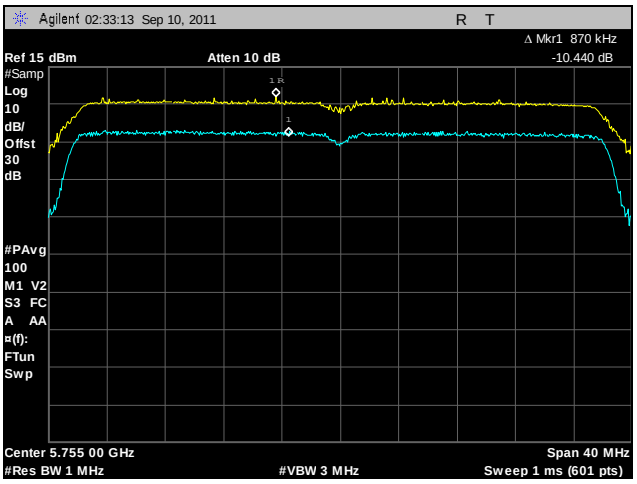

**Plot 103. Peak Excursion, 802.11n 20 MHz, Port B, 5785 MHz**



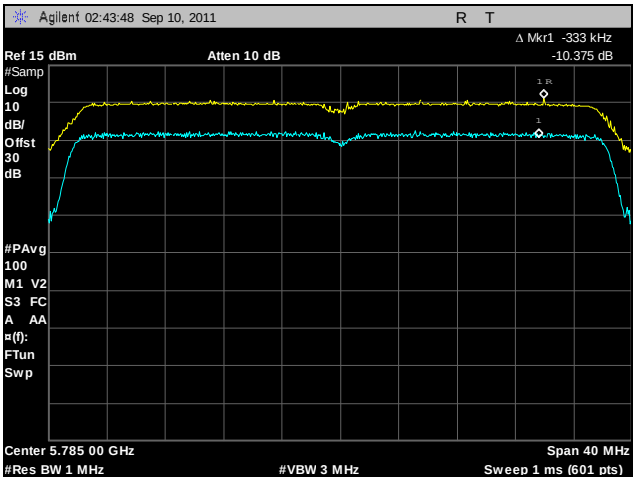

**Plot 104. Peak Excursion, 802.11n 20 MHz, Port B, 5805 MHz**

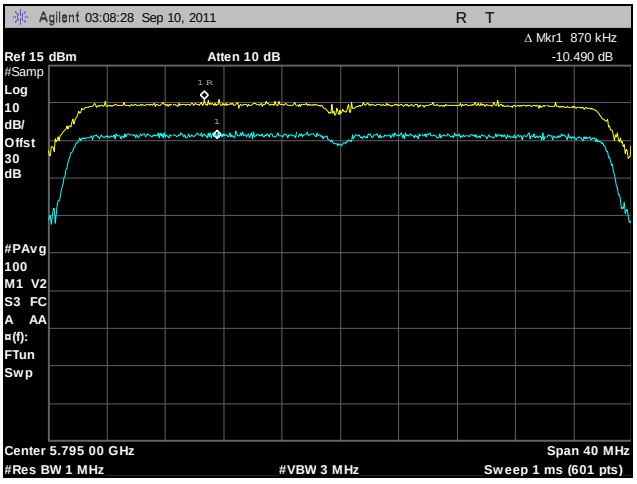
## Peak Excursion Ratio, 802.11n 40 MHz, Port A




**Plot 105. Peak Excursion, 802.11n 40 MHz, Port A, 5755 MHz**



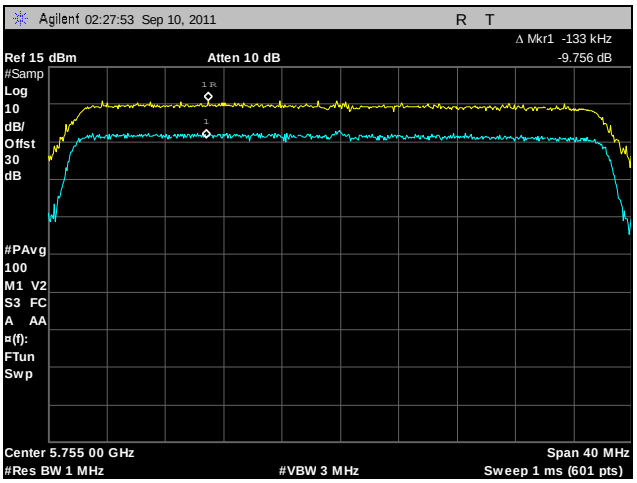

**Plot 106. Peak Excursion, 802.11n 40 MHz, Port A, 5785 MHz**



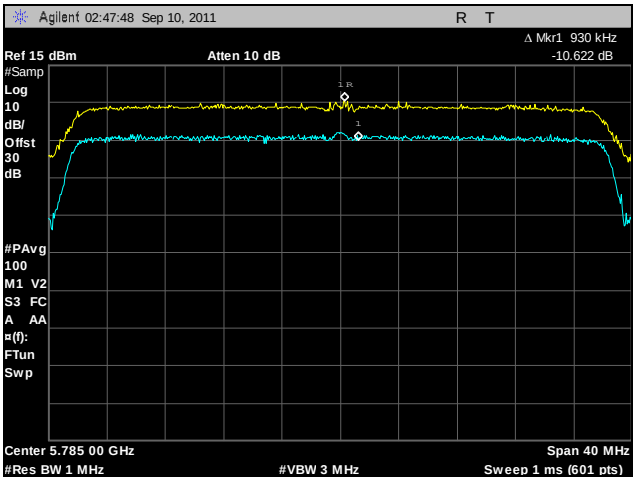

**Plot 107. Peak Excursion, 802.11n 40 MHz, Port A, 5795 MHz**

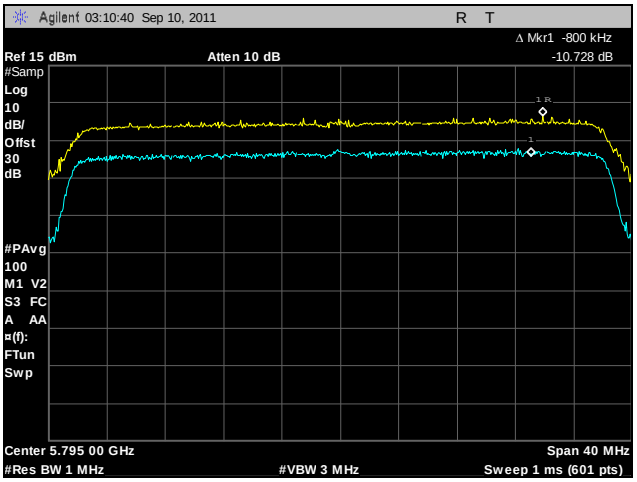
## Peak Excursion Ratio, 802.11n 40 MHz, Port B




**Plot 108. Peak Excursion, 802.11n 40 MHz, Port B, 5755 MHz**




**Plot 109. Peak Excursion, 802.11n 40 MHz, Port B, 5785 MHz**




**Plot 110. Peak Excursion, 802.11n 40 MHz, Port B, 5795 MHz**

# Electromagnetic Compatibility Criteria for Intentional Radiators

## § 15.407(b)(1),(2), (5), (6) Undesirable Emissions

**Test Requirements:** **§ 15.407(b)(1),(2), (5), (6)**; **§15.205:** Emissions outside the frequency band.

**§ 15.407(b)(1):** In any 1MHz bandwidth outside the frequency band 5.15-5.25GHz in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power shall not exceed -27dBm.

**§ 15.407(b)(2):** In any 1MHz bandwidth outside the frequency band 5.25-5.35GHz in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power shall not exceed -27dBm.

**§ 15.407(b)(6):** Radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a).

**§15.205(a):** Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

| MHz | MHz | MHz | GHz |
|---|---|---|---|
| 0.090–0.110---------- | 16.42–16.423 | 399.9–410 | 4.5–5.15 |
| [1] 0.495–0.505---------- | 16.69475–16.69525 | 608–614 | 5.35–5.46 |
| 2.1735–2.1905---------- | 16.80425–16.80475 | 960–1240 | 7.25–7.75 |
| 4.125–4.128---------- | 25.5–25.67 | 1300–1427 | 8.025–8.5 |
| 4.17725–4.17775---------- | 37.5–38.25 | 1435–1626.5 | 9.0–9.2 |
| 4.20725–4.20775---------- | 73–74.6 | 1645.5–1646.5 | 9.3–9.5 |
| 6.215–6.218---------- | 74.8–75.2 | 1660–1710 | 10.6–12.7 |
| 6.26775–6.26825---------- | 108–121.94 | 1718.8–1722.2 | 13.25–13.4 |
| 6.31175–6.31225---------- | 123–138 | 2200–2300 | 14.47–14.5 |
| 8.291–8.294---------- | 149.9–150.05 | 2310–2390 | 15.35–16.2 |
| 8.362–8.366---------- | 156.52475–156.52525 | 2483.5–2500 | 17.7–21.4 |
| 8.37625–8.38675---------- | 156.7–156.9 | 2655–2900 | 22.01–23.12 |
| 8.41425–8.41475---------- | 162.0125–167.17 | 3260–3267 | 23.6–24.0 |
| 12.29–12.293---------- | 167.72–173.2 | 3332–3339 | 31.2–31.8 |
| 12.51975–12.52025---------- | 240–285 | 3345.8–3358 36. | 43–36.5 |
| 12.57675–12.57725---------- | 322–335.4 | 3600–4400 | ([2]) |

**Table 27. Restricted Bands of Operation**

**Test Procedure:** The EUT was placed on a 0.8m acrylic table inside a semi-anechoic chamber. The transmitter was set to transmit on low, mid, and high channels. The table was rotated 360 degrees and the height of the receiving antenna was varied between 1m and 4m to maximize spurious emissions.

For frequencies between 30 MHz and 1 GHz, a peak detector was used with a resolution bandwidth of 100 kHz. For frequencies above 1 GHz, an average detector was used with a resolution bandwidth of 1 MHz. Measurements were made on frequencies up to 40 GHz. When emissions were found within restricted bands, their field strength was measured to determine compliance with the 15.209 limit.

The equation EIRP= E + 20 log D – 104.77 was used to convert between field strength and equivalent isotropic radiated power (EIRP), where E is the measured field strength in dBuV/m and d was the measurement distance in meters.

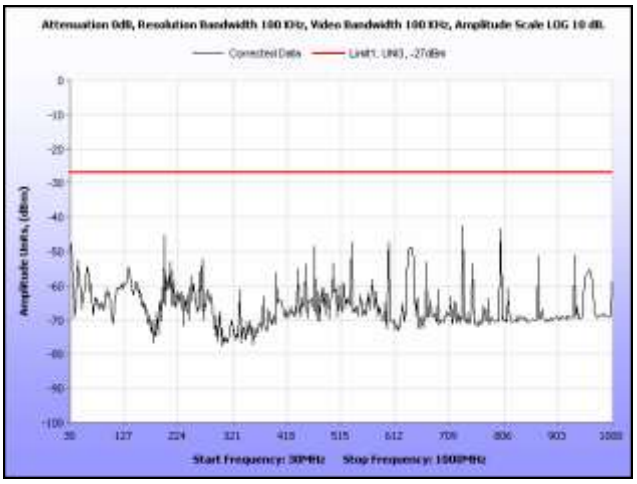
**Test Results:** The EUT was found compliant with the requirement(s) of this section. Measured emissions were below applicable limits.

**Test Engineer(s):** Jeff Pratt

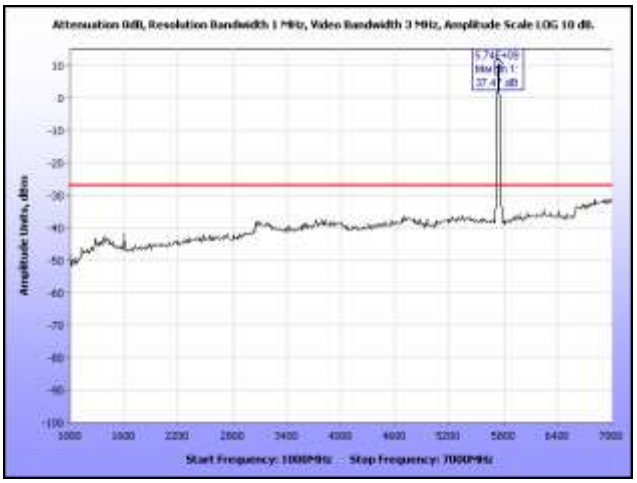
**Test Date(s):** 10/1/11

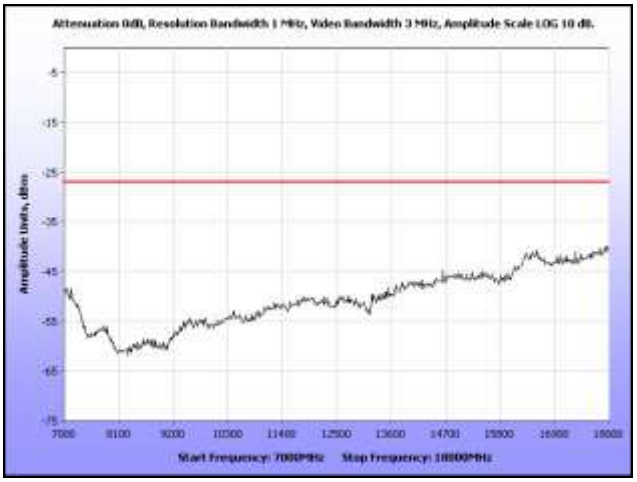
## Radiated Spurious Emissions Limits, 802.11a, Omni Antenna




**Plot 111. Radiated Spurious, 802.11a, 5745 MHz, 30 MHz – 1 GHz, Omni Antenna**

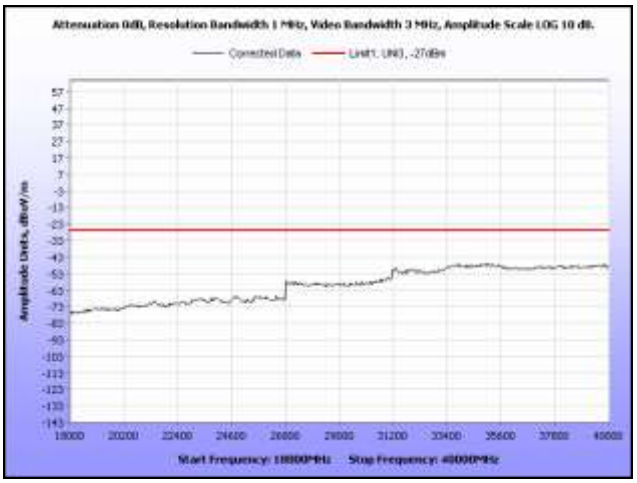



**Plot 112. Radiated Spurious, 802.11a, 5745 MHz, 1 GHz – 7 GHz, Omni Antenna**

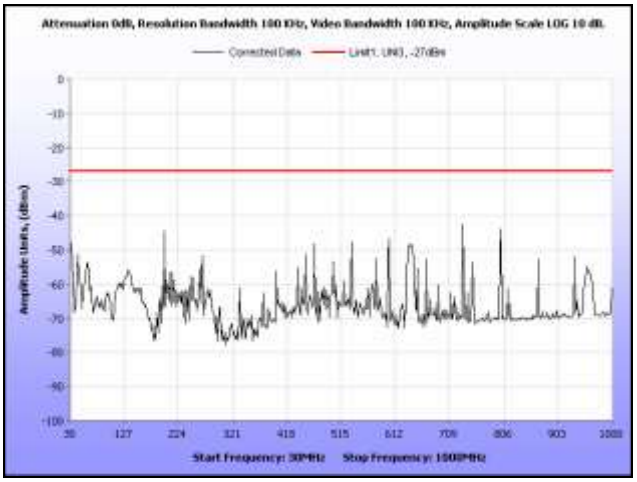



**Plot 113. Radiated Spurious, 802.11a, 5745 MHz, 7 GHz – 18 GHz, Omni Antenna**

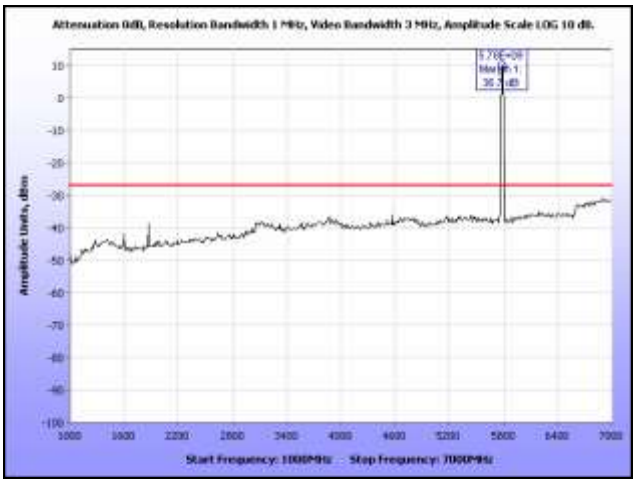
  




**Plot 114. Radiated Spurious, 802.11a, 5745 MHz, 18 GHz – 40 GHz, Omni Antenna**

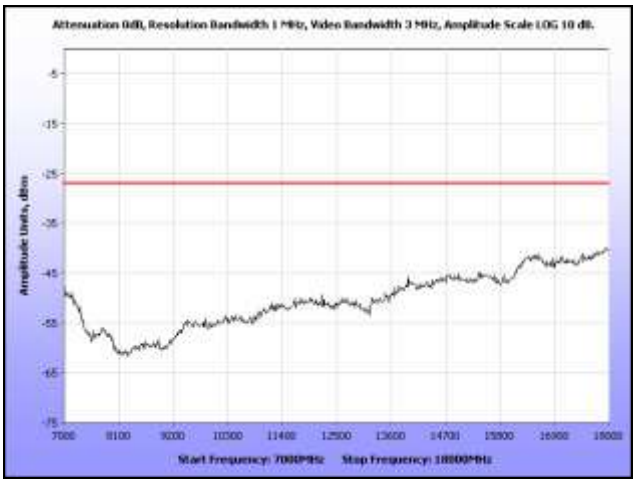



**Plot 115. Radiated Spurious, 802.11a, 5785 MHz, 30 MHz – 1 GHz, Omni Antenna**

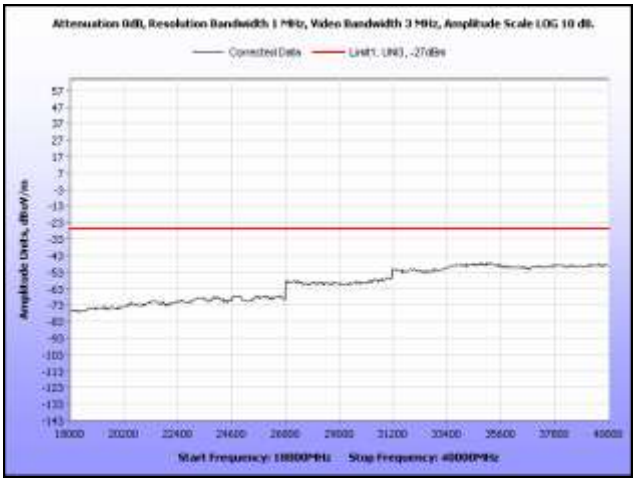



**Plot 116. Radiated Spurious, 802.11a, 5785 MHz, 1 GHz – 7 GHz, Omni Antenna**

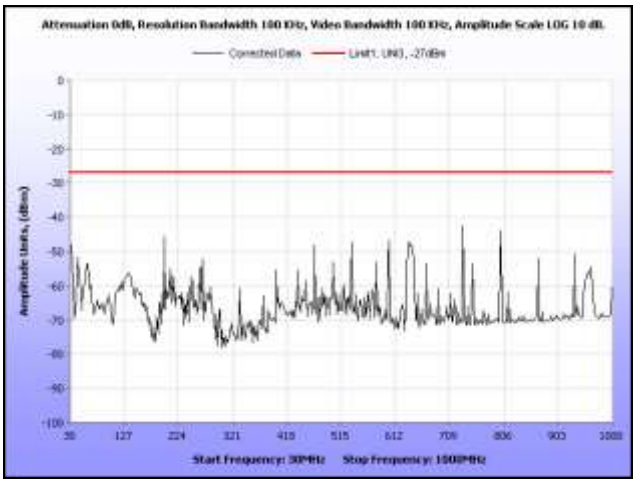
  




**Plot 117. Radiated Spurious, 802.11a, 5785 MHz, 7 GHz – 18 GHz, Omni Antenna**

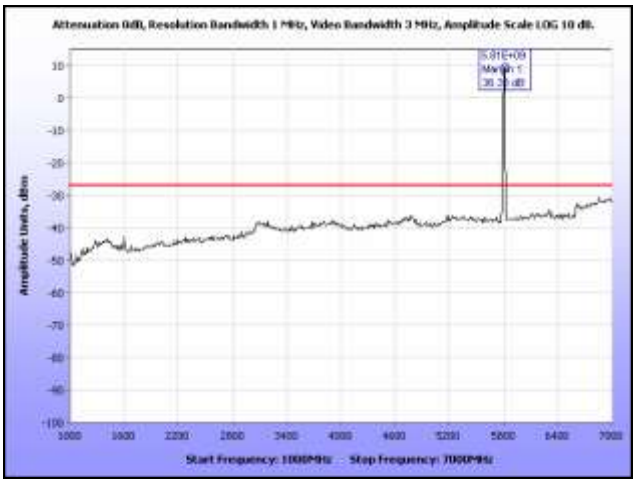



**Plot 118. Radiated Spurious, 802.11a, 5785 MHz, 18 GHz – 40 GHz, Omni Antenna**

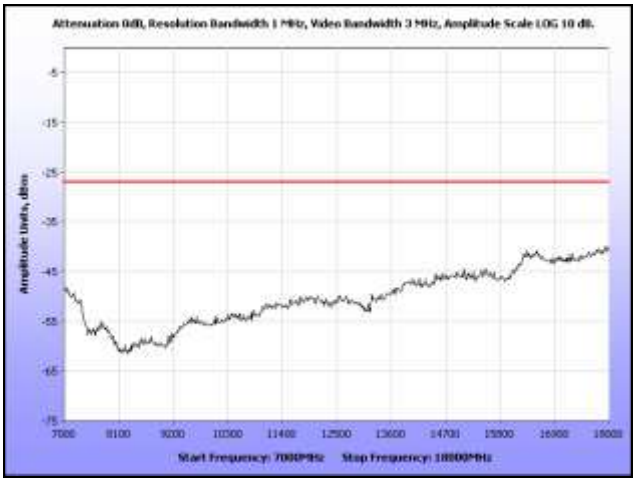



**Plot 119. Radiated Spurious, 802.11a, 5805 MHz, 30 MHz – 1 GHz, Omni Antenna**

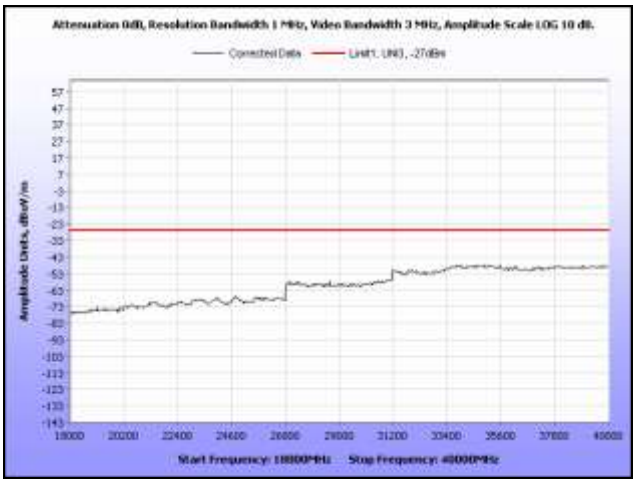
  




**Plot 120. Radiated Spurious, 802.11a, 5805 MHz, 1 GHz – 7 GHz, Omni Antenna**



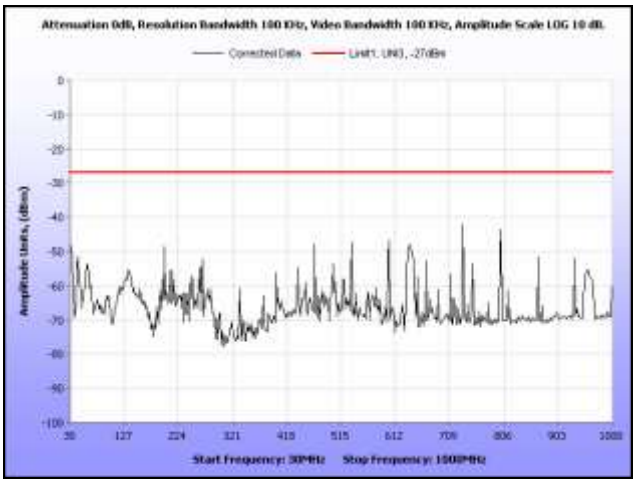

**Plot 121. Radiated Spurious, 802.11a, 5805 MHz, 7 GHz – 18 GHz, Omni Antenna**



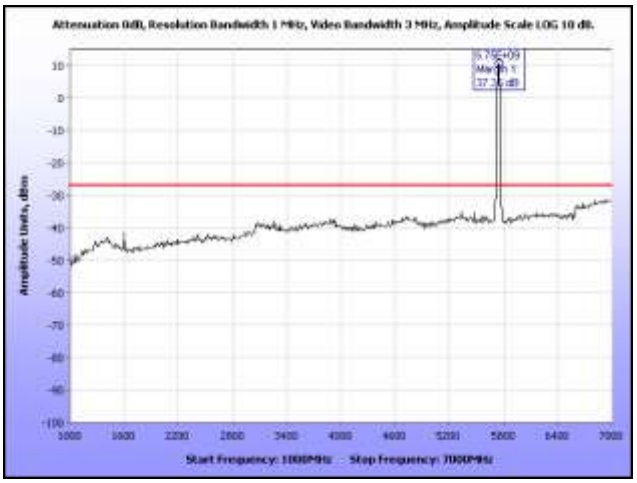

**Plot 122. Radiated Spurious, 802.11a, 5805 MHz, 18 GHz – 40 GHz, Omni Antenna**

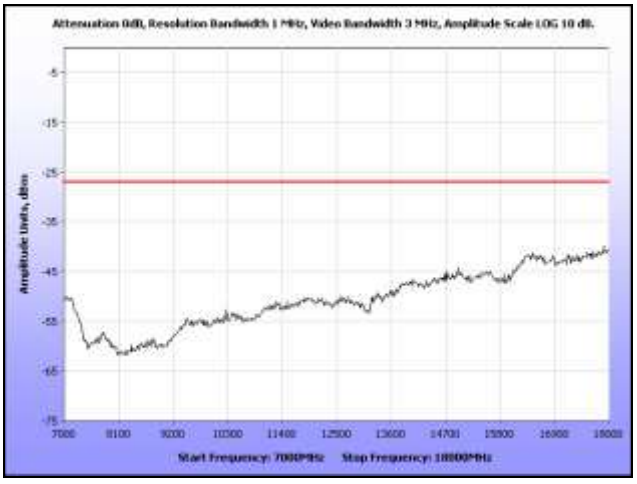
## Radiated Spurious Emissions Limits, 802.11n 20 MHz, Omni Antenna




**Plot 123. Radiated Spurious, 802.11n 20 MHz, 5745 MHz, 30 MHz – 1 GHz, Omni Antenna**

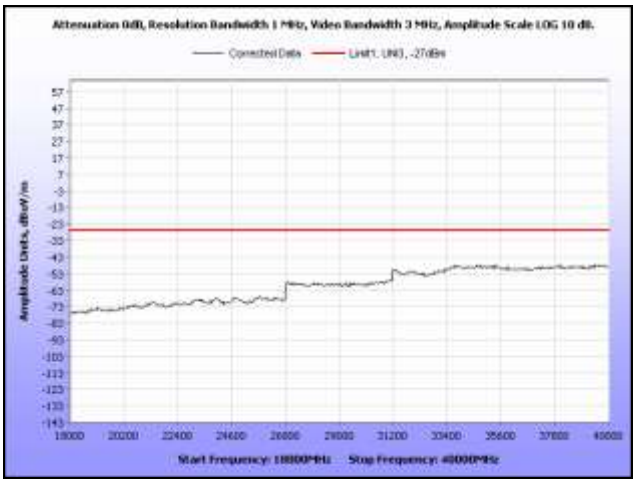



**Plot 124. Radiated Spurious, 802.11n 20 MHz, 5745 MHz, 1 GHz – 7 GHz, Omni Antenna**

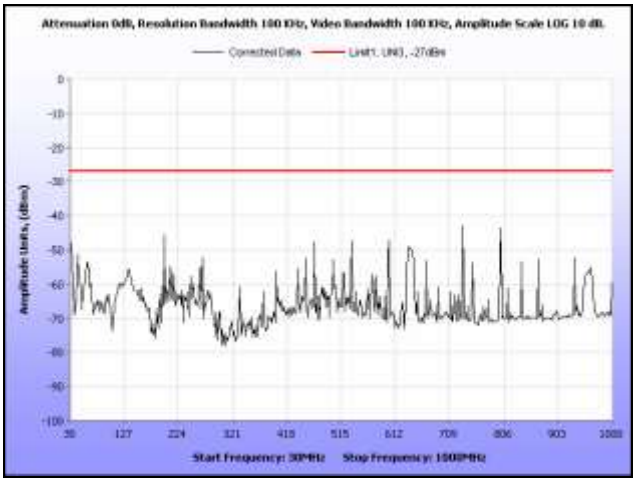



**Plot 125. Radiated Spurious, 802.11n 20 MHz, 5745 MHz, 7 GHz – 18 GHz, Omni Antenna**

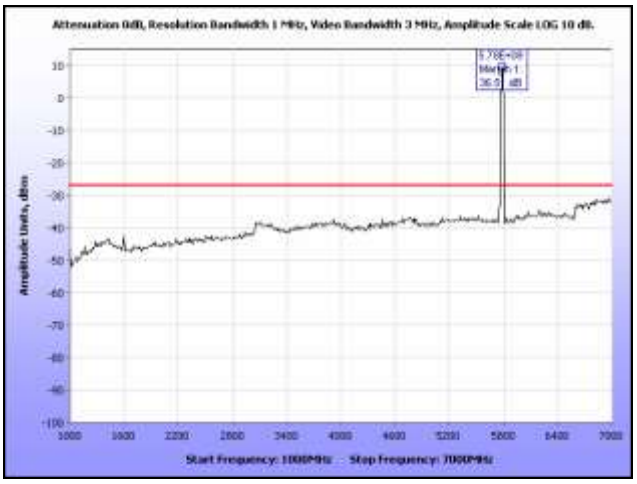
  




**Plot 126. Radiated Spurious, 802.11n 20 MHz, 5745 MHz, 18 GHz – 40 GHz, Omni Antenna**

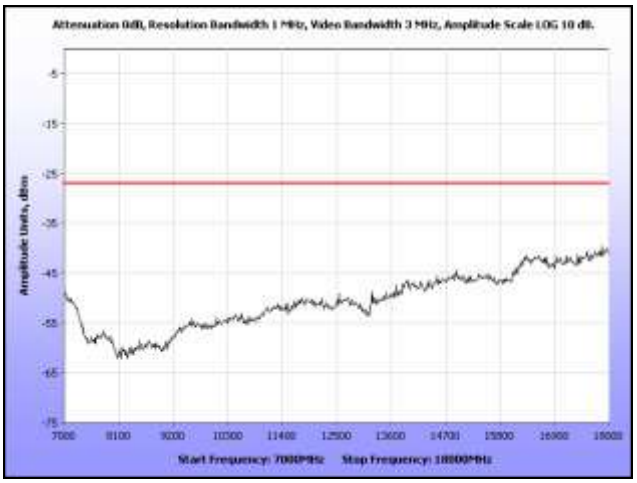



**Plot 127. Radiated Spurious, 802.11n 20 MHz, 5785 MHz, 30 MHz – 1 GHz, Omni Antenna**

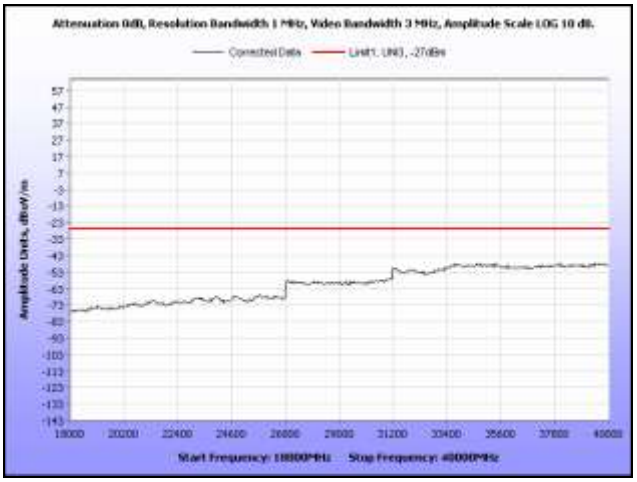



**Plot 128. Radiated Spurious, 802.11n 20 MHz, 5785 MHz, 1 GHz – 7 GHz, Omni Antenna**

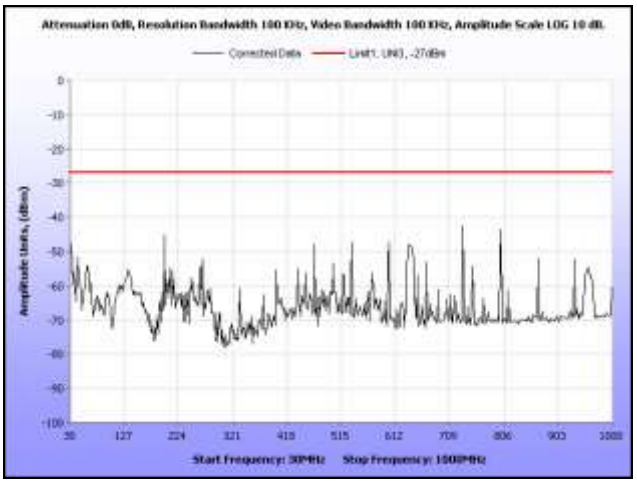
  




**Plot 129. Radiated Spurious, 802.11n 20 MHz, 5785 MHz, 7 GHz – 18 GHz, Omni Antenna**

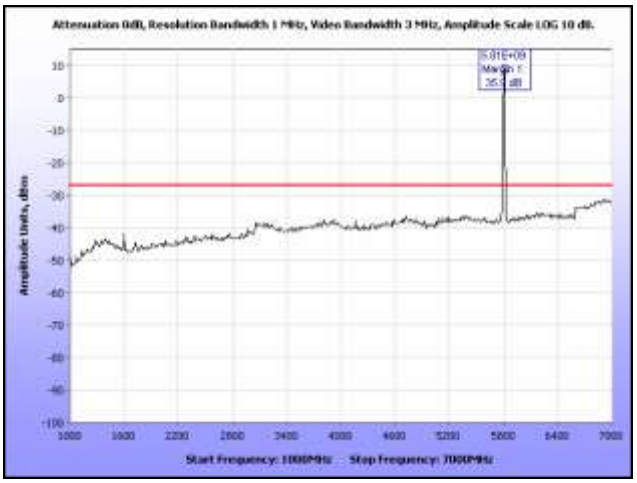



**Plot 130. Radiated Spurious, 802.11n 20 MHz, 5785 MHz, 18 GHz – 40 GHz, Omni Antenna**

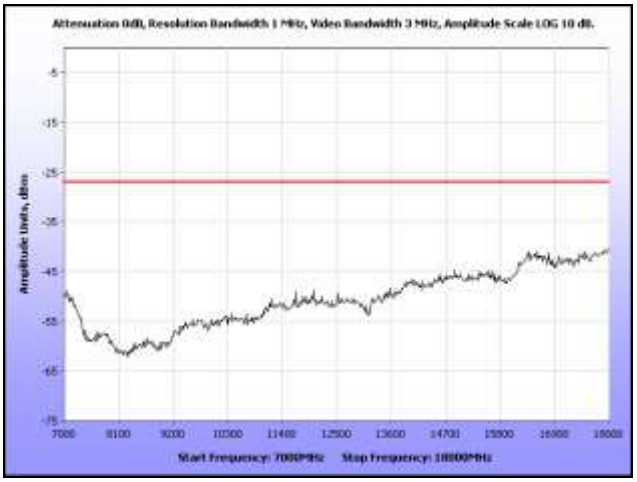



**Plot 131. Radiated Spurious, 802.11n 20 MHz, 5805 MHz, 30 MHz – 1 GHz, Omni Antenna**




**Plot 132. Radiated Spurious, 802.11n 20 MHz, 5805 MHz, 1 GHz – 7 GHz, Omni Antenna**

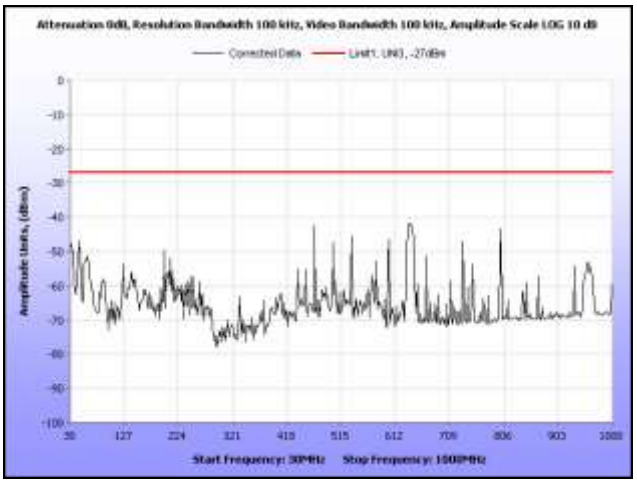



**Plot 133. Radiated Spurious, 802.11n 20 MHz, 5805 MHz, 7 GHz – 18 GHz, Omni Antenna**

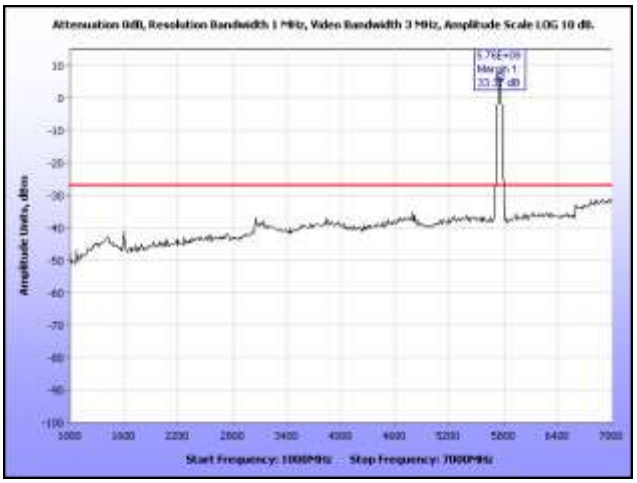

**Plot 134. Radiated Spurious, 802.11n 20 MHz, 5805 MHz, 18 GHz – 40 GHz, Omni Antenna**

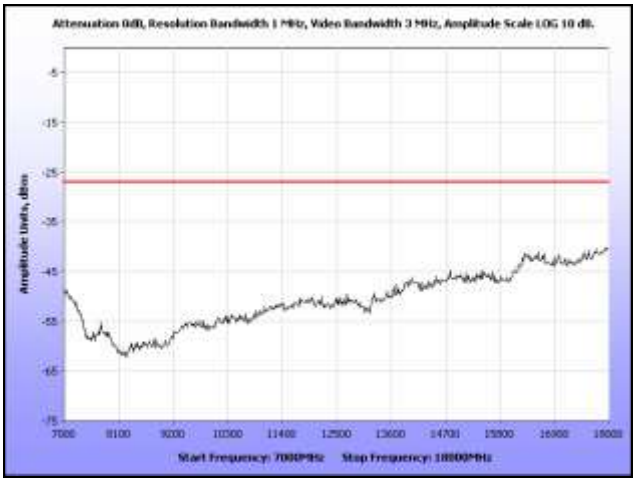
## Radiated Spurious Emissions Limits, 802.11n 40 MHz, Omni Antenna




**Plot 135. Radiated Spurious, 802.11n 40 MHz, 5755 MHz, 30 MHz – 1 GHz, Omni Antenna**

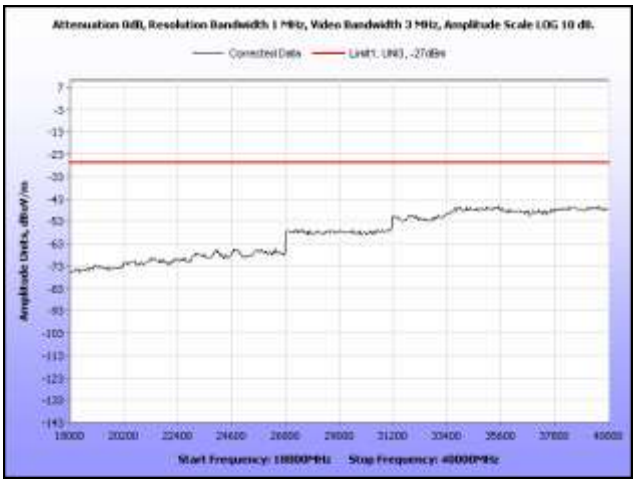



**Plot 136. Radiated Spurious, 802.11n 40 MHz, 5755 MHz, 1 GHz – 7 GHz, Omni Antenna**

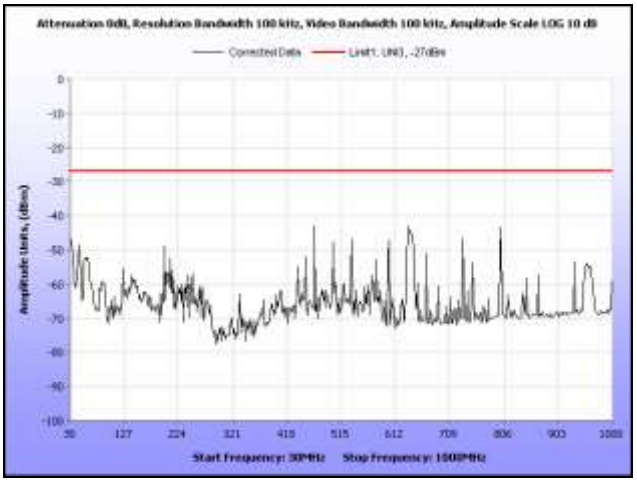



**Plot 137. Radiated Spurious, 802.11n 40 MHz, 5755 MHz, 7 GHz – 18 GHz, Omni Antenna**

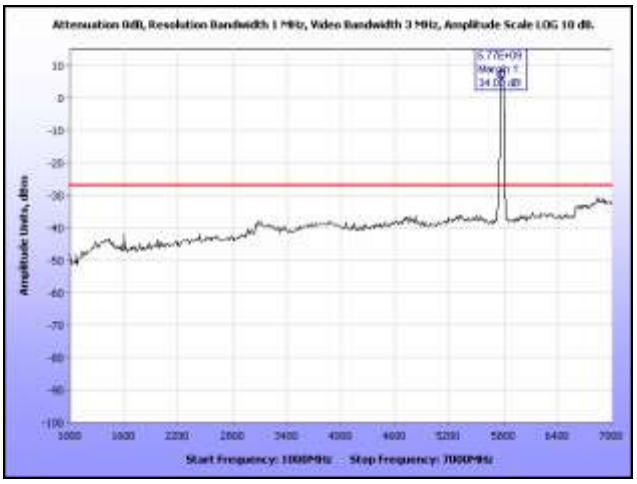
  




**Plot 138. Radiated Spurious, 802.11n 40 MHz, 5755 MHz, 18 GHz – 40 GHz, Omni Antenna**

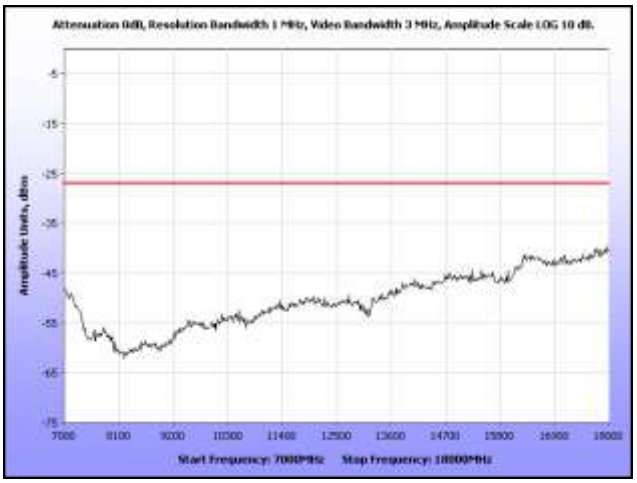



**Plot 139. Radiated Spurious, 802.11n 40 MHz, 5785 MHz, 30 MHz – 1 GHz, Omni Antenna**

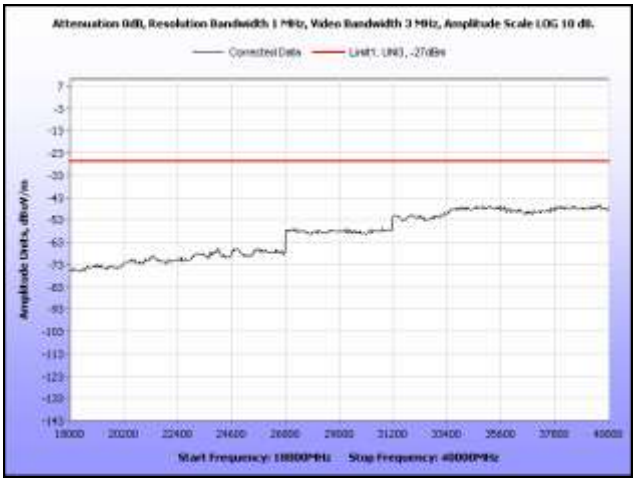



**Plot 140. Radiated Spurious, 802.11n 40 MHz, 5785 MHz, 1 GHz – 7 GHz, Omni Antenna**

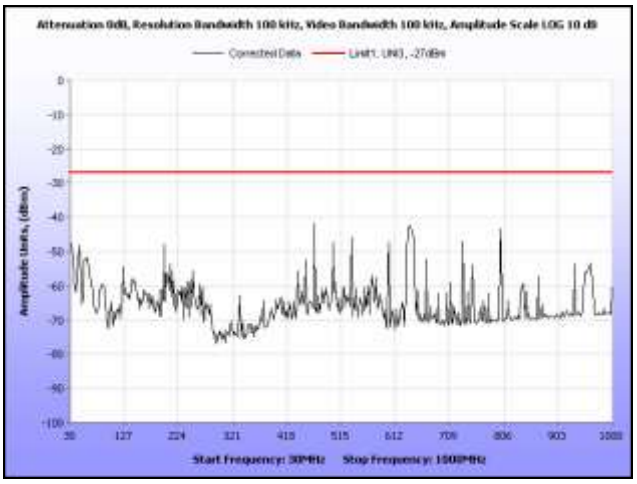
  




**Plot 141. Radiated Spurious, 802.11n 40 MHz, 5785 MHz, 7 GHz – 18 GHz, Omni Antenna**

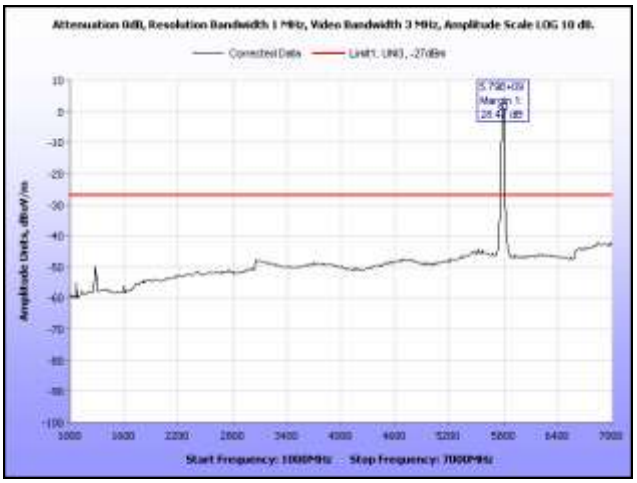



**Plot 142. Radiated Spurious, 802.11n 40 MHz, 5785 MHz, 18 GHz – 40 GHz, Omni Antenna**

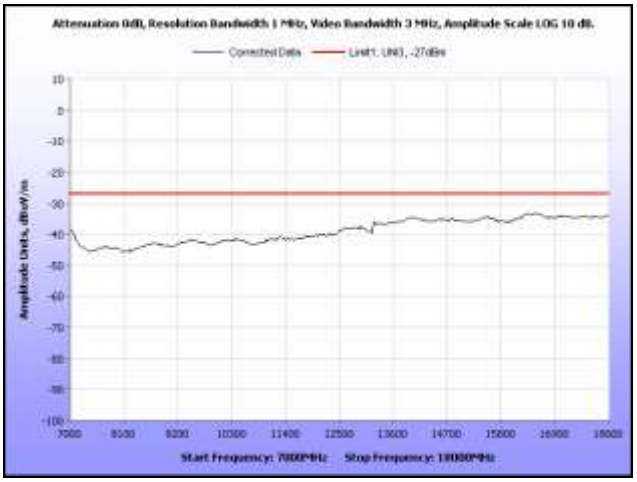



**Plot 143. Radiated Spurious, 802.11n 40 MHz, 5795 MHz, 30 MHz – 1 GHz, Omni Antenna**

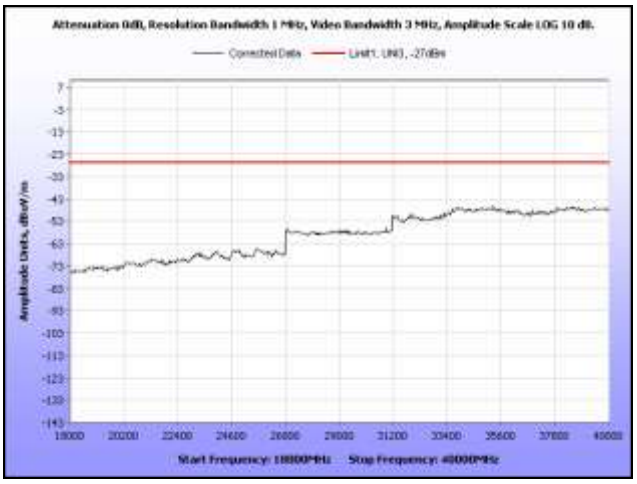
  




**Plot 144. Radiated Spurious, 802.11n 40 MHz, 5795 MHz, 1 GHz – 7 GHz, Omni Antenna**



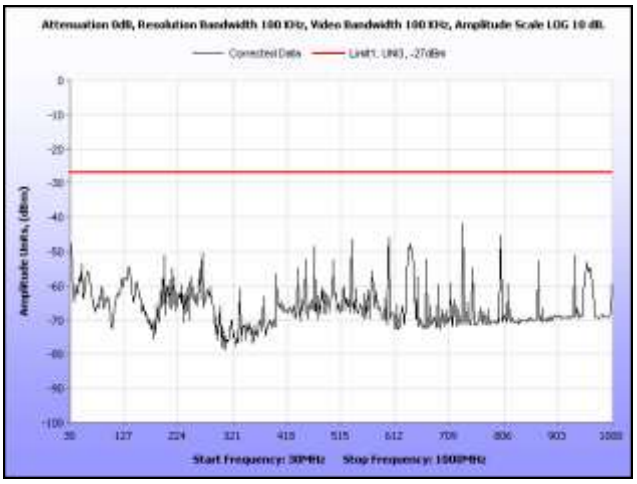

**Plot 145. Radiated Spurious, 802.11n 40 MHz, 5795 MHz, 7 GHz – 18 GHz, Omni Antenna**



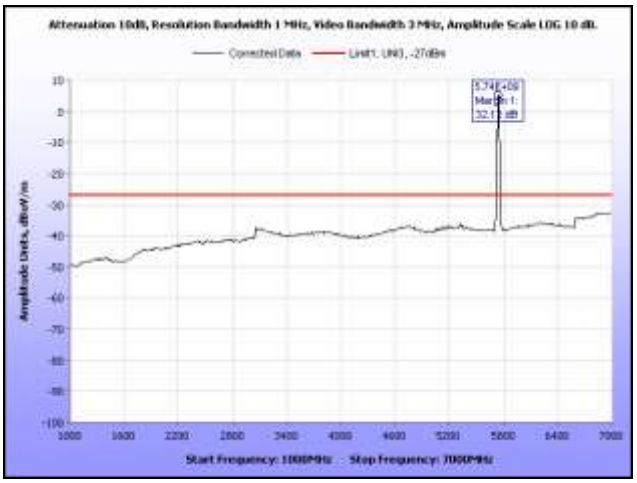

**Plot 146. Radiated Spurious, 802.11n 40 MHz, 5795 MHz, 18 GHz – 40 GHz, Omni Antenna**

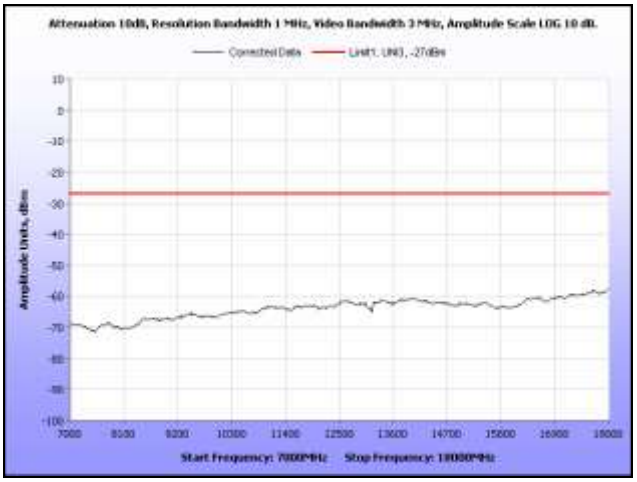
## Radiated Spurious Emissions Limits, 802.11a, Sector Antenna




**Plot 147. Radiated Spurious, 802.11a, 5745 MHz, 30 MHz – 1 GHz, Sector Antenna**

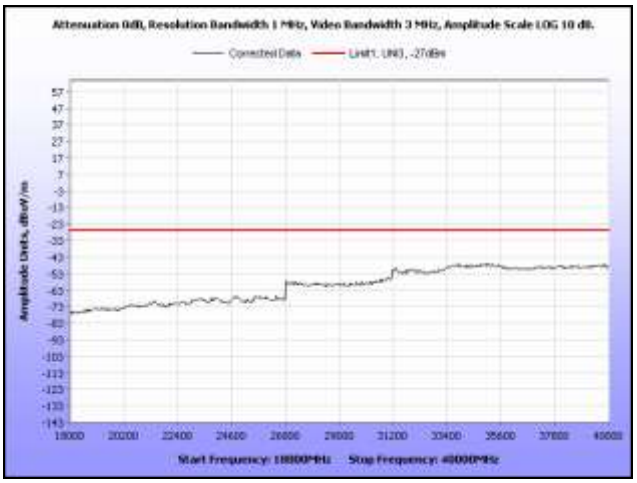



**Plot 148. Radiated Spurious, 802.11a, 5745 MHz, 1 GHz – 7 GHz, Sector Antenna**

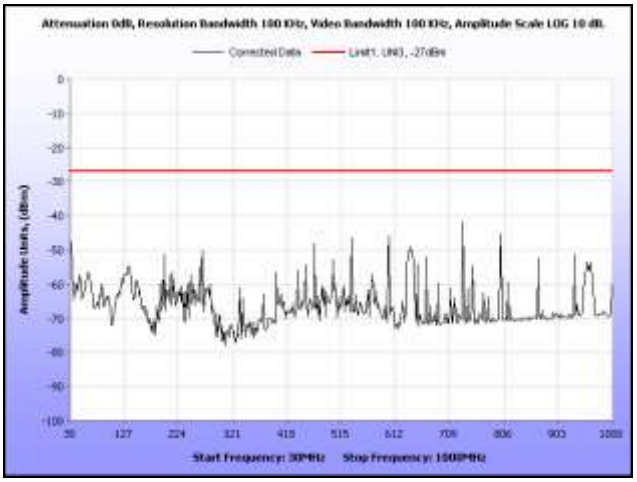



**Plot 149. Radiated Spurious, 802.11a, 5745 MHz, 7 GHz – 18 GHz, Sector Antenna**

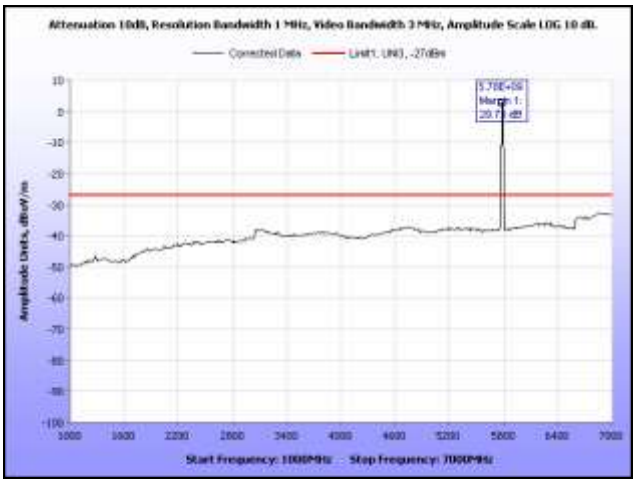
  




**Plot 150. Radiated Spurious, 802.11a, 5745 MHz, 18 GHz – 40 GHz, Sector Antenna**

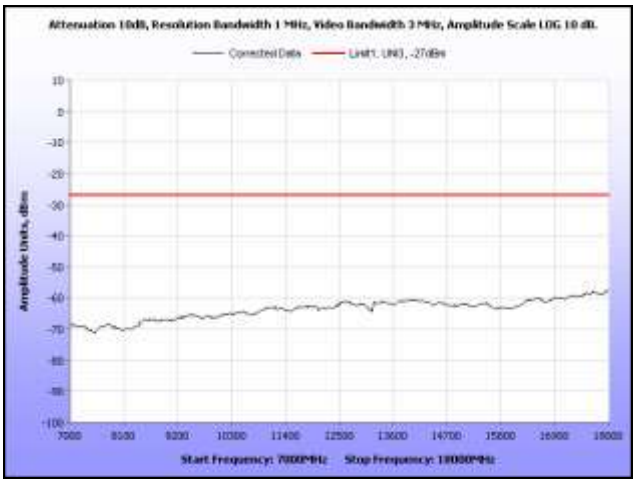



**Plot 151. Radiated Spurious, 802.11a, 5785 MHz, 30 MHz – 1 GHz, Sector Antenna**

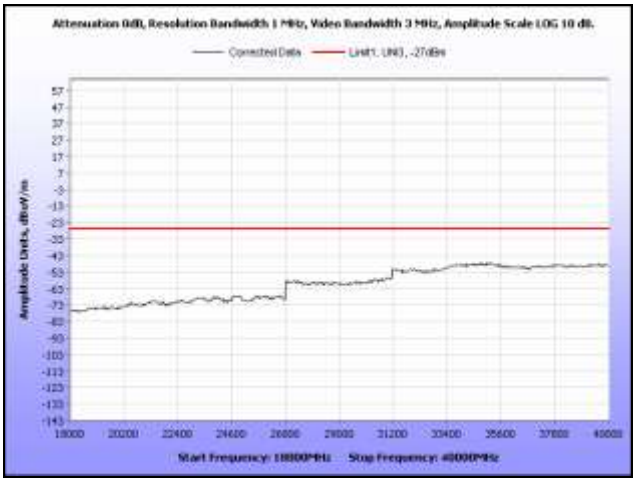



**Plot 152. Radiated Spurious, 802.11a, 5785 MHz, 1 GHz – 7 GHz, Sector Antenna**

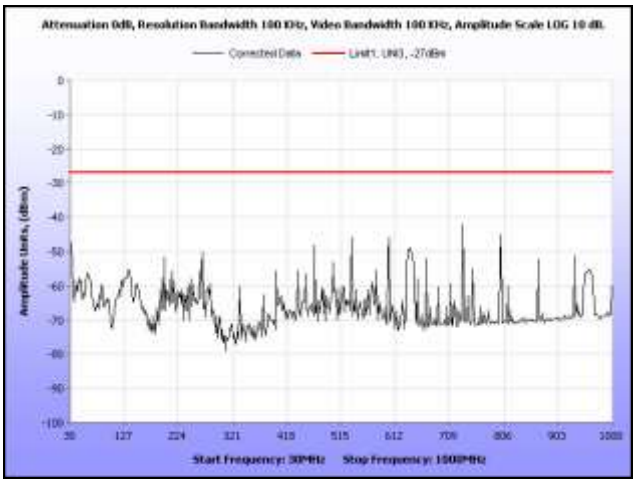
  




**Plot 153. Radiated Spurious, 802.11a, 5785 MHz, 7 GHz – 18 GHz, Sector Antenna**

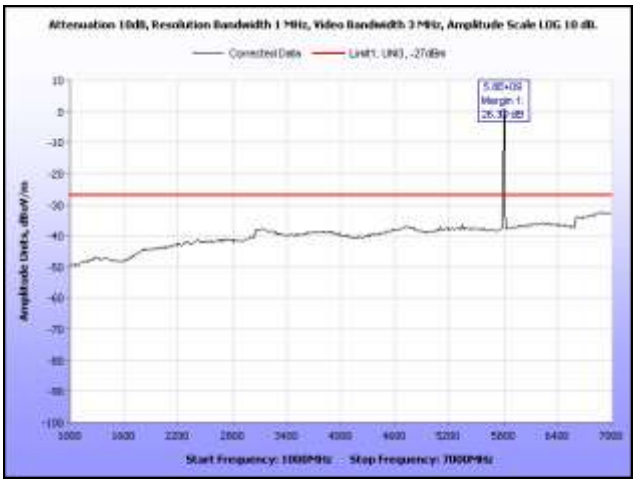



**Plot 154. Radiated Spurious, 802.11a, 5785 MHz, 18 GHz – 40 GHz, Sector Antenna**

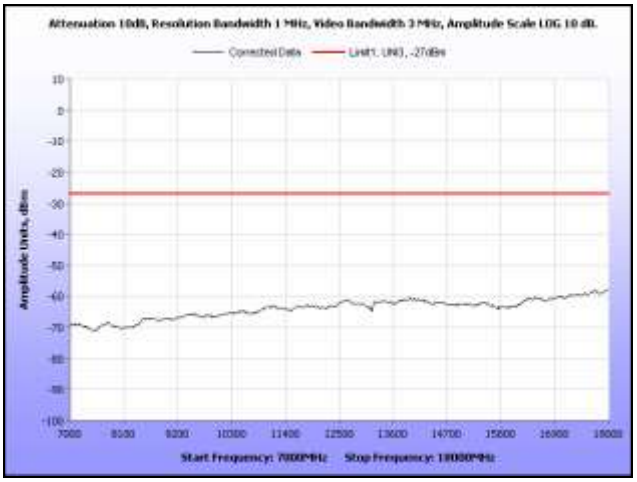



**Plot 155. Radiated Spurious, 802.11a, 5805 MHz, 30 MHz – 1 GHz, Sector Antenna**

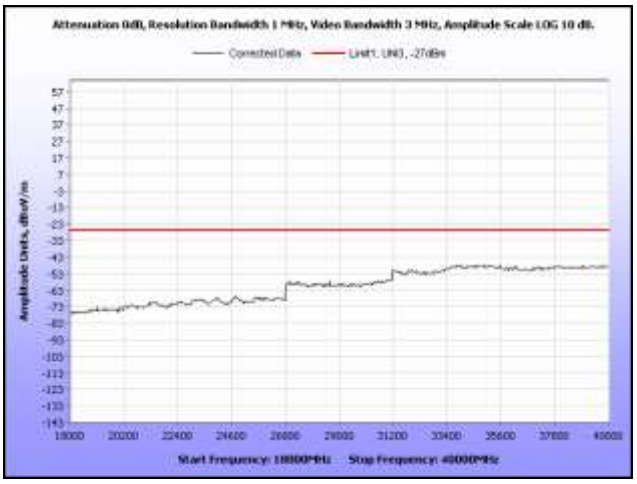
  




**Plot 156. Radiated Spurious, 802.11a, 5805 MHz, 1 GHz – 7 GHz, Sector Antenna**



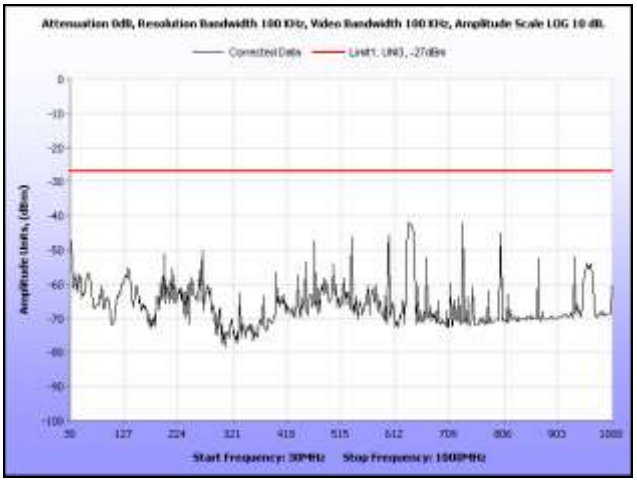

**Plot 157. Radiated Spurious, 802.11a, 5805 MHz, 7 GHz – 18 GHz, Sector Antenna**



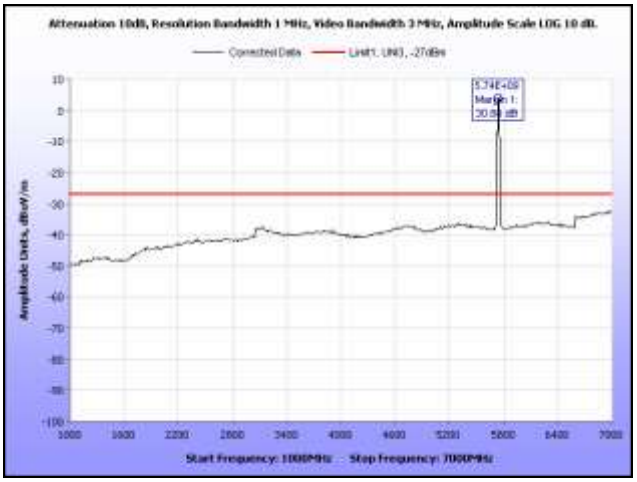

**Plot 158. Radiated Spurious, 802.11a, 5805 MHz, 18 GHz – 40 GHz, Sector Antenna**

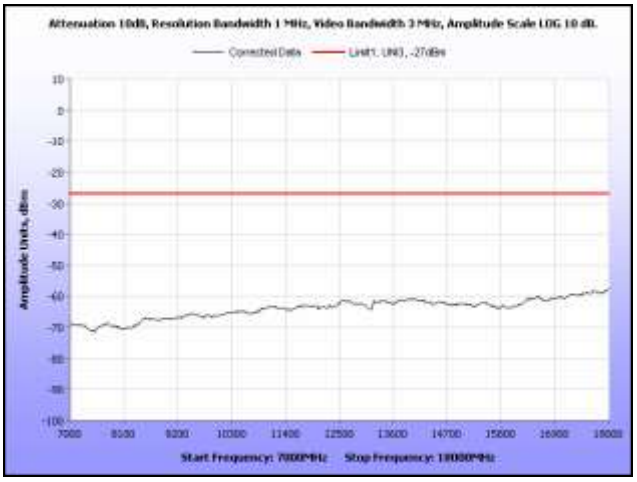
## Radiated Spurious Emissions Limits, 802.11n 20 MHz, Sector Antenna




**Plot 159. Radiated Spurious, 802.11n 20 MHz, 5745 MHz, 30 MHz – 1 GHz, Sector Antenna**

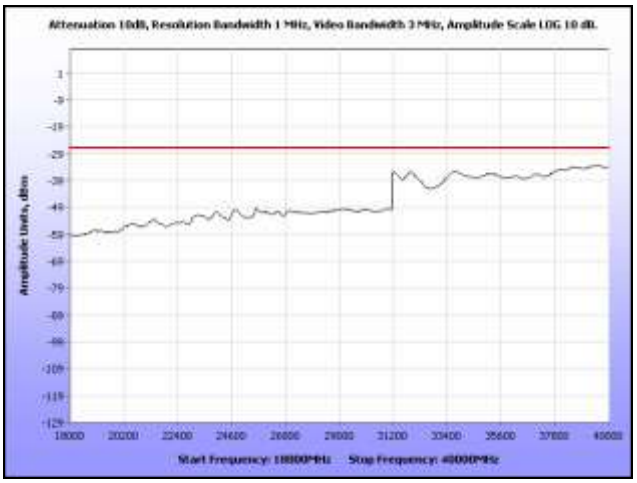



**Plot 160. Radiated Spurious, 802.11n 20 MHz, 5745 MHz, 1 GHz – 7 GHz, Sector Antenna**

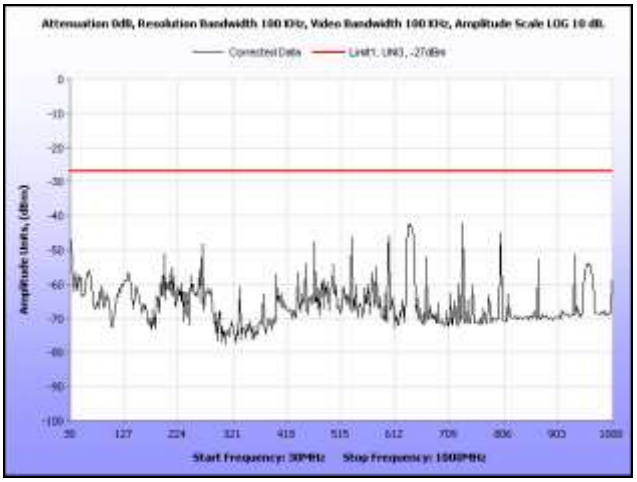



**Plot 161. Radiated Spurious, 802.11n 20 MHz, 5745 MHz, 7 GHz – 18 GHz, Sector Antenna**

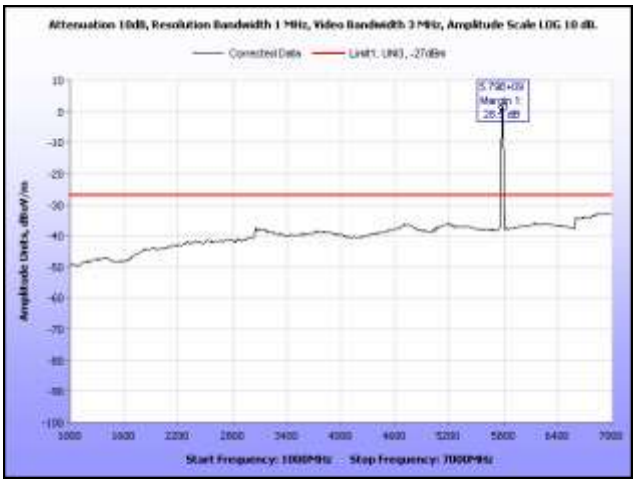
  




**Plot 162. Radiated Spurious, 802.11n 20 MHz, 5745 MHz, 18 GHz – 40 GHz, Sector Antenna**

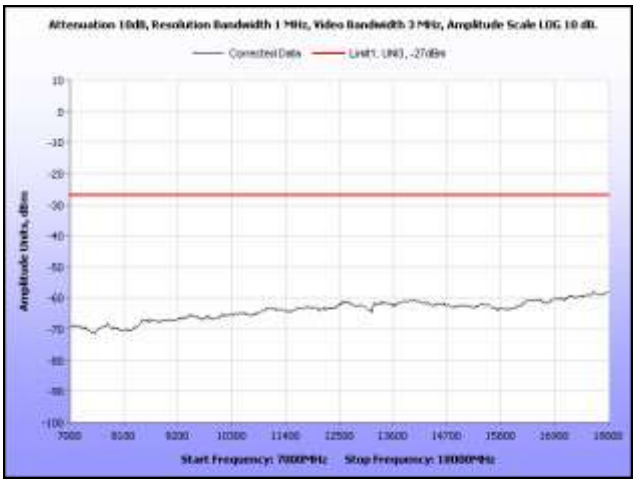



**Plot 163. Radiated Spurious, 802.11n 20 MHz, 5785 MHz, 30 MHz – 1 GHz, Sector Antenna**

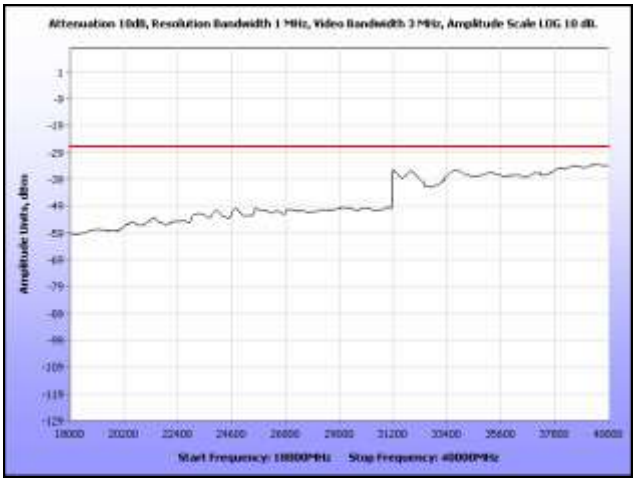



**Plot 164. Radiated Spurious, 802.11n 20 MHz, 5785 MHz, 1 GHz – 7 GHz, Sector Antenna**

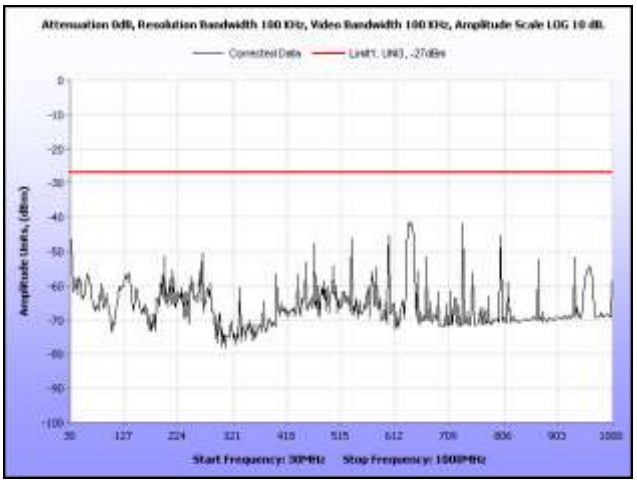
  




**Plot 165. Radiated Spurious, 802.11n 20 MHz, 5785 MHz, 7 GHz – 18 GHz, Sector Antenna**

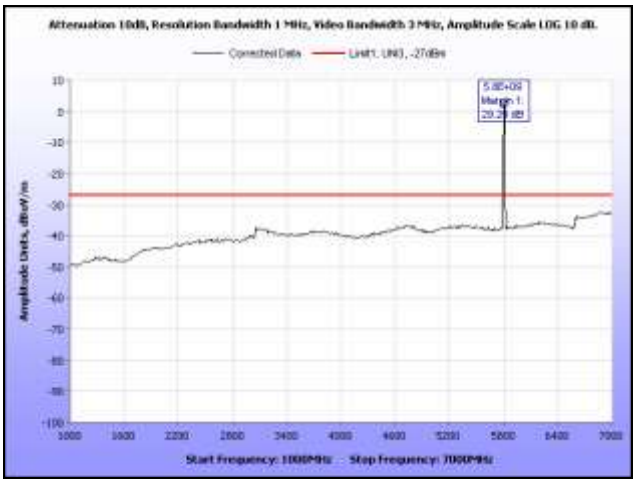



**Plot 166. Radiated Spurious, 802.11n 20 MHz, 5785 MHz, 18 GHz – 40 GHz, Sector Antenna**

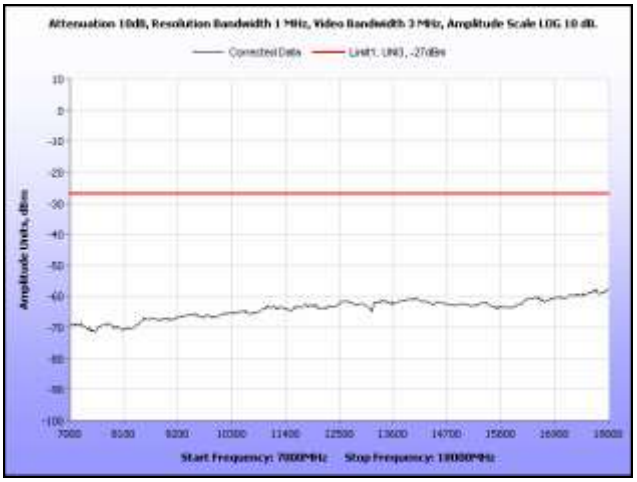



**Plot 167. Radiated Spurious, 802.11n 20 MHz, 5805 MHz, 30 MHz – 1 GHz, Sector Antenna**

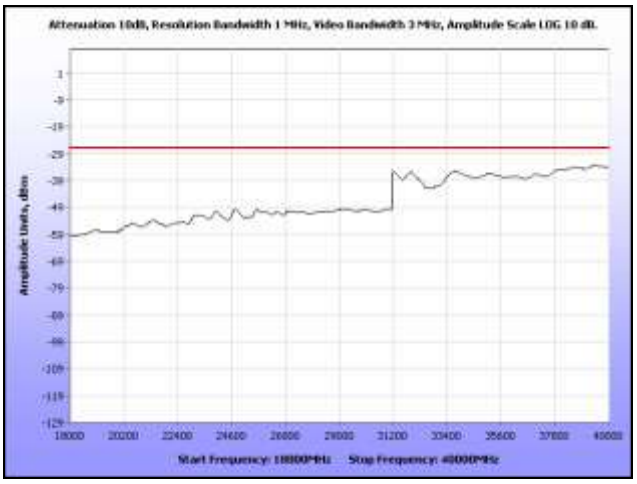
  




**Plot 168. Radiated Spurious, 802.11n 20 MHz, 5805 MHz, 1 GHz – 7 GHz, Sector Antenna**



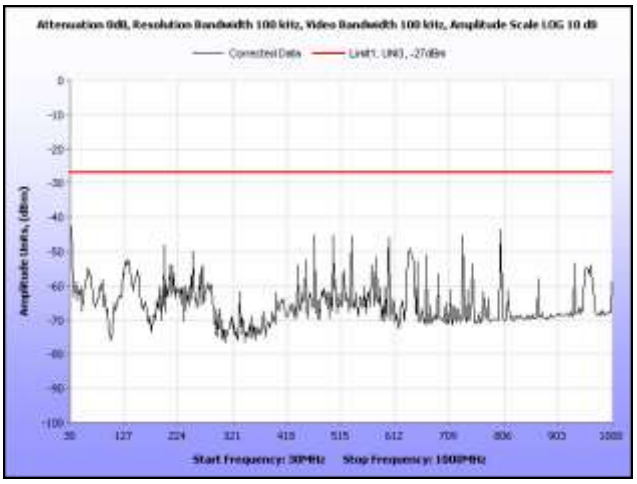

**Plot 169. Radiated Spurious, 802.11n 20 MHz, 5805 MHz, 7 GHz – 18 GHz, Sector Antenna**



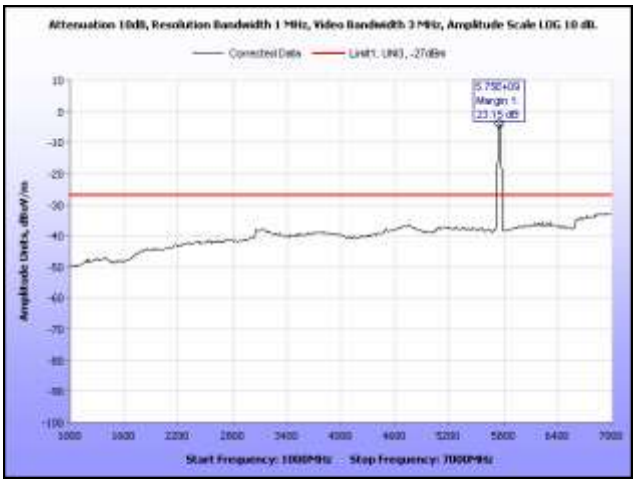

**Plot 170. Radiated Spurious, 802.11n 20 MHz, 5805 MHz, 18 GHz – 40 GHz, Sector Antenna**

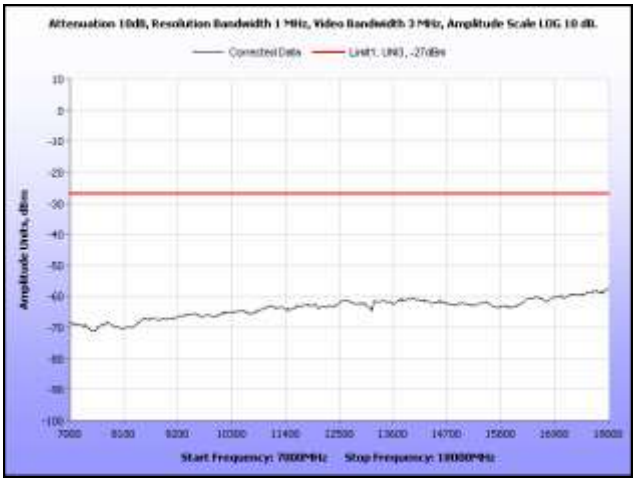
## Radiated Spurious Emissions Limits, 802.11n 40 MHz, Sector Antenna




**Plot 171. Radiated Spurious, 802.11n 40 MHz, 5755 MHz, 30 MHz – 1 GHz, Sector Antenna**

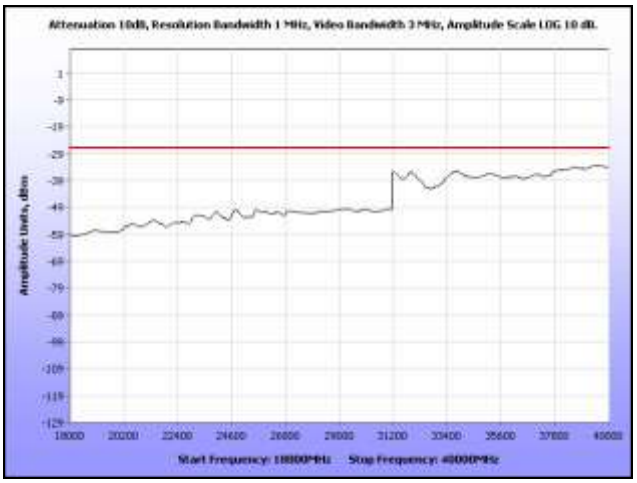



**Plot 172. Radiated Spurious, 802.11n 40 MHz, 5755 MHz, 1 GHz – 7 GHz, Sector Antenna**

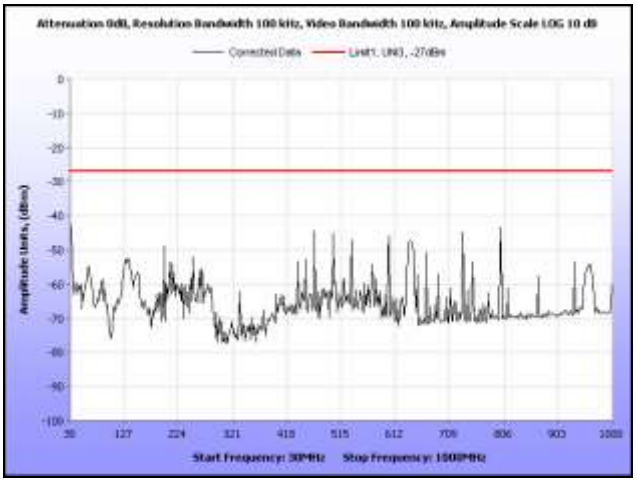



**Plot 173. Radiated Spurious, 802.11n 40 MHz, 5755 MHz, 7 GHz – 18 GHz, Sector Antenna**

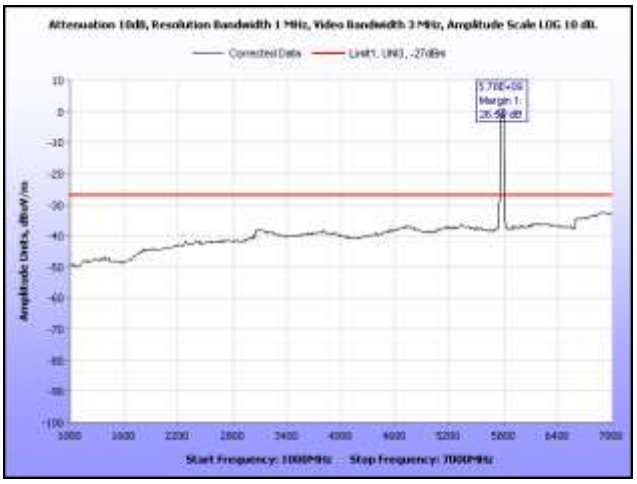
  




**Plot 174. Radiated Spurious, 802.11n 40 MHz, 5755 MHz, 18 GHz – 40 GHz, Sector Antenna**

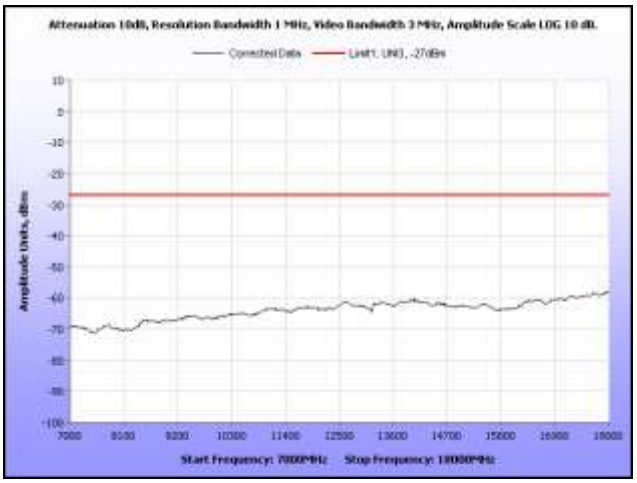



**Plot 175. Radiated Spurious, 802.11n 40 MHz, 5785 MHz, 30 MHz – 1 GHz, Sector Antenna**

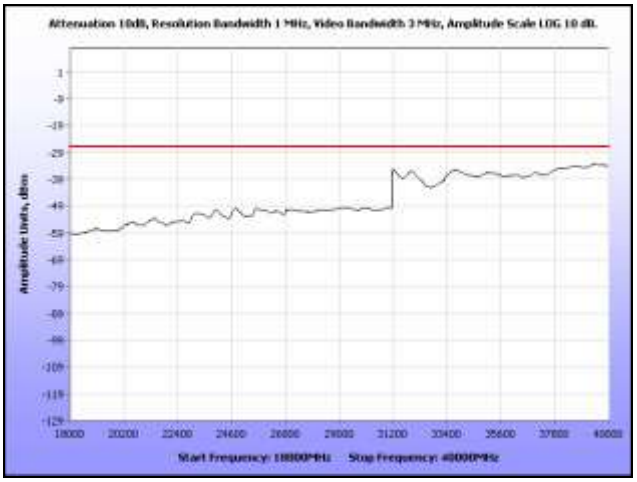



**Plot 176. Radiated Spurious, 802.11n 40 MHz, 5785 MHz, 1 GHz – 7 GHz, Sector Antenna**

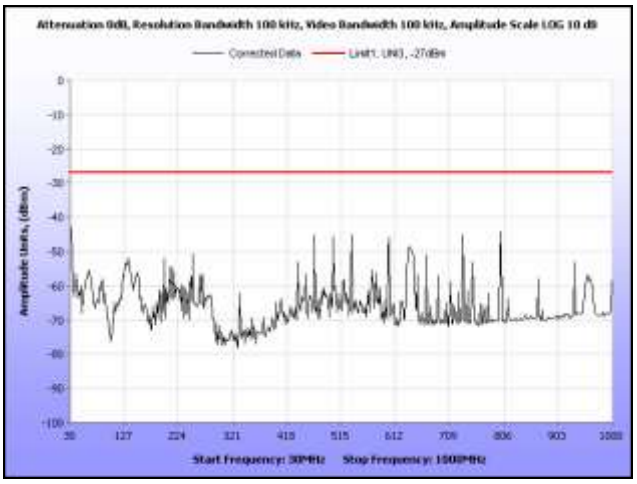
  



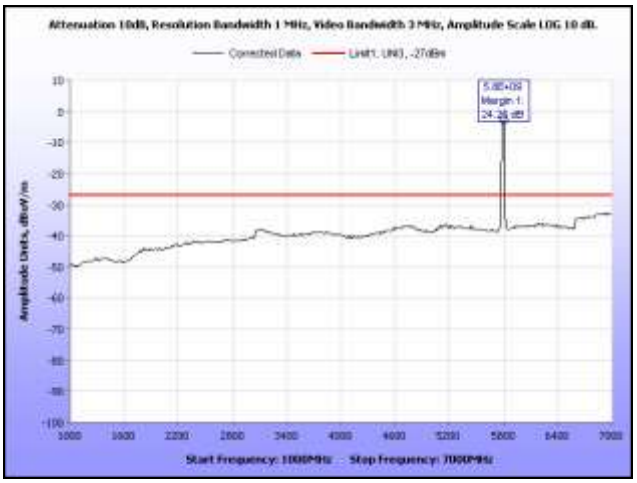

**Plot 177. Radiated Spurious, 802.11n 40 MHz, 5785 MHz, 7 GHz – 18 GHz, Sector Antenna**



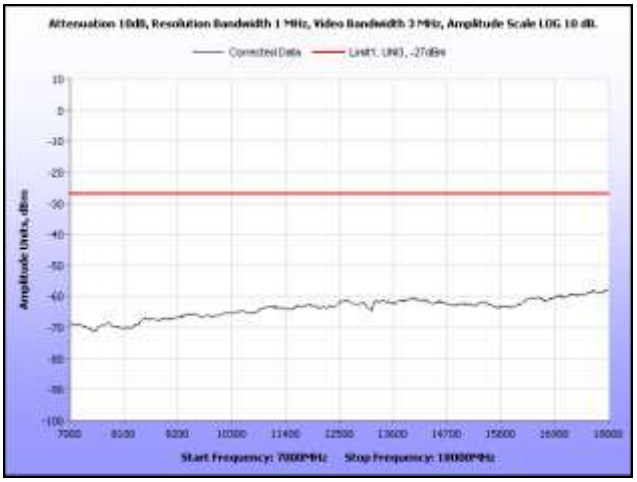

**Plot 178. Radiated Spurious, 802.11n 40 MHz, 5785 MHz, 18 GHz – 40 GHz, Sector Antenna**



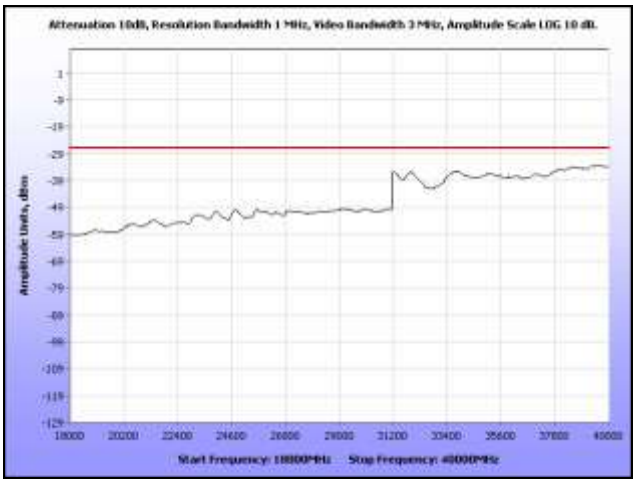

**Plot 179. Radiated Spurious, 802.11n 40 MHz, 5795 MHz, 30 MHz – 1 GHz, Sector Antenna**




**Plot 180. Radiated Spurious, 802.11n 40 MHz, 5795 MHz, 1 GHz – 7 GHz, Sector Antenna**



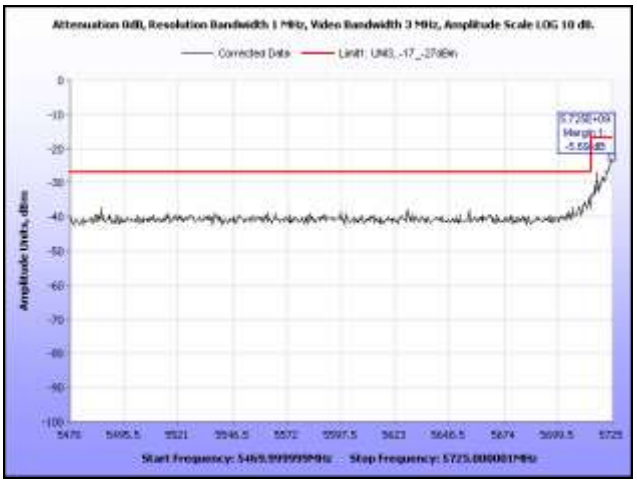

**Plot 181. Radiated Spurious, 802.11n 40 MHz, 5795 MHz, 7 GHz – 18 GHz, Sector Antenna**



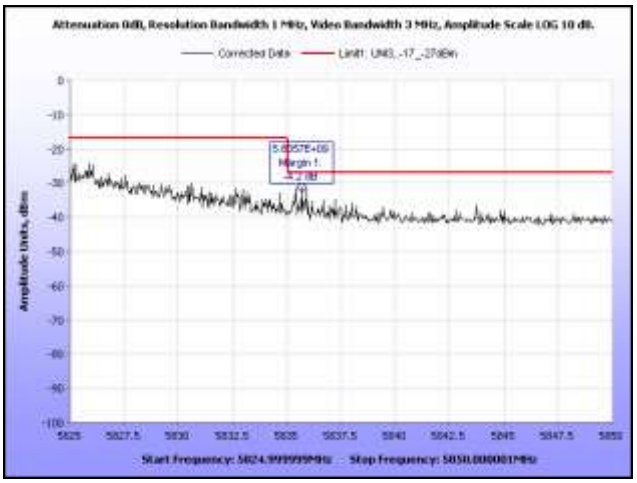

**Plot 182. Radiated Spurious, 802.11n 40 MHz, 5795 MHz, 18 GHz – 40 GHz, Sector Antenna**

## EIRP
## EIRP, 802.11a, Omni Antenna



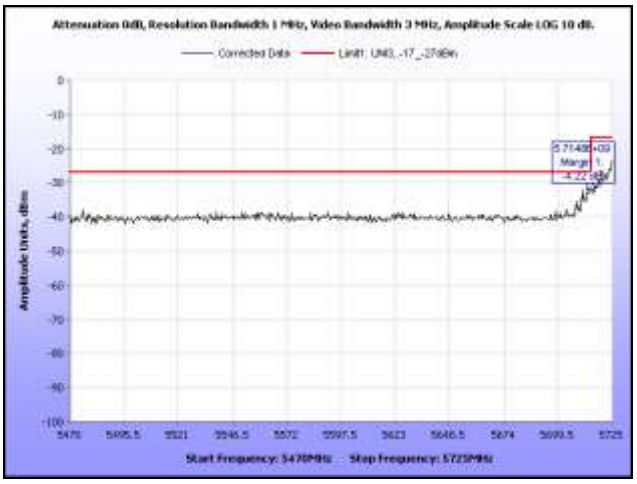

**Plot 183. EIRP, 802.11a, 5745 MHz, Band Edge, Omni Antenna**



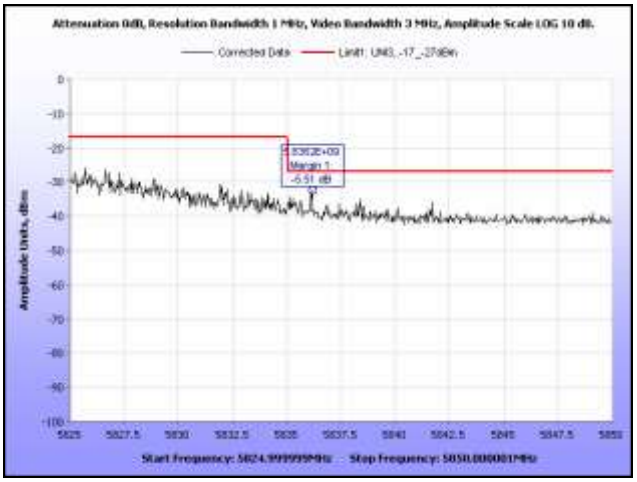

**Plot 184. EIRP, 802.11a, 5805 MHz, Band Edge, Omni Antenna**

## EIRP, 802.11n 20 MHz, Omni Antenna



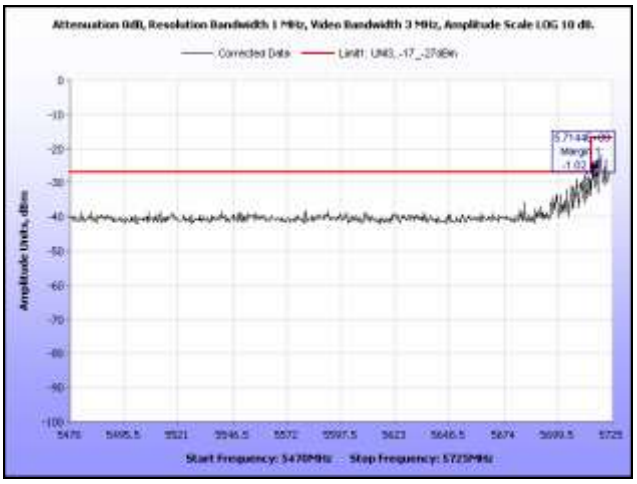

**Plot 185. EIRP, 802.11n 20 MHz, 5745 MHz, Band Edge, Omni Antenna**



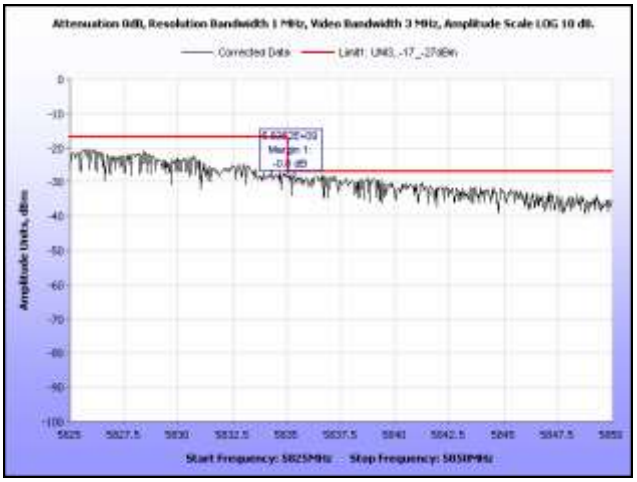

**Plot 186. EIRP, 802.11n 20 MHz, 5805 MHz, Band Edge, Omni Antenna**

## EIRP, 802.11n 40 MHz, Omni Antenna



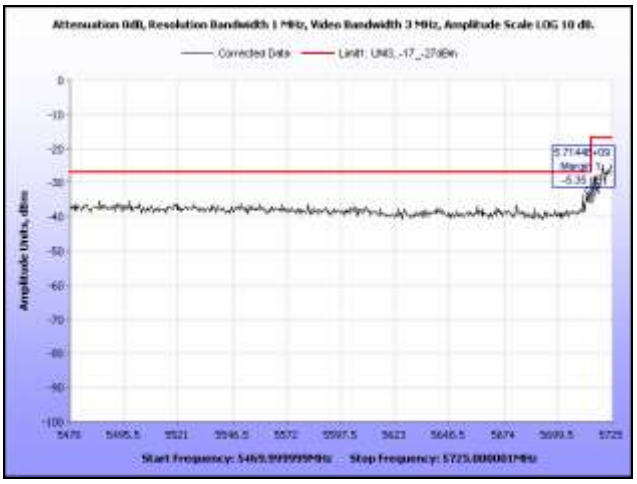

**Plot 187. EIRP, 802.11n 40 MHz, 5755 MHz, Band Edge, Omni Antenna**



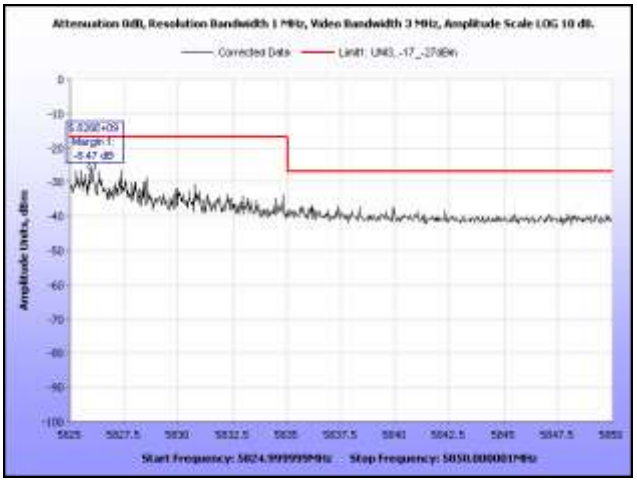

**Plot 188. EIRP, 802.11n 40 MHz, 5795 MHz, Band Edge, Omni Antenna**

## EIRP, 802.11a, Sector Antenna



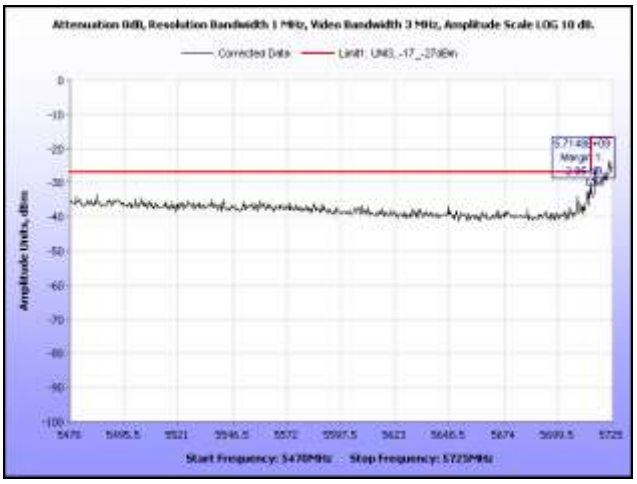

**Plot 189. EIRP, 802.11a, 5745 MHz, Band Edge, Sector Antenna**



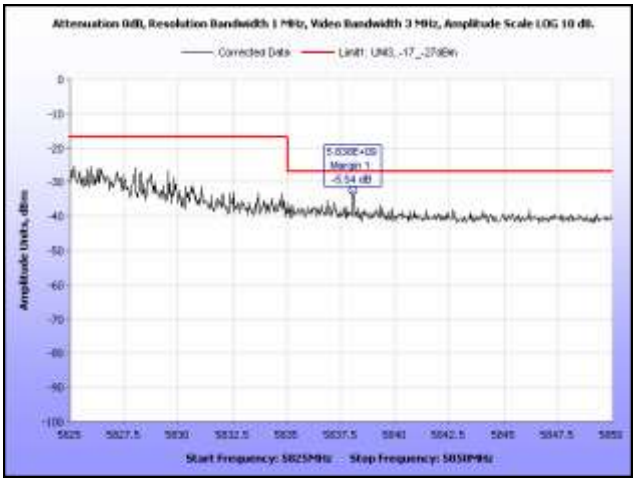

**Plot 190. EIRP, 802.11a, 5805 MHz, Band Edge, Sector Antenna**

## EIRP, 802.11n 20 MHz, Sector Antenna



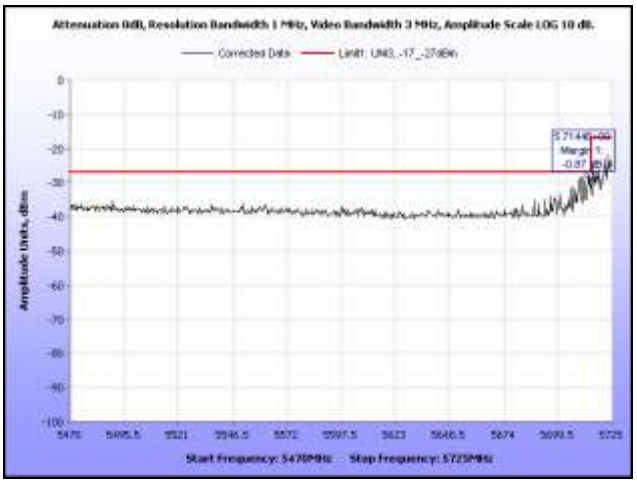

**Plot 191. EIRP, 802.11n 20 MHz, 5745 MHz, Band Edge, Sector Antenna**



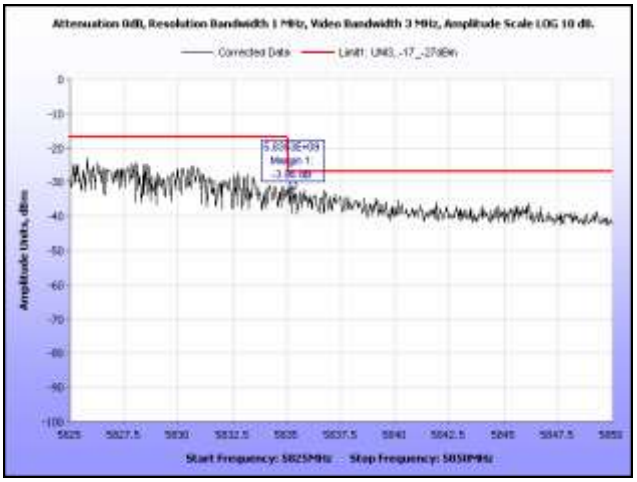

**Plot 192. EIRP, 802.11n 20 MHz, 5805 MHz, Band Edge, Sector Antenna**

## EIRP, 802.11n 40 MHz, Sector Antenna




**Plot 193. EIRP, 802.11n 40 MHz, 5755 MHz, Band Edge, Sector Antenna**




**Plot 194. EIRP, 802.11n 40 MHz, 5795 MHz, Band Edge, Sector Antenna**

# Electromagnetic Compatibility Criteria for Intentional Radiators

## § 15.407(f) RF Exposure

**RF Exposure Requirements:** **§1.1307(b)(1) and §1.1307(b)(2):** Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines.

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

MPE Limit Calculation: EUT's operating frequencies @ 5725-5825 MHz; highest conducted power = 15.574 *dBm* (peak) therefore, **Limit for Uncontrolled exposure: 1 mW/cm$^2$ or 10 W/m$^2$**

Gain of Antenna @ 5GHz = 10 dBi

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

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

where, S = Power Density (mW/cm$^2$)
P = Power Input to antenna (36.088 mW)
G = Antenna Gain (10)
R = Radius (20 cm)

$S = (36.088 * 10)/(4*3.14*20^2) = 0.072$ mW/cm$^2$
Gain of Sector Antenna @ 5GHz = 15.5 dBi
Highest Conducted Power with Sector Antenna = 15.5 dBm

S = Power Density (mW/cm$^2$)
P = Power Input to Antenna (35.48 dBm)
G = Numeric Antenna Gain (35.48)
R = Radius (20 cm)

$S = (35.48 * 35.48)/(4 * 3.14 * 20^2) = 0.241$ mW/cm$^2$

# Electromagnetic Compatibility Criteria for Intentional Radiators

## § 15.407(g) Frequency Stability

**Test Requirements:** **§ 15.407(g):** Manufacturers of U-NII devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the user's manual.

**Test Procedure:** The EUT was placed in a temperature chamber and connected directly to a spectrum analyzer through an attenuator. The resolution bandwidth was set to 1 MHz with an average detector and the span was set to encompass the complete frequency band. The transmitter was set to transmit on the low and high channels. Markers were used to measure the channels to ensure that the entire emission was contained within the frequency band. The temperature was varied between the minimum and maximum temperature (-20°C and +55°C) at increments of 10°C and the measurements were repeated. At ambient temperature (+20°C), the input voltage was varied between +/- 10% of the nominal input voltage and the measurements were repeated. Measurements were repeated for each frequency band.

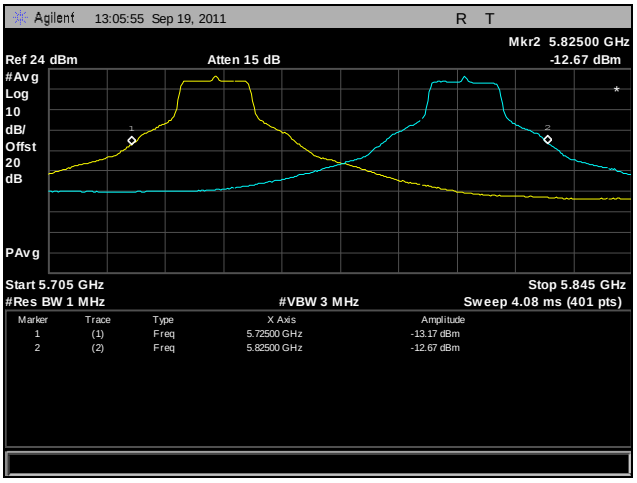
**Test Results:** The EUT was found compliant with the requirements of §15.407(g).

**Test Engineer(s):** Jeff Pratt

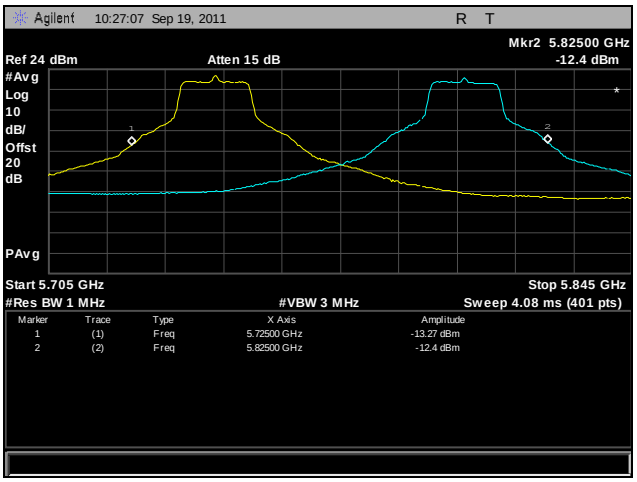
**Test Date(s):** 09/20/11

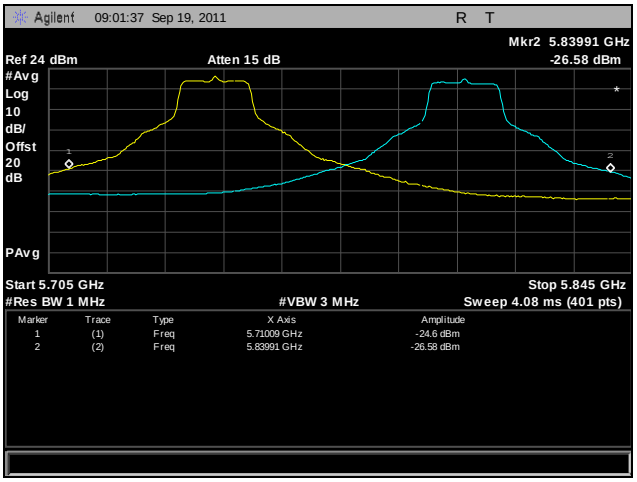
## Frequency Stability, 802.11a




**Plot 195. Frequency Stability, 802.11a, 5725 MHz - 5825 MHz @ -20°C, 120 V**

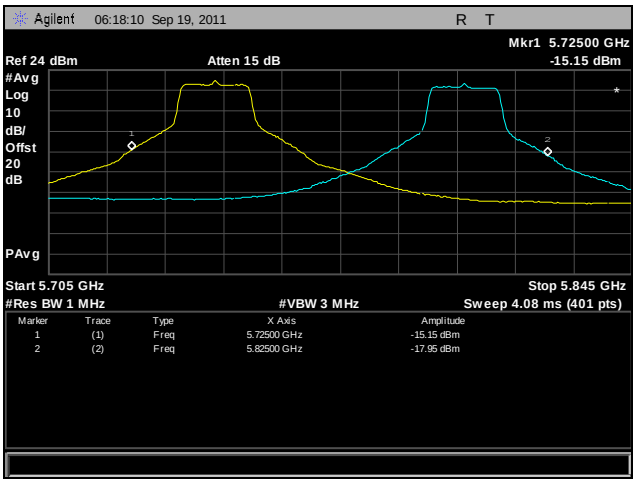



**Plot 196. Frequency Stability, 802.11a, 5725 MHz - 5825 MHz @ -10°C, 120 V**

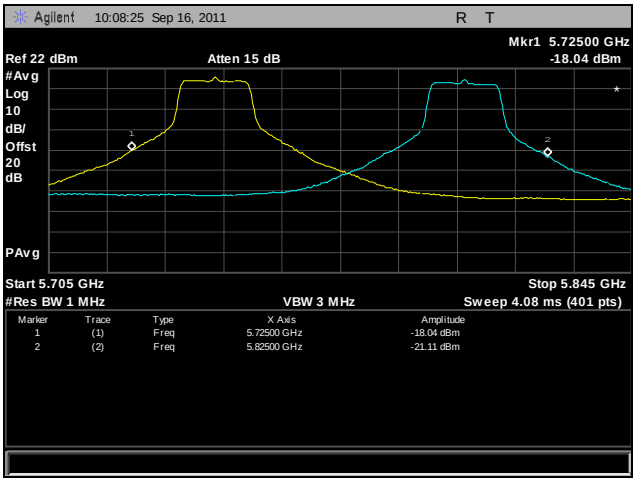



**Plot 197. Frequency Stability, 802.11a, 5725 MHz - 5825 MHz @ 0°C, 120 V**

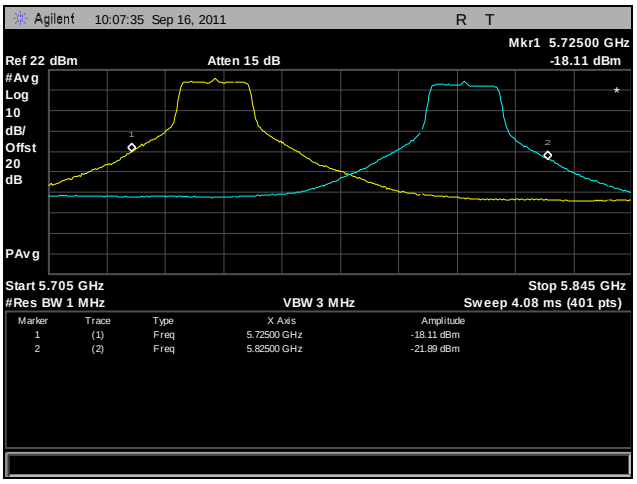
  




**Plot 198. Frequency Stability, 802.11a, 5725 MHz - 5825 MHz @ 10°C, 120 V**

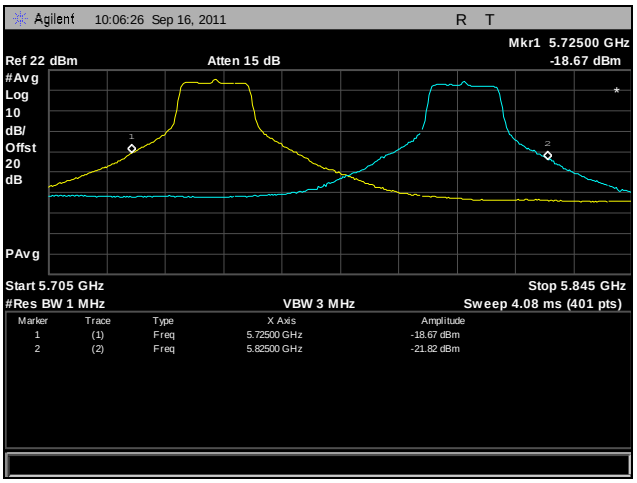



**Plot 199. Frequency Stability, 802.11a, 5725 MHz - 5825 MHz @ 20°C, 108 V**

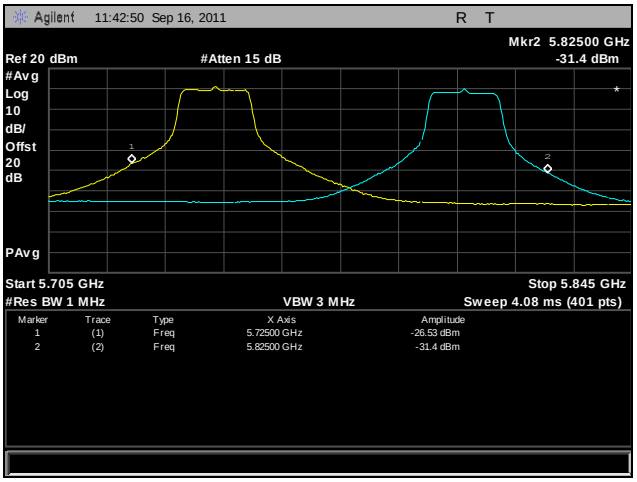



**Plot 200. Frequency Stability, 802.11a, 5725 MHz - 5825 MHz @ 20°C, 120 V**

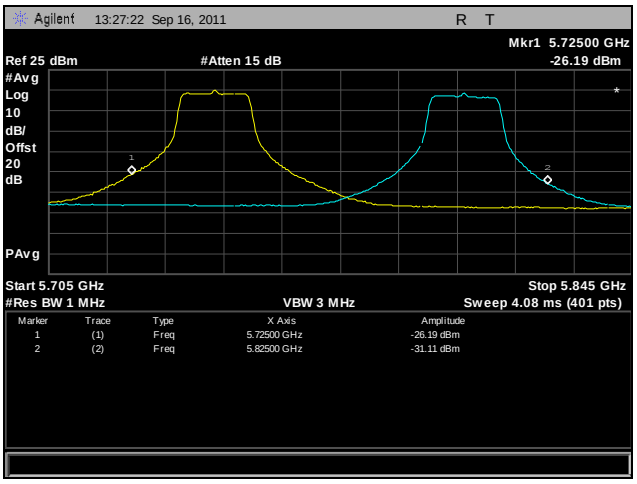
  




**Plot 201. Frequency Stability, 802.11a, 5725 MHz - 5825 MHz @ 20°C, 132 V**

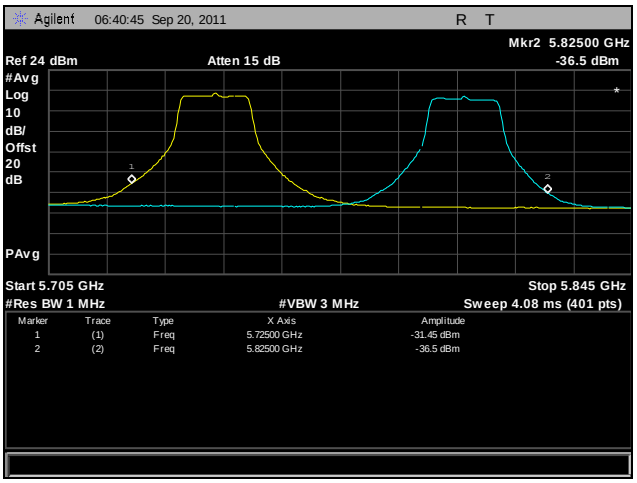



**Plot 202. Frequency Stability, 802.11a, 5725 MHz - 5825 MHz @ 30°C, 120 V**

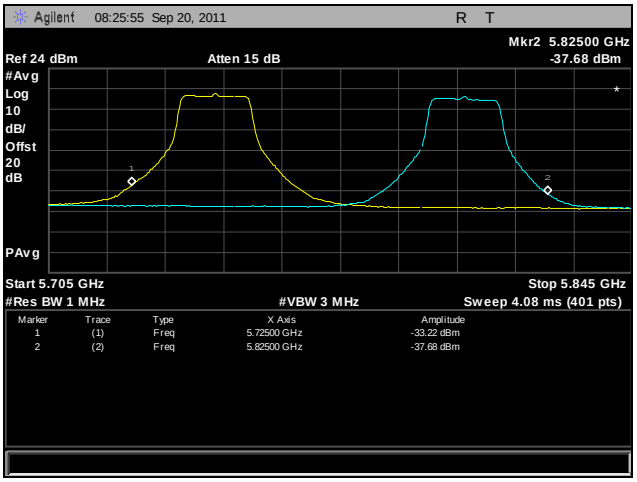



**Plot 203. Frequency Stability, 802.11a, 5725 MHz - 5825 MHz @ 40°C, 120 V**



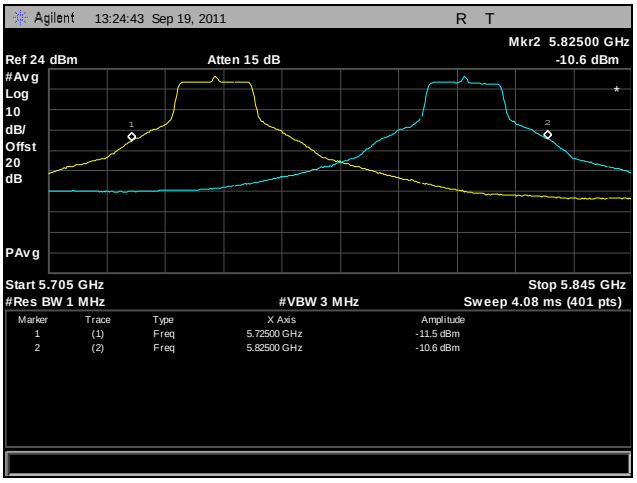

**Plot 204. Frequency Stability, 802.11a, 5725 MHz - 5825 MHz @ 50°C, 120 V**



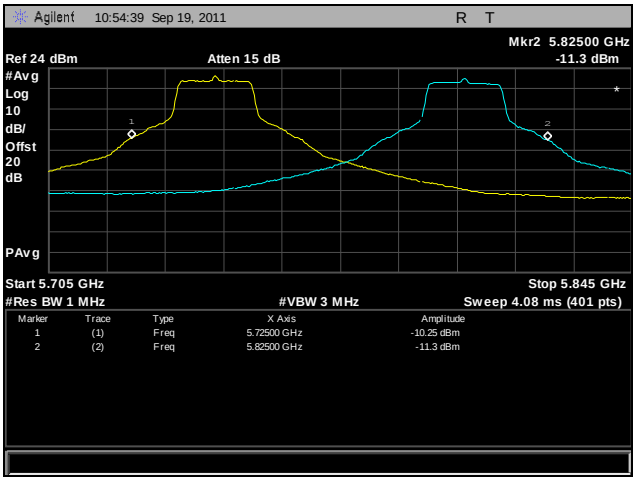

**Plot 205. Frequency Stability, 802.11a, 5725 MHz - 5825 MHz @ 55°C, 120 V**

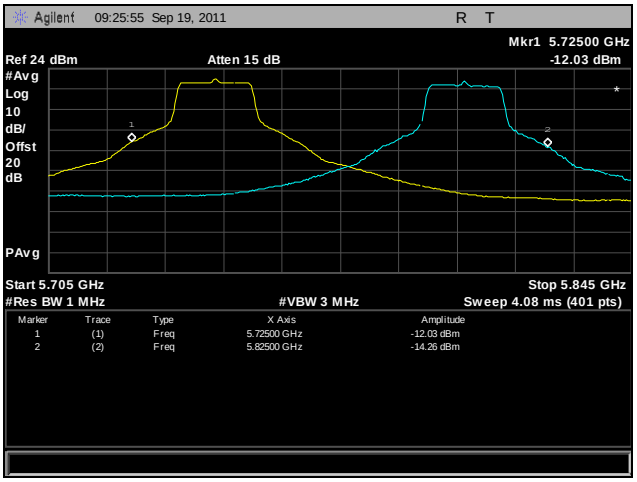
## Frequency Stability, 802.11n 20 MHz




**Plot 206. Frequency Stability, 802.11n 20 MHz, 5725 MHz - 5825 MHz @ -20°C, 120 V**

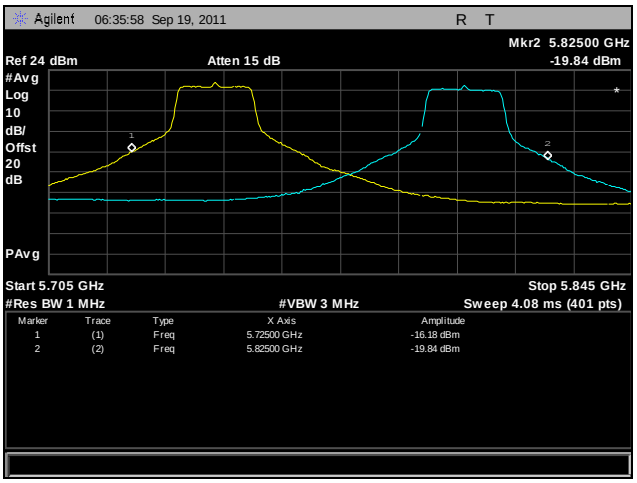



**Plot 207. Frequency Stability, 802.11n 20 MHz, 5725 MHz - 5825 MHz @ -10°C, 120 V**

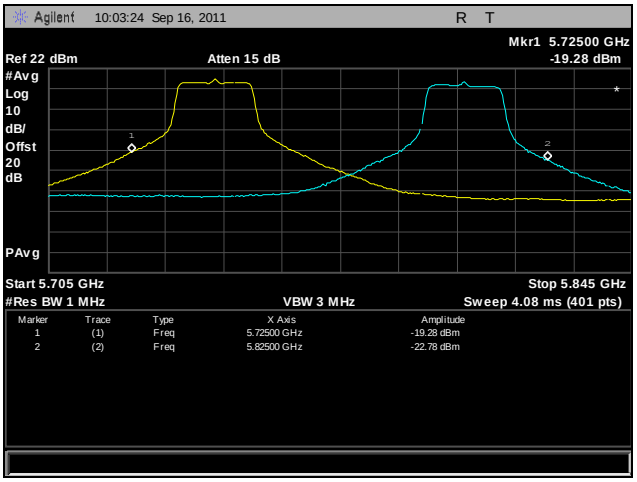



**Plot 208. Frequency Stability, 802.11n 20 MHz, 5725 MHz - 5825 MHz @ 0°C, 120 V**

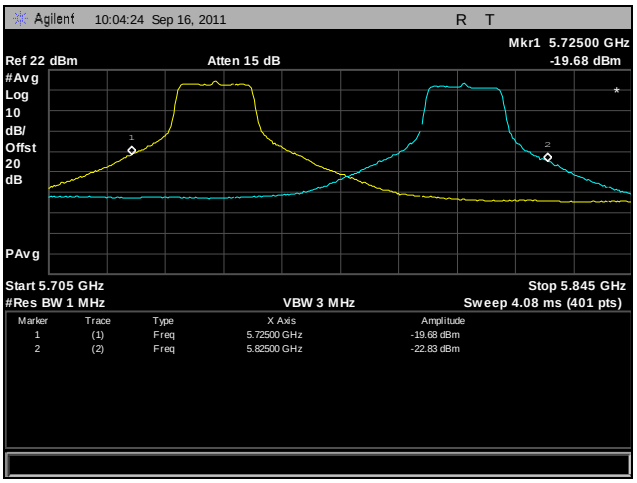
  



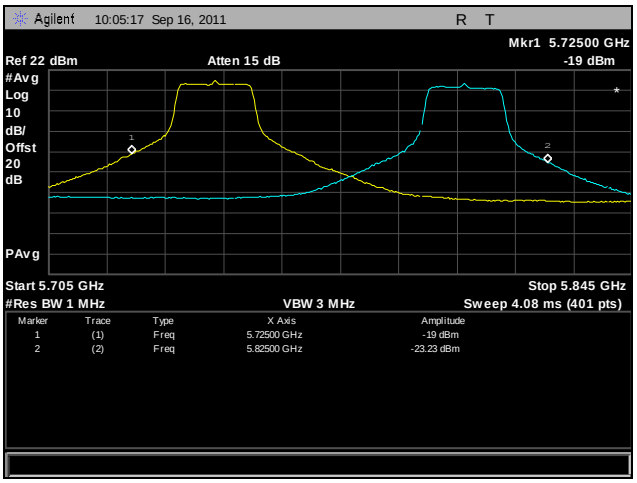

**Plot 209. Frequency Stability, 802.11n 20 MHz, 5725 MHz - 5825 MHz @ 10°C, 120 V**



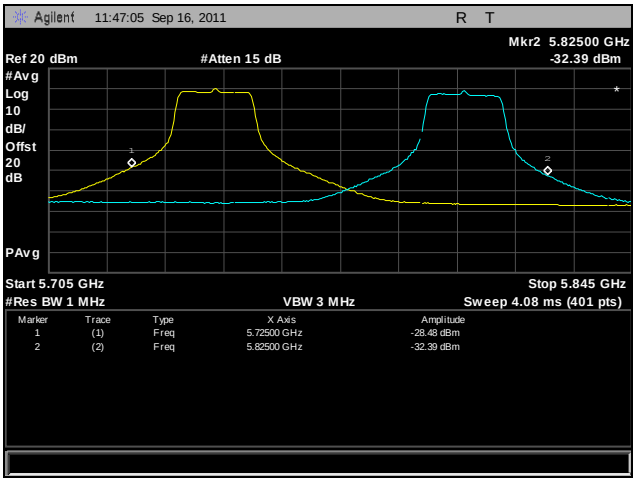

**Plot 210. Frequency Stability, 802.11n 20 MHz, 5725 MHz - 5825 MHz @ 20°C, 108 V**



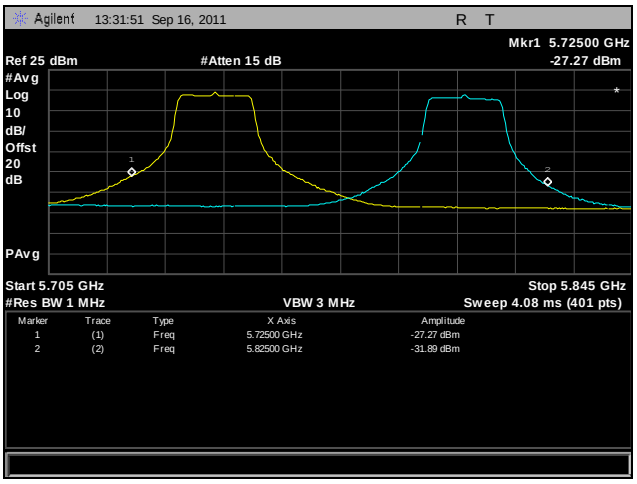

**Plot 211. Frequency Stability, 802.11n 20 MHz, 5725 MHz - 5825 MHz @ 20°C, 120 V**



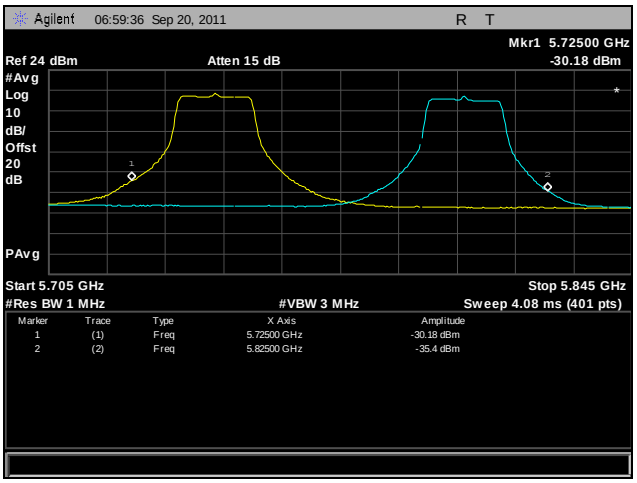

**Plot 212. Frequency Stability, 802.11n 20 MHz, 5725 MHz - 5825 MHz @ 20°C, 132 V**



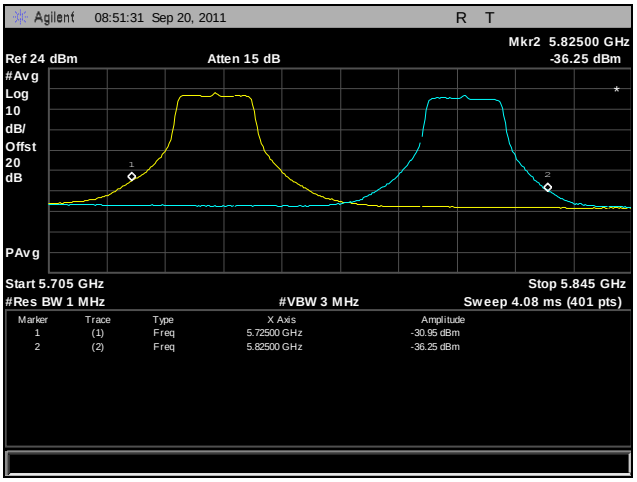

**Plot 213. Frequency Stability, 802.11n 20 MHz, 5725 MHz - 5825 MHz @ 30°C, 120 V**




**Plot 214. Frequency Stability, 802.11n 20 MHz, 5725 MHz - 5825 MHz @ 40°C, 120 V**



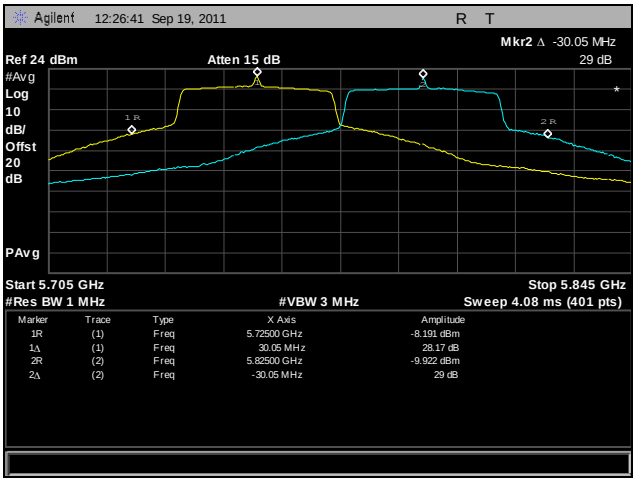

**Plot 215. Frequency Stability, 802.11n 20 MHz, 5725 MHz - 5825 MHz @ 50°C, 120 V**



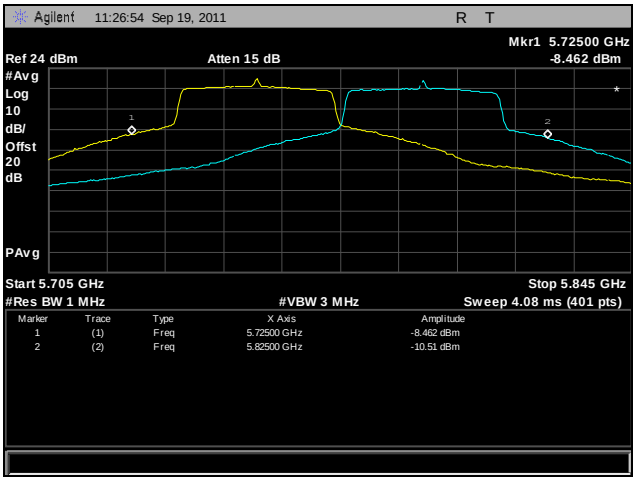

**Plot 216. Frequency Stability, 802.11n 20 MHz, 5725 MHz - 5825 MHz @ 55°C, 120 V**

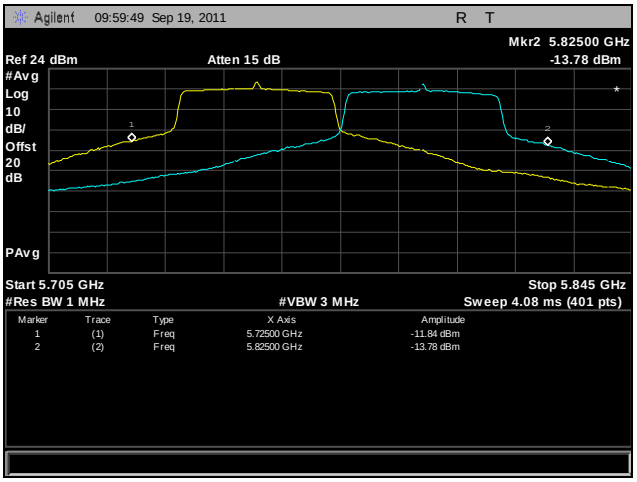
## Frequency Stability, 802.11n 40 MHz




**Plot 217. Frequency Stability, 802.11n 40 MHz, 5725 MHz - 5825 MHz @ -20°C, 120 V**

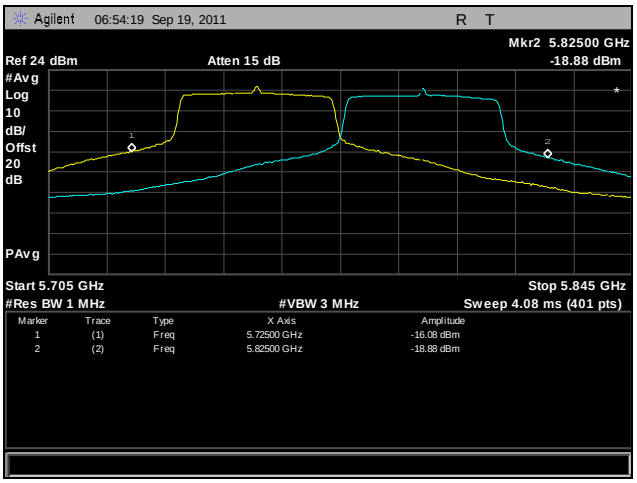



**Plot 218. Frequency Stability, 802.11n 40 MHz, 5725 MHz - 5825 MHz @ -10°C, 120 V**

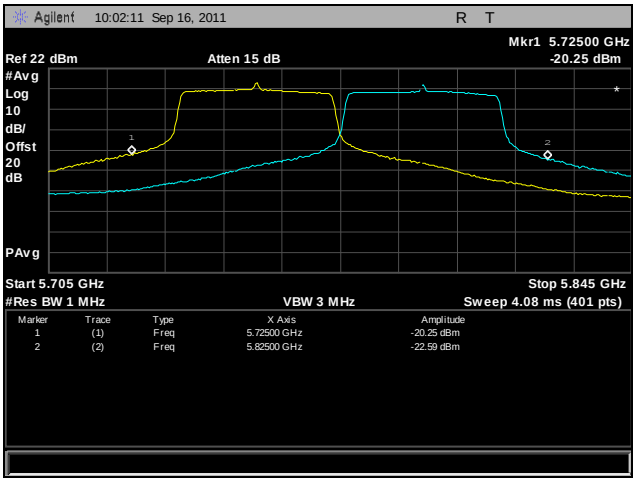



**Plot 219. Frequency Stability, 802.11n 40 MHz, 5725 MHz - 5825 MHz @ 0°C, 120 V**

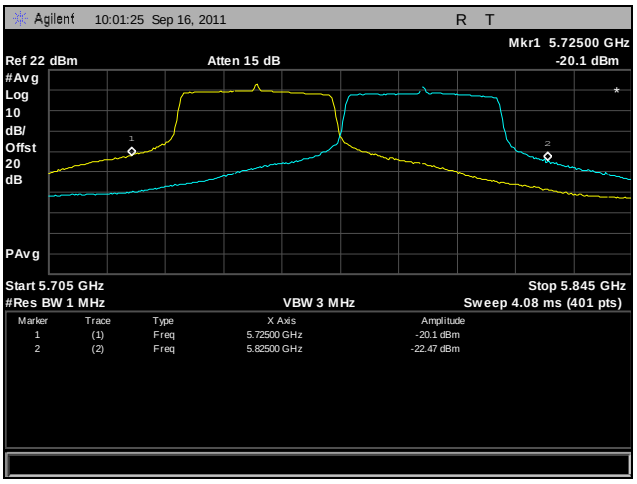
  




**Plot 220. Frequency Stability, 802.11n 40 MHz, 5725 MHz - 5825 MHz @ 10°C, 120 V**

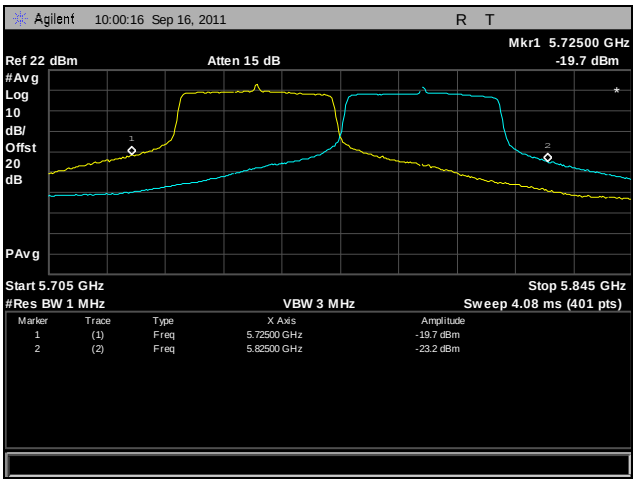



**Plot 221. Frequency Stability, 802.11n 40 MHz, 5725 MHz - 5825 MHz @ 20°C, 108 V**

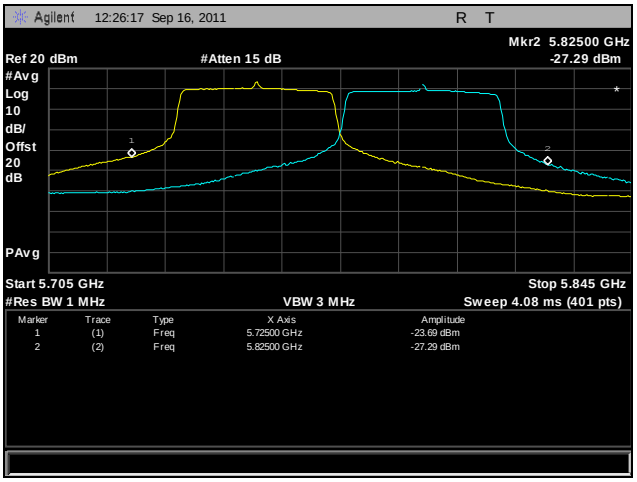



**Plot 222. Frequency Stability, 802.11n 40 MHz, 5725 MHz - 5825 MHz @ 20°C, 120 V**

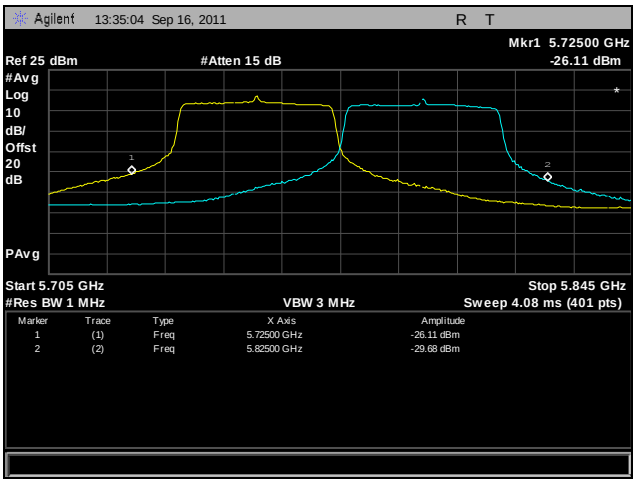
  




**Plot 223. Frequency Stability, 802.11n 40 MHz, 5725 MHz - 5825 MHz @ 20°C, 132 V**

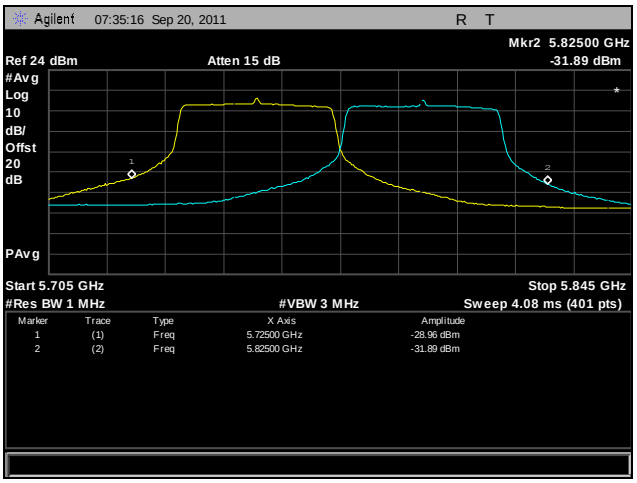



**Plot 224. Frequency Stability, 802.11n 40 MHz, 5725 MHz - 5825 MHz @ 30°C, 120 V**

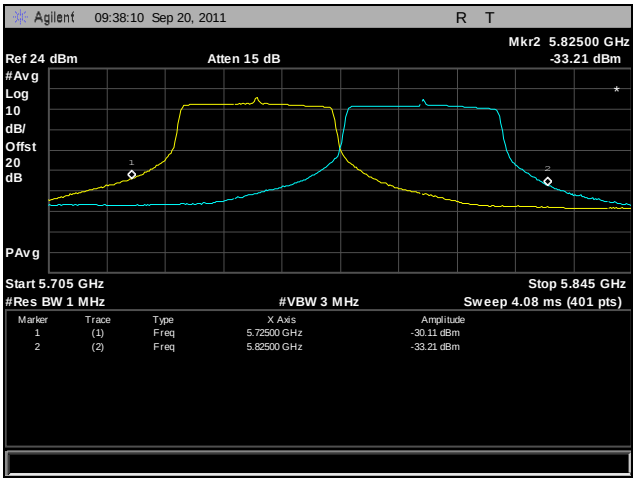



**Plot 225. Frequency Stability, 802.11n 40 MHz, 5725 MHz - 5825 MHz @ 40°C, 120 V**




**Plot 226. Frequency Stability, 802.11n 40 MHz, 5725 MHz - 5825 MHz @ 50°C, 120 V**




**Plot 227. Frequency Stability, 802.11n 40 MHz, 5725 MHz - 5825 MHz @ 55°C, 120 V**

# Electromagnetic Compatibility Criteria for Intentional Radiators

## RSS-GEN Receiver Spurious Emissions

**Test Requirement:** The following receiver spurious emission limits shall be complied with:

a) If a radiated measurement is made, all spurious emissions shall comply with the limits of Table 28.

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

**Table 28. Spurious Emission Limits for Receivers**

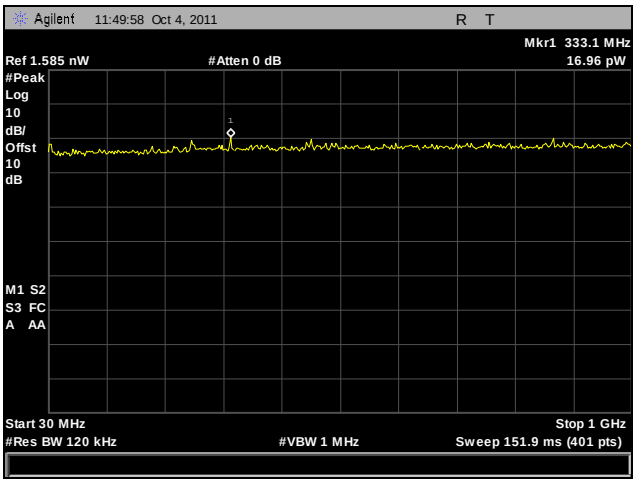
b) If a conducted measurement is made, no spurious output signals appearing at the antenna terminals shall exceed 2 nanowatts per any 4 kHz spurious frequency in the band 30-1000 MHz, or 5 nanowatts above 1 GHz.

**Test Procedure:** The receiver spurious emissions were tested in compliance with the limits of Table 12. The testing was performed conducted.

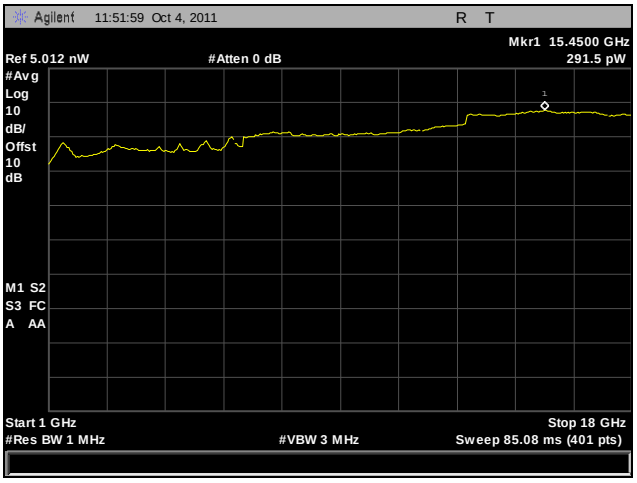
**Test Results:** The EUT was compliant with the Receiver Spurious Emission limits of this requirement.

**Test Engineer(s):** Jeff Pratt

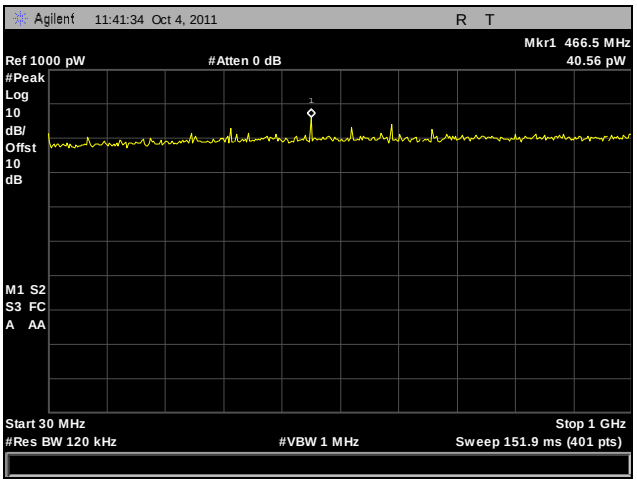
**Test Date(s):** 10/04/11




**Plot 228. Receiver Spurious Emission, 5.8 GHz, 30 MHz – 1 GHz, Port A**

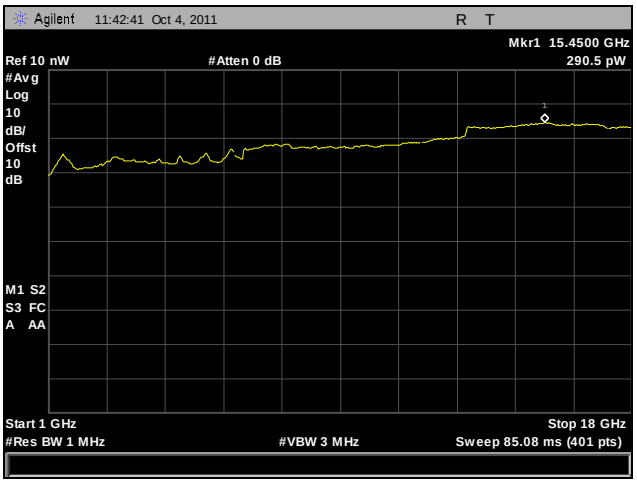



**Plot 229. Receiver Spurious Emission, 5.8 GHz, 1 GHz – 18 GHz, Port A**




**Plot 230. Receiver Spurious Emission, 5.8 GHz, 30 MHz – 1 GHz, Port B**




**Plot 231. Receiver Spurious Emission, 5.8 GHz, 1 GHz – 18 GHz, Port B**

# IV. Test Equipment

## Test Equipment

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

| MET Asset # | Equipment | Manufacturer | Model | Last Cal Date | Cal Due Date |
|---|---|---|---|---|---|
| 1T4771 | SPECTRUM ANALYZER | AGILENT | E4446A | 6/25/2011 | 6/25/2012 |
| 1T4442 | PRE-AMPLIFIER, MICROWAVE | MITEQ | AFS42-01001800-30-10P | SEE NOTE | |
| 1T4612 | SPECTRUM ANALYZER | AGILENT TECHNOLOGIES | E4407B | 10/27/2010 | 10/27/2011 |
| 1T4483 | ANTENNA; HORN | ETS-LINDGREN | 3117 | 7/19/2011 | 7/19/2012 |
| 1T4752 | PRE-AMPLIFIER | MITEQ | JS44-18004000-35-8P | SEE NOTE | |
| 1T4745 | ANTENNA, HORN | ETS-LINDGREN | 3116 | 10/4/2011 | 10/4/2012 |
| 1T4394 | ISOLATION TRANSFORMER | TOPAZ | 91005-31 | SEE NOTE | |
| 1T4751 | ANTENNA – BILOG | SUNOL SCIENCES | JB6 | 11/3/2010 | 11/3/2011 |
| 1T4728 | PROGRAMMABLE AC POWER SOURCE | QUADTECH | 31010 | SEE NOTE | |
| 1T4409 | EMI RECEIVER | ROHDE & SCHWARZ | ESIB7 | 6/14/2011 | 6/14/2012 |
| 1T4568 | RADIATING NOISE SOURCE | MET LABORATORIES | N/A | SEE NOTE | |
| 1T4565 | LISN (24 AMP) | SOLAR ELECTRONICS | 9252-50-R-24-BNC | 10/28/2010 | 10/28/2011 |
| 1T4563 | LISN (24 AMP) | SOLAR ELECTRONICS | 9252-50-R-24-BNC | 10/6/2010 | 10/6/2011 |
| 1T2109 | RECEIVER, EMI, RECEIVER SECTION | HEWLETT PACKARD | 85462A | 1/7/2011 | 1/7/2012 |
| 1T4414 | MICROWAVE PRE-AMPLIFIER | A.H. SYSTEMS INC. | PAM-0118 | SEE NOTE | |
| 1T2108 | RECEIVER, EMI, FILTER SECTION | HEWLETT PACKARD | 85460A | 1/7/2011 | 1/7/2012 |
| 1S2602 | DFS SIGNAL GENERATOR | NATIONAL INSTRUMENTS | NIPXI-1042 | SEE NOTE | |
| 1T4502 | COMB GENERATOR | COM-POWER | CGC-255 | 10/6/2010 | 10/6/2011 |
| 1T4634 | THERMO/HYGRO/BAROMETER | CONTROL COMPANY | 02-401 | 3/11/2010 | 3/11/2012 |
| 1T4758 | THERMO-HYGROMETER | CONTROL COMPANY | 4040 | 5/21/2010 | 5/21/2012 |
| 1T4505 | TEMPERATURE CHAMBER | TEST EQUITY | 115 | 11/29/2010 | 11/29/2011 |

**Table 29. Test Equipment List**

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

# V. Certification & User's Manual Information

# Certification & User's Manual Information

## A. Certification Information

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

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

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

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

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

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

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

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

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

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

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

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

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

*(i) Compliance testing;*

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

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

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

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

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

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

## Certification & User's Manual Information

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

**§ 2.901 Basis and Purpose**

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

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

**§ 2.907 Certification.**

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

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

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

## Certification & User's Manual Information

### § 2.948 Description of measurement facilities.

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

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

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

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

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

# Certification & User's Manual Information

## Label and User's Manual Information

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

**§ 15.19 Labeling requirements.**

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

(1) Receivers associated with the operation of a licensed radio service, e.g., FM broadcast under Part 73 of this chapter, land mobile operation under Part 90, etc., shall bear the following statement in a conspicuous location on the device:

This device complies with Part 15 of the FCC Rules. Operation is subject to the condition that this device does not cause harmful interference.

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

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

(3) All other devices shall bear the following statement in a conspicuous location on the device:

*This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.*

(4) Where a device is constructed in two or more sections connected by wires and marketed together, the statement specified under paragraph (a) of this section is required to be affixed only to the main control unit.

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

**§ 15.21 Information to user.**

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

## Verification & User's Manual Information

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

**§ 15.105 Information to the user.**

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

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

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

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

– Reorient or relocate the receiving antenna.

– Increase the separation between the equipment and receiver.

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

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

## ICES-003 Procedural & Labeling Requirements

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

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

**Procedural Requirements:**

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

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

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

**Labeling Requirements:**

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

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

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

# End of Report