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May 05, 2020

GridPlus, Inc.
100 Congress Avenue, Suite 2025
Austin, Texas 78701

Dear Karl Kreder,

Enclosed is the EMC Wireless test report for compliance testing of the GridPlus, Inc., Lattice1 with WiFi Module as tested to the requirements of Title 47 of the CFR, Ch. 1 (10-1-06 ed.), Part 15 Subpart C for Intentional Radiators.

Thank you for using the services of Eurofins E&E North America. If you have any questions regarding these results or if Eurofins can be of further service to you, please feel free to contact me.

Sincerely yours,
EUROFINS E&E NORTH AMERICA

Angela D. Kekovski

Angela D. Kekovski
Documentation Department

Reference: (\GridPlus, Inc.\EMCA102875B-FCC247 Rev. 1)

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# Electromagnetic Compatibility Criteria
# Test Report

for the

**GridPlus, Inc.**
**Lattice1 with WiFi Module**

**Tested under**
the FCC Certification Rules
contained in
15.247 Subpart C for Intentional Radiators

**Report: EMCA102875B-FCC247 Rev. 1**

May 05, 2020

**Prepared For:**

**GridPlus, Inc.**
**100 Congress Avenue, Suite 2025**
**Austin, Texas 78701**

**Prepared By:**
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13501 McCallen Pass
Austin, TX 78753

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# Electromagnetic Compatibility Criteria
# Test Report

for the

## GridPlus, Inc.
## Lattice1 with WiFi Module

**Tested under**
the FCC Certification Rules
contained in
15.247 Subpart C for Intentional Radiators

Jonathan Tavira, Project Engineer
Electromagnetic Compatibility Lab

Angela D. Kekovski
Documentation Department

**Engineering Statement:** The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of the FCC Rules Part 15.247 under normal use and maintenance.

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# Report Status Sheet

| Revision | Report Date | Reason for Revision |
|---|---|---|
| ∅ | January 6, 2020 | Initial Issue. |
| 1 | March 13, 2020 | TCB Comments. |
| 2 | May 5, 2020 | TCB Comments. |

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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 |
| **NEBS** | **N**etwork **E**quipment-**B**uilding **S**ystem |
| **PRF** | **P**ulse **R**epetition **F**requency |
| **RF** | **R**adio **F**requency |
| **RMS** | **R**oot-**M**ean-**S**quare |
| **TWT** | **T**raveling **W**ave **T**ube |
| **V/m** | **V**olts **per m**eter |
| **VCP** | **V**ertical **C**oupling **P**lane |


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# I. Executive Summary

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## A. Purpose of Test

An EMC evaluation was performed to determine compliance of the GridPlus, Inc. Lattice1 with WiFi Module, with the requirements of Part 15, §15.247. All references are to the most current version of Title 47 of the Code of Federal Regulations in effect. In accordance with §2.1033, the following data is presented in support of the Certification of the Lattice1 with WiFi Module. GridPlus, Inc. should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the Lattice1 with WiFi Module, has been **permanently** discontinued.

## B. Executive Summary

The following tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 15, §15.247, in accordance with GridPlus, Inc., purchase order number 00123. All tests were conducted using measurement procedure ANSI C63.10:2013

| FCC Reference<br>47 CFR Part 15.247 | Description | Compliance |
|---|---|---|
| Title 47 of the CFR, Part 15 §15.203 | Antenna Requirement | Compliant |
| Title 47 of the CFR, Part 15 §15.207(a) | Conducted Emission Limits | Compliant |
| Title 47 of the CFR, Part 15 §15.247(a)(2) | 6dB Occupied Bandwidth | Compliant |
| Title 47 of the CFR, Part 15 §15.247(b) | Peak Power Output | Compliant |
| Title 47 of the CFR, Part 15 §15.247(c) | Spurious Emissions in Non-restricted Bands | Compliant |
| Title 47 of the CFR, Part 15 §15.247(d); §15.209; §15.205 | Radiated Spurious Emissions Requirements | Compliant |
| Title 47 of the CFR, Part 15; §15.247(e) | Peak Power Spectral Density | Compliant |
| Title 47 of the CFR, Part 15 §15.247(i) | RF Human Exposure, SAR Exclusion | Compliant |

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

Eurofins MET Laboratories Inc. (Eurofins E&E North America) is part of the Eurofins Electrical & Electronics (E&E) global compliance network.


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# II. Equipment Configuration


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# A. Overview

Eurofins E&E North America was contracted by GridPlus, Inc. to perform testing on the Lattice1 with WiFi Module, under GridPlus, Inc.'s purchase order number 00123.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the GridPlus, Inc., Lattice1 with WiFi Module.

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

| | | |
|---|---|---|
| **Model(s) Tested:** | Lattice1 with WiFi Module | |
| **Model(s) Covered:** | Lattice1 with WiFi Module | |
| **EUT Specifications:** | Primary Power: 12 VDC | |
| | FCC ID: 2AT2CBRINKOFBAILOUT | |
| | Type of Modulations: | 802.11b/g (20 MHz) |
| | Equipment Code: | DTS |
| | Peak RF Output Power: | 15.80 dBm |
| | EUT Frequency Ranges: | 2412-2462 MHz |
| | Antenna Type: | PCB Etched – Invert F Type |
| | Antenna Gain: | 3.3 dBi |
| | Firmware Version: | k8x_firmware_production, safe-card, gpd |
| **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:** | Jonathan Tavira | |
| **Report Date(s):** | May 05, 2020 | |

**Table 2. EUT Summary Table**


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## B. References

| | |
|---|---|
| **CFR 47, Part 15, Subpart C** | Federal Communication Commission, Code of Federal Regulations, Title 47, Part 15: General Rules and Regulations, Allocation, Assignment, and Use of Radio Frequencies |
| **ANSI C63.4:2014** | Methods and Measurements of Radio-Noise Emissions from Low-Voltage Electrical And Electronic Equipment in the Range of 9 kHz to 40 GHz |
| **ISO/IEC 17025:2017** | General Requirements for the Competence of Testing and Calibration Laboratories |
| **ANSI C63.10-2013** | American National Standard for Testing Unlicensed Wireless Devices |
| **KDB 558074 v04** | Guidance For Performing Compliance Measurements On Digital Transmission Systems (DTS) Operating Under Section 15.247 |

**Table 3. References**

## C. Test Site

Eurofins MET Laboratories Inc. (Eurofins E&E North America) is part of the Eurofins Electrical & Electronics (E&E) global compliance network.

All testing was performed at Eurofins E&E North America, 13501 McCallen Pass, Austin, TX 78753. 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 Eurofins E&E North America.

## D. Measurement Uncertainty

| Test Method | Typical Expanded Uncertainty | K | Confidence Level |
|---|---|---|---|
| **RF Frequencies** | ±4.52 Hz | 2 | 95% |
| **RF Power Conducted Emissions** | ±2.32 dB | 2 | 95% |
| **RF Power Conducted Spurious Emissions** | ±2.25 dB | 2 | 95% |
| **RF Power Radiated Emissions** | ±3.01 dB | 2 | 95% |

**Table 4. Uncertainty Calculations Summary**


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## E. Description of Test Sample

The GridPlus, Inc. Lattice1 with WiFi Module, Equipment Under Test (EUT), is an anti-tamper consumer electronic security device which is used for verifying and signing cryptographic messages usually related to blockchains. While waiting for either an external signature request or locally initiated request (via onboard screen input) the device generally sits idle. The device saves signing privileges on an internal flash chip, checks signing requests against those privileges, and then uses a smart card chip for signing the requested message. The Lattice1 with WiFi Module can receive requests via WiFi, ZigBee, Ethernet, or the touch screen interface. The Lattice1 with WiFi Module is intended to be used by consumers in residences as well as IT and finance professionals in an office building.

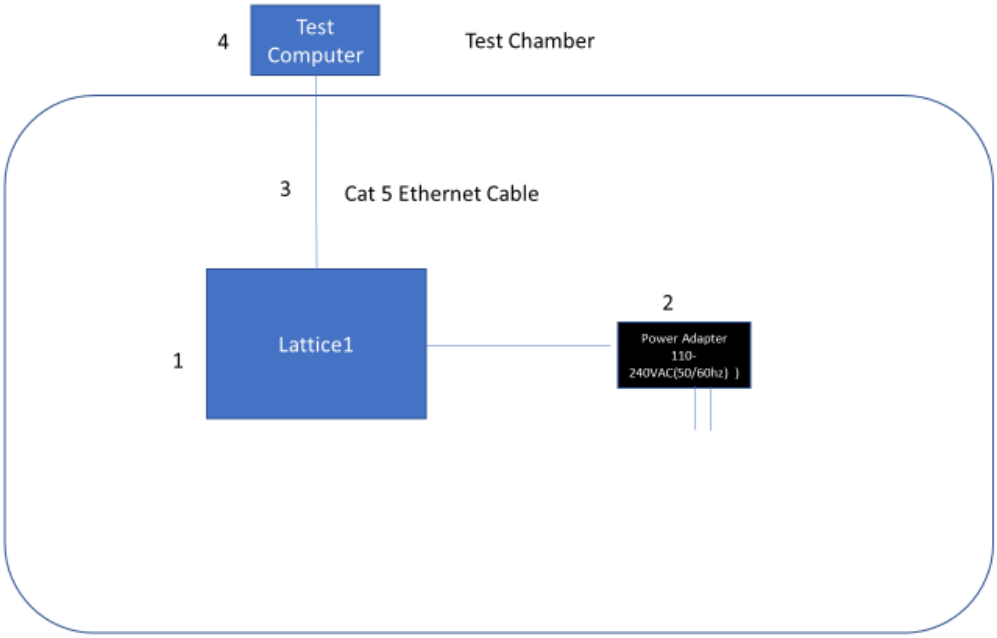


**Figure 1. Block Diagram of Test Configuration**


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## F. Equipment Configuration

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

| Ref. ID | Slot # | Name / Description | Model Number | Serial Number | Revision |
|---|---|---|---|---|---|
| 1 | Lattice1 | GridPlus Inc. | GPLattice1 00 | | |

**Table 5. Equipment Configuration**

## G. Support Equipment

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

| Ref. ID | Name / Description | Manufacturer | Model Number | *Customer Supplied Calibration Data |
|---|---|---|---|---|
| 2 | 110-240VAC (50/60hz) Power Adapter | Shenzhen Teng Da Xing Electronic Co., Ltd | NA | |
| 3 | Cat5 Ethernet Cord | Ningbo Lucktech Electronics Co.,Ltd | TDK1201000 | |
| 4 | Test Computer | | | |
| The 'Customer Supplied Calibration Data' column will be marked as either not applicable, not available, or will contain the calibration date supplied by the customer. | | | | |

**Table 6. Support Equipment**

## H. Ports and Cabling Information

| Ref. ID | Port name on EUT | Cable Description or reason for no cable | Qty | Length as tested (m) | Max Length (m) | Shielded? (Y/N) | Termination Box ID & Port Name |
|---|---|---|---|---|---|---|---|
| 1 | AC Input | 2m AC/DC power adapter | 1 | 2 | 2 | No | |
| 2 | Ethernet Port | 2m Ethernet Cable | 1 | 2 | 2 | No | |

**Table 7. Ports and Cabling Information**

## I. Mode of Operation

Operation Test Mode – The Lattice1 will monitor both the WiFi, ZigBee, and Ethernet for requests. The Lattice1 will internally generate events emulating both external requests and direct user interactions once every 10 seconds. These events will cause the Lattice1 to behave in a manner similar to if the requests were received via user interaction. The requests will include processes which cause all of the subsystems to be exercised as if a user event was received, including the SPI buses, internal memory, the user interface, the smart card interface, the graphics processor, the Linux environment, the ethernet interface, and the SD card. This is level of event generation is 100 times more frequent than typical operation by a user.

Radio Test Mode – The Lattice1 will operate normally except for the operation of the WiFi and ZigBee interfaces. The radios will be controllable via the ethernet connection and an external computer. All channels, power levels, frequency and modulation will be set by the external computer.

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## J. Method of Monitoring EUT Operation

The Lattice1 will be in Operation test mode when:

1. The screen changes without user interaction approximately once every 10 seconds.

The Lattice1 will be in Radio Test Mode when:

1. The WiFi test tool is running on connected computer and responsive to inputs.

The ZigBee test tool is running on connected computer and responsive to inputs.

## K. 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.

## L. Disposition of EUT

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


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# III. Electromagnetic Compatibility Criteria for Intentional Radiators


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## 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 EUT utilizes an etched PCB antenna, which is to be considered permanently attached to the EUT.

**Test Engineer(s):** Jonathan Tavira

**Test Date(s):** October 7, 2019

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# Electromagnetic Compatibility Criteria for Intentional Radiators

## § 15.207(a) 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- 0.5 | 66 - 56 | 56 - 46 |
| 0.5 - 5 | 56 | 46 |
| 5 - 30 | 60 | 50 |

**Table 8. Conducted Limits for Intentional Radiators from FCC Part 15 § 15.207(a)**

**Test Procedure:** The EUT was placed on a 0.8 m-high wooden table inside a screen room. The EUT was situated such that the back of the EUT was 0.4 m from one wall of the vertical ground plane, and the remaining sides of the EUT were no closer than 0.8 m from any other conductive surface. The EUT was powered from a 50 Ω/50 μH Line Impedance Stabilization Network (LISN). The EMC receiver scanned the frequency range from 150 kHz to 30 MHz. Conducted Emissions measurements were made in accordance with *ANSI C63.10:2013* The measurements were performed over the frequency range of 0.15 MHz to 30 MHz using a 50 Ω/50 μH LISN as the input transducer to an EMC/field intensity meter. For the purpose of this testing, the transmitter was turned on. Scans were performed with the transmitter on.

**Test Results:** The EUT was compliant with this requirement. Emissions were below applicable limits.

**Test Engineer(s):** Jonathan Tavira

**Test Date(s):** 8/26/19

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**Sample Calculation:**

Rr – S = M

where:

Rr = Receiver Reading in dBµV
S = Specification Limit in dBµV
M = Margin to Specification in +/- dB

**Sample formula for calculating the Corrected Data for the Conducted Emissions Measurements:**

| Line | Freq (MHz) | Uncorrected QP** Amplitude (dBµV) | LISN IL (dB) | CBL (dB) | Corrected QP** Amplitude (dBµV) | QP** Limit (dBµV) | Delta (dB) | Results |
|---|---|---|---|---|---|---|---|---|
| XYZ | 0.18 | 42.65 | 10 | 0.58 | 53.23 | 79 | -25.77 | Pass |

*Corrected QP** Amplitude (dBµV) = Uncorrected Amplitude (dBµV) +LISN IL (dB) + CBL (dB)=42.65+10+0.58=53.23*
*** Same Calculation applies to Corrected Avg. amplitude as well.*


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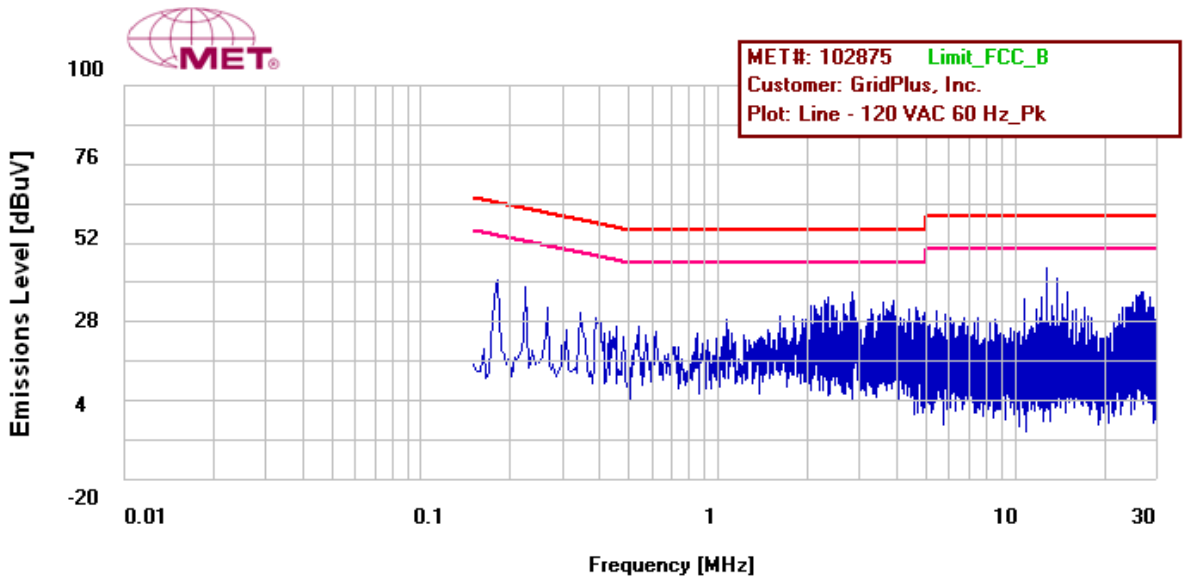
## 15.207(a) Conducted Emissions Test Results

| Line | Freq (MHz) | QP Amplitude | QP Limit | Delta | Pass | Average Amplitude | Average Limit | Delta | Pass |
|---|---|---|---|---|---|---|---|---|---|
| Line - 120VAC 60Hz | 4.478 | 29.04 | 56 | -26.96 | Pass | 15.6 | 46 | -30.4 | Pass |
| Line - 120VAC 60Hz | 12.902 | 43.94 | 60 | -16.06 | Pass | 37.47 | 50 | -12.53 | Pass |
| Line - 120VAC 60Hz | 13.978 | 41.51 | 60 | -18.49 | Pass | 37.39 | 50 | -12.61 | Pass |
| Line - 120VAC 60Hz | 0.182 | 39.98 | 64.398 | -24.418 | Pass | 21.47 | 54.398 | -32.928 | Pass |
| Line - 120VAC 60Hz | 0.226 | 36.45 | 62.605 | -26.155 | Pass | 20.08 | 52.605 | -32.525 | Pass |
| Line - 120VAC 60Hz | 15.054 | 38.71 | 60 | -21.29 | Pass | 36.13 | 50 | -13.87 | Pass |

**Table 9. Conducted Emissions, 15.207(a), Phase Line, Test Results**




**Plot 1. Conducted Emissions, 15.207(a), Phase Line**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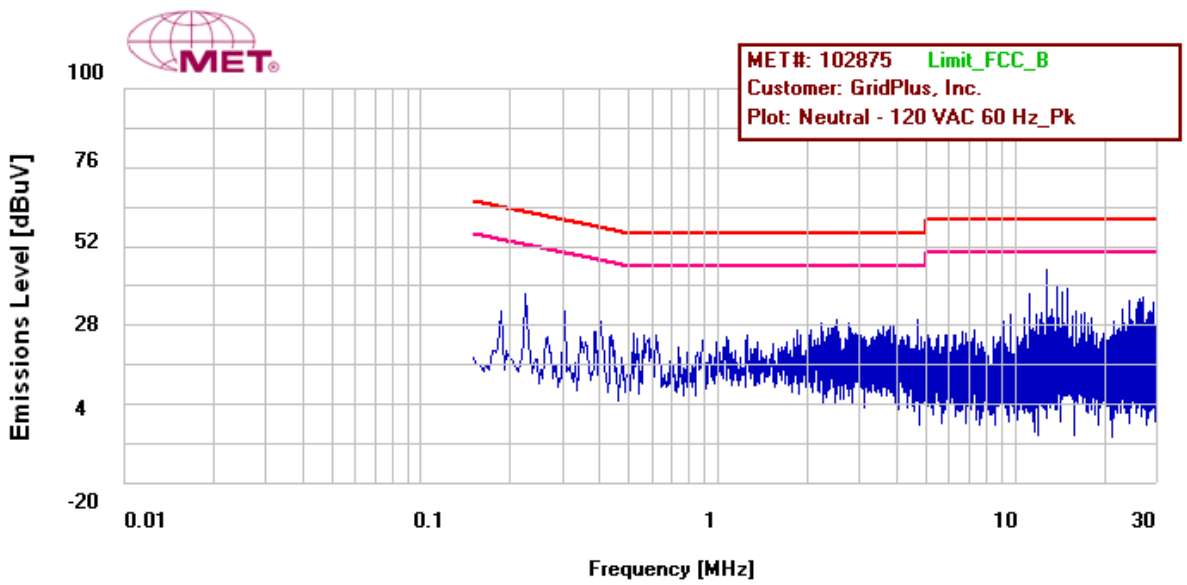
## 15.207(a) Conducted Emissions Test Results

| Line | Freq (MHz) | QP Amplitude | QP Limit | Delta | Pass | Average Amplitude | Average Limit | Delta | Pass |
|---|---|---|---|---|---|---|---|---|---|
| Neutral - 120VAC 60Hz | 12.906 | 43.75 | 60 | -16.25 | Pass | 36.29 | 50 | -13.71 | Pass |
| Neutral - 120VAC 60Hz | 13.982 | 41.15 | 60 | -18.85 | Pass | 35.72 | 50 | -14.28 | Pass |
| Neutral - 120VAC 60Hz | 15.054 | 39.49 | 60 | -20.51 | Pass | 37.02 | 50 | -12.98 | Pass |
| Neutral - 120VAC 60Hz | 14.514 | 40.03 | 60 | -19.97 | Pass | 35.05 | 50 | -14.95 | Pass |
| Neutral - 120VAC 60Hz | 0.226 | 36.31 | 62.605 | -26.295 | Pass | 21.26 | 52.605 | -31.345 | Pass |
| Neutral - 120VAC 60Hz | 11.290 | 37.95 | 60 | -22.05 | Pass | 30.82 | 50 | -19.18 | Pass |

**Table 10. Conducted Emissions, 15.207(a), Neutral Line, Test Results**




**Plot 2. Conducted Emissions, 15.207(a), Neutral Line**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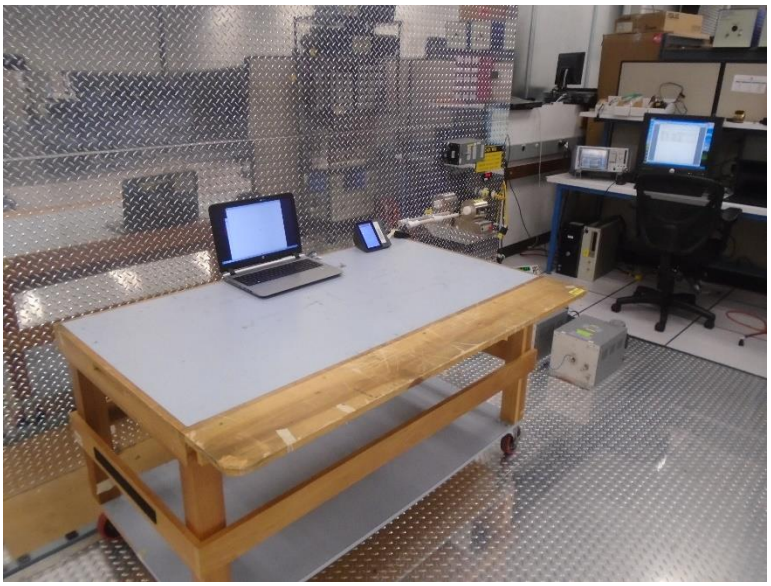
## 15.207(a) Conducted Emissions Test Setup Photo

**Photograph 1. Conducted Emissions, 15.207(a), Test Setup, Rear View**



**Photograph 2. Conducted Emissions, 15.207(a), Test Setup, Front View**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## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.247(a)(2) 6 dB Bandwidth

**Test Requirements:** **§ 15.247(a)(2):** Operation under the provisions of this section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

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

**Test Procedure:** The EUT was connected to a spectrum analyzer through a cable and an attenuator. Measurements were taken with the EUT set to transmit continuously on its low, mid, and high channels for all its bandwidths. The 6dB bandwidth was measured according to measurement method 11.8.2 Option 2 of ANSI C63.10-2013**.**

**Test Results** The EUT was compliant with § 15.247 (a)(2).

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

**Test Engineer(s):** Jonathan Tavira

**Test Date(s):** 7/17/19

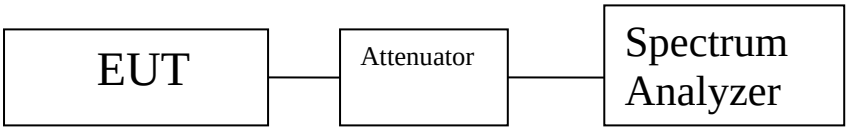


**Figure 2. Block Diagram, Occupied Bandwidth Test Setup**

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## Occupied Bandwidth Test Results

| Occupied Bandwidth | | | |
|---|---|---|---|
| **Mode** | **Frequency (MHz)** | **Measured 6dB Bandwidth (MHz)** | **Limit (MHz)** |
| 802.11b | 2412 | 9.617 | ≥ 0.500 |
| 802.11b | 2437 | 9.145 | ≥ 0.500 |
| 802.11b | 2462 | 9.173 | ≥ 0.500 |
| 802.11g | 2412 | 16.370 | ≥ 0.500 |
| 802.11g | 2437 | 16.137 | ≥ 0.500 |
| 802.11g | 2462 | 16.137 | ≥ 0.500 |

**Table 11. 6 dB Occupied Bandwidth, Test Results**


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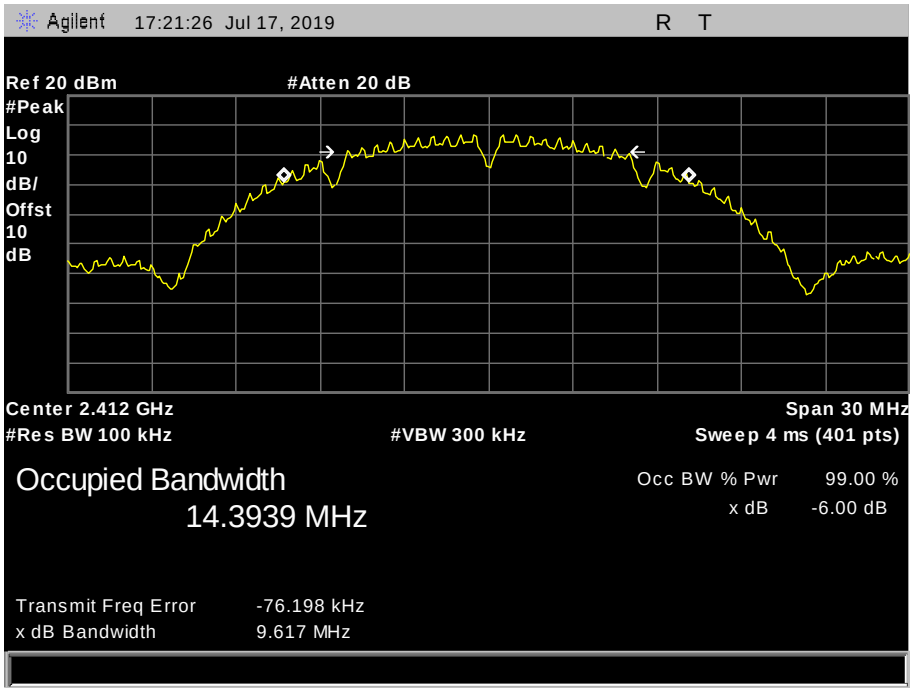
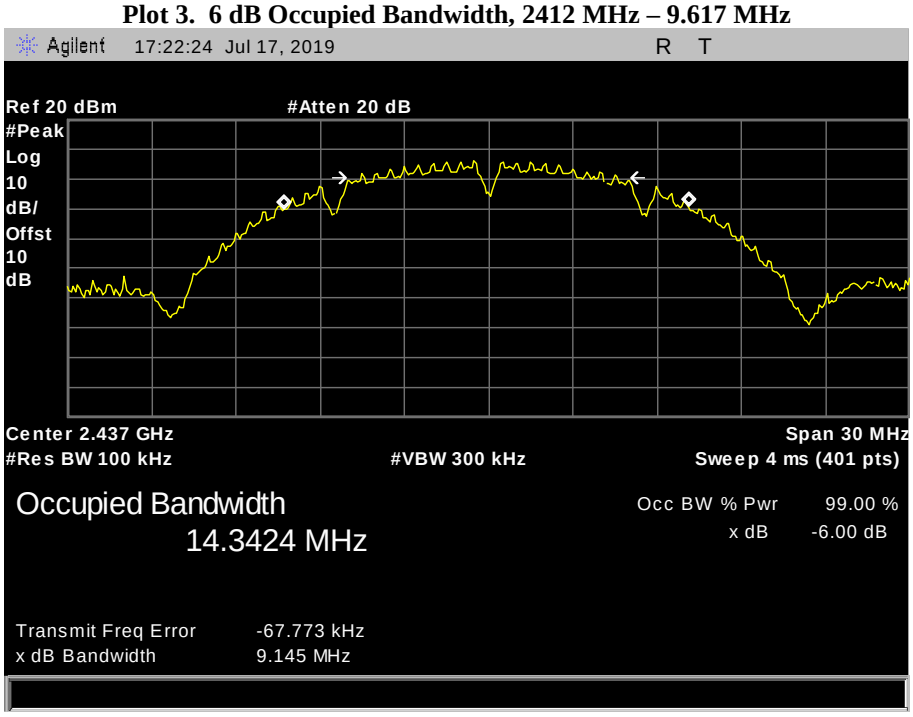
## 6 dB Occupied Bandwidth Test Results




**Plot 3. 6 dB Occupied Bandwidth, 2412 MHz – 9.617 MHz**




**Plot 4. 6 dB Occupied Bandwidth, 2437 MHz – 9.145 MHz**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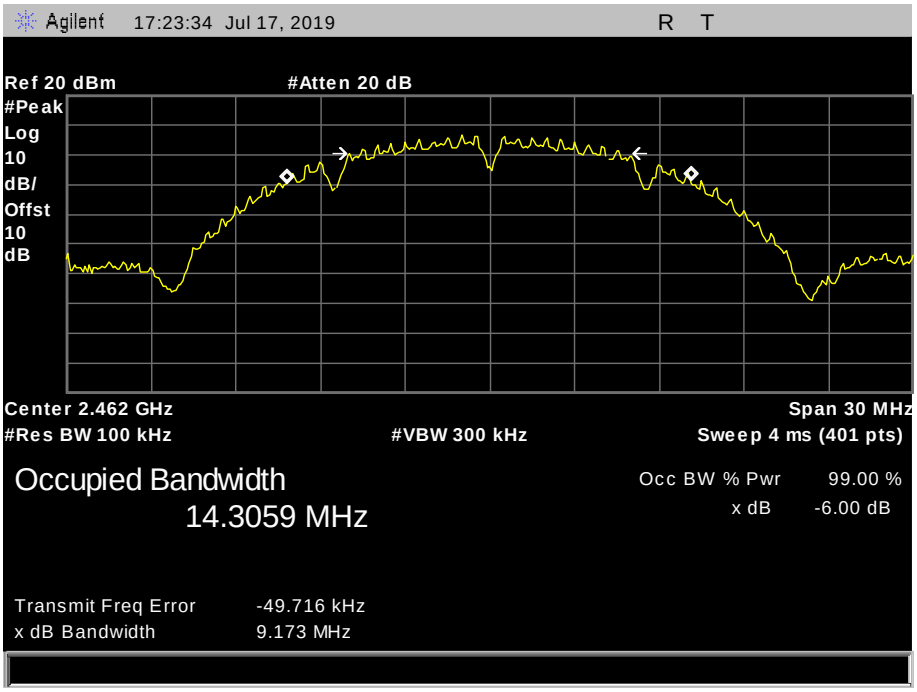
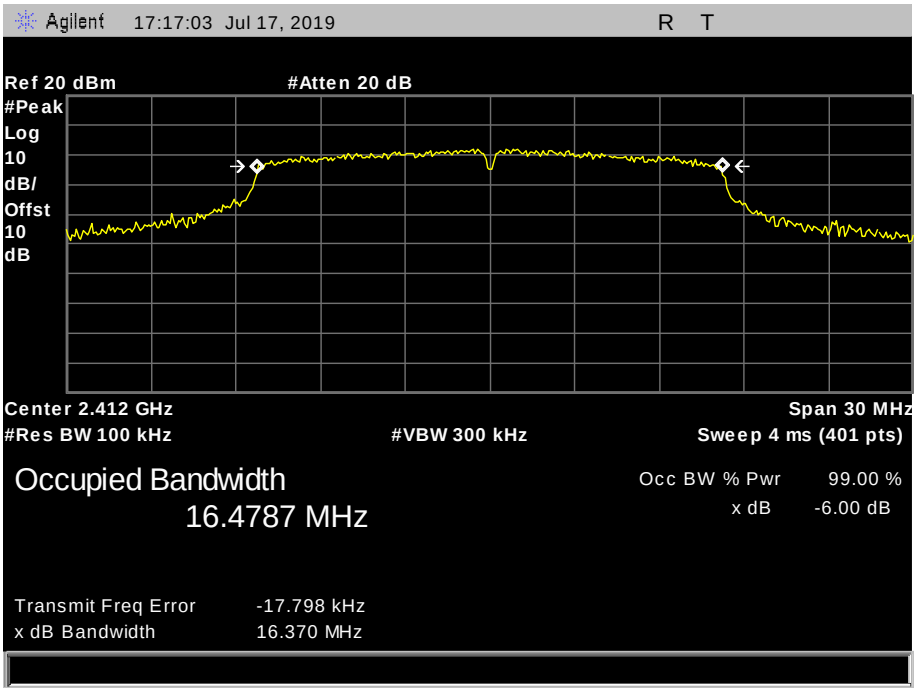



**Plot 5. 6 dB Occupied Bandwidth, 2462 MHz – 9.145 MHz**




**Plot 6. 6 dB Occupied Bandwidth, 2412 MHz – 16.370 MHz**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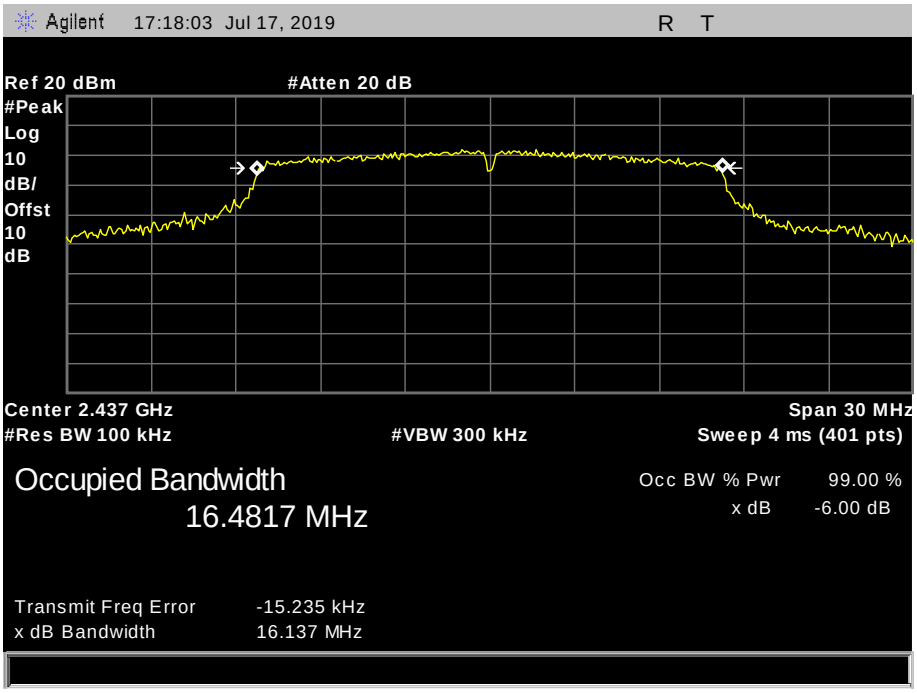
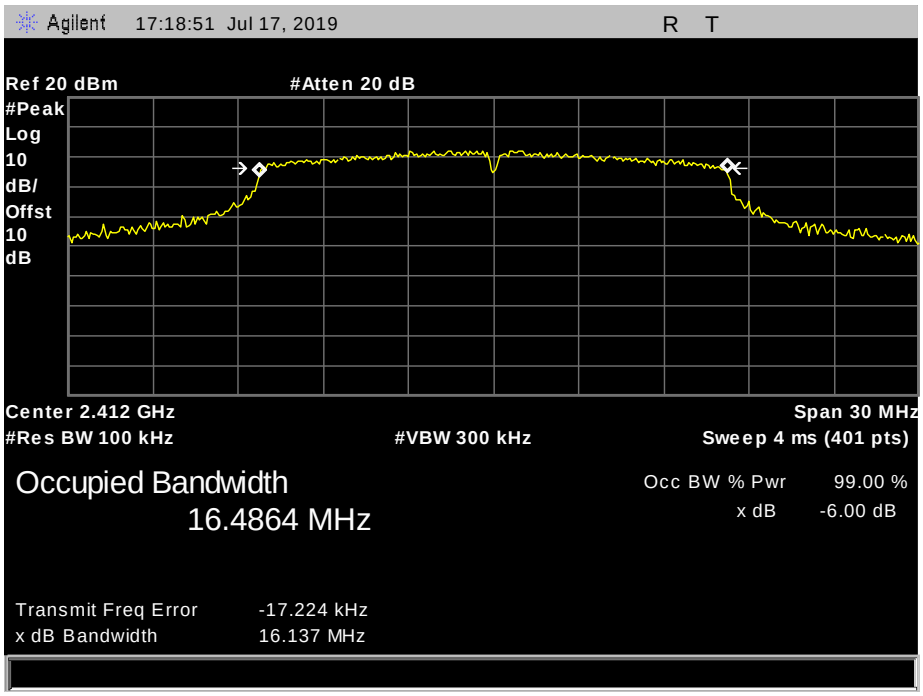



**Plot 7. 6 dB Occupied Bandwidth, 2437 MHz – 16.137 MHz**




**Plot 8. 6 dB Occupied Bandwidth, 2462 MHz – 16.137 MHz**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## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.247(b) Maximum Conducted Output Power

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

| Digital Transmission Systems (MHz) | Output Limit (Watts) |
|---|---|
| 2400–2483.5 | 1.000 |

**Table 12. Output Power Requirements from §15.247(b)**

**§15.247(c):** if transmitting antennas of directional gain greater than 6 dBi are used the peak output power from the intentional radiator shall be reduced below the stated values in the 9, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

**Test Procedure:** The EUT was connected to a spectrum analyzer through a cable and an attenuator. Measurements were taken with the EUT set to transmit continuously on its low, mid, and high channels for all its bandwidths at maximum power. Power was measured according to measurement method AVGSA-2, as described in ANSI C63.10-2013, section 11.9.2.2.4. Attenuator, and cables loss were programmed into the spectrum analyzer.

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

**Test Engineer(s):** Jonathan Tavira

**Test Date(s):** 7/17/19

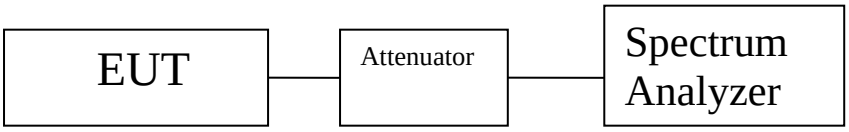


**Figure 3. Block Diagram, Maximum Conducted Output Power Test Setup**


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## Maximum Conducted Output Power Test Results

| Maximum Conducted Output Power | | |
|---|---|---|
| **Mode** | **Frequency (MHz)** | **Measured Conducted (Average) Output Power dBm** |
| 802.11b | 2412 | 15.80 |
| 802.11b | 2437 | 15.59 |
| 802.11b | 2462 | 15.79 |
| 802.11g | 2412 | 15.11 |
| 802.11g | 2437 | 14.72 |
| 802.11g | 2462 | 14.81 |

**Table 13. Maximum Conducted Output Power, Test Results**


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# Maximum Conducted Output Power Test Results

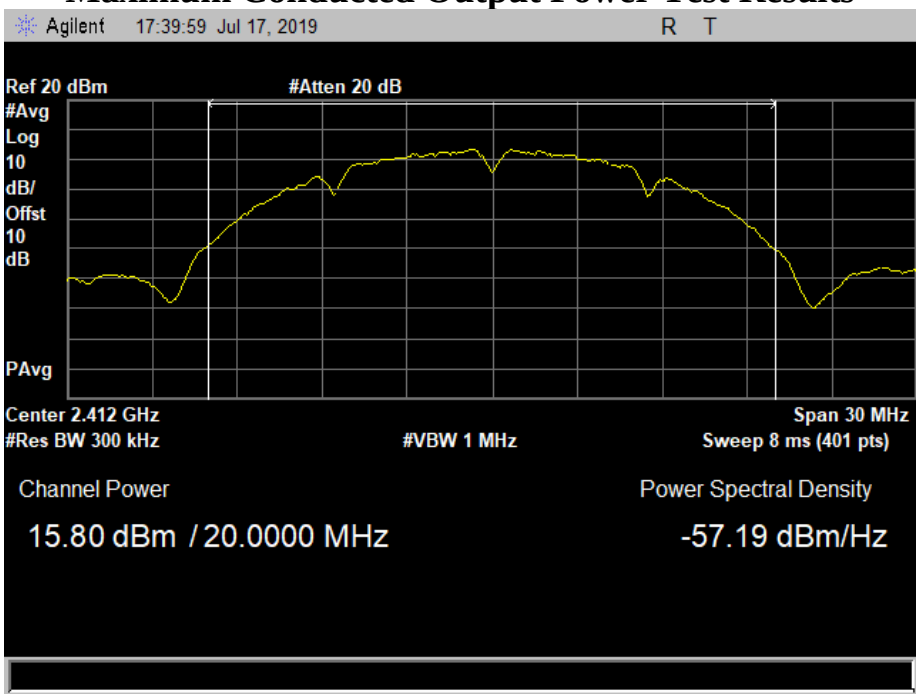


**Figure 4. Maximum (Average) Output Power, 802.11b,2412 MHz , 15.80 dBm**

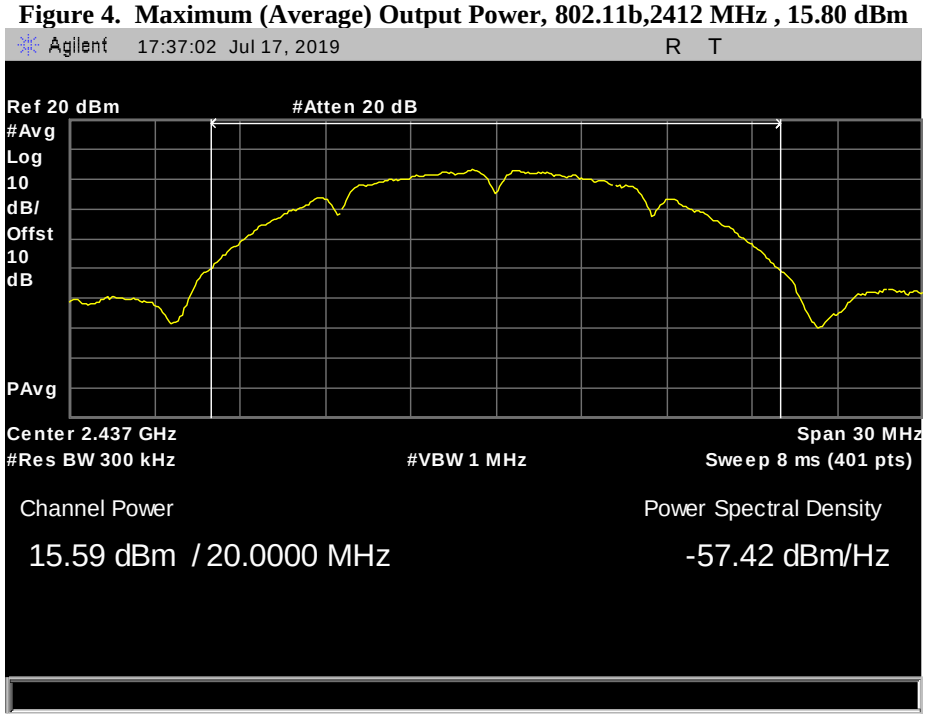


**Figure 5. Maximum (Average) Output Power,802.11b, 2437 MHz, 15.59 dBm**


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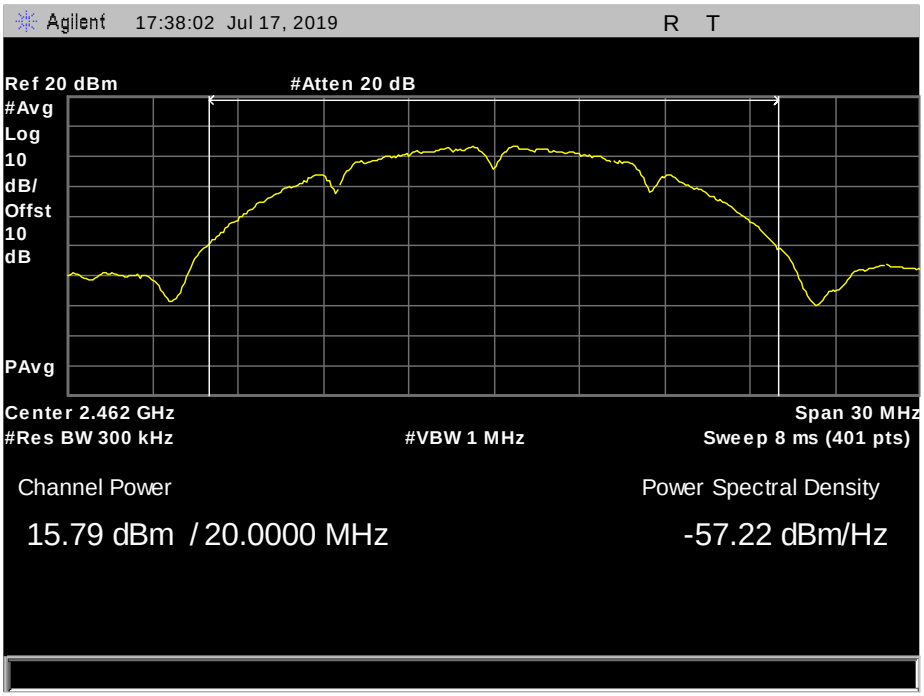


**Figure 6. Maximum (Average) Output Power, 802.11b, 2462 MHz , 15.79 dBm**

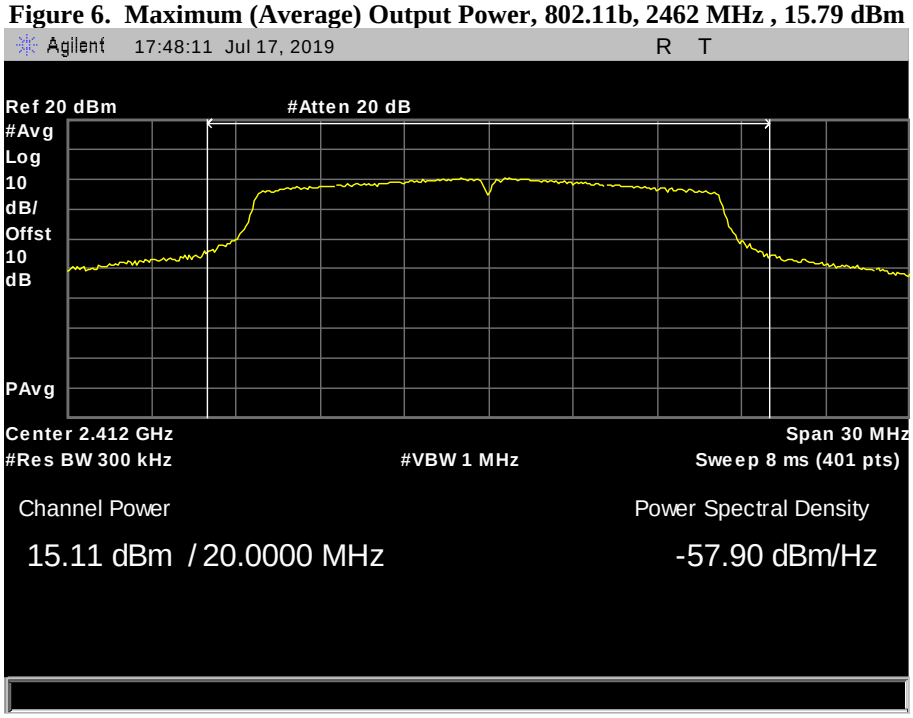


**Figure 7. Maximum (Average) Output Power 802.11g,, 2412 MHz , 15.11 dBm**


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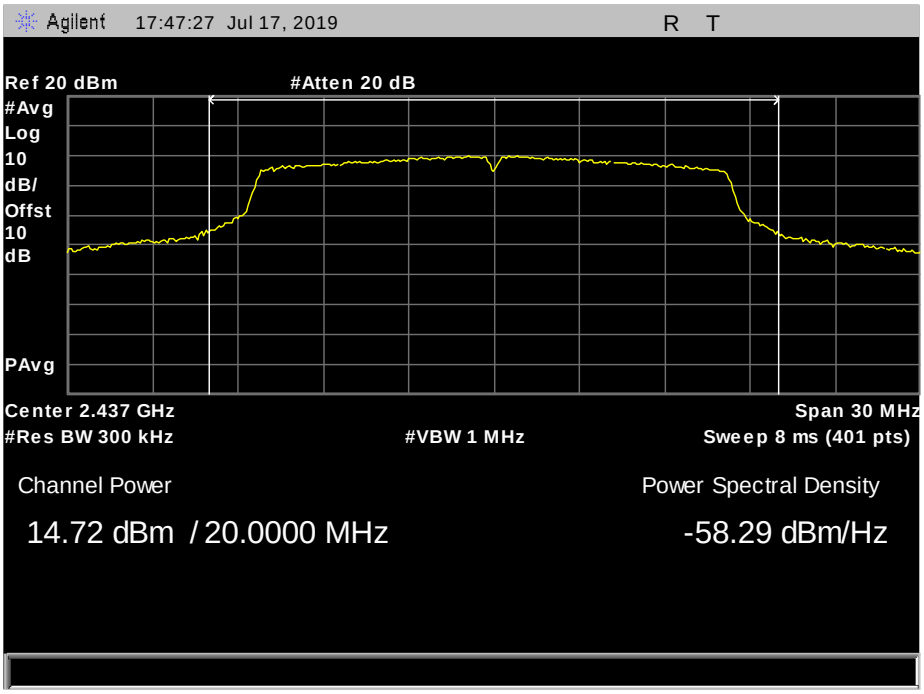


**Figure 8. Maximum (Average) Output Power,802.11g, 2437 MHz , 14.72 dBm**

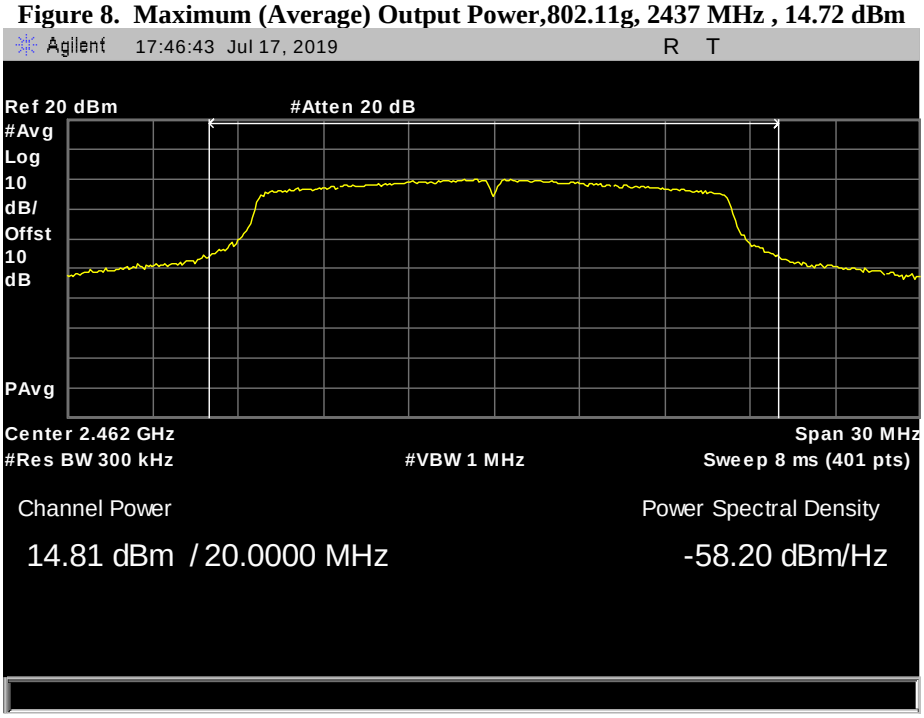


**Figure 9. Maximum (Average) Output Power , 802.11g, 2462 MHz , 14.81 dBm**


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# Electromagnetic Compatibility Criteria for Intentional Radiators

## § 15.209 Radiated Spurious Emissions Requirements and Band Edge

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

**§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 14. Restricted Bands of Operation**

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

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**Test Requirement(s):** **§ 15.209 (a):** Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in Table 15.

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

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

**Test Procedures:** The transmitter was turned on. Measurements were performed of the low, mid and high Channels. The EUT was rotated orthogonally through all three axes. Plots shown are corrected for both antenna correction factor and distance and compared to a 3 m limit line. Only noise floor was measured above 18 GHz.

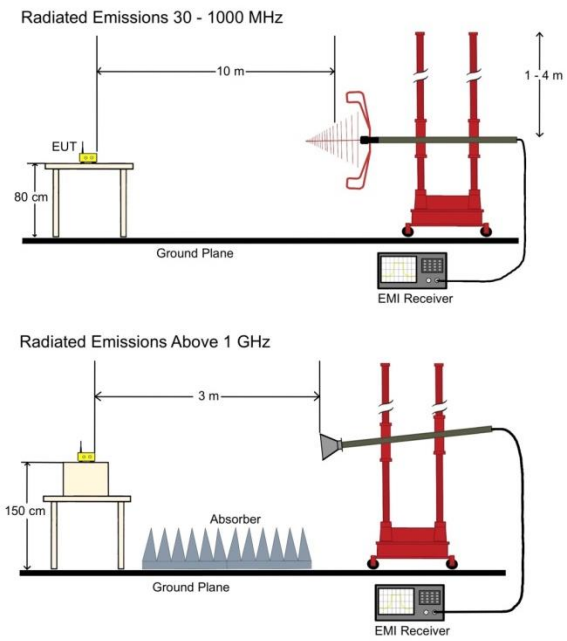


**Figure 10. Radiated Emissions Test Setup**

**Test Results:** The EUT was compliant with the Radiated Spurious Emission limits of **§ 15.247(d) and § 15.209**. Emissions were within applicable limits.

**Test Engineer(s):** Jonathan Tavira

**Test Date(s):** 7/10-11/19

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**Sample Calculation for Distance Correction factor (DCF) measurement:**

$$F_d = 20*LOG_{10}(D_m/D_s)$$

where:

$F_d$ = Distance Factor in dB

$D_m$ = Measurement Distance in meters

$D_s$ = Specification Distance in meters

**Sample formula for calculating the Corrected Data for the Radiated Emissions Measurements:**

| Frequency (MHz) | Antenna Polarity | EUT Azimuth (Degrees) | Antenna Height (cm) | Uncorrected Amplitude (dBµV/m) | ACF (dB/m) (+) | Pre Amp Gain + CBL (dB)(-) | DCF (dB) (+) | Corrected Amplitude (dBµV/m) | Limit (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|---|
| 249.99 | V | 359.9 | 240.7 | 55.46 | 11.4 | 28.335 | 10.46 | ***38.525*** | 47 | -8.475 |

*Corrected Amplitude (dBµV/m) = Uncorrected Amplitude (dBµV/m) +ACF (dB/m) – (Preamp Gain (dB) + CBL (dB) +DCF (dB) ** = 55.46 + 11.4 – 28.355 + 10.46 =* ***38.525***

*** DCF Column represents the appropriate correction factor used when the measurement distance differs from the specification distance.*


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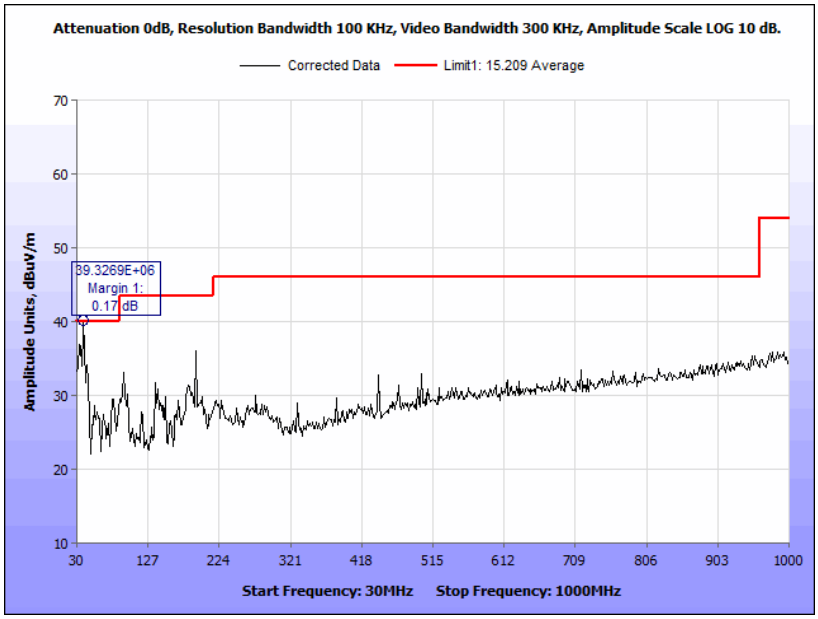
## Radiated Spurious Emissions, Test Results




*Note: Peak Emissions that appear over the 15.209 spurious limits were determined to be sourced from digital devices unrelated to the transmitter

**Figure 11. Radiated Emissions, 802.11b, 2412 MHz, 30 – 1000 MHz, Vertical**

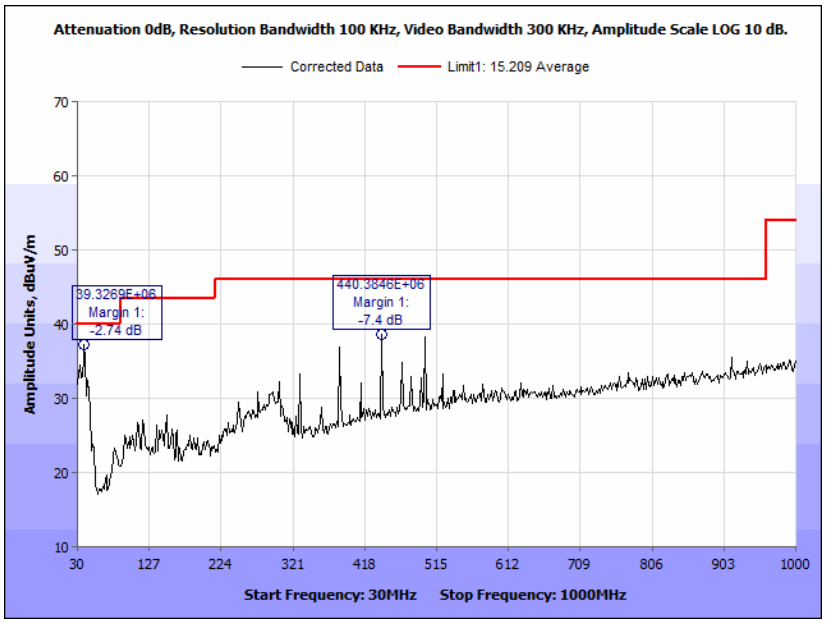



**Figure 12. Radiated Emissions, 802.11b, 2412 MHz, 30 – 1000 MHz, Horizontal**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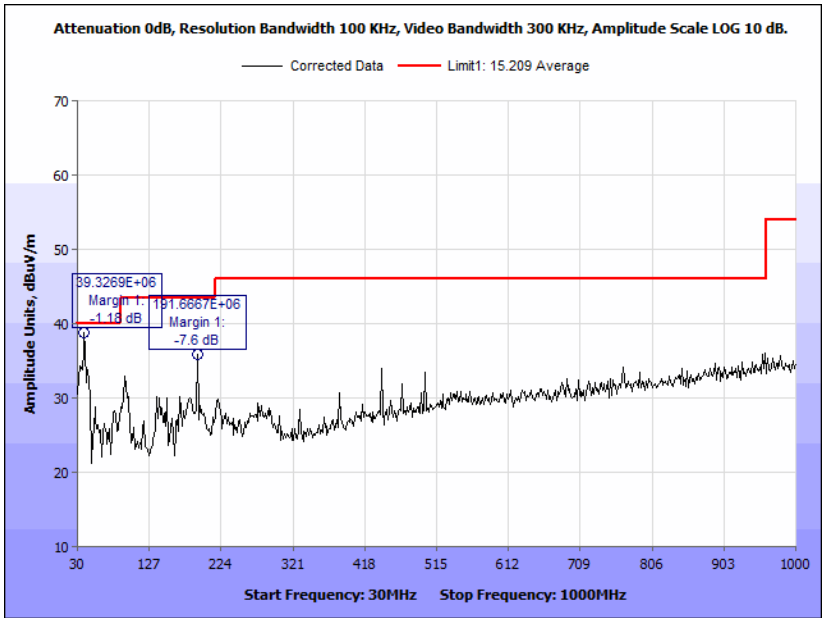


**Figure 13. Radiated Emissions, 802.11b, 2437 MHz, 30 – 1000 MHz, Vertical**

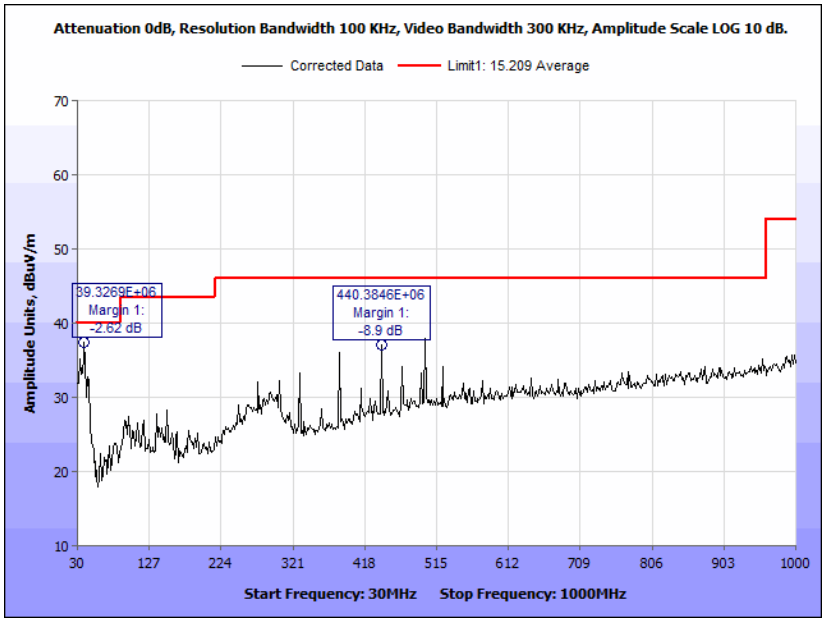


**Figure 14. Radiated Emissions, 802.11b, 2437 MHz, 30 – 1000 MHz, Horizontal**


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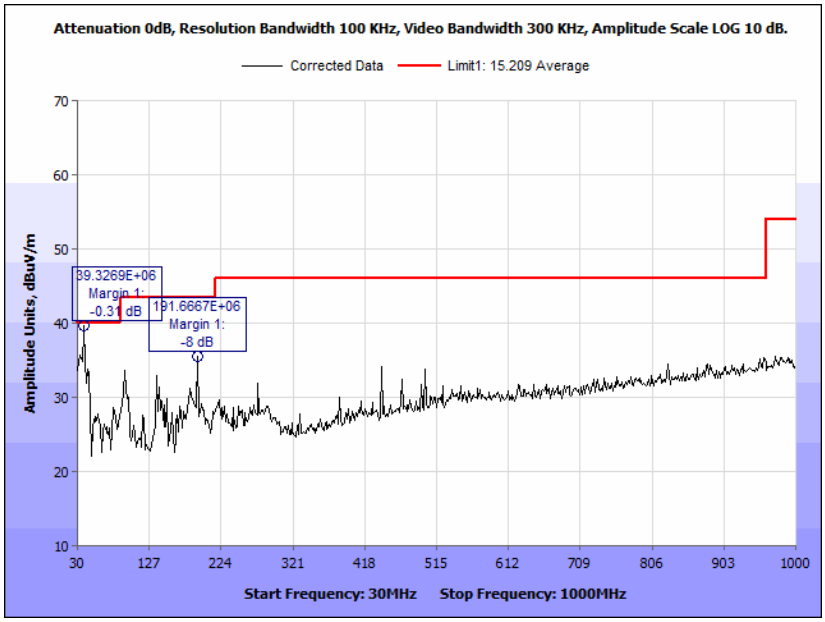


**Figure 15. Radiated Emissions, 802.11b, 2462 MHz, 30 – 1000 MHz, Vertical**

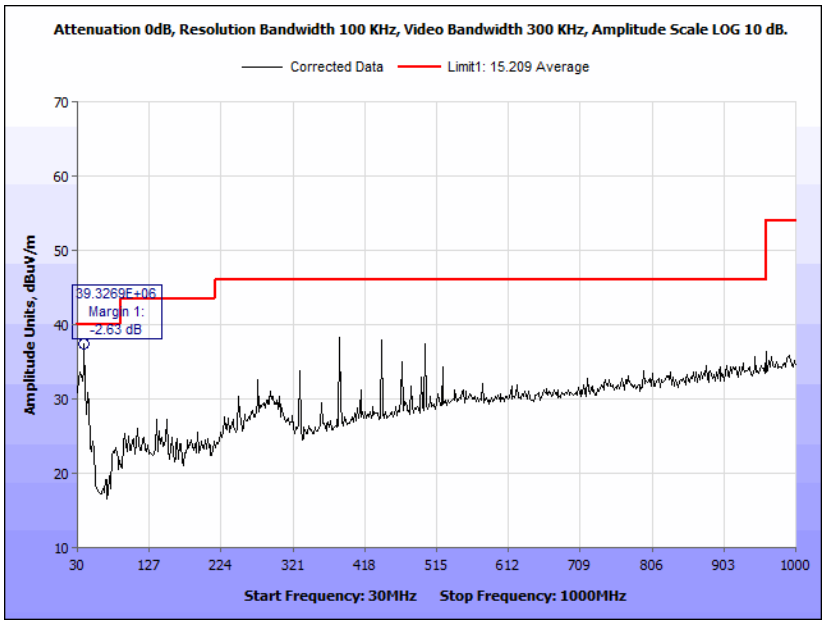


**Figure 16. Radiated Emissions, 802.11b, 2462 MHz, 30 – 1000 MHz, Horizontal**


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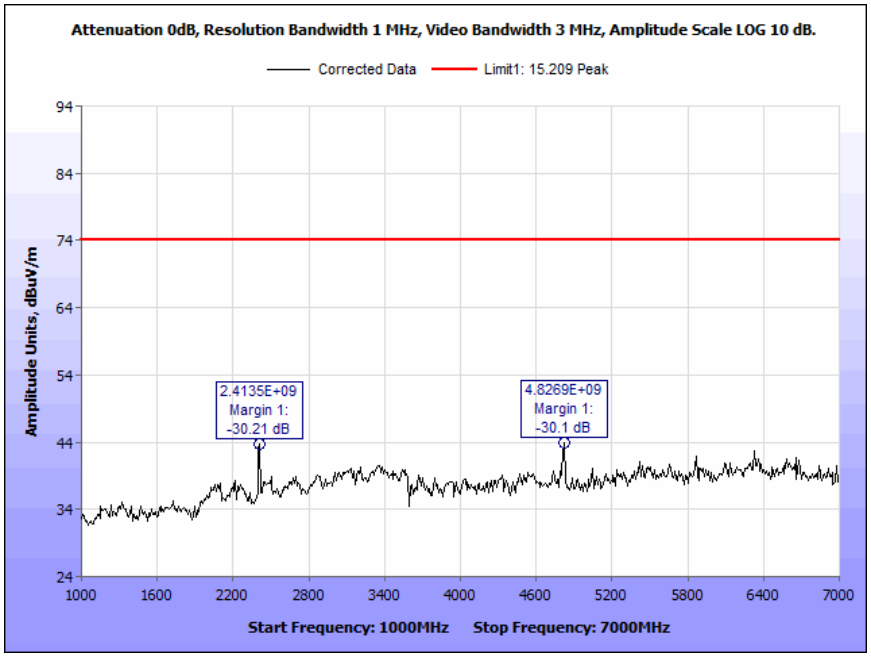


**Figure 17. Radiated Emissions, 802.11b, 2412 MHz, 1 – 7 GHz, Peak, Vertical**

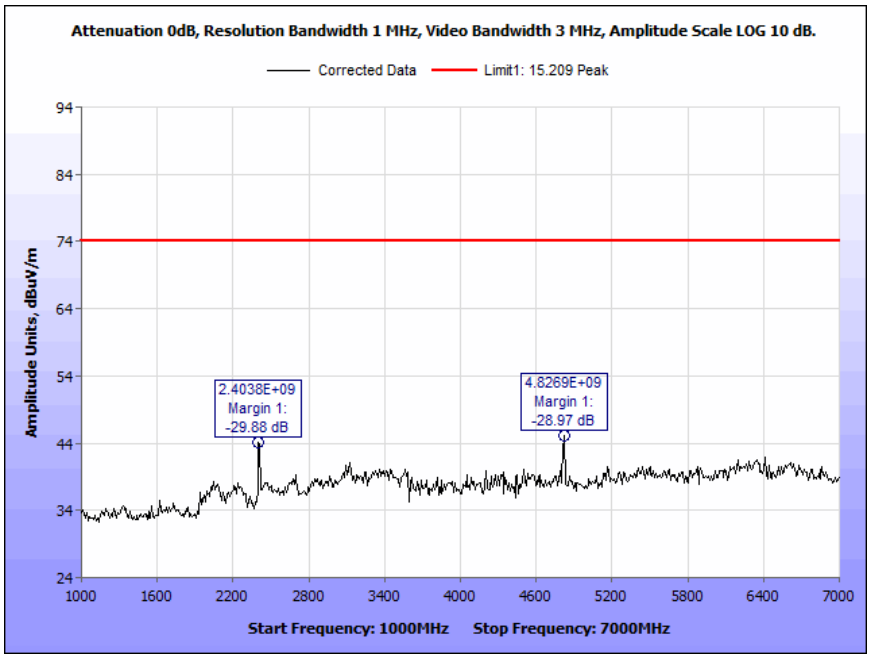


**Figure 18. Radiated Emissions, 802.11b, 2412 MHz, 1 – 7 GHz, Peak, Horizontal**


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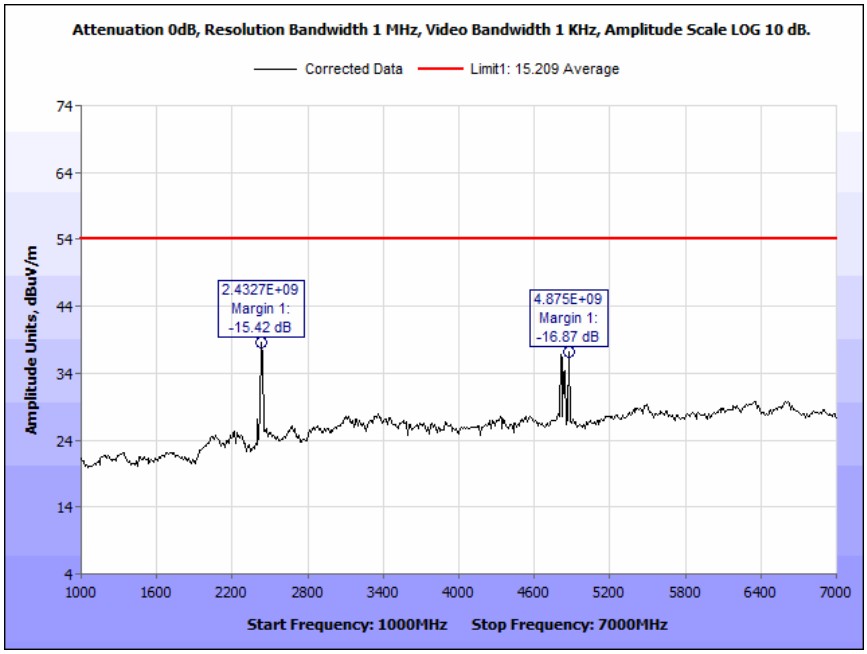


**Figure 19. Radiated Emissions, 802.11b, 2437 MHz, 1 – 7 GHz, Average, Vertical**

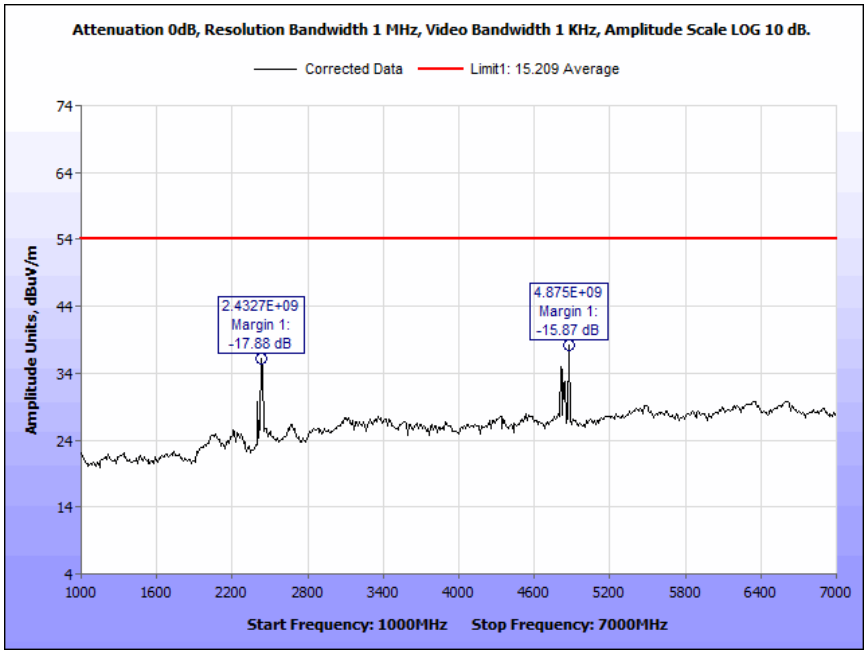


**Figure 20. Radiated Emissions, 802.11b, 2437 MHz, 1 – 7 GHz, Average, Horizontal**


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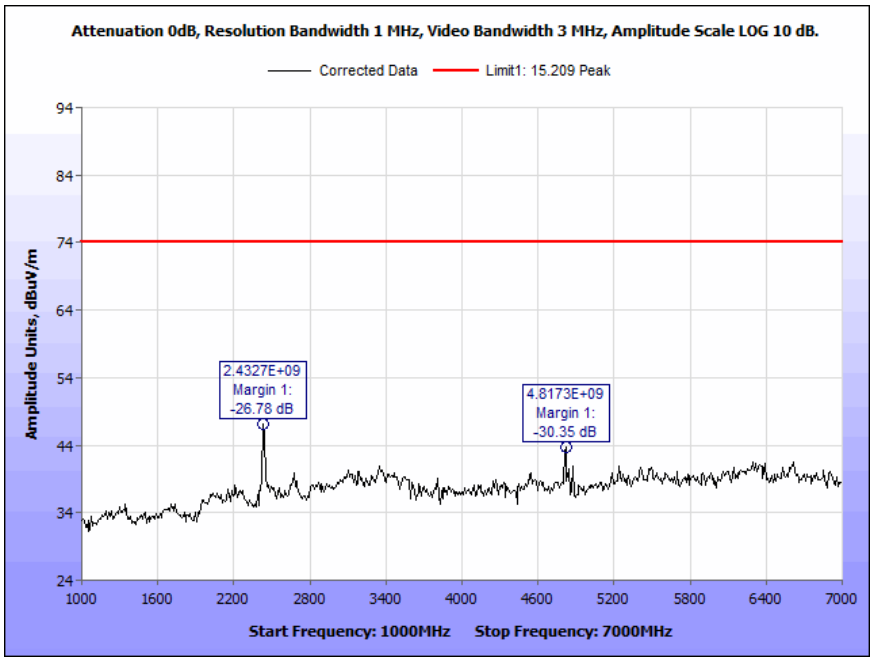


**Figure 21. Radiated Emissions, 802.11b, 2437 MHz, 1 – 7 GHz, Peak, Vertical**

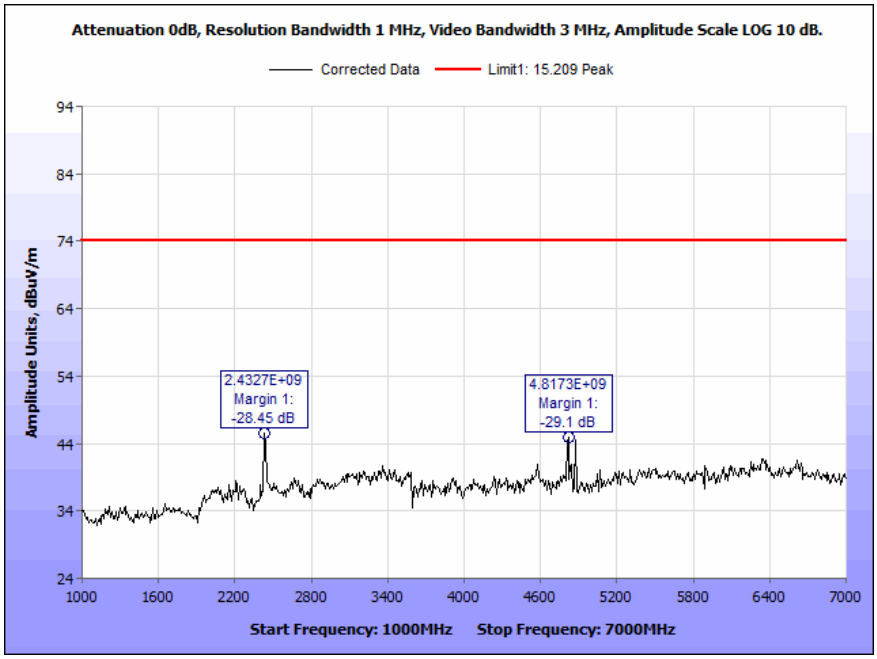


**Figure 22. Radiated Emissions, 802.11b, 2437 MHz, 1 – 7 GHz, Peak, Horizontal**


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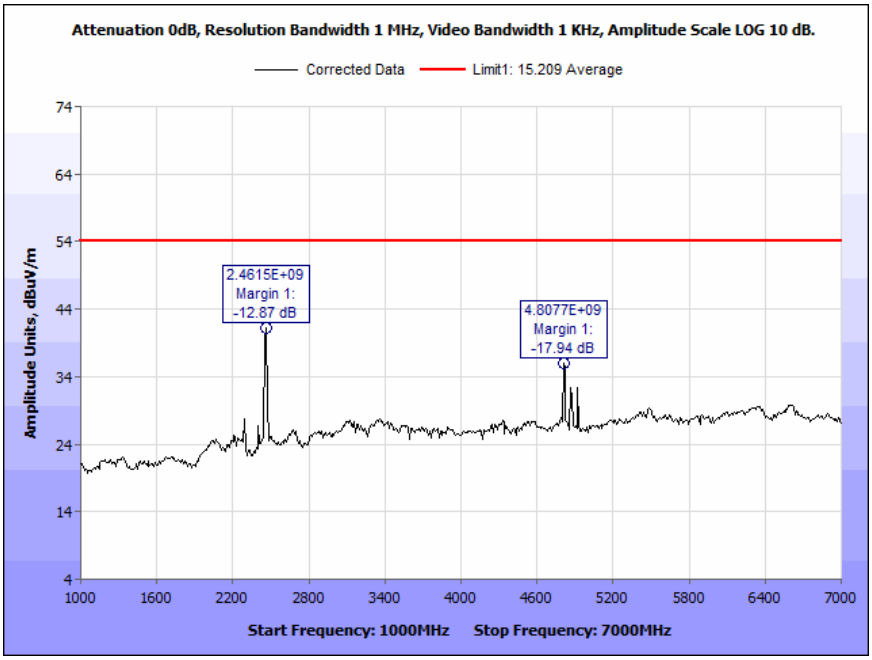


**Figure 23. Radiated Emissions, 802.11b, 2462 MHz, 1 – 7 GHz, Average, Vertical**

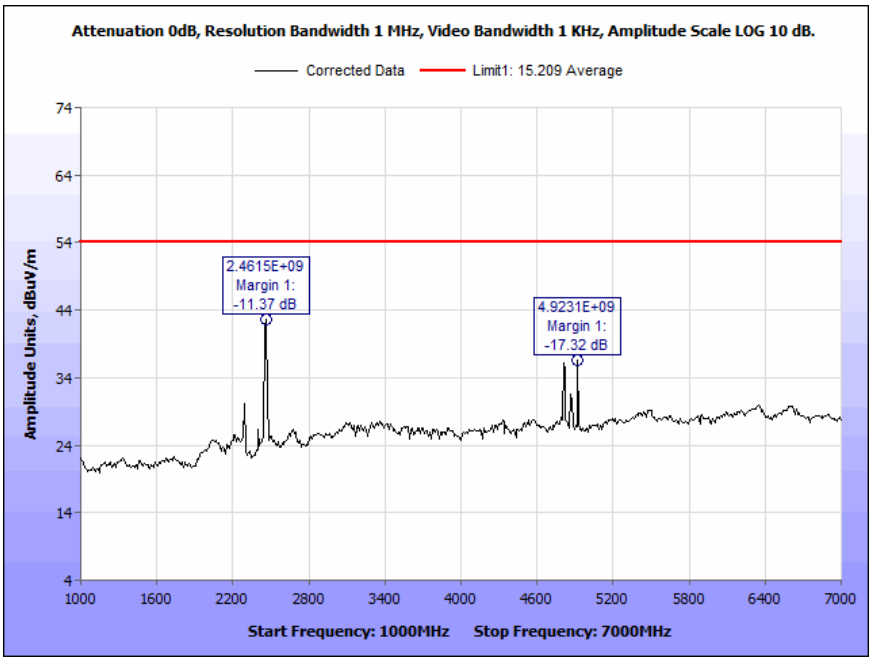


**Figure 24. Radiated Emissions, 802.11b, 2462 MHz, 1 – 7 GHz, Average, Horizontal**


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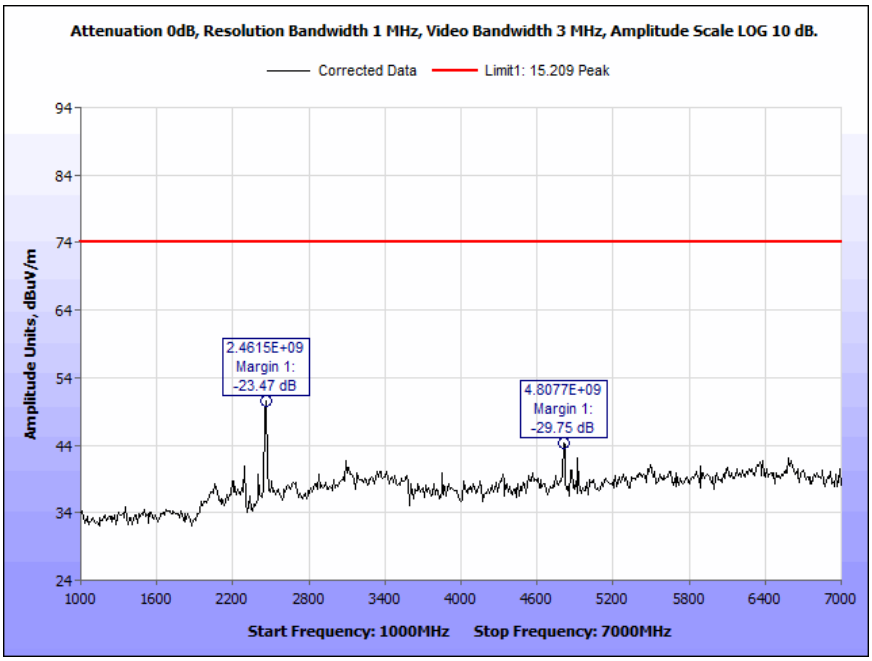


**Figure 25. Radiated Emissions, 802.11b, 2462 MHz, 1 – 7 GHz, Peak, Vertical**

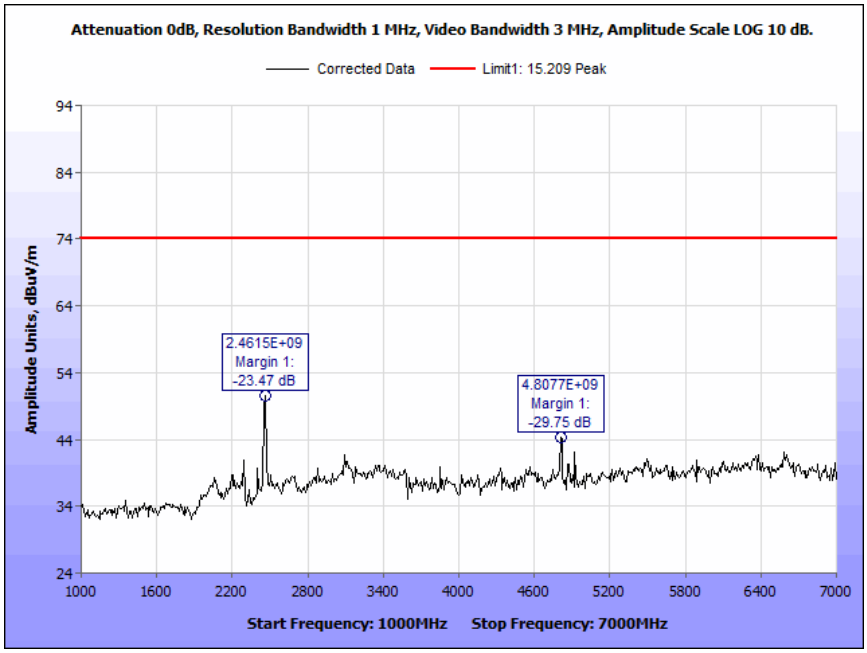


**Figure 26. Radiated Emissions, 802.11b, 2462 MHz, 1 – 7 GHz, Peak, Horizontal**


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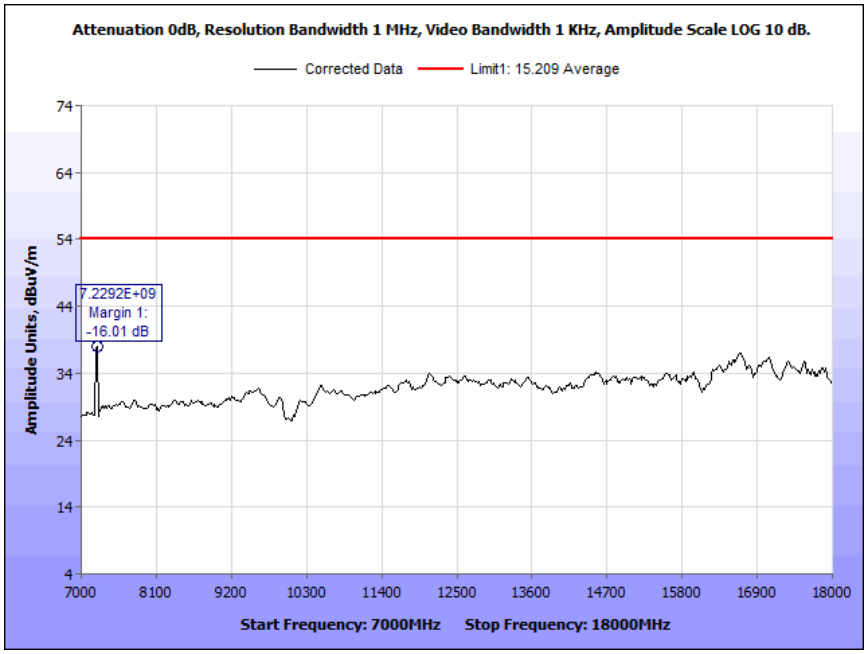


**Figure 27. Radiated Emissions, 802.11b, 2412 MHz, 7-18 GHz, Average, Vertical**

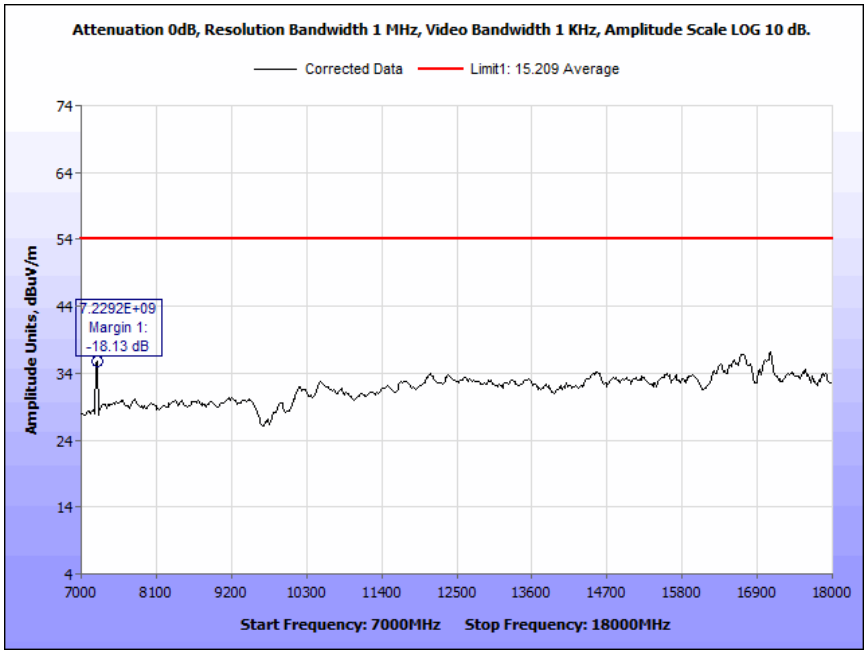


**Figure 28. Radiated Emissions, 802.11b, 2412 MHz, 7-18 GHz, Average, Horizontal**


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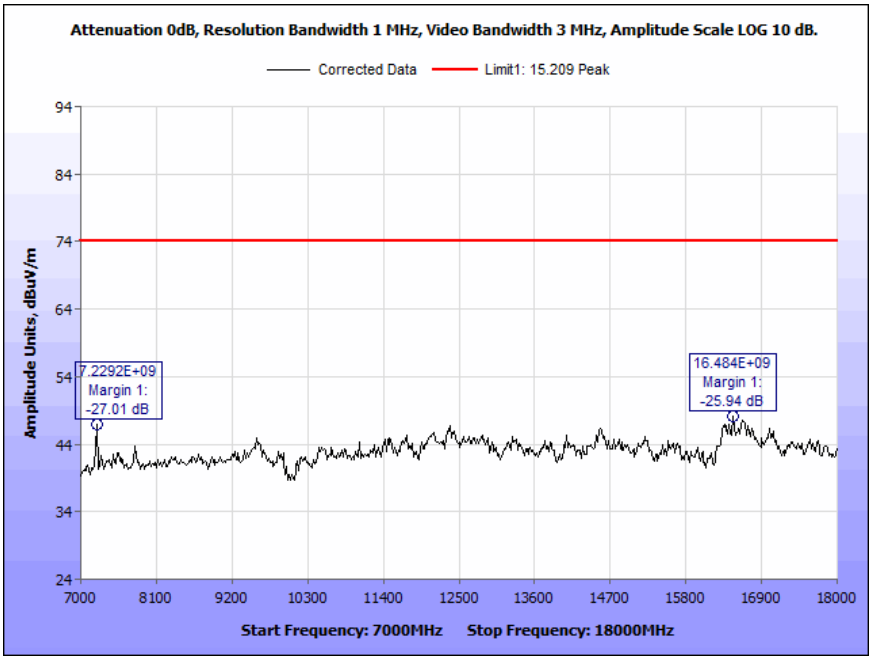


**Figure 29. Radiated Emissions, 802.11b, 2412 MHz, 7-18 GHz, Peak, Vertical**

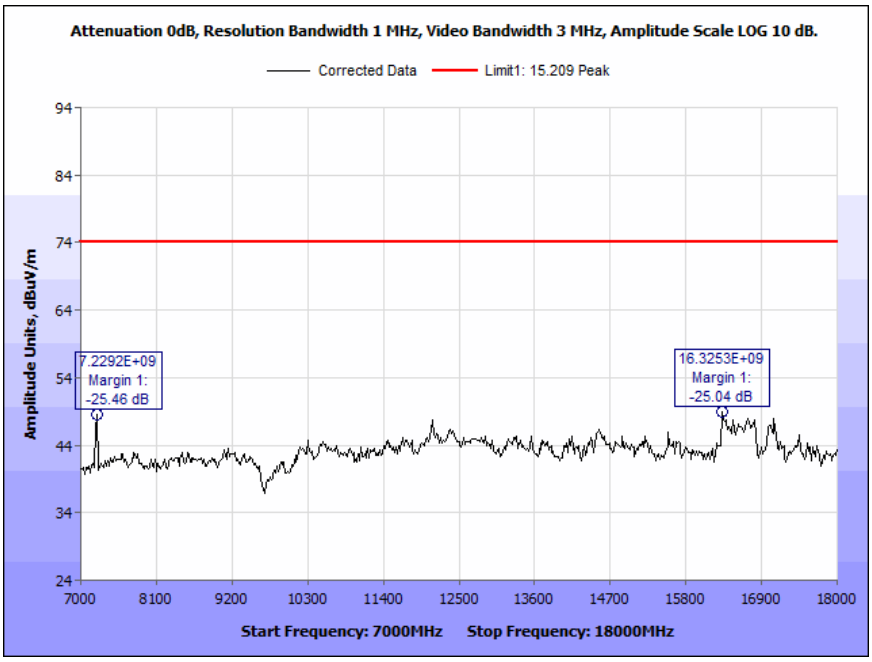


**Figure 30. Radiated Emissions, 802.11b, 2412 MHz, 7-18 GHz, Peak, Horizontal**


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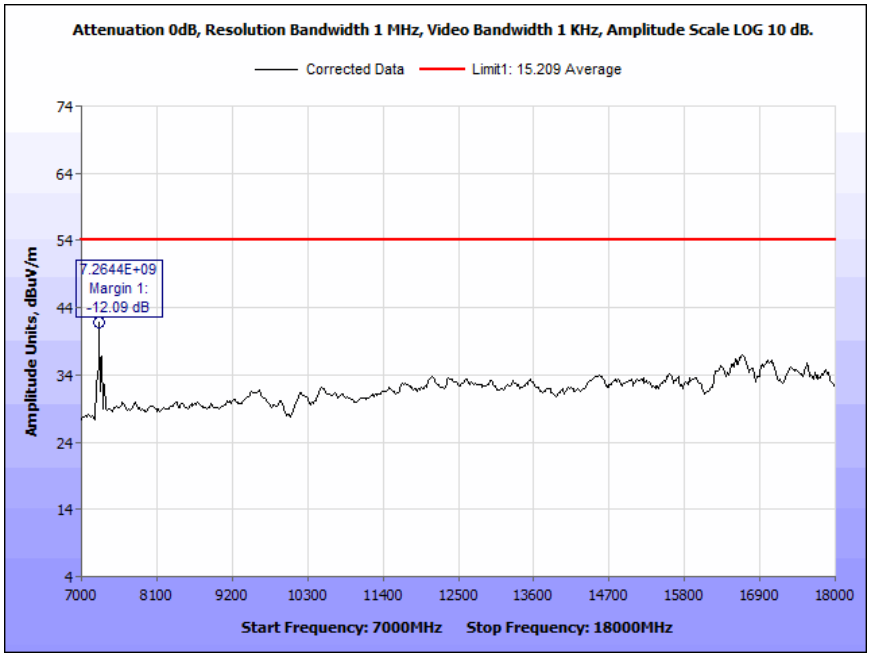


**Figure 31. Radiated Emissions, 802.11b, 2437 MHz, 7 - 18 GHz, Average, Vertical**

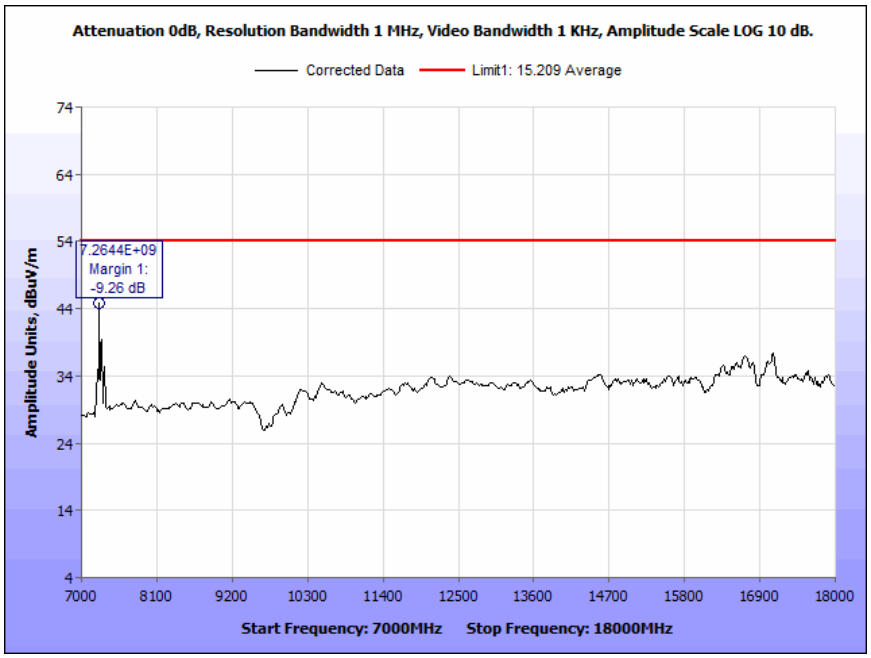


**Figure 32. Radiated Emissions, 802.11b, 2437 MHz, 7 - 18 GHz, Average, Horizontal**


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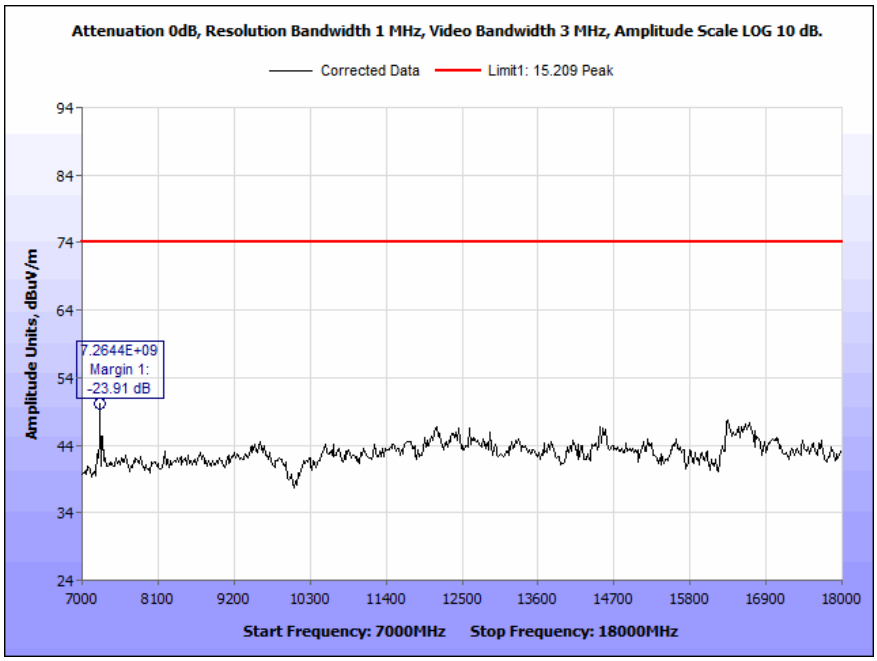


**Figure 33. Radiated Emissions, 802.11b, 2437 MHz, 7 - 18 GHz, Peak, Vertical**

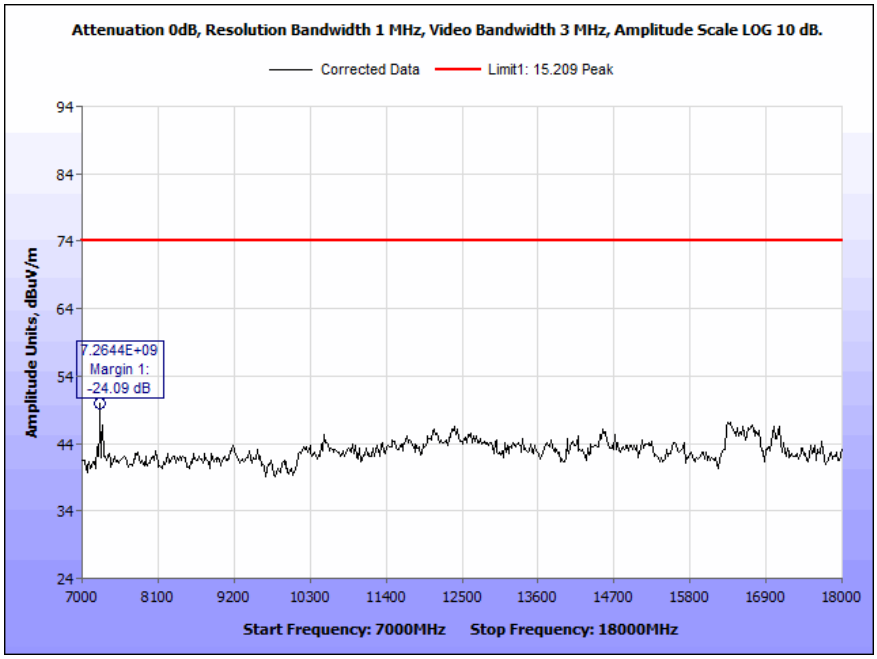


**Figure 34. Radiated Emissions, 802.11b, 2437 MHz, 7 – 18 GHz, Peak, Horizontal**


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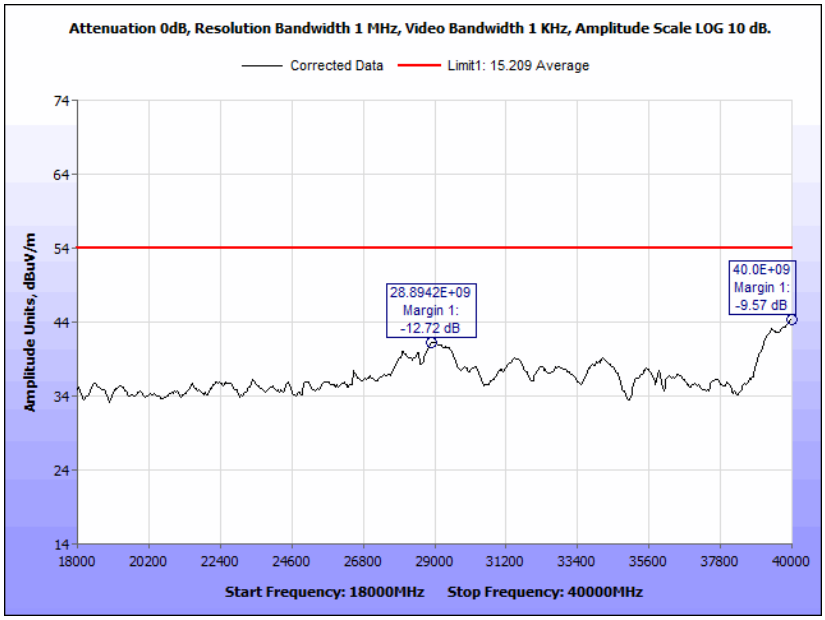


**Figure 35. Radiated Emissions, 802.11b, 2437MHz, 18 - 40 GHz, Average, Vertical**

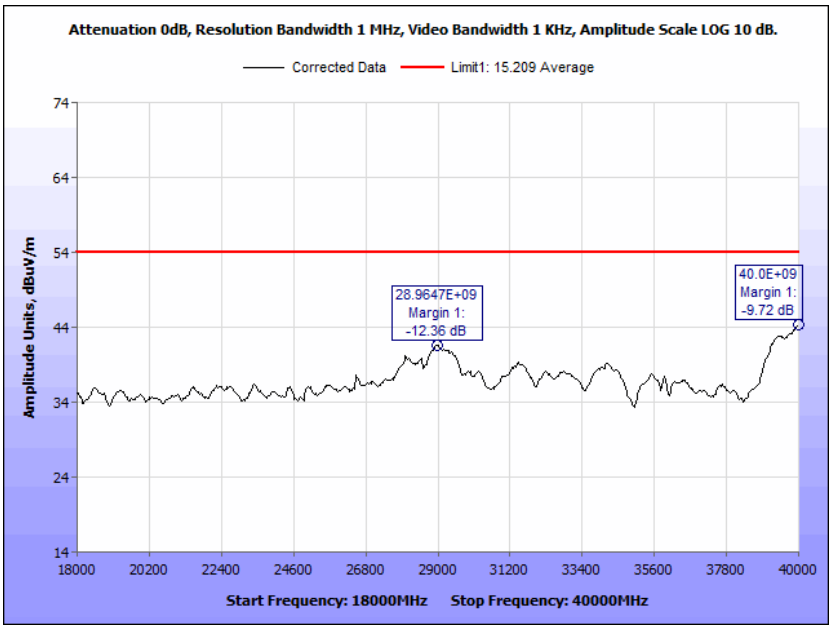


**Figure 36. Radiated Emissions, 802.11b, 2437MHz, 18 - 40 GHz, Average, Horizontal**


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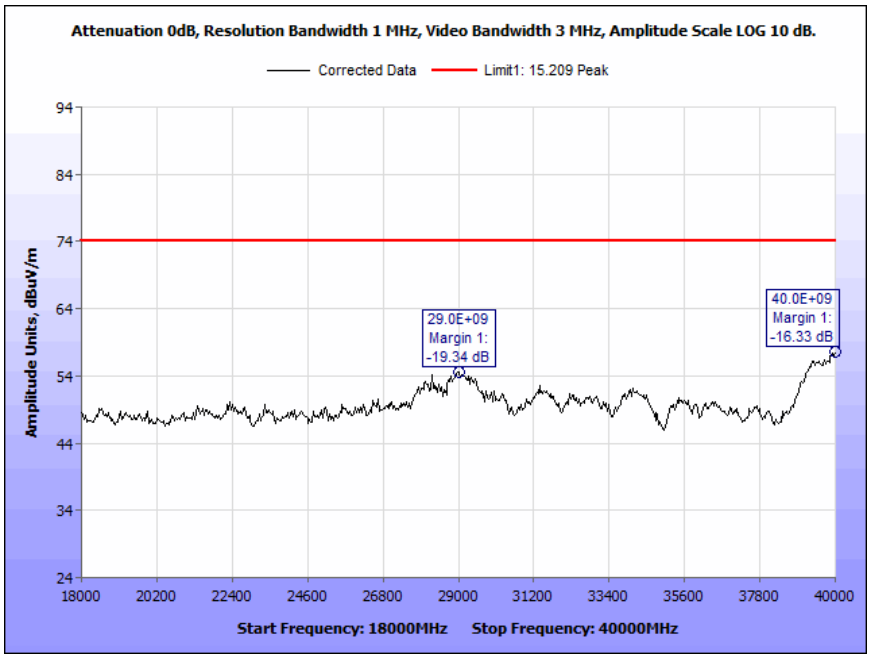


**Figure 37. Radiated Emissions, 802.11b, 2437MHz, 18 - 40 GHz, Peak, Vertical**

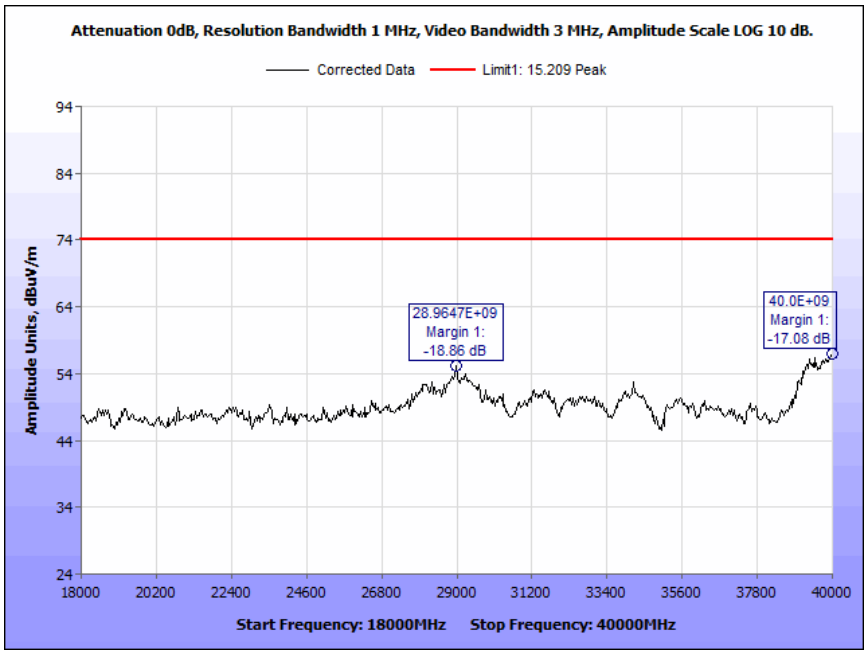


**Figure 38. Radiated Emissions, 802.11b, 2437MHz, 18 - 40 GHz, Peak, Horizontal**


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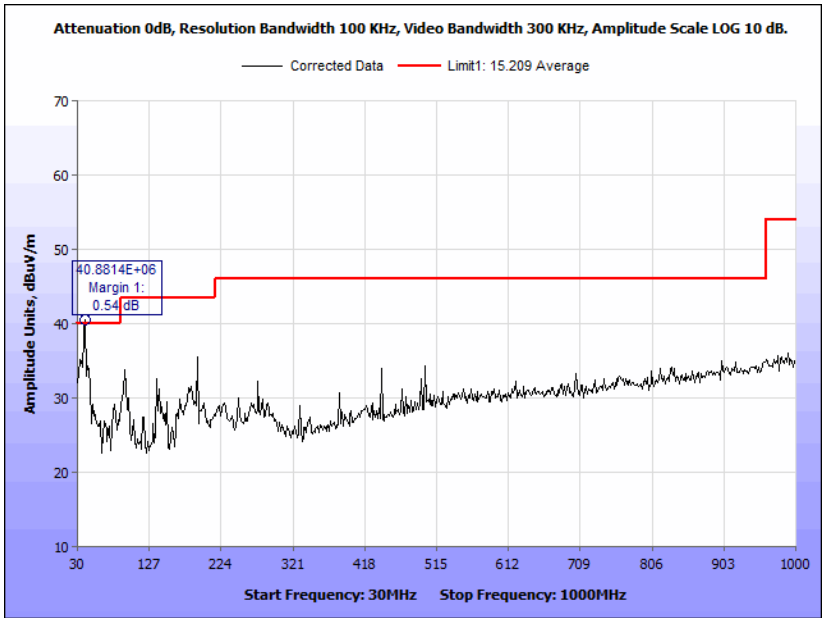


*Note: Peak Emissions that appear over the 15.209 spurious limits were determined to be sourced from digital devices unrelated to the transmitter

**Figure 39. Radiated Emissions, 802.11g, 2412 MHz, 30 – 1000 MHz, Vertical**

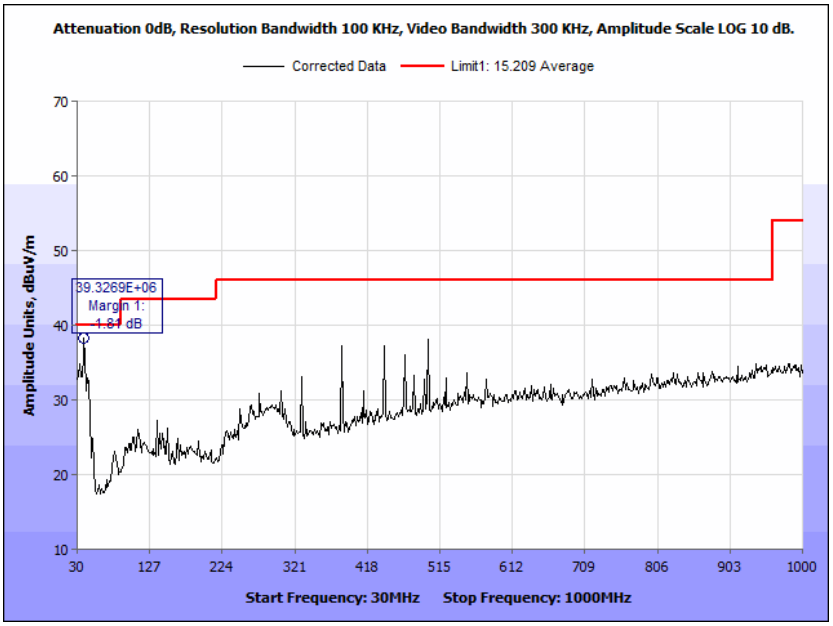


**Figure 40. Radiated Emissions, 802.11g, 2412 MHz, 30 – 1000 MHz, Horizontal**


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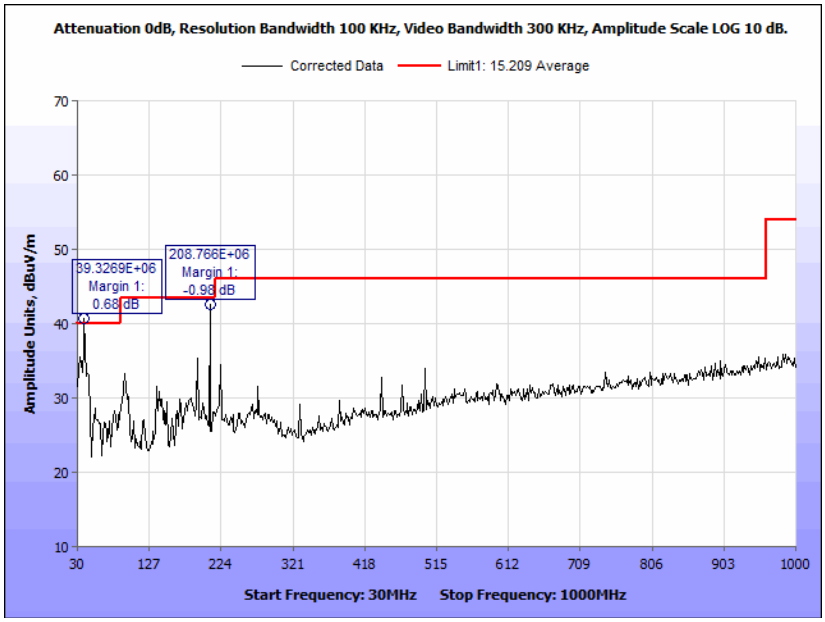


*Note: Peak Emissions that appear over the 15.209 spurious limits were determined to be sourced from digital devices unrelated to the transmitter

**Figure 41. Radiated Emissions, 802.11g, 2437 MHz, 30 – 1000 MHz, Vertical**

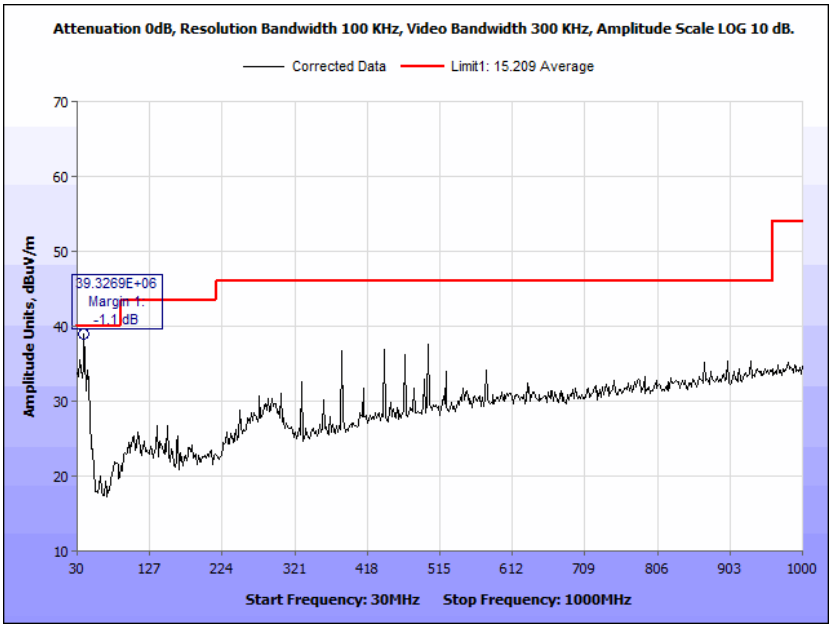


**Figure 42. Radiated Emissions, 802.11g, 2437 MHz, 30 – 1000 MHz, Horizontal**


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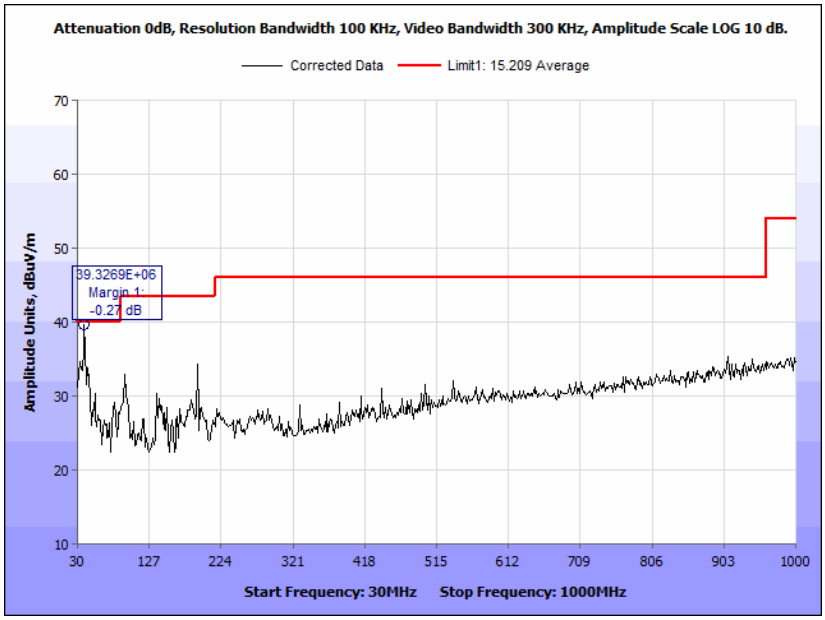


**Figure 43. Radiated Emissions, 802.11g, 2462 MHz, 30 – 1000 MHz, Vertical**

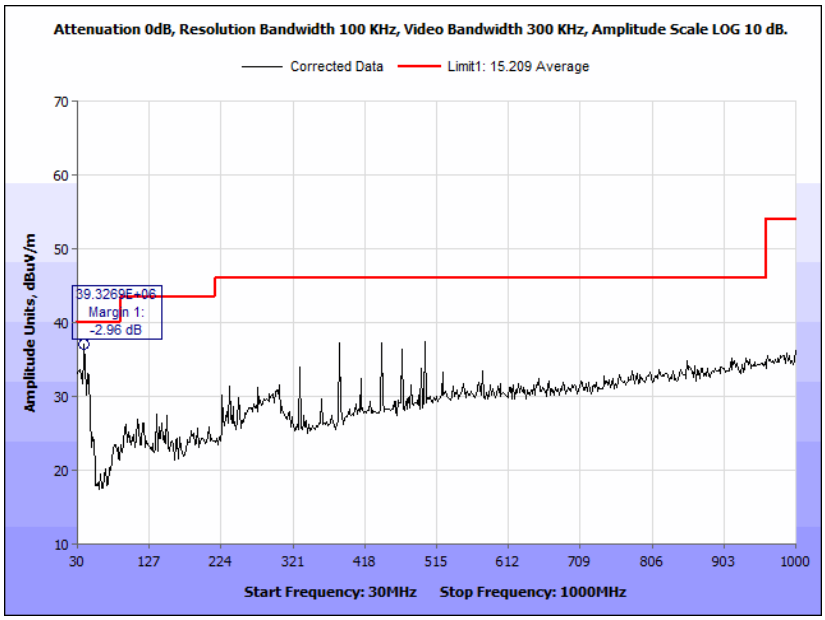


**Figure 44. Radiated Emissions, 802.11g, 2462 MHz, 30 – 1000 MHz, Horizontal**


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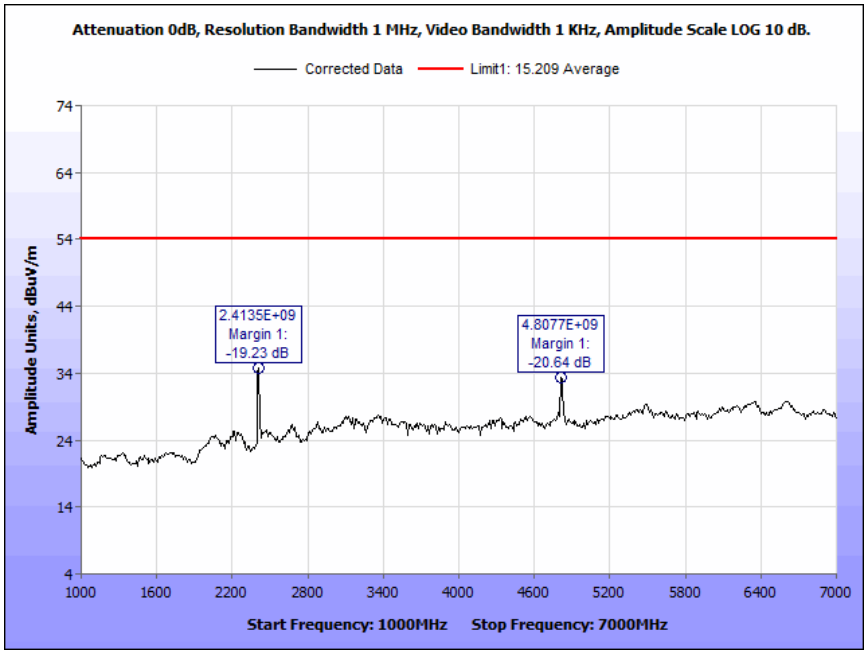


**Figure 45. Radiated Emissions, 802.11g, 2412 MHz, 1 – 7 GHz, Average, Vertical**

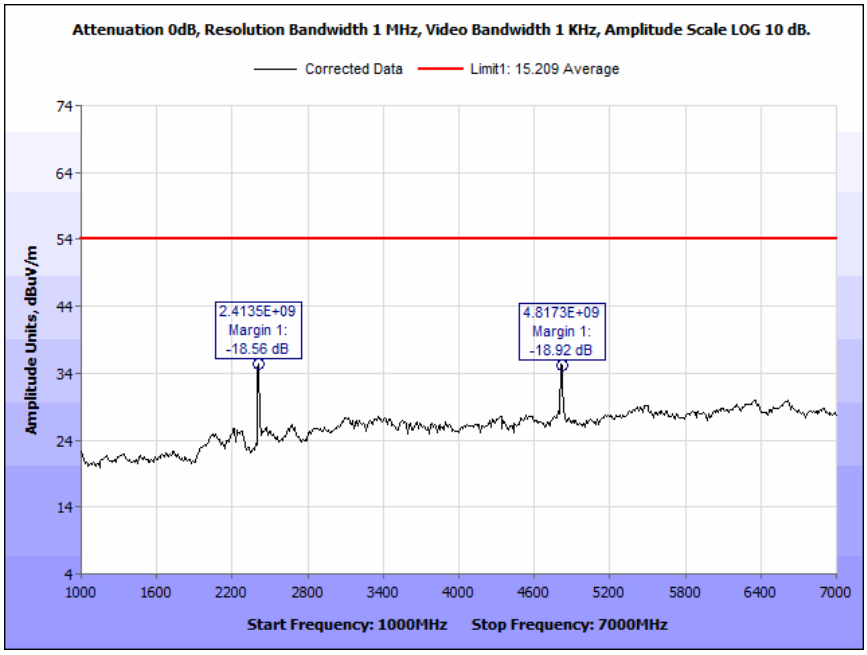


**Figure 46. Radiated Emissions, 802.11g, 2412 MHz, 1 – 7 GHz, Average, Horizontal**


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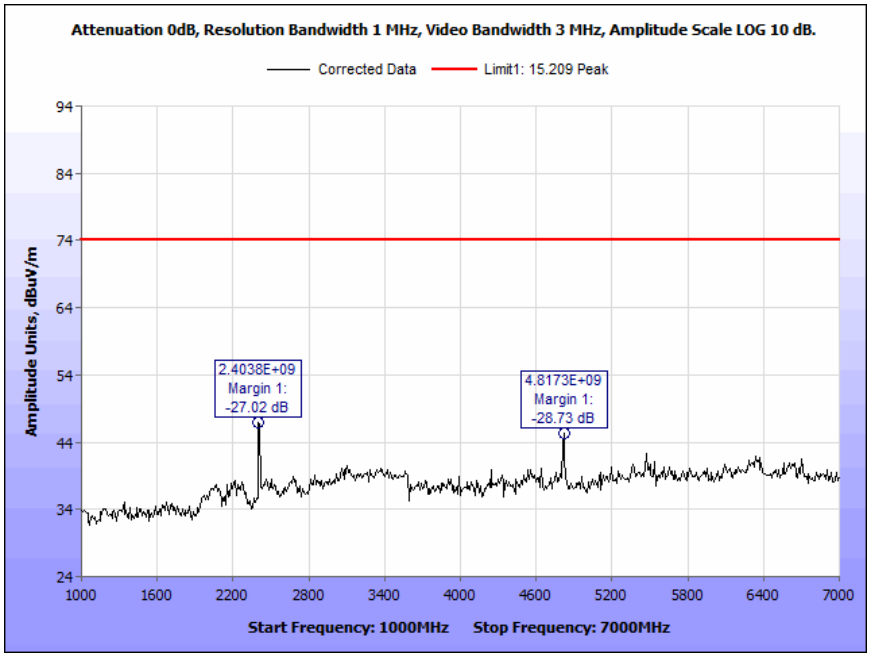


**Figure 47. Radiated Emissions, 802.11g, 2412 MHz, 1 – 7 GHz, Peak, Vertical**

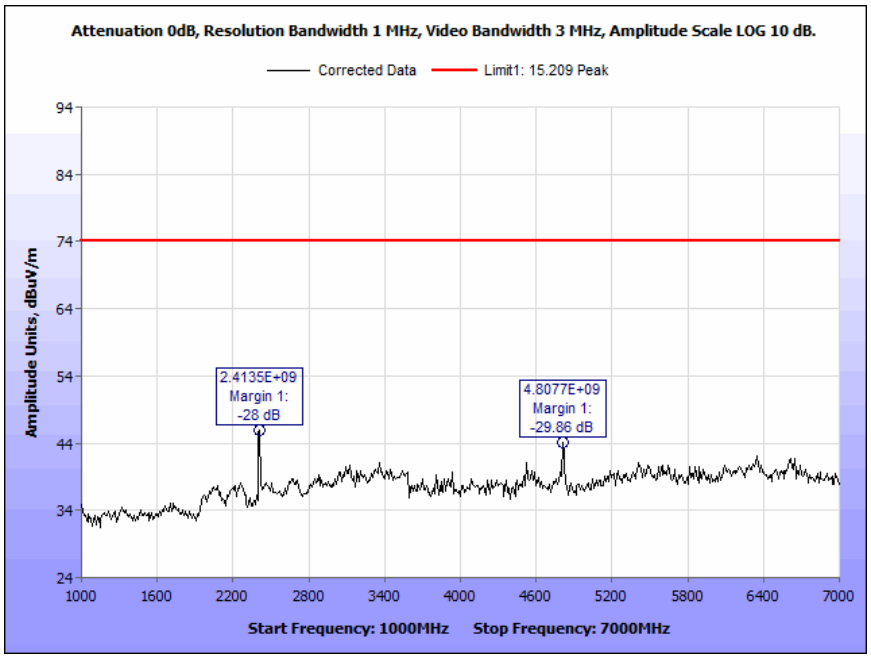


**Figure 48. Radiated Emissions, 802.11g, 2412 MHz, 1 – 7 GHz, Peak, Horizontal**


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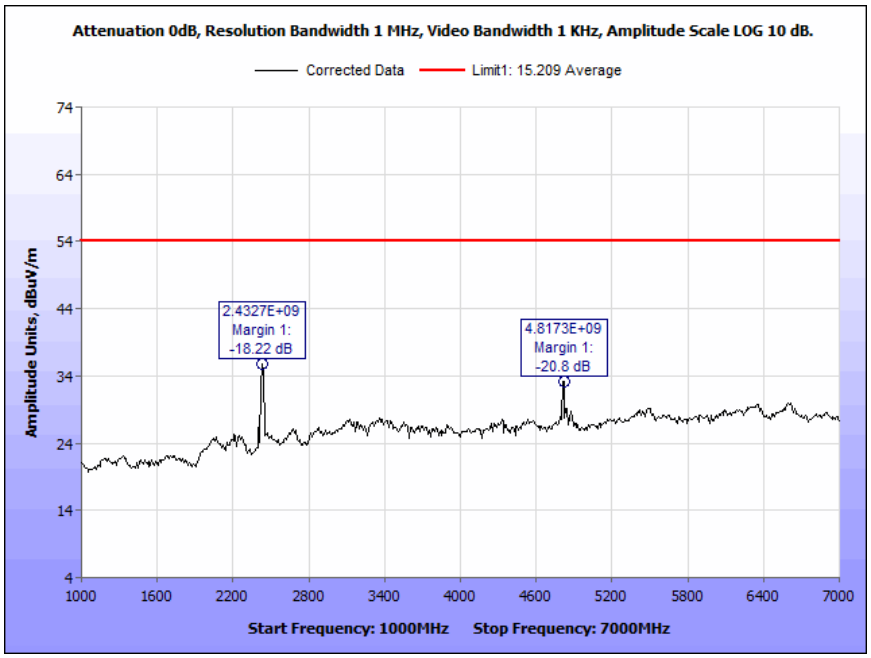


**Figure 49. Radiated Emissions, 802.11g, 2437 MHz, 1 – 7 GHz, Average, Vertical**

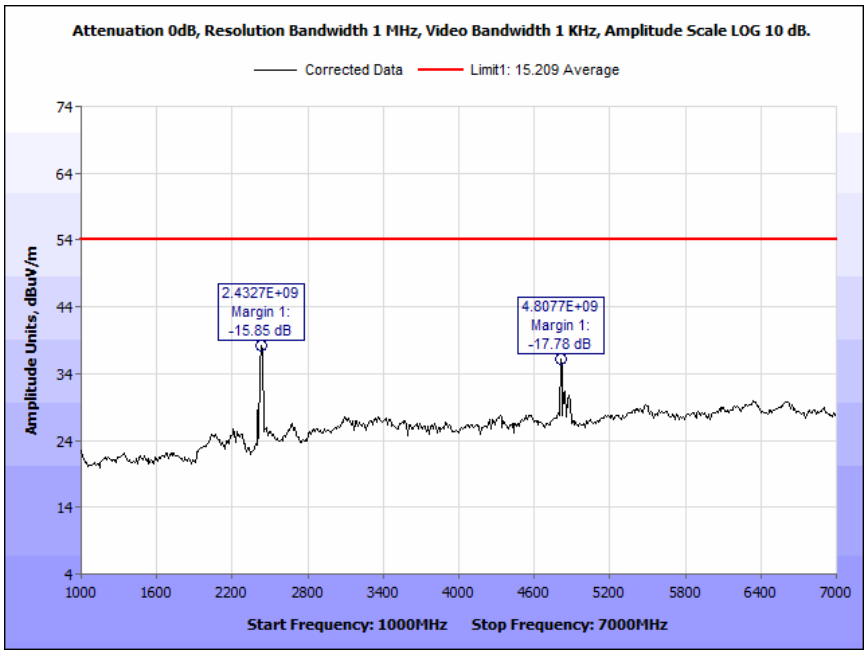


**Figure 50. Radiated Emissions, 802.11g, 2437 MHz, 1 – 7 GHz, Average, Horizontal**


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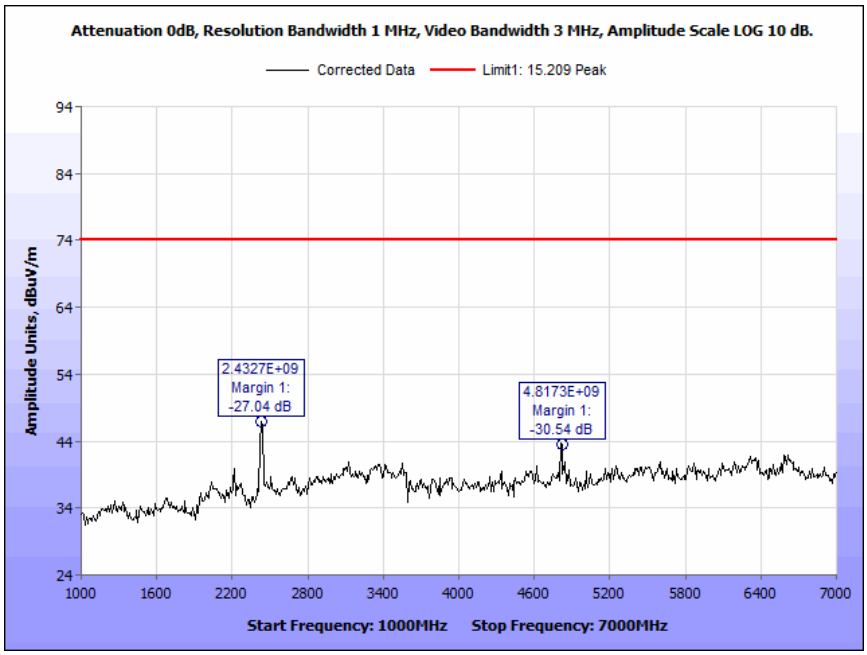


**Figure 51. Radiated Emissions, 802.11g, 2437 MHz, 1 – 7 GHz, Peak, Vertical**

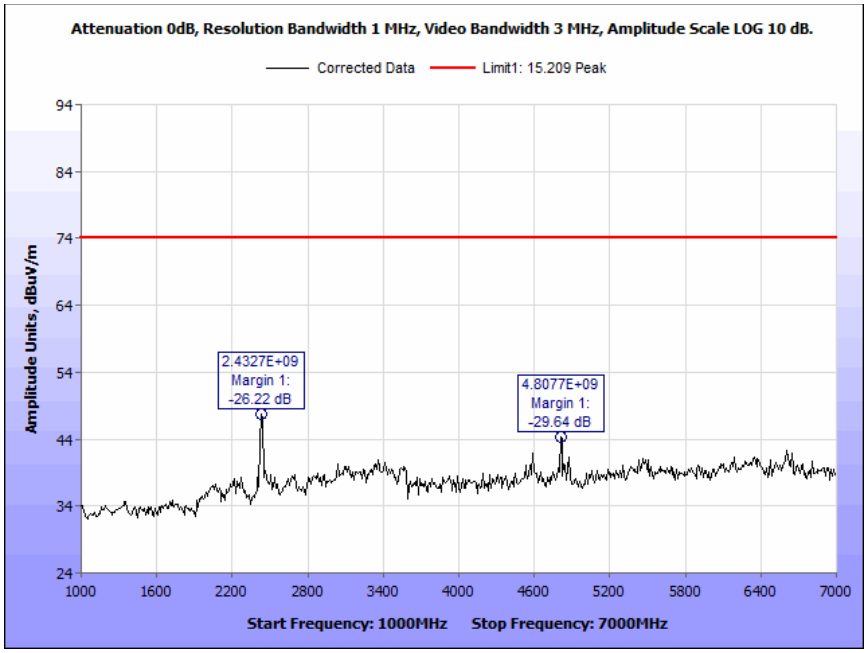


**Figure 52. Radiated Emissions, 802.11g, 2437 MHz, 1 – 7 GHz, Peak, Horizontal**


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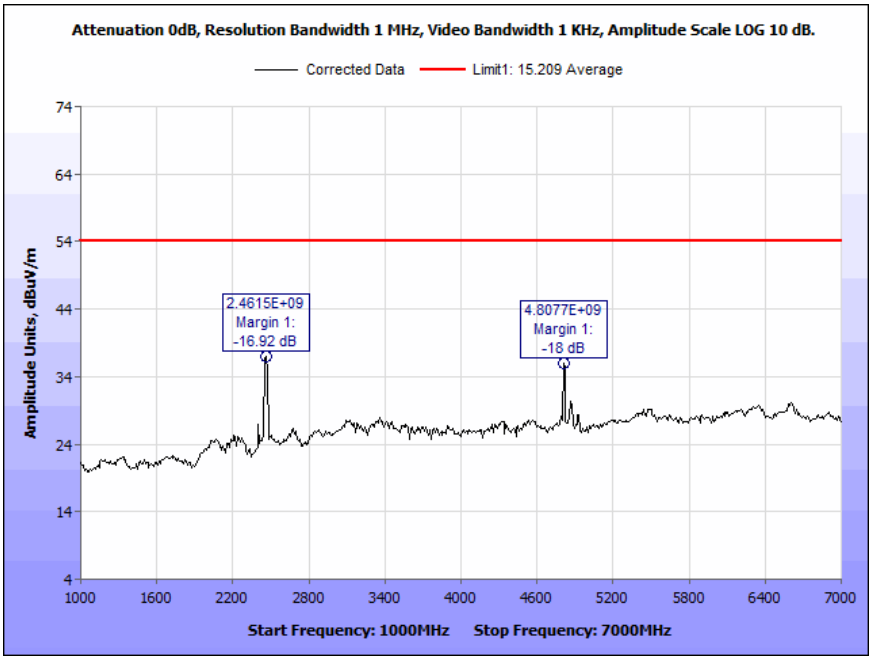


**Figure 53. Radiated Emissions, 802.11g, 2462 MHz, 1 – 7 GHz, Average, Vertical**

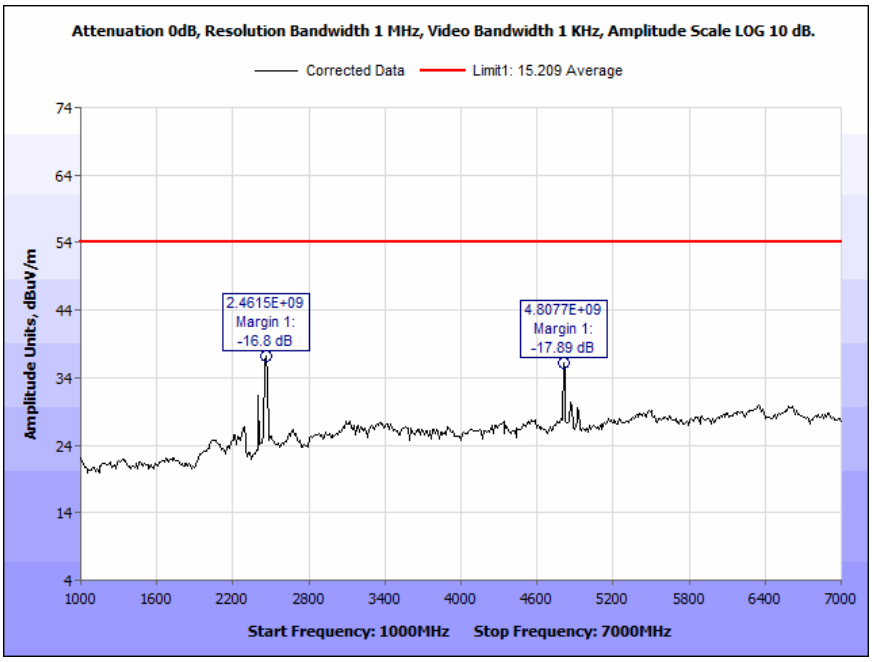


**Figure 54. Radiated Emissions, 802.11g, 2462 MHz, 1 – 7 GHz, Average, Horizontal**


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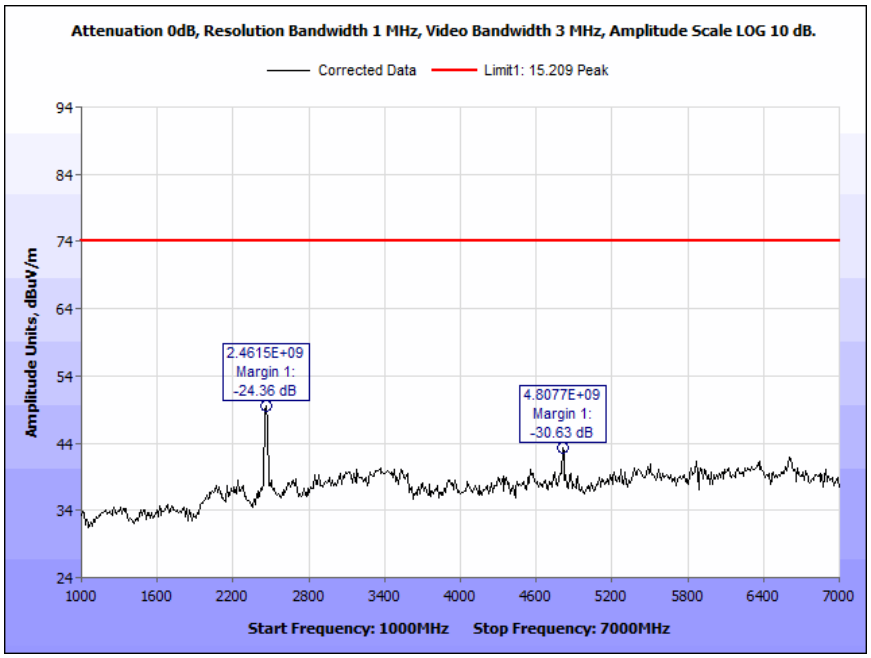


**Figure 55. Radiated Emissions, 802.11g, 2462 MHz, 1 – 7 GHz, Peak, Vertical**

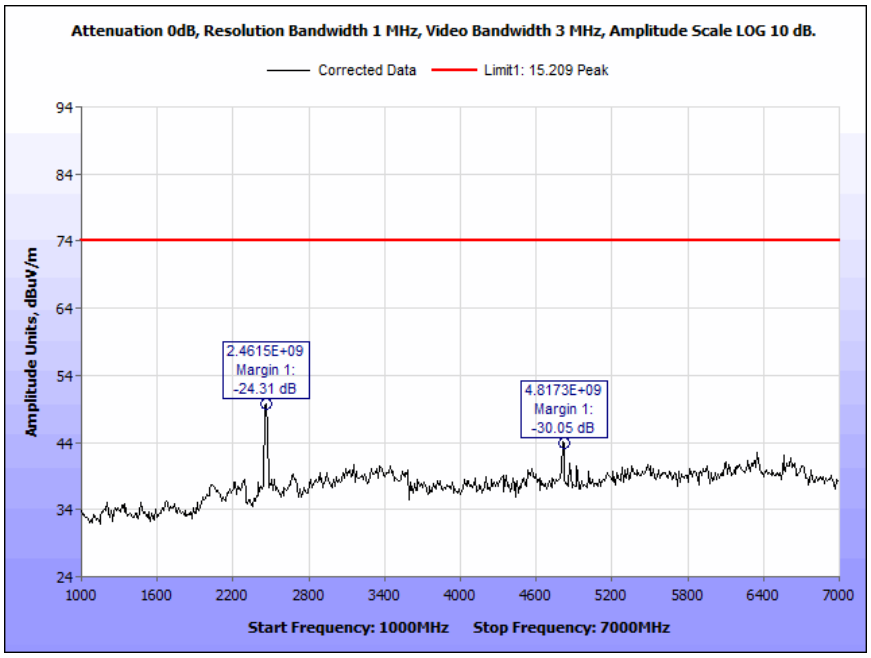


**Figure 56. Radiated Emissions, 802.11g, 2462 MHz, 1 – 7 GHz, Peak, Horizontal**


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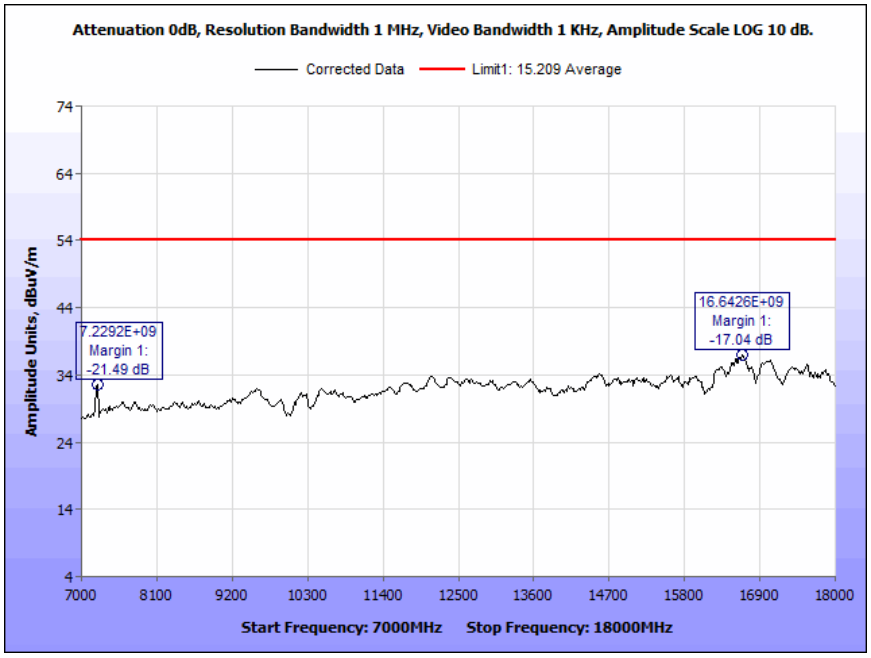


**Figure 57. Radiated Emissions, 802.11g, 2412 MHz, 7-18 GHz, Average, Vertical**

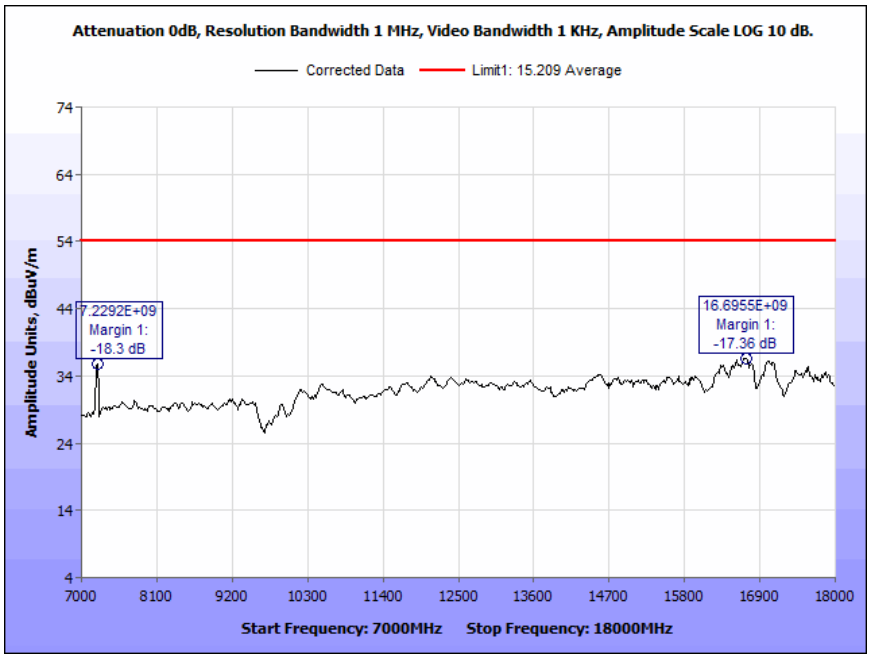


**Figure 58. Radiated Emissions, 802.11g, 2412 MHz, 7-18 GHz, Average, Horizontal**


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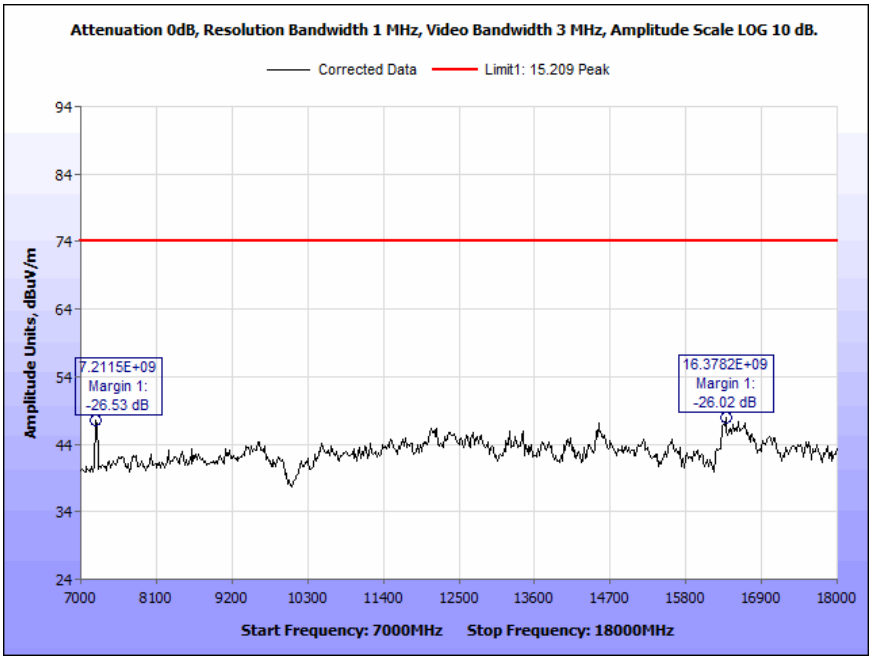


**Figure 59. Radiated Emissions, 802.11g, 2412 MHz, 7-18 GHz, Peak, Vertical**

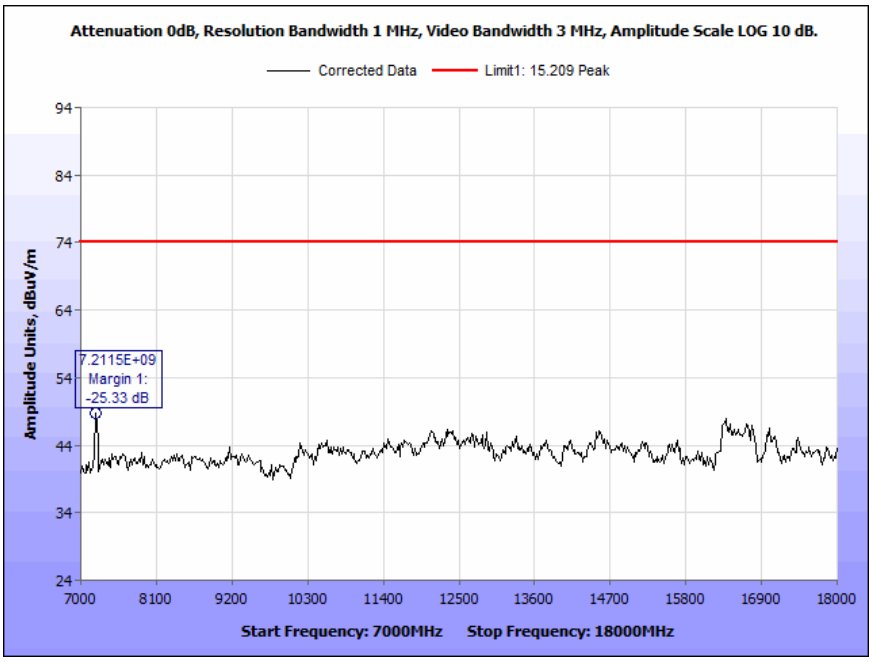


**Figure 60. Radiated Emissions, 802.11g, 2412 MHz, 7-18 GHz, Peak, Horizontal**


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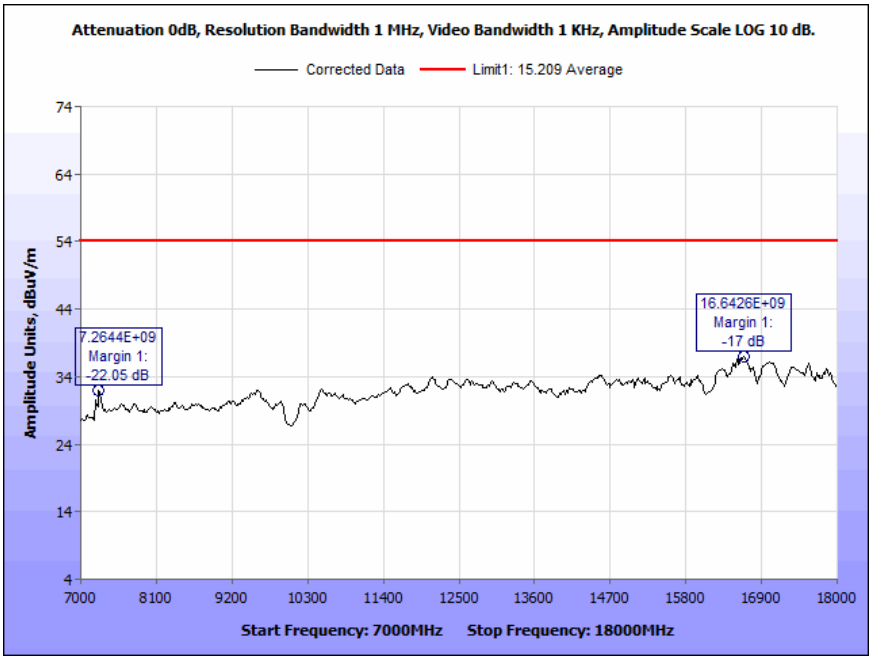


**Figure 61. Radiated Emissions, 802.11g, 2437 MHz, 7 - 18 GHz, Average, Vertical**

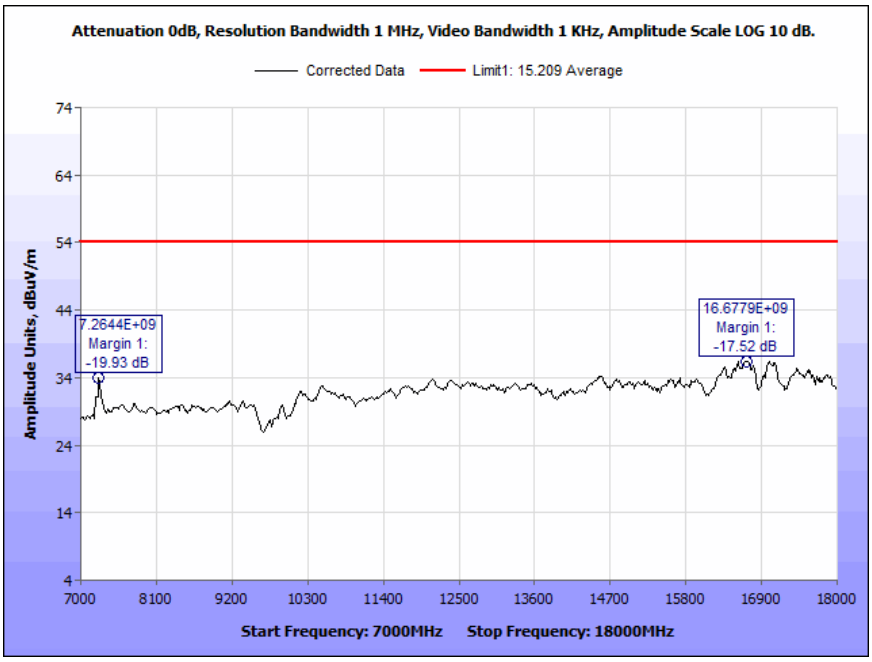


**Figure 62. Radiated Emissions, 802.11g, 2437 MHz, 7 - 18 GHz, Average, Horizontal**


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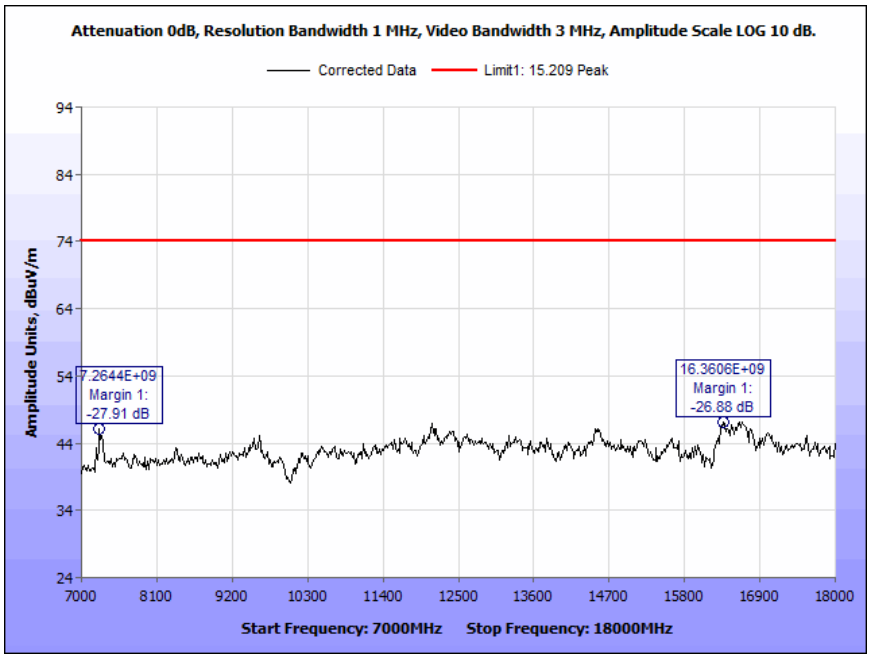


**Figure 63. Radiated Emissions, 802.11g, 2437 MHz, 7 - 18 GHz, Peak, Vertical**

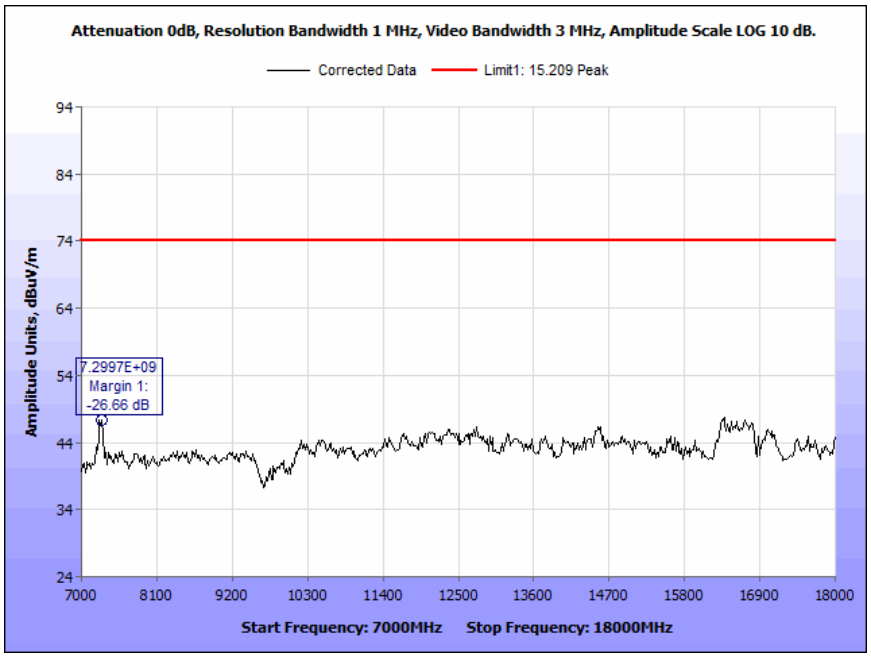


**Figure 64. Radiated Emissions, 802.11g, 2437 MHz, 7 – 18 GHz, Peak, Horizontal**


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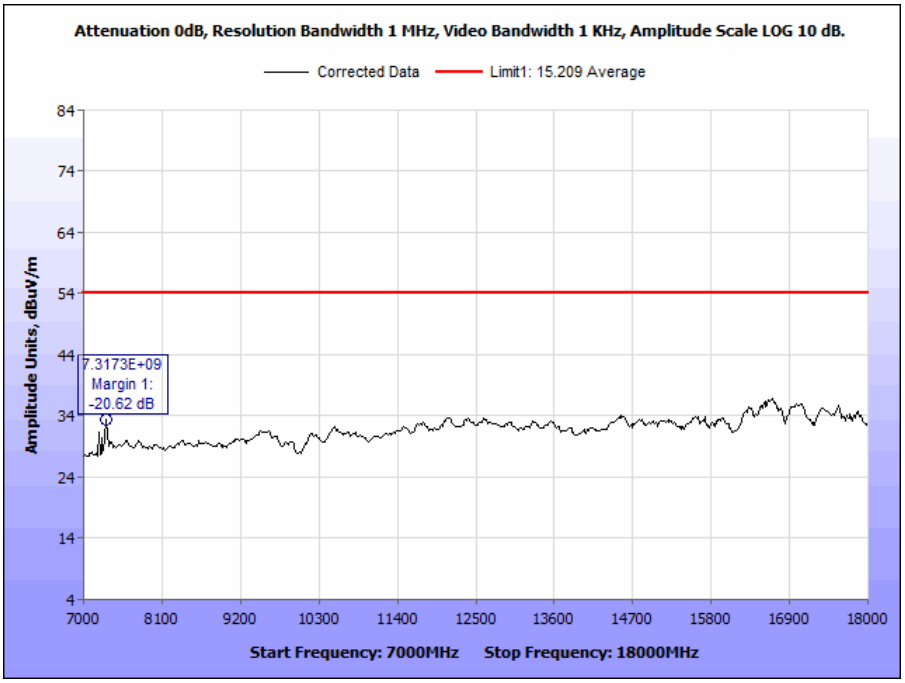


**Figure 65. Radiated Emissions, 802.11g, 2462 MHz, 7 – 18 GHz, Average, Vertical**

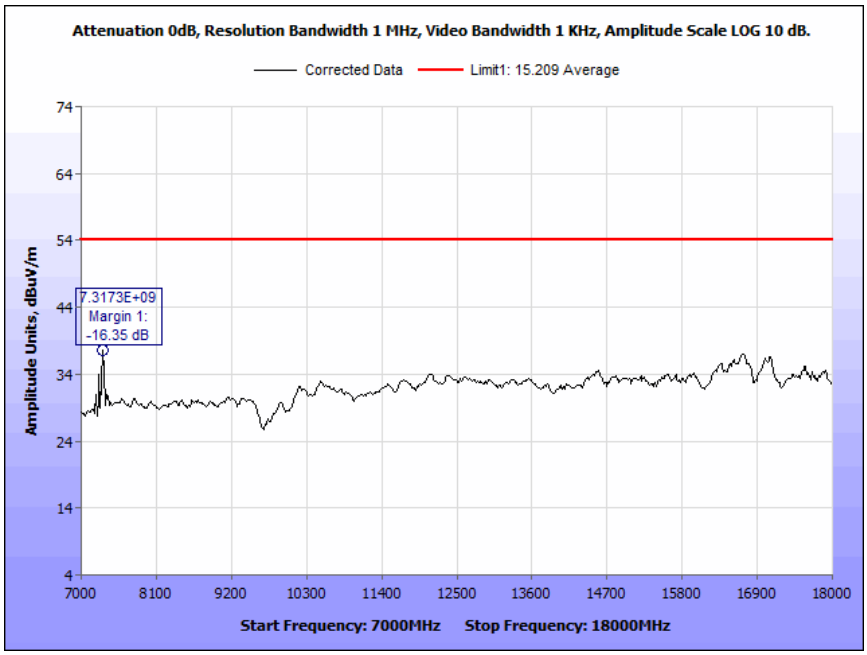


**Figure 66. Radiated Emissions, 802.11g, 2462 MHz, 7 – 18 GHz, Average, Horizontal**


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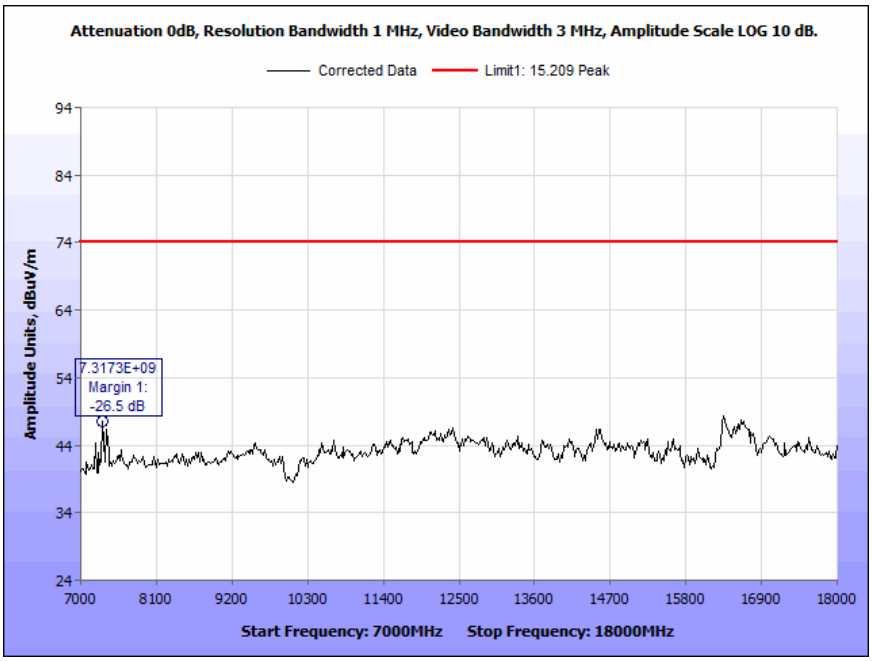


**Figure 67. Radiated Emissions, 802.11g, 2462 MHz, 7 – 18 GHz, Peak, Vertical**

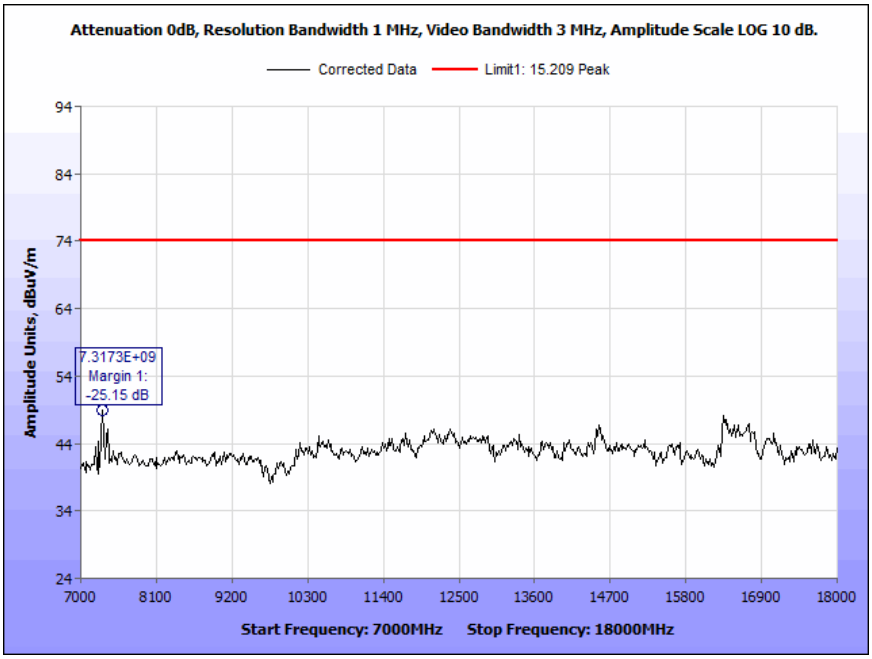


**Figure 68. Radiated Emissions, 802.11g, 2462 MHz, 7 – 18 GHz, Peak, Horizontal**


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| Frequency (MHz) | EUT Azimuth (Degrees) | Antenna Polarity (H/V) | Antenna HEIGHT (m) | Uncorrected EMI Meter Reading (dBuV) | Antenna Correction Factor (dB/m) (+) | Cable Loss/Pre-amp (dB) (+) | Distance Correction Factor (dB) (-) | Corrected Amplitude (dBuV/m) | Limit (dBuV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|---|
| 208.7660 | 179.90 | V | 1.70 | 37.61 | 14.52 | -22.83 | 10.46 | 39.76 | 43.50 | -3.74 |
| 39.3269 | 180.50 | V | 1.52 | 29.90 | 17.14 | -24.52 | 10.46 | 32.98 | 40 | -7.02 |
| 39.3269 | 180.50 | V | 1.52 | 29.66 | 17.14 | -24.52 | 10.46 | 32.74 | 40 | -7.26 |
| 39.3269 | 180.60 | V | 1.54 | 29.10 | 17.14 | -24.52 | 10.46 | 32.18 | 40 | -7.82 |
| 40.8814 | 181.20 | V | 1.53 | 29.70 | 16.27 | -24.56 | 10.46 | 31.87 | 40 | -8.13 |
| 39.3269 | 180.50 | V | 1.52 | 26.61 | 17.14 | -24.52 | 10.46 | 29.69 | 40 | -10.31 |

**Figure 69. Radiated Spurious Emissions, Quasi-Peak Test Results**

| Frequency (MHz) | EUT Azimuth (Degrees) | Antenna Polarity (H/V) | Antenna HEIGHT (m) | Uncorrected EMI Meter Reading (dBuV) | Antenna Correction Factor (dB/m) (+) | Cable Loss/Pre-amp (dB) (+) | Distance Correction Factor (dB) (-) | Corrected Amplitude (dBuV/m) | Limit (dBuV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|---|
| 7352.600 | 180.60 | H | 1.86 | 54.07 | 35.41 | -39.73 | 0.00 | 49.75 | 54 | -4.25 |
| 7264.400 | 180.60 | H | 1.86 | 46.50 | 35.43 | -40.03 | 0.00 | 41.91 | 54 | -12.09 |
| 4826.900 | 180.60 | V | 1.86 | 44.30 | 33.76 | -38.53 | 0.00 | 39.53 | 54 | -14.47 |
| 2432.700 | 181.20 | H | 1.86 | 41.79 | 31.85 | -35.06 | 0.00 | 38.58 | 54 | -15.42 |
| 4875.000 | 180.20 | V | 1.86 | 42.10 | 33.72 | -38.69 | 0.00 | 37.13 | 54 | -16.87 |
| 2403.800 | 180.60 | H | 1.86 | 40.20 | 31.76 | -34.97 | 0.00 | 37.00 | 54 | -17.00 |

**Table 16. Radiated Spurious Emissions, Average Test Results**


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## Radiated Band Edge Measurements

**Test Procedures:** The transmitter was turned on. Measurements were performed of the low and high Channels. The EUT was rotated orthogonally through all three axes. Plots shown are corrected for both antenna correction factor and distance and compared to a 3 m limit line.

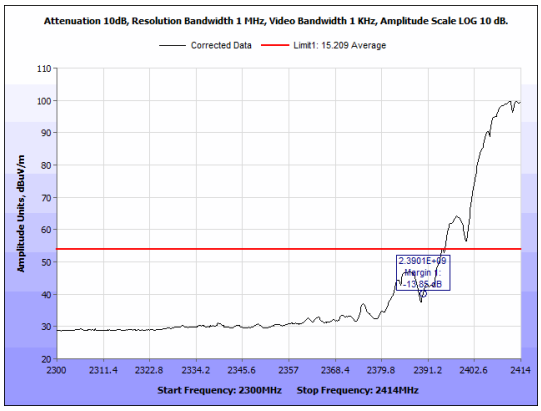


**Figure 70: Radiated Band Edge, 802.11b - 2402 MHz - Average - Horizontal.**

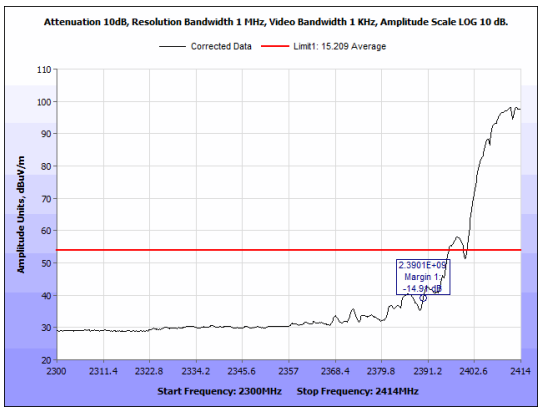


**Figure 71: Radiated Band Edge, 802.11b - 2402 MHz - Average - Vertical.**

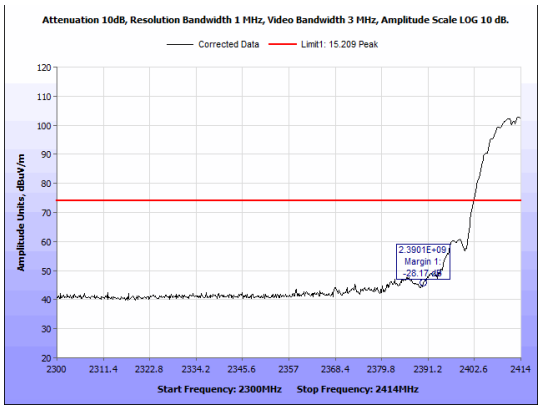



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**Figure 72: Radiated Band Edge, 802.11b - 2402 MHz - Peak - Horizontal.**

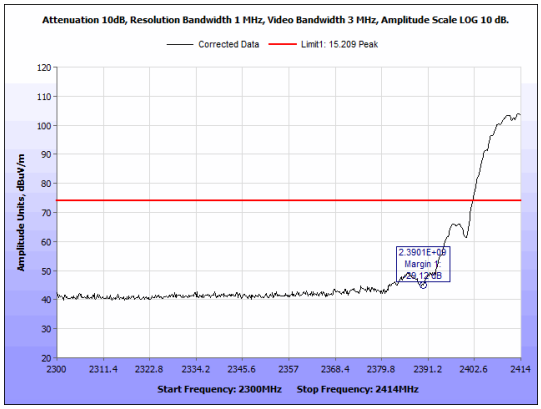


**Figure 73: Radiated Band Edge, 802.11b - 2402 MHz - Peak - Vertical.**

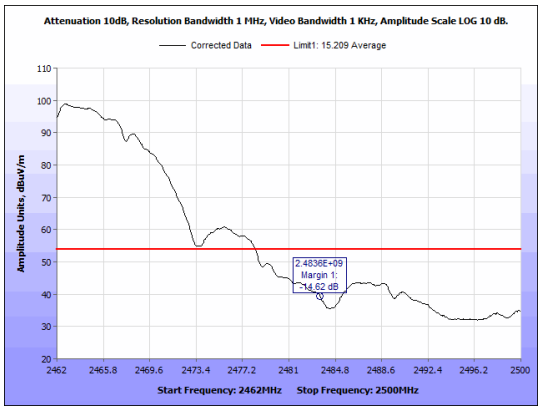


**Figure 74: Radiated Band Edge, 802.11b - 2462 MHz - Average - Horizontal.**

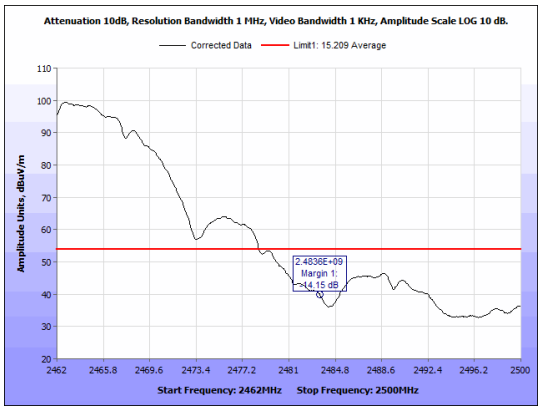


**Figure 75: Radiated Band Edge, 802.11b - 2462 MHz - Average - Vertical.**


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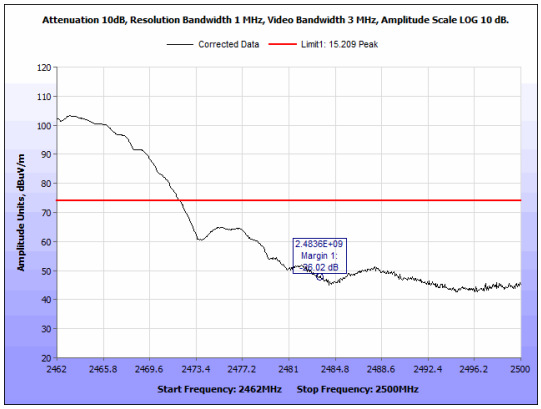


**Figure 76: Radiated Band Edge, 802.11b - 2462 MHz - Peak - Horizontal.**

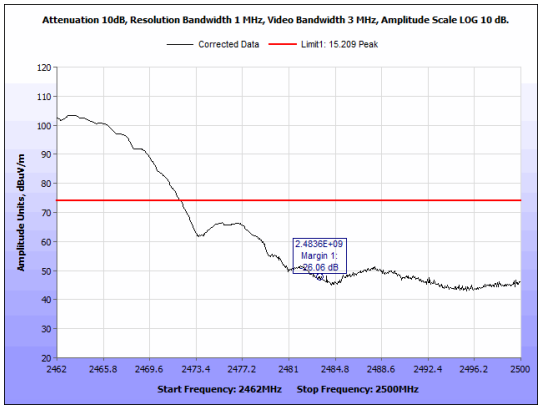


**Figure 77: Radiated Band Edge, 802.11b - 2462 MHz - Peak - Vertical.**

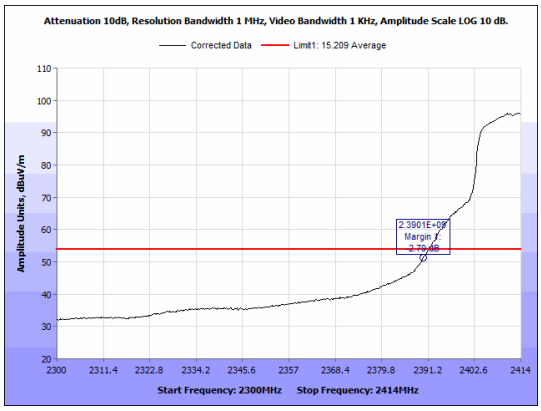


**Figure 78: Radiated Band Edge, 802.11g - 2402 MHz - Average - Horizontal.**


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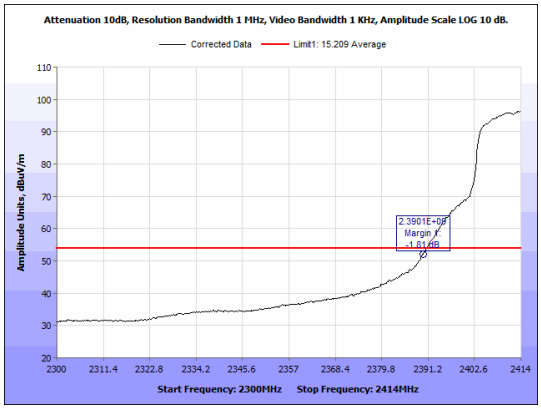


**Figure 79: Radiated Band Edge, 802.11g - 2402 MHz - Average - Vertical.**

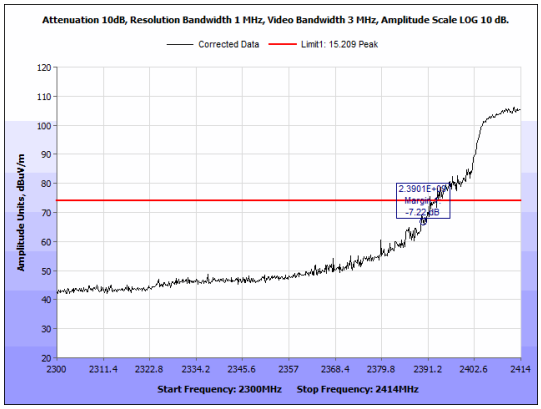


**Figure 80: Radiated Band Edge, 802.11g - 2402 MHz - Peak - Horizontal.**

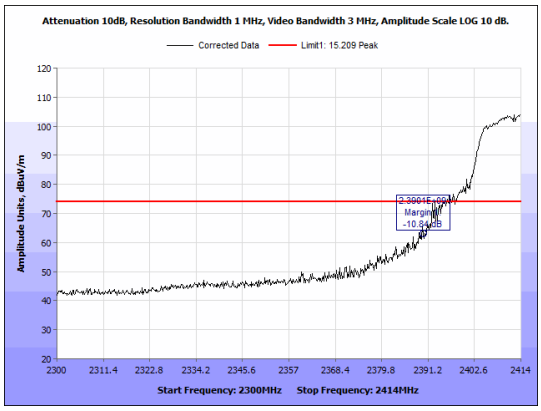


**Figure 81: Radiated Band Edge, 802.11g - 2402 MHz - Peak - Vertical.**


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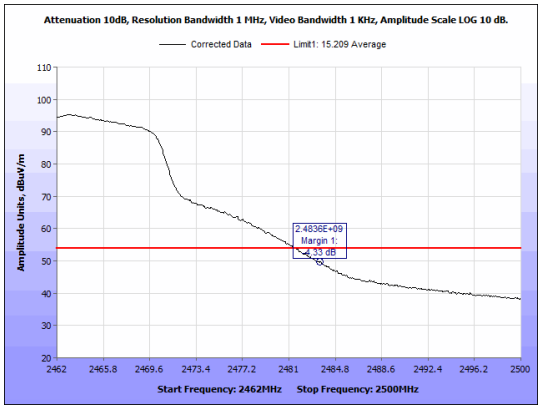


**Figure 82: Radiated Band Edge, 802.11g - 2462 MHz - Average - Horizontal.**

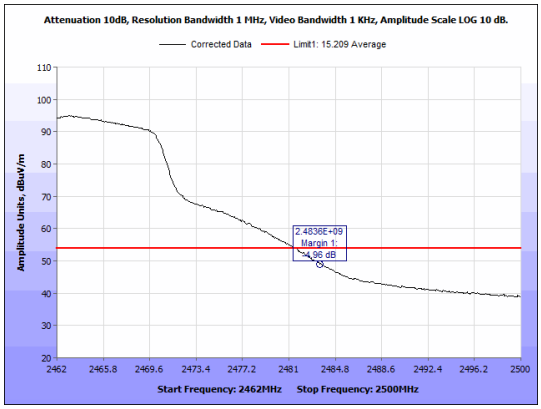


**Figure 83: Radiated Band Edge, 802.11g - 2462 MHz - Average - Vertical.**

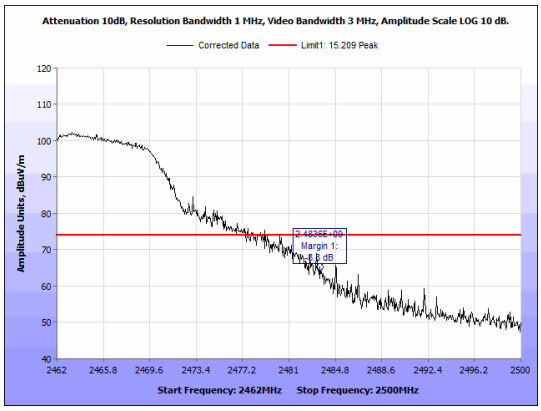


**Figure 84: Radiated Band Edge, 802.11g - 2462 MHz - Peak - Horizontal.**


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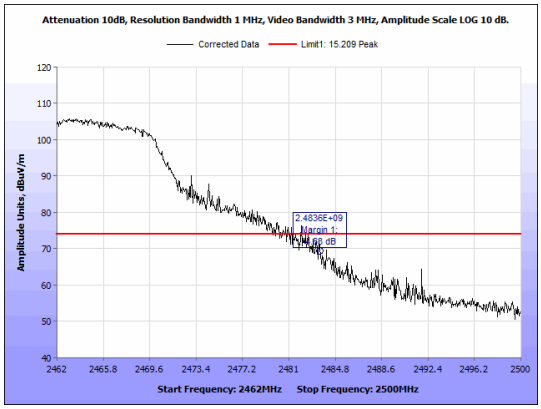


**Figure 85: Radiated Band Edge, 802.11g - 2462 MHz - Peak - Vertical.**


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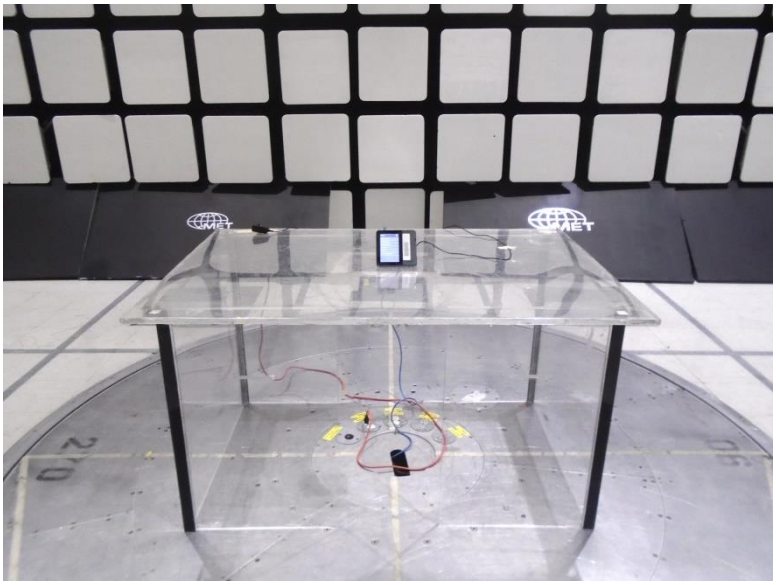
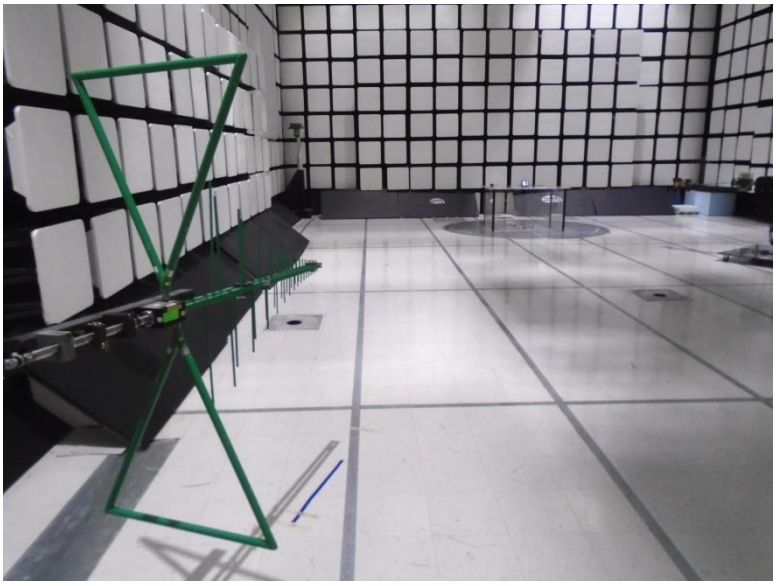
## Radiated Spurious Emissions Test Setup



**Photograph 3. Radiated Emissions, 30MHz – 1 GHz, Test Setup, Front View**



**Photograph 4. Radiated Emissions, 30MHz – 1 GHz, Test Setup, Antenna View**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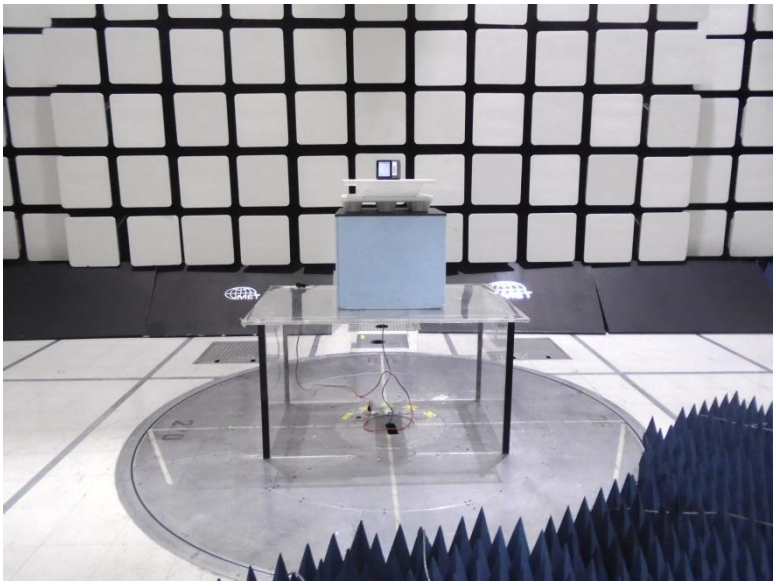
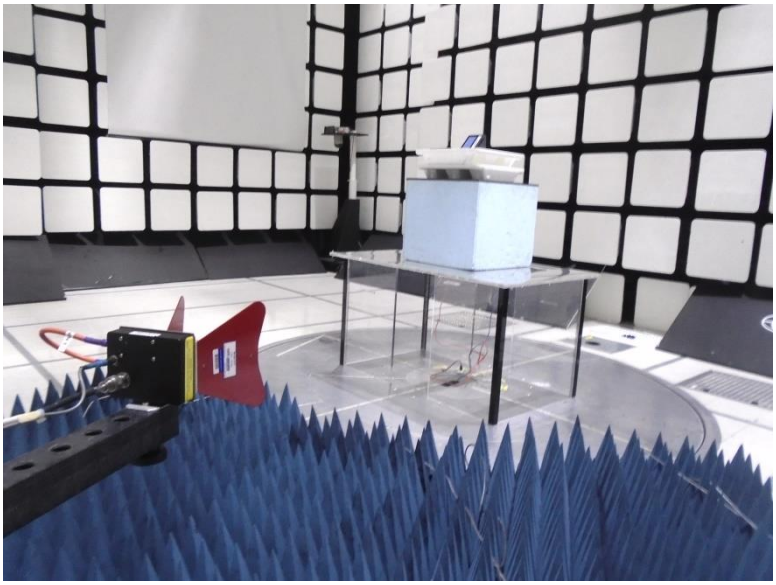


**Photograph 5. Radiated Emissions, 1-18 GHz, Test Setup, Front View**



**Photograph 6. Radiated Emissions, 1-18 GHz, Test Setup, Antenna View**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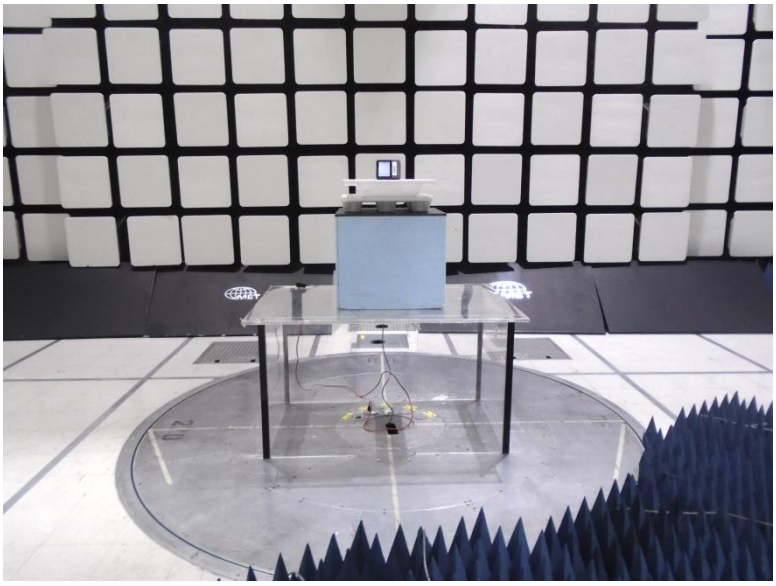
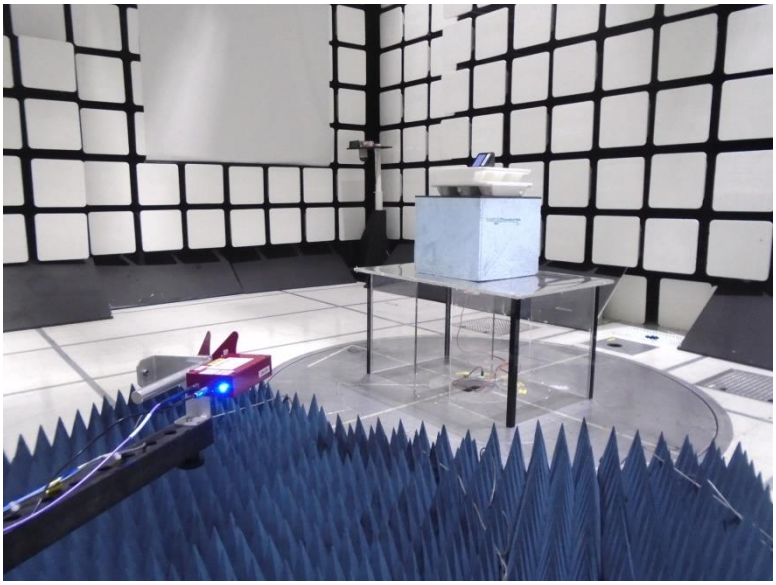


**Photograph 7. Radiated Emissions, 18 – 40 GHz, Test Setup, Front View**



**Photograph 8. Radiated Emissions, 18 - 40 GHz, Test Setup, Antenna View**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## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.247(d) Spurious Emissions in Non-restricted Bands

**Test Requirement:** **15.247(d)** In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

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

The EUT was connected to a spectrum analyzer through a cable and an attenuator. Measurements were taken with the EUT set to transmit continuously on its low, mid, and high channels for all its bandwidths at maximum power. Conducted spurious emissions were measured according to sections 11.11.2 and 11.11.3 of ANSI C63.10-2013.

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

**Test Engineer(s):** Jonathan Tavira

**Test Date(s):** July 15, 2019

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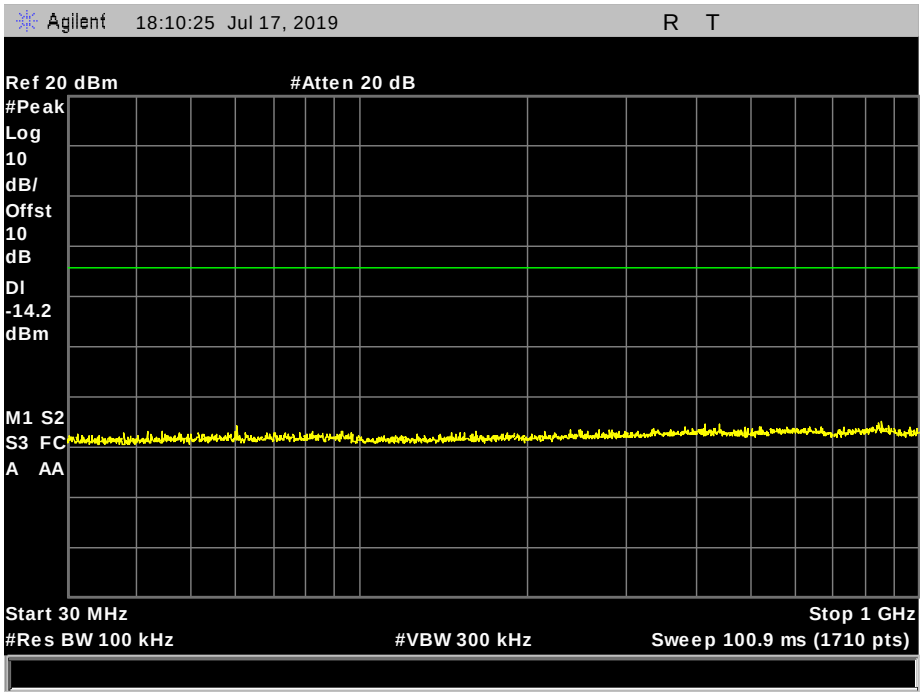
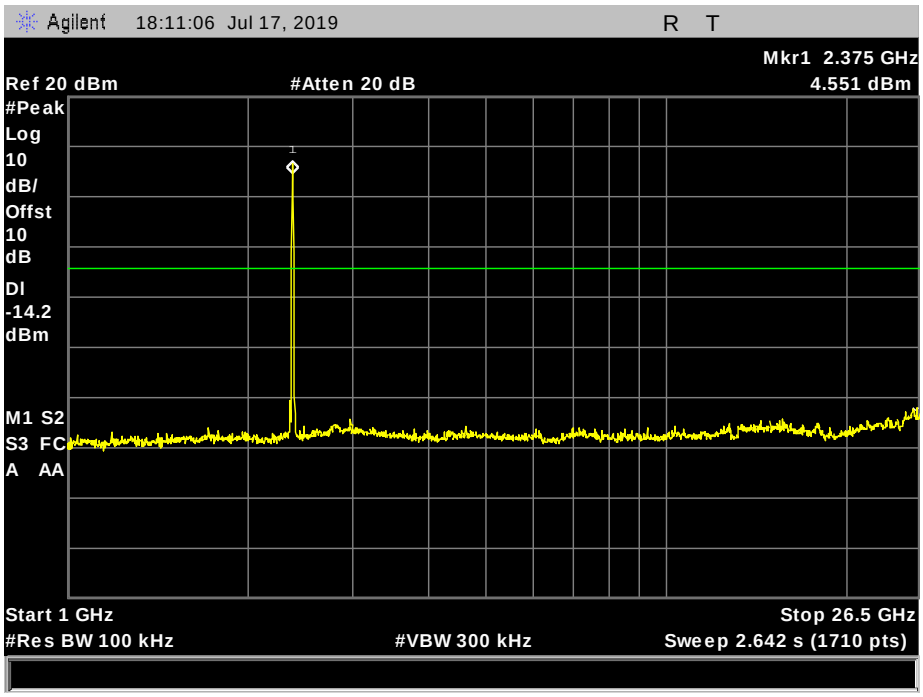
## Spurious Emissions in Non-restricted Bands, Test Results




**Plot 9. Conducted Spurious Emissions, 802.11b, 2412 MHz, 30-1000 MHz**




**Plot 10. Conducted Spurious Emissions, 802.11b, 2412 MHz, 1-26.5 GHz**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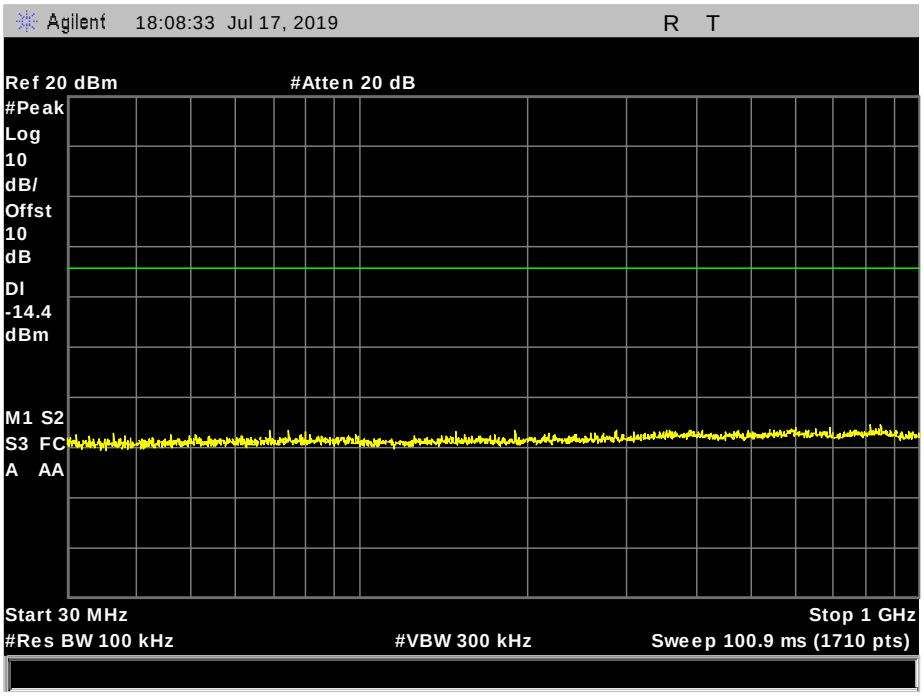
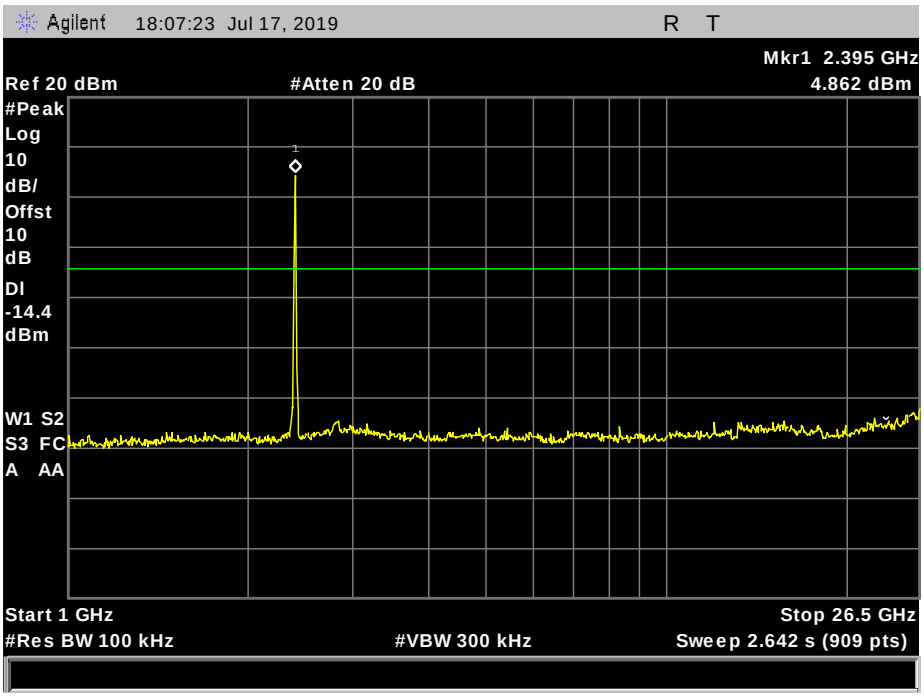



**Plot 11. Conducted Spurious Emissions, 802.11b, 2437 MHz, 30-1000 MHz**




**Plot 12. Conducted Spurious Emissions, 802.11b, 2437 MHz, 1-26.5 GHz**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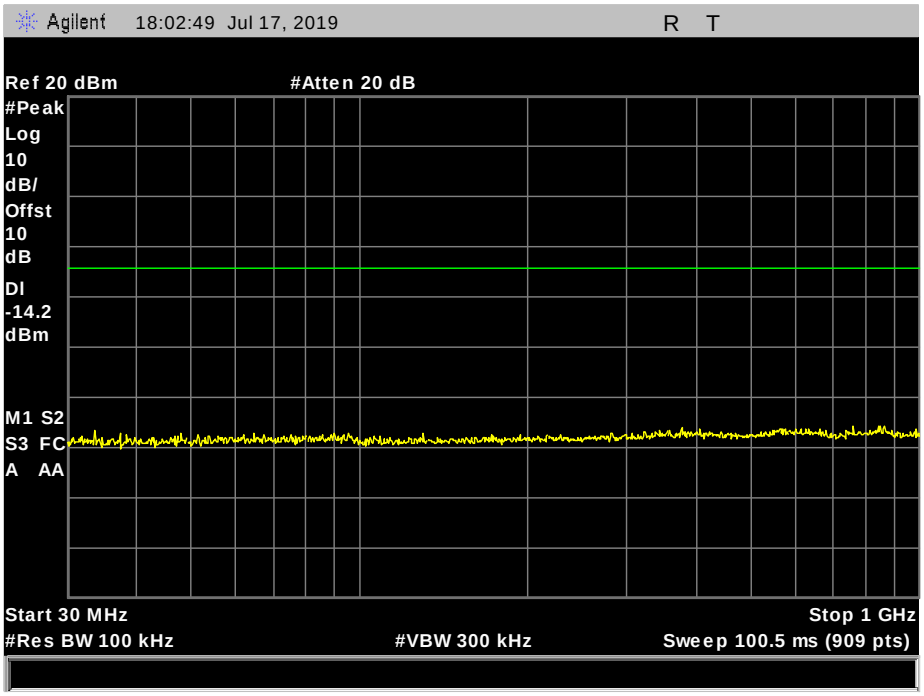
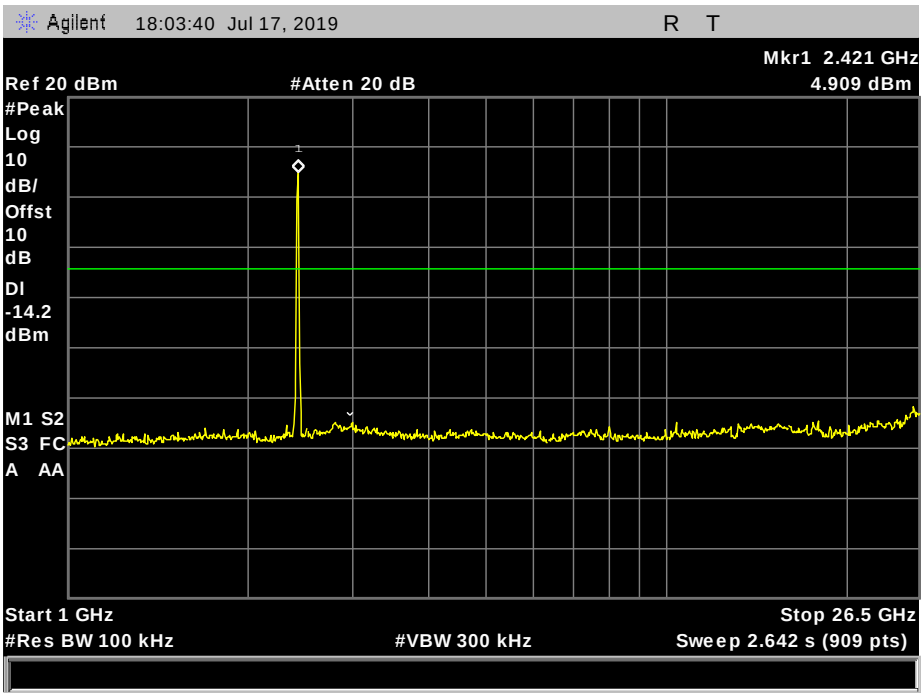



**Plot 13. Conducted Spurious Emissions, 802.11b, 2462 MHz, 30-1000 MHz**




**Plot 14. Conducted Spurious Emissions, 802.11b, 2462 MHz, 1-26.5 GHz**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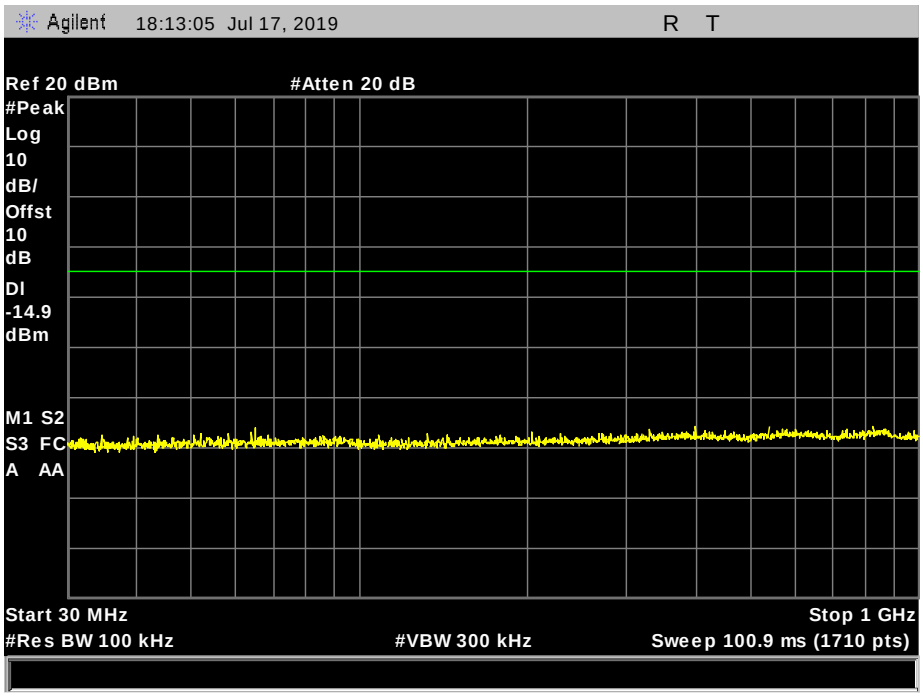
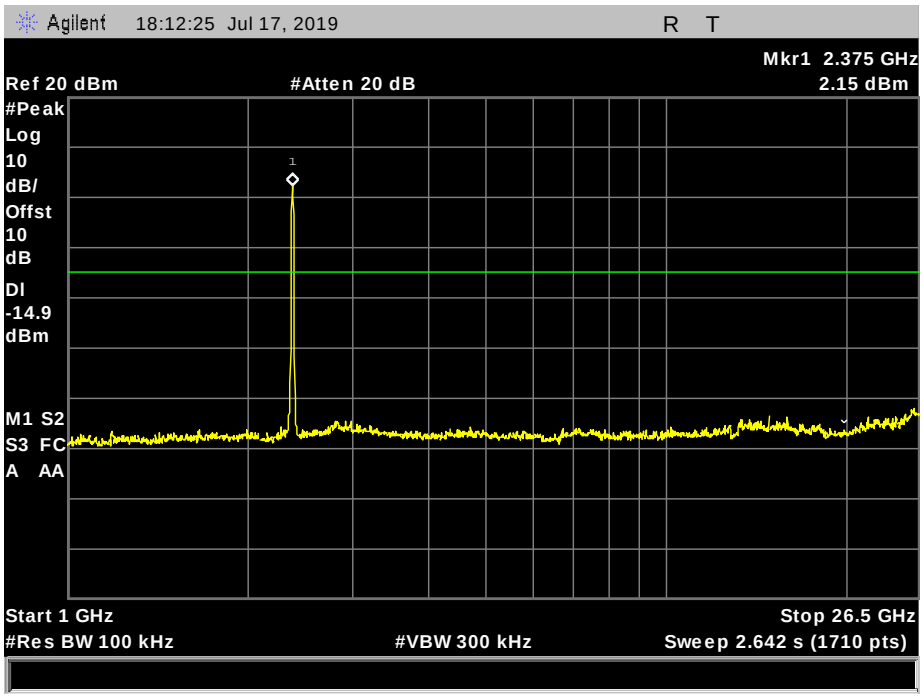



**Plot 15. Conducted Spurious Emissions, 802.11g, 2412 MHz, 30-1000 MHz**




**Plot 16. Conducted Spurious Emissions, 802.11g, 2412 MHz, 1-26.5 GHz**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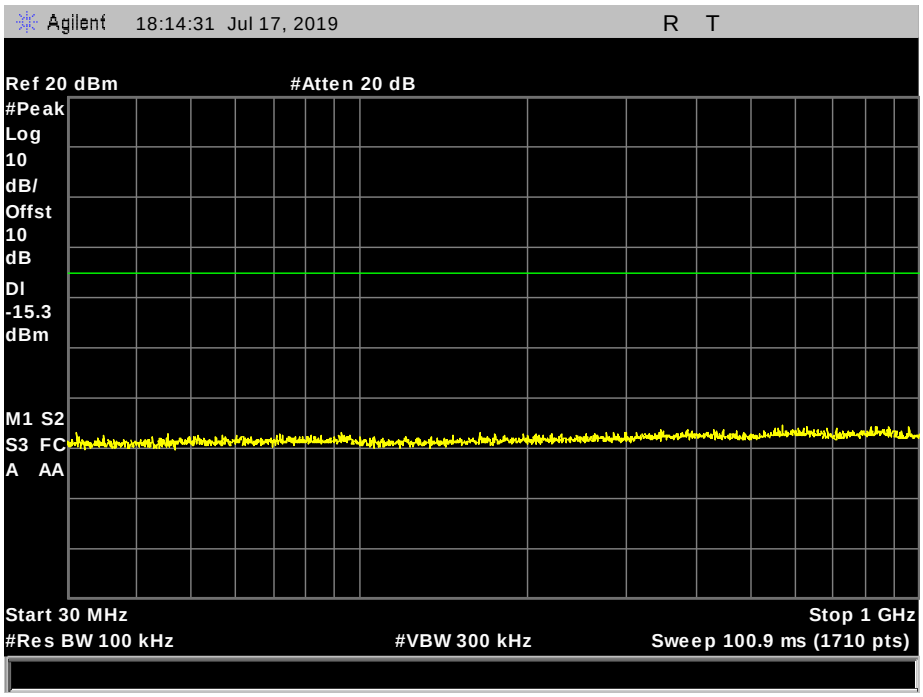
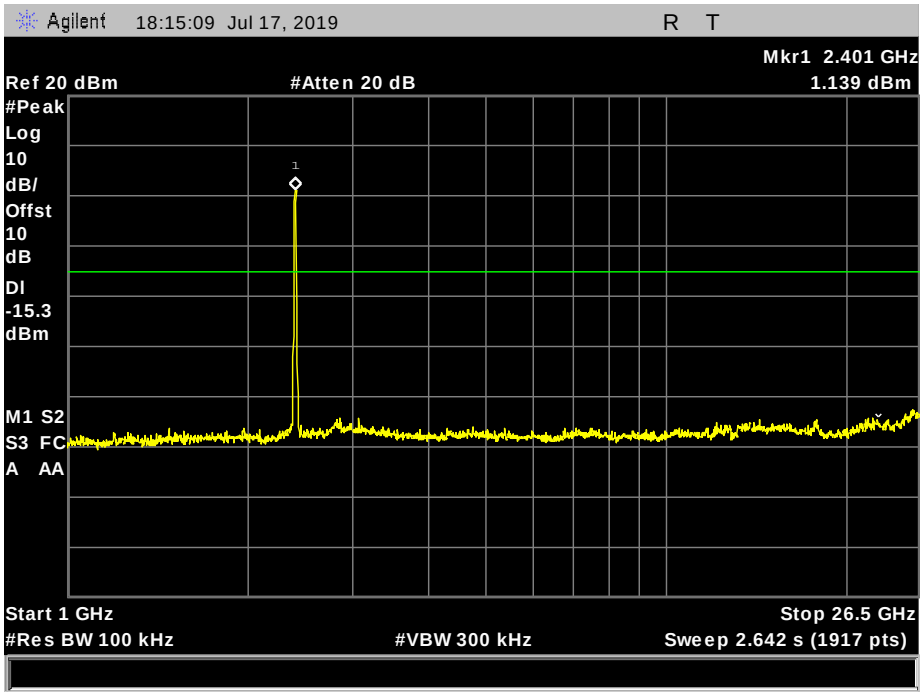



**Plot 17. Conducted Spurious Emissions, 802.11g, 2437 MHz, 30-1000 MHz**




**Plot 18. Conducted Spurious Emissions, 802.11g, 2437 MHz, 1-26.5 GHz**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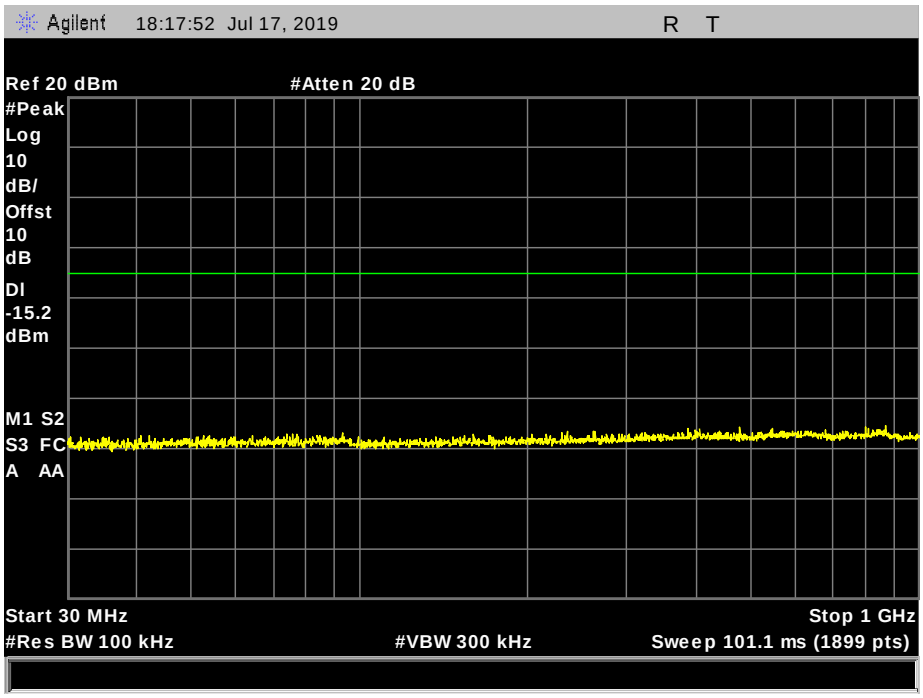
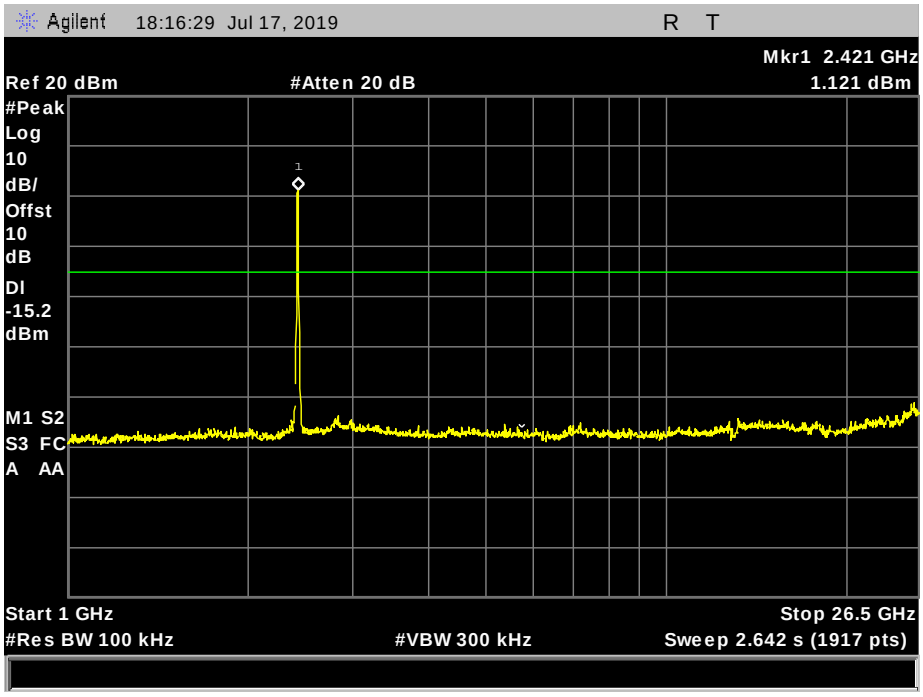



**Plot 19. Conducted Spurious Emissions, 802.11g, 2462 MHz, 30-1000 MHz**




**Plot 20. Conducted Spurious Emissions, 802.11g, 2462 MHz, 1-26.5 GHz**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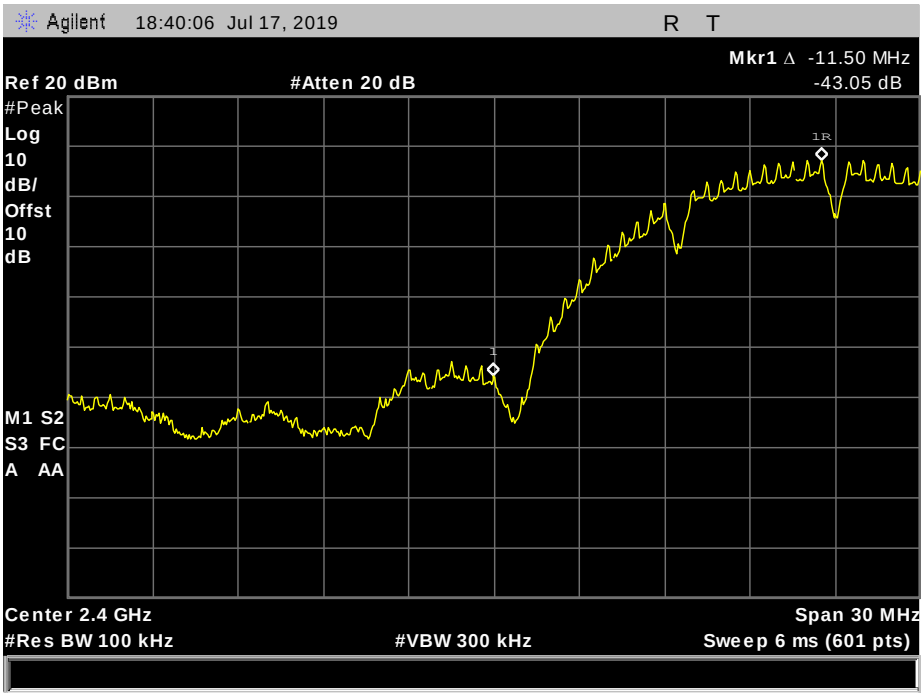
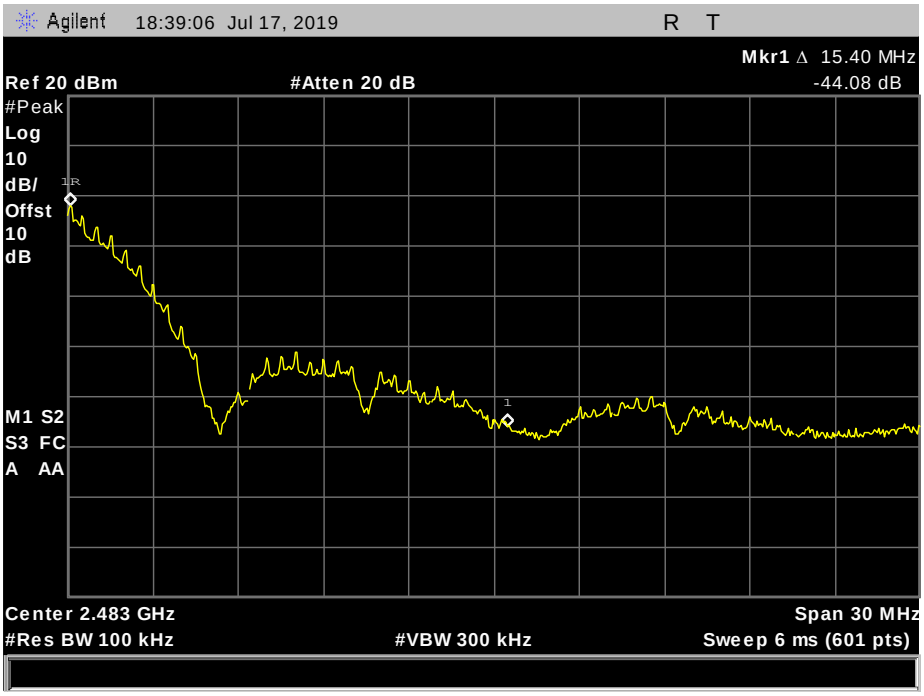



**Plot 21. Conducted Spurious Emissions, Bandedge, 802.11b, 2412 MHz**




**Plot 22. Conducted Spurious Emissions, Bandedge, 802.11b, 2462 MHz**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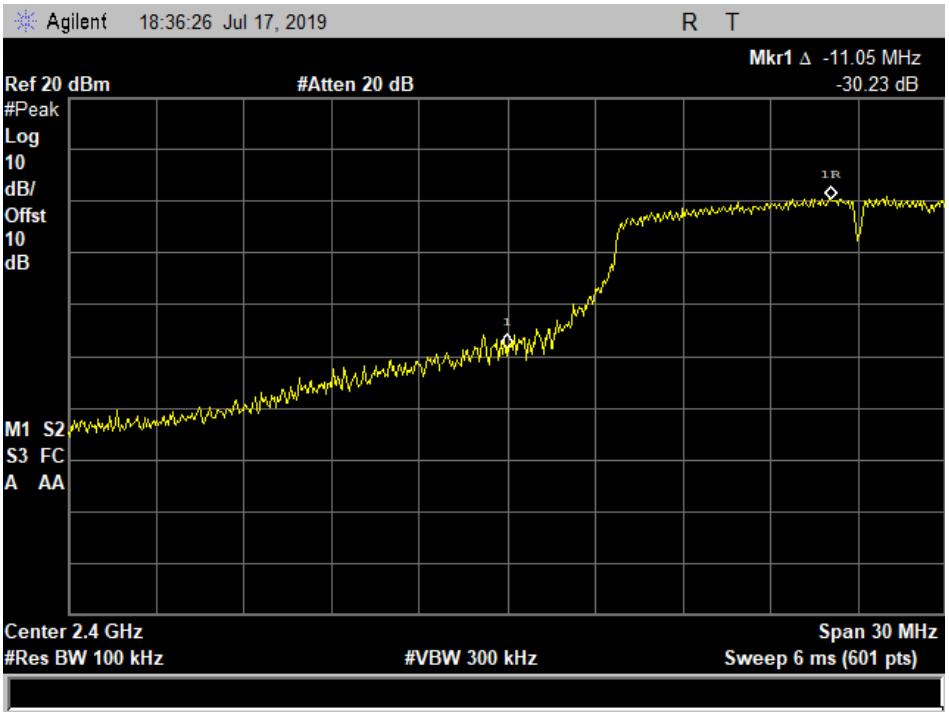
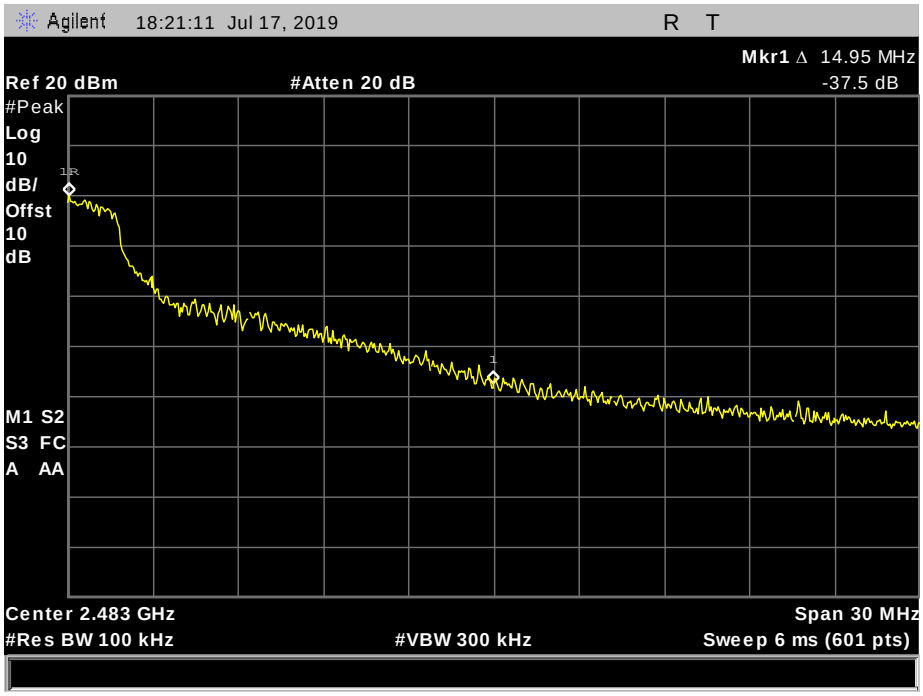



**Plot 23. Conducted Spurious Emissions, Bandedge, 802.11g, 2412 MHz**




**Plot 24. Conducted Spurious Emissions, Bandedge, 802.11g, 2462 MHz**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## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.247(e) Power Spectral Density

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

**Test Procedure:** The EUT was connected to a spectrum analyzer through a cable and an attenuator. Measurements were taken with the EUT set to transmit continuously on its low, mid, and high channels for all its bandwidths at maximum power. Power spectral density was measured according to measurement method AVGPSD-1A as described in ANSI C63.10-2013, section 11.10.4. Attenuator and cable loss were programmed into the spectrum analyzer.

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

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

**Test Engineer:** Jonathan Tavira

**Test Date:** July 15, 2019

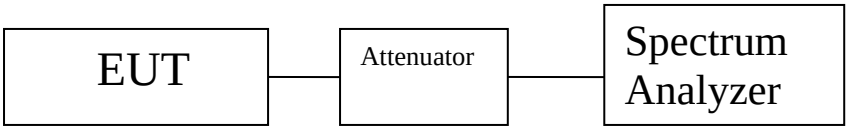


**Figure 86. Block Diagram, Power Spectral Density Test Setup**

## Power Spectral Density Test Results

| Mode | Frequency (MHz) | Measured (Average) Power Spectral Density (dBm) |
|---|---|---|
| 802.11b | 2412 | -0.93 |
| 802.11b | 2437 | -1.382 |
| 802.11b | 2462 | -1.255 |
| 802.11g | 2412 | -3.627 |
| 802.11g | 2437 | -3.889 |
| 802.11g | 2462 | -3.767 |

**Table 17. Peak Power Spectral Density, Test Results**


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## Peak Power Spectral Density

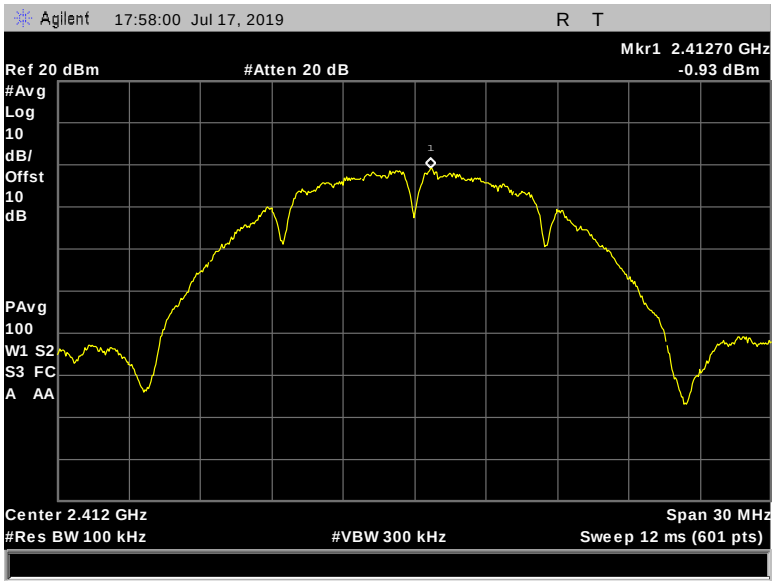


**Figure 87. Power Density, 802.11b, 2412 MHz, -0.93 dBm**

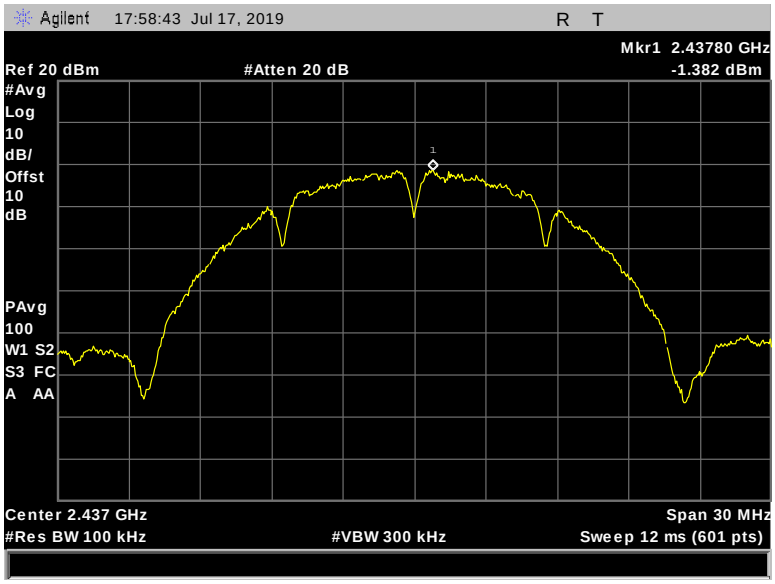


**Figure 88. Power Density, 802.11b, 2437 MHz, -1.382 dBm**


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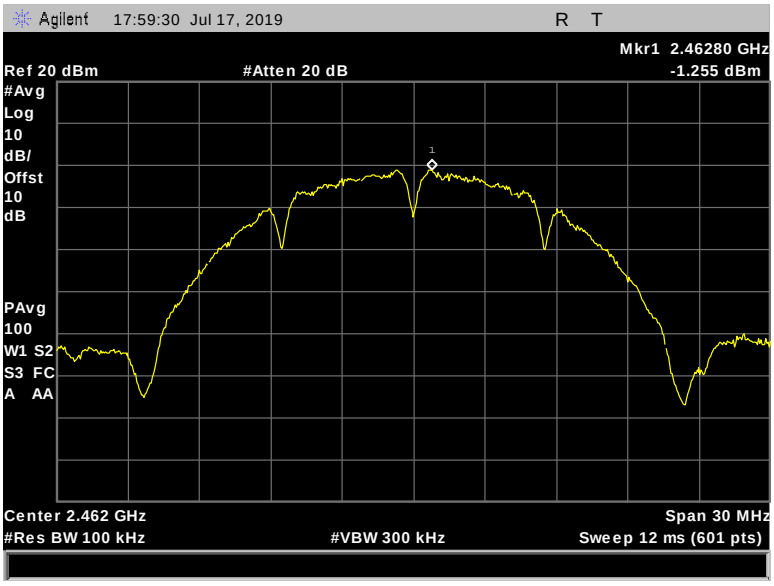


**Figure 89. Power Density, 802.11b, 2462 MHz, -1.255 dBm**

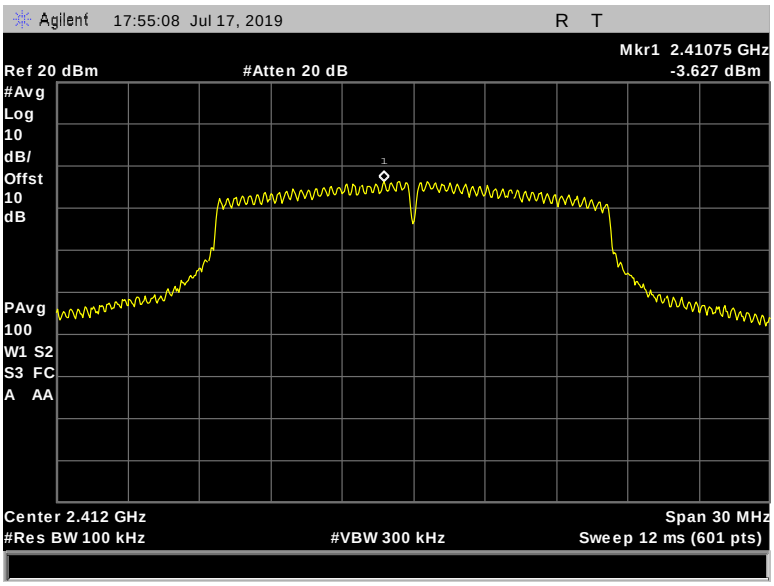


**Figure 90. Power Density, 802.11g, 2412 MHz, -3.627 dBm**


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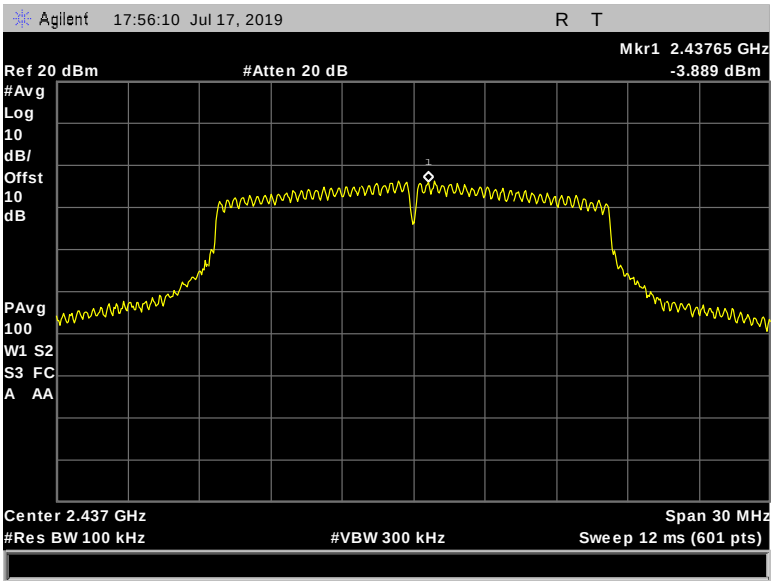


**Figure 91. Power Density, 802.11g, 2437 MHz, -3.889 dBm**

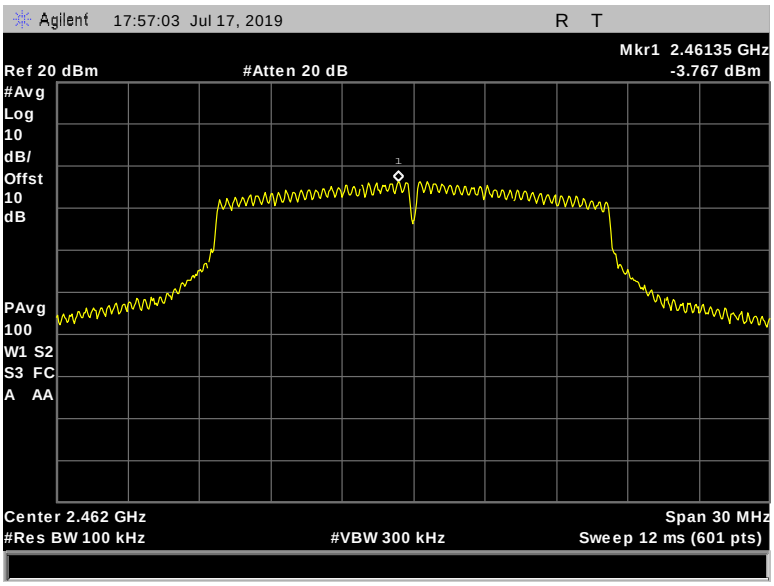


**Figure 92. Power Density, 802.11g, 2462 MHz, -3.767 dBm**


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# Electromagnetic Compatibility Criteria for Intentional Radiators

## § 15.247(i) RF Human 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:** **2.1093:** As specified in this section, a portable device is defined as a transmitting device designed to be used so that the radiated structure(s) of the device is within 20 centimeters of the body of the user. Calculations below are in accordance with KDB 447498 D01 General RF Exposure Guidance v06, Section 4.3 General SAR test exclusion guidance.
The SAR test exclusion thresholds are 3.0 for 1-g SAR and 7.5 for 10-g extremity SAR

**Test Results**: The separation distance was determined by measuring the distance from the transmitter to the edge of the touch screen on the EUT. That distance was measured to be 25 mm.

| 802.11b (2.4 GHz WiFi) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Frequency (MHz)** | **Con. Pwr. (dBm)** | **Tuneup tolerance (dB)** | **Total Pwr. (mW)** | **Calculated SAR Threshold** | **10.0-g SAR Limit** | **Margin** | **Separation Distance Declared (mm)** | **Result** |
| 2412 | 15.80 | 1 | 47.863 | 2.9734 | 7.5 | -4.5266 | 25 | Exempt |

Per KDB 447498, Section 4.3.1 (a), applicable for 100 MHz to 6 GHz and test separation distances ≤ 50 mm:

$$\frac{max.power\ of\ channel, including\ tuneup\ tolerance\ [mW]}{min.test\ separation\ distance\ [mm]} * \sqrt{f\ [GHz]} \leq 7.5\ (10 - g\ SAR\ Limit)$$

$$\frac{47.863\ mW}{25\ mm} * \sqrt{2.412} = 2.9734 \leq 7.5\ (10 - g\ SAR)$$

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# IV. Test Equipment


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## Test Equipment

Calibrated test equipment utilized during testing was maintained in a current state of calibration per the requirements of ISO/IEC 17025:2017.

| MET ASSET # | EQUIPMENT | MANUFACTURER | MODEL | LAST CAL DATE | CAL DUE DATE |
|---|---|---|---|---|---|
| 1A1065 | EMI RECEIVER | ROHDE & SCHWARZ | ESCI | 05/01/2019 | 05/01/2020 |
| 1A1177 | ATTENUATOR | ROHDE & SCHWARZ | ESH3Z2 | 11/30/2018 | 11/30/2019 |
| 1A1123 | LISN | TESEQ | NNB 51 | 07/18/2019 | 08/18/2019 |
| 1A1076 | VARIABLE AC TRANSFORMER | POWERSTAT | N/A | SEE NOTE | |
| 1A1119 | TEST AREA | CUSTOM MADE | N/A | SEE NOTE | |
| 1A1184 | SPECTRUM ANALYZER | AGILENT | E4407B | 06/25/2019 | 06/25/2020 |
| 1A1083 | EMI RECIVER | ROHDE & SCHWARZ | ESU40 | 10/10/2019 | 10/10/2020 |
| 1A1050 | HYBRID ANTENNA | SCHAFFNER | CBL 6112D | 08/29/2018 | 02/29/2020 |
| 1A1183 | DOUBLE RIDGED WAVEGUIDE ANTENNA | ETS-LINDGREN | 3117 | 10/10/2018 | 04/10/2020 |
| 1A1088 | PRE-AMP | ROHDE & SCHWARZ | TS-PR1 | SEE NOTE | |
| 1A1080 | MULTI-DEVICE CONTROLLER | ETS-EMCO | 2090 | SEE NOTE | |
| 1A1180 | PRE-AMP | MITEQ | AMF-7D-01001800-22-10P | SEE NOTE | |
| 1A1106 | 10M SEMI-ANECHOIC CHAMBER | LINDGREN | N/a | SEE NOTE | |

**Table 18. Test Equipment List**

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


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# 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.


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(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.


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## 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.


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## 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.


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# Certification & User's Manual Information

## 1. 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 user's 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.


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## 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.


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# End of Report

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