HEADQUARTERS: 914 WEST PATAPSCO AVENUE • BALTIMORE, MARYLAND 21230 • PHONE (410) 354-3300 • FAX (410) 354-3313

November 4, 2020

Raven Connected Inc.
441 Maclarem Street Suite 408
Ottawa, ON K2P 2H3

Dear Shing Ho,

Enclosed is the EMC Wireless test report for compliance testing of the Raven Connected Inc., Raven+ 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 we can be of further service to you, please feel free to contact me.

Sincerely yours,
EUROFINS E&E NORTH AMERICA

Michelle Tawmging
Documentation Department

Reference: (\Raven Connected Inc.\WIR108581-FCC247 Rev. 1)

Electromagnetic Compatibility Criteria
Test Report

for the

Raven Connected Inc.
Raven+

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

Report: WIR108581-FCC247 Rev. 1

November 4, 2020

Prepared For:

Raven Connected Inc.
441 Maclarem Street Suite 408
Ottawa, ON K2P 2H3

Prepared By:
Eurofins E&E North America
914 West Patapsco Ave.,
Baltimore MD 21230

Electromagnetic Compatibility Criteria
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Donald Salguero
Electromagnetic Compatibility Lab

Michelle Tawmging
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.

Deepak Giri,
Director, Electromagnetic Compatibility Lab

Report Status Sheet

Revision	Report Date	Reason for Revision
∅	August 26, 2020	Initial Issue.
1	November 4, 2020	Added FCC ID.

Table of Contents

List of Figures

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

Executive Summary

A. Purpose of Test

An EMC evaluation was performed to determine compliance of the Raven Connected Inc. Raven+, 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 Raven+. Raven Connected Inc. should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the Raven+, 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 Raven Connected Inc., purchase order number 308. All tests were conducted using measurement procedure ANSI C63.10-2013.

FCC Reference 47 CFR Part 15.247:2005	Description	Compliance
Title 47 of the CFR, Part 15 §15.203	Antenna Requirement	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(b)	Peak Power Output	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)	Maximum Permissible Exposure (MPE)	Compliant

Figure 1: Executive Summary of EMC Part 15.247 ComplianceTesting

Equipment Configuration

A. Overview

Eurofins MET Laboratories, Inc. was contracted by Raven Connected Inc. to perform testing on the Raven+, under Raven Connected Inc.'s purchase order number 308.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Raven Connected Inc., Raven+.

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

Model(s) Tested:	Raven+	
Model(s) Covered:	Raven+	
EUT Specifications:	Primary Power: 12-15 VDC	
	FCC ID: 2AN9Y-RVN0A0	
	Type of Modulations:	QAM, QPSK
	Equipment Code:	DTS
	Peak RF Output Power:	14.97 dBm; 31.4 mW
	EUT Frequency Ranges:	2412 – 2462 MHz; 2422 – 2452 MHz
Analysis:	The results obtained relate only to the item(s) tested.	
Environmental Test Conditions:	Temperature: 15-35° C	
	Relative Humidity: 30-60%	
	Barometric Pressure: 860-1060 mbar	
Evaluated by:	Donald Salguero	
Report Date(s):	November 4, 2020	

Figure 2: EUT Summary Table

B. References

CFR 47, Part 15, Subpart C	Federal Communication Commission, Code of Federal Regulations, Title 47, Part 15: General Rules and Regulations, Allocation, Assignment, and Use of Radio Frequencies
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

Figure 3: References

C. Test Site

All testing was performed at Eurofins MET Laboratories, Inc., 914 West Patapsco Ave., Baltimore MD 21230. All equipment used in making physical determinations is accurate and bears recent traceability to the National Institute of Standards and Technology.

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

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

D. Description of Test Sample

The Raven Connected Inc. Raven+, Equipment Under Test (EUT), is a complete all-in-one connected vehicle system, Raven+ provides monitoring solutions for consumers and for small businesses. Raven+ integrates advanced technologies into a single product, including an always-connected, 4G LTE cellular system; AI-powered dash cameras; telematics-capturing OBD; Wi-Fi and Bluetooth; GPS; displays; a security system and motion sensors; and shareable video and media.

Figure 4: Raven Connected Inc. Raven+

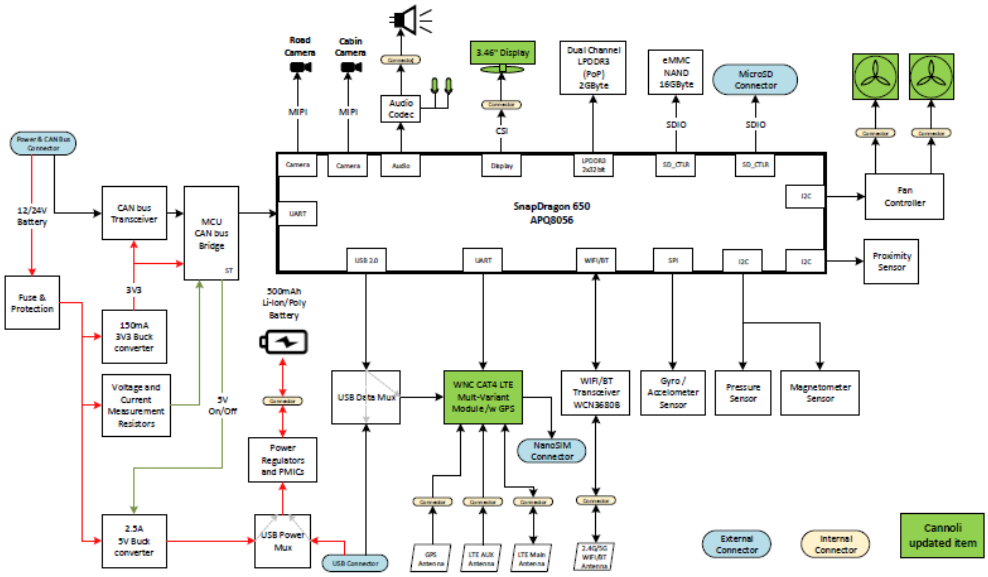

Figure 5: Block Diagram of Test Configuration

E. Equipment Configuration

The EUT was set up as outlined in Figure 5, Block Diagram of Test Setup. All cards, racks, etc., incorporated as part of the EUT is included in the following list.

Ref. ID	Slot #	Name/Description	Model Number	Part Number	Serial Number	Rev. #
		Raven+	TBD	TBD		

Figure 6: Equipment Configuration

F. Support Equipment

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

Ref. ID	Name/Description	Manufacturer	Model Number	Customer Supplied Calibration Data
	Laptop	IBM	Lenovo	

Figure 7: Support Equipment

G. 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
	Power	Custom to OBD	1	2	2.6	No	Lab power supply

Figure 8: Ports and Cabling Information

H. Mode of Operation

There are three main modes of operation. - Park: Raven+ spends most of time in this mode. All features are available but are event based or user initiated. - Drive: During drive mode the unit is encoding/recording events and videos - Test: It allows firmware changes to be installed easily and comprise between both above mode.

I. Method of Monitoring EUT Operation

When Raven+ is plugged into power supply, it will self turn on. A test screen will appear on the LCD. Once power is removed the unit will self power off in 2-3 minutes. It has an internal battery for the unit to gracefully power down.

J. Modifications

a) Modifications to EUT
No modifications were made to the EUT.

b) Modifications to Test Standard
No modifications were made to the test standard.

K. Disposition of EUT

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

Electromagnetic Compatibility Criteria for Intentional Radiators

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.203 Antenna Requirement

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

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

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

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

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

Results: The EUT as tested is **compliant** the criteria of §15.203. EUT uses a built-in antenna.

Test Engineer(s): Donald Salguero

Test Date(s): August 13, 2020

Antenna Type: PCB (FR4)
Antenna Gain: 3.6 dBi
Manufacturer: WNC
Model/Part No: 81XCAZ15.G06

Electromagnetic Compatibility Criteria for Intentional Radiators

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

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

§15.247(d): In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a).

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

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

Figure 9: Restricted Bands of Operation

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

[2] Above 38.6

Test Requirement(s): **§ 15.209 (a):** Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in Figure 10:

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

Figure 10: 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.

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

Test Engineer(s): Donald Salguero

Test Date(s): August 10 and August 13, 2020

Radiated Spurious Emissions Test Results

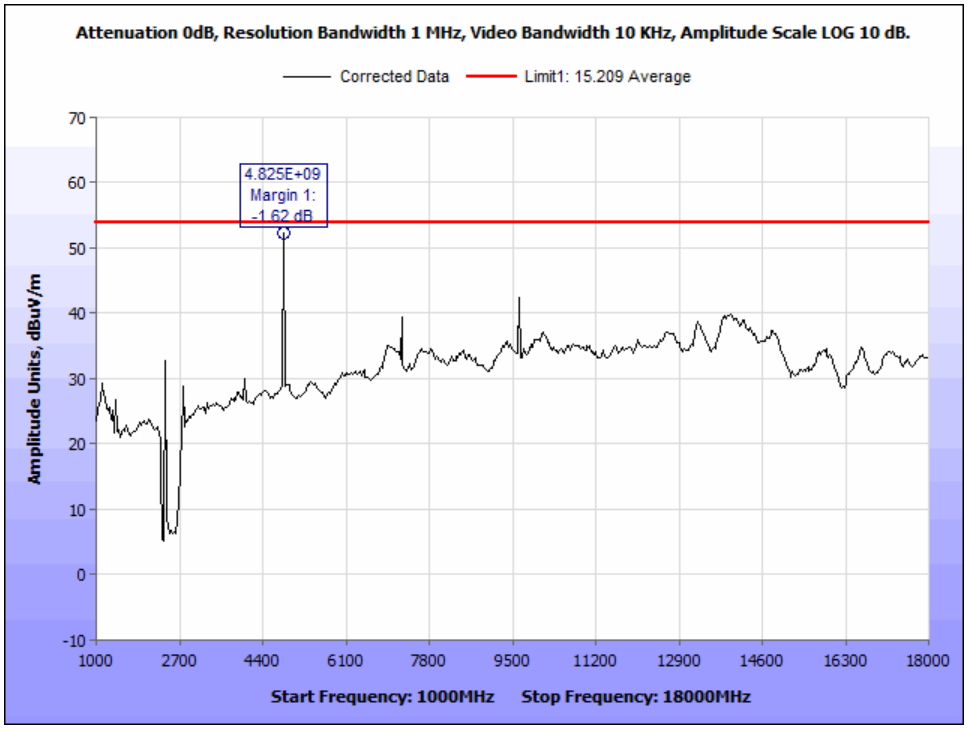

Figure 11: AVG_Radiated Emissions_802.11b_2412Mz_1-18GHz.

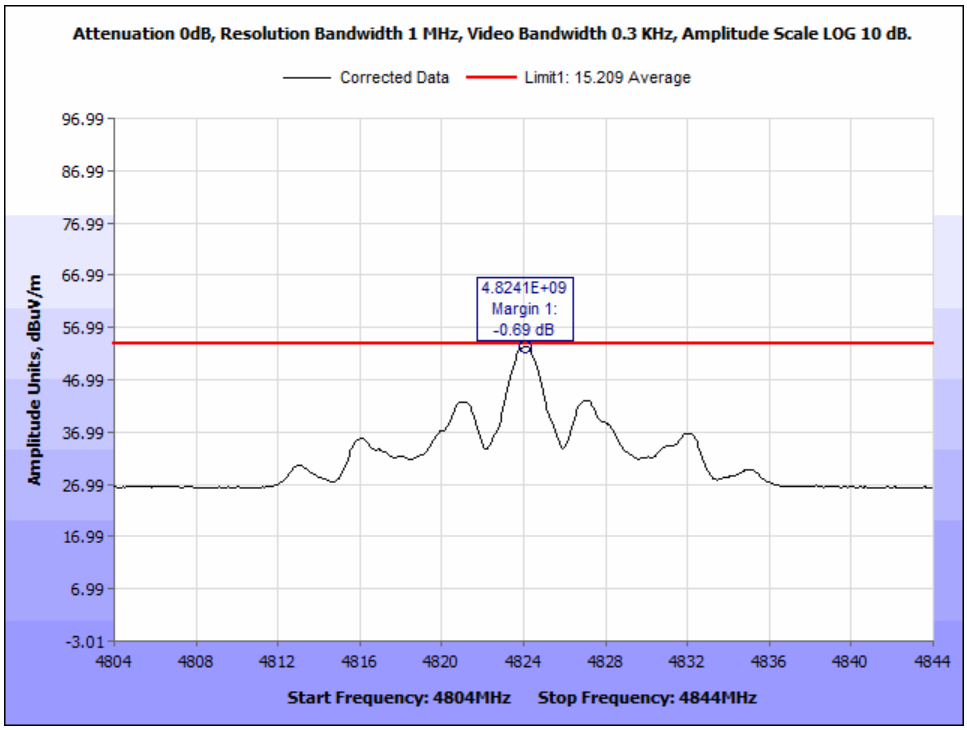

Figure 12: AVG_Radiated Emissions_802.11b_2412Mz_1-18GHz_2x harmonic

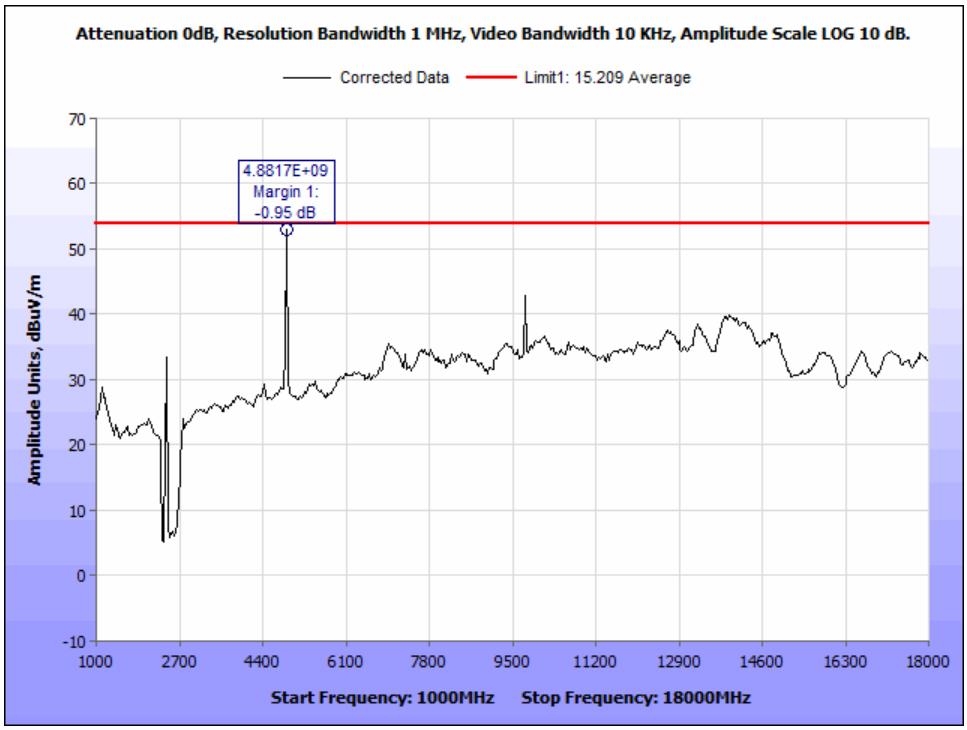

Figure 13: AVG_Radiated Emissions_802.11b_2437Mz_1-18GHz.

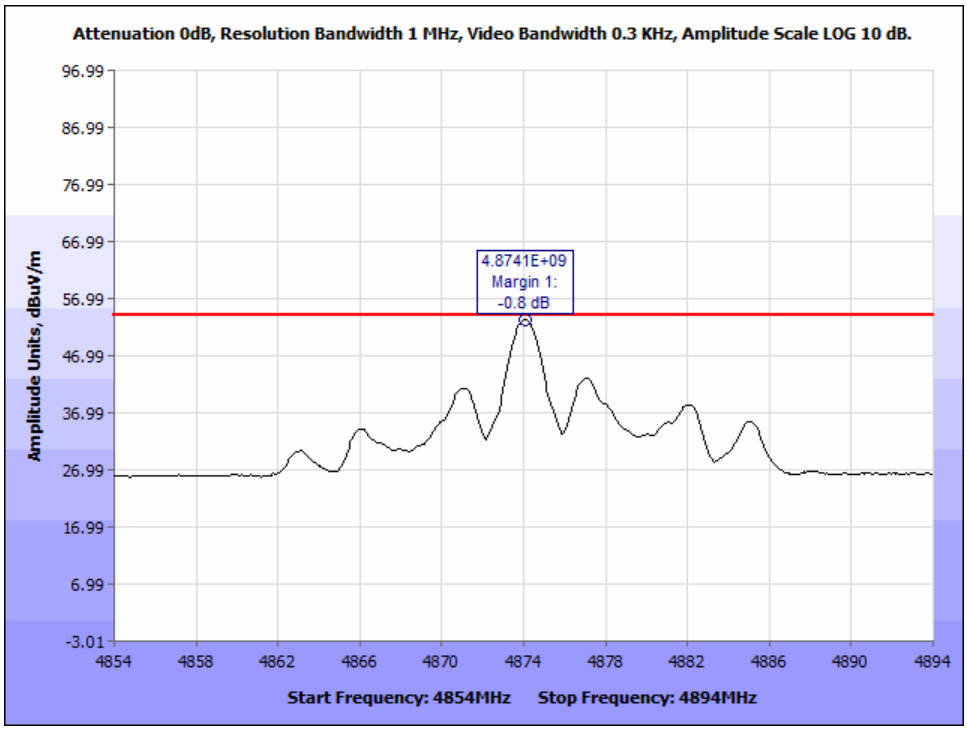

Figure 14: AVG_Radiated Emissions_802.11b_2437Mz_1-18GHz_2x harmonic

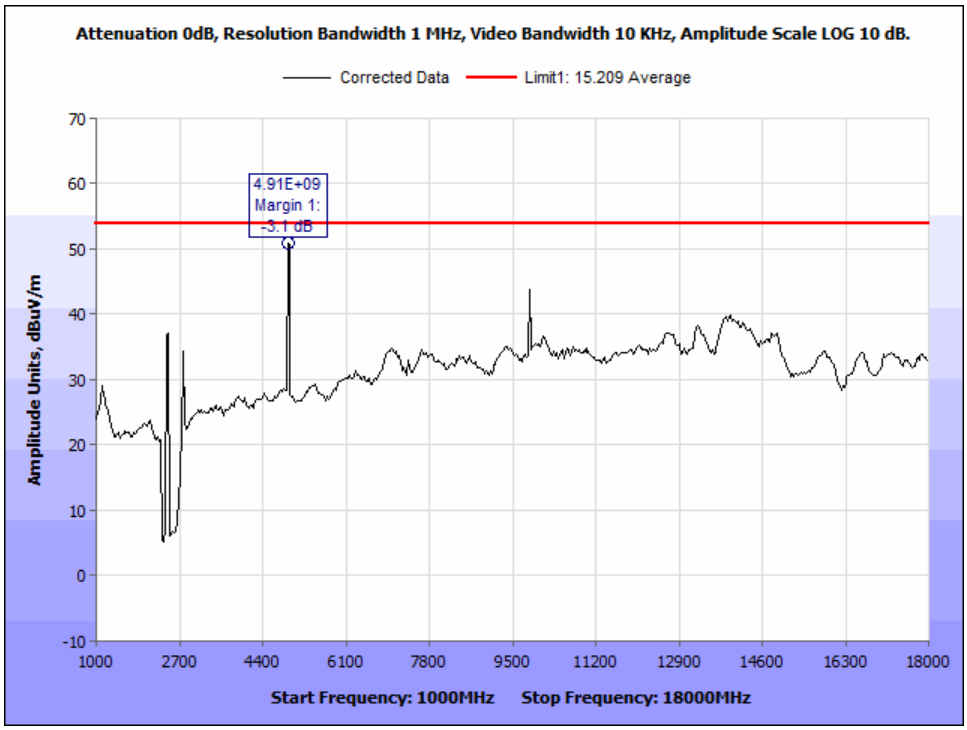

Figure 15: AVG_Radiated Emissions_802.11b_2462Mz_1-18GHz.

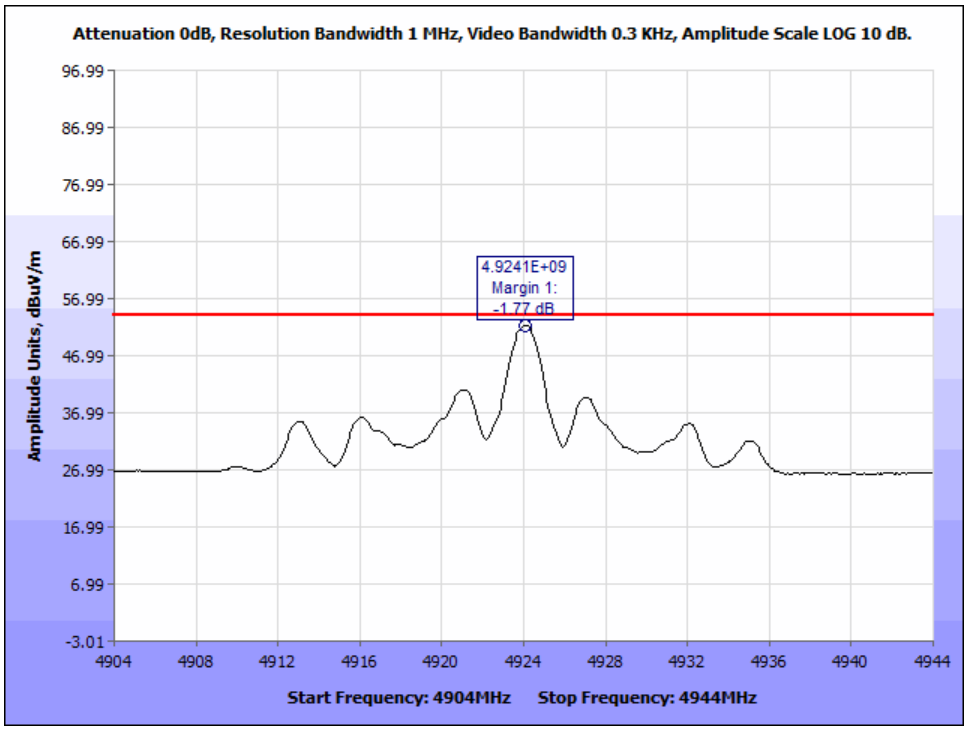

Figure 16: AVG_Radiated Emissions_802.11b_2462Mz_1-18GHz_2x harmonic.

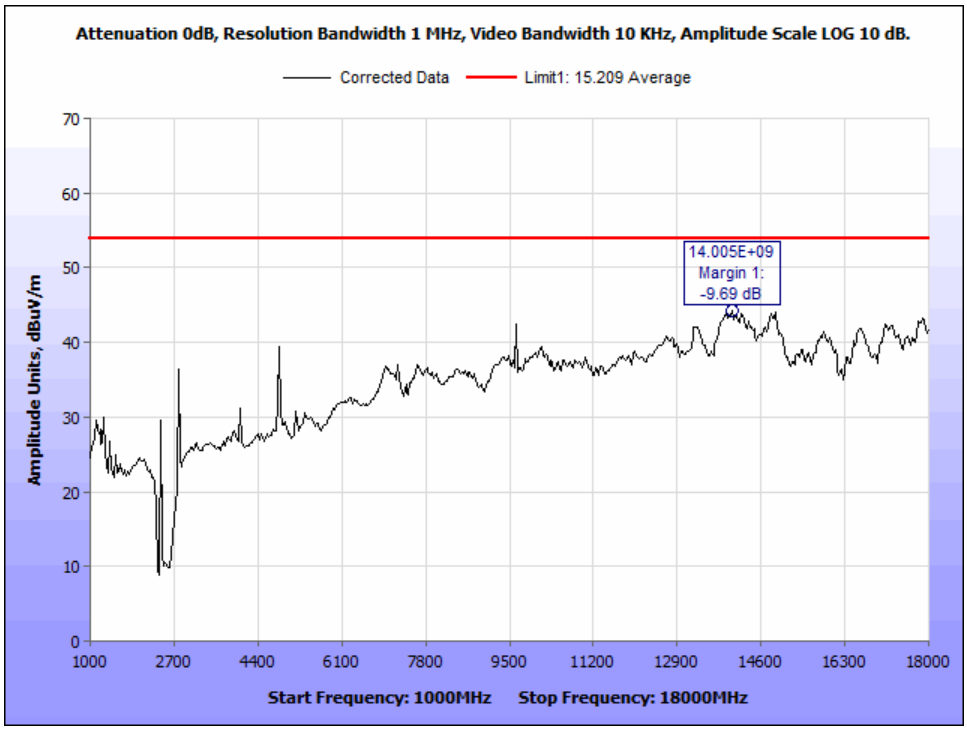

Figure 17: AVG_Radiated Emissions_802.11g_2412Mz_1-18GHz.

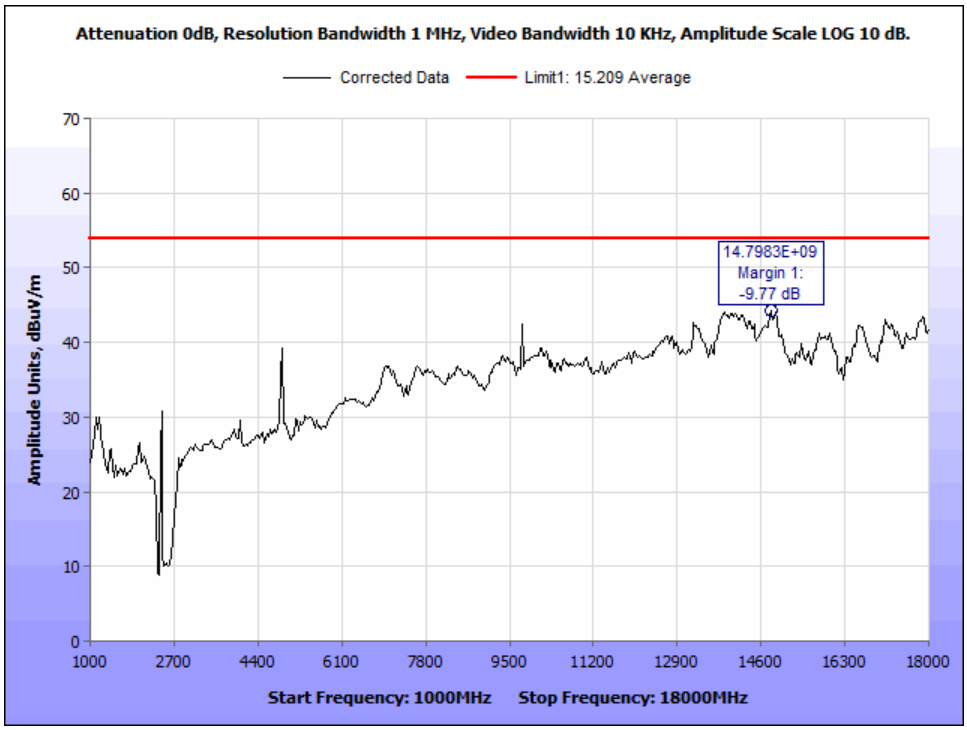

Figure 18: AVG_Radiated Emissions_802.11g_2437Mz_1-18GHz.

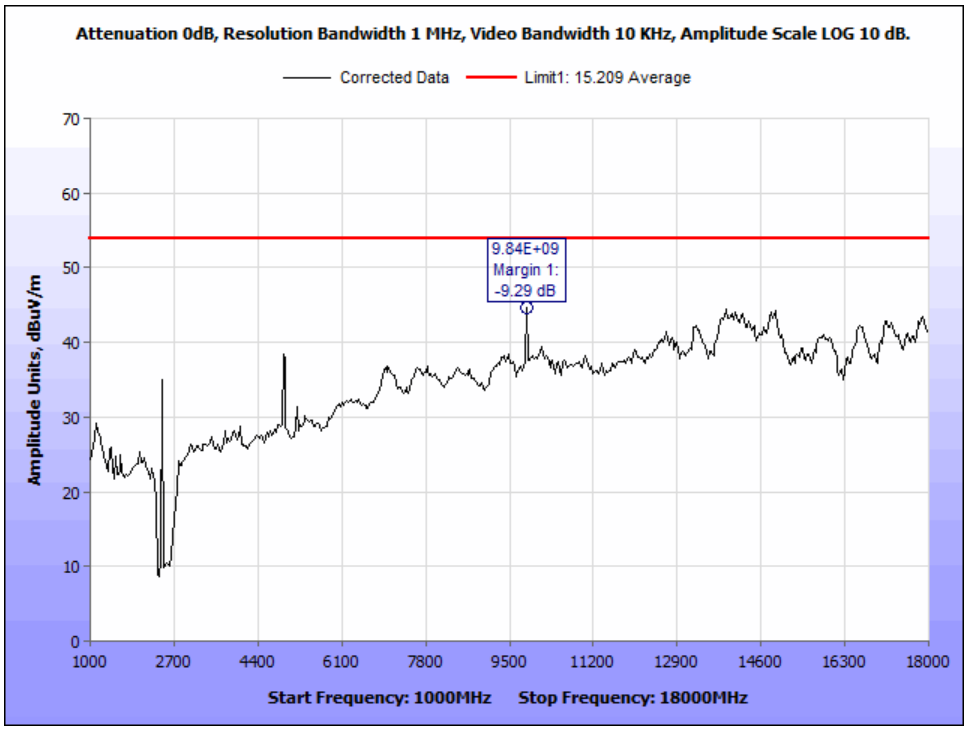

Figure 19: AVG_Radiated Emissions_802.11g_2462Mz_1-18GHz.

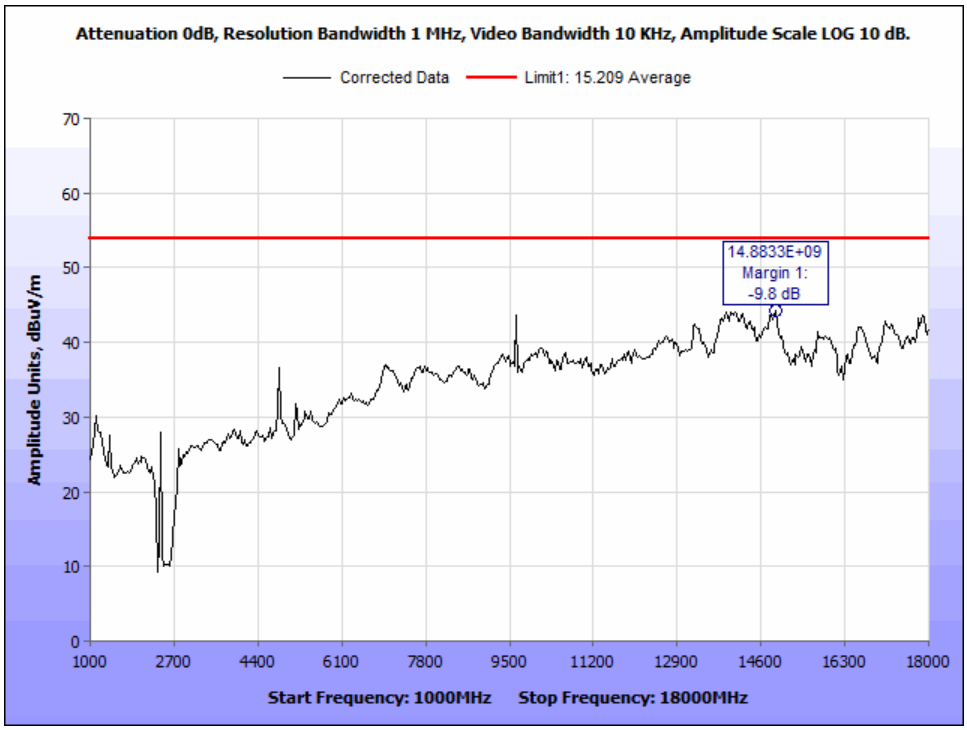

Figure 20: AVG_Radiated Emissions_802.11n20_2412Mz_1-18GHz.

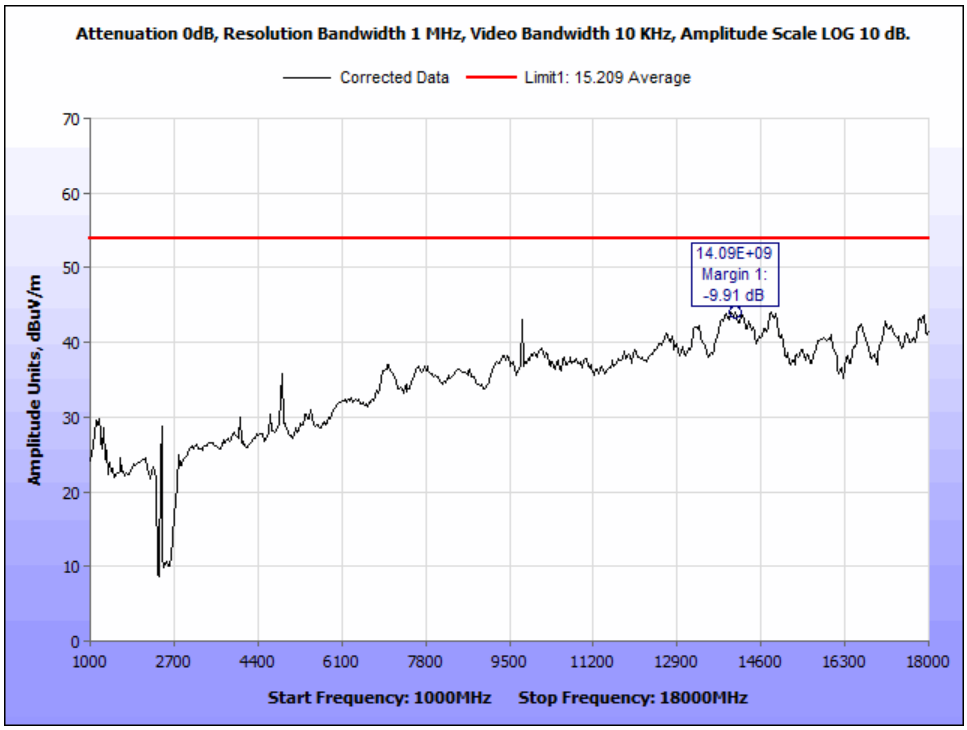

Figure 21: AVG_Radiated Emissions_802.11n20_2437Mz_1-18GHz.

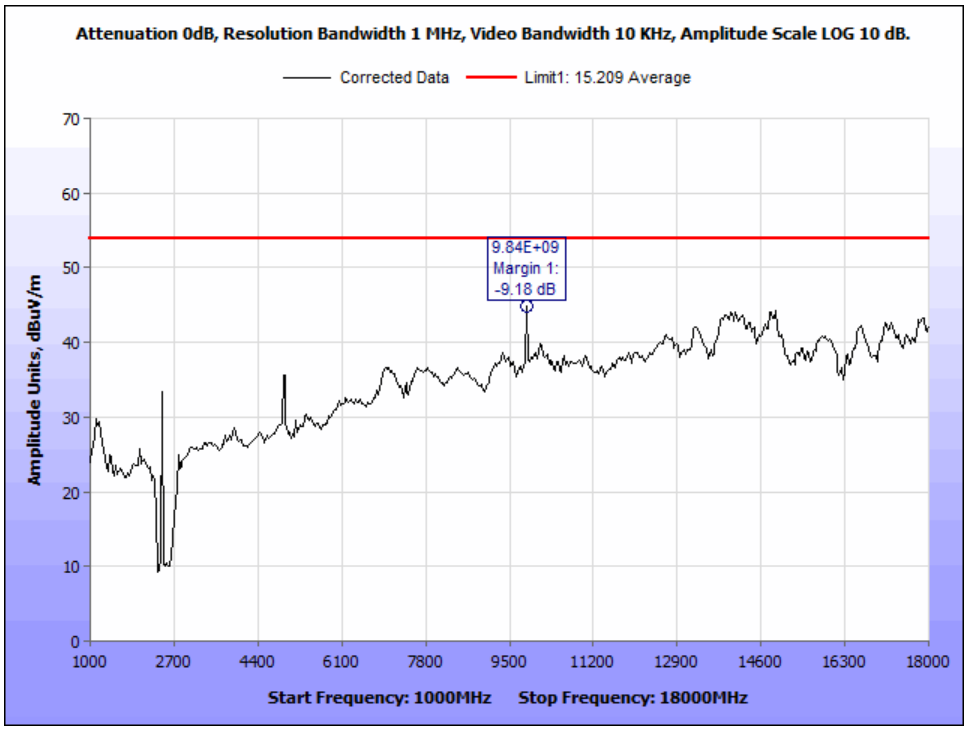

Figure 22: AVG_Radiated Emissions_802.11n20_2462Mz_1-18GHz.

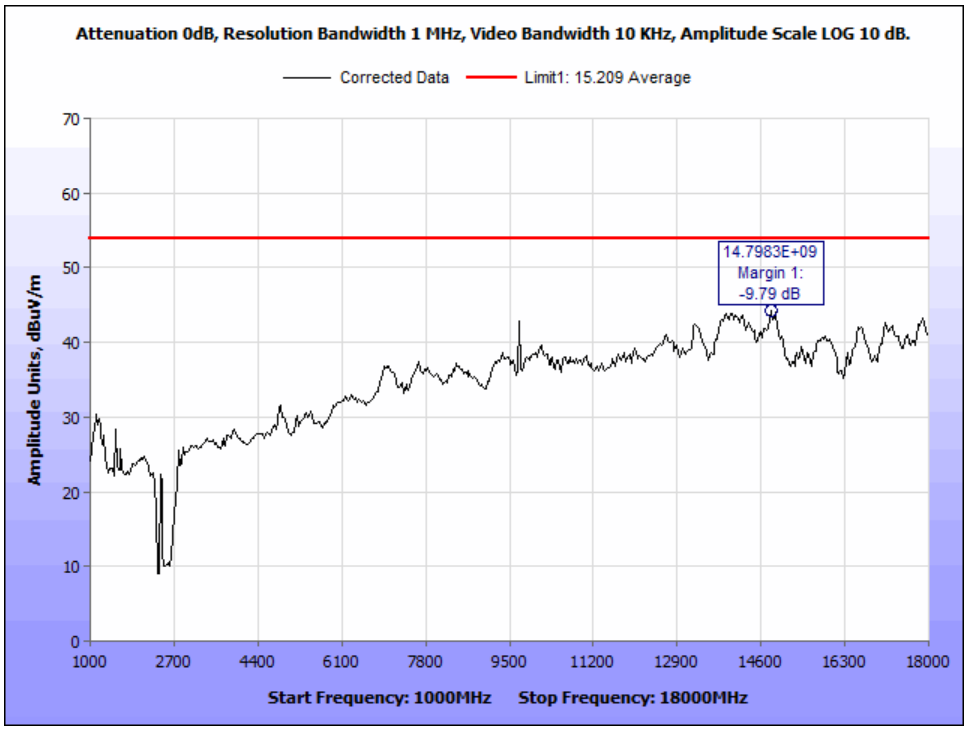

Figure 23: AVG_Radiated Emissions_802.11n40_2422Mz_1-18GHz.

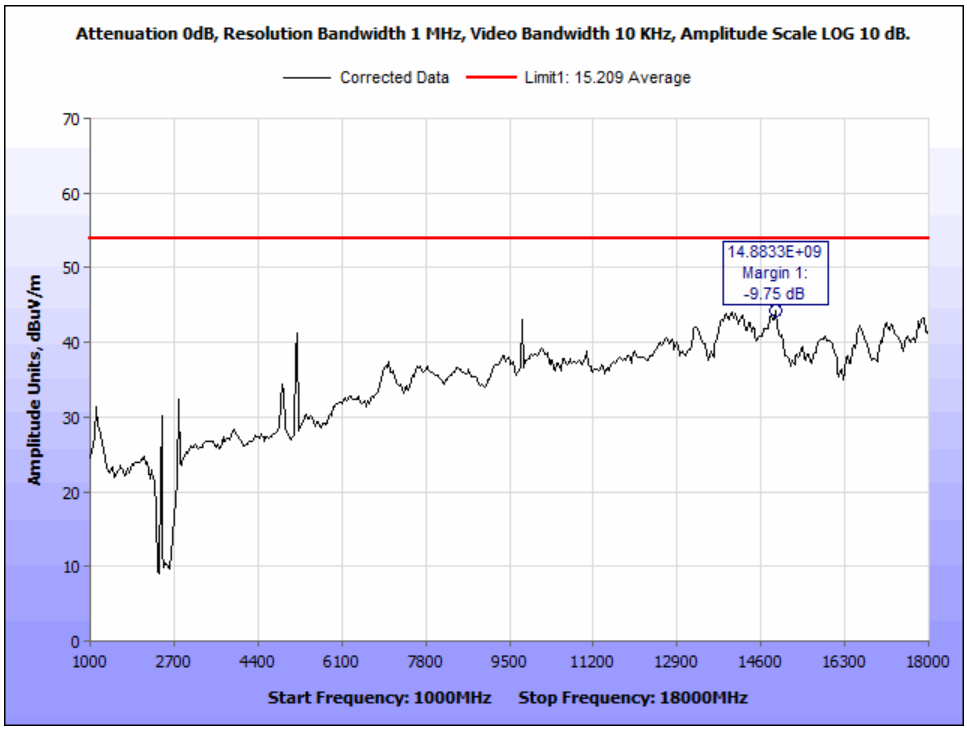

Figure 24: AVG_Radiated Emissions_802.11n40_2437Mz_1-18GHz.

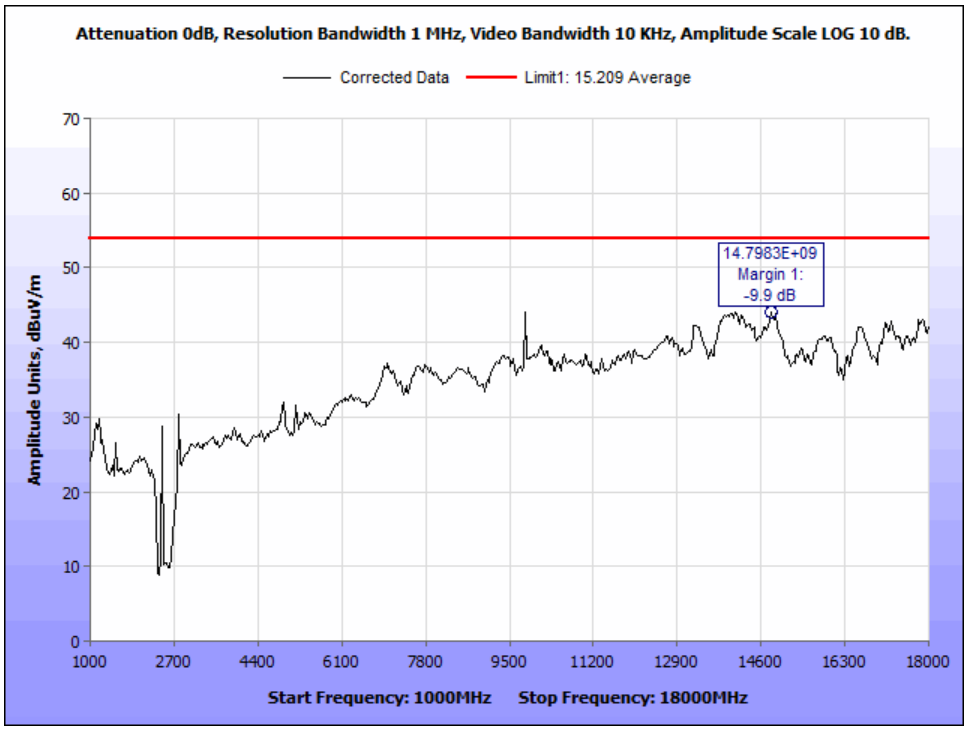

Figure 25: AVG_Radiated Emissions_802.11n40_2452Mz_1-18GHz.

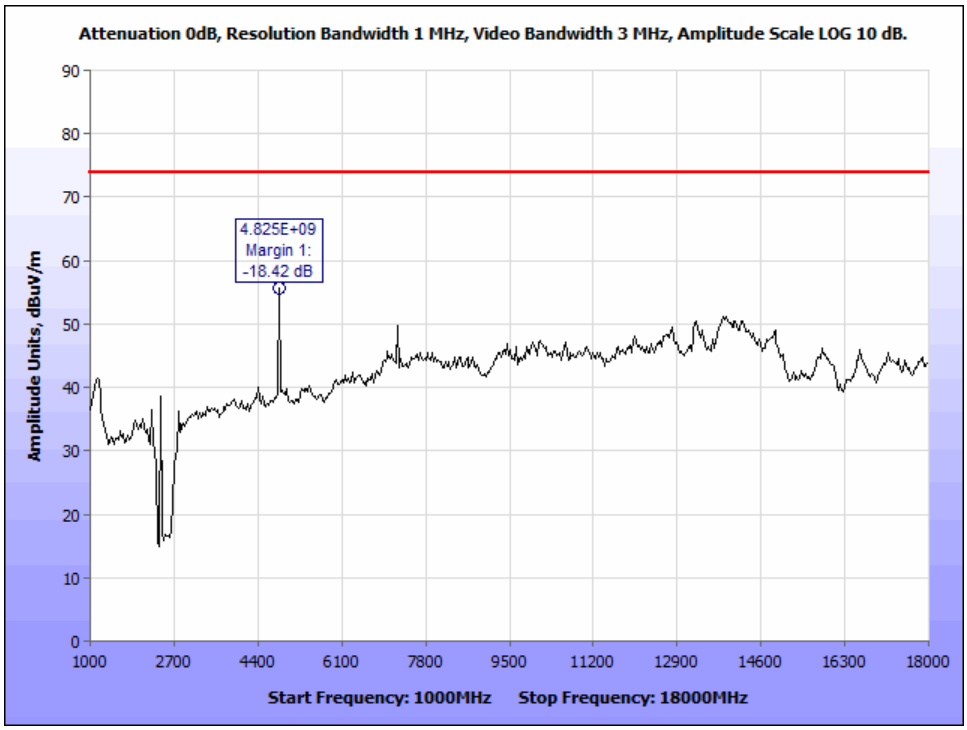

Figure 26: PK_Radiated Emissions_802.11b_2412Mz_1-18GHz.

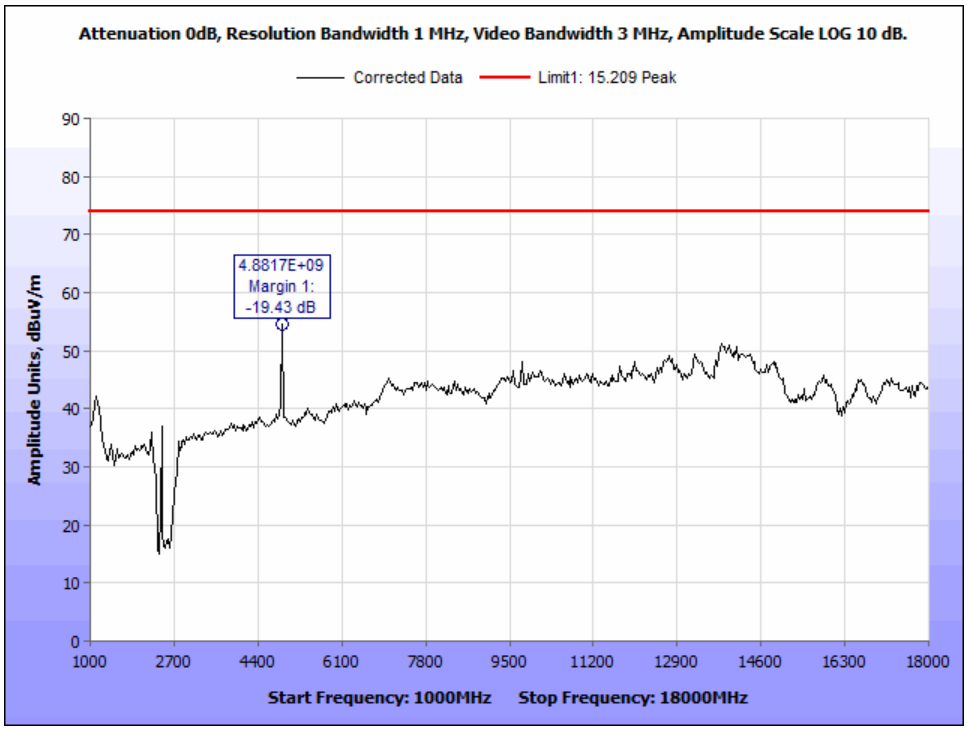

Figure 27: PK_Radiated Emissions_802.11b_2437Mz_1-18GHz.

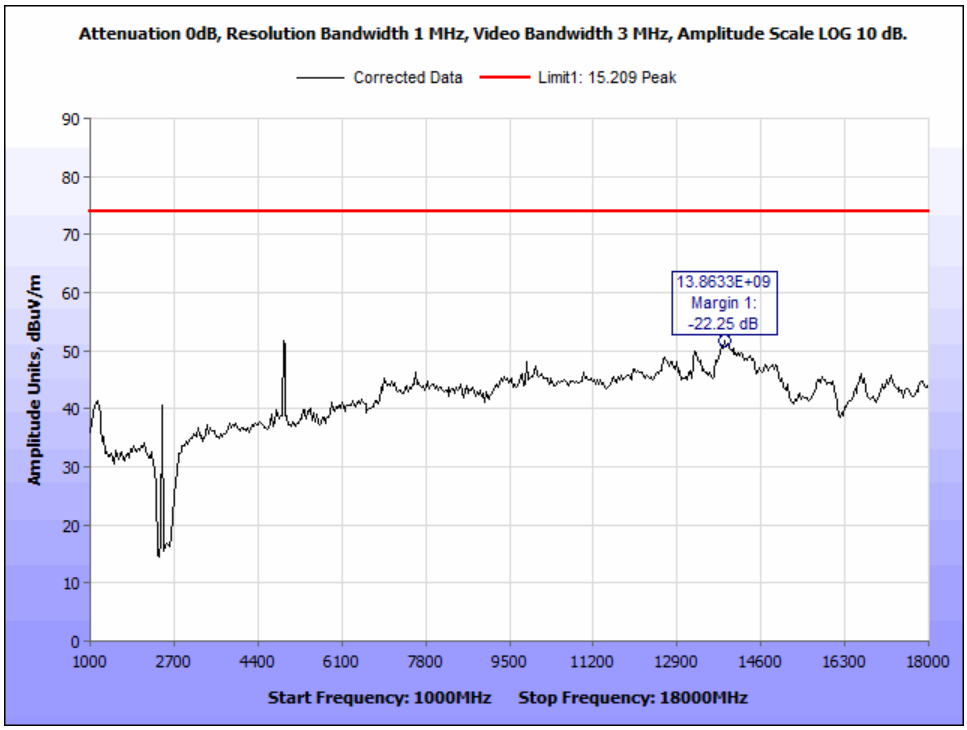

Figure 28: PK_Radiated Emissions_802.11b_2462Mz_1-18GHz.

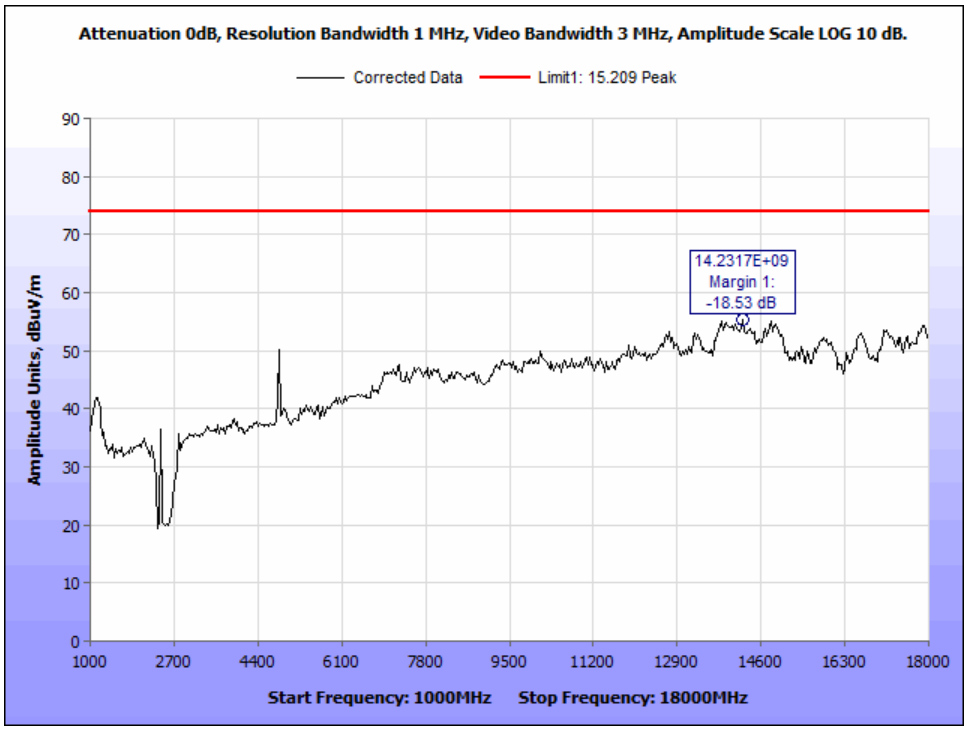

Figure 29: PK_Radiated Emissions_802.11g_2412Mz_1-18GHz.

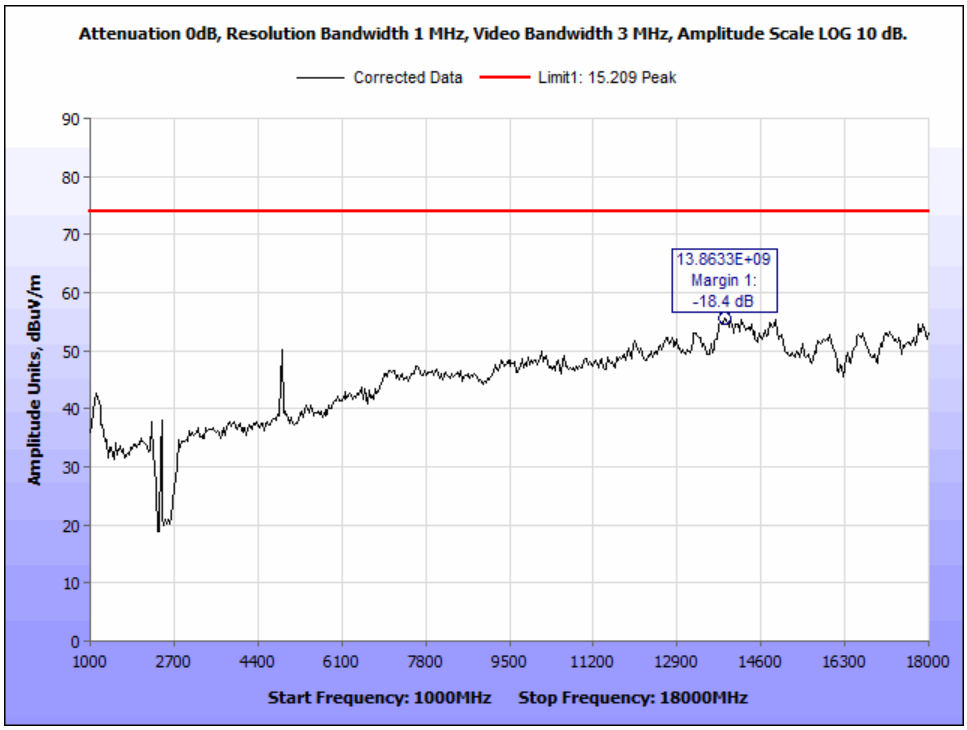

Figure 30: PK_Radiated Emissions_802.11g_2437Mz_1-18GHz.

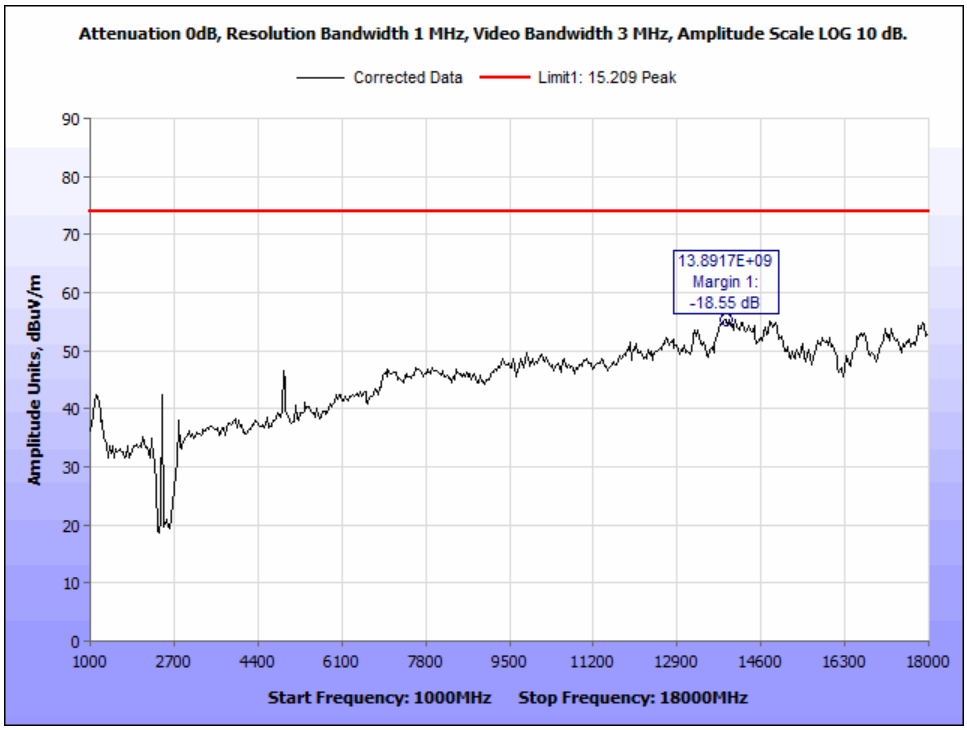

Figure 31: PK_Radiated Emissions_802.11g_2462Mz_1-18GHz.

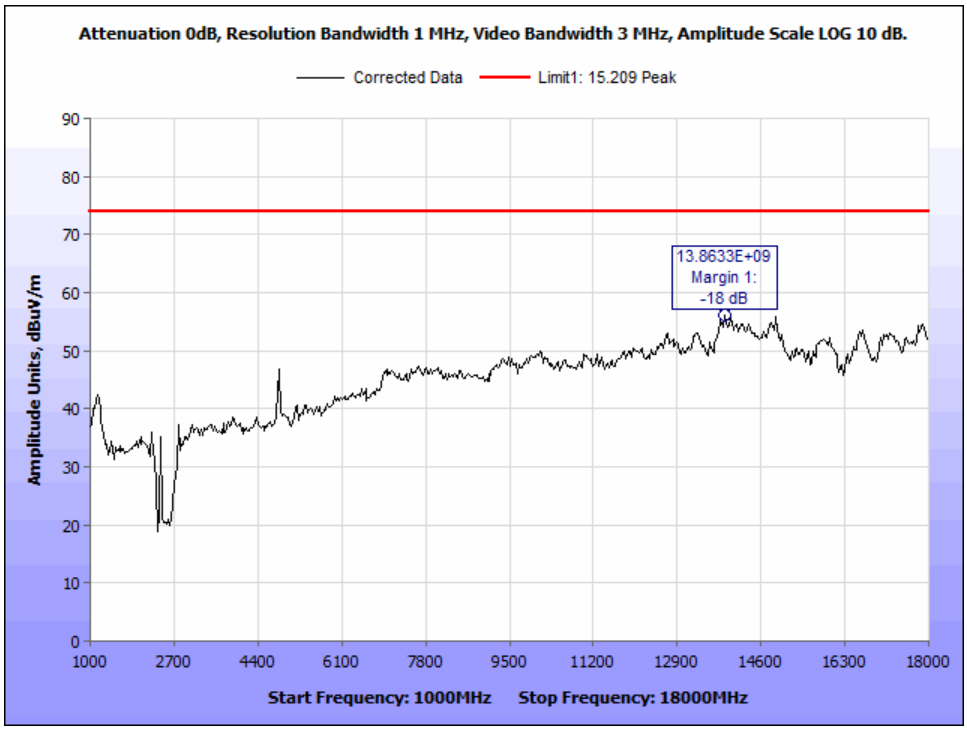

Figure 32: PK_Radiated Emissions_802.11n20_2412Mz_1-18GHz.

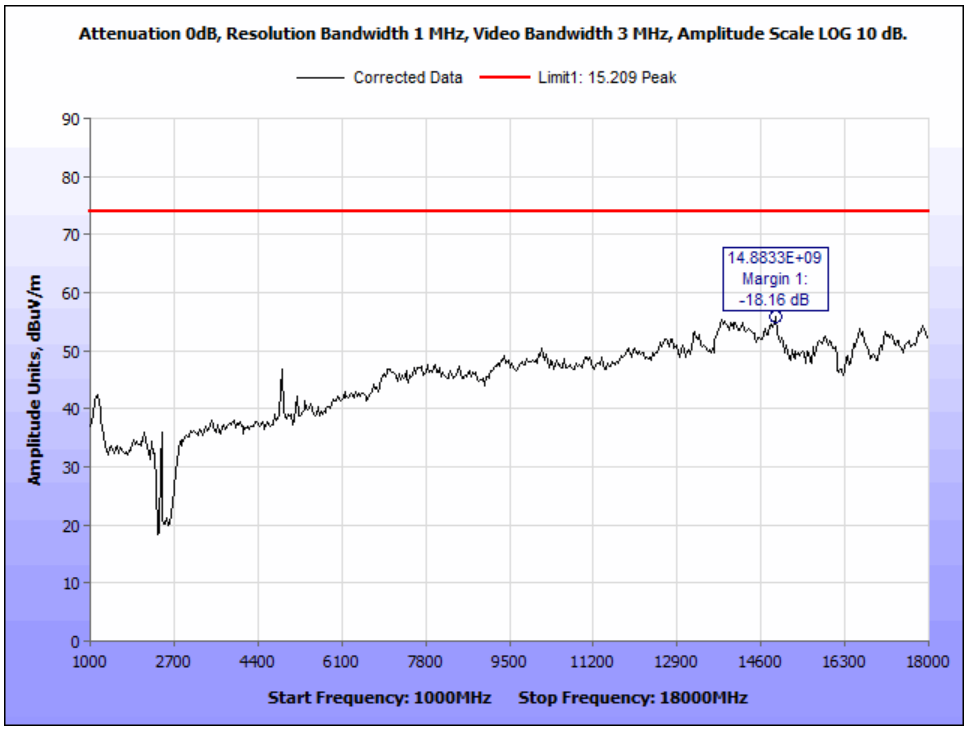

Figure 33: PK_Radiated Emissions_802.11n20_2437Mz_1-18GHz.

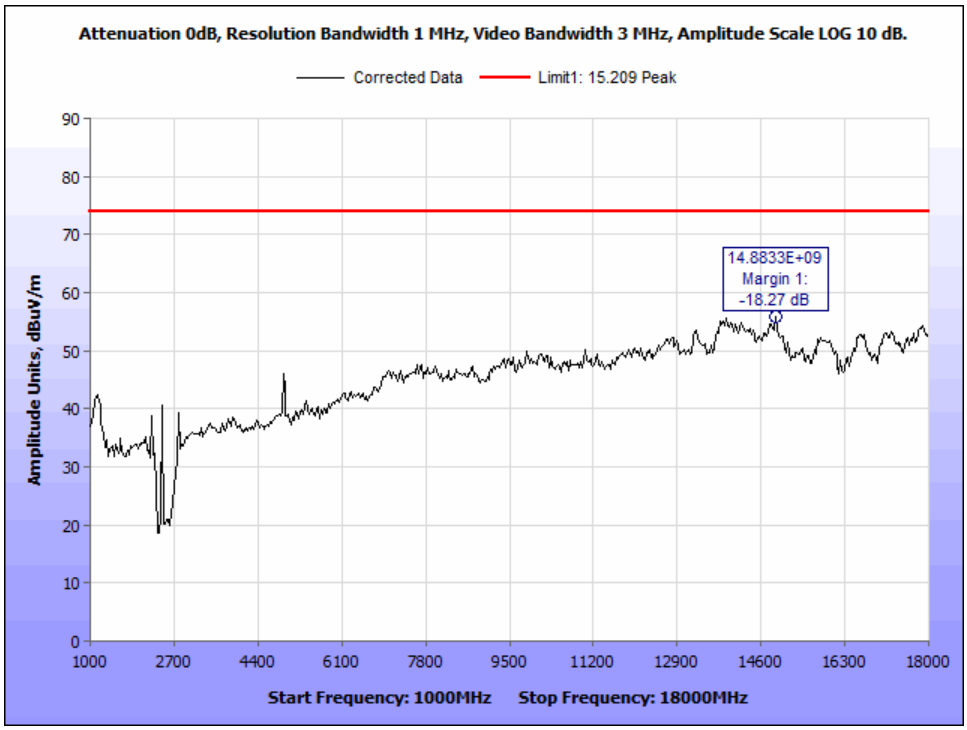

Figure 34: PK_Radiated Emissions_802.11n20_2462Mz_1-18GHz.

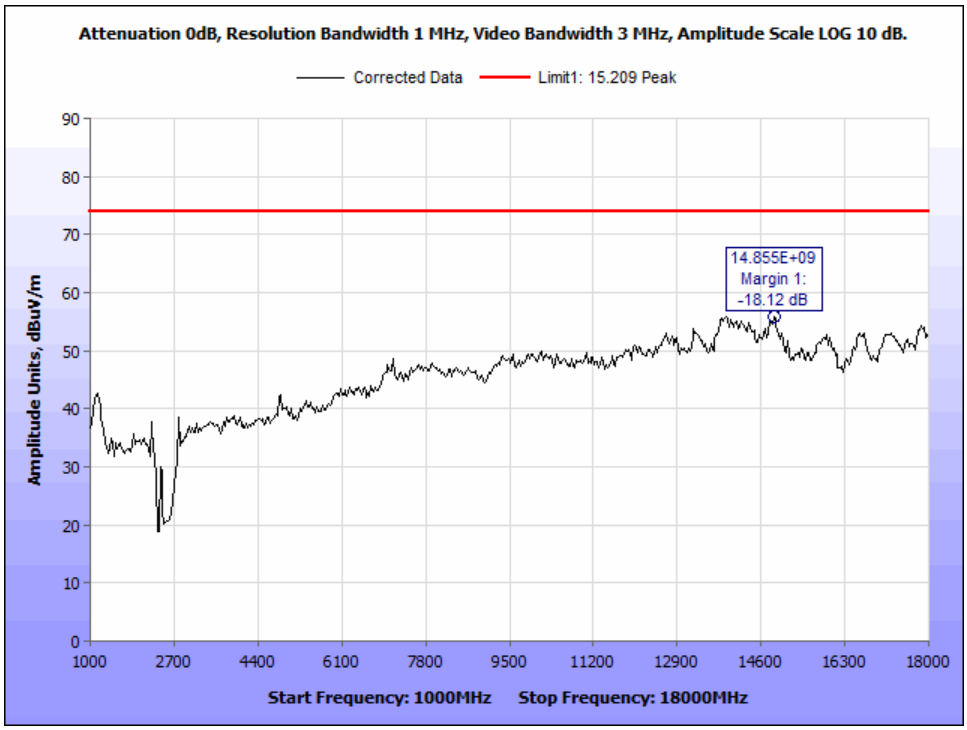

Figure 35: PK_Radiated Emissions_802.11n40_2422Mz_1-18GHz.

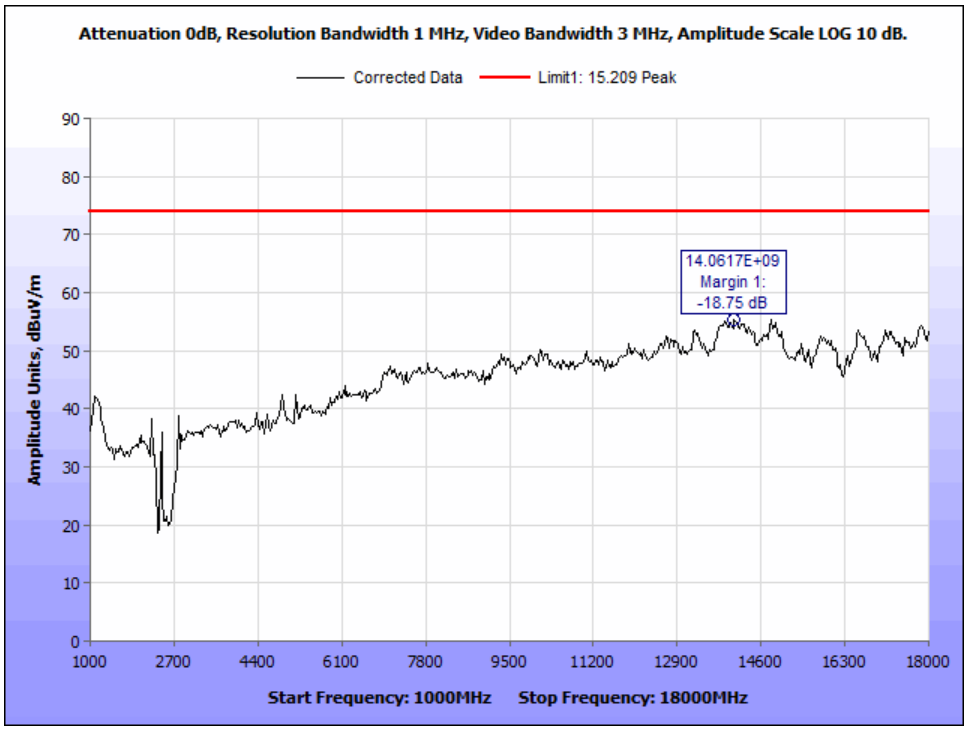

Figure 36: PK_Radiated Emissions_802.11n40_2437Mz_1-18GHz.

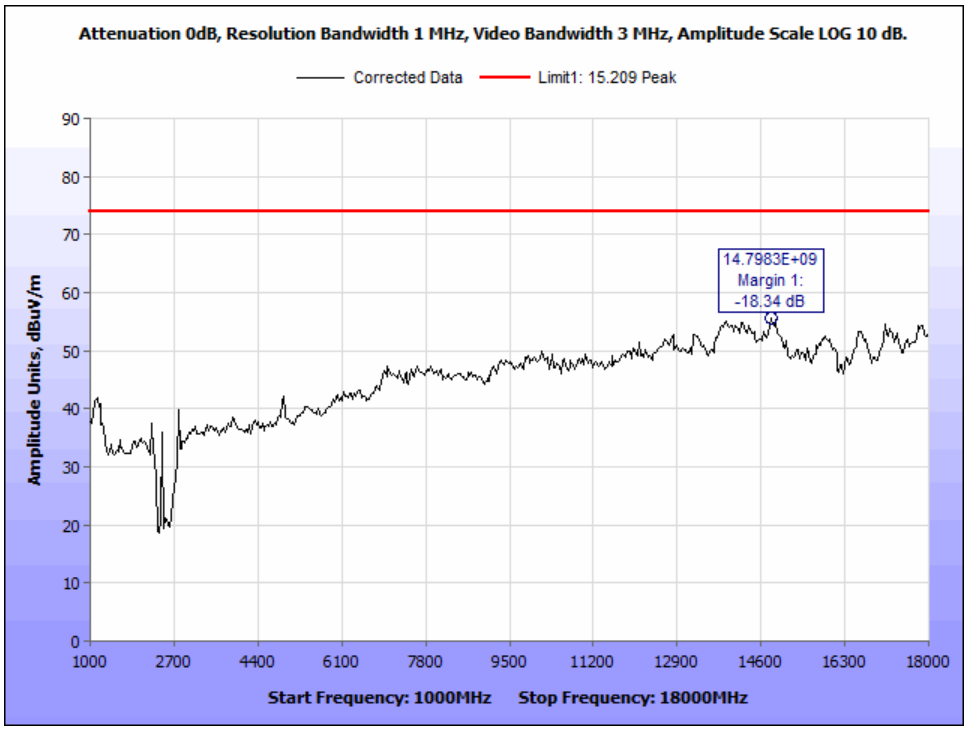

Figure 37: PK_Radiated Emissions_802.11n40_2452Mz_1-18GHz.

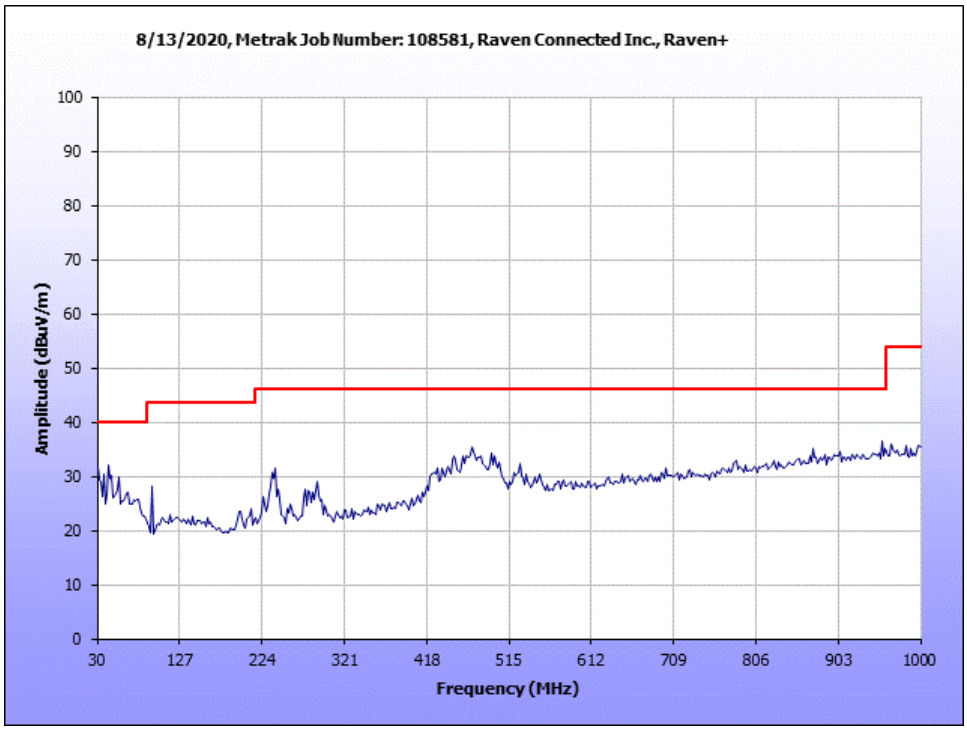

Figure 38: Radiated Emissions_worst case_30-1000MHz.

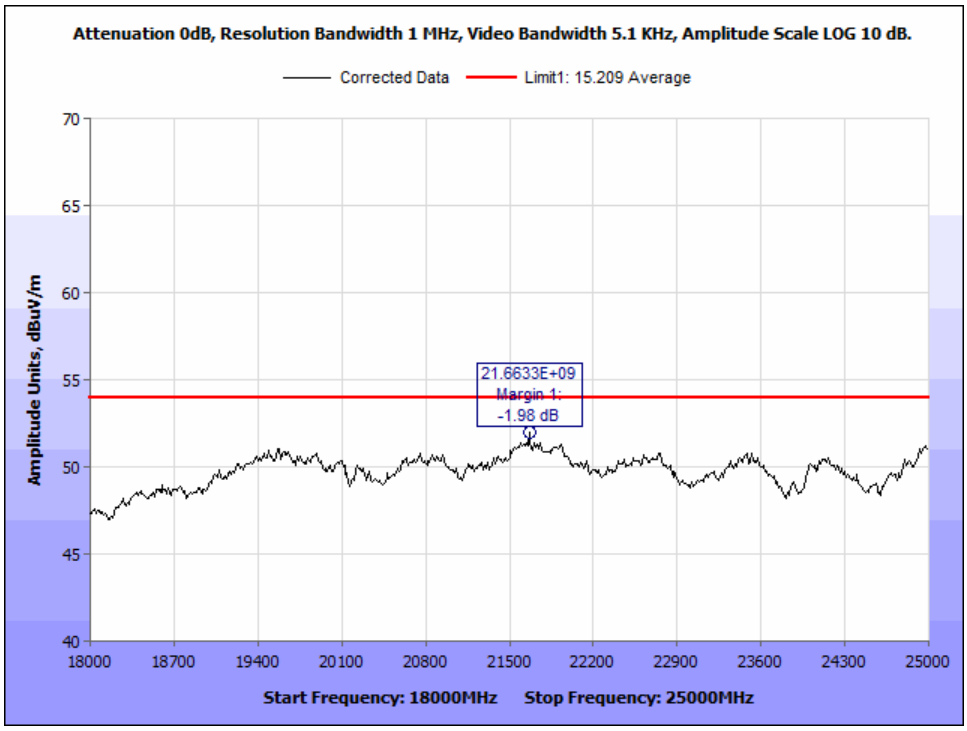

Figure 39: Average Radiated Emissions_worst case_18-25 GHz.

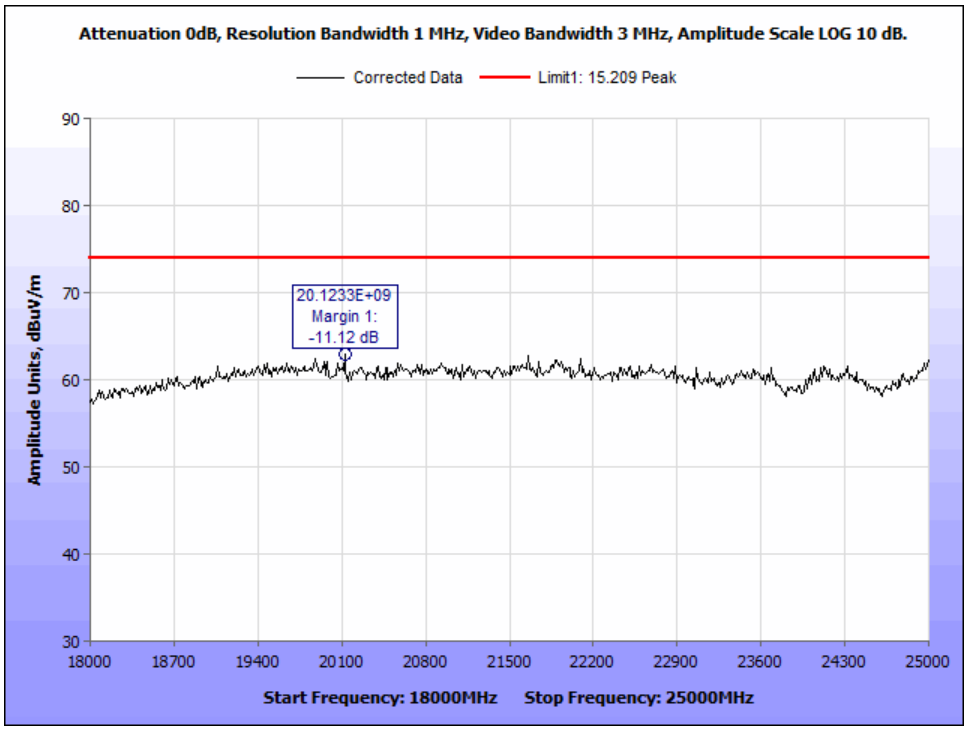

Figure 40: Peak Radiated Emissions_worst case_18-25 GHz.

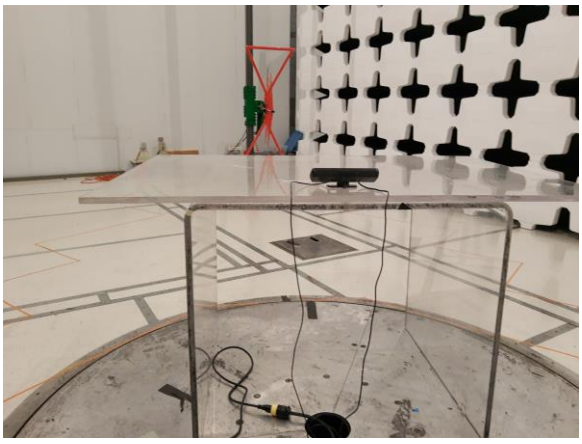

Figure 41: REE Test Setup - 30-1000MHz

Figure 42: REE Test Setup - 1-18 GHz

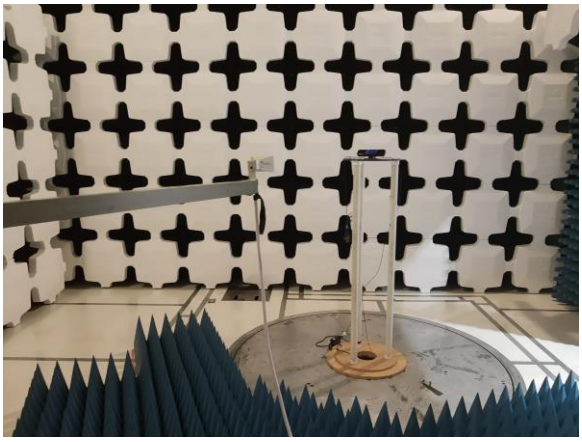

Figure 43: REE Test Setup - 18-25 GHz

Radiated Band Edge Measurements

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.

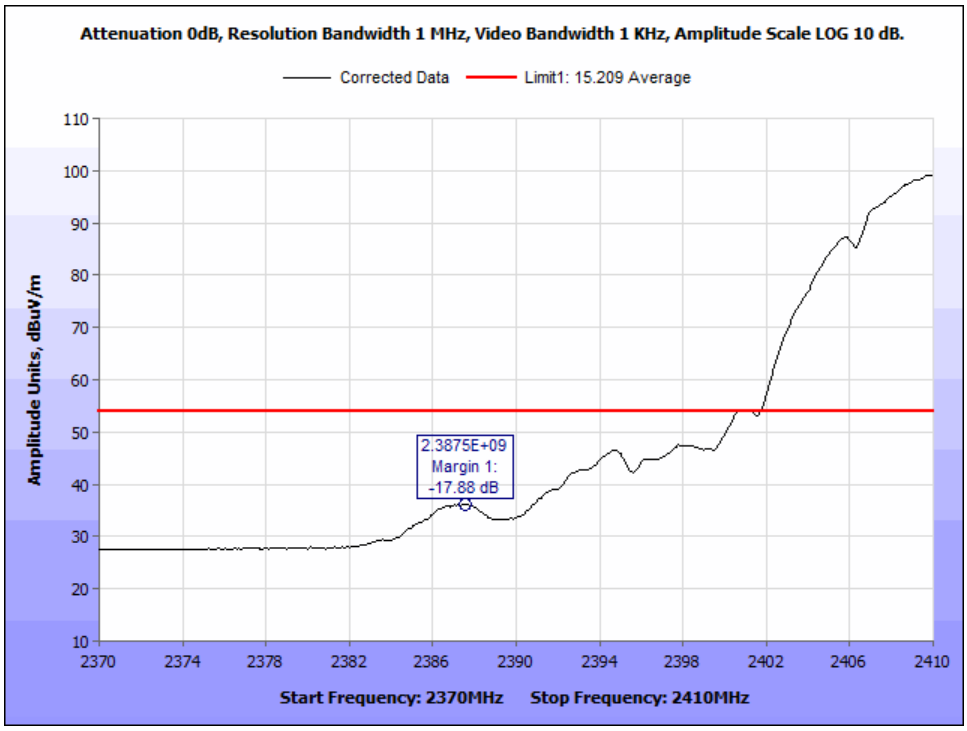

Figure 44: 802.11b_AVG_V_radiated band edge_2390MHz_Channel 1 - 2412MHz.

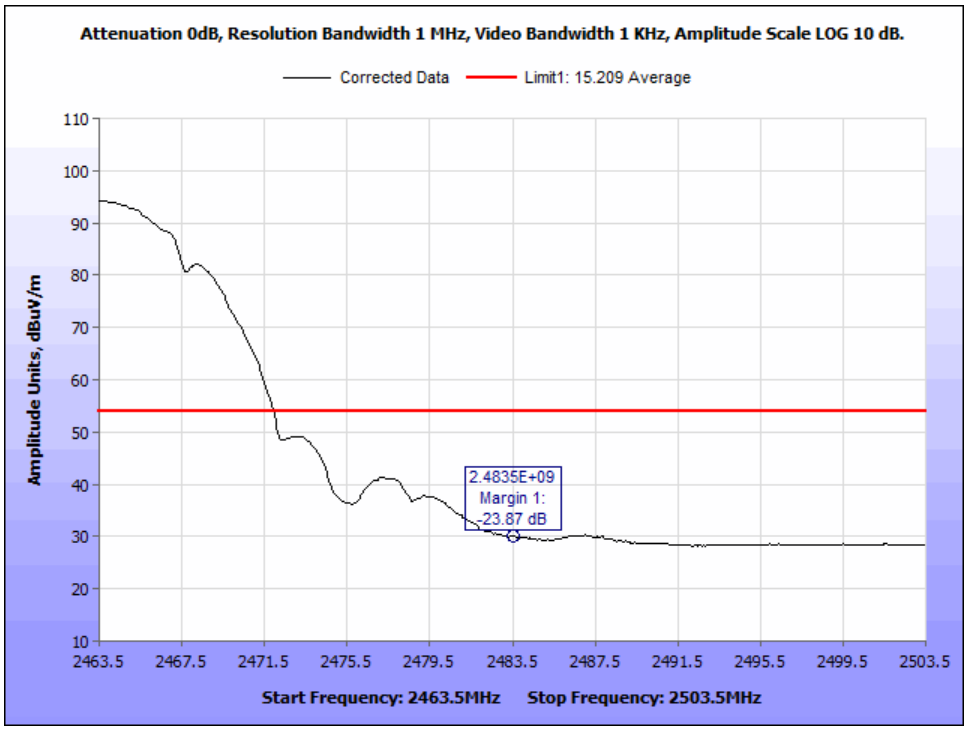

Figure 45: 802.11b_AVG_V_radiated band edge_2483.5MHz_Channel 11 - 2462MHz.

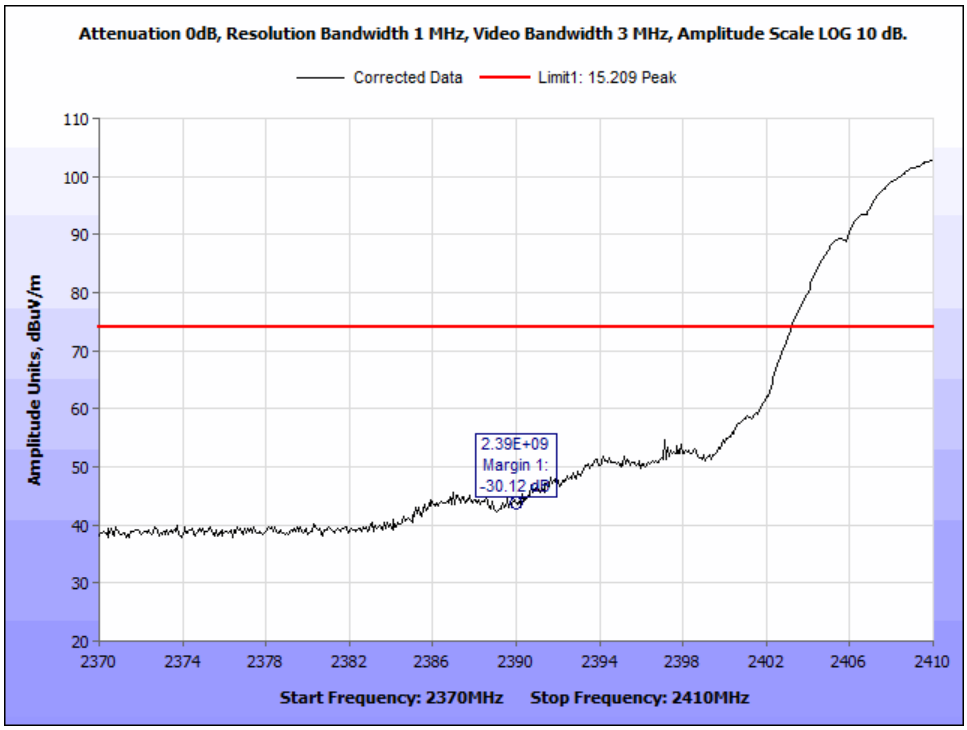

Figure 46: 802.11b_PK_V_radiated band edge_2390MHz_Channel 1 - 2412MHz.

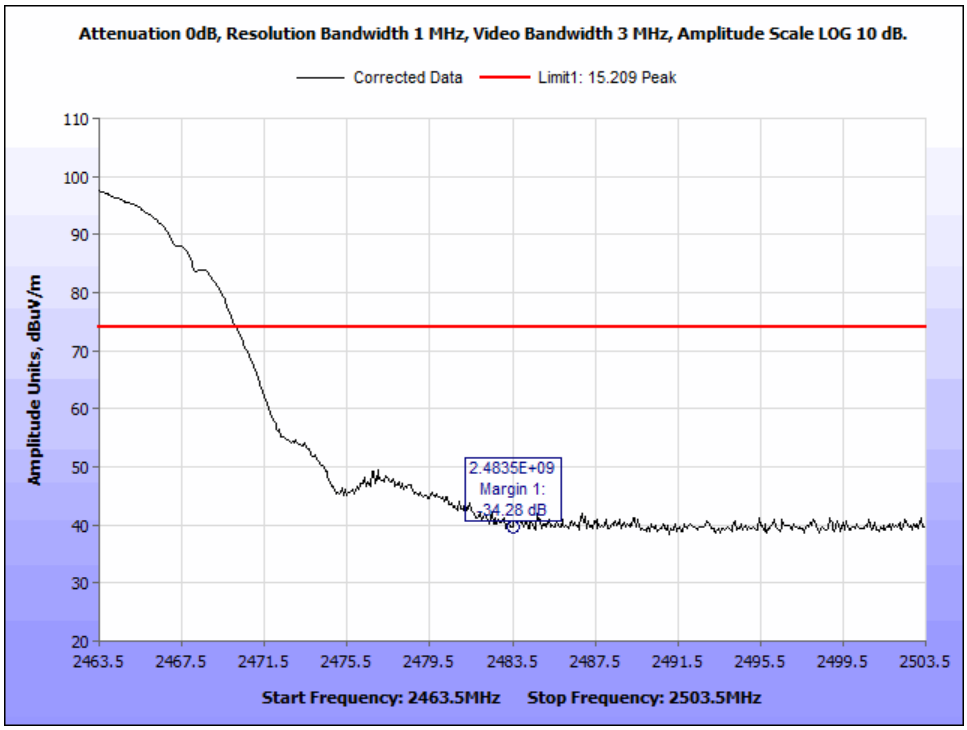

Figure 47: 802.11b_PK_V_radiated band edge_2483.5MHz_Channel 11 - 2462MHz.

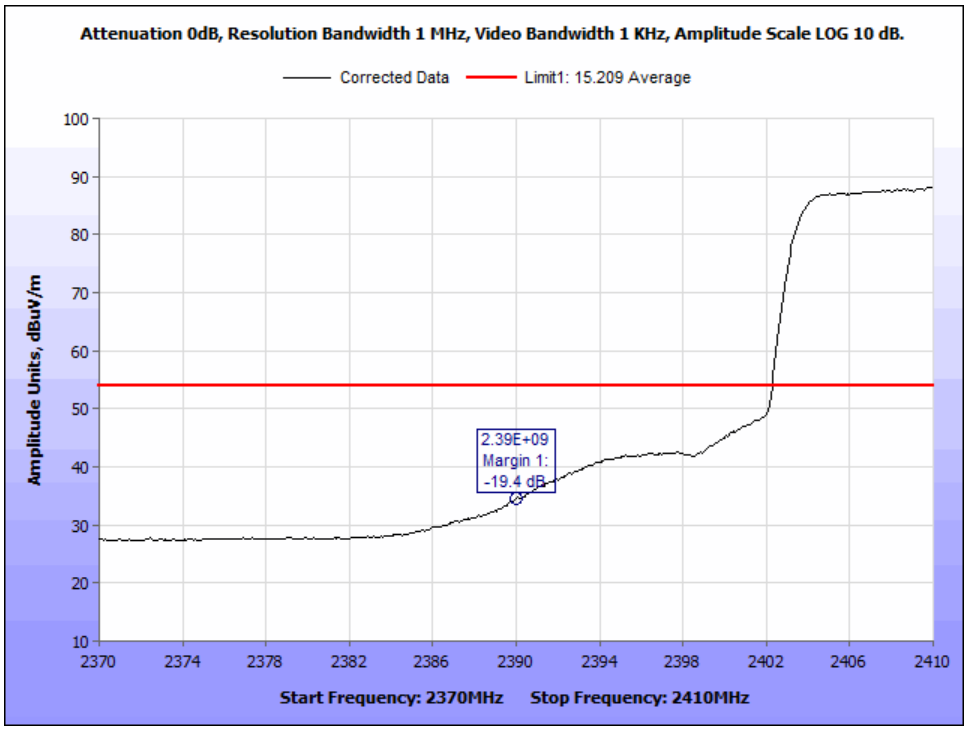

Figure 48: 802.11g_AVG_V_radiated band edge_2390MHz_Channel 1 - 2412MHz.

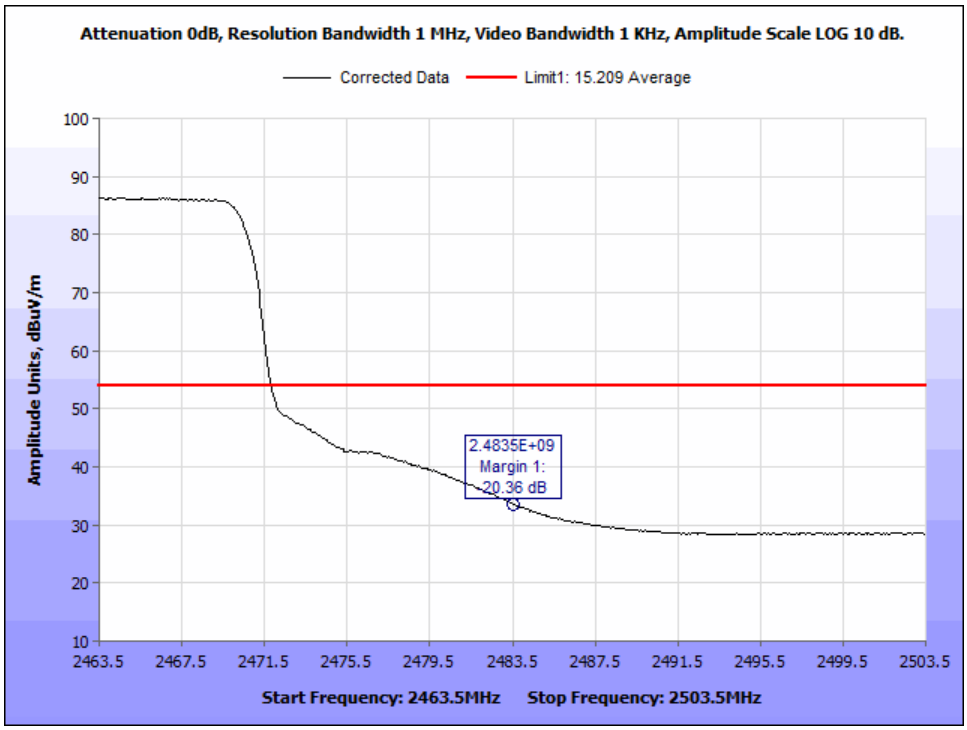

Figure 49: 802.11g_AVG_V_radiated band edge_2483.5MHz_Channel 11 - 2462MHz.

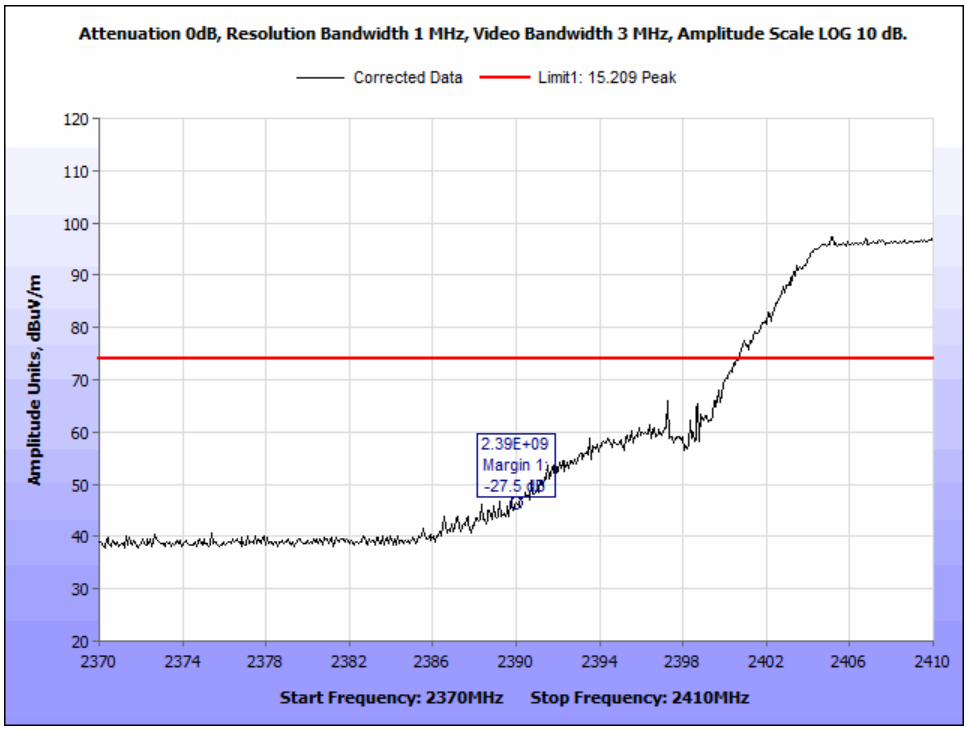

Figure 50: 802.11g_PK_V_radiated band edge_2390MHz_Channel 1 - 2412MHz.

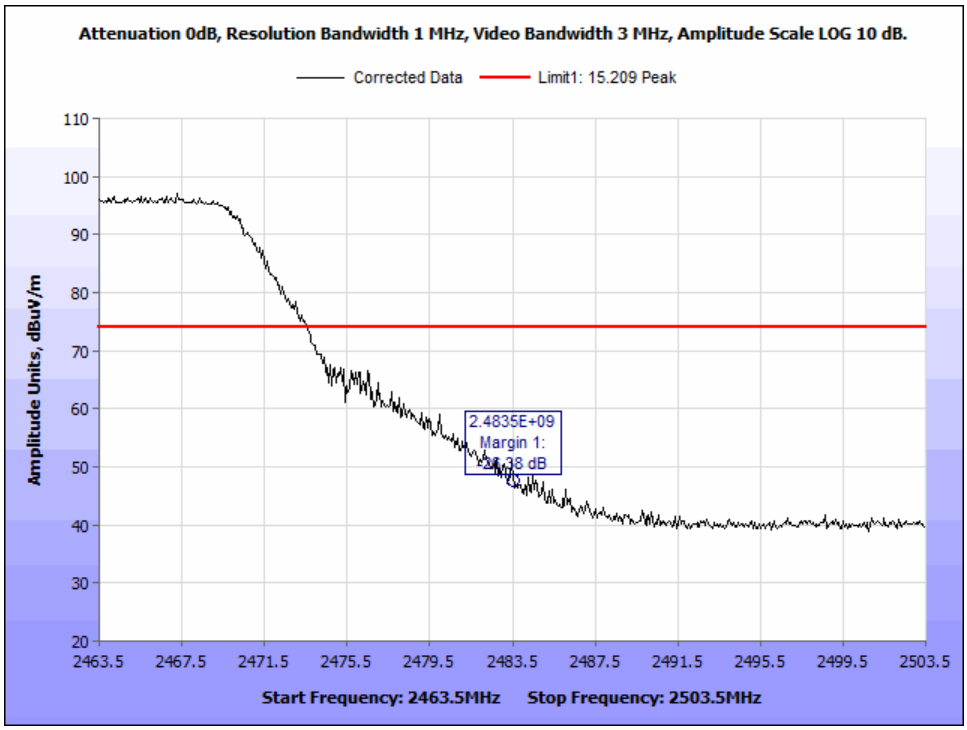

Figure 51: 802.11g_PK_V_radiated band edge_2483.5MHz_Channel 11 - 2462MHz.

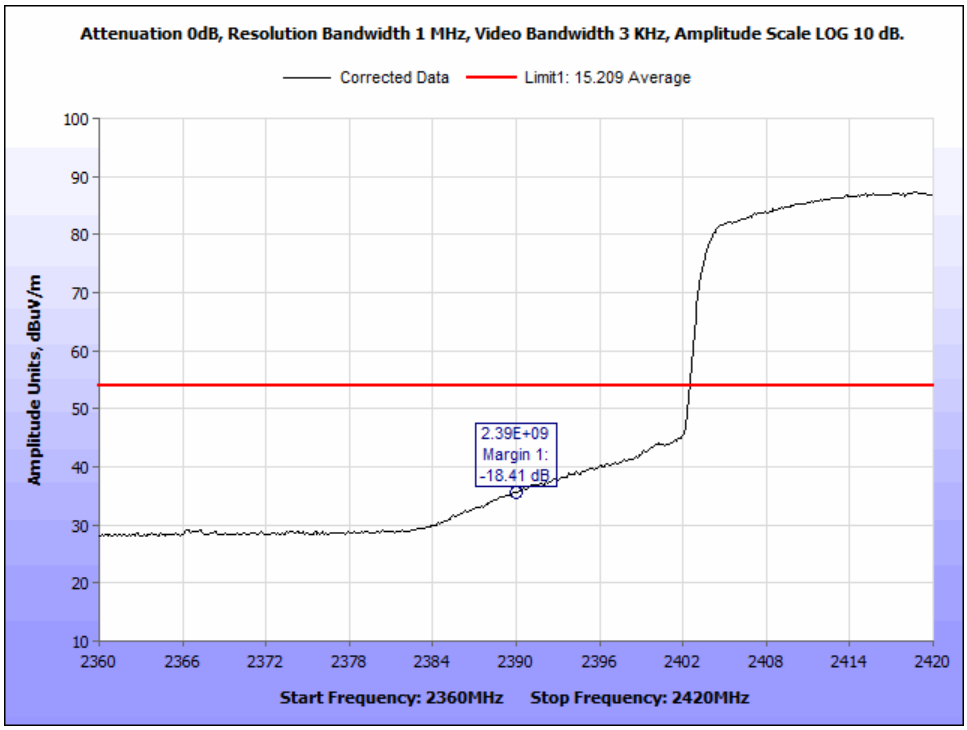

Figure 52: 802.11n40_AVG_V_radiated band edge_2390MHz_Channel 3 - 2422MHz.

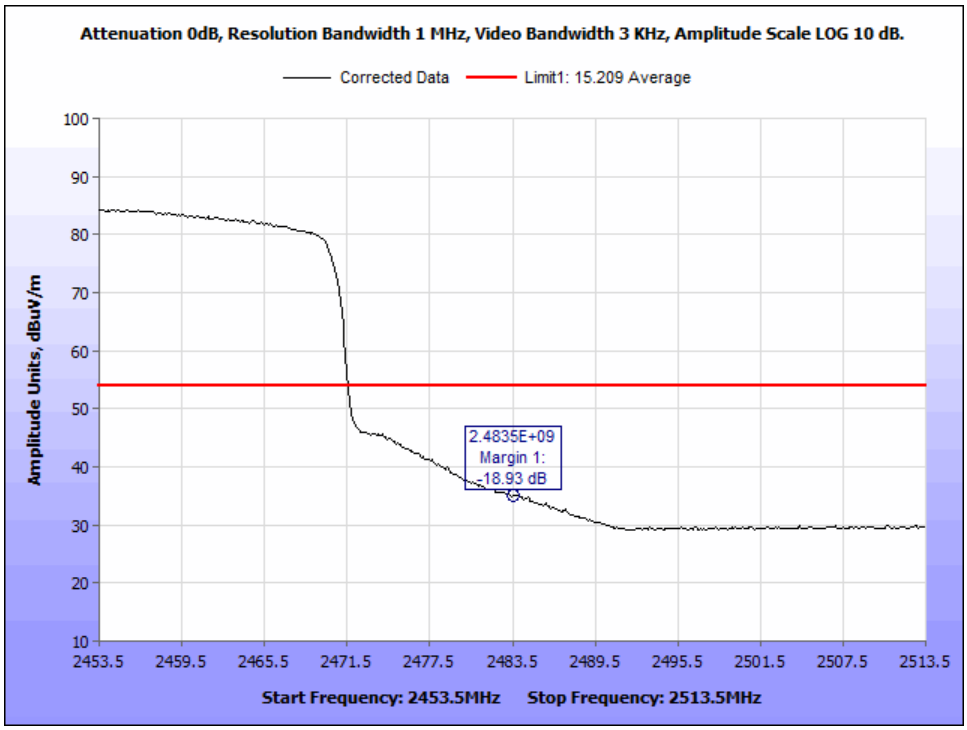

Figure 53: 802.11n40_AVG_V_radiated band edge_2483.5MHz_Channel 9 - 2452MHz.

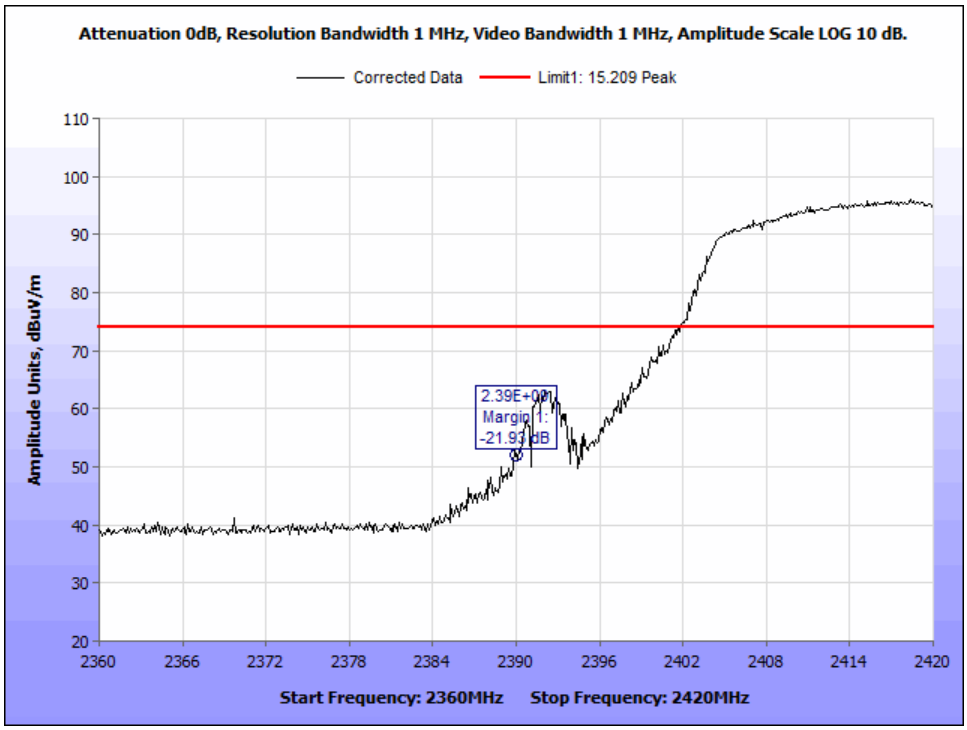

Figure 54: 802.11n40_PK_V_radiated band edge_2390MHz_Channel 3 - 2422MHz.

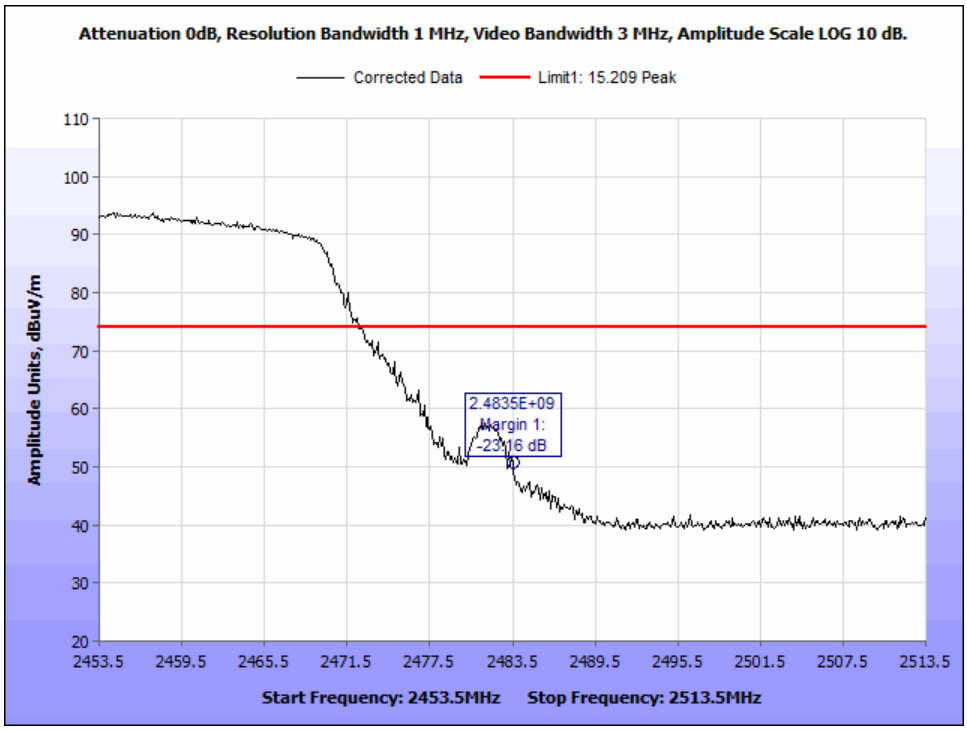

Figure 55: 802.11n40_PK_V_radiated band edge_2483.5MHz_Channel 9 - 2452MHz.

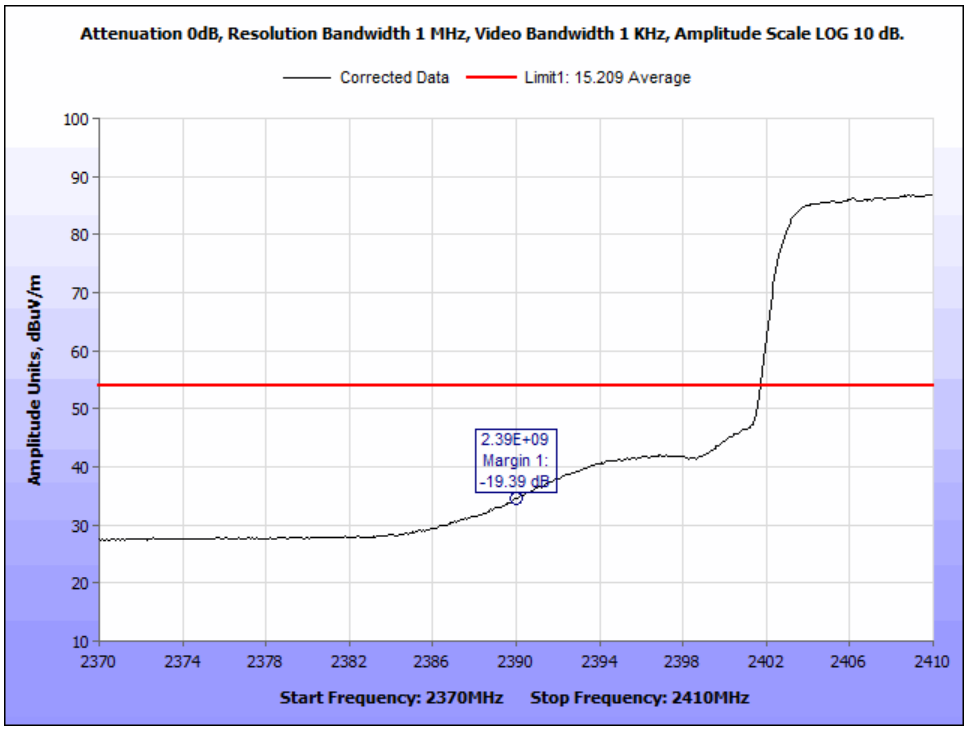

Figure 56: 802.11n_AVG_V_radiated band edge_2390MHz_Channel 1 - 2412MHz.

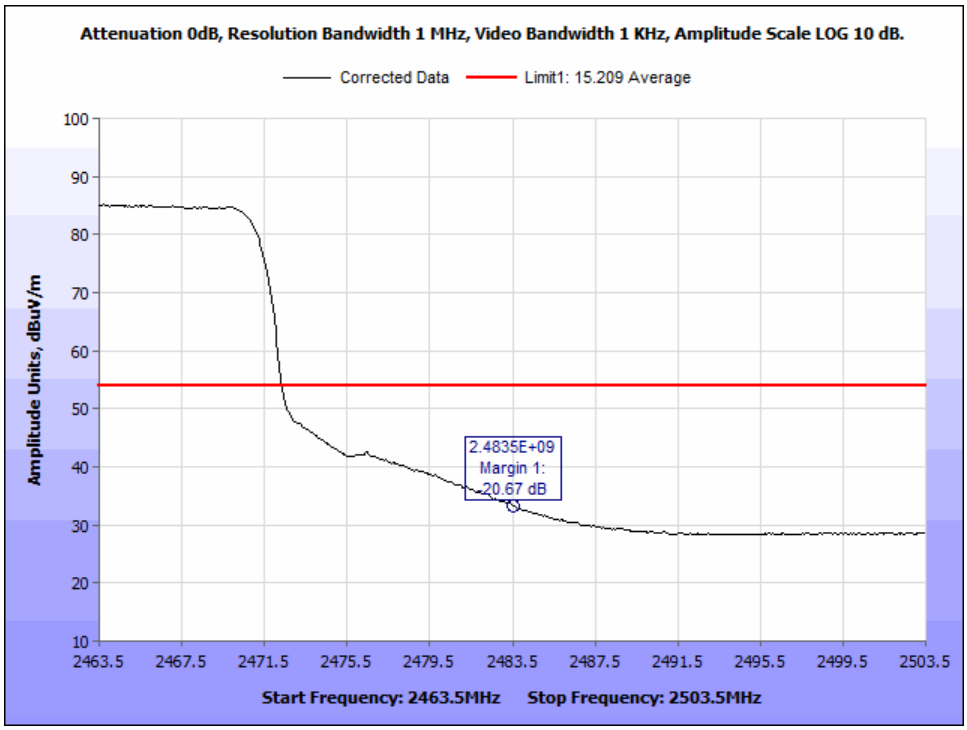

Figure 57: 802.11n_AVG_V_radiated band edge_2483.5MHz_Channel 11 - 2462MHz.

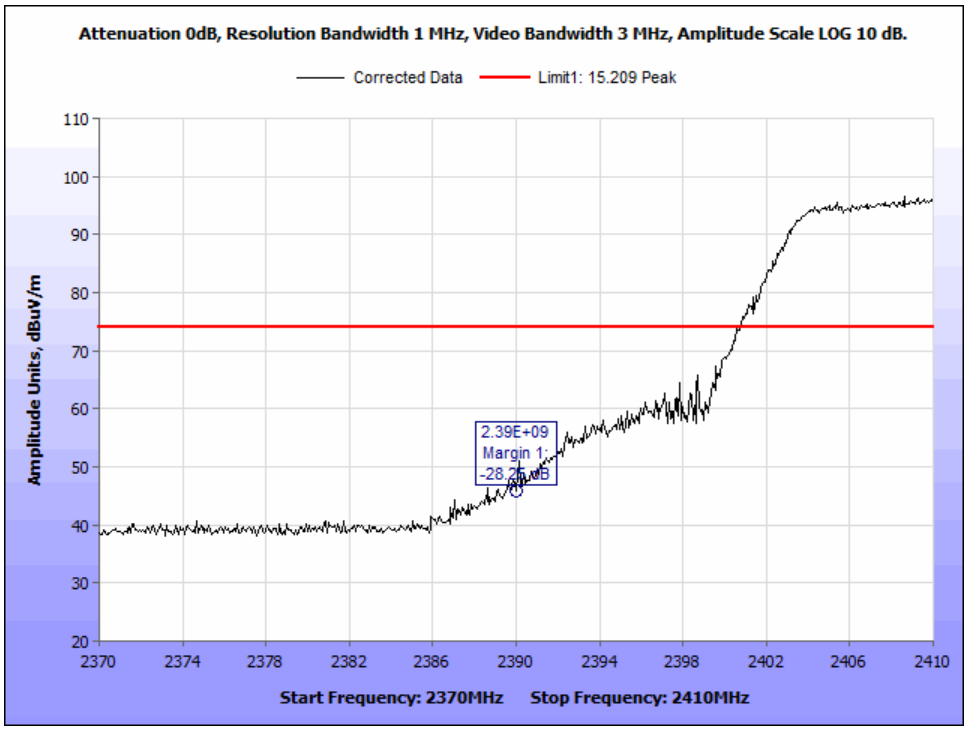

Figure 58: 802.11n_PK_V_radiated band edge_2390MHz_Channel 1 - 2412MHz.

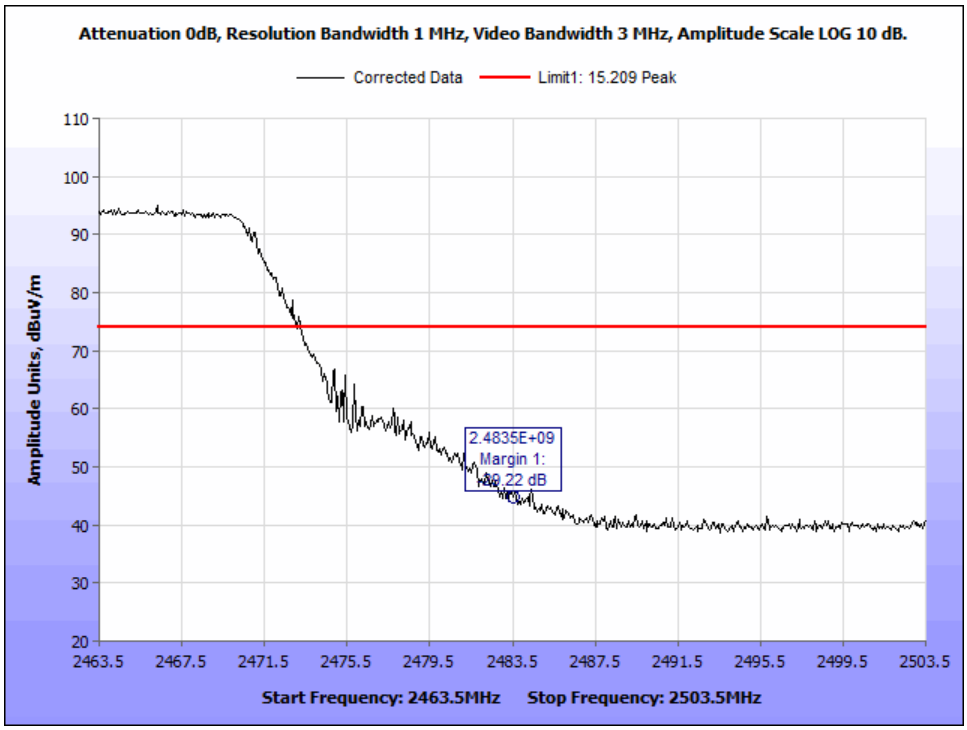

Figure 59: 802.11n_PK_V_radiated band edge_2483.5MHz_Channel 11 - 2462MHz.

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(b) Peak Power Output

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

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

Figure 60: 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 Figure 60, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

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

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

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

Test Procedure: The transmitter was connected to a calibrated spectrum analyzer. The EUT was measured at the low and mid of each band at the maximum power level. Procedure AVGSA-1 from ANSI C63.10:2013 was used to measure the conducted output power.

Test Results: The EUT was **compliant** with the Peak Power Output limits of **§15.247(b)**. No anomalies noted.

Test Engineer(s): Donald Salguero

Test Date(s): August 14, 2020

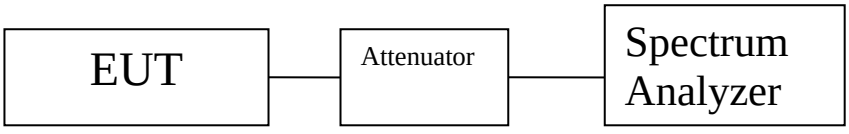

Figure 61: Peak Power Output Test Setup

Peak Power Output Test Results

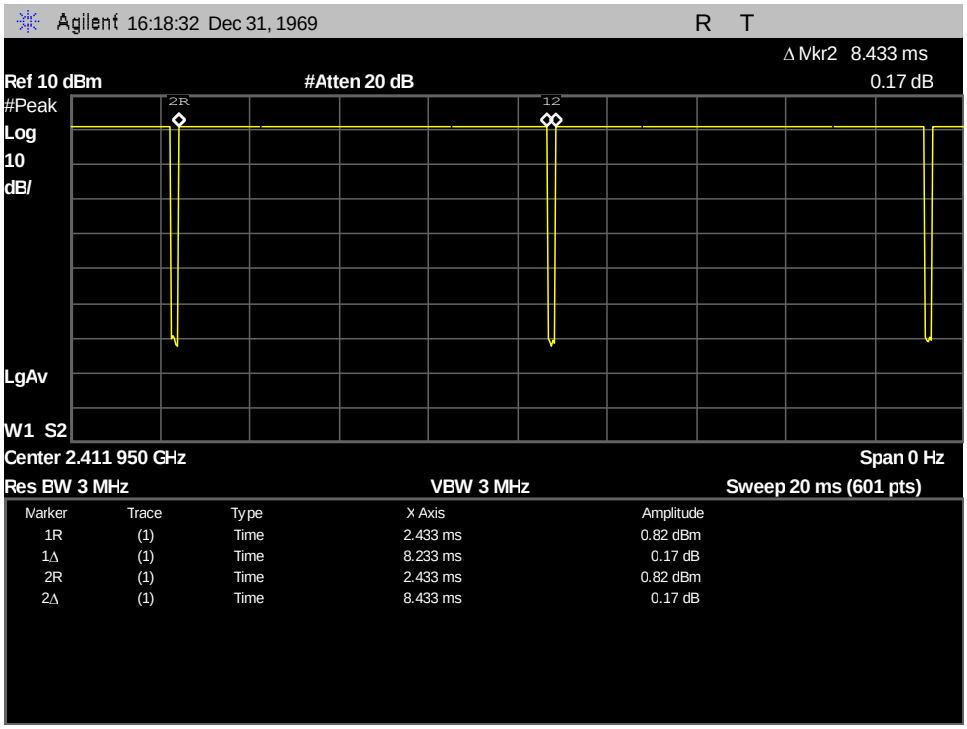

Figure 62: 802.11b DC

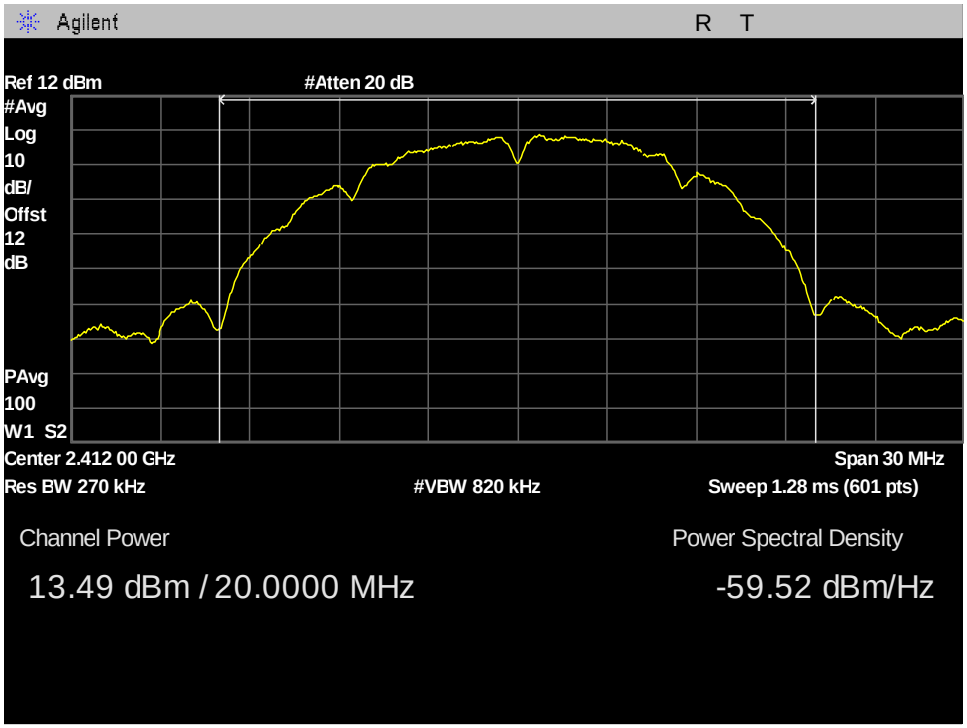

Figure 63: OP_802.11b_2412MHz

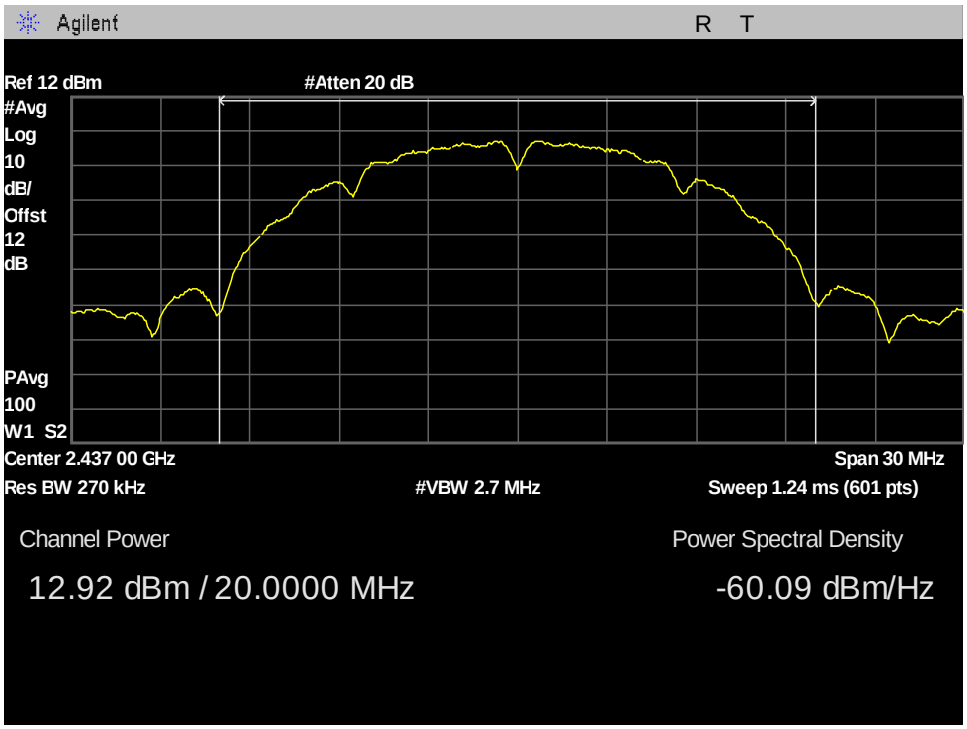

Figure 64: OP_802.11b_2437MHz

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(e) Peak Power Spectral Density

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

Test Procedure: The transmitter was connected directly to a Spectrum Analyzer through an attenuator. The power level was set to the maximum level throughout each of the 100 sweeps of power averaging. The RBW was set to 100 kHz and a VBW set to 300 kHz or greater. The spectrum analyzer was set to an auto sweep time and a peak detector was used. Measurements were carried out at the low and mid channels. Procedure AVGPSD-1 from ANSI C63.10:2013 was used to measure the conducted PSD.

Test Results: The EUT was **compliant** with the peak power spectral density limits of **§ 15.247 (e)**. No anomalies noted.

Test Engineer(s): Donald Salguero

Test Date(s): August 14, 2020

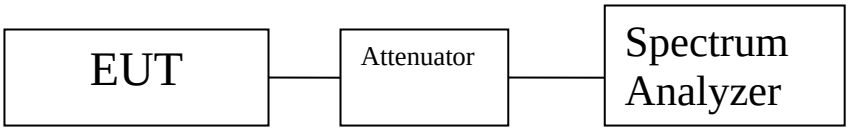

Figure 65: Block Diagram, Peak Power Spectral Density Test Setup

Peak Power Spectral Density Test Results

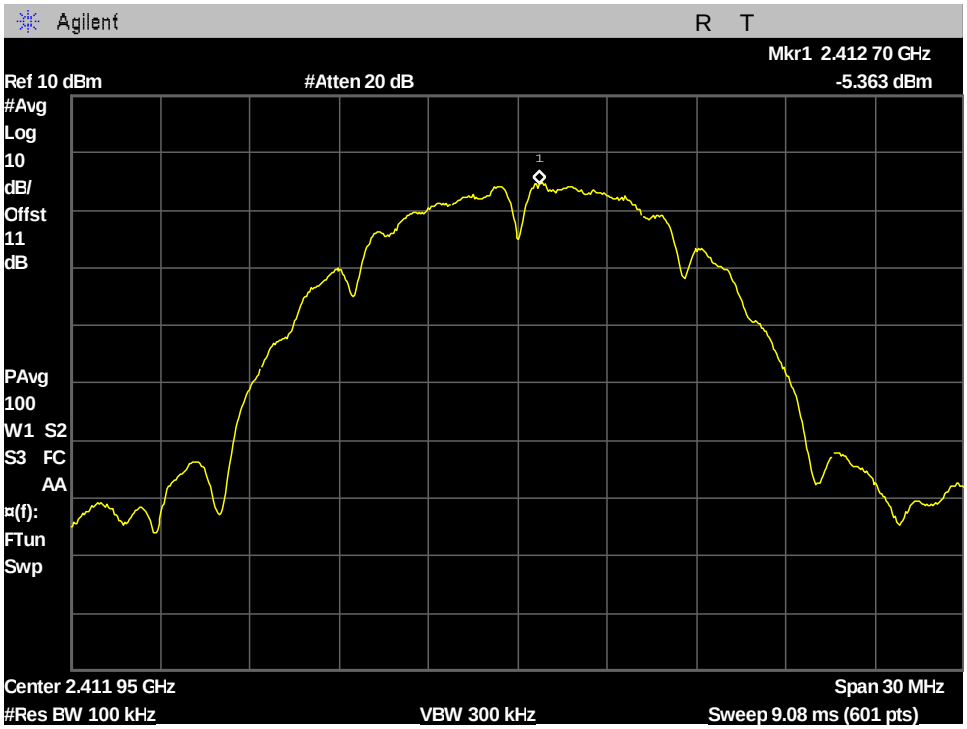

Figure 66: PSD_802.11b_2412MHz

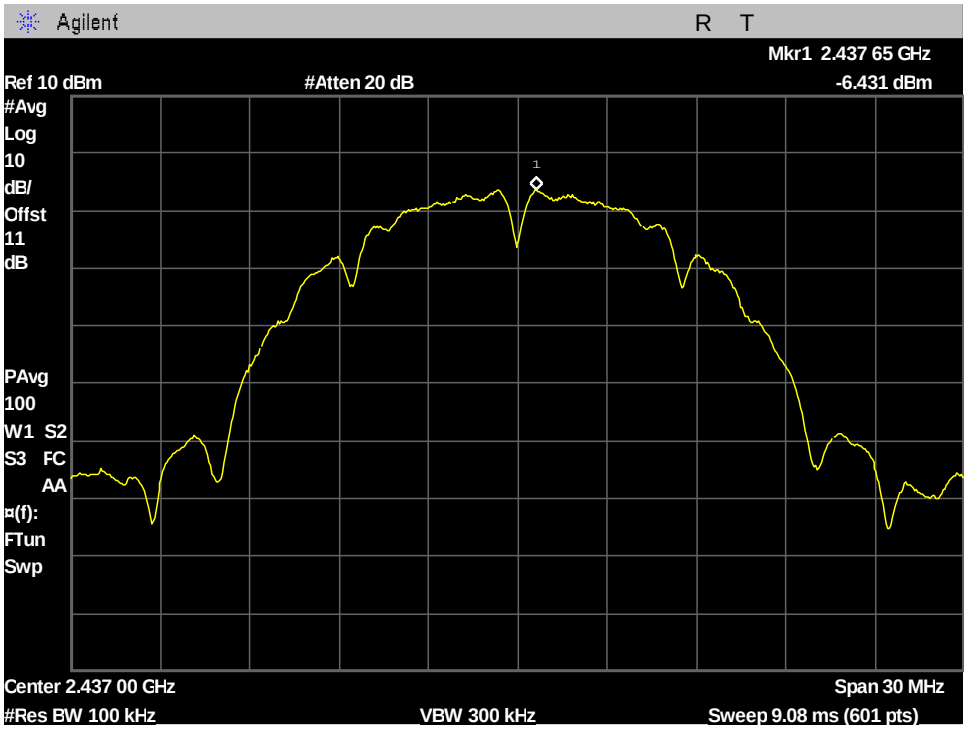

Figure 67: PSD_802.11b_2437MHz

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(i) Maximum Permissible Exposure

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

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

MPE Limit: EUT's operating frequencies @ 2400-2483.5 MHz; **Limit for Uncontrolled exposure: 1 mW/cm^2 or 10 W/m^2**

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

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

where, S = Power Density (mW/cm^2)
P = Power Input to antenna (mW)
G = Antenna Gain (numeric value)
R = Distance (cm)

Test Results:

FCC									
Frequency (MHz)	**Con. Pwr. (dBm)**	**Con. Pwr. (mW)**	**Ant. Gain (dBi)**	**Ant. Gain numeric**	**Pwr. Density (mW/cm^2)**	**Limit (mW/cm^2)**	**Margin**	**Distance (cm)**	**Result**
2412	14.97	31.405	3.6	2.291	0.01431	1	0.98569	20	Pass

The safe distance where Power Density is less than the MPE Limit listed above was found to be 20 cm.

Test Equipment

Test Equipment

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

ASSET #	EQUIPMENT	MANUFACTURER	MODEL	LAST CAL	CAL DUE
1T4771	PSA SPECTRUM ANALYZER	AGILENT TECHNOLOGIES	E4446A	2/26/2020	8/26/2021
1T4751	ANTENNA - BILOG	SUNOL SCIENCES	JB6	5/2/2019	11/2/2020
1T4576	ANTENNA, ACTIVE HORN	COM-POWER	AHA-118	5/8/2019	11/8/2020
1T4414	MICROWAVE PRE-AMPLIFIER	A.H. SYSTEMS, INC.	PAM-0118	FUNC VERIFY	FUNC VERIFY
1T4745	ANTENNA, HORN	ETS-LINDGREN	3116	11/27/2018	8/27/2020
1T4752	PRE-AMPLIFIER	MITEQ	JS44-18004000-35-8P	FUNC VERIFY	FUNC VERIFY
1T4409	EMI RECEIVER	ROHDE & SCHWARZ	ESIB7	1/4/2019	1/4/2021
1T4300B	SEMI-ANECHOIC 3M CHAMBER SVSWR	EMC TEST SYSTEMS	NONE	6/30/2019	12/30/2020

Figure 68: Test Equipment List

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

Certification & User's Manual Information

Certification & User's Manual Information

L. Certification Information

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

§ 2.801 Radio-frequency device defined.

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

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

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

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

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

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

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

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

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

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

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

(i) Compliance testing;

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

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

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

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

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

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

Certification & User's Manual Information

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

§ 2.901 Basis and Purpose

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

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

§ 2.907 Certification.

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

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

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

Certification & User's Manual Information

§ 2.948 Description of measurement facilities.

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

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

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

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

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

Certification & User's Manual Information

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.

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.

End of Report