

# **Nemko-CCL, Inc.**

1940 West Alexander Street  
Salt Lake City, UT 84119  
801-972-6146

## **Test Report**

Certification

Test Of:  
CWFI001

FCC ID:  
ZRW-CWFI001

Test Specifications:  
FCC PART 15, Subpart C

Test Report Serial No: 181932-2.2

Applicant:  
Provo Craft and Novelty, Inc.  
10876 South River Front Pkwy, Suite 600  
South Jordan, UT 84095

Date of Test: June 13, 2011

Issue Date: August 30, 2011

Accredited Testing Laboratory By:



NVLAP Lab Code 100272-0

## **CERTIFICATION OF ENGINEERING REPORT**

This report has been prepared by Nemko-CCL, Inc. to document compliance of the device described below with the requirements of Federal Communications Commission (FCC) Part 15, Subpart C. This report may be reproduced in full, partial reproduction may only be made with the written consent of the laboratory. The results in this report apply only to the sample tested.

- Applicant: Provo Craft and Novelty, Inc.
- Manufacturer: VPI Engineering
- Brand Name: Cricut
- Model Number: CWFI001
- FCC ID Number: ZRW-CWFI001

On this 30<sup>th</sup> day of August 2011, I, individually, and for Nemko-CCL, Inc., certify that the statements made in this engineering report are true, complete, and correct to the best of my knowledge, and are made in good faith.

Although NVLAP has recognized that the Nemko-CCL, Inc. EMC testing facilities are in good standing, this report must not be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government.

Nemko-CCL, Inc.



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Tested by: Norman P. Hansen  
EMC Technician

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## **SECTION 1.0 CLIENT INFORMATION**

### **1.1 Applicant:**

Company Name: Provo Craft and Novelty, Inc.  
10876 South River Front Pkwy, Suite 600  
South Jordan, UT 84095

Contact Name: Chris Dodge  
Title: Regulatory Compliance

### **1.2 Manufacturer:**

Company Name: Provo Craft and Novelty, Inc.  
10876 South River Front Pkwy, Suite 600  
South Jordan, UT 84095  
U.S.A.

Contact Name: Kurt Jensen  
Title: VP Project Management

**SECTION 2.0 EQUIPMENT UNDER TEST (EUT)****2.1 Identification of EUT:**

Brand Name: Cricut  
Model Number: CWFI001  
Serial Number: None

**2.2 Description of EUT:**

The Cricut Wireless Adapter model CWFI001 is an 802.11bg transceiver module designed for use in the Cricut product line. The CWFI001 receives 5 Vdc from the host device. The CWFI001 uses a Johanson 2450AT45A100, 1.0 dBi, chip antenna.

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

Testing was performed using available data rates and modulations at channels 1, 6, and 11 for 802.11b and 802.11g.

This report covers the circuitry of the devices subject to FCC Part 15, Subpart C. The circuitry of the device subject to FCC Subpart B is covered in Nemko-CCL, Inc. report #181932-1.2.

**2.3 EUT and Support Equipment:**

The FCC ID numbers for all the EUT and support equipment used during the test are listed below:

Brand Name Model Number Serial Number	FCC ID Number or Compliance	Description	Name of Interface Ports / Interface Cables
BN: Cricut MN: CWFI001 (Note 1) SN: None	ZRW-CWFI001	802.11bg Module	See Section 2.4
BN: Cricut MN: Mojo 1.5 PCB SN: None	None	Cricut Main PCB	Module Interface / 6 conductors (Note 2)
BN: Cricut MN: Power/USB Interface PCB SN: None	None	Interface PCB	Power/2 conductors
BN: Cricut MN: KSAH1800200T1M2 SN: None	None	Power Supply	DC/2 conductor cable

Note: (1) EUT

(2) Interface port connected to EUT (See Section 2.4)

The support equipment listed above was not modified in order to achieve compliance with this standard.

#### **2.4 Interface Ports on EUT:**

Name of Ports	No. of Ports Fitted to EUT	Cable Descriptions/Length
Ethernet with Power	1	Cat 5e with RJ45 connectors/1 meter

**2.5 Modification Incorporated/Special Accessories on EUT:**

The following modifications were made to the EUT by the Client during testing to comply with the specification. This report is not complete without an accompanying signed attestation, included as Appendix 3, that the product will have all of the documented modifications incorporated into the product when manufactured and placed on the market.

1. To comply with the requirements of 15.247(d) at the band edges, the transmit power for the individual channels was set in firmware as shown in the table below.

Channel	Transmitter Power Setting (dBm)	
	802.11b	802.11g
1	+18.0	+13.0
2	+18.0	+15.0
3	+18.0	+17.0
4	+18.0	+19.0
5	+18.0	+19.0
6	+18.0	+19.0
7	+18.0	+19.0
8	+18.0	+19.0
9	+18.0	+18.0
10	+18.0	+16.0
11	+18.0	+15.0

## **SECTION 3.0 TEST SPECIFICATION, METHODS & PROCEDURES**

### **3.1 Test Specification:**

Title: FCC PART 15, Subpart C (47 CFR 15)  
15.203, 15.207, and 15.247

Limits and methods of measurement of radio interference  
characteristics of radio frequency devices.

Purpose of Test: The tests were performed to demonstrate initial compliance.

### **3.2 Methods & Procedures:**

#### **3.2.1 §15.203 Antenna Requirement**

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. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded.

#### **3.2.2 §15.207 Conducted Limits**

(a) Except for Class A digital devices, for equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50  $\mu$ H/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the band edges.



Frequency of Emission (MHz)	Conducted Limit (dB $\mu$ V)	
	Quasi-peak	Average
0.15 – 0.5*	66 to 56*	56 to 46*
0.5 – 5	56	46
5 – 30	60	50

\*Decreases with the logarithm of the frequency.

### **3.2.3 §15.247 Operation within the bands 902 – 928 MHz, 2400 – 2483.5 MHz, and 5725 – 5850 MHz**

(a) Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

(1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400 – 2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudorandomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

(i) For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

(ii) Frequency hopping systems operating in the 5725-5850 MHz band shall use at least 75 hopping frequencies. The maximum 20 dB bandwidth of the hopping channel is 1 MHz. The average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 30 second period.

(iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 non-overlapping channels. The average time of occupancy on any

channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 non-overlapping channels are used.

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

(b) The maximum peak output power of the intentional radiator shall not exceed the following:

(1) For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

(2) For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section.

(3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725 - 5850 MHz bands: 1 watt. As an alternative to a peak power measurement, compliance with the Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

(4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(c) Operation with directional antenna gains greater than 6 dBi.

(1) Fixed point-to-point operation:

(i) Systems operating in the 2400-2483.5 MHz band that are used exclusively for fixed, point-to-point operations 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.

(ii) 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.

(iii) Fixed, point-to-point operation, as used in paragraphs (b)(4)(i) and (b)(4)(ii) of this section, excludes the use of point-to-multipoint systems, omnidirectional applications, and multiple co-located intentional radiators transmitting the same information. The operator of the spread spectrum or digitally modulated 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.

(2) In addition to the provisions in paragraphs (b)(1), (b)(3), (b)(4) and (c)(1)(i) of this section, transmitters operating in the 2400-2483.5 MHz band that emit multiple directional beams, simultaneously or sequentially, for the purpose of directing signals to individual receivers or to groups of receivers provided the emissions comply with the following:

(i) Different information must be transmitted to each receiver.

(ii) If the transmitter employs an antenna system that emits multiple directional beams but does not emit multiple directional beams simultaneously, the total output power conducted to the array or arrays that comprise the device, i.e., the sum of the power supplied to all antennas, antenna elements, staves, etc. and summed across all carriers or frequency channels, shall not exceed the limit specified in paragraph (b)(1) or (b)(3) of this section, as applicable. However, the total conducted output power shall be reduced by 1 dB below the specified limits for each 3 dB that the directional gain of the antenna /antenna array exceeds 6 dBi. The directional antenna gain shall be computed as follows:

(A) The directional gain shall be calculated as the sum of  $10 \log$  (number of array elements or staves) plus the directional gain of the element or staff having the highest gain.

(B) A lower value for the directional gain than that calculated in paragraph (c)(2)(ii)(A) of this section will be accepted if sufficient

evidence is presented, e.g., due to shading of the array or coherence loss in the beamforming.

(iii) If a transmitter employs an antenna that operates simultaneously on multiple directional beams using the same or different frequency channels, the power supplied to each emission beam is subject to the power limit specified in paragraph (c)(2)(ii) of this section. If transmitted beams overlap, the power shall be reduced to ensure that their aggregate power does not exceed the limit specified in paragraph (c)(2)(ii) of this section. In addition, the aggregate power transmitted simultaneously on all beams shall not exceed the limit specified in paragraph (c)(2)(ii) of this section by more than 8 dB.

(iv) Transmitters that emit a single directional beam shall operate under the provisions of paragraph (c)(1) of this section.

(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. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

(e) For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

(f) For the purposes of this section, hybrid systems are those that employ a combination of both frequency hopping and digital modulation techniques. The frequency hopping operation of the hybrid system, with the direct sequence or digital modulation operation turned off, shall have an average time of occupancy on any frequency not to exceed 0.4 seconds within a time period in seconds equal to the number of hopping frequencies employed multiplied by 0.4. The digital modulation operation of the hybrid system, with the frequency hopping turned off, shall comply with the power density requirements of paragraph (d) of this section.

(g) Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this section should the transmitter be presented with a continuous data (or information) stream. In addition, a system employing short transmission bursts must comply with the definition of a frequency hopping system and must distribute its transmissions over the minimum number of hopping channels specified in this section.

(h) The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hopsets to avoid hopping on occupied channels is permitted. The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

(i) 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. See § 1.1307(b)(1) of this Chapter.

Note: Spread spectrum systems are sharing these bands on a noninterference basis with systems supporting critical Government requirements that have been allocated the usage of these bands, secondary only to ISM equipment operated under the provisions of Part 18 of this Chapter. Many of these Government systems are airborne radiolocation systems that emit a high EIRP which can cause interference to other users. Also, investigations of the effect of spread spectrum interference to U. S. Government operations in the 902-928 MHz band may require a future decrease in the power limits allowed for spread spectrum operation.

### **3.2.4§ 15.212 Modular transmitter Requirements**

(a) Single modular transmitters consist of a completely self-contained radiofrequency transmitter device that is typically incorporated into another product, host or device. Split modular transmitters consist of two components: a radio front end with antenna (or radio devices) and a transmitter control element (or specific hardware on which the software that controls the radio operation resides). All single or split modular transmitters are approved with an antenna. All of the following requirements apply, except as provided in paragraph (b) of this section.

(1) Single modular transmitters must meet the following requirements to obtain a modular transmitter approval.

(i) The radio elements of the modular transmitter must have their own shielding. The physical crystal and tuning capacitors may be located external to the shielded radio elements.

(ii) The modular transmitter must have buffered modulation/data inputs (if such inputs are provided) to ensure that the module will comply with part 15 requirements under conditions of excessive data rates or over-modulation.

(iii) The modular transmitter must have its own power supply regulation.

(iv) The modular transmitter must comply with the antenna and transmission system requirements of §§15.203, 15.204(b) and 15.204(c). The antenna must either be permanently attached or employ a “unique” antenna coupler (at all connections between the module and the antenna, including the cable). The “professional installation” provision of §15.203 is not applicable to modules but can apply to limited modular approvals under paragraph (b) of this section.

(v) The modular transmitter must be tested in a stand-alone configuration, i.e. , the module must not be inside another device during testing for compliance with part 15 requirements. Unless the transmitter module will be battery powered, it must comply with the AC line conducted requirements found in §15.207. AC or DC power lines and data input/output lines connected to the module must not contain ferrites, unless they will be marketed with the module (see §15.27(a)). The length of these lines shall be the length typical of actual use or, if that length is unknown, at least 10 centimeters to insure that there is no coupling between the case of the module and supporting equipment. Any accessories, peripherals, or support equipment connected to the module during testing shall be unmodified and commercially available (see §15.31(i)).

(vi) The modular transmitter must be equipped with either a permanently affixed label or must be capable of electronically displaying its FCC identification number.

(A) If using a permanently affixed label, the modular transmitter must be labeled with its own FCC identification number, and, if the FCC identification number is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. This exterior label can use wording such as the following: “Contains Transmitter Module FCC ID: XYZMODEL1” or “Contains FCC ID: XYZMODEL1.” Any similar wording that expresses the same meaning may be used. The Grantee may either provide such a label, an example of which must be included in the application for equipment authorization, or, must provide adequate instructions along with the module which explain this requirement. In the latter case, a copy of these instructions must be included in the application for equipment authorization.

(B) If the modular transmitter uses an electronic display of the FCC identification number, the information must be readily accessible and visible on the modular transmitter or on the device in which it is installed. If the module is installed inside another device, then the outside of the device into which the module is installed must display a label referring to the enclosed module. This

exterior label can use wording such as the following: "Contains FCC certified transmitter module(s)." Any similar wording that expresses the same meaning may be used. The user manual must include instructions on how to access the electronic display. A copy of these instructions must be included in the application for equipment authorization.

(vii) The modular transmitter must comply with any specific rules or operating requirements that ordinarily apply to a complete transmitter and the manufacturer must provide adequate instructions along with the module to explain any such requirements. A copy of these instructions must be included in the application for equipment authorization.

(viii) The modular transmitter must comply with any applicable RF exposure requirements in its final configuration.

(2) Split modular transmitters must meet the requirements in paragraph (a)(1) of this section, excluding paragraphs (a)(1)(i) and (a)(1)(v), and the following additional requirements to obtain a modular transmitter approval.

(i) Only the radio front end must be shielded. The physical crystal and tuning capacitors may be located external to the shielded radio elements. The interface between the split sections of the modular system must be digital with a minimum signaling amplitude of 150 mV peak-to-peak.

(ii) Control information and other data may be exchanged between the transmitter control elements and radio front end.

(iii) The sections of a split modular transmitter must be tested installed in a host device(s) similar to that which is representative of the platform(s) intended for use.

(iv) Manufacturers must ensure that only transmitter control elements and radio front end components that have been approved together are capable of operating together. The transmitter module must not operate unless it has verified that the installed transmitter control elements and radio front end have been authorized together. Manufacturers may use means including, but not limited to, coding in hardware and electronic signatures in software to meet these requirements, and must describe the methods in their application for equipment authorization.

(b) A limited modular approval may be granted for single or split modular transmitters that do not comply with all of the above requirements, e.g. , shielding, minimum signaling amplitude, buffered modulation/data inputs, or power supply regulation, if the manufacturer can demonstrate by alternative means in the application for equipment authorization that the modular transmitter meets all the applicable part 15 requirements under the operating conditions in which the transmitter will be used. Limited modular approval also may be granted in those instances where compliance with RF exposure rules is demonstrated only for particular product configurations. The applicant for certification must state how control of the end product into

which the module will be installed will be maintained such that full compliance of the end product is always ensured.

### **3.2.5 Test Procedure**

The conducted disturbance at mains ports and radiated disturbance testing was performed according to the procedures in ANSI C63.4: 2003. Testing was performed at Nemko-CCL, Inc.'s Wanship open area test site #2, located at 29145 Old Lincoln Highway, Wanship, UT. This site has been fully described in a report submitted to the FCC, and was accepted in a letter dated March 11, 2009 (90504).

Nemko-CCL, Inc. is accredited by National Voluntary Laboratory Accreditation Program (NVLAP); NVLAP Lab Code: 100272-0, which is effective until September 30, 2011.

For radiated emission testing at 30 MHz or above that is performed at distances closer than the specified distance, an inverse proportionality factor of 20 dB per decade was used to normalize the measured data for determining compliance.



## **SECTION 4.0 OPERATION OF EUT DURING TESTING**

### **4.1 Operating Environment:**

Power Supply:           120 VAC at 60 Hz to Host  
                              +5.0 VDC to Wireless Adapter from Host

### **4.2 Operating Modes:**

The transmitter was tested on three orthogonal axes while in a constant transmit mode at the desired frequency. 802.11b and 802.11g, modes were tested at the available data rates to find worst-case emissions. The AC power to Host was varied in accordance with FCC §15.31(e). The DC output remained constant and no change was seen in transmitter characteristics.

### **4.3 EUT Exercise Software:**

VPI Engineering software was used to exercise the transmitter.

**SECTION 5.0 SUMMARY OF TEST RESULTS****5.1 FCC Part 15, Subpart C****5.1.1 Summary of Tests:**

<b>Section</b>	<b>Environmental Phenomena</b>	<b>Frequency Range (MHz)</b>	<b>Result</b>
15.203	Antenna Requirements	Structural requirement	Complied
15.207	Conducted Disturbance at Mains Ports	0.15 to 30	Complied
15.247(a)	Bandwidth Requirement	2400 – 2483.5	Complied
15.247(b)	Peak Output Power	2400 – 2483.5	Complied
15.247(c)	Antenna Conducted Spurious Emissions	30 - 25000	Complied
15.247(c)	Radiated Spurious Emissions	30 - 25000	Complied
15.247(d)	Peak Power Spectral Density	2400 – 2483.5	Complied
15.247(e)	Reserved Paragraph	N/A	Not Applicable
15.247(f)	Hybrid System Requirements	2400 – 2483.5	Not Applicable
15.247(g)	Frequency Hopping Channel Usage	2400 – 2438.5	Not Applicable
15.247(h)	Frequency Hopping Intelligence	2400 – 2483.5	Not Applicable
15.212	Modular Transmitter Requirements	N/A	Complied

**5.2 Result**

In the configuration tested, the EUT complied with the requirements of the specification.

**SECTION 6.0 MEASUREMENTS, EXAMINATIONS AND DERIVED RESULTS****6.1 General Comments:**

This section contains the test results only. Details of the test methods used and a list of the test equipment used during the measurements can be found in Appendix 1 of this report.

**6.2 Test Results:****6.2.1 §15.203 Antenna Requirements**

The EUT uses a Johanson 2450AT45A100 chip antenna on the PCB and is not user replaceable.

**RESULT**

The EUT complied with the specification.

**6.2.2 §15.207 Conducted Disturbance at the AC Mains Ports**

Frequency (MHz)	AC Mains Lead	Detector	Measured Level (dBμV)	Limit (dBμV)	Margin (dB)
0.15	Hot Lead	Quasi-Peak (Note 2)	54.0	66.0	-12.0
0.15	Hot Lead	Average (Note 2)	38.9	56.0	-17.1
0.17	Hot Lead	Peak (Note 1)	50.9	54.8	-3.9
0.21	Hot Lead	Peak (Note 1)	47.1	53.3	-6.2
0.28	Hot Lead	Peak (Note 1)	45.0	50.9	-5.9
0.33	Hot Lead	Peak (Note 1)	40.1	49.3	-9.2
0.36	Hot Lead	Peak (Note 1)	39.0	48.7	-9.7
22.60	Hot Lead	Peak (Note 1)	41.4	50.0	-8.6
0.19	Neutral Lead	Quasi-Peak (Note 1)	43.7	54.1	-10.4
0.20	Neutral Lead	Peak (Note 1)	48.3	53.6	-5.3
0.32	Neutral Lead	Peak (Note 1)	40.9	49.8	-8.9
0.35	Neutral Lead	Peak (Note 1)	39.3	49.0	-9.7
0.39	Neutral Lead	Peak (Note 1)	35.8	48.0	-12.2

Frequency (MHz)	AC Mains Lead	Detector	Measured Level (dBμV)	Limit (dBμV)	Margin (dB)
0.53	Neutral Lead	Peak (Note 1)	35.6	46.0	-10.4
22.60	Neutral Lead	Peak (Note 1)	40.5	50.0	-9.5
<p>Note 1: The reference detector used for the measurements was Quasi-Peak or Peak and the data was compared to the average limit; therefore, the EUT was deemed to meet both the average and quasi-peak limits.</p> <p>Note 2: The reference detector used for the measurements was quasi-peak and average and the data was compared to the respective limits.</p>					

**RESULT**

In the configuration tested, the EUT complied with the specification by 3.9 dB.

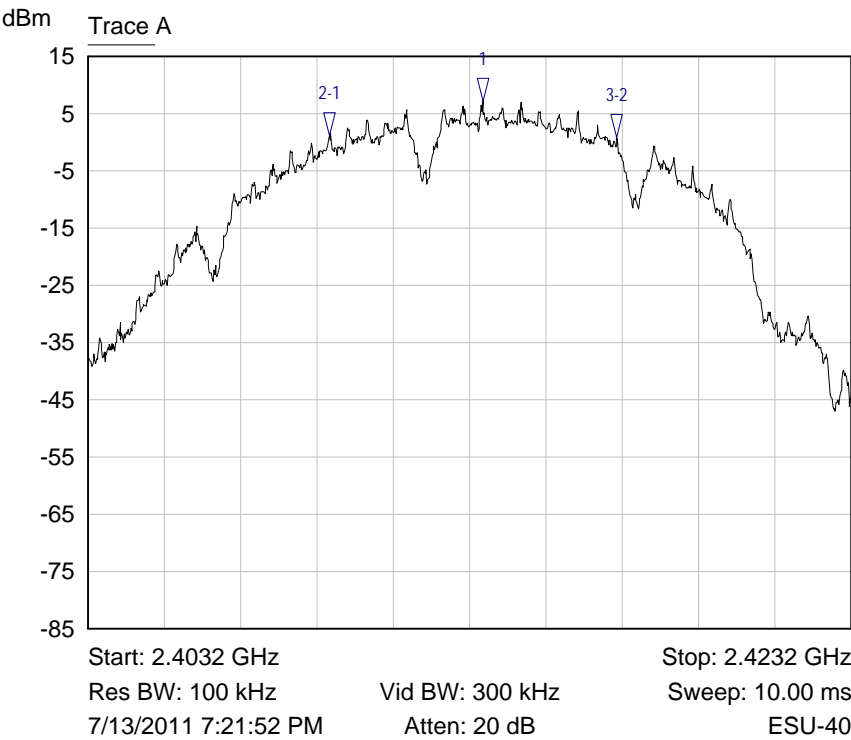
**6.2.3 §15.247(a)(2) Emission 6 dB Bandwidth**

Frequency (MHz)	802.11b (MHz)	802.11g (MHz)
2412	7.54	15.75
2437	7.50	15.55
2462	7.46	15.55

**RESULT**

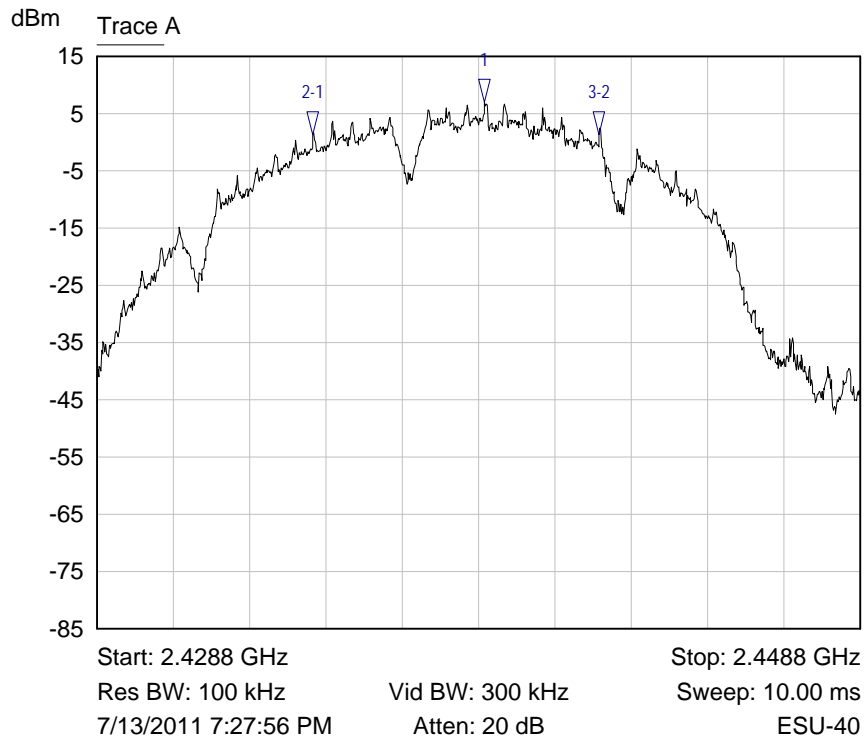
In the configuration tested, the 6 dB bandwidth was greater than 500 kHz; therefore, the EUT complied with the requirements of the specification (see spectrum analyzer plots below).

Channel 1 Emission 6 dB Bandwidth – 802.11b



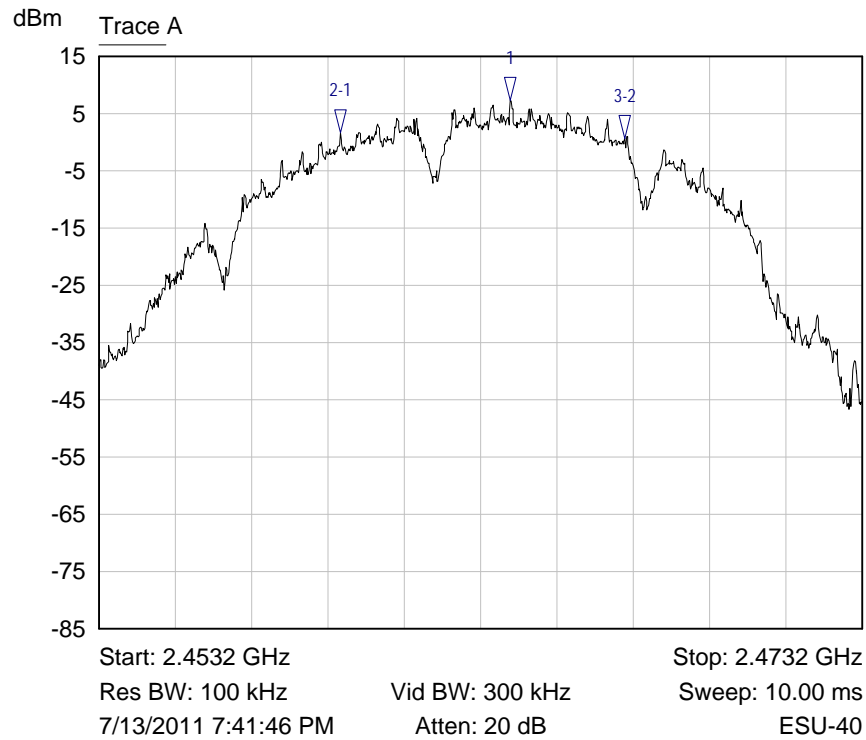
Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4135 GHz	7.13 dBm	
2-1 ▽	Trace A	-4.0200 MHz	-5.89 dB	
3-2 ▽	Trace A	7.5400 MHz	-0.35 dB	

## Channel 6 Emission 6 dB Bandwidth – 802.11b



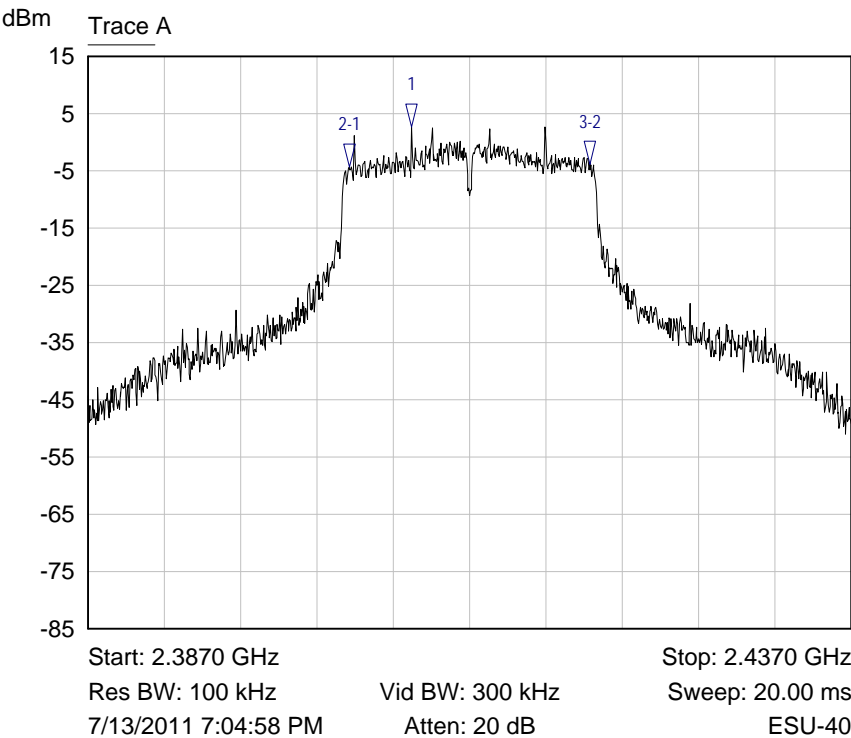
Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4390 GHz	6.94 dBm	
2-1 ▽	Trace A	-4.5000 MHz	-5.53 dB	
3-2 ▽	Trace A	7.5000 MHz	-0.04 dB	

## Channel 11 Emission 6 dB Bandwidth – 802.011b



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4640 GHz	7.38 dBm	
2-1 ▽	Trace A	-4.4600 MHz	-5.78 dB	
3-2 ▽	Trace A	7.4600 MHz	-0.91 dB	

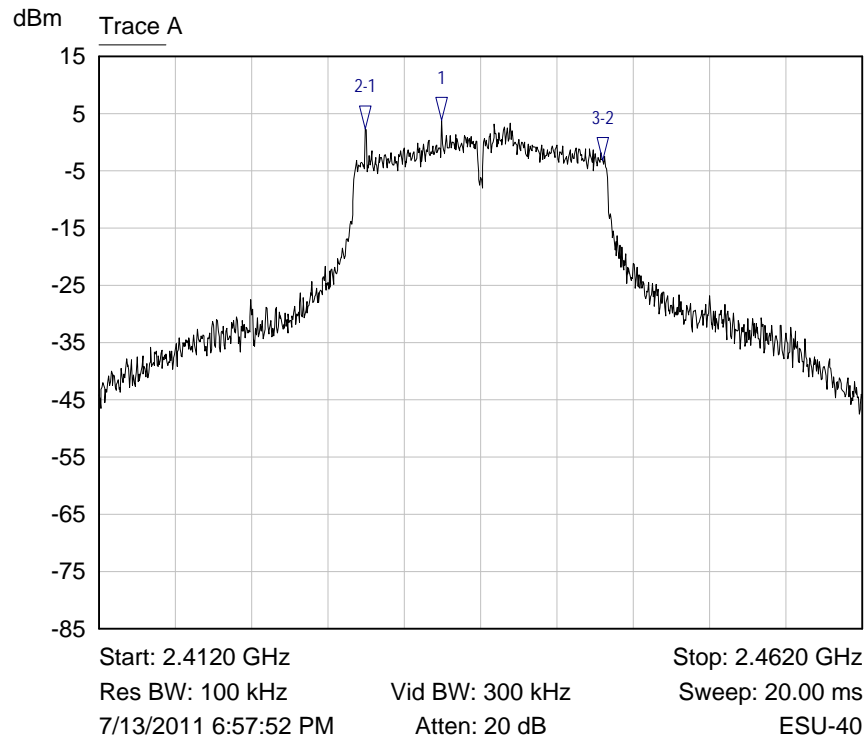
Channel 1 Emission 6 dB Bandwidth – 802.11g



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4082 GHz	2.63 dBm	
2-1 ▽	Trace A	-4.1000 MHz	-6.92 dB	
3-2 ▽	Trace A	15.7500 MHz	0.47 dB	

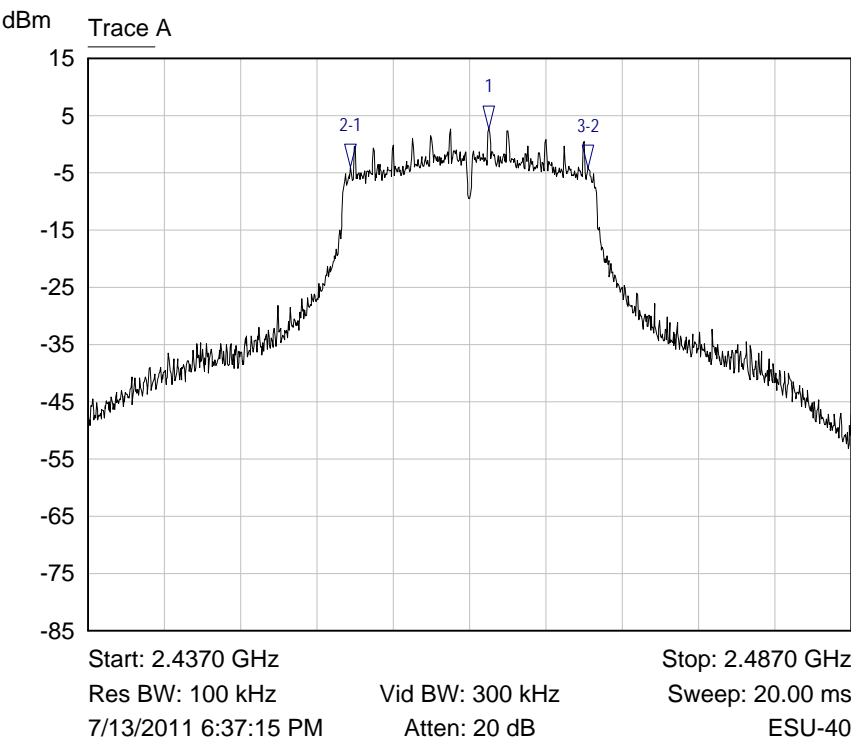


## Channel 6 Emission 6 dB Bandwidth – 802.11g



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4345 GHz	3.78 dBm	
2-1 ▽	Trace A	-5.0000 MHz	-1.49 dB	
3-2 ▽	Trace A	15.5500 MHz	-5.40 dB	

Channel 11 Emission 6 dB Bandwidth – 802.11g



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4633 GHz	2.74 dBm	
2-1 ▽	Trace A	-9.0500 MHz	-6.76 dB	
3-2 ▽	Trace A	15.5500 MHz	-0.13 dB	

**6.2.4 §15.247(b)(3) Peak Output Power**

The maximum peak RF Conducted output power measured for this device was 103.6 mW. The limit is 1 Watt when using antennas with 6 dBi or less gain

The maximum RBW of the spectrum analyzer was not larger than the bandwidth of the signal to be measured; therefore, the method described in Power Output Option 2, Method #1 of the attachment to FCC Public Notice DA000705 was used to measure and sum the power, as allowed in §15.247(b)(3).

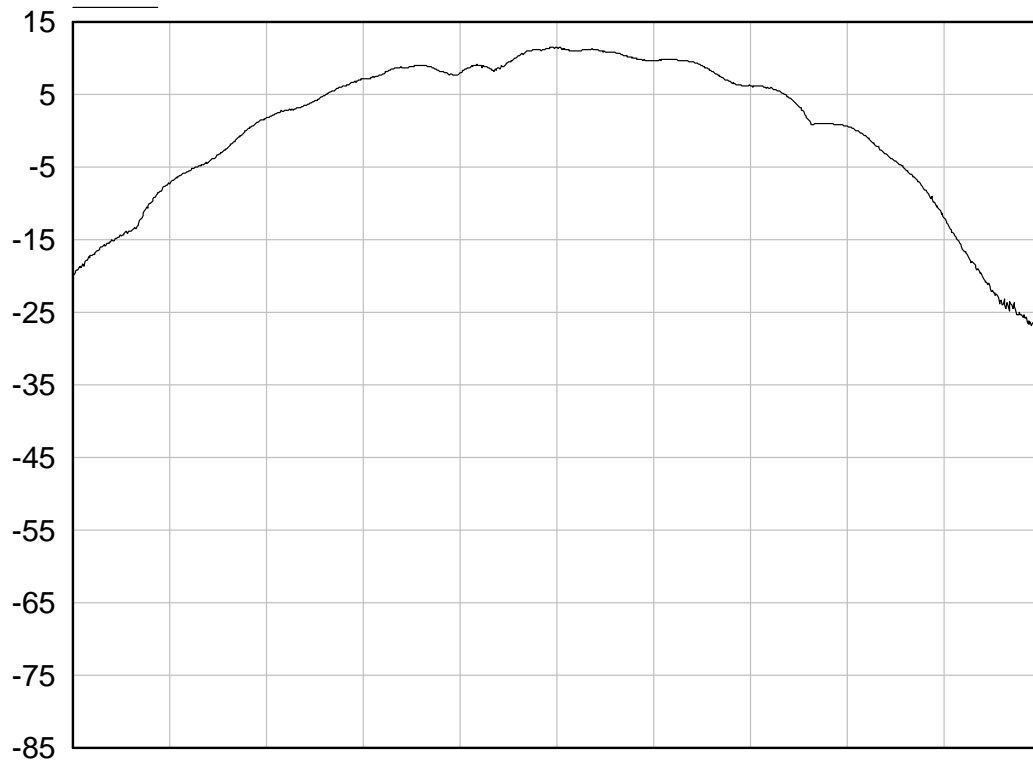
Frequency (MHz)	802.11b (mW)	802.11g (mW)
2412	64.88	94.83
2437	66.87	103.69
2462	67.92	65.86

**RESULT**

In the configuration tested, the RF peak output power was less than 1 Watt; therefore, the EUT complied with the requirements of the specification (see spectrum analyzer plots below).

## Channel 1 Output Power – 802.11b

dBm Trace A



Start: 2.4044 GHz

Stop: 2.4224 GHz

Res BW: 1 MHz

Vid BW: 3 MHz

Sweep: 5.00 ms

7/13/2011 7:18:06 PM

Atten: 20 dB

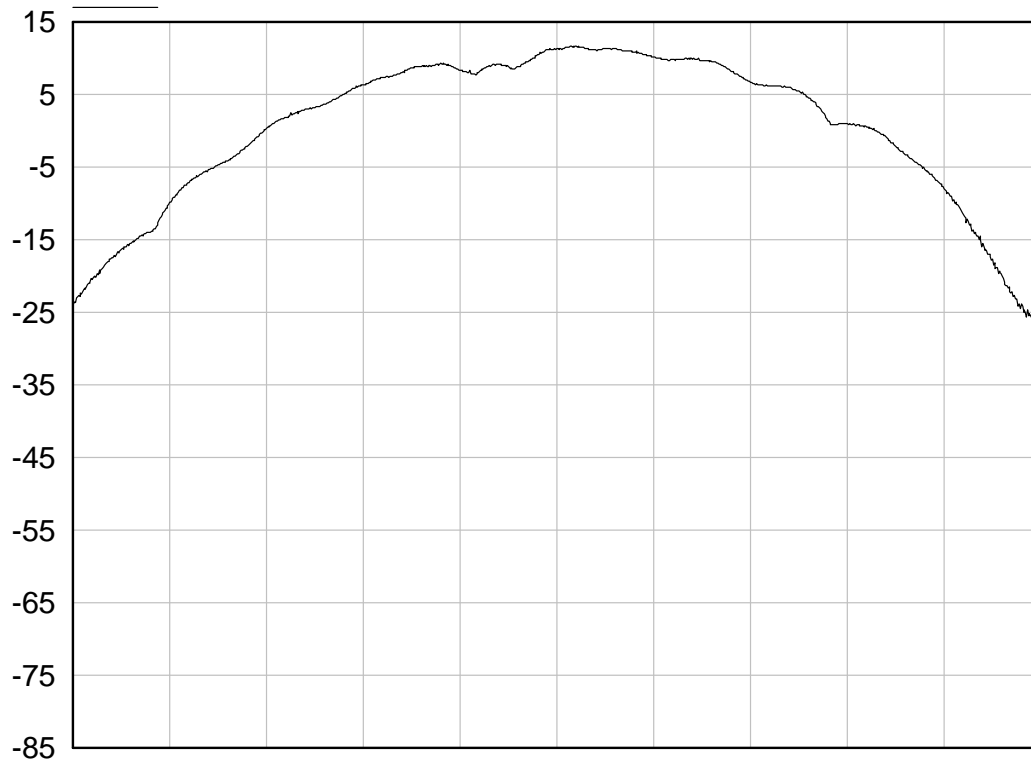
ESU-40

Trace A

Measurement Parameter	Value
Channel power	64.88 mW

## Channel 6 Output Power – 802.11b

dBm Trace A



Start: 2.4291 GHz

Stop: 2.4471 GHz

Res BW: 1 MHz

Vid BW: 3 MHz

Sweep: 5.00 ms

7/13/2011 7:34:15 PM

Atten: 20 dB

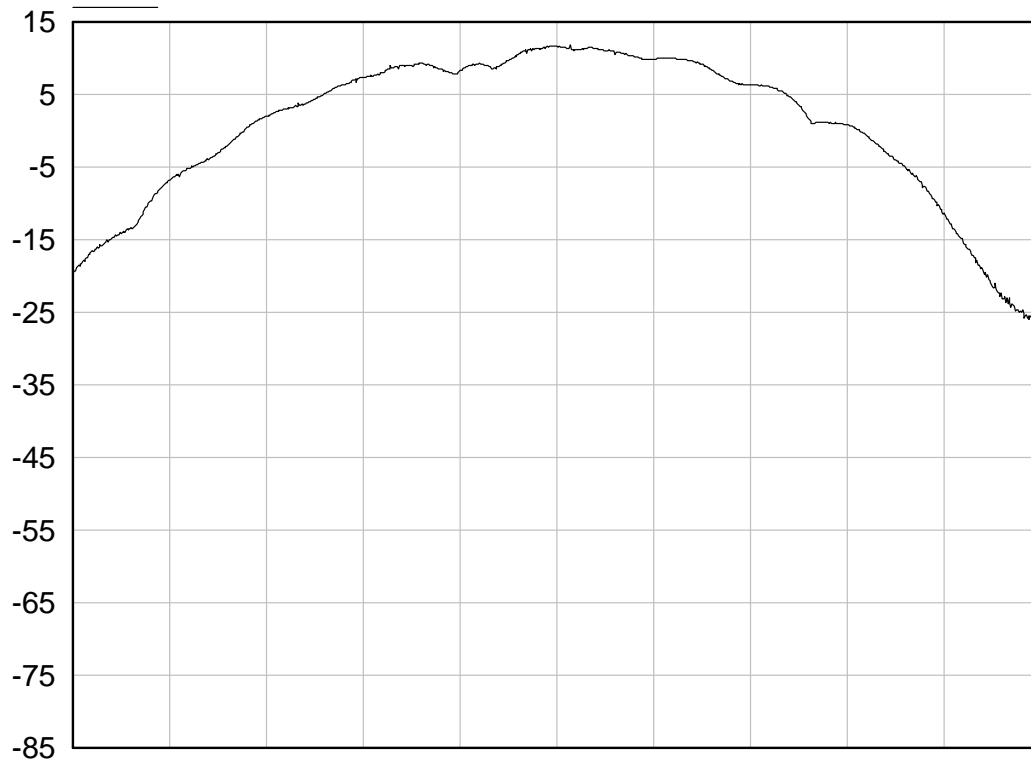
ESU-40

Trace A

Measurement Parameter	Value
Channel power	66.87 mW

## Channel 11 Output Power – 802.11b

dBm Trace A



Start: 2.4544 GHz

Stop: 2.4724 GHz

Res BW: 1 MHz

Vid BW: 3 MHz

Sweep: 5.00 ms

7/13/2011 7:38:41 PM

Atten: 20 dB

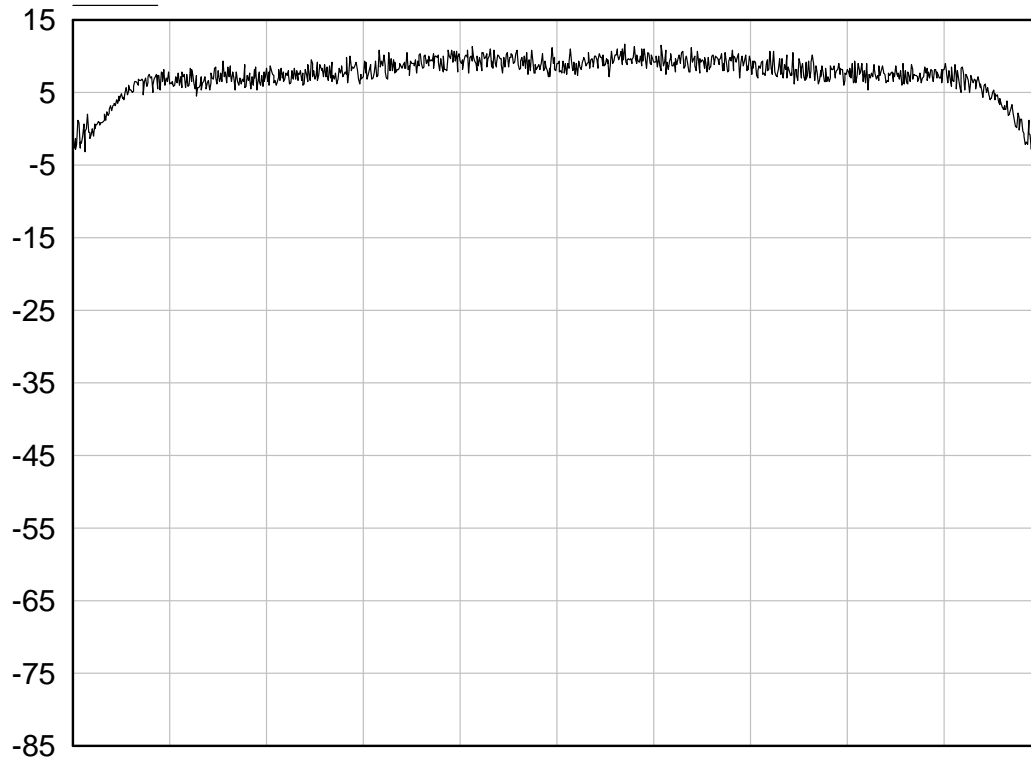
ESU-40

Trace A

Measurement Parameter	Value
Channel power	67.92 mW

## Channel 1 Output Power – 802.11g

dBm Trace A



Start: 2.4030 GHz

Stop: 2.4210 GHz

Res BW: 1 MHz

Vid BW: 3 MHz

Sweep: 5.00 ms

7/13/2011 7:12:28 PM

Atten: 20 dB

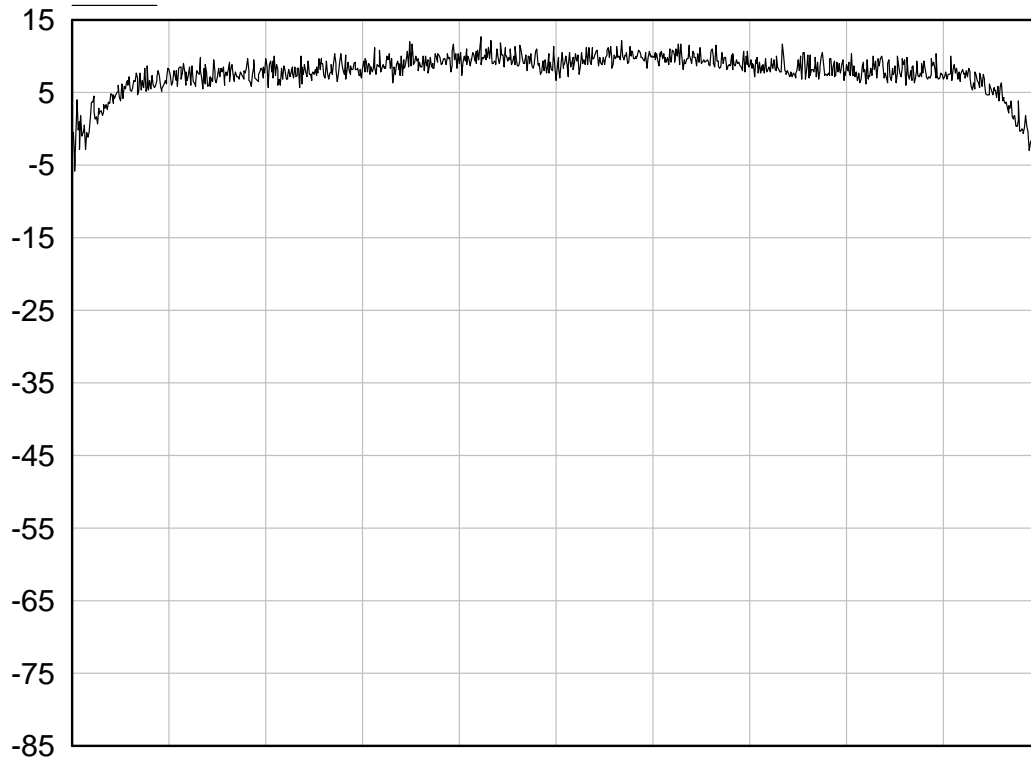
ESU-40

Trace A

Measurement Parameter	Value
Channel power	94.83 mW

## Channel 6 Output Power – 802.11g

dBm Trace A



Start: 2.4280 GHz

Stop: 2.4460 GHz

Res BW: 1 MHz

Vid BW: 3 MHz

Sweep: 5.00 ms

7/13/2011 6:55:42 PM

Atten: 20 dB

ESU-40

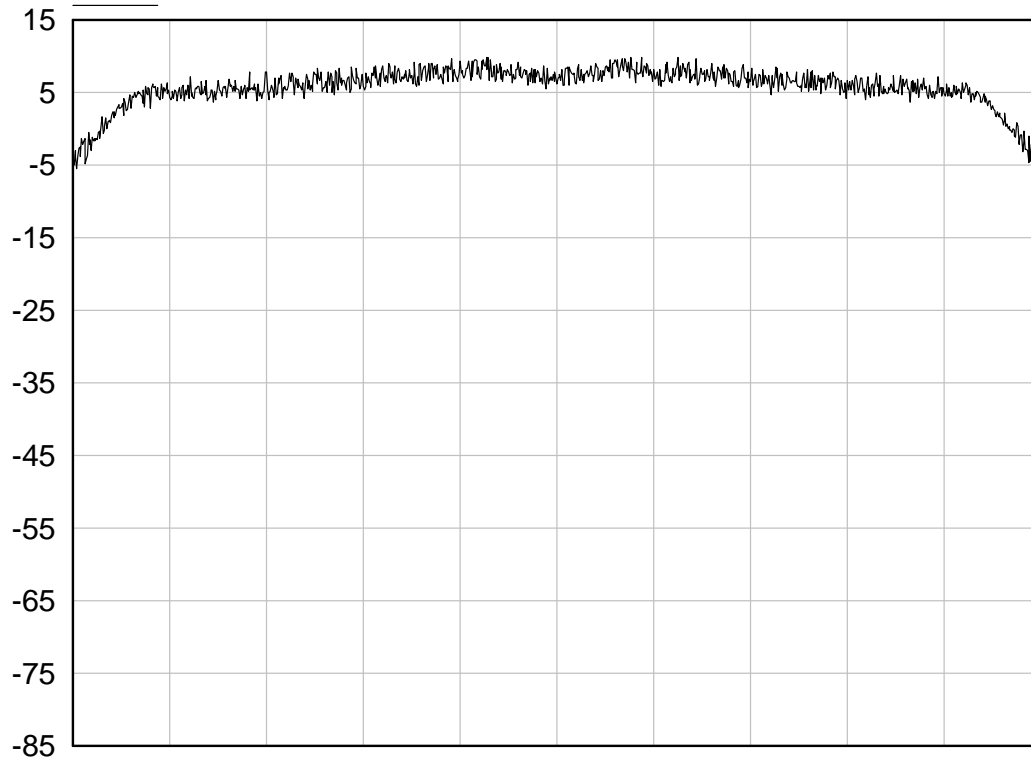
Trace A

Measurement Parameter	Value
Channel power	103.69 mW



## Channel 11 Output Power – 802.11g

dBm Trace A



Start: 2.4530 GHz

Stop: 2.4710 GHz

Res BW: 1 MHz

Vid BW: 3 MHz

Sweep: 5.00 ms

7/13/2011 6:34:24 PM

Atten: 20 dB

ESU-40

Trace A

Measurement Parameter	Value
Channel power	65.86 mW

**6.2.5 §15.247(c) Spurious Emissions****6.2.5.1 Conducted Spurious Emissions**

The frequency range from 8 MHz to the tenth harmonic of the highest fundamental frequency was investigated to measure any antenna-conducted emissions. The tables show the measurement data from spurious emissions noted across the frequency range when transmitting at the lowest frequency, middle frequency, and upper frequency. Shown below are plots with the EUT tuned to the upper and lower channels. These demonstrate compliance with the provisions of this section at the band edges.

The emissions must be attenuated 30 dB below the highest power level measured within the authorized band as measured with a 100 kHz RBW since §15.247(b)(3) was used in determining the output power. The highest level when operating at 802.11b was 7.29 dBm; therefore, the criteria is  $7.29 - 30.0 = -22.71$  dBm. The highest level when operating at 802.11g was 4.06 dBm; therefore, the criteria is  $4.06 - 30.0 = -25.94$  dBm.

**RESULT**

Conducted spurious emissions were attenuated 30 dB or more from the fundamental; therefore, the EUT complies with the specification.

Transmitting at 2412 MHz – 802.11b

Frequency (MHz)	Corrected Level (dBm)	Criteria (dBm)
4824	-44.0	-22.71
7236	-61.9	-22.71
9648	-62.9	-22.71
12060	-63.2	-22.71
14472	-63.8	-22.71
16884	-64.4	-22.71
19296	-64.3	-22.71
21708	-64.0	-22.71
24120	-60.3	-22.71

## Transmitting at 2437 MHz – 802.11b

Frequency (MHz)	Corrected Level (dBm)	Criteria (dBm)
4874	-48.2	-22.71
7311	-61.5	-22.71
9748	-64.5	-22.71
12185	-63.9	-22.71
14662	-64.0	-22.71
17059	-64.5	-22.71
19496	-62.9	-22.71
21993	-63.3	-22.71
24370	-60.5	-22.71

## Transmitting at 2462 MHz – 802.11b

Frequency (MHz)	Corrected Level (dBm)	Criteria (dBm)
4924	-52.6	-22.71
7386	-61.1	-22.71
9848	-64.4	-22.71
12310	-65.7	-22.71
14772	-63.3	-22.71
17234	-63.5	-22.71
19696	-67.2	-22.71
22158	-63.7	-22.71
24620	-60.0	-22.71

## Transmitting at 2412 MHz – 802.11g

Frequency (MHz)	Corrected Level (dBm)	Criteria (dBm)
4824	-55.9	-25.94
7236	-60.7	-25.94
9648	-62.9	-25.94
12060	-60.9	-25.94
14472	-61.7	-25.94
16884	-61.2	-25.94
19296	-60.7	-25.94
21708	-61.1	-25.94
24120	-60.8	-25.94

## Transmitting at 2437 MHz – 802.11g

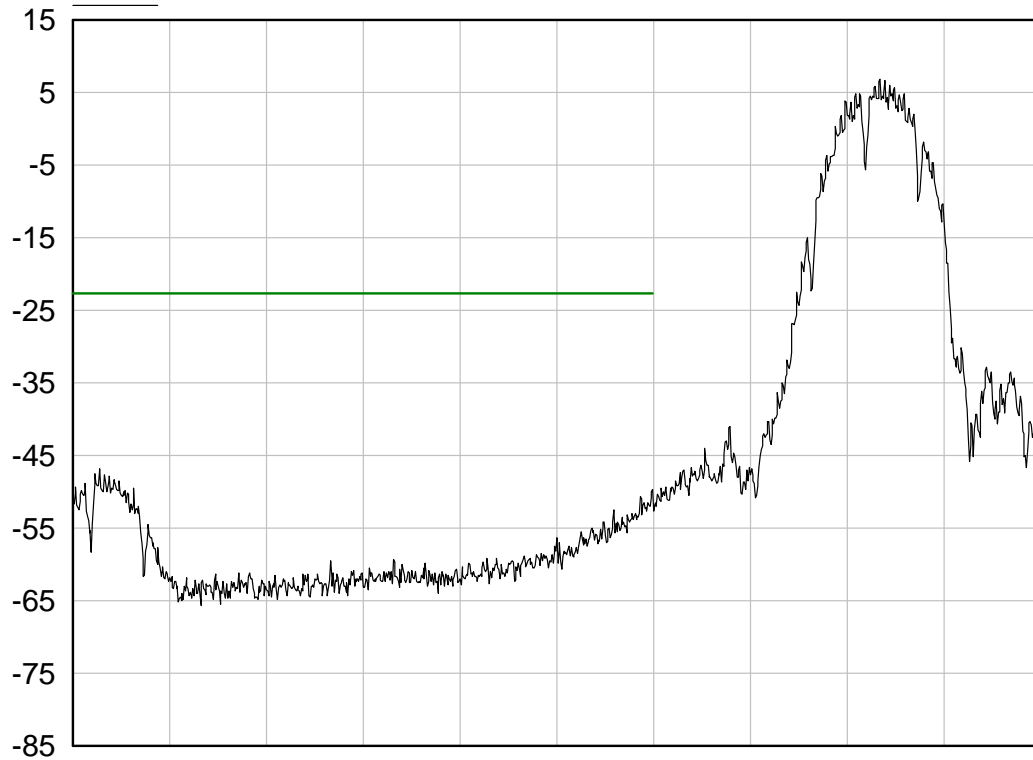
Frequency (MHz)	Corrected Level (dBm)	Criteria (dBm)
4874	-56.2	-25.94
7311	-61.4	-25.94
9748	-62.4	-25.94
12185	-61.3	-25.94
14662	-62.1	-25.94
17059	-61.5	-25.94
19496	-60.7	-25.94
21993	-64.4	-25.94
24370	-60.4	-25.94

## Transmitting at 2462 MHz – 802.11g

Frequency (MHz)	Corrected Level (dBm)	Criteria (dBm)
4924	-61.2	-25.94
7386	-63.9	-25.94
9848	-63.5	-25.94
12310	-63.6	-25.94
14772	-63.4	-25.94
17234	-62.6	-25.94
19696	-64.1	-25.94
22158	-63.2	-25.94
24620	-60.1	-25.94

Channel 1 Band Edge – 802.11b

dBm Trace A



Start: 2.3302 GHz

Res BW: 100 kHz

7/13/2011 7:24:14 PM

Vid BW: 300 kHz

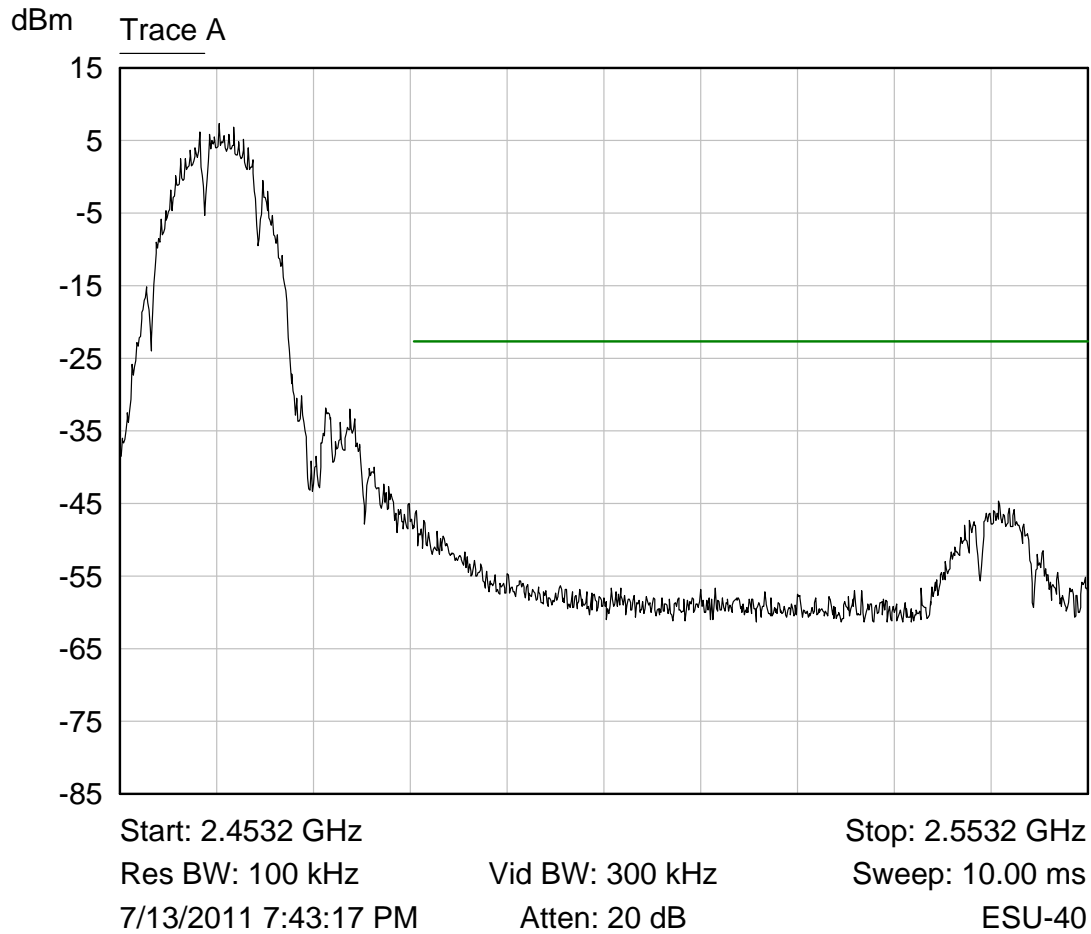
Atten: 20 dB

Stop: 2.4302 GHz

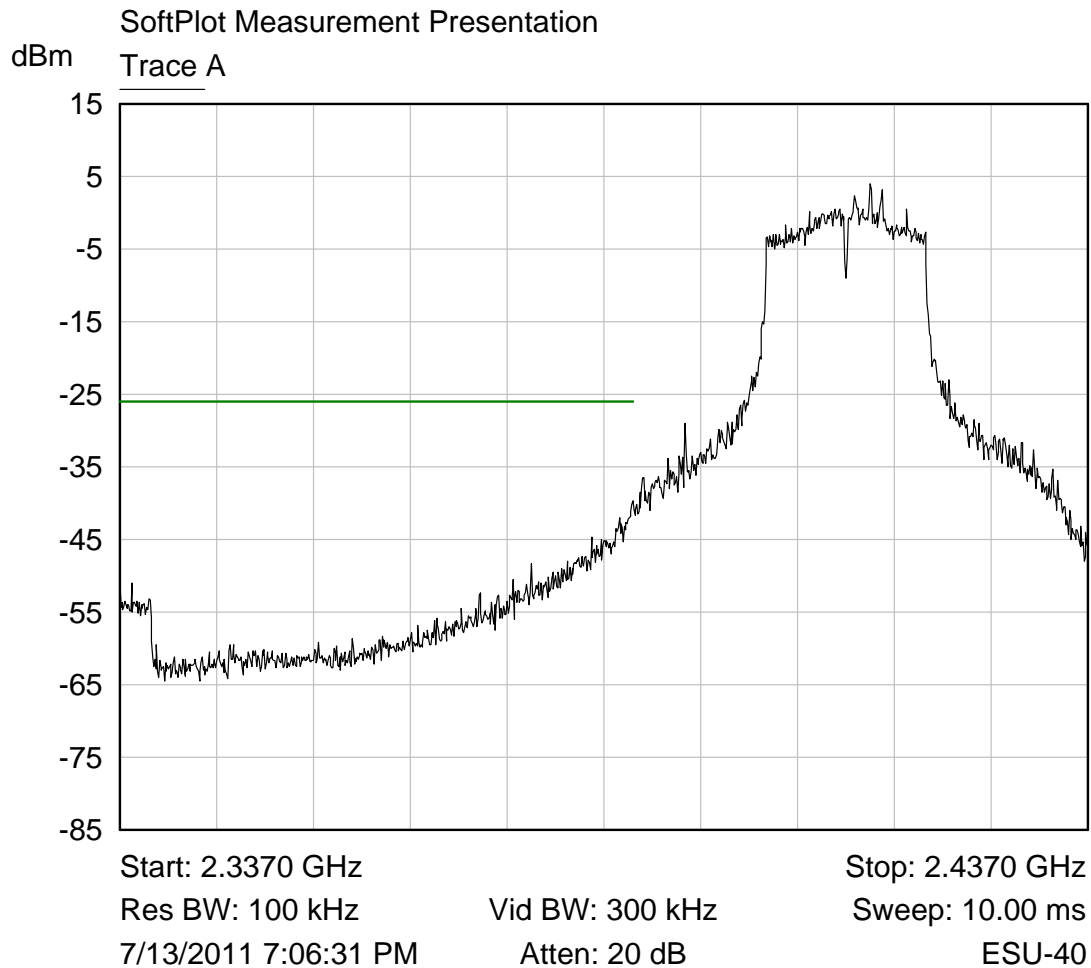
Sweep: 10.00 ms

ESU-40

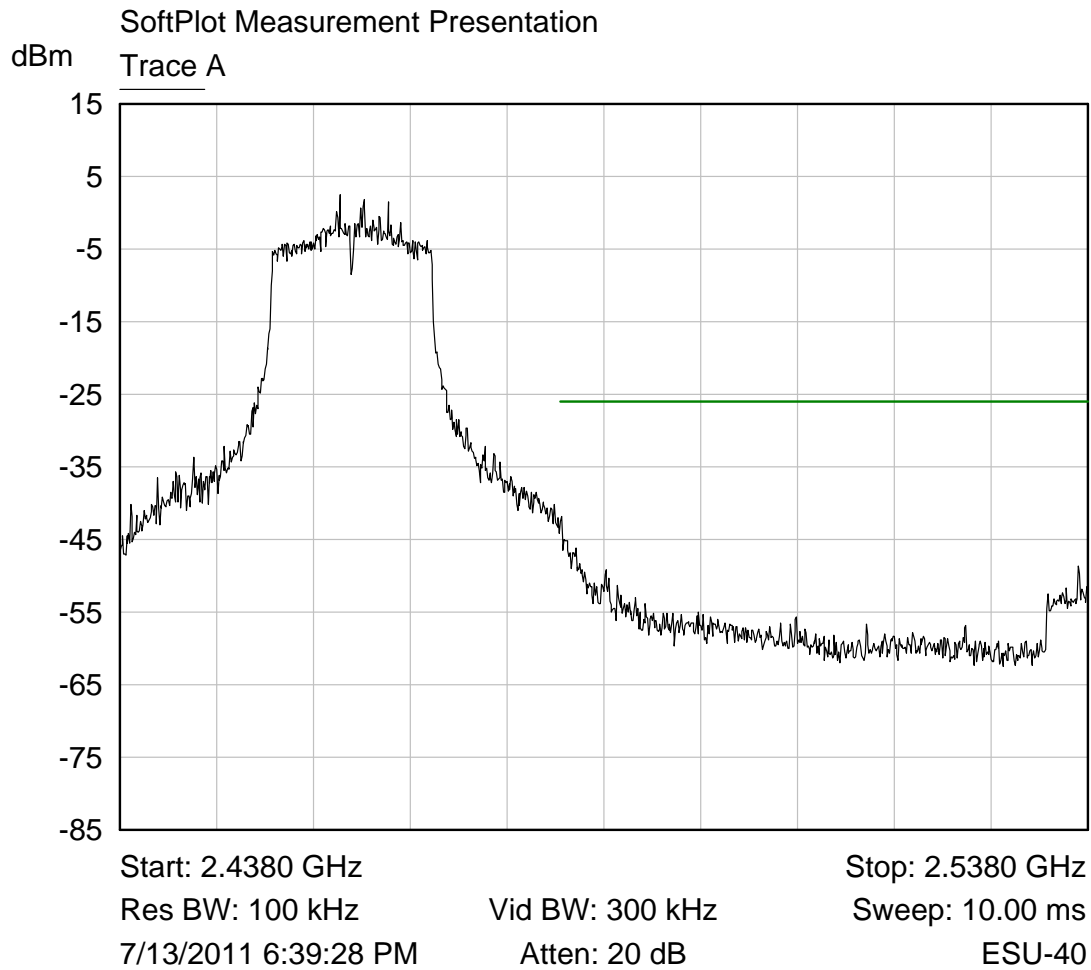
Channel 11 Band Edge – 802.11b



Channel 1 Band Edge – 802.11g



Channel 11 Band Edge – 802.11g





### **6.2.5.2 Radiated Emissions in the Restricted Bands of §15.205**

The frequency range from 30 MHz to 25 GHz was investigated to measure any radiated emissions in the restricted bands. The following tables show measurements of any emission that fell into the restricted bands of §15.205. The tables show the worst-case emission measured from the CWFI001. For frequencies above 12.5 GHz, a measurement distance of 1 meter was used. The noise floor was a minimum of 6 dB below the limit. The emissions in the restricted bands must meet the limits specified in §15.209. Tabular data for each of the spurious emissions is shown below for each of the units. Plots of the band edges are also shown.

For frequencies below 1000 MHz RBW = 100 kHz and VBW = 300 kHz, For frequencies above 1000 MHz RBW = 1 Mhz and VBW = 3 MHz.

#### **AVERAGE FACTOR**

There was not an average factor applied.

#### **RESULT**

All emissions in the restricted bands of §15.205 met the limits specified in §15.209; therefore, the EUT complies with the specification.

Transmitting at 2412 MHz – 802.11b

Frequency (MHz)	Detection Mode	Antenna Polarity	Receiver Reading (dBμV)	Correction Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
4824.0	Peak	Vertical	16.7	37.7	54.4	74.0	-19.6
4824.0	Average	Vertical	13.9	37.7	51.6	54.0	-2.4
4824.0	Peak	Horizontal	16.9	37.7	54.6	74.0	-19.4
4824.0	Average	Horizontal	14.7	37.7	52.4	54.0	-1.6
7236.0	Peak	Vertical	5.1	42.1	47.2	74.0	-26.8
7236.0	Average	Vertical	-3.4	42.1	38.7	54.0	-15.3
7236.0	Peak	Horizontal	5.0	42.1	47.1	74.0	-26.9
7236.0	Average	Horizontal	-3.3	42.1	38.8	54.0	-15.2
12060.0	Peak	Vertical	0.7	47.2	47.9	74.0	-26.1
12060.0	Average	Vertical	-10.5	47.2	36.7	54.0	-17.3
12060.0	Peak	Horizontal	0.9	47.2	48.1	74.0	-25.9
12060.0	Average	Horizontal	-10.5	47.2	36.7	54.0	-17.3

## Transmitting at 2437 MHz – 802.11b

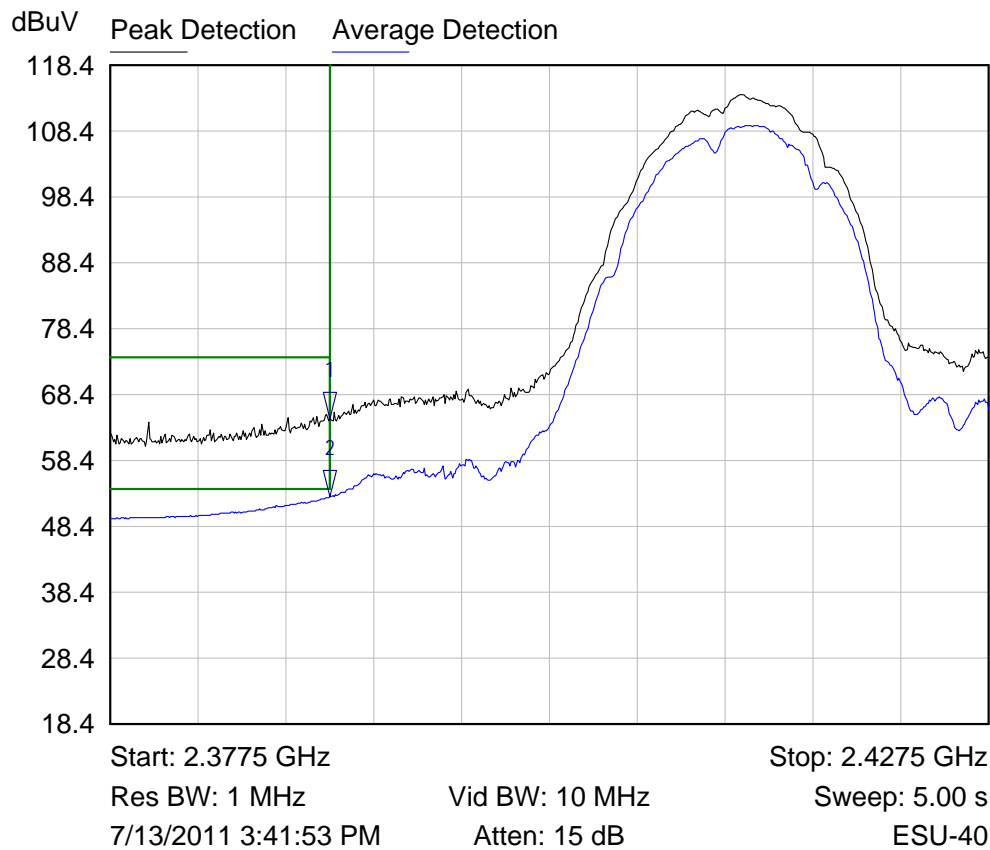
Frequency (MHz)	Detection Mode	Antenna Polarity	Receiver Reading (dBμV)	Correction Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
4874.0	Peak	Vertical	15.7	37.8	53.5	74.0	-20.5
4874.0	Average	Vertical	13.4	37.8	51.2	54.0	-2.8
4874.0	Peak	Horizontal	15.0	37.8	52.8	74.0	-21.2
4874.0	Average	Horizontal	11.8	37.8	49.6	54.0	-4.4
7311.0	Peak	Vertical	5.6	42.3	47.9	74.0	-26.1
7311.0	Average	Vertical	-2.5	42.3	39.8	54.0	-14.2
7311.0	Peak	Horizontal	5.7	42.3	48.0	74.0	-26.0
7311.0	Average	Horizontal	-2.4	42.3	39.9	54.0	-14.1
12185.0	Peak	Vertical	0.1	47.1	47.2	74.0	-26.8
12185.0	Average	Vertical	-11.0	47.1	36.1	54.0	-17.9
12185.0	Peak	Horizontal	0.4	47.1	47.5	74.0	-26.5
12185.0	Average	Horizontal	-11.1	47.1	36.0	54.0	-18.0

## Transmitting at 2462 MHz – 802.11b

Frequency (MHz)	Detection Mode	Antenna Polarity	Receiver Reading (dBμV)	Correction Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
4924.0	Peak	Vertical	12.0	37.9	49.9	74.0	-24.1
4924.0	Average	Vertical	8.3	37.9	46.2	54.0	-7.8
4924.0	Peak	Horizontal	12.7	37.9	50.6	74.0	-23.4
4924.0	Average	Horizontal	10.0	37.9	47.9	54.0	-6.1
7386.0	Peak	Vertical	3.7	42.5	46.2	74.0	-27.8
7386.0	Average	Vertical	-7.0	42.5	35.5	54.0	-18.5
7386.0	Peak	Horizontal	3.1	42.5	45.6	74.0	-28.4
7386.0	Average	Horizontal	-7.9	42.5	34.6	54.0	-19.4
12310.0	Peak	Vertical	0.5	47.0	47.5	74.0	-26.5
12310.0	Average	Vertical	-11.7	47.0	35.3	54.0	-18.7
12310.0	Peak	Horizontal	1.2	47.0	48.2	74.0	-25.8
12310.0	Average	Horizontal	-11.6	47.0	35.4	54.0	-18.6

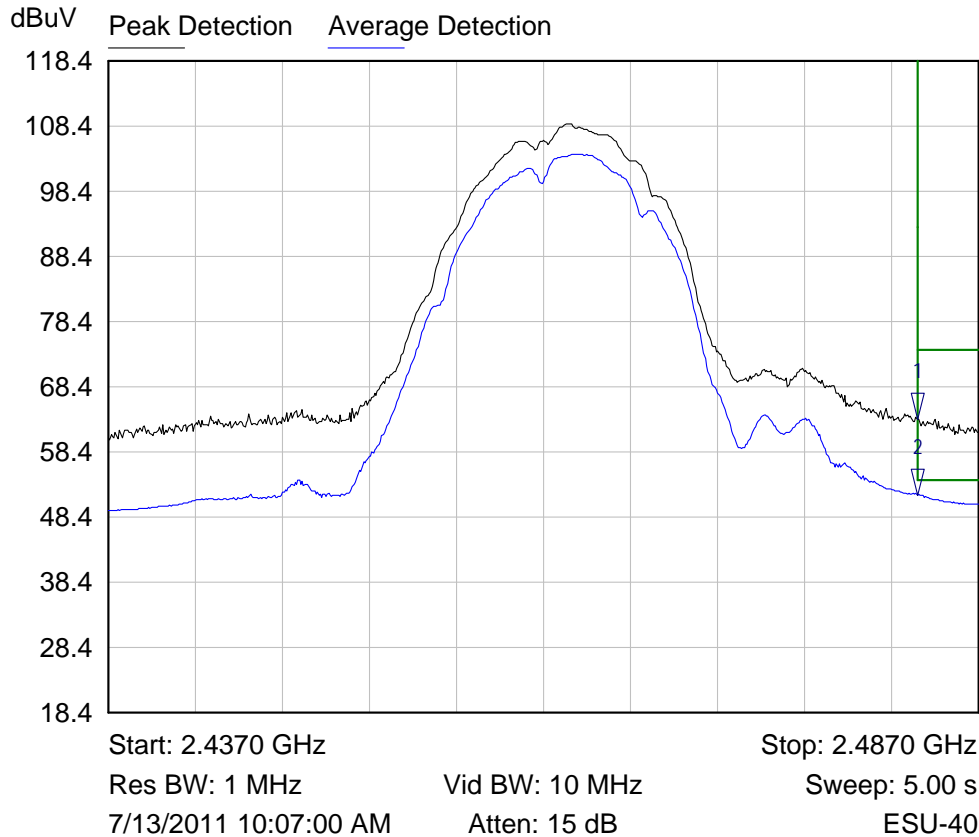
No other emissions were seen in the restricted bands when operating at 802.11b. Noise floor was greater than 6 dB below the limit. At frequencies above 12.5 GHz, a 1 meter measurement distance was used.

### Lower Channel Radiated Band Edge – 802.11b



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Peak Detection	2.3900 GHz	64.76 dBuV	
2 ▽	Average Detection	2.3900 GHz	52.85 dBuV	

## Upper Channel Radiated Band Edge – 802.11b



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Peak Detection	2.4835 GHz	63.37 dBuV	
2 ▽	Average Detection	2.4835 GHz	51.78 dBuV	

## Transmitting at 2412 MHz – 802.11g

Frequency (MHz)	Detection Mode	Antenna Polarity	Receiver Reading (dBμV)	Correction Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
4824.0	Peak	Vertical	10.9	37.7	48.6	74.0	-25.4
4824.0	Average	Vertical	5.3	37.7	43.0	54.0	-11.0
4824.0	Peak	Horizontal	12.7	37.7	50.4	74.0	-23.6
4824.0	Average	Horizontal	6.7	37.7	44.4	54.0	-9.6
7236.0	Peak	Vertical	3.3	42.1	45.4	74.0	-28.6
7236.0	Average	Vertical	-7.9	42.1	34.2	54.0	-19.8
7236.0	Peak	Horizontal	2.9	42.1	45.0	74.0	-29.0
7236.0	Average	Horizontal	-8.1	42.1	34.0	54.0	-20.0
12060.0	Peak	Vertical	0.1	47.2	47.3	74.0	-26.7
12060.0	Average	Vertical	-11.4	47.2	35.8	54.0	-18.2
12060.0	Peak	Horizontal	0.0	47.2	47.2	74.0	-26.8
12060.0	Average	Horizontal	-11.0	47.2	36.2	54.0	-17.8

## Transmitting at 2437 MHz – 802.11g

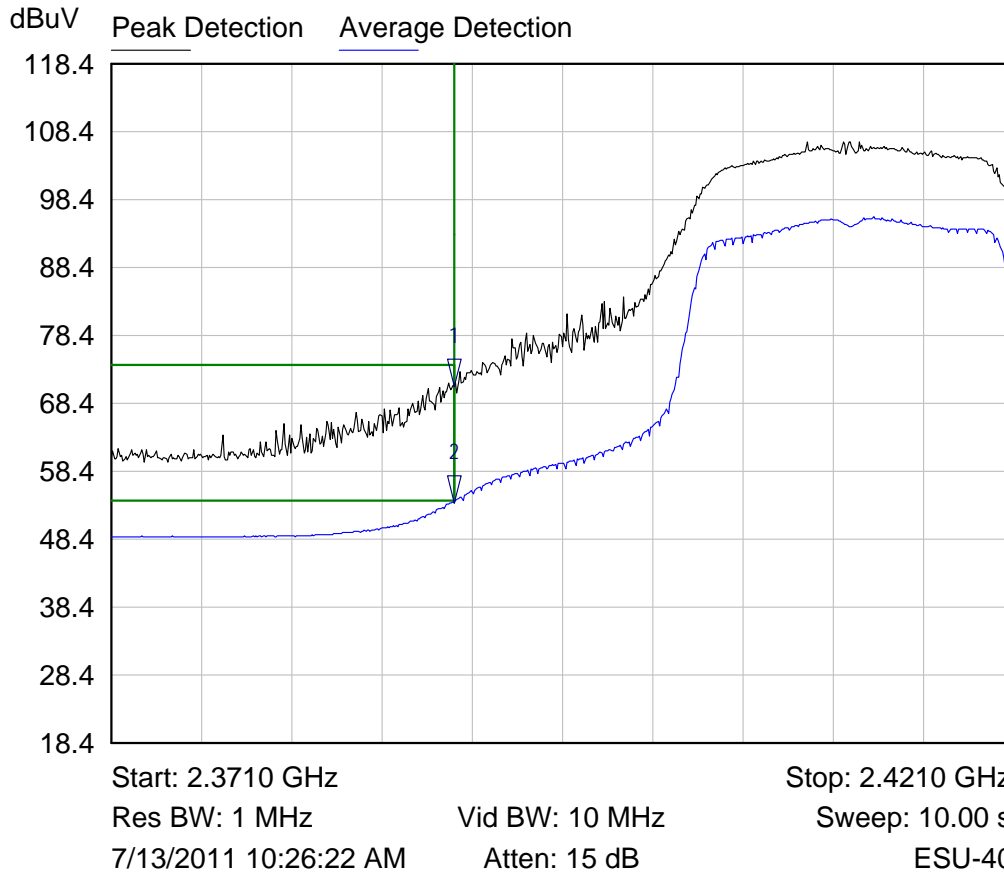
Frequency (MHz)	Detection Mode	Antenna Polarity	Receiver Reading (dBμV)	Correction Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
4874.0	Peak	Vertical	13.8	37.8	51.6	74.0	-22.4
4874.0	Average	Vertical	4.8	37.8	42.6	54.0	-11.4
4874.0	Peak	Horizontal	16.2	37.8	54.0	74.0	-20.0
4874.0	Average	Horizontal	4.7	37.8	42.5	54.0	-11.5
7311.0	Peak	Vertical	6.2	42.3	48.5	74.0	-25.5
7311.0	Average	Vertical	-4.9	42.3	37.4	54.0	-16.6
7311.0	Peak	Horizontal	6.4	42.3	48.7	74.0	-25.3
7311.0	Average	Horizontal	-4.8	42.3	37.5	54.0	-16.5
12185.0	Peak	Vertical	1.6	47.1	48.7	74.0	-25.3
12185.0	Average	Vertical	-9.5	47.1	37.6	54.0	-16.4
12185.0	Peak	Horizontal	1.0	47.1	48.1	74.0	-25.9
12185.0	Average	Horizontal	-10.3	47.1	36.8	54.0	-17.2

## Transmitting at 2462 MHz – 802.11g

Frequency (MHz)	Detection Mode	Antenna Polarity	Receiver Reading (dBμV)	Correction Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
4924.0	Peak	Vertical	10.9	37.9	54.1	74.0	-19.9
4924.0	Average	Vertical	5.3	37.9	43.9	54.0	-10.1
4924.0	Peak	Horizontal	12.7	37.9	50.0	74.0	-24.0
4924.0	Average	Horizontal	6.7	37.9	40.1	54.0	-13.9
7386.0	Peak	Vertical	3.3	42.5	47.9	74.0	-26.1
7386.0	Average	Vertical	-7.9	42.5	37.3	54.0	-16.7
7386.0	Peak	Horizontal	2.9	42.5	50.6	74.0	-23.4
7386.0	Average	Horizontal	-8.1	42.5	39.5	54.0	-14.5
12310.0	Peak	Vertical	0.1	47.0	53.4	74.0	-20.6
12310.0	Average	Vertical	-11.4	47.0	43.8	54.0	-10.2
12310.0	Peak	Horizontal	0.0	47.0	50.4	74.0	-23.6
12310.0	Average	Horizontal	-11.0	47.0	39.9	54.0	-14.1

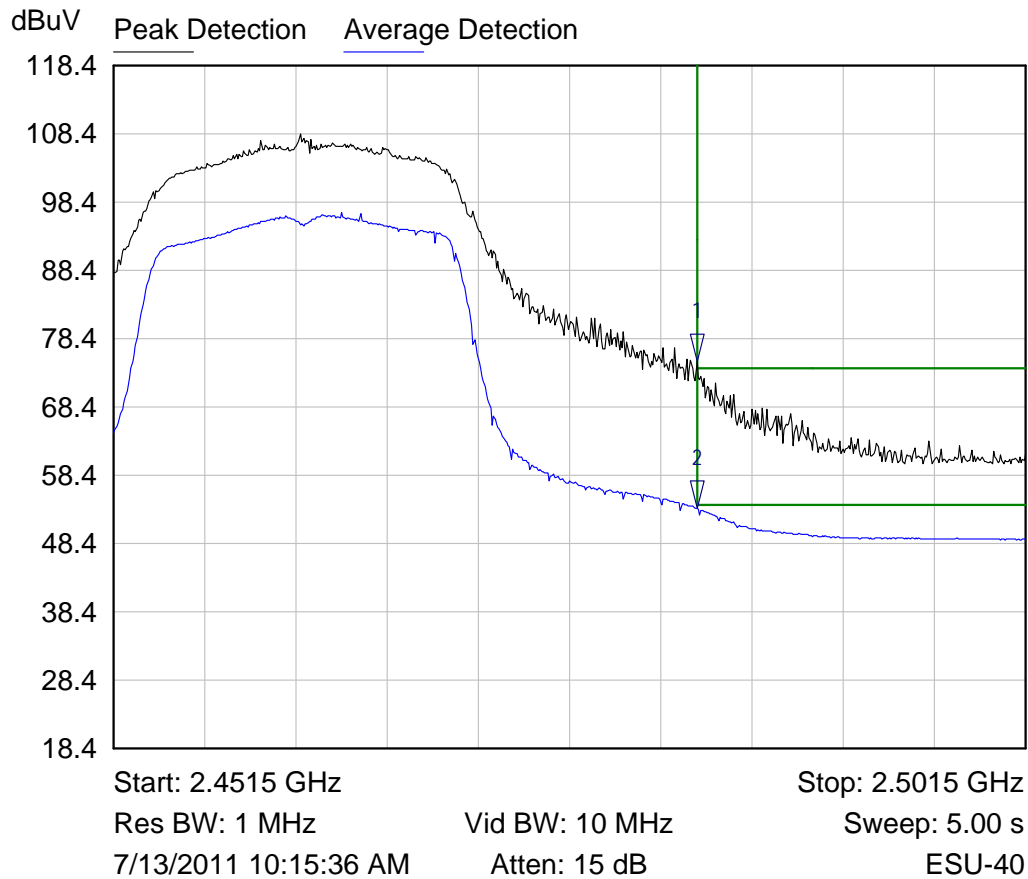
No other emissions were seen in the restricted bands when operating at 802.11g. Noise floor was greater than 6 dB below the limit. At frequencies above 12.5 GHz, a 1 meter measurement distance was used.

## Lower Channel Radiated Band Edge – 802.11g



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Peak Detection	2.3900 GHz	70.90 dBuV	
2 ▽	Average Detection	2.3900 GHz	53.66 dBuV	

## Upper Channel Radiated Band Edge – 802.11g



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Peak Detection	2.4835 GHz	75.02 dBuV	
2 ▽	Average Detection	2.4835 GHz	53.59 dBuV	



**6.2.6 §15.247(d) Peak Power Spectral Density**

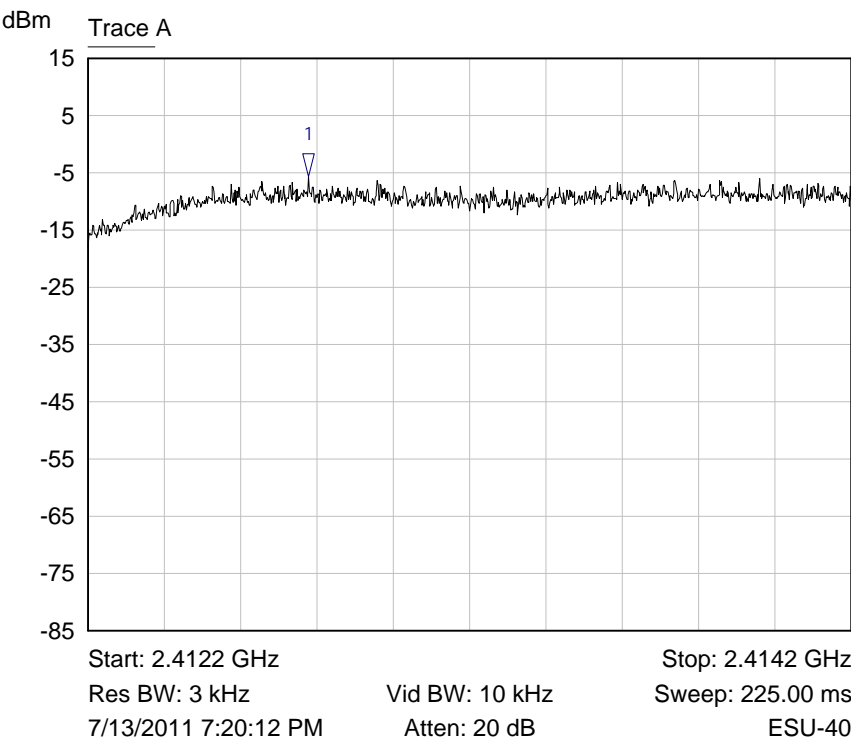
The peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. Since the method described in Power Output Option 2, Method #1 of the attachment to FCC Public Notice DA000705 was used to measure and sum the power, the method in PSD Option 2 of the attachment to FCC Public Notice DA000705 was used to measure the 3 kHz power spectral density of the emission. The result of this testing is summarized in the table below.

Frequency (MHz)	802.11b (dBm)	802.11g (dBm)
2412	-5.73	-10.43
2437	-3.45	-9.06
2462	-4.27	-10.68

**RESULT**

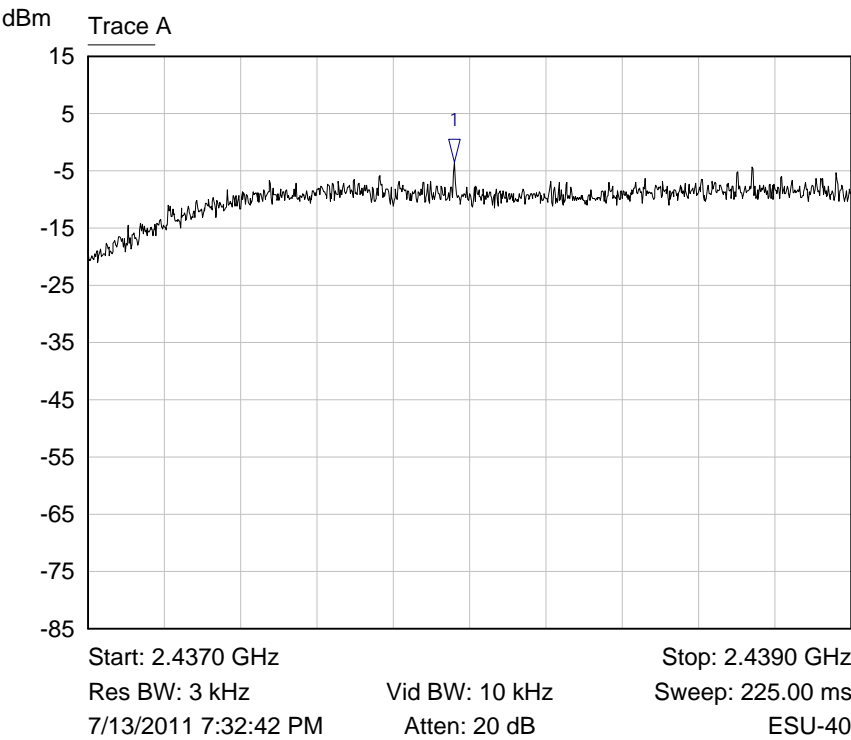
The maximum peak power spectral density was -3.45 dBm. The EUT complies with the specification by 11.45 dB.

Lowest channel – 802.11b



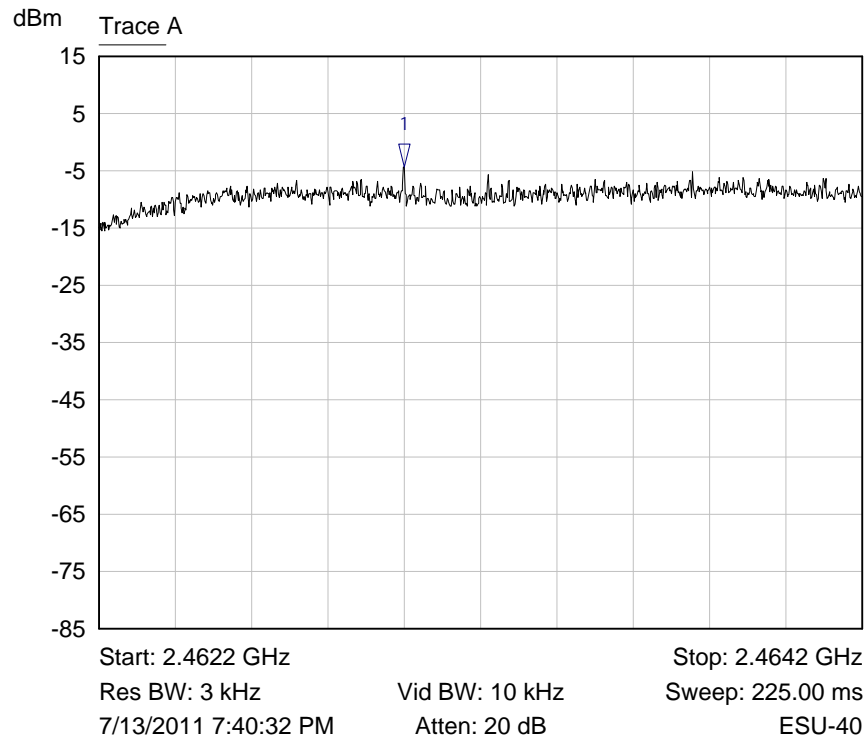
Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4127 GHz	-5.73 dBm	

Middle channel – 802.11b



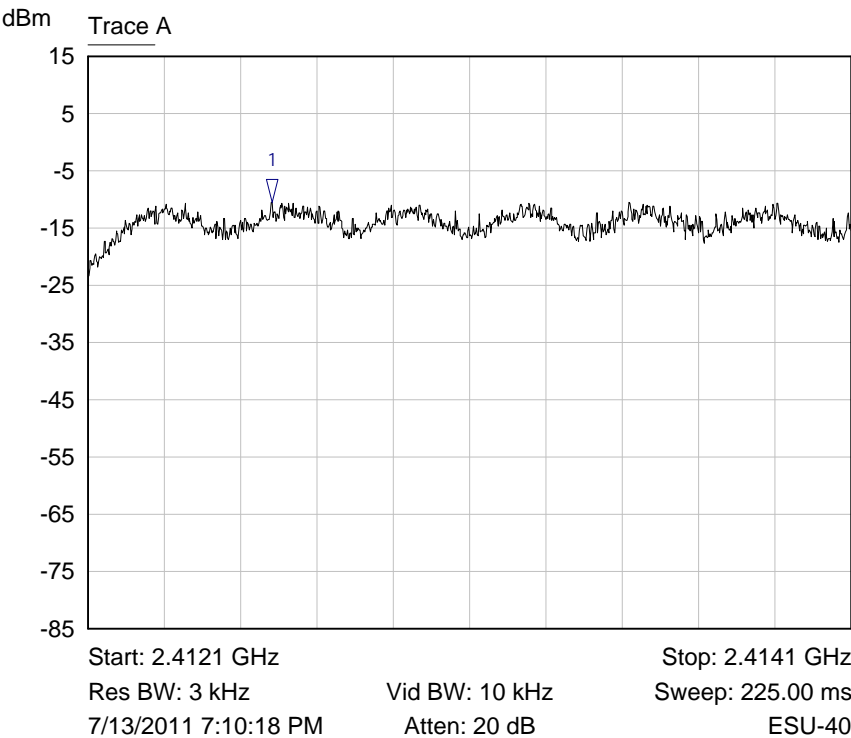
Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4380 GHz	-3.45 dBm	

## Upper channel – 802.11b



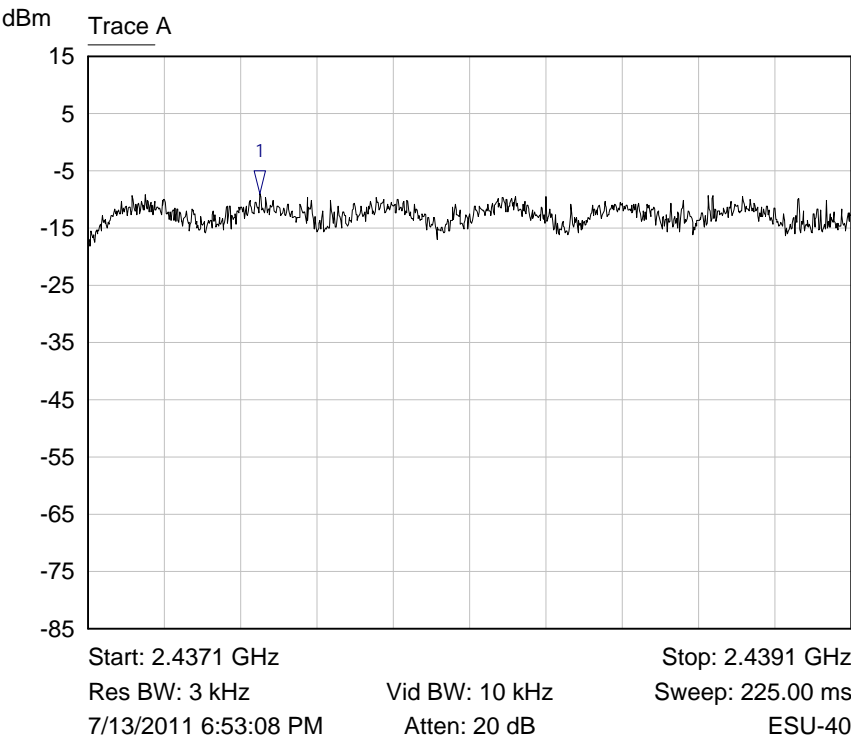
Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4630 GHz	-4.27 dBm	

Lower channel – 802.11g



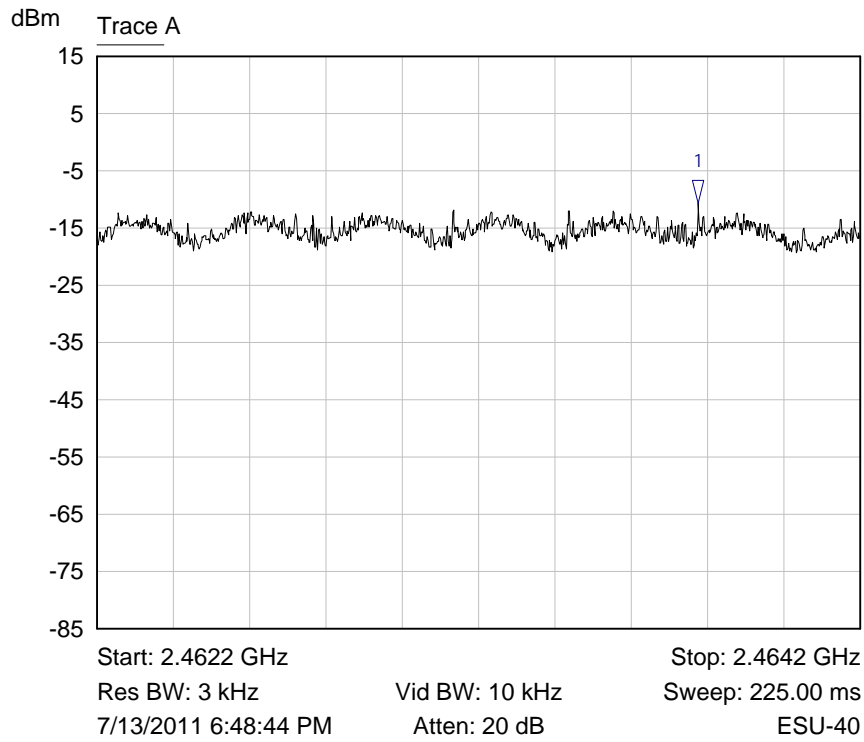
Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4126 GHz	-10.43 dBm	

Middle channel – 802.11g



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4376 GHz	-9.06 dBm	

Upper channel – 802.11g



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4638 GHz	-10.68 dBm	

## **6.2.7 §15.212 Modular Transmitter Requirements**

### **6.2.7.1 §15.212(a)(1)(i) RF Shielding**

The RF transceiver chip is in a shielded housing/enclosure. See Photo 5 of Appendix 2.

### **6.2.7.2 §15.212(a)(1)(ii) Buffering/Data Input**

The transceiver cannot be overdriven/overmodulated. See documents in the exhibits provided for certification.

### **6.2.7.3 §15.212(a)(1)(iii) Power Supply Regulation**

The transceiver chip has its own internal regulator.

### **6.2.7.4 §15.212(a)(1)(iv) Antenna Requirements**

The EUT uses a chip antenna on the PCB and is not user replaceable.

### **6.2.7.5 §15.212(a)(1)(v) Test Configuration and AC Mains Conductance**

The EUT was tested in a standalone configuration and the EUT was found to comply with the AC mains conducted emission limits. See Photographs 1 – 4 of Appendix 2 and Section 6.2.2 of this report.

### **6.2.7.6 §15.212(a)(1)(vi) Labeling**

The labeling of the device is shown in documents filed for certification.

### **6.2.7.7 §15.212(a)(1)(vii) Incorporation of EUT**

The module is designed for use in Provo Craft and Novelty, Inc. products and has control of the final product the device will be used in.

### **6.2.7.7 §15.212(a)(1)(vii) Incorporation of EUT**

The EUT complies with the MPE requirements and documentation can be found in documents filed for certification. Provo Craft and Novelty, Inc. will be responsible for end product compliance with RF exposure requirements.



**APPENDIX 1 TEST PROCEDURES AND TEST EQUIPMENT****A1.1 §15.207 Conducted Disturbance at the AC Mains**

The conducted disturbance at mains ports from the EUT was measured using a spectrum analyzer with a quasi-peak adapter for peak, quasi-peak and average readings. The quasi-peak adapter uses a bandwidth of 9 kHz, with the spectrum analyzer's resolution bandwidth set at 100 kHz, for readings in the 150 kHz to 30 MHz frequency ranges.

The conducted disturbance at mains ports measurements are performed in a screen room using a (50  $\Omega$ /50  $\mu$ H) Line Impedance Stabilization Network (LISN).

Where mains flexible power cords are longer than 1 m, the excess cable is folded back and forth as far as possible so as to form a bundle not exceeding 0.4 m in length.

Where the EUT is a collection of equipment with each device having its own power cord, the point of connection for the LISN is determined from the following rules:

- a) Each power cord, which is terminated in a mains supply plug, shall be tested separately.
- b) Power cords, which are not specified by the manufacturer to be connected via a host unit, shall be tested separately.
- c) Power cords which are specified by the manufacturer to be connected via a host unit or other power supplying equipment shall be connected to that host unit and the power cords of that host unit connected to the LISN and tested.
- d) Where a special connection is specified, the necessary hardware to effect the connection is supplied by the manufacturer for the testing purpose.
- e) When testing equipment with multiple mains cords, those cords not under test are connected to an artificial mains network (AMN) different than the AMN used for the mains cord under test.

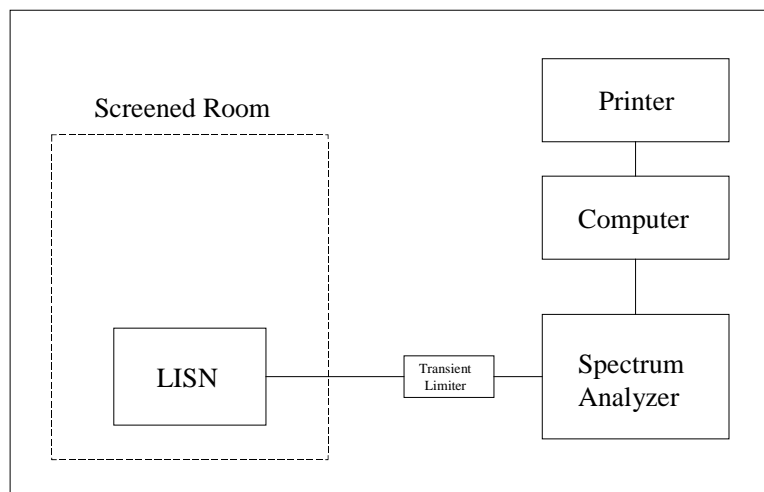
For AC mains port testing the desktop EUT are placed on a non-conducting table at least 0.8 meters from the metallic floor. The equipment is placed a minimum of 40 cm from all walls. Floor standing equipment is placed directly on the earth grounded floor.

Type of Equipment	Manufacturer	Model Number	Serial Number	Date of Last Calibration
Wanship Open Area Test Site #2	Nemko-CCL, Inc.	N/A	N/A	11/15/2010
Test Software	Nemko-CCL, Inc.	Conducted Emissions	Revision 1.2	N/A
Spectrum Analyzer	Hewlett Packard	8566B	2230A01711	01/05/2011
Quasi-Peak Detector	Hewlett Packard	85650A	2043A00137	01/05/2011

Type of Equipment	Manufacturer	Model Number	Serial Number	Date of Last Calibration
LISN	EMCO	3825/2	9305-2099	03/07/2011
Conductance Cable Wanship Site #2	Nemko-CCL, Inc.	Cable J	N/A	12/21/2010
Transient Limiter	Hewlett Packard	11947A	3107A02266	12/21/2010

An independent calibration laboratory or Nemko-CCL, Inc. personnel calibrates all the equipment listed above at intervals defined in ANSI C63.4:2003 Section 4.4 following outlined calibration procedures. All measurement instrumentation is traceable to the National Institute of Standards and Technology (NIST). Supporting documentation relative to tractability is on file and is available for examination upon request.

#### Conducted Emissions Test Setup



**A1.2 §15.247(a)(2) Emission Bandwidth**

The EUT was connected to the spectrum analyzer using an attenuator via the antenna output port as shown in the block diagram below.

The measurements were performed on three channels, as per 47 CFR 15.31(m), one near the bottom of the spectrum, one near the middle of the spectrum and one near the top of the spectrum.

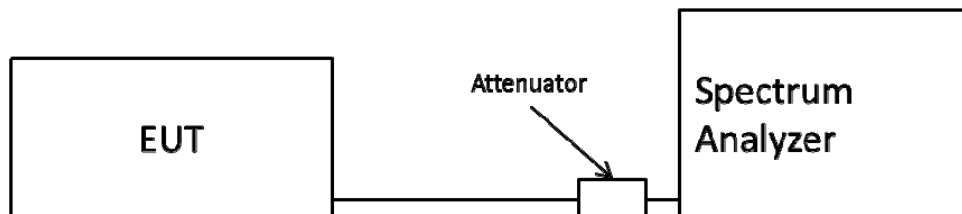
The spectrum analyzer's resolution bandwidth and video bandwidth were set as follows:

RBW = 100 kHz

VBW = 300 kHz

Type of Equipment	Manufacturer	Model Number	Serial Number
Spectrum Analyzer	Hewlett Packard	8566B	2230A01711
Quasi-Peak Detector	Hewlett Packard	85650A	2043A00137
Spectrum Analyzer/Receiver	Rohde & Schwarz	1302.6005.40	100064
Low Loss Cable (1 dB)	N/A	N/A	N/A

An independent calibration laboratory or Nemko-CCL, Inc. personnel calibrates all the equipment listed above at intervals defined in ANSI C63.4:2003 Section 4.4 following outlined calibration procedures. All measurement instrumentation is traceable to the National Institute of Standards and Technology (NIST). Supporting documentation relative to tractability is on file and is available for examination upon request.

**Test Configuration Block Diagram**

**A1.3 §15.247(b)(3) Peak Output Power**

The EUT was connected to the spectrum analyzer using an attenuator via the antenna output port as shown in the block diagram below.

The measurements were performed on three channels, as per 47 CFR 15.31(m), one near the bottom of the spectrum, one near the middle of the spectrum and one near the top of the spectrum.

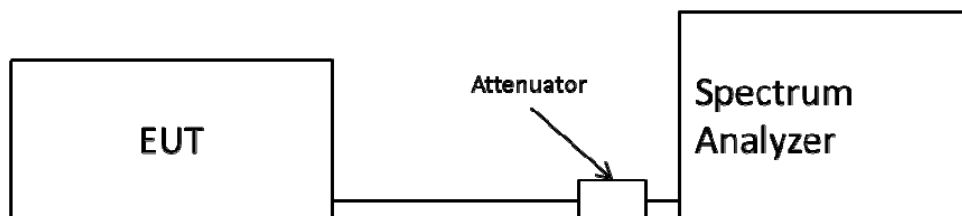
The spectrum analyzer's resolution bandwidth and video bandwidth were set as follows:

RBW = 1 MHz

VBW = >1 MHz

Type of Equipment	Manufacturer	Model Number	Serial Number
Spectrum Analyzer	Hewlett Packard	8566B	2230A01711
Quasi-Peak Detector	Hewlett Packard	85650A	2043A00137
Spectrum Analyzer/Receiver	Rohde & Schwarz	1302.6005.40	100064
Low Loss Cable (1 dB)	N/A	N/A	N/A

An independent calibration laboratory or Nemko-CCL, Inc. personnel calibrates all the equipment listed above at intervals defined in ANSI C63.4:2003 Section 4.4 following outlined calibration procedures. All measurement instrumentation is traceable to the National Institute of Standards and Technology (NIST). Supporting documentation relative to tractability is on file and is available for examination upon request.

**Test Configuration Block Diagram**

**A1.4 §15.247(c) Conducted Spurious Emissions**

The EUT was connected to the spectrum analyzer using an attenuator via the antenna output port as shown in the block diagram below.

The measurements were performed on three channels, as per 47 CFR 15.31(m), one near the bottom of the spectrum, one near the middle of the spectrum and one near the top of the spectrum.

The spectrum analyzer's resolution bandwidth and video bandwidth were set as follows:

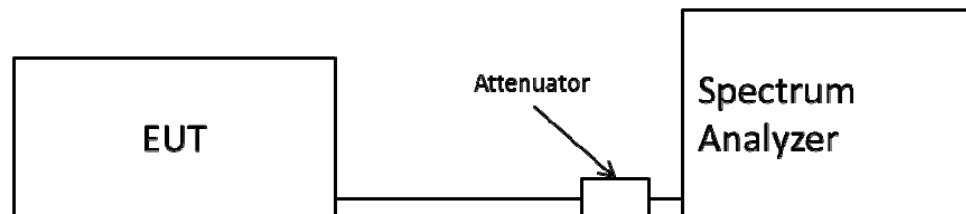
RBW = 100 kHz

VBW = 300 kHz

Type of Equipment	Manufacturer	Model Number	Serial Number
Spectrum Analyzer	Hewlett Packard	8566B	2230A01711
Quasi-Peak Detector	Hewlett Packard	85650A	2043A00137
Spectrum Analyzer/Receiver	Rohde & Schwarz	1302.6005.40	100064
Low Loss Cable (1 dB)	N/A	N/A	N/A

An independent calibration laboratory or Nemko-CCL, Inc. personnel calibrates all the equipment listed above at intervals defined in ANSI C63.4:2003 Section 4.4 following outlined calibration procedures. All measurement instrumentation is traceable to the National Institute of Standards and Technology (NIST). Supporting documentation relative to tractability is on file and is available for examination upon request.

**Test Configuration Block Diagram**



**A1.5 §15.247(c) Radiated Spurious Emissions in the Restricted Bands**

The radiated emissions from the intentional radiator were measured using a spectrum analyzer with a quasi-peak adapter for peak and quasi-peak readings. An amplifier and preamplifier were used to increase the sensitivity of the measuring instrumentation. The quasi-peak adapter uses a bandwidth of 120 kHz, with the spectrum analyzer's resolution bandwidth set at 1 MHz, for readings in the 30 to 1000 MHz frequency ranges. For peak emissions above 1000 MHz the spectrum analyzer's resolution bandwidth was set to 1 MHz and the video bandwidth was set to 3 MHz. For average emissions above 1000 MHz the spectrum analyzer's resolution bandwidth was set to 1 MHz and the average detector of the analyzer was used.

A biconilog antenna was used to measure the frequency range of 30 to 1000 MHz and a Double Ridge Guide Horn antenna was used to measure the frequency range of 1 GHz to 18 GHz, and a Pyramidal Horn antenna was used to measure the frequency range of 18 GHz to 25 GHz, at a distance of 3 meters and 1 meter from the EUT. The readings obtained by the antenna are correlated to the levels obtained with a tuned dipole antenna by adding antenna factors.

The configuration of the intentional radiator was varied to find the maximum radiated emission. The intentional radiator was connected to the peripherals listed in Section 2.4 via the interconnecting cables listed in Section 2.5. These interconnecting cables were manipulated manually by a technician to obtain worst case radiated emissions. The intentional radiator was rotated 360 degrees, and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission. Where there are multiple interface ports all of the same type, cables are either placed on all of the ports or cables added to these ports until the emissions do not increase by more than 2 dB.

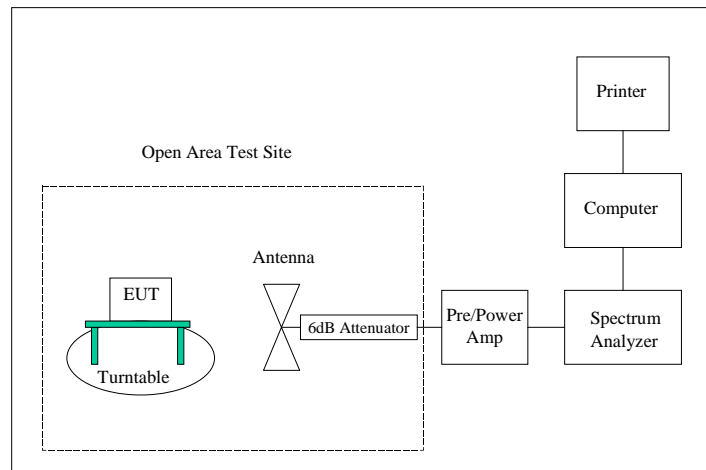
Desktop intentional radiators are measured on a non-conducting table 80 centimeters above the ground plane. The table is placed on a turntable which is level with the ground plane. The turntable has slip rings, which supply AC power to the intentional radiator. For equipment normally placed on floors, the equipment shall be placed directly on the turntable.

Type of Equipment	Manufacturer	Model Number	Serial Number	Date of Last Calibration
Wanship Open Area Test Site #2	Nemko-CCL, Inc.	N/A	N/A	11/15/2010
Test Software	Nemko-CCL, Inc.	Radiated Emissions	Revision 1.3	N/A
Spectrum Analyzer/Receiver	Rohde & Schwarz	1302.6005.40	100064	07/30/2010
Spectrum Analyzer	Hewlett Packard	8566B	2230A01711	01/05/2011
Quasi-Peak Detector	Hewlett Packard	85650A	2043A00137	01/05/2011

Type of Equipment	Manufacturer	Model Number	Serial Number	Date of Last Calibration
Biconilog Antenna	EMCO	3142	9601-1008	10/15/2010
Double Ridged Guide Antenna	EMCO	3115	9604-4779	03/10/2011
High Frequency Amplifier	Miteq	AFS4-01002650-35-10P-4	1637474	05/25/2011
20' High Frequency Cable	Microcoax	UFB197C-1-3120-000000	1297	05/10/2011
10 Meter Radiated Emissions Cable Wanship Site #2	Nemko-CCL, Inc.	Cable L	N/A	12/21/2010
Pre/Power-Amplifier	Hewlett Packard	8447F	3113A05161	08/25/2010
6 dB Attenuator	Hewlett Packard	8491A	32835	12/21/2010

An independent calibration laboratory or Nemko-CCL, Inc. personnel calibrates all the equipment listed above at intervals defined in ANSI C63.4:2003 Section 4.4 following outlined calibration procedures. All measurement instrumentation is traceable to the National Institute of Standards and Technology (NIST). Supporting documentation relative to tractability is on file and is available for examination upon request.

#### Radiated Emissions Test Setup



**A1.6 §15.247(d) Peak Power Spectral Density**

The EUT was connected to the spectrum analyzer using an attenuator via the antenna output port as shown in the block diagram below.

The measurements were performed on three channels, as per 47 CFR 15.31(m), one near the bottom of the spectrum, one near the middle of the spectrum and one near the top of the spectrum.

The spectrum analyzer's resolution bandwidth and video bandwidth were set as follows:

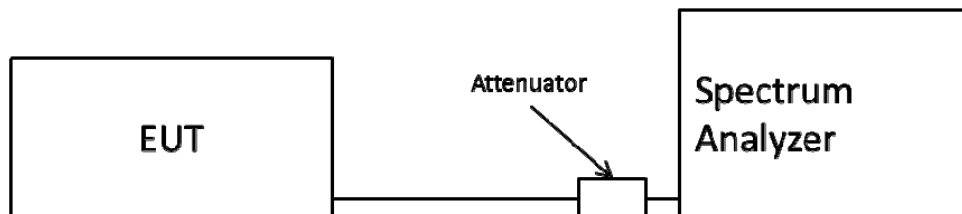
RBW = 3 kHz

VBW = 10 kHz

Type of Equipment	Manufacturer	Model Number	Serial Number
Spectrum Analyzer	Hewlett Packard	8566B	2230A01711
Quasi-Peak Detector	Hewlett Packard	85650A	2043A00137
Spectrum Analyzer/Receiver	Rohde & Schwarz	1302.6005.40	100064
Low Loss Cable (1 dB)	N/A	N/A	N/A

An independent calibration laboratory or Nemko-CCL, Inc. personnel calibrates all the equipment listed above at intervals defined in ANSI C63.4:2003 Section 4.4 following outlined calibration procedures. All measurement instrumentation is traceable to the National Institute of Standards and Technology (NIST). Supporting documentation relative to tractability is on file and is available for examination upon request.

**Test Configuration Block Diagram**





**APPENDIX 2 PHOTOGRAPHS**

Photograph 1 – Front View Radiated Disturbance Worst Case Configuration



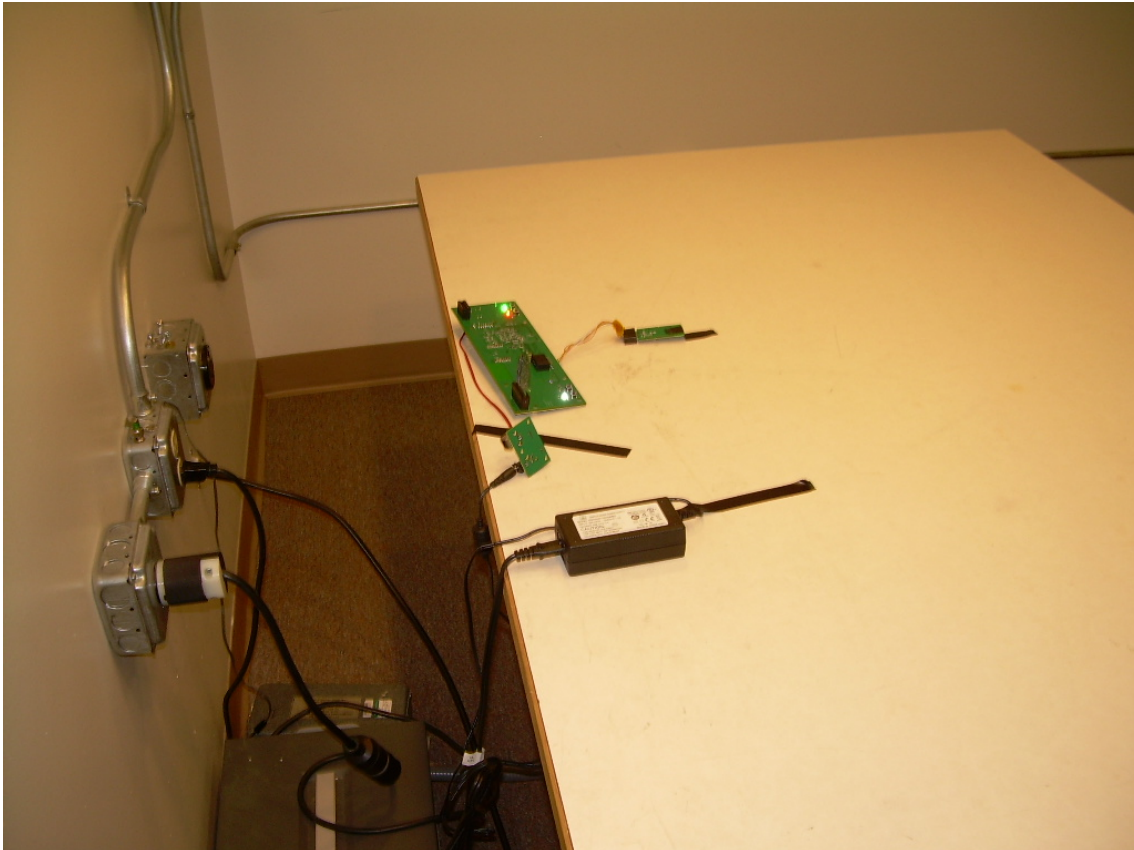
Photograph 2 – Back View Radiated Disturbance Worst Case Configuration



Photograph 3 – Front View Conducted Disturbance Worst Case Configuration

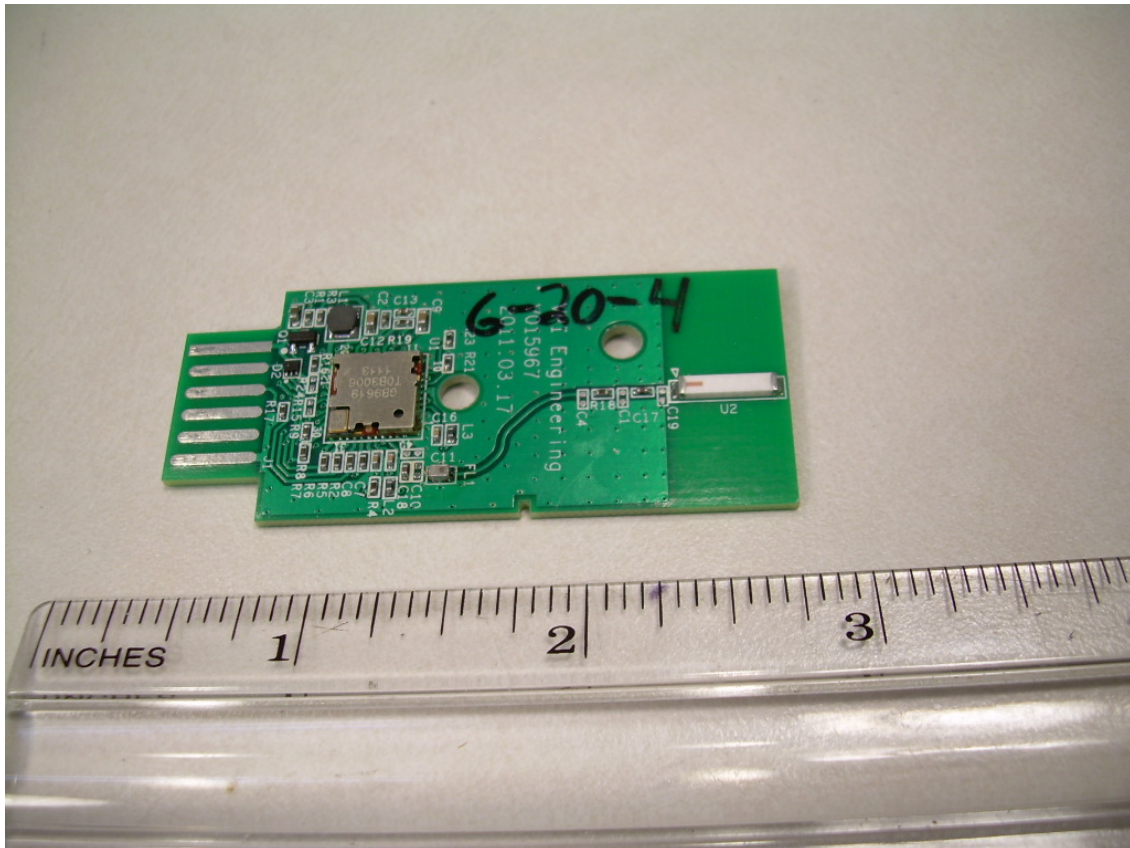


Photograph 4 – Back View Conducted Disturbance Worst Case Configuration

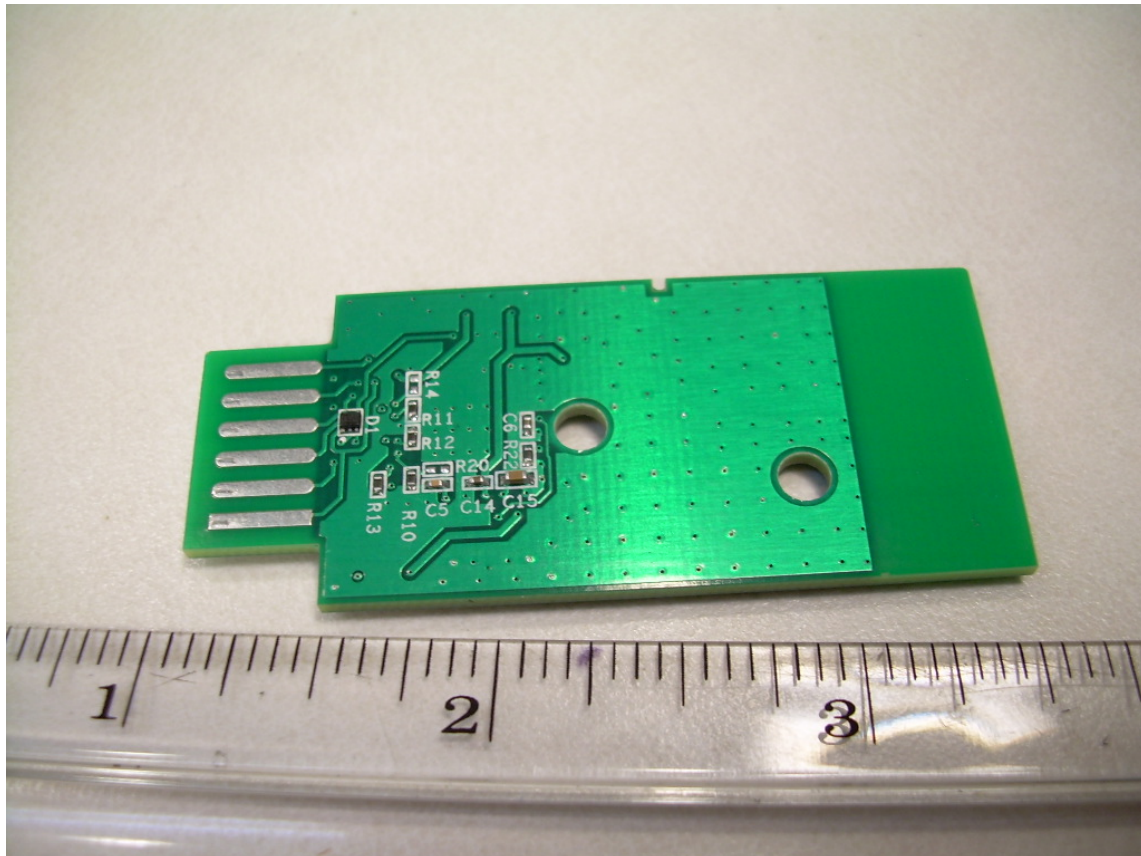




Photograph 5 – Front View of the EUT



Photograph 6 – Back View of the EUT



**APPENDIX 3 MANUFACTURER'S STATEMENT/ATTESTATION**

The manufacturer or responsible party for the equipment tested hereby affirms:

- a) That he/she has reviewed and concurs that the tests shown in this report are reflective of the operational characteristics of the device for which certification is sought;
- b) That the device in this test report will be representative of production units;
- c) That the product will have all of the documented modifications incorporated into the product when manufactured and placed on the market;
- d) That all changes in hardware and software/firmware to the subject device will be reviewed.
- e) That any changes impacting the attributes, functionality or operational characteristics documented in this report will be communicated to the body responsible for approving or certifying the subject equipment.

CHRIS DODGE

Printed name of official



Signature of official

9.2.11

Date

NOTE—This affirmation must be signed by the responsible party before it is submitted to a regulatory body for approval.