Nemko-CCL, Inc.

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

Test Report

Certification

Test Of: C4-WT100

FCC ID: R33H1

Test Specifications:

FCC PART 15, Subpart C

Test Report Serial No: 2625

Applicant:

Control4
11734 S. Election Road, Suite 200
Draper, UT 84020

Dates of Test: February 24 & 25, 2010

Issue Date: March 4, 2010

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: Control4
- Manufacturer: Control4
- Brand Name: Control4
- Model Number: C4-WT100
- FCC ID Number: R33H1

On this 4th day of March 2010, 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.

Tested by: Norman P. Hansen
EMC Technician

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SECTION 1.0 CLIENT INFORMATION

1.1 Applicant:

Company Name:	Control4 11734 S. Election Road, Suite 200 Draper, UT 84020
Contact Name:	Bobby Bruhn
Title:	Engineer

1.2 Manufacturer:

Company Name:	Control4 11734 S. Election Road, Suite 200 Draper, UT 84020
Contact Name:	Bobby Bruhn
Title:	Engineer

SECTION 2.0 EQUIPMENT UNDER TEST (EUT)

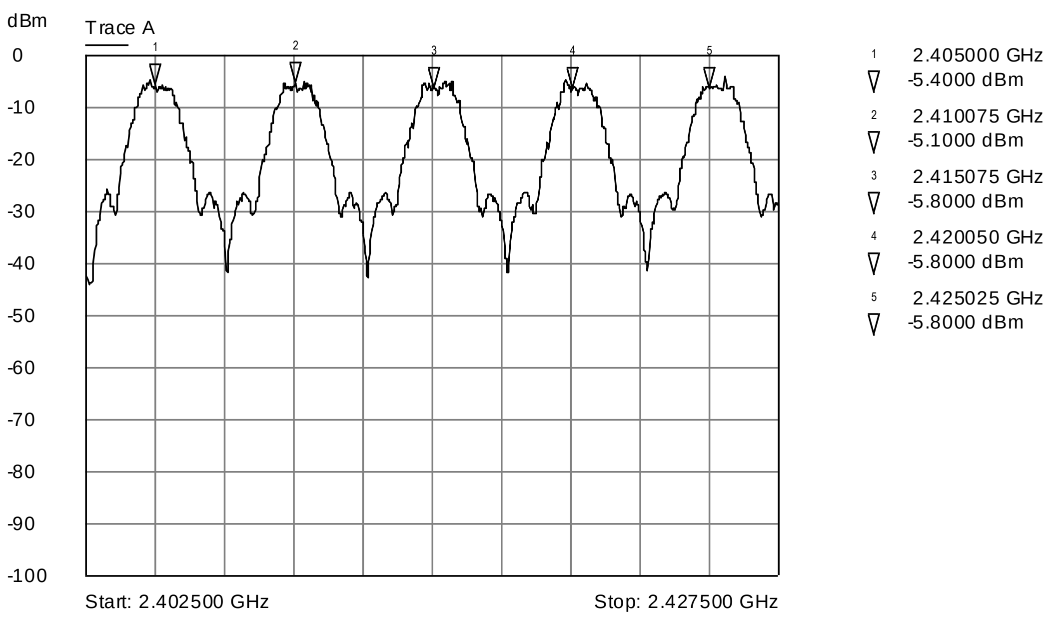
2.1 Identification of EUT:

Brand Name:	Control4
Model Name or Number:	C4-WT100
Serial Number:	None

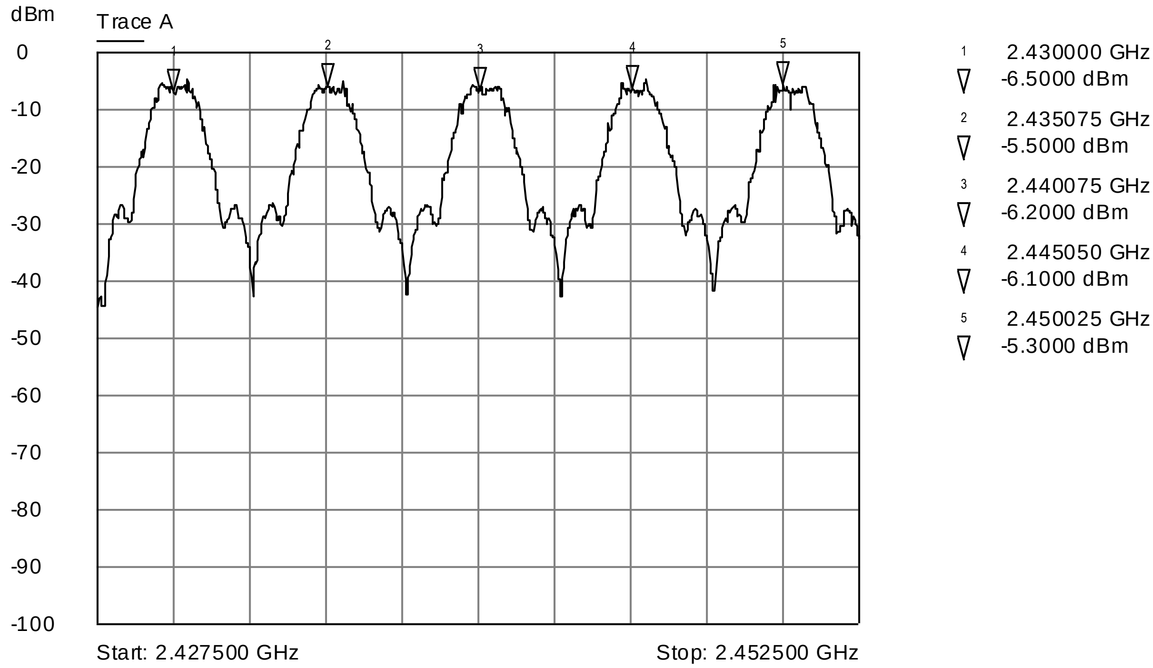
2.2 Description of EUT:

The C4-WT100 is a thermostat for use in the Control4 home automation systems. The C4-WT100 provides 6 conductors for interfacing the HVAC system. Interface to the Control4 home automation system is via buttons on the front panel or a 2.4 GHz Zigbee transceiver. The C4-WT100 is powered by 3 Vdc from 4 AA batteries.

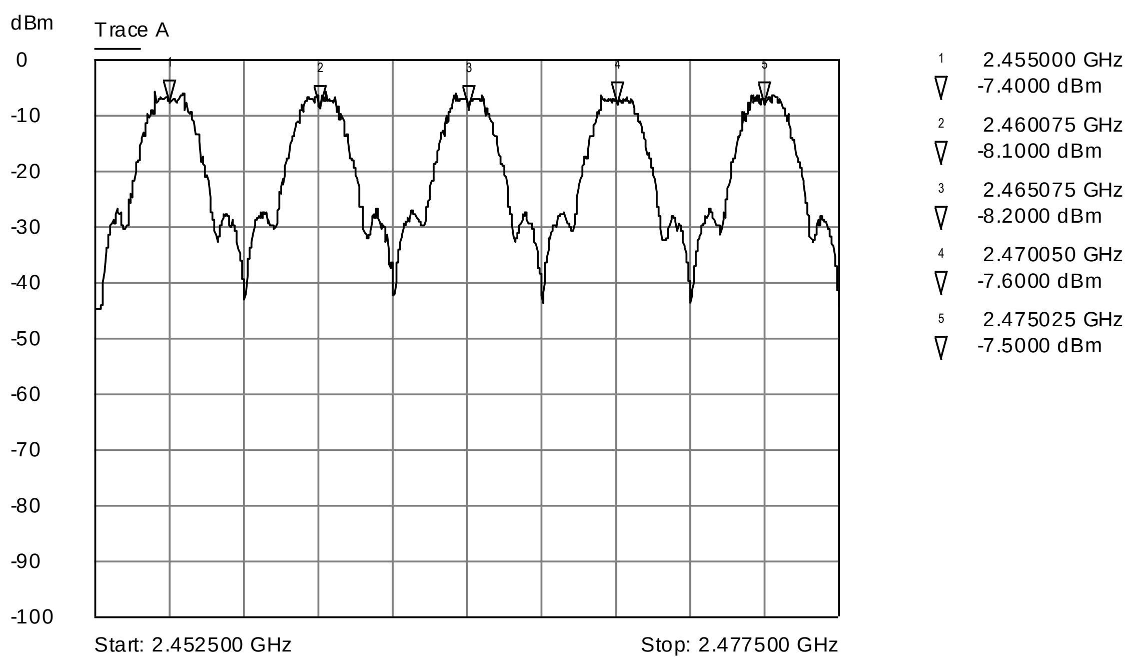
The Zigbee transceiver uses 15 channels in the 2400 to 2483.5 MHz band. The individual channels are shown in the following plots.



Trace A Lower 5 channels



Trace A Middle 5 channels



Trace A Upper 5 channels

This report covers the ZigBee transceiver and testing was performed to FCC Part 15 Subpart C. The digital and control circuitry testing is covered in CCL report #2624.

2.3 EUT and Support Equipment:

The FCC ID numbers for all the EUT and support equipment used during the test (including inserted cards) are listed below:

Brand Name Model Number	FCC ID Number	Description	Name of Interface Ports / Interface Cables
BN: Control4 MN: C4-WT100 (Note 1)	R33H1	Thermostat	See Section 2.4

Note 1: EUT

2.4 Interface Ports on EUT:

Name of Ports	No. of Ports Fitted to EUT	Cable Descriptions/Length
HVAC	1	6 unshielded conductors/1 meter

2.5 Modification Incorporated/Special Accessories on EUT:

The following modifications were made to the C4-WT100 by the Client during testing to comply with the specification. These modifications will be implemented during manufacturing.

1. The transmitter filter was installed on pads on the PCB that had been left out in the original build.

Signature: ___________________________

Typed Name: Bobby Bruhn

Title: Engineer

SECTION 3.0 TEST SPECIFICATION, METHODS & PROCEDURES

3.1 Test Specification:

Title: FCC PART 15, Subpart C (47 CFR 15)
15.203 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 §15.247 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 stave 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.

3.2.3 Test Procedure

The testing was performed according to the procedures in ANSI C63.4 (2003). Testing was performed at CCL'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).

CCL participates in the National Voluntary Laboratory Accreditation Program (NVLAP) and has been accepted under NVLAP Lab Code: 100272-0, which is effective until September 30, 2010.

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 is used to normalize the measured data for determining compliance.

SECTION 4.0 OPERATION OF EUT DURING TESTING

4.1 Operating Environment:

Power Supply: 3 Vdc from 4 AA batteries

4.2 Operating Modes:

The transmitter was tested while in a constant transmit mode at the desired frequency.

4.3 EUT Exercise Software:

Control4 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:

Section	Environmental Phenomena	Frequency Range (MHz)	Result
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

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 antenna is a 2.5 dBi antenna etched on the PCB and is not user replaceable; therefore, the requirements of this section are met.

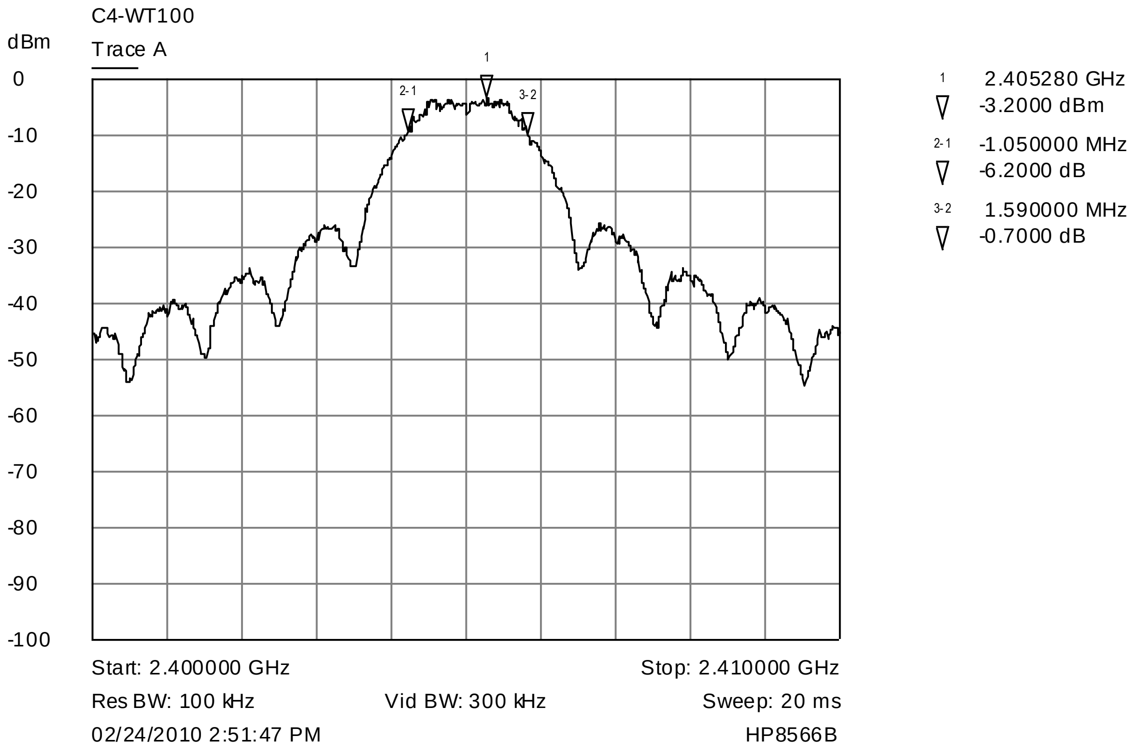
6.2.2 §15.247(a)(2) Emission Bandwidth

A diagram of the test configuration and the test equipment used is found in Appendix 1.

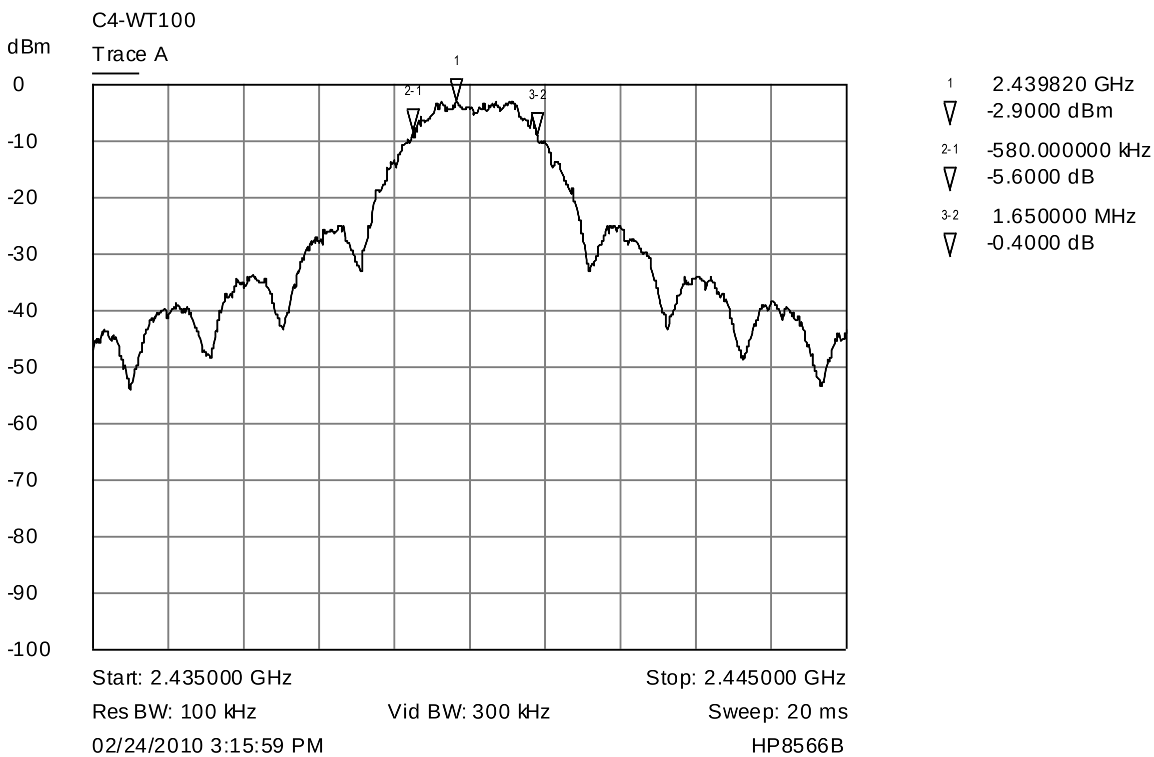
Frequency (MHz)	Emission 6dB Bandwidth (kHz)
2405	1590
2440	1650
2475	1670

RESULT

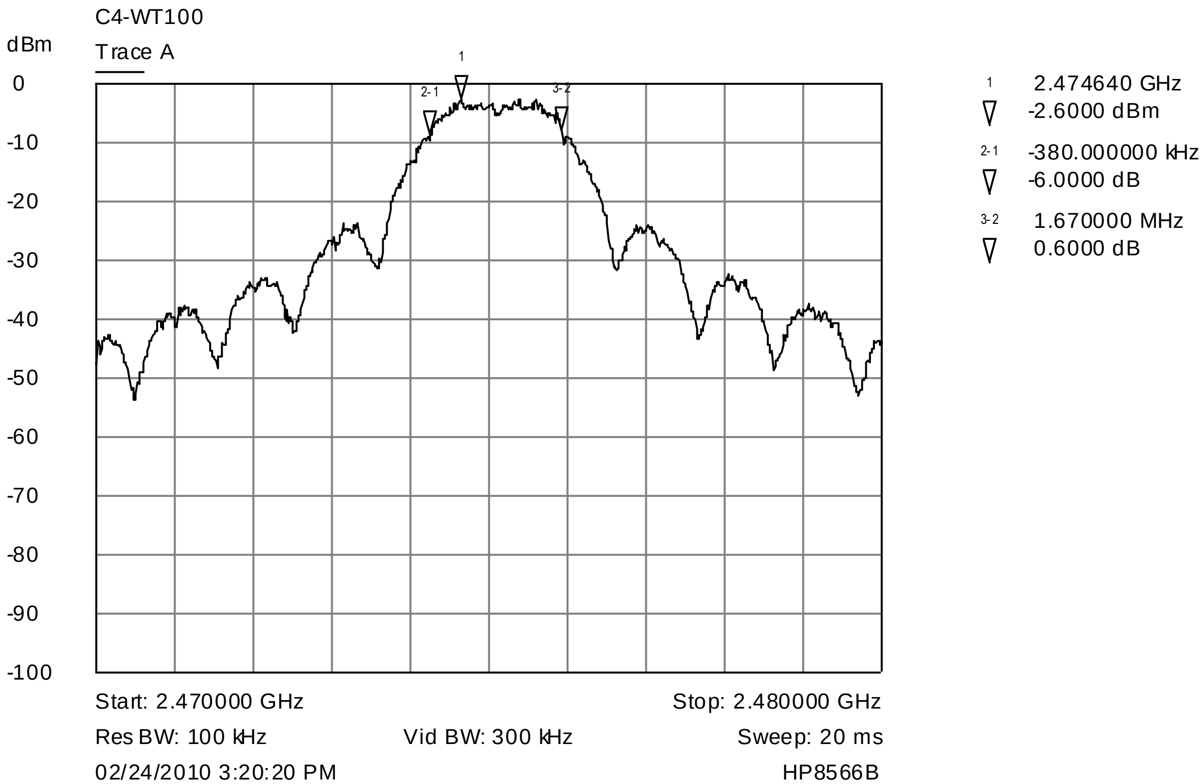
In the configuration tested, the 6 dB bandwidth was greater than 500 kHz; therefore, the EUT complied with the requirements of the specification (see spectrum analyzer plots below).



Trace A   Lower channel bandwidth plot



Trace A   Middle channel bandwidth plot



Trace A Upper channel bandwidth plot

6.2.4 §15.247(b)(3) Peak Output Power

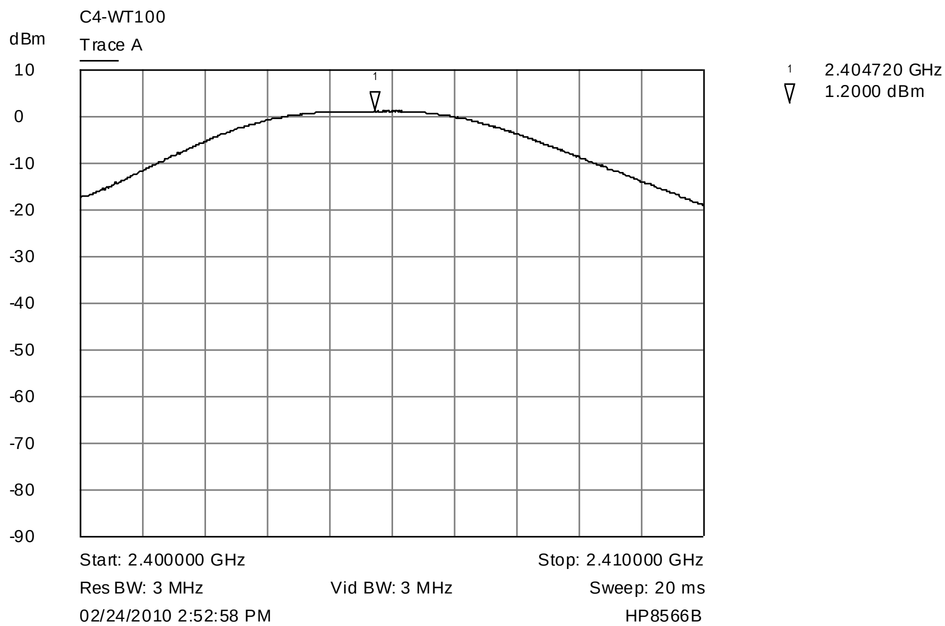
The maximum peak RF conducted output power measured for this device was 2.6 dBm or 1.82 mW. The maximum directional gain of the antenna is less than 6 dBi; therefore, the maximum output power is not required to be reduced from the value measured.

A diagram of the test configuration and the test equipment used is shown in Appendix 1.

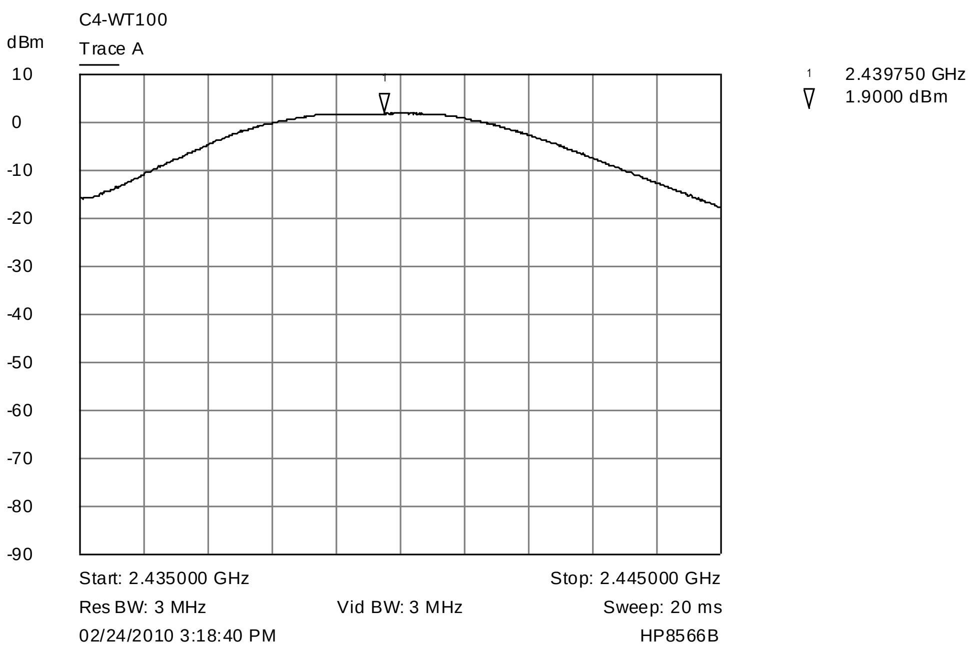
Frequency (MHz)	Measured Output Power (dBm)	Measured Output Power (mW)
2405	1.2	1.32
2440	1.9	1.55
2475	2.6	1.82

RESULT

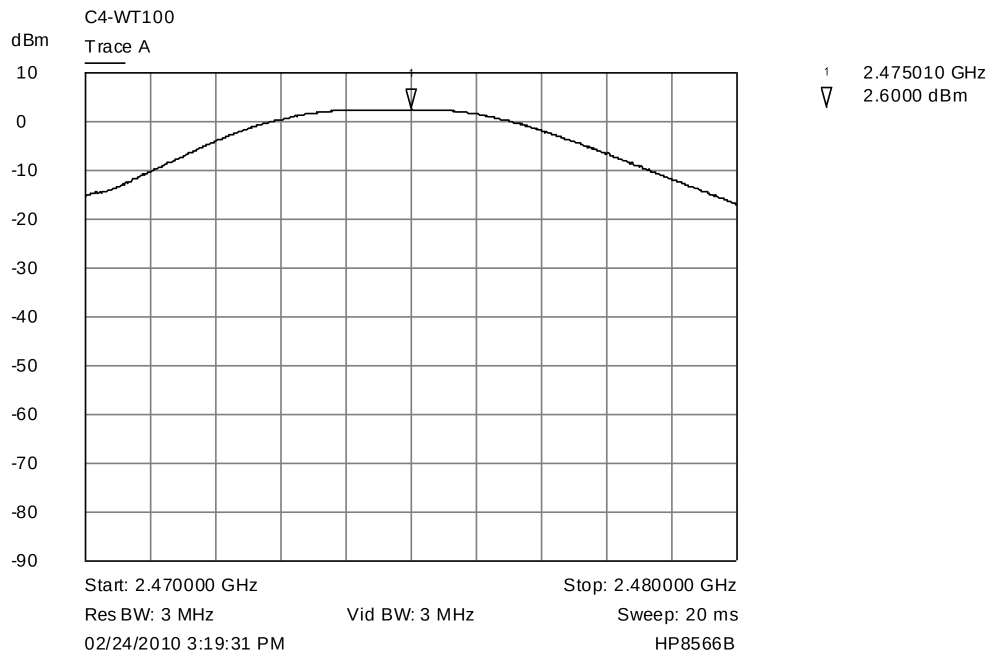
In the configuration tested, the RF peak output power was less than 1 Watt; therefore, the EUT complied with the requirements of the specification (see spectrum analyzer plots below).



Trace A Lower channel output power plot



Trace A Middle channel output power plot



Trace A Upper channel output power plot

6.2.5 §15.247(c) Spurious Emissions

6.2.5.1 Conducted Spurious Emissions

The frequency range from 30 MHz to the tenth harmonic of the highest fundamental frequency was investigated to measure any antenna-conducted emissions. 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 tables following the band edge plots shows the measurement data from spurious emissions noted across the frequency range when transmitting at the lowest frequency, middle frequency, and upper frequency.

The emissions must be attenuated 20 dB below the highest power level measured within the authorized band as measured with a 100 kHz RBW; the highest level measured was -0.6 dBm; therefore, the criteria is -0.6 – 20.0 = -20.6 dBm.

A diagram of the test configuration and the test equipment used is shown in Appendix 1.

RESULT

Spurious emissions must be attenuated below -20.6 dBm. The highest emission noted was -44.9 dBm; therefore, the EUT complies with the specification.

Transmitting on the Lowest Channel (2.405 GHz)

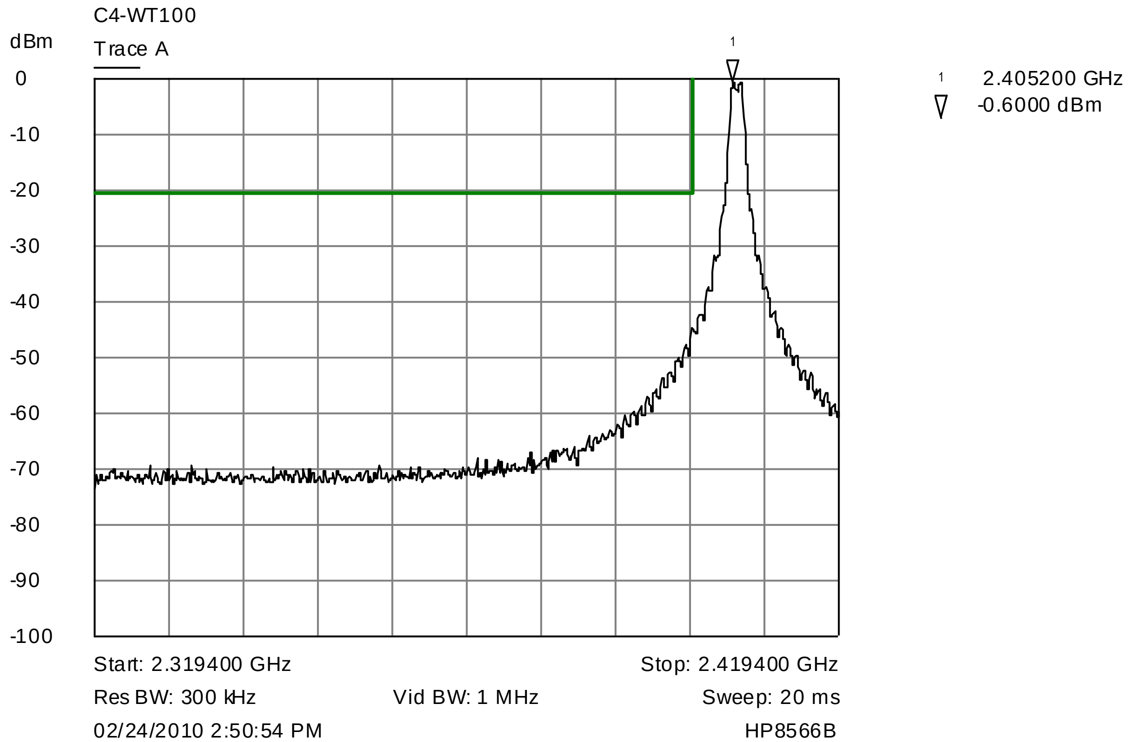
Frequency (MHz)	Corrected Level (dBm)	Criteria (dBm)
4810.0	-46.9	-20.6
7215.0	-57.8	-20.6
9620.0	-68.0	-20.6
12025.0	-69.5	-20.6
14430.0	-65.7	-20.6
16835.0	-64.7	-20.6
19240.0	-62.0	-20.6
21645.0	-58.6	-20.6
24050.0	-57.0	-20.6

Transmitting on the Middle Channel (2.440 GHz)

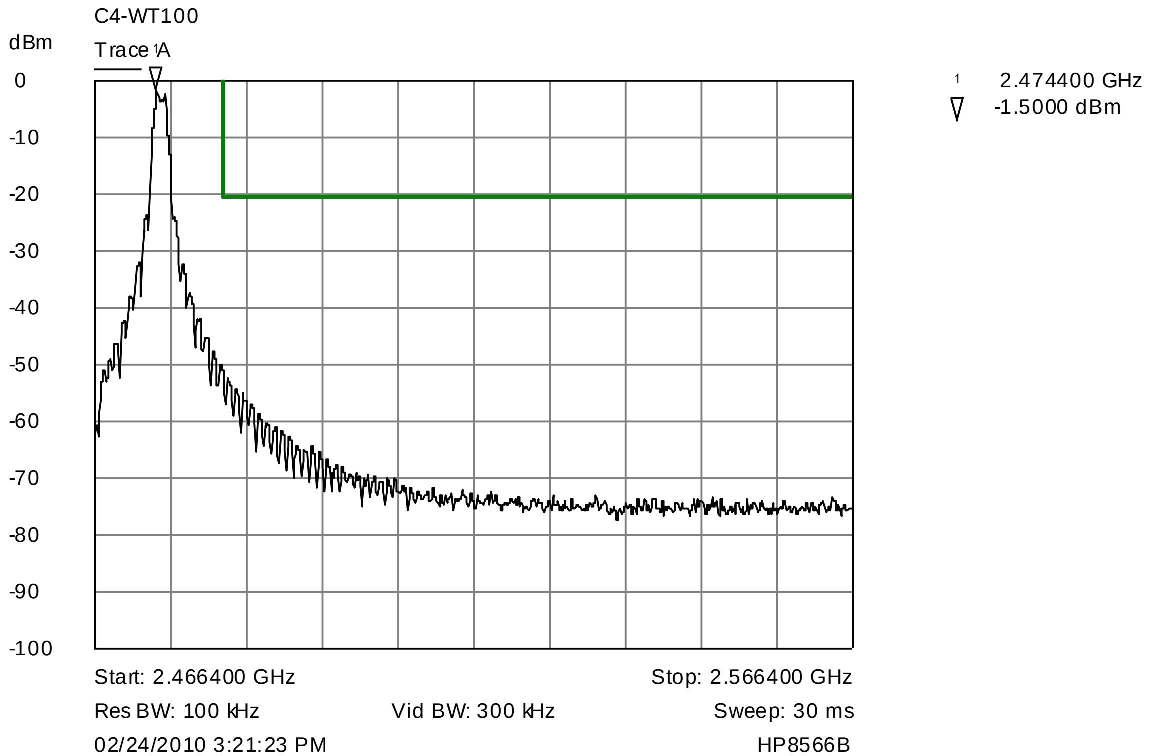
Frequency (MHz)	Corrected Level (dBm)	Criteria (dBm)
4880.0	-48.1	-20.6
7320.0	-55.2	-20.6
9760.0	-67.1	-20.6
12200.0	-70.0	-20.6
14640.0	-65.7	-20.6
17080.0	-65.5	-20.6
19520.0	-62.0	-20.6
21960.0	-60.5	-20.6
24400.0	-57.0	-20.6

Transmitting on the Highest Channel (2.475 GHz)

Frequency (MHz)	Corrected Level (dBm)	Criteria (dBm)
4950.0	-44.9	-20.6
7425.0	-48.5	-20.6
9900.0	-65.6	-20.6
12375.0	-70.7	-20.6
14850.0	-65.3	-20.6
17325.0	-65.6	-20.6
19800.0	-62.0	-20.6
22275.0	-59.8	-20.6
24750.0	-57.0	-20.6



Trace A Lower channel band edge plot



Trace A Upper channel band edge plot

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. 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 tables following the plots show measurements of any emission that fell into the restricted bands of §15.205. The tables show the worst-case emission measured. For frequencies above 7.5 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.

A diagram of the test configuration and the test equipment used is enclosed in Appendix 1. For frequencies below 1000 MHz, RBW = 100 kHz and VBW = 300 kHz. For frequencies above 1000 MHz, RBW = 1 MHz and VBW = 3 MHz. For average readings the Average detector of the receiver was used.

AVERAGE FACTOR

The EUT transmits continuously therefore; there is not an average factor for this device.

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 the Lowest Frequency (2.405 GHz)

Frequency (MHz)	Detection Mode	Antenna Polarity	Receiver Reading (dBμV)	Correction Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
4810.0	Peak	Vertical	18.6	37.5	56.1	74.0	-17.9
4810.0	Average	Vertical	12.9	37.5	50.4	54.0	-3.6
4810.0	Peak	Horizontal	18.8	37.5	56.3	74.0	-17.7
4810.0	Average	Horizontal	12.8	37.5	50.3	54.0	-3.7
7215.0	Peak	Vertical	14.5	41.4	55.9	74.0	-18.1
7215.0	Average	Vertical	7.2	41.4	48.6	54.0	-5.4

Frequency (MHz)	Detection Mode	Antenna Polarity	Receiver Reading (dBµV)	Correction Factor (dB)	Field Strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
7215.0	Peak	Horizontal	7.8	41.4	49.2	74.0	-24.8
7215.0	Average	Horizontal	-1.0	41.4	40.4	54.0	-13.6
12025.0	Peak	Vertical	4.0	46.0	50.0	74.0	-24.0
12025.0	Average	Vertical	-7.0	46.0	39.0	54.0	-15.0
12025.0	Peak	Horizontal	-1.7	46.0	44.3	74.0	-29.7
12025.0	Average	Horizontal	-12.8	46.0	33.2	54.0	-20.8
14430.0	Peak	Vertical	-0.8	49.8	49.0	74.0	-25.0
14430.0	Average	Vertical	-12.9	49.8	36.9	54.0	-17.1
14430.0	Peak	Horizontal	-0.9	49.8	48.9	74.0	-25.1
14430.0	Average	Horizontal	-12.6	49.8	37.2	54.0	-16.8

Transmitting at the Middle Frequency (2.440 GHz)

Frequency (MHz)	Detection Mode	Antenna Polarity	Receiver Reading (dBµV)	Correction Factor (dB)	Field Strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
4880.0	Peak	Vertical	18.5	37.7	56.2	74.0	-17.8
4880.0	Average	Vertical	13.1	37.7	50.8	54.0	-3.2
4880.0	Peak	Horizontal	18.7	37.7	56.4	74.0	-17.6
4880.0	Average	Horizontal	13.5	37.7	51.2	54.0	-2.8
7320.0	Peak	Vertical	12.7	41.7	54.4	74.0	-19.6
7320.0	Average	Vertical	6.3	41.7	48.0	54.0	-6.0
7320.0	Peak	Horizontal	6.5	41.7	48.2	74.0	-25.8
7320.0	Average	Horizontal	-1.0	41.7	40.7	54.0	-13.3
12200.0	Peak	Vertical	4.1	45.7	49.8	74.0	-24.2
12200.0	Average	Vertical	-4.3	45.7	41.4	54.0	-12.6

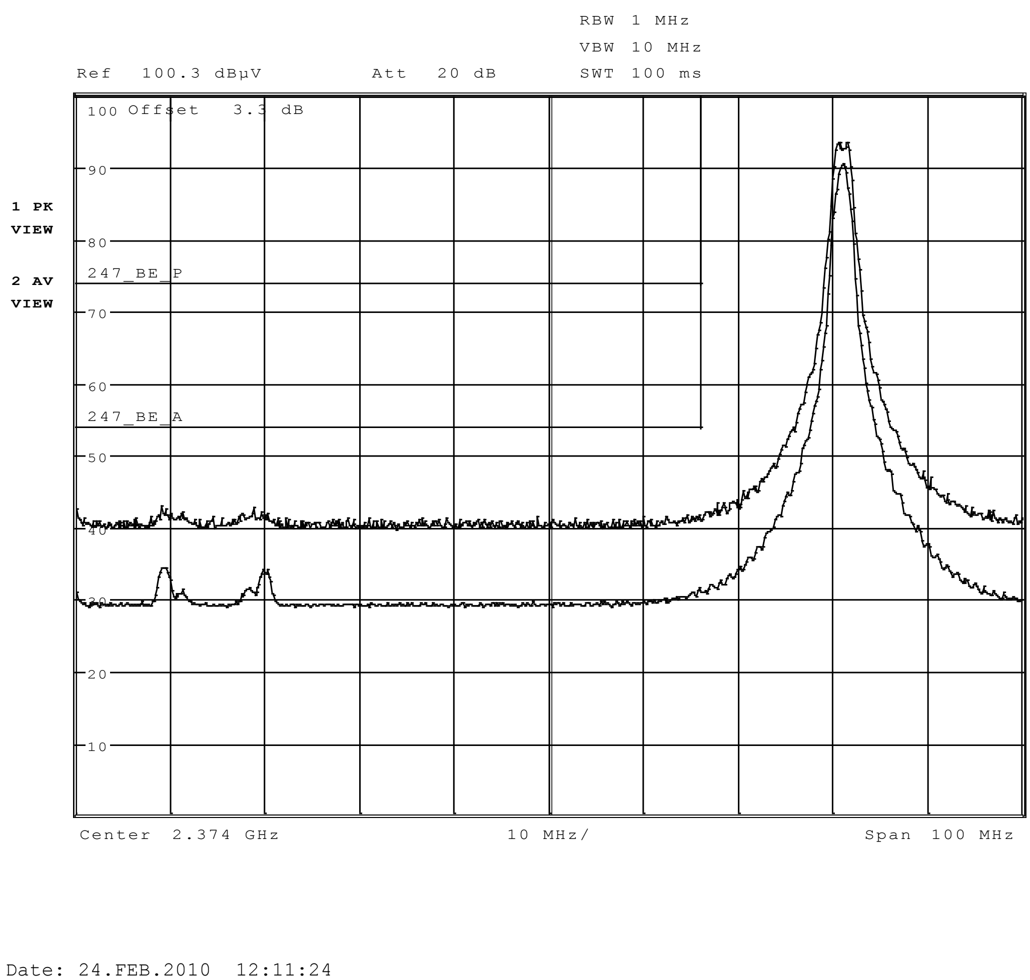
Frequency (MHz)	Detection Mode	Antenna Polarity	Receiver Reading (dBµV)	Correction Factor (dB)	Field Strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
12200.0	Peak	Horizontal	0.9	45.7	46.6	74.0	-27.4
12200.0	Average	Horizontal	-9.7	45.7	36.0	54.0	-18.0
14640.0	Peak	Vertical	0.0	49.3	49.3	74.0	-24.7
14640.0	Average	Vertical	-12.1	49.3	37.2	54.0	-16.8
14640.0	Peak	Horizontal	-0.4	49.3	48.9	74.0	-25.1
14640.0	Average	Horizontal	-12.1	49.3	37.2	54.0	-16.8

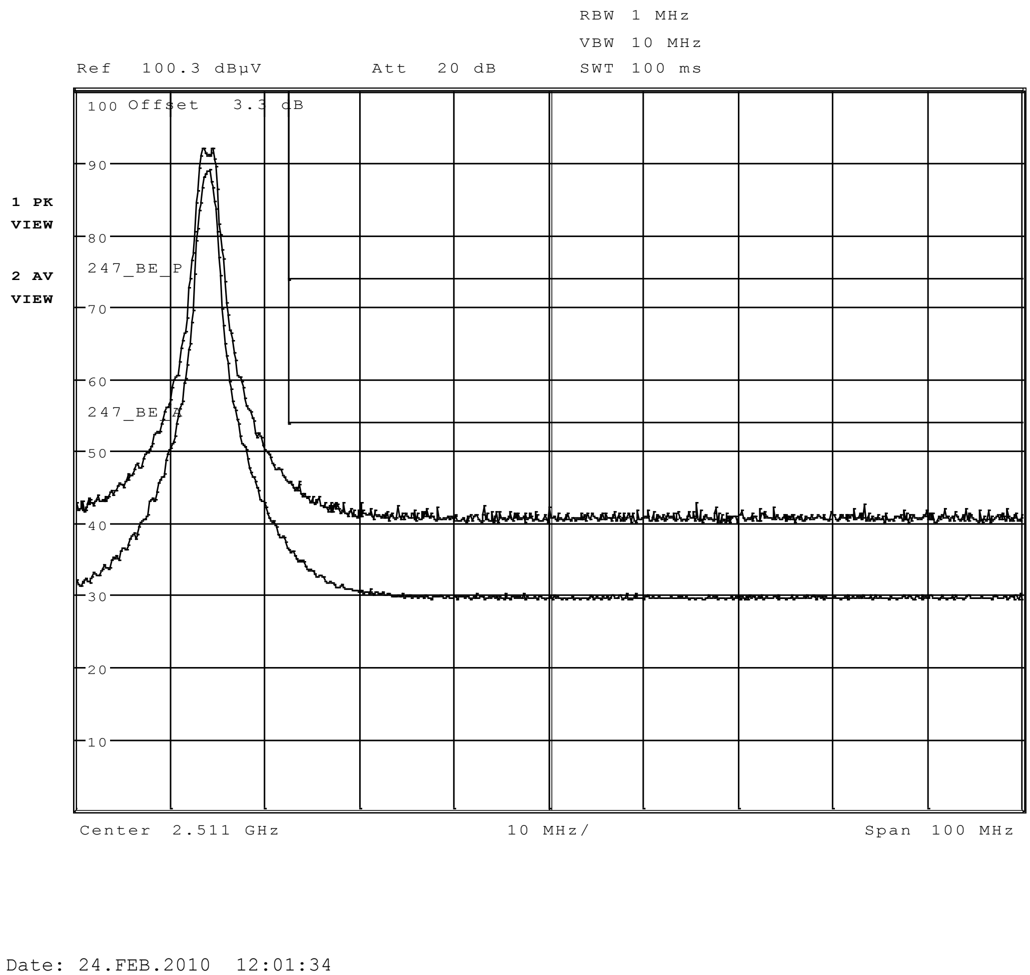
Transmitting at the Highest Frequency (2.475 GHz)

Frequency (MHz)	Detection Mode	Antenna Polarity	Receiver Reading (dBµV)	Correction Factor (dB)	Field Strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
4950.0	Peak	Vertical	14.6	37.8	52.4	74.0	-21.6
4950.0	Average	Vertical	9.3	37.8	47.1	54.0	-6.9
4950.0	Peak	Horizontal	14.7	37.8	52.5	74.0	-21.5
4950.0	Average	Horizontal	9.3	37.8	47.1	54.0	-6.9
7425.0	Peak	Vertical	12.7	42.0	54.7	74.0	-19.3
7425.0	Average	Vertical	6.6	42.0	48.6	54.0	-5.4
7425.0	Peak	Horizontal	5.2	42.0	47.2	74.0	-26.8
7425.0	Average	Horizontal	-2.7	42.0	39.3	54.0	-14.7
12375.0	Peak	Vertical	3.5	45.4	48.9	74.0	-25.1
12375.0	Average	Vertical	-5.3	45.4	40.1	54.0	-13.9
12375.0	Peak	Horizontal	2.5	45.4	47.9	74.0	-26.1
12375.0	Average	Horizontal	-7.0	45.4	38.4	54.0	-15.6
14850.0	Peak	Vertical	-1.3	48.5	47.2	74.0	-26.8
14850.0	Average	Vertical	-13.2	48.5	35.3	54.0	-18.7

Frequency (MHz)	Detection Mode	Antenna Polarity	Receiver Reading (dBμV)	Correction Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
14850.0	Peak	Horizontal	-0.8	48.5	47.7	74.0	-26.3
14850.0	Average	Horizontal	-12.9	48.5	35.6	54.0	-18.4

No other emissions were seen in the restricted bands. Noise floor was greater than 6 dB below the limit. At frequencies above 15.0 GHz, a 1 meter measurement distance was used.





6.2.6 §15.247(d) Peak Power Spectral Density

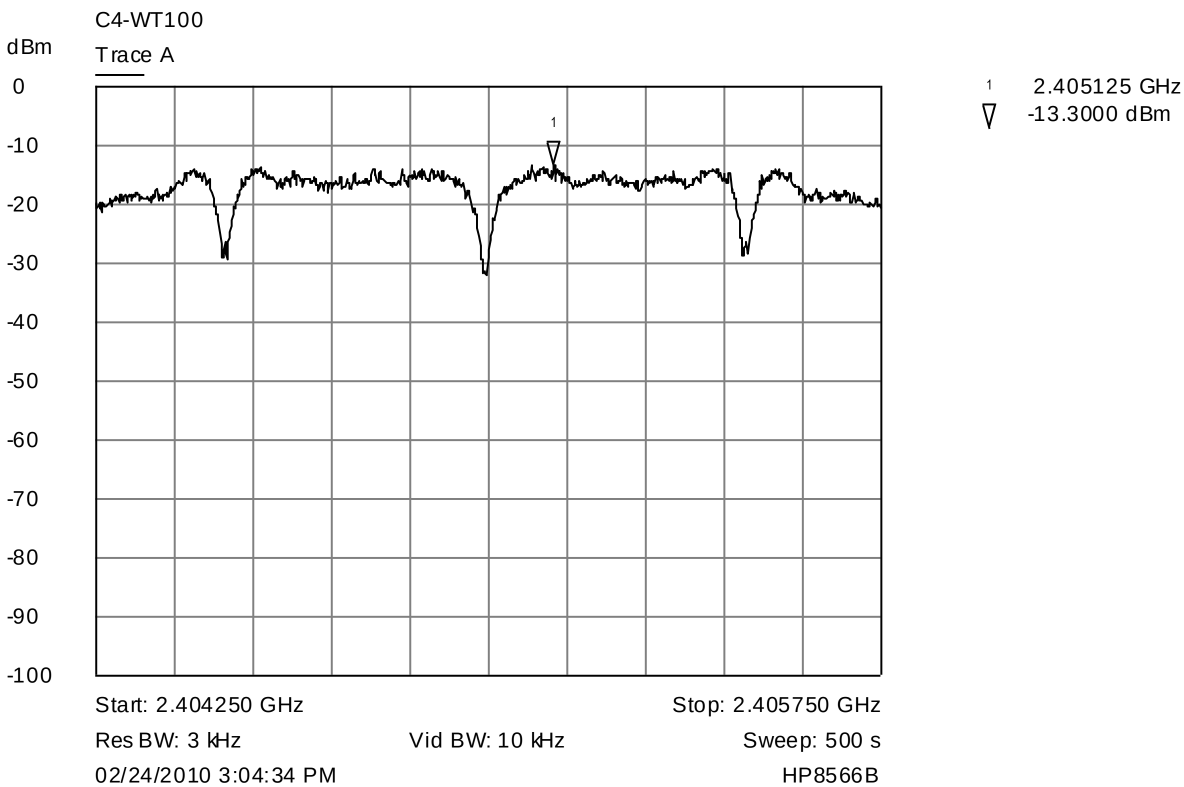
The peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. The plots are shown below and the results of this testing are summarized in the table below.

Frequency (MHz)	Measurement (dBm)	Criteria (dBm)	Margin (dBm)
2405	-13.3	8.0	-21.3
2440	-12.8	8.0	-20.8
2475	-11.9	8.0	-19.9

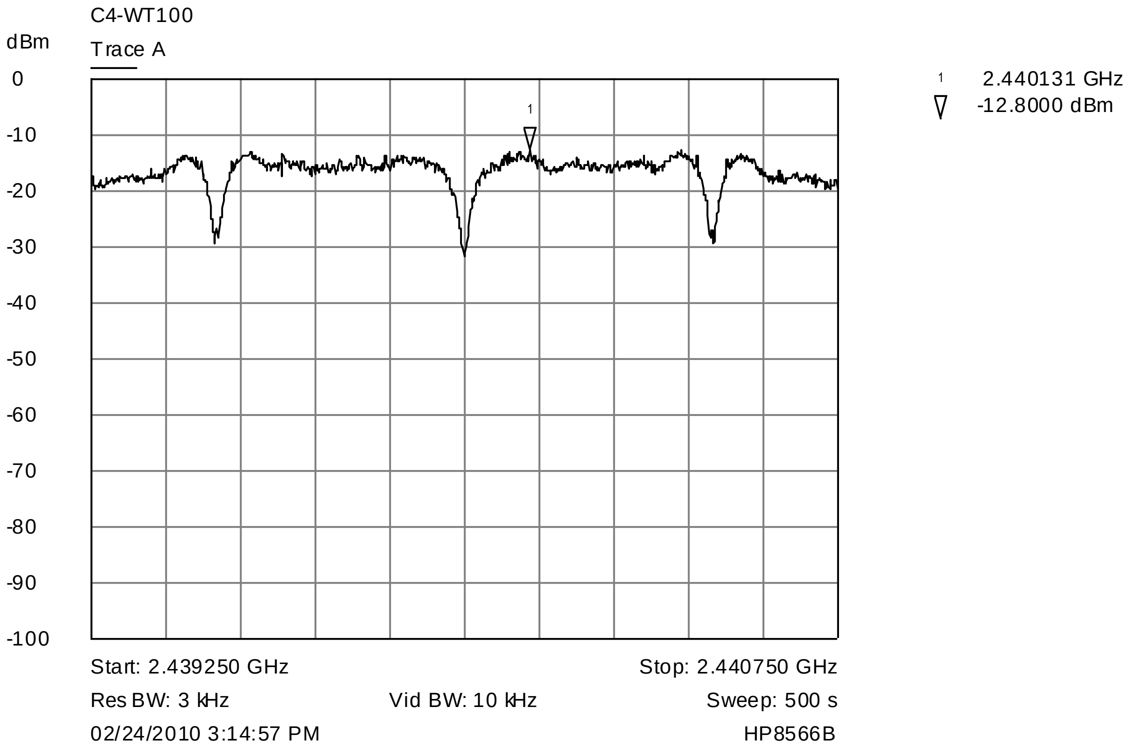
A diagram of the test setup is included in Appendix 1. The spectrum analyzer RBW was set to 3 kHz and the VBW set greater than the RBW. The span was set to 1.5 MHz and the sweep was set to 500 seconds **(**Sweep = (Span/3 kHz)**)**.

RESULT

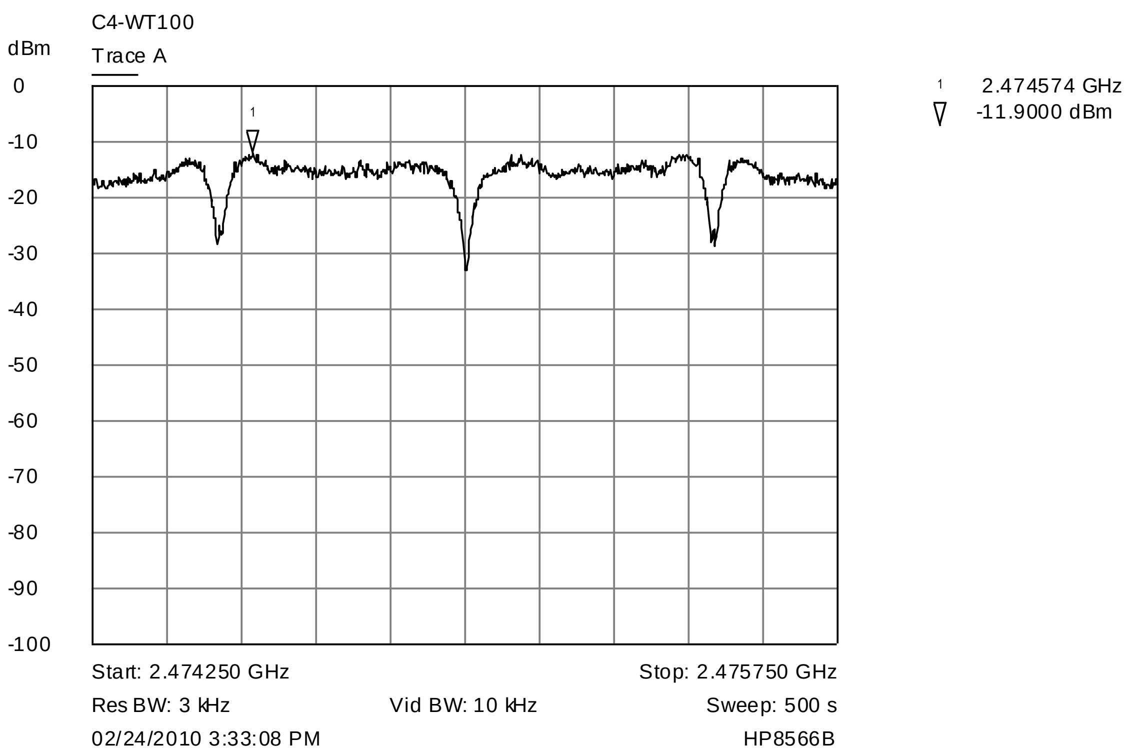
The maximum peak power spectral density was -11.9 dBm. The limit is 8 dBm. The EUT complies with the specification by 19.9 dB.



Trace A Lower channel 3kHz power spectral density plot



Trace A Middle channel 3kHz power spectral density plot



Trace A Upper channel 3kHz power spectral density plot

APPENDIX 1 TEST PROCEDURES AND TEST EQUIPMENT

§15.247(a)(2) Emission Bandwidth

The EUT was directly connected to the spectrum analyzer 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.

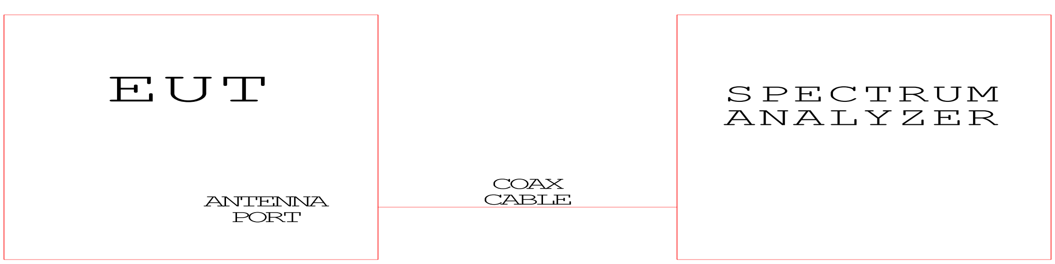
The spectrum analyzer's resolution bandwidth and video bandwidth were set as follows:

RBW = 100 kHz
VBW = 300 kHz

Type of Equipment	Manufacturer	Model Number	Serial Number	Date of Last Calibration
Spectrum Analyzer	Hewlett Packard	8566B	2330A01711	11/06/2009
Quasi-Peak Detector	Hewlett Packard	85650A	2043A00137	11/06/2009
Low Loss Cable (1 dB)	N/A	N/A	N/A	12/31/2009

An independent calibration laboratory or CCL 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



§15.247(b)(3) Peak Output Power

The EUT was directly connected to the spectrum analyzer 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:

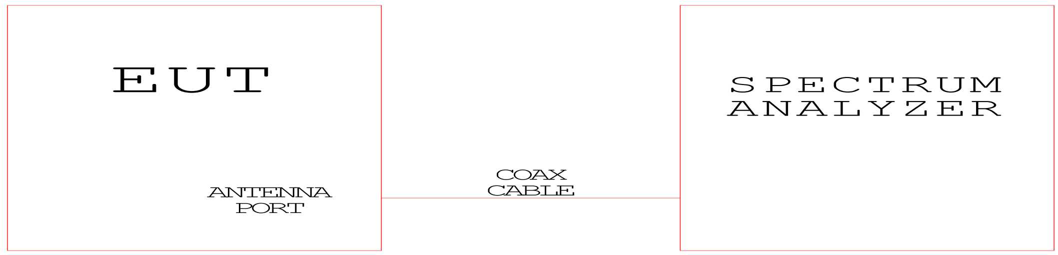
RBW = 3 MHz

VBW = 3 MHz

Type of Equipment	Manufacturer	Model Number	Serial Number	Date of Last Calibration
Spectrum Analyzer	Hewlett Packard	8566B	2330A01711	11/06/2009
Quasi-Peak Detector	Hewlett Packard	85650A	2043A00137	11/06/2009
Low Loss Cable (1 dB)	N/A	N/A	N/A	12/31/2009

An independent calibration laboratory or CCL 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



§15.247(c) Conducted Spurious Emissions

The EUT was directly connected to the spectrum analyzer 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	Date of Last Calibration
Spectrum Analyzer	Hewlett Packard	8566B	2330A01711	11/06/2009
Quasi-Peak Detector	Hewlett Packard	85650A	2043A00137	11/06/2009
Spectrum Analyzer/Receiver	Rohde & Schwarz	1302.6005.40	100064	07/08/2009
Low Loss Cable (1 dB)	N/A	N/A	N/A	12/31/2009

An independent calibration laboratory or CCL 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

§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 video bandwidth was set to 10 Hz.

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 from the EUT. The readings obtained by these antennas 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.

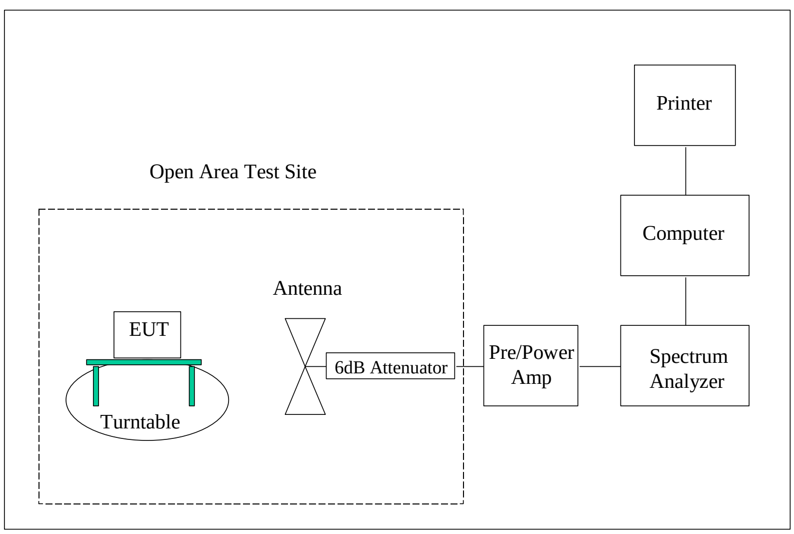
Desktop intentional radiators are measured on a non-conducting table 80 centimeters above the ground plane. The table is placed on a turntable which is level with the ground plane. The turntable has slip rings, which supply AC power to the intentional radiator. For equipment normally placed on floors, 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	10/08/2009
Test Software	Nemko-CCL, Inc.	Radiated Emissions	Revision 1.3	N/A
Spectrum Analyzer/Receiver	Rohde & Schwarz	1302.6005.40	100064	07/08/2009
Spectrum Analyzer	Hewlett Packard	8566B	2230A01711	11/06/2009

Type of Equipment	Manufacturer	Model Number	Serial Number	Date of Last Calibration
Quasi-Peak Detector	Hewlett Packard	85650A	2043A00137	11/06/2009
Biconilog Antenna	EMCO	3142	9601-1008	9/26/2008
Double Ridged Guide Antenna	EMCO	3115	9409-4355	03/11/2009
High Frequency Amplifier	Miteq	AFS4-01001800-43-10P-4	1096455	06/04/2009
20’ High Frequency Cable	Utiflex	UFA210A-1-2400-30050U	1175	03/05/2009
3 Meter Radiated Emissions Cable Wanship Site #2	Nemko-CCL, Inc.	Cable K	N/A	12/31/2009
Pre/Power-Amplifier	Hewlett Packard	8447F	3113A05161	08/24/2009
6 dB Attenuator	Hewlett Packard	8491A	32835	12/31/2009

An independent calibration laboratory or CCL 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



§15.247(d) 3 kHz Power Spectral Density

The EUT was directly connected to the spectrum analyzer 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.

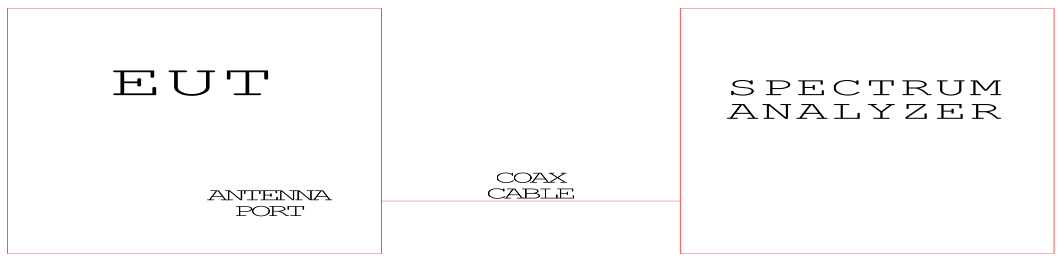
The spectrum analyzer's resolution bandwidth and video bandwidth were set as follows:

RBW = 3 kHz
VBW = 10 kHz

Type of Equipment	Manufacturer	Model Number	Serial Number	Date of Last Calibration
Spectrum Analyzer	Hewlett Packard	8566B	2330A01711	11/06/2009
Quasi-Peak Detector	Hewlett Packard	85650A	2043A00137	11/06/2009
Low Loss Cable (1 dB)	N/A	N/A	N/A	12/31/2009

An independent calibration laboratory or CCL 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.

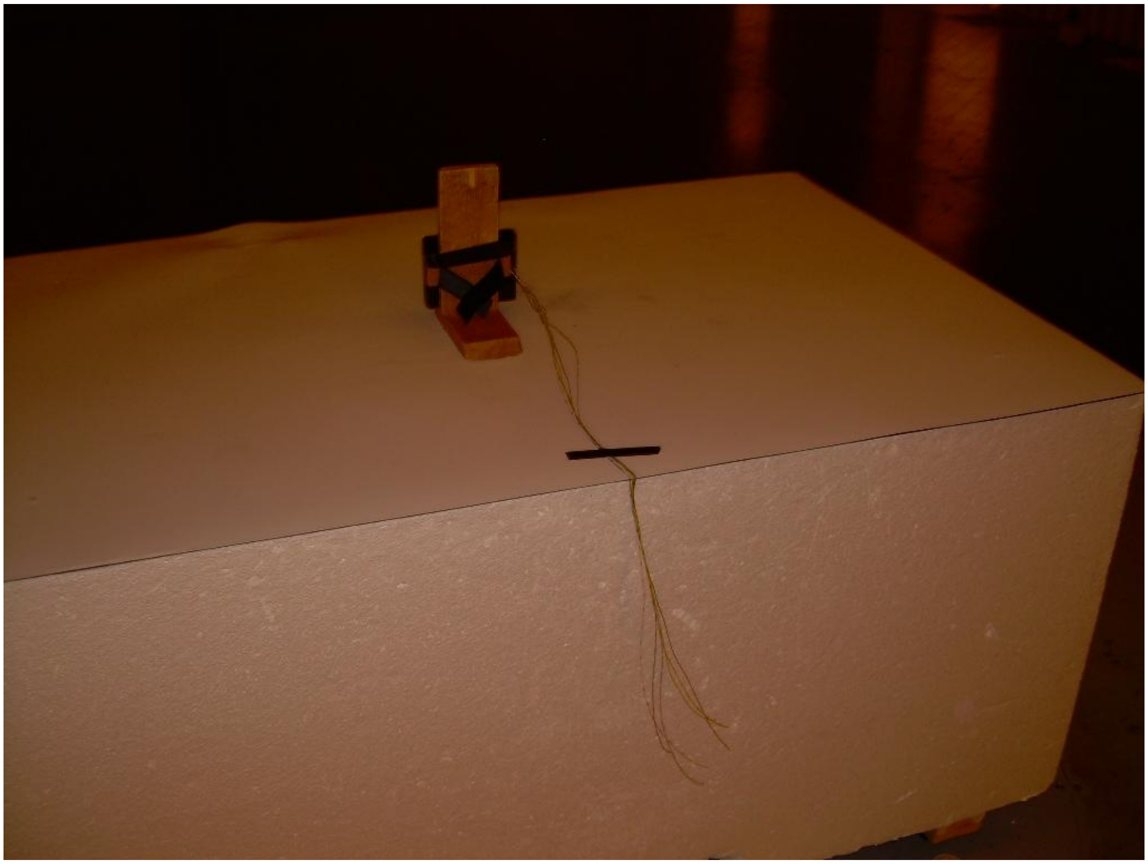
Test Configuration Block Diagram



APPENDIX 2 PHOTOGRAPHS

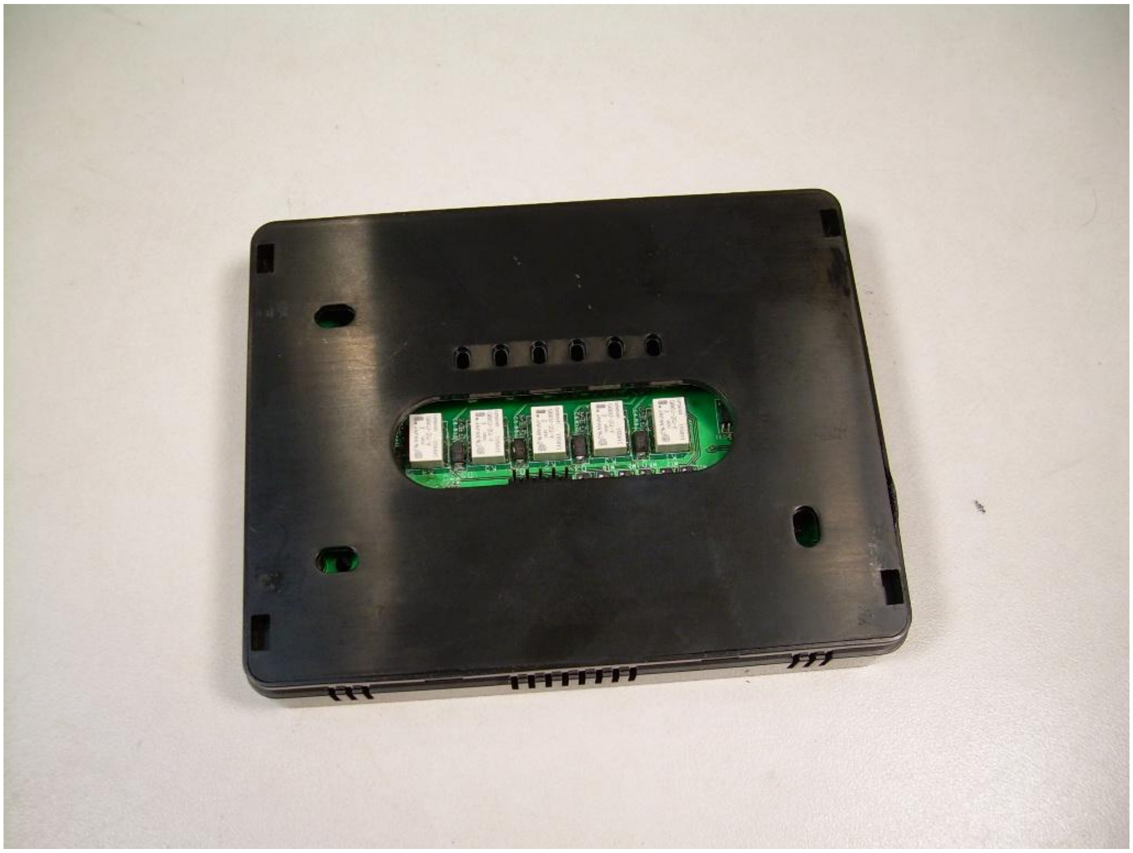
Photograph 1 – Front View Radiated Spurious Emissions – Worst Case Configuration

Photograph 2 – Back View Radiated Spurious Emissions – Worst Case Configuration



Photograph 3 – Front View of the EUT

Photograph 4– Back View of the EUT



Photograph 5 – View of the EUT with Rear Cover Removed

Photograph 6 – View of the Front of the PCB

Photograph 7 – View of the Back of the PCB