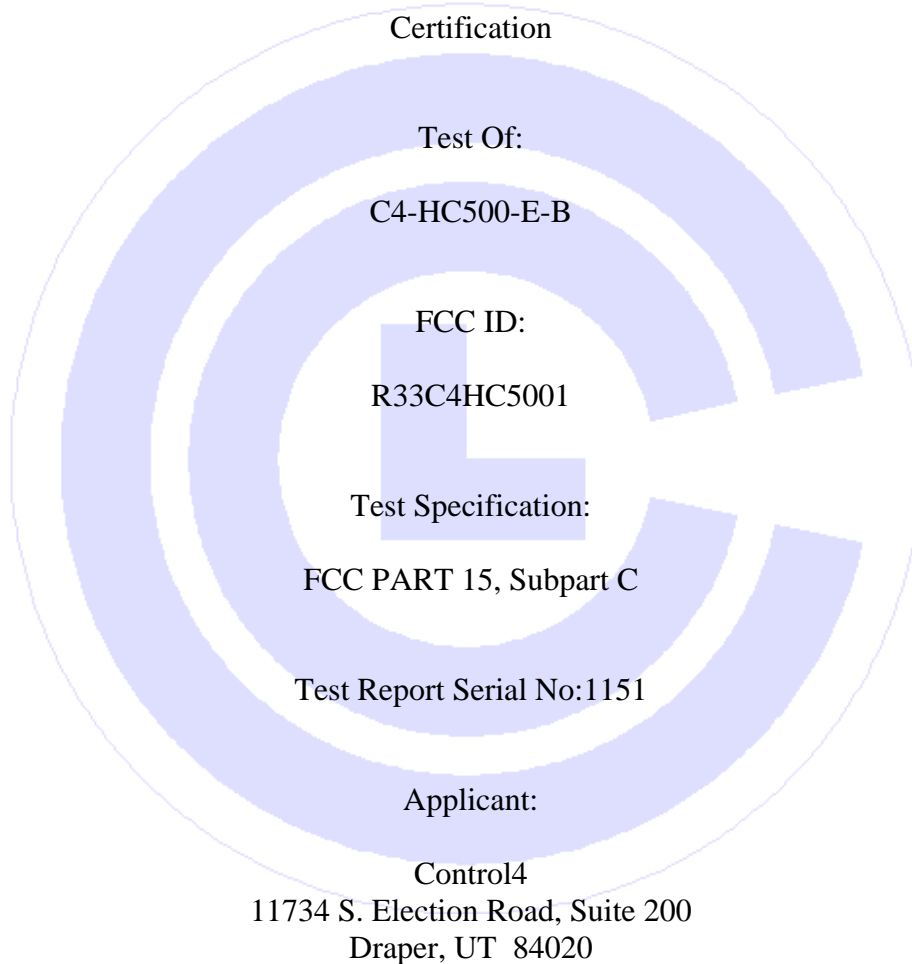


COMMUNICATION CERTIFICATION LABORATORY

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

Test Report



Date of Test: October 18, 2007

Issue Date: October 23, 2007

Accredited Testing Laboratory By:



NVLAP Lab Code 100272-0

CERTIFICATION OF ENGINEERING REPORT

This report has been prepared by Communication Certification Laboratory 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-HC500-E-B
- FCC ID Number: R33C4HC5001

On this 23rd day of October 2007, I, individually, and for Communication Certification Laboratory, 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 Communication Certification Laboratory 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.

COMMUNICATION CERTIFICATION LABORATORY



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: Grant Dearden
Title: Senior Engineer

1.2 Manufacturer:

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

Contact Name: Grant Dearden
Title: Senior Engineer

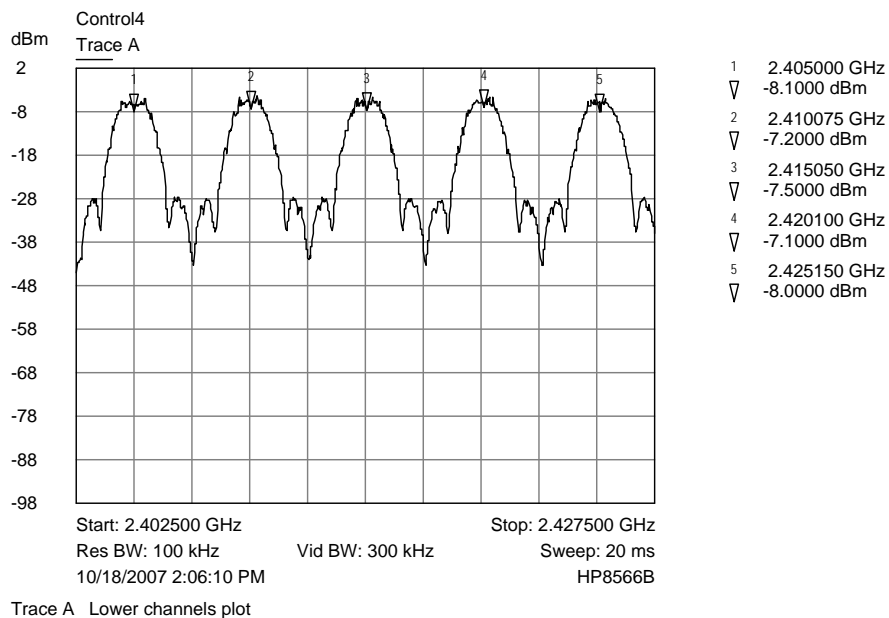
SECTION 2.0 EQUIPMENT UNDER TEST (EUT)**2.1 Identification of EUT:**

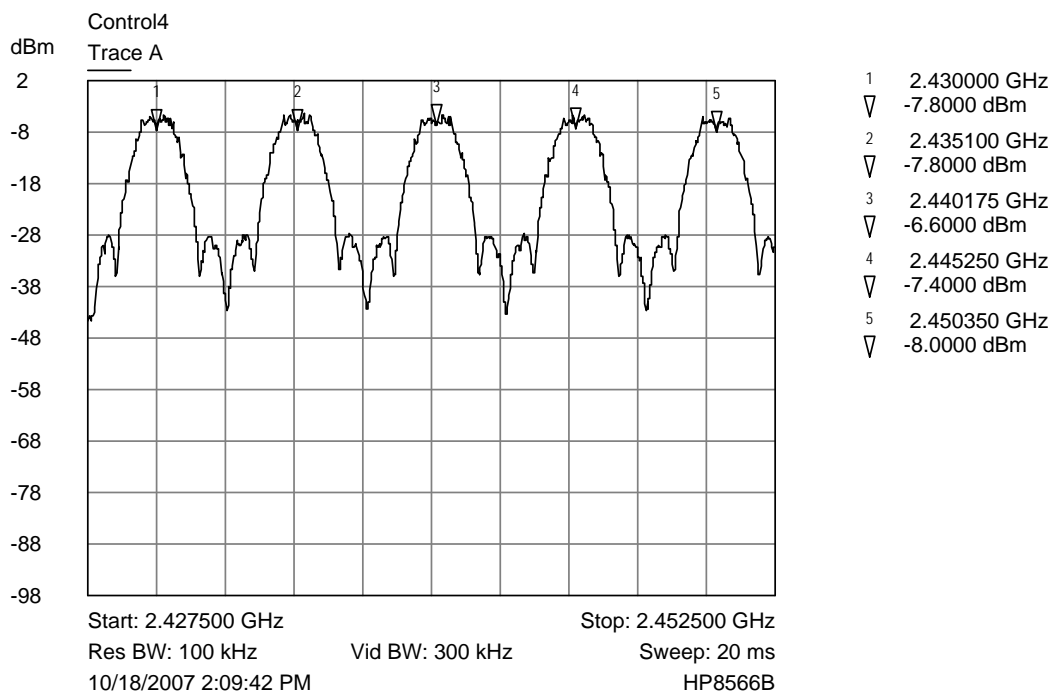
Brand Name: Control4
Model Number: C4-HC500-E-B
Serial Number: None
Options Fitted: N/A
Country of Manufacture: China

2.2 Description of EUT:

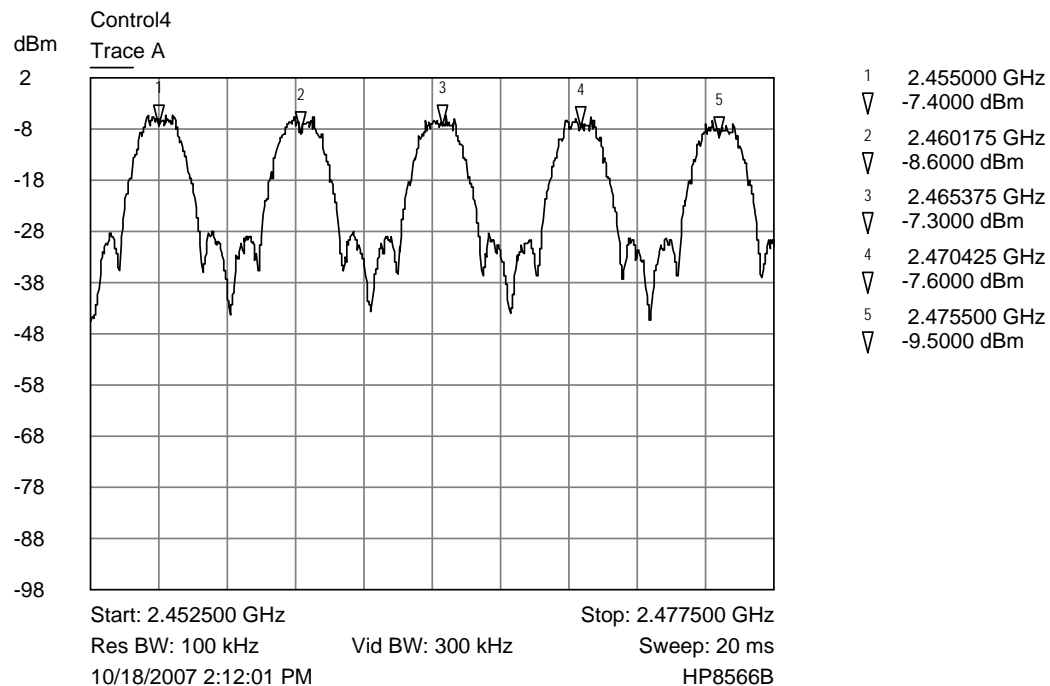
The C4-HC500-E-B is a controller for a home automation system. Typical applications include automating home theater, multi-room music, lighting, temperature, and security. The C4-HC500-E-B has a main PCB, a front panel/transceiver PCB, a Western Digital WD3200YS hard drive, and a Mean Well TF-449 power supply. The C4-HC500-E-B uses an 802.15.4 Zigbee transceiver to interface a home network. Other interfaces include IR, Serial, Ethernet, USB, Audio, video, video sense, contacts, and relays.

The 802.15.4 transceiver uses 15 channels in the 2400 to 2483.5 MHz band. The individual channels are shown in the following plots.





Trace A Middle 5 channel plot



Trace A Upper 5 channel plot

This report covers the transceiver circuitry of this device.
The other circuitry, subject to FCC 15 Subpart B, is to be tested and covered in a separate report.

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 Serial Number	FCC ID Number	Description	Name of Interface Ports / Interface Cables
BN: Control4 MN: C4-HC500-E-B (Note 1)	R33C4HC5001	System Controller	See Section 2.4
BN: TRENDnet MN: TEG-S50TXE	DoC	5 port Ethernet Hub	Ethernet/Cat5 cable (Note 2)

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
Video Out - Composite	1	RCA cable/1.5 meter
Video Out - S-video	1	S-video cable/1.5 meter
Component Video Out (Y, Pb, Pr)	1	RCA cable/1.5 meters
Analog Audio Out Left and Right	3	RCA cable/1.5 meter
Digital Audio Out	1	RCA cable/1.5 meter
Analog Audio In Left and Right	2	RCA cable/1.5 meter
Digital Audio In	1	RCA cable/1.5 meter
Video Sense In	2	RCA cable/1.5 meter
Video Sense Out	2	RCA cable/1.5 meter

Name of Ports	No. of Ports Fitted to EUT	Cable Descriptions/Length
Ethernet	1	Cat 5 cable/7 meters
USB	2	USB cable/1.5 meter
Serial	4	Shielded cable with DB9 connectors/2 meters
IR Out	6	Cables with 2.5 mm mono jack connectors/1 meter
Contact (+12 Vdc, Grnd, Contact)	4	Unshielded conductors/1 meter
Relay (NO, C, NC)	4	Unshielded conductors/1 meter

2.5 Modification Incorporated/Special Accessories on EUT:

There were no modifications or special accessories required to comply with the specification.

Signature: _____

Typed Name: Grant Dearden

Title: Senior Engineer

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 μ 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 (dBµV)	
	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.

3.2.3 Test Procedure

The emissions 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 550 West Wanship Road, Wanship, UT. This site has been fully described in a report submitted to the FCC, and was accepted in a letter dated June 6, 2006 (90504).

CCL participates in the National Voluntary Laboratory Accreditation Program (NVLAP) and has been accredited under NVLAP Lab Code: 100272-0, which is effective until September 30, 2008.

For radiated emissions 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: 120 VAC/60 Hz

4.2 Operating Modes:

The worst-case emissions were seen when the transmitter was 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	10 - 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 must be designed to ensure that no antenna other than the antenna supplied by the responsible party can be used with the device. The EUT complies with this requirement as the antenna is a trace on the front panel/tranceiver PCB.

6.2.2 §15.207 Conducted Emissions at the AC Mains Port

The EUT complied with the specification limit by a margin of 3.5 dB.

Frequency (MHz)	Lead (Hot or Neutral)	Detector	Measured Level (dBμV)	Limit (dBμV)	Margin (dB)
0.20	Hot	Peak (Note 1)	50.0	53.5	-3.5
0.27	Hot	Peak (Note 1)	45.6	51.1	-5.5
0.33	Hot	Peak (Note 1)	41.0	49.3	-8.3
0.40	Hot	Peak (Note 1)	38.8	47.8	-9.0
0.54	Hot	Peak (Note 1)	38.8	46.0	-7.2
0.61	Hot	Peak (Note 1)	38.0	46.0	-8.0
4.15	Hot	Peak (Note 1)	37.6	46.0	-8.4
8.10	Hot	Peak (Note 1)	43.8	50.0	-6.2
8.40	Hot	Peak (Note 1)	43.4	50.0	-6.6
0.20	Neutral	Quasi-Peak (Note 1)	43.4	53.5	-10.1
0.27	Neutral	Peak (Note 1)	45.1	51.1	-6.0
0.33	Neutral	Peak (Note 1)	45.1	49.3	-4.2
4.07	Neutral	Peak (Note 1)	40.2	46.0	-5.8
4.14	Neutral	Peak (Note 1)	40.2	46.0	-5.8
4.21	Neutral	Peak (Note 1)	40.6	46.0	-5.4
4.27	Neutral	Peak (Note 1)	40.1	46.0	-5.9

Frequency (MHz)	Lead (Hot or Neutral)	Detector	Measured Level (dBμV)	Limit (dBμV)	Margin (dB)
8.15	Neutral	Peak (Note 1)	45.7	50.0	-4.3
8.43	Neutral	Peak (Note 1)	43.9	50.0	-6.1
<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>					

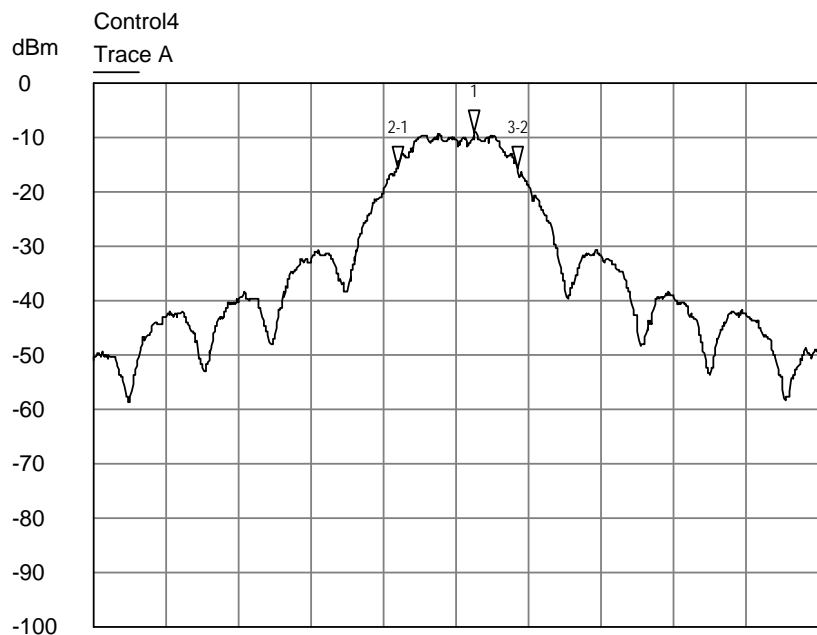
6.2.3 §15.247(a)(2) Emission Bandwidth

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

Frequency (MHz)	Emission 6dB Bandwidth (kHz)
2405.35	1650
2439.84	1660
2474.78	1640

RESULT

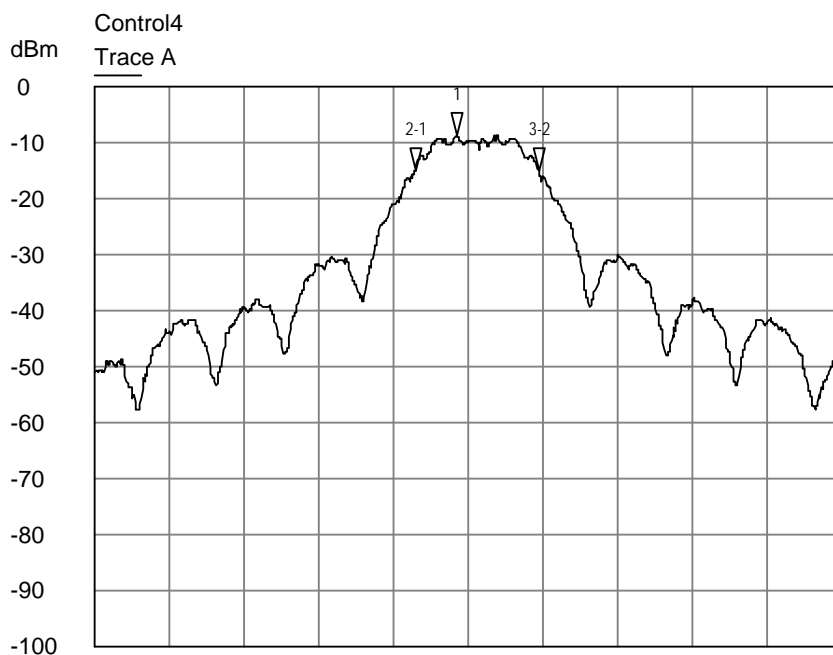
In the configuration tested, the 6 dB bandwidth was greater than 500 kHz; therefore, the EUT complied with the requirements of the specification (see spectrum analyzer plots below).



Start: 2.400090 GHz Stop: 2.410090 GHz
Res BW: 100 kHz Vid BW: 300 kHz Sweep: 20 ms
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1 2.405350 GHz
▽ -9.1000 dBm
2-1 -1.070000 MHz
▽ -6.5000 dB
3-2 1.650000 MHz
▽ 0 dB

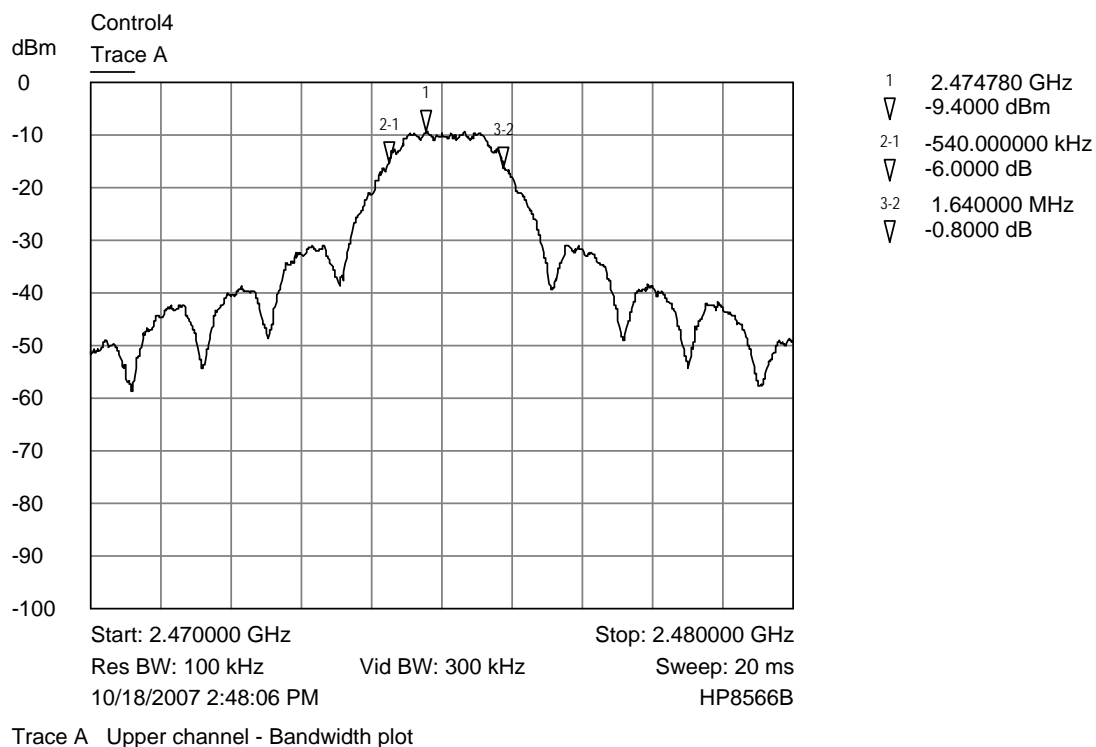
Trace A Lower channel - Bandwidth plot



Start: 2.435000 GHz Stop: 2.445000 GHz
Res BW: 100 kHz Vid BW: 300 kHz Sweep: 20 ms
10/18/2007 2:26:29 PM HP8566B

1 2.439840 GHz
▽ -8.8000 dBm
2-1 -550.000000 kHz
▽ -6.3000 dB
3-2 1.660000 MHz
▽ 0.2000 dB

Trace A Middle channel - Bandwidth plot



6.2.4 §15.247(b)(3) Peak Output Power

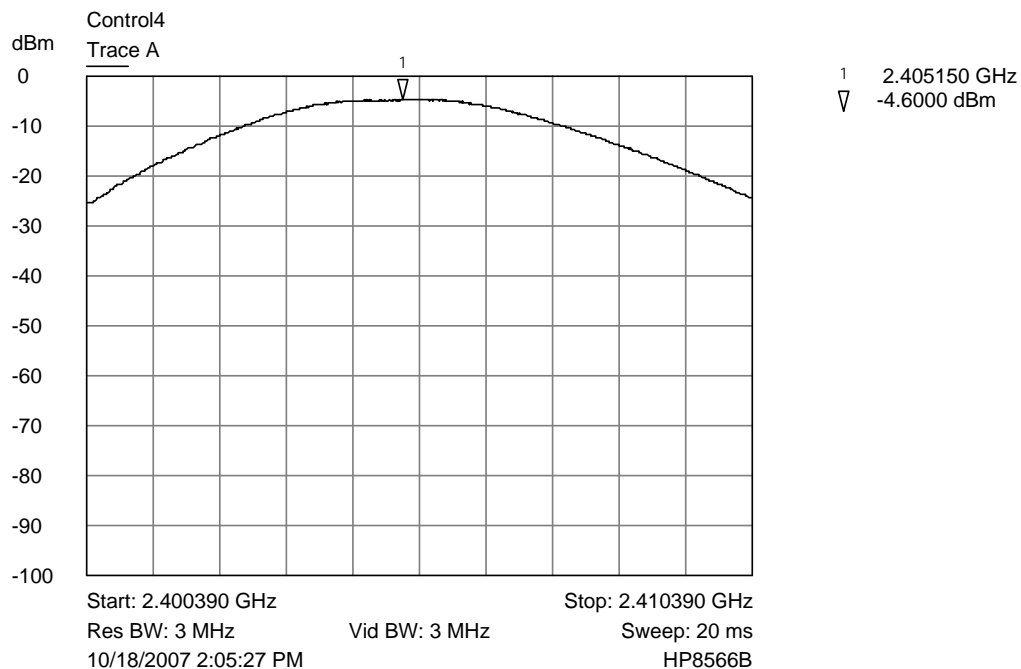
The maximum peak RF Conducted output power measured for this device was 0.39 mW or -4.1 dBm. The maximum directional gain of the antenna is less than 6 dBi; therefore, the maximum output power is not required to be reduced from the value measured.

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

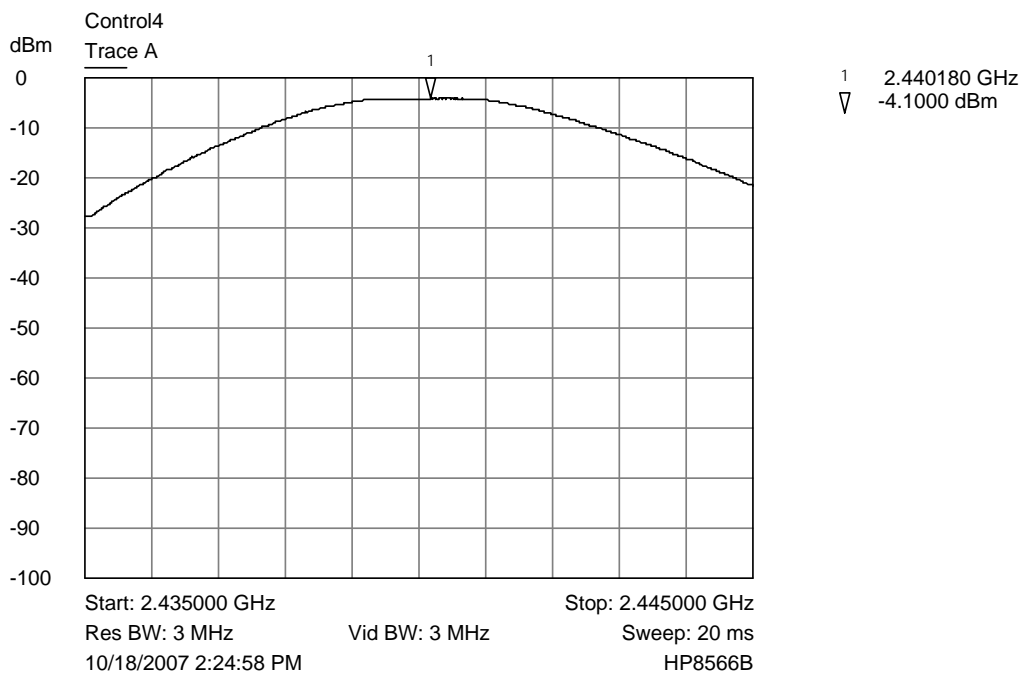
Frequency (MHz)	Measured Output Power (dBm)	Measured Output Power (mW)
2404.15	-4.6	0.35
2440.18	-4.1	0.39
2475.27	-4.6	0.35

RESULT

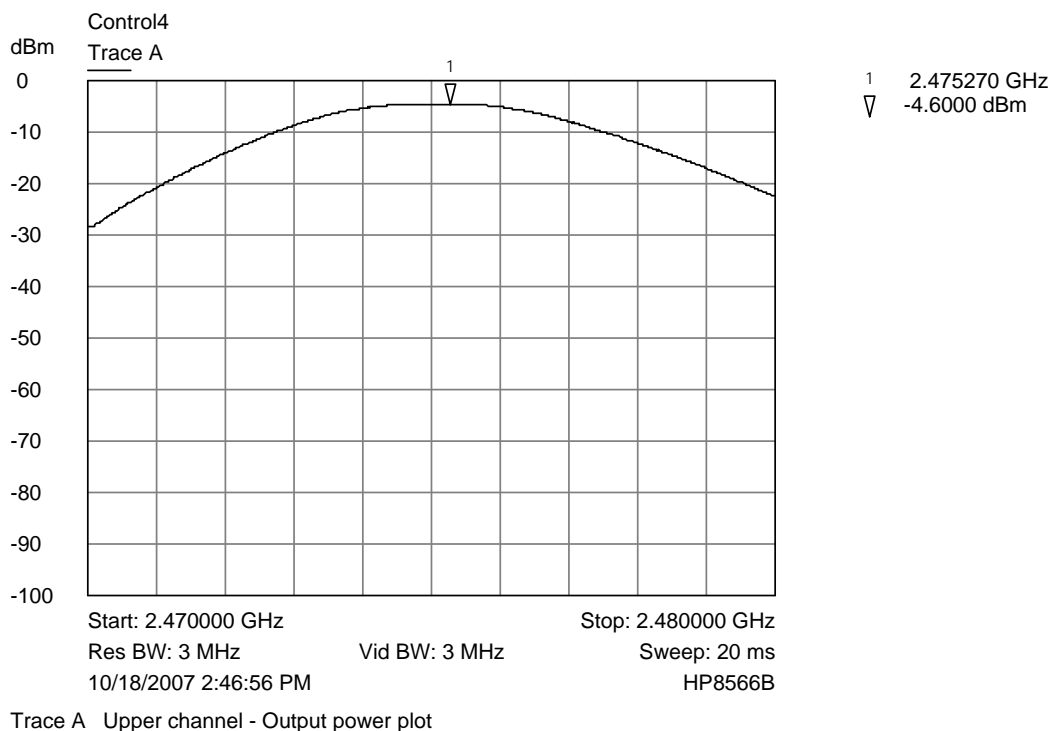
In the configuration tested, the RF peak output power was less than 1 Watt; therefore, the EUT complied with the requirements of the specification (see spectrum analyzer plots below).



Trace A Lower channel - Output power plot



Trace A Middle channel - Output power plot



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 with a 100 kHz RBW was -4.1 dBm therefore, the criteria is $-4.1 - 20.0 = -24.1$ dBm.

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

RESULT

Spurious emissions must be attenuated below -24.1 dBm. The highest emission noted was at -43.5 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	-43.5	-24.1
7215.0	-59.0	-24.1
9620.0	-69.3	-24.1
12025.0	-70.3	-24.1
14430.0	-66.5	-24.1
16835.0	-65.4	-24.1
19240.0	-60.8	-24.1
21645.0	-59.7	-24.1
24050.0	-55.8	-24.1

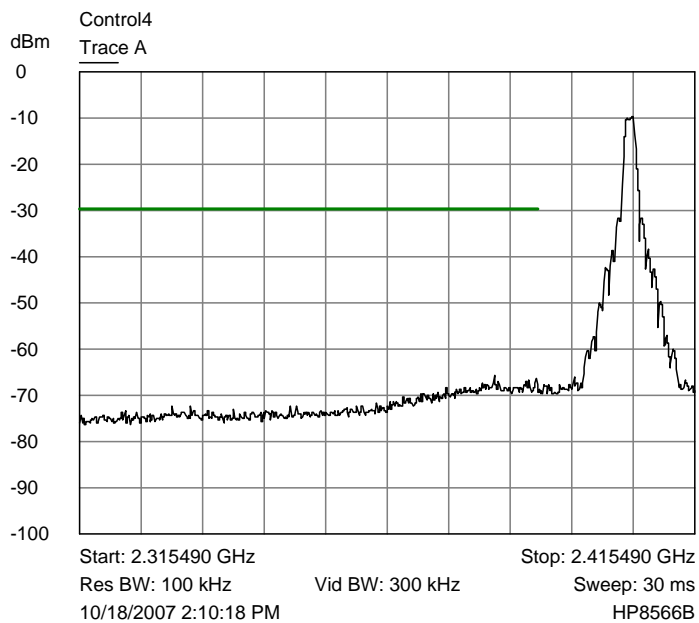
Transmitting on the Middle Channel (2.440 GHz)

Frequency (MHz)	Corrected Level (dBm)	Criteria (dBm)
4880.0	-45.4	-24.1
7320.0	-58.9	-24.1
11510.0	-70.4	-24.1
12200.0	-71.0	-24.1
14640.0	-65.6	-24.1
17080.0	-65.8	-24.1
19520.0	-61.8	-24.1
21960.0	-62.2	-24.1
24400.0	-55.8	-24.1

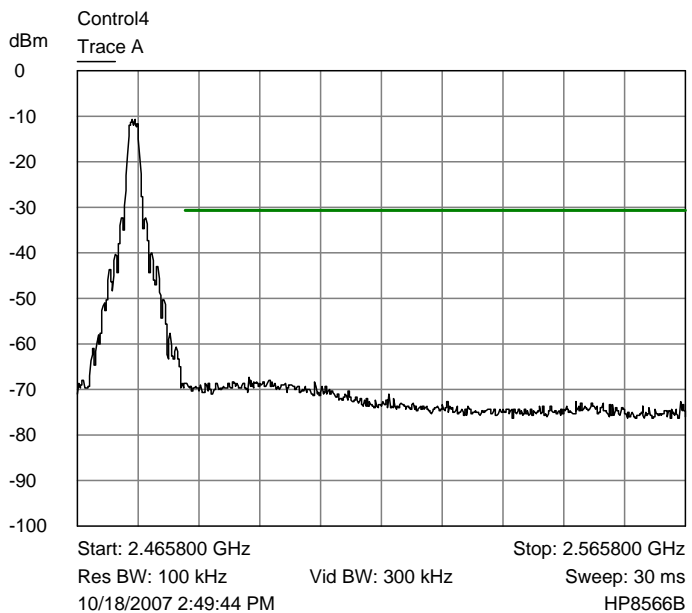
Transmitting on the Highest Channel (2.475 GHz)

Frequency (MHz)	Corrected Level (dBm)	Criteria (dBm)
4950.0	-47.0	-24.1
7425.0	-59.2	-24.1
9900.0	-70.4	-24.1
12375.0	-70.1	-24.1

Frequency (MHz)	Corrected Level (dBm)	Criteria (dBm)
14850.0	-65.0	-24.1
17325.0	-66.3	-24.1
19800.0	-61.3	-24.1
22275.0	-58.4	-24.1
24750.0	-55.8	-24.1



Trace A Lower channel - Bandedge plot



Trace A Upper channel - Bandedge 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 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 VBW was reduced to 10 Hz.

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	22.9	37.1	60.0	74.0	-14.0
4810.0	Average	Vertical	15.2	37.1	52.3	54.0	-1.7
4810.0	Peak	Horizontal	22.4	37.1	59.5	74.0	-14.5
4810.0	Average	Horizontal	14.9	37.1	52.0	54.0	-2.0
7215.0	Peak	Vertical	12.7	41.0	53.7	74.0	-20.3
7215.0	Average	Vertical	2.0	41.0	43.0	54.0	-11.0
7215.0	Peak	Horizontal	13.3	41.0	54.3	74.0	-19.7
7215.0	Average	Horizontal	1.7	41.0	42.7	54.0	-11.3

No other emissions were seen in the restricted bands. For frequencies above 7.5 GHz, a 1 meter measurement distance was used and only the noise floor was seen. The noise floor was at least 6 dB below the limit.

Transmitting at the Middle Frequency (2.440 GHz)

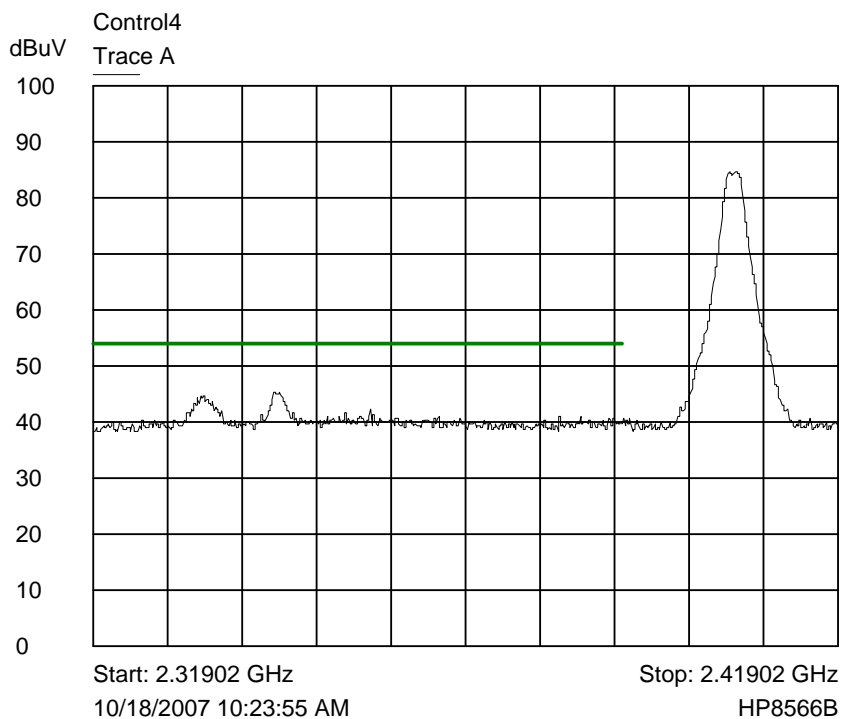
Frequency (MHz)	Detection Mode	Antenna Polarity	Receiver Reading (dBμV)	Correction Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
4880.0	Peak	Vertical	19.1	37.2	56.3	74.0	-17.7
4880.0	Average	Vertical	11.4	37.2	48.6	54.0	-5.4
4880.0	Peak	Horizontal	18.7	37.2	55.9	74.0	-18.1
4880.0	Average	Horizontal	11.0	37.2	48.2	54.0	-5.8
7320.0	Peak	Vertical	12.9	40.9	53.8	74.0	-20.2
7320.0	Average	Vertical	1.1	40.9	42.0	54.0	-12.0
7320.0	Peak	Horizontal	12.3	40.9	53.2	74.0	-20.8
7320.0	Average	Horizontal	1.0	40.9	41.9	54.0	-12.1

No other emissions were seen in the restricted bands. For frequencies above 7.5 GHz, a 1 meter measurement distance was used and only the noise floor was seen. The noise floor was at least 6 dB below the limit.

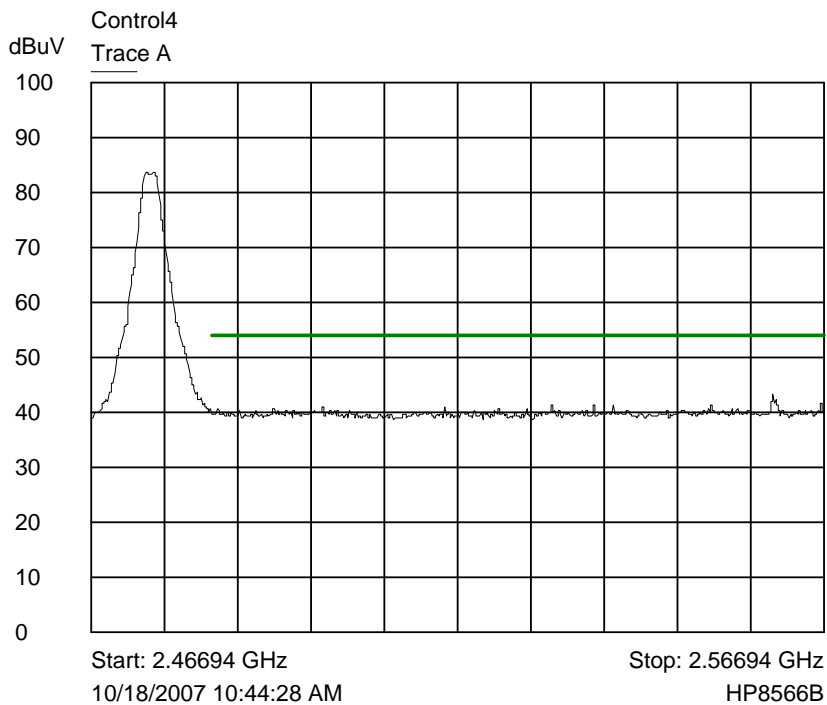
Transmitting at the Highest Frequency (2.476 GHz)

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	20.5	37.5	58.0	74.0	-16.0
4950.0	Average	Vertical	13.3	37.5	50.8	54.0	-3.2
4950.0	Peak	Horizontal	20.2	37.5	57.7	74.0	-16.3
4950.0	Average	Horizontal	12.9	37.5	50.4	54.0	-3.6
7425.0	Peak	Vertical	12.1	40.9	53.0	74.0	-21.0
7425.0	Average	Vertical	0.2	40.9	41.1	54.0	-12.9
7425.0	Peak	Horizontal	12.0	40.9	52.9	74.0	-21.1
7425.0	Average	Horizontal	-0.4	40.9	40.5	54.0	-13.5

No other emissions were seen in the restricted bands. For frequencies above 7.5 GHz, a 1 meter measurement distance was used and only the noise floor was seen. The noise floor was at least 6 dB below the limit.



Trace A Upper channel band edge plot - corrected - radiated



Trace A Upper channel band edge plot - corrected - radiated

6.2.6 §15.247(d) Peak Power Spectral Density

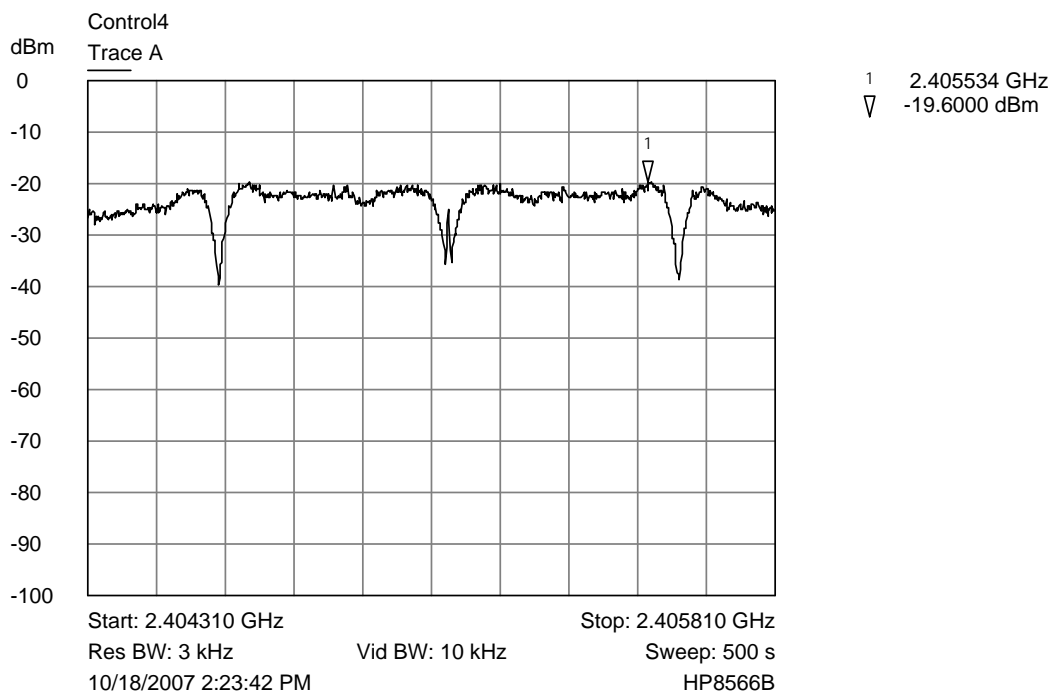
The peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. The plots are shown below and the results of this testing is summarized in the table below.

Frequency (MHz)	Measurement (dBm)	Criteria (dBm)	Margin (dB)
2405.53	-19.6	8.0	-27.6
2440.55	-19.0	8.0	-27.0
2475.53	-19.1	8.0	-27.1

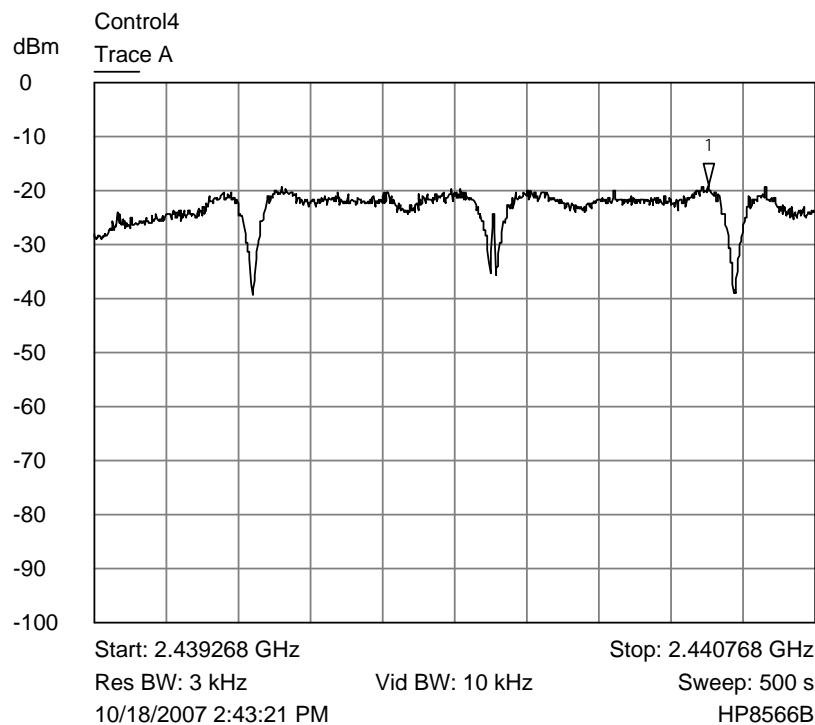
A diagram of the test setup is included in Appendix 1. The spectrum analyzer RBW was set to 3 kHz and the VBW set greater than the RBW. The span was set to 1.5 MHz and the sweep was set to 500 seconds (sweep = (Span/3 kHz)).

RESULT

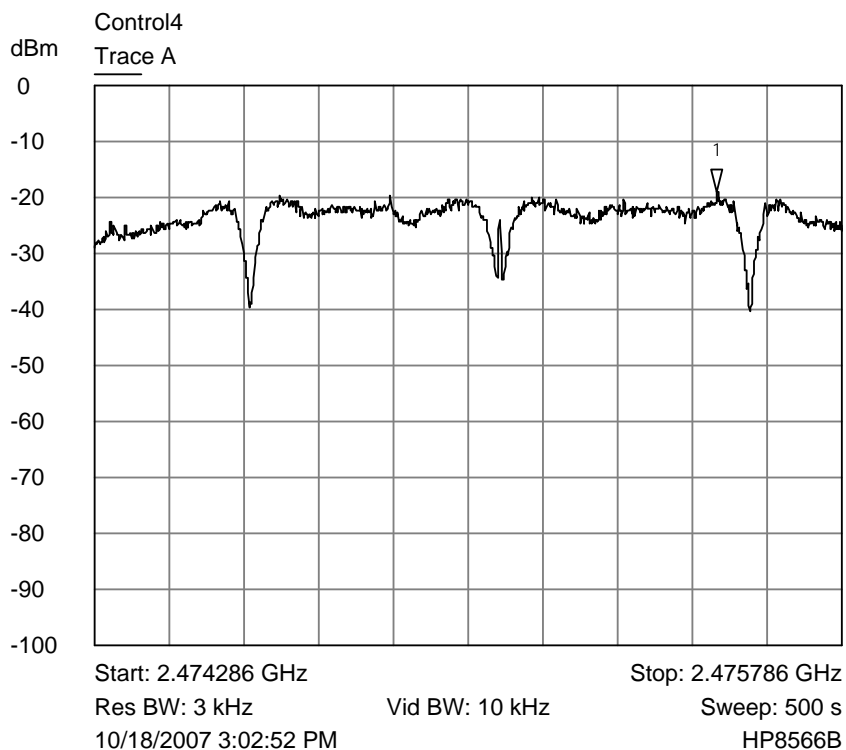
The maximum peak power spectral density was -19.0 dBm. The limit is 8 dBm. The EUT complies with the specification by 27.0 dB.



Trace A Lower channel - 3 kHz Power spectral density plot



Trace A Middle channel - 3 kHz Power spectral density plot



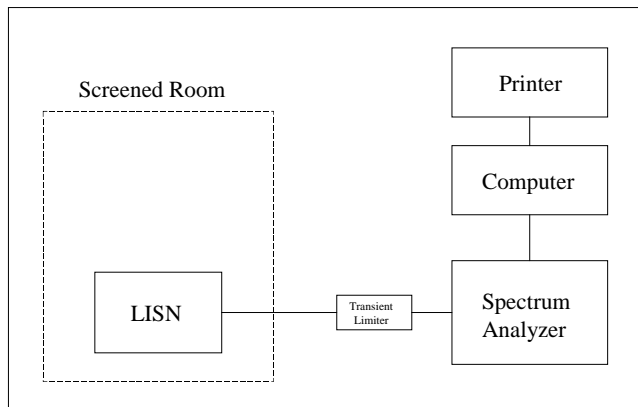
Trace A Upper channel - 3 kHz Power spectral density plot

APPENDIX 1 TEST PROCEDURES AND TEST EQUIPMENT**§15.207 Conducted Emissions at the AC Mains**

Type of Equipment	Manufacturer	Model Number	Serial Number	Date of Last Calibration
Wanship Open Area Test Site #2	CCL	N/A	N/A	10/25/2006
Test Software	CCL	Conducted Emissions	Revision 1.2	N/A
Spectrum Analyzer	Hewlett Packard	8566B	2232A02726	03/19/2007
Quasi-Peak Detector	Hewlett Packard	85650A	2043A00287	03/20/2007
LISN	EMCO	3825/2	9305-2099	03/16/2007
Conductance Cable Wanship Site #2	CCL	Cable J	N/A	12/26/2006
Transient Limiter	Hewlett Packard	11947A	3107A02266	12/26/2006

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.

Conducted Emissions Test Setup



§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.

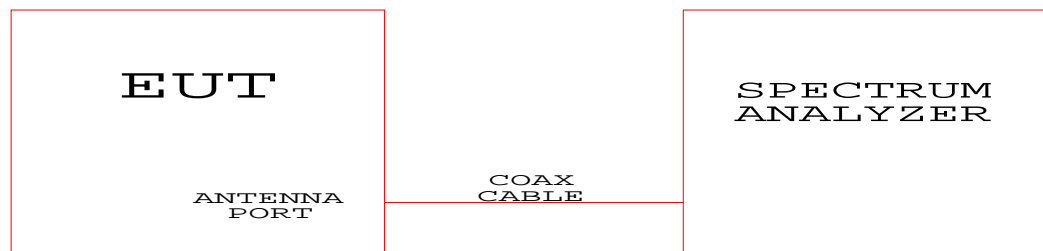
The measurements were performed on three channels, as per 47 CFR 15.31(m), one near the bottom of the spectrum, one near the middle of the spectrum and one near the top of the spectrum.

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
Spectrum Analyzer	Hewlett Packard	8566B	2232A02726
Quasi-Peak Detector	Hewlett Packard	85650A	2043A00287
Low Loss Cable (1 dB)	N/A	N/A	N/A

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.

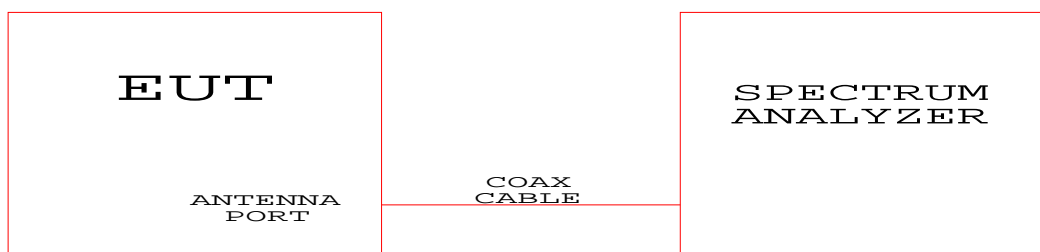
The spectrum analyzer's resolution bandwidth and video bandwidth were set as follows:

RBW = 3 MHz

VBW = 3 MHz

Type of Equipment	Manufacturer	Model Number	Serial Number
Spectrum Analyzer	Hewlett Packard	8566B	2232A02726
Quasi-Peak Detector	Hewlett Packard	85650A	2043A00287
Low Loss Cable (1 dB)	N/A	N/A	N/A

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.

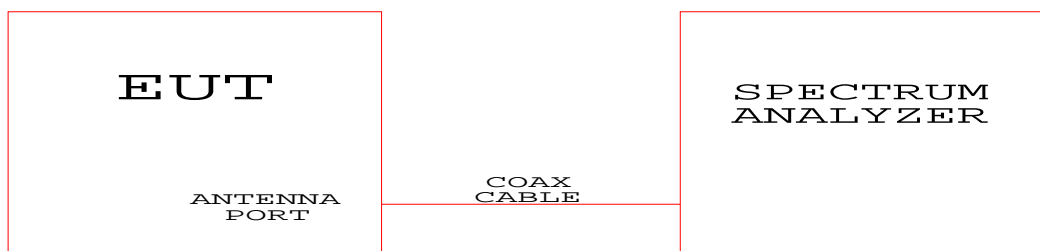
The measurements were performed on three channels, as per 47 CFR 15.31(m), one near the bottom of the spectrum, one near the middle of the spectrum and one near the top of the spectrum.

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
Spectrum Analyzer	Hewlett Packard	8566B	2232A02726
Quasi-Peak Detector	Hewlett Packard	85650A	2043A00287
Low Loss Cable (1 dB)	N/A	N/A	N/A

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.

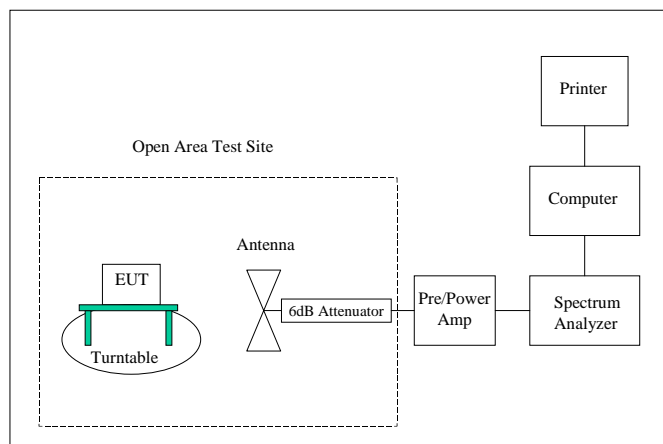
Test Configuration Block Diagram

§15.247(c) Radiated Spurious Emissions in the Restricted Bands

Type of Equipment	Manufacturer	Model Number	Serial Number	Date of Last Calibration
Wanship Open Area Test Site #2	CCL	N/A	N/A	10/25/2006
Test Software	CCL	Radiated Emissions	Revision 1.3	N/A
Spectrum Analyzer	Hewlett Packard	8566B	2232A02726	03/19/2007
Quasi-Peak Detector	Hewlett Packard	85650A	2043A00287	03/20/2007
Biconilog Antenna	EMCO	3142	9601-1008	09/27/2007
Double Ridged Guide Antenna	EMCO	3115	9409-4355	04/30/2007
High Frequency Amplifier	Hewlett Packard	8449B	3008A00777	04/30/2007
Amplifier	Hewlett Packard	11975A	2738A2030	05/18/2006
Harmonic Mixer	Hewlett Packard	11970K	3003A05756	04/19/2006
2.4 GHz Filter	Microtronics	HPM50111-03	001	09/06/2006
High Frequency Amplifier	Miteq	AFS4-01001800-43-10P-4	1096455	05/29/2007
20' High Frequency Cable	Utiflex	UFA210A-1-2400-30050U	1175	04/12/2007
3 Meter Radiated Emissions Cable Wanship Site #2	CCL	Cable K	N/A	12/26/2006
Pre/Power-Amplifier	Hewlett Packard	8447F	3113A05161	09/04/2007
6 dB Attenuator	Hewlett Packard	8491A	32835	12/26/2006

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

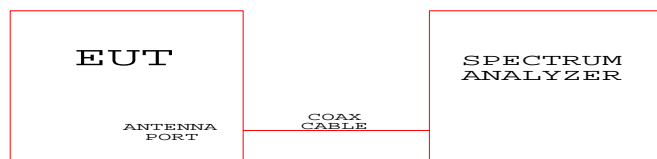
**§15.247(d) Peak Power Spectral Density**

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 to RBW = 3 kHz & VBW = 10 kHz

Type of Equipment	Manufacturer	Model Number	Serial Number
Spectrum Analyzer	Hewlett Packard	8566B	2232A02726
Quasi-Peak Detector	Hewlett Packard	85650A	2043A00287
Low Loss Cable (1 dB)	N/A	N/A	N/A

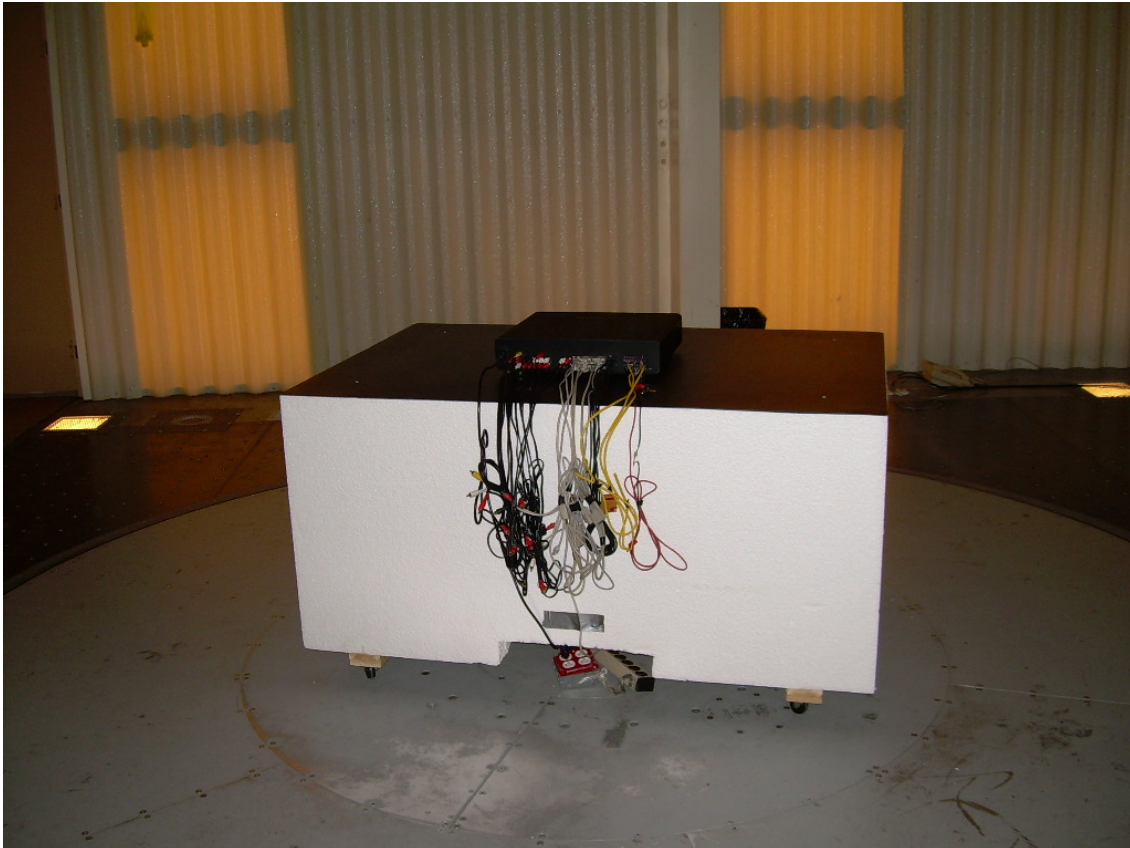
Test Configuration Block Diagram

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



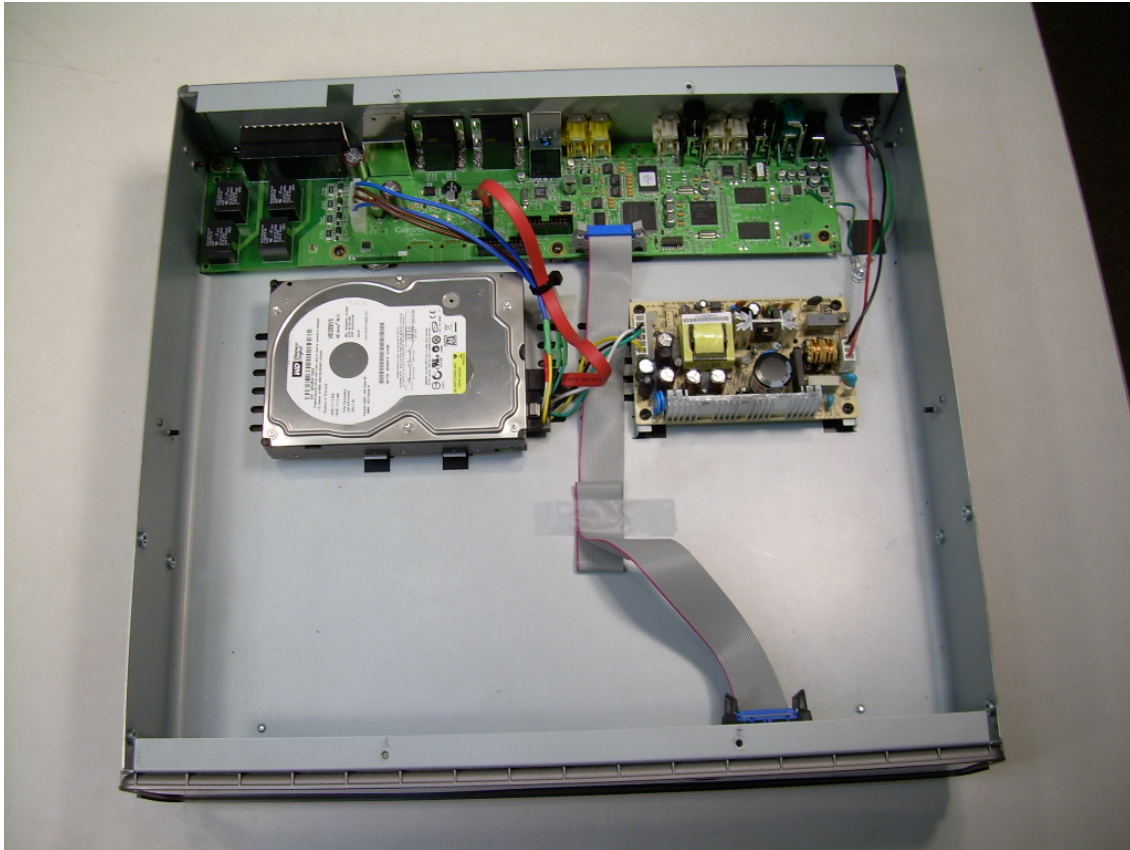
Photograph 5 - Front View of the EUT



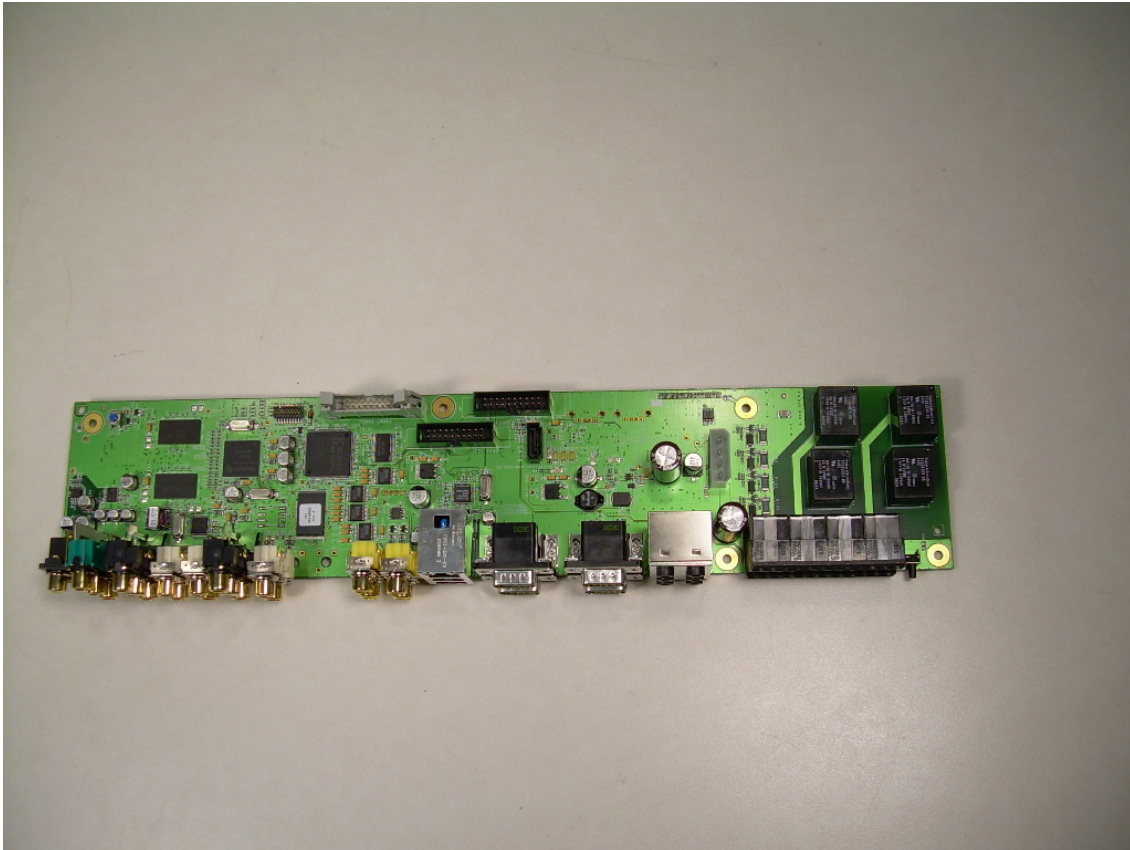
Photograph 6 - Back View of the EUT



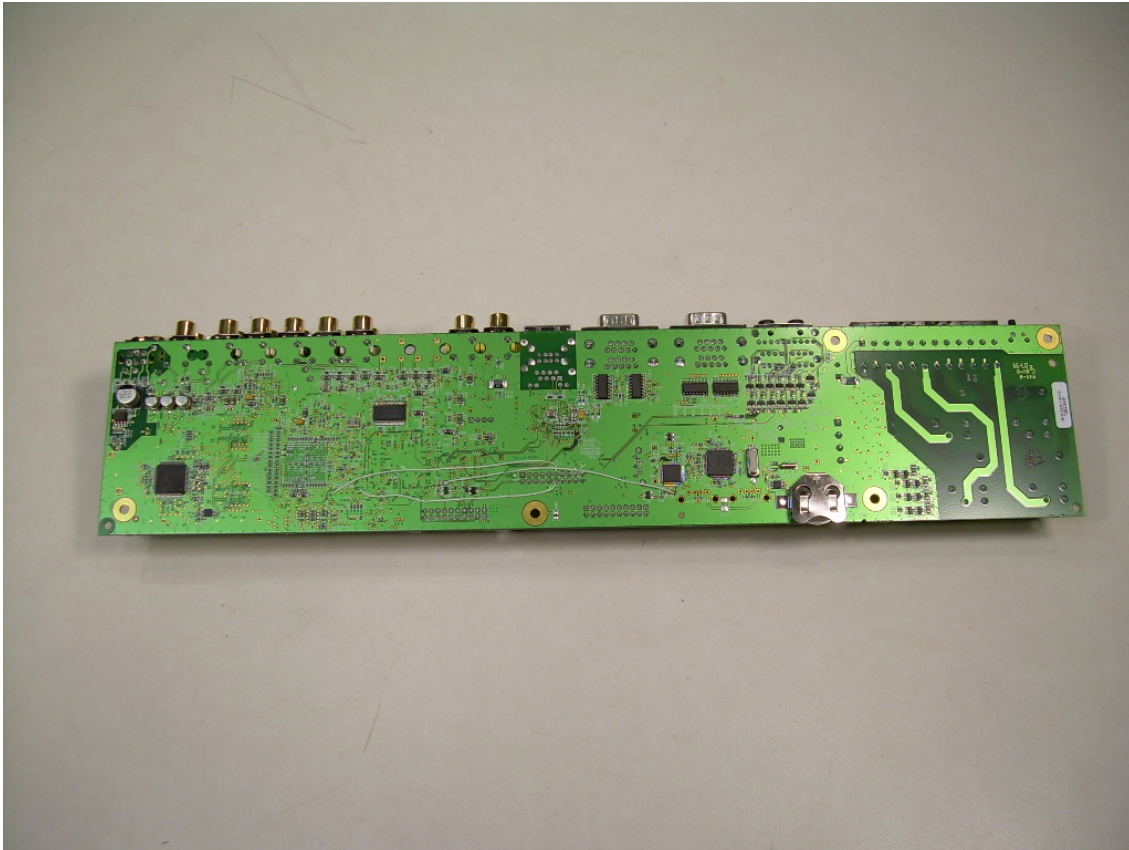
Photograph 7 - Internal View Front of the EUT



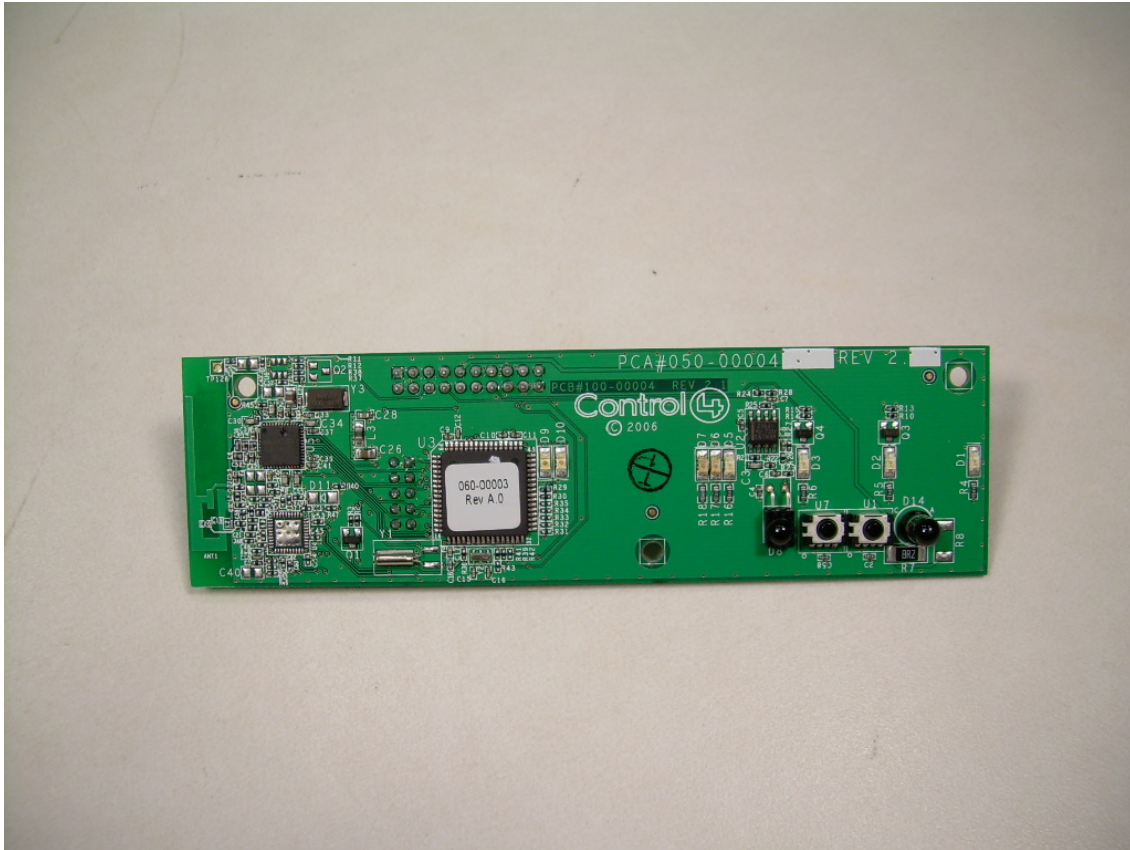
Photograph 8 - Component Side of the Main PCB



Photograph 9 - Trace Side of the Main PCB



Photograph 10 - Component Side of the Front Panel/Transceiver PCB



Photograph 11 - Trace Side of the Front Panel/Transceiver PCB

