Nemko-CCL, Inc.
1940 West Alexander Street
Salt Lake City, UT 84119
801-972-6146

Test Report

Certification

Test Of:
C4-TSWMC7

FCC ID:
R33D3

Test Specifications:
FCC PART 15, Subpart C

Test Report Serial No: 155278-2.1

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

Date of Test: July 19, 26 & 27, 2010

Issue Date: August 23, 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-TSWMC7
- FCC ID Number: R33D3

On this 23rd day of August 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.

Norman P Hansen

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: Troy Huebner
Title: Engineer

1.2 Manufacturer:

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

Contact Name: Troy Huebner
Title: Engineer

SECTION 2.0 EQUIPMENT UNDER TEST (EUT)

2.1 Identification of EUT:

Brand Name: Control4
Model Number: C4-TSWMC7
Serial Number: None

2.2 Description of EUT:

The C4-TSWMC7 is a 7" display with capacitive touchscreen for use in Control4 home automation and security systems. The C4-TSWMC7 may be powered by the AC mains or by power over the Ethernet port. Configurations using both power options were tested. For POE power, an Ault PW130 power supply/injector was used to power the C4-TSWMC7. The C4-TSWMC7 has an 802.11b/g transceiver and an Ethernet port for interfacing the Control4 system. The C4-TSWMC7 uses 11 channels in the 2400 to 2483.5 MHz frequency range. The antenna is a trace on the PCB. See the table below.

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 at the upper, middle, and lower channels using both "B" and "G" and data rates of 5.5, 11, and 48 mbps were used for the test results shown in this report.

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 #155278-1.1.

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: Control4 MN: C4-TSWMC7 (Note 1) SN: None	R33D3	Display/ Touchscreen	See Section 2.4
BN: TRENDnet MN: TEG-S50TXE	DoC	5 port Ethernet Hub	Ethernet/Cat5 cable (Note 2)
BN: Ault MN: PW130 SN: None	DoC	POE Supply/Injector	Ethernet/Cat 5e cable Ethernet with Power/Cat 5e cable (Note 2)
BN: Dell MN: Latitude SN: None	DoC	Computer	Ethernet/Cat 5e 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
AC	1	2 Conductor power cord/1.5 meter
Ethernet	1	Cat 5e cable/7 meters

2.5 Modification Incorporated/Special Accessories on EUT:

The following modifications were made to the C4-TSWMC7 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. A Steward 28R1654-000 ferrite was placed around the display/touchscreen flex cable. See Photograph 16 of Appendix 2.
2. A 0.01 μF capacitor was added across the AC input on the Power Supply PCB. See Photographs 17 and 18 of Appendix 2.
3. A 0.1 μF capacitor was placed across C5 on the Power Supply PCB. See Photographs 17 and 18 of Appendix 2.
4. A Steward 28A2025-0A2 ferrite was added to the Ethernet cable and the AC power lines at the EUT when powered from the AC mains. When powered by POE, 2 Steward 20A2025-0A2 ferrites were placed on the Ethernet cable at the EUT. See Photographs 9 and 10 of Appendix 2.
5. The LCD shield was connected to digital ground via copper braid. See Photograph 16 of Appendix 2.
6. The transmitter power level setting was set to +12 for operation using 802.11b and +14 when using 802.11g.

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 μH/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 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 conducted disturbance at mains and telecommunications ports and radiated disturbance testing was performed according to the procedures in ANSI C63.4: 2004. 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, 2010.

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 at 60 Hz to EUT when using AC power or to POE Supply when using power over Ethernet
48 VDC to EUT from POE Supply

4.2 Operating Modes:

The transmitter was tested while in a constant transmit mode at the desired frequency. Both 802.11b and 802.11g modes were tested. Data rates were at 5.5 mb for spurious emissions and at 11 mb for all other testing in 802.11b mode. The data rate was at 48 mb for all 802.11g testing. The AC power was varied in accordance with FCC §15.31(e). No change was seen in transmitter characteristics.

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 EUT uses a trace 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)
0.64	Hot Lead	Quasi-Peak (Note 1)	51.5	56.0	-4.5
0.64	Hot Lead	Average (Note 1)	42.5	46.0	-3.5
4.52	Hot Lead	Quasi-Peak (Note 1)	47.5	56.0	-8.5
4.52	Hot Lead	Average (Note 1)	40.2	46.0	-5.8
8.95	Hot Lead	Quasi-Peak (Note 1)	51.9	60.0	-8.1
8.95	Hot Lead	Average (Note 1)	46.6	50.0	-3.4
9.45	Hot Lead	Quasi-Peak (Note 1)	51.0	60.0	-9.0
9.45	Hot Lead	Average (Note 1)	46.8	50.0	-3.2
11.93	Hot Lead	Quasi-Peak (Note 1)	51.4	60.0	-8.6
11.93	Hot Lead	Average (Note 1)	48.2	50.0	-1.8
12.45	Hot Lead	Quasi-Peak (Note 1)	51.5	60.0	-8.5
12.45	Hot Lead	Average (Note 1)	49.0	50.0	-1.0
0.65	Neutral Lead	Quasi-Peak (Note 1)	53.6	56.0	-2.4

Frequency (MHz)	AC Mains Lead	Detector	Measured Level (dBµV)	Limit (dBµV)	Margin (dB)
0.65	Neutral Lead	Average (Note 1)	43.5	46.0	-2.5
0.72	Neutral Lead	Quasi-Peak (Note 1)	51.9	56.0	-4.1
0.72	Neutral Lead	Average (Note 1)	42.0	46.0	-4.0
8.90	Neutral Lead	Quasi-Peak (Note 1)	50.6	60.0	-9.4
8.90	Neutral Lead	Average (Note 1)	45.5	50.0	-4.5
9.33	Neutral Lead	Quasi-Peak (Note 1)	51.9	60.0	-8.1
9.33	Neutral Lead	Average (Note 1)	47.6	50.0	-2.4
11.78	Neutral Lead	Quasi-Peak (Note 1)	51.7	60.0	-8.3
11.78	Neutral Lead	Average (Note 1)	48.2	50.0	-1.8
12.28	Neutral Lead	Quasi-Peak (Note 1)	53.3	60.0	-6.7
12.28	Neutral Lead	Average (Note 1)	49.7	50.0	-0.3
Note 1: The reference detector used for the measurements was quasi-peak and average and the data was compared to the respective limits.					

RESULT

In the configuration tested, the EUT complied with the specification by 0.3 dB.

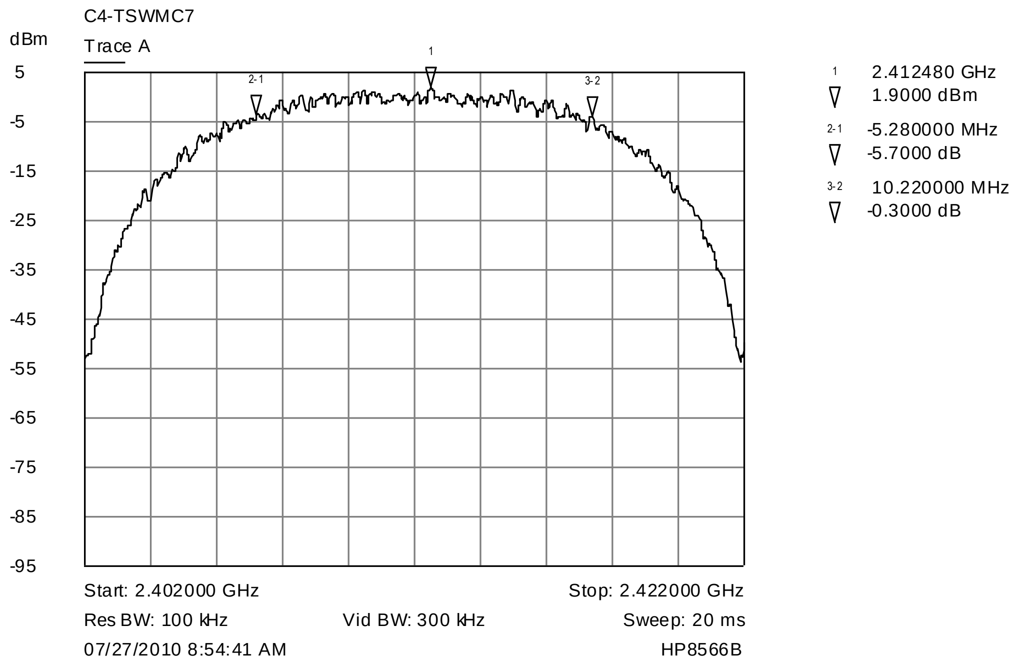
6.2.3 §15.247(a)(2) Emission Bandwidth

Frequency (MHz)	802.11b mode Emission 6 dB bandwidth (MHz)	802.11g mode Emission 6 dB bandwidth (MHz)
2412	10.22	16.74
2437	10.24	16.76
2462	10.06	16.58

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).

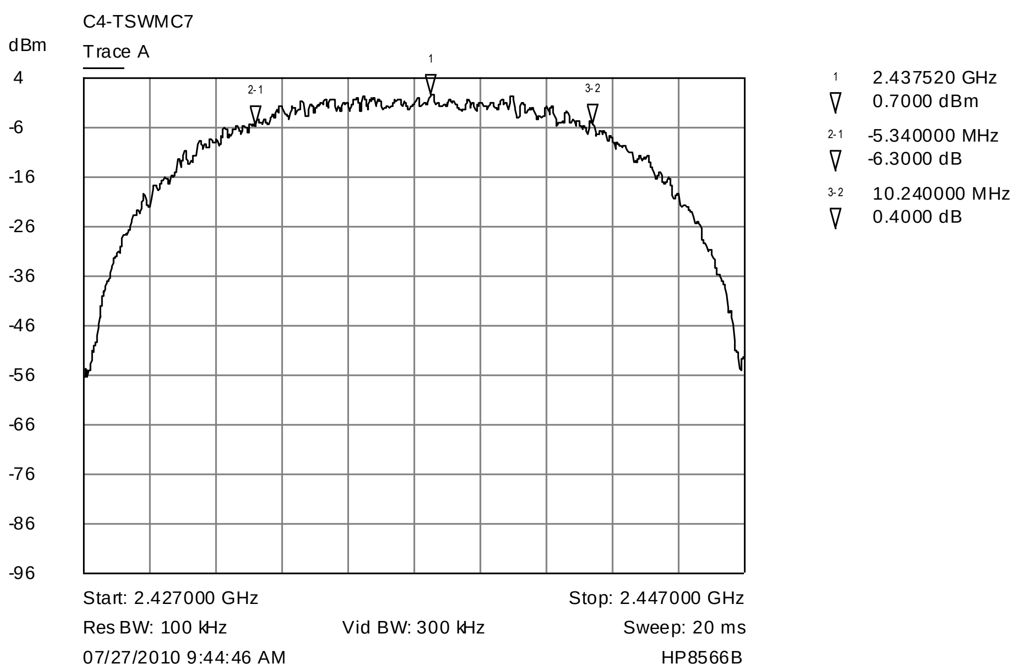
Lowest Channel "B" Mode Emission 6 dB Bandwidth



"B" mode, power level 12

Trace A Lower channel bandwidth plot

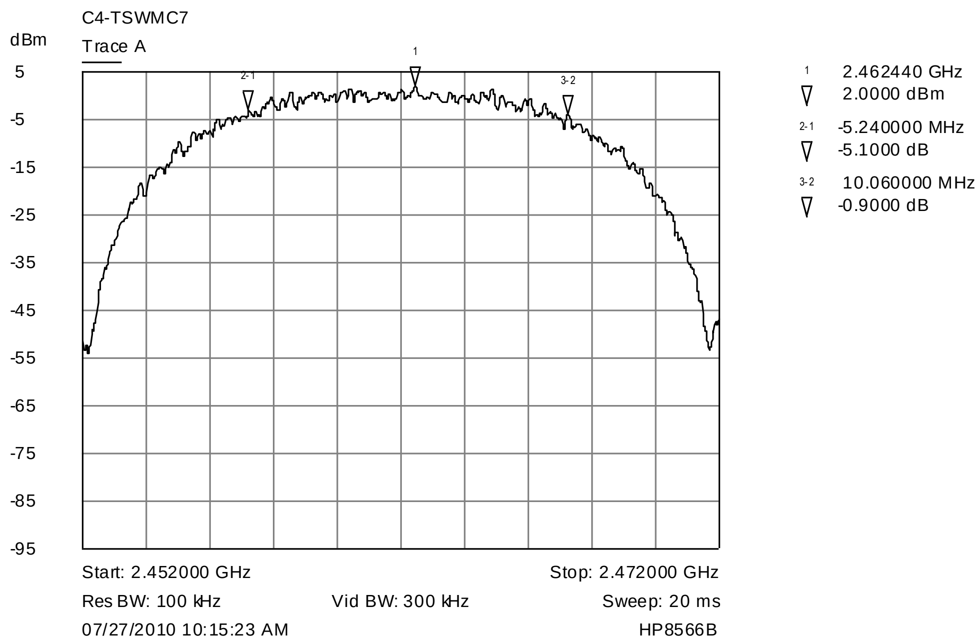
Middle Channel "B" Mode Emission 6 dB Bandwidth



"B" mode, power level 12

Trace A Middle channel bandwidth plot

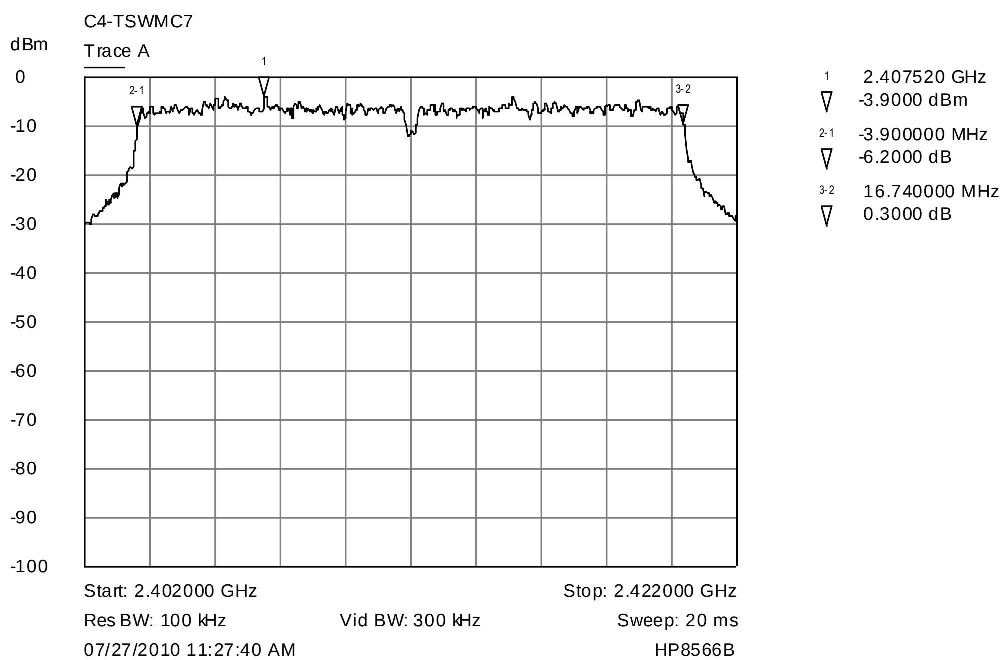
Highest Channel “B” Mode Emission 6 dB Bandwidth



"B" mode, power level 12

Trace A Upper channel bandwidth plot

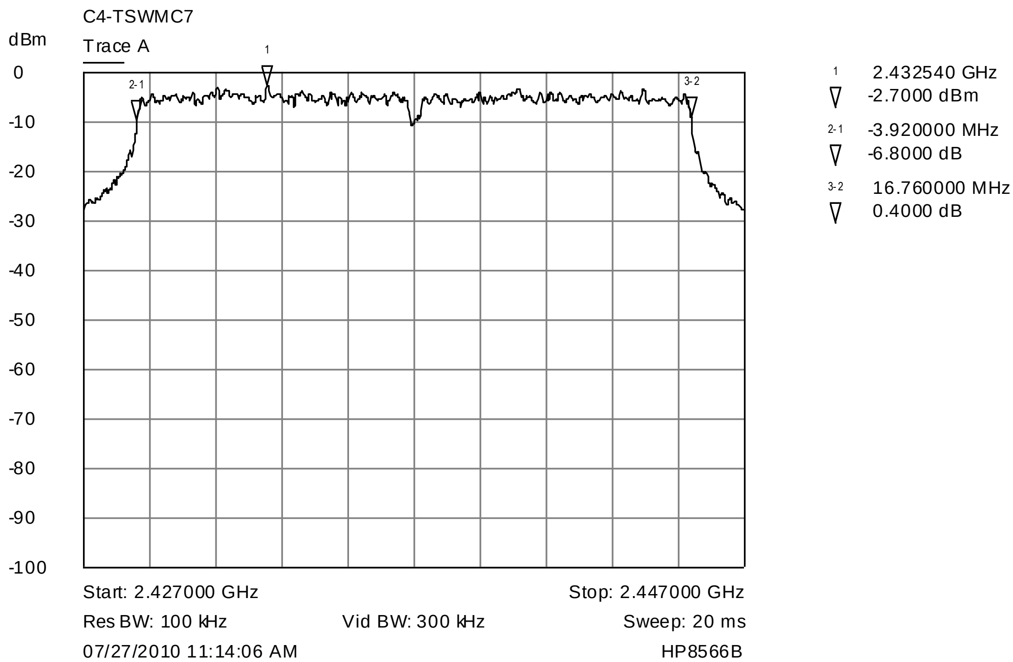
Lowest Channel “G” Mode Emission 6 dB Bandwidth



"G" Mode, power level 14

Trace A Lower channel bandwidth plot

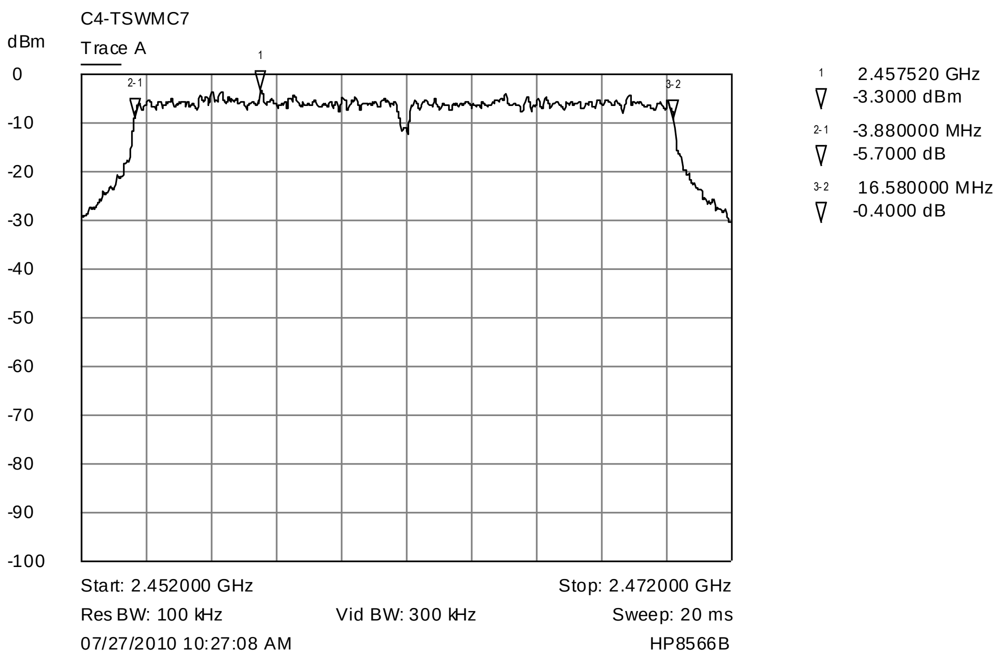
Middle Channel “G” Mode Emission 6 dB Bandwidth



"G" Mode, power level 14

Trace A Middle channel band width plot

Highest Channel “G” Mode Emission 6 dB Bandwidth



"G" Mode, power level 14

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 12.6 dBm or 18.2 mW. The limit is 30 dBm or 1 Watt when using antennas with 6 dBi or less gain. The antenna on this device is a 0.336 dBi antenna.

The maximum RBW of the spectrum analyzer was not larger than the bandwidth of the signal to be measured; therefore, a correction factor (CF) must be added to get the proper peak power measurement. The CF was calculated using the equation:

CF = 10 log (6 dB Bandwidth/RBW)

In this testing, the 6 dB bandwidth was 16.76 MHz in "G" mode and 10.22 MHz in "B" mode. The RBW of the spectrum analyzer was 3 MHz. The calculations are shown below.

CF = 10 log (16.76/3) = 7.47 dB "G" Mode
CF = 10 log (10.22/3) = 5.32 dB "B" Mode

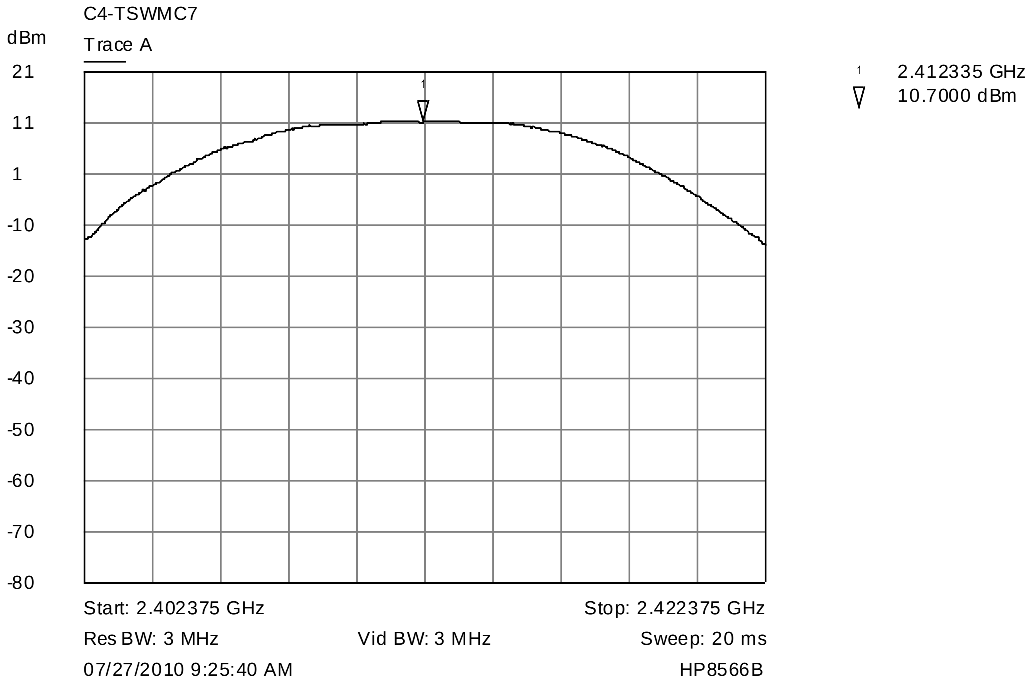
In order to properly report the peak power, 7.47 dB or 5.32 dB will be accounted for in the measurement of the spectrum analyzer.

Frequency (MHz)	802.11b mode Measured Output Power (dBm)	802.11b mode Measured Output Power (mW)	802.11g mode Measured Output Power (dBm)	802.11g mode Measured Output Power (mW)
2412	10.7	11.7	10.7	11.7
2437	11.1	12.9	12.6	18.2
2462	12.4	17.4	11.2	13.2

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).

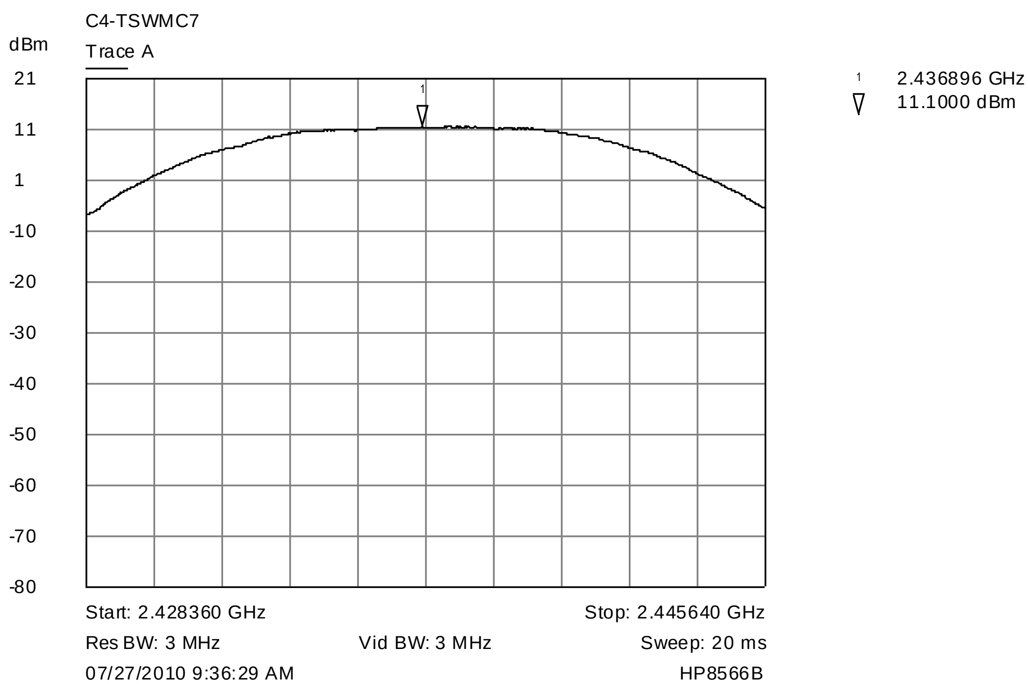
Lowest Channel "B" Mode Corrected Output Power Plot



"B" mode, power level 12

Trace A Lower output power, corrected for RBW

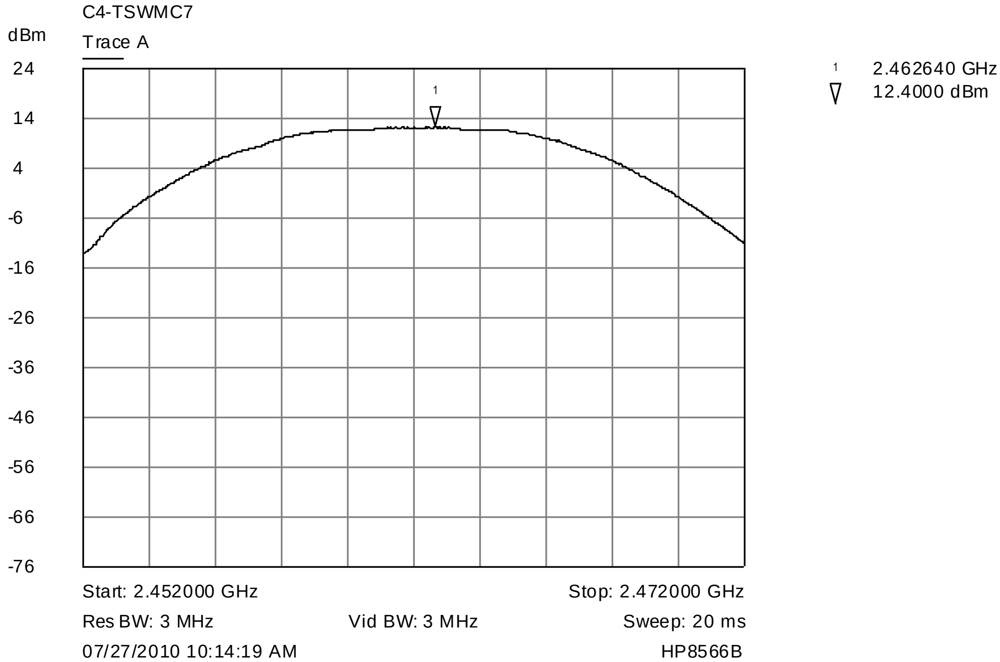
Middle Channel "B" Mode Corrected Output Power Plot



"B" mode, power level 12

Trace A Middle output power, corrected for RBW

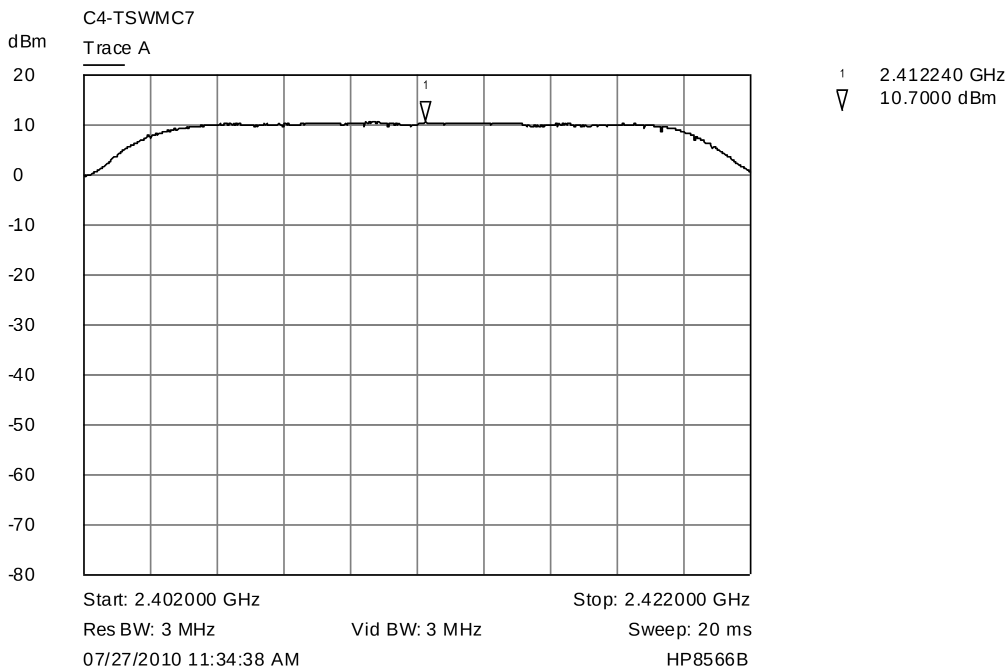
Highest Channel "B" Mode Corrected Output Power Plot



"B" mode, power level 12

Trace A Upper channel output power plot, corrected for RBW

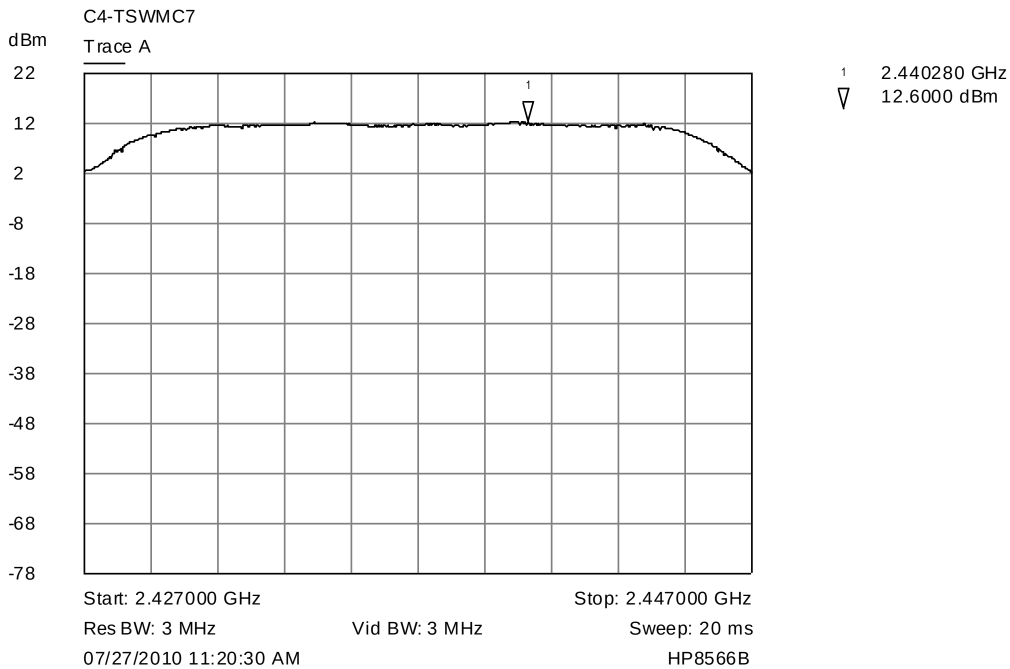
Lowest Channel "G" Mode Corrected Output Power Plot



"G" Mode, power level 14

Trace A Lower channel output power plot, corrected for RBW

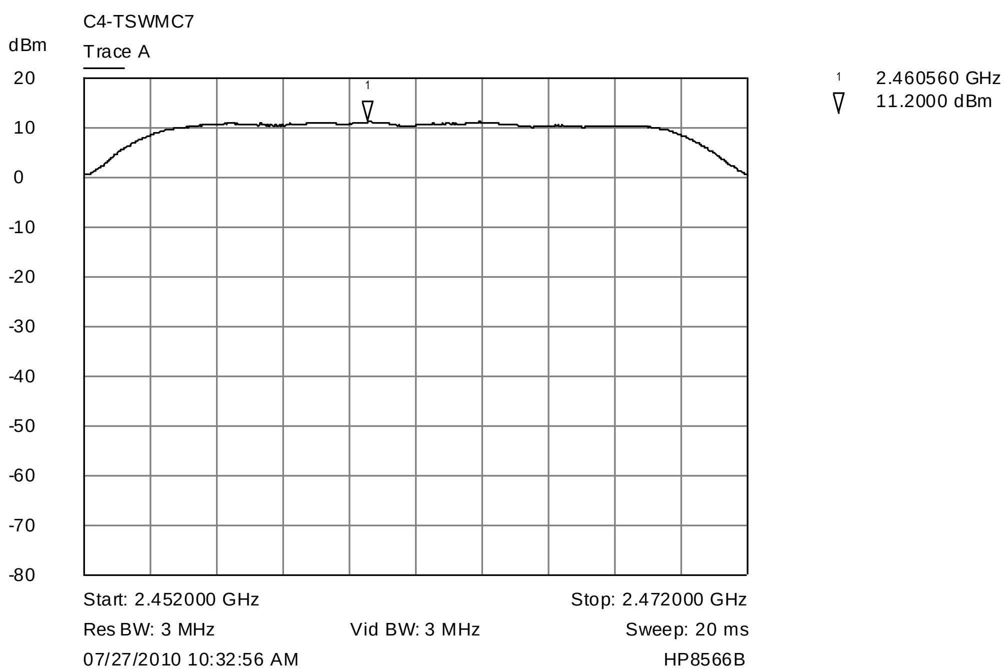
Middle Channel “G” Mode Corrected Output Power Plot



"G" Mode, power level 14

Trace A Middle channel output power, corrected for RBW

Highest Channel “G” Mode Corrected Output Power Plot



"G" Mode, power level 14

Trace A Upper channel output power plot, corrected for RBW

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 20 dB below the highest power level measured within the authorized band as measured with a 100 kHz RBW. The highest level measured in “B” mode was 1.1 dBm; therefore, the criteria is 1.1 – 20.0 = -18.9 dBm. For “G” mode, the maximum level was -4.1 dBm; therefore, the criteria is -4.1 – 20 = -24.1 dBm.

RESULT

Conducted spurious emissions were attenuated 20 dB or more from the fundamental; therefore, the EUT complies with the specification.

6.2.5.1.1 802.11b Mode

Transmitting on the Lowest Channel (2412 MHz) “B” Mode

Frequency (MHz)	Corrected Level (dBm)	Criteria (dBm)
4824	-60.8	-18.9
7236	-70.4	-18.9
9648	-69.8	-18.9
12060	-70.4	-18.9
14472	-65.3	-18.9
16884	-64.9	-18.9
19296	-61.3	-18.9
21708	-59.2	-18.9
24120	-58.0	-18.9

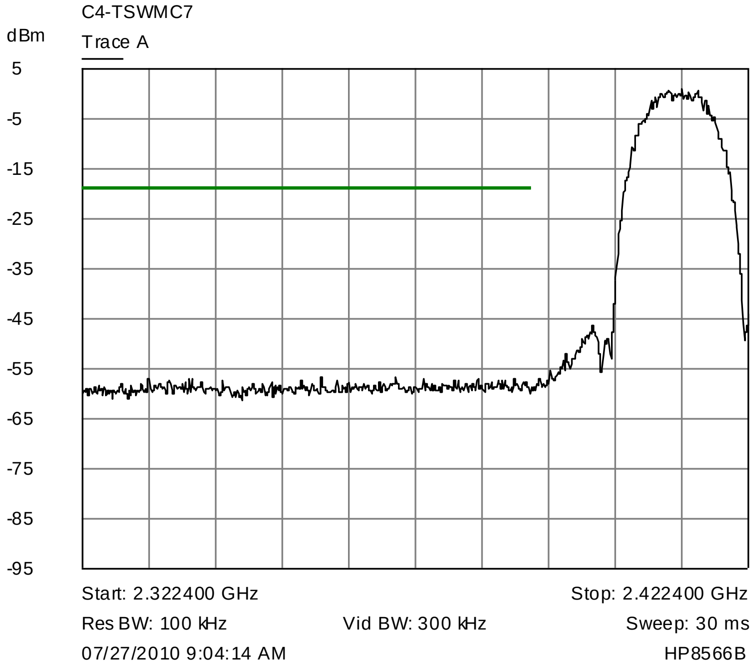
Transmitting on the Middle Channel (2437 MHz) “B” Mode

Frequency (MHz)	Corrected Level (dBm)	Criteria (dBm)
4874	-64.2	-18.9
7311	-69.8	-18.9
9748	-69.6	-18.9
12185	-71.1	-18.9
14662	-65.3	-18.9
17059	-64.6	-18.9
19496	-60.8	-18.9
21993	-58.3	-18.9
24370	-58.0	-18.9

Transmitting on the Highest Channel (2462 MHz) “B” Mode

Frequency (MHz)	Corrected Level (dBm)	Criteria (dBm)
4924	-61.1	-18.9
7386	-70.7	-18.9
9848	-70.4	-18.9
12310	-71.0	-18.9
14772	-65.6	-18.9
17234	-64.7	-18.9
19696	-60.5	-18.9
22158	-57.5	-18.9
24620	-58.0	-18.9

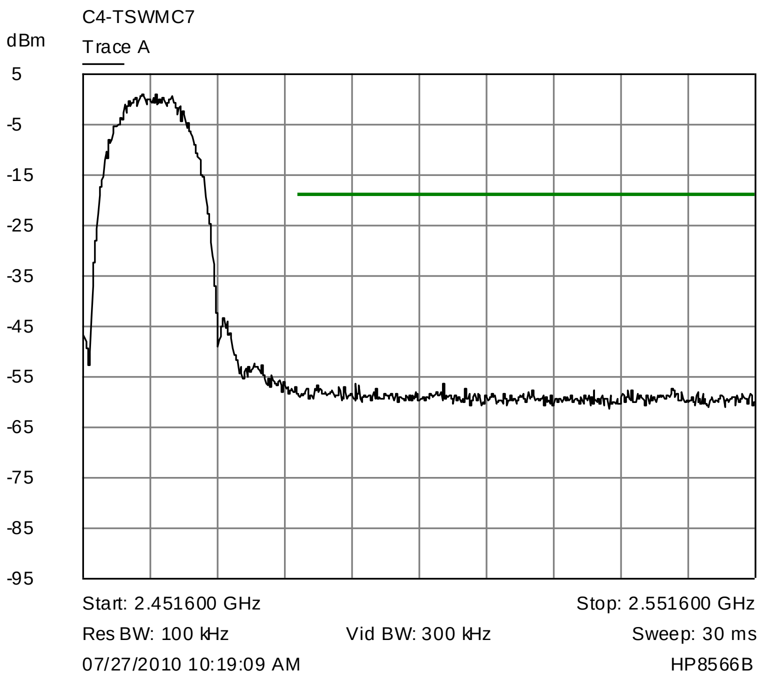
Lower Band Edge Plot – "B" Mode



"B" mode, power level 12

Trace A Lower band edge plot

Upper Band Edge Plot – "B" Mode



"B" mode, power level 12

Trace A Upper channel band edge plot

6.2.5.1.2 802.11g Mode

Transmitting on the Lowest Channel (2412 MHz) "G" Mode

Frequency (MHz)	Corrected Level (dBm)	Criteria (dBm)
4824	-65.7	-24.1
7236	-69.5	-24.1
9648	-70.1	-24.1
12060	-70.5	-24.1
14472	-65.4	-24.1
16884	-65.0	-24.1
19296	-61.1	-24.1
21708	-59.6	-24.1
24120	-58.0	-24.1

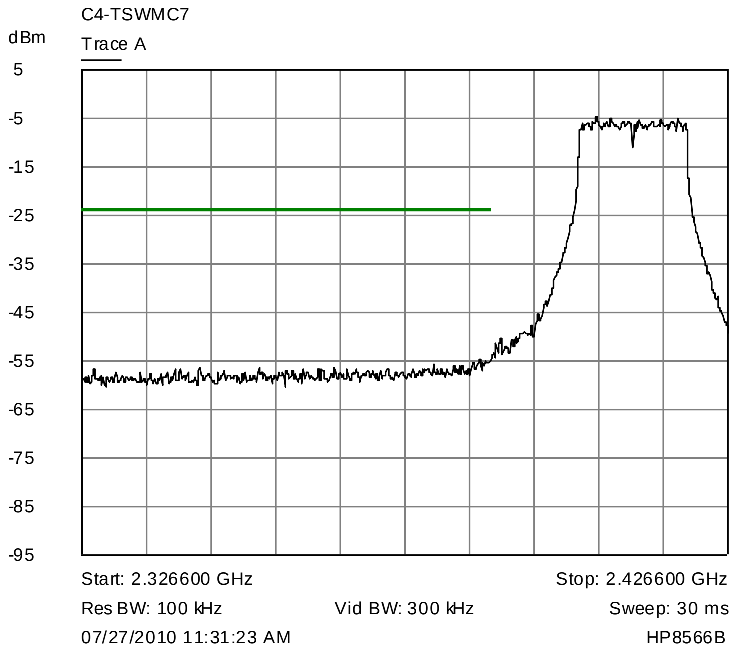
Transmitting on the Middle Channel (2437 MHz) "G" Mode

Frequency (MHz)	Corrected Level (dBm)	Criteria (dBm)
4874	-68.2	-24.1
7311	-71.0	-24.1
9748	-71.2	-24.1
12185	-70.5	-24.1
14662	-67.0	-24.1
17059	-65.0	-24.1
19496	-61.0	-24.1
21993	-59.5	-24.1
24370	-58.0	-24.1

Transmitting on the Highest Channel (2462 MHz) "G" Mode

Frequency (MHz)	Corrected Level (dBm)	Criteria (dBm)
4924	-69.0	-24.1
7386	-70.2	-24.1
9848	-70.3	-24.1
12310	-71.5	-24.1
14772	-65.7	-24.1
17234	-65.8	-24.1
19696	-61.0	-24.1
22158	-58.6	-24.1
24620	-58.0	-24.1

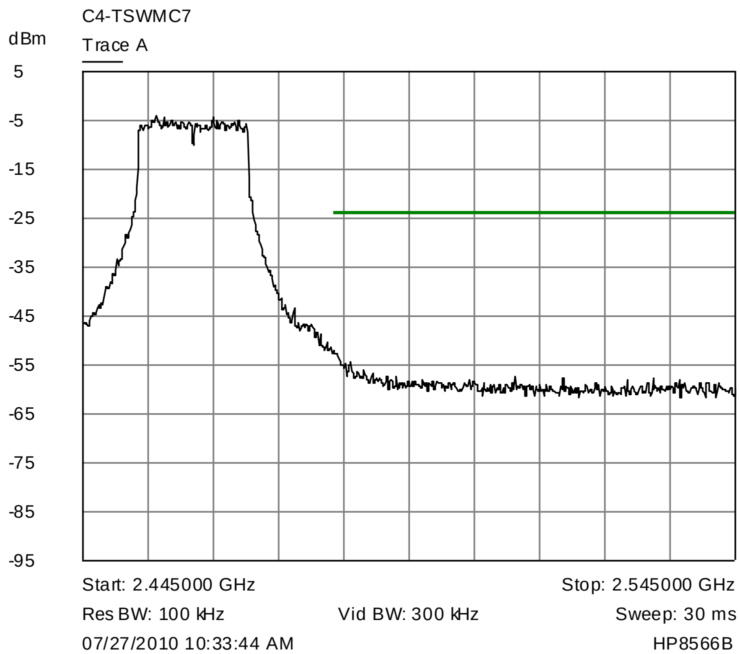
Lower Band Edge Plot – "G" Mode



"G" Mode, power level 14

Trace A   Lower channel band edge plot

Upper Band Edge Plot – "G" Mode



"G" Mode, power level 14

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. 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 C4-TSWMC7. 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

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.

6.2.5.2.1 802.11b Mode

Transmitting at the Lowest Frequency (2412 MHz)

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	20.7	37.6	58.3	74.0	-15.7
4824.0	Average	Vertical	15.0	37.6	52.6	54.0	-1.4
4824.0	Peak	Horizontal	16.1	37.6	53.7	74.0	-20.3
4824.0	Average	Horizontal	6.0	37.6	43.6	54.0	-10.4
7236.0	Peak	Vertical	18.2	41.4	59.6	74.0	-14.4
7236.0	Average	Vertical	6.3	41.4	47.7	54.0	-6.3
7236.0	Peak	Horizontal	19.3	41.4	60.7	74.0	-13.3
7236.0	Average	Horizontal	6.3	41.4	47.7	54.0	-6.3
12060.0	Peak	Vertical	4.7	46.0	50.7	74.0	-23.3

Frequency (MHz)	Detection Mode	Antenna Polarity	Receiver Reading (dBμV)	Correction Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
12060.0	Average	Vertical	-2.1	46.0	43.9	54.0	-10.1
12060.0	Peak	Horizontal	-0.3	46.0	45.7	74.0	-28.3
12060.0	Average	Horizontal	-8.3	46.0	37.7	54.0	-16.3

Transmitting at the Middle Frequency (2437 MHz)

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	19.6	37.7	57.3	74.0	-16.7
4874.0	Average	Vertical	12.1	37.7	49.8	54.0	-4.2
4874.0	Peak	Horizontal	15.6	37.7	53.3	74.0	-20.7
4874.0	Average	Horizontal	5.4	37.7	43.1	54.0	-10.9
7311.0	Peak	Vertical	17.9	41.7	59.6	74.0	-14.4
7311.0	Average	Vertical	6.0	41.7	47.7	54.0	-6.3
7311.0	Peak	Horizontal	17.9	41.7	59.6	74.0	-14.4
7311.0	Average	Horizontal	5.9	41.7	47.6	54.0	-6.4
12185.0	Peak	Vertical	-0.5	45.7	45.2	74.0	-28.8
12185.0	Average	Vertical	-7.7	45.7	38.0	54.0	-16.0
12185.0	Peak	Horizontal	-1.4	45.7	44.3	74.0	-29.7
12185.0	Average	Horizontal	-10.7	45.7	35.0	54.0	-19.0

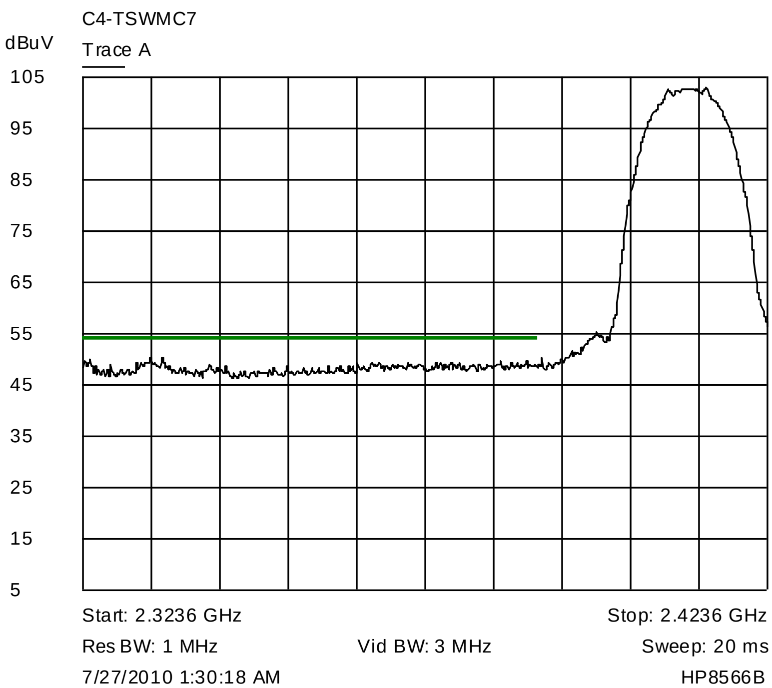
Transmitting at the Highest Frequency (2462 MHz)

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	19.7	37.8	57.5	74.0	-16.5
4924.0	Average	Vertical	12.9	37.8	50.7	54.0	-3.3
4924.0	Peak	Horizontal	15.2	37.8	53.0	74.0	-21.0
4924.0	Average	Horizontal	5.3	37.8	43.1	54.0	-10.9

Frequency (MHz)	Detection Mode	Antenna Polarity	Receiver Reading (dBμV)	Correction Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
7386.0	Peak	Vertical	19.1	41.8	60.9	74.0	-13.1
7386.0	Average	Vertical	4.1	41.8	45.9	54.0	-8.1
7386.0	Peak	Horizontal	18.0	41.8	59.8	74.0	-14.2
7386.0	Average	Horizontal	4.1	41.8	45.9	54.0	-8.1
12310.0	Peak	Vertical	-0.8	45.5	44.7	74.0	-29.3
12310.0	Average	Vertical	-9.6	45.5	35.9	54.0	-18.1
12310.0	Peak	Horizontal	-1.4	45.5	44.1	74.0	-29.9
12310.0	Average	Horizontal	-10.2	45.5	35.3	54.0	-18.7

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

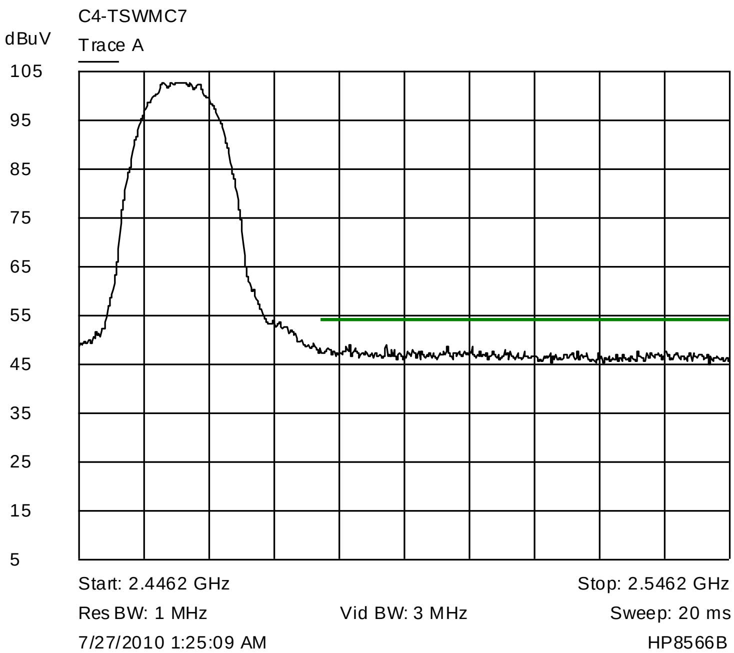
Radiated Lower Band Edge Plot



Corrected peak detection trace shown against average limit

Trace A "B" mode radiated lower band edge plot

Radiated Upper Band Edge Plot



Corrected peak detection trace shown against average limit

Trace A "B" mode radiated upper band edge plot

6.2.5.2.2 802.11g Mode

Transmitting at the Lowest Frequency (2412 MHz)

Frequency (MHz)	Detection Mode	Antenna Polarity	Receiver Reading (dBμV)	Correction Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2390.0	Peak	Vertical	27.2	31.4	58.6	74.0	-15.4
2390.0	Average	Vertical	10.1	31.4	41.5	54.0	-12.5
2390.0	Peak	Horizontal	24.7	31.4	56.1	74.0	-17.9
2390.0	Average	Horizontal	8.9	31.4	40.3	54.0	-13.7
4824.0	Peak	Vertical	22.3	37.6	59.9	74.0	-14.1
4824.0	Average	Vertical	9.9	37.6	47.5	54.0	-6.5
4824.0	Peak	Horizontal	14.3	37.6	51.9	74.0	-22.1
4824.0	Average	Horizontal	2.5	37.6	40.1	54.0	-13.9
7236.0	Peak	Vertical	20.2	41.4	61.6	74.0	-12.4
7236.0	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)
7236.0	Peak	Horizontal	19.0	41.4	60.4	74.0	-13.6
7236.0	Average	Horizontal	6.3	41.4	47.7	54.0	-6.3
12060.0	Peak	Vertical	2.5	46.0	48.5	74.0	-25.5
12060.0	Average	Vertical	-6.2	46.0	39.8	54.0	-14.2
12060.0	Peak	Horizontal	0.3	46.0	46.3	74.0	-27.7
12060.0	Average	Horizontal	-9.6	46.0	36.4	54.0	-17.6

Transmitting at the Middle Frequency (2437 MHz)

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	24.5	37.7	62.2	74.0	-11.8
4874.0	Average	Vertical	10.9	37.7	48.6	54.0	-5.4
4874.0	Peak	Horizontal	17.5	37.7	55.2	74.0	-18.8
4874.0	Average	Horizontal	3.9	37.7	41.6	54.0	-12.4
7311.0	Peak	Vertical	20.5	41.7	62.2	74.0	-11.8
7311.0	Average	Vertical	7.3	41.7	49.0	54.0	-5.0
7311.0	Peak	Horizontal	19.4	41.7	61.1	74.0	-12.9
7311.0	Average	Horizontal	6.1	41.7	47.8	54.0	-6.2
12185.0	Peak	Vertical	-1.1	45.7	44.6	74.0	-29.4
12185.0	Average	Vertical	-10.4	45.7	35.3	54.0	-18.7
12185.0	Peak	Horizontal	-1.5	45.7	44.2	74.0	-29.8
12185.0	Average	Horizontal	-10.4	45.7	35.3	54.0	-18.7

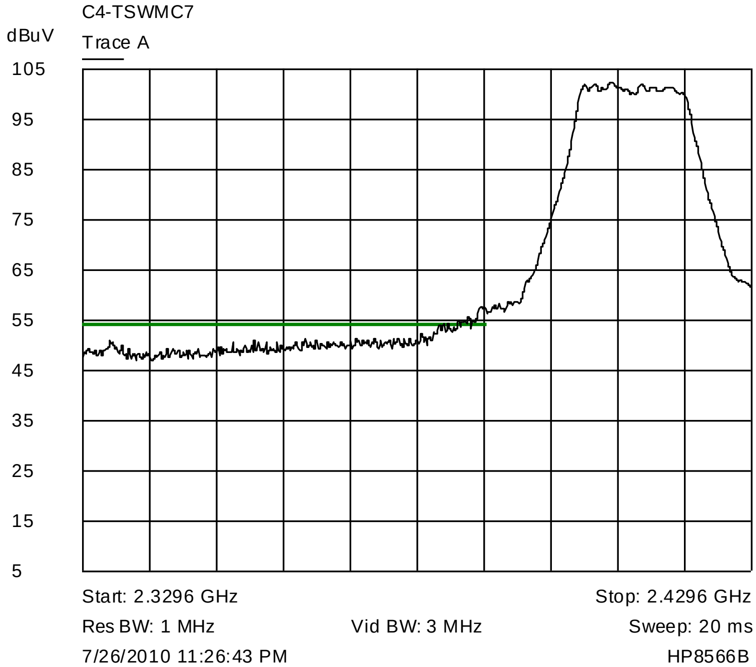
Transmitting at the Highest Frequency (2462 MHz)

Frequency (MHz)	Detection Mode	Antenna Polarity	Receiver Reading (dBμV)	Correction Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2483.5	Peak	Vertical	29.2	31.6	60.8	74.0	-13.2
2483.5	Average	Vertical	11.9	31.6	43.5	54.0	-10.5

Frequency (MHz)	Detection Mode	Antenna Polarity	Receiver Reading (dBμV)	Correction Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2483.5	Peak	Horizontal	25.7	31.6	57.3	74.0	-16.7
2483.5	Average	Horizontal	7.9	31.6	39.5	54.0	-14.5
4924.0	Peak	Vertical	22.0	37.8	59.8	74.0	-14.2
4924.0	Average	Vertical	9.8	37.8	47.6	54.0	-6.4
4924.0	Peak	Horizontal	15.2	37.8	53.0	74.0	-21.0
4924.0	Average	Horizontal	2.6	37.8	40.4	54.0	-13.6
7386.0	Peak	Vertical	19.2	41.8	61.0	74.0	-13.0
7386.0	Average	Vertical	6.7	41.8	48.5	54.0	-5.5
7386.0	Peak	Horizontal	19.6	41.8	61.4	74.0	-12.6
7386.0	Average	Horizontal	6.3	41.8	48.1	54.0	-5.9
12310.0	Peak	Vertical	-0.6	45.5	44.9	74.0	-29.1
12310.0	Average	Vertical	-11.5	45.5	34.0	54.0	-20.0
12310.0	Peak	Horizontal	-0.9	45.5	44.6	74.0	-29.4
12310.0	Average	Horizontal	-12.6	45.5	32.9	54.0	-21.1

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

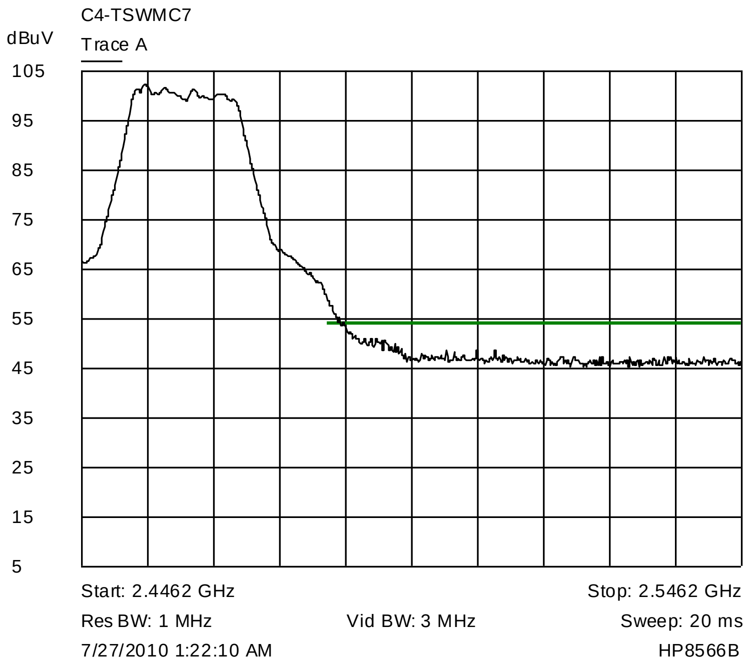
Radiated Lower Band Edge Plot



Corrected peak detection plot versus average limit - see tables for band edge compliance data

Trace A "G" mode radiated lower band edge plot

Radiated Upper Band Edge Plot



Corrected peak detection plot versus average limit - see tables for band edge compliance data

Trace A "G" mode radiated upper band edge plot

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.

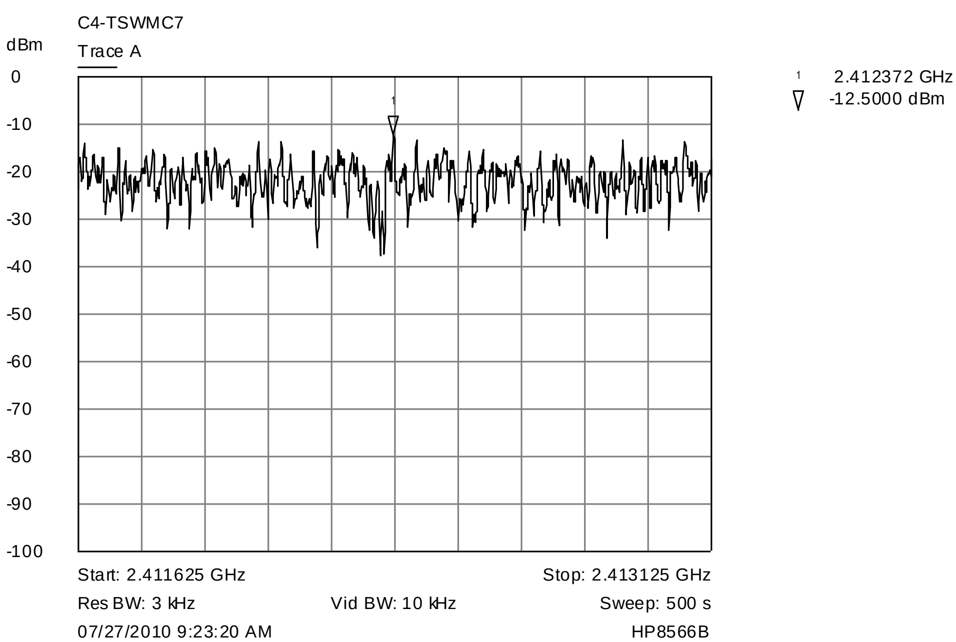
Frequency (MHz)	802.11b Measurement (dBm)	802.11g Measurement (dBm)	Criteria (dBm)
2412	-12.5	-17.5	8.0
2437	-12.4	-15.6	8.0
2462	-11.5	-16.6	8.0

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 -11.5 dBm. The EUT complies with the specification by 19.5 dB.

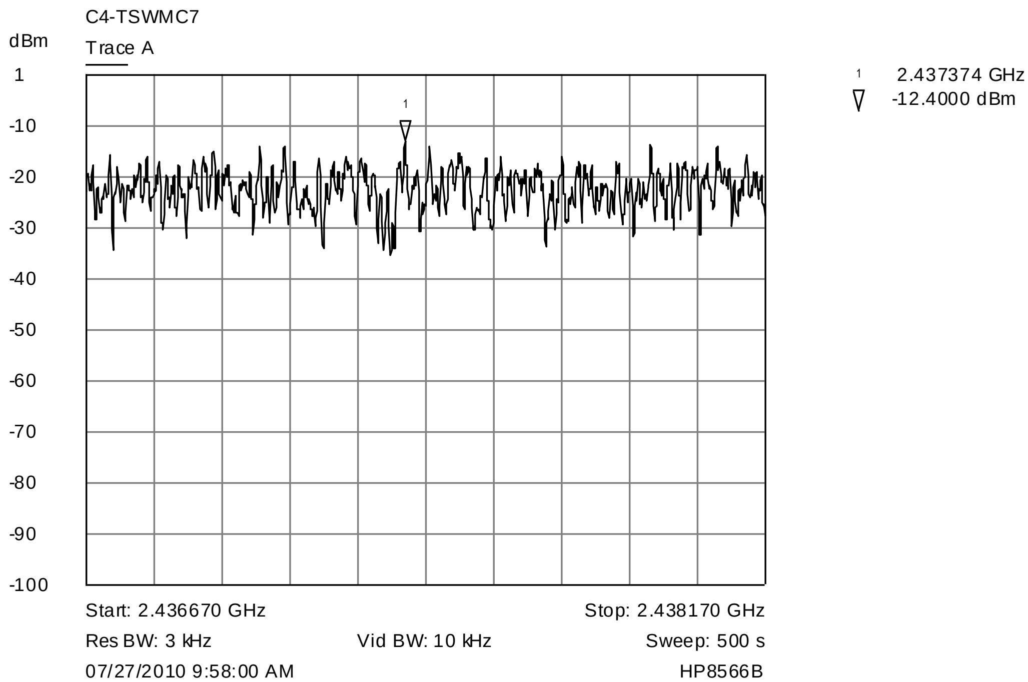
Lowest channel – 802.11b



"B" mode, power level 12

Trace A Lower 3 kHz power spectral density plot

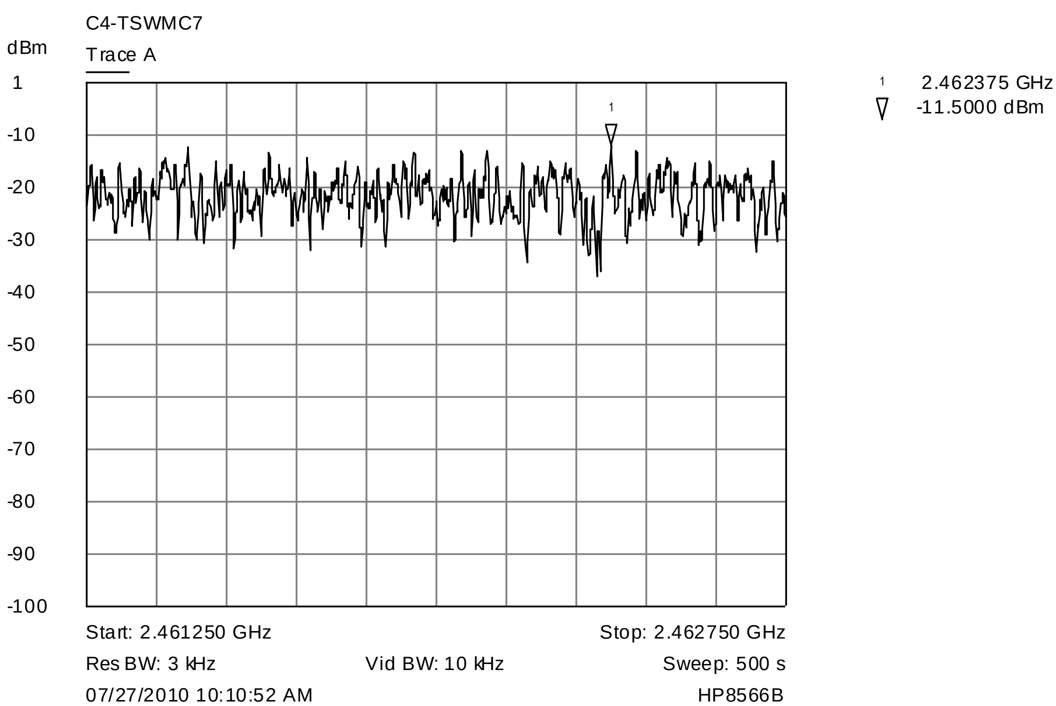
Middle channel – 802.11b



"B" mode, power level 12

Trace A   Middle channel 3 kHz power spectral density plot

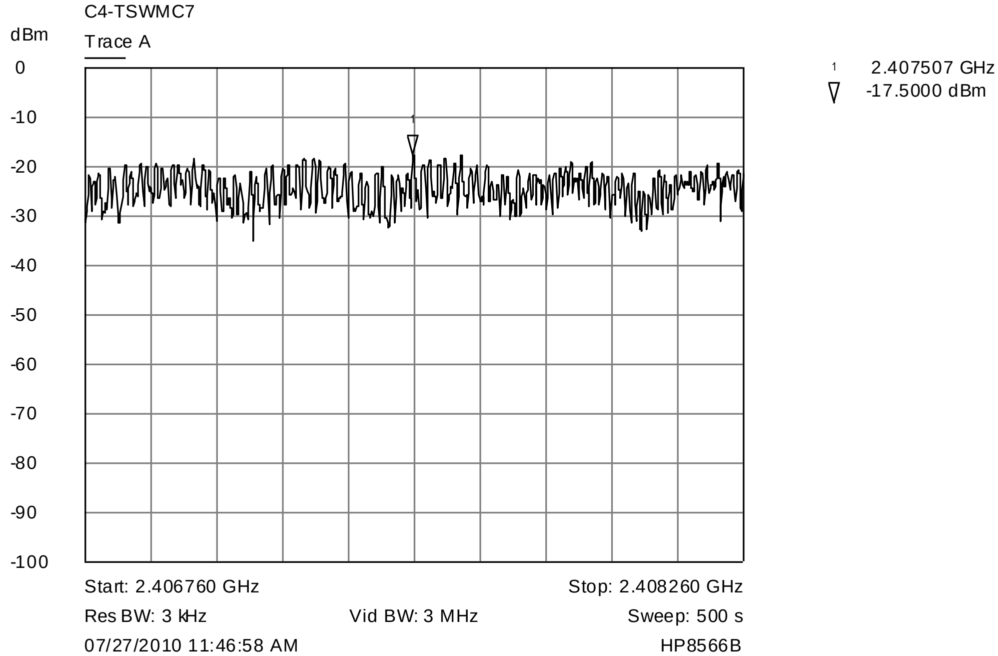
Upper channel – 802.11b



"B" mode, power level 12

Trace A   Upper channel 3 kHz power spectral density plot

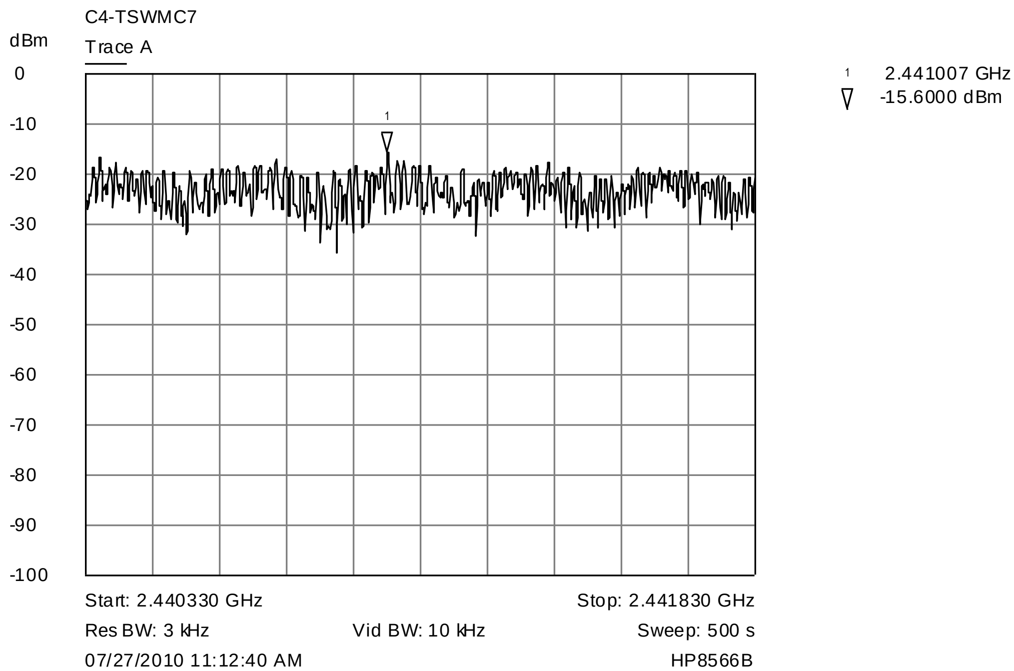
Lower channel – 802.11g



"G" Mode, power level 14

Trace A Lower channel output power plot

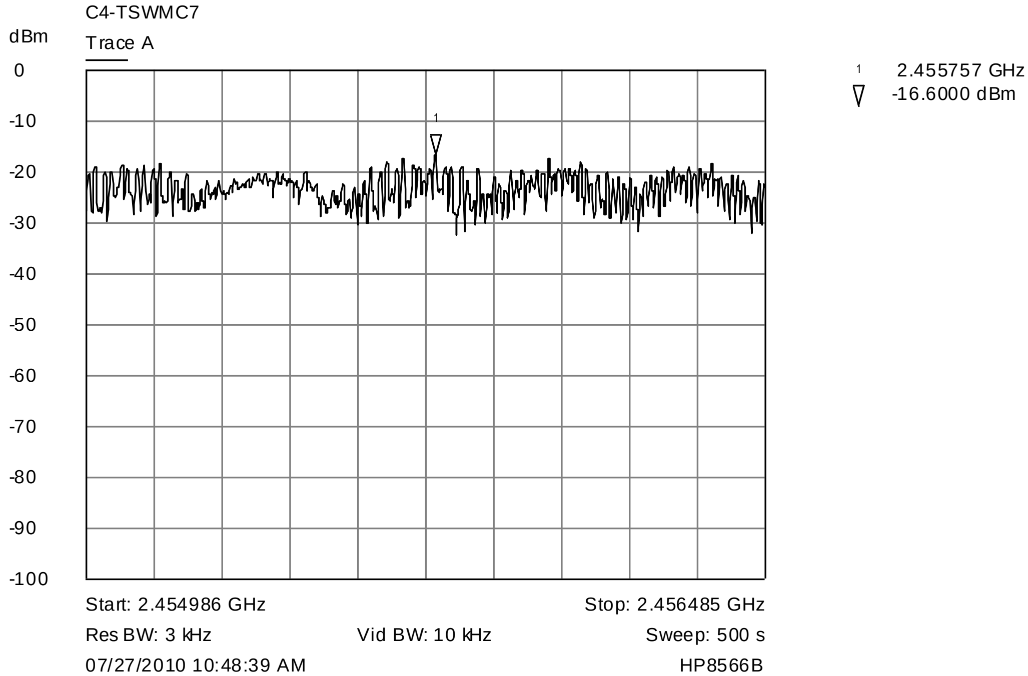
Middle channel – 802.11g



"G" Mode, power level 14

Trace A Middle channel 3 kHz power spectral density plot

Upper channel – 802.11g



"G" Mode, power level 14

Trace A Upper channel 3 kHz power spectral density plot

APPENDIX 1 TEST PROCEDURES AND TEST EQUIPMENT

§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 Ω/50 μH) 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.

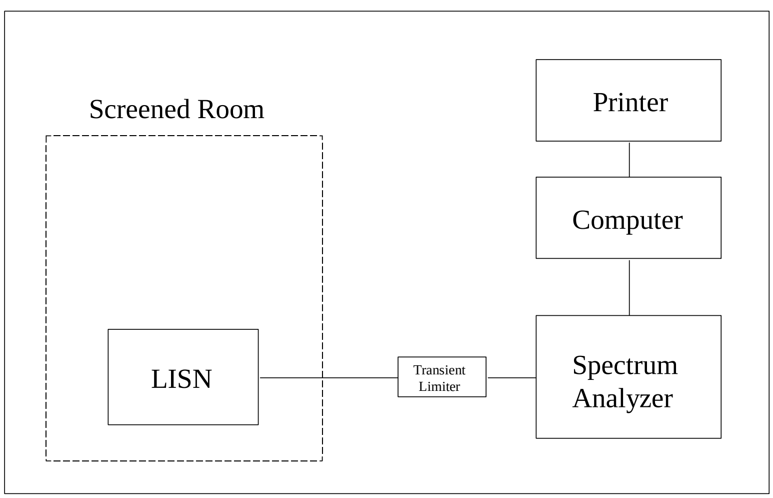
For AC mains port testing the desktop EUT are placed on a non-conducting table at least 0.8 meters from the metallic floor. The equipment is placed a minimum of 40 cm from all walls. Floor standing equipment is placed directly on the earth grounded floor.

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	10/08/2009
Test Software	Nemko-CCL, Inc.	Conducted Emissions	Revision 1.2	N/A
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
LISN	EMCO	3825/2	9305-2099	03/08/2010
Conductance Cable Wanship Site #2	Nemko-CCL, Inc.	Cable J	N/A	12/31/2009
Transient Limiter	Hewlett Packard	11947A	3107A02266	12/31/2009

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



§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.

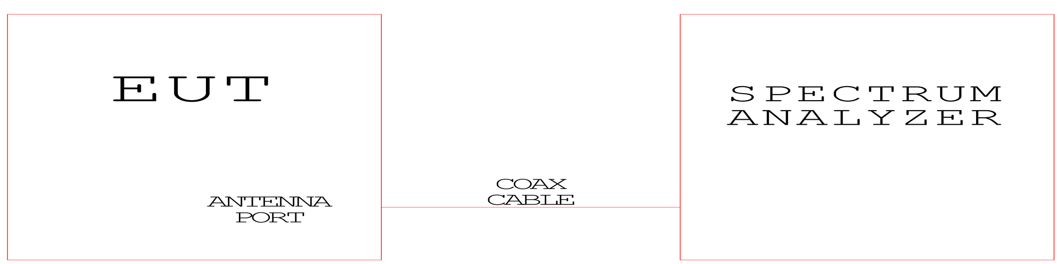
The spectrum analyzer’s resolution bandwidth and video bandwidth were set as follows:

RBW = 100 kHz
VBW = 300 kHz

Type of Equipment	Manufacturer	Model Number	Serial Number
Spectrum Analyzer	Hewlett Packard	8566B	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



§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:

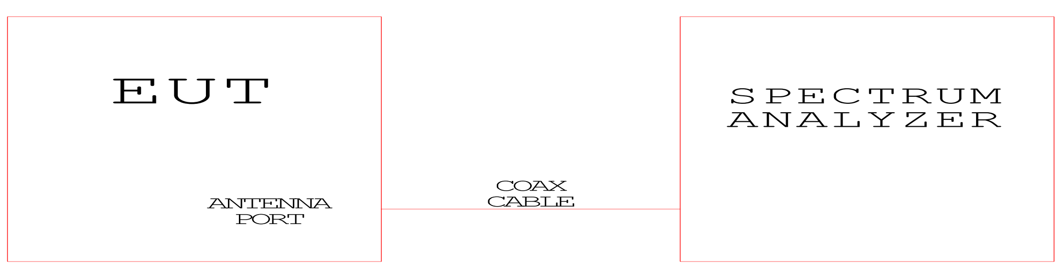
RBW = 3 MHz

VBW = 3 MHz

Type of Equipment	Manufacturer	Model Number	Serial Number
Spectrum Analyzer	Hewlett Packard	8566B	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



§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.

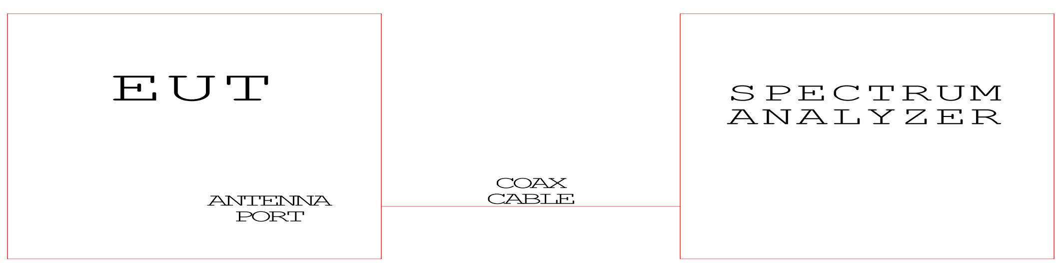
The spectrum analyzer's resolution bandwidth and video bandwidth were set as follows:

RBW = 100 kHz
VBW = 300 kHz

Type of Equipment	Manufacturer	Model Number	Serial Number
Spectrum Analyzer	Hewlett Packard	8566B	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



§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.

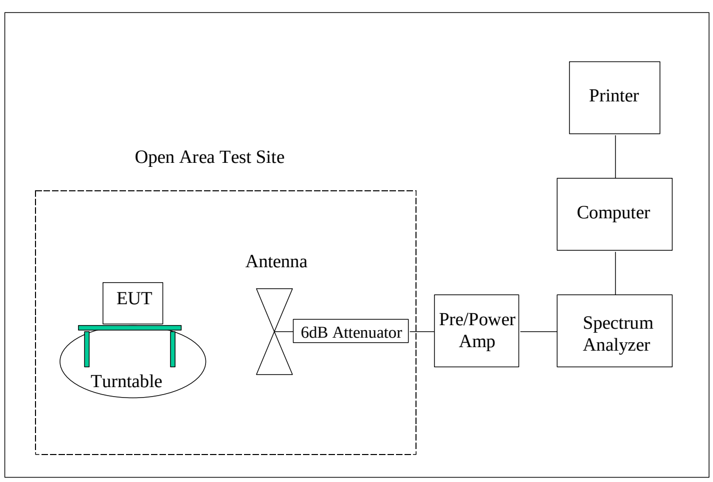
Desktop intentional radiators are measured on a non-conducting table 80 centimeters above the ground plane. The table is placed on a turntable which is level with the ground plane. The turntable has slip rings, which supply AC power to the intentional radiator. For equipment normally placed on floors,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

Type of Equipment	Manufacturer	Model Number	Serial Number	Date of Last Calibration
Spectrum Analyzer	Hewlett Packard	8566B	2230A01711	11/06/2009
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	03/04/2010
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 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



§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.

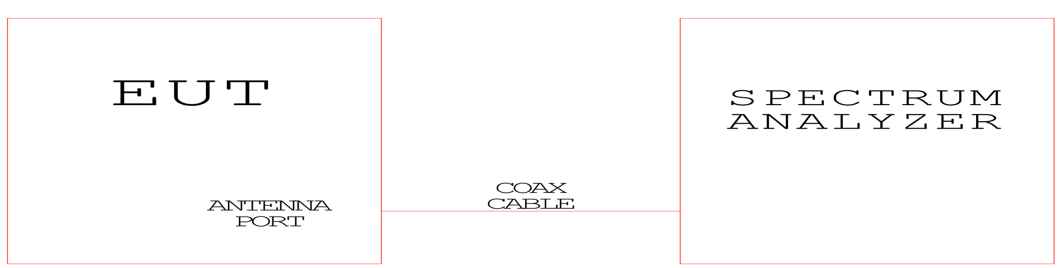
The spectrum analyzer's resolution bandwidth and video bandwidth were set as follows:

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

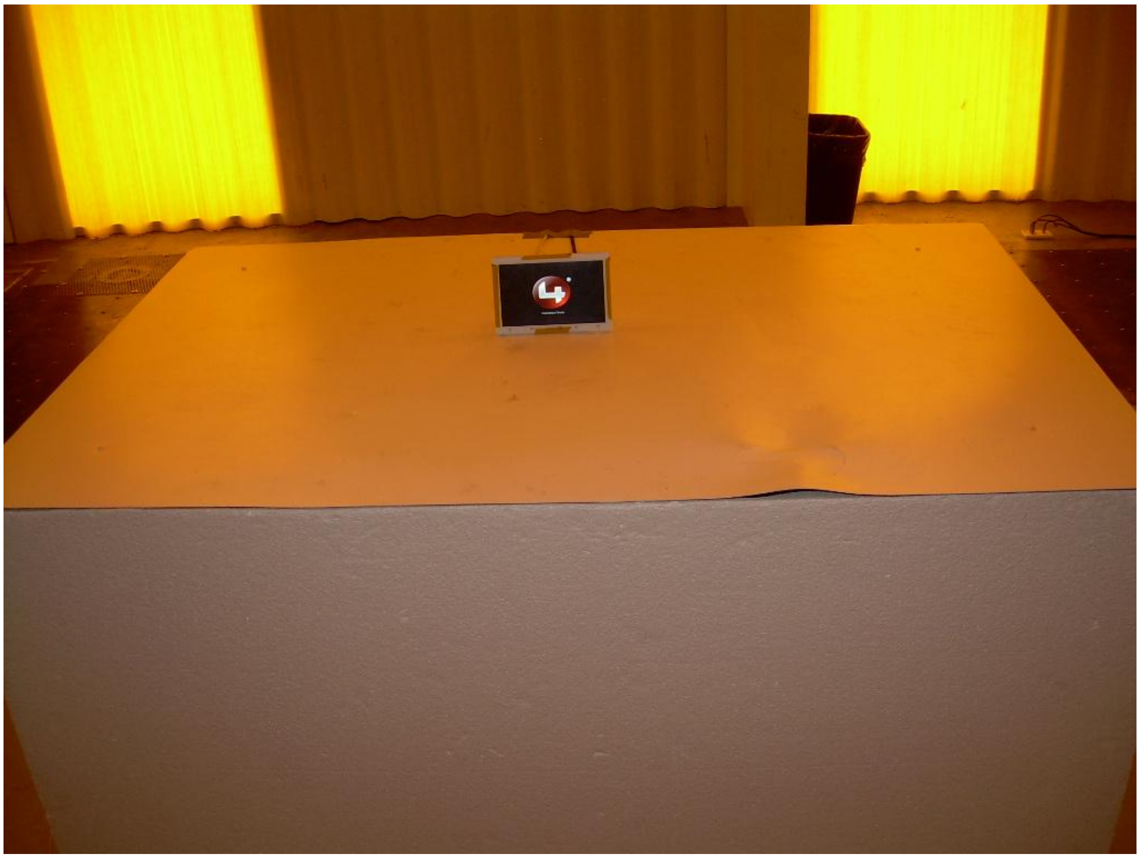
An independent calibration laboratory or Nemko-CCL, Inc. personnel calibrates all the equipment listed above at intervals defined in ANSI C63.4:2003 Section 4.4 following outlined calibration procedures. All measurement instrumentation is traceable to the National Institute of Standards and Technology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

Test Configuration Block Diagram

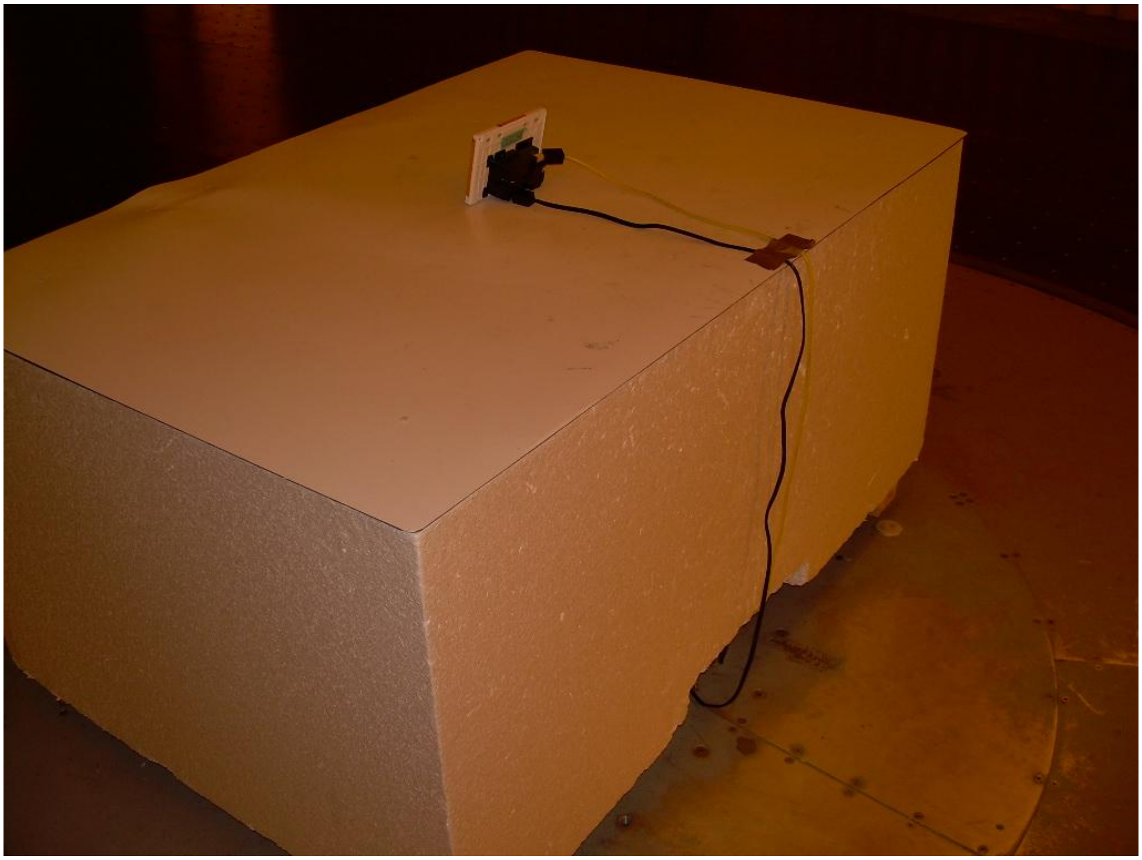


APPENDIX 2 PHOTOGRAPHS

Photograph 1 – Front View Radiated Disturbance/ AC Powered Configuration

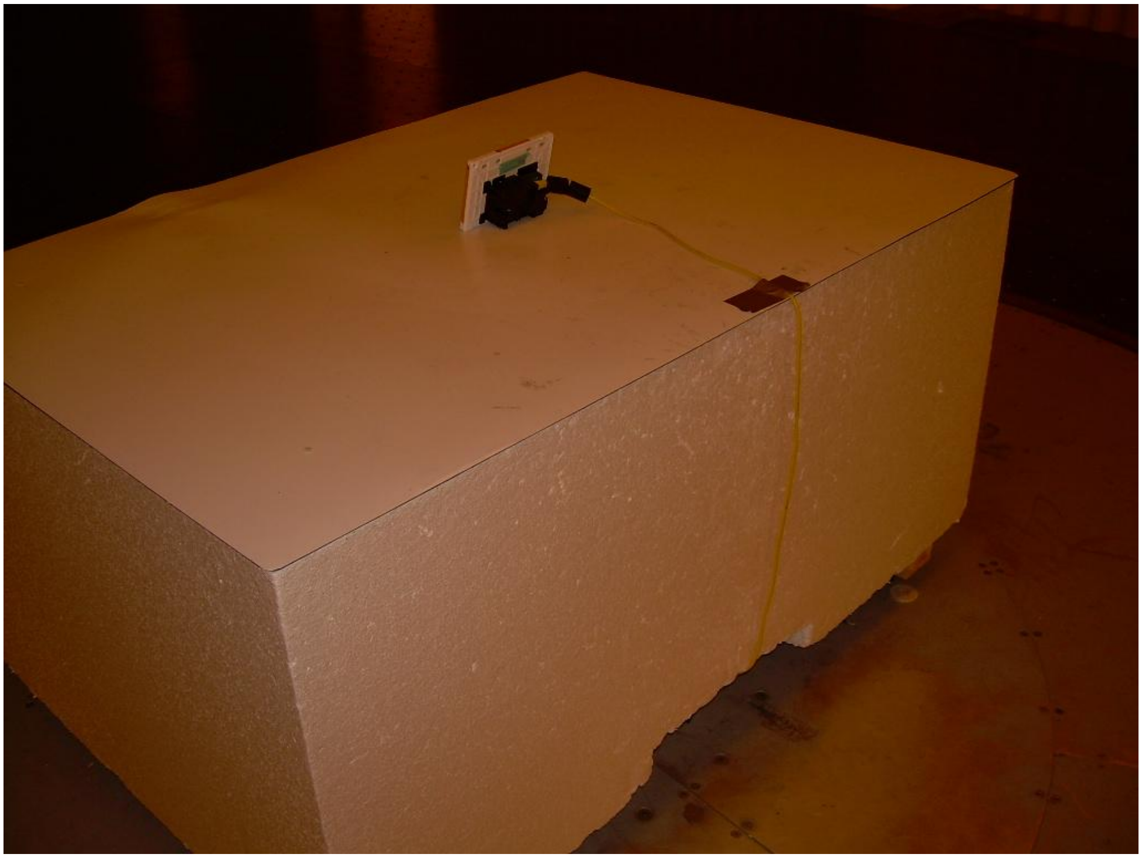


Photograph 2 – Back View Radiated Disturbance/ AC Powered Configuration



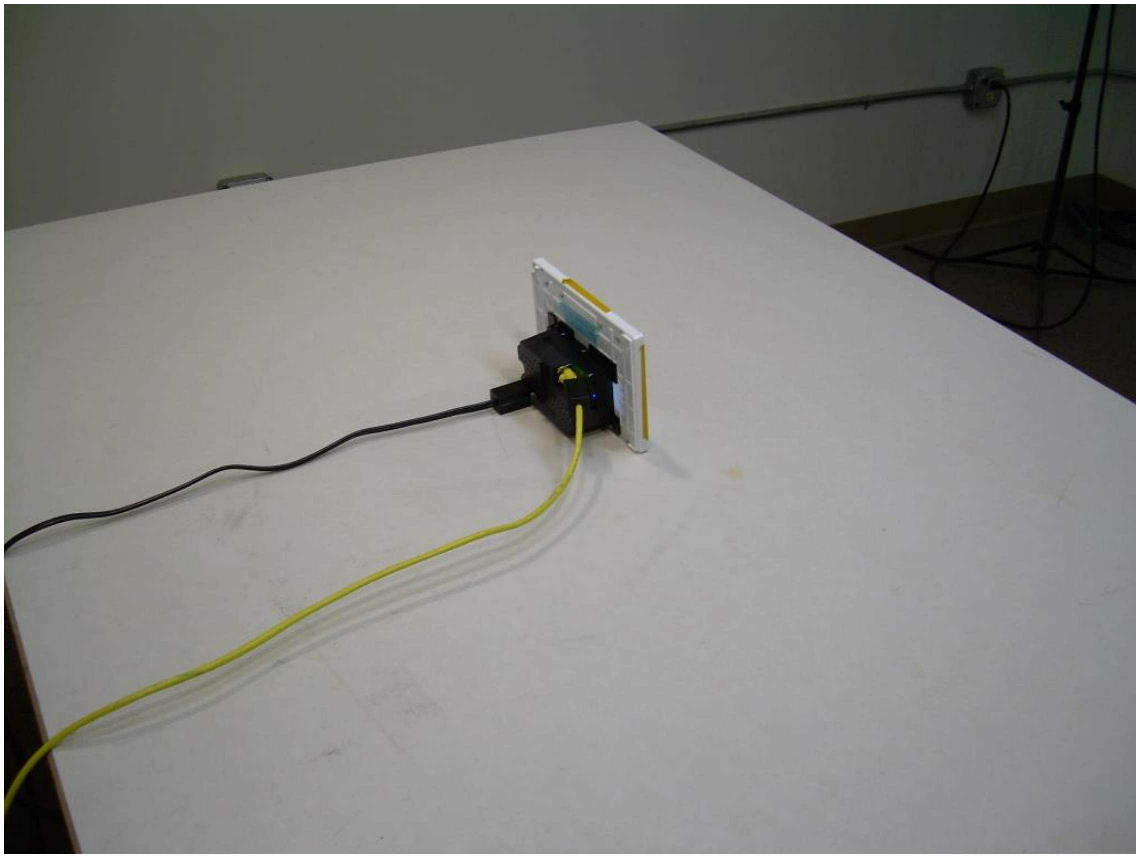
Photograph 3 – Front View Radiated Disturbance/ POE Configuration

Photograph 4 – Back View Radiated Disturbance/ POE Configuration



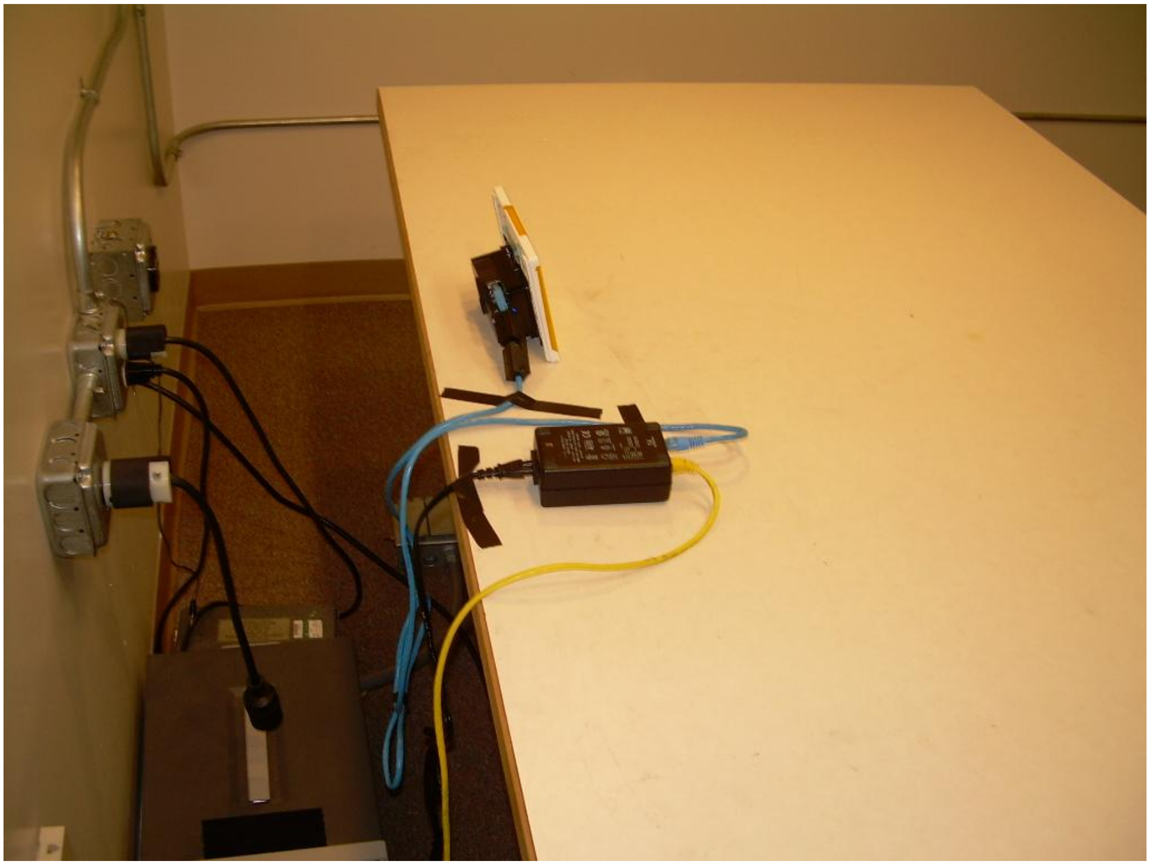
Photograph 5 – Front View Conducted Disturbance/AC Powered Case Configuration

Photograph 6 – Back View Conducted Disturbance/AC Powered Configuration

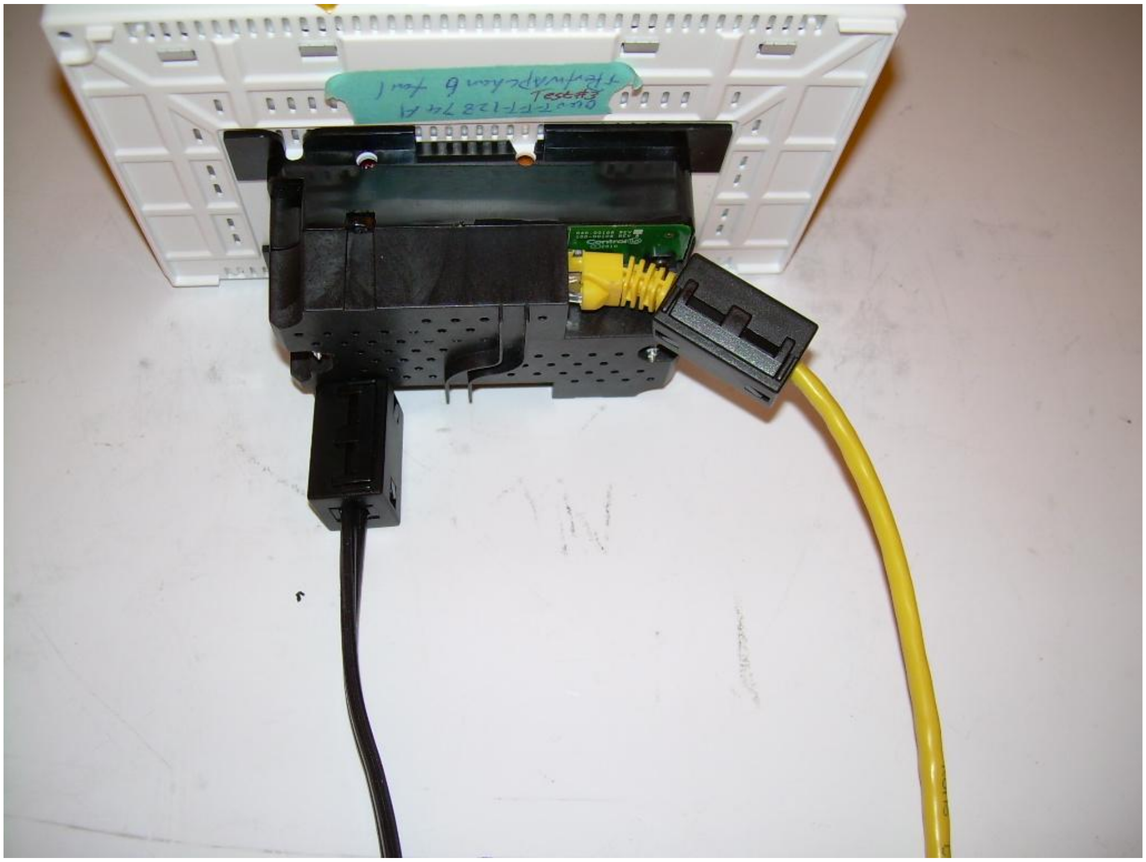


Photograph 7 – Front View Conducted Disturbance/POE Configuration

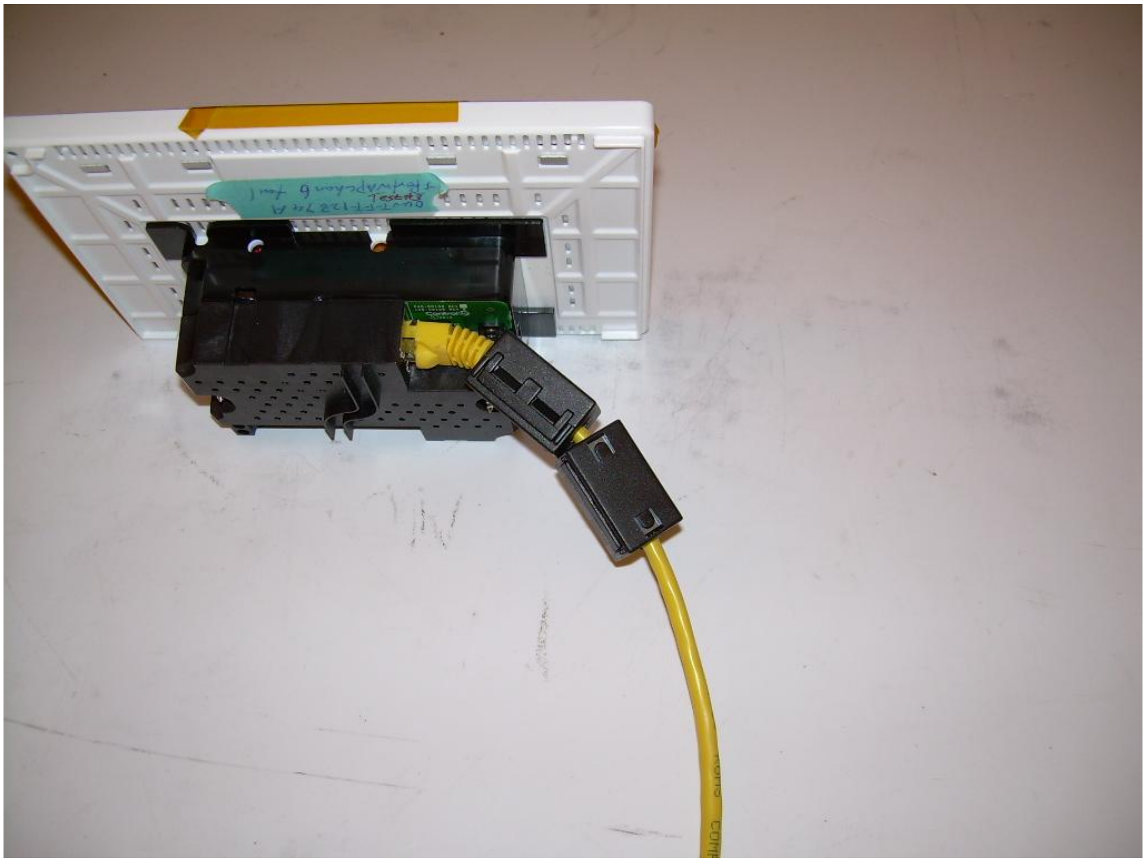
Photograph 8 – Back View Conducted Disturbance/POE Configuration



Photograph 9 – Ferrite Placement on AC and Ethernet Cables

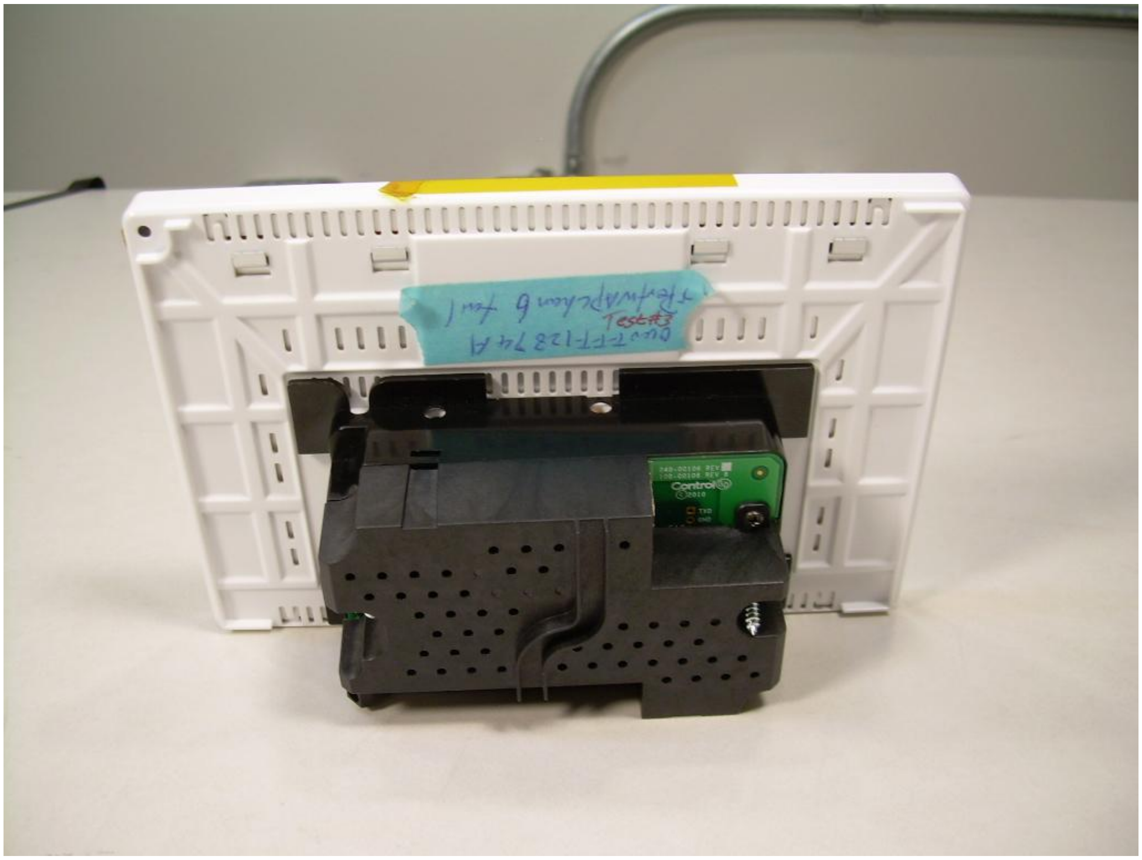


Photograph 10 - Ferrite Placement on Ethernet Cable when Operated with POE



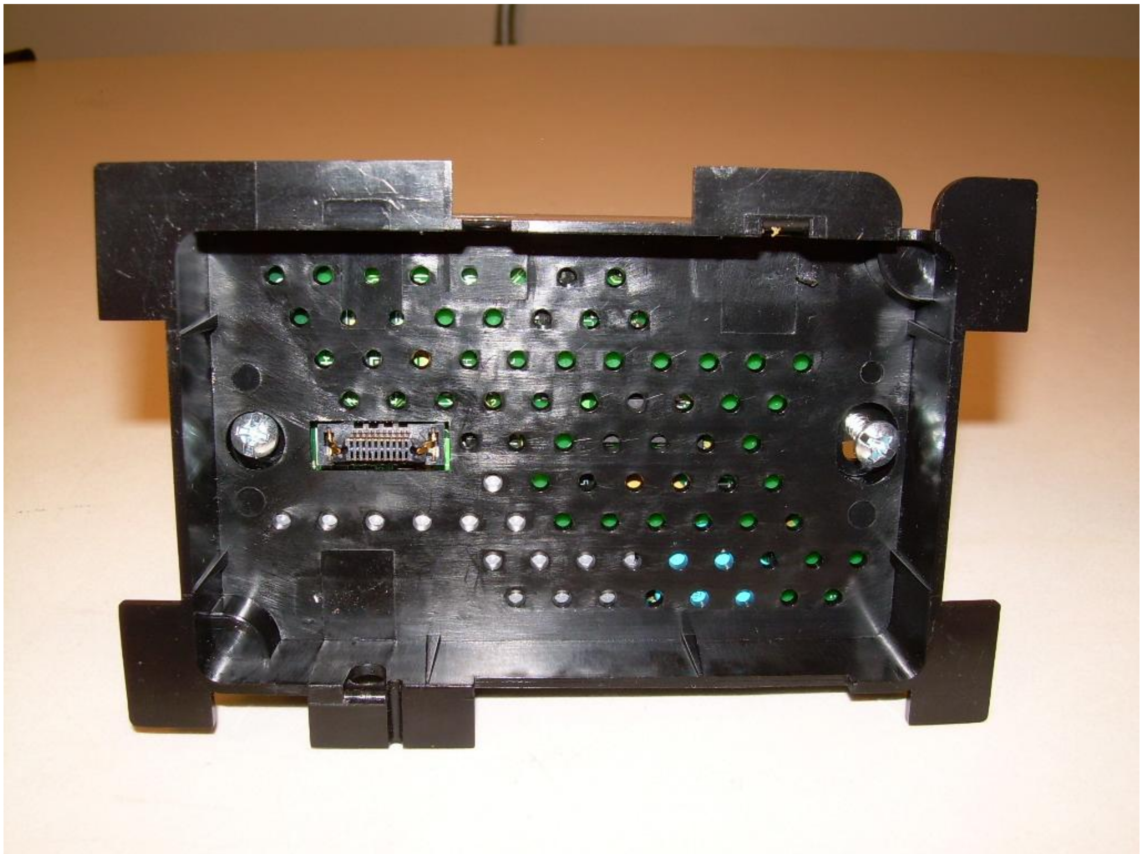
Photograph 11 – Front View of the EUT

Photograph 12 – Back View of the EUT



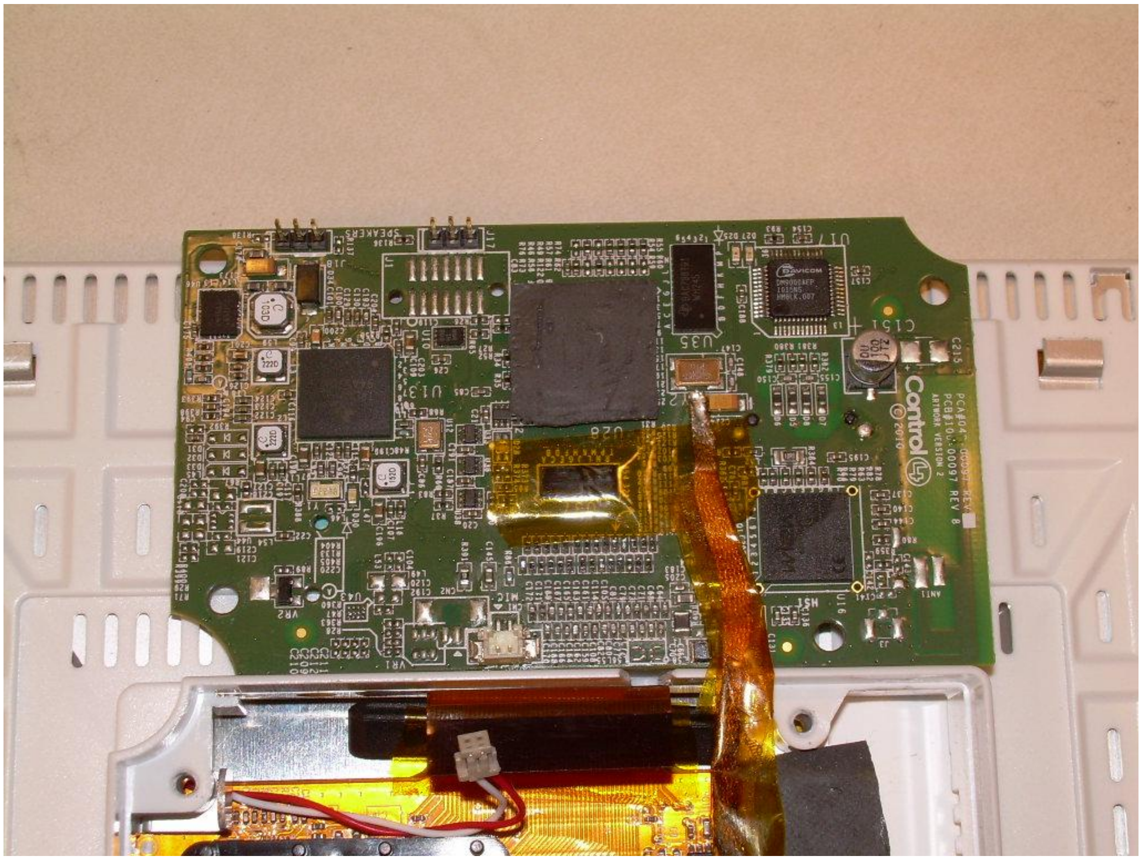
Photograph 13 – Back View of the Display Separated from Power Supply/Interface Module

Photograph 14 – View of the Power Supply/Interface Module with Display Removed

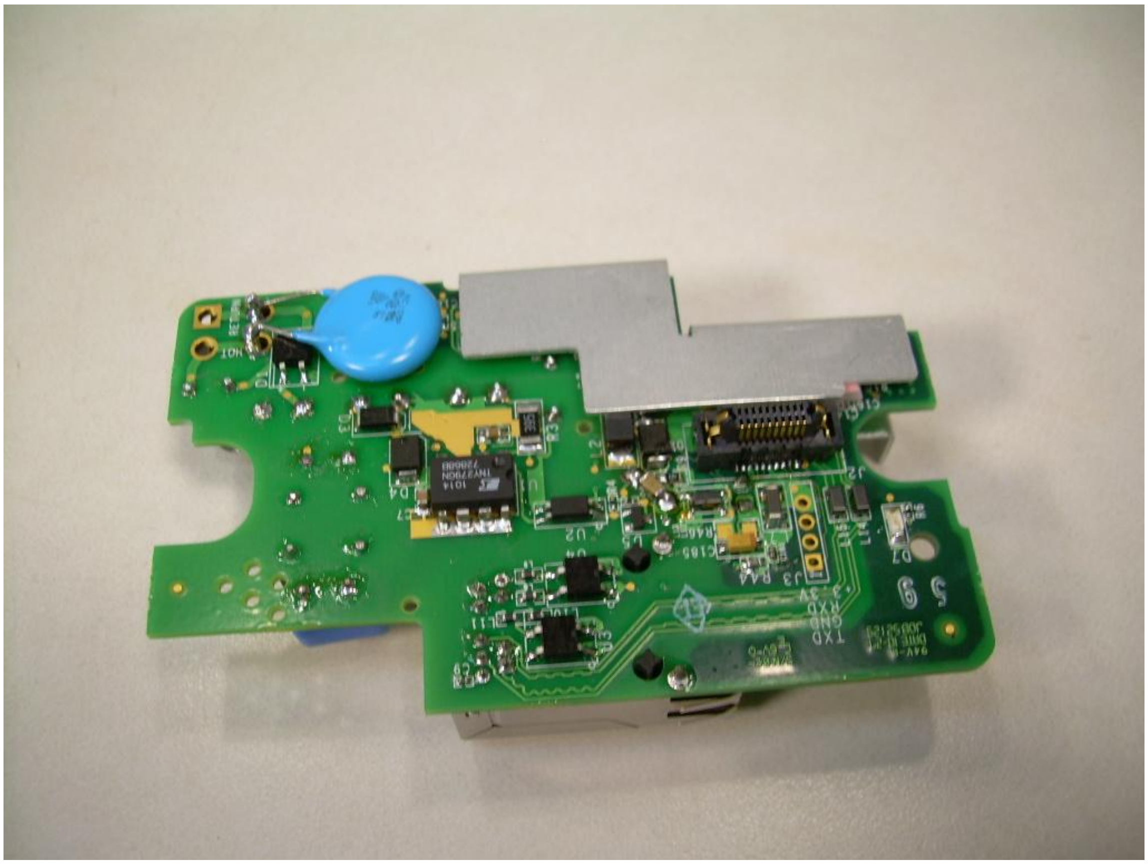


Photograph 15 – View of the Interface Side of the Display PCB

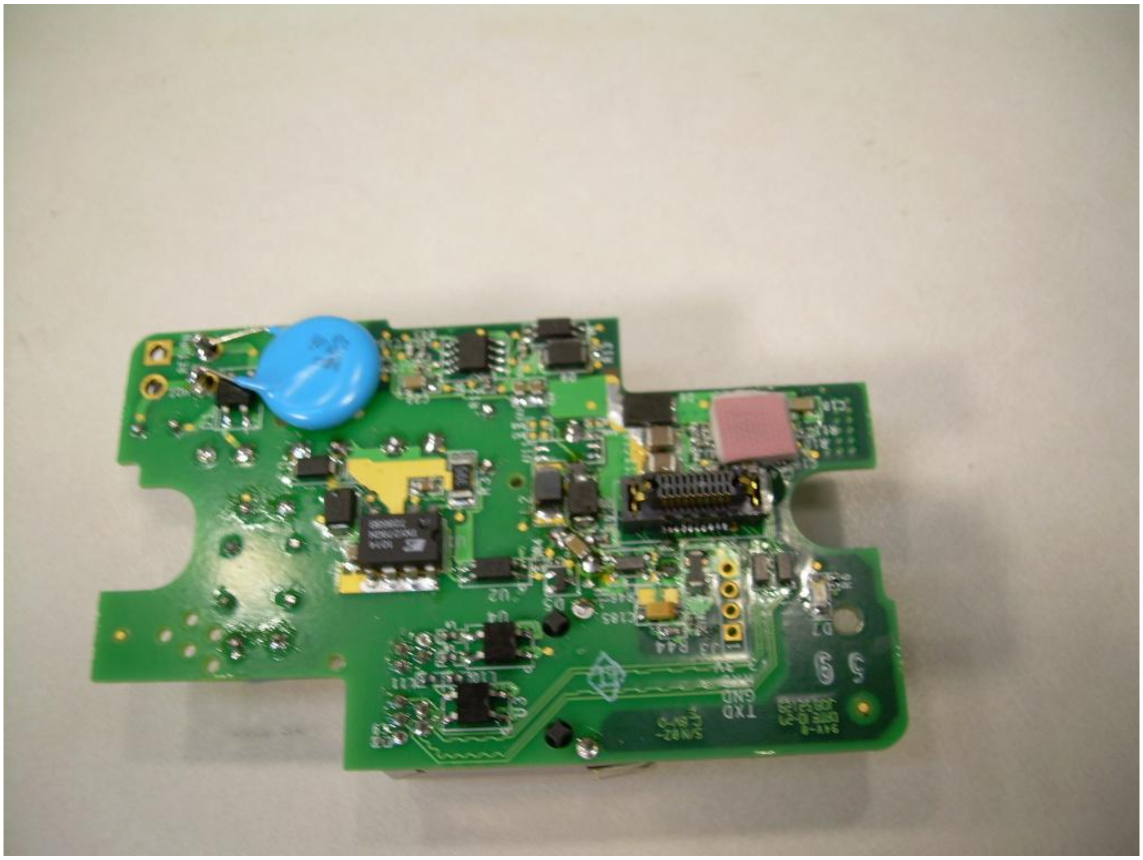
Photograph 16 – View of the Component Side of the Display PCB showing Ferrite on Flex Cable



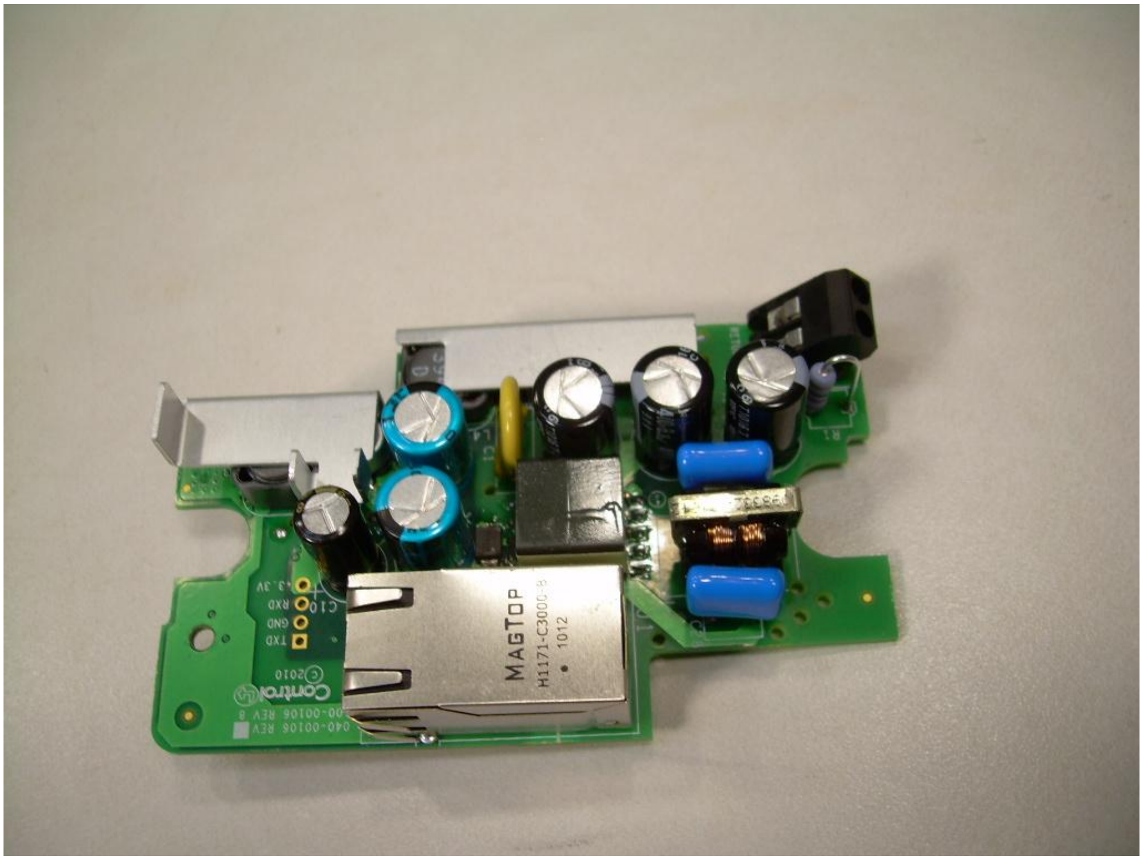
Photograph 17 – View of the Interface Side of the Power Supply/Interface PCB with Heatsink in Place



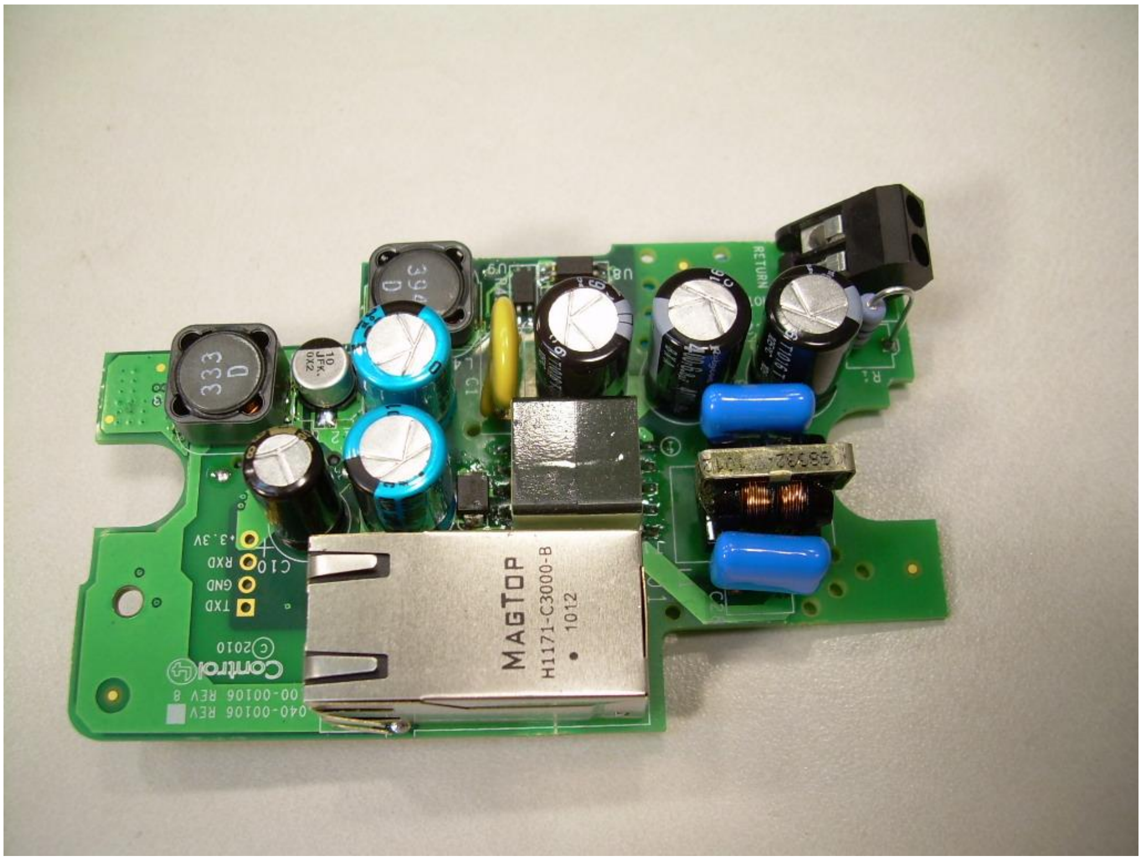
Photograph 18 - View of the Interface Side of the Power Supply/Interface PCB with Heatsink Removed



Photograph 19 - View of the Component Side of the Power Supply/Interface PCB with Heatsink in Place



Photograph 20 - View of the Component Side of the Power Supply/Interface PCB with Heatsink Removed



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 test 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.

AJIT SAMPALLI		8/27/2010
Printed name of official	Signature of official	Date

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