

COMMUNICATION CERTIFICATION LABORATORY

1940 West Alexander Street
Salt Lake City, UT 84119
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Test Report

Certification

Test Of:

AP2 Series

FCC ID:

PII-AP2RL

Test Specification:

FCC PART 15, Subpart C

Test Report Serial No: 1398

Applicant:

Vantage Controls
1061 South 800 East
Orem, UT 84097

Dates of Tests: March 18, 2008

Issue Date: March 19, 2008

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: Vantage Controls
- Manufacturer: Vantage Controls
- Brand Name: Vantage Controls
- Model Number: AP2 Series
- FCC ID Number: PII-AP2RL

On this 19th day of March 2008, 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: Vantage Controls
1061 South 800 East
Orem, UT 84097

Contact Name: Jared Lemke
Title: Engineer

1.2 Manufacturer:

Company Name: Vantage Controls
1061 South 800 East
Orem, UT 84097

Contact Name: Jared Lemke
Title: Engineer

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

Brand Name: Vantage Controls
Model Number: AP2 Series
Serial Number: None
Country of Manufacture: U.S.A.

2.2 Description of EUT:

The AP2 series are electronic lighting control devices that incorporate a wireless transceiver. They are designed to be plugged into a standard wall outlet to allow central control of lighting for a building. The transceiver operates in the 902-928 MHz unlicensed ISM frequency band and uses Frequency Hopping Spread Spectrum technology.

The AP2 series comes in two configurations depending on the type of loads to be controlled. The configurations both use the exact same transceiver. The components are the same and PCB layout of the transceiver is the same for all configurations. The only differences between devices are the load controls. One version uses relays to control the loads, and the other uses dimmer circuits. The configurations are shown below:

Ordering Code	Description
APREL	2-Load Relay Control
APDIM	2-Load Dimmer Control

This report covers the transmitter that is required to meet the requirements of FCC Part 15, Subpart C. The receiver and digital circuitry is covered in separate testing and report.

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	FCC ID Number	Description	Name of Interface Ports / Interface Cables
BN: Vantage Controls MN: APDIM (Note 1)	PII-AP2RL	Load Controller - Dimmer	See Section 2.4
BN: Vantage Controls MN: APREL (Note 1)	PII-AP2RL	Load Controller - Relay	See Section 2.4

Note: (1) EUT

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

2.4 Modification Incorporated/Special Accessories on EUT:

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

Signature: _____

Typed Name: Jared Lemke

Title: Engineer

SECTION 3.0 TEST SPECIFICATION, METHODS & PROCEDURES**3.1 Test Specification:**

Title: FCC PART 15, Subpart C (47 CFR 15)

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

3.2 Requirements:**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 as shown in paragraphs (b) and (c) of this section, for an intentional radiator 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.

(b) The shown limit in paragraph (a) of this Section shall not apply to carrier current systems operating as intentional radiators on frequencies below 30 MHz. In lieu thereof, these carrier current systems shall be subject to the following standards:

- (1) For carrier current systems containing their fundamental emission within the frequency band 535-1705 kHz and intended to be received using a standard AM broadcast receiver: no limit on conducted emissions.
- (2) For all other carrier current systems: 1000 uV within the frequency band 535-1705 kHz, as measured using a 50 μH/50 ohms LISN.
- (3) Carrier current systems operating below 30 MHz are also subject to the radiated emission limits in Section 15.205 and Section 15.209, 15.221, 15.223, 15.225 or 15.227, as appropriate.

(c) Measurements to demonstrate compliance with the conducted limits are not required for devices which only employ battery power for operation and which do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines. Devices that include, or make provision for, the use of battery chargers which permit operating while charging, AC adaptors or battery eliminators or that connect to the AC power lines indirectly, obtaining their power through another device which is connected to the AC power lines, shall be tested to demonstrate compliance with the conducted limits.

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 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 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 conducted 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 one Watt limit can be based on a measurement of the maximum conducted output power. Maximum 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 output 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 conducted 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 conducted output power.

(iii) Fixed, point-to-point operation, as used in paragraphs (c)(4)(i) and (c)(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 do [the word "do" should be deleted from this sentence] 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.

3.3 Test Procedure:

The line conducted and radiated 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 accepted 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 EUT was tested when placed on three orthogonal axes. The worst-case emissions were with the AP2 Series constantly transmitting when placed vertically on the EUT table. The EUT operates on 25 channels in the band of 907.3 to 916.9 MHz (9.6 MHz range) and was tested at the lowest frequency and the highest frequency to meet the requirements of §15.31(m).

4.3 EUT Exercise Software:

Vantage Controls software was used to control the AP2 Series transmitter.

4.4 Configuration & Peripherals:

The AP2 Series was placed on the table and connected to the support equipment listed in Section 2.3 via each port listed in Section 2.4. Shown in Section 4.5 is a block diagram of the test configuration.

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 Requirement	N/A	Complied
15.207	Conducted Disturbance at Mains Ports	0.15 to 30	Complied
15.247(a)	Transmitter Channel Characteristics	902 - 928	Complied
15.247(b)	Transmitter Output Power	902 - 928	Complied
15.247(c)	Operation with Directional Antenna Gains Greater than 6 dBi	902 - 928	Not Applicable
15.247(d)	Conducted Emissions at the Antenna Port	8 - 9280	Complied
15.247(d)	Radiated Emissions in the Restricted Bands	8 - 9280	Complied
15.247(e)	3 kHz Power Spectral Density	902 - 928	Not Applicable
15.247(f)	Hybrid Systems	902 - 928	Not Applicable
15.247(g)	Channel Usage	902 - 928	Complied
15.247(h)	Channel Hopset Coordination	902 - 928	Complied
15.247(i)	RF Exposure	902 - 928	Complied

5.2 Result

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

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

This section contains the test results and determinations 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 Requirement**

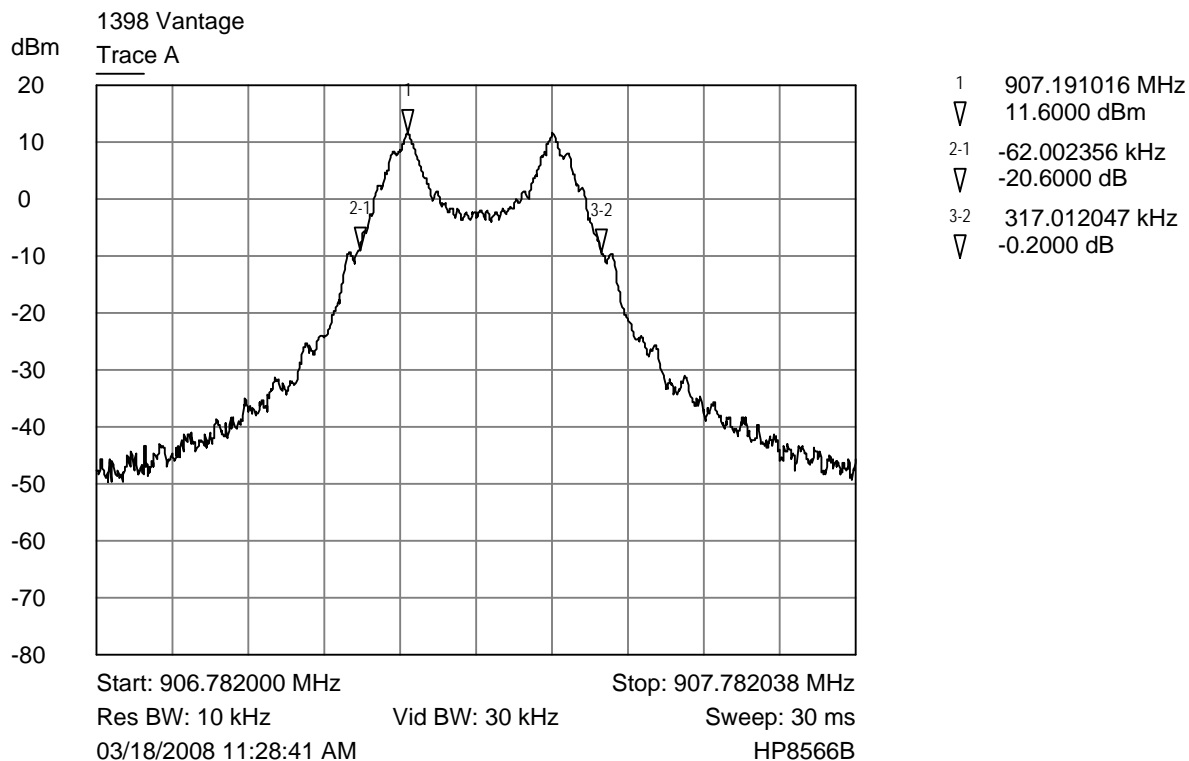
The antenna is an etched portion of the PCB; therefore, the requirements of this paragraph are met.

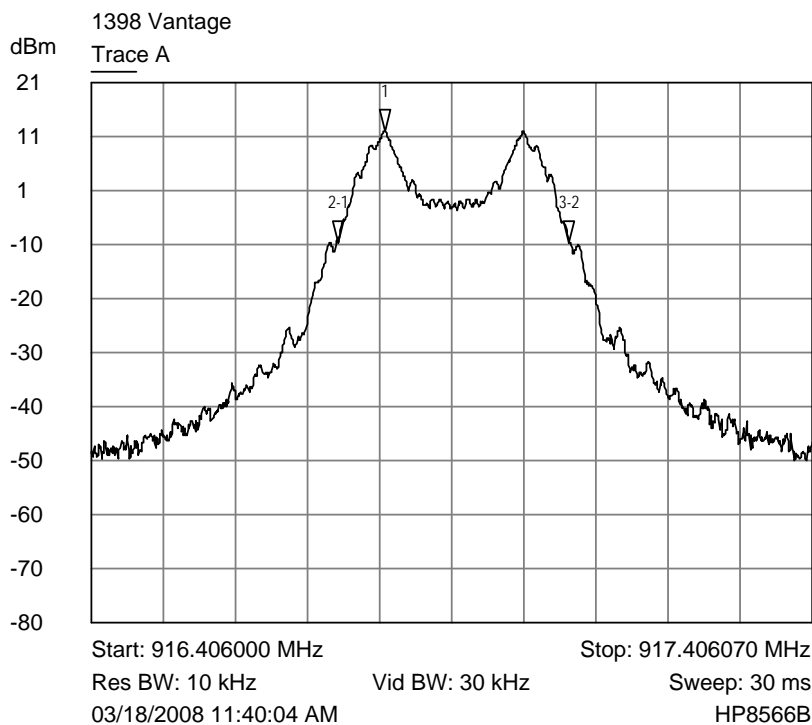
6.2.2 §15.207 Conducted Disturbance at Mains Ports Data

Frequency (MHz)	AC Mains Lead	Detector	Measured Level (dBμV)	Limit (dBμV)	Margin (dB)
0.27	Hot Lead	Peak (Note 1)	45.4	51.2	-5.8
0.55	Hot Lead	Peak (Note 1)	39.5	46.0	-6.5
0.67	Hot Lead	Quasi-Peak (Note 1)	40.6	46.0	-5.4
0.81	Hot Lead	Peak (Note 1)	39.2	46.0	-6.8
0.93	Hot Lead	Peak (Note 1)	38.6	46.0	-7.4
1.07	Hot Lead	Peak (Note 1)	37.5	46.0	-8.5
0.16	Neutral Lead	Peak (Note 1)	48.9	55.5	-6.6
0.18	Neutral Lead	Peak (Note 1)	46.2	54.5	-8.3
0.24	Neutral Lead	Peak (Note 1)	44.3	52.2	-7.9
0.66	Neutral Lead	Quasi-Peak (Note 1)	41.8	46.0	-4.2
0.81	Neutral Lead	Peak (Note 1)	38.2	46.0	-7.8
0.91	Neutral Lead	Peak (Note 1)	38.3	46.0	-7.7

6.2.3 §15.247(a)**6.2.3.1 §15.247(a)(1)**

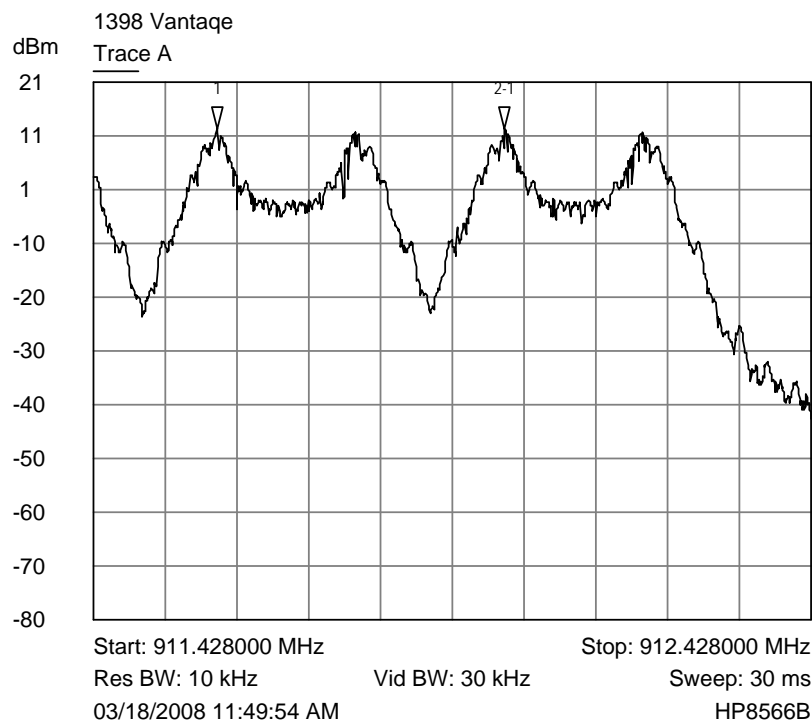
The EUT shall have the hopping channels separated by the greater of 25 kHz or the 20 dB bandwidth. The 20 dB bandwidth is 320 kHz and the channel separation is 401 kHz. See the plots below:





1 916.813028 MHz
▽ 11.6000 dBm
2-1 -64.004480 kHz
▽ -20.6000 dB
3-2 320.022400 kHz
▽ 0 dB

Trace A Upper channel bandwidth plot



1 911.600000 MHz
▽ 11.8000 dBm
2-1 401.000000 kHz
▽ 0.1000 dB

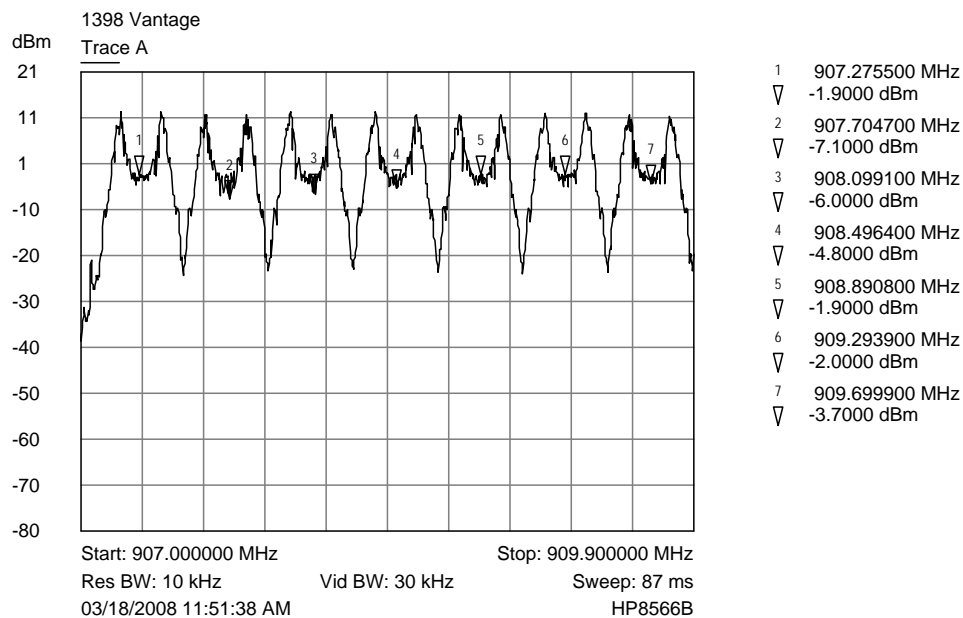
Trace A Channel separation plot

The EUT hops to channel frequencies that are selected at the system hopping rate from a pseudorandomly ordered list of hopping frequencies. Each frequency is used equally on the average by each transmitter. See the hop sequence table below. The receiver has input bandwidths that match the hopping channel bandwidths of the corresponding transmitter and shifts frequencies in synchronization with the transmitted signals.

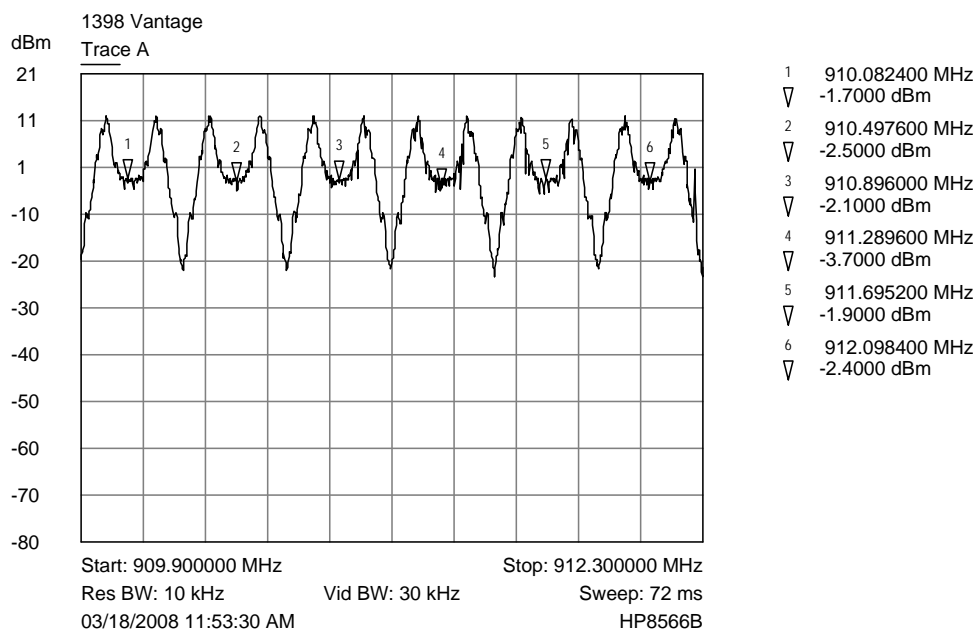
Hop Sequences															
#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	#11	#12	#13	#14	#15	#16
2	1	17	21	5	3	20	24	13	22	9	14	10	12	21	17
12	13	10	16	10	23	9	14	20	15	4	5	23	6	8	6
18	9	3	8	18	10	21	3	16	9	24	12	19	24	12	14
11	3	7	4	2	2	14	21	5	23	16	3	3	7	17	7
24	19	25	19	11	9	18	11	22	18	6	24	8	2	9	11
17	12	8	9	15	18	3	1	12	14	19	8	2	13	1	25
21	22	23	25	25	6	22	12	23	24	1	21	14	25	11	20
3	11	4	1	12	17	17	20	11	2	8	1	6	3	16	12
25	23	21	6	16	8	11	5	7	21	18	20	20	16	3	1
10	2	2	10	21	24	4	19	14	10	22	4	11	22	14	15
15	10	16	17	7	15	8	15	1	19	7	25	22	8	25	21
6	4	24	3	20	19	13	8	18	7	17	16	1	19	15	13
23	15	12	20	13	11	7	17	4	13	12	23	21	14	7	18
16	24	5	7	8	21	23	22	17	3	2	6	12	21	19	5
7	18	1	15	14	25	1	10	25	11	15	11	25	4	5	24
1	25	19	22	19	13	25	25	19	5	20	19	17	11	23	19
5	7	6	14	23	4	5	4	10	17	25	13	7	20	13	4
9	21	13	2	3	12	16	13	21	4	11	17	18	10	24	23
19	17	22	23	17	7	12	6	6	20	3	2	24	1	4	8
8	5	18	12	1	16	19	18	2	1	13	18	9	9	18	3
20	14	9	24	24	1	24	23	8	16	23	7	13	17	10	10
14	8	14	5	6	14	10	9	15	25	14	22	5	23	20	22
4	16	20	11	22	22	6	16	3	6	10	9	15	15	2	16
22	20	15	18	4	5	15	2	9	12	5	15	4	5	22	9
13	6	11	13	9	20	2	7	24	8	21	10	16	18	6	2

6.2.3.2 §15.247(a)(1)(i)

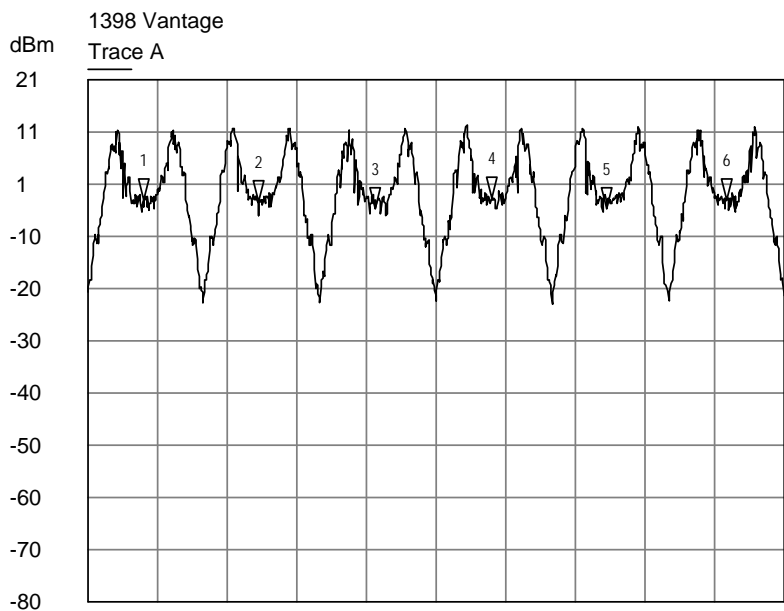
The EUT has a channel bandwidth of 320 kHz (see the plots of 6.2.3.1) and uses 25 channels. The average time of channel occupancy is 396.5 milliseconds within any 10 second time frame. See the plots below:



Trace A lower 7 channels



Trace A lower middle 6 channels



Start: 912.300000 MHz

Stop: 914.700000 MHz

Res BW: 10 kHz

Vid BW: 30 kHz

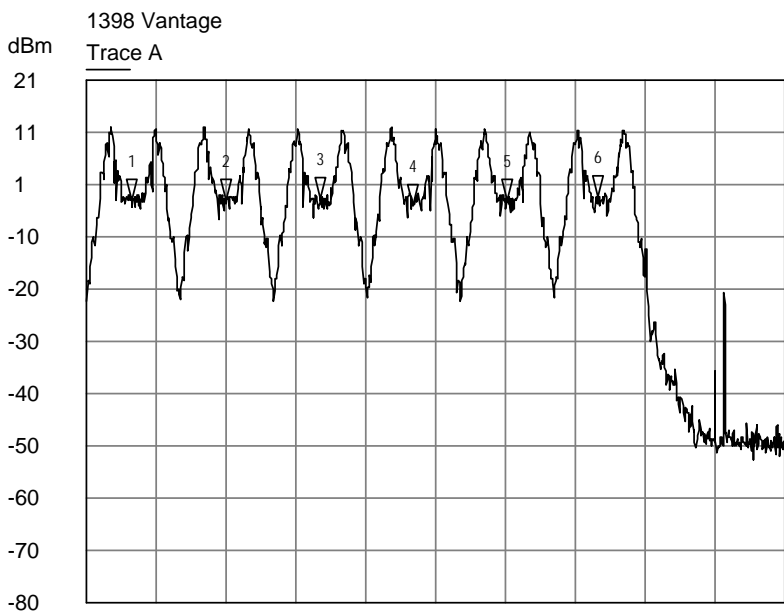
Sweep: 72 ms

03/18/2008 11:58:35 AM

HP8566B

Trace A upper middle 6 channels

1	912.489600 MHz
▽	-2.4000 dBm
2	912.890400 MHz
▽	-2.7000 dBm
3	913.291200 MHz
▽	-4.3000 dBm
4	913.689600 MHz
▽	-2.2000 dBm
5	914.090400 MHz
▽	-4.1000 dBm
6	914.500800 MHz
▽	-2.5000 dBm



Start: 914.700000 MHz

Stop: 917.700000 MHz

Res BW: 10 kHz

Vid BW: 30 kHz

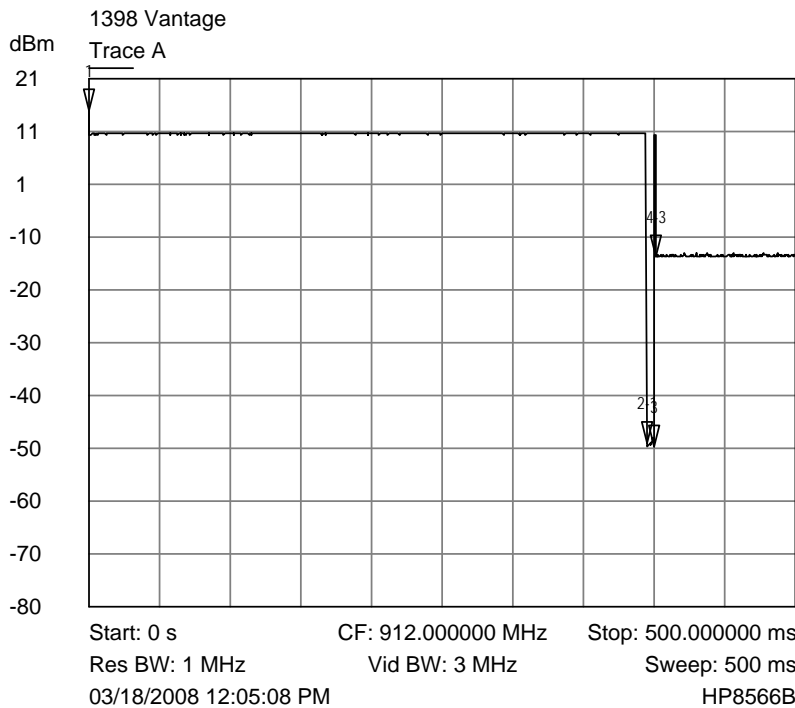
Sweep: 90 ms

03/18/2008 11:59:51 AM

HP8566B

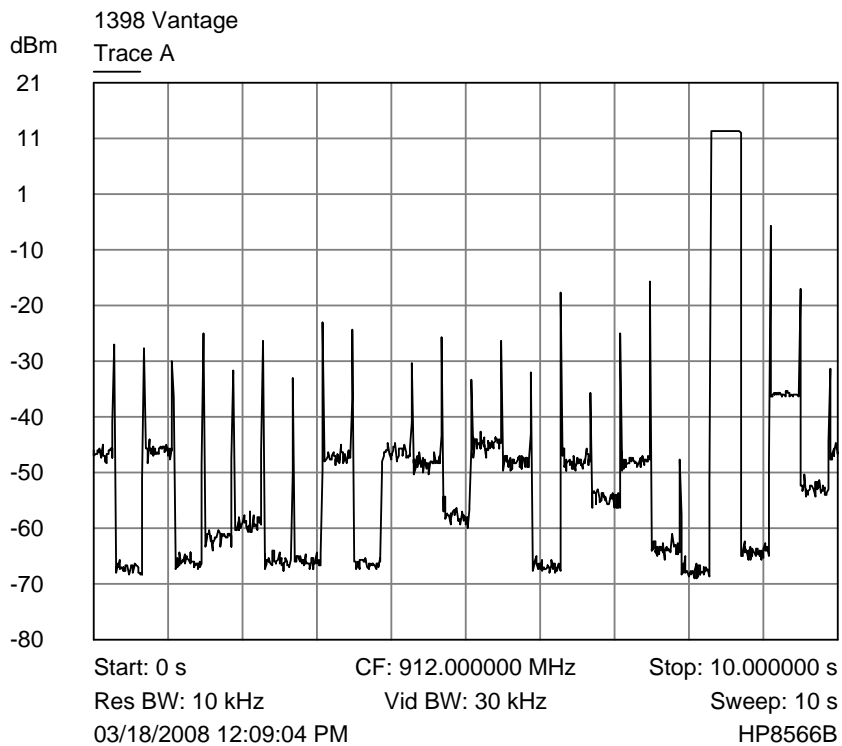
Trace A upper 6 channels

1	914.898000 MHz
▽	-2.6000 dBm
2	915.300000 MHz
▽	-2.5000 dBm
3	915.705000 MHz
▽	-2.3000 dBm
4	916.104000 MHz
▽	-3.4000 dBm
5	916.506000 MHz
▽	-2.5000 dBm
6	916.899000 MHz
▽	-1.8000 dBm



1	0 s
▽	14.5000 dBm
2-1	394.500000 ms
▽	-62.9000 dB
3	399.500000 ms
▽	-49.2000 dBm
4-3	2.000000 ms
▽	36.2000 dB

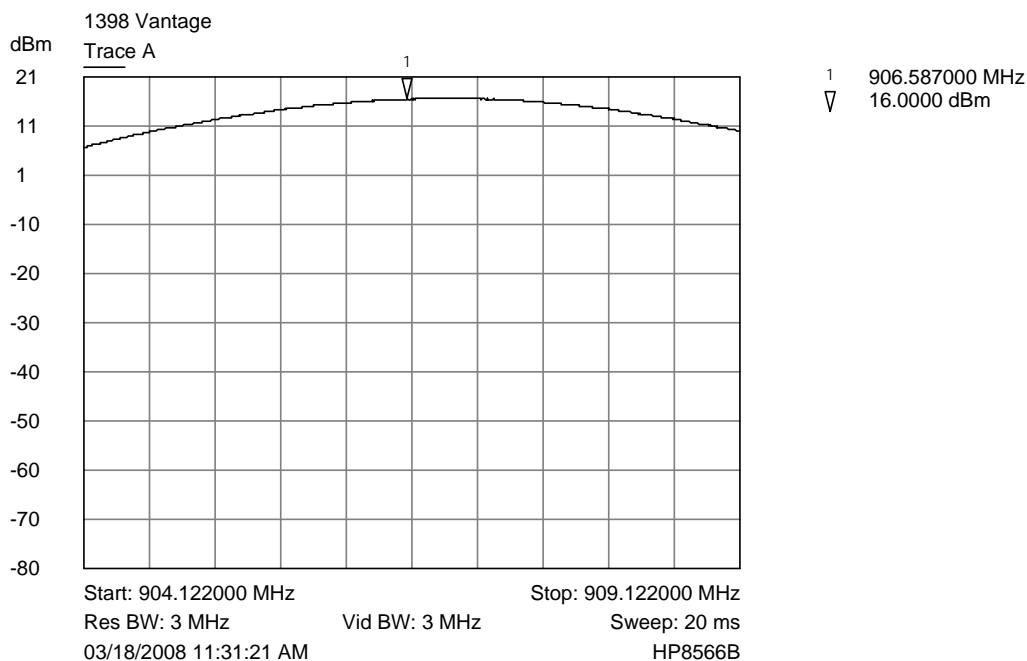
Trace A Channel dwell time



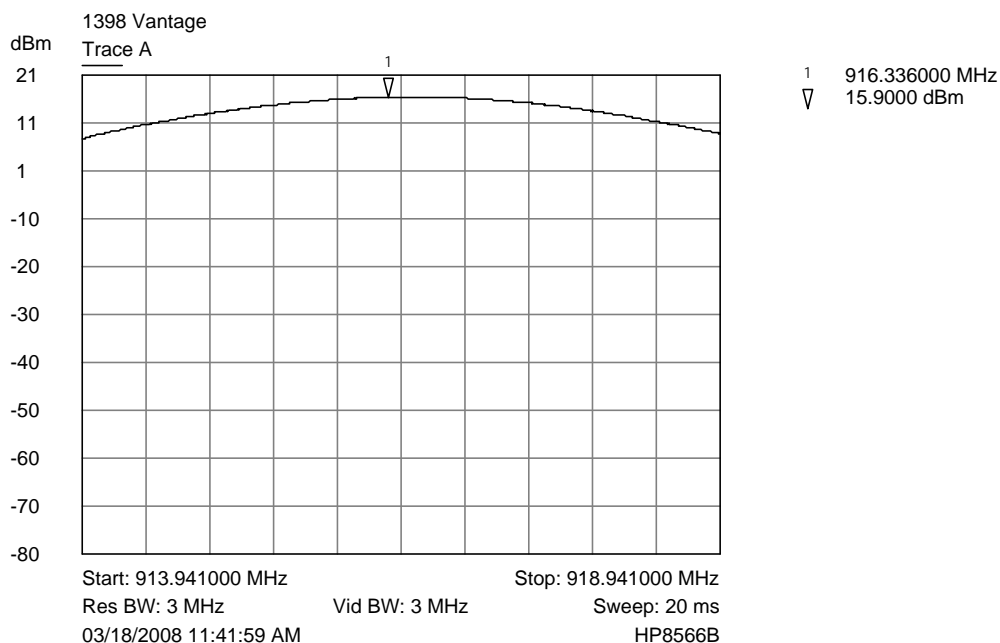
Trace A channel hits in 10 seconds

6.2.4 §15.247(b)(2) Peak Conducted Power Requirement

The EUT has a measured peak conducted power of 39.81 mW or 16.0 dBm. The limit for this device is 250 mW or 23.98 dBm. See the plots below.



Trace A Lower channel output power plot



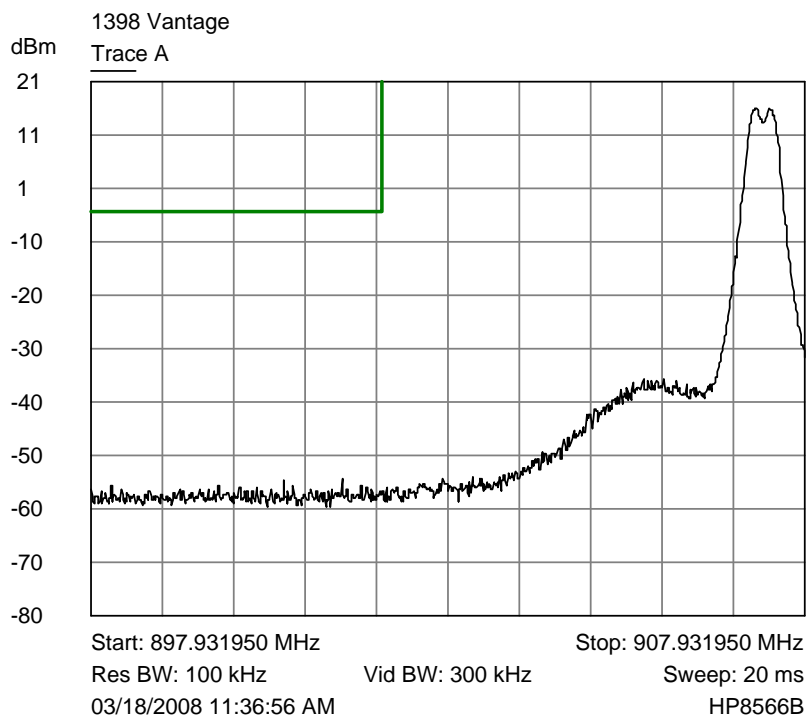
Trace A Upper channel output power plot

6.2.5 §15.247(d) Spurious Emission Measurements**6.2.5.1 Conducted Measurements at the Antenna Port**

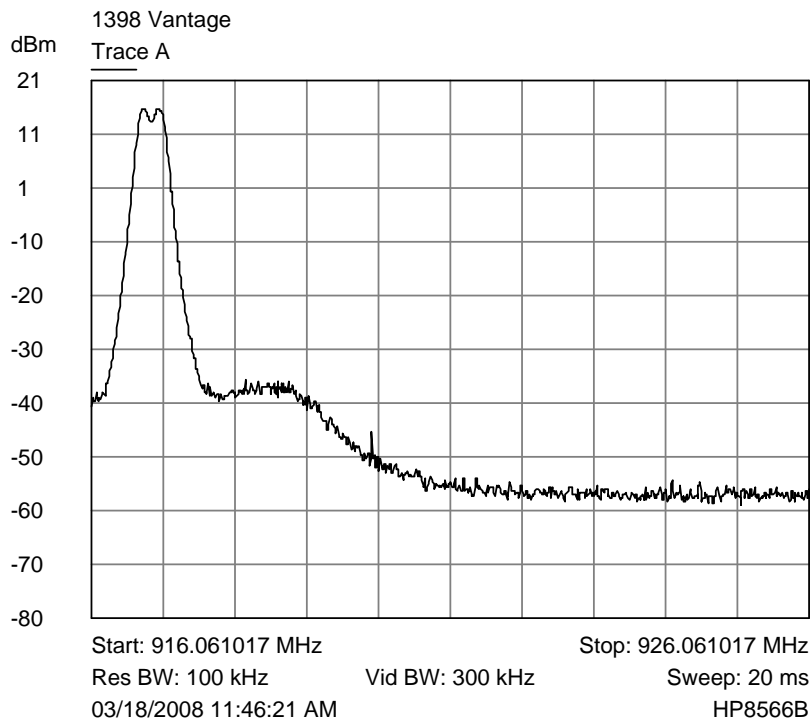
The conducted spurious emissions, in any 100 kHz bandwidth outside the operating band, must be attenuated to at least 20 dB below the measured fundamental emission level. The measured level was 16.0 dBm; therefore, the spurious conducted emissions must be attenuated below -4.0 dBm. The EUT maximum conducted spurious emission was measured at -18.9 dBm on a frequency of 1833.8 MHz. See the tables and plots below:

907.3 MHz			
Frequency (MHz)	Measurement (dBm)	Limit (dBm)	Margin (dB)
1814.6	-24.3	-4.0	-20.3
2721.9	-57.1	-4.0	-53.1
3629.2	-58.3	-4.0	-54.3
4536.5	-63.0	-4.0	-59.0
5443.8	-64.7	-4.0	-60.7
6351.1	-60.0	-4.0	-56.0
7258.4	-60.3	-4.0	-56.3
8165.7	-59.6	-4.0	-55.6
9073.0	-60.1	-4.0	-56.1

916.9 MHz			
Frequency (MHz)	Measurement (dBm)	Limit (dBm)	Margin (dB)
1833.8	-18.9	-4.0	-14.9
2750.7	-52.5	-4.0	-48.5
3667.6	-52.0	-4.0	-48.0
4584.5	-57.8	-4.0	-53.8
5501.4	-64.2	-4.0	-60.2
6418.3	-60.1	-4.0	-56.1
7335.2	-60.8	-4.0	-56.8
8252.1	-59.7	-4.0	-55.7
9169.0	-59.9	-4.0	-55.9



Trace A Lower channel bandedge plot



Trace A Upper channel band edge plot

6.2.5.2 Radiated Spurious Emission Measurements

The radiated spurious emissions that fall in restricted bands, as specified in §15.205, must comply with the limits of §15.209. The nearest emission to the limit, was 11.9 dB below the limit at 3629.2 MHz. See the tables below:

907.3 MHz							
Frequency (MHz)	Detection Mode	Antenna Polarity	Receiver Reading (dBμV)	Correction Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2721.9	Peak	Vertical	18.3	31.6	49.9	74.0	-24.1
2721.9	Average	Vertical	7.3	31.6	38.9	54.0	-15.1
2721.9	Peak	Horizontal	20.2	31.6	51.8	74.0	-22.2
2721.9	Average	Horizontal	10.1	31.6	41.7	54.0	-12.3
3629.2	Peak	Vertical	16.3	34.4	50.7	74.0	-23.3
3629.2	Average	Vertical	7.7	34.4	42.1	54.0	-11.9
3629.2	Peak	Horizontal	15.0	34.4	49.4	74.0	-24.6
3629.2	Average	Horizontal	6.5	34.4	40.9	54.0	-13.1
4536.5	Peak	Vertical	13.3	35.4	48.7	74.0	-25.3
4536.5	Average	Vertical	0.5	35.4	35.9	54.0	-18.1
4536.5	Peak	Horizontal	12.7	35.4	48.1	74.0	-25.9
4536.5	Average	Horizontal	1.3	35.4	36.7	54.0	-17.3
5443.8	Peak	Vertical	12.2	37.6	49.8	74.0	-24.2
5443.8	Average	Vertical	0.7	37.6	38.3	54.0	-15.7
5443.8	Peak	Horizontal	13.2	37.6	50.8	74.0	-23.2
5443.8	Average	Horizontal	0.8	37.6	38.4	54.0	-15.6
7258.4*	Peak	Vertical	8.6	40.5	49.1	74.0	-24.9
7258.4*	Average	Vertical	-5.2	40.5	35.3	54.0	-18.7
7258.4*	Peak	Horizontal	8.7	40.5	49.2	74.0	-24.8
7258.4*	Average	Horizontal	-5.1	40.5	35.4	54.0	-18.6
8165.7*	Peak	Vertical	10.5	41.5	52.0	74.0	-22.0
8165.7*	Average	Vertical	-2.1	41.5	39.4	54.0	-14.6
8165.7*	Peak	Horizontal	9.4	41.5	50.9	74.0	-23.1
8165.7*	Average	Horizontal	-2.0	41.5	39.5	54.0	-14.5
9073.0*	Peak	Vertical	9.9	42.5	52.4	74.0	-21.6
9073.0*	Average	Vertical	-1.3	42.5	41.2	54.0	-12.8
9073.0*	Peak	Horizontal	10.8	42.5	53.3	74.0	-20.7
9073.0*	Average	Horizontal	-1.3	42.5	41.2	54.0	-12.8

916.9 MHz							
Frequency (MHz)	Detection Mode	Antenna Polarity	Receiver Reading (dBμV)	Correction Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2750.7	Peak	Vertical	15.6	31.8	47.4	74.0	-26.6
2750.7	Average	Vertical	6.7	31.8	38.5	54.0	-15.5
2750.7	Peak	Horizontal	17.6	31.8	49.4	74.0	-24.6
2750.7	Average	Horizontal	8.8	31.8	40.6	54.0	-13.4
3667.6	Peak	Vertical	17.3	34.5	51.8	74.0	-22.2
3667.6	Average	Vertical	9.5	34.5	44.0	54.0	-10.0
3667.6	Peak	Horizontal	13.5	34.5	48.0	74.0	-26.0
3667.6	Average	Horizontal	6.2	34.5	40.7	54.0	-13.3
4584.5	Peak	Vertical	13.3	35.5	48.8	74.0	-25.2
4584.5	Average	Vertical	1.9	35.5	37.4	54.0	-16.6
4584.5	Peak	Horizontal	13.5	35.5	49.0	74.0	-25.0
4584.5	Average	Horizontal	1.9	35.5	37.4	54.0	-16.6
5501.4	Peak	Vertical	12.5	37.7	50.2	74.0	-23.8
5501.4	Average	Vertical	0.7	37.7	38.4	54.0	-15.6
5501.4	Peak	Horizontal	12.5	37.7	50.2	74.0	-23.8
5501.4	Average	Horizontal	0.7	37.7	38.4	54.0	-15.6
7335.2*	Peak	Vertical	8.6	40.5	49.1	74.0	-24.9
7335.2*	Average	Vertical	-5.2	40.5	35.3	54.0	-18.7
7335.2*	Peak	Horizontal	8.7	40.5	49.2	74.0	-24.8
7335.2*	Average	Horizontal	-5.1	40.5	35.4	54.0	-18.6
8252.1*	Peak	Vertical	10.5	41.5	52.0	74.0	-22.0
8252.1*	Average	Vertical	-2.1	41.5	39.4	54.0	-14.6
8252.1*	Peak	Horizontal	9.4	41.5	50.9	74.0	-23.1
8252.1*	Average	Horizontal	-2.0	41.5	39.5	54.0	-14.5
9169.0*	Peak	Vertical	9.9	42.5	52.4	74.0	-21.6
9169.0*	Average	Vertical	-1.3	42.5	41.2	54.0	-12.8
9169.0*	Peak	Horizontal	10.8	42.5	53.3	74.0	-20.7
9169.0*	Average	Horizontal	-1.3	42.5	41.2	54.0	-12.8

* Measurements were taken at a 1 meter measurement distance and the measurement adjusted to compare to the 3 meter limit. See Section 3.3 of this report.

6.2.5.3 Sample Field Strength Calculation for Radiated Measurements:

The field strength is calculated by adding the Correction Factor (Antenna Factor + Cable Factor), to the measured level from the receiver. The receiver amplitude reading is compensated for any amplifier gain. The basic equation with a sample calculation is shown below:

$$FS = RA + CF \quad \text{Where}$$

FS = Field Strength

RA = Receiver Amplitude Reading (Receiver Reading - Amplifier Gain)

CF = Correction Factor (Antenna Factor + Cable Factor)

Assume a receiver reading of 42.5 dBμV is obtained from the receiver, an amplifier gain of 26.5 dB and a correction factor of 8.5 dB/m. The field strength is calculated by subtracting the amplifier gain and adding the correction factor, giving a field strength of 24.5 dBμV/m, $FS = (42.5 - 26.5) + 8.5 = 24.5 \text{ dBμV/m}$.

6.2.6 §15.247(g) Channel Usage

The EUT meets the requirements of this section as described in Exhibit 12 (Operational Description) of the submittal files.

6.2.7 §15.247(h) Channel Coordination

The EUT meets the requirements of this section as described in Exhibit 12 (Operational Description) of the submittal files.

6.2.8 §15.247(i) Exposure to RF Energy

MPE data and calculations are found in Exhibit 11 of the submittal files.

APPENDIX 1 TEST PROCEDURES AND TEST EQUIPMENT**A1.1 Conducted Disturbance at Mains Ports:**

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.

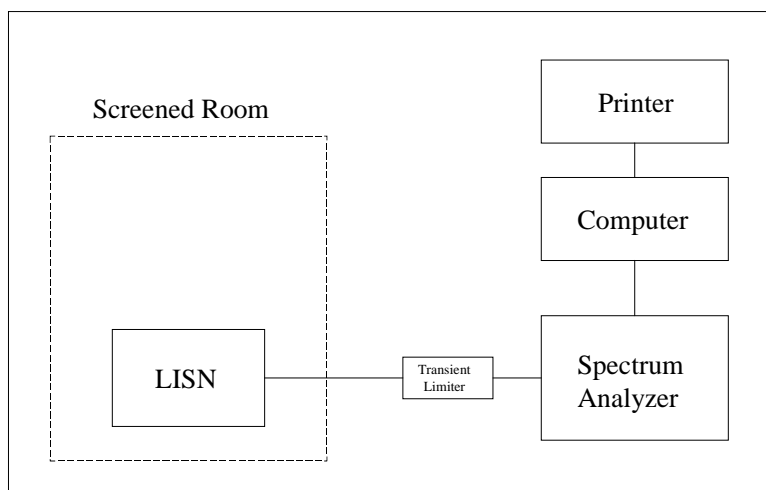
The conducted disturbance at mains ports measurements are performed in a screen room using a (50 Ω /50 μ H) Line Impedance Stabilization Network (LISN).

Desktop EUT are placed on a non-conducting table at 0.8 meters from the metallic floor. The vertical coupling plane (wall of the screened room) is located 40 cm to the rear of the EUT.

Type of Equipment	Manufacturer	Model Number	Serial Number	Date of Last Calibration
Wanship Open Area Test Site #2	CCL	N/A	N/A	10/24/2007
Test Software	CCL	Conducted Emissions	Revision 1.2	N/A
Spectrum Analyzer	Hewlett Packard	8566B	2232A001711	10/31/2007
Quasi-Peak Detector	Hewlett Packard	85650A	2043A00137	11/12/2007
LISN	EMCO	3825/2	9305-2099	03/16/2007
Conductance Cable Wanship Site #2	CCL	Cable J	N/A	12/31/2007
Transient Limiter	Hewlett Packard	11947A	3107A02266	12/31/2007

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

**A1.2 Radiated Disturbance:**

The radiated spurious emissions in the restricted bands from the EUT were measured using a spectrum analyzer with a quasi-peak adapter for peak and quasi-peak readings. A preamplifier was 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 and average measurements above 1000 MHz, a 1 MHz RBW was used and the quasi-peak adapter bypassed.

A biconilog antenna was used to measure the frequency range of 30 to 1000 MHz, at a distance of 3 meters from the EUT. The readings obtained by these antennas are correlated to the levels obtained with a tuned dipole antenna by adding antenna factors. A double-ridged guide antenna was used to measure the emissions at frequencies above 1000 MHz at a distance of either 3 meters or 1 meter from the EUT.

The configuration of the EUT was varied to find the maximum radiated emission. The EUT was rotated 360 degrees, and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission.

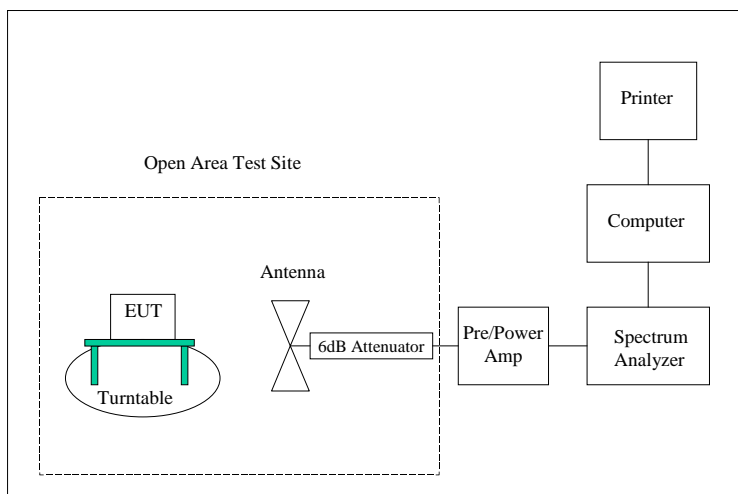
Desktop equipment is measured on a non-conducting table 0.8 meters above the ground plane. The table is placed on a

turntable, which is level with the ground plane.

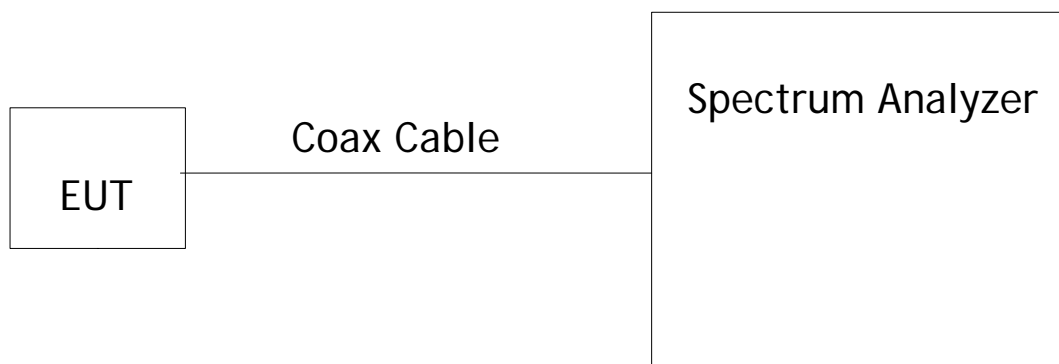
Type of Equipment	Manufacturer	Model Number	Serial Number	Date of Last Calibration
Wanship Open Area Test Site #2	CCL	N/A	N/A	10/24/2007
Test Software	CCL	Radiated Emissions	Revision 1.3	N/A
Spectrum Analyzer	Hewlett Packard	8566B	2232A001711	10/31/2007
Quasi-Peak Detector	Hewlett Packard	85650A	2043A00137	11/12/2007
Biconilog Antenna	EMCO	3142	9601-1008	9/27/2007
Double Ridged Guide Antenna	EMCO	3115	9409-4355	04/30/2007
High Frequency Amplifier	Miteq	AFS4-01001800-43-10P-4	1096455	05/29/2007
900 MHz Filter	Microtronics	HPM50108	001	09/06/2006
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	12/31/2007
Pre/Power-Amplifier	Hewlett Packard	8447F	3113A05161	09/04/2007
6 dB Attenuator	Hewlett Packard	8491A	32835	12/31/2007

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

**A1.3 Measurements at the Antenna Port**

Type of Equipment	Manufacturer	Model Number	Serial Number	Date of Last Calibration
Spectrum Analyzer	Hewlett Packard	8566B	2232A001711	10/31/2007
Quasi-Peak Detector	Hewlett Packard	85650A	2043A00137	11/12/2007
Cable	Andrews	Coax w/SMA	BC1116	12/31/2007
6 dB Attenuator	Hewlett Packard	8491A	32835	12/31/2007



APPENDIX 2 PHOTOGRAPHS

Photograph 1 - Front View Radiated Spurious Emissions Worst Case Configuration



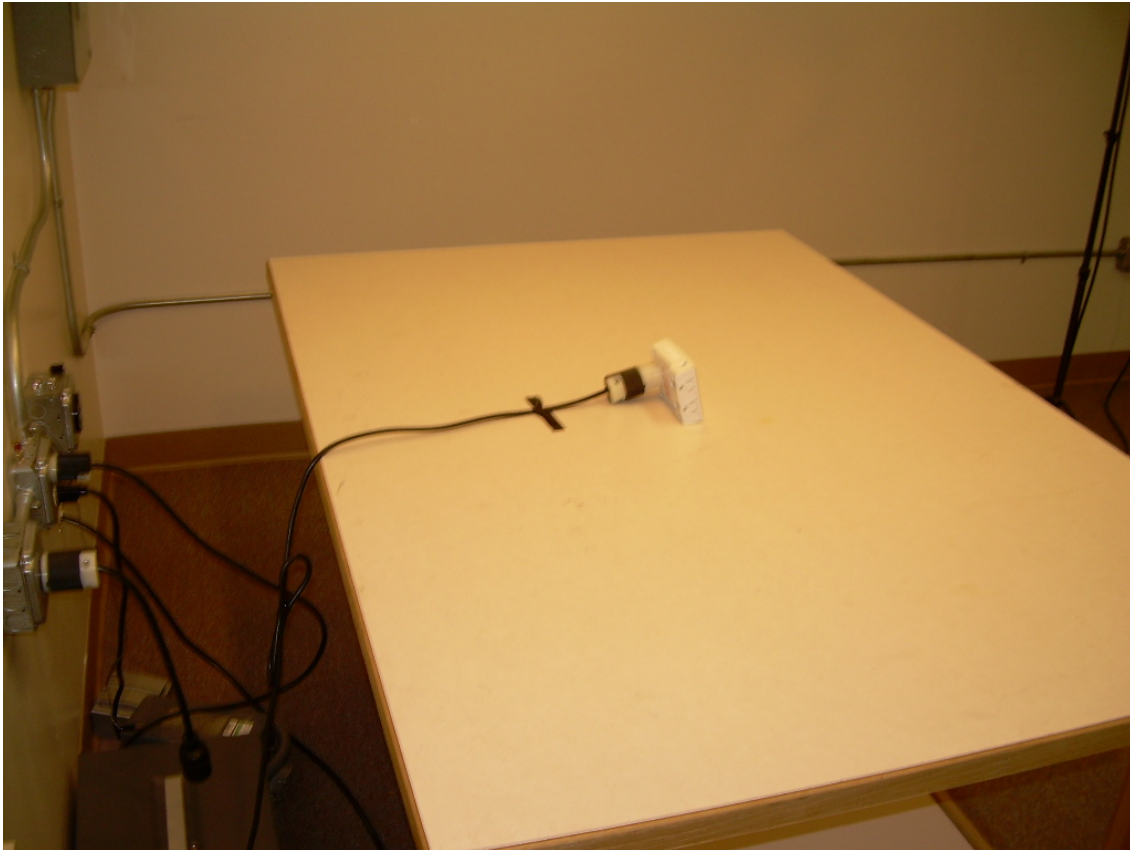
Photograph 2 - Back View Radiated Spurious Emissions Worst Case Configuration



Photograph 3 - Front View Conducted Disturbance Worst Case Configuration



Photograph 4 - Back View Conducted Disturbance Worst Case Configuration



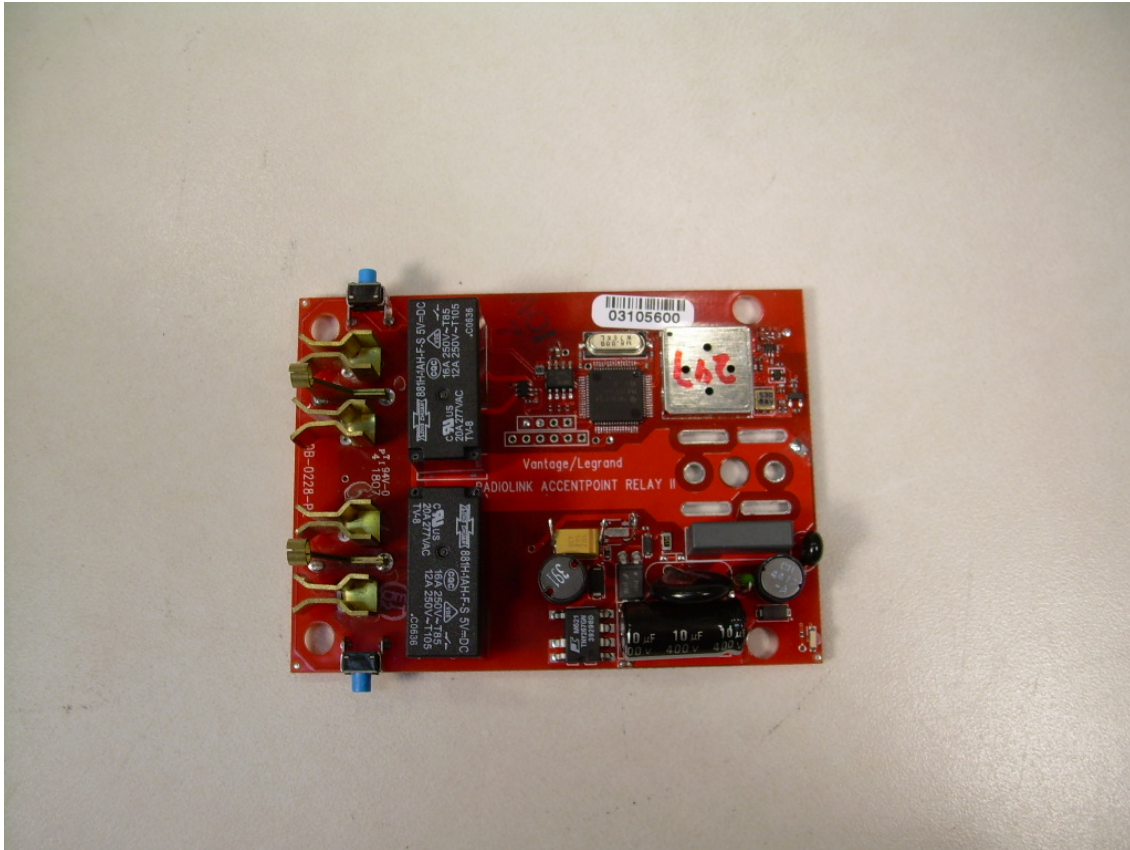
Photograph 5 - Front View of the APREL



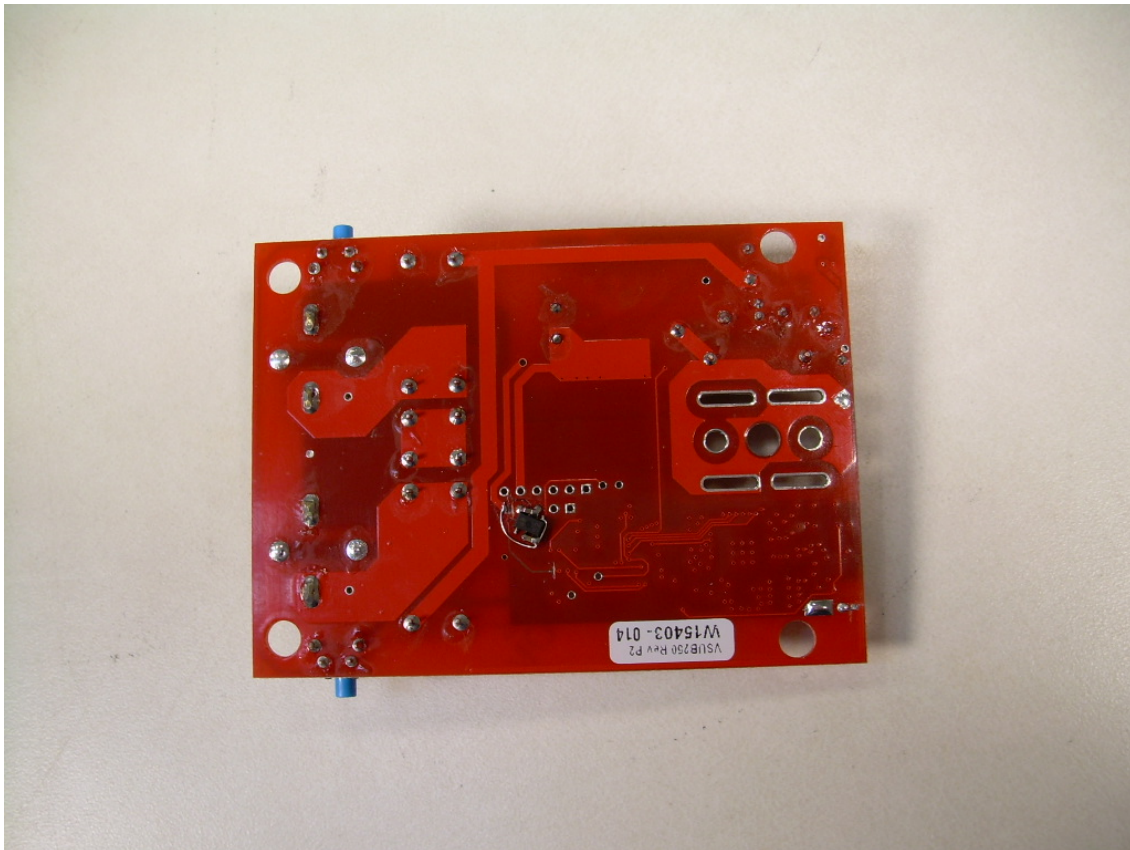
Photograph 6 - Back View of the APREL



Photograph 7 - Front Side of the APREL PCB



Photograph 8 - Back Side of the APREL PCB



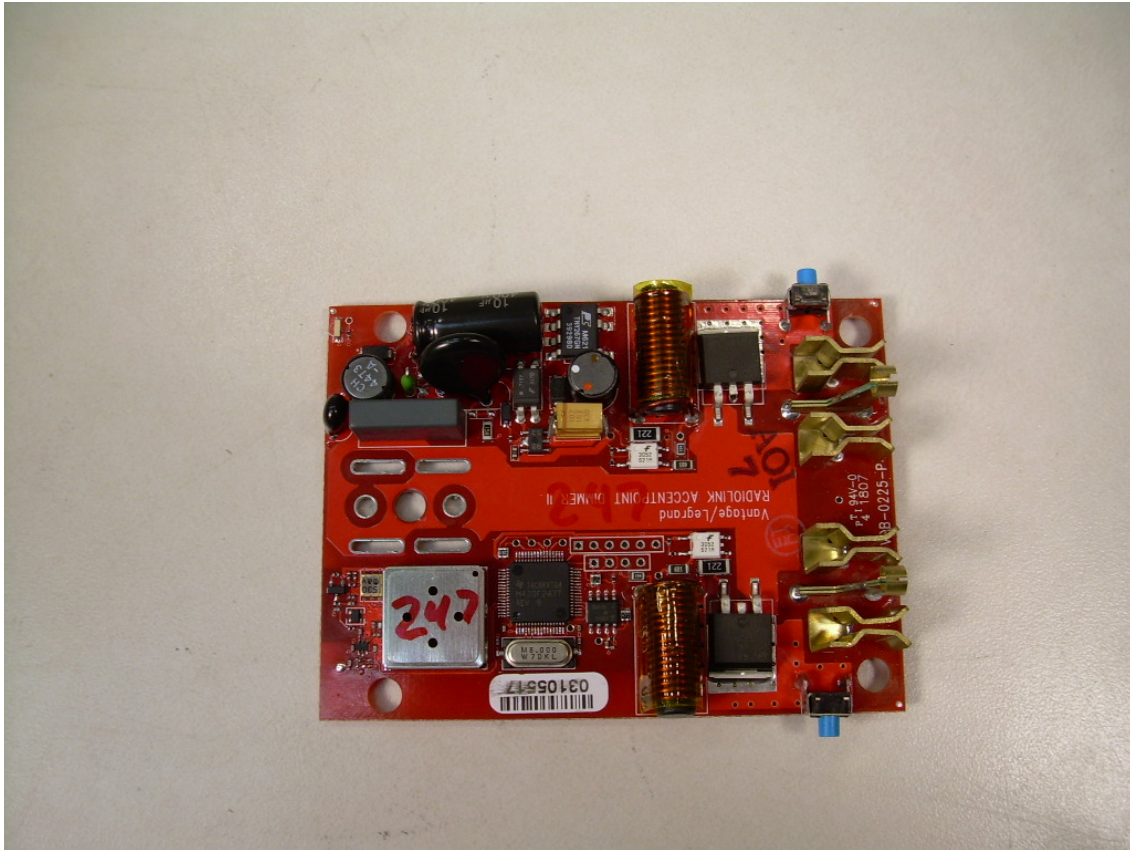
Photograph 9 - Front View of the APDIM



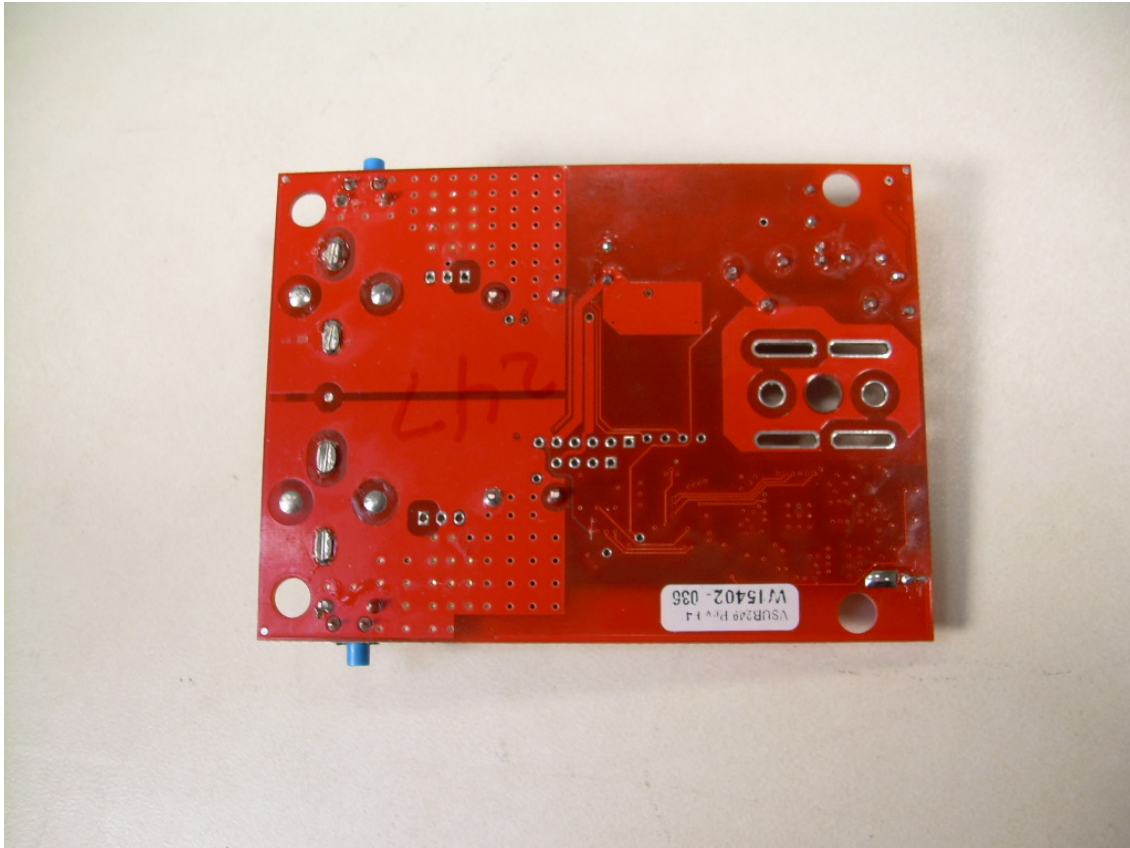
Photograph 10 - Back View of the APDIM



Photograph 11 - Front Side of the APDIM PCB



Photograph 12 - Back Side of the APDIM PCB



Photograph 13 - PCBs with Shielding Removed

