COMMUNICATION CERTIFICATION LABORATORY

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

Test Report

Certification

TEST OF: VSUB235

FCC ID: PII-VSUB235

To FCC PART 15, Subpart C

Test Report Serial No: 73-8297

Applicant:

Vantage Controls
1061 South 800 East
Orem, UT 84097

Dates of Test: April 25 & 26, 2006

Issue Date: May 2, 2006

Equipment Receipt Date: April 25, 2006

Accredited Testing Laboratory By:

NVLAP

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: VSUB235
- FCC ID Number: PII-VSUB235

On this 2nd day of May 2006, 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

Norman P Hansen

Tested by: Norman P. Hansen
EMC Technician

TABLE OF CONTENTS

PAGE

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: VSUB235
Serial Number: None
Options Fitted: N/A
Country of Manufacture: U.S.A.

2.2 Description of EUT:

The VSUB235 modular transceiver is a daughter-board designed to enable wireless control of lighting, HVAC, home theater, and other systems. The VSUB235 operates in the 902 to 928 MHz band. The receiver is a direct-conversion type and demodulates the received signal using a local oscillator that matches the frequency of the desired received channel. The VSUB235 will be incorporated into devices that Vantage Controls sells. For testing purposes, the VSUB235 was powered from a 9 VDC linear wall mount supply. The VSUB235 can use several different antennas as shown in the table below:

Manufacturer	Model #	Type	Gain (dBi)
Vantage Controls	VDA-0055	¼ Wave	2
Astron Wireless	PCD09A0V	½ Wave	2.1
Astron Wireless	AXH9	½ Wave	2
Astron Wireless	AXH92	½ Wave	2
Antenna Factor	ANT-916-PML	½ Wave	2.1
Astron Wireless	918-2	2-element Yagi	6.1

The VSUB235 was tested using the highest gain antenna of each antenna type.

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 Serial No.	FCC ID Number	Description	Name of Interface Ports / Interface Cables
BN: Vantage Controls MN: VSUB235 (Note 1)	PII-VSUB235	Modular Transceiver	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 Interface Ports on EUT:

Name of Port	No. of Ports Fitted to EUT	Cable Descriptions/Length
Interface	1	Unshielded 5 conductor cable/1.5 meters

2.5 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 for modular certification.

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 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.

(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 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.

3.2.4 Modular Approval Requirements

The requirements for obtaining a modular approval are listed below. A cover letter requesting modular approval and addressing the items below must be submitted.

1. The modular transmitter must have its own RF shielding. This is intended to ensure that the module does not have to rely upon the shielding provided by the device into which it is installed in order for all modular transmitter emissions to comply with Part 15 limits. It is also intended to prevent coupling between the RF circuitry of the module and any wires or circuits in the device into which the module is installed. Such coupling may result in non-compliant operation.

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

3. The modular transmitter must have its own power supply regulation. This is intended to ensure that the module will comply with Part 15 requirements regardless of the design of the power supplying circuitry in the device into which the module is installed.

4. The modular transmitter must comply with the antenna requirements of Section 15.203 and 15.204(c). The antenna must either be permanently attached or employ a “unique” antenna coupler (at all connections between the module and the antenna, including the cable). Any antenna used with the module must be approved with the module, either at the time of initial authorization or through a Class II permissive change. The “professional installation” provision of Section 15.203

may not be applied to modules.

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

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

7. The modular transmitter must comply with any specific rule or operating requirements applicable to the transmitter and the manufacturer must provide adequate instructions along with the module to explain any such requirements. A copy of these instructions must be included in the application for equipment authorization. For example, there are very strict operational and timing requirements that must be met before a transmitter is authorized for operation under Section 15.231. For instance, data transmission is

prohibited, except for operation under Section 15.231(e), in which case there are separate field strength level and timing requirements. Compliance with these requirements must be assured.

8. The modular transmitter must comply with any applicable RF exposure requirements. For example, FCC Rules in Sections 2.1091, 2.1093 and specific Sections of Part 15, including 15.319(i), 15.407(f), 15.253(f) and 15.255(g), require that Unlicensed PCS, UNII and millimeter wave devices perform routine environmental evaluation for RF Exposure to demonstrate compliance. In addition, spread spectrum transmitters operating under Section 15.247 are required to address RF Exposure compliance in accordance with Section 15.247(b)(4). Modular transmitters approved under other Sections of Part 15, when necessary, may also need to address certain RF Exposure concerns, typically by providing specific installation and operating instructions for users, installers and other interested parties to ensure compliance.

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 August 11, 2003 (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, 2006.

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: 5 - 9 VDC

For testing purposes, a 9 VDC linear wall mount supply operating from 120 VAC was used to provide power to the EUT.

4.2 Operating Modes:

The EUT was tested in 3 orthogonal placements with the highest gain antenna of each antenna type to be used as listed in Section 2.2. The worst-case emissions were with the VSUB235 constantly transmitting, placed flat on the EUT table with the Vantage Controls VDA-0055 ¼ wave antenna vertical. The EUT operates on 25 channels in the band of 907.3 to 916.9 MHz (9.6 MHz band range) and was tested at the lowest frequency and the highest frequency to meet the requirements of §15.31(m).

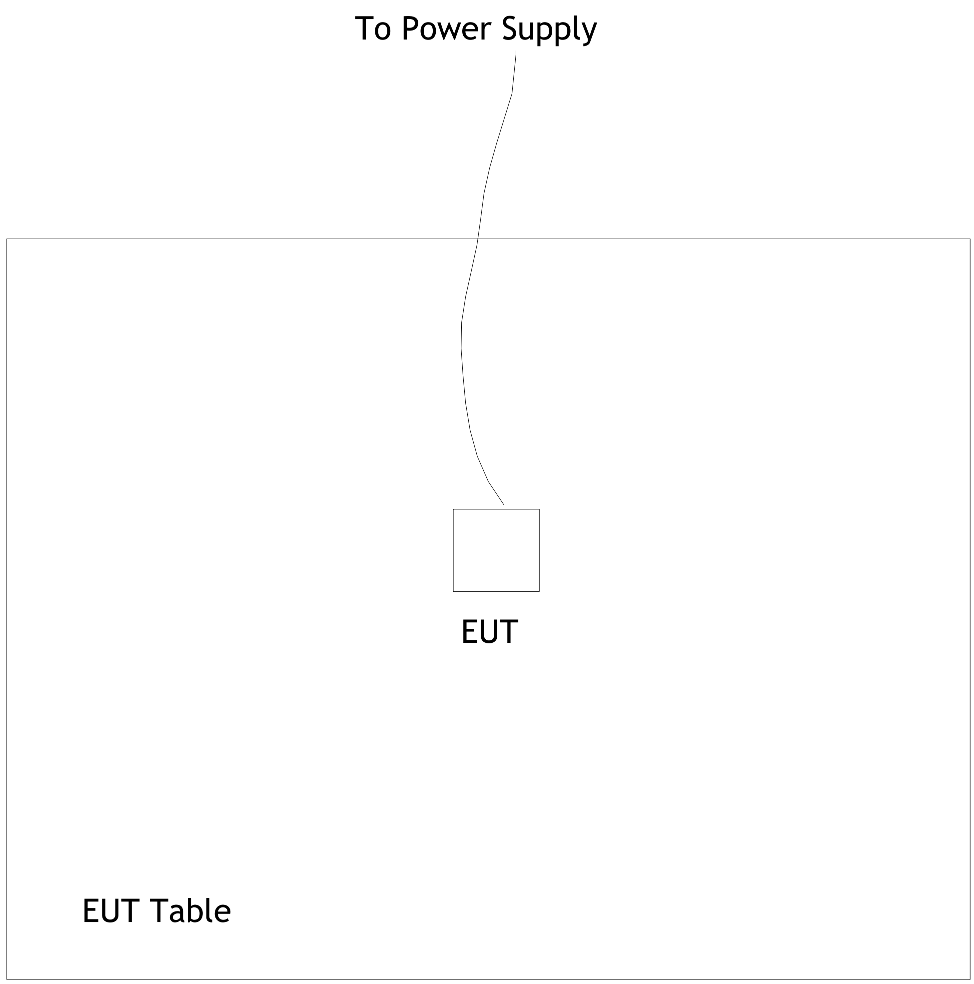
4.3 EUT Exercise Software:

Vantage Controls software was used to control the VSUB235 transmitter.

4.4 Configuration & Peripherals:

The VSUB235 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.

4.5 Block Diagram of 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 (Note 1)
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
DA 00-1407	Modular Approval Requirements	N/A	Complied
Note 1: The EUT may use an antenna with a gain of 6.1 dBi. §15.247 (b)(4) requirements were applied.			

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 antennas to be used with this device are listed in Section 2.2 of this report. All of the antennas use a permanent solder connection or a unique connector, such as a reverse-thread, reverse-polarity, etc. which allows the EUT to meet the requirements of §15.203.

6.2.2 Conducted Disturbance at Mains Ports Data

Frequency (MHz)	AC Mains Lead	Detector	Measured Level (dBμV)	Limit (dBμV)	Margin (dB)
0.15	Hot Lead	Peak (Note 1)	45.2	56.0	-10.8
0.19	Hot Lead	Peak (Note 1)	42.5	53.9	-11.4
0.26	Hot Lead	Peak (Note 1)	43.0	51.5	-8.5
0.63	Hot Lead	Peak (Note 1)	37.9	46.0	-8.1
0.68	Hot Lead	Peak (Note 1)	35.9	46.0	-10.1
1.06	Hot Lead	Peak (Note 1)	32.2	46.0	-13.8
0.16	Neutral Lead	Peak (Note 1)	45.3	55.5	-10.2
0.22	Neutral Lead	Peak (Note 1)	43.5	52.7	-9.2
0.26	Neutral Lead	Peak (Note 1)	43.1	51.5	-8.4
0.61	Neutral Lead	Peak (Note 1)	38.4	46.0	-7.6
0.66	Neutral Lead	Peak (Note 1)	36.9	46.0	-9.1
0.89	Neutral Lead	Peak (Note 1)	32.4	46.0	-13.6

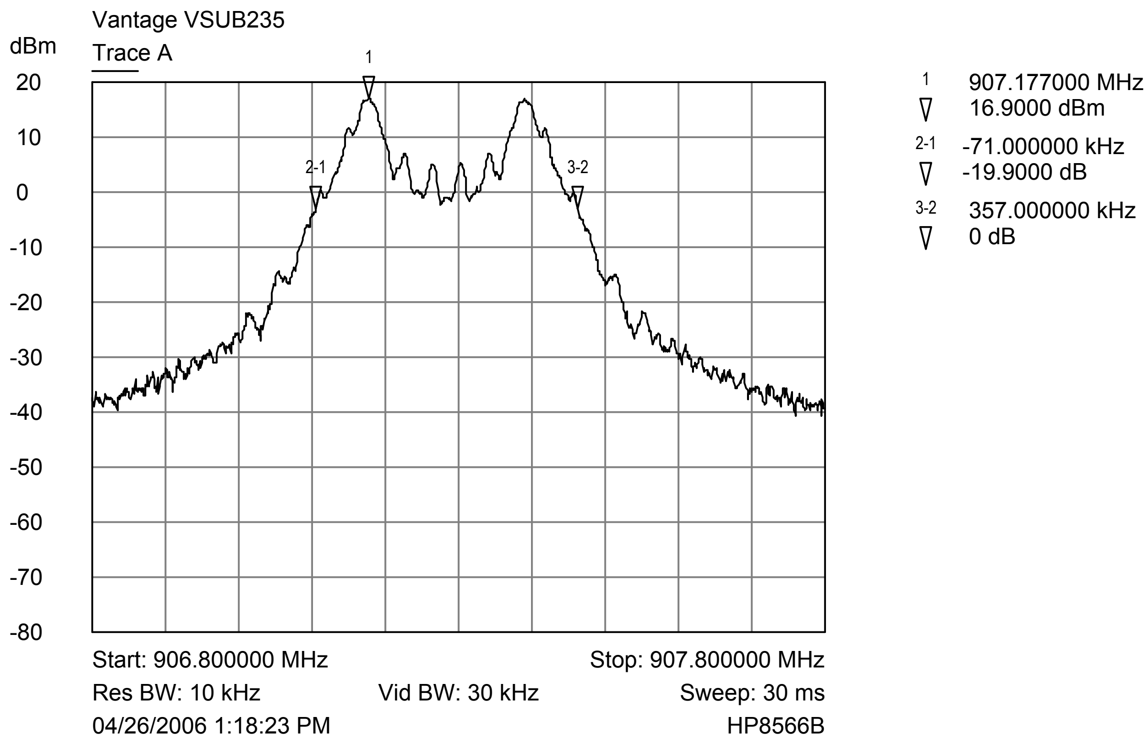
Note 1: The reference detector used for the measurements was Quasi-Peak or Peak and the data was compared to the average limit; therefore, the EUT was deemed to meet both the average and quasi-peak limits.

Note 2: The reference detector used for the measurements was quasi-peak and average and the data was compared to the respective limits.

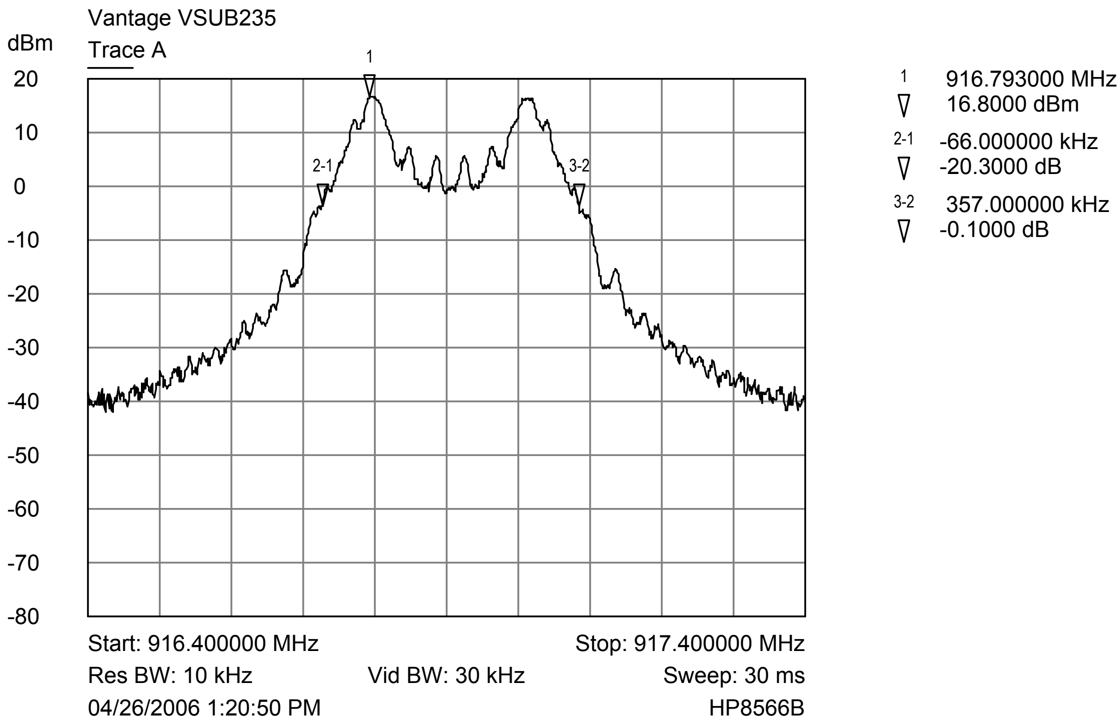
6.2.3 §15.247(a)

6.2.3.1 §15.247(a)(1)

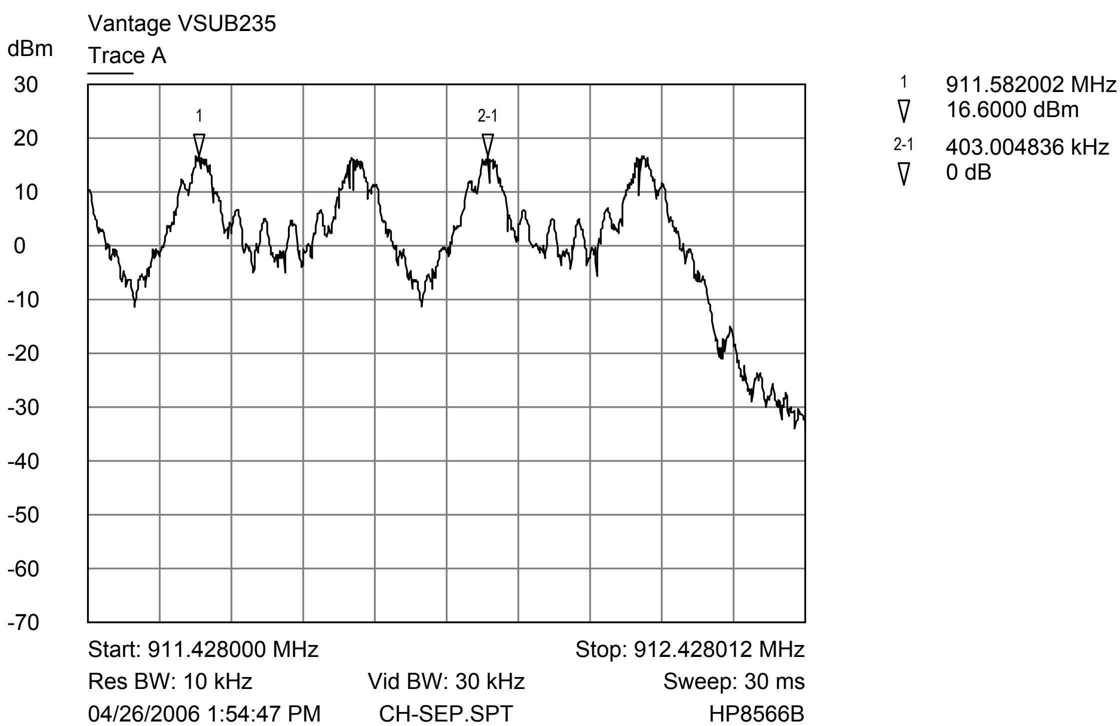
The EUT shall have the hopping channels separated by the greater of 25 kHz or the 20 dB bandwidth. The 20 dB bandwidth is 357 kHz and the channel separation is 403 kHz. See the plots below:



Trace A lower bandwidth plot



Trace A upper bandwidth plot



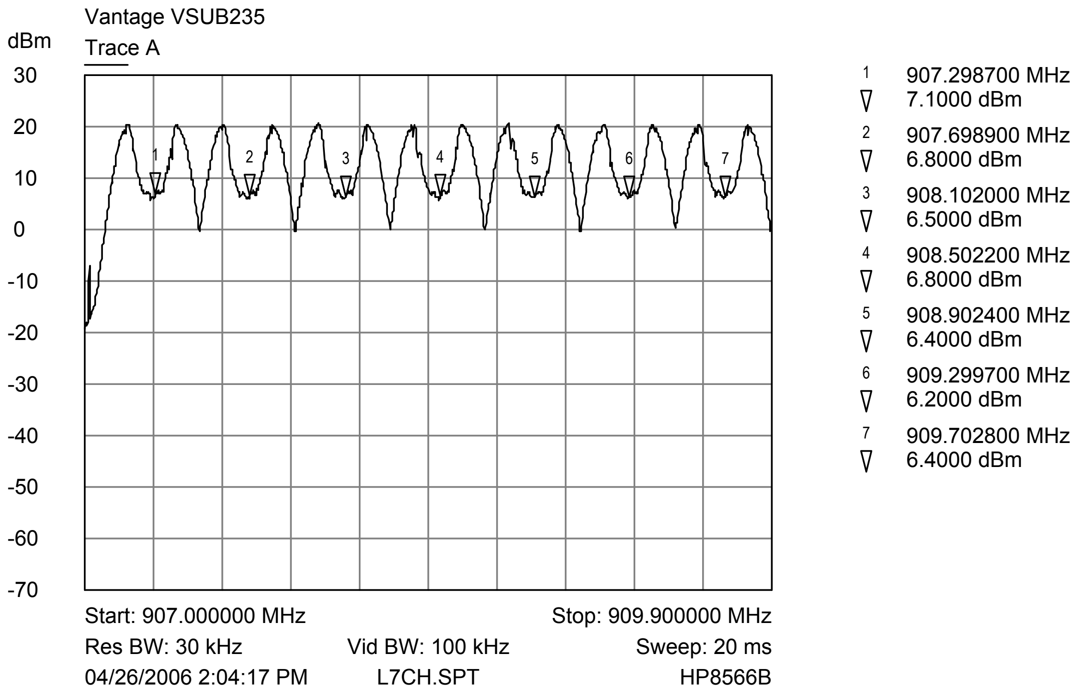
Trace A channel separation

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.

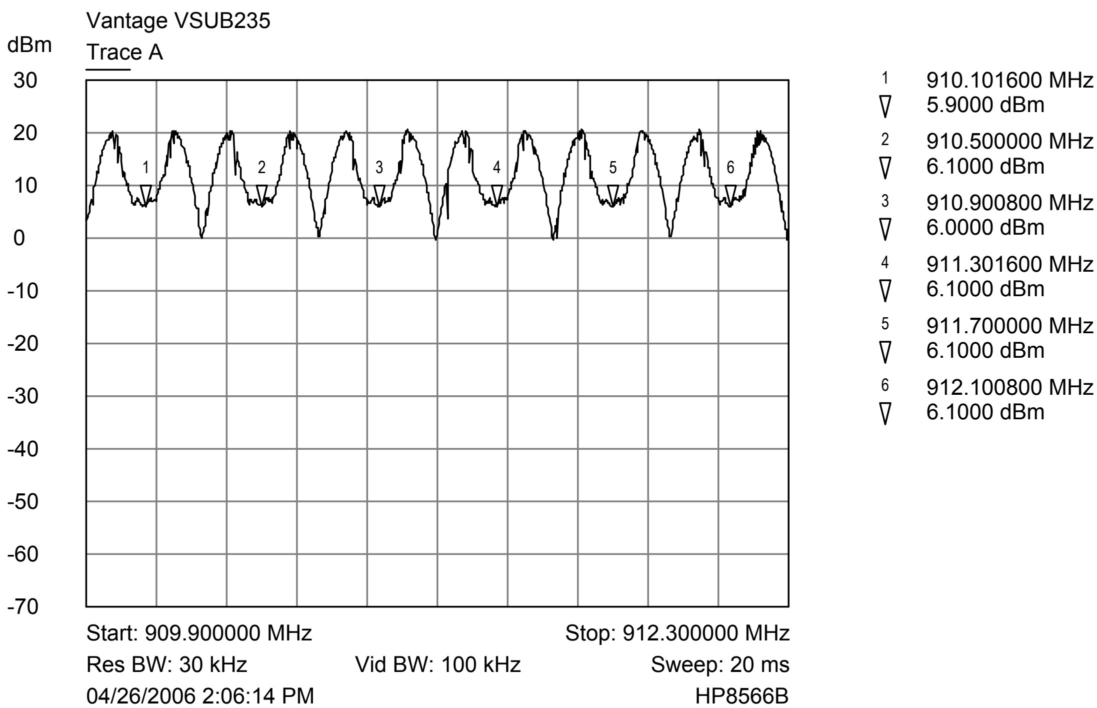
Hop Sequences															
#1	**#2**	**#3**	**#4**	**#5**	**#6**	**#7**	**#8**	**#9**	**#10**	**#11**	**#12**	**#13**	**#14**	**#15**	**#16**
2	1	17	21	5	3	20	24	13	22	9	14	10	12	21	717
12	13	10	16	10	23	9	14	20	15	4	5	23	6	8	6
18	9	3	8	18	10	21	3	16	9	24	12	19	24	12	14
11	3	7	4	2	2	14	21	5	23	16	3	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)

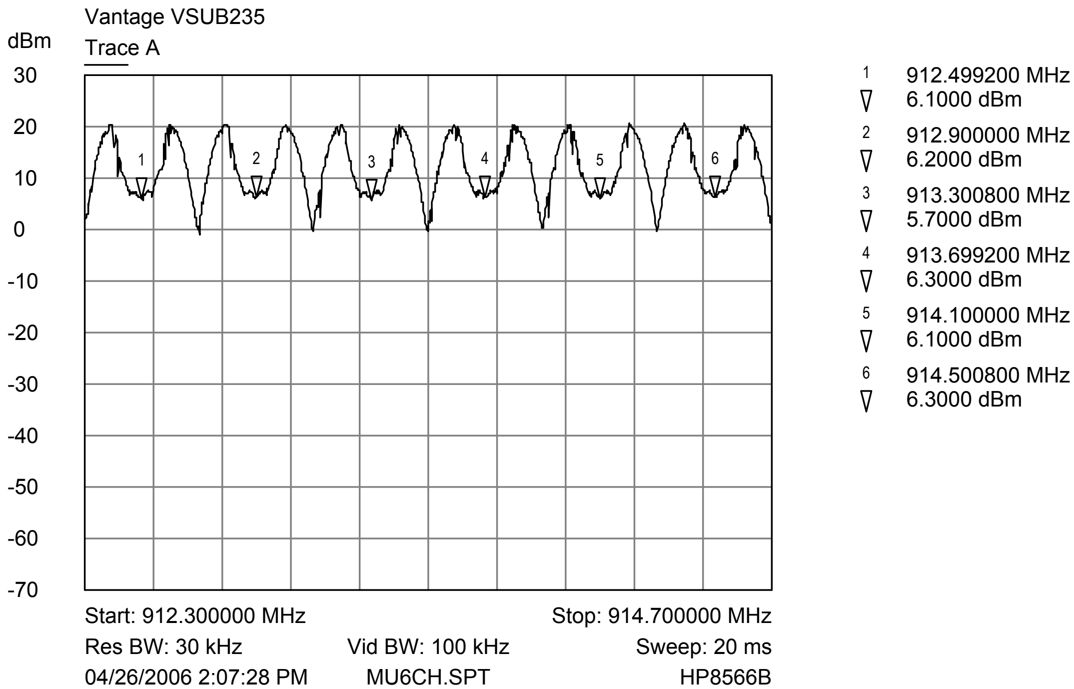
The EUT has a channel bandwidth of 357 kHz (see the plots of 6.2.3.1) and uses 25 channels. The average time of channel occupancy is 394.5 milliseconds within any 10 second time frame. See the plots below:



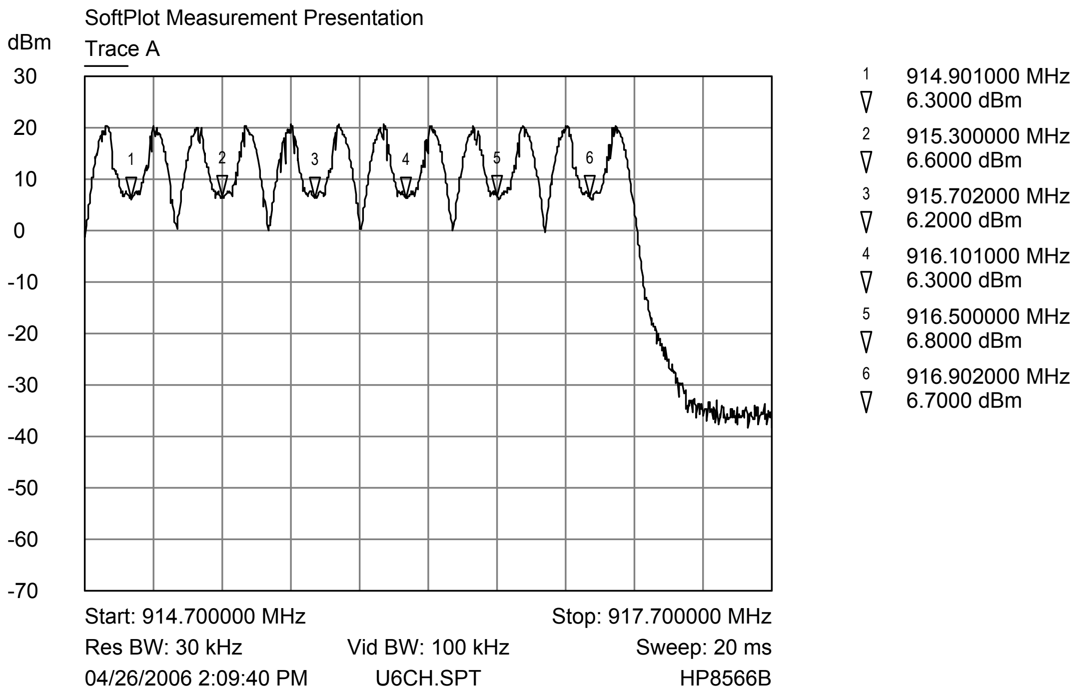
Trace A lower 7 channels



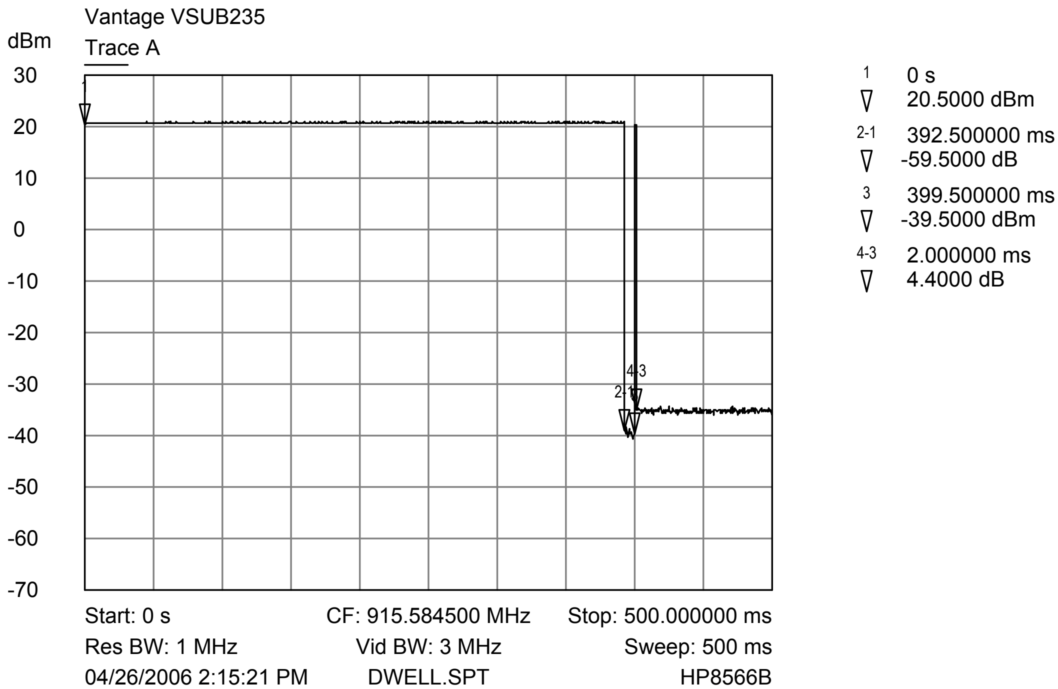
Trace A lower middle channels



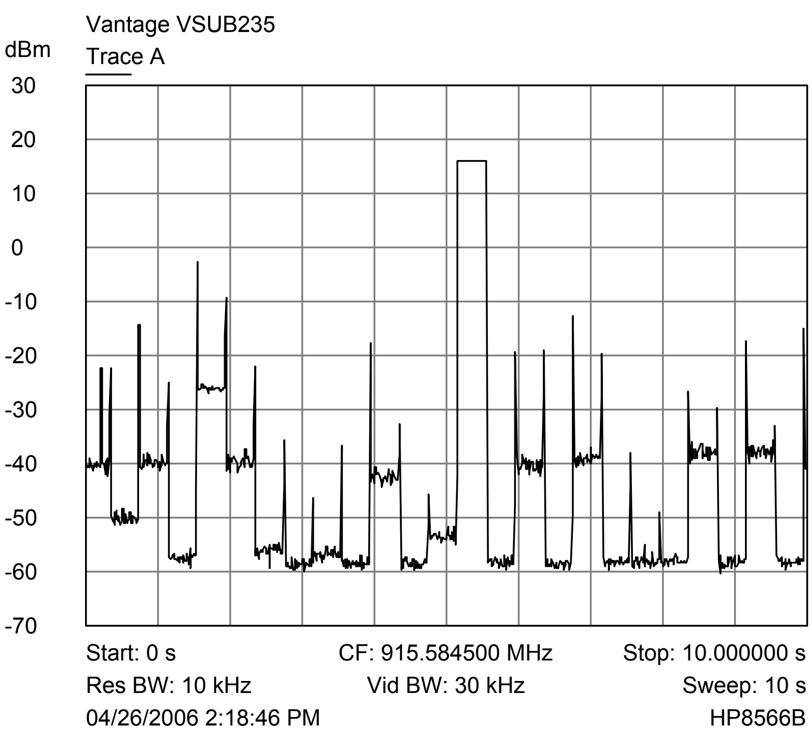
Trace A upper middle channels



Trace A upper 6 channels



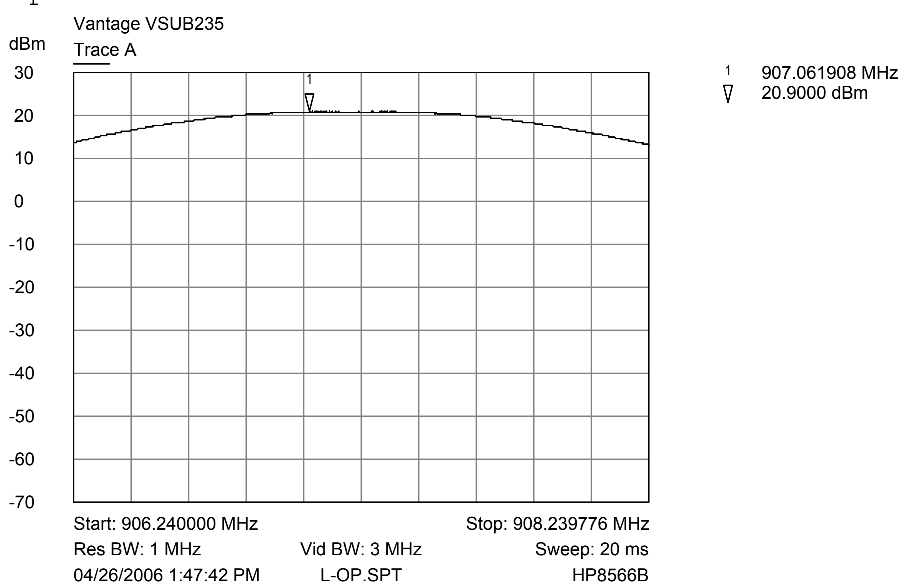
Trace A Channel dwell time



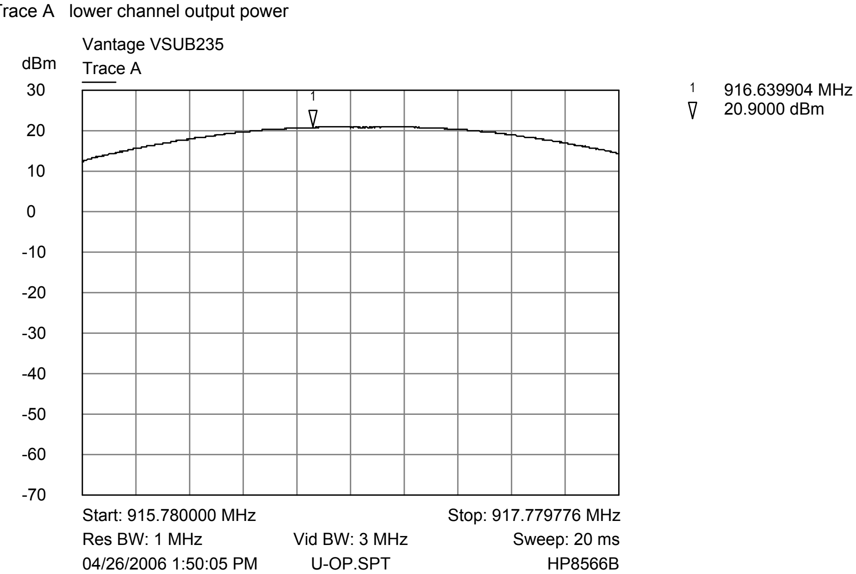
Trace A hits per 10 seconds

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

The EUT has a measured peak conducted power of 20.9 dBm or 123 mW. The limit for this device is 250 mW or 23.98 dBm. See the plots below. §15.247(b)(4) states that if antennas with directional gain of more than 6 dBi are used, the output power of the transmitter shall be reduced below the stated limits by the amount that the directional gain exceeds 6 dBi. The EUT has a margin of 3.08 dB which is greater than the amount by which the antenna exceeds 6 dBi; therefore, no reduction is necessary to assure compliance.



Trace A lower channel output power



Trace A upper channel output power

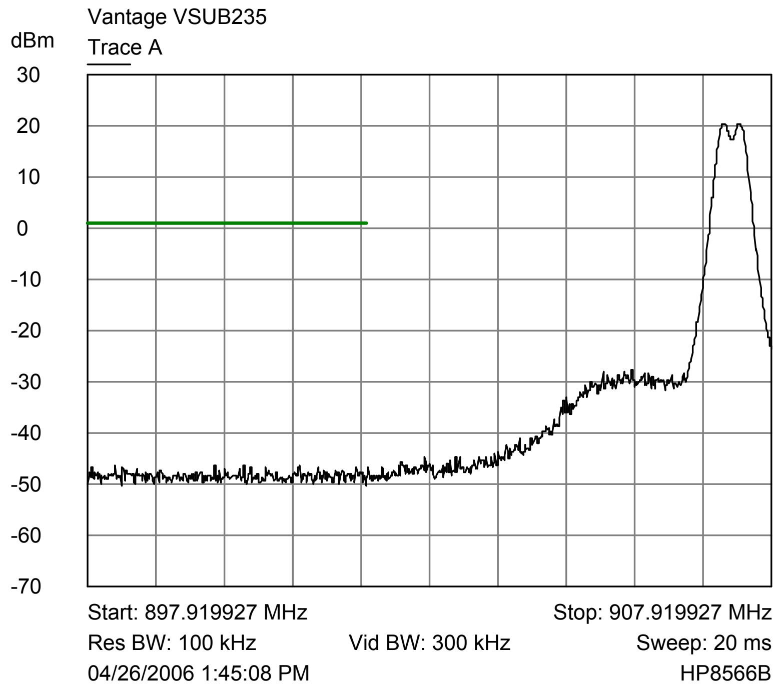
6.2.5 §15.247(d) Spurious Emission Measurements

6.2.5.1 Conducted Measurements at the Antenna Port

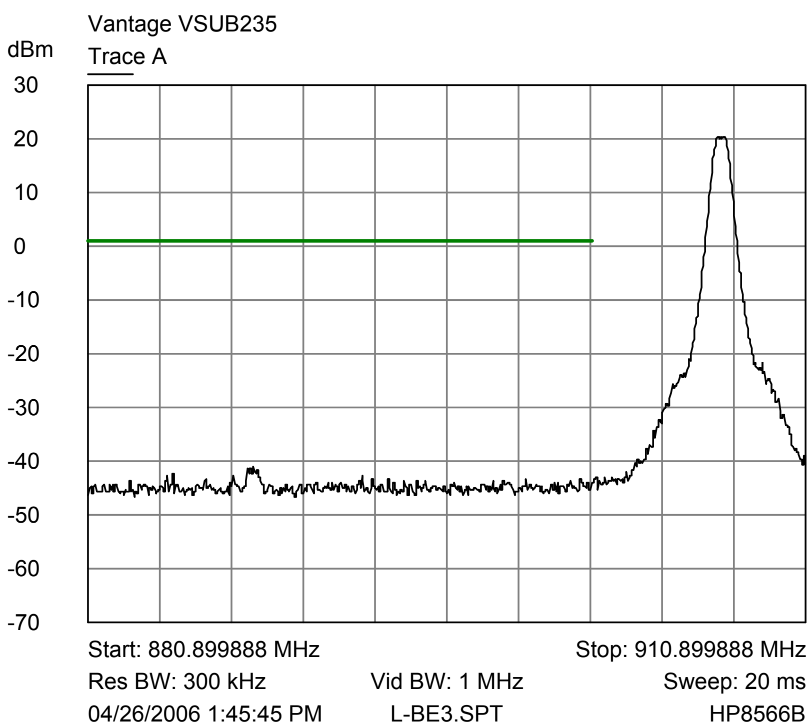
The conducted spurious emissions, in any 100 kHz bandwidth outside the operating band, must be attenuated to at least 20 dB below the measured fundamental emission level. The measured level was 20.9 dBm; therefore, the spurious conducted emissions must be attenuated below 0.9 dBm. The EUT maximum conducted spurious emission was measured at −16.7 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)
674.6	-39.8	0.9	-40.7
1814.6	-17.9	0.9	-18.8
2721.9	-45.8	0.9	-46.7
3629.2	-46.0	0.9	-46.9
4536.5	-47.0	0.9	-47.9
5443.8	-46.1	0.9	-47.0
6351.1	-42.8	0.9	-43.7
7258.4	-42.8	0.9	-43.7
8165.7	-42.5	0.9	-43.4
9073.0	-42.4	0.9	-43.3

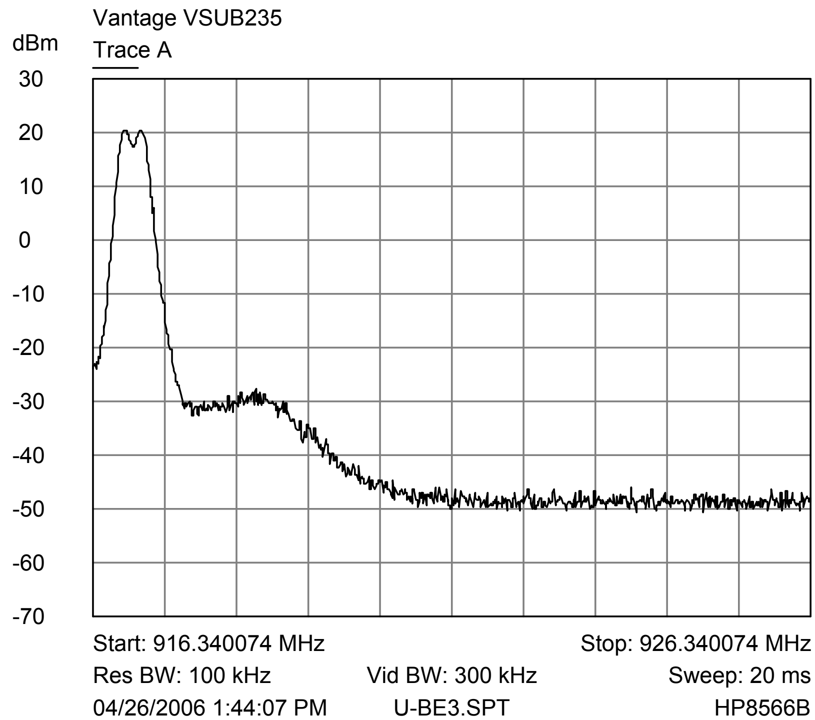
916.9 MHz			
Frequency (MHz)	Measurement (dBm)	Limit (dBm)	Margin (dB)
684.8	-41.3	0.9	-42.2
1833.8	-16.7	0.9	-17.6
2750.7	-45.1	0.9	-46.0
3667.6	-46.0	0.9	-46.9
4584.5	-45.8	0.9	-46.7
5501.4	-45.9	0.9	-46.8
6418.3	-42.4	0.9	-43.3
7335.2	-43.0	0.9	-43.9
8252.1	-43.1	0.9	-44.0
9169.0	-41.6	0.9	-42.5



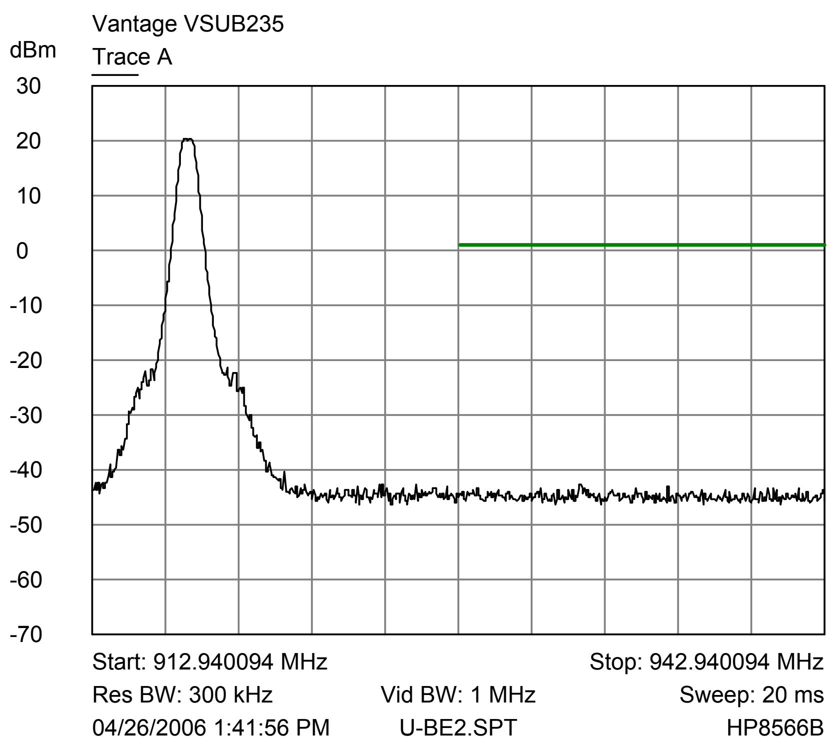
Trace A Lower band edge plot - 100 kHz RBW and 10 MHz Span



Trace A Lower band edge plot - 300 kHz RBW and 30 MHz Span



Trace A Upper band edge plot - 100 kHz RBW and 10 MHz Span



Trace A Upper band edge plot - 300 kHz RBW and 30 MHz Span

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 7.0 dB below the limit at 9169.0 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	21.9	30.8	52.7	74.0	-21.3
2721.9	Average	Vertical	9.6	30.8	40.4	54.0	-13.6
2721.9	Peak	Horizontal	19.6	30.8	50.4	74.0	-23.6
2721.9	Average	Horizontal	9.1	30.8	39.9	54.0	-14.1
3629.2	Peak	Vertical	14.7	33.4	48.1	74.0	-25.9
3629.2	Average	Vertical	3.8	33.4	37.2	54.0	-16.8
3629.2	Peak	Horizontal	15.0	33.4	48.4	74.0	-25.6
3629.2	Average	Horizontal	3.9	33.4	37.3	54.0	-16.7
4536.5	Peak	Vertical	17.4	34.5	51.9	74.0	-22.1
4536.5	Average	Vertical	5.0	34.5	39.5	54.0	-14.5
4536.5	Peak	Horizontal	17.8	34.5	52.3	74.0	-21.7
4536.5	Average	Horizontal	5.3	34.5	39.8	54.0	-14.2
5443.8	Peak	Vertical	15.9	36.3	52.2	74.0	-21.8
5443.8	Average	Vertical	3.5	36.3	39.8	54.0	-14.2
5443.8	Peak	Horizontal	16.3	36.3	52.6	74.0	-21.4
5443.8	Average	Horizontal	3.2	36.3	39.5	54.0	-14.5
7258.4	Peak	Vertical	16.8	39.1	55.9	74.0	-18.1
7258.4	Average	Vertical	5.5	39.1	44.6	54.0	-9.4
7258.4	Peak	Horizontal	16.6	39.1	55.7	74.0	-18.3
7258.4	Average	Horizontal	4.9	39.1	44.0	54.0	-10.0
8165.7	Peak	Vertical	18.6	40.4	59.0	74.0	-15.0
8165.7	Average	Vertical	5.9	40.4	46.3	54.0	-7.7
8165.7	Peak	Horizontal	16.9	40.4	57.3	74.0	-16.7
8165.7	Average	Horizontal	3.8	40.4	44.2	54.0	-9.8
9073.0	Peak	Vertical	17.8	41.8	59.6	74.0	-14.4
9073.0	Average	Vertical	5.1	41.8	46.9	54.0	-7.1
9073.0	Peak	Horizontal	15.8	41.8	57.6	74.0	-16.4
9073.0	Average	Horizontal	4.2	41.8	46.0	54.0	-8.0

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	19.0	30.9	49.9	74.0	-24.1
2750.7	Average	Vertical	6.7	30.9	37.6	54.0	-16.4
2750.7	Peak	Horizontal	17.7	30.9	48.6	74.0	-25.4
2750.7	Average	Horizontal	4.8	30.9	35.7	54.0	-18.3
3667.6	Peak	Vertical	15.2	33.5	48.7	74.0	-25.3
3667.6	Average	Vertical	3.6	33.5	37.1	54.0	-16.9
3667.6	Peak	Horizontal	13.4	33.5	46.9	74.0	-27.1
3667.6	Average	Horizontal	3.8	33.5	37.3	54.0	-16.7
4584.5	Peak	Vertical	19.5	34.6	54.1	74.0	-19.9
4584.5	Average	Vertical	7.4	34.6	42.0	54.0	-12.0
4584.5	Peak	Horizontal	18.1	34.6	53.0	74.0	-21.0
4584.5	Average	Horizontal	6.3	34.6	40.9	54.0	-13.1
7335.2	Peak	Vertical	17.7	39.3	57.0	74.0	-17.0
7335.2	Average	Vertical	5.2	39.3	44.5	54.0	-9.5
7335.2	Peak	Horizontal	16.5	39.3	55.8	74.0	-18.2
7335.2	Average	Horizontal	5.0	39.3	44.3	54.0	-9.7
8252.1	Peak	Vertical	17.6	40.5	58.1	74.0	-15.9
8252.1	Average	Vertical	5.4	40.5	45.9	54.0	-8.1
8252.1	Peak	Horizontal	17.1	40.5	57.6	74.0	-16.4
8252.1	Average	Horizontal	5.6	40.5	46.1	54.0	-7.9
9169.0	Peak	Vertical	15.9	41.7	57.6	74.0	-16.4
9169.0	Average	Vertical	4.8	41.7	46.5	54.0	-7.5
9169.0	Peak	Horizontal	15.8	41.7	57.5	74.0	-16.5
9169.0	Average	Horizontal	5.3	41.7	47.0	54.0	-7.0

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 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 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.

6.2.7 §15.247(i) Exposure to RF Energy

MPE data and calculations are found in Exhibit 11 of the submittal files. The limit is 0.6 mW/cm^2 and the maximum exposure possible was calculated at 0.00997 mW/cm^2.

6.3 DA 00-1407 Modular Approval Compliance

6.3.1 RF Shielding

The VSUB235 is produced with an RF shield soldered onto the board. The PCB is 4 layers. All components are on one the top side which is layer 1. The second Layer is a ground plane. Layer 3 is a routing layer and the bottom layer is another ground plane. The RF shield encloses the entire transceiver (transmitter, receiver, LNA, PA, T/R switch). The module does not rely on the host system in which it is installed to provide shielding.

6.3.2 Data I/O

The data input and output pins run through buffers and then directly into the onboard microprocessor. The processor controls transmitter on/off time and modulation. This ensures that the transmitter spectrum remains independent of the I/O pins.

6.3.3 Power Supply

The module operates from an input of 5-9VDC source. All circuitry critical to determining RF frequency or RF output power levels operate from an internally regulated 3.6V DC source.

6.3.4 Antenna

The module was tested with the following antennas:

Manufacturer	Model #	Type	Gain (dBi)
Vantage Controls	VDA-0055	¼ Wave	2
Astron Wireless	PCD09A0V	½ Wave	2.1
Astron Wireless	AXH9	½ Wave	2
Astron Wireless	AXH92	½ Wave	2
Antenna Factor	ANT-916-PML	½ Wave	2.1
Astron Wireless	918-2	2-element Yagi	6.1

All of these antennas use either a permanent solder connection or a unique connector such as a reverse-thread, reverse-polarity, etc. to satisfy the requirement of section 15.203.

6.3.5 Testing

The module was tested as a stand-alone device utilizing its own shielding and filtering to achieve compliance.

6.3.6 Labeling

The module contains the required FCC label (See Exhibit 1 of the submittal files) located on the shield. In cases where the module is installed inside another product, an additional label containing the following wording is placed on the outside of the final product:

This device contains Transceiver Module FCC ID: PII-VSUB235

6.3.7 RF Exposure

MPE data and calculations are found in Exhibit 11 of the submittal files. The limit is 0.6 mW/cm^2 and the maximum exposure possible was calculated at 0.00997 mW/cm^2.

6.3.8 Product Integration

This modular transmitter has been developed for internal use by Vantage Controls. Vantage Controls has complete control of the end products that it will be used in and can ensure that all labeling and warning statements follow the guidelines listed above.

APPENDIX 1 TEST PROCEDURES AND TEST EQUIPMENT

A1.1 Conducted Disturbance at Mains Ports:

The conducted disturbance at mains ports from the ITE 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 ITE with each ITE having its own power cord, the point of connection for the LISN is determined from the following rules:

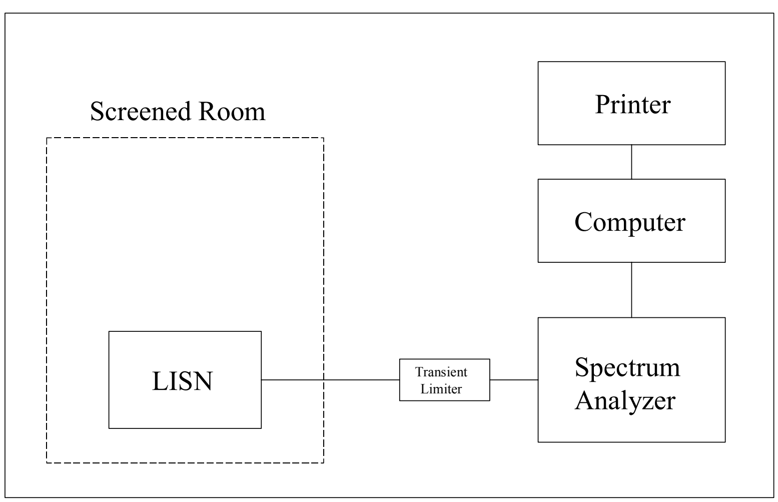
a) Each power cord, which is terminated in a mains supply plug, shall be tested separately.
b) Power cords, which are not specified by the manufacturer to be connected via a host unit, shall be tested separately.
c) Power cords which are specified by the manufacturer to be connected via a host unit or 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.

Desktop ITE is 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. 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	CCL	N/A	N/A	10/28/2005
Test Software	CCL	Conducted Emissions	Revision 1.2	N/A
Spectrum Analyzer	Hewlett Packard	8566B	2230A01711	10/10/2005
Quasi-Peak Detector	Hewlett Packard	85650A	2043A00137	03/06/2006
LISN	EMCO	3825/2	9508-2435	03/15/2006
Conductance Cable Wanship Site #2	CCL	Cable J	N/A	12/12/2005
Transient Limiter	Hewlett Packard	11947A	3107A02266	12/12/2005

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 disturbance from the EUT was measured using a spectrum analyzer with a quasi-peak adapter for peak and quasi-peak readings. A preamplifier with a fixed gain of 26 dB and a power amplifier with a fixed gain of 22 dB 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.

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 3 meters from the EUT.

The configuration of the EUT was varied to find the maximum radiated emission. The EUT was connected to the peripherals listed in Section 2.3 via the interconnecting cables listed in Section 2.4. A technician manually manipulated these interconnecting cables to obtain worst-case radiated disturbance. The EUT was rotated 360 degrees, and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission. Where there was 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.

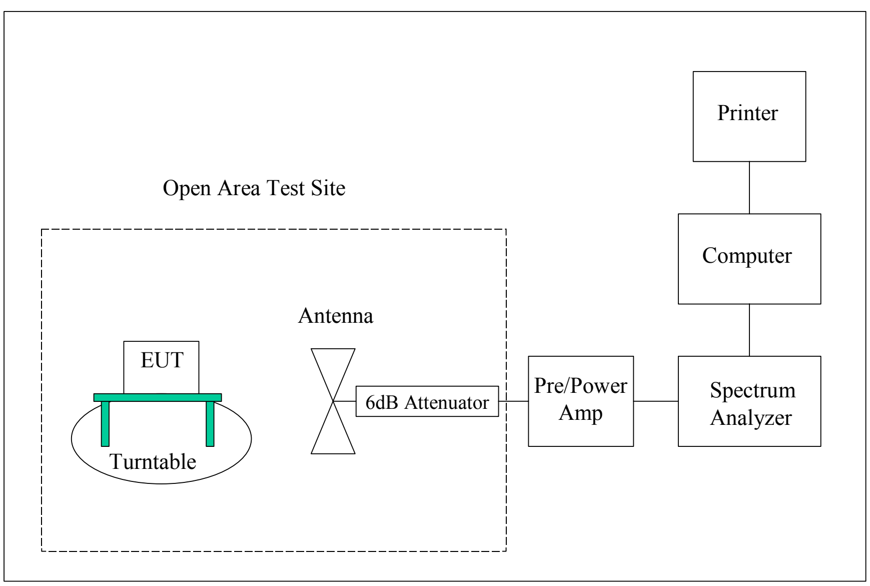
Desktop equipment is measured on a non-conducting table 0.8 meters above the ground plane. The table is placed on a turntable, which is level with the ground plane. For equipment normally placed on floors, the equipment shall be placed directly on the turntable.

Type of Equipment	Manufacturer	Model Number	Serial Number	Date of Last Calibration
Wanship Open Area Test Site #2	CCL	N/A	N/A	10/28/2005
Test Software	CCL	Radiated Emissions	Revision 1.3	N/A
Spectrum Analyzer	Hewlett Packard	8566B	2230A01711	10/10/2005
Quasi-Peak Detector	Hewlett Packard	85650A	2043A00137	03/06/2006

Type of Equipment	Manufacturer	Model Number	Serial Number	Date of Last Calibration
Biconilog Antenna	EMCO	3142	9601-1009	12/28/2005
Double Ridged Guide Antenna	EMCO	3115	9604-4779	05/26/2005
High Frequency Amplifier	Hewlett Packard	8449B	3008A00990	05/25/2005
3 Meter Radiated Emissions Cable Wanship Site #2	CCL	Cable K	N/A	12/12/2005
Pre/Power-Amplifier	Hewlett Packard	8447F	3113A05161	09/19/2005
6 dB Attenuator	Hewlett Packard	8491A	32835	12/12/2005

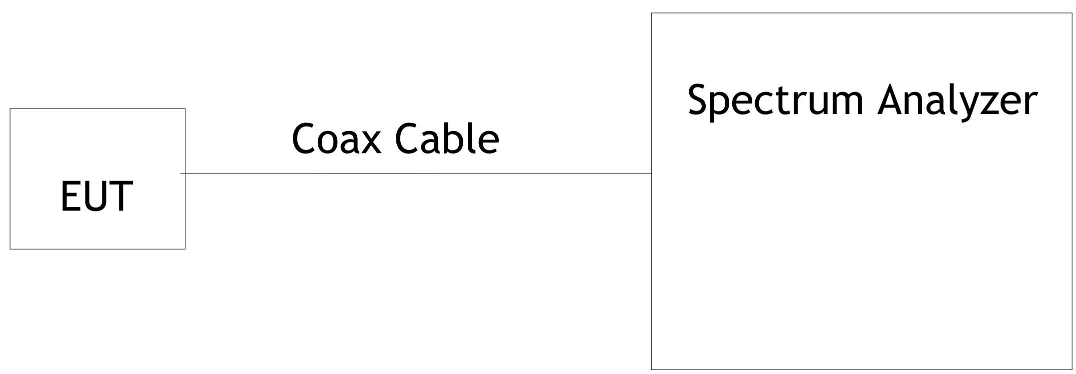
An independent calibration laboratory or CCL personnel calibrates all the equipment listed above at intervals defined in ANSI C63.4:2003 Section 4.4 following outlined calibration procedures. All measurement instrumentation is traceable to the National Institute of Standards and Technology (NIST). Supporting 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	2230A01711	10/10/2005
Quasi-Peak Detector	Hewlett Packard	85650A	2043A00137	03/06/2006
Cable	Andrews	Coax w/SMA	001116	11/16/2005
6 dB Attenuator	Hewlett Packard	8491A	32835	12/12/2005

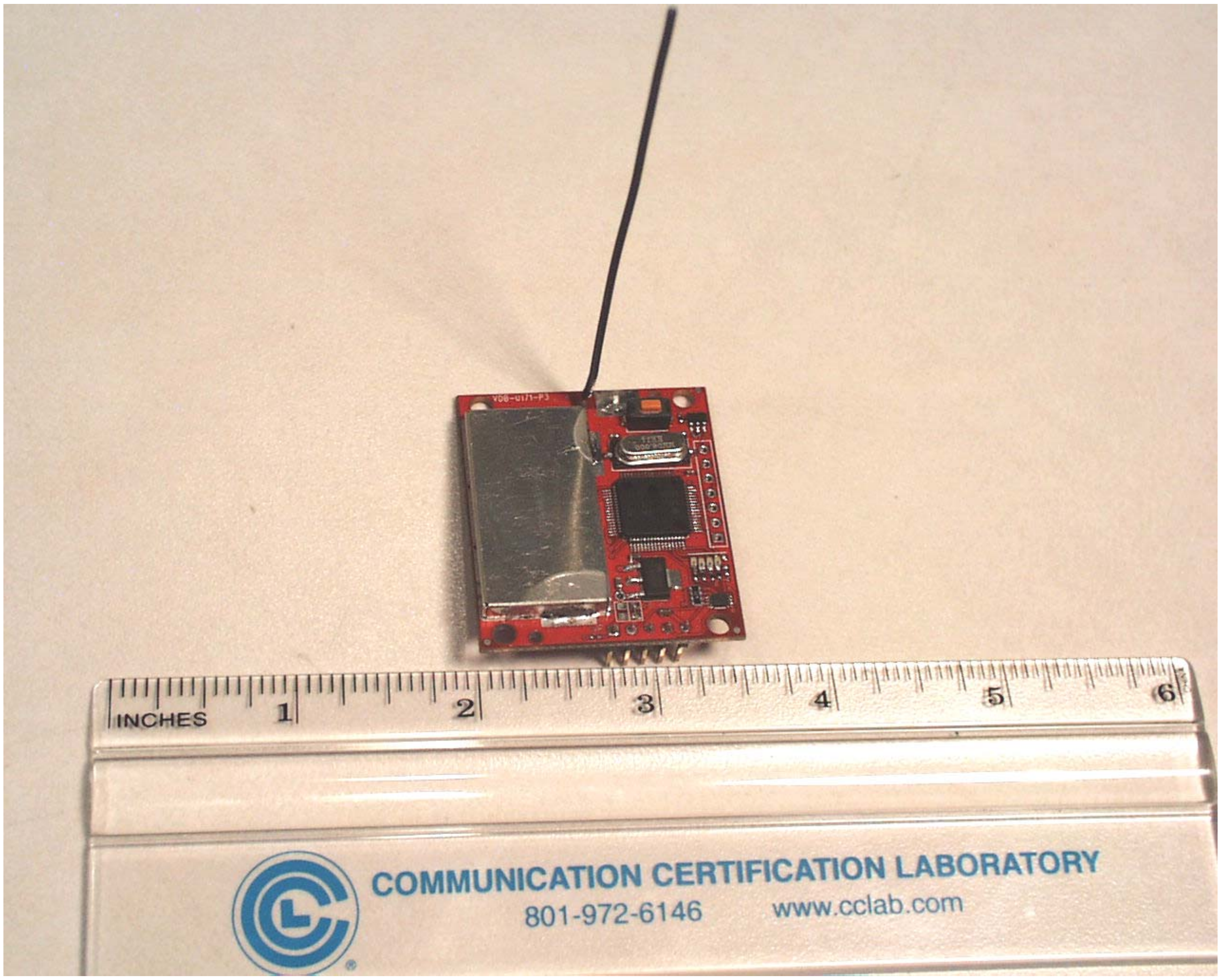


APPENDIX 2 PHOTOGRAPHS

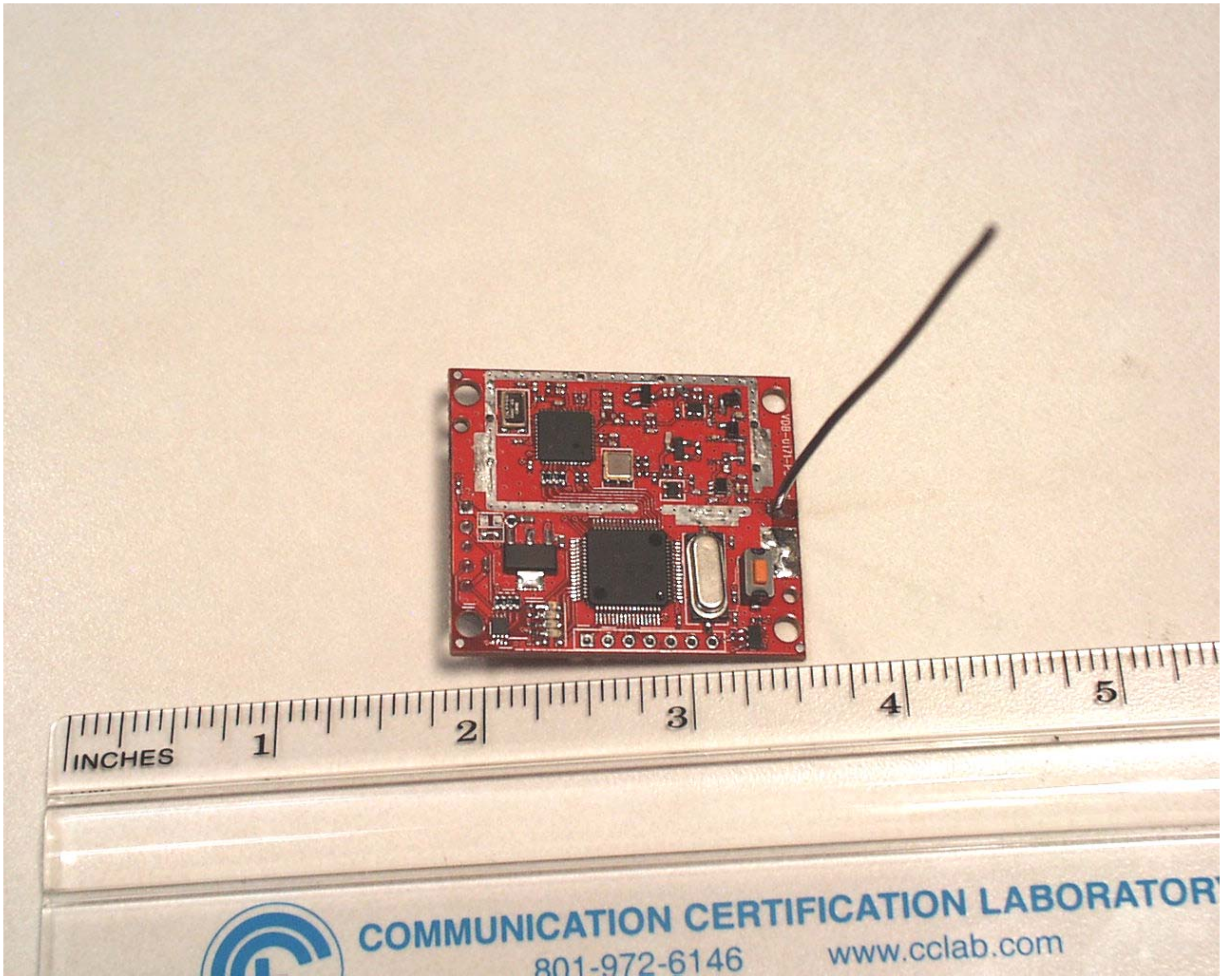
Photograph 1 – Radiated Disturbance Worst Case Configuration

Photograph 2 – Conducted Disturbance Worst Case Configuration

Photograph 3 – Top View of the EUT With RF Shielding in Place



Photograph 4 – Top View of the EUT With RF Shielding in Removed



Photograph 7 – Bottom View of the EUT