TEST REPORT FROM:

COMMUNICATION CERTIFICATION LABORATORY
1940 W. Alexander Street
Salt Lake City, Utah
84119-2039

Type of Report: Certification

TEST OF: VSUB075

FCC ID: PII-VSUB075

To FCC PART 15.247, Subpart C

Test Report Serial No: 73-7537

Applicant:

Vantage Controls
1061 South 800 East
Orem, UT 84097

Date(s) of Test: May 8, 2001

Issue Date: June 1, 2001

Equipment Receipt Date: May 8, 2001

CERTIFICATION OF ENGINEERING REPORT

This report has been prepared by Communication Certification Laboratory to determine compliance of the device described below with the requirements of FCC PART 15.247, 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's: Vantage Controls
- Brand Name: Vantage
- Model Number: VSUB075
- FCC ID: PII-VSUB075

On this 1st day of June 2001, 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.

COMMUNICATION CERTIFICATION LABORATORY

Kirk P. Thomas

Tested by: Kirk P. Thomas
Project Engineer

TABLE OF CONTENTS

PAGE

SECTION 1. CLIENT INFORMATION AND MANUFACTURER:

1.1 Client Information:

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

Contact Name: Jared Lemke
Title: Engineer

1.2 Manufacturer:

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

Contact Name: Jared Lemke
Title: Engineer

SECTION 2. EQUIPMENT UNDER TEST (EUT)

2.1 Identification of EUT:

Trade Name: Vantage Controls
Model Name or Number: VSUB075
Serial Number: N/A
Options Fitted: None
Country of Manufacture: U.S.A.

2.2 Description of EUT:

The VSUB075 modular transceiver is a daughter-board designed to enable wireless control of lighting/HVAC/theater and other systems. The VSUB075 will be incorporated into devices that Vantage currently sells to create a new line of products. The VSUB075 replaces the hard-wired communications bus that is currently used to send control signals throughout the system.

This report covers the transmitter only. The receiver is covered under a separate verification report.

2.3 Modification Incorporated/Special Accessories on EUT:

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

2.4 EUT and Support Equipment:

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

Brand Name Model Number	FCC ID Number	Description	Name of Interface Ports / Interface Cables
BN: Vantage (1) MN: VSUB075	PII-VSUB075	Transceiver	See Section 2.5.

Brand Name Model Number	FCC ID Number	Description	Name of Interface Ports / Interface Cables
BN: Vantage MN: VDB-0092	N/A	RF Enabler	Power / None

Note: (1) EUT.
(2) Interface port connected to EUT (See Section 2.5)
(3) Mouse cable permanently attached.

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

2.5 Interface Ports on EUT:

Name of Ports	No. of Ports Fitted to EUT.	Cable Descriptions/Length
Power	1	Soldered directly to host
Antenna	1	Soldered directly to EUT

SECTION 3. TEST SPECIFICATION, METHODS & PROCEDURES

3.1 Test Specification:

Title:	FCC PART 15.247, Subpart C (47 CFR 15). Limits and methods of measurement of radio interference characteristics of radio frequency devices. Operation within the bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz.
Purpose of Test:	The tests were performed to demonstrate Initial compliance.

3.2 Methods & Procedures:

3.2.1 § 15.247

(a) Operation under the provisions of this section is limited to frequency hopping and direct sequence spread spectrum 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. 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 2400–2483.5 MHz and 5725– 5850 MHz bands 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 may utilize hopping channels whose 20 dB bandwidth is greater than 1 MHz provided the systems use at least 15 non-overlapping channels. The total span of hopping channels shall be at least 75 MHz. The average time of occupancy on any one channel shall not be greater than 0.4 seconds within the time period required to hop through all channels.

(2) For direct sequence systems, the minimum 6 dB bandwidth shall be at least 500 kHz.

(b) The maximum peak output power of the intentional radiator shall not exceed the following:

(1) For frequency hopping systems in the 2400–2483.5 MHz band employing at least 75 hopping channels, all frequency hopping systems in the 5725–5850 MHz band, and all direct sequence systems: 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) Except as shown in paragraphs (b)(3) (i), (ii) and (iii) of this section, if transmitting antennas of directional gain greater than 6 dBi are used the peak output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1) or (b)(2) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(i) Systems operating in the 2400– 2483.5 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

(ii) Systems operating in the 5725– 5850 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter peak output power.

(iii) Fixed, point-to-point operation, as used in paragraphs (b)(3)(i) and (b)(3)(ii) of this section, excludes the use of point-to-multipoint systems, omni-directional applications, and multiple collocated intentional radiators transmitting the same information. The operator of the spread spectrum 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.

(4) 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.

(c) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum 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. Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a) (see § 15.205(c)).

(d) For direct sequence systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

(e) The processing gain of a direct sequence system shall be at least 10 dB. The processing gain represents the improvement to the received signal-to-noise ratio, after filtering to the information bandwidth, from the spreading/ despreading function. The processing gain may be determined using one of the following methods:

(1) As measured at the demodulated output of the receiver: the ratio in dB of the signal-to-noise ratio with the system spreading code turned off to the signal-to-noise ratio with the system spreading code turned on.

(2) As measured using the CW jamming margin method: a signal generator is stepped in 50 kHz increments across the pass band of the system, recording at each point the generator level required to produce the recommended Bit Error Rate (BER). This level is the jammer level. The output power of the intentional radiator is measured at the same point. The jammer to signal ratio (J/S) is then calculated, discarding the worst 20% of the J/S data points. The lowest remaining J/S ratio is used to calculate the processing gain, as follows: Gp = (S/N) o + Mj + Lsys, where Gp = processing gain of the system, (S/N) o = signal to noise ratio required for the chosen BER, Mj = J/S ratio, and Lsys = system losses. Note that total losses in a system, including intentional radiator and receiver, should be assumed to be no more than 2 dB.

(f) Hybrid systems that employ a combination of both direct sequence and frequency hopping modulation techniques shall achieve a processing gain of at least 17 dB from the combined techniques. The frequency hopping operation of the hybrid system, with the direct sequence 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 direct sequence operation of the hybrid system, with the frequency hopping operation 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.

3.2.2 § 15.207 Conducted Limits

(a) For an intentional radiator which 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 450 kHz to 30 MHz shall not exceed 250 microvolts. Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminals.

(b) The following option may be employed if the conducted emissions exceed the limits in paragraph (a) of this section when measured using instrumentation employing a quasipeak detector function: If the level of the emission measured using the quasipeak instrumentation is 6 dB, or more, higher than the level of the same emission measured with instrumentation having an average detector and a 9 kHz minimum bandwidth, that emission is considered broadband and the level obtained with the quasipeak detector may be reduced by 13 dB for comparison to the limits. When employing this option, the following conditions shall be observed:

(1) The measuring instrumentation with the average detector shall employ a linear IF amplifier.

(2) Care must be taken not to exceed the dynamic range of the measuring instrument when measuring an emission with a low duty cycle.

(3) The test report required for verification or for an application for a grant of equipment authorization shall contain all details supporting the use of this option.

(c) The limit shown 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 system 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.

(3) Carrier current systems operating below 30 MHz are also subject to the radiated emission limits in § 15.205, § 15.209, § 15.221, § 15.223, or § 15.227, as appropriate.

(d) 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 provisions for, the use of battery chargers which permit operating while charging, AC adapters 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 Test Procedure

The testing was performed according to the procedures in ANSI C63.4 (1992). Testing was performed at CCL’s anechoic chamber located in Salt Lake City, Utah. This site has been fully described in a report submitted to the FCC, and was accepted in a letter dated March 1, 1999 (31040/SIT).

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 30,2001.

For radiated emissions testing 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. OPERATION OF EUT DURING TESTING.

4.1 Operating Environment:

Power Supply: 8-12 VDC

4.2 Operating Modes:

Each mode of operation was exercised to produce worst-case emissions. The worst-case emissions were with the VSUB075 running in the following mode. The VSUB075 was placed in the transmit mode with the same type of modulation that would normally be used during normal operation.

4.3 Configuration & Peripherals:

The VSUB075 was placed on the table in the transmit mode with the same type of modulation that would normally be used during normal operation.

SECTION 5. SUMMARY OF TEST RESULTS:

5.1 FCC PART 15.247, Subpart C

5.1.1 Summary of Tests:

Section	Test Performed	Frequency Range (MHz)	Result
15.247 (a)(1)	Hopping Channel Carrier Frequencies	902 to 928	Complied
15.247 (a)(1)(i)	Average Time of Occupancy	902 to 928	Complied
15.247 (a)(1)(i)	Emission Bandwidth	902 to 928	Complied
15.247 (b)(1)	Peak Output Power	902 to 928	Complied
15.247 (C)	Antenna Conducted Spurious Emissions	10 to 25,000	Complied
15.247 (C)	Radiated Spurious Emissions	10 to 25,000	Complied
15.247 (f)	Hybrid Systems	902 to 928	Complied
15.207	Line Conducted Emissions (Hot Lead to Ground)	0.45 to 30	Complied
15.207	Line Conducted Emissions (Neutral Lead to Ground)	0.45 to 30	Complied

5.2 Result

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

SECTION 6. MEASUREMENTS, EXAMINATIONS AND DERIVED RESULTS:

6.1 General Comments:

This section contains the test results only. Details of the test methods used, etc., can be found in Appendix 1 of this report.

6.2 Test Results

6.2.1 § 15.247 (a)(1) pseudorandomly ordered list of hopping frequencies and receiver input bandwidth

The VSUB075 hops on a set of 25 channels. The occupancy of each channel is limited to an average of 400ms in a 10s period. Each device has 16 pseudo-randomly ordered lists to choose from for its hop sequence. At the time of installation, the installer determines which of the 16 sequences the device will use. There is no coordination between transmitters to adjust the hopping sequence. The 16 sequences are shown in the table below:

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

These sequences were generated using a computer program that selected numbers from 1 to 25 at random. The one condition enforced was that each channel had to be at least 4 channels away from the one before it in each sequence. After generating a long list of sequences, these 16 were chosen.

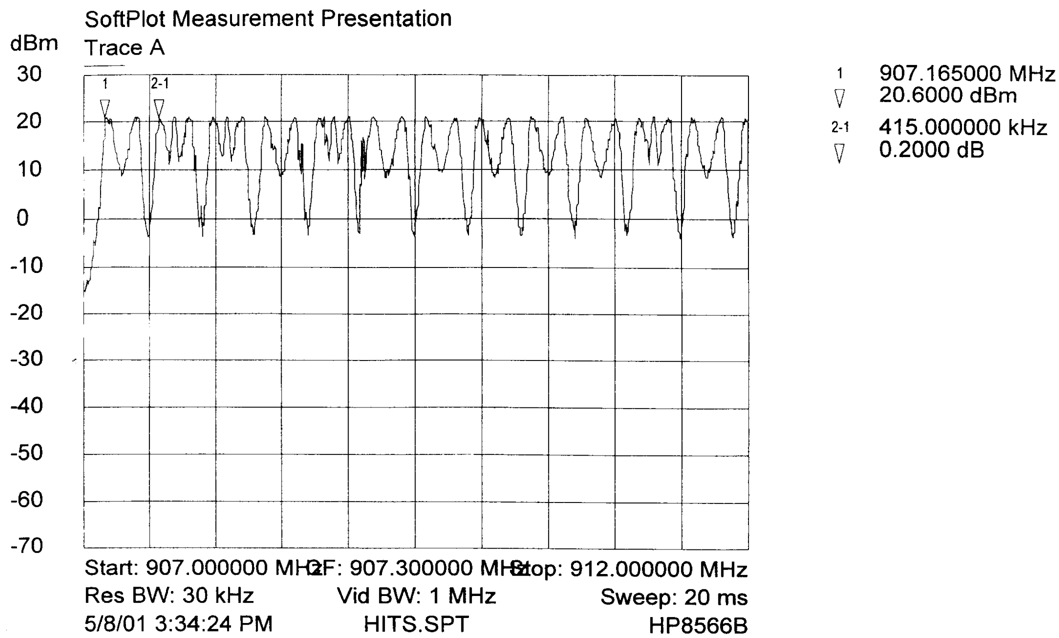
6.2.2 § 15.247 (a)(1) Hopping Channel Carrier Frequencies
§ 15.247 (a)(1)(i) Number of Hopping Channels

The VSUB075 operates on the following 25 channels; 400 KHz separates these channels. Shown below are plots that show the number of hopping channels and the carrier frequency separation:

Channel	Frequency(MHz)
1	907.3
2	907.7
3	908.1
4	908.5
5	908.9
6	909.3
7	909.7
8	910.1
9	910.5
10	910.9
11	911.3
12	911.7
13	912.1

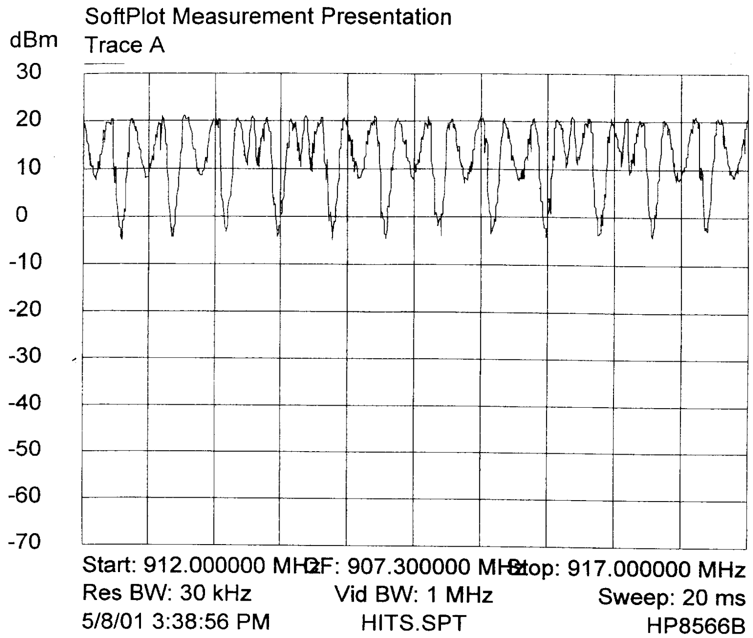
Channel	Frequency(MHz)
14	912.5
15	912.9
16	913.3
17	913.7
18	914.1
19	914.5
20	914.9
21	915.3
22	915.7
23	916.1
24	916.5
25	916.9

Number of Hopping Channels (Plot 1)



channels plot 1

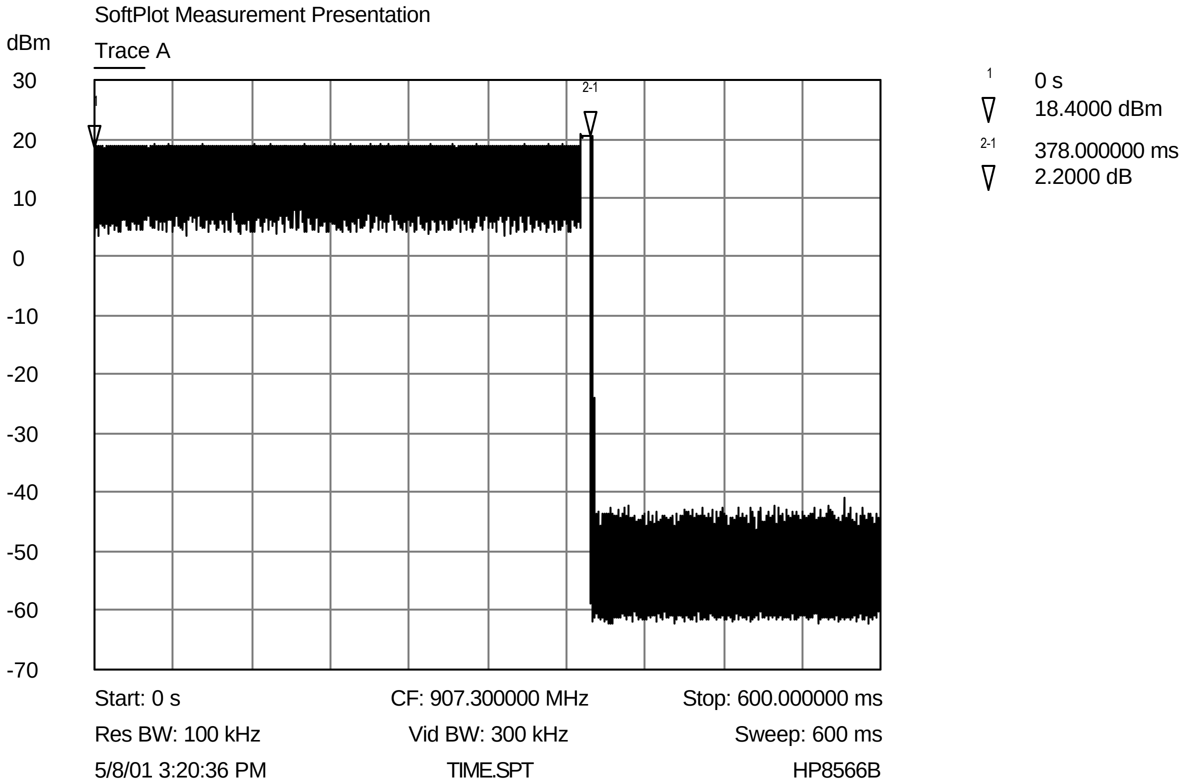
Number of Hopping Channels (Plot 2)



channels plot 2

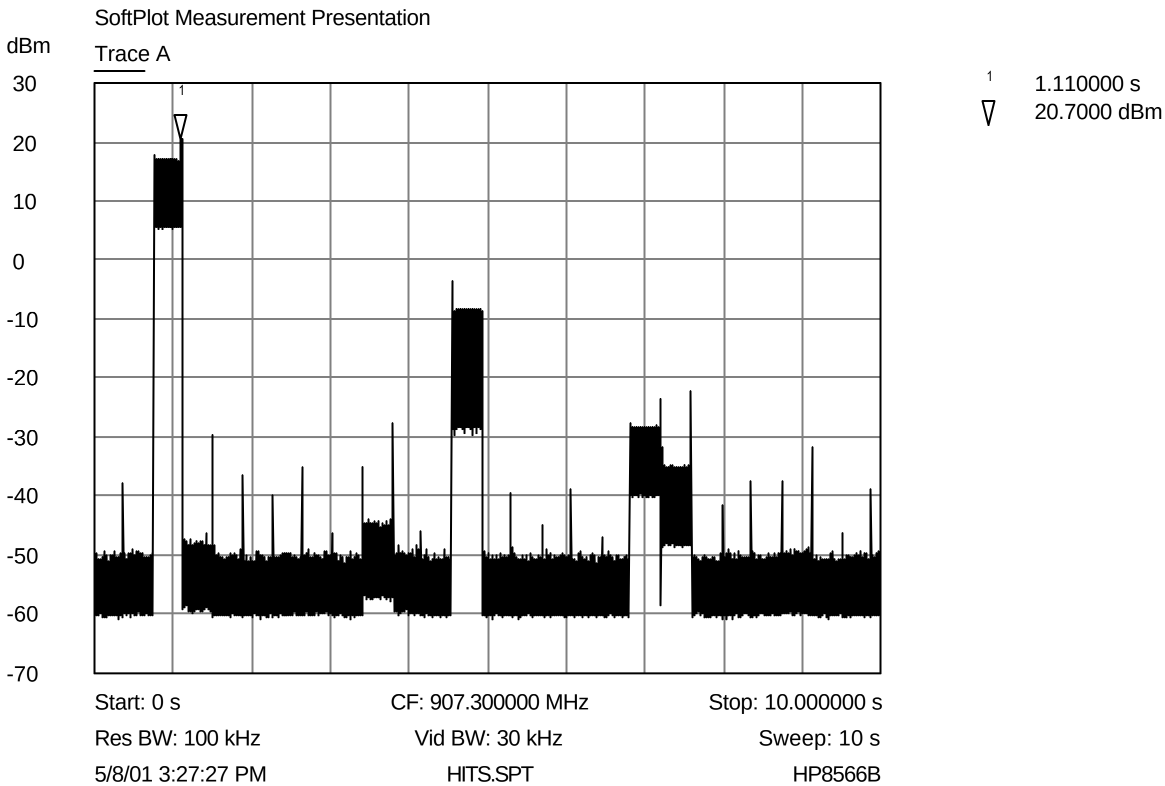
6.2.3 § 15.247 (a)(1)(i) Average Time of Occupancy

Pulse Width Plot



Time of Occupancy

Number of Hits Plot



Hits per ten seconds

Average time of occupancy = Hits in 10 seconds * Pulse Width

Average time of occupancy = 1 * 378 msec

Average time of occupancy = 0.378 seconds

6.2.4 § 15.247 (a)(1)(i) Emission Bandwidth

Measurement Data:

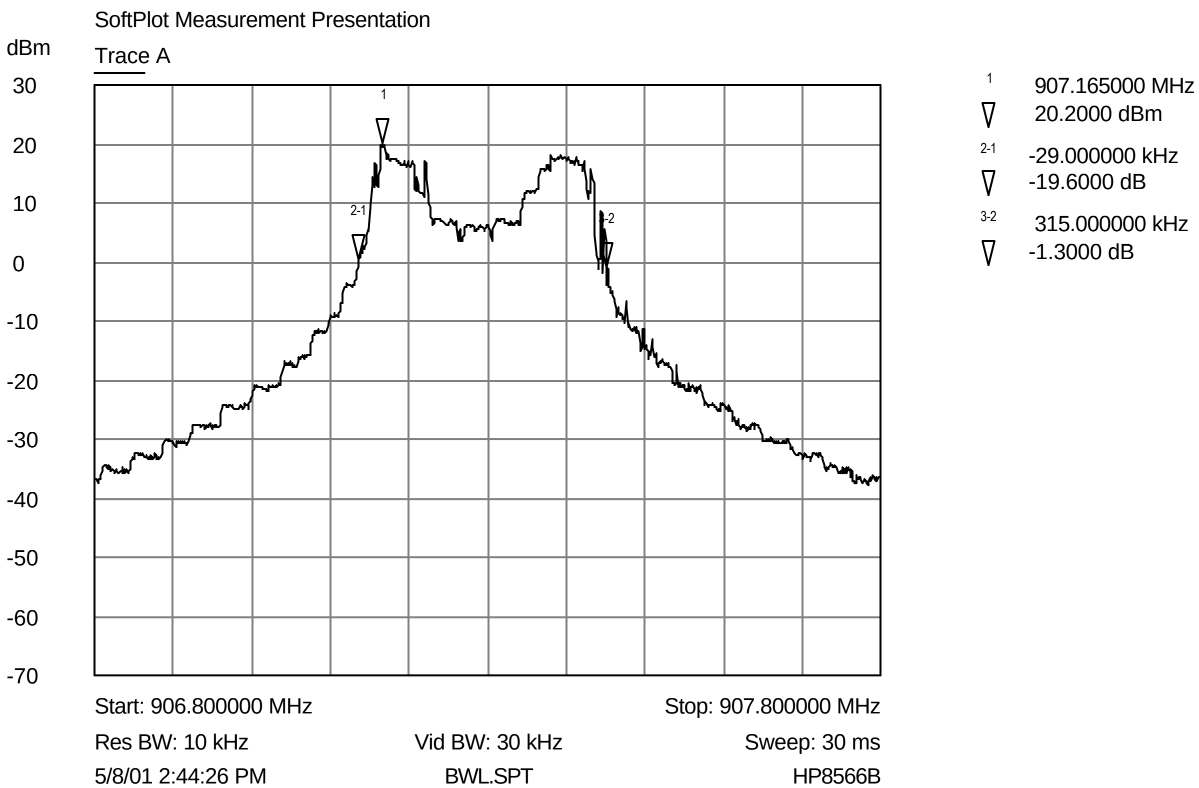
A diagram of the test configuration and the test equipment used is enclosed in Appendix 1.

Frequency (MHz)	Emission Bandwidth (kHz)
907.3	315.0
912.1	319.0
916.9	339.0

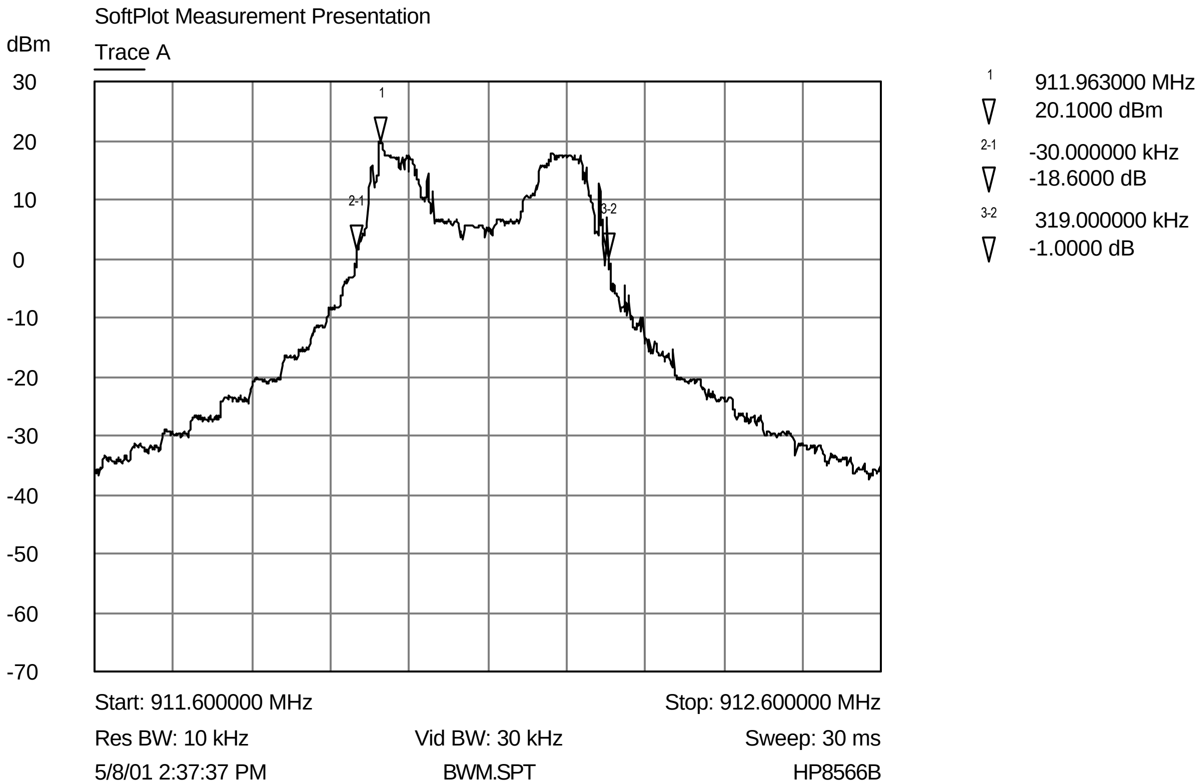
RESULT

In the configuration tested, the 20 dB bandwidth was less than 1 MHz; therefore, the EUT complied with the requirements of the specification (see spectrum analyzer plots below).

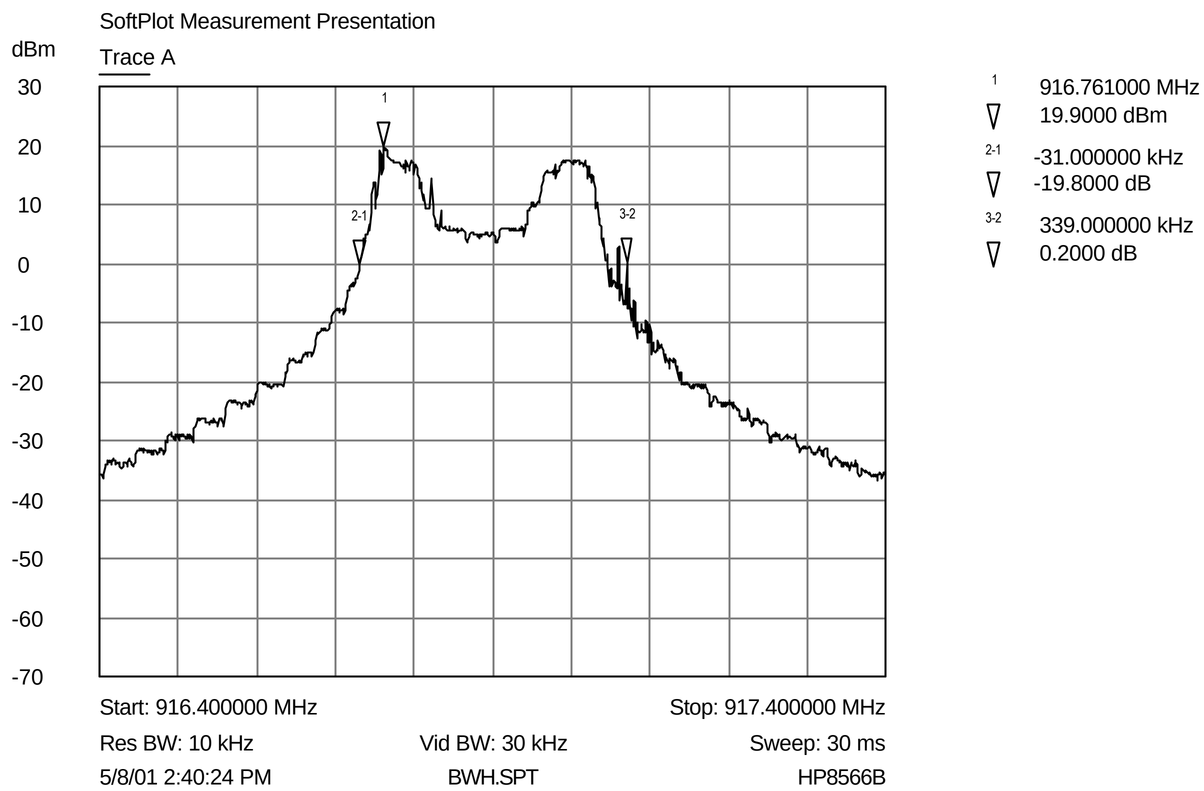
Emission Bandwidth Plot - (Low Channel)



Emission Bandwidth Plot - (Middle Channel)



Emission Bandwidth Plot - (High Channel)



6.2.5 § 15.247 (b)(1) Peak Output Power:

Measurement Data:

The maximum peak RF Conducted output power measured for this device was 138.0 mW or 21.4 dBm. The maximum directional gain of the antenna is 2 dBi; therefore, the maximum output power is not required to be reduced from the value measured.

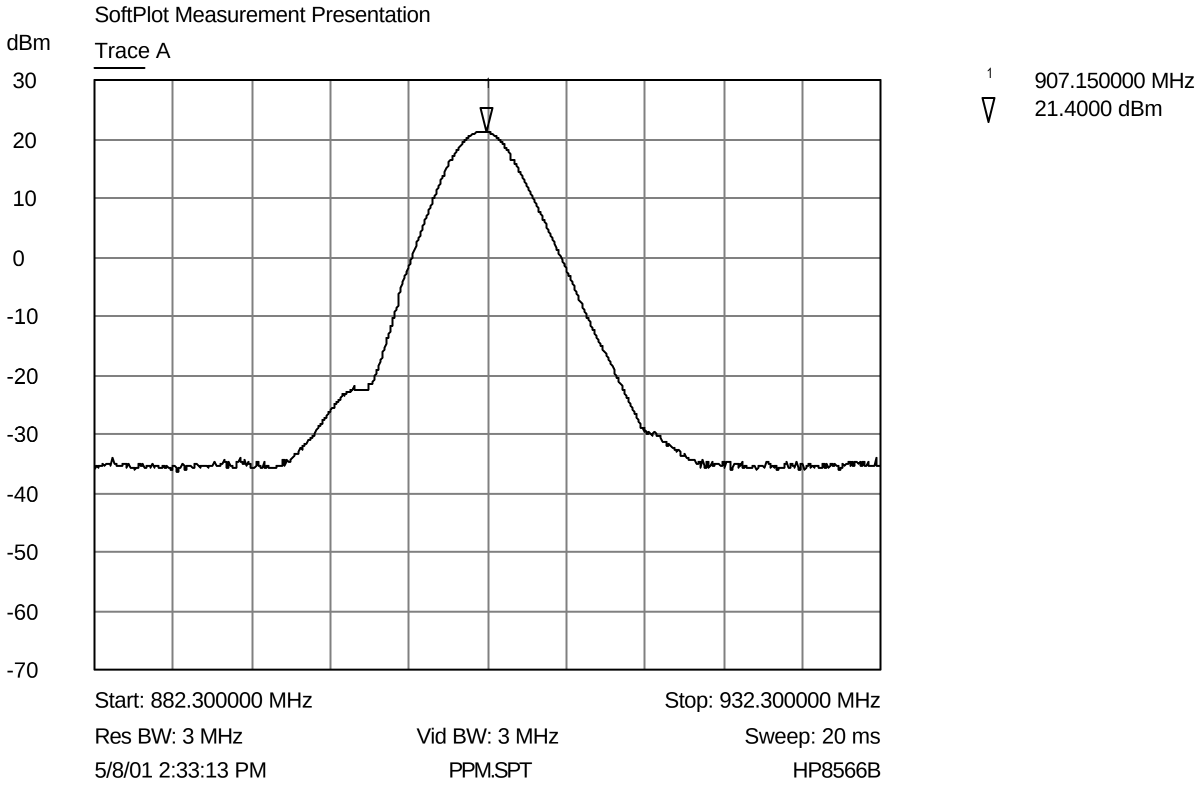
A diagram of the test configuration and the test equipment used is enclosed in Appendix 1.

Frequency (MHz)	Measured Output Power (dBm)	Measured Output Power (mW)
907.3	21.4	138.0
912.1	21.3	134.8
916.9	21.3	134.8

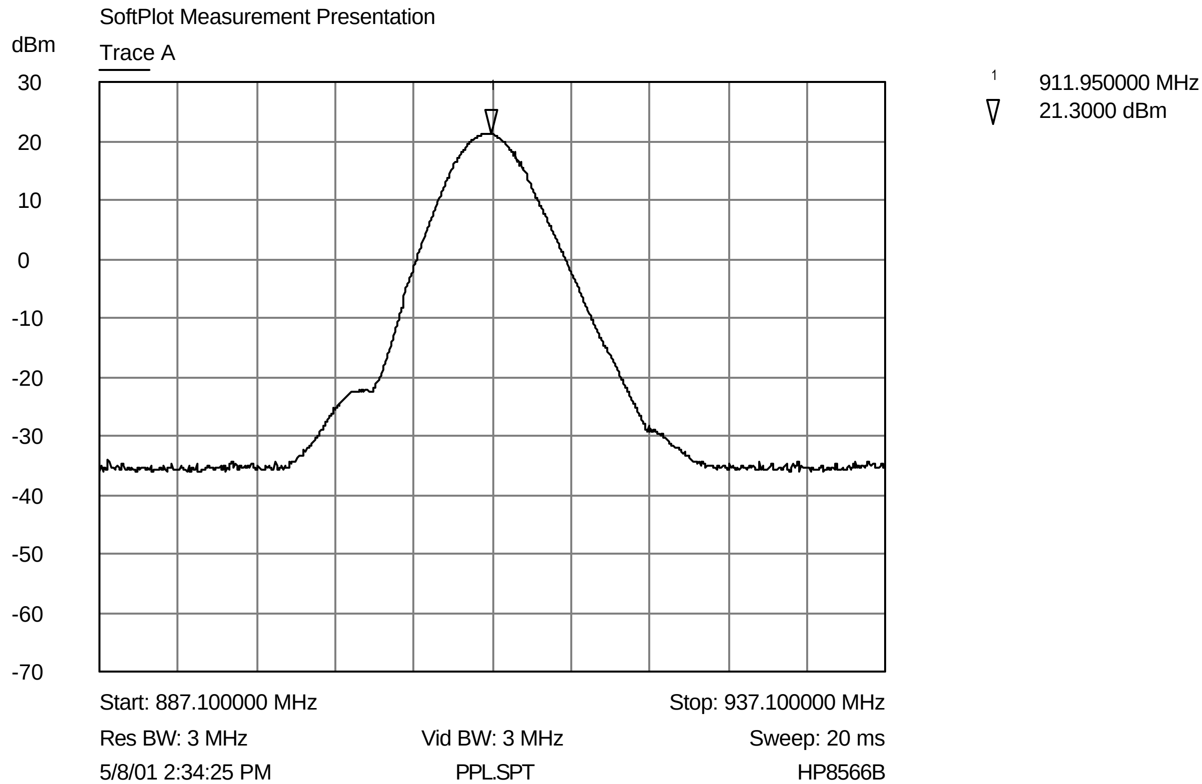
RESULT

In the configuration tested, the RF peak output power was less than 250 mW; therefore, the EUT complied with the requirements of the specification (see spectrum analyzer plots below).

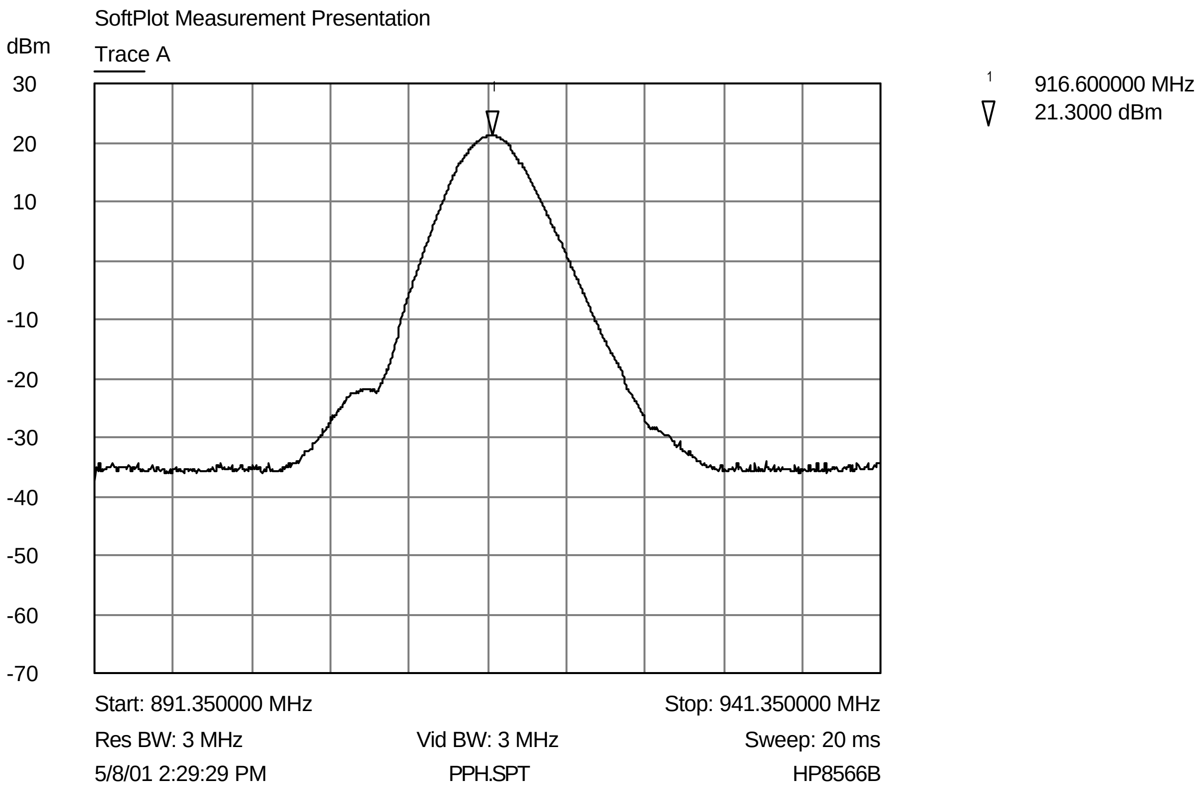
Peak Output Power Plot - (Low Channel)



Peak Output Power Plot - (Middle Channel)



Peak Output Power Plot - (High Channel)



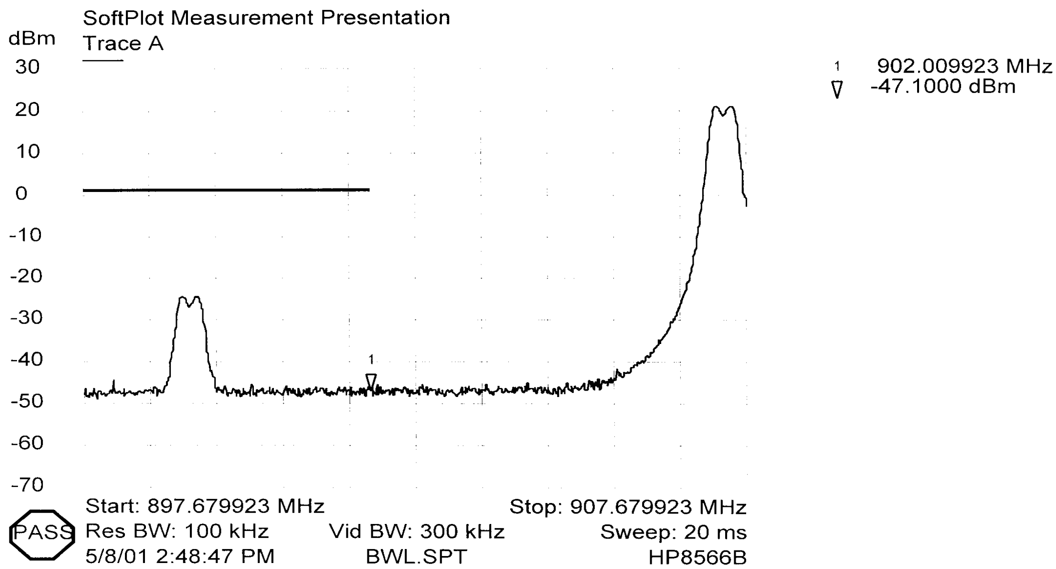
6.2.6 § 15.247 (c) Spurious Emissions:

Measurement Data Antenna Conducted Emissions:

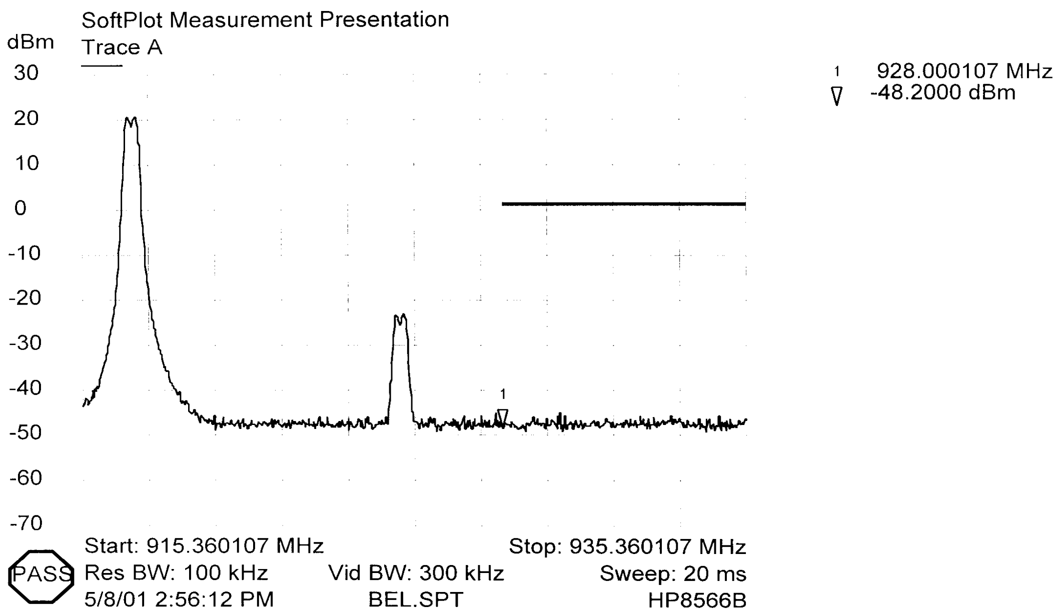
The frequency range from 10 MHz to the tenth harmonic of the highest fundamental frequency was investigated to measure any antenna-conducted emissions. Shown below are plots with the VSUB075 tuned to the upper and lower channels. These demonstrate compliance with the provisions of this section.

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

Spurious emissions plot (Transmitting at 907.3 MHz)



Spurious emissions plot (Transmitting at 916.9 MHz)



The emissions must be attenuated 20 dB below the highest power level measured within the authorized band as measured with a 100 kHz RBW; the highest level measured with a 100 kHz RBW was 21.4 dBm therefore, the criteria is 21.4 – 20.0 = 1.4 dBm.

Transmitting at 907.3 MHz			
Frequency Range MHz	Frequency MHz	Corrected Level dBm	Criteria dBm
10 - 200	173.0	-44.4	1.4
200 - 902	901.3	-24.7	1.4
928 – 2000	1820.0	-26.9	1.4
2000 – 4000	2722.0	-41.2	1.4
4000 - 6000	5448.0	-32.7	1.4
6000 - 8000	6348.0	-54.4	1.4
8000 – 10,000	9988.0	-56.5	1.4
10 - 200	173.0	-44.4	1.4
200 - 902	901.3	-24.7	1.4
* Noise Floor			

The emissions must be attenuated 20 dB below the highest power level measured within the authorized band as measured with a 100 kHz RBW; the highest level measured with a 100 kHz RBW was 21.3 dBm therefore, the criteria is 21.3 – 20.0 = 1.3 dBm.

Transmitting at 912.1 MHz			
Frequency Range MHz	Frequency MHz	Corrected Level dBm	Criteria dBm
10 - 200	13.8	-38.6	1.3
200 - 902	470.3	-19.7	1.3
928 – 2000	1830.0	-28.5	1.3
2000 – 4000	2736.0	-44.1	1.3
4000 - 6000	5476.0	-34.1	1.3
6000 - 8000	6382.0	-54.5	1.3
8000 – 10,000	8208.0	-59.1	1.3
* Noise Floor			

The emissions must be attenuated 20 dB below the highest power level measured within the authorized band as measured with a 100 kHz RBW; the highest level measured with a 100 kHz RBW was 21.3 dBm therefore, the criteria is 21.3 – 20.0 = 1.3 dBm.

Transmitting at 916.9 MHz			
Frequency Range MHz	Frequency MHz	Corrected Level dBm	Criteria dBm
10 - 200	23.3	-39.1	1.3
200 - 902	482.2	-19.9	1.3
928 – 2000	1839.0	-28.5	1.3
2000 – 4000	2752.0	-43.9	1.3
4000 - 6000	5508.0	-34.8	1.3
6000 - 8000	6416.0	-54.6	1.3
8000 – 10,000	8252.0	-58.9	1.3
* Noise Floor			

Measurement Data Radiated Emissions Restricted Bands § 15.205:

The frequency range from 10 MHz to 25 GHz was investigated to measure any radiated emissions in the restricted bands. Shown below are any emissions that fell into the restricted bands of § 15.205.

A diagram of the test configuration and the test equipment used is enclosed in Appendix 1. RBW = 100 kHz, VBW = 300 kHz

AVERAGE FACTOR

The VSUB075 transmits continuously therefore; there is not an average factor for this device.

Vertical Polarity

Transmitting at 907.3 MHz							
Frequency MHz	Receiver Reading dBµV	Antenna & Cable Correction Factor dB	Amp Correction Factor dB	Average Factor dB	Corrected Reading dBµV/m	Limit dBµV/m	Margin dB
960.0 P	51.6	36.2	-37.4	0.0	50.4	74.0	-23.6
960.0 A	39.8	36.2	-37.4	0.0	38.6	54.0	-15.4
2721.9 P	52.7	36.6	-36.0	0.0	53.3	74.0	-20.7
2721.9 A	47.5	36.6	-36.0	0.0	48.1	54.0	-5.9
3629.2 P	45.2	39.9	-35.7	0.0	49.4	74.0	-24.6
3629.2 A	31.9	39.9	-35.7	0.0	36.1	54.0	-17.9
4536.5 P	54.1	41.2	-35.2	0.0	60.1	74.0	-13.9
4536.5 A	47.5	41.2	-35.2	0.0	53.5	54.0	-0.5
7258.4 P	47.1	37.6	-34.6	0.0	50.1	74.0	-23.9
7258.4 A	34.8	37.6	-34.6	0.0	37.8	54.0	-16.2
8165.7 P	46.3	38.0	-34.8	0.0	49.5	74.0	-24.5
8165.7 A	34.8	38.0	-34.8	0.0	38.0	54.0	-16.0
9073.0 P	47.4	39.6	-35.5	0.0	51.5	74.0	-22.5
9073.0 A	34.8	39.6	-35.5	0.0	38.9	54.0	-15.1

P = Peak Detection

A = Average Detection

* No emissions were detected with the antenna 1 meter from the EUT, the indicated readings are the noise floor measurements from the spectrum analyzer

Transmitting at 912.1 MHz							
Frequency MHz	Receiver Reading dBµV	Antenna & Cable Correction Factor dB	Amp Correction Factor dB	Average Factor dB	Corrected Reading dBµV/m	Limit dBµV/m	Margin dB
960.0 P	50.5	36.2	-37.4	0.0	49.3	74.0	-24.7
960.0 A	42.0	36.2	-37.4	0.0	40.8	54.0	-13.2
2736.3 P	51.3	36.6	-36.0	0.0	51.9	74.0	-22.1
2736.3 A	45.6	36.6	-36.0	0.0	46.2	54.0	-7.8
3648.4 P	44.1	39.9	-35.7	0.0	48.3	74.0	-25.7
3648.4 A	32.7	39.9	-35.7	0.0	36.9	54.0	-17.1
4560.5 P	51.4	41.4	-35.1	0.0	57.7	74.0	-16.3
4560.5 A	45.3	41.4	-35.1	0.0	51.6	54.0	-2.4
7296.8 P	55.4	37.6	-34.5	0.0	58.5	74.0	-15.5
7296.8 A	36.0	37.6	-34.5	0.0	39.1	54.0	-14.9
8208.9 P	55.4	38.0	-34.8	0.0	58.6	74.0	-15.4
8208.9 A	34.6	38.0	-34.8	0.0	37.8	54.0	-16.2
9121.0 P	55.7	39.5	-35.5	0.0	59.7	74.0	-14.3
9121.0 A	34.7	39.5	-35.5	0.0	38.7	54.0	-15.3

P = Peak Detection

A = Average Detection

* No emissions were detected with the antenna 1 meter from the EUT, the indicated readings are the noise floor measurements from the spectrum analyzer

Transmitting at 916.9 MHz							
Frequency MHz	Receiver Reading dBµV	Antenna & Cable Correction Factor dB	Amp Correction Factor dB	Average Factor dB	Corrected Reading dBµV/m	Limit dBµV/m	Margin dB
960.0 P	51.1	36.2	-37.4	0.0	49.9	74.0	-24.1
960.0 A	40.6	36.2	-37.4	0.0	39.4	54.0	-14.6
2750.7 P	46.8	36.8	-36.1	0.0	47.5	74.0	-26.5
2750.7 A	46.1	36.8	-36.1	0.0	46.8	54.0	-7.2
3667.6 P	45.5	40.1	-35.7	0.0	49.9	74.0	-24.1
3667.6 A	33.5	40.1	-35.7	0.0	37.9	54.0	-16.1
4584.5 P	48.8	41.4	-35.1	0.0	55.1	74.0	-18.9
4584.5 A	41.4	41.4	-35.1	0.0	47.7	54.0	-6.3
7335.2 P	48.2	37.7	-34.5	0.0	51.4	74.0	-22.6
7335.2 A	37.6	37.7	-34.5	0.0	40.8	54.0	-13.2
8252.1 P	46.2	38.1	-34.8	0.0	49.5	74.0	-24.5
8252.1 A	34.6	38.1	-34.8	0.0	37.9	54.0	-16.1
9169.0 P	46.7	39.4	-35.4	0.0	50.7	74.0	-23.3
9169.0 A	34.5	39.4	-35.4	0.0	38.5	54.0	-15.5

P = Peak Detection

A = Average Detection

* No emissions were detected with the antenna 1 meter from the EUT, the indicated readings are the noise floor measurements from the spectrum analyzer

Horizontal Polarity

Transmitting at 907.3 MHz							
Frequency MHz	Receiver Reading dBµV	Antenna & Cable Correction Factor dB	Amp Correction Factor dB	Average Factor dB	Corrected Reading dBµV/m	Limit dBµV/m	Margin dB
960.0 P	48.8	36.2	-37.4	0.0	47.6	74.0	-26.4
960.0 A	37.7	36.2	-37.4	0.0	36.5	54.0	-17.5
2721.9 P	51.1	36.6	-36.0	0.0	51.7	74.0	-22.3
2721.9 A	44.9	36.6	-36.0	0.0	45.5	54.0	-8.5
3629.2 P	44.1	39.9	-35.7	0.0	48.3	74.0	-25.7
3629.2 A	32.1	39.9	-35.7	0.0	36.3	54.0	-17.7
4536.5 P	48.6	41.2	-35.2	0.0	54.6	74.0	-19.4
4536.5 A	40.2	41.2	-35.2	0.0	46.2	54.0	-7.8
7258.4 P	46.5	37.6	-34.6	0.0	49.5	74.0	-24.5
7258.4 A	34.7	37.6	-34.6	0.0	37.7	54.0	-16.3
8165.7 P	46.5	38.0	-34.8	0.0	49.7	74.0	-24.3
8165.7 A	34.8	38.0	-34.8	0.0	38.0	54.0	-16.0
9073.0 P	46.7	39.6	-35.5	0.0	50.8	74.0	-23.2
9073.0 A	34.7	39.6	-35.5	0.0	38.8	54.0	-15.2

P = Peak Detection

A = Average Detection

* No emissions were detected with the antenna 1 meter from the EUT, the indicated readings are the noise floor measurements from the spectrum analyzer

Transmitting at 912.1 MHz							
Frequency MHz	Receiver Reading dBμV	Antenna & Cable Correction Factor dB	Amp Correction Factor dB	Average Factor dB	Corrected Reading dBμV/m	Limit dBμV/m	Margin dB
960.0 P	49.8	36.2	-37.4	0.0	48.6	74.0	-25.4
960.0 A	37.8	36.2	-37.4	0.0	36.6	54.0	-17.4
2736.3 P	50.9	36.6	-36.0	0.0	51.5	74.0	-22.5
2736.3 A	44.6	36.6	-36.0	0.0	45.2	54.0	-8.8
3648.4 P	44.8	39.9	-35.7	0.0	49.0	74.0	-25.0
3648.4 A	31.4	39.9	-35.7	0.0	35.6	54.0	-18.4
4560.5 P	46.8	41.4	-35.1	0.0	53.1	74.0	-20.9
4560.5 A	37.7	41.4	-35.1	0.0	44.0	54.0	-10.0
7296.8 P	56.5	37.6	-34.5	0.0	59.6	74.0	-14.4
7296.8 A	35.1	37.6	-34.5	0.0	38.2	54.0	-15.8
8208.9 P	55.6	38.0	-34.8	0.0	58.8	74.0	-15.2
8208.9 A	34.6	38.0	-34.8	0.0	37.8	54.0	-16.2
9121.0 P	55.4	39.5	-35.5	0.0	59.4	74.0	-14.6
9121.0 A	34.6	39.5	-35.5	0.0	38.6	54.0	-15.4

P = Peak Detection

A = Average Detection

* No emissions were detected with the antenna 1 meter from the EUT, the indicated readings are the noise floor measurements from the spectrum analyzer

Transmitting at 916.9 MHz							
Frequency MHz	Receiver Reading dBμV	Antenna & Cable Correction Factor dB	Amp Correction Factor dB	Average Factor dB	Corrected Reading dBμV/m	Limit dBμV/m	Margin dB
960.0 P	48.8	36.2	-37.4	0.0	47.6	74.0	-26.4
960.0 A	36.7	36.2	-37.4	0.0	35.5	54.0	-18.5
2750.7 P	52.2	36.8	-36.1	0.0	52.9	74.0	-21.1
2750.7 A	45.9	36.8	-36.1	0.0	46.6	54.0	-7.4
3667.6 P	45.6	40.1	-35.7	0.0	50.0	74.0	-24.0
3667.6 A	33.3	40.1	-35.7	0.0	37.7	54.0	-16.3
4584.5 P	46.8	41.4	-35.1	0.0	53.1	74.0	-20.9
4584.5 A	37.2	41.4	-35.1	0.0	43.5	54.0	-10.5
7335.2 P	46.4	37.7	-34.5	0.0	49.6	74.0	-24.4
7335.2 A	34.9	37.7	-34.5	0.0	38.1	54.0	-15.9
8252.1 P	46.2	38.1	-34.8	0.0	49.5	74.0	-24.5
8252.1 A	34.6	38.1	-34.8	0.0	37.9	54.0	-16.1
9169.0 P	46.6	39.4	-35.4	0.0	50.6	74.0	-23.4
9169.0 A	34.5	39.4	-35.4	0.0	38.5	54.0	-15.5

P = Peak Detection

A = Average Detection

* No emissions were detected with the antenna 1 meter from the EUT, the indicated readings are the noise floor measurements from the spectrum analyzer

Sample Field Strength Calculation:

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

FS = RA + CF - AF Where
FS = Field Strength
RA = Receiver Amplitude (Receiver Reading - Amplifier Gain)
CF = Correction Factor (Antenna Factor + Cable Factor)
AF = Average Factor

RESULT

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

6.2.7 § 15.247 (f) Hybrid System:

The VSUB075 does not operate in a hybrid mode; see technical description in manufacturer's Exhibit 12.

6.2.7 § 15.247 (g) and § 15.247 (h):

The VSUB075 is designed to comply with these sections; see technical description in manufacturer's Exhibit 12.

6.2.8 § 15.207 Line Conducted Emissions:

The frequency range from 450 kHz to 30 MHz was investigated to measure any AC line conducted emissions.

A diagram of the test configuration and the test equipment used is enclosed in Appendix 1. RBW = 100 kHz, VBW = 300 kHz

Line Conducted Data - (Hot Lead)

Frequency (MHz)	Detector	Measured Level (dBµV)	Limit (dBµV)	Margin (dB)
0.48	Peak (Note 1)	40.1	48.0	-7.9
0.89	Peak (Note 1)	36.3	48.0	-11.7
0.92	Peak (Note 1)	35.2	48.0	-12.8
21.18	Peak (Note 1)	20.6	48.0	-27.4
24.06	Peak (Note 1)	21.0	48.0	-27.0

Note 1: The reference detector used for the measurements was peak or quasi-peak and the data was compared to the quasi-peak limit.

Note 2: The reference detector used for the measurements ware quasi-peak and average. The level of the emission measured using the quasi-peak detector was 6 dB, or more, higher than the level of the same emission measured with average detection; therefore, the quasi-peak level was reduced by 13 dB for comparison to the limits, as per FCC § 15.107 (d).

Line Conducted Data - (Neutral Lead)

Frequency (MHz)	Detector	Measured Level (dBµV)	Limit (dBµV)	Margin (dB)
0.77	Peak (Note 1)	39.6	48.0	-8.4
0.89	Peak (Note 1)	39.5	48.0	-8.5
0.99	Peak (Note 1)	38.2	48.0	-9.8
19.05	Peak (Note 1)	20.6	48.0	-27.4

Note 1: The reference detector used for the measurements was peak or quasi-peak and the data was compared to the quasi-peak limit.

Note 2: The reference detector used for the measurements ware quasi-peak and average. The level of the emission measured using the quasi-peak detector was 6 dB, or more, higher than the level of the same emission measured with average detection; therefore, the quasi-peak level was reduced by 13 dB for comparison to the limits, as per FCC § 15.107 (d).

APPENDIX 1 TEST PROCEDURES AND TEST EQUIPMENT

FCC Sections 15.247 (a)(1)(i) Emission Bandwidth

The EUT was directly connected to the spectrum analyzer via the antenna output port as shown in the block diagram below.

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

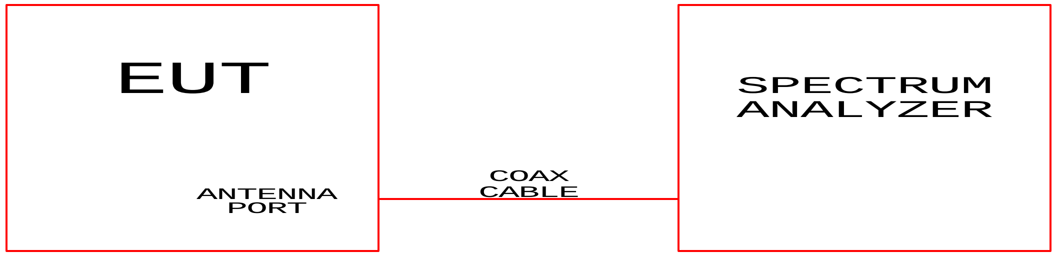
The spectrum analyzer's resolution bandwidth and video bandwidth were set as follows:

RBW = 10 kHz
VBW = 30 kHz

Type of Equipment	Manufacturer	Model Number	Serial Number
Spectrum Analyzer	Hewlett Packard	8566B	2230A01711
Quasi-Peak Detector	Hewlett Packard	8565A	3107A01582
Low Loss Cable (1 dB)	N/A	N/A	N/A

All the equipment listed above is calibrated every 12 months by an independent calibration laboratory or by CCL personal
following outlined calibration procedures.

Test Configuration Block Diagram



FCC Sections 15.247 (b)(1) Peak Output Power

The EUT was directly connected to the spectrum analyzer via the antenna output port as shown in the block diagram below.

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

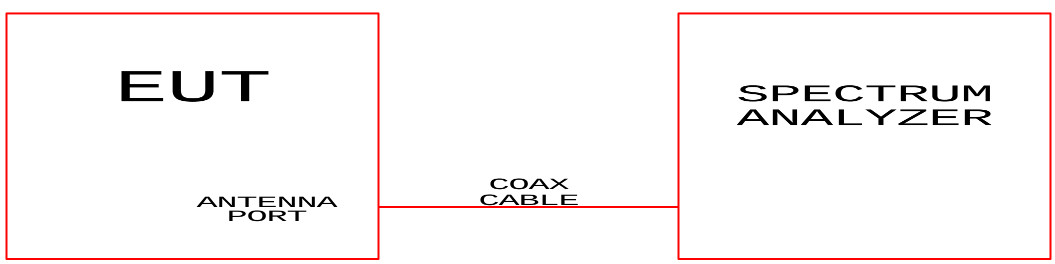
The spectrum analyzer's resolution bandwidth and video bandwidth were set as follows:

RBW = 3 MHz
VBW = 3 MHz

Type of Equipment	Manufacturer	Model Number	Serial Number
Spectrum Analyzer	Hewlett Packard	8566B	2230A01711
Quasi-Peak Detector	Hewlett Packard	8565A	3107A01582
Low Loss Cable (1 dB)	N/A	N/A	N/A

All the equipment listed above is calibrated every 12 months by an independent calibration laboratory or by CCL personal
following outlined calibration procedures.

Test Configuration Block Diagram



FCC Sections 15.247 (c) Spurious Emissions

Conducted Spurious Emissions

The EUT was directly connected to the spectrum analyzer via the antenna output port as shown in the block diagram below.

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

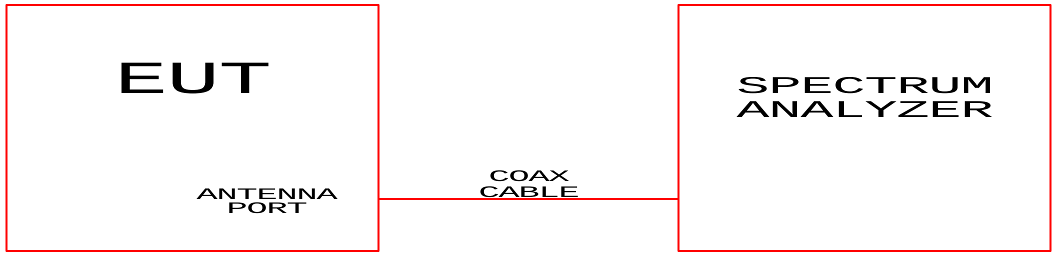
The spectrum analyzer's resolution bandwidth and video bandwidth were set as follows:

RBW = 100 kHz
VBW = 300 kHz

Type of Equipment	Manufacturer	Model Number	Serial Number
Spectrum Analyzer	Hewlett Packard	8566B	2230A01711
Quasi-Peak Detector	Hewlett Packard	8565A	3107A01582
Low Loss Cable (1 dB)	N/A	N/A	N/A

All the equipment listed above is calibrated every 12 months by an independent calibration laboratory or by CCL personal
following outlined calibration procedures.

Test Configuration Block Diagram



Radiated Spurious Emissions in Restricted Bands:

The radiated emissions from the intentional radiator were measured using a spectrum analyzer with a quasi-peak adapter for peak and quasi-peak readings. An amplifier and preamplifier were used to increase the sensitivity of the measuring instrumentation. The quasi-peak adapter uses a bandwidth of 120 kHz, with the spectrum analyzer's resolution bandwidth set at 1 MHz, for readings in the 30 to 1000 MHz frequency ranges. For peak emissions above 1000 MHz the spectrum analyzer’s resolution bandwidth was set to 1 MHz and the video bandwidth was set to 3 MHz. For average emissions above 1000 MHz the spectrum analyzer’s resolution bandwidth was set to 1 MHz and the video bandwidth was set to 10 Hz.

A biconilog antenna was used to measure the frequency range of 30 to 1000 MHz and a Double Ridge Guide Horn antenna was used to measure the frequency range of 1 GHz to 18 GHz, and a Pyramidal Horn antenna was used to measure the frequency range of 18 GHz to 25 GHz, at a distance of 3 meters from the EUT. The readings obtained by these antennas are correlated to the levels obtained with a tuned dipole antenna by adding antenna factors.

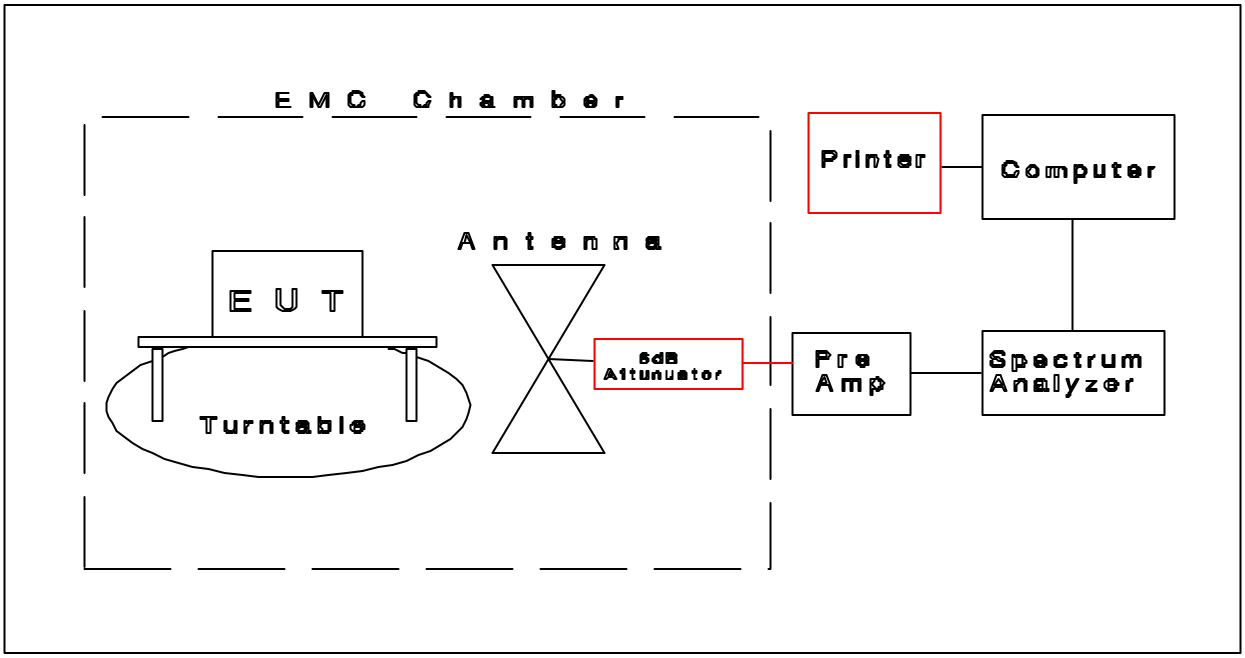
The configuration of the intentional radiator was varied to find the maximum radiated emission. The EUT was connected to the peripherals listed in Section 2.4 via the interconnecting cables listed in Section 2.5. These interconnecting cables were manipulated manually by a technician to obtain worst case radiated emissions. The intentional radiator was rotated 360 degrees, and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission. Where there were multiple interface ports all of the same type, cables are either placed on all of the ports or cables added to these ports until the emissions do not increase by more than 2 dB.

Desktop intentional radiator is measured on a non-conducting table one meter above the ground plane. The table is placed on a turntable which is level with the ground plane. The turntable has slip rings, which supply AC power to the intentional radiator. For equipment normally placed on floors, the equipment shall be placed directly on the turntable.

Type of Equipment	Manufacturer	Model Number	Serial Number
Anechoic Chamber	CCL	N/A	N/A
Test Software	CCL	Radiated Emissions	Revision 1.3
Spectrum Analyzer	Hewlett Packard	8566B	2230A01711
Quasi-Peak Detector	Hewlett Packard	8565A	3107A01582
Biconilog Antenna	EMCO	3141	1045
Double Ridged Guide Antenna	EMCO	3115	9409-4355
Pyramidal Horn Antenna	EMCO	3160-09	0003-1197
Harmonic Mixer	Hewlett Packard	11970K	3003A05756
Radiated Emissions Cable Anechoic Chamber	CCL	Cable B	N/A
Amplifier	Hewlett Packard	11975A	2738A02030
Pre-Amplifier	Hewlett Packard	8447D	1937A03151
Pre-Amplifier	Hewlett Packard	8449B	3008A00777
6 dB Attenuator	Hewlett Packard	8491A	32835

All the equipment listed above is calibrated every 12 months by an independent calibration laboratory or by CCL personal following outlined calibration procedures.

Radiated Emissions Test



FCC Sections 15.207 AC Line Conducted Emissions:

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 450 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.

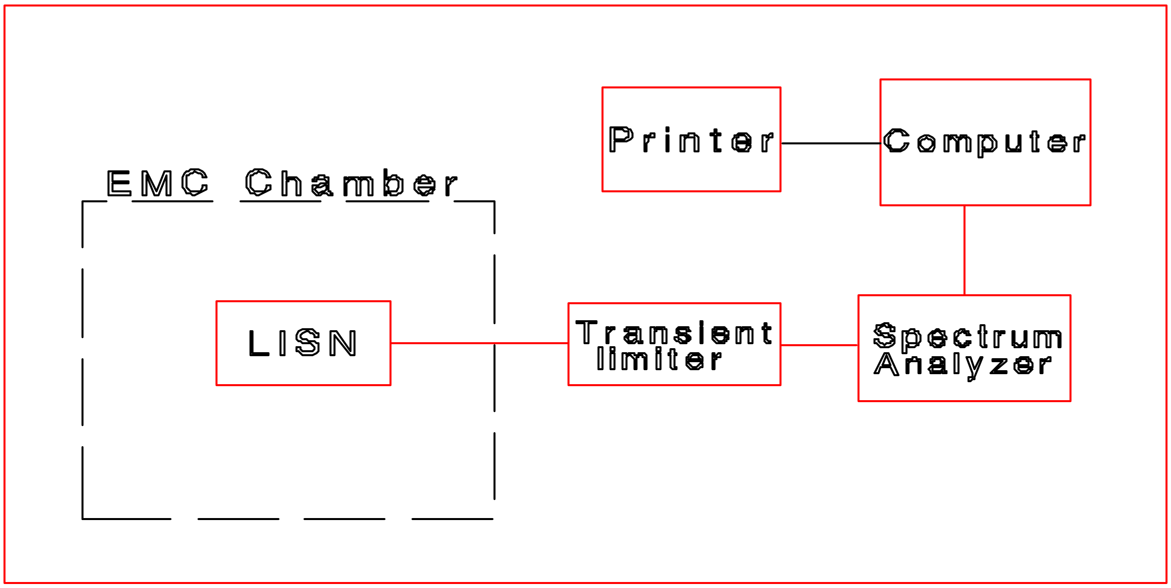
e) When testing equipment with multiple mains cords, those cords not under test are connected to an artificial mains network (AMN) different than the AMN used for the mains cord under test.

Desktop ITE are placed on a non-conducting table at least 0.8 meters from the metallic floor. The equipment is placed a minimum of 40 cm from all walls. Floor standing equipment is placed directly on the earth grounded floor.

Type of Equipment	Manufacturer	Model Number	Serial Number
Anechoic Chamber Test Site #2	CCL	N/A	N/A
Test Software	CCL	Conducted Emissions	Revision 1.2
Spectrum Analyzer	Hewlett Packard	8566B	2230A01711
Quasi-Peak Detector	Hewlett Packard	8565A	3107A01582
LISN	EMCO	3825/2	9307-1893
Conductance Cable Anechoic Chamber	CCL	Cable A	N/A
Transient Limiter	Hewlett Packard	11947A	3107A00895

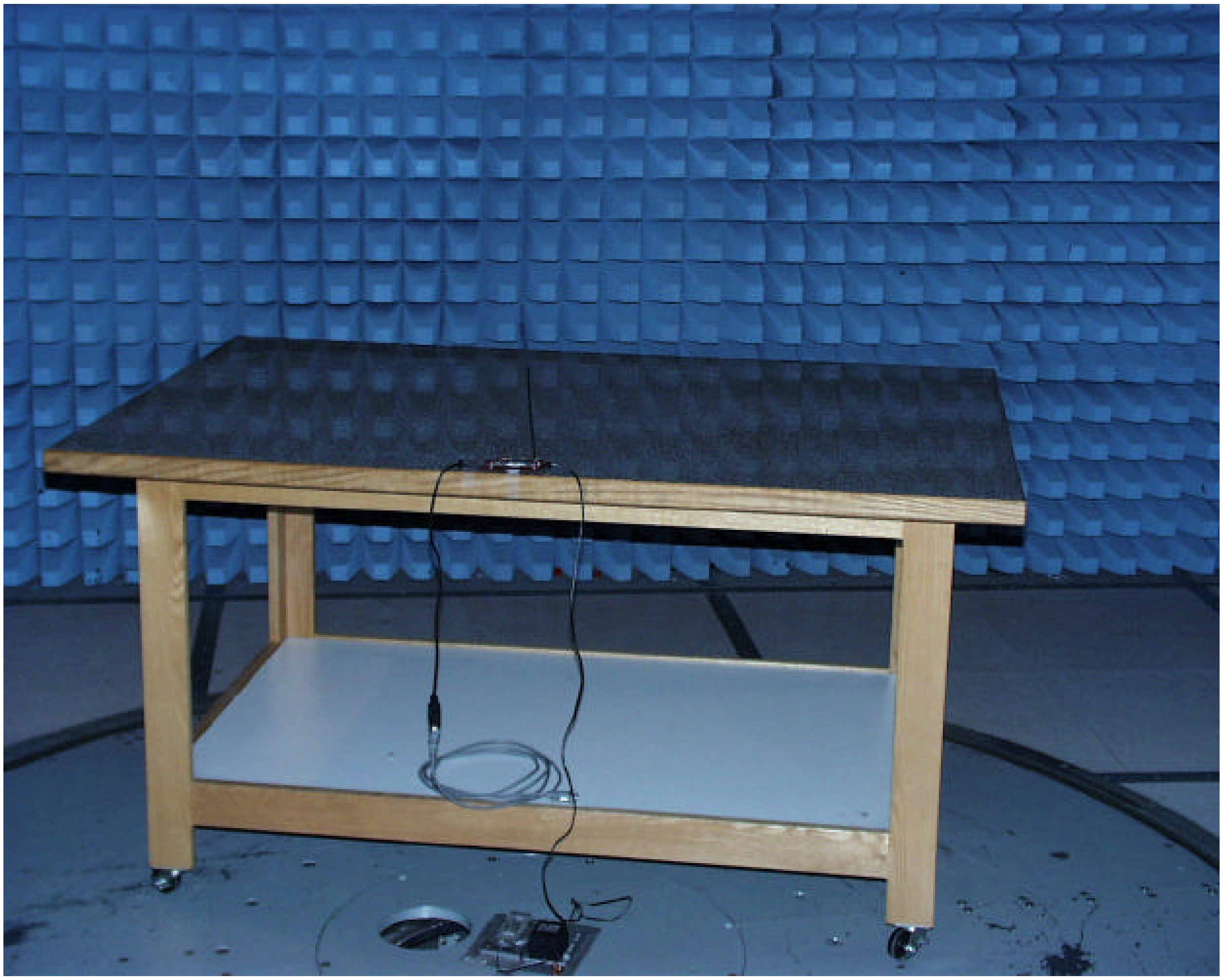
An independent calibration laboratory or CCL personal calibrates all the equipment listed above every 12 months following outlined calibration procedures. All measurement instrumentation is traceable to the National Institute of Standards and Technology (NIST). Supporting documentation relative to tractability is on file and is available for examination upon request.

Line Conducted Emissions Test



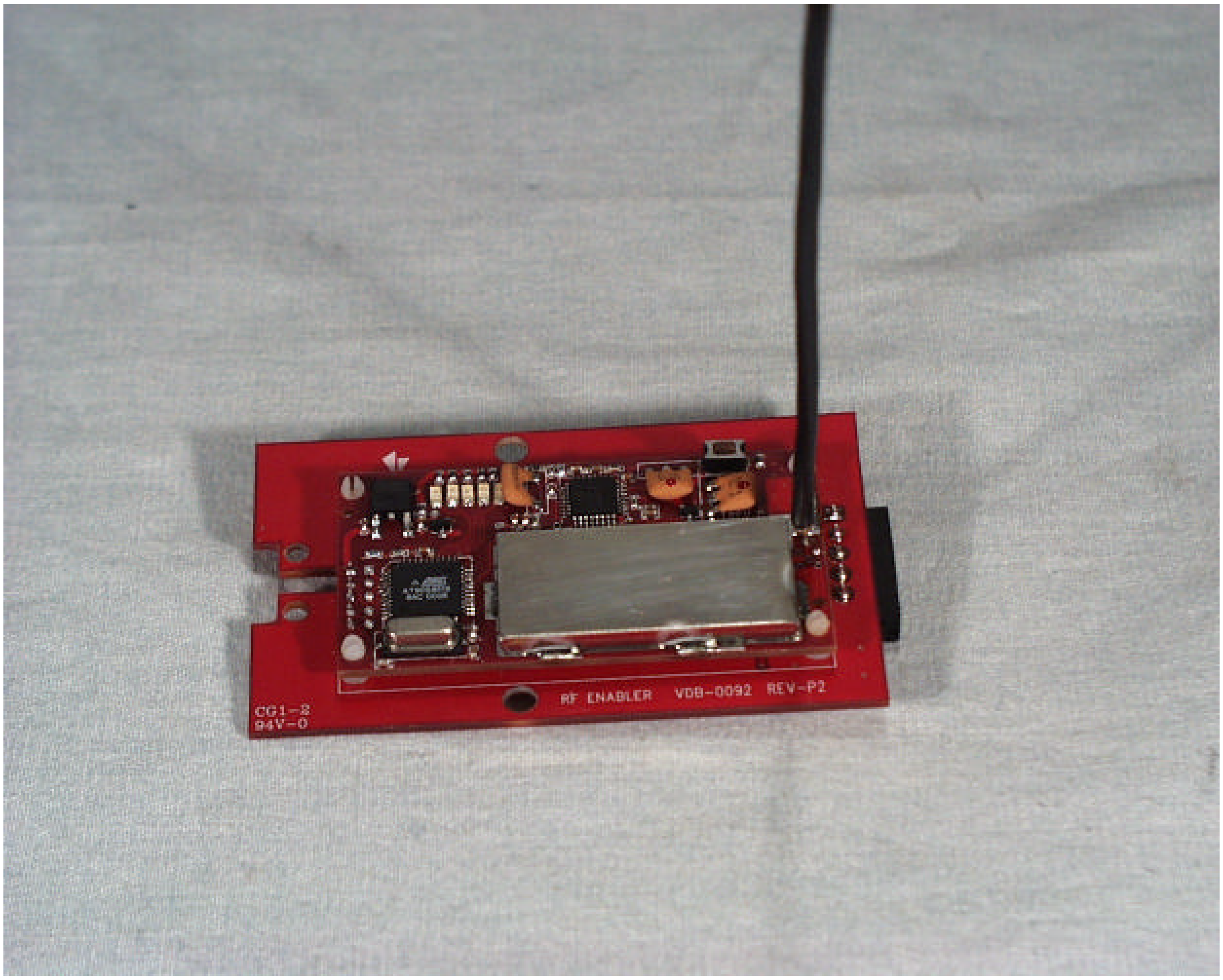
APPENDIX 2 PhOTOGRAPHS

Front View of Radiated Test Setup

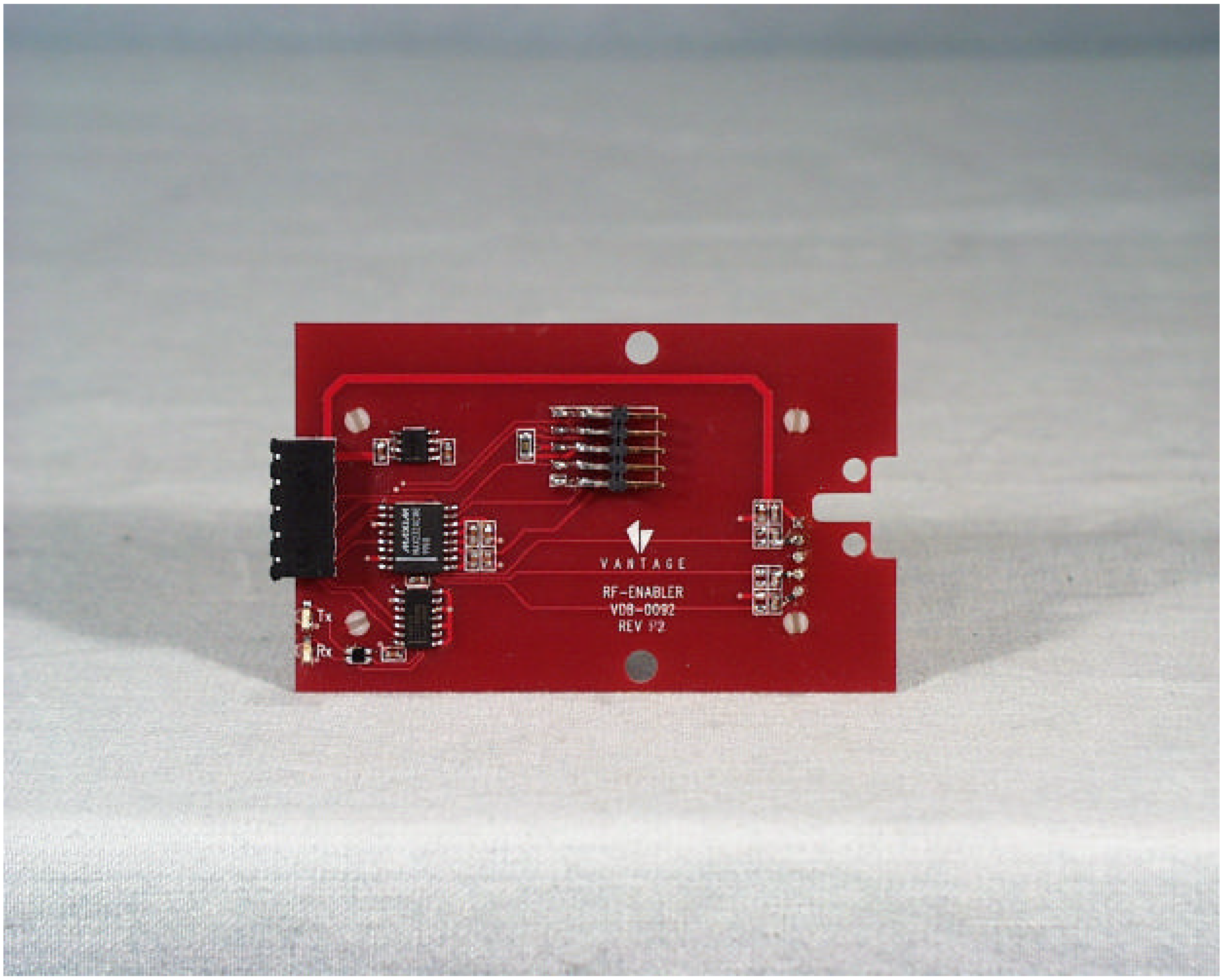


Back View Of Radiated Test Setup

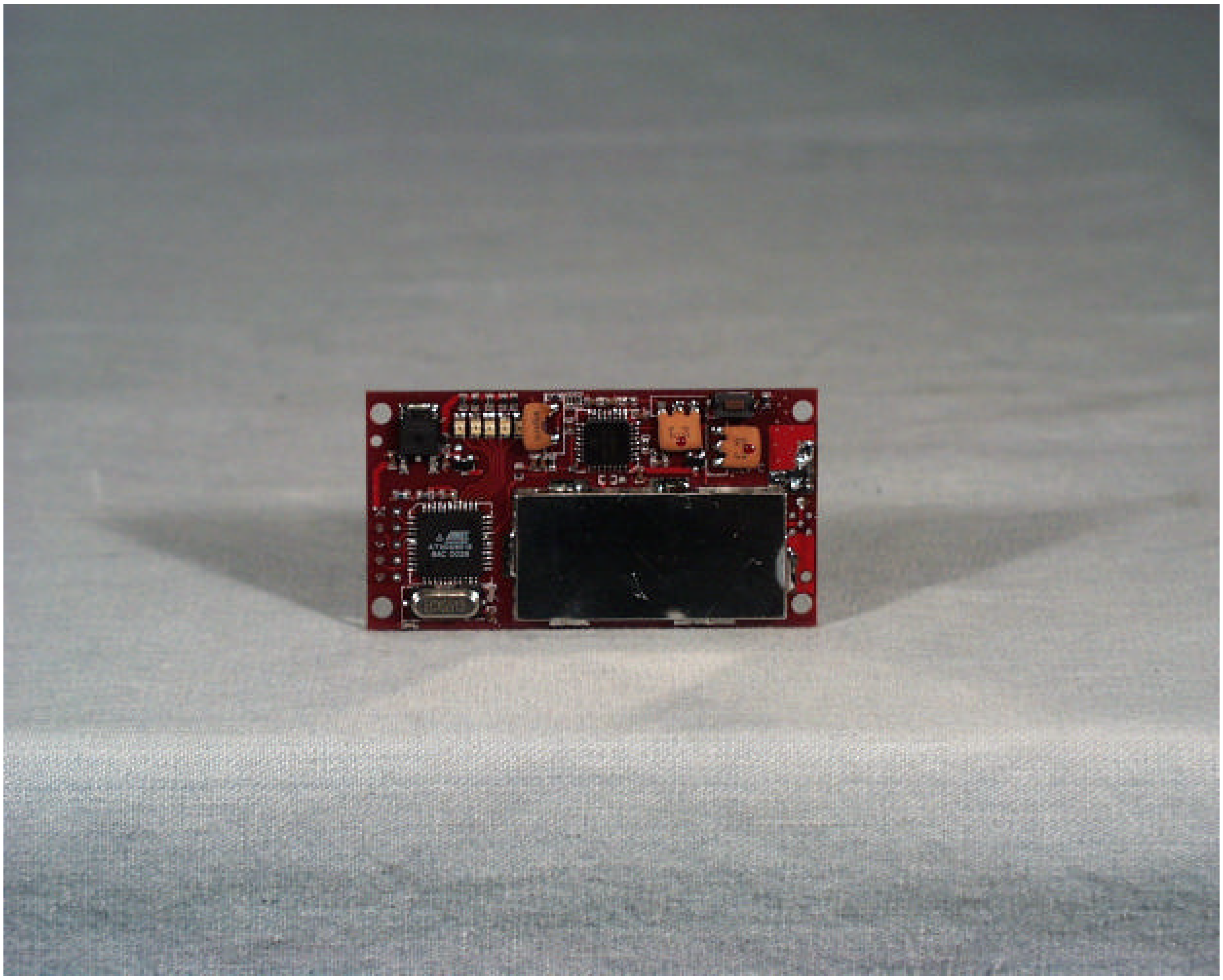
Front View Of The RF Enabler Board With VSUB075 Attached



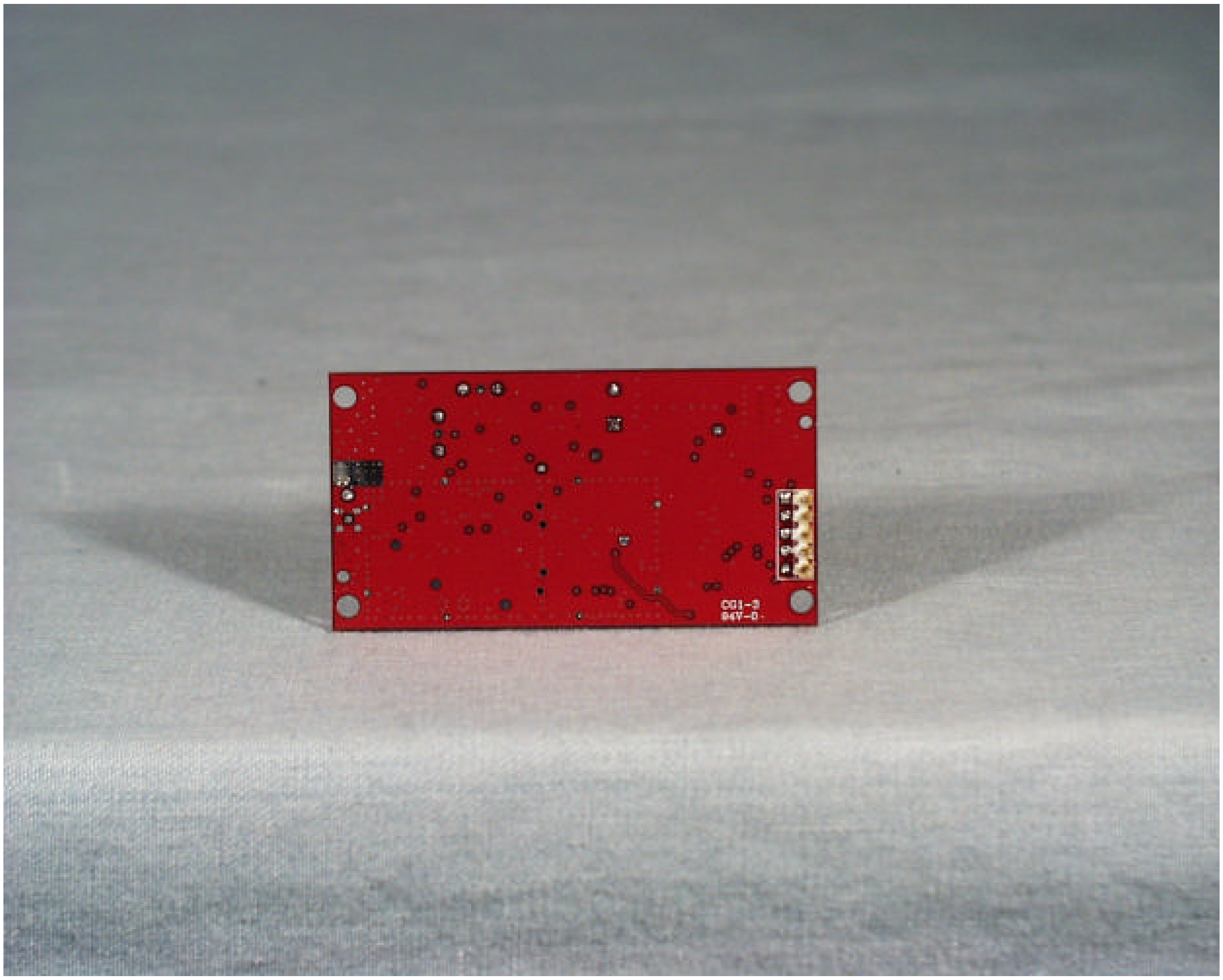
Back View Of The RF Enabler Board



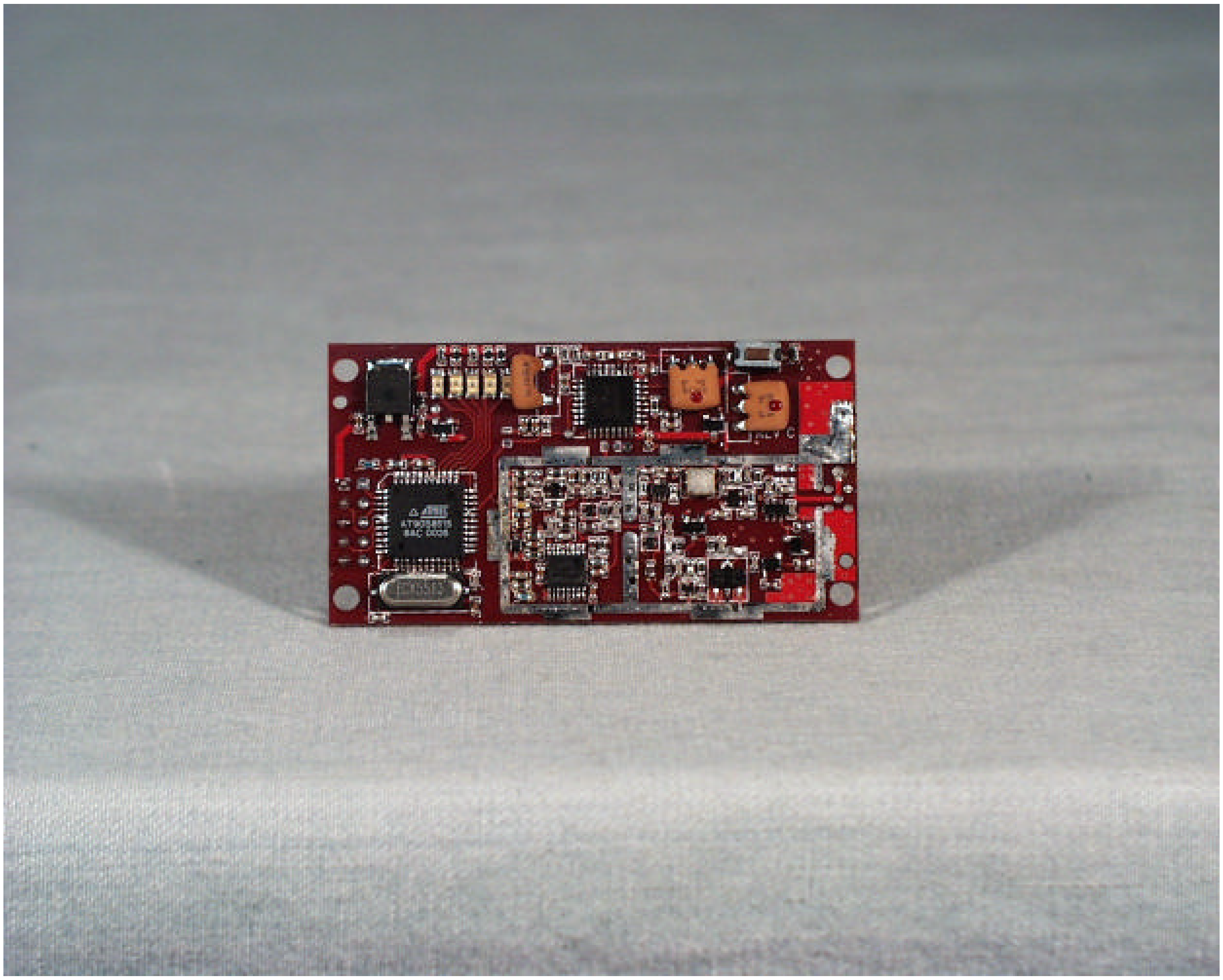
Front View Of The VSUB075



Back View Of The VSUB075



Front View Of The VSUB075 with Shield Removed



VSUB075 Antenna