

Test of Bright Star Engineering VCI Pod
To: FCC 47 CFR Part15.247 & IC RSS-210
Test Report Serial No.: BTSR03-A2 Rev A



TEST REPORT
FROM
MiCOMLabs

Test of Bright Star Engineering VCI Pod
to
To FCC 47 CFR Part15.247 & IC RSS-210

Test Report Serial No.: BTSR03-A2 Rev A

This report supersedes: None

Manufacturer: Bright Star Engineering Inc.
299 Ballardvale Street, Suite 5
Wilmington, Massachusetts 01887
USA

Product Function: Communicating Vehicle System
Information

Copy No: pdf **Issue Date:** 29th July '08

This Test Report is Issued Under the Authority of:

MiCOM Labs, Inc.
440 Boulder Court, Suite 200
Pleasanton, CA 94566 USA
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MiCOM Labs is an ISO 17025 Accredited Testing Laboratory



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ACCREDITATION, LISTINGS & RECOGNITION

MiCOM Labs, Inc. an accredited laboratory complies with the international standard BS EN ISO/IEC 17025. The company is accredited by the American Association for Laboratory Accreditation (A2LA) www.a2la.org test laboratory number 2381.01. MiCOM Labs test schedule is available at the following URL; <http://www.a2la.org/scopepdf/2381-01.pdf>



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LISTINGS

MiCOM Labs test facilities are listed by the following organizations;

North America

United States of America

Federal Communications Commission (FCC) Listing #: 102167

Canada

Industry Canada (IC) Listing #: 4143A

RECOGNITION

APEC MRA (Asia-Pacific Economic Community Mutual Recognition Agreement)

Conformity Assessment Body (CAB) – MiCOM Labs

Test data generated by MiCOM Labs is accepted in the following countries under the APEC MRA.

Country	Recognition Body	Phase	CAB Identification No.
Australia	Australian Communications and Media Authority (ACMA)	I	US0159
Hong Kong	Office of the Telecommunication Authority (OFTA)	I	
Korea	Ministry of Information and Communication Radio Research Laboratory (RRL)	I	
Singapore	Infocomm Development Authority (IDA)	I	
Taiwan	Directorate General of Telecommunications (DGT) Bureau of Standards, Metrology and Inspection (BSMI)	I	

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DOCUMENT HISTORY

Document History		
Revision	Date	Comments
Draft		
Rev A	29 th July 2008	Initial Release

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1. TEST RESULT CERTIFICATE

Manufacturer:	Bright Star Engineering 299 Ballardvale Street, Suite 5 Wilmington, Massachusetts 01887 USA	Tested By:	MiCOM Labs, Inc. 440 Boulder Court Suite 200 Pleasanton California, 94566, USA
EUT:	VCI Pod	Phone:	+1 925 462 0304
Model:	VCI Pod	Fax:	+1 925 462 0306
S/N:	Integral Antenna 00-50-15-0C-00-1A External Antenna 00-50-15-0C-00-2E		
Test Date(s):	3rd to 20th July '08	Website:	www.micomlabs.com

STANDARD(S)	TEST RESULTS
FCC 47 CFR Part15.247 & IC RSS-210	EQUIPMENT COMPLIES

MiCOM Labs, Inc. tested the equipment mentioned in accordance with the requirements set forth in the above standards. Test results indicate that the equipment tested is capable of demonstrating compliance with the requirements as documented within this report.

Notes:

1. This document reports conditions under which testing was conducted and the results of testing performed.
2. Details of test methods used have been recorded and kept on file by the laboratory.
3. Test results apply only to the item(s) tested.

Approved & Released for MiCOM Labs, Inc. by:

Graeme Grieve
Quality Manager MiCOM Labs,



CERTIFICATE #2381.01

Gordon Hurst
President & CEO MiCOM Labs, Inc.

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2. REFERENCES AND MEASUREMENT UNCERTAINTY

2.1. Normative References

Ref.	Publication	Year	Title
(i)	FCC 47 CFR Part 15.247	2007	Code of Federal Regulations
(ii)	Industry Canada RSS-210	Issue 7 June 2007	Low Power License-Exempt Radiocommunication Devices (All Frequency Bands)
(iii)	Industry Canada RSS-Gen	Issue 2 June 2007	General Requirements and Information for the Certification of Radiocommunication Equipment.
(iv)	ANSI C63.4	2003	American National Standards for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
(v)	CISPR 22/ EN 55022	1997 1998	Limits and Methods of Measurements of Radio Disturbance Characteristics of Information Technology Equipment
(vi)	M 3003	Edition 1 Dec. 1997	Expression of Uncertainty and Confidence in Measurements
(vii)	LAB34	Edition 1 Aug 2002	The expression of uncertainty in EMC Testing
(viii)	ETSI TR 100 028	2001	Parts 1 and 2 Electromagnetic compatibility and Radio Spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics
(ix)	A2LA	14 th September 2005	Reference to A2LA Accreditation Status – A2LA Advertising Policy

2.2. Test and Uncertainty Procedures

Conducted and radiated emission measurements were conducted in accordance with American National Standards Institute ANSI C63.4, listed in the Normative References section of this report.

Measurement uncertainty figures are calculated in accordance with ETSI TR 100 028 Parts 1 and 2.

Measurement uncertainties stated are based on a standard uncertainty multiplied by a coverage factor $k = 2$, providing a level of confidence of approximately 95 % in accordance with UKAS document M 3003 listed in the Normative References section of this report.

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3. PRODUCT DETAILS AND TEST CONFIGURATIONS

3.1. Technical Details

Details	Description
Purpose:	Test of the Bright Star Engineering VCI Pod to FCC Part 15.247 and Industry Canada RSS-210 regulations
Applicant:	Bright Star Engineering, Inc. 299 Ballardvale Street, Suite 5 Wilmington, Massachusetts 01887 USA
Manufacturer:	As Applicant
Laboratory performing the tests:	MiCOM Labs, Inc. 440 Boulder Court, Suite 200 Pleasanton, California 94566 USA
Test report reference number:	BTSR03-A2 Rev A
Date EUT received:	3 rd July 2008
Standard(s) applied:	FCC 47 CFR Part15.247 & IC RSS-210
Dates of test (from - to):	3rd to 20th July '08
No of Units Tested:	2
Type of Equipment:	802.11b/g Wireless Local Area Network Module
Model:	VCIPOD
Location for use:	Indoor
Declared Frequency Range(s):	2400 - 2483.5 MHz
Type of Modulation:	DSSS (OFDM, DBPSK, DQPSK, CCK, 16QAM, 64QAM)
Declared Nominal Output Power:	Peak Power +15 dBm
EUT Modes of Operation:	802.11b/g
Transmit/Receive Operation:	Simplex
Rated Input Voltage and Current:	15 Vdc nominal, 0.4 A
Operating Temperature Range:	Client Declared: -20C to +50C (-4F to +122F)
ITU Emission Designator:	802.11b – 13M8G1D 802.11g – 16M6D1D
Equipment Dimensions:	4.8" x 3.5" x 1.7" (122mm x 89mm x 43mm)
Weight:	0.47 pounds (213 grams)
Primary function of equipment:	Communicating vehicle system information

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3.2. Scope of Test Program

The scope of the test program was to test the Bright Star Engineering Inc VCI Pod (WLAN 802.11 b/g) in the frequency range 2400 - 2483.5 MHz for compliance against FCC 47 CFR Part 15.247 specifications.

The VCI Pod employs DSSS modulation (802.11b/g) and is available in two models; one with an integral antenna and the second model with an external antennae.

**Bright Star Engineering Inc
VCIPOD External Antenna
Reverse SMA Connector**



**Bright Star Engineering Inc
VCIPOD Integral Antenna**



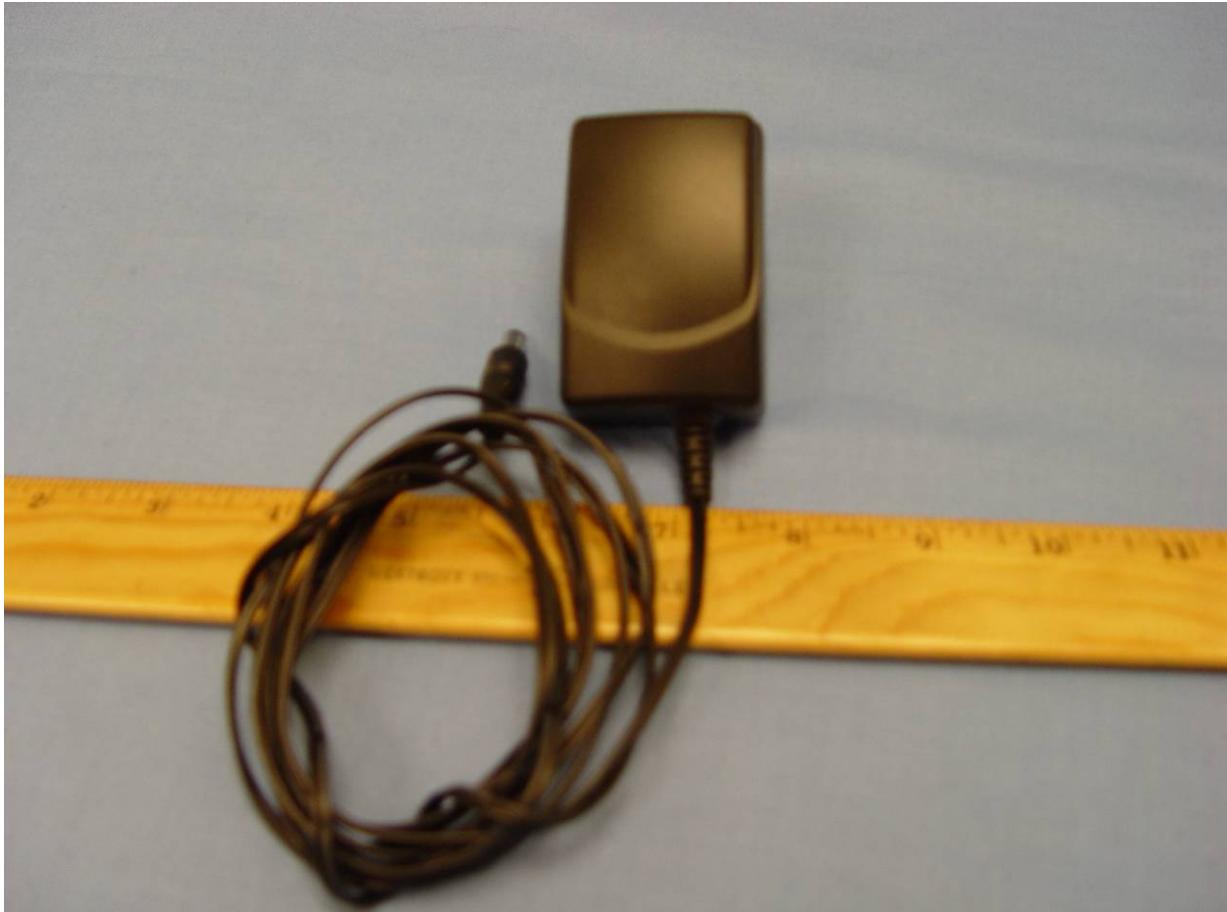
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**Bright Star Engineering Inc
wiTECH VCI Pod Power Supply Labeling**



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**Bright Star Engineering Inc
wiTECH VCI Pod Power Supply**



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3.3. Equipment Model(s) and Serial Number(s)

Type (EUT/Support)	Equipment Description (Including Brand Name)	Mfr	Model No.	Serial No.
EUT	WLAN External Antenna	BrightStar	VCI Pod	00-50-15-0C-00-1A
EUT	WLAN Integral Antenna	BrightStar	VCI Pod	00-50-15-0C-00-2E
EUT	Switch Mode Power Supply 90-264Vac 47-63Hz 15Vdc @ 0.4A	CUI Inc.	EMS150040 N-P5P-SZ	N/A

3.4. Antenna Details

1. 2 dBi external antenna – Nearson Half Wave Dipole Swivel Antenna
- Part No#: S131AH-2405S
2. Integral antenna – Centurion Nonoblade 3.8 dBi @ 2.45 GHz

3.5. Cabling and I/O Ports

Number and type of I/O ports

1. Trigger Input (Serial Port) – RJ-11 (unscreened)
2. Ethernet – 10/100 BT (unscreened)
3. USB – miniature cable (screened)
4. Vehicle – Cable details
5. Recessed reset button

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3.6. Test Configurations

Matrix of Channel test configurations.

Operational Mode (802.11)	802.11 Operating Channel #	EUT Channel #	Frequencies (MHz)
b, g	1, 6, 11	1, 6, 11	2,412 2,437 2,462

Data rate V's output power was measured prior to the start of the test program. In each case the data rate yielding the highest output power was chosen as the test variant;

802.11 b = 1 MBit/s, 802.11g 6 MBit/s

System Duty Cycle

The EUT was delivered with a fixed 100% duty cycle for 802.11b and 802.11g modes of operation.

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3.7. Equipment Modifications

The following modifications were required to bring the equipment into compliance:

1. Initial unit tested had temperature problems
 - this was a problem running the system continuously at 100% duty cycle. Unit stopped transmitting and could not be restarted until cool. EUT was replaced and there was no further apparent temperature related issues

3.8. Deviations from the Test Standard

The following deviations from the test standard were required in order to complete the test program:

1. NONE

3.9. Subcontracted Testing or Third Party Data

The following tests were subcontracted; -

1. NONE

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4. TEST SUMMARY

List of Measurements

The following table represents the list of measurements required under the **FCC CFR47 Part 15.247** and **Industry Canada RSS-210** and **Industry Canada RSS-Gen**.

Section(s)	Test Items	Description	Condition	Result	Test Report Section
15.247(a)(2) A8.2(1) 4.4	6 dB and 99 % Bandwidths	≥ 500 kHz	Conducted	Complies	5.1.1
15.247(b)(3) 15.31(e) A8.4(4)	Peak Output Power Voltage Variation	Shall not exceed 1W Variation of supply voltage 85 % -115 %	Conducted	Complies	5.1.2
15.247(e) A8.2	Peak Power Spectral Density	Shall not be greater than +8 dBm in any 3 kHz band	Conducted	Complies	5.1.3
15.247(i) 5.5	Maximum Permissible Exposure	Exposure to radio frequency energy levels	Conducted	Complies	5.1.4
15.247(d) 15.205 / 15.209 A8.5 2.2 4.7	Spurious Emissions (30MHz - 26 GHz)	The radiated emission in any 100 kHz of out-band shall be at least 20 dB below the highest in-band spectral density	Conducted	Complies	5.1.5

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List of Measurements (continued)

The following table represents the list of measurements required under the **FCC CFR47 Part 15.247**, **Industry Canada RSS-210**, and **Industry Canada RSS-Gen**.

Section(s)	Test Items	Description	Condition	Result	Test Report Section
15.247(d) 15.205 / 15.209 A8.5 2.2 2.6 4.7 Industry Canada only RSS-Gen §4.8, §6	Radiated Emissions	Restricted Bands	Radiated	Complies	5.1.6
	Transmitter Radiated Spurious Emissions	Emissions above 1 GHz		Complies	5.1.6.1
	Receiver Radiated Spurious Emissions	Emissions above 1 GHz		Complies	5.1.6.2
	Radiated Band Edge	Band edge results		Complies	5.1.6.2.1
15.205 / 15.209 2.2	Radiated Spurious Emissions	Emissions <1 GHz (30M-1 GHz)	Radiated	Complies Class A	5.1.6.3
15.207 7.2.2	AC Wireline Conducted Emissions 150 kHz–30 MHz	Conducted Emissions	Conducted	Complies Class B	5.1.7

Note 1: Test results reported in this document relate only to the items tested

Note 2: The required tests demonstrated compliance as per client declaration of test configuration, monitoring methodology and associated pass/fail criteria

Note 3: Appendix A - Equipment Modifications highlights the equipment modifications that were required to bring the product into compliance with the above test matrix

5. TEST RESULTS

5.1. Device Characteristics

5.1.1. 6 dB and 99 % Bandwidth

FCC, Part 15 Subpart C §15.247(a)(2)

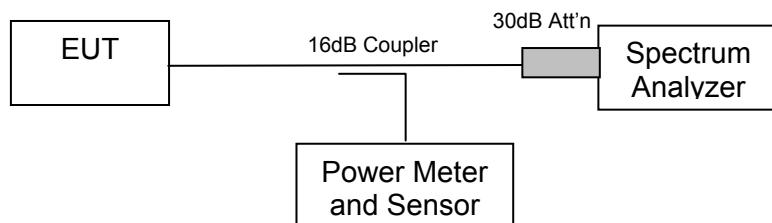
Industry Canada RSS-210 §A8.2

Industry Canada RSS-Gen §4.4

Test Procedure

The bandwidth at 6 dB and 99 % is measured with a spectrum analyzer connected to the antenna terminal, while EUT is operating in transmission mode at the appropriate center frequency. The analyzer was set for a 6 dB resolution bandwidth filter during this measurement.

Test Measurement Set up



Measurement set up for 6 dB and 99 % bandwidth test

Radio Parameters

Power: Maximum Power

Duty Cycle: 100%

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Measurement Results for 6 dB and 99 % Operational Bandwidth(s)

Ambient conditions.

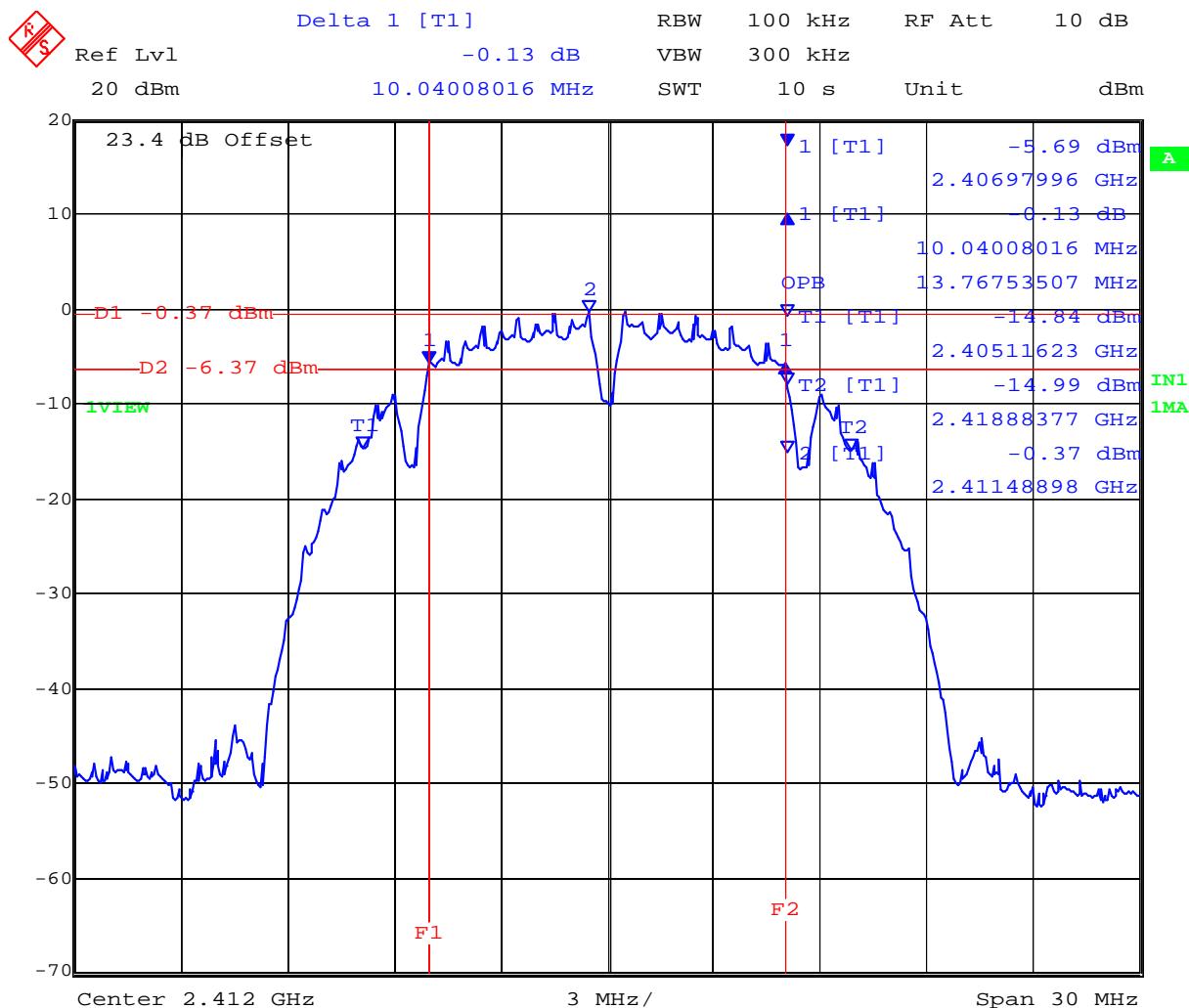
Temperature: 17 to 23 °C Relative humidity: 31 to 57 % Pressure: 999 to 1012 mbar

TABLE OF RESULTS – 802.11b - 1 Mb/s

Center Frequency (MHz)	6 dB Bandwidth (MHz)	99 % Bandwidth (MHz)
2,412	10.0401	13.7675
2,437	10.1002	13.7074
2,462	10.1002	13.7675

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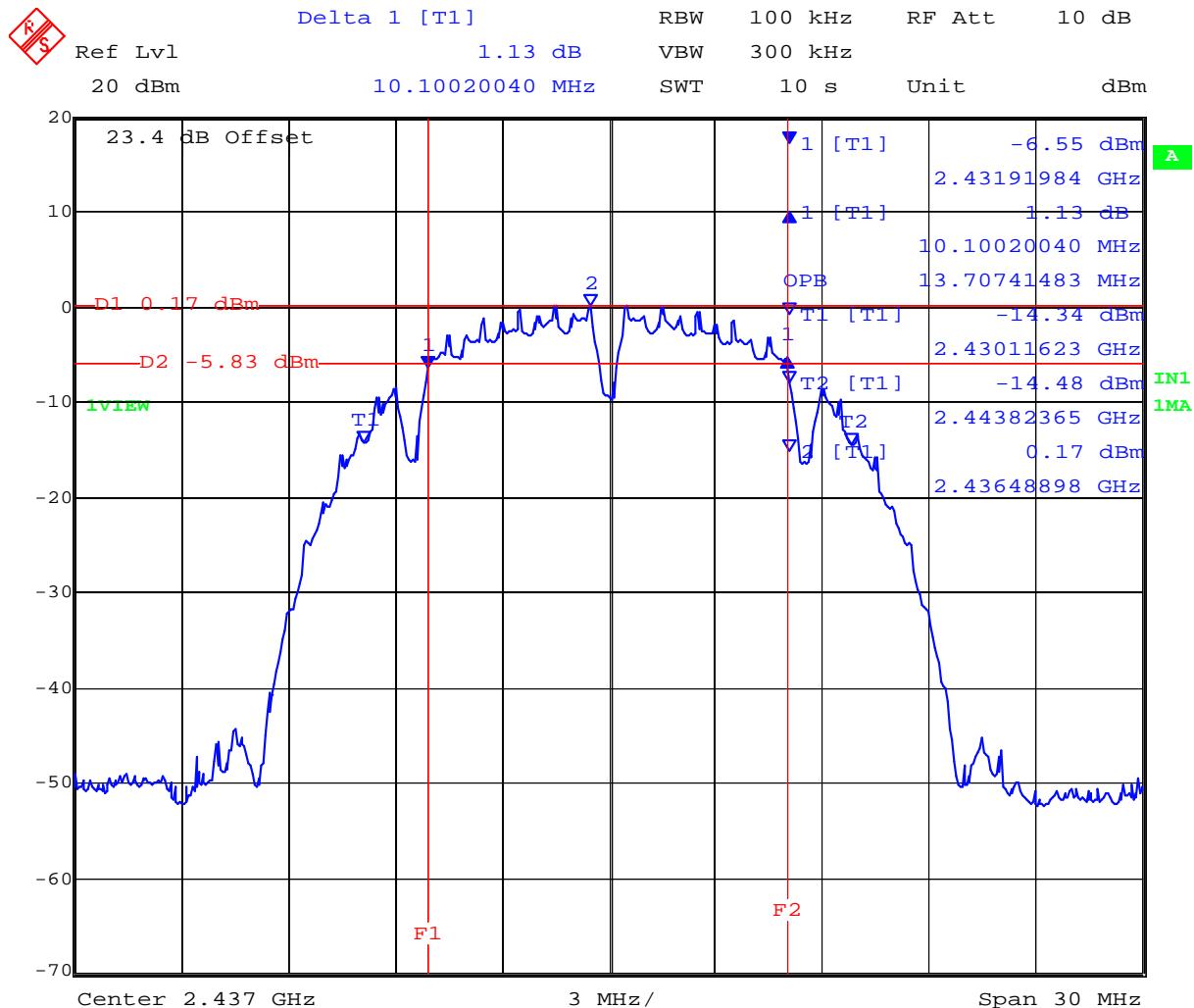
2,412 MHz 802.11b 6 dB & 99% Bandwidth



Date: 9.JUL.2008 18:19:00

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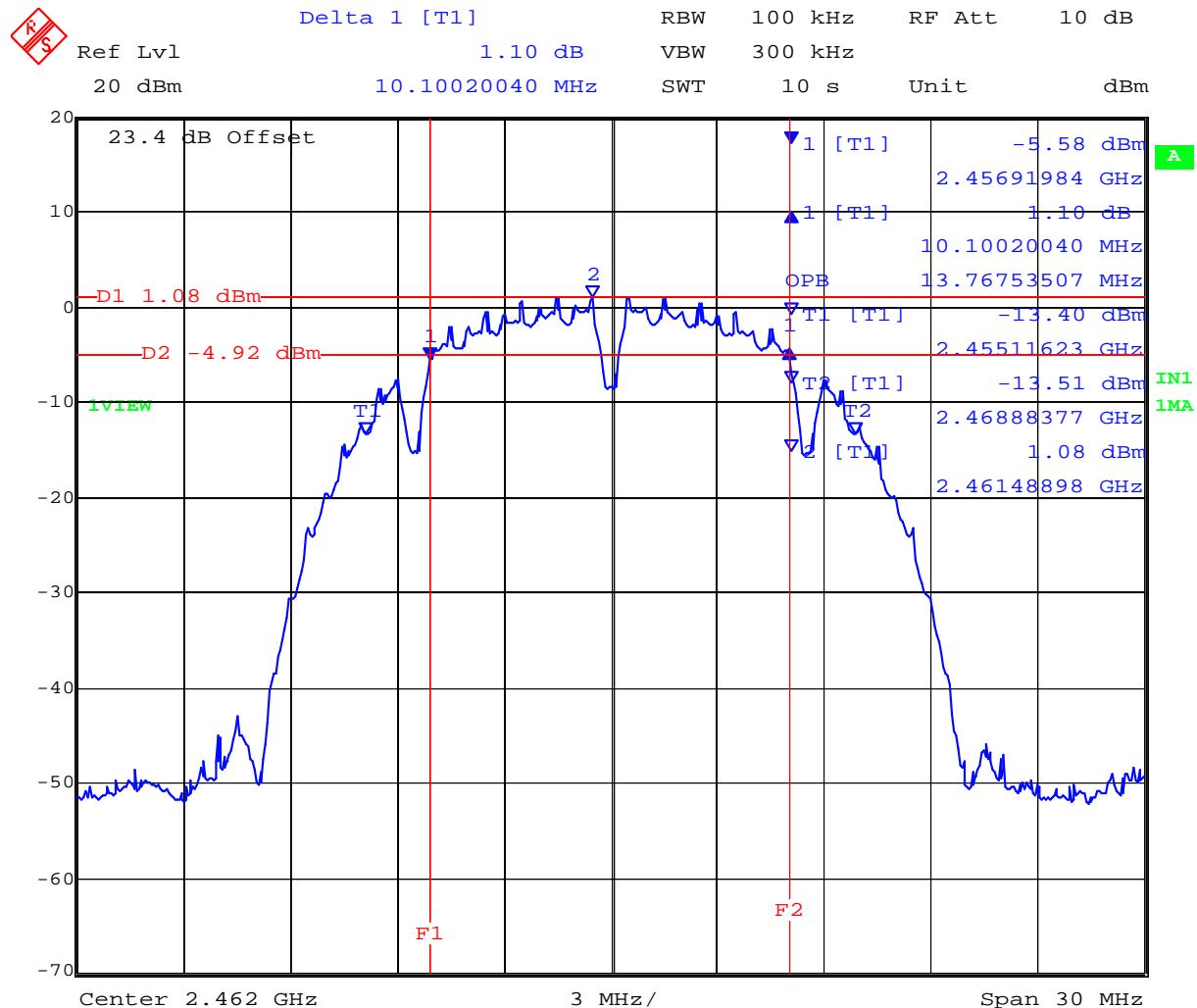
2,437 MHz 802.11b 6 dB & 99% Bandwidth



Date: 9.JUL.2008 18:26:10

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2,462 MHz 802.11b 6 dB & 99% Bandwidth



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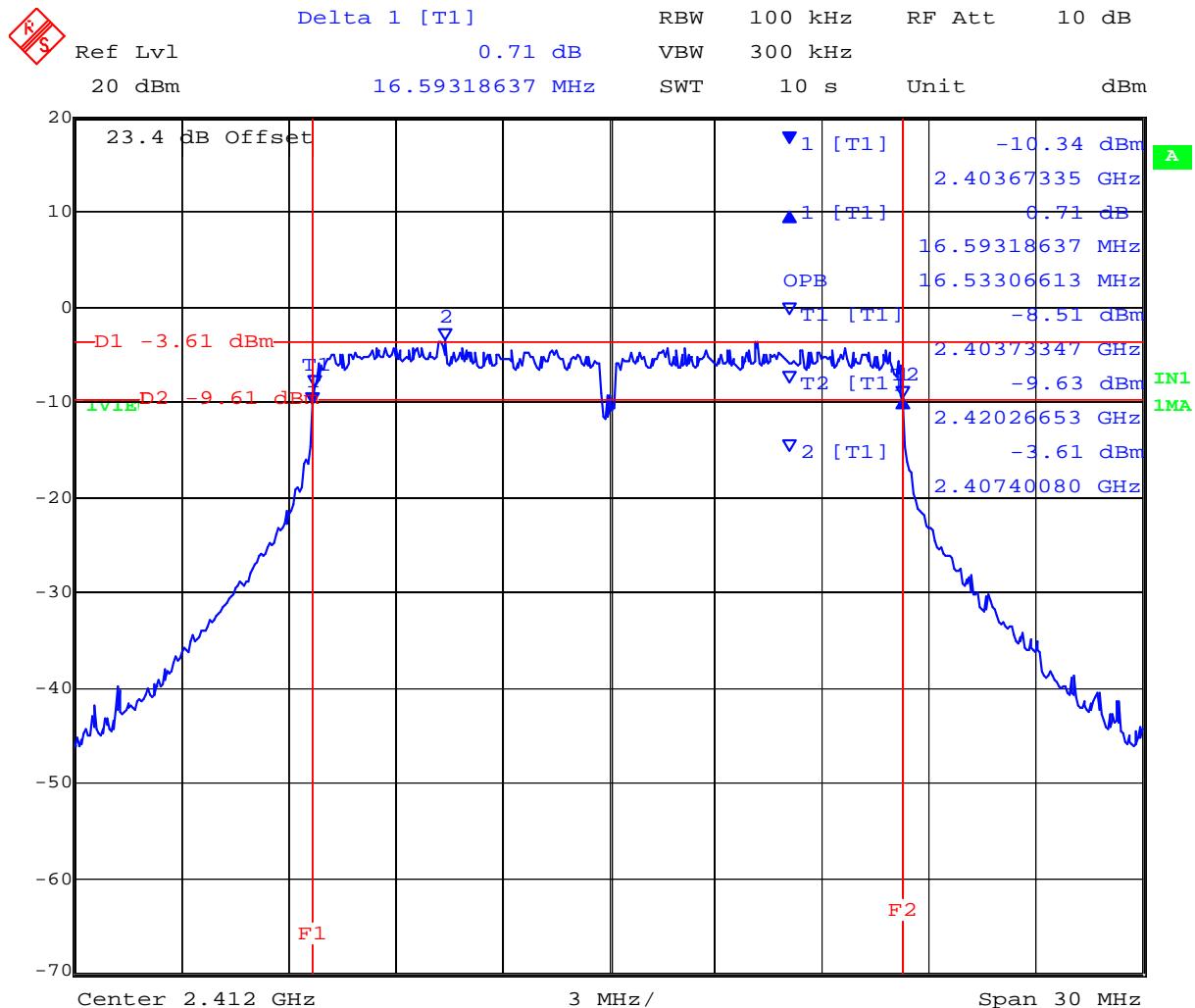
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TABLE OF RESULTS – 802.11g - 6 Mb/s

Center Frequency (MHz)	6 dB Bandwidth (MHz)	99 % Bandwidth (MHz)
2,412	16.5932	16.5331
2,437	16.5331	16.5331
2,462	16.5932	16.5331

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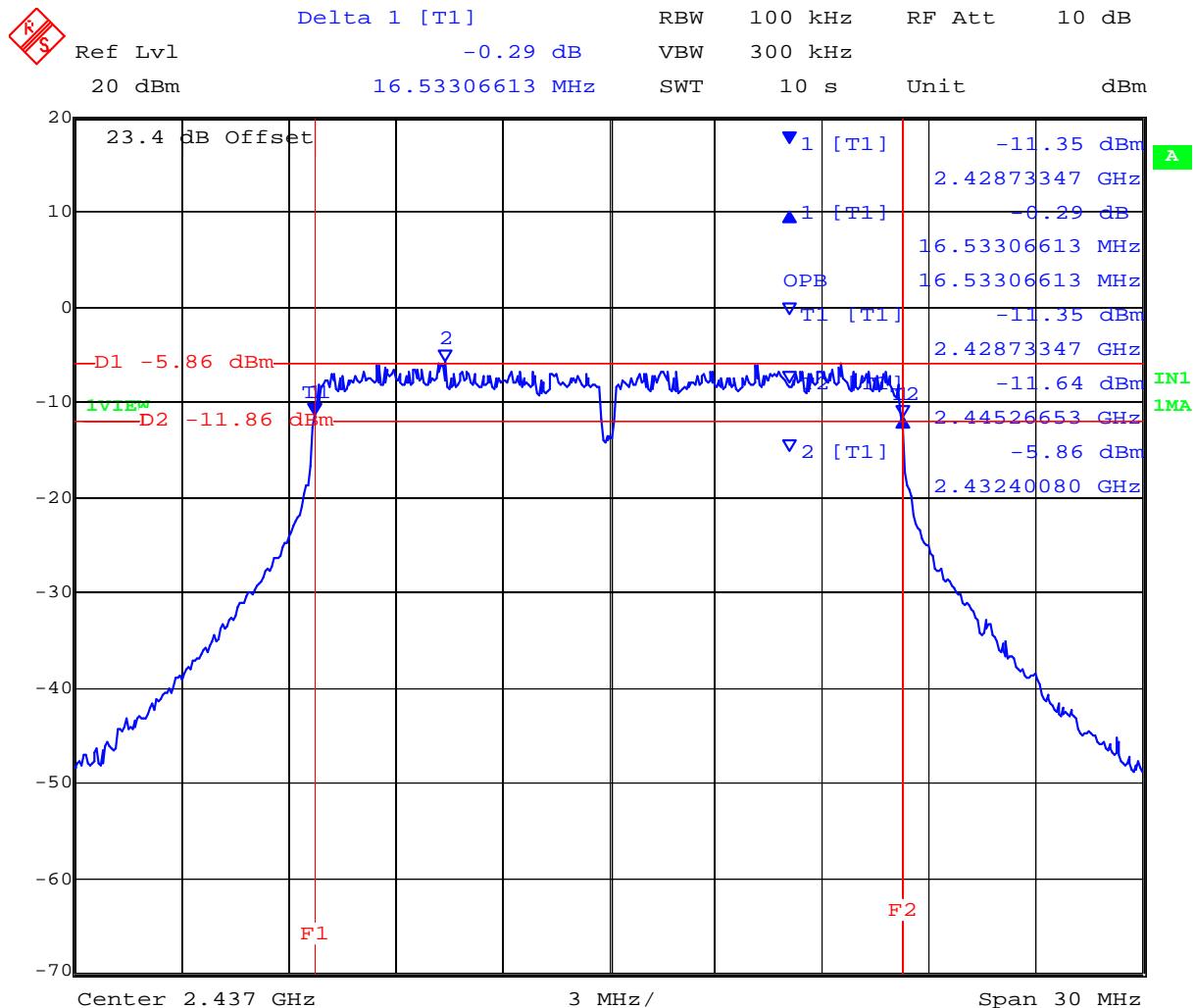
2,412 MHz 802.11g 6 dB & 99% Bandwidth



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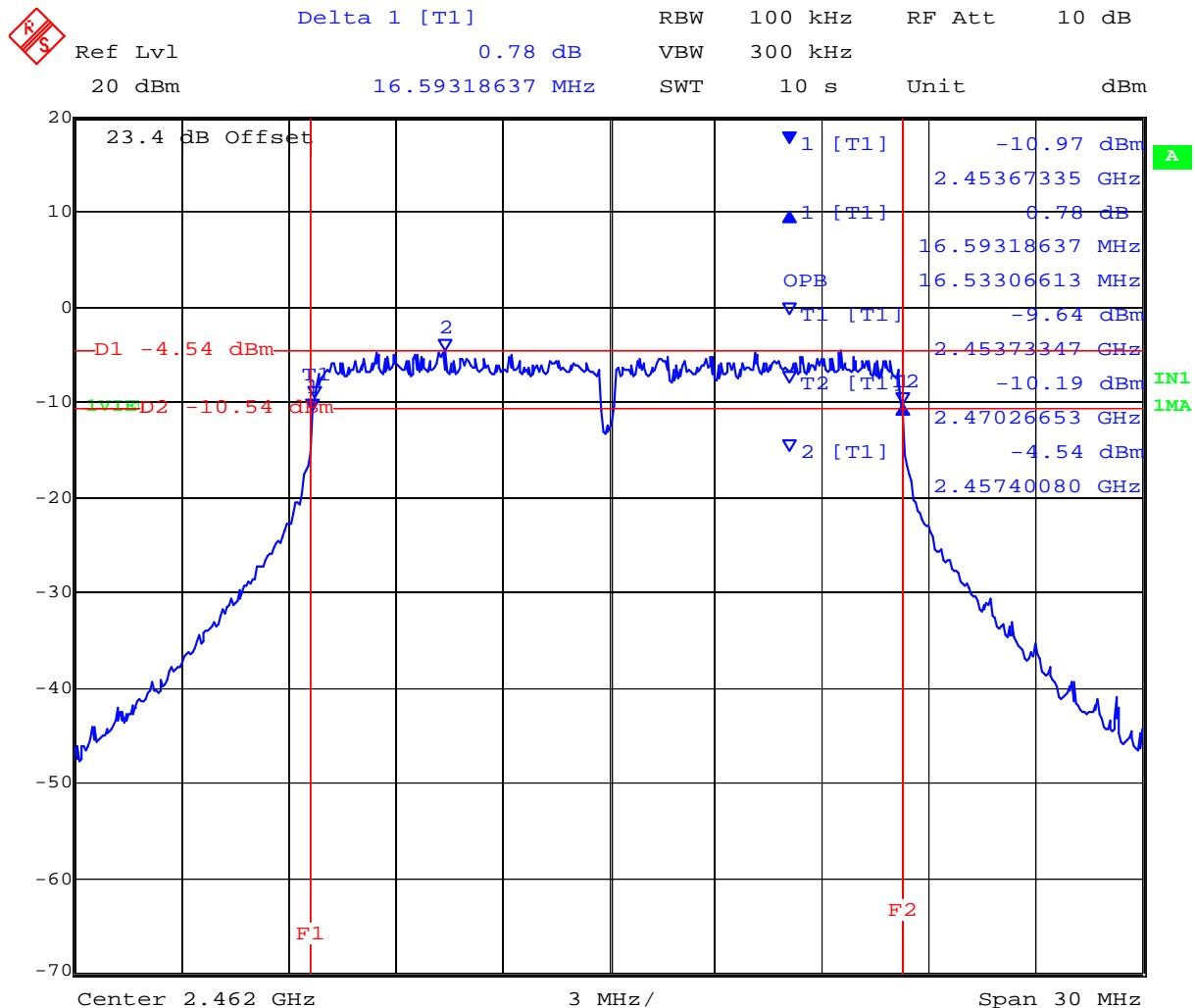
2,437 MHz 802.11g 6 dB & 99% Bandwidth



Date: 9.JUL.2008 18:28:10

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2,462 MHz 802.11g 6 dB & 99% Bandwidth



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Specification

Limits

§15.247 (a)(2) & RSS-210 §A8.2(1)

The minimum 6 dB bandwidth shall be at least 500 kHz.

§ IC RSS-Gen 4.4.1 Occupied Bandwidth When an occupied bandwidth value is not specified in the applicable RSS, the transmitted signal bandwidth to be reported is to be its 99% emission bandwidth, as calculated or measured.

§ IC RSS-Gen 4.4.2 6 dB Bandwidth Where indicated, the 6 dB bandwidth is measured at the points when the spectral density of the signal is 6 dB down from the in –band spectral density of the modulated signal, with the transmitter modulated by a representative signal.

Laboratory Measurement Uncertainty for Spectrum Measurement

Measurement uncertainty	±2.81 dB
-------------------------	----------

Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-03 'Measurement of RF Spectrum Mask'	0158, 0193, 0252, 0313, 0314, 0070, 0116, 0117

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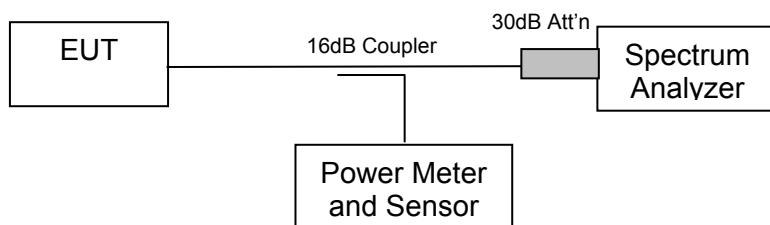
5.1.2. Peak Output Power

FCC, Part 15 Subpart C §15.247(b)(3), §15.31(e)
Industry Canada RSS-210 §A8.4(4)

Test Procedure

The transmitter terminal of EUT was connected to the input of the spectrum analyzer set to measure peak power. The resolution filter bandwidth was set to 6 dB, peak detector selected and the analyzer built-in power function was used to measure peak power over the 99 % bandwidth.

Test Measurement Set up



Measurement set up for Transmitter Peak Output Power

Ambient conditions.

Temperature: 17 to 23 °C Relative humidity: 31 to 57 % Pressure: 999 to 1012 mbar

Radio Parameters

Power: Maximum Power

Duty Cycle: 100%

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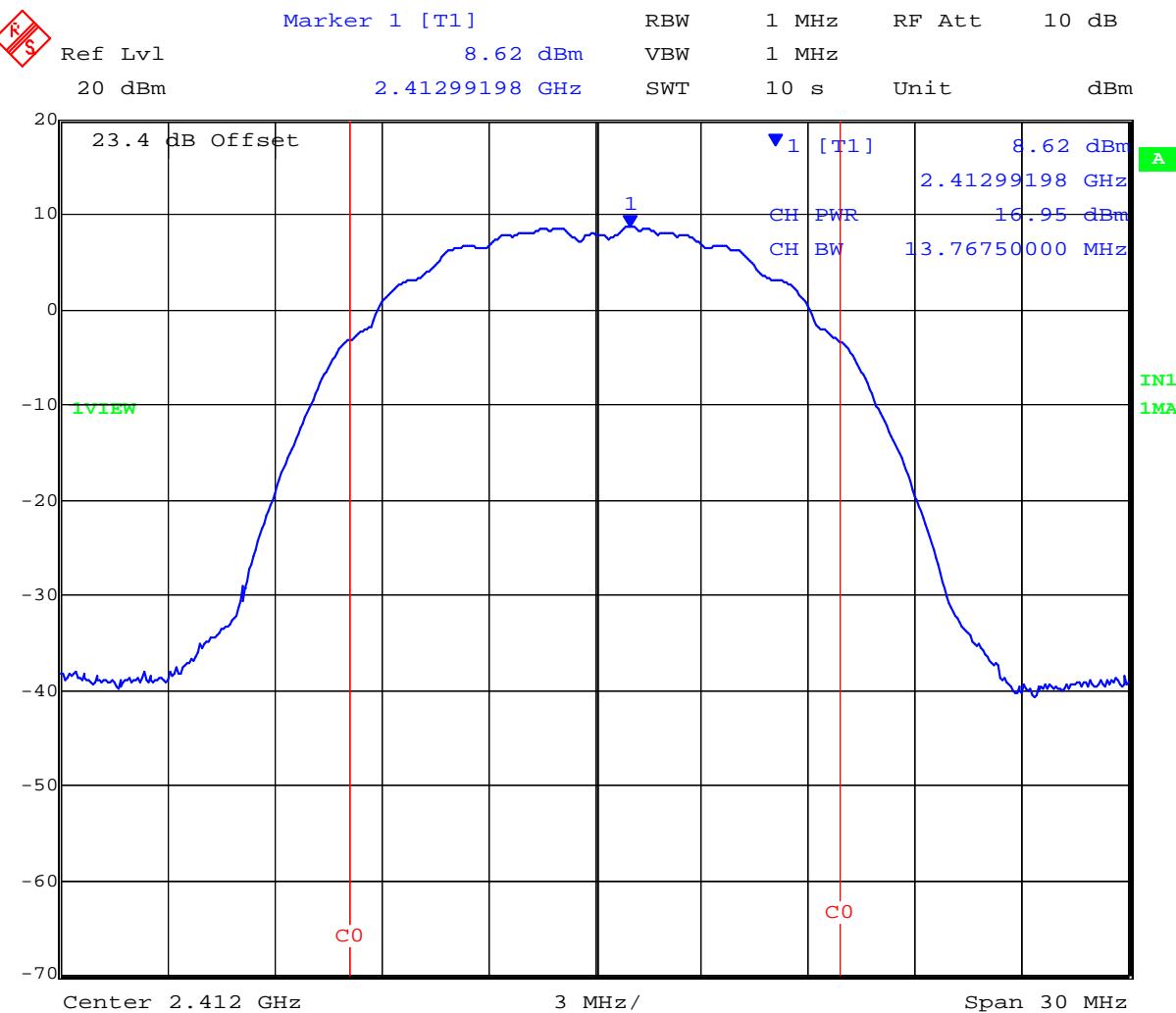
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TABLE OF RESULTS – 802.11b – 1Mb/s

Center Frequency (MHz)	99% Measurement Bandwidth (MHz)	Peak Power (dBm)	Peak Power EIRP (dBm)
2,412	13.7675	+16.95	+18.95
2,437	13.7074	+15.88	+17.88
2,462	13.7676	+16.86	+18.86

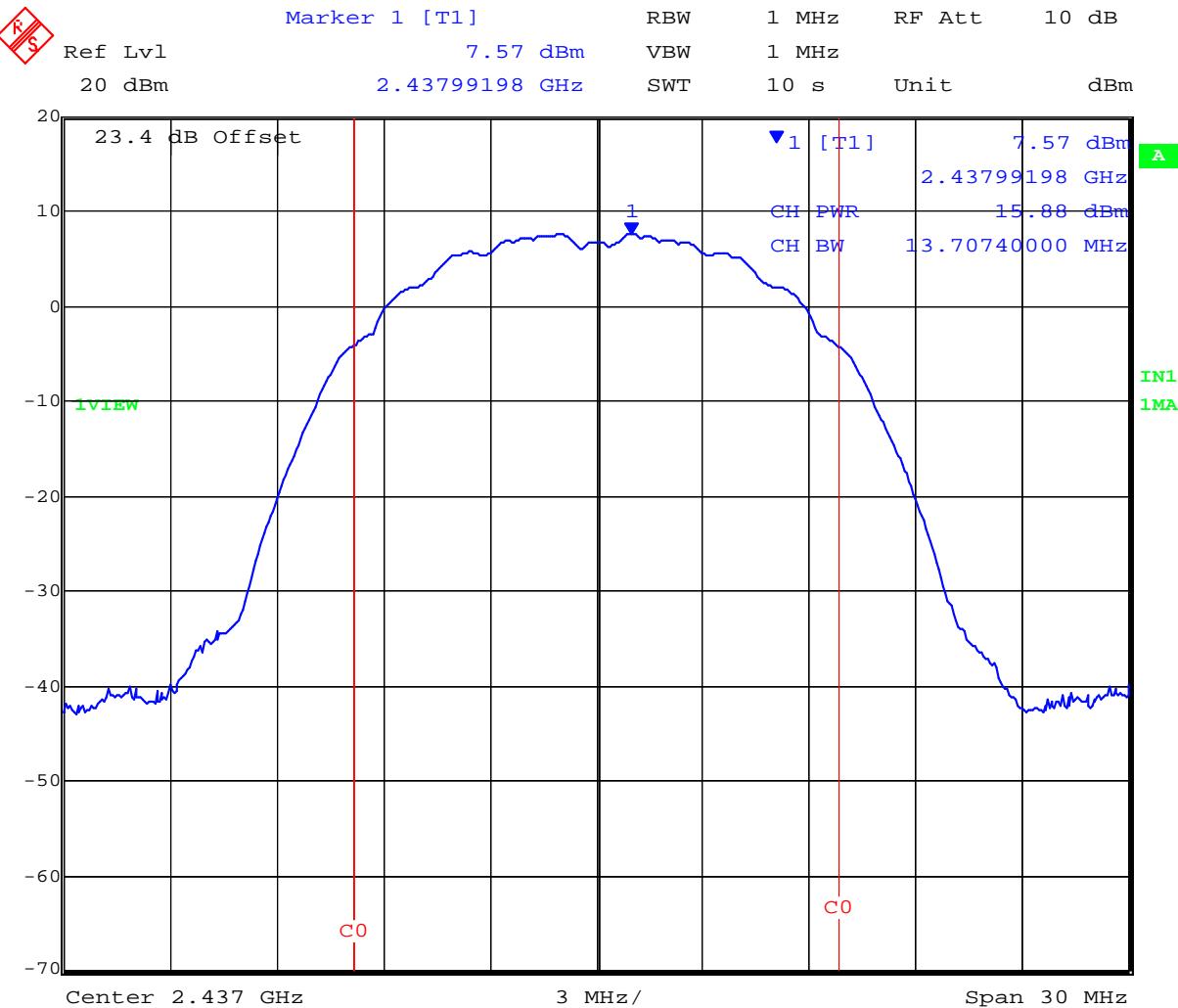
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2,412 MHz 802.11b Peak Power (dBm)



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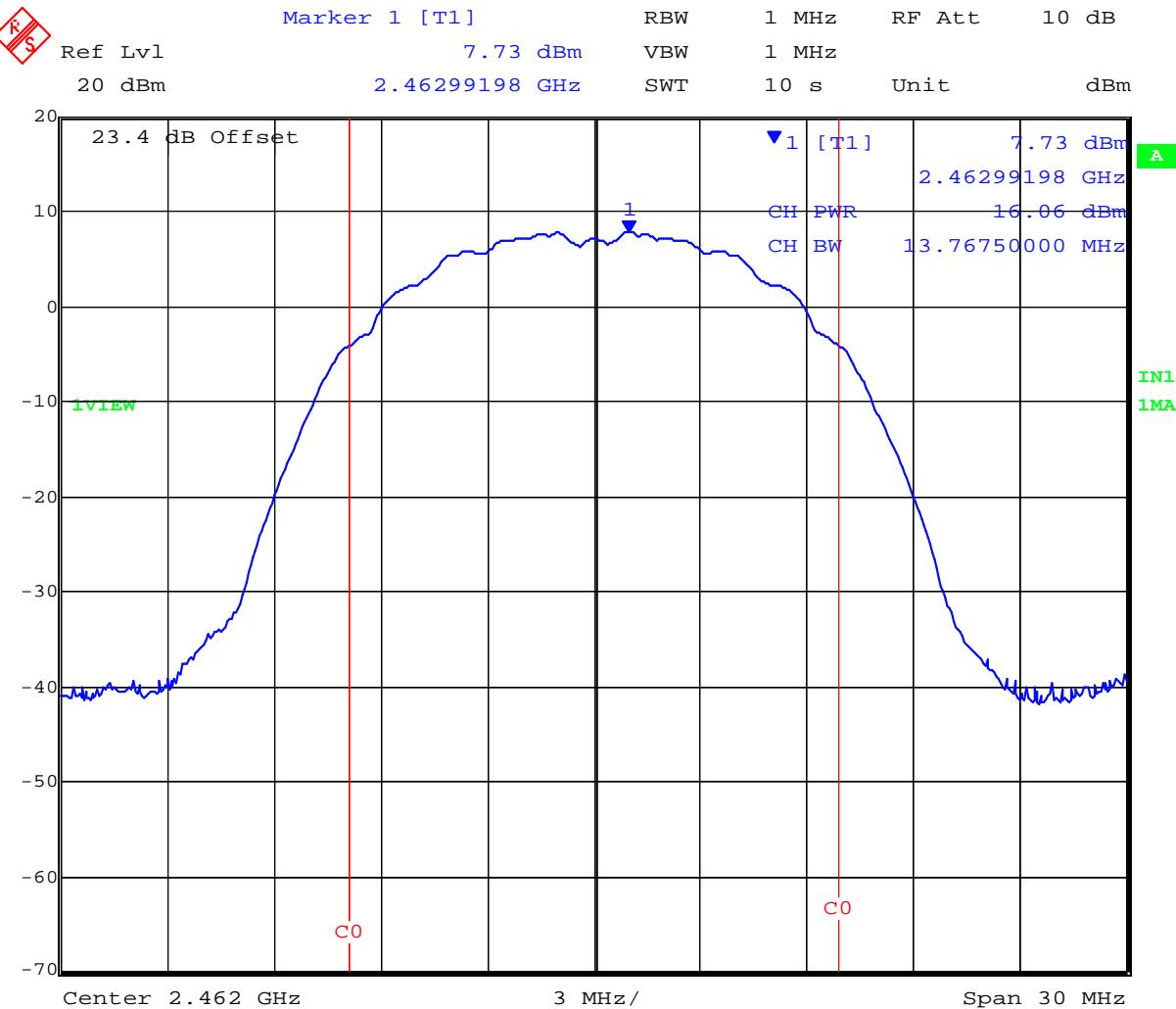
2,437 MHz 802.11b Peak Power (dBm)



Date: 9.JUL.2008 20:38:00

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2,462 MHz 802.11b Peak Power (dBm)



Date: 9.JUL.2008 20:36:06

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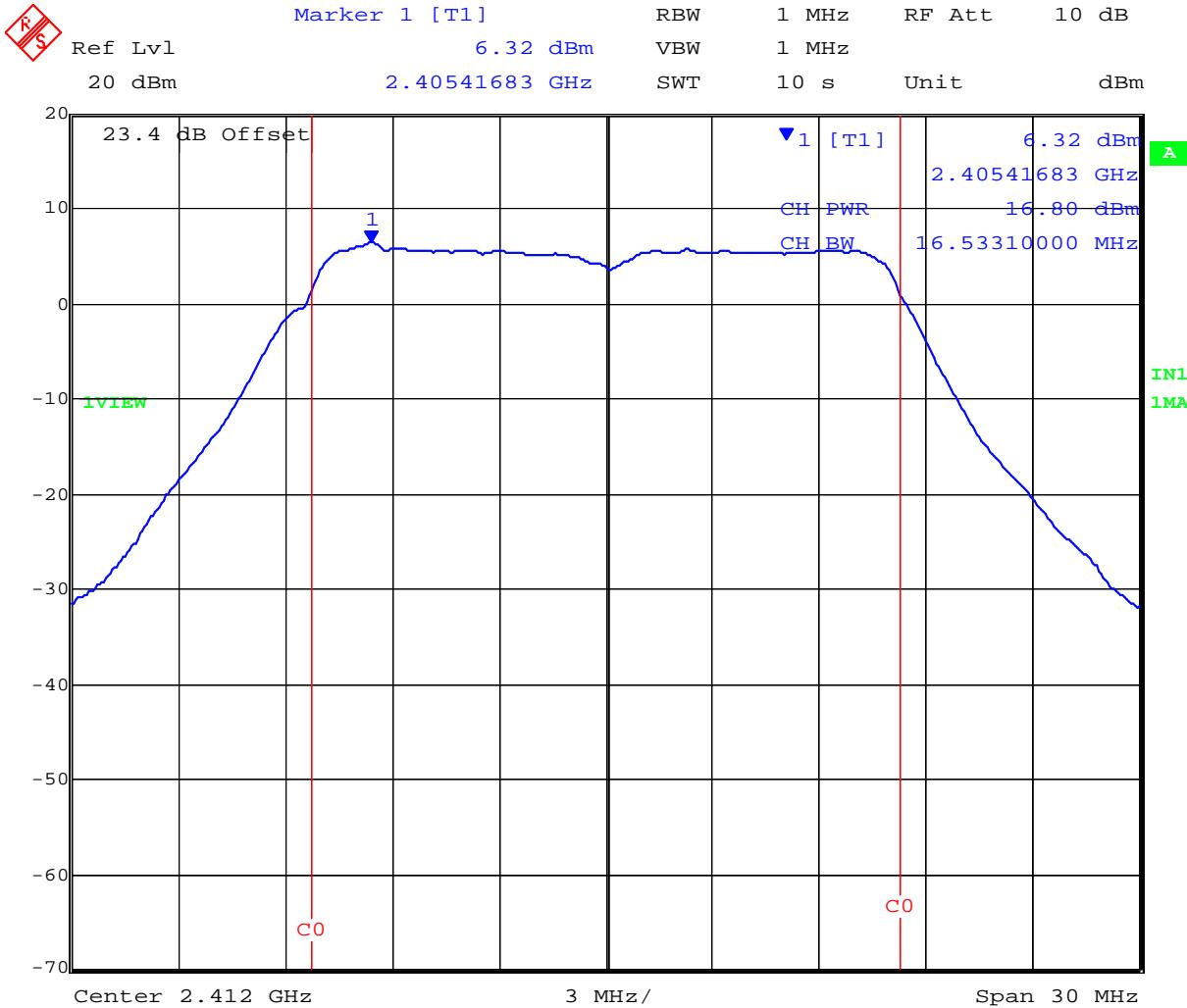
Title: Bright Star Engineering VCI Pod
To: FCC 47 CFR Part15.247 & IC RSS-210
Serial #: BTSR03-A2 Rev A
Issue Date: 29th July '08
Page: 35 of 110

TABLE OF RESULTS – 802.11g – 6Mb/s

Center Frequency (MHz)	99% Measurement Bandwidth (MHz)	Peak Power (dBm)	Peak Power EIRP (dBm)
2,412	16.5331	+16.88	+18.88
2,437	16.5331	+16.99	+18.99
2,462	16.5331	+17.30	+19.30

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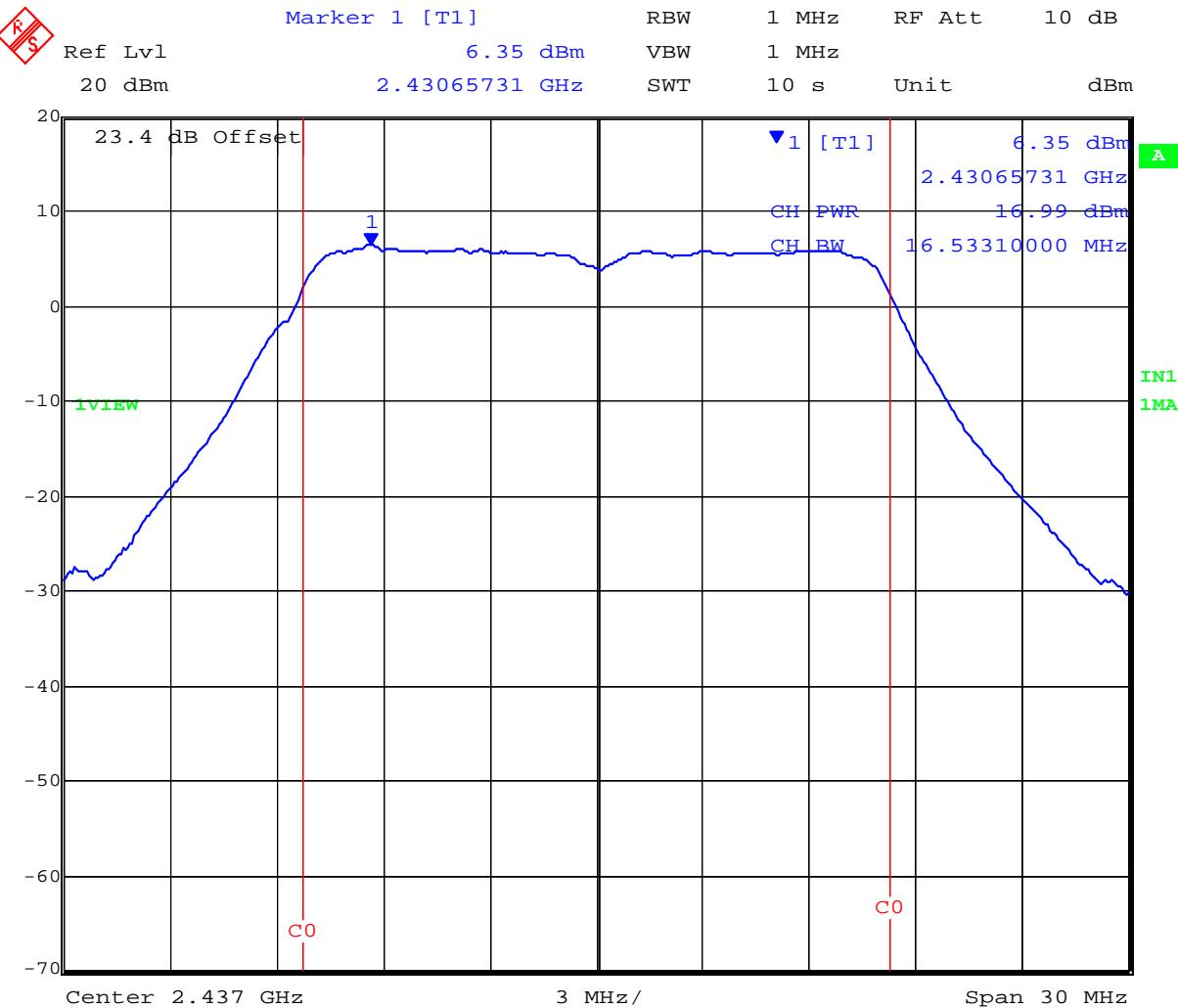
2,412 MHz 802.11g Peak Power (dBm)



Date: 9.JUL.2008 20:40:52

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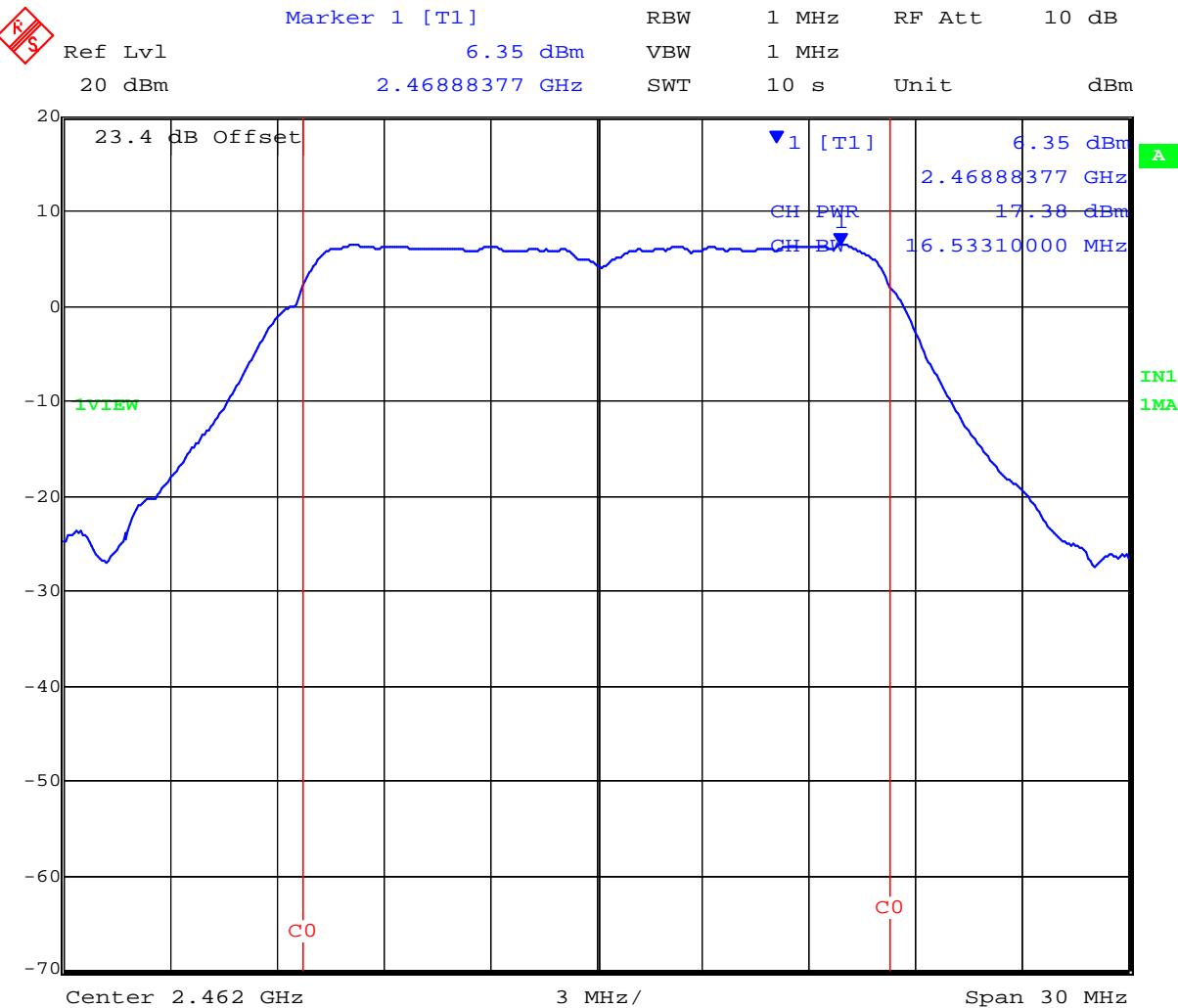
2,437 MHz 802.11g Peak Power (dBm)



Date: 9.JUL.2008 20:42:14

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2,462 MHz 802.11g Peak Power (dBm)



Date: 9.JUL.2008 20:43:23

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Title: Bright Star Engineering VCI Pod
To: FCC 47 CFR Part15.247 & IC RSS-210
Serial #: BTSR03-A2 Rev A
Issue Date: 29th July '08
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Specification

Limits

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

§15.247 (b) (3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz bands: 1.0 watt.

§15.31 (e) For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. For battery operated equipment, the equipment tests shall be performed using a new battery.

§ RSS-210 A8.4(4) For systems employing digital modulation techniques operating in the 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz bands the maximum peak conducted power shall not exceed 1 watt.

Laboratory Measurement Uncertainty for Power Measurements

Measurement uncertainty	±1.33 dB
-------------------------	----------

Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-01 'Measuring RF Output Power'	0158, 0193, 0252, 0313, 0314, 0070, 0116, 0117

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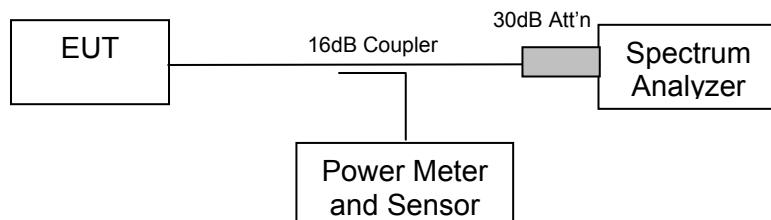
5.1.3. Peak Power Spectral Density

FCC, Part 15 Subpart C §15.247(e)
Industry Canada RSS-210 §A8.2

Test Procedure

The transmitter output was connected to a spectrum analyzer and the maximum level in a 3 kHz bandwidth was measured. A peak value was found over the full emission bandwidth and the frequency span reduced to obtain enhanced resolution. Sweep time \geq span / 3 kHz with video averaging turned off. The Peak Power Spectral Density is the highest level found across the emission in a 3 kHz resolution bandwidth.

Test Measurement Set up



Measurement set up for Peak Power Spectral Density

Measurement Results for Peak Power Spectral Density

Ambient conditions.

Temperature: 17 to 23 °C Relative humidity: 31 to 57 % Pressure: 999 to 1012 mbar

Radio Parameters

Power: Maximum Power

Duty Cycle: 100%

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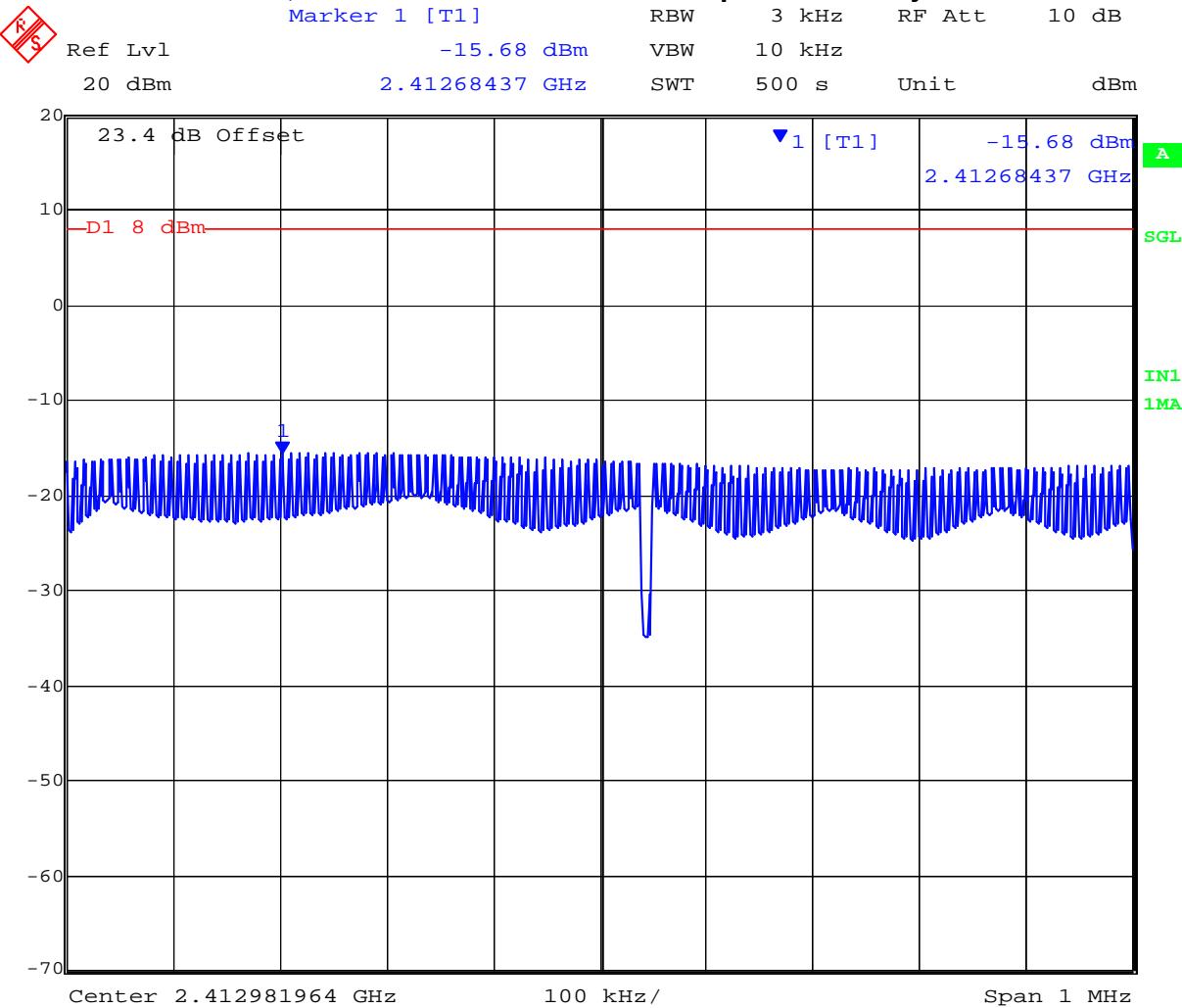
Title: Bright Star Engineering VCI Pod
To: FCC 47 CFR Part15.247 & IC RSS-210
Serial #: BTSR03-A2 Rev A
Issue Date: 29th July '08
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TABLE OF RESULTS – 802.11b – 1 Mb/s

Center Frequency (MHz)	Peak Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dBm)
2,412	2412.68437	-15.68	+8	-23.68
2,437	2437.73046	-15.53	+8	-23.53
2,462	2462.73046	-16.03	+8	-24.03

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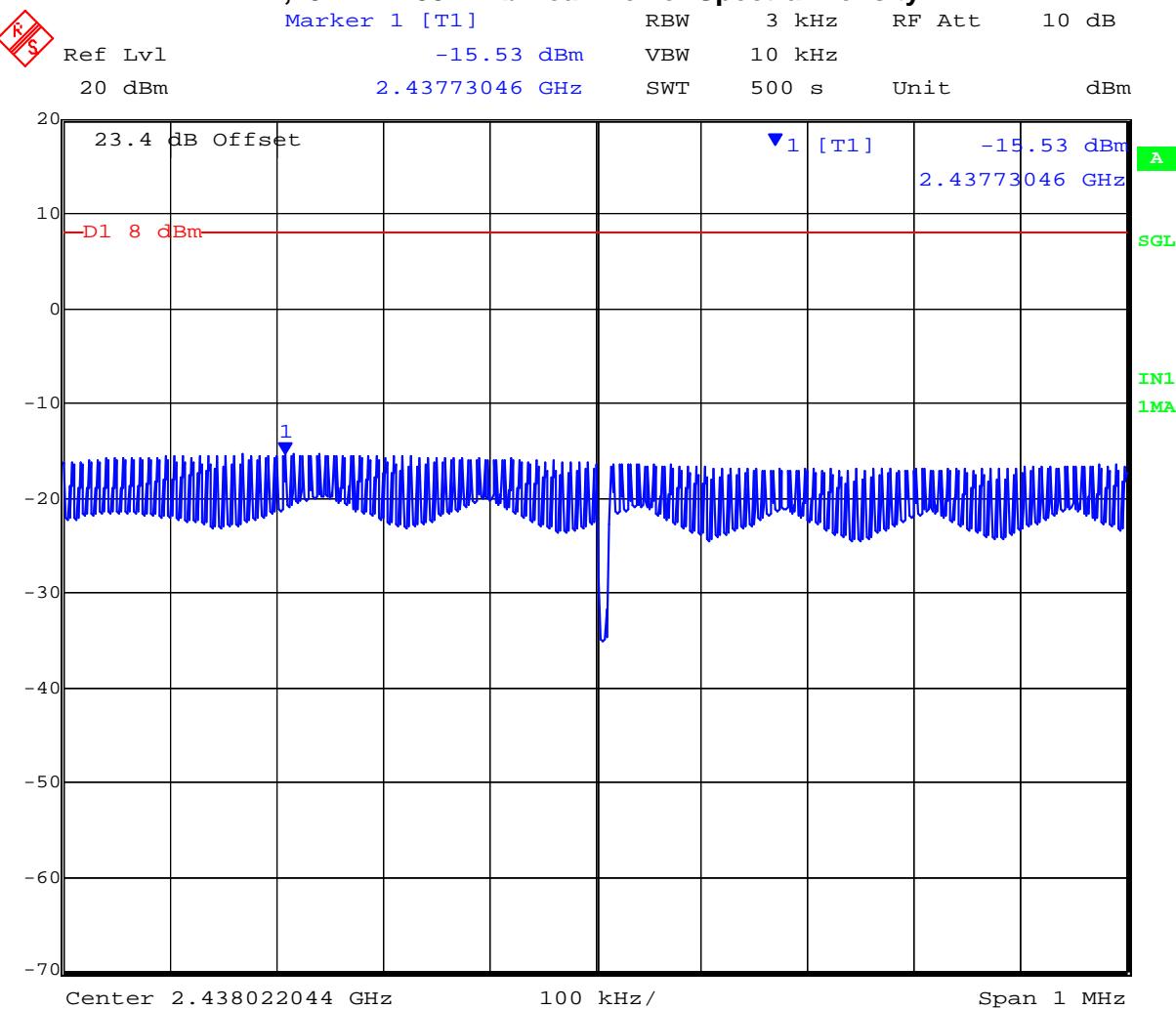
2,412 MHz 802.11b Peak Power Spectral Density



Date: 9.JUL.2008 19:27:53

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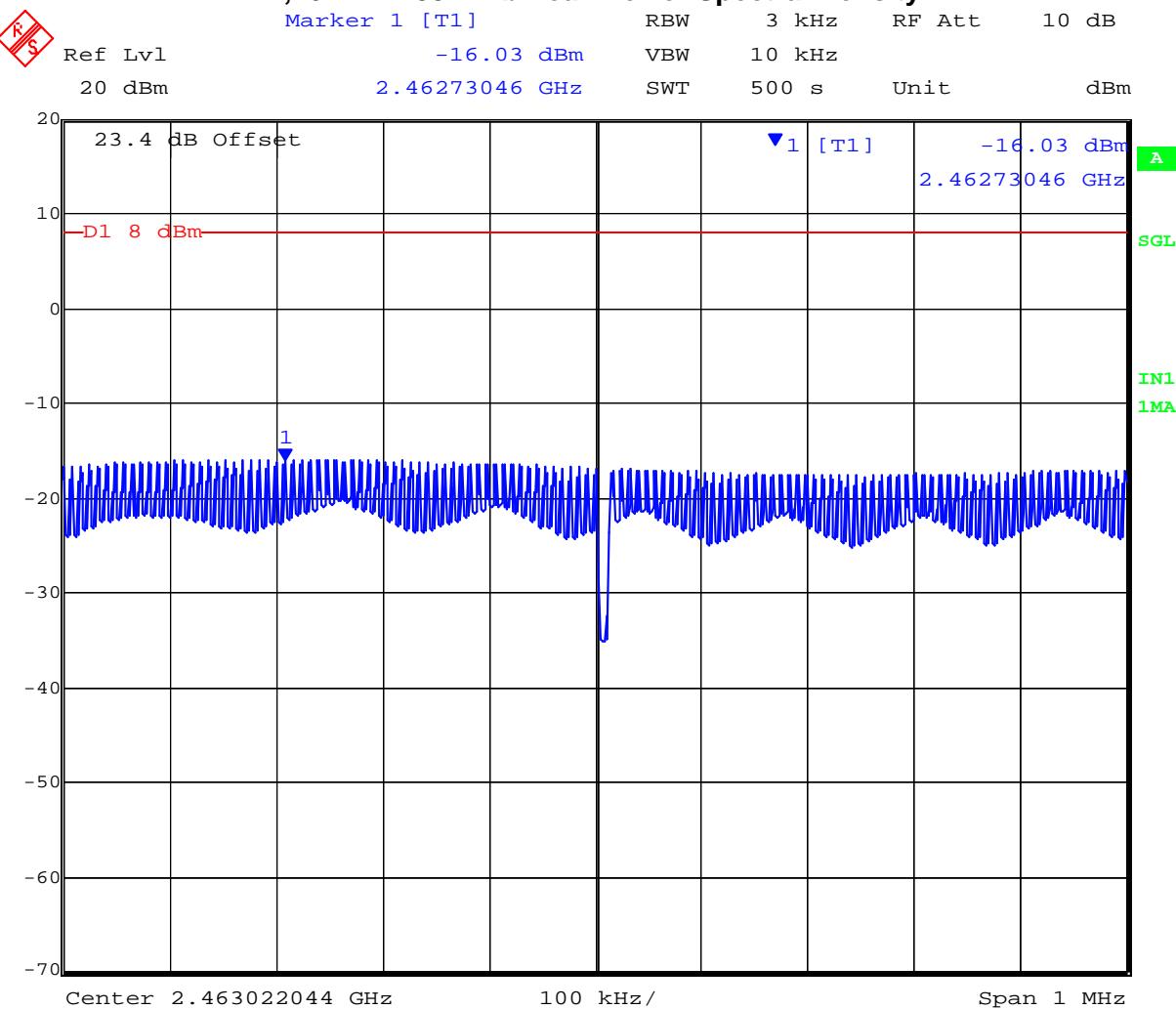
2,437 MHz 802.11b Peak Power Spectral Density



Date: 9.JUL.2008 19:51:50

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2,462 MHz 802.11b Peak Power Spectral Density



Date: 9.JUL.2008 20:12:42

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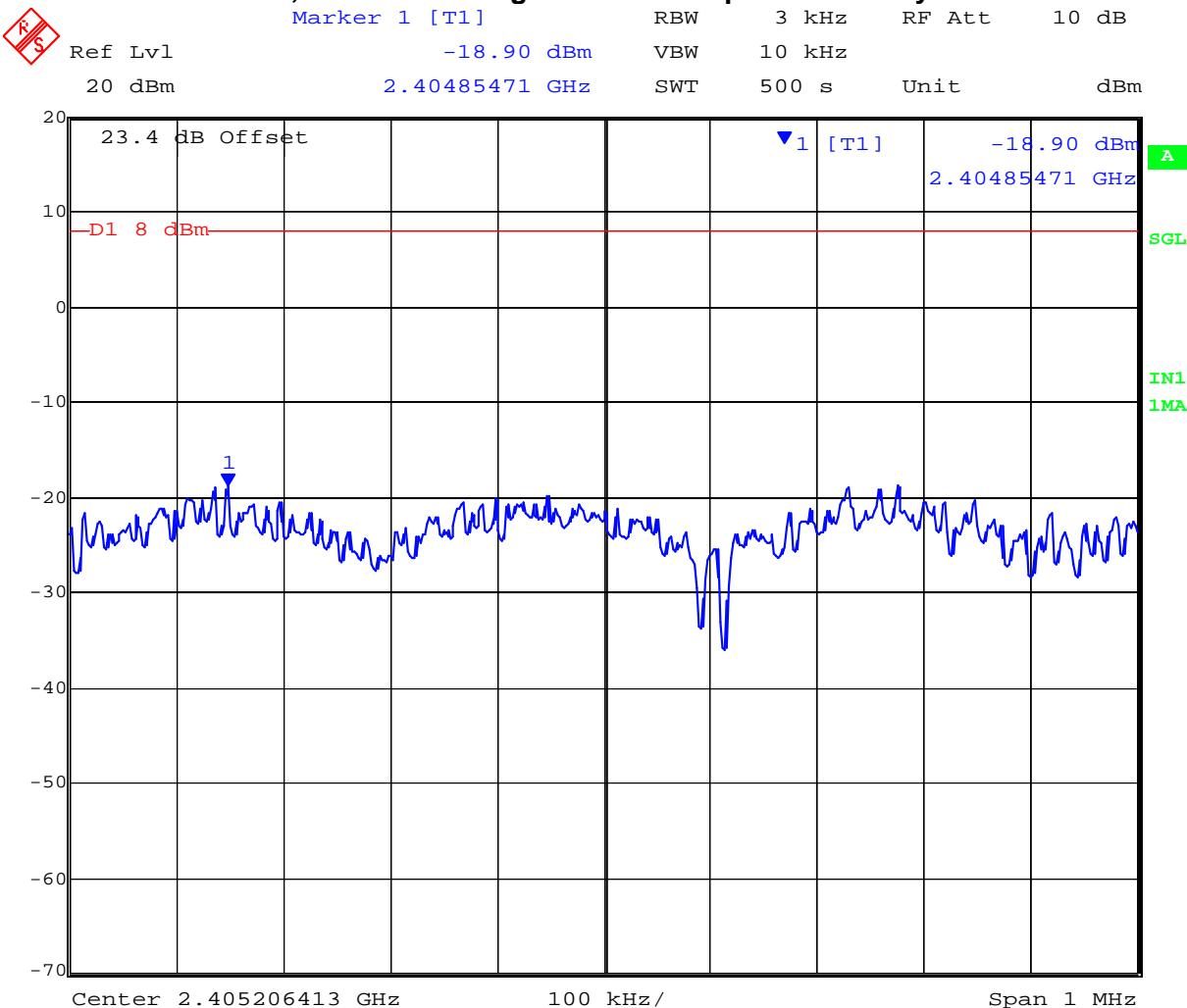
Title: Bright Star Engineering VCI Pod
To: FCC 47 CFR Part15.247 & IC RSS-210
Serial #: BTSR03-A2 Rev A
Issue Date: 29th July '08
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TABLE OF RESULTS – 802.11g – 6 Mb/s

Center Frequency (MHz)	Peak Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dBm)
2,412	2404.85471	-18.90	+8	-26.90
2,437	2430.79459	-19.16	+8	-27.16
2,462	2468.63828	-18.85	+8	-27.85

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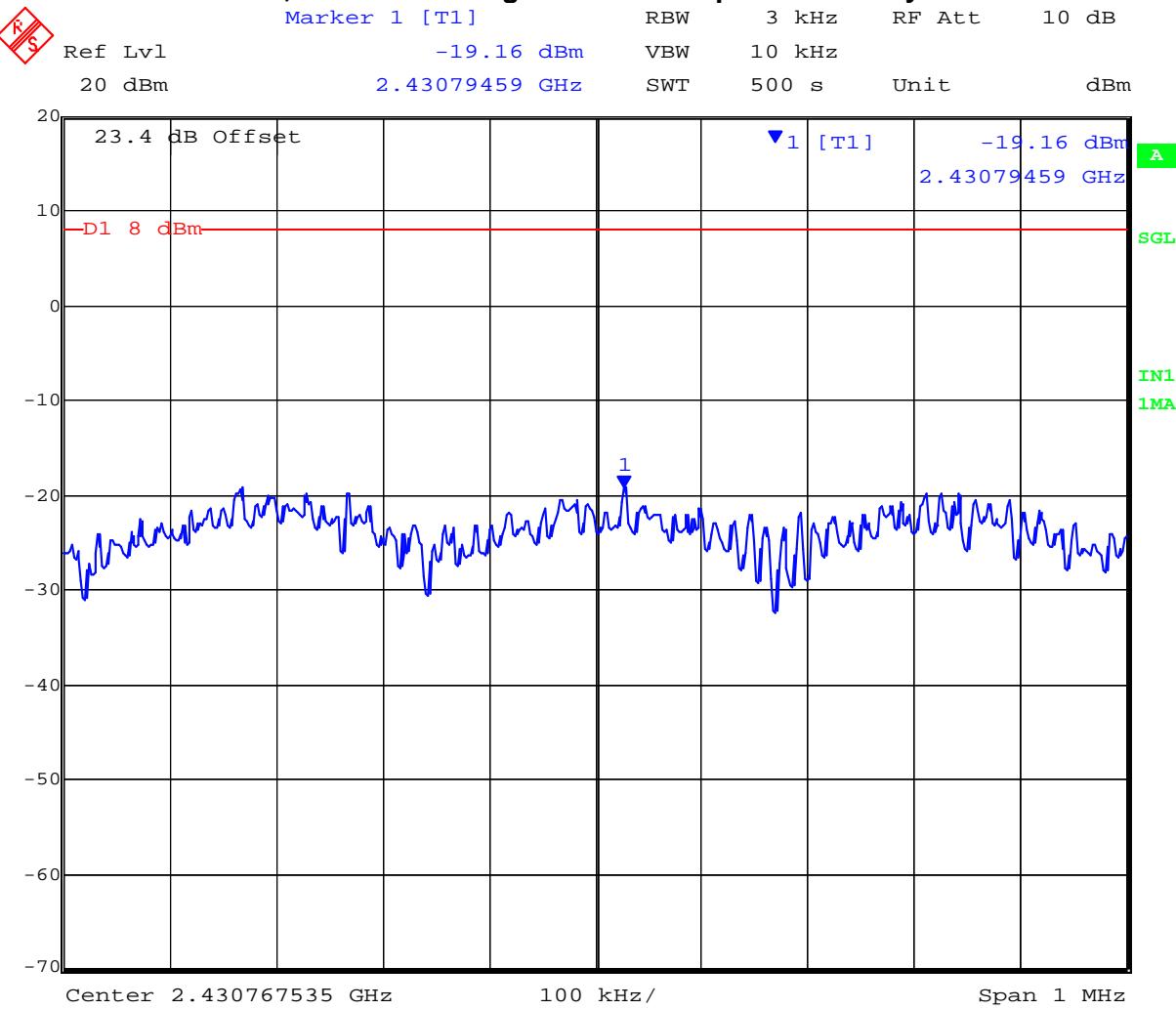
2,412 MHz 802.11g Peak Power Spectral Density



Date: 9.JUL.2008 19:40:09

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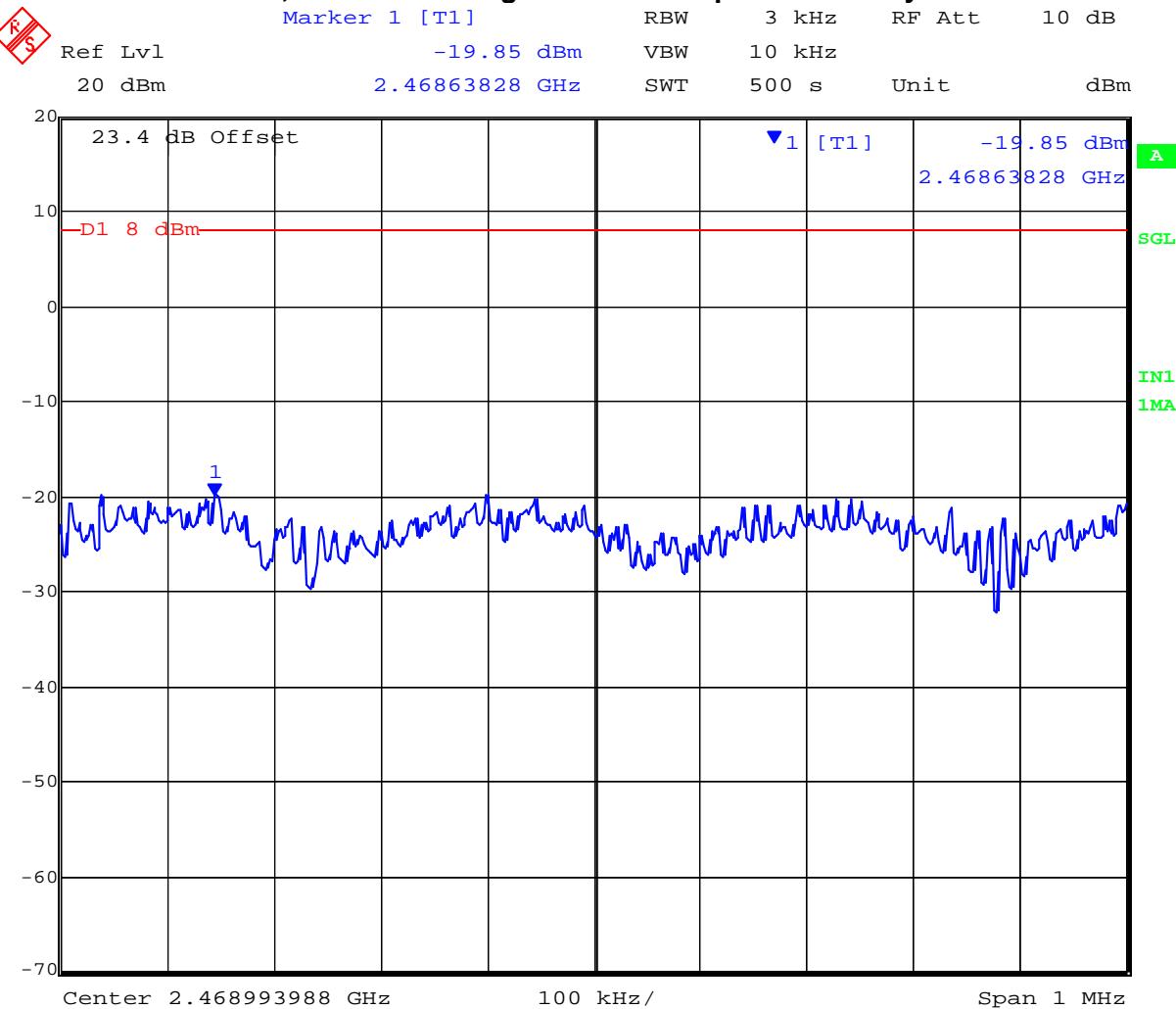
2,437 MHz 802.11g Peak Power Spectral Density



Date: 9.JUL.2008 20:02:03

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2,462 MHz 802.11g Peak Power Spectral Density



Date: 9.JUL.2008 20:23:51

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Title: Bright Star Engineering VCI Pod
To: FCC 47 CFR Part15.247 & IC RSS-210
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Specification

Peak Power Spectral Density Limits

§15.247(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

RSS-210 §A8.2(2) The transmitter power spectral density (into the antenna) shall not be greater than +8 dBm in any 3 kHz band during any time interval of continuous transmission or over 1.0 second if the transmission exceeds 1.0 second duration.

Laboratory Measurement Uncertainty for Spectral Density

Measurement uncertainty	±1.33 dB
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Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-01 'Measuring RF Output Power'	0158, 0193, 0252, 0313, 0314, 0070, 0116, 0117

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5.1.4. Maximum Permissible Exposure

FCC, Part 15 Subpart C §15.247(i)

Industry Canada RSS-Gen §5.5

Calculations for Maximum Permissible Exposure Levels

$$\text{Power Density} = P_d \text{ (mW/cm}^2\text{)} = \text{EIRP}/(4\pi d^2)$$

$$\text{EIRP} = P * G$$

P = Peak output power (mW)

G = Antenna numeric gain (numeric)

d = Separation distance (cm)

$$\text{Numeric Gain} = 10 ^ (G \text{ (dBi)})/10$$

Because the EUT belongs to the General Population/Uncontrolled Exposure the limit of power density is 1.0 mW/cm²

Freq. Band (GHz)	Antenna Gain (dBi)	Numeric Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Calculated Safe Distance @ 1mW/cm ² Limit(cm)	Minimum Separation Distance (cm)
2.4	2	1.585	+17.30	53.70	2.602*	20.0

***Note:** for mobile or fixed location transmitters the minimum separation distance is 20cm, even if calculations indicate the MPE distance to be less.

Specification

Maximum Permissible Exposure Limits

§15.247(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 levels in excess of the Commission's guidelines.

Limit S = 1mW / cm² from 1.310 Table 1

Note: for mobile or fixed location transmitters the minimum separation distance is 20cm, even if calculations indicate the MPE distance to be less.

RSS-Gen §5.5 Before equipment certification is granted, the applicable requirements of RSS-102 shall be met.

Laboratory Measurement Uncertainty for Power Measurements

Measurement uncertainty	±1.33 dB
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5.1.5. Conducted Spurious Emissions

FCC, Part 15 Subpart C §15.247(d); 15.205; 15.209

Industry Canada RSS-210 §A8.5, §2.2

Industry Canada RSS-Gen 4.7

Test Procedure

Conducted emissions were measured at a limit of 20 dB below the highest in-band spectral density measured with a spectrum analyzer connected to the antenna terminal. Emissions at the band edge were measured and recorded. Measurements were made while EUT was operating in transmit mode of operation at the appropriate center frequency.

Test Measurement Set up



Band-edge measurement test configuration

Measurement Results of Conducted Spurious Emissions

Ambient conditions.

Temperature: 17 to 23 °C Relative humidity: 31 to 57 % Pressure: 999 to 1012 mbar

Radio Parameters

Power: Maximum Power

Duty Cycle: 100%

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Title: Bright Star Engineering VCI Pod
To: FCC 47 CFR Part15.247 & IC RSS-210
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Conducted Band-Edge Results

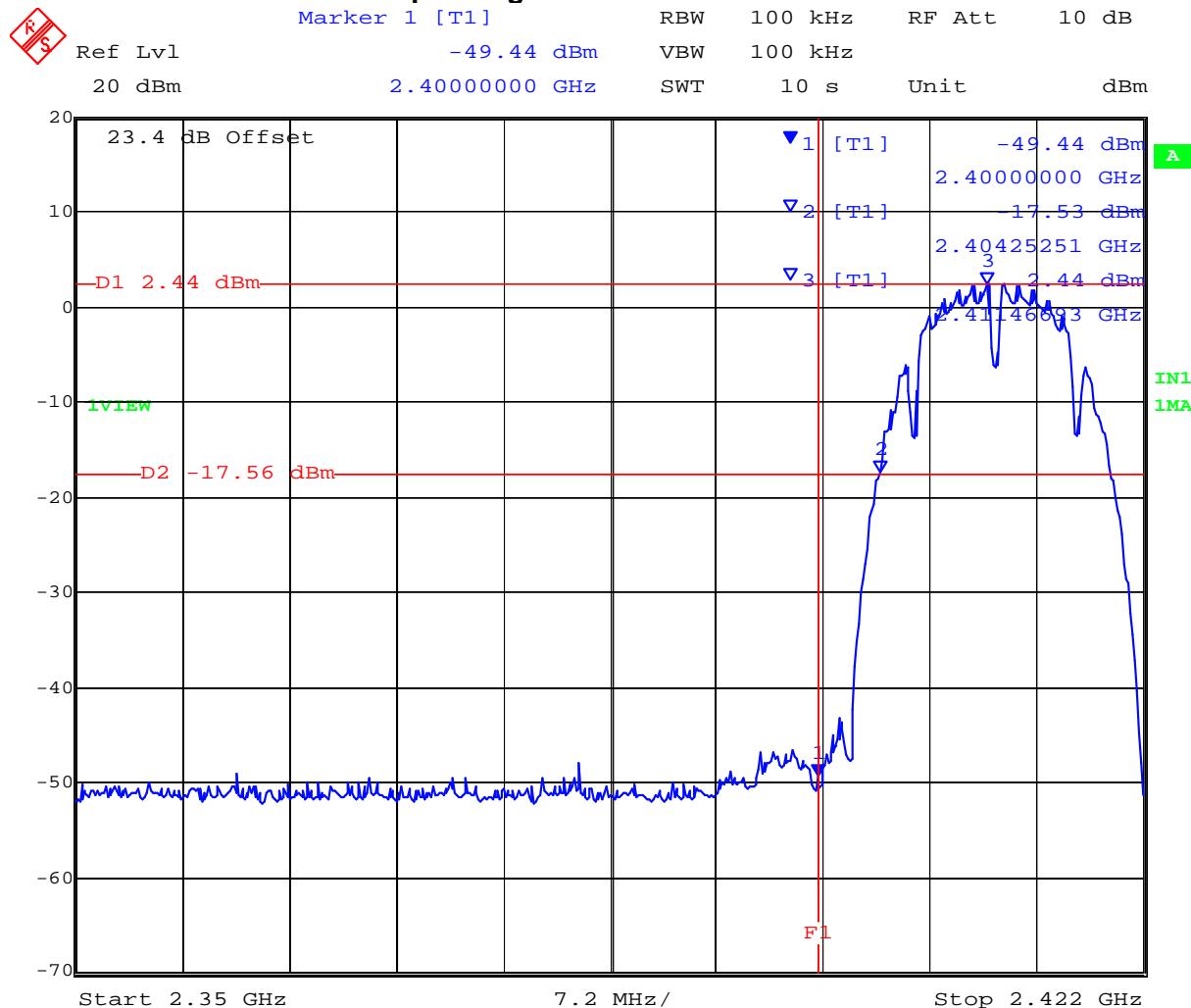
Measurements were performed with the transmitter tuned to the channel closest to the band-edge being measured. All emissions were maximized during measurement. Limits which were derived from the band-edge measurements provided below are drawn on each plot.

TABLE OF RESULTS – 802.11b – 1 Mbit/s

Center Frequency (MHz)	Band edge Frequency (MHz)	Limit (20 dB below peak of fundamental)	Amplitude @ Band edge (dBm)	Margin (dB)
2,412	2,400	-17.56	-49.44	-31.88
2,462	2,483.5	-17.04	-51.86	-34.82

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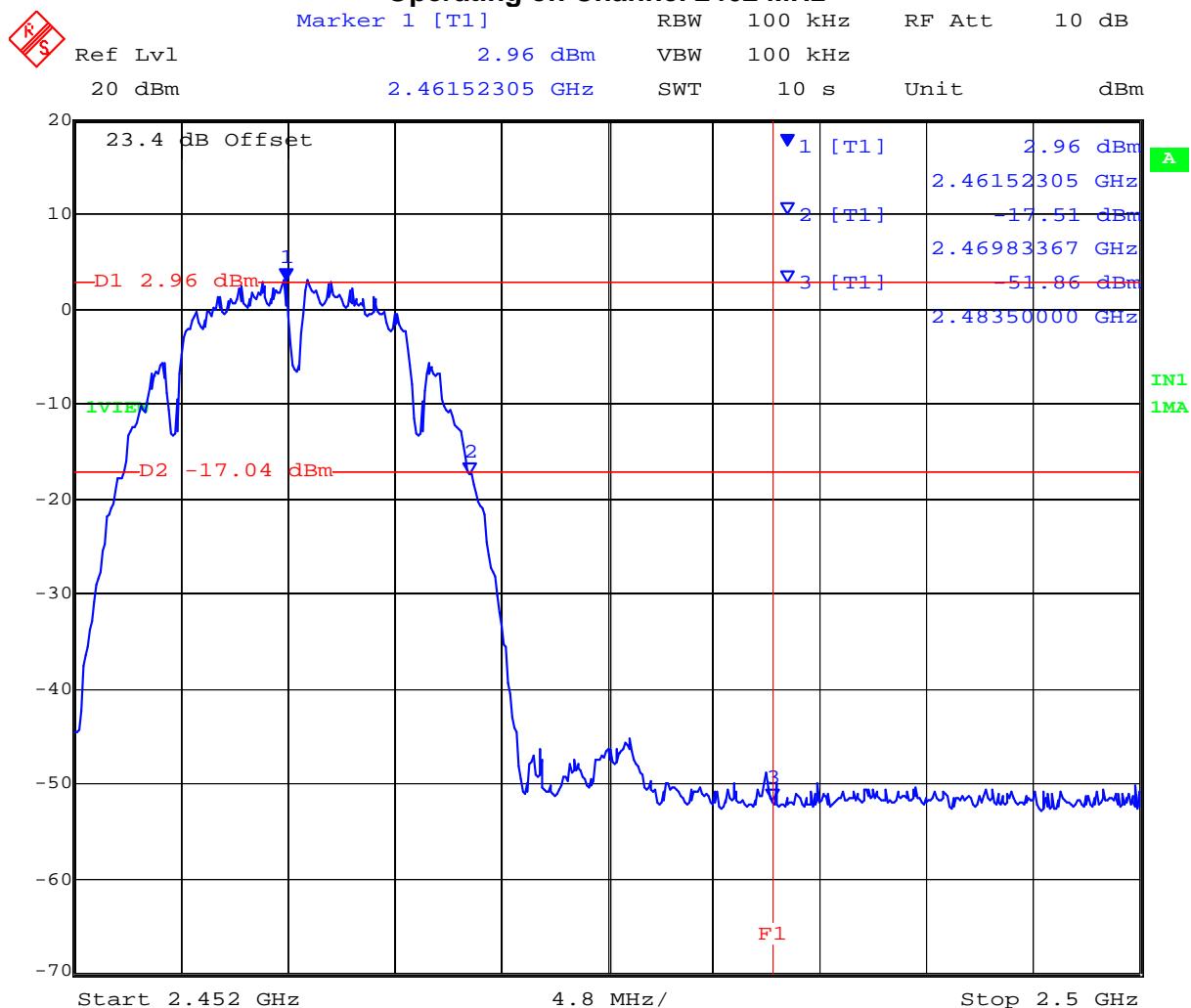
**802.11b Conducted Spurious Emissions at the 2,400 MHz Band Edge
Operating on Channel 2412 MHz**



Date: 9.JUL.2008 19:15:52

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**802.11b Conducted Spurious Emissions at the 2,483.5 MHz Band Edge
Operating on Channel 2462 MHz**



Date: 9.JUL.2008 18:59:40

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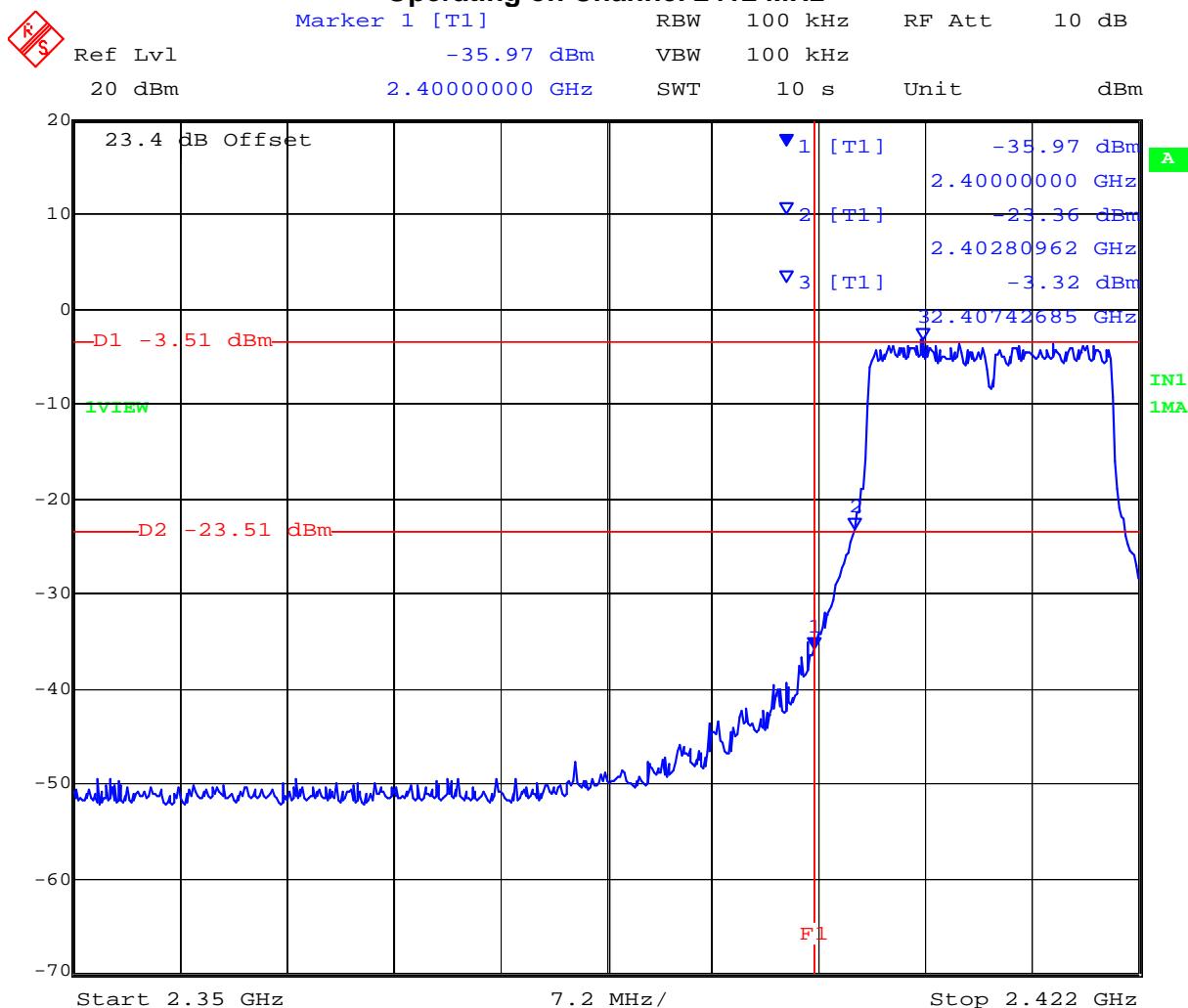
Title: Bright Star Engineering VCI Pod
To: FCC 47 CFR Part15.247 & IC RSS-210
Serial #: BTSR03-A2 Rev A
Issue Date: 29th July '08
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TABLE OF RESULTS – 802.11g – 6 Mbit/s

Center Frequency (MHz)	Band edge Frequency (MHz)	Limit (20 dB below peak of fundamental)	Amplitude @ Band edge (dBm)	Margin (dB)
2,412	2,400	-23.51	-35.97	-12.46
2,462	2,483.5	-23.66	-48.18	-24.52

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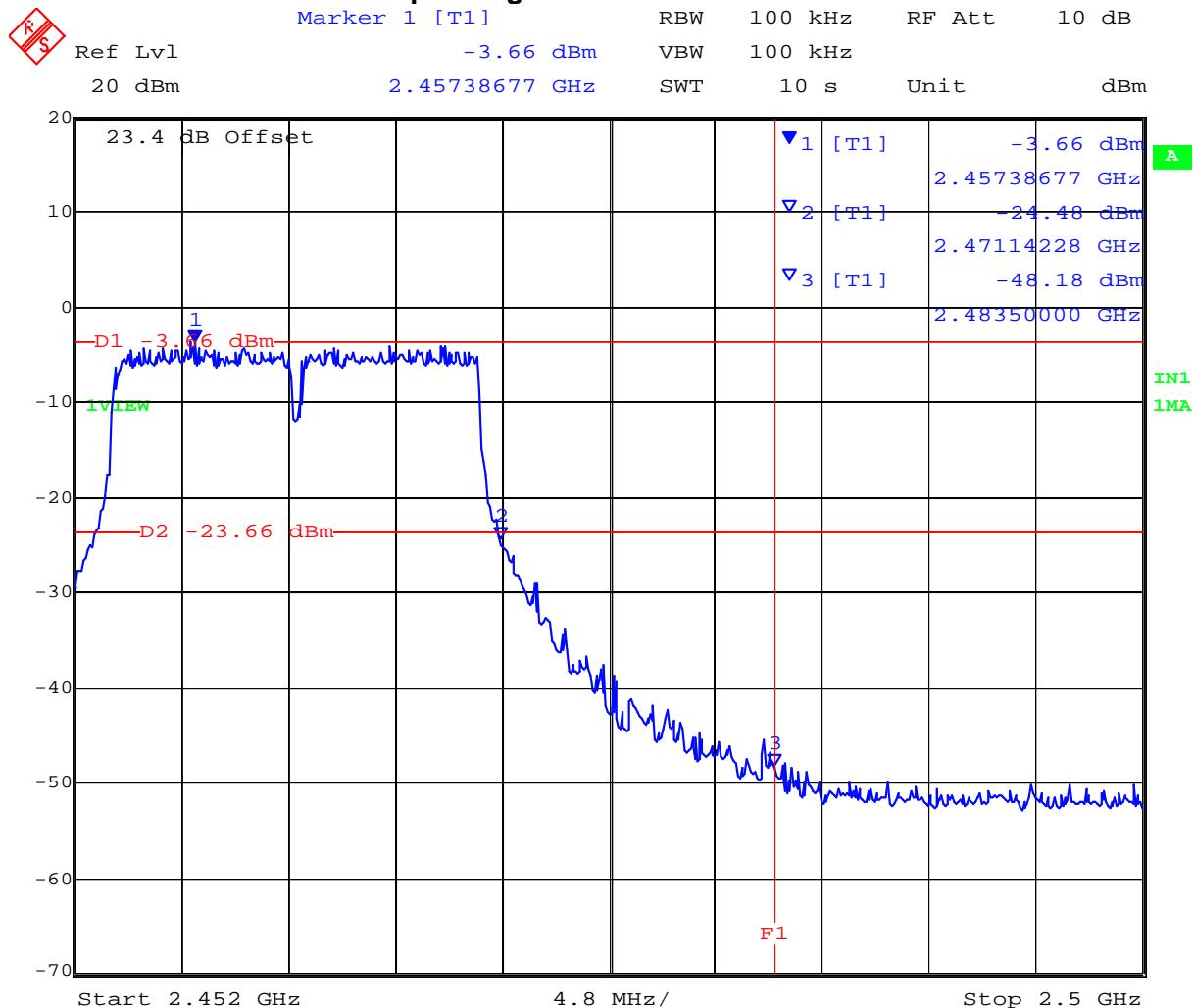
**802.11g Conducted Spurious Emissions at the 2,400 MHz Band Edge
Operating on Channel 2412 MHz**



Date: 9.JUL.2008 18:55:15

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**802.11g Conducted Spurious Emissions at the 2,483.5 MHz Band Edge
Operating on Channel 2462 MHz**



Date: 9.JUL.2008 19:01:48

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Title: Bright Star Engineering VCI Pod
To: FCC 47 CFR Part15.247 & IC RSS-210
Serial #: BTSR03-A2 Rev A
Issue Date: 29th July '08
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Spurious Emissions (1-26 GHz)

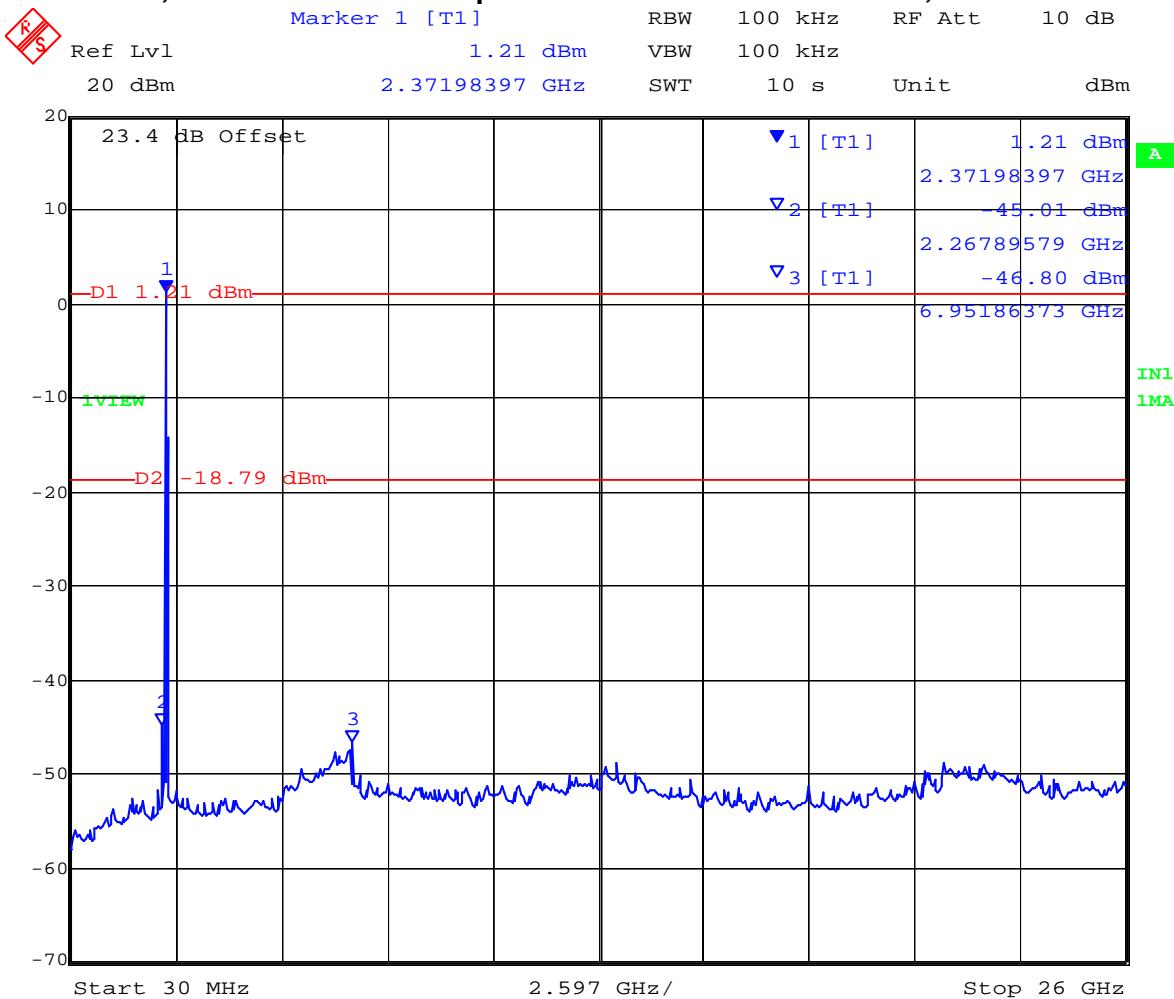
TABLE OF RESULTS – 802.11b – 1 Mbit/s

Channel Centre Frequency (MHz)	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Margin (dB)
2,412	30	26,000	-45.01	-18.79	-26.22
2,437	30	26,000	-45.39	-19.35	-26.04
2,462	30	26,000	-44.10	-18.39	-25.71

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802.11b – 1 Mbit/s

2,412 MHz Conducted Spurious Emissions 30 MHz to 26,000 MHz

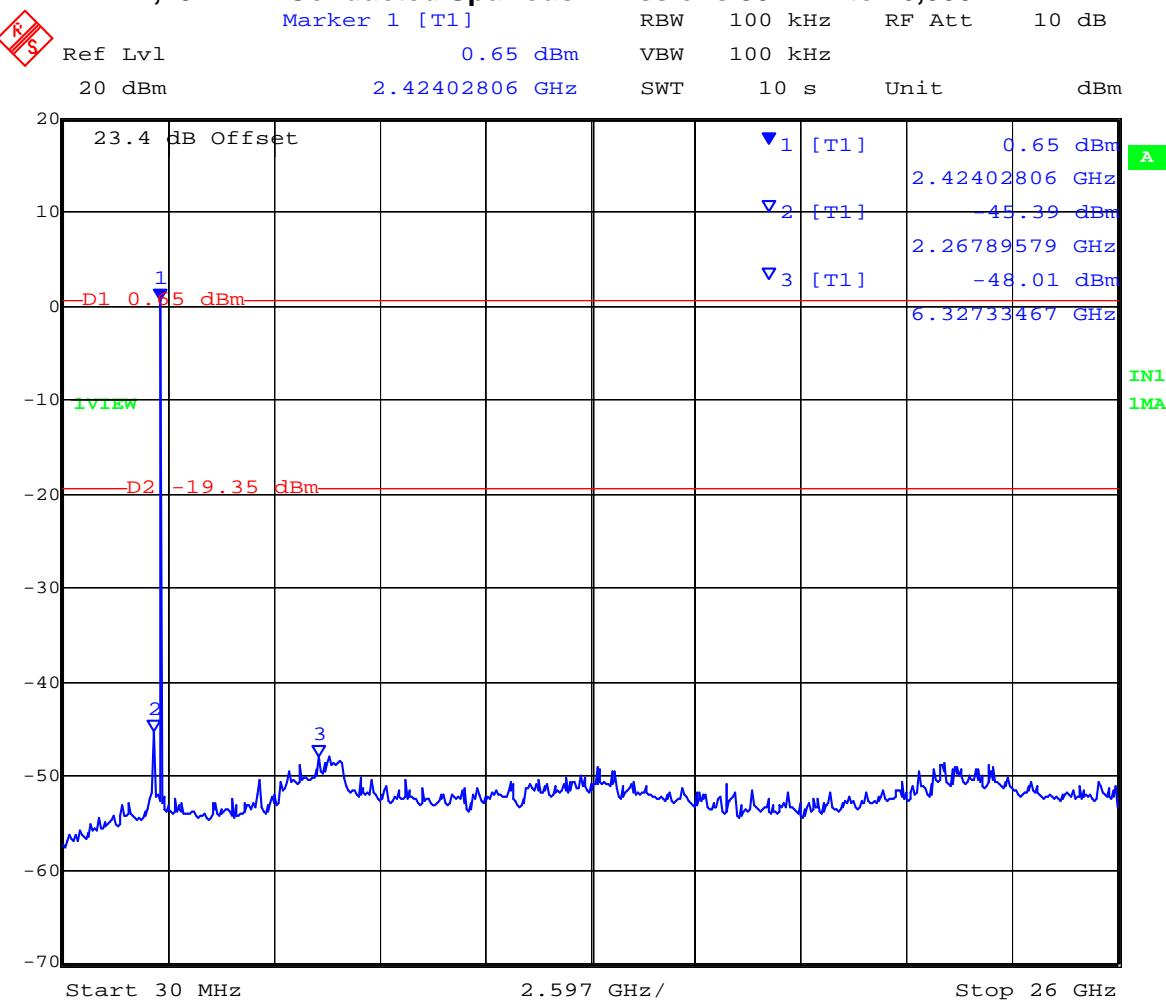


Date: 9.JUL.2008 18:38:27

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802.11b – 1 Mbit/s

2,437 MHz Conducted Spurious Emissions 30 MHz to 26,000 MHz

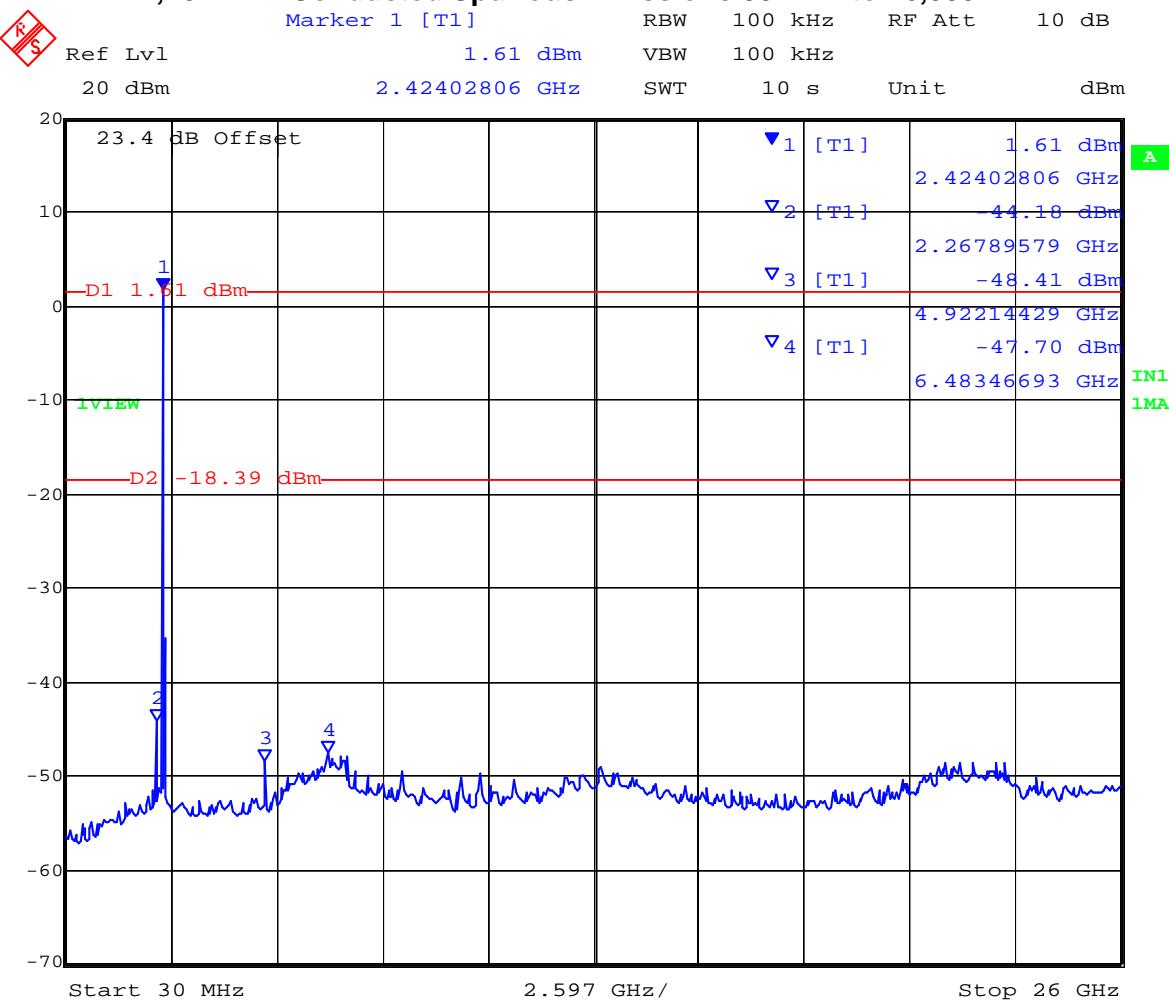


Date: 9.JUL.2008 18:40:58

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802.11b – 1 Mbit/s

2,462 MHz Conducted Spurious Emissions 30 MHz to 26,000 MHz



Date: 9.JUL.2008 18:43:04

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Title: Bright Star Engineering VCI Pod
To: FCC 47 CFR Part15.247 & IC RSS-210
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Spurious Emissions (1-26 GHz)

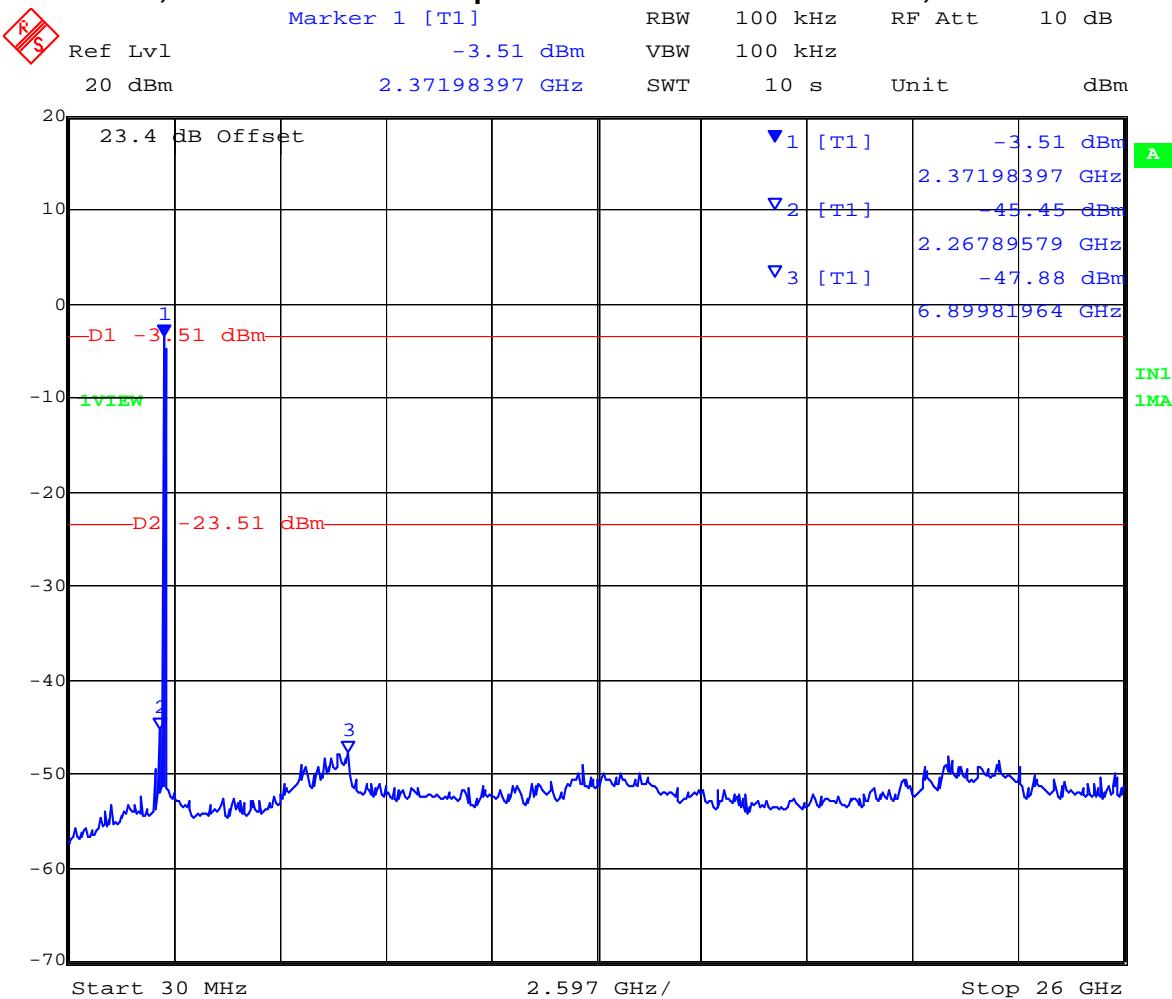
TABLE OF RESULTS – 802.11g – 6 Mbit/s

Channel Centre Frequency (MHz)	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Margin (dB)
2,412	30	26,000	-45.45	-23.51	-21.94
2,437	30	26,000	-46.13	-25.27	-20.86
2,462	30	26,000	-45.20	-25.62	-19.58

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802.11g – 6 Mbit/s

2,412 MHz Conducted Spurious Emissions 30 MHz to 26,000 MHz

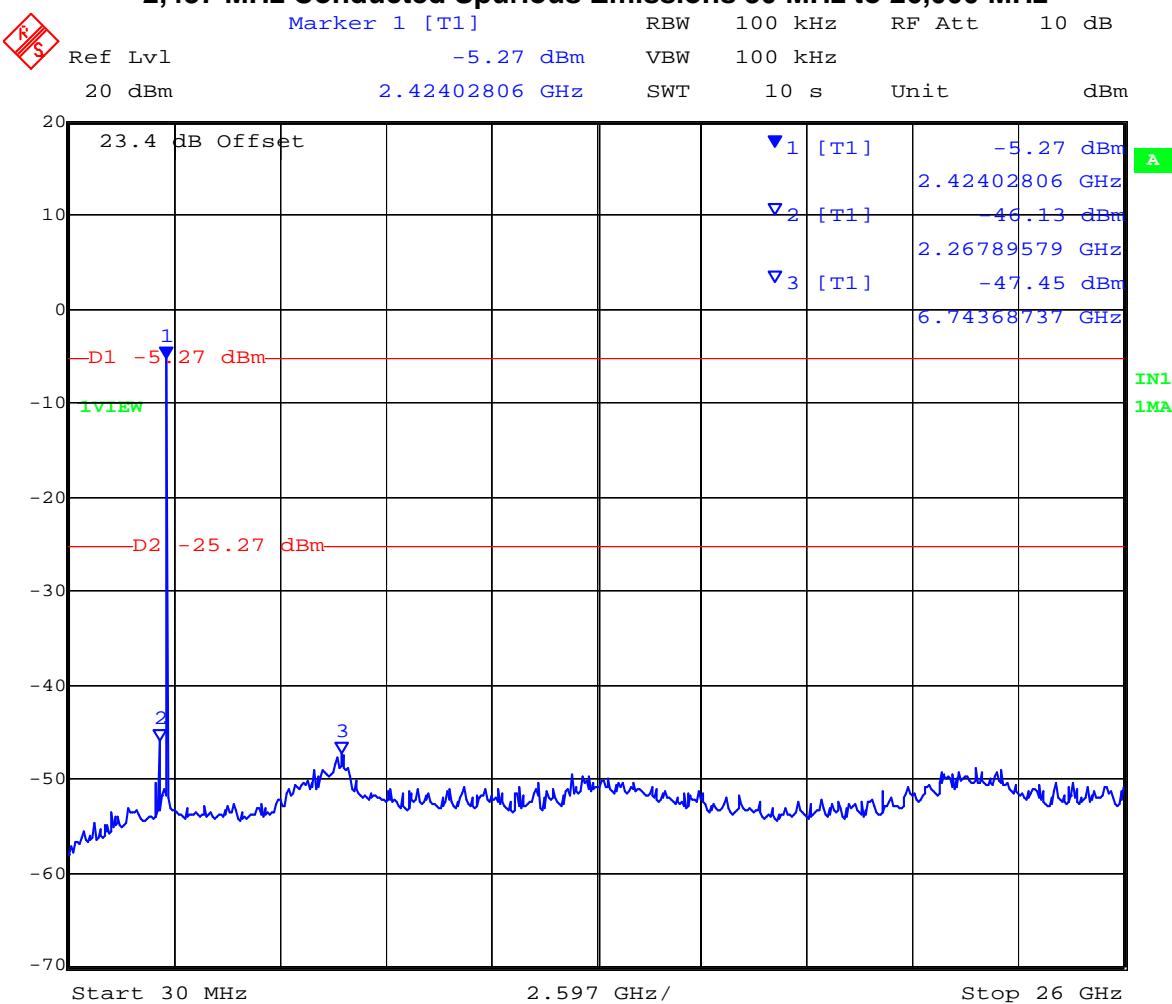


Date: 9.JUL.2008 18:49:48

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802.11g – 6 Mbit/s

2,437 MHz Conducted Spurious Emissions 30 MHz to 26,000 MHz

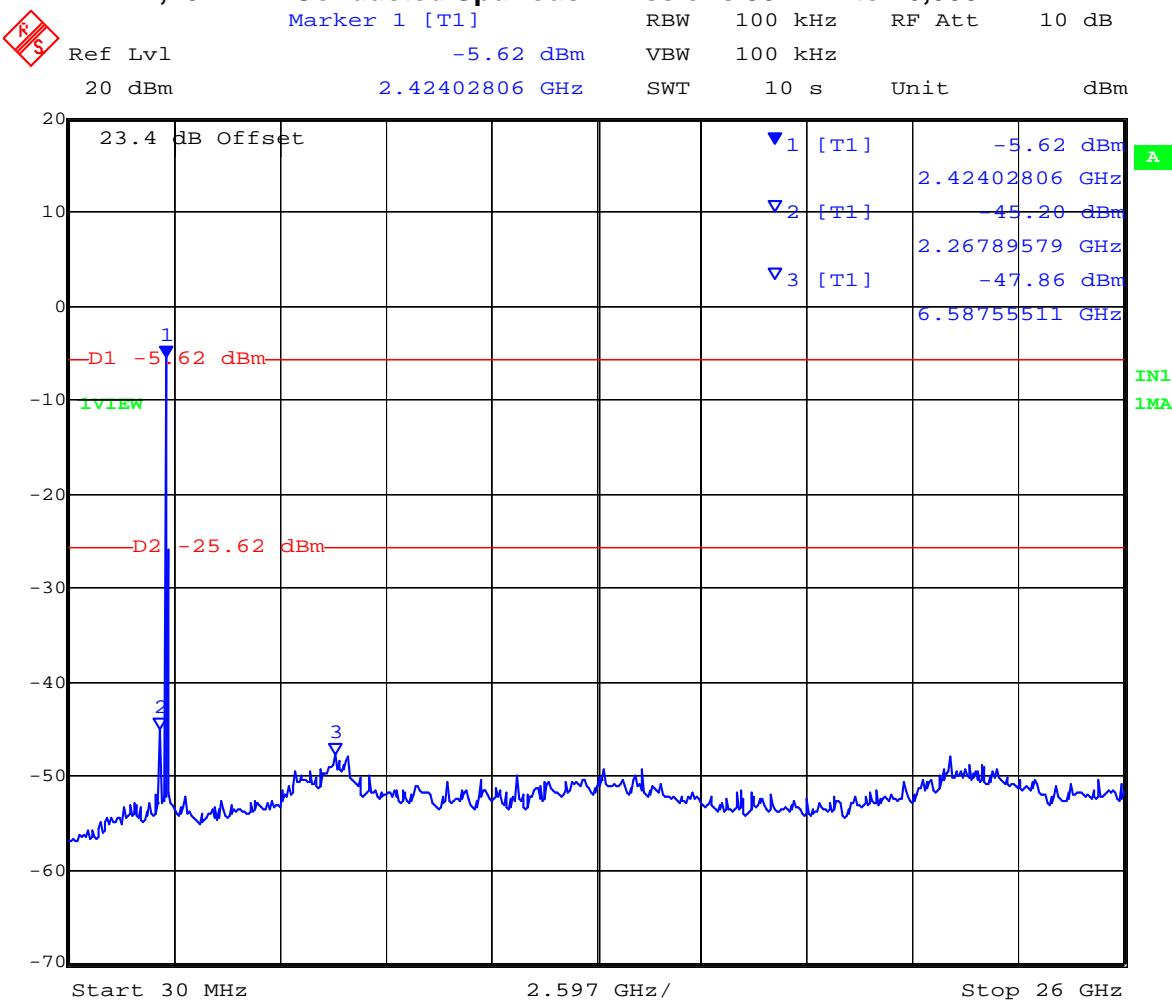


Date: 9.JUL.2008 18:47:52

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802.11g – 6 Mbit/s

2,462 MHz Conducted Spurious Emissions 30 MHz to 26,000 MHz



Date: 9.JUL.2008 18:45:30

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Specification

Limits Band-Edge

Lower Limit Band-edge	Upper Limit Band-edge	Limit below highest level of desired power
2,400 MHz	2,483.5 MHz	≥ 20 dB

§15.247(d) and RSS-210 §A8.5 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 radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

§15.247(d)

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 §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(a)).

RSS-210 §A8.5 If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under section A8.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Tables 2 and 3 is not required. In addition, radiated emissions which fall in the restricted bands of Table 1 must also comply with the radiated emission limits specified in Tables 2 and 3.

RSS-Gen §4.7

The search for unwanted emissions shall be from the lowest frequency internally generated or used in the device (local oscillator, intermediate of carrier frequency), or from 30 MHz, whichever is the lowest frequency, to the 5th harmonic of the highest frequency generated without exceeding 40 GHz.

Laboratory Measurement Uncertainty for Conducted Spurious Emissions

Measurement uncertainty	±2.37 dB
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Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-05 'Measurement of Spurious Emissions'	0088, 0158, 0193, 0252, 0313, 0314, 0070, 0116, 0117.

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5.1.6. Radiated Emissions

5.1.6.1. Transmitter Radiated Spurious Emissions (above 1 GHz)

FCC, Part 15 Subpart C §15.247(d) 15.205; 15.209

Industry Canada RSS-210 §A8.5, §2.2, §2.6

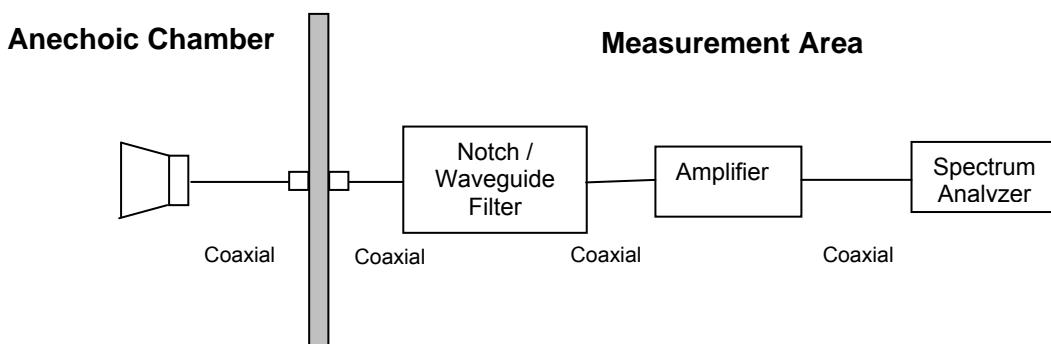
Industry Canada RSS-Gen §4.7

Test Procedure

Radiated emissions above 1 GHz are measured in the anechoic chamber at a 3-meter distance on every azimuth in both horizontal and vertical polarities. The emissions are recorded and maximized as a function of azimuth by rotation through 360° with a spectrum analyzer in peak hold mode. Depending on the frequency band spanned a notch filter and waveguide filter was used to remove the fundamental frequency. The highest emissions relative to the limit are listed for each frequency spanned.

All measurements on any frequency or frequencies over 1 MHz are based on the use of measurement instrumentation employing an average detector function. All measurements above 1 GHz were performed using a minimum resolution bandwidth of 1 MHz.

Test Measurement Set up



Measurement set up for Radiated Emission Test

Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Loss, and subtracting Amplifier Gain from the measured reading. All factors are included in the reported data.

$$FS = R + AF + CORR - FO$$

where: FS = Field Strength

R = Measured Spectrum analyzer Input Amplitude

AF = Antenna Factor

CORR = Correction Factor = CL - AG + NFL

CL = Cable Loss

AG = Amplifier Gain

FO = Distance Falloff Factor

NFL = Notch Filter Loss or Waveguide Loss

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For example:

Given receiver input reading of 51.5 dB μ V; Antenna Factor of 8.5 dB; Cable Loss of 1.3 dB; Falloff Factor of 0 dB, an Amplifier Gain of 26 dB and Notch Filter Loss of 1 dB. The Field Strength of the measured emission is:

$$FS = 51.5 + 8.5 + 1.3 - 26.0 + 1 = 36.3 \text{ dB}\mu\text{V/m}$$

Conversion between dB μ V/m (or dB μ V) and μ V/m (or μ V) are done as:

$$\text{Level (dB}\mu\text{V/m)} = 20 * \text{Log} (\text{level (\mu V/m)})$$

$$40 \text{ dB}\mu\text{V/m} = 100 \mu\text{V/m}$$

$$48 \text{ dB}\mu\text{V/m} = 250 \mu\text{V/m}$$

Radio Parameters

Power: Maximum Power

Duty Cycle: 100%

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Radiated Spurious Emissions above 1 GHz

Ambient conditions.

Temperature: 17 to 23°C

Relative humidity: 31 to 57 %

Pressure: 999 to 1012 mbar

External 2 dBi Antenna

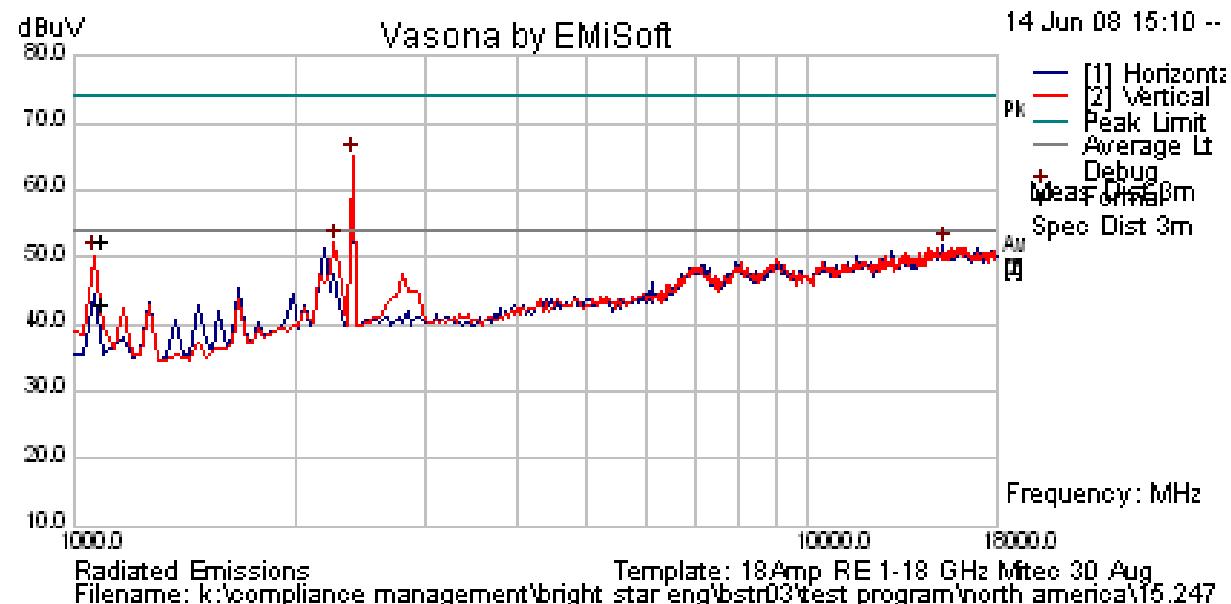
TABLE OF RESULTS – 802.11b – 1 Mb/s 2,412 MHz

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2413.052	79.98	32.96	-10.56	102.38	Peak Emission	V					N/A	Peak
1092.86	66.05	2.04	-15.6	52.50	Peak Max	V	110	10	74	-21.5	Pass	
1092.86	56.78	2.04	-15.6	43.22	Average Max	V	110	10	54	-10.78	Pass	
15240.48	44.46	8.15	-0.92	51.70	Peak [Scan]	H	100	0	82.38	-30.68	Pass	NRB
2330.842				51.26	Peak Max	V			74			Band-Edge
2383.908				40.01	Average Max	V			54			Band-Edge

Peak – Peak of the fundamental Emission i.e. carrier

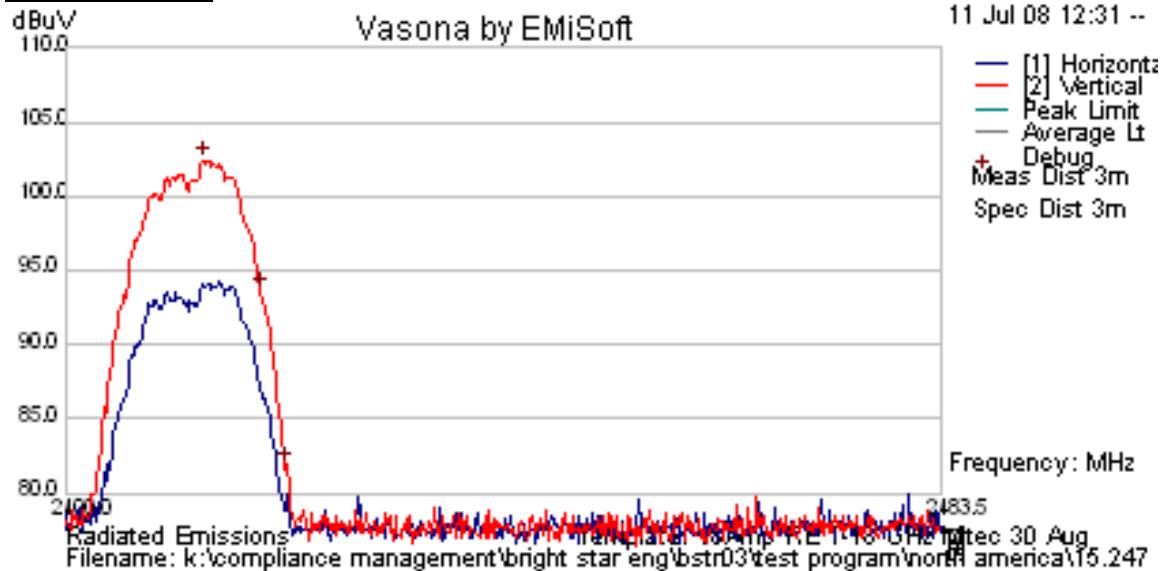
NRB – Non-restricted band emission (limit 20 dB down from peak emission)

The following plot identifies peak emissions only

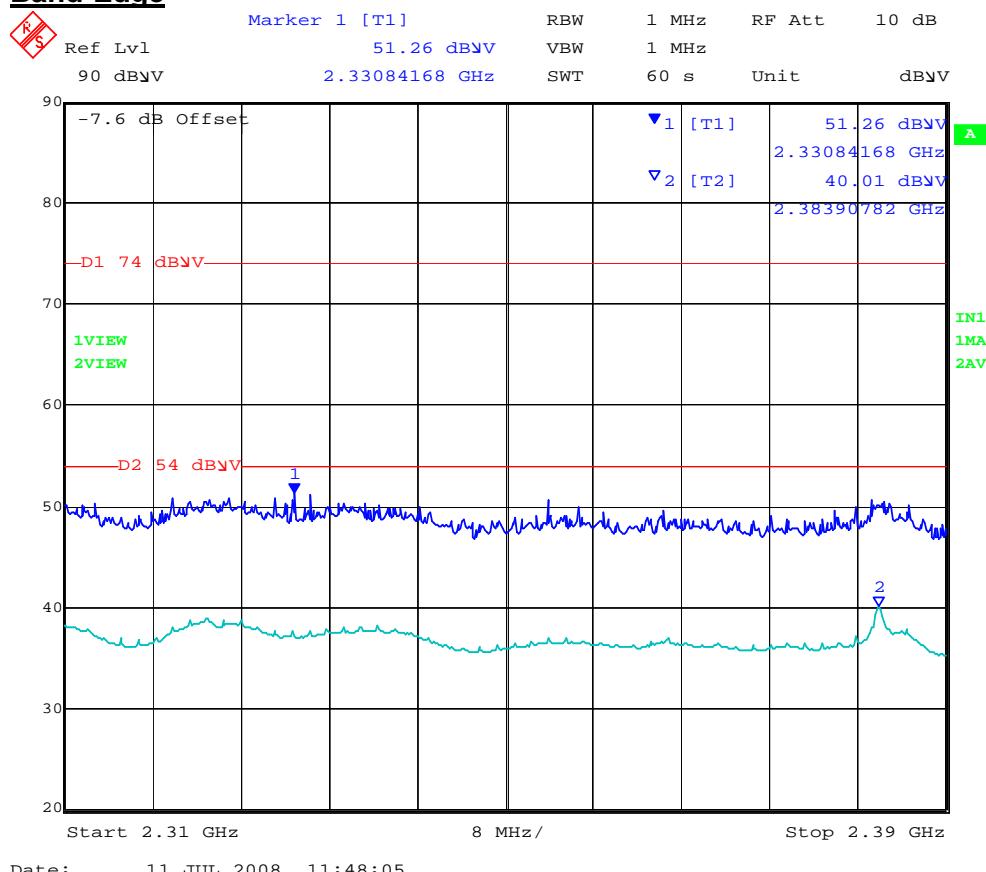


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Peak Emission



Band-Edge



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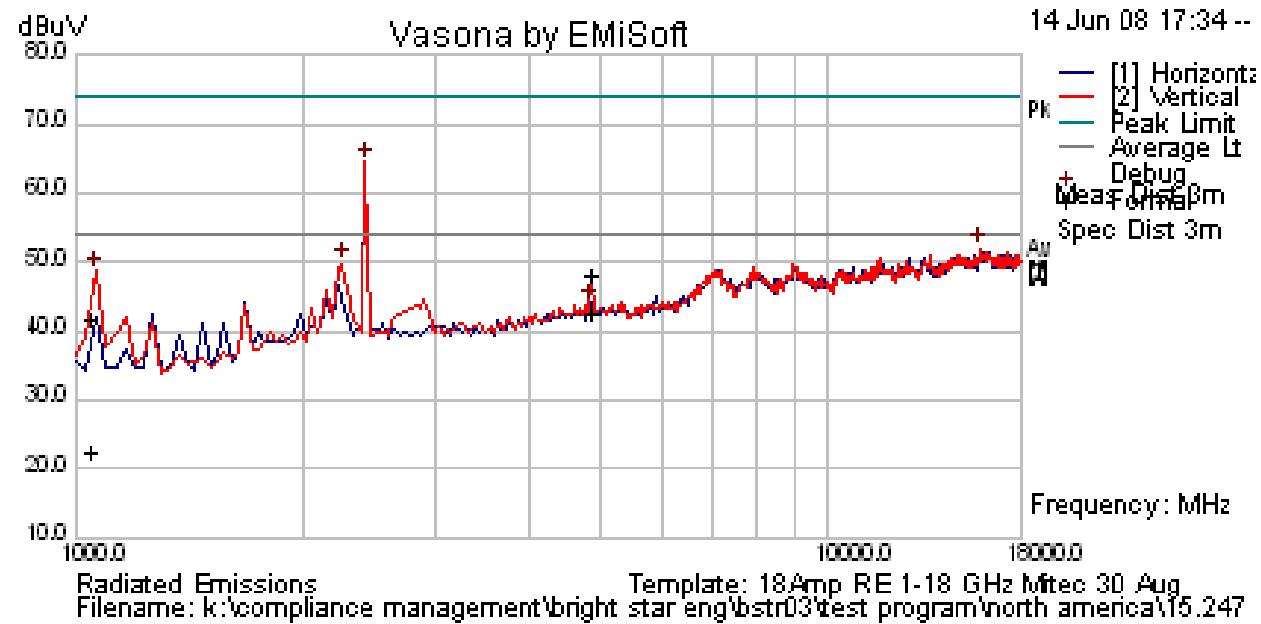
TABLE OF RESULTS – 802.11b – 1 Mb/s 2,437 MHz

External 2 dBi Antenna

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2435.977	80.24	32.97	-10.57	102.65	Peak [Scan]	V	100	0	54	48.65	N/A	Peak
1059.358	55.28	2.01	-15.65	41.64	Peak Max	V	102	188	74	-32.36	Pass	
4873.973	52.62	4.51	-8.75	48.38	Peak Max	V	98	269	74	-25.62	Pass	
1059.358	35.99	2.01	-15.65	22.35	Average Max	V	102	188	54	-31.65	Pass	
4873.973	47.06	4.51	-8.75	42.82	Average Max	V	98	269	54	-11.18	Pass	

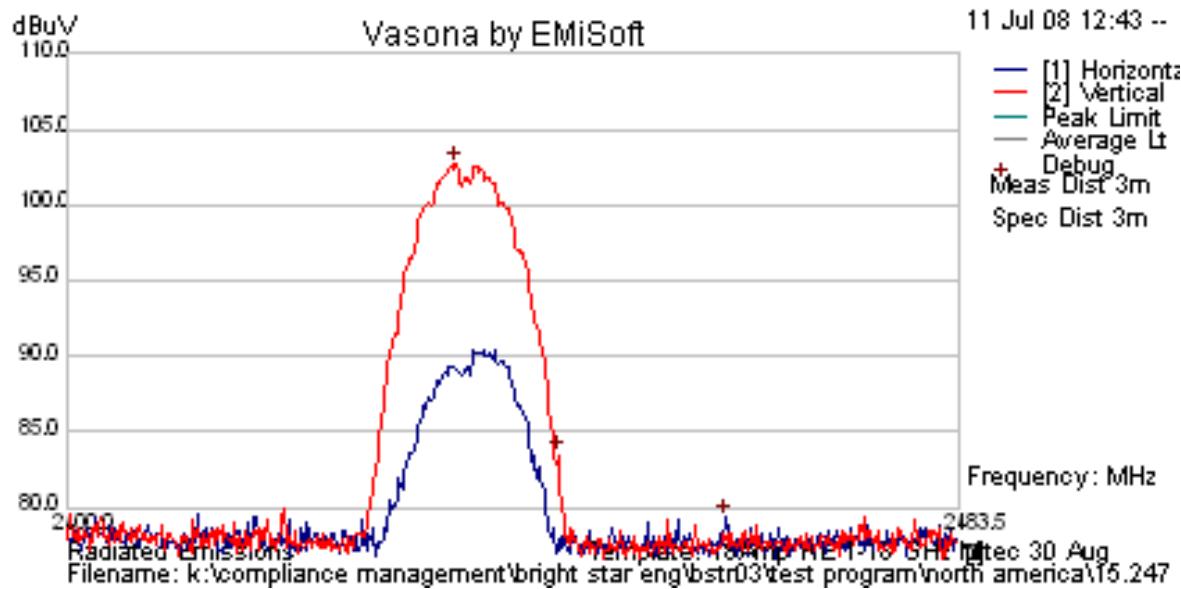
Peak – Peak of the fundamental Emission i.e. carrier

The following plot identifies peak emissions only



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Peak Emission



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TABLE OF RESULTS – 802.11b – 1 Mb/s 2,462 MHz

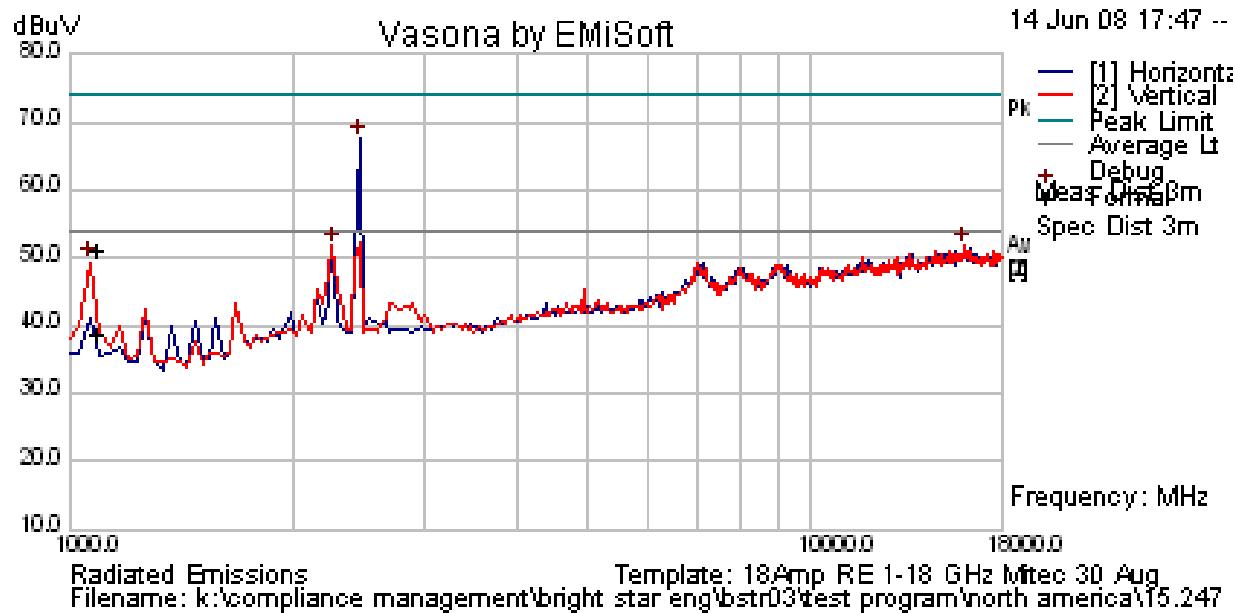
External 2 dBi Antenna

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2413.052	79.98	32.96	-10.56	102.38	Peak Emission	V					N/A	Peak
1092.86	66.05	2.04	-15.6	52.50	Peak Max	V	110	10	74	-21.5	Pass	
1092.86	56.78	2.04	-15.6	43.22	Average Max	V	110	10	54	-10.78	Pass	
15240.48	44.46	8.15	-0.92	51.70	Peak [Scan]	H	100	0	82.38	-30.68	Pass	NRB
2483.5				48.24	Peak Max	V			74	-25.76	Pass	Band-Edge
2483.5				36.98	Average Max	V			54	-17.02	Pass	Band-Edge

Peak – Peak of the fundamental Emission i.e. carrier

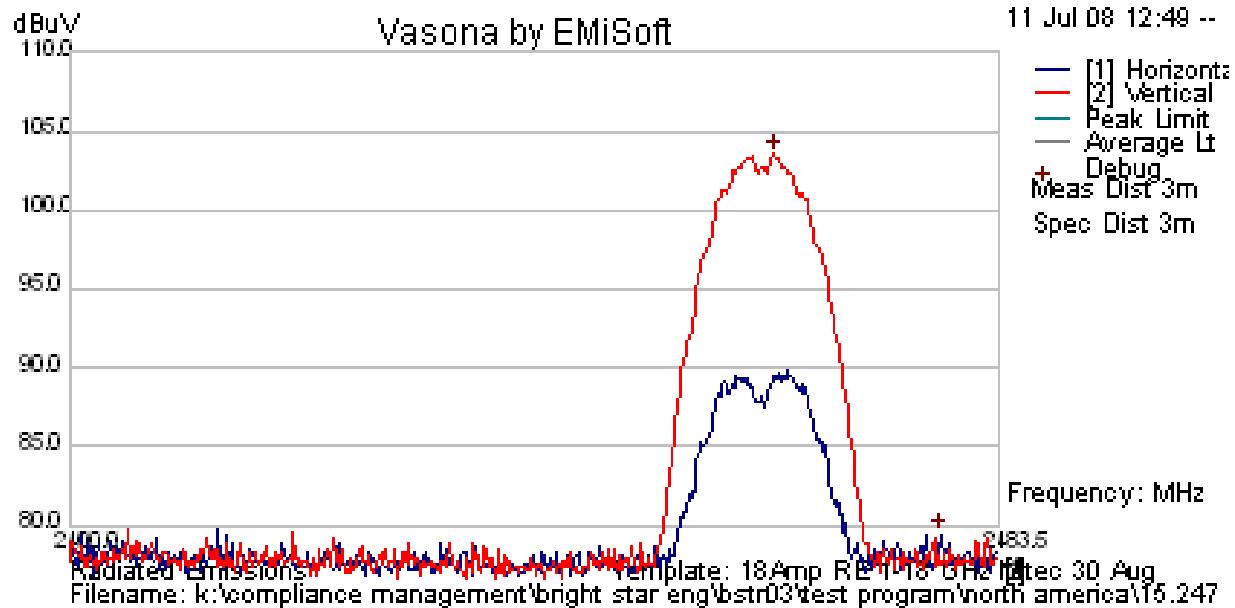
NRB – Non-restricted band emission (limit 20 dB down from peak emission)

The following plot identifies peak emissions only

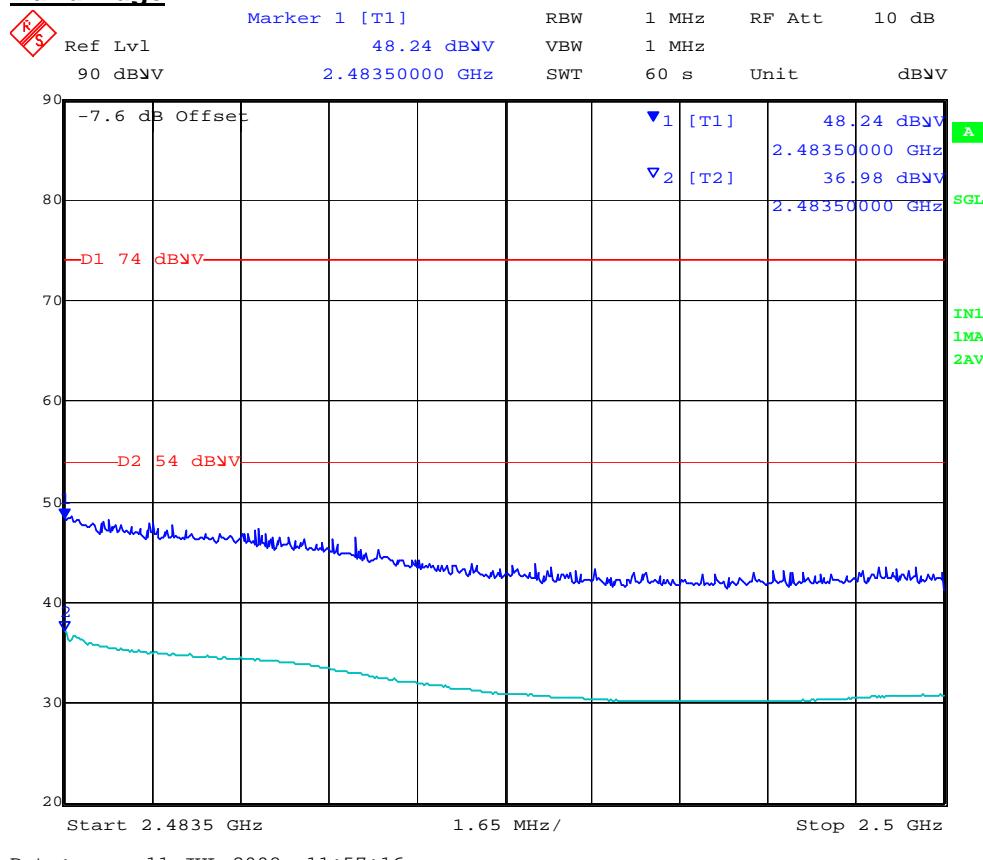


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Peak Emission



Band-Edge



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802.11g Results

External 2 dBi Antenna

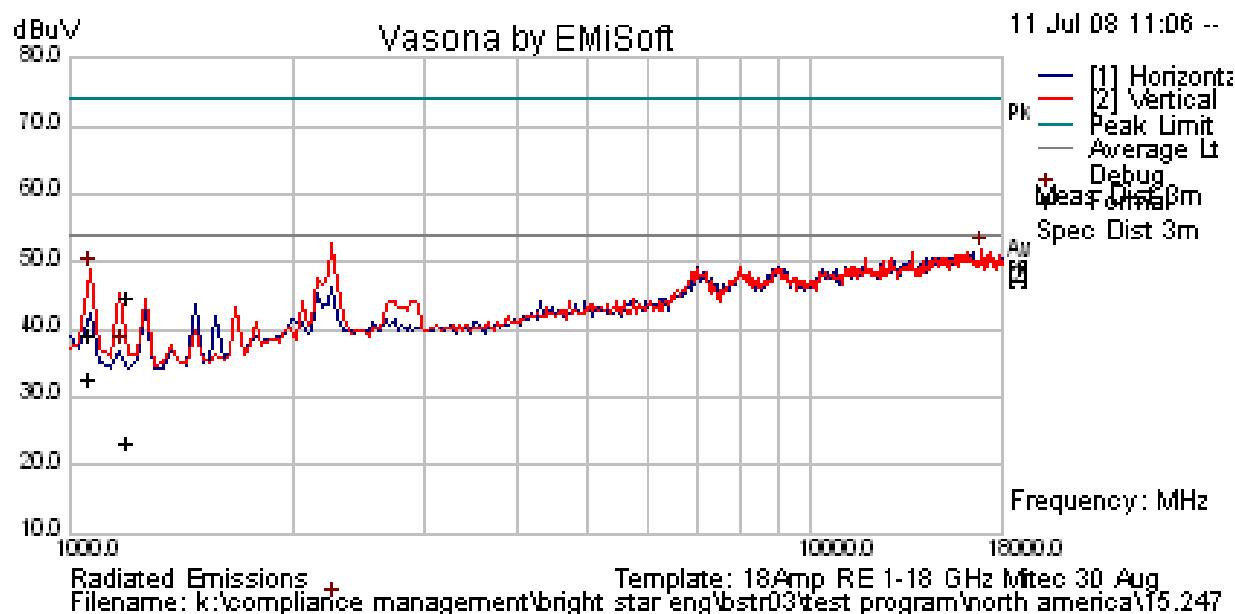
TABLE OF RESULTS – 802.11g – 6 Mb/s 2,412 MHz

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2405.355	80.75	32.96	-10.56	103.14	Peak [Scan]	V	100				N/A	Peak
1067.927	52.62	2.02	-15.64	39	Peak Max	H	133	302	74	-35	Pass	
1192.724	57.73	2.13	-15.31	44.56	Peak Max	V	98	131	74	-29.44	Pass	
1067.927	46.2	2.02	-15.64	32.58	Average Max	H	133	302	54	-21.42	Pass	
1192.724	36.29	2.13	-15.31	23.11	Average Max	V	98	131	54	-30.89	Pass	
2330.842				51.53	Peak Max	V			74	-22.47	Pass	Band-Edge
2383.908				39.54	Average Max	V			54	-14.46		Band-Edge

Peak – Peak of the fundamental Emission i.e. carrier

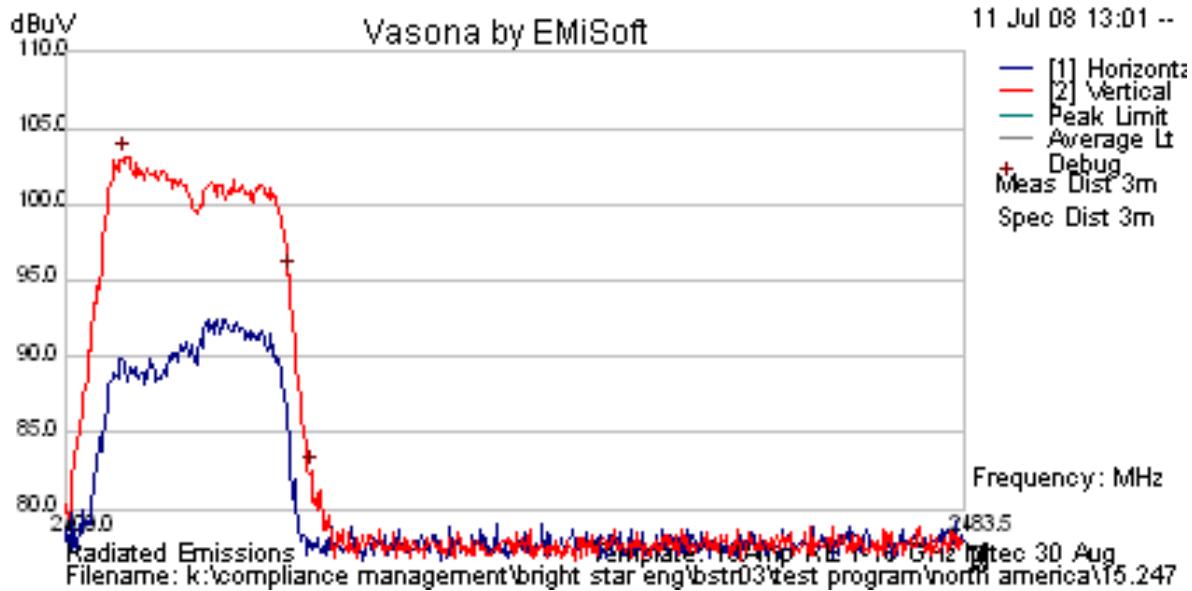
NRB – Non-restricted band emission (limit 20 dB down from peak emission)

The following plot identifies peak emissions only

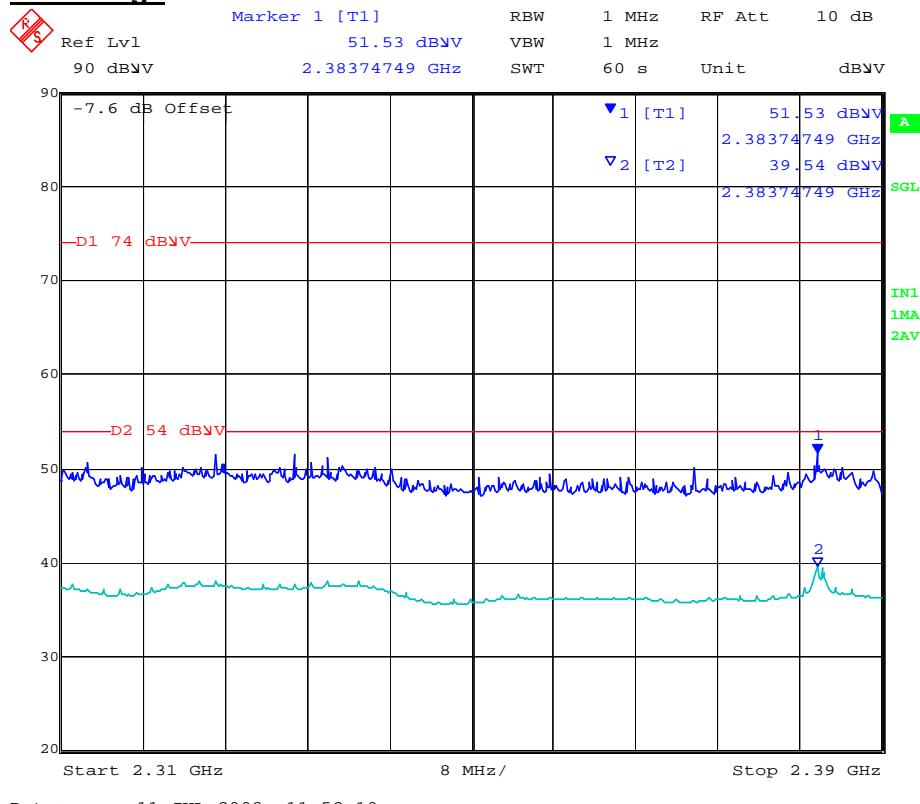


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Peak Emission



Band-Edge



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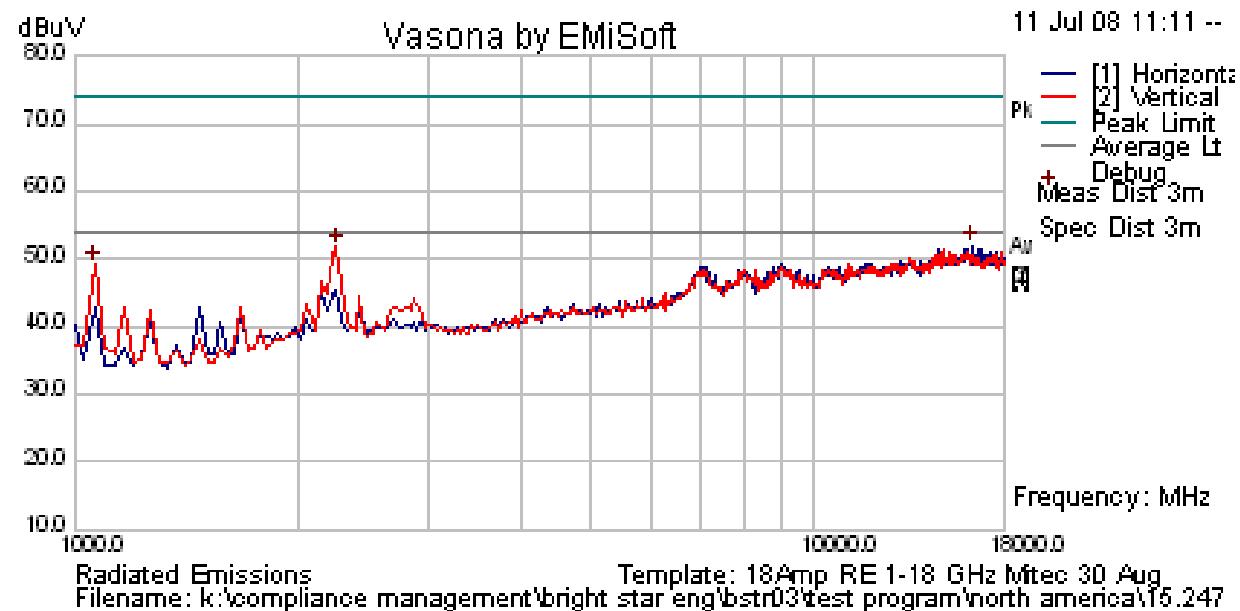
TABLE OF RESULTS – 802.11g – 6 Mb/s 2,437 MHz

External 2 dBi Antenna

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2444.009	78.71	32.97	-10.57	101.11	Peak [Scan]	V					N/A	Peak
1192.635	56.53	2.13	-15.31	43.36	Peak Max	V	98	131	74	-30.64	Pass	
1192.635	36.59	2.13	-15.31	23.41	Average Max	V	98	131	54	-30.59	Pass	

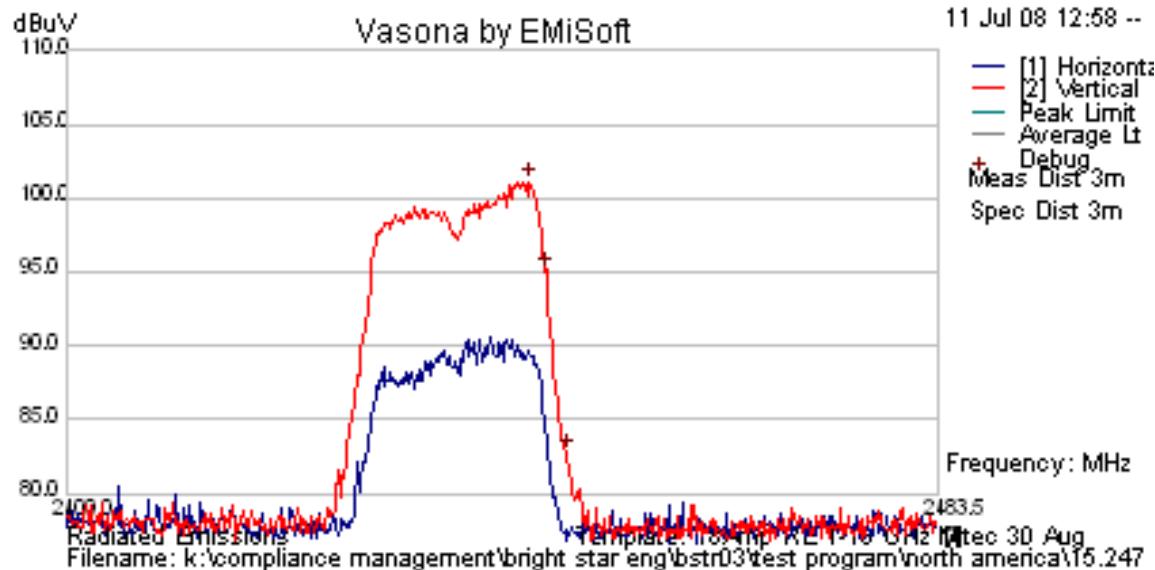
Peak – Peak of the fundamental Emission i.e. carrier

The following plot identifies peak emissions only

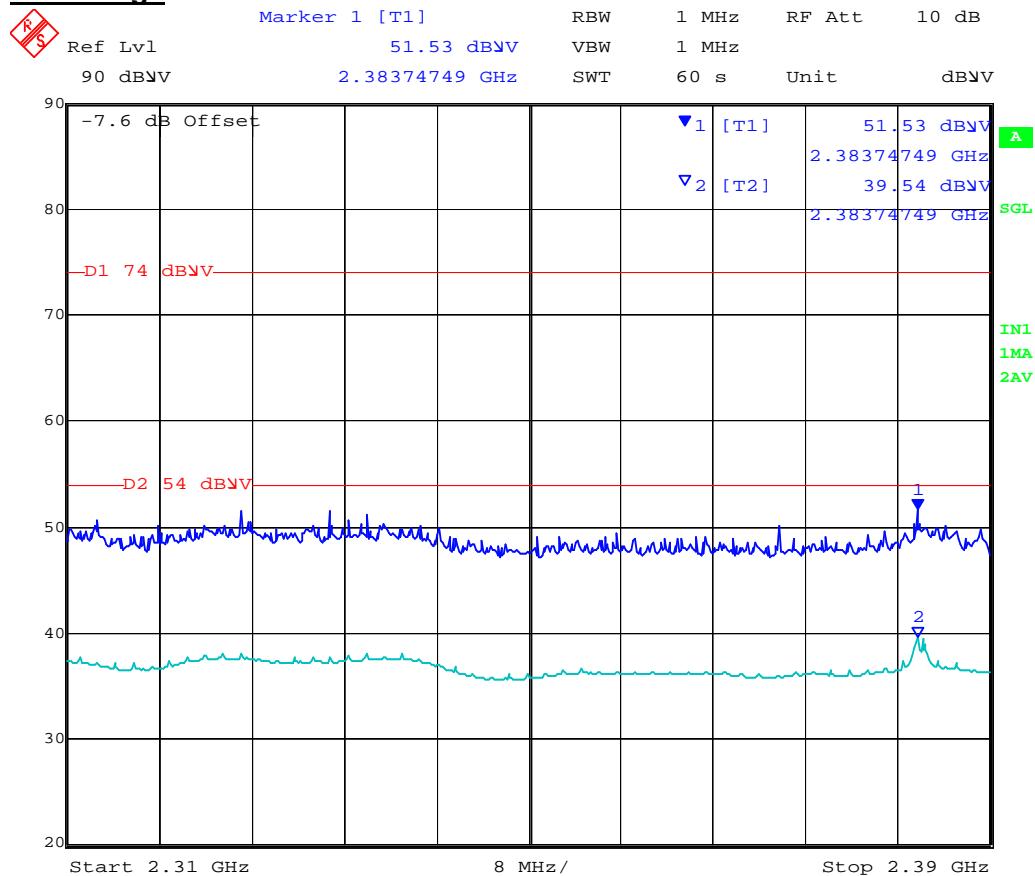


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Peak Emission



Band-Edge



Date: 11.JUL.2008 11:52:10

TABLE OF RESULTS – 802.11g – 6 Mb/s 2,462 MHz

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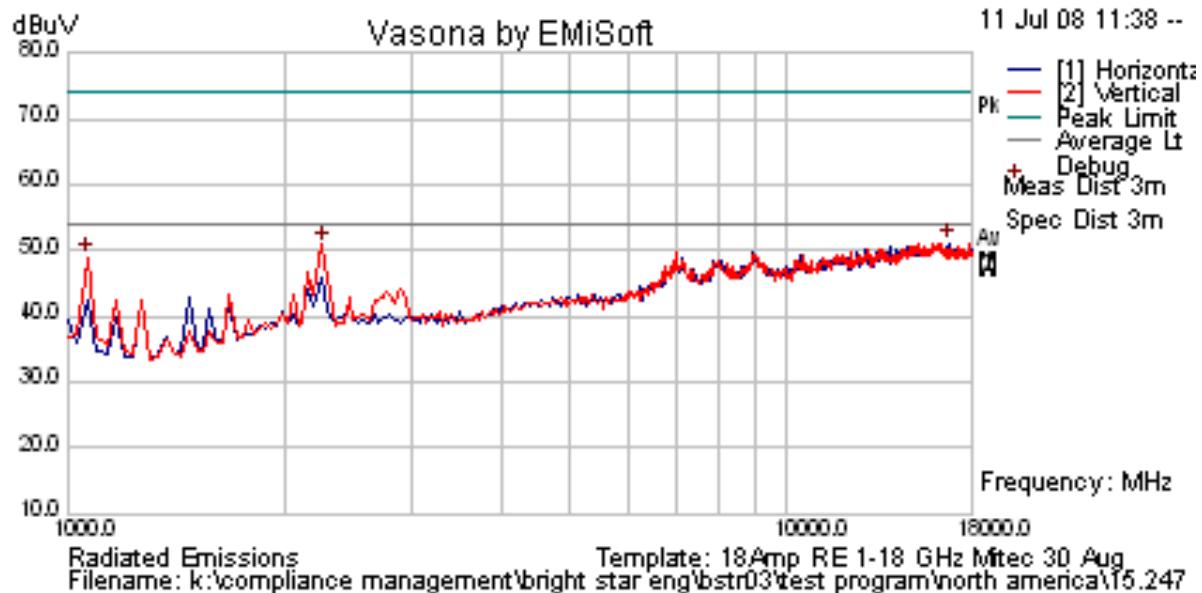
External 2 dBi Antenna

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2466.767	78.13	32.99	-10.59	100.53	Peak [Scan]	V					N/A	Peak
16807.62	42.94	8.6	-0.44	51.1	Peak [Scan]	H	100	0	54	-2.9	Pass	
1068.136	62.58	2.02	-15.64	48.96	Peak [Scan]	V	100	0	54	-5.04	Pass	
2483.5				56.29	Peak Max	V			74	-17.71	Pass	Band-Edge
2483.5				38.89	Average Max	V			54	-15.11	Pass	Band-Edge

Peak – Peak of the fundamental Emission i.e. carrier

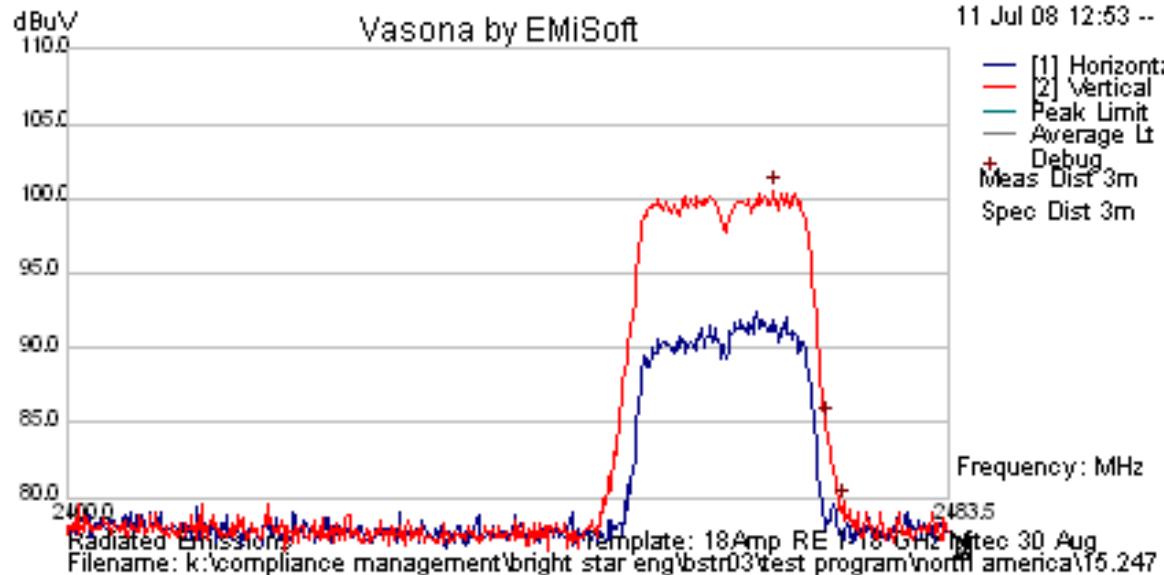
NRB – Non-restricted band emission (limit 20 dB down from peak emission)

The following plot identifies peak emissions only

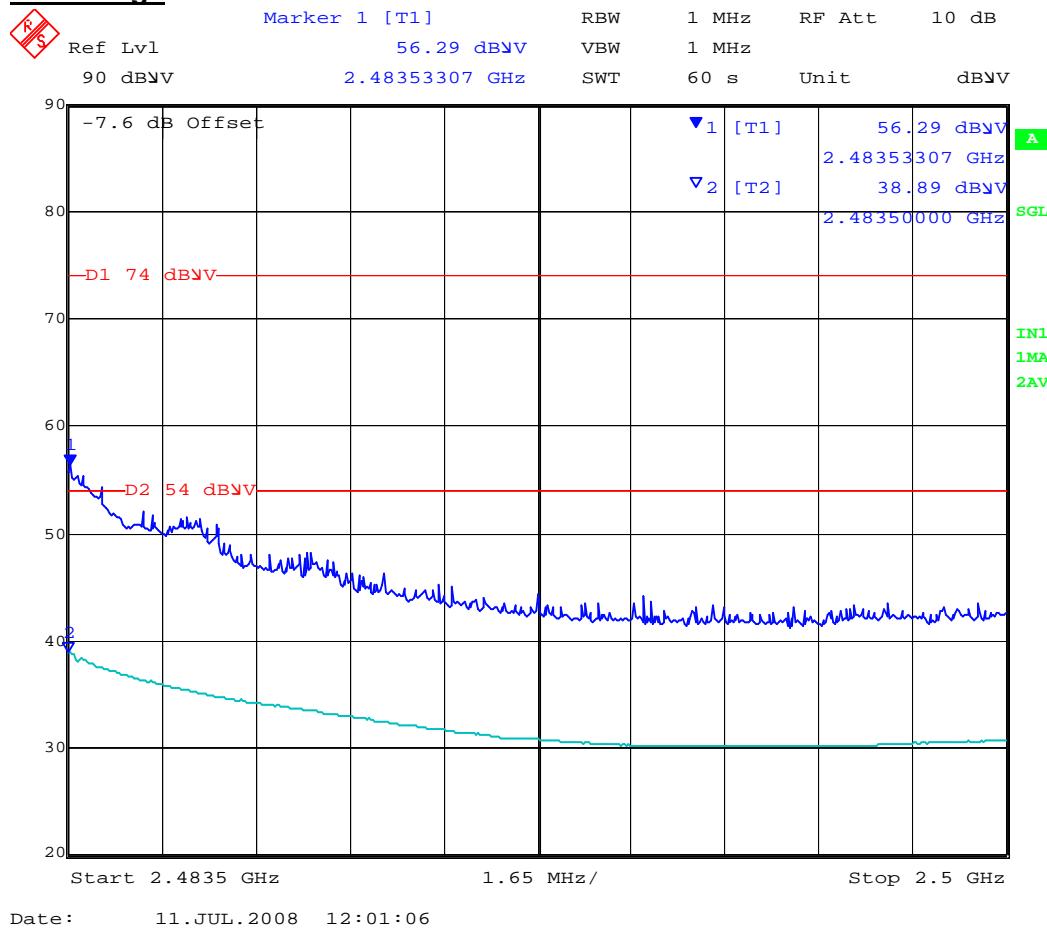


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Peak Emission



Band-Edge



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Integral Antenna Results

Integral Antenna

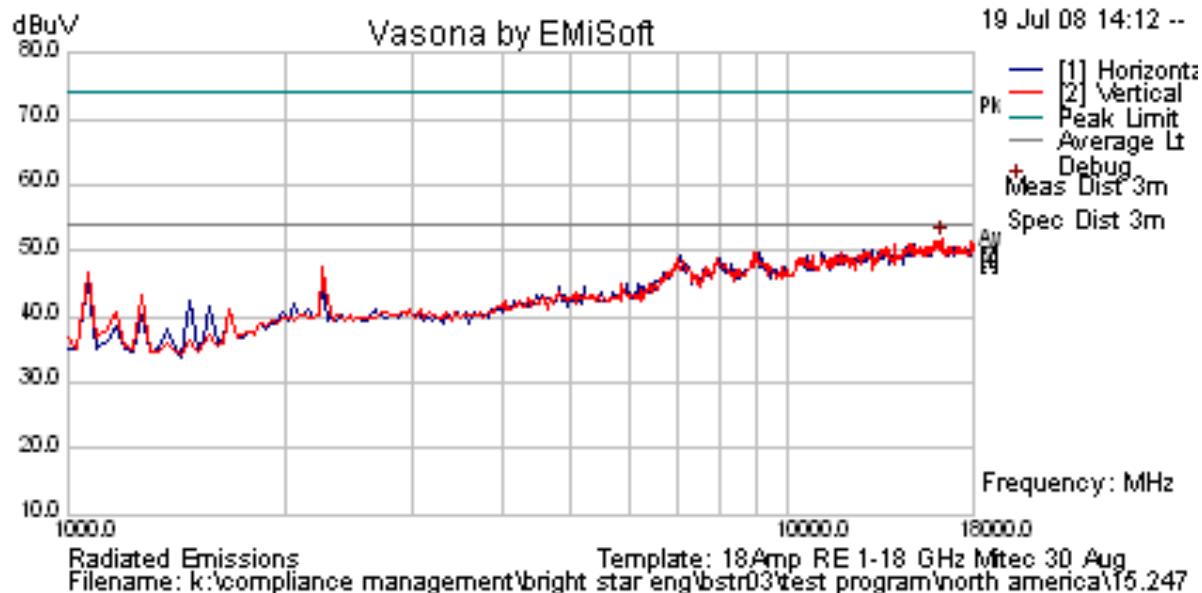
TABLE OF RESULTS – 802.11b – 1 Mb/s 2,412 MHz

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2411.044	45.97	22.96	32.35	101.28	Peak [Scan]	V					N/A	Peak
1092.86	61.05	2.04	-15.6	47.50	Peak Max	V	110	10	74	-26.5	Pass	
1092.86	51.78	2.04	-15.6	38.22	Average Max	V	110	10	54	-15.78	Pass	
2330.842			50.67	51.26	Peak Max	V			74	-22.74	Pass	Band-Edge
2383.908			39.82	40.01	Average Max	V			54	-13.99	Pass	Band-Edge

Peak – Peak of the fundamental Emission i.e. carrier

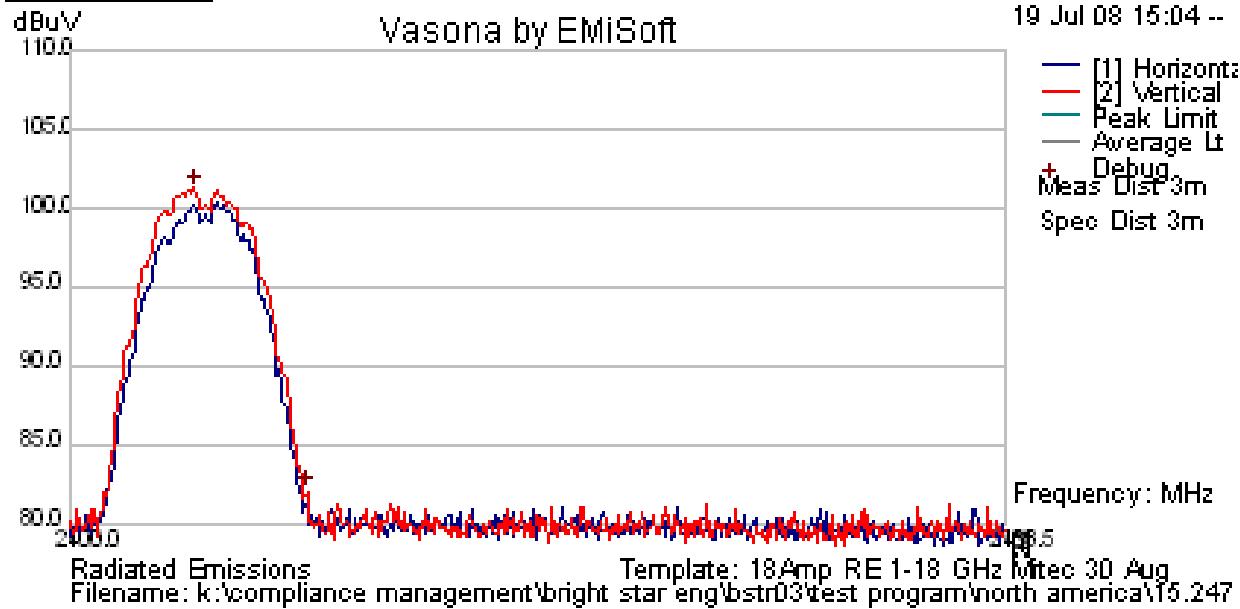
NRB – Non-restricted band emission (limit 20 dB down from peak emission)

The following plot identifies peak emissions only

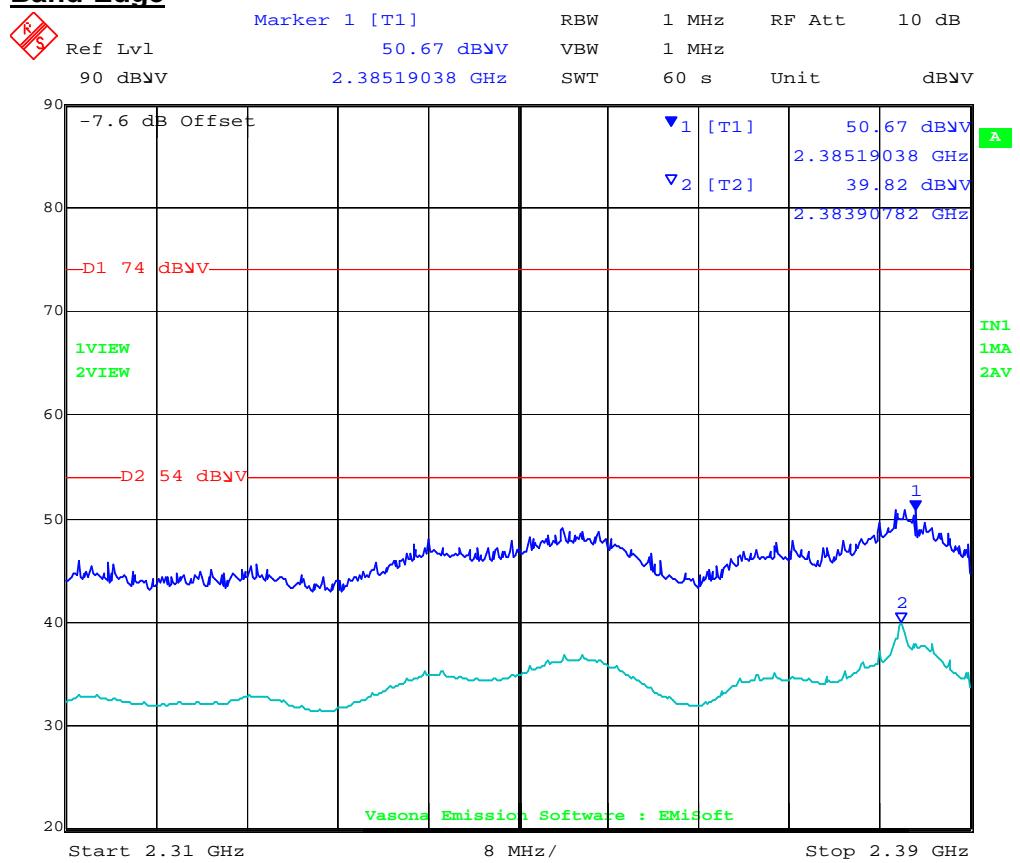


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Peak Emission



Band-Edge



Date: 19.JUL.2008 15:26:46

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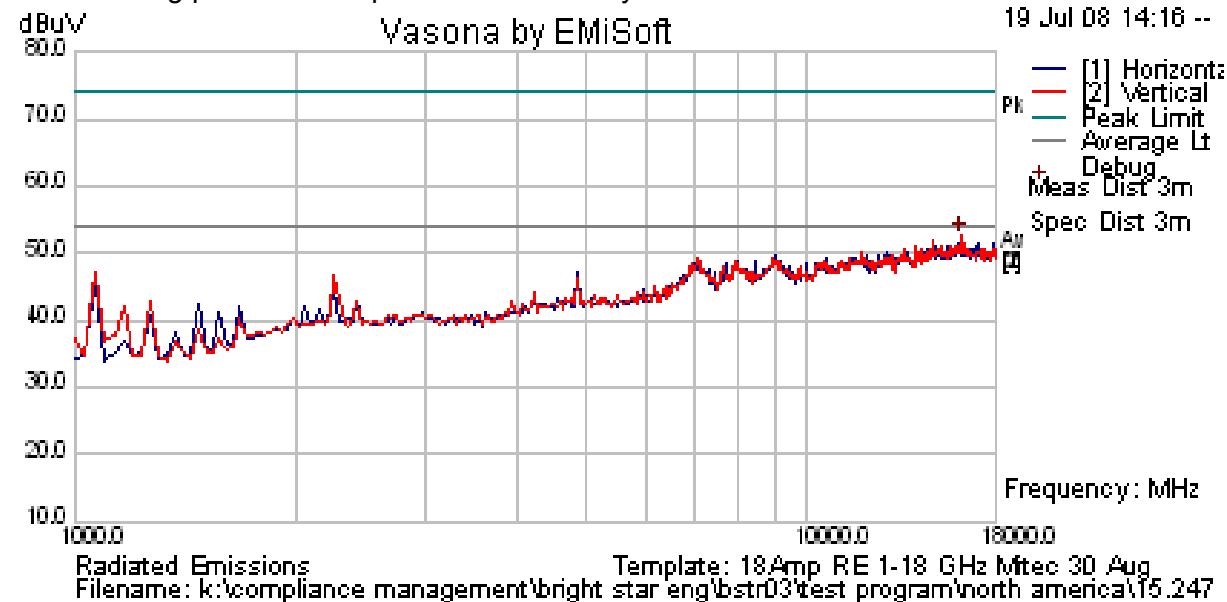
TABLE OF RESULTS – 802.11b – 1 Mb/s 2,437 MHz

Integral Antenna

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2435.977	80.24	32.97	-10.57	102.65	Peak [Scan]	V					N/A	Peak
1092.86	61.05	2.04	-15.6	47.50	Peak Max	V	110	10	74	-26.5	Pass	
1092.86	51.78	2.04	-15.6	38.22	Average Max	V	110	10	54	-15.78	Pass	

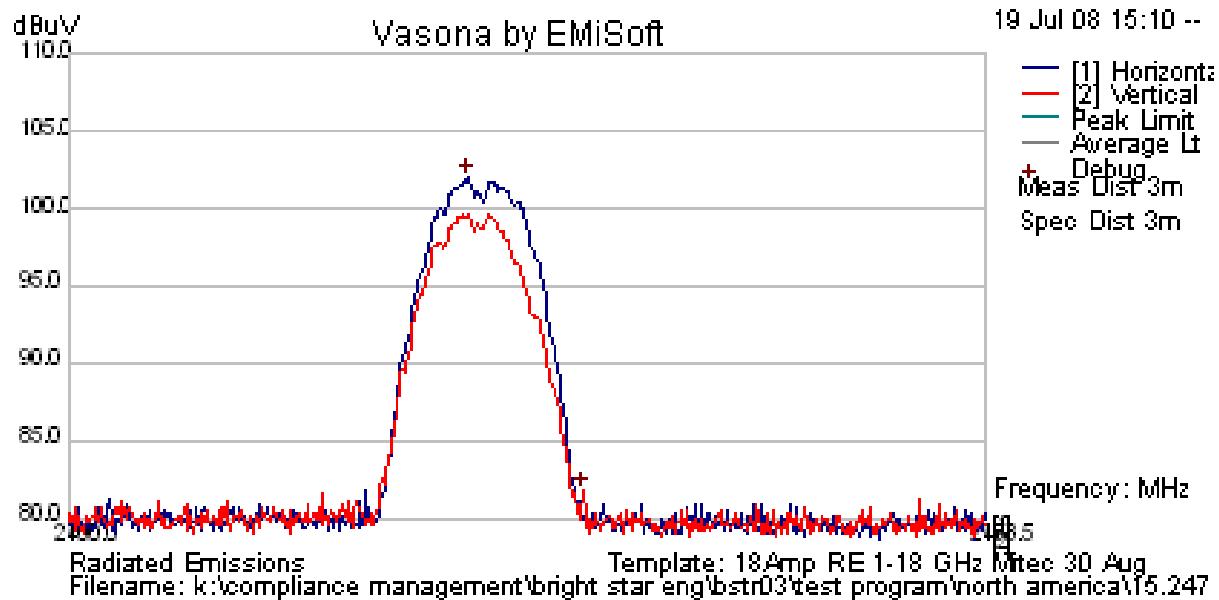
Peak – Peak of the fundamental Emission i.e. carrier

The following plot identifies peak emissions only



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Peak Emission



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TABLE OF RESULTS – 802.11b – 1 Mb/s 2,462 MHz

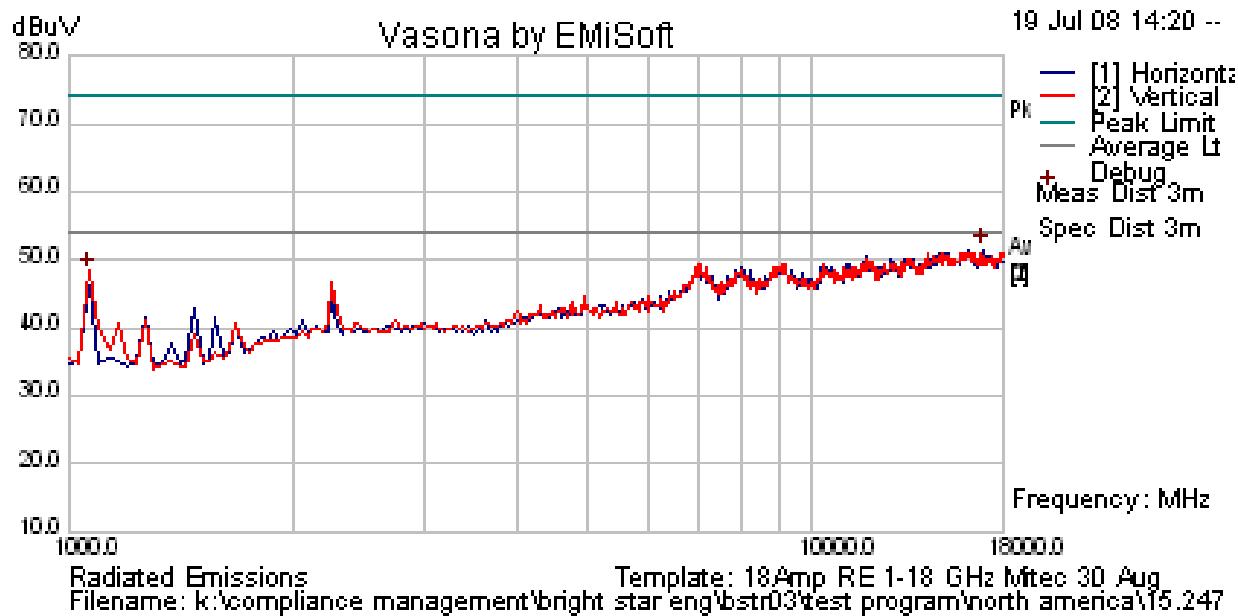
Integral Antenna

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2463.085	44.21	22.98	32.38	99.57	Peak [Scan]						N/A	Peak
1068.12	63.05	2.04	-15.6	49.50	Peak Max	V	110	10	74	-24.5	Pass	
1068.12	53.78	2.04	-15.6	40.22	Average Max	V	110	10	54	-13.78	Pass	
2483.5				44.83	Peak Max	V			74	-29.17	Pass	Band-Edge
2483.5				32.28	Average Max	V			54	-21.72	Pass	Band-Edge

Peak – Peak of the fundamental Emission i.e. carrier

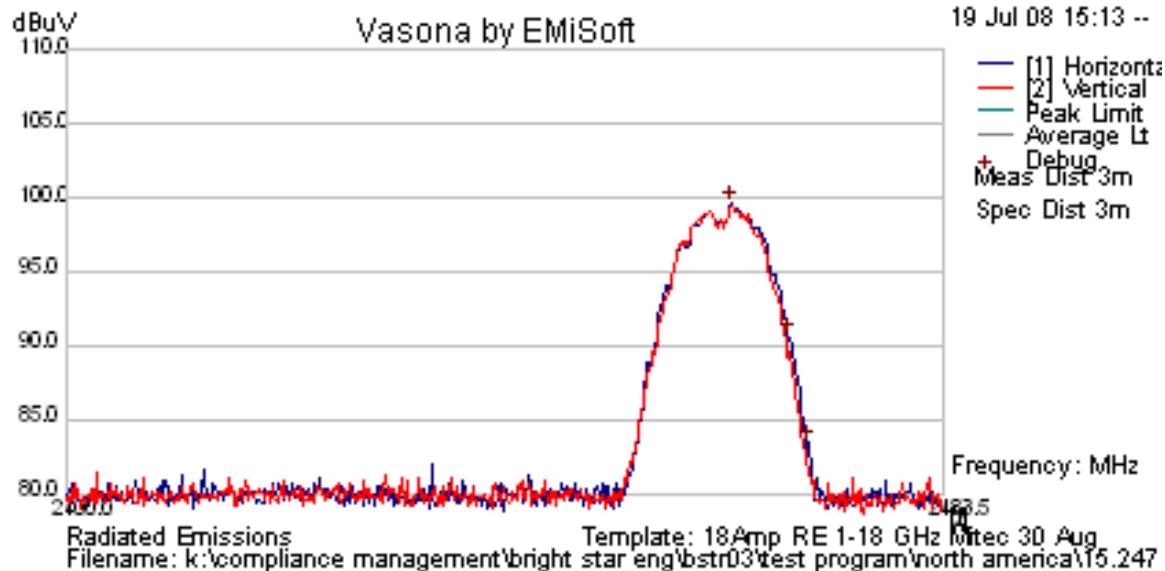
NRB – Non-restricted band emission (limit 20 dB down from peak emission)

The following plot identifies peak emissions only

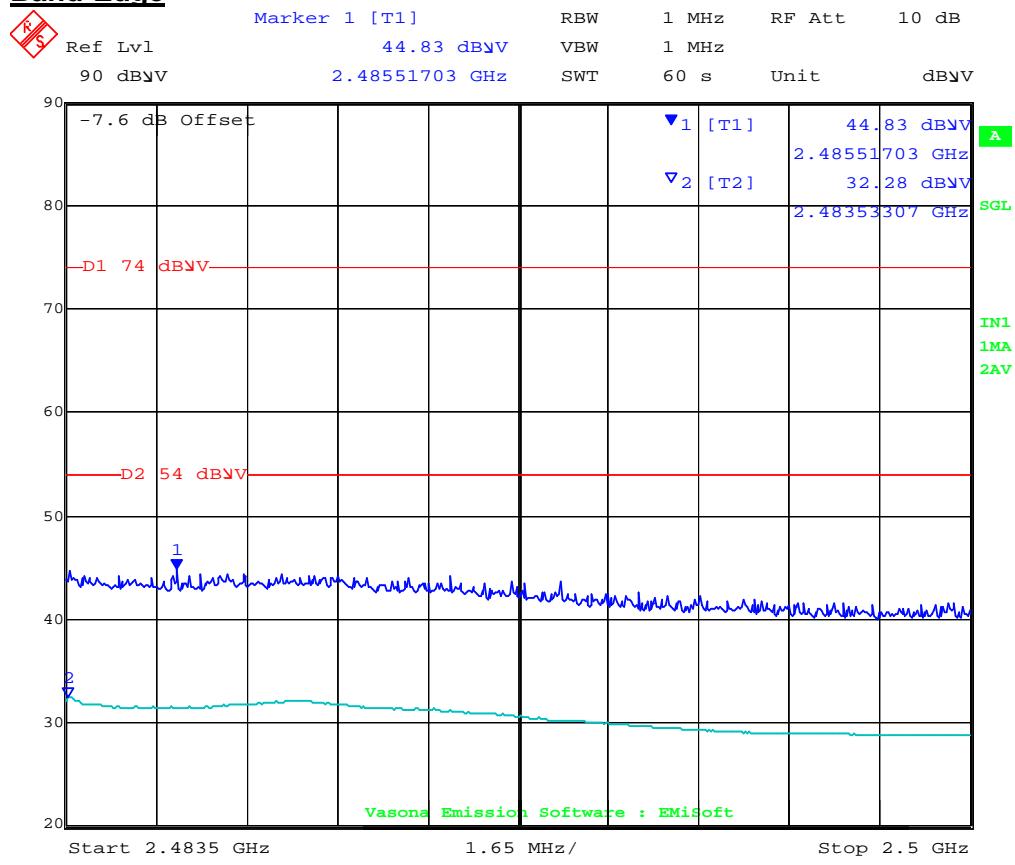


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Peak Emission



Band-Edge



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802.11g Results

Integral Antenna

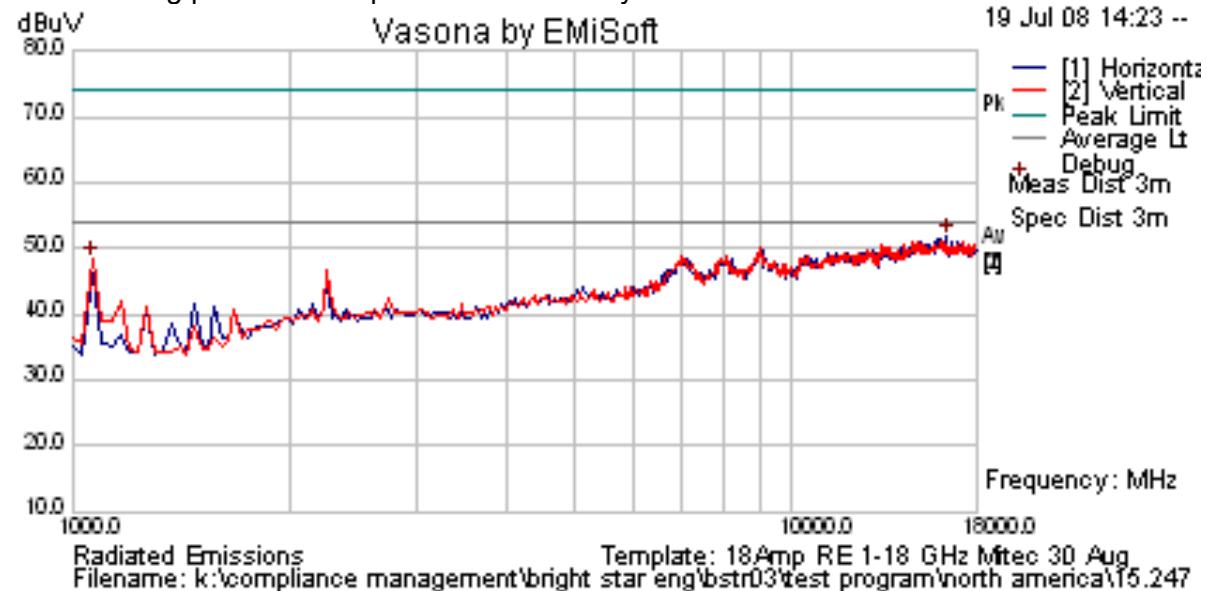
TABLE OF RESULTS – 802.11g – 6 Mb/s 2,412 MHz

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2406.359	45.01	22.96	32.35	100.31	Peak [Scan]	V					N/A	Peak
1067.927	52.62	2.02	-15.64	39.00	Peak Max	H	133	302	74	-35.00	Pass	
1067.927	46.2	2.02	-15.64	32.58	Average Max	H	133	302	54	-21.42	Pass	
2389.078				50.60	Peak Max	V			74	-23.40	Pass	Band-Edge
2383.908				39.09	Average Max	V			54	-14.91	Pass	Band-Edge

Peak – Peak of the fundamental Emission i.e. carrier

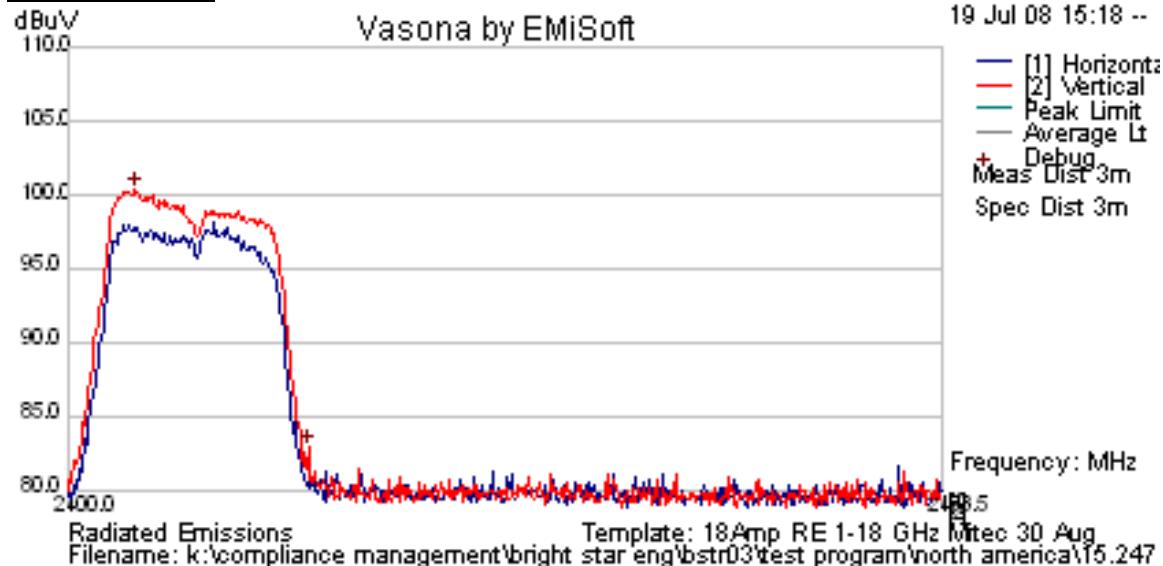
NRB – Non-restricted band emission (limit 20 dB down from peak emission)

The following plot identifies peak emissions only

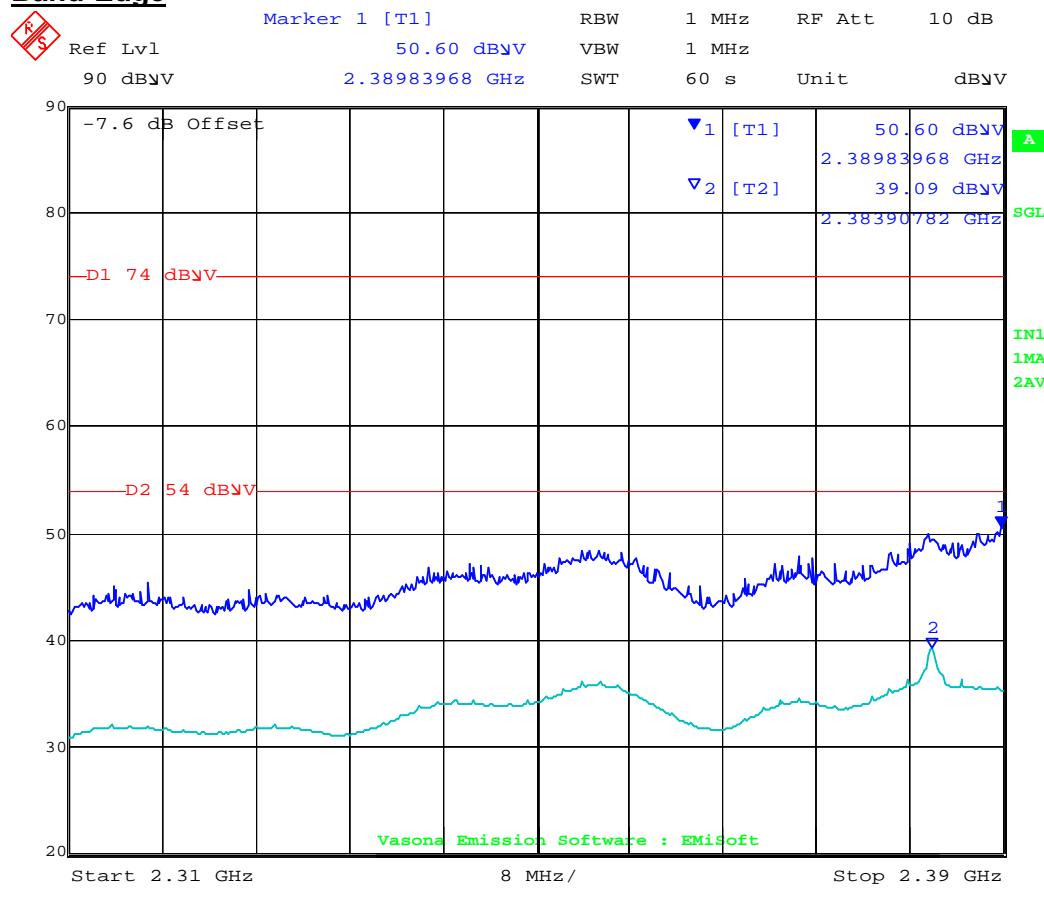


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Peak Emission



Band-Edge



Date: 19.JUL.2008 15:30:08

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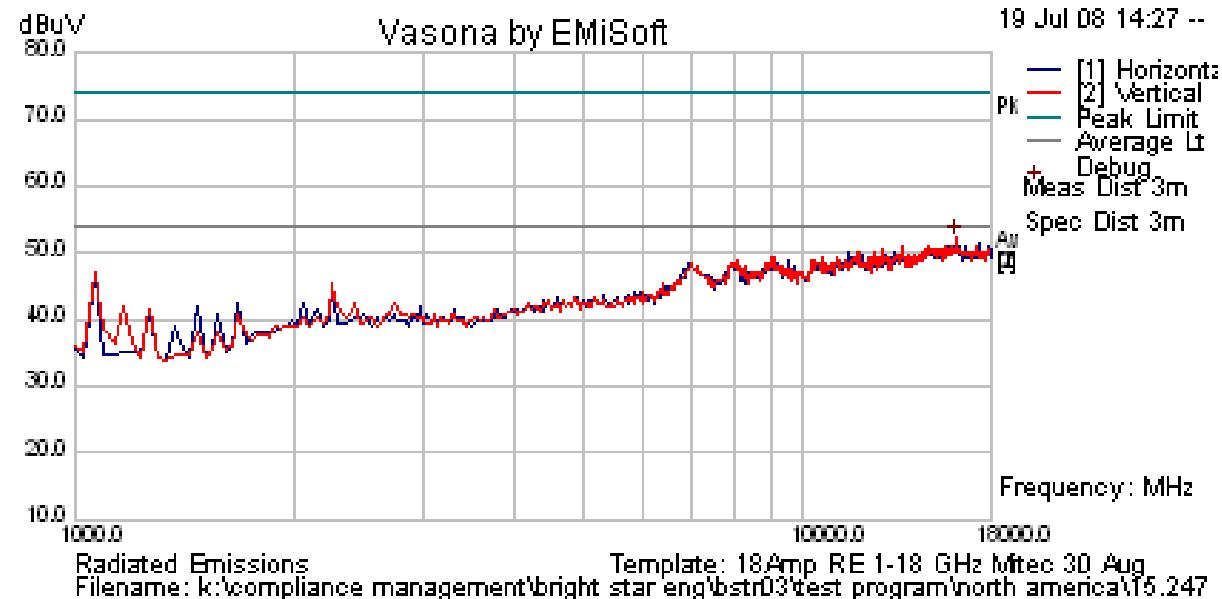
TABLE OF RESULTS – 802.11g – 6 Mb/s 2,437 MHz

Integral Antenna

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2440.328	44.54	22.97	32.37	99.88	Peak [Scan]	H					N/A	Peak
1092.86	61.05	2.04	-15.6	47.50	Peak Max	V	110	10	74	-26.5	Pass	
1092.86	51.78	2.04	-15.6	38.22	Average Max	V	110	10	54	-15.78	Pass	

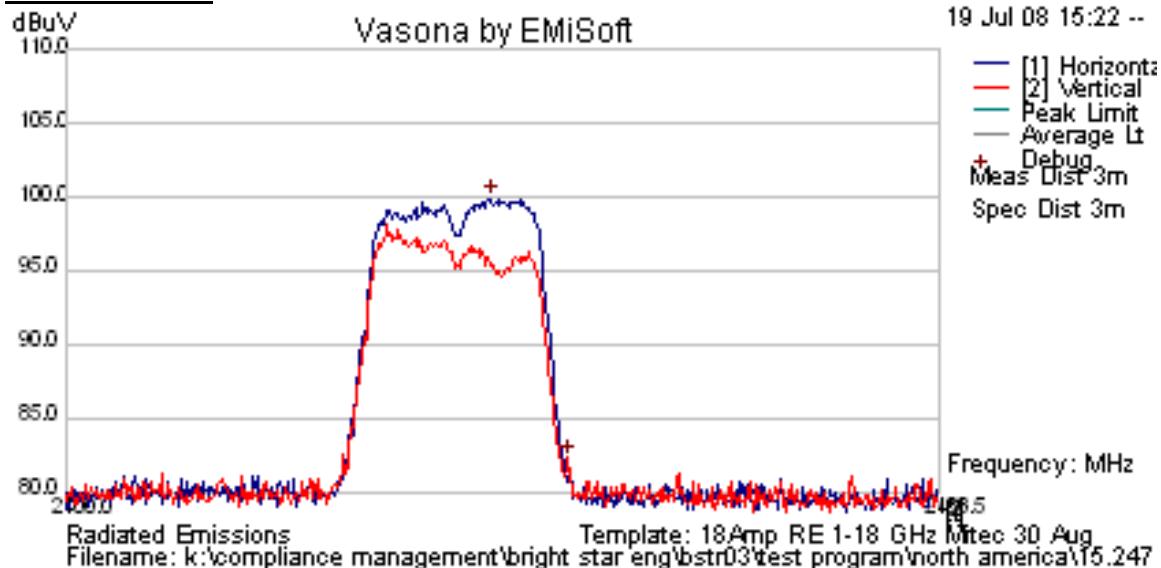
Peak – Peak of the fundamental Emission i.e. carrier

The following plot identifies peak emissions only



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Peak Emission



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TABLE OF RESULTS – 802.11g – 6 Mb/s 2,462 MHz

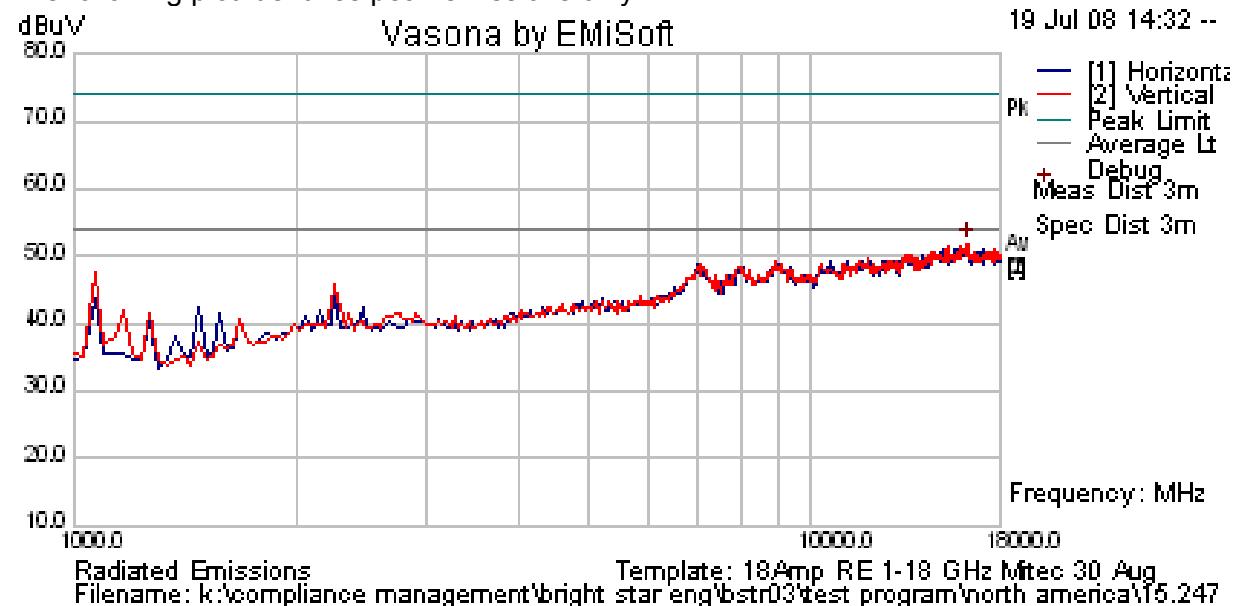
Integral Antenna

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2469.277	42.83	22.99	32.38	98.2	Peak [Scan]	H					N/A	Peak
1068.136	42.94	8.6	-0.44	51.1	Peak [Scan]	H	100	0	54	-2.9	Pass	
1068.136	62.58	2.02	-15.64	48.96	Peak [Scan]	V	100	0	54	-5.04	Pass	
2483.5				48.24	Peak Max	V			74	-25.76	Pass	Band-Edge
2483.5				33.12	Average Max	V			54	-20.88	Pass	Band-Edge

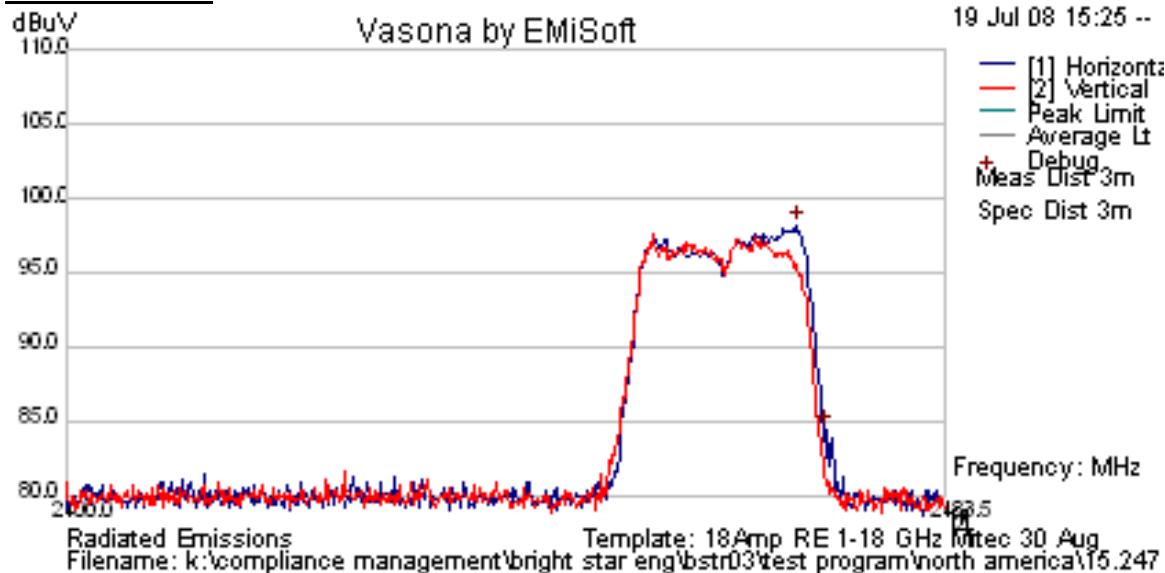
Peak – Peak of the fundamental Emission i.e. carrier

NRB – Non-restricted band emission (limit 20 dB down from peak emission)

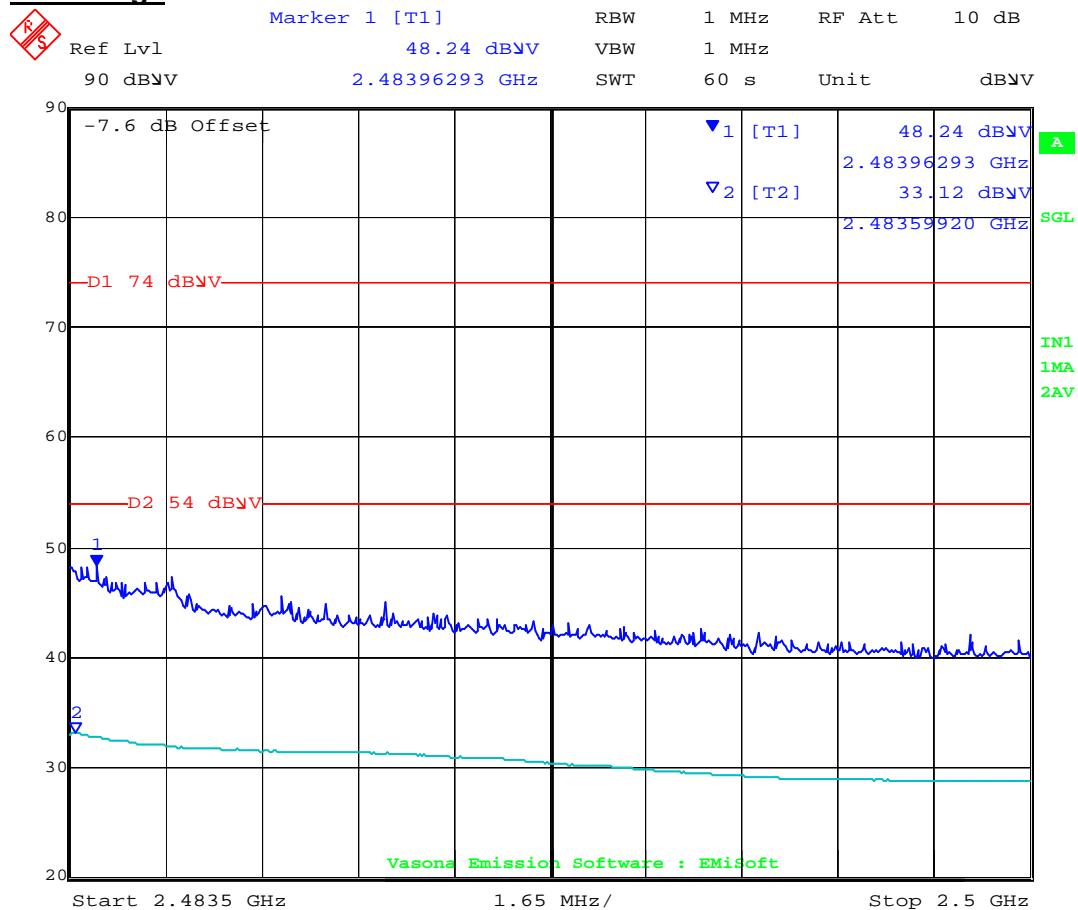
The following plot identifies peak emissions only



Peak Emission



Band-Edge



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5.1.6.2. Receiver Radiated Spurious Emissions (above 1 GHz)

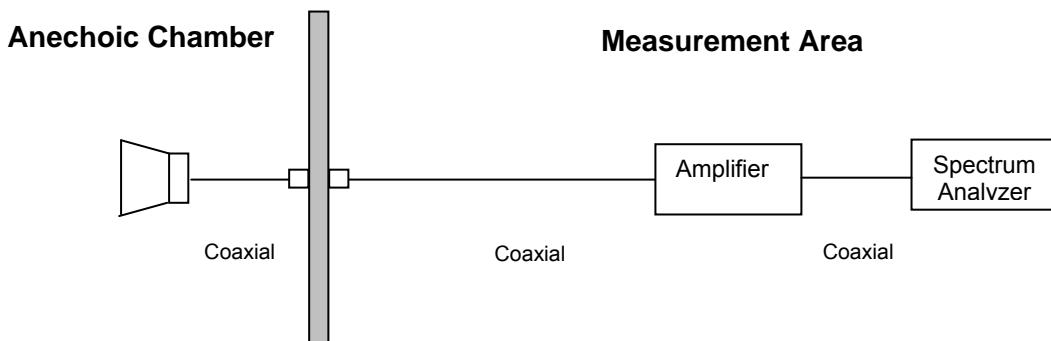
Industry Canada RSS-Gen §4.8, §6

Test Procedure

Radiated emissions above 1 GHz are measured in the anechoic chamber at a 3-meter distance on every azimuth in both horizontal and vertical polarities. The emissions are recorded and maximized as a function of azimuth by rotation through 360° with a spectrum analyzer in peak hold mode. Depending on the frequency band spanned a notch filter and waveguide filter was used to remove the fundamental frequency. The highest emissions relative to the limit are listed for each frequency spanned.

All measurements on any frequency or frequencies over 1 MHz are based on the use of measurement instrumentation employing an average detector function. All measurements above 1 GHz were performed using a minimum resolution bandwidth of 1 MHz.

Test Measurement Set up



Measurement set up for Radiated Emission Test

Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Loss, and subtracting Amplifier Gain from the measured reading. All factors are included in the reported data.

$$FS = R + AF + CORR - FO$$

where: FS = Field Strength

R = Measured Spectrum analyzer Input Amplitude

AF = Antenna Factor

CORR = Correction Factor = CL - AG + NFL

CL = Cable Loss

AG = Amplifier Gain

FO = Distance Falloff Factor

NFL = Notch Filter Loss or Waveguide Loss



Title: Bright Star Engineering VCI Pod
To: FCC 47 CFR Part15.247 & IC RSS-210
Serial #: BTSR03-A2 Rev A
Issue Date: 29th July '08
Page: 94 of 110

For example:

Given receiver input reading of 51.5 dB μ V; Antenna Factor of 8.5 dB; Cable Loss of 1.3 dB; Falloff Factor of 0 dB, an Amplifier Gain of 26 dB and Notch Filter Loss of 1 dB. The Field Strength of the measured emission is:

$$FS = 51.5 + 8.5 + 1.3 - 26.0 + 1 = 36.3 \text{ dB}\mu\text{V/m}$$

Conversion between dB μ V/m (or dB μ V) and μ V/m (or μ V) are done as:

$$\text{Level (dB}\mu\text{V/m)} = 20 * \text{Log} (\text{level (\mu V/m)})$$

$$40 \text{ dB}\mu\text{V/m} = 100 \mu\text{V/m}$$

$$48 \text{ dB}\mu\text{V/m} = 250 \mu\text{V/m}$$

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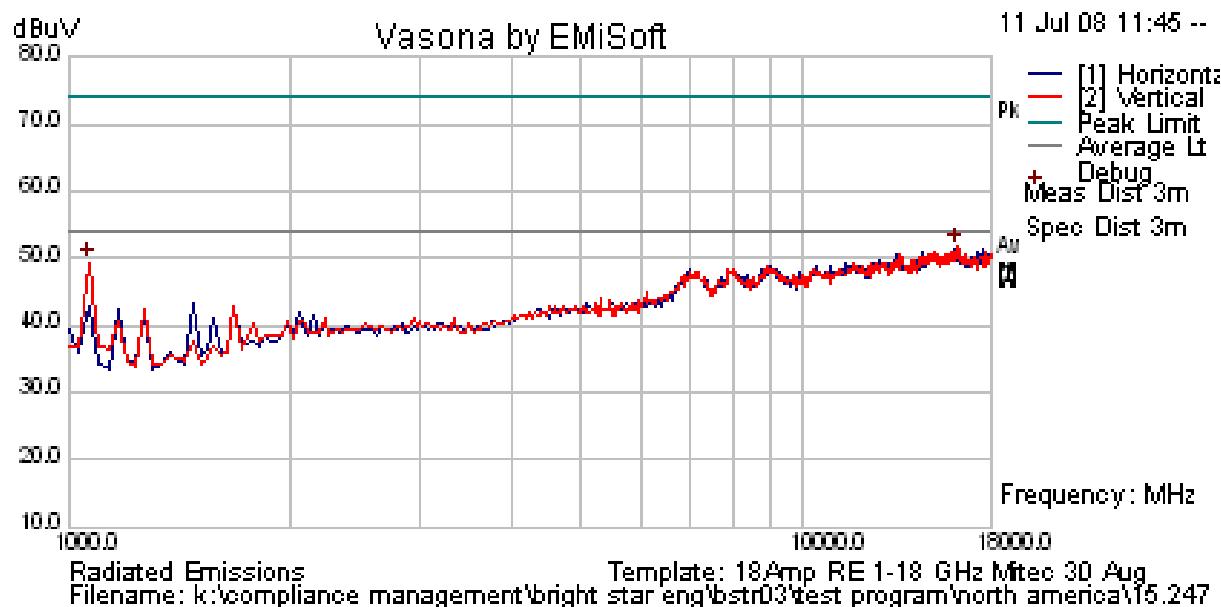
Receiver Radiated Spurious Emissions above 1 GHz

Test Setup

Channel 2437 MHz

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
1068.721	63.05	2.04	-15.6	49.50	Peak Max	V	110	10	74	-24.5	Pass	
1068.721	56.78	2.04	-15.6	43.22	Average Max	V	110	10	54	-10.78	Pass	

Receiver Radiated Emissions



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Specification Limits

FCC §15.247(d) and RSS-210 §A8.5 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 radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

FCC §15.247(d)

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 §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(a)).

IC RSS-210 §A8.5 If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under section A8.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Tables 2 and 3 is not required. In addition, radiated emissions which fall in the restricted bands of Table 1 must also comply with the radiated emission limits specified in Tables 2 and 3.

IC RSS-Gen §4.7

The search for unwanted emissions shall be from the lowest frequency internally generated or used in the device (local oscillator, intermediate of carrier frequency), or from 30 MHz, whichever is the lowest frequency, to the 5th harmonic of the highest frequency generated without exceeding 40 GHz.

FCC §15.205 (a) Except as shown in paragraph (d) of 15.205 (a), only spurious emissions are permitted in any of the frequency bands listed.

FCC §15.205 (a) Except as shown in paragraphs (d) and (e) of this section, the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

FCC §15.209 (a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table.



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Frequency (MHz)	Field Strength (μ V/m)	Field Strength (dB μ V/m)	Measurement Distance (meters)
30-88	100	40.0	3
88-216	150	43.5	3
216-960	200	46.0	3
Above 960	500	54.0	3

Laboratory Measurement Uncertainty for Radiated Emissions

Measurement uncertainty	+5.6/ -4.5 dB
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Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-03 'Measurement of Radiated Emissions'	0088, 0158, 0134, 0304, 0311, 0315, 0310, 0312

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5.1.6.3. Radiated Spurious Emissions (30M-1 GHz)

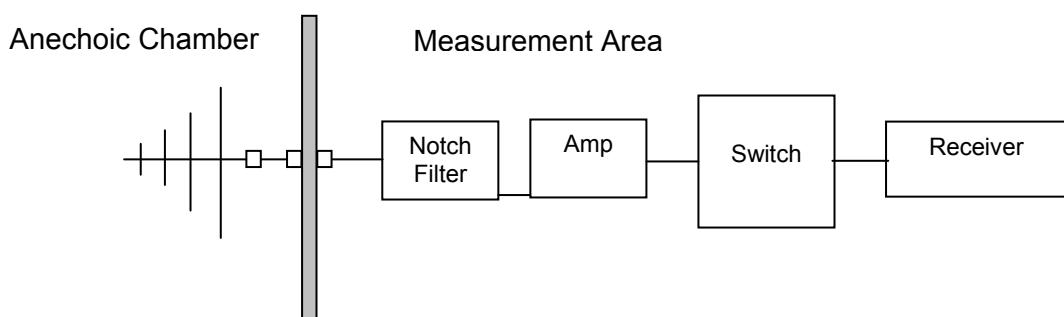
FCC, Part 15 Subpart C §15.205/ §15.209
Industry Canada RSS-210 §2.2

Test Procedure

The emissions are recorded and maximized as a function of azimuth by rotation through 360° with a spectrum analyzer in peak hold mode. The highest emissions relative to the limit are listed for each frequency scanned.

The emissions are recorded with a spectrum analyzer in peak hold mode. Emissions closest to the limits are measured in the quasi-peak mode with the tuned receiver using a bandwidth of 120 kHz. Only the highest emissions relative to the limit are listed.

Test Measurement Set up



Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Loss, and subtracting Amplifier Gain from the measured reading. In this test facility, the Antenna Factor, Cable Loss, and Amplifier Gains are loaded into the Rohde & Schwarz Receiver and the corrected field strength can be read directly on the receiver.

$$FS = R + AF + CORR$$

where:

FS = Field Strength

R = Measured Receiver Input Amplitude

AF = Antenna Factor

CORR = Correction Factor = CL – AG + NFL

CL = Cable Loss

AG = Amplifier Gain



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For example:

Given a Receiver input reading of 51.5dB μ V; Antenna Factor of 8.5dB; Cable Loss of 1.3dB; Falloff Factor of 0dB, an Amplifier Gain of 26dB and Notch Filter Loss of 1dB. The Field Strength of the measured emission is:

$$FS = 51.5 + 8.5 + 1.3 - 26.0 + 1 = 36.3\text{dB}\mu\text{V/m}$$

Conversion between dB μ V/m (or dB μ V) and μ V/m (or μ V) are done as:

$$\text{Level (dB}\mu\text{V/m)} = 20 * \text{Log} (\text{level (}\mu\text{V/m)})$$

$$40 \text{ dB}\mu\text{V/m} = 100\mu\text{V/m}$$

$$48 \text{ dB}\mu\text{V/m} = 250\mu\text{V/m}$$

Measurement Results for Spurious Emissions (30 MHz – 1 GHz)

Ambient conditions.

Temperature: 17 to 23 °C Relative humidity: 31 to 57 % Pressure: 999 to 1012 mbar

Radio Parameters

Power: Maximum Power

Duty Cycle: 100%

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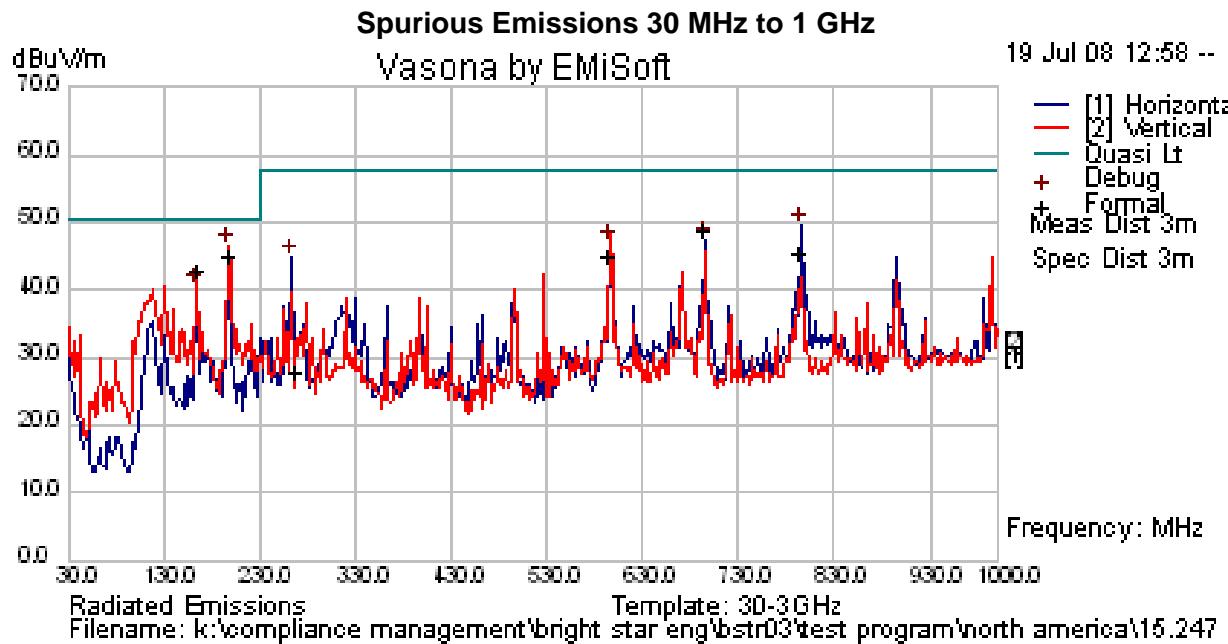
Operation mode: 802.11b

EUT tested fully loaded – all EUT ports exercised
 EUT output power: Maximum

TABLE OF RESULTS

Class A Limits

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
198.636	69.63	4.74	-29.42	44.95	Quasi Max	V	157	166	50.5	-5.55	Pass	
794.597	59.77	7.15	-21.36	45.56	Quasi Max	H	127	361	57.5	-11.94	Pass	
164.97	68.34	4.57	-30.06	42.84	Quasi Max	V	100	285	50.5	-7.66	Pass	
695.337	64.74	6.67	-22.59	48.82	Quasi Max	H	260	146	57.5	-8.68	Pass	
595.934	62.55	6.39	-23.94	45	Quasi Max	V	117	307	57.5	-12.5	Pass	
268.099	52.14	5.06	-29.4	27.79	Quasi Max	H	173	139	57.5	-29.71	Pass	



EUT Meets CLASS A Emissions

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Specification

Limits

§15.205 (a) Except as shown in paragraph (d) of 15.205 (a), only spurious emissions are permitted in any of the frequency bands listed.

§15.205 (a) Except as shown in paragraphs (d) and (e) of this section, the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

§15.209 (a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table.

§15.209 (a) and RSS-Gen §2.2 Limit Matrix

Frequency(MHz)	Field Strength (μ V/m)	Field Strength (dB μ V/m)	Measurement Distance (meters)
30-88	100	40.0	3
88-216	150	43.5	3
216-960	200	46.0	3
Above 960	500	54.0	3

Laboratory Measurement Uncertainty for Radiated Emissions

Measurement uncertainty	+5.6/ -4.5 dB
-------------------------	---------------

Traceability

Method	Test Equipment Used
Measurements were made per Sanmina work instruction	8546A HP Receiver and RF Filter, HP Pre-amp, Antenna EMCO Biconilog

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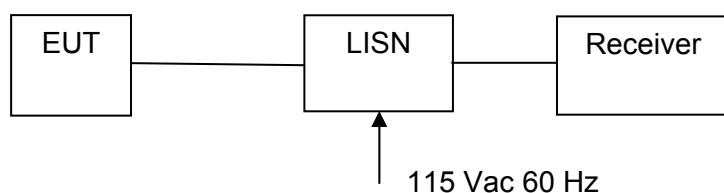
5.1.7. AC Wireline Conducted Emissions (150 kHz – 30 MHz)

FCC, Part 15 Subpart C §15.207
Industry Canada RSS-Gen §7.2.2

Test Procedure

The EUT is configured in accordance with ANSI C63.4. The conducted emissions are measured in a shielded room with a spectrum analyzer in peak hold in the first instance. Emissions closest to the limit are measured in the quasi-peak mode (QP) with the tuned receiver using a bandwidth of 9 kHz. The emissions are maximized further by cable manipulation. The highest emissions relative to the limit are listed.

Test Measurement Set up



Measurement set up for AC Wireline Conducted Emissions Test

Measurement Results for AC Wireline Conducted Emissions (150 kHz – 30 MHz)

Ambient conditions.

Temperature: 17 to 23 °C Relative humidity: 31 to 57 % Pressure: 999 to 1012 mbar

Radio Parameters

Power: Maximum Power

Duty Cycle: 100%

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Operation mode: 802.11b

EUT: installed in laptop on extender card

EUT output power: Maximum

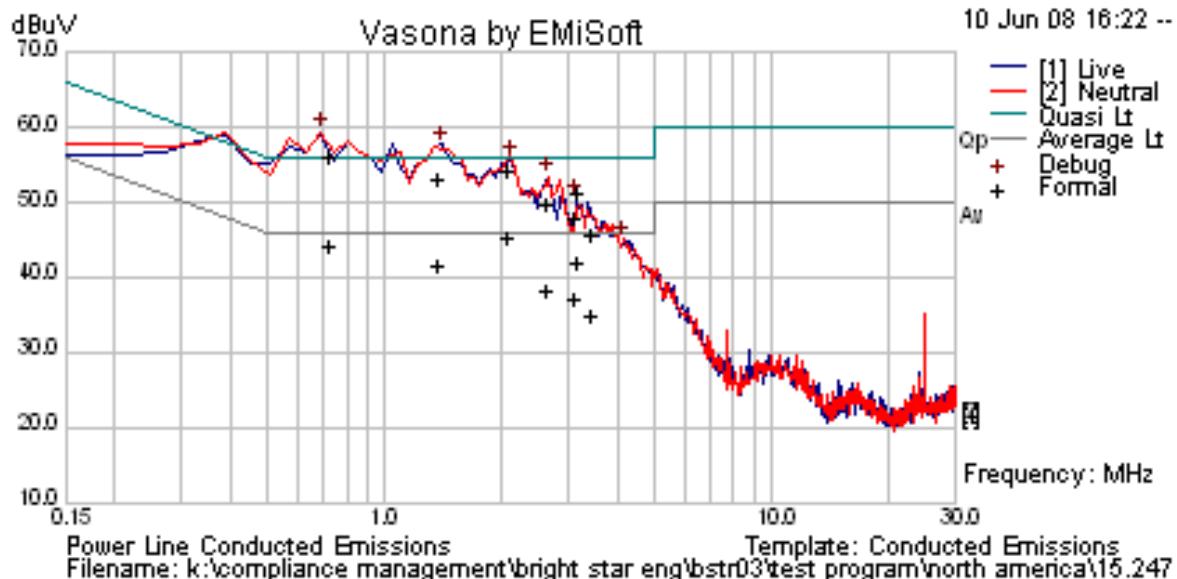
Duty cycle: 100%

TABLE OF RESULTS

115 Vac 60 Hz

Freq (MHz)	Line	Peak (dB μ V)	QP (dB μ V)	QP Limit (dB μ V)	QP Margin (dB)	Ave. (dB μ V)	Ave. Limit (dB μ V)	Ave. Margin (dB)
3.150	Live	50.6	46.27	56	-9.7	35.37	46	-10.63
3.197	Live	50.45	49.48	56	-6.52	40.19	46	-5.81
2.659	Live	53.47	47.95	56	-8.05	36.56	46	-9.44
1.392	Live	57.66	51.44	56	-4.56	40.03	46	-5.97
2.108	Neutral	56.1	52.61	56	-3.39	43.69	46	-2.31
0.728	Neutral	59.48	54.27	56	-1.73	42.48	46	-3.52

AC Wireline Conducted Emissions – 150 kHz – 30 MHz



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Specification

Limit

§15.207 (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 $\mu\Omega$ line impedance stabilization network (LISN), see §15.207 (a) matrix below. 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.

RSS-Gen §7.2.2

The radio frequency voltage that is conducted back into the AC power lines in the frequency range of 0.15 MHz to 30 MHz shall not exceed the limits shown in the table below. The tighter limit applies at the frequency range boundaries.

§15.207 (a) and RSS-Gen §7.2.2 Limit Matrix

The lower limit applies at the boundary between frequency ranges

Frequency of Emission (MHz)	Conducted Limit (dB μ V)	
	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

Laboratory Measurement Uncertainty for Conducted Emissions

Measurement uncertainty	± 2.64 dB
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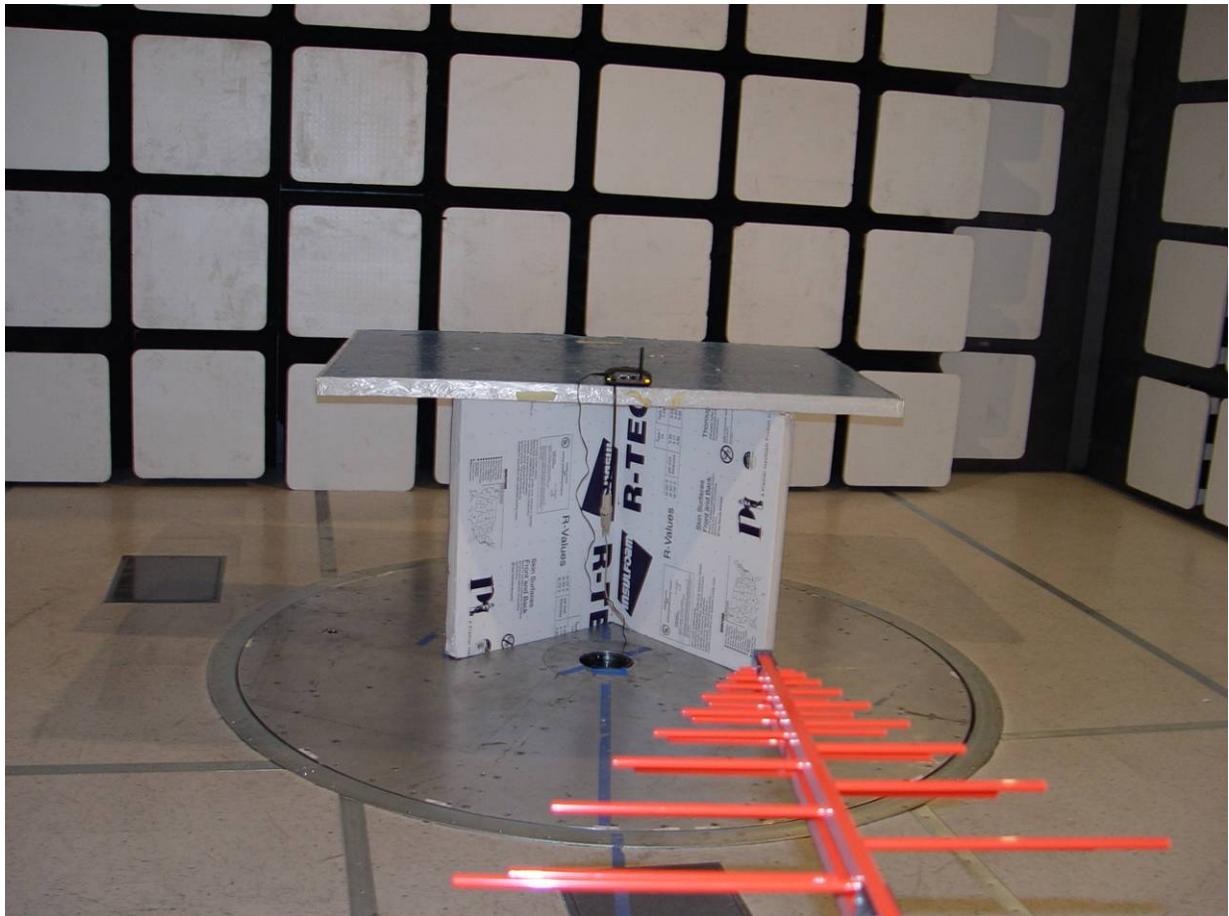
Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-EMC-01 'Measurement of Conducted Emissions'	0158, 0184, 0193, 0190, 0293, 0307

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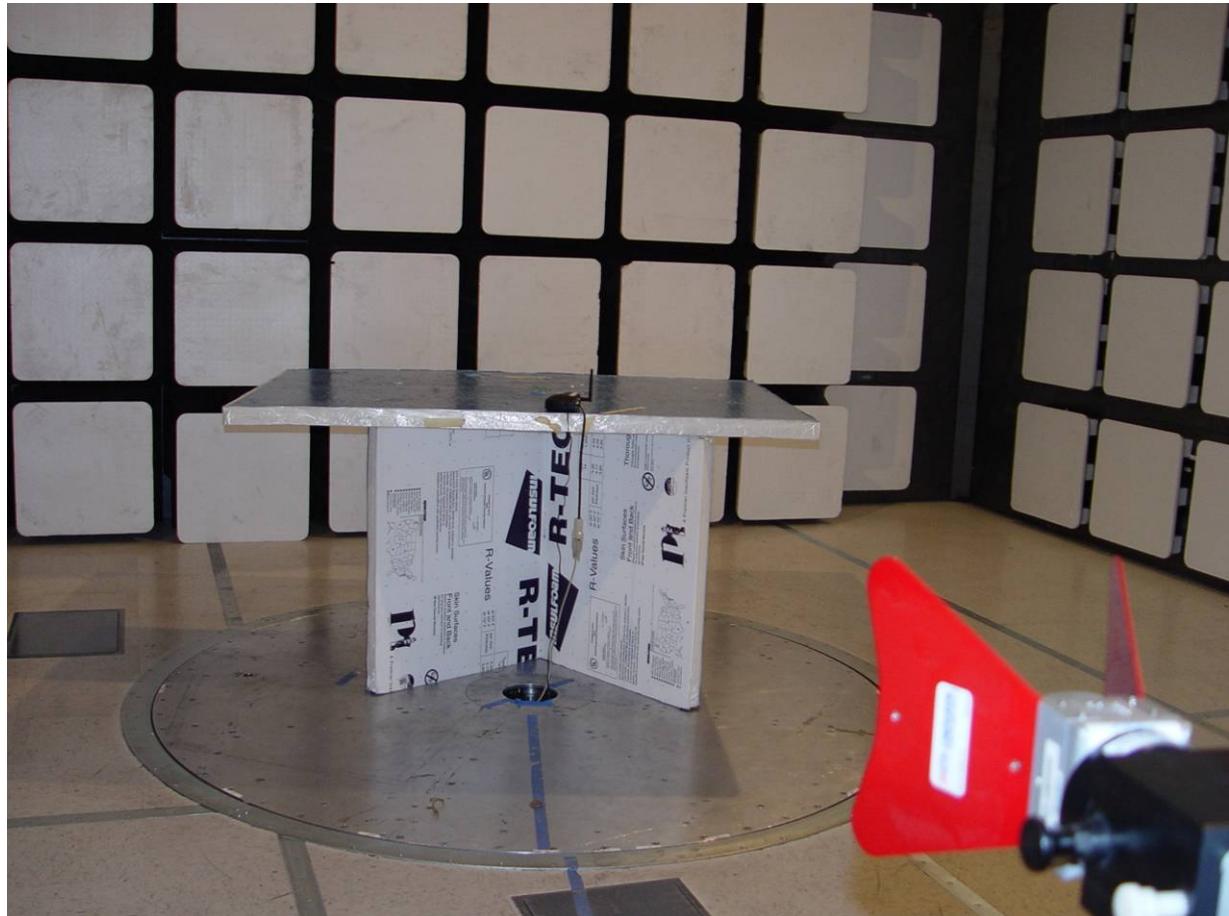
6. PHOTOGRAPHS

6.1. Spurious Emissions <1 GHz



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6.2. Spurious Emissions >1 GHz



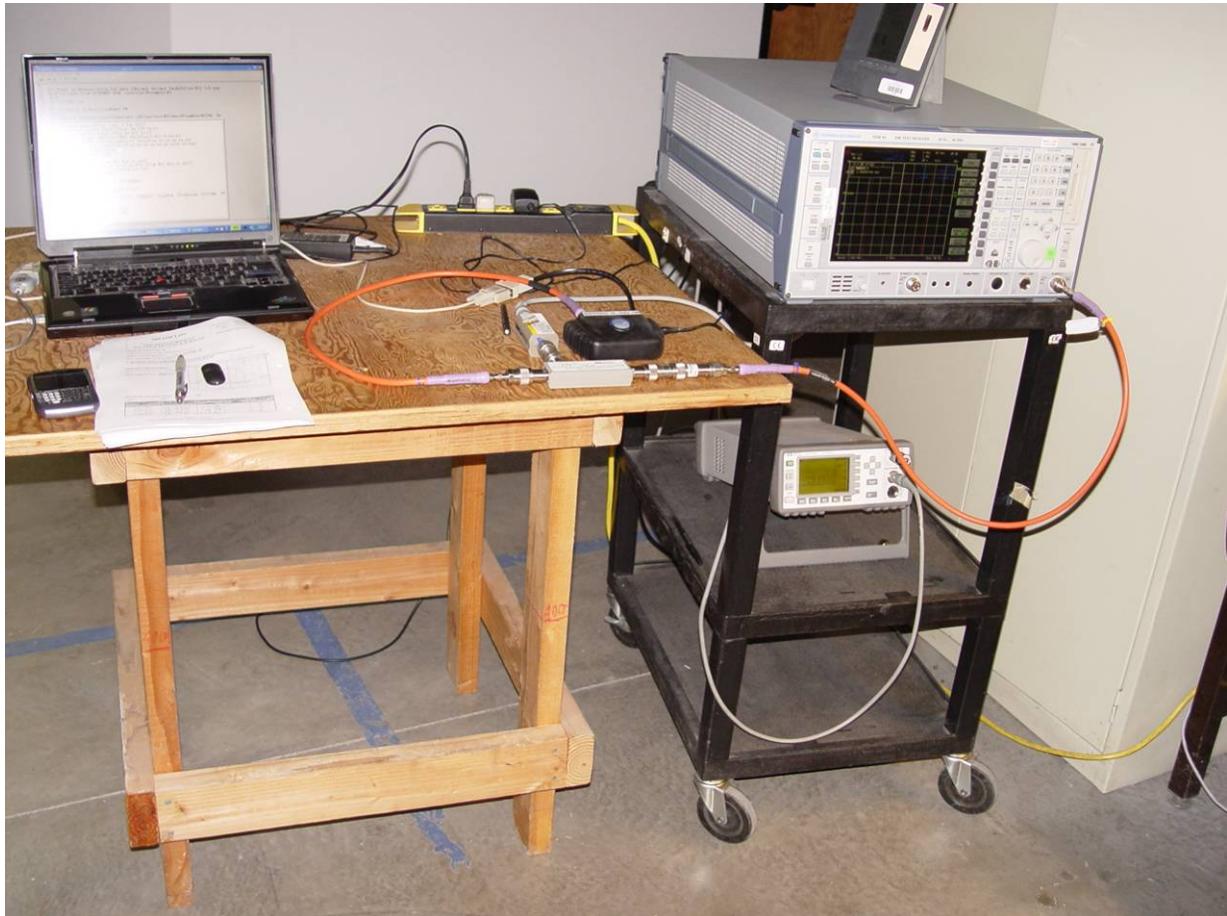
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6.3. AC Wireline Emissions (150 kHz - 30 MHz)



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6.4. General Measurement Test Set-Up



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7. TEST EQUIPMENT DETAILS

Asset #	Instrument	Manufacturer	Part #	Serial #
0088	Spectrum Analyzer	Hewlett Packard	8564E	3410A00141
0134	Amplifier	Com Power	PA 122	181910
0158	Barometer /Thermometer	Control Co.	4196	E2846
0193	EMI Receiver	Rhode & Schwartz	ESI 7	838496/007
0252	SMA Cable	Megaphase	Sucoflex 104	None
0310	2m SMA Cable	Micro-Coax	UFA210A-0-0787-3G03G0	209089-001
0312	3m SMA Cable	Micro-Coax	UFA210A-1-1181-3G0300	209092-001
0313	Coupler	Hewlett Packard	86205A	3140A01285
0314	30dB N-Type Attenuator	ARRA	N9444-30	1623
0070	Power Meter	Hewlett Packard	437B	3125U11552
0116	Power Sensor	Hewlett Packard	8485A	3318A19694
0117	Power Sensor	Hewlett Packard	8487D	3318A00371
0184	Pulse Limiter	Rhode & Schwartz	ESH3Z2	357.8810.52
0190	LISN	Rhode & Schwartz	ESH3Z5	836679/006
0293	BNC Cable	Megaphase	1689 1GVT4	15F50B001
0301	5.6 GHz Notch Filter	Micro-Tronics	RBC50704	001
0302	5.25 GHz Notch Filter	Micro-Tronics	BRC50703	002
0303	5.8 GHz Notch Filter	Micro-Tronics	BRC50705	003
0304	2.4GHzHz Notch Filter	Micro-Tronics	--	001
0307	BNC Cable	Megaphase	1689 1GVT4	15F50B002
0335	1-18GHz Horn Antenna	ETS- Lindgren	3117	00066580
0337	Amplifier	MiCOM Labs	--	--
0338	Antenna	Sunol Sciences	JB-3	A052907

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