

Test of SPEEDLAN 9200

To FCC 47 CFR Part 15.247

Test Report Serial No.: WAVW01-A1 Rev A





Test of SPEEDLAN 9200

To FCC 47 CFR Part 15.247

Test Report Serial No.: WAVW01-A1 Rev A

This report supersedes None

Manufacturer: Wave Wireless Corporation
1996 Lundy Avenue
San Jose, CA 95131
USA

Product Function: Wireless Mesh Router
Operating at 2.4 GHz and 5.8 GHz

Copy No: pdf

Issue Date: 27th Oct 2005

This Test Report is Issued Under the Authority of:

MiCOM Labs, Inc.
3922 Valley Avenue, Suite B
Pleasanton, CA 94566 USA
Phone: +1 (925) 462-0304
Fax: +1 (925) 462-0306
www.micomlabs.com



CERTIFICATE #2381.01

MiCOM Labs is an ISO 17025 Accredited Testing Laboratory



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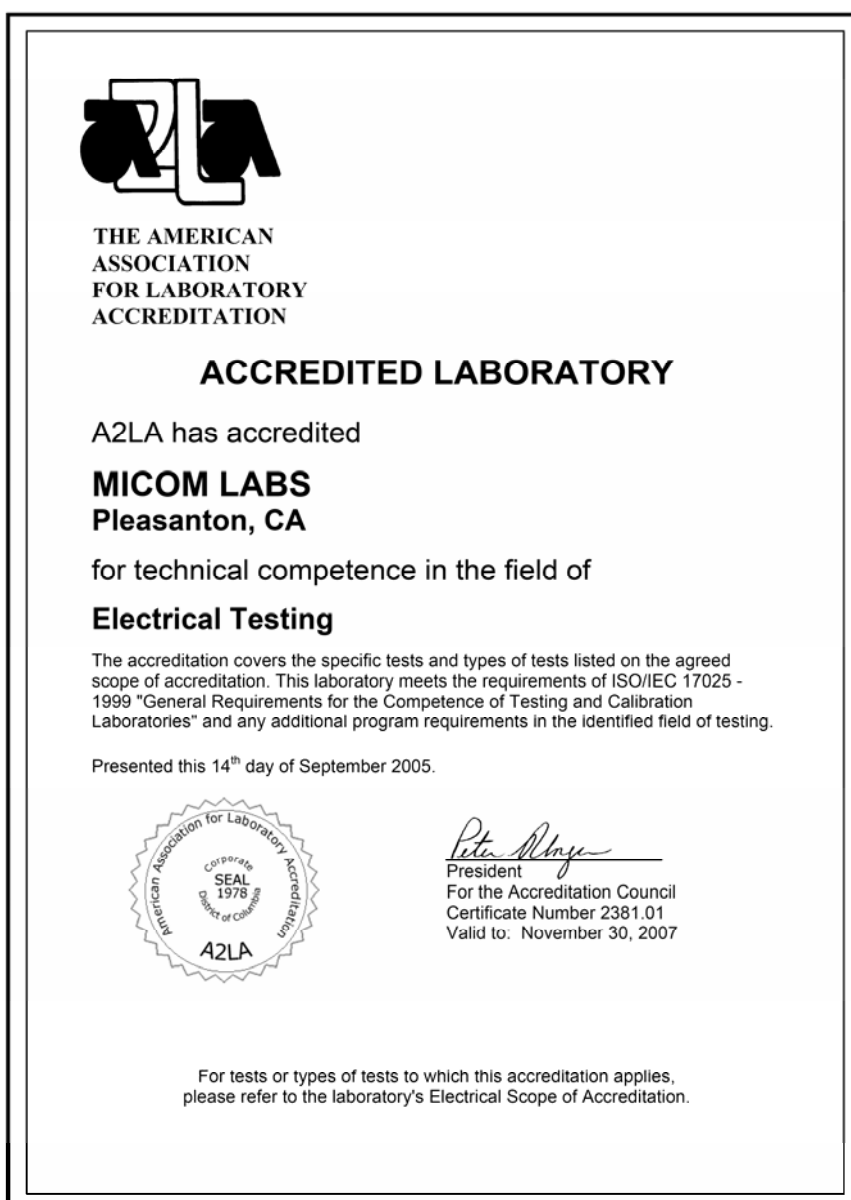


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ACCREDITATION & LISTINGS

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 #: 4143

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DOCUMENT HISTORY

Document History		
Revision	Date	Comments
Draft		
Rev A	27 th Oct 2005	First issue.

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1. TEST RESULT CERTIFICATE

Manufacturer:	Wave Wireless Corporation 1996 Lundy Avenue San Jose, CA 95131 USA	Tested By:	MiCOM Labs, Inc. 3922 Valley Avenue 'B' Pleasanton California, 94566, USA
EUT:	Wireless Mesh Router operating at 2.4 GHz and 5.8 GHz	Telephone:	+1 925 462 0304
Model:	SPEEDLAN 9200	Fax:	+1 925 462 0306
S/N:	1430544		
Test Date(s):	19th Sept - 14th Oct 2005	Website:	www.micomlabs.com

STANDARD(S)	TEST RESULTS
FCC 47 CFR Part 15.247	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:



CERTIFICATE #2381.01



Graeme Grieve
Quality Manager MiCOM Labs,



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	2001	Code of Federal Regulations
(ii)	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
(iii)	CISPR 22/ EN 55022	1997 1998	Limits and Methods of Measurements of Radio Disturbance Characteristics of Information Technology Equipment
(iv)	M 3003	Edition 1 Dec. 1997	Expression of Uncertainty and Confidence in Measurements
(v)	LAB34	Edition 1 Aug 2002	The expression of uncertainty in EMC Testing
(vi)	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
(vii)	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:	Compliance testing of the SPEEDLAN 9200 to North American standards FCC 47 Part 15.247.
Applicant:	As Manufacturer
Manufacturer:	Wave Wireless Corporation 1996 Lundy Avenue San Jose, CA 95131 USA
Laboratory performing the tests:	MiCOM Labs, Inc. 3922 Valley Avenue, Suite "B" Pleasanton, California 94566 USA
Test report reference number:	WAVW01-A1 Rev A
Date EUT received:	19 th September 2005
Standard(s) applied:	FCC 47 CFR Part 15.247
Dates of test (from - to):	19th Sept - 14th Oct 2005
No of Units Tested:	1
Type of Equipment:	2.4 GHz and 5.8 GHz Mesh Radio.
Manufacturers Trade Name:	Wave Wireless Corporation
Model:	SPEEDLAN 9200
Location for use:	Indoor and Outdoor
Declared Frequency Range(s):	2.4 – 2.4835 GHz 5.725 – 5.850 GHz
Type of Modulation:	DSSS – CCK, DQPSK, DBPSK, OFDM
Declared Nominal Output Power:	+17 dBm
ITU Emission Designator:	802.11b: 15M7D7W 802.11g: 18M8D7W 802.11a: 18M8D7W 802.11 a (Turbo): 34M9D7W
Transmit/Receive Operation:	Simplex
Rated Input Voltage and Current:	100 to 240 VAC, 50/60 Hz, 0.7 A
Operating Temperature Range:	-33°C to +55°C
Microprocessor(s) Model:	AMD Elan SC520
Clock/Oscillator(s):	32.768 kHz, 25 MHz, 33.333 MHz, 66.666 MHz, 133.333 MHz, 40MHz
Frequency Stability:	± 20ppm
Equipment Dimensions:	9" x 7" x 3.5"
Weight:	5.5 lbs
Primary function of equipment:	Wireless Mesh Router operating at 2.4 GHz or 5.8 GHz

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3.2. Scope of Test Program

The scope of the test program was to test the Wave Wireless Corporation SPEEDLAN 9200 for compliance against FCC 47 CFR Part 15.247.

The SPEEDLAN 9200 is a wireless mesh router employing DSSS modulation in the frequency ranges 2.400 to 2.4835 GHz and 5.725 to 5.850 GHz.

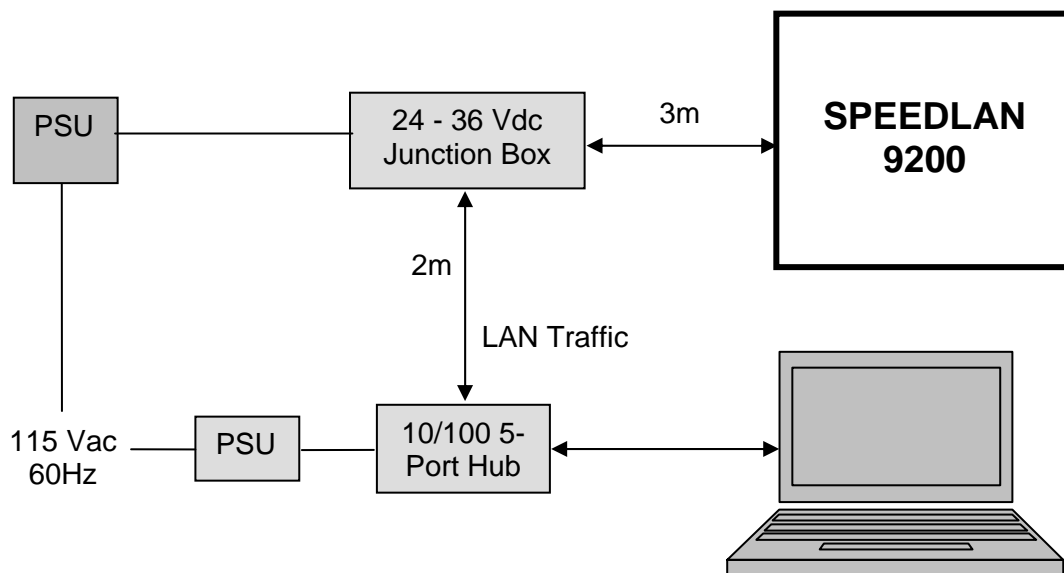
SPEEDLAN 9200 2.4 GHz and 5.8 GHz Radio



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

EUT/ Support	Name	Manufacturer	Model No.	Serial No.
EUT	2.4 GHz and 5.8 GHz Radio	Wave Wireless Corporation	SPEEDLAN 9200	1430544
EUT	24-36 Volt Junction Box	Wave Wireless Networking	--	--
EUT	Class 1 PSU 100-250V 47-63 Hz 0.9 A / 24 Vdc 1.5A	Sceptre	PS-2415APL05	034493
EUT	IP Recover	Wave Wireless Corporation	Software Utility	REV 2.2.1b
Support	10/100 5-Port Workgroup Hub	Cisco	EFAH05W	RA1304B0 00738
Support	Power Supply	I.T.E.	D75-07A-950	R0410200 00420
Support	Laptop computer	IBM	Thinkpad R40	FX 05793

Test Measurement Set Up



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3.4. Antenna's

Antenna Type	Gain (dBi)	Manufacturer	Model No.
2.4GHz Planar Patch	8	Huber+Suhner	1324.19.0002
2.4GHz 4 ft dipole	12	Pacific Wireless	OD24-12
2.4GHz Yagi - Panel	15	Cushcraft	PC2415
2.4GHz 90° Sectoral	16	Andrew	DB980G90N-R
2.4GHz Parabolic	24	Andrew	AWP M0528D T-2400
5.8GHz Dipole	10	Radiall-Larsen	R380.700.205
5.8GHz 120° Sectoral	16	Radio Waves	SEC-5V-120-16
5.8GHz	17	Echo	ES58-17
5.8GHz Flat Panel ^{Note 1}	23	MTI	MT-485002
5.8GHz Parabolic ^{Note 1}	29	M WAVE	RP2-58-N

3.5. Cabling and I/O Ports

Number and type of I/O ports

1. ODU - single cable for power, data and maintenance functions
2. Junction box – to ODU cable, LAN traffic and 24-36V dc power

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3.6. Test Configurations

Data rates selected for test purposes was as a result of measuring output power V's data rate and selecting the highest power for each configuration.

Matrix of test configurations

Operational Mode (802.11)	Operating Channel	Frequencies (MHz)	Maximum Data Rates (MBit/s)	Data Rate(s) Selected for Test Purposes (Mbit/s)	
				Conducted	Radiated
a	149, 157, 165	5,745 5,785 5,825	54	6	6
a _T ^{NOTE 1}	152, 160	5,760 5,800	108	12	12
b	1, 6, 11	2,412	11	11	11
g		2,437 2,462	54	6	6

Note 1: a_T – “Turbo” mode

Only worst case plots are provided for each test parameter are identified within this report. Plots not included are held on file by the test laboratory and available upon request with client permission.



3.7. Equipment Modifications

The following modifications were required during testing to bring the equipment into compliance;-

1. The ferrite clamp installed in the RF Unit between the motherboard and the external data I/O power connector had to be repositioned along the cable towards the inside of the bulkhead and a second cable loop formed around the ferrite. This modification brought the 533.3 MHz emission into compliance.
2. Band Edge Power Reduction: the output power for 802.11g configuration was reduced to comply with the 2.4 GHz band edge requirements. The table below identifies the power levels to bring the product into compliance.

Antenna Type	Gain (dBi)	Manufacturer	Model No.	Transmit Power at Band Edge (+dBm)	
				802.11 g	
				LBE	UBE
2.4GHz Planar Patch	8	Huber+Suhner	1324.19.0002	15	14
2.4GHz 4 ft dipole	12	Pacific Wireless	OD24-12	15	15
2.4GHz Yagi - Panel	15	Cushcraft	PC2415	13	13
2.4GHz 90° Sectoral	16	Andrew	DB980G90N-R	14	14
2.4GHz Parabolic	24	Andrew	AWP M0528D T-2400	17	15

3. 802.11a: the 23dBi and 29dBi antennas had problems meeting the FCC 47 CFR 15.247 Restricted Band (15.205) 5.35 - 5.46 GHz requirements. As a result the client decided to install a filter which mounts external to the product.

Antennas

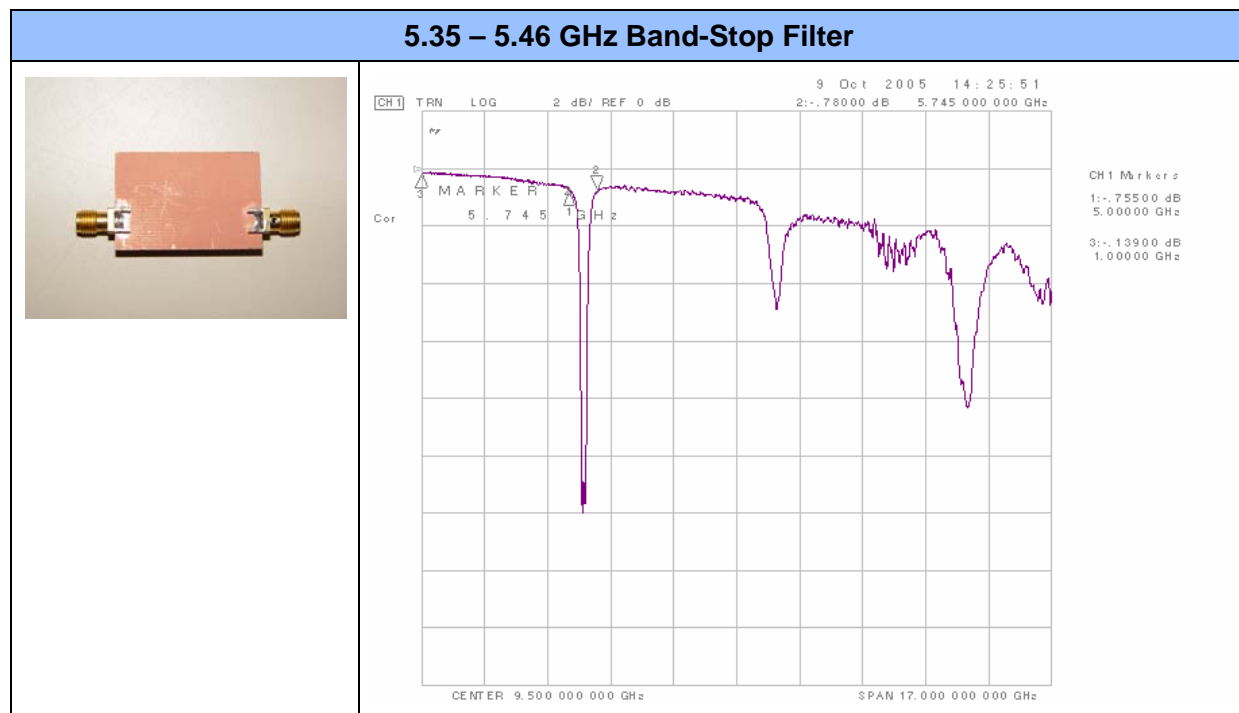
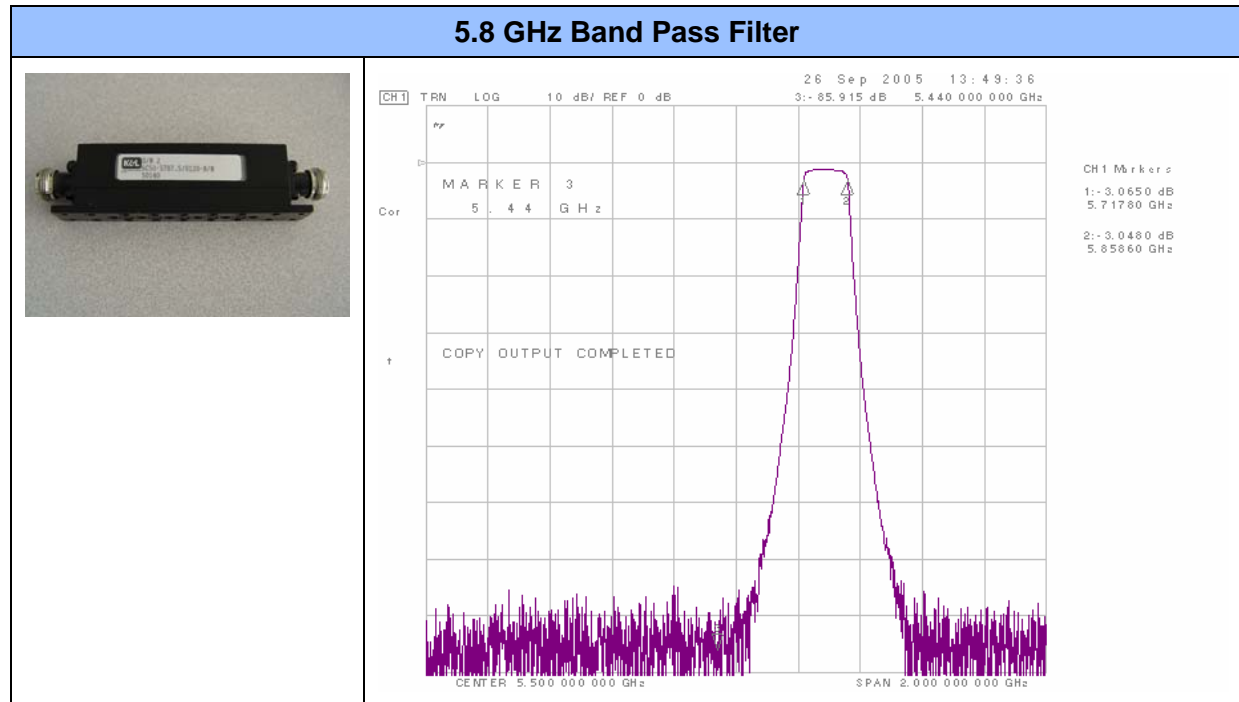
Antenna Type	Gain (dBi)	Manufacturer	Model No.
5.8GHz Flat Panel	23	MTI	MT-485002
5.8GHz Parabolic	29	M WAVE	RP2-58-N

In order to prove compliance two separate filter types were tested;

- a).. band pass filter, and
- b).. band-stop filter;

The filter response for both types was recorded on an HP 8722ET Network Analyzer.

Response of Band Pass Filter



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Both filters brought the EUT into compliance

Filter Type	23 dBi Antenna	29 dBi Antenna
5.8 GHz Band Pass Filter	Required	Required
5.35 – 5.46 GHz Band-stop Filter	Required	Required

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

Radiated emission testing 30 MHz-1 GHz was subcontracted to the following test facility;

Sanmina-SCI
Homologation Services
EMI Test Laboratory
2305 Mission College Blvd.
Santa Clara, California 95054
USA

Sanmina-SCI, NVLAP (National Voluntary Laboratory Accreditation Program) Lab Code 100411-0 are ISO/IEC 17025 accredited for emission testing 30 MHz-1 GHz.

Sanmina SCI: FCC Registration Number: 90844

IC Registration Number: IC5541

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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**.

Section(s)	Test Items	Description	Condition	Result	Test Report Section
15.247(a)(2)	6 dB and 99 % Bandwidths	>=500 kHz	Conducted	Complies	5.1.1
15.247(b) 15.31(e)	Peak Output Power Voltage Variation	Shall not exceed 1W Variation of supply voltage 85 % -115 %	Conducted	Complies	5.1.2
15.247(d)	Peak Power Spectral Density	Shall not be greater than +8 dBm in any 3 kHz band	Conducted	Complies	5.1.3
15.247(b)(5)	Maximum Permissible Exposure	Exposure to radio frequency energy levels	Conducted	Complies	5.1.4
15.247(c) 15.205(a) / 15.209(a)	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
5.205(a) / 15.209(a)	Radiated Emissions	Restricted Bands	Radiated	Complies	5.1.6
	Transmitter Radiated Spurious Emissions	Emissions above 1 GHz		Complies	5.1.6.1
	Radiated Band Edge	Band edge results		Complies	5.1.6.2



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Section(s)	Test Items	Description	Condition	Result	Test Report Section
5.205(a) / 15.209(a)	Radiated Spurious Emissions	Emissions <1 GHz (30M-1 GHz)	Radiated	Complies	5.1.6.3
15.207	AC Wireline Conducted Emissions 150 kHz–30 MHz	Conducted Emissions	Conducted	Complies	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: Section 3.7 Equipment Modifications highlights the equipment modifications that were required to bring the product into compliance with the above test matrix

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5. TEST RESULTS

5.1. Device Characteristics

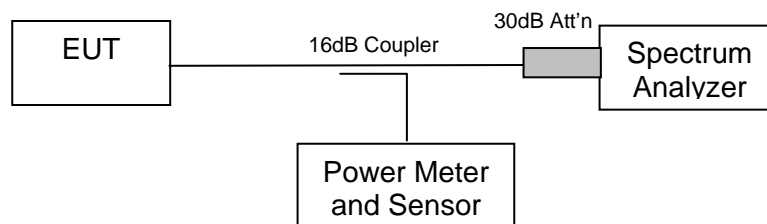
5.1.1. 6 dB, 26 dB and 99 % Bandwidth

FCC, Part 15 Subpart C §15.247(a)(2)

Test Procedure

The bandwidth at 6 dB, 26 dB and 99 % was measured with a spectrum analyzer connected to the antenna terminal, while EUT is operating in transmission mode at the appropriate center frequency. Using a 3 dB resolution bandwidth filter setting the spectrum analyzer was set to the following for 6 dB BW, 26 dB BW and 99 % BW measurements;

Test Measurement Set up



Measurement set up for 6 dB, 26 dB and 99 % bandwidth test

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

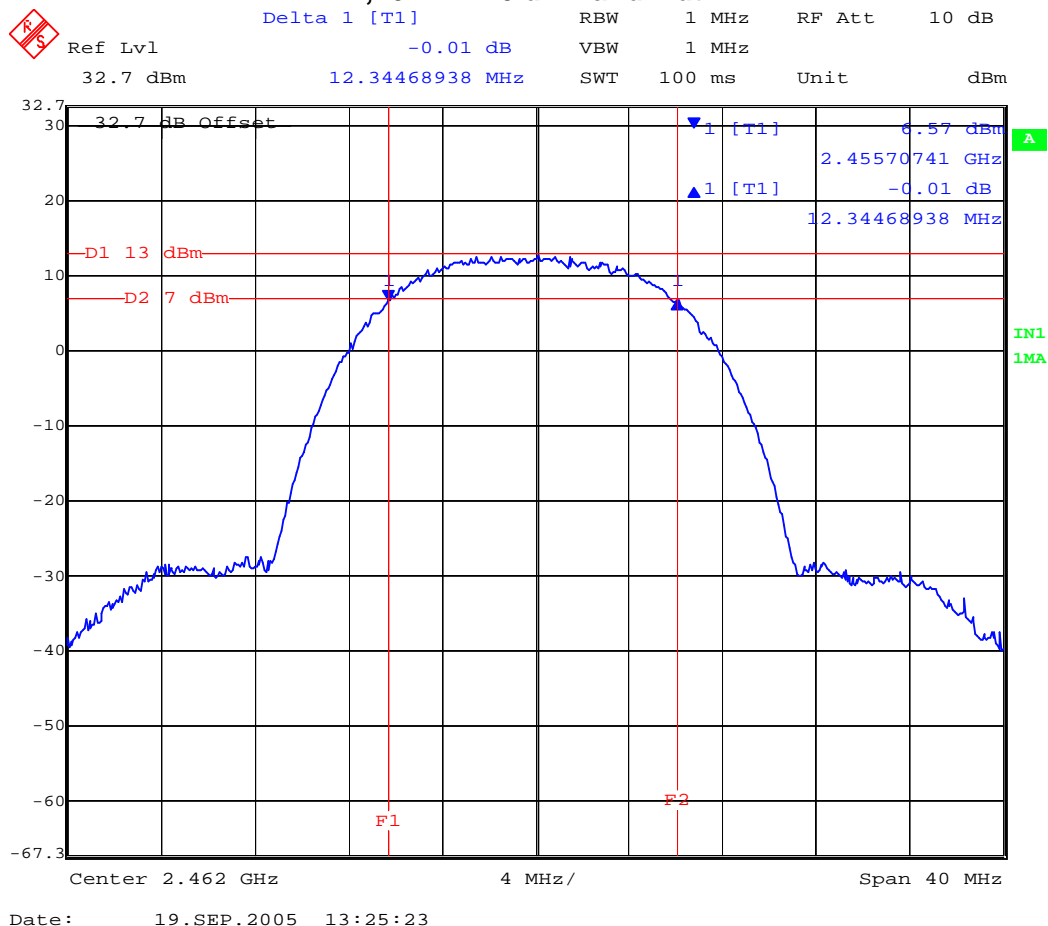
Ambient conditions.

Temperature: 19 to 26 °C Relative humidity: 31 to 57 % Pressure: 999 to 1009 mbar

TABLE OF RESULTS – 802.11b 11Mbit/s Maximum Power +17 dBm

Center Frequency (MHz)	6 dB Bandwidth (MHz)	6 dB Plot #	26 dB Bandwidth (MHz)	26 dB Plot #	99 % BW (MHz)	99 % BW Plots
2,412	12.024	On File	19.559	On File	15.711	On File
2,437	12.114	On File	19.559	On File	15.711	3
2,462	12.345	1	19.639	2	15.631	On File

Plot 1
802.11b 11Mbit/s Maximum Power +17 dBm
2,462 MHz 6 dB Bandwidth



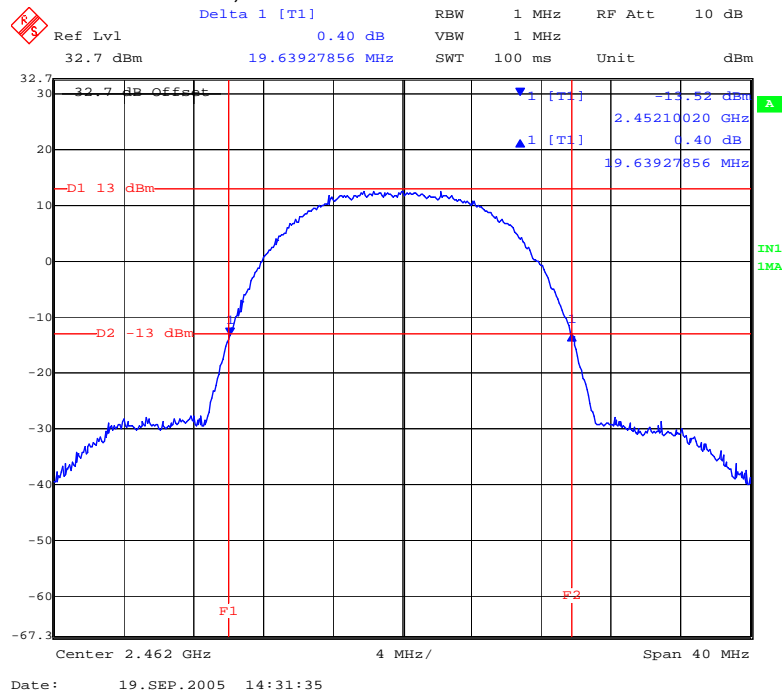
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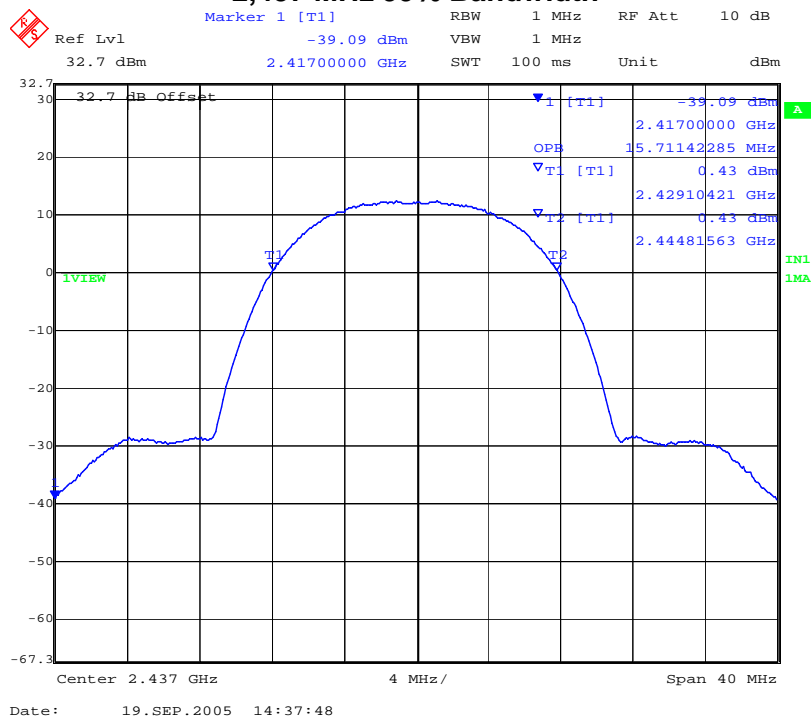


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Plot 2
802.11b 11Mbit/s Maximum Power +17 dBm
2,462 MHz 26 dB Bandwidth



Plot 3
802.11b 11Mbit/s Maximum Power +17 dBm
2,437 MHz 99% Bandwidth



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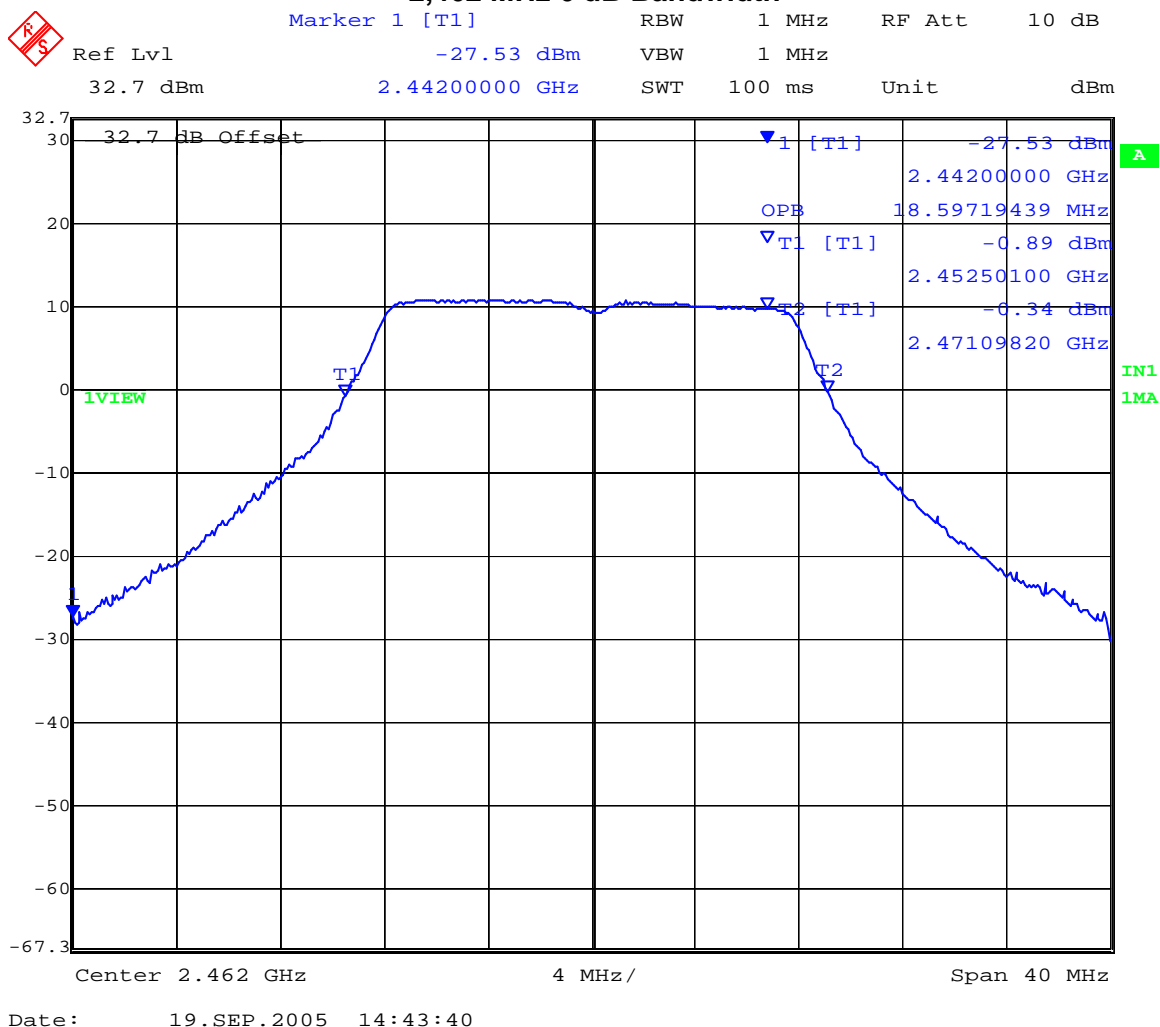


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TABLE OF RESULTS – 802.11g 6Mbit/s Maximum Power +17 dBm

Center Frequency (MHz)	6 dB Bandwidth (MHz)	6 dB Plot #	26 dB Bandwidth (MHz)	26 dB Plot #	99 % BW (MHz)	99 % BW Plots
2,412	16.994	On File	27.014	On File	18.758	On File
2,437	16.994	On File	26.774	On File	18.758	6
2,462	17.074	4	27.014	5	18.597	On File

Plot 4
802.11g 6Mbit/s Maximum Power +17 dBm
2,462 MHz 6 dB Bandwidth



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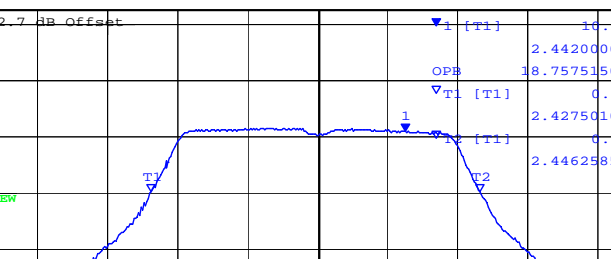
Delta 1 [T1] -0.03 dB
 Ref Lvl 32.7 dBm
 RBW 1 MHz
 VBW 1 MHz
 RF Att 10 dB
 SWT 100 ms
 Unit dBm

32.7 dB Offset
 -14.89 dBm
 2.44825251 GHz
 -0.03 dB
 27.01402806 MHz

D1 11 dBm
 D2 -15 dBm
 F1
 F2

Center 2.462 GHz
 4 MHz/
 Span 40 MHz

Date: 19.SEP.2005 14:57:38



Marker 1 [T1] RBW 1 MHz RF Att 10 dB
 Ref Lvl 10.85 dBm VBW 1 MHz
 32.7 dBm 2.4420000 GHz SWT 100 ms Unit dBm

32.7 dB Offset

▼ 1 [T1] 10.85 dBm
 2.4420000 GHz
 OPB 18.75751503 MHz
 ▼ T1 [T1] 0.10 dBm
 2.42750100 GHz
 ▼ 1 [T1] 0.16 dBm
 2.44625852 GHz

1VIEW

IN1
 LMA

Center 2.437 GHz 4 MHz/ Span 40 MHz

Date: 19.SEP.2005 14:44:50

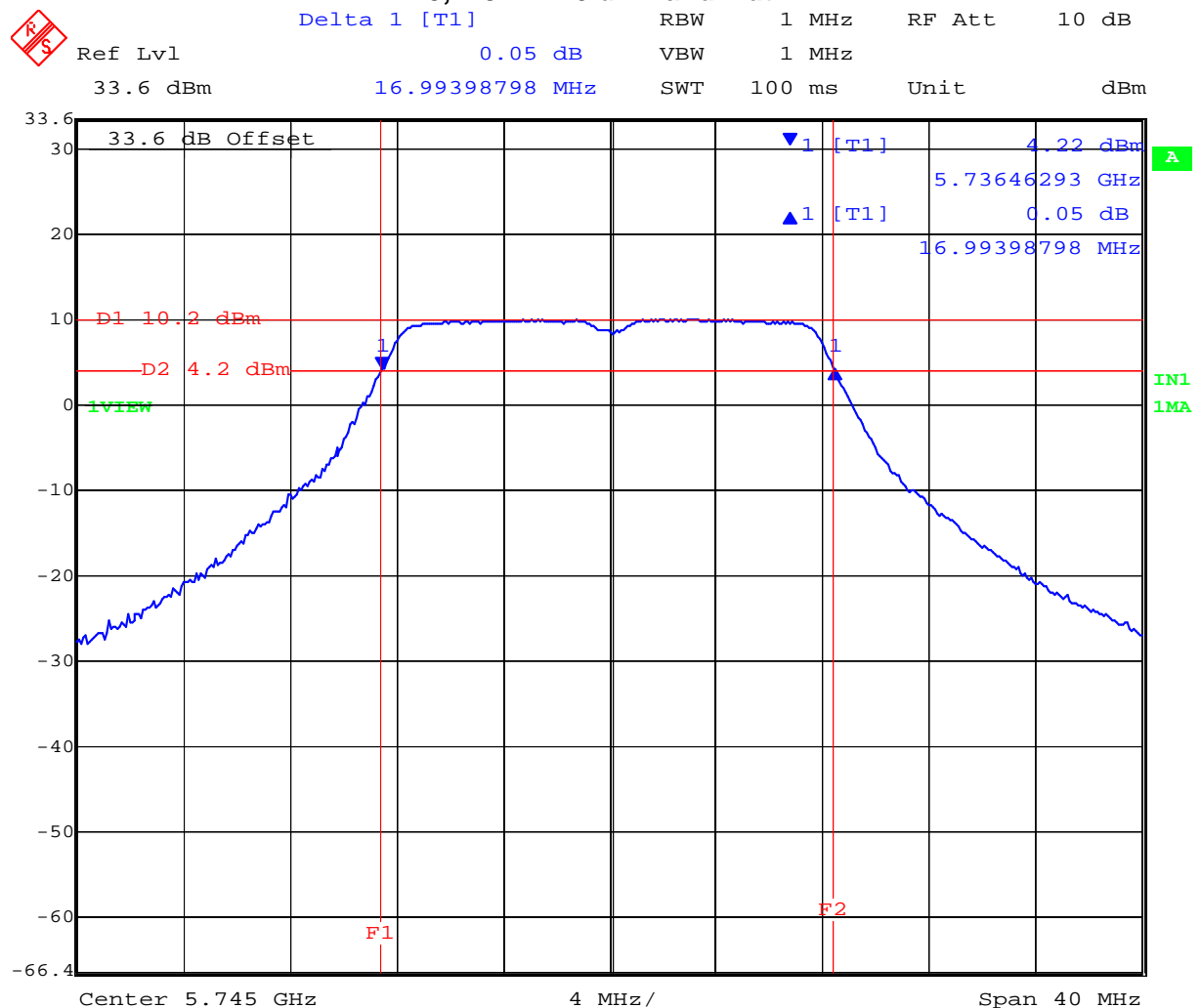


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TABLE OF RESULTS – 802.11a 6Mbit/s Maximum Power +17 dBm

Center Frequency (MHz)	6 dB Bandwidth (MHz)	6 dB Plot #	26 dB Bandwidth (MHz)	26 dB Plot #	99 % BW (MHz)	99 % BW Plots
5,745	16.994	7	27.495	8	18.758	9
5,785	16.994	On File	27.255	On File	18.597	On File
5,825	16.994	On File	27.415	On File	18.517	On File

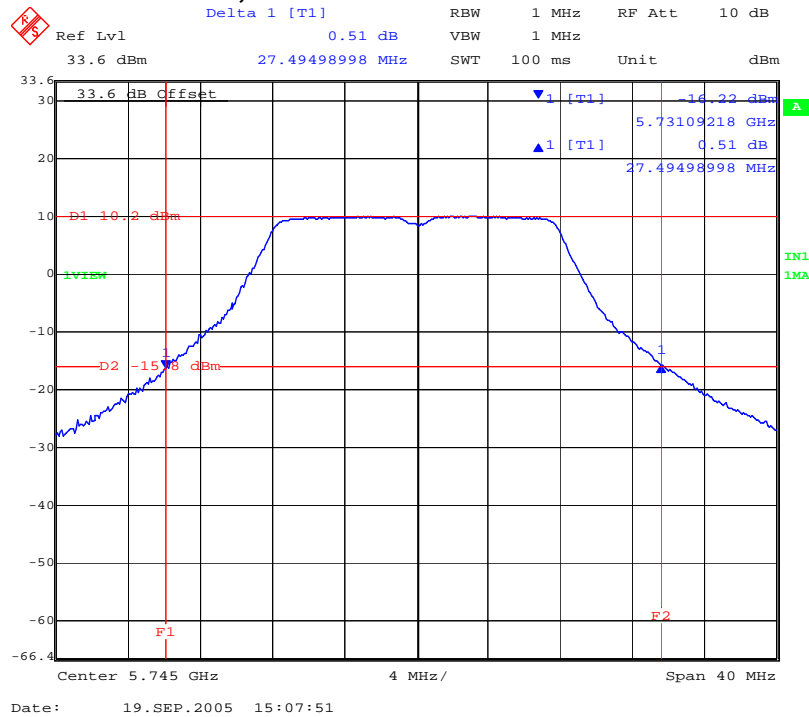
Plot 7
802.11a 6Mbit/s Maximum Power +17 dBm
5,745 MHz 6 dB Bandwidth



Date: 19.SEP.2005 15:10:42

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Plot 8
802.11a 6Mbit/s Maximum Power +17 dBm
5,745 MHz 26 dB Bandwidth



Plot 9
802.11a 6Mbit/s Maximum Power +17 dBm
5,745 MHz 99% Bandwidth



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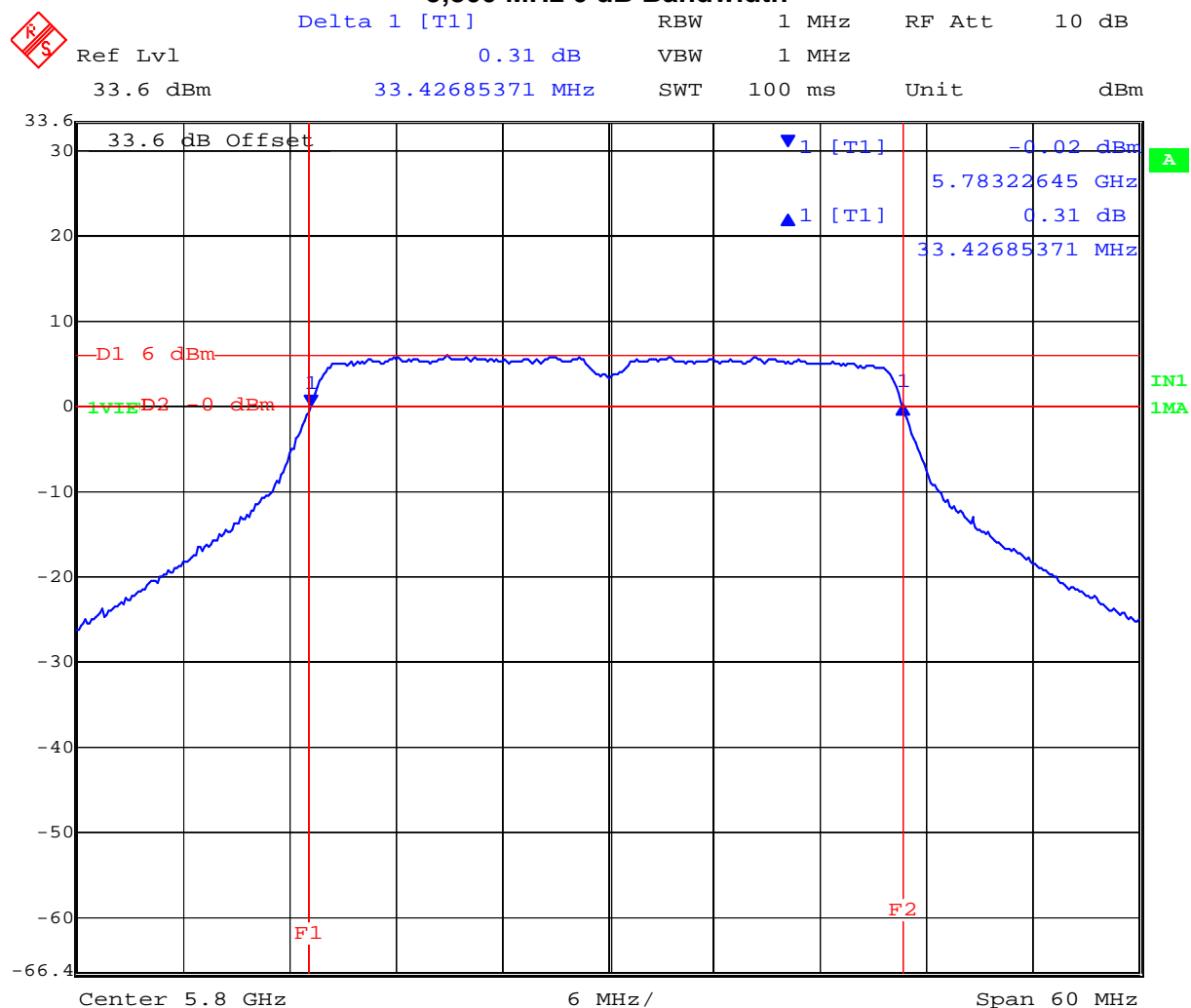


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TABLE OF RESULTS – 802.11a_T 12Mbit/s Maximum Power +17 dBm

Center Frequency (MHz)	6 dB Bandwidth (MHz)	6 dB Plot #	26 dB Bandwidth (MHz)	26 dB Plot #	99 % BW (MHz)	99 % BW Plots
5,760	33.307	On File	40.882	On File	34.629	On File
5,800	33.427	10	41.603	11	34.990	12

Plot 10 802.11a_T
12Mbit/s Maximum Power +17 dBm
5,800 MHz 6 dB Bandwidth



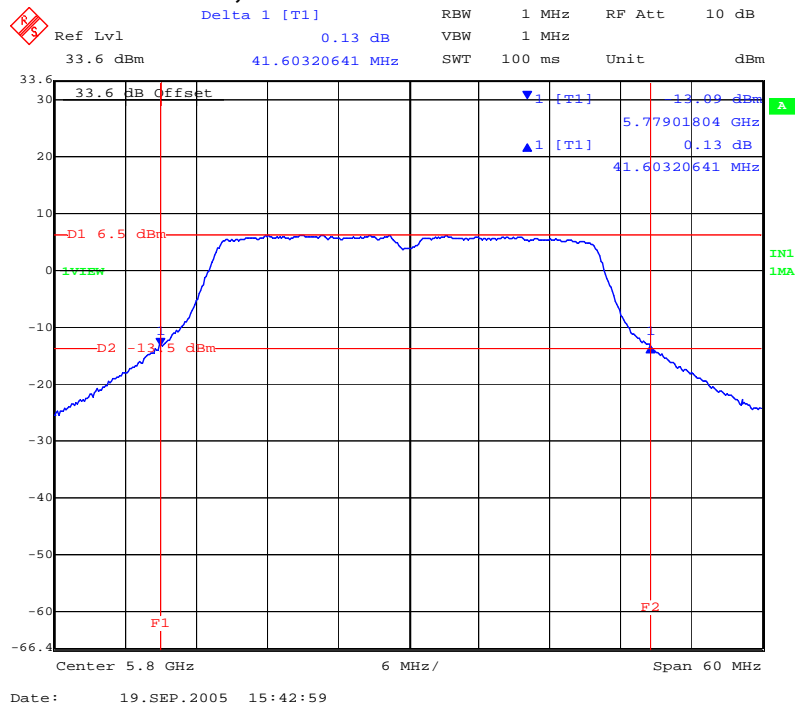
Date: 19.SEP.2005 15:35:16

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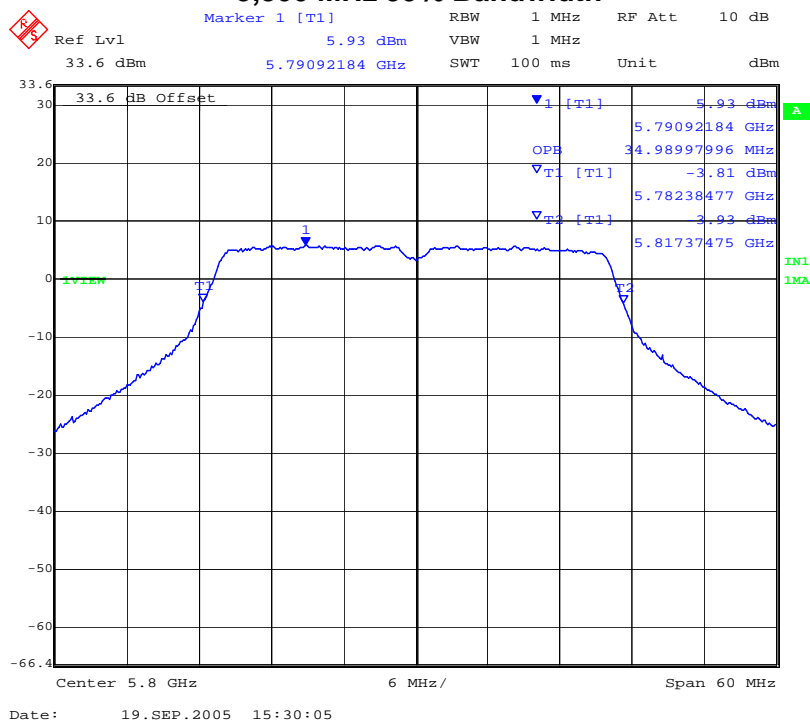


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Plot 11 802.11a_T
12Mbit/s Maximum Power +17 dBm
5,800 MHz 26 dB Bandwidth



Plot 12 802.11a_T
12Mbit/s Maximum Power +17 dBm
5,800 MHz 99% Bandwidth



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Specification

Limits

§15.247 (a)(2) For direct sequence systems the minimum 6 dB bandwidth shall be at least 500 kHz

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

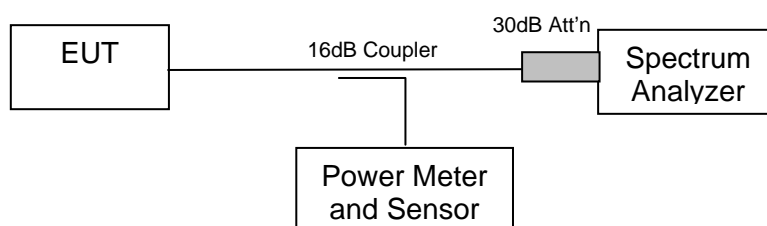
FCC, Part 15 Subpart C §15.247(b)

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 on the spectrum analyzer was set for 3 dB measurement, peak detector selected and the analyzer built-in power function was used to measure peak power over the 99 % bandwidth.

Measurements were made while EUT was operating in a continuous transmission mode i.e. 100 % duty cycle at the appropriate center frequency.

Test Measurement Set up



Measurement set up for Transmitter Peak Output Power

Antenna Gain - Maximum Allowable Power Level

2400 – 2483.5 MHz Band: If transmitting antennas of directional gain greater than 6 dBi are used the peak output power from the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi. Maximum allowable peak power +30 dBm.

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

Antenna Type	Gain (dBi)	Antenna Gain >6dBi (dB)	Max. Allowable Peak Power (+dBm)
2.4GHz Planar Patch	8	2	$30 - 2/3 = 29 \frac{1}{3}$
2.4GHz 4 ft dipole	12	6	$30 - 6/3 = 28$
2.4GHz Yagi - Panel	15	9	$30 - 9/3 = 27$
2.4GHz 90° Sectoral	16	10	$30 - 10/3 = 26 \frac{2}{3}$
2.4GHz Parabolic	24	18	$30 - 18/3 = 24$



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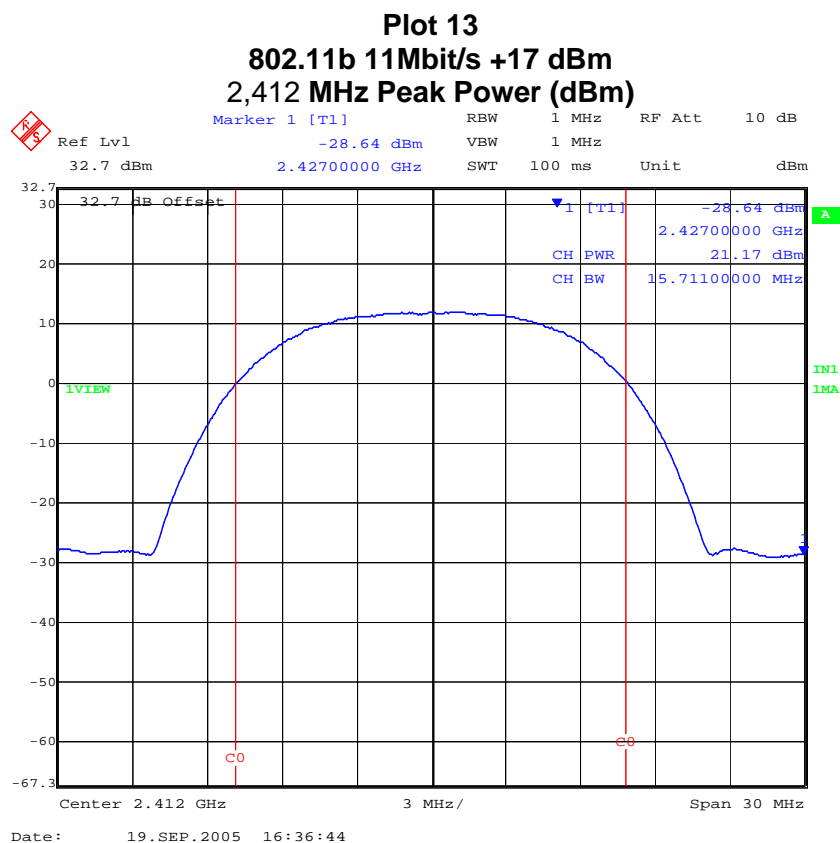
Measurement Results for Peak Output Power

Ambient conditions.

Temperature: 19 to 26 °C Relative humidity: 31 to 57 % Pressure: 999 to 1009 mbar

TABLE OF RESULTS – 802.11b 11Mbit/s +17 dBm

Center Frequency (MHz)	99% Measurement Bandwidth (MHz)	Peak Power (dBm)	Average Power (dBm)	Plot #
2,412	15.711	21.17	15.7	13
2,437	15.711	20.97	15.6	On File
2,462	15.631	20.84	16.0	On File



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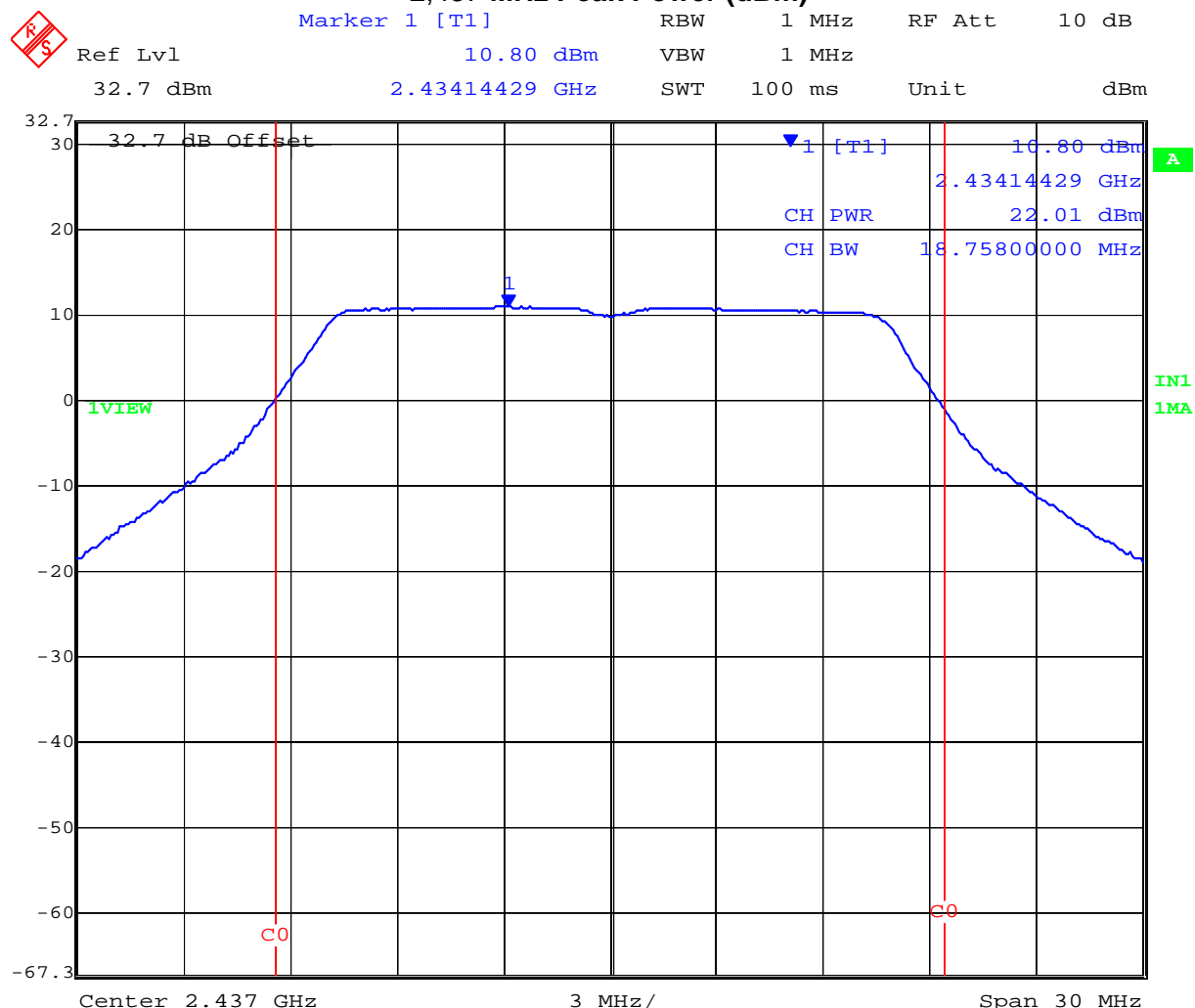


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TABLE OF RESULTS – 802.11g 6Mbit/s +17 dBm

Center Frequency (MHz)	99% Measurement Bandwidth (MHz)	Peak Power (dBm)	Average Power (dBm)	Plot #
2,412	18.758	21.38	15.04	On File
2,437	18.758	22.01	15.54	14
2,462	18.597	21.61	15.27	On File

Plot 14
802.11g 6Mbit/s +17 dBm
2,437 MHz Peak Power (dBm)



Date: 19.SEP.2005 16:49:03

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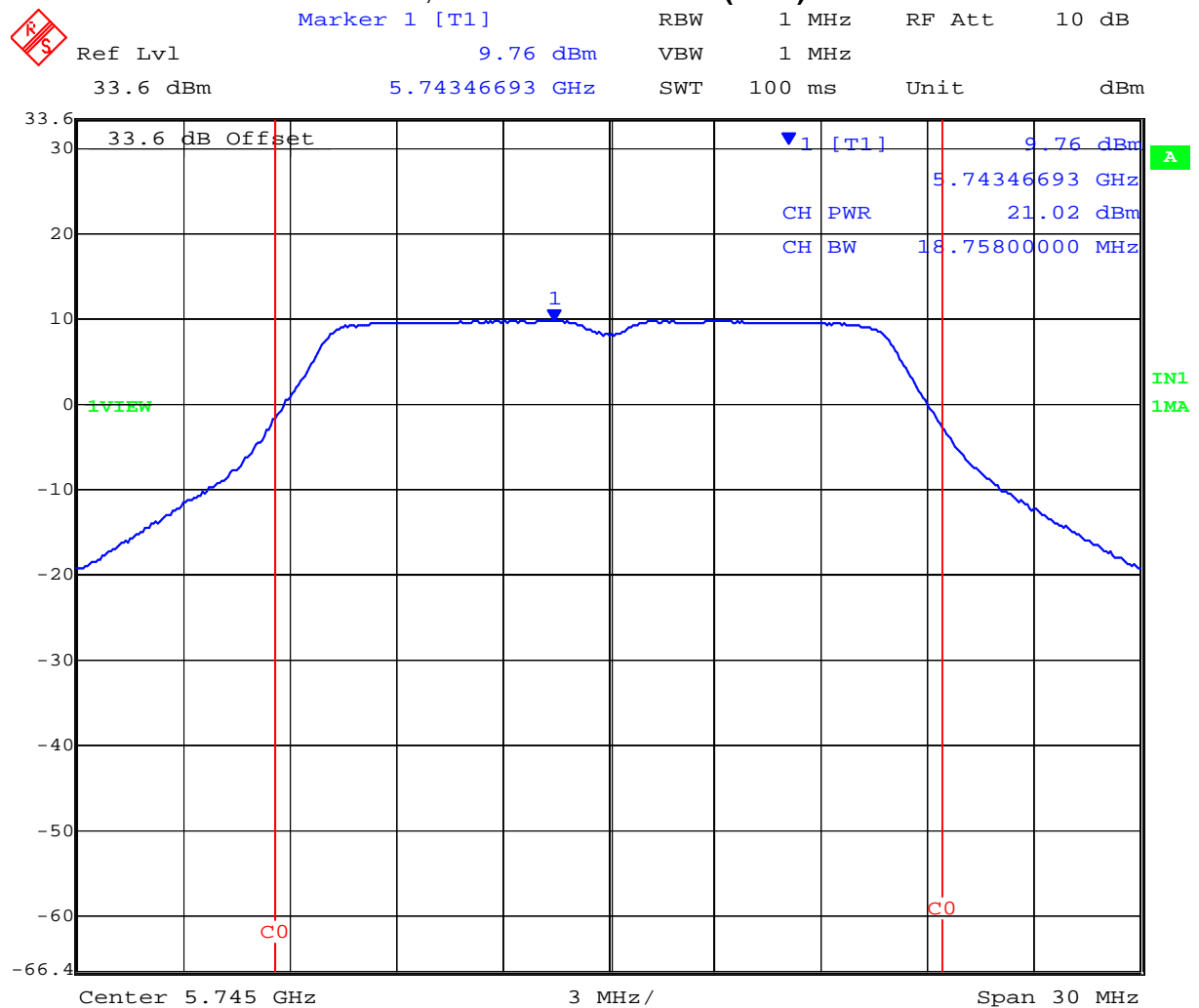


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TABLE OF RESULTS – 802.11a 6Mbit/s +17 dBm

Center Frequency (MHz)	99% Measurement Bandwidth (MHz)	Peak Power (dBm)	Average Power (dBm)	Plot #
5,745	18.758	21.02	15.01	15
5,785	18.597	21.00	14.87	On File
5,825	18.517	21.01	14.80	On File

Plot 15
802.11a 6Mbit/s +17 dBm
5,745 MHz Peak Power (dBm)



Date: 19.SEP.2005 16:57:45

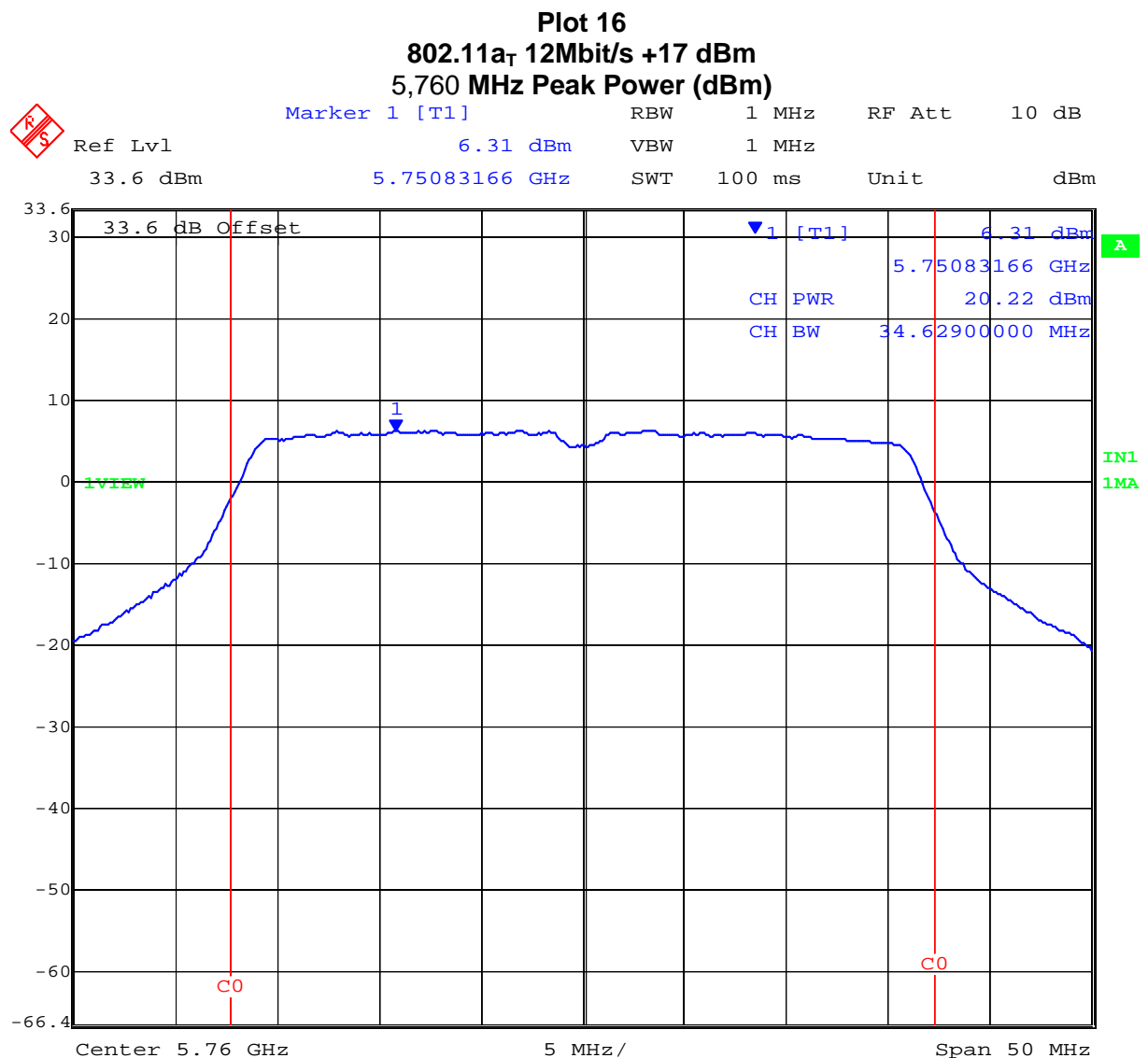
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TABLE OF RESULTS – 802.11a_T 12Mbit/s +17 dBm

Center Frequency (MHz)	99% Measurement Bandwidth (MHz)	Peak Power (dBm)	Average Power (dBm)	Plot #
5,760	34.629	20.22	14.79	16
5,800	34.990	19.96	14.56	On File



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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 watt

§15.247 (b) (4) 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.

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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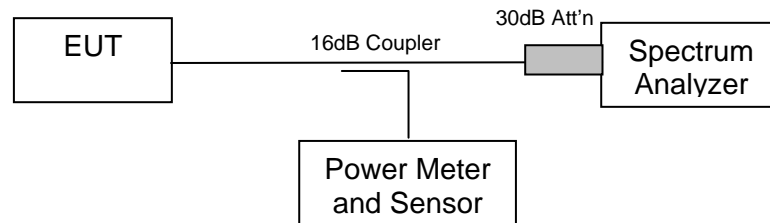
5.1.3. Peak Power Spectral Density

FCC, Part 15 Subpart C §15.247(d)

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 => 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: 19 to 26 °C Relative humidity: 31 to 57 % Pressure: 999 to 1009 mbar

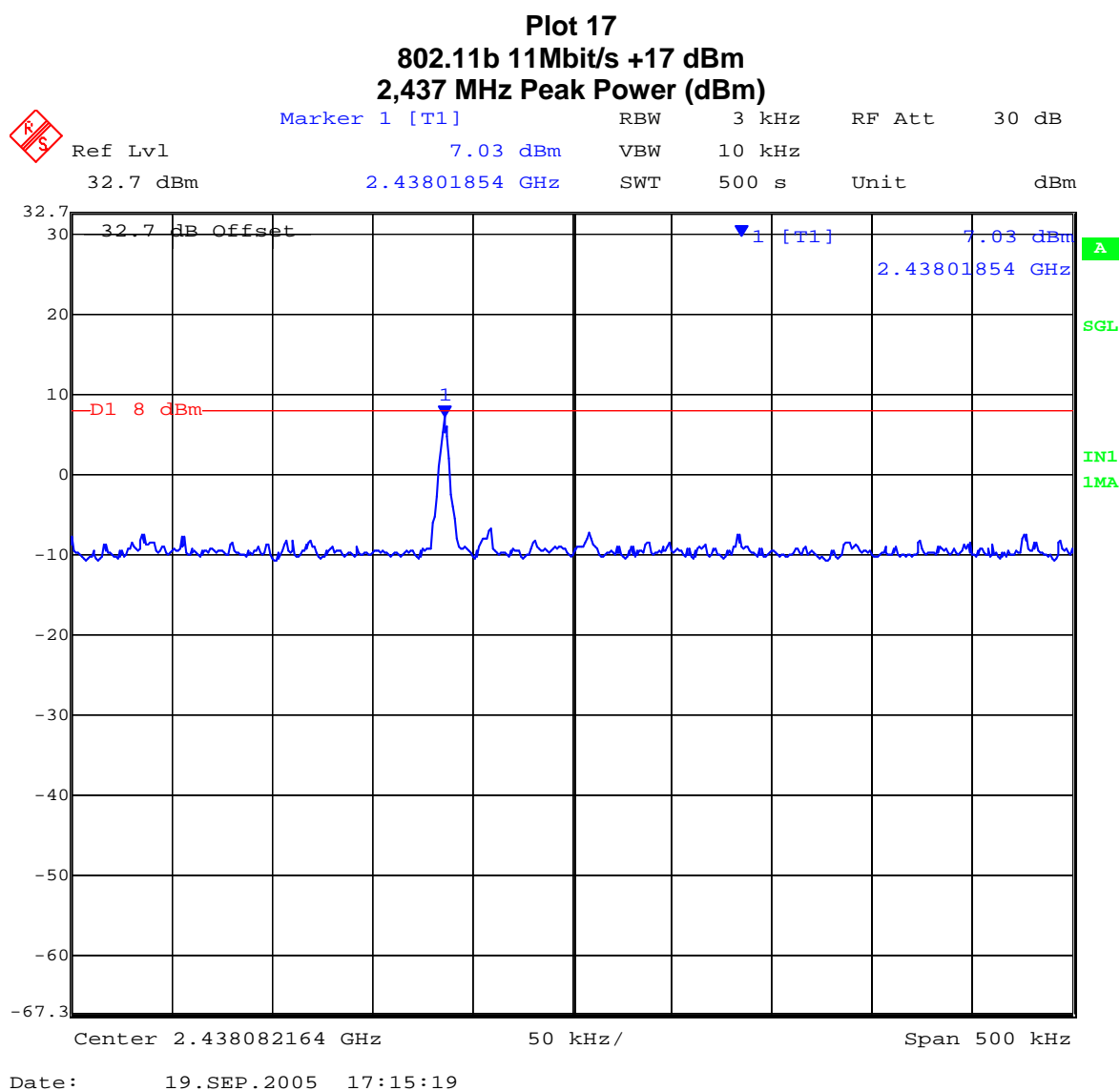


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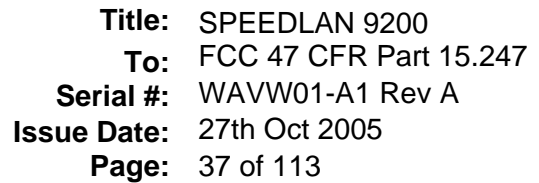
Measurement Results for Peak Power Spectral Density

TABLE OF RESULTS – 802.11b 11Mbit/s +17 dBm

Center Frequency (MHz)	Peak Frequency (MHz)	PPSD (dBm)	Plot #
2,412	2413.01854	-1.36	On File
2,437	2438.01854	+7.03	17
2,462	2463.01653	+3.76	On File



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Center Frequency (MHz)	Peak Frequency (MHz)	PPSD (dBm)	Plot #
2,412	2417.23798	-8.63	On File
2,437	2434.48948	-8.03	18
2,462	2465.73898	-8.94	On File



MiCOM Labs, 3922 Valley Avenue, Suite B, Pleasanton, CA 94566 USA, Phone: 925.462.0304, Fax: 925.462.0306, www.micomlabs.com

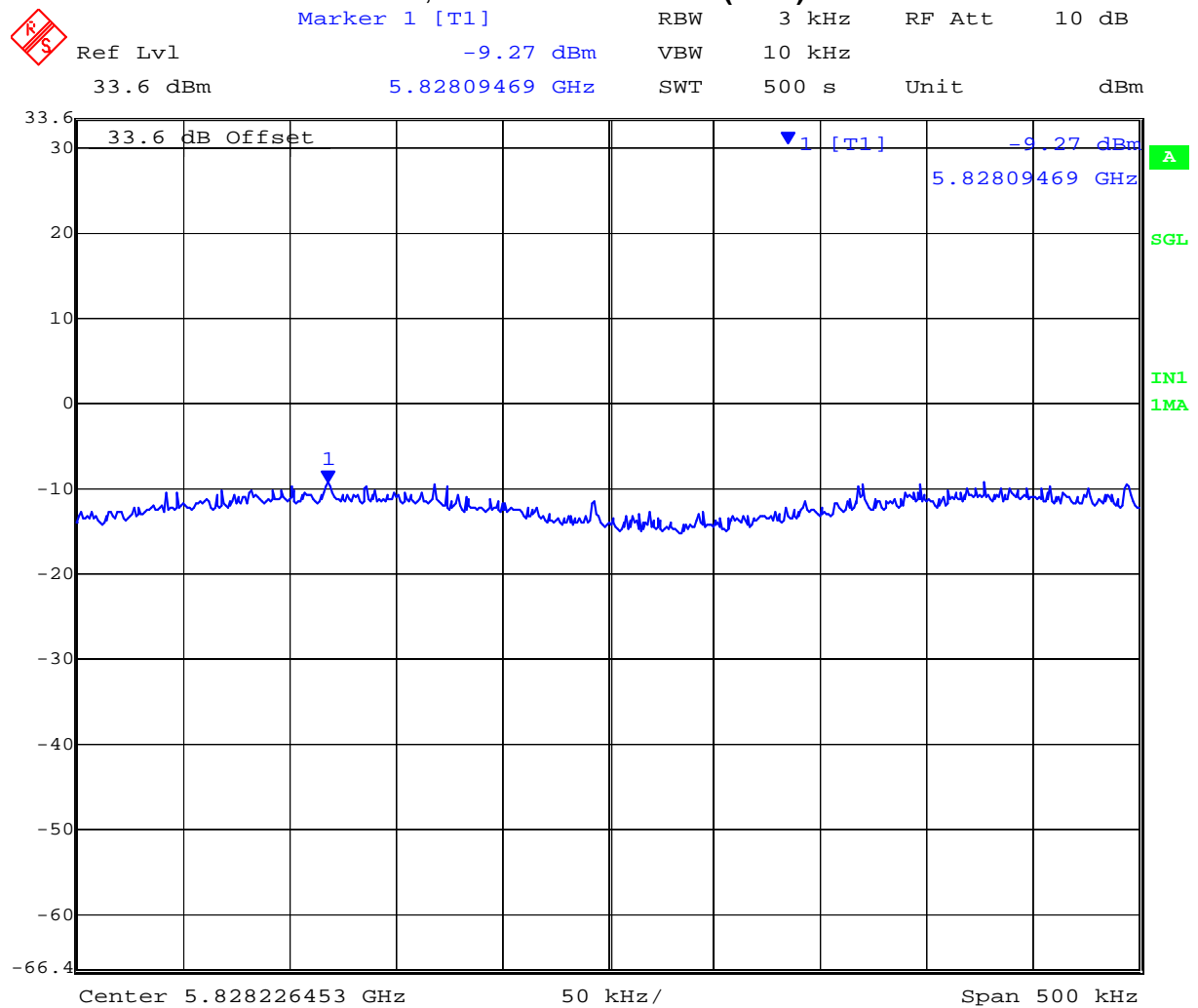


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TABLE OF RESULTS – 802.11a 6Mbit/s +17 dBm

Center Frequency (MHz)	Peak Frequency (MHz)	PPSD (dBm)	Plot #
5,745	5742.46743	-10.60	On File
5,785	5783.71894	-9.30	On File
5,825	5828.09469	-9.27	19

Plot 19
802.11a 6Mbit/s +17 dBm
5,825 MHz Peak Power (dBm)



Date: 20.SEP.2005 10:41:35

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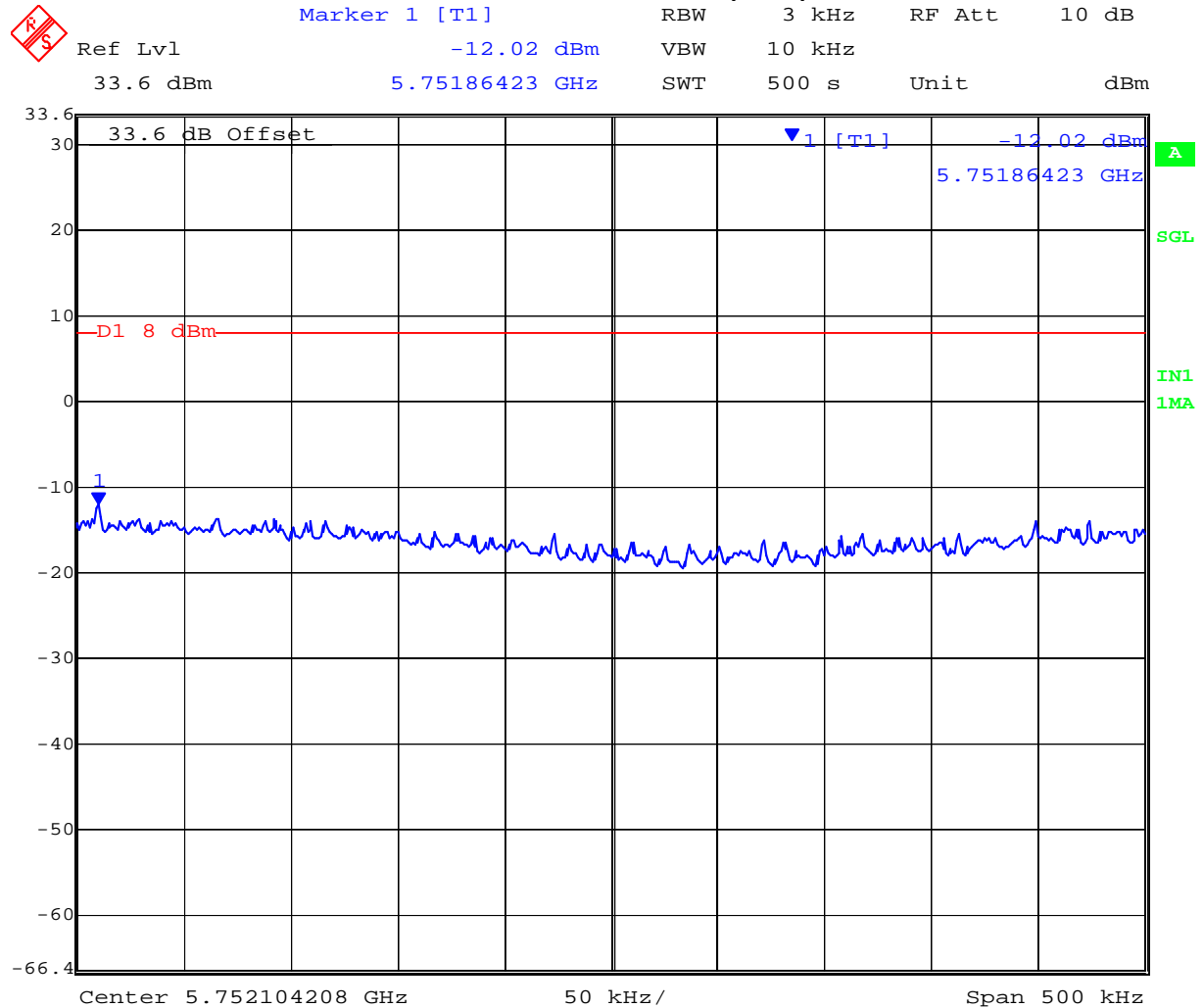


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TABLE OF RESULTS – 802.11a_T 12Mbit/s +17 dBm

Center Frequency (MHz)	Peak Frequency (MHz)	PPSD (dBm)	Plot #
5,760	5751.86423	-12.02	20
5,800	5788.22194	-12.99	On File

Plot 20
802.11a_T 12Mbit/s +17 dBm
5,760 MHz Peak Power (dBm)



Date: 20.SEP.2005 10:55:46

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Specification
Peak Power Spectral Density Limits

§15.247 (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

Laboratory Measurement Uncertainty for Spectral Density

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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5.1.4. Maximum Permissible Exposure

FCC, Part 15 Subpart C §15.247(b)(5)

Calculations for Maximum Permissible Exposure Levels

Power Density = Pd (mW/cm²) = EIRP/(4πd²)

EIRP = P * G

P = Peak output power (mW)

G = Antenna numeric gain (numeric)

d = Separation distance (cm)

Numeric Gain = 10 ^ (G (dBi)/10)

2.4 GHz 802.11g = Max. Output Power +22.01 dBm, 158.9 mW

Max. Antenna Gain = 24 dBi, **251.2 numeric**

Min. Antenna Gain = 8 dBi, **6.3 numeric**

5.8 GHz 802.11a = Max. Output Power +21.02 dBm, 126.5 mW

Max. Antenna Gain = 29 dBi, **794.3 numeric**

Min. Antenna Gain = 10 dBi, **10.0 numeric**

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

Minimum Gain Antennas

Freq. Band	Antenna Gain (Numeric)	Peak Output Power (mW)	Calculated RF Exposure at d=20cm (mW/cm ²)	Limit (mW/cm ²)
2.4 GHz	6.3	158.9	0.2	1
5.8 GHz	10	126.5	0.25	1

Maximum Gain Antennas – Calculated Safe Distance @ 1 mW/cm²

Freq. Band	Antenna Gain (Numeric)	Peak Output Power (mW)	Calculated Safe Distance (at 1 mW/cm ²) (cm)	Limit (mW/cm ²)
2.4 GHz	251.2	158.9	56.4	1
5.8 GHz	794.3	126.5	89.4	1

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Specification

Maximum Permissible Exposure Limits

§15.247 (b)(5) 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. See §1.1307 (b)(1) of this chapter.

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.

Laboratory Measurement Uncertainty for Power Measurements

Measurement uncertainty	±1.33dB
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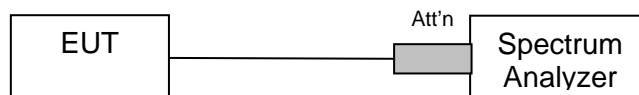
5.1.5. Conducted Spurious Emissions

FCC, Part 15 Subpart C §15.247(c)

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: 19 to 26 °C Relative humidity: 31 to 57 % Pressure: 999 to 1009 mbar



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Conducted Band-Edge Results

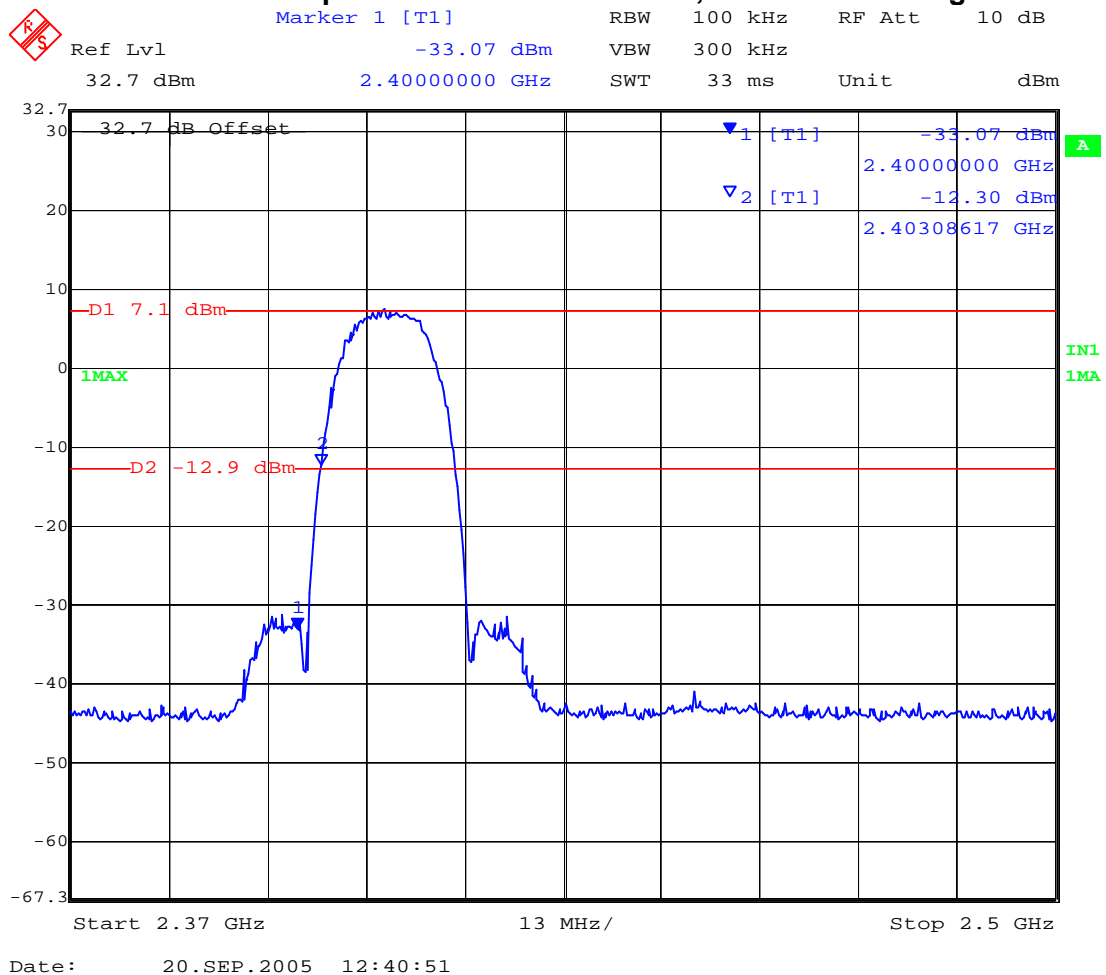
TABLE OF RESULTS – 802.11b 11Mbit/s +17 dBm

Center Frequency (MHz)	Band edge Frequency (MHz)	Limit (20 dB below peak of fundamental)	Amplitude @ Band edge (dBm)	Plot #	Margin (dB)
2,412	2,402.82565	-12.9	-33.07	21	-20.17
2,462	2,470.82164	-12.9	-43.91	22	-31.01

Plot 21

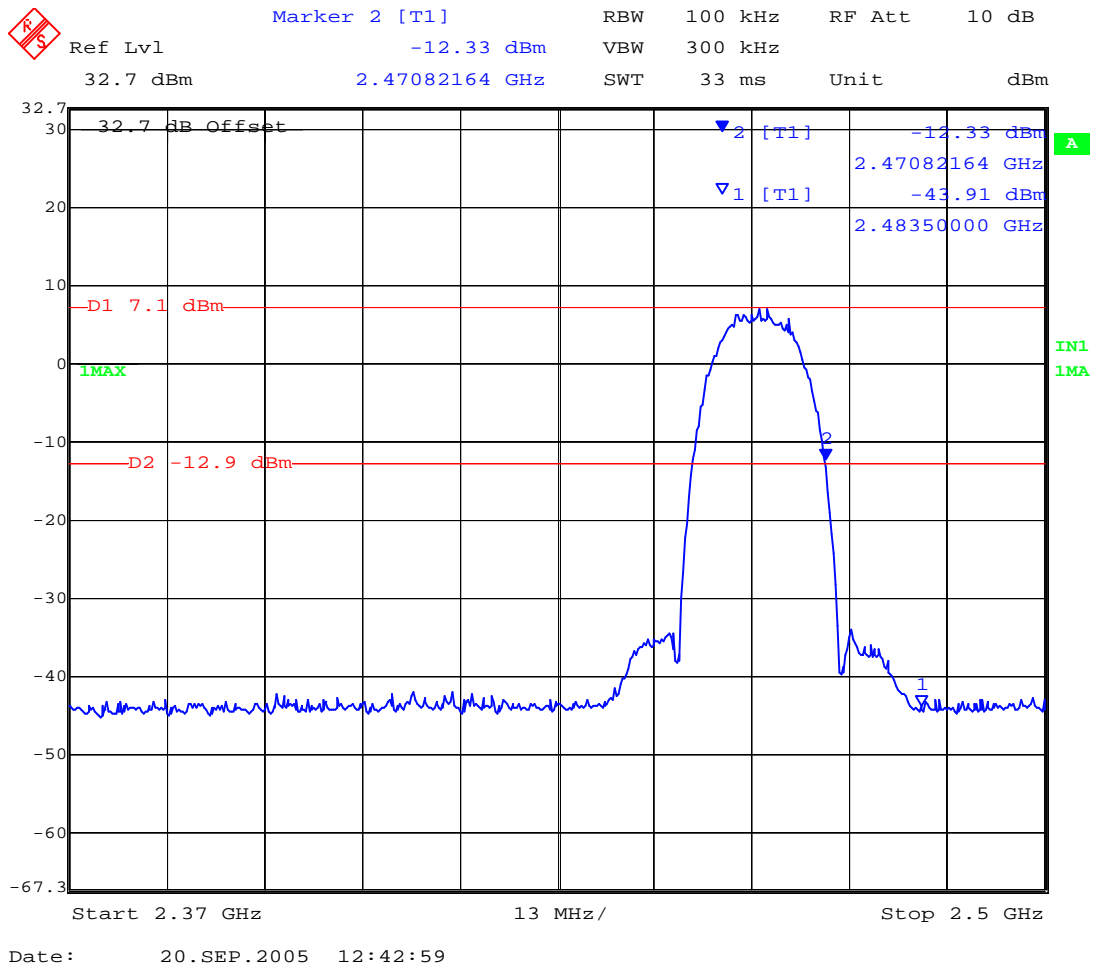
802.11b 11Mbit/s +17 dBm

Conducted Spurious Emissions at the 2,400 MHz Band Edge



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Plot 22
802.11b 11Mbit/s +17 dBm
Conducted Spurious Emissions at the 2,483.5 MHz Band Edge



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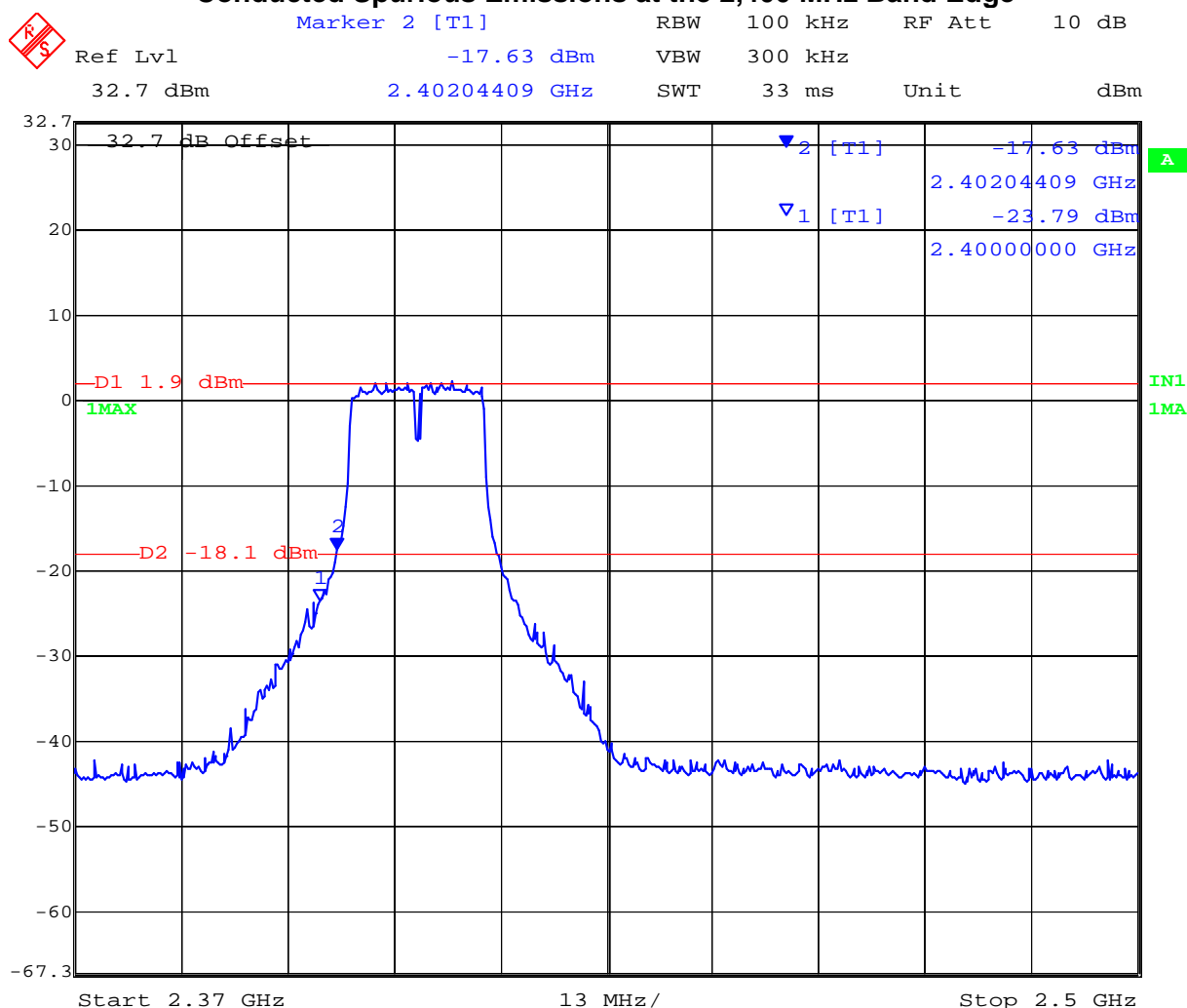


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TABLE OF RESULTS – 802.11g 6Mbit/s +17 dBm

Center Frequency (MHz)	Band edge Frequency (MHz)	Limit (20 dB below peak of fundamental)	Amplitude @ Band edge (dBm)	Plot #	Margin (dB)
2,412	2,402.04409	-18.1	-23.79	23	-5.69
2,462	2,471.86373	-18.1	-38.05	24	-19.95

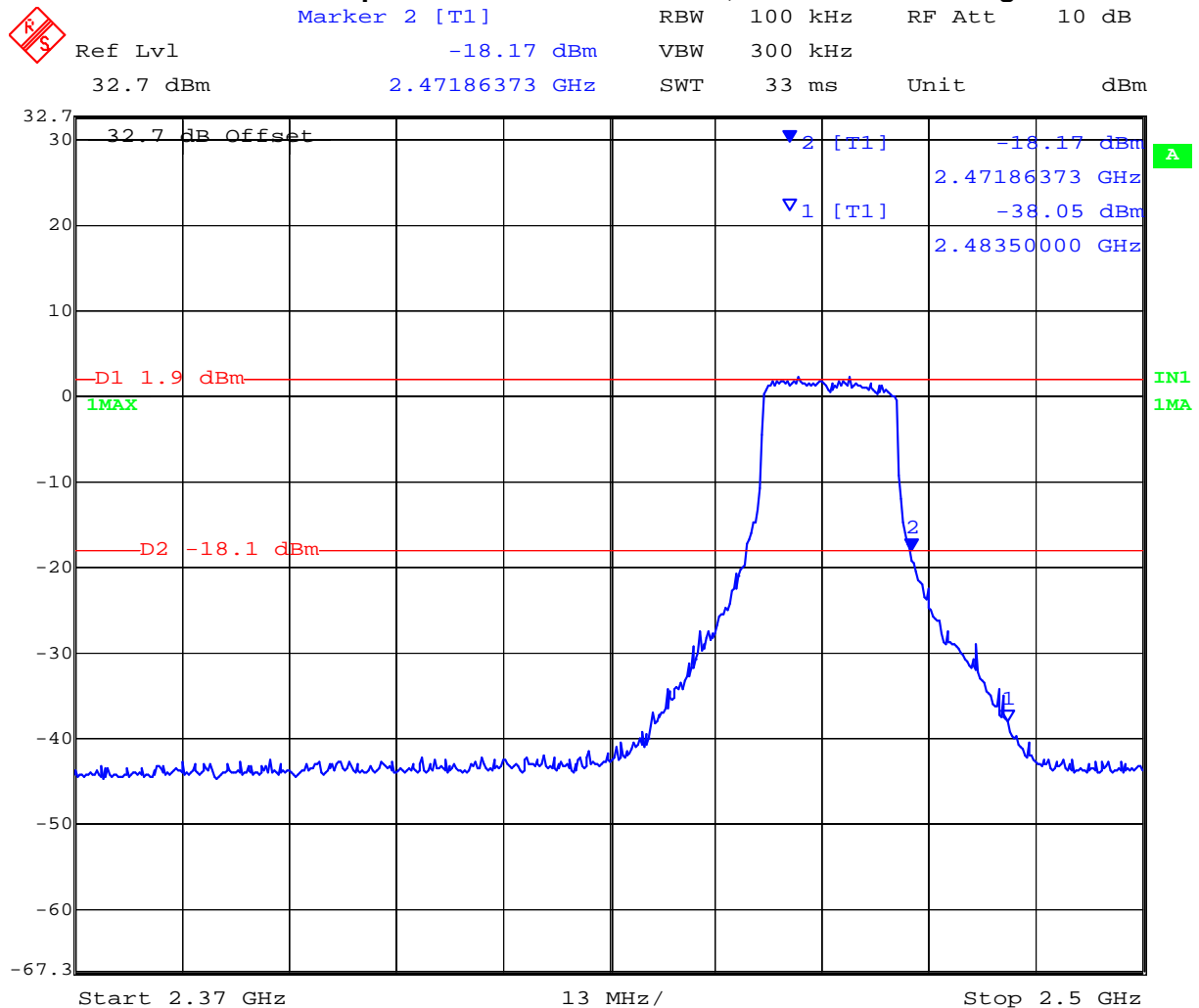
Plot 23
802.11g 6Mbit/s +17 dBm
Conducted Spurious Emissions at the 2,400 MHz Band Edge



Date: 20.SEP.2005 12:47:50

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Plot 24
802.11g 6Mbit/s +17 dBm
Conducted Spurious Emissions at the 2,483.5 MHz Band Edge



Date: 20.SEP.2005 12:46:27

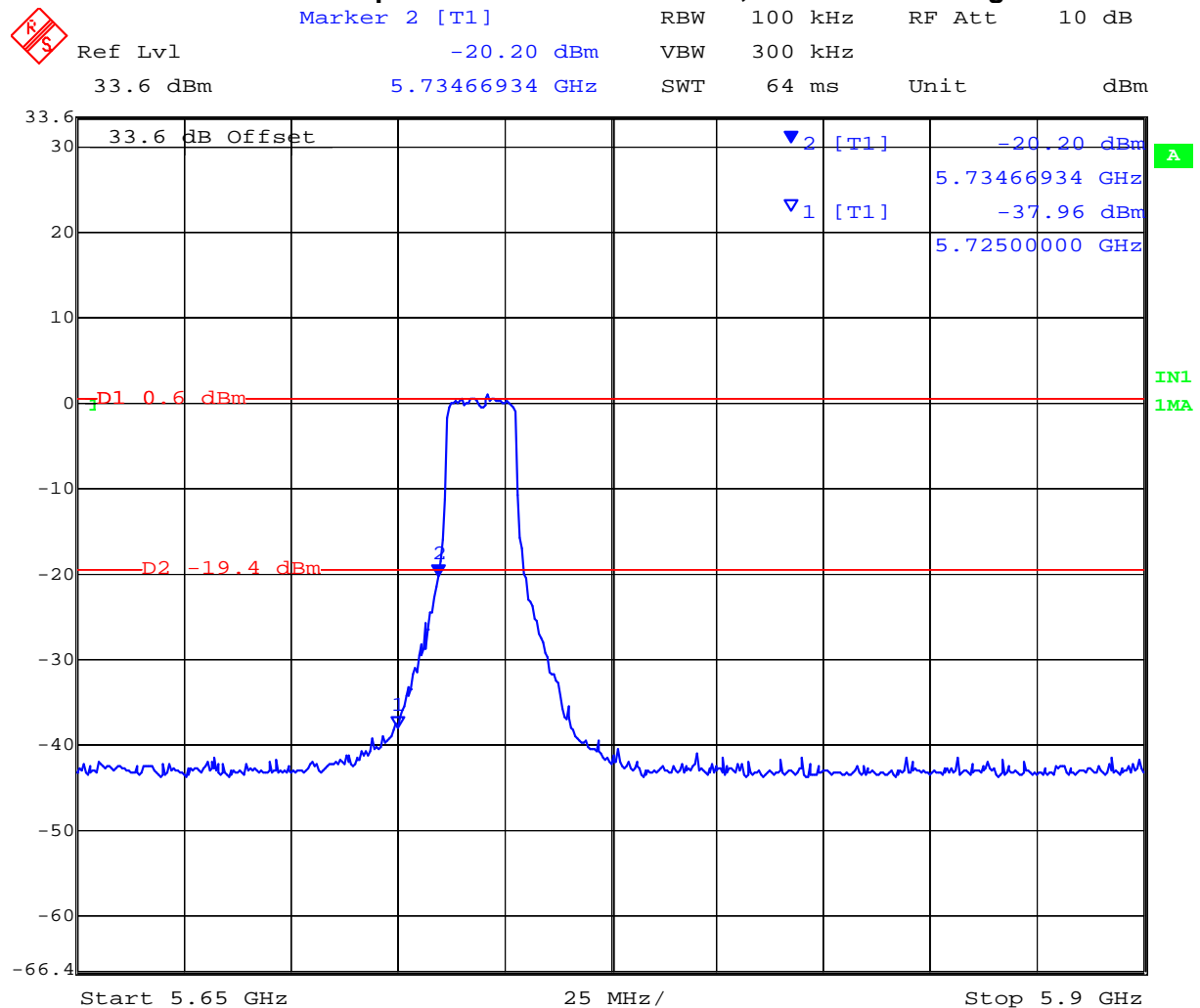


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TABLE OF RESULTS – 802.11a 6Mbit/s +17 dBm

Center Frequency (MHz)	Band edge Frequency (MHz)	Limit (20 dB below peak of fundamental)	Amplitude @ Band edge (dBm)	Plot #	Margin (dB)
5,745	5,734.66934	-19.4	-37.96	25	-18.56
5,825	5,835.37074	-19.4	-36.77	26	-17.37

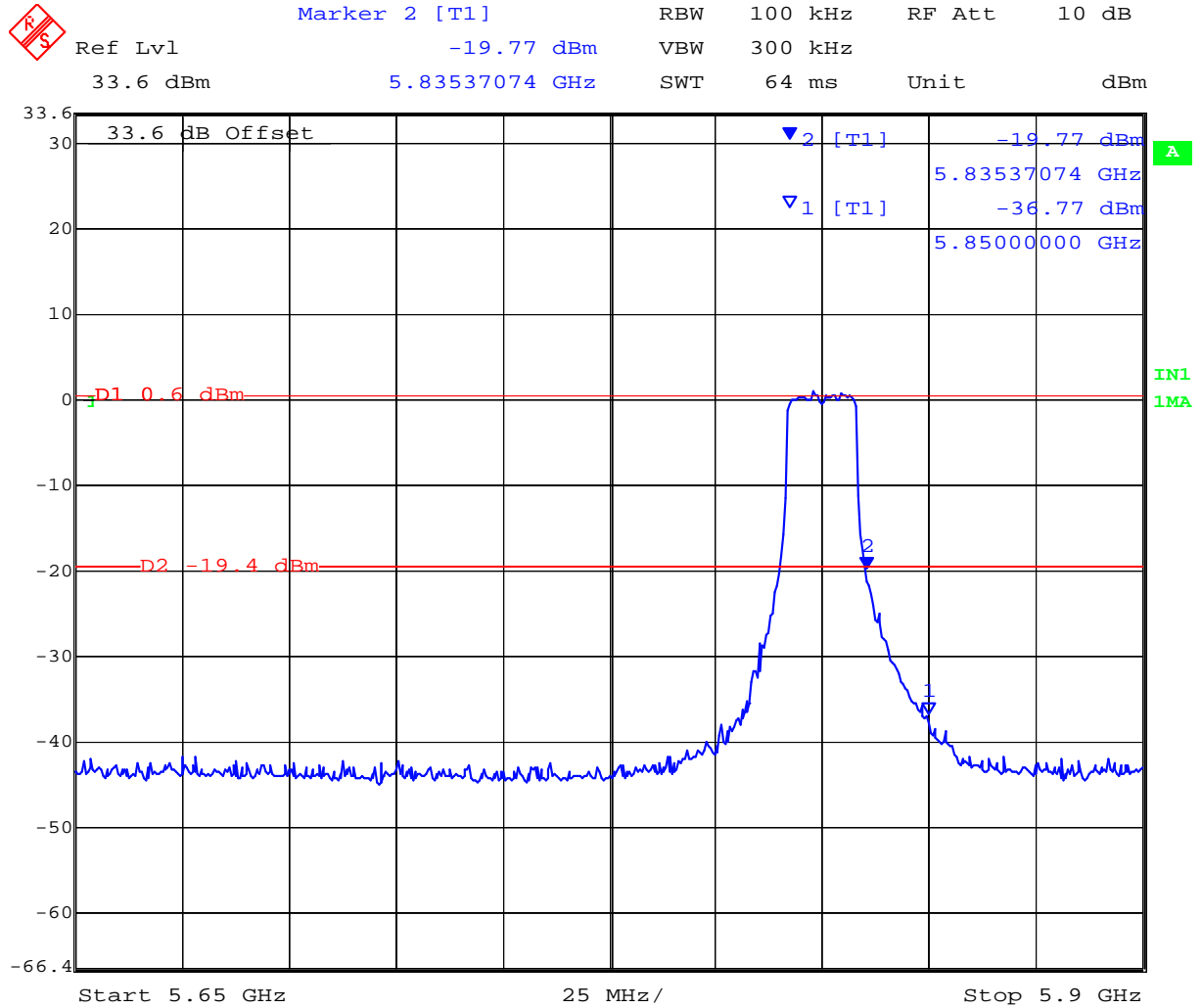
Plot 25
802.11a 6Mbit/s +17 dBm
Conducted Spurious Emissions at the 5,725 MHz Band Edge



Date: 20.SEP.2005 13:22:21

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Plot 26
802.11a 6Mbit/s +17 dBm
Conducted Spurious Emissions at the 5,850 MHz Band Edge



Date: 20.SEP.2005 13:25:12

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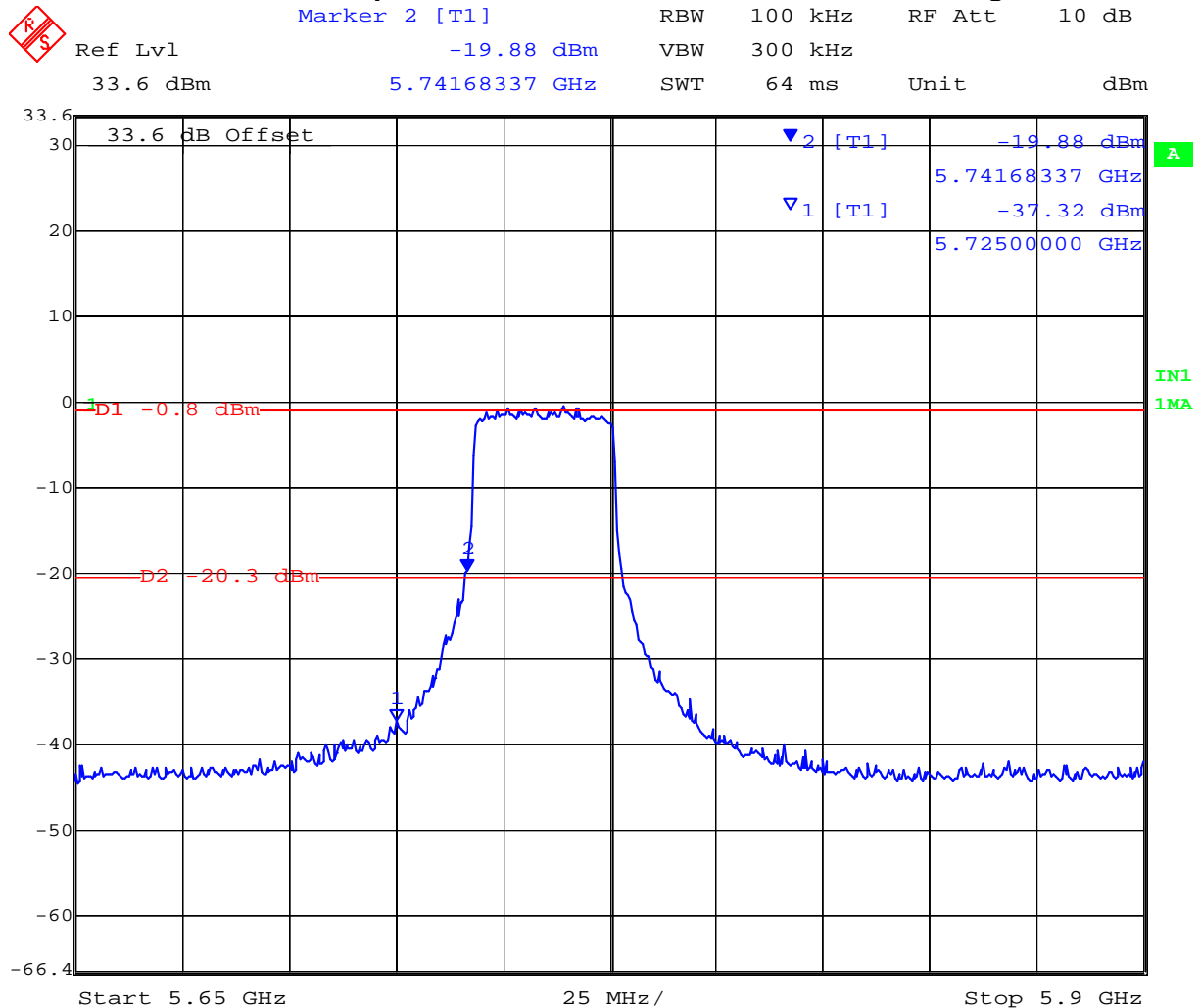


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TABLE OF RESULTS – 802.11a_T 12Mbit/s +17 dBm

Center Frequency (MHz)	Band edge Frequency (MHz)	Limit (20 dB below peak of fundamental)	Amplitude @ Band edge (dBm)	Plot #	Margin (dB)
5,760	5,741.68337	-20.3	-37.32	27	-17.02
5,800	5,818.83768	-20.3	-38.99	28	-18.69

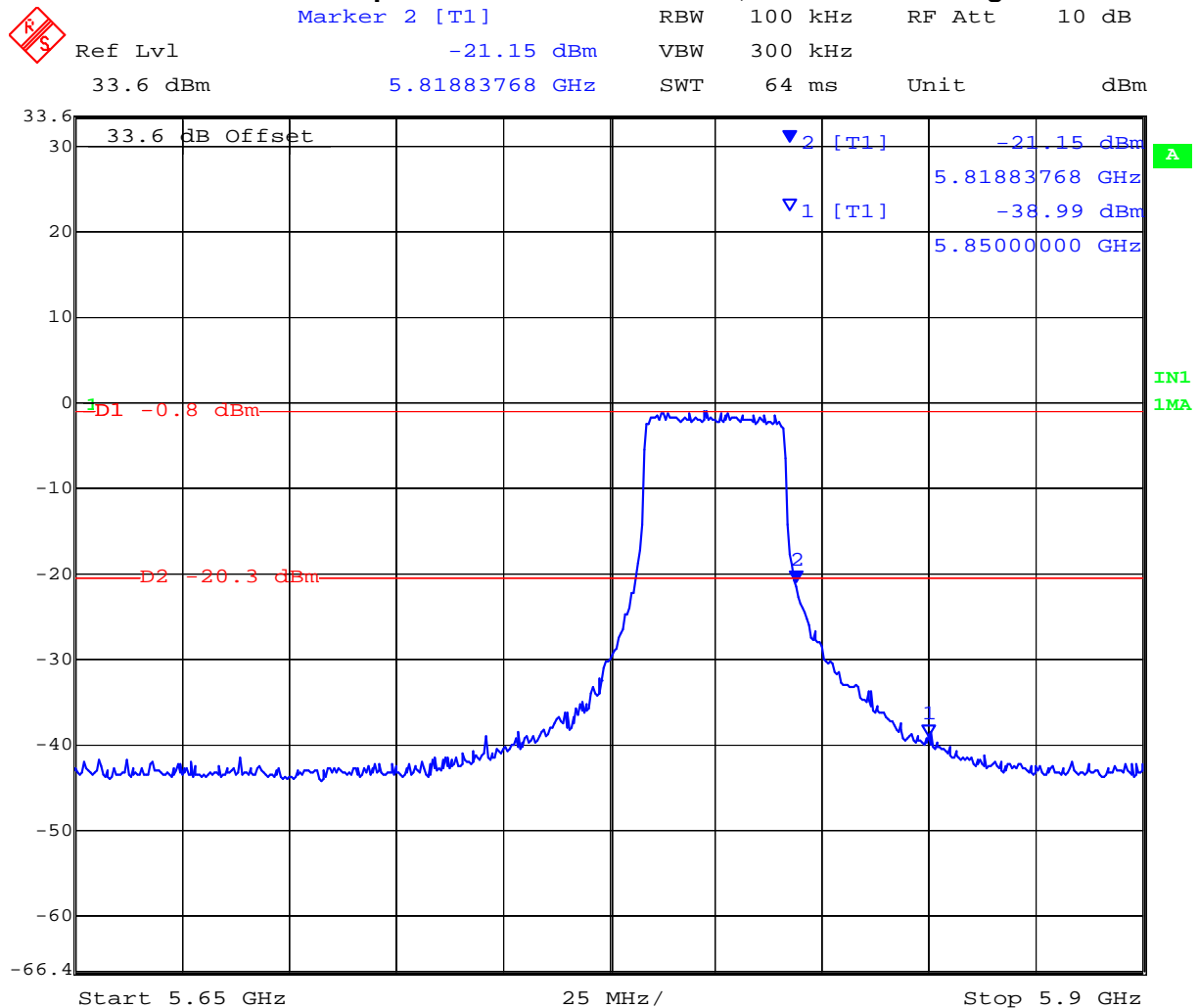
Plot 27
802.11a_T 12Mbit/s +17 dBm
Conducted Spurious Emissions at the 5,725 MHz Band Edge



Date: 20.SEP.2005 13:35:47

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Plot 28
802.11a_T 12Mbit/s +17 dBm
Conducted Spurious Emissions at the 5,850 MHz Band Edge



Date: 20.SEP.2005 13:34:50



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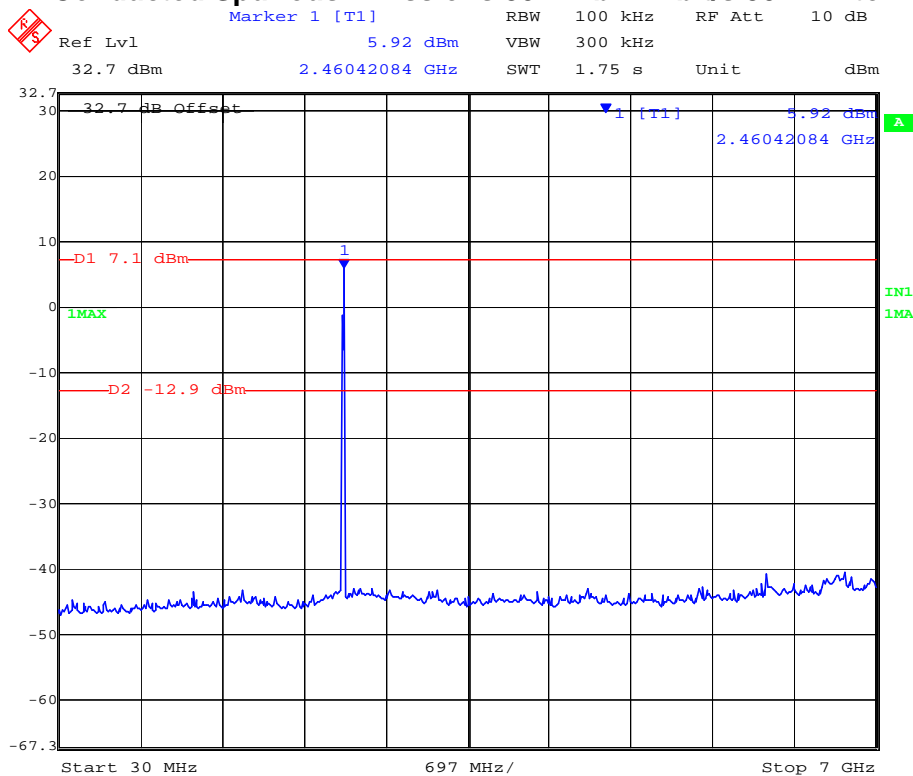
Spurious Emissions

Conducted spurious emissions were measured over the frequency ranges 30 MHz to 26.5 GHz for the b and g options, and 30 MHz to 40 GHz for the a and a_T options. 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 11Mbit/s +17 dBm

CH	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Plot #	Margin (dB)
1	30	7,000	-41.5	-12.9	On File	-28.6
1	7,000	26,500	-56.0	-12.9	On File	-43.1
11	30	7,000	-40.5	-12.9	Plot 29	-27.6
11	7,000	26,500	-58.5	-12.9	Plot 30	-45.6

Plot 29
CH 11 Conducted Spurious Emissions 802.11b 11Mbit/s 30 MHz to 7 GHz



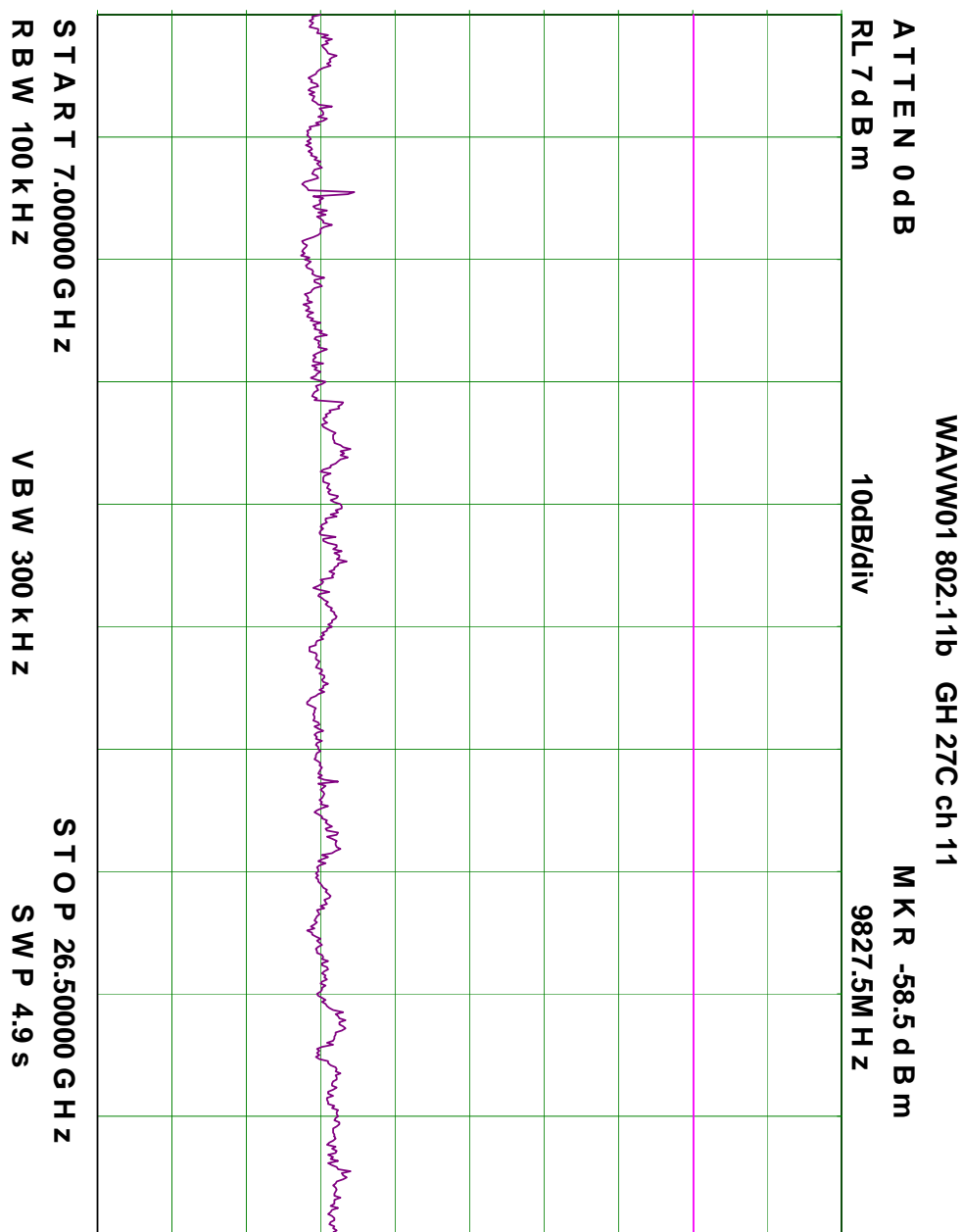
Date: 20.SEP.2005 13:00:00

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Plot 30
CH 11 Conducted Spurious Emissions 802.11b 11Mbit/s 7 GHz to 26.5 GHz



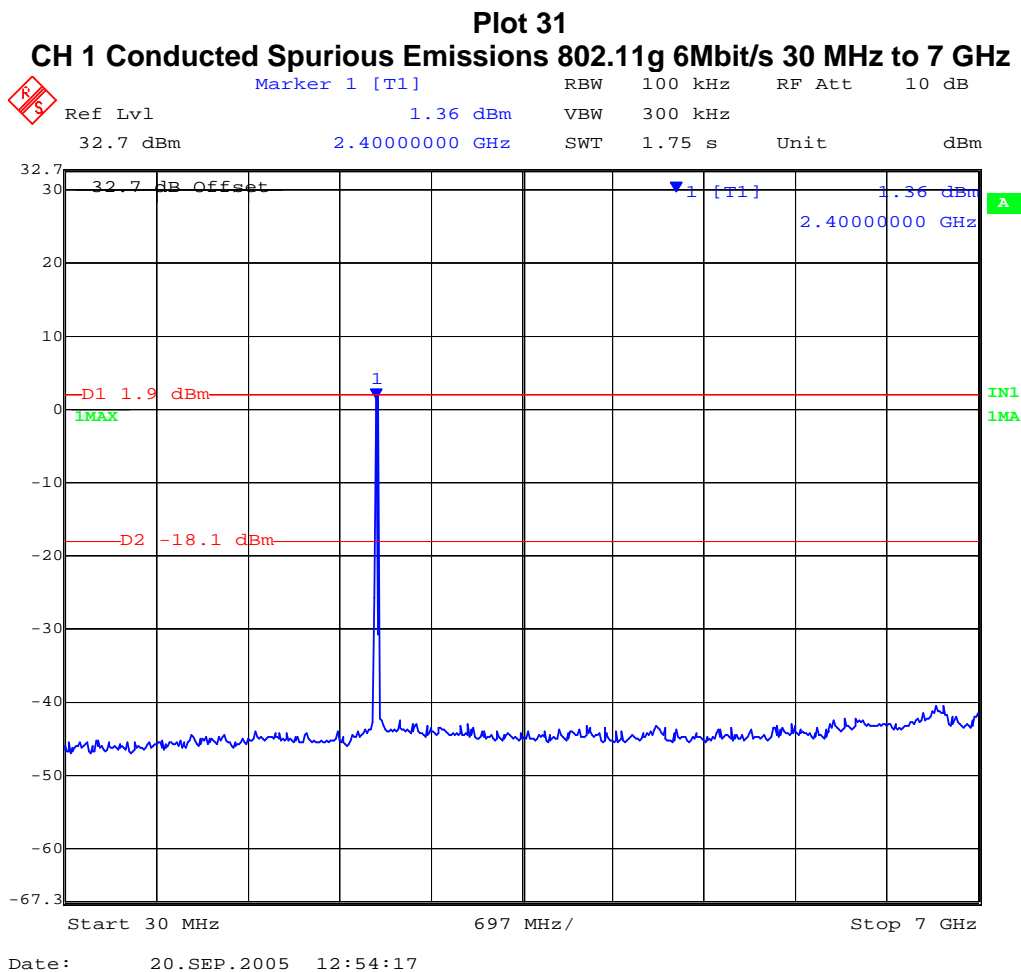
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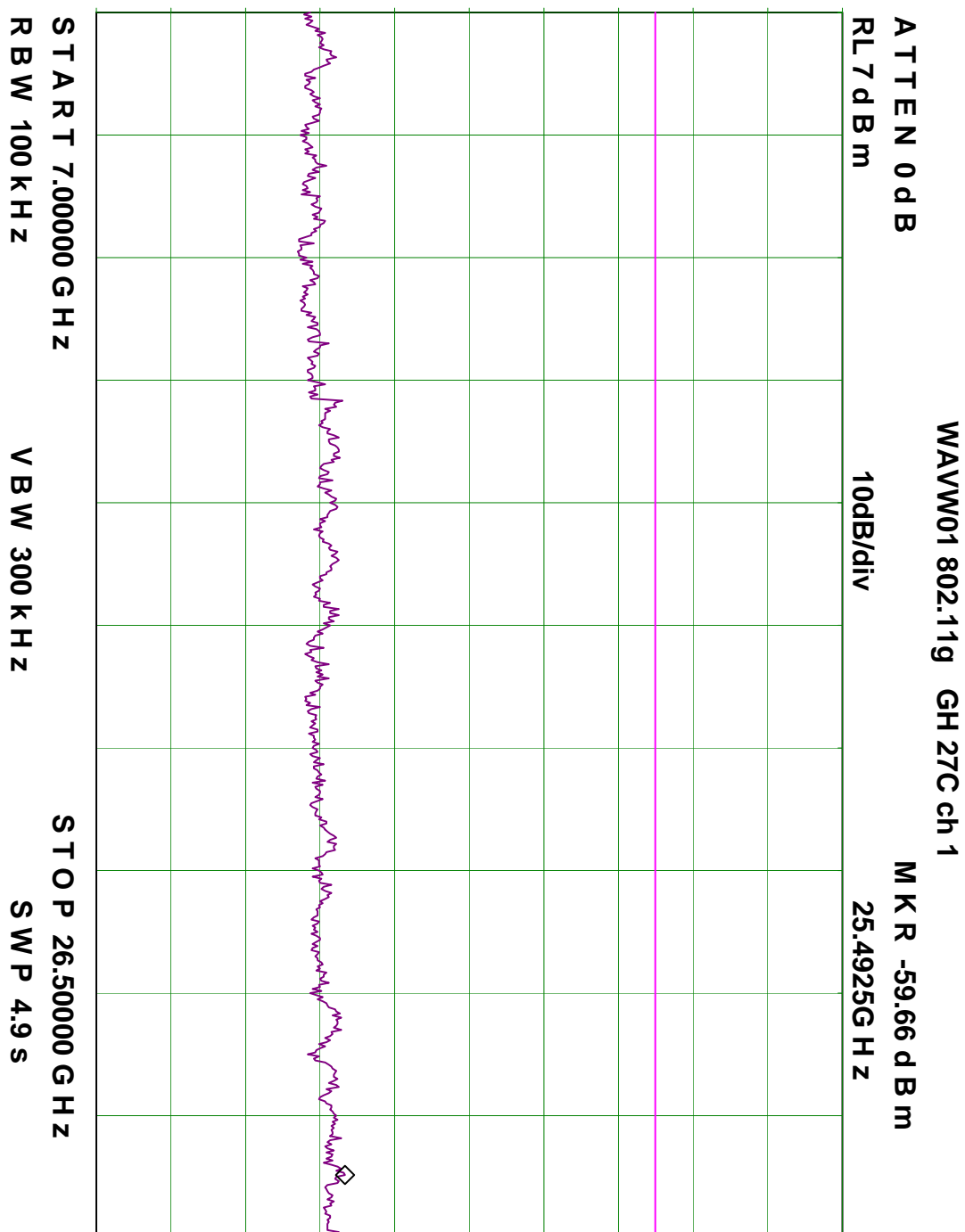
TABLE OF RESULTS – 802.11g 6Mbit/s +17 dBm

CH	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Plot #	Margin (dB)
1	30	7,000	-40.0	-18.1	Plot 31	-21.9
1	7,000	26,500	-59.7	-18.1	Plot 32	-41.6
11	30	7,000	-40.0	-18.1	On File	-21.9
11	7,000	26,500	-59.0	-18.1	On File	-40.9



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Plot 32
CH 1 Conducted Spurious Emissions 802.11g 6Mbit/s 7 GHz to 26.5 GHz





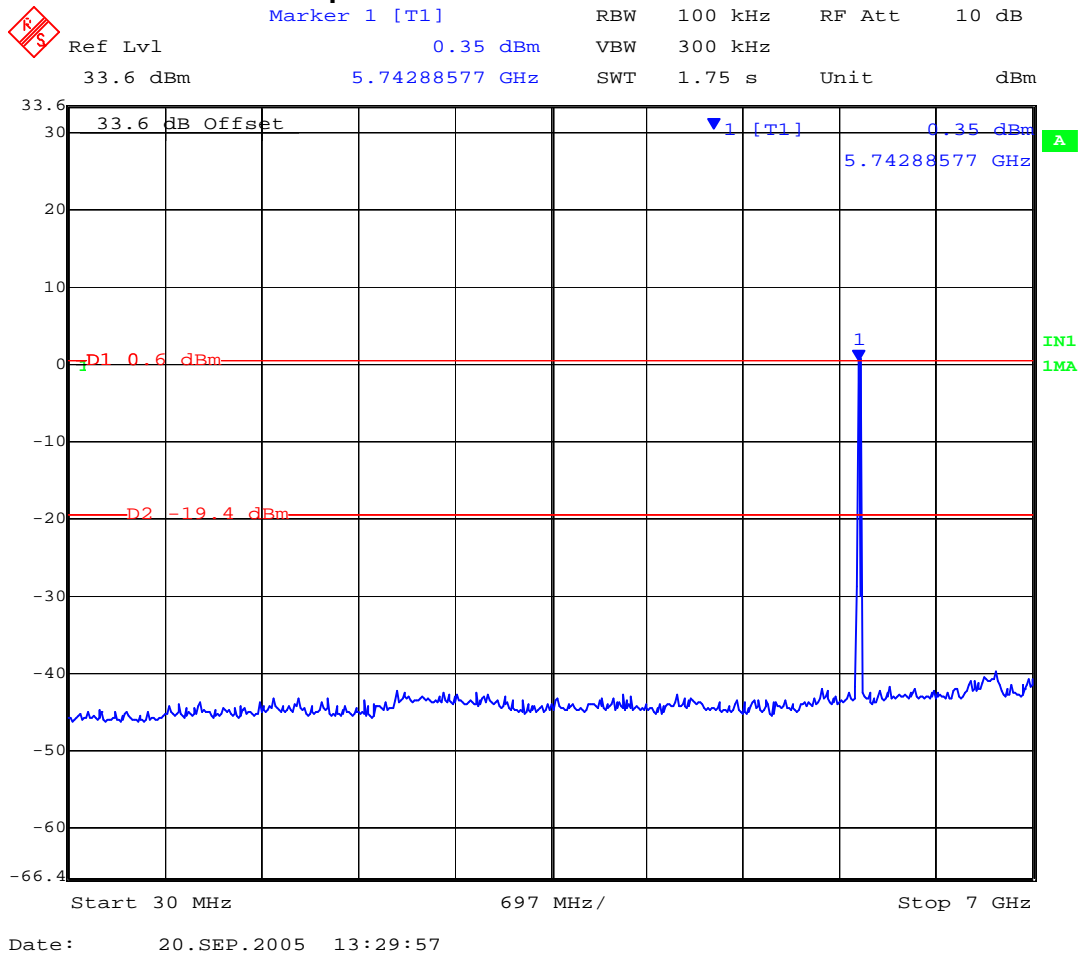
Title: SPEEDLAN 9200
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TABLE OF RESULTS – 802.11a 6Mbit/s +17 dBm

CH	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Plot #	Margin (dB)
149	30	7,000	-40.0	-19.4	Plot 33	-20.6
149	7,000	40,000	-58.8	-19.4	Plot 34	-39.4
165	30	7,000	-40.0	-19.4	On File	-20.6
165	7,000	40,000	-59.1	-19.4	On File	-39.7

Plot 33

CH 149 Conducted Spurious Emission 802.11a 6Mbit/s s 30 MHz to 7 GHz



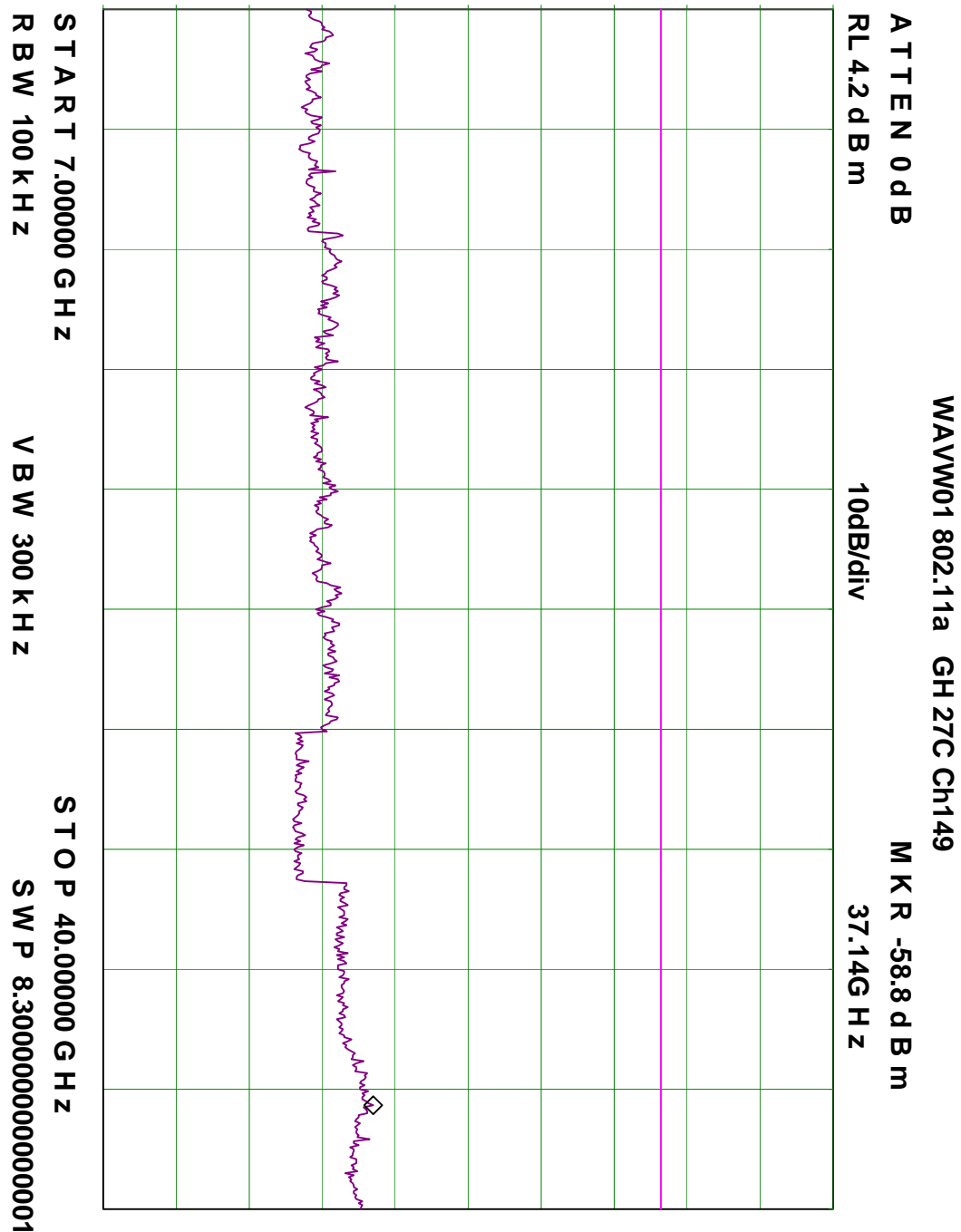
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Plot 34

CH 149 Conducted Spurious Emission 802.11a 6Mbit/s s 7 GHz to 40 GHz



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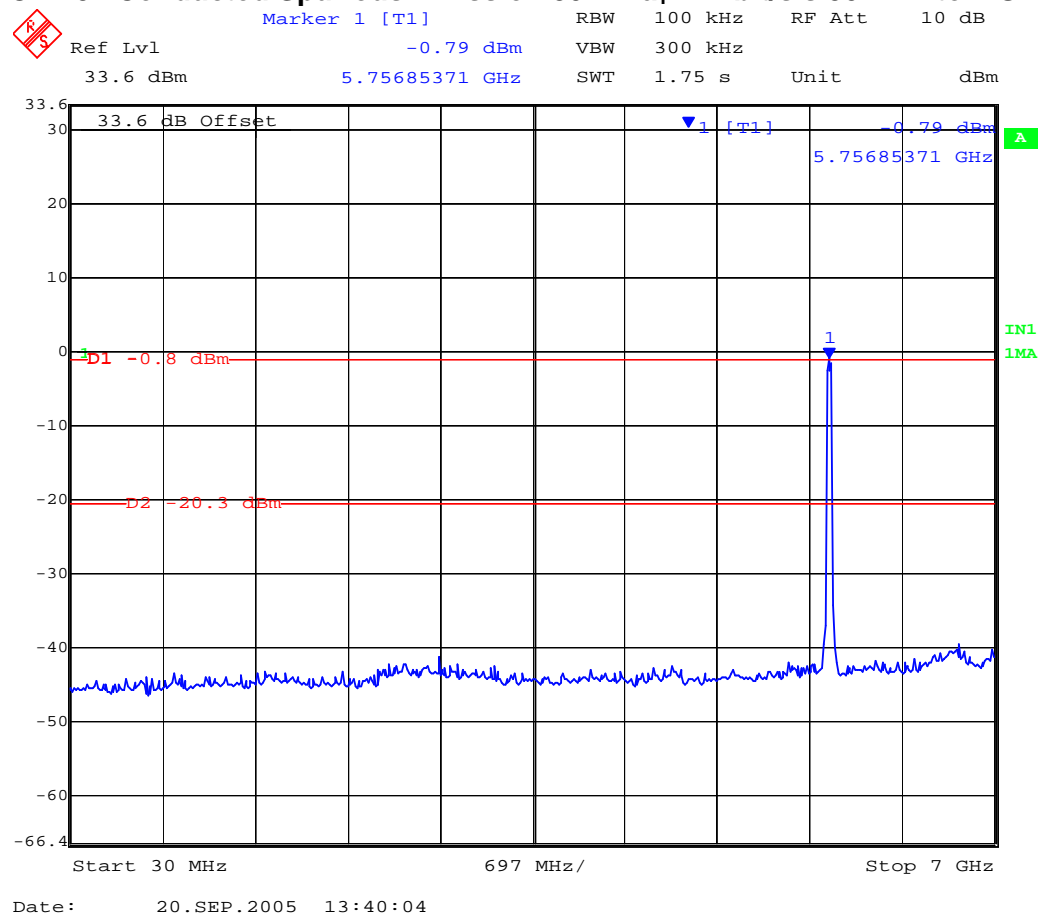
Title: SPEEDLAN 9200
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TABLE OF RESULTS –802.11a_T 12Mbit/s +17 dBm

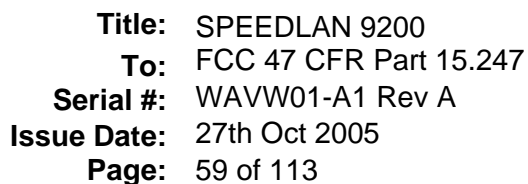
CH	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Plot #	Margin (dB)
152	30	7,000	-39.5	-20.3	35	-19.2
152	7,000	40,000	-58.5	-20.3	36	-38.2
160	30	7,000	-40.0	-20.3	On File	-19.7
160	7,000	40,000	-59.0	-20.3	On File	-38.7

Plot 35

CH 152 Conducted Spurious Emission 802.11a_T 12Mbit/s s 30 MHz to 7 GHz



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[illegible]



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Specification

§15.247(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 radiated measurement. Attenuation below the general limits specified in §15.209(a) is not required.

Laboratory Measurement Uncertainty for Conducted Spurious Emissions

Measurement uncertainty	±2.37 dB
-------------------------	----------

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)

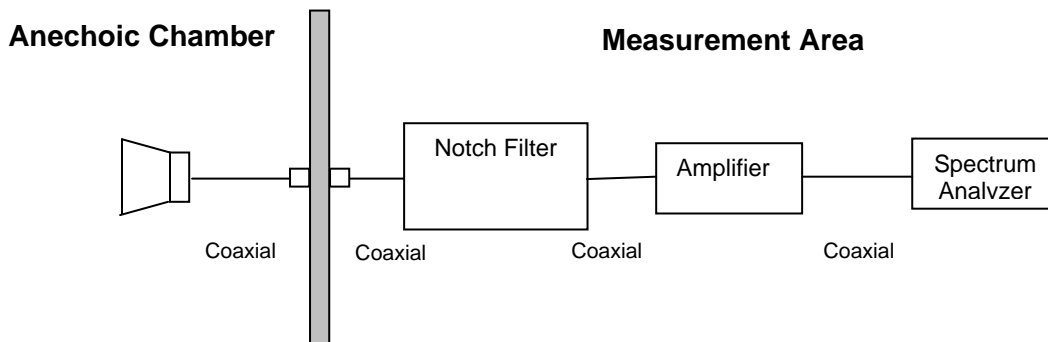
FCC, Part 15 Subpart C §15.247(c)

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. A notch filter and 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 = Band-stop 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:

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

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

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

Transmitter Radiated Spurious Emissions > 1GHz - Test Configurations

Antenna Configuration	Transmitter Spurious Emission
2.4GHz 8dBi (Planar Patch) Huber+Suhner 1324.19.0002	✓
2.4GHz 12dBi (4 ft dipole) Pacific Wireless Omni Directional OD24-12 S/N 04360034	✓
2.4GHz 15dBi (Yagi - Panel) Cushcraft PC2415	✓
2.4GHz 16dBi (90° Sectoral) Andrew Panel antenna DB980G90N-R	✓
2.4GHz 24dBi (Parabolic) Andrew AWP M0528D T-2400	✓
5.8GHz 10dBi (Omni Dipole) Radiall-Larsen R380.700.205	✓ Note 1
5.8GHz 16dBi(120° Sectoral Cylinder body) Radio Waves SEC-5V-120-16 Dipole	✓ Note 1
5.8GHz 17dBi Echo ES58-17 s/n 05240153	✓ Note 1
5.8GHz 23dBi (Flat Panel) MTI MT-485002 S/N 04103	✓ Note 1
5.8GHz 29dBi (Parabolic) M WAVE RP2-58-N S/N 1216	✓ Note 1

Note 1: Band Edge emissions were measured for 5.8GHz Antennas to verify compliance with FCC 47 CFR 15.205 Restricted Bands 5.35 – 5.46 GHz requirements (Ref Section 3.4) as part of the spurious emission test.

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Measurement Results Transmitter Radiated Spurious Emissions above 1 GHz

Ambient conditions.

Temperature: 19 to 26°C Relative humidity: 31 to 57 % Pressure: 999 to 1009 mbar

Radio parameters.

2.4GHz 8dBi (Planar Patch) Huber+Suhner 1324.19.0002

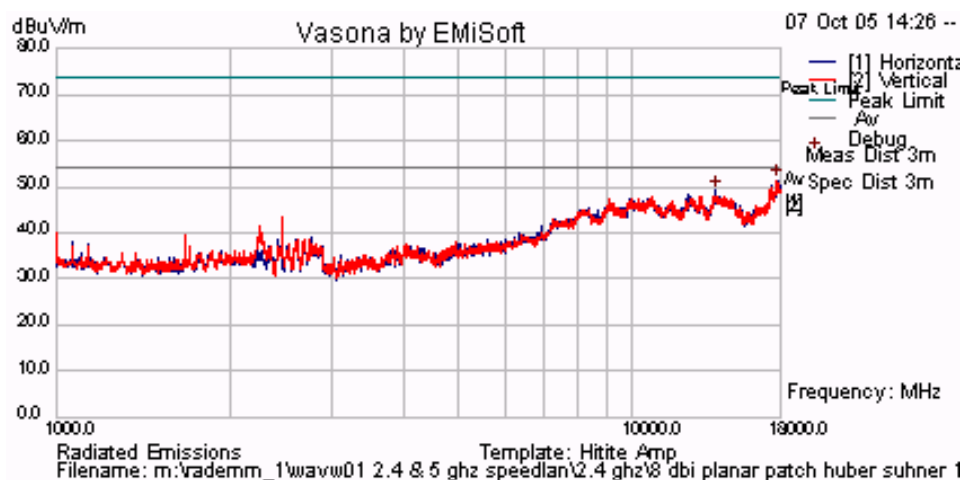
TABLE OF RESULTS – **802.11b 11Mbit/s +17 dBm**

CH.	Freq. (MHz)	Pol. (H/V)	Raw Reading (dB μ V/m)	Correction Factor (dB)	Corrected Field Strength (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
			Note			54.00	

Note: No peak emissions were observed above the limit.

Worst Case Plot(s) shown. All other results are held on file.

Plot 37 2.4GHz 8dBi Antenna 802.11b 11Mbit/s +17 dBm
Ch 11 Radiated Spurious Emissions > 1 GHz



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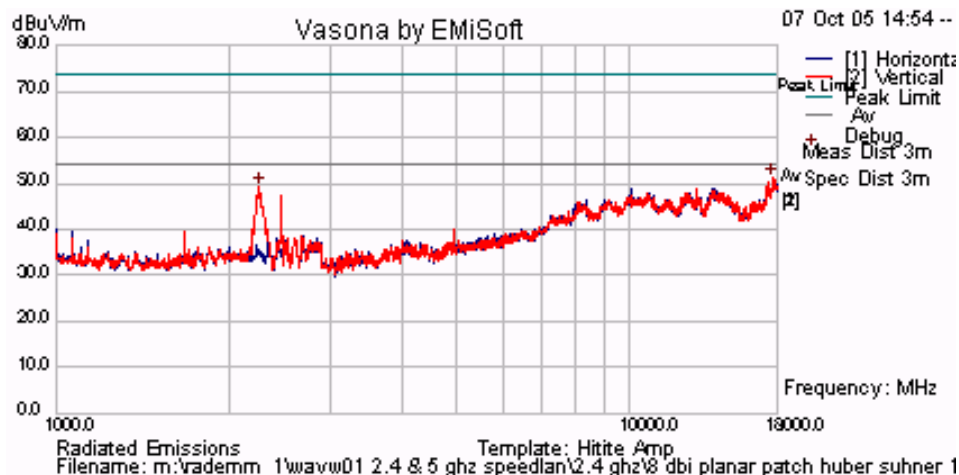
2.4GHz 8dBi (Planar Patch) Huber+Suhner 1324.19.0002
 TABLE OF RESULTS – 802.11g 6Mbit/s +17 dBm

CH.	Freq. (MHz)	Pol. (H/V)	Raw Reading (dB μ V/m)	Correction Factor (dB)	Corrected Field Strength (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
			Note			54.00	

Note: No peak emissions were observed above the limit.

Worst Case Plot(s) shown. All other results are held on file.

Plot 38 2.4GHz 8dBi Antenna 802.11g 6Mbit/s +17 dBm
Ch 11 Radiated Spurious Emissions > 1 GHz



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2.4GHz 12dBi (4 ft dipole) Pacific Wireless Omni Directional OD24-12 S/N 04360034

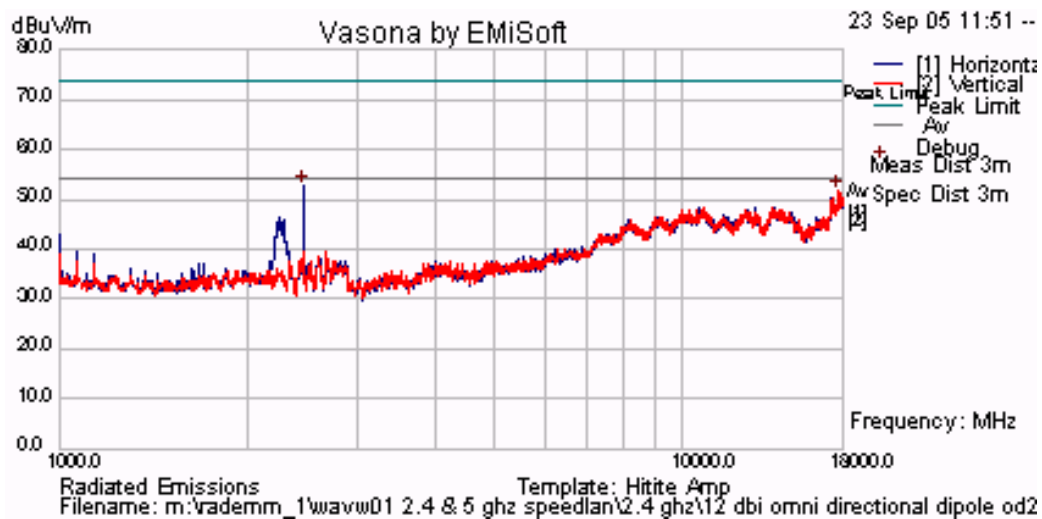
TABLE OF RESULTS – 802.11b 11Mbit/s +17 dBm

CH.	Freq. (MHz)	Pol. (H/V)	Raw Reading (dB μ V/m)	Correction Factor (dB)	Corrected Field Strength (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
			Note			54.00	

Note: No peak emissions were observed above the limit.

Worst Case Plot(s) shown. All other results are held on file.

Plot 39 2.4GHz 12dBi Antenna 802.11b 11Mbit/s +17 dBm
Ch 11 Radiated Spurious Emissions > 1 GHz



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2.4GHz 12dBi (4 ft dipole) Pacific Wireless Omni Directional OD24-12 S/N 04360034

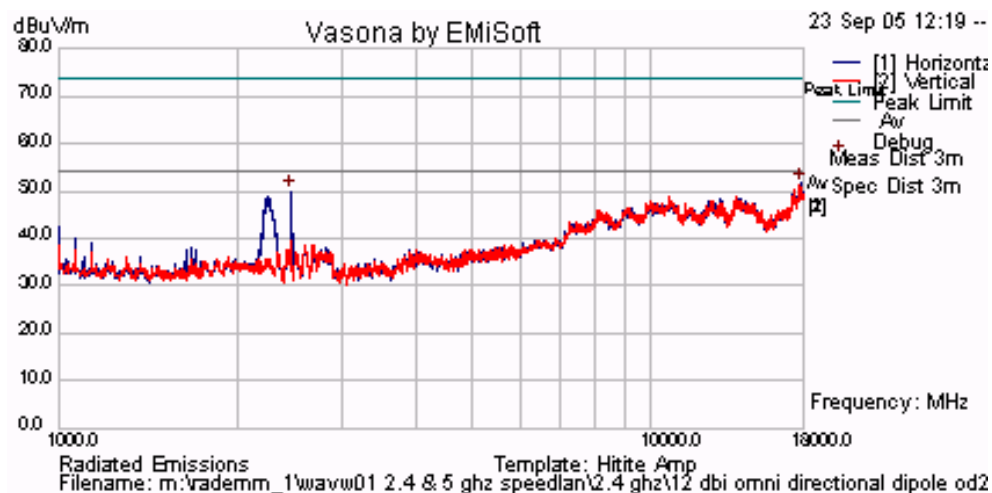
TABLE OF RESULTS – 802.11g 6Mbit/s +17 dBm

CH.	Freq. (MHz)	Pol. (H/V)	Raw Reading (dB μ V/m)	Correction Factor (dB)	Corrected Field Strength (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
			Note			54.00	

Note: No peak emissions were observed above the limit.

Worst Case Plot(s) shown. All other results are held on file.

Plot 40 2.4GHz 12dBi Antenna 802.11g 6Mbit/s +17 dBm
Ch 11 Radiated Spurious Emissions > 1 GHz



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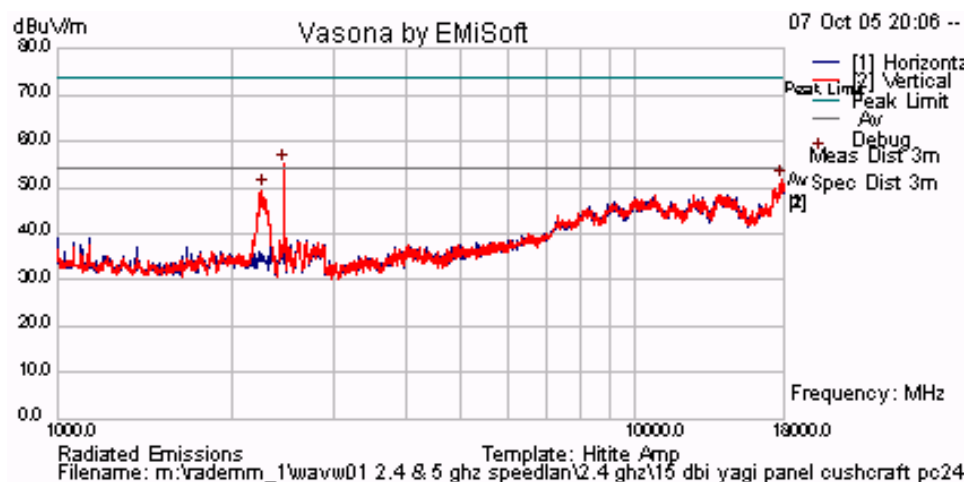
2.4GHz 15dBi (Yagi - Panel) Cushcraft PC2415
 TABLE OF RESULTS – 802.11b 11Mbit/s +17 dBm

CH.	Freq. (MHz)	Pol. (H/V)	Raw Reading (dB μ V/m)	Correction Factor (dB)	Corrected Field Strength (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
			Note			54.00	

Note: No peak emissions were observed above the limit. The emission breaking the 54 dB μ V/m limit line is the carrier breaking through the band-stop filter

Worst Case Plot(s) shown. All other results are held on file.

Plot 41 2.4GHz 15dBi Antenna 802.11b 11Mbit/s +17 dBm
Ch 11 Radiated Spurious Emissions > 1 GHz



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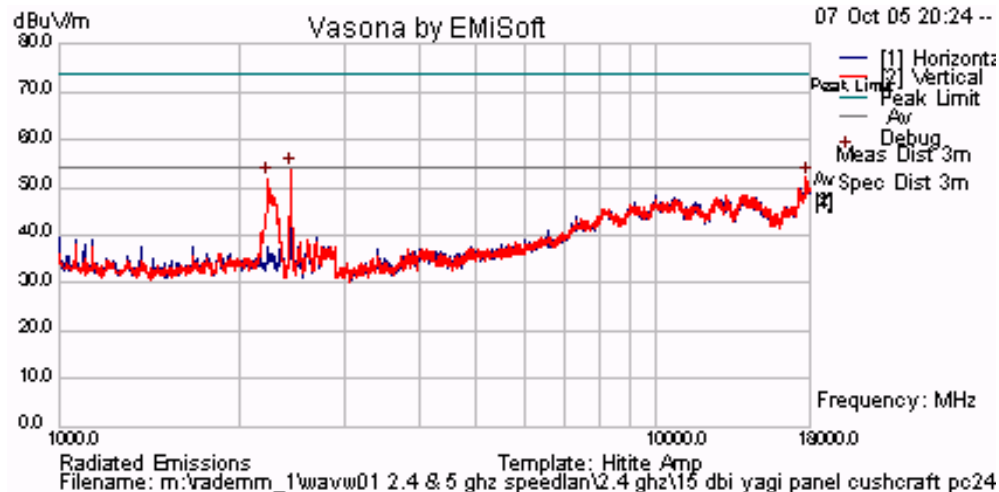
2.4GHz 15dBi (Yagi - Panel) Cushcraft PC2415
 TABLE OF RESULTS – 802.11g 6Mbit/s +17 dBm

CH.	Freq. (MHz)	Pol. (H/V)	Raw Reading (dB μ V/m)	Correction Factor (dB)	Corrected Field Strength (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
			Note			54.00	

Note: No peak emissions were observed above the limit.

Worst Case Plot(s) shown. All other results are held on file.

Plot 42 2.4GHz 15dBi Antenna 802.11g 6Mbit/s +17 dBm
Ch 6 Radiated Spurious Emissions > 1 GHz



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2.4GHz 16dBi (90° Sectoral) Andrew Panel antenna DB980G90N-R

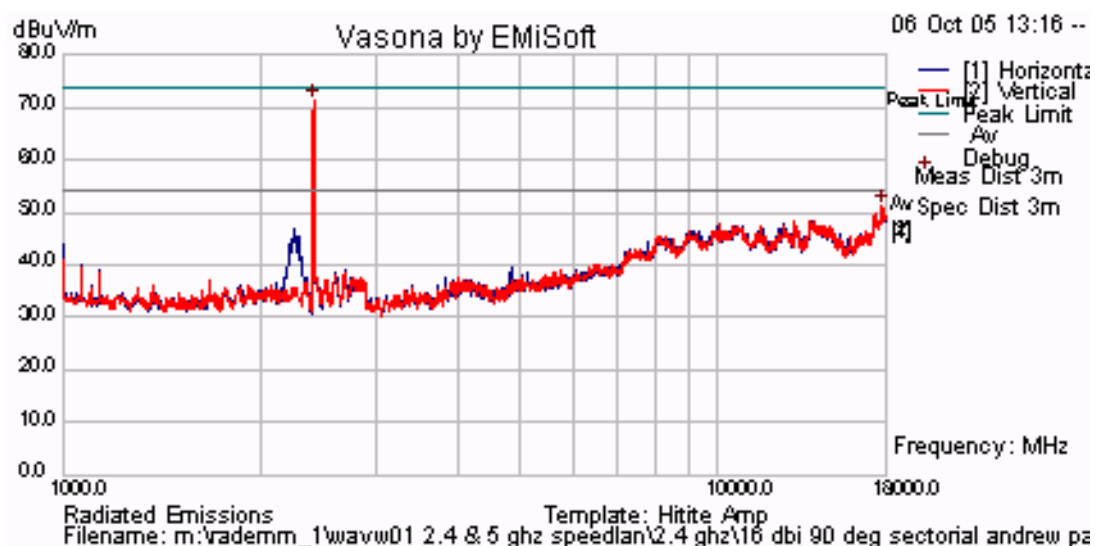
TABLE OF RESULTS – 802.11b 11Mbit/s +17 dBm

CH.	Freq. (MHz)	Pol. (H/V)	Raw Reading (dB μ V/m)	Correction Factor (dB)	Corrected Field Strength (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
			Note			54.00	

Note: No peak emissions were observed above the limit. The emission breaking the 54 dB μ V/m limit line is the carrier breaking through the band-stop filter

Worst Case Plot(s) shown. All other results are held on file.

Plot 43 2.4GHz 16dBi Antenna 802.11b 11Mbit/s +17 dBm
Ch 1 Radiated Spurious Emissions > 1 GHz



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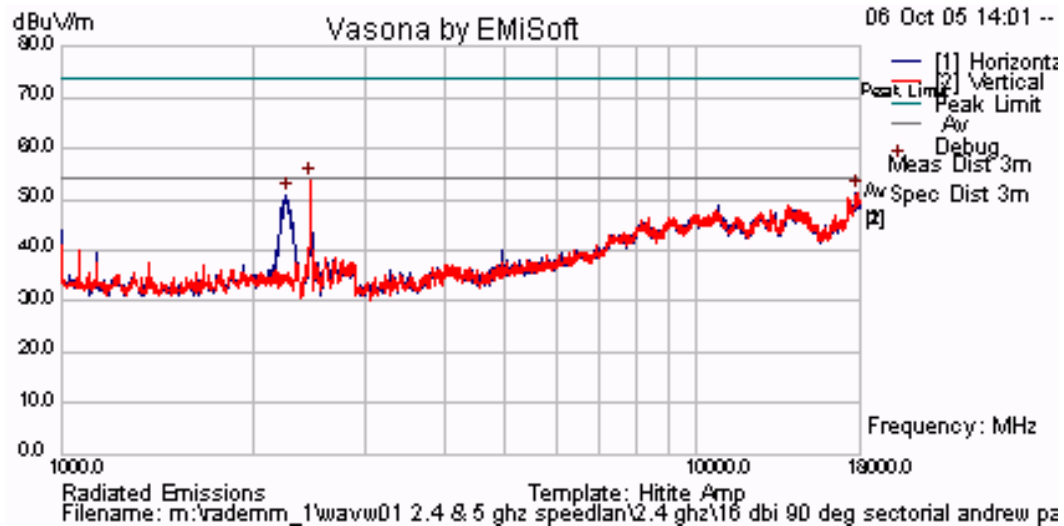
2.4GHz 16dBi (90° Sectoral) Andrew Panel antenna DB980G90N-R
 TABLE OF RESULTS – 802.11g 6Mbit/s +17 dBm

CH.	Freq. (MHz)	Pol. (H/V)	Raw Reading (dB μ V/m)	Correction Factor (dB)	Corrected Field Strength (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
			Note			54.00	

Note: No peak emissions were observed above the limit.

Worst Case Plot(s) shown. All other results are held on file.

Plot 44 2.4GHz 16dBi Antenna 802.11g 6Mbit/s +17 dBm
Ch 11 Radiated Spurious Emissions > 1 GHz



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2.4GHz 24dBi (Parabolic) Andrew AWP M0528D T-2400

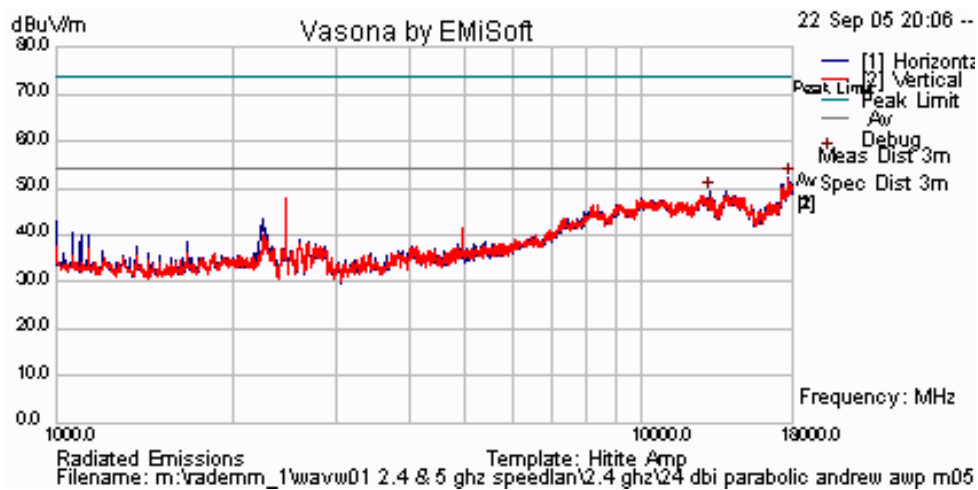
TABLE OF RESULTS – 802.11b 11Mbit/s +17 dBm

CH.	Freq. (MHz)	Pol. (H/V)	Raw Reading (dB μ V/m)	Correction Factor (dB)	Corrected Field Strength (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
			Note			54.00	

Note: No peak emissions were observed above the limit.

Worst Case Plot(s) shown. All other results are held on file.

Plot 45 2.4GHz 24dBi Antenna 802.11b 11Mbit/s +17 dBm
Ch 11 Radiated Spurious Emissions > 1 GHz



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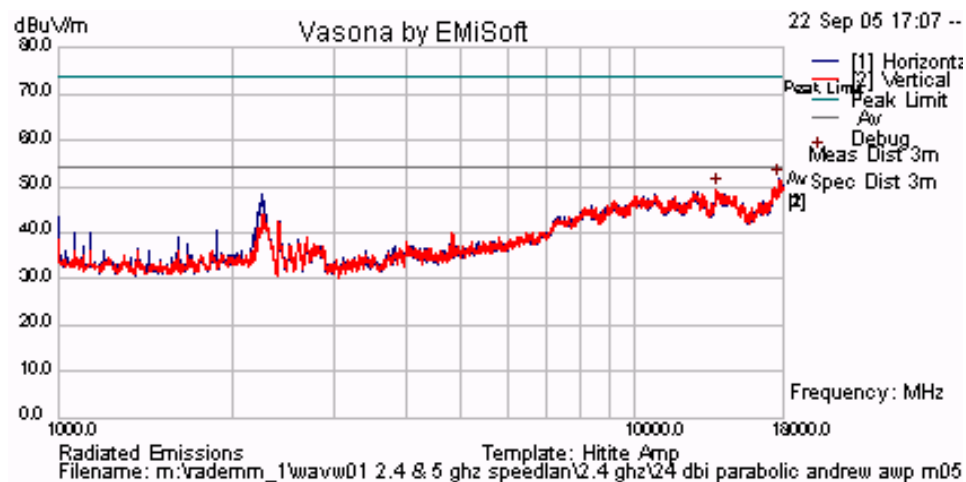
2.4GHz 24dBi (Parabolic) Andrew AWP M0528D T-2400
 TABLE OF RESULTS – 802.11g 6Mbit/s +17 dBm

CH.	Freq. (MHz)	Pol. (H/V)	Raw Reading (dB μ V/m)	Correction Factor (dB)	Corrected Field Strength (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
			Note			54.00	

Note: No peak emissions were observed above the limit.

Worst Case Plot(s) shown. All other results are held on file.

Plot 46 2.4GHz 24dBi Antenna 802.11g 6Mbit/s +17 dBm
Ch 1 Radiated Spurious Emissions > 1 GHz



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Transmitter Radiated Spurious Emissions > 1GHz - Test Configurations

Antenna Configuration	Transmitter Spurious Emission
5.8GHz 10dBi (Omni Dipole) Radiall-Larsen R380.700.205	✓
5.8GHz 16dBi(120° Sectoral Cylinder body) Radio Waves SEC-5V-120-16 Dipole	✓
5.8GHz 17dBi Echo ES58-17 s/n 05240153	✓
5.8GHz 23dBi (Flat Panel) MTI MT-485002 S/N 04103	✓
5.8GHz 29dBi (Parabolic) M WAVE RP2-58-N S/N 1216	✓

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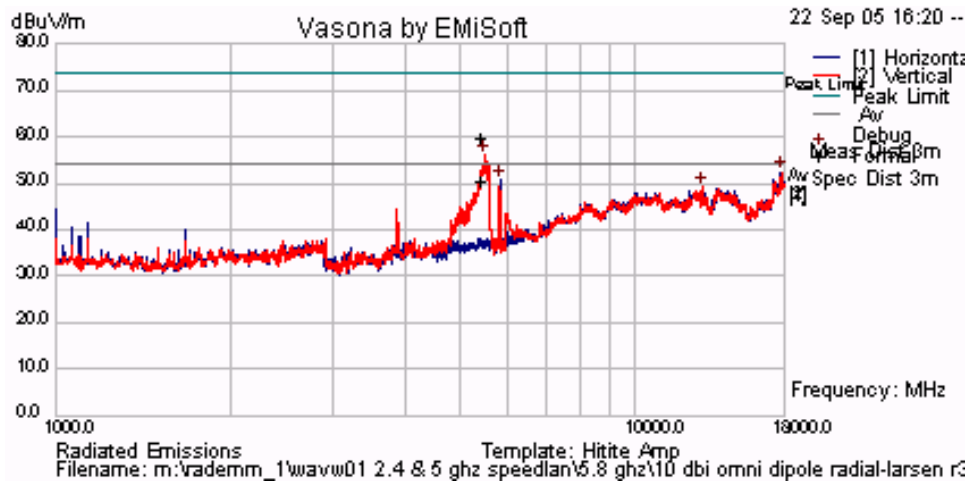
5.8GHz 10dBi (Omni Dipole) Radial-Larsen R380.700.205

TABLE OF RESULTS – 802.11a 6Mbit/s +17 dBm

CH.	Freq. (MHz)	Pol. (H/V)	Raw Reading (dB μ V/m)	Correction Factor (dB)	Corrected Field Strength (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
165	5439.87	V	48.57	-0.5	48.07	54.00	-5.93

Worst Case Plot(s) shown. All other results are held on file.

Plot 47 5.8GHz 10dBi Antenna 802.11a 6Mbit/s +17 dBm
Ch 165 Radiated Spurious Emissions > 1 GHz



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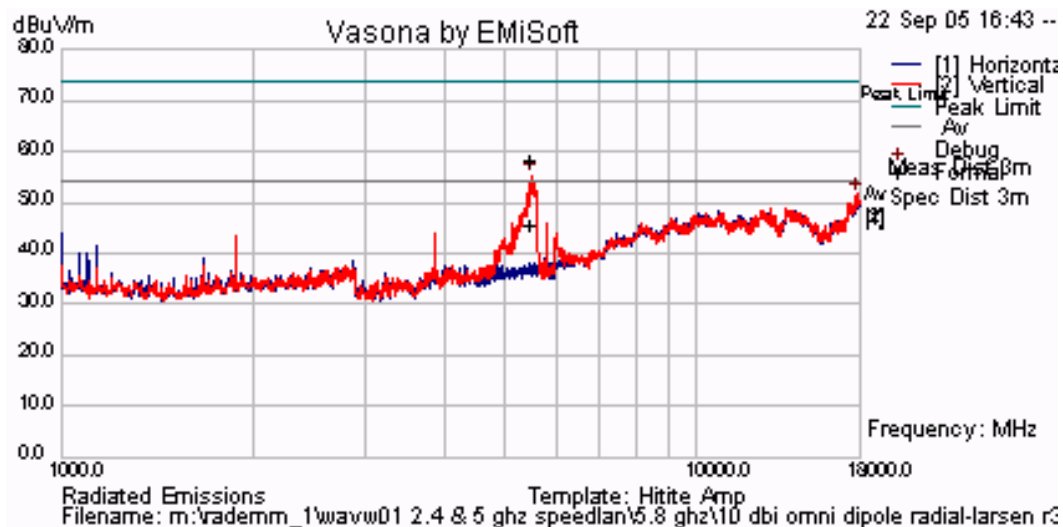
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5.8GHz 10dBi (Omni Dipole) Radial-Larsen R380.700.205
TABLE OF RESULTS – 802.11aT 12Mbit/s +17 dBm

CH.	Freq. (MHz)	Pol. (H/V)	Raw Reading (dB μ V/m)	Correction Factor (dB)	Corrected Field Strength (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
160	5479.62	V	43.55	-0.42	43.13	54.00	-10.87

Worst Case Plot(s) shown. All other results are held on file

Plot 48 5.8GHz 10dBi Antenna 802.11aT 12Mbit/s +17 dBm
Ch 160 Radiated Spurious Emissions > 1 GHz



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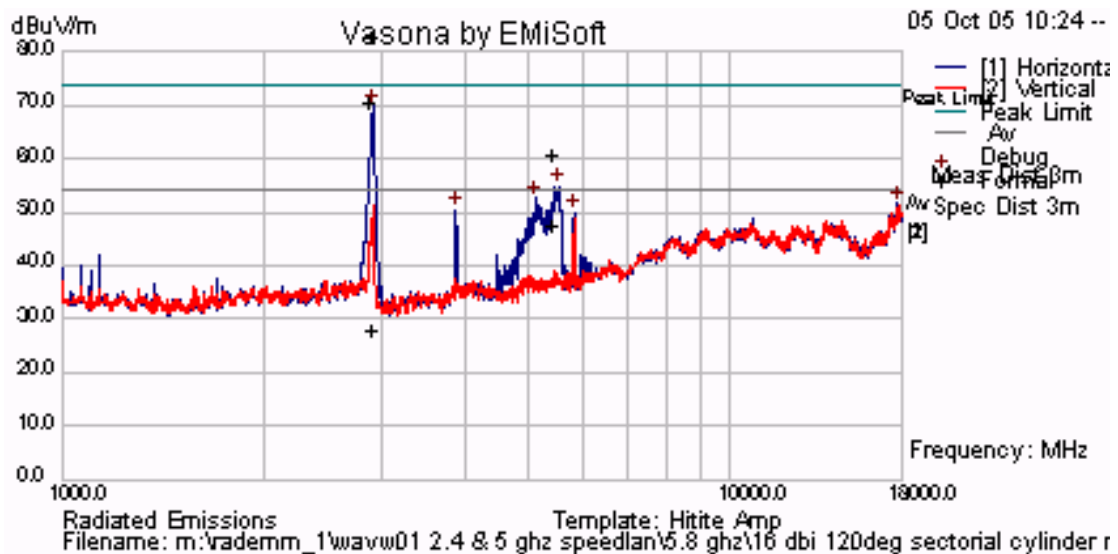
5.8GHz 16dBi (120° Sectoral Cylinder body) Radio Waves SEC-5V-120-16 Dipole
 TABLE OF RESULTS – 802.11a 6Mbit/s +17 dBm

CH.	Freq. (MHz)	Pol. (H/V)	Raw Reading (dB μ V/m)	Correction Factor (dB)	Corrected Field Strength (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
165	2900.00	H	35.65	-4.93	30.72	54.00	-23.28
165	2915.65	H	30.73	-5.02	25.71	54.00	-28.29
165	5441.54	H	45.74	-0.49	45.25	54.00	-8.75

No peak emissions were observed above the limit.

Worst Case Plot(s) shown. All other results are held on file.

Plot 49 5.8GHz 16dBi Antenna 802.11a 6Mbit/s +17 dBm
Ch 165 Radiated Spurious Emissions > 1 GHz



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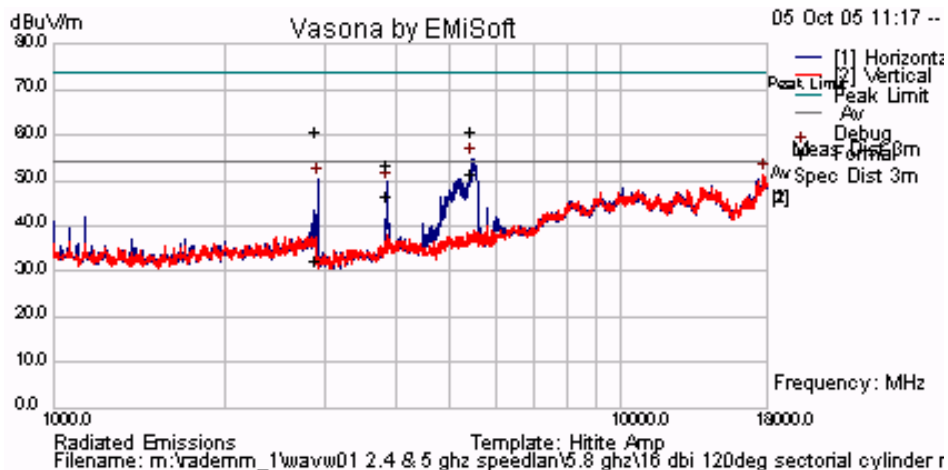
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5.8GHz 16dBi (120° Sectoral Cylinder body) Radio Waves SEC-5V-120-16 Dipole
TABLE OF RESULTS – 802.11aT 12Mbit/s +17 dBm

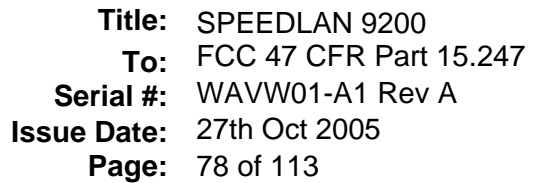
CH.	Freq. (MHz)	Pol. (H/V)	Raw Reading (dBμV/m)	Correction Factor (dB)	Corrected Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
160	2895.079	H	34.96	-4.91	30.05	54.00	-23.95
160	3866.466	H	46.22	-1.93	44.29	54.00	-9.71
160	5439.08	H	49.55	-0.50	49.05	54.00	-4.95

Worst Case Plot(s) shown. All other results are held on file

Plot 50 5.8GHz 16dBi Antenna 802.11aT 12Mbit/s +17 dBm
Ch 160 Radiated Spurious Emissions > 1 GHz

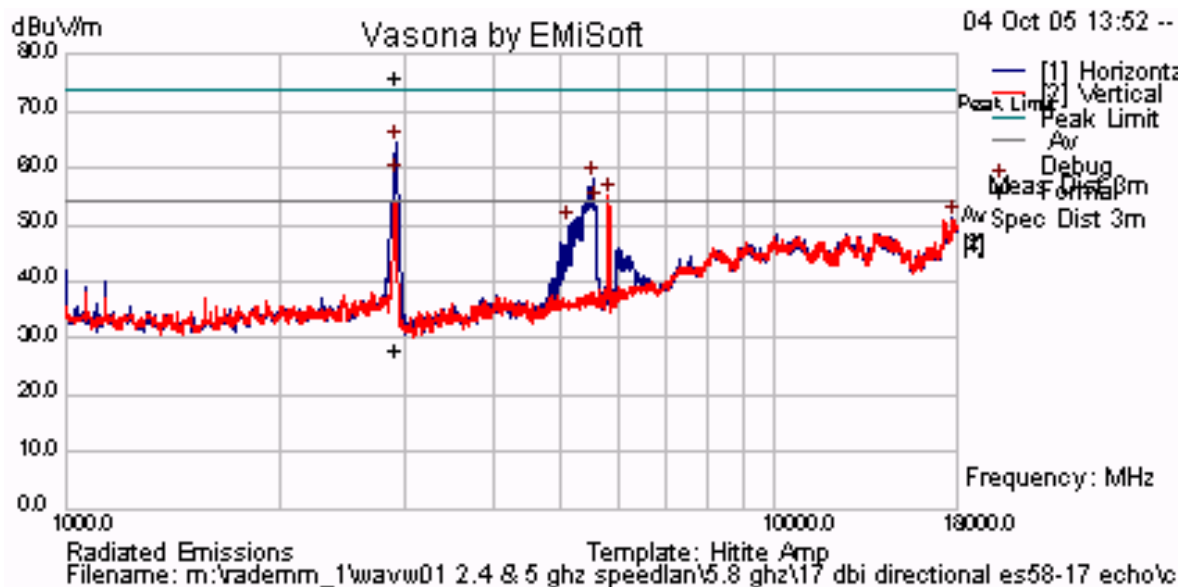


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CH.	Freq. (MHz)	Pol. (H/V)	Raw Reading (dBμV/m)	Correction Factor (dB)	Corrected Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
165	2910.943	H	30.8	-4.99	25.81	54.00	-28.19

Plot 51 5.8GHz 17dBi Antenna 802.11a 6Mbit/s +17 dBm
Ch 165 Radiated Spurious Emissions > 1 GHz



MiCOM Labs, 3922 Valley Avenue, Suite B, Pleasanton, CA 94566 USA, Phone: 925.462.0304, Fax: 925.462.0306, www.micomlabs.com



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5.8GHz 17dBi Echo ES58-17 s/n 05240153

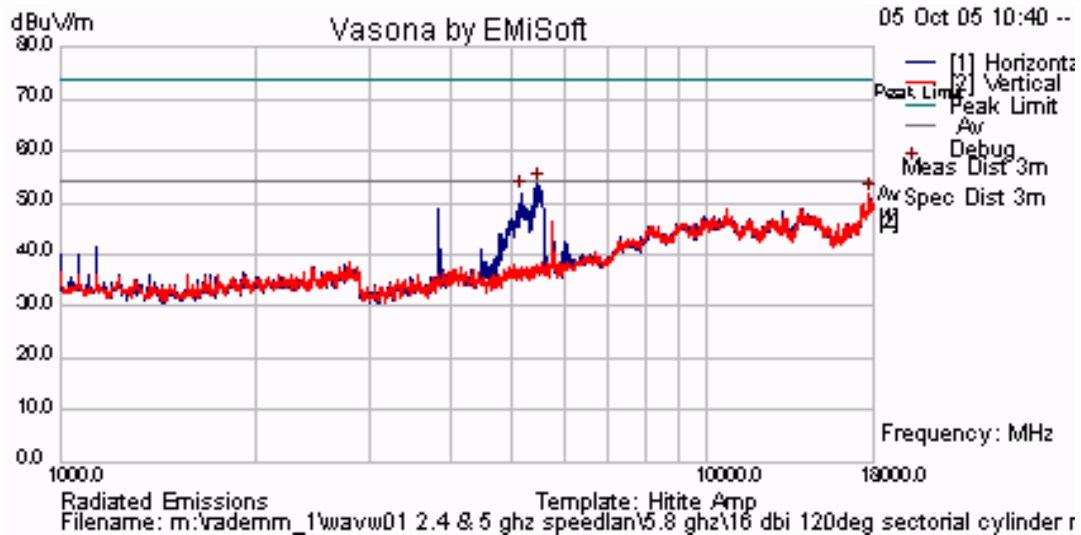
TABLE OF RESULTS – 802.11aT 12Mbit/s +17 dBm

CH.	Freq. (MHz)	Pol. (H/V)	Raw Reading (dB μ V/m)	Correction Factor (dB)	Corrected Field Strength (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
			Note			54.00	

Note: No peak emissions were observed above the limit.

Worst Case Plot(s) shown. All other results are held on file

Plot 52 5.8GHz 17dBi Antenna 802.11aT 12Mbit/s +17 dBm
Ch 160 Radiated Spurious Emissions > 1 GHz



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5.8GHz 23dBi (Flat Panel) MTI MT-485002 S/N 04103 with 5.8 GHz BPF (refer to Section 3.7 Equipment Modifications)

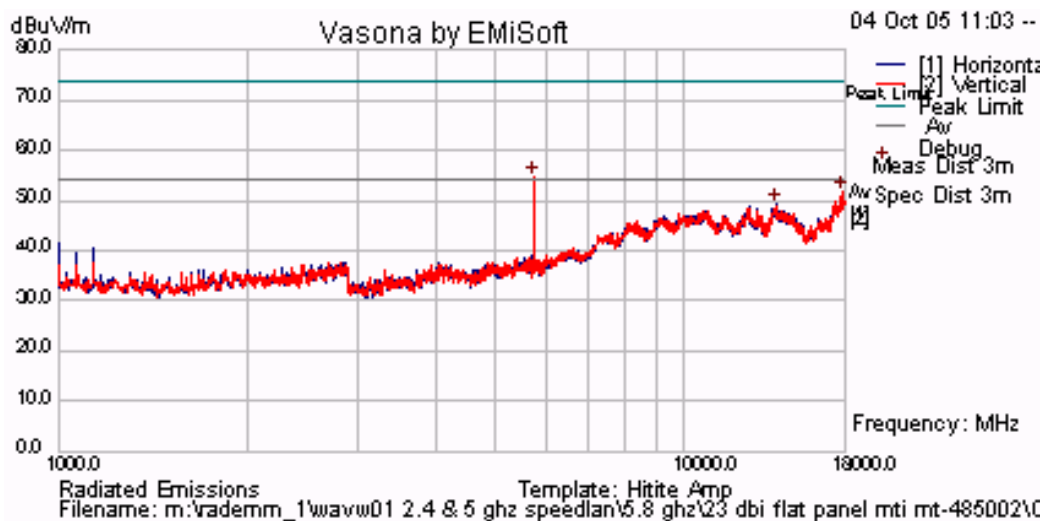
TABLE OF RESULTS – 802.11a 6Mbit/s +17 dBm

CH.	Freq. (MHz)	Pol. (H/V)	Raw Reading (dBμV/m)	Correction Factor (dB)	Corrected Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
			Note			54.00	

Note: No peak emissions were observed above the limit. The emission breaking the 54 dBμV/m limit line is the carrier breaking through the band-stop filter

Worst Case Plot(s) shown. All other results are held on file.

Plot 53 5.8GHz 23dBi Antenna 802.11a 6Mbit/s +17 dBm
Ch 149 Radiated Spurious Emissions > 1 GHz



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5.8GHz 23dBi (Flat Panel) MTI MT-485002 S/N 04103 with 5.8 GHz BPF (refer to Section 3.7 Equipment Modifications)

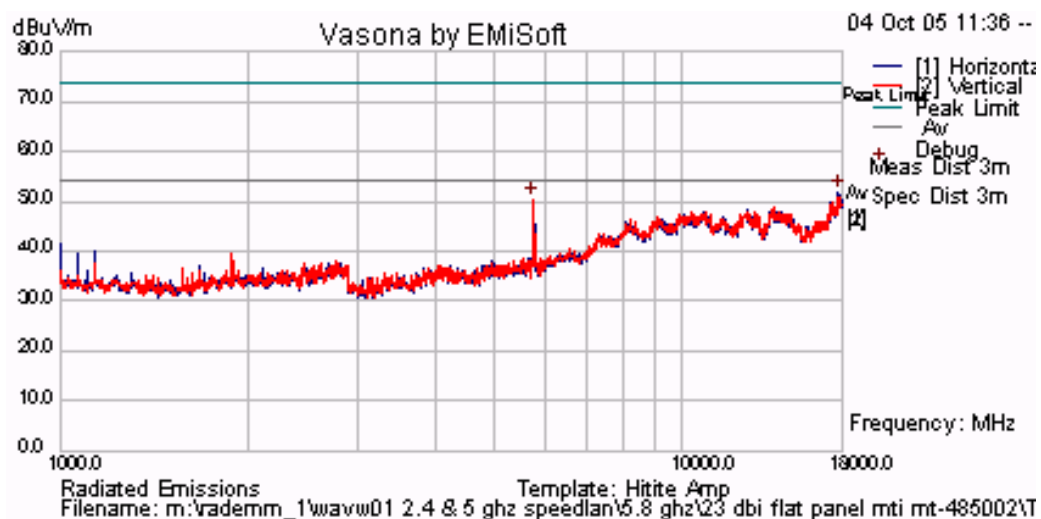
TABLE OF RESULTS – 802.11aT 12Mbit/s +17 dBm

CH.	Freq. (MHz)	Pol. (H/V)	Raw Reading (dB μ V/m)	Correction Factor (dB)	Corrected Field Strength (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
			Note			54.00	

Note: No peak emissions were observed above the limit.

Worst Case Plot(s) shown. All other results are held on file

Plot 54 5.8GHz 23dBi Antenna 802.11aT 12Mbit/s +17 dBm
Ch 160 Radiated Spurious Emissions > 1 GHz



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5.8GHz 29dBi (Parabolic) M WAVE RP2-58-N S/N 1216 with 5.8 GHz BPF (refer to Section 3.7 Equipment Modifications)

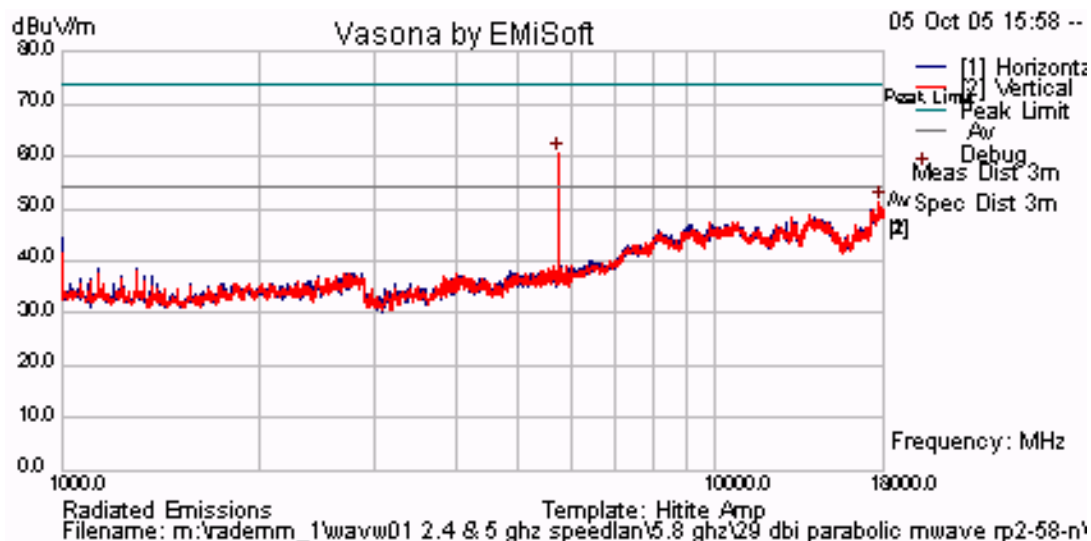
TABLE OF RESULTS – 802.11a 6Mbit/s +17 dBm

CH.	Freq. (MHz)	Pol. (H/V)	Raw Reading (dBμV/m)	Correction Factor (dB)	Corrected Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
			Note			54.00	

Note: No peak emissions were observed above the limit. The emission breaking the 54 dBμV/m limit line is the carrier breaking through the band-stop filter

Worst Case Plot(s) shown. All other results are held on file.

Plot 55 5.8GHz 29dBi Antenna 802.11a 6Mbit/s +17 dBm
Ch 165 Radiated Spurious Emissions > 1 GHz



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5.8GHz 29dBi (Parabolic) M WAVE RP2-58-N S/N 1216 with 5.8 GHz BPF (refer to Section 3.7 Equipment Modifications)

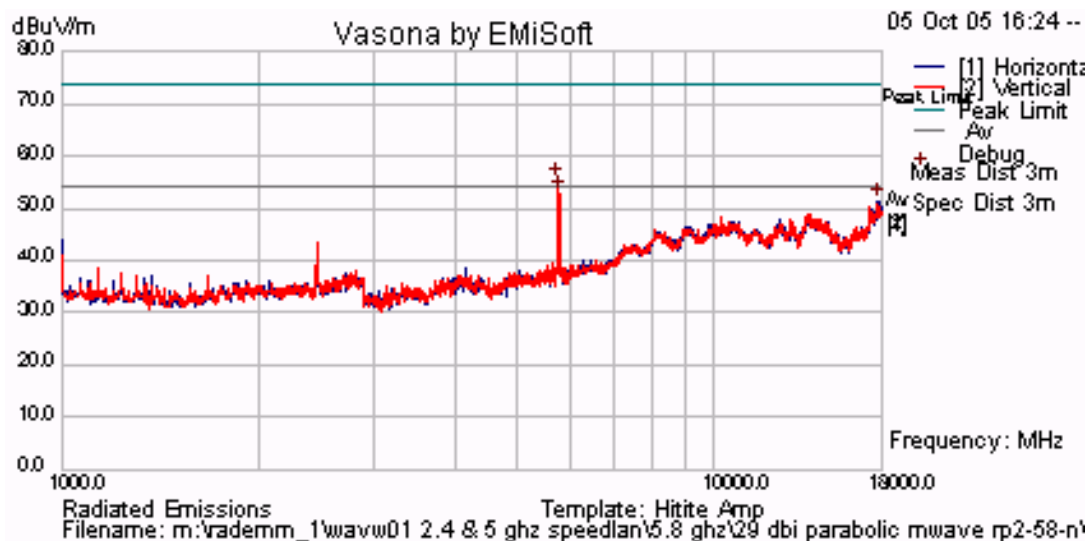
TABLE OF RESULTS – 802.11aT 12Mbit/s +17 dBm

CH.	Freq. (MHz)	Pol. (H/V)	Raw Reading (dBμV/m)	Correction Factor (dB)	Corrected Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
			Note			54.00	

Note: No peak emissions were observed above the limit. The emission breaking the 54 dBμV/m limit line is the carrier breaking through the band-stop filter

Worst Case Plot(s) shown. All other results are held on file

Plot 56 5.8GHz 29dBi Antenna 802.11aT 12Mbit/s +17 dBm
Ch 152 Radiated Spurious Emissions > 1 GHz



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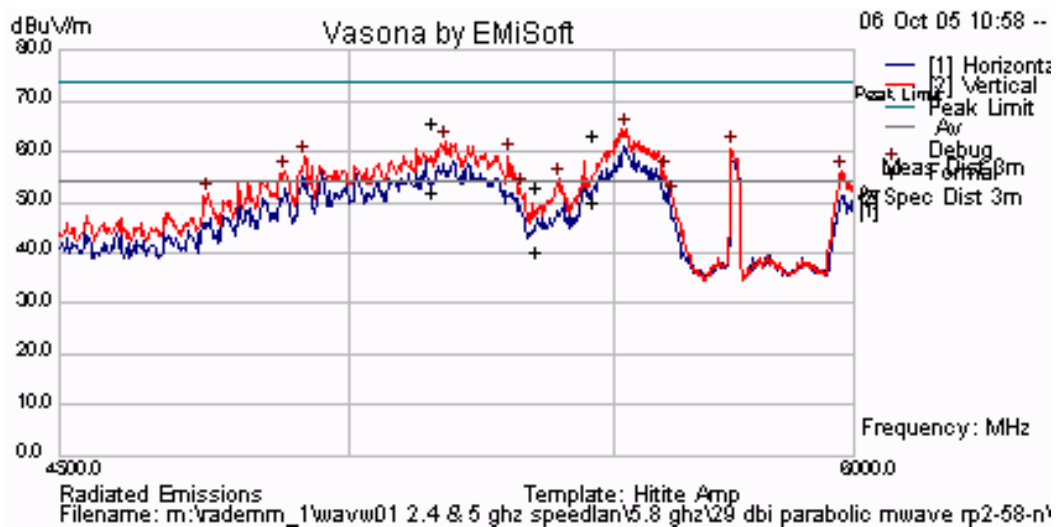
5.8GHz 29dBi (Parabolic) M WAVE RP2-58-N S/N 1216 with 5.35 – 5.46 GHz implementing the 11dB Band-stop Filter (refer to Section 3.7 Equipment Modifications)

TABLE OF RESULTS – RESTRICTED BANDS 802.11a 6Mbit/s +17 dBm
Worst Case is CH 149

CH.	Freq. (MHz)	Pol. (H/V)	Raw Reading (dB μ V/m)	Correction Factor (dB)	Corrected Field Strength (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
149	5150.00	V	50.79	-1.34	49.45	54	-4.55
149	5350.00	V	38.50	-0.84	37.66	54	-16.34
149	5460.00	V	48.02	-0.46	47.56	54	-6.44

Restricted Bands Worst Case Plot shown

Plot 57 5.8GHz 29dBi Antenna 802.11a 6Mbit/s +17 dBm
Ch 149 Restricted Bands



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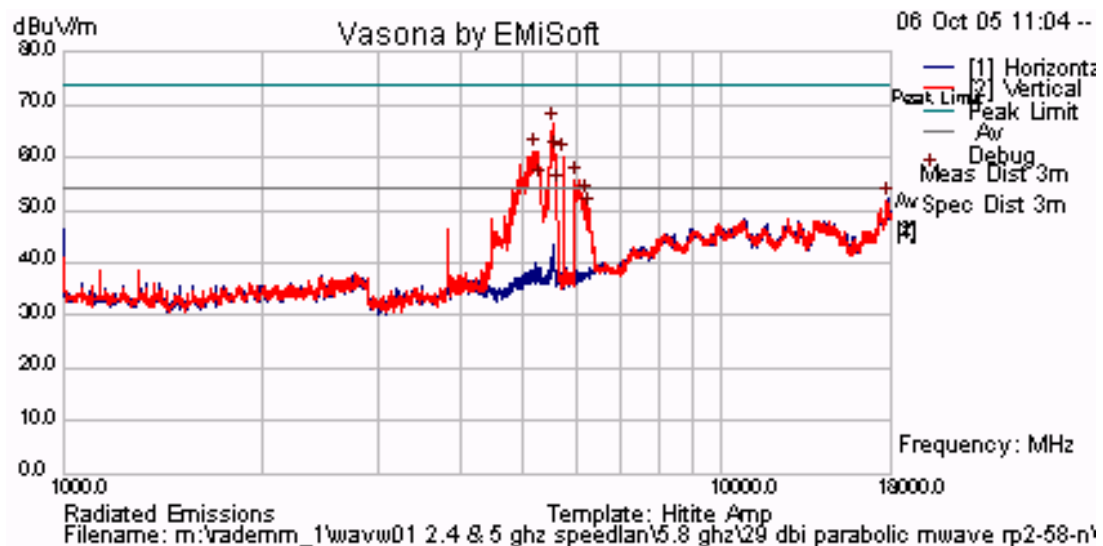
5.8GHz 29dBi (Parabolic) M WAVE RP2-58-N S/N 1216 with 5.35 – 5.46 GHz implementing the 11dB Band-stop Filter (refer to Section 3.7 Equipment Modifications)

TABLE OF RESULTS – 802.11a 6Mbit/s +17 dBm

CH.	Freq. (MHz)	Pol. (H/V)	Raw Reading (dBμV/m)	Correction Factor (dB)	Corrected Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
149	5398.64	V	44.64	-0.63	44.01	54.00	-9.99
149	5470.00	V	47.85	-0.44	47.41	54.00	-6.59

Worst Case Plot(s) shown. All other results are held on file.

Plot 58 5.8GHz 29dBi Antenna 802.11a 6Mbit/s +17 dBm
Ch 149 Radiated Spurious Emissions > 1 GHz



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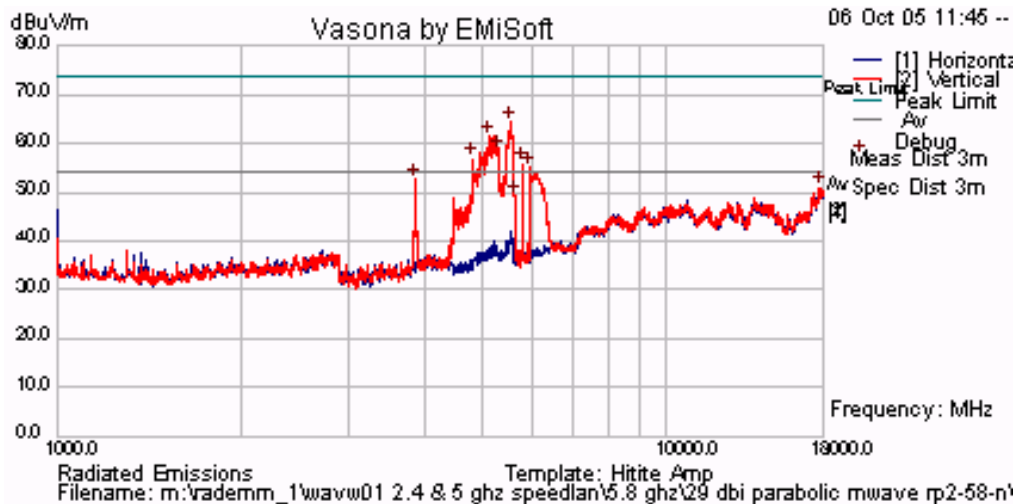
5.8GHz 29dBi (Parabolic) M WAVE RP2-58-N S/N 1216 with 5.35 – 5.46 GHz implementing the 11dB Band-stop Filter (refer to Section 3.7 Equipment Modifications)

TABLE OF RESULTS – 802.11aT 12Mbit/s +17 dBm

CH.	Freq. (MHz)	Pol. (H/V)	Raw Reading (dBμV/m)	Correction Factor (dB)	Corrected Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
160	5398.58	V	44.59	-0.63	43.96	54.00	-10.04
160	5470.10	V	47.78	-0.44	47.34	54.00	-6.66

Worst Case Plot(s) shown. All other results are held on file

Plot 59 5.8GHz 29dBi Antenna 802.11aT 12Mbit/s +17 dBm
Ch 160 Radiated Spurious Emissions > 1 GHz



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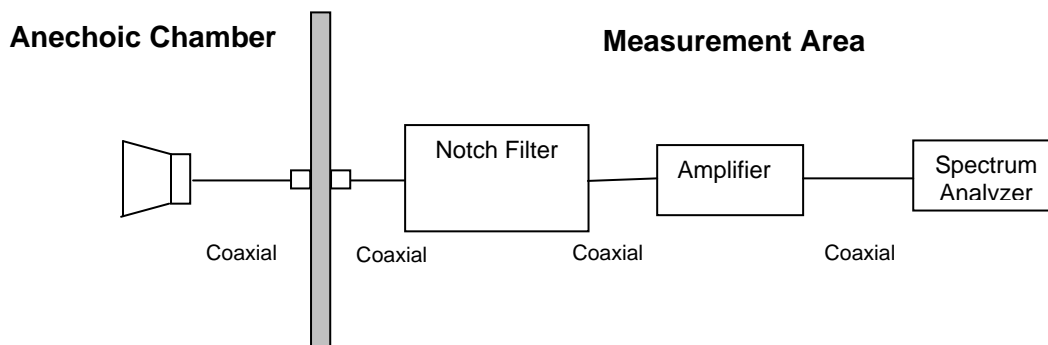
5.1.6.2. Radiated Band-Edge – Restricted Bands

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. A notch 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 = Band-stop 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:

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

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

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

Radiated Band Edge - Test Configurations

Antenna	Band Edge
2.4GHz 8dBi (Planar Patch) Huber+Suhner 1324.19.0002	✓
2.4GHz 12dBi (4 ft dipole) Pacific Wireless Omni Directional OD24-12 S/N 04360034	✓
2.4GHz 15dBi (Yagi - Panel) Cushcraft PC2415	✓
2.4GHz 16dBi (90° Sectoral) Andrew Panel antenna DB980G90N-R	✓
2.4GHz 24dBi (Parabolic) Andrew AWP M0528D T-2400	✓
5.8GHz 10dBi (Omni Dipole) Radiall-Larsen R380.700.205	Note 1
5.8GHz 16dBi(120° Sectoral Cylinder body) Radio Waves SEC-5V-120-16 Dipole	Note 1
5.8GHz 17dBi Echo ES58-17 s/n 05240153	Note 1
5.8GHz 23dBi (Flat Panel) MTI MT-485002 S/N 04103	Note 1
5.8GHz 29dBi (Parabolic) M WAVE RP2-58-N S/N 1216	Note 1

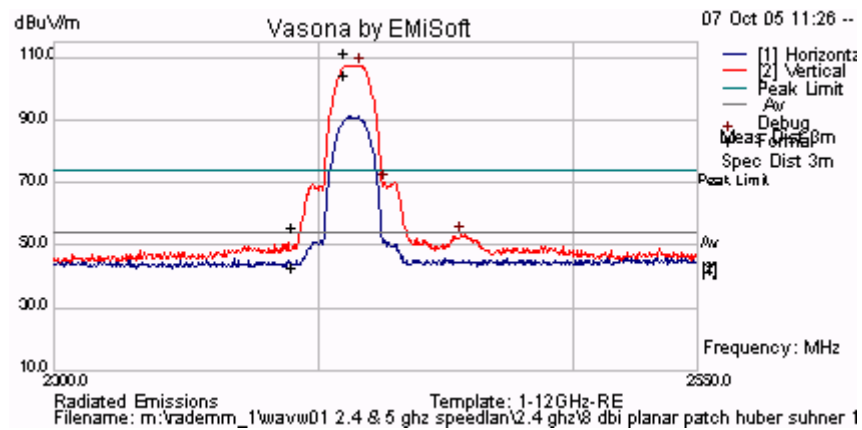
NOTE 1: For band edge measurements refer to Section 5.1.6.1 Transmitter Radiated Spurious Emission for the 5.8 GHz antennas.

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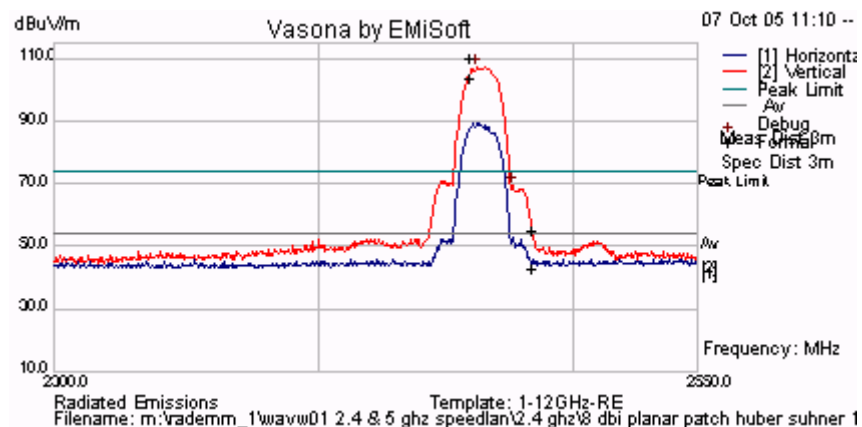
Radiated Band Edge Test Results for 2.4 GHz 8 dBi Planar Patch Antenna
TABLE OF RESULTS – 802.11b 11Mbit/s

Ch #	Tx Pwr (dBm)	Tx Freq. (MHz)	Restricted Band Edge Frequency (MHz)	Measured (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Plot #
1	+17	2,412 _{PEAK}	2,390	58.69	74	-15.31	60
1	+17	2,412 _{AVE}	2,390	45.78	54	-8.22	60
11	+17	2,462 _{PEAK}	2,483.5	57.59	74	-16.41	61
11	+17	2,462 _{AVE}	2,483.5	45.58	54	-8.42	61

Plot 60 Channel 1 - Lower Band Edge, Peak Emission = 114.42 dBuV/m



Plot 61 Channel 11 – Upper Band Edge, Peak Emission = 113.46 dBuV/m

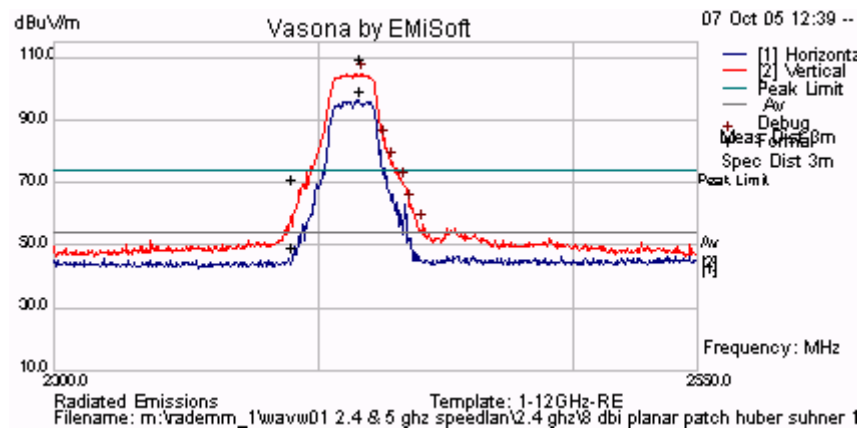


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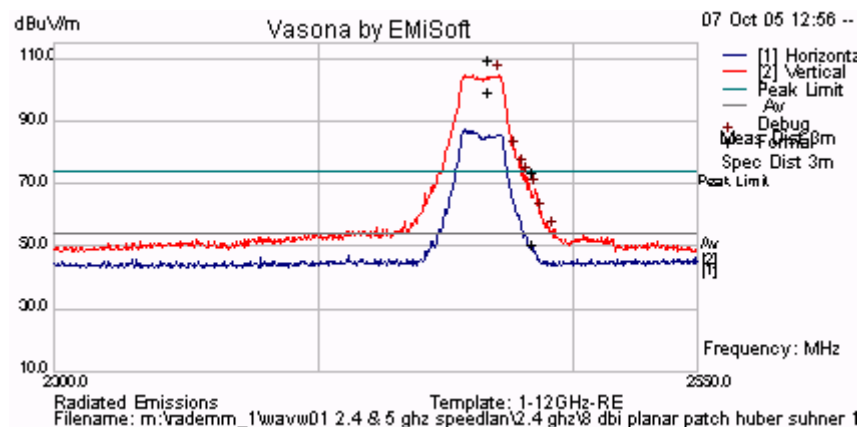
Radiated Band Edge Test Results for 2.4 GHz 8 dBi Planar Patch Antenna
TABLE OF RESULTS – 802.11g 6Mbit/s

Ch #	Tx Pwr (dBm)	Tx Freq. (MHz)	Restricted Band Edge Frequency (MHz)	Measured (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Plot #
1	+15	2,412 _{PEAK}	2,390	73.75	74	-0.25	62
1	+15	2,412 _{AVE}	2,390	52.36	54	-1.64	62
11	+14	2,462 _{PEAK}	2,483.5	66.11	74	-7.89	63
11	+14	2,462 _{AVE}	2,483.5	44.18	54	-9.82	63

Plot 62 Channel 1 - Lower Band Edge, Peak Emission = 112.35 dBμV



Plot 63 Channel 11 – Upper Band Edge, Peak Emission = 112.61 dBμV/m



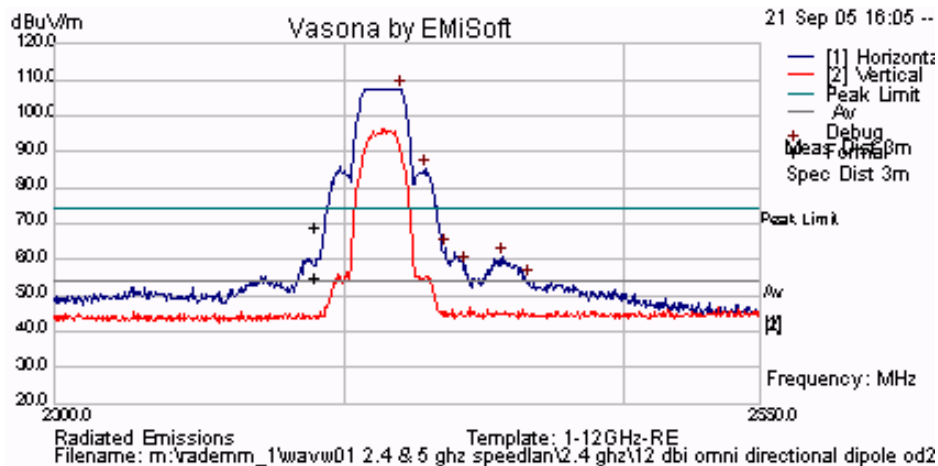
NOTE : The plots show levels that are 6dB lower as a result of attenuation at EUT to reduce intermodulations.

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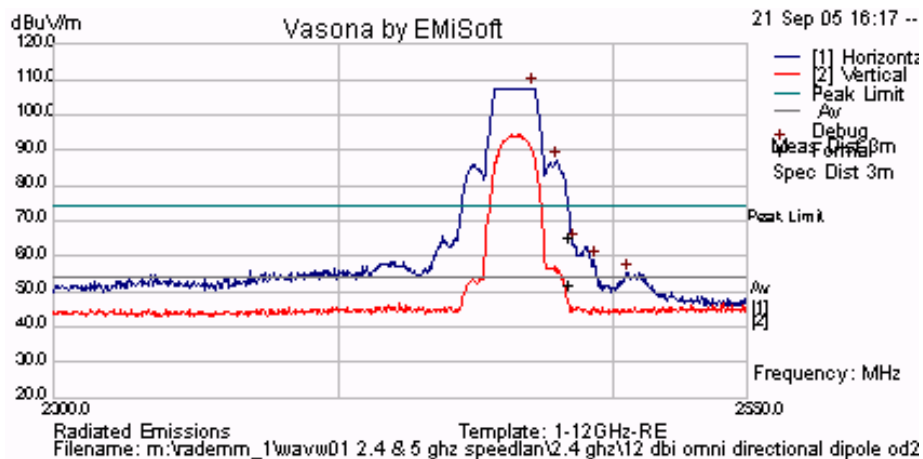
Radiated Band Edge Test Results for 2.4 GHz 12 dBi Omni Directional OD24-12
TABLE OF RESULTS – 802.11b 11Mbit/s

Ch #	Tx Pwr (dBm)	Tx Freq. (MHz)	Restricted Band Edge Frequency (MHz)	Measured (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Plot #
1	+17	2,412 _{PEAK}	2,390	66.22	74	-7.78	64
1	+17	2,412 _{AVE}	2,390	52.15	54	-1.85	64
11	+17	2,462 _{PEAK}	2,483.5	62.46	74	-11.54	65
11	+17	2,462 _{AVE}	2,483.5	48.75	54	-5.25	65

Plot 64 Channel 1 - Lower Band Edge



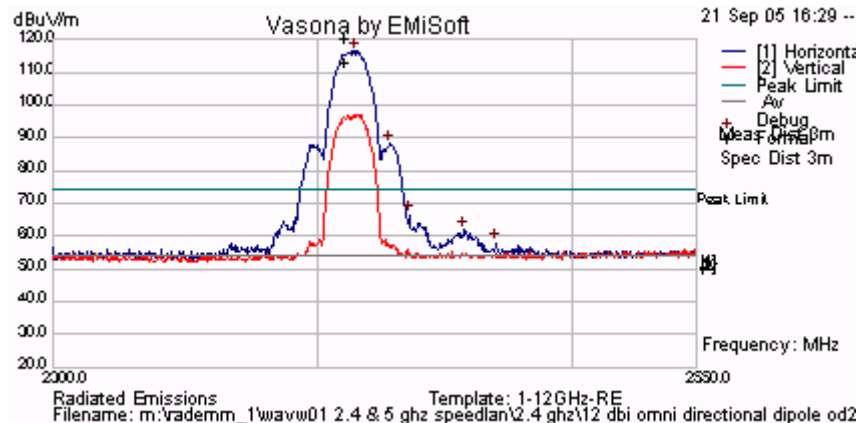
Plot 65 Channel 11 – Upper Band Edge



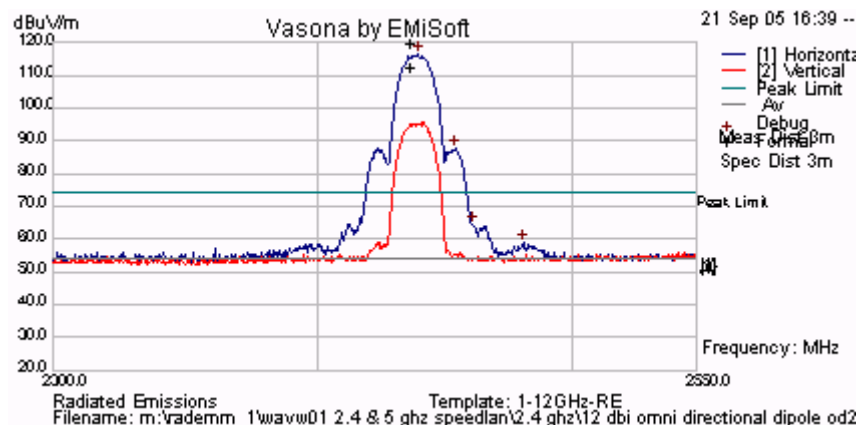
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**Radiated Band Edge Test Results for 2.4 GHz 12 dBi Omni Directional OD24-12
 802.11b 11Mbit/s**

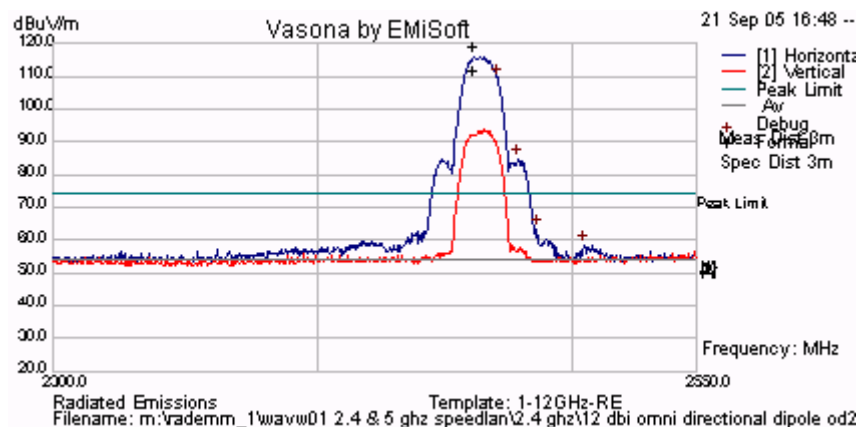
Plot 66 CH 1 Peak Emission = 117.39 dB μ V/m



Plot 67 CH 6 Peak Emission = 117.31 dB μ V/m



Plot 68 CH 11 Peak Emission = 116.31 dB μ V/m



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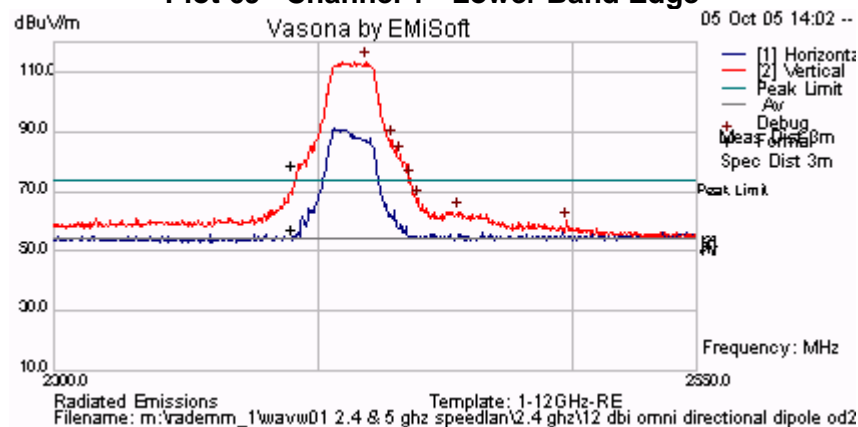
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Radiated Band Edge Test Results for 2.4 GHz 12 dBi Omni Directional OD24-12

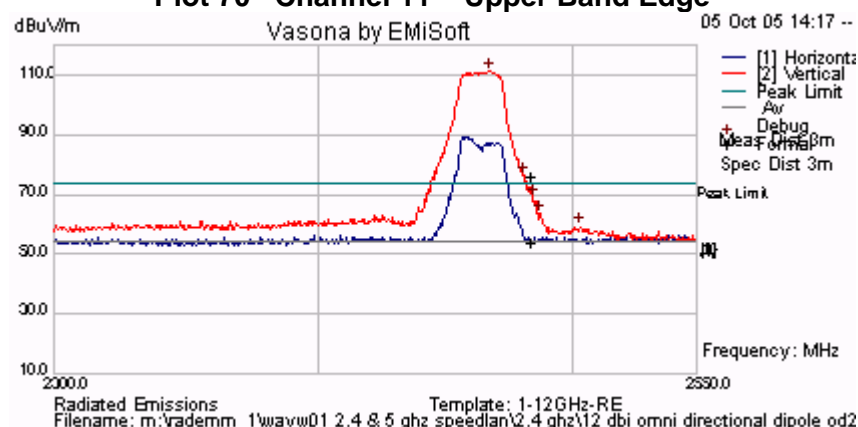
TABLE OF RESULTS – 802.11g 6Mbit/s

Ch #	Tx Pwr (dBm)	Tx Freq. (MHz)	Restricted Band Edge Frequency (MHz)	Measured (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Plot #
1	+15	2,412 _{PEAK}	2,390	73.8	74	-0.20	69
1	+15	2,412 _{AVE}	2,390	53.57	54	-0.43	69
11	+15	2,462 _{PEAK}	2,483.5	72.65	74	-1.35	70
11	+15	2,462 _{AVE}	2,483.5	50.74	54	-3.26	70

Plot 69 Channel 1 - Lower Band Edge



Plot 70 Channel 11 – Upper Band Edge



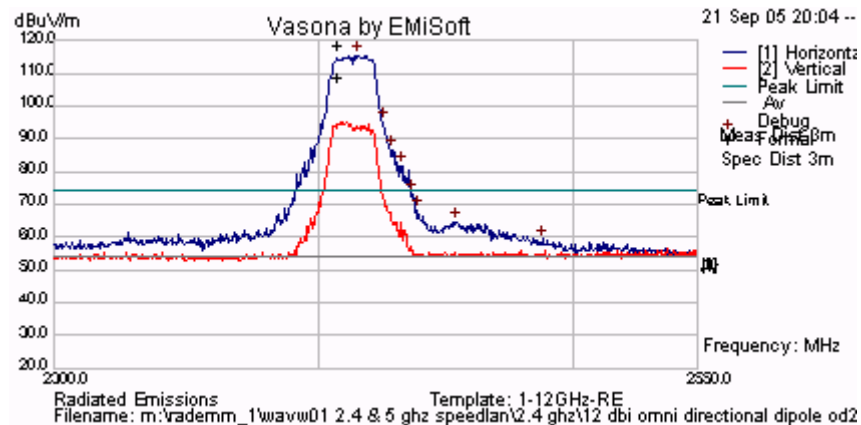
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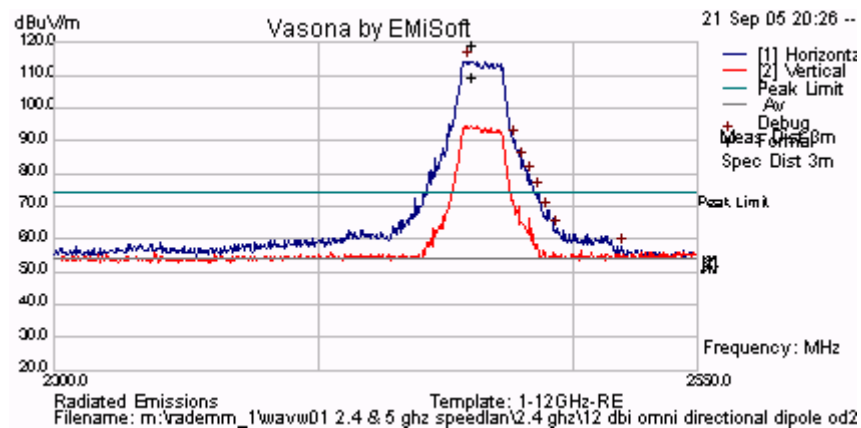
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**Radiated Band Edge Test Results for 2.4 GHz 12 dBi Omni Directional OD24-12
802.11g 6Mbit/s**

Plot 71 Channel 1 Peak Emission = 115.58 dB μ V/m



Plot 72 Channel 11 Peak Emission = 116.15 dB μ V/m



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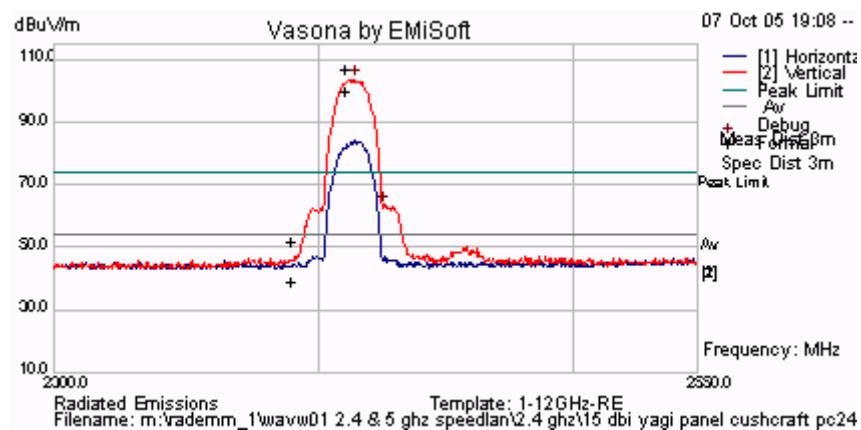


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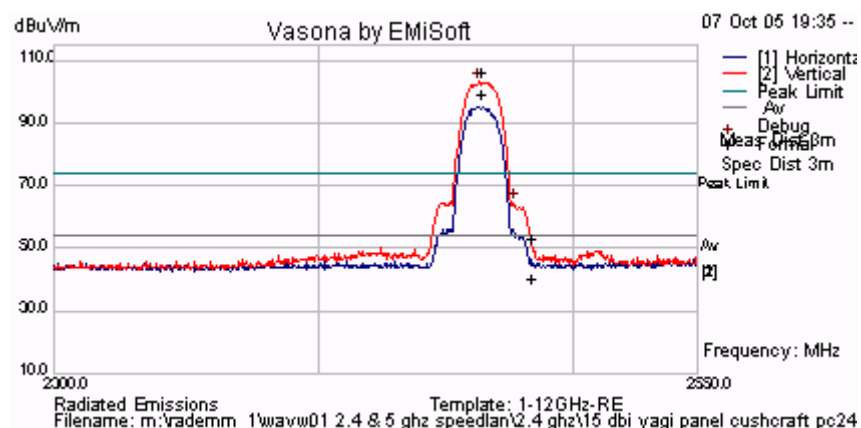
Radiated Band Edge Test Results for 2.4 GHz 15dBi (Yagi Panel) Cushcraft PC2415
TABLE OF RESULTS – 802.11b 11Mbit/s

Ch #	Tx Pwr (dBm)	Tx Freq. (MHz)	Restricted Band Edge Frequency (MHz)	Measured (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Plot #
1	+17	2,412 _{PEAK}	2,390	64.96	74	-9.04	73
1	+17	2,412 _{AVE}	2,390	51.72	54	-2.28	73
11	+17	2,462 _{PEAK}	2,483.5	65.70	74	-8.30	74
11	+17	2,462 _{AVE}	2,483.5	53.08	54	-0.92	74

Plot 73 Channel 1 - Lower Band Edge, Peak Emission = 120.0 dBuV/m



Plot 74 Channel 11 – Upper Band Edge, Peak Emission = 119.66 dBuV/m

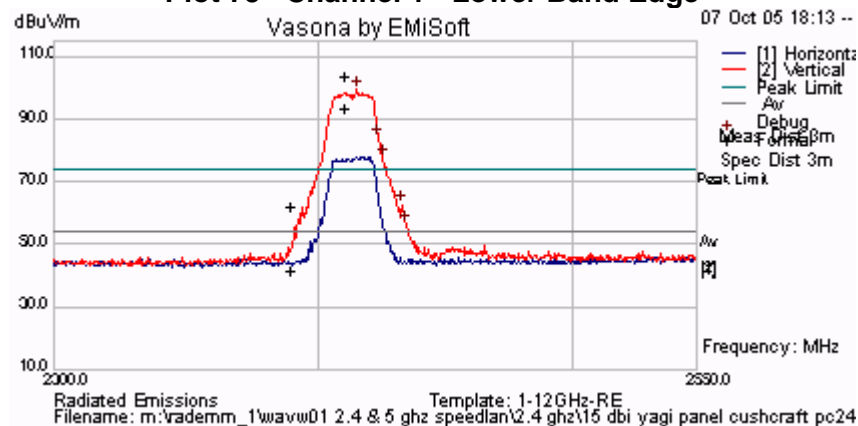


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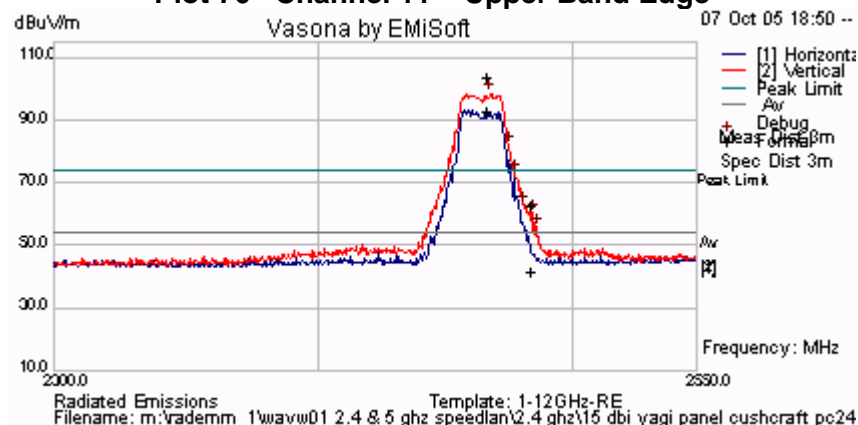
Radiated Band Edge Test Results for 2.4 GHz 15dBi (Yagi Panel) Cushcraft PC2415
TABLE OF RESULTS – 802.11g 6Mbit/s

Ch #	Tx Pwr (dBm)	Tx Freq. (MHz)	Restricted Band Edge Frequency (MHz)	Measured (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Plot #
1	+13	2,412 _{PEAK}	2,390	73.46	74	-0.54	75
1	+13	2,412 _{AVE}	2,390	53.02	54	-0.98	75
11	+13	2,462 _{PEAK}	2,483.5	73.42	74	-0.58	76
11	+13	2,462 _{AVE}	2,483.5	52.47	54	-1.53	76

Plot 75 Channel 1 - Lower Band Edge



Plot 76 Channel 11 – Upper Band Edge



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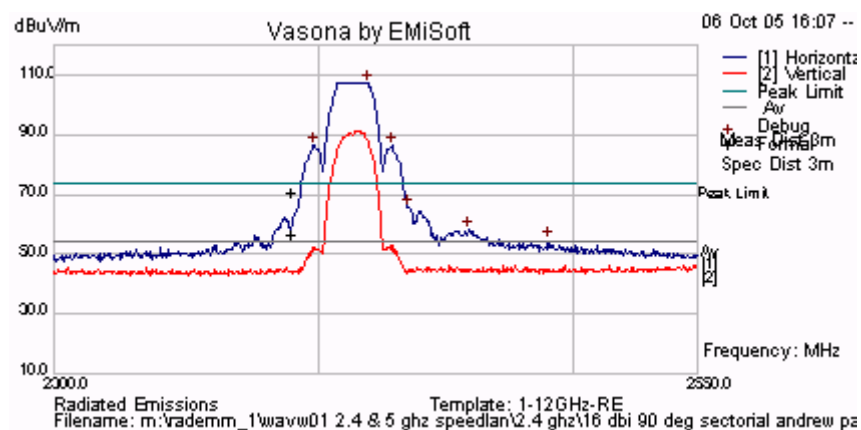


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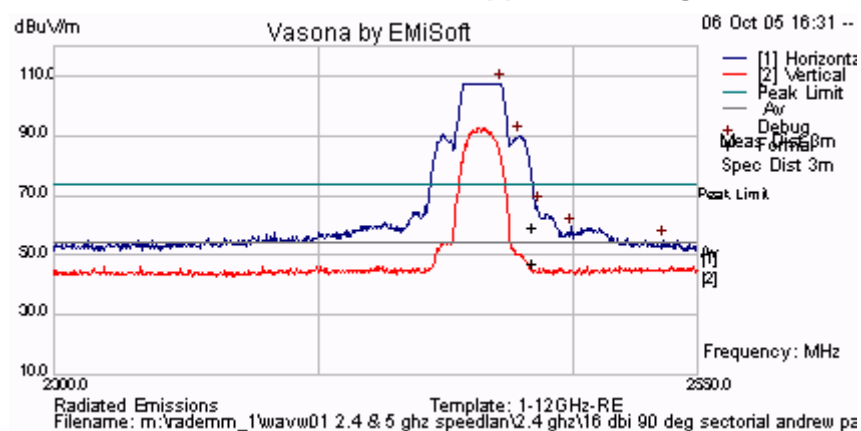
Radiated Band Edge Test Results for 2.4 GHz 16dBi (90° Sectoral) Andrew DB980G90N-R
TABLE OF RESULTS – 802.11b 11Mbit/s

Ch #	Tx Pwr (dBm)	Tx Freq. (MHz)	Restricted Band Edge Frequency (MHz)	Measured (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Plot #
1	+17	2,412 _{PEAK}	2,390	61.08	74	-12.92	77
1	+17	2,412 _{AVE}	2,390	47.83	54	-6.17	77
11	+17	2,462 _{PEAK}	2,483.5	61.77	74	-12.23	78
11	+17	2,462 _{AVE}	2,483.5	49.49	54	-4.51	78

Plot 77 Channel 1 - Lower Band Edge



Plot 78 Channel 11 – Upper Band Edge



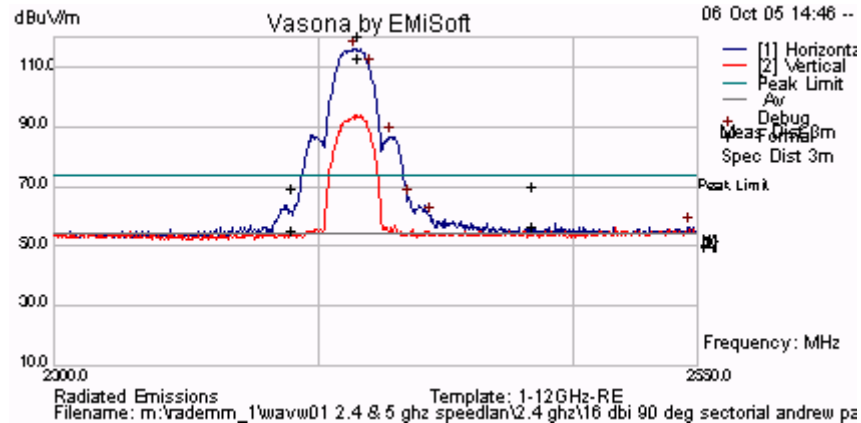
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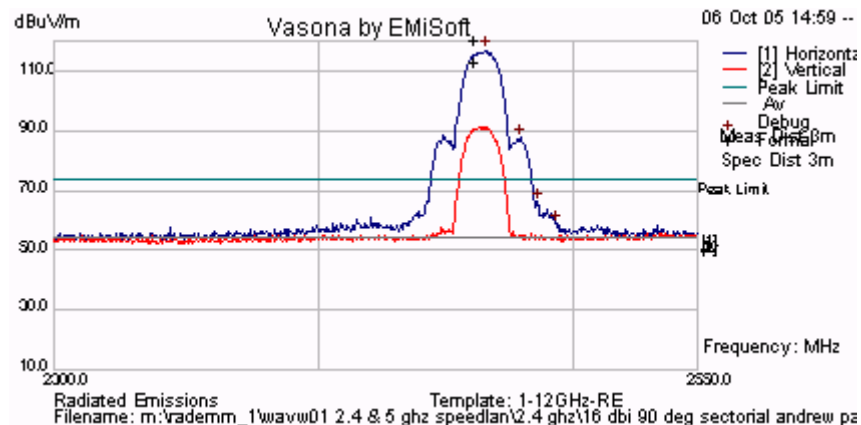
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Radiated Band Edge Test Results for 2.4 GHz 16dBi (90° Sectoral) Andrew DB980G90N-R
802.11b 11Mbit/s +17 dBm

Plot 79 CH 1 Peak Emission = 117.17 dB μ V/m



Plot 80 CH 11 Peak Emission = 117.02 dB μ V/m



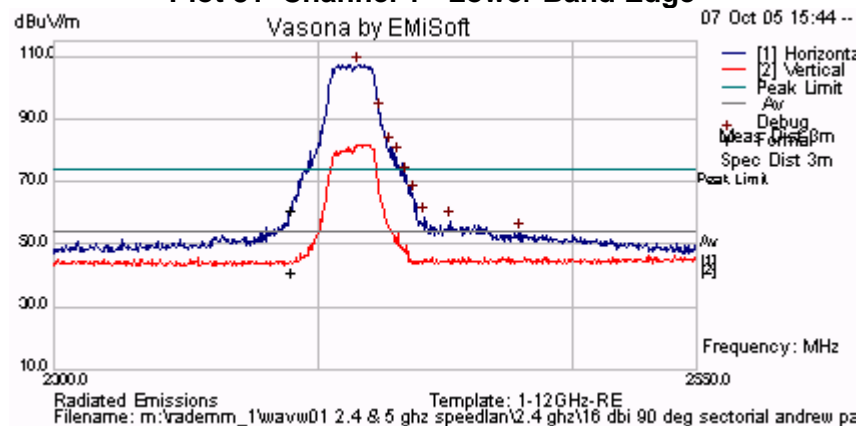
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Radiated Band Edge Test Results for 2.4 GHz 16dBi (90° Sectoral) Andrew DB980G90N-R
TABLE OF RESULTS – 802.11g 6Mbit/s

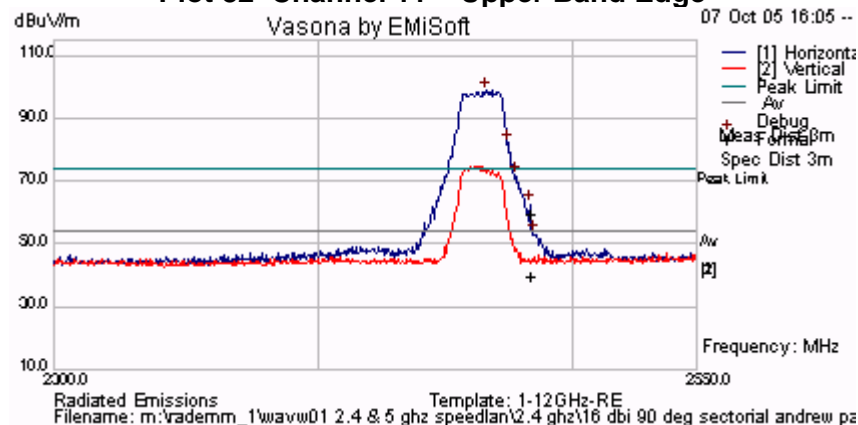
Ch #	Tx Pwr (dBm)	Tx Freq. (MHz)	Restricted Band Edge Frequency (MHz)	Measured (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Plot #
1	+14 ^{Note 1}	2,412 _{PEAK}	2,390	73.72	74	-0.28	81
1	+14 ^{Note 1}	2,412 _{AVE}	2,390	53.47	54	-0.53	81
11	+14 ^{Note 1}	2,462 _{PEAK}	2,483.5	73.35	74	-0.65	82
11	+14 ^{Note 1}	2,462 _{AVE}	2,483.5	51.94	54	-2.06	82

Note 1 A 16dB attenuator pad was used on the output of the EUT, Ref Section 3.7

Plot 81 Channel 1 - Lower Band Edge



Plot 82 Channel 11 – Upper Band Edge

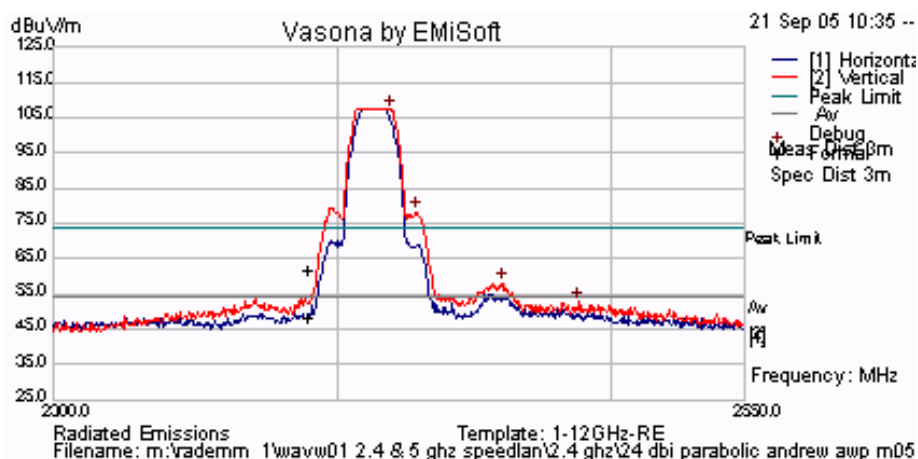


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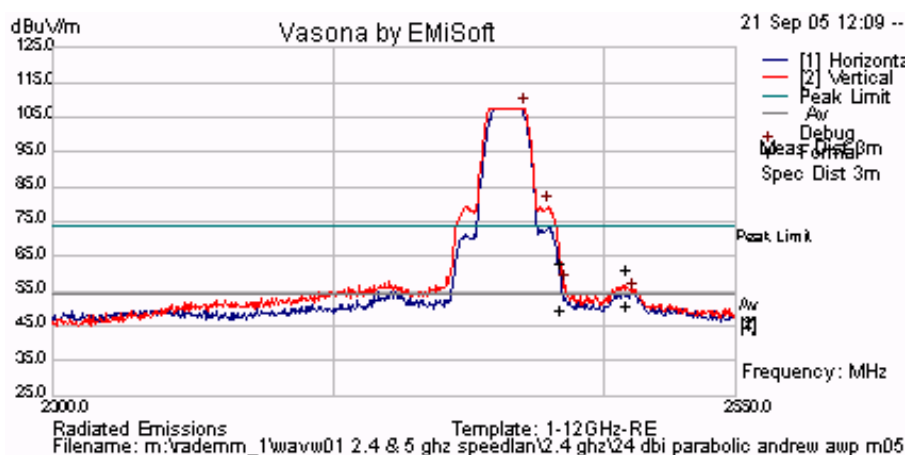
Radiated Band Edge Test Results for 2.4 GHz 24dBi Parabolic Andrew AWP M0528D T-2400
TABLE OF RESULTS – 802.11b 11Mbit/s

Ch #	Tx Pwr (dBm)	Tx Freq. (MHz)	Restricted Band Edge Frequency (MHz)	Measured (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Plot #
1	+17	2,412 _{PEAK}	2,390	58.87	74	-15.13	83
1	+17	2,412 _{AVE}	2,390	45.39	54	-8.61	83
11	+17	2,462 _{PEAK}	2,483.5	59.75	74	-14.25	84
11	+17	2,462 _{AVE}	2,483.5	46.51	54	-7.49	84

Plot 83 Channel 1 - Lower Band Edge



Plot 84 Channel 11 – Upper Band Edge

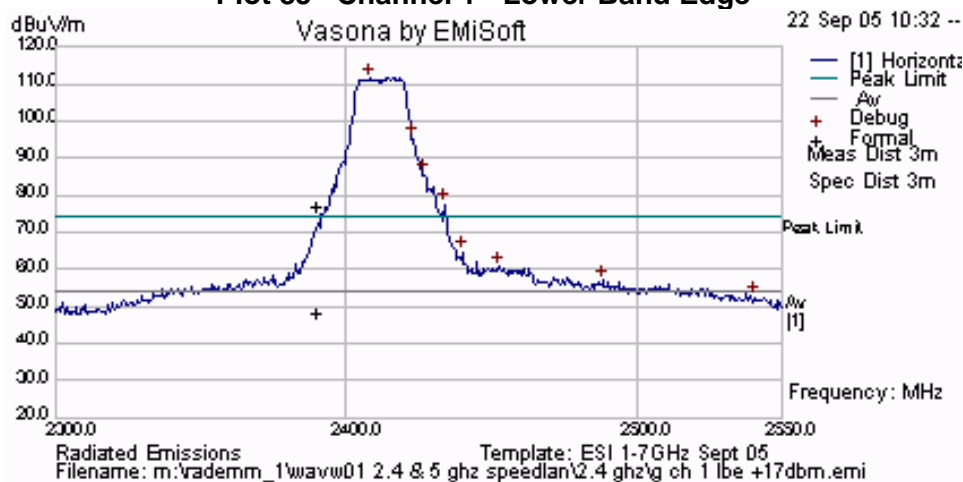


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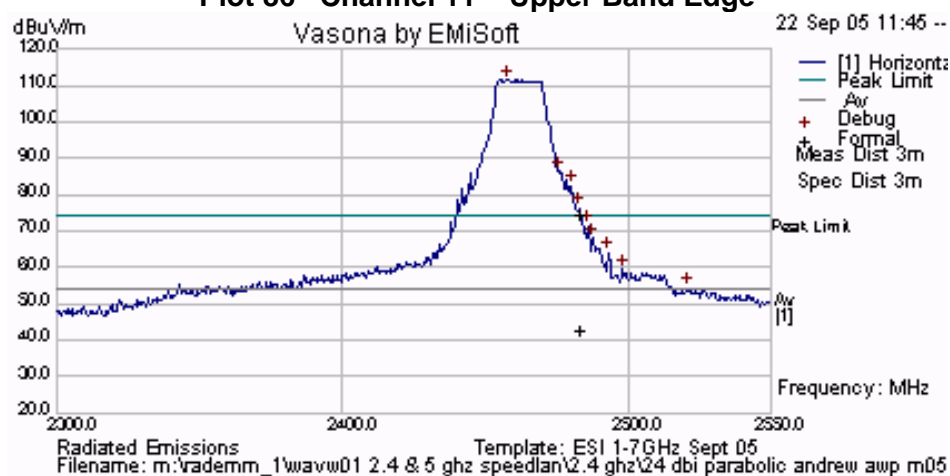
Radiated Band Edge Test Results for 2.4 GHz 24dBi Parabolic Andrew AWP M0528D T-2400
TABLE OF RESULTS – 802.11g 6Mbit/s +17 dBm

Ch #	Tx Power (dBm)	Tx Freq. (MHz)	Restricted Band Edge Frequency (MHz)	Measured (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Plot #
1	+17	2,412 _{PEAK}	2,390	73.82	74	-0.18	85
1	+17	2,412 _{AVE}	2,390	45.12	54	-8.88	85
11	+15	2,462 _{PEAK}	2,483.5	73.56	74	-0.44	86
11	+15	2,462 _{AVE}	2,483.5	42.42	54	-11.58	86

Plot 85 Channel 1 - Lower Band Edge



Plot 86 Channel 11 – Upper Band Edge



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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.

Frequency (MHz)	Field Strength ($\mu\text{V/m}$)	Field Strength (dB $\mu\text{V/m}$)	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, 0310, 0312

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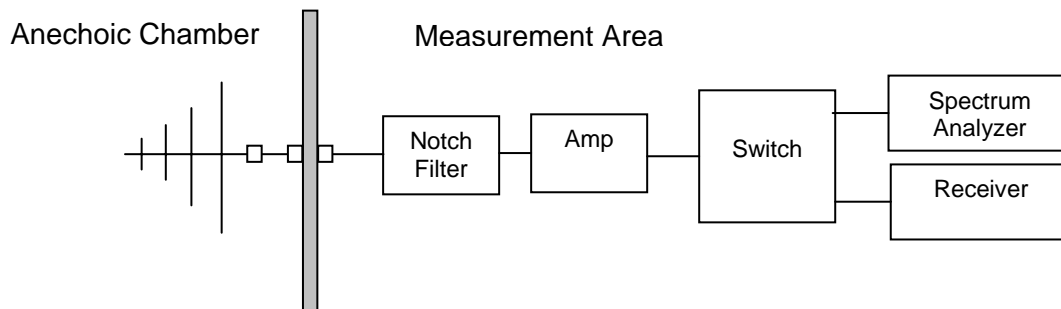
5.1.6.3. Radiated Spurious Emissions (30M-1 GHz)

FCC, Part 15 Subpart C §15.247(c)/ §15.209
Industry Canada RSS-210 §6.2.2(q1)(ii)

Test Procedure

Testing 30M-1 GHz was subcontracted to the company identified in Section 3.9 Subcontracted Testing. Preliminary radiated emissions are measured in the anechoic chamber at a 10-meter distance on every azimuth in both horizontal and vertical polarity. 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. The anechoic chamber test set-up is identified in Section 6 Test Set-Up Photographs.

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:

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

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

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

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

Ambient conditions.

Temperature: 19 to 26 °C Relative humidity: 31 to 57 % Pressure: 999 to 1009 mbar

Radio parameters. 5.8 GHz CH 149 802.11a +17 dBm

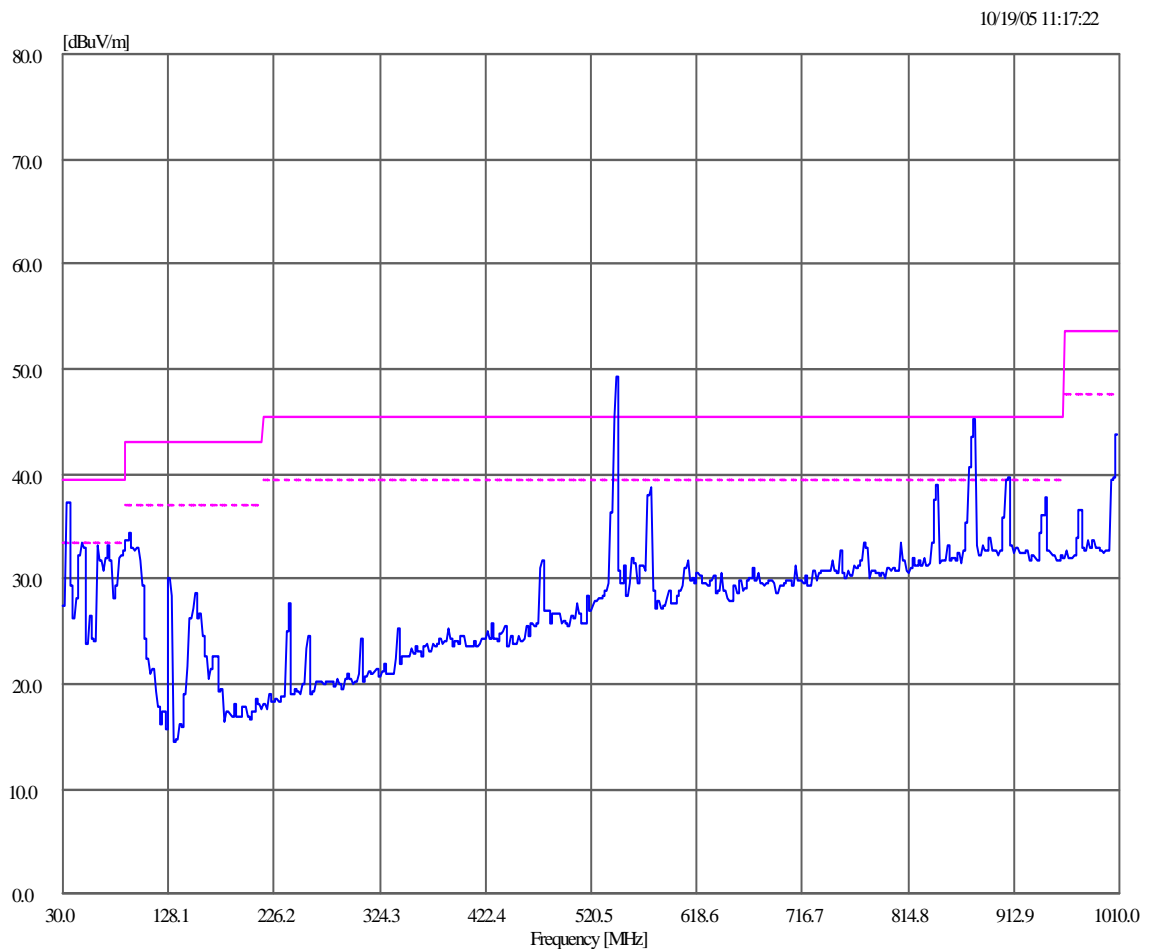
Data Rate(s): 6Mbit/s

Antenna Type: 29 dBi 5.8 GHz Parabolic, Mfr by: M-WAVE Model RP2-58-N

TABLE OF RESULTS

Freq. (MHz)	Peak (dBuV/m)	QP (dBuV/m)	QP Lmt (dBuV/m)	QP Margin (dB)	Angle (deg)	Height (cm)	Polarity
31.293026	39.98	35.69	40	-4.31	150	102	Vert
533.325868	45.02	42.56	46	-3.44	90	101	Horz
866.667156	46.52	45.33	46	-0.67	343	102	Horz

Plot 87 Radiated Spurious Emissions 30 MHz to 1 GHz



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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.

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 Sanmina work instruction	8546A HP Receiver and RF Filter, HP Pre-amp, Antenna EMCO Biconilog

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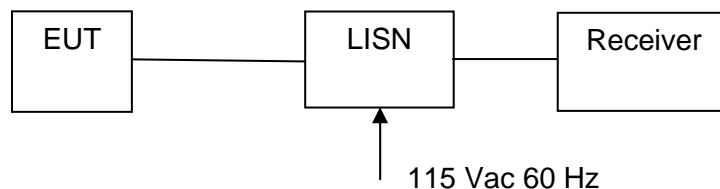
5.1.7. AC Wireline Conducted Emissions (150 kHz – 30 MHz)

FCC, Part 15 Subpart C §15.207

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: 19 to 26 °C

Relative humidity: 31 to 57 %

Pressure: 999 to 1009 mbar

Radio parameters.

Data Rate(s): 802.11a, 6 MBit/s, +17 dBm output power

TABLE OF RESULTS

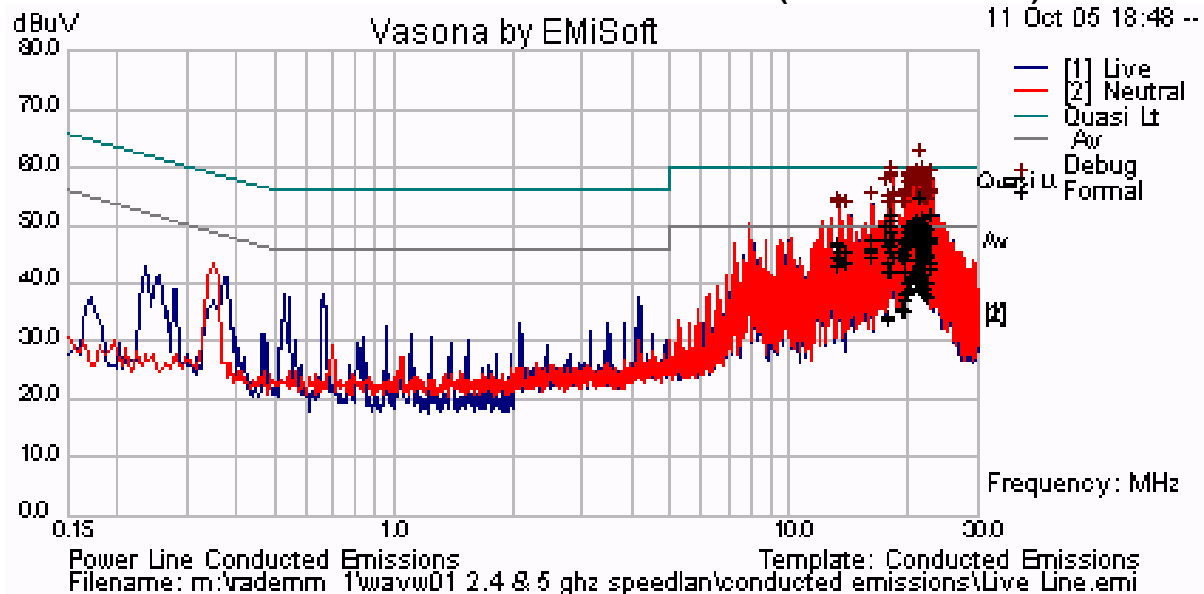
LINE - LIVE

Frequency (MHz)	Peak (dBμV)	QP (dBμV)	QP Limit (dBμV)	QP Margin (dB)	Ave. (dBμV)	Ave. Limit (dBμV)	Ave. Margin (dB)
17.694	55.91	47.68	60	-12.32	45.07	50	-4.93
18.244	57.96	49.67	60	-10.33	46.59	50	-3.41

LINE - NEUTRAL

Frequency (MHz)	Peak (dBμV)	QP (dBμV)	QP Limit (dBμV)	QP Margin (dB)	Ave. (dBμV)	Ave. Limit (dBμV)	Ave. Margin (dB)
18.304	56.85	48.46	60	-11.54	45.38	50	-4.62
20.807	57.03	47.74	60	-12.26	45.00	50	-5.00
21.663	60.80	52.41	60	-7.59	47.88	50	-2.12
23.129	57.60	49.46	60	-10.54	45.13	50	-4.87

Plot 88 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.

§15.207 (a) 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

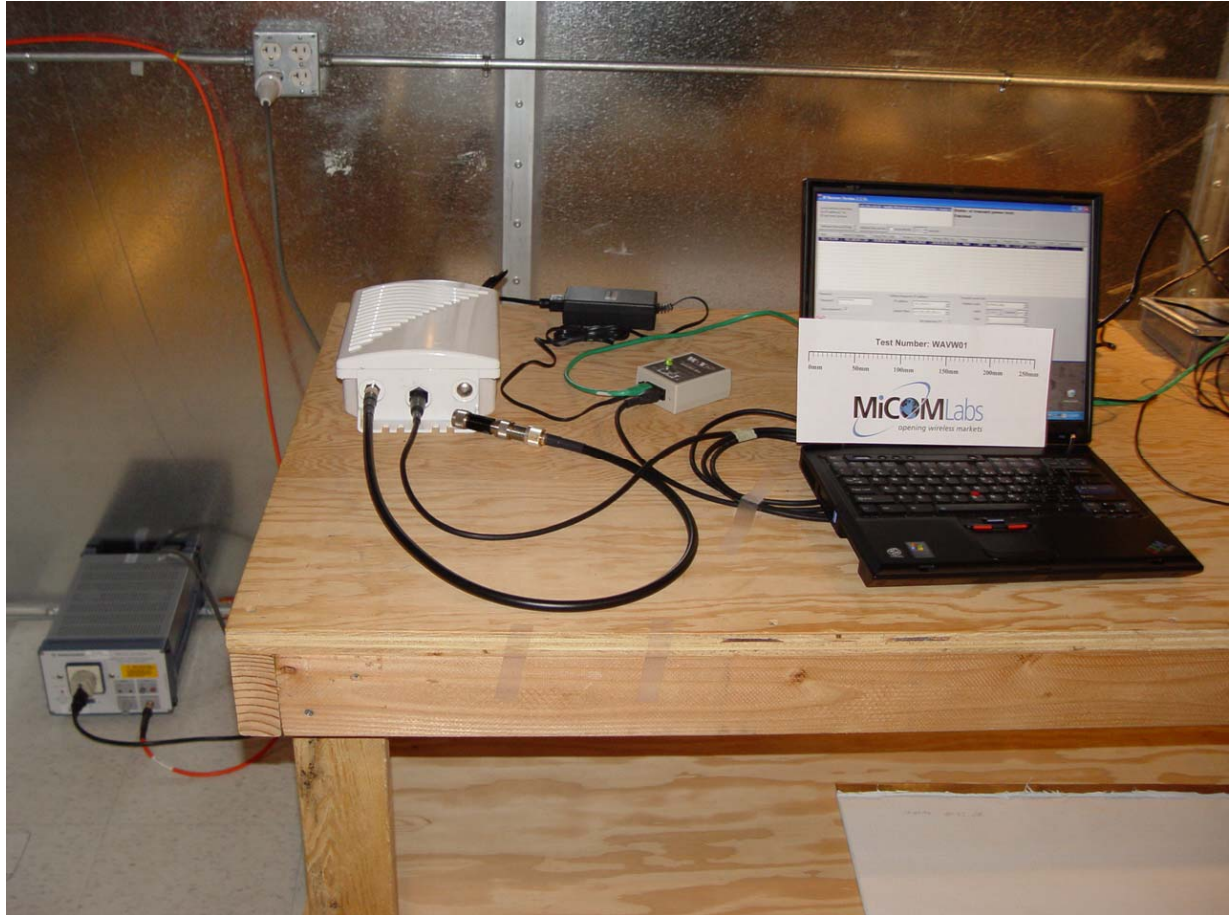
6. PHOTOGRAPHS

6.1. Radiated Emissions >1 GHz



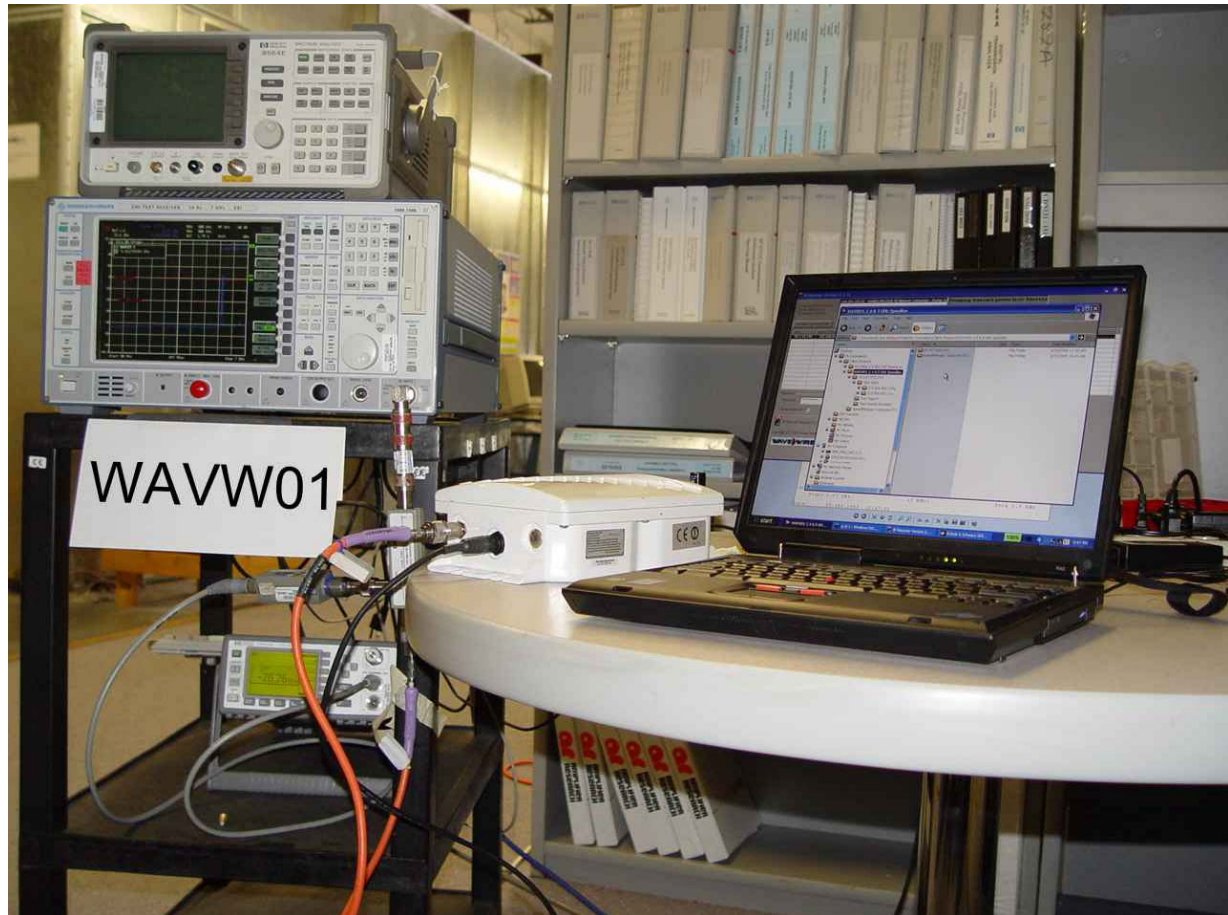
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6.2. Conducted Emissions (150 kHz - 30 MHz)



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6.3. General Measurement Test Set-Up



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7. TEST EQUIPMENT DETAILS

Asset #	Instrument	Manufacturer	Part #	Calibration Due Date	Serial #
0088	Spectrum Analyzer	Hewlett Packard	8564E	20 th June '06	3410A00141
0104	1-18GHz Horn Antenna	The Electro-Mechanics Company	3115	21 st Oct '06	9205-3882
0134	Amplifier	Com Power	PA 122	1 st Dec '05	181910
0158	Barometer /Thermometer	Control Co.	4196	25 th Aug '06	E2846
0193	EMI Receiver	Rhode & Schwartz	ESI 7	8 th Apr '06	838496/007
0252	SMA Cable	Megaphase	Sucoflex 104	11 th Jun '06	None
0304	2.4GHzHz Notch Filter	Micro-Tronics	--	1 st Dec 05	001
0310	2m SMA Cable	Micro-Coax	UFA210A-0-0787-3G03G0	7 th Dec '05	209089-001
0312	3m SMA Cable	Micro-Coax	UFA210A-1-1181-3G0300	9 ^h Dec '05	209092-001
0313	Coupler	Hewlett Packard	86205A	N/A	3140A01285
0314	30dB N-Type Attenuator	ARRA	N9444-30	N/A	1623
0070	Power Meter	Hewlett Packard	437B	13 th May 06	3125U11552
0116	Power Sensor	Hewlett Packard	8485A	7 th April 06	3318A19694
0117	Power Sensor	Hewlett Packard	8487D	20 th June 06	3318A00371
0184	Pulse Limiter	Rhode & Schwartz	ESH3Z2	3 RD Oct 06	357.8810.52
0190	LISN	Rhode & Schwartz	ESH3Z5	22 nd Jun 07	836679/006
0293	BNC Cable	Megaphase	1689 1GVT4	13 TH Jul 06	15F50B001
0307	BNC Cable	Megaphase	1689 1GVT4	13 th Jul 06	15F50B002

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