EMISSIONS TEST REPORT FOR A LOW POWER TRANSMITTER

I. GENERAL INFORMATION

Requirement: FCC, Industry Canada
Test Requirements: FCC Part 15, RSS-Gen, RSS-210

Applicant: SONOS, INC.
223 E. De La Guerra
Santa Barbara**, CA 93101**

FCC ID: SBVRM002
IC: 5373A-RM002
Model No.: WMP-N06

II. DESCRIPTION OF EQUIPMENT UNDER TEST (EUT)

The Sonos WMP-N06 is a 2.4 GHz 3x3 MIMO radio module operating in accordance with provisions in IEEE 802.11n.

Testing was performed for the purpose of qualifying a new antenna set for use with this module, the ZPS5 antenna set. For this antenna set, only two transmit modes are supported:

802.11g, 24 Mbps, CDD
802.11 HT20 3x3 MIMO, MCS9

III. TEST DATES AND TEST LOCATION

Testing was performed 7,8, and 12 October. Tests were performed at:

Compliance Certification Services
47173 Benicia Street
Fremont, CA 94538

T.N. Cokenias 18 October 2009
EMC Consultant/Agent for Sonos Inc.

15.203 Antenna description

The ZPS5 antenna set consists of 3 monopole antennas mounted on pcbs, one for each transmitter chain, with integral antenna cables of differing lengths. Maximum antenna gains for each monopole/cable combination are listed below

Antenna description	Gain, dBi
Chain A antenna	1.5
Chain B antenna	1.3
Chain C antenna	0.46

TEST PROCEDURES

All tests were performed in accordance with the applicable procedures called out in the following documents, unless otherwise noted:

FCC 47CFR15

RSS-210 Issue 7: Low power license exempt radio frequency devices (July 2007)
RSS-212: Test Facilities and Test Methods for Radio Equipment

ANSI C63.4 – 2003, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.

FCC KDB 558074: DTS Measurement, published on Apr 16 2007

Tests were performed at three frequencies:

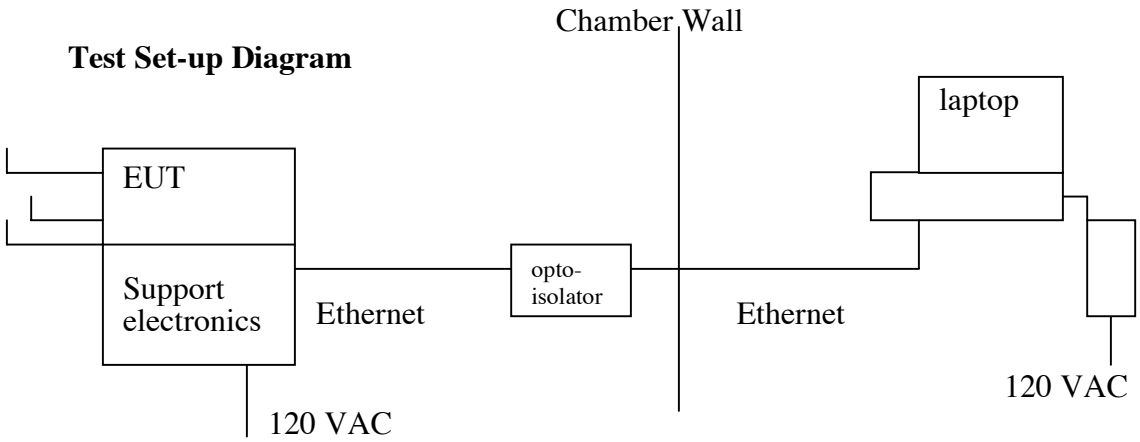
LOW: Channel 1 2412 MHz
MID: Channel 6 2437 MHz
HIGH: Channel 11 2462 MHz

Test Equipment

Compliance Certification Services:

TEST EQUIPMENT LIST				
Description	**Manufacturer**	**Model**	**Asset Number**	**Cal Due**
Spectrum Analyzer, 44 GHz	Agilent / HP	E4446A	C01069	01/05/10
Antenna, Bilog, 2 GHz	Sunol Sciences	JB1	C01011	01/14/10
Preamplifier, 1300 MHz	Agilent / HP	8447D	C00885	12/16/09
Antenna, Horn, 18 GHz	EMCO	3115	C00945	01/29/10
Preamplifier, 26.5 GHz	Agilent / HP	8449B	C01052	02/04/10

Test Set-up Diagram



Support Equipment

Equipment	Mfr	Model
DC Power Supply	Apple	A1021
Laptop	Apple	PP01L
Support electronics for power and I/O	Sonos	TBD

TEST RESULTS

Radiated Test Set-up, 30 MHz-25 GHz

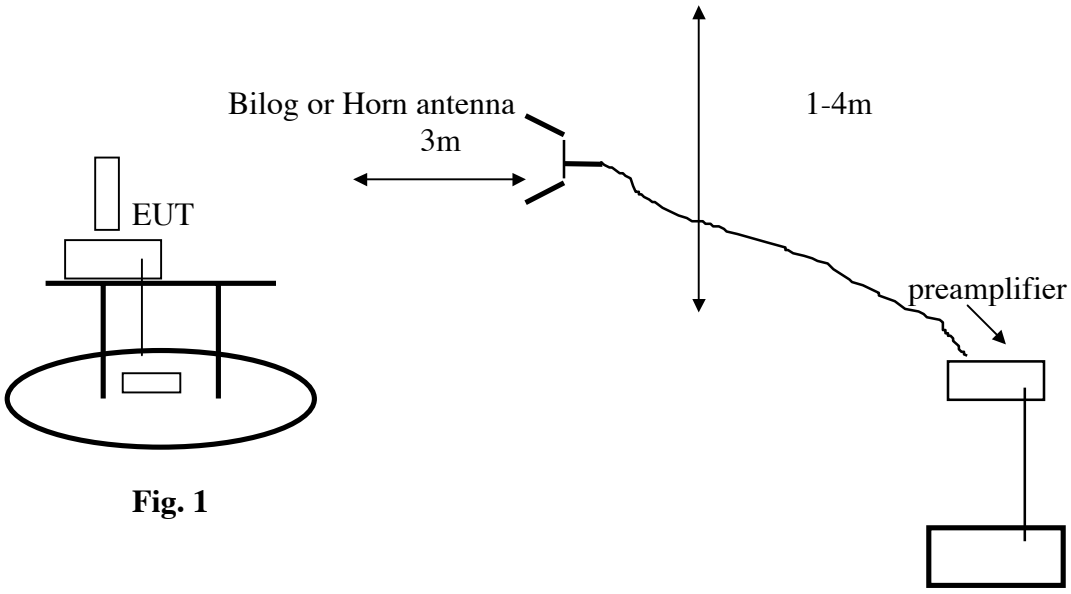


Fig. 1

Test Procedures

Radiated emissions generated by the transmitter portion of the EUT were measured.

1. The EUT was placed on a non-conductive table resting on a turntable on the test site. The search antenna was placed 3m from the EUT. The EUT antenna was mounted in the with the EUT TX antenna pointed directly to the search antenna.

2. The turntable was slowly rotated to locate the direction of maximum emission at each emission falling in the restricted bands of 15.205.

3. Emissions were investigated to the 10^{th} harmonic of the fundamental.

4. Once maximum direction was determined, the search antenna was raised and lowered in both vertical and horizontal polarizations. The maximum readings so obtained are recorded in the data listed below.

Test Results: Worst-case results are presented. Refer to data sheets below. Restricted band emissions meet 54 dBuV/m. Other undesired emissions from the transmitter meet the -20 dBc requirement in 15.247(d).

15.205 Restricted Frequency Bands

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
0.495 - 0.505 (1)	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 -	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.52525	2655 - 2900	22.01 - 23.12
8.41425 - 8.41475	156.7 - 156.9	3260 - 3267	23.6 - 24.0
12.29 - 12.293	162.0125 - 167.17	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	167.72 - 173.2	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	240 - 285	3600 - 4400	
13.36 - 13.41	322 - 335.4		

15.209 General Field Strength Limits

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100 **	3
88 - 216	150 **	3
216 - 960	200 **	3
Above 960	500	3

Peak RF Output Power Measurements

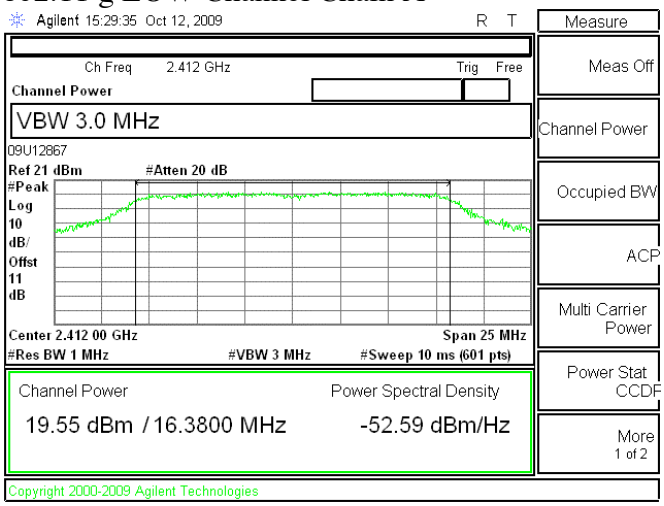
Peak Power and Average Power Test Results Summary
(average power readings for reference only)

FCC ID: SBVRM002
C2PC Power Settings

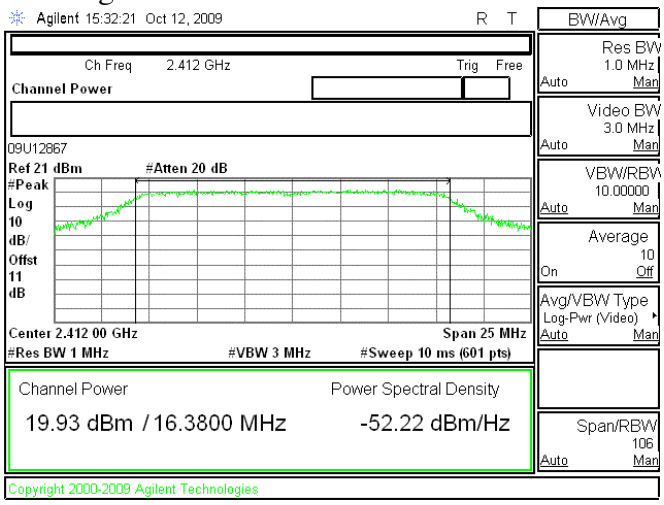
Channel	Mode	Pset dBm	P meter ChB dBm	P meter ChA dBm	P meter ChC dBm	Pout Tot dBm
Ave Power						
1	802.11g	15	14.1	13.9	13.3	18.6
6	802.11g	19	18.31	17.7	18	22.8
11	802.11g	15	14.34	13.9	14	18.9
1	HT20	15	14.27	13.8	13.3	18.6
6	HT20	19	18.38	17.8	18	22.8
11	HT20	15	14.3	13.8	13.9	18.8
Peak Power						
1	802.11g	15	19.9	19.5	19.3	24.3
6	802.11g	19	24.33	23.86	23.82	28.78
11	802.11g	15	19.97	19.9	19.6	24.6
1	HT20	15	19.99	19.79	19.52	24.5
6	HT20	19	24.47	23.88	23.98	28.89
11	HT20	15	20.21	19.99	20.02	24.8

Peak Output Power Plots

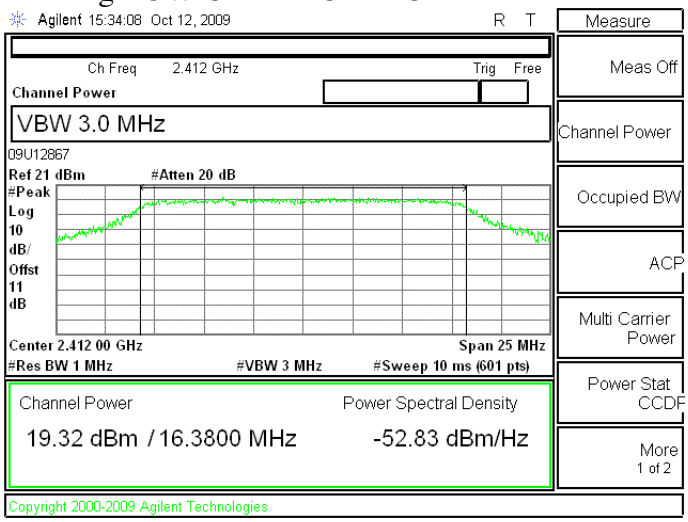
802.11 g LOW Channel Chain A



802.11 g LOW Channel Chain B

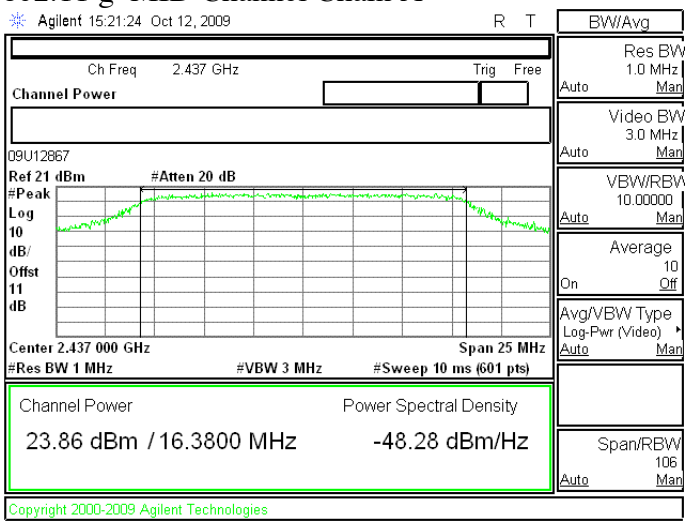


802.11 g LOW Channel Chain C

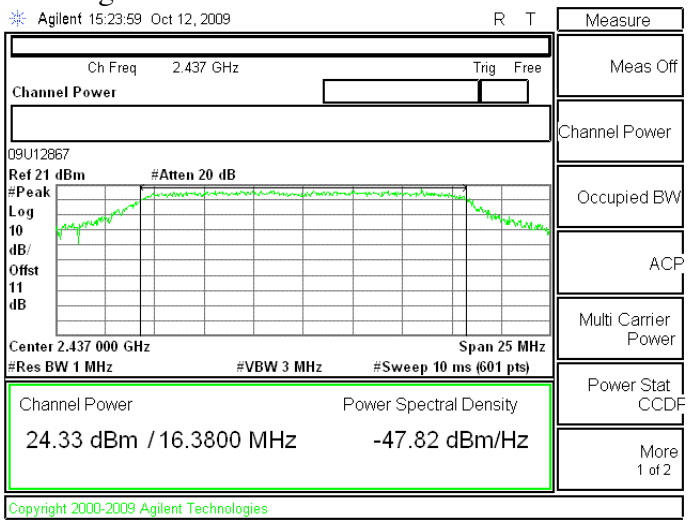


Peak Output Power Plots

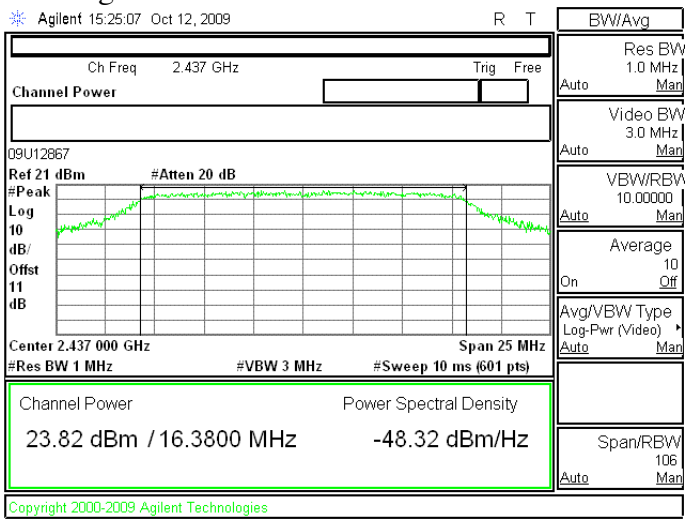
802.11 g MID Channel Chain A



802.11 g MID Channel Chain B

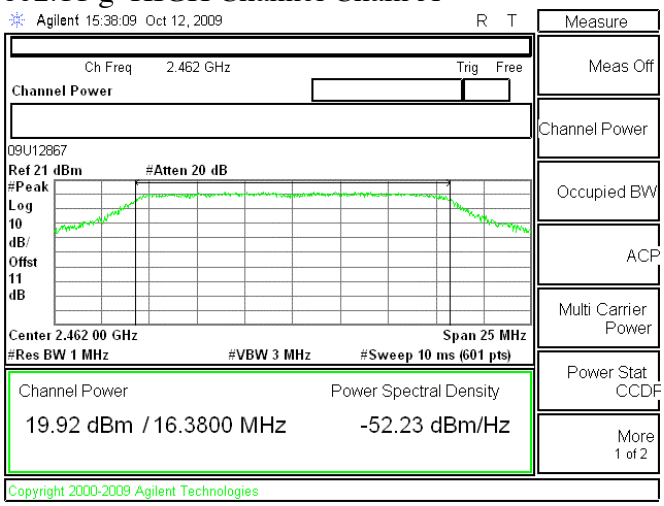


802.11 g MID Channel Chain C

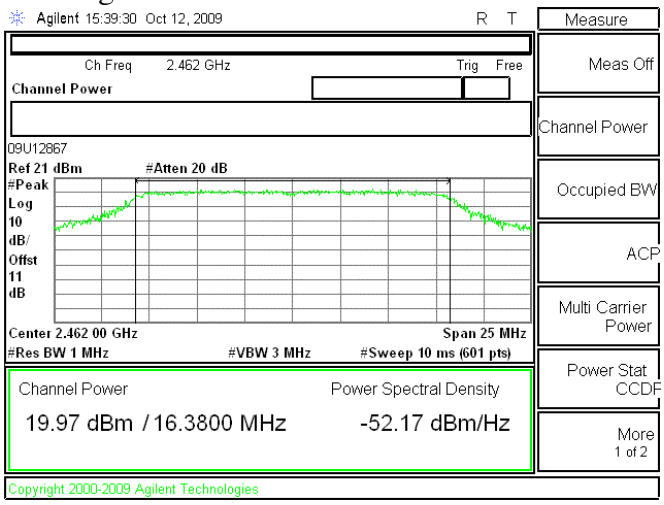


Peak Output Power Plots

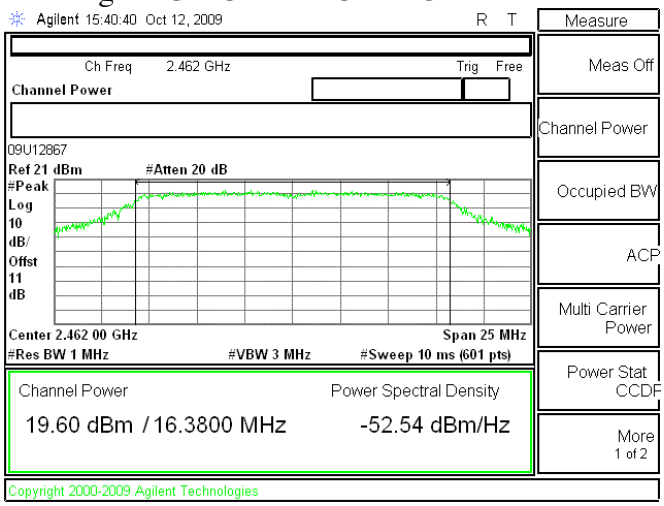
802.11 g HIGH Channel Chain A



802.11 g HIGH Channel Chain B

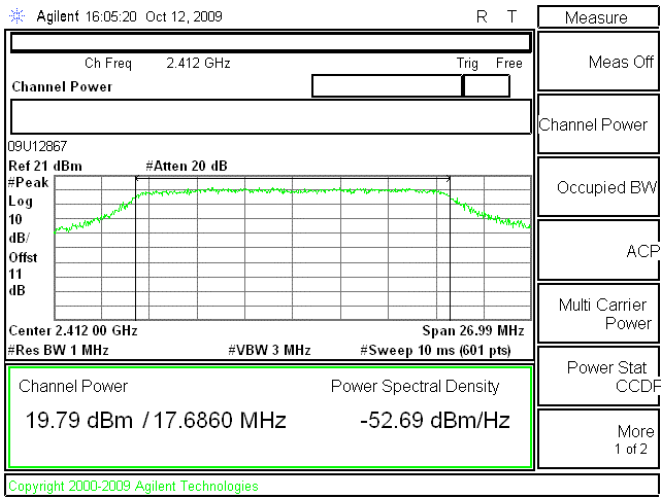


802.11 g HIGH Channel Chain C

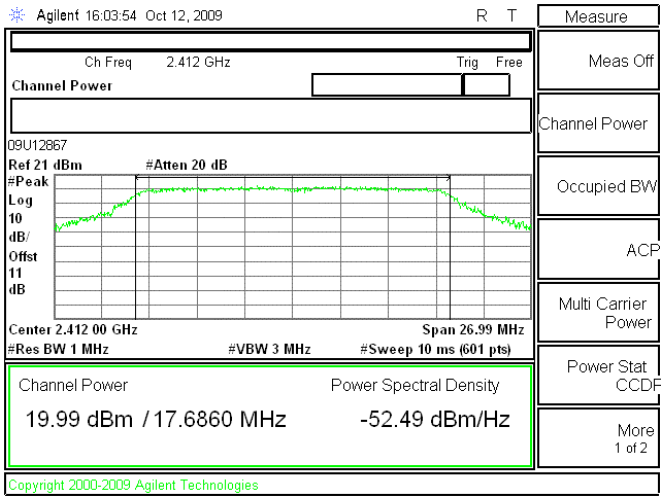


Peak Output Power Plots

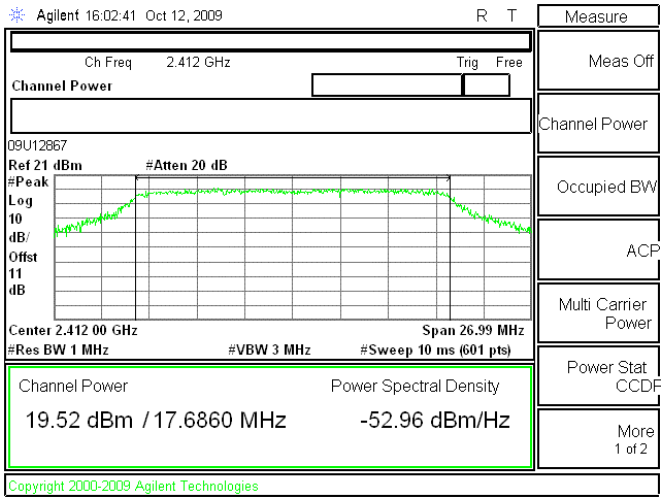
802.11 HT20 LOW Channel Chain A



802.11 HT20 LOW Channel Chain B

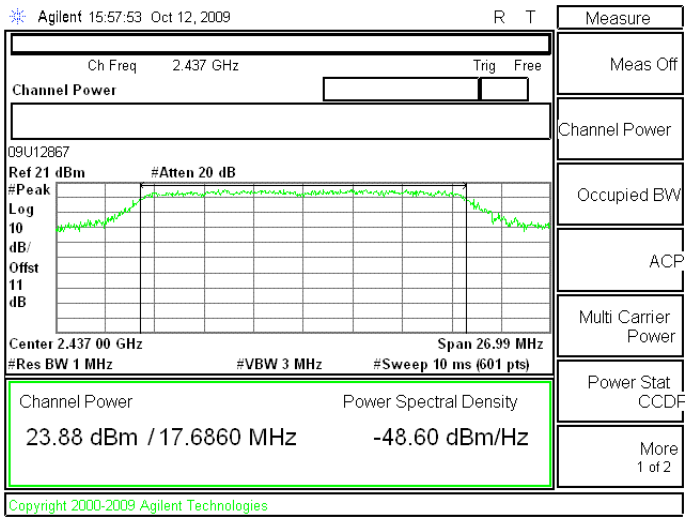


802.11 HT20 LOW Channel Chain C

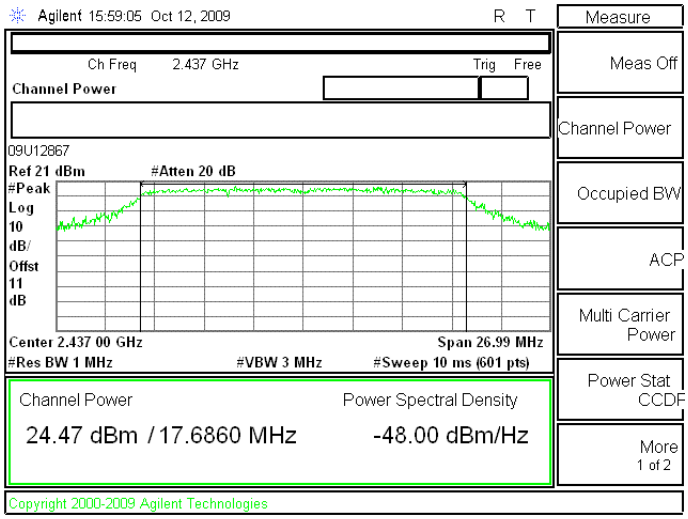


Peak Output Power Plots

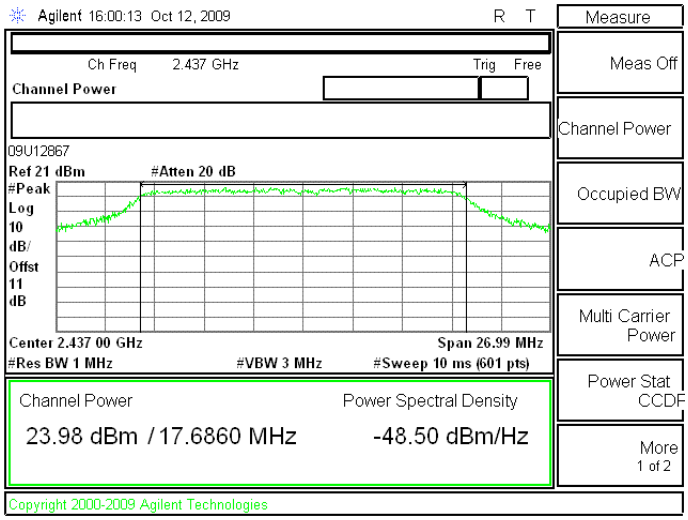
802.11 HT20 MID Channel Chain A



802.11 HT20 MID Channel Chain B

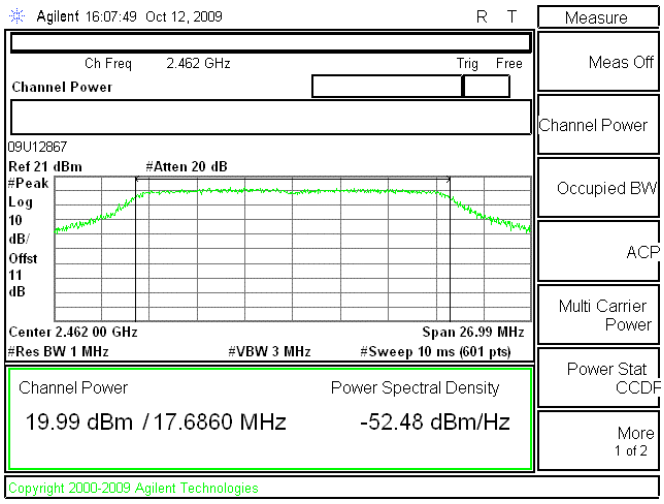


802.11 HT20 MID Channel Chain C

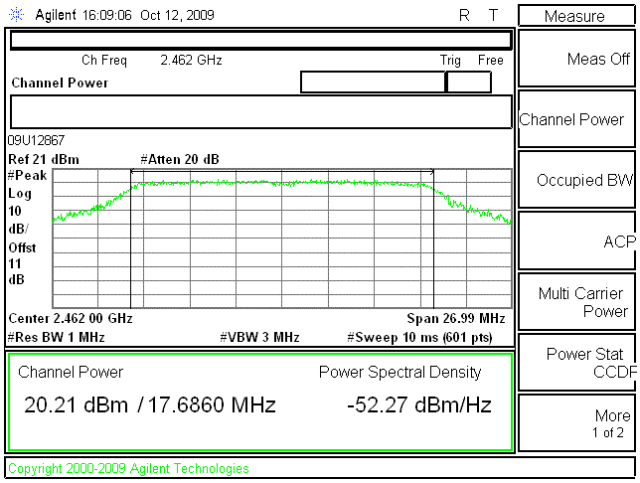


Peak Output Power Plots

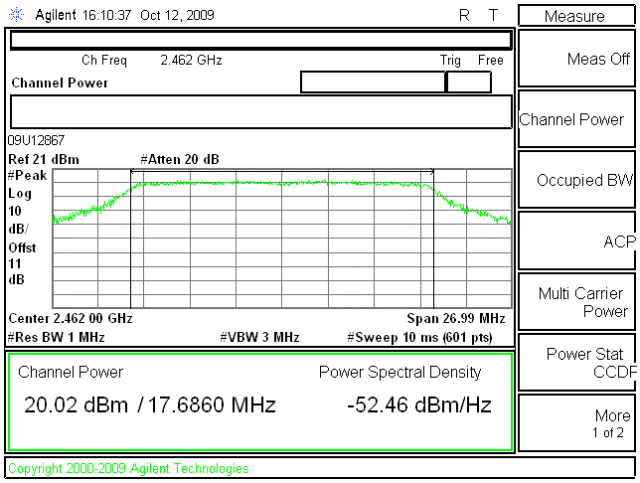
802.11 HT20 HGH Channel Chain A



802.11 HT20 HGH Channel Chain B

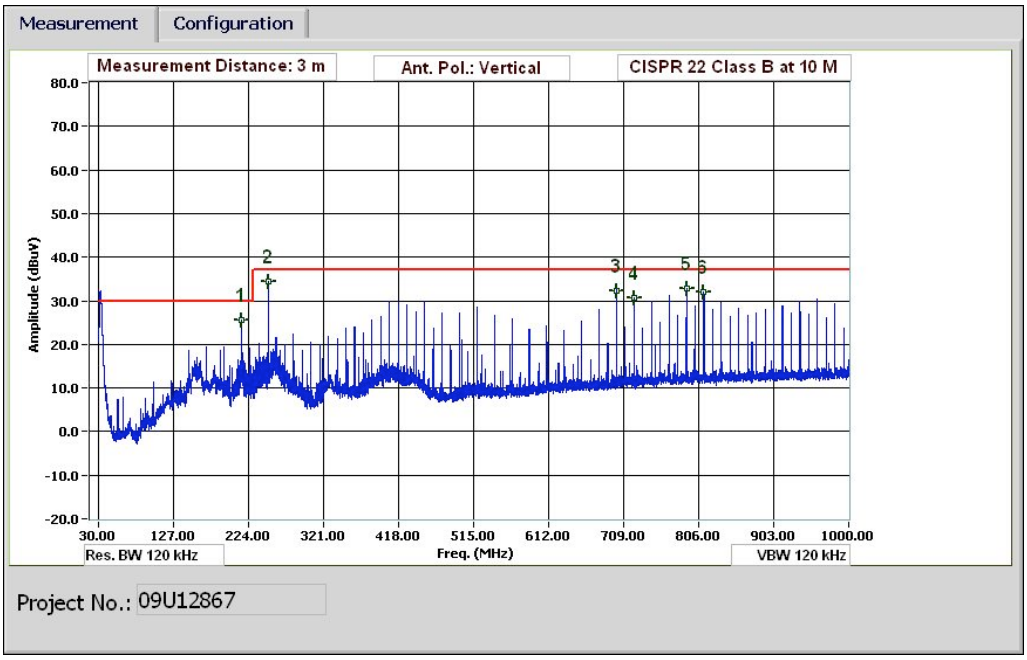


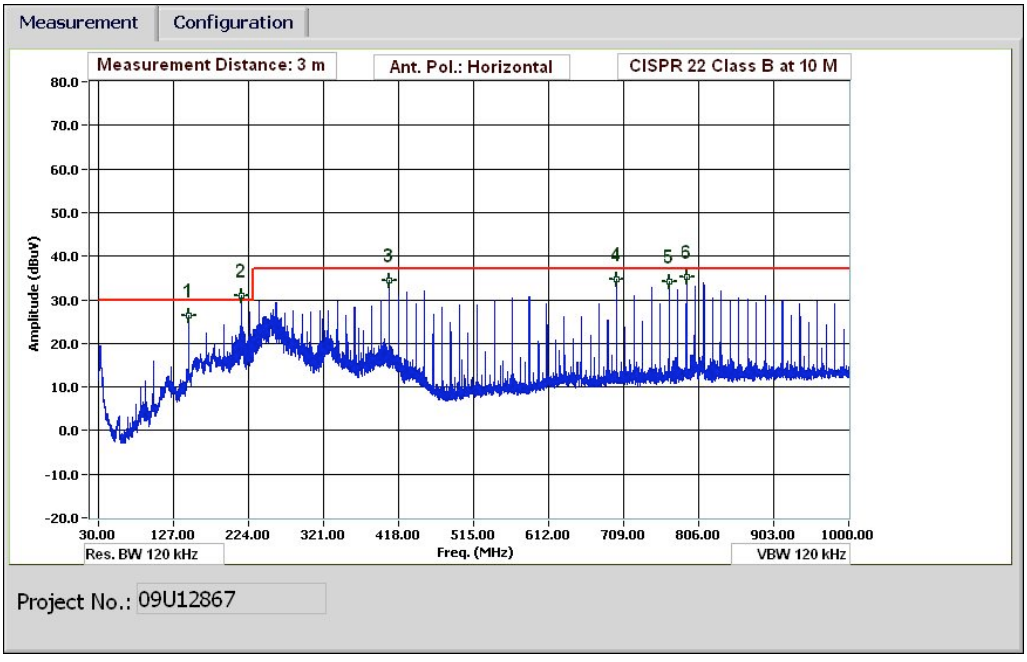
802.11 HT20 HGH Channel Chain C



Radiated Emissions, 30 – 1000 MHz

All emissions detected are more than -20dBc from TX peak output or from support equipment emissions. Tabulated data is for radio module emissions only.





Radiated Emissions, Tabulated Data

30-1000MHz Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Test Engr: **Tom Chen**
Date: **10/12/09**
Project #: **09U12867**
Company: **Sonos**
EUT Description: **802.11 module**
EUT M/N: **FCC ID: SBVRM002 with ZPS5 antennas**
Test Target: **FCC Class B**
Mode Oper:

f	Measurement Frequency	Amp	Preamp Gain	Margin	Margin vs. Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters		
Read	Analyzer Reading	Filter	Filter Insert Loss		
AF	Antenna Factor	Corr.	Calculated Field Strength		
CL	Cable Loss	Limit	Field Strength Limit		

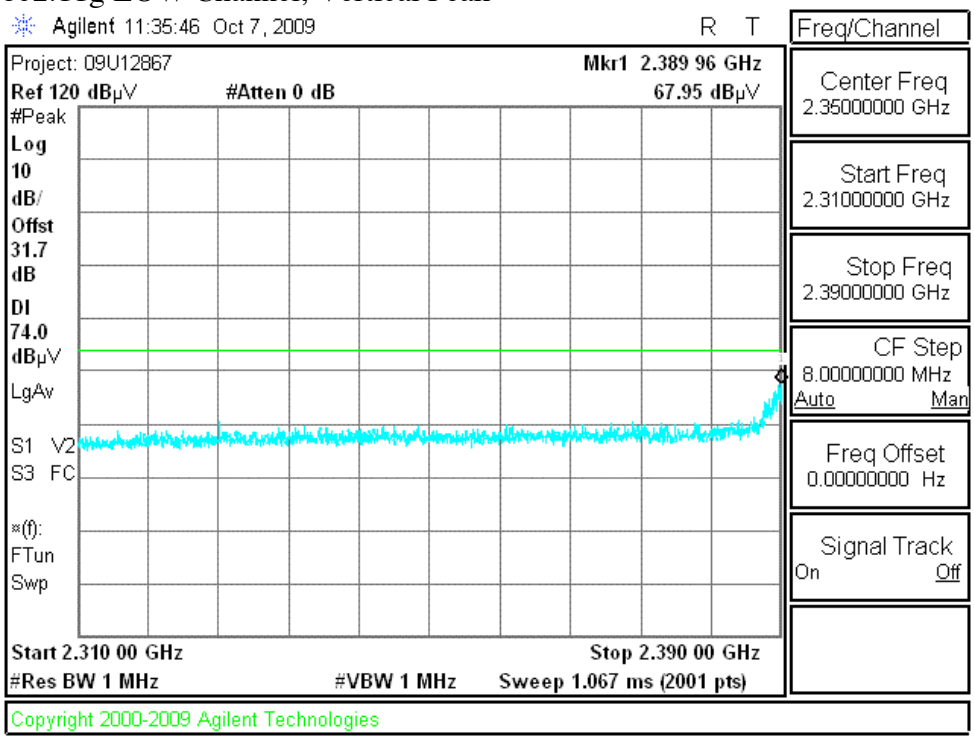
f MHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Filter dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol. V/H	Det. P/A/QP	Ant. High cm	Table Angle Degree
Vertical														
214.448	3.0	51.0	11.9	1.3	28.2	-10.5	0.0	25.5	30.0	-4.5	V	EP	100.0	0 - 360
249.969	3.0	59.9	11.8	1.4	28.2	-10.5	0.0	34.4	37.0	-2.6	V	EP	100.0	0 - 360
699.868	3.0	47.9	19.6	2.4	27.2	-10.5	0.0	32.3	37.0	-4.7	V	EP	100.0	0 - 360
722.549	3.0	45.9	19.9	2.5	27.2	-10.5	0.0	30.6	37.0	-6.4	V	EP	100.0	0 - 360
790.231	3.0	47.2	20.8	2.6	27.4	-10.5	0.0	32.8	37.0	-4.2	V	EP	100.0	0 - 360
812.792	3.0	46.3	21.1	2.7	27.5	-10.5	0.0	32.1	37.0	-4.9	V	EP	100.0	0 - 360
Horizontal														
146.765	3.0	51.2	12.8	1.1	28.3	-10.5	0.0	26.4	30.0	-3.6	H	EP	100.0	0 - 360
214.568	3.0	56.4	11.9	1.3	28.2	-10.5	0.0	30.9	30.0	0.9	H	EP	100.0	0 - 360
214.568	3.0	54.9	11.9	1.3	28.2	-10.5	0.0	29.4	30.0	-0.6	H	EP	100.0	0 - 360
406.456	3.0	56.1	15.0	1.8	28.1	-10.5	0.0	34.4	37.0	-2.6	H	EP	100.0	0 - 360
699.988	3.0	50.3	19.6	2.4	27.2	-10.5	0.0	34.7	37.0	-2.3	H	EP	100.0	0 - 360
767.670	3.0	49.0	20.5	2.6	27.4	-10.5	0.0	34.2	37.0	-2.8	H	EP	100.0	0 - 360
790.231	3.0	49.7	20.8	2.6	27.4	-10.5	0.0	35.3	37.0	-1.7	H	EP	100.0	0 - 360

Rev. 1.27.09
Note: No other emissions from EUT were detected above the system noise floor.

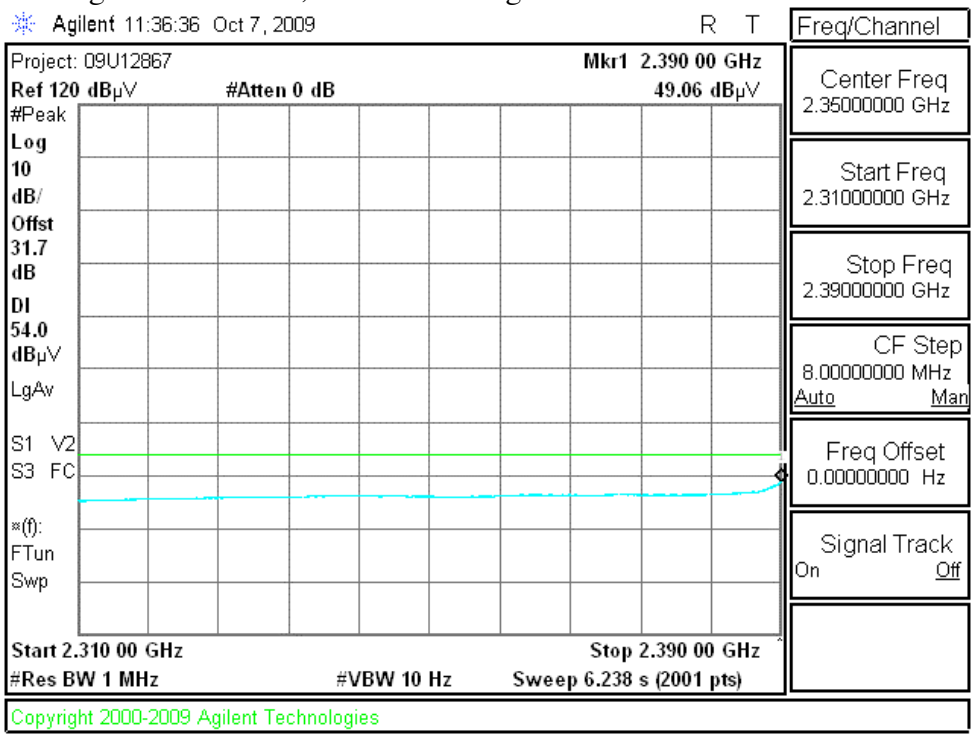
Radiated Emissions Above 1 GHz

Band Edge Emissions

802.11g LOW Channel, Vertical Peak

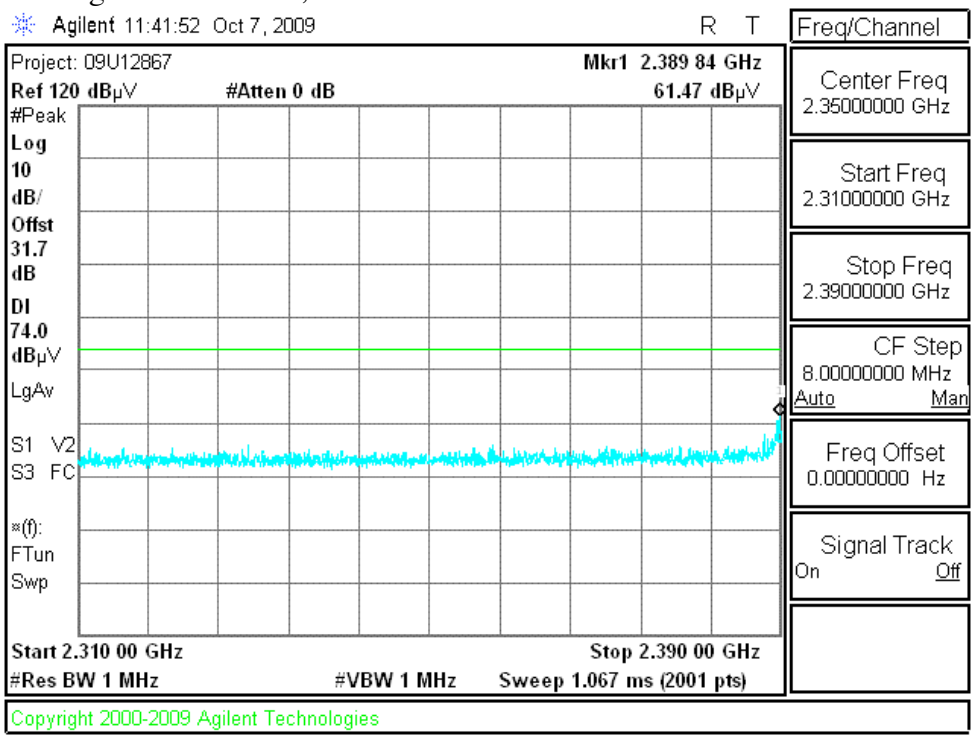


802.11g LOW Channel, Vertical Average

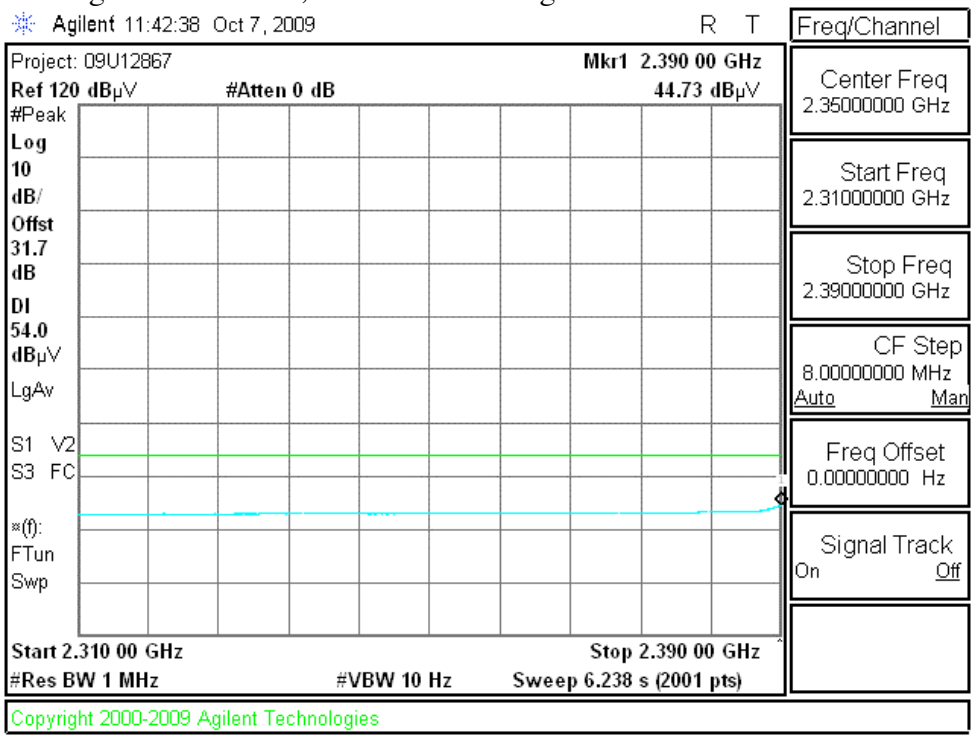


Band Edge Emissions

802.11g LOW Channel, Horizontal Peak

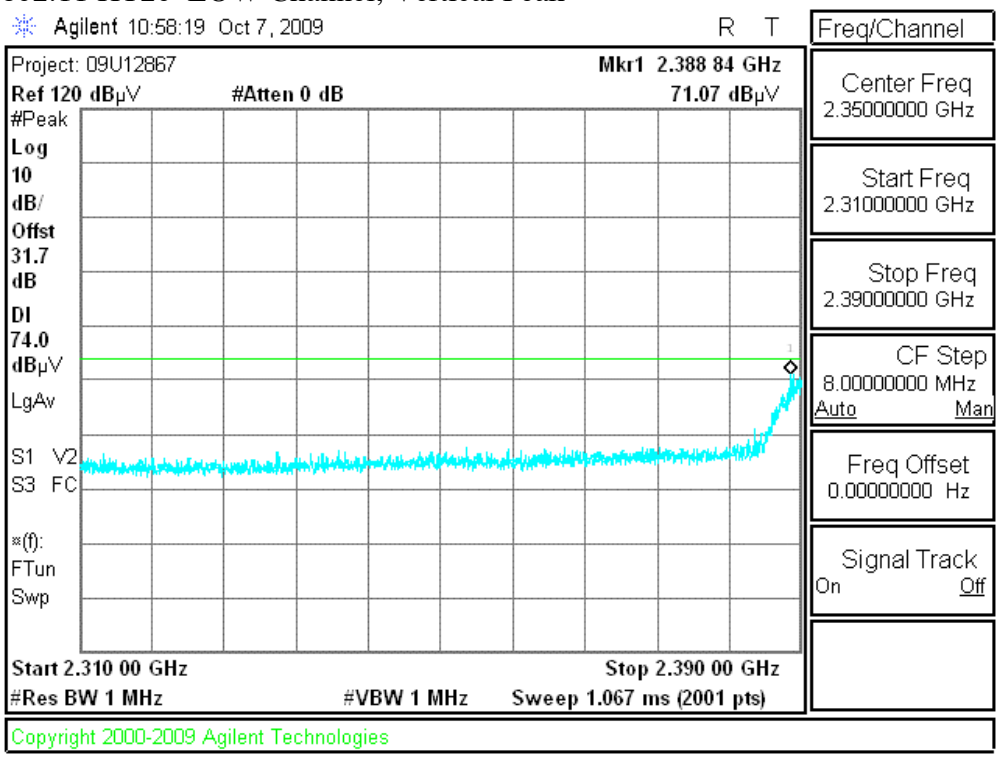


802.11g LOW Channel, Horizontal Average

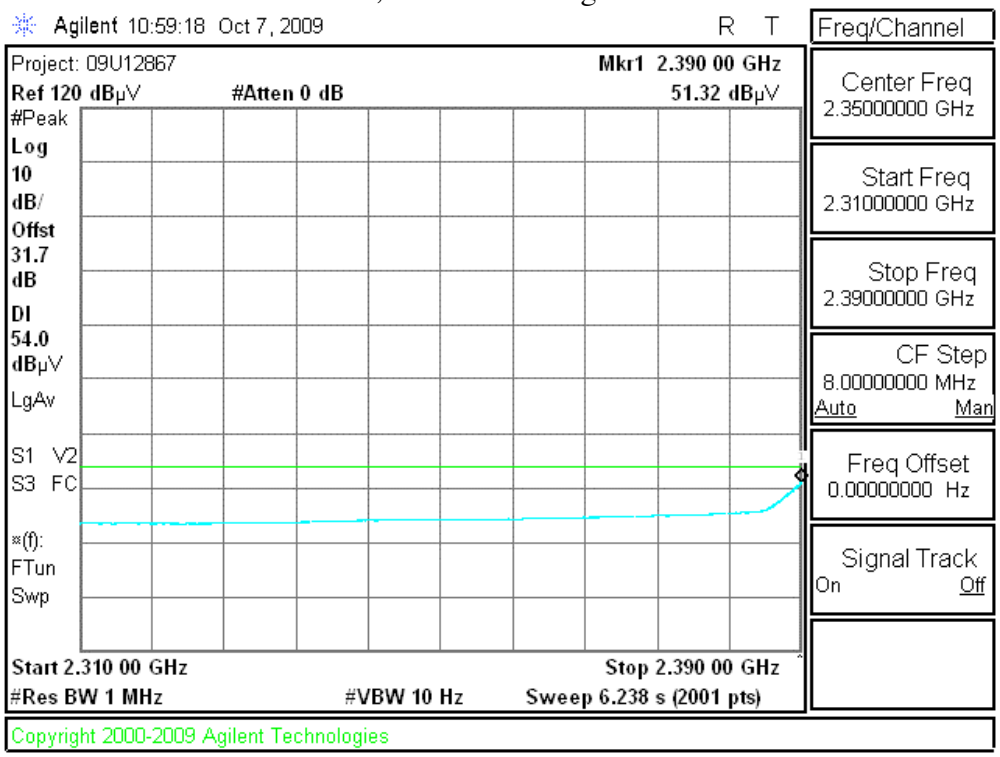


Band Edge Emissions

802.11 HT20 LOW Channel, Vertical Peak

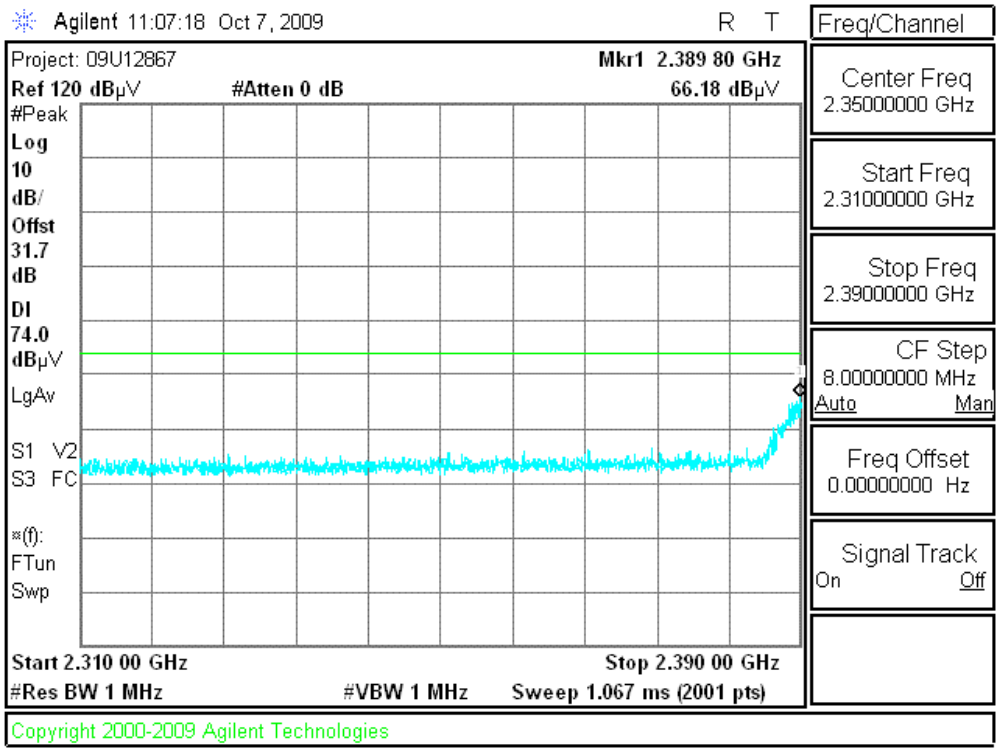


802.11 HT20 LOW Channel, Vertical Average

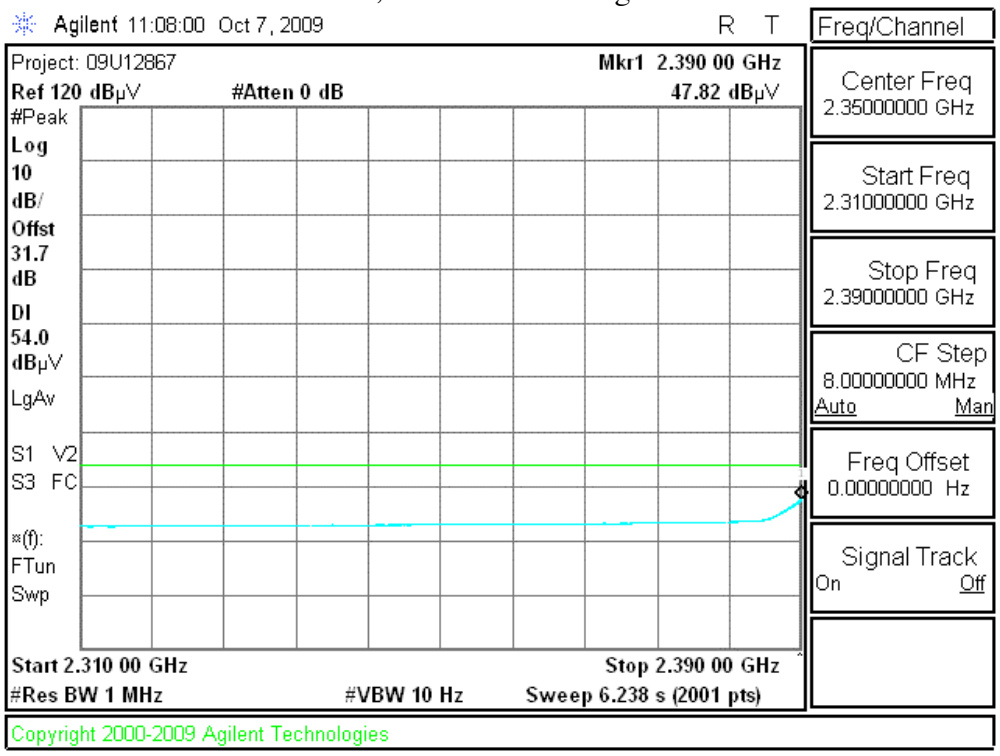


Band Edge Emissions

802.11 HT20 LOW Channel, Horizontal Peak

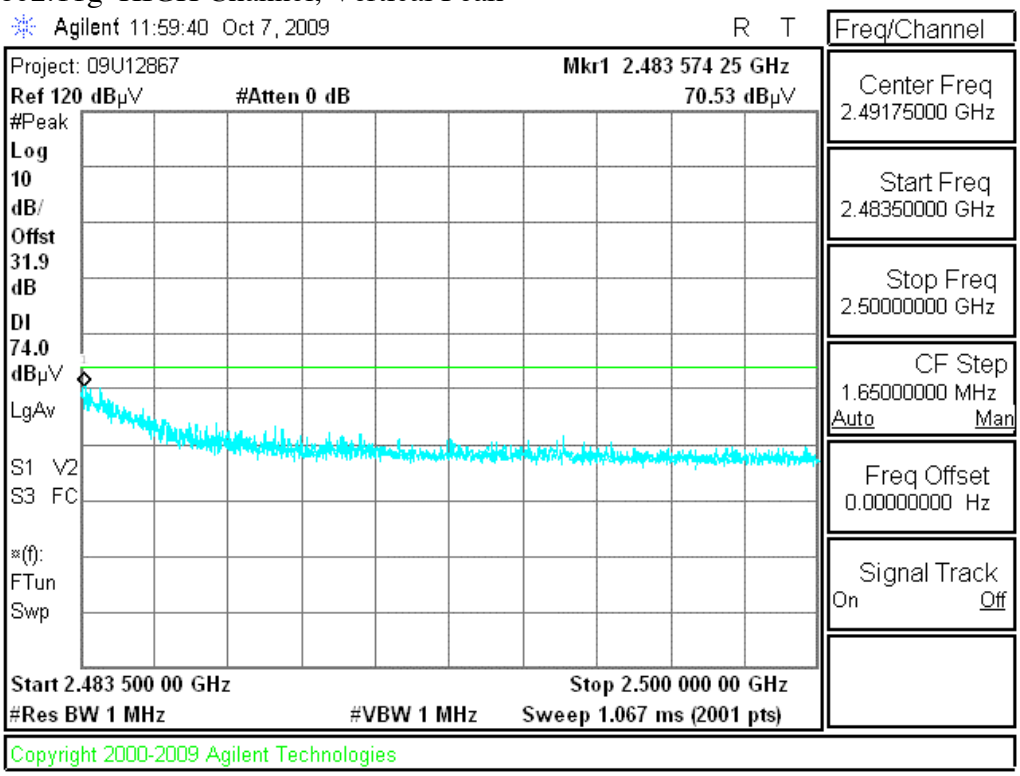


802.11 HT20 LOW Channel, Horizontal Average

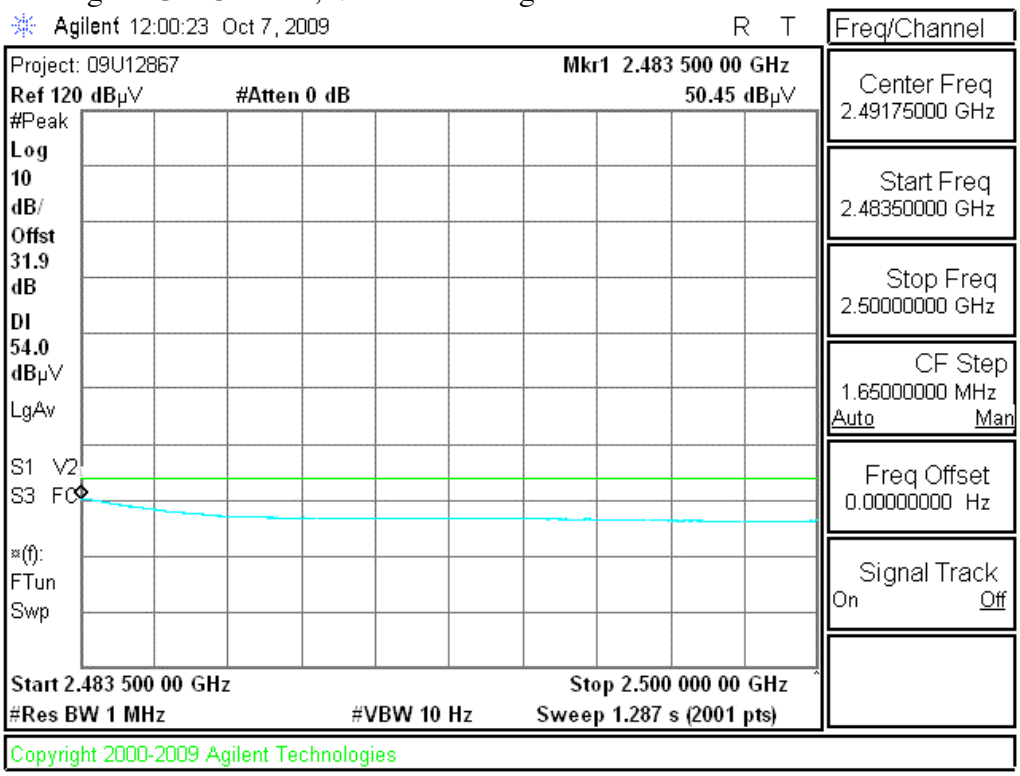


Band Edge Emissions

802.11g HIGH Channel, Vertical Peak

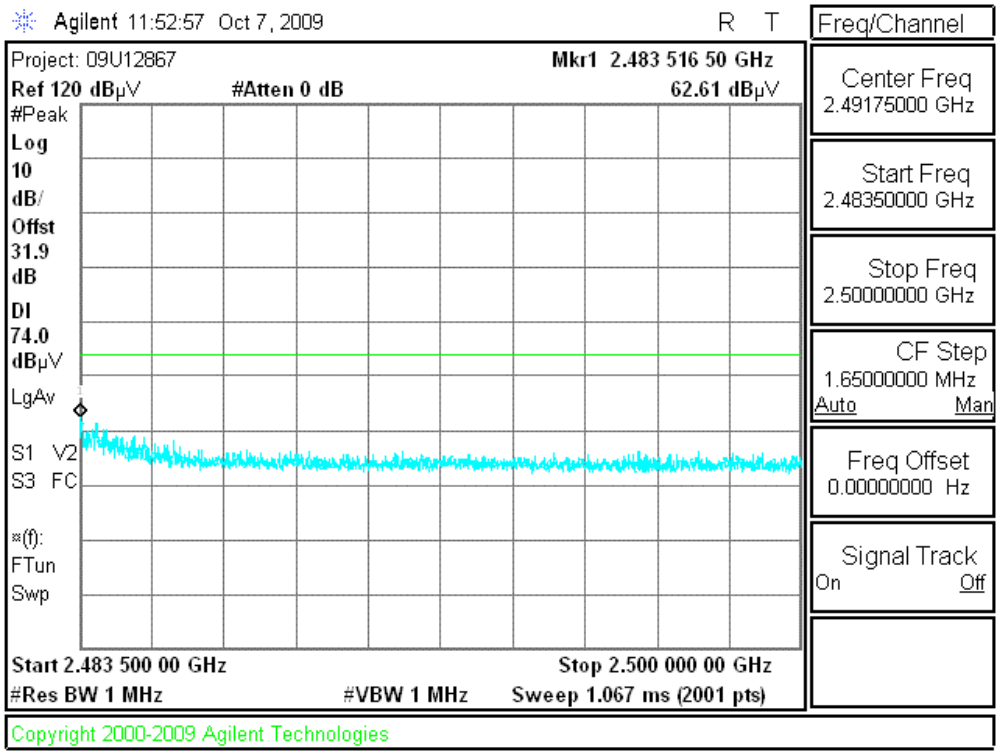


802.11g HIGH Channel, Vertical Average

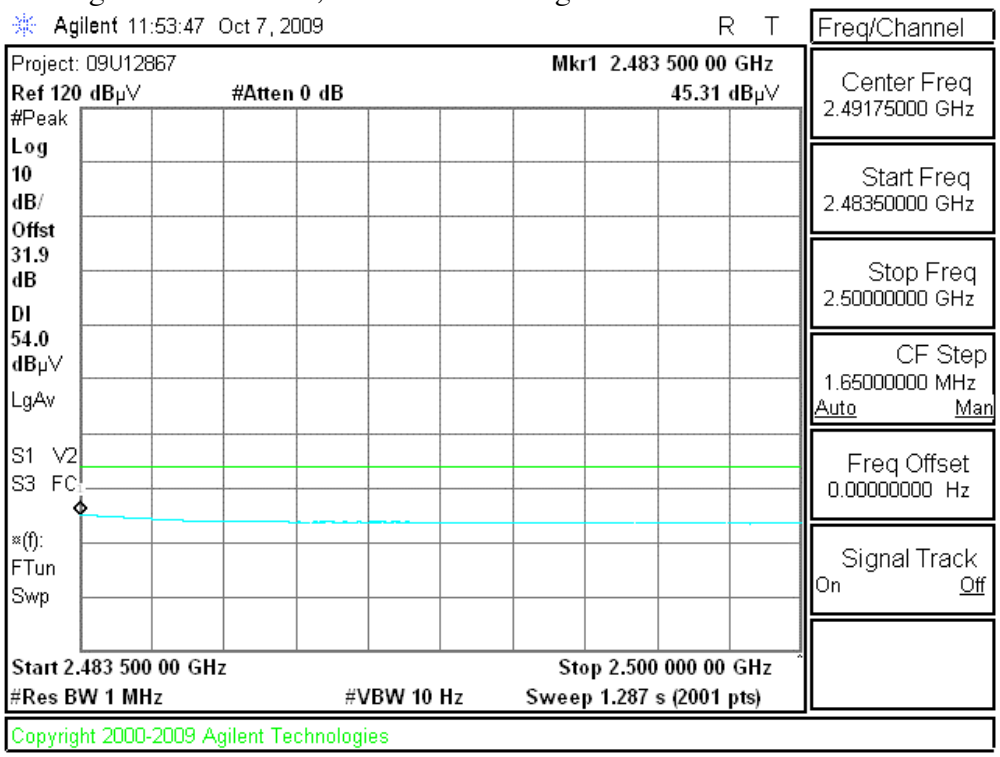


Band Edge Emissions

802.11g HIGH Channel, Horizontal Peak

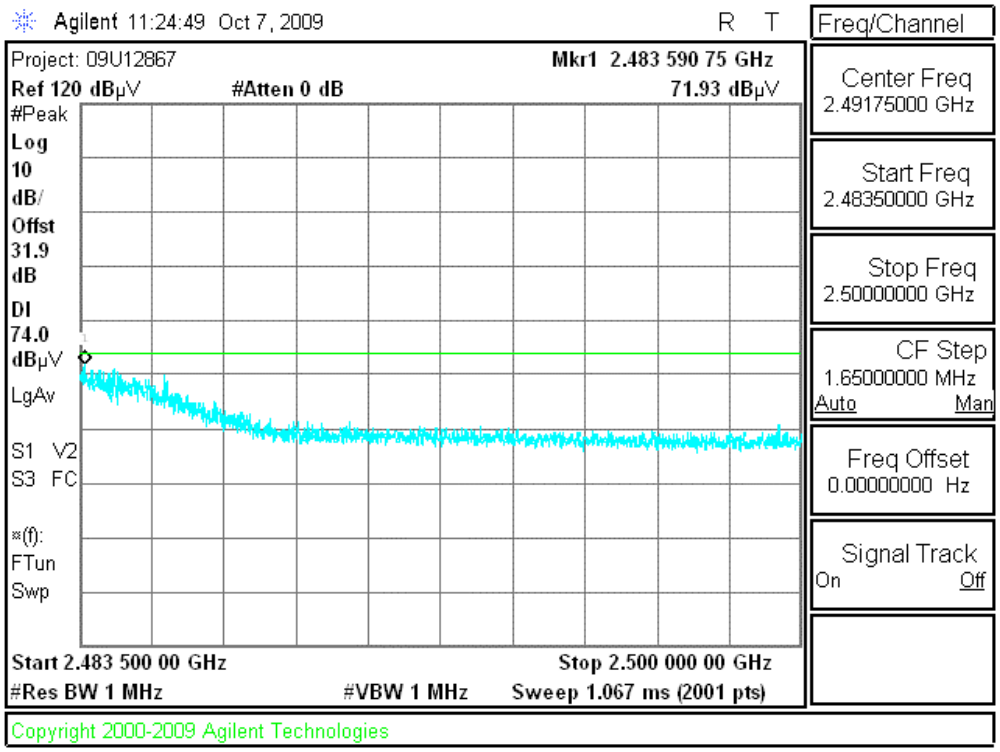


802.11g HIGH Channel, Horizontal Average

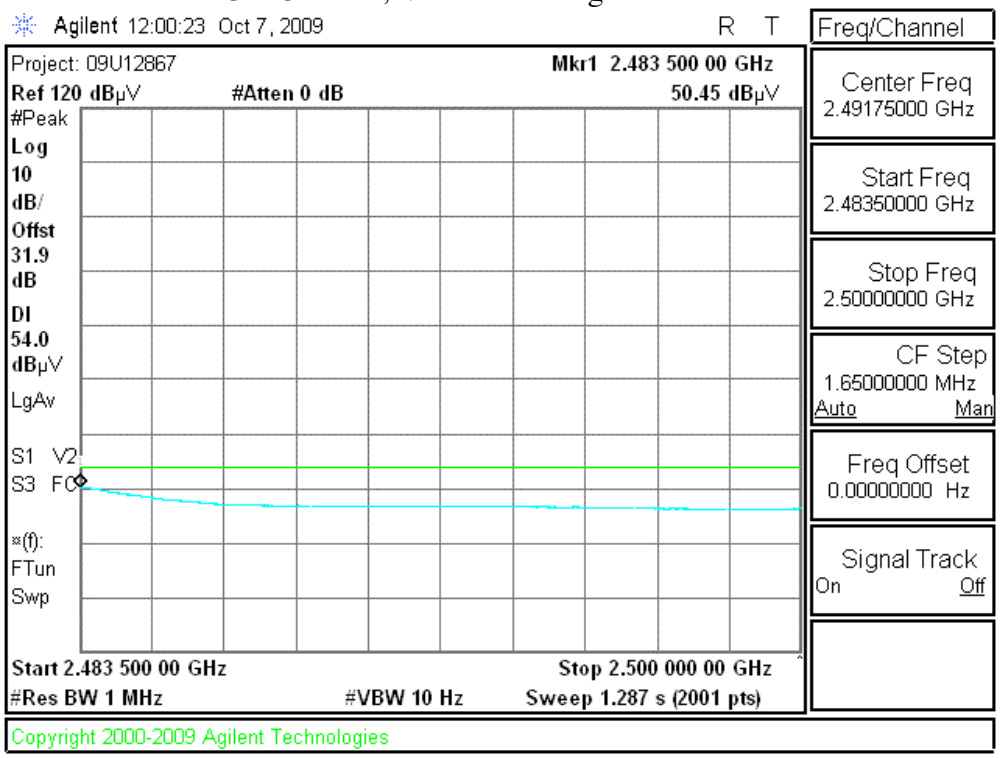


Band Edge Emissions

802.11 HT20 HIGH Channel, Vertical Peak

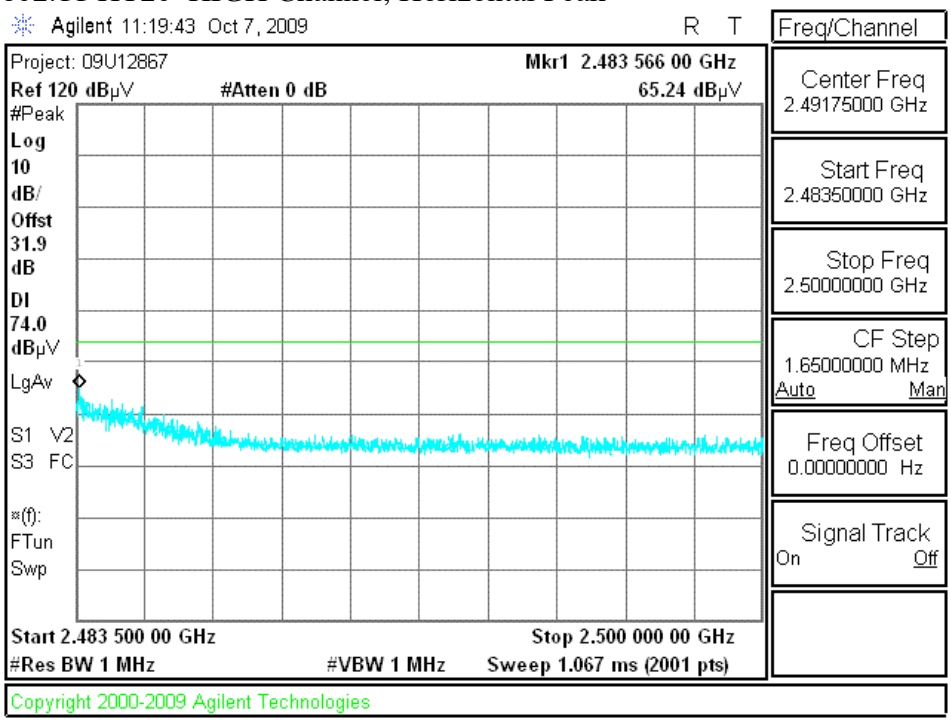


802.11 HT20 HIGH Channel, Vertical Average

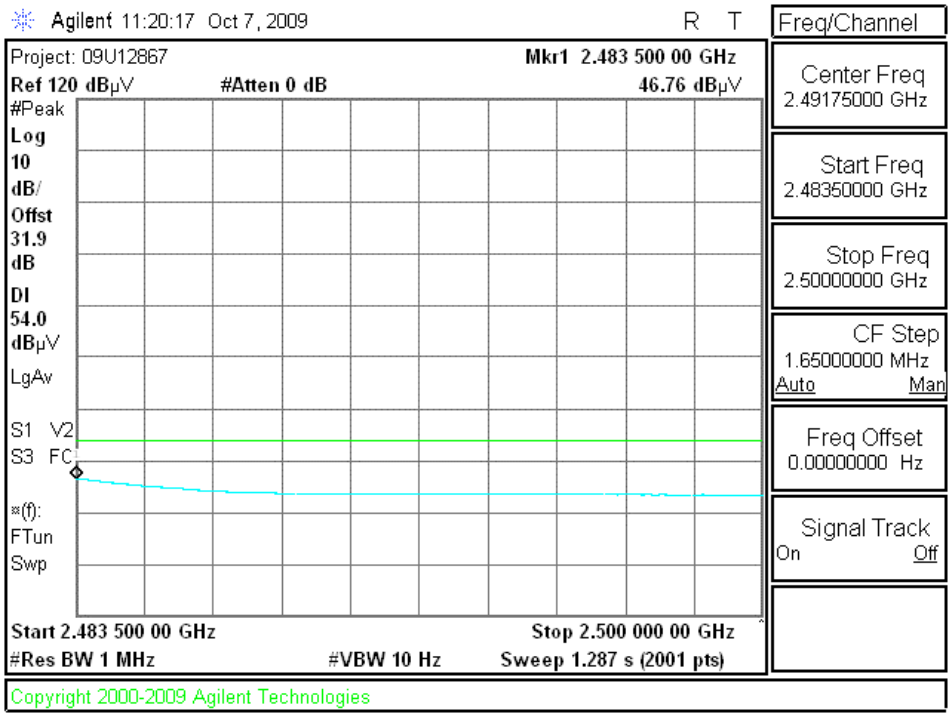


Band Edge Emissions

802.11 HT20 HIGH Channel, Horizontal Peak



802.11 HT20 HIGH Channel, Horizontal Average



Radiated Emissions Above 1 GHz: Harmonic and Spurious Emissions

802.11g

High Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Test Engr: Tom Chen
Date: 10/17/08
Project #: 09U12867
Company: Sonos Inc.
EUT Description:
EUT M/N:
Test Target:
Mode Oper:

f	Measurement Frequency	Amp	Preamp Gain	Average Field Strength Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters	Peak Field Strength Limit
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m	Margin vs. Average Limit
AF	Antenna Factor	Peak	Calculated Peak Field Strength	Margin vs. Peak Limit
CL	Cable Loss	HPF	High Pass Filter	

f GHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol. V/H	Det. P/A/QP	Ant.High cm	Table Angle Degree	Notes
2462MHz High CH															
4.924	3.0	39.7	33.1	5.9	-34.9	0.0	0.0	43.8	74.0	-30.2	V	P	172.3	327.1	g mode, 24MB, 15dBm
4.924	3.0	26.6	33.1	5.9	-34.9	0.0	0.0	30.8	54.0	-23.2	V	A	172.3	327.1	g mode, 24MB, 15dBm
2462MHz High CH															
4.924	3.0	39.0	33.1	5.9	-34.9	0.0	0.0	43.1	74.0	-30.9	H	P	168.4	32.9	g mode, 24MB, 15dBm
4.924	3.0	26.6	33.1	5.9	-34.9	0.0	0.0	30.8	54.0	-23.2	H	A	168.4	32.9	g mode, 24MB, 15dBm
2462MHz High CH															
7.386	3.0	38.7	35.4	7.3	-34.6	0.0	0.0	46.8	74.0	-27.2	H	P	168.7	32.9	g mode, 24MB, 15dBm
7.386	3.0	25.8	35.4	7.3	-34.6	0.0	0.0	33.9	54.0	-20.1	H	A	168.7	32.9	g mode, 24MB, 15dBm
2437MHz Mid CH															
4.874	3.0	38.7	33.1	5.8	-36.5	0.0	0.0	41.2	74.0	-32.8	H	P	130.6	224.8	g mode, 24MB, 19dBm
4.874	3.0	26.5	33.1	5.8	-36.5	0.0	0.0	29.0	54.0	-25.0	H	A	130.6	224.8	g mode, 24MB, 19dBm
2437MHz Mid CH															
7.311	3.0	41.4	35.3	7.3	-36.2	0.0	0.0	47.8	74.0	-26.2	H	P	130.6	224.8	g mode, 24MB, 19dBm
7.311	3.0	27.6	35.3	7.3	-36.2	0.0	0.0	33.9	54.0	-20.1	H	A	130.6	224.8	g mode, 24MB, 19dBm
2437MHz Mid CH															
9.748	3.0	43.3	37.4	8.6	-37.0	0.0	0.0	52.4	74.0	-21.6	H	P	130.6	224.8	g mode, 24MB, 19dBm
9.748	3.0	29.2	37.4	8.6	-37.0	0.0	0.0	38.3	54.0	-15.7	H	A	130.6	224.8	g mode, 24MB, 19dBm
2437MHz Mid CH															
4.874	3.0	39.9	33.1	5.8	-36.5	0.0	0.0	42.4	74.0	-31.6	V	P	178.5	288.6	g mode, 24MB, 19dBm
4.874	3.0	27.1	33.1	5.8	-36.5	0.0	0.0	29.5	54.0	-24.5	V	A	178.5	288.6	g mode, 24MB, 19dBm
2437MHz Mid CH															
7.311	3.0	39.8	35.3	7.3	-36.2	0.0	0.0	46.1	74.0	-27.9	V	P	178.5	288.6	g mode, 24MB, 19dBm
7.311	3.0	26.7	35.3	7.3	-36.2	0.0	0.0	33.0	54.0	-21.0	V	A	178.5	288.6	g mode, 24MB, 19dBm
2437MHz Mid CH															
9.748	3.0	37.3	37.4	8.6	-37.0	0.0	0.0	46.3	74.0	-27.7	V	P	178.5	288.6	g mode, 24MB, 19dBm
9.748	3.0	24.8	37.4	8.6	-37.0	0.0	0.0	33.8	54.0	-20.2	V	A	178.5	288.6	g mode, 24MB, 19dBm
2412MHz Low CH															
4.824	3.0	39.3	33.0	5.8	-36.5	0.0	0.0	41.7	74.0	-32.3	V	P	182.0	280.1	g mode, 24MB, 15dBm
4.824	3.0	26.8	33.0	5.8	-36.5	0.0	0.0	29.2	54.0	-24.8	V	A	182.0	280.1	g mode, 24MB, 15dBm
2412MHz Low CH															
7.236	3.0	37.9	35.2	7.2	-36.2	0.0	0.0	44.1	74.0	-29.9	V	P	182.0	280.1	g mode, 24MB, 15dBm
7.236	3.0	25.3	35.2	7.2	-36.2	0.0	0.0	31.5	54.0	-22.5	V	A	182.0	280.1	g mode, 24MB, 15dBm
2412MHz Low CH															
9.648	3.0	36.8	37.4	8.5	-37.0	0.0	0.0	45.8	74.0	-28.2	V	P	182.0	280.1	g mode, 24MB, 15dBm
9.648	3.0	24.7	37.4	8.5	-37.0	0.0	0.0	33.7	54.0	-20.3	V	A	182.0	280.1	g mode, 24MB, 15dBm
2412MHz Low CH															
4.824	3.0	39.8	33.0	5.8	-36.5	0.0	0.0	42.2	74.0	-31.8	H	P	111.9	31.7	g mode, 24MB, 15dBm
4.824	3.0	26.5	33.0	5.8	-36.5	0.0	0.0	28.9	54.0	-25.1	H	A	111.9	31.7	g mode, 24MB, 15dBm
2412MHz Low CH															
7.236	3.0	37.8	35.2	7.2	-36.2	0.0	0.0	43.9	74.0	-30.1	H	P	111.9	31.7	g mode, 24MB, 15dBm
7.236	3.0	25.4	35.2	7.2	-36.2	0.0	0.0	31.6	54.0	-22.4	H	A	111.9	31.7	g mode, 24MB, 15dBm
2412MHz Low CH															
9.648	3.0	36.9	37.4	8.5	-37.0	0.0	0.0	45.9	74.0	-28.1	H	P	111.9	31.7	g mode, 24MB, 15dBm
9.648	3.0	24.7	37.4	8.5	-37.0	0.0	0.0	33.7	54.0	-20.3	H	A	111.9	31.7	g mode, 24MB, 15dBm

Rev. 4.1.2.7
Note: No other emissions were detected above the system noise floor.

Radiated Emissions Above 1 GHz: Harmonic and Spurious Emissions

802.11 HT20

High Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Test Engr: **Tom Chen**
Date: **10/17/08**
Project #: **09U12867**
Company: **Sonos Inc.**
EUT Description:
EUT M/N:
Test Target:
Mode Oper:

f	Measurement Frequency	Amp	Preamp Gain	Average Field Strength Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters	Peak Field Strength Limit
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m	Margin vs. Average Limit
AF	Antenna Factor	Peak	Calculated Peak Field Strength	Margin vs. Peak Limit
CL	Cable Loss	HPF	High Pass Filter	

f GHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol. V/H	Det. P/A/QP	Ant.High cm	Table Angle Degree	Notes
2412MHz Low CH															
4.824	3.0	38.9	33.0	5.8	-36.5	0.0	0.0	41.3	74.0	-32.7	V	P	137.1	318.3	HT20, MCS9, 15dBm
4.824	3.0	26.5	33.0	5.8	-36.5	0.0	0.0	28.9	54.0	-25.1	V	A	137.1	318.3	HT20, MCS9, 15dBm
2412MHz Low CH															
7.236	3.0	38.0	35.2	7.2	-36.2	0.0	0.0	44.2	74.0	-29.8	V	P	137.1	318.3	HT20, MCS9, 15dBm
7.236	3.0	25.3	35.2	7.2	-36.2	0.0	0.0	31.5	54.0	-22.5	V	A	137.1	318.3	HT20, MCS9, 15dBm
2412MHz Low CH															
9.648	3.0	36.8	37.4	8.5	-37.0	0.0	0.0	45.8	74.0	-28.2	V	P	137.1	318.3	HT20, MCS9, 15dBm
9.648	3.0	24.5	37.4	8.5	-37.0	0.0	0.0	33.5	54.0	-20.5	V	A	137.1	318.3	HT20, MCS9, 15dBm
2412MHz Low CH															
4.824	3.0	38.8	33.0	5.8	-36.5	0.0	0.0	41.2	74.0	-32.8	H	P	136.9	21.8	HT20, MCS9, 15dBm
4.824	3.0	26.5	33.0	5.8	-36.5	0.0	0.0	28.8	54.0	-25.2	H	A	136.9	21.8	HT20, MCS9, 15dBm
2412MHz Low CH															
7.236	3.0	38.1	35.2	7.2	-36.2	0.0	0.0	44.3	74.0	-29.7	H	P	136.9	21.8	HT20, MCS9, 15dBm
7.236	3.0	25.3	35.2	7.2	-36.2	0.0	0.0	31.4	54.0	-22.6	H	A	136.9	21.8	HT20, MCS9, 15dBm
2412MHz Low CH															
9.648	3.0	37.5	37.4	8.5	-37.0	0.0	0.0	46.5	74.0	-27.5	H	P	136.9	21.8	HT20, MCS9, 15dBm
9.648	3.0	24.6	37.4	8.5	-37.0	0.0	0.0	33.6	54.0	-20.4	H	A	136.9	21.8	HT20, MCS9, 15dBm
2437MHz Mid CH															
4.874	3.0	39.0	33.1	5.8	-36.5	0.0	0.0	41.5	74.0	-32.5	H	P	141.4	0.0	HT20, MCS9, 19dBm
4.874	3.0	26.0	33.1	5.8	-36.5	0.0	0.0	28.5	54.0	-25.5	H	A	141.4	0.0	HT20, MCS9, 19dBm
2437MHz Mid CH															
7.311	3.0	40.3	35.3	7.3	-36.2	0.0	0.0	46.6	74.0	-27.4	H	P	141.4	0.0	HT20, MCS9, 19dBm
7.311	3.0	27.4	35.3	7.3	-36.2	0.0	0.0	33.7	54.0	-20.3	H	A	141.4	0.0	HT20, MCS9, 19dBm
2437MHz Mid CH															
9.748	3.0	41.1	37.4	8.6	-37.0	0.0	0.0	50.1	74.0	-23.9	H	P	141.4	0.0	HT20, MCS9, 19dBm
9.748	3.0	26.0	37.4	8.6	-37.0	0.0	0.0	35.1	54.0	-18.9	H	A	141.4	0.0	HT20, MCS9, 19dBm
2437MHz Mid CH															
4.874	3.0	39.4	33.1	5.8	-36.5	0.0	0.0	41.9	74.0	-32.1	V	P	100.0	174.1	HT20, MCS9, 19dBm
4.874	3.0	26.6	33.1	5.8	-36.5	0.0	0.0	29.1	54.0	-25.0	V	A	100.0	174.1	HT20, MCS9, 19dBm
2437MHz Mid CH															
7.311	3.0	40.2	35.3	7.3	-36.2	0.0	0.0	46.5	74.0	-27.5	V	P	100.0	174.2	HT20, MCS9, 19dBm
7.311	3.0	26.5	35.3	7.3	-36.2	0.0	0.0	32.8	54.0	-21.2	V	A	100.0	174.2	HT20, MCS9, 19dBm
2437MHz Mid CH															
9.748	3.0	40.3	37.4	8.6	-37.0	0.0	0.0	49.3	74.0	-24.7	V	P	100.0	174.2	HT20, MCS9, 19dBm
9.748	3.0	26.0	37.4	8.6	-37.0	0.0	0.0	35.0	54.0	-19.0	V	A	100.0	174.2	HT20, MCS9, 19dBm
2462MHz High CH															
4.924	3.0	38.9	33.1	5.9	-36.5	0.0	0.0	41.4	74.0	-32.6	V	P	131.9	290.1	HT20, MCS9, 15dBm
4.924	3.0	26.3	33.1	5.9	-36.5	0.0	0.0	28.9	54.0	-25.1	V	A	131.9	290.1	HT20, MCS9, 15dBm
2462MHz High CH															
7.386	3.0	39.0	35.4	7.3	-36.2	0.0	0.0	45.5	74.0	-28.5	V	P	131.9	290.1	HT20, MCS9, 15dBm
7.386	3.0	25.4	35.4	7.3	-36.2	0.0	0.0	31.9	54.0	-22.1	V	A	131.9	290.1	HT20, MCS9, 15dBm
2462MHz High CH															
9.848	3.0	37.3	37.5	8.7	-37.0	0.0	0.0	46.4	74.0	-27.6	V	P	131.9	290.1	HT20, MCS9, 15dBm
9.848	3.0	24.9	37.5	8.7	-37.0	0.0	0.0	34.0	54.0	-20.0	V	A	131.9	290.1	HT20, MCS9, 15dBm
2462MHz High CH															
4.924	3.0	38.7	33.1	5.9	-36.5	0.0	0.0	41.2	74.0	-32.8	H	P	146.2	5.8	HT20, MCS9, 15dBm
4.924	3.0	26.3	33.1	5.9	-36.5	0.0	0.0	28.8	54.0	-25.2	H	A	146.2	5.8	HT20, MCS9, 15dBm
2462MHz High CH															
7.386	3.0	38.4	35.4	7.3	-36.2	0.0	0.0	44.9	74.0	-29.1	H	P	146.3	5.4	HT20, MCS9, 15dBm
7.386	3.0	26.0	35.4	7.3	-36.2	0.0	0.0	32.5	54.0	-21.5	H	A	146.3	5.4	HT20, MCS9, 15dBm
2462MHz High CH															
9.848	3.0	37.3	37.5	8.7	-37.0	0.0	0.0	46.4	74.0	-27.6	H	P	146.3	5.4	HT20, MCS9, 15dBm
9.848	3.0	24.6	37.5	8.7	-37.0	0.0	0.0	33.7	54.0	-20.3	H	A	146.3	5.4	HT20, MCS9, 15dBm

Rev. 4.1.2.7
Note: No other emissions were detected above the system noise floor.

MAXIMUM PERMISSIBLE EXPOSURE

LIMITS

§1.1310 The criteria listed in Table 1 shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in §1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of §2.1093 of this chapter.

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3–3.0	614	1.63	*(100)	6
3.0–30	1842/f	4.89/f	*($900/f^2$)	6
30–300	61.4	0.163	1.0	6
300–1500			f/300	6
1500–100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*($180/f^2$)	30

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)—Continued

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
30–300	27.5	0.073	0.2	30
300–1500			f/1500	30
1500–100,000			1.0	30

f = frequency in MHz
* = Plane-wave equivalent power density

NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

NOTE 2 TO TABLE 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

CALCULATIONS

Given

$E = \sqrt{(30 * P * G)} / d$

and

$S = E \wedge 2 / 3770$

where

E = Field Strength in Volts/meter
P = Power in Watts
G = Numeric antenna gain
d = Distance in meters
S = Power Density in milliwatts/square centimeter

Combining equations and rearranging the terms to express the distance as a function of the remaining variables yields:

$d = \sqrt{((30 * P * G) / (3770 * S))}$

Changing to units of Power to mW and Distance to cm, using:

P (mW) = P (W) / 1000 and
d (cm) =100 * d (m)

yields

$d = 100 * \sqrt{((30 * (P / 1000) * G) / (3770 * S))}$
$d = 0.282 * \sqrt{(P * G / S)}$

where

d = distance in cm
P = Power in mW
G = Numeric antenna gain
S = Power Density in mW/cm^2

Substituting the logarithmic form of power and gain using:

P (mW) = 10 ^ (P (dBm) / 10) and
G (numeric) = 10 ^ (G (dBi) / 10)

yields

$d = 0.282 * 10 \wedge ((P + G) / 20) / \sqrt{S}$ Equation (1)

where

d = MPE distance in cm
P = Power in dBm
G = Antenna Gain in dBi
S = Power Density Limit in mW/cm^2

Equation (1) and the measured peak power is used to calculate the MPE distance.

LIMITS

From §1.1310 Table 1 (B), S = 1.0 mW/cm^2

RESULTS

No non-compliance noted:

Legacy 802.11g Mode

Power Density Limit (mW/cm^2)	Output Power (dBm)	Antenna Gain (dBi)	S, mW/cm2 at 20cm	MPE Distance (cm)
1.0	28.80	5.88	0.58	15.3

HT20 MIMO Mode

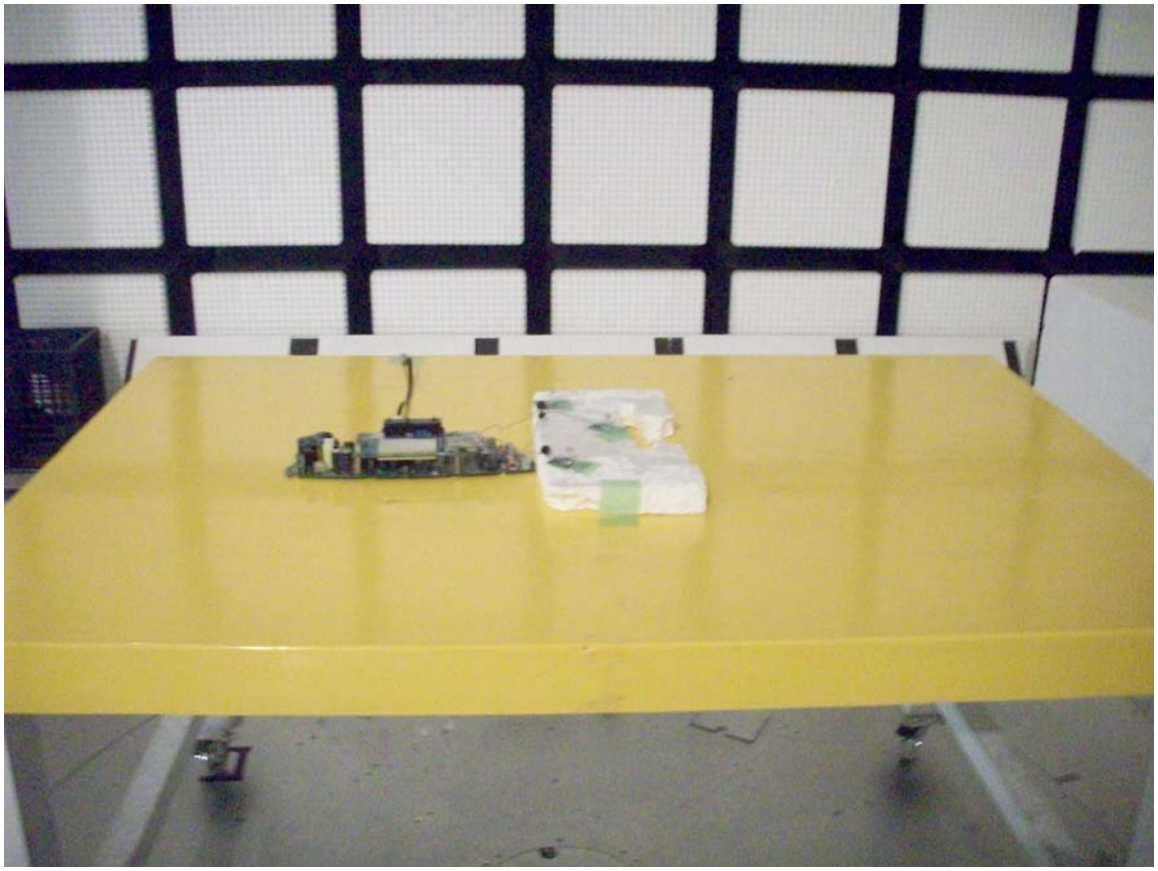
Power Density Limit (mW/cm^2)	Output Power (dBm)	Antenna Gain (dBi)	S, mW/cm2 at 20cm	MPE Distance (cm)
1.0	28.80	1.50	0.21	9.23

Antenna gains: 1.5 dBi, 1.3 dBi, and 0.46 dBi
Maximum Antenna gain, legacy mode = $10\log(10^{1.5}+10^{1.3}+10^{0.46}) = 5.88$ dBi

NOTE: For mobile or fixed location transmitters, the minimum separation distance is 20 cm, even if calculations indicate that the MPE distance would be less.

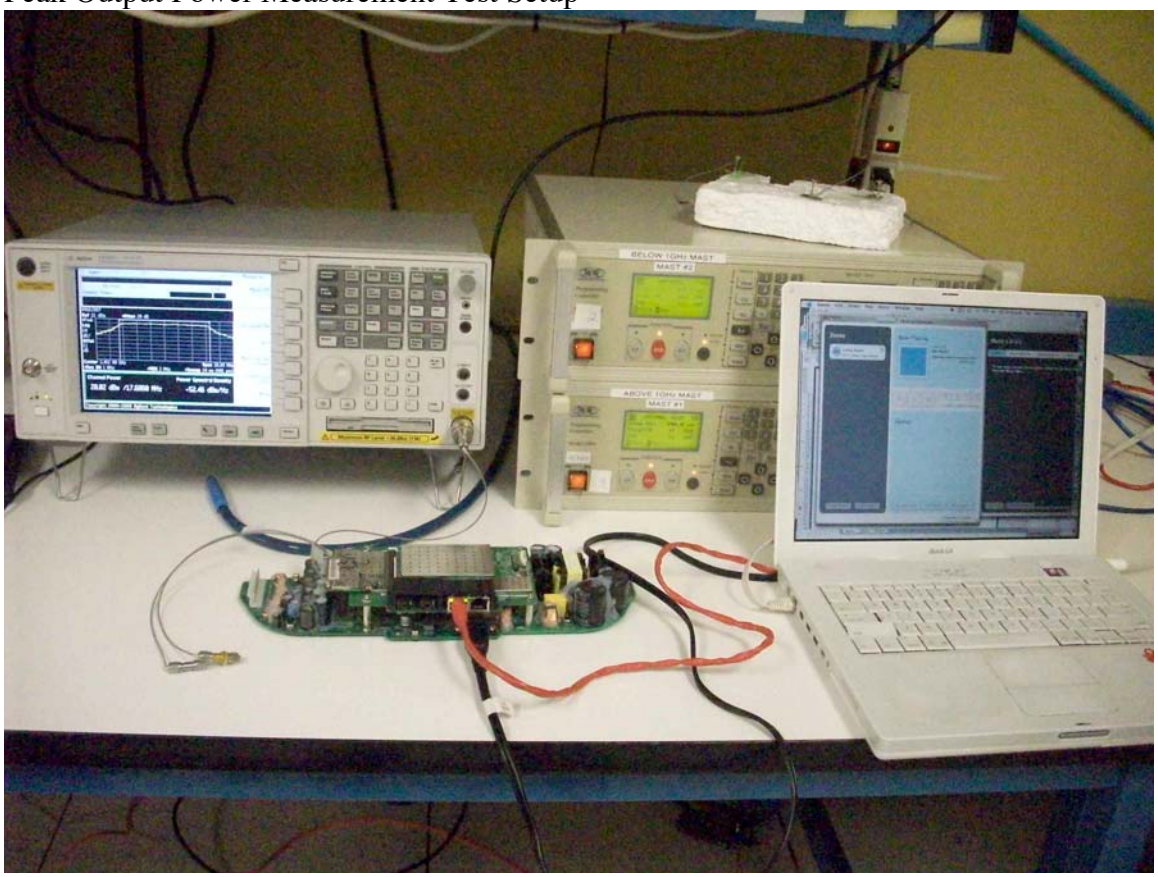
SETUP PHOTOS

Radiated Emissions Test Setup



SETUP PHOTOS

Peak Output Power Measurement Test Setup



END OF REPORT

Report Revision History

Revision No.	Revision Description	Pages Revised	Revised by	Date
-	Original Issue		T. Cokenias	10/15/09
1	Insert correct plot HT20 mid channel chain A Add MPE calculation for legacy mode		T. Cokenias	10/16/09
2	Correct legacy antenna gain	27	T.Cokenias	10/18/09