FCC OET BULLETIN 65 SUPPLEMENT C
CLASS II PERMISSIVE CHANGE
IC RSS-102 ISSUE 2

SAR EVALUATION REPORT

FOR

802.11ag/Draft 802.11n WLAN PCI-E Mini Card
(Tested inside of Dell PP19S)

MODEL: BCM94322HM8L

FCC ID: QDS-BRCM1031
IC: 4324A-BRCM1031

REPORT NUMBER: 08U12308-1

ISSUE DATE: JANUARY 22, 2008

Prepared for

BROADCOM CORPORATION
190 MATHILDA PLACE
SUNNYVALE, CA 94086

Prepared by

COMPLIANCE CERTIFICATION SERVICES
47173 BENICIA STREET
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NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
--	January 22, 2008	Initial Issue	--

TABLE OF CONTENTS

1 ATTESTATION OF TEST RESULTS

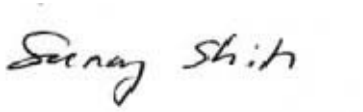
COMPANY NAME:	BROADCOM CORPORATION 190 MATHILDA PLACE SUNNYVALE, CA 94086
EUT DESCRIPTION:	802.11ag / Draft 802.11n WLAN PCI-E MINI CARD (Tested inside of Dell PP19S)
MODEL:	BCM94322HM8L
DEVICE CATEGORY:	Portable
EXPOSURE CATEGORY:	General Population/Uncontrolled Exposure
DATE TESTED:	January 12, 13 and 17, 2009
THE HIGHEST SAR VALUES:	See Table below

FCC / IC Rule Parts	Frequency Range [MHz]	The Highest SAR Values (1g_mW/g)	Limit (mW/g)
15.247 / RSS-102	2400 – 2483.5	0.009	1.6
15.407 / RSS-102	5150 – 5725	0.054	1.6

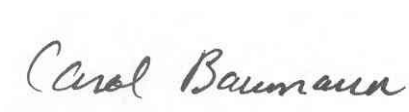
APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
FCC OET BULLETIN 65 SUPPLEMENT C	Pass
RSS-102 ISSUE 2	Pass

Compliance Certification Services, Inc. (CCS) tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by CCS based on interpretations and/or observations of test results. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.
Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by CCS and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by CCS will constitute fraud and shall nullify the document. No part of this report may be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any government agency.

Approved & Released For CCS By:



SUNNY SHIH
EMC SUPERVISOR
COMPLIANCE CERTIFICATION SERVICES



CAROL BAUMANN
SAR ENGINEER
COMPLIANCE CERTIFICATION SERVICES

2 TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC OET Bulletin 65 Supplement C, Specific FCC Procedure KDB 248227 SAR Measurement Procedure for 820.11abg Transmitters and IC RSS 102 Issue 2.

3 FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 Benicia Street, Fremont, California, USA.
CCS is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at http://www.ccsemc.com.

4 CALIBRATION AND UNCERTAINTY

4.1 MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

5 MEASUREMENT UNCERTAINTY

Measurement uncertainty for 300 MHz – 3000 MHz

Uncertainty component	Tol. (±%)	Probe Dist.	Div.	Ci (1g)	Ci (10g)	Std. Unc.(±%)	
						Ui (1g)	Ui(10g)
Measurement System							
Probe Calibration	4.80	N	1	1	1	4.80	4.80
Axial Isotropy	4.70	R	1.732	0.707	0.707	1.92	1.92
Hemispherical Isotropy	9.60	R	1.732	0.707	0.707	3.92	3.92
Boundary Effects	1.00	R	1.732	1	1	0.58	0.58
Linearity	4.70	R	1.732	1	1	2.71	2.71
System Detection Limits	1.00	R	1.732	1	1	0.58	0.58
Readout Electronics	1.00	N	1	1	1	1.00	1.00
Response Time	0.80	R	1.732	1	1	0.46	0.46
Integration Time	2.60	R	1.732	1	1	1.50	1.50
RF Ambient Conditions - Noise	1.59	R	1.732	1	1	0.92	0.92
RF Ambient Conditions - Reflections	0.00	R	1.732	1	1	0.00	0.00
Probe Positioner Mechnical Tolerance	0.40	R	1.732	1	1	0.23	0.23
Probe Positioning With Respect to Phantom Shell	2.90	R	1.732	1	1	1.67	1.67
Extrapolation, interpolation, and integration algorithms for max. SAR evaluation	3.90	R	1.732	1	1	2.25	2.25
Test sample Related							
Test Sample Positioning	1.10	N	1	1	1	1.10	1.10
Device Holder Uncertainty	3.60	N	1	1	1	3.60	3.60
Power and SAR Drift Measurement	5.00	R	1.732	1	1	2.89	2.89
Phantom and Tissue Parameters							
Phantom Uncertainty	4.00	R	1.732	1	1	2.31	2.31
Liquid Conductivity - Target	5.00	R	1.732	0.64	0.43	1.85	1.24
Liquid Conductivity - Meas.	8.60	N	1	0.64	0.43	5.50	3.70
Liquid Permittivity - Target	5.00	R	1.732	0.6	0.49	1.73	1.41
Liquid Permittivity - Meas.	3.30	N	1	0.6	0.49	1.98	1.62
Combined Standard Uncertainty			RSS			11.44	10.49
Expanded Uncertainty (95% Confidence Interval)			K=2			22.87	20.98

Notesfor table
1. Tol. - tolerance in influence quaitity
2. N - Nomal
3. R - Rectangular
4. Div. - Divisor used to obtain standard uncertainty
5. Ci - is te sensitivity coefficient

Measurement uncertainty for 3 GHz – 6 GHz

Uncertainty component	Tol. (±%)	Probe Dist.	Div.	Ci (1g)	Ci (10g)	Std. Unc.(±%)	
						Ui (1g)	Ui(10g)
Measurement System							
Probe Calibration	4.80	N	1	1	1	4.80	4.80
Axial Isotropy	4.70	R	1.732	0.707	0.707	1.92	1.92
Hemispherical Isotropy	9.60	R	1.732	0.707	0.707	3.92	3.92
Boundary Effects	1.00	R	1.732	1	1	0.58	0.58
Linearity	4.70	R	1.732	1	1	2.71	2.71
System Detection Limits	1.00	R	1.732	1	1	0.58	0.58
Readout Electronics	1.00	N	1	1	1	1.00	1.00
Response Time	0.80	R	1.732	1	1	0.46	0.46
Integration Time	2.60	R	1.732	1	1	1.50	1.50
RF Ambient Conditions - Noise	3.00	R	1.732	1	1	1.73	1.73
RF Ambient Conditions - Reflections	3.00	R	1.732	1	1	1.73	1.73
Probe Positioner Mechnical Tolerance	0.40	R	1.732	1	1	0.23	0.23
Probe Positioning With Respect to Phantom Shell	2.90	R	1.732	1	1	1.67	1.67
Extrapolation, interpolation, and integration algorithms for max. SAR evaluation	3.90	R	1.732	1	1	2.25	2.25
Test sample Related							
Test Sample Positioning	1.10	N	1	1	1	1.10	1.10
Device Holder Uncertainty	3.60	N	1	1	1	3.60	3.60
Power and SAR Drift Measurement	5.00	R	1.732	1	1	2.89	2.89
Phantom and Tissue Parameters							
Phantom Uncertainty	4.00	R	1.732	1	1	2.31	2.31
Liquid Conductivity - Target	5.00	R	1.732	0.64	0.43	1.85	1.24
Liquid Conductivity - Meas.	8.60	N	1	0.64	0.43	5.50	3.70
Liquid Permittivity - Target	5.00	R	1.732	0.6	0.49	1.73	1.41
Liquid Permittivity - Meas.	3.30	N	1	0.6	0.49	1.98	1.62
Combined Standard Uncertainty	RSS					11.66	10.73
Expanded Uncertainty (95% Confidence Interval)	K=2					23.32	21.46

Notesfor table
1. Tol. - tolerance in influence quaitity
2. N - Nomal
3. R - Rectangular
4. Div. - Divisor used to obtain standard uncertainty
5. Ci - is te sensitivity coefficient

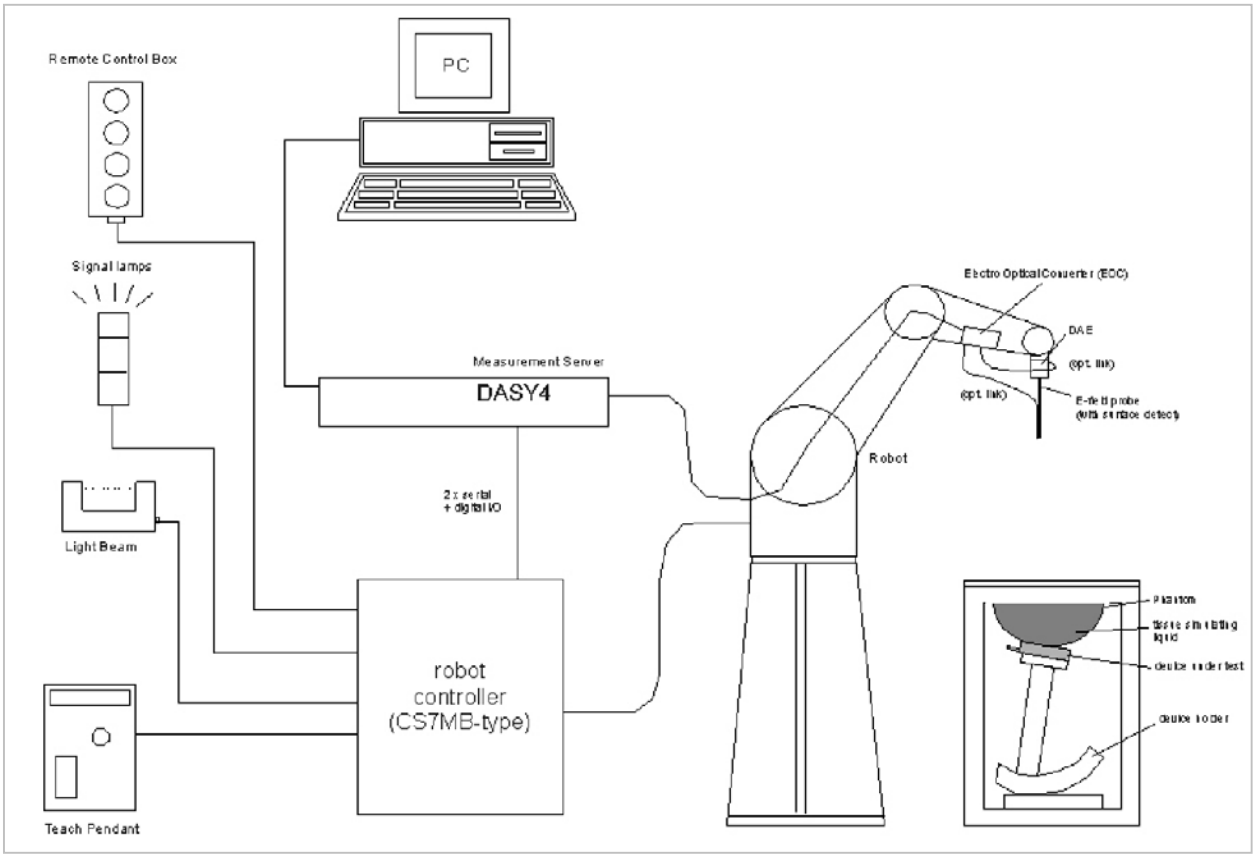
6 TEST EQUIPMENT LIST

Name of Equipment	Manufacturer	Type/Model	Serial Number	Cal. Due date		
				MM	DD	Year
Robot - Six Axes	Stäubli	RX90BL	N/A		N/A	
Robot Remote Control	Stäubli	CS7MB	3403-91535		N/A	
DASY4 Measurement Server	SPEAG	SEUMS001BA	1041		N/A	
Probe Alignment Unit	SPEAG	LB (V2)	261		N/A	
SAM Phantom (SAM1)	SPEAG	QD000P40CA	1185		N/A	
SAM Phantom (SAM2)	SPEAG	QD000P40CA	1050		N/A	
Oval Flat Phantom (ELI 4.0)	SPEAG	QD OVA001 B	1003		N/A	
Electronic Probe kit	HP	85070C	N/A		N/A	
S-Parameter Network Analyzer	Agilent	8753ES-6	MY40001647	11	22	2010
E-Field Probe	SPEAG	EX3DV3	3531	4	24	2009
Thermometer	ERTCO	639-1S	1718	5	28	2009
Data Acquisition Electronics	SPEAG	DAE3 V1	427	10	20	2009
System Validation Dipole	SPEAG	D2450V2	748	4	14	2010
Signal Generator	R&S	SMP 04	DE34210	2	16	2009
Power Meter	Giga-tronics	8651A	8651404	1	11	2010
Power Sensor	Giga-tronics	80701A	1834588	1	11	2010
Amplifier	Mini-Circuits	ZHL-42W	D072701-5		N/A	
Radio Communication Tester	R &S	CMU 200	106291	5	16	2009
Simulating Liquid	CCS	H2450	N/A	Within 24 hrs of first test		
Simulating Liquid	CCS	M2450	N/A	Within 24 hrs of first test		

7 DEVICE UNDER TEST (DUT) DESCRIPTION

<table>
<tr><td colspan="2">802.11ag / Draft 802.11n WLAN PCI-E MINI CARD
(Tested inside of Dell PP19S)</td></tr>
<tr><td>Normal operation:</td><td>Lap-held only
Note: SAR test with display open at 90° to the keyboard</td></tr>
<tr><td>Host device:</td><td>Dell PP19S</td></tr>
<tr><td>Antenna tested:</td><td>The radio has been tested with the following antennas combination:
<table>
<tr><th>No</th><th>Antenna Manufacturer</th><th>Antenna type</th><th>Model number</th></tr>
<tr><td rowspan="2">1[2]</td><td rowspan="2">Yageo</td><td rowspan="2">PIFA</td><td>CAN4313811012501B (TX1)</td></tr>
<tr><td>CAN4313811012501B (TX2)</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">Yageo</td><td rowspan="2">PIFA</td><td>CAN4313811022701B (TX1)</td></tr>
<tr><td>CAN4313811022701B (TX2)</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">Tyco Electronics</td><td rowspan="2">PIFA</td><td>2023641-1 (TX1)</td></tr>
<tr><td>2023641-1 (TX2)</td></tr>
<tr><td rowspan="2">4[1]</td><td rowspan="2">Tyco Electronics</td><td rowspan="2">PIFA</td><td>2023642-1 (TX1)</td></tr>
<tr><td>2023642-1 (TX2)</td></tr>
<tr><td rowspan="2">5</td><td rowspan="2">WNC</td><td rowspan="2">PIFA</td><td>81.EJU15.002 (Main)</td></tr>
<tr><td>81.EJU15.002 (Aux)</td></tr>
</table>
1) Under test for 2.4 GHz Band (with highest antenna gain 2.29 dBi).
2) Under test for 5.2, 5.3, 5.5 and 5.8 GHz Bands (with highest antenna gain 2.99 dBi).</td></tr>
<tr><td>Power supply:</td><td>Power supplied through laptop computer (host device)</td></tr>
</table>

8 SYSTEM DESCRIPTION



The DASY4 system for performing compliance tests consists of the following items:

- A standard high precision 6-axis robot (Stäubli RX family) with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- A dosimetric probe, i.e., an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid. The probe is equipped with an optical surface detector system.
- A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- A probe alignment unit which improves the (absolute) accuracy of the probe positioning.
- A computer operating Windows 2000 or Windows XP.
- DASY4 software.
- Remote controls with teach pendant and additional circuitry for robot safety such as warning lamps, etc.
- The SAM twin phantom enabling testing left-hand and right-hand usage.
- The device holder for handheld mobile phones.
- Tissue simulating liquid mixed according to the given recipes.
- Validation dipole kits to validate the proper functioning of the system.

8.1 COMPOSITION OF INGREDIENTS FOR TISSUE SIMULATING LIQUIDS

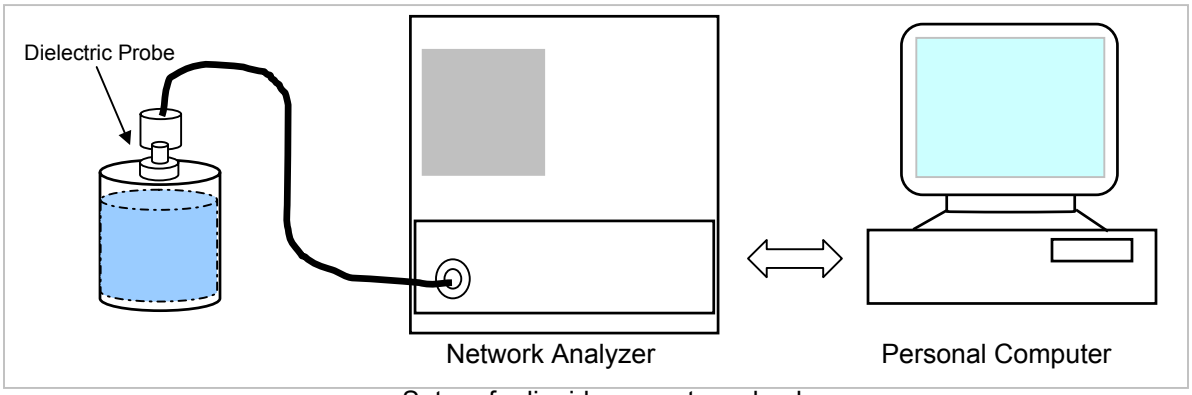
The following tissue formulations are provided for reference only as some of the parameters have not been thoroughly verified. The composition of ingredients may be modified accordingly to achieve the desired target tissue parameters required for routine SAR evaluation.

Ingredients (% by weight)	Frequency (MHz)									
	450		835		915		1900		2450	
Tissue Type	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body
Water	38.56	51.16	41.45	52.4	41.05	56.0	54.9	40.4	62.7	73.2
Salt (NaCl)	3.95	1.49	1.45	1.4	1.35	0.76	0.18	0.5	0.5	0.04
Sugar	56.32	46.78	56.0	45.0	56.5	41.76	0.0	58.0	0.0	0.0
HEC	0.98	0.52	1.0	1.0	1.0	1.21	0.0	1.0	0.0	0.0
Bactericide	0.19	0.05	0.1	0.1	0.1	0.27	0.0	0.1	0.0	0.0
Triton X-100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.8	0.0
DGBE	0.0	0.0	0.0	0.0	0.0	0.0	44.92	0.0	0.0	26.7
Dielectric Constant	43.42	58.0	42.54	56.1	42.0	56.8	39.9	54.0	39.8	52.5
Conductivity (S/m)	0.85	0.83	0.91	0.95	1.0	1.07	1.42	1.45	1.88	1.78

Salt: 99+% Pure Sodium Chloride Sugar: 98+% Pure Sucrose
Water: De-ionized, 16 MΩ+ resistivity HEC: Hydroxyethyl Cellulose
DGBE: 99+% Di(ethylene glycol) butyl ether, [2-(2-butoxyethoxy)ethanol]
Triton X-100 (ultra pure): Polyethylene glycol mono [4-(1,1, 3, 3-tetramethylbutyl)phenyl]ether

9 SIMULATING LIQUID PARAMETERS CHECK

The simulating liquids should be checked at the beginning of a series of SAR measurements to determine of the dielectric parameters are within the tolerances of the specified target values. The relative permittivity and conductivity of the tissue material should be within ± 5% of the values given in the table below.



Set-up for liquid parameters check

Reference Values of Tissue Dielectric Parameters for Head and Body Phantom (for 150 – 3000 MHz and 5800 MHz)

The head tissue dielectric parameters recommended by the IEEE SCC-34/SC-2 in IEEE Standard 1528 have been incorporated in the following table. These head parameters are derived from planar layer models simulating the highest expected SAR for the dielectric properties and tissue thickness variations in a human head. Other head and body tissue parameters that have not been specified in P1528 are derived from the tissue dielectric parameters computed from the 4-Cole-Cole equations and extrapolated according to the head parameters specified in IEEE Standard 1528.

Target Frequency (MHz)	Head		Body	
	ε_r	σ (S/m)	ε_r	σ (S/m)
150	52.3	0.76	61.9	0.80
300	45.3	0.87	58.2	0.92
450	43.5	0.87	56.7	0.94
835	41.5	0.90	55.2	0.97
900	41.5	0.97	**55.0**	**1.05**
915	41.5	0.98	55.0	1.06
1450	40.5	1.20	54.0	1.30
1610	40.3	1.29	53.8	1.40
1800 – 2000	40.0	1.40	**53.3**	**1.52**
2450	39.2	1.80	52.7	1.95
3000	38.5	2.40	52.0	2.73
5800	35.3	5.27	48.2	6.00

(ε_r = relative permittivity, σ = conductivity and ρ = 1000 kg/m^3)

9.1 SIMULATING LIQUID PARAMETER CHECK RESULT

Simulating Liquid Dielectric Parameter Check Result @ Muscle 2450 MHz

Room Ambient Temperature = 25°C; Relative humidity = 30% Measured by: Carol Baumann

Simulating Liquid			Parameters			Measured	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)							
2450	24	15	e'	51.9499	Relative Permittivity (ϵ_r):	51.9499	52.7	-1.42	± 5
			e"	14.2669	Conductivity (σ):	1.94453	1.95	-0.28	± 5

Liquid Check
Ambient temperature: 25 deg. C; Liquid temperature: 24 deg. C
January 12, 2009 11:56 AM

Frequency	e'	e"
2400000000.	51.8941	13.9844
2405000000.	51.9473	14.0633
2410000000.	51.8884	13.9537
2415000000.	51.8832	13.9938
2420000000.	51.7916	14.0751
2425000000.	51.8119	14.0607
2430000000.	51.8266	14.0801
2435000000.	51.8164	14.1833
2440000000.	51.8142	14.1828
2445000000.	51.8650	14.2353
2450000000.	**51.9499**	**14.2669**
2455000000.	51.8587	14.2901
2460000000.	51.9464	14.3934
2465000000.	51.8589	14.3367
2470000000.	51.9665	14.4335
2475000000.	51.8540	14.4247
2480000000.	51.8438	14.4238
2485000000.	51.7995	14.5018
2490000000.	51.7565	14.4112
2495000000.	51.6818	14.3399
2500000000.	51.7582	14.4886

The conductivity (σ) can be given as:

$$\sigma = \omega \varepsilon_0 e'' = 2 \pi f \varepsilon_0 e''$$

where $f = target\ f * 10^6$

$\varepsilon_0 = 8.854 * 10^{-12}$

Simulating Liquid Parameter Check Result @ Muscle 5GHz

Room Ambient Temperature = 25°C; Relative humidity = 32% Measured by: Carol Baumann

Simulating Liquid			Parameters			Measured	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)							
5200	24	15	e'	46.3588	Relative Permittivity (ε_r):	46.3588	49.0	-5.39	± 10
			e"	18.0026	Conductivity (σ):	5.20784	5.30	-1.74	± 5
5500	24	15	e'	46.0417	Relative Permittivity (ε_r):	46.0417	48.6	-5.26	± 10
			e"	18.7551	Conductivity (σ):	5.73854	5.65	1.57	± 5
5800	24	15	e'	44.9844	Relative Permittivity (ε_r):	44.9844	48.2	-6.67	± 10
			e"	18.6162	Conductivity (σ):	6.00673	6.00	0.11	± 5

Liquid Check
Ambient temperature: 25 deg. C; Liquid temperature: 24 deg. C
January 13, 2009 11:42 AM

Frequency	e'	e"
4600000000.	47.0986	17.4781
4650000000.	47.1400	17.4033
4700000000.	47.0284	17.5983
4750000000.	47.1335	17.5956
4800000000.	47.0340	17.6351
4850000000.	47.0148	17.7451
4900000000.	46.9515	18.0526
4950000000.	46.6857	17.8706
5000000000.	46.6104	18.0795
5050000000.	46.5115	18.1000
5100000000.	46.3726	18.0056
5150000000.	46.2702	18.1145
5200000000.	**46.3588**	**18.0026**
5250000000.	46.3108	18.3247
5300000000.	46.1190	18.2968
5350000000.	46.0777	18.5714
5400000000.	46.0499	18.5299
5450000000.	45.8870	18.6881
5500000000.	**46.0417**	**18.7551**
5550000000.	45.8213	18.4830
5600000000.	46.0141	18.8509
5650000000.	45.8334	18.4122
5700000000.	45.5769	18.9564
5750000000.	45.7875	18.5454
5800000000.	**44.9844**	**18.6162**
5850000000.	45.5746	18.8728
5900000000.	45.0116	18.4966
5950000000.	44.7474	18.9907
6000000000.	44.6048	18.8244

The conductivity (σ) can be given as:

$$\sigma = \omega \varepsilon_0 e'' = 2 \pi f \varepsilon_0 e''$$

where $f = target\ f * 10^6$

$\varepsilon_0 = 8.854 * 10^{-12}$

Simulating Liquid Parameter Check Result @ Muscle 5GHz

Room Ambient Temperature = 25°C; Relative humidity = 38% Measured by: Carol Baumann

Simulating Liquid f (MHz)	Parameters			Measured	Target	Deviation (%)	Limit (%)
5200	e'	45.0832	Relative Permittivity (ε_r):	45.0832	49.0	-7.99	± 10
	e"	18.7940	Conductivity (σ):	5.43678	5.30	2.58	± 5
5500	e'	44.7098	Relative Permittivity (ε_r):	44.7098	48.6	-8.00	± 10
	e"	18.5377	Conductivity (σ):	5.67202	5.65	0.39	± 5
5800	e'	44.1506	Relative Permittivity (ε_r):	44.1506	48.2	-8.40	± 10
	e"	19.3589	Conductivity (σ):	6.24637	6.00	4.11	± 5

Liquid Check
Ambient temperature: 25 deg. C; Liquid temperature: 24 deg. C
January 17, 2008 08:41 AM

Frequency	e'	e"
4600000000.	46.1429	17.8935
4650000000.	46.4114	17.7470
4700000000.	45.8363	17.6881
4750000000.	46.2491	18.2906
4800000000.	45.8617	17.6473
4850000000.	45.9059	18.4341
4900000000.	45.8377	17.9213
4950000000.	45.4081	18.3288
5000000000.	45.6217	18.3461
5050000000.	45.0749	18.1683
5100000000.	45.3008	18.7162
5150000000.	45.0069	17.9349
5200000000.	**45.0832**	**18.7940**
5250000000.	45.1880	18.1886
5300000000.	44.6346	18.7820
5350000000.	45.1739	18.8180
5400000000.	44.4942	18.5660
5450000000.	44.9030	19.2340
5500000000.	**44.7098**	**18.5377**
5550000000.	44.6964	19.4353
5600000000.	44.8007	18.8662
5650000000.	44.2552	19.1037
5700000000.	44.7663	19.1347
5750000000.	44.0729	18.7845
5800000000.	**44.1506**	**19.3589**
5850000000.	43.6785	18.7076
5900000000.	43.6394	19.3909
5950000000.	43.3137	18.7095
6000000000.	42.9866	19.4442

The conductivity (σ) can be given as:

$$\sigma = \omega \varepsilon_0 e'' = 2 \pi f \varepsilon_0 e''$$

where $f = target\ f * 10^6$

$\varepsilon_0 = 8.854 * 10^{-12}$

10 SYSTEM PERFORMANCE CHECK

The system performance check is performed prior to any usage of the system in order to guarantee reproducible results. The system performance check verifies that the system operates within its specifications of ±10%.

System Performance Check Measurement Conditions

- The measurements were performed in the flat section of the SAM twin phantom filled with Body simulating liquid of the following parameters.
- The DASY4 system with an Isotropic E-Field Probe EX3DV3-SN: 3531 was used for the measurements.
- The dipole was mounted on the small tripod so that the dipole feed point was positioned below the center marking of the flat phantom section and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 10 mm (above 1 GHz) and 15 mm (below 1 GHz) from dipole center to the simulating liquid surface.
- The coarse grid with a grid spacing of 15 mm was aligned with the dipole.
  For 5 GHz band - The coarse grid with a grid spacing of 10 mm was aligned with the dipole.
- Special 7x7x7 (2.4 GHz) fine cube was chosen for cube integration and Special 8x8x10 (5 GHz) fine cube was chosen for cube integration
- Distance between probe sensors and phantom surface was set to 4 mm.
  For 5 GHz band - Distance between probe sensors and phantom surface was set to 2.5mm
- The dipole input power (forward power) was 250 mW±3%.
- The results are normalized to 1 W input power.

450 to 2450 MHz Reference SAR Values for body-tissue

In the table below, the numerical reference SAR values of a SPEAG validation dipoles placed below the flat phantom filled with body-tissue simulating liquid are given. The reference SAR values were calculated using the finite-difference time-domain method and the geometry parameters.

Dipole Type	Distance (mm)	Frequency (MHz)	SAR (1g) [W/kg]	SAR (10g) [W/kg]	SAR (peak) [W/kg]
D450V2	15	450	5.01	3.36	7.22
D835V2	15	835	9.71	6.38	14.1
D900V2	15	900	**11.1**	**7.17**	16.3
D1450V2	10	1450	29.6	16.6	49.8
D1800V2	10	1800	**38.5**	**20.3**	67.5
D1900V2	10	1900	39.8	20.8	69.6
D2000V2	10	2000	**40.9**	**21.2**	71.5
D2450V2	10	2450	51.2	23.7	97.6

Note: All SAR values normalized to 1 W forward power.

5 GHz Reference SAR Values for body-tissue

In the table below, the numerical reference SAR values of a SPEAG validation dipoles placed below the flat phantom filled with body-tissue simulating liquid are given. The reference SAR values were calculated using finite-difference time-domain FDTD method (feed point-impedance set to 50 ohms) and the mechanical dimensions of the D5GHzV2 dipole (manufactured by SPEAG).

f (MHz)	Head Tissue		Body Tissue		
	SAR_{1g}	SAR_{10g}	SAR_{1g}	SAR_{10g}	SAR_{Peak}
5000	72.9	20.7	68.1	19.2	260.3
5100	74.6	21.1	78.8	19.6	272.3
5200	76.5	21.6	71.8	20.1	284.7
5500	83.3	23.4	79.1	22.0	326.3
5800	78.0	21.9	74.1	20.5	324.7

Note: All SAR values normalized to 1 W forward power.

10.1 SYSTEM PERFORMANCE CHECK RESULTS

System Validation Dipole: D2450V2 SN: 748

The dipole input power (forward power): 250 mW

Results

Date: January 12, 2008

Ambient Temperature = 25°C; Relative humidity = 30% Measured by: Carol Baumann

Body Simulating Liquid			SAR (mW/g)	Normalized	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)					
2450	24	15	1g	47.7	51.2	-6.84	± 10
			10g	21.8	23.7	-8.02	± 10

System Validation Dipole: D5GHzV2 SN 1003

Date: January 13, 2009

Ambient Temperature = 25°C; Relative humidity = 32% Measured by: Carol Baumann

Body Simulating Liquid			SAR (mW/g)	Normalized to 1 W	Target	Deviation (%)	Limit (%)
f(MHz)	Temp. (°C)	Depth (cm)					
5200	24	15	1g	69.1	71.8	-3.76	± 10
			10g	19.3	20.1	-3.98	± 10

Body Simulating Liquid			SAR (mW/g)	Normalized to 1 W	Target	Deviation (%)	Limit (%)
f(MHz)	Temp. (°C)	Depth (cm)					
5500	24	15	1g	79.7	79.1	0.76	± 10
			10g	22.1	22.0	0.45	± 10

Body Simulating Liquid			SAR (mW/g)	Normalized to 1 W	Target	Deviation (%)	Limit (%)
f(MHz)	Temp. (°C)	Depth (cm)					
5800	24	15	1g	72.7	74.1	-1.89	± 10
			10g	20.3	20.5	-0.98	± 10

Date: January 17, 2009

Ambient Temperature = 25°C; Relative humidity = 38% Measured by: Carol Baumann

Body Simulating Liquid			SAR (mW/g)	Normalized to 1 W	Target	Deviation (%)	Limit (%)
f(MHz)	Temp. (°C)	Depth (cm)					
5200	24	15	1g	74.5	71.8	3.76	± 10
			10g	20.9	20.1	3.98	± 10

Body Simulating Liquid			SAR (mW/g)	Normalized to 1 W	Target	Deviation (%)	Limit (%)
f(MHz)	Temp. (°C)	Depth (cm)					
5500	24	15	1g	78.3	79.1	-1.01	± 10
			10g	21.7	22.0	-1.36	± 10

Body Simulating Liquid			SAR (mW/g)	Normalized to 1 W	Target	Deviation (%)	Limit (%)
f(MHz)	Temp. (°C)	Depth (cm)					
5800	24	15	1g	74.7	74.1	0.81	± 10
			10g	20.8	20.5	1.46	± 10

11 PROCEDURE USED TO ESTABLISH TEST SIGNAL

The following procedures had been used to prepare the EUT for the SAR test.

The client provided a special driver and program, w1_tools, which enable a user to control the frequency and output power of the module.

The cable assembly insertion loss of 20.3 dB (including attenuator and connectors) was entered as an offset in the power meter to allow for direct reading of power.

RF Conducted Output Power Measurement Results:

See Broadcom's Operational Description document for Average Power information.

12 SAR TEST RESULTS

12.1 SAR TEST RESULT FOR THE BAND 2400 – 2483.5 MHZ

Tyco Antenna					
Mode	Channel	f (MHz)	Antenna	Measured SAR 1g (mW/g)	Limit
802.11b	6	2437 (M)	Main	0.006	1.6
802.11b	6	2437 (M)	Aux	**0.009**	1.6

Notes:

1) The modes with highest output power channel were chosen for the testing.
2) Test configuration: Lapheld with display open at 90° to the keyboard.
3) The SAR measured at the middle channel for this configuration is at least 3 dB lower (0.8 mW/g) than SAR limit (1.6 mW/g), thus testing at low & high channel is optional.

SAR Plot & Data for 2.4 GHz Band (Main Antenna)

Date/Time: 1/12/2009 4:41:19 PM

Test Laboratory: Compliance Certification Services

Lapheld Position Main Antenna

DUT: Dell; Type: Tiger; Serial: 398

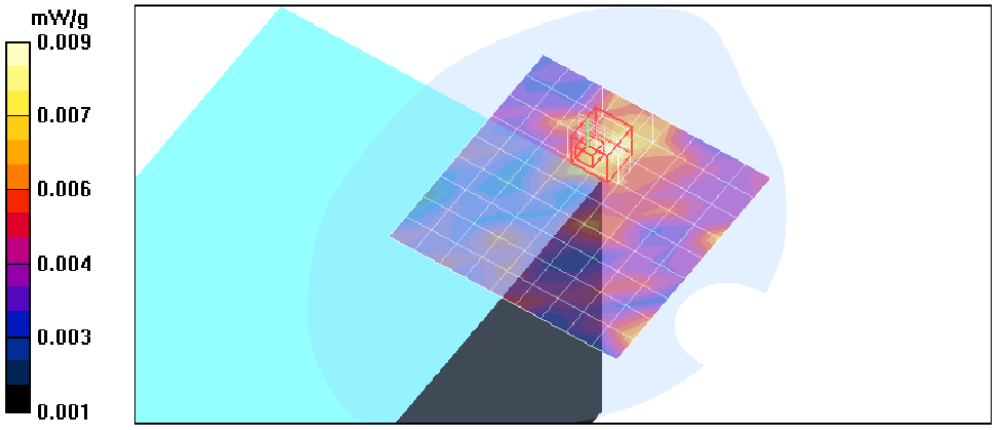
Communication System: 802.11bg; Frequency: 2437 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 2437 MHz; σ = 1.92 mho/m; ε_r = 51.8; ρ = 1000 kg/m^3
Phantom section: Flat Section

Room Ambient Temperature: 25.0 deg. C; Liquid Temperature: 24.0 deg. C

DASY4 Configuration:
- Area Scan setting - Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Probe: EX3DV3 - SN3531; ConvF(7.91, 7.91, 7.91); Calibrated: 4/23/2008
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 10/20/2008
- Phantom: SAM 2 (Twin); Type: SAM 2; Serial: 1050
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

802.11b M-ch Main Antenna/Area Scan (10x10x1): Measurement grid: dx=15mm, dy=15mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.009 mW/g

802.11b M-ch Main Antenna/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=3mm
Reference Value = 1.43 V/m; Power Drift = -2.48 dB
Peak SAR (extrapolated) = 0.016 W/kg
SAR(1 g) = 0.00595 mW/g; SAR(10 g) = 0.00419 mW/g
Info: Interpolated medium parameters used for SAR evaluation.



SAR Plot & Data for 2.4 GHz Band (Aux Antenna)

Date/Time: 1/13/2009 10:30:49 AM

Test Laboratory: Compliance Certification Services

Lapheld Position

DUT: Dell; Type: Tiger; Serial: 398

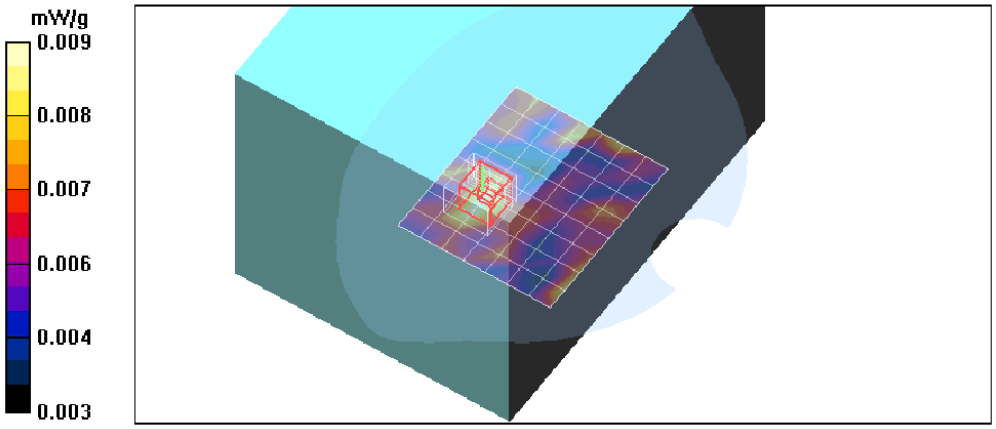
Communication System: 802.11bg; Frequency: 2437 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 2437 MHz; σ = 1.92 mho/m; ε_r = 51.8; ρ = 1000 kg/m^3
Phantom section: Flat Section

Room Ambient Temperature: 25.0 deg. C; Liquid Temperature: 24.0 deg. C

DASY4 Configuration:
- Area Scan setting - Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Probe: EX3DV3 - SN3531; ConvF(7.91, 7.91, 7.91); Calibrated: 4/23/2008
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 10/20/2008
- Phantom: SAM 2 (Twin); Type: SAM 2; Serial: 1050
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

802.11b M-ch Aux Antenna/Area Scan (8x9x1): Measurement grid: dx=15mm, dy=15mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.009 mW/g

802.11b M-ch Aux Antenna/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=3mm
Reference Value = 1.35 V/m; Power Drift = 1.17 dB
Peak SAR (extrapolated) = 0.026 W/kg
SAR(1 g) = 0.00927 mW/g; SAR(10 g) = 0.0071 mW/g
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.011 mW/g



12.2 SAR TEST RESULT FOR THE BAND 5.15- 5.25 GHz

Normal Test Position					
Mode	Channel	f (MHz)	Antenna	Measured SAR 1g (mW/g)	Limit
802.11a	40	5200 (M)	Main	Noise Only	1.6

12.3 SAR TEST RESULT FOR THE BAND 5.25–5.35 GHz

Normal Test Position					
Mode	Channel	f (MHz)	Antenna	Measured SAR 1g (mW/g)	Limit
802.11a	60	5300 (M)	Main	Noise Only	1.6

12.4 SAR TEST RESULT FOR THE BAND 5.47–5.725 GHz

Normal Test Position					
Mode	Channel	f (MHz)	Antenna	Measured SAR 1g (mW/g)	Limit
802.11a	140	5700 (H)	Main	Noise Only	1.6

Worst Case Position: Maximum Angle at 135° (Limited by Host Device)					
Mode	Channel	f (MHz)	Antenna	Measured SAR 1g (mW/g)	Limit
802.11a	140	5700 (H)	Main	0.054	1.6

12.5 SAR TEST RESULT FOR THE BAND 5.725-5.850 GHz

Normal Test Position					
Mode	Channel	f (MHz)	Antenna	Measured SAR 1g (mW/g)	Limit
802.11a	157	5785 (M)	Main	Noise Only	1.6

Notes:

1) The modes with highest output power channel were chosen for the testing.
2) Normal Test Position: Lapheld with display open at 90° to the keyboard.
3) The SAR measured at the middle channel for this configuration is at least 3 dB lower (0.8 mW/g) than SAR limit (1.6 mW/g), thus testing at low & high channel is optional.

The Highest SAR Plot & Data for 5.5 GHz Band

Date/Time: 1/17/2009 2:16:03 PM

Test Laboratory: Compliance Certification Services

Lapheld Position

DUT: Dell; Type: Tiger; Serial: 398

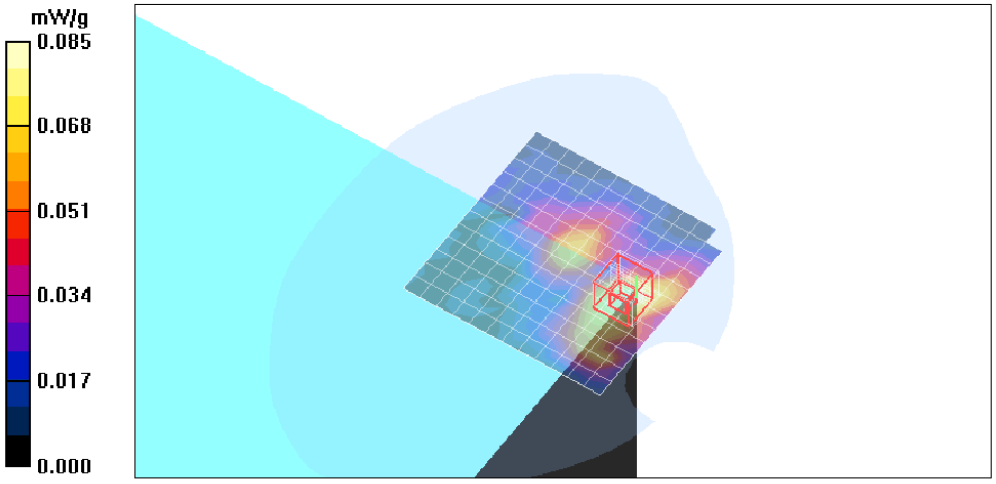
Communication System: 802.11abgn; Frequency: 5700 MHz;Duty Cycle: 1:1
Medium parameters used: f = 5700 MHz; σ = 6.07 mho/m; ε_r = 44.8; ρ = 1000 kg/m^3
Phantom section: Flat Section

Room Ambient Temperature: 25.0 deg. C; Liquid Temperature: 24.0 deg. C

DASY4 Configuration:
- Area Scan setting - Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Probe: EX3DV3 - SN3531; ConvF(3.7, 3.7, 3.7); Calibrated: 4/23/2008
- Sensor-Surface: 2.5mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 10/20/2008
- Phantom: SAM 2 (Twin); Type: SAM 2; Serial: 1050
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

802.11a H-ch 5.5 GHz Band Main Ant Worst/Area Scan (13x13x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 0.085 mW/g

802.11a H-ch 5.5 GHz Band Main Ant Worst/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 0.885 V/m; Power Drift = -2.67 dB
Peak SAR (extrapolated) = 0.255 W/kg
SAR(1 g) = 0.054 mW/g; SAR(10 g) = 0.022 mW/g
Maximum value of SAR (measured) = 0.091 mW/g



13 ATTACHMENTS

No.	Contents	No. Of Pages
1	System Performance Check Plots	14
2	Certificate of E-Field Probe - EX3DV3SN3531	10
3	Certificate of System Validation Dipole - D2450V2 SN:748	6
4	Certificate of System Validation Dipole - D5GHzV2 SN:1003	15

14 PHOTOS

Setup Photo for 2.4 GHz Band (Main Antenna)

Setup Photo for 2.4 GHz Band (Aux Antenna)

Setup Photo for 5 GHz Bands (Main Antenna)

Setup Photo for 5.5 GHz Band (Main Antenna-Worst Case)
Maximum Angle at 135º (Limited by Host Device)

End of Report