FCC OET BULLETIN 65 SUPPLEMENT C
CLASS II PERMISSIVE CHANGE

SAR EVALUATION REPORT

FOR

802.11ag/Draft 802.11n WLAN PCI-E Minicard

(Tested inside of HP Tablet PC, HSTNN-W75C)

MODEL: BCM943224HMS

FCC ID: QDS-BRCM1041

REPORT NUMBER: 09U12939-2

ISSUE DATE: December 28, 2009

Prepared for

BROADCOM CORPORATION
190 MATHILDA PLACE
SUNNYVALE, CA 94086

Prepared by

COMPLIANCE CERTIFICATION SERVICES
47173 BENICIA STREET
FREMONT, CA 94538, U.S.A.
TEL: (510) 771-1000
FAX: (510) 661-0888

NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
--	December 28, 2009	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 Minicard (Tested inside of HP Tablet PC, HSTNN-W75C)
MODEL NUMBER:	BCM943224HMS
DEVICE CATEGORY:	Portable
EXPOSURE CATEGORY:	General Population/Uncontrolled Exposure
DATE TESTED:	December 22 - 27, 2009

THE HIGHEST SAR VALUES:

FCC/IC Rule Parts	Frequency Range [MHz]	The Highest 1-g SAR Values (mW/g)	Limit (mW/g)
15.247 / RSS-102	2400 – 2483.5	0.92 (Secondary landscape)	1.6
	5725 – 5850	1.39 (Secondary landscape)	
15.407 / RSS-102	5150 – 5250	1.01 (Secondary landscape)	1.6
	5250 – 5350	1.56 (Secondary landscape)	
	5470 – 5725	1.57 (Secondary landscape)	

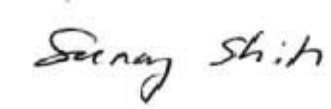
APPLICABLE STANDARDS:

STANDARD	TEST RESULTS
FCC OET BULLETIN 65 SUPPLEMENT C and the following Test Procedures: o KDB 248227 SAR measurement procedures for 802.11a/b/g transmitters o KDB 447498 D01 Mobile Portable RF Exposure v04, supplemental to KDB 616217 D03	Pass
RSS-102 ISSUE 3	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. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

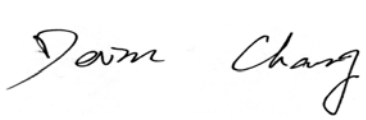
Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by CCS and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by CCS will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government.

Approved & Released For CCS By:



SUNNY SHIH
ENGINEERING SUPERVISOR
COMPLIANCE CERTIFICATION SERVICES

Tested By:



DEVIN CHANG
EMC 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 802.11abg Transmitters, KDB 447498 D01 Mobile Portable RF Exposure v04, supplemental to KDB 616217 D03 and IC RSS 102 Issue 3.

And Schedule 2 of Radiocommunications (Electromagnetic Radiation - Human Exposure) Standard 2003 incl Amendment No 1, 2007 and NZS 2772.1:1999 Radiofrequency fields - Maximum exposure levels - 3 kHz to 300 GHz incl Amendment No. 1, 1999.

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.

Name of Equipment	Manufacturer	Type/Model	Serial No.	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
Signal Generator	Agilent	8753ES-6	MY40001647	11	22	2010
E-Field Probe	SPEAG	EX3DV4	3686	3	23	1010
Data Acquisition Electronics	SPEAG	DAE3 V1	500	9	15	2010
System Validation Dipole	SPEAG	D900V2	108	1	21	2010
System Validation Dipole	SPEAG	D1800V2	294	1	29	2010
System Validation Dipole	SPEAG	D1900V2	5d043	1	29	2010
System Validation Dipole	SPEAG	D2450V2	748	4	14	2010
System Validation Dipole	SPEAG	D5GHzV2	1075	10	3	2012
ESG Vector Signal Generator	Agilent	E4438C	US44271090	9	17	2010
Power Meter	Giga-tronics	8651A	8651404	1	11	2010
Power Sensor	Giga-tronics	80701A	1834588	1	11	2010
Amplifier	Mini-Circuits	ZVE-8G	90606	N/A		
Amplifier	Mini-Circuits	ZHL-42W	D072701-5	N/A		
Simulating Liquid	SPAEG	M2450	N/A	Within 24 hrs of first test		
Simulating Liquid	SPAEG	M5800	N/A	Within 24 hrs of first test		

4.2. 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
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

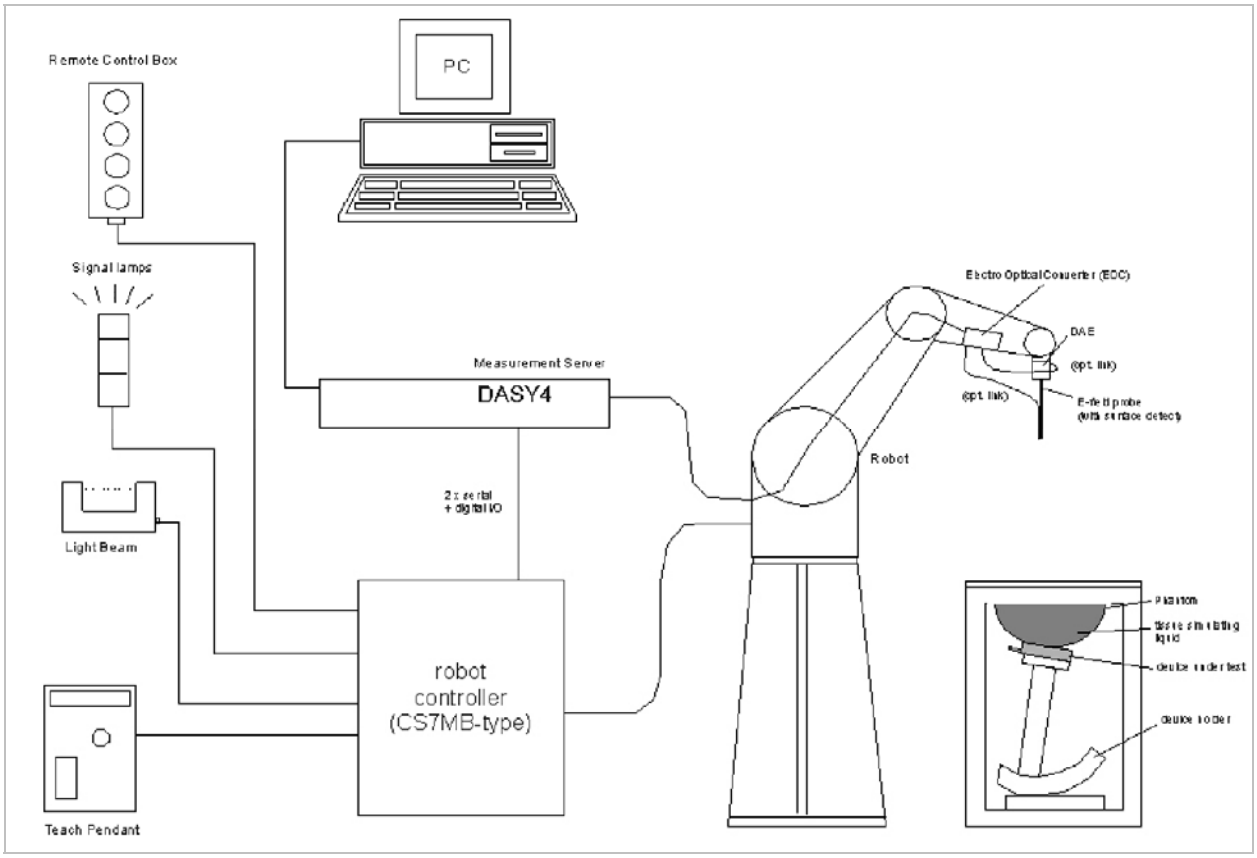
Uncertainty component	Tol. (±%)	Probe Dist.	Div.	Ci (1g)	Ci (10g)	Std. Unc.(±%)	
						Ui (1g)	Ui(10g)
Measurement System							
Probe Calibration	4.80	N	1	1	1	4.80	4.80
Axial Isotropy	4.70	R	1.732	0.707	0.707	1.92	1.92
Hemispherical Isotropy	9.60	R	1.732	0.707	0.707	3.92	3.92
Boundary Effects	1.00	R	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

5. EQUIPMENT UNDER TEST

802.11ag/Draft 802.11n WLAN PCI-E Minicard (Tested inside of HP Tablet PC, HSTNN-W75C)			
Normal operation:	Laptop - Lap-held, Tablet - Edge (underarm) & lap-held		
Antenna tested:	Install in		
	Host device	Manufactured	Model Number
	HSTNN-W75C	Ethertronics	Main: 25.90946.001 Aux: 25.90947.001
Antenna-to-user separation distance:	Refer to Section 11 for antenna-to-user separation distance and		
Antenna-to-antenna distance:	Refer to antenna specifications		
Require SAR evaluation for Simultaneous transmission?	WWAN co-located RF exposure assessment will be addressed in a separate FCC application filed under WWAN application.		
Power supply:	Power supplied through laptop computer (host device)		

6. SYSTEM SPECIFICATIONS



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 allowing to validate the proper functioning of the system.

7. 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

8. 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.

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	0.8
300	45.3	0.87	58.2	0.92
450	43.5	0.87	56.7	0.94
835	41.5	0.9	55.2	0.97
900	41.5	0.97	55	1.05
915	41.5	0.98	55	1.06
1450	40.5	1.2	54	1.3
1610	40.3	1.29	53.8	1.4
1800 – 2000	40	1.4	53.3	1.52
2450	39.2	1.8	52.7	1.95
3000	38.5	2.4	52	2.73
5800	35.3	5.27	48.2	6

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

8.1. LIQUID CHECK RESULTS FOR 2450 MHZ

Simulating Liquid Dielectric Parameters for Muscle 2450 MHz

Room Ambient Temperature = 24°C; Relative humidity = 40% Measured by: Sunny Shih

f (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit (%)
2450	e'	52.22	Relative Permittivity (ϵ_r):	52.215	52.7	-0.92	± 5
	e"	14.88	Conductivity (σ):	2.028	1.95	3.98	± 5

Liquid Check
Ambient temperature: 24 deg. C; Liquid temperature: 23 deg. C
December 27, 2009 02:51 PM

Frequency	e'	e"
2400000000.	53.4197	15.2224
2405000000.	53.4521	15.1226
2410000000.	53.4367	15.0494
2415000000.	53.3720	14.9775
2420000000.	53.2708	14.9106
2425000000.	53.1250	14.8632
2430000000.	52.9412	14.8311
2435000000.	52.7301	14.8159
2440000000.	52.5402	14.8166
2445000000.	52.3704	14.8382
2450000000.	**52.2150**	**14.8765**
2455000000.	52.0925	14.9609
2460000000.	52.0108	15.0620
2465000000.	51.9780	15.1773
2470000000.	51.9893	15.3207
2475000000.	52.0142	15.4626
2480000000.	52.0668	15.5926
2485000000.	52.1706	15.6958
2490000000.	52.2724	15.7787
2495000000.	52.4156	15.8235
2500000000.	52.5645	15.8449

The conductivity (σ) can be given as:

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

where f = target f * 10^6

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

8.2. LIQUID CHECK RESULTS FOR 5 GHZ

Simulating Liquid Dielectric Parameters for Muscle 5 GHz

Room Ambient Temperature = 25°C; Relative humidity = 38% Measured by: Sunny Shih

f (MHz)	Muscle Liquid Parameters			Measured	Target	Delta (%)	Limit (%)
5200	e'	48.9469	Relative Permittivity (ϵ_r):	48.9469	49.0	-0.11	± 10
	e"	18.5194	Conductivity (σ):	5.35734	5.30	1.08	± 5
5500	e'	48.3244	Relative Permittivity (ϵ_r):	48.3244	48.6	-0.57	± 10
	e"	18.9709	Conductivity (σ):	5.80456	5.65	2.74	± 5
5800	e'	47.715	Relative Permittivity (ϵ_r):	47.7150	48.2	-1.01	± 10
	e"	19.4068	Conductivity (σ):	6.26183	6.00	4.36	± 5

Liquid Check
Ambient temperature: 25 deg. C; Liquid temperature: 24 deg. C
December 22, 2009 11:01 AM

Frequency	e'	e"
4600000000.	50.1726	17.4557
4650000000.	50.0676	17.5535
4700000000.	49.9918	17.6601
4750000000.	49.8867	17.7645
4800000000.	49.7809	17.8414
4850000000.	49.6887	17.9351
4900000000.	49.5927	18.0349
4950000000.	49.5262	18.1408
5000000000.	49.3710	18.1923
5050000000.	49.2675	18.2868
5100000000.	49.1450	18.3699
5150000000.	49.0308	18.4734
5200000000.	**48.9469**	**18.5194**
5250000000.	48.8378	18.6236
5300000000.	48.7307	18.6895
5350000000.	48.6165	18.7754
5400000000.	48.5215	18.8260
5450000000.	48.4122	18.9278
5500000000.	**48.3244**	**18.9709**
5550000000.	48.2129	19.0515
5600000000.	48.1183	19.1269
5650000000.	48.0202	19.1971
5700000000.	47.9072	19.2556
5750000000.	47.8267	19.3328
5800000000.	**47.7150**	**19.4068**
5850000000.	47.6195	19.4730
5900000000.	47.5449	19.5492
5950000000.	47.4151	19.6163
6000000000.	47.3102	19.6729

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 Dielectric Parameters for Muscle 5 GHz

Room Ambient Temperature = 25°C; Relative humidity = 40% Measured by: Sunny Shih

f (MHz)	Muscle Liquid Parameters			Measured	Target	Delta (%)	Limit (%)
5200	e'	49.1127	Relative Permittivity (ϵ_r):	49.1127	49.0	0.23	± 10
	e"	18.5634	Conductivity (σ):	5.37007	5.30	1.32	± 5
5500	e'	48.5008	Relative Permittivity (ϵ_r):	48.5008	48.6	-0.20	± 10
	e"	19.0176	Conductivity (σ):	5.81885	5.65	2.99	± 5
5800	e'	47.8943	Relative Permittivity (ϵ_r):	47.8943	48.2	-0.63	± 10
	e"	19.4342	Conductivity (σ):	6.27067	6.00	4.51	± 5

Liquid Check
Ambient temperature: 25 deg. C; Liquid temperature: 24 deg. C
December 23, 2009 10:12 AM

Frequency	e'	e"
4600000000.	50.3367	17.4950
4650000000.	50.2259	17.5995
4700000000.	50.1625	17.6978
4750000000.	50.0419	17.8052
4800000000.	49.9594	17.8967
4850000000.	49.8668	17.9709
4900000000.	49.7624	18.0733
4950000000.	49.6817	18.1679
5000000000.	49.5454	18.2344
5050000000.	49.4453	18.3307
5100000000.	49.3208	18.4088
5150000000.	49.2103	18.5167
5200000000.	**49.1127**	**18.5634**
5250000000.	49.0035	18.6576
5300000000.	48.9150	18.7263
5350000000.	48.7837	18.8088
5400000000.	48.6904	18.8664
5450000000.	48.5900	18.9493
5500000000.	**48.5008**	**19.0176**
5550000000.	48.3794	19.0941
5600000000.	48.2896	19.1585
5650000000.	48.2009	19.2352
5700000000.	48.0863	19.2962
5750000000.	48.0023	19.3581
5800000000.	**47.8943**	**19.4342**
5850000000.	47.7955	19.5086
5900000000.	47.7096	19.5913
5950000000.	47.5935	19.6565
6000000000.	47.4889	19.7104

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 Dielectric Parameters for Muscle 5 GHz

Room Ambient Temperature = 25°C; Relative humidity = 38% Measured by: Sunny Shih

f (MHz)	Muscle Liquid Parameters			Measured	Target	Delta (%)	Limit (%)
5200	e'	48.7725	Relative Permittivity (ε_r):	48.7725	49.0	-0.46	± 10
	e"	18.5075	Conductivity (σ):	5.35390	5.30	1.02	± 5
5500	e'	48.1383	Relative Permittivity (ε_r):	48.1383	48.6	-0.95	± 10
	e"	18.9652	Conductivity (σ):	5.80282	5.65	2.70	± 5
5800	e'	47.5417	Relative Permittivity (ε_r):	47.5417	48.2	-1.37	± 10
	e"	19.3899	Conductivity (σ):	6.25637	6.00	4.27	± 5

Liquid Check
Ambient temperature: 25 deg. C; Liquid temperature: 24 deg. C
December 24, 2009 11:05 AM

Frequency	e'	e"
4600000000.	49.9509	17.4554
4650000000.	49.8661	17.5601
4700000000.	49.7868	17.6655
4750000000.	49.6772	17.7498
4800000000.	49.5930	17.8475
4850000000.	49.4897	17.9308
4900000000.	49.4073	18.0351
4950000000.	49.3009	18.1350
5000000000.	49.1792	18.1894
5050000000.	49.0966	18.2878
5100000000.	48.9675	18.3598
5150000000.	48.8505	18.4688
5200000000.	**48.7725**	**18.5075**
5250000000.	48.6444	18.6016
5300000000.	48.5322	18.6734
5350000000.	48.4244	18.7589
5400000000.	48.3447	18.8210
5450000000.	48.2302	18.9060
5500000000.	**48.1383**	**18.9652**
5550000000.	48.0238	19.0262
5600000000.	47.9384	19.1009
5650000000.	47.8369	19.1718
5700000000.	47.7263	19.2354
5750000000.	47.6528	19.3145
5800000000.	**47.5417**	**19.3899**
5850000000.	47.4507	19.4467
5900000000.	47.3632	19.5208
5950000000.	47.2469	19.6059
6000000000.	47.1266	19.6515

The conductivity (σ) can be given as:

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

where f = target f * 10^6

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

9. SYSTEM PERFORMANCE

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 EX3DV4-SN: 3686 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 3mm.
  For 5 GHz band - Distance between probe sensors and phantom surface was set to 2.5mm
- The dipole input power (forward power) were 100 mW (5GHz) and 250 mW (2.4GHz) ±3%
- The results are normalized to 1 W input power.

Reference SAR Values for HEAD & BODY-tissue from calibration certificate of SPEAG.
Certificate no: D2450V2-748_April 14, 2008

f (MHz)	Head Tissue		Body Tissue	
	SAR_{1g}	SAR_{10g}	SAR_{1g}	SAR_{10g}
2450			49.5	23.3

Reference SAR Values for BODY-tissue from calibration certificate of SPEAG.
Certificate no: D5GHzV2-1075_Sep09

f (MHz)	Head Tissue		Body Tissue	
	SAR_{1g}	SAR_{10g}	SAR_{1g}	SAR_{10g}
5200			78.7	21.9
5500			85.0	23.4
5800			72.9	20.0

9.1. SYSTEM CHECK RESULTS FOR D2450V2

Date: November 27, 2009

Ambient Temperature = 24°C; Relative humidity = 40% Measured by: Sunny Shih

Medium	CW Signal (MHz)	Forward Pwr (mW)	Measured (Normalized to 1 W)		Target	Delta (%)	Tolerance (%)
Body	2450	100	1g SAR:	54.4	49.5	9.90	±10
			10g SAR:	24.9	23.3	6.87	

9.2. SYSTEM CHECK RESULTS FOR D5GHzV2

Date: December 22, 2009

Ambient Temperature = 25°C; Relative humidity = 40% Measured by: Sunny Shih

Medium	CW Signal (MHz)	Forward Pwr (mW)	Measured (Normalized to 1 W)		Target	Delta (%)	Tolerance (%)
Muscle	5200	100	1g SAR:	74.4	78.7	-5.46	±10
			10g SAR:	21.5	21.9	-1.83	
Muscle	5500	100	1g SAR:	83.1	85.0	-2.24	±10
			10g SAR:	23.6	23.4	0.85	
Muscle	5800	100	1g SAR:	70.5	72.9	-3.29	±10
			10g SAR:	19.8	20.0	-1.00	

Date: December 23, 2009

Ambient Temperature = 25°C; Relative humidity = 40% Measured by: Sunny Shih

Medium	CW Signal (MHz)	Forward Pwr (mW)	Measured (Normalized to 1 W)		Target	Delta (%)	Tolerance (%)
Muscle	5200	100	1g SAR:	77.8	78.7	-1.14	±10
			10g SAR:	22.4	21.9	2.28	
Muscle	5500	100	1g SAR:	83.7	85.0	-1.53	±10
			10g SAR:	23.8	23.4	1.71	
Muscle	5800	100	1g SAR:	75.6	72.9	3.70	±10
			10g SAR:	21.3	20.0	6.50	

10. OUTPUT POWER VERIFICATION

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

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

RF Conducted Output Power Measurement Results:

Please refer to Broadcom's Operational Description document for Average Power information (confidential exhibit) as documented in 04/02/2009 original filing.

Before SAR evaluation, CCS has verified the RF conducted average powers which are in an agreement with previous reported average output powers.

11. SUMMARY OF TEST RESULTS

11.1. SAR TEST RESULTS FOR 2.4 GHZ BAND

1) Laptop - Lap-held (with the display open at 90° to the keyboard)

Note: WLAN main and aux antennas are more than 20 cm from phantom for laptop mode, SAR test is not required.

2) Tablet - Lap-held (2.8 cm from Main/Aux antennas-to-user)

Mode	Channel	f (MHz)	Antenna	Results (mW/g)	
				1g-SAR	10g-SAR
802.11b	6	2437	Main	0.078	0.058
802.11g	6	2437	Aux	0.083	0.059

3) Tablet - Primary Landscape

Note: WLAN main and aux antennas are more than 20 cm from phantom for laptop mode, SAR test is not required.

4) Tablet - Secondary Landscape (0.4 cm from Main/Aux antennas-to-user)

Mode	Channel	f (MHz)	Antenna	Results (mW/g)	
				1g-SAR	10g-SAR
802.11b	6	2437	Main	0.741	0.324
802.11g	1	2412	Aux	0.812	0.336
	6	2437	Aux	0.920	0.380
	11	2462	Aux	0.449	0.194

5) Tablet - Primary Portrait (8.9 cm from Main antenna-to-user)

Mode	Channel	f (MHz)	Antenna	Results (mW/g)	
				1g-SAR	10g-SAR
802.11g	6	2437	Main	0.071	0.031

6) Tablet – Secondary Portrait (8.8 cm from Aux antenna-to-user)

Mode	Channel	f (MHz)	Antenna	Results (mW/g)	
				1g-SAR	10g-SAR
802.11g	6	2437	Aux	0.063	0.027

Notes:

1. 802.11b doesn't operate for Aux antenna. Thus, 802.11g is performed for Aux antenna instead.
2. The modes with highest output power channel were chosen for the testing.

11.2. SAR TEST RESULTS FOR 5 GHZ BANDS

1) Laptop - Lap-held (with the display open at 90° to the keyboard)

Note: WLAN main and aux antennas are more than 20 cm from phantom for laptop mode, SAR test is not required.

2) Tablet - Lap-held (2.8 cm from Main/Aux antennas-to-user)

Mode	Channel	f (MHz)	Antenna	Results (mW/g)	
				1g-SAR	10g-SAR
802.11a	40	5200	Main	0.089	0.0795
	60	5300	Main	0.097	0.0910
	120	5600	Main	0.118	0.1090
	157	5785	Main	0.107	0.0980
802.11a	40	5200	Aux	0.098	0.0150
	60	5300	Aux	0.137	0.1030
	120	5600	Aux	0.106	0.0990
	157	5785	Aux	0.098	0.0906

3) Tablet - Primary Landscape

Note: WLAN main and aux antennas are more than 20 cm from phantom for laptop mode, SAR test is not required.

4) Tablet - Secondary Landscape (0.4 cm from Main/Aux antennas-to-user)

Mode	Channel	f (MHz)	Antenna	Results (mW/g)	
				1g-SAR	10g-SAR
802.11a (5.2 - 5.3 GHz)	36	5180	Main	0.727	0.215
	40	5200	Main	**1.010**	0.282
	48	5240	Main	0.931	0.265
	52	5260	Main	**1.560**	0.441
	60	5300	Main	1.510	0.365
	64	5320	Main	1.560	0.368
802.11a (5.6 GHz)	100	5500	Main	1.550	0.415
	120	5600	Main	1.490	0.369
	140	5700	Main	**1.570**	0.422
802.11a (5.8 GHz)	149	5745	Main	**1.390**	0.381
	157	5785	Main	1.010	0.292
	165	5825	Main	0.912	0.263
802.11a (5.2 - 5.3 GHz)	36	5180	Aux	0.697	0.238
	40	5200	Aux	0.942	0.299
	48	5240	Aux	0.739	0.250
	52	5260	Aux	1.010	0.329
	60	5300	Aux	1.160	0.382
	64	5320	Aux	1.050	0.352
802.11a (5.6 GHz)	100	5500	Aux	0.939	0.310
	120	5600	Aux	0.703	0.265
	140	5700	Aux	0.885	0.301
802.11a (5.8 GHz)	149	5745	Aux	0.836	0.298
	157	5785	Aux	0.525	0.207
	165	5825	Aux	0.491	0.197

5) Tablet - Primary Portrait (8.9 cm from Main antenna-to-user)

Mode	Channel	f (MHz)	Antenna	Results (mW/g)	
				1g-SAR	10g-SAR
802.11a	40	5200	Main	0.161	0.089
802.11a	60	5300	Main	0.179	0.099
802.11a	120	5600	Main	0.202	0.115
802.11a	157	5785	Main	0.208	0.116

6) Tablet – Secondary Portrait (8.8 cm from Aux antenna-to-user)

Mode	Channel	f (MHz)	Antenna	Results (mW/g)	
				1g-SAR	10g-SAR
802.11a	40	5200	Aux	0.113	0.078
802.11a	60	5300	Aux	0.149	0.091
802.11a	120	5600	Aux	0.163	0.100
802.11a	157	5785	Aux	0.086	0.035

12. SAR TEST PLOTS

WORST-CASE SAR PLOT FOR 2.4 GHZ

Date/Time: 12/27/2009 5:28:16 PM

Test Laboratory: Compliance Certification Services

Tablet - Secondary landscape

DUT: HP; Type: NA; Serial: NA

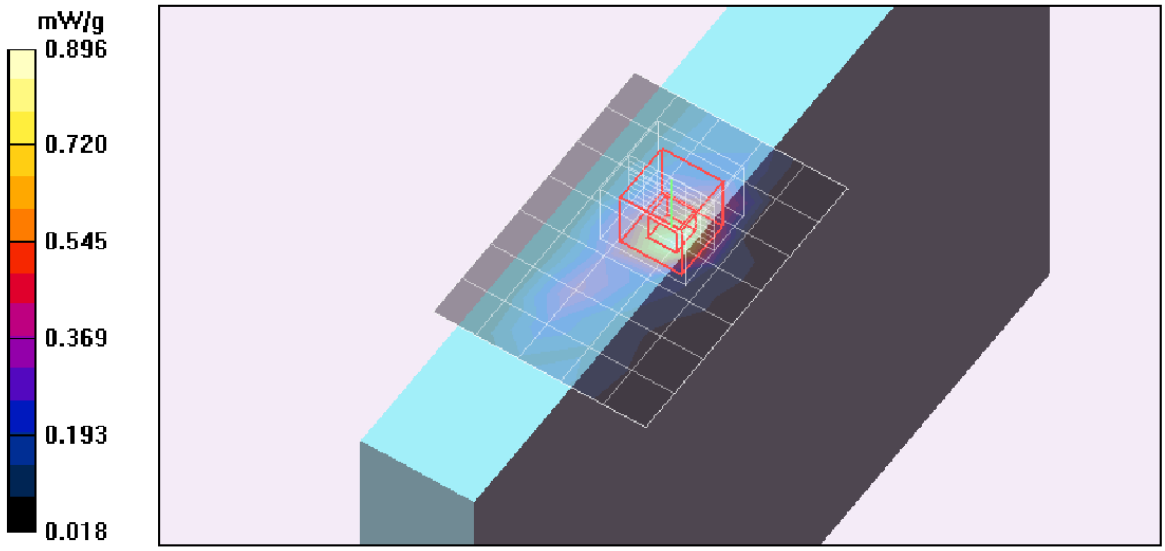
Communication System: 802.11bg; Frequency: 2437 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 2437 MHz; σ = 2.01 mho/m; ε_r = 52.7; ρ = 1000 kg/m^3
Phantom section: Flat Section

Room Ambient Temperature: 24.0 deg. C; Liquid Temperature: 23.0 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: EX3DV4 - SN3686; ConvF(6.48, 6.48, 6.48); Calibrated: 3/23/2009
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn500; Calibrated: 9/15/2009
- Phantom: Flat Phantom ELI4.0; Type: QDOVA001BA; Serial: SN:1003
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

802.11g Aux_M-ch/Area Scan (6x8x1): Measurement grid: dx=15mm, dy=15mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.896 mW/g

802.11g Aux_M-ch/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=3mm
Reference Value = 18.5 V/m; Power Drift = 0.488 dB
Peak SAR (extrapolated) = 2.22 W/kg
SAR(1 g) = 0.920 mW/g; SAR(10 g) = 0.380 mW/g
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 1.28 mW/g



WORST-CASE SAR PLOT FOR 5.2 GHZ

Date/Time: 12/24/2009 10:02:45 AM

Test Laboratory: Compliance Certification Services

Omega Tablet - Secondary landscape

DUT: HP; Type: NA; Serial: NA

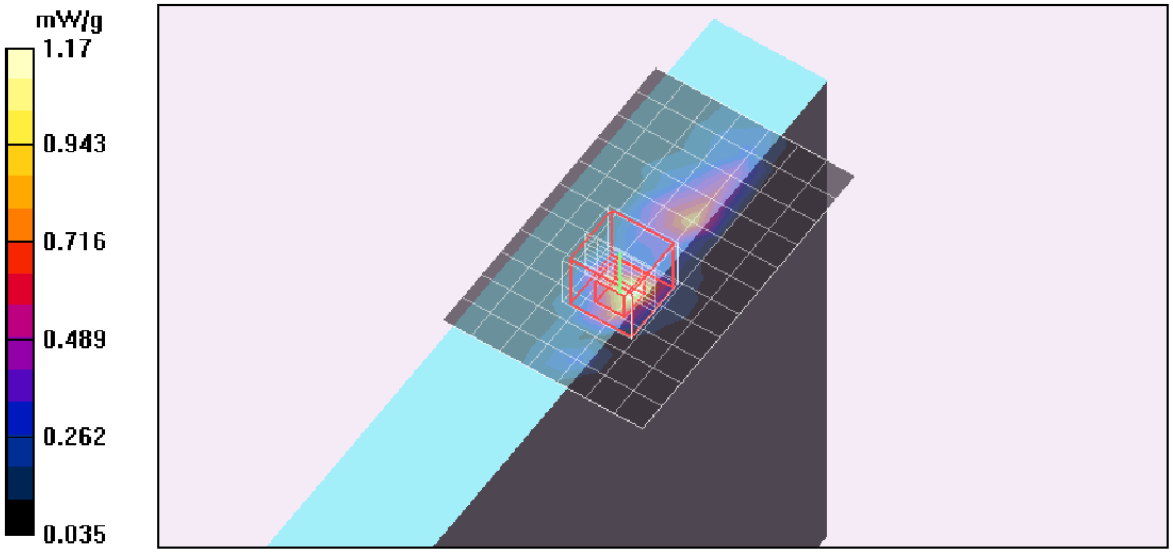
Communication System: 802.11abgn; Frequency: 5200 MHz;Duty Cycle: 1:1
Medium parameters used: f = 5200 MHz; σ = 5.35 mho/m; ε_r = 48.8; ρ = 1000 kg/m^3
Phantom section: Flat Section

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: EX3DV4 - SN3686; ConvF(4.08, 4.08, 4.08); Calibrated: 3/23/2009
- Sensor-Surface: 2.5mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn500; Calibrated: 9/15/2009
- Phantom: Flat Phantom ELI4.0; Type: QDOVA001BA; Serial: SN:1003
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

802.11a_Main_Ch 40/Area Scan (8x12x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 1.17 mW/g

802.11a_Main_Ch 40/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 16.1 V/m; Power Drift = 1.09 dB
Peak SAR (extrapolated) = 3.82 W/kg
SAR(1 g) = 1.01 mW/g; SAR(10 g) = 0.282 mW/g
Maximum value of SAR (measured) = 2.00 mW/g



WORST-CASE SAR PLOT FOR 5.3 GHZ

Date/Time: 12/22/2009 2:31:59 PM

Test Laboratory: Compliance Certification Services

Omega Tablet - Secondary landscape_5.2-5.3 GHz

DUT: HP; Type: NA; Serial: NA

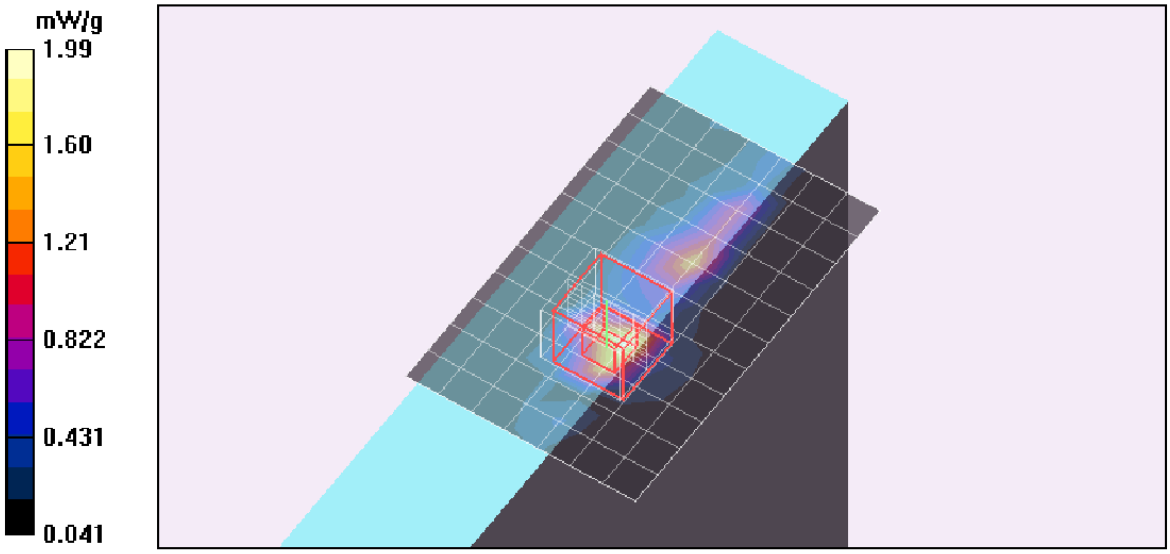
Communication System: 802.11abgn; Frequency: 5260 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 5260 MHz; σ = 5.45 mho/m; ε_r = 48.8; ρ = 1000 kg/m^3
Phantom section: Flat Section

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: EX3DV4 - SN3686; ConvF(3.81, 3.81, 3.81); Calibrated: 3/23/2009
- Sensor-Surface: 2.5mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn500; Calibrated: 9/15/2009
- Phantom: Flat Phantom ELI4.0; Type: QDOVA001BA; Serial: SN:1003
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

802.11a_Main_Ch 52/Area Scan (8x12x1): Measurement grid: dx=10mm, dy=10mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 1.99 mW/g

802.11a_Main_Ch 52/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 20.6 V/m; Power Drift = 0.767 dB
Peak SAR (extrapolated) = 5.41 W/kg
SAR(1 g) = 1.56 mW/g; SAR(10 g) = 0.441 mW/g
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 3.15 mW/g



WORST-CASE SAR PLOT FOR 5.3 GHZ

Date/Time: 12/22/2009 8:06:32 PM

Test Laboratory: Compliance Certification Services

Omega Tablet - Secondary landscape_5.5-5.7 GHz

DUT: HP; Type: NA; Serial: NA

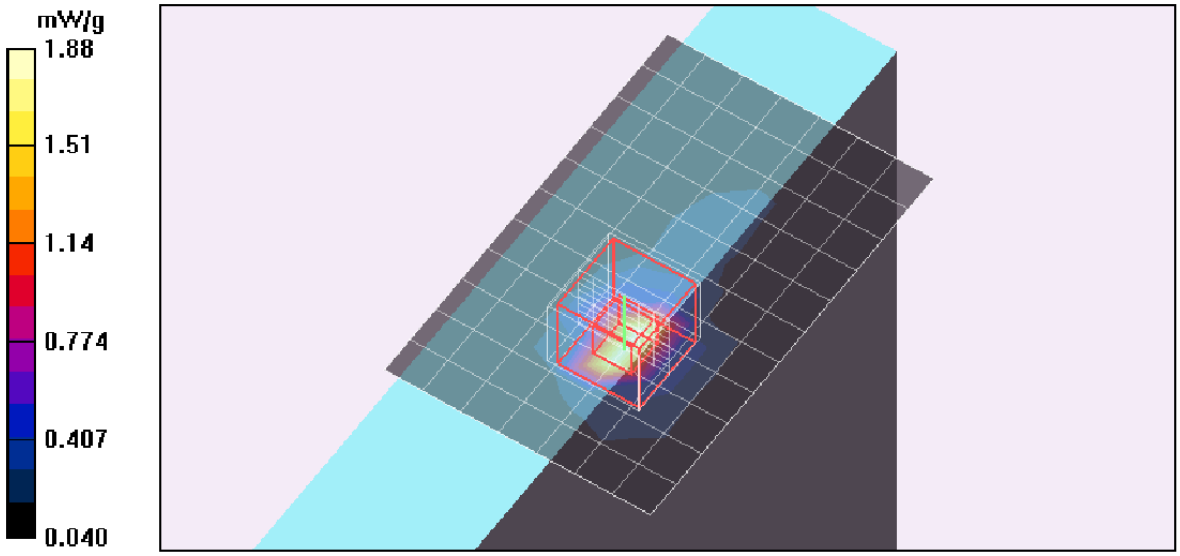
Communication System: 802.11abgn; Frequency: 5700 MHz;Duty Cycle: 1:1
Medium parameters used: f = 5700 MHz; σ = 6.11 mho/m; ε_r = 47.9; ρ = 1000 kg/m^3
Phantom section: Flat Section

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: EX3DV4 - SN3686; ConvF(3.84, 3.84, 3.84); Calibrated: 3/23/2009
- Sensor-Surface: 2.5mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn500; Calibrated: 9/15/2009
- Phantom: Flat Phantom ELI4.0; Type: QDOVA001BA; Serial: SN:1003
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

802.11a_Main_Ch 140/Area Scan (8x12x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 1.88 mW/g

802.11a_Main_Ch 140/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 19.3 V/m; Power Drift = 0.071 dB
Peak SAR (extrapolated) = 6.98 W/kg
SAR(1 g) = 1.57 mW/g; SAR(10 g) = 0.422 mW/g
Maximum value of SAR (measured) = 2.83 mW/g



WORST-CASE SAR PLOT FOR 5.8 GHZ

Date/Time: 12/22/2009 8:48:05 PM

Test Laboratory: Compliance Certification Services

Omega Tablet - Secondary landscape_5.745-5.825 GHz

DUT: HP; Type: NA; Serial: NA

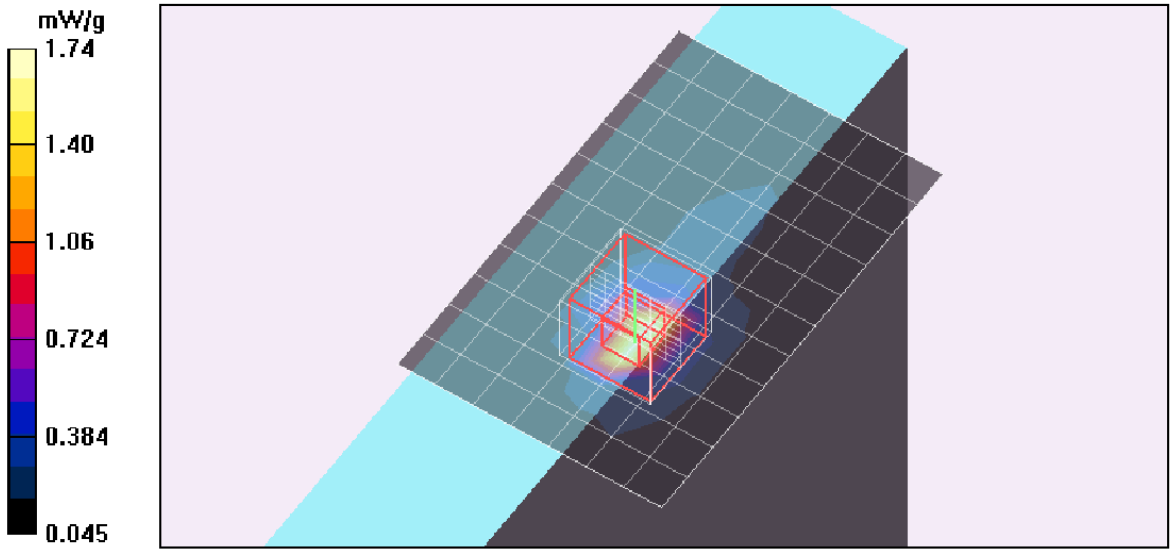
Communication System: 802.11abgn; Frequency: 5745 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 5745 MHz; σ = 6.18 mho/m; ε_r = 47.8; ρ = 1000 kg/m^3
Phantom section: Flat Section

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: EX3DV4 - SN3686; ConvF(3.84, 3.84, 3.84); Calibrated: 3/23/2009
- Sensor-Surface: 2.5mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn500; Calibrated: 9/15/2009
- Phantom: Flat Phantom ELI4.0; Type: QDOVA001BA; Serial: SN:1003
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

802.11a_Main_Ch149/Area Scan (8x12x1): Measurement grid: dx=10mm, dy=10mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 1.74 mW/g

802.11a_Main_Ch149/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 18.3 V/m; Power Drift = 0.488 dB
Peak SAR (extrapolated) = 5.93 W/kg
SAR(1 g) = 1.39 mW/g; SAR(10 g) = 0.381 mW/g
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 2.50 mW/g



13. ATTACHMENTS

No.	Contents	No. of page (s)
1	System Validation Plots	10
2	SAR Test Plots for 2.4 GHz band	9
3-1	SAR Test Plots for 5 GHz bands	20
3-2	SAR Test Plots for 5 GHz bands	20
4	Certificate of E-Field Probe - EX3DV4 SN 3686	10
5	Certificate of System Validation Dipole D2450V2 SN 748	6
6	Certificate of System Validation Dipole D5GHzV2 SN 1075	9