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 PP15S)

MODEL: BCM94322HM8L

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

REPORT NUMBER: 08U11950-3

ISSUE DATE: AUGUST 11, 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.	Issued date	Revisions	Revised By
--	August 11, 2008	Initial issue	--

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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 PP15S)
MODEL:	BCM94322HM8L
DEVICE CATEGORY:	Portable
EXPOSURE CATEGORY:	General Population/Uncontrolled Exposure
DATE TESTED:	August 7 - 11, 2008
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 5725 – 5850	0.060 0.084	1.6
15.407 / RSS-102	5150 – 5250 5250 – 5350 5470 – 5725	0.058 0.178 0.065	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 May 2007 and IC RSS 102 Issue 2: NOVERMBER 2005.

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

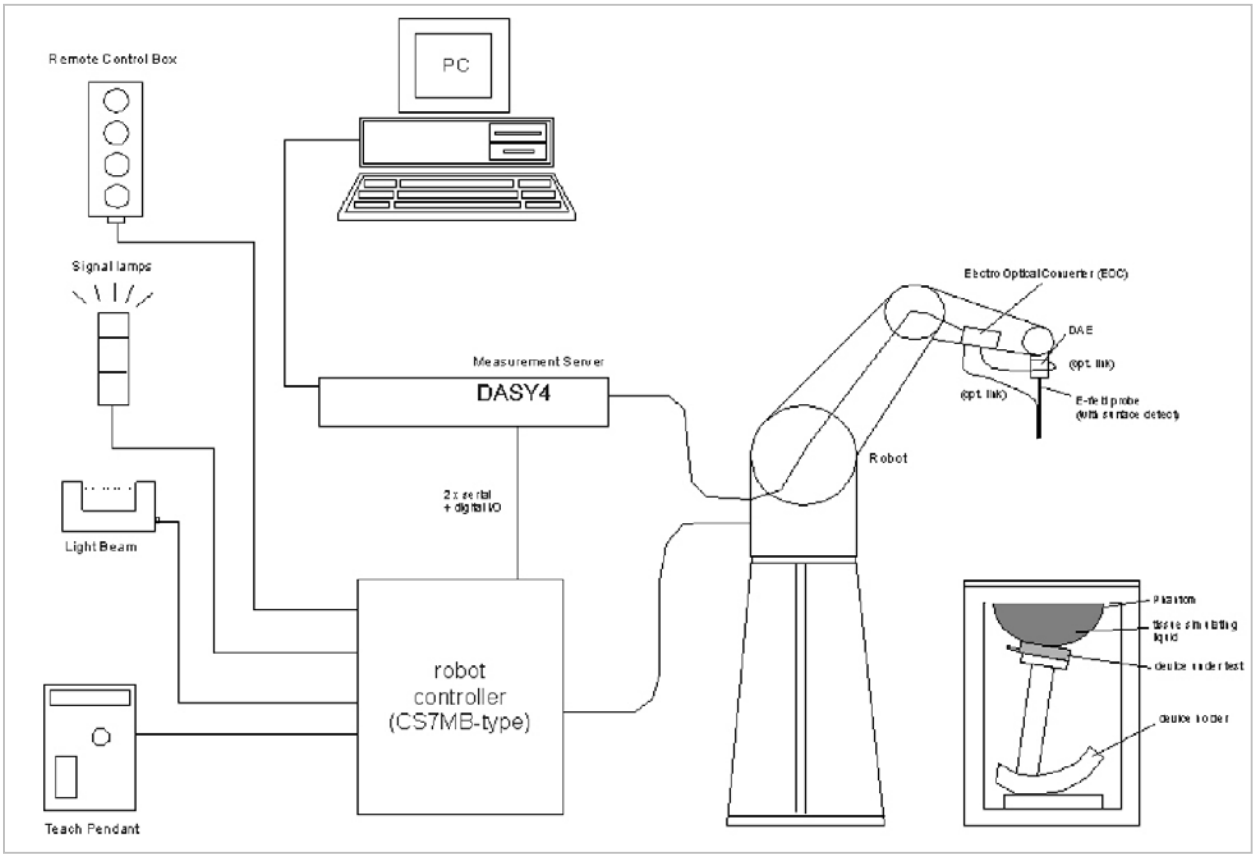
Uncertainty component	Tol. (±%)	Probe Dist.	Div.	Ci (1g)	Ci (10g)	Std. Unc.(±%)	
						Ui (1g)	Ui(10g)
Measurement System							
Probe Calibration	4.80	N	1	1	1	4.80	4.80
Axial Isotropy	4.70	R	1.732	0.707	0.707	1.92	1.92
Hemispherical Isotropy	9.60	R	1.732	0.707	0.707	3.92	3.92
Boundary Effects	1.00	R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

<table>
<tr><td colspan="2">802.11ag / Draft 802.11n WLAN PCI-E MINI CARD
(Tested inside of Dell PP15S)</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 PP15S</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*</td><td rowspan="2">GALTRONICS</td><td rowspan="2">PIFA</td><td>06-7015-03 (MAIN)</td></tr>
<tr><td>06-7016-03 (AUX)</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">GALTRONICS</td><td rowspan="2">PIFA</td><td>06-7015-03 (MAIN)</td></tr>
<tr><td>06-7016-03 (AUX)</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">GALTRONICS</td><td rowspan="2">PIFA</td><td>06-7018-03 (MAIN)</td></tr>
<tr><td>06-7031-03 (AUX)</td></tr>
<tr><td rowspan="2">4*</td><td rowspan="2">Tyco Electronics</td><td rowspan="2">PIFA</td><td>2023987-1(TX1)</td></tr>
<tr><td>2023987-1(TX2)</td></tr>
<tr><td rowspan="2">5</td><td rowspan="2">Tyco Electronics</td><td rowspan="2">PIFA</td><td>2023987-1(TX1)</td></tr>
<tr><td>2023986-1(TX2)</td></tr>
<tr><td rowspan="2">6</td><td rowspan="2">Tyco Electronics</td><td rowspan="2">PIFA</td><td>2023989-1(TX1)</td></tr>
<tr><td>2023988-1(TX2)</td></tr>
</table>
*: Antenna under testing.</td></tr>
<tr><td>Power supply:</td><td>Power supplied through laptop computer (host device)</td></tr>
</table>

7 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.

7.1 COMPOSITION OF INGREDIENTS FOR TISSUE SIMULATING LIQUIDS

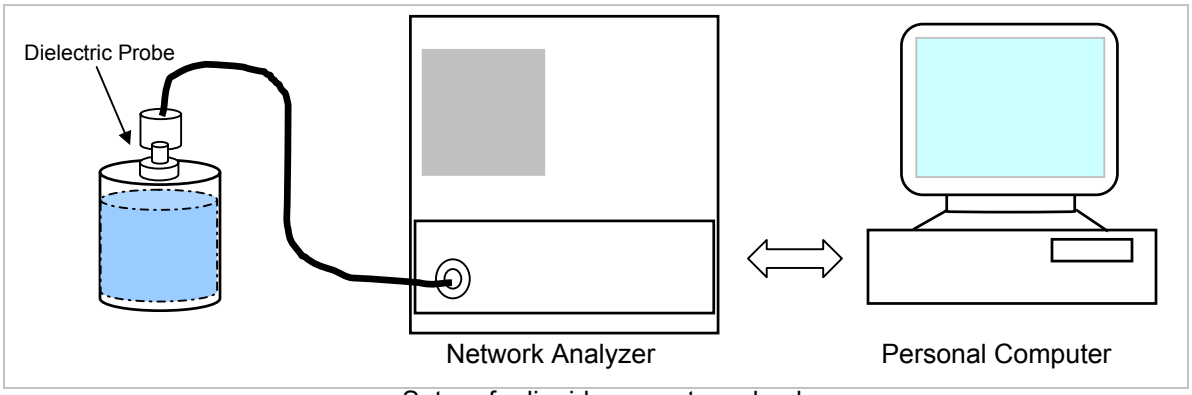
The following tissue formulations are provided for reference only as some of the parameters have not been thoroughly verified. The composition of ingredients may be modified accordingly to achieve the desired target tissue parameters required for routine SAR evaluation.

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

8 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)

8.1 SIMULATING LIQUID PARAMETER CHECK RESULT

Simulating Liquid Dielectric Parameter Check Result @ Muscle 2450 MHz

Room Ambient Temperature = 25°C; Relative humidity = 37% Measured by: Carol Baumann

Simulating Liquid			Parameters			Measured	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)							
2450	24	15	e'	52.4045	Relative Permittivity (ϵ_r):	52.4045	52.7	-0.56	± 5
			e"	14.2671	Conductivity (σ):	1.94456	1.95	-0.28	± 5

Liquid Check
Ambient temperature: 26 deg. C; Liquid temperature: 24 deg. C
August 07, 2008 08:26 AM

Frequency	e'	e"
2400000000.	52.5557	14.1747
2405000000.	52.6511	14.2074
2410000000.	52.4050	14.1236
2415000000.	52.5207	14.2249
2420000000.	52.4273	14.1984
2425000000.	52.4001	14.2317
2430000000.	52.3196	14.1818
2435000000.	52.3857	14.2517
2440000000.	52.3906	14.3094
2445000000.	52.4327	14.2654
2450000000.	**52.4045**	**14.2671**
2455000000.	52.3201	14.2958
2460000000.	52.3579	14.4180
2465000000.	52.3341	14.3989
2470000000.	52.3171	14.3903
2475000000.	52.2402	14.4527
2480000000.	52.2305	14.5076
2485000000.	52.2532	14.4818
2490000000.	52.1483	14.5133
2495000000.	52.2120	14.5411
2500000000.	52.1665	14.5677

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 = 40% Measured by: Carol Baumann

Simulating Liquid			Parameters			Measured	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)							
5200	24	15	e'	44.7607	Relative Permittivity (ϵ_r):	44.7607	49.0	-8.65	± 10
			e"	18.2953	Conductivity (σ):	5.29251	5.30	-0.14	± 5
5500	24	15	e'	44.0985	Relative Permittivity (ϵ_r):	44.0985	48.6	-9.26	± 10
			e"	18.6378	Conductivity (σ):	5.70265	5.65	0.93	± 5
5800	24	15	e'	43.6535	Relative Permittivity (ϵ_r):	43.6535	48.2	-9.43	± 10
			e"	18.8947	Conductivity (σ):	6.09659	6.00	1.61	± 5

Liquid Check
Ambient temperature: 25 deg. C; Liquid temperature: 24 deg. C
August 08, 2008 07:58 PM

Frequency	e'	e"
4600000000.	45.9358	17.5483
4650000000.	45.8430	17.6083
4700000000.	45.7514	17.6778
4750000000.	45.6429	17.7534
4800000000.	45.5752	17.8098
4850000000.	45.4707	17.8673
4900000000.	45.3598	17.9537
4950000000.	45.2466	17.9987
5000000000.	45.1777	18.0715
5050000000.	45.0843	18.1290
5100000000.	44.9830	18.1883
5150000000.	44.8874	18.2193
5200000000.	**44.7607**	**18.2953**
5250000000.	44.6916	18.3429
5300000000.	44.5846	18.4113
5350000000.	44.4934	18.4583
5400000000.	44.3969	18.5023
5450000000.	44.2962	18.5564
5500000000.	44.1973	18.5925
5550000000.	**44.0985**	**18.6378**
5600000000.	44.0398	18.7023
5650000000.	43.9038	18.7524
5700000000.	43.8421	18.7987
5750000000.	43.7185	18.8239
5800000000.	**43.6535**	**18.8947**
5850000000.	43.5175	18.9222
5900000000.	43.4644	19.0036
5950000000.	43.3678	19.0260
6000000000.	43.2753	19.0948

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 = 40% Measured by: Carol Baumann

Simulating Liquid			Parameters			Measured	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)							
5200	24	15	e'	45.5212	Relative Permittivity (ϵ_r):	45.5212	49.0	-7.10	± 10
			e"	18.3784	Conductivity (σ):	5.31655	5.30	0.31	± 5
5500	24	15	e'	44.9883	Relative Permittivity (ϵ_r):	44.9883	48.6	-7.43	± 10
			e"	18.6439	Conductivity (σ):	5.70451	5.65	0.96	± 5
5800	24	15	e'	44.4311	Relative Permittivity (ϵ_r):	44.4311	48.2	-7.82	± 10
			e"	18.9676	Conductivity (σ):	6.12011	6.00	2.00	± 5

Liquid Check
Ambient temperature: 25 deg. C; Liquid temperature: 24 deg. C
August 11, 2008 08:14 AM

Frequency	e'	e"
4600000000.	46.7003	17.5888
4650000000.	46.6133	17.6626
4700000000.	46.5289	17.7122
4750000000.	46.4269	17.7937
4800000000.	46.3529	17.8644
4850000000.	46.2355	17.9205
4900000000.	46.1492	18.0027
4950000000.	46.0554	18.0611
5000000000.	45.9755	18.1285
5050000000.	45.8675	18.1675
5100000000.	45.7659	18.2565
5150000000.	45.6639	18.2858
5200000000.	**45.5212**	**18.3784**
5250000000.	45.4651	18.4072
5300000000.	45.3458	18.4569
5350000000.	45.2578	18.5112
5400000000.	45.1757	18.5692
5450000000.	45.0770	18.6266
5500000000.	**44.9883**	**18.6439**
5550000000.	44.8681	18.7156
5600000000.	44.8071	18.7543
5650000000.	44.7020	18.8245
5700000000.	44.6400	18.8539
5750000000.	44.4931	18.8786
5800000000.	**44.4311**	**18.9676**
5850000000.	44.2979	18.9908
5900000000.	44.2537	19.0573
5950000000.	44.1156	19.0744
6000000000.	44.0417	19.1582

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 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.

9.1 SYSTEM PERFORMANCE CHECK RESULTS

System Validation Dipole: D2450V2 SN: 748

The dipole input power (forward power): 250 mW

Results

Date: August 7, 2008

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)					
2450	24	15	1g	48.2	51.2	-5.86	± 10
			10g	22.7	23.7	-4.22	± 10

System Validation Dipole: D5GHzV2 SN: 1003

Date: August 8, 2008

Ambient Temperature = 25°C; Relative humidity = 40% 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	75.3	71.8	4.87	± 10
			10g	21.6	20.1	7.46	± 10

Body Simulating Liquid			SAR (mW/g)	Normalized to 1 W	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)					
5500	24	15	1g	79.2	79.1	0.13	± 10
			10g	22.6	22.0	2.73	± 10

Body Simulating Liquid			SAR (mW/g)	Normalized to 1 W	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)					
5800	24	15	1g	78.3	74.1	5.67	± 10
			10g	22.4	20.5	9.27	± 10

System Validation Dipole: D5GHzV2 SN: 1003

Date: August 11, 2008

Ambient Temperature = 25°C; Relative humidity = 40% 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	75.7	71.8	5.43	± 10
			10g	21.9	20.1	8.96	± 10

Body Simulating Liquid			SAR (mW/g)	Normalized to 1 W	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)					
5500	24	15	1g	83.6	79.1	5.69	± 10
			10g	23.9	22.0	8.64	± 10

Body Simulating Liquid			SAR (mW/g)	Normalized to 1 W	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)					
5800	24	15	1g	77.4	74.1	4.45	± 10
			10g	21.8	20.5	6.34	± 10

10 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.

11 SAR TEST RESULTS

11.1 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)**	**Aux**	**0.060**	1.6
802.11g	6	2437 (M)	Aux	0.055	1.6

Galtronics Antenna					
Mode	Channel	f (MHz)	Antenna	Measured SAR 1g (mW/g)	Limit
802.11b	6	2437 (M)	Aux	0.026	1.6
802.11g	6	2437 (M)	Aux	0.020	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.

The Highest SAR Plot & Data for 2.4 GHz Band

Date/Time: 8/7/2008 2:54:56 PM

Test Laboratory: Compliance Certification Services

Lapheld Position Tyco Antenna

DUT: Dell ; Type: PP15S; Serial: N/A

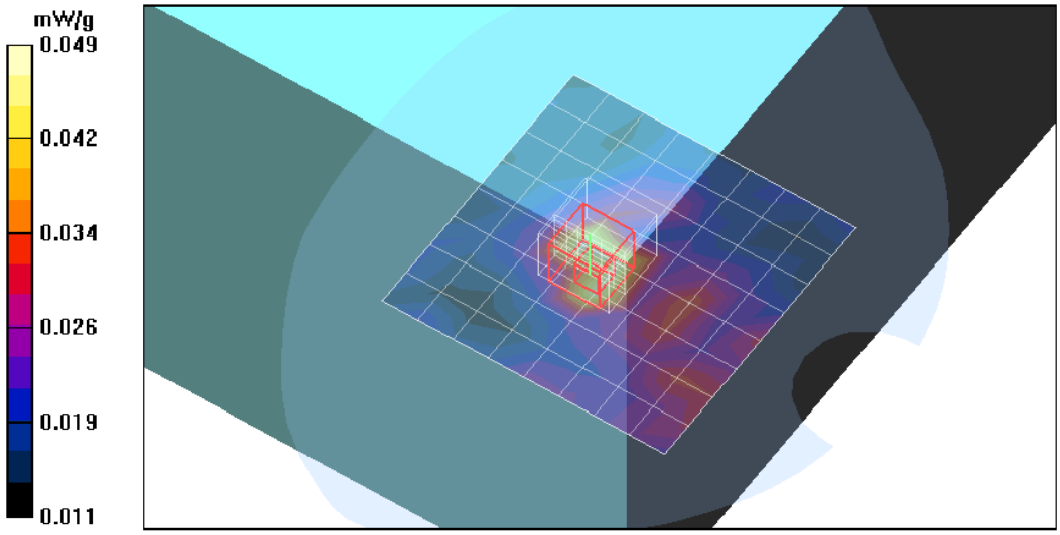
Communication System: 802.11bg; Frequency: 2437 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 2437 MHz; σ = 1.94 mho/m; ε_r = 52.4; ρ = 1000 kg/m^3
Phantom section: Flat Section

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 Sn500; Calibrated: 11/16/2007
- Phantom: SAM 2; Type: SAM 2; Serial: 1050
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

802.11b M-ch Tyco Aux Antenna/Area Scan (9x9x1): Measurement grid: dx=15mm, dy=15mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.049 mW/g

802.11b M-ch Tyco Aux Antenna/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=3mm
Reference Value = 3.86 V/m; Power Drift = 1.07 dB
Peak SAR (extrapolated) = 0.126 W/kg
SAR(1 g) = 0.060 mW/g; SAR(10 g) = 0.034 mW/g
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.080 mW/g



11.2 SAR TEST RESULT FOR THE BAND 5.15- 5.25 GHz

Tyco Antenna					
Mode	Channel	f (MHz)	Antenna	Measured SAR 1g (mW/g)	Limit
802.11a	**40**	**5200 (M)**	**Aux**	**0.058**	1.6
802.11n 40 MHz	46	5230 (H)	Aux	0.043	1.6

Spot test worst-case mode based on Tyco antenna above.

Galtronics Antenna					
Mode	Channel	f (MHz)	Antenna	Measured SAR 1g (mW/g)	Limit
802.11a	40	5200 (M)	Aux	0.030	1.6
802.11n 40 MHz	46	5230 (H)	Aux		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.

The Highest SAR Plot & Data for 5.2 GHz Band

Date/Time: 8/9/2008 11:15:16 AM

Test Laboratory: Compliance Certification Services

Lapheld Position 5.2 GHz Band Tyco Antenna

DUT: Dell ; Type: PP15S; Serial: N/A

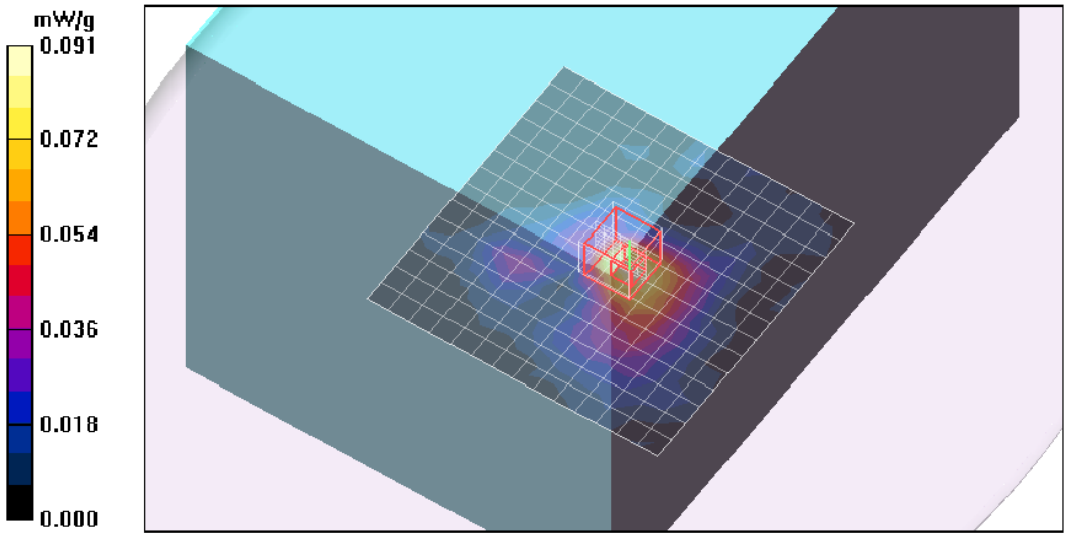
Communication System: 802.11an; Frequency: 5200 MHz;Duty Cycle: 1:1
Medium parameters used: f = 5200 MHz; σ = 5.29 mho/m; ε_r = 44.8; ρ = 1000 kg/m^3
Phantom section: Flat Section

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(4.21, 4.21, 4.21); Calibrated: 4/23/2008
- Sensor-Surface: 2.5mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn500; Calibrated: 11/16/2007
- Phantom: Flat Phantom ELI4.0; Type: QDOVA001BA; Serial: SN:XXXX
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

802.11a M-ch Tyco Antenna/Area Scan (15x15x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 0.091 mW/g

802.11a M-ch Tyco Antenna/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 4.18 V/m; Power Drift = -0.034 dB
Peak SAR (extrapolated) = 0.197 W/kg
SAR(1 g) = 0.058 mW/g; SAR(10 g) = 0.023 mW/g
Maximum value of SAR (measured) = 0.095 mW/g



11.3 SAR TEST RESULT FOR THE BAND 5.25–5.35 GHz

Tyco Antenna					
Mode	Channel	f (MHz)	Antenna	Measured SAR 1g (mW/g)	Limit
802.11a	**60**	**5300 (M)**	**Aux**	**0.178**	1.6
802.11n 40 MHz	54	5270 (L)	Aux	0.103	1.6

Spot test worst-case mode based on Tyco antenna above.

Galtronics Antenna					
Mode	Channel	f (MHz)	Antenna	Measured SAR 1g (mW/g)	Limit
802.11a	60	5300 (M)	Aux	0.040	1.6
802.11n 40 MHz	54	5270 (L)	Aux		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.

The Highest SAR Plot & Data for 5.3 GHz Band

Date/Time: 8/9/2008 12:53:00 PM

Test Laboratory: Compliance Certification Services

Lapheld Position 5.3 GHz Band Tyco Antenna

DUT: Dell ; Type: PP15S; Serial: N/A

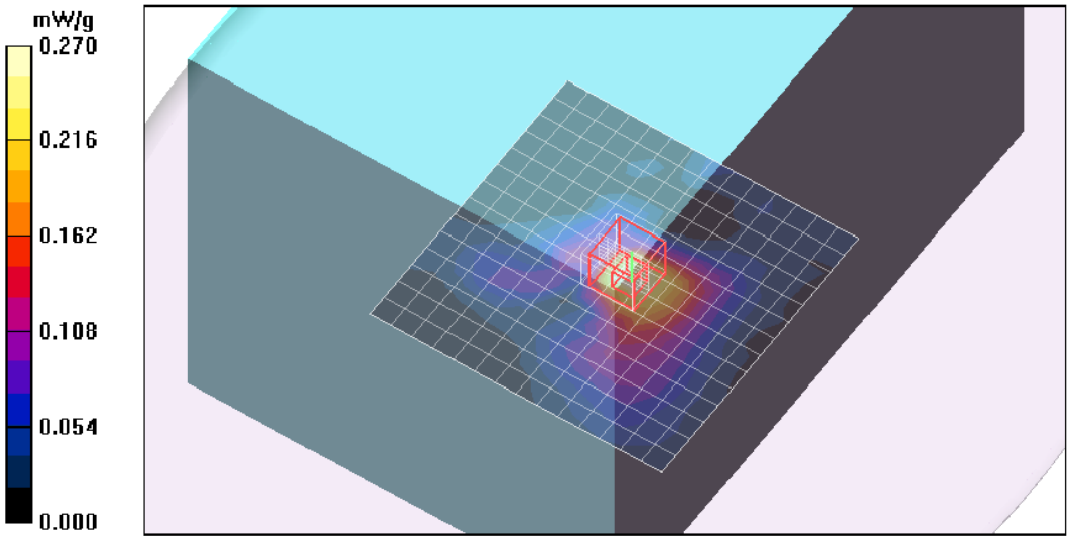
Communication System: 802.11an; Frequency: 5300 MHz;Duty Cycle: 1:1
Medium parameters used: f = 5300 MHz; σ = 5.43 mho/m; ε_r = 44.6; ρ = 1000 kg/m^3
Phantom section: Flat Section

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(3.92, 3.92, 3.92); Calibrated: 4/23/2008
- Sensor-Surface: 2.5mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn500; Calibrated: 11/16/2007
- Phantom: Flat Phantom ELI4.0; Type: QDOVA001BA; Serial: SN:XXXX
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

802.11a M-ch Tyco Antenna/Area Scan (15x15x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 0.270 mW/g

802.11a M-ch Tyco Antenna/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 7.25 V/m; Power Drift = -0.159 dB
Peak SAR (extrapolated) = 0.577 W/kg
SAR(1 g) = 0.178 mW/g; SAR(10 g) = 0.075 mW/g
Maximum value of SAR (measured) = 0.273 mW/g



11.4 SAR TEST RESULT FOR THE BAND 5.47–5.725 GHz

Tyco Antenna					
Mode	Channel	f (MHz)	Antenna	Measured SAR 1g (mW/g)	Limit
802.11a	140	5700 (H)	Aux	0.041	1.6
802.11n 40 MHz	**118**	**5590 (M)**	**Aux**	**0.065**	1.6

Spot test worst-case mode based on Tyco antenna above.

Galtronics Antenna					
Mode	Channel	f (MHz)	Antenna	Measured SAR 1g (mW/g)	Limit
802.11a	140	5700 (H)	Aux		1.6
802.11n 40 MHz	118	5590 (M)	Aux	0.053	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.

The Highest SAR Plot & Data for 5.5 GHz Band

Date/Time: 8/9/2008 5:35:19 PM

Test Laboratory: Compliance Certification Services

Lapheld Position 5.5 GHz Band Tyco Antenna

DUT: Dell ; Type: PP15S; Serial: N/A

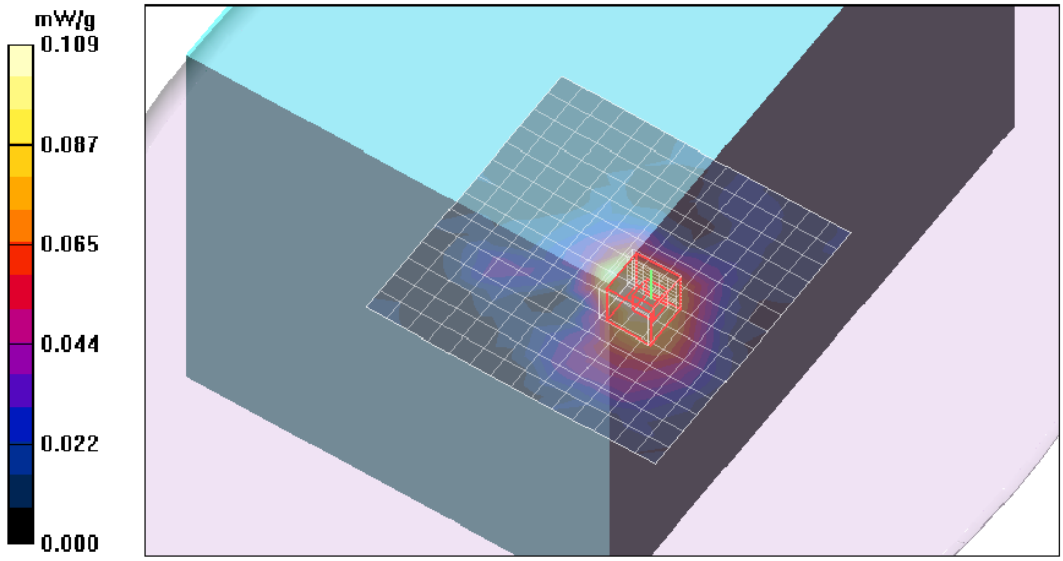
Communication System: 802.11an; Frequency: 5590 MHz;Duty Cycle: 1:1
Medium parameters used: f = 5590 MHz; σ = 5.81 mho/m; ε_r = 44.1; ρ = 1000 kg/m^3
Phantom section: Flat Section

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(3.5, 3.5, 3.5); Calibrated: 4/23/2008
- Sensor-Surface: 2.5mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn500; Calibrated: 11/16/2007
- Phantom: Flat Phantom ELI4.0; Type: QDOVA001BA; Serial: SN:XXXX
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

802.11n 40 MHz M-ch Tyco Antenna/Area Scan (15x15x1): Measurement grid: dx=10mm, dy=10mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.109 mW/g

802.11n 40 MHz M-ch Tyco Antenna/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 4.43 V/m; Power Drift = -0.101 dB
Peak SAR (extrapolated) = 0.357 W/kg
SAR(1 g) = 0.065 mW/g; SAR(10 g) = 0.023 mW/g
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.108 mW/g



11.5 SAR TEST RESULT FOR THE BAND 5.725-5.850 GHz

Tyco Antenna					
Mode	Channel	f (MHz)	Antenna	Measured SAR 1g (mW/g)	Limit
802.11a	157	5785 (M)	Aux	0.074	1.6
802.11n 40 MHz	**159**	**5795 (H)**	**Aux**	**0.084**	1.6

Spot test worst-case mode based on Tyco antenna above.

Galtronics Antenna					
Mode	Channel	f (MHz)	Antenna	Measured SAR 1g (mW/g)	Limit
802.11a	157	5785 (M)	Aux		1.6
802.11n 40 MHz	159	5795 (H)	Aux	0.071	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.

The Highest SAR Plot & Data for 5.8 GHz Band

Date/Time: 8/11/2008 6:32:11 PM

Test Laboratory: Compliance Certification Services

Lapheld Position 5.8 GHz Band Tyco Antenna

DUT: Dell ; Type: PP15S; Serial: N/A

Communication System: 802.11an; Frequency: 5795 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 5795 MHz; σ = 6.11 mho/m; ε_r = 44.4; ρ = 1000 kg/m^3
Phantom section: Flat Section

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

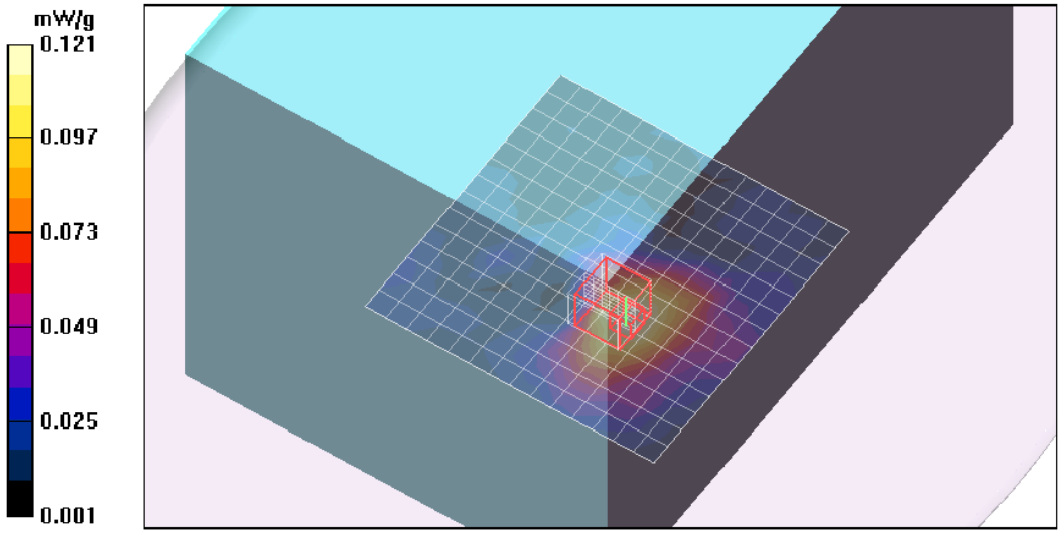
DASY4 Configuration:
- Area Scan setting - Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Probe: EX3DV3 - SN3531; ConvF(3.7, 3.7, 3.7); Calibrated: 4/23/2008
- Sensor-Surface: 2.5mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn500; Calibrated: 11/16/2007
- Phantom: Flat Phantom ELI4.0; Type: QDOVA001BA; Serial: SN:XXXX
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

802.11n 40 MHz H-ch Tyco Antenna/Area Scan (15x15x1): Measurement grid: dx=10mm, dy=10mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.121 mW/g

802.11n 40 MHz H-ch Tyco Antenna/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm

Reference Value = 4.03 V/m; Power Drift = -1.08 dB
Peak SAR (extrapolated) = 0.328 W/kg
SAR(1 g) = 0.084 mW/g; SAR(10 g) = 0.035 mW/g
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.130 mW/g



12 ATTACHMENTS

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2-2	SAR Test Plots for 5 GHz Band	15
3	Certificate of E-Field Probe - EX3DV3SN3531	10
4	Certificate of System Validation Dipole - D2450V2 SN:748	6