FCC OET BULLETIN 65 SUPPLEMENT C
CLASS II PERMISSIVE CHANGE
IC RSS-102 ISSUE 3

SAR EVALUATION REPORT

FOR
802.11g / Draft 802.11n WLAN + BLUETOOTH PCI-E MINI CARD
(Tested inside of HP Notebook PC, HSTNN-I82C)

MODEL: BCM94312HMGB

FCC ID: QDS-BRCM1044

REPORT NUMBER: 10U13028-2, Revision A

ISSUE DATE: January 27, 2010

Prepared for

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Prepared by

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NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
--	January 26, 2010	Initial Issue	--
A	January 27, 2010	Removed IC ID from report.	Aliza Zaffar

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME:	BROADCOM CORPORATION 190 MATHILDA PLACE SUNNYVALE, CA 94086
EUT DESCRIPTION:	802.11g / Draft 802.11n WLAN + BLUETOOTH PCI-E MINICARD (Tested inside of HP Notebook PC, HSTNN-I82C)
MODEL NUMBER:	BCM94312HMGB
DEVICE CATEGORY:	Portable
EXPOSURE CATEGORY:	General Population/Uncontrolled Exposure
DATE TESTED:	January 19, 2010

THE HIGHEST SAR VALUES:

FCC/IC Rule Parts	Frequency Range [MHz]	1g SAR (mW/g)	Limit (mW/g)
15.247 / RSS-102	2400 – 2483.5	1.38 mW/g (Secondary Portrait)	1.6

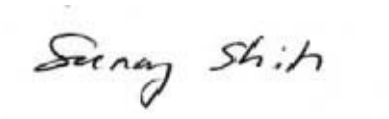
APPLICABLE STANDARDS:

STANDARD	TEST RESULTS
FCC OET BULLETIN 65 SUPPLEMENT C and the following specific 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, KDB 616217 D03 SAR Supp Note and Netbook Laptop v01 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	9	3	2011
ESG Vector Signal Generator	Agilent	E4438C	US44271090	9	17	2010
Amplifier	Mini-Circuits	ZVE-8G	90606	N/A		
Amplifier	Mini-Circuits	ZHL-42W	D072701-5	N/A		
Simulating Liquid	SPAEG	H2450	N/A	Within 24 hrs of first test		
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

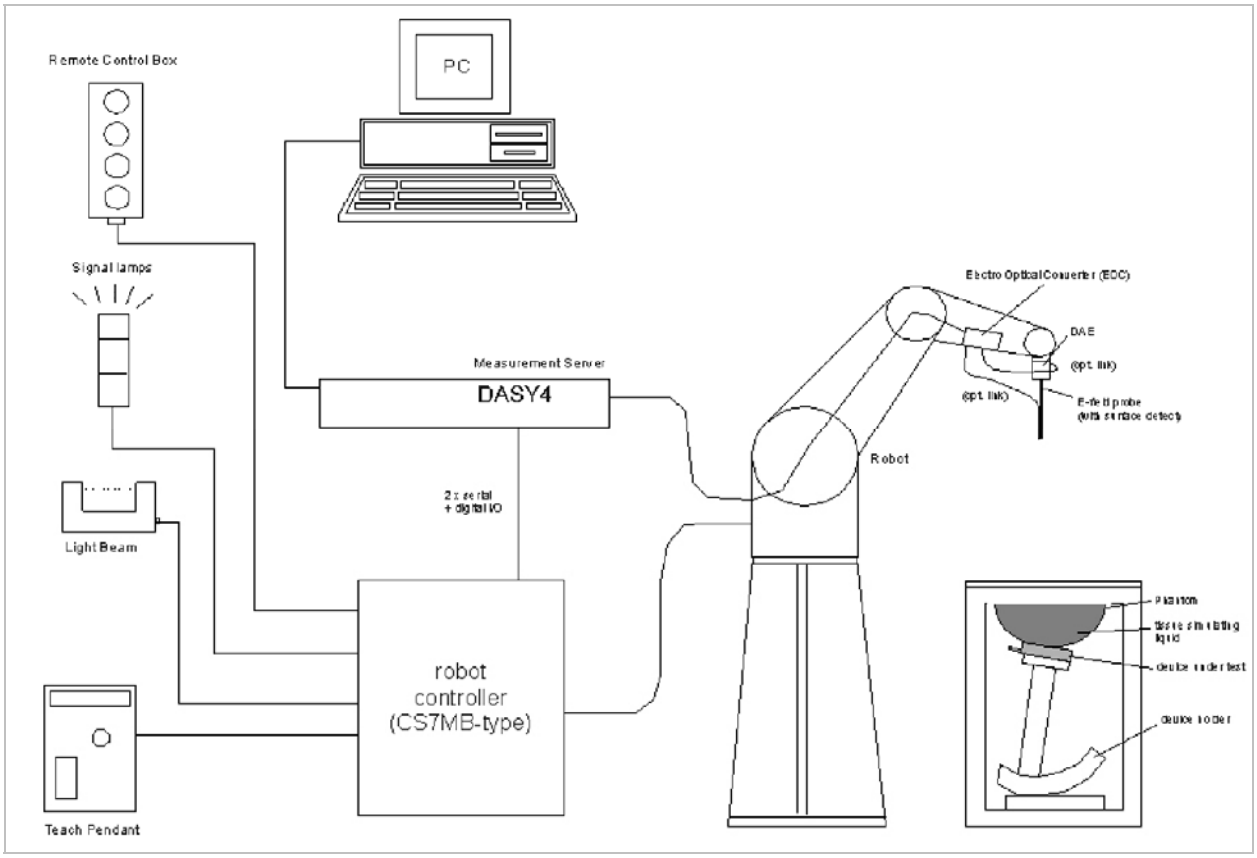
Uncertainty component	Tol. (±%)	Probe Dist.	Div.	Ci (1g)	Ci (10g)	Std. Unc.(±%)	
						Ui (1g)	Ui(10g)
Measurement System							
Probe Calibration	4.80	N	1	1	1	4.80	4.80
Axial Isotropy	4.70	R	1.732	0.707	0.707	1.92	1.92
Hemispherical Isotropy	9.60	R	1.732	0.707	0.707	3.92	3.92
Boundary Effects	1.00	R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

5. EQUIPMENT UNDER TEST

802.11g / Draft 802.11n WLAN + BLUETOOTH PCI-E MINICARD (Tested inside of HP Notebook PC, HSTNN-I82C)	
Normal operation:	Tablet bottom face, and Tablet edges - Multiple display orientations supporting both portrait and landscape configurations
Antenna tested:	Install in Host device / Manufactured / Model Number HSTNN-I82C / Ethertronics Inc / Main: 6036B0067603 Aux: 6036B0067403
Antenna-to-user separation distances:	Tablet – Bottom face • Lap-held: 1.5 cm from Main/Aux antenna-to-user Tablet – Edges • Primary landscape: 3.0 cm from Main antenna-to-user • Secondary landscape: **Disabled** by software • Primary Portrait: **Disabled** by software • Secondary Portrait: 0.35 cm from Main antenna-to-user
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 Body 2450 MHz

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

f (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit (%)
2450	e'	54.09	Relative Permittivity (ϵ_r):	54.088	52.7	2.63	± 5
	e"	14.02	Conductivity (σ):	1.910	1.95	-2.04	± 5

Liquid Check
Ambient temperature: 24 deg. C; Liquid temperature: 23 deg. C
January 19, 2010 7:38 AM

Frequency	e'	e"
2400000000.	55.3348	14.4127
2405000000.	55.3816	14.3750
2410000000.	55.3448	14.3507
2415000000.	55.2773	14.2952
2420000000.	55.1736	14.2253
2425000000.	55.0202	14.1519
2430000000.	54.8380	14.0750
2435000000.	54.6467	14.0204
2440000000.	54.4568	14.0013
2445000000.	54.2801	13.9970
2450000000.	**54.0875**	**14.0155**
2455000000.	53.9106	14.0650
2460000000.	53.7941	14.1118
2465000000.	53.7269	14.1710
2470000000.	53.7035	14.2503
2475000000.	53.7282	14.3354
2480000000.	53.8243	14.4225
2485000000.	53.9660	14.5271
2490000000.	54.1378	14.6549
2495000000.	54.3111	14.7854
2500000000.	54.4886	14.8941

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

9.1. SYSTEM CHECK RESULTS FOR D2450V2

System Validation Dipole: D2450V2 SN: 748

Date: January 19, 2009

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

Medium	CW Signal (MHz)	Forward power (mW)	Measured (Normalized to 1 W)		Target	Delta (%)	Tolerance (%)
Body	2450	100	1g SAR:	50.2	49.5	1.41	±10
			10g SAR:	23	23.3	-1.29	

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 04/06/2009 original filing.

Before SAR evaluation, CCS has verified the RF conducted average power which is in a agreement with previous reported average output power.

11. SUMMARY OF TEST RESULTS

1. Tablet – Bottom face (1.5 cm from Main/Aux antennas-to-user)

Mode	Channel	f (MHz)	Antenna	Results (mW/g)	
				1g-SAR	10g-SAR
802.11b	1	2412	Main	0.944	0.443
	6	2437	Main	0.961	0.445
	11	2462	Main	0.954	0.441
802.11g	1	2412	Aux	0.536	0.227
	6	2437	Aux	0.854	0.377
	11	2462	Aux	0.937	0.407

Note: 802.11b doesn't operate for Aux antenna. Thus, 802.11g is performed for Aux antenna instead.

1. Table – Edges with the following configurations

According to KDB 447498 4) b) ii) (2).SAR is required only for the edge with the most conservative exposure conditions.
Based on above, the following edge configuration was chosen.

1.1 ☐ Edge - Primary Landscape (3.0 cm from WLAN Main antenna-to-user)

Skip SAR evaluation due to the most conservative configuration is Secondary Portrait

1.2 ☐ Edge - Secondary Landscape (Disabled - WLAN Aux antenna)

1.3 ☐ Edge - Primary Portrait (Disabled – 14.0 cm from Main antenna-to-user)

1.4 ☒ Edge - Secondary Portrait (0.35 cm from Main antenna-to-user)

Edge in direct contact with a flat phantom

Mode	Channel	f (MHz)	Antenna	Results (mW/g)	
				1g-SAR	10g-SAR
802.11b	1	2412	Main	1.380	0.608
	6	2437	Main	1.310	0.575
	11	2462	Main	1.280	0.565

12. SAR TEST PLOTS

Worst-Case SAR Plot

Date/Time: 1/19/2010 12:26:14 PM

Test Laboratory: Compliance Certification Services

Secondary portrait_Main Ant

DUT: HP; Type: NA; Serial: NA

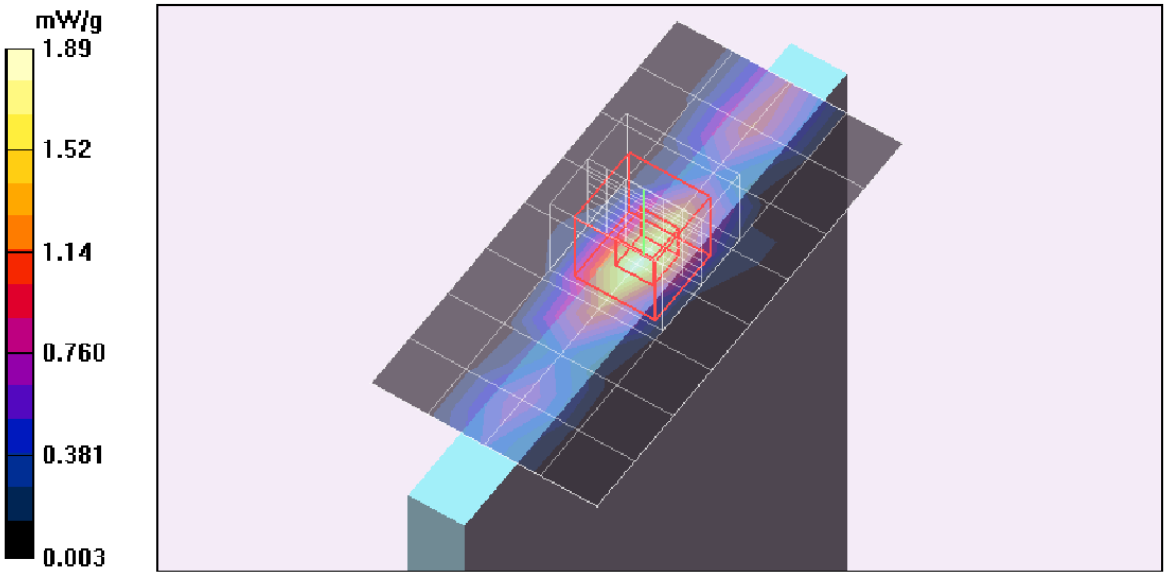
Communication System: 802.11bg; Frequency: 2412 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 2412 MHz; σ = 1.92 mho/m; ε_r = 55.3; ρ = 1000 kg/m^3
Phantom section: Flat Section

Room Ambient Temperature: 23.0 deg. C; Liquid Temperature: 22.0 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

802.11b L-ch Mian Ant/Area Scan (5x9x1): Measurement grid: dx=15mm, dy=15mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 1.89 mW/g

802.11b L-ch Mian Ant/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=3mm
Reference Value = 26.3 V/m; Power Drift = 0.812 dB
Peak SAR (extrapolated) = 3.17 W/kg
SAR(1 g) = 1.38 mW/g; SAR(10 g) = 0.608 mW/g
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 1.88 mW/g



13. ATTACHMENTS

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