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

SAR EVALUATION REPORT

For

802.11abg/Draft 802.11n WLAN + Bluetooth PCI-E MiniCard
(Tested inside of MacBook)

Model: BCM943224PCIEBT

FCC ID: QDS-BRCM1047
IC: 4324A-BRCM1047

REPORT NUMBER: 09U12800-2C

ISSUE DATE: October 19, 2009

Prepared for

BROADCOM CORPORATION
190 MATHILDA PLACE
SUNNYVALE, CA 94086

Prepared by

COMPLIANCE CERTIFICATION SERVICES
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NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
--	September 29, 2009	Initial Issue	--
A	October 2, 2009	Updated test setup photo at page 26	Chao Lin
B	October 15, 2009	Added relevant KDB at page 4 and 5 Updated test mode for 2.4GHz at page 19	Chao Lin
C	October 19, 2009	Added antenna gain and type in page9	Chao Lin

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME:	BROADCOM CORPORATION 190 MATHILDA PLACE SUNNYVALE, CA 94086
FCC ID:	QDS-BRCM1047
MODEL:	BCM943224PCIEBT
IC	4324A-BRCM1047
DEVICE CATEGORY:	Portable
EXPOSURE CATEGORY:	General Population/Uncontrolled Exposure
DATE TESTED:	September 23-26, 2009

THE HIGHEST SAR VALUES:

FCC / IC Rule Parts	Frequency Range [MHz]	The Highest SAR Values (1g_mW/g)	Limit (mW/g)
15.247 / RSS-102	2400 – 2483.5	0.0054	1.6
	5725 – 5850	0.056	
15.407 / RSS-102	5150 – 5250	0.000139	
	5250 – 5350	0.052	
	5470 – 5725	0.000195	

APPLICABLE STANDARDS AND TEST PROCEDURES:

STANDARD	TEST RESULTS
FCC OET BULLETIN 65 SUPPLEMENT C o KDB 248227 SAR measurement procedures for 802.11 a/b/g transmitters o KDB 616217 SAR evaluation considerations for laptop computers with antennas built-in on display screens	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:

CHAO YEN LIN
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 o KDB 616217 SAR evaluation considerations for laptop computers with antennas built-in display screens, o KDB 248227 SAR measurement procedures for 802.11 a/b/g transmitters and IC RSS 102 Issue 3.

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	14	2009
Signal Generator	Agilent	8753ES-6	MY40001647	11	14	2009
E-Field Probe	SPEAG	EX3DV4	3686	3	23	2010
Thermometer	ERTCO	639-1S	1718	5	1	2010
Data Acquisition Electronics	SPEAG	DAE3 V1	427	10	20	2009
System Validation Dipole	SPEAG	D835V2	4d002	4	23	2011
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	1003	11	21	2009
MXA Signal Analyzer	Agilent	N9020A	US48350984	10	23	2009
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	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

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

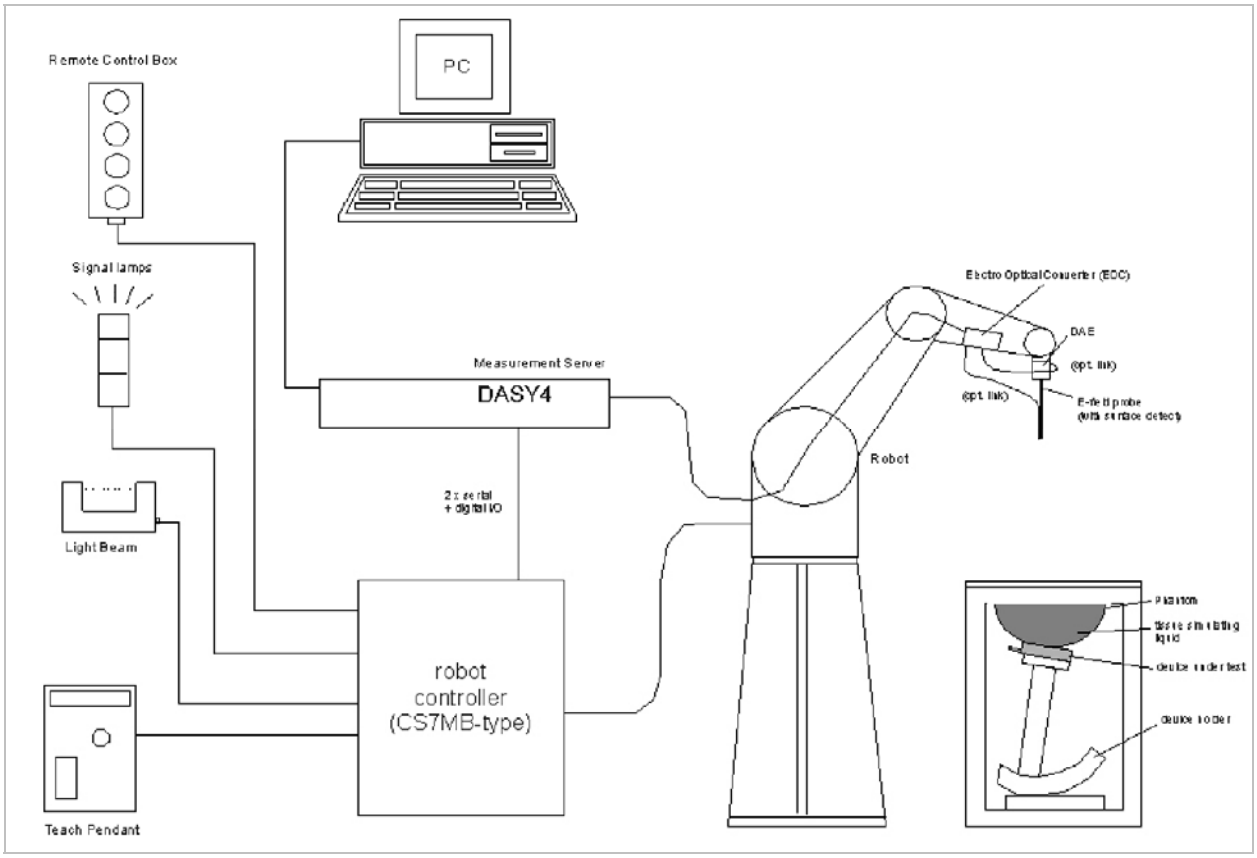
5. EQUIPMENT UNDER TEST

802.11abg/Draft 802.11n WLAN + Bluetooth PCI-E MiniCard (Tested inside of MacBook)

820.11abgn MIMO with HT20 and HT40

Normal operation:	Lap-held only Note: SAR test with display open at 90° to the keyboard
Antenna tested:	Main Antenna
Antenna Type:	PIFA. Model K84WIFI2
Antenna Gain:	2.4GHz 4.6 dBi, 5.6GHz 3.94 dBi
Antenna-to-antenna separation distance:	24.0 cm between WiFi, Main antenna and Bluetooth antenna. 22 cm between WiFi, Main antenna and Bluetooth antenna. 8.5 cm between WiFi Main antenna and WiFi Aux antenna
Antenna-to-user separation distance:	13.5 cm between WiFi, Main antenna and user. 21 cm between WiFi, Aux antenna and user. 1 cm between Bluetooth Main antenna and user
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: Chaoyen Lin

f (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit (%)
2450	e'	52.93	Relative Permittivity (ϵ_r):	52.934	52.7	0.44	± 5
	e"	13.99	Conductivity (σ):	1.907	1.95	-2.19	± 5

Liquid Temperature: 23 deg. C
September 26, 2009 4:06 PM

Frequency	e'	e"
2400000000	53.0304	13.746
2405000000	53.0183	13.8194
2410000000	53.0037	13.8846
2415000000	53.0001	13.9281
2420000000	52.9862	13.9543
2425000000	52.9816	13.9725
2430000000	52.9873	13.9658
2435000000	52.9715	13.9719
2440000000	52.9671	13.9864
2445000000	52.9381	14.0141
2450000000	**52.9342**	**13.9932**
2455000000	52.8652	13.9698
2460000000	52.8291	13.9417
2465000000	52.7653	13.9045
2470000000	52.7499	13.8569
2475000000	52.7348	13.8327
2480000000	52.7426	13.8398
2485000000	52.7358	13.8589
2490000000	52.7382	13.9162
2495000000	52.7401	13.99
2500000000	52.7352	14.0929

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 5800 MHz

Room Ambient Temperature = 25°C; Relative humidity = 38% Measured by: Chaoyen Lin

f (MHz)	Muscle Liquid Parameters			Measured	Target	Delta (%)	Limit (%)
5200	e'	47.7893	Relative Permittivity (ϵ_r):	47.7893	49.0	-2.47	± 10
	e"	17.9052	Conductivity (σ):	5.17966	5.30	-2.27	± 5
5500	e'	47.9126	Relative Permittivity (ϵ_r):	47.9126	48.6	-1.41	± 10
	e"	18.6588	Conductivity (σ):	5.70907	5.65	1.05	± 5
5800	e'	46.8128	Relative Permittivity (ϵ_r):	46.8128	48.2	-2.88	± 10
	e"	19.0694	Conductivity (σ):	6.15296	6.00	2.55	± 5

Liquid temperature: 24 deg. C
September 23, 2009 6:17 AM

Frequency	e'	e"
4600000000	49.131	17.0587
4650000000	49.1697	17.2768
4700000000	49.0162	17.1564
4750000000	48.7963	17.4133
4800000000	48.9811	17.3849
4850000000	48.5659	17.3927
4900000000	48.6974	17.736
4950000000	48.3271	17.4904
5000000000	48.2083	17.8573
5050000000	48.1967	17.7749
5100000000	47.7769	17.8607
5150000000	47.9712	17.9066
5200000000	**47.7893**	**17.9052**
5250000000	48.2733	18.4886
5300000000	48.1273	18.4793
5350000000	48.0269	18.7027
5400000000	48.0924	18.5964
5450000000	47.7683	18.7408
5500000000	**47.9126**	**18.6588**
5550000000	47.5634	18.7189
5600000000	47.5749	18.8228
5650000000	47.3424	18.8006
5700000000	47.2995	18.999
5750000000	47.3074	18.965
5800000000	**46.8128**	**19.0694**
5850000000	47.0667	19.2454
5900000000	46.8323	19.0349
5950000000	46.5167	19.2636
6000000000	46.9208	19.5076

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 5800 MHz

Room Ambient Temperature = 25°C; Relative humidity = 38% Measured by: Chaoyen Lin

f (MHz)	Muscle Liquid Parameters			Measured	Target	Delta (%)	Limit (%)
5200	e'	51.2024	Relative Permittivity (ϵ_r):	51.2024	49.0	4.49	± 10
	e"	17.8970	Conductivity (σ):	5.17729	5.30	-2.32	± 5
5500	e'	50.6559	Relative Permittivity (ϵ_r):	50.6559	48.6	4.23	± 10
	e"	17.9296	Conductivity (σ):	5.48596	5.65	-2.90	± 5
5800	e'	49.9174	Relative Permittivity (ϵ_r):	49.9174	48.2	3.56	± 10
	e"	18.7403	Conductivity (σ):	6.04677	6.00	0.78	± 5

Liquid Check
Ambient temperature: 25 deg. C; Liquid temperature: 24 deg. C
September 24, 2009 09:18 AM

Frequency	e'	e"
4600000000.	51.9653	17.2000
4650000000.	52.0668	16.9994
4700000000.	51.7618	17.2160
4750000000.	52.1721	17.3383
4800000000.	51.7412	17.1037
4850000000.	51.9391	17.5806
4900000000.	51.7445	17.3599
4950000000.	51.2309	17.6697
5000000000.	51.6711	17.5404
5050000000.	50.8939	17.6546
5100000000.	51.3197	17.7249
5150000000.	50.8016	17.3943
5200000000.	**51.2024**	**17.8970**
5250000000.	51.3458	17.6312
5300000000.	50.7723	18.0676
5350000000.	51.4286	18.0946
5400000000.	50.5722	17.9668
5450000000.	51.0298	18.3594
5500000000.	**50.6559**	**17.9296**
5550000000.	50.3618	18.2137
5600000000.	50.6874	18.1541
5650000000.	50.1855	18.1523
5700000000.	50.6129	18.7707
5750000000.	50.3725	18.2041
5800000000.	**49.9174**	**18.7403**
5850000000.	50.8449	18.8086
5900000000.	50.0771	18.5482
5950000000.	50.1817	19.0801
6000000000.	50.3573	19.0737

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 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 Head or Body simulating liquid of the following parameters.
- The DASY4 system with an Isotropic E-Field Probe EX3DV3 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 fine cube was chosen for cube
- Distance between probe sensors and phantom surface was set to 3 mm.
  For 5 GHz band - Distance between probe sensors and phantom surface was set to 2.5 mm
- The dipole input power (forward power) was 250 mW±3%.
- The results are normalized to 1 W input power

Reference SAR Values for HEAD & BODY-tissue from calibration certificate of SPEAG. Certificate no: D5GHzV2-1003_Nov07 and D2450V2-748_Apr08

f (MHz)	Head Tissue		Body Tissue	
	SAR_{1g}	SAR_{10g}	SAR_{1g}	SAR_{10g}
2450			49.5	23.3
5200	78.6	22.1	74.7	21.1
5500	80.4	22.7	80.1	22.5
5800	79.9	22.4	70.8	19.8

9.1. SYSTEM CHECK RESULTS FOR D2450V2

System Validation Dipole: D2450V2 SN: 748

Date: September 26, 2009

Ambient Temperature = 24°C; Relative humidity = 40% Measured by: Chaoyen Lin

Medium	CW Signal (MHz)	Forward power (mW)	Measured (Normalized to 1 W)		Target	Delta (%)	Tolerance (%)
Body	2450	250	1g SAR:	53.8	49.5	8.69	±10
			10g SAR:	25.3	23.3	8.58	

9.2. SYSTEM CHECK RESULTS FOR D5GHzV2

System Validation Dipole: D5GHzV2 SN 1003

Date: September 23, 2009

Ambient Temperature = 25°C; Relative humidity = 40% Measured by: Chaoyen Lin

Medium	CW Signal (MHz)	Forward power (mW)	Measured (Normalized to 1 W)		Target	Delta (%)	Tolerance (%)
Muscle	5200	250	1g SAR:	77.9	74.7	4.28	±10
			10g SAR:	22.5	21.1	6.64	
Muscle	5500	250	1g SAR:	78.6	80.1	-1.87	±10
			10g SAR:	22.1	22.5	-1.78	
Muscle	5800	250	1g SAR:	71.5	70.8	0.99	±10
			10g SAR:	20.2	19.8	2.02	

Date: September 24, 2009

Ambient Temperature = 25°C; Relative humidity = 40% Measured by: Chaoyen Lin

Medium	CW Signal (MHz)	Forward power (mW)	Measured (Normalized to 1 W)		Target	Delta (%)	Tolerance (%)
Muscle	5200	250	1g SAR:	78.3	74.7	4.82	±10
			10g SAR:	22.2	21.1	5.21	
Muscle	5500	250	1g SAR:	76.6	80.1	-4.37	±10
			10g SAR:	21.6	22.5	-4.00	
Muscle	5800	250	1g SAR:	67.6	70.8	-4.52	±10
			10g SAR:	19.2	19.8	-3.03	

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:

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

11. SUMMARY OF TEST RESULTS

If the SAR measured at the middle channel for each test configuration is at least 3.0 dB (0.8 mW/g) lower than the SAR limit (1.6 mW/g), testing at the high and low channels is optional for such test configuration(s).

11.1. SAR TEST RESULT FOR THE 2.4 GHZ BAND

Mode	Channel	Antenna	f (MHz)	Measured SAR 1g (mW/g)	Limit
802.11b	6	Main	2437	0.0054	1.6

11.2. 11.2. SAR TEST RESULT FOR THE 5 GHZ BANDS

Mode	Channel	Antenna	f (MHz)	Measured SAR 1g (mW/g)	Limit
802.11a	36	Main	5180	0.000139	1.6
802.11a	56	Main	5280	0.052000	
802.11a	120	Main	5600	0.000195	
802.11a	157	Main	5785	0.056000	

Note1: Aux antenna is more than 20 (cm) from user body, SAR test is not required for Aux antenna.

Note2: Since bluetooth output power is less than $60/f_{(GHz)}$, bluetooth individual SAR is not required. Distances between Bluetooth antenna to WiFi main and WiFi aux antennas are both more than 5 cm, and thus bluetooth is not required for simultaneous transmitting test.

12. WORST-CASE SAR TEST PLOTS

WORST-CASE SAR PLOT for 2.4 GHz Band

Date/Time: 9/26/2009 8:46:13 PM

Test Laboratory: Compliance Certification Services

802.11bgn for Lapheld

DUT: NA; Type: NA; Serial: NA

Communication System: 802.11bgn; Frequency: 2437 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 2437 MHz; σ = 1.9 mho/m; ε_r = 53; ρ = 1000 kg/m^3
Phantom section: Flat Section

Room Ambient Temperature: 24.0 deg. C; Liquid Temperature: 23.0 deg. C

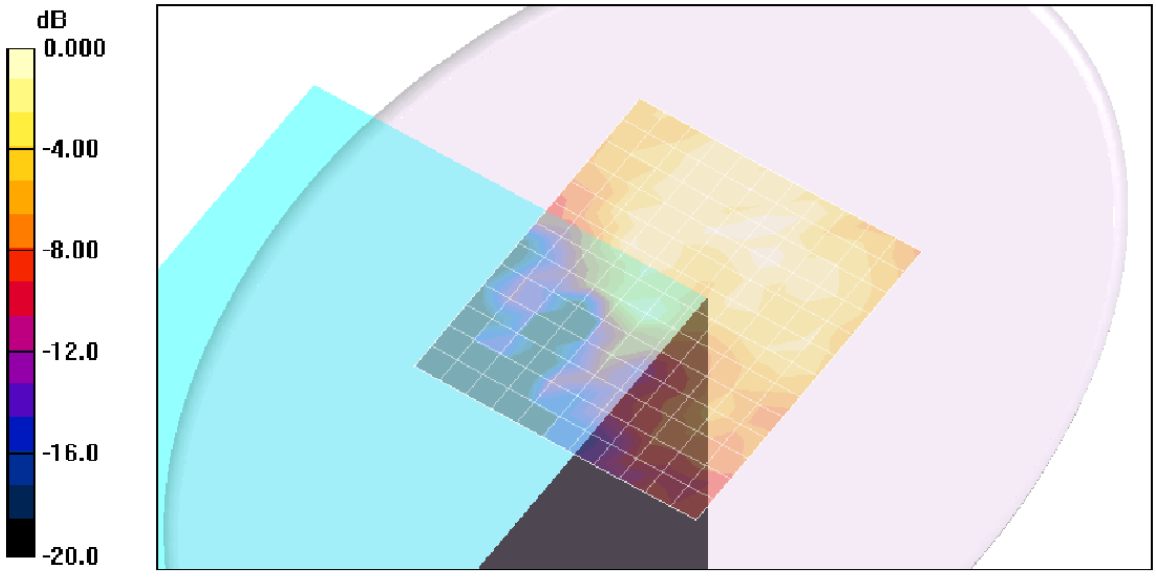
DASY4 Configuration:
- Area Scan setting - Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Probe: EX3DV4 - SN3686; ConvF(6.48, 6.48, 6.48); Calibrated: 3/23/2009
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 10/20/2008
- Phantom: Flat Phantom ELI4.0; Type: QDOVA001BA; Serial: SN:1003
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Lapheld, 802.11b M-ch_Main Antenna/Area Scan (12x14x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (measured) = 0.017 mW/g

Lapheld, 802.11b M-ch_Main Antenna/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=3mm
Reference Value = 0.938 V/m; Power Drift = -2.49 dB
Peak SAR (extrapolated) = 0.062 W/kg
SAR(1 g) = 0.00543 mW/g; SAR(10 g) = 0.00071 mW/g

Maximum value of SAR (measured) = 0.018 mW/g



0 dB = 0.018mW/g

WORST-CASE SAR PLOT for 5.2 GHz Band

Date/Time: 9/23/2009 5:36:47 PM

Test Laboratory: Compliance Certification Services

802.11a 5.2GHz

DUT: NA; Type: NA; Serial: NA

Communication System: 802.11abgn; Frequency: 5180 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 5180 MHz; σ = 5.16 mho/m; ε_r = 47.9; ρ = 1000 kg/m^3
Phantom section: Flat Section

Room Ambient Temperature: 24.0 deg. C; Liquid Temperature: 23.0 deg. C

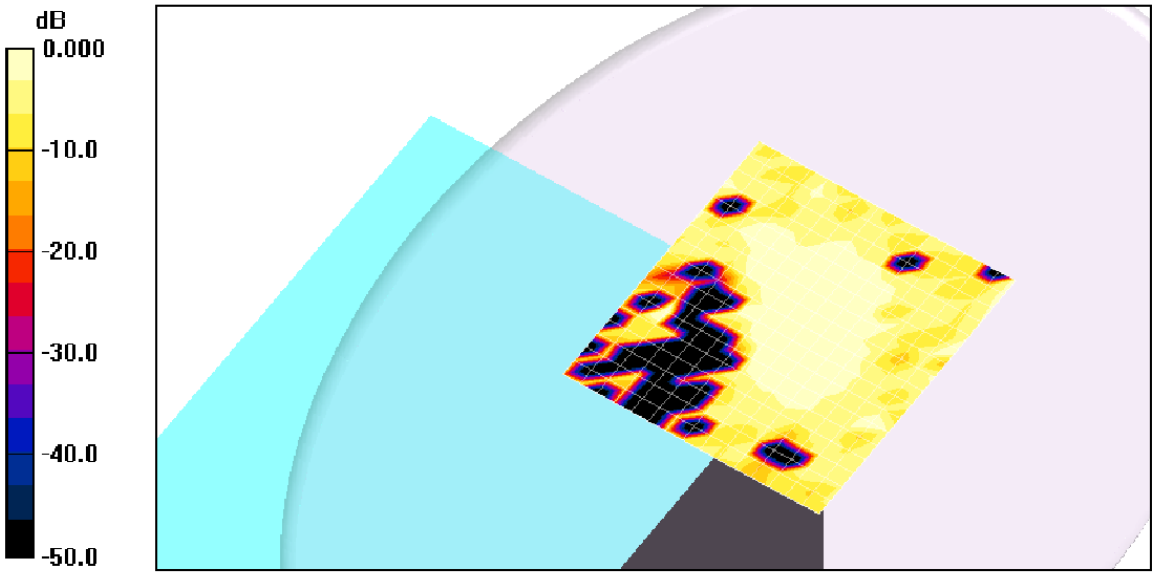
DASY4 Configuration:
- Area Scan setting - Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Probe: EX3DV4 - SN3686; ConvF(4.08, 4.08, 4.08); Calibrated: 3/23/2009
- Sensor-Surface: 2.5mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 10/20/2008
- Phantom: Flat Phantom ELI4.0; Type: QDOVA001BA; Serial: SN:1003
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Lapheld - 5.2G_Main Ant/Area Scan (16x18x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (measured) = 0.071 mW/g

Lapheld - 5.2G_Main Ant/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 1.26 V/m; Power Drift = -3.92 dB
Peak SAR (extrapolated) = 0.011 W/kg
SAR(1 g) = 0.000139 mW/g; SAR(10 g) = 2.49e-005 mW/g

Maximum value of SAR (measured) = 0.013 mW/g



0 dB = 0.013mW/g

WORST-CASE SAR PLOT for 5.3 GHz Band

Date/Time: 9/24/2009 2:49:23 PM

Test Laboratory: Compliance Certification Services

802.11a 5.3GHz

DUT: NA; Type: NA; Serial: NA

Communication System: 802.11abgn; Frequency: 5280 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 5280 MHz; σ = 5.26 mho/m; ε_r = 51; ρ = 1000 kg/m^3
Phantom section: Flat Section

Room Ambient Temperature: 24.0 deg. C; Liquid Temperature: 23.0 deg. C

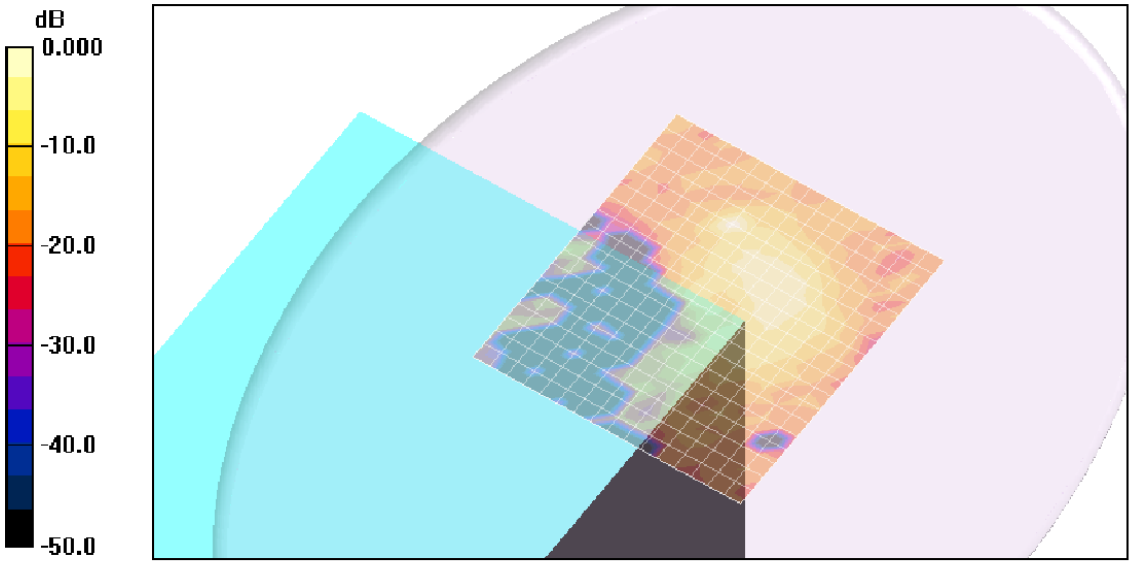
DASY4 Configuration:
- Area Scan setting - Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Probe: EX3DV4 - SN3686; ConvF(3.81, 3.81, 3.81); Calibrated: 3/23/2009
- Sensor-Surface: 2.5mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 10/20/2008
- Phantom: Flat Phantom ELI4.0; Type: QDOVA001BA; Serial: SN:1003
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Lapheld - 5.3G_Main Ant/Area Scan (17x19x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (measured) = 0.211 mW/g

Lapheld - 5.3G_Main Ant/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 0.704 V/m; Power Drift = 4.82 dB
Peak SAR (extrapolated) = 0.287 W/kg
SAR(1 g) = 0.052 mW/g; SAR(10 g) = 0.019 mW/g

Maximum value of SAR (measured) = 0.216 mW/g



0 dB = 0.216mW/g

WORST-CASE SAR PLOT for 5.5 GHz Band

Date/Time: 9/24/2009 4:15:40 PM

Test Laboratory: Compliance Certification Services

802.11a 5.5GHz

DUT: NA; Type: NA; Serial: NA

Communication System: 802.11abgn; Frequency: 5600 MHz;Duty Cycle: 1:1
Medium parameters used: f = 5600 MHz; σ = 5.66 mho/m; ε_r = 50.7; ρ = 1000 kg/m^3
Phantom section: Flat Section

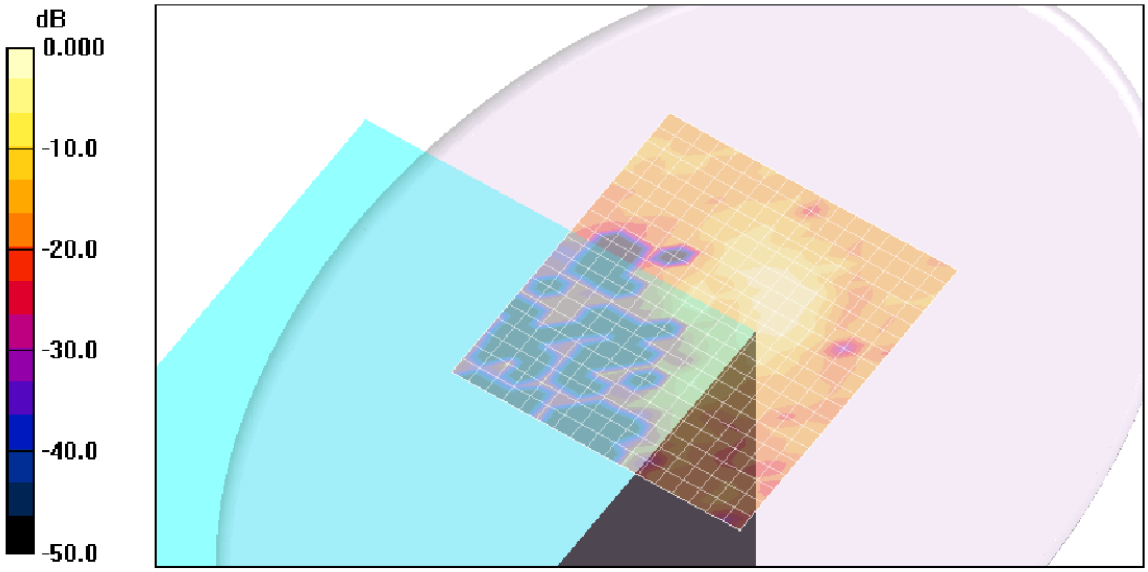
Room Ambient Temperature: 24.0 deg. C; Liquid Temperature: 23.0 deg. C

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(3.61, 3.61, 3.61); Calibrated: 3/23/2009
- Sensor-Surface: 2.5mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 10/20/2008
- Phantom: Flat Phantom ELI4.0; Type: QDOVA001BA; Serial: SN:1003
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Lapheld - 5.5G_Main Ant/Area Scan (18x20x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 0.096 mW/g

Lapheld - 5.5G_Main Ant/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 1.79 V/m; Power Drift = -4.32 dB
Peak SAR (extrapolated) = 0.080 W/kg
SAR(1 g) = 0.000195 mW/g; SAR(10 g) = 8.76e-006 mW/g

Maximum value of SAR (measured) = 0.301 mW/g



0 dB = 0.301mW/g

WORST-CASE SAR PLOT for 5.8 GHz Band

Date/Time: 9/24/2009 5:53:17 PM

Test Laboratory: Compliance Certification Services

802.11a 5.8GHz

DUT: NA; Type: NA; Serial: NA

Communication System: 802.11abgn; Frequency: 5785 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 5785 MHz; σ = 5.98 mho/m; ε_r = 50.1; ρ = 1000 kg/m^3
Phantom section: Flat Section

Room Ambient Temperature: 24.0 deg. C; Liquid Temperature: 23.0 deg. C

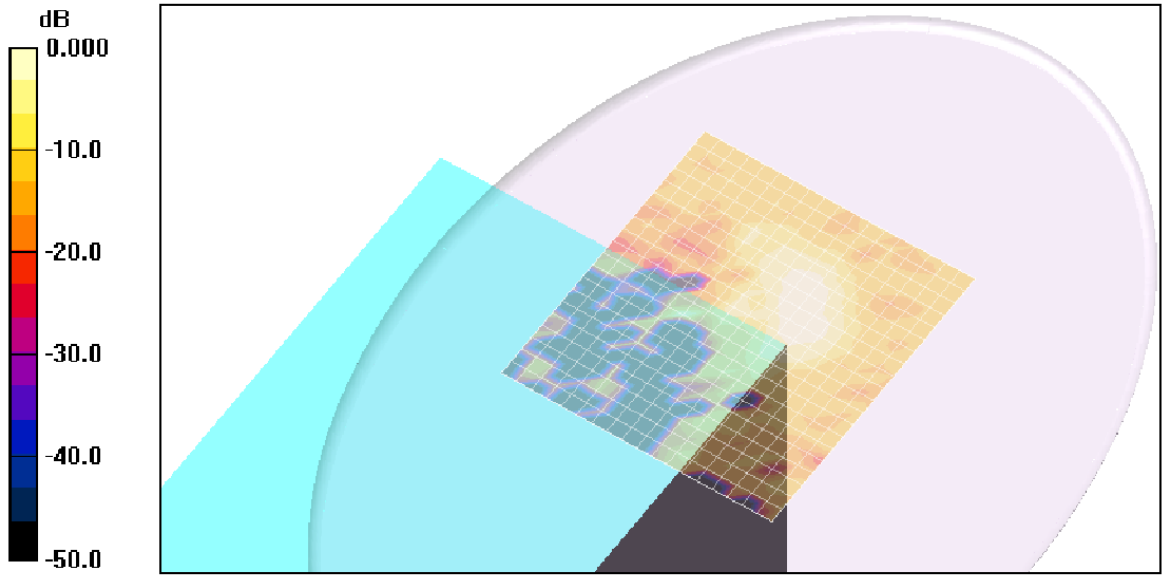
DASY4 Configuration:
- Area Scan setting - Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Probe: EX3DV4 - SN3686; ConvF(3.84, 3.84, 3.84); Calibrated: 3/23/2009
- Sensor-Surface: 2.5mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 10/20/2008
- Phantom: Flat Phantom ELI4.0; Type: QDOVA001BA; Serial: SN:1003
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Lapheld - 5.8G_Main Ant/Area Scan (19x21x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (measured) = 0.089 mW/g

Lapheld - 5.8G_Main Ant/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 0.675 V/m; Power Drift = 0.726 dB
Peak SAR (extrapolated) = 0.346 W/kg
SAR(1 g) = 0.056 mW/g; SAR(10 g) = 0.020 mW/g

Maximum value of SAR (measured) = 0.092 mW/g



0 dB = 0.092mW/g

13. ATTACHMENTS

No.	Contents	No. of page (s)
1	System Performance Check Plots	14
2	Certificate of E-Field Probe – EX3DV4 SN 3686	10
3	Certificate of System Validation Dipole - D2450V2 SN:748	6
4	Certificate of System Validation Dipole – D5GHzV2 SN 1003	15