



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

**SAR EVALUATION REPORT**

*For*

**802.11 b/g PCIExpress Minicard  
(Tested inside of Notebook PC, Model NP-N310)**

**MODEL: AR5BXB63  
FCC ID: PPD-AR5BXB63  
IC: 4104A-AR5BXB63**

**REPORT NUMBER: 09I12581-1**

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*Prepared for*

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**NVLAP LAB CODE 200065-0**

Revision History

Rev.	Issue Date	Revisions	Revised By
--	May 14, 2009	Initial Issue	--

## TABLE OF CONTENTS

1. ATTESTATION OF TEST RESULTS.....	4
2. TEST METHODOLOGY .....	5
3. FACILITIES AND ACCREDITATION.....	5
4. CALIBRATION AND UNCERTAINTY.....	6
4.1. MEASURING INSTRUMENT CALIBRATION.....	6
4.2. MEASUREMENT UNCERTAINTY.....	7
5. EQUIPMENT UNDER TEST .....	8
6. SYSTEM SPECIFICATIONS.....	9
7. COMPOSITION OF INGREDIENTS FOR TISSUE SIMULATING LIQUIDS .....	10
8. LIQUID PARAMETERS CHECK.....	11
8.1. LIQUID CHECK RESULTS FOR 2450 MHZ.....	12
9. SYSTEM CHECK .....	13
9.1. SYSTEM CHECK RESULTS FOR D2450V2.....	13
10. OUTPUT POWER VERIFICATION.....	14
11. SUMMARY OF TEST RESULTS.....	15
11.1. SAR TEST RESULT FOR THE 2.4 GHZ BAND .....	15
12. WORST-CASE SAR TEST PLOTS .....	16
13. ATTACHMENTS.....	17
14. TEST SETUP PHOTO .....	18
15. HOST DEVICE PHOTO .....	19

# 1. ATTESTATION OF TEST RESULTS

**COMPANY NAME:** Atheros Communications, Inc.  
 5480 Great America Parkway  
 Santa Clara, CA 95054

**EUT DESCRIPTION:** Atheros 802.11b/g WLAN PCI-E Mini Card  
 (Tested inside of Notebook PC, Model NP-N310)

**MODEL NUMBER:** AR5BXB63

**DEVICE CATEGORY:** Portable

**EXPOSURE CATEGORY:** General Population/Uncontrolled Exposure

**DATE TESTED:** May 13, 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-210	2412 – 2462	0.052	1.6

**APPLICABLE STANDARDS AND TEST PROCEDURES:**

STANDARDS AND TEST PROCEDURES	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. 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:

Tested By:

*Sunny Shih*

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## 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: NOVEMBER 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://ts.nist.gov/Standards/scopes/2000650.htm>.

## 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	1010
Thermometer	ERTCO	639-1S	1718	5	28	2009
Data Acquisition Electronics	SPEAG	DAE3 V1	427	10	20	2009
System Validation Dipole	SPEAG	D835V2	4d002	6	22	2009
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		

## 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)	
<b>Measurement System</b>								
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 Mechanical 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	
<b>Test sample Related</b>								
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	
<b>Phantom and Tissue Parameters</b>								
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	
<b>Combined Standard Uncertainty</b>						RSS	11.44	10.49
<b>Expanded Uncertainty (95% Confidence Interval)</b>						K=2	22.87	20.98
Notes for table								
1. Tol. - tolerance in influence quantity								
2. N - Nomal								
3. R - Rectangular								
4. Div. - Divisor used to obtain standard uncertainty								
5. Ci - is te sensitivity coefficient								

## 5. EQUIPMENT UNDER TEST

Atheros 802.11b/g WLAN PCI-E Mini Card

(Tested inside of Notebook PC, Model NP-N310)

Normal operation:

Lap-held only

Note: SAR test with display open at 90° to the keyboard

Antenna(s):

Located at top of the display

Antenna tested:

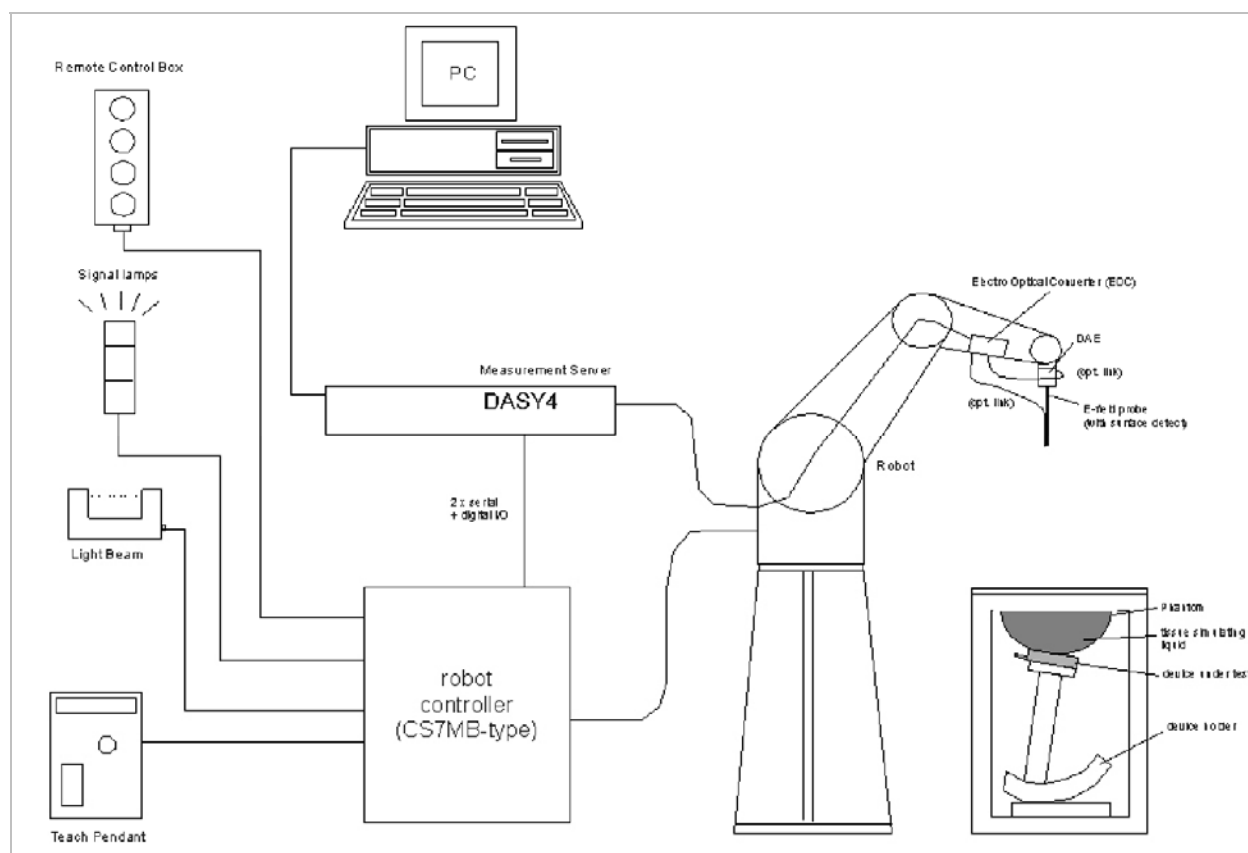
- **Foxconn:**
  - Main Antenna: WDAN-M1PB1001-DF
  - Aux Antenna: WDAN- M1PB 1002-DF
- **WNC:**
  - Main Antenna: 81.EHD15.G09
  - Aux Antenna: 81.EHD15.G10

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 if the dielectric parameters are within the tolerances of the specified target values. The relative permittivity and conductivity of the tissue material should be within  $\pm 5\%$  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	
	$\epsilon_r$	$\sigma$ (S/m)	$\epsilon_r$	$\sigma$ (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

( $\epsilon_r$  = relative permittivity,  $\sigma$  = conductivity and  $\rho = 1000 \text{ kg/m}^3$ )

### 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'	52.12	Relative Permittivity ( $\epsilon_r$ ):	52.118	52.7	-1.11	? 5
	e"	14.31	Conductivity ( $\sigma$ ):	1.950	1.95	0.02	? 5

Liquid Temperature: 23 deg. C

May 13, 2009 09:14 AM

Frequency	e'	e"
2400000000.	52.2851	14.0583
2405000000.	52.2470	14.1237
2410000000.	52.2223	14.1575
2415000000.	52.2122	14.1994
2420000000.	52.1705	14.2250
2425000000.	52.1601	14.2451
2430000000.	52.1531	14.2497
2435000000.	52.1461	14.2659
2440000000.	52.1434	14.2881
2445000000.	52.1226	14.3107
<b>2450000000.</b>	<b>52.1175</b>	<b>14.3097</b>
2455000000.	52.0791	14.3326
2460000000.	52.0797	14.3207
2465000000.	52.0498	14.3028
2470000000.	52.0369	14.2859
2475000000.	52.0266	14.2885
2480000000.	52.0433	14.2940
2485000000.	52.0407	14.3019
2490000000.	52.0363	14.3314
2495000000.	52.0279	14.3779
2500000000.	52.0246	14.4597

The conductivity ( $\sigma$ ) can be given as:

$$\sigma = \omega \epsilon_0 e'' = 2 \pi f \epsilon_0 e''$$

where  $f = \text{target } f * 10^6$

$$\epsilon_0 = 8.854 * 10^{-12}$$

## 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  $\pm 10\%$ .

### 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  $250 \text{ mW} \pm 3\%$ .
- The results are normalized to 1 W input power.

450 to 2450 MHz Reference SAR Values for Body-tissue (From SPEAG)

Dipole Type	Distance	Frequency	SAR (1g)	SAR (10g)	SAR (peak)
	(mm)	(MHz)	[W/kg]	[W/kg]	[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

### 9.1. SYSTEM CHECK RESULTS FOR D2450V2

Date: May 13, 2009

Ambient Temperature =  $24^{\circ}\text{C}$ ; Relative humidity = 40%

Measured by: Chaoyen Lin

Medium	CW Signal (MHz)	Forward power (mW)	Measured (Normalized to 1 W)		Target	Delta (%)	Tolerance (%)
			1g SAR:	10g SAR:			
Body	2450	250	1g SAR:	54	51.2	5.47	$\pm 10$
			10g SAR:	25.2	23.7	6.33	

## 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, ART Revision 5.3, which enables a user to control the frequency, output power and data rate of the module.

### Average Conducted Output Power

#### 802.11b

Ch. No.	f (MHz)	Average Conducted power (dBm)
1	2412	20.60
6	2437	20.60
11	2462	19.00

#### 802.11g

Ch. No.	f (MHz)	Average Conducted power (dBm)
1	2412	17.50
6	2437	20.70
11	2462	15.50

## 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	f (MHz)	Antenna	1g SAR (mW/g)	Limit (mW/g)
802.11b	6	2437	Main	0.050	1.6
			Aux	0.052	

## 12. WORST-CASE SAR TEST PLOTS

### WORST-CASE SAR PLOT for 2.4 GHz Band

Date/Time: 5/13/2009 9:11:04 PM

Test Laboratory: Compliance Certification Services

#### 802.11bg for Lapheld Sample 1

DUT: Samsung; Type: NP-N310; Serial: Sample #5

Communication System: 802.11bg; Frequency: 2437 MHz; Duty Cycle: 1:1

Medium parameters used (interpolated):  $f = 2437$  MHz;  $\sigma = 1.94$  mho/m;  $\epsilon_r = 52.1$ ;  $\rho = 1000$  kg/m<sup>3</sup>

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, Aux Ant M-ch/Area Scan (13x14x1): Measurement grid: dx=15mm, dy=15mm

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 0.053 mW/g

#### Lapheld, Aux Ant M-ch/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=3mm

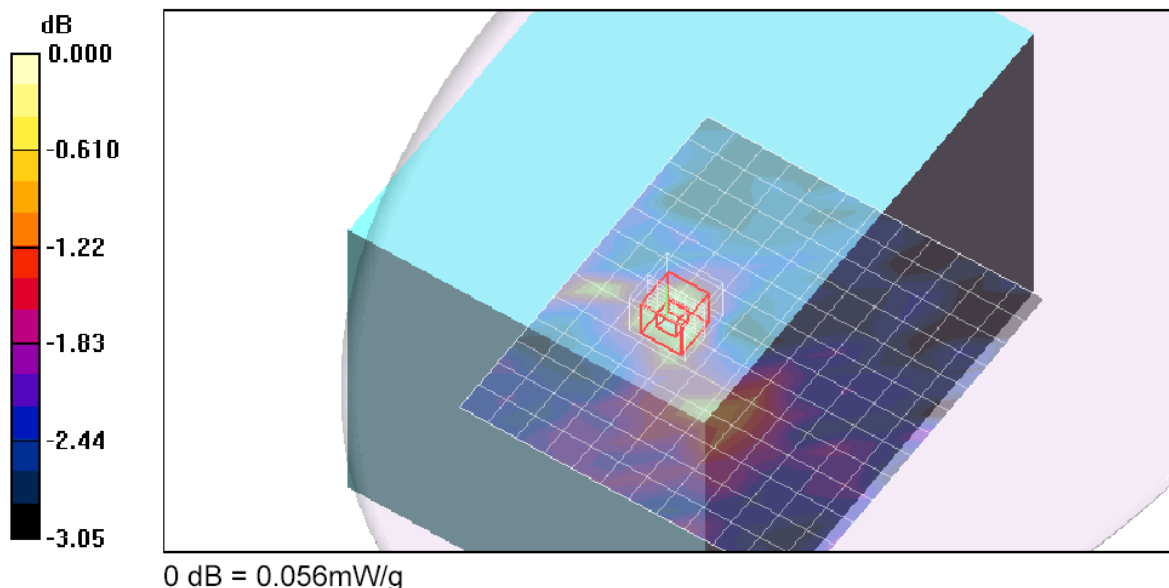
Reference Value = 3.78 V/m; Power Drift = 0.663 dB

Peak SAR (extrapolated) = 0.085 W/kg

SAR(1 g) = 0.052 mW/g; SAR(10 g) = 0.042 mW/g

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 0.056 mW/g





### 13. ATTACHMENTS

No.	Contents	No. of page (s)
1	System Performance Check Plots	2
2	SAR Test Plots for 2.4 GHz Band	2
3	Certificate of E-Field Probe – EX3DV4 SN 3686	10
4	Certificate of System Validation Dipole - D2450V2 SN:748	6

## 14. TEST SETUP PHOTO

TEST SETUP PHOTO



## 15. HOST DEVICE PHOTO

HOST DEVICE PHOTO (NP-N310)



**END OF REPORT**