FCC OET BULLETIN 65 SUPPLEMENT C 01-01
IEEE STD 1528:2003
RSS-102 Issue 4, March 2010

SAR EVALUATION REPORT

For
IEEE 802.11bgn Wireless LAN, Bluetooth and FM Rx Combo Half Mini Card
(Tested inside of Toshiba Tablet ATS10)

MODEL NUMBER: AW-NH931
FCC ID: TLZ-NH931
IC: 6100A-NH931

REPORT NUMBER: 11J13995-1

ISSUE DATE: August 22, 2011

Prepared for
AZUREWAVE TECHNOLOGIES, INC.
8F NO. 94, BAOZHONG RD.,
XINDIAN, 231 TAIWAN

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

NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
–	August 22, 2011	Initial Issue	--

TABLE OF CONTENTS

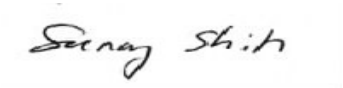
1. Attestation of Test Results

Applicant name:	AzureWave Technologies, Inc.		
EUT description:	IEEE 802.11bgn Wireless LAN, Bluetooth and FM Rx Combo Half Mini Card (Tested inside of Toshiba Tablet, Model ATS10)		
Model number:	AW-NH931		
Device category:	Portable		
Exposure category:	General Population/Uncontrolled Exposure		
Date tested:	August 18, 2011		
FCC / IC Rule Parts	Freq. Range [MHz]	Highest 1g SAR (mW/g)	Limit (mW/g)
15.247 / RSS-102	2412 – 2462	0.712 mW/g (Secondary Landscape)	1.6
Applicable Standards			Test Results
OET Bulletin 65 Supplement C 01-01, IEEE STD 1528: 2003, RSS-102 Issue 4, March 2010			Pass

Compliance Certification Services, Inc. (UL 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 UL 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 UL CCS and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL 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 (NIST Handbook 150, Annex A). This report is written to support regulatory compliance of the applicable standards stated above.

Approved & Released For CCS By:



Sunny Shih
Engineering Team Leader
Compliance Certification Services (UL CCS)

Tested By:

Tomochika Sato
SAR Engineer
Compliance Certification Services (UL CCS)

2. Test Methodology

The tests documented in this report were performed in accordance with FCC OET Bulletin 65 Supplement C Edition 01-01, IEEE STD 1528:2003, RSS-102 Issue 4, March 2010 and the following KDB Procedures.

- 248227 SAR measurement procedures for 802.11a/b/g transmitters
- 447498 D01 Mobile Portable RF Exposure v04

3. Facilities and Accreditation

The test sites and measurement facilities used to collect data are located at 47173 Benicia Street, Fremont, California, USA.

UL 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	S-0396	N/A		
DASY4 Measurement Server	SPEAG	SEUMS001BA	1246	N/A		
Probe Alignment Unit	SPEAG	LB5/ 80	SE UKS 030 AA	N/A		
Oval Flat Phantom (ELI 4.0)	SPEAG	QDOVA001BB	1017	N/A		
Dielectric Probe kit	HP	85070C	N/A	N/A		
ESA Series Network Analyzer	Agilent	E5071B	MY42100131	8	2	2011
Synthesized Signal Generator	HP	83732B	US34490599	7	14	2012
E-Field Probe	SPEAG	EX3DV4	3749	12	13	2012
Thermometer	ERTCO	639-1S	1718	8	19	2011
Data Acquisition Electronics	SPEAG	DAE4	1259	5	3	2012
System Validation Dipole	SPEAG	*D2450V2	706	4	19	2012
Power Meter	Giga-tronics	8651A	8651404	3	13	2012
Power Sensor	Giga-tronics	80701A	1834588	3	13	2012
Amplifier	Mini-Circuits	ZVE-8G	90606	N/A		
Amplifier	Mini-Circuits	ZHL-42W	D072701-5	N/A		
Simulating Liquid	SPEAG	MSL2450	N/A	Within 24 hrs of first test		

Note:

*Per KDB 450824 D02 requirements for dipole calibration, UL CCS has adopted two years calibration intervals. On annual basis, each measurement dipole has been evaluated and is in compliance with the following criteria:

1. There is no physical damage on the dipole
2. System validation with specific dipole is within 10% of calibrated value.
3. Return-loss is within 20% of calibrated measurement. (Verification data include with D2450V2 calibration certificates)
4. Impedance is within 5Ω of calibrated measurement. (Verification data include with dipole D2450V2 calibration certificates)

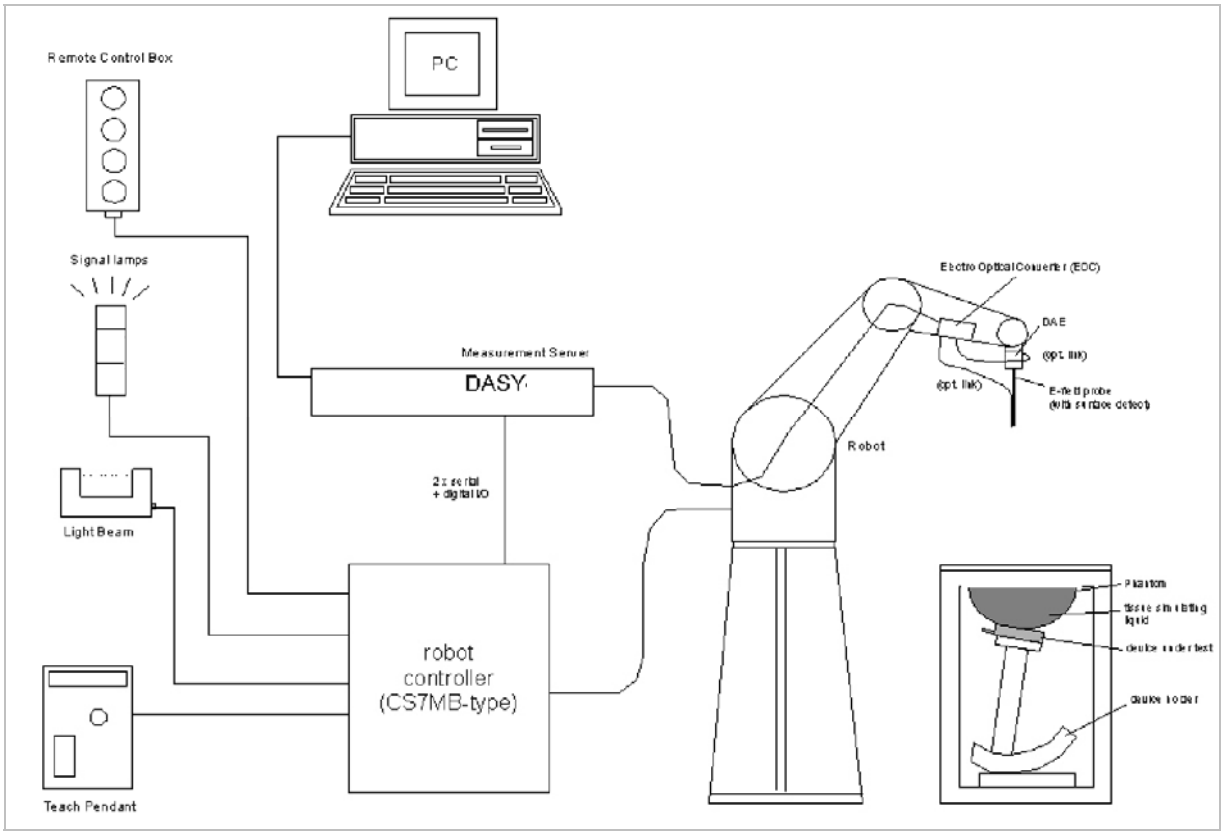
4.2. Measurement Uncertainty

Measurement uncertainty for 300 MHz to 3 GHz averaged over 1 gram					
Component	error, %	Probe Distribution	Divisor	Sensitivity	U (Xi), %
Measurement System					
Probe Calibration (k=1) @ 2450 MHz	5.50	Normal	1	1	5.50
Axial Isotropy	1.15	Rectangular	1.732	0.7071	0.47
Hemispherical Isotropy	2.30	Rectangular	1.732	0.7071	0.94
Boundary Effect	0.90	Rectangular	1.732	1	0.52
Probe Linearity	3.45	Rectangular	1.732	1	1.99
System Detection Limits	1.00	Rectangular	1.732	1	0.58
Readout Electronics	0.30	Normal	1	1	0.30
Response Time	0.80	Rectangular	1.732	1	0.46
Integration Time	2.60	Rectangular	1.732	1	1.50
RF Ambient Conditions - Noise	3.00	Rectangular	1.732	1	1.73
RF Ambient Conditions - Reflections	3.00	Rectangular	1.732	1	1.73
Probe Positioner Mechanical Tolerance	0.40	Rectangular	1.732	1	0.23
Probe Positioning with respect to Phantom	2.90	Rectangular	1.732	1	1.67
Extrapolation, Interpolation and Integration	1.00	Rectangular	1.732	1	0.58
Test Sample Related					
Test Sample Positioning	2.90	Normal	1	1	2.90
Device Holder Uncertainty	3.60	Normal	1	1	3.60
Output Power Variation - SAR Drift	5.00	Rectangular	1.732	1	2.89
Phantom and Tissue Parameters					
Phantom Uncertainty (shape and thickness)	4.00	Rectangular	1.732	1	2.31
Liquid Conductivity - deviation from target	5.00	Rectangular	1.732	0.64	1.85
Liquid Conductivity - measurement	0.46	Normal	1	0.64	0.29
Liquid Permittivity - deviation from target	5.00	Rectangular	1.732	0.6	1.73
Liquid Permittivity - measurement	0.54	Normal	1	0.6	0.32
				Combined Standard Uncertainty Uc(y) =	9.45
				Expanded Uncertainty U, Coverage Factor = 2, > 95 % Confidence = 18.90	%
				Expanded Uncertainty U, Coverage Factor = 2, > 95 % Confidence = 1.50	dB

5. Equipment Under Test

IEEE 802.11bgn Wireless LAN, Bluetooth and FM Rx Combo Half Mini Card, Model AW-NH931 (Tested inside of Toshiba Tablet, Model ATS10)	
Normal operation:	Tablet bottom face and Tablet edges multiple display orientations supporting both portrait and landscape configurations.
Antenna tested:	Manufactured: Wha Yu; Part number: C1335-520099-A
Antenna-to-antenna/user separation distances:	See Section 14 for details of antenna locations and separation distances.
Assessment for SAR evaluation for Simultaneous transmission:	WiFi Main antenna can transmit simultaneously with Bluetooth. Due to Bluetooth's maximum output is 11.5 mW <$60/f_{(GHz)}$ and stand-alone SAR is not required, therefore simultaneous transmission evaluation is not required.

6. System Specification



The DASY 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.
- DASY 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 validating 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. Tissue Dielectric Parameters

The simulating liquids are 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. For frequencies in 300 MHz to just under 2 GHz, the measured conductivity and relative permittivity were within ± 5% of the target values. For frequencies above 2 GHz the measured conductivity was within ± 5% of the target values. The measured relative permittivity tolerance was within ± 10% of the target value.

Reference Values of Tissue Dielectric Parameters for Head & Body Phantom

The 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

Measured by: Tomochika Sato

Date	Freq. (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit ±(%)
8/18/2011	Body 2450	e'	52.9835	Relative Permittivity (ε_r):	52.98	52.70	0.54	5
		e"	14.2483	Conductivity (σ):	1.94	1.95	-0.46	5

Liquid Check
Ambient temperature: 25 deg. C; Liquid temperature: 24 deg. C; Relative humidity = 40%
August 18, 2011 09:41 AM

Frequency	e'	e"
2400000000.	53.1274	14.0678
2405000000.	53.1144	14.0888
2410000000.	53.1009	14.1092
2415000000.	53.0871	14.1283
2420000000.	53.0764	14.1451
2425000000.	53.0618	14.1618
2430000000.	53.0480	14.1792
2435000000.	53.0334	14.1947
2440000000.	53.0171	14.2121
2445000000.	53.0002	14.2286
2450000000.	**52.9835**	**14.2483**
2455000000.	52.9670	14.2674
2460000000.	52.9477	14.2866
2465000000.	52.9278	14.3070
2470000000.	52.9096	14.3295
2475000000.	52.8903	14.3514
2480000000.	52.8712	14.3744
2485000000.	52.8517	14.3981
2490000000.	52.8344	14.4258
2495000000.	52.8174	14.4471
2500000000.	52.8031	14.4695

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 Verification

The system performance check is performed prior to any usage of the system in order to verify SAR system accuracy. 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: 3749 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 7x7x9 (2.4 GHz) fine cube was chosen for cube integration
- Distance between probe sensors and phantom surface was set to 2.5 mm.
  For 5 GHz band - Distance between probe sensors and phantom surface was set to 2.5 mm
- The dipole input powers (forward power) were 100 mW.
- The results are normalized to 1 W input power.

Reference SAR Values for HEAD & BODY-tissue from calibration certificate of SPEAG.

System validation dipole	Cal. certificate #	Cal. date	SAR Avg (mW/g)			
			Tissue:	Freq.	Head	Body
D2450V2 SN 706	D2450V2-706_Apr10	4/19/10	1g SAR:	2.4 GHz	51.6	52.4
			10g SAR:		24.4	24.5

9.1. System Check Results

System validation dipole	Date Tested	Measured (Normalized to 1 W)		Target	Delta (%)	Tolerance (%)
		Tissue:	Body			
D2450V2 (2.45GHz)	08/18/11	1g SAR:	50.6	52.4	-3.44	±10
		10g SAR:	23.8	24.5	-2.86	

10. SAR Measurement Procedures

Step 1: Power Reference Measurement
The Power Reference Measurement and Power Drift Measurements are for monitoring the power drift of the device under test in the batch process. The Minimum distance of probe sensors to surface determines the closest measurement point to phantom surface. The minimum distance of probe sensors to surface is 2.1 mm. This distance cannot be smaller than the Distance of sensor calibration points to probe tip as defined in the probe properties (for example, 1.2 mm for an EX3DV3 probe type).

Step 2: Area Scan
The Area Scan is used as a fast scan in two dimensions to find the area of high field values, before doing a fine measurement around the hot spot. The sophisticated interpolation routines implemented in DASY5 software can find the maximum locations even in relatively coarse grids. When an Area Scan has measured all reachable points, it computes the field maximal found in the scanned area, within a range of the global maximum. The range (in dB) is specified in the standards for compliance testing. For example, a 2 dB range is required in IEEE Standard 1528, EN 50361 and IEC 62209 standards, whereby 3 dB is a requirement when compliance is assessed in accordance with the ARIB standard (Japan). If only one Zoom Scan follows the Area Scan, then only the absolute maximum will be taken as reference. For cases where multiple maximums are detected, the number of Zoom Scans has to be increased accordingly.

Step 3: Zoom Scan
Zoom Scans are used to assess the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g of simulated tissue. The Zoom Scan measures ≥ 7x7x9 (above 4.5 GHz) or 5x5x7 (below 3 GHz) points within a cube whose base faces are centered on the maxima found in a preceding area scan job within the same procedure. When the measurement is done, the Zoom Scan evaluates the averaged SAR for 1 g and 10 g and displays these values next to the job's label.

Step 4: Power drift measurement
The Power Drift Measurement measures the field at the same location as the most recent power reference measurement within the same procedure, and with the same settings. The Power Drift Measurement gives the field difference in dB from the reading conducted within the last Power Reference Measurement. This allows a user to monitor the power drift of the device under test within a batch process. The measurement procedure is the same as Step 1.

Step 5: Z-Scan
The Z Scan measures points along a vertical straight line. The line runs along the Z-axis of a one-dimensional grid. In order to get a reasonable extrapolation, the extrapolated distance should not be larger than the step size in Z-direction.

11. RF Output Power Verification

11.1. RF Output Power for 2.4 GHz

2.4 GHz Band					
Mode	Rate	Ch. #	Freq. (MHz)	Average output pwr (dBm)	
				Original output power	Actual measured power
802.11b	1 Mbps	1	2412	16.2	**16.42**
		6	2437	16.1	**16.45**
		11	2462	16.0	**16.34**
802.11g	6 Mbps	1	2412	14.8	15.08
		6	2437	15.4	15.52
		11	2462	13.0	13.11
802.11n HT20	MCS 0	1	2412	14.8	15.10
		6	2437	15.4	15.49
		11	2462	13.0	13.04

Note:

1. The modes with highest output power channel were chosen for the conducted output power.
2. Please refer to original report for average power information named `991223X06_FCC Power Table for AW-NH931_V01`.

12. Standalone SAR Test Results

12.1. SAR Test Results for 2.4 GHz

(1) Bottom Face

Mode	Rate	Ch. #	Freq. (MHz)	Avg. Output Pwr (dBm)	Measured Result (mW/g)	
				Original output power	1g SAR	10g SAR
802.11b	1 Mbps	1	2412	16.42		
		6	2437	16.45	0.329	0.145
		11	2462	16.34		

(2) Edge Secondary Landscape

Mode	Rate	Ch. #	Freq. (MHz)	Avg. Output Pwr (dBm)	Measured Result (mW/g)	
				Original output power	1g SAR	10g SAR
802.11b	1 Mbps	1	2412	16.42		
		6	2437	16.45	**0.712**	**0.259**
		11	2462	16.34		

(3) Edge Primary Portrait

Mode	Rate	Ch. #	Freq. (MHz)	Avg. Output Pwr (dBm)	Measured Result (mW/g)	
				Original output power	1g SAR	10g SAR
802.11b	1 Mbps	1	2412	16.42		
		6	2437	16.45	0.075	0.040
		11	2462	16.34		

12.2. Worst-Case SAR Plots

Date/Time: 8/18/2011

Test Laboratory: UL CCS SAR Lab D

WiFi_Body_Secondary Landscape

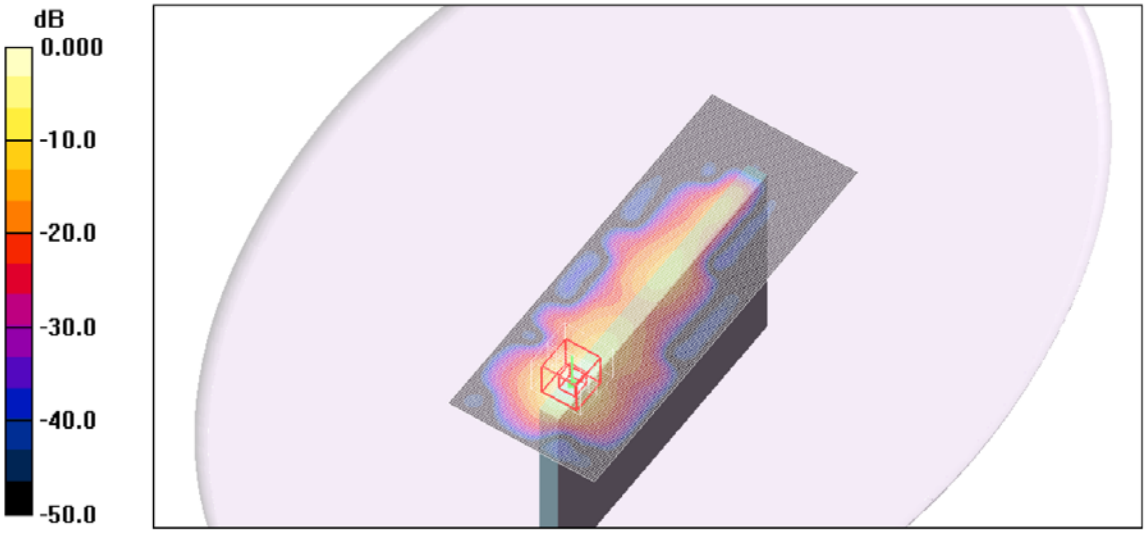
Communication System: 802.11b/g 2.4GHz; Frequency: 2437 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 2437 MHz; σ = 1.93 mho/m; ε_r = 53; ρ = 1000 kg/m^3
Phantom section: Flat Section

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 - SN3749; ConvF(6.9, 6.9, 6.9); Calibrated: 12/13/2010
- Sensor-Surface: 2.5mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1259; Calibrated: 5/3/2011
- Phantom: Flat Phantom ELI4.0; Type: QDOVA001BB; Serial: 1017
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

11b_6Ch_1Mbps/Area Scan (61x161x1): Measurement grid: dx=15mm, dy=15mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (interpolated) = 1.14 mW/g

11b_6Ch_1Mbps/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=3mm
Reference Value = 24.8 V/m; Power Drift = -0.166 dB
Peak SAR (extrapolated) = 1.99 W/kg
SAR(1 g) = 0.712 mW/g; SAR(10 g) = 0.259 mW/g
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 1.17 mW/g



0 dB = 1.17mW/g

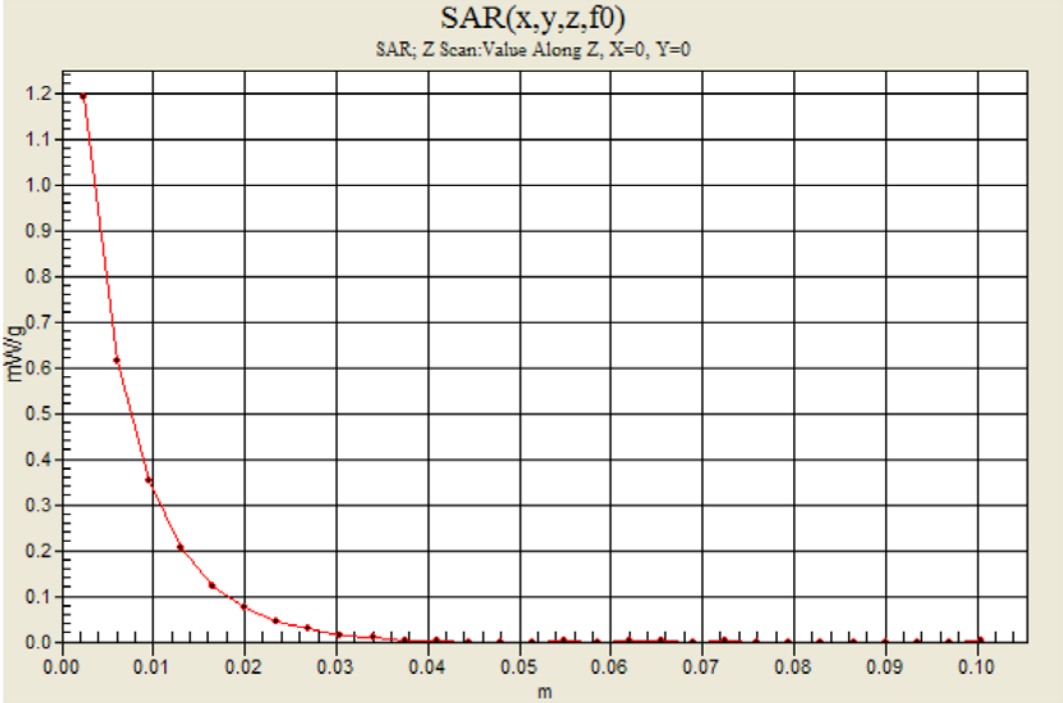
Date/Time: 8/18/2011

Test Laboratory: UL CCS SAR Lab D

WiFi_Body_Secondary Landscape

Communication System: 802.11b/g 2.4GHz; Frequency: 2437 MHz;Duty Cycle: 1:1

11b_6Ch_1Mbps/Z Scan (1x1x29): Measurement grid: dx=20mm, dy=20mm, dz=3.5mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 1.19 mW/g



13. Appendixes

13.1. Appendix A: System Check Plots

13.2. Appendix B: SAR Test Plots

13.3. Appendix C: Calibration Certificate for EX3DV4 SN 3749

13.4. Appendix D: Calibration Certificate for D2450V2 SN 706 with Extended Cal. data