



FCC OET BULLETIN 65 SUPPLEMENT C 01-01

IEEE STD 1528:2003

RSS-102 Issue 4, March 2010

SAR EVALUATION REPORT

For

**Intel® Centrino® Advanced-N 6230 abgn+BT Combo
(Tested inside of Samsung Tablet PC XE700T1A)**

MODEL: 62230ANHMW

FCC ID: A3L62230ANH

IC: 649E-62230ANH

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Prepared for

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Revision History

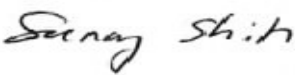
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1. ATTESTATION OF TEST RESULTS

Tested for:	Samsung Electronics Co., LTD		
EUT description:	Intel® Centrino® Advanced-N 6230 abgn+BT Combo (Tested inside of Samsung Tablet PC XE700T1A)		
Model number:	62230ANHMW		
Device category:	Portable devices		
Exposure category:	General Population/Uncontrolled Exposure		
Date tested:	Aug 9 – Aug 14 , 2011		
FCC / IC rule parts	Frequency Range [MHz]	Highest 1-g SAR (W/kg)	Limit (W/kg)
15.247 / RSS-102	2412 – 2462	0.564 W/kg (Bottom Face Chain B)	1.6
15.407 / RSS-102	5150 – 5250	0.717 W/kg (Secondary Portrait Chain A)	
	5250 – 5350	0.657 W/kg (Secondary Landscape Chain B)	
	5500 – 5700	0.706 W/kg (Secondary Landscape Chain B)	
15.247 / RSS-102	5725 – 5850	0.685 W/kg (Secondary Portrait Chain A)	
Applicable Standards			Test Results
FCC 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 UL CCS By:		Tested By:	
			
Sunny Shih Engineering Team Leader Compliance Certification Services (UL CCS)		David Rodgers 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
SAM Twin Phantom	SPEAG	QDOOOP40CD	1629			N/A
Oval Flat Phantom (ELI 5.0) A	SPEAG	QDOVA001BB	1120			N/A
Oval Flat Phantom (ELI 5.0) B	SPEAG	QDOVA001BB	1118			N/A
Dielectric Probe kit	HP	85070C	N/A			N/A
ESA Series Network Analyzer	Agilent	E5071B	MY42100131	2	2	2012
Synthesized Signal Generator	HP	83732B	US34490599	7	14	2012
E-Field Probe	SPEAG	EX3DV4	3773	5	3	2012
Thermometer, Mercury Bulb	ERTCO	639-1S	8350	7	30	2012
Data Acquisition Electronics	SPEAG	DAE4	1258	5	2	2012
System Validation Dipole	SPEAG	*D5GHzV2	1075	9	3	2011
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	M2450	N/A	Within 24 hrs of first test		
Simulating Liquid	SPEAG	M5GHz	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 (test data on file in UL CCS)
4. Impedance is within 5Ω of calibrated measurement (test data on file in UL CCS)

4.2. MEASUREMENT UNCERTAINTY

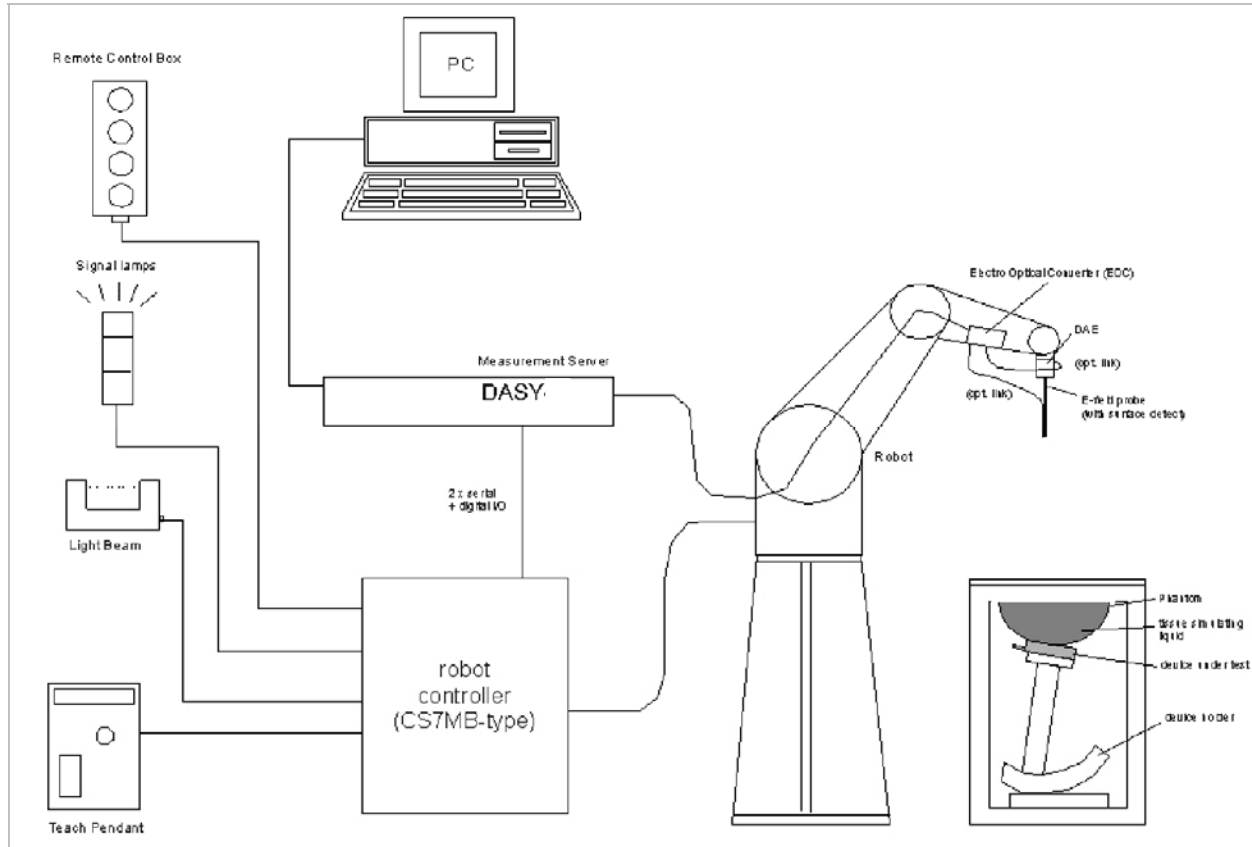
Measurement uncertainty for 300 MHz to 3 GHz averaged over 1 gram

Component	error, %	Probe Distribution	Divisor	Sensitivity	U (Xi), %
Measurement System					
Probe Calibration (k=1)	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	3.26	Normal	1	0.64	2.09
Liquid Permittivity - deviation from target		Rectangular	1.732	0.6	0.00
Liquid Permittivity - measurement uncertainty	-2.97	Normal	1	0.6	-1.78
Combined Standard Uncertainty $U_c(y)$ =					9.68
Expanded Uncertainty U, Coverage Factor = 2, > 95 % Confidence =				19.35	%
Expanded Uncertainty U, Coverage Factor = 2, > 95 % Confidence =				1.54	dB

Measurement uncertainty for 3 to 6 GHz averaged over 1 gram

Component	error, %	Distribution	Divisor	Sensitivity	U (Xi), %
Measurement System					
Probe Calibration (k=1)	6.55	Normal	1	1	6.55
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	1.00	Normal	1	1	1.00
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	3.90	Rectangular	1.732	1	2.25
Test Sample Related					
Test Sample Positioning	1.10	Normal	1	1	1.10
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	2.94	Normal	1	0.64	1.88
Liquid Permittivity - deviation from target	10.00	Rectangular	1.732	0.6	3.46
Liquid Permittivity - measurement uncertainty	2.66	Normal	1	0.6	1.60
Combined Standard Uncertainty $U_c(y)$, %:					10.74
Expanded Uncertainty U, Coverage Factor = 1.96, > 95 % Confidence =				21.05	%
Expanded Uncertainty U, Coverage Factor = 1.96, > 95 % Confidence =				1.66	dB

5. SYSTEM SPECIFICATIONS



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.

6. 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

Simulating Liquids for 5 GHz, Manufactured by SPEAG

Ingredients	(% by weight)
Water	78
Mineral oil	11
Emulsifiers	9
Additives and Salt	2

7. SAR MEASUREMENT PROCEDURE

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 $\geq 7 \times 7 \times 9$ (above 4.5 GHz) or $5 \times 5 \times 7$ (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.

8. EQUIPMENT UNDER TEST

The Intel® Centrino® Advanced-N 6230 is a PCIe half mini card form factor Bluetooth/IEEE 802.11a/b/g/n wireless network adapter. The card supports MIMO (2x2) for 802.11n modes and MISO (1x2) for 802.11a/b/g modes. Bluetooth only operation mode is a 1x1. When Bluetooth is operational then 802.11b/g/n modes operate as SISO (1x1). 802.11a/n modes still operate as MIMO (2x2) with Bluetooth operational.

Normal operation:	Tablet bottom face, and Tablet edges - Multiple display orientations supporting both portrait and landscape configurations	
Antenna tested:	<u>Manufacturer</u> Galtronics	<u>Part number</u> Main (Chain A): 02102140-04957-1 Aux1 (Chain B): 02102140-04957-2
Antenna-to-antenna/user separation distances:	See Section 16 for details of antenna locations and separation distances	
Simultaneous transmission:	WiFi 2.4 GHz can transmit simultaneously with Bluetooth WiFi 5 GHz bands can transmit simultaneously with Bluetooth	
Assessment for SAR evaluation for Simultaneous transmission:	WiFi and BT The Bluetooth's output power is 4 mW which is $\leq 60/f(\text{GHz})$ mW, making a stand-alone SAR evaluation not required. Thus, simultaneous transmission SAR evaluation is not required for the WiFi and Bluetooth antenna pair (FCC ID: PD962230ANH and PD962230ANHU).	

9. SIMULATING LIQUID 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 should be within $\pm 5\%$ of the target values. For frequencies in the range of 2–3 GHz and above the measured conductivity should be within $\pm 5\%$ of the target values. The measured relative permittivity tolerance can be relaxed to no more than $\pm 10\%$.

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

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

Reference Values of Tissue Dielectric Parameters for Body Phantom (for 3000 MHz – 5800 MHz)

In the current guidelines and draft standards for compliance testing of mobile phones (i.e., IEEE P1528, OET 65 Supplement C), the dielectric parameters suggested for head and body tissue simulating liquid are given only at 3.0 GHz and 5.8 GHz. As an intermediate solution, dielectric parameters for the frequencies between 5 to 5.8 GHz were obtained using linear interpolation (see table below).

SPEAG has developed suitable head and body tissue simulating liquids consisting of the following ingredients: de-ionized water, salt and a special composition including mineral oil and an emulgators. Dielectric parameters of these liquids were measured using a HP 8570C Dielectric Probe Kit in conjunction with HP 8753ES Network Analyzer (30 kHz – 6G Hz). The differences with respect to the interpolated values were well within the desired $\pm 5\%$ for the whole 5 to 5.8 GHz range.

Target Frequency (MHz)	Head		Body	
	ϵ_r	σ (S/m)	ϵ_r	σ (S/m)
5000	36.2	4.45	49.3	5.07
5100	36.1	4.55	49.1	5.18
5200	36.0	4.66	49.0	5.30
5300	35.9	4.76	48.9	5.42
5400	35.8	4.86	48.7	5.53
5500	35.6	4.96	48.6	5.65
5600	35.5	5.07	48.5	5.77
5700	35.4	5.17	48.3	5.88
5800	35.3	5.27	48.2	6.00

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

9.1. LIQUID PARAMETERS CHECK RESULTS

Measured by: David Rodgers

Date	Freq. (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit ±(%)
8/9/2011	Body 2450	e'	51.1356	Relative Permittivity (ϵ_r):	51.14	52.70	-2.97	5
		e''	14.4227	Conductivity (σ):	1.96	1.95	0.76	5

Liquid Check

Ambient temperature: 25 deg. C; Liquid temperature: 24 deg. C; Relative humidity = 40%

August 09, 2011 09:01 AM

Frequency	e'	e''
2350000000.	51.4238	13.9908
2355000000.	51.3897	14.0174
2360000000.	51.3547	14.0486
2365000000.	51.3194	14.0834
2370000000.	51.2845	14.1192
2375000000.	51.2540	14.1567
2380000000.	51.2276	14.1963
2385000000.	51.2049	14.2314
2390000000.	51.1891	14.2673
2395000000.	51.1798	14.2984
2400000000.	51.1749	14.3255
2405000000.	51.1742	14.3494
2410000000.	51.1752	14.3651
2415000000.	51.1816	14.3791
2420000000.	51.1842	14.3867
2425000000.	51.1861	14.3900
2430000000.	51.1854	14.3948
2435000000.	51.1811	14.3987
2440000000.	51.1712	14.4049
2445000000.	51.1565	14.4110
2450000000.	51.1356	14.4227
2455000000.	51.1094	14.4376
2460000000.	51.0785	14.4557
2465000000.	51.0444	14.4789
2470000000.	51.0093	14.5049
2475000000.	50.9719	14.5374
2480000000.	50.9332	14.5714
2485000000.	50.8982	14.6088
2490000000.	50.8680	14.6469
2495000000.	50.8415	14.6851
2500000000.	50.8213	14.7193

The conductivity (σ) can be given as:

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

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

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

Measured by: David Rodgers

Date	Freq. (MHz)	Liquid Parameters		Measured	Target	Delta (%)	Limit ±(%)
8/10/2011	Body 2450	e'	50.7858	Relative Permittivity (ϵ_r):	50.79	52.70	-3.63
		e''	14.7804	Conductivity (σ):	2.01	1.95	3.26

Liquid Check

Ambient temperature: 25 deg. C; Liquid temperature: 24 deg. C; Relative humidity = 40%

August 10, 2011 08:56 AM

Frequency	e'	e''
2375000000.	51.0476	14.4496
2380000000.	51.0292	14.4746
2385000000.	51.0118	14.4979
2390000000.	50.9937	14.5220
2395000000.	50.9748	14.5482
2400000000.	50.9599	14.5734
2405000000.	50.9447	14.5960
2410000000.	50.9288	14.6186
2415000000.	50.9133	14.6407
2420000000.	50.8971	14.6593
2425000000.	50.8805	14.6773
2430000000.	50.8624	14.6984
2435000000.	50.8432	14.7186
2440000000.	50.8240	14.7391
2445000000.	50.8061	14.7584
2450000000.	50.7858	14.7804
2455000000.	50.7658	14.8012
2460000000.	50.7469	14.8229
2465000000.	50.7259	14.8447
2470000000.	50.7041	14.8671
2475000000.	50.6841	14.8910
2480000000.	50.6633	14.9136
2485000000.	50.6433	14.9369
2490000000.	50.6257	14.9615
2495000000.	50.6076	14.9835
2500000000.	50.5902	15.0060

The conductivity (σ) can be given as:

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

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

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

Measured by: David Rodgers

Date	Freq. (MHz)	Liquid Parameters		Measured	Target	Delta (%)	Limit ±(%)
8/10/2011	Body 5200	e'	50.3216	Relative Permittivity (ϵ_r):	50.32	49.02	2.66
		e''	18.8508	Conductivity (σ):	5.45	5.29	2.94

Liquid Check

Ambient temperature: 25 deg. C; Liquid temperature: 24 deg. C; Relative humidity = 40%

August 10, 2011 09:04 AM

Frequency	e'	e''
5180000000.	50.3449	18.7953
5185000000.	50.3350	18.8103
5190000000.	50.3292	18.8254
5195000000.	50.3239	18.8364
5200000000.	50.3216	18.8508
5205000000.	50.3197	18.8563
5210000000.	50.3169	18.8585
5215000000.	50.3089	18.8603
5220000000.	50.2991	18.8636
5225000000.	50.2852	18.8665
5230000000.	50.2707	18.8726
5235000000.	50.2550	18.8803
5240000000.	50.2425	18.8893
5245000000.	50.2269	18.8960
5250000000.	50.2120	18.9048
5255000000.	50.1980	18.9136
5260000000.	50.1823	18.9204
5265000000.	50.1677	18.9304
5270000000.	50.1530	18.9443
5275000000.	50.1383	18.9562
5280000000.	50.1247	18.9697
5285000000.	50.1141	18.9821
5290000000.	50.1059	18.9958
5295000000.	50.0983	19.0090
5300000000.	50.0933	19.0187
5305000000.	50.0907	19.0298
5310000000.	50.0902	19.0343
5315000000.	50.0837	19.0403
5320000000.	50.0730	19.0450
5325000000.	50.0636	19.0486
5330000000.	50.0498	19.0549
5335000000.	50.0358	19.0602
5340000000.	50.0236	19.0676
5345000000.	50.0137	19.0757
5350000000.	50.0005	19.0816

The conductivity (σ) can be given as:

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

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

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

Measured by: David Rodgers

Date	Freq. (MHz)	Liquid Parameters		Measured	Target	Delta (%)	Limit ±(%)
8/11/2011	Body 5200	e'	49.6925	Relative Permittivity (ϵ_r):	49.69	49.02	1.37
		e''	18.7326	Conductivity (σ):	5.42	5.29	2.30

Liquid Check

Ambient temperature: 25 deg. C; Liquid temperature: 24 deg. C; Relative humidity = 40%

August 11, 2011 08:32 AM

Frequency	e'	e''
5200000000.	49.6925	18.7326
5205000000.	49.6881	18.7394
5210000000.	49.6818	18.7401
5215000000.	49.6730	18.7420
5220000000.	49.6609	18.7464
5225000000.	49.6469	18.7510
5230000000.	49.6300	18.7594
5235000000.	49.6145	18.7685
5240000000.	49.6037	18.7804
5245000000.	49.5916	18.7889
5250000000.	49.5809	18.7987
5255000000.	49.5704	18.8057
5260000000.	49.5592	18.8129
5265000000.	49.5477	18.8236
5270000000.	49.5345	18.8358
5275000000.	49.5214	18.8442
5475000000.	49.0998	19.1647
5480000000.	49.0885	19.1744
5485000000.	49.0787	19.1842
5490000000.	49.0707	19.1942
5495000000.	49.0631	19.2042
5500000000.	49.0563	19.2152
5505000000.	49.0507	19.2239
5510000000.	49.0432	19.2264
5515000000.	49.0325	19.2328
5520000000.	49.0210	19.2367
5525000000.	49.0115	19.2428
5530000000.	48.9963	19.2490
5535000000.	48.9857	19.2581
5540000000.	48.9709	19.2641
5545000000.	48.9599	19.2731
5550000000.	48.9511	19.2798
5555000000.	48.9381	19.2892

The conductivity (σ) can be given as:

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

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

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

Measured by: David Rodgers

Date	Freq. (MHz)	Liquid Parameters		Measured	Target	Delta (%)	Limit ±(%)
8/12/2011	Body 5500	e'	46.8390	Relative Permittivity (ϵ_r):	46.84	48.61	-3.65
		e''	18.4725	Conductivity (σ):	5.65	5.64	0.08

Liquid Check

Ambient temperature: 25 deg. C; Liquid temperature: 24 deg. C; Relative humidity = 40%

August 12, 2011 08:57 AM

Frequency	e'	e''
5150000000.	47.5878	17.8819
5155000000.	47.5678	17.8908
5160000000.	47.5518	17.8990
5165000000.	47.5383	17.9110
5170000000.	47.5267	17.9259
5175000000.	47.5167	17.9401
5180000000.	47.5089	17.9563
5185000000.	47.5004	17.9711
5190000000.	47.4926	17.9845
5195000000.	47.4831	17.9952
5200000000.	47.4770	18.0050
5500000000.	46.8390	18.4725
5505000000.	46.8391	18.4823
5510000000.	46.8347	18.4896
5515000000.	46.8293	18.4961
5520000000.	46.8204	18.5013
5525000000.	46.8076	18.5075
5530000000.	46.7943	18.5113
5535000000.	46.7810	18.5187
5540000000.	46.7749	18.5243
5545000000.	46.7643	18.5331
5550000000.	46.7545	18.5402
5555000000.	46.7474	18.5471
5560000000.	46.7369	18.5545
5565000000.	46.7223	18.5587
5570000000.	46.7089	18.5666
5575000000.	46.6925	18.5728
5580000000.	46.6777	18.5819
5585000000.	46.6651	18.5923
5590000000.	46.6565	18.6035
5595000000.	46.6514	18.6163
5600000000.	46.6418	18.6286

The conductivity (σ) can be given as:

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

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

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

Measured by: David Rodgers

Date	Freq. (MHz)	Liquid Parameters		Measured	Target	Delta (%)	Limit ±(%)
8/14/2011	Body 5800	e'	46.8371	Relative Permittivity (ϵ_r):	46.84	48.20	-2.83
		e''	19.0225	Conductivity (σ):	6.13	6.00	2.25

Liquid Check

Ambient temperature: 25 deg. C; Liquid temperature: 24 deg. C; Relative humidity = 40%

August 14, 2011 09:57 AM

Frequency	e'	e''
5725000000.	46.9937	18.9028
5730000000.	46.9839	18.9093
5735000000.	46.9707	18.9154
5740000000.	46.9618	18.9235
5745000000.	46.9527	18.9320
5750000000.	46.9432	18.9396
5755000000.	46.9342	18.9473
5760000000.	46.9245	18.9529
5765000000.	46.9140	18.9600
5770000000.	46.9044	18.9662
5775000000.	46.8919	18.9709
5780000000.	46.8804	18.9775
5785000000.	46.8668	18.9863
5790000000.	46.8545	18.9982
5795000000.	46.8439	19.0107
5800000000.	46.8371	19.0225
5805000000.	46.8275	19.0351
5810000000.	46.8207	19.0427
5815000000.	46.8094	19.0463
5820000000.	46.8013	19.0505
5825000000.	46.7923	19.0590
5830000000.	46.7806	19.0638
5835000000.	46.7706	19.0715
5840000000.	46.7605	19.0777
5845000000.	46.7509	19.0875
5850000000.	46.7423	19.0952
5855000000.	46.7327	19.1021
5860000000.	46.7243	19.1090
5865000000.	46.7121	19.1173
5870000000.	46.7022	19.1219
5875000000.	46.6913	19.1273
5880000000.	46.6781	19.1338
5885000000.	46.6674	19.1417
5890000000.	46.6536	19.1541
5895000000.	46.6422	19.1642
5900000000.	46.6330	19.1780

The conductivity (σ) can be given as:

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

where $f = \text{target } f * 10^6$
 $\epsilon_0 = 8.854 * 10^{-12}$

10. SYSTEM VERIFICATION

The system performance check is performed prior to any usage of the system in order to verify SAR system measurement accuracy. 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 SN3531 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 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	Cal. Freq. (GHz)	SAR Avg (mW/g)		
				Tissue:	Head	Body
D2450V2	D2450V2-706_Apr10	4/19/10	2.4	1g SAR:	51.6	52.4
				10g SAR:	24.4	24.5
D5GHzV2	D5GHzV2-1075_Sep09	9/3/09	5.2	1g SAR:		79.0
				10g SAR:		22.0
			5.5	1g SAR:		85.4
				10g SAR:		23.5
			5.8	1g SAR:		73.2
				10g SAR:		20.1

10.1. SYSTEM CHECK RESULTS

System validation dipole	Date Tested	Measured (Normalized to 1 W)		Target	Delta (%)	Tolerance (%)
		Tissue:	Body			
D2450V2	08/09/11	SAR _{1g} :	54.1	52.4	3.24	±10
		SAR _{10g} :	24.9	24.5	1.63	
D2450V2	08/10/11	SAR _{1g} :	55.8	52.4	6.49	±10
		SAR _{10g} :	25.7	24.5	4.90	

System validation dipole	Date Tested	Measured (Normalized to 1 W)		Target	Delta (%)	Tolerance (%)
		Tissue:	Body			
D5GHzV2 (5.2GHz)	08/10/11	SAR _{1g} :	78.2	79.0	-1.01	±10
		SAR _{10g} :	22.6	22.0	2.73	
D5GHzV2 (5.2GHz)	08/11/11	SAR _{1g} :	77.7	79.0	-1.65	±10
		SAR _{10g} :	22.1	22.0	0.45	
D5GHzV2 (5.5GHz)	08/12/11	1g SAR:	80.50	85.4	-5.74	±10
		10g SAR:	22.70	23.5	-3.40	
D5GHzV2 (5.8GHz)	08/14/11	1g SAR:	70.70	73.2	-3.42	±10
		10g SAR:	19.80	20.1	-1.49	

Note(s):

See appendix for details of data and plots

11. RF 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, DRTU 1.3.11-0254, which enable to control the frequency and output power of the module.

11.1. RF OUTPUT POWER FOR 2.4 GHZ

2.4 GHz Band							
Mode	Ch. #	Freq. (MHz)	Rate	Original Pwr (dBm)		Measured Pwr (dBm)	
				Chain A	Chain B	Chain A	Chain B
802.11b	1	2412	1 kbps	16.8			
	6	2437	1 kbps	16.8		16.9	
	11	2462	1 kbps	16.8			
	1	2412	1 kbps		16.6		16.8
	6	2437	1 kbps		15.0		
	11	2462	1 kbps		16.0		
802.11g	1	2412	6 kbps	14.1			
	6	2437	6 kbps	16.6			
	11	2462	6 kbps	14.0			
	1	2412	6 kbps		13.9		
	6	2437	6 kbps		16.7		
	11	2462	6 kbps		13.5		
802.11n HT20	1	2412	HT0	13.1			
	6	2437	HT0	16.5			
	11	2462	HT0	12.5			
	1	2412	HT0		12.5		
	6	2437	HT0		16.6		
	11	2462	HT0		12.4		
	1	2412	HT8	11.6	11.6		
	6	2437	HT8	13.3	13.0	13.3	13.1
	11	2462	HT8	11.1	10.4		
802.11n HT40	3	2422	HT0	10.6			
	6	2437	HT0	13.6			
	9	2450	HT0	10.1			
	3	2422	HT0		9.2		
	6	2437	HT0		12.7		
	9	2450	HT0		10.1		
	3	2422	HT8	7.3	7.0		
	6	2437	HT8	12.3	12.3	12.4	12.3
	9	2450	HT8	6.5	6.7		

Note:

The modes with highest output power channel were chosen for the conducted output power measurement. Please refer to original report (FCC ID: PD962230ANH and PD962230ANHU) for Average Power information as documented in 10/21/2010 original filing.

11.2. RF OUTPUT POWER FOR 5 GHZ BANDS

5.2 GHz Band							
Mode	Ch. #	Freq. (MHz)	Rate	Original Pwr (dBm)		Measured Pwr (dBm)	
				Chain A	Chain B	Chain A	Chain B
802.11a	36	5180	6kbps	16.2			
	40	5200	6kbps	16.2			
	48	5240	6kbps	15.9			
	36	5180	6kbps		15.9		
	40	5200	6kbps		15.8		
	48	5240	6kbps		15.7		
802.11n HT20	36	5180	HT0	15.9			
	40	5200	HT0	16.5		16.5	
	48	5240	HT0	16.4			
	36	5180	HT0		16.0		
	40	5200	HT0		16.0		16.2
	48	5240	HT0		15.9		
	36	5180	HT8	13.3	13.3	13.3	13.3
	40	5200	HT8	13.2	13.2		
	48	5240	HT8	13.0	12.9		
802.11n HT40	38	5190	HT7	12.8			
	46	5230	HT7	16.4			
	38	5190	HT7		12.7		
	46	5230	HT7		15.8		
	38	5190	HT8	10.0	10.8		
	46	5230	HT8	13.4	13.3	13.5	13.4

Note:

The modes with highest output power channel were chosen for the conducted output power measurement. Please refer to original report (FCC ID: PD962230ANH and PD962230ANHU) for Average Power information as documented in 10/21/2010 original filing.

5.3 GHz Band							
Mode	Ch. #	Freq. (MHz)	Rate	Original Pwr (dBm)		Measured Pwr (dBm)	
				Chain A	Chain B	Chain A	Chain B
802.11a	52	5260	6kbps	15.9			
	60	5300	6kbps	16.3			
	64	5320	6kbps	16.4			
	52	5260	6kbps		15.3		
	60	5300	6kbps		15.4		
	64	5320	6kbps		15.9		16.1
802.11n HT20	52	5260	HT0	16.1			
	60	5300	HT0	16.6		16.7	
	64	5320	HT0	16.6			
	52	5260	HT0		15.4		
	60	5300	HT0		15.3		
	64	5320	HT0		15.7		
	52	5260	HT8	12.7	12.5		
	60	5300	HT8	13.2	12.6		
802.11n HT40	64	5320	HT8	12.9	13.1	12.9	13.2
	54	5270	HT7	16.0			
	62	5310	HT7	11.5			
	54	5270	HT7		15.2		
	62	5310	HT7		12.4		
	54	5270	HT8	12.6	12.5	12.7	12.5
	62	5310	HT8	12.4	12.3		

Note:

The modes with highest output power channel were chosen for the conducted output power measurement. Please refer to original report (FCC ID: PD962230ANH and PD962230ANHU) for Average Power information as documented in 10/21/2010 original filing.

5.5 GHz Band							
Mode	Ch. #	Freq. (MHz)	Rate	Original Pwr (dBm)		Measured Pwr (dBm)	
				Chain A	Chain B	Chain A	Chain B
802.11a	100	5500	6kbps	16.4			
	116	5580	6kbps	16.5		16.7	
	140	5700	6kbps	16.5			
	100	5500	6kbps		15.6		
	120	5580	6kbps		15.7		
	140	5700	6kbps		15.5		
802.11n HT20	100	5500	HT0	16.4			
	116	5580	HT0	16.4			
	140	5700	HT0	16.3			
	100	5500	HT0		15.6		
	116	5580	HT0		15.7		
	140	5700	HT0		15.5		
	100	5500	HT8	12.7	13.2		
	116	5580	HT8	12.7	13.2	12.8	13.2
	140	5700	HT8	12.4	12.4		
802.11n HT40	102	5510	HT7	15.5			
	110	5550	HT7	16.5			
	134	5670	HT7	16.4			
	102	5510	HT7		14.8		
	110	5550	HT7		15.8		16.0
	134	5670	HT7		15.6		
	102	5510	HT8	13.1	13.0		
	110	5550	HT8	13.2	13.2	13.2	13.2
	134	5670	HT8	12.6	12.8		

Note:

The modes with highest output power channel were chosen for the conducted output power measurement. Please refer to original report (FCC ID: PD962230ANH and PD962230ANHU) for Average Power information as documented in 10/21/2010 original filing.

5.8 GHz Band							
Mode	Ch. #	Freq. (MHz)	Rate	Original Pwr (dBm)		Measured Pwr (dBm)	
				Chain A	Chain B	Chain A	Chain B
802.11a	149	5745	6kbps	16.5			
	157	5785	6kbps	16.5			
	165	5825	6kbps	16.5			
	149	5745	6kbps		16.7		
	157	5785	6kbps		16.7		16.7
	165	5825	6kbps		16.6		
802.11n HT20	149	5745	HT0	16.6		16.6	
	157	5785	HT0	16.5			
	165	5825	HT0	16.5			
	149	5745	HT0		16.0		
	157	5785	HT0		15.9		
	165	5825	HT0		15.9		
	149	5745	HT8	13.6	13.5	13.6	13.6
	157	5785	HT8	13.5	13.4		
	165	5825	HT8	13.3	13.7		
802.11n HT40	151	5755	HT7	16.5			
	159	5795	HT7	16.5			
	151	5755	HT7		16.6		
	159	5795	HT7		16.6		
	151	5755	HT8	13.5	13.5	13.5	13.5
	159	5795	HT8	13.3	13.4		

Note:

The modes with highest output power channel were chosen for the conducted output power measurement. Please refer to original report (FCC ID: PD962230ANH and PD962230ANHU) for Average Power information as documented in 10/21/2010 original filing.

12. SUMMARY OF SAR TEST RESULTS

12.1. 2.4 GHZ

(1) Bottom Face

Mode	Ch. #	Freq. (MHz)	Antenna (Chain)	Avg. output	Test Results (W/kg)	
				Pwr (dBm)	1g-SAR	10g-SAR
802.11b	1	2412	A	16.8		
	6	2437	A	16.8	0.564	0.255
	11	2462	A	16.8		
	1	2412	B	16.6	0.564	0.266
	6	2437	B	15.0		
	11	2462	B	16.0		

Mode	Ch. #	Freq. (MHz)	Antenna (Chain)	Avg. output Pwr (dBm)	Test Results (W/kg)			
					1g-SAR		10g-SAR	
					Chain A	Chain B	Chain A	Chain B
802.11n (HT20)	1	2412	A&B					
	6	2437	A&B	13.3 & 13.1	0.156	0.122	0.073	0.055
	11	2462	A&B					
802.11n (HT40)	3	2422	A&B					
	6	2437	A&B	12.4 & 12.3	0.125	0.059	0.121	0.055
	9	2450	A&B					

(2) Secondary Landscape

Mode	Ch. #	Freq. (MHz)	Antenna (Chain)	Avg. output	Test Results (W/kg)	
				Pwr (dBm)	1g-SAR	10g-SAR
802.11b	1	2412	B	16.6	0.241	0.103
	6	2437	B	15.0		
	11	2462	B	16.0		

Mode	Ch. #	Freq. (MHz)	Antenna (Chain)	Avg. output Pwr (dBm)	Test Results (W/kg)			
					1g-SAR		10g-SAR	
					Chain A	Chain B	Chain	Chain B
802.11n (HT20)	1	2412	A&B					
	6	2437	A&B	13.3 & 13.1	0.199	0.115	0.089	0.056
	11	2462	A&B					

(3) Secondary Portrait

Mode	Ch. #	Freq. (MHz)	Antenna (Chain)	Avg. output	Test Results (W/kg)	
				Pwr (dBm)	1g-SAR	10g-SAR
802.11b	1	2412	A	16.8		
	6	2437	A	16.8	0.227	0.113
	11	2462	A	16.8		

Mode	Ch. #	Freq. (MHz)	Antenna (Chain)	Avg. output Pwr (dBm)	Test Results (W/kg)			
					1g-SAR		10g-SAR	
					Chain A	Chain B	Chain A	Chain B
802.11n (HT20)	1	2412	A&B					
	6	2437	A&B	13.3 & 13.1	0.160	0.147	0.079	0.069
	11	2462	A&B					

Note(s)

1. According to KDB 248227, SAR is not required for 802.11g/n HT20/HT40 single chain channels when the maximum average output power is less than 1/4 dB higher than that measured on the corresponding 802.11b channels.
2. The modes with highest output power channel were chosen for the conducted output power.

12.2. 5 GHZ BANDS

5.2 GHz band (5150 – 5250 MHz)

(1) Bottom Face

Mode	Ch. #	Freq. (MHz)	Antenna (Chain)	Avg. output	Test Results (W/kg)	
				Pwr (dBm)	1g-SAR	10g-SAR
802.11n (HT20)	36	5180	A	15.9		
	40	5200	A	16.5	0.429	0.137
	48	5240	A	16.4		
	36	5180	B	16.0		
	40	5200	B	16.0	0.330	0.121
	48	5240	B	15.9		

Mode	Ch. #	Freq. (MHz)	Antenna (Chain)	Avg. output Pwr (dBm)	Test Results (W/kg)			
					1g-SAR		10g-SAR	
					Chain A	Chain B	Chain A	Chain B
802.11n (HT20)	36	5180	A&B	13.3 & 13.3	0.214	0.162	0.066	0.057
	40	5200	A&B					
	48	5240	A&B					
802.11n (HT40)	38	5190	A&B					
	46	5230	A&B	13.5 & 13.4	0.172	0.119	0.053	0.040

(2) Secondary Landscape

Mode	Ch. #	Freq. (MHz)	Antenna (Chain)	Avg. output	Test Results (W/kg)	
				Pwr (dBm)	1g-SAR	10g-SAR
802.11n (HT20)	36	5180	B	16.0		
	40	5200	B	16.0	0.668	0.213
	48	5240	B	15.9		

Mode	Ch. #	Freq. (MHz)	Antenna (Chain)	Avg. output Pwr (dBm)	Test Results (W/kg)			
					1g-SAR		10g-SAR	
					Chain A	Chain B	Chain A	Chain B
802.11n (HT20)	36	5180	A&B	13.3 & 13.3	0.266	0.215	0.081	0.060
	40	5200	A&B					
	48	5240	A&B					

(3) Secondary Portrait

Mode	Ch. #	Freq. (MHz)	Antenna (Chain)	Avg. output	Test Results (W/kg)	
				Pwr (dBm)	1g-SAR	10g-SAR
802.11n (HT20)	36	5180	A	15.9		
	40	5200	A	16.5	0.717	0.179
	48	5240	A	16.4		

Mode	Ch. #	Freq. (MHz)	Antenna (Chain)	Avg. output Pwr (dBm)	Test Results (W/kg)			
					1g-SAR		10g-SAR	
					Chain A	Chain B	Chain A	Chain B
802.11n (HT20)	36	5180	A&B	13.3 & 13.3	0.546	0.274	0.132	0.077
	40	5200	A&B					
	48	5240	A&B					

Note

- The modes with highest output power channel were chosen for the conducted output power.

5.3 GHz band (5250 – 5350 MHz)

(1) Bottom Face

Mode	Ch. #	Freq. (MHz)	Antenna (Chain)	Avg. output	Test Results (W/kg)	
				Pwr (dBm)	1g-SAR	10g-SAR
802.11n (HT20)	52	5260	A	16.1		
	60	5300	A	16.6	0.502	0.181
	64	5320	A	16.6		
802.11a Legacy	52	5260	B	15.3		
	60	5300	B	15.4		
	64	5320	B	15.9	0.431	0.137

Mode	Ch. #	Freq. (MHz)	Antenna (Chain)	Avg. output Pwr (dBm)	Test Results (W/kg)			
					1g-SAR		10g-SAR	
					Chain A	Chain B	Chain A	Chain B
802.11n (HT20)	52	5260	A&B					
	60	5300	A&B					
	64	5320	A&B	12.9 & 13.2	0.188	0.185	0.067	0.054
802.11n (HT40)	54	5270	A&B	12.7 & 12.5	0.225	0.181	0.078	0.054
	62	5310	A&B					

(2) Secondary Landscape

Mode	Ch. #	Freq. (MHz)	Antenna (Chain)	Avg. output	Test Results (W/kg)	
				Pwr (dBm)	1g-SAR	10g-SAR
802.11n (HT20)	52	5260	B	15.3		
	60	5300	B	15.4		
	64	5320	B	15.9	0.657	0.203

Mode	Ch. #	Freq. (MHz)	Antenna (Chain)	Avg. output Pwr (dBm)	Test Results (W/kg)			
					1g-SAR		10g-SAR	
					Chain A	B	Chain A	Chain B
802.11n (HT40)	54	5270	A&B	12.7 & 12.5	0.211	0.147	0.064	0.042
	62	5310	A&B					

(3) Secondary Portrait

Mode	Ch. #	Freq. (MHz)	Antenna (Chain)	Avg. output	Test Results (W/kg)	
				Pwr (dBm)	1g-SAR	10g-SAR
802.11n (HT20)	52	5260	A	16.1		
	60	5300	A	16.6	0.592	0.143
	64	5320	A	16.6		

Mode	Ch. #	Freq. (MHz)	Antenna (Chain)	Avg. output Pwr (dBm)	Test Results (W/kg)			
					1g-SAR		10g-SAR	
					Chain A	Chain B	Chain A	Chain B
802.11n (HT40)	54	5270	A&B	12.7 & 12.5	0.196	0.194	0.047	0.049
	62	5310	A&B					

Note

1. The modes with highest output power channel were chosen for the conducted output power.

5.5 GHz band (5500 – 5700 MHz)

(1) Bottom Face

Mode	Ch. #	Freq. (MHz)	Antenna (Chain)	Avg. output	Test Results (W/kg)	
				Pwr (dBm)	1g-SAR	10g-SAR
802.11a Legacy	100	5500	A	16.4		
	116	5580	A	16.5	0.387	0.118
	140	5700	A	16.5		
802.11n (HT40)	100	5500	B	14.8		
	116	5580	B	15.8	0.496	0.173
	140	5700	B	15.6		

Mode	Ch. #	Freq. (MHz)	Antenna (Chain)	Avg. output Pwr (dBm)	Test Results (W/kg)			
					1g-SAR		10g-SAR	
					Chain A	Chain B	Chain A	Chain B
802.11n (HT20)	100	5500	A&B					
	116	5580	A&B	12.8 & 13.2	0.248	0.153	0.084	0.047
	140	5700	A&B					
802.11n (HT40)	102	5510	A&B					
	118	5550	A&B	13.2 & 13.2	0.261	0.258	0.087	0.061
	134	5670	A&B	15.7				

(2) Secondary Landscape

Mode	Ch. #	Freq. (MHz)	Antenna (Chain)	Avg. output	Test Results (W/kg)	
				Pwr (dBm)	1g-SAR	10g-SAR
802.11n (HT40)	100	5510	B	14.8		
	116	5550	B	15.8	0.706	0.184
	140	5670	B	15.6		

Mode	Ch. #	Freq. (MHz)	Antenna (Chain)	Avg. output Pwr (dBm)	Test Results (W/kg)			
					1g-SAR		10g-SAR	
					Chain A	Chain B	Chain A	Chain B
802.11n (HT40)	102	5510	A&B					
	118	5550	A&B	13.2 & 13.2	0.491	0.159	0.127	0.040
	134	5670	A&B					

(3) Secondary Portrait

Mode	Ch. #	Freq. (MHz)	Antenna (Chain)	Avg. output	Test Results (W/kg)	
				Pwr (dBm)	1g-SAR	10g-SAR
802.11a Legacy	100	5500	A	16.4		
	116	5580	A	16.5	0.607	0.145
	140	5700	A	16.5		

Mode	Ch. #	Freq. (MHz)	Antenna (Chain)	Avg. output Pwr (dBm)	Test Results (W/kg)			
					1g-SAR		10g-SAR	
					Chain A	Chain B	Chain A	Chain B
802.11n (HT40)	102	5510	A&B					
	118	5550	A&B	13.2 & 13.2	0.230	0.124	0.051	0.028
	134	5670	A&B					

Note

1. The modes with highest output power channel were chosen for the conducted output power.

5.8 GHz band (5500 – 5700 MHz)

(1) Bottom Face

Mode	Ch. #	Freq. (MHz)	Antenna (Chain)	Avg. output	Test Results (W/kg)	
				Pwr (dBm)	1g-SAR	10g-SAR
802.11n (HT20)	149	5745	A	16.6	0.229	0.074
	157	5785	A	16.5		
	165	5825	A	16.5		
802.11a Legacy	149	5745	B	16.7		
	157	5785	B	16.7	0.310	0.100
	165	5825	B	16.6		

Mode	Ch. #	Freq. (MHz)	Antenna (Chain)	Avg. output Pwr (dBm)	Test Results (W/kg)			
					1g-SAR		10g-SAR	
					Chain A	Chain B	Chain A	Chain B
802.11n (HT20)	149	5745	A&B	13.6 & 13.6	0.121	0.101	0.036	0.029
	157	5785	A&B					
	165	5825	A&B					
802.11n (HT40)	151	5755	A&B	13.5 & 13.5	0.088	0.068	0.028	0.020
	159	5795	A&B					

(2) Secondary Landscape

Mode	Ch. #	Freq. (MHz)	Antenna (Chain)	Avg. output	Test Results (W/kg)	
				Pwr (dBm)	1g-SAR	10g-SAR
802.11a Legacy	149	5745	B	16.7		
	157	5785	B	16.7	0.685	0.162
	165	5825	B	16.6		

Mode	Ch. #	Freq. (MHz)	Antenna (Chain)	Avg. output Pwr (dBm)	Test Results (W/kg)			
					1g-SAR		10g-SAR	
					Chain A	Chain B	Chain A	Chain B
802.11n (HT20)	149	5745	A&B	13.6 & 13.6	0.447	0.079	0.102	0.019
	157	5785	A&B					
	165	5825	A&B					

(3) Secondary Portrait

Mode	Ch. #	Freq. (MHz)	Antenna (Chain)	Avg. output	Test Results (W/kg)	
				Pwr (dBm)	1g-SAR	10g-SAR
802.11n (HT20)	149	5745	A	16.6	0.685	0.175
	157	5785	A	16.5		
	165	5825	A	16.5		

Mode	Ch. #	Freq. (MHz)	Antenna (Chain)	Avg. output Pwr (dBm)	Test Results (W/kg)			
					1g-SAR		10g-SAR	
					Chain A	Chain B	Chain A	Chain B
802.11n (HT20)	149	5745	A&B	13.6 & 13.6	0.278	0.174	0.070	0.051
	157	5785	A&B					
	165	5825	A&B					

Note

1. The modes with highest output power channel were chosen for the conducted output power.

13. Worst Case Test Plots

Date: 8/9/2011

Test Laboratory: UL CCS SAR Lab B

001_Bottom Face

Communication System: 802.11b/g 2.4GHz; Frequency: 2412 MHz; Duty Cycle: 1:1
Medium parameters used (interpolated): $f = 2412$ MHz; $\sigma = 1.952$ mho/m; $\epsilon_r = 51.177$; $\rho = 1000$ kg/m³
Phantom section: Flat Section

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

DASY5 Configuration:

- Area Scan setting - Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Probe: EX3DV4 - SN3773; ConvF(6.87, 6.87, 6.87); Calibrated: 5/3/2011
- Sensor-Surface: 2.5mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 2.5mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1258; Calibrated: 5/2/2011
- Phantom: ELI v5.0 (B); Type: QDOVA001BB; Serial: 1118
- Measurement SW: DASY52, Version 52.6 (2); SEMCAD X Version 14.4.5 (3634)

802.11b/g/n_Ch 1_Chain B/Area Scan (191x171x1): Measurement grid: dx=15mm, dy=15mm

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

Maximum value of SAR (interpolated) = 0.726 mW/g

802.11b/g/n_Ch 1_Chain B/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

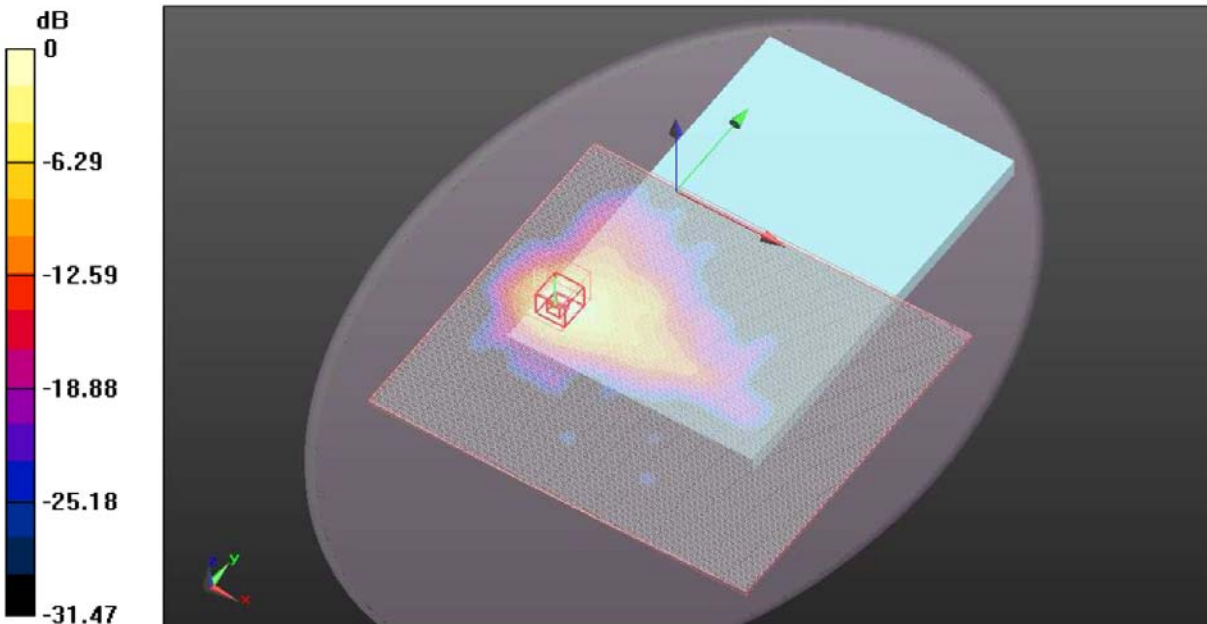
Reference Value = 18.824 V/m; Power Drift = 0.0016 dB

Peak SAR (extrapolated) = 1.179 W/kg

SAR(1 g) = 0.564 mW/g; SAR(10 g) = 0.266 mW/g

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

Maximum value of SAR (measured) = 0.789 mW/g



0 dB = 0.790mW/g

Date: 8/9/2011

Test Laboratory: UL CCS SAR Lab B

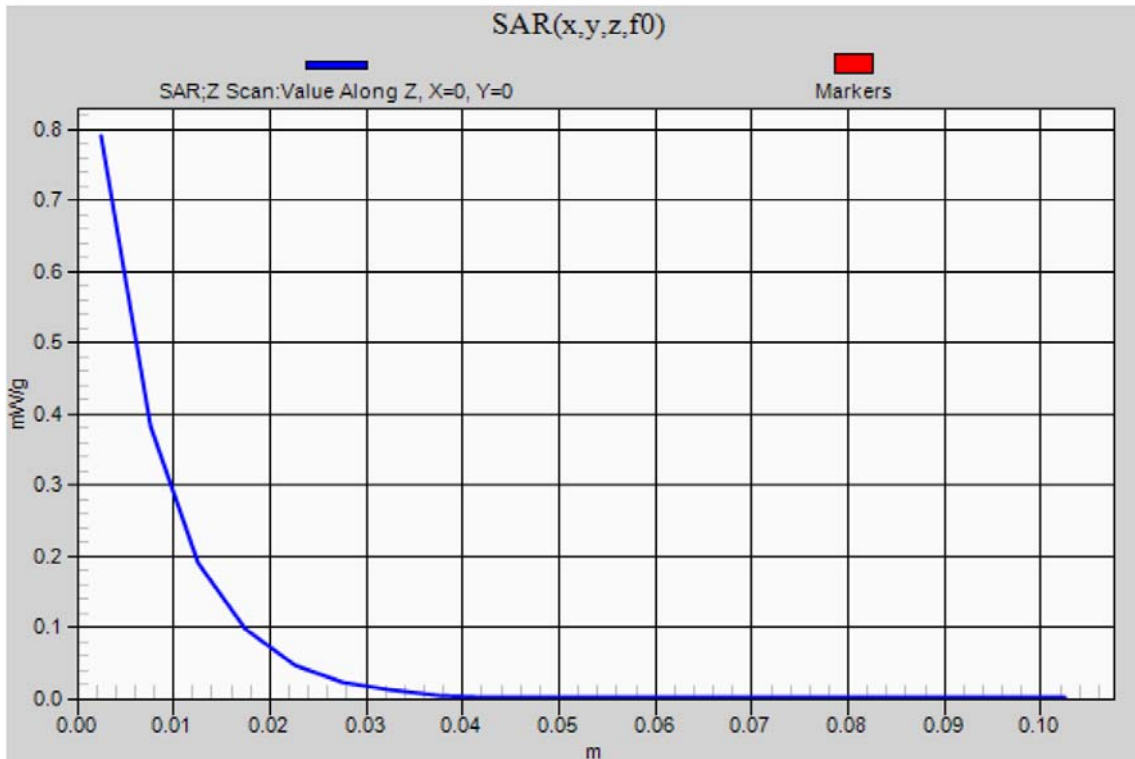
001_Bottom Face

Communication System: 802.11b/g 2.4GHz; Frequency: 2412 MHz; Duty Cycle: 1:1

802.11b/g/n_Ch 1_Chain B/Z Scan (1x1x21): Measurement grid: dx=20mm, dy=20mm, dz=5mm

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

Maximum value of SAR (measured) = 0.791 mW/g



Date: 8/10/2011

Test Laboratory: UL CCS SAR Lab B

021_Secondary Portrait

Communication System: WLAN_5GHz; Frequency: 5200 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 5200$ MHz; $\sigma = 5.453$ mho/m; $\epsilon_r = 50.322$; $\rho = 1000$ kg/m³
Phantom section: Flat Section

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

DASY5 Configuration:

- Area Scan setting - Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Probe: EX3DV4 - SN3773; ConvF(4.1, 4.1, 4.1); Calibrated: 5/3/2011
- Sensor-Surface: 2.5mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 2.5mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1258; Calibrated: 5/2/2011
- Phantom: ELI v5.0 (A); Type: QDOVA001BB; Serial: 1117
- Measurement SW: DASY52, Version 52.6 (2); SEMCAD X Version 14.4.5 (3634)

802.11a/n_Ch 40_Chain A/Area Scan (111x151x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.980 mW/g

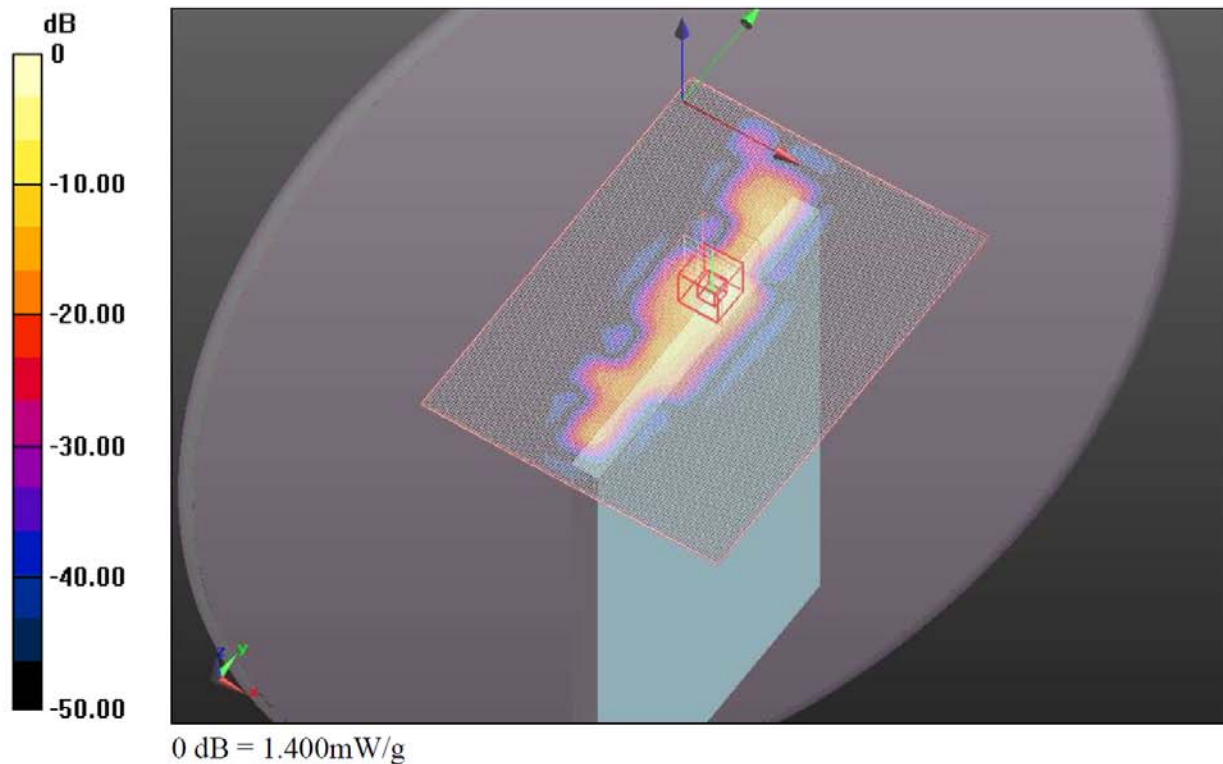
802.11a/n_Ch 40_Chain A/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm

Reference Value = 13.229 V/m; Power Drift = 0.0017 dB

Peak SAR (extrapolated) = 3.041 W/kg

SAR(1 g) = 0.717 mW/g; SAR(10 g) = 0.179 mW/g

Maximum value of SAR (measured) = 1.400 mW/g



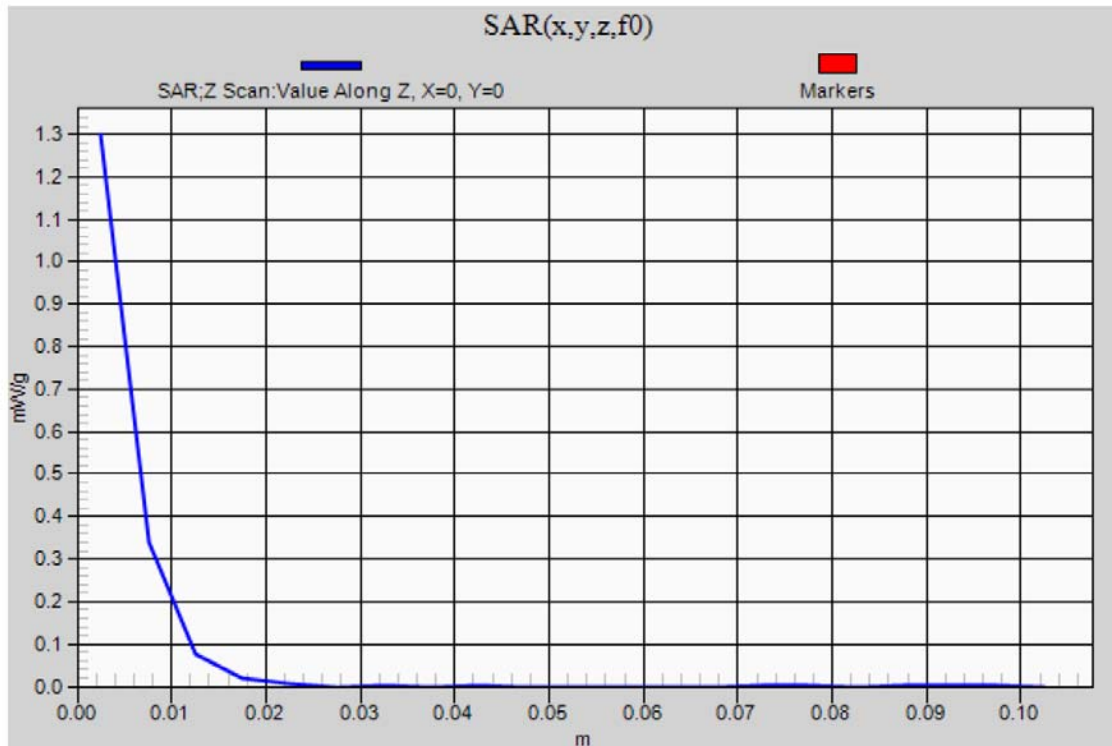
Date: 8/10/2011

Test Laboratory: UL CCS SAR Lab B

021_Secondary Portrait

Communication System: WLAN_5GHz; Frequency: 5200 MHz; Duty Cycle: 1:1

802.11a/n_Ch 40_Chain A/Z Scan (1x1x21): Measurement grid: dx=20mm, dy=20mm, dz=5mm
Maximum value of SAR (measured) = 1.299 mW/g



Date: 8/11/2011

Test Laboratory: UL CCS SAR Lab B

027_Secondary Landscape

Communication System: WLAN_5GHz; Frequency: 5320 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 5320$ MHz; $\sigma = 5.598$ mho/m; $\epsilon_r = 49.443$; $\rho = 1000$ kg/m³
Phantom section: Flat Section

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

DASY5 Configuration:

- Area Scan setting - Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Probe: EX3DV4 - SN3773; ConvF(3.88, 3.88, 3.88); Calibrated: 5/3/2011
- Sensor-Surface: 2.5mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1258; Calibrated: 5/2/2011
- Phantom: ELI v5.0 (A); Type: QDOVA001BB; Serial: 1117
- Measurement SW: DASY52, Version 52.6 (2);SEMCAD X Version 14.4.5 (3634)

802.11a/n_Ch 64_Chain B/Area Scan (121x151x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 1.164 mW/g

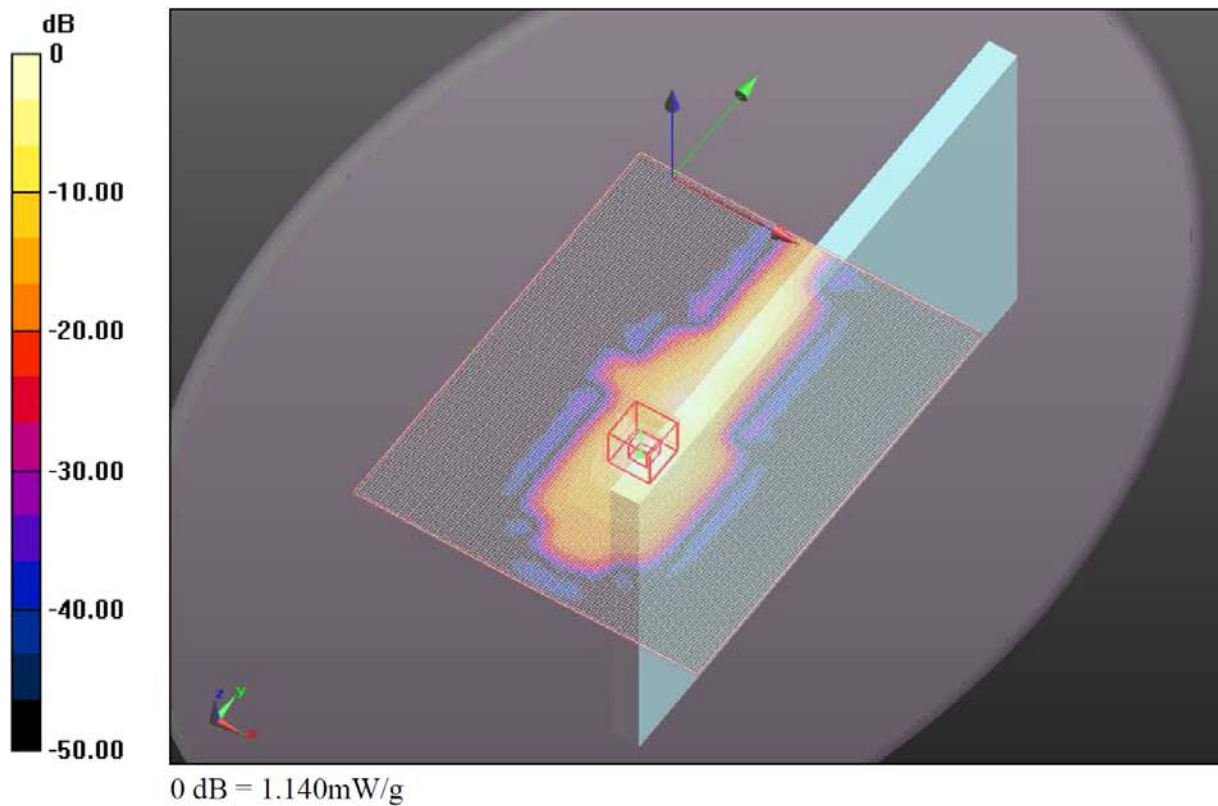
802.11a/n_Ch 64_Chain B/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm

Reference Value = 15.451 V/m; Power Drift = -0.10 dB

Peak SAR (extrapolated) = 2.224 W/kg

SAR(1 g) = 0.657 mW/g; SAR(10 g) = 0.203 mW/g

Maximum value of SAR (measured) = 1.138 mW/g



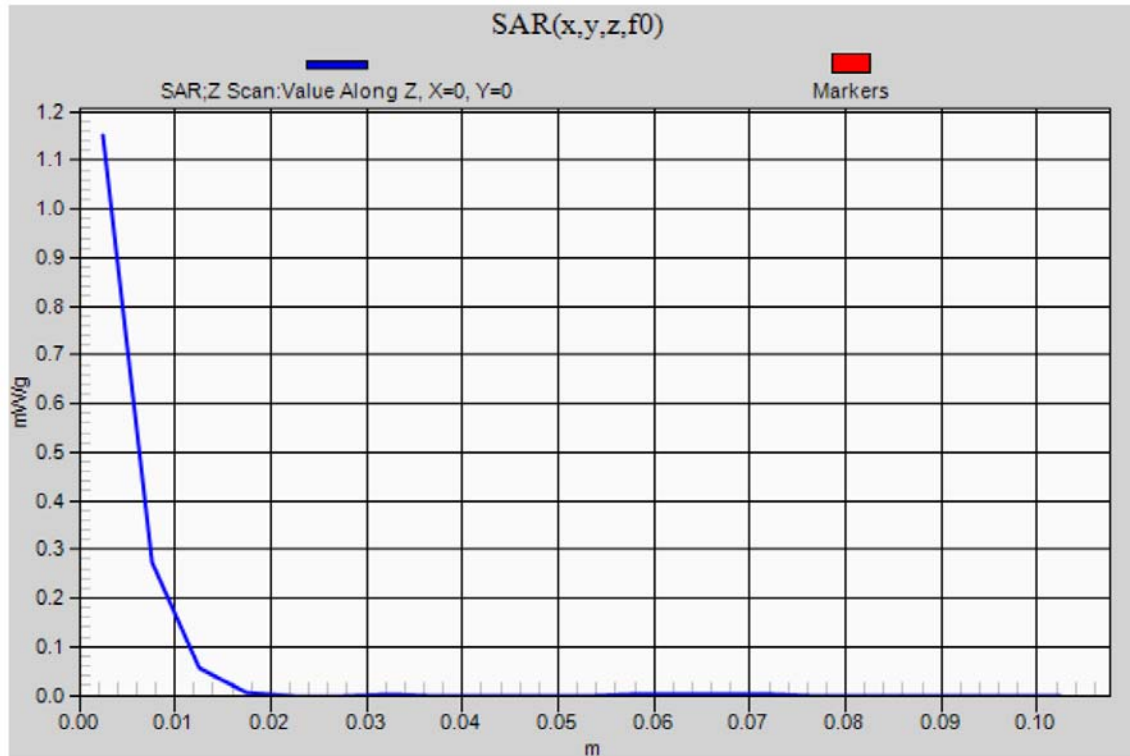
Date: 8/11/2011

Test Laboratory: UL CCS SAR Lab B

027_Secondary Landscape

Communication System: WLAN_5GHz; Frequency: 5320 MHz; Duty Cycle: 1:1

802.11a/n_Ch 64_Chain B/Z Scan (1x1x21): Measurement grid: dx=20mm, dy=20mm, dz=5mm
Maximum value of SAR (measured) = 1.151 mW/g



Date: 8/12/2011

Test Laboratory: UL CCS SAR Lab B

035_Secondary Landscape

Communication System: WLAN_5GHz; Frequency: 5550 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 5550$ MHz; $\sigma = 5.724$ mho/m; $\epsilon_r = 46.755$; $\rho = 1000$ kg/m³
Phantom section: Flat Section

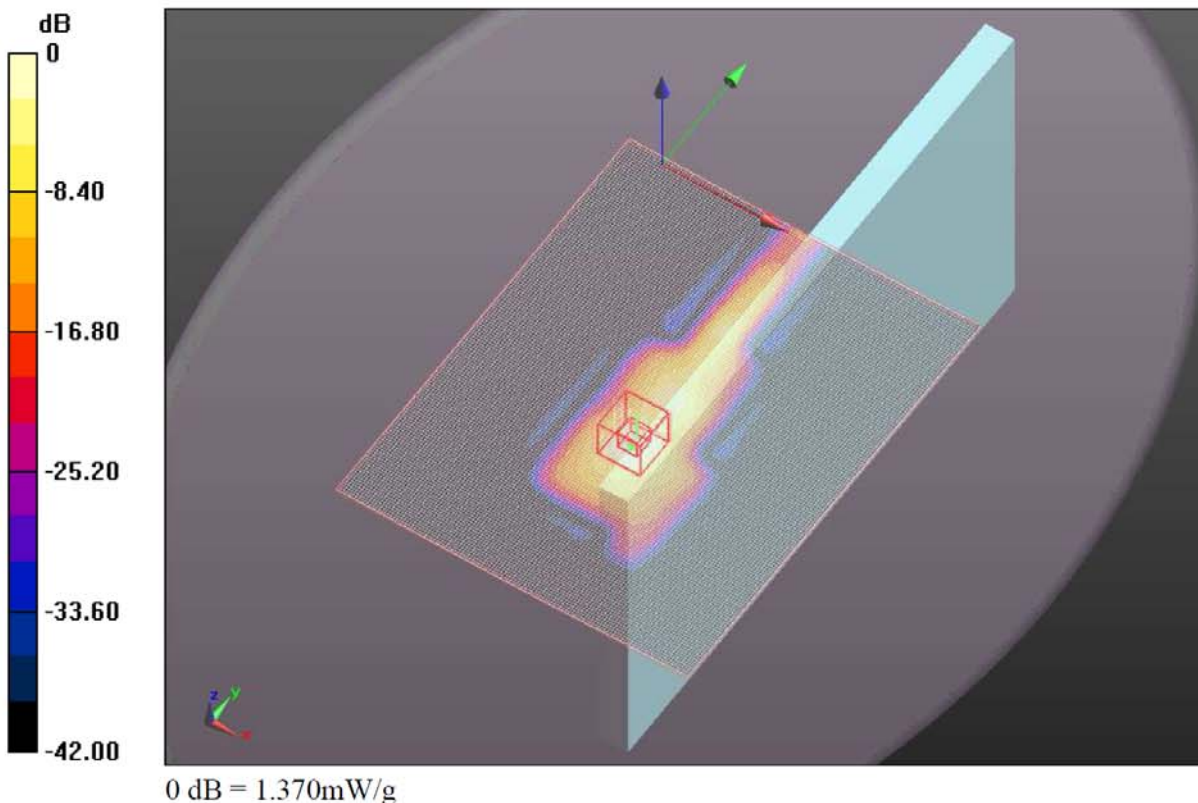
Room Ambient Temperature: 25.0 deg. C; Liquid Temperature: 24.0 deg. C

DASY5 Configuration:

- Area Scan setting - Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Probe: EX3DV4 - SN3773; ConvF(3.49, 3.49, 3.49); Calibrated: 5/3/2011
- Sensor-Surface: 2.5mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1258; Calibrated: 5/2/2011
- Phantom: ELI v5.0 (A); Type: QDOVA001BB; Serial: 1117
- Measurement SW: DASY52, Version 52.6 (2); SEMCAD X Version 14.4.5 (3634)

802.11a/n_Ch 110_Chain B/Area Scan (121x151x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 1.905 mW/g

802.11a/n_Ch 110_Chain B/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 19.764 V/m; Power Drift = 0.12 dB
Peak SAR (extrapolated) = 1.800 W/kg
SAR(1 g) = 0.706 mW/g; SAR(10 g) = 0.184 mW/g
Maximum value of SAR (measured) = 1.374 mW/g



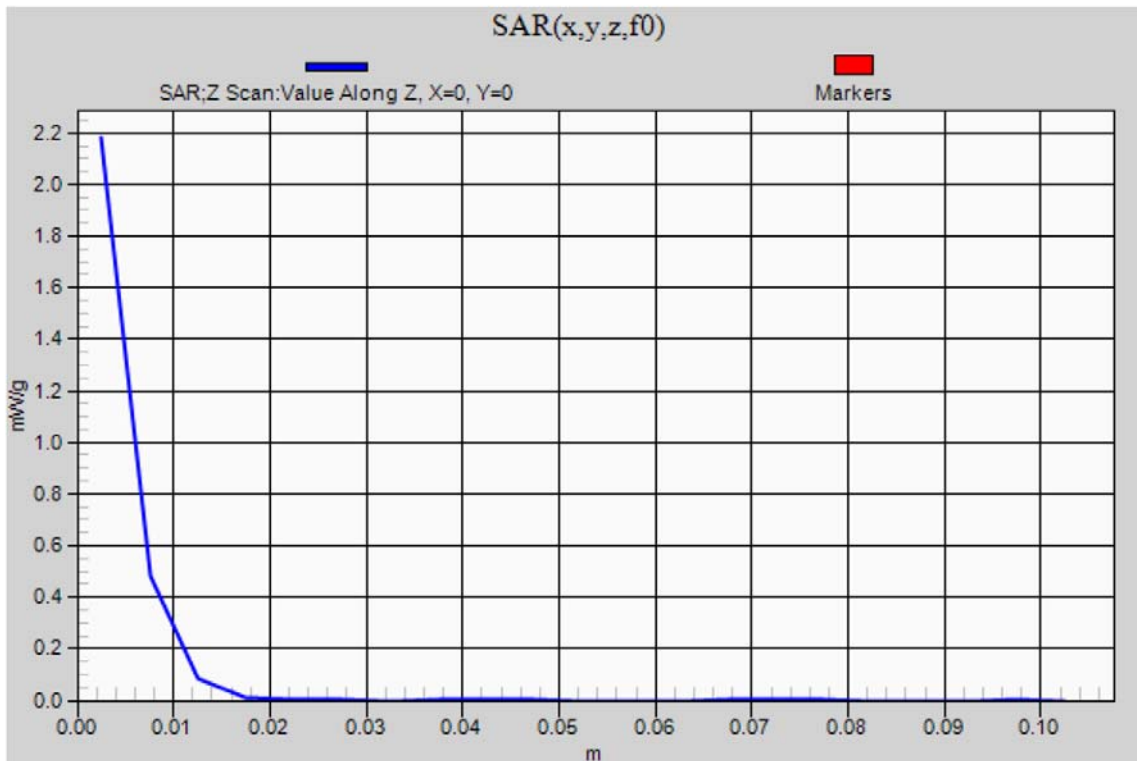
Date: 8/12/2011

Test Laboratory: UL CCS SAR Lab B

035_Secondary Landscape

Communication System: WLAN_5GHz; Frequency: 5550 MHz; Duty Cycle: 1:1

802.11a/n_Ch 110_Chain B/Z Scan (1x1x21): Measurement grid: dx=20mm, dy=20mm, dz=5mm
Maximum value of SAR (measured) = 2.181 mW/g



Date: 8/14/2011

Test Laboratory: UL CCS SAR Lab B

045_Secondary Portrait

Communication System: WLAN_5GHz; Frequency: 5745 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 5745$ MHz; $\sigma = 6.051$ mho/m; $\epsilon_r = 46.953$; $\rho = 1000$ kg/m³
Phantom section: Flat Section

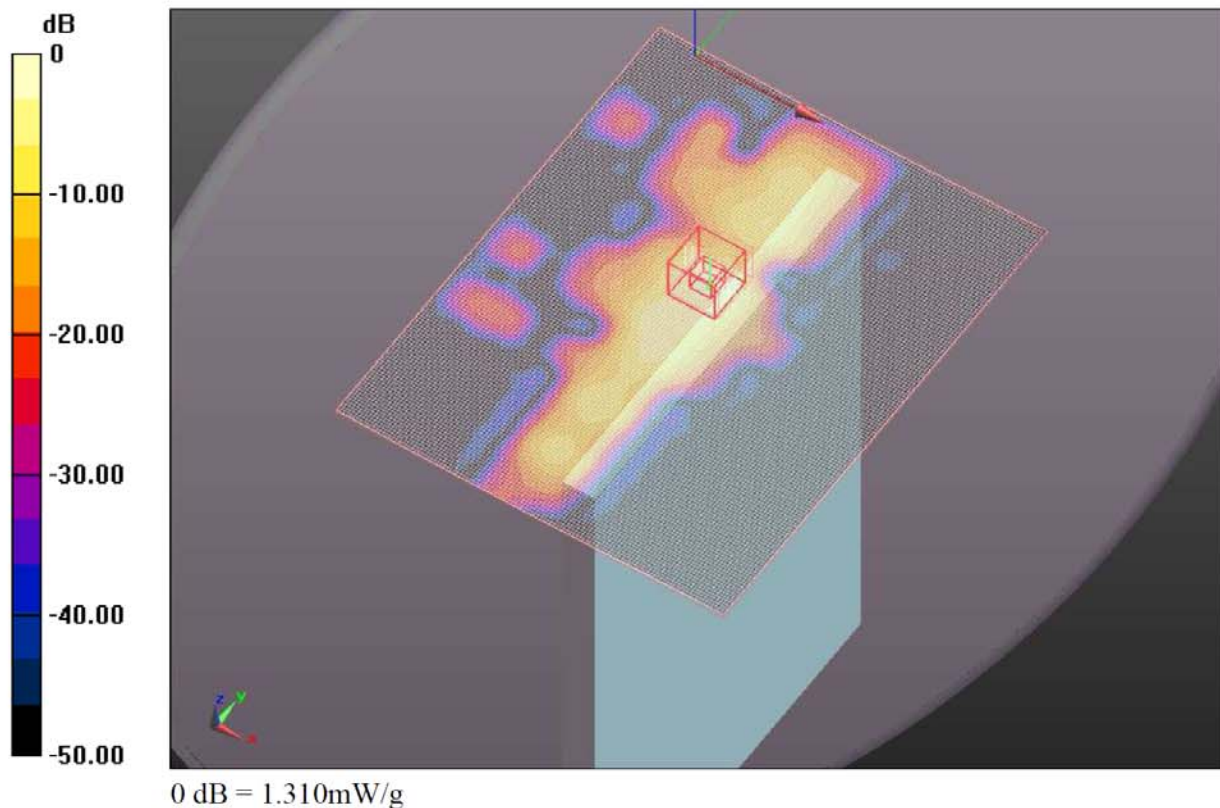
Room Ambient Temperature: 25.0 deg. C; Liquid Temperature: 24.0 deg. C

DASY5 Configuration:

- Area Scan setting - Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Probe: EX3DV4 - SN3773; ConvF(3.58, 3.58, 3.58); Calibrated: 5/3/2011
- Sensor-Surface: 2.5mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 2.5mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1258; Calibrated: 5/2/2011
- Phantom: ELI v5.0 (A); Type: QDOVA001BB; Serial: 1117
- Measurement SW: DASY52, Version 52.6 (2); SEMCAD X Version 14.4.5 (3634)

802.11a/n_Ch 149_Chain A/Area Scan (121x151x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.935 mW/g

802.11a/n_Ch 149_Chain A/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 10.955 V/m; Power Drift = 0.22 dB
Peak SAR (extrapolated) = 2.671 W/kg
SAR(1 g) = 0.685 mW/g; SAR(10 g) = 0.175 mW/g
Maximum value of SAR (measured) = 1.306 mW/g



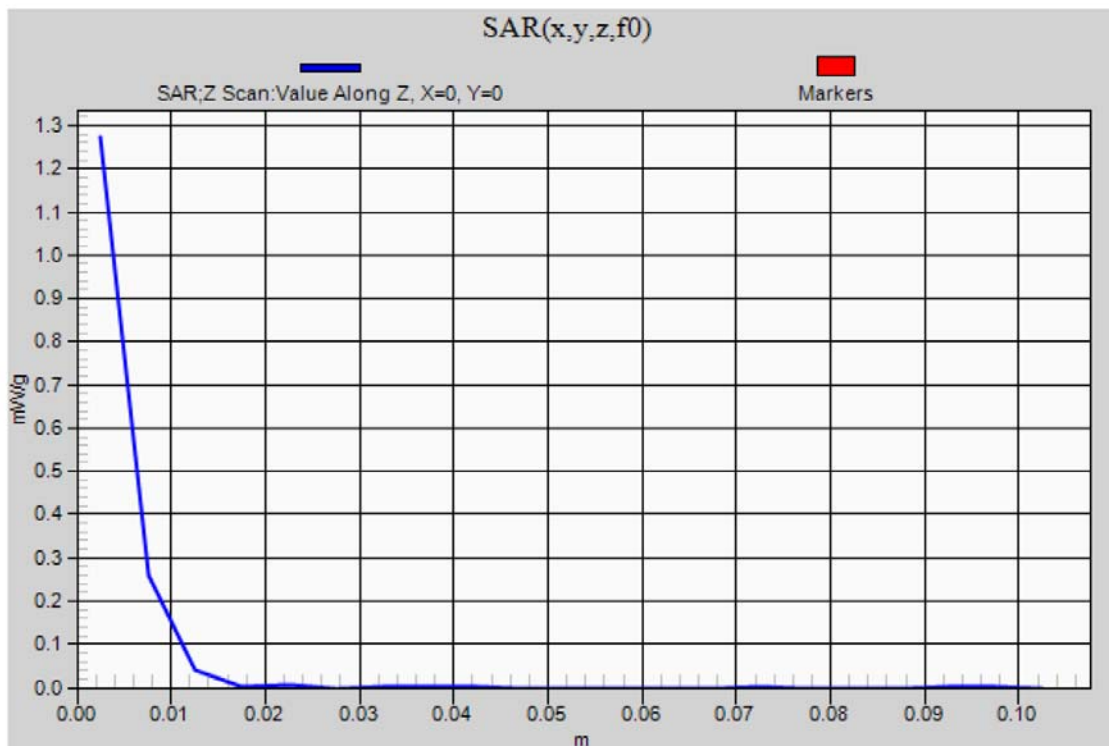
Date: 8/14/2011

Test Laboratory: UL CCS SAR Lab B

045_Secondary Portrait

Communication System: WLAN_5GHz; Frequency: 5745 MHz; Duty Cycle: 1:1

802.11a/n_Ch 149_Chain A/Z Scan (1x1x21): Measurement grid: dx=20mm, dy=20mm, dz=5mm
Maximum value of SAR (measured) = 1.273 mW/g



14. APPENDIXES

Refer to individual files for the following appendixes:

- 14.1. Appendix A: System Check Plots
- 14.2. Appendix B: SAR Plots for 2.4GHz
- 14.3. Appendix C: SAR Plots for 5GHz
- 14.4. Appendix D: Certificate of E-Field Probe - EX3DV3 SN 3773
- 14.5. Appendix E: Calibration Certificate - Validation Dipole D2450V2 - SN 706 (w/ext. cal data)
- 14.6. Appendix F: Calibration Certificate - Validation Dipole D5GHzV2 - SN 1075 (w/ext. cal data)

15. SUMMARY OF SAR TEST CONFIGURATIONS

Configuration	Antenna-to-User distance	SAR Require	Comments
(1) Bottom Face	2.5 mm From Main/Aux. to-user	Yes	
Primary Landscape	44.6 mm From Main-to-user	No	This is not the most conservative antenna-to-user distance at edge mode. According to KDB 447498 4) b) ii) (2), SAR is required only for the edge with the most conservative exposure conditions.
	168 mm From Aux.-to-user	No	This is not the most conservative antenna-to-user distance at edge mode. According to KDB 447498 4) b) ii) (2), SAR is required only for the edge with the most conservative exposure conditions.
(2) Secondary Landscape	107 mm From Main-to-user	No	This is not the most conservative antenna-to-user distance at edge mode. According to KDB 447498 4) b) ii) (2), SAR is required only for the edge with the most conservative exposure conditions.
	4.5 mm From Aux.-to-user	Yes	
Primary Portrait	275 mm from Main antenna to edge	No	This is not the most conservative antenna-to-user distance at edge mode. According to KDB 447498 4) b) ii) (2), SAR is required only for the edge with the most conservative exposure conditions.
	263 mm from Aux. antenna to edge	No	This is not the most conservative antenna-to-user distance at edge mode. According to KDB 447498 4) b) ii) (2), SAR is required only for the edge with the most conservative exposure conditions.
(3) Secondary Portrait	5.2 mm from Main antenna to edge	Yes	
	8.7 mm from Aux. antenna to edge	No	This is not the most conservative antenna-to-user distance at edge mode. According to KDB 447498 4) b) ii) (2), SAR is required only for the edge with the most conservative exposure conditions.