FCC OET BULLETIN 65 SUPPLEMENT C Edition 01-01
IEEE STD 1528: 2003
RSS-102 Issue 4, March 2010
RSS-102 Supplementary Procedures (SPR)-001, January 1, 2011
(Class II Permissive Change)

SAR EVALUATION REPORT

For

AR5BHB116 2x2 802.11n PCIe Module
(Tested inside of Samsung Notebook PC Model Name: XE500C21)

MODEL: AR5BHB116
FCC ID: PPD-AR5BHB116
IC: 4104A-AR5BHB116

REPORT NUMBER: 11I13731-1B

ISSUE DATE: April 19, 2011

Prepared for

ATHEROS COMMUNICATIONS, INC.
1700 TECHNOLOGY DR
SAN JOSE, CA 95110

Prepared by

COMPLIANCE CERTIFICATION SERVICES (UL CCS)
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NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
--	April 4, 2011	Initial Issue	--
A	April 5, 2011	Updated host model name from “XE500C21A” to “XE500C21”	Sunny Shih
A1	April 14, 2011	Revised report based on reviewer’s comments. 1. Updated Date of tested in Section 1 from “March 25 - 28, 2011” to “March 25 – 30, 2011” 2. Updated Notes in section 11.2 from “802.11g/HT20/HT40” to “802.11n HT20/HT40” and changed “802.11b” to “802.11a”	Sunny Shih
B	April 19, 2011	Re-measured RF output power and updated power table in section 11.1 and 11.2.	Sunny Shih

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1. ATTESTATION OF TEST RESULTS

Applicant name:	ATHEROS COMMUNICATIONS, INC. 1700 TECHNOLOGY DR SAN JOSE, CA 95110
EUT description:	AR5BHB116 2x2 802.11n PCIe Module (Tested inside of Samsung Notebook PC Model Name: XE500C21)
Model number:	AR5BHB116
Device category:	Portable
Exposure category:	General Population/Uncontrolled Exposure
Date tested:	March 25 - 30, 2011 (SAR testing) April 19 (Re-measured RF output power)

FCC / IC Rule Parts	Freq. Range [MHz]	The Highest 1g SAR	Limit (W/kg)
15.247 / RSS-102	2412 – 2462	0.343 W/kg	1.6
15.407 / RSS-102	5150 – 5250	0.775 W/kg	
	5250 – 5350	0.843 W/kg	
	5500 – 5700	0.638 W/kg	
15.247 / RSS-102	5725 – 5850	0.362 W/kg	

Applicable Standards	Test Results
FCC OET Bulletin 65 Supplement C Edition 01-01, IEEE STD 1528, RSS-102 Issue 4, March 2010 and RSS-102 Supplementary Procedures (SPR)-001, January 1, 2011	Pass

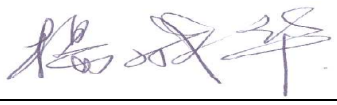
Compliance Certification Services (UL CCS) tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL CCS based on interpretations and/or observations of test results. Measurement Uncertainties 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:

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

Tested By:



Chenghua Yang
Associate RF 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 RSS-102 Supplementary Procedures (SPR)-001, January 1, 2011 and the following specific FCC Test Procedures.

- KDB 248227 SAR measurement procedures for 802.11a/b/g transmitters
- KDB 616217 D03 SAR Supp. Note and Netbook Laptop V01

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	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		
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	11	13	2011
Thermometer	ERTCO	639-1S	1718	7	19	2011
Data Acquisition Electronics	SPEAG	DAE3 V1	427	7	21	2011
System Validation Dipole	SPEAG	D2450V2	706	4	19	2012
System Validation Dipole	SPEAG	*D5GHzV2	1075	9	3	2011
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	M5800 (5-6GHz)	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) @ Body 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	2.97	Normal	1	0.64	1.90
Liquid Permittivity - deviation from target		Rectangular	1.732	0.6	0.00
Liquid Permittivity - measurement uncertainty	-3.40	Normal	1	0.6	-2.04
				Combined Standard Uncertainty Uc(y) =	9.69
				Expanded Uncertainty U, Coverage Factor = 2, > 95 % Confidence = 19.38	%
				Expanded Uncertainty U, Coverage Factor = 2, > 95 % Confidence = 1.54	dB

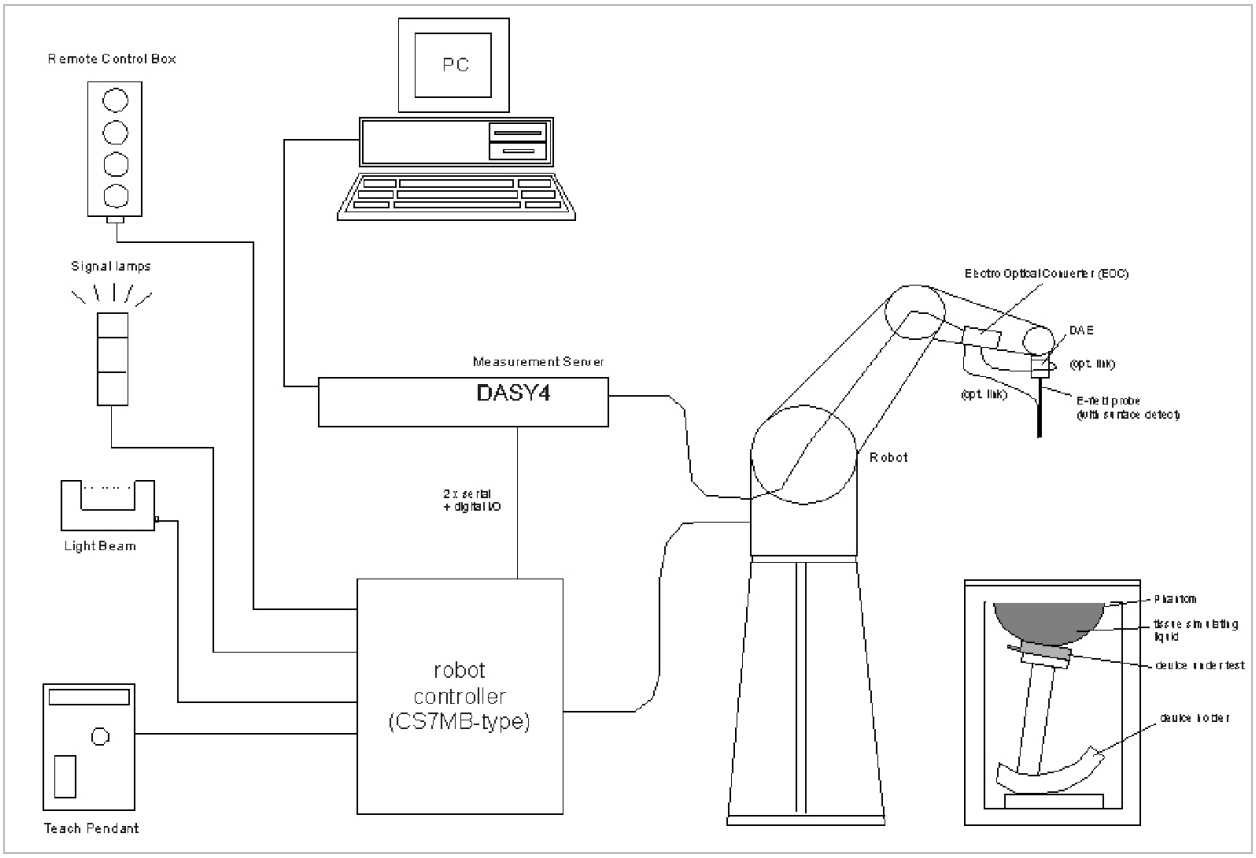
3 to 6 GHz averaged over 1 gram

Component	error, %	Distribution	Divisor	Sensitivity	U (Xi), %
Measurement System					
Probe Calibration (k=1) @ 5GHz	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	3.96	Normal	1	0.64	2.53
Liquid Permittivity - deviation from target	10.00	Rectangular	1.732	0.6	3.46
Liquid Permittivity - measurement uncertainty	1.99	Normal	1	0.6	1.19
				Combined Standard Uncertainty Uc(y), %:	10.82
				Expanded Uncertainty U, Coverage Factor = 1.96, > 95 % Confidence = 21.21	%
				Expanded Uncertainty U, Coverage Factor = 1.96, > 95 % Confidence = 1.67	dB

5. EQUIPMENT UNDER TEST

AR5BHB116 2x2 802.11n PCIe Module. The radio module is manufactured by Atheros. (Tested inside of Samsung Notebook PC Model Name: XE500C21)	
Normal operation:	Lap-held (with display open at 90° to the keyboard)
Antennas tested:	Manufacturer Antenna name Wistron (WNC) 81.EHD15.G38 for both Main (Chain 0) & Aux (Chain 1) antenna
Antenna-to-antenna/user separation distances:	See Section 14 for details of antenna locations and separation distances
Simultaneous transmission:	WiFi can transmit simultaneously with WWAN
Assessment for SAR evaluation for Simultaneous transmission:	**WiFi vs WWAN** Due to separation distance is greater than 20 cm from WWAN main antenna-to-user, therefore standalone for WWAN is not required. Thus WiFi and WWAN are not considered as co-located transmitters each other.

6. 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.

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		900		1800 - 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

8. TISSUE DIELECTRIC PARAMETERS

The simulating liquids should be checked at the beginning of a series of SAR measurements to determine of the dielectric parameters are within the tolerances of the specified target values. For frequencies in 300 MHz to just under 2 GHz, the measured conductivity and relative permittivity should be within ± 5% of the target values. For frequencies in the range of 2–3 GHz and above the measured conductivity should be within ± 5% of the target values. The measured relative permittivity tolerance can be relaxed to no more than ± 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
5800	35.3	5.27	48.2	6

(ε_r = relative permittivity, σ = conductivity and ρ = 1000 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 suing 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 ±5% for the whole 5 to 5.8 GHz range.

f (MHz)	Body Tissue		Reference
	rel. permitivity	conductivity	
3000	52.0	2.73	Standard
5100	49.1	5.18	Interpolated
5200	49.0	5.30	Interpolated
5300	48.9	5.42	Interpolated
5400	48.7	5.53	Interpolated
5500	48.6	5.65	Interpolated
5600	48.5	5.77	Interpolated
5700	48.3	5.88	Interpolated
5800	48.2	6.00	Standard

(ε_r = relative permittivity, σ = conductivity and ρ = 1000 kg/m^3)

8.1. TISSUE DIELECTRIC PARAMETERS RESULTS

Date	Freq. (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit ±(%)
3/25/2011	Body 2450	e'	50.9092	Relative Permittivity (ε_r):	50.91	52.70	-3.40	5
		e''	14.7387	Conductivity (σ):	2.01	1.95	2.97	5

Liquid Check
Ambient temperature: 24 deg. C; Liquid temperature: 23 deg. C; Relative humidity = 41%
March 25, 2011 02:16 PM

Frequency	e'	e''
2410000000.	51.0489	14.5761
2415000000.	51.0305	14.5947
2420000000.	51.0157	14.6165
2425000000.	50.9962	14.6367
2430000000.	50.9816	14.6572
2435000000.	50.9635	14.6776
2440000000.	50.9474	14.6993
2445000000.	50.9271	14.7164
2450000000.	**50.9092**	**14.7387**
2455000000.	50.8912	14.7575
2460000000.	50.8717	14.7761
2465000000.	50.8502	14.7977
2470000000.	50.8333	14.8158
2475000000.	50.8144	14.8351
2480000000.	50.7938	14.8567
2485000000.	50.7721	14.8753

The conductivity (σ) can be given as:

$$\sigma = \omega \varepsilon_0 e'' = 2 \pi f \varepsilon_0 e''$$

where f = target f * 10^6

$\varepsilon_0 = 8.854 * 10^{-12}$

Date	Freq. (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit ±(%)
3/28/2011	Body 5200	e'	47.7955	Relative Permittivity (ϵ_r):	47.80	49.02	-2.50	10
		e''	17.9379	Conductivity (σ):	5.19	5.29	-2.04	5
3/28/2011	Body 5500	e'	47.1940	Relative Permittivity (ϵ_r):	47.19	48.61	-2.92	10
		e''	18.3741	Conductivity (σ):	5.62	5.64	-0.45	5
3/28/2011	Body 5800	e'	46.6097	Relative Permittivity (ϵ_r):	46.61	48.20	-3.30	10
		e''	18.8011	Conductivity (σ):	6.06	6.00	1.06	5

Liquid Check
Ambient temperature: 25 deg. C; Liquid temperature: 24 deg. C; Relative humidity = 39%
March 28, 2011 03:04 PM

Frequency	e'	e''
4600000000.	48.9683	16.8361
4650000000.	48.8868	16.9201
4700000000.	48.7876	17.0278
4750000000.	48.7151	17.1160
4800000000.	48.6093	17.2141
4850000000.	48.4997	17.3011
4900000000.	48.4164	17.4049
4950000000.	48.3044	17.4787
5000000000.	48.2135	17.5895
5050000000.	48.1113	17.6621
5100000000.	48.0044	17.7686
5150000000.	47.9150	17.8351
5200000000.	**47.7955**	**17.9379**
5250000000.	47.7271	18.0032
5300000000.	47.5882	18.0848
5350000000.	47.5262	18.1633
5400000000.	47.4022	18.2288
5450000000.	47.3056	18.3069
5500000000.	**47.1940**	**18.3741**
5550000000.	47.1036	18.4503
5600000000.	46.9863	18.5168
5650000000.	46.9085	18.5970
5700000000.	46.7799	18.6542
5750000000.	46.7060	18.7592
5800000000.	**46.6097**	**18.8011**
5850000000.	46.4992	18.8831
5900000000.	46.4199	18.9431
5950000000.	46.2940	19.0115
6000000000.	46.2048	19.0911

The conductivity (σ) can be given as:

$$\sigma = \omega \varepsilon_0 e'' = 2 \pi f \varepsilon_0 e''$$

where f = target f * 10^6

$\varepsilon_0 = 8.854 * 10^{-12}$

Date	Freq. (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit ±(%)
3/30/2011	Body 5200	e'	49.9962	Relative Permittivity (ε_r):	50.00	49.02	1.99	10
		e''	18.4924	Conductivity (σ):	5.35	5.29	0.98	5
3/30/2011	Body 5500	e'	49.3966	Relative Permittivity (ε_r):	49.40	48.61	1.61	10
		e''	18.9191	Conductivity (σ):	5.79	5.64	2.50	5
3/30/2011	Body 5800	e'	48.7615	Relative Permittivity (ε_r):	48.76	48.20	1.16	10
		e''	19.3412	Conductivity (σ):	6.24	6.00	3.96	5

Liquid Check
Ambient temperature: 24 deg. C; Liquid temperature: 23 deg. C; Relative humidity = 40%
March 30, 2011 10:20 AM

Frequency	e'	e''
4600000000.	51.2908	17.4551
4650000000.	51.1628	17.5146
4700000000.	51.0841	17.6450
4750000000.	50.9552	17.7019
4800000000.	50.8744	17.8310
4850000000.	50.7607	17.8934
4900000000.	50.6603	17.9986
4950000000.	50.5528	18.0684
5000000000.	50.4466	18.1669
5050000000.	50.3334	18.2340
5100000000.	50.2180	18.3323
5150000000.	50.1080	18.3921
5200000000.	**49.9962**	**18.4924**
5250000000.	49.8956	18.5478
5300000000.	49.7950	18.6351
5350000000.	49.6794	18.6951
5400000000.	49.5984	18.7791
5450000000.	49.4668	18.8296
5500000000.	**49.3966**	**18.9191**
5550000000.	49.2464	18.9653
5600000000.	49.1933	19.0653
5650000000.	49.0407	19.0939
5700000000.	48.9671	19.2116
5750000000.	48.8568	19.2410
5800000000.	**48.7615**	**19.3412**
5850000000.	48.6666	19.3855
5900000000.	48.5617	19.4766
5950000000.	48.4784	19.5284
6000000000.	48.3532	19.6159

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 measurement 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 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 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 SN 706	D2450V2-706_Apr10	4/19/10	2.4	SAR_{1g}:	51.6	52.4
				SAR_{10g}:	24.4	24.5
D5GHzV2 SN 1075	D5GHzV2-1075_Sep09	9/3/09	5.2	SAR_{1g}:		79.0
				SAR_{10g}:		22.0
			5.5	SAR_{1g}:		85.4
				SAR_{10g}:		23.5
			5.8	SAR_{1g}:		73.2
				SAR_{10g}:		20.1

9.1. SYSTEM CHECK RESULTS

System validation dipole	Date Tested	Measured (Normalized to 1 W)		Target	Delta (%)	Tolerance (%)
		Tissue:	Body			
D2450V2	03/25/11	1g SAR:	52.3	52.4	-0.19	±10
		10g SAR:	24.2	24.5	-1.22	

System validation dipole	Date Tested	Measured (Normalized to 1 W)		Target	Delta (%)	Tolerance (%)
		Tissue:	Body			
D5GHzV2 (5.2GHz)	03/28/11	1g SAR:	74.30	79.0	-5.95	±10
		10g SAR:	21.50	22.0	-2.27	
D5GHzV2 (5.5GHz)	03/28/11	1g SAR:	85.40	85.4	0.00	±10
		10g SAR:	24.10	23.5	2.55	
D5GHzV2 (5.8GHz)	03/28/11	1g SAR:	74.00	73.2	1.09	±10
		10g SAR:	21.00	20.1	4.48	
D5GHzV2 (5.5GHz)	03/30/11	1g SAR:	86.20	85.4	0.94	±10
		10g SAR:	24.60	23.5	4.68	
D5GHzV2 (5.8GHz)	03/30/11	1g SAR:	71.30	73.2	-2.60	±10
		10g SAR:	20.30	20.1	1.00	

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 DASY4 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 ≥ 7 x 7 x 9 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 BAND

Mode	Ch. #	Freq. (MHz)	Avg RF Output Pwr (dBm)			
			Target Pwr form EMC report		Actual Measured	
			Chain 0	Chain 1	Chain 0	Chain 1
802.11b	1	2412	16.84	16.80	17.10	16.80
	6	2437	17.12	16.98	17.50	17.30
	11	2462	17.05	16.60	17.45	16.60
802.11g	1	2412	11.05	10.60		
	6	2437	16.90	16.68		
	11	2462	10.63	10.05		
802.11n HT20	1	2412	11.33	11.08		
	6	2437	16.12	15.92		
	11	2462	10.26	9.76		
802.11n HT40	3	2422	9.84	9.42		
	6	2437	13.00	12.90		
	9	2452	9.52	9.35		

Notes:

1. RF output power verified on the highest output power channels only.
2. According to the KDB 248227, SAR is not required for 802.11g/HT20/HT40 channels when the maximum average output power is less than 1/4 dB higher than that measured on the corresponding 802.11b channels.
3. Chain 0 = Main antenna, Chain 1 = Aux antenna

11.2. RF OUTPUT POWER FOR 5 GHZ BANDS

5.2 GHz Band						
Mode	Ch. #	Freq. (MHz)	Avg RF Output Pwr (dBm)			
			Target Pwr form EMC report		Actual Measured	
			Chain 0	Chain 1	Chain 0	Chain 1
802.11a	36	5180	11.94	11.31	12.00	11.40
	40	5200	11.66	11.08	12.00	11.33
	48	5240	11.74	11.71	11.85	11.82
802.11n HT20	36	5180	11.86	11.74		
	40	5200	12.31	12.31		
	48	5240	14.33	12.21	14.34	12.60
802.11n HT40	38	5190	11.06	10.41		
	46	5230	14.77	12.75	14.90	13.10

5.3 GHz Band						
Mode	Ch. #	Freq. (MHz)	Avg RF Output Pwr (dBm)			
			Target Pwr form EMC report		Actual Measured	
			Chain 0	Chain 1	Chain 0	Chain 1
802.11a	52	5260	14.82	14.72	15.00	14.80
	60	5300	15.21	13.44	15.28	13.80
	64	5320	14.37	12.95	14.60	13.30
802.11n HT20	52	5260	14.62	13.23		
	60	5300	15.30	13.54		
	64	5320	14.31	13.13		
802.11n HT40	54	5270	13.11	11.51		
	62	5310	8.71	8.19		

5.5 GHz Band						
Mode	Ch. #	Freq. (MHz)	Avg RF Output Pwr (dBm)			
			Target Pwr form EMC report		Actual Measured	
			Chain 0	Chain 1	Chain 0	Chain 1
802.11a	100	5500	14.84	14.92	14.85	15.20
	120	5600	13.59	14.07	13.70	14.50
	140	5700	13.12	15.89	13.40	15.90
802.11n HT20	100	5500	15.33	14.59		
	120	5600	13.63	14.19		
	140	5700	13.17	15.92	13.50	15.93
802.11n HT40	102	5510	13.83	14.06		
	118	5590	13.94	14.21		
	134	5670	14.02	16.40	14.40	16.50

Notes:

1. RF output power verified on the highest output power channels only.
2. According to the KDB 248227, SAR is not required for 802.11n HT20/HT40 channels when the maximum average output power is less than 1/4 dB higher than that measured on the corresponding 802.11a channels.
3. Chain 0 = Main antenna, Chain 1 = Aux antenna

5.8 GHz Band

Mode	Ch. #	Freq. (MHz)	Avg RF Output Pwr (dBm)			
			Target Pwr form EMC report		Actual Measured	
			Chain 0	Chain 1	Chain 0	Chain 1
802.11a	149	5745	14.92	16.33	15.4	16.4
	157	5785	14.90	14.62	14.9	15.0
	165	5825	14.30	14.69	14.3	15.1
802.11n HT20	149	5745	14.98	16.28		
	157	5785	15.10	15.13		
	165	5825	14.30	14.68		
802.11n HT40	151	5755	15.70	15.68		
	159	5795	15.39	14.92		

Notes:

1. RF output power verified on the highest output power channels only.
2. According to the KDB 248227, SAR is not required for 802.11n HT20/HT40 channels when the maximum average output power is less than 1/4 dB higher than that measured on the corresponding 802.11a channels.
3. Chain 0 = Main antenna, Chain 1 = Aux antenna

12. SUMMARY OF SAR TEST RESULTS

Configuration	Antenna-to-User distance	SAR Require	Comments
Laptop mode: Lap-held	1.1 cm From Main/Aux Antenna-to-user	Yes	SAR evaluation
Laptop mode: By Stander (Back side)	--	No	This configuration does not require SAR assessment as the closest antenna-to-user configuration was covered by 'Lap-help' test configuration above and is within 2.5 cm from By Stander.

12.1. SAR TEST RESULT FOR 2.4 GHZ

Lap-held

Mode	Channel	f (MHz)	Output Power (dBm)		1g SAR	
			Chain 0	Chain 1	Chain 0	Chain 1
802.11b	1	2412				
	6	2437	17.50	17.30	**0.343**	0.189
	11	2462				

Notes:

1. SAR on the highest output power channels only.
2. According to the KDB 248227, SAR is not required for 802.11g/HT20/HT40 channels when the maximum average output power is less than 1/4 dB higher than that measured on the corresponding 802.11b channels.
3. Chain 0 = Main antenna, Chain 1 = Aux antenna

12.2. SAR TEST RESULTS FOR 5 GHZ BANDS

Lap-held

5.2 GHz Band

Mode	Channel	f (MHz)	Output Power (dBm)		1g SAR	
			Chain 0	Chain 1	Chain 0	Chain 1
802.11a	36	5180				
	40	5200	12.00	11.33	0.172	0.141
	48	5240				
802.11n HT20	36	5180				
	40	5200				
	48	5240	14.34	12.60	0.355	0.363
802.11n HT40	38	5190				
	46	5230	14.90	13.10	0.697	**0.775**

5.3 GHz Band

Mode	Channel	f (MHz)	Output Power (dBm)		1g SAR	
			Chain 0	Chain 1	Chain 0	Chain 1
802.11a	52	5260	15.00	14.80	0.766	0.641
	60	5300	15.28	13.80	**0.843**	0.714
	64	5320	14.60	13.30	0.637	0.479
802.11n HT20	52	5260				
	60	5300				
	64	5320				
802.11n HT40	54	5270				
	62	5310				

5.5 GHz Band

Mode	Channel	f (MHz)	Output Power (dBm)		1g SAR	
			Chain 0	Chain 1	Chain 0	Chain 1
802.11a	100	5500	14.85	15.20	**0.638**	0.477
	120	5600	13.70	14.60	0.573	0.369
	140	5700	13.80	15.90	0.364	0.286
802.11n HT20	100	5500				
	120	5600				
	140	5700	13.85	15.93	0.438	0.385
802.11n HT40	102	5510				
	118	5590				
	134	5670	14.40	16.50	0.575	0.481

5.8 GHz Band

Mode	Channel	f (MHz)	Output Power (dBm)		1g SAR	
			Chain 0	Chain 1	Chain 0	Chain 1
802.11a	149	5745	15.4	16.4	**0.362**	0.310
	157	5785	14.9	15.0	0.330	0.250
	165	5825				
802.11n HT20	149	5745				
	157	5785				
	165	5825				
802.11n HT40	151	5755				
	159	5795				

12.3. WORST-CASE SAR PLOTS

2.4 GHz

Date/Time: 3/25/2011 8:47:06 PM

Test Laboratory: Compliance Certification Services (UL CCS)

2.4 GHz_Laptop Mode

DUT: Samsung; Type: NA; Serial: CZGU93CB200090M

Communication System: 802.11b/g 2.4GHz; Frequency: 2437 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 2437 MHz; σ = 1.99 mho/m; ε_r = 51; ρ = 1000 kg/m^3
Phantom section: Flat Section

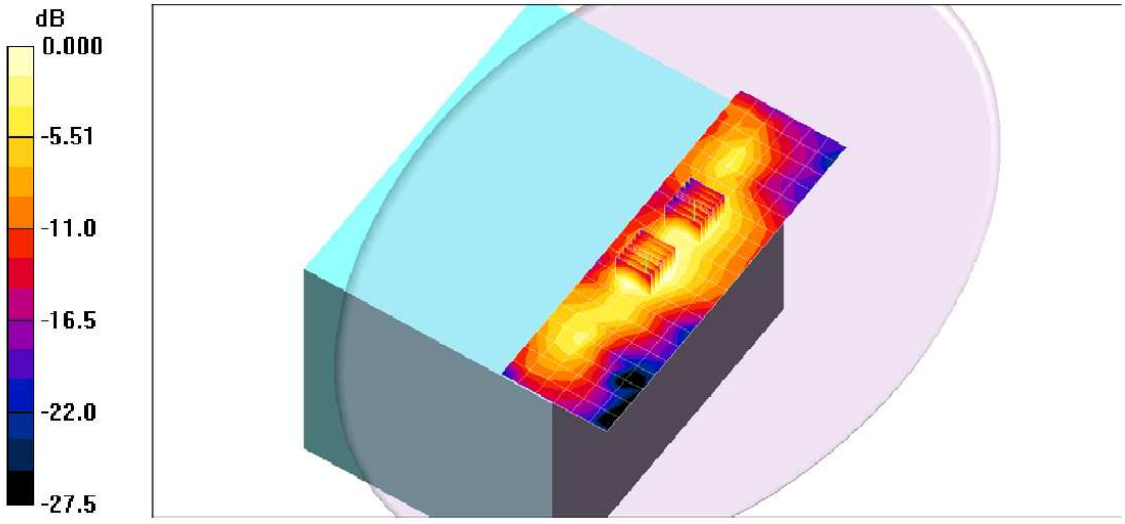
Room Ambient Temperature: 24.0 deg. C; Liquid Temperature: 23.0 deg. C

DASY4 Configuration:
- Area Scan setting - Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Probe: EX3DV4 - SN3749; ConvF(6.9, 6.9, 6.9); Calibrated: 12/13/2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 7/21/2010
- Phantom: Flat Phantom ELI4.0; Type: QDOVA001BA; Serial: SN:1003
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

802.11b M-ch M&A Ant/Area Scan (7x21x1): Measurement grid: dx=15mm, dy=15mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.388 mW/g

802.11b M-ch M&A Ant/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=3mm
Reference Value = 14.0 V/m; Power Drift = -0.113 dB
Peak SAR (extrapolated) = 0.638 W/kg
SAR(1 g) = 0.343 mW/g; SAR(10 g) = 0.174 mW/g
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.425 mW/g

802.11b M-ch M&A Ant/Zoom Scan (7x7x9)/Cube 1: Measurement grid: dx=5mm, dy=5mm, dz=3mm
Reference Value = 14.0 V/m; Power Drift = -0.113 dB
Peak SAR (extrapolated) = 0.371 W/kg
SAR(1 g) = 0.189 mW/g; SAR(10 g) = 0.098 mW/g
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.241 mW/g



0 dB = 0.241mW/g

Z-axis Plot

Date/Time: 3/25/2011 9:33:34 PM

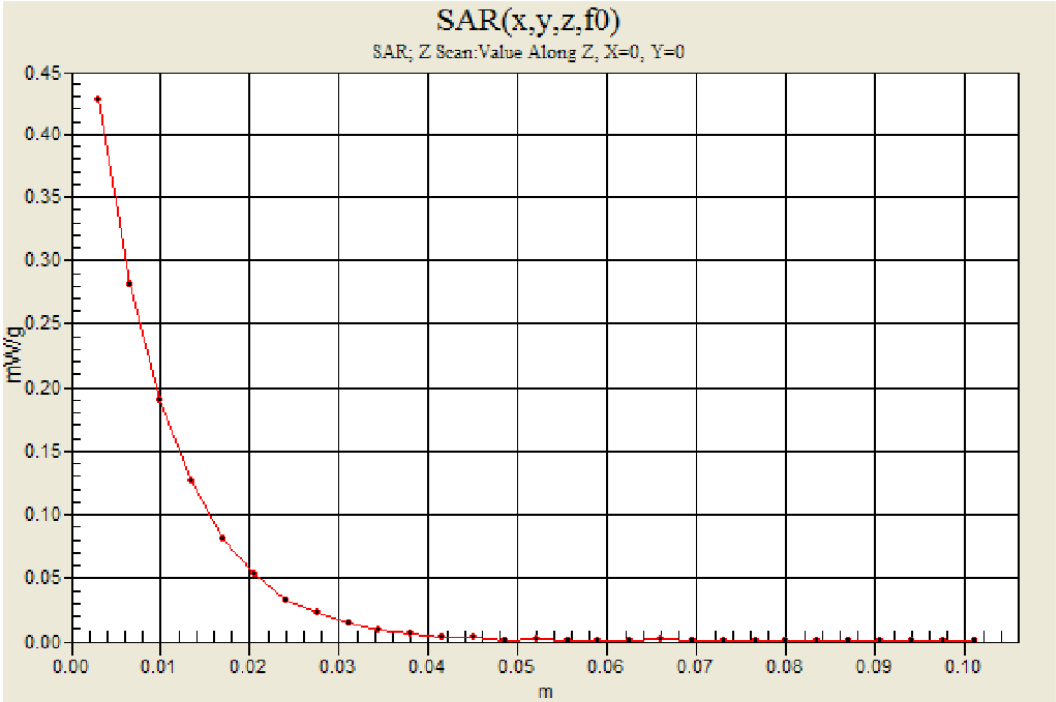
Test Laboratory: Compliance Certification Services (UL CCS)

2.4 GHz_Laptop Mode

DUT: Samsung; Type: NA; Serial: CZGU93CB200090M

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

802.11b M-ch M&A Ant/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) = 0.427 mW/g



5.2 GHz Band

Date/Time: 3/28/2011 9:47:31 PM

Test Laboratory: Compliance Certification Services (UL CCS)

5.2 GHz_Laptop Mode

DUT: Samsung; Type: NA; Serial: CZGU93CB200090M

Communication System: 802.11abgn; Frequency: 5230 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 5230 MHz; σ = 5.23 mho/m; ε_r = 47.8; ρ = 1000 kg/m^3
Phantom section: Flat Section

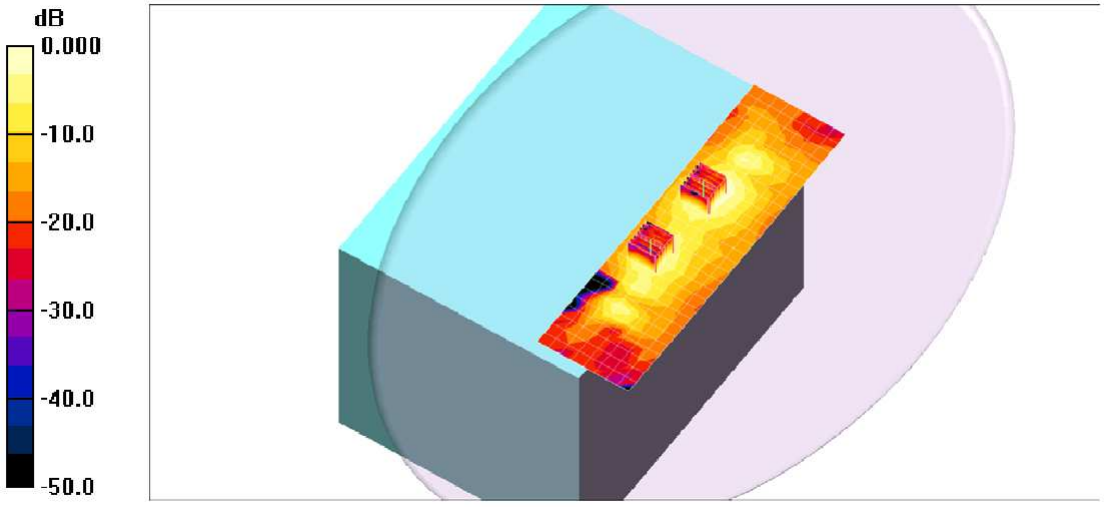
Room Ambient Temperature: 25.0 deg. C; Liquid Temperature: 24.0 deg. C

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(4.07, 4.07, 4.07); Calibrated: 12/13/2010
- Sensor-Surface: 2.5mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 7/21/2010
- Phantom: Flat Phantom ELI4.0; Type: QDOVA001BA; Serial: SN:1003
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

802.11n HT40_ch 46_M&A Ant/Area Scan (9x29x1): Measurement grid: dx=10mm, dy=10mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 1.21 mW/g

802.11n HT40_ch 46_M&A Ant/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 16.4 V/m; Power Drift = 0.141 dB
Peak SAR (extrapolated) = 1.94 W/kg
SAR(1 g) = 0.697 mW/g; SAR(10 g) = 0.245 mW/g
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 1.16 mW/g

802.11n HT40_ch 46_M&A Ant/Zoom Scan (7x7x9)/Cube 1: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 16.4 V/m; Power Drift = 0.141 dB
Peak SAR (extrapolated) = 2.12 W/kg
SAR(1 g) = 0.775 mW/g; SAR(10 g) = 0.295 mW/g
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 1.26 mW/g



0 dB = 1.26mW/g

Z-axis Plot

Date/Time: 3/28/2011 10:37:12 PM

Test Laboratory: Compliance Certification Services (UL CCS)

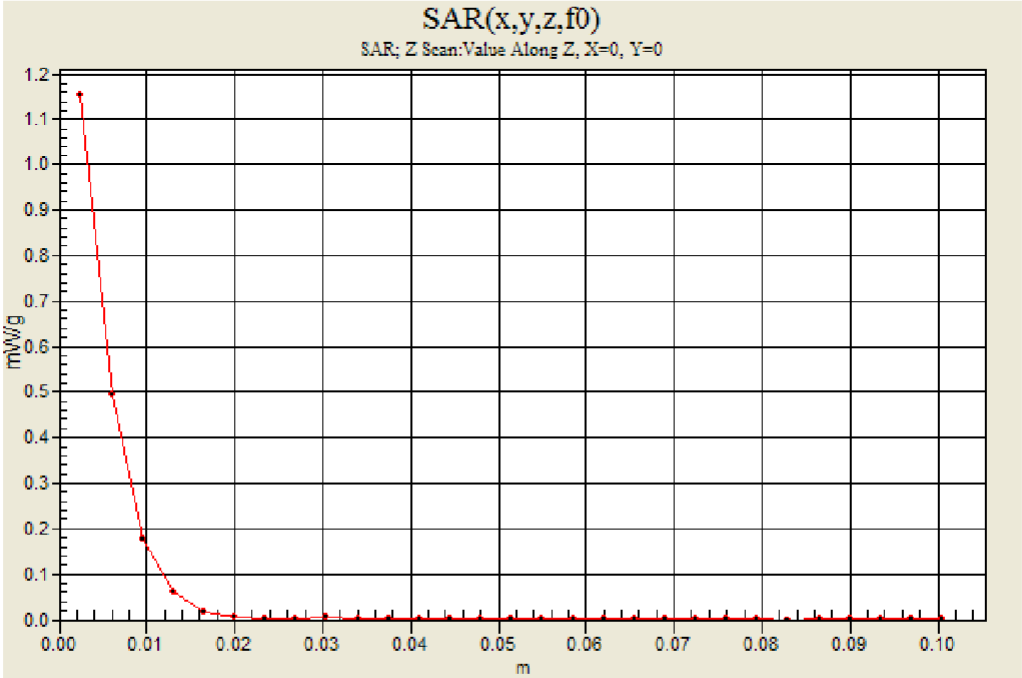
5.2 GHz_Laptop Mode

DUT: Samsung; Type: NA; Serial: CZGU93CB200090M

Communication System: 802.11abgn; Frequency: 5230 MHz;Duty Cycle: 1:1

802.11n HT40_ch 46_M&A Ant/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) = 1.15 mW/g



5.3 GHz Band

Date/Time: 3/28/2011 10:43:08 PM

Test Laboratory: Compliance Certification Services (UL CCS)

5.3 GHz_Laptop Mode

DUT: Samsung; Type: NA; Serial: CZGU93CB200090M

Communication System: 802.11abgn; Frequency: 5300 MHz;Duty Cycle: 1:1
Medium parameters used: f = 5300 MHz; σ = 5.33 mho/m; ε_r = 47.6; ρ = 1000 kg/m^3
Phantom section: Flat Section

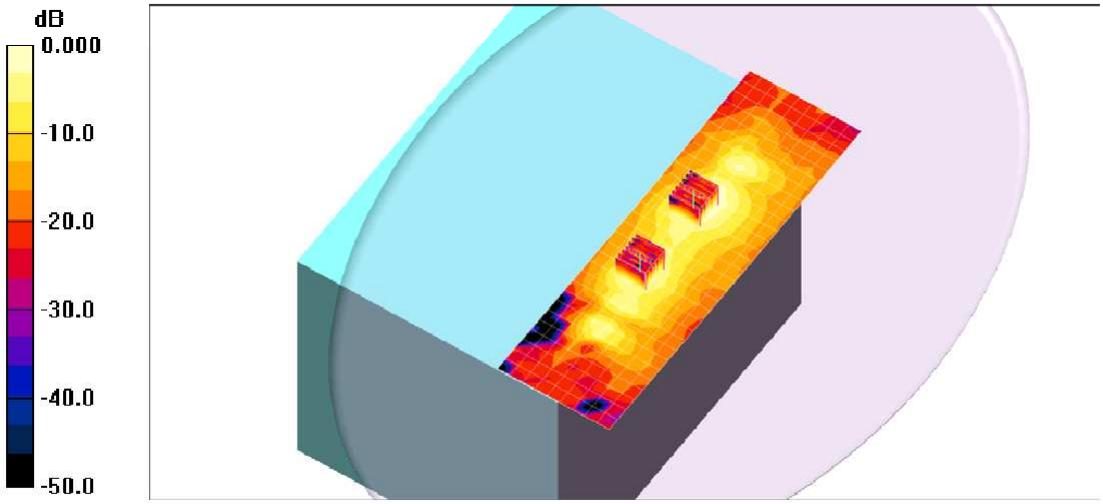
Room Ambient Temperature: 25.0 deg. C; Liquid Temperature: 24.0 deg. C

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(3.88, 3.88, 3.88); Calibrated: 12/13/2010
- Sensor-Surface: 2.5mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 7/21/2010
- Phantom: Flat Phantom ELI4.0; Type: QDOVA001BA; Serial: SN:1003
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

802.11a_ch 60_M&A Ant/Area Scan (10x31x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 1.21 mW/g

802.11a_ch 60_M&A Ant/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 16.4 V/m; Power Drift = -0.109 dB
Peak SAR (extrapolated) = 2.33 W/kg
SAR(1 g) = 0.843 mW/g; SAR(10 g) = 0.312 mW/g
Maximum value of SAR (measured) = 1.38 mW/g

802.11a_ch 60_M&A Ant/Zoom Scan (7x7x9)/Cube 1: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 16.4 V/m; Power Drift = -0.109 dB
Peak SAR (extrapolated) = 2.05 W/kg
SAR(1 g) = 0.714 mW/g; SAR(10 g) = 0.256 mW/g
Maximum value of SAR (measured) = 1.15 mW/g



0 dB = 1.15mW/g

Z-axis Plot

Date/Time: 3/28/2011 11:37:01 PM

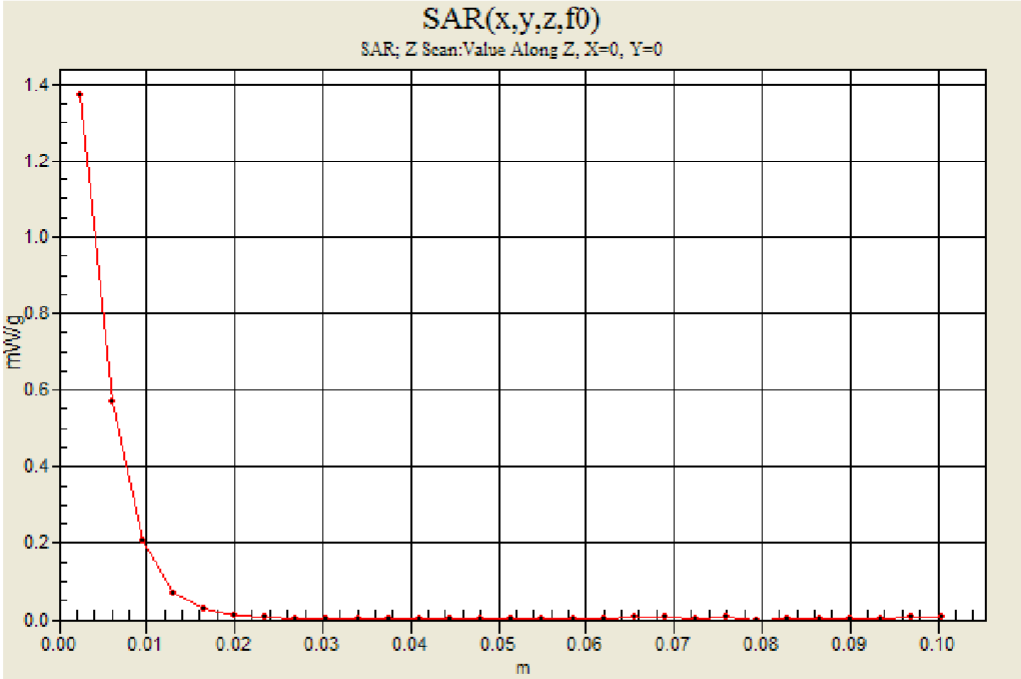
Test Laboratory: Compliance Certification Services (UL CCS)

5.3 GHz_Laptop Mode

DUT: Samsung; Type: NA; Serial: CZGU93CB200090M

Communication System: 802.11abgn; Frequency: 5300 MHz;Duty Cycle: 1:1

802.11a_ch 60_M&A Ant/Z Scan (1x1x29): Measurement grid: dx=20mm, dy=20mm, dz=3.5mm
Maximum value of SAR (measured) = 1.37 mW/g



5.5 GHz Band

Date/Time: 3/30/2011 1:46:32 PM

Test Laboratory: UL CCS

5.5 GHz_Laptop Mode

DUT: Samsung; Type: NA; Serial: CZGU93CB200090M

Communication System: 802.11abgn; Frequency: 5500 MHz;Duty Cycle: 1:1
Medium parameters used: f = 5500 MHz; σ = 5.79 mho/m; ε_r = 49.4; ρ = 1000 kg/m^3
Phantom section: Flat Section

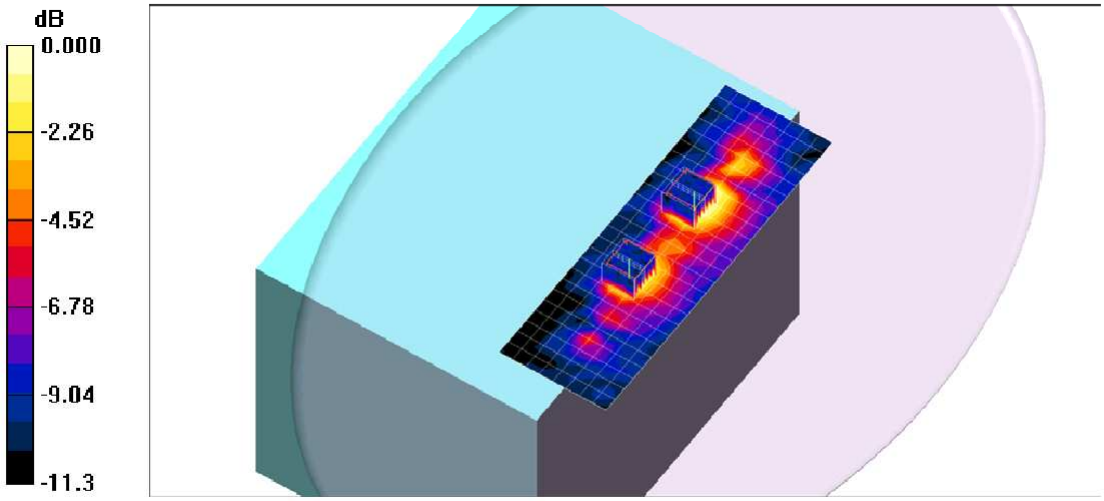
Room Ambient Temperature: 25.0 deg. C; Liquid Temperature: 24.0 deg. C

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(3.53, 3.53, 3.53); Calibrated: 12/13/2010
- Sensor-Surface: 2.5mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 7/21/2010
- Phantom: Flat Phantom ELI4.0; Type: QDOVA001BA; Serial: SN:1003
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

802.11a_ch 100_M&A Ant/Area Scan (9x26x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 0.849 mW/g

802.11a_ch 100_M&A Ant/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 13.5 V/m; Power Drift = 0.134 dB
Peak SAR (extrapolated) = 1.75 W/kg
SAR(1 g) = 0.638 mW/g; SAR(10 g) = 0.283 mW/g
Maximum value of SAR (measured) = 0.970 mW/g

802.11a_ch 100_M&A Ant/Zoom Scan (7x7x9)/Cube 1: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 13.5 V/m; Power Drift = 0.134 dB
Peak SAR (extrapolated) = 1.19 W/kg
SAR(1 g) = 0.477 mW/g; SAR(10 g) = 0.236 mW/g
Maximum value of SAR (measured) = 0.727 mW/g



0 dB = 0.727mW/g

Z-axis Plot

Date/Time: 3/30/2011 2:34:51 PM

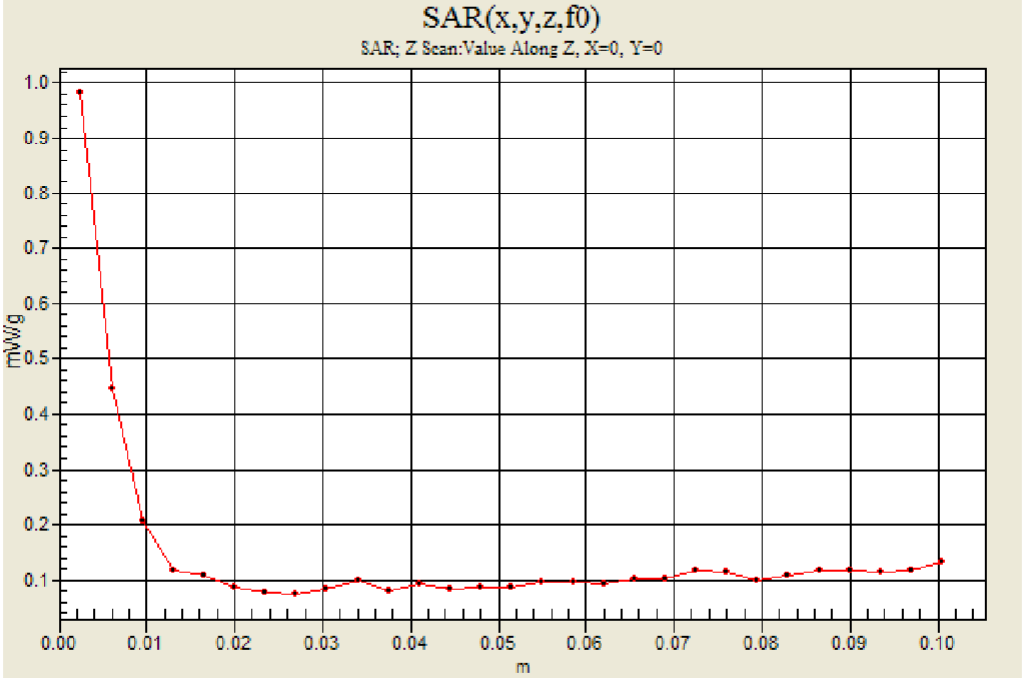
Test Laboratory: UL CCS

5.5 GHz_Laptop Mode

DUT: Samsung; Type: NA; Serial: CZGU93CB200090M

Communication System: 802.11abgn; Frequency: 5500 MHz;Duty Cycle: 1:1

802.11a_ch 100_M&A Ant/Z Scan (1x1x29): Measurement grid: dx=20mm, dy=20mm, dz=3.5mm
Maximum value of SAR (measured) = 0.982 mW/g



5.8 GHz Band

Date/Time: 3/30/2011 9:56:29 PM

Test Laboratory: UL CCS

5.8 GHz_Laptop Mode

DUT: Samsung; Type: NA; Serial: CZGU93CB200090M

Communication System: 802.11abgn; Frequency: 5745 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 5745 MHz; σ = 6.15 mho/m; ε_r = 48.9; ρ = 1000 kg/m^3
Phantom section: Flat Section

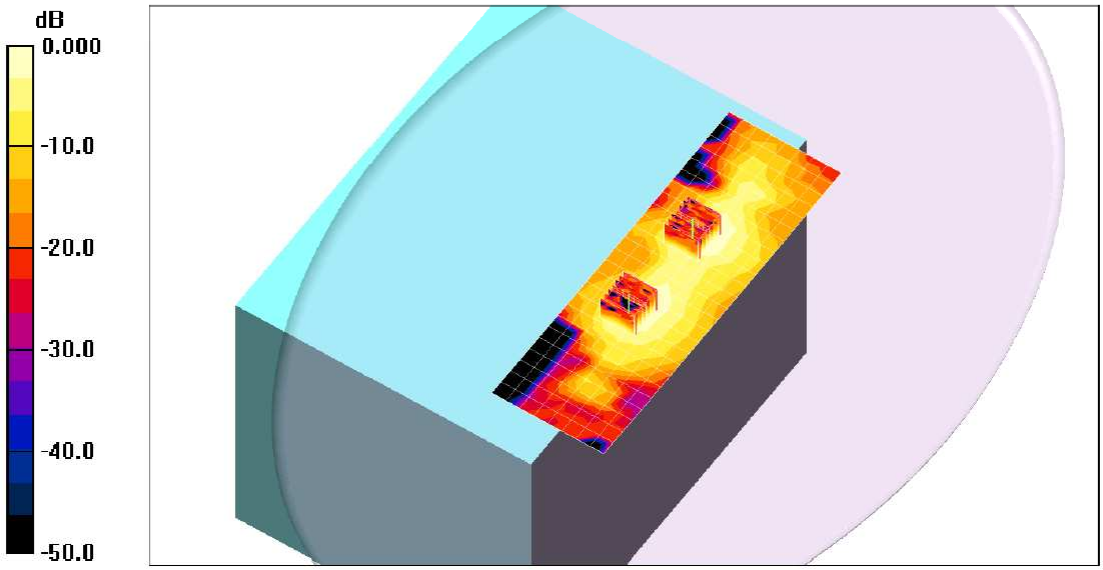
Room Ambient Temperature: 25.0 deg. C; Liquid Temperature: 24.0 deg. C

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(3.65, 3.65, 3.65); Calibrated: 12/13/2010
- Sensor-Surface: 2.5mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 7/21/2010
- Phantom: Flat Phantom ELI4.0; Type: QDOVA001BA; Serial: SN:1003
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

802.11a_ch 149_M&A Ant/Area Scan (9x26x1): Measurement grid: dx=10mm, dy=10mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.585 mW/g

802.11a_ch 149_M&A Ant/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 10.6 V/m; Power Drift = 0.153 dB
Peak SAR (extrapolated) = 1.09 W/kg
SAR(1 g) = 0.362 mW/g; SAR(10 g) = 0.127 mW/g
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.610 mW/g

802.11a_ch 149_M&A Ant/Zoom Scan 1 (7x7x9)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 10.6 V/m; Power Drift = 0.153 dB
Peak SAR (extrapolated) = 0.896 W/kg
SAR(1 g) = 0.310 mW/g; SAR(10 g) = 0.117 mW/g
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.511 mW/g



0 dB = 0.511mW/g

Z-axis Plot

Date/Time: 3/30/2011 9:02:13 PM

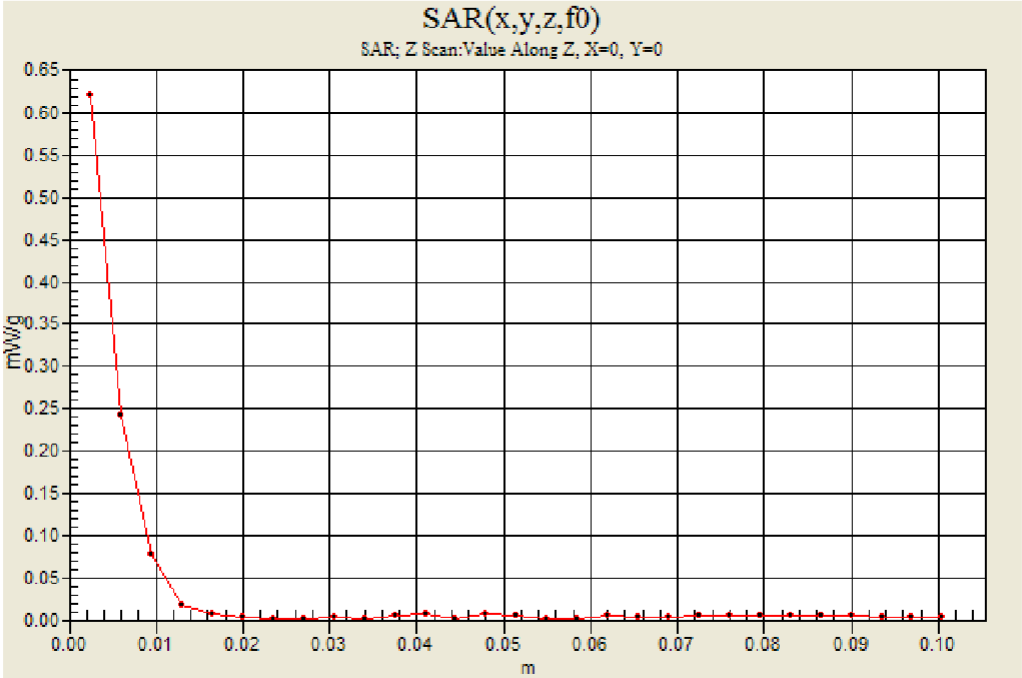
Test Laboratory: UL CCS

5.8 GHz_Laptop Mode

DUT: Samsung; Type: NA; Serial: CZGU93CB200090M

Communication System: 802.11abgn; Frequency: 5785 MHzFrequency: 5745 MHz;Duty Cycle: 1:1

802.11a_ch 149_M&A Ant/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) = 0.622 mW/g



13. ATTACHMENTS

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2	SAR Test Plots	19
3	Certificate of E-Field Probe - EX3DV4 SN 3749	11
4	Certificate of System Validation Dipole - D2450 SN:706	9
5	Certificate of System Validation Dipole - D5GHzV2 SN:1075 (with extended calibration verification data)	11