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

SAR EVALUATION REPORT

For
Handheld Terminal (802.11abg+BT+13.56MHz)

MODEL: IT-800A-35U
FCC ID: BBQIT800A
IC: 2388F-IT800A

REPORT NUMBER: 11J13697-1

ISSUE DATE: June 28, 2011

Prepared for
CASIO COMPUTER CO., LTD.
6-2 Hon-machi 1-Chome
Shibuya-ku Tokyo 151-8543 JAPAN
TEL: +81 42 639 5157
FAX: +81 42 639 5046

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

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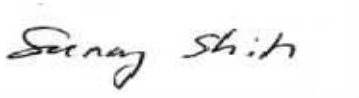
1. ATTESTATION OF TEST RESULTS

Tested for:	CASIO COMPUTER CO., LTD. 6-2 Hon-machi 1-Chome Shibuya-ku 151-8543 Tokyo JAPAN		
EUT description:	Handheld Terminal (802.11abg+BT+13.56MHz)		
Model number:	IT-800A-35U, Serial Number: 22PFU A21400509AAAA1		
Device category:	Portable devices (§2.1093)		
Exposure category:	General Population/Uncontrolled Exposure		
Date tested:	June 21-25, 2011		
FCC / IC rule parts	Frequency Range [MHz]	Highest 1-g SAR	Limit (W/kg)
15.247 / RSS-102	2412 – 2462	1.130 mW/kg (Face down)	1.6
15.407 / RSS-102	5150 – 5250	0.378 mW/kg (Face down)	
	5250 – 5350	0.513 mW/kg (Face down)	
	5500 – 5700	0.165 mW/kg (Face down)	
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:



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

Tested By:

David Rodgers
EMC 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 D01 SAR meas for 802 11abg v01r02
- 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		
Dielectronic 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	3773	5	3	2012
Thermometer	ERTCO	639-1S	1718	7	19	2011
Data Acquisition Electronics	SPEAG	DAE4	1258	5	2	2012
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	SPAEG	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

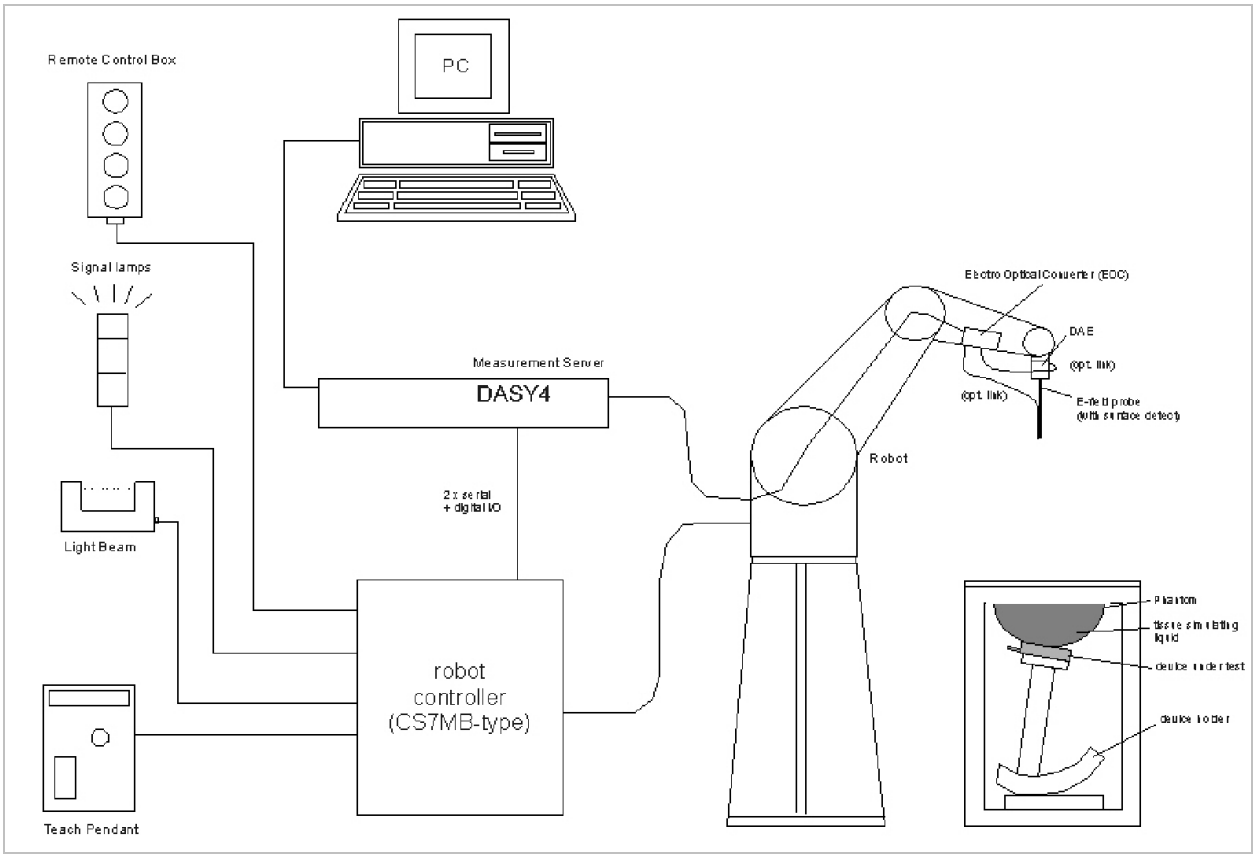
Measurement uncertainty for 300 MHz to 3 GHz averaged over 1 gram

Component	error, %	Probe Distribution	Divisor	Sensitivity	U (Xi), %
Measurement System					
Probe Calibration (k=1)	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	4.79	Normal	1	0.64	3.07
Liquid Permittivity - deviation from target		Rectangular	1.732	0.6	0.00
Liquid Permittivity - measurement uncertainty	-2.59	Normal	1	0.6	-1.55
				Combined Standard Uncertainty Uc(y) =	9.90
				Expanded Uncertainty U, Coverage Factor = 2, > 95 % Confidence = 19.79	%
				Expanded Uncertainty U, Coverage Factor = 2, > 95 % Confidence = 1.57	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	1.95	Normal	1	0.64	1.25
Liquid Permittivity - deviation from target	10.00	Rectangular	1.732	0.6	3.46
Liquid Permittivity - measurement uncertainty	4.41	Normal	1	0.6	2.65
				Combined Standard Uncertainty Uc(y), %:	10.85
				Expanded Uncertainty U, Coverage Factor = 1.96, > 95 % Confidence = 21.27	%
				Expanded Uncertainty U, Coverage Factor = 1.96, > 95 % Confidence = 1.68	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 DASY software can find the maximum locations even in relatively coarse grids. When an Area Scan has measured all reachable points, it computes the field maximal found in the scanned area, within a range of the global maximum. The range (in dB) is specified in the standards for compliance testing. For example, a 2 dB range is required in IEEE Standard 1528, EN 50361 and IEC 62209 standards, whereby 3 dB is a requirement when compliance is assessed in accordance with the ARIB standard (Japan). If only one Zoom Scan follows the Area Scan, then only the absolute maximum will be taken as reference. For cases where multiple maximums are detected, the number of Zoom Scans has to be increased accordingly.

Step 3: Zoom Scan

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

Step 4: Power drift measurement

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

Step 5: Z-Scan

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

8. EQUIPMENT UNDER TEST

EUT description Handheld Terminal with 802.11abg, Bluetooth and 13.56MHz	
Normal operation:	Handheld with hand belt
Antenna tested:	Manufactured Model number. Casio FPC-PY022-ABG1 (for both antenna 1& 2)
Body worn accessory:	Neck strap
Antenna-to-antenna/user separation distances:	See Section 16 for details of antenna locations and separation distances
Battery Pack:	Standard – Lithium ion, model HA-D20BAT-A, 3.7 Vdc, 1850 mAh Extended – Lithium ion, model HA-D21LBAT, 3.7 Vdc, 3700 mAh
Simultaneous transmission:	WiFi 2.4 GHz cannot 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 1.67 mW ≤ 60/f(GHz) mW, which stand-alone SAR evaluation is not required. Thus, simultaneous transmission SAR evaluation is not required for WiFi and Bluetooth antenna pair.

9. SIMULATING LIQUID 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

(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.

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 ρ = 1000 kg/m^3)

9.1. LIQUID PARAMETERS CHECK RESULTS

Measured by: David Rodgers

Date	Freq. (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit ±(%)
6/21/2011	Body 2450	e'	51.0157	Relative Permittivity (ε_r):	51.02	52.70	-3.20	5
		e''	14.7410	Conductivity (σ):	2.01	1.95	2.98	5

Liquid Check
Ambient temperature: 25 deg. C; Liquid temperature: 24 deg. C; Relative humidity = 40%
June 21, 2011 11:04 AM

Frequency	e'	e''
2300000000.	51.3159	14.3755
2310000000.	51.2504	14.4685
2320000000.	51.1954	14.5577
2330000000.	51.1606	14.6337
2340000000.	51.1420	14.6828
2350000000.	51.1371	14.7041
2360000000.	51.1372	14.7004
2370000000.	51.1291	14.6869
2380000000.	51.1105	14.6821
2390000000.	51.0707	14.6949
2400000000.	51.0157	14.7410
2410000000.	50.9481	14.8098
2420000000.	50.8787	14.8957
2430000000.	50.8160	14.9891
2440000000.	50.7706	15.0760
2450000000.	**50.7418**	**15.1419**
2460000000.	50.7343	15.1788
2470000000.	50.7365	15.1879
2480000000.	50.7418	15.1783
2490000000.	50.7330	15.1651
2500000000.	50.7069	15.1687
2510000000.	50.6580	15.1966
2520000000.	50.5910	15.2536
2530000000.	50.5117	15.3321
2540000000.	50.4350	15.4288
2550000000.	50.3719	15.5263

The conductivity (σ) can be given as:

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

where f = target f * 10^6

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

Measured by: David Rodgers

Date	Freq. (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit ±(%)
6/23/2011	Body 2450	e'	51.1609	Relative Permittivity (ε_r):	51.16	52.70	-2.92	5
		e''	14.2645	Conductivity (σ):	1.94	1.95	-0.35	5

Liquid Check
Ambient temperature: 25 deg. C; Liquid temperature: 24 deg. C; Relative humidity = 40%
June 23, 2011 10:50 AM

Frequency	e'	e''
2300000000.	51.6322	13.6344
2310000000.	51.5987	13.6892
2320000000.	51.5658	13.7373
2330000000.	51.5395	13.7845
2340000000.	51.5138	13.8215
2350000000.	51.4890	13.8541
2360000000.	51.4608	13.8794
2370000000.	51.4315	13.9054
2380000000.	51.3984	13.9375
2390000000.	51.3634	13.9751
2400000000.	51.3291	14.0203
2410000000.	51.2938	14.0718
2420000000.	51.2594	14.1233
2430000000.	51.2248	14.1729
2440000000.	51.1911	14.2211
2450000000.	**51.1609**	**14.2645**
2460000000.	51.1334	14.3022
2470000000.	51.1062	14.3355
2480000000.	51.0773	14.3664
2490000000.	51.0482	14.3986
2500000000.	51.0167	14.4330
2510000000.	50.9836	14.4755
2520000000.	50.9481	14.5181
2530000000.	50.9085	14.5604
2540000000.	50.8692	14.6070
2550000000.	50.8317	14.6500

The conductivity (σ) can be given as:

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

where f = target f * 10^6

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

Measured by: David Rodgers

Date	Freq. (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit ±(%)
6/23/2011	Body 5200	e'	51.1796	Relative Permittivity (ϵ_r):	51.18	49.02	4.41	10
		e''	18.2064	Conductivity (σ):	5.26	5.29	-0.58	5
6/23/2011	Body 5500	e'	50.5439	Relative Permittivity (ϵ_r):	50.54	48.61	3.97	10
		e''	18.6540	Conductivity (σ):	5.70	5.64	1.07	5

Liquid Check
Ambient temperature: 25 deg. C; Liquid temperature: 24 deg. C; Relative humidity = 40%
June 23, 2011 05:27 PM

Frequency	e'	e''
5200000000.	**51.1796**	**18.2064**
5210000000.	51.1513	18.2153
5220000000.	51.1178	18.2259
5230000000.	51.0847	18.2436
5240000000.	51.0599	18.2709
5250000000.	51.0460	18.2970
5260000000.	51.0439	18.3129
5270000000.	51.0434	18.3303
5280000000.	51.0298	18.3416
5290000000.	51.0175	18.3576
5300000000.	51.0002	18.3725
5310000000.	50.9806	18.3872
5320000000.	50.9536	18.3891
5330000000.	50.9187	18.3951
5340000000.	50.8808	18.4059
5350000000.	50.8528	18.4174
5360000000.	50.8292	18.4273
5370000000.	50.8078	18.4454
5380000000.	50.7850	18.4676
5390000000.	50.7701	18.4945
5400000000.	50.7582	18.5236
5410000000.	50.7499	18.5500
5420000000.	50.7381	18.5614
5430000000.	50.7191	18.5722
5440000000.	50.6942	18.5787
5450000000.	50.6712	18.5827
5460000000.	50.6471	18.5849
5470000000.	50.6181	18.5912
5480000000.	50.5886	18.6030
5490000000.	50.5626	18.6252
5500000000.	**50.5439**	**18.6540**

The conductivity (σ) can be given as:

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

where f = target f * 10^6

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

Measured by: David Rodgers

Date	Freq. (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit ±(%)
6/24/2011	Body 5200	e'	47.4329	Relative Permittivity (ϵ_r):	47.43	49.02	-3.24	10
		e''	18.3596	Conductivity (σ):	5.31	5.29	0.26	5
6/24/2011	Body 5500	e'	46.5773	Relative Permittivity (ϵ_r):	46.58	48.61	-4.19	10
		e''	18.8163	Conductivity (σ):	5.75	5.64	1.95	5

Liquid Check
Ambient temperature: 25 deg. C; Liquid temperature: 24 deg. C; Relative humidity = 40%
June 24, 2011 05:39 PM

Frequency	e'	e''
5200000000.	**47.4329**	**18.3596**
5210000000.	47.4110	18.3617
5220000000.	47.3804	18.3584
5230000000.	47.3403	18.3662
5240000000.	47.3003	18.3898
5250000000.	47.2679	18.4230
5260000000.	47.2419	18.4527
5270000000.	47.2183	18.4844
5280000000.	47.1931	18.5039
5290000000.	47.1680	18.5191
5300000000.	47.1470	18.5244
5310000000.	47.1313	18.5227
5320000000.	47.1044	18.5090
5330000000.	47.0664	18.5053
5340000000.	47.0238	18.5159
5350000000.	46.9867	18.5391
5360000000.	46.9540	18.5660
5370000000.	46.9267	18.6010
5380000000.	46.8978	18.6334
5390000000.	46.8739	18.6591
5400000000.	46.8558	18.6785
5410000000.	46.8443	18.6832
5420000000.	46.8219	18.6730
5430000000.	46.7882	18.6622
5440000000.	46.7500	18.6652
5450000000.	46.7127	18.6756
5460000000.	46.6789	18.6963
5470000000.	46.6503	18.7248
5480000000.	46.6199	18.7559
5490000000.	46.5936	18.7897
5500000000.	**46.5773**	**18.8163**

The conductivity (σ) can be given as:

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

where f = target f * 10^6

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

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 ±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	4/19/12	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	06/21/11	1g SAR:	55.9	52.4	6.68	±10
		10 SAR:	25.6	24.5	4.49	
D2450V2	06/23/11	1g SAR:	51.5	52.4	-1.72	±10
		10 SAR:	23.7	24.5	-3.27	

System validation dipole	Date Tested	Measured (Normalized to 1 W)		Target	Delta (%)	Tolerance (%)
		Tissue:	Body			
D5GHzV2 (5.2GHz)	06/23/11	1g SAR:	73.0	79.0	-7.59	±10
		10 SAR:	20.8	22.0	-5.45	
D5GHzV2 (5.5GHz)	06/23/11	1g SAR:	82.9	85.4	-2.93	±10
		10 SAR:	23.4	23.5	-0.43	
D5GHzV2 (5.2GHz)	06/24/11	1g SAR:	73.1	79.0	-7.47	±10
		10 SAR:	20.8	22.0	-5.45	
D5GHzV2 (5.5GHz)	06/24/11	1g SAR:	78.0	85.4	-8.67	±10
		10 SAR:	22.1	23.5	-5.96	

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, RFTestTool, which enable to control the frequency and output power of the module.

11.1. RF OUTPUT POWER FOR 2.4 GHZ BAND

2.4 GHz Band

Mode	Ch. #	Freq. (MHz)	Average Pwr (dBm)	
			Antenna 1	Antenna 2
802.11b	1	2412	12.56	
	6	2437	12.66	
	11	2462	12.15	
	1	2412		12.86
	6	2437		12.90
	11	2462		12.38
802.11g	1	2412	13.08	
	6	2437	14.02	
	11	2462	13.10	
	1	2412		13.16
	6	2437		14.08
	11	2462		13.20

Note:

11.2. RF OUTPUT POWER FOR 5 GHZ BANDS

5.2 GHz Band

Mode	Ch. #	Freq. (MHz)	Average Pwr (dBm)	
			Antenna 1	Antenna 2
802.11a	36	5180	13.63	
	40	5200	13.48	
	48	5240	13.38	
	36	5180		13.74
	40	5200		13.78
	48	5240		13.50

5.3 GHz Band

Mode	Ch. #	Freq. (MHz)	Average Pwr (dBm)	
			Antenna 1	Antenna 2
802.11a	52	5260	12.66	
	60	5300	12.63	
	64	5320	12.38	
	52	5260		12.88
	60	5300		12.93
	64	5320		12.53

5.5 GHz Band

Mode	Ch. #	Freq. (MHz)	Average Pwr (dBm)	
			Antenna 1	Antenna 2
802.11a	100	5500	10.99	
	120	5600	11.36	
	140	5700	10.74	
	100	5500		10.87
	120	5600		11.24
	140	5700		10.77

Note:

12. SUMMARY OF SAR TEST CONFIGURATIONS

Configuration	Antenna-to-User distance	SAR Require	Comments
(1) LCD Face up	18 mm From Antenna 1-to-user 25 mm From Antenna 2-to-user	Yes	With hand belt
(2) LCD Face down (with both Standard/Extended Battery pack)	12 mm From Antenna 1-to-user 8 mm From Antenna 2-to-user	Yes	With hand belt

13. SUMMARY OF SAR TEST RESULTS

13.1. 2.4 GHZ BAND

(1) LCD Face Up with hand belt

Mode	Ch. #	Freq. (MHz)	Antenna	Avg. output	Test Results (W/kg)	
				Pwr (dBm)	1g-SAR	10g-SAR
802.11b	1	2412	1	12.56		
	6	2437	1	12.66	0.024	0.010
	11	2462	1	12.15		
	1	2412	2	12.86		
	6	2437	2	12.90	0.023	0.010
	11	2462	2	12.38		
802.11g	1	2412	1	13.08		
	6	2437	1	14.02	0.030	0.011
	11	2462	1	13.10		
	1	2412	2	13.16		
	6	2437	2	14.08	0.018	0.008
	11	2462	2	13.20		

(2) LCD Face Down with hand belt

Mode	Ch. #	Freq. (MHz)	Antenna	Avg. output	Test Results (W/kg)	
				Pwr (dBm)	1g-SAR	10g-SAR
802.11b	1	2412	1	12.56		
	6	2437	1	12.66	0.095	0.046
	11	2462	1	12.15		
	1	2412	2	12.86	0.937	0.386
	6	2437	2	12.90	0.922	0.378
	11	2462	2	12.38	0.935	0.379
802.11g	1	2412	1	13.08		
	6	2437	1	14.02	0.133	0.065
	11	2462	1	13.10		
	1	**2412**	**2**	**13.16**	**1.130**	**0.469**
	6	2437	2	14.08	1.090	0.448
	11	2462	2	13.20	1.080	0.443

(2) LCD Face Down with Extended Battery Pack (based on the worst-case result from std Battery)

Mode	Ch. #	Freq. (MHz)	Antenna	Avg. output	Test Results (W/kg)	
				Pwr (dBm)	1g-SAR	10g-SAR
802.11g	1	2412	2	13.16		
	6	2437	2	14.08	0.741	0.321
	11	2462	2	12.78		

Note(s)

13.2. 5 GHZ BANDS

(1) LCD Face Up with hand belt

5.2 GHz band (5150 – 5250 MHz)

Mode	Ch. #	Freq. (MHz)	Antenna	Avg. output	Test Results (W/kg)	
				Pwr (dBm)	1g-SAR	10g-SAR
802.11a Legacy	36	5180	1	13.63		
	40	5200	1	13.48	0.183	0.062
	48	5240	1	13.38		
	36	5180	2	13.74		
	40	5200	2	13.78	0.001	0.001
	48	5240	2	13.50		

5.3 GHz band (5250 – 5350 MHz)

Mode	Ch. #	Freq. (MHz)	Antenna	Avg. output	Test Results (W/kg)	
				Pwr (dBm)	1g-SAR	10g-SAR
802.11a Legacy	52	5260	1	12.66		
	56	5280	1	12.63	0.015	0.0019
	62	5320	1	12.38		
	52	5260	2	12.88		
	56	5280	2	12.93	0.001	0.001
	62	5320	2	12.53		

5.5 GHz band (5500 – 5700 MHz)

Mode	Ch. #	Freq. (MHz)	Antenna	Avg. output	Test Results (W/kg)	
				Pwr (dBm)	1g-SAR	10g-SAR
802.11a Legacy	100	5500	1	10.99		
	120	5600	1	11.36	0.052	0.018
	140	5700	1	10.74		
	100	5500	2	10.87		
	120	5600	2	11.24	0.000304	2.060E-05
	140	5700	2	10.77		

Note(s)

(2) L CD Face down with hand belt

5.2 GHz band (5150 – 5250 MHz)

Mode	Ch. #	Freq. (MHz)	Antenna	Avg. output	Test Results (W/kg)	
				Pwr (dBm)	1g-SAR	10g-SAR
802.11a Legacy	36	5180	1	13.63		
	40	5200	1	13.48	0.156	0.050
	48	5240	1	13.38		
	36	5180	2	13.74		
	40	5200	2	13.78	**0.378**	**0.081**
	48	5240	2	13.50		

5.3 GHz band (5250 – 5350 MHz)

Mode	Ch. #	Freq. (MHz)	Antenna	Avg. output	Test Results (W/kg)	
				Pwr (dBm)	1g-SAR	10g-SAR
802.11a Legacy	52	5260	1	12.66		
	56	5280	1	12.63	0.117	0.036
	62	5320	1	12.38		
	52	5260	2	12.88		
	56	**5280**	**2**	**12.93**	**0.513**	**0.108**
	62	5320	2	12.53		

5.5 GHz band (5500 – 5700 MHz)

Mode	Ch. #	Freq. (MHz)	Antenna	Avg. output	Test Results (W/kg)	
				Pwr (dBm)	1g-SAR	10g-SAR
802.11a Legacy	100	5500	1	10.99		
	120	5600	1	11.36	0.123	0.048
	140	5700	1	10.74		
	100	5500	2	10.87		
	120	5600	2	11.24	**0.165**	**0.041**
	140	5700	2	10.77		

(2) LCD Face Down with Extended Battery Pack (based on the worst-case result from std Battery)

5.3 GHz band (5250 – 5350 MHz)

Mode	Ch. #	Freq. (MHz)	Antenna	Avg. output	Test Results (W/kg)	
				Pwr (dBm)	1g-SAR	10g-SAR
802.11a Legacy	52	5260	2	12.88		
	56	5280	2	12.93	0.361	0.082
	62	5320	2	12.53		

WORST-CASE SAR PLOTS FOR 2.4 GHZ

2.4 GHz

Date: 23/06/2011

Test Laboratory: UL CCS SAR Lab B

Face down

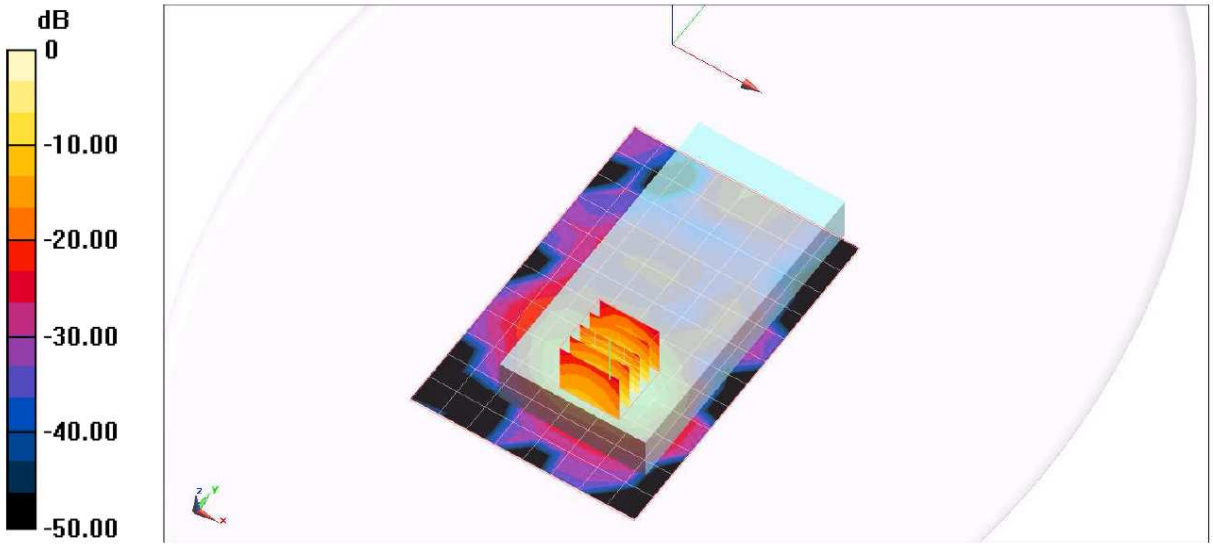
Communication System: WLAN_2.4GHz; Frequency: 2412 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 2412 MHz; σ = 1.89 mho/m; ε_r = 51.287; ρ = 1000 kg/m^3
Phantom section: Flat Section

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(6.87, 6.87, 6.87); Calibrated: 03/05/2011
- Sensor-Surface: 2.5mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1258; Calibrated: 02/05/2011
- Phantom: ELI v5.0 (B); Type: QDOVA001BB; Serial: 1118
- Measurement SW: DASY52, Version 52.6 (2);SEMCAD X Version 14.4.5 (3634)

802.11g/Ant 2_Ch 1/Area Scan (9x13x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 1.367 mW/g

802.11g/Ant 2_Ch 1/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 27.108 V/m; Power Drift = -0.06 dB
SAR(1 g) = 1.130 mW/g; SAR(10 g) = 0.469 mW/g
Maximum value of SAR (measured) = 1.697 mW/g



0 dB = 1.700mW/g

Z-axis Plot

Date/Time: 23/06/2011

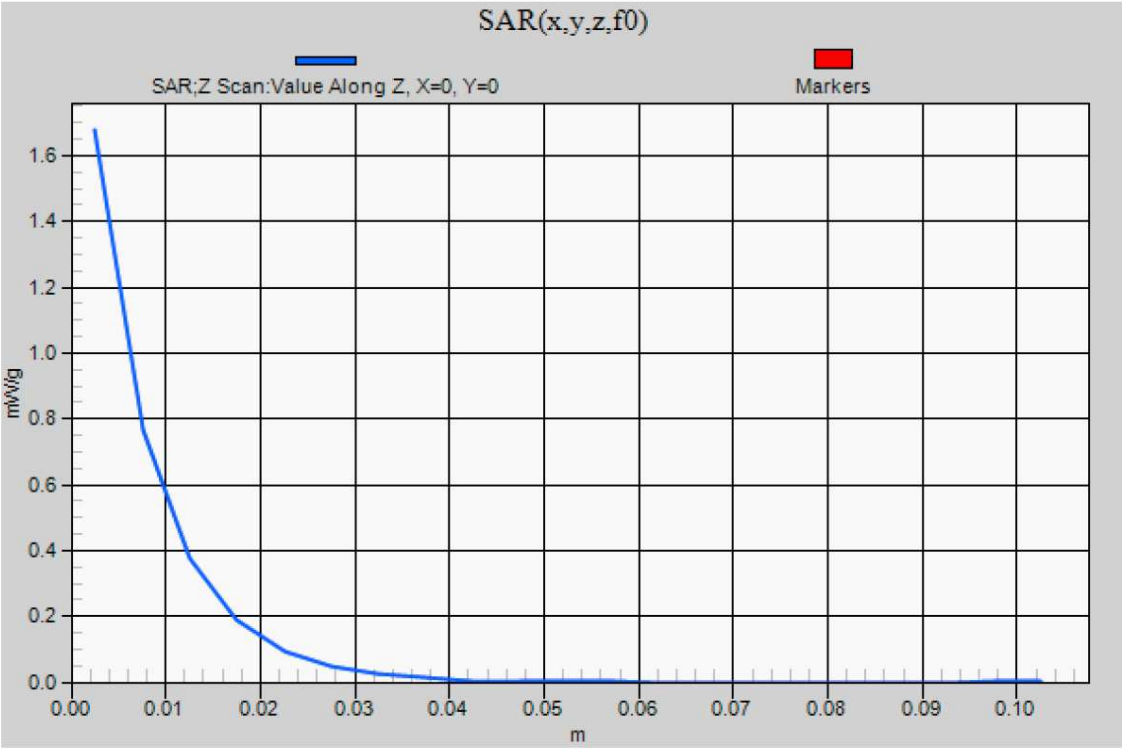
Test Laboratory: UL CCS SAR Lab B

Face down

DUT: Casio Handheld; Type: N/A; Serial: N/A

Communication System: WLAN_2.4GHz; Frequency: 2437 MHz;Duty Cycle: 1:1

802.11g/Ant 2_Ch 6/Z Scan (1x1x21): Measurement grid: dx=20mm, dy=20mm, dz=5mm
Maximum value of SAR (measured) = 1.677 mW/g



WORST-CASE SAR PLOTS FOR 5 GHZ BANDS

5.2 GHz Band

Date: 24/06/2011

Test Laboratory: UL CCS SAR Lab B

Face Down

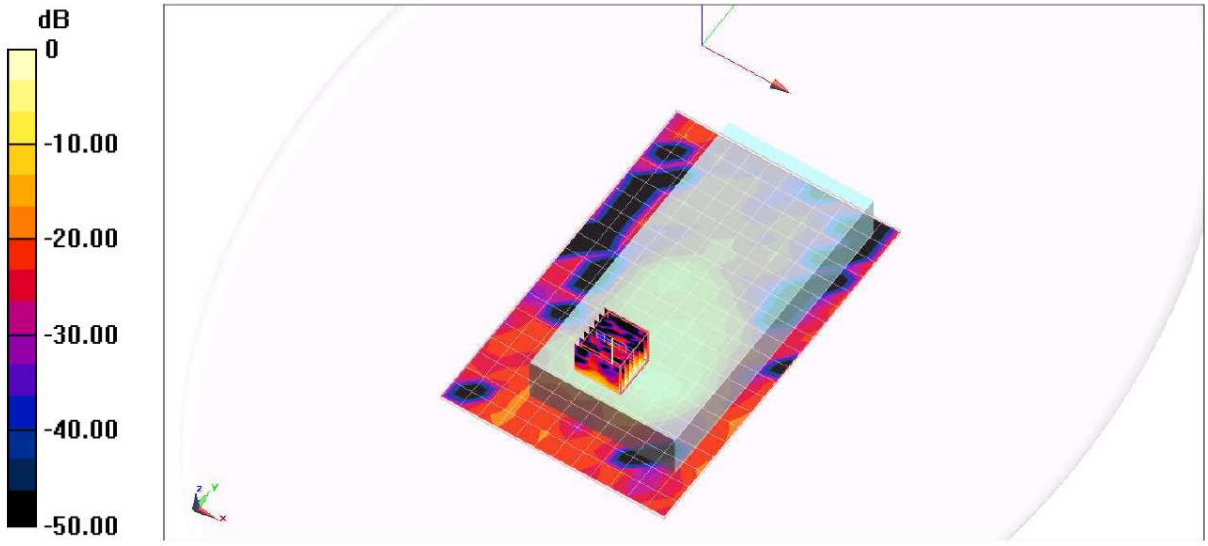
Communication System: 802.11a 5.2-802.11a; Frequency: 5200 MHz;Duty Cycle: 1:1
Medium parameters used: f = 5200 MHz; σ = 5.267 mho/m; ε_r = 51.18; ρ = 1000 kg/m^3
Phantom section: Flat Section

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: 03/05/2011
- Sensor-Surface: 2.5mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 2.5mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1258; Calibrated: 02/05/2011
- Phantom: ELI v5.0 (A); Type: QDOVA001BB; Serial: 1120
- Measurement SW: DASY52, Version 52.6 (2);SEMCAD X Version 14.4.5 (3634)

802.11a/Ch 40_Ant 2/Area Scan (13x20x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 0.524 mW/g

802.11a/Ch 40_Ant 2/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 10.954 V/m; Power Drift = 0.10 dB
Peak SAR (extrapolated) = 1.483 W/kg
SAR(1 g) = 0.378 mW/g; SAR(10 g) = 0.081 mW/g
Maximum value of SAR (measured) = 0.770 mW/g



0 dB = 0.770mW/g

5.3 GHz Band

Date: 24/06/2011

Test Laboratory: UL CCS SAR Lab B

Face Down

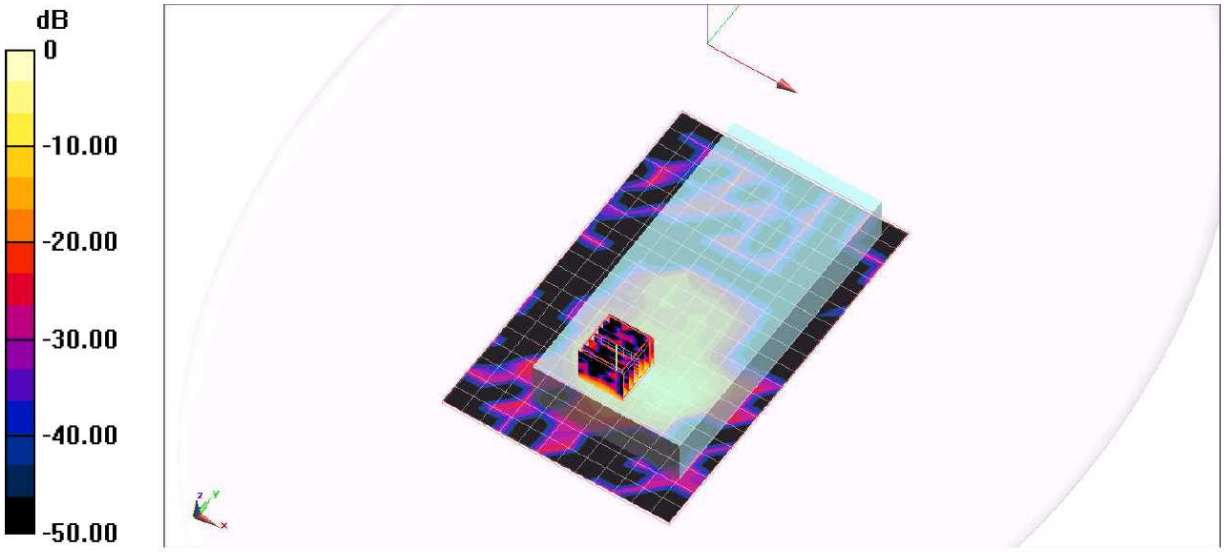
Communication System: WLAN_5GHz; Frequency: 5280 MHz;Duty Cycle: 1:1
Medium parameters used: f = 5280 MHz; σ = 5.388 mho/m; ε_r = 51.03; ρ = 1000 kg/m^3
Phantom section: Flat Section

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: 03/05/2011
- Sensor-Surface: 2.5mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1258; Calibrated: 02/05/2011
- Phantom: ELI v5.0 (A); Type: QDOVA001BB; Serial: 1120
- Measurement SW: DASY52, Version 52.6 (2);SEMCAD X Version 14.4.5 (3634)

802.11a/Ant2_Ch56/Area Scan (13x20x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 0.675 mW/g

802.11a/Ant2_Ch56/Zoom Scan 2 (7x7x9)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 11.956 V/m; Power Drift = -0.10 dB
Peak SAR (extrapolated) = 2.023 W/kg
SAR(1 g) = 0.513 mW/g; SAR(10 g) = 0.108 mW/g
Maximum value of SAR (measured) = 1.009 mW/g



0 dB = 1.010mW/g

Z-axis Plot

Date/Time: 24/06/2011

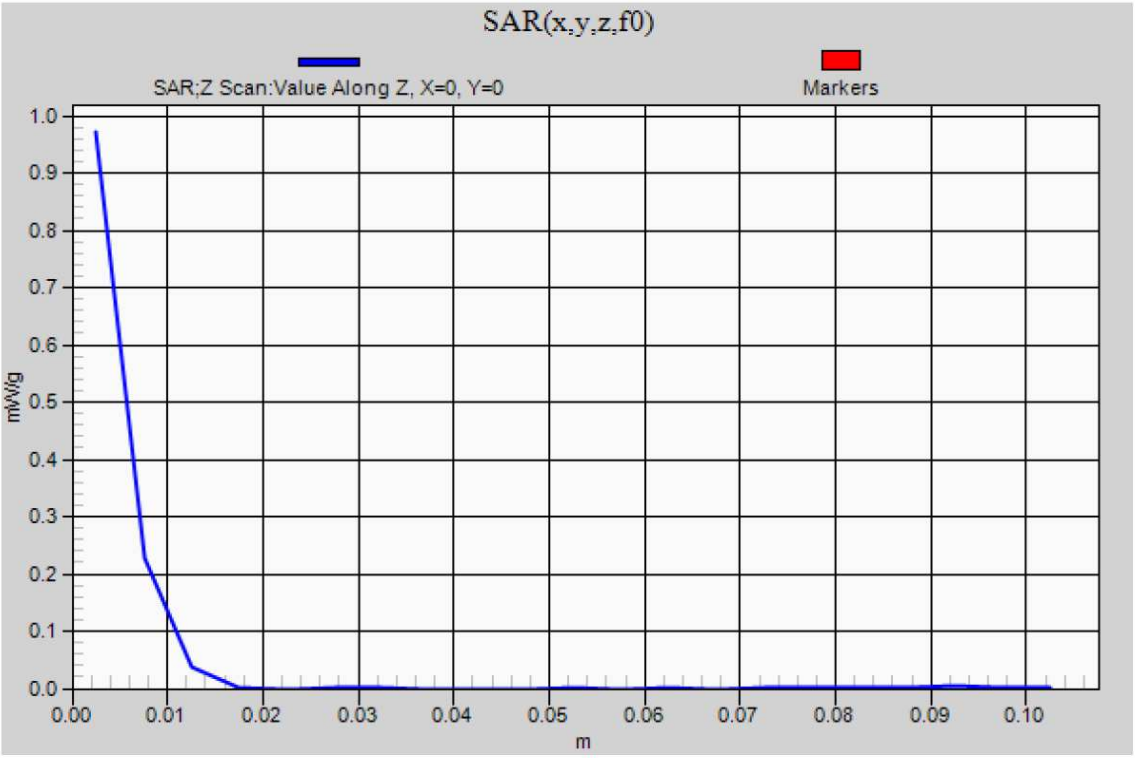
Test Laboratory: UL CCS SAR Lab B

Face Down

DUT: Casio Handheld; Type: N/A; Serial: N/A

Communication System: WLAN_5GHz; Frequency: 5280 MHz;Duty Cycle: 1:1

Ant2_Ch56/Z Scan (1x1x21): Measurement grid: dx=20mm, dy=20mm, dz=5mm
Maximum value of SAR (measured) = 0.971 mW/g



5.6 GHz Band

Date: 24/06/2011

Test Laboratory: UL CCS SAR Lab B

Face Down

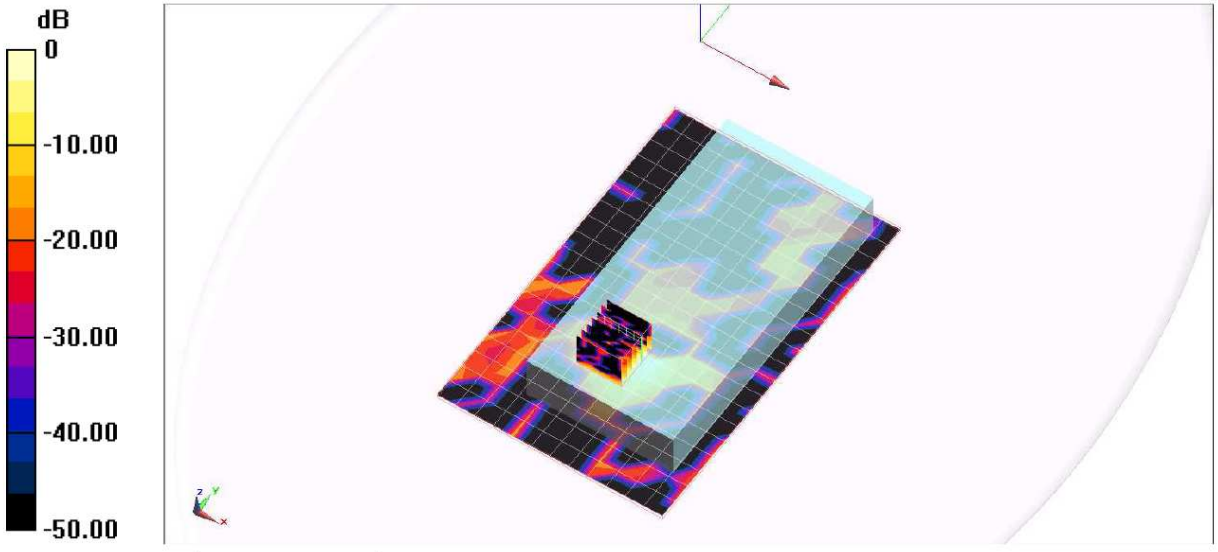
Communication System: WLAN_5GHz; Frequency: 5600 MHz;Duty Cycle: 1:1
Medium parameters used: f = 5600 MHz; σ = 5.849 mho/m; ε_r = 50.342; ρ = 1000 kg/m^3
Phantom section: Flat Section

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(3.26, 3.26, 3.26); Calibrated: 03/05/2011
- Sensor-Surface: 2.5mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1258; Calibrated: 02/05/2011
- Phantom: ELI v5.0 (A); Type: QDOVA001BB; Serial: 1120
- Measurement SW: DASY52, Version 52.6 (2);SEMCAD X Version 14.4.5 (3634)

802.11a/Ch 120_Ant 2/Area Scan (13x20x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 0.281 mW/g

802.11a/Ch 120_Ant 2/Zoom Scan (7x7x9)/Cube 1: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 7.488 V/m; Power Drift = 0.24 dB
Peak SAR (extrapolated) = 0.612 W/kg
SAR(1 g) = 0.165 mW/g; SAR(10 g) = 0.041 mW/g
Maximum value of SAR (measured) = 0.319 mW/g



0 dB = 0.320mW/g

14. SIMULTANEOUS SAR DATA SUMMARY

KDB 648474 Simultaneous Transmission consideration

Individual Transmitter	Stand-alone SAR
WiFi	Yes
Bluetooth	Not required (average output is < $60/f_{(GHz)}$) (mW))

15. APPENDIX

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