FCC OET BULLETIN 65 SUPPLEMENT C 01-01
IEEE Std 1528-2003 & IEEE 1528a-2005

SAR EVALUATION REPORT

For
Tablet with IEEE 802.11a/b/g/n radio and Bluetooth radio

Model: A1432
FCC ID: BCGA1432

Report Number: 12U14526-7
Issue Date: 10/5/2012

Prepared for
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Revision History

Rev.	Issue Date	Revisions	Revised By
--	10/5/2012	Initial Issue	--

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1. Attestation of Test Results

Applicant	Apple Inc.		
DUT description	Tablet with IEEE 802.11a/b/g/n radio and Bluetooth radio		
Model	A1432		
Test device is	An identical prototype		
Device category	Portable		
Exposure category	General Population/Uncontrolled Exposure		
Date tested	7/31/2012 – 9/4/2012		
FCC Rule Parts	Freq. Range	Highest 1-g SAR	Limit
15.247 (WiFi)	2412-2462 MHz	1.07 W/kg (Body Edge 3 w/ 0 mm distance)	1.6 W/kg
15.247 (BT)	2402-2480 MHz	0.323 W/kg (Body Edge 3 w/ 0 mm distance)	
15.407 (WiFi)	5150-5250 MHz	0.856 W/kg (Body Edge 3 w/ 0 mm distance)	
	5250-5350 MHz	1.100 W/kg (Body Edge 3 w/ 0 mm distance)	
	5500-5700 MHz	1.190 W/kg (Body Edge 3 w/ 0 mm distance)	
15.247 (WiFi)	5725-5850 MHz	1.160 W/kg (Body Edge 3 w/ 0 mm distance)	
Simultaneous transmission condition		1.513 W/kg (refer to Section 14.1) (The highest SAR across exposure conditions)	
Applicable Standards			Test Results
FCC OET Bulletin 65 Supplement C 01-01, IEEE Std 1528-2003 & IEEE 1528a-2005			Pass

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:

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Tested By:

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SAR Engineer
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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 & IEEE 1528a-2005 and the following KDB Procedures:

- 447498 D01 Mobile Portable RF Exposure v04
- 248227 D01 SAR Meas for 802 11abg v01r02

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 used to perform the tests documented in this report has been calibrated in accordance with the manufacturers' recommendations, and is traceable to recognized national standards.

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due date		
				MM	DD	Year
S-Parameter Network Analyzer	Agilent	8753ES	MY40001647	6	27	2013
Dielectronic Probe kit	HP	85070C	2569	N/A		
ENA Series Network Analyzer	Agilent	E5071B	MY42100131	2	11	2013
Dielectronic Probe kit	HP	85070E	594	N/A		
Synthesized Signal Generator	HP	8665B	3438A00633	2	22	2013
Power Meter	HP	438A	3513U04320	9	17	2013
Power Sensor A	HP	8481A	2237A31744	8	17	2013
Power Sensor B	HP	8481A	3318A95392	8	17	2013
Amplifier	MITEQ	4D00400600-50-30P	1622052	N/A		
Directional coupler	Werlatone	C8060-102	2149	N/A		
Synthesized Signal Generator	HP	8665B	3744A01084	5	3	2013
Power Meter	HP	438A	2822A05684	10	7	2013
Power Sensor A	HP	8481A	2702A66876	8	1	2013
Power Sensor B	HP	8482A	2349A08568	4	14	2013
Amplifier	MITEQ	4D00400600-50-30P	1620606	N/A		
Directional coupler	Werlatone	C8060-102	2141	N/A		
Thermometer	ERTCO	639-1S	8350	7	30	2013
E-Field Probe	SPEAG	EX3DV4	3686	2	16	2013
E-Field Probe	SPEAG	EX3DV4	3772	2	16	2013
E-Field Probe	SPEAG	EX3DV4	3773	3	14	2013
Data Acquisition Electronics	SPEAG	DAE4	1239	6	6	2013
Data Acquisition Electronics	SPEAG	DAE4	1258	3	8	2013
Data Acquisition Electronics	SPEAG	DAE4	1259	2	13	2013
System Validation Dipole	SPEAG	D2450V2	748	2	7	2013
System Validation Dipole	SPEAG	D5GHzV2	1075	2	14	2013
System Validation Dipole	SPEAG	D5GHzV2	1003	8	23	2012
Power Meter	R & S	NRP	100673	5	5	2013
Power Sensor	R & S	NRP - Z23	100168	5	5	2013

4.2. Measurement Uncertainty

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

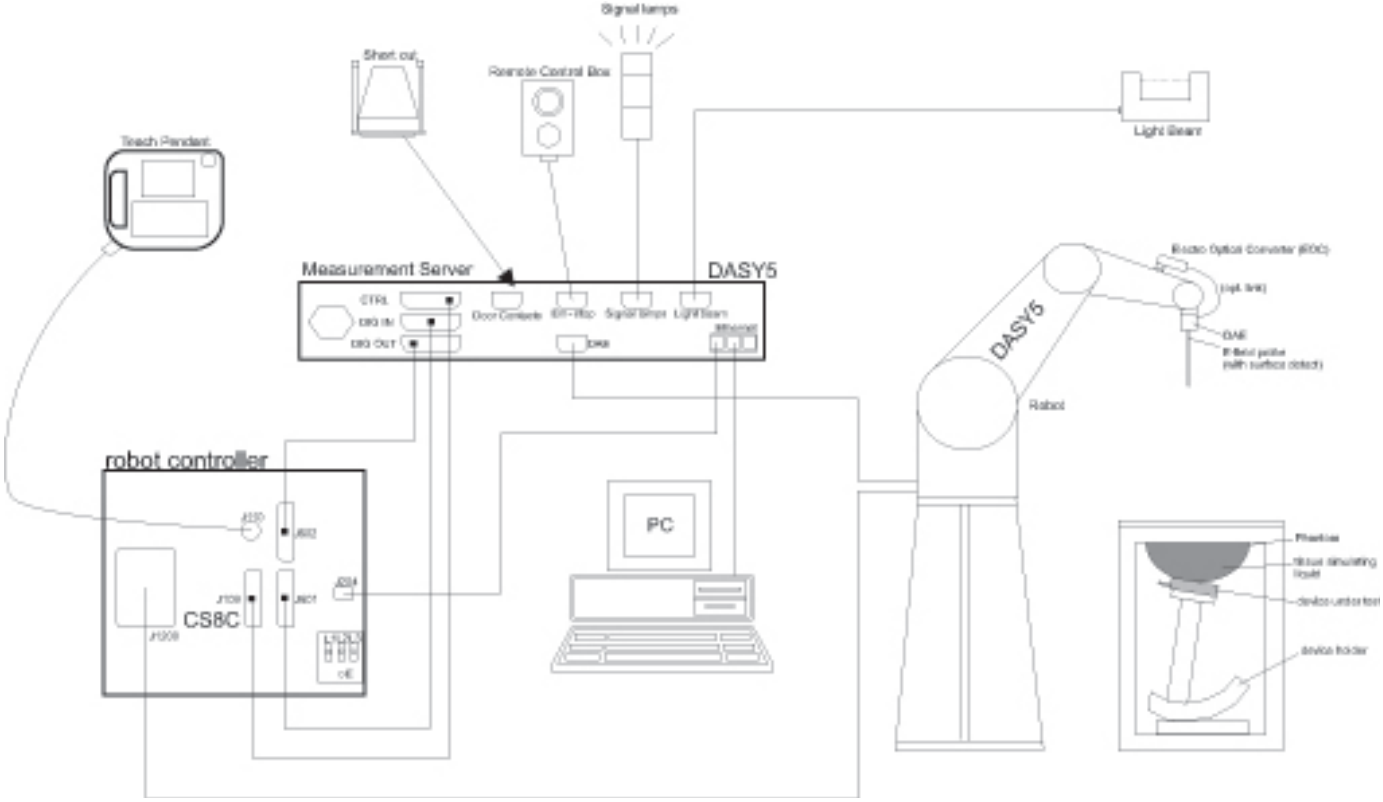
Component	Error, %	Distribution	Divisor	Sensitivity	U (Xi), %
Measurement System					
Probe Calibration (k=1)	**6.00**	Normal	1	1	6.00
Axial Isotropy	1.15	Rectangular	1.732	0.7071	0.47
Hemispherical Isotropy	2.30	Rectangular	1.732	0.7071	0.94
Boundary Effect	0.90	Rectangular	1.732	1	0.52
Probe Linearity	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	**-2.41**	Normal	1	0.64	-1.54
Liquid Permittivity - deviation from target	5.00	Rectangular	1.732	0.6	1.73
Liquid Permittivity - measurement uncertainty	**-3.72**	Normal	1	0.6	-2.23
Combined Standard Uncertainty Uc(y) =					10.11
Expanded Uncertainty U, Coverage Factor = 2, > 95 % Confidence =				20.22	%
Expanded Uncertainty U, Coverage Factor = 2, > 95 % Confidence =				1.60	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	**4.87**	Normal	1	0.64	3.12
Liquid Permittivity - deviation from target	10.00	Rectangular	1.732	0.6	3.46
Liquid Permittivity - measurement uncertainty	**-6.78**	Normal	1	0.6	-4.07
Combined Standard Uncertainty Uc(y), %:					11.64
Expanded Uncertainty U, Coverage Factor = 1.96, > 95 % Confidence =				22.81	%
Expanded Uncertainty U, Coverage Factor = 1.96, > 95 % Confidence =				1.78	dB

5. Measurement System Description and Setup

The DASY5 system used for performing compliance tests consists of the following items:



- A standard high precision 6-axis robot with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- An isotropic Field probe optimized and calibrated for the targeted measurement.
- 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 Electro-optical converter (EOC) performs the conversion from optical to electrical signals for the digital communication to the DAE. To use optical surface detection, a special version of the EOC is required. The EOC signal is transmitted to the measurement server.
- 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.
- The Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positioning.
- A computer running WinXP or Win7 and the DASY5 software.
- Remote control and teach pendant as well as additional circuitry for robot safety such as warning lamps, etc.
- The phantom, the device holder and other accessories according to the targeted measurement.

6. SAR Measurement Procedure

6.1. Normal 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.

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 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.

Area Scan Parameters extracted from KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz v01 (Draft)

	≤ 3 GHz	> 3 GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface	5 ± 1 mm	½·δ·ln(2) ± 0.5 mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location	30° ± 1°	20° ± 1°
Maximum area scan spatial resolution: Δx_{Area}, Δy_{Area}	≤ 2 GHz: ≤ 15 mm 2 – 3 GHz: ≤ 12 mm	3 – 4 GHz: ≤ 12 mm 4 – 6 GHz: ≤ 10 mm
	When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device.	

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 points (refer to table below) 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.

Zoom Scan Parameters extracted from KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz v01 (Draft)

			≤ 3 GHz	> 3 GHz
Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}			≤ 2 GHz: ≤ 8 mm 2 – 3 GHz: ≤ 5 mm*	3 – 4 GHz: ≤ 5 mm* 4 – 6 GHz: ≤ 4 mm*
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{Zoom}(n)$		≤ 5 mm	3 – 4 GHz: ≤ 4 mm 4 – 5 GHz: ≤ 3 mm 5 – 6 GHz: ≤ 2 mm
	graded grid	$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface	≤ 4 mm	3 – 4 GHz: ≤ 3 mm 4 – 5 GHz: ≤ 2.5 mm 5 – 6 GHz: ≤ 2 mm
		$\Delta z_{Zoom}(n>1)$: between subsequent points	≤ 1.5·$\Delta z_{Zoom}(n-1)$	
Minimum zoom scan volume	x, y, z		≥ 30 mm	3 – 4 GHz: ≥ 28 mm 4 – 5 GHz: ≥ 25 mm 5 – 6 GHz: ≥ 22 mm

Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details.

* When zoom scan is required and the *reported* SAR from the area scan based *1-g SAR estimation* procedures of KDB 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.

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 (FCC only)

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.

6.2. Volume Scan Procedures

Step 1: Repeat Step 1-4 in Section 6.1

Step 2: Volume Scan
Volume Scans are used to assess peak SAR and averaged SAR measurements in largely extended 3-dimensional volumes within any phantom. This measurement does not need any previous area scan. The grid can be anchored to a user specific point or to the current probe location.

Step 3: 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.

7. Device Under Test

Model A1432, is a tablet with multimedia functions (music, application support, and video), IEEE 802.11a/b/g/n radio and Bluetooth radio.	
Exposure conditions	Body Exposure with all surfaces and edges. Refer to Section 8 for detailed.

7.1. Band and Air Interfaces

Tx Frequency Bands	- 802.11a/b/g/n: 2412 - 2462 MHz 5180 – 5825 MHz - Bluetooth: 2402 - 2480 MHz
Mode	▪ 802.11a/b/g/n HT20/HT40(a mode only) • Bluetooth 4.0 LE

Note(s):

There are three Bill of Material variations of the Wi-Fi/Bluetooth Radio to support the production volumes of the device. The three BOM variants are:

- BOM # 1
- BOM # 2
- BOM # 3

The Model A1432 share the same Wi-Fi/Bluetooth chipset, have the same mechanical outline (e.g., the same dimension package and pin-out layout), use the same on-board antenna matching circuit, have an identical antenna structure, and are built and tested to conform the same specifications and to operate within the same tolerances.

Complete SAR evaluation is performed on the BOM # 1 that has the highest SAR, and then, the test is repeated for the other BOM variants at the highest peak SAR value.

8. Exposure Conditions

Refer to Section 17 "Antenna Location and Separation Distances" for the specific details of the antenna-to-antenna and antenna-to-edge(s) distances.

8.1. Body

For WiFi (Primary Antenna)

Test Configurations	Antenna-to-edge/surface	SAR Required	Note
Rear	6.47 mm	Yes	
Edge 1	181.3 mm	No	This is not the most conservative antenna-to-user distance at edge mode. According to KDB 447498 4) b) ii) (2)
Edge 2	93.5 mm	No	This is not the most conservative antenna-to-user distance at edge mode. According to KDB 447498 4) b) ii) (2)
Edge 3	3.4 mm	Yes	
Edge 4	9.8 mm	Yes	

For WiFi (Secondary Antenna)

Test Configurations	Antenna-to-edge/surface	SAR Required	Note
Rear	6.47 mm	Yes	
Edge 1	191.1 mm	No	This is not the most conservative antenna-to-user distance at edge mode. According to KDB 447498 4) b) ii) (2)
Edge 2	14.4 mm	Yes	
Edge 3	3.4 mm	Yes	
Edge 4	93.5 mm	No	This is not the most conservative antenna-to-user distance at edge mode. According to KDB 447498 4) b) ii) (2)

Notes:

- Edge 1= Top Edge
- Edge 2= Right Edge
- Edge 3= Bottom Edge
- Edge 4= Left Edge

9. RF Output Power Measurement

9.1. WiFi (2.4 GHz Band)

Required Test Channels per KDB 248227 D01

Mode	Band	GHz	Channel	"Default Test Channels"	
				802.11b	802.11g
802.11b/g	2.4 GHz	**2.412**	1#	√	∇
		2.437	6	√	∇
		2.462	11#	√	∇

Notes:
√ = "default test channels"
∇ = possible 802.11g channels with maximum average output ¼ dB ≥ the "default test channels"
= when output power is reduced for channel 1 and /or 11 to meet restricted band requirements the highest output channels closest to each of these channels should be tested.

Band (MHz)	Mode	Ch #	Freq. (MHz)	Avg Pwr (dBm)	
				Primary	Secondary
2.4	802.11b	1	2412	15.9	15.9
		6	2437	16.0	16.0
		11	2462	16.0	16.0
	802.11g	1	2412	16.0	16.0
		6	2437	15.9	15.9
		11	2462	16.0	15.9
	802.11n (HT20)	1	2412	16.0	15.9
		6	2437	16.0	16.0
		11	2462	15.9	16.0

Note(s):
Per KDB 248227 D01, SAR is not required for 802.11g/HT20 channels when the maximum average output power is less than 1/4 dB higher than that measured on the corresponding 802.11a/b channels.

9.2. WiFi (5 GHz Bands)

Required Test Channels per KDB 248227 D01

Mode		Band	GHz	Channel	"Default Test Channels"	
					802.11a	
802.11a	UNII (15.407)	5.2 GHz	5.180	36	√	
			5.200	40		*
			2.220	44		*
			5.240	48	√	
		5.3 GHz	5.260	52	√	
			5.280	56		*
			5.300	60		*
			5.320	64	√	
		5.5 GHz	5.500	100		
			5.520	104	√	
			5.540	108		*
			5.560	112		*
			5.580	116	√	
			5.600	120		*
			5.620	124	√	
			5.640	128		*
			5.660	132		*
			5.680	136	√	
			5.700	140		*
	DTS (15.247)	5.8 GHz	5.745	149	√	
			5.765	153		*
			5.785	157	√	
			5.805	161		*
			5.825	165	√	

√ = "default test channels"

* = possible 802.11a channels with maximum average output > the "default test channels"

= when output power is reduced for channel 1 and /or 11 to meet restricted band requirements the highest output channels closest to each of these channels should be tested.

Band (MHz)	Mode	Ch #	Freq. (MHz)	Avg Pwr (dBm)	
				Primary	Secondary
5.2	802.11a	36	5180	14.0	14.0
		40	5200	13.9	14.0
		44	5220	13.9	13.9
		48	5240	13.9	13.9
	802.11n (HT20)	36	5180	13.9	14.0
		40	5200	13.9	13.9
		48	5240	13.9	13.9
	802.11n (HT40)	38	5190	12.0	12.0
		46	5230	15.5	15.5
5.3	802.11a	52	5260	16.9	17.0
		56	5280	16.9	16.9
		60	5300	16.9	16.9
		64	5320	16.0	15.9
	802.11n (HT20)	52	5260	16.9	17.0
		60	5300	16.9	16.9
		64	5320	15.9	16.0
	802.11n (HT40)	54	5270	17.0	16.9
		62	5310	11.9	11.9
5.5	802.11a	100	5500	15.5	15.5
		104	5520	16.0	16.0
		108	5540	15.9	15.9
		112	5560	15.9	15.9
		116	5580	15.9	16.0
		120	5600	15.9	15.9
		124	5620	16.0	16.0
		128	5640	16.0	16.0
		132	5660	16.0	16.0
		136	5680	16.0	16.0
		140	5700	15.5	15.5
	802.11n (HT20)	100	5500	15.5	15.5
		104	5520	16.0	15.9
		116	5580	15.9	15.9
		136	5680	16.0	16.0
		140	5700	14.5	14.5
	802.11n (HT40)	102	5510	12.5	12.5
		110	5550	16.0	16.0
		134	5670	16.0	16.0
5.8	802.11a	149	5745	15.9	16.0
		153	5765	15.9	15.9
		157	5785	15.9	16.0
		161	5805	15.9	15.9
		165	5825	16.0	16.0
	802.11n (HT20)	149	5745	16.0	16.0
		157	5785	16.0	16.0
		165	5825	16.0	15.9
	802.11n (HT40)	151	5755	16.0	15.9
		159	5795	15.9	15.9

Note(s):

Per KDB 248227 D01, SAR is not required for 802.11g/HT20 channels when the maximum average output power is less than 1/4 dB higher than that measured on the corresponding 802.11a/b channels.

9.3. Bluetooth

Mode	Channel #	Freq. (MHz)	Conducted Avg Power	
			(dBm)	(mW)
V2.1 + EDR, GFSK	0	2402	11.8	15.14
	39	2441	12.0	15.85
	78	2480	11.9	15.49
V2.1 + EDR, π/4 DQPSK	0	2402	9.5	8.91
	39	2441	9.3	8.51
	78	2480	9.4	8.71
V2.1 + EDR, 8-DPSK	0	2402	9.0	7.94
	39	2441	9.5	8.91
	78	2480	9.5	8.91
V4.0 LE, GFSK	0	2402	7.9	6.17
	19	2440	7.8	6.03
	39	2480	7.8	6.03

10. Tissue Dielectric Properties

IEEE Std 1528-2003 Table 2

Target Frequency (MHz)	Head	
	ε_r	σ (S/m)
300	45.3	0.87
450	43.5	0.87
835	41.5	0.90
900	41.5	0.97
1450	40.5	1.20
1800 – 2000	40.0	1.40
2450	39.2	1.80
2600	39.0	1.96
3000	38.5	2.40

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Target Frequency (MHz)	Head		Body	
	ε_r	σ (S/m)	ε_r	σ (S/m)
150	52.3	0.76	61.9	0.80
300	45.3	0.87	58.2	0.92
450	43.5	0.87	56.7	0.94
835	41.5	0.90	55.2	0.97
900	41.5	0.97	55.0	1.05
915	41.5	0.98	55.0	1.06
1450	40.5	1.20	54.0	1.30
1610	40.3	1.29	53.8	1.40
1800 – 2000	40.0	1.40	53.3	1.52
2450	39.2	1.80	52.7	1.95
3000	38.5	2.40	52.0	2.73
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

10.1. Composition of Ingredients for the Tissue Material Used in the SAR Tests

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

10.2. Tissue Dielectric Parameter Check Results

Tissue dielectric parameters were measured at the low, middle and high frequency of each operating frequency range of the test device.

SAR Room A

Date	Freq. (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit ±(%)
8/2/2012	Body 5180	e'	47.4227	Relative Permittivity (ϵ_r):	47.42	49.05	-3.31	10
		e''	18.5990	Conductivity (σ):	5.36	5.27	1.62	5
	Body 5200	e'	47.4484	Relative Permittivity (ϵ_r):	47.45	49.02	-3.21	10
		e''	18.5067	Conductivity (σ):	5.35	5.29	1.06	5
	Body 5500	e'	46.9694	Relative Permittivity (ϵ_r):	46.97	48.61	-3.38	10
		e''	18.7858	Conductivity (σ):	5.75	5.64	1.78	5
	Body 5800	e'	46.5704	Relative Permittivity (ϵ_r):	46.57	48.20	-3.38	10
		e''	18.8566	Conductivity (σ):	6.08	6.00	1.35	5
	Body 5825	e'	46.3940	Relative Permittivity (ϵ_r):	46.39	48.20	-3.75	10
		e''	19.1079	Conductivity (σ):	6.19	6.00	3.15	5
8/6/2012	Body 5180	e'	45.9306	Relative Permittivity (ϵ_r):	45.93	49.05	-6.35	10
		e''	17.6803	Conductivity (σ):	5.09	5.27	-3.40	5
	Body 5200	e'	45.9133	Relative Permittivity (ϵ_r):	45.91	49.02	-6.34	10
		e''	17.7380	Conductivity (σ):	5.13	5.29	-3.14	5
	Body 5500	e'	45.4718	Relative Permittivity (ϵ_r):	45.47	48.61	-6.46	10
		e''	17.7883	Conductivity (σ):	5.44	5.64	-3.62	5
	Body 5800	e'	44.9462	Relative Permittivity (ϵ_r):	44.95	48.20	-6.75	10
		e''	18.0618	Conductivity (σ):	5.82	6.00	-2.92	5
	Body 5825	e'	44.9319	Relative Permittivity (ϵ_r):	44.93	48.20	-6.78	10
		e''	17.9827	Conductivity (σ):	5.82	6.00	-2.93	5
8/7/2012	Body 5180	e'	47.4889	Relative Permittivity (ϵ_r):	47.49	49.05	-3.18	10
		e''	18.7223	Conductivity (σ):	5.39	5.27	2.30	5
	Body 5200	e'	47.4517	Relative Permittivity (ϵ_r):	47.45	49.02	-3.20	10
		e''	18.7441	Conductivity (σ):	5.42	5.29	2.36	5
	Body 5500	e'	46.8770	Relative Permittivity (ϵ_r):	46.88	48.61	-3.57	10
		e''	19.0817	Conductivity (σ):	5.84	5.64	3.39	5
	Body 5800	e'	46.2821	Relative Permittivity (ϵ_r):	46.28	48.20	-3.98	10
		e''	18.2845	Conductivity (σ):	5.90	6.00	-1.72	5
	Body 5825	e'	46.1998	Relative Permittivity (ϵ_r):	46.20	48.20	-4.15	10
		e''	19.4270	Conductivity (σ):	6.29	6.00	4.87	5
8/8/2012	Body 5180	e'	48.6849	Relative Permittivity (ϵ_r):	48.68	49.05	-0.74	10
		e''	18.4545	Conductivity (σ):	5.32	5.27	0.83	5
	Body 5200	e'	48.6780	Relative Permittivity (ϵ_r):	48.68	49.02	-0.70	10
		e''	18.6699	Conductivity (σ):	5.40	5.29	1.95	5
	Body 5500	e'	48.2502	Relative Permittivity (ϵ_r):	48.25	48.61	-0.75	10
		e''	18.7538	Conductivity (σ):	5.74	5.64	1.61	5
	Body 5800	e'	47.7486	Relative Permittivity (ϵ_r):	47.75	48.20	-0.94	10
		e''	18.9256	Conductivity (σ):	6.10	6.00	1.72	5
	Body 5825	e'	47.5942	Relative Permittivity (ϵ_r):	47.59	48.20	-1.26	10
		e''	18.9113	Conductivity (σ):	6.13	6.00	2.09	5
8/17/2012	Body 5180	e'	47.9306	Relative Permittivity (ϵ_r):	47.93	49.05	-2.28	10
		e''	18.5457	Conductivity (σ):	5.34	5.27	1.33	5
	Body 5200	e'	47.8616	Relative Permittivity (ϵ_r):	47.86	49.02	-2.36	10
		e''	18.6181	Conductivity (σ):	5.38	5.29	1.67	5
	Body 5500	e'	47.4940	Relative Permittivity (ϵ_r):	47.49	48.61	-2.30	10
		e''	18.6422	Conductivity (σ):	5.70	5.64	1.00	5
	Body 5800	e'	47.0629	Relative Permittivity (ϵ_r):	47.06	48.20	-2.36	10
		e''	18.8077	Conductivity (σ):	6.07	6.00	1.09	5
	Body 5825	e'	46.8756	Relative Permittivity (ϵ_r):	46.88	48.20	-2.75	10
		e''	18.7591	Conductivity (σ):	6.08	6.00	1.26	5

Tissue Dielectric Parameter Check Results (continued)
SAR Room A

Date	Freq. (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit ±(%)
8/27/2012	Body 5180	e'	47.2415	Relative Permittivity (ϵ_r):	47.24	49.05	-3.68	10
		e''	18.5984	Conductivity (σ):	5.36	5.27	1.62	5
	Body 5200	e'	47.2065	Relative Permittivity (ϵ_r):	47.21	49.02	-3.70	10
		e''	18.6171	Conductivity (σ):	5.38	5.29	1.67	5
	Body 5500	e'	46.6486	Relative Permittivity (ϵ_r):	46.65	48.61	-4.04	10
		e''	18.8665	Conductivity (σ):	5.77	5.64	2.22	5
	Body 5800	e'	46.1472	Relative Permittivity (ϵ_r):	46.15	48.20	-4.26	10
		e''	19.1023	Conductivity (σ):	6.16	6.00	2.67	5
	Body 5825	e'	46.0816	Relative Permittivity (ϵ_r):	46.08	48.20	-4.40	10
		e''	19.1185	Conductivity (σ):	6.19	6.00	3.20	5
8/28/2012	Body 5180	e'	47.2238	Relative Permittivity (ϵ_r):	47.22	49.05	-3.72	10
		e''	18.0169	Conductivity (σ):	5.19	5.27	-1.56	5
	Body 5200	e'	47.2053	Relative Permittivity (ϵ_r):	47.21	49.02	-3.70	10
		e''	18.0399	Conductivity (σ):	5.22	5.29	-1.49	5
	Body 5500	e'	46.5932	Relative Permittivity (ϵ_r):	46.59	48.61	-4.16	10
		e''	18.3279	Conductivity (σ):	5.60	5.64	-0.70	5
	Body 5800	e'	46.0728	Relative Permittivity (ϵ_r):	46.07	48.20	-4.41	10
		e''	18.6698	Conductivity (σ):	6.02	6.00	0.35	5
	Body 5825	e'	46.0851	Relative Permittivity (ϵ_r):	46.09	48.20	-4.39	10
		e''	18.6606	Conductivity (σ):	6.04	6.00	0.73	5
9/5/2012	Body 2450	e'	50.8651	Relative Permittivity (ϵ_r):	50.87	52.70	-3.48	5
		e''	14.0522	Conductivity (σ):	1.91	1.95	-1.83	5
	Body 2410	e'	50.9890	Relative Permittivity (ϵ_r):	50.99	52.76	-3.36	5
		e''	13.8909	Conductivity (σ):	1.86	1.91	-2.41	5
	Body 2435	e'	50.9818	Relative Permittivity (ϵ_r):	50.98	52.73	-3.31	5
		e''	13.9931	Conductivity (σ):	1.89	1.93	-1.89	5
	Body 2475	e'	50.7789	Relative Permittivity (ϵ_r):	50.78	52.67	-3.59	5
		e''	14.1619	Conductivity (σ):	1.95	1.99	-1.82	5
9/6/2012	Body 2450	e'	50.7704	Relative Permittivity (ϵ_r):	50.77	52.70	-3.66	5
		e''	14.1683	Conductivity (σ):	1.93	1.95	-1.02	5
	Body 2410	e'	50.9272	Relative Permittivity (ϵ_r):	50.93	52.76	-3.47	5
		e''	13.9886	Conductivity (σ):	1.87	1.91	-1.73	5
	Body 2435	e'	50.8207	Relative Permittivity (ϵ_r):	50.82	52.73	-3.61	5
		e''	14.0969	Conductivity (σ):	1.91	1.93	-1.16	5
	Body 2475	e'	50.7079	Relative Permittivity (ϵ_r):	50.71	52.67	-3.72	5
		e''	14.2785	Conductivity (σ):	1.96	1.99	-1.02	5

Tissue Dielectric Parameter Check Results (continued)
SAR Room B

Date	Freq. (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit ±(%)
8/9/2012	Body 5180	e'	50.1412	Relative Permittivity (ϵ_r):	50.14	49.05	2.23	10
		e''	17.6598	Conductivity (σ):	5.09	5.27	-3.51	5
	Body 5200	e'	50.1077	Relative Permittivity (ϵ_r):	50.11	49.02	2.22	10
		e''	17.5405	Conductivity (σ):	5.07	5.29	-4.21	5
	Body 5500	e'	49.6400	Relative Permittivity (ϵ_r):	49.64	48.61	2.11	10
		e''	17.9349	Conductivity (σ):	5.48	5.64	-2.83	5
	Body 5800	e'	49.1484	Relative Permittivity (ϵ_r):	49.15	48.20	1.97	10
		e''	18.1093	Conductivity (σ):	5.84	6.00	-2.66	5
	Body 5825	e'	49.1677	Relative Permittivity (ϵ_r):	49.17	48.20	2.01	10
		e''	18.1718	Conductivity (σ):	5.89	6.00	-1.91	5
8/14/2012	Body 5180	e'	49.0752	Relative Permittivity (ϵ_r):	49.08	49.05	0.06	10
		e''	17.7595	Conductivity (σ):	5.12	5.27	-2.96	5
	Body 5200	e'	49.0160	Relative Permittivity (ϵ_r):	49.02	49.02	-0.01	10
		e''	17.8327	Conductivity (σ):	5.16	5.29	-2.62	5
	Body 5500	e'	48.5035	Relative Permittivity (ϵ_r):	48.50	48.61	-0.23	10
		e''	17.9545	Conductivity (σ):	5.49	5.64	-2.72	5
	Body 5800	e'	48.1823	Relative Permittivity (ϵ_r):	48.18	48.20	-0.04	10
		e''	18.2509	Conductivity (σ):	5.89	6.00	-1.90	5
	Body 5825	e'	48.0949	Relative Permittivity (ϵ_r):	48.09	48.20	-0.22	10
		e''	18.2699	Conductivity (σ):	5.92	6.00	-1.38	5
8/15/2012	Body 5180	e'	48.0595	Relative Permittivity (ϵ_r):	48.06	49.05	-2.01	10
		e''	18.1991	Conductivity (σ):	5.24	5.27	-0.56	5
	Body 5200	e'	47.9316	Relative Permittivity (ϵ_r):	47.93	49.02	-2.22	10
		e''	18.2833	Conductivity (σ):	5.29	5.29	-0.16	5
	Body 5500	e'	47.5440	Relative Permittivity (ϵ_r):	47.54	48.61	-2.20	10
		e''	18.5148	Conductivity (σ):	5.66	5.64	0.31	5
	Body 5800	e'	47.0569	Relative Permittivity (ϵ_r):	47.06	48.20	-2.37	10
		e''	18.8771	Conductivity (σ):	6.09	6.00	1.46	5
	Body 5825	e'	46.9506	Relative Permittivity (ϵ_r):	46.95	48.20	-2.59	10
		e''	18.8884	Conductivity (σ):	6.12	6.00	1.96	5
8/16/2012	Body 5180	e'	49.2839	Relative Permittivity (ϵ_r):	49.28	49.05	0.48	10
		e''	18.6913	Conductivity (σ):	5.38	5.27	2.13	5
	Body 5200	e'	49.2187	Relative Permittivity (ϵ_r):	49.22	49.02	0.41	10
		e''	18.6436	Conductivity (σ):	5.39	5.29	1.81	5
	Body 5500	e'	48.7253	Relative Permittivity (ϵ_r):	48.73	48.61	0.23	10
		e''	18.9824	Conductivity (σ):	5.81	5.64	2.85	5
	Body 5800	e'	48.1800	Relative Permittivity (ϵ_r):	48.18	48.20	-0.04	10
		e''	19.1824	Conductivity (σ):	6.19	6.00	3.10	5
	Body 5825	e'	48.1298	Relative Permittivity (ϵ_r):	48.13	48.20	-0.15	10
		e''	19.1786	Conductivity (σ):	6.21	6.00	3.53	5
8/20/2012	Body 5180	e'	47.7515	Relative Permittivity (ϵ_r):	47.75	49.05	-2.64	10
		e''	18.1913	Conductivity (σ):	5.24	5.27	-0.60	5
	Body 5200	e'	47.8549	Relative Permittivity (ϵ_r):	47.85	49.02	-2.38	10
		e''	18.4420	Conductivity (σ):	5.33	5.29	0.71	5
	Body 5500	e'	47.2314	Relative Permittivity (ϵ_r):	47.23	48.61	-2.84	10
		e''	18.6035	Conductivity (σ):	5.69	5.64	0.79	5
	Body 5800	e'	46.7722	Relative Permittivity (ϵ_r):	46.77	48.20	-2.96	10
		e''	18.9938	Conductivity (σ):	6.13	6.00	2.09	5
	Body 5825	e'	46.7596	Relative Permittivity (ϵ_r):	46.76	48.20	-2.99	10
		e''	19.0485	Conductivity (σ):	6.17	6.00	2.83	5

Tissue Dielectric Parameter Check Results (continued)
SAR Room C

Date	Freq. (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit ±(%)
8/9/2012	Body 5180	e'	50.6505	Relative Permittivity (ϵ_r):	50.65	49.05	3.27	10
		e''	18.5131	Conductivity (σ):	5.33	5.27	1.15	5
	Body 5200	e'	50.7573	Relative Permittivity (ϵ_r):	50.76	49.02	3.54	10
		e''	18.4001	Conductivity (σ):	5.32	5.29	0.48	5
	Body 5500	e'	50.2265	Relative Permittivity (ϵ_r):	50.23	48.61	3.32	10
		e''	18.8221	Conductivity (σ):	5.76	5.64	1.98	5
	Body 5800	e'	49.5784	Relative Permittivity (ϵ_r):	49.58	48.20	2.86	10
		e''	19.1053	Conductivity (σ):	6.16	6.00	2.69	5
	Body 5825	e'	49.7488	Relative Permittivity (ϵ_r):	49.75	48.20	3.21	10
		e''	19.2240	Conductivity (σ):	6.23	6.00	3.77	5
8/10/2012	Body 5180	e'	50.6616	Relative Permittivity (ϵ_r):	50.66	49.05	3.29	10
		e''	18.5124	Conductivity (σ):	5.33	5.27	1.15	5
	Body 5200	e'	50.7758	Relative Permittivity (ϵ_r):	50.78	49.02	3.58	10
		e''	18.5459	Conductivity (σ):	5.36	5.29	1.28	5
	Body 5500	e'	50.2002	Relative Permittivity (ϵ_r):	50.20	48.61	3.26	10
		e''	18.7610	Conductivity (σ):	5.74	5.64	1.65	5
	Body 5800	e'	49.6879	Relative Permittivity (ϵ_r):	49.69	48.20	3.09	10
		e''	19.0538	Conductivity (σ):	6.14	6.00	2.41	5
	Body 5825	e'	49.6407	Relative Permittivity (ϵ_r):	49.64	48.20	2.99	10
		e''	19.1026	Conductivity (σ):	6.19	6.00	3.12	5
8/13/2012	Body 5180	e'	48.0072	Relative Permittivity (ϵ_r):	48.01	49.05	-2.12	10
		e''	19.0712	Conductivity (σ):	5.49	5.27	4.20	5
	Body 5200	e'	47.9843	Relative Permittivity (ϵ_r):	47.98	49.02	-2.11	10
		e''	19.0098	Conductivity (σ):	5.50	5.29	3.81	5
	Body 5500	e'	47.3566	Relative Permittivity (ϵ_r):	47.36	48.61	-2.58	10
		e''	19.2492	Conductivity (σ):	5.89	5.64	4.29	5
	Body 5800	e'	46.8841	Relative Permittivity (ϵ_r):	46.88	48.20	-2.73	10
		e''	19.4430	Conductivity (σ):	6.27	6.00	4.51	5
	Body 5825	e'	46.9549	Relative Permittivity (ϵ_r):	46.95	48.20	-2.58	10
		e''	19.3493	Conductivity (σ):	6.27	6.00	4.45	5
8/14/2012	Body 2450	e'	51.7921	Relative Permittivity (ϵ_r):	51.79	52.70	-1.72	5
		e''	14.2409	Conductivity (σ):	1.94	1.95	-0.51	5
	Body 2410	e'	51.9321	Relative Permittivity (ϵ_r):	51.93	52.76	-1.57	5
		e''	14.1021	Conductivity (σ):	1.89	1.91	-0.93	5
	Body 2435	e'	51.8417	Relative Permittivity (ϵ_r):	51.84	52.73	-1.68	5
		e''	14.1868	Conductivity (σ):	1.92	1.93	-0.53	5
	Body 2475	e'	51.7143	Relative Permittivity (ϵ_r):	51.71	52.67	-1.81	5
		e''	14.3417	Conductivity (σ):	1.97	1.99	-0.58	5
8/14/2012	Body 5180	e'	49.1518	Relative Permittivity (ϵ_r):	49.15	49.05	0.21	10
		e''	18.3560	Conductivity (σ):	5.29	5.27	0.30	5
	Body 5200	e'	49.0101	Relative Permittivity (ϵ_r):	49.01	49.02	-0.02	10
		e''	18.3938	Conductivity (σ):	5.32	5.29	0.45	5
	Body 5500	e'	48.5548	Relative Permittivity (ϵ_r):	48.55	48.61	-0.12	10
		e''	18.5777	Conductivity (σ):	5.68	5.64	0.65	5
	Body 5800	e'	48.2517	Relative Permittivity (ϵ_r):	48.25	48.20	0.11	10
		e''	18.8030	Conductivity (σ):	6.06	6.00	1.07	5
	Body 5825	e'	48.1728	Relative Permittivity (ϵ_r):	48.17	48.20	-0.06	10
		e''	18.8948	Conductivity (σ):	6.12	6.00	2.00	5

Tissue Dielectric Parameter Check Results (continued)
SAR Room C

Date	Freq. (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit ±(%)
8/15/2012	Body 2450	e'	51.7454	Relative Permittivity (ϵ_r):	51.75	52.70	-1.81	5
		e''	14.3203	Conductivity (σ):	1.95	1.95	0.04	5
	Body 2410	e'	51.8113	Relative Permittivity (ϵ_r):	51.81	52.76	-1.80	5
		e''	14.1058	Conductivity (σ):	1.89	1.91	-0.90	5
	Body 2435	e'	51.7429	Relative Permittivity (ϵ_r):	51.74	52.73	-1.87	5
		e''	14.3036	Conductivity (σ):	1.94	1.93	0.29	5
	Body 2475	e'	51.6605	Relative Permittivity (ϵ_r):	51.66	52.67	-1.91	5
		e''	14.4150	Conductivity (σ):	1.98	1.99	-0.07	5
8/16/2012	Body 5180	e'	48.4064	Relative Permittivity (ϵ_r):	48.41	49.05	-1.31	10
		e''	18.6560	Conductivity (σ):	5.37	5.27	1.93	5
	Body 5200	e'	48.3425	Relative Permittivity (ϵ_r):	48.34	49.02	-1.38	10
		e''	18.5963	Conductivity (σ):	5.38	5.29	1.55	5
	Body 5500	e'	47.9376	Relative Permittivity (ϵ_r):	47.94	48.61	-1.39	10
		e''	18.7508	Conductivity (σ):	5.73	5.64	1.59	5
	Body 5800	e'	47.3793	Relative Permittivity (ϵ_r):	47.38	48.20	-1.70	10
		e''	18.9161	Conductivity (σ):	6.10	6.00	1.67	5
	Body 5825	e'	47.3125	Relative Permittivity (ϵ_r):	47.31	48.20	-1.84	10
		e''	18.9128	Conductivity (σ):	6.13	6.00	2.09	5
8/16/2012	Body 2450	e'	52.2979	Relative Permittivity (ϵ_r):	52.30	52.70	-0.76	5
		e''	14.6373	Conductivity (σ):	1.99	1.95	2.26	5
	Body 2410	e'	52.3673	Relative Permittivity (ϵ_r):	52.37	52.76	-0.74	5
		e''	14.3715	Conductivity (σ):	1.93	1.91	0.96	5
	Body 2435	e'	52.3166	Relative Permittivity (ϵ_r):	52.32	52.73	-0.78	5
		e''	14.4953	Conductivity (σ):	1.96	1.93	1.63	5
	Body 2475	e'	52.1746	Relative Permittivity (ϵ_r):	52.17	52.67	-0.94	5
		e''	14.6164	Conductivity (σ):	2.01	1.99	1.33	5
8/17/2012	Body 5180	e'	48.7582	Relative Permittivity (ϵ_r):	48.76	49.05	-0.59	10
		e''	18.2983	Conductivity (σ):	5.27	5.27	-0.02	5
	Body 5200	e'	48.6895	Relative Permittivity (ϵ_r):	48.69	49.02	-0.67	10
		e''	18.5292	Conductivity (σ):	5.36	5.29	1.19	5
	Body 5500	e'	48.2614	Relative Permittivity (ϵ_r):	48.26	48.61	-0.72	10
		e''	18.4879	Conductivity (σ):	5.65	5.64	0.17	5
	Body 5800	e'	47.8280	Relative Permittivity (ϵ_r):	47.83	48.20	-0.77	10
		e''	18.5839	Conductivity (σ):	5.99	6.00	-0.11	5
	Body 5825	e'	47.6417	Relative Permittivity (ϵ_r):	47.64	48.20	-1.16	10
		e''	18.6662	Conductivity (σ):	6.05	6.00	0.76	5

11. System Performance Check

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%.

11.1. System Performance Check Measurement Conditions

- The measurements were performed in the flat section of the TWIN SAM or ELI phantom, shell thickness: 2.0 ±0.2 mm (bottom plate) filled with Body or Head simulating liquid of the following parameters.
- The DASY system with an E-Field Probe 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 (below 3 GHz) and/or 8x8x7 (above 3 GHz) fine cube was chosen for the 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.

11.2. Reference SAR Values for System Performance Check

The reference SAR values can be obtained from the calibration certificate of system validation dipoles

System Dipole	Serial No.	Cal. Date	Freq. (MHz)	Target SAR Values (mW/g)		
				1g/10g	Head	Body
D2450V2	748	2/7/12	2450	1g	52.7	49.9
				10g	24.6	23.4
D5GHzV2	1075	2/14/12	5200	1g	79.4	72.7
				10g	22.8	20.5
			5500	1g	85.7	77.7
				10g	24.3	21.7
			5800	1g	78.9	72.5
				10g	22.5	20.2
D5GHzV2	1003	8/23/11	5200	1g	76.3	74.4
				10g	21.7	20.8
			5500	1g	80.7	79.9
				10g	23.0	22.3
			5800	1g	76.0	76.2
				10g	21.6	21.2

11.3. System Performance Check Results

SAR Room A

Date Tested	System Dipole		T.S. Liquid	SAR Measured (Normalized to 1 W)		Target (Ref. Value)	Delta (%)	Tolerance (%)
	Type	Serial No.						
8/2/2012	D5GHzV2 (5.2GHz)	1075	Body	1g	72.1	72.7	-0.83	±10
				10g	20.5	20.5	0.00	
8/6/2012	D5GHzV2 (5.2GHz)	1075	Body	1g	72.1	72.7	-0.83	±10
				10g	20.5	20.5	0.00	
8/7/2012	D5GHzV2 (5.2GHz)	1075	Body	1g	70.5	72.7	-3.03	±10
				10g	20.0	20.5	-2.44	
8/8/2012	D5GHzV2 (5.2GHz)	1075	Body	1g	71.2	72.7	-2.06	±10
				10g	20.2	20.5	-1.46	
8/17/2012	D5GHzV2 (5.2GHz)	1075	Body	1g	72.1	72.7	-0.83	±10
				10g	20.4	20.5	-0.49	
8/27/2012	D5GHzV2 (5.2GHz)	1075	Body	1g	72.9	72.7	0.28	±10
				10g	20.7	20.5	0.98	
8/28/2012	D5GHzV2 (5.2GHz)	1075	Body	1g	70.6	72.7	-2.89	±10
				10g	20.1	20.5	-1.95	
9/5/2012	D2450V2	748	Body	1g	49.9	49.9	0.00	±10
				10g	23.1	23.4	-1.28	
9/6/2012	D2450V2	748	Body	1g	50.3	49.9	0.80	±10
				10g	23.2	23.4	-0.85	

SAR Room B

Date Tested	System Dipole		T.S. Liquid	SAR Measured (Normalized to 1 W)		Target (Ref. Value)	Delta (%)	Tolerance (%)
	Type	Serial No.						
8/9/2012	D5GHzV2 (5.5GHz)	1003	Body	1g	76.5	79.9	-4.26	±10
				10g	21.7	22.3	-2.69	
8/9/2012	D5GHzV2 (5.6GHz)	1003	Body	1g	77.4	79.9	-3.13	±10
				10g	21.8	23.3	-6.44	
8/14/2012	D5GHzV2 (5.5GHz)	1003	Body	1g	78.7	79.9	-1.50	±10
				10g	22.2	22.3	-0.45	
8/14/2012	D5GHzV2 (5.6GHz)	1003	Body	1g	83.2	79.9	4.13	±10
				10g	23.4	23.3	0.43	
8/15/2012	D5GHzV2 (5.5GHz)	1003	Body	1g	83.5	79.9	4.51	±10
				10g	23.6	22.3	5.83	
8/15/2012	D5GHzV2 (5.6GHz)	1003	Body	1g	77.3	79.9	-3.25	±10
				10g	21.9	23.3	-6.01	
8/16/2012	D5GHzV2 (5.5GHz)	1003	Body	1g	79.4	79.9	-0.63	±10
				10g	22.5	22.3	0.90	
8/16/2012	D5GHzV2 (5.6GHz)	1003	Body	1g	76.8	79.9	-3.88	±10
				10g	21.5	23.3	-7.73	
8/20/2012	D5GHzV2 (5.5GHz)	1003	Body	1g	80.2	79.9	0.38	±10
				10g	22.6	22.3	1.35	
8/20/2012	D5GHzV2 (5.6GHz)	1003	Body	1g	79.6	79.9	-0.38	±10
				10g	22.3	23.3	-4.29	

SAR Room C

Date Tested	System Dipole		T.S. Liquid	SAR Measured (Normalized to 1 W)		Target (Ref. Value)	Delta (%)	Tolerance (%)
	Type	Serial No.						
8/9/2012	D5GHzV2 (5.8GHz)	1003	Body	1g	69.1	76.2	-9.32	±10
				10g	19.5	21.2	-8.02	
8/10/2012	D5GHzV2 (5.8GHz)	1075	Body	1g	72.2	72.5	-0.41	±10
				10g	20.2	20.2	0.00	
8/13/2012	D5GHzV2 (5.8GHz)	1003	Body	1g	79.5	76.2	4.33	±10
				10g	22.4	21.2	5.66	
8/14/2012	D2450V2	748	Body	1g	54.2	49.9	8.62	±10
				10g	25.4	23.4	8.55	
8/14/2012	D5GHzV2 (5.8GHz)	1075	Body	1g	74.4	72.5	2.62	±10
				10g	20.9	20.2	3.47	
8/15/2012	D2450V2	748	Body	1g	47.3	49.9	-5.21	±10
				10g	22.1	23.4	-5.56	
8/16/2012	D5GHzV2 (5.8GHz)	1075	Body	1g	66.6	72.5	-8.14	±10
				10g	18.8	20.2	-6.93	
8/16/2012	D2450V2	748	Body	1g	52.3	49.9	4.81	±10
				10g	24.3	23.4	3.85	
8/17/2012	D5GHzV2 (5.8GHz)	1075	Body	1g	74.4	72.5	2.62	±10
				10g	20.9	20.2	3.47	

12. SAR Test Results

12.1. Wi-Fi (2.4 GHz Band)

(BOM #1)

Test Position	Mode	Dist. (mm)	Antenna	Ch #.	Freq. (MHz)	Power (dBm)	1g SAR (W/kg)	Note
Rear	802.11b	0	Primary	1	2412	15.9		1
				6	2437	16.0	0.064	
				11	2462	16.0		1
Edge 3	802.11b	0	Primary	1	2412	15.9	0.611	
				6	2437	16.0	0.912	
				11	2462	16.0	**1.070**	
Edge 4	802.11b	0	Primary	1	2412	15.9		1
				6	2437	16.0	0.138	
				11	2462	16.0		1
Test Position	Mode	Dist. (mm)	Antenna	Ch #.	Freq. (MHz)	Power (dBm)	1g SAR (W/kg)	Note
Rear	802.11b	0	Secondary	1	2412	15.9		1
				6	2437	16.0	0.013	
				11	2462	16.0		1
Edge 2	802.11b	0	Secondary	1	2412	15.9		1
				6	2437	16.0	0.00967	
				11	2462	16.0		1
Edge 3	802.11b	0	Secondary	1	2412	15.9		1
				6	2437	16.0	0.362	
				11	2462	16.0		1

Highest SAR Configuration (BOM #2)

Test Position	Mode	Dist. (mm)	Antenna	Ch #.	Freq. (MHz)	Power (dBm)	1g SAR (W/kg)	Note
Edge 3	802.11b	0	Primary	11	2462	16.0	1.060	

Highest SAR Configuration (BOM #3)

Test Position	Mode	Dist. (mm)	Antenna	Ch #.	Freq. (MHz)	Power (dBm)	1g SAR (W/kg)	Note
Edge 3	802.11b	0	Primary	11	2462	16.0	0.933	

Note(s):

1. When the 1-g SAR for the mid-band channel, or the channel with the highest output power satisfy the following conditions, testing of the other channels in the band is not required. (Per KDB 447498)
   ≤ 0.8 W/kg and transmission band ≤ 100 MHz
   ≤ 0.6 W/kg and, 100 MHz < transmission bandwidth ≤ 200 MHz
   ≤ 0.4 W/kg and transmission band > 200 MHz

12.2. Wi-Fi (5 GHz Bands)

(BOM #1)

Band (GHz)	Test Position	Dist. (mm)	Antenna	Mode	Ch #.	Freq. (MHz)	Power (dBm)	1g SAR (W/kg)	Note
5.2	Rear	0	Primary	802.11a	36	5180	14.0	0.024	
					48	5240	13.9	0.027	
				802.11n HT40	46	5230	15.5	0.055	
	Edge 3	0	Primary	802.11a	36	5180	14.0	0.462	
					48	5240	13.9	0.435	
				802.11n HT40	46	5230	15.5	0.792	
	Edge 4	0	Primary	802.11a	36	5180	14.0	0.065	
					48	5240	13.9	0.057	
				802.11n HT40	46	5230	15.5	0.092	
5.3	Rear	0	Primary	802.11a	52	5260	16.9	0.063	
					60	5300	16.9	0.047	
	Edge 3	0	Primary	802.11a	52	5260	16.9	0.947	
					60	5300	16.9	0.786	
	Edge 4	0	Primary	802.11a	52	5260	16.9	0.134	
					60	5300	16.9	0.111	
5.5	Rear	0	Primary	802.11a	104	5520	16.0	0.018	
					116	5580	15.9	0.054	
					124	5620	16.0	0.090	
					136	5680	16.0	0.100	
	Edge 3	0	Primary	802.11a	104	5520	16.0	0.734	
					116	5580	15.9	0.782	
					124	5620	16.0	0.840	
					136	5680	16.0	0.950	
	Edge 4	0	Primary	802.11a	104	5520	16.0	0.126	
					116	5580	15.9	0.116	
					124	5620	16.0	0.157	
					136	5680	16.0	0.171	
5.8	Rear	0	Primary	802.11a	149	5745	15.9	0.071	
					157	5785	15.9	0.070	
					165	5825	16.0	0.059	
	Edge 3	0	Primary	802.11a	149	5745	15.9	0.855	
					157	5785	15.9	0.845	
					165	5825	16.0	0.971	
	Edge 4	0	Primary	802.11a	149	5745	15.9	0.042	
					157	5785	15.9	0.132	
					165	5825	16.0	0.106	

Wi-Fi (5 GHz Bands) continued

Band (GHz)	Test Position	Dist. (mm)	Antenna	Mode	Ch #.	Freq. (MHz)	Power (dBm)	1g SAR (W/kg)	Note
5.2	Rear	0	Secondary	802.11a	36	5180	14.0	0.054	
					48	5240	13.9	0.089	
				802.11n HT40	46	5230	15.5	0.092	
	Edge 2	0	Secondary	802.11a	36	5180	14.0	0.021	
					48	5240	13.9	0.030	
				802.11n HT40	46	5230	15.5	0.030	
	Edge 3	0	Secondary	802.11a	36	5180	14.0	0.445	
					48	5240	13.9	0.585	
				802.11n HT40	46	5230	15.5	**0.856**	
5.3	Rear	0	Secondary	802.11a	52	5260	17.0	0.153	
					60	5300	16.9	0.119	
	Edge 2	0	Secondary	802.11a	52	5260	17.0	0.053	
					60	5300	16.9	0.049	
	Edge 3	0	Secondary	802.11a	52	5260	17.0	**1.100**	
					60	5300	16.9	1.020	
5.5	Rear	0	Secondary	802.11a	104	5520	16.0	0.184	
					116	5580	16.0	0.176	
					124	5620	16.0	0.164	
					136	5680	16.0	0.137	
	Edge 2	0	Secondary	802.11a	104	5520	16.0	0.095	
					116	5580	16.0	0.080	
					124	5620	16.0	0.077	
					136	5680	16.0	0.090	
	Edge 3	0	Secondary	802.11a	104	5520	16.0	**1.190**	
					116	5580	16.0	1.120	
					124	5620	16.0	1.120	
					136	5680	16.0	1.180	
5.8	Rear	0	Secondary	802.11a	149	5745	16.0	0.122	
					157	5785	16.0	0.189	
					165	5825	16.0	0.126	
	Edge 2	0	Secondary	802.11a	149	5745	16.0	0.031	
					157	5785	16.0	0.053	
					165	5825	16.0	0.035	
	Edge 3	0	Secondary	802.11a	149	5745	16.0	**1.160**	
					157	5785	16.0	1.130	
					165	5825	16.0	1.150	

Highest SAR Configuration (BOM #2)

Band (GHz)	Test Position	Dist. (mm)	Antenna	Mode	Ch #.	Freq. (MHz)	Power (dBm)	1g SAR (W/kg)	Note
5.2	Edge 3	0	Secondary	802.11n HT40	46	5230	15.5	0.844	
5.3	Edge 3	0	Secondary	802.11a	52	5260	17.0	1.100	
5.5	Edge 3	0	Secondary	802.11a	104	5520	16.0	0.902	
5.8	Edge 3	0	Secondary	802.11a	149	5745	16.0	1.060	

Highest SAR Configuration (BOM #3)

Band (GHz)	Test Position	Dist. (mm)	Antenna	Mode	Ch #.	Freq. (MHz)	Power (dBm)	1g SAR (W/kg)	Note
5.2	Edge 3	0	Secondary	802.11n HT40	46	5230	15.5	0.796	
5.3	Edge 3	0	Secondary	802.11a	52	5260	17.0	0.727	
5.5	Edge 3	0	Secondary	802.11a	104	5520	16.0	0.840	
5.8	Edge 3	0	Secondary	802.11a	149	5745	16.0	1.160	

12.3. Bluetooth

(BOM #1)

Test Position	Mode	Antenna	Dist. (mm)	Ch #.	Freq. (MHz)	Power (dBm)	1g SAR (W/kg)	Note
Rear	V2.1 + EDR, GFSK	primary	0	0	2412	11.8		1
				39	2437	12.0	0.029	
				78	2462	11.9		1
Edge 3	V2.1 + EDR, GFSK	primary	0	0	2412	11.8		1
				39	2437	12.0	**0.323**	
				78	2462	11.9		1
Edge 4	V2.1 + EDR, GFSK	primary	0	0	2412	11.8		1
				39	2437	12.0	0.070	
				78	2462	11.9		1
Test Position	Mode	Antenna	Dist. (mm)	Ch #.	Freq. (MHz)	Power (dBm)	1g SAR (W/kg)	Note
Rear	V2.1 + EDR, GFSK	Secondary	0	0	2412	11.8		1
				39	2437	12.0	0.00191	
				78	2462	11.9		1
Edge 2	V2.1 + EDR, GFSK	Secondary	0	0	2412	11.8		1
				39	2437	12.0	0.022	
				78	2462	11.9		1
Edge 3	V2.1 + EDR, GFSK	Secondary	0	0	2412	11.8		1
				39	2437	12.0	0.121	
				78	2462	11.9		1

Highest SAR Configuration (BOM #2)

Test Position	Mode	Antenna	Dist. (mm)	Ch #.	Freq. (MHz)	Power (dBm)	1g SAR (W/kg)	Note
Edge 3	V2.1 + EDR, GFSK	primary	0	39	2437	12.0	0.294	

Highest SAR Configuration (BOM #3)

Test Position	Mode	Antenna	Dist. (mm)	Ch #.	Freq. (MHz)	Power (dBm)	1g SAR (W/kg)	Note
Edge 3	V2.1 + EDR, GFSK	primary	0	39	2437	12.0	0.292	

Note(s):

1. When the 1-g SAR for the mid-band channel, or the channel with the highest output power satisfy the following conditions, testing of the other channels in the band is not required. (Per KDB 447498)
   ≤ 0.8 W/kg and transmission band ≤ 100 MHz
   ≤ 0.6 W/kg and, 100 MHz < transmission bandwidth ≤ 200 MHz
   ≤ 0.4 W/kg and transmission band > 200 MHz

13. Summary of Highest SAR Values

Results for highest SAR values for each frequency band and mode

Technology/Band	Test configuration			Mode	Highest 1g SAR (W/kg)
	Exposure	Position	Tx Ant.		
WiFi 2.4 GHz	Body	Edge 3	Primary	802.11b 1Mbps	1.070
Bluetooth	Body	Edge 3	Primary	V2.1 + EDR, GFSK	0.323
WiFi 5.2 GHz	Body	Edge 3	Secondary	802.11n HT40 MCS0	0.856
WiFi 5.3 GHz	Body	Edge 3	Secondary	802.11a 6Mbps	1.100
WiFi 5.5 GHz	Body	Edge 3	Secondary	802.11a 6Mbps	1.190
WiFi 5.8 GHz	Body	Edge 3	Secondary	802.11a 6Mbps	1.160

13.1. Scaled SAR Values to the Maximum Target Output Power

The highest measured SAR results were scaled, in cases where measured output power is lower than the maximum Target output power level, in each frequency band.

Technology/ Band	Test Configuration			Mode	Dist. (mm)	Ch #.	Freq. (MHz)	Power (dBm)		SAR (W/kg)	
	Exposure	Position	Tx Ant.					Tune-up limit	Measured	Measured	Scaled
WiFi 2.4 GHz	Body	Edge 3	Primary	802.11b 1Mbps	0	6	2437	16.0	16.0	1.070	*
WiFi 5.2 GHz	Body	Edge 3	Secondary	802.11n HT40 MCS0	0	46	5230	15.5	15.5	0.856	*
WiFi 5.3 GHz	Body	Edge 3	Secondary	802.11a 6Mbps	0	52	5260	17.0	17.0	1.100	*
WiFi 5.5 GHz	Body	Edge 3	Secondary	802.11a 6Mbps	0	136	5680	16.0	16.0	1.190	*
WiFi 5.8 GHz	Body	Edge 3	Secondary	802.11a 6Mbps	0	157	5785	16.0	16.0	1.160	*

Note(s):

*: SAR Scaling was not applied when the measured output power is equal or greater than the maximum target output power.

13.2. SAR Plots (from Summary of Highest SAR Values)

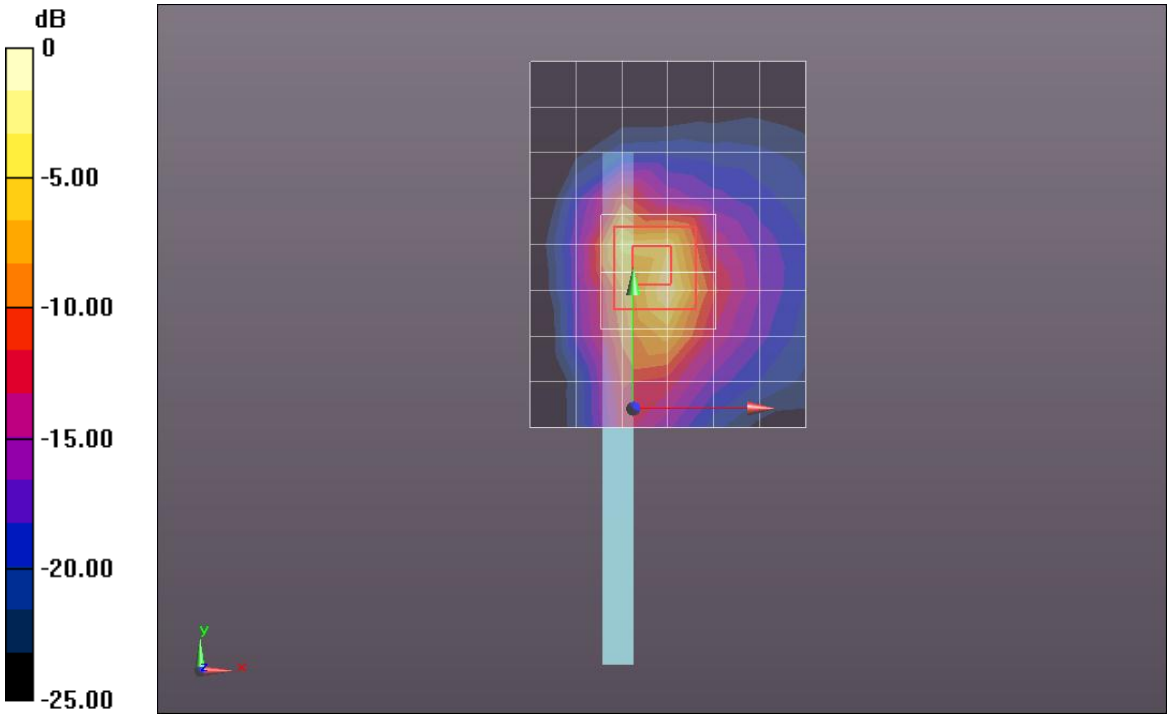
Test Laboratory: UL CCS SAR Lab C Date: 8/15/2012

WiFi 2.4GHz (Primary Antenna)

Frequency: 2462 MHz; Duty Cycle: 1:1; Room Ambient Temperature: 24.0°C; Liquid Temperature: 23.0°C
Medium parameters used (interpolated): f = 2462 MHz; σ = 1.962 mho/m; ε_r = 51.69; ρ = 1000 kg/m^3
DASY5 Configuration:
- Area Scan setting - Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Electronics: DAE4 Sn1239; Calibrated: 6/6/2012
- Probe: EX3DV4 - SN3773; ConvF(6.67, 6.67, 6.67); Calibrated: 3/14/2012
- Sensor-Surface: 2.5mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 2.5mm (Mechanical Surface Detection)
- Phantom: ELI v5.0 (B); Type: QDOVA001BB; Serial: 1099

Edge 3/802.11b_ch 11/Area Scan (7x9x1): Measurement grid: dx=12mm, dy=12mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 1.148 mW/g

Edge 3/802.11b_ch 11/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 23.715 V/m; Power Drift = 0.14 dB
Peak SAR (extrapolated) = 3.2630
SAR(1 g) = 1.07 mW/g; SAR(10 g) = 0.328 mW/g
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 1.638 mW/g



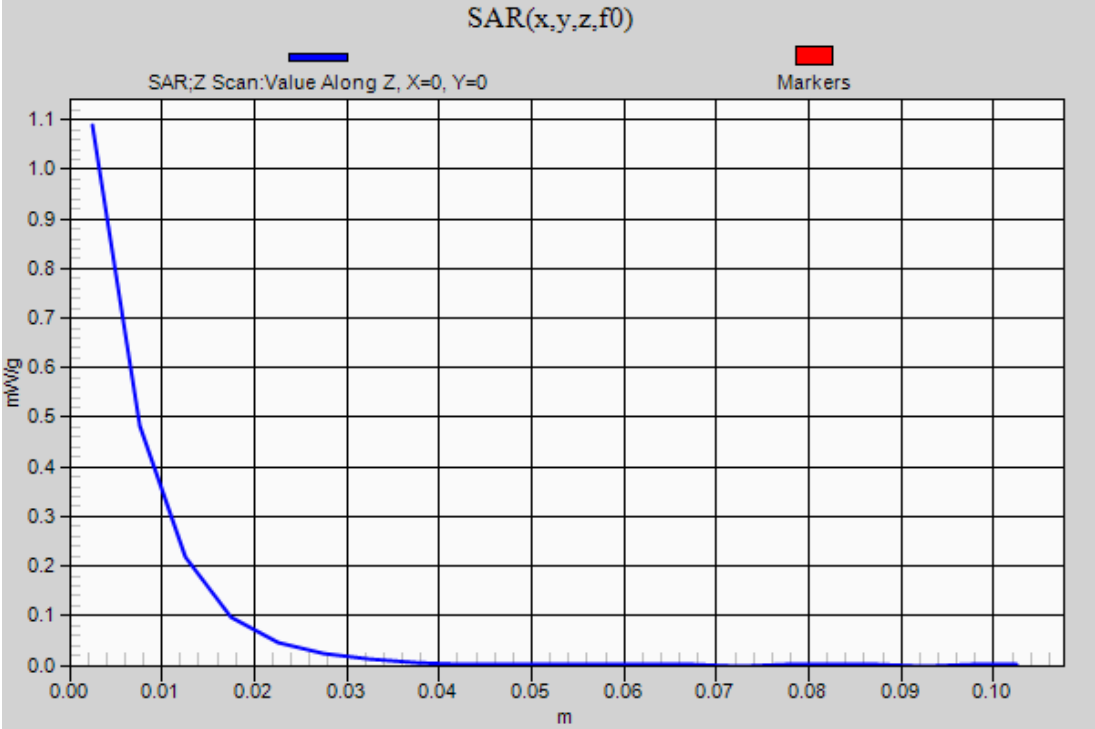
0 dB = 1.640mW/g = 4.30 dB mW/g

Test Laboratory: UL CCS SAR Lab C Date: 8/15/2012

WiFi 2.4GHz (Primary Antenna)

Frequency: 2462 MHz; Duty Cycle: 1:1

Edge 3/802.11b_ch 11/Z Scan (1x1x21): Measurement grid: dx=20mm, dy=20mm, dz=5mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 1.089 mW/g



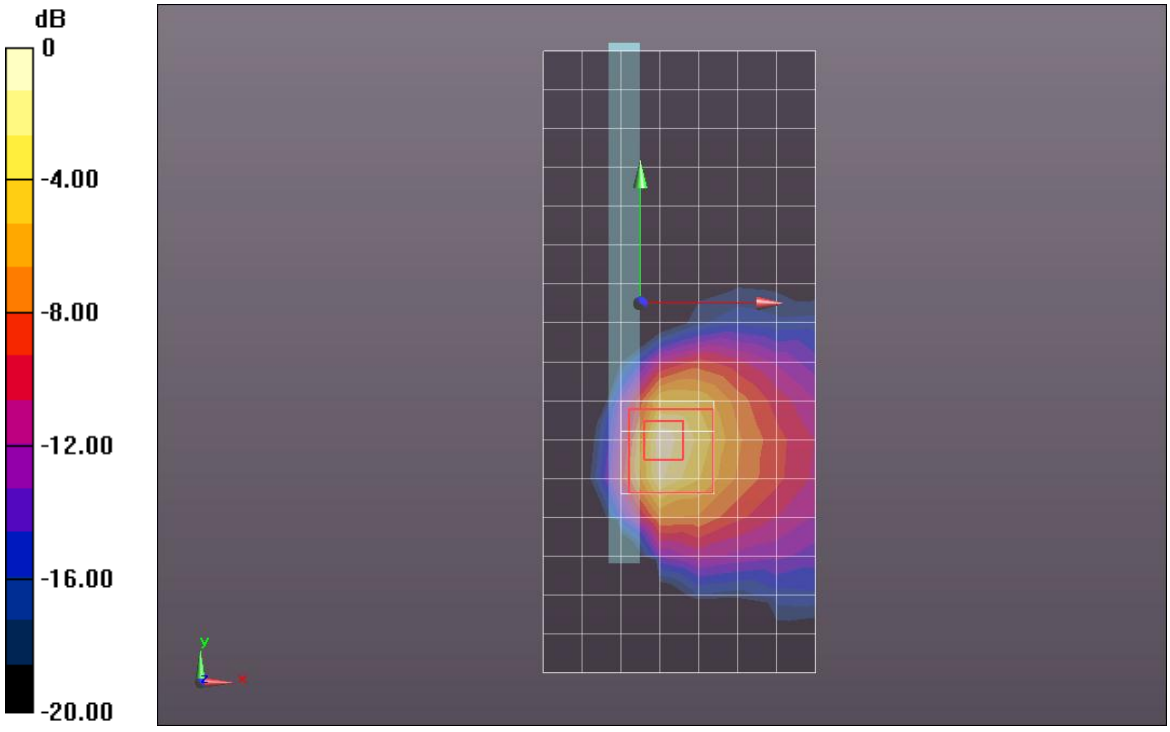
Test Laboratory: UL CCS SAR Lab A Date: 8/27/2012

WiFi 5.2GHz (Secondary Antenna)

Frequency: 5230 MHz; Duty Cycle: 1:1; Room Ambient Temperature: 25.0°C; Liquid Temperature: 24.0°C
Medium parameters used: f = 5230 MHz; σ = 5.426 mho/m; ε_r = 47.157; ρ = 1000 kg/m^3
DASY5 Configuration:
- Area Scan setting - Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Electronics: DAE4 Sn1258; Calibrated: 3/8/2012
- Probe: EX3DV4 - SN3772; ConvF(4.17, 4.17, 4.17); Calibrated: 2/16/2012
- Sensor-Surface: 2.5mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 2mm (Mechanical Surface Detection)
- Phantom: ELI v5.0 (A); Type: QDOVA001BB; Serial: 1120

Edge 3/802.11n HT40_ch 46/Area Scan (8x17x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 1.535 mW/g

Edge 3/802.11n HT40_ch 46/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 17.786 V/m; Power Drift = -0.19 dB
Peak SAR (extrapolated) = 3.3420
SAR(1 g) = 0.856 mW/g; SAR(10 g) = 0.291 mW/g
Maximum value of SAR (measured) = 1.623 mW/g



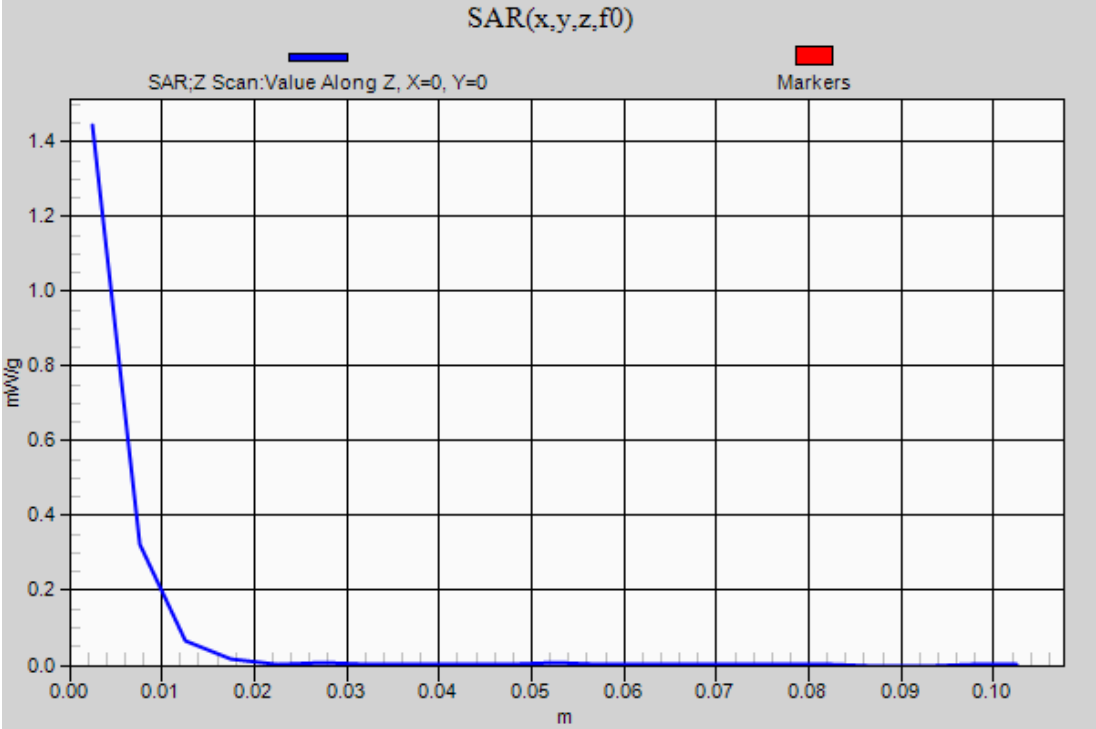
0 dB = 1.620mW/g = 4.19 dB mW/g

Test Laboratory: UL CCS SAR Lab A Date: 8/27/2012

WiFi 5.2GHz (Secondary Antenna)

Frequency: 5230 MHz; Duty Cycle: 1:1

Edge 3/802.11n HT40_ch 46/Z Scan (1x1x21): Measurement grid: dx=20mm, dy=20mm, dz=5mm
Maximum value of SAR (measured) = 1.444 mW/g



Test Laboratory: UL CCS SAR Lab A Date: 8/7/2012

WiFi 5.3GHz (Secondary Antenna)

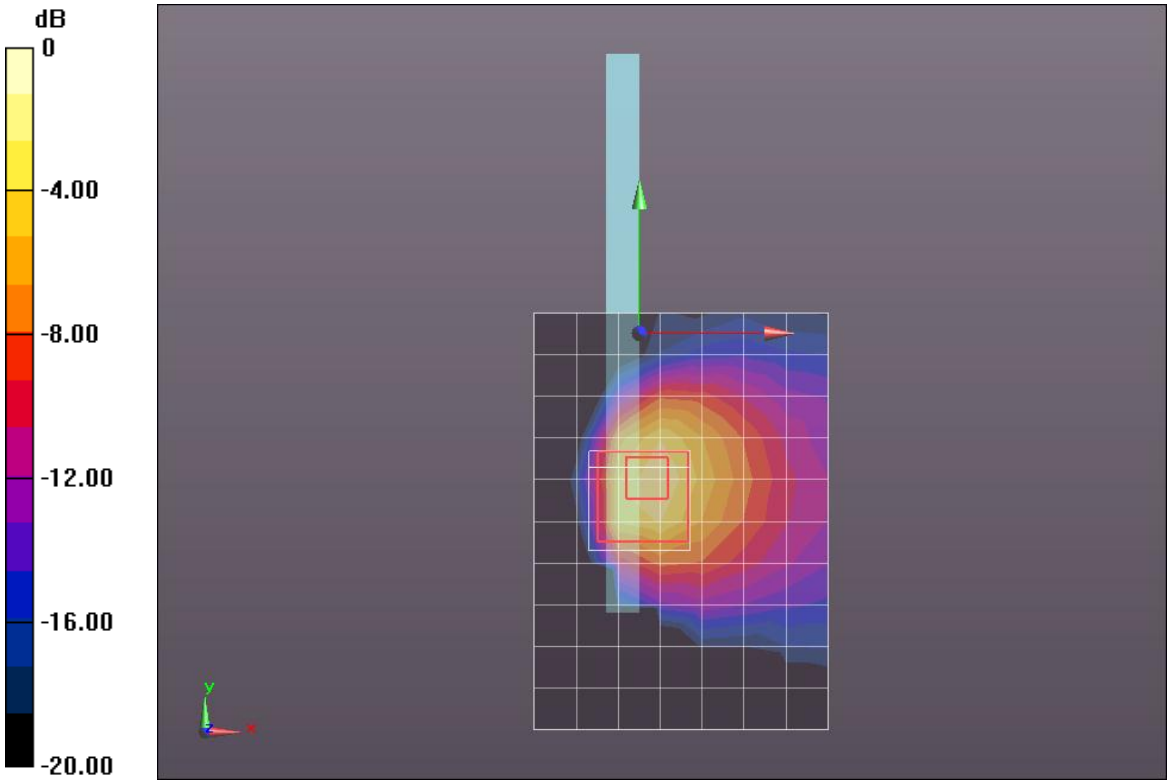
Frequency: 5260 MHz; Duty Cycle: 1:1; Room Ambient Temperature: 25.0°C; Liquid Temperature: 24.0°C
Medium parameters used: f = 5260 MHz; σ = 5.418 mho/m; ε_r = 46.87; ρ = 1000 kg/m^3
DASY5 Configuration:
- Area Scan setting - Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Electronics: DAE4 Sn1258; Calibrated: 3/8/2012
- Probe: EX3DV4 - SN3772; ConvF(3.99, 3.99, 3.99); Calibrated: 2/16/2012
- Sensor-Surface: 2.5mm (Mechanical Surface Detection), Sensor-Surface: 2mm (Mechanical Surface Detection)
- Phantom: ELI v5.0 (A); Type: QDOVA001BB; Serial: 1119

Edge 3/802.11a_ch 52/Area Scan (8x11x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (measured) = 1.562 mW/g

Edge 3/802.11a_ch 52/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 18.357 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 4.1430
SAR(1 g) = 1.1 mW/g; SAR(10 g) = 0.352 mW/g
Maximum value of SAR (measured) = 2.085 mW/g



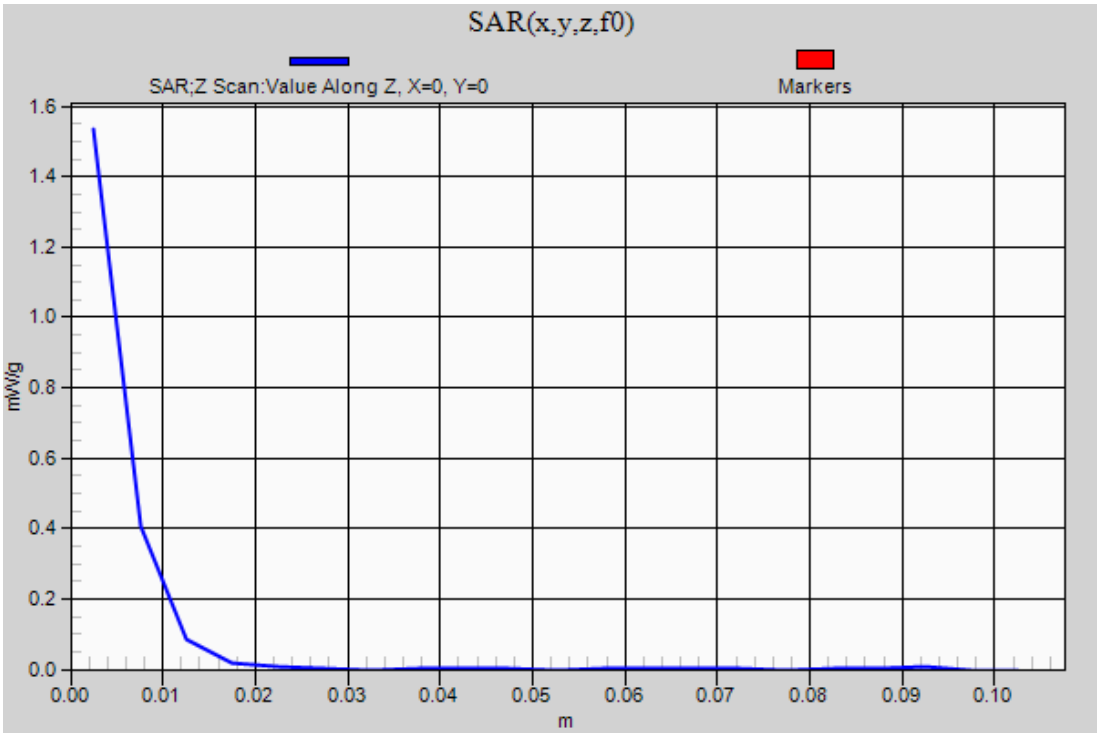
0 dB = 2.080mW/g = 6.36 dB mW/g

Test Laboratory: UL CCS SAR Lab A Date: 8/7/2012

WiFi 5.3GHz (Secondary Antenna)

Frequency: 5260 MHz; Duty Cycle: 1:1

Edge 3/802.11a_ch 52/Z Scan (1x1x21): Measurement grid: dx=20mm, dy=20mm, dz=5mm
Maximum value of SAR (measured) = 1.535 mW/g



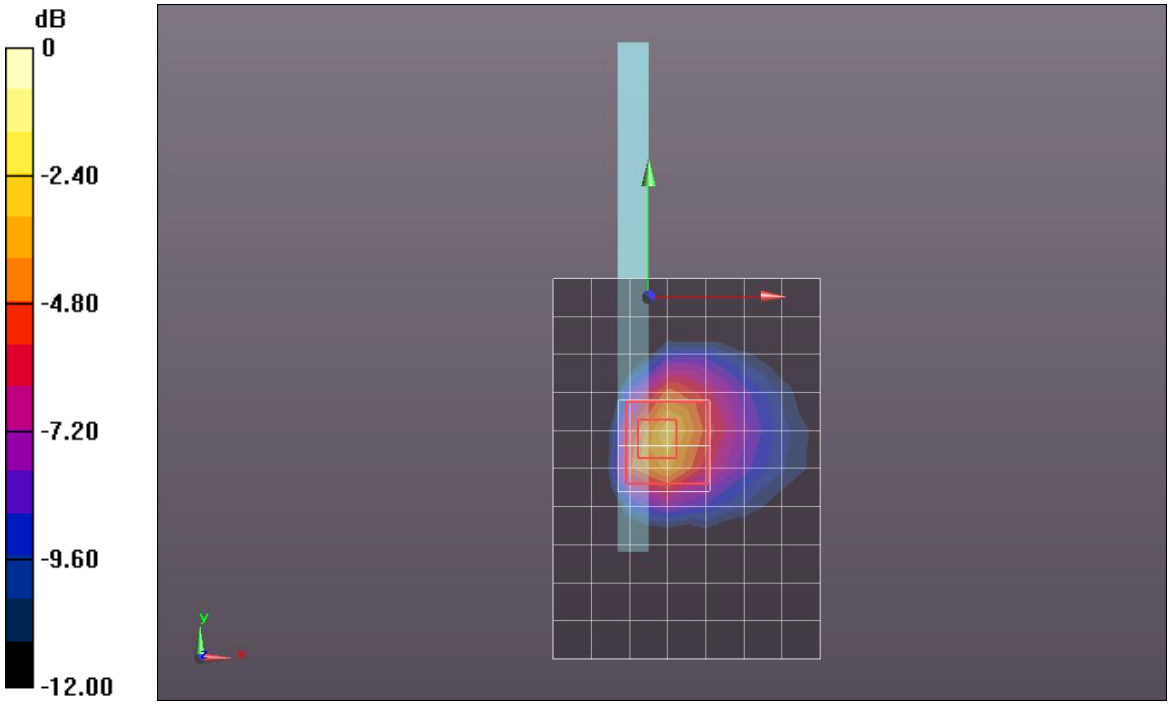
Test Laboratory: UL CCS SAR Lab B Date: 8/16/2012

WiFi 5.5GHz (Secondary Antenna)

Frequency: 5520 MHz; Duty Cycle: 1:1; Room Ambient Temperature: 25.0°C; Liquid Temperature: 24.0°C
Medium parameters used: f = 5520 MHz; σ = 5.832 mho/m; ε_r = 48.706; ρ = 1000 kg/m^3
DASY5 Configuration:
- Area Scan setting - Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Electronics: DAE4 Sn1259; Calibrated: 2/13/2012
- Probe: EX3DV4 - SN3686; ConvF(3.62, 3.62, 3.62); Calibrated: 2/16/2012
- Sensor-Surface: 2.5mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 2mm (Mechanical Surface Detection)
- Phantom: ELI v5.0 (B); Type: QDOVA001BB; Serial: 1118

Edge 3/802.11a_ch 104/Area Scan (8x11x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 1.523 mW/g

Edge 3/802.11a_ch 104/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 18.712 V/m; Power Drift = -0.19 dB
Peak SAR (extrapolated) = 4.4590
SAR(1 g) = 1.19 mW/g; SAR(10 g) = 0.427 mW/g
Maximum value of SAR (measured) = 2.222 mW/g



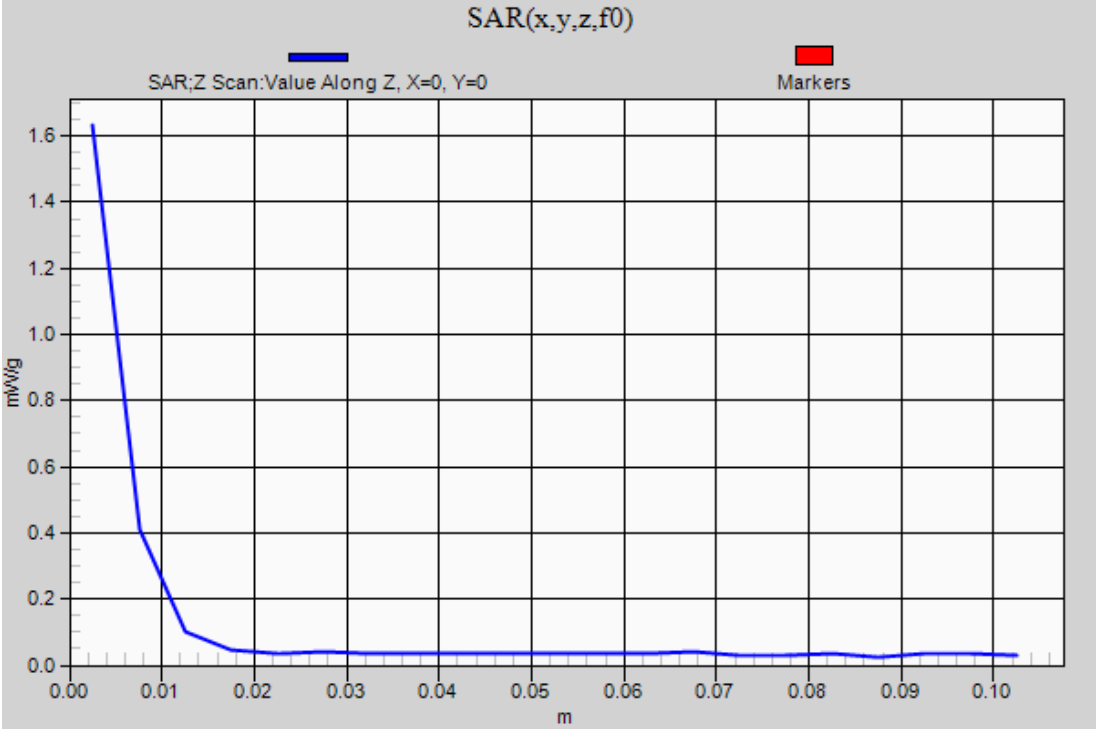
0 dB = 2.220mW/g = 6.93 dB mW/g

Test Laboratory: UL CCS SAR Lab B Date: 8/16/2012

WiFi 5.5GHz (Secondary Antenna)

Frequency: 5520 MHz; Duty Cycle: 1:1

Edge 3/802.11a_ch 104/Z Scan (1x1x21): Measurement grid: dx=20mm, dy=20mm, dz=5mm
Maximum value of SAR (measured) = 1.632 mW/g



Test Laboratory: UL CCS SAR Lab C Date: 8/13/2012

WiFi 5.8GHz (Secondary Antenna)

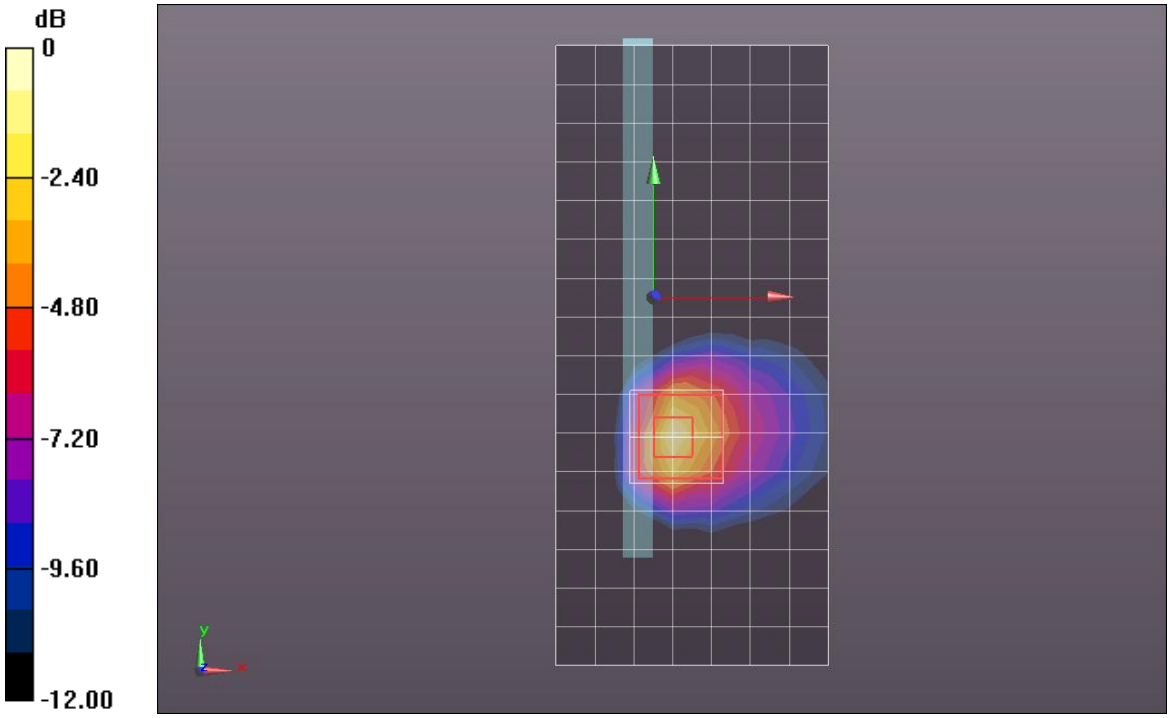
Frequency: 5745 MHz; Duty Cycle: 1:1; Room Ambient Temperature: 25.0°C; Liquid Temperature: 24.0°C
Medium parameters used: f = 5745 MHz; σ = 6.155 mho/m; ε_r = 47.115; ρ = 1000 kg/m^3
DASY5 Configuration:
- Area Scan setting - Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Electronics: DAE4 Sn1239; Calibrated: 6/6/2012
- Probe: EX3DV4 - SN3773; ConvF(3.57, 3.57, 3.57); Calibrated: 3/14/2012
- Sensor-Surface: 2.5mm (Mechanical Surface Detection), Sensor-Surface: 2mm (Mechanical Surface Detection)
- Phantom: ELI v5.0 (A); Type: QDOVA001BB; Serial: 1117

Edge 3/802.11a_ch 149/Area Scan (8x17x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (measured) = 1.962 mW/g

Edge 3/802.11a_ch 149/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 19.161 V/m; Power Drift = 0.13 dB
Peak SAR (extrapolated) = 4.5070
SAR(1 g) = 1.16 mW/g; SAR(10 g) = 0.395 mW/g
Maximum value of SAR (measured) = 2.190 mW/g



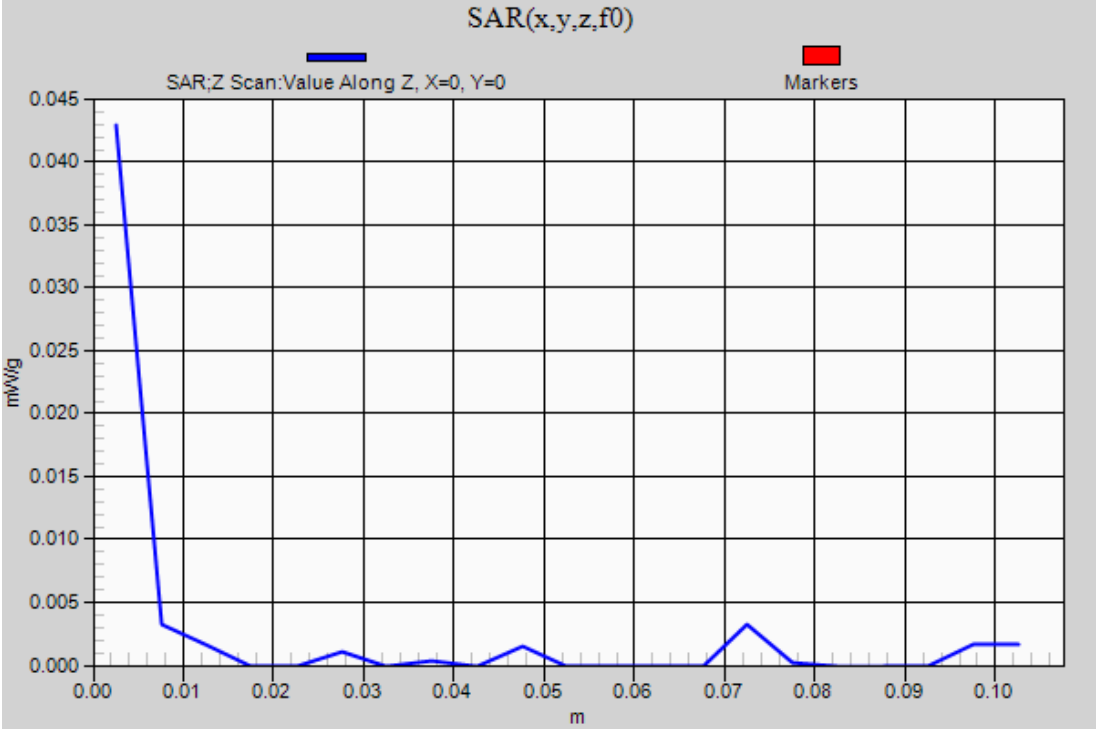
0 dB = 2.190mW/g = 6.81 dB mW/g

Test Laboratory: UL CCS SAR Lab C Date: 8/14/2012

WiFi 5.8GHz (Secondary Antenna)

Frequency: 5745 MHz; Duty Cycle: 1:1

Edge2/802.11a_ch 149/Z Scan (1x1x21): Measurement grid: dx=20mm, dy=20mm, dz=5mm
Maximum value of SAR (measured) = 0.043 mW/g



14. Simultaneous Transmission SAR Analysis

14.1. Sum of the SAR for WiFi 5 GHz and Bluetooth

Sum of the SAR with Measured Values (WiFi Primary Antenna)

Test Position	Data						∑ 1-g SAR (mW/g)
	WiFi 5.2 GHz	WiFi 5.3 GHz	WiFi 5.5 GHz	WiFi 5.8 GHz	Bluetooth (Primary)	Bluetooth (Secondary)	
Rear	0.055				0.029		0.084
		0.063			0.029		0.092
			0.100		0.029		0.129
				0.071	0.029		0.100
	0.055					0.002	0.057
		0.063				0.002	0.065
			0.100			0.002	0.102
				0.071		0.002	0.073
Edge 1	0				0		0
		0			0		0
			0		0		0
				0	0		0
	0					0	0
		0				0	0
			0			0	0
				0		0	0
Edge 2	0				0		0
		0			0		0
			0		0		0
				0	0		0
	0					0.022	0.022
		0				0.022	0.022
			0			0.022	0.022
				0		0.022	0.022
Edge 3	0.792				0.323		1.115
		0.947			0.323		1.270
			0.950		0.323		1.273
				0.971	0.323		1.294
	0.792					0.121	0.913
		0.947				0.121	1.068
			0.950			0.121	1.071
				0.971		0.121	1.092
Edge 4	0.092				0.070		0.162
		0.134			0.070		0.204
			0.171		0.070		0.241
				0.132	0.070		0.202
	0.092					0	0.092
		0.134				0	0.134
			0.171			0	0.171
				0.132		0	0.132

Sum of the SAR with Measured Values (WiFi Secondary Antenna)

Test Position	Data						∑ 1-g SAR (mW/g)
	WiFi 5.2 GHz	WiFi 5.3 GHz	WiFi 5.5 GHz	WiFi 5.8 GHz	Bluetooth (Primary)	Bluetooth (Secondary)	
Rear	0.092				0.029		0.121
		0.153			0.029		0.182
			0.184		0.029		0.213
				0.189	0.029		0.218
	0.092					0.002	0.094
		0.153				0.002	0.155
			0.184			0.002	0.186
				0.189		0.002	0.191
Edge 1	0				0		0
		0			0		0
			0		0		0
				0	0		0
	0					0	0
		0				0	0
			0			0	0
				0		0	0
Edge 2	0.030				0		0
		0.053			0		0
			0.095		0		0
				0.053	0		0
	0.030					0.022	0.052
		0.053				0.022	0.075
			0.095			0.022	0.117
				0.053		0.022	0.075
Edge 3	0.856				0.323		1.179
		1.100			0.323		1.423
			1.190		0.323		1.513
				1.160	0.323		1.483
	0.856					0.121	0.977
		1.100				0.121	1.221
			1.190			0.121	1.311
				1.160		0.121	1.281
Edge 4	0				0.070		0.070
		0			0.070		0.070
			0		0.070		0.070
				0	0.070		0.070
	0					0	0
		0				0	0
			0			0	0
				0		0	0

Sum of the SAR with Scaled Values for the Worst-case Configuration

As the SAR for these configurations were measured at the maximum of tune-up tolerance limit, SAR scaling does not need to be applied.

SAR to Peak Location Separation Ratio (SPLSR)

As the Sum of the SAR is not greater than 1.6 W/kg SPLSR assessment is not required.

Conclusion:

Simultaneous transmission SAR measurement (Volume Scan) is not required because the either sum of the 1-g SAR is < 1.6 W/kg or the SPLSR is < 0.3 for all circumstances that require SPLSR calculation.

15. Appendixes

Refer to separated files for the following appendixes.

15.1. System Performance Check Plots

15.2. SAR Test Plots for WiFi 2.4 GHz Band

15.3. SAR Test Plots for WiFi 5 GHz Bands

15.4. SAR Test Plots for Bluetooth

15.5. Calibration Certificate for E-Field Probe EX3DV4 - SN 3686

15.6. Calibration Certificate for E-Field Probe EX3DV4 - SN 3772

15.7. Calibration Certificate for E-Field Probe EX3DV4 - SN 3773

15.8. Calibration Certificate for D2450V2 - SN 748

15.9. Calibration Certificate for D5GHzV2 - SN 1075

15.10. Calibration Certificate for D5GHzV2 - SN 1003