FCC OET BULLETIN 65 SUPPLEMENT C 01-01
IEEE STD 1528:2003
IC RSS-102 ISSUE 4

SAR EVALUATION REPORT

For

iPhone

MODEL: A1349

FCC ID: BCG-E2422B

REPORT NUMBER: 10U13473-6B2

ISSUE DATE: January 26, 2011

Prepared for

Apple Inc.
1 Infinite Loop, MS-26A
Cupertino, CA 95014-2084

Prepared by

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

Revision History

Rev.	Issue Date	Revisions	Revised By
--	December 6, 2010	Initial Issue	--
A	January 9, 2011	Added IEEE Std 1528:2003 to the cover page, in section 1 and 2.	Sunny Shih
B	January 14, 2011	Includes Personal Hot Spot Measurement	Sunny Shih
B1	January 19, 2011	Updated D850 Dipole cal due date and added appendix with impedance and return loss data	Sunny Shih
B2	January 26, 2011	Updated report with additional note on page 46 and 48.	Sunny Shih

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1. ATTESTATION OF TEST RESULTS

Applicant:	Apple Inc. 1 Infinite Loop, MS-26A Cupertino, CA 95014-2084
EUT description:	iPhone
Model number:	A1349
Device category:	Portable
Exposure category:	General Population/Uncontrolled Exposure
Date tested:	November 11, 2010 (WiFi) October 29 – November 1, 2010 (WWAN) Jan.13- 14 , 2011 (Personal Hot Spot)

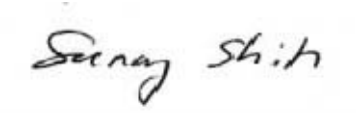
FCC / IC Rule Parts	Frequency Range [MHz]	Highest 1-g SAR (mW/g)	Limit (mW/g)
22H / RSS-132	824 - 849	Head: 1.060 (LHS Touch) Body: 1.100 (Back side)	1.6
24E / RSS-133	1850 - 1910	Head: 1.150 (LHS Touch) Body: 0.574 (Front side)	
15.247 / RSS-102	2412 – 2462	Head: 0.538 (RHS Touch) Body: 0.226 (Back side)	

Applicable Standards	Test Results
FCC OET Bulletin 65 Supplement C 01-01 IEEE Std 1528:2003 IC RSS 102 Issue 4	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.

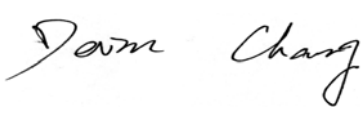
Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL CCS and all revisions are duly noted in the revisions section. Any alteration of this 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:



Devin Chang
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 01-01, IEEE Std 1528:2003, IC RSS 102 Issue 4 and the following specific FCC Test Procedures.

- KDB 648474 D01 SAR Handsets Multi Xmiter and Ant, v01r05
- KDB 941225 D01 SAR test for 3G devices v02
- KDB 248227 D01 SAR meas for 802 11abg v01r02
- Oct 2010 TCB Council Workshop – FCC Personal Hot Spot Presentation

3. FACILITIES AND ACCREDITATION

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

UL CCS is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at http://www.ccsemc.com.

4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due date		
				MM	DD	Year
Robot - Six Axes	Stäubli	RX90BL	N/A	N/A		
Robot Remote Control	Stäubli	CS7MB	3403-91535	N/A		
DASY4 Measurement Server	SPEAG	SEUMS001BA	1041	N/A		
Probe Alignment Unit	SPEAG	LB (V2)	261	N/A		
SAM Phantom (SAM1)	SPEAG	QD000P40CA	1185	N/A		
SAM Phantom (SAM2)	SPEAG	QD000P40CA	1050	N/A		
Oval Flat Phantom (ELI 4.0)	SPEAG	QD OVA001 B	1003	N/A		
Dielectric Probe Kit	HP	85070C	N/A	N/A		
S-Parameter Network Analyzer	Agilent	8753ES-6	8753ES-6	11	22	2011
Signal Generator	Agilent	8753ES-6	8753ES-6	11	22	2011
E-Field Probe	SPEAG	EX3DV3	3531	2	23	2011
E-Field Probe	SPEAG	EX3DV4	3749	11	13	2011
E-Field Probe	SPEAG	EX3DV4	3721	6	23	2011
Thermometer	ERTCO	639-1S	1718	4	30	2011
Data Acquisition Electronics	SPEAG	DAE3 V1	427	7	21	2011
Data Acquisition Electronics	SPEAG	DAE3 V4	1239	11	17	2011
System Validation Dipole	SPEAG	D835V2*	4d002	4	23	2010
System Validation Dipole	SPEAG	D1900V2	5d043	11	24	2011
System Validation Dipole	SPEAG	D2450V2	706	4	19	2011
Amplifier	Mini-Circuits	ZVE-8G	90606	N/A		
Amplifier	Mini-Circuits	ZHL-42W	D072701-5	N/A		
Simulating Liquid	SPEAG	H1900	N/A	Within 24 hrs of first test		
Simulating Liquid	SPEAG	M1900	N/A	Within 24 hrs of first test		
Simulating Liquid	SPEAG	H835	N/A	Within 24 hrs of first test		
Simulating Liquid	SPEAG	M835	N/A	Within 24 hrs of first test		
Simulating Liquid	SPEAG	H2450	N/A	Within 24 hrs of first test		

***Note:** Per KDB 450824 D02 requirements for dipole calibration, UL CCS has adopted three 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) @ 835, 1900 and 2450 MHz	5.50	Normal	1	1	5.50
Axial Isotropy	1.15	Rectangular	1.732	0.7071	0.47
Hemispherical Isotropy	9.20	Rectangular	1.732	0.7071	3.76
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 @ Body 1900 MHz	-2.46	Normal	1	0.64	-1.57
Liquid Permittivity - deviation from target	5.00	Rectangular	1.732	0.6	1.73
Liquid Permittivity - measurement @ Body 835 MHz	-2.79	Normal	1	0.6	-1.67
Combined Standard Uncertainty Uc(y) =					10.37
Expanded Uncertainty U, Coverage Factor = 2, > 95 % Confidence =				20.75	%
Expanded Uncertainty U, Coverage Factor = 2, > 95 % Confidence =				1.64	dB

Measurement uncertainty for 300 MHz to 3 GHz averaged over 10 gram

Component	error, %	Probe Distribution	Divisor	Sensitivity	U (Xi), %
Measurement System					
Probe Calibration (k=1) @ 835, 1900 and 2450 MHz	5.50	Normal	1	1	5.50
Axial Isotropy	1.15	Rectangular	1.732	0.7071	0.47
Hemispherical Isotropy	9.20	Rectangular	1.732	0.7071	3.76
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
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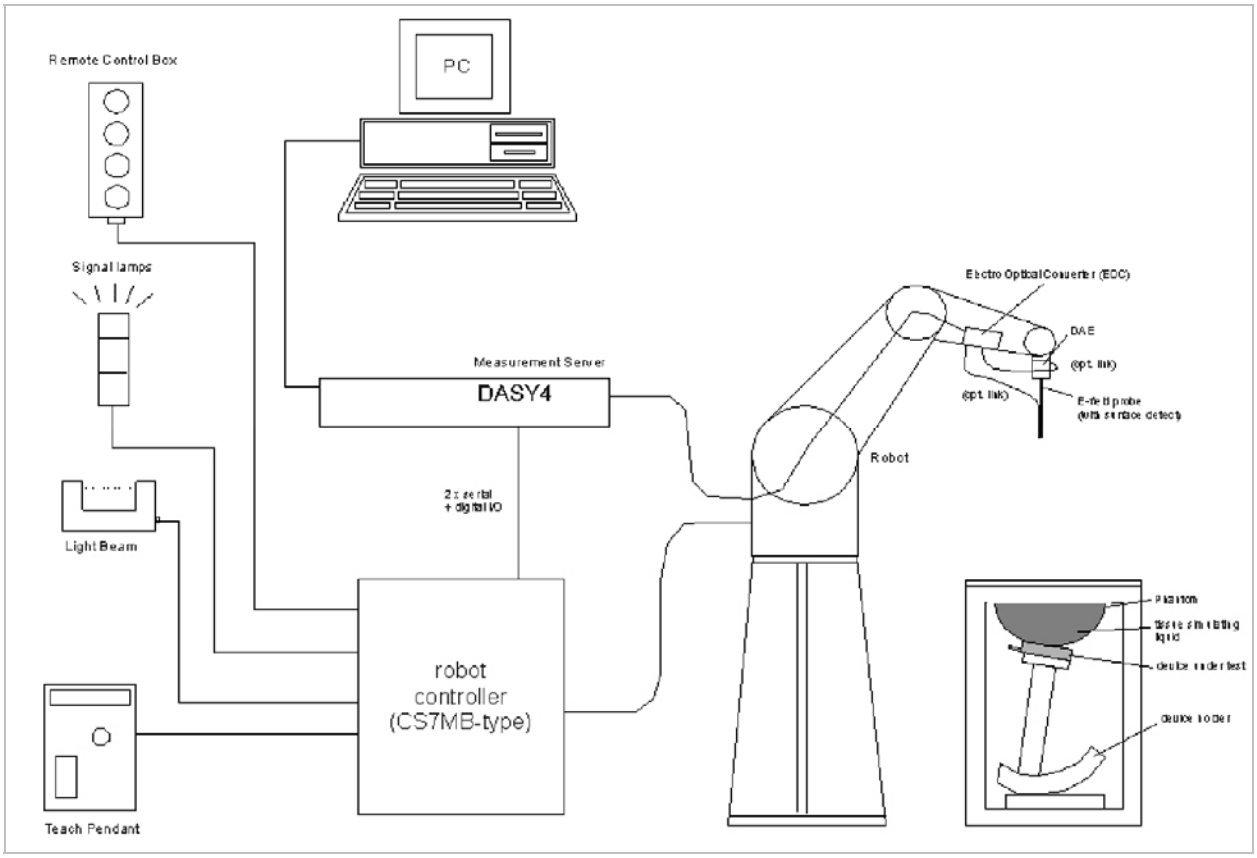
Test Sample Related					
Test Sample Positioning	2.90	Normal	1	1	2.90
Device Holder Uncertainty	3.60	Normal	1	1	3.60
Output Power Variation - SAR Drift	5.00	Rectangular	1.732	1	2.89
Phantom and Tissue Parameters					
Phantom Uncertainty (shape and thickness)	4.00	Rectangular	1.732	1	2.31
Liquid Conductivity - deviation from target	5.00	Rectangular	1.732	0.43	1.24
Liquid Conductivity - measurement @ Body 1900 MHz	-2.46	Normal	1	0.43	-1.06
Liquid Permittivity - deviation from target	5.00	Rectangular	1.732	0.49	1.41
Liquid Permittivity - measurement @ Body 835 MHz	-2.79	Normal	1	0.49	-1.37
Combined Standard Uncertainty Uc(y), % =					10.12
Expanded Uncertainty U, Coverage Factor = 2, > 95 % Confidence =				20.24	%
Expanded Uncertainty U, Coverage Factor = 2, > 95 % Confidence =				1.60	dB

5. EQUIPMENT UNDER TEST

iPhone with 802.11bgn and Bluetooth radio modules. Model number A1349 WiFi module: Semco	
Normal operation:	• Held to head, • Worn on body (LCD facing-up and LCD facing-down) with 15 mm separation distance. • Personal Hot Spot with 1 cm separation distance to all sides and edges.
Body Worn Accessory	Headset
Antenna tested:	Antenna — Apple part number WWAN — 632-1296-02 WiFi/BT — 632-1429-01 (shared with BT)
Antenna-to-antenna separation distances:	8.7 cm from WWAN main antenna-to-WiFi/BT main antenna
Simultaneous transmission:	- 3G can transmit simultaneously with WiFi - 3G can transmit simultaneously with Bluetooth - WiFi can not transmit simultaneously with Bluetooth

6. SYSTEM SPECIFICATIONS



The DASY4 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.
- DASY4 software.
- Remote controls with teach pendant and additional circuitry for robot safety such as warning lamps, etc.
- The SAM twin phantom enabling testing left-hand and right-hand usage.
- The device holder for handheld mobile phones.
- Tissue simulating liquid mixed according to the given recipes.
- Validation dipole kits allowing validating the proper functioning of the system.

7. LIQUID PARAMETERS CHECK

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 and Body Phantom

The head tissue dielectric parameters recommended by the IEEE SCC-34/SC-2 in IEEE Standard 1528 have been incorporated in the following table. These head parameters are derived from planar layer models simulating the highest expected SAR for the dielectric properties and tissue thickness variations in a human head. Other head and body tissue parameters that have not been specified in P1528 are derived from the tissue dielectric parameters computed from the 4-Cole-Cole equations and extrapolated according to the head parameters specified in IEEE Standard 1528.

Target Frequency (MHz)	Head		Body	
	ε_r	σ (S/m)	ε_r	σ (S/m)
150	52.3	0.76	61.9	0.8
300	45.3	0.87	58.2	0.92
450	43.5	0.87	56.7	0.94
835	41.5	0.9	55.2	0.97
900	41.5	0.97	55	1.05
915	41.5	0.98	55	1.06
1450	40.5	1.2	54	1.3
1610	40.3	1.29	53.8	1.4
1800 – 2000	40	1.4	53.3	1.52
2450	39.2	1.8	52.7	1.95
3000	38.5	2.4	52	2.73
5800	35.3	5.27	48.2	6

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

7.1. LIQUID CHECK RESULTS FOR 835 MHZ

Simulating Liquid Dielectric Parameters for Head 835 MHz Measured by: Devin Chang

f (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit (%)
835	e'	42.65	Relative Permittivity (ϵ_r):	42.652	41.5	2.78	± 5
	e"	19.28	Conductivity (σ):	0.895	0.90	-0.51	± 5

Liquid Check
Ambient temperature: 24 deg. C; Liquid temperature: 23 deg. C; Relative humidity = 40%
November 01, 2010 09:21 AM

Frequency	e'	e"
800000000.	43.0548	19.3466
805000000.	43.0052	19.3352
810000000.	42.9511	19.3332
815000000.	42.8975	19.3212
820000000.	42.8377	19.3131
825000000.	42.7756	19.3019
830000000.	42.7127	19.2886
835000000.	**42.6524**	**19.2753**
840000000.	42.5910	19.2607
845000000.	42.5254	19.2499
850000000.	42.4626	19.2337
855000000.	42.4000	19.2224
860000000.	42.3286	19.2160
865000000.	42.2636	19.1932
870000000.	42.1976	19.1803
875000000.	42.1454	19.1589
880000000.	42.0804	19.1476
885000000.	42.0232	19.1354
890000000.	41.9737	19.1209
895000000.	41.9193	19.1091
900000000.	41.8619	19.1010
905000000.	41.8067	19.0778
910000000.	41.7506	19.0736
915000000.	41.7040	19.0663
920000000.	41.6526	19.0565
925000000.	41.6012	19.0448
930000000.	41.5529	19.0319
935000000.	41.5023	19.0242
940000000.	41.4496	19.0186
945000000.	41.3957	19.0052
950000000.	41.3417	18.9967

The conductivity (σ) can be given as:

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

where f = target f * 10^6

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

Simulating Liquid Dielectric Parameters for Body 835 MHz Measured by: Devin Chang

f (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit (%)
835	e'	53.66	Relative Permittivity (ϵ_r):	53.657	55.2	-2.79	± 5
	e"	21.14	Conductivity (σ):	0.982	0.97	1.26	± 5

Liquid Check
Ambient temperature: 24 deg. C; Liquid temperature: 23 deg. C; Relative humidity = 40%
November 01, 2010 11:07 AM

Frequency	e'	e''
800000000.	53.9738	21.2436
805000000.	53.9327	21.2169
810000000.	53.8932	21.2081
815000000.	53.8509	21.1935
820000000.	53.8047	21.1771
825000000.	53.7542	21.1626
830000000.	53.7075	21.1571
835000000.	**53.6574**	**21.1442**
840000000.	53.6067	21.1275
845000000.	53.5564	21.1180
850000000.	53.5053	21.1005
855000000.	53.4519	21.0864
860000000.	53.3989	21.0713
865000000.	53.3474	21.0520
870000000.	53.2990	21.0265
875000000.	53.2569	21.0014
880000000.	53.2079	20.9675
885000000.	53.1636	20.9492
890000000.	53.1258	20.9280
895000000.	53.0824	20.9020
900000000.	53.0425	20.8857
905000000.	53.0038	20.8564
910000000.	52.9622	20.8409
915000000.	52.9241	20.8284
920000000.	52.8846	20.8133
925000000.	52.8414	20.7992
930000000.	52.7960	20.7824
935000000.	52.7520	20.7739
940000000.	52.7051	20.7671
945000000.	52.6580	20.7550
950000000.	52.6033	20.7459

The conductivity (σ) can be given as:

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

where f = target f * 10^6

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

Simulating Liquid Dielectric Parameters for Body 835 MHz Measured by: David Lee

f (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit (%)
835	e'	55.01	Relative Permittivity (ϵ_r):	55.008	55.2	-0.35	± 5
	e"	21.44	Conductivity (σ):	0.996	0.97	2.68	± 5

Liquid Check
Ambient temperature: 24 deg. C; Liquid temperature: 23 deg. C; Relative humidity = 42%
January 13, 2011 01:39 PM

Frequency	e'	e"
800000000.	55.3546	21.5511
805000000.	55.2966	21.5380
810000000.	55.2536	21.5263
815000000.	55.2017	21.5279
820000000.	55.1498	21.5044
825000000.	55.1013	21.4905
830000000.	55.0510	21.4700
835000000.	**55.0084**	**21.4404**
840000000.	54.9598	21.4162
845000000.	54.9201	21.3850
850000000.	54.8754	21.3490
855000000.	54.8369	21.3217
860000000.	54.7992	21.2801
865000000.	54.7484	21.2478
870000000.	54.7004	21.2208
875000000.	54.6605	21.1867
880000000.	54.6125	21.1594
885000000.	54.5627	21.1407
890000000.	54.5128	21.1225
895000000.	54.4583	21.1067
900000000.	54.4022	21.0928
905000000.	54.3484	21.0887
910000000.	54.2987	21.0832
915000000.	54.2449	21.0789
920000000.	54.1898	21.0756
925000000.	54.1329	21.0659
930000000.	54.0881	21.0642
935000000.	54.0349	21.0539
940000000.	53.9954	21.0435
945000000.	53.9488	21.0268
950000000.	53.9102	21.0107

The conductivity (σ) can be given as:

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

where f = target f * 10^6

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

7.2. LIQUID CHECK RESULTS FOR 1900 MHZ

Simulating Liquid Dielectric Parameters for Head 1900 MHz Measured by: Devin Chang

f (MHz)	Liquid Parameters		Measured Results		Target	Delta (%)	Limit (%)
1900	e'	40.060	Relative Permittivity (ε_r):	40.0600	40.0	0.15	± 5
	e"	13.438	Conductivity (σ):	1.42038	1.40	1.46	± 5

Liquid Check
Ambient temperature: 24 deg. C; Liquid temperature: 23 deg. C; Relative humidity = 42%
October 29, 2010 09:18 AM

Frequency	e'	e''
1710000000.	40.8568	12.9024
1720000000.	40.8132	12.9314
1730000000.	40.7707	12.9608
1740000000.	40.7327	12.9889
1750000000.	40.6907	13.0196
1760000000.	40.6489	13.0499
1770000000.	40.6083	13.0836
1780000000.	40.5616	13.1144
1790000000.	40.5175	13.1453
1800000000.	40.4748	13.1777
1810000000.	40.4311	13.2058
1820000000.	40.3882	13.2330
1830000000.	40.3491	13.2614
1840000000.	40.3036	13.2838
1850000000.	40.2633	13.3124
1860000000.	40.2237	13.3341
1870000000.	40.1815	13.3586
1880000000.	40.1370	13.3827
1890000000.	40.0982	13.4107
1900000000.	**40.0600**	**13.4379**
1910000000.	40.0254	13.4638

The conductivity (σ) can be given as:

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

where f = target f * 10^6

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

Simulating Liquid Dielectric Parameters for Head 1900 MHz Measured by: Devin Chang

f (MHz)	Liquid Parameters		Measured Results		Target	Delta (%)	Limit (%)
1900	e'	40.679	Relative Permittivity (ε_r):	40.6785	40.0	1.70	± 5
	e"	13.195	Conductivity (σ):	1.39465	1.40	-0.38	± 5

Liquid Check
Ambient temperature: 24 deg. C; Liquid temperature: 23 deg. C; Relative humidity = 42%
October 30, 2010 02:02 PM

Frequency	e'	e"
1710000000.	41.4286	12.6103
1720000000.	41.3906	12.6367
1730000000.	41.3491	12.6682
1740000000.	41.3082	12.6996
1750000000.	41.2654	12.7356
1760000000.	41.2229	12.7663
1770000000.	41.1786	12.8034
1780000000.	41.1367	12.8353
1790000000.	41.0953	12.8721
1800000000.	41.0611	12.9050
1810000000.	41.0276	12.9298
1820000000.	40.9897	12.9517
1830000000.	40.9523	12.9779
1840000000.	40.9172	13.0009
1850000000.	40.8772	13.0290
1860000000.	40.8321	13.0597
1870000000.	40.7925	13.0901
1880000000.	40.7516	13.1203
1890000000.	40.7144	13.1582
1900000000.	**40.6785**	**13.1945**
1910000000.	40.6449	13.2280

The conductivity (σ) can be given as:

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

where f = target f * 10^6

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

Simulating Liquid Dielectric Parameters for Body 1900 MHz Measured by: Devin Chang

f (MHz)	Muscle Liquid Parameters			Measured	Target	Delta (%)	Limit (%)
1900	e'	52.189	Relative Permittivity (ε_r):	52.1892	53.3	-2.08	± 5
	e"	14.026	Conductivity (σ):	1.48258	1.52	-2.46	± 5

Liquid Check
Ambient temperature: 24 deg. C; Liquid temperature: 23 deg. C; Relative humidity = 42%
October 30, 2010 11:53 AM

Frequency	e'	e"
1710000000.	52.8453	13.4539
1720000000.	52.8086	13.4869
1730000000.	52.7678	13.5201
1740000000.	52.7310	13.5508
1750000000.	52.6939	13.5817
1760000000.	52.6575	13.6144
1770000000.	52.6290	13.6463
1780000000.	52.5989	13.6820
1790000000.	52.5685	13.7148
1800000000.	52.5390	13.7462
1810000000.	52.5080	13.7786
1820000000.	52.4721	13.8067
1830000000.	52.4338	13.8369
1840000000.	52.3930	13.8647
1850000000.	52.3516	13.8949
1860000000.	52.3116	13.9209
1870000000.	52.2757	13.9452
1880000000.	52.2407	13.9711
1890000000.	52.2144	14.0010
1900000000.	**52.1892**	**14.0264**
1910000000.	52.1674	14.0517

The conductivity (σ) can be given as:

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

where f = target f * 10^6

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

Simulating Liquid Dielectric Parameters for Body 1900 MHz Measured by: David Lee

f (MHz)	Muscle Liquid Parameters			Measured	Target	Delta (%)	Limit (%)
1900	e'	51.897	Relative Permittivity (ε_r):	51.8971	53.3	-2.63	± 5
	e"	14.333	Conductivity (σ):	1.51496	1.52	-0.33	± 5

Liquid Check
Ambient temperature: 24 deg. C; Liquid temperature: 23 deg. C; Relative humidity = 42%
January 12, 2011 09:19 AM

Frequency	e'	e"
1710000000.	52.3899	13.9132
1720000000.	52.4784	13.9635
1730000000.	52.5707	13.9769
1740000000.	52.6390	13.9728
1750000000.	52.6541	13.9543
1760000000.	52.6150	13.9378
1770000000.	52.5255	13.9409
1780000000.	52.4025	13.9708
1790000000.	52.2667	14.0216
1800000000.	52.1535	14.0931
1810000000.	52.0781	14.1650
1820000000.	52.0435	14.2247
1830000000.	52.0441	14.2645
1840000000.	52.0640	14.2829
1850000000.	52.0944	14.2843
1860000000.	52.1121	14.2816
1870000000.	52.1080	14.2851
1880000000.	52.0663	14.2957
1890000000.	51.9928	14.3132
1900000000.	**51.8971**	**14.3327**
1910000000.	51.7951	14.3481

The conductivity (σ) can be given as:

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

where f = target f * 10^6

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

7.3. LIQUID CHECK RESULTS FOR 2450 MHZ

Simulating Liquid Dielectric Parameters for Head 2450 MHz Measured by: Devin Chang

f (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit (%)
2450	e'	38.67	Relative Permittivity (ϵ_r):	38.668	39.2	-1.36	± 5
	e"	13.45	Conductivity (σ):	1.833	1.80	1.81	± 5

Liquid Check
Ambient temperature: 24 deg. C; Liquid temperature: 23 deg. C; Relative humidity = 41%
November 11, 2010 07:43 AM

Frequency	e'	e"
2400000000.	38.8316	13.2772
2405000000.	38.8126	13.2931
2410000000.	38.7980	13.3124
2415000000.	38.7833	13.3281
2420000000.	38.7722	13.3455
2425000000.	38.7569	13.3607
2430000000.	38.7435	13.3806
2435000000.	38.7277	13.3968
2440000000.	38.7121	13.4129
2445000000.	38.6907	13.4304
2450000000.	**38.6676**	**13.4457**
2455000000.	38.6444	13.4618
2460000000.	38.6156	13.4762
2465000000.	38.5889	13.4917
2470000000.	38.5606	13.5071
2475000000.	38.5323	13.5197
2480000000.	38.5056	13.5310
2485000000.	38.4816	13.5435
2490000000.	38.4606	13.5559
2495000000.	38.4439	13.5677
2500000000.	38.4302	13.5821

The conductivity (σ) can be given as:

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

where f = target f * 10^6

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

Simulating Liquid Dielectric Parameter Check Result @ Body 2450 MHz Measured by: Devin Chang

f (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit (%)
2450	e'	51.78	Relative Permittivity (ϵ_r):	51.778	52.7	-1.75	± 5
	e"	14.54	Conductivity (σ):	1.982	1.95	1.66	± 5

Liquid Check
Ambient temperature: 24 deg. C; Liquid temperature: 23 deg. C; Relative humidity = 41%
November 11, 2010 09:01 AM

Frequency	e'	e"
2400000000.	51.9349	14.2938
2405000000.	51.9198	14.3146
2410000000.	51.9056	14.3378
2415000000.	51.8962	14.3611
2420000000.	51.8851	14.3824
2425000000.	51.8721	14.4056
2430000000.	51.8608	14.4304
2435000000.	51.8452	14.4530
2440000000.	51.8315	14.4757
2445000000.	51.8108	14.4995
2450000000.	**51.7778**	**14.5441**
2455000000.	51.7639	14.5436
2460000000.	51.7364	14.5637
2465000000.	51.7095	14.5825
2470000000.	51.6851	14.6023
2475000000.	51.6583	14.6202
2480000000.	51.6332	14.6386
2485000000.	51.6121	14.6540
2490000000.	51.5953	14.6729
2495000000.	51.5815	14.6879
2500000000.	51.5734	14.7090

The conductivity (σ) can be given as:

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

where f = target f * 10^6

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

Simulating Liquid Dielectric Parameter Check Result @ Body 2450 MHz Measured by: David Lee

f (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit (%)
2450	e'	52.12	Relative Permittivity (ϵ_r):	52.119	52.7	-1.10	± 5
	e"	14.61	Conductivity (σ):	1.992	1.95	2.15	± 5

Liquid Check
Ambient temperature: 24 deg. C; Liquid temperature: 23 deg. C; Relative humidity = 39%
January 12, 2011 07:30 AM

Frequency	e'	e"
2400000000.	52.1793	14.2687
2405000000.	52.1287	14.3038
2410000000.	52.0864	14.3457
2415000000.	52.0548	14.3823
2420000000.	52.0335	14.4248
2425000000.	52.0247	14.4652
2430000000.	52.0281	14.5029
2435000000.	52.0411	14.5376
2440000000.	52.0647	14.5705
2445000000.	52.0915	14.5956
2450000000.	**52.1192**	**14.6141**
2455000000.	52.1478	14.6270
2460000000.	52.1706	14.6373
2465000000.	52.1870	14.6433
2470000000.	52.1972	14.6454
2475000000.	52.1939	14.6469
2480000000.	52.1787	14.6474
2485000000.	52.1512	14.6474
2490000000.	52.1113	14.6504
2495000000.	52.0622	14.6574
2500000000.	52.0062	14.6692

The conductivity (σ) can be given as:

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

where f = target f * 10^6

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

8. SYSTEM VERIFICATION

The system performance check is performed prior to any usage of the system in order to verify SAR system measurement accuracy. The system performance check verifies that the system operates within its specifications of ±10%.

System Performance Check Measurement Conditions

- The measurements were performed in the flat section of the SAM twin phantom filled with Head or Body simulating liquid of the following parameters.
- The DASY4 system with an Isotropic E-Field Probe EX3DV3 was used for the measurements.
- The dipole was mounted on the small tripod so that the dipole feed point was positioned below the center marking of the flat phantom section and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 10 mm (above 1 GHz) and 15 mm (below 1 GHz) from dipole center to the simulating liquid surface.
- The coarse grid with a grid spacing of 15 mm was aligned with the dipole.
  For 5 GHz band - The coarse grid with a grid spacing of 10 mm was aligned with the dipole.
- Special 7x7x7 fine cube was chosen for cube
- Distance between probe sensors and phantom surface was set to 3 mm.
  For 5 GHz band - Distance between probe sensors and phantom surface was set to 2.5 mm
- The dipole input power (forward power) was 100 mW
- The results are normalized to 1 W input power.

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

System validation dipole	Cal. certificate #	Cal. date	SAR Avg (mW/g)		
			Tissue:	Head	Body
D835V2	D835V2-4d002_Apr09	4/23/09	SAR_{1g}:	9.64	9.96
			SAR_{10g}:	6.28	6.56
D1900V2	D1900V2-5d043_Nov09	11/24/09	SAR_{1g}:	39.8	40.4
			SAR_{10g}:	20.7	21.4
D2450V2	D2450V2-706_Apr10	4/19/10	SAR_{1g}:	51.6	52.4
			SAR_{10g}:	24.4	24.5

8.1. SYSTEM CHECK RESULTS FOR D835V2

Measured by: Devin Chang

System validation dipole	Date Tested	Measured (Normalized to 1 W)		Target	Delta (%)	Tolerance (%)
		Tissue:	Head			
D835V2	11/01/10	SAR_{1g}:	9.75	9.64	1.14	±10
		SAR_{10g}:	6.43	6.28	2.39	
System validation dipole	Date Tested	Measured (Normalized to 1 W)		Target	Delta (%)	Tolerance (%)
		Tissue:	Body			
D835V2	01/13/11	SAR_{1g}:	9.84	9.96	-1.20	±10
		SAR_{10g}:	6.46	6.56	-1.52	

8.2. SYSTEM CHECK RESULTS FOR D1900V2

Measured by: Devin Chang

System validation dipole	Date Tested	Measured (Normalized to 1 W)		Target	Delta (%)	Tolerance (%)
		Tissue:	Head			
D1900V2	10/29/10	SAR_{1g}:	38.7	39.8	-2.76	±10
		SAR_{10g}:	20.3	20.7	-1.93	
D1900V2	10/30/10	SAR_{1g}:	38.5	39.8	-3.27	±10
		SAR_{10g}:	20.4	20.7	-1.45	
System validation dipole	Date Tested	Measured (Normalized to 1 W)		Target	Delta (%)	Tolerance (%)
		Tissue:	Body			
D1900V2	1/1211	SAR_{1g}:	40.8	40.4	0.99	±10
		SAR_{10g}:	21.3	21.4	-0.47	

8.3. SYSTEM CHECK RESULTS FOR D2450V2

Measured by: Devin Chang

System validation dipole	Date Tested	Measured (Normalized to 1 W)		Target	Delta (%)	Tolerance (%)
		Tissue:	Head			
D2450V2	11/11/10	SAR_{1g}:	52.9	51.6	2.52	±10
		SAR_{10g}:	24.4	24.4	0.00	
System validation dipole	Date Tested	Measured (Normalized to 1 W)		Target	Delta (%)	Tolerance (%)
		Tissue:	Body			
D2450V2	01/12/11	SAR_{1g}:	49.6	52.4	-5.34	±10
		SAR_{10g}:	22.7	24.5	-7.35	

SYSTEM CHECK PLOT for D835V2

Date/Time: 11/1/2010 9:00:17 AM

Test Laboratory: Compliance Certification Services

System Performance Check - D835V2

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:xxx

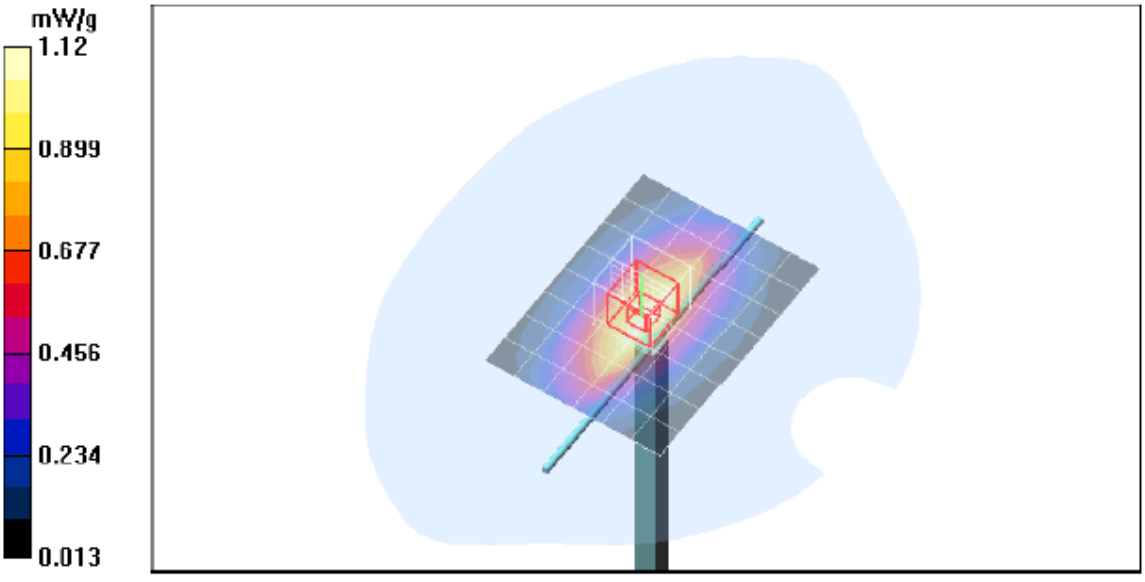
Communication System: CW 835; Frequency: 835 MHz;Duty Cycle: 1:1
Medium parameters used: f = 835 MHz; σ = 0.895 mho/m; ε_r = 42.7; ρ = 1000 kg/m^3
Phantom section: Flat Section

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

DASY4 Configuration:
- Area Scan setting - Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Probe: EX3DV3 - SN3531; ConvF(10.13, 10.13, 10.13); Calibrated: 2/23/2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 7/21/2010
- Phantom: SAM 2 (Twin); Type: SAM 2; Serial: 1050
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

d=15mm, Pin=100 mW/Area Scan (7x9x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 1.12 mW/g

d=15mm, Pin=100 mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 35.6 V/m; Power Drift = 0.030 dB
Peak SAR (extrapolated) = 1.46 W/kg
SAR(1 g) = 0.975 mW/g; SAR(10 g) = 0.643 mW/g
Maximum value of SAR (measured) = 1.14 mW/g



Z-Axis PLOT for D835V2

Date/Time: 11/1/2010 9:18:04 AM

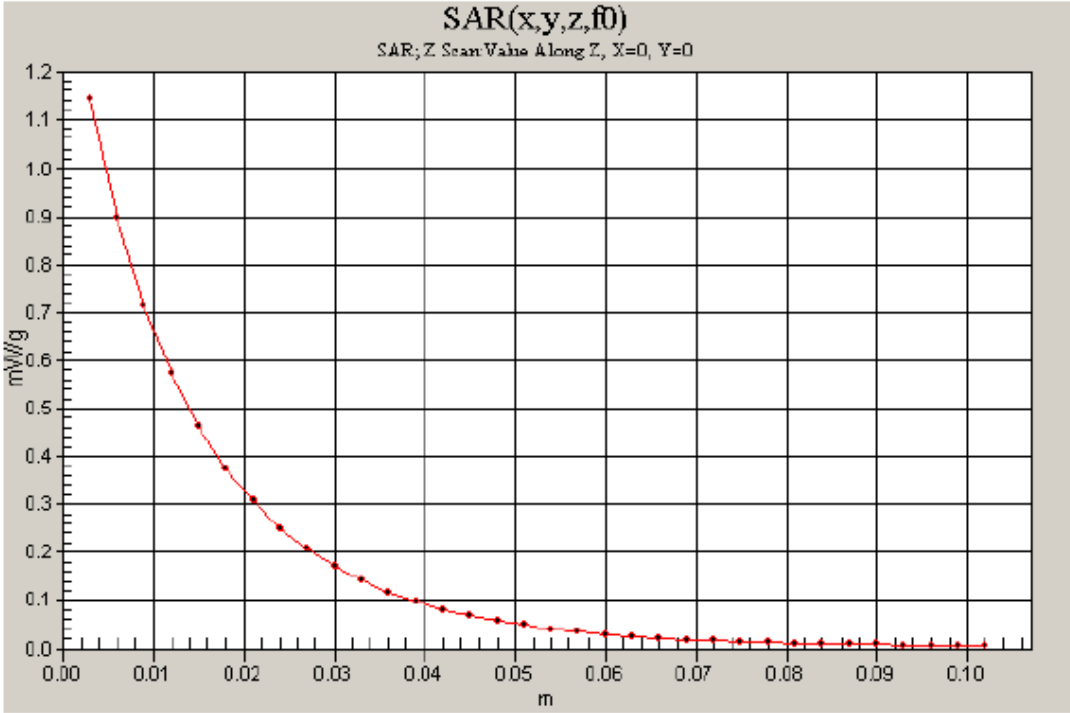
Test Laboratory: Compliance Certification Services

System Performance Check - D835V2

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:xxx

Communication System: CW 835; Frequency: 835 MHz;Duty Cycle: 1:1

d=15mm, Pin=100 mW/Z Scan (1x1x34): Measurement grid: dx=20mm, dy=20mm, dz=3mm
Maximum value of SAR (measured) = 1.14 mW/g



SYSTEM CHECK PLOT for D835V2

Date/Time: 1/13/2011 1:24:30 PM

Test Laboratory: Compliance Certification Services (UL CCS)

System Performance Check - D835V2

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:xxx

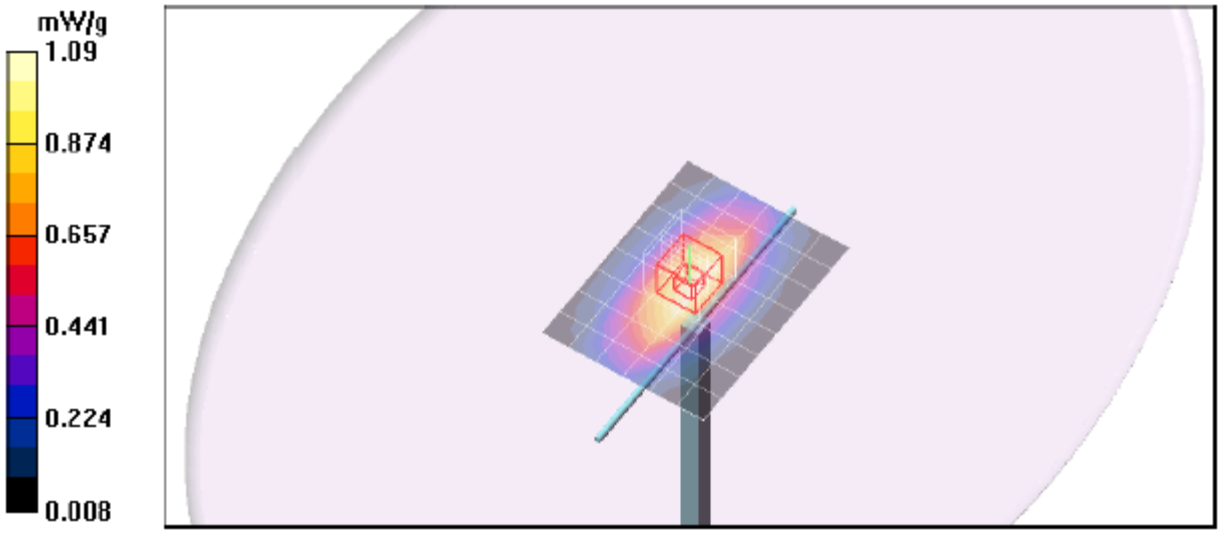
Communication System: CW 835; Frequency: 835 MHz;Duty Cycle: 1:1
Medium parameters used: f = 835 MHz; σ = 0.996 mho/m; ε_r = 55; ρ = 1000 kg/m^3
Phantom section: Flat Section

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

DASY4 Configuration:
- Area Scan setting - Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Probe: EX3DV4 - SN3749; ConvF(8.79, 8.79, 8.79); Calibrated: 12/13/2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 7/21/2010
- Phantom: Flat Phantom ELI4.0; Type: QDOVA001BA; Serial: SN:1003
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

d=15mm, Pin=100 mW/Area Scan (7x9x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 1.09 mW/g

d=15mm, Pin=100 mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 33.3 V/m; Power Drift = 0.155 dB
Peak SAR (extrapolated) = 1.47 W/kg
SAR(1 g) = 0.984 mW/g; SAR(10 g) = 0.646 mW/g
Maximum value of SAR (measured) = 1.15 mW/g



Z-Axis PLOT for D835V2

Date/Time: 1/13/2011 1:41:43 PM

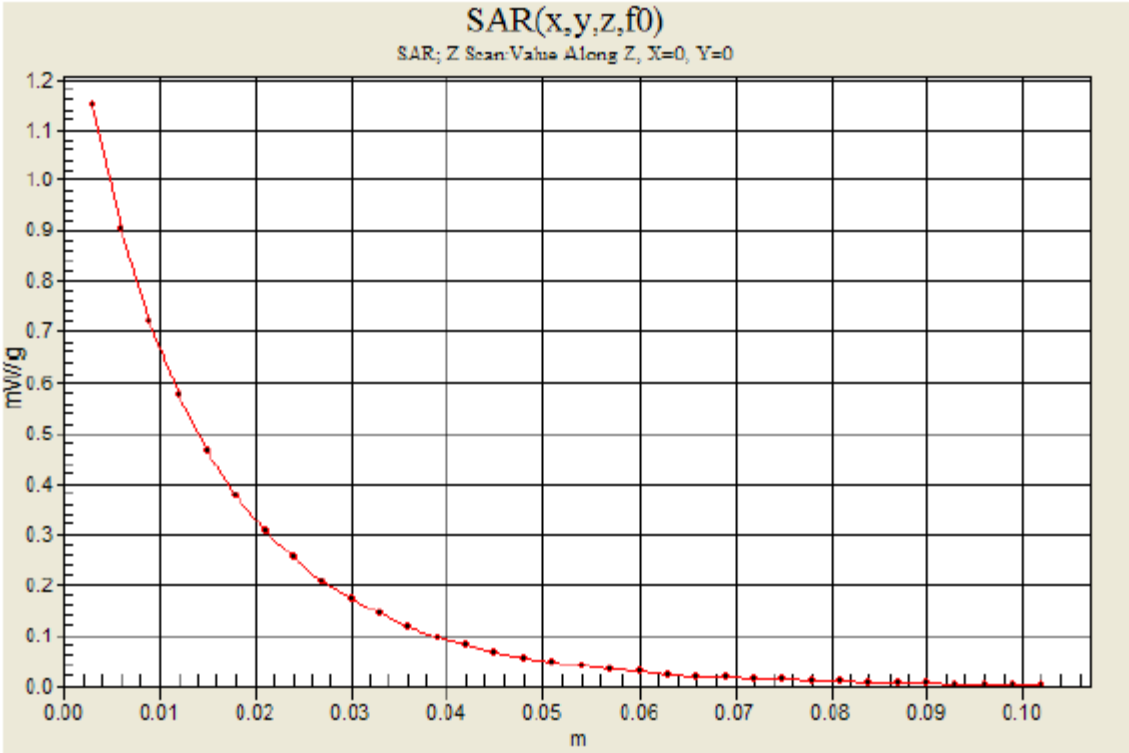
Test Laboratory: Compliance Certification Services (UL CCS)

System Performance Check - D835V2

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:xxx

Communication System: CW 835; Frequency: 835 MHz;Duty Cycle: 1:1

d=15mm, Pin=100 mW/Z Scan (1x1x34): Measurement grid: dx=20mm, dy=20mm, dz=3mm
Maximum value of SAR (measured) = 1.15 mW/g



SYSTEM CHECK PLOT for D1900V2

Date/Time: 10/29/2010 10:45:43 AM

Test Laboratory: Compliance Certification Services

System Performance Check - D1900V2

DUT: D1900V2; Type: D1900V2; Serial: 5d043

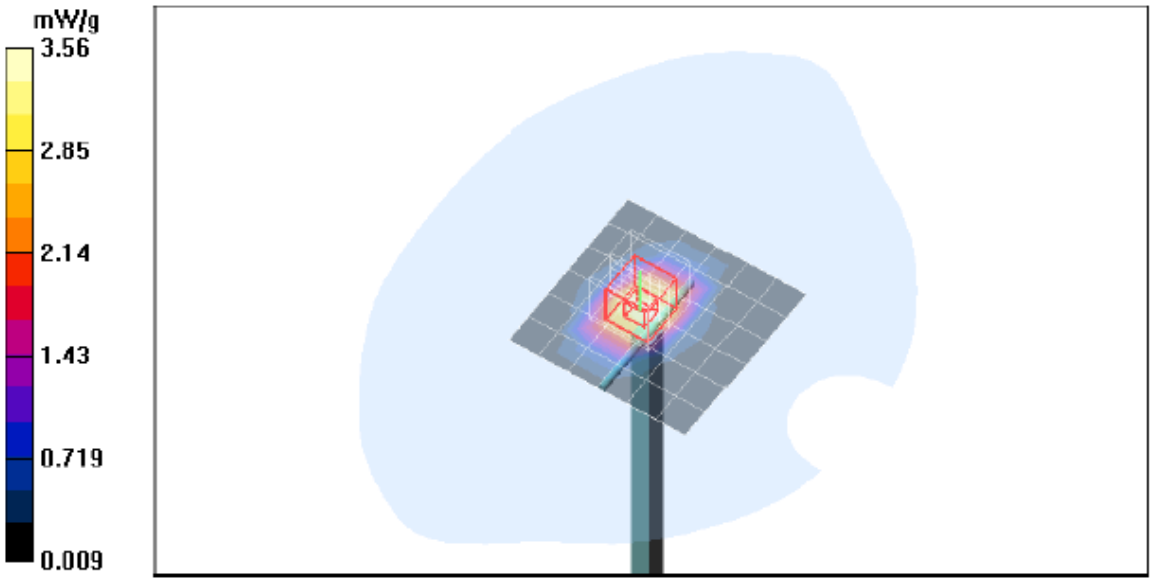
Communication System: CW 1900MHz; Frequency: 1900 MHz;Duty Cycle: 1:1
Medium parameters used: f = 1900 MHz; σ = 1.42 mho/m; ε_r = 40.1; ρ = 1000 kg/m^3
Phantom section: Flat Section

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

DASY4 Configuration:
- Area Scan setting - Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Probe: EX3DV3 - SN3531; ConvF(8.64, 8.64, 8.64); Calibrated: 2/23/2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 7/21/2010
- Phantom: SAM 2 (Twin); Type: SAM 2; Serial: 1050
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

d=10mm, Pin=100mW/Area Scan (7x7x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 3.56 mW/g

d=10mm, Pin=100mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 58.1 V/m; Power Drift = 0.091 dB
Peak SAR (extrapolated) = 7.12 W/kg
SAR(1 g) = 3.87 mW/g; SAR(10 g) = 2.03 mW/g
Maximum value of SAR (measured) = 4.89 mW/g



Z-Axis PLOT for D1900V2

Date/Time: 10/29/2010 11:03:48 AM

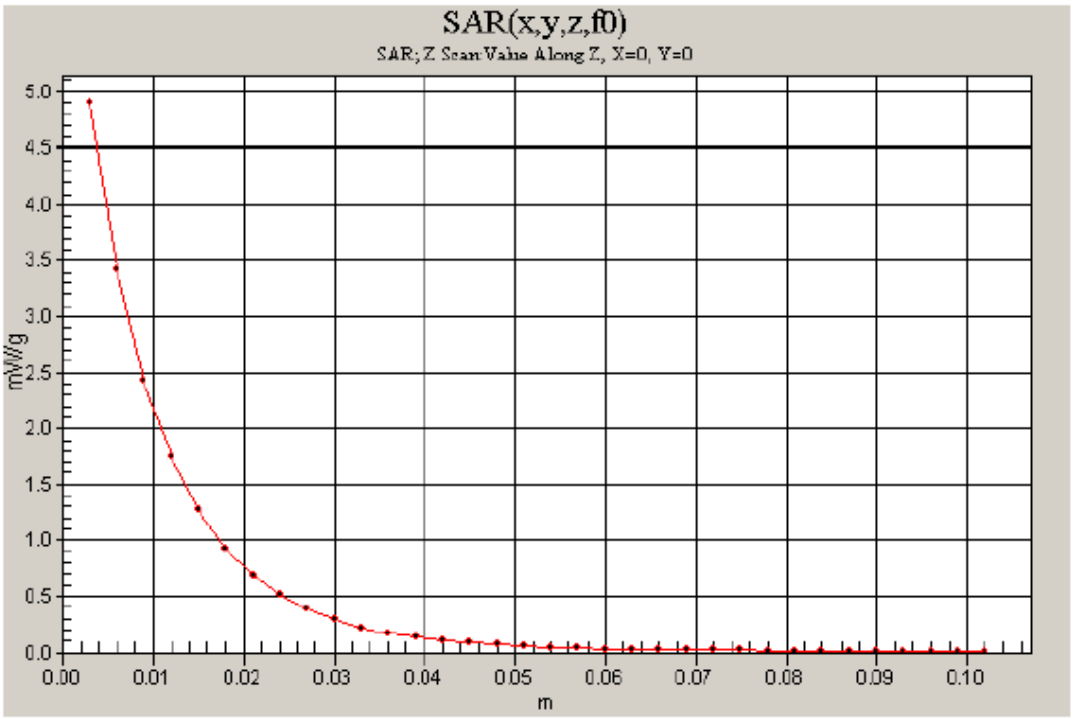
Test Laboratory: Compliance Certification Services

System Performance Check - D1900V2

DUT: D1900V2; Type: D1900V2; Serial: 5d043

Communication System: CW 1900MHz; Frequency: 1900 MHz;Duty Cycle: 1:1

d=10mm, Pin=100mW/Z Scan (1x1x34): Measurement grid: dx=20mm, dy=20mm, dz=3mm
Maximum value of SAR (measured) = 4.90 mW/g



SYSTEM CHECK PLOT for D1900V2

Date/Time: 10/30/2010 2:11:28 PM

Test Laboratory: Compliance Certification Services

System Performance Check - D1900V2

DUT: D1900V2; Type: D1900V2; Serial: 5d043

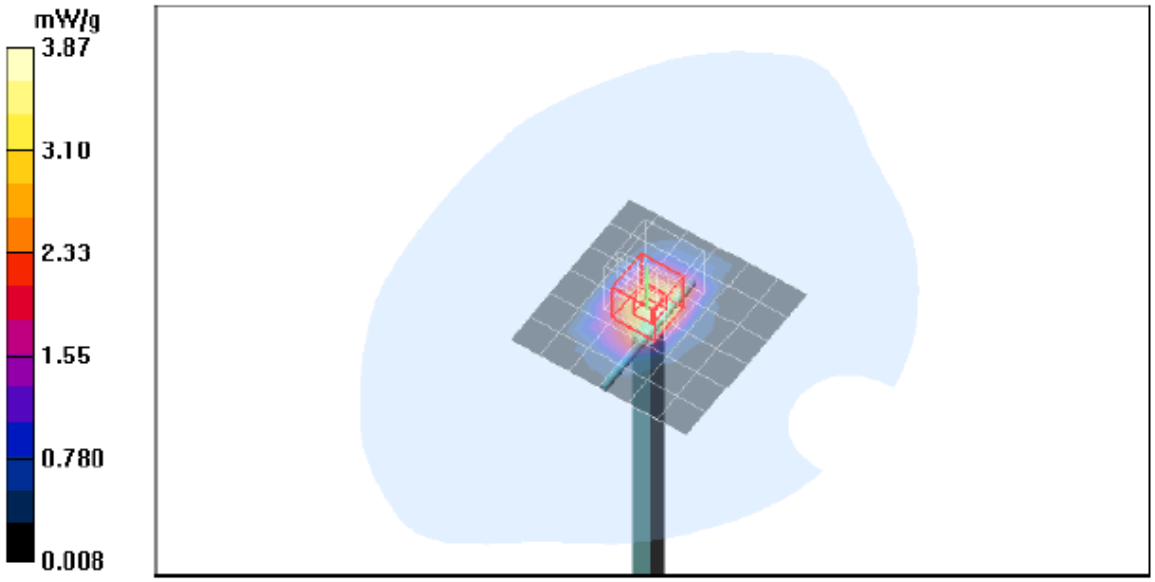
Communication System: CW 1900MHz; Frequency: 1900 MHz;Duty Cycle: 1:1
Medium parameters used: f = 1900 MHz; σ = 1.39 mho/m; ε_r = 40.7; ρ = 1000 kg/m^3
Phantom section: Flat Section

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

DASY4 Configuration:
- Area Scan setting - Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Probe: EX3DV3 - SN3531; ConvF(8.64, 8.64, 8.64); Calibrated: 2/23/2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 7/21/2010
- Phantom: SAM 2 (Twin); Type: SAM 2; Serial: 1050
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

d=10mm, Pin=100mW/Area Scan (7x7x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 3.87 mW/g

d=10mm, Pin=100mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 59.1 V/m; Power Drift = -0.057 dB
Peak SAR (extrapolated) = 6.97 W/kg
SAR(1 g) = 3.85 mW/g; SAR(10 g) = 2.04 mW/g
Maximum value of SAR (measured) = 4.85 mW/g



Z-Axis PLOT for D1900V2

Date/Time: 10/30/2010 2:28:05 PM

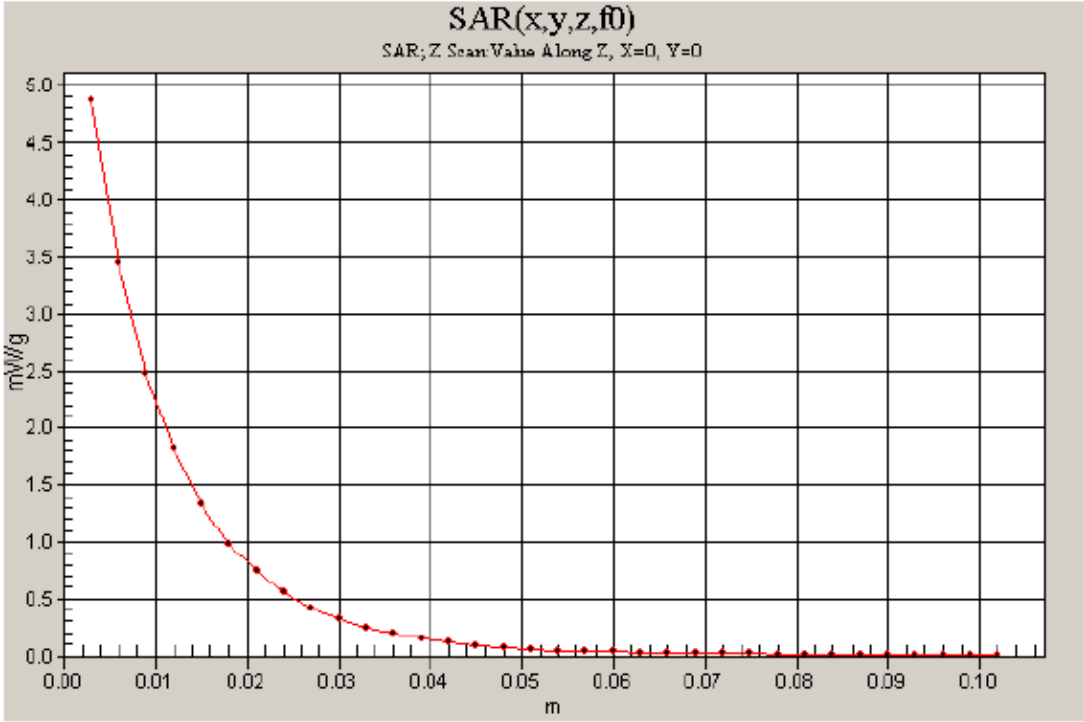
Test Laboratory: Compliance Certification Services

System Performance Check - D1900V2

DUT: D1900V2; Type: D1900V2; Serial: 5d043

Communication System: CW 1900MHz; Frequency: 1900 MHz;Duty Cycle: 1:1

d=10mm, Pin=100mW/Z Scan (1x1x34): Measurement grid: dx=20mm, dy=20mm, dz=3mm
Maximum value of SAR (measured) = 4.87 mW/g



SYSTEM CHECK PLOT for D1900V2

Date/Time: 1/12/2011 9:37:06 AM

Test Laboratory: Compliance Certification Services (UL CCS)

System Performance Check - D1900V2

DUT: Dipole; Type: D1900V2; Serial: 5d043

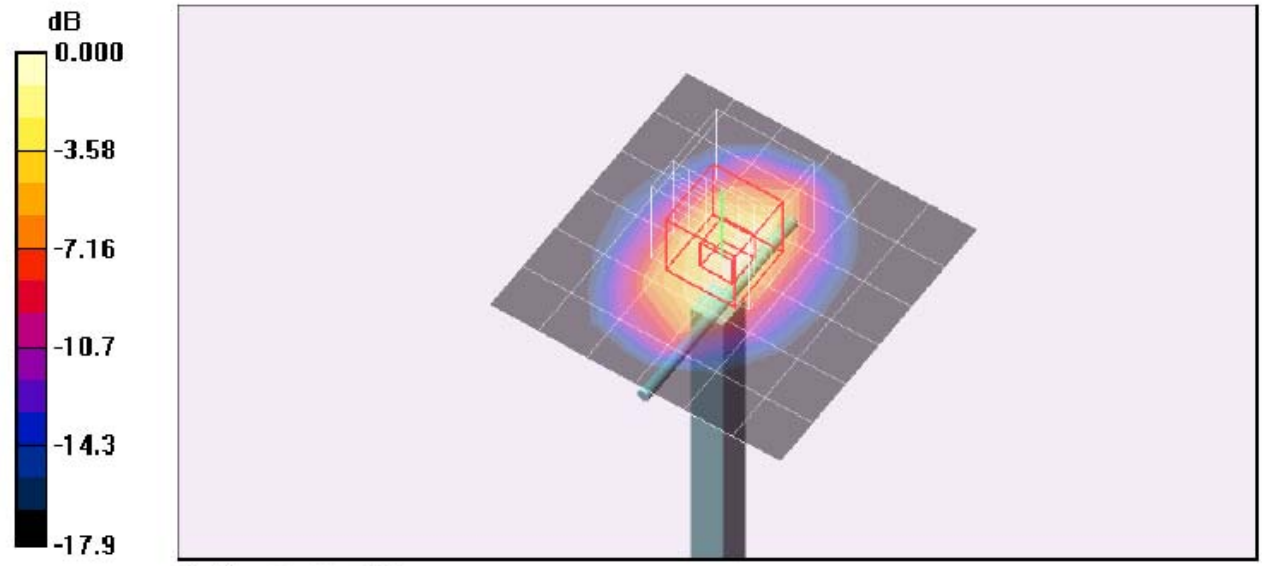
Communication System: System Check Signal - CW; Frequency: 1900 MHz;Duty Cycle: 1:1
Medium parameters used: f = 1900 MHz; σ = 1.51 mho/m; ε_r = 51.9; ρ = 1000 kg/m^3
Phantom section: Flat Section

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

DASY4 Configuration:
- Area Scan setting - Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Probe: EX3DV4 - SN3749; ConvF(7.33, 7.33, 7.33); Calibrated: 12/13/2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 7/21/2010
- Phantom: Flat Phantom ELI4.0; Type: QDOVA001BA; Serial: SN:1003
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

d=10mm, Pin=100mW/Area Scan (7x7x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 4.65 mW/g

d=10mm, Pin=100mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 58.4 V/m; Power Drift = -0.173 dB
Peak SAR (extrapolated) = 7.47 W/kg
SAR(1 g) = 4.08 mW/g; SAR(10 g) = 2.13 mW/g
Maximum value of SAR (measured) = 5.19 mW/g



0 dB = 5.19mW/g

Z-Axis PLOT for D1900V2

Date/Time: 1/12/2011 9:53:03 AM

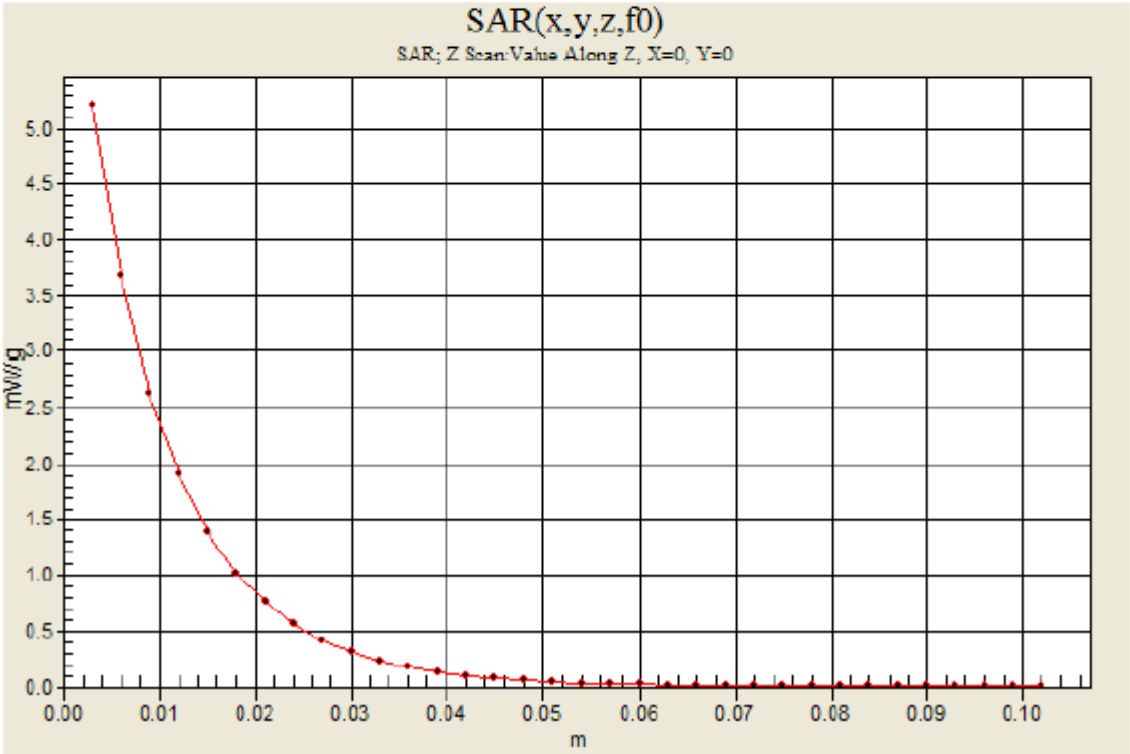
Test Laboratory: Compliance Certification Services (UL CCS)

System Performance Check - D1900V2

DUT: Dipole; Type: D1900V2; Serial: 5d043

Communication System: System Check Signal - CW; Frequency: 1900 MHz;Duty Cycle: 1:1

d=10mm, Pin=100mW/Z Scan (1x1x34): Measurement grid: dx=20mm, dy=20mm, dz=3mm
Maximum value of SAR (measured) = 5.21 mW/g



SYSTEM CHECK plot for D2450V2

Date/Time: 11/11/2010 8:07:02 AM

Test Laboratory: Compliance Certification Services

System Performance Check - D2450V2

DUT: Dipole ; Type: D2450V2; Serial: 706

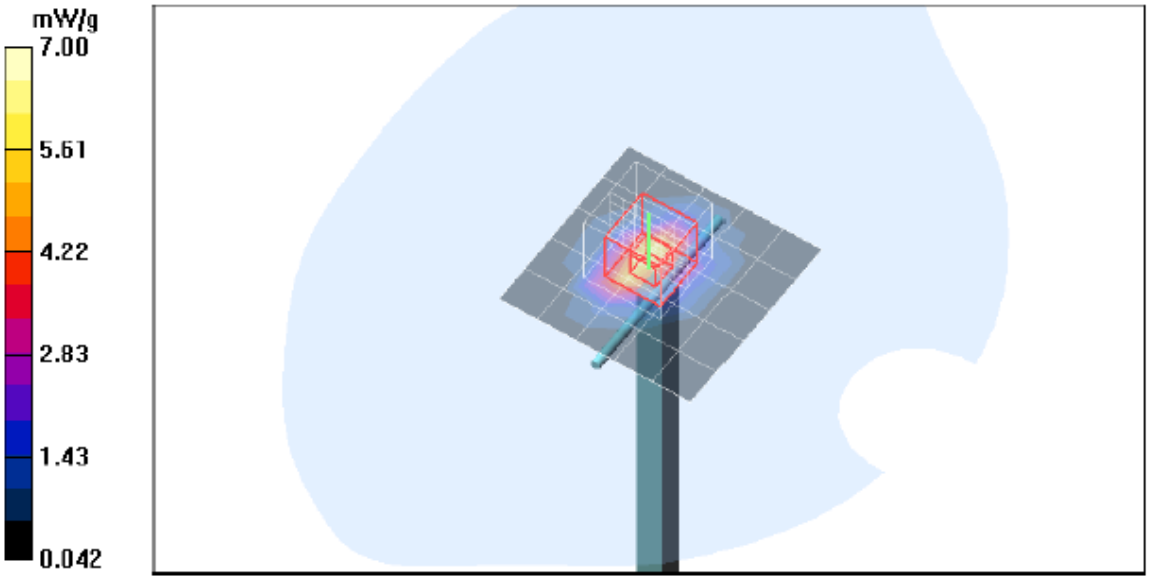
Communication System: System Check Signal - CW; Frequency: 2450 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2450 MHz; σ = 1.84 mho/m; ε_r = 38.9; ρ = 1000 kg/m^3
Phantom section: Flat Section

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

DASY4 Configuration:
- Area Scan setting - Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Probe: EX3DV3 - SN3531; ConvF(7.6, 7.6, 7.6); Calibrated: 2/23/2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn500; Calibrated: 9/15/2009
- Phantom: SAM 2 (Twin); Type: SAM 2; Serial: 1050
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

d=10mm, Pin=100mW/Area Scan (6x6x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 6.05 mW/g

d=10mm, Pin=100mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 61.8 V/m; Power Drift = 0.040 dB
Peak SAR (extrapolated) = 11.2 W/kg
SAR(1 g) = 5.29 mW/g; SAR(10 g) = 2.44 mW/g
Maximum value of SAR (measured) = 7.00 mW/g



Z-Axis Plot for D2450V2

Date/Time: 11/11/2010 8:22:18 AM

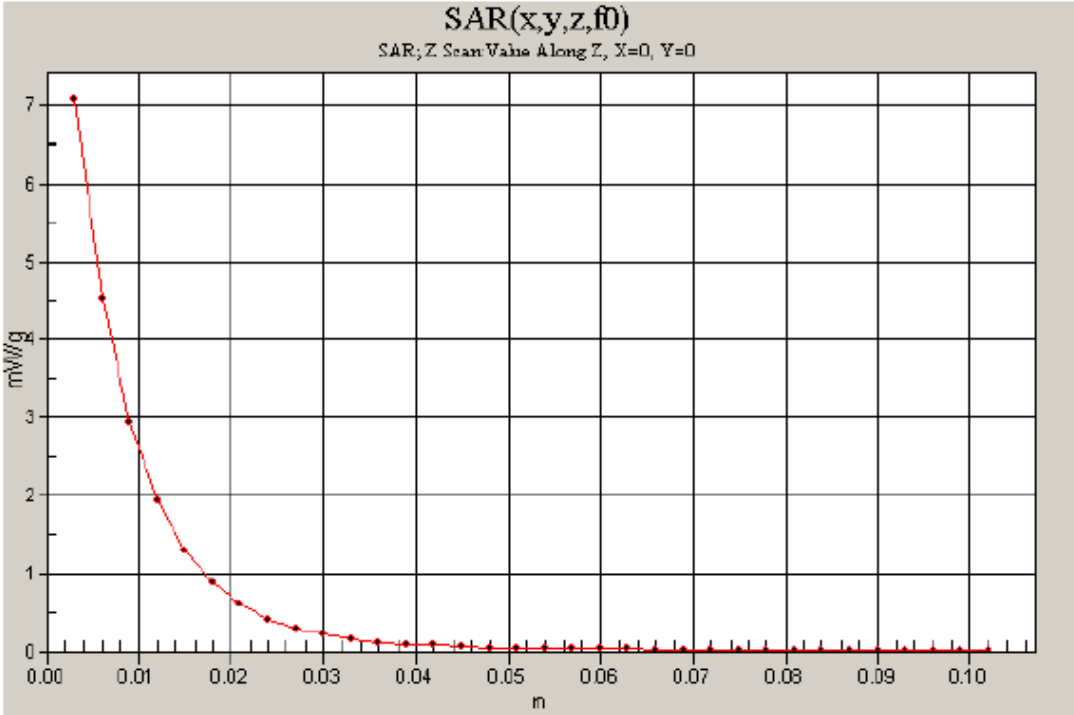
Test Laboratory: Compliance Certification Services

System Performance Check - D2450V2

DUT: Dipole ; Type: D2450V2; Serial: 706

Communication System: System Check Signal - CW; Frequency: 2450 MHz;Duty Cycle: 1:1

d=10mm, Pin=100mW/Z Scan (1x1x34): Measurement grid: dx=20mm, dy=20mm, dz=3mm
Maximum value of SAR (measured) = 7.07 mW/g



System Check Plot for D2450V2

Date/Time: 1/12/2011 2:37:57 PM, Date/Time: 1/12/2011 2:42:38 PM

Test Laboratory: UL CCS

DUT: Dipole 2450 MHz D2450V2; Serial: 706

Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium parameters used: f = 2450 MHz; σ = 1.992 mho/m; ε_r = 52.119; ρ = 1000 kg/m^3
Phantom section: Flat Section

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

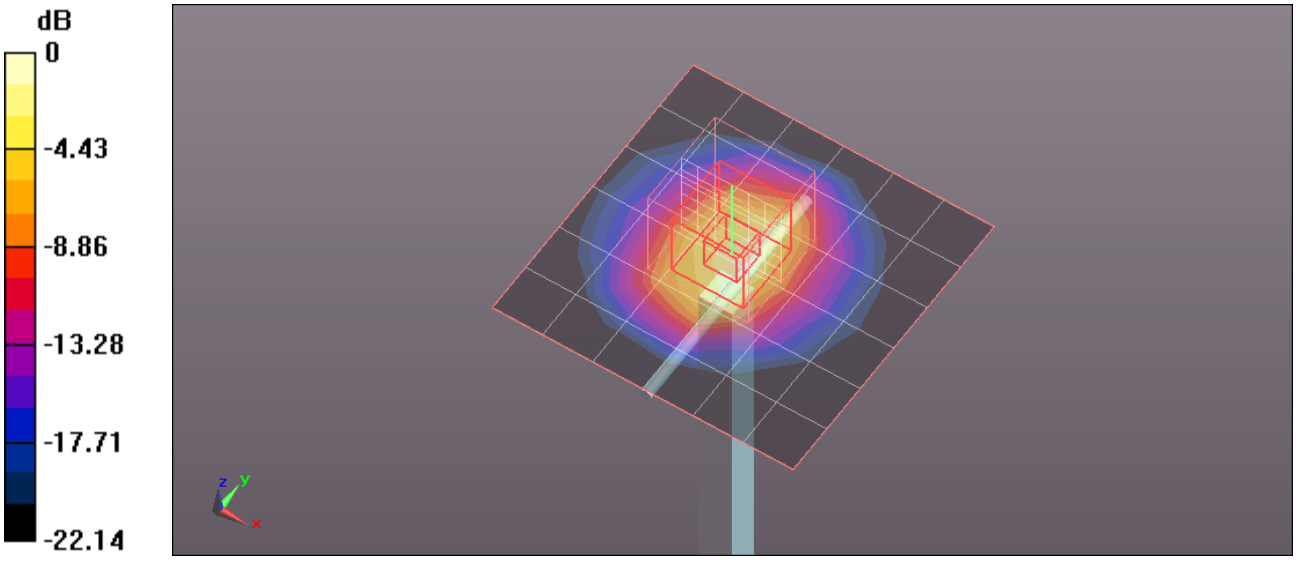
DASY4 Configuration:
- Area Scan setting - Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Probe: EX3DV4 - SN3721; ConvF(6.8, 6.8, 6.8); Calibrated: 6/23/2010
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1239; Calibrated: 11/17/2010
- Phantom: ELI 4.0; Type: QDOVA001BB; Serial: 1099
- Measurement SW: DASY52, Version 52.6 (1);SEMCAD X Version 14.4.2 (2595)

D2450V2 SN 706/d=10mm, Pin=100 mW (EX-Probe)/Area Scan (7x7x1):

Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 6.429 mW/g

D2450V2 SN 706/d=10mm, Pin=100 mW (EX-Probe)/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 62.917 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 10.265 W/kg
SAR(1 g) = 4.96 mW/g; SAR(10 g) = 2.27 mW/g
Maximum value of SAR (measured) = 7.613 mW/g



0 dB = 7.610mW/g

Z-Axis Plot for D2450V2

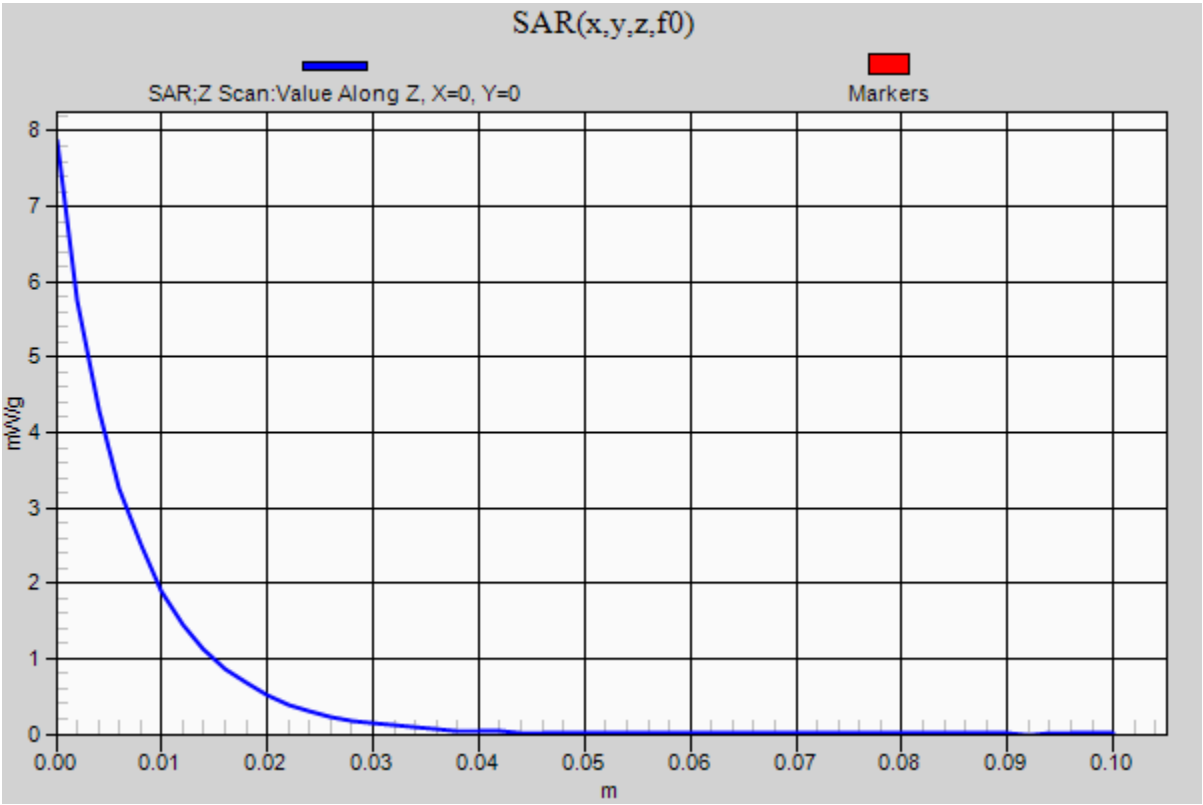
Date/Time: 1/12/2011 2:57:44 PM

Test Laboratory: UL CCS

DUT: Dipole 2450 MHz D2450V2; Serial: 706

Communication System: CW; Frequency: 2450 MHz;Duty Cycle: 1:1

D2450V2 SN 706/d=10mm, Pin=100 mW (EX-Probe)/Z Scan (1x1x51): Measurement grid: dx=20mm, dy=20mm, dz=2mm
Maximum value of SAR (measured) = 7.871 mW/g



9. SAR MEASUREMENT PROCEDURES

A summary of the procedure follows:

1. A measurement of the SAR value at a fixed location is used as a reference value for assessing the power drop of the EUT. The SAR at this point is measured at the start of the test, and then again at the end of the test.
2. The SAR distribution at the exposed flat section of the flat phantom is measured at a distance of 3 mm from the inner surface of the shell. The area covers the entire dimension of the EUT and the horizontal grid spacing is 15 mm x 15 mm. Based on this data, the area of the maximum absorption is determined by Spline interpolation. The first Area Scan covers the entire dimension of the EUT to ensure that the hotspot was correctly identified.
   For 5 GHz band - The SAR distribution at the exposed flat section of the flat phantom is measured at a distance of 2.5 mm from the inner surface of the shell. The area covers the entire dimension of the EUT and the horizontal grid spacing is 10 mm x 10 mm. Based on this data, the area of the maximum absorption is determined by Spline interpolation. The first Area Scan covers the entire dimension of the EUT to ensure that the hotspot was correctly identified.
3. Around this point, a volume of X=Y= 30 and Z=24 mm is assessed by measuring 7 x 7 x 9 mm points. On the basis of this data set, the spatial peak SAR value is evaluated with the following procedure:
   For 5 GHz band - Around this point, a volume of X=Y=24 and Z=20 mm is assessed by measuring 7 x 7 x 9 mm points. On the basis of this data set, the spatial peak SAR value is evaluated with the following procedure:
   a) The data at the surface are extrapolated, since the centre of the dipoles is 1.2 mm away from the tip of the probe and the distance between the surface and the lowest measuring point is 1.3 mm. The extrapolation is based on a least square algorithm. A polynomial of the fourth order is calculated through the points in z-axes. This polynomial is then used to evaluate the points between the surface and the probe tip.
   b) The maximum interpolated value is searched with a straightforward algorithm. Around this maximum the SAR values averaged over the spatial volumes (1 g and 10 g) are computed using the 3D-Spline interpolation algorithm. The 3D-Spline is composed of three one-dimensional splines with the “Not a knot”- condition (in x, y and z-direction). The volume is integrated with the trapezoidal – algorithm. One thousand points (10 x 10 x 10) are interpolated to calculate the averages.
   c) All neighboring volumes are evaluated until no neighboring volume with a higher average value is found.
   d) The SAR value at the same location as in Step (a) is again measured to evaluate the actual power drift.

9.1. DASY4 SAR MEASUREMENT PROCEDURES

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

Step 2: Area Scan
The Area Scan is used as a fast scan in two dimensions to find the area of high field values, before doing a fine measurement around the hot spot. The sophisticated interpolation routines implemented in DASY4 software can find the maximum locations even in relatively coarse grids. When an Area Scan has measured all reachable points, it computes the field maximal found in the scanned area, within a range of the global maximum. The range (in dB) is specified in the standards for compliance testing. For example, a 2 dB range is required in IEEE Standard 1528, EN 50361 and IEC 62209 standards, whereby 3 dB is a requirement when compliance is assessed in accordance with the ARIB standard (Japan). If only one Zoom Scan follows the Area Scan, then only the absolute maximum will be taken as reference. For cases where multiple maximums are detected, the number of Zoom Scans has to be increased accordingly.

Step 3: Zoom Scan
Zoom Scans are used to assess the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g of simulated tissue. The Zoom Scan measures 7 x 7 x 9 points within a cube whose base faces are centered on the maxima found in a preceding area scan job within the same procedure. When the measurement is done, the Zoom Scan evaluates the averaged SAR for 1 g and 10 g and displays these values next to the job's label.

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

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

10. KDB 941225 TEST REDUCTION CONSIDERATION

CDMA2000 1x handsets Test configurations based on KDB 941225 SAR test for 3G devices v02

Head SAR

1. SAR for RC3 with the DUT configured to transmit at full rate using Loopback Service Option SO55.
2. SAR for RC1
    1) Not required when the maximum average output of each channel is less than 0.25 dB higher than as measured in RC3.
    2) Else SAR is measured on the maximum output channel in RC1, for exposure configuration that produced highest SAR for that channel in RC3.

Based upon the power measurement in section 9.1, SAR for RC1 is not required due to the output power is not ¼ dB higher than RC3. Thus **RC3/SO55** is used for Head SAR measurement.

Body SAR

1. SAR for RC3
    1) With DUT configured using TDSO/SO32, to transmit at full rate on FCH with all other code channels disabled.
    2) For multiples code channels (FCH + SCH_n)
        (1) Not required when the maximum average output of each RF channel is less than 0.25 dB higher than as measured with FCH only.
        (2) Else SAR is measured on the maximum output channel (FCH + SCH_n) with FCH at full rate and SCH_0 enabled at 9600 bps, for exposure configuration that produced highest SAR for that channel with FCH only.
2. SAR for RC1
    1) Not required when the maximum average output of each channel is less than 0.25 dB higher than as measured in RC3.
    2) Else SAR is measured on the maximum output channel in RC1, with Loopback Service Option SO55, at full rate, for exposure configuration that produced highest SAR for that channel in RC3.
3. Handsets with Ev-Do
    1) SAR for Release 0 (Rel. 0)
        (1) Not required when the maximum average output of each channel is less than 0.25 dB higher than as measured in RC3 (1xRTT)
        (2) Else SAR is measured on the maximum output channel, at 153.6 kbps, for exposure configuration that produced highest SAR for that channel in RC3.
    2) SAR for Revision A (Rev. A)
        (1) Not required when the maximum average output of each channel is less than as measured in Release 0, or is lees than 0.25 dB higher than as measured in RC3 (1xRTT).
        (2) Else SAR is measured on the maximum output channel, using a Reverse Data Channel payload size of 4096 bits and a Termination Target of 16 slots defined for Subtype 2 Physical Layer configurations (TBD: may be “for exposure configuration that produced highest SAR for that channel in RC3”)

11. RF OUTPUT POWER VERIFICATION

Maximum output power is verified on the Low, Middle and High channels according to procedures in section 4.4.5.2 of 3GPP2 C.S0011/TIA-98-E for 1xRTT, section 3.1.2.3.4 of 3GPP2 C.S0033-0/TIA-866 for Rel. 0 and section 4.3.4 of 3GPP2 C.S0033-A for Rev. A

11.1. WWAN

11.1.1. CDMA2000 1xRTT

This procedure assumes the Agilent 8960 Test Set has the following applications installed and with valid license.

Application	Rev, License
CDMA2000 Mobile Test	B.13.08, L

- Protocol Rev > 6 (IS-2000-0)
- System ID: 28 (Cell) & 18 (PCS); NID: 65535 (Cell & PCS); Reg. Ch. #.: 384 (Cell) & 600 (PCS)
- Radio Config (RC) > Please see following table for details
- FCH Service Option (SO) Setup > Please see following table or details
- Traffic Data Rate > Full
- TDSO SCH Info > F-SCH Parameters > F-SCH Data Rate > 153.6 kbps
  > R-SCH Parameters > R-SCH Data Rate > 153.6 kbps
- Rvs Power Ctrl > All Up bits (Maximum TxPout)

RF Output Power for Cellular Band

Radio Configuration (RC)	Service Option (SO)	Conducted Output Power (dBm)		
		Ch. 1013 / 824.7 MHz	Ch. 384 / 836.52 MHz	Ch. 777 / 848.31 MHz
		Average	Average	Average
RC1	55 (Loopback)	24.1	24.1	24.0
RC3	55 (Loopback)	24.1	24.1	24.1
	32 (+ F-SCH)	24.1	24.1	24.0
	32 (+ SCH)	24.0	24.0	24.0

RF Output Power for PCS Band

Radio Configuration (RC)	Service Option (SO)	Conducted Output Power (dBm)		
		Ch. 25 / 1851.25 MHz	Ch. 600 / 1880 MHz	MHz
		Average	Average	Average
RC1	55 (Loopback)	23.1	23.1	23.1
RC3	55 (Loopback)	23.1	23.1	23.2
	32 (+ F-SCH)	23.1	23.1	23.2
	32 (+ SCH)	23.0	23.1	23.1

11.1.2. CDMA200 1xEv-Do

11.1.2.1. Release 0 (Rel. 0)

This procedure assumes the Agilent 8960 Test Set has the following applications installed and with valid license.

EVDO Release 0 - RTAP

- Call Setup > Shift & Preset
- Call Control:
  - Access Network Info > Cell Parameters > Sector ID > 00000000 : 00000000 : 00000000 : 00000000 > Subnet Mask > 0
  - Generator Info > Termination Parameters > Max Forward Packet Duration > 16 Slots
- Call Parms:
  - Cell Power > -105.5 dBm/1.23 MHz
  - Cell Band > (Select US Cellular or US PCS)
  - Channel > (Enter channel number)
  - Application Config > Enhanced Test Application Protocol > RTAP
  - RTAP Rate > 153.6 kbps
  - Rvs Power Ctrl > Active bits
  - Protocol Rel > 0 (1xEV-DO)
- Press “Start Data Connection” when “Session Open” appear in “Active Cell”
- Rvs Power Ctrl > All Up bits (Maximum TxPout)

EVDO Release 0 - FTAP

- Call Setup > Shift & Preset
- Call Control:
  - Access Network Info > Cell Parameters > Sector ID > 00000000 : 00000000 : 00000000 : 00000000 > Subnet Mask > 0
  - Generator Info > Termination Parameters > Max Forward Packet Duration > 16 Slots
- Call Parms:
  - Cell Power > -105.5 dBm/1.23 MHz
  - Cell Band > (Select US Cellular or US PCS)
  - Channel > (Enter channel number)
  - Application Config > Enhanced Test Application Protocol > FTAP (default)
  - FTAP Rate > 307.2 kbps (2 Slot, QPSK)
  - Rvs Power Ctrl > Active bits
  - Protocol Rel > 0 (1xEV-DO)
- Press “Start Data Connection” when “Session Open” appear in “Active Cell”
- Rvs Power Ctrl > All Up bits (Maximum TxPout)

RF Power Output for EV-DO Rel 0

Band	FTAP Rate	RTAP Rate	Channel	f (MHz)	Conducted power (dBm)	
					Average	Peak
Cellular	307.2 kbps (2 slot, QPSK)	153.6 kbps	1013	824.70	24.0	
			384	836.52	24.1	
			777	848.31	24.0	
PCS	307.2 kbps (2 slot, QPSK)	153.6 kbps	25	1851.25	23.0	
			600	1880.00	23.1	
			1175	1908.75	23.1	

11.1.2.2. Revision A (Rev. A)

This procedure assumes the Agilent 8960 Test Set has the following applications installed and with valid license.

Application	Rev, License
1xEV-DO Terminal Test	A.09.13

EVDO Rev. A – RETAP

- Call Setup > Shift & Preset
- Cell Power > -60 dBm/1.23 MHz
- Protocol Rev > A (1xEV-DO-A)
- Application Config > Enhanced Test Application Protocol > RETAP
- R-Data Pkt Size > 4096
- Protocol Subtype Config > Release A Physical Layer Subtype > Subtype 2 > PL Subtype 2 Access Channel MAC Subtype > Default (Subtype 0)
- Access Network Info > Cell Parameters > Sector ID > 00000000: 00000000: 00000000: 00000000 > Subnet Mask > 0
- Generator Info > Termination Parameters > Max Forward Packet Duration >16 Slots > ACK R-Data After > Subpacket 0 (All ACK)
- Rvs Power Ctrl > All Up bits (to get the maximum power)

EVDO Rev. A - FETAP

- Call Setup > Shift & Preset
- Cell Power > -60 dBm/1.23 MHz
- Protocol Rev > A (1xEV-DO-A)
- Application Config > Enhanced Test Application Protocol > FETAP
- F-Traffic Format > 4 (1024, 2,128) Canonical (307.2k, QPSK)
- Protocol Subtype Config > Release A Physical Layer Subtype > Subtype 2 > PL Subtype 2 Access Channel MAC Subtype > Default (Subtype 0)
- Access Network Info > Cell Parameters > Sector ID > 00000000: 00000000: 00000000: 00000000 > Subnet Mask > 0
- Generator Info > Termination Parameters > Max Forward Packet Duration >16 Slots > ACK R-Data After > Subpacket 0 (All ACK)
- Rvs Power Ctrl > All Up bits (to get the maximum power)

Band	FETAP Traffic Format	RETAP Data Payload Size	Channel	f (MHz)	Conducted power (dBm)	
					Average	Peak
Cellular	307.2k, QPSK/ ACK channel is transmitted at all the slots	4096	1013	824.70	24.0	
			384	836.52	24.1	
			777	848.31	24.1	
PCS	307.2k, QPSK/ ACK channel is transmitted at all the slots	4096	25	1851.25	23.0	
			600	1880.00	23.0	
			1175	1908.75	23.0	

11.2. WIFI RF OUTPUT POWER

802.11b			
Channel #	Freq. (MHz)	Conducted Avg Power	
		(dBm)	(mW)
1	2412	16.6	45.7
6	2437	16.6	45.7
11	2462	16.6	45.7
802.11g			
1	2412	14.1	25.7
6	2437	16.7	46.8
11	2462	13.9	24.5
802.11n HT20			
1	2412	13.3	21.4
6	2437	16.5	44.7
11	2462	13.4	21.9

Note: KDB 248227 - 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 802.11b channels.

11.3. BLUETOOTH RF OUTPUT POWER

Bluetooth				
Mode	Channel #	Freq. (MHz)	Conducted Avg Power	
			(dBm)	(mW)
GFSK	0	2402	9.1	8.1
	39	2441	9.9	9.8
	78	2480	10.1	10.2
QPSK	0	2402	8.7	7.4
	39	2441	9.4	8.7
	78	2480	9.7	9.3
8PSK	0	2402	6.1	4.1
	39	2441	6.9	4.9
	78	2480	7.2	5.2

Note: According to KDB 648474, Table 2, Unlicensed transmitters
When there is simultaneous transmission, Stand-alone SAR not required due to

- ☐ Output ≤ 2 · P_{Ref} (24 mW) and antenna is ≥ 5.0 cm from other antennas
- ☐ Output ≤ P_{Ref} (12 mW) and antenna is ≥ 2.5 cm from other antennas
- ☒ Output ≤ P_{Ref} (12 mW) and antenna is < 2.5 cm from other antennas

12. SUMMARY OF SAR TEST RESULTS

12.1. WWAN

12.1.1. CELL BAND

Left Hand Side (LHS)

Test position	Mode	Ch No.	f (MHz)	SAR (mW/g)	
				1-g	10-g
Touch	1xRTT (RC3, SO55)	1013	824.70	0.831	0.605
		384	836.52	1.000	0.726
		777	848.31	**1.060**	0.762
Tilt	1xRTT (RC3, SO55)	1013	824.70		
		384	836.52	0.415	0.317
		777	848.31		

Right Hand Side (RHS)

Test position	Mode	Ch No.	f (MHz)	SAR (mW/g)	
				1-g	10-g
Touch	1xRTT (RC3, SO55)	1013	824.70	0.646	0.456
		384	836.52	0.804	0.561
		777	848.31	0.825	0.541
Tilt	1xRTT (RC3, SO55)	1013	824.70		
		384	836.52	0.462	0.349
		777	848.31		

Notes:

- Head SAR for RC3 with the DUT configured to transmit at full rate using Loopback Service Option SO55.
- Head SAR for RC1 is not required when the maximum average output of each channel is less than 0.25 dB higher than as measured in RC3.

Body with 1.5 cm separation distance

Test position	Mode	UL Ch No.	f (MHz)	SAR (mW/g)	
				1-g	10-g
Face up	1xRTT (RC3, SO32)	1013	824.70	0.691	0.506
		384	836.52	0.812	0.602
		777	848.31	0.756	0.565
Face down	1xRTT (RC3, SO32)	1013	824.70	0.726	0.535
		384	836.52	**0.869**	0.641
		777	848.31	0.813	0.606
Face down (with headset)	1xRTT (RC3, SO32)	384	836.52	0.656	0.466

Notes:

- Based upon the power measurement in section 9.2, Body SAR for multiple code channel (FCH+SCH) is not required due to the output power is not ¼ dB higher than RC3/SO32.
- Based upon the power measurement in section 9.1.2 and 9.1.3, Body SAR for 1xEVDO Rel.0 and Rev. A power measurement is not ¼ dB higher than RC3.
- Thus, RC3/SO32 is used for all Body SAR measurement.

Body with 1.0 cm separation distance (Wireless routers incorporated in device)

Test position	Mode	UL Ch No.	f (MHz)	SAR (mW/g)	
				1-g	10-g
Front side (Face up)	1xRTT (RC3, SO32)	1013	824.70	0.865	0.634
		384	836.52	1.020	0.756
		777	848.31	0.956	0.712
Back side (Face down)	1xRTT (RC3, SO32)	1013	824.70	0.932	0.670
		384	836.52	**1.100**	0.797
		777	848.31	1.030	0.761
Left edge	1xRTT (RC3, SO32)	1013	824.70	0.912	0.628
		384	836.52	1.080	0.742
		777	848.31	1.040	0.711
Right edge	1xRTT (RC3, SO32)	1013	824.70		
		384	836.52	0.698	0.466
		777	848.31		
Bottom edge	1xRTT (RC3, SO32)	1013	824.70		
		384	836.52	0.230	0.131
		777	848.31		

Notes:

- WWAN antenna is located at bottom edge; antenna-to-top edge distance is more than 2.5 cm. Based upon Oct. 2010 TCB council workshop - FCC presentation on personal hot spot SAR evaluation guideline, when the antenna-to-edge distance is greater than 2.5, such position does not need to be tested. Top Edge with 1 cm separation distance is excluded from SAR evaluation.
- Since the power levels for 1xEVDO Rev-0 and 1xEVDO Rev-A are not higher than 1xRTT the SAR levels are equivalent.

12.1.2. PCS BAND

Left Hand Side (LHS)

Test position	Mode	UL Ch No.	f (MHz)	SAR (mW/g)	
				1-g	10-g
Touch	1xRTT (RC3, SO55)	25	1851.25	1.070	0.698
		600	1880.00	1.030	0.673
		1175	1908.75	**1.150**	0.755
Tilt (15°)	1xRTT (RC3, SO55)	25	1851.25		
		600	1880.00	0.471	0.299
		1175	1908.75		

Right Hand Side (RHS)

Test position	Mode	UL Ch No.	f (MHz)	SAR (mW/g)	
				1-g	10-g
Touch	1xRTT (RC3, SO55)	25	1851.25	0.968	0.661
		600	1880.00	0.947	0.644
		1175	1908.75	1.140	0.772
Tilt (15°)	1xRTT (RC3, SO55)	25	1851.25		
		600	1880.00	0.422	0.283
		1175	1908.75		

Notes:
- Head SAR for RC3 with the DUT configured to transmit at full rate using Loopback Service Option SO55.
- Head SAR for RC1 is not required when the maximum average output of each channel is less than 0.25 dB higher than as measured in RC3.

Body with 1.5 cm separation distance

Test position	Mode	UL Ch No.	f (MHz)	SAR (mW/g)	
				1-g	10-g
Face up	1xRTT (RC3, SO32)	25	1851.25		
		600	1880.00	0.387	0.261
		1175	1908.75		
Face down	1xRTT (RC3, SO32)	25	1851.25		
		600	1880.00	**0.388**	0.251
		1175	1908.75		
Face down (with headset)	1xRTT (RC3, SO32)	1175	1880.00	0.309	0.198

Notes:
- Based upon the power measurement in section 9.2, Body SAR for multiple code channel (FCH+SCH) is not required due to the output power is not ¼ dB higher than RC3/SO32.
- Based upon the power measurement in section 9.1.2 and 9.1.3, Body SAR for 1xEVDO Rel.0 and Rev. A power measurement is not ¼ dB higher than RC3.
- Thus, RC3/SO32 is used for all Body SAR measurement.

Body with 1.0 cm separation distance (Wireless routers incorporated in device)

Test position	Mode	UL Ch No.	f (MHz)	SAR (mW/g)	
				1-g	10-g
Front side (Face up)	1xRTT (RC3, SO32)	25	1851.25		
		600	1880.00	**0.574**	0.343
		1175	1908.75		
Back side (Face down)	1xRTT (RC3, SO32)	25	1851.25		
		600	1880.00	0.493	0.298
		1175	1908.75		
Left edge	1xRTT (RC3, SO32)	25	1851.25		
		600	1880.00	0.416	0.221
		1175	1908.75		
Right edge	1xRTT (RC3, SO32)	25	1851.25		
		600	1880.00	0.208	0.114
		1175	1908.75		
Bottom edge	1xRTT (RC3, SO32)	25	1851.25		
		600	1880.00	0.249	0.137
		1175	1908.75		

Notes:

- WWAN antenna is located at bottom edge; antenna-to-top edge distance is more than 2.5 cm. Based upon Oct. 2010 TCB council workshop - FCC presentation on personal hot spot SAR evaluation guideline, when the antenna-to-edge distance is greater than 2.5, such position does not need to be tested. Top Edge with 1 cm separation distance is excluded from SAR evaluation.
- Since the power levels for 1xEVDO Rev-0 and 1xEVDO Rev-A are not higher than 1xRTT the SAR levels are equivalent.

12.1.3. Worst-case SAR Plots for WWAN

Worst-case HEAD SAR Plot for Part 22

Date/Time: 11/1/2010 12:01:36 PM

Test Laboratory: Compliance Certification Services

Cell band_Left Hand Side

DUT: Apple; Type: N/A; Serial: N/A

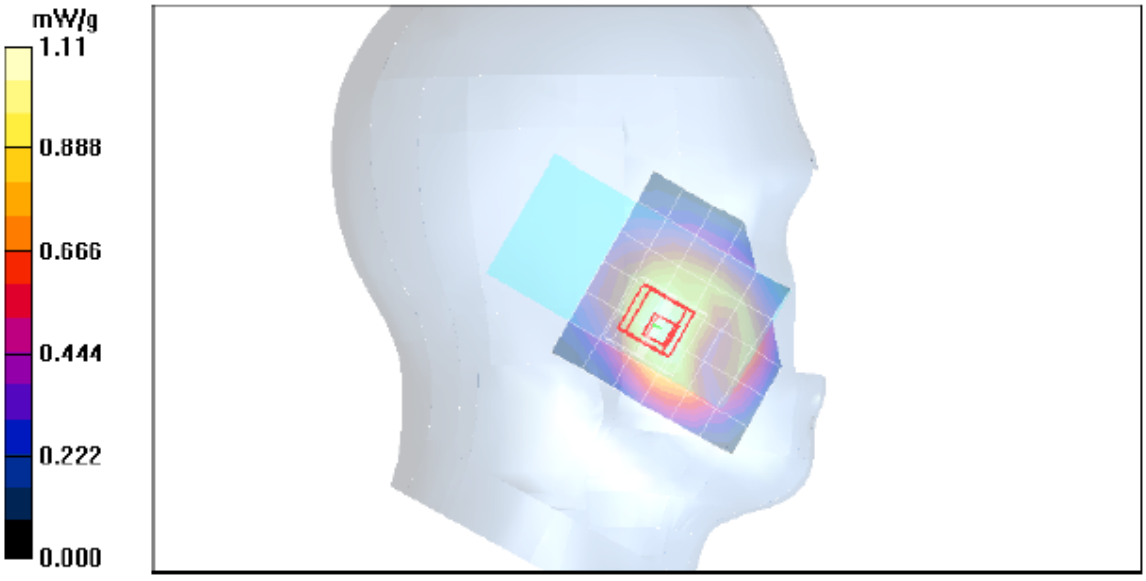
Communication System: CDMA Cell Band; Frequency: 848.31 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 848.31 MHz; σ = 0.908 mho/m; ε_r = 42.5; ρ = 1000 kg/m^3
Phantom section: Left Section

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

DASY4 Configuration:
- Area Scan setting - Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Probe: EX3DV3 - SN3531; ConvF(10.13, 10.13, 10.13); Calibrated: 2/23/2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 7/21/2010
- Phantom: SAM 2 (Twin); Type: SAM 2; Serial: 1050
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Touch_H-ch/Area Scan (7x7x1): Measurement grid: dx=15mm, dy=15mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 1.11 mW/g

Touch_H-ch/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=3mm
Reference Value = 34.7 V/m; Power Drift = -0.012 dB
Peak SAR (extrapolated) = 1.34 W/kg
SAR(1 g) = 1.06 mW/g; SAR(10 g) = 0.762 mW/g
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 1.18 mW/g



Worst-case HEAD SAR Plot for Part 22 – Z plot

Date/Time: 11/1/2010 12:23:22 PM

Test Laboratory: Compliance Certification Services

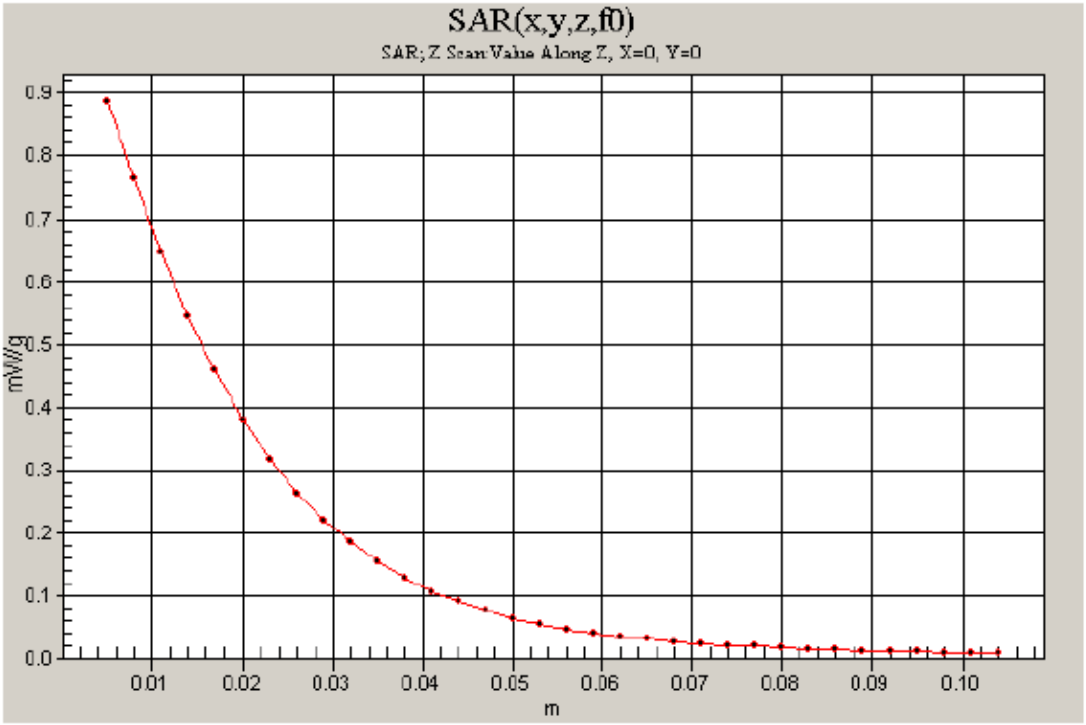
Cell band_Left Hand Side

DUT: Apple; Type: N/A; Serial: N/A

Communication System: CDMA Cell Band; Frequency: 848.31 MHz;Duty Cycle: 1:1

Touch_H-ch/Z Scan (1x1x34): Measurement grid: dx=20mm, dy=20mm, dz=3mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.886 mW/g



Worst-case BODY SAR plot for Part 22

Date/Time: 1/13/2011 7:14:07 PM

Test Laboratory: Compliance Certification Services (UL CCS)

Cell band_Body

DUT: Apple; Type: NA; Serial: NA

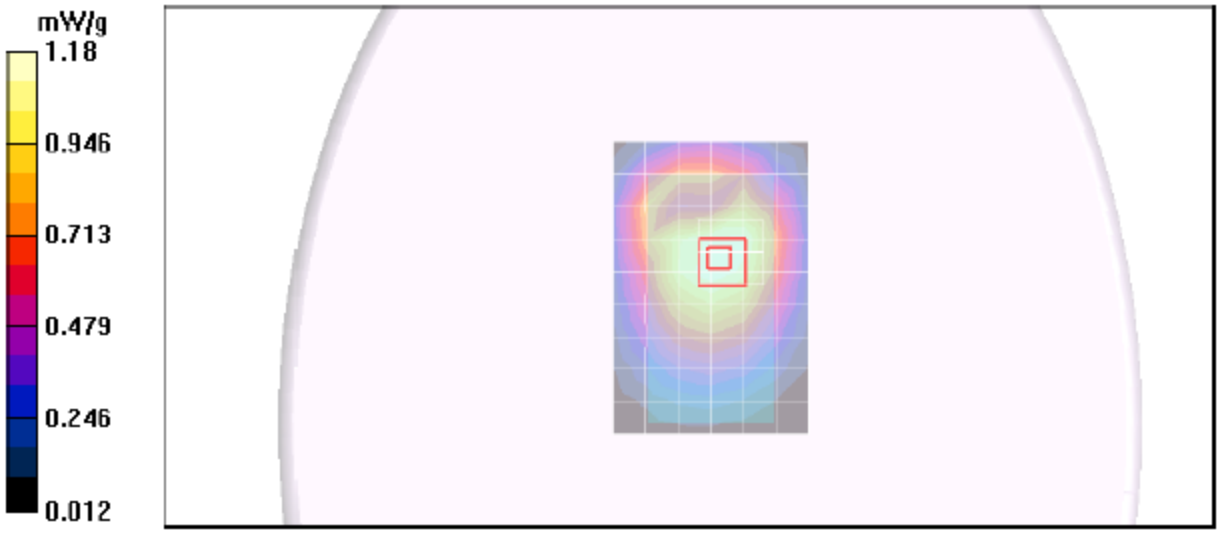
Communication System: CDMA Cell Band; Frequency: 836.52 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 836.52 MHz; σ = 0.997 mho/m; ε_r = 55; ρ = 1000 kg/m^3
Phantom section: Flat Section

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

DASY4 Configuration:
- Area Scan setting - Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Probe: EX3DV4 - SN3749; ConvF(8.79, 8.79, 8.79); Calibrated: 12/13/2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 7/21/2010
- Phantom: Flat Phantom ELI4.0; Type: QDOVA001BA; Serial: SN:1003
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Back side_M-ch/Area Scan (7x10x1): Measurement grid: dx=15mm, dy=15mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 1.18 mW/g

Back side_M-ch/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=3mm
Reference Value = 34.6 V/m; Power Drift = -0.040 dB
Peak SAR (extrapolated) = 1.48 W/kg
SAR(1 g) = 1.1 mW/g; SAR(10 g) = 0.797 mW/g
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 1.23 mW/g



Worst-case BODY SAR plot for Part 22 – Z plot

Date/Time: 1/13/2011 7:35:29 PM

Test Laboratory: Compliance Certification Services (UL CCS)

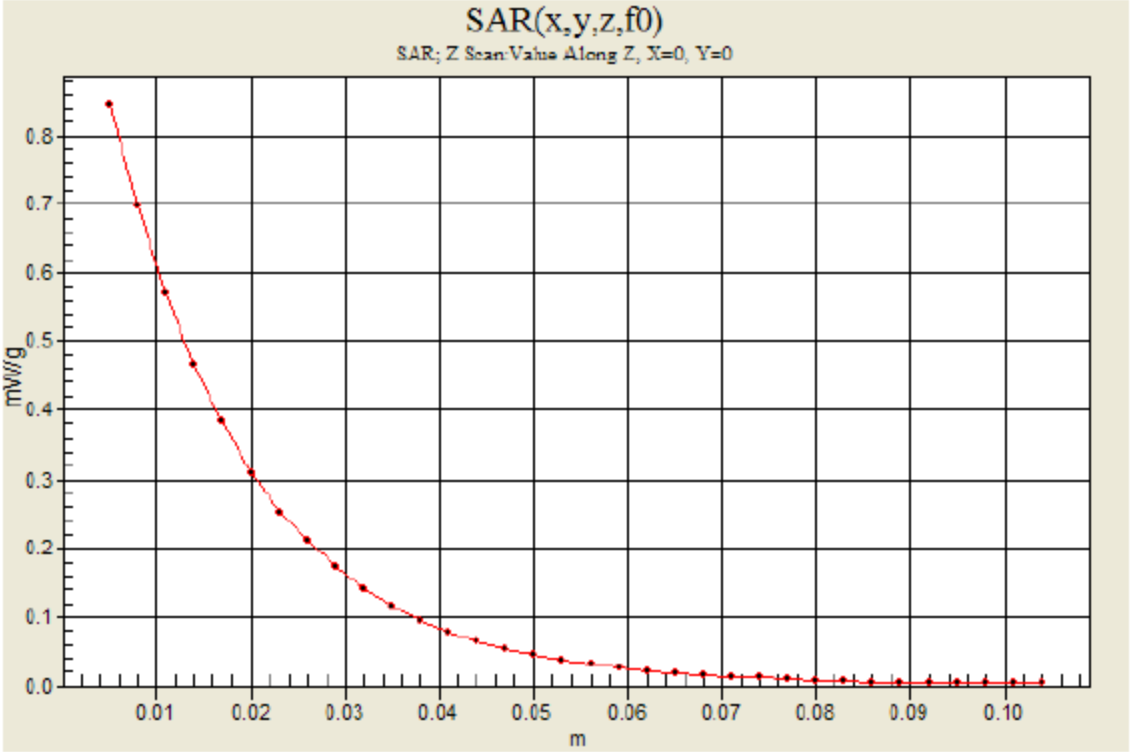
Cell band_Body

DUT: Apple; Type: NA; Serial: NA

Communication System: CDMA Cell Band; Frequency: 836.52 MHz;Duty Cycle: 1:1

Back side_M-ch/Z Scan (1x1x34): Measurement grid: dx=20mm, dy=20mm, dz=3mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.846 mW/g



Worst-case HEAD SAR Plot for Part 24

Date/Time: 10/29/2010 6:47:35 PM

Test Laboratory: Compliance Certification Services

PCS band_Left Hand Side

DUT: Apple; Type: N/A; Serial: N/A

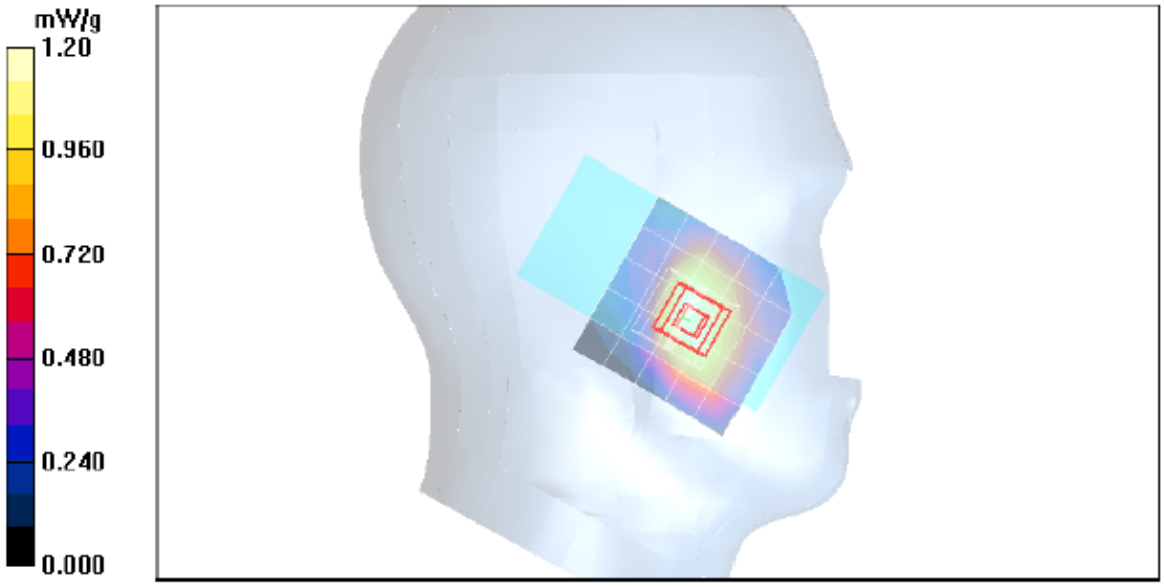
Communication System: CDMA PCS Band; Frequency: 1908.75 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 1908.75 MHz; σ = 1.43 mho/m; ε_r = 40; ρ = 1000 kg/m^3
Phantom section: Left Section

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

DASY4 Configuration:
- Area Scan setting - Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Probe: EX3DV3 - SN3531; ConvF(8.64, 8.64, 8.64); Calibrated: 2/23/2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 7/21/2010
- Phantom: SAM 2 (Twin); Type: SAM 2; Serial: 1050
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Touch_H-ch/Area Scan (6x6x1): Measurement grid: dx=15mm, dy=15mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 1.20 mW/g

Touch_H-ch/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=3mm
Reference Value = 10.3 V/m; Power Drift = 0.007 dB
Peak SAR (extrapolated) = 1.59 W/kg
SAR(1 g) = 1.15 mW/g; SAR(10 g) = 0.755 mW/g
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 1.32 mW/g



Worst-case HEAD SAR Plot for Part 24 – Z plot

Date/Time: 10/29/2010 7:08:58 PM

Test Laboratory: Compliance Certification Services

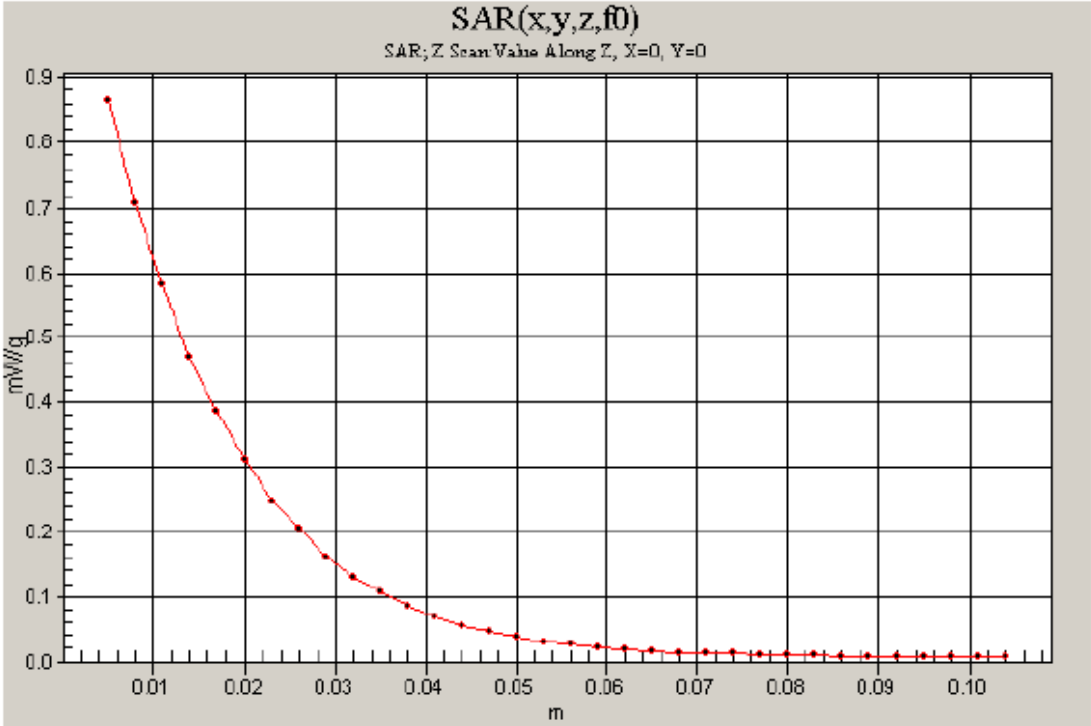
PCS band_Left Hand Side

DUT: Apple; Type: N/A; Serial: N/A

Communication System: CDMA PCS Band; Frequency: 1908.75 MHz;Duty Cycle: 1:1

Touch_H-ch/Z Scan (1x1x34): Measurement grid: dx=20mm, dy=20mm, dz=3mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.865 mW/g



Worst-case BODY SAR plot for Part 24

Date/Time: 1/13/2011 1:23:08 AM

Test Laboratory: Compliance Certification Services (UL CCS)

PCS band_Body

DUT: Apple; Type: NA; Serial: NA

Communication System: CDMA PCS Band; Frequency: 1880 MHz;Duty Cycle: 1:1
Medium parameters used: f = 1880 MHz; σ = 1.5 mho/m; ε_r = 52.1; ρ = 1000 kg/m^3
Phantom section: Flat Section

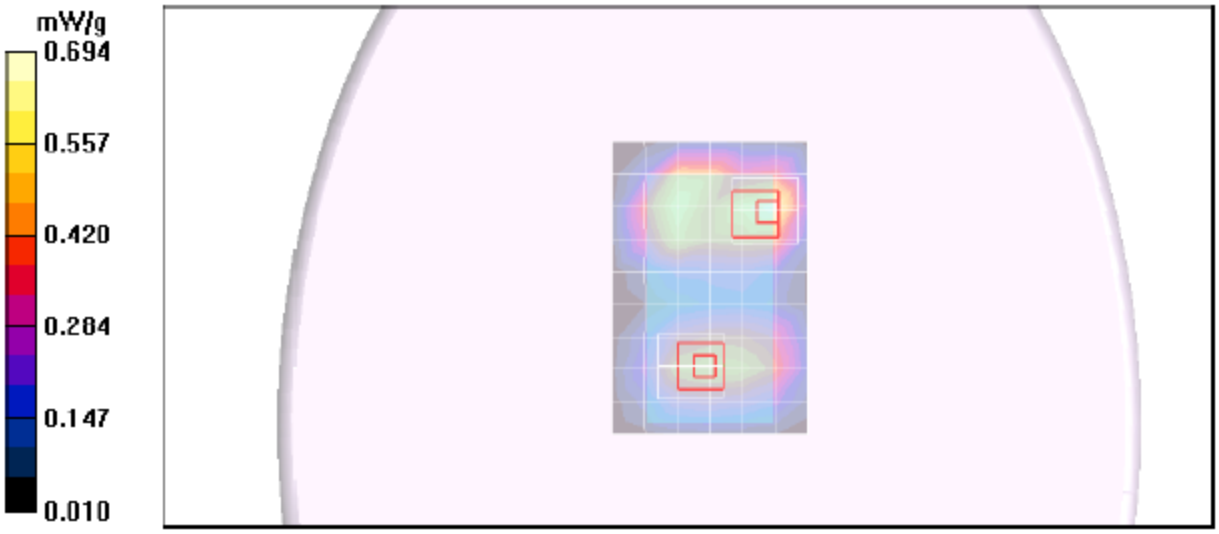
Room Ambient Temperature: 24.0 deg. C; Liquid Temperature: 23.0 deg. C

DASY4 Configuration:
- Area Scan setting - Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Probe: EX3DV4 - SN3749; ConvF(7.33, 7.33, 7.33); Calibrated: 12/13/2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 7/21/2010
- Phantom: Flat Phantom ELI4.0; Type: QDOVA001BA; Serial: SN:1003
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Front side_M-ch/Area Scan (7x10x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 0.694 mW/g

Front side_M-ch/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=3mm
Reference Value = 21.5 V/m; Power Drift = 0.104 dB
Peak SAR (extrapolated) = 1.01 W/kg
SAR(1 g) = 0.574 mW/g; SAR(10 g) = 0.343 mW/g
Maximum value of SAR (measured) = 0.696 mW/g

Front side_M-ch/Zoom Scan 2 (7x7x9)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=3mm
Reference Value = 21.5 V/m; Power Drift = 0.104 dB
Peak SAR (extrapolated) = 0.675 W/kg
SAR(1 g) = 0.450 mW/g; SAR(10 g) = 0.292 mW/g
Maximum value of SAR (measured) = 0.522 mW/g



Worst-case BODY SAR plot for Part 24 – Z plot

Date/Time: 1/13/2011 1:58:56 AM

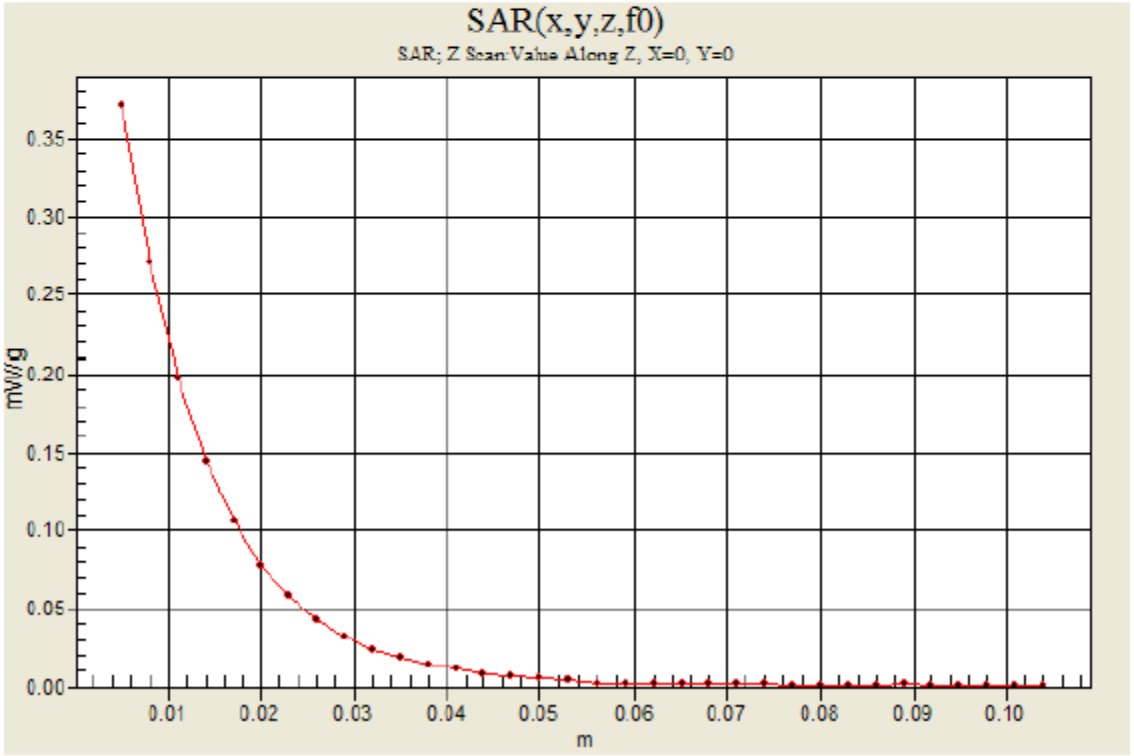
Test Laboratory: Compliance Certification Services (UL CCS)

PCS band_Body

DUT: Apple; Type: NA; Serial: NA

Communication System: CDMA PCS Band; Frequency: 1880 MHz;Duty Cycle: 1:1

Front side_M-ch/Z Scan (1x1x34): Measurement grid: dx=20mm, dy=20mm, dz=3mm
Maximum value of SAR (measured) = 0.372 mW/g



12.2. WIFI

Left Hand Side (LHS)

Band	Mode	Test position	Ch No.	Freq. (MHz)	SAR (mW/g)	
					1-g	10-g
2.4 GHz	802.11b	Touch	1	2412		
			6	2437	0.230	0.121
			11	2462		
		Tilt (15°C)	1	2412		
			6	2437	0.178	0.088
			11	2462		

Right Hand Side (RHS)

Band	Mode	Test position	Ch No.	Freq. (MHz)	SAR (mW/g)	
					1-g	10-g
2.4 GHz	802.11b	Touch	1	2412		
			6	2437	**0.538**	0.267
			11	2462		
		Tilt (15°C)	1	2412		
			6	2437	0.378	0.193
			11	2462		

Body with 1.5 cm separation distance

Band	Mode	Test position	Ch No.	Freq. (MHz)	SAR (mW/g)	
					1-g	10-g
2.4 GHz	802.11b	Face up	1	2412		
			6	2437	0.053	0.032
			11	2462		
		Face down	1	2412		
			6	2437	**0.128**	0.065
			11	2462		
		w/ headset	6	2437	0.082	0.041

Note: KDB 248227 - 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 802.11b channels

Body with 1.0 cm separation distance (Wireless routers incorporated in device)

Band	Mode	Test position	Ch No.	Freq. (MHz)	SAR (mW/g)	
					1-g	10-g
2.4 GHz	802.11b	Front side (Face up)	6	2437	0.073	0.0400
		Back side (Face down)	6	2437	**0.226**	0.0950
		Left Edge	6	2437	0.174	0.0885
		Right Edge	6	2437	0.012	0.0057
		Top Edge	6	2437	0.066	0.0286

Note:

WLAN antenna is located at top edge; antenna-to-bottom edge distance is more than 2.5 cm. Based upon Oct. 2010 TCB council workshop - FCC presentation on personal hot spot SAR evaluation guideline, when the antenna-to-edge distance is greater than 2.5, such position does not need to be tested. Bottom Edge with 1 cm separation distance is excluded from SAR evaluation.

12.3. Worst-case SAR Plots for WiFi

Worst-case HEAD SAR Plot for Part 15 C

Date/Time: 11/11/2010 11:43:20 AM

Test Laboratory: Compliance Certification Services

WiFi_Right Hand Side

DUT: Apple; Type: N/A; Serial: N/A

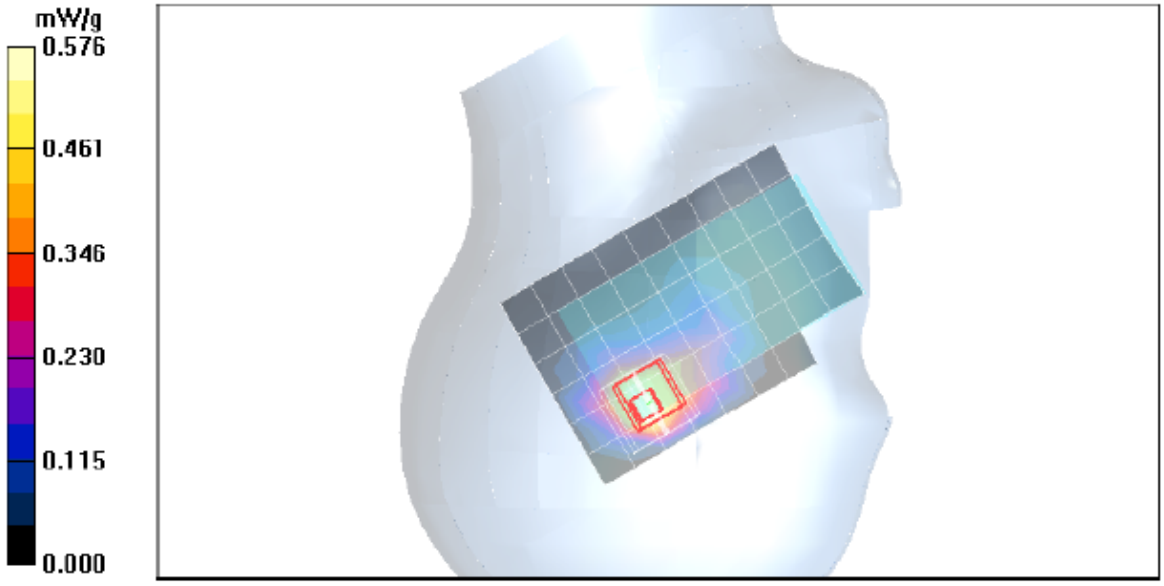
Communication System: 802.11b/g 2.4GHz; Frequency: 2437 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 2437 MHz; σ = 1.82 mho/m; ε_r = 38.7; ρ = 1000 kg/m^3
Phantom section: Right Section

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

DASY4 Configuration:
- Area Scan setting - Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Probe: EX3DV3 - SN3531; ConvF(7.6, 7.6, 7.6); Calibrated: 2/23/2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 7/21/2010
- Phantom: SAM 2 (Twin); Type: SAM 2; Serial: 1050
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Touch_M-ch/Area Scan (7x10x1): Measurement grid: dx=15mm, dy=15mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.576 mW/g

Touch_M-ch/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=3mm
Reference Value = 11.3 V/m; Power Drift = -0.130 dB
Peak SAR (extrapolated) = 1.17 W/kg
SAR(1 g) = 0.538 mW/g; SAR(10 g) = 0.267 mW/g
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.699 mW/g



Worst-case HEAD SAR Plot for Part 15 C – Z plot

Date/Time: 11/11/2010 1:51:48 PM

Test Laboratory: Compliance Certification Services

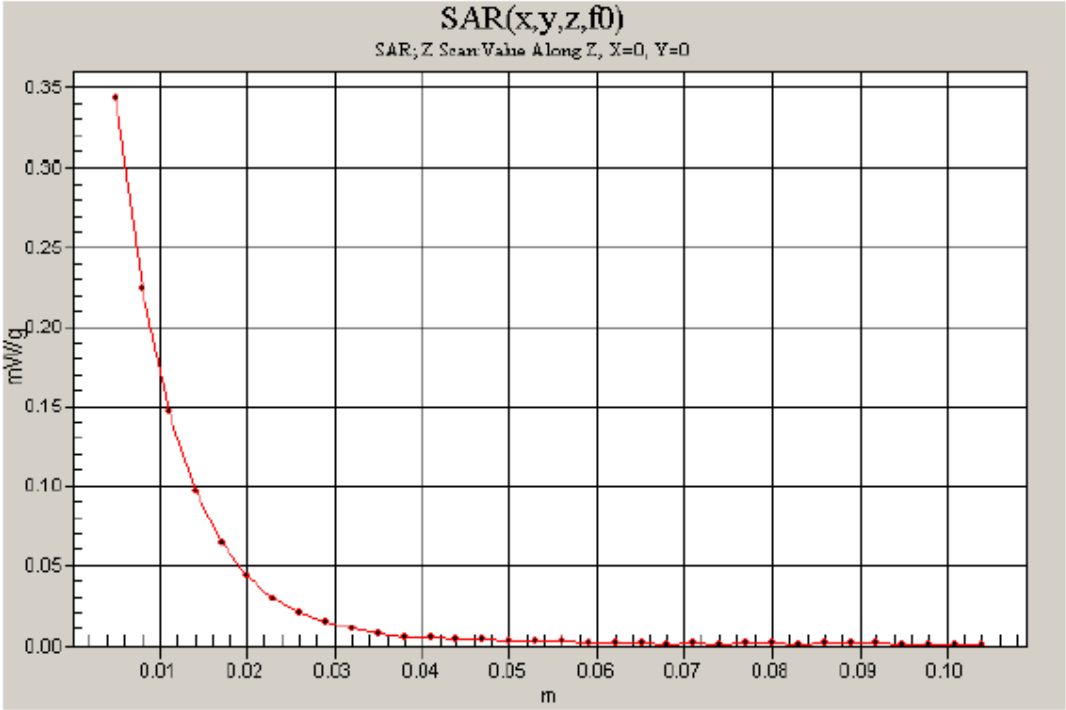
WiFi_Right Hand Side

DUT: Apple; Type: N/A; Serial: N/A

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

Touch_M-ch/Z Scan (1x1x34): Measurement grid: dx=20mm, dy=20mm, dz=3mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.343 mW/g



Worst-case BODY SAR plot for Part 15 C

Date/Time: 1/12/2011 3:48:10 PM, Date/Time: 1/12/2011 4:19:00 PM

Test Laboratory: UL CCS

WiFi_Body

DUT: Apple; Type: NA; Serial: NA

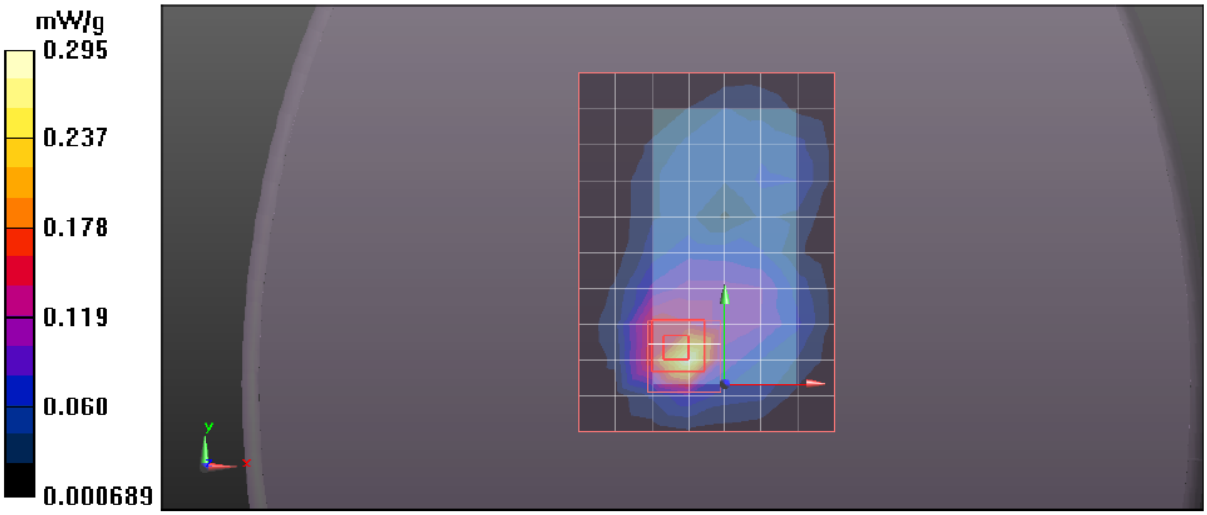
Communication System: 802.11b/g 2.4GHz; Frequency: 2437 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 2437 MHz; σ = 1.973 mho/m; ε_r = 52.051; ρ = 1000 kg/m^3
Phantom section: Flat Section

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

DASY4 Configuration:
- Area Scan setting - Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Probe: EX3DV4 - SN3721; ConvF(6.8, 6.8, 6.8); Calibrated: 6/23/2010
- Sensor-Surface: 2mm (Mechanical Surface Detection), Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1239; Calibrated: 11/17/2010
- Phantom: ELI 4.0; Type: QDOVA001BB; Serial: 1099
- Measurement SW: DASY52, Version 52.6 (1);SEMCAD X Version 14.4.2 (2595)

Configuration/Face down_M-ch/Area Scan (8x11x1): Measurement grid: dx=15mm, dy=15mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.295 mW/g

Configuration/Face down_M-ch/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 12.582 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 0.530 W/kg
SAR(1 g) = 0.226 mW/g; SAR(10 g) = 0.095 mW/g
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.258 mW/g



Worst-case BODY SAR plot for Part 15 C - Z plot

Date/Time: 1/12/2011 4:33:56 PM

Test Laboratory: UL CCS

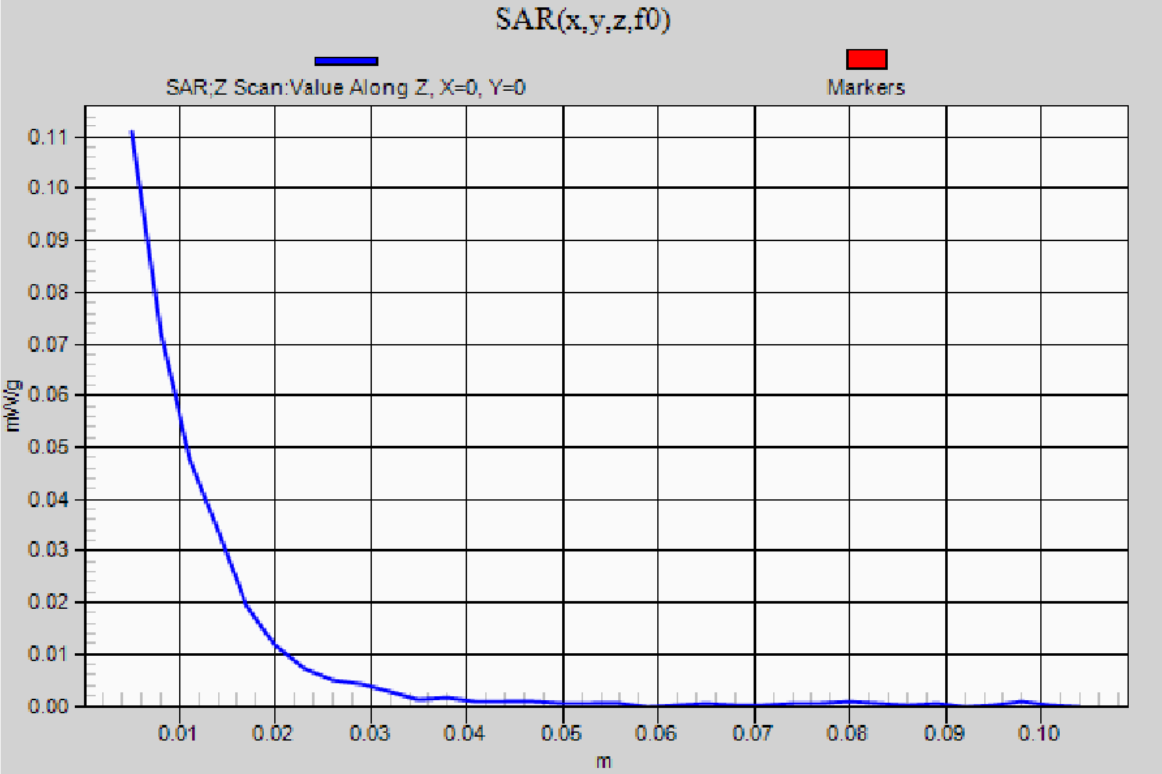
WiFi_Body

DUT: Apple; Type: NA; Serial: NA

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

Configuration/Face down_M-ch/Z Scan (1x1x34): Measurement grid: dx=20mm, dy=20mm, dz=3mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.111 mW/g



13. KDB 648474 SIMULTANEOUS TRANSMISSION CONSIDERATION

SUMMARY OF SAR EVALUATION FOR A CELL PHONE WITH MULTIPLE TRANSMITTERS

Individual Transmitter	Stand-alone SAR
WWAN	Yes
WiFi	Yes
Bluetooth	Not required (average output is < P_{Ref} / 12mW)

SIMULTANEOUS TRANSMISSION

- WWAN can transmit simultaneously with WiFi
- WWAN can transmit simultaneously with Bluetooth
- WiFi can not transmit simultaneously with Bluetooth

The sum of the stand-alone SAR and the SAR to peak location separation ratios

WWAN + WiFi (Highset 1g SAR for WWAN vs WiFi)						
Tes position	Highest 1-g SAR (W/kg)			∑ 1g SAR (W/kg)	SAR to peak location	
	WWAN		WiFi 2.4G		Separation (cm)	Ratio
Head (LHS touch)	Cell Band	1.060	0.230	1.290	n/a	n/a
	PCS Band	1.150		1.380	n/a	n/a
Body (Face Down w/ 1.5 cm)	Cell Band	0.869	0.128	0.997	n/a	n/a
	PCS Band	0.388				

WiFi + WWAN (Highset 1g SAR for WiFi vs WWAN)						
Tes position	Highest 1-g SAR (W/kg)			∑ 1g SAR (W/kg)	SAR to peak location	
	WiFi 2.4G	WWAN			Separation (cm)	Ratio
Head (RHS touch)	0.538	Cell Band	0.825	1.363	n/a	n/a
		PCS Band	1.140	**1.678**	6.18	0.272
Body (Face Down) w/ 1.5 cm	0.128	Cell Band	0.869	0.997	n/a	n/a
		PCS Band	0.388	0.516	n/a	n/a

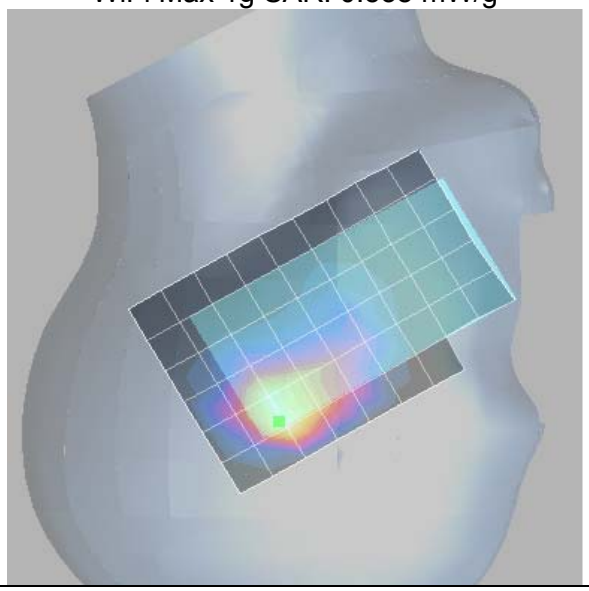
WiFi + WWAN (Highset 1g SAR for WiFi vs WWAN) - Personal Hot Spot Mode with 1.0 cm distance						
Tes position	Highest 1-g SAR (W/kg)			∑ 1g SAR (W/kg)	SAR to peak location	
	WiFi 2.4G	WWAN			Separation (cm)	Ratio
Front Side	0.073	Cell Band	1.020	1.093	n/a	n/a
		PCS Band	0.574	0.647	n/a	n/a
Back side	0.226	Cell Band	1.100	1.326	n/a	n/a
		PCS Band	0.493	0.719	n/a	n/a
Left Edge	0.174	Cell Band	1.080	1.254	n/a	n/a
		PCS Band	0.416	0.590	n/a	n/a
Right Edge	0.012	Cell Band	0.698	0.710	n/a	n/a
		PCS Band	0.208	0.220	n/a	n/a
Top Edge	0.066	Cell Band	N/A	N/A	n/a	n/a
		PCS Band	N/A	N/A	n/a	n/a
Bottom Edge	N/A	Cell Band	0.23	N/A	n/a	n/a
		PCS Band	0.249	N/A	n/a	n/a

CONCLUSIONS:

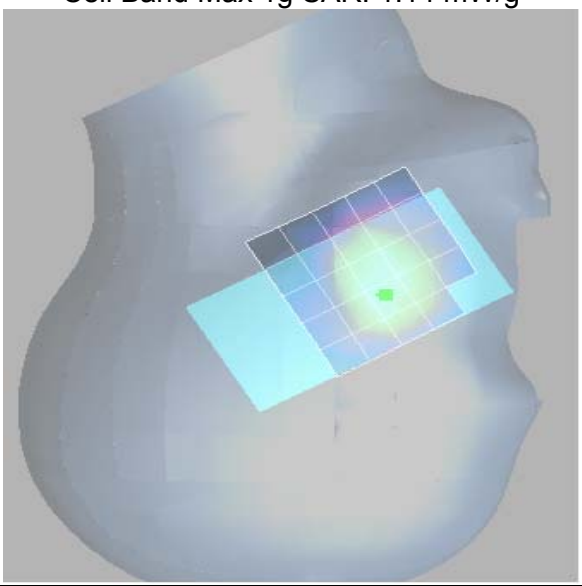
- Simultaneous transmission SAR is not required for WWAN & WiFi because the sum of the 1-g SAR is < 1.6 W/kg
- Simultaneous transmission SAR is not required for WiFi & WWAN because the SAR to peak location separation ratios is < 0.3 for WiFi and WWAN antenna pairs.

Peak SAR Separation distance between WiFi and WWAN at Head (RHS Touch) position

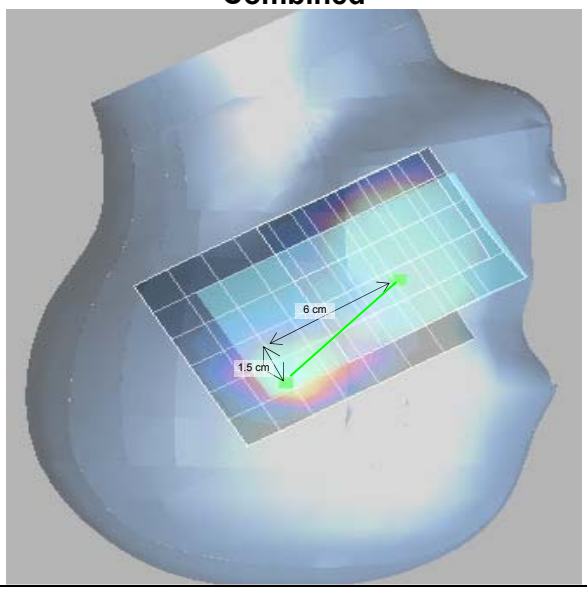
WiFi Max 1g SAR: 0.538 mW/g



Cell Band Max 1g SAR: 1.14 mW/g



Combined



The sum of the 1g SAR = 1.678 mW/g. (0.538 + 1.14)

Separation distances between peaks SAR in area scans = 6.18 cm (SQRT(6.0^2+1.5^2))

SAR to Peak location separation ratio: 0.272 (1.678 /6.18) < 0.3

14. ATTACHMENTS

No.	Contents	No. of page (s)
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1-2	SAR Test Plots for PCS band (Semco)	19
1-3	SAR Test Plots for WiFi (Semco)	15
2-1	Certificate of E-Field Probe - EX3DV3 SN 3531	11
2-2	Certificate of E-Field Probe - EX3DV4 SN 3749	11
2-3	Certificate of E-Field Probe - EX3DV4 SN 3721	11
3	Certificate of System Validation Dipole - D835V2 SN:4d002	9
4	Certificate of System Validation Dipole - D1900V2 SN:5d043	9
5	Certificate of System Validation Dipole - D2450 SN:706	9
6	Impedance and return loss plot for D835V2	4