FCC OET BULLETIN 65 SUPPLEMENT C
IC RSS-102 ISSUE 4

SAR EVALUATION REPORT

For

iPhone

MODEL: A1332B

FCC ID: BCG-E2380B
IC: 579C-E2380B

REPORT NUMBER: 10U13135-1C3

ISSUE DATE: June 17, 2010

Prepared for

APPLE INC
1 INFINITE LOOP, MS-26A
CUPERTINO, CA 95014

Prepared by

COMPLIANCE CERTIFICATION SERVICES
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NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
--	April 15, 2010	Initial Issue	--
A	June 1, 2010	Updated model designation from A1332 to A1332B	Sunny Shih
A1	June 2, 2010	Updated average power table in section 9.5 WiFi RF output power.	Sunny Shih
B	June 3, 2010	Modify section 5 by including model variation statement between Model No: A1332 and A1332A.	Sunny Shih
C	June 14, 2010	- Additional 3G SAR test with USI unit and replaced all 3G SAR data from Murata unit - Deleted model variation statement in section 5	Sunny Shih
C1	June 15, 2010	Added serial number in the section 1	Sunny Shih
C2	June 16, 2010	Update section 12 SAR-to-Peak Location Distance	Sunny Shih
C3	June 17, 2010	Revised based upon TCB comments	Sunny Shih

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME:	APPLE INC 1 INFINITE LOOP, MS-26A CUPERTINO, CA 95014
EUT DESCRIPTION:	iPhone
MODEL NUMBER:	A1332B Serial number: 88012002FRX
DEVICE CATEGORY:	Portable
EXPOSURE CATEGORY:	General Population/Uncontrolled Exposure
DATE TESTED:	April 2, 2010 (WiFi), June 9 – 14, 2010 (3G)

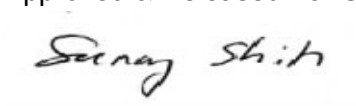
FCC / IC Rule Parts	Frequency Range [MHz]	Highest 1-g SAR (mW/g)	Limit (mW/g)
22H / RSS-132	824 - 849	Head: 0.987 (LHS Touch) Body: 1.11 (Face down)	1.6
24E / RSS-133	1850 - 1910	Head: 1.17 (LHS Touch) Body: 0.424 (Face down)	
15.247 / RSS-102	2400 – 2483.5	Head: 0.881 (LHS Tilt) Body: 0.067 (Face down)	

Applicable Standards	Test Results
FCC OET Bulletin 65 Supplement C 01-01 IC RSS 102 Issue 4	Pass

Compliance Certification Services, Inc. (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 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.

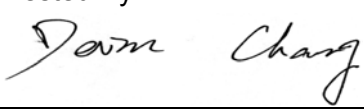
Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by CCS and all revisions are duly noted in the revisions section. Any alteration of this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



SUNNY SHIH
ENGINEERING SUPERVISOR
COMPLIANCE CERTIFICATION SERVICES

Tested By:



DEVIN CHANG
EMC ENGINEER
COMPLIANCE CERTIFICATION SERVICES

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC OET Bulletin 65 Supplement C 01-01, IC RSS 102 Issue 4 and the following specific FCC Test Procedures.

- o KDB 941225 D01 SAR test for 3G devices v02
- o KDB 941225 D03 SAR Test Reduction GSM/GPRS/EDGE vo1
- o KDB 648474 D01 SAR Handsets Multi Xmiter and Ant, v01r05
- o KDB 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.

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		
Electronic Probe kit	HP	85070C	N/A	N/A		
S-Parameter Network Analyzer	Agilent	8753ES-6	MY40001647	11	22	2010
Signal Generator	Agilent	8753ES-6	MY40001647	11	22	2010
E-Field Probe	SPEAG	EX3DV3	3531	2	22	2011
Thermometer	ERTCO	639-1S	1718	4	30	2011
Data Acquisition Electronics	SPEAG	DAE3 V1	500	9	15	2010
System Validation Dipole	SPEAG	D835V2	4d002	4	22	2011
System Validation Dipole	SPEAG	D900V2	108	11	23	2011
System Validation Dipole	SPEAG	D1800V2	294	11	24	2011
System Validation Dipole	SPEAG	D1900V2	5d043	11	23	2011
System Validation Dipole	SPEAG	D2450V2	748	4	13	2011
Amplifier	Mini-Circuits	ZVE-8G	90606	N/A		
Amplifier	Mini-Circuits	ZHL-42W	D072701-5	N/A		
Simulating Liquid	CCS	H1900	N/A	Within 24 hrs of first test		
Simulating Liquid	CCS	M1900	N/A	Within 24 hrs of first test		
Simulating Liquid	CCS	H1800	N/A	Within 24 hrs of first test		
Simulating Liquid	CCS	M1800	N/A	Within 24 hrs of first test		
Simulating Liquid	CCS	H835	N/A	Within 24 hrs of first test		
Simulating Liquid	CCS	M835	N/A	Within 24 hrs of first test		
Simulating Liquid	CCS	H900	N/A	Within 24 hrs of first test		
Simulating Liquid	CCS	M900	N/A	Within 24 hrs of first test		
Simulating Liquid	SPEAG	H2450	N/A	Within 24 hrs of first test		
Simulating Liquid	SPEAG	M2450	N/A	Within 24 hrs of first test		

Note: Per KDB 450824 D02 requirements for dipole calibration, 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 CCS)
4. Impedance is within 5Ω of calibrated measurement (test data on file in 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 @ Head 1900 MHz	3.78	Normal	1	0.64	2.42
Liquid Permittivity - deviation from target	5.00	Rectangular	1.732	0.6	1.73
Liquid Permittivity - measurement @ Head 835 MHz	3.96	Normal	1	0.6	2.38
Combined Standard Uncertainty Uc(y) =					10.67
Expanded Uncertainty U, Coverage Factor = 2, > 95 % Confidence =				21.34	%
Expanded Uncertainty U, Coverage Factor = 2, > 95 % Confidence =				1.68	dB

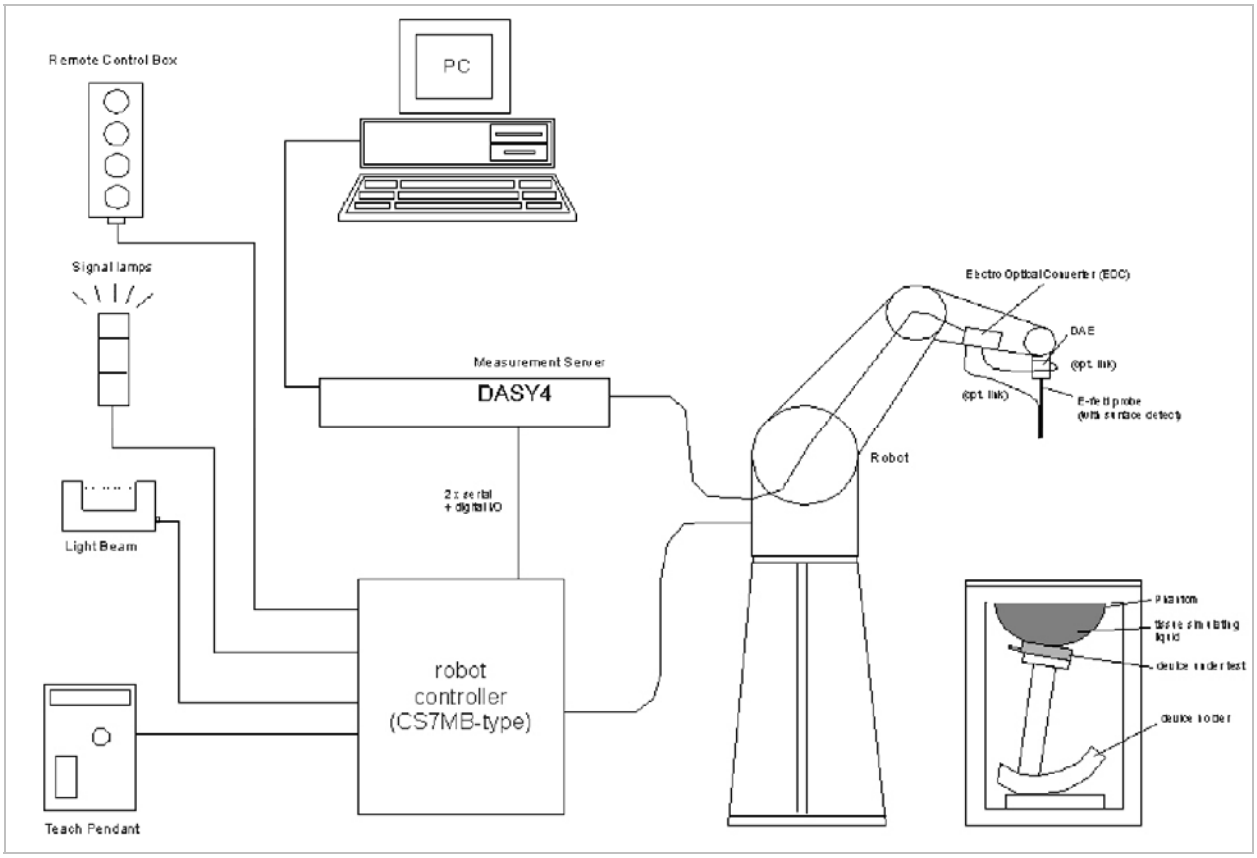
Measurement uncertainty for 300 MHz to 3 GHz averaged over 10 gram

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
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	0.43	1.24
Liquid Conductivity - measurement @ Head 1900 MHz	3.78	Normal	1	0.43	1.63
Liquid Permittivity - deviation from target	5.00	Rectangular	1.732	0.49	1.41
Liquid Permittivity - measurement @ Head 835 MHz	3.96	Normal	1	0.49	1.94
Combined Standard Uncertainty Uc(y), % =					10.29
Expanded Uncertainty U, Coverage Factor = 2, > 95 % Confidence =				20.58	%
Expanded Uncertainty U, Coverage Factor = 2, > 95 % Confidence =				1.63	dB

5. EQUIPMENT UNDER TEST

iPhone with 802.11bgn and Bluetooth radio modules. Model A1332B	
Mobile phone capability:	Class B
GPRS Multi-slot class:	Class 10
Serial Number	88012002FRX
Normal operation:	Held to head, Worn on body (LCD facing-up and LCD facing-down) with 15 mm separation distance
Body Worn Accessory	Headset
Antenna tested:	Antenna — Apple part number 3G — 817-0286 WiFi/BT — 817-0286 (shared with BT)
Antenna-to-antenna separation distances:	8.7 cm from 3G 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
Room Ambient Temperature = 24°C; Relative humidity = 40% Measured by: Sunny Shih

f (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit (%)
835	e'	43.14	Relative Permittivity (ε_r):	43.142	41.5	3.96	± 5
	e"	19.65	Conductivity (σ):	0.913	0.90	1.43	± 5

Liquid Check
Ambient temperature: 24 deg. C; Liquid temperature: 23 deg. C
June 10, 2010 07:57 AM

Frequency	e'	e"
800000000.	43.5799	19.7385
805000000.	43.5126	19.7275
810000000.	43.4502	19.7143
815000000.	43.3940	19.7032
820000000.	43.3242	19.6826
825000000.	43.2668	19.6727
830000000.	43.1997	19.6606
835000000.	**43.1415**	**19.6526**
840000000.	43.0832	19.6317
845000000.	43.0195	19.6211
850000000.	42.9653	19.6112
855000000.	42.8992	19.5989
860000000.	42.8441	19.5831
865000000.	42.7829	19.5727
870000000.	42.7211	19.5525
875000000.	42.6620	19.5429
880000000.	42.6011	19.5281
885000000.	42.5397	19.5176
890000000.	42.4834	19.4996
895000000.	42.4215	19.4881
900000000.	42.3601	19.4767
905000000.	42.3081	19.4593
910000000.	42.2515	19.4483
915000000.	42.1924	19.4402
920000000.	42.1332	19.4198
925000000.	42.0760	19.4089
930000000.	42.0201	19.3915
935000000.	41.9679	19.3799
940000000.	41.9153	19.3683
945000000.	41.8632	19.3520
950000000.	41.8153	19.3394

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
Room Ambient Temperature = 24°C; Relative humidity = 40% Measured by: Devin Chang

f (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit (%)
835	e'	55.25	Relative Permittivity (ε_r):	55.246	55.2	0.08	± 5
	e"	21.32	Conductivity (σ):	0.990	0.97	2.08	± 5

Liquid Check
Ambient temperature: 24 deg. C; Liquid temperature: 23 deg. C
June 10, 2010 04:37 PM

Frequency	e'	e"
800000000.	55.5879	21.4774
805000000.	55.5425	21.4541
810000000.	55.4844	21.4308
815000000.	55.4335	21.4117
820000000.	55.3894	21.3869
825000000.	55.3375	21.3617
830000000.	55.2915	21.3460
835000000.	**55.2459**	**21.3168**
840000000.	55.1954	21.2938
845000000.	55.1511	21.2729
850000000.	55.1052	21.2500
855000000.	55.0600	21.2245
860000000.	55.0166	21.2083
865000000.	54.9780	21.1875
870000000.	54.9318	21.1674
875000000.	54.8888	21.1527
880000000.	54.8436	21.1438
885000000.	54.7964	21.1258
890000000.	54.7410	21.1131
895000000.	54.6879	21.0942
900000000.	**54.6436**	**21.0815**
905000000.	54.5839	21.0618
910000000.	54.5420	21.0458
915000000.	54.4945	21.0238
920000000.	54.4461	21.0049
925000000.	54.3980	20.9872
930000000.	54.3569	20.9691
935000000.	54.3138	20.9519
940000000.	54.2636	20.9329
945000000.	54.2239	20.9156
950000000.	54.1864	20.9014

The conductivity (σ) can be given as:

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

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

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

Simulating Liquid Dielectric Parameters for Head 835 MHz

Room Ambient Temperature = 24°C; Relative humidity = 43% Measured by: Devin Chang

f (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit (%)
835	e'	42.49	Relative Permittivity (ϵ_r):	42.490	41.5	2.39	± 5
	e"	18.99	Conductivity (σ):	0.882	0.90	-1.99	± 5

Liquid Check
Ambient temperature: 24 deg. C; Liquid temperature: 23 deg. C
June 14, 2010 05:03 PM

Frequency	e'	e"
800000000.	42.9451	19.1833
805000000.	42.8332	19.1911
810000000.	42.7838	19.1411
815000000.	42.7138	19.1000
820000000.	42.6642	19.0970
825000000.	42.5928	19.0371
830000000.	42.5128	19.0144
835000000.	**42.4903**	**18.9893**
840000000.	42.4370	18.9771
845000000.	42.3752	18.9810
850000000.	42.3123	18.9694
855000000.	42.2796	18.9698
860000000.	42.2299	18.9654
865000000.	42.1675	18.9666
870000000.	42.1317	18.9808
875000000.	42.0600	18.9825
880000000.	42.0145	19.0248
885000000.	41.9364	19.0336
890000000.	41.8989	19.0332
895000000.	41.8547	18.9969
900000000.	41.7888	18.9898
905000000.	41.7191	18.9266
910000000.	41.6533	18.8973
915000000.	41.6127	18.8884
920000000.	41.5524	18.8501
925000000.	41.5093	18.7971
930000000.	41.4920	18.7752
935000000.	41.4302	18.7884
940000000.	41.3879	18.7667
945000000.	41.3207	18.7716
950000000.	41.2648	18.7492

The conductivity (σ) can be given as:

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

where f = target f * 10^6

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

LIQUID CHECK RESULTS FOR 1900 MHZ

Simulating Liquid Dielectric Parameters for Head 1900 MHz
Room Ambient Temperature = 24°C; Relative humidity = 35% Measured by: Devin Chang

f (MHz)	Liquid Parameters		Measured Results		Target	Delta (%)	Limit (%)
1900	e'	40.801	Relative Permittivity (ϵ_r):	40.8014	40.0	2.00	± 5
	e"	13.172	Conductivity (σ):	1.39227	1.40	-0.55	± 5

Liquid Check
Ambient temperature: 24 deg. C; Liquid temperature: 23 deg. C
June 09, 2010 04:14 PM

Frequency	e'	e"
1710000000.	41.1235	12.6057
1720000000.	41.1035	12.6188
1730000000.	41.0913	12.6307
1740000000.	41.0938	12.6451
1750000000.	41.0772	12.6575
1760000000.	41.0308	12.6626
1770000000.	40.9569	12.6709
1780000000.	40.8778	12.6835
1790000000.	40.8223	12.7006
1800000000.	40.7960	12.7168
1810000000.	40.8089	12.7450
1820000000.	40.8641	12.7877
1830000000.	40.9546	12.8566
1840000000.	41.0437	12.9414
1850000000.	41.0933	13.0249
1860000000.	41.0912	13.0844
1870000000.	41.0421	13.1187
1880000000.	40.9657	13.1332
1890000000.	40.8756	13.1461
1900000000.	**40.8014**	**13.1720**
1910000000.	40.7568	13.2295

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
Room Ambient Temperature = 24°C; Relative humidity = 40% Measured by: Devin Chang

f (MHz)	Muscle Liquid Parameters			Measured	Target	Delta (%)	Limit (%)
1900	e'	53.374	Relative Permittivity (ϵ_r):	53.3737	53.3	0.14	± 5
	e"	13.996	Conductivity (σ):	1.47938	1.52	-2.67	± 5

Liquid Check
Ambient temperature: 24 deg. C; Liquid temperature: 23 deg. C
June 09, 2010 04:20 PM

Frequency	e'	e"
1710000000.	53.5188	13.3843
1720000000.	53.5145	13.4003
1730000000.	53.5152	13.4128
1740000000.	53.5220	13.4290
1750000000.	53.5077	13.4393
1760000000.	53.4590	13.4429
1770000000.	53.3830	13.4494
1780000000.	53.3074	13.4597
1790000000.	53.2616	13.4730
1800000000.	53.2507	13.4909
1810000000.	53.2850	13.5218
1820000000.	53.3618	13.5681
1830000000.	53.4738	13.6415
1840000000.	53.5771	13.7341
1850000000.	53.6286	13.8157
1860000000.	53.6251	13.8740
1870000000.	53.5781	13.9122
1880000000.	53.5055	13.9294
1890000000.	53.4297	13.9541
1900000000.	**53.3737**	**13.9961**
1910000000.	53.3527	14.0711

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
Room Ambient Temperature = 24°C; Relative humidity = 45% Measured by: Devin Chang

f (MHz)	Muscle Liquid Parameters			Measured	Target	Delta (%)	Limit (%)
1900	e'	53.191	Relative Permittivity (ϵ_r):	53.1913	53.3	-0.20	± 5
	e"	13.877	Conductivity (σ):	1.46677	1.52	-3.50	± 5

Liquid Check
Ambient temperature: 23 deg. C; Liquid temperature: 22 deg. C
June 11, 2010 06:18 AM

Frequency	e'	e"
1710000000.	53.7733	13.1882
1720000000.	53.7613	13.2201
1730000000.	53.7435	13.2454
1740000000.	53.7172	13.2909
1750000000.	53.7030	13.3370
1760000000.	53.6784	13.3788
1770000000.	53.6431	13.4447
1780000000.	53.6068	13.4820
1790000000.	53.5747	13.5228
1800000000.	53.5400	13.5567
1810000000.	53.4840	13.5987
1820000000.	53.4427	13.6211
1830000000.	53.4066	13.6617
1840000000.	53.3736	13.6913
1850000000.	53.3560	13.7239
1860000000.	53.3029	13.7579
1870000000.	53.2797	13.7855
1880000000.	53.2505	13.8072
1890000000.	53.2198	13.8449
1900000000.	**53.1913**	**13.8768**
1910000000.	53.1468	13.9018

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

Room Ambient Temperature = 24°C; Relative humidity = 42% Measured by: Devin Chang

f (MHz)	Liquid Parameters		Measured Results		Target	Delta (%)	Limit (%)
1900	e'	41.506	Relative Permittivity (ϵ_r):	41.5059	40.0	3.76	± 5
	e"	12.744	Conductivity (σ):	1.34705	1.40	-3.78	± 5

Liquid Check
Ambient temperature: 24 deg. C; Liquid temperature: 23 deg. C
June 13, 2010 03:20 PM

Frequency	e'	e"
1710000000.	42.3505	11.9780
1720000000.	42.3058	11.9988
1730000000.	42.2593	12.0159
1740000000.	42.2164	12.0653
1750000000.	42.1779	12.1110
1760000000.	42.1257	12.1706
1770000000.	42.0824	12.2309
1780000000.	42.0273	12.2799
1790000000.	41.9944	12.3226
1800000000.	41.9613	12.3719
1810000000.	41.9339	12.3926
1820000000.	41.8669	12.4184
1830000000.	41.8478	12.4495
1840000000.	41.8007	12.4743
1850000000.	41.7318	12.5190
1860000000.	41.6688	12.5703
1870000000.	41.6113	12.6080
1880000000.	41.5766	12.6377
1890000000.	41.5306	12.6915
1900000000.	**41.5059**	**12.7442**
1910000000.	41.4704	12.7679

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

Room Ambient Temperature = 24°C; Relative humidity = 43% Measured by: Devin Chang

f (MHz)	Muscle Liquid Parameters			Measured	Target	Delta (%)	Limit (%)
1900	e'	53.428	Relative Permittivity (ϵ_r):	53.4284	53.3	0.24	± 5
	e"	13.967	Conductivity (σ):	1.47634	1.52	-2.87	± 5

Liquid Check
Ambient temperature: 24 deg. C; Liquid temperature: 23 deg. C
June 14, 2010 08:26 PM

Frequency	e'	e"
1710000000.	53.9357	13.3457
1720000000.	53.9297	13.3925
1730000000.	53.9022	13.4616
1740000000.	53.8753	13.4996
1750000000.	53.8574	13.5187
1760000000.	53.8614	13.5086
1770000000.	53.8512	13.5431
1780000000.	53.8038	13.5631
1790000000.	53.7686	13.5953
1800000000.	53.7302	13.6455
1810000000.	53.6809	13.7251
1820000000.	53.6148	13.7907
1830000000.	53.5579	13.8771
1840000000.	53.5103	13.8790
1850000000.	53.5161	13.8849
1860000000.	53.5339	13.8944
1870000000.	53.5442	13.9241
1880000000.	53.5124	13.9321
1890000000.	53.4696	13.9501
1900000000.	**53.4284**	**13.9673**
1910000000.	53.3778	14.0089

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 2450 MHZ

Simulating Liquid Dielectric Parameters for Head 2450 MHz
Room Ambient Temperature = 25°C; Relative humidity = 40% Measured by: Devin Chang

f (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit (%)
2450	e'	39.76	Relative Permittivity (ε_r):	39.756	39.2	1.42	± 5
	e"	13.19	Conductivity (σ):	1.797	1.80	-0.16	± 5

Liquid Check
Ambient temperature: 25 deg. C; Liquid temperature: 24 deg. C
April 02, 2010 02:06 PM

Frequency	e'	e"
2400000000.	39.8777	12.9447
2405000000.	39.8551	12.9906
2410000000.	39.8216	13.0484
2415000000.	39.7894	13.0711
2420000000.	39.7613	13.1008
2425000000.	39.7529	13.1068
2430000000.	39.7500	13.1210
2435000000.	39.7506	13.1242
2440000000.	39.7499	13.1417
2445000000.	39.7560	13.1684
2450000000.	**39.7556**	**13.1858**
2455000000.	39.7195	13.2037
2460000000.	39.6928	13.1839
2465000000.	39.6497	13.1566
2470000000.	39.6364	13.1373
2475000000.	39.6130	13.1108
2480000000.	39.6116	13.0997
2485000000.	39.6152	13.0879
2490000000.	39.6265	13.1117
2495000000.	39.6104	13.1621
2500000000.	39.5867	13.2111

The conductivity (σ) can be given as:

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

where f = target f * 10^6

ε_0 = 8.854 * 10^{-12}

Simulating Liquid Dielectric Parameters for Body 2450 MHz
Room Ambient Temperature = 25°C; Relative humidity = 40% Measured by: Devin Chang

f (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit (%)
2450	e'	52.90	Relative Permittivity (ϵ_r):	52.901	52.7	0.38	± 5
	e"	14.30	Conductivity (σ):	1.949	1.95	-0.03	± 5

Liquid Check
Ambient temperature: 25 deg. C; Liquid temperature: 24 deg. C
April 02, 2010 02:01 PM

Frequency	e'	e"
2400000000.	53.0014	14.0434
2405000000.	52.9818	14.1003
2410000000.	52.9627	14.1618
2415000000.	52.9226	14.1641
2420000000.	52.9110	14.1984
2425000000.	52.9009	14.2126
2430000000.	52.8963	14.2197
2435000000.	52.8955	14.2349
2440000000.	52.9158	14.2379
2445000000.	52.9057	14.2830
2450000000.	**52.9013**	**14.3027**
2455000000.	52.8668	14.3193
2460000000.	52.8630	14.2934
2465000000.	52.8189	14.2786
2470000000.	52.8047	14.2572
2475000000.	52.7793	14.2360
2480000000.	52.7867	14.2296
2485000000.	52.7952	14.2438
2490000000.	52.7963	14.2774
2495000000.	52.7908	14.3285
2500000000.	52.7693	14.4046

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. due date	SAR Avg (mW/g)		
			Tissue:	Head	Body
D835V2	D835V2-5d043_Nov09	04/22/11	SAR_{1g}:	9.64	9.96
			SAR_{10g}:	6.28	6.56
D1900V2	D1900V2-4d002_Apr09	11/23/11	SAR_{1g}:	39.8	40.4
			SAR_{10g}:	20.7	21.4
D2450V2	D2450V2-748_Apr08	04/13/11	SAR_{1g}:		50.8
			SAR_{10g}:		23.7

8.1. SYSTEM CHECK RESULTS FOR D835V2

Ambient Temperature = 24C; Relative humidity = 40% Measured by: Sunny Shih

System validation dipole	Date Tested	Measured (Normalized to 1 W)		Target	Delta (%)	Tolerance (%)
		Tissue:	Head			
D835V2	06/10/10	SAR_{1g}:	9.68	9.64	0.41	±10
		SAR_{10g}:	6.34	6.28	0.96	

Ambient Temperature = 24C; Relative humidity = 43% Measured by: Devin Chang

System validation dipole	Date Tested	Measured (Normalized to 1 W)		Target	Delta (%)	Tolerance (%)
		Tissue:	Head			
D835V2	06/14/10	SAR_{1g}:	9.21	9.64	-4.46	±10
		SAR_{10g}:	6.05	6.28	-3.66	

8.2. SYSTEM CHECK RESULTS FOR D1900V2

Ambient Temperature = 24C; Relative humidity = 35% Measured by: Devin Chang

System validation dipole	Date Tested	Measured (Normalized to 1 W)		Target	Delta (%)	Tolerance (%)
		Tissue:	Head			
D1900V2	06/09/10	SAR_{1g}:	40.6	39.8	2.01	±10
		SAR_{10g}:	21.2	20.7	2.42	

Ambient Temperature = 24C; Relative humidity = 45% Measured by: Devin Chang

System validation dipole	Date Tested	Measured (Normalized to 1 W)		Target	Delta (%)	Tolerance (%)
		Tissue:	Body			
D1900V2	06/11/10	SAR_{1g}:	39.7	40.4	-1.73	±10
		SAR_{10g}:	21.1	21.4	-1.40	

Ambient Temperature = 24C; Relative humidity = 42% Measured by: Devin Chang

System validation dipole	Date Tested	Measured (Normalized to 1 W)		Target	Delta (%)	Tolerance (%)
		Tissue:	Head			
D1900V2	06/13/10	SAR_{1g}:	38.1	39.8	-4.27	±10
		SAR_{10g}:	20.1	20.7	-2.90	

Ambient Temperature = 24C; Relative humidity = 43% Measured by: Devin Chang

System validation dipole	Date Tested	Measured (Normalized to 1 W)		Target	Delta (%)	Tolerance (%)
		Tissue:	Body			
D1900V2	06/14/10	SAR_{1g}:	38.3	40.4	-5.20	±10
		SAR_{10g}:	20.3	21.4	-5.14	

8.3. SYSTEM CHECK RESULTS FOR D2450V2

Ambient Temperature = 25°C; Relative humidity = 40% Measured by: Devin Chang

System validation dipole	Date Tested	Measured (Normalized to 1 W)		Target	Delta (%)	Tolerance (%)
		Tissue:	Body			
D2450V2	04/02/10	SAR_{1g}:	51.8	50.8	1.97	±10
		SAR_{10g}:	24.1	23.7	1.69	

9. OUTPUT POWER VERIFICATION

9.1. GSM

GSM (GMSK)

Band	Ch No.	f (MHz)	Avg burst Pwr (dBm)
GSM850	128	824.2	32.4
	190	836.6	32.5
	251	848.8	32.4
GSM1900	512	1850.2	30.3
	661	1880	30.4
	810	1909.8	30.4

GPRS (GMSK) - Coding Scheme: CS1

Band	Ch No.	f (MHz)	Avg burst Pwr (dBm)			
			1 slot	Frame Avg Pwr	2 slot	Frame Avg Pwr
GSM850	128	824.2	32.3	23.3	31.5	25.5
	190	836.6	32.4	23.4	31.5	25.5
	251	848.8	32.4	23.4	31.5	25.5
GSM1900	512	1850.2	30.4	21.4	28.6	22.6
	661	1880	30.5	21.5	28.8	22.8
	810	1909.8	30.4	21.4	28.7	22.7

EGPRS (8PSK) - Coding Scheme: MCS5

Band	Ch No.	f (MHz)	Avg burst Pwr (dBm)			
			1 slot	Frame Avg Pwr	2 slot	Frame Avg Pwr
GSM850	128	824.2	27.1	18.1	27.0	21.0
	190	836.6	27.2	18.2	27.0	21.0
	251	848.8	27.2	18.2	27.1	21.1
GSM1900	512	1850.2	26.0	20.0	26.2	20.2
	661	1880	26.1	20.1	26.1	20.1
	810	1909.8	26.2	20.2	26.2	20.2

9.2. UMTS RELEASE 99

The following tests were completed according to the test requirements outlined in section 5.2 of the 3GPP TS34.121-1 specification. The EUT supports power Class 3, which has a nominal maximum output power of 24 dBm (+1.7/-3.7).

	Mode	Rel99
	Subtest	-
WCDMA General Settings	Loopback Mode	Test Mode 1
	Rel99 RMC	12.2kbps RMC
	Power Control Algorithm	Algorithm2
	βc/βd	8/15

Results

Rel 99 (12.2kbps RMC)

Band	Mode	UL Ch No.	DL Ch No.	f (MHz)	Avg Tx Pwr (dBm)
UMTS850 (Band V)	Rel 99 12.2kbps RMC	4132	4357	826.4	23.7
		4183	4408	836.6	23.4
		4233	4458	846.6	23.6
UMTS1900 (Band II)	Rel 99 12.2kbps RMC	9262	9662	1852.4	22.8
		9400	9800	1880.0	22.9
		9538	9938	1907.6	22.8

9.3. UMTS HSDPA

The following 4 Sub-tests were completed according to Release 6 procedures in section 5.2 of 3GPP TS34.121. A summary of these settings are illustrated below:

	Mode	Rel6 HSDPA	Rel6 HSDPA	Rel6 HSDPA	Rel6 HSDPA
	Subtest	1	2	3	4
WCDMA General Settings	Loopback Mode	Test Mode 1			
	Rel99 RMC	12.2kbps RMC			
	HSDPA FRC	H-Set1			
	Power Control Algorithm	Algorithm 2			
	βc	2/15	12/15	15/15	15/15
	βd	15/15	15/15	8/15	4/15
	Bd (SF)	64			
	βc/βd	2/15	12/15	15/8	15/4
	βhs	4/15	24/15	30/15	30/15
	CM (dB)	0	1	1.5	1.5
HSDPA Specific Settings	D_{ACK}	8			
	D_{NAK}	8			
	DCQI	8			
	Ack-Nack repetition factor	3			
	CQI Feedback (Table 5.2B.4)	4ms			
	CQI Repetition Factor (Table 5.2B.4)	2			
	Ahs =βhs/βc	30/15			

Results

Rel 6 HSDPA

Band	Mode	UL Ch No.	DL Ch No.	f (MHz)	Avg Tx Pwr (dBm)
UMTS850 (Band V)	Subtest 1	4132	4357	826.4	23.66
		4183	4408	836.6	23.43
		4233	4458	846.6	23.64
	Subtest 2	4132	4357	826.4	22.57
		4183	4408	836.6	22.32
		4233	4458	846.6	22.52
	Subtest 3	4132	4357	826.4	22.31
		4183	4408	836.0	22.23
		4233	4458	846.6	22.25
	Subtest 4	4132	4357	826.4	22.18
		4183	4408	836.4	22.06
		4233	4458	846.6	22.14
UMTS1900 (Band II)	Subtest 1	9262	9662	1852.4	22.83
		9400	9800	1880.0	22.82
		9538	9938	1907.6	22.81
	Subtest 2	9262	9662	1852.4	21.83
		9400	9800	1880.0	21.78
		9538	9938	1907.6	21.75
	Subtest 3	9262	9662	1852.4	21.43
		9400	9800	1880.0	21.41
		9538	9938	1907.6	21.50
	Subtest 4	9262	9662	1852.4	21.48
		9400	9800	1880.0	21.46
		9538	9938	1907.6	21.51

Note: KDB 941225 D01 – Body SAR is not required for HSDPA when the maximum average output of each RF channel with HSDPA active is less than ¼ dB higher than that measured without HSDPA using 12.2 kbps RMC or the maximum SAR for 12.2 kbps RMC is < 75% of the SAR limit.

9.4. UMTS Rel 6 HSPA (HSDPA & HSUPA)

The following 5 Sub-tests were completed according to Release 6 procedures in section 5.2 of 3GPP TS34.121. A summary of these settings are illustrated below:

	Mode	Rel6 HSPA	Rel6 HSPA	Rel6 HSPA	Rel6 HSPA	Rel6 HSPA
	Subtest	1	2	3	4	5
WCDMA General Settings	Loopback Mode	Test Mode 1				
	Rel99 RMC	12.2kbps RMC				
	HSDPA FRC	H-Set1				
	HSUPA Test	HSUPA Loopback				
	Power Control Algorithm	Algorithm2				
	βc	11/15	6/15	15/15	2/15	15/15
	βd	15/15	15/15	9/15	15/15	15/15
	βec	209/225	12/15	30/15	2/15	24/15
	βc/βd	11/15	6/15	15/9	2/15	15/15
	βhs	22/15	12/15	30/15	4/15	30/15
	βed	1309/225	94/75	47/15 47/15	56/75	134/15
	CM (dB)	1.0	3.0	2.0	3.0	1.0
	MPR (dB)	0	2	1	2	0
HSDPA Specific Settings	DACK	8				
	DNAK	8				
	DCQI	8				
	Ack-Nack repetition factor	3				
	CQI Feedback (Table 5.2B.4)	4ms				
	CQI Repetition Factor (Table 5.2B.4)	2				
	Ahs = βhs/βc	30/15				
HSUPA Specific Settings	D E-DPCCH	6	8	8	5	7
	DHARQ	0	0	0	0	0
	AG Index	20	12	15	17	21
	ETFCI (from 34.121 Table C.11.1.3)	75	67	92	71	81
	Associated Max UL Data Rate kbps	242.1	174.9	482.8	205.8	308.9
	Reference E_TFCIs	E-TFCI 11 E-TFCI PO 4 E-TFCI 67 E-TFCI PO 18 E-TFCI 71 E-TFCI PO 23 E-TFCI 75 E-TFCI PO 26 E-TFCI 81 E-TFCI PO 27		E-TFCI 11 E-TFCI PO 4 E-TFCI 92 E-TFCI PO 18	E-TFCI 11 E-TFCI PO 4 E-TFCI 67 E-TFCI PO 18 E-TFCI 71 E-TFCI PO 23 E-TFCI 75 E-TFCI PO 26 E-TFCI 81 E-TFCI PO 27	

Results

Rel 6 HSDPA/HSUPA

Band	Mode	UL Ch No.	DL Ch No.	f (MHz)	Avg Tx Pwr (dBm)
UMTS850 (Band V)	Subtest 1	4132	4357	826.4	23.67
		4182	4407	836.4	23.43
		4233	4458	846.6	23.61
	Subtest 2	4132	4357	826.4	21.91
		4182	4407	836.4	21.85
		4233	4458	846.6	21.87
	Subtest 3	4132	4357	826.4	22.76
		4182	4407	836.4	22.62
		4233	4458	846.6	22.75
	Subtest 4	4132	4357	826.4	21.88
		4182	4407	836.4	21.78
		4233	4458	846.6	21.76
	Subtest 5	4132	4357	826.4	23.67
		4182	4407	836.4	23.58
		4233	4458	846.6	23.41
UMTS1900 (Band II)	Subtest 1	9262	9662	1852.4	22.82
		9400	9800	1880.0	22.83
		9538	9938	1907.6	22.82
	Subtest 2	9262	9662	1852.4	21.22
		9400	9800	1880.0	21.20
		9538	9938	1907.6	21.15
	Subtest 3	9262	9662	1852.4	21.98
		9400	9800	1880.0	21.95
		9538	9938	1907.6	21.89
	Subtest 4	9262	9662	1852.4	21.11
		9400	9800	1880.0	21.00
		9538	9938	1907.6	21.05
	Subtest 5	9262	9662	1852.4	22.80
		9400	9800	1880.0	22.78
		9538	9938	1907.6	22.71

Note: KDB 941225 D01 – Body SAR is not required for handsets with HSPA capabilities when the maximum average output of each RF channel with HSUPA/HSDPA active is less than ¼ dB higher than that measured without HSUPA/HSDPA using 12.2 kbps RMC and the maximum SAR for 12.2kbps RMC is ≤ 75% of the SAR limit.

9.5. WIFI RF OUTPUT POWER

USI unit

802.11b

Channel #	Freq. (MHz)	Avg Power (dBm)
Low	2412	16.5
Middle	2437	16.6
High	2462	16.5
802.11g		
Low	2412	13.1
Middle	2437	16.5
High	2462	14.1
802.11n HT20		
Low	2412	13.1
Middle	2437	16.5
High	2462	14.0

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.

10. SUMMARY OF TEST RESULTS

10.1. GSM850

Left Hand Side

Band	Mode	Test position	Ch No.	Freq. (MHz)	SAR (mW/g)	
					1-g	10-g
GSM850	GSM	Touch	128	824.2	0.792	0.572
			190	836.6	0.954	0.689
			251	848.8	0.965	0.714
		Tilt (15°C)	128	824.2		
			190	836.6	0.380	0.290
			251	848.8		

Right Hand Side

Band	Mode	Test position	Ch No.	Freq. (MHz)	SAR (mW/g)	
					1-g	10-g
GSM850	GSM	Touch	128	824.2		
			190	836.6	0.714	0.494
			251	848.8		
		Tilt (15°C)	128	824.2		
			190	836.6	0.429	0.325
			251	848.8		

Body with 1.5 cm separation distance

Band	Mode	Test position	Ch No.	Freq. (MHz)	SAR (mW/g)	
					1-g	10-g
GSM850	GSM	Face up	190	836.6	0.728	0.533
		Face down	128	824.2	0.757	0.549
			190	836.6	0.847	0.616
			251	848.8	0.854	0.624
		w/ headset	251	848.8	0.696	0.498
	GPRS 1 slots	Face up	190	836.6	0.692	0.508
		Face down	190	836.6	0.677	0.500
	GPRS 2 slots	Face up	128	824.2	0.985	0.723
			190	836.6	1.090	0.800
			251	848.8	1.080	0.804
		Face down	128	824.2	1.050	0.764
			190	836.6	**1.110**	0.813
			251	848.8	1.090	0.800
		w/ headset	190	836.6	1.060	0.788
	EGPRS 1 slots	Face up	190	836.6	0.195	0.142
		Face down	190	836.6	0.215	0.156
	EGPRS 2 slots	Face up	190	836.6	0.382	0.283
		Face down	190	836.6	0.425	0.311
		w/ headset	190	836.6	0.305	0.214

10.2. GSM1900

Left Hand Side

Band	Mode	Test position	Ch No.	Freq. (MHz)	SAR (mW/g)	
					1-g	10-g
GSM1900	GSM	Touch	512	1850.2		
			661	1880.0	**0.776**	0.509
			810	1909.8		
		Tilt (15°C)	512	1850.2		
			661	1880.0	0.286	0.187
			810	1909.8		

Right Hand Side

Band	Mode	Test position	Ch No.	Freq. (MHz)	SAR (mW/g)	
					1-g	10-g
GSM1900	GSM	Touch	512	1850.2		
			661	1880.0	0.755	0.496
			810	1909.8		
		Tilt (15°C)	512	1850.2		
			661	1880.0	0.373	0.227
			810	1909.8		

Body with 1.5 cm separation distance

Band	Mode	Test position	Ch No.	Freq. (MHz)	SAR (mW/g)	
					1-g	10-g
GSM1900	GSM	Face up	661	1880.0	0.277	0.180
		w/ headset	661	1880.0	0.285	0.189
		Face down	661	1880.0	0.230	0.154
	GPRS 1 slots	Face up	661	1880.0	0.255	0.168
		Face down	661	1880.0	0.269	0.178
	GPRS 2 slots	Face up	661	1880.0	0.339	0.222
		Face down	661	1880.0	**0.367**	0.243
		w/ headset	661	1880.0	0.268	0.177
	EGPRS 1 slots	Face up	661	1880.0	0.097	0.060
		Face down	661	1880.0	0.101	0.066
	EGPRS 2 slots	Face up	661	1880.0	0.189	0.122
		Face down	661	1880.0	0.194	0.128
		w/ headset	661	1880.0	0.147	0.097

10.3. UMTS BAND V

Left Hand Side

Band	Mode	Test position	UL Ch No.	DL Ch No.	f (MHz)	SAR (mW/g)	
						1-g	10-g
Band V	R99 12.2kbps RMC	Touch	4132	4357	826.4	0.918	0.661
			4183	4408	836.6	0.973	0.720
			4233	4458	846.6	**0.987**	0.731
		Tilt (15°C)	4132	4357	826.4		
			4183	4408	836.6	0.447	0.340
			4233	4458	846.6		

Right Hand Side

Band	Mode	Test position	UL Ch No.	DL Ch No.	f (MHz)	SAR (mW/g)	
						1-g	10-g
Band V	R99 12.2kbps RMC	Touch	4132	4357	826.4	0.674	0.507
			4183	4408	836.6	0.833	0.625
			4233	4458	846.6	0.850	0.639
		Tilt (15°C)	4132	4357	826.4		
			4183	4408	836.6	0.481	0.363
			4233	4458	846.6		

Body with 1.5 cm separation distance

Band	Mode	Test position	UL Ch No.	DL Ch No.	f (MHz)	SAR (mW/g)	
						1-g	10-g
Band V	R99 12.2kbps RMC	Face up	4132	4357	826.4		
			4183	4408	836.6	0.765	0.564
			4233	4458	846.6		
		Face down	4132	4357	826.4		
			4183	4408	836.6	0.753	0.553
			4233	4458	846.6		
		w/ headset	4233	4458	846.6	0.634	0.446

Notes:

1) KDB 941225 D01 – Body SAR is not required for HSDPA when the maximum average output of each RF channel with HSDPA active is less than ¼ dB higher than that measured without HSDPA using 12.2 kbps RMC or the maximum SAR for 12.2 kbps RMC is < 75% of the SAR limit.
2) KDB 941225 D01 – Body SAR is not required for handsets with HSPA capabilities when the maximum average output of each RF channel with HSUPA/HSDPA active is less than ¼ dB higher than that measured without HSUPA/HSDPA using 12.2 kbps RMC and the maximum SAR for 12.2kbps RMC is ≤ 75% of the SAR limit.

10.4. UMTS BAND II

Left Hand Side

Band	Mode	Test position	UL Ch No.	DL Ch No.	f (MHz)	SAR (mW/g)	
						1-g	10-g
Band II	R99 12.2kbps RMC	Touch	9262	9662	1850.2	**1.170**	0.770
			9400	9800	1880.0	1.150	0.750
			9538	9938	1907.6	1.150	0.749
		Tilt (15°C)	9262	9662	1850.2		
			9400	9800	1880.0	0.418	0.263
			9538	9938	1907.6		

Right Hand Side

Band	Mode	Test position	UL Ch No.	DL Ch No.	f (MHz)	SAR (mW/g)	
						1-g	10-g
Band II	R99 12.2kbps RMC	Touch	9262	9662	1850.2	1.140	0.784
			9400	9800	1880.0	1.090	0.741
			9538	9938	1907.6	1.140	0.770
		Tilt (15°C)	9262	9662	1850.2		
			9400	9800	1880.0	0.531	0.322
			9538	9938	1907.6		

Body with 1.5 cm separation distance

Band	Mode	Test position	UL Ch No.	DL Ch No.	f (MHz)	SAR (mW/g)	
						1-g	10-g
Band II	R99 12.2kbps RMC	Face up	9262	9662	1850.2		
			9400	9800	1880.0	0.405	0.266
			9538	9938	1907.6		
		Face down	9262	9662	1850.2		
			9400	9800	1880.0	**0.424**	0.281
			9538	9938	1907.6		
		w/ headset	9400	9800	1880.0	0.342	0.215

Notes:

1) KDB 941225 D01 – Body SAR is not required for HSDPA when the maximum average output of each RF channel with HSDPA active is less than ¼ dB higher than that measured without HSDPA using 12.2 kbps RMC or the maximum SAR for 12.2 kbps RMC is < 75% of the SAR limit.
2) KDB 941225 D01 – Body SAR is not required for handsets with HSPA capabilities when the maximum average output of each RF channel with HSUPA/HSDPA active is less than ¼ dB higher than that measured without HSUPA/HSDPA using 12.2 kbps RMC and the maximum SAR for 12.2kbps RMC is ≤ 75% of the SAR limit.

10.5. WIFI

USI unit

Left Hand Side

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	0.695	0.305
			11	2462		
		Tilt (15°C)	1	2412	0.701	0.306
			6	2437	0.852	0.368
			11	2462	**0.881**	0.375

Right Hand Side

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	0.554	0.248
			11	2462		
		Tilt (15°C)	1	2412		
			6	2437	0.733	0.321
			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	0.051	0.028
			11	2462		
		Face down	1	2412		
			6	2437	0.065	0.036
			11	2462		
		w/ headset	6	2437	**0.067**	0.037

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. WORST-CASE SAR TEST PLOTS

Worst-case HEAD SAR Plot for Part 22

Date/Time: 6/14/2010 7:40:38 PM

Test Laboratory: Compliance Certification Services

UMTS band V_Left Hand Side

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

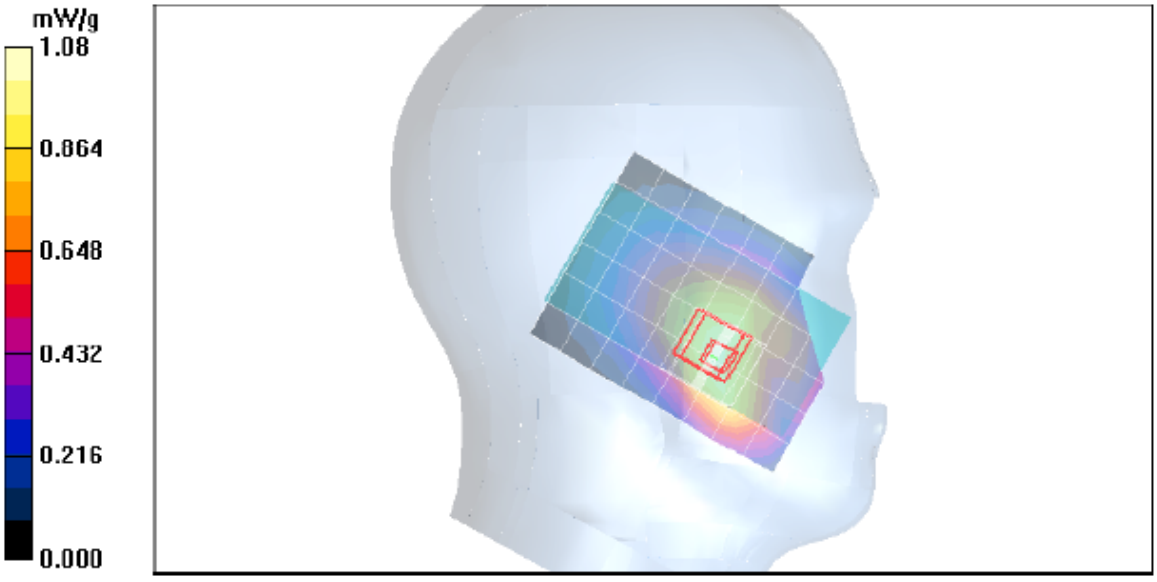
Communication System: UMTS850; Frequency: 846.6 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 846.6 MHz; σ = 0.894 mho/m; ε_r = 42.4; ρ = 1000 kg/m^3
Phantom section: Left Section

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 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

Touch_H-ch/Area Scan (7x9x1): Measurement grid: dx=15mm, dy=15mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 1.08 mW/g

Touch_H-ch/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=3mm
Reference Value = 35.0 V/m; Power Drift = 0.005 dB
Peak SAR (extrapolated) = 1.24 W/kg
SAR(1 g) = 0.987 mW/g; SAR(10 g) = 0.731 mW/g
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 1.09 mW/g



Worst-case HEAD SAR Plot for Part 24

Date/Time: 6/13/2010 6:06:15 PM

Test Laboratory: Compliance Certification Services

UMTS band II_Left Hand Side

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

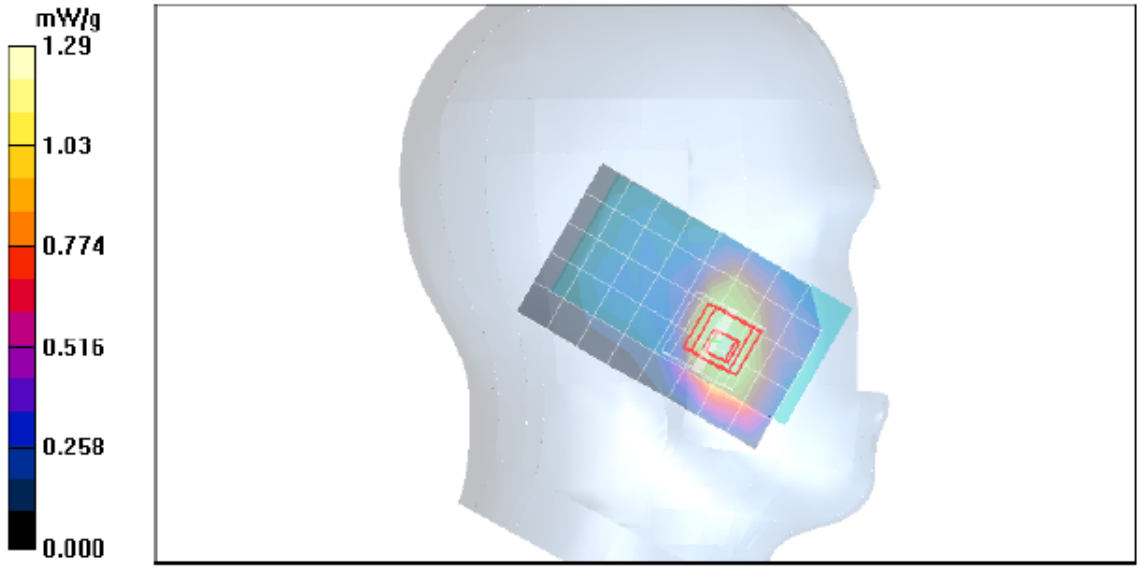
Communication System: PCS 1900; Frequency: 1852.4 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 1852.4 MHz; σ = 1.29 mho/m; ε_r = 41.7; ρ = 1000 kg/m^3
Phantom section: Left Section

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 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

Touch_L-ch/Area Scan (6x9x1): Measurement grid: dx=15mm, dy=15mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 1.29 mW/g

Touch_L-ch/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=3mm
Reference Value = 31.7 V/m; Power Drift = -0.031 dB
Peak SAR (extrapolated) = 1.61 W/kg
SAR(1 g) = 1.17 mW/g; SAR(10 g) = 0.770 mW/g
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 1.34 mW/g



Worst-case HEAD SAR Plot for Part 15 C

Date/Time: 4/2/2010 11:23:50 PM

Test Laboratory: Compliance Certification Services

USI_WiFi_Left Hand Side

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

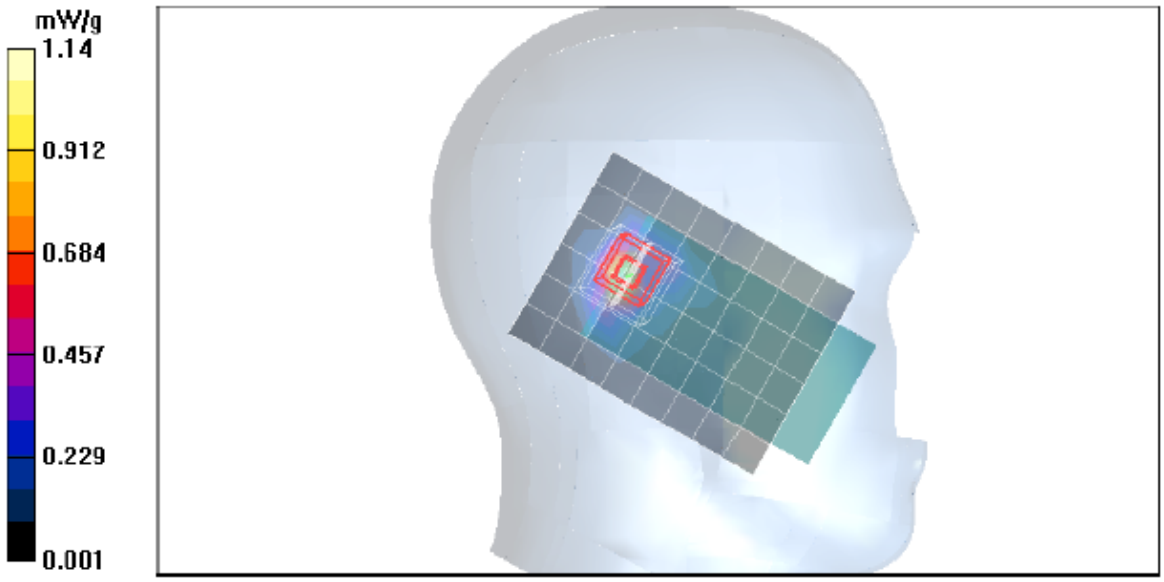
Communication System: 802.11b; Frequency: 2462 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 2462 MHz; σ = 1.86 mho/m; ε_r = 38.8; ρ = 1000 kg/m^3
Phantom section: Left Section

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: 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

Tilt_H-ch/Area Scan (7x9x1): Measurement grid: dx=15mm, dy=15mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 1.14 mW/g

Tilt_H-ch/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=3mm
Reference Value = 16.2 V/m; Power Drift = -0.132 dB
Peak SAR (extrapolated) = 1.90 W/kg
SAR(1 g) = 0.881 mW/g; SAR(10 g) = 0.375 mW/g
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 1.20 mW/g



Worst-case BODY SAR plot for Part 22

Date/Time: 6/11/2010 12:14:30 AM

Test Laboratory: Compliance Certification Services

GPRS850_Body

DUT: Apple; Type: NA; Serial: NA

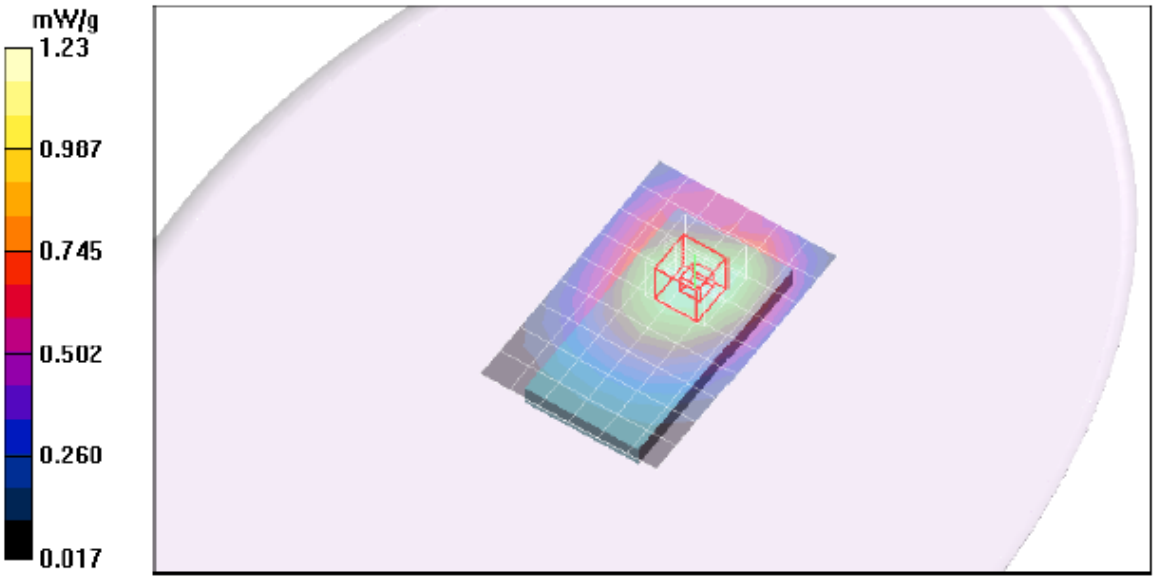
Communication System: GSM850; Frequency: 836.6 MHz;Duty Cycle: 1:4
Medium parameters used (interpolated): f = 836.6 MHz; σ = 0.992 mho/m; ε_r = 55.2; ρ = 1000 kg/m^3
Phantom section: Flat Section

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(10.18, 10.18, 10.18); Calibrated: 2/23/2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn500; Calibrated: 9/15/2009
- Phantom: Flat Phantom ELI4.0; Type: QDOVA001BA; Serial: SN:1003
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Face down_GPRS 2 slots M-ch/Area Scan (7x10x1): Measurement grid: dx=15mm, dy=15mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 1.23 mW/g

Face down_GPRS 2 slots M-ch/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=3mm
Reference Value = 35.2 V/m; Power Drift = -0.087 dB
Peak SAR (extrapolated) = 1.44 W/kg
SAR(1 g) = 1.11 mW/g; SAR(10 g) = 0.813 mW/g
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 1.24 mW/g



Worst-case BODY SAR plot for Part 24

Date/Time: 6/14/2010 10:16:18 PM

Test Laboratory: Compliance Certification Services

UMTS band II_Body

DUT: Apple; Type: NA; Serial: NA

Communication System: PCS 1900; Frequency: 1880 MHz;Duty Cycle: 1:1
Medium parameters used: f = 1880 MHz; σ = 1.46 mho/m; ε_r = 53.5; ρ = 1000 kg/m^3
Phantom section: Flat Section

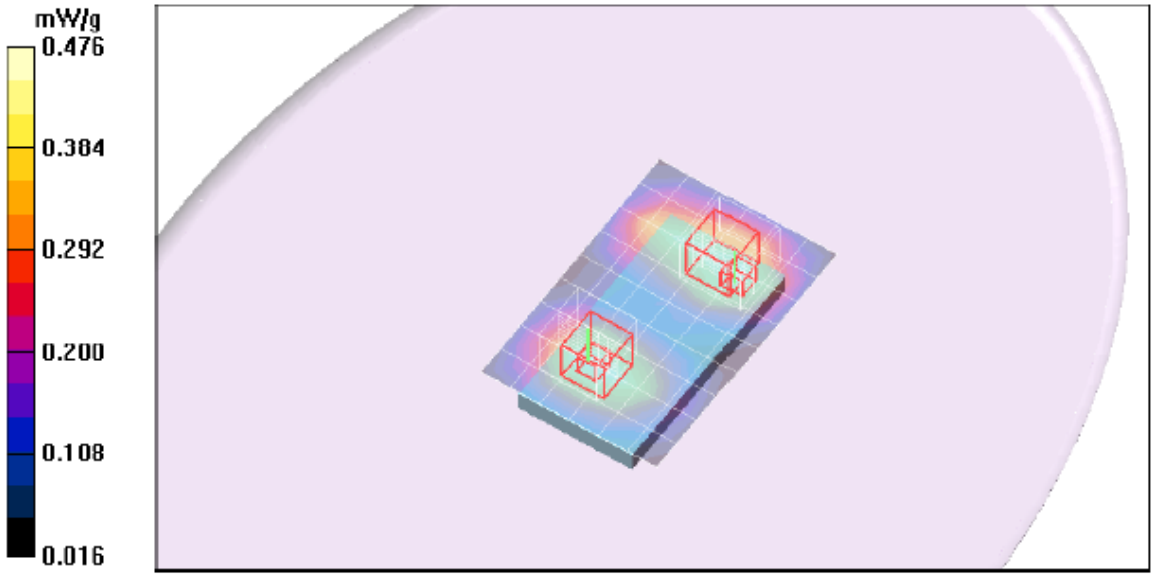
Room Ambient Temperature: 24.0 deg. C; Liquid Temperature: 23.0 deg. C

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(8.04, 8.04, 8.04); Calibrated: 2/23/2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn500; Calibrated: 9/15/2009
- Phantom: Flat Phantom ELI4.0; Type: QDOVA001BA; Serial: SN:1003
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Face down_M-ch/Area Scan (7x10x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 0.476 mW/g

Face down_M-ch/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=3mm
Reference Value = 11.4 V/m; Power Drift = 0.003 dB
Peak SAR (extrapolated) = 0.613 W/kg
SAR(1 g) = 0.424 mW/g; SAR(10 g) = 0.281 mW/g
Maximum value of SAR (measured) = 0.488 mW/g

Face down_M-ch/Zoom Scan (7x7x9)/Cube 1: Measurement grid: dx=5mm, dy=5mm, dz=3mm
Reference Value = 11.4 V/m; Power Drift = 0.003 dB
Peak SAR (extrapolated) = 0.648 W/kg
SAR(1 g) = 0.415 mW/g; SAR(10 g) = 0.267 mW/g
Maximum value of SAR (measured) = 0.491 mW/g



Worst-case BODY SAR plot for Part 15 C

Date/Time: 4/2/2010 9:04:13 PM

Test Laboratory: Compliance Certification Services

USI_WiFi_Body

DUT: Apple; Type: NA; Serial: NA

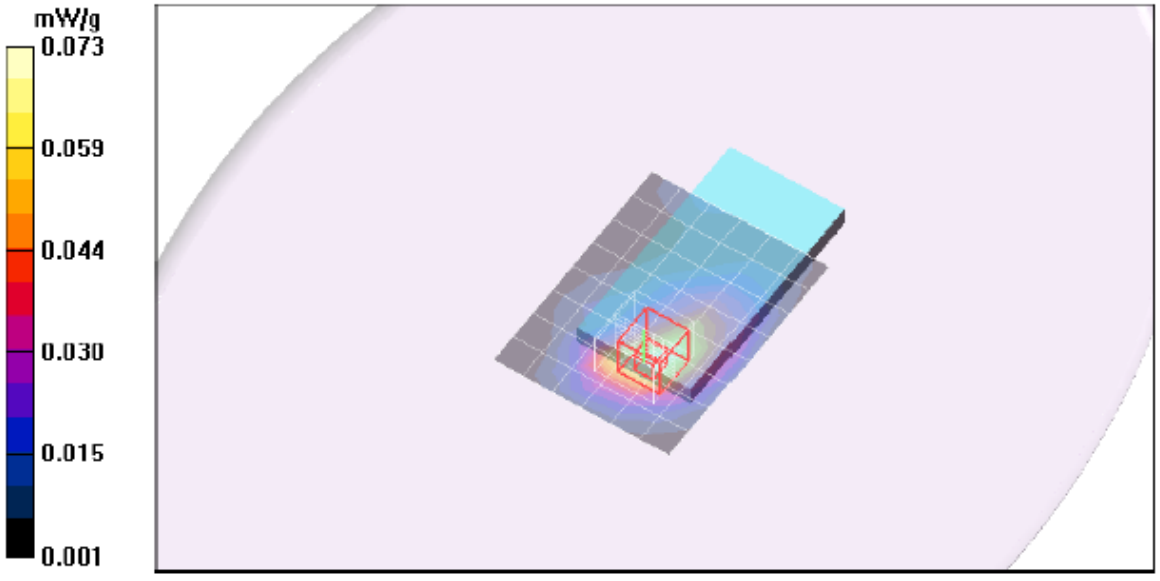
Communication System: 802.11b; Frequency: 2437 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 2437 MHz; σ = 1.93 mho/m; ε_r = 52.9; ρ = 1000 kg/m^3
Phantom section: Flat Section

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

DASY4 Configuration:
- Area Scan setting - Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Probe: EX3DV3 - SN3531; ConvF(7.58, 7.58, 7.58); Calibrated: 2/23/2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn500; Calibrated: 9/15/2009
- Phantom: Flat Phantom ELI4.0; Type: QDOVA001BA; Serial: SN:1003
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Face down_M-ch w/headset/Area Scan (7x9x1): Measurement grid: dx=15mm, dy=15mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.073 mW/g

Face down_M-ch w/headset/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=3mm
Reference Value = 5.19 V/m; Power Drift = -0.181 dB
Peak SAR (extrapolated) = 0.119 W/kg
SAR(1 g) = 0.067 mW/g; SAR(10 g) = 0.037 mW/g
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.083 mW/g



12. KDB 648474 SIMULTANEOUS TRANSMISSION CONSIDERATION

SUMMARY OF SAR EVALUATION FOR A CELL PHONE WITH MULTIPLE TRANSMITTERS

Individual Transmitter	Stand-alone SAR
3G	Yes
WiFi	Yes
Bluetooth	Not required (average output is < P_{Ref} / 12mW)

SIMULTANEOUS TRANSMISSION

- 3G can transmit simultaneously with WiFi
- 3G can transmit simultaneously with Bluetooth
- WiFi can not transmit simultaneously with Bluetooth

Highest SAR value and the sum of the 1-g SAR for 3G & WiFi

Tes position	Highest 1-g SAR (W/kg)			∑ 1-g SAR (W/kg)
	3G		WiFi	
Head (LHS Touch)	UMTS850	0.987	0.695	**1.682**
	UMTS1900	1.17		**1.865**
Body (Face down)	GPRS850 2 slots	1.11	0.067	1.177
	UMTS1900	0.424		0.424

Antenna Pair SAR to Peak Location Separation Ratio if ∑ 1-g SAR > 1.6 W/kg

∑ 1-g SAR (W/kg)	Separation distance of peak location (cm) (3G-to-WiFi antenna)	Antenna Pair SAR to Peak Location Separation Ratio (∑ 1-g SAR / Antenna separation distance)
1.682	7.15	0.24
1.865	6.96	0.27

Highest SAR value and the sum of the 1-g SAR for WiFi & 3G

Tes position	Highest 1-g SAR (W/kg)			∑ 1-g SAR (W/kg)
	WiFi	3G		
Head (LHS Tilt)	0.881	UMTS850	0.481	1.362
		UMTS1900	0.531	1.412
Body (Face down)	0.067	GPRS850 2 slots	1.110	1.177
		UMTS1900	0.424	0.491

CONCLUSION:

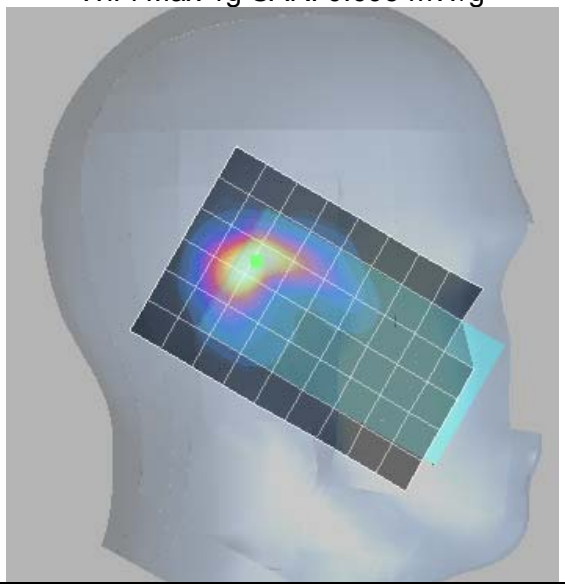
Simultaneous transmission	Simultaneous SAR
3G & Bluetooth	No (Stand-alone SAR not required for Bluetooth)
WiFi & Bluetooth	No (Stand-alone SAR not required for Bluetooth)
3G & WiFi	No (see note below)

Note: SAR not required:

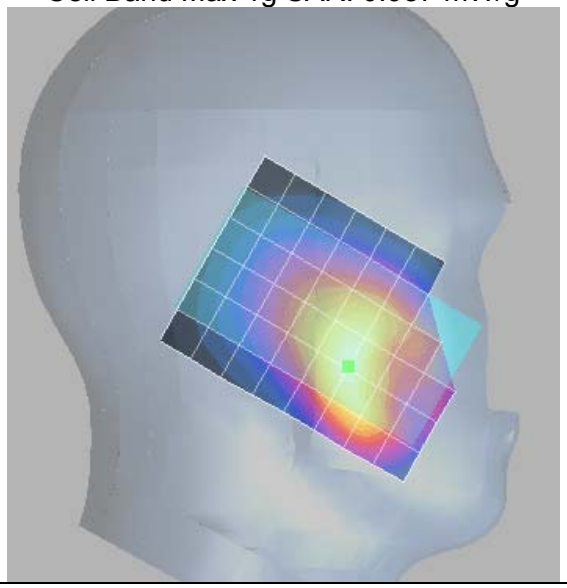
- o when the sum of the 1-g SAR is < 1.6 W/kg for 3G and WiFi
- o when the sum of the 1-g SAR is greater than 1.6 W/kg but SAR to peak location separation ratio of simultaneous transmitting antenna pair is < 0.3.

Separation distances between Peaks SAR in area scans for Head (LHS Touch) position

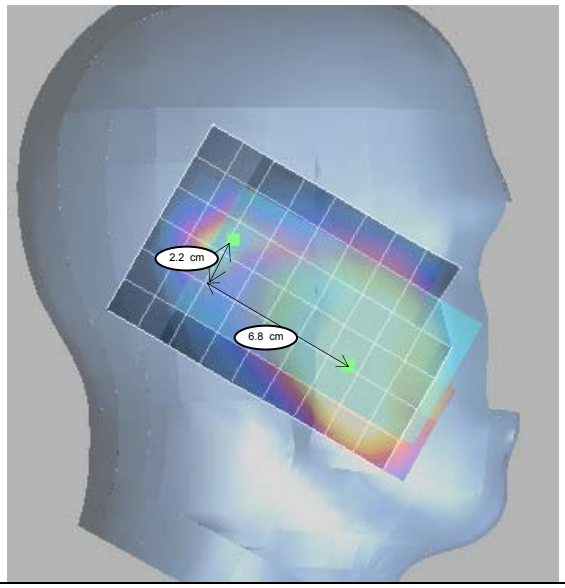
WiFi Max 1g SAR: 0.695 mW/g



Cell Band Max 1g SAR: 0.987 mW/g



Combined



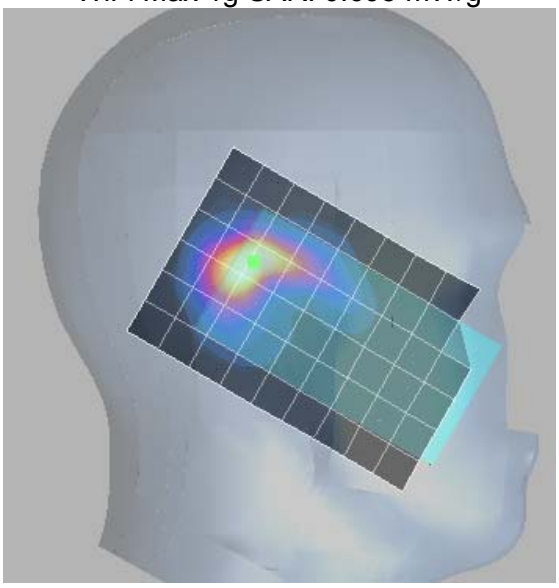
The sum of the 1g SAR = 1.682 mW/g. (0.695 + 0.987)

Separation distances between peaks SAR in area scans = 7.15 cm (SQRT(6.8^2+2.2^2))

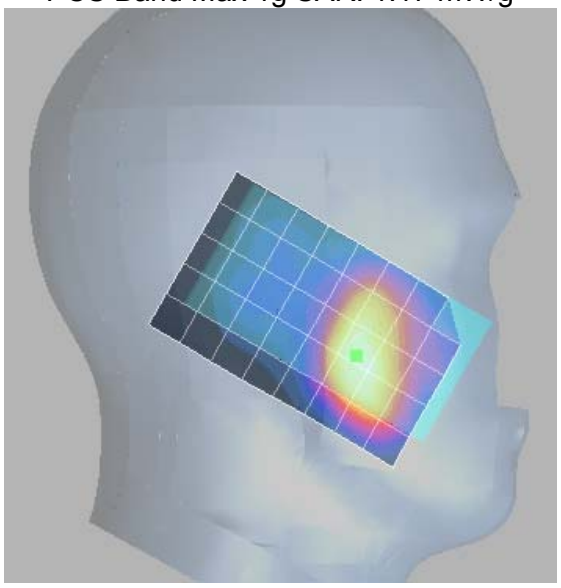
SAR to Peak location separation ratio: 0.237 (1.682 /7.15), < 0.3

Separation distances between Peaks SAR in area scans for Head (LHS Touch) position

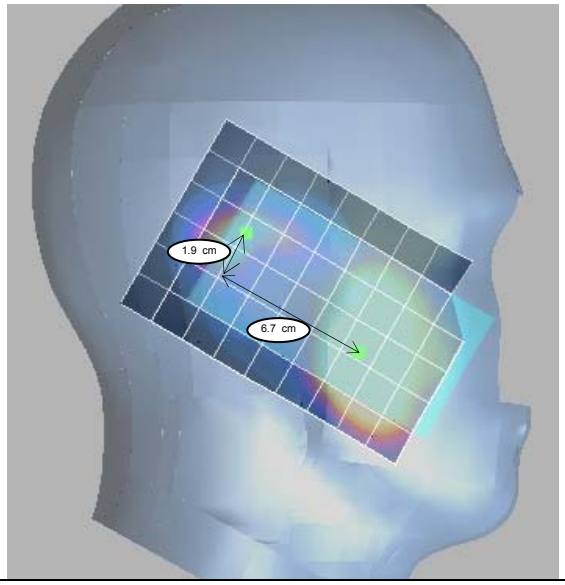
WiFi Max 1g SAR: 0.695 mW/g



PCS Band Max 1g SAR: 1.17 mW/g



Combined



The sum of the 1g SAR = 1.865 mW/g (0.695 + 1.17)

Separation distances between peaks SAR in area scans = 6.96 cm (SQRT(6.7^2+1.9^2))

SAR to Peak location separation ratio: 0.268(1.865 /6.96), < 0.3

13. ATTACHMENTS

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