SAR Evaluation Report

IN ACCORDANCE WITH THE REQUIREMENTS OF
FCC OET BULLETIN 65 SUPPLEMENT C
IC RSS 102 ISSUE 2 : NOVERMBER 2005

FOR

IPHONE

MODEL: A1241

FCC ID: BCGA1241
IC: 579C-A1241

REPORT NUMBER: 08U11814-3

ISSUE DATE: JUNE 03, 2008

Prepared for

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

Prepared by

COMPLIANCE CERTIFICATION SERVICES
47173 BENICIA STREET,
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NVLAP LAB CODE 200065-0

Revision History

Rev.	Issued date	Revisions	Revised By
--	June 2, 2008	Initial issue	J. King

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CERTIFICATE OF COMPLIANCE (SAR EVALUATION)

DATES OF TEST: May 17th, 18th, and 19th

APPLICANT: ADDRESS:	APPLE INC 1 INFINITE LOOP, MS-26A CUPERTINO, CA 95014
FCC ID: MODEL:	BCGA1241 A1241
DEVICE CATEGORY: EXPOSURE CATEGORY:	Portable Device General Population/Uncontrolled Exposure

IPHONE, WITH BLUETOOTH AND WIFI COMBINATION RADIO INSTALLED		
Test Sample is a:	Production unit	
Modulation type:	Direct Sequence Spread Spectrum (DSSS) for 802.11b Orthogonal Frequency Division Multiplexing (OFDM) for 802.11g Frequency Hopping Spread Spectrum (FHSS) for Bluetooth module Gaussian-Fitered Minimum Shift Keying (GMSK) for GSM / GPRS 8PSK (8 Phase Shift Keying) for EGPRS Quadrature Phase Shift Keying (QPSK) for WCDMA	
Rule Parts	Frequency Range [MHz]	The Highest SAR Values [1g_mW/g]
FCC 22H	824 - 849	Head: 0.521 Body: 1.030
FCC 24E	1850 - 1910	Head: 1.388 Body: 0.522

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Testing has been carried out in accordance with:

47CFR §2.1093 - Radiofrequency Radiation Exposure Evaluation: Portable Devices

FCC OET Bulletin 65 (Edition 97-01), Supplement C (Edition 01-01) - Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields

RSS-102 - Evaluation Procedure for Mobile and Portable Radio Transmitters with Respect to Health Canada's Safety Code 6 for Exposure of Humans to Radio Frequency Fields

IEEE 1528_2003 - IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques

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 Compliance Certification Services and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by Compliance Certification Services will constitute fraud and shall nullify the document. No part of this report may be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any government agency.

Approved & Released For CCS By:

Mike C.I. Kuo
Vice President
Compliance Certification Services

Tested By:

Jonathan King
EMC Engineer
Compliance Certification Services

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1 DEVICE UNDER TEST (DUT) DESCRIPTION

IPHONE, WITH BLUETOOTH AND WIFI COMBINATION RADIO INSTALLED	
EUT capabilities:	UMTS 2100/1900/850 and GSM/GPRS/EGPRS 850/1900
Mobile phone capabilities: GPRS Multi-Slot class:	Class B Class 10
Accessories:	Ear bud headset Manufacturer: Apple PN: MA814
Duty cycle:	UMTS: 100% GPRS/EGPRS: 1 Slot: 12.5% 2 Slots: 25% 802.11bg: 100%
Antenna(s):	<u>WWAN</u> Manufacturer: Apple Type: PIFA PN: 632-0615 <u>WiFi/Bluetooth</u> Manufacturer: Apple Type: PIFA PN: 607-1451
Battery:	Manufacturer: ATL PN: 6160366

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2 FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 Benicia Street, Fremont, CA 94538 USA. The sites are constructed in conformance with the requirements of ANSI C63.4, ANSI C63.7 and CISPR Publication 22. All receiving equipment conforms to CISPR Publication 16-1, “Radio Interference Measuring Apparatus and Measurement Methods.”

NVLAP LAB CODE 200065-0

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

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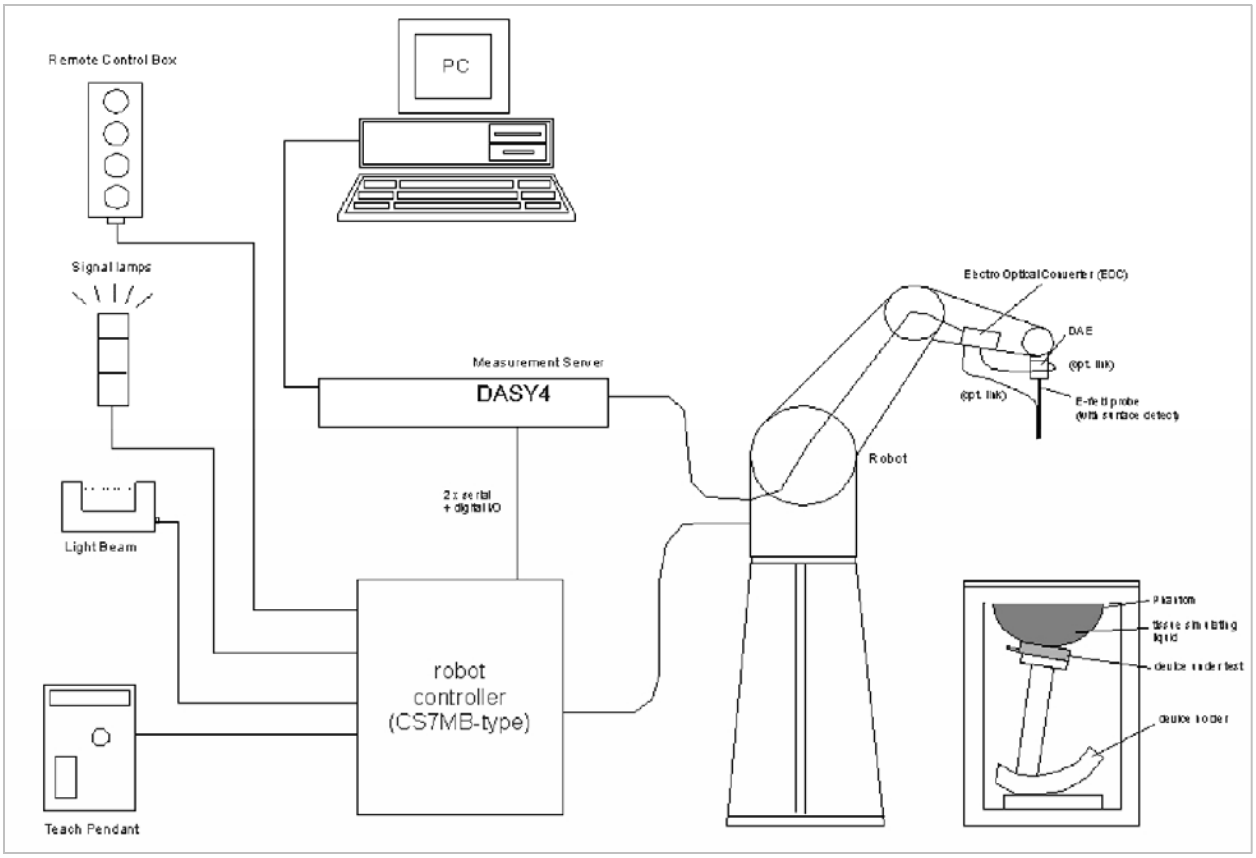
3 SYSTEM DESCRIPTION



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 to validate the proper functioning of the system.

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3.1 COMPOSITION OF INGREDIENTS FOR TISSUE SIMULATING LIQUIDS

The following tissue formulations are provided for reference only as some of the parameters have not been thoroughly verified. The composition of ingredients may be modified accordingly to achieve the desired target tissue parameters required for routine SAR evaluation.

Ingredients (% by weight)	Frequency (MHz) 450		835		915		1900		2450	
Tissue Type	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body
Water	38.56	51.16	41.45	52.4	41.05	56.0	54.9	40.4	62.7	73.2
Salt (NaCl)	3.95	1.49	1.45	1.4	1.35	0.76	0.18	0.5	0.5	0.04
Sugar	56.32	46.78	56.0	45.0	56.5	41.76	0.0	58.0	0.0	0.0
HEC	0.98	0.52	1.0	1.0	1.0	1.21	0.0	1.0	0.0	0.0
Bactericide	0.19	0.05	0.1	0.1	0.1	0.27	0.0	0.1	0.0	0.0
Triton X-100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.8	0.0
DGBE	0.0	0.0	0.0	0.0	0.0	0.0	44.92	0.0	0.0	26.7
Dielectric Constant	43.42	58.0	42.54	56.1	42.0	56.8	39.9	54.0	39.8	52.5
Conductivity (S/m)	0.85	0.83	0.91	0.95	1.0	1.07	1.42	1.45	1.88	1.78

Salt: 99+% Pure Sodium Chloride Sugar: 98+% Pure Sucrose
Water: De-ionized, 16 MΩ+ resistivity HEC: Hydroxyethyl Cellulose
DGBE: 99+% Di(ethylene glycol) butyl ether, [2-(2-butoxyethoxy)ethanol]
Triton X-100 (ultra pure): Polyethylene glycol mono [4-(1,1, 3, 3-tetramethylbutyl)phenyl]ether

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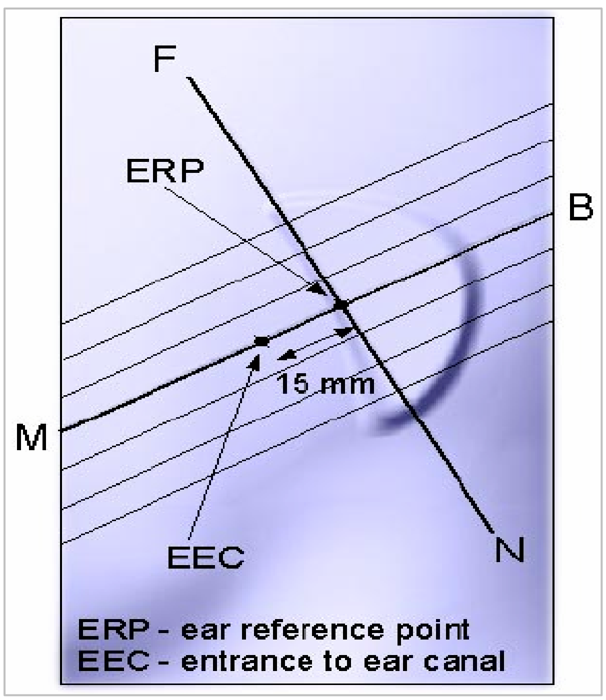
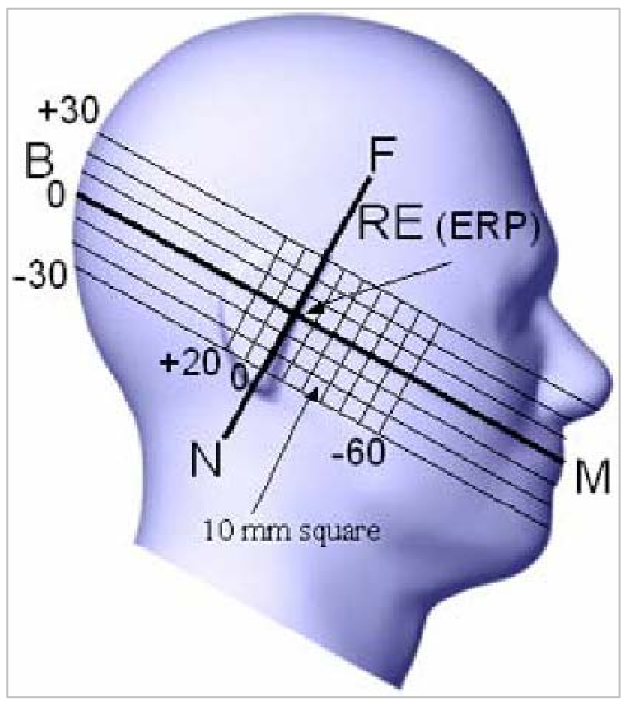
4 TEST POSITIONS FOR DEVICES OPERATING NEXT TO A PERSON'S EAR

This category includes most wireless handsets with fixed, retractable or internal antennas located toward the top half of the device, with or without a foldout, sliding or similar keypad cover. The handset should have its earpiece located within the upper ¼ of the device, either along the centerline or off-centered, as perceived by its users. This type of handset should be positioned in a normal operating position with the "test device reference point" located along the "vertical centerline" on the front of the device aligned to the "ear reference point". The "test device reference point" should be located at the same level as the center of the earpiece region. The "vertical centerline" should bisect the front surface of the handset at its top and bottom edges. A "ear reference point" is located on the outer surface of the head phantom on each ear spacer. It is located 1.5 cm above the center of the ear canal entrance in the "phantom reference plane" defined by the three lines joining the center of each "ear reference point" (left and right) and the tip of the mouth.

A handset should be initially positioned with the earpiece region pressed against the ear spacer of a head phantom. For the SCC-34/SC-2 head phantom, the device should be positioned parallel to the "N-F" line defined along the base of the ear spacer that contains the "ear reference point". For interim head phantoms, the device should be positioned parallel to the cheek for maximum RF energy coupling. The "test device reference point" is aligned to the "ear reference point" on the head phantom and the "vertical centerline" is aligned to the "phantom reference plane". This is called the "initial ear position". While maintaining these three alignments, the body of the handset is gradually adjusted to each of the following positions for evaluating SAR:





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4.1 CHEEK/TOUCH POSITION

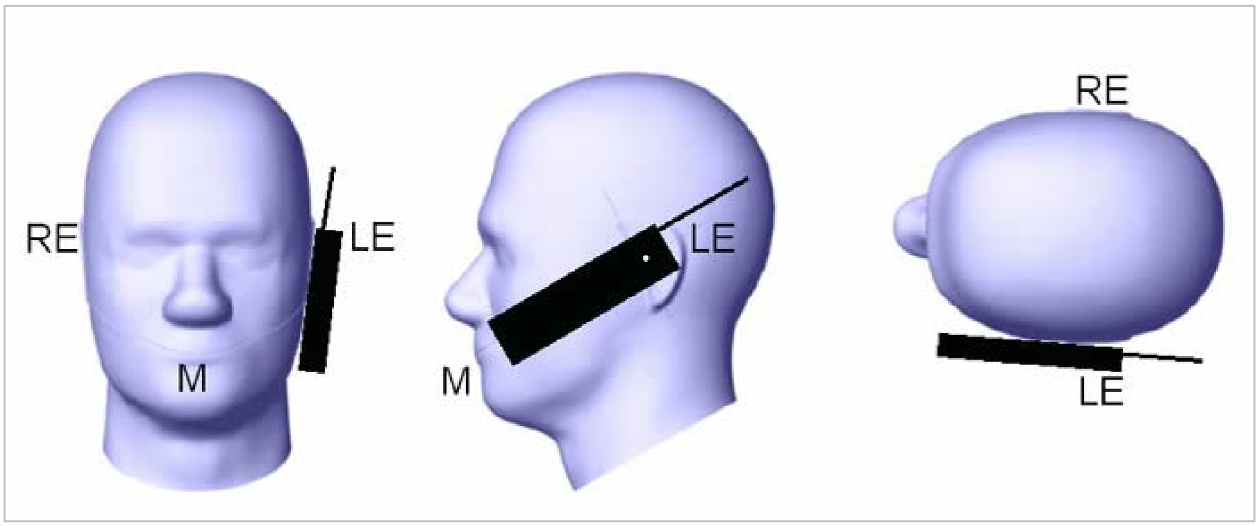
The device is brought toward the mouth of the head phantom by pivoting against the “ear reference point” or along the “N-F” line for the SCC-34/SC-2 head phantom.

This test position is established:

i. When any point on the display, keypad or mouthpiece portions of the handset is in contact with the phantom.
ii. (or) When any portion of a foldout, sliding or similar keypad cover opened to its intended self-adjusting normal use position is in contact with the cheek or mouth of the phantom.

For existing head phantoms – when the handset loses contact with the phantom at the pivoting point, rotation should continue until the device touches the cheek of the phantom or breaks its last contact from the ear spacer.

Cheek / Touch Position



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4.2 EAR/TILT POSITION

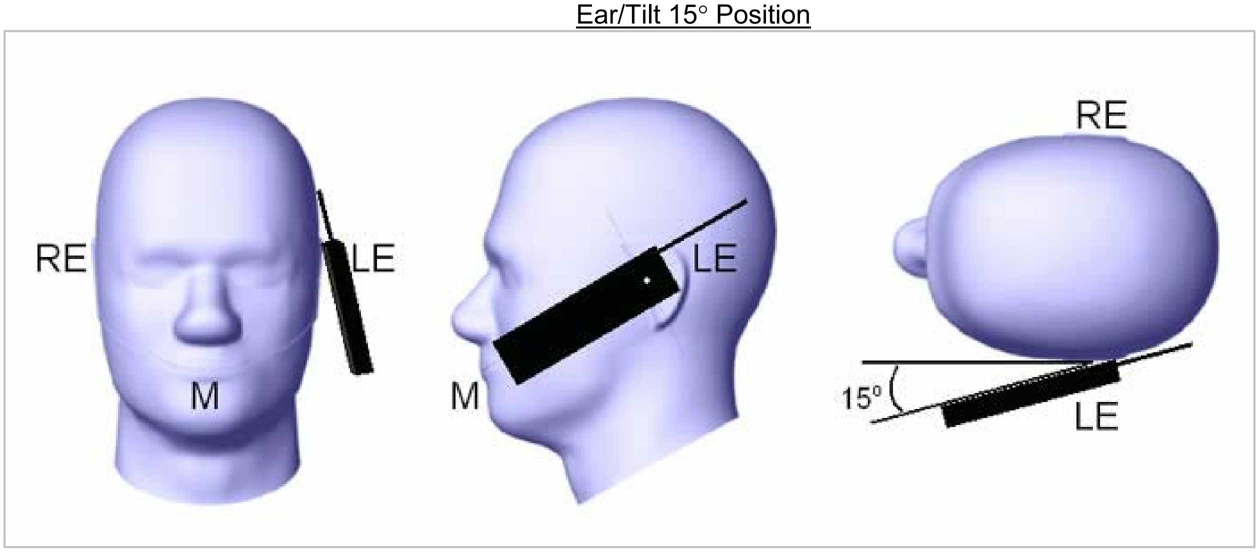
With the handset aligned in the "Cheek/Touch Position":

i. If the earpiece of the handset is not in full contact with the phantom's ear spacer (in the "Cheek/Touch position") and the peak SAR location for the "Cheek/Touch" position is located at the ear spacer region or corresponds to the earpiece region of the handset, the device should be returned to the "initial ear position" by rotating it away from the mouth until the earpiece is in full contact with the ear spacer.

ii. (otherwise) The handset should be moved (translated) away from the cheek perpendicular to the line passes through both "ear reference points" (note: one of these ear reference points may not physically exist on a split head model) for approximate 2-3 cm. While it is in this position, the device handset is tilted away from the mouth with respect to the "test device reference point" until the inside angle between the vertical centerline on the front surface of the phone and the horizontal line passing through the ear reference point is by 15°. After the tilt, it is then moved (translated) back toward the head perpendicular to the line passes through both "ear reference points" until the device touches the phantom or the ear spacer. If the antenna touches the head first, the positioning process should be repeated with a tilt angle less than 15° so that the device and its antenna would touch the phantom simultaneously. This test position may require a device holder or positioner to achieve the translation and tilting with acceptable positioning repeatability.

If a device is also designed to transmit with its keypad cover closed for operating in the head position, such positions should also be considered in the SAR evaluation. The device should be tested on the left and right side of the head phantom in the "Cheek/Touch" and "Ear/Tilt" positions. When applicable, each configuration should be tested with the antenna in its fully extended and fully retracted positions. These test configurations should be tested at the high, middle and low frequency channels of each operating mode; for example, AMPS, CDMA, and TDMA. If the SAR measured at the middle channel for each test configuration (left, right, Cheek/Touch, Tilt/Ear, extended and retracted) is at least 3.0 dB lower than the SAR limit, testing at the high and low channels is optional for such test configuration(s). If the transmission band of the test device is less than 10 MHz, testing at the high and low frequency channels is optional.

Ear/Tilt 15° Position



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4.3 TEST POSITIONS FOR BODY-WORN AND OTHER SIMILAR CONFIGURATIONS

Without the belt-clips or holsters

Body-worn accessories may not always be supplied or available as options for some devices that are intended to be authorized for body-worn use. A separation distance of 1.5 cm between the back of the device and a flat phantom is recommended for testing body-worn SAR compliance under such circumstances. Other separation distances may be used, but they should not exceed 2.5 cm. In these cases, the device may use body-worn accessories that provide a separation distance greater than that tested for the device provided however that the accessory contains no metallic components.

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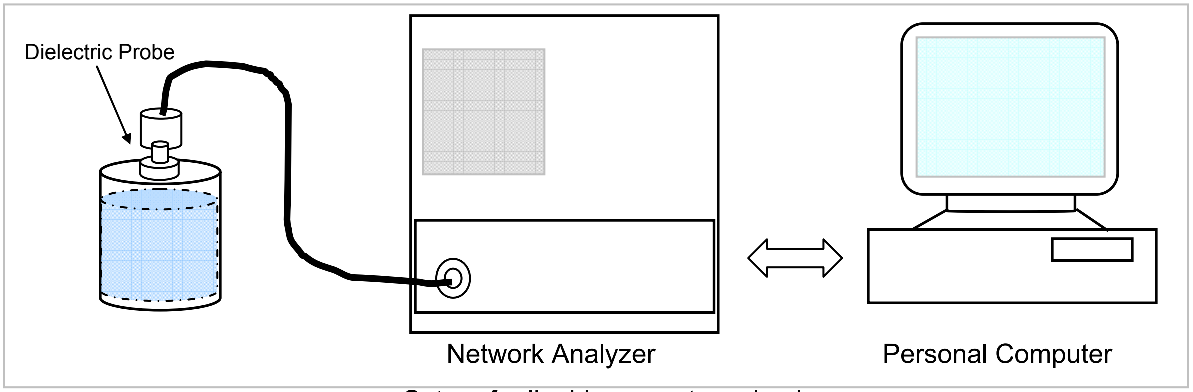
5 SIMULATING LIQUID PARAMETERS CHECK

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. The relative permittivity and conductivity of the tissue material should be within ± 5% of the values given in the table below.



Set-up for liquid parameters check

Reference Values of Tissue Dielectric Parameters for Head and Body Phantom (for 150 – 3000 MHz and 5800 MHz)

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	0.80
300	45.3	0.87	58.2	0.92
450	43.5	0.87	56.7	0.94
835	41.5	0.90	55.2	0.97
900	41.5	0.97	55.0	1.05
915	41.5	0.98	55.0	1.06
1450	40.5	1.20	54.0	1.30
1610	40.3	1.29	53.8	1.40
1800 – 2000	40.0	1.40	53.3	1.52
2450	39.2	1.80	52.7	1.95
3000	38.5	2.40	52.0	2.73
5800	35.3	5.27	48.2	6.00

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

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5.1 SIMULATING LIQUID PARAMETER CHECK RESULT

Simulating Liquid Dielectric Parameters Check Result @ Head 835 MHz

Room Ambient Temperature = 24°C; Relative humidity = 40% Measured by: Jonathan King

Simulating Liquid			Parameters			Measured	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)							
835	23	15	e'	42.1919	Relative Permittivity (ϵ_r):	42.1919	41.5	1.67	± 5
			e''	19.5009	Conductivity (σ):	0.90586	0.90	0.65	± 5

Liquid Check
Ambient temperature: 24 deg. C; Liquid temperature: 23 deg. C
May 18, 2008 09:17 AM

Frequency	e'	e''
800000000.	42.5360	19.5621
805000000.	42.5532	19.5959
810000000.	42.3978	19.5904
815000000.	42.3884	19.5610
820000000.	42.1770	19.5348
825000000.	42.1865	19.4904
830000000.	41.9183	19.5880
835000000.	**42.1919**	**19.5009**
840000000.	42.0942	19.3720
845000000.	41.8983	19.4814
850000000.	41.8339	19.6048
855000000.	41.8724	19.3253
860000000.	41.7346	19.2947
865000000.	41.9505	19.4180
870000000.	41.7541	19.4252
875000000.	41.6578	19.4543
880000000.	41.5666	19.2901
885000000.	41.4585	19.1177
890000000.	41.3938	19.2246
895000000.	41.4835	19.3594
900000000.	41.3063	19.0666
905000000.	41.5599	19.3483
910000000.	41.2860	19.2551
915000000.	41.1278	19.3734
920000000.	41.2889	19.0916
925000000.	41.2104	19.1761
930000000.	40.9048	19.1463
935000000.	40.9842	19.0763
940000000.	41.0600	19.1512
945000000.	40.9013	19.2695
950000000.	40.6921	19.1274

The conductivity (σ) can be given as:

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

where f = target $f * 10^6$
$\varepsilon_0 = 8.854 * 10^{-12}$

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Simulating Liquid Dielectric Parameters Check Result @ Head 1900 MHz

Room Ambient Temperature = 24°C; Relative humidity = 40% Measured by: Jonathan King

Simulating Liquid			Parameters			Measured	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)							
1900	22	15	e'	39.7514	Relative Permittivity (ϵ_r):	39.7514	40.0	-0.62	± 5
			e"	13.3298	Conductivity (σ):	1.40895	1.40	0.64	± 5

Liquid Check
Ambient temperature: 23 deg. C; Liquid temperature: 22 deg. C
May 17, 2008 011:50 AM

frequency	e'	e"
1710000000.0000	40.1970	13.1105
1720000000.0000	40.1795	13.1506
1730000000.0000	40.1893	13.1714
1740000000.0000	40.1951	13.1942
1750000000.0000	40.1870	13.1815
1760000000.0000	40.1832	13.1540
1770000000.0000	40.1424	13.1303
1780000000.0000	40.0791	13.1236
1790000000.0000	39.9757	13.1295
1800000000.0000	39.9019	13.1514
1810000000.0000	39.8115	13.2083
1820000000.0000	39.7458	13.2533
1830000000.0000	39.6736	13.3146
1840000000.0000	39.6450	13.3220
1850000000.0000	39.6583	13.3273
1860000000.0000	39.7337	13.2965
1870000000.0000	39.8008	13.3089
1880000000.0000	39.8315	13.3288
1890000000.0000	39.8115	13.3148
1900000000.0000	**39.7514**	**13.3298**
1910000000.0000	39.6904	13.3279

The conductivity (σ) can be given as:

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

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

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

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Simulating Liquid Dielectric Parameters Check Result @ Head 1900 MHz

Room Ambient Temperature = 24°C; Relative humidity = 35% Measured by: Jonathan King

Simulating Liquid			Parameters			Measured	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)							
1900	23	15	e'	39.7109	Relative Permittivity (ϵ_r):	39.7109	40.0	-0.72	± 5
			e''	13.2993	Conductivity (σ):	1.40573	1.40	0.41	± 5

Liquid Check
Ambient temperature: 23 deg. C; Liquid temperature: 22 deg. C
May 19, 2008 09:34 PM

Frequency	e'	e''
1710000000.	40.4821	12.8349
1720000000.	40.4355	12.8606
1730000000.	40.3967	12.8815
1740000000.	40.3589	12.9175
1750000000.	40.3031	12.9518
1760000000.	40.2665	12.9747
1770000000.	40.2327	13.0052
1780000000.	40.1932	13.0391
1790000000.	40.1417	13.0712
1800000000.	40.1109	13.0998
1810000000.	40.0652	13.1072
1820000000.	40.0193	13.1271
1830000000.	39.9603	13.1433
1840000000.	39.9156	13.1658
1850000000.	39.8827	13.2052
1860000000.	39.8493	13.2178
1870000000.	39.8053	13.2403
1880000000.	39.7775	13.2675
1890000000.	39.7364	13.2675
1900000000.	**39.7109**	**13.2993**
1910000000.	39.6775	13.3124

The conductivity (σ) can be given as:

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

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

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

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Simulating Liquid Dielectric Parameters Check Result @ Muscle 835 MHz

Room Ambient Temperature = 24°C; Relative humidity = 40% Measured by: Jonathan King

Simulating Liquid			Parameters			Measured	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)							
835	23	15	e'	53.7138	Relative Permittivity (ε_r):	53.7138	55.2	-2.69	± 5
			e''	21.5387	Conductivity (σ):	1.00052	0.97	3.15	± 5

Liquid Check
Ambient temperature: 24 deg. C; Liquid temperature: 23 deg. C
May 18, 2008 07:14 PM

Frequency	e'	e''
800000000.	53.9112	21.4974
805000000.	53.9651	21.5040
810000000.	53.9297	21.5924
815000000.	53.8693	21.4639
820000000.	53.6568	21.5029
825000000.	53.7118	21.6584
830000000.	53.7039	21.5129
835000000.	**53.7138**	**21.5387**
840000000.	53.6482	21.4156
845000000.	53.5112	21.4842
850000000.	53.5025	21.4510
855000000.	53.5134	21.4107
860000000.	53.3450	21.1780
865000000.	53.3359	21.2541
870000000.	53.3416	21.2810
875000000.	53.1702	21.2038
880000000.	53.1089	21.1605
885000000.	53.0434	21.2146
890000000.	53.0502	21.1513
895000000.	53.1277	20.9038
900000000.	53.0402	21.1233
905000000.	53.1028	20.9606
910000000.	53.1402	21.0259
915000000.	52.9763	21.0767
920000000.	52.8169	21.0026
925000000.	52.7791	21.0251
930000000.	52.7984	21.1881
935000000.	52.5134	21.1458
940000000.	52.6151	20.9502
945000000.	52.5550	20.9820
950000000.	52.6342	20.6860

The conductivity (σ) can be given as:

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

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

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

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Simulating Liquid Dielectric Parameters Check Result @ Muscle 1900 MHz

Room Ambient Temperature = 24°C; Relative humidity = 40% Measured by: Jonathan King

Simulating Liquid			Parameters			Measured	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)							
1900	23	15	e'	51.9433	Relative Permittivity (ε_r):	51.9433	53.3	-2.55	± 5
			e''	14.5315	Conductivity (σ):	1.53597	1.52	1.05	± 5

Liquid Check
Ambient temperature: 23 deg. C; Liquid temperature: 22 deg. C
May 18, 2008 04:02 AM

Frequency	e'	e''
1710000000.	52.1831	14.4062
1720000000.	52.1822	14.4719
1730000000.	52.2060	14.5249
1740000000.	52.2566	14.5229
1750000000.	52.2666	14.4735
1760000000.	52.2829	14.4041
1770000000.	52.2602	14.3524
1780000000.	52.1720	14.3336
1790000000.	52.0421	14.3362
1800000000.	51.9480	14.3962
1810000000.	51.8342	14.4771
1820000000.	51.7466	14.5690
1830000000.	51.6879	14.6622
1840000000.	51.6755	14.6556
1850000000.	51.7423	14.6311
1860000000.	51.8734	14.5678
1870000000.	51.9828	14.5360
1880000000.	52.0486	14.5268
1890000000.	52.0121	14.5181
1900000000.	**51.9433**	**14.5315**
1910000000.	51.8375	14.6253

The conductivity (σ) can be given as:

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

where f = target $f * 10^6$

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

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Simulating Liquid Dielectric Parameters Check Result @ Muscle 1900 MHz

Room Ambient Temperature = 24°C; Relative humidity = 40% Measured by: Jonathan King

Simulating Liquid			Parameters			Measured	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)							
1900	23	15	e'	53.5824	Relative Permittivity (ϵ_r):	53.5824	53.3	0.53	± 5
			e''	14.2629	Conductivity (σ):	1.50758	1.52	-0.82	± 5

Liquid Check
Ambient temperature: 24.0 deg. C; Liquid temperature: 23.0 deg C
May 20, 2007 09:38 AM

Frequency	e'	e''
1710000000.	54.0606	13.7363
1720000000.	54.0744	13.7940
1730000000.	54.1328	13.8359
1740000000.	54.2246	13.8446
1750000000.	54.2810	13.8230
1760000000.	54.2825	13.7962
1770000000.	54.2432	13.7973
1780000000.	54.1164	13.8274
1790000000.	53.9663	13.8533
1800000000.	53.8130	13.9312
1810000000.	53.6998	13.9932
1820000000.	53.6219	14.0837
1830000000.	53.6105	14.1964
1840000000.	53.6409	14.2421
1850000000.	53.7388	14.2703
1860000000.	53.8331	14.2601
1870000000.	53.8829	14.2639
1880000000.	53.8540	14.2405
1890000000.	53.7322	14.2343
1900000000.	**53.5824**	**14.2629**
1910000000.	53.4152	14.3019

The conductivity (σ) can be given as:

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

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

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

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6 SYSTEM PERFORMANCE CHECK

The system performance check is performed prior to any usage of the system in order to guarantee reproducible results. 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 simulating liquid of the following parameters.
- The DASY4 system with an Isotropic E-Field Probe EX3DV3-SN: 3531 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 7 x 7 x 7 fine cube was chosen for cube integration(dx=dy=5mm; dz=5mm).
  For 5 GHz band - Special 8x8x8 fine cube was chosen for cube integration(dx=dy=4.3mm; dz=3mm)
- Distance between probe sensors and phantom surface was set to 4 mm.
  For 5 GHz band - Distance between probe sensors and phantom surface was set to 2.0mm
- The dipole input power (forward power) was 250 mW±3%.
- The results are normalized to 1 W input power.

IEEE Standard 1528-2003 Recommended Reference Value.

Frequency (MHz)	Distance (mm)	1g SAR [W/kg]	10g SAR [W/kg]
300	15	3.0	2.0
450	15	4.9	3.3
835	15	9.5	6.2
900	15	10.8	6.9
1450	10	29.0	16.0
1800	10	38.1	19.8
1900	10	39.7	20.5
2000	10	41.1	21.1
2450	10	52.4	24.0
3000	10	63.8	25.7

Note: All SAR values normalized to 1 W forward power.

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6.1 SYSTEM PERFORMANCE CHECK RESULTS

System Validation Dipole: D835V2 SN:4d002

Date: May 18, 2008

Ambient Temperature = 24°C; Relative humidity = 40% Measured by: Jonathan King

Head Simulating Liquid			SAR (mW/g)		Normalized to 1 W	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)						
835	23	15	1g	2.48	9.92	9.5	4.42	± 10
			10g	1.66	6.64	6.2	7.10	± 10

Date: May 21, 2008

Ambient Temperature = 24°C; Relative humidity = 35% Measured by: Jonathan King

Body Simulating Liquid			SAR (mW/g)		Normalized to 1 W	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)						
835	23	15	1g	2.47	9.88	9.71	1.75	± 10
			10g	1.65	6.6	6.38	3.45	± 10

System Validation Dipole: D1900V2 SN:5d043

Date: May 17, 2008

Ambient Temperature = 24°C; Relative humidity = 40% Measured by: Jonathan King

Head Simulating Liquid			SAR (mW/g)		Normalize d to 1 W	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)						
1900	23	15	1g	10.30	41.2	39.7	3.78	± 10
			10g	5.36	21.44	20.5	4.59	± 10

Date: May 19, 2008

Ambient Temperature = °C; Relative humidity = 35% Measured by: Jonathan King

Head Simulating Liquid			SAR (mW/g)		Normalized to 1 W	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)						
1900	23	15	1g	10.20	40.8	39.7	2.77	± 10
			10g	5.37	21.48	20.5	4.78	± 10

Date: May 20, 2008

Ambient Temperature = 24°C; Relative humidity = 35% Measured by: Jonathan King

Body Simulating Liquid			SAR (mW/g)		Normalized to 1 W	Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)						
1900	23	15	1g	9.84	39.36	39.8	-1.11	± 10
			10g	5.27	21.08	20.8	1.35	± 10

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7 SAR MEASURMENT PROCEDURE

A summary of the procedure follows:

a) 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.

b) The SAR distribution at the exposed flat section of the flat phantom is measured at a distance of 4 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 2.0 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.

c) Around this point, a volume of X=Y= 30 and Z=21 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:

(i) 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.

(ii) 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.

(iii) All neighbouring volumes are evaluated until no neighbouring volume with a higher average value is found.

(iv) The SAR value at the same location as in Step (a) is again measured to evaluate the actual power drift.

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7.1 DASY4 SAR MEASURMENT PROCEDURE

Step 1: Power Reference Measurement

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

Step 2: Area Scan

The Area Scan is used as a fast scan in two dimensions to find the area of high field values, before doing a fine measurement around the hot spot. The sophisticated interpolation routines implemented in 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.

For 5 GHz band – Same as above except the Zoom Scan measures 7 x 7 x 9 points.

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.

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8 PROCEDURE USED TO ESTABLISH TEST SIGNAL

GSM/EGSM Procedure
The following settings were used to configure the Radio Communication Tester, CMU200.

GSM Only

Function: Menu select > GSM Mobile Station > GSM 850/1900

Press **Connection control** to choose the different menus
Press **RESET** > choose all to reset all settings

Connection	Press **Signal Off** to turn off the signal and change settings Network Support > GSM only Main Service > Circuit Switch	
MS Signal	Press Slot Config bottom on the right twice to select and change the power setting	
	> Slot mode	> Single slot
	> PCL	> 0 (39 dBm for GSM 850) > 0 (30 dBm for GSM 1900)
BS Signal	GSM 850	channel 128/190/251
	GSM1900	channel 512/661/810
Network	Traffic Mode >	Full Rate Version 1

GPRS/EGPRS

Function: Menu select > GSM Mobile Station > GSM 850/900/1800/1900

Press **Connection control** to choose the different menus
Press **RESET** > choose all to reset all settings

Connection	Press **Signal Off** to turn off the signal and change settings Network Support > GSM+GPRS or GSM+EGPRS Main Service > Packet Data Service selection > Test Mode A – Auto Slot Config. off	
MS Signal	Press Slot Config bottom on the right twice to select and change the number of time slots and power setting	
	> Slot configuration	> Uplink/Gamma > 33 dBm for GPRS 850 > 27 dBm for EGPRS 850 > 30 dBm for GPRS1900 > 26 dBm for EGPRS1900
BS Signal	GSM 850	channel 128/190/251
	GSM1900	channel 512/661/810
Network	Coding Scheme >	CS4 (GPRS) and MCS9 (EGPRS)
	Bit Stream >	2E9-1PSR Bit Pattern

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Average power:

GSM850

Channel	Frequency (MHz)	Power (dBm)
128	824.2	32.60
190	836.6	32.40
251	848.8	32.30

GSM1900

Channel	Frequency (MHz)	Power (dBm)
512	1850.2	29.00
661	1880.0	29.20
810	1909.8	29.10

GSM850

Channel	Frequency (MHz)	GPRS	
		1 slot Power (dBm)	2 slots Power (dBm)
128	824.2	32.6	31.0
190	836.6	32.4	30.9
251	848.8	32.3	30.7

Channel	Frequency (MHz)	EGPRS	
		1 slot Power (dBm)	2 slots Power (dBm)
128	824.2	27.5	27.6
190	836.6	27.4	27.5
251	848.8	27.1	27.1

GSM1900

Channel	Frequency (MHz)	GPRS	
		1 slot Power (dBm)	2 slots Power (dBm)
512	1850.2	29.0	27.6
661	1880.0	29.2	27.7
810	1909.8	29.1	27.6

Channel	Frequency (MHz)	EGPRS	
		1 slot Power (dBm)	2 slots Power (dBm)
512	1850.2	26.1	26.3
661	1880.0	26.3	26.5
810	1909.8	26.5	26.7

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WCDMA + HSDPA Procedure
The following settings were used to configure the Radio Communication Tester, CMU200.

- Connection
    - Dedicated Chan (CS): RMC
    - Band Select:
        - Band VI for US Cell Band
        - Band II for US PCS Band
- Network
    - Requested UE Data
        - Authentication: On
        - Security: On
        - IMEI: ON
        - RLC Reestablish: Off
- BS Signal
    - Node –B Setting
        - RF Channel Downlink
            - Band V: 4357 / 4407 / 4458
            - Band II: 9662 / 9800 / 9938
            - Band I: 10562 / 10700 / 10838

    - Circuit Switched
        - RMC Setting
            - Reference Channel Type: 12.2Kbps
            - Test Mode: Loop Mode 1 RLC TM
            - Channel Data Source DTCH: All One

        - Signaling RAB Setting
            - SRB Cell DCH: 13.6 Kbps

    - HSDPA HS-DSCH
        - Fixed Reference Channel
            - H-Set Selection: H-Set 1 QPSK
- UE Signal
    - Analyzer Setting
        - RF Channel Uplink:
            - Band V: 4132 / 4182 / 4233
            - Band II: 9262 / 9400 / 9538

        - UE power Control
            - Max Allowed UE Power: 25

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- UE Gain Factor
  - **HSDPA (for WCDMA + HSDPA mode only**)
    - βc: 2 (See table below for settings)
    - βd: 15 (See table below for settings)
    - DeltaACK: 5
    - DeltaNACK: 5
    - DeltaCQI: 2

The Quantization of the Gain Paramenters			
Signaled values for β_c and β_d	Quantized amplitude ratios β_c and β_d	Signaled values for β_c and β_d	Quantized amplitude ratios β_c and β_d
15	1.0 (15/15)	7	7/15
14	14/15	6	6/15
13	13/15	5	5/15
12	12/15	4	4/15
11	11/15	3	3/15
10	10/15	2	2/15
9	9/15	1	1/15
8	8/15	0	Switch off

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RF Output Power Measurement Results – for RMC Channel Type

Channel Type: 12.2K RMC

Band V

Channel	Frequency (MHz)	Ch Power (dBm)
4132	826.4	23.84
4182	836.4	23.81
4233	846.6	23.98

Band II

Channel	Frequency (MHz)	Ch Power (dBm)
9262	1852.4	21.10
9400	1880.0	21.27
9538	1907.6	21.15

RF Output Power Measurement Results - for 12.2k RMC HSDPA Channel Type

12.2k RMC + HSDPA

Cell Band

Channel	Frequency (MHz)	Ch Power (dBm)
4132	826.4	23.54
4182	836.4	23.55
4233	846.6	23.68

PCS Band

Channel	Frequency (MHz)	Ch Power (dBm)
9262	1852.4	21.00
9400	1880.0	21.04
9538	1907.6	21.06

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9 SAR MEASURMENT RESULTS

9.1 RIGHT HAND SIDE

9.1.1 GSM

Touch Position	Tilt (15°) Position

Test Position	Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
GSM850					
	128	824.2			
Touch	**190**	**836.6**	**0.506**	**-0.123**	**0.521**
	251	848.8			
	128	824.2			
Tilt (15°)	190	836.6	0.268	0.000	0.268
	251	848.8			
GSM1900					
	512	1850.2	1.240	-0.029	1.248
Touch	661	1880.0	1.250	0.000	1.250
	810	1909.8	1.290	0.000	1.290
	512	1850.2			
Tilt (15°)	661	1880.0	0.359	-0.042	0.362
	810	1909.8			

Notes:

1) The exact method of extrapolation is Measured SAR x 10^(-drift/10). The SAR reported at the end of the measurement process by the DASY4 system can be scaled up by the Power drift to determine the SAR at the beginning of the measurement process.
2) The SAR measured at the middle channel for this configuration is at least 3 dB lower (0.8 mW/g) than SAR limit (1.6 mW/g), thus testing at low & high channel is optional.
3) Please see attachments for the detailed measurement data and plots showing the maximum SAR location of the EUT.
4) The battery was fully charged in accordance with manufacture's instructions prior to SAR measurements.

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9.1.2 UMTS/WCDMA

Touch Position	Tilt (15°) Position

Test Position	Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
WCDMA Band V					
Touch	4132 4182 4233	826.40 836.40 846.60	0.504	-0.098	0.516
Tilt (15°)	4132 4182 4233	826.40 836.40 846.60	0.234	-0.001	0.234
WCDMA Band II					
Touch	9262	1852.40	1.220	-0.022	1.226
	9400	1880.00	1.270	0.000	1.270
	9538	**1907.60**	**1.380**	**-0.024**	**1.388**
Tilt (15°)	9262 9400 9538	1852.40 1880.00 1907.60	0.447	-0.063	0.453

Notes:

1) The exact method of extrapolation is Measured SAR x 10^(-drift/10). The SAR reported at the end of the measurement process by the DASY4 system can be scaled up by the Power drift to determine the SAR at the beginning of the measurement process.
2) The SAR measured at the middle channel for this configuration is at least 3 dB lower (0.8 mW/g) than SAR limit (1.6 mW/g), thus testing at low & high channel is optional.
3) Please see attachments for the detailed measurement data and plots showing the maximum SAR location of the EUT.
4) The battery was fully charged in accordance with manufacture's instructions prior to SAR measurements.

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Head position testing using flat phantom

Ear Reference Point – 0.5cm	Bottom Edge of EUT – 1.2cm

GSM850					
Test Position	**Channel**	**f (MHz)**	**Measured SAR 1g (mW/g)**	**Power Drift (dB)**	**Extrapolated[1)] SAR 1g (mW/g)**
Touch - Using flat phantom	9262 9400 9538	1852.40 1880.00 1907.60	0.577	-0.074	0.587

Notes:

1) The exact method of extrapolation is Measured SAR x 10^(-drift/10). The SAR reported at the end of the measurement process by the DASY4 system can be scaled up by the Power drift to determine the SAR at the beginning of the measurement process.
2) The SAR measured at the middle channel for this configuration is at least 3 dB lower (0.8 mW/g) than SAR limit (1.6 mW/g), thus testing at low & high channel is optional.
3) Please see attachments for the detailed measurement data and plots showing the maximum SAR location of the EUT.

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9.2 LEFT HAND SIDE

9.2.1 GSM

Touch Position	Tilt (15°) Position

Test Position	Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
GSM850					
Touch	128 190 251	824.2 836.6 848.8	0.463	-0.066	0.470
Tilt (15°)	128 190 251	824.2 836.6 848.8	0.253	0.000	0.253
GSM1900					
Touch	512 661 810	1850.2 1880.0 1909.8	0.952 0.959 0.968	-0.056 0.000 -0.044	0.964 0.959 0.978
Tilt (15°)	512 661 810	1850.2 1880.0 1909.8	0.345	-0.030	0.347

Notes:

1) The exact method of extrapolation is Measured SAR x 10^(-drift/10). The SAR reported at the end of the measurement process by the DASY4 system can be scaled up by the Power drift to determine the SAR at the beginning of the measurement process.
2) The SAR measured at the middle channel for this configuration is at least 3 dB lower (0.8 mW/g) than SAR limit (1.6 mW/g), thus testing at low & high channel is optional.
3) Please see attachments for the detailed measurement data and plots showing the maximum SAR location of the EUT.
4) The battery was fully charged in accordance with manufacture's instructions prior to SAR measurements.

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9.2.2 UMTS/WCDMA

Touch Position	Tilt (15°) Position

Test Position	Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
WCDMA Band V					
Touch	4132 4182 4233	826.40 836.40 846.60	0.442	-0.042	0.446
Tilt (15°)	4132 4182 4233	826.40 836.40 846.60	0.270	-0.081	0.275
WCDMA Band II					
Touch	9262 9400 9538	1852.40 1880.00 1907.60	1.000 1.160 1.140	0.000 -0.092 -0.103	1.000 1.185 1.167
Tilt (15°)	9262 9400 9538	1852.40 1880.00 1907.60	0.422	-0.032	0.425

Notes:
1) The exact method of extrapolation is Measured SAR x 10^(-drift/10). The SAR reported at the end of the measurement process by the DASY4 system can be scaled up by the Power drift to determine the SAR at the beginning of the measurement process.
2) The SAR measured at the middle channel for this configuration is at least 3 dB lower (0.8 mW/g) than SAR limit (1.6 mW/g), thus testing at low & high channel is optional.
3) Please see attachments for the detailed measurement data and plots showing the maximum SAR location of the EUT.
4) The battery was fully charged in accordance with manufacture's instructions prior to SAR measurements.

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9.3 BODY WORN – WITH 15MM SEPARATION DISTANCE

9.3.1 Cell BAND

Back of EUT facing phantom	Front of EUT facing phantom

Test Position	Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
GPRS - 1 Slots					
Back of EUT facing phantom	128 190 251	824.20 836.60 848.80	0.621	0.000	0.621
GPRS - 2 Slots					
Back of EUT facing phantom	128 190 **251**	824.20 836.60 **848.80**	0.985 0.994 **1.030**	0.000 -0.017 **0.000**	0.985 0.998 **1.030**
Front of EUT facing phantom	128 190 251	824.20 836.60 848.80	0.539	-0.127	0.555
Back of EUT facing phantom with headset	128 190 251	824.20 836.60 848.80	0.486	-0.074	0.494
WCDMA					
Back of EUT facing phantom	4132 4182 4233	826.40 836.40 846.60	0.707	-0.156	0.733
Front of EUT facing phantom	4132 4182 4233	826.40 836.40 846.60	0.387	0.000	0.387

Notes:

1) The exact method of extrapolation is Measured SAR x 10^(-drift/10). The SAR reported at the end of the measurement process by the DASY4 system can be scaled up by the Power drift to determine the SAR at the beginning of the measurement process.
2) The SAR measured at the middle channel for this configuration is at least 3 dB lower (0.8 mW/g) than SAR limit (1.6 mW/g), thus testing at low & high channel is optional.
3) Please see attachments for the detailed measurement data and plots showing the maximum SAR location of the EUT.
4) The battery was fully charged in accordance with manufacture’s instructions prior to SAR measurements.

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9.3.2 PCS BAND

Back of EUT facing phantom	Front of EUT facing phantom

Test Position	Channel	f (MHz)	Measured SAR 1g (mW/g)	Power Drift (dB)	Extrapolated[1)] SAR 1g (mW/g)
GPRS - 1 Slots					
Back of EUT facing phantom	512 661 810	1850.20 1880.00 1909.80	0.282	0.000	0.282
GPRS - 2 Slots					
Back of EUT facing phantom	512 **661** 810	1850.20 **1880.00** 1909.80	**0.521**	**-0.009**	**0.522**
Front of EUT facing phantom	512 661 810	1850.20 1880.00 1909.80	0.505	-0.035	0.509
Back of EUT facing phantom with headset	512 661 810	1850.20 1880.00 1909.80	0.468	0.000	0.468
WCDMA					
Back of EUT facing phantom	9262 9400 9538	1852.40 1880.00 1907.60	0.402	0.000	0.402
Front of EUT facing phantom	9262 9400 9538	1852.40 1880.00 1907.60	0.377	0.000	0.377

Notes:

1) The exact method of extrapolation is Measured SAR x 10^(-drift/10). The SAR reported at the end of the measurement process by the DASY4 system can be scaled up by the Power drift to determine the SAR at the beginning of the measurement process.
2) Please see attachments for the detailed measurement data and plots showing the maximum SAR location of the EUT.

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9.4 RF EXPOSURE PROCEDURES AND EQUIPMENT AUTHORIZATION CONSIDERATION

A. Reference document:
   a. KDB 447498 D01 Mobile Portable RF Exposure v03 ,Published on April 17 2008
   b. KDB 248227 D01 SAR measurement for 802 11 a b g v01r02 ,Published on: May 30 2007
   c. KDB 648474 D01 SAR Handsets Multi Xmiter and Ant v01r02 ,Published on: Apr 9 2008

B. Product Description:

Smart Phone (GSM/GPRS/EDGE/WCDMA/HSDPA) with 802.11 b/g and Bluetooth embedded.

C. Co-located Transmission:
   a. Part 22/24 radio can transmit simultaneously with 802.11 b/g
   b. Part 22/24 radio can transmit simultaneously with Bluetooth.
   c. 802.11 b/g and Bluetooth cannot transmit simultaneously.

D. Antenna location:
   a. Part 22/24 antenna is located at bottom edge of phone.
   b. 802.11 b/g and Bluetooth antenna is located on the top edge of phone.

E. Antenna Separation Distance
   a. Part 22/24 antenna-to-Bluetooth antenna : 8 cm
   b. Part 22/24 antenna-to-802.11 b/g antenna: 8 cm
   c. 802.11 b/g antenna-to-Bluetooth antenna: 0 cm (802.11 b/g radio and Bluetooth radio are sharing a common antenna

F. Highest SAR values:/ KDB 648474
   a. Highest stand alone SAR values for Part 22/24 radio are:

Mode	Band	Channel	Mode	Measured 1 g SAR
WCDMA	**1900 MHz**	**9538**	**Head – Right Hand Side**	**1.388**
WCDMA	**1900 MHz**	**9800**	**Mouth and Jaw Regions**	**0.553**
GPRS	**850MHz**	**251**	**Body**	**1.030**

KDB 648474: *SAR Tests in Mouth and Jaw Regions of the SAM Phantom*:

Due to Part 22/24 transmitting antenna is located near bottom edge of phone; Smart Phone is positioned with its bottom edge positioned from the flat phantom with 1.2 cm distance provided by the cheek touching position using SAM. The ear reference point of the phone is positioned at 0.5 cm from the flat phantom shell.

   b. WLAN Portion: 802.11 b/g radio/ KDB 248227

Frequency Band	Channel	Mode of Operation	SAR Value (mW/g)
2.4 GHz	6	Head	0.779
2.4 GHz	6	Body	0.088

   c. Bluetooth Portion: Bluetooth conducted average power is below Pref/12mW, stand alone SAR evaluation is not required.

G. Simultaneously Transmission and SAR evaluation consideration

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a. Part 22/24 and 802.11 b/g radios: The sum of stand-alone 1-g SAR is: 1.388+0.779=2.16 W/kg > 1.6 W/kg
b. SAR-to-Antenna pair ratio: 2.16 / 8 = 0.270 < 0.3

H. Conclusion:
a. Based upon KDB 648474 simultaneous SAR evaluation requirements, since the SAR-to-Antenna pair ratio is less than 0.3, simultaneously SAR evaluation is not required.
b. Based upon KDB 628591 TCB exclusion list, smart phone with embedded 802.11 b/g radio and BT radios is not subject to TCB exclusion list.

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10 MEASURMENT UNCERTAINTY

10.1 MEASURMENT UNCERTAINTY FOR 300 MHz – 3000 MHz

Uncertainty component	Tol. (±%)	Probe Dist.	Div.	Ci (1g)	Ci (10g)	Std. Unc.(±%)	
						Ui (1g)	Ui(10g)
Measurement System							
Probe Calibration	4.80	N	1	1	1	4.80	4.80
Axial Isotropy	4.70	R	1.732	0.707	0.707	1.92	1.92
Hemispherical Isotropy	9.60	R	1.732	0.707	0.707	3.92	3.92
Boundary Effects	1.00	R	1.732	1	1	0.58	0.58
Linearity	4.70	R	1.732	1	1	2.71	2.71
System Detection Limits	1.00	R	1.732	1	1	0.58	0.58
Readout Electronics	1.00	N	1	1	1	1.00	1.00
Response Time	0.80	R	1.732	1	1	0.46	0.46
Integration Time	2.60	R	1.732	1	1	1.50	1.50
RF Ambient Conditions - Noise	1.59	R	1.732	1	1	0.92	0.92
RF Ambient Conditions - Reflections	0.00	R	1.732	1	1	0.00	0.00
Probe Positioner Mechnical Tolerance	0.40	R	1.732	1	1	0.23	0.23
Probe Positioning With Respect to Phantom Shell	2.90	R	1.732	1	1	1.67	1.67
Extrapolation, interpolation, and integration algorithms for max. SAR evaluation	3.90	R	1.732	1	1	2.25	2.25
Test sample Related							
Test Sample Positioning	1.10	N	1	1	1	1.10	1.10
Device Holder Uncertainty	3.60	N	1	1	1	3.60	3.60
Power and SAR Drift Measurement	5.00	R	1.732	1	1	2.89	2.89
Phantom and Tissue Parameters							
Phantom Uncertainty	4.00	R	1.732	1	1	2.31	2.31
Liquid Conductivity - Target	5.00	R	1.732	0.64	0.43	1.85	1.24
Liquid Conductivity - Meas.	8.60	N	1	0.64	0.43	5.50	3.70
Liquid Permittivity - Target	5.00	R	1.732	0.6	0.49	1.73	1.41
Liquid Permittivity - Meas.	3.30	N	1	0.6	0.49	1.98	1.62
Combined Standard Uncertainty	RSS					11.44	10.49
Expanded Uncertainty (95% Confidence Interval)	K=2					22.87	20.98

Notesfor table
1. Tol. - tolerance in influence quaitity
2. N - Nomal
3. R - Rectangular
4. Div. - Divisor used to obtain standard uncertainty
5. Ci - is te sensitivity coefficient

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11 EQUIPMENT LIST AND CALIBRATION

Name of Equipment	Manufacturer	Type/Model	Serial Number	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	14	2008
E-Field Probe	SPEAG	EX3DV3	3531	4	23	2009
Thermometer	ERTCO	639-1S	1718	8	30	2008
Data Acquisition Electronics	SPEAG	DAE3 V1	500	11	16	2008
System Validation Dipole	SPEAG	D835V2	4d002	6	22	2009
System Validation Dipole	SPEAG	D1900V2	5d043	1	29	2010
System Validation Dipole	SPEAG	D2450V2	748	4	14	2010
Signal Generator	R&S	SMP 04	DE34210	2	16	2009
Power Meter	Giga-tronics	8651A	8651404	1	11	2010
Power Sensor	Giga-tronics	80701A	1834588	1	11	2010
Radio Communication Tester	R &S	CMU 200	106291	5	16	2009
Radio Communication Tester	Agilent	E5515C	GB46160222	6	29	2008
Amplifier	Mini-Circuits	ZHL-42W	D072701-5	N/A		
Simulating Liquid	CCS	H835	N/A	Within 24 hrs of first test		
Simulating Liquid	CCS	H1900	N/A	Within 24 hrs of first test		
Simulating Liquid	CCS	M835	N/A	Within 24 hrs of first test		
Simulating Liquid	CCS	M1900	N/A	Within 24 hrs of first test		

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12 ATTACHMENTS

No.	Contents	No. Of Pages
1	System Performance Check Plots	6
2-1	SAR Test Plots – Right Hand Side	13
2-2	SAR Test Plots – Left Hand Side	12
2-3	SAR Test Plots – Body Worn	14
3	Certificate of E-Field Probe - EX3DV3SN3531	10
4	Certificate of System Validation Dipole - D835V2 SN:4d002	9
5	Certificate of System Validation Dipole - D1900V2 SN:5d043	9
6	Certificate of System Validation Dipole - D2450V2 SN:748	6

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13 PHOTOS

EUT

END OF REPORT

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