SAR Test Report

Product Name: GSM Mobile Phone

Model No： EZ TWO

FCC ID: ZXL-EZTWOB

Applicant : SeniorTech LLC

Address : 100 Cherokee Blvd, Suite 216, Chattanooga, TN 37405

Prepared : IAC Compliance Laboratory

Address : No.789 Pu Xing Road,Shanghai,PRC

Date of Test : 2013.04.15

Test Report Certification

Test Date : 2013.04.15

Report No. : 130416001SAR-FCC

Product Name	:	GSM Mobile Phone
Applicant	:	SeniorTech LLC
Address	:	100 Cherokee Blvd, Suite 216, Chattanooga, TN 37405
Manufacturer	:	ENJOY GROUP(HK) CO,LIMITED
Model No.	:	EZ TWO
EUT Stage	:	Identical Prototype
Standard	:	FCC 47 CFR Part2 (2.1093) IEEE C95.1-1999 IEEE 1528-2003 KDB 450824 FCC OET Bulletin 65 supplement C

Test Result : Complied

The Test Results relate only to the samples tested.
The test report shall not be reproduced except in full without the written approval of IAC Compliance Lab.

Documented By : Judy Ge/Engineer

Tested By : Jack Wang/Engineer

Approved By : Jeff Huang/Director of Operations

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1. GENERAL INFORMATION

1.1. Applicant

Company Name: SeniorTech LLC

Address: 100 Cherokee Blvd, Suite 216, Chattanooga, TN 37405

1.2. Manufacturer

Company Name: ENJOY GROUP(HK) CO,LIMITED

Address: Rm.1305A,Fujian dasha Caitian road, Futian District, Shenzhen, Guangdong, China

1.3. Test Environment

Ambient conditions in the laboratory:

Items	Required	Actural
Temperature(℃)	15~30	21.4
Humidity(%RH)	30~70	46

2. SAR Measurement System

2.1. ALSAS-10U System Description

ALSAS-10-U is fully compliant with the technical and scientific requirements of IEEE 1528, IEC 62209, CENELEC, ARIB, ACA, and the Federal Communications Commission. The system comprises of a six axes articulated robot which utilizes a dedicated controller. ALSAS-10U uses the latest methodologies and FDTD order to provide a platform which is repeatable with minimum uncertainty.

2.1.1. Applications

Predefined measurement procedures compliant with the guidelines of CENELEC, IEEE, IEC, FCC, etc are utilized during the assessment for the device. Automatic detection for all SAR maxima are embedded within the core architecture for the system, ensuring that peak locations used for centering the zoom scan are within a 1mm resolution and a 0.05mm repeatable position. System operation range currently is available up to 6 GHz in simulated tissue.

2.1.2. Area Scans

Area Scans are defined prior to the measurement process being executed with a user defined variable spacing between each measurement point (integral) allowing low uncertainty measurements to be conducted. Scans defined for FCC applications utilize a $10mm^2$ step integral, with 1mm interpolation used to locate the peak SAR area used for zoom scan assessments.

Where the system identifies multiple SAR peaks (which are within 25% of peak value) the system will provide the user with the option of assessing each peak location individually for zoom scan averaging.

2.1.3. Zoom Scan (Cube Scan Averaging)

The averaging zoom scan volume utilized in the ALSAS-10U software is in the shape of a cube and the side dimension of a 1g or 10g mass is dependent on the density of the liquid representing the simulated tissue. A density of $1000kg/m^3$ is used to represent the head and body tissue density and not the phantom liquid density, in order to be consistent with the definition of the liquid dielectric properties, i.e. the side length of the 1g cube is 10mm, with the side length of the 10g cube 21.5mm.

When the cube intersects with the surFront of the phantom, it is oriented so that 3 vertices touch the surFront of the shell or the center of a Front is tangent to the surFront.

The zoom Scan integer steps can be user defined so as to reduce uncertainty, but normal practice for typical test applications (including FCC) utilize a physical step of 5×5×8 (8mm×8mm×5mm) providing a volume of 32mm in the X & Y axis, and 35mm in the Z axis.

2.1.4. ALSAS-10U Interpolation and Extrapolation Uncertainty

The overall uncertainty for the methodology and algorithms the used during the SAR calculation was evaluated using the data from IEEE 1528 based on the example f3 algorithm:

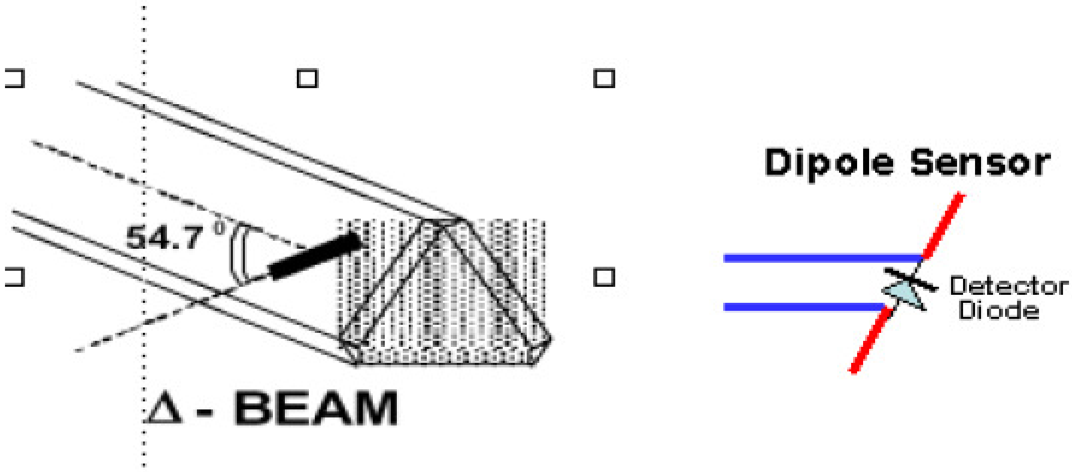
$$f_3(x,y,z) = A\frac{a^2}{\frac{a^2}{4} + x'^2 + y'^2}\cdot\left(e^{-\frac{2z}{a}} + \frac{a^2}{2(a+2z)^2}\right)$$

2.2. Isotropic E-Field Probe

The isotropic E-Field probe has been fully calibrated and assessed for isotropic, and boundary effect within a controlled environment. Depending on the frequency for which the probe is calibrated the method utilized for calibration will change. A number of methods is used for calibrating probes, and these are outlined in the table below:

Calibration Frequency	Air Calibration	Tissue Calibration
900MHz	TEM Cell	Temperature
1800MHz	TEM Cell	Temperature

The E-Field probe utilizes a triangular sensor arrangement as detailed in the diagram below:



SAR is assessed with a calibrated probe which moves at a default height of 5mm from the center of the diode, which is mounted to the sensor, to the phantom surFront (in the Z Axis). The 5mm offset height has been selected so as to minimize any resultant boundary effect due to the probe being in close proximity to the phantom surFront.

The following algorithm is an example of the function used by the system for linearization of the output from the probe when measuring complex modulation schemes.

$$V_i = U_i + U_i^2 \cdot \frac{cf}{dcp_i}$$

2.2.1. Isotropic E-Field Probe Specification

Calibration in Air	Frequency Dependent Below 2GHz Calibration in air performed in a TEM Cell Above 2GHz Calibration in air performed in waveguide
Sensitivity	0.70 $\mu V/(V/m)^2$ to 0.85 $\mu V/(V/m)^2$
Dynamic Range	0.0005 W/kg to 100W/kg
Isotropic Response	Better than 0.2dB
Diode Compression point (DCP)	Calibration for Specific Frequency
Probe Tip Radius	< 5mm
Sensor Offset	1.56 (+/- 0.02mm)
Probe Length	290mm
Video Bandwidth	@ 500 Hz: 1dB @1.02 KHz: 3dB
Boundary Effect	Less than 2% for distance greater than 2.4mm
Spatial Resolution	Diameter less than 5mm Compliant with Standards

Probe model no: ALS-E-020, S/N:500-00273

2.3. Boundary detection Unit and Probe Mounting Device

ALSAS-10U incorporates a boundary detection unit with a sensitivity of 0.05mm for detecting all types of surFronts. The robust design allows for detecting during probe tilt (probe normalize) exercises, and utilizes a second stage emergency sTop. The signal electronics are directly into the robot controller for high accuracy surFront detection in lateral and axial detection modes (X, Y, &Z).

The probe is mounted directly onto the Boundary Detection unit for accurate tooling and displacement calculations controlled by the robot kinematics. The probe is connected to an isolated probe interconnect where the output stage of the probe is fed directly into the amplifier stage of the Daq-Paq.

2.4. Daq-Paq (Analog to Digital Electronics)

ALSAS-10U incorporates a fully calibrated Daq-Paq (analog to digital conversion system) which has a 4 channel input stage, sent via a 2 stage auto-set amplifier module. The input signal is amplified accordingly so as to offer a dynamic range from 5 μ V to 800mV. Integration of the fields measured is carried out at board level utilizing a Co-Processor which then sends the measured fields down into the main computational module in digitized form via a RS232 communications port. Probe linearity and duty cycle compensation is carried out within the main Daq-Paq module.

ADC	12 Bit
Amplifier Range	20mV to 200mV and 150mV to 800mV
Field Integration	Local Co-Processor utilizing proprietary integration algorithms
Number of Input Channels	4 in total 3 dedicated and 1 spare
Communication	Packet data via RS232

2.5. Axis Articulated Robot

ALSAS-10U utilizes a six articulated robot, which is controlled using a Pentium based real-time movement controller. The movement kinematics engine utilizes proprietary (Thermo CRS) interpolation and extrapolation algorithms, which allow full freedom of movement for each of the six joints within the working envelop. Utilization of joint 6 allows for full probe rotation with a tolerance better than 0.05mm around the central axis.

Robot/Controller Manufacturer	Thermo CRS
Number of Axis	Six independently controlled axis
Positioning Repeatability	0.05mm
Controller Type	Single phase Pentium based C500C
Robot Reach	710mm
Communication	RS232 and LAN compatible

2.6. ALSAS Universal Workstation

ALSAS Universal workstation allows for repeatability and fast adaptability. It allows users to do calibration, testing and measurement using different types of phantoms with one set up, which significantly speeds up the measurement process.

2.7. Universal Device Positioner

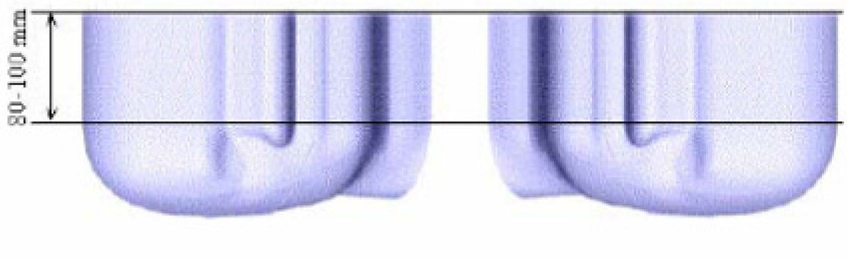
The universal device positioner allows complete freedom of movement of the EUT. Developed to hold a EUT in a free-space scenario any additional loading attributable to the material used in the construction of the positioner has been eliminated. Repeatability has been enhanced through the linear scales which form the design used to indicate positioning for any given test scenario in all major axes. A 15° tilt movements for head SAR analysis. Overall uncertainty for measurements has been reduced due to the design of the Universal device positioner, which allows positioning of a device in as near to a free-space scenario as possible, and by providing the means for complete repeatability.

2.8. Phontom Types

The ALSAS-10U allows the integration of multiple phantom types. SAM Phantoms fully compliant with IEEE 1528, Universal Phantom, and Universal Flat.

2.8.1. APREL SAM Phantoms

The SAM phantoms developed using the IEEE SAM CAD file. They are fully compliant with the requirements for both IEEE 1528 and FCC Supplement C. Both the left and right SAM phantoms are interchangeable, transparent and include the IEEE 1528 grid with visible NF and MB lines.



2.8.2. APREL Laboratories Universal Phantom

The Universal Phantom is used on the ALSAS-10U as a system validation phantom. The Universal Phantom has been fully validated both experimentally from 800MHz to 6GHz and numerically using XFDTD numerical software. The shell thickness is 2mm overall, with a 4mm spacer located at the NF/MB intersection providing an overall thickness of 6mm in line with the requirements of IEEE-1528.

The design allows for fast and accurate measurements, of handsets , by allowing the conservative SAR to be evaluated at on frequency for both left and right head experiments in one measurement.

3. Tissue Simulating Liquid

3.1. The composition of the tissue simulating liquid

INGREDIENT (% Weight)	850MHz Head	1900MHZ Head	850MHZ Body	1900MHz Body
Water	40.45%	54.9%	45.0%	70.17%
Salt	1.45%	0.18%	52.4%	0.39%
Sugar	57.6%	0%	1.4%	0%
HEC	0.4%	0%	1.0%	0%
Preventol	0.1%	0%	0.1%	0%
DGBE	0%	44.92%	0%	29.44%

3.2. Tissue Calibration Result

The dielectric parameters of the liquids were verified prior to SAR evaluation using APREL Dielectric Probe Kit and Agilent E5071B Vector Network Analyzer.

Head Tissue Simulate Measurement				
Frequency (MHz)	Description	Dielectric Parameters		Tissue Temp.(℃)
		ε_r	σ (s/m)	
850MHz	Reference result	41.5	0.90	NA
	+/-5% window	39.425to43.575	0.855to0.945	
	15-Apr-13	40.39	0.92	20.7
1900MHz	Reference result	40.0	1.40	NA
	+/-5% window	38to42	1.33 to 1.47	
	15-Apr-13	41.56	1.44	20.7

Body Tissue Simulate Measurement				
Frequency (MHz)	Description	Dielectric Parameters		Tissue Temp.(℃)
		ε_r	σ (s/m)	
850MHz	Reference result	55.2	0.97	NA
	+/-5% window	52.44to57.96	0.922to1.019	
	15-Apr-13	53.36	0.95	20.7
1900MHz	Reference result	53.3	1.52	NA
	+/-5% window	50.635to55.965	1.444to1.596	
	15-Apr-13	52.91	1.50	20.7

3.3. Tissue Dielectric Parameters for Head and Body Phantoms

The head tissue dielectric parameters recommended by the IEEE SCC-34/SC-2 in PP1528 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 P1428 are derived from the tissue dielectric parameters computed from the 4-Cole-Cole equations described in Reference [12] and extrapolated according to the head parameters specified in P1528.

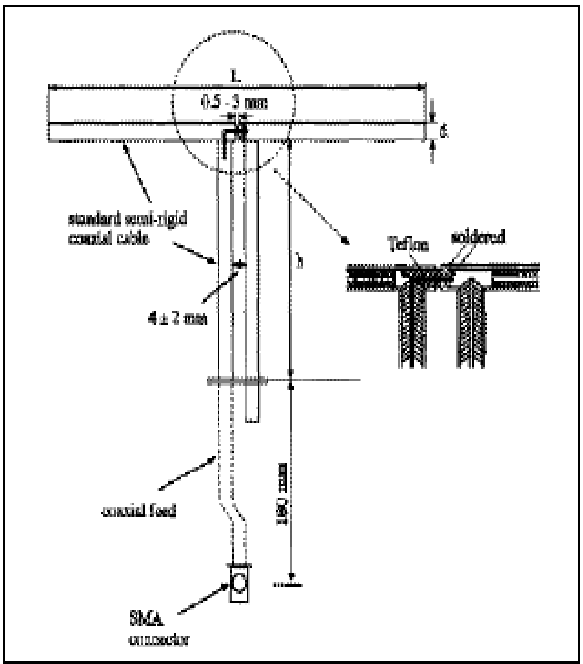
Target Frequency	Head		Body	
(MHz)	ε_r	σ (S/m)	ε_r	σ (S/m)
150	52.3	0.76	61.9	0.80
300	45.3	0.87	58.2	0.92
450	43.5	0.87	56.7	0.94
835	41.5	0.90	55.2	0.97
900	41.5	0.97	55.0	1.05
915	41.5	0.98	55.0	1.06
1450	40.5	1.20	54.0	1.30
1610	40.3	1.29	53.8	1.40
1800 – 2000	40.0	1.40	53.3	1.52
2450	39.2	1.80	52.7	1.95
3000	38.5	2.40	52.0	2.73
5800	35.3	5.27	48.2	6.00

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

4. SAR Measurement Procedure

4.1. SAR System Validation

4.1.1. Validation Dipoles



The dipoles used are based on the IEEE-1528 standard, and is complied with mechanical and electrical specifications in line with the requirements of both IEEE and FCC Supplement C. The table below provides details for the mechanical and electrical specifications for the dipoles.

Frequency	L(mm)	h(mm)	d(mm)
850MHz	161	89.8	3.6
1900MHz	67.1	38.9	3.6

4.1.2. Validation Result

Measurement Date	Frequency (MHz)	Liquid Type	Targeted SAR(W/kg)1g	Measured SAR(W/kg)1g	Deviation (%)
2012/05/28	835	Head	9.590	9.498	-0.96
2013/04/15	835	Head	9.590	9.654	0.67
2012/05/28	835	Body	9.981	9.657	-3.25
2013/04/15	835	Body	9.981	9.553	-4.29
2012/05/28	1900	Head	39.378	38.546	-2.11
2013/04/15	1900	Head	39.378	38.683	-1.77
2012/05/28	1900	Body	39.654	39.713	0.15
2013/04/15	1900	Body	39.654	39.645	-0.02

Head System Performance Check at 850MHZ&1900MHz				
Validation Kit: ASL-D-850-S-2				
Frequency(MHz)	Description	SAR(W/kg) 1g	SAR(W/kg) 10g	Tissue Temp.(℃)
850MHz	Reference result	9.590	6.003	N/A
	+/-5%window	9.110to10.07	5.702to6.303	
	15-Apr-13(1W)	9.484	5.871	20.7
Validation Kit: ASL-D-1900-S-2				
Frequency(MHz)	Description	SAR(W/kg) 1g	SAR(W/kg) 10g	Tissue Temp.(℃)
1900MHz	Reference result	39.378	19.668	N/A
	+/-5%window	37.418to41.356	18.685to20.651	
	15-Apr-13(1W)	38.683	19.247	20.7
Note: All SAR values are normalized to 1 W forward power.				

Body System Performance Check at 850MHZ&1900MHz

Validation Kit: ASL-D-850-S-2

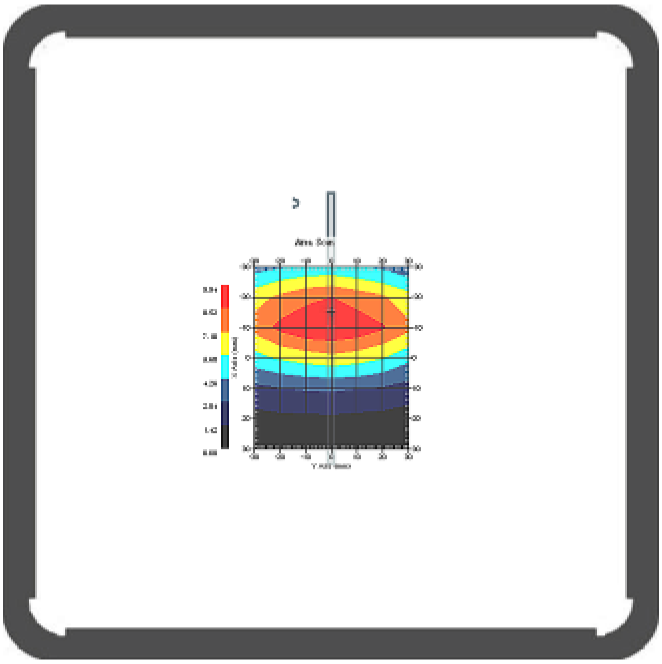
Frequency(MHz)	Description	SAR(W/kg) 1g	SAR(W/kg) 10g	Tissue Temp.(℃)
850MHz	Reference result	9.981	6.006	N/A
	+/-5%window	9.482to10.48	5.706to6.306	
	15-Apr-13(1W)	9.553	5.876	20.7

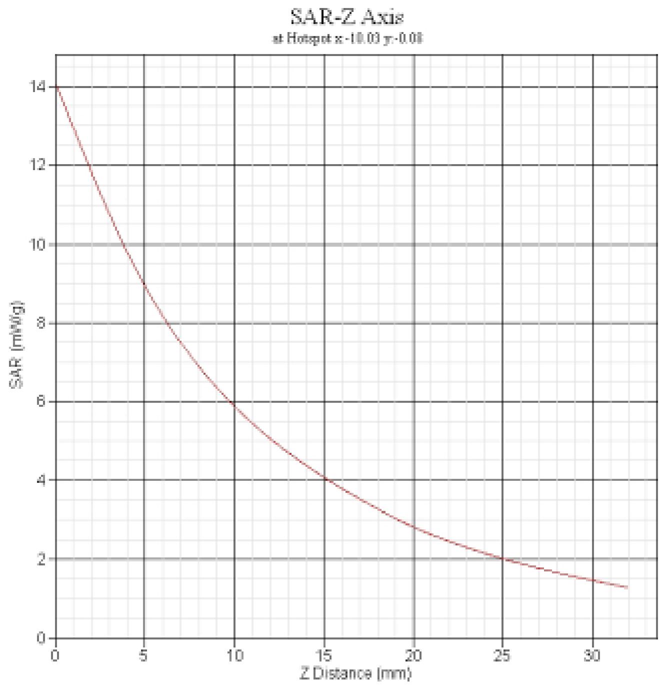
Validation Kit: ASL-D-1900-S-2

Frequency(MHz)	Description	SAR(W/kg) 1g	SAR(W/kg) 10g	Tissue Temp.(℃)
1900MHz	Reference result	39.654	19.668	N/A
	+/-5%window	37.671to41.637	18.685to20.651	
	15-Apr-13(1W)	39.645	19.736	20.7

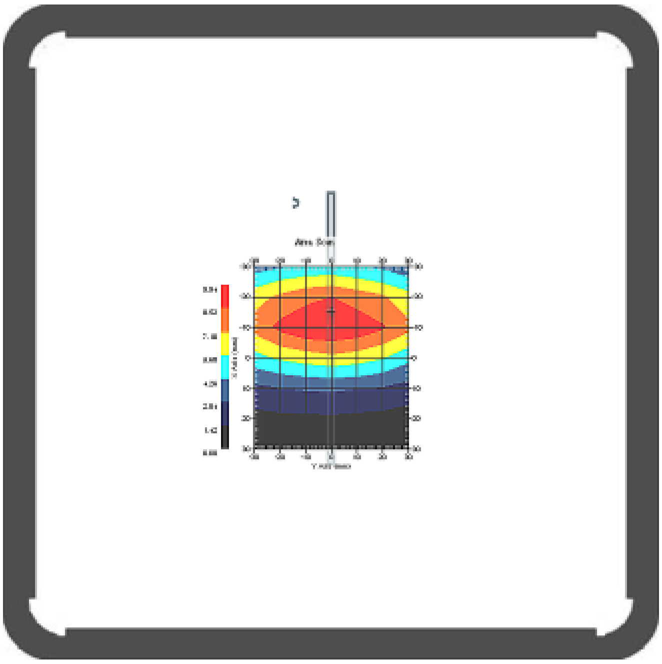
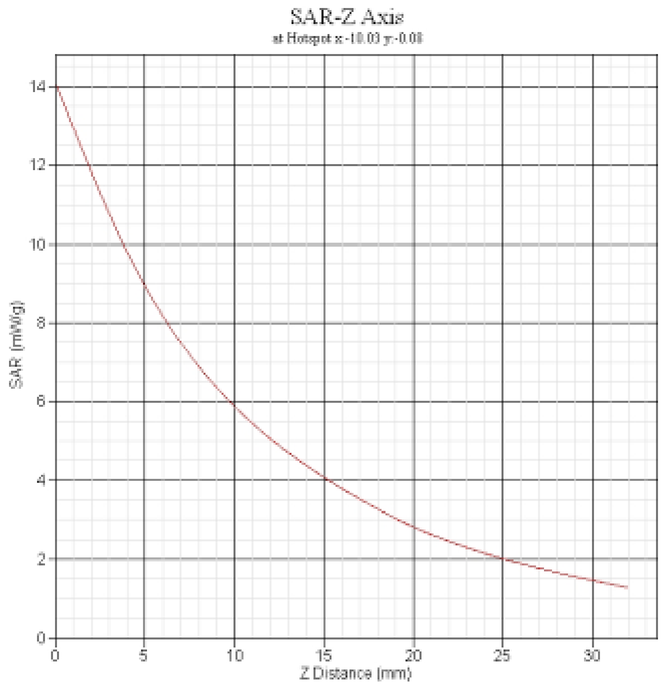
Note: All SAR values are normalized to 1W forward power.

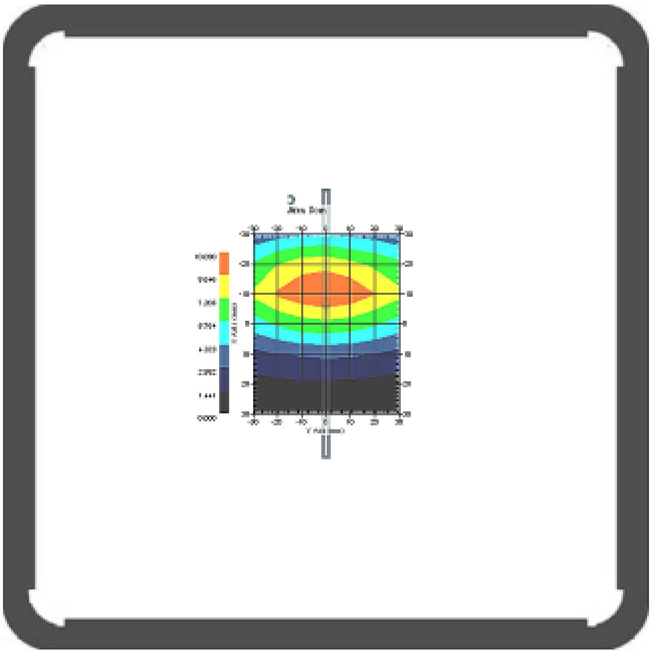
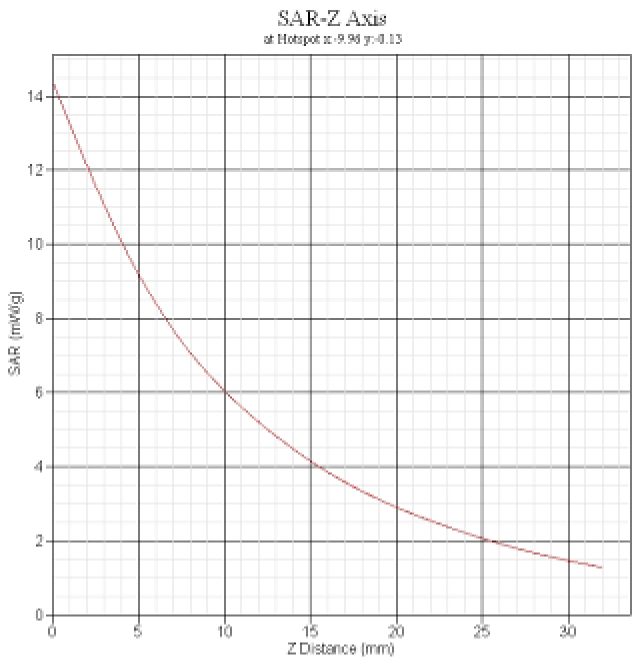
Frequency(MHz)	850
Relative permittivity(real part)	40.36
Conductivity(S/m)	0.94
Variation(%)	-0.524
Duty Cycle Factor	1
Crest factor	1
Conversion Factor	6.5
Probe Sensitivity	1.20 1.20 1.20 μV/(V/m)2
Data	2012-05-28



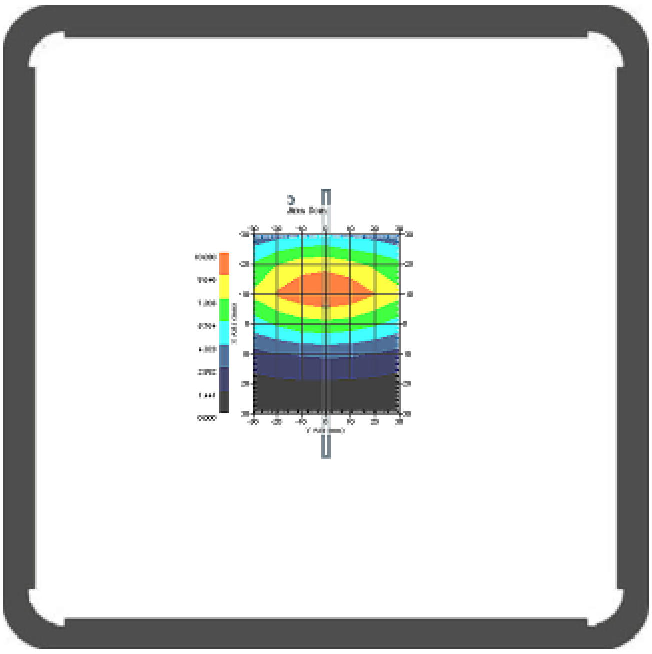


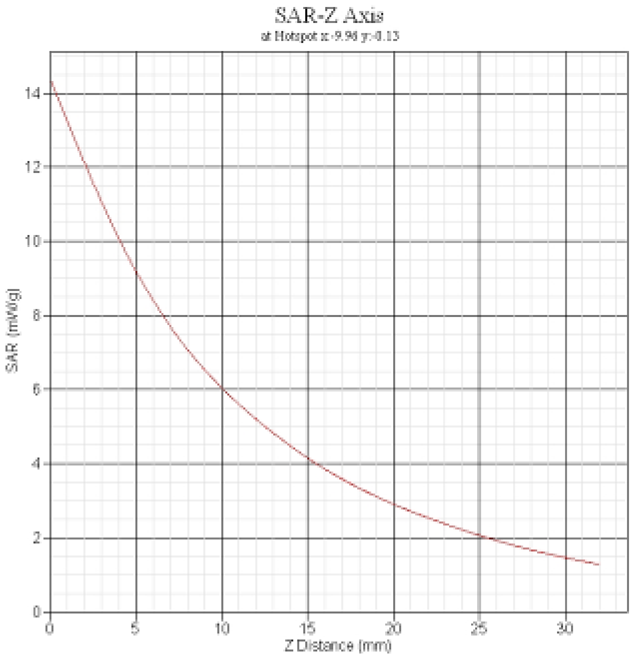
SAR 1g(W/kg)	9.498
SAR 10g(W/kg)	5.883

Frequency(MHz)	850
Relative permittivity(real part)	40.39
Conductivity(S/m)	0.92
Variation(%)	0.242
Duty Cycle Factor	1
Crest factor	1
Conversion Factor	6.5
Probe Sensitivity	1.20 1.20 1.20 μV/(V/m)2
Data	2013-04-15
	
SAR 1g(W/kg)	9.484
SAR 10g(W/kg)	5.871

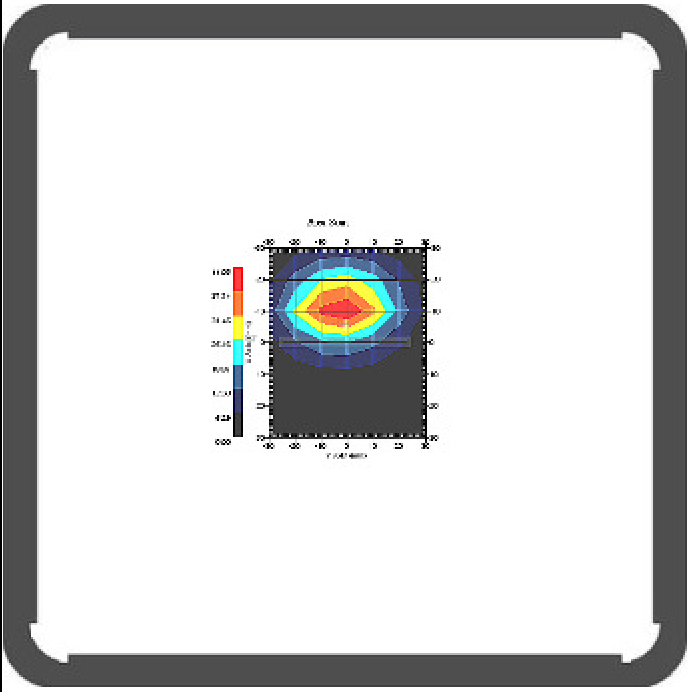
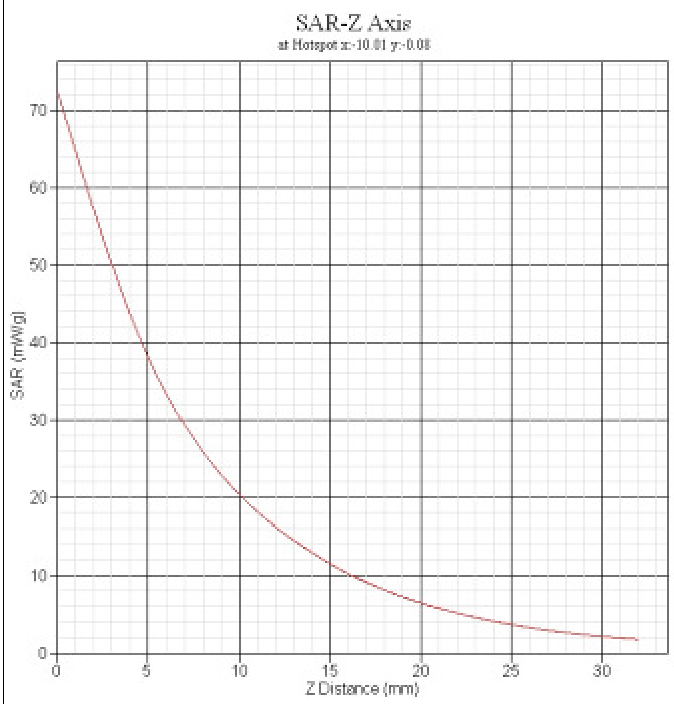
Frequency(MHz)	850
Relative permittivity(real part)	53.36
Conductivity(S/m)	0.95
Variation(%)	-0.374
Duty Cycle Factor	1
Crest factor	1
Conversion Factor	6.4
Probe Sensitivity	1.20 1.20 1.20 μV/(V/m)2
Data	2012-05-28
	
SAR 1g(W/kg)	9.657
SAR 10g(W/kg)	5.863

Frequency(MHz)	850
Relative permittivity(real part)	53.38
Conductivity(S/m)	0.94
Variation(%)	0.268
Duty Cycle Factor	1
Crest factor	1
Conversion Factor	6.4
Probe Sensitivity	1.20 1.20 1.20 µV/(V/m)2
Data	2013-04-15

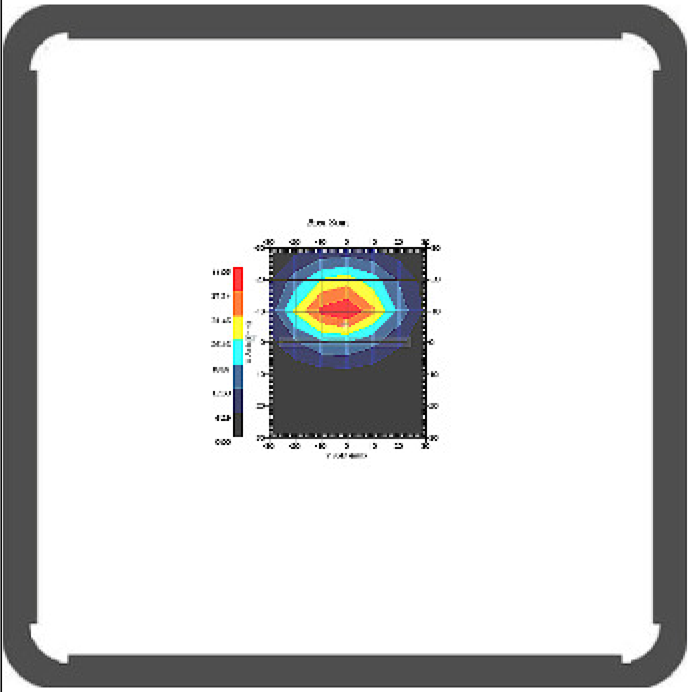


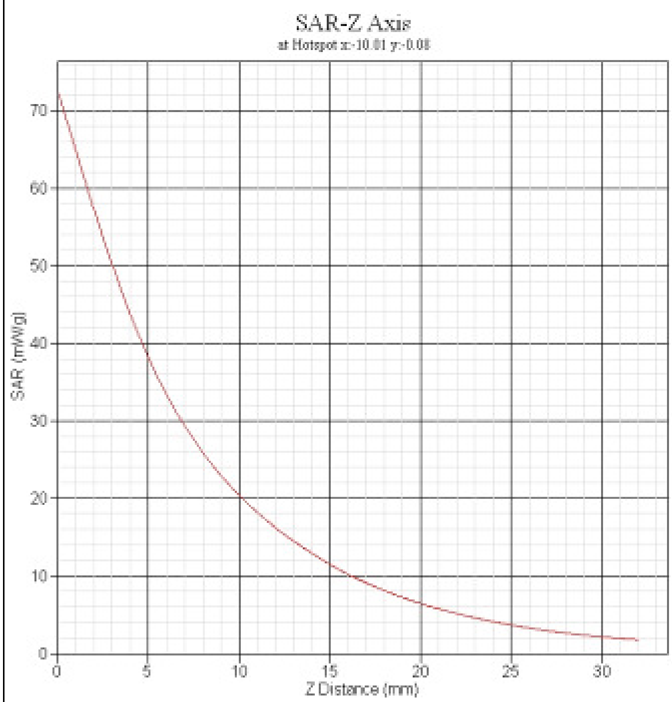


SAR 1g(W/kg)	9.553
SAR 10g(W/kg)	5.876

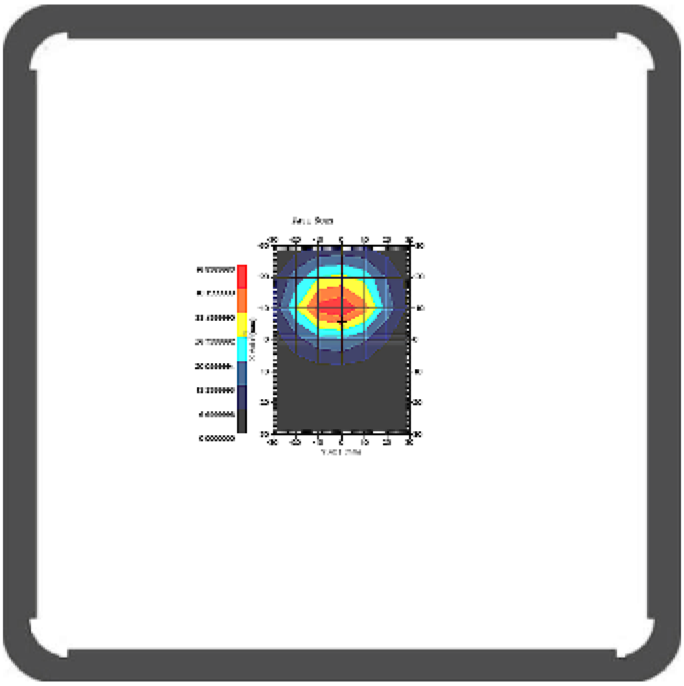
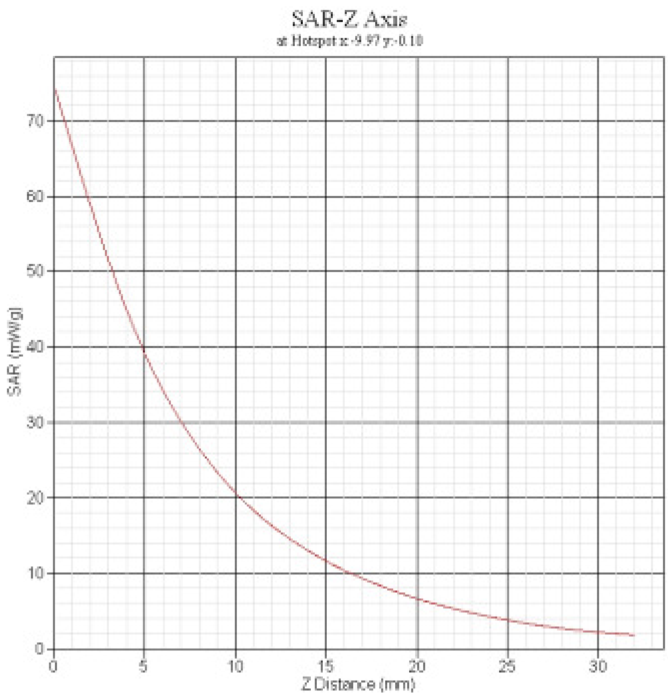
Frequency(MHz)	1900
Relative permittivity(real part)	41.55
Conductivity(S/m)	1.47
Variation(%)	0.168
Duty Cycle Factor	1
Crest factor	1
Conversion Factor	5.7
Probe Sensitivity	1.20 1.20 1.20 μV/(V/m)2
Data	2012-05-28
	
SAR 1g(W/kg)	38.546
SAR 10g(W/kg)	19.228

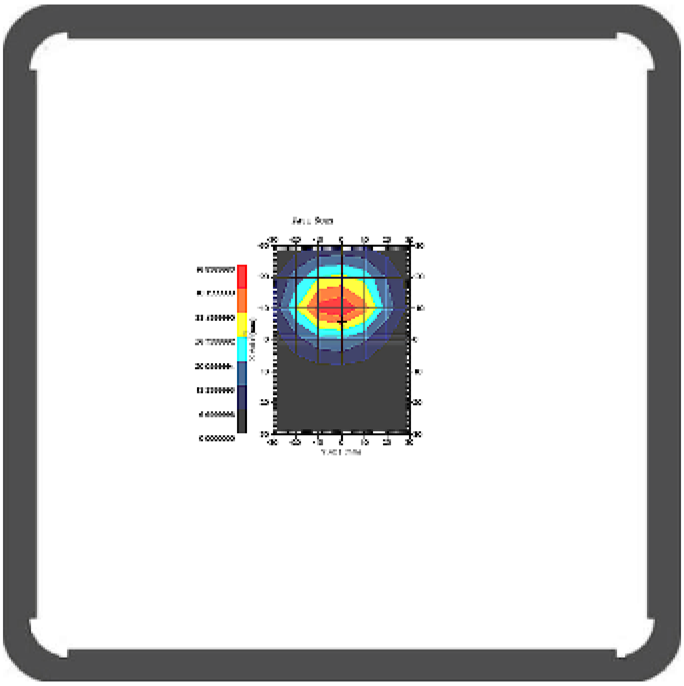
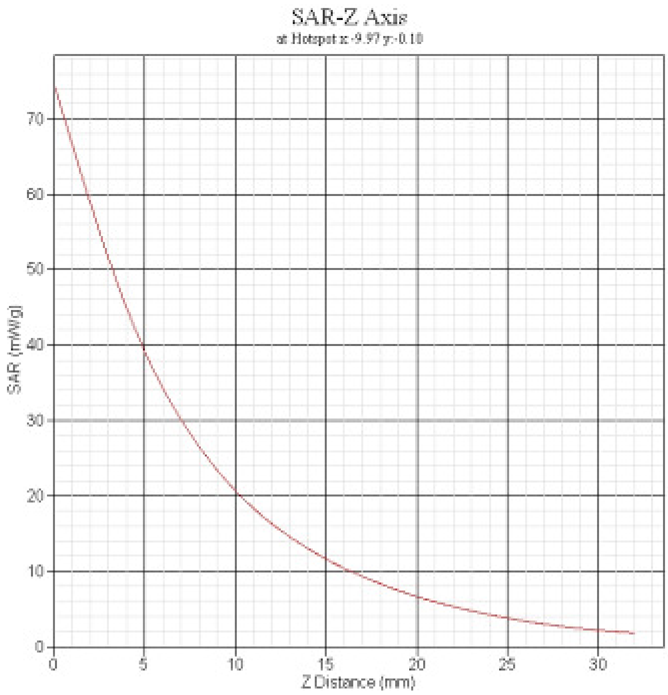
Frequency(MHz)	1900
Relative permittivity(real part)	41.56
Conductivity(S/m)	1.44
Variation(%)	0.168
Duty Cycle Factor	1
Crest factor	1
Conversion Factor	5.7
Probe Sensitivity	1.20 1.20 1.20 µV/(V/m)2
Data	2013-04-15





SAR 1g(W/kg)	38.683
SAR 10g(W/kg)	19.247

Frequency(MHz)	1900
Relative permittivity(real part)	52.90
Conductivity(S/m)	1.51
Variation(%)	-0.421
Duty Cycle Factor	1
Crest factor	1
Conversion Factor	5.4
Probe Sensitivity	1.20 1.20 1.20 μV/(V/m)2
Data	2012-05-28
	
SAR 1g(W/kg)	39.713
SAR 10g(W/kg)	19.764

Frequency(MHz)	1900
Relative permittivity(real part)	52.91
Conductivity(S/m)	1.50
Variation(%)	0.164
Duty Cycle Factor	1
Crest factor	1
Conversion Factor	5.4
Probe Sensitivity	1.20 1.20 1.20 μV/(V/m)2
Data	2013-04-15
	
SAR 1g(W/kg)	39.645
SAR 10g(W/kg)	19.736

4.2. Arrangement Assessment Setup

4.2.1. Test Positions of Device Relative to Head

This specifies exactly two test positions for the handset against the head phantom, the "cheek" position and the "tilted" position. The handset should be tested in both positions on the left and right sides of the SAM phantom. If the handset construction is such that it cannot be positioned using the handset positioning procedures described in 4.2.2.1 and 4.2.2.2 to represent normal use conditions (e.g. asymmetric handset), alternative alignment procedures should be considered with details provided in the test report.

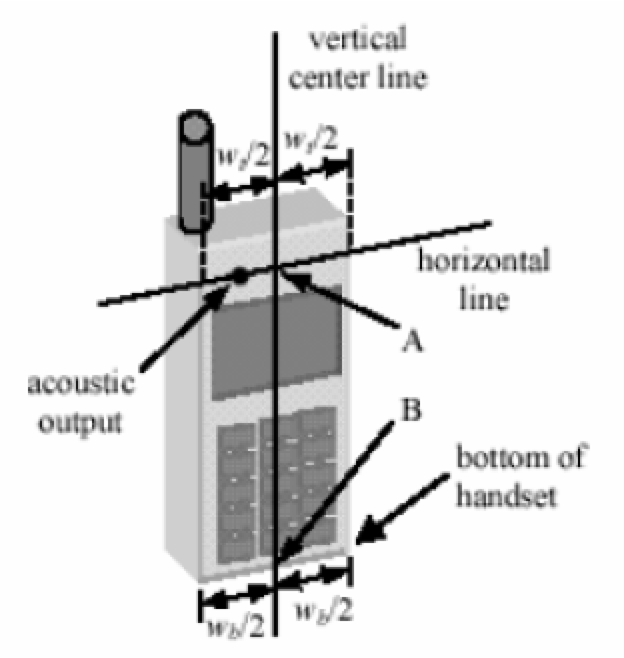


Figure 4.1a Internal Case

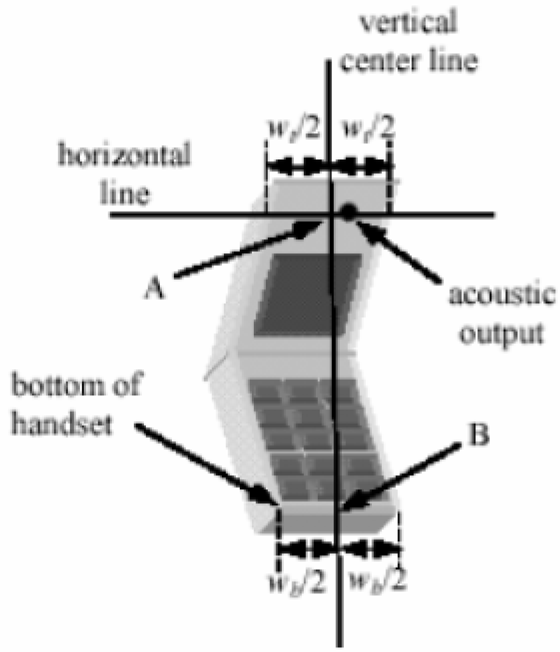


Figure4.1b Clam Shell

4.2.2.1. Definition of the "Cheek" Position

The "cheek" position is defined as follows:

a. Ready the handset for talk operation, if necessary. For example, for hand sets with a cover piece, open the cover. (If the handset can also be used with the cover closed both configurations must be tested.)

b. Define two imaginary lines on the handset: the vertical centerline and the horizontal line. The vertical centerline passes through two points on the front side of the handset: the midpoint of the width wt of the handset at the level of the acoustic output (point A on Figures 4.1 a and 4.1 b), and the midpoint of the width wb of the Back of the handset through the center of the acoustic output (see Figure 4.1 a). The two lines intersect at point A. Note that for many handsets, point A coincides with the center of the acoustic output. However, the acoustic output may be located elsewhere on the horizontal line. Also note that the vertical centerline is not necessarily parallel to the front Front of the handset (see Figure 4.1 b), especially for clamshell handsets, handsets with flip pieces, and other irregularly-shaped handsets.

c. Position the handset close to the surFront of the phantom such that point A is on the (virtual) extension of the line passing through points RE and LE on the phantom (see 4.2), such that the plan defined by the vertical center line and the horizontal line of the handset is approximately parallel to the sagittal plane of the phantom.
d. Translate the handset towards the phantom along the line passing through RE and LE until the handset touches the pinna.
e. While maintaining the handset in this plane, rotate it around the LE-RE line until the vertical centerline is in the plane normal to MB-NF including the line MB (called the reference plane).
f. Rotate the handset around the vertical centerline until the handset (horizontal line) is symmetrical with respect to the line NF.

While maintaining the vertical centerline in the reference plane, keeping point A on the line passing through RE and LE and maintaining the handset contact with the pinna, rotate the handset about the line NF until any point on the handset is in contact with a phantom point below the pinna (cheek). See Figure 4.2 the physical angles of rotation should be noted.

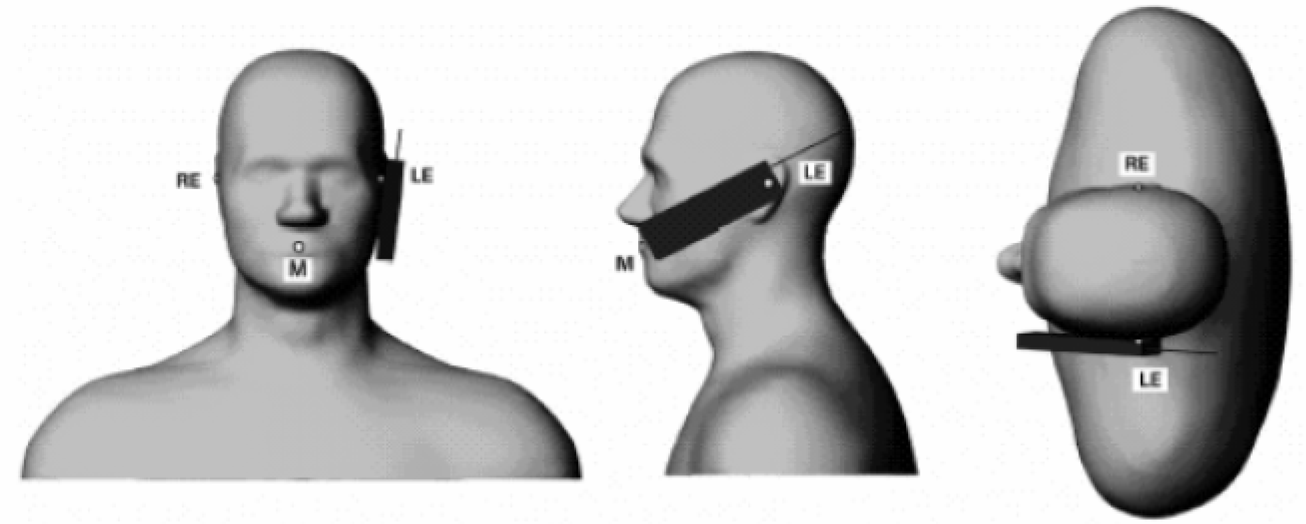


Figure 4.2 – Phone position 1, “cheek” or “touch” position.

4.2.1.2 Definition of the “Tilted” Position

The “tilted” position is defined as follows:

a. Repeat steps (a) – (g) of 4.2.1.1 to place the device in the “cheek position”.

b. While maintaining the orientation of the handset move the handset away from the pinna along the line passing through RE and LE in order to enable a rotation of the handset by 15 degrees.

c. Rotate the handset around the horizontal line by 15 degrees.

d. While maintaining the orientation of the handset, move the handset towards the phantom on a line passing through RE and LE until any part of the handset touches the ear. The tilted position is obtained when the contact is on the pinna. If the contact is at any location other than the pinna (e.g. the antenna with the Back of the phantom head), the angle of the handset should be reduced. In this case, the tilted position is obtained if any part of the handset is in contact with the pinna as well as a second part of the handset is contact with the phantom (e.g. the antenna with Back of the head).

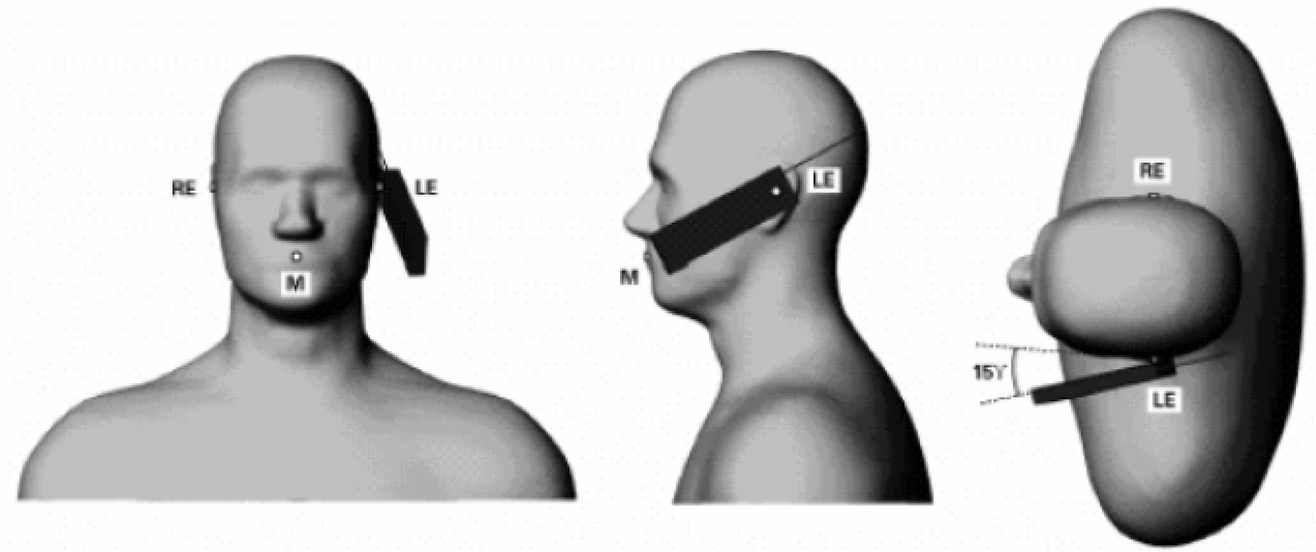


Figure 4.3 – Phone position 2, "tilted" position.

4.2.2. Test Positions for body-worn

Body-worn operating configurations should be tested with the belt-clips and holsters attached to the device and positioned against a flat phantom in normal use configurations. 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 distance may be use, but not exceed 2.5cm.

4.3. SAR Measurement Procedure

The ALSAS-10U calculates SAR using the following equation,

$$SAR = \frac{\sigma |E|^2}{\rho}$$

σ :represents the simulated tissue conductivity
ρ :represents the tissue density

The EUT is set to transmit at the required power in line with product specification, at each frequency relating to the LOW, MID, and HIGH channel settings.

Pre-scans are made on the device to establish the location for the transmitting antenna, using a large area scan in either air or tissue simulation fluid.

The EUT is placed against the Universal Phantom where the maximum area scan dimensions are large than the physical size of the resonating antenna. When the scan size is not large enough to cover the peak SAR distribution, it is modified by either extending the area scan size in both the X and Y directions, or the device is shifted within the predefined area.

The area scan is then run to establish the peak SAR location (interpolated resolution set at 1 mm^2) which is then used to orient the center of the zoom scan. The zoom scan is then executed and the 1g and 10g averages are derived from the zoom scan volume (interpolated resolution set at 1 mm^3).

5. SAR Exposure Limits

SAR assessments have been made in line with the requirements of IEEE C95.1-1999, IEEE 1528-2003 , FCC OET Bulletin 65 supplement C.

Type Exposure (W/kg)	Uncontrolled Environment Limit
Spatial Peak SAR (10g cube tissue for head and trunk)	1.60 W/kg
Spatial Average SAR (whole body)	0.08 W/kg
Spatial Peak SAR (10g for limb)	4.00 W/kg

6. Test Equipment List

Instrument	Manufacture	Model No.	Serial No.	Last Calibration
Universal Work Station	Aprel	ALS-UWS	100-00154	NCR
Data Acquisition Package	Aprel	ALS-DAQ-PAQ-3	110-00215	NCR
Probe Mounting Device and Boundary Detection Sensor System	Aprel	ALS-PMDPS-3	120-00265	NCR
Miniature E-Field Probe	Aprel	ALS-E-020	500-00273	Oct.01,2012
Left ear SAM Phantom	Aprel	ALS-P-SAM-L	130-00312	NCR
Right ear SAM Phantom	Aprel	ALS-P-SAM-R	140-00362	NCR
Universal SAM Phantom	Aprel	ALS-P-SU-1	150-00410	NCR
Reference Validation Dipole 850MHz	Aprel	ALS-D-850-S-2	180-00556	May.19,2011
Reference Validation Dipole 1900MHz	Aprel	ALS-D-1900-S-2	210-00707	May.16,2011
Dielectric Probe Kit	Aprel	ALS-PR-DIEL	260-00955	NCR
Device Holder 2.0	Aprel	ALS-H-E-SET-2	170-00506	NCR
SAR software	Aprel	ALS-SAR-AL-10	Ver.2.3.8	NCR
CRS C500C Controller	Thermo	ALS-C500	RCF0504291	NCR
CRS F3 Robot	Aprel	ALS-F3-SW	N/A	NCR
Power Amplifier	Mini-Circuit	ZHL- 42	040306	Jul.17,2012
Directional Coupler	Agilent	778D-012	51011	Jul.17,2012
Universal Radio Communication Tester	Agilent	E5515C	104845	Mar.1,2013
Vector Network	Agilent	E5071B	MY4230146	Jul.19,2012
Signal Generator	Agilent	E8257D	N/A	Dec.10,2012
Power Meter	Rohde&Schwarz	NRP	N/A	Dec.10,2012

Note: All equipment upon which need to be calibrated are with calibration period of 1 year, except validation dipole antenna of every 3 years.

7. Measurement Uncertainty

Exposure Assessment Measurement Uncertainty

Source of Uncertainty	Tolerance Value	Probability Distribution	Divisor	c_i^1 (1-g)	c_i^1 (10-g)	Standard Uncertainty (1-g) %	Standard Uncertainty (10-g) %
Measurement System							
Probe Calibration	3.5	normal	1	1	1	3.5	3.5
Axial Isotropy	3.7	rectangular	$\sqrt{3}$	$(1-cp)^{1/2}$	$(1-cp)^{1/2}$	1.5	1.5
Hemispherical Isotropy	10.9	rectangular	$\sqrt{3}$	$\sqrt{cp}$	$\sqrt{cp}$	4.4	4.4
Boundary Effect	1.0	rectangular	$\sqrt{3}$	1	1	0.6	0.6
Linearity	4.7	rectangular	$\sqrt{3}$	1	1	2.7	2.7
Detection Limit	1.0	rectangular	$\sqrt{3}$	1	1	0.6	0.6
Readout Electronics	1.0	normal	1	1	1	1.0	1.0
Response Time	0.8	rectangular	$\sqrt{3}$	1	1	0.5	0.5
Integration Time	1.7	rectangular	$\sqrt{3}$	1	1	1.0	1.0
RF Ambient Condition	3.0	rectangular	$\sqrt{3}$	1	1	1.7	1.7
Probe Positioner Mech.	0.4	rectangular	$\sqrt{3}$	1	1	0.2	0.2
Restriction							
Probe Positioning with respect to Phantom Shell	2.9	rectangular	$\sqrt{3}$	1	1	1.7	1.7
Extrapolation and Integration	3.7	rectangular	$\sqrt{3}$	1	1	2.1	2.1
Test Sample Positioning	4.0	normal	1	1	1	4.0	4.0
Device Holder Uncertainty	2.0	normal	1	1	1	2.0	2.0
Drift of Output Power	0.6	rectangular	$\sqrt{3}$	1	1	0.3	0.3
Phantom and Setup							
Phantom Uncertainty(shape & thickness tolerance)	3.4	rectangular	$\sqrt{3}$	1	1	2.0	2.0
Liquid Conductivity(target)	5.0	rectangular	$\sqrt{3}$	0.7	0.5	2.0	1.4
Liquid Conductivity(meas.)	0.0	normal	1	0.7	0.5	0.0	0.0

Liquid Permittivity(target)	5.0	rectangular	$\sqrt{3}$	0.6	0.5	1.7	1.4
Liquid Permittivity(meas.)	2.4	normal	1	0.6	0.5	1.4	1.2
Combined Uncertainty		RSS				9.3	9.2
Combined Uncertainty (coverage factor=2)		Normal(k=2)				18.7	18.3

8. SAR Test Results

8.1. Conducted Power(Unit:dBm)

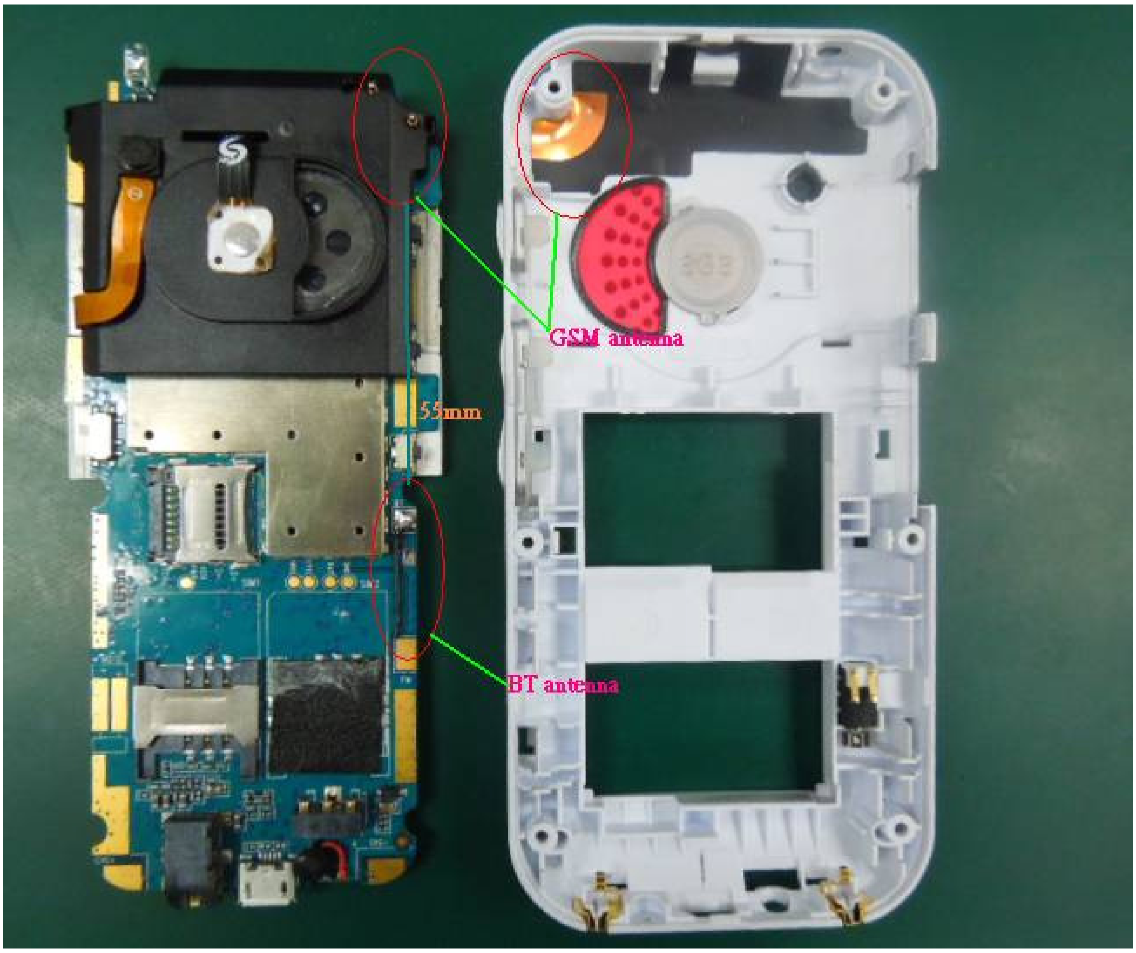
<GSM Conducted Power>

Band	GSM850			GSM1900		
Channel	128	190	251	512	661	810
Frequency(MHz)	824.2	836.6	848.8	1850.2	1880.0	1909.8
GSM	32.64	**32.72**	32.68	**29.80**	29.70	29.72

<Bluetooth Conducted Power>

Channel	Frequency	Bluetooth RF Output Power (dBm)		
		Data Rate / Modulation		
		GFSK	π /4-DQPSK	8-DPSK
		1Mbps	2Mbps	3Mbps
Ch00	2402MHz	**3.03**	1.11	1.01
Ch39	2441MHz	2.89	0.93	0.88
Ch78	2480MHz	2.54	0.57	0.51

8.2. Exposure Positions Consideration



Sides for SAR tests; Body-worn mode Test distance: 10 mm						
Band	Back	Front	Top	Bottom	Right	Left
GSM 850	✓	✓	X	X	X	X
GSM 1900	✓	✓	X	X	X	X

Note:

1. Base on KDB447498 D01v05 4.3.1.1 formula, BT SAR is exclude as below table:

	Wireless Interface	Bluetooth
	Tune-up Maximum power(dBm)	4
	Tune-up Maximum power(mW)	3
Head	Antenna to user(mm)	5
	SAR exclusion threshold(mW)	10
	SAR testing required or not?	NOT
Body	Antenna to user(mm)	10
	SAR exclusion threshold(mW)	19
	SAR testing required or not?	NOT

The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:

[(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] · [√f(GHz)] ≤ 3.0 for 1-g SAR and ≤ 7.5 for 10-g extremity SAR,

3mW(4dBm)/5mm*√2.45=0.939<3.0, So standalone Bluetooth SAR test is not required.

The SAR threshold for 5mm distance at 2450MHz is 10mW. The power of the BT transmitter is below 10mW. Therefore standalone SAR does not required.

8.3. SAR Test Results Summary

8.2.1 Test results for Head SAR Test

Band	Position	Channel	Measured Power(dBm)	Tune-up Power(dBm)	SAR 1g (W/kg)	Scale factor	Scaled SAR 1g(W/kg)
GSM850	LC	190	32.72	33	0.733	1.067	0.782
	LT	190	32.72	33	0.681	1.067	0.726
	RC	190	32.72	33	0.749	1.067	0.799
	RT	190	32.72	33	0.702	1.067	0.749
GSM1900	LC	512	29.80	30	0.346	1.047	0.362
	LT	512	29.80	30	0.476	1.047	0.498
	RC	512	29.80	30	0.500	1.047	0.524
	RT	512	29.80	30	0.563	1.047	0.590

8.2.2 Test results for Body-worn SAR Test

Band	Position	CH	Measured Power(dBm)	Tune-up Power(dBm)	SAR 1g (W/kg)	Scale factor	Scaled SAR 1g(W/kg)
GSM850	Front	190	32.72	33	0.736	1.067	0.785
	Back	128	32.64	33	0.749	1.086	0.814
	Back	190	32.72	33	1.071	1.067	1.142
	Back	251	32.68	33	0.895	1.076	0.936
GSM850 + earphone	Back	251	32.68	33	0.970	1.076	1.044
GSM1900	Front	512	29.80	30	0.161	1.047	0.169
	Back	512	29.80	30	0.532	1.047	0.557
GSM1900 + earphone	Back	512	29.80	30	0.452	1.047	0.473

8.2.3 Repeated SAR Measurement

Band	Position	CH	Measured Power (dBm)	Tune-up Power (dBm)	SAR 1g (W/kg)	Scale factor	Scaled SAR 1g(W/kg)
GSM850	Back	190	32.72	33	1.071	1.067	1.142
	Back	190	32.72	33	1.058	1.067	1.128

Note：

1. Per KDB 865664 D01v01,for each frequency band, repeated SAR measurement is required only when the measured SAR is≥0.8W/kg
2. Per KDB 447498D01v05, for each exposure position, if the highest output channel<0.8W/kg, other channels SAR testing are not necessary.
3. Per KDB 865664 D01v01,if the deviation among the repeated measurement is≤20% and the measured SAR<1.45W/kg, only one repeated measurement is required.
4. The deviation is the difference in percentage between original and repeated measured SAR.
5. All measurement SAR result is scaled-up to account for tune-up tolerance and is compliant.

8.4. Simultaneous Transmitting Configurations

Simultaneous Transmitting Configuration	Applicable Combination
Simultaneous Transmission	**WWAN+BT**

1. If 1g SAR sum>1.6W/kg, SPLSR calculation is necessary.
2. For simultaneous transmission analysis, Bluetooth SAR is estimated per KDB447498 D01v05 base on formula as below:

   (*max. power of channel, including tune-up tolerance, mW*)/(*min. test separation distance, mm*)]·[√f(GHz)/*x*] W/kg for *test separation distances* ≤ 50 mm;

   where x = 7.5 for 1-g SAR, and x = 18.75 for 10-g SAR.0.4 W/kg for 1-g SAR and 1.0 W/kg for 10-g SAR, when the *test separation distances* is> 50 mm.
3. If the test separation distance(antenna-user)is<5mm.5mm is used for estimated SAR calculation.

	Head(0 cm)	Body(1 cm)
Estimated SAR(W/kg)	0.125W/kg	0.063W/kg

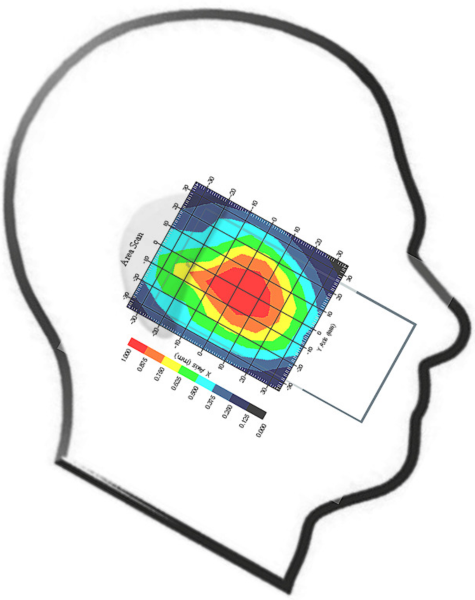
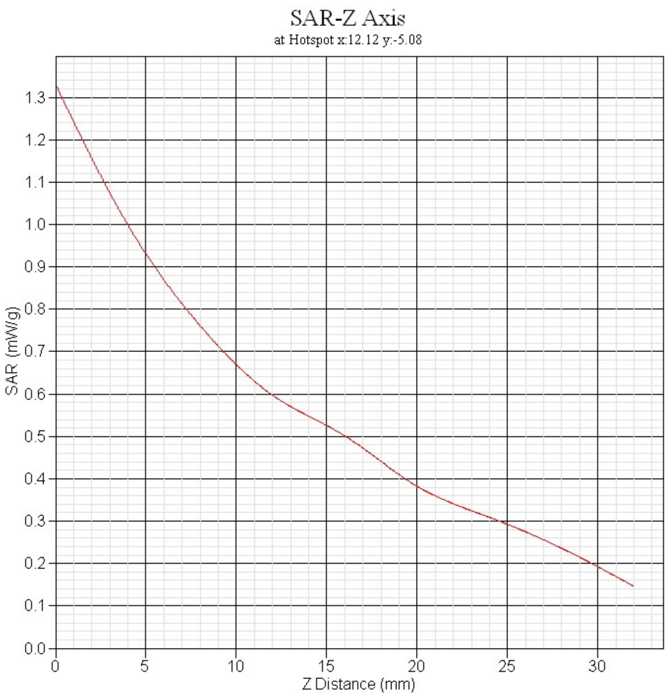
<Head SAR>

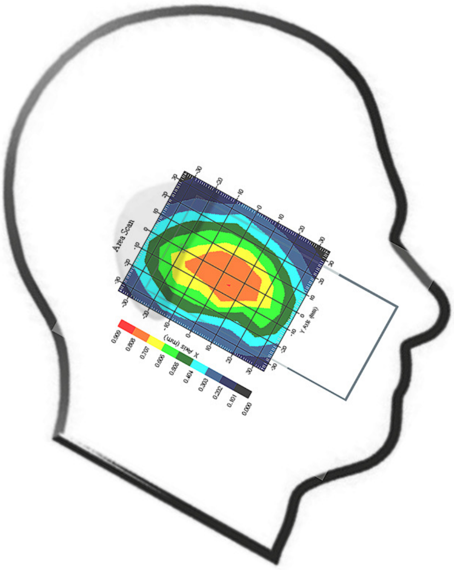
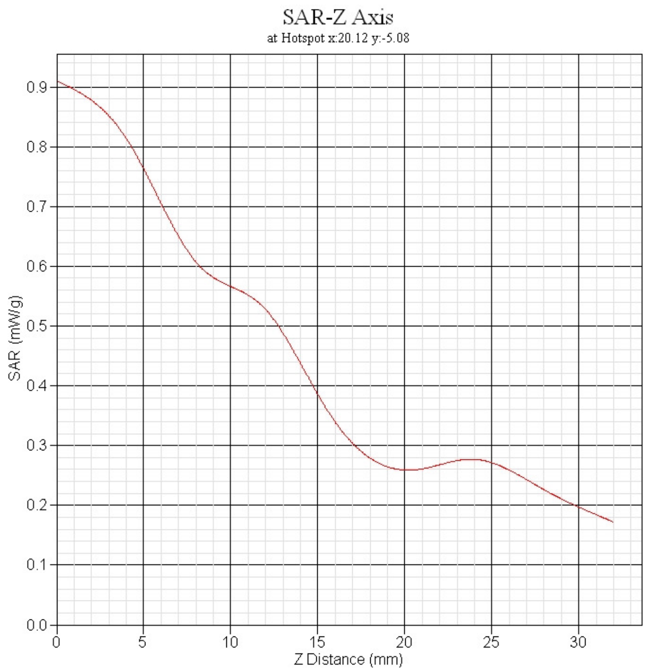
	Scaled WWAN		Scaled BT	Scaled WWAN+BT
Position	**WWAN band**	**Max. WWAN SAR**	**Max. WLAN SAR**	
Left Cheek	GSM850	0.782	0.125	0.907
	GSM1900	0.362	0.125	0.487
Left Tilt	GSM850	0.726	0.125	0.851
	GSM1900	0.498	0.125	0.623
Right Cheek	GSM850	0.799	0.125	0.924
	GSM1900	0.524	0.125	0.649
Right Tilt	GSM850	0.749	0.125	0.874
	GSM1900	0.590	0.125	0.715

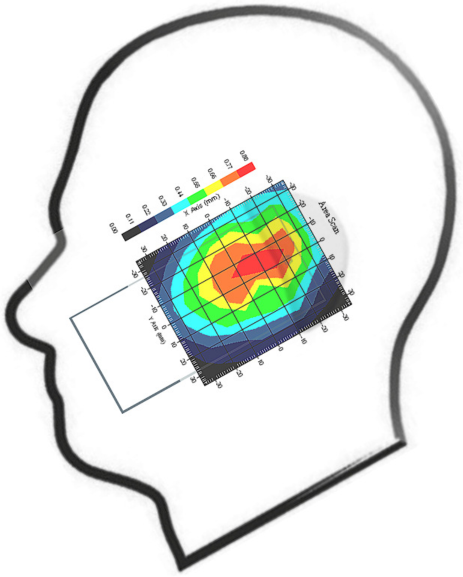
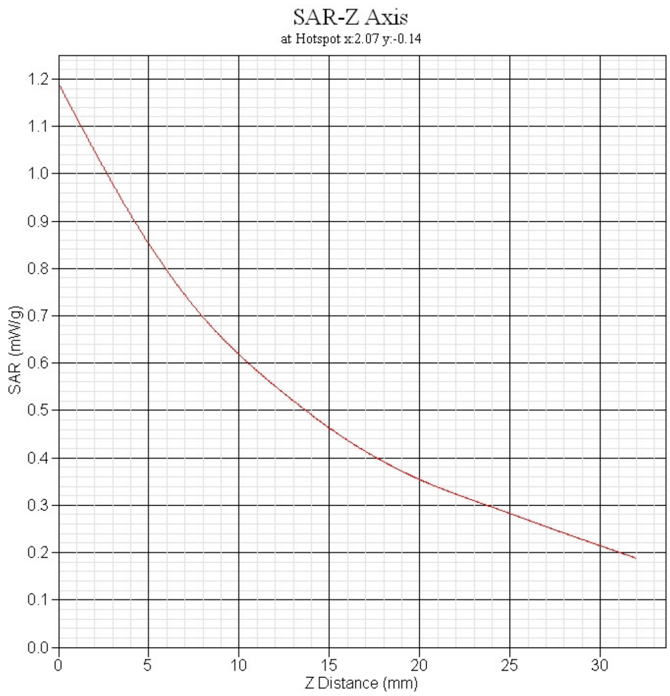
< Body-worn SAR>

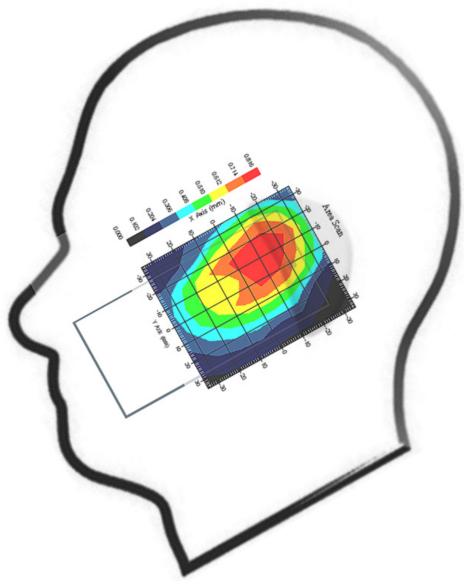
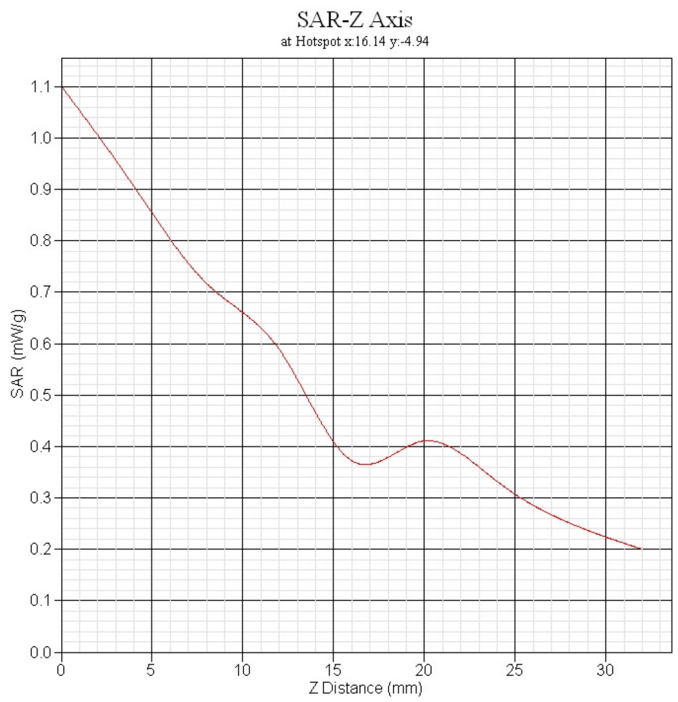
	Scaled WWAN		Scaled BT	Scaled WWAN+BT
Position	**WWAN band**	**Max. WWAN SAR**	**Max. WLAN SAR**	
Front	GSM850	0.785	0.063	0.848
	GSM1900	0.169	0.063	0.232
Back	GSM850	1.142	0.063	1.205
	GSM1900	0.557	0.063	0.620
Back (With earphone)	GSM850	1.044	0.063	1.107
	GSM1900	0.473	0.063	0.536

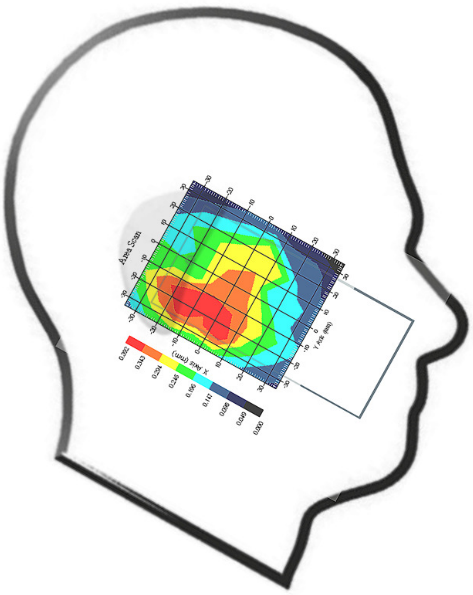
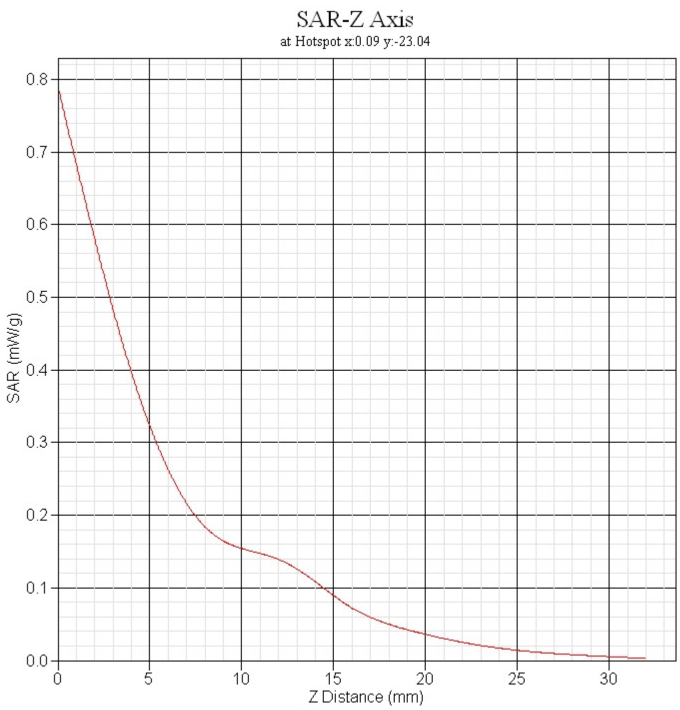
8.5. SAR Measurement Data

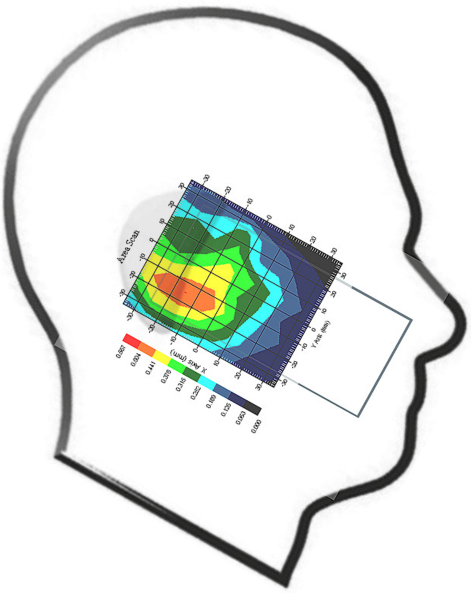
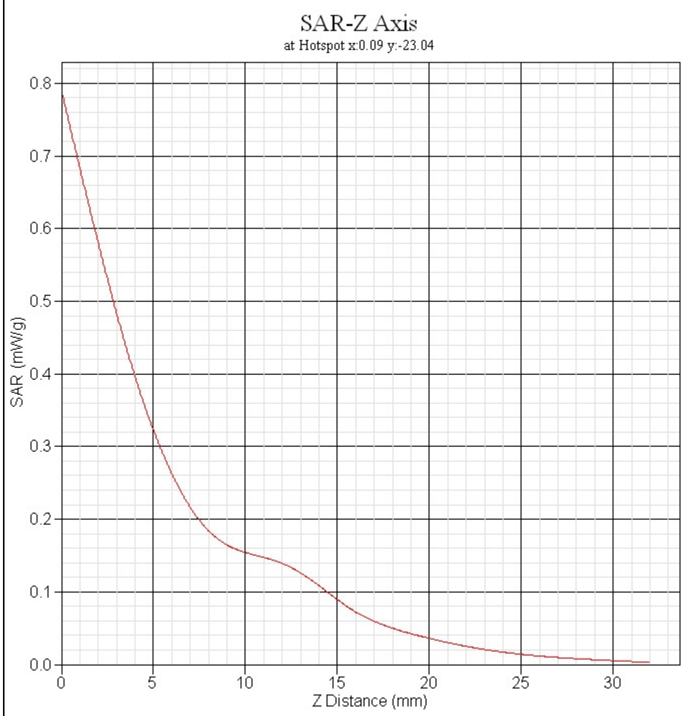
GSM850 left cheek ch190	
Frequency(MHz)	836.6
Relative permittivity(real part)	40.39
Conductivity(S/m)	0.92
Variation(%)	3.232
Duty Cycle Factor	8
Crest factor	8
4Conversion Factor	6.5
Probe Sensitivity	1.20 1.20 1.20 μV/(V/m)2
Data	2013-04-15
	
SAR 1g(W/kg)	0.733
SAR 10g(W/kg)	0.555

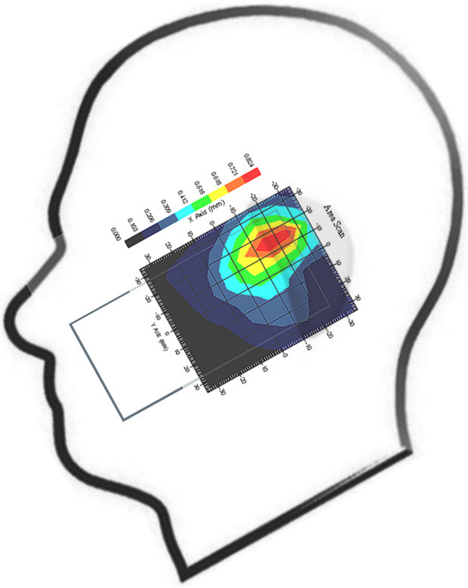
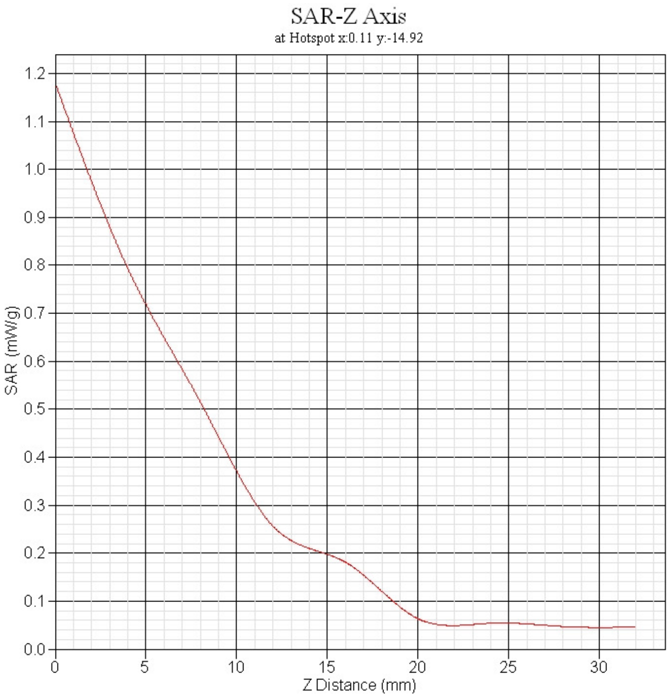
GSM850 left tilt ch190	
Frequency(MHz)	836.6
Relative permittivity(real part)	40.39
Conductivity(S/m)	0.92
Variation(%)	-2.088
Duty Cycle Factor	8
Crest factor	8
Conversion Factor	6.5
Probe Sensitivity	1.20 1.20 1.20 μV/(V/m)2
Data	2013-04-15
	
SAR 1g(W/kg)	0.681
SAR 10g(W/kg)	0.458

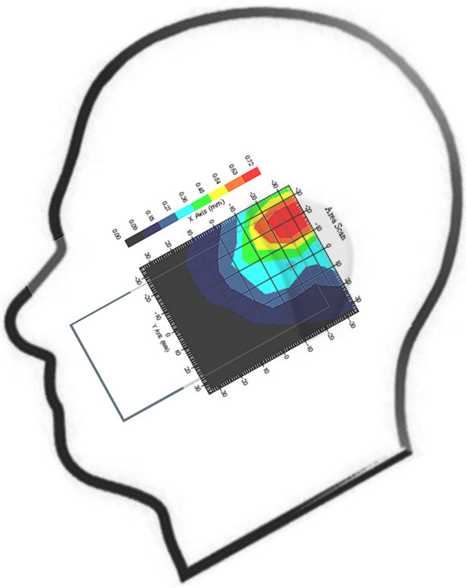
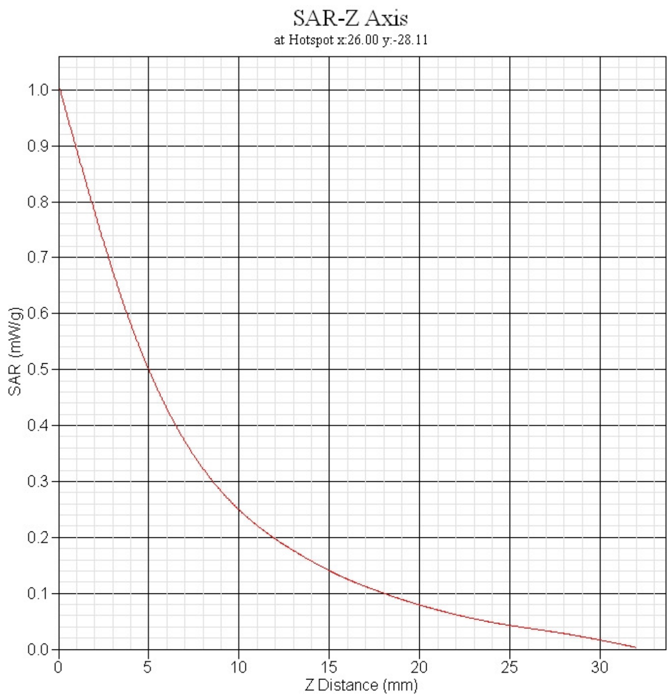
GSM850 Right cheek ch190	
Frequency(MHz)	836.6
Relative permittivity(real part)	40.39
Conductivity(S/m)	0.92
Variation(%)	3.436
Duty Cycle Factor	8
Crest factor	8
Conversion Factor	6.5
Probe Sensitivity	1.20 1.20 1.20 μV/(V/m)2
Data	2013-04-15
	
SAR 1g(W/kg)	0.749
SAR 10g(W/kg)	0.566

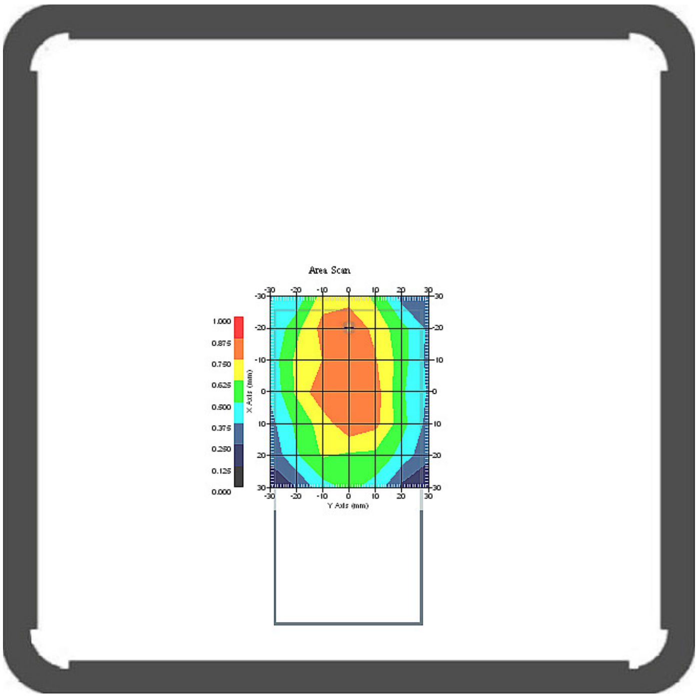
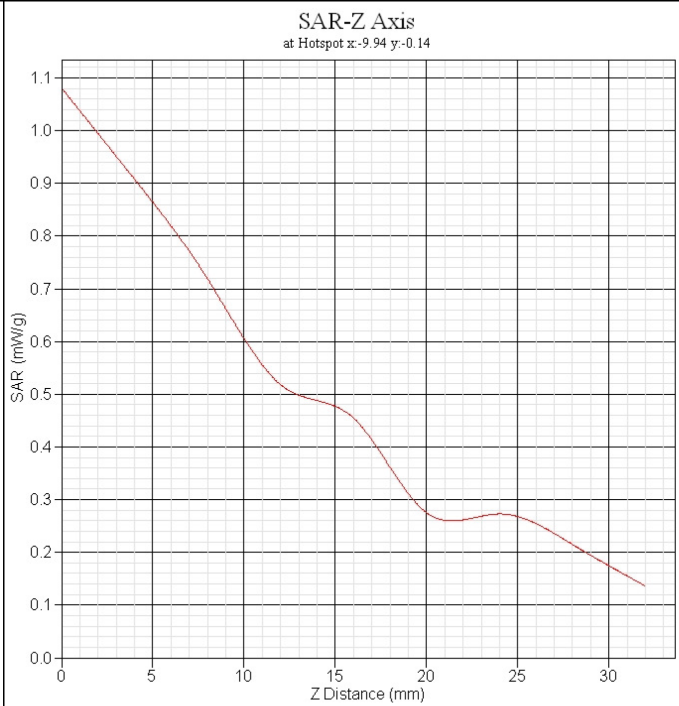
GSM850 Right tilt CH190	
Frequency(MHz)	836.6
Relative permittivity(real part)	40.39
Conductivity(S/m)	0.92
Variation(%)	-1.482
Duty Cycle Factor	8
Crest factor	8
Conversion Factor	6.5
Probe Sensitivity	1.20 1.20 1.20 μV/(V/m)2
Data	2013-04-15
	
SAR 1g(W/kg)	0.702
SAR 10g(W/kg)	0.517

GSM1900 Left cheek CH512	
Frequency(MHz)	1850.2
Relative permittivity(real part)	41.56
Conductivity(S/m)	1.44
Variation(%)	2.260
Duty Cycle Factor	8
Crest factor	8
Conversion Factor	5.7
Probe Sensitivity	1.20 1.20 1.20 μV/(V/m)2
Data	2013-04-15
	
SAR 1g(W/kg)	0.346
SAR 10g(W/kg)	0.181

GSM1900 Left tilt CH512	
Frequency(MHz)	1850.2
Relative permittivity(real part)	41.56
Conductivity(S/m)	1.44
Variation(%)	2.632
Duty Cycle Factor	8
Crest factor	8
Conversion Factor	5.7
Probe Sensitivity	1.20 1.20 1.20 μV/(V/m)2
Data	2013-04-15
	
SAR 1g(W/kg)	0.476
SAR 10g(W/kg)	0.246

GSM1900 Right cheek CH512	
Frequency(MHz)	1850.2
Relative permittivity(real part)	41.56
Conductivity(S/m)	1.44
Variation(%)	-2.237
Duty Cycle Factor	8
Crest factor	8
Conversion Factor	5.7
Probe Sensitivity	1.20 1.20 1.20 µV/(V/m)2
Data	2013-04-15
	
SAR 1g(W/kg)	0.500
SAR 10g(W/kg)	0.283

GSM1900 Right tilt CH512	
Frequency(MHz)	1850.2
Relative permittivity(real part)	41.56
Conductivity(S/m)	1.44
Variation(%)	-2.217
Duty Cycle Factor	8
Crest factor	8
Conversion Factor	5.7
Probe Sensitivity	1.20 1.20 1.20 μV/(V/m)2
Data	2013-04-15
	
SAR 1g(W/kg)	0.563
SAR 10g(W/kg)	0.339

GSM850 body Front CH190	
Frequency(MHz)	836.6
Relative permittivity(real part)	53.36
Conductivity(S/m)	0.95
Variation(%)	-2.773
Duty Cycle Factor	8
Crest factor	8
Conversion Factor	6.4
Probe Sensitivity	1.20 1.20 1.20 μV/(V/m)2
Data	2013-04-15
	
SAR 1g(W/kg)	0.736
SAR 10g(W/kg)	0.529