



FCC SAR TEST REPORT

Report No.: SET2014-01609
Product: Toughshield
Model No.: R750
FCC ID: OHV-R750
Applicant: Toughshield devices ltd
Address: 2nd Floor, Belgravia House, 34-44 Circular Road,
Douglas, Isle of Man. IM1 1AE
Issued by: CCIC-SET
Lab Location: Electronic Testing Building, Shahe Road, Xili, Nanshan
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Test Report

Product.....: Toughshield
Model No.: R750
Brand Name.....: ToughShield
FCC ID.....: OHV-R750
Applicant.....: Toughshield devices ltd
Applicant Address.....: 2nd Floor, Belgravia House, 34-44 Circular Road,
Douglas, Isle of Man. IM1 1AE
Manufacturer.....: Toughshield devices ltd
Manufacturer Address.....: 2nd Floor, Belgravia House, 34-44 Circular Road,
Douglas, Isle of Man. IM1 1AE
Test Standards.....: **7CFR § 2.1093-** Radiofrequency Radiation Exposure
Evaluation: Portable Devices;

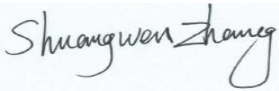
ANSI C95.1-1999: IEEE Standard for Safety Levels
with Respect to Human Exposure to Radio Frequency
Electromagnetic Fields, 3 kHz to 300 GHz;

IEEE 1528-2013: Recommended Practice for
Determining the Peak Spatial-Average Specific Absorption
Rate (SAR) in the Human Body Due to Wireless
Communications Devices: Experimental Techniques;

ANSI C95.1-1999: IEEE Standard for Safety Levels
with Respect to Human Exposure to Radio Frequency
Electromagnetic Fields, 3 kHz to 300 GHz;

Test Result.....: **Pass**

Tested by  **2014-03-07**
Mei Chun, Test Engineer

Reviewed by.....:  **2014-03-07**
Shuangwen Zhang, Senior Engineer

Approved by.....:  **2014-03-07**
Wu Li'an , Manager

Contents

1. GENERAL CONDITIONS	4
2. ADMINISTRATIVE DATA	5
2.1. Identification of the Responsible Testing Laboratory	5
2.2. Identification of the Responsible Testing Location(s)	5
2.3. Organization Item	5
2.4. Identification of Applicant	5
2.5. Identification of Manufacture	5
3. EQUIPMENT UNDER TEST (EUT)	6
4. OPERATIONAL CONDITIONS DURING TEST	7
4.1. Introduction	7
4.2. SAR Definition	7
4.3. Phantoms	8
4.4. Device Holder	8
4.5. Probe Specification	9
5. OPERATIONAL CONDITIONS DURING TEST	10
5.1. Schematic Test Configuration	10
5.2. SAR Measurement System	10
5.3. Equipments and results of validation testing	13
5.4. SAR measurement procedure	16
5.5. Antennas position and test position	17
6. CHARACTERISTICS OF THE TEST	18
6.1. Applicable Limit Regulations	18
6.2. Applicable Measurement Standards	19
7. LABORATORY ENVIRONMENT	19
8. CONDUCTED RF OUTPUT POWER	20
9. TEST RESULTS	26
10. MEASUREMENT UNCERTAINTY	32
11. MAIN TEST INSTRUMENTS	33

This Test Report consists of the following Annexes:

Annex A: Accreditation Certificate	34
Annex B: Test Layout	36
Annex C: Sample Photographs	43
Annex D: System Performance Check Data and Highest SAR Plots	45
Annex E: Calibration Certificate of Probe and Dipoles	82

1. GENERAL CONDITIONS

1.1 This report only refers to the item that has undergone the test.

1.2 This report standalone dose not constitute or imply by its own an approval of the product by the certification Bodies or competent Authorities.

1.3 This document is only valid if complete; no partial reproduction can be made without written approval of CCIC-SET

1.4 This report cannot be used partially or in full for publicity and/or promotional purposes without previous written approval of CCIC-SET and the Accreditation Bodies, if it applies.



2. Administrative Date

2.1. Identification of the Responsible Testing Laboratory

Company Name: CCIC-SET

Department: EMC & RF Department

Address: Electronic Testing Building, Shahe Road, Nanshan District,
ShenZhen, P. R. China

Telephone: +86-755-26629676

Fax: +86-755-26627238

**Responsible Test Lab
Managers:** Mr. Wu Li'an

2.2. Identification of the Responsible Testing Location(s)

Company Name: CCIC-SET

Address: Electronic Testing Building, Shahe Road, Nanshan District,
Shenzhen, P. R. China

2.3. Organization Item

CCIC-SET Report No.: SET2014-01609

CCIC-SET Project Leader: Mr. Li Sixiong

**CCIC-SET Responsible
for accreditation scope:** Mr. Wu Li'an

Start of Testing: 2014-02-24

End of Testing: 2014-02-25

2.4. Identification of Applicant

Company Name: Toughshield devices ltd

Address: 2nd Floor, Belgravia House, 34-44 Circular Road, Douglas,
Isle of Man. IM1 1AE

2.5. Identification of Manufacture

Company Name: Toughshield devices ltd

Address: 2nd Floor, Belgravia House, 34-44 Circular Road, Douglas,
Isle of Man. IM1 1AE

Notes: This data is based on the information by the applicant.

3. Equipment Under Test (EUT)

3.1. Identification of the Equipment under Test

Sample Name:	ToughShield	
Type Name:	R750	
Brand Name:	ToughShield	
	Support Band	GSM850MHz/1900MHz/900MHz/1800MHz WCDMA 1900MHz/850MHz/2100MHz Wi-Fi 2.4GHz/ Bluetooth 2.4GHz/GPS/NFC
	Test Band	GSM 850MHz/ GSM 1900MHz WCDMA 1900/850MHz Wi-Fi 802.11b
	Multislot Class	GPRS:Class 12 EGPRS:Class 12
	GPRS Class	Class B
	EGPRS Class	Class B
General description:	Development Stage	Identical Prototype
	Accessories	Power Supply
	Battery type	BAK654460A
	Battery specification	3.7V/2000mAh
	Antenna type	PIFI Antenna
	Operation mode	GSM / GPRS/WCDMA / Bluetooth / WIFI/NFC/GPS
	Modulation mode	GMSK, 8PSK,QPSK, DSSS, OFDM, GFSK/ π /4-DQPSK/8-DPSK
	Max. SAR Value	Head:0.360w/kg; Body:1.164w/kg

NOTE:

- The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.
- This device supports GPRS / EGPRS operation up to class12
(max.uplin:4, max.downlink:4, total timeslots:5)
- The EUT does not support 16QAM uplink function in HSPA+ mode.

4 Specific Absorption Rate (SAR)

4.1 Introduction

SAR is related to the rate at which energy is absorbed per unit mass in an object exposed to a radio field. The SAR distribution in a biological body is complicated and is usually carried out by experimental techniques or numerical modeling. The standard recommends limits for two tiers of groups, occupational/controlled and general population/uncontrolled, based on a person's awareness and ability to exercise control over his or her exposure. In general, occupational/controlled exposure limits are higher than the limits for general population/uncontrolled.

4.2 SAR Definition

The SAR definition is the time derivative (rate) of the incremental energy (dW) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dv) of a given density (ρ). The equation description is as below:

$$\text{SAR} = \frac{d}{dt} \left(\frac{dW}{dm} \right) = \frac{d}{dt} \left(\frac{dW}{\rho dv} \right)$$

SAR is expressed in units of Watts per kilogram (W/kg)

SAR measurement can be either related to the temperature elevation in tissue by

$$\text{SAR} = C \frac{\delta T}{\delta t}$$

where C is the specific heat capacity, δT is the temperature rise and δt the exposure duration, or related to the electrical field in the tissue by

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

where σ is the conductivity of the tissue, ρ is the mass density of the tissue and E is the rms electrical field strength.

However for evaluating SAR of low power transmitter, electrical field measurement is typically applied.

4.3 Phantoms

The phantom used for all tests i.e. for both system checks and device testing, was the twin-headed "SAM Phantom", manufactured by SATIMO. The SAM twin phantom is a fiberglass shell phantom with 2mm shell thickness (except the ear region, where shell thickness increases to 6mm).

System checking was performed using the flat section, whilst Head SAR tests used the left and right head profile sections. Body SAR testing also used the flat section between the head profiles.

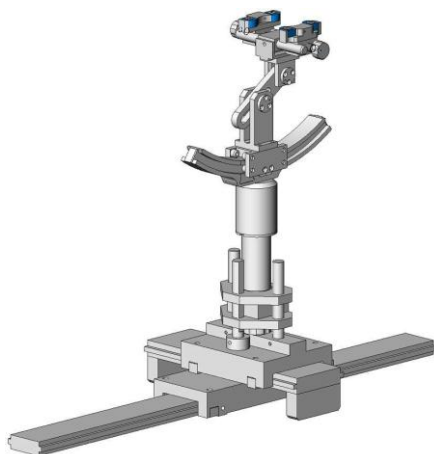


SAM Twin Phantom

4.4 Device Holder

The device was placed in the device holder (illustrated below) that is supplied by SATIMO as an integral part of the COMOSAR test system.

The device holder is designed to cope with the different positions given in the standard. It has two scales for device rotation (with respect to the body axis) and device inclination (with respect to the line between the ear reference points). The rotation centers for both scales is the ear reference point (ERP). Thus the device needs no repositioning when changing the angles.



Device holder

4.5 Probe Specification

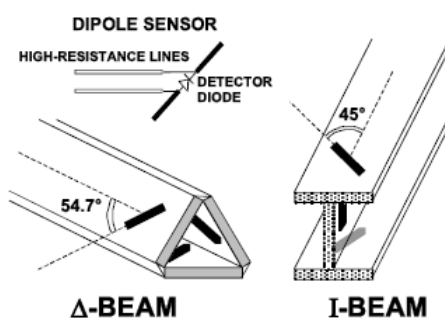


Construction	Symmetrical design with triangular core Interleaved sensors Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
Calibration	ISO/IEC 17025 calibration service available.
Frequency	700 MHz to 3 GHz; Linearity: ± 0.5 dB (700 MHz to 3 GHz)
Directivity	± 0.25 dB in HSL (rotation around probe axis) ± 0.5 dB in tissue material (rotation normal to probe axis)
Dynamic Range	1.5 μ W/g to 100 mW/g; Linearity: ± 0.5 dB
Dimensions	Overall length: 330 mm (Tip: 20 mm) Tip diameter: 5 mm (Body: 8 mm) Distance from probe tip to dipole centers: <2.7 mm
Application	General dosimetry up to 3 GHz Dosimetry in strong gradient fields Compliance tests of mobile phones
Compatibility	COMOSAR

Isotropic E-Field Probe

The isotropic E-Field probe has been fully calibrated and assessed for isotropicity, and boundary effect within a controlled environment. Depending on the frequency for which the probe is calibrated the method utilized for calibration will change.

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



5 OPERATIONAL CONDITIONS DURING TEST

5.1 Schematic Test Configuration

During SAR test, EUT was operating in Traffic Mode (Channel Allocated) at Normal Voltage Condition. A communication link is set up with a System Simulator (SS) by air link, and a call is established.

The Absolute Radio Frequency Channel Number (ARFCN) was allocated to 128, 190 and 251 respectively in the case of GSM 850MHz, or to 512, 661 and 809 respectively in the case of PCS 1900MHz, or to 4132, 4183 and 4233 respectively in the case of WCDMA 850MHz, or to 9262, 9400 and 9538 respectively in the case of WCDMA 1900 MHz. The EUT was commanded to operate at maximum transmitting power.

The EUT should use its internal transmitter. The antenna(s), battery and accessories shall be those specified by the manufacturer. The EUT battery must be fully charged and checked periodically during the test to ascertain uniform power output. If a wireless link was used, the antenna connected to the output of the base station simulator shall be placed at least 50 cm away from the handset.

The signal transmitted by the simulator to the antenna feeding point should be lower than the output power level of the handset by at least 35 dB

5.2 SAR Measurement System

The SAR measurement system being used is the SATIMO system, the system is controlled remotely from a PC, which contains the software to control the robot and data acquisition equipment. The software also displays the data obtained from test scans.

In operation, the system first does an area (2D) scan at a fixed depth within the liquid from the inside wall of the phantom. When the maximum SAR point has been found, the system will then carry out a 3D scan centred at that point to determine volume averaged SAR level.

5.2.1 Tissue Dielectric Parameters for Head and Body Phantoms

The head tissue dielectric parameters recommended by the IEEE SCC-34/SC-2 in P1528 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 Power drifts 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 described in Reference [12] and extrapolated according to the head parameters specified in P1528.

Table 1: Recommended Dielectric Performance of Tissue

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

Table 2 Recommended Tissue Dielectric Parameters

Frequency (MHz)	Head Tissue		Body Tissue	
	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

5.2.2 Simulant liquids

For measurements against the phantom head, the “cheek” and “tilt” position on both the left hand and the right hand sides of the phantom. For body-worn measurements, the EUT was tested against flat phantom representing the user body. The EUT was put on in the belt holder. Simulant liquids that are used for testing at frequencies of GSM 850MHz, GSM 1900MHz, WCDMA 850MHz WCDMA 1900MHz, and Wi-Fi 2.4GHz, which are made mainly of sugar, salt and water solutions may be left in the phantoms.

Table 3: Dielectric Performance of Head Tissue Simulating Liquid

Temperature: 23.2°C; Humidity: 64%;					
/	Frequency	Permittivity ϵ	Conductivity σ (S/m)	Deviation (%)	
Target value	835MHz	41.5	0.90	ϵ	σ
Validation value (February 24th, 2014)	835MHz	41.45	0.91	-0.1	1.1
Target value	1900MHz	40.0	1.40	--	--
Validation value (February 24th, 2014)	1900MHz	39.98	1.41	-0.1	0.7
Target value	2450MHz	39.2	1.80	--	--
Validation value (February 24th, 2014)	2450MHz	38.98	1.81	-0.6	0.6

Table 4: Dielectric Performance of Body Tissue Simulating Liquid

Temperature: 23.2°C; Humidity: 64%;					
/	Frequency	Permittivity ϵ	Conductivity σ (S/m)	Deviation (%)	
Target value	835MHz	55.2	0.97	ϵ	σ
Validation value (February 25th, 2014)	835MHz	55.27	0.98	0.1	1.0
Target value	1900MHz	53.3	1.52	--	--
Validation value (February 25th, 2014)	1900MHz	53.28	1.53	0.0	-0.7
Target value	2450MHz	52.7	1.95	--	--
Validation value (February 25th, 2014)	2450MHz	52.64	1.96	-0.1	0.5

According to Annex F (IEC62209-2), the delta SAR refers to the percent change in SAR relative to the percent change in dielectric properties versus the target values. A negative delta SAR would translate to a lower measured SAR value than what would be measured if using dielectric properties equal to the target values. A positive delta SAR would translate to a higher measured SAR value than what would be measured if using dielectric properties equal to the target values. SAR correction shall not be made when the delta SAR has a

positive sign to provide a conservative SAR value. The SAR is only corrected when delta SAR has a negative sign. The Δ SAR were given as follow:

Table 5: Δ SAR of each band

Frequency	SAR correction formula	Δ SAR	
		Head	Body
835MHz	$0.7521 \cdot \Delta \sigma(\%) - 0.2194 \cdot \Delta \epsilon(\%)$	>0	>0
1900MHz	$0.594 \cdot \Delta \sigma(\%) - 0.1556 \cdot \Delta \epsilon(\%)$	>0	>0
2450MHz	$0.4801 \cdot \Delta \sigma(\%) - 0.225 \cdot \Delta \epsilon(\%)$	>0	>0

Since each band has a positive Δ SAR, the SAR correction is not required.



Fig. 1 Configuration of body tissue

5.3 Equipments and results of validation testing

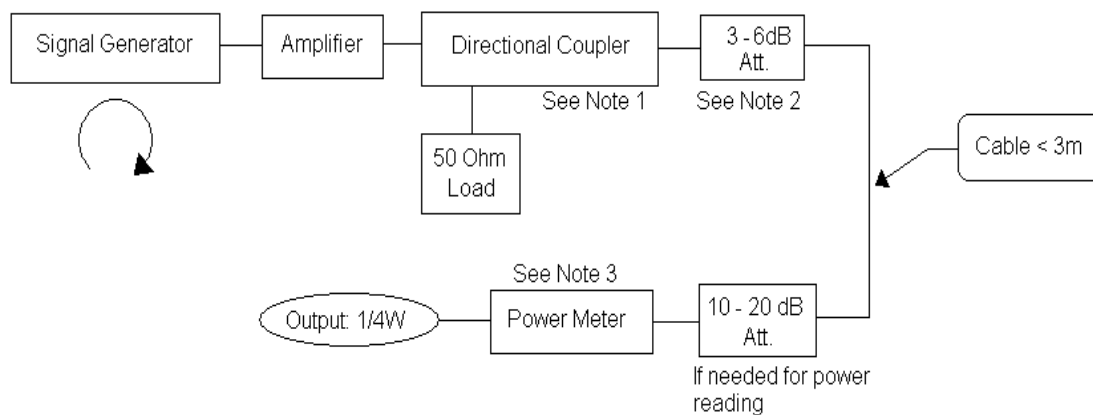
Important equipments :

Equipment description	Manufacturer/Model	Identification No.
System Simulator	E5515C	GB 47200710
SAR Probe	SATIMO	SN 09/13 EP169
Dipole	SID835	SN 09/13 DIP 0G835-217
Dipole	SID1900	SN 09/13 DIP 1G900-218
Dipole	SID2450	SN 09/13 DIP 2G450-220
Vector Network Analyzer	ZVB8	A0802530

Signal Generator	SMR27	A0304219
Amplifier	Nucletudes	143060
Power Meter	NRVS	1020.1809.02
Power Sensor	NRV-Z4	100069
Multimeter	Keithley-2000	4014020
Device Holder	SATIMO	SN 09/13 MSH80
SAM Phantom	SAM97	SN 09/13 SAM97

Prior to the assessment, the system validation kit was used to test whether the system was operating within its specifications of $\pm 10\%$. The validation results are tabulated below. And also the corresponding SAR plot is attached as well in the SAR plots files.

The following procedure, recommended for performing validation tests using box phantoms is based on the procedures described in the draft IEEE standard P1528. Setup according to the setup diagram below :



With the SG and Amp and with directional coupler in place, set up the source signal at the relevant frequency and use a power meter to measure the power at the end of the SMA cable that you intend to connect to the balanced dipole. Adjust the SG to make this, say, 0.25W (24 dBm). If this level is too high to read directly with the power meter sensor, insert a calibrated attenuator (e.g. 10 or 20 dB) and make a suitable correction to the power meter reading.

Note 1: In this method, the directional coupler is used for monitoring rather than setting the exact feed power level. If, however, the directional coupler is used for power measurement, you should check the frequency range and power rating of the coupler and measure the coupling factor (referred to output) at the test frequency using a VNA.

Note 2: Remember that the use of a 3dB attenuator (as shown in Figure 8.1 of P1528) means that you need an RF amplifier of 2 times greater power for the same feed power. The other issue is the cable length. You might get up to 1dB of loss per meter of cable, so the cable length after the coupler needs to be quite short.

Note 3: For the validation testing done using CW signals, most power meters are suitable. However, if you are measuring the output of a modulated signal from either a signal generator or a handset, you must ensure that the power meter correctly reads the modulated signals.

The measured 1-gram averaged SAR values of the device against the phantom are provided in Tables 7 and Table 8. The humidity and ambient temperature of test facility were 64% and 23.2°C respectively. The body phantom were full of the body tissue simulating liquid. The EUT was supplied with full-charged battery for each measurement.

The distance between the back of the EUT and the bottom of the flat phantom is 10 mm (taking into account of the IEEE 1528 and the place of the antenna).

Table 7: Head Liquid Verification Results (1g)

Frequency	Duty cycle	Target value (W/kg)	Test value (W/kg)	
			250 mW	1W
835MHz (February 24th, 2014)	1:1	9.72	2.46	9.84
1900MHz (February 24th, 2014)	1:1	40.95	9.77	39.08
2450MHz (February 24th, 2014)	1:1	53.33	13.15	52.60

Note: Target value was referring to the required value in the calibration certificate of reference dipole.

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

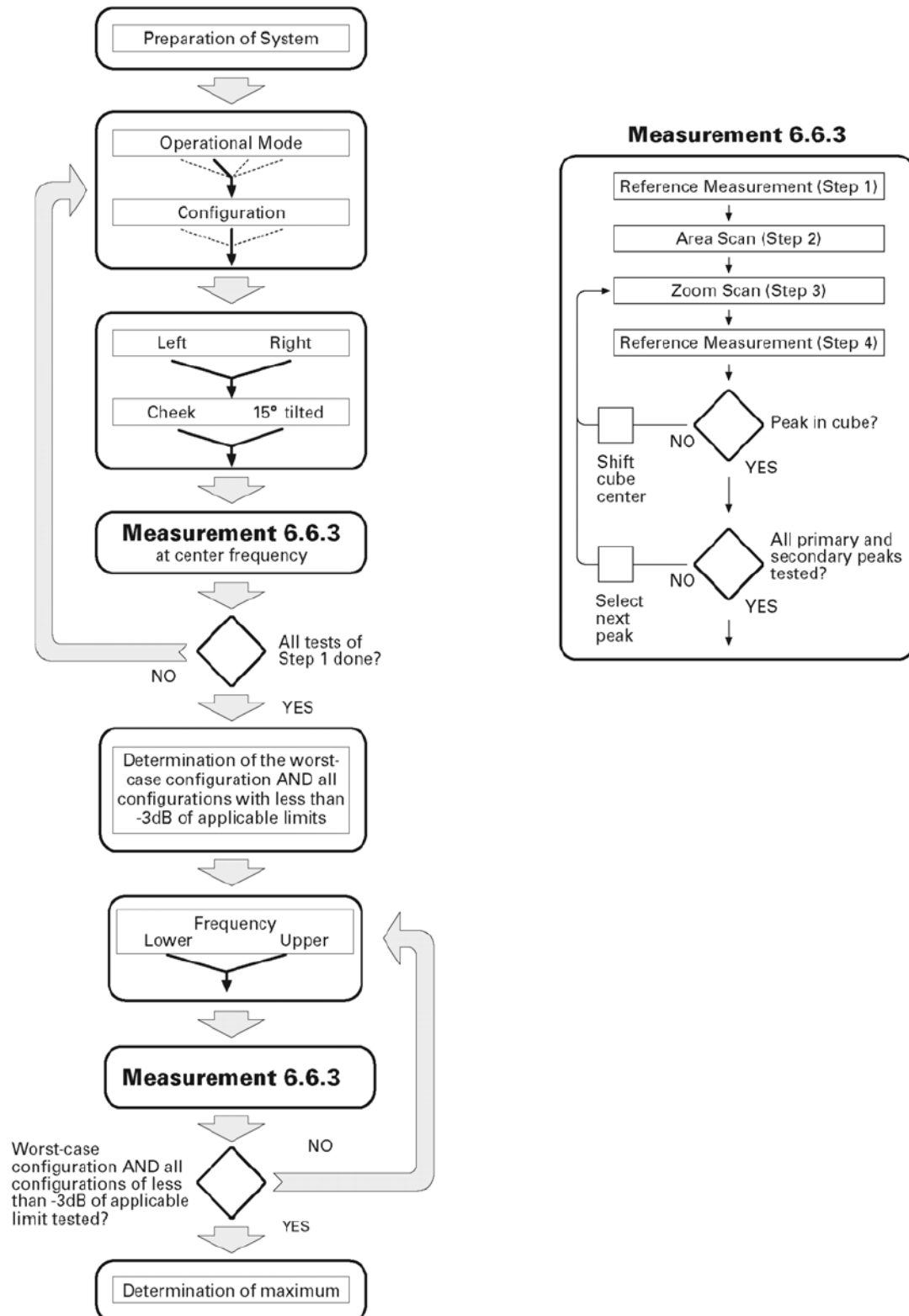
Table 8: Body Liquid Verification Results (1g)

Frequency	Duty cycle	Target value (W/kg)	Test value (W/kg)	
			250 mW	1W
835MHz (February 25th, 2014)	1:1	9.92	2.43	9.72
1900MHz (February 25th, 2014)	1:1	40.29	9.98	39.92
2450MHz (February 25th, 2014)	1:1	51.99	13.10	52.40

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

5.4 SAR measurement procedure

The SAR test against the head phantom was carried out as follow:



Establish a call with the maximum output power with a base station simulator, the connection between the EUT and the base station simulator is established via air interface.

After an area scan has been done at a fixed distance of 8mm from the surface of the

phantom on the source side, a 3D scan is set up around the location of the maximum spot SAR. First, a point within the scan area is visited by the probe and a SAR reading taken at the start of testing. At the end of testing, the probe is returned to the same point and a second reading is taken. Comparison between these start and end readings enables the power drift during measurement to be assessed.

Above is the scanning procedure flow chart and table from the IEEE p1528 standard. This is the procedure for which all compliant testing should be carried out to ensure that all variations of the device position and transmission behaviour are tested.

For body-worn measurement, the EUT was tested under two position: face upward and back upward.

5.5 Transmitting antenna information

There are four antennas (GSM antenna, WCDMA antenna, BT/Wi-Fi antenna and GPS antenna) inside the EUT, the former three antennas are the transmitting source, and they are a type of IFA antenna.

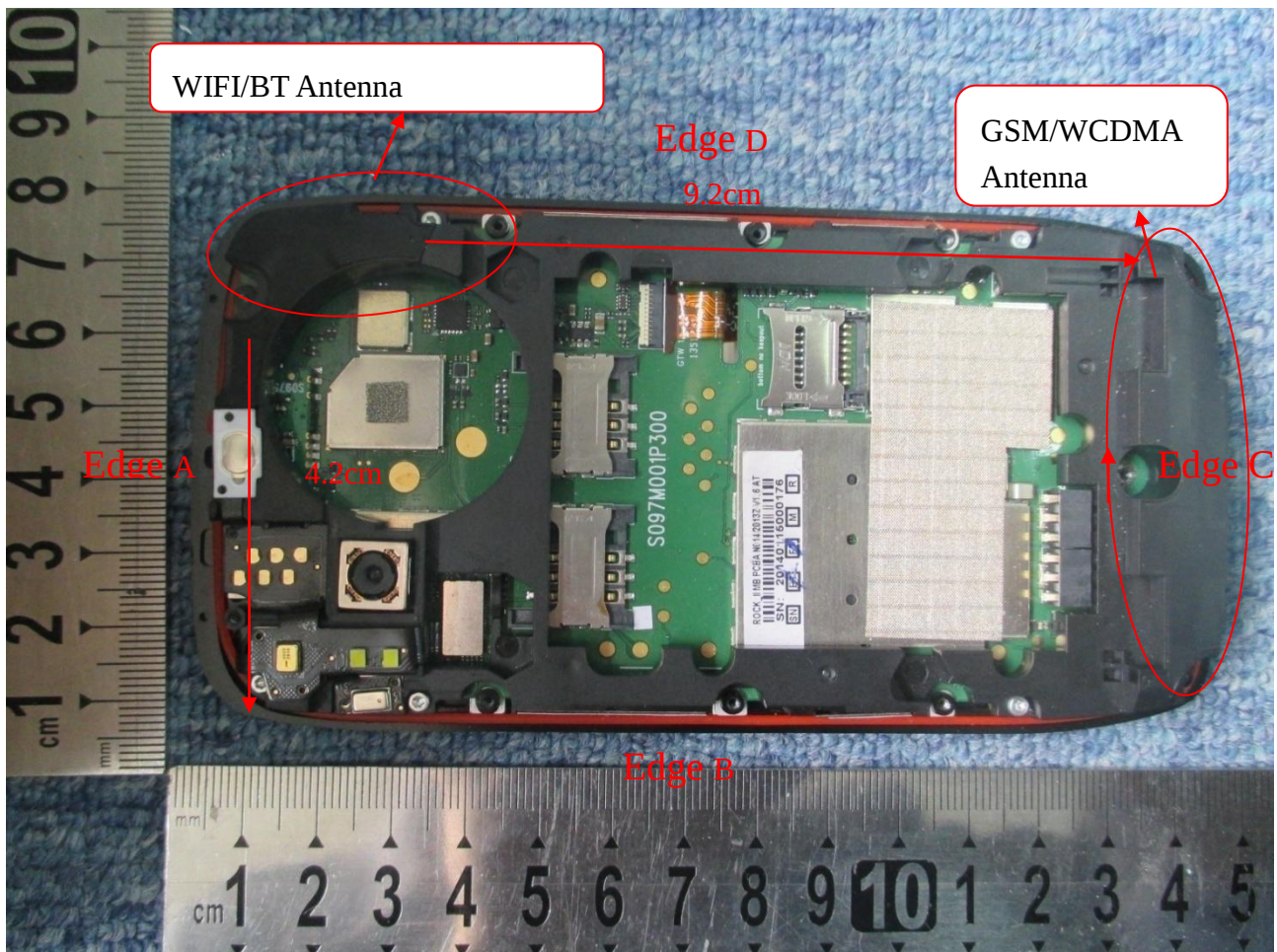


Fig. 3 Position of the antennas

HOTSPOT MODE EVALUATION PROCEDURE

The SAR evaluation procedures for Portable Devices with Wireless Router function is according to KDB 941225 D06 Hot Spot SAR v01.

SAR must be tested for all surfaces and edges(side) with a transmitting antenna with in 2.5cm from that surface or edge, at a test separation distance of 10mm, in the wireless modes that support wireless routing.

Assessment		Hotspot side for SAR				
Antennas	Back	Front	Edge A	Edge B	Edge C	Edge D
GSM/WCDMA	Yes	Yes	No	Yes	Yes	Yes
WLAN/BT	Yes	Yes	Yes	No	No	Yes

6 CHARACTERISTICS OF THE TEST

6.1 Applicable Limit Regulations

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;

ANSI C95.1–1999: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz;

IEEE 1528–2013: Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques;

It specifies the maximum exposure limit of **1.6 W/kg** as averaged over any 1 gram of tissue for portable devices being used within 20 cm of the user in the uncontrolled environment.

6.2 Applicable Measurement Standards

The Specific Absorption Rate (SAR) testing specification, method, and procedure for this is in accordance with the following standards:

FCC 47 CFR Part2 (2.1093)

ANSI/IEEE C95.1-1992

IEEE 1528-2003

IC RSS 102 Issue 4

FCC KDB 447498 D01 v05r01 General RF Exposure Guidance v05r01

FCC KDB 648474 D04 v01r01 SAR Evaluation Considerations for Wireless Handsets

FCC KDB 248227 D01 v01r02 SAR Measurement Procedures-802.11a/b/g Transmitters

FCC KDB 865664 D01 v01r01 SAR Measurement 100MHz to 6GHz

FCC KDB 865664 D02 v01r01 SAR Reporting

FCC KDB 941225 D01 SAR test for 3G devices v02

FCC KDB 941225 D02 HSPA and 1x Advanced v02r02

FCC KDB 941225 D03 v01 Recommended SAR Test Reduction Procedures for GSM/GPRS/EDGE

FCC KDB 941225 D04 v01 Evaluating SAR for GSM/(E)GPRS Dual Transfer Mode

7 LABORATORY ENVIRONMENT

7.1 The Ambient Conditions during SAR Test

Temperature	Min. = 15 ° C, Max. = 30 ° C
Atmospheric pressure	Min.=86 kPa, Max.=106 kPa
Relative humidity	Min. = 30%, Max. = 70%
Ground system resistance	< 0.5 Ω
Ambient noise is checked and found very low and in compliance with requirement of standards.	
Reflection of surrounding objects is minimized and in compliance with requirement of standards.	

8. Conducted RF Output Power

8.1 GSM Conducted Power

Band		Burst Average Power (dBm)			Frame-Average Power (dBm)		
GSM850	TX Channel	128	189	251	128	189	251
	Frequency(MHz)	824.2	836.6	848.8	824.2	836.6	848.8
	GSM (GMSK, 1 Tx slot)	31.58	32.35	33.16	22.55	23.32	24.13
	GPRS(GMSK, 1 Tx slot)	26.84	26.92	26.87	17.81	17.89	17.84
	GPRS(GMSK, 2 Tx slot)	27.77	27.84	27.81	21.75	21.82	21.79
	GPRS(GMSK, 3 Tx slot)	28.65	28.73	28.69	24.39	24.47	24.43
	GPRS(GMSK, 4 Tx slot)	30.18	30.89	31.69	27.17	27.88	28.68
	EDGE(8PSK, 1 Tx slot)	28.65	28.74	28.69	19.62	19.71	19.66
	EDGE(8PSK, 2 Tx slot)	29.73	29.85	29.82	23.71	23.83	23.8
	EDGE(8PSK, 3 Tx slot)	30.75	30.82	30.79	26.49	26.56	26.53
	EDGE(8PSK, 4 Tx slot)	31.60	32.37	33.25	28.59	29.36	30.24
GSM1900	TX Channel	512	661	810	512	661	810
	Frequency(MHz)	1850.2	1880.0	1909.8	1850.2	1880.0	1909.8
	GSM (GMSK, 1 Tx slot)	30.31	30.47	29.20	21.28	21.44	20.17
	GPRS(GMSK, 1 Tx slot)	25.93	26.04	25.97	16.9	17.01	16.94
	GPRS(GMSK, 2 Tx slot)	26.87	27.06	26.92	20.85	21.04	20.9
	GPRS(GMSK, 3 Tx slot)	27.92	28.12	28.06	23.66	23.86	23.8
	GPRS(GMSK, 4 Tx slot)	28.83	29.03	27.77	25.82	26.02	24.21
	EDGE(8PSK, 1 Tx slot)	27.43	27.53	27.21	18.40	18.50	18.18
	EDGE(8PSK, 2 Tx slot)	28.32	28.44	28.03	22.3	22.42	22.01

	EDGE(8PSK, 3 Tx slot)CS5	29.21	29.48	28.76	24.95	25.22	24.5
	EDGE(8PSK, 4 Tx slot)CS5	30.36	30.51	29.24	27.35	27.5	26.23

Note:

- Per KDB 447498 D01 v05r01, the maximum output power channel is used for SAR testing and for further SAR test reduction.

Timeslot consignations:

No. Of Slots	Slot 1	Slot 2	Slot 3	Slot 4
Slot Consignation	1Up4Down	2Up3Down	3Up2Down	4Up1Down
Duty Cycle	1:8	1:4	1:2.67	1:2
Correct Factor	-9.03dB	-6.02dB	-4.26dB	-3.01dB

8.2 WCDMA Conducted peak output Power

Item	band	WCDMA 850			WCDMA 1900		
	ARFCN	4132	4183	4233	9262	9400	9538
	subtest	dBm			dBm		
5.2(WCDMA)	non	23.52	23.60	23.58	23.35	23.52	22.90
HSDPA	1	23.58	23.63	23.31	23.33	23.33	22.89
	2	23.53	23.61	23.52	23.28	23.26	22.84
	3	22.57	22.45	22.23	22.74	22.71	22.36
	4	23.04	23.02	22.21	22.77	22.72	22.34
HSUPA	1	23.50	23.61	23.55	23.28	23.28	22.89
	2	22.66	22.72	22.67	21.26	21.23	20.87
	3	22.58	22.60	22.56	22.19	22.20	21.88
	4	22.63	22.71	22.53	21.23	21.29	20.86
	5	23.55	23.61	23.60	23.24	23.25	22.85

HSPA+	1	23.50	23.51	23.42	23.26	23.29	22.89
Note:	The Conducted RF Output Power test of WCDMA /HSDPA /HSUPA /HSPA+ was tested by power meter.						

Note:

1. WCDMA SAR was tested under PMC 12.2kbps with HSPA Inactive per KDB Publication 941225 D01.HSPA SAR was not requires since the average output power of the HSPA subtests was not more than 0.25dB higher than the RMC level and SAR was less than 1.2W/kg.
2. It is expected by the manufacturer that MPR for some HSPA subtests may be up to 2dB more than specified by 3GPP, but also as low as 0dB according to the chipset implementation in this model.

8.3 WLAN 2.4GHz Band Conducted Power

Channel	Frequency (MHz)	WIFI Output Power(dBm)		
		802.11b	802.11g	802.11n-20
CH 01	2412	15.53	13.78	13.25
CH 06	2437	15.34	13.85	13.32
CH 11	2462	15.45	13.69	13.29

Note:

1. Per KDB 248227 D01 v01r02, choose the highest output power channel to test SAR and determine further SAR exclusion
2. For each frequency band, testing at higher data rates and higher order modulations is not required when the maximum average output power for each of these configurations is less than 1/4dB higher than those measured at lowest data rate
3. Per KDB 248227 D01 v01r02, 11g and 11n-HT20 output power is less than 1/4dB higher than 11b mode. Thus the SAR can be excluded.

Bluetooth Conducted Power

Channel	Frequency (MHz)	BT Output Power(dBm)		
		GFSK	π /4-DQPSK	8-DPSK
CH 0	2402	1.23	0.42	0.22
CH 39	2441	1.33	0.37	0.48
CH 78	2480	2.27	1.47	1.11

Note:



1. Per KDB 447498 D01v05r01, the 1-g and 10-g SAR test exclusion thresholds for 100MHz to 6GHz at test separation distances $\leq 50\text{mm}$ are determined by: $[(\text{max. power of channel, including tune-up tolerance, mW})/(\text{min. test separation distance, mm})] \cdot [\sqrt{f} \text{ (GHz)}] \leq 3.0$ for 1-g SAR and ≤ 7.5 for 10-g extremity SAR

(1) $f(\text{GHz})$ is the RF channel transmit frequency in GHz

(2) Power and distance are round to the nearest mW and mm before calculation

(3) The result is rounded to one decimal place for comparison

(4) If the test separation distance(antenna-user) is $< 5\text{mm}$, 5mm is used for excluded SAR calculation

Bluetooth Max Power (dBm)	mW	Test Distance (mm)	Frequency(GHz)	Exclusion Thresholds
3	1.995	5	2.48	0.628

2. Per KDB 447498 D01v05r01 exclusion thresholds is $0.628 < 3$, RF exposure evaluation is not required.

SAR DATA SUMMARY

General Note:

- Per KDB 447498 D01v05r01, the reported SAR is the measured SAR value adjusted for maximum tune-up tolerance.
 - Tune-up scaling Factor = tune-up limit power(mW)/EUT RF power(mW), where tune-up limit is the maximum rated power among all production units.
 - For SAR testing of WLAN signal with non-100% duty cycle , the measured SAR is scaled-up by the duty cycle scaling factor which is equal to "1/(duty cycle)"
 - For WWAN: Reported SAR(W/kg)=Measured SAR(W/kg)*Tune-up Scaling Factor
 - For WLAN: Reported SAR(W/kg)=Measured SAR(W/kg)*Duty Cycle scaling factor * Tune-up scaling factor
- Per KDB 447498 D01v05r01, for each exposure position, if the highest output channel reported SAR $\leq 0.8\text{W/kg}$, other channels SAR testing is not necessary.
- For SAR testing of WLAN signal with non-100% duty cycle, the measured SAR is scaled-up by the duty cycle scaling factor which is equal to "1/(duty cycle)"
- Body-worn SAR testing was performed at 10mm separation, and this distance is determined by the handset manufacturer that there will be body-worn accessories with the required minimum separation.
- Per KDB 648474 D04v01r01, when the reported SAR for a body-worn accessory measured without a headset connected to the handset is $\leq 1.2\text{W/kg}$, SAR testing with a headset connected to the handset is not required.

6. Scaling Factor calculation

Operation Mode	Channel	Max. Output Power(dBm)	Tune up Power in tolerance(dBm)	Scaling Factor
GSM 850	128	31.58	32.50 ± 1	1.556
	189	32.35	32.50 ± 1	1.303
	251	33.16	32.50 ± 1	1.081
GPRS 850(4Tx)	128	30.18	31 ± 1	1.521
	189	30.89	31 ± 1	1.291
	251	31.69	31 ± 1	1.074
EDGE 850(4Tx)	128	31.60	32.50 ± 1	1.549
	189	32.37	32.50 ± 1	1.297
	251	33.25	32.50 ± 1	1.059
GSM 1900	512	30.31	29.50 ± 1	1.045
	661	30.47	29.50 ± 1	1.007
	880	29.20	29.50 ± 1	1.349
GPRS1900(4Tx)	512	28.83	28.55 ± 1	1.180
	661	29.03	28.55 ± 1	1.127
	810	27.77	28.55 ± 1	1.507
EDGE1900(4Tx)	512	30.36	29.55 ± 1	1.045
	661	30.51	29.55 ± 1	1.009
	810	29.24	29.55 ± 1	1.352
WCDMA 850	4132	23.52	23.25 ± 0.5	1.054
	4182	23.60	23.25 ± 0.5	1.035
	4233	23.58	23.25 ± 0.5	1.040
WCDMA1900	9262	23.35	23.15 ± 0.5	1.072
	9400	23.52	23.15 ± 0.5	1.030
	9538	22.90	23.15 ± 0.5	1.189
802.11b	2412	15.45	15.15 ± 0.5	1.047
Bluetooth	78	2.27	2 ± 1	1.183

Simultaneous SAR

Description of Simultaneous Transmit Capabilities			
No.	Transmitter Combinations	Scenario Supported or not	Supported for Mobile Hotspot or not
1	GSM(Voice)+GSM(Data)	No	No
2	WCDMA(Voice)+WCDMA(Data)	Yes	No
3	GSM(Voice)+ WCDMA(Data)	No	No
4	WCDMA(Voice)+GSM(Data)	No	No
5	GSM(Voice)+ WCDMA(Voice)	No	No
6	GSM(Voice)+Wifi(/BT)	Yes	No
7	WCDMA(Voice) +Wifi(/BT)	Yes	No
8	WCDMA(Voice)+WCDMA(Data)+ Wifi(/BT)	Yes	No
9	GSM(Data)+wifi	Yes	No
10	WCDMA(Data) +wifi	Yes	No

Not applicable	Applicable	Head	Body-worn	Hotspot
1,3,4,5	2,6,7,8,9,10	2,6,7,8	2,6,7,8	-

Note :

1. This device does not support hotspot mode.
2. EUT system architecture support simultaneous voice and data(except on WCDMA), multiple voice channels, or multiple data channels during a single session on the cellular net work.
3. WCDMA supports voice and data transmission simultaneously.
4. Simultaneous Transmission SAR evaluation is not required for BT and WiFi, because the software mechanism have been incorporated to gurantee that the WLAN and Bluetooth transmitters would not simultaneously operate.
5. For Scenario No.2,7,8,10 , WCDMA and WiFi is tested separately, the WCDMA mode is test with 12.2kbps RMC and TPC set to all "1", if maximum SAR for 12.2kbps RMC is $\leq 75\%$ of the SAR limit(i.e. 1.2W/kg 1g) and maximum average output of each RF channel with HSDPA/HSUPA active is less than 1/4 dB Middle than that measured without HSDPA/HSUPA using 12.2kbps RMC, according to KDB 941224 D01v02, SAR is not required for this handset with HSPA capabilities.

Applicable Multiple Scenario Evaluation

Test Position	WCDMA&GSM SAR Max.(W/Kg)	Wifi SAR Max.(W/Kg)	Bluetooth Max.(W/Kg)	Σ 1-gSARMAX.(W/Kg)	
				BT&Main Ant	Wifi&Main Ant
Head SAR	0.360	0.025	0.084	0.444	0.385
Body SAR	1.164	0.095	0.084	1.248	1.259

Simultaneous Transmission SAR evaluation is not required for Wifi and WCDMA&GSM, because the sum of 1g SAR Max is 1.259W/Kg<1.6 W/Kg for Wifi and WCDMA&GSM.

Simultaneous Transmission SAR evaluation is not required for BT and WCDMA&GSM, because the sum of 1g SAR Max is 1.248W/Kg<1.6 W/Kg for BT and WCDMA&GSM.

(According to KDB 447498D01v05,the sum of the Highest reported SAR of each antenna does not exceed the limit, simultaneous transmission SAR evaluation is not required.)

9 TEST RESULTS

9.1 Summary of Power Measurement Results

According the description above, the measurements against the head phantom were executed on the operation mode: GSM 850 MHz/1900MHz,GPRS 850 MHz /1900MHz, WCDMA850/1900MHz, WIFI 802.11b,while the tests against the body-worn were carried out on the operation mode: GSM 850 MHz/1900MHz, GPRS 850 MHz /1900MHz, WCDMA 850/1900MHz,WIFI 802.11b.

Table 1: SAR Values of GSM 850MHz Band

Temperature: 23.0~23.5°C, humidity: 62~64%.					
Test Positions		Channel /Frequency (MHz)	SAR(W/Kg), 1.6 (1g average)		
			SAR(W/Kg1g Peak)	Scaled SAR(W/Kg),1g	
Right Side of Head	Cheek	190/836.6	0.276	0.360	
	Tilt 15 degrees	190/836.6	0.183	0.238	
Left Side of Head	Cheek	190/836.6	0.218	0.284	
	Tilt 15 degrees	190/836.6	0.169	0.220	
Body	GSM	Face Upward	190/836.6	0.745	0.971
		Back Upward	128/824.2	0.748	1.164
			190/836.6	0.776	1.011
			251/848.8	0.761	0.823
		Edge B	190/836.6	0.259	0.338
		Edge C	190/836.6	0.518	0.675
		Edge D	190/836.6	0.342	0.446
	GPRS	Face Upward	190/836.6	0.687	0.887
		Back Upward	128/824.2	0.764	1.162
			190/836.6	0.789	1.019
			251/848.8	0.771	0.828
		Edge B	190/836.6	0.229	0.296
		Edge C	190/836.6	0.658	0.850
		Edge D	190/836.6	0.342	0.442

Table 2: SAR Values of GSM1900 MHz Band

Temperature: 23.0~23.5°C, humidity: 62~64%.					
Test Positions			Channel /Frequency (MHz)	SAR(W/Kg), 1.6 (1g average)	
				SAR(W/Kg1g Peak)	Scaled SAR(W/Kg),1g
Right Side of Head	Cheek		661/1880.0	0.061	0.061
	Tilt 15 degrees		661/1880.0	0.043	0.043
Left Side of Head	Cheek		661/1880.0	0.069	0.069
	Tilt 15 degrees		661/1880.0	0.053	0.053
Body	GSM	Face Upward	661/1880.0	0.278	0.280
		Back Upward	661/1880.0	0.303	0.305
		Edge B	661/1880.0	0.062	0.062
		Edge C	661/1880.0	0.102	0.102
		Edge D	661/1880.0	0.042	0.042
	GPRS	Face Upward	661/1880.0	0.225	0.254
		Back Upward	661/1880.0	0.256	0.289
		Edge B	661/1880.0	0.067	0.076
		Edge C	661/1880.0	0.092	0.104
		Edge D	661/1880.0	0.046	0.052

Table 3: SAR Values of WCDMA850

Temperature: 23.0~23.5°C, humidity: 62~64%.				
Test Positions		Channel /Frequency (MHz)	SAR(W/Kg), 1.6 (1g average)	
			SAR(W/Kg1g Peak)	Scaled SAR(W/Kg),1g
Right Side of Head	Cheek	4183/836.6	0.275	0.285
	Tilt 15 degrees	4183/836.6	0.181	0.187
Left Side of Head	Cheek	4183/836.6	0.253	0.262
	Tilt 15 degrees	4183/836.6	0.173	0.179
Body	Face upward	4182/836.6	0.342	0.354
	Back upward	4132/826.4	0.441	0.465
		4183/836.6	0.487	0.504
		4233/846.6	0.458	0.476
	Edge B	4182/836.6	0.216	0.224
	Edge C	4132/826.4	0.394	0.415
		4183/836.6	0.417	0.432
		4233/846.6	0.405	0.421
	Edge D	4182/836.6	0.224	0.232

Table 4: SAR Values of WCDMA1900

Temperature: 23.0~23.5°C, humidity: 62~64%.				
Test Positions		Channel /Frequency (MHz)	SAR(W/Kg), 1.6 (1g average)	
			SAR(W/Kg1g Peak)	Scaled SAR(W/Kg),1g
Right Side of Head	Cheek	9400/1880.0	0.050	0.052
	Tilt 15 degrees	9400/1880.0	0.046	0.047
Left Side of Head	Cheek	9400/1880.0	0.066	0.068
	Tilt 15 degrees	9400/1880.0	0.051	0.053
Body	Face upward	9400/1880.0	0.262	0.270
	Back Upward	9400/1880.0	0.390	0.402
	Edge B	9400/1880.0	0.070	0.072
	Edge C	9400/1880.0	0.104	0.107
	Edge D	9400/1880.0	0.041	0.042

Table 5:SAR Values of Wi-Fi 802.11b

Temperature: 23.0~23.5°C, humidity: 62~64%.				
Test Positions		Channel /Frequency (MHz)	SAR(W/Kg), 1.6 (1g average)	
			SAR(W/Kg1g Peak)	Scaled SAR(W/Kg),1g
Right Side of Head	Cheek	1/2412	0.024	0.025
	Tilt 15 degrees	1/2412	0.013	0.014
Left Side of Head	Cheek	1/2412	0.018	0.019
	Tilt 15 degrees	1/2412	0.009	0.009



802.11b Body	Face Upward	1/2412	0.047	0.049
	Back Upward	1/2412	0.091	0.095
	Edge A	1/2412	0.061	0.064
	Edge D	1/2412	0.054	0.057

Note:

a) According to KDB 941225 D01, since the maximum average output of each RF channel with HSDPA/HSUPA active is less than that measured without HSDPA/HSUPA using 12.2 kbps RMC and the maximum SAR for 12.2 kbps RMC is less 1.2 W/kg, the measurement against HSDPA and HSUPA were ignored in this report.

b) When the 1-g SAR for the mid-band channel or the channel with the Highest output power satisfy the following conditions, testing of the other channels in the band is not required.(Per KDB 447498 D01 General RF Exposure Guidance v05)

- ≤ 0.8 W/kg, when the transmission band is ≤ 100 MHz
- ≤ 0.6 W/kg, when the transmission band is between 100 MHz and 200 MHz
- ≤ 0.4 W/kg, when the transmission band is ≥ 200 MHz

8.3 Conclusion

Localized Specific Absorption Rate (SAR) of this portable wireless device has been measured in all cases requested by the relevant standards cited in Clause 6 of this report. Maximum localized SAR is **below** exposure limits specified in the relevant standards.

10 Measurement Uncertainty

No.	Uncertainty Component	Type	Uncertainty Value (%)	Probability Distribution	k	ci	Standard Uncertainty (%) $u_i(\%)$	Degree of freedom v_{eff} or v_i
Measurement System								
1	—Probe Calibration	B	7	N	3	1	3.5	∞
2	—Axial isotropy	B	4.7	R	$\sqrt{3}$	0.5	4.3	∞
3	—Hemispherical Isotropy	B	9.4	R	$\sqrt{3}$	0.5	4.3	∞
4	—Boundary Effect	B	11.0	R	$\sqrt{3}$	1	6.4	∞
5	—Linearity	B	4.7	R	$\sqrt{3}$	1	2.7	∞
6	—System Detection Limits	B	1.0	R	$\sqrt{3}$	1	0.6	∞
7	—Readout Electronics	B	1.0	N	3	1	1.00	∞
8	—Response Time	B	0.00	R	$\sqrt{3}$	1	0.00	∞
9	—Integration Time	B	0.00	R	$\sqrt{3}$	1	0.00	∞
10	—RF Ambient Conditions	B	3.0	R	$\sqrt{3}$	1	1.73	∞
11	—Probe Position Mechanical tolerance	B	0.4	R	$\sqrt{3}$	1	0.2	∞
12	—Probe Position with respect to Phantom Shell	B	2.9	R	$\sqrt{3}$	1	1.7	∞
13	—Extrapolation, Interpolation and Integration Algorithms for Max. SAR evaluation	B	3.9	R	$\sqrt{3}$	1	2.3	∞
Uncertainties of the DUT								
14	—Position of the DUT	A	4.8	N	3	1	4.8	5
15	—Holder of the DUT	A	7.1	N	3	1	7.1	5

16	– Output Power Variation – SAR drift measurement	B	5.0	R	$\sqrt{3}$	1	2.9	∞
Phantom and Tissue Parameters								
17	– Phantom Uncertainty(shape and thickness tolerances)	B	1.0	R	$\sqrt{3}$	1	0.6	∞
18	– Liquid Conductivity Target – tolerance	B	5.0	R	$\sqrt{3}$	0.6	1.7	∞
19	– Liquid Conductivity – measurement Uncertainty)	B	0.23	N	3	1	0.23	9
20	– Liquid Permittivity Target tolerance	B	5.0	R	$\sqrt{3}$	0.6	1.7	∞
21	– Liquid Permittivity – measurement uncertainty	B	0.46	N	3	1	0.46	∞
Combined Standard Uncertainty				RSS			12.92	44.15
Expanded uncertainty (Confidence interval of 95 %)				K=2			25.84	

11 MAIN TEST INSTRUMENTS

No	EQUIPMENT	TYPE	Series No.	Due Date
1	System Simulator	E5515C	GB 47200710	2015/02/23
2	SAR Probe	SATIMO	SN 09/13 EP169	2014/04/04
3	Dipole	SID835	SN 09/13 DIP 0G835-217	2014/04/04
4	Dipole	SID1900	SN 09/13 DIP 1G900-218	2014/04/04
5	Dipole	SID2450	SN 09/13 DIP 2G450-220	2014/04/04
6	Vector Network Analyzer	ZVB8	A0802530	2014/06/13
7	Signal Generator	SMR27	A0304219	2014/06/10
8	Amplifier	Nucletudes	143060	2014/04/05
9	Power Meter	NRVS	1020.1809.02	2014/06/13
10	Power Sensor	NRV-Z4	100069	2014/06/10
11	Multimeter	Keithley-2000	4014020	2015/01/29
12	Device Holder	SATIMO	SN 09/13 MSH80	2014/04/04
13	SAM Phantom	SAM97	SN 09/13 SAM97	2014/04/04



ANNEX A
of
CCIC Southern Electronic Product Testing (Shenzhen) Co., Ltd.

CONFORMANCE TEST REPORT FOR
HUMAN EXPOSURE TO ELECTROMAGNETIC FIELDS

SET2014-01609

Toughshield devices ltd

ToughShield

Type Name: R750

Hardware Version: S097M001P110

Software Version: R750_VER_2.0_01035_20131114

Accreditation Certificate

This Annex consists of 2 pages

Date of Report: 2014-03-07



China National Accreditation Service for Conformity Assessment

LABORATORY ACCREDITATION CERTIFICATE

(Registration No. CNAS L1659)

CCIC Southern Electronic Product Testing (Shenzhen) Co., Ltd.

Building 28/29, Shigudong, Xili Industrial Area, Xili Street,

Nanshan District, Shenzhen, Guangdong, China

is accredited to ISO/IEC 17025:2005 General Requirements for the Competence of Testing and Calibration Laboratories(CNAS-CL01 Accreditation Criteria for the Competence of Testing and Calibration Laboratories) for the competence of testing and calibration.

The scope of accreditation is detailed in the attached appendices bearing the same registration number as above. The appendices form an integral part of this certificate.

Date of Issue: 2012-09-29

Date of Expiry: 2015-09-28

Date of Initial Accreditation: 1999-08-03

Date of Update: 2012-09-29



Signed on behalf of China National Accreditation Service
for Conformity Assessment

China National Accreditation Service for Conformity Assessment (CNAS) is authorized by Certification and Accreditation Administration of the People's Republic of China (CNCA) to operate the national accreditation schemes for conformity assessment. CNAS is the signatory to International Laboratory Accreditation Cooperation Multilateral Recognition Arrangement (ILAC MRA) and Asia Pacific Laboratory Accreditation Cooperation Multilateral Recognition Arrangement (APLAC MRA).

No.CNAS AL 2

0005210

ANNEX B

of

CCIC-SET

CONFORMANCE TEST REPORT FOR

HUMAN EXPOSURE TO ELECTROMAGNETIC FIELDS

SET2014-01609

Toughshield devices ltd

ToughShield

Type Name: R750

Hardware Version: S097M001P110

Software Version: R750_VER_2.0_01035_20131114

TEST LAYOUT

This Annex consists of 7 pages

Date of Report: 2014-03-07

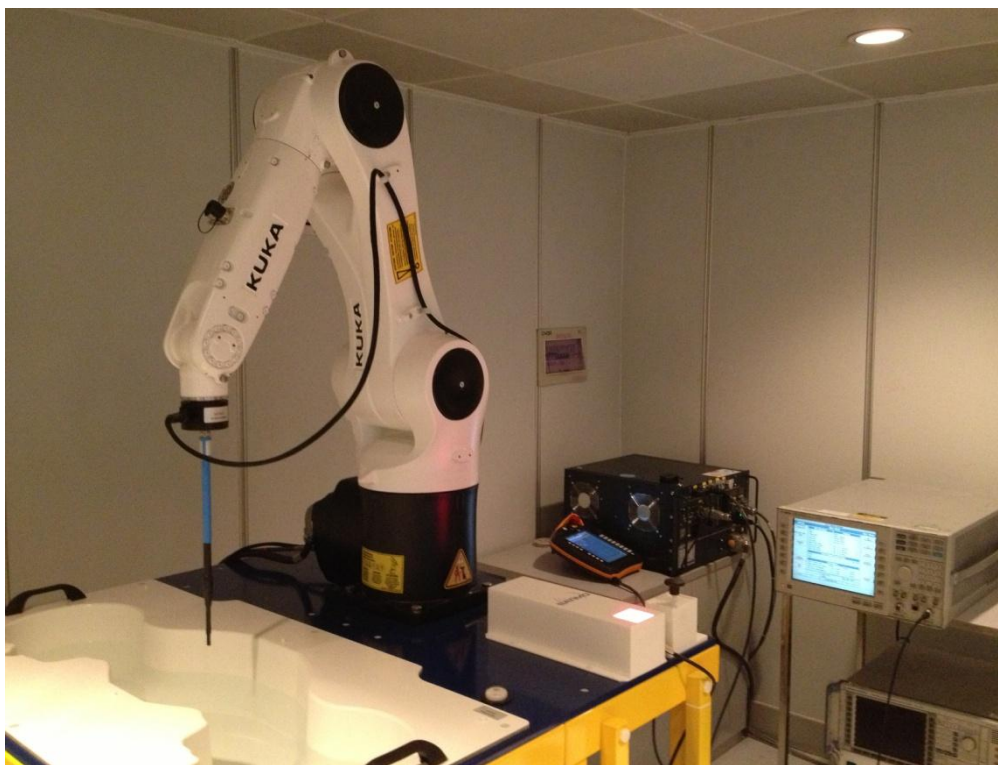


Fig.1 COMO SAR Test System

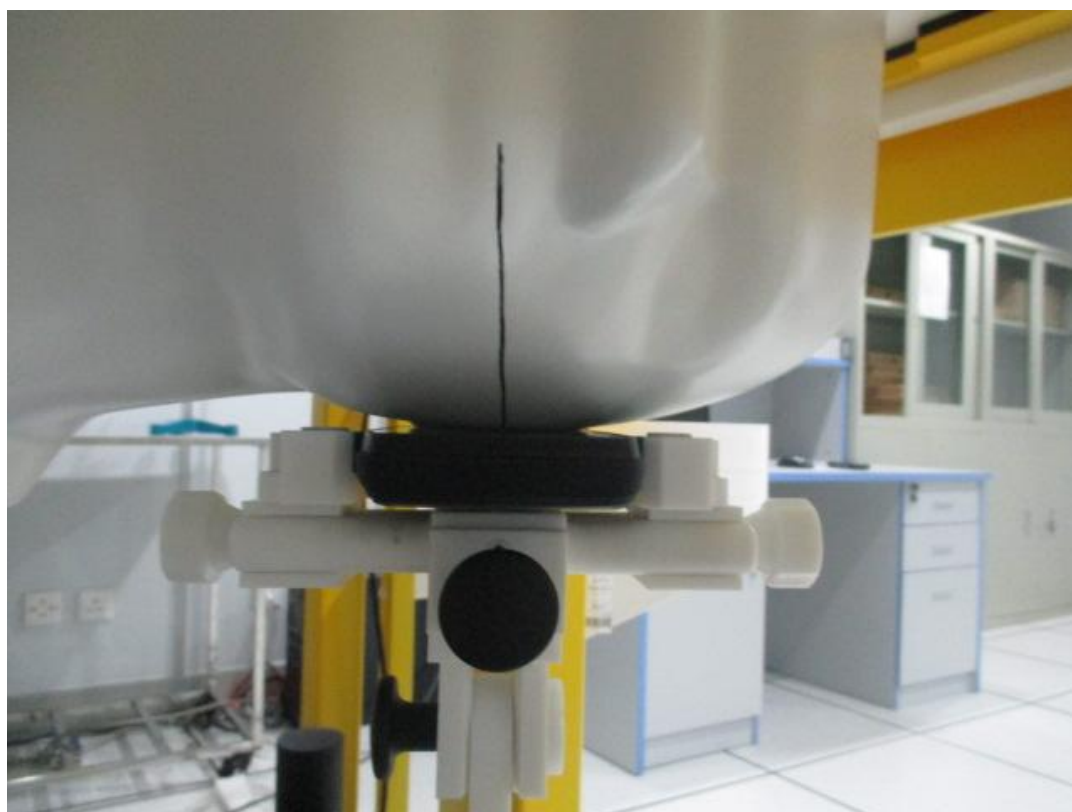


Fig.2 Left Cheek



Fig.3 Left Tilt

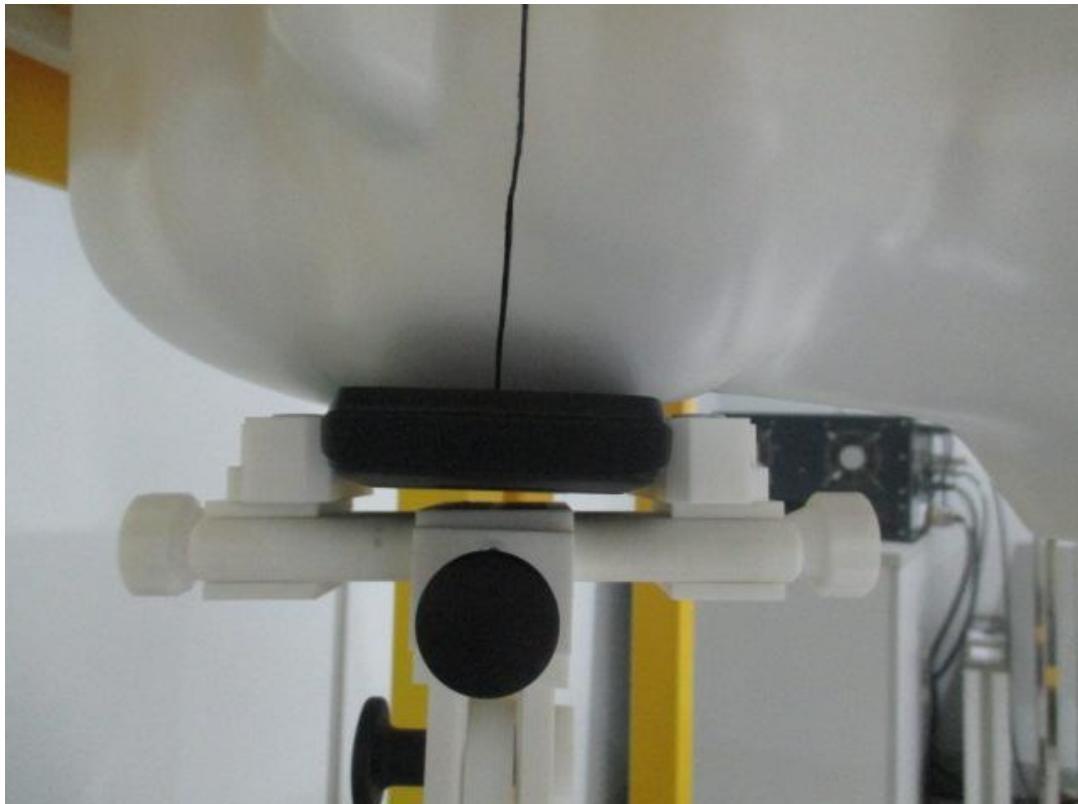


Fig.4 Right Cheek

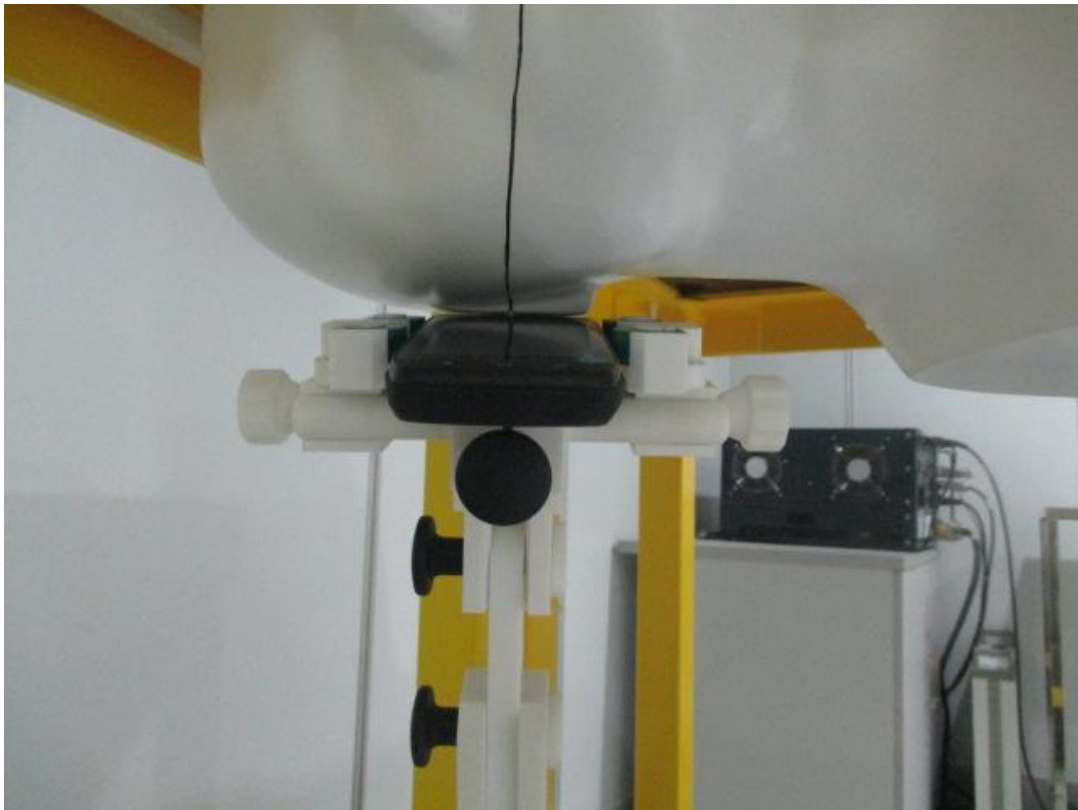


Fig.5 Right Tilt



Fig.6 Body Face Upward



Fig.7 Body Back Upward

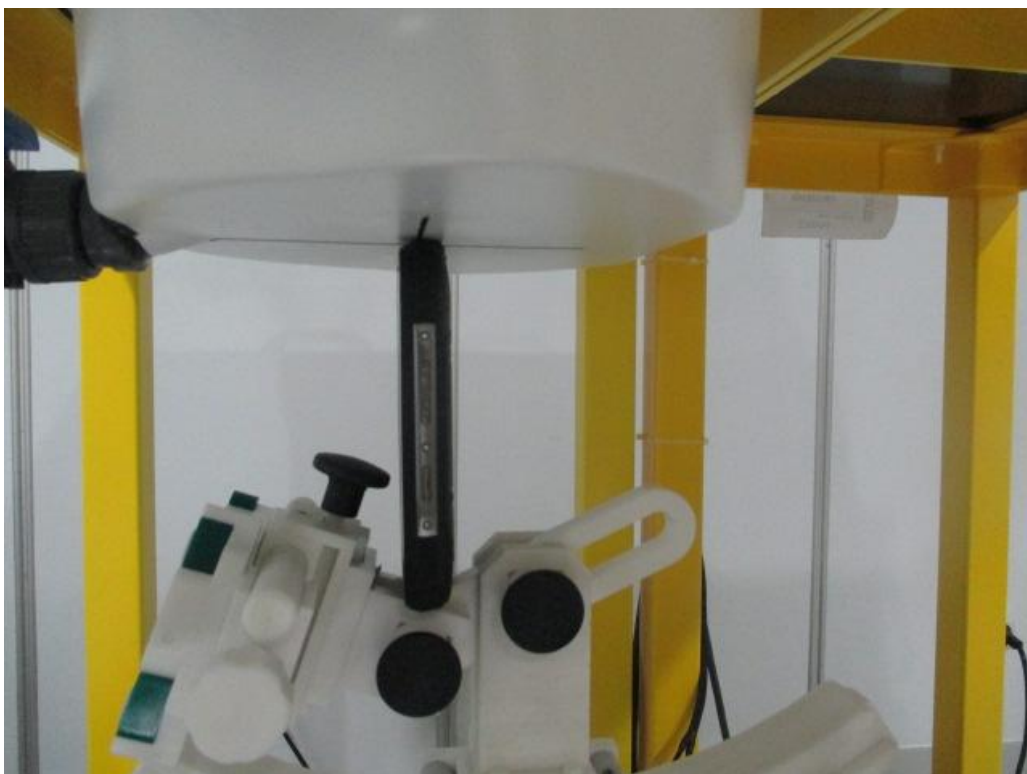


Fig.8 Edge A

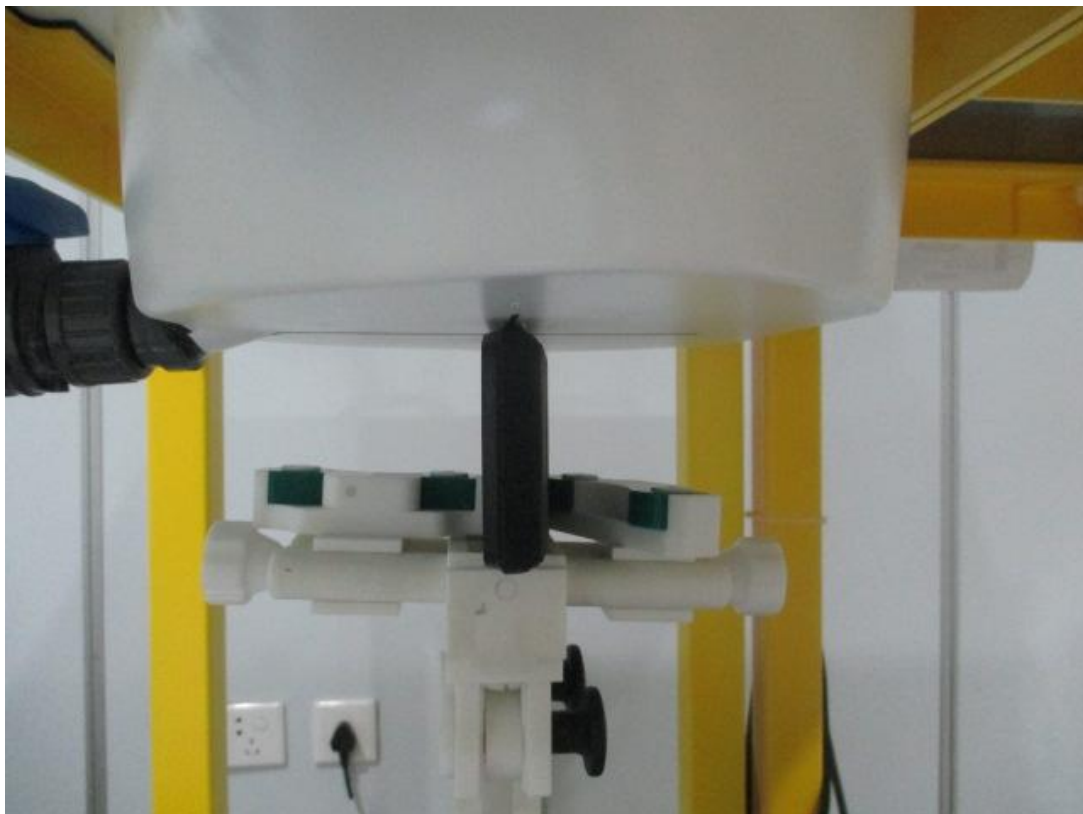


Fig.9 Edge B

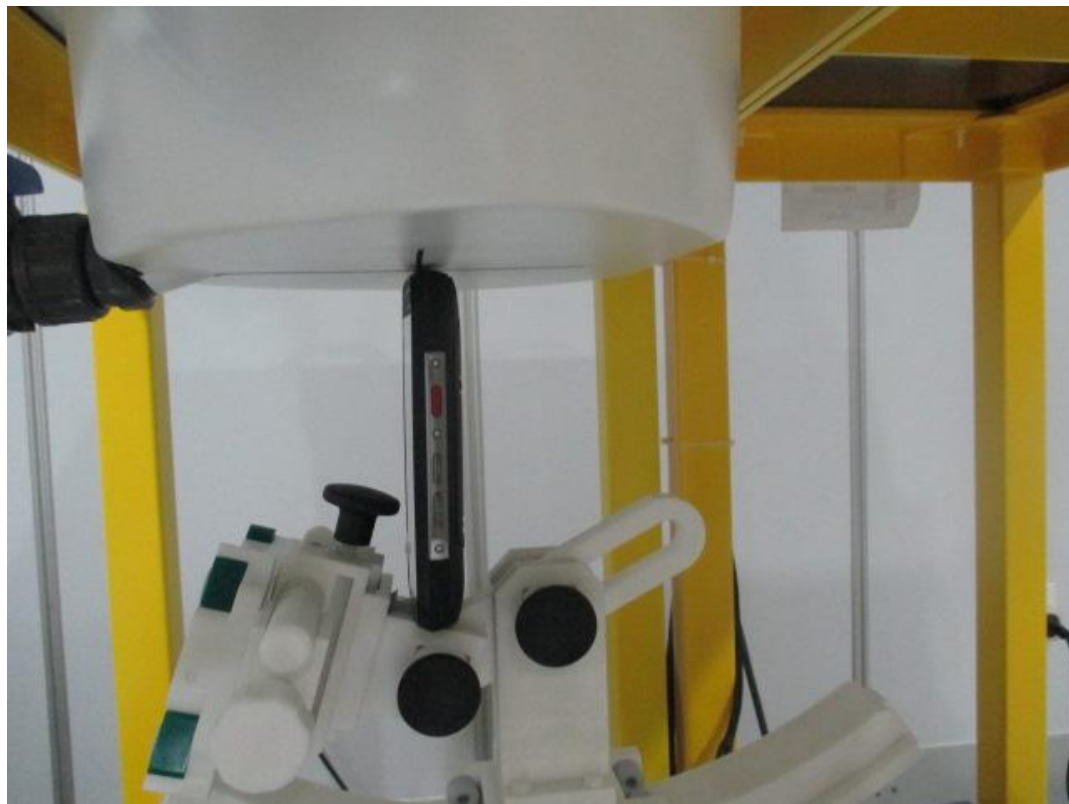


Fig.10 Edge C

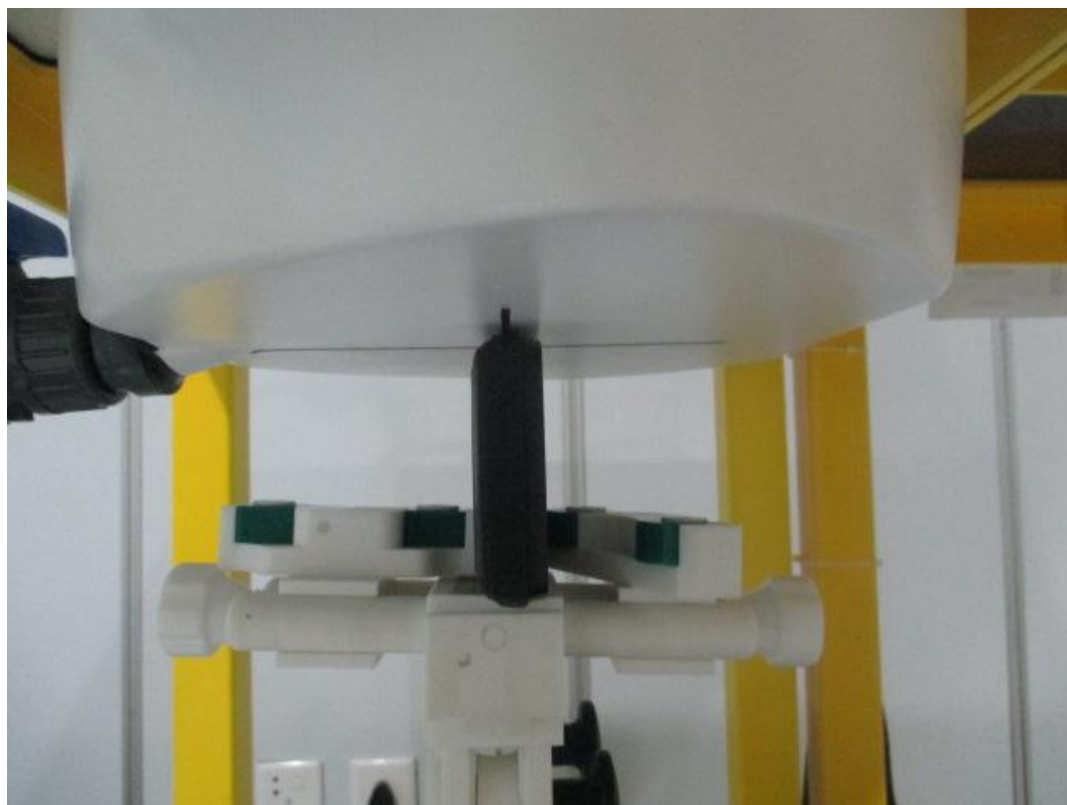


Fig.11 Edge D



ANNEX C

of

CCIC-SET

CONFORMANCE TEST REPORT FOR

HUMAN EXPOSURE TO ELECTROMAGNETIC FIELDS

SET2014-01609

ToughShield

Type Name: R750

Hardware Version: S097M001P110

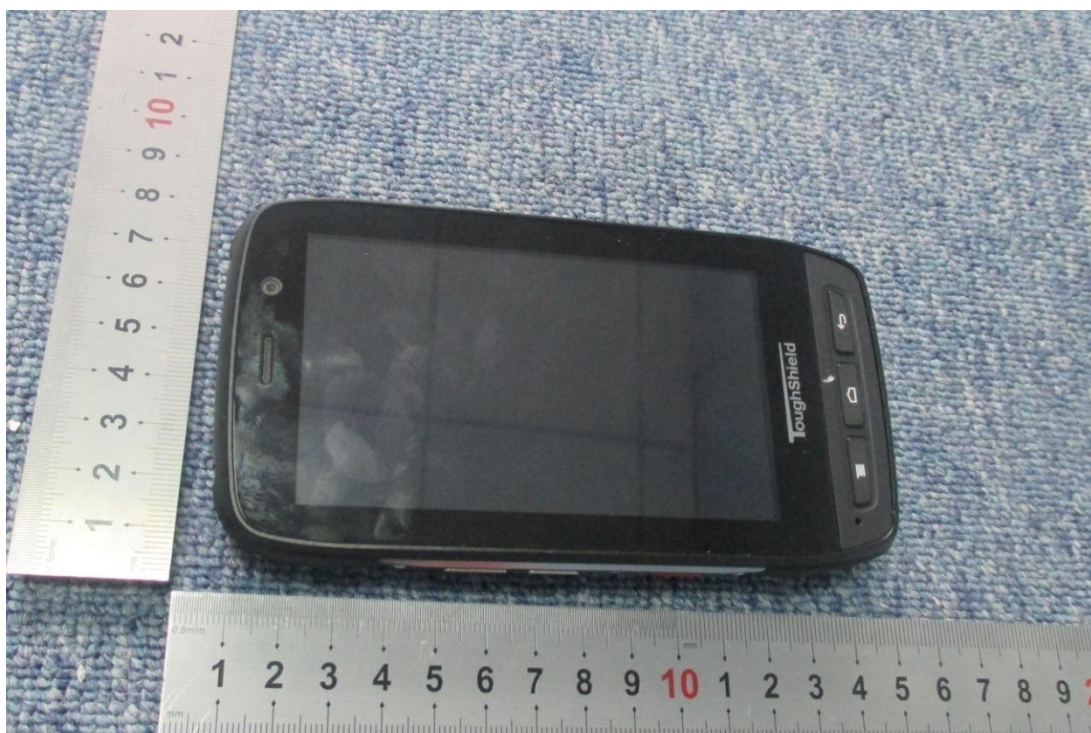
Software Version: R750_VER_2.0_01035_20131114

Sample Photographs

This Annex consists of 5 pages

Date of Report: 2014-03-07

1. Appearance



Appearance and size (obverse)



Appearance and size (reverse)



ANNEX D

of

CCIC-SET

CONFORMANCE TEST REPORT FOR

HUMAN EXPOSURE TO ELECTROMAGNETIC FIELDS

SET2014-01609

ToughShield

Type Name: R750

Hardware Version: S097M001P110

Software Version: R750_VER_2.0_01035_20131114

System Performance Check Data and Highest SAR Plots

This Annex consists of 33 pages

Date of Report: 2014-03-07

System Performance Check (Head, 835MHz)

Type: Phone measurement (Complete)

Area scan resolution: dx=8mm,dy=8mm

Zoom scan resolution: dx=8mm, dy=8mm, dz=5mm

Date of measurement:24/02/2014

Measurement duration: 12 minutes 57 seconds

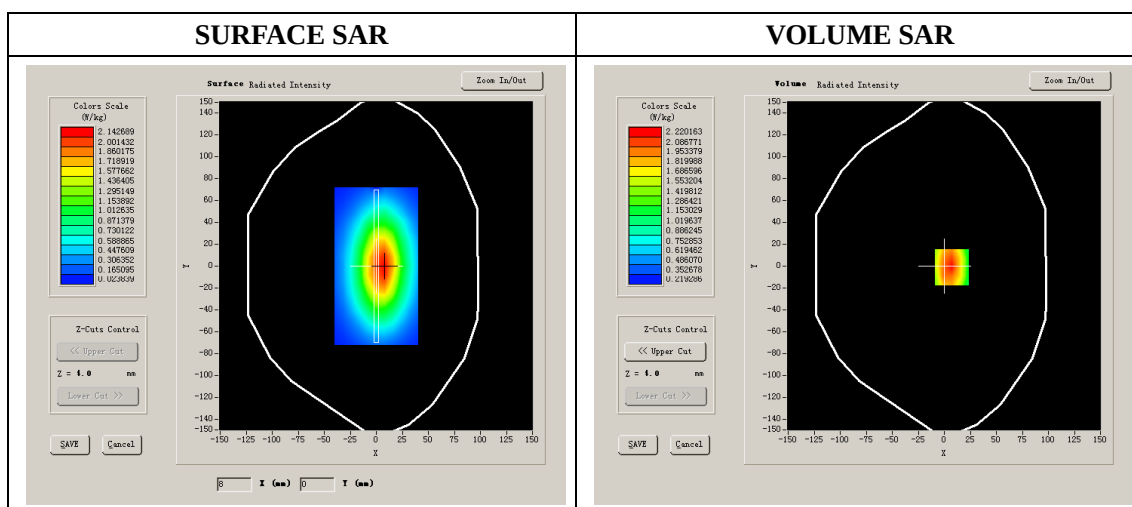
A. Experimental conditions.

Phantom File	surf_sam_plan.txt
Phantom	Flat Plane
Device Position	
Band	835MHz
Channels	
Signal	CW

B. SAR Measurement Results

Band SAR

Frequency (MHz)	835.000000
Relative permittivity (real part)	41.45
Relative permittivity	15.07
Conductivity (S/m)	0.91
Power drift (%)	-0.230000
Ambient Temperature:	23.2 °C
Liquid Temperature:	23.5 °C
ConvF:	5.52
Duty factor:	1:1



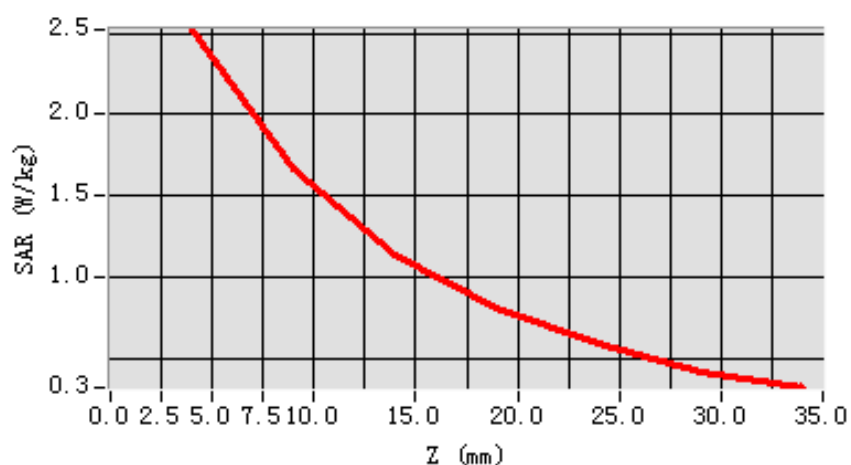
Maximum location: X=7.00, Y=-1.00

SAR 10g (W/Kg)	1.823516
SAR 1g (W/Kg)	2.463742

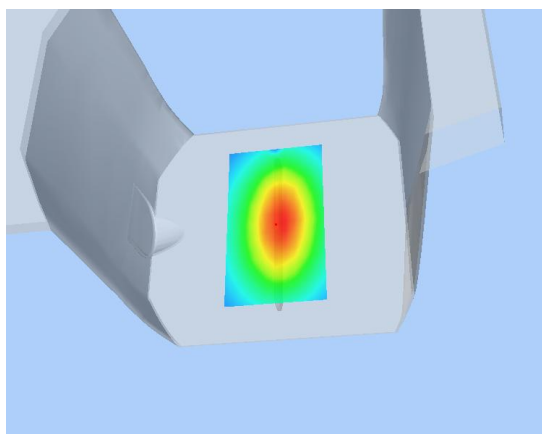
Z Axis Scan

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	0.0000	2.5212	1.6625	1.1452	0.8068	0.5876	0.4154

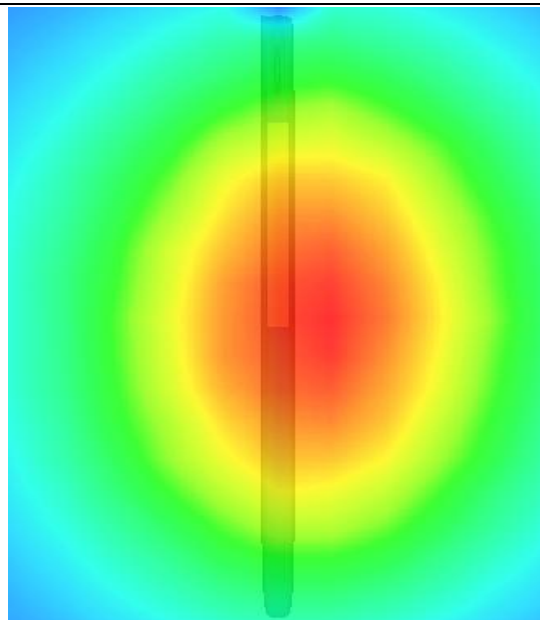
SAR, Z Axis Scan (X = 7, Y = -1)



3D scene shot



Hot spot position



System Performance Check (Head, 1900MHz)

Type: Phone measurement (Complete)

Area scan resolution: dx=8mm,dy=8mm

Zoom scan resolution: dx=8mm, dy=8mm, dz=5mm

Date of measurement: 24/02/2014

Measurement duration: 12 minutes 57 seconds

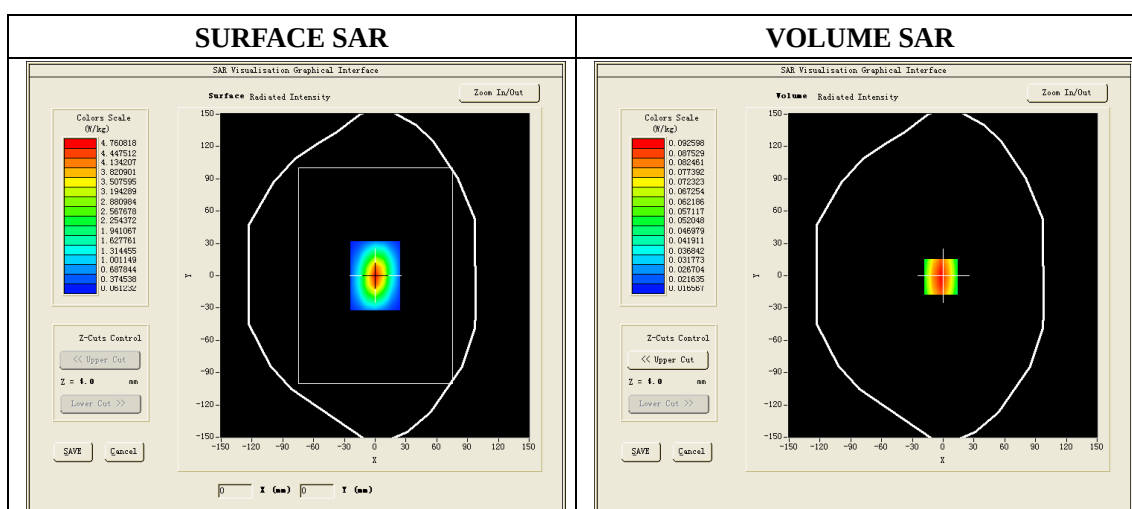
A. Experimental conditions.

Phantom File	surf_sam_plan.txt
Phantom	Flat Plane
Device Position	
Band	1900MHz
Channels	
Signal	CW

B. SAR Measurement Results

Band SAR

Frequency (MHz)	1900.000000
Relative permittivity (real part)	39.98
Relative permittivity	15.07
Conductivity (S/m)	1.41
Power drift (%)	-0.150000
Ambient Temperature:	22.3 °C
Liquid Temperature:	22.6 °C
ConvF:	5.48
Duty factor:	1:1

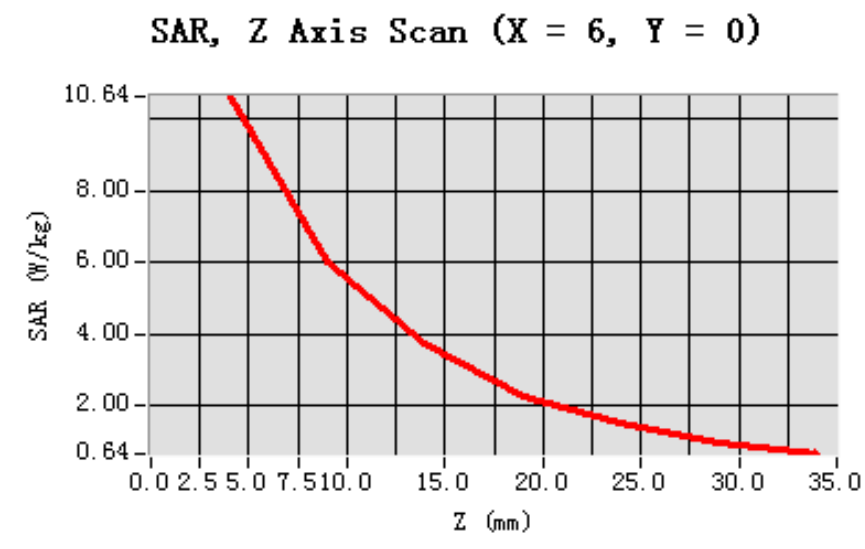


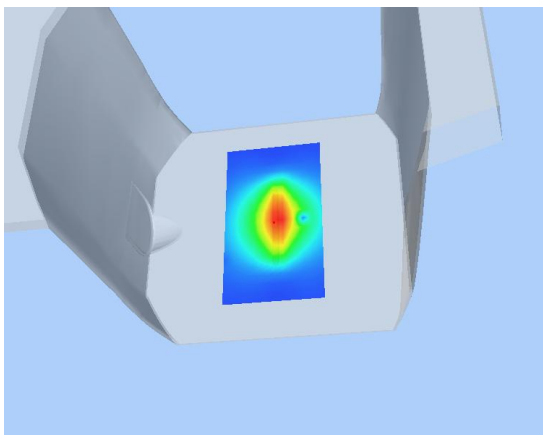
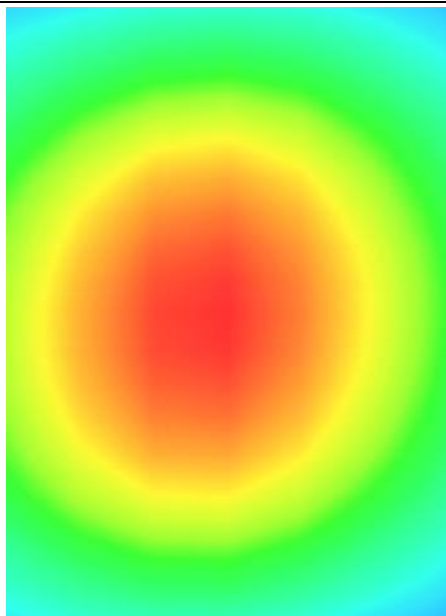
Maximum location: X=6.00, Y=0.00

SAR 10g (W/Kg)	5.135278
SAR 1g (W/Kg)	9.768435

Z Axis Scan

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	0.0000	10.6419	6.0043	3.7297	2.2606	1.5119	0.9792



3D sceen shot	Hot spot position
	

System Performance Check (Head, 2450MHz)

Type: Phone measurement (Complete)

Area scan resolution: dx=8mm,dy=8mm

Zoom scan resolution: dx=8mm, dy=8mm, dz=5mm

Date of measurement: 24/02/2014

Measurement duration: 15 minutes 24 seconds

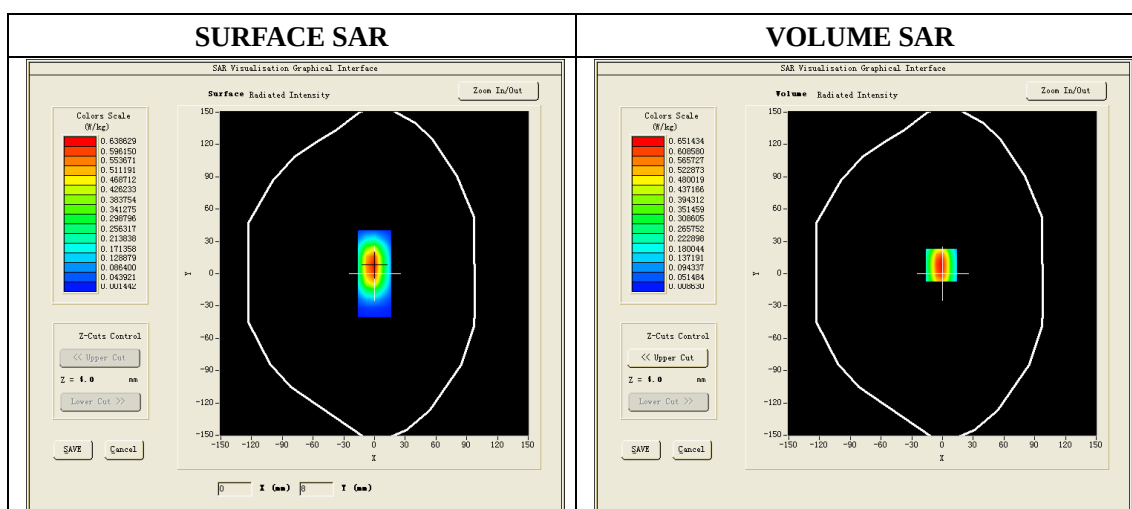
A. Experimental conditions.

Phantom File	surf_sam_plan.txt
Phantom	Validation plane
Device Position	Dipole
Band	2450MHz
Channels	
Signal	CW

B. SAR Measurement Results

Band SAR

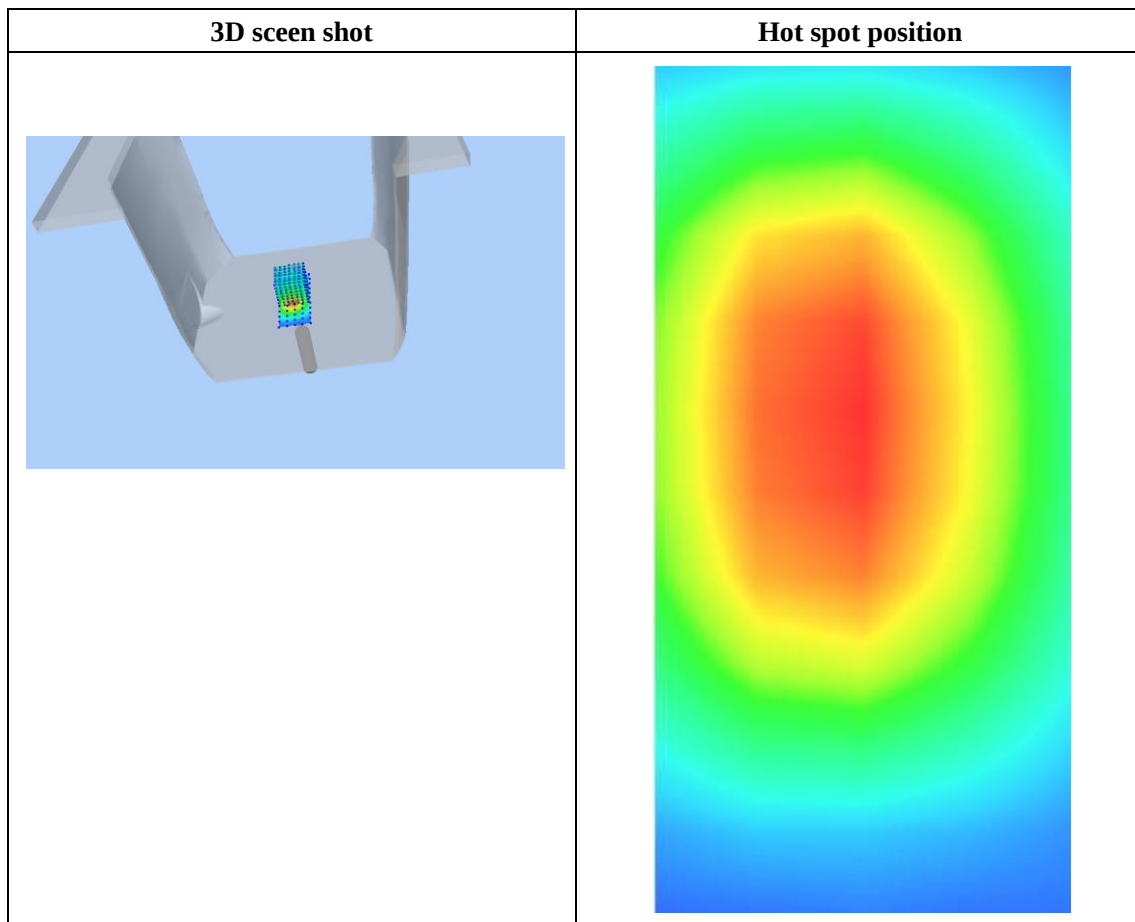
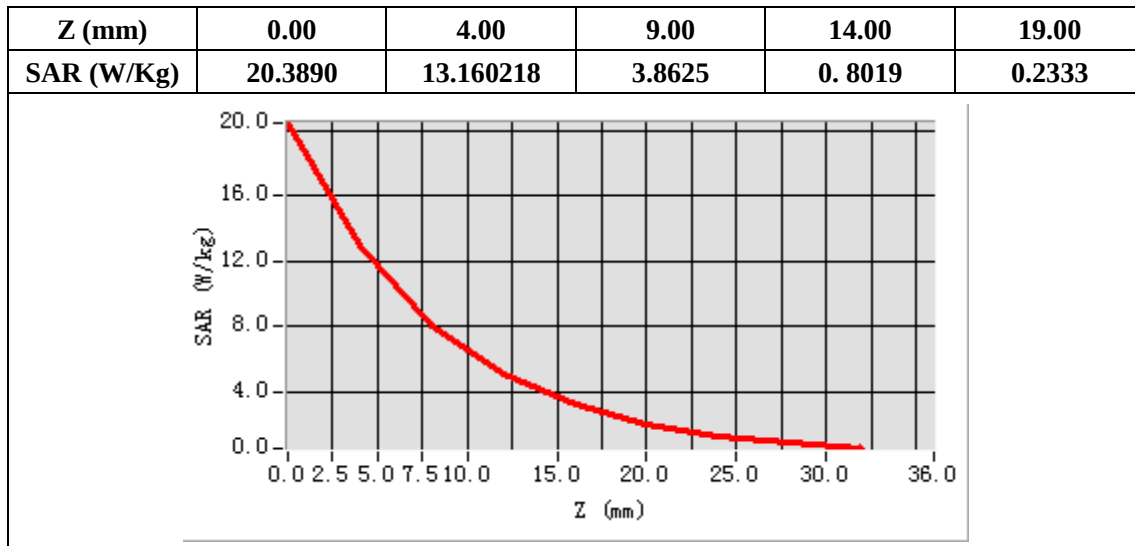
Frequency (MHz)	2450.000000
Relative permittivity (real part)	38.98
Relative permittivity	13.19
Conductivity (S/m)	1.81
Power Drift (%)	0.420000
ConvF:	4.80
Duty factor:	1:1



Maximum location: X=0.00, Y=8.00

SAR 10g (W/Kg)	5.901231
SAR 1g (W/Kg)	13.152314

Z Axis Scan



System Performance Check (Body, 835MHz)

Type: Phone measurement (Complete)

Area scan resolution: dx=8mm,dy=8mm

Zoom scan resolution: dx=8mm, dy=8mm, dz=5mm

Date of measurement: 25/02/2014

Measurement duration: 13 minutes 12 seconds

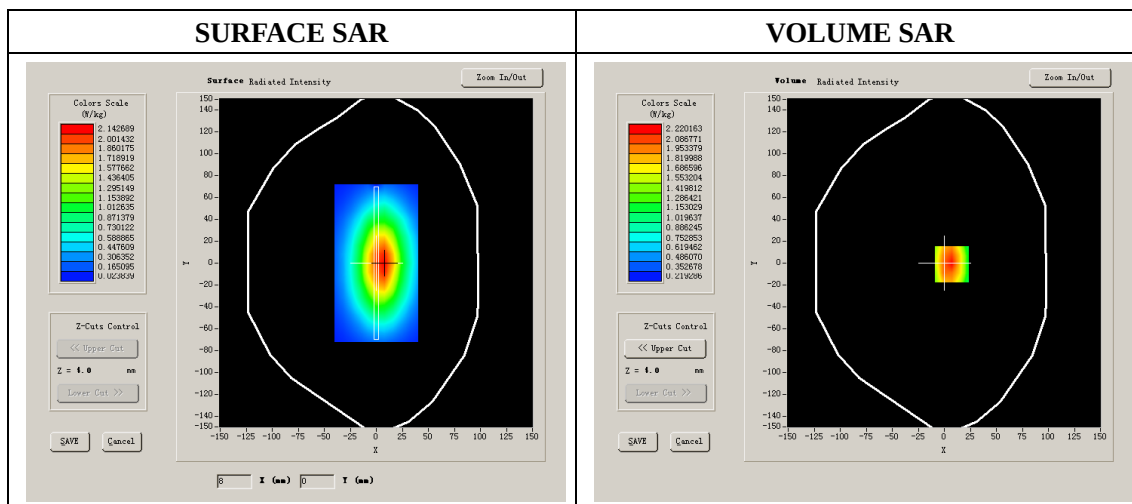
A. Experimental conditions.

Phantom File	surf_sam_plan.txt
Phantom	Flat Plane
Device Position	
Band	835MHz
Channels	
Signal	CW

B. SAR Measurement Results

Band SAR

Frequency (MHz)	835.000000
Relative permittivity (real part)	55.27
Relative permittivity	21.71
Conductivity (S/m)	0.98
Power drift (%)	-0.270000
Ambient Temperature:	23.2 °C
Liquid Temperature:	23.5 °C
ConvF:	5.67
Duty factor:	1:1



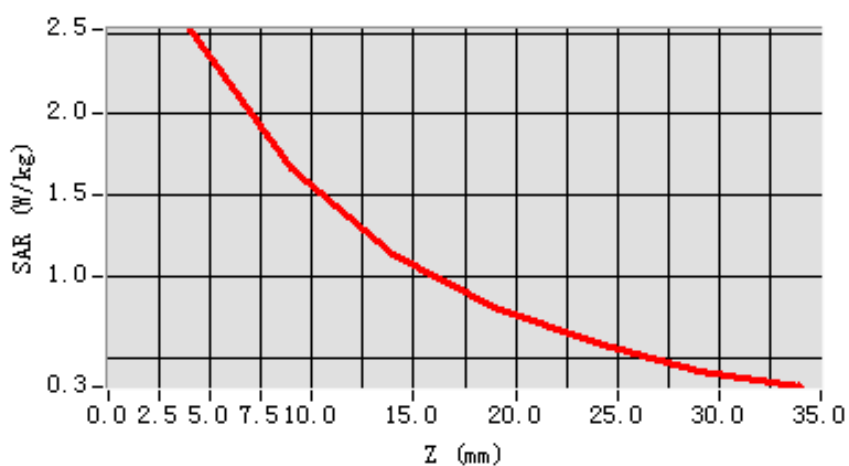
Maximum location: X=7.00, Y=-1.00

SAR 10g (W/Kg)	1.726483
SAR 1g (W/Kg)	2.429546

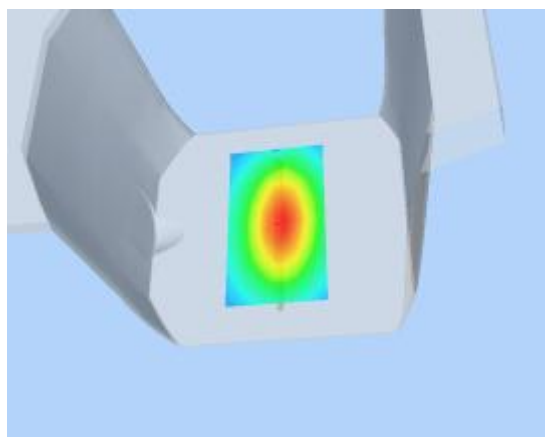
Z Axis Scan

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	0.0000	2.5209	1.6629	1.1437	0.8075	0.5889	0.4143

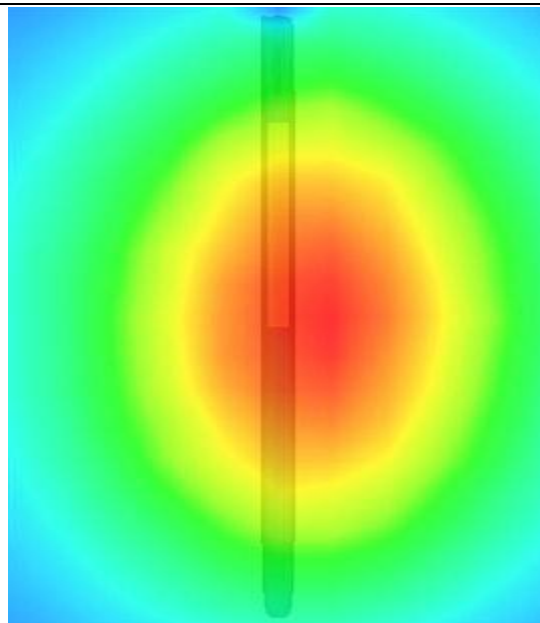
SAR, Z Axis Scan (X = 7, Y = -1)



3D scene shot



Hot spot position



System Performance Check (Body, 1900MHz)

Type: Phone measurement (Complete)

Area scan resolution: dx=8mm,dy=8mm

Zoom scan resolution: dx=8mm, dy=8mm, dz=5mm

Date of measurement: 25/02/2014

Measurement duration: 13 minutes 12 seconds

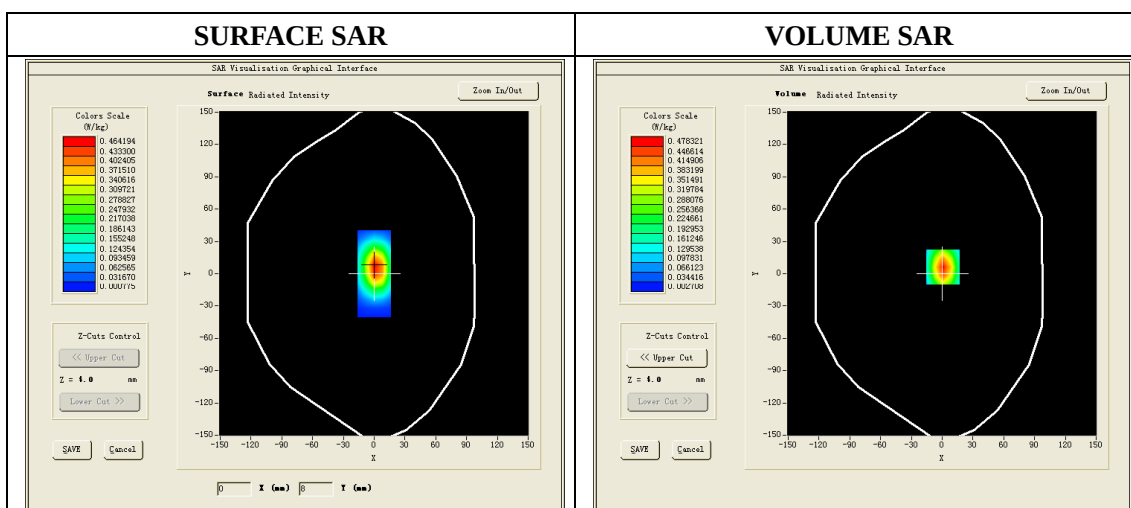
A. Experimental conditions.

Phantom File	surf_sam_plan.txt
Phantom	Validation plane
Device Position	
Band	1900MHz
Channels	
Signal	CW

B. SAR Measurement Results

Band SAR

Frequency (MHz)	1900.000000
Relative permittivity (real part)	53.28
Relative permittivity	12.99
Conductivity (S/m)	1.53
Power Drift (%)	0.410000
Ambient Temperature:	22.0 °C
Liquid Temperature:	21.8 °C
ConvF:	5.64
Duty factor:	1:1



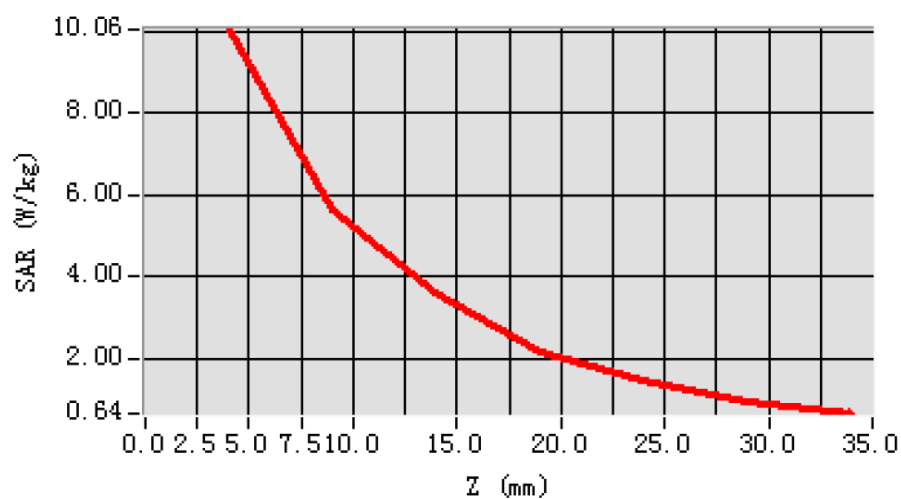
Maximum location: X=1.00, Y=6.00

SAR 10g (W/Kg)	5.215326
SAR 1g (W/Kg)	9.982523

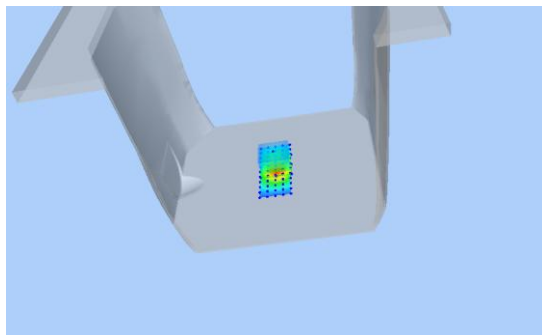
Z Axis Scan

Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.0000	10.0613	5.7282	3.6529	2.0314

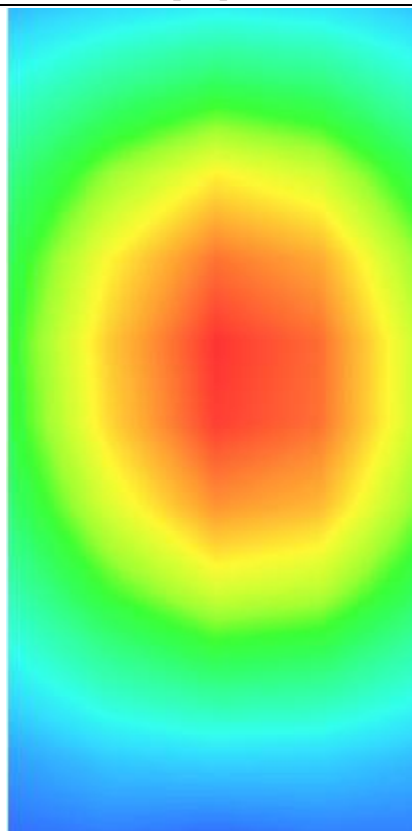
SAR, Z Axis Scan (X = 1, Y = 6)



3D scene shot



Hot spot position



System Performance Check (Body, 2450MHz)

Type: Phone measurement (Complete)

Area scan resolution: dx=8mm,dy=8mm

Zoom scan resolution: dx=8mm, dy=8mm, dz=5mm

Date of measurement: 25/02/2014

Measurement duration: 13 minutes 21 seconds

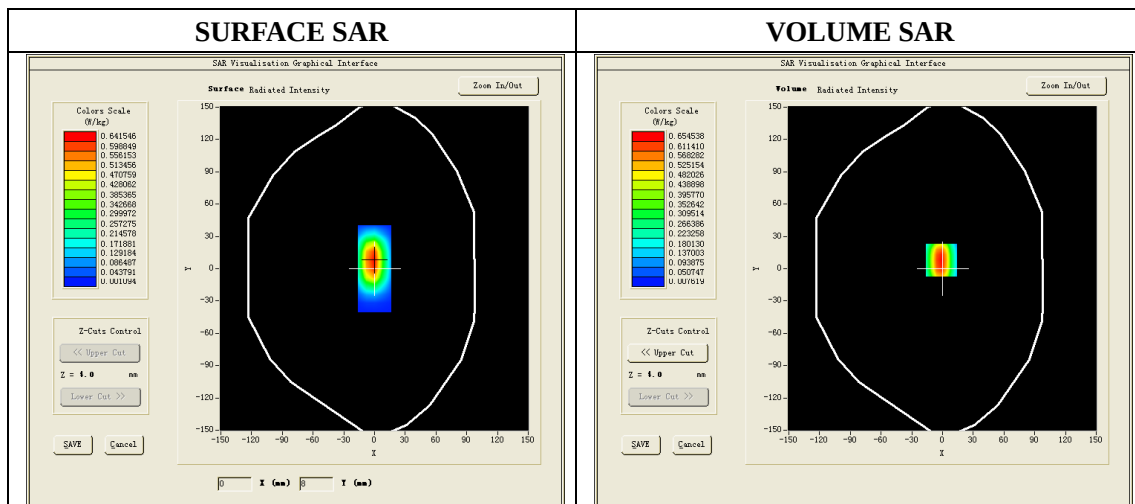
A. Experimental conditions.

Phantom File	surf_sam_plan.txt
Phantom	Validation plane
Device Position	Dipole
Band	2450MHz
Channels	
Signal	CW

B. SAR Measurement Results

Band SAR

Frequency (MHz)	2450.000000
Relative permittivity (real part)	52.64
Relative permittivity	13.02
Conductivity (S/m)	1.96
Power Drift (%)	-0.310000
Duty factor:	1:1
ConvF:	4.90



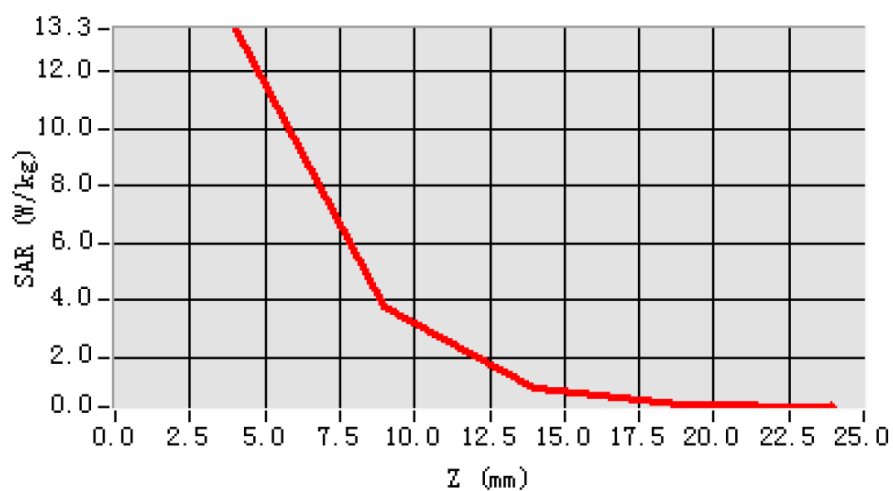
Maximum location: X=0.00, Y=8.00

SAR 10g (W/Kg)	6.015324
SAR 1g (W/Kg)	13.101421

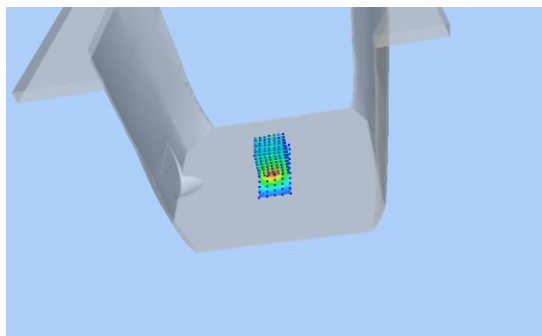
Z Axis Scan

Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.0000	13.3122	3.8625	0.8019	0.2333

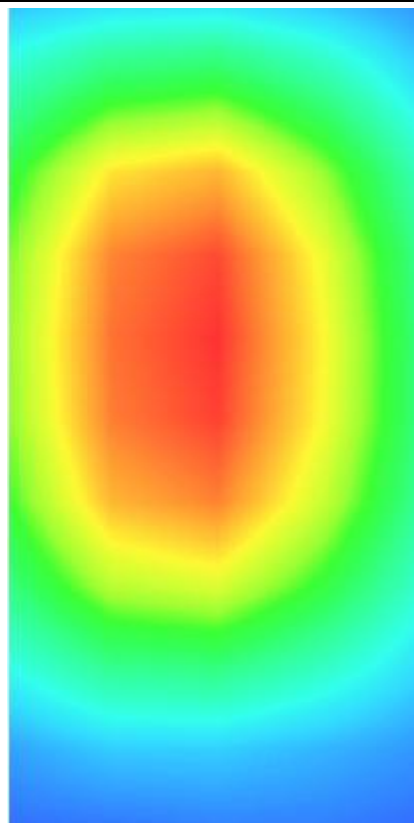
SAR, Z Axis Scan (X = 0, Y = 8)



3D scene shot



Hot spot position



GSM850, Right Cheek, Middle

Type: Phone measurement (Very fast, 11 points in the volume)

Date of measurement: 24/02/2014

Measurement duration: 5 minutes 13 seconds

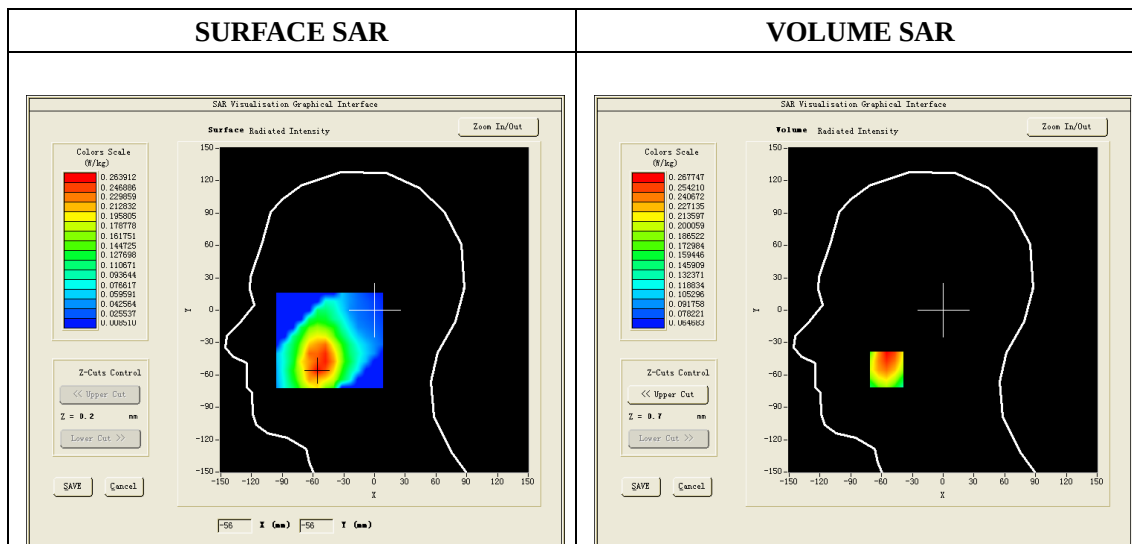
Mobile Phone IMEI number: --

A. Experimental conditions.

Area Scan	sam_direct_droit2_surf8mm.txt
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Very fast
Phantom	Right head
Device Position	Cheek
Band	GSM850
Channels	190
Signal	GSM (Crest factor: 1:8)

B. SAR Measurement Results

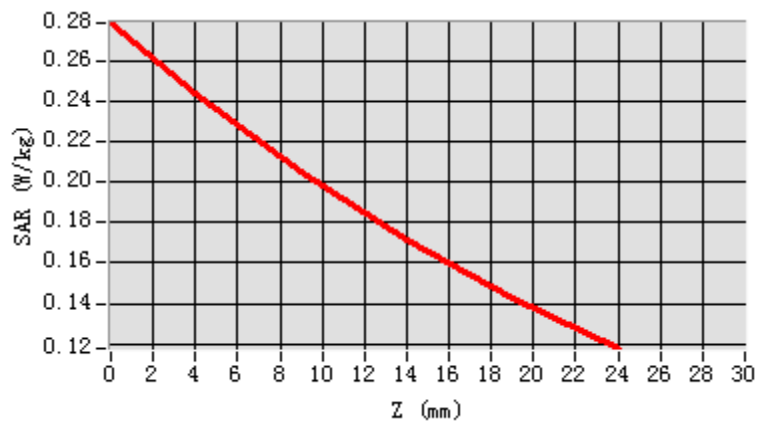
Frequency (MHz)	836.6
Relative permittivity (real part)	41.45
Relative permittivity (imaginary part)	15.07
Conductivity (S/m)	0.91
Variation (%)	-1.450000
ConvF:	5.52



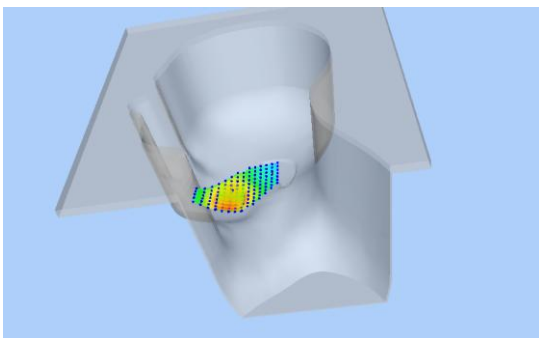
Maximum location: X=-55.00, Y=-55.00

SAR 10g (W/Kg)	0.212577
SAR 1g (W/Kg)	0.276422

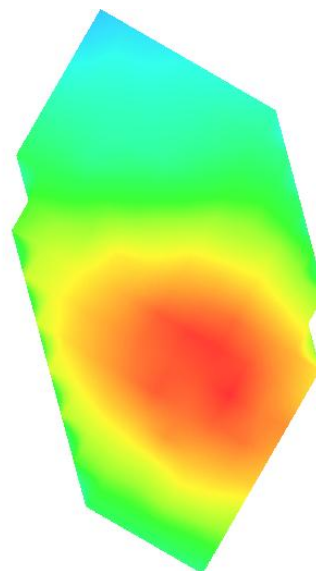
Z axis scan



3D screen shot



Hot spot position



GSM 850,Back,Middle

Type: Phone measurement (Very fast, 11 points in the volume)

Date of measurement: 25/02/2014

Measurement duration: 7 minutes 14 seconds

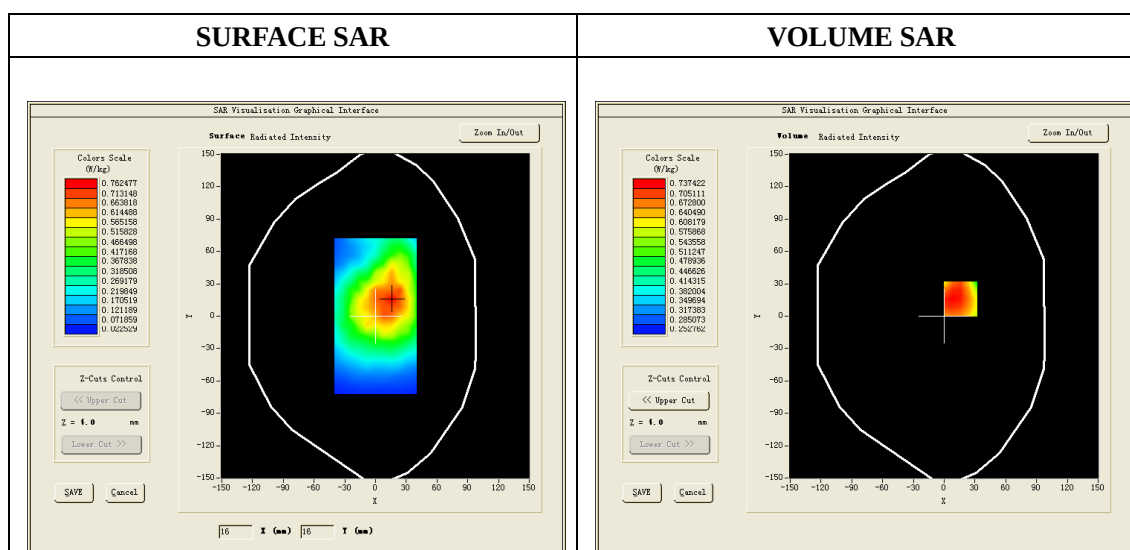
Mobile Phone IMEI number: --

A. Experimental conditions.

Area Scan	surf_sam_plan.txt
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Very fast
Phantom	Validation plane
Device Position	Body
Band	GSM850
Channels	190
Signal	GSM(Crest factor: 1:8)

B. SAR Measurement Results

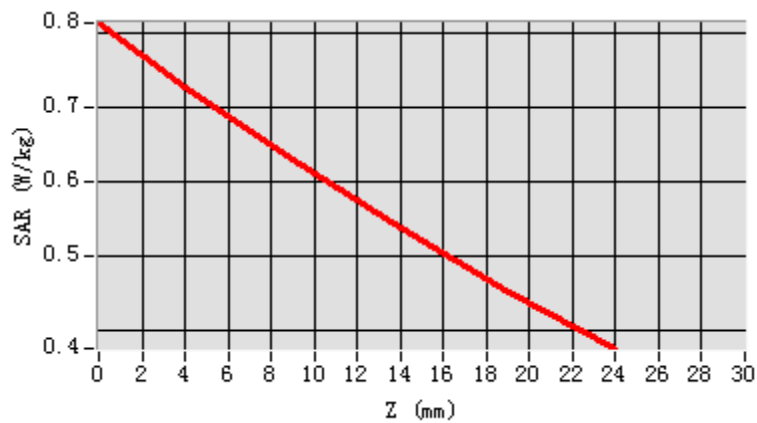
Frequency (MHz)	836.6
Relative permittivity (real part)	55.27
Relative permittivity (imaginary)	21.71
Conductivity (S/m)	0.98
Variation (%)	-3.470000
ConvF:	5.67



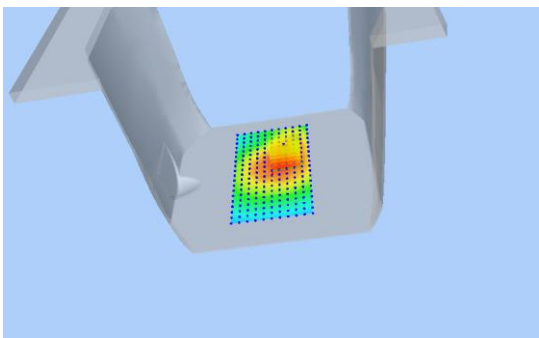
Maximum location: X=16.00, Y=16.00

SAR 10g (W/Kg)	0.635318
SAR 1g (W/Kg)	0.775854

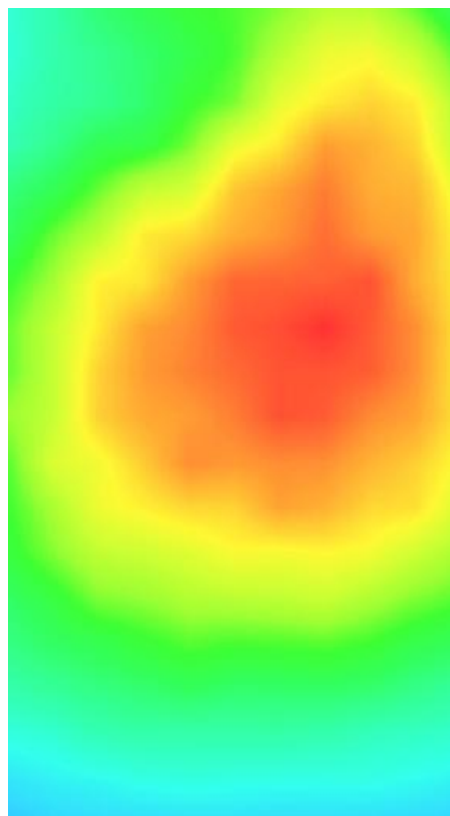
Z axis scan



3D screen shot



Hot spot position



GPRS 850, BACK, Middle

Type: Phone measurement (Very fast, 11 points in the volume)

Date of measurement: 25/02/2014

Measurement duration: 7 minutes 14 seconds

Mobile Phone IMEI number: --

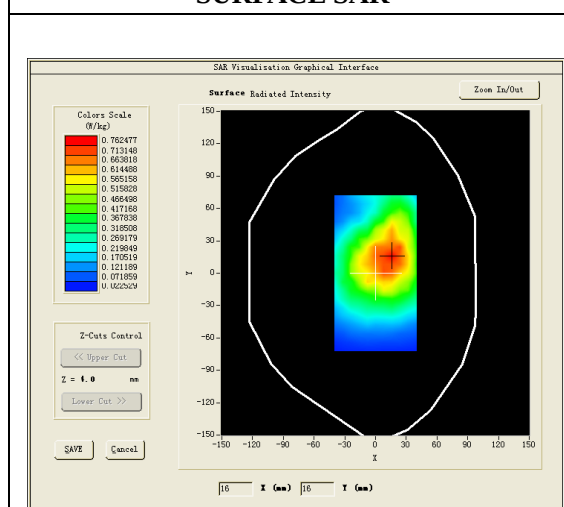
A. Experimental conditions.

Area Scan	surf_sam_plan.txt
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Very fast
Phantom	Validation plane
Device Position	Body
Band	GPRS 850 4Tx
Channels	190
Signal	GSM(Crest factor: 1:2)

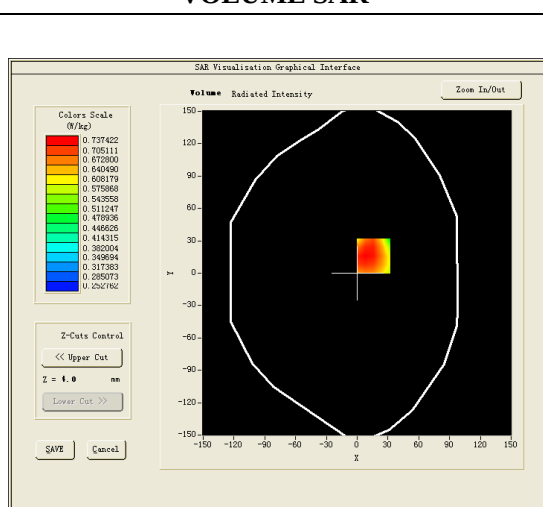
B. SAR Measurement Results

Frequency (MHz)	836.6
Relative permittivity (real part)	55.27
Relative permittivity (imaginary)	21.71
Conductivity (S/m)	0.98
Variation (%)	-4.270000
ConvF:	5.67

SURFACE SAR



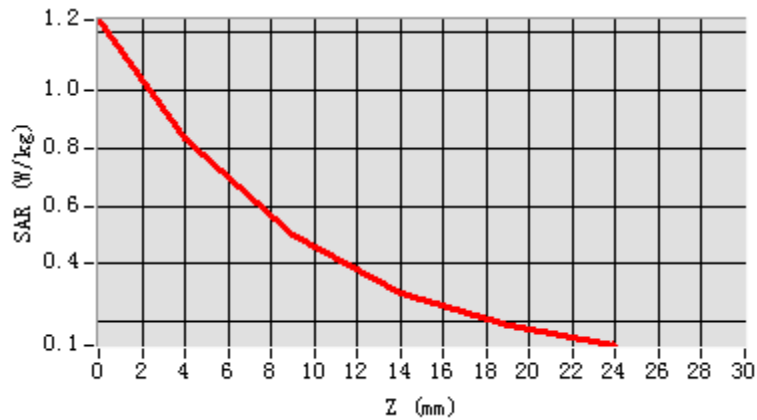
VOLUME SAR



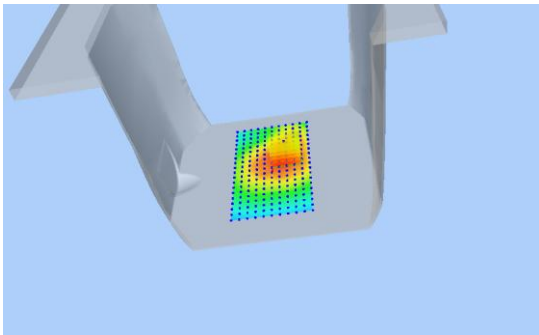
Maximum location: X=8.00, Y=8.00

SAR 10g (W/Kg)	0.443327
SAR 1g (W/Kg)	0.789152

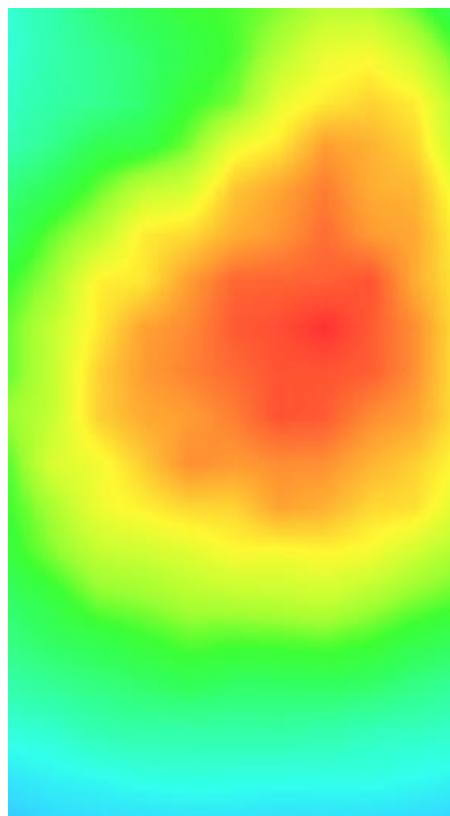
Z axis scan



3D screen shot



Hot spot position



GSM1900, Left Cheek, Middle

Type: Phone measurement (Very fast, 11 points in the volume)

Date of measurement: 24/02/2014

Measurement duration: 5 minutes 21 seconds

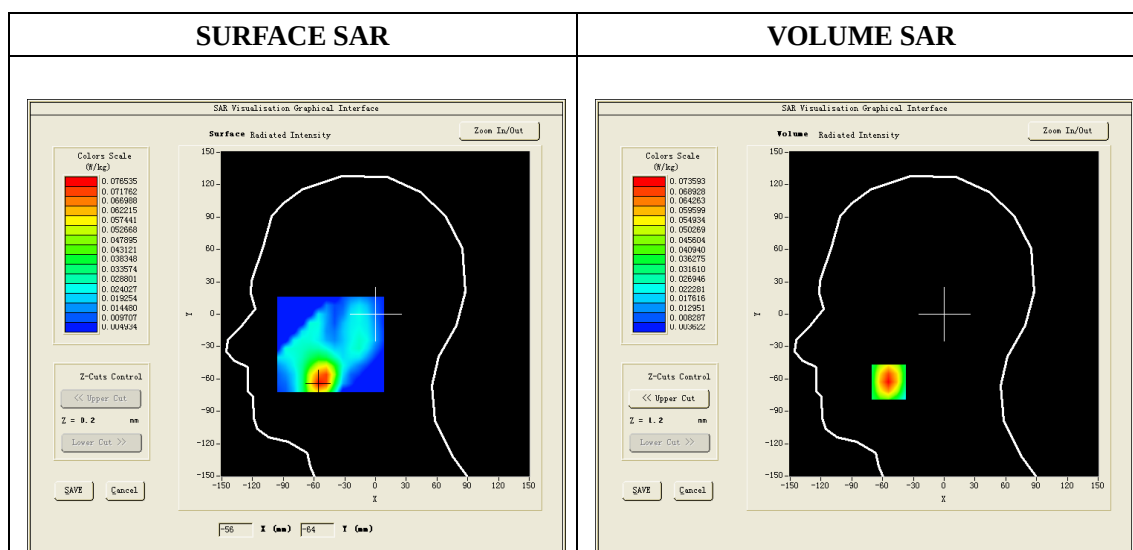
Mobile Phone IMEI number: --

A. Experimental conditions.

Area Scan	sam_direct_droit2_surf8mm.txt
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Very fast
Phantom	Left head
Device Position	Cheek
Band	GSM1900
Channels	661
Signal	GSM (Crest factor: 1:8)

B. SAR Measurement Results

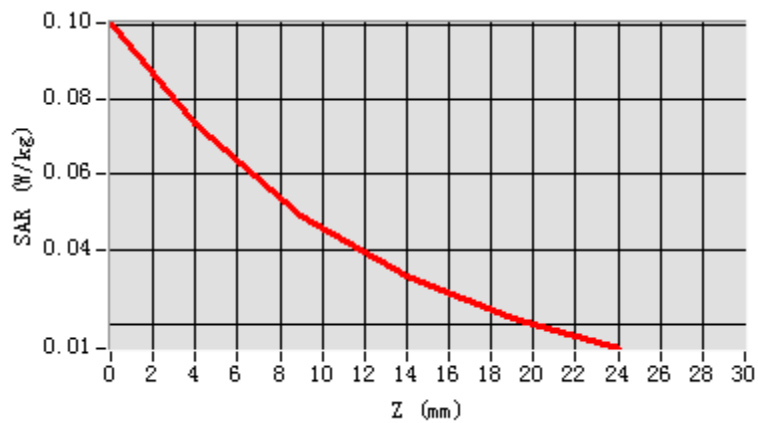
Frequency (MHz)	1880.0
Relative permittivity (real part)	39.98
Relative permittivity (imaginary part)	15.07
Conductivity (S/m)	1.41
Variation (%)	0.420000
ConvF:	5.48



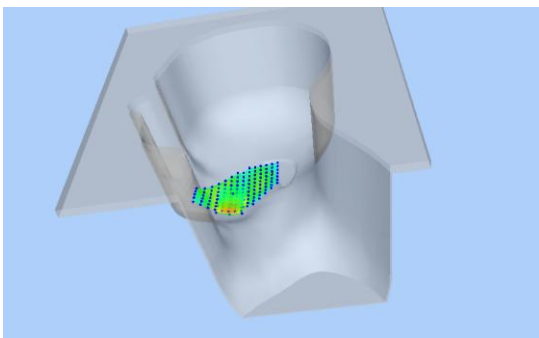
Maximum location: X=-54.00, Y=-63.00

SAR 10g (W/Kg)	0.040903
SAR 1g (W/Kg)	0.068701

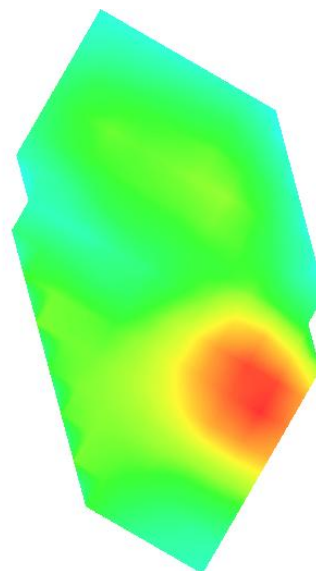
Z axis scan



3D screen shot



Hot spot position



GSM 1900, Back, Middle

Type: Phone measurement (Very fast, 11 points in the volume)

Date of measurement: 25/02/2014

Measurement duration: 10 minutes 24 seconds

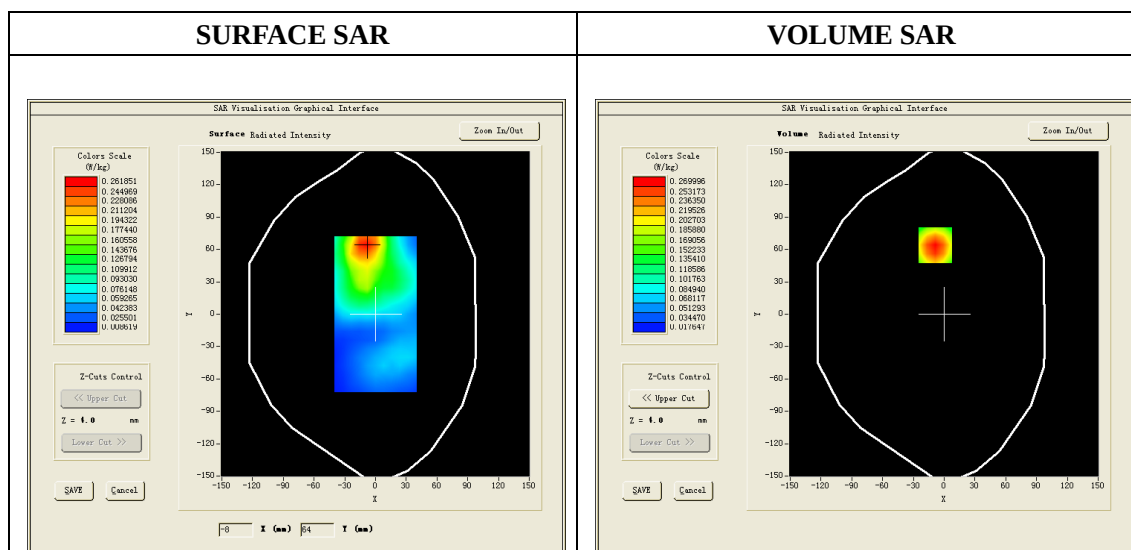
Mobile Phone IMEI number: --

A. Experimental conditions.

Area Scan	surf_sam_plan.txt
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Very fast
Phantom	Validation plane
Device Position	Body
Band	GSM1900
Channels	661
Signal	Crest factor:1:8

B. SAR Measurement Results

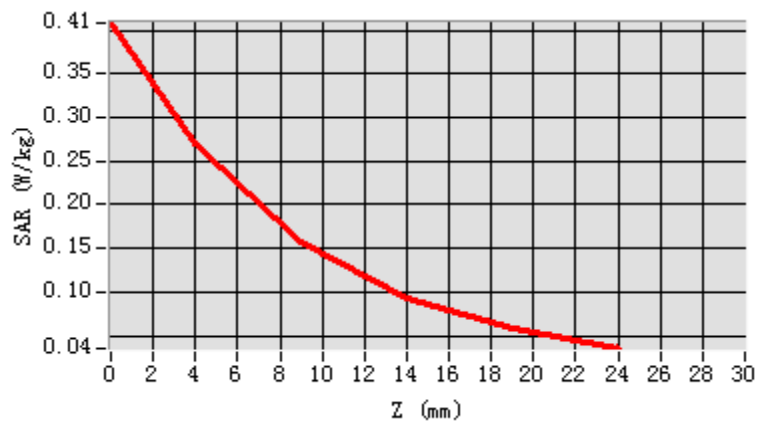
Frequency (MHz)	1880.0
Relative permittivity (real part)	53.28
Relative permittivity (imaginary part)	12.99
Conductivity (S/m)	1.53
Variation (%)	0.85
ConvF:	5.64



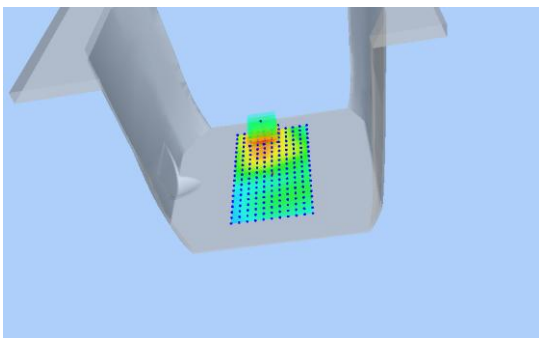
Maximum location: X=-9.00, Y=64.00

SAR 10g (W/Kg)	0.166693
SAR 1g (W/Kg)	0.302596

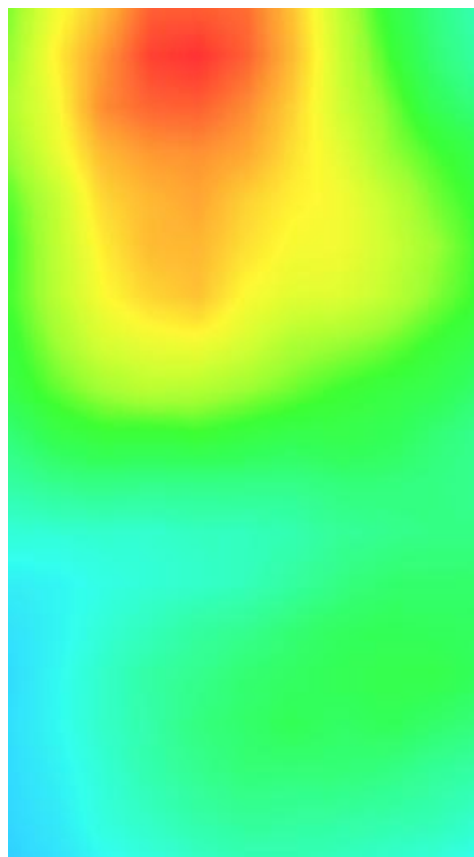
Z axis scan



3D screen shot



Hot spot position



GPRS 1900, Back, Middle

Type: Phone measurement (Very fast, 11 points in the volume)

Date of measurement: 25/02/2014

Measurement duration: 10 minutes 24 seconds

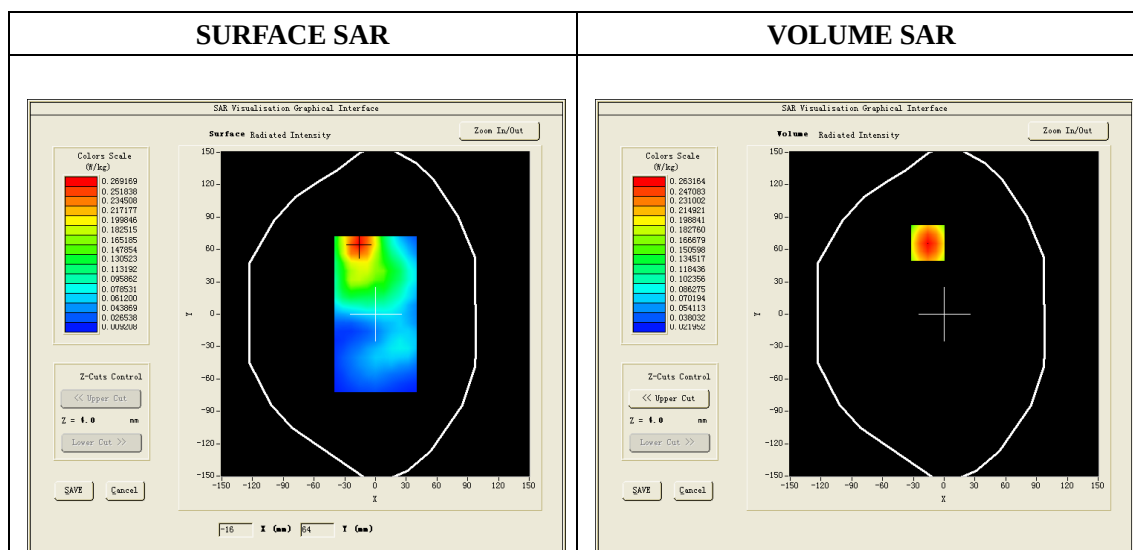
Mobile Phone IMEI number: --

A. Experimental conditions.

Area Scan	surf_sam_plan.txt
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Very fast
Phantom	Validation plane
Device Position	Body
Band	CUSTOM (GPRS1900_4Tx)
Channels	661
Signal	GPRS (Crest factor:1:2)

B. SAR Measurement Results

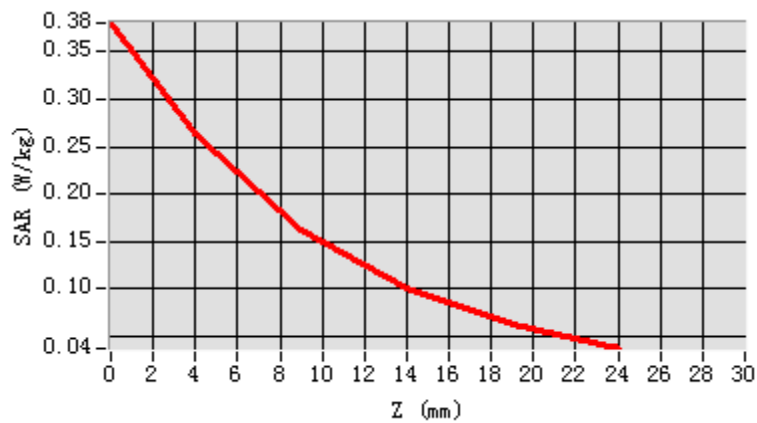
Frequency (MHz)	1880.0
Relative permittivity (real part)	53.28
Relative permittivity (imaginary part)	12.99
Conductivity (S/m)	1.53
Variation (%)	0.31
ConvF:	5.64



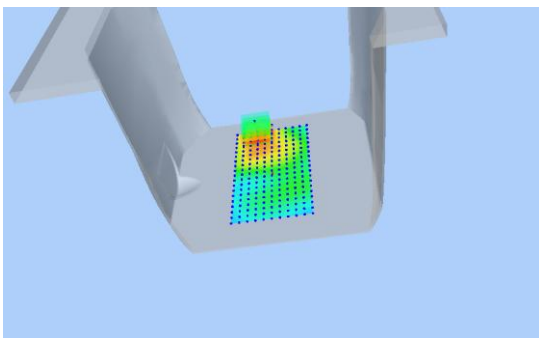
Maximum location: X=-16.00, Y=66.00

SAR 10g (W/Kg)	0.154320
SAR 1g (W/Kg)	0.255910

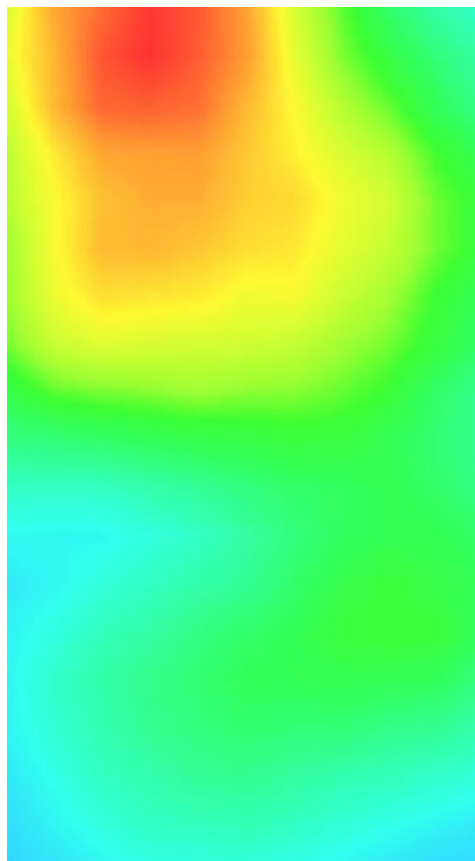
Z axis scan



3D screen shot



Hot spot position



WCDMA1900,Left Cheek, Middle

Type: Phone measurement (Very fast, 11 points in the volume)

Date of measurement: 24/02/2014

Measurement duration: 5 minutes 22 seconds

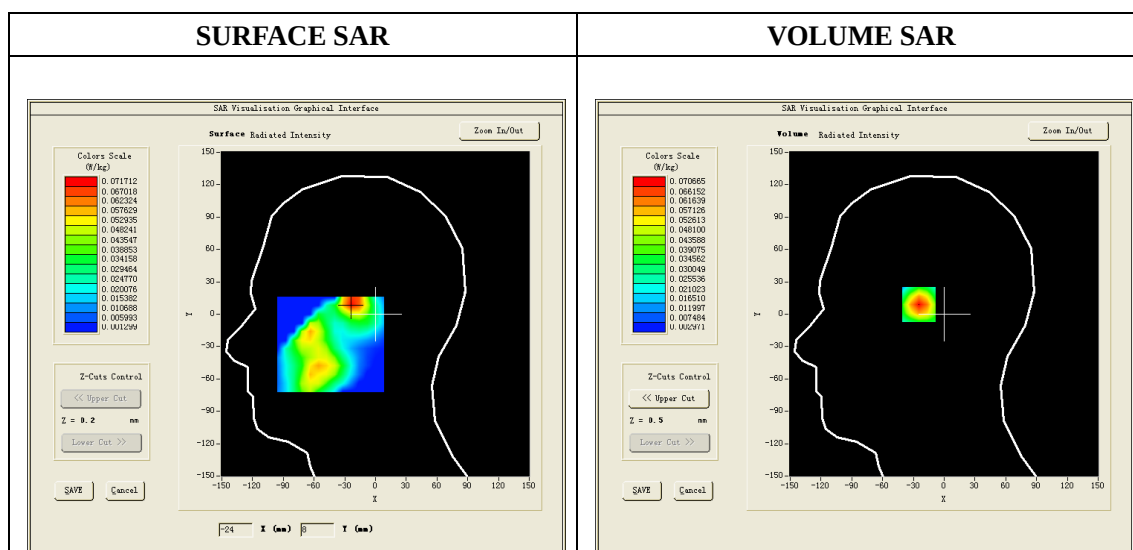
Mobile Phone IMEI number: --

A. Experimental conditions.

Area Scan	sam_direct_droit2_surf8mm.txt
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Very fast
Phantom	Left head
Device Position	Cheek
Band	Band2_WCDMA1900
Channels	9400
Signal	WCDMA (Crest factor: 1:1)

B. SAR Measurement Results

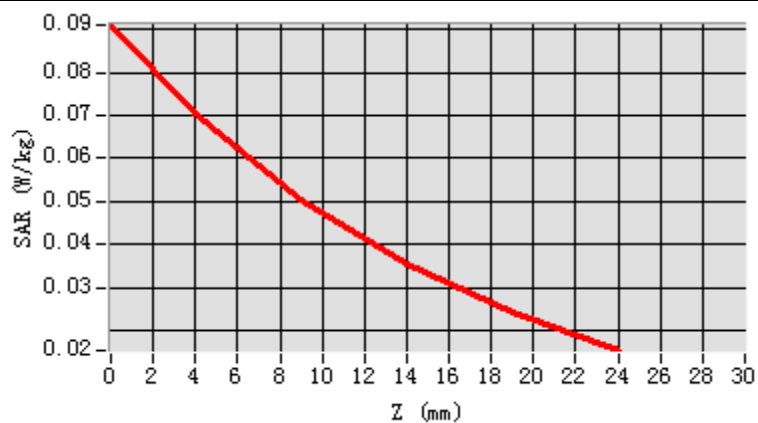
Frequency (MHz)	1880.0
Relative permittivity (real part)	39.88
Relative permittivity (imaginary part)	15.07
Conductivity (S/m)	1.41
Variation (%)	-1.560000
ConvF:	5.48



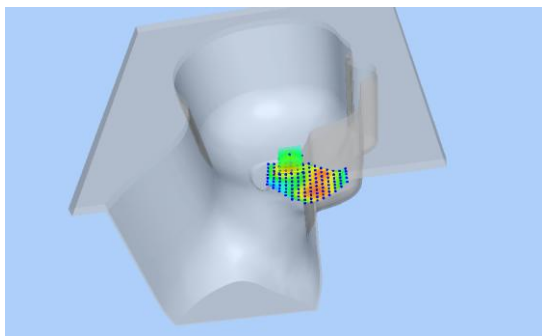
Maximum location: X=-23.00, Y=10.00

SAR 10g (W/Kg)	0.040349
SAR 1g (W/Kg)	0.065794

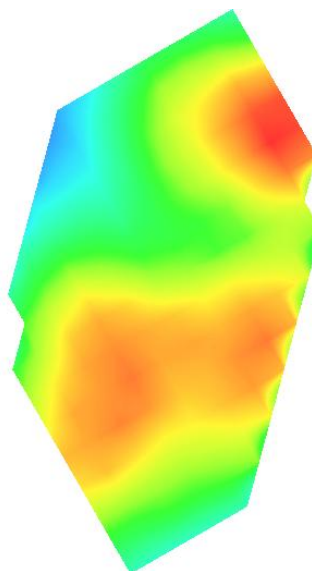
Z axis scan



3D screen shot



Hot spot position



WCDMA1900, Edge B, Middle

Type: Phone measurement (Very fast, 11 points in the volume)

Date of measurement: 25/02/2014

Measurement duration: 7 minutes 15 seconds

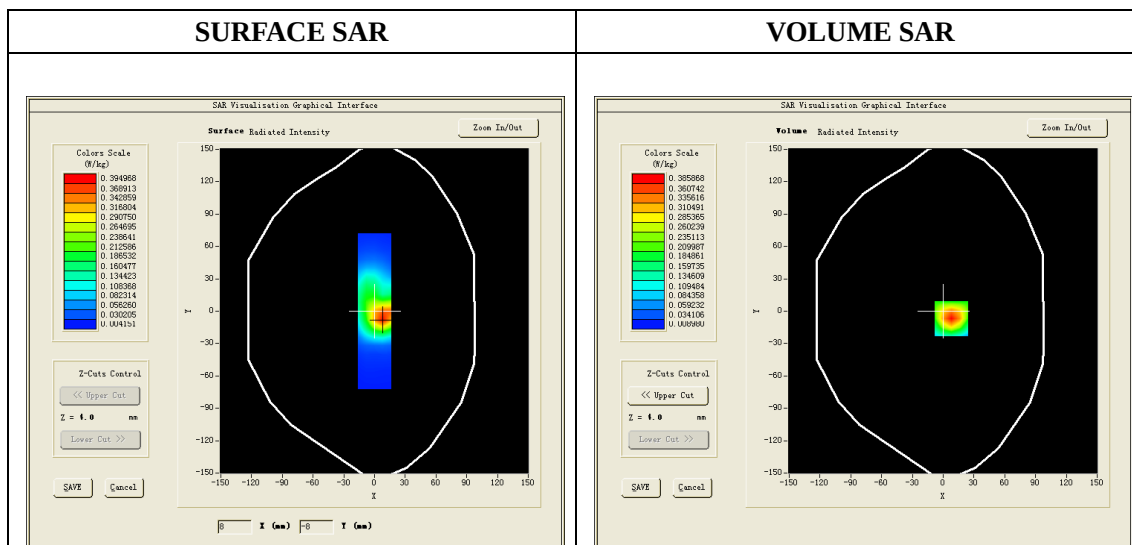
Mobile Phone IMEI number: --

A. Experimental conditions.

Area Scan	surf_sam_plan.txt
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Very fast
Phantom	Validation plane
Device Position	Body
Band	Band2_WCDMA1900
Channels	9400
Signal	WCDMA (Crest factor: 1:1)

B. SAR Measurement Results

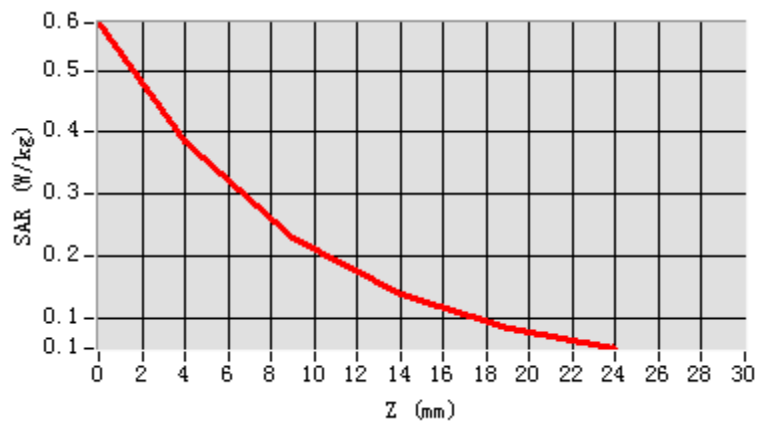
Frequency (MHz)	1880.0
Relative permittivity (real part)	53.28
Relative permittivity (imaginary part)	12.99
Conductivity (S/m)	1.53
Variation (%)	-4.210000
ConvF:	5.64



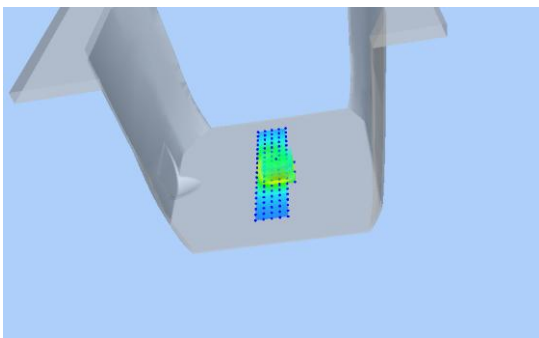
Maximum location: X=8.00, Y=-7.00

SAR 10g (W/Kg)	0.210570
SAR 1g (W/Kg)	0.389621

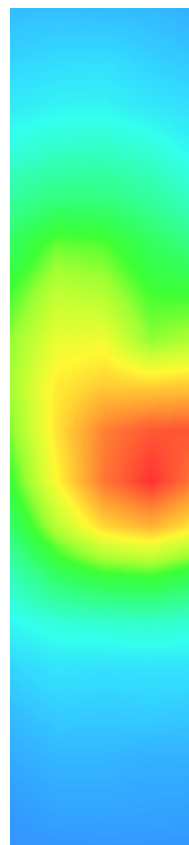
Z axis scan



3D screen shot



Hot spot position



WCDMA850, Right Cheek, Low

Type: Phone measurement (Very fast, 11 points in the volume)

Date of measurement: 24/02/2014

Measurement duration: 5 minutes 19 seconds

Mobile Phone IMEI number: --

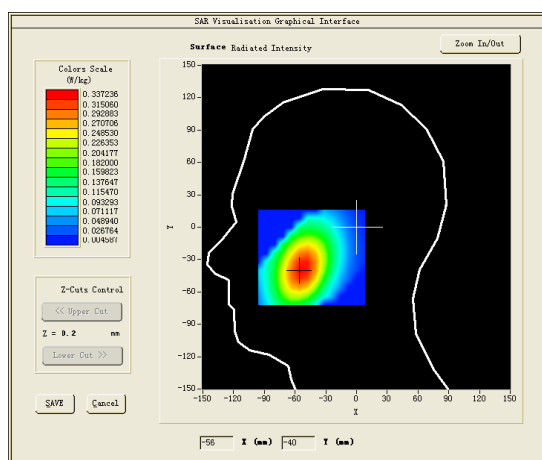
A. Experimental conditions.

Area Scan	sam_direct_droit2_surf8mm.txt
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Very fast
Phantom	Right head
Device Position	Cheek
Band	Band5_WCDMA850
Channels	4132
Signal	WCDMA (Duty cycle: 1:1)

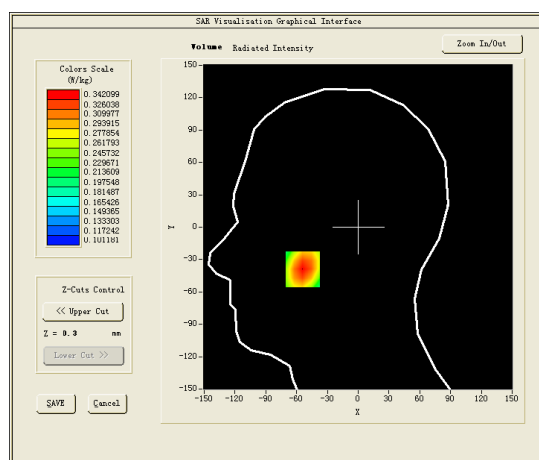
B. SAR Measurement Results

Frequency (MHz)	826.4
Relative permittivity (real part)	41.45
Relative permittivity (imaginary part)	15.07
Conductivity (S/m)	0.91
Variation (%)	0.430000
ConvF:	5.52

SURFACE SAR



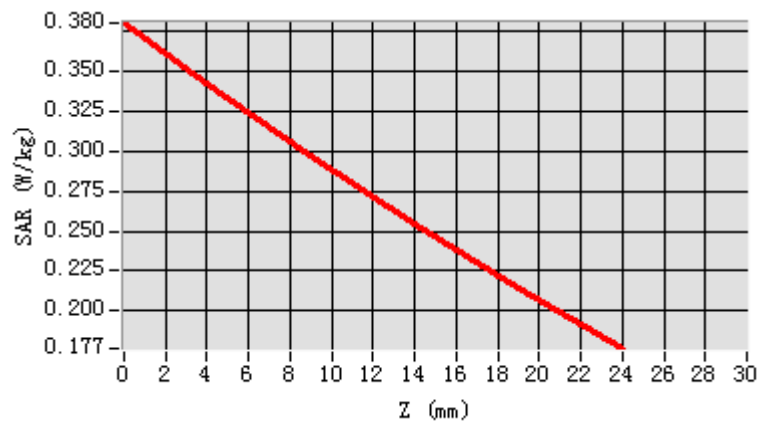
VOLUME SAR



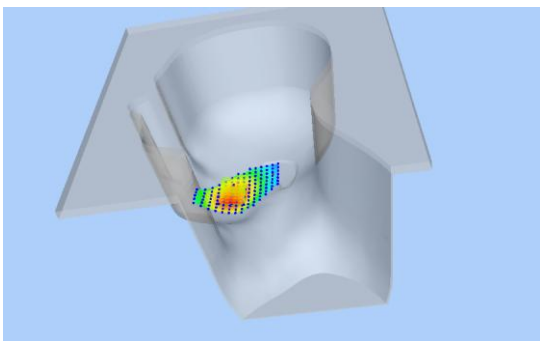
Maximum location: X=-54.00, Y=-39.00

SAR 10g (W/Kg)	0.187572
SAR 1g (W/Kg)	0.275468

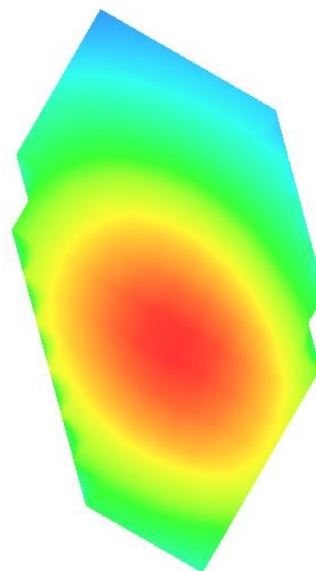
Z axis scan



3D screen shot



Hot spot position



WCDMA850, Back, Low

Type: Phone measurement (Very fast, 11 points in the volume)

Date of measurement: 25/02/2014

Measurement duration: 7 minutes 26 seconds

Mobile Phone IMEI number: --

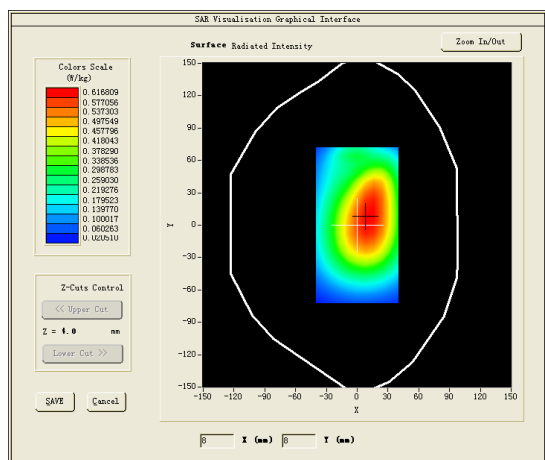
A. Experimental conditions.

Area Scan	surf_sam_plan.txt
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Very fast
Phantom	Validation plane
Device Position	Back
Band	Band5_WCDMA850
Channels	4132
Signal	WCDMA (Crest factor: 1:1)

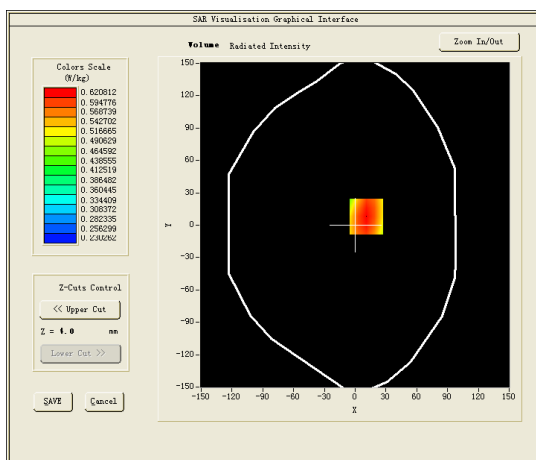
B. SAR Measurement Results

Frequency (MHz)	826.4
Relative permittivity (real part)	55.27
Relative permittivity (imaginary part)	21.71
Conductivity (S/m)	0.98
Variation (%)	-0.310000
ConvF:	5.67

SURFACE SAR



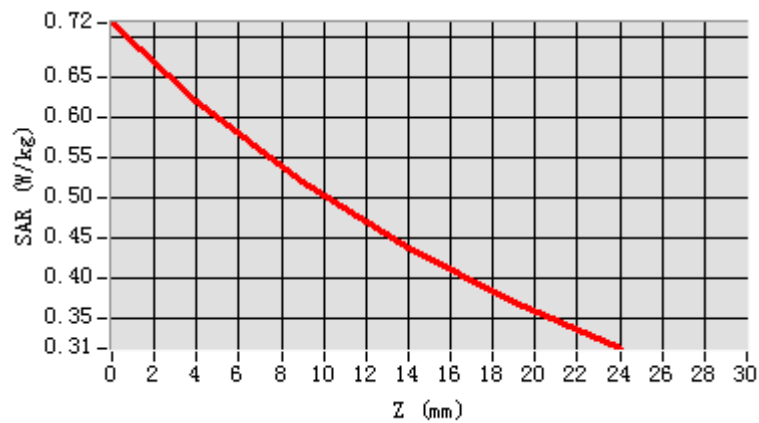
VOLUME SAR



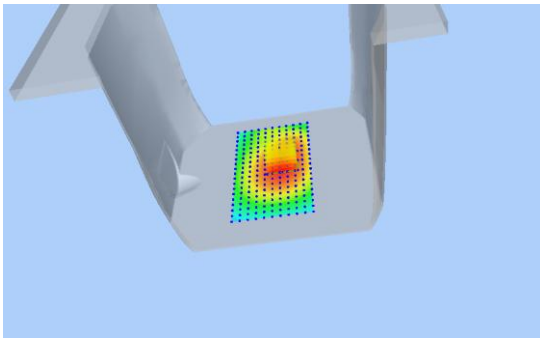
Maximum location: X=11.00, Y=8.00

SAR 10g (W/Kg)	0.364413
SAR 1g (W/Kg)	0.487342

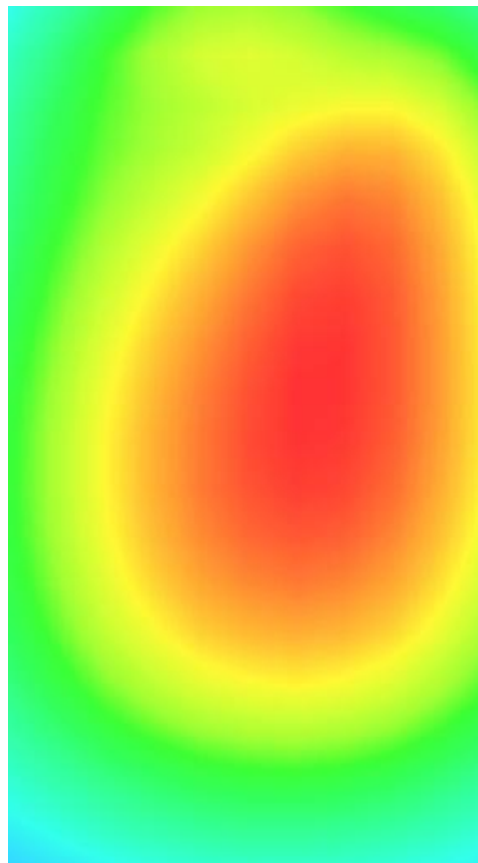
Z axis scan



3D screen shot



Hot spot position



Wi-Fi 802.11b , Right Cheek, Middle

Type: Phone measurement (Very fast, 11 points in the volume)

Date of measurement: 24/02/2014

Measurement duration: 7 minutes 21 seconds

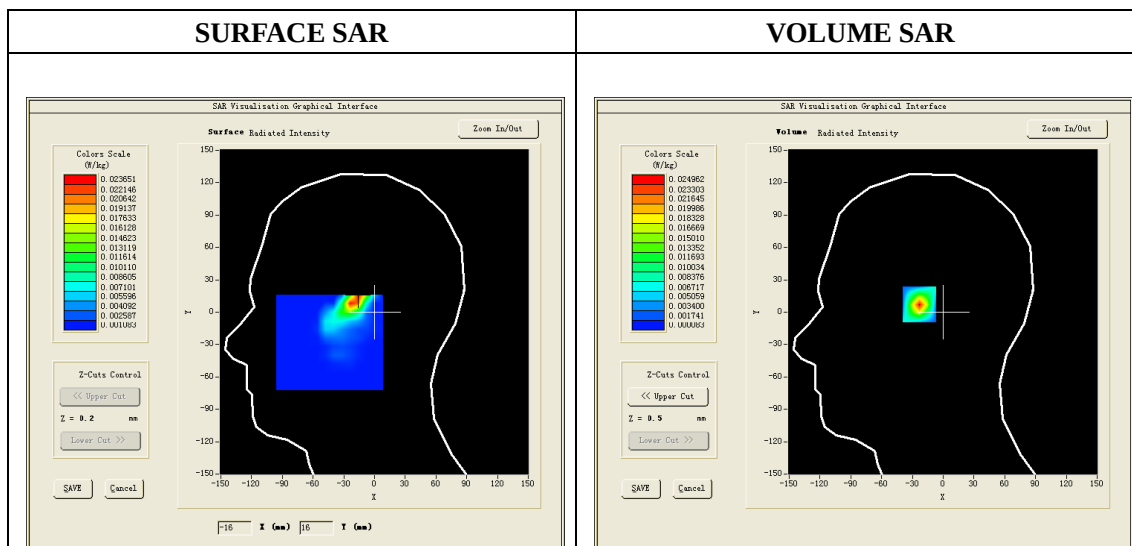
Mobile Phone IMEI number: --

A. Experimental conditions.

Area Scan	dx=8mm dy=8mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Very fast
Phantom	Validation plane
Device Position	Body
Band	IEEE 802.11b ISM
Channels	1
Signal	DSSS (Crest factor: 1:1)

B. SAR Measurement Results

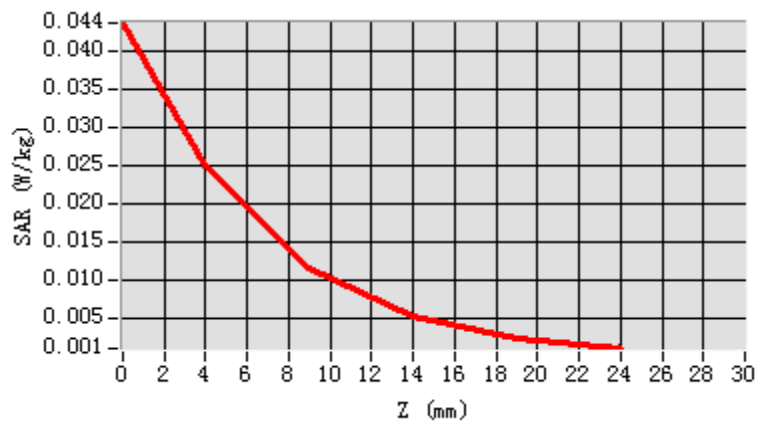
Frequency (MHz)	2412
Relative permittivity (real part)	38.98
Relative permittivity (imaginary part)	13.19
Conductivity (S/m)	1.81
Variation (%)	0.670000
ConvF:	4.80



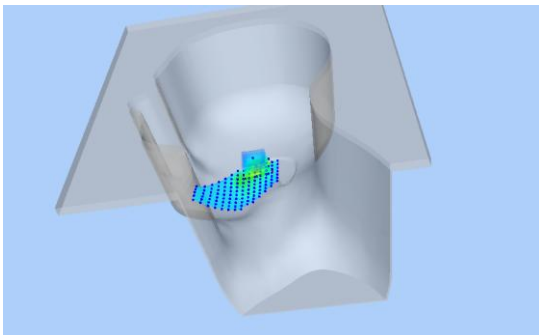
Maximum location: X=-21.00, Y=8.00

SAR 10g (W/Kg)	0.008758
SAR 1g (W/Kg)	0.024355

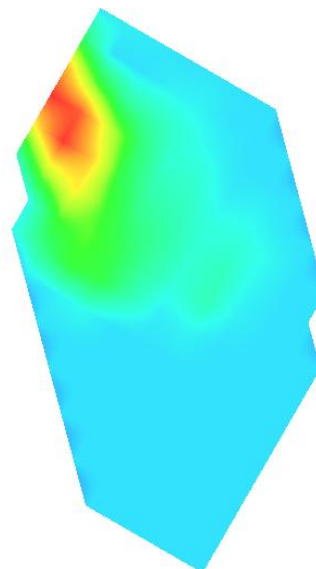
Z axis scan



3D screen shot



Hot spot position



Wi-Fi 802.11b , Back, Middle

Type: Phone measurement (Very fast, 11 points in the volume)

Date of measurement: 25/02/2014

Measurement duration: 7 minutes 21 seconds

Mobile Phone IMEI number: --

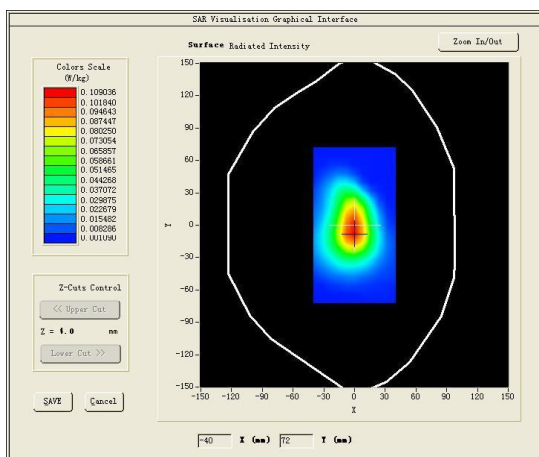
A. Experimental conditions.

Area Scan	dx=8mm dy=8mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Very fast
Phantom	Validation plane
Device Position	Body
Band	IEEE 802.11b ISM
Channels	1
Signal	DSSS (Crest factor: 1:1)

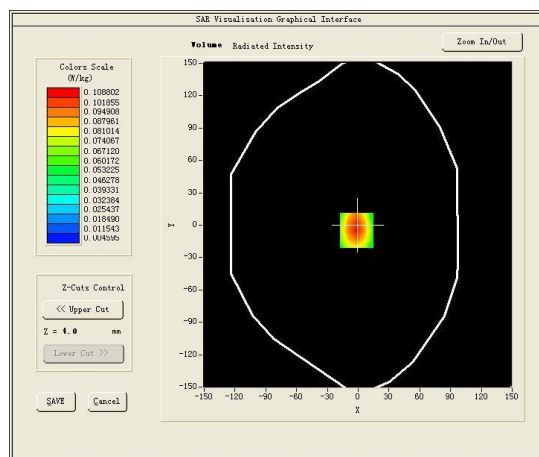
B. SAR Measurement Results

Frequency (MHz)	2412
Relative permittivity (real part)	52.64
Relative permittivity (imaginary part)	13.02
Conductivity (S/m)	1.96
Variation (%)	0.280000
ConvF:	4.90

SURFACE SAR



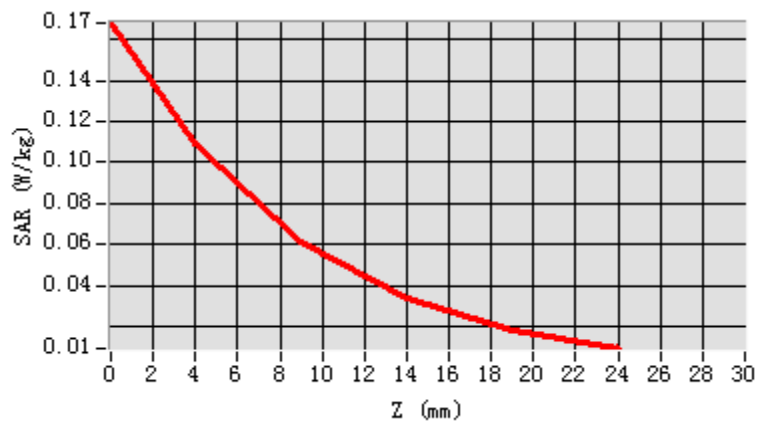
VOLUME SAR



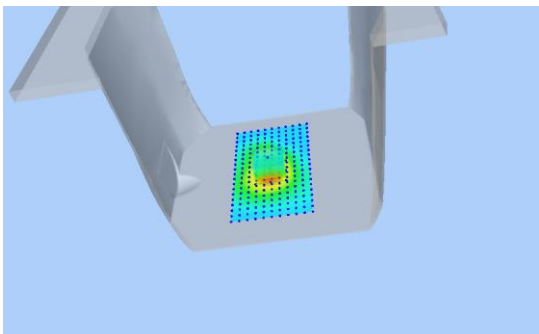
Maximum location: X=-1.00, Y=-5.00

SAR 10g (W/Kg)	0.049752
SAR 1g (W/Kg)	0.091364

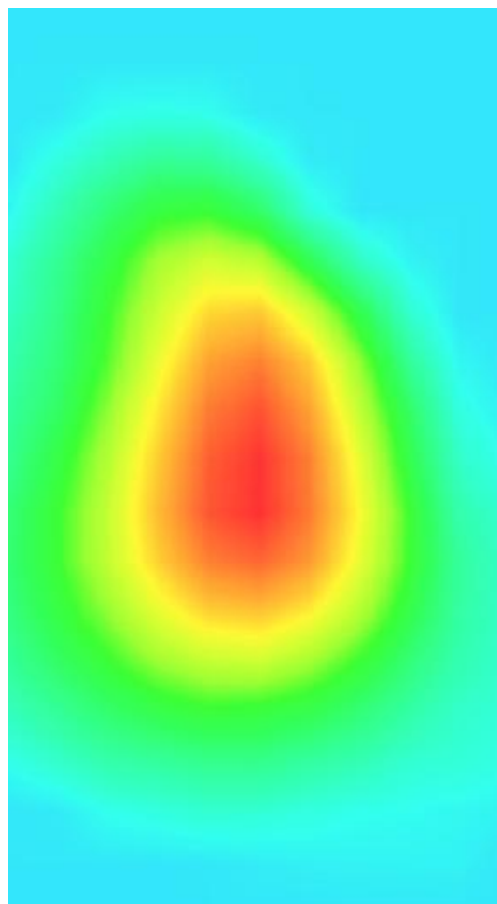
Z axis scan



3D screen shot



Hot spot position



ANNEX E

of

CCIC-SET

CONFORMANCE TEST REPORT FOR

HUMAN EXPOSURE TO ELECTROMAGNETIC FIELDS

SET2014-01609

Mobilephone

Type Name: R750

Hardware Version: S097M001P110

Software Version: R750_VER_2.0_01035_20131114

Calibration Certificate of Probe and Dipoles

This Annex consists of 42 pages

Date of Report: 2014-03-07

Probe Calibration Certificate**COMOSAR E-Field Probe Calibration Report**

Ref : ACR.96.2.13.SATU.A

**CCIC SOUTHERN ELECTRONIC PRODUCT TESTING
(SHENZHEN) CO.,LTD**

**ELECTRONIC TESTING BUILDING,SHAHE ROAD, XILI.
TOWN SHENZHEN,P.R.CHINA**

**SATIMO COMOSAR DOSIMETRIC E-FIELD PROBE
SERIAL NO.: SN 09/13 EP169**

**Calibrated at SATIMO US
2105 Barrett Park Dr. - Kennesaw, GA 30144**

**04/05/13***Summary:*

This document presents the method and results from an accredited COMOSAR Dosimetric E-Field Probe calibration performed in SATIMO USA using the CALISAR / CALIBAIR test bench, for use with a SATIMO COMOSAR system only. All calibration results are traceable to national metrology institutions.



COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.96.2.13.SATU.A

	<i>Name</i>	<i>Function</i>	<i>Date</i>	<i>Signature</i>
<i>Prepared by :</i>	Jérôme LUC	Product Manager	4/5/2013	
<i>Checked by :</i>	Jérôme LUC	Product Manager	4/5/2013	
<i>Approved by :</i>	Kim RUTKOWSKI	Quality Manager	4/5/2013	

	<i>Customer Name</i>
<i>Distribution :</i>	Shenzhen EMC-united Co., Ltd

<i>Issue</i>	<i>Date</i>	<i>Modifications</i>
A	4/5/2013	Initial release

Page: 2/10

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TABLE OF CONTENTS

1	Device Under Test	4
2	Product Description.....	4
2.1	General Information	4
3	Measurement Method.....	4
3.1	Linearity	4
3.2	Sensitivity	5
3.3	Lower Detection Limit	5
3.4	Isotropy	5
3.5	Boundary Effect	5
4	Measurement Uncertainty	5
5	Calibration Measurement Results	6
5.1	Sensitivity in air	6
5.2	Linearity	7
5.3	Sensitivity in liquid	7
5.4	Isotropy	8
6	List of Equipment	10

Page: 3/10

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COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.96.2.13.SATU.A

1 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR DOSIMETRIC E FIELD PROBE
Manufacturer	Satimo
Model	SSE5
Serial Number	SN 09/13 EP169
Product Condition (new / used)	new
Frequency Range of Probe	0.7 GHz-3GHz
Resistance of Three Dipoles at Connector	Dipole 1: R1=0.223 MΩ Dipole 2: R2=0.233 MΩ Dipole 3: R3=0.222 MΩ

A yearly calibration interval is recommended.

2 PRODUCT DESCRIPTION

2.1 GENERAL INFORMATION

Satimo's COMOSAR E field Probes are built in accordance to the IEEE 1528, OET 65 Bulletin C and CEI/IEC 62209 standards.



Figure 1 – Satimo COMOSAR Dosimetric E field Dipole

Probe Length	330 mm
Length of Individual Dipoles	4.5 mm
Maximum external diameter	8 mm
Probe Tip External Diameter	5 mm
Distance between dipoles / probe extremity	2.7 mm

3 MEASUREMENT METHOD

The IEEE 1528, OET 65 Bulletin C, CENELEC EN50361 and CEI/IEC 62209 standards provide recommended practices for the probe calibrations, including the performance characteristics of interest and methods by which to assess their affect. All calibrations / measurements performed meet the fore mentioned standards.

3.1 LINEARITY

The evaluation of the linearity was done in free space using the waveguide, performing a power sweep to cover the SAR range 0.01W/kg to 100W/kg.

Page: 4/10

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3.2 SENSITIVITY

The sensitivity factors of the three dipoles were determined using a two step calibration method (air and tissue simulating liquid) using waveguides as outlined in the standards.

3.3 LOWER DETECTION LIMIT

The lower detection limit was assessed using the same measurement set up as used for the linearity measurement. The required lower detection limit is 10 mW/kg.

3.4 ISOTROPY

The axial isotropy was evaluated by exposing the probe to a reference wave from a standard dipole with the dipole mounted under the flat phantom in the test configuration suggested for system validations and checks. The probe was rotated along its main axis from 0 - 360 degrees in 15 degree steps. The hemispherical isotropy is determined by inserting the probe in a thin plastic box filled with tissue-equivalent liquid, with the plastic box illuminated with the fields from a half wave dipole. The dipole is rotated about its axis (0°–180°) in 15° increments. At each step the probe is rotated about its axis (0°–360°).

3.5 BOUNDARY EFFECT

The boundary effect is defined as the deviation between the SAR measured data and the expected exponential decay in the liquid when the probe is oriented normal to the interface. To evaluate this effect, the liquid filled flat phantom is exposed to fields from either a reference dipole or waveguide. With the probe normal to the phantom surface, the peak spatial average SAR is measured and compared to the analytical value at the surface.

4 MEASUREMENT UNCERTAINTY

The guidelines outlined in the IEEE 1528, OET 65 Bulletin C, CENELEC EN50361 and CEI/IEC 62209 standards were followed to generate the measurement uncertainty associated with an E-field probe calibration using the waveguide technique. All uncertainties listed below represent an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k=2$, traceable to the Internationally Accepted Guides to Measurement Uncertainty.

Uncertainty analysis of the probe calibration in waveguide					
ERROR SOURCES	Uncertainty value (%)	Probability Distribution	Divisor	ci	Standard Uncertainty (%)
Incident or forward power	3.00%	Rectangular	$\sqrt{3}$	1	1.732%
Reflected power	3.00%	Rectangular	$\sqrt{3}$	1	1.732%
Liquid conductivity	5.00%	Rectangular	$\sqrt{3}$	1	2.887%
Liquid permittivity	4.00%	Rectangular	$\sqrt{3}$	1	2.309%
Field homogeneity	3.00%	Rectangular	$\sqrt{3}$	1	1.732%
Field probe positioning	5.00%	Rectangular	$\sqrt{3}$	1	2.887%
Field probe linearity	3.00%	Rectangular	$\sqrt{3}$	1	1.732%

Page: 5/10

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COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref. ACR.96.2.13.SATUA

Combined standard uncertainty					5.831%
Expanded uncertainty 95 % confidence level k = 2					12%

5 CALIBRATION MEASUREMENT RESULTS

Calibration Parameters	
Liquid Temperature	21 °C
Lab Temperature	21 °C
Lab Humidity	45 %

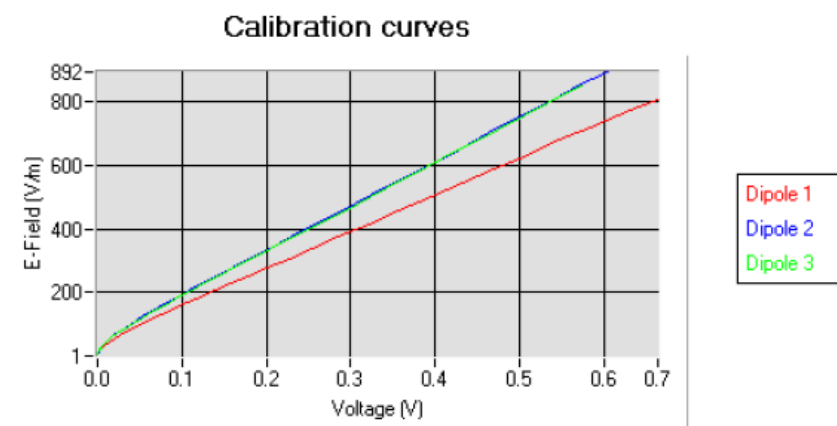
5.1 SENSITIVITY IN AIR

Normx dipole 1 ($\mu\text{V}/(\text{V}/\text{m})^2$)	Normy dipole 2 ($\mu\text{V}/(\text{V}/\text{m})^2$)	Normz dipole 3 ($\mu\text{V}/(\text{V}/\text{m})^2$)
7.21	6.08	5.72

DCP dipole 1 (mV)	DCP dipole 2 (mV)	DCP dipole 3 (mV)
93	93	90

Calibration curves $e_i=f(V)$ ($i=1,2,3$) allow to obtain H-field value using the formula:

$$E = \sqrt{E_1^2 + E_2^2 + E_3^2}$$



Page: 6/10

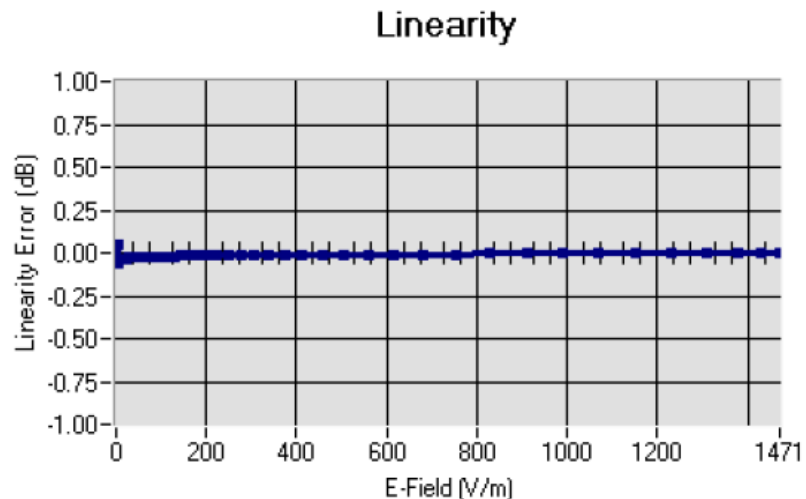
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COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref ACR.96.2.13.SATU.A

5.2 LINEARITY



Linearity: $\pm 1.42\%$ ($\pm 0.06\text{dB}$)

5.3 SENSITIVITY IN LIQUID

Liquid	Frequency (MHz $\pm$ 100MHz)	Permittivity	Epsilon (S/m)	ConvF
HL850	835	42.56	0.88	5.52
BL850	835	55.26	0.96	5.67
HL900	900	41.79	0.96	5.19
BL900	900	55.98	1.04	5.32
HL1800	1750	40.17	1.38	4.79
BL1800	1750	52.05	1.48	4.95
HL1900	1880	39.80	1.43	5.48
BL1900	1880	52.55	1.50	5.64
HL2000	1950	38.93	1.44	4.82
BL2000	1950	53.12	1.51	5.01
HL2450	2450	38.64	1.82	4.80
BL2450	2450	52.02	1.94	4.90

LOWER DETECTION LIMIT: 9mW/kg

Page: 7/10

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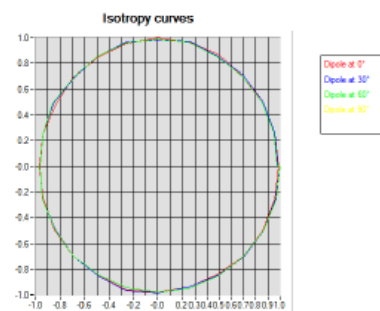
COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.96.2.13.SATU.A

5.4 ISOTROPY

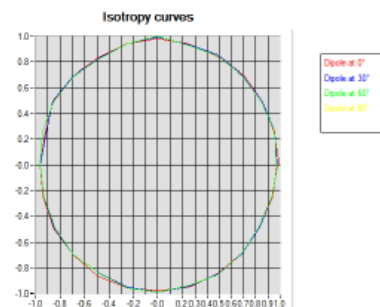
HL 900 MHz

- Axial isotropy: 0.04 dB
- Hemispherical isotropy: 0.05 dB



HL 1800 MHz

- Axial isotropy: 0.05 dB
- Hemispherical isotropy: 0.07 dB



Page: 8/10

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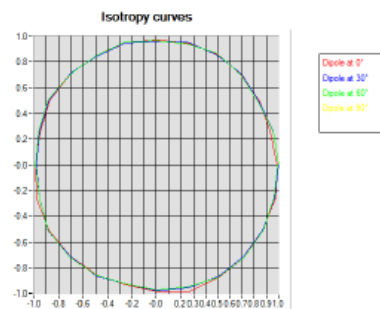


COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref ACR.96.2.13.SATU.A

HL2450 MHz

- Axial isotropy: 0.06 dB
- Hemispherical isotropy: 0.09 dB



Page: 9/10

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COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref ACR.96.2.13.SATU.A

6 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Description	Manufacturer / Model	Identification No.	Current Calibration Date	Next Calibration Date
Flat Phantom	Satimo	SN-20/09-SAM71	Validated. No cal required.	Validated. No cal required.
COMOSAR Test Bench	Version 3	NA	Validated. No cal required.	Validated. No cal required.
Network Analyzer	Rhode & Schwarz ZVA	SN100132	02/2013	02/2016
Reference Probe	Satimo	EP 94 SN 37/08	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Multimeter	Keithley 2000	1188656	11/2010	11/2013
Signal Generator	Agilent E4438C	MY49070581	12/2010	12/2013
Amplifier	Aethercomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	HP E4418A	US38261498	11/2010	11/2013
Power Sensor	HP ECP-E26A	US37181460	11/2010	11/2013
Directional Coupler	Narda 4216-20	01386	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Waveguide	Mega Industries	069Y7-158-13-712	Validated. No cal required.	Validated. No cal required.
Waveguide Transition	Mega Industries	069Y7-158-13-701	Validated. No cal required.	Validated. No cal required.
Waveguide Termination	Mega Industries	069Y7-158-13-701	Validated. No cal required.	Validated. No cal required.
Temperature / Humidity Sensor	Control Company	11-661-9	3/2012	3/2014

Page: 10/10

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SID835 Dipole Calibration Certificate**SAR Reference Dipole Calibration Report**

Ref: ACR.96.3.13.SATU.A

**CCIC SOUTHERN ELECTRONIC PRODUCT TESTING
(SHENZHEN) CO.,LTD****ELECTRONIC TESTING BUILDING,SHAHE ROAD, XILI
TOWN SHENZHEN,P.R.CHINA****SATIMO COMOSAR REFERENCE DIPOLE
FREQUENCY: 835 MHZ****Calibrated at SATIMO US
2105 Barrett Park Dr. - Kennesaw, GA 30144****04/05/13***Summary:*

This document presents the method and results from an accredited SAR reference dipole calibration performed in SATIMO USA using the COMOSAR test bench. All calibration results are traceable to national metrology institutions.



SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref. ACR.96.3.13.SATU.A

	<i>Name</i>	<i>Function</i>	<i>Date</i>	<i>Signature</i>
<i>Prepared by :</i>	Jérôme LUC	Product Manager	4/5/2013	
<i>Checked by :</i>	Jérôme LUC	Product Manager	4/5/2013	
<i>Approved by :</i>	Kim RUTKOWSKI	Quality Manager	4/5/2013	

	<i>Customer Name</i>
<i>Distribution :</i>	Shenzhen EMC-united Co., Ltd

<i>Issue</i>	<i>Date</i>	<i>Modifications</i>
A	4/5/2013	Initial release

Page: 2/10

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TABLE OF CONTENTS

1	Introduction	4
2	Device Under Test	4
3	Product Description.....	4
3.1	General Information	4
4	Measurement Method.....	5
4.1	Return Loss Requirements	5
4.2	Mechanical Requirements	5
5	Measurement Uncertainty	5
5.1	Return Loss	5
5.2	Dimension Measurement	5
5.3	Validation Measurement	5
6	Calibration Measurement Results	6
6.1	Return Loss	6
6.2	Mechanical Dimensions	6
7	Validation measurement.....	7
7.1	Measurement Condition	7
7.2	Head Liquid Measurement	7
7.3	Measurement Result	8
7.4	Body Measurement Result	9
8	List of Equipment	10

Page: 3/10

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1 INTRODUCTION

This document contains a summary of the requirements set forth by the IEEE 1528, OET 65 Bulletin C and CEI/IEC 62209 standards for reference dipoles used for SAR measurement system validations and the measurements that were performed to verify that the product complies with the fore mentioned standards.

2 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR 835 MHz REFERENCE DIPOLE
Manufacturer	Satimo
Model	SID835
Serial Number	SN 09/13 DIP0G835-217
Product Condition (new / used)	new

A yearly calibration interval is recommended.

3 PRODUCT DESCRIPTION

3.1 GENERAL INFORMATION

Satimo's COMOSAR Validation Dipoles are built in accordance to the IEEE 1528, OET 65 Bulletin C and CEI/IEC 62209 standards. The product is designed for use with the COMOSAR test bench only.



Figure 1 – Satimo COMOSAR Validation Dipole

Page: 4/10

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