FCC SAR TEST REPORT

Report No.:	SET2017-01489
Product:	3G/2G fixed wireless phone
Brand Name:	CO-COMM
Model No.:	F800C
FCC ID:	2AKWZF800C
Applicant:	CO-COMM SERVICIOS TELECOMUNICACIONES S.L.
Address:	C/Lisboa, 20 – 28232 Las Rozas (Madrid), Spain.
Issued by:	CCIC-SET
Lab Location:	Building 28/29, East of Shigu, Xili Industrial Zone, Xili Road, Nanshan District, Shenzhen, Guangdong, China
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Website:	http://www.ccic-set.com

Test Report

Product. ……………….:	3G/2G fixed wireless phone
Model No. ……………..:	F800C
Brand Name…………..:	CO-COMM
FCC ID…………….…….:	2AKWZF800C
Applicant………………..:	CO-COMM SERVICIOS TELECOMUNICACIONES S.L.
Applicant Address…….:	C/Lisboa, 20 – 28232 Las Rozas (Madrid), Spain.
Manufacturer…………:	CO-COMM SERVICIOS TELECOMUNICACIONES S.L.
Manufacturer Address:	C/Lisboa, 20 – 28232 Las Rozas (Madrid), Spain.
Test Standards……….:	**47CFR § 2.1093-** Radiofrequency Radiation Exposure Evaluation: Portable Devices; **ANSI C95.1–1992:** Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz – 300 GHz.(IEEE Std C95.1-1991)
Test Result……………:	Pass

Tested by …………..: Mei Chun 2017-02-09

Chun Mei, Test Engineer

Reviewed by………….: Shuangwen Zhang 2017-02-11

Shuangwen Zhang, Senior Egineer

Approved by……………: Wu Li'an 2017-02-11

Wu Li'an , Manager

Contents

This Test Report consists of the following Annexes:

1. GENERAL CONDITIONS

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

1.2 This report standalone does 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:	Building 28/29, East of Shigu, Xili Industrial Zone, Xili Road, Nanshan District, Shenzhen, Guangdong, 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:	Building 28/29, East of Shigu, Xili Industrial Zone, Xili Road, Nanshan District, Shenzhen, Guangdong, China

2.3. Organization Item

CCIC-SET Report No.:	SET2017-01489
CCIC-SET Project Leader:	Mr. Li Sixiong
CCIC-SET Responsible for accreditation scope:	Mr. Wu Li'an
Start of Testing:	2017-02-06
End of Testing:	2017-02-10

2.4. Identification of Applicant

Company Name:	CO-COMM SERVICIOS TELECOMUNICACIONES S.L.
Address:	C/Lisboa, 20 – 28232 Las Rozas (Madrid), Spain.

2.5. Identification of Manufacture

Company Name:	CO-COMM SERVICIOS TELECOMUNICACIONES S.L.
Address:	C/Lisboa, 20 – 28232 Las Rozas (Madrid), Spain.

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:	3G/2G fixed wireless phone	
Model Name:	F800C	
Brand Name:	CO-COMM	
General description:	Support Band	GSM 850/1900, WCDMA Band II/V, WIFI b/g/n20/n40, BT 4.1LE
	Test Band	GSM 850/1900, WCDMA Band II/V, WIFI b/g/n20/n40
	Development Stage	Identical Prototype
	Accessories	Power Supply
	Battery type	Li-ion Battery, 3100mAh
	Antenna type	Inner Antenna
	Modulation mode	GSM:GMSK BT: GFSK WIFI: OFDM/DSSS
	Max. RF Power	33.83 dBm
	Max. SAR Value	0.816W/Kg (Body: 0mm distance, WWAN+WLAN simultaneously transmission)

NOTE:

a. The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.

4 SAR SUMMARY

Highest Standalone SAR Summary

Exposure Position	Frequency Band	Scaled 1g-SAR(W/kg)	Highest Scaled 1g-SAR(W/kg)
Body-worn (0mm Separation)	GSM 850	0.144	0.181
	GSM 1900	0.259	0.456
	WCDMA Band II	0.450	0.788
	WCDMA Band V	0.089	0.156
	WIFI	0.028	0.028

Highest Simultaneously transmission SAR Summary

Exposure Position	Frequency Band	Scaled 1g-SAR(W/kg)	Highest Scaled 1g-SAR(W/kg)
Body-worn (0mm Separation)	WCDMA Band II + WIFI	0.478	0.816

5 Specific Absorption Rate (SAR)

5.1 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.

5.2 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 (). The equation description is as below:

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

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

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

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

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

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

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.

5.3 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).

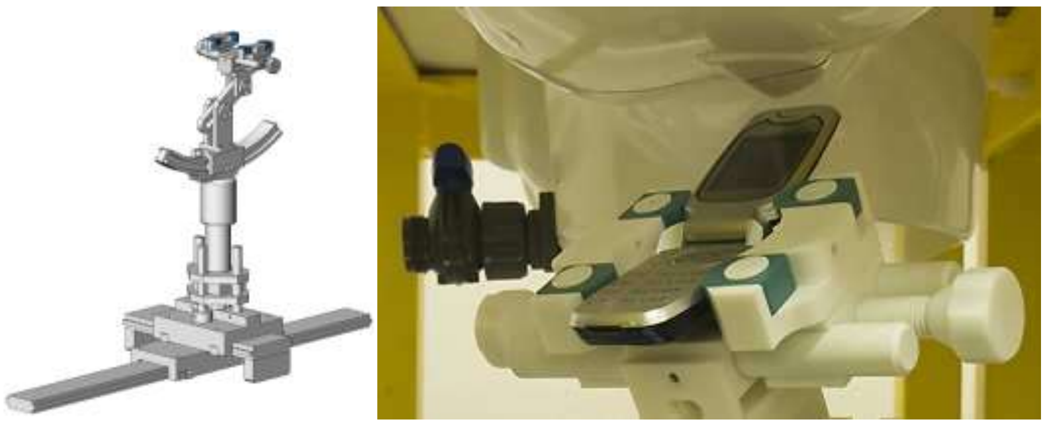
System checking was performed using the flat section, whilst Head SAR tests used the left and right head profile sections. Body SAR testing also used the flat section between the head profiles.

SAM Twin Phantom

5.4 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

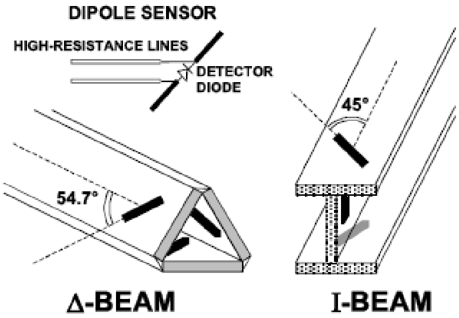
5.5 Probe Specification

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 μW/g to 100 mW/g; Linearity: ± 0.5 dB
Dimensions	Overall length: 330 mm (Tip: 20 mm) Tip diameter: 5 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 \s
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:



6 OPERATIONAL CONDITIONS DURING TEST

6.1 Test Configuration

For WLAN SAR testing, WLAN engineering testing software installed on the EUT can provide continuous transmitting RF signal.

6.2 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.

6.2.1 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.

Recommended Dielectric Performance of Tissue

Ingredients (% by weight)	Frequency (MHz)											
	450		835		915		1900		2450		2600	
Tissue Type	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body
Water	38.56	51.16	41.46	52.4	41.05	56.0	54.9	40.4	62.7	73.2	55.24	64.49
Salt (Nacl)	3.95	1.49	1.45	1.4	1.35	0.76	0.18	0.5	0.5	0.04	0.5	0.024
Sugar	56.32	46.78	56.0	45.0	56.5	41.76	0.0	58.0	0.0	0.0	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	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	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	44.45	32.25
DGBE	0.0	0.0	0.0	0.0	0.0	0.0	44.92	0.0	0.0	26.7	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	39.0	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	1.96	2.16

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

6.2.2 Simulate liquid

For body-worn measurements, the EUT was tested against flat phantom representing the user body. The EUT was put on in the belt holder. Stimulate liquid that are used for testing at frequencies of Wi-Fi 2.4GHz, which are made mainly of sugar, salt and water solutions may be left in the phantoms.

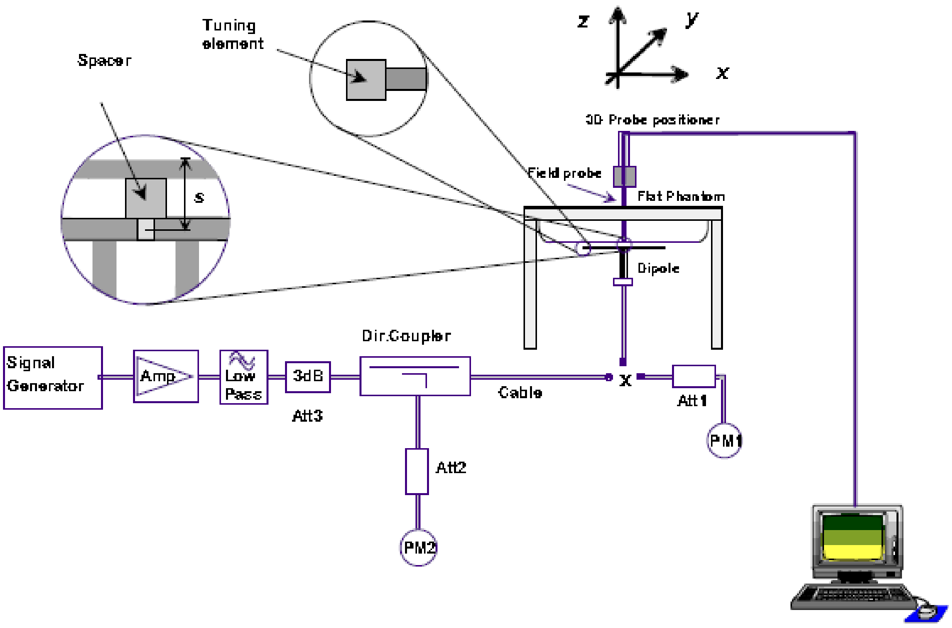
Dielectric Performance of Body Tissue Simulating Liquid

Temperature: 21.5℃ ; Humidity: 64%;			
/	Frequency	Permittivity ε	Conductivity σ (S/m)
Target value	835MHz	55.2±5%	0.97±5%
Validation value (Feb. 06h, 2017)	835MHz	55.31	0.96
Target value	1900MHz	53.3±5%	1.52±5%
Validation value (Feb. 07th, 2017)	1900MHz	53.32	1.51
Target value	2450MHz	52.7±5%	1.95±5%
Validation value (Feb. 08th, 2017)	2450MHz	52.36	1.95

6.3 Results of validation testing

Prior to the assessment, the system validation kit was used to test whether the system was operating within its specifications of ±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 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 5 and Table 6. 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).

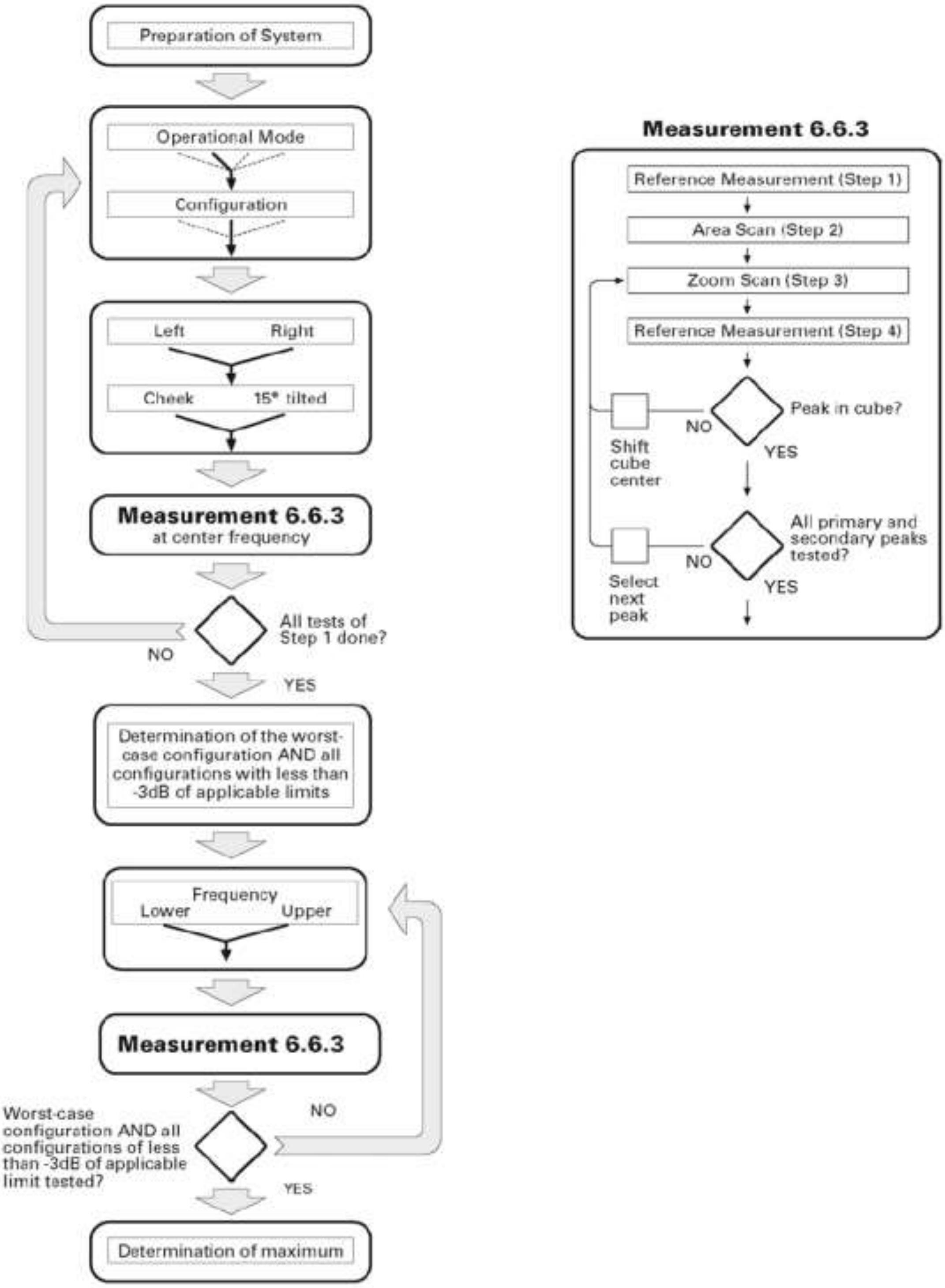
Body SAR system validation (1g)

Frequency	Duty cycle	Target value (W/kg)	Test value (W/kg)
835MHz(Feb. 06th, 2017)	1:1	10.31±10%	10.97
1900MHz(Feb. 07th, 2017)	1:1	40.81±10%	40.65
2450MHz(Feb. 08th, 2017)	1:1	52.66±10%	55.27

* Note: Target value was referring to the measured value in the calibration certificate of reference dipole. All SAR values are normalized to 1W forward power.

6.4 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 2mm 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.

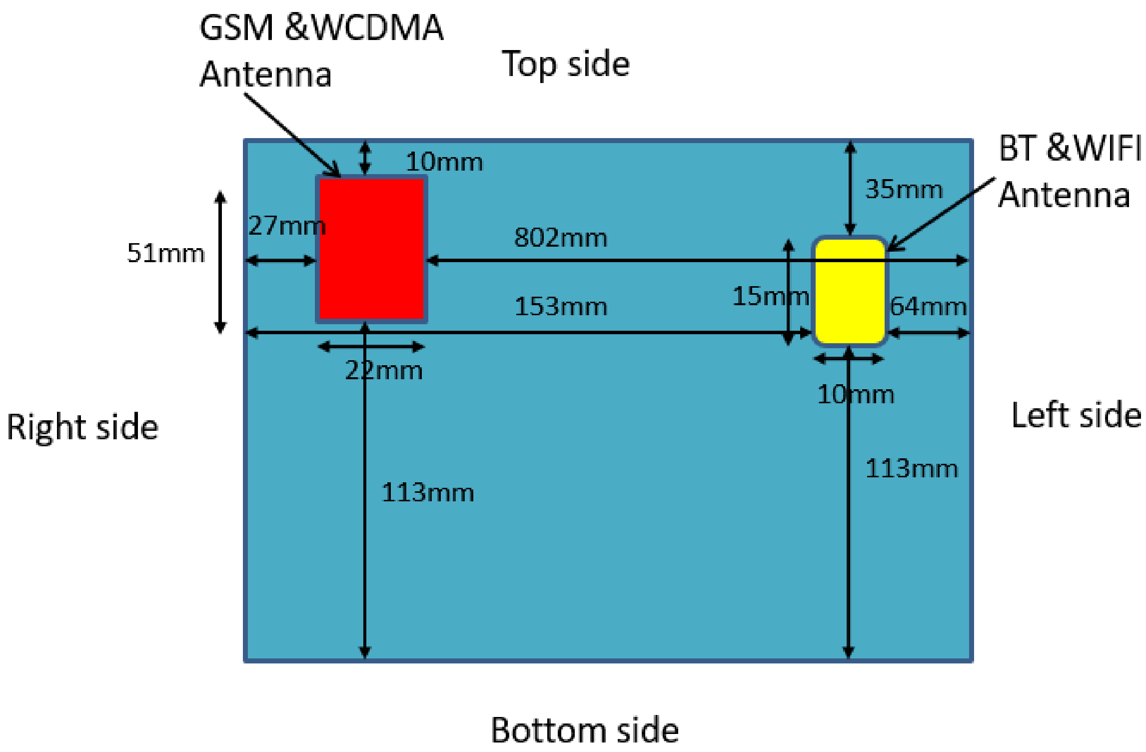
Above is the scanning procedure flow chart and table from the IEEEp1528 standard. This is the procedure for which all compliant testing should be carried out to ensure that all variations of the device position and transmission behavior are tested.

For SAR measurement, the liquid deep max more than 15cm as below photo

Head Liquid	Body Liquid
	

6.5 Transmitting antenna information

The antennas inside the EUT.



*Note: The back side of EUT is upward.

The Body SAR measurement positions of each band are as below:

Antenna	TOP	Back
Main Antenna (GSM&WCDMA)	Yes	Yes
WIFI Antenna	No	Yes

Note: When antenna-to-edge > 2.5cm, SAR measurement is not required.

7 CHARACTERISTICS OF THE TEST

7.1 Applicable Limit Regulations

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

ANSI C95.1–1992: Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz – 300 GHz.(IEEE Std C95.1-1991)

IEEE 1528–2013: IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement 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.

7.2 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
FCC KDB 248227 D01 802.11 Wi-Fi SAR v02r02
FCC KDB 447498 D01 v06 General RF Exposure Guidance
FCC KDB 648474 D04 v01r03 Handset SAR
FCC KDB 865664 D01 v01r04 SAR Measurement 100MHz to 6GHz
FCC KDB 865664 D02 v01r02 SAR Exposure Reporting
FCC KDB 941225 D01 v03 3G SAR Procedures

8 LABORATORY ENVIRONMENTS

The Ambient Conditions during SAR Test

Temperature	Min. = 22 ° C, Max. = 25 ° C
Atmospheric pressure	Min.=86 kPa, Max.=106 kPa
Relative humidity	Min. = 45%, Max. = 75%
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.	

9. Conducted RF Output Power

9.1 Conducted Power

Conducted Power (Unit: dBm)						
Band	GSM 850			PCS 1900		
Channel	128	190	251	512	661	810
Frequency	824.2	836.6	848.8	1850.2	1880	1909.8
GSM(GMSK, 1 Tx slot) CS1	33.79	33.83	33.80	28.12	28.54	28.20
GPRS (GMSK, 1 Tx slot) CS1	33.48	33.37	33.47	28.08	28.52	28.18
GPRS (GMSK, 2 Tx slot) CS1	30.83	30.86	30.87	25.95	25.39	25.04
GPRS (GMSK, 3 Tx slot) CS1	29.14	29.10	29.11	24.10	23.60	23.20
GPRS (GMSK, 4 Tx slot) CS1	27.98	27.99	27.97	23.34	23.54	22.71
Band	WCDMA Band II			WCDMA Band V		
Channel	9262	9400	9538	1852	1880	1908
Frequency	1852.4	1880	1907.6	826.4	836.4	846.6
RMC 12.2Kbps	23.11	23.58	22.20	23.40	23.57	23.65
HSDPA Subtest-1	23.06	22.31	22.17	23.03	22.97	23.07
HSDPA Subtest-2	23.04	22.23	22.05	23.01	22.96	23.06
HSDPA Subtest-3	22.63	21.75	21.58	22.60	22.56	22.65
HSDPA Subtest-4	22.57	21.74	21.57	22.55	22.48	22.59

Mode	Channel	Frequency (MHz)	Average Power (dBm) Data Rate (Mbps)			
			1	2	5.5	11
802.11b	1	2412	17.3	17.3	17.9	17.6
	6	2437	17.8	17.7	17.8	17.9
	11	2462	17.5	17.6	17.5	17.7

Mode	Channel	Frequency (MHz)	Average Power (dBm) Data Rate (Mbps)							
			6	9	12	18	24	36	48	54
802.11g	1	2412	16.2	16.1	16.2	16.3	16.4	16.2	16.0	16.3
	6	2437	16.5	16.4	16.3	16.5	16.6	16.6	16.5	16.6
	11	2462	16.7	16.8	16.7	16.7	16.3	16.5	16.4	16.8

Mode	Channel	Frequency (MHz)	Average Power (dBm) Data Rate (Mbps)							
			6.5	13	19.5	26	39	52	58.5	65
802.11n 20	1	2412	15.3	15.1	15.8	15.3	15.3	15.1	15.1	15.4
	6	2437	15.6	15.5	15.1	15.2	15.5	15.6	15.5	15.7
	11	2462	15.7	15.3	15.6	15.5	15.6	15.2	15.6	15.8

Mode	Channel	Frequency (MHz)	Average Power (dBm) Data Rate (Mbps)							
			13.5	27	40.5	54	81	108	121.5	135
802.11n 40	3	2422	14.6	14.1	14.5	14.8	14.3	14.5	14.1	14.7
	6	2437	14.8	14.9	14.5	14.6	14.4	14.7	14.5	14.9
	9	2452	14.4	14.0	14.3	14.0	14.0	14.3	14.6	14.6

Conducted Power (Unit: dBm)			
Modulation Type	GFSK		
Channel	0	39	78
Frequency	2402	2441	2480
Power	1.4	1.5	1.2

Note:

1. Per KDB248227 D01 v02r02 and KDB941225 D01 v03, 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

9.2 General Note:

1. Per KDB 447498 D01v06, the reported SAR is the measured SAR value adjusted for maximum tune-up tolerance.
   a. 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.
   b. 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)”
   c. For WWAN: Reported SAR(W/kg)=Measured SAR(W/kg)*Tune-up Scaling Factor
   d. For WLAN: Reported SAR(W/kg)=Measured SAR(W/kg)*Duty Cycle scaling factor * Tune-up scaling factor
2. Per KDB447498 D01v06, testing of other required channels within the operating mode of a frequency band is not required when the reported 1-g or 10-g SAR for the mid-band or highest output power channel is: ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is≤ 100 MHz. When the maximum output power variation across the required test channels is > ½ dB, instead of the middle channel, the highest output power channel must be used.
3. Per KDB 865664 D01v01r04,for each frequency band, repeated SAR measurement is required only when the measured SAR is ≥0.8W/Kg; if the deviation among the repeated measurement is ≤20%,and the measured SAR <1.45W/Kg, only one repeated measurement is required.
4. Per KDB865664 D02 v01r02, SAR plot is only required for the highest measured SAR in each exposure configuration, wireless mode and frequency band combination; Plots are also required when the measured SAR is > 1.5 W/kg, or > 7.0 W/kg for occupational exposure. The published RF exposure KDB procedures may require additional plots; for example, to support SAR to peak location separation ratio test exclusion and/or volume scan post-processing(Refer to appendix D for details).
5. Per KDB248227 D01 v02r02, 802.11g /11n-HT20/11n-HT40 is not required. When the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤1.2W/Kg. Thus the SAR can be excluded.

9.3. Scaling Factor calculation

Operation Mode	Channel	Output Power (dBm)	Tune up Power in tolerance (dBm)	Output Power (Watt)	Tune up Power in tolerance (Watt)	Scaling Factor
GSM 850	190	33.83	35	2.4155	3.1623	1.31
GPRS 850 4Tx	190	27.99	29	0.6295	0.7943	1.26
GSM 1900	661	28.54	32	0.7145	1.5849	2.22
GPRS 1900 4Tx	661	23.54	26	0.2259	0.3981	1.76
WCDMA Band II	9400	23.58	26	0.2280	0.3981	1.75
WCDMA Band V	4183	23.57	26	0.2275	0.3981	1.75
WIFI 802.11b	6	17.9	--	0.0617	--	--

10 TEST RESULTS

10.1 Summary of SAR Measurement Results

Summary of SAR Measurement Results

Mode	Test Positions		Channel /Frequency (MHz)	SAR(W/Kg), 1.6 (1g average)			Plot No.
				SAR(W/Kg)1g	Scaled Factor	Scaled SAR(W/Kg),1g	
GSM 850	Body-worn (0mm Separation)	TOP Upward	190/836.6	0.077	1.31	0.101	1
		Back Upward	190/836.6	0.047	1.31	0.062	--
GPRS 850 4Tx		TOP Upward	190/836.6	0.144	1.26	0.181	2
		Back Upward	190/836.6	0.120	1.26	0.151	--
GSM 1900		TOP Upward	661/1880	0.092	2.22	0.204	3
		Back Upward	661/1880	0.071	2.22	0.158	--
GPRS 1900 4Tx		TOP Upward	661/1880	0.259	1.76	0.456	4
		Back Upward	661/1880	0.231	1.76	0.407	--
WCDMA Band II		TOP Upward	9400/1880	0.442	1.75	0.774	--
		Back Upward	**9400/1880**	**0.450**	**1.75**	**0.788**	**5**
WCDMA Band V		TOP Upward	1880/836.4	0.089	1.75	0.156	6
		Back Upward	1880/836.4	0.069	1.75	0.121	--
WIFI 802.11b		TOP Upward	6/2437	--	--	--	--
		Back Upward	6/2437	0.028	--	--	7

WWAN+WLAN simultaneously transmission

WWAN Band	Max WWAN SAR (W/kg)	Scaled WWAN SAR (W/kg)	Max WLAN SAR (W/kg)	Max SAR Summation (W/kg)	Scaled SAR Summation (W/kg)
GSM 850	0.077	0.101	0.028	0.105	0.129
GPRS 850 4Tx	0.144	0.181		0.172	0.209
GSM 1900	0.092	0.204		0.120	0.232
GPRS 1900 4Tx	0.259	0.456		0.287	0.484
WCDMA Band II	**0.450**	**0.788**		**0.478**	**0.816**
WCDMA Band V	0.089	0.156		0.117	0.184

Note:

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 v06)

- ≤ 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

10.2 Simultaneous Transmissions Analysis

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.

11 Measurement Uncertainty

No.	Uncertainty Component	Type	Uncertainty Value (%)	Probability Distribution	k	ci	Standard Uncertainty (%) ui(%)	Degree of freedom Veff or vi
	Measurement System							
1	—Probe Calibration	B	5.8	N	1	1	5.8	∞
2	—Axial isotropy	B	3.5	R	$\sqrt{3}$	0.5	1.43	∞
3	—Hemispherical Isotropy	B	5.9	R	$\sqrt{3}$	0.5	2.41	∞
4	—Boundary Effect	B	1	R	$\sqrt{3}$	1	0.58	∞
5	—Linearity	B	4.7	R	$\sqrt{3}$	1	2.71	∞
6	—System Detection Limits	B	1.0	R	$\sqrt{3}$	1	0.58	∞
7	Modulation response	B	3	N	1	1	3.00	
8	—Readout Electronics	B	0.5	N	1	1	0.50	∞
9	—Response Time	B	1.4	R	$\sqrt{3}$	1	0.81	∞
10	—Integration Time	B	3.0	R	$\sqrt{3}$	1	1.73	∞
11	—RF Ambient Conditions	B	3.0	R	$\sqrt{3}$	1	1.73	∞
12	—Probe Position Mechanical tolerance	B	1.4	R	$\sqrt{3}$	1	0.81	∞
13	—Probe Position with respect to Phantom Shell	B	1.4	R	$\sqrt{3}$	1	0.81	∞
14	—Extrapolation, Interpolation and Integration Algorithms for Max. SAR evaluation	B	2.3	R	$\sqrt{3}$	1	1.33	∞
	Uncertainties of the DUT							
15	—Position of the DUT	A	2.6	N	$\sqrt{3}$	1	2.6	5
16	—Holder of the DUT	A	3	N	$\sqrt{3}$	1	3.0	5

17	—Output Power Variation –SAR drift measurement	B	5.0	R	$\sqrt{3}$	1	2.89	∞
	Phantom and Tissue Parameters							
18	—Phantom Uncertainty(shape and thickness tolerances)	B	4	R	$\sqrt{3}$	1	2.31	∞
19	Uncertainty in SAR correction for deviation(in permittivity and conductivity)	B	2	N	1	1	2.00	
20	—Liquid Conductivity Target –tolerance	B	2.5	R	$\sqrt{3}$	0.6	1.95	∞
21	—Liquid Conductivity –measurement Uncertainty)	B	4	N	$\sqrt{3}$	1	0.92	9
22	—Liquid Permittivity Target tolerance	B	2.5	R	$\sqrt{3}$	0.6	1.95	∞
23	—Liquid Permittivity –measurement uncertainty	B	5	N	$\sqrt{3}$	1	1.15	∞
Combined Standard Uncertainty				RSS			10.63	
Expanded uncertainty (Confidence interval of 95 %)				K=2			21.26	

System Check Uncertainty

No.	Uncertainty Component	Type	Uncertainty Value (%)	Probability Distribution	k	ci	Standard Uncertainty (%) ui(%)	Degree of freedom Veff or vi
	Measurement System							
1	—Probe Calibration	B	5.8	N	1	1	5.8	∞
2	—Axial isotropy	B	3.5	R	$\sqrt{3}$	0.5	1.43	∞
3	—Hemispherical Isotropy	B	5.9	R	$\sqrt{3}$	0.5	2.41	∞
4	—Boundary Effect	B	1	R	$\sqrt{3}$	1	0.58	∞
5	—Linearity	B	4.7	R	$\sqrt{3}$	1	2.71	∞
6	—System Detection Limits	B	1	R	$\sqrt{3}$	1	0.58	∞
7	Modulation response	B	0	N	1	1	0.00	

8	—Readout Electronics	B	0.5	N	1	1	0.50	∞
9	—Response Time	B	0.00	R	$\sqrt{3}$	1	0.00	∞
10	—Integration Time	B	1.4	R	$\sqrt{3}$	1	0.81	∞
11	—RF Ambient Conditions	B	3.0	R	$\sqrt{3}$	1	1.73	∞
12	—Probe Position Mechanical tolerance	B	1.4	R	$\sqrt{3}$	1	0.81	∞
13	—Probe Position with respect to Phantom Shell	B	1.4	R	$\sqrt{3}$	1	0.81	∞
14	—Extrapolation, Interpolation and Integration Algorithms for Max. SAR evaluation	B	2.3	R	$\sqrt{3}$	1	1.33	∞
	Uncertainties of the DUT							
15	Deviation of experimental source from numberical source	A	4	N	1	1	4.00	5
16	Input Power and SAR drift measurement	A	5	R	$\sqrt{3}$	1	2.89	5
17	Dipole Axis to Liquid Distance	B	2	R	$\sqrt{3}$	1	1.2	∞
Phantom and Tissue Parameters								
18	—Phantom Uncertainty(shape and thickness tolerances)	B	4	R	$\sqrt{3}$	1	2.31	∞
19	Uncertainty in SAR correction for deviation(in permittivity and conductivity)	B	2	N	1	1	2.00	
20	—Liquid Conductivity Target –tolerance	B	2.5	R	$\sqrt{3}$	0.6	1.95	∞
21	—Liquid Conductivity –measurement Uncertainty)	B	4	N	$\sqrt{3}$	1	0.92	9
22	—Liquid Permittivity Target tolerance	B	2.5	R	$\sqrt{3}$	0.6	1.95	∞
23	—Liquid Permittivity –measurement uncertainty	B	5	N	$\sqrt{3}$	1	1.15	∞
Combined Standard Uncertainty				RSS			10.15	
Expanded uncertainty (Confidence interval of 95 %)				K=2			20.29	

12 MAIN TEST INSTRUMENTS

EQUIPMENT	TYPE	Series No.	Calibration Date	calibration period
System Simulator	E5515C	GB 47200710	2016/06/10	1 Year
System Simulator	CMW500	130805	2016/08/10	1 Year
SAR Probe	SATIMO	SN04/13 EP166	2016/12/09	1 Year
Dipole	SID835	SN09/13 DIP0G835-217	2014/08/28	3 Year
Dipole	SID1900	SN09/13 DIP1G900-218	2014/08/28	3 Year
Dipole	SID2450	SN09/13 DIP2G450-220	2014/08/28	3 Year
Vector Network Analyzer	ZVB8	A0802530	2016/06/08	1 Year
Signal Generator	SMR27	A0304219	2016/06/08	1 Year
Power Meter	NRP2	A140401673	2016/03/27	1 Year
Power Sensor	NPR-Z11	1138.3004.02-114072-nq	2016/03/27	1 Year
Amplifier	Nucletudes	143060	2016/03/27	1 Year
Directional Coupler	DC6180A	305827	2016/03/27	1 Year
Power Meter	NRVS	A0802531	2016/03/27	1 Year
Power Sensor	NRV-Z4	100069	2016/03/27	1 Year
Multimeter	Keithley-2000	4014020	2016/03/27	1 Year

ANNEX A

of

CCIC-SET

CONFORMANCE TEST REPORT FOR

HUMAN EXPOSURE TO ELECTROMAGNETIC FIELDS

SET2017-01489

3G/2G fixed wireless phone

Type Name: F800C

Hardware Version： F800C57v1.0

Software Version： F800C57v000.1.0

TEST SETUP

This Annex consists of 2 pages

Date of Report: 2017-02-11

Photo 1: Measurement System SATIMO	Photo 2: Back Upward(0mm)
	
Photo 3: Top Upward(0mm)	
	

ANNEX B

of

CCIC-SET

CONFORMANCE TEST REPORT FOR

HUMAN EXPOSURE TO ELECTROMAGNETIC FIELDS

SET2017-01489

3G/2G fixed wireless phone

Type Name: F800C

Hardware Version： F800C57v1.0

Software Version： F800C57v000.1.0

Sample Photographs

This Annex consists of 2 page

Date of Report: 2017-02-11

1. Appearance

ANNEX C

of

CCIC-SET

CONFORMANCE TEST REPORT FOR

HUMAN EXPOSURE TO ELECTROMAGNETIC FIELDS

SET2017-01489

3G/2G fixed wireless phone

Type Name: F800C

Hardware Version: F800C57v1.0

Software Version: F800C57v000.1.0

System Performance Check Data and Highest SAR Plots

This Annex consists of 21 pages

Date of Report: 2017-02-11

System Performance Check (Body, 835MHz)

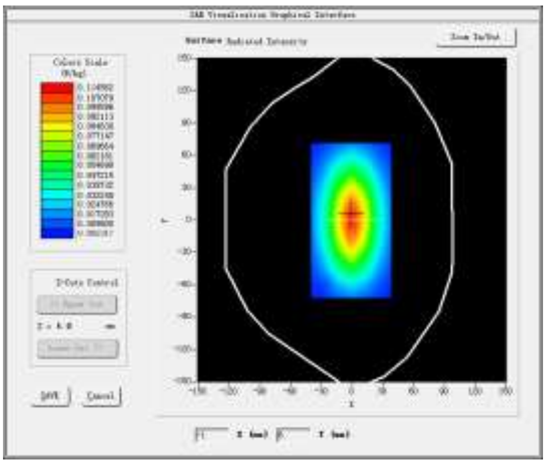
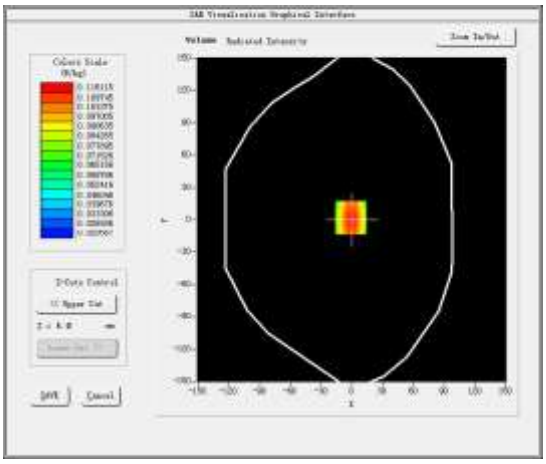
Type: Validation measurement
Date of measurement: 06/02/2017
Measurement duration: 22 minutes 46 seconds
Mobile Phone IMEI number: --

A. Experimental conditions.

Area Scan	dx=8mm dy=8mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm
Phantom	Validation plane
Device Position	Body
Band	CW835
Channels	Middle
Signal	CW (Crest factor: 1.0)

B. SAR Measurement Results:

E-Field Probe	SATIMO SN_04/13_EP166
Frequency (MHz)	835.0
Relative permittivity (real part)	53.314521
Relative permittivity (imaginary part)	20.791875
Conductivity (S/m)	0.964512
Variation (%)	-0.36
Temperature:	21.3°C
ConvF:	5.82

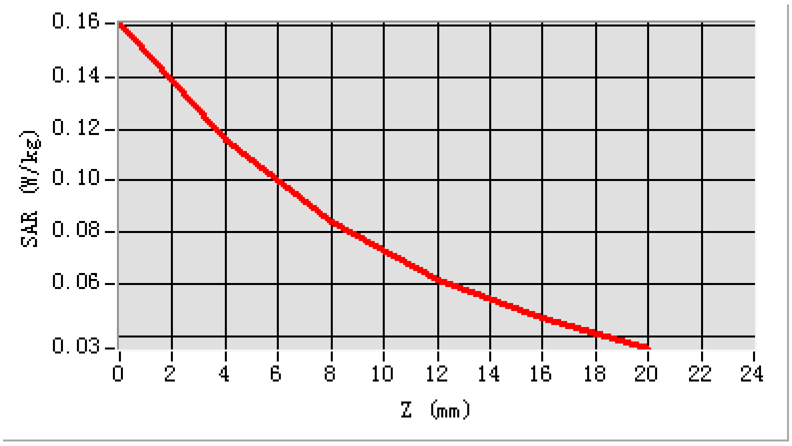
SURFACE SAR	VOLUME SAR
	

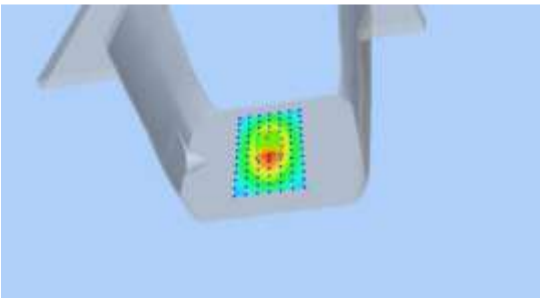
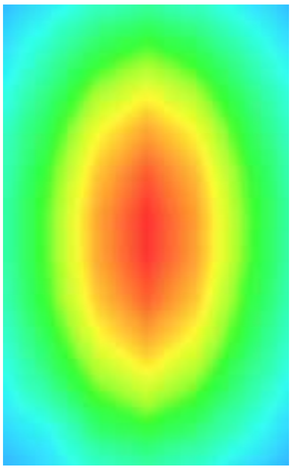
Maximum location: X=-1.00, Y=2.00

SAR Peak: 0.16 W/kg

SAR 10g (W/Kg)	0.071180
SAR 1g (W/Kg)	0.109736

Z (mm)	0.00	4.00	8.00	12.00	16.00
SAR (W/Kg)	0.1611	0.1161	0.0839	0.0617	0.0465



3D screen shot	Hot spot position
	

System Performance Check (Body, 1900MHz)

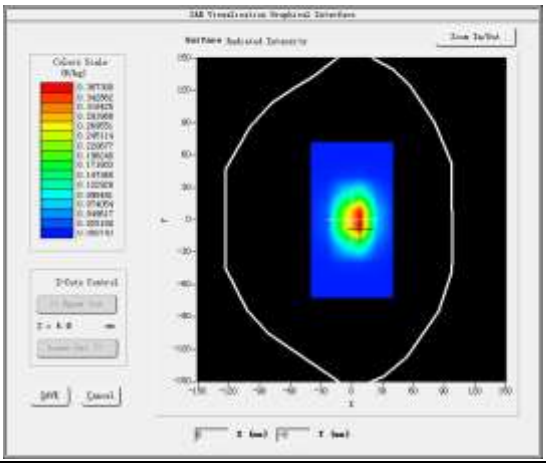
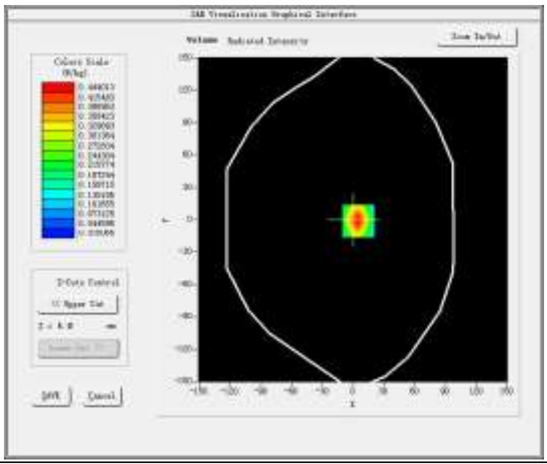
Type: Validation measurement
Date of measurement: 06/02/2017
Measurement duration: 22 minutes 46 seconds
Mobile Phone IMEI number: --

A. Experimental conditions.

Area Scan	dx=8mm dy=8mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm
Phantom	Validation plane
Device Position	Body
Band	CW1900
Channels	Middle
Signal	CW (Crest factor: 1.0)

B. SAR Measurement Results:

E-Field Probe	SATIMO SN_04/13_EP166
Frequency (MHz)	1900.0
Relative permittivity (real part)	53.326441
Relative permittivity (imaginary part)	14.327479
Conductivity (S/m)	1.512345
Variation (%)	-0.23
Temperature:	21.3°C
ConvF:	5.43

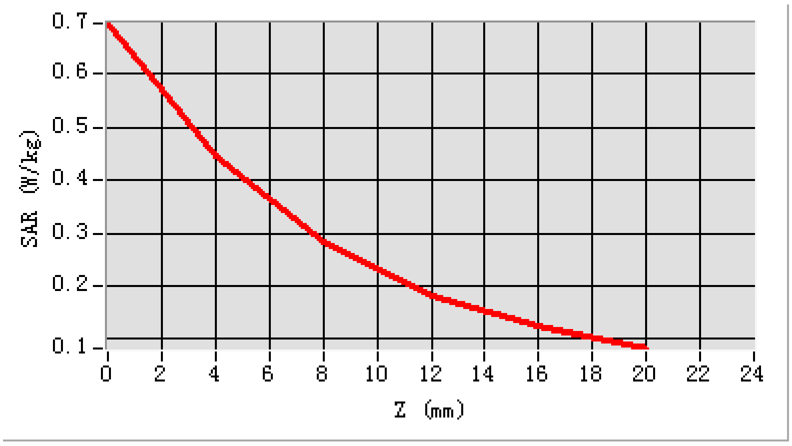
SURFACE SAR	VOLUME SAR
	

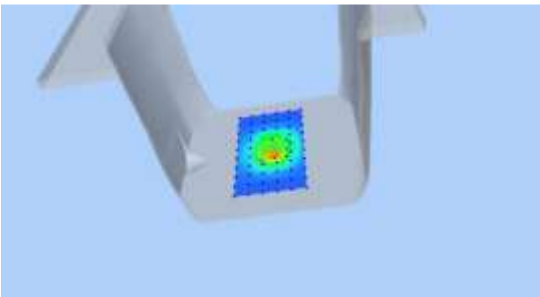
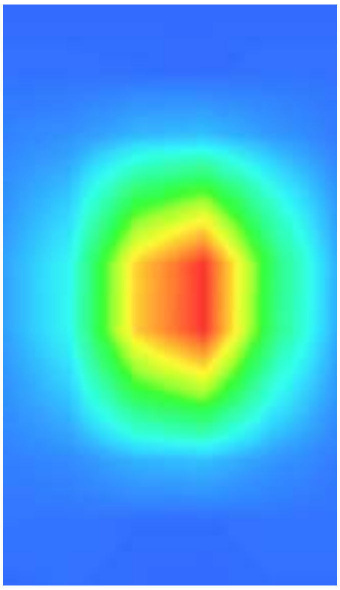
Maximum location: X=5.00, Y=-1.00

SAR Peak: 0.70 W/kg

SAR 10g (W/Kg)	0.215978
SAR 1g (W/Kg)	0406524

Z (mm)	0.00	4.00	8.00	12.00	16.00
SAR (W/Kg)	0.6957	0.4440	0.2813	0.1819	0.1225



3D screen shot	Hot spot position
	

System Performance Check (Body, 2450MHz)

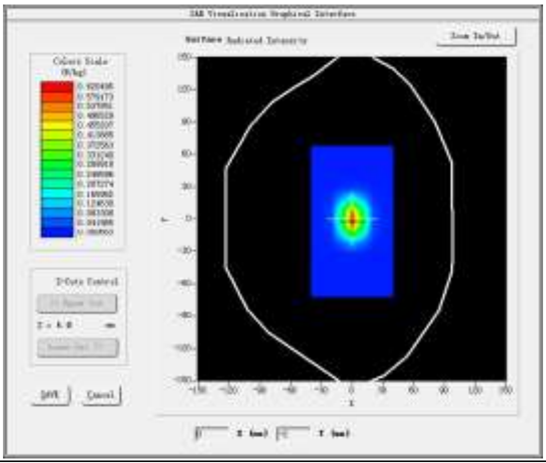
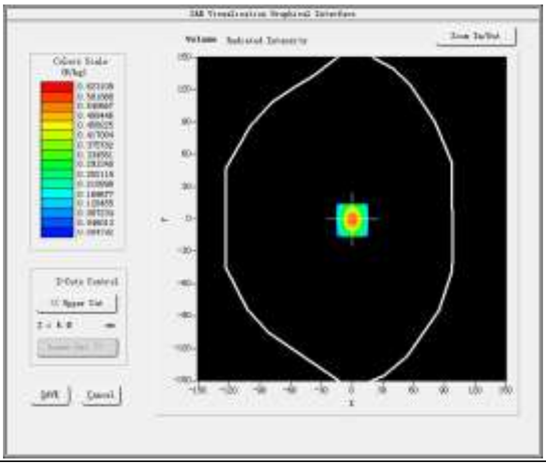
Type: Validation measurement
Date of measurement: 08/02/2017
Measurement duration: 22 minutes 46 seconds
Mobile Phone IMEI number: --

A. Experimental conditions.

Area Scan	dx=8mm dy=8mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm
Phantom	Validation plane
Device Position	Body
Band	CW2450
Channels	Middle
Signal	CW (Crest factor: 1.0)

B. SAR Measurement Results:

E-Field Probe	SATIMO SN_04/13_EP166
Frequency (MHz)	2450.0
Relative permittivity (real part)	52.365478
Relative permittivity (imaginary part)	14.349637
Conductivity (S/m)	1.953145
Variation (%)	-0.56
Temperature:	21.3°C
ConvF:	5.09

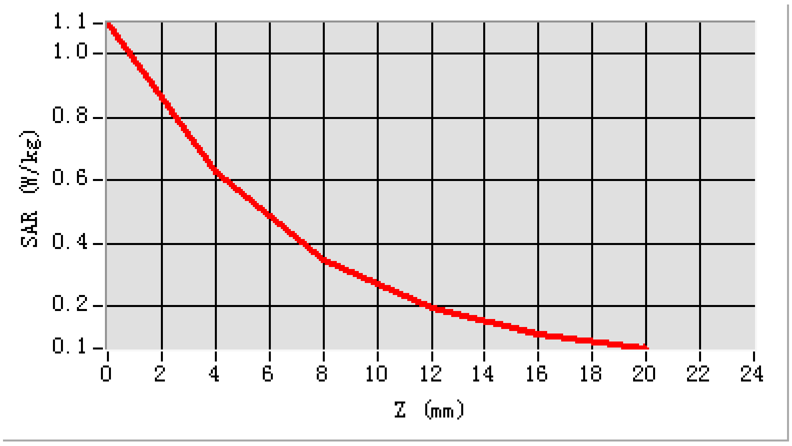
SURFACE SAR	VOLUME SAR
	

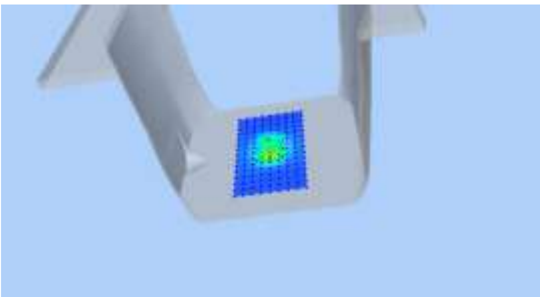
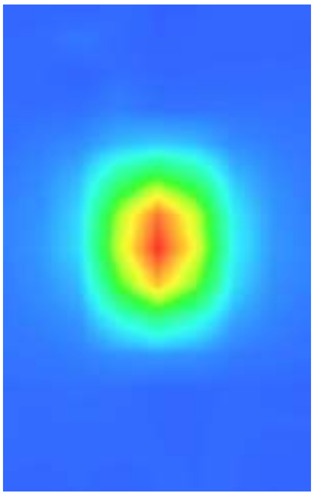
Maximum location: X=0.00, Y=-1.00

SAR Peak: 1.09 W/kg

SAR 10g (W/Kg)	0.244542
SAR 1g (W/Kg)	0.552732

Z (mm)	**0.00**	**4.00**	**8.00**	**12.00**	**16.00**
SAR (W/Kg)	**1.0941**	**0.6231**	**0.3452**	**0.1940**	**0.1159**



3D screen shot	**Hot spot position**
	

Plot No	Band	Mode	Test Position	Channel
1	G850	GSM	Top	190

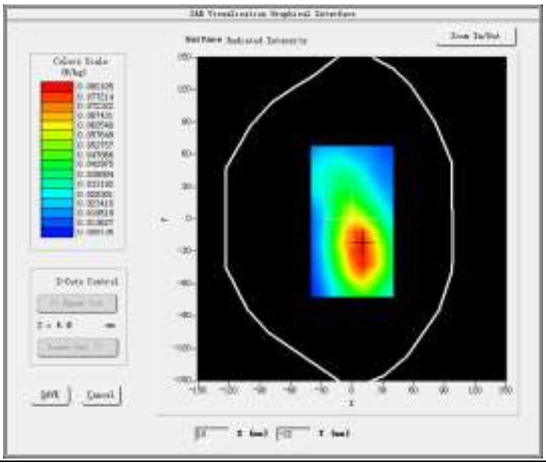
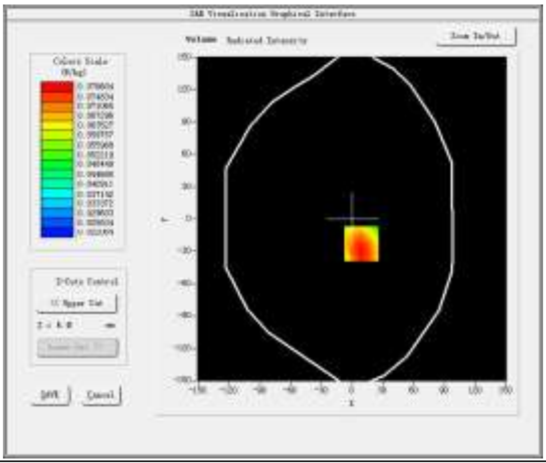
Type: Phone measurement
Date of measurement: 6/2/2017
Measurement duration: 22 minutes 42 seconds
Mobile Phone IMEI number: --

A. Experimental conditions.

Area Scan	dx=8mm dy=8mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm
Phantom	Validation plane
Device Position	Body
Band	GSM850
Channels	Middle
Signal	TDMA (Crest factor: 8.3)

B. SAR Measurement Results

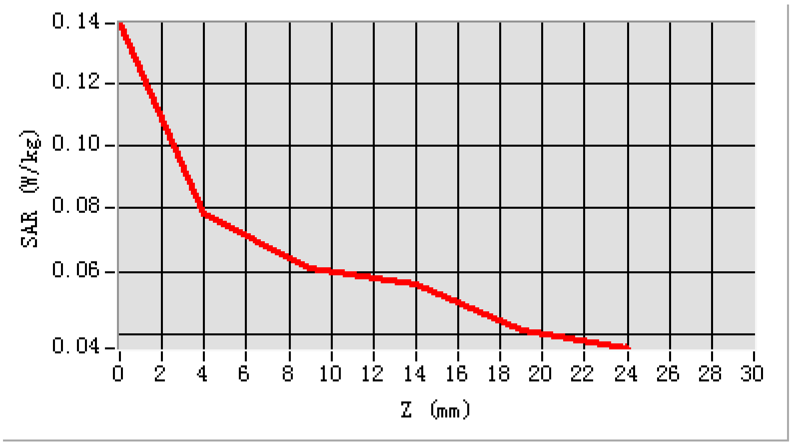
E-Field Probe	SATIMO SN_04/13_EP166
Frequency (MHz)	836.6
Relative permittivity (real part)	53.314521
Relative permittivity (imaginary	20.791875
Conductivity (S/m)	0.964512
Variation (%)	4.06
ConvF:	5.82

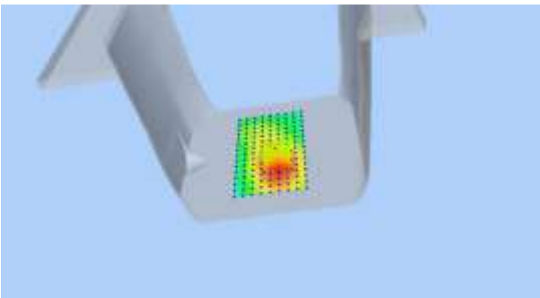
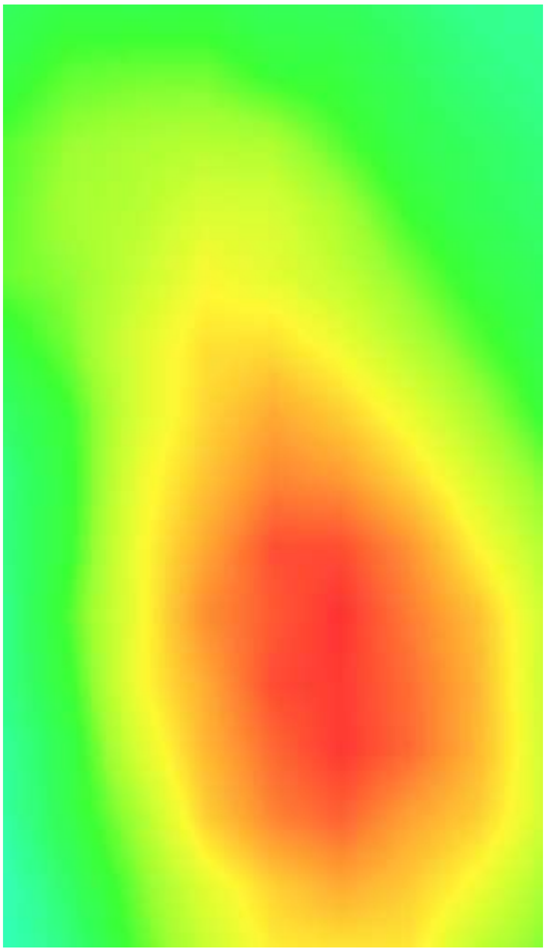
SURFACE SAR	VOLUME SAR
	

Maximum location: X=9.00, Y=-23.00
SAR Peak: 0.09 W/kg

SAR 10g (W/Kg)	0.060234
SAR 1g (W/Kg)	0.076529

Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.1391	0.0786	0.0613	0.0557	0.0413



3D screen shot	Hot spot position
	

Plot No	Band	Mode	Test Position	Channel
2	G850	GPRS12	Top	190

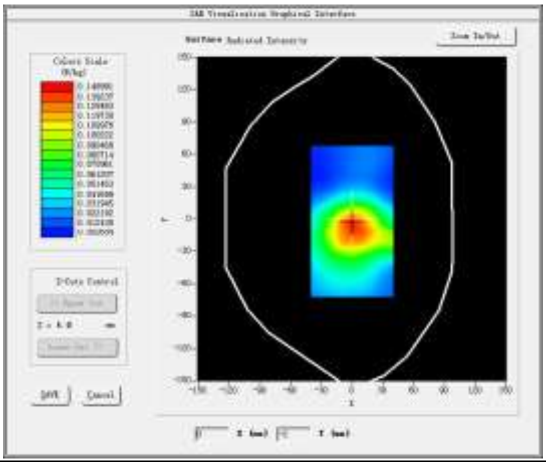
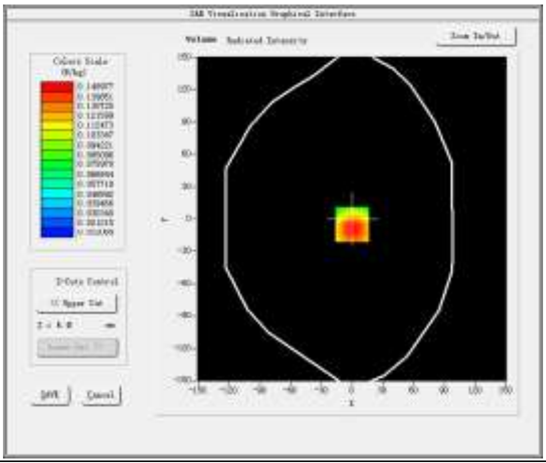
Type: Phone measurement
Date of measurement: 6/2/2017
Measurement duration: 22 minutes 23 seconds
Mobile Phone IMEI number: --

A. Experimental conditions.

Area Scan	dx=8mm dy=8mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm
Phantom	Validation plane
Device Position	Body
Band	CUSTOM (GPRS850-4Tx)
Channels	Middle
Signal	Duty Cycle: 2.00(Crest factor: 2.0)

B. SAR Measurement Results

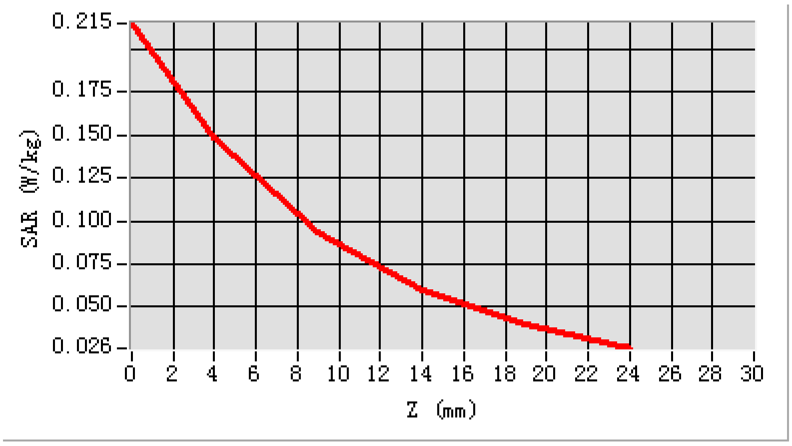
E-Field Probe	SATIMO SN_04/13_EP166
Frequency (MHz)	836.6
Relative permittivity (real part)	53.314521
Relative permittivity (imaginary	20.791875
Conductivity (S/m)	0.964512
Variation (%)	-2.23
ConvF:	5.82

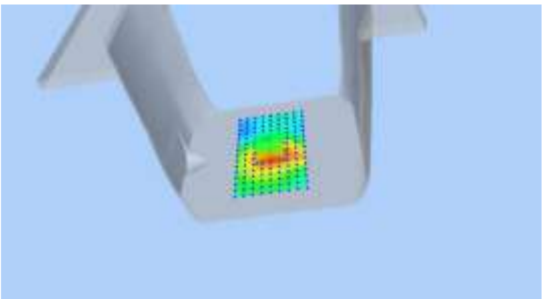
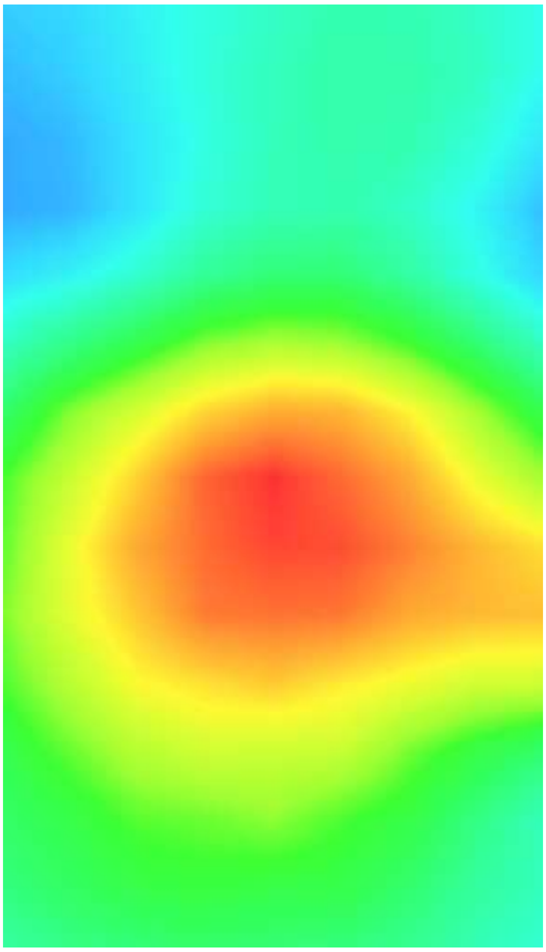
SURFACE SAR	VOLUME SAR
	

Maximum location: X=0.00, Y=-5.00
SAR Peak: 0.22 W/kg

SAR 10g (W/Kg)	0.088757
SAR 1g (W/Kg)	0.143695

Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.2150	0.1490	0.0935	0.0596	0.0395



3D screen shot	Hot spot position
	

Plot No	Band	Mode	Test Position	Channel
3	G1900	GSM	Top	661

Type: Phone measurement

Date of measurement: 7/2/2017

Measurement duration: 22 minutes 13 seconds

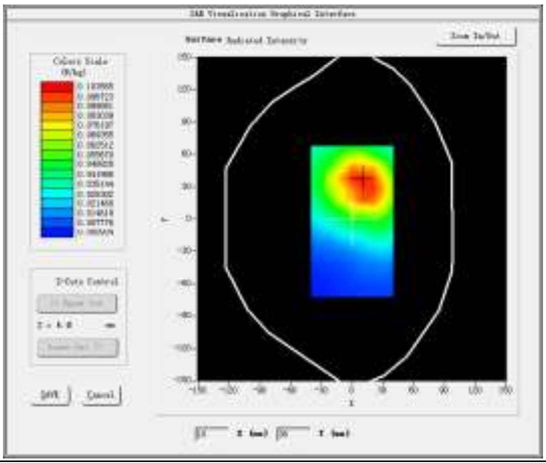
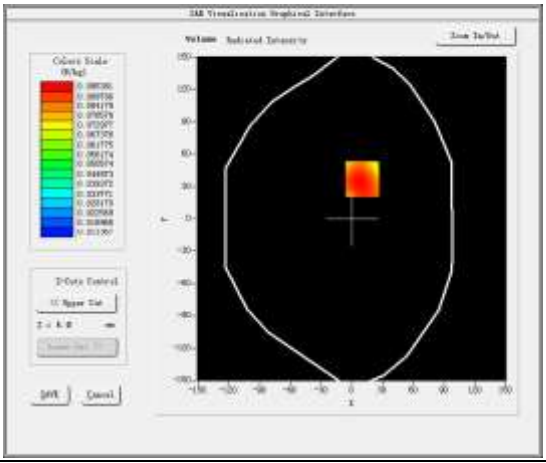
Mobile Phone IMEI number: --

A. Experimental conditions.

Area Scan	dx=8mm dy=8mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm
Phantom	Validation plane
Device Position	Body
Band	GSM1900
Channels	Middle
Signal	TDMA (Crest factor: 8.3)

B. SAR Measurement Results

E-Field Probe	SATIMO SN_04/13_EP166
Frequency (MHz)	1880.0
Relative permittivity (real part)	53.326441
Relative permittivity (imaginary	14.327479
Conductivity (S/m)	1.512345
Variation (%)	2.49
ConvF:	5.43

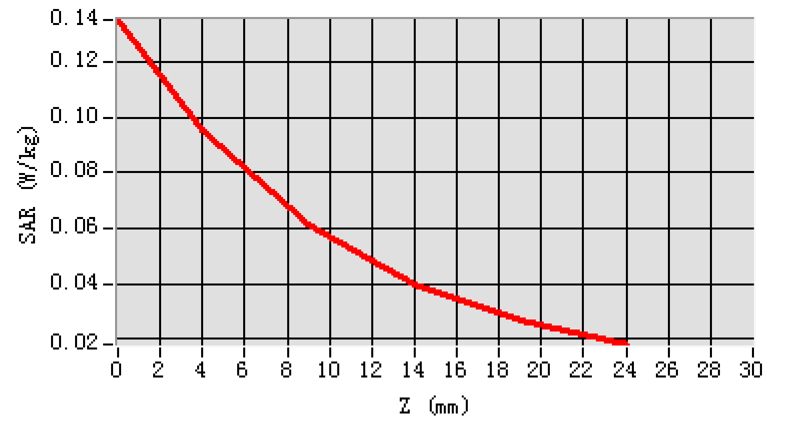
SURFACE SAR	VOLUME SAR
	

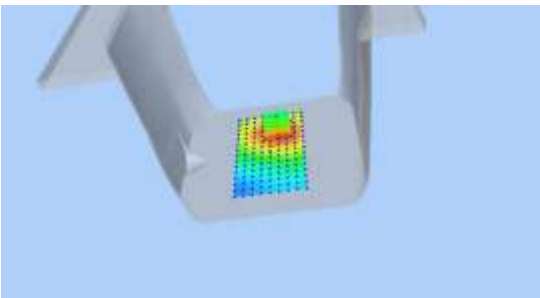
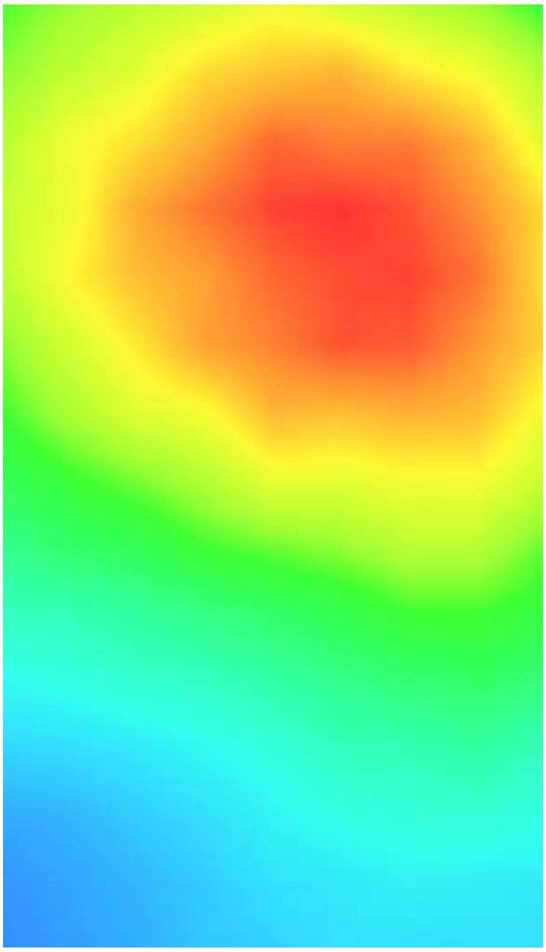
Maximum location: X=10.00, Y=37.00

SAR Peak: 0.14 W/kg

SAR 10g (W/Kg)	0.060073
SAR 1g (W/Kg)	0.092029

Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.1350	0.0954	0.0614	0.0402	0.0271



3D screen shot	Hot spot position
	

Plot No	Band	Mode	Test Position	Channel
4	G1900	GPRS12	Top	661

Type: Phone measurement

Date of measurement: 7/2/2017

Measurement duration: 22 minutes 57 seconds

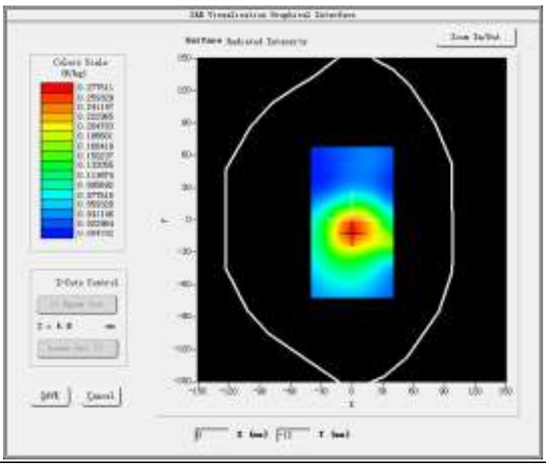
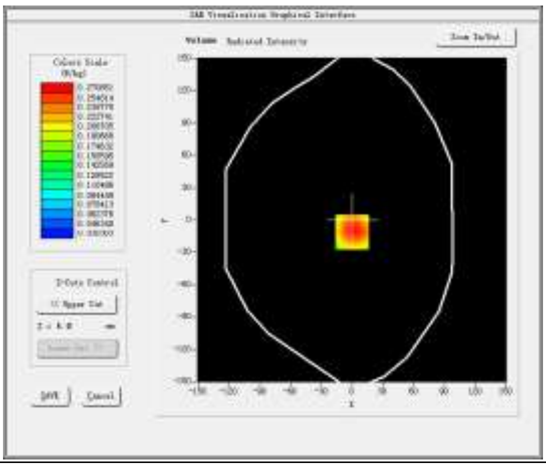
Mobile Phone IMEI number: --

A. Experimental conditions.

Area Scan	dx=8mm dy=8mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm
Phantom	Validation plane
Device Position	Body
Band	CUSTOM (GPRS1900-4Tx)
Channels	Middle
Signal	Duty Cycle: 2.00 (Crest factor: 2.0)

B. SAR Measurement Results

E-Field Probe	SATIMO SN_04/13_EP166
Frequency (MHz)	1880.0
Relative permittivity (real part)	53.326441
Relative permittivity (imaginary	14.327479
Conductivity (S/m)	1.512345
Variation (%)	-0.23
ConvF:	5.43

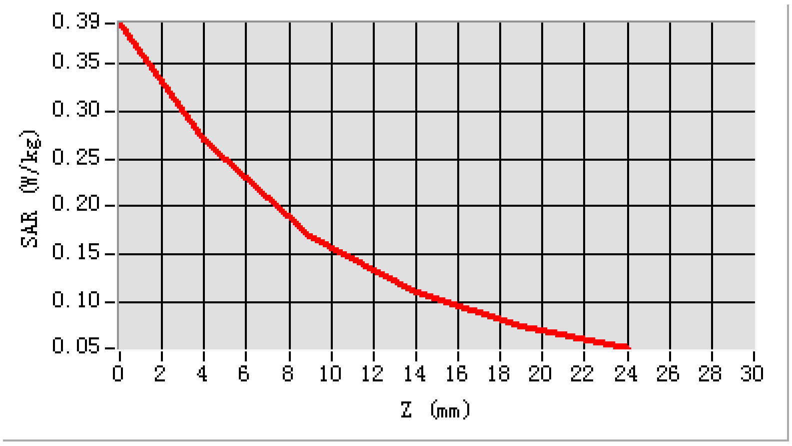
SURFACE SAR	VOLUME SAR
	

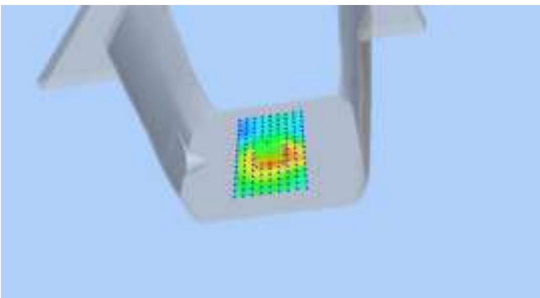
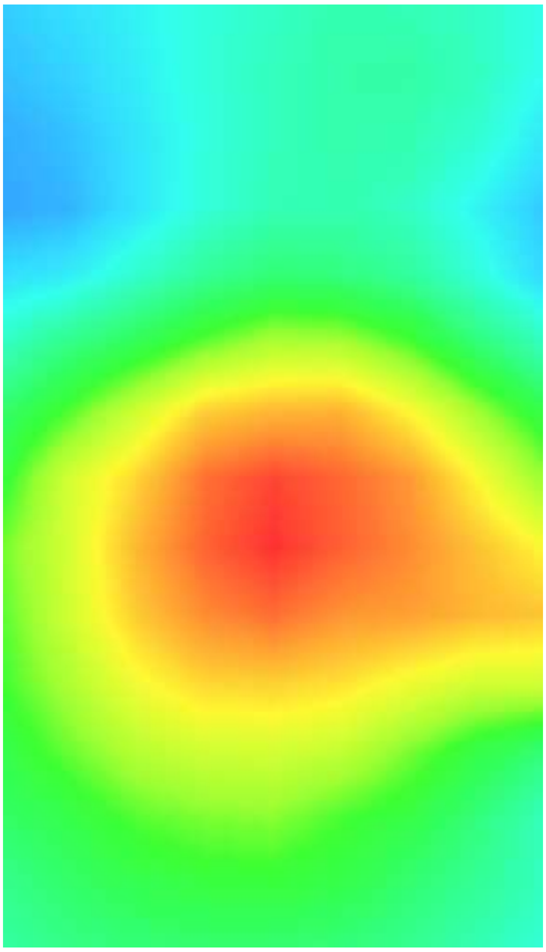
Maximum location: X=0.00, Y=-11.00

SAR Peak: 0.39 W/kg

SAR 10g (W/Kg)	0.162521
SAR 1g (W/Kg)	0.259175

Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.3927	0.2709	0.1695	0.1089	0.0737



3D screen shot	Hot spot position
	

Plot No	Band	Mode	Test Position	Channel
5	WCDMA II	12.2RMC	Back	9400

Type: Phone measurement

Date of measurement: 7/2/2017

Measurement duration: 22 minutes 26 seconds

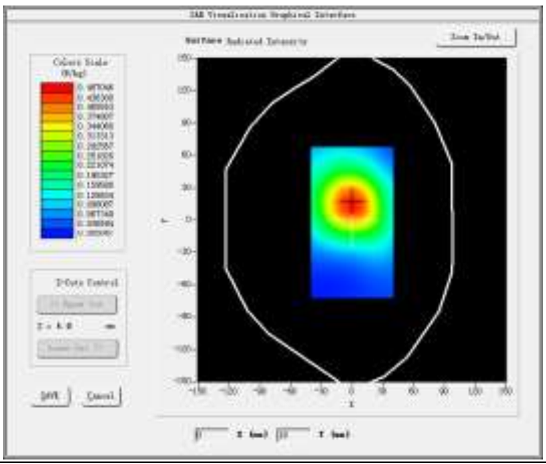
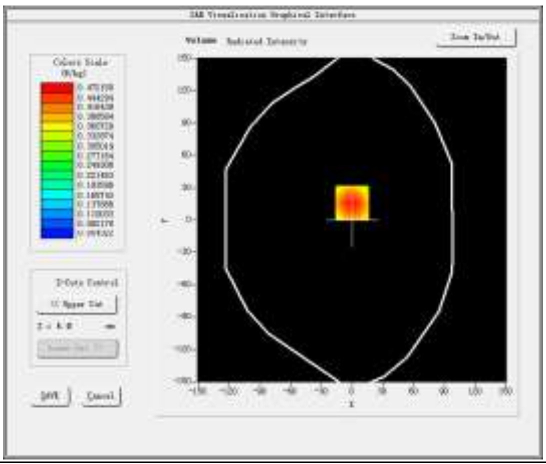
Mobile Phone IMEI number: --

A. Experimental conditions.

Area Scan	dx=8mm dy=8mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm
Phantom	Validation plane
Device Position	Body
Band	Band2_WCDMA1900
Channels	Middle
Signal	WCDMA (Crest factor: 1.0)

B. SAR Measurement Results

E-Field Probe	SATIMO SN_04/13_EP166
Frequency (MHz)	1880.0
Relative permittivity (real part)	53.326441
Relative permittivity (imaginary	14.327479
Conductivity (S/m)	1.512345
Variation (%)	-1.97
ConvF:	5.43

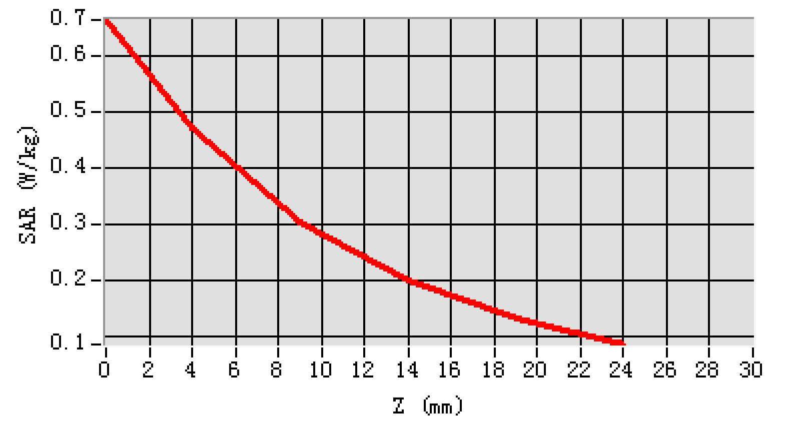
SURFACE SAR	VOLUME SAR
	

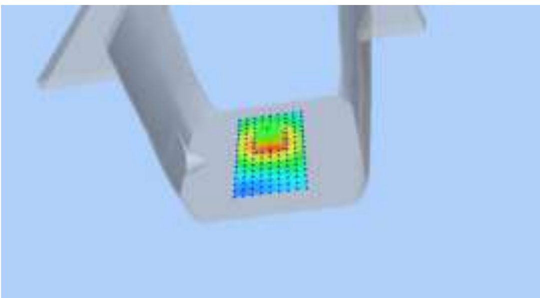
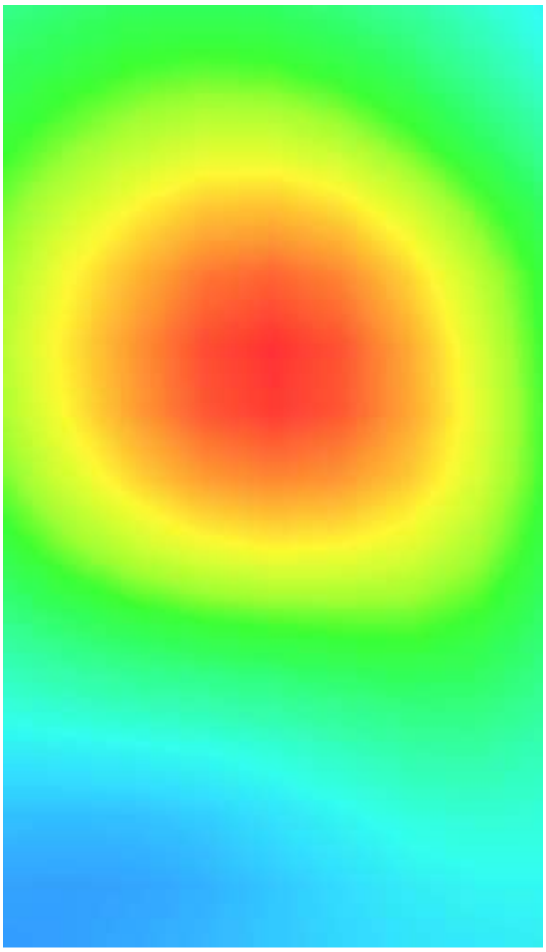
Maximum location: X=0.00, Y=16.00

SAR Peak: 0.66 W/kg

SAR 10g (W/Kg)	0.285898
SAR 1g (W/Kg)	0.449820

Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.6635	0.4722	0.3060	0.2001	0.1336



3D screen shot	Hot spot position
	

Plot No	Band	Mode	Test Position	Channel
6	WCDMA V	12.2RMC	Top	1880

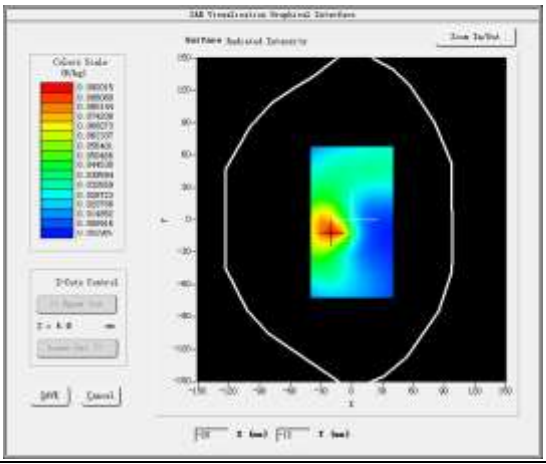
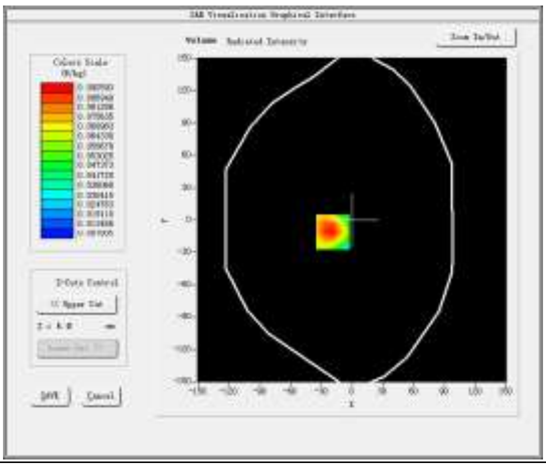
Type: Phone measurement
Date of measurement: 6/2/2017
Measurement duration: 23minutes 01 seconds
Mobile Phone IMEI number: --

A. Experimental conditions.

Area Scan	dx=8mm dy=8mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm
Phantom	Validation plane
Device Position	Body
Band	Band5_WCDMA850
Channels	Middle
Signal	WCDMA (Crest factor: 1.0)

B. SAR Measurement Results

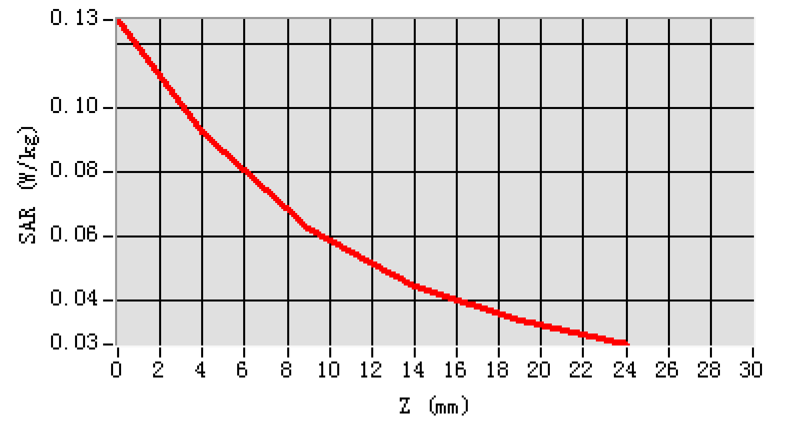
E-Field Probe	SATIMO SN_04/13_EP166
Frequency (MHz)	836.4
Relative permittivity (real part)	53.314521
Relative permittivity (imaginary	20.791875
Conductivity (S/m)	0.964512
Variation (%)	-0.35
ConvF:	5.82

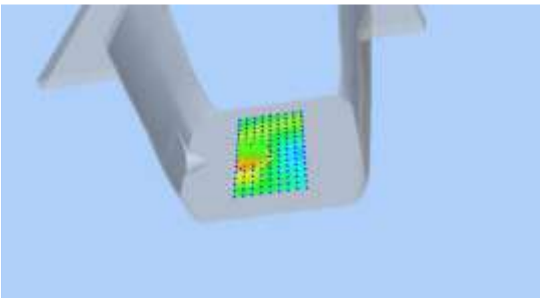
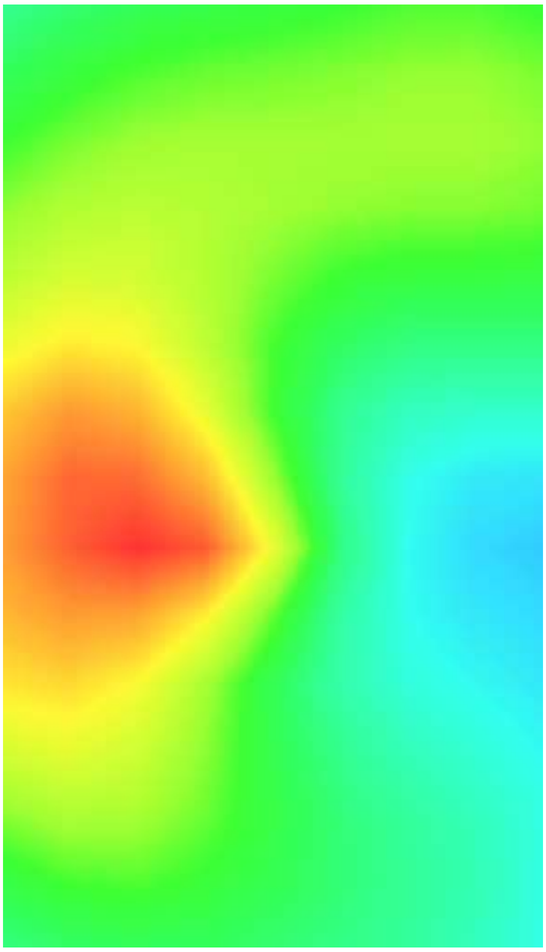
SURFACE SAR	VOLUME SAR
	

Maximum location: X=-19.00, Y=-11.00
SAR Peak: 0.13 W/kg

SAR 10g (W/Kg)	0.057931
SAR 1g (W/Kg)	0.088553

Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.1277	0.0926	0.0627	0.0445	0.0338



3D screen shot	Hot spot position
	

Plot No	Band	Mode	Test Position	Channel
7	WIFI	802.11b	Back	6

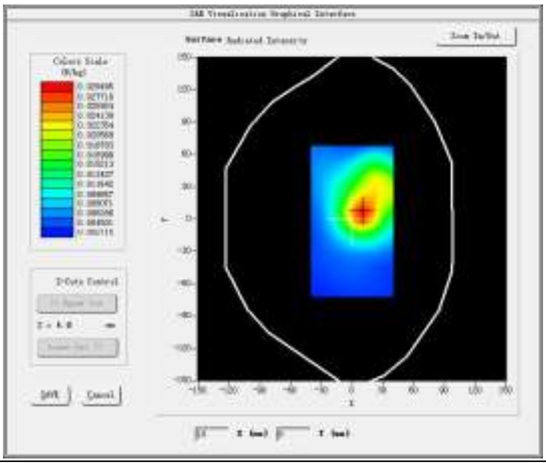
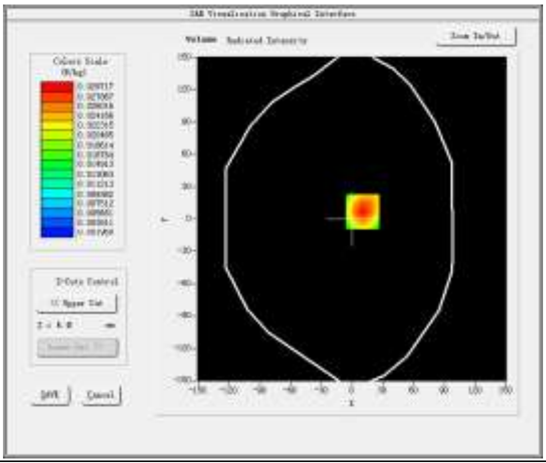
Type: Phone measurement
Date of measurement: 8/2/2017
Measurement duration: 22minutes 41 seconds
Mobile Phone IMEI number: --

A. Experimental conditions.

Area Scan	dx=8mm dy=8mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm
Phantom	Validation plane
Device Position	Body
Band	IEEE 802.11b ISM
Channels	Middle
Signal	IEEE802.b (Crest factor: 1.0)

B. SAR Measurement Results

E-Field Probe	SATIMO SN_04/13_EP166
Frequency (MHz)	2437
Relative permittivity (real part)	52.365478
Relative permittivity (imaginary	14.349637
Conductivity (S/m)	1.953145
Variation (%)	-1.17
ConvF:	5.09

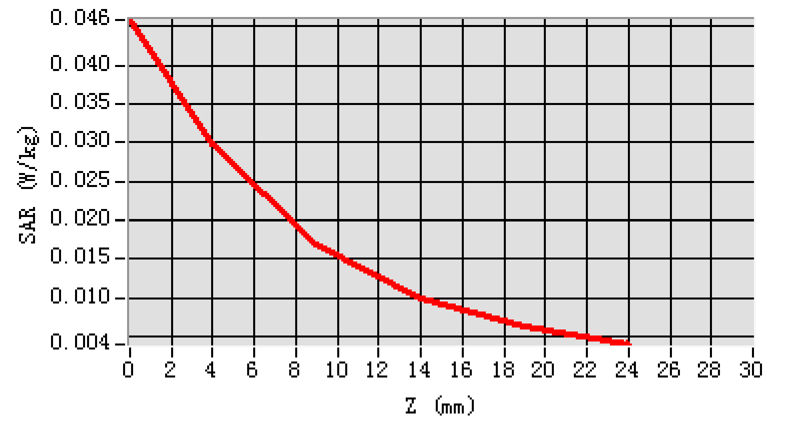
SURFACE SAR	VOLUME SAR
	

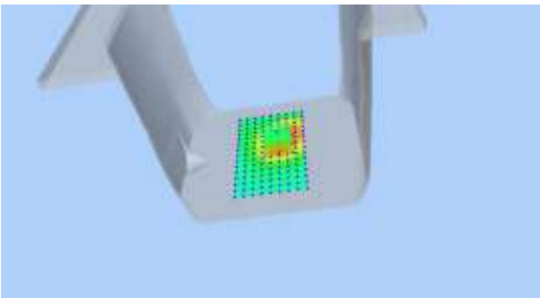
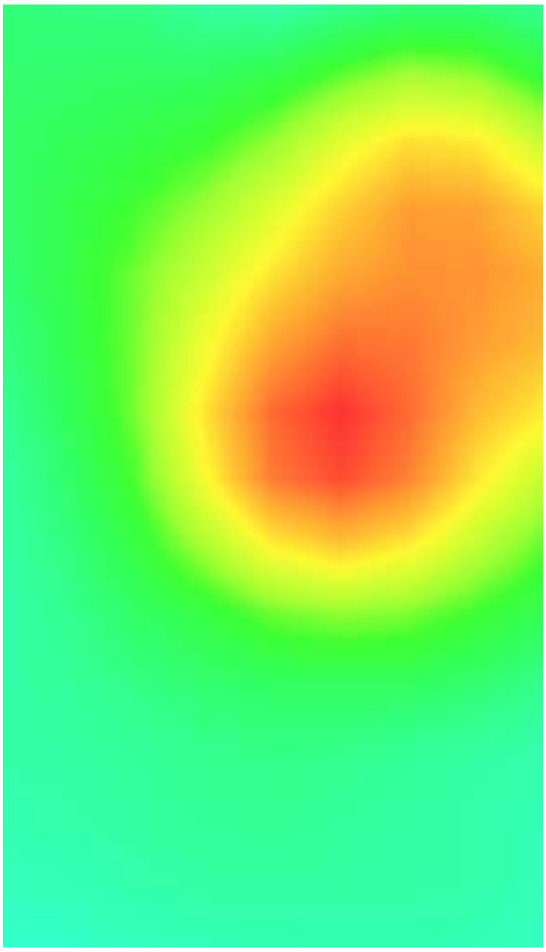
Maximum location: X=10.00, Y=7.00

SAR Peak: 0.05 W/kg

SAR 10g (W/Kg)	0.016359
SAR 1g (W/Kg)	0.028233

Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.0459	0.0297	0.0170	0.0100	0.0062



3D screen shot	Hot spot position
	

ANNEX D

of

CCIC-SET

CONFORMANCE TEST REPORT FOR

HUMAN EXPOSURE TO ELECTROMAGNETIC FIELDS

SET2017-01489

3G/2G fixed wireless phone

Type Name: F800C

Hardware Version: F800C57v1.0

Software Version: F800C57v000.1.0

Calibration Certificate of Probe

This Annex consists of 9 pages

Date of Report: 2017-02-11

Probe Calibration Certificate

COMOSAR E-Field Probe Calibration Report

Ref : ACR.227.15.14.SATU.A

CCIC SOUTHERN ELECTRONIC PRODUCT TESTING (SHENZHEN) CO., LTD
ELECTRONIC TESTING BUILDING, SHAHE ROAD, XILI TOWN
SHENZHEN, P.R. CHINA (POST CODE:518055)
SATIMO COMOSAR DOSIMETRIC E-FIELD PROBE
SERIAL NO.: SN 04/13 EP166

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

08/10/2016

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.

	Name	*Function*	*Date*	*Signature*
Prepared by :	Jérôme LUC	Product Manager	8/11/2016	JL
Checked by :	Jérôme LUC	Product Manager	8/11/2016	JL
Approved by :	Kim RUTKOWSKI	Quality Manager	8/11/2016	Kim Rutkowski

	Customer Name
Distribution :	CCIC SOUTHERN ELECTRONIC PRODUCT TESTING (SHENZHEN) Co., Ltd

Issue	*Date*	*Modifications*
A	8/11/2016	Initial release

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1 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR DOSIMETRIC E FIELD PROBE
Manufacturer	Satimo
Model	SSE5
Serial Number	SN 04/13 EP166
Product Condition (new / used)	Used
Frequency Range of Probe	0.7 GHz-3 GHz
Resistance of Three Dipoles at Connector	Dipole 1: R1=0.231 MΩ Dipole 2: R2=0.225 MΩ Dipole 3: R3=0.228 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.

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%

Combined standard uncertainty					5.831%
Expanded uncertainty 95 % confidence level k = 2					12.0%

5 CALIBRATION MEASUREMENT RESULTS

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

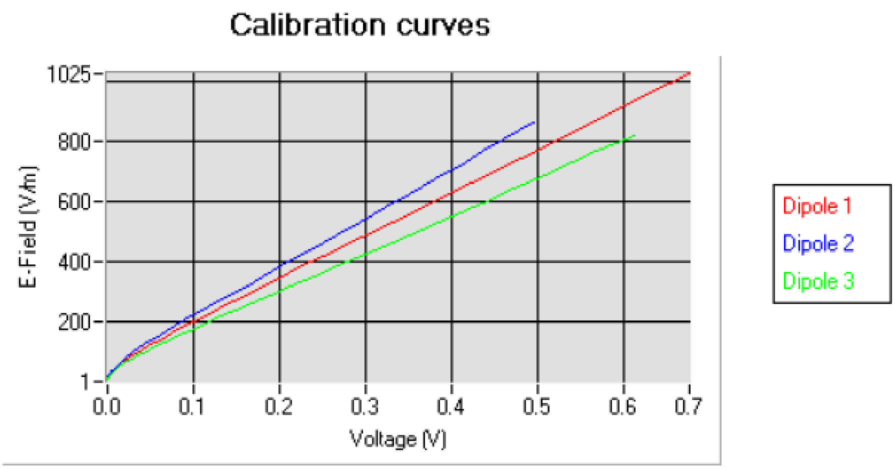
5.1 SENSITIVITY IN AIR

Normx dipole 1 ($\mu V/(V/m)^2$)	Normy dipole 2 ($\mu V/(V/m)^2$)	Normz dipole 3 ($\mu V/(V/m)^2$)
8.57	4.83	7.15

DCP dipole 1 (mV)	DCP dipole 2 (mV)	DCP dipole 3 (mV)
92	90	95

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

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



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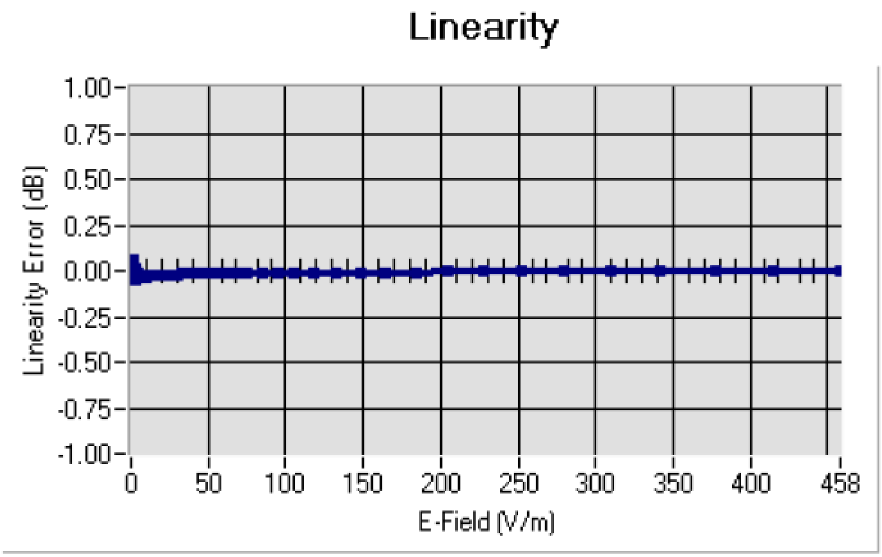
5.2 LINEARITY



Linearity:+/-1.55% (+/-0.07dB)

5.3 SENSITIVITY IN LIQUID

Liquid	Frequency (MHz +/- 100MHz)	Permittivity	Epsilon (S/m)	ConvF
HL850	835	42.80	0.89	5.69
BL850	835	53.45	0.96	5.82
HL900	900	42.47	0.96	5.34
BL900	900	56.68	1.08	5.55
HL1800	1800	41.30	1.38	4.75
BL1800	1800	53.27	1.51	4.96
HL1900	1900	41.09	1.42	5.25
BL1900	1900	54.20	1.54	5.43
HL2000	2000	39.72	1.43	4.81
BL2000	2000	53.90	1.53	4.95
HL2450	2450	39.05	1.77	4.93
BL2450	2450	52.98	1.93	5.09
HL2600	2600	38.35	1.92	5.08
BL2600	2600	51.82	2.19	5.22

LOWER DETECTION LIMIT: 7mW/kg

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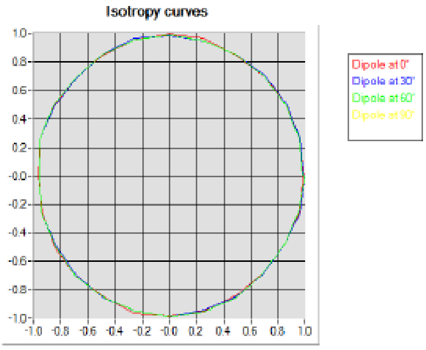
5.4 <u>ISOTROPY</u>

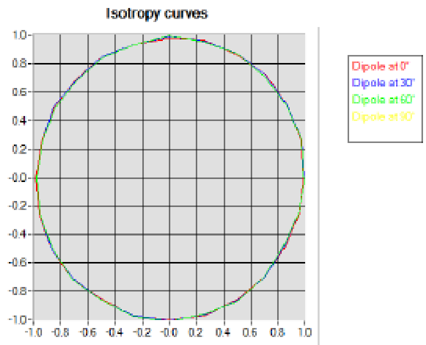
<u>HL900 MHz</u>

- Axial isotropy: 0.04 dB
- Hemispherical isotropy: 0.07 dB



<u>HL1800 MHz</u>

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



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	02/2016	02/2019
Reference Probe	Satimo	EP 94 SN 37/08	10/2015	10/2016
Multimeter	Keithley 2000	1188656	12/2013	12/2016
Signal Generator	Agilent E4438C	MY49070581	12/2013	12/2016
Amplifier	Aethercomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	HP E4418A	US38261498	12/2013	12/2016
Power Sensor	HP ECP-E26A	US37181460	12/2013	12/2016
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	7/2016	7/2019

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———End of the Report———