



# FCC SAR TEST REPORT

**Report No.:** SET2015-04152  
**Product:** GSM digital mobile phone  
**Model No.:** M220  
**FCC ID:** SG720150318M220  
**Applicant:** Haier Telecom (Qingdao) Co., Ltd.  
**Address:** No1. Haier Road , Hi-tech Zone, Qingdao China  
**Issued by:** CCIC-SET  
**Lab Location:** Building 28/29, Shigudong,Xili Industrial Area,Xili Street,Nanshan District,Shenzhen,Guangdong,China  
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## Test Report

**Product. ....:** GSM digital mobile phone  
**Model No. ....:** M220  
**Brand Name.....:** Haier  
**FCC ID.....:** SG720150318M220  
**Applicant.....:** Haier Telecom (Qingdao) Co., Ltd.  
**Applicant Address.....:** No1. Haier Road , Hi-tech Zone, Qingdao China  
**Manufacturer.....:** Haier Telecom (Qingdao) Co., Ltd.  
**Manufacturer Address:** No1. Haier Road , Hi-tech Zone, Qingdao China  
**Test Standards.....:**  
**447CFR § 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 1528-2003:** IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques;  
**Test Result.....:** Pass  
**Tested by .....** Mei Chun 2015-04-08  
Chun Mei, Test Engineer  
**Reviewed by.....:** Shuangwen Zhang 2015-04-08  
Shuangwen Zhang, Senior Engineer  
**Approved by.....:** Wu Lian 2015-04-08  
Wu Li'an , Manager

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## **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, Shigudong, Xili Industrial Area, Xili Street,  
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, Shigudong, Xili Industrial Area, Xili Street, Nanshan District, Shenzhen, Guangdong, China

### 2.3. Organization Item

**CCIC-SET Report No.:** SET2015-04152

**CCIC-SET Project Leader:** Mr. Li Sixiong

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

**Start of Testing:** 2015-03-24

**End of Testing:** 2015-03-25

### 2.4. Identification of Applicant

**Company Name:** Haier Telecom (Qingdao) Co., Ltd.

**Address:** No1. Haier Road , Hi-tech Zone, Qingdao China

### 2.5. Identification of Manufacture

**Company Name:** Haier Telecom (Qingdao) Co., Ltd.

**Address:** No1. Haier Road , Hi-tech Zone, Qingdao China

**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:** GSM digital mobile phone

**Type Name:** M220

**Brand Name:** Haier

|                             |                   |                                                        |
|-----------------------------|-------------------|--------------------------------------------------------|
| <b>General description:</b> | Support Band      | GSM850MHz/1900MHz,BT 3.0                               |
|                             | Test Band         | GSM 850MHz/ GSM 1900MHz,<br>GPRS 850MHz/ GPRS 1900MHz, |
|                             | Multislot Class   | GPRS: Class 12                                         |
|                             | GPRS Class        | Class B                                                |
|                             | Development Stage | Identical Prototype                                    |
|                             | Accessories       | Power Supply                                           |
|                             | Battery type      | 3.7V 600mAh                                            |
|                             | Antenna type      | PIFI Antenna                                           |
|                             | Operation mode    | GSM / GPRS,GFSK, $\pi$ /4-DQPSK, 8-DPSK                |
|                             | Modulation mode   | GMSK                                                   |
|                             | IMEI              | 135790246811220                                        |
|                             | Max. RF Power     | 33.15dBm                                               |
|                             | Max. SAR Value    | Head:0.164w/kg; Body:0.204w/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 operation up to class12(max.uplin:4, max.downlink:4, total timeslots:5)

## 4 SAR SUMMARY

### Highest Measured Standalone SAR Summary

| Exposure Position    | Frequency Band | Scaled 1g-SAR(W/kg) | Highest Scaled 1g-SAR(W/kg) |
|----------------------|----------------|---------------------|-----------------------------|
| Head                 | GSM850         | 0.016               | 0.164                       |
|                      | GSM1900        | 0.018               |                             |
|                      | BT             | 0.164               |                             |
| Body-worn (10mm Gap) | GSM850         | 0.204               | 0.204                       |
|                      | GSM1900        | 0.029               |                             |
|                      | BT             | 0.082               |                             |

### Highest Simultaneous SAR Summary

| Exposure Position    | Frequency Band | Scaled 1g-SAR(W/kg) | Highest Scaled 1g-SAR(W/kg) |
|----------------------|----------------|---------------------|-----------------------------|
| Body-worn (10mm Gap) | GPRS850&BT     | 0.204+0.082         | 0.286                       |
|                      | GPRS1900&BT    | 0.039+0.082         |                             |

## 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 ( $\rho$ ). 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,  $\delta T$  is the temperature rise and  $\delta t$  the exposure duration, or related to the electrical field in the tissue by

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

where  $\sigma$  is the conductivity of the tissue,  $\rho$  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.

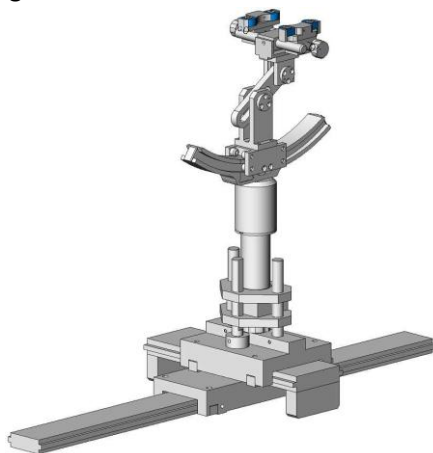


SAM Twin Phantom

### 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

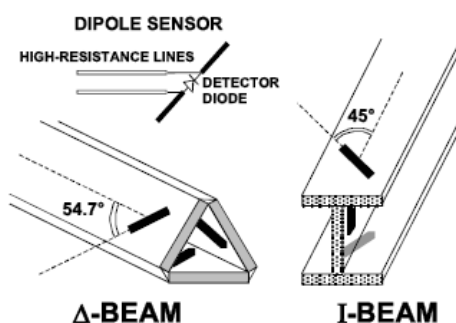


|               |                                                                                                                                                                                    |
|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------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



## **6 OPERATIONAL CONDITIONS DURING TEST**

### **6.1 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, 189 and 251 respectively in the case of GSM 850MHz, or to 512, 661 and 810 respectively in the case of PCS 1900MHz. 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

### **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.

Table 1: Recommended Dielectric Performance of Tissue

| Ingredients<br>(% 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 | 41.46 | 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  |               |
|-----------------|--------------|---------------|--------------|---------------|
|                 | $\epsilon_r$ | $\sigma(S/m)$ | $\epsilon_r$ | $\sigma(S/m)$ |
| 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 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/1900MHz, 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 $\epsilon$ | Conductivity $\sigma$ (S/m) |
| Target value                          | 835MHz    | $41.5 \pm 5\%$          | $0.90 \pm 5\%$              |
| Validation value<br>(Mar. 24th, 2015) | 835MHz    | 41.37                   | 0.91                        |
| Target value                          | 1900MHz   | $40.0 \pm 5\%$          | $1.40 \pm 5\%$              |
| Validation value<br>(Mar. 25th, 2015) | 1900MHz   | 39.87                   | 1.41                        |

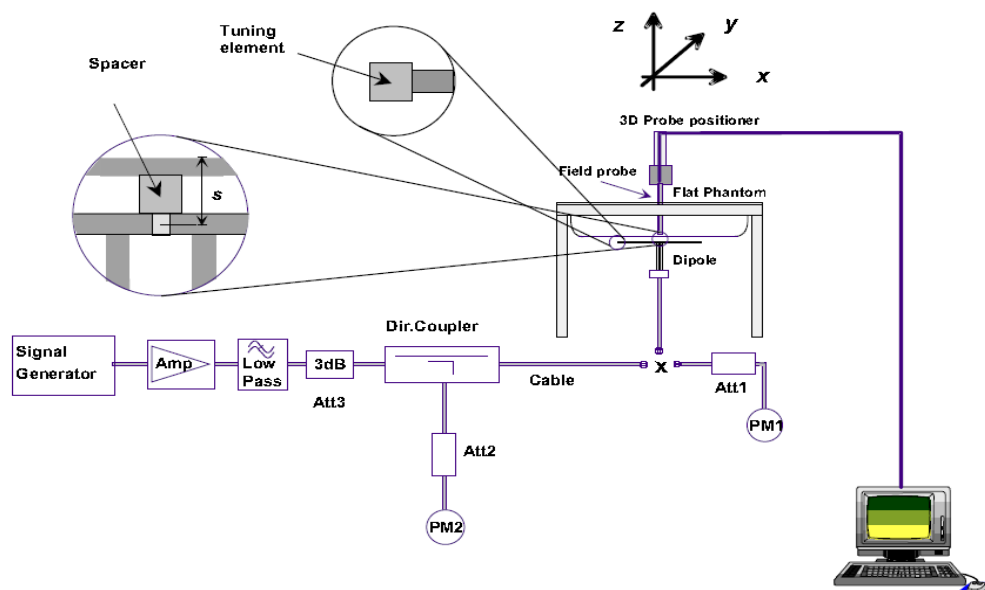
Table 4: Dielectric Performance of Body Tissue Simulating Liquid

| Temperature: 23.2°C; Humidity: 64%;   |           |                         |                             |
|---------------------------------------|-----------|-------------------------|-----------------------------|
| /                                     | Frequency | Permittivity $\epsilon$ | Conductivity $\sigma$ (S/m) |
| Target value                          | 835MHz    | $55.2 \pm 5\%$          | $0.97 \pm 5\%$              |
| Validation value<br>(Mar. 24th, 2015) | 835MHz    | 55.16                   | 0.98                        |
| Target value                          | 1900MHz   | $53.3 \pm 5\%$          | $1.52 \pm 5\%$              |
| Validation value<br>(Mar. 25th, 2015) | 1900MHz   | 53.23                   | 1.53                        |

### 6.3 Equipments and 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  $\pm 10\%$ . 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 IEEE standard P1528 2003. 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 5 mm (taking into account of the IEEE 1528 and the place of the antenna).

Table 7: Head SAR system validation (1g)

| Frequency                | Duty cycle | Target value<br>(W/kg) | Test value (W/kg) |       |
|--------------------------|------------|------------------------|-------------------|-------|
|                          |            |                        | 250 mW            | 1W    |
| 835MHz(Mar. 24th, 2015)  | 1:1        | 9.77                   | 2.45              | 9.80  |
| 1900MHz(Mar. 25th, 2015) | 1:1        | 40.37                  | 9.79              | 39.16 |

Table 8: Body SAR system validation (1g)

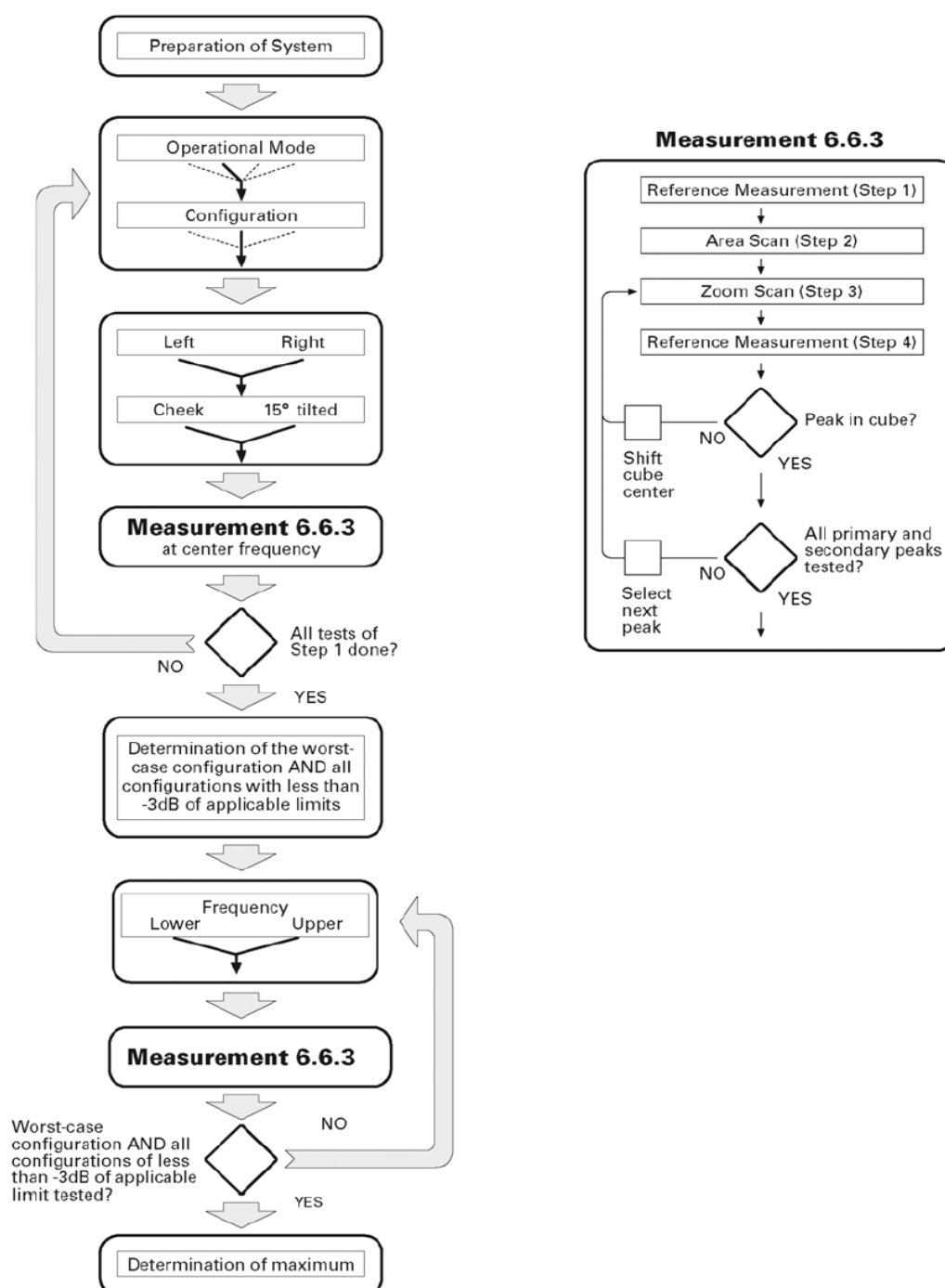
| Frequency                | Duty cycle | Target value<br>(W/kg) | Test value (W/kg) |       |
|--------------------------|------------|------------------------|-------------------|-------|
|                          |            |                        | 250 mW            | 1W    |
| 835MHz(Mar. 24th, 2015)  | 1:1        | 10.31                  | 2.46              | 9.84  |
| 1900MHz(Mar. 25th, 2015) | 1:1        | 40.81                  | 9.98              | 39.92 |

\* Note: Target value was referring to the measured value in the calibration certificate of reference dipole.

Note: 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.

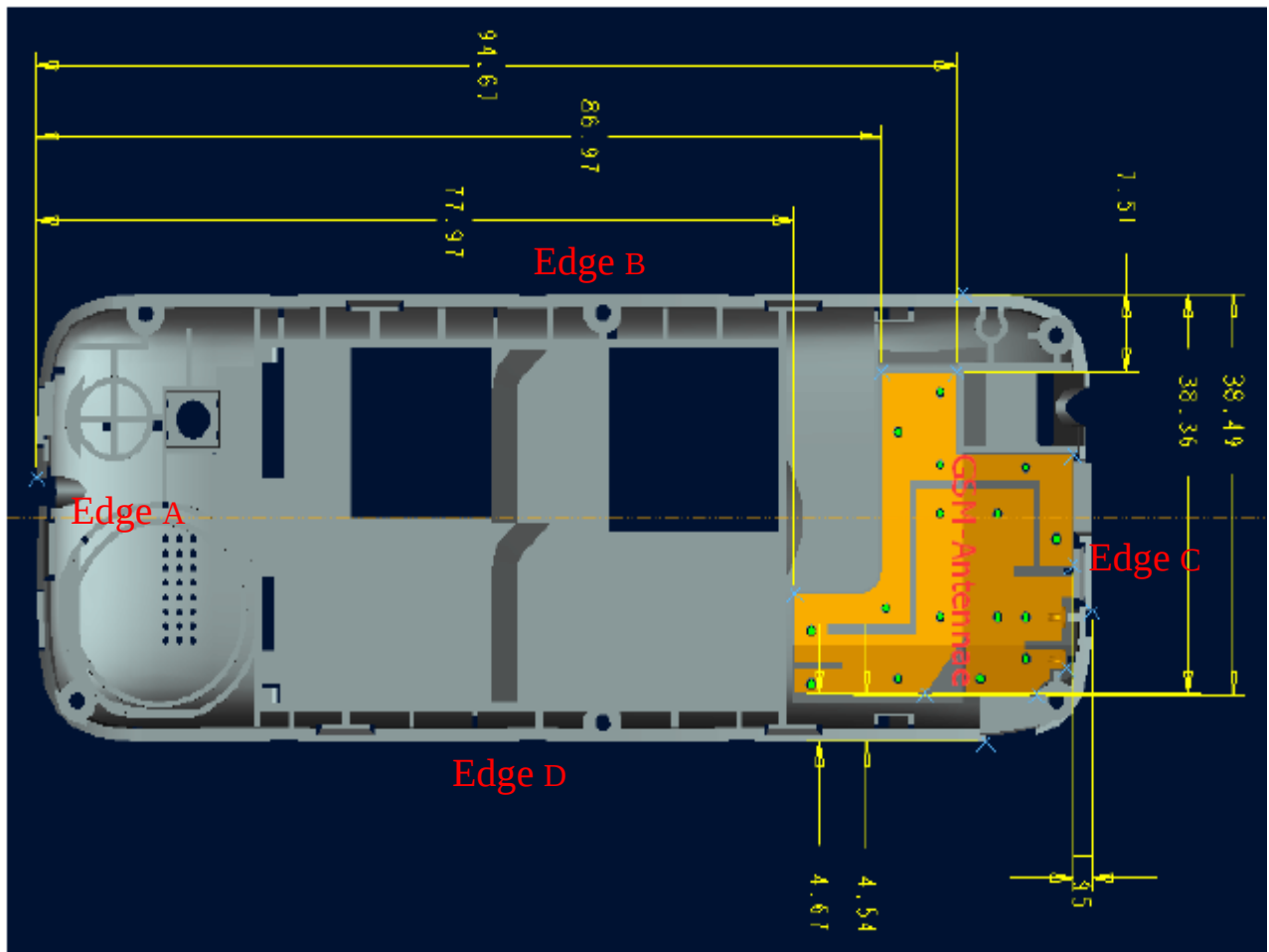
After an area scan has been done at a fixed distance of 2mm from the surface of the phantom on the source side, a 3D scan is set up around the location of the maximum spot SAR. First, a point within the scan area is visited by the probe and a SAR reading taken at the start of testing. At the end of testing, 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.

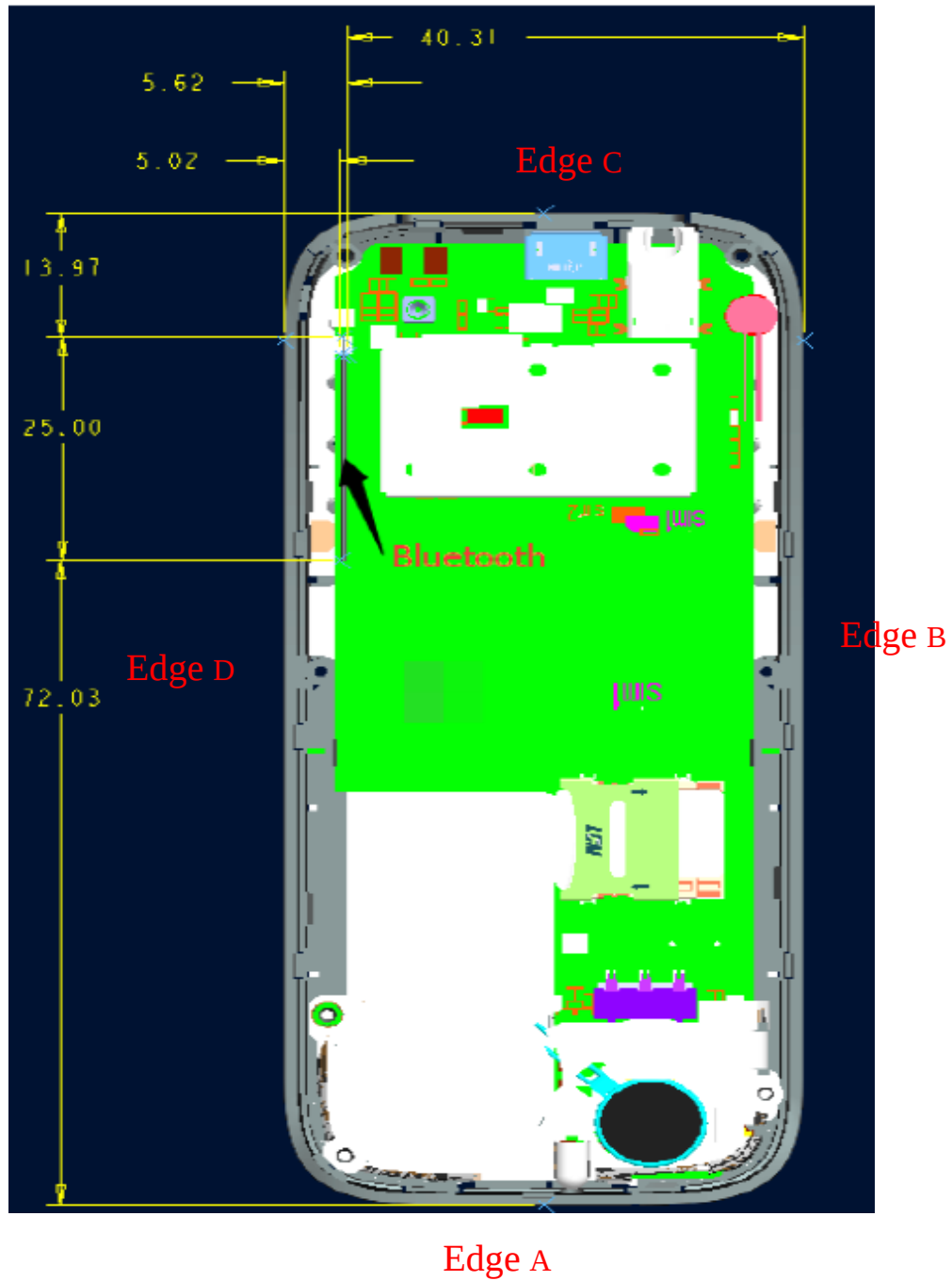
Above is the scanning procedure flow chart and table from the IEEE p1528 standard. This is the procedure for which all compliant testing should be carried out to ensure that all variations of the device position and transmission behaviour are tested.

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

## 6.5 Transmitting antenna information

There are GSM antenna, BT antenna inside the EUT





## 7 Applicable Measurement 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)

**IEEE 1528–2003:** IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques;

**IEEE Std 1528a-2005:** IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques

**FCC KDB 865664 D01 v01r03** SAR Measurement 100MHz to 6GHz

**FCC KDB 865664 D02 v01r01** RF Exposure Reporting

**FCC KDB 447498 D01 v05r02** General RF Exposure Guidance v05r02

**FCC KDB 648474 D04 v01r02** SAR Evaluation Considerations for Wireless Handsets

**FCC KDB 941225 D01 v03** SAR test for 3G devices

## 8 LABORATORY ENVIRONMENT

### 8.1 The Ambient Conditions during SAR Test

|                          |                            |
|--------------------------|----------------------------|
| Temperature              | Min. = 18 °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 GSM Conducted Power

| Band    |                | Burst Average Power (dBm) |       |        | Frame-Average Power (dBm) |              |              |
|---------|----------------|---------------------------|-------|--------|---------------------------|--------------|--------------|
| GSM850  | TX Channel     | 128                       | 190   | 251    | 128                       | 190          | 251          |
|         | Frequency(MHz) | 824.2                     | 836.4 | 848.8  | 824.2                     | 836.4        | 848.8        |
|         | GSM            | 33.12                     | 33.10 | 33.15  | 24.09                     | 24.07        | 24.12        |
|         | GPRS (Slot 1)  | 32.79                     | 32.93 | 32.84  | 23.76                     | 23.9         | 23.81        |
|         | GPRS (Slot 2)  | 29.99                     | 30.02 | 29.91  | <b>23.97</b>              | <b>24.00</b> | <b>23.89</b> |
|         | GPRS (Slot 3)  | 28.08                     | 28.10 | 28.14  | 23.82                     | 23.84        | 23.88        |
|         | GPRS (Slot 4)  | 26.49                     | 26.47 | 26.27  | 23.48                     | 23.46        | 23.26        |
| GSM1900 | TX Channel     | 512                       | 661   | 810    | 512                       | 661          | 810          |
|         | Frequency(MHz) | 1850.2                    | 1880  | 1909.8 | 1850.2                    | 1880         | 1909.8       |
|         | GSM            | 30.19                     | 30.23 | 30.26  | 21.16                     | 21.20        | 21.23        |
|         | GPRS (Slot 1)  | 29.78                     | 29.61 | 30.01  | 20.75                     | 20.58        | 20.98        |
|         | GPRS (Slot 2)  | 27.01                     | 26.96 | 27.02  | <b>20.99</b>              | <b>20.94</b> | <b>21.00</b> |
|         | GPRS (Slot 3)  | 25.36                     | 25.20 | 25.40  | 21.10                     | 20.94        | 21.14        |
|         | GPRS (Slot 4)  | 23.52                     | 23.18 | 23.72  | 20.51                     | 20.17        | 20.71        |

**Note:** Per KDB 447498 D01 v05r02, the maximum output power channel is used for SAR testing and for further SAR test reduction.

For Head SAR testing, GSM should be evaluated, therefore the EUT was set in GSM Voice for GSM850 and GSM1900 due to its highest frame-average power.

For Body worn SAR testing, GSM should be evaluated, therefore the EUT was set in GSM Voice for GSM850 and GSM 1900 due to its highest frame-average power.

GPRS should be evaluated, therefore the EUT was set in GPRS (2Tx slots) due to its highest frame-average power.

### 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      | 1:267    | 1:2      |
| Crest Factor      | -9.03dB  | -6.02dB  | -4.26dB  | -3.01dB  |

### Bluetooth Conducted Power

| Channel | Frequency (MHz) | BT3.0 Output Power(dBm) |                |        |
|---------|-----------------|-------------------------|----------------|--------|
|         |                 | GFSK                    | $\pi/4$ -DQPSK | 8-DPSK |
| CH 0    | 2402            | 5.74                    | 3.70           | 3.99   |
| CH 39   | 2441            | 5.09                    | 2.84           | 3.13   |
| CH 78   | 2480            | 5.31                    | 3.05           | 3.35   |

#### Note:

- Per KDB 447498 D01v05r02, 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  $\leq 7.5$  for 10-g extremity SAR
  - $f(\text{GHz})$  is the RF channel transmit frequency in GHz
  - Power and distance are round to the nearest mW and mm before calculation
  - The result is rounded to one decimal place for comparison
  - 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 |
|---------------------------|-------|--------------------|----------------|----------------------|
| 6                         | 3.981 | 5                  | 2.4            | 1.233                |

Per KDB 447498 D01v05r02 exclusion thresholds is  $1.233 < 3$ , RF exposure evaluation is not required.

BT estimated SAR value=Exclusion Thresholds/7.5= $1.233/7.5=0.164\text{W/Kg}$

| Bluetooth Max Power (dBm) | mW    | Test Distance (mm) | Frequency(GHz) | Exclusion Thresholds |
|---------------------------|-------|--------------------|----------------|----------------------|
| 6                         | 3.981 | 10                 | 2.4            | 0.617                |

Per KDB 447498 D01v05r02 exclusion thresholds is  $0.617 < 3$ , RF exposure evaluation is not required.

BT estimated SAR value=Exclusion Thresholds/7.5= $0.617/7.5=0.082\text{W/Kg}$

The estimated SAR value is used for simultaneous transmission analysis.

## General Note:

1. Per KDB 447498 D01v05r02, the reported SAR is the measured SAR value adjusted for maximum tune-up tolerance.
2. Per KDB447498 D01v05r02, 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:  $\leq 0.8$  W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is  $\leq 100$  MHz. When the maximum output power variation across the required test channels is  $> \frac{1}{2}$  dB, instead of the middle channel, the highest output power channel must be used.
3. The maximum reported SAR of each test band is shown in **bold** letters.
4. Per KDB941225 D06v02, the DUT Dimension is bigger than 9 cm x 5 cm, so 10mm is chosen as the test separation distance.
5. Per KDB 865664 D01v01r03, for each frequency band, repeated SAR measurement is required only when the measured SAR is  $\geq 0.8$  W/Kg; if the deviation among the repeated measurement is  $\leq 20\%$ , and the measured SAR  $< 1.45$  W/Kg, only one repeated measurement is required.
6. Per KDB865664 D02v01r01, 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).
7. Per KDB941225 D01, when multiple slots can be used, the GPRS/EDGE slot configuration with the highest frame-averaged output power was selected for SAR testing.
8. Per KDB941225 D01v03, when the maximum output power and tune-up tolerance specified for production units in a secondary mode is  $\leq \frac{1}{4}$  dB higher than the primary mode or when the highest reported SAR of the primary mode is scaled by the ratio of specified maximum output power and tune-up tolerance of secondary to primary mode and the adjusted SAR is  $\leq 1.2$  W/kg, SAR measurement is not required for the secondary mode.

### . Scaling Factor calculation

| Operation Mode | Channel | Output Power(dBm) | Tune up Power in tolerance(dBm) | Scaling Factor |
|----------------|---------|-------------------|---------------------------------|----------------|
| GSM 850        | 128     | 33.12             | 33.00 $\pm$ 0.5                 | 1.091          |
|                | 190     | 33.10             | 33.00 $\pm$ 0.5                 | 1.096          |
|                | 251     | 33.15             | 33.00 $\pm$ 0.5                 | 1.084          |
| GPRS 850(2Tx)  | 128     | 29.99             | 30.00 $\pm$ 0.5                 | 1.125          |
|                | 190     | 30.02             | 30.00 $\pm$ 0.5                 | 1.117          |
|                | 251     | 29.91             | 30.00 $\pm$ 0.5                 | 1.146          |
| GSM1900        | 512     | 30.19             | 30.00 $\pm$ 0.5                 | 1.074          |
|                | 661     | 30.23             | 30.00 $\pm$ 0.5                 | 1.064          |
|                | 810     | 30.26             | 30.00 $\pm$ 0.5                 | 1.057          |
| GPRS1900(2Tx)  | 512     | 27.01             | 27.00 $\pm$ 0.5                 | 1.119          |
|                | 661     | 26.96             | 27.00 $\pm$ 0.5                 | 1.132          |
|                | 810     | 27.02             | 27.00 $\pm$ 0.5                 | 1.117          |
| BT GFSK        | 2402    | 5.74              | 5 $\pm$ 1                       | 1.062          |
|                | 2441    | 5.09              | 5 $\pm$ 1                       | 1.233          |
|                | 2480    | 5.31              | 5 $\pm$ 1                       | 1.172          |

## 10 TEST RESULTS

### 10.1 Summary of Power Measurement Results

According the description above, the measurements against the head phantom were executed on the operation mode: GSM850 /1900MHz, while the tests against the body-worn were carried out on the operation mode : GSM850/1900MHz, GPRS 850 /1900MHz.

Table 1: SAR Values of GSM 850MHz Band

| Temperature: 22.0~23.5°C, humidity: 62~64%. |                 |             |                             |                             |                     |
|---------------------------------------------|-----------------|-------------|-----------------------------|-----------------------------|---------------------|
| Test Positions                              |                 |             | Channel<br>/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                   | 0.014                       | 0.015               |
|                                             | Tilt 15 degrees |             | 190/836.6                   | 0.012                       | 0.013               |
| Left Side of Head                           | Cheek           |             | 190/836.6                   | <b>0.015</b>                | 0.016               |
|                                             | Tilt 15 degrees |             | 190/836.6                   | 0.012                       | 0.013               |
| Body (10mm<br>Separation)                   | GSM             | Face Upward | 190/836.6                   | 0.021                       | 0.023               |
|                                             |                 | Back Upward | 190/836.6                   | <b>0.186</b>                | 0.204               |
|                                             |                 | Edge A      | 190/836.6                   | 0.002                       | 0.002               |
|                                             |                 | Edge B      | 190/836.6                   | 0.011                       | 0.012               |
|                                             |                 | Edge C      | 190/836.6                   | 0.005                       | 0.005               |
|                                             |                 | Edge D      | 190/836.6                   | 0.016                       | 0.018               |
|                                             | GPRS<br>(2Tx)   | Face Upward | 190/836.6                   | 0.019                       | 0.021               |
|                                             |                 | Back Upward | 190/836.6                   | <b>0.182</b>                | 0.204               |
|                                             |                 | Edge A      | 190/836.6                   | 0.002                       | 0.002               |
|                                             |                 | Edge B      | 190/836.6                   | 0.012                       | 0.013               |
|                                             |                 | Edge C      | 190/836.6                   | 0.005                       | 0.006               |
|                                             |                 | Edge D      | 190/836.6                   | 0.015                       | 0.017               |

Table 2: SAR Values of GSM1900 MHz Band

| Temperature: 22.0~23.5°C, humidity: 62~64%. |                 |                             |                             |                        |
|---------------------------------------------|-----------------|-----------------------------|-----------------------------|------------------------|
| Test Positions                              |                 | Channel /Frequency<br>(MHz) | SAR(W/Kg), 1.6 (1g average) |                        |
|                                             |                 |                             | SAR(W/Kg1g<br>Peak)         | Scaled<br>SAR(W/Kg),1g |
| Right Side of Head                          | Cheek           | 661/1880.0                  | <b>0.017</b>                | 0.018                  |
|                                             | Tilt 15 degrees | 661/1880.0                  | 0.013                       | 0.014                  |
| Left Side of Head                           | Cheek           | 661/1880.0                  | 0.016                       | 0.017                  |
|                                             | Tilt 15 degrees | 661/1880.0                  | 0.012                       | 0.013                  |
| Body (10mm<br>Separation)                   | GSM             | Face Upward                 | 661/1880.0                  | 0.007                  |
|                                             |                 | Back Upward                 | 661/1880.0                  | <b>0.027</b>           |
|                                             |                 | Edge A                      | 661/1880.0                  | 0.002                  |
|                                             |                 | Edge B                      | 661/1880.0                  | 0.006                  |
|                                             |                 | Edge C                      | 661/1880.0                  | 0.008                  |
|                                             |                 | Edge D                      | 661/1880.0                  | 0.007                  |
|                                             | GPRS<br>(2Tx)   | Face Upward                 | 661/1880.0                  | 0.008                  |
|                                             |                 | Back Upward                 | 661/1880.0                  | <b>0.034</b>           |
|                                             |                 | Edge A                      | 661/1880.0                  | 0.002                  |
|                                             |                 | Edge B                      | 661/1880.0                  | 0.007                  |
|                                             |                 | Edge C                      | 661/1880.0                  | 0.008                  |
|                                             |                 | Edge D                      | 661/1880.0                  | 0.006                  |

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 v05r02)

- $\leq 0.8$  W/kg, when the transmission band is  $\leq 100$  MHz
- $\leq 0.6$  W/kg, when the transmission band is between 100 MHz and 200 MHz
- $\leq 0.4$  W/kg, when the transmission band is  $\geq 200$  MHz

## SIMULTANEOUS TRANSMISSION ANALYSIS

| Test Position                       |         | Right Cheek | Right Title | Left Cheek | Left Tilt |
|-------------------------------------|---------|-------------|-------------|------------|-----------|
| Head<br>MAX 1-g<br>SAR(W/Kg)        | GSM850  | 0.015       | 0.013       | 0.016      | 0.013     |
|                                     | GSM1900 | 0.018       | 0.014       | 0.017      | 0.013     |
|                                     | BT      | *0.164      | *0.164      | *0.164     | *0.164    |
| Simultaneous $\Sigma$ 1-g SAR(W/Kg) |         | 0.182       | 0.178       | 0.181      | 0.177     |

Simultaneous Tx Combination of GSM and BT (Head).

The estimated SAR value with \* Signal

| Test Position                                      |         | Face   | Back   | Edge A | Edge B | Edge C | Edge D |
|----------------------------------------------------|---------|--------|--------|--------|--------|--------|--------|
| Body<br>10mm<br>separation<br>MAX 1-g<br>SAR(W/Kg) | GSMS850 | 0.023  | 0.204  | 0.002  | 0.013  | 0.006  | 0.018  |
|                                                    | GSM1900 | 0.009  | 0.039  | 0.002  | 0.008  | 0.009  | 0.007  |
|                                                    | BT      | *0.082 | *0.082 | *0.082 | *0.082 | *0.082 | *0.082 |
| Simultaneous $\Sigma$ 1-g SAR(W/Kg)                |         | 0.105  | 0.286  | 0.084  | 0.095  | 0.088  | 0.100  |

Simultaneous Tx Combination of GSM and BT (Body).

The estimated SAR value with \* Signal

### SAR to Peak Location Separation Ratio (SPLSR)

As the Sum of the SAR is not greater than 1.6 W/kg SPLSR assessment is not required

## 11 Measurement Uncertainty

| No.                             | Uncertainty Component                                                             | Type | Uncertainty Value (%) | Probability Distribution | k          | ci  | Standard Uncertainty (%) $u_i(\%)$ | Degree of freedom $V_{eff}$ or $v_i$ |
|---------------------------------|-----------------------------------------------------------------------------------|------|-----------------------|--------------------------|------------|-----|------------------------------------|--------------------------------------|
| <b>Measurement System</b>       |                                                                                   |      |                       |                          |            |     |                                    |                                      |
| 1                               | – Probe Calibration                                                               | B    | 5.8                   | N                        | 1          | 1   | 5.8                                | $\infty$                             |
| 2                               | – Axial isotropy                                                                  | B    | 3.5                   | R                        | $\sqrt{3}$ | 0.5 | 1.43                               | $\infty$                             |
| 3                               | – Hemispherical Isotropy                                                          | B    | 5.9                   | R                        | $\sqrt{3}$ | 0.5 | 2.41                               | $\infty$                             |
| 4                               | – Boundary Effect                                                                 | B    | 1                     | R                        | $\sqrt{3}$ | 1   | 0.58                               | $\infty$                             |
| 5                               | – Linearity                                                                       | B    | 4.7                   | R                        | $\sqrt{3}$ | 1   | 2.71                               | $\infty$                             |
| 6                               | – System Detection Limits                                                         | B    | 1.0                   | R                        | $\sqrt{3}$ | 1   | 0.58                               | $\infty$                             |
| 7                               | Modulation response                                                               | B    | 3                     | N                        | 1          | 1   | 3.00                               |                                      |
| 8                               | – Readout Electronics                                                             | B    | 0.5                   | N                        | 1          | 1   | 0.50                               | $\infty$                             |
| 9                               | – Response Time                                                                   | B    | 1.4                   | R                        | $\sqrt{3}$ | 1   | 0.81                               | $\infty$                             |
| 10                              | – Integration Time                                                                | B    | 3.0                   | R                        | $\sqrt{3}$ | 1   | 1.73                               | $\infty$                             |
| 11                              | – RF Ambient Conditions                                                           | B    | 3.0                   | R                        | $\sqrt{3}$ | 1   | 1.73                               | $\infty$                             |
| 12                              | – Probe Position Mechanical tolerance                                             | B    | 1.4                   | R                        | $\sqrt{3}$ | 1   | 0.81                               | $\infty$                             |
| 13                              | – Probe Position with respect to Phantom Shell                                    | B    | 1.4                   | R                        | $\sqrt{3}$ | 1   | 0.81                               | $\infty$                             |
| 14                              | – Extrapolation, Interpolation and Integration Algorithms for Max. SAR evaluation | B    | 2.3                   | R                        | $\sqrt{3}$ | 1   | 1.33                               | $\infty$                             |
| <b>Uncertainties of the DUT</b> |                                                                                   |      |                       |                          |            |     |                                    |                                      |
| 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<br>–SAR drift measurement                                  | B | 5.0 | R   | $\sqrt{3}$ | 1   | 2.89  | $\infty$ |
| <b>Phantom and Tissue Parameters</b>                         |                                                                                     |   |     |     |            |     |       |          |
| 18                                                           | – Phantom<br>Uncertainty(shape and<br>thickness tolerances)                         | B | 4   | R   | $\sqrt{3}$ | 1   | 2.31  | $\infty$ |
| 19                                                           | Uncertainty in SAR<br>correction for deviation(in<br>permittivity and conductivity) | B | 2   | N   | 1          | 1   | 2.00  |          |
| 20                                                           | – Liquid Conductivity Target<br>–tolerance                                          | B | 2.5 | R   | $\sqrt{3}$ | 0.6 | 1.95  | $\infty$ |
| 21                                                           | – Liquid Conductivity<br>–measurement Uncertainty)                                  | B | 4   | N   | $\sqrt{3}$ | 1   | 0.92  | 9        |
| 22                                                           | – Liquid Permittivity Target<br>tolerance                                           | B | 2.5 | R   | $\sqrt{3}$ | 0.6 | 1.95  | $\infty$ |
| 23                                                           | – Liquid Permittivity<br>–measurement uncertainty                                   | B | 5   | N   | $\sqrt{3}$ | 1   | 1.15  | $\infty$ |
| <b>Combined Standard Uncertainty</b>                         |                                                                                     |   |     | RSS |            |     | 10.63 |          |
| <b>Expanded uncertainty</b><br>(Confidence interval of 95 %) |                                                                                     |   |     | K=2 |            |     | 21.26 |          |

### System Check Uncertainty

| No.                       | Uncertainty Component     | Type | Uncertainty Value (%) | Probability Distribution | k          | ci  | Standard Uncertainty (%) $u_i(\%)$ | Degree of freedom $V_{eff}$ or $v_i$ |
|---------------------------|---------------------------|------|-----------------------|--------------------------|------------|-----|------------------------------------|--------------------------------------|
| <b>Measurement System</b> |                           |      |                       |                          |            |     |                                    |                                      |
| 1                         | – Probe Calibration       | B    | 5.8                   | N                        | 1          | 1   | 5.8                                | $\infty$                             |
| 2                         | – Axial isotropy          | B    | 3.5                   | R                        | $\sqrt{3}$ | 0.5 | 1.43                               | $\infty$                             |
| 3                         | – Hemispherical Isotropy  | B    | 5.9                   | R                        | $\sqrt{3}$ | 0.5 | 2.41                               | $\infty$                             |
| 4                         | – Boundary Effect         | B    | 1                     | R                        | $\sqrt{3}$ | 1   | 0.58                               | $\infty$                             |
| 5                         | – Linearity               | B    | 4.7                   | R                        | $\sqrt{3}$ | 1   | 2.71                               | $\infty$                             |
| 6                         | – System Detection Limits | B    | 1                     | R                        | $\sqrt{3}$ | 1   | 0.58                               | $\infty$                             |

|                               |                                                                                   |   |      |     |            |     |       |          |
|-------------------------------|-----------------------------------------------------------------------------------|---|------|-----|------------|-----|-------|----------|
| 7                             | Modulation response                                                               | B | 0    | N   | 1          | 1   | 0.00  |          |
| 8                             | – Readout Electronics                                                             | B | 0.5  | N   | 1          | 1   | 0.50  | $\infty$ |
| 9                             | – Response Time                                                                   | B | 0.00 | R   | $\sqrt{3}$ | 1   | 0.00  | $\infty$ |
| 10                            | – Integration Time                                                                | B | 1.4  | R   | $\sqrt{3}$ | 1   | 0.81  | $\infty$ |
| 11                            | – RF Ambient Conditions                                                           | B | 3.0  | R   | $\sqrt{3}$ | 1   | 1.73  | $\infty$ |
| 12                            | – Probe Position Mechanical tolerance                                             | B | 1.4  | R   | $\sqrt{3}$ | 1   | 0.81  | $\infty$ |
| 13                            | – Probe Position with respect to Phantom Shell                                    | B | 1.4  | R   | $\sqrt{3}$ | 1   | 0.81  | $\infty$ |
| 14                            | – Extrapolation, Interpolation and Integration Algorithms for Max. SAR evaluation | B | 2.3  | R   | $\sqrt{3}$ | 1   | 1.33  | $\infty$ |
| Uncertainties of the DUT      |                                                                                   |   |      |     |            |     |       |          |
| 15                            | Deviation of experimental source from numerical 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   | $\infty$ |
| Phantom and Tissue Parameters |                                                                                   |   |      |     |            |     |       |          |
| 18                            | – Phantom Uncertainty(shape and thickness tolerances)                             | B | 4    | R   | $\sqrt{3}$ | 1   | 2.31  | $\infty$ |
| 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  | $\infty$ |
| 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  | $\infty$ |
| 23                            | – Liquid Permittivity –measurement uncertainty                                    | B | 5    | N   | $\sqrt{3}$ | 1   | 1.15  | $\infty$ |
| Combined Standard Uncertainty |                                                                                   |   |      | RSS |            |     | 10.15 |          |



|                                                              |  |  |     |  |  |       |  |
|--------------------------------------------------------------|--|--|-----|--|--|-------|--|
| <b>Expanded uncertainty</b><br>(Confidence interval of 95 %) |  |  | K=2 |  |  | 20.29 |  |
|--------------------------------------------------------------|--|--|-----|--|--|-------|--|

## 12 MAIN TEST INSTRUMENTS

| No. | EQUIPMENT           | TYPE         | Series No.             | Last Calibration | Due Date |
|-----|---------------------|--------------|------------------------|------------------|----------|
| 1   | System Simulator    | E5515C       | GB 47200710            | 2015/02/23       | 1 Year   |
| 2   | System Simulator    | CMW500       | 130805                 | 2014/06/10       | 1 Year   |
| 3   | SAR Probe           | SATIMO       | SN 09/13 EP169         | 2014/04/05       | 1 Year   |
| 4   | SAR Probe           | SATIMO       | SN 27/14 EPG210        | 2014/05/16       | 1 Year   |
| 5   | Dipole              | SID835       | SN09/13 DIP0G835-217   | 2014/08/28       | 1 Year   |
| 6   | Dipole              | SID1900      | SN09/13 DIP1G900-218   | 2014/08/28       | 1 Year   |
| 7   | Network Analyzer    | ZVB8         | A0802530               | 2014/06/13       | 1 Year   |
| 8   | Signal Generator    | SMR27        | A0304219               | 2014/06/10       | 1 Year   |
| 9   | Amplifier           | Nucletudes   | 143060                 | 2014/04/05       | 1 Year   |
| 10  | Directional Coupler | DC6180A      | 305827                 | 2014/06/10       | 1 Year   |
| 11  | Power Meter         | NRVS         | 1020.1809.02           | 2014/06/13       | 1 Year   |
| 12  | Power Sensor        | NRV-Z4       | 100069                 | 2014/06/10       | 1 Year   |
| 13  | Power Meter         | NRP2         | A140401673             | 2014/04/04       | 1 Year   |
| 14  | Power Sensor        | NPR-Z11      | 1138.3004.02-114072-nq | 2014/04/04       | 1 Year   |
| 15  | Multimeter          | Keithley2000 | 4014020                | 2015/03/27       | 1 Year   |
| 16  | Device Holder       | SATIMO       | SN 09/13 MSH80         | 2014/04/05       | 1 Year   |
| 17  | SAM Phantom         | SAM97        | SN 09/13 SAM97         | 2014/04/05       | 1 Year   |

**ANNEX A**

**of**

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

**CONFORMANCE TEST REPORT FOR**

**HUMAN EXPOSURE TO ELECTROMAGNETIC FIELDS**

**SET2015-04152**

**Haier Telecom (Qingdao) Co., Ltd.**

**GSM digital mobile phone**

**Type Name: M220**

**M721C\_FS\_MB\_V0.1**

**Hardware Version:**

**M721C\_LD\_SINGLE\_CARD\_F08\_WNRL\_V003\_20150312**

**Software Version:**

**Accreditation Certificate**

**This Annex consists of 2 pages**

**Date of Report: 2015-04-08**



**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

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No.CNAS AL 2

0005210

**ANNEX B**

**of**

**CCIC-SET**

**CONFORMANCE TEST REPORT FOR**

**HUMAN EXPOSURE TO ELECTROMAGNETIC FIELDS**

**SET2015-04152**

**Haier Telecom (Qingdao) Co., Ltd.**

**GSM digital mobile phone**

**Type Name: M220**

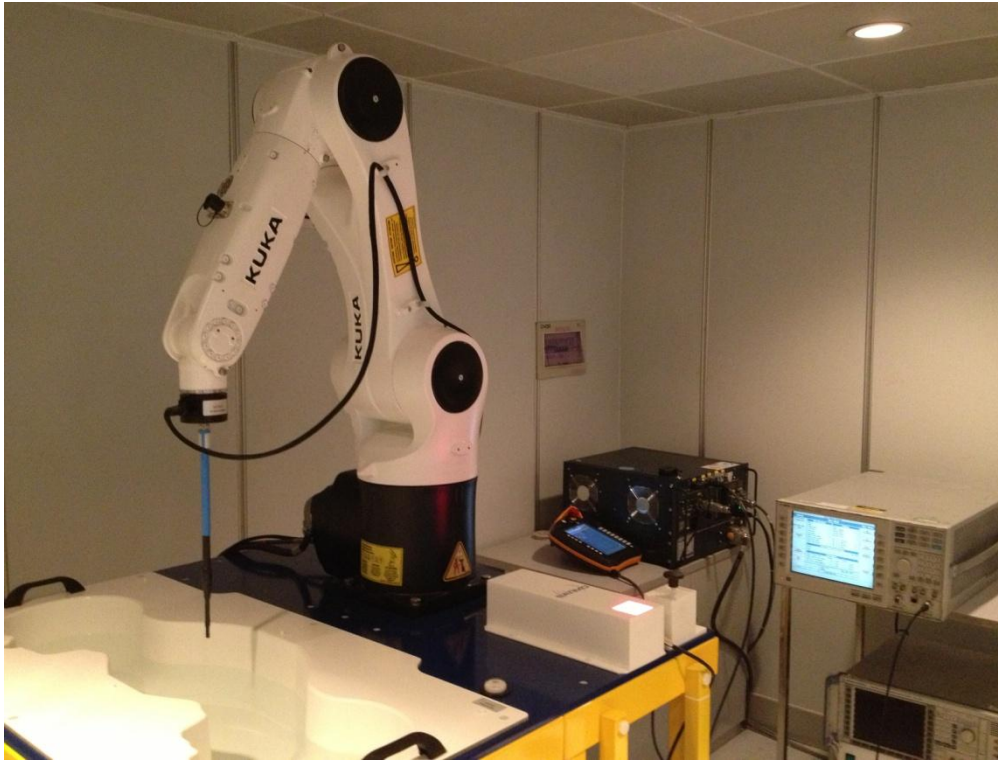
**Hardware Version: M721C\_FS\_MB\_V0.1**

**Software Version: M721C\_LD\_SINGLE\_CARD\_F08\_WNRL\_V003\_20150312**

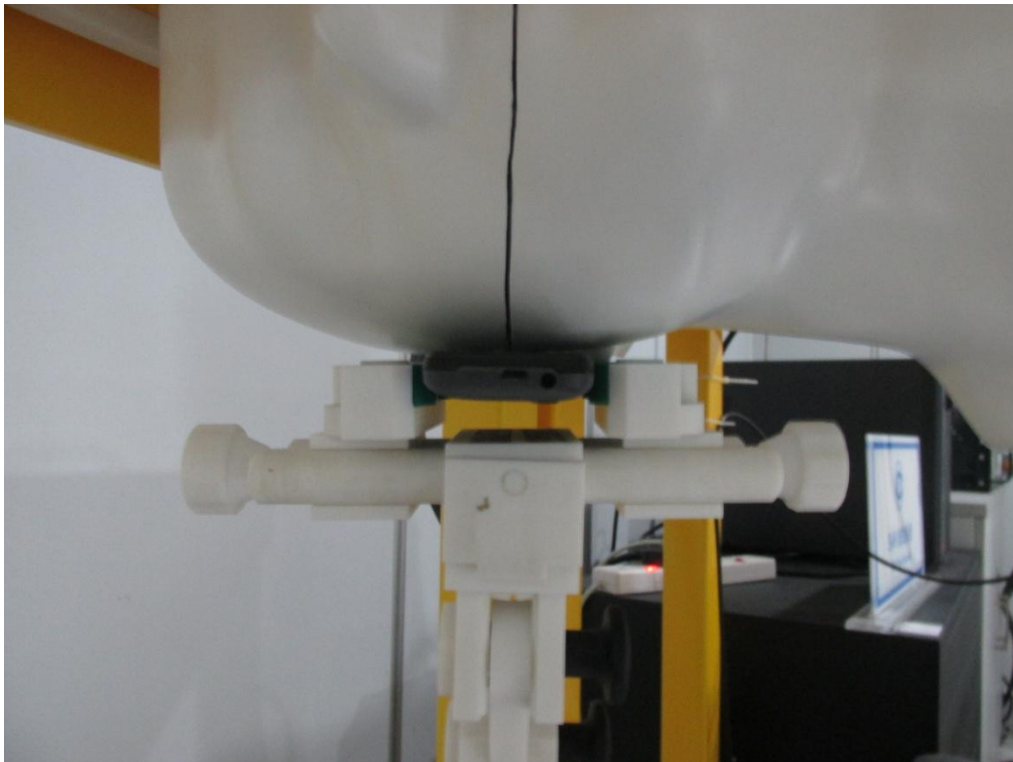
**TEST LAYOUT**

**This Annex consists of 7 pages**

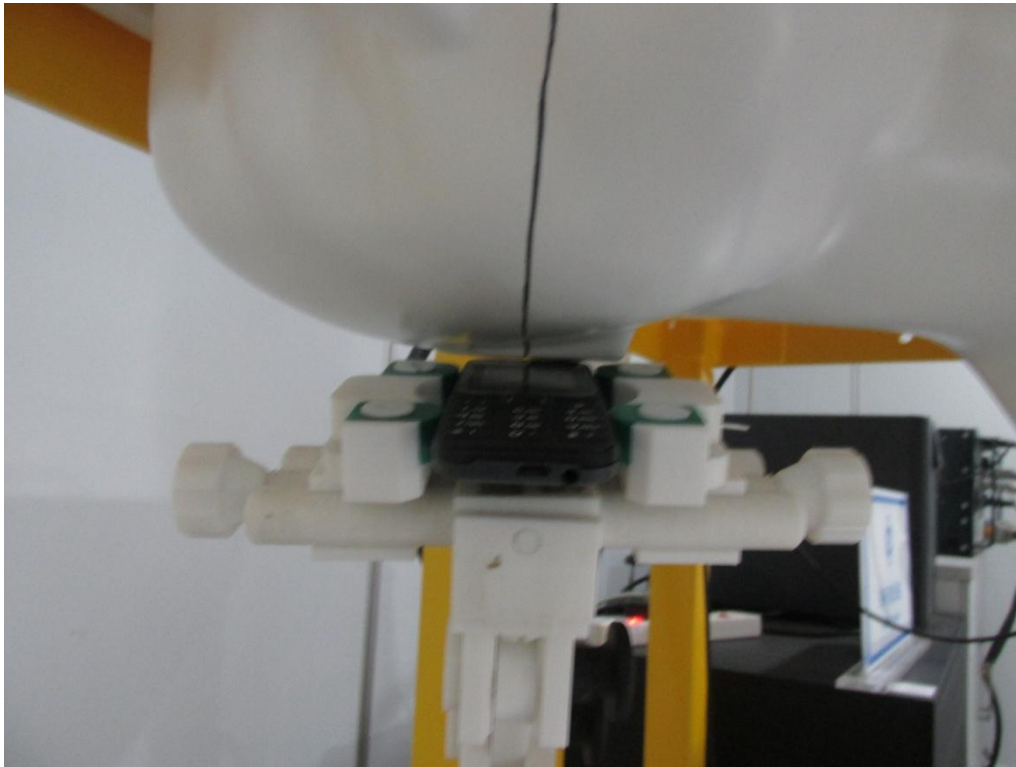
**Date of Report: 2015-04-08**



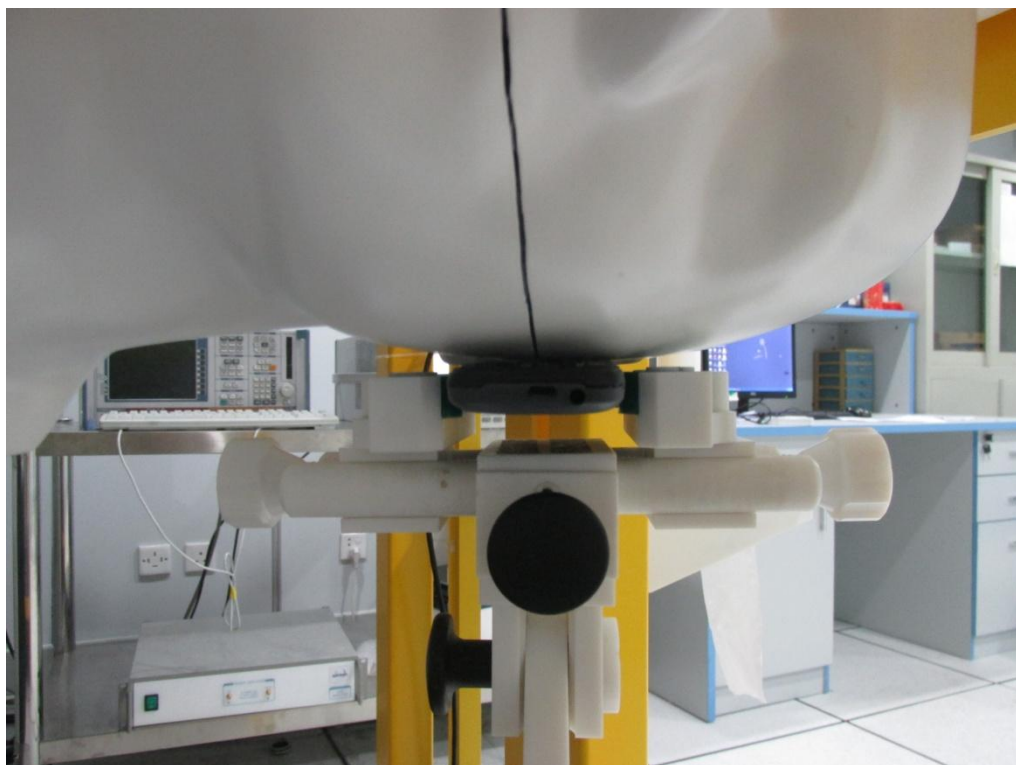
**Fig.1 COMO SAR Test System**



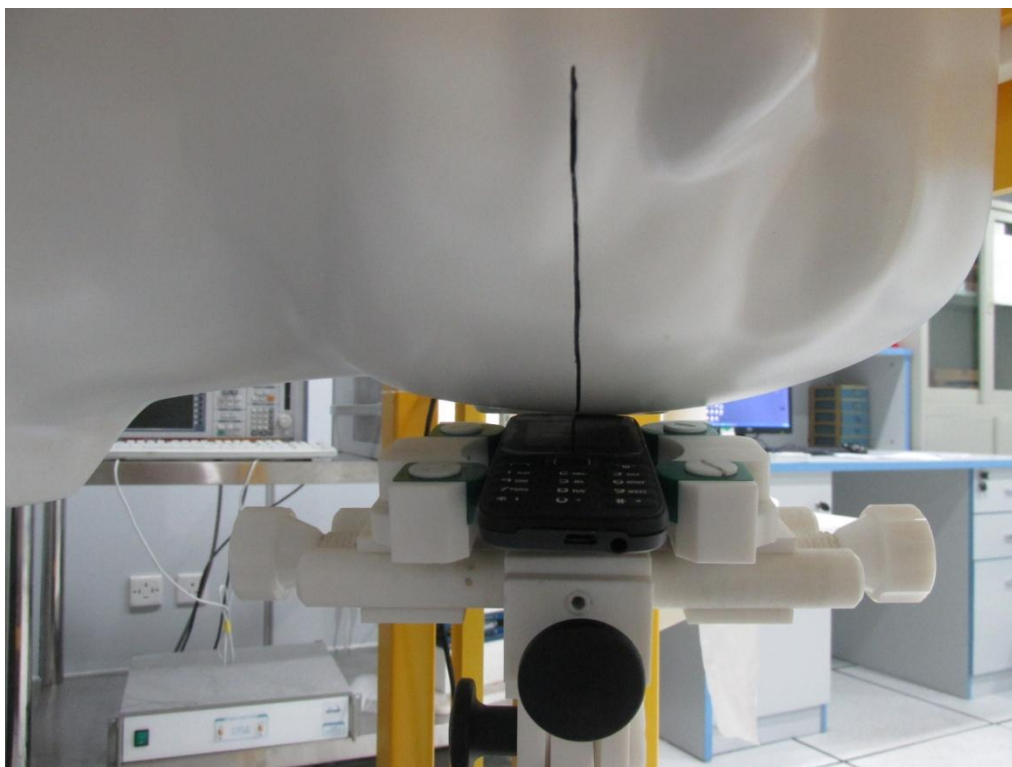
**Fig.2 Right\_Cheek**



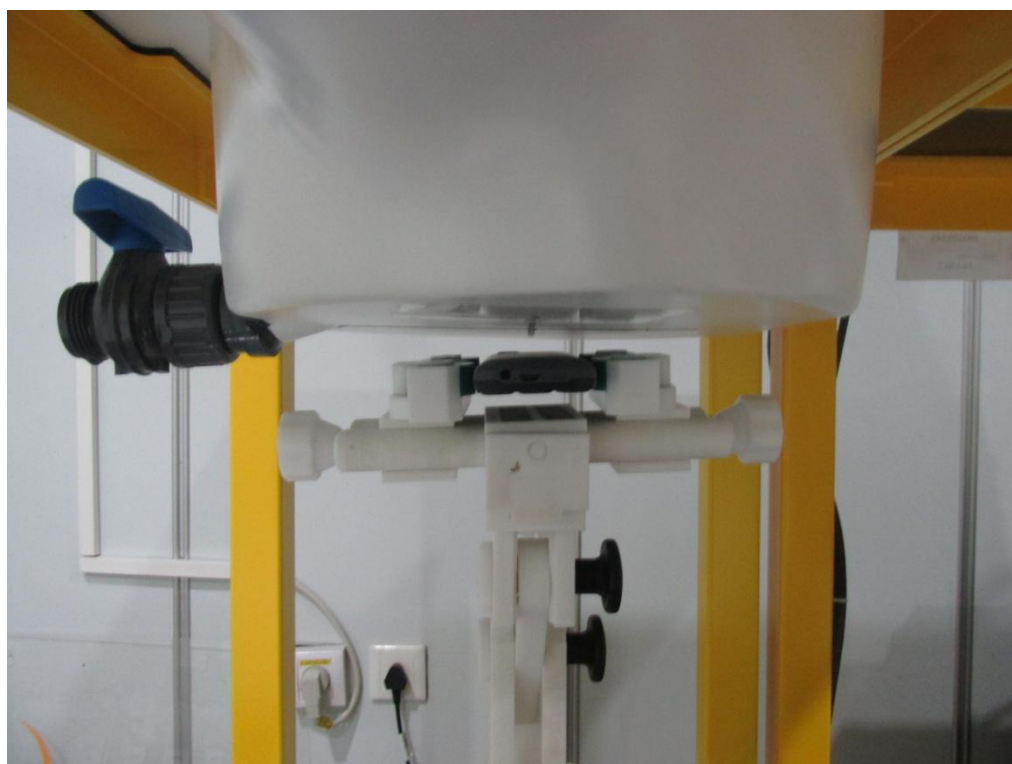
**Fig.3 Right\_Tilt**



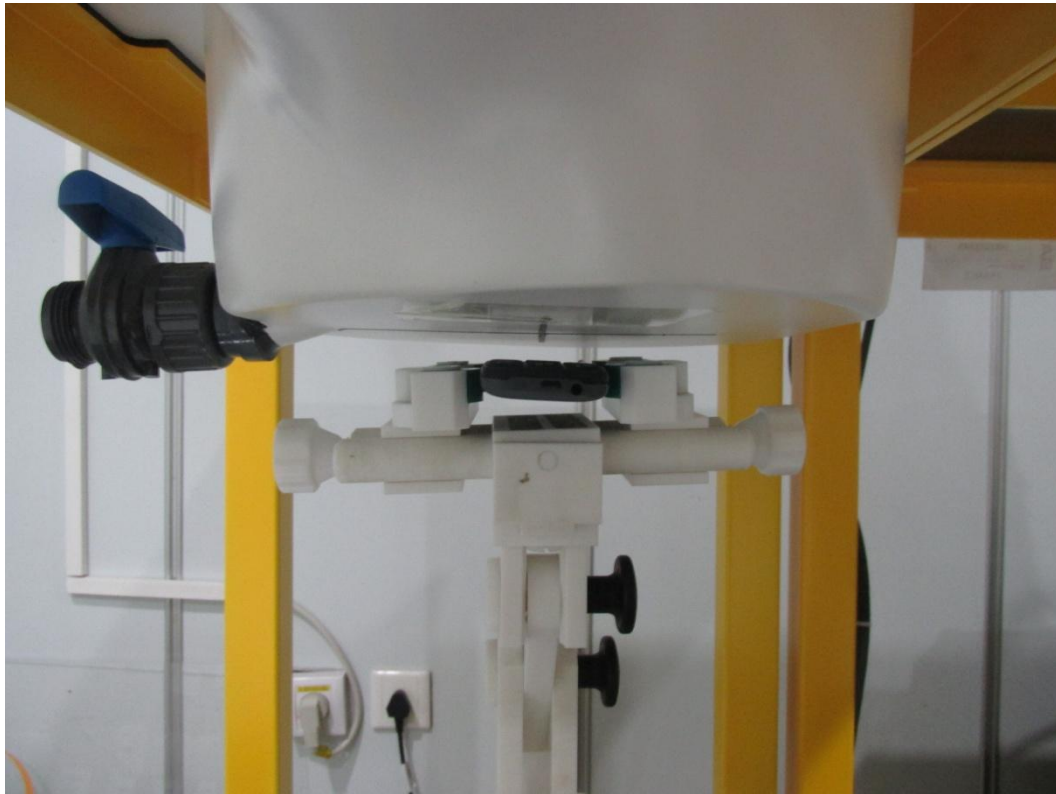
**Fig.4 Left Cheek**



**Fig.5 Left\_Tilt**



**Fig.6 Body(Back upside,10mm separation)**



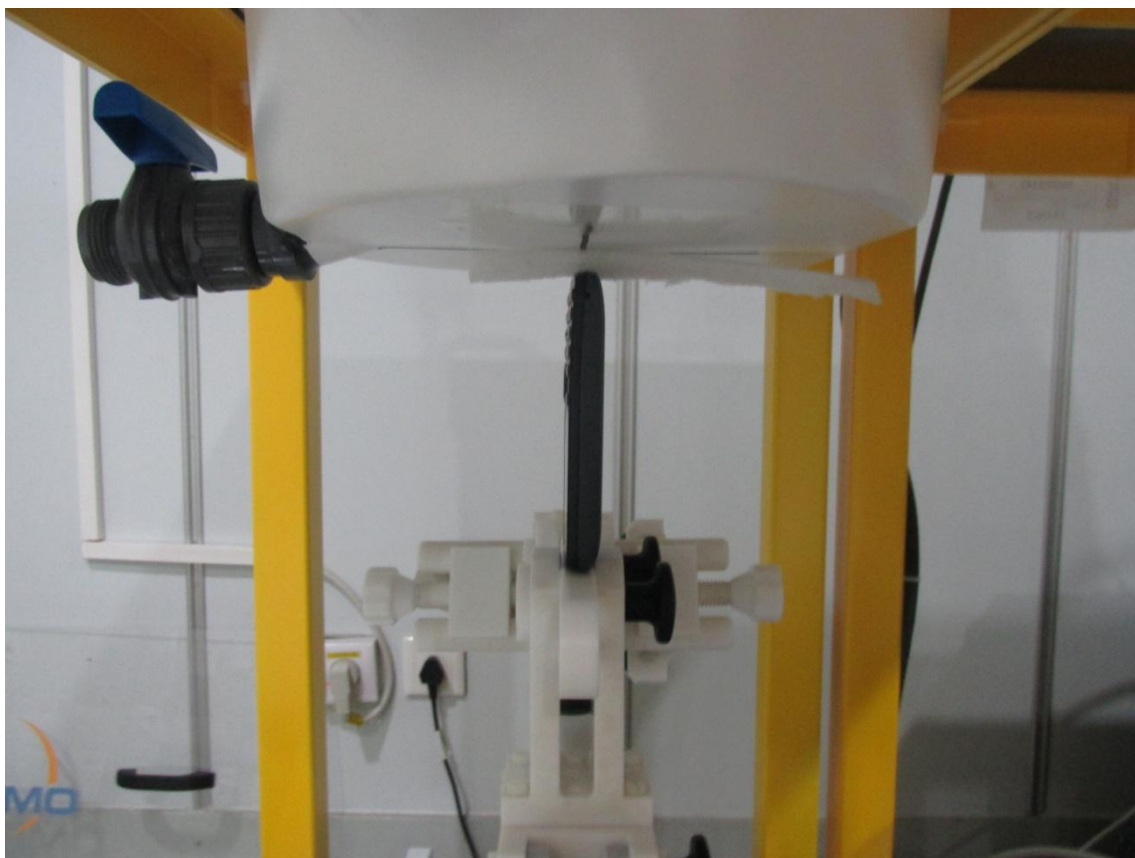
**Fig.7 Body(Face upside,10mm separation)**



**Fig.8 Body Edge A(UP,10mm separation)**



**Fig.9 Body Edge B(Right upside,10mm separation)**



**Fig.10 Body Edge C(Down,10mm separation)**



**Fig.11 Body Edge D(Left upside,10mm separation)**



**Fig.12 Head Liquid of 835MHz(15cm)**



**Fig.13 Body Liquid of 835MHz(15cm)**



**Fig.14 Head Liquid of 1900MHz(15cm)**



**Fig.15 Body Liquid of 1900MHz(15cm)**

**ANNEX C**

**of**

**CCIC-SET**

**CONFORMANCE TEST REPORT FOR**

**HUMAN EXPOSURE TO ELECTROMAGNETIC FIELDS**

**SET2015-04152**

**GSM digital mobile phone**

**Type Name: M220**

**Hardware Version: M721C\_FS\_MB\_V0.1**

**Software Version: M721C\_LD\_SINGLE\_CARD\_F08\_WNRL\_V003\_20150312**

**Sample Photographs**

**This Annex consists of 2 pages**

**Date of Report: 2015-04-08**

## 1. Appearance



Appearance and size (obverse)



Appearance and size (reverse)

**ANNEX D**

**of**

**CCIC-SET**

**CONFORMANCE TEST REPORT FOR**

**HUMAN EXPOSURE TO ELECTROMAGNETIC FIELDS**

**SET2015-04152**

**GSM digital mobile phone**

**Type Name: M220**

**Hardware Version: M721C\_FS\_MB\_V0.1**

**Software Version: M721C\_LD\_SINGLE\_CARD\_F08\_WNRL\_V003\_20150312**

**System Performance Check Data and Highest SAR Plots**

**This Annex consists of 50 pages**

**Date of Report: 2015-04-08**

## 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:24/03/2015

Measurement duration: 12 minutes 57 seconds

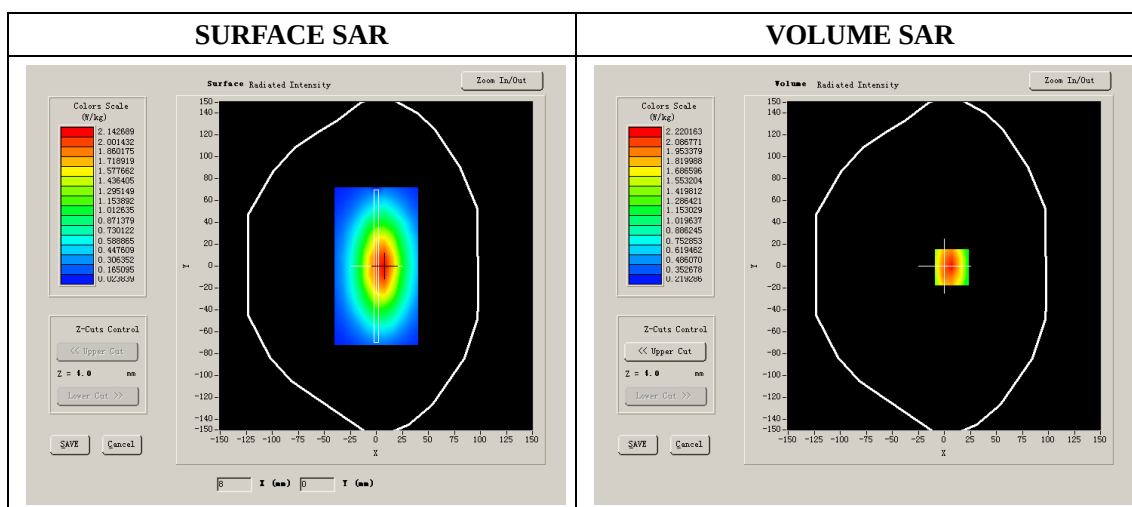
### A. Experimental conditions.

|                 |                   |
|-----------------|-------------------|
| 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) | 41.37      |
| Relative permittivity             | 19.62      |
| Conductivity (S/m)                | 0.91       |
| Power drift (%)                   | -0.430000  |
| Ambient Temperature:              | 23.2 °C    |
| Liquid Temperature:               | 23.5 °C    |
| ConvF:                            | 5.51       |
| Duty factor:                      | 1:1        |

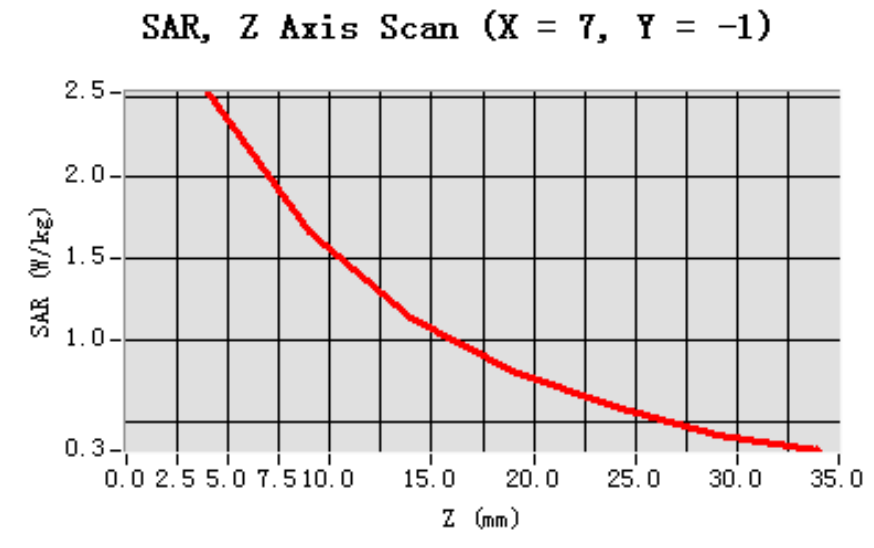


Maximum location: X=7.00, Y=-1.00

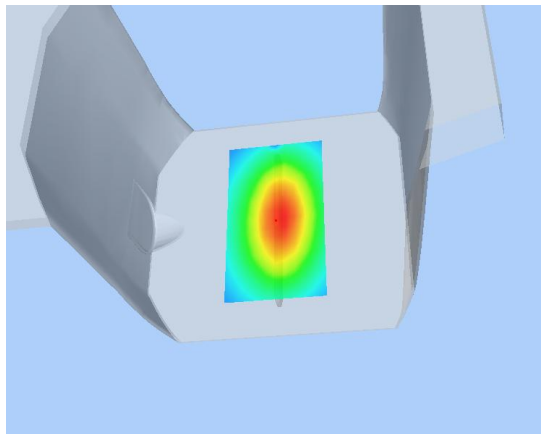
|                |          |
|----------------|----------|
| SAR 10g (W/Kg) | 1.824256 |
| SAR 1g (W/Kg)  | 2.454673 |

### Z Axis Scan

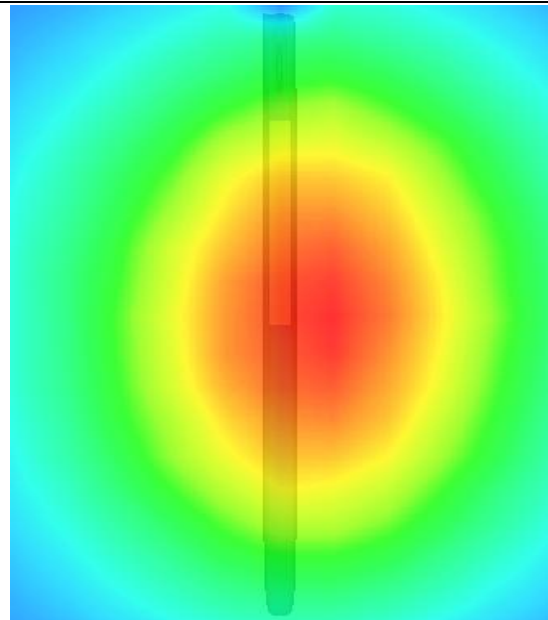
| Z (mm)     | 0.00   | 4.00   | 9.00   | 14.00  | 19.00  | 24.00  | 29.00  |
|------------|--------|--------|--------|--------|--------|--------|--------|
| SAR (W/Kg) | 0.0000 | 2.5214 | 1.6624 | 1.1451 | 0.8065 | 0.5875 | 0.4153 |



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: 25/03/2015

Measurement duration: 12 minutes 57 seconds

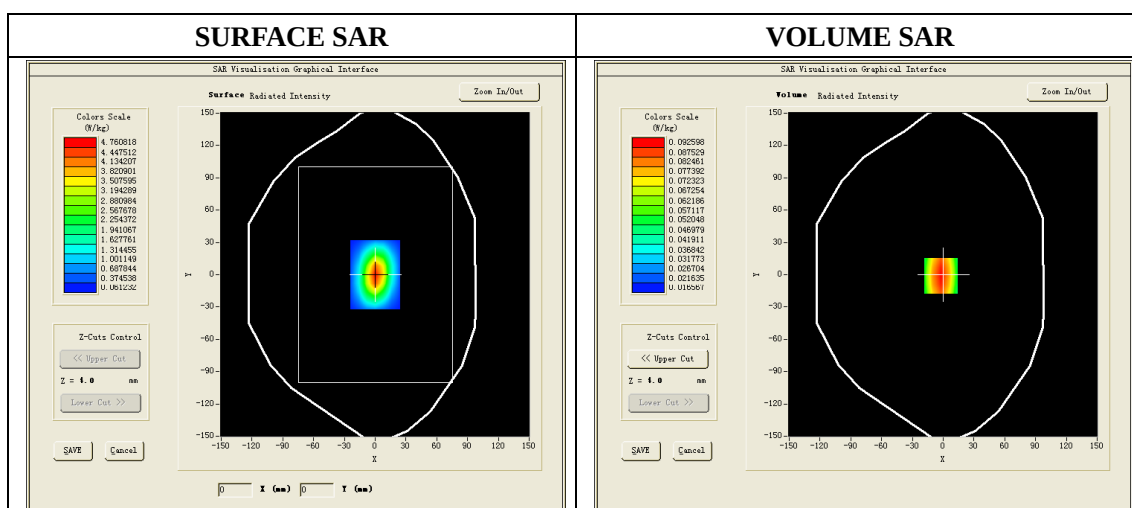
### A. Experimental conditions.

|                 |                   |
|-----------------|-------------------|
| 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) | 39.87       |
| Relative permittivity             | 13.36       |
| Conductivity (S/m)                | 1.41        |
| Power drift (%)                   | -0.150000   |
| Ambient Temperature:              | 22.3 °C     |
| Liquid Temperature:               | 22.6 °C     |
| ConvF:                            | 5.49        |
| Duty factor:                      | 1:1         |

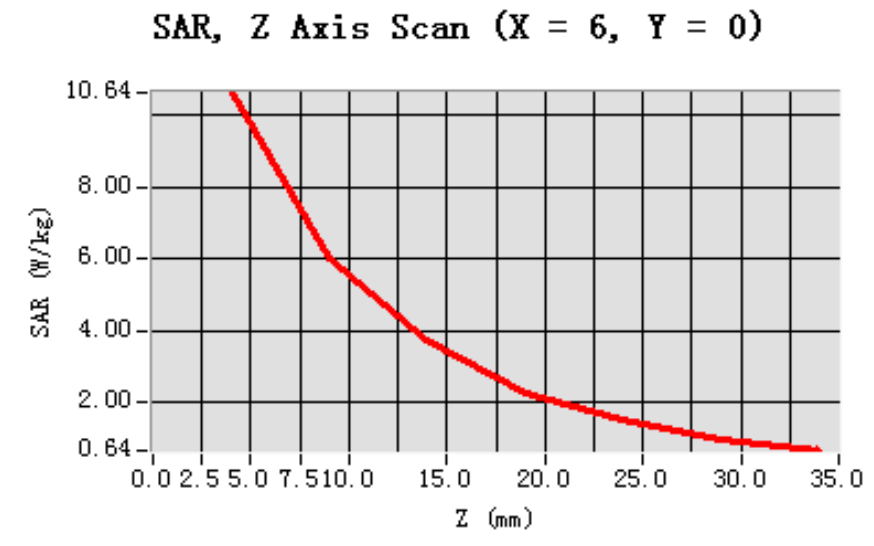


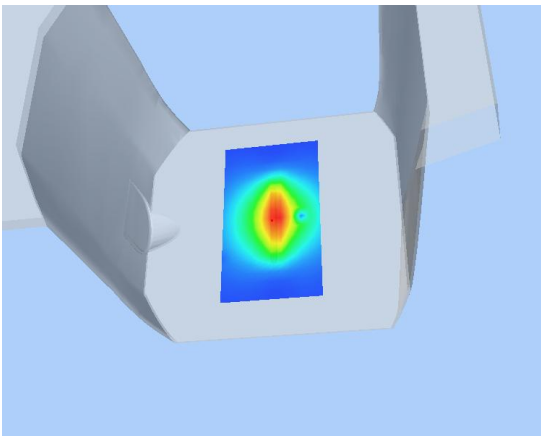
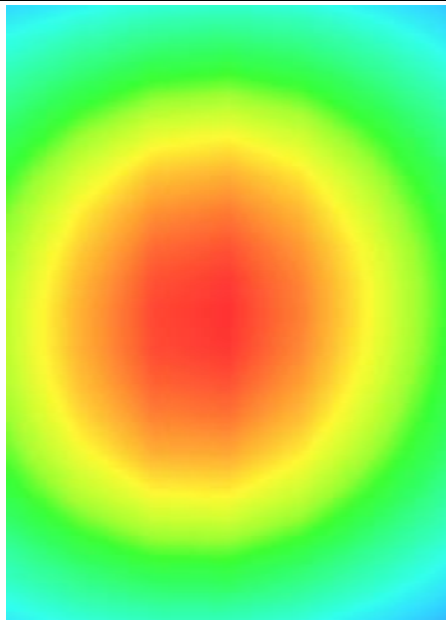
Maximum location: X=6.00, Y=0.00

|                |          |
|----------------|----------|
| SAR 10g (W/Kg) | 5.142873 |
| SAR 1g (W/Kg)  | 9.794237 |

### Z Axis Scan

| Z (mm)     | 0.00   | 4.00    | 9.00   | 14.00  | 19.00  | 24.00  | 29.00  |
|------------|--------|---------|--------|--------|--------|--------|--------|
| SAR (W/Kg) | 0.0000 | 10.6418 | 6.0044 | 3.7296 | 2.2605 | 1.5117 | 0.9790 |



| 3D scene shot                                                                       | Hot spot position                                                                    |
|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
|  |  |

## 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: 24/03/2015

Measurement duration: 13 minutes 12 seconds

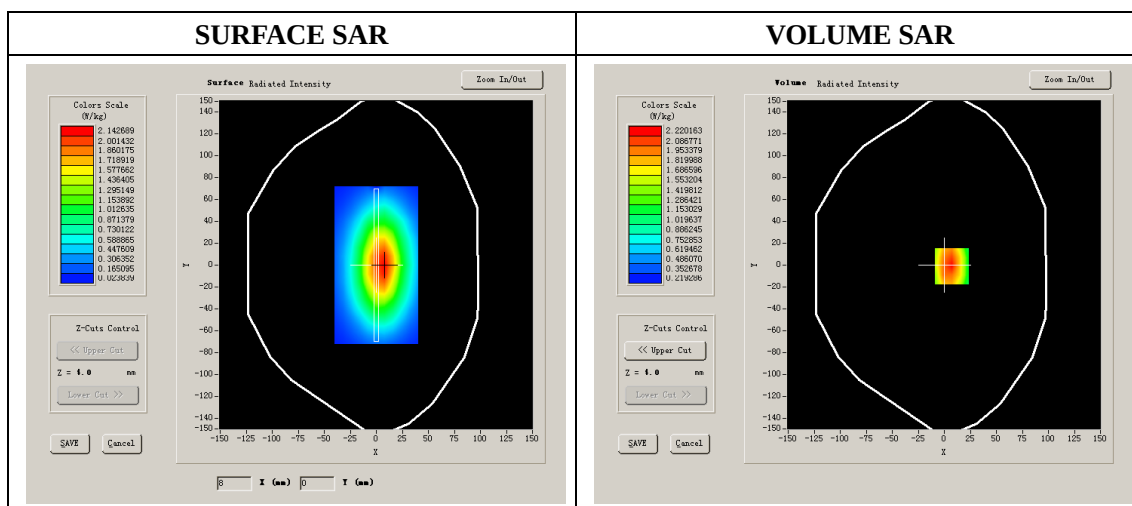
### A. Experimental conditions.

|                 |                   |
|-----------------|-------------------|
| 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) | 55.16      |
| Relative permittivity             | 21.12      |
| Conductivity (S/m)                | 0.98       |
| Power drift (%)                   | -0.270000  |
| Ambient Temperature:              | 23.2 °C    |
| Liquid Temperature:               | 23.5 °C    |
| ConvF:                            | 5.68       |
| Duty factor:                      | 1:1        |



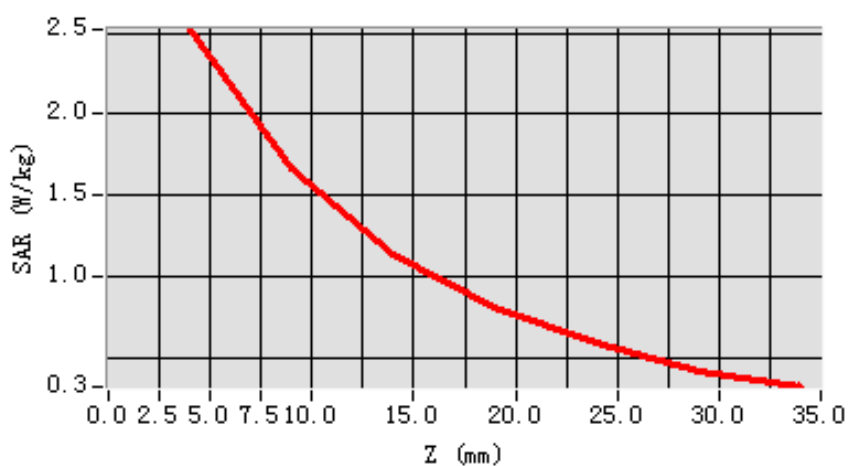
Maximum location: X=7.00, Y=-1.00

|                |          |
|----------------|----------|
| SAR 10g (W/Kg) | 1.735712 |
| SAR 1g (W/Kg)  | 2.463547 |

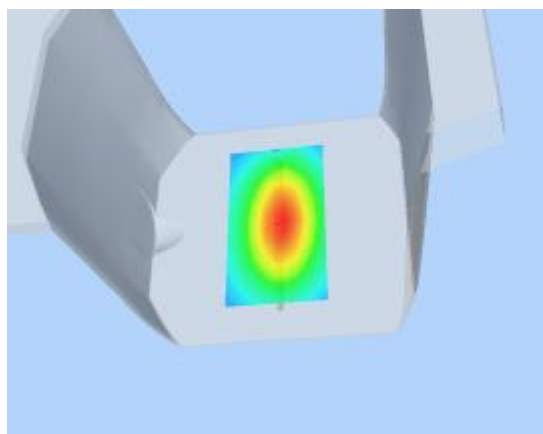
### Z Axis Scan

| Z (mm)     | 0.00   | 4.00   | 9.00   | 14.00  | 19.00  | 24.00  | 29.00  |
|------------|--------|--------|--------|--------|--------|--------|--------|
| SAR (W/Kg) | 0.0000 | 2.5212 | 1.6645 | 1.1443 | 0.8082 | 0.5893 | 0.4148 |

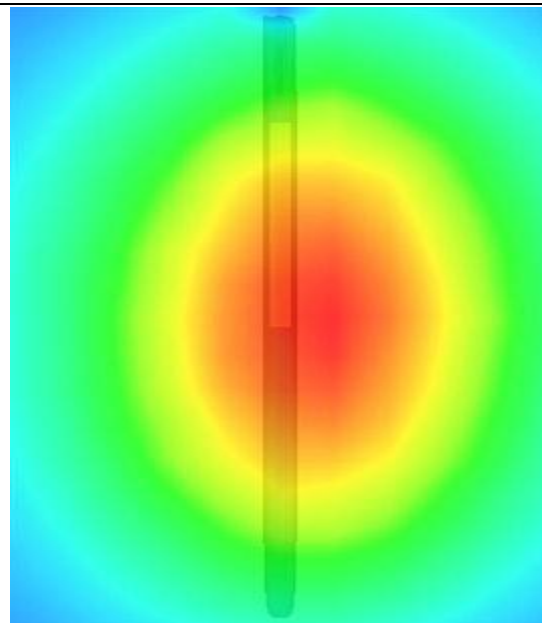
**SAR, Z Axis Scan (X = 7, Y = -1)**



**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: 25/03/2015

Measurement duration: 13 minutes 12 seconds

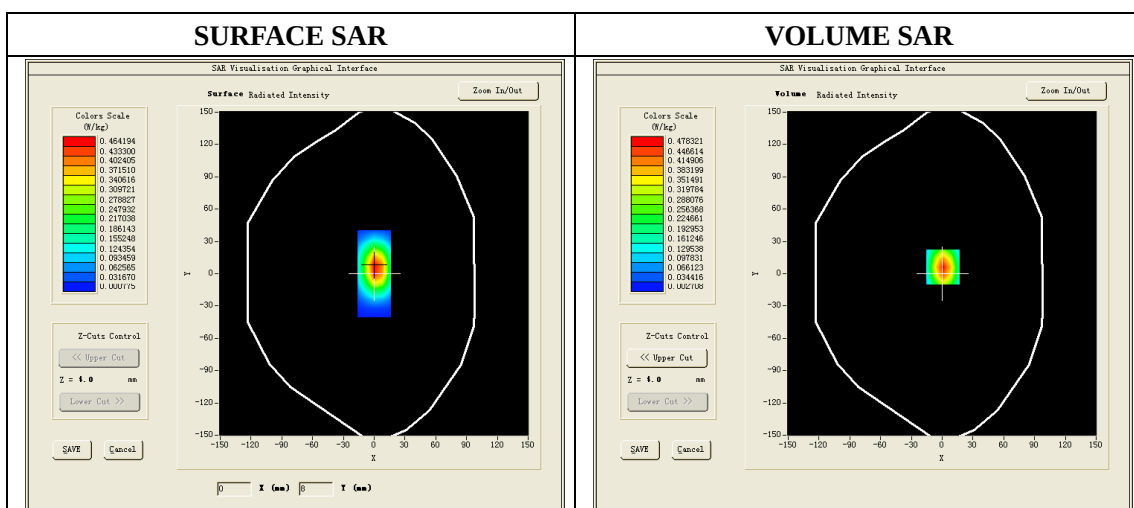
### A. Experimental conditions.

|                 |                   |
|-----------------|-------------------|
| 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) | 53.23       |
| Relative permittivity             | 14.49       |
| Conductivity (S/m)                | 1.53        |
| Power Drift (%)                   | 0.410000    |
| Ambient Temperature:              | 22.0 °C     |
| Liquid Temperature:               | 21.8 °C     |
| ConvF:                            | 5.65        |
| Duty factor:                      | 1:1         |



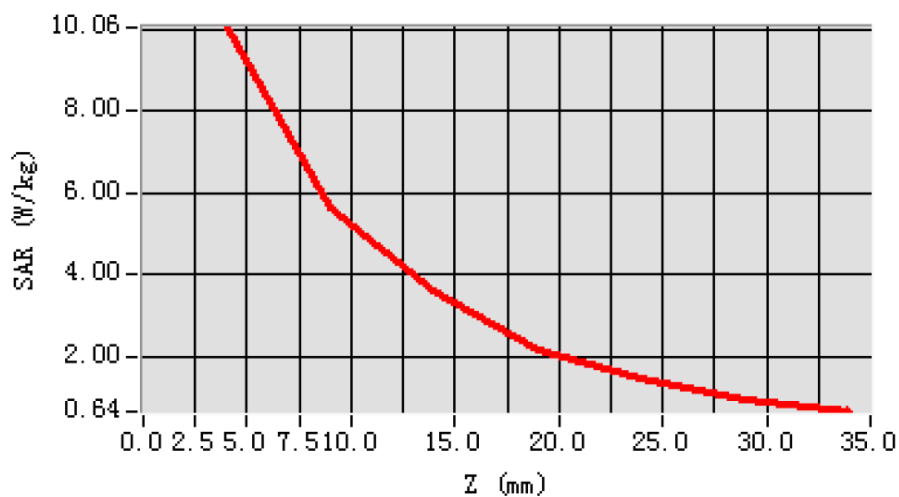
Maximum location: X=1.00, Y=6.00

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

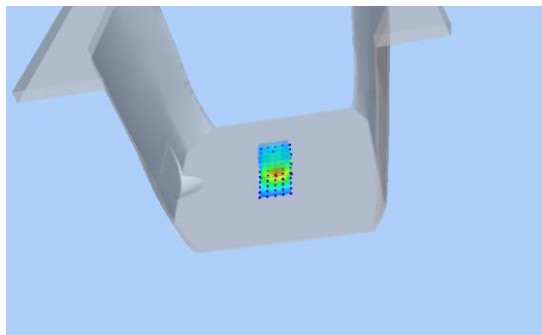
### Z Axis Scan

| 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 |

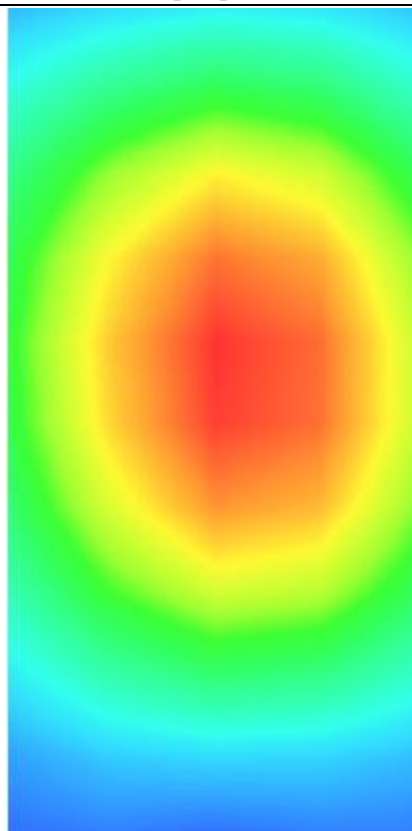
#### SAR, Z Axis Scan (X = 1, Y = 6)



#### 3D scene shot



#### Hot spot position



## GSM850, Left Cheek, Middle

Type: Phone measurement (11 points in the volume)

Date of measurement: 24/03/2015

Measurement duration: 6 minutes 35 seconds

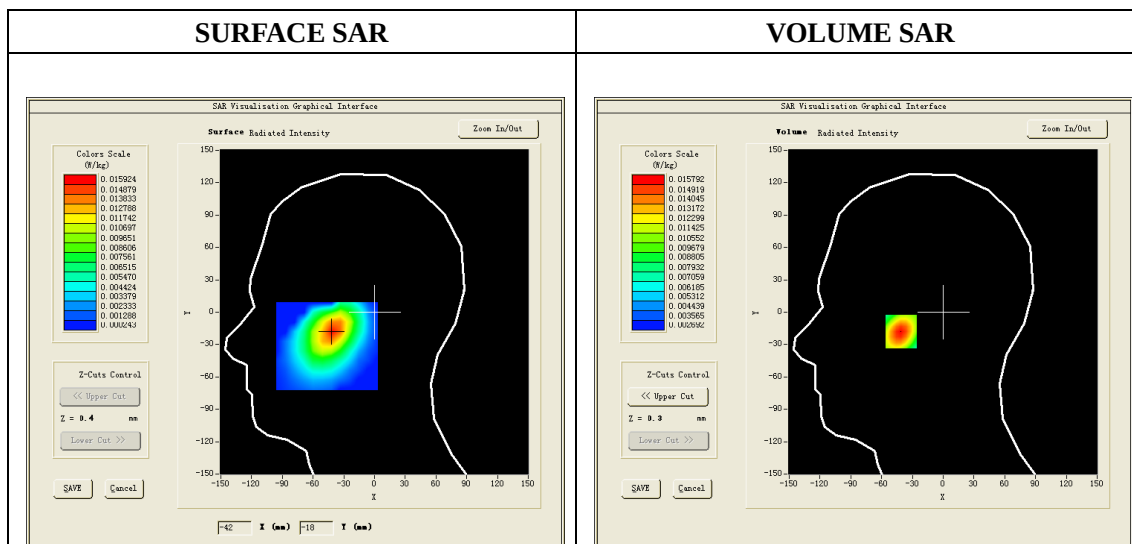
Mobile Phone IMEI number: --

### A. Experimental conditions.

|                 |                               |
|-----------------|-------------------------------|
| Area Scan       | sam_direct_droit2_surf8mm.txt |
| ZoomScan        | 5x5x7,dx=8mm dy=8mm dz=5mm    |
| Phantom         | Left head                     |
| Device Position | Cheek                         |
| Band            | GSM850                        |
| Channels        | 190                           |
| Signal          | GSM (Duty cycle: 1:8)         |

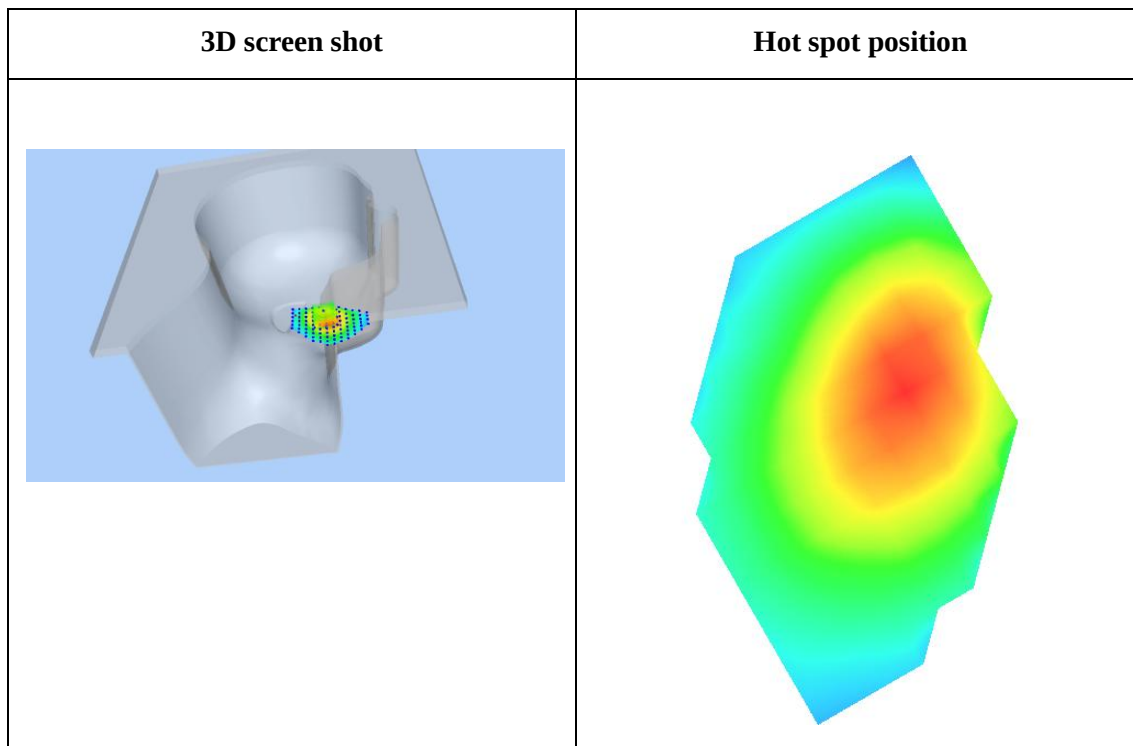
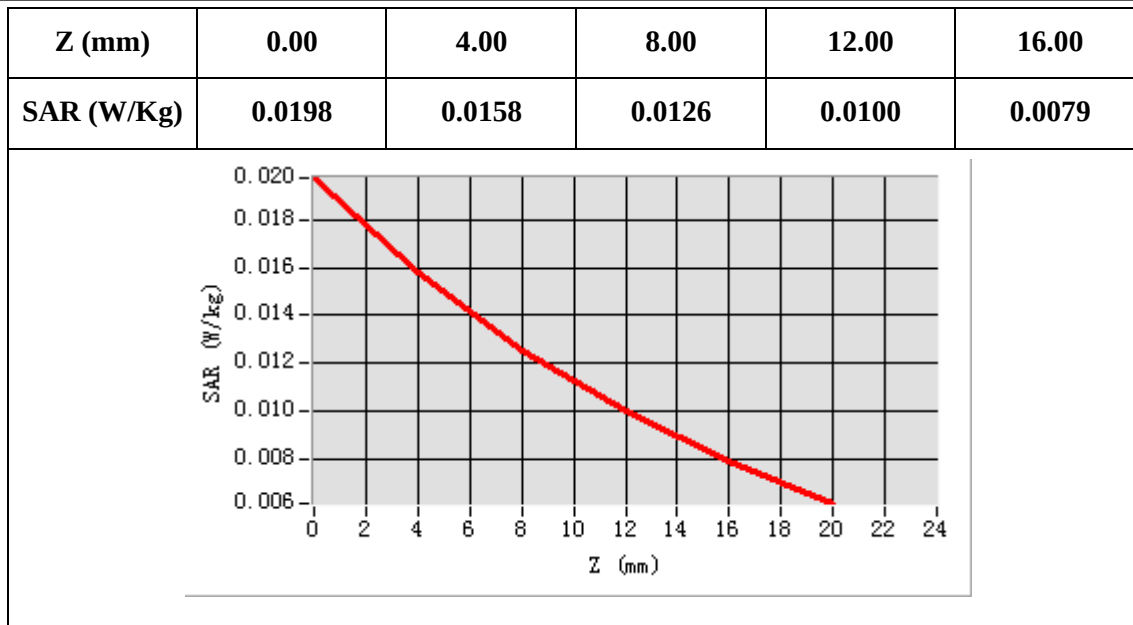
### B. SAR Measurement Results

|                                        |           |
|----------------------------------------|-----------|
| Frequency (MHz)                        | 836.6     |
| Relative permittivity (real part)      | 41.37     |
| Relative permittivity (imaginary part) | 19.62     |
| Conductivity (S/m)                     | 0.91      |
| Variation (%)                          | -1.080000 |
| ConvF:                                 | 5.51      |



Maximum location: X=-41.00, Y=-18.00

|                |          |
|----------------|----------|
| SAR 10g (W/Kg) | 0.010074 |
| SAR 1g (W/Kg)  | 0.014785 |



## GSM850, Back, Middle

Type: Phone measurement (11 points in the volume)

Date of measurement: 24/03/2015

Measurement duration: 7 minutes 32 seconds

Mobile Phone IMEI number: --

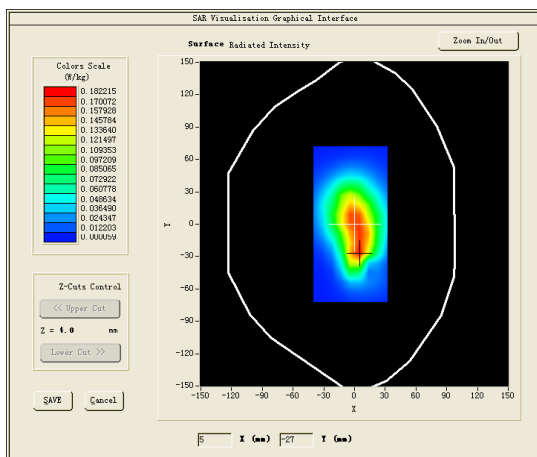
### A. Experimental conditions.

|                 |                            |
|-----------------|----------------------------|
| Area Scan       | surf_sam_plan.txt          |
| ZoomScan        | 5x5x7,dx=8mm dy=8mm dz=5mm |
| Phantom         | Validation plane           |
| Device Position | Back                       |
| Band            | GSM850                     |
| Channels        | 190                        |
| Signal          | GSM(Duty cycle: 1:8)       |

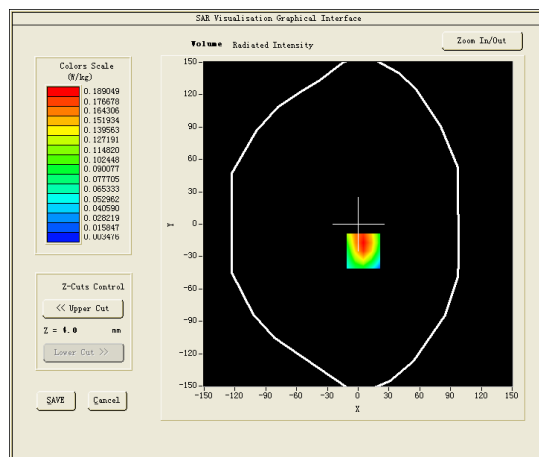
### B. SAR Measurement Results

|                                        |          |
|----------------------------------------|----------|
| Frequency (MHz)                        | 836.6    |
| Relative permittivity (real part)      | 55.16    |
| Relative permittivity (imaginary part) | 21.12    |
| Conductivity (S/m)                     | 0.98     |
| Variation (%)                          | 0.060000 |
| ConvF:                                 | 5.68     |

#### SURFACE SAR



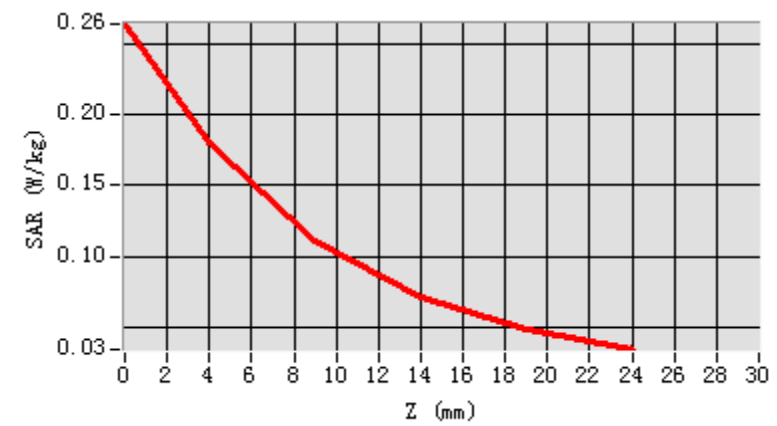
#### VOLUME SAR

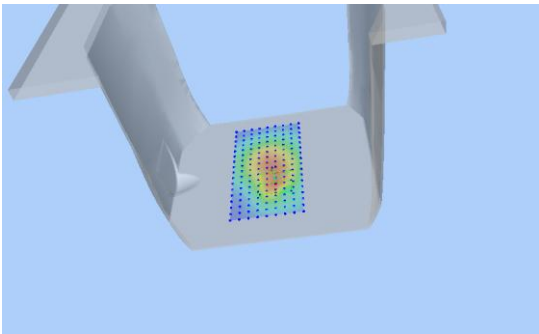
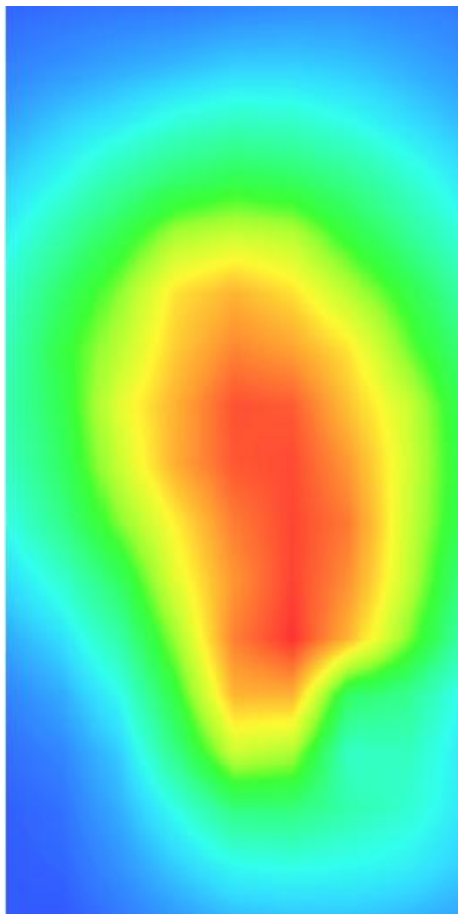


Maximum location: X=5.00, Y=-25.00

|                |          |
|----------------|----------|
| SAR 10g (W/Kg) | 0.110868 |
| SAR 1g (W/Kg)  | 0.186105 |

| Z (mm)     | 0.00   | 4.00   | 9.00   | 14.00  | 19.00  |
|------------|--------|--------|--------|--------|--------|
| SAR (W/Kg) | 0.2636 | 0.1797 | 0.1112 | 0.0713 | 0.0489 |



| 3D screen shot                                                                      | Hot spot position                                                                    |
|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
|  |  |

## GPRS 850, Back, Middle

Type: Phone measurement (11 points in the volume)

Date of measurement: 24/03/2015

Measurement duration: 7 minutes 33 seconds

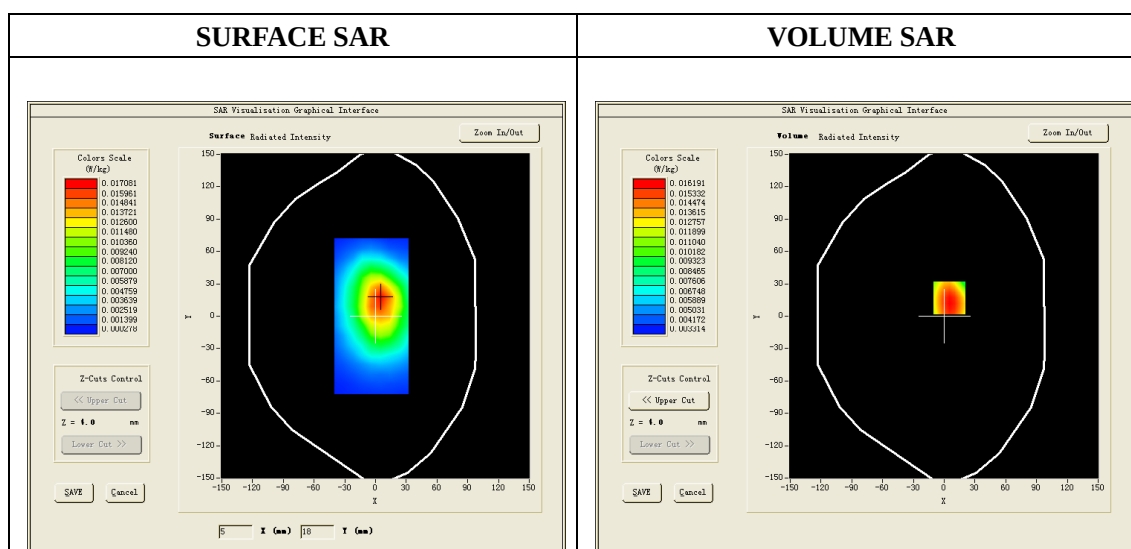
Mobile Phone IMEI number: --

### A. Experimental conditions.

|                 |                            |
|-----------------|----------------------------|
| Area Scan       | surf_sam_plan.txt          |
| ZoomScan        | 5x5x7,dx=8mm dy=8mm dz=5mm |
| Phantom         | Validation plane           |
| Device Position | Back                       |
| Band            | CUSTOM (GPRS850_2Tx)       |
| Channels        | 190                        |
| Signal          | GPRS(Duty cycle: 1:4)      |

### B.SAR Measurement Results

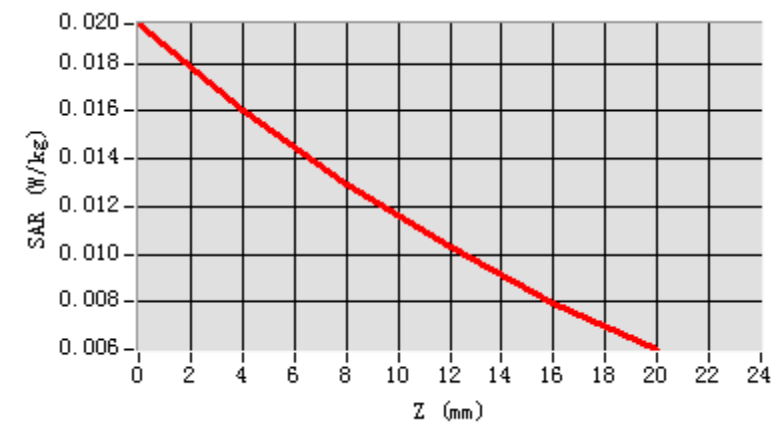
|                                        |          |
|----------------------------------------|----------|
| Frequency (MHz)                        | 836.6    |
| Relative permittivity (real part)      | 55.16    |
| Relative permittivity (imaginary part) | 21.12    |
| Conductivity (S/m)                     | 0.98     |
| Variation (%)                          | 0.870000 |
| ConvF:                                 | 5.68     |

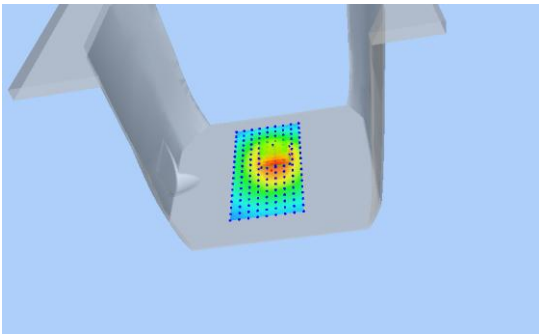
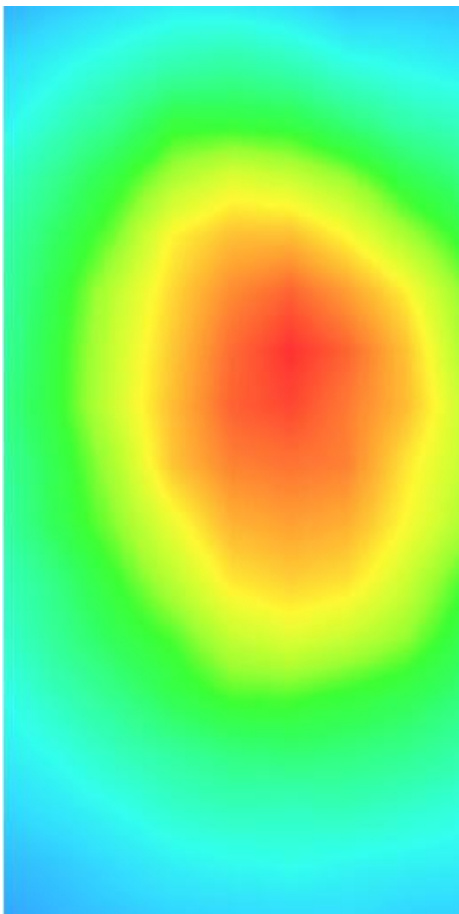


Maximum location: X=5.00, Y=17.00

|                |          |
|----------------|----------|
| SAR 10g (W/Kg) | 0.011413 |
| SAR 1g (W/Kg)  | 0.018191 |

| Z (mm)     | 0.00   | 4.00   | 8.00   | 12.00  | 16.00  |
|------------|--------|--------|--------|--------|--------|
| SAR (W/Kg) | 0.0197 | 0.0161 | 0.0129 | 0.0103 | 0.0080 |



| 3D screen shot                                                                      | Hot spot position                                                                    |
|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
|  |  |

## GSM1900, Right Cheek, Middle

Type: Phone measurement (11 points in the volume)

Date of measurement: 25/03/2015

Measurement duration: 7 minutes 37 seconds

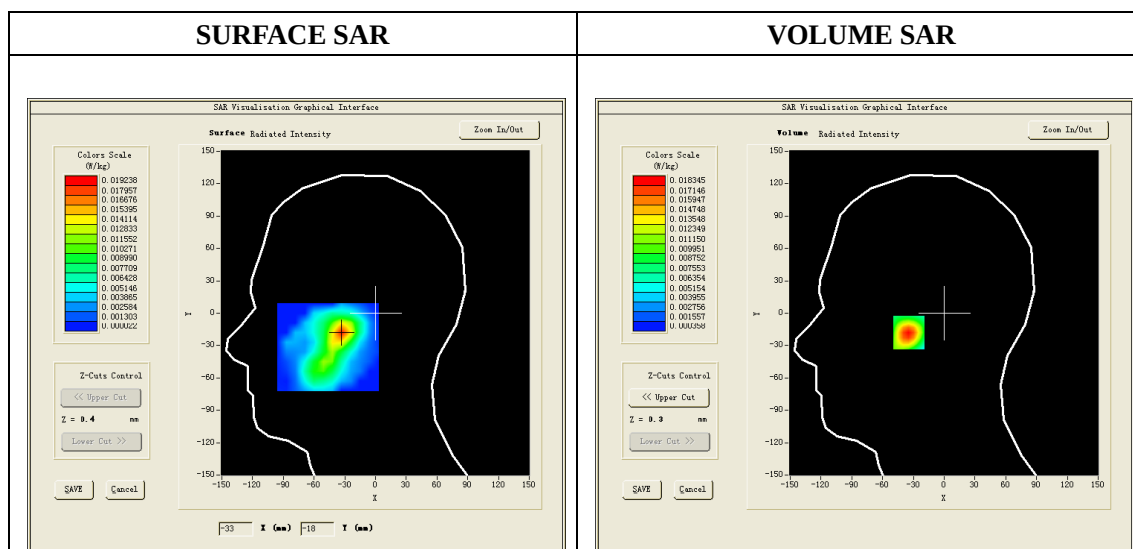
Mobile Phone IMEI number: --

### A. Experimental conditions.

|                 |                               |
|-----------------|-------------------------------|
| Area Scan       | sam_direct_droit2_surf8mm.txt |
| ZoomScan        | 5x5x7,dx=8mm dy=8mm dz=5mm    |
| Phantom         | Right head                    |
| Device Position | Cheek                         |
| Band            | GSM1900                       |
| Channels        | 661                           |
| Signal          | GSM (Duty cycle: 1:8)         |

### B.SAR Measurement Results

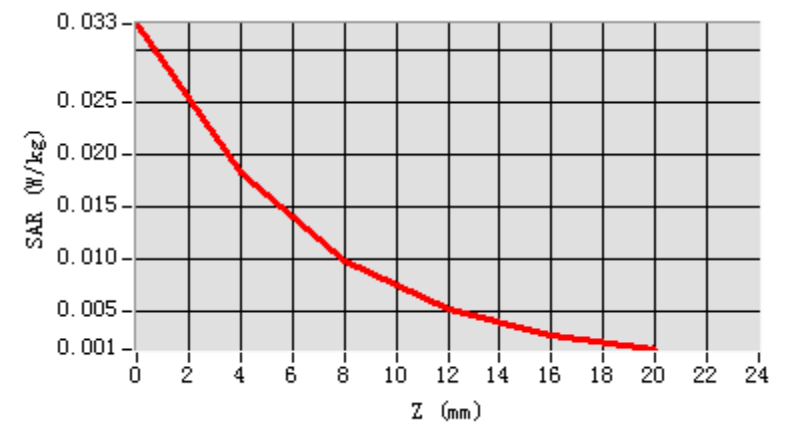
|                                        |           |
|----------------------------------------|-----------|
| Frequency (MHz)                        | 1880      |
| Relative permittivity (real part)      | 39.87     |
| Relative permittivity (imaginary part) | 13.36     |
| Conductivity (S/m)                     | 1.41      |
| Variation (%)                          | -4.530000 |
| ConvF:                                 | 5.49      |

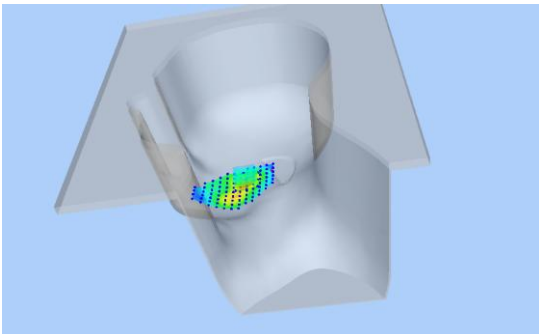
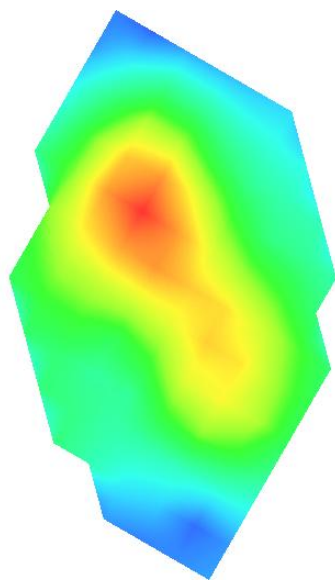


Maximum location: X=-33.00, Y=-18.00

|                |          |
|----------------|----------|
| SAR 10g (W/Kg) | 0.008024 |
| SAR 1g (W/Kg)  | 0.016806 |

| Z (mm)     | 0.00   | 4.00   | 8.00   | 12.00  | 16.00  |
|------------|--------|--------|--------|--------|--------|
| SAR (W/Kg) | 0.0325 | 0.0183 | 0.0099 | 0.0053 | 0.0028 |



| 3D screen shot                                                                      | Hot spot position                                                                    |
|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
|  |  |

## GSM1900, Back, Middle

Type: Phone measurement (11 points in the volume)

Date of measurement: 25/03/2015

Measurement duration: 6 minutes 52 seconds

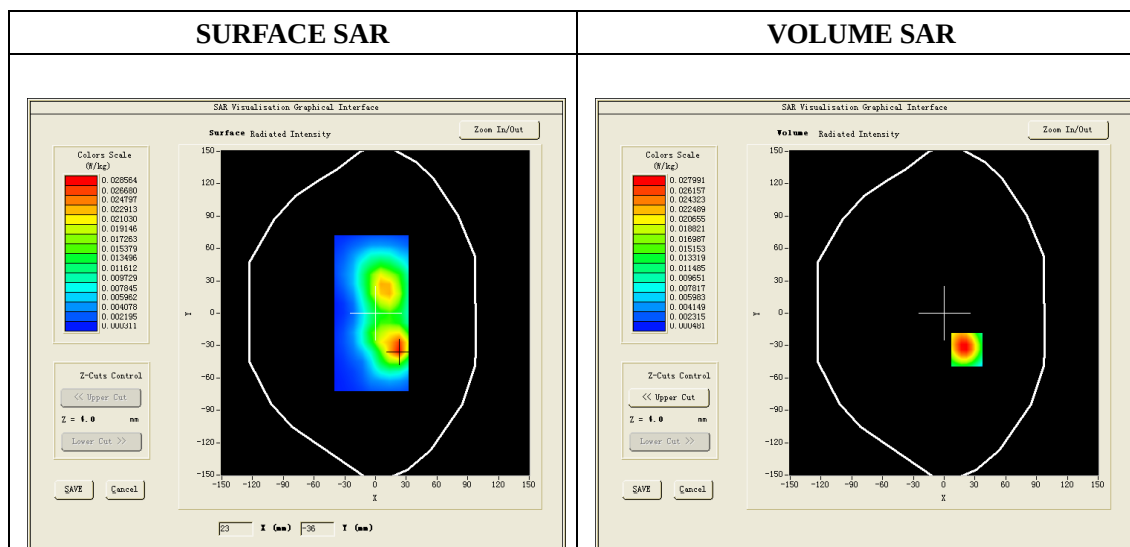
Mobile Phone IMEI number: --

### A. Experimental conditions.

|                 |                            |
|-----------------|----------------------------|
| Area Scan       | dx=8mm dy=8mm              |
| ZoomScan        | 5x5x7,dx=8mm dy=8mm dz=5mm |
| Phantom         | Validation plane           |
| Device Position | Back                       |
| Band            | GSM1900                    |
| Channels        | 661                        |
| Signal          | GSM (Duty cycle: 1:8)      |

### B. SAR Measurement Results

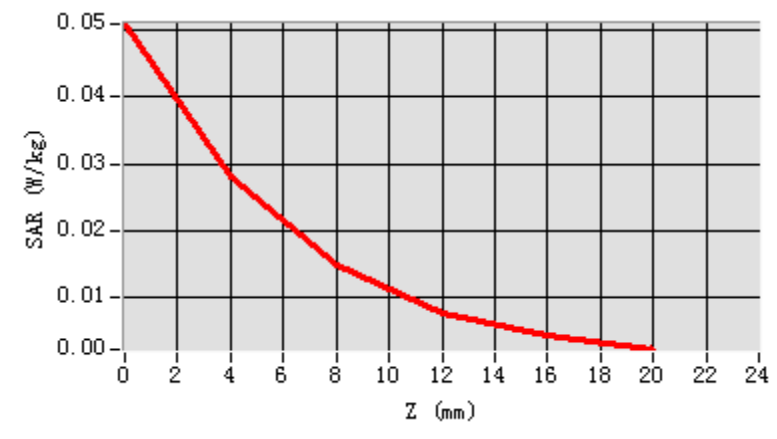
|                                        |           |
|----------------------------------------|-----------|
| Frequency (MHz)                        | 1880.0    |
| Relative permittivity (real part)      | 53.23     |
| Relative permittivity (imaginary part) | 14.49     |
| Conductivity (S/m)                     | 1.53      |
| Variation (%)                          | -2.960000 |
| ConvF:                                 | 5.65      |

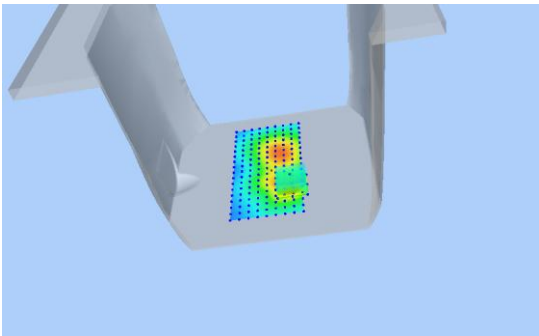
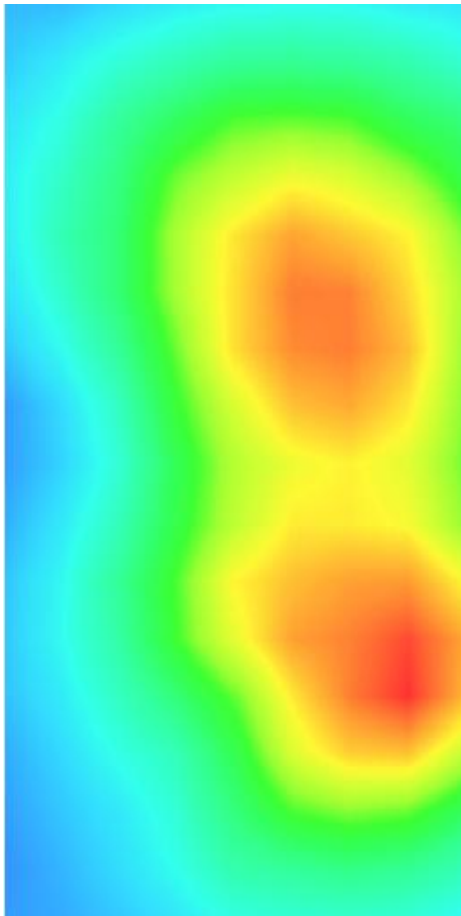


Maximum location: X=22.00, Y=-34.00

|                |          |
|----------------|----------|
| SAR 10g (W/Kg) | 0.013194 |
| SAR 1g (W/Kg)  | 0.026988 |

| Z (mm)     | 0.00   | 4.00   | 8.00   | 12.00  | 16.00  |
|------------|--------|--------|--------|--------|--------|
| SAR (W/Kg) | 0.0510 | 0.0280 | 0.0147 | 0.0077 | 0.0042 |



| 3D screen shot                                                                      | Hot spot position                                                                    |
|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
|  |  |



# GPRS1900, BACK, Middle

Type: Phone measurement ( 11 points in the volume)

Date of measurement: 25/03/2015

Measurement duration: 7 minutes 24 seconds

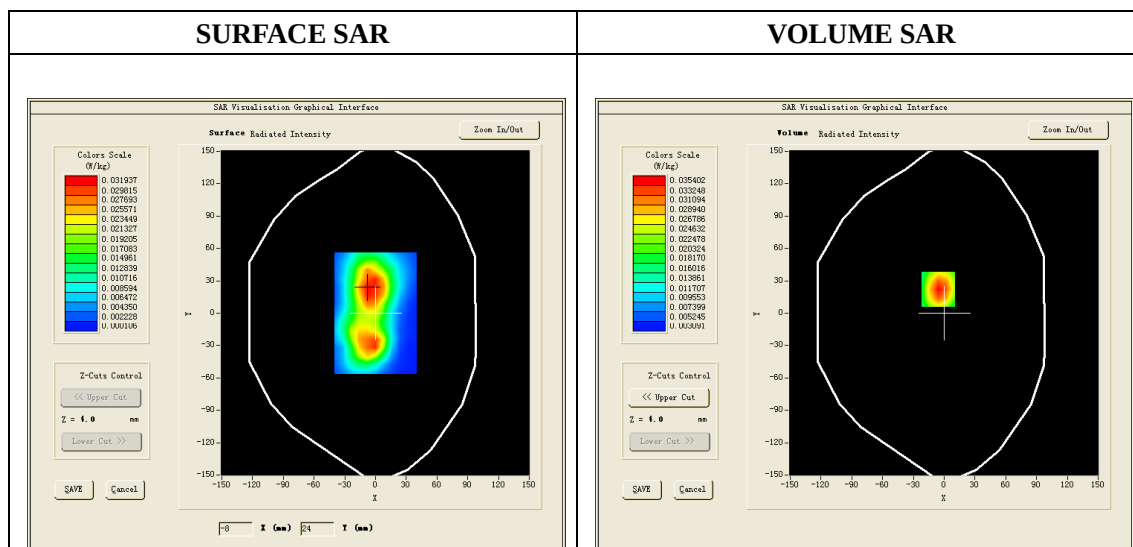
Mobile Phone IMEI number: --

## A. Experimental conditions.

|                 |                            |
|-----------------|----------------------------|
| Area Scan       | surf_sam_plan.txt          |
| ZoomScan        | 5x5x7,dx=8mm dy=8mm dz=5mm |
| Phantom         | Validation plane           |
| Device Position | Body                       |
| Band            | CUSTOM (GPRS1900_2Tx)      |
| Channels        | 661                        |
| Signal          | GPRS (Duty cycle: 1:4)     |

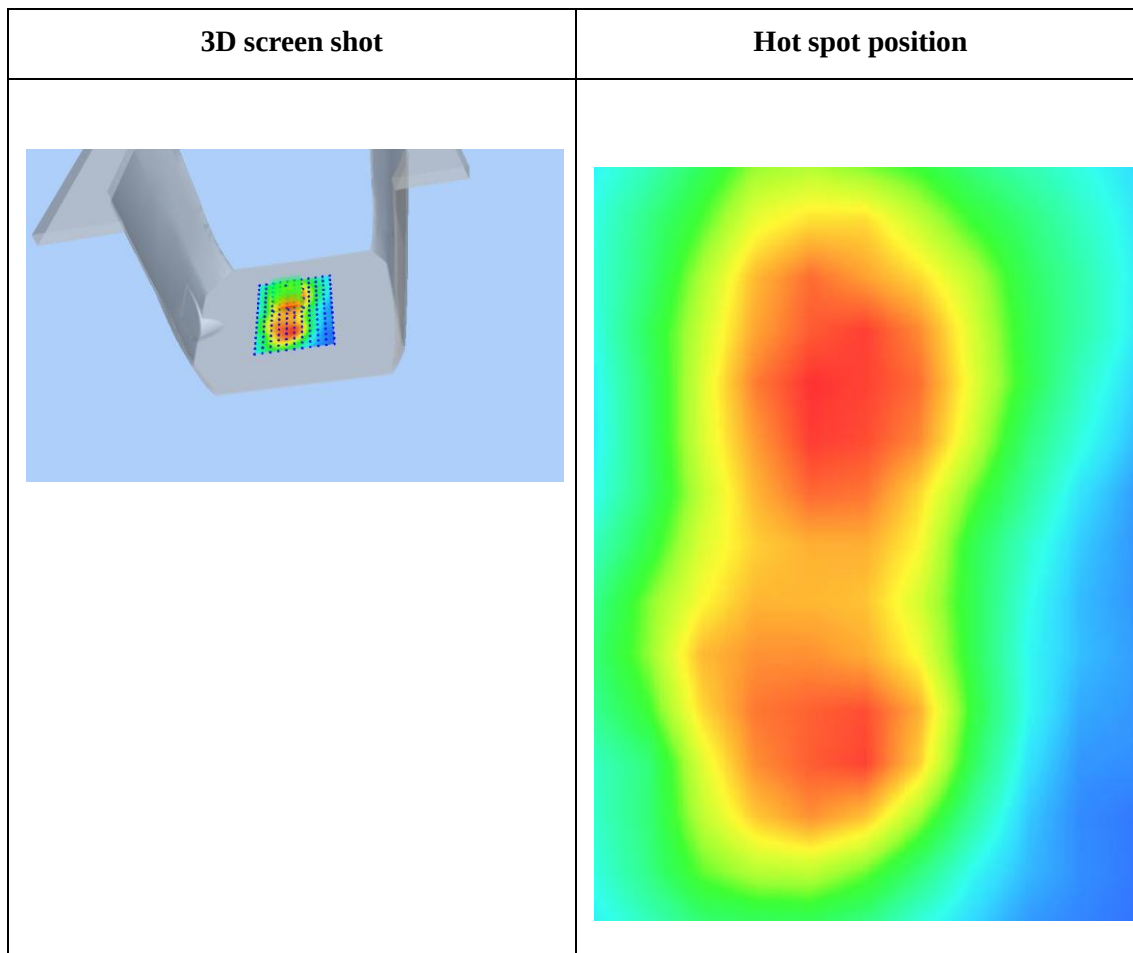
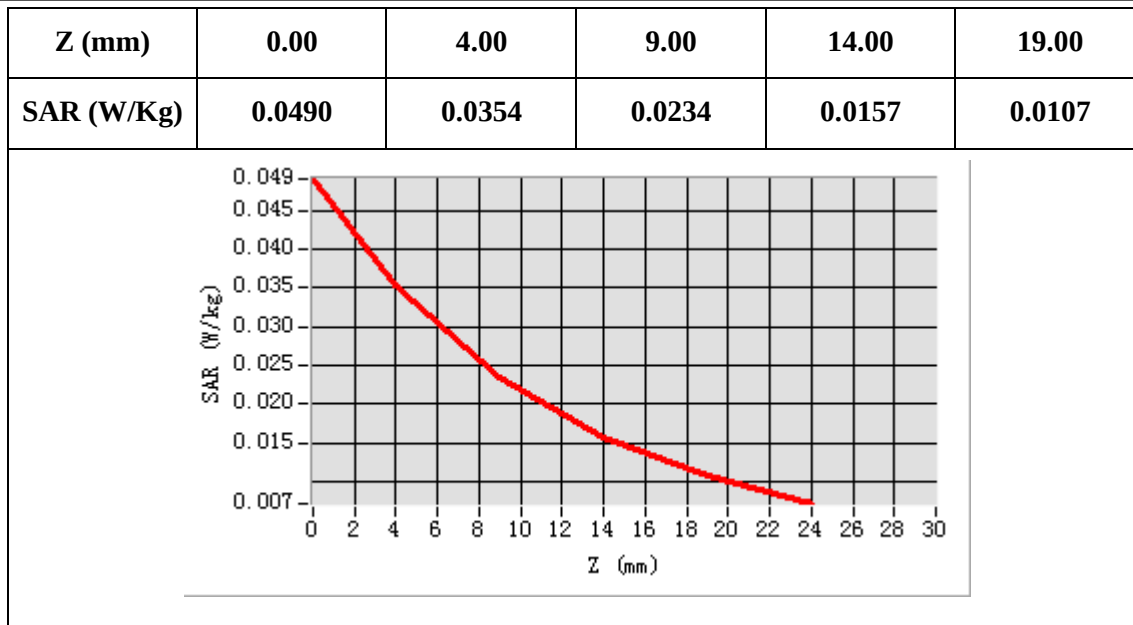
## B. SAR Measurement Results

|                                        |           |
|----------------------------------------|-----------|
| Frequency (MHz)                        | 1880.0    |
| Relative permittivity (real part)      | 53.23     |
| Relative permittivity (imaginary part) | 14.49     |
| Conductivity (S/m)                     | 1.53      |
| Variation (%)                          | -0.300000 |
| ConvF:                                 | 5.65      |



Maximum location: X=-6.00, Y=22.00

|                |          |
|----------------|----------|
| SAR 10g (W/Kg) | 0.020921 |
| SAR 1g (W/Kg)  | 0.034235 |





**ANNEX E**

**of**

**CCIC-SET**

**CONFORMANCE TEST REPORT FOR**

**HUMAN EXPOSURE TO ELECTROMAGNETIC FIELDS**

**SET2015-04152**

**GSM digital mobile phone**

**Type Name: M220**

**Hardware Version: M721C\_FS\_MB\_V0.1**

**Software Version: M721C\_LD\_SINGLE\_CARD\_F08\_WNRL\_V003\_20150312**

**Calibration Certificate of Probe and Dipoles**

**This Annex consists of 45 pages**

**Date of Report: 2015-04-08**

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

Ref : ACR.96.2.14.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 09/13 EP169

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



04/05/14

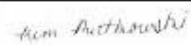
**Summary:**

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.96.2.14.SATU.A

|               | Name          | Function        | Date       | Signature                                                                           |
|---------------|---------------|-----------------|------------|-------------------------------------------------------------------------------------|
| Prepared by : | Jérôme LUC    | Product Manager | 04/05/2014 |  |
| Checked by :  | Jérôme LUC    | Product Manager | 04/05/2014 |  |
| Approved by : | Kim RUTKOWSKI | Quality Manager | 04/08/2014 |  |

|                | Customer Name                                                         |
|----------------|-----------------------------------------------------------------------|
| Distribution : | CCIC Southern<br>Electronic Product<br>Testing (Shenzhen)<br>Co., Ltd |

| Issue | Date       | Modifications   |
|-------|------------|-----------------|
| A     | 04/08/2014 | Initial release |
|       |            |                 |
|       |            |                 |
|       |            |                 |

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## COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR-96.2.14.SATUA

### 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<br>Dipole 2: R2=0.233 MΩ<br>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.

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## COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.96.2.14.SATU.A

### 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  | 1.733%                   |
| Reflected power                                            | 3.00%                 | Rectangular              | $\sqrt{3}$ | 1  | 1.733%                   |
| Liquid conductivity                                        | 5.00%                 | Rectangular              | $\sqrt{3}$ | 1  | 2.886%                   |
| Liquid permittivity                                        | 4.00%                 | Rectangular              | $\sqrt{3}$ | 1  | 2.310%                   |
| Field homogeneity                                          | 3.00%                 | Rectangular              | $\sqrt{3}$ | 1  | 1.733%                   |
| Field probe positioning                                    | 5.00%                 | Rectangular              | $\sqrt{3}$ | 1  | 2.886%                   |
| Field probe linearity                                      | 3.00%                 | Rectangular              | $\sqrt{3}$ | 1  | 1.733%                   |

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# COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.96.2.14.SATU.A

|                                                     |  |  |  |  |        |
|-----------------------------------------------------|--|--|--|--|--------|
| Combined standard uncertainty                       |  |  |  |  | 5.832% |
| Expanded uncertainty<br>95 % confidence level k = 2 |  |  |  |  | 12.1%  |

## 5 CALIBRATION MEASUREMENT RESULTS

| Calibration Parameters |       |
|------------------------|-------|
| Liquid Temperature     | 23 °C |
| Lab Temperature        | 23 °C |
| Lab Humidity           | 58 %  |

### 5.1 SENSITIVITY IN AIR

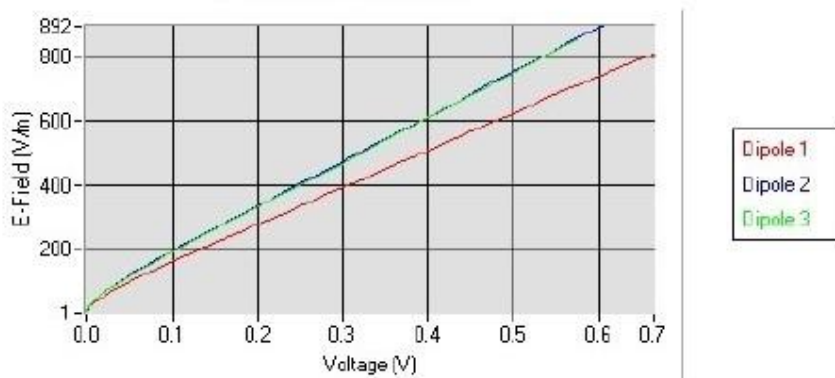
| Normx dipole<br>1 ( $\mu\text{V}/(\text{V}/\text{m})^2$ ) | Normy dipole<br>2 ( $\mu\text{V}/(\text{V}/\text{m})^2$ ) | Normz dipole<br>3 ( $\mu\text{V}/(\text{V}/\text{m})^2$ ) |
|-----------------------------------------------------------|-----------------------------------------------------------|-----------------------------------------------------------|
| 7.23                                                      | 6.10                                                      | 5.74                                                      |

| DCP dipole 1<br>(mV) | DCP dipole 2<br>(mV) | DCP dipole 3<br>(mV) |
|----------------------|----------------------|----------------------|
| 93.2                 | 93.1                 | 90.2                 |

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

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

Calibration curves



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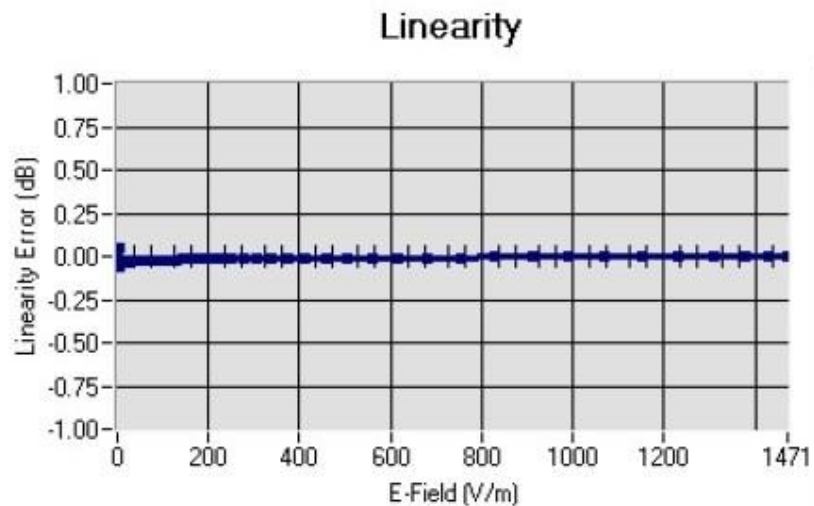
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## COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.96.2.14.SATU.A

### 5.2 LINEARITY



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

### 5.3 SENSITIVITY IN LIQUID

| Liquid | Frequency<br>(MHz $\pm$ 100MHz) | Permittivity | Epsilon (S/m) | ConvF |
|--------|---------------------------------|--------------|---------------|-------|
| HL850  | 835                             | 42.56        | 0.87          | 5.51  |
| BL850  | 835                             | 55.26        | 0.97          | 5.68  |
| HL900  | 900                             | 41.79        | 0.97          | 5.20  |
| BL900  | 900                             | 55.98        | 1.05          | 5.33  |
| HL1800 | 1750                            | 40.17        | 1.39          | 4.80  |
| BL1800 | 1750                            | 52.05        | 1.49          | 4.94  |
| HL1900 | 1880                            | 39.80        | 1.45          | 5.49  |
| BL1900 | 1880                            | 52.55        | 1.52          | 5.65  |
| HL2000 | 1950                            | 38.93        | 1.42          | 4.80  |
| BL2000 | 1950                            | 53.12        | 1.50          | 5.02  |
| HL2450 | 2450                            | 38.64        | 1.83          | 4.81  |
| BL2450 | 2450                            | 52.02        | 1.95          | 4.91  |

LOWER DETECTION LIMIT: 9mW/kg

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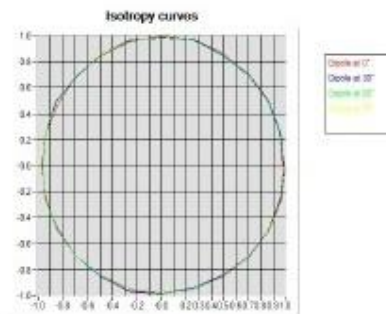
## COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.96.2.14.SATU.A

### 5.4 ISOTROPY

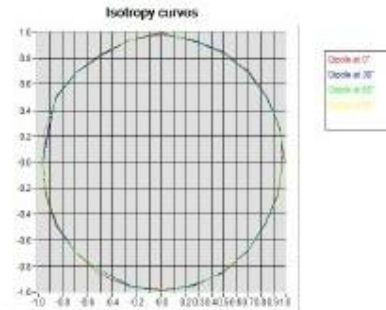
#### HL900 MHz

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



#### HL1800 MHz

- Axial isotropy: 0.05 dB
- Hemispherical isotropy: 0.06 dB



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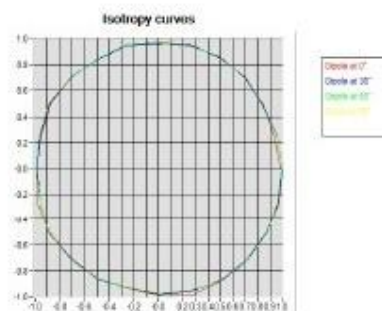


# COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR-96.2.14.SATU.A

## HL2450 MHz

- Axial isotropy: 0.07 dB  
- Hemispherical isotropy: 0.08 dB



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## COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.96.2.14.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            | 11/2013                                       | 11/2016                                       |
| 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         | 11/2013                                       | 11/2016                                       |
| Power Sensor                  | HP ECP-E26A          | US37181460         | 11/2013                                       | 11/2016                                       |
| 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           | 3/2014                                        | 3/2016                                        |

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

Ref : ACR.240.1.14.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 REFERENCE DIPOLE**  
FREQUENCY: 835 MHZ  
SERIAL NO.: SN 09/13 DIP0G835-217

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



08/28/14

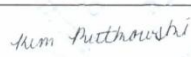
*Summary:*

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.240.1.14.SATU.A

|               | Name          | Function        | Date      | Signature                                                                           |
|---------------|---------------|-----------------|-----------|-------------------------------------------------------------------------------------|
| Prepared by : | Jérôme LUC    | Product Manager | 8/29/2014 |  |
| Checked by :  | Jérôme LUC    | Product Manager | 8/29/2014 |  |
| Approved by : | Kim RUTKOWSKI | Quality Manager | 8/29/2014 |  |

|                | Customer Name                                                               |
|----------------|-----------------------------------------------------------------------------|
| Distribution : | CCIC SOUTHERN<br>ELECTRONIC<br>PRODUCT<br>TESTING<br>(SHENZHEN) Co.,<br>Ltd |

| Issue | Date      | Modifications   |
|-------|-----------|-----------------|
| A     | 8/29/2014 | Initial release |
|       |           |                 |
|       |           |                 |
|       |           |                 |



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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) | used                             |

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**

#### 4 MEASUREMENT METHOD

The IEEE 1528, OET 65 Bulletin C and CEI/IEC 62209 standards provide requirements for reference dipoles used for system validation measurements. The following measurements were performed to verify that the product complies with the fore mentioned standards.

##### 4.1 RETURN LOSS REQUIREMENTS

The dipole used for SAR system validation measurements and checks must have a return loss of -20 dB or better. The return loss measurement shall be performed against a liquid filled flat phantom, with the phantom constructed as outlined in the fore mentioned standards.

##### 4.2 MECHANICAL REQUIREMENTS

The IEEE Std. 1528 and CEI/IEC 62209 standards specify the mechanical components and dimensions of the validation dipoles, with the dimensions frequency and phantom shell thickness dependent. The COMOSAR test bench employs a 2 mm phantom shell thickness therefore the dipoles sold for use with the COMOSAR test bench comply with the requirements set forth for a 2 mm phantom shell thickness.

#### 5 MEASUREMENT UNCERTAINTY

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.

##### 5.1 RETURN LOSS

The following uncertainties apply to the return loss measurement:

| Frequency band | Expanded Uncertainty on Return Loss |
|----------------|-------------------------------------|
| 400-6000MHz    | 0.1 dB                              |

##### 5.2 DIMENSION MEASUREMENT

The following uncertainties apply to the dimension measurements:

| Length (mm) | Expanded Uncertainty on Length |
|-------------|--------------------------------|
| 3 - 300     | 0.05 mm                        |

##### 5.3 VALIDATION MEASUREMENT

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 for validation measurements.

| Scan Volume | Expanded Uncertainty |
|-------------|----------------------|
| 1 g         | 20.3 %               |
| 10 g        | 20.1 %               |

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