

# WCDMA1900, BACK, Middle

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

Date of measurement: 28/11/2014

Measurement duration: 7 minutes 37 seconds

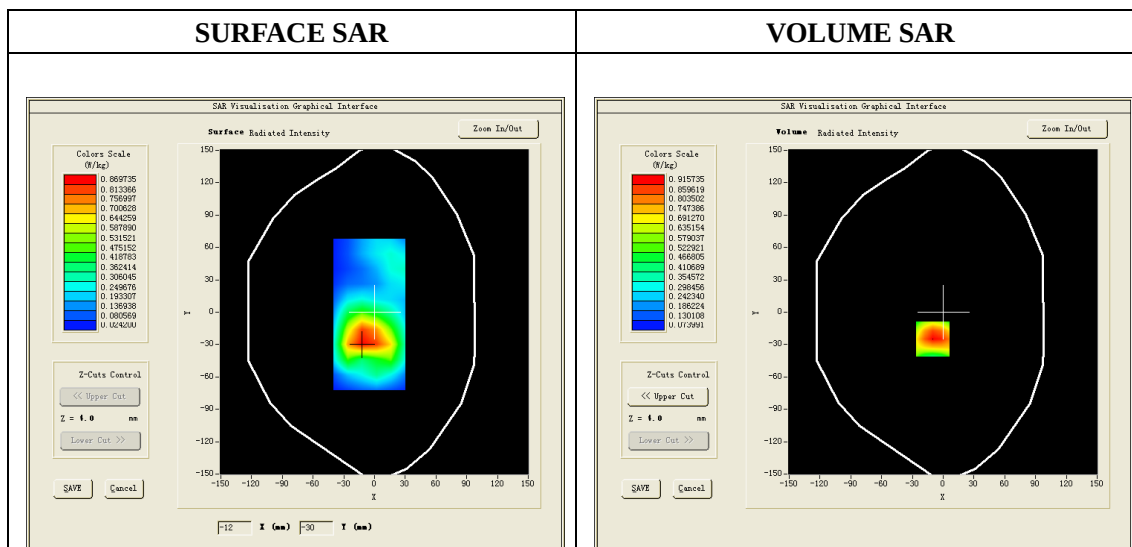
Mobile Phone IMEI number: --

## A. Experimental conditions.

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

## B. SAR Measurement Results

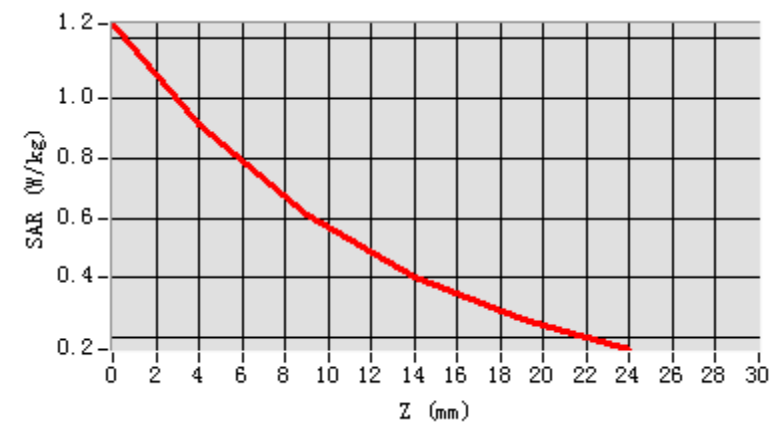
|                                   |           |
|-----------------------------------|-----------|
| Frequency (MHz)                   | 1880.0    |
| Relative permittivity (real part) | 53.28     |
| Relative permittivity (imaginary) | 12.99     |
| Conductivity (S/m)                | 1.53      |
| Variation (%)                     | -0.650000 |
| ConvF:                            | 5.65      |

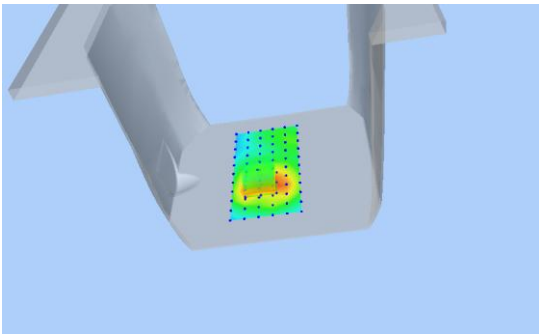
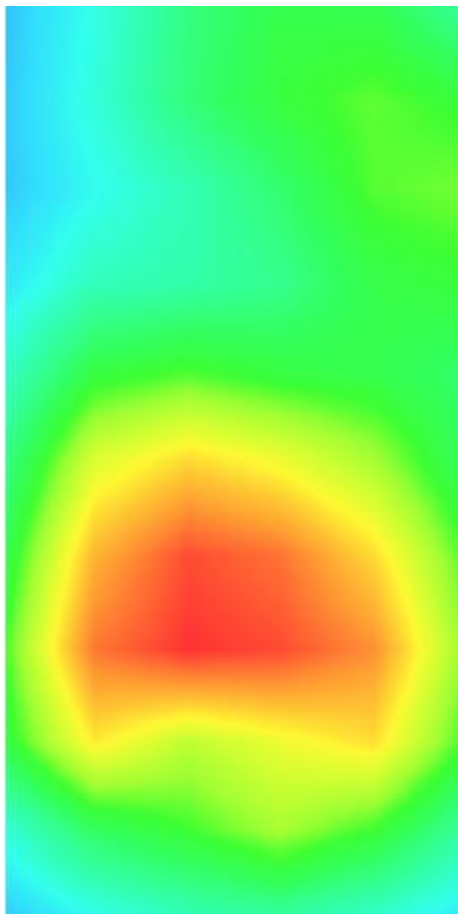


Maximum location: X=-10.00, Y=-25.00

|                |          |
|----------------|----------|
| SAR 10g (W/Kg) | 0.564718 |
| SAR 1g (W/Kg)  | 0.919290 |

| Z (mm)     | 0.00   | 4.00   | 9.00   | 14.00  | 19.00  |
|------------|--------|--------|--------|--------|--------|
| SAR (W/Kg) | 1.2497 | 0.9157 | 0.6105 | 0.4018 | 0.2605 |



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

# Wi-Fi 802.11b ,Right Cheek, High

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

Date of measurement: 27/11/2014

Measurement duration: 7 minutes 21 seconds

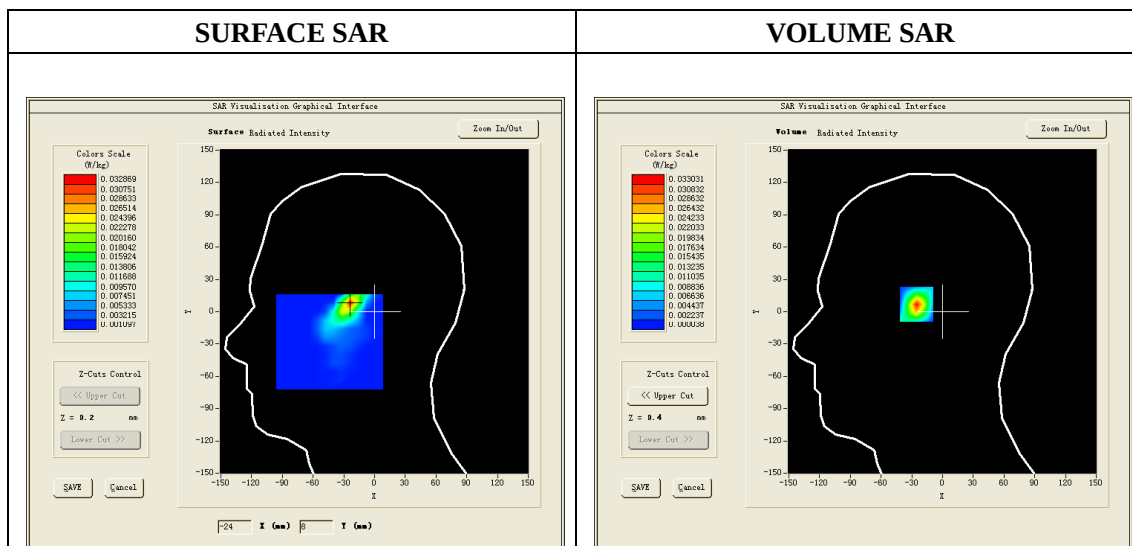
Mobile Phone IMEI number: --

## A. Experimental conditions.

|                 |                                      |
|-----------------|--------------------------------------|
| Area Scan       | dx=8mm dy=8mm                        |
| ZoomScan        | 5x5x7,dx=8mm dy=8mm dz=5mm,Very fast |
| Phantom         | Right head                           |
| Device Position | Cheek                                |
| Band            | IEEE 802.11b ISM                     |
| Channels        | 11                                   |
| Signal          | DSSS (Crest factor: 1:1)             |

## B. SAR Measurement Results

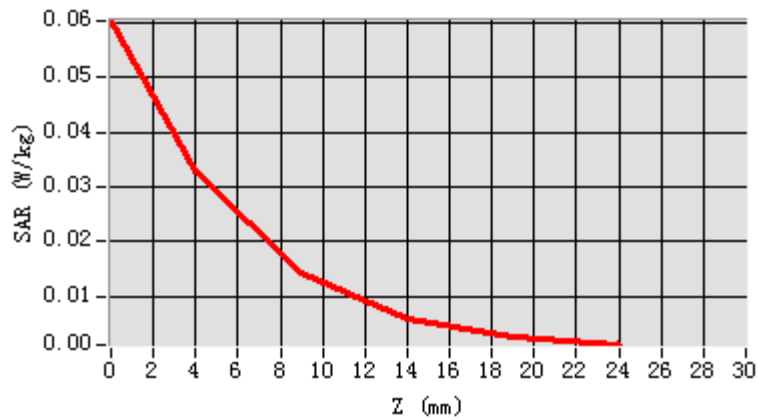
|                                        |          |
|----------------------------------------|----------|
| Frequency (MHz)                        | 2462     |
| Relative permittivity (real part)      | 38.99    |
| Relative permittivity (imaginary part) | 13.19    |
| Conductivity (S/m)                     | 1.81     |
| Variation (%)                          | 1.350000 |
| ConvF:                                 | 4.81     |



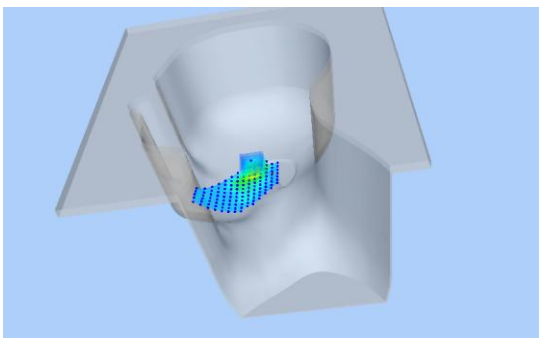
Maximum location: X=-24.00, Y=8.00

|                |          |
|----------------|----------|
| SAR 10g (W/Kg) | 0.017542 |
| SAR 1g (W/Kg)  | 0.032421 |

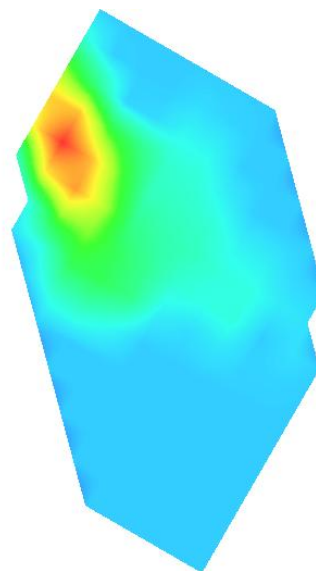
### Z axis scan



### 3D screen shot



### Hot spot position



## Wi-Fi 802.11b , Back, Middle

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

Date of measurement: 28/11/2014

Measurement duration: 7 minutes 11 seconds

Mobile Phone IMEI number: --

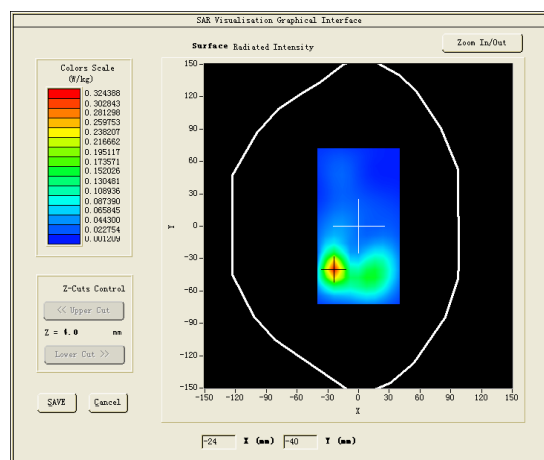
### A. Experimental conditions.

|                 |                                      |
|-----------------|--------------------------------------|
| Area Scan       | dx=8mm dy=8mm                        |
| ZoomScan        | 5x5x7,dx=8mm dy=8mm dz=5mm,Very fast |
| Phantom         | Validation plane                     |
| Device Position | Back                                 |
| Band            | IEEE 802.11b ISM                     |
| Channels        | 11                                   |
| Signal          | DSSS (Crest factor: 1:1)             |

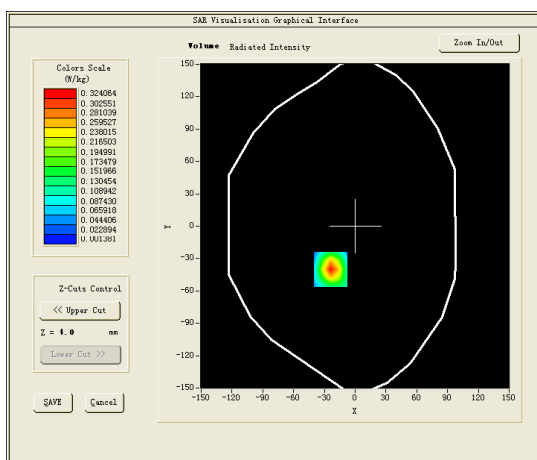
### B. SAR Measurement Results

|                                        |          |
|----------------------------------------|----------|
| Frequency (MHz)                        | 2462     |
| Relative permittivity (real part)      | 52.65    |
| Relative permittivity (imaginary part) | 13.02    |
| Conductivity (S/m)                     | 1.96     |
| Variation (%)                          | 3.010000 |
| ConvF:                                 | 4.91     |

#### SURFACE SAR



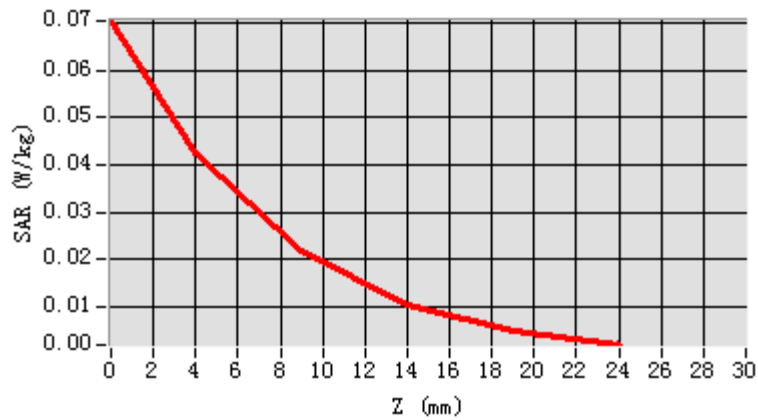
#### VOLUME SAR



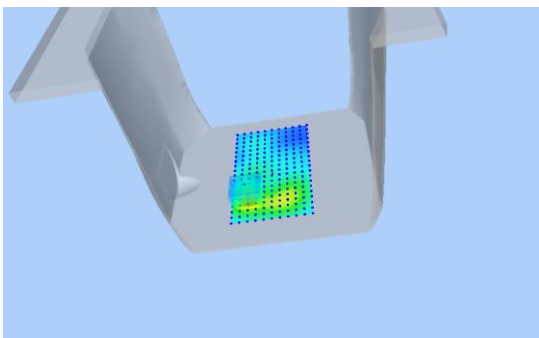
Maximum location: X=-10.00, Y=55.00

|                |          |
|----------------|----------|
| SAR 10g (W/Kg) | 0.012354 |
| SAR 1g (W/Kg)  | 0.024327 |

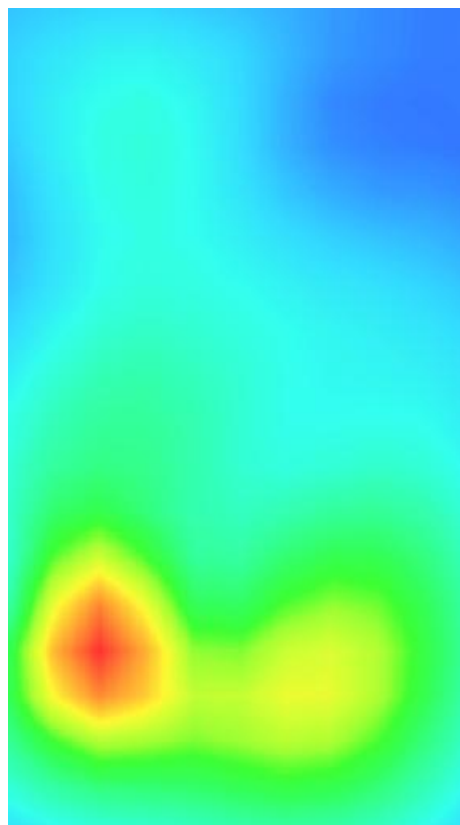
### Z axis scan



### 3D screen shot



### Hot spot position



**ANNEX E**

**of**

**CCIC-SET**

**CONFORMANCE TEST REPORT FOR**

**HUMAN EXPOSURE TO ELECTROMAGNETIC FIELDS**

**SET2014-13183**

**WCDMA digital mobile phone**

**Type Name: W861**

**Hardware Version: UALD07 VER.A**

**Software Version: HW-W861-H01-S004-VE**

**Calibration Certificate of Probe and Dipoles**

**This Annex consists of 45 pages**

**Date of Report: 2014-12-03**

**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

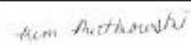
**Summary:**

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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### 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

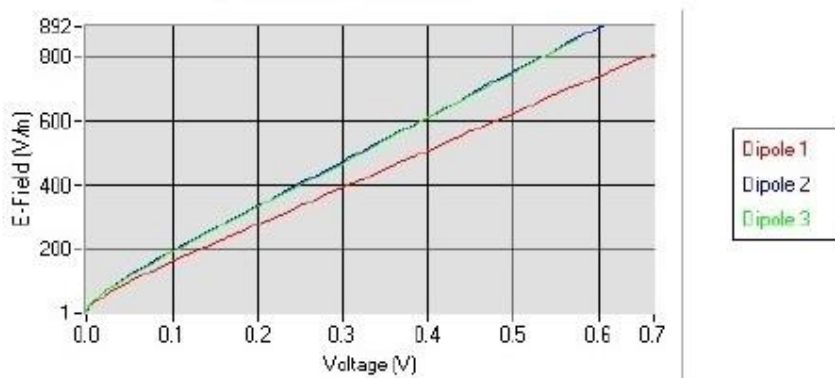
| Normx dipole<br>1 ( $\mu\text{V}/(\text{V}/\text{m})^2$ ) | Normy dipole<br>2 ( $\mu\text{V}/(\text{V}/\text{m})^2$ ) | Normz dipole<br>3 ( $\mu\text{V}/(\text{V}/\text{m})^2$ ) |
|-----------------------------------------------------------|-----------------------------------------------------------|-----------------------------------------------------------|
| 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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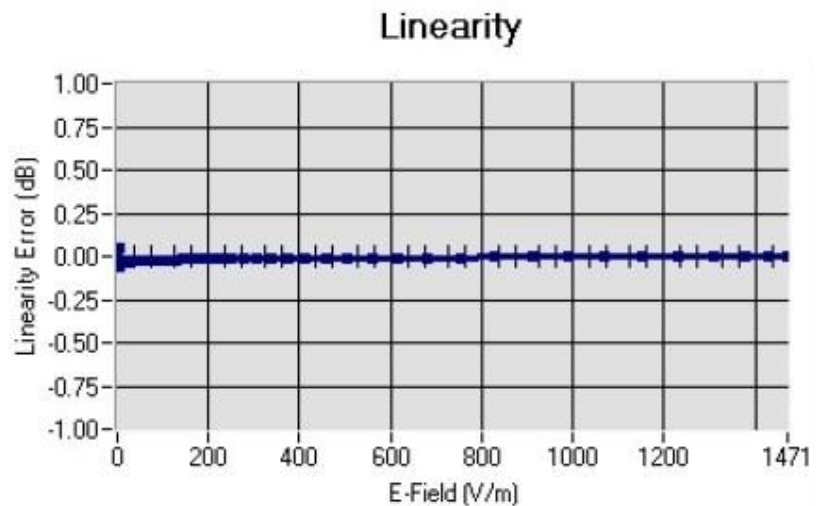
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## COMOSAR E-FIELD PROBE CALIBRATION REPORT

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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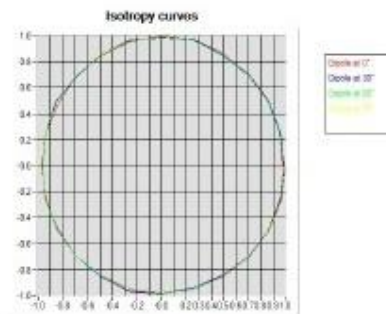
# COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.96.2.14.SATU.A

## 5.4 ISOTROPY

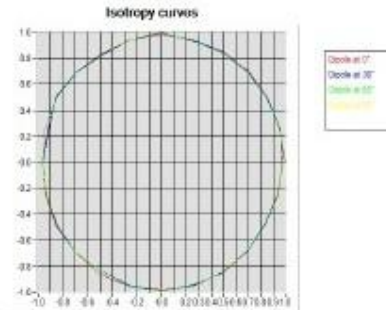
### HL900 MHz

- 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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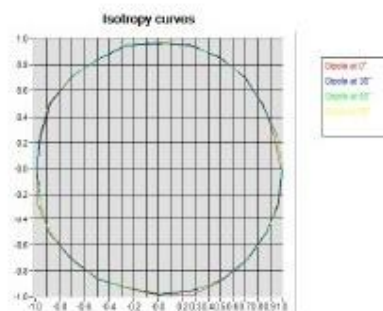


# COMOSAR E-FIELD PROBE CALIBRATION REPORT

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

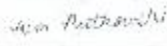
*Summary:*

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

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

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

| <i>Issue</i> | <i>Date</i> | <i>Modifications</i> |
|--------------|-------------|----------------------|
| 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

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#### 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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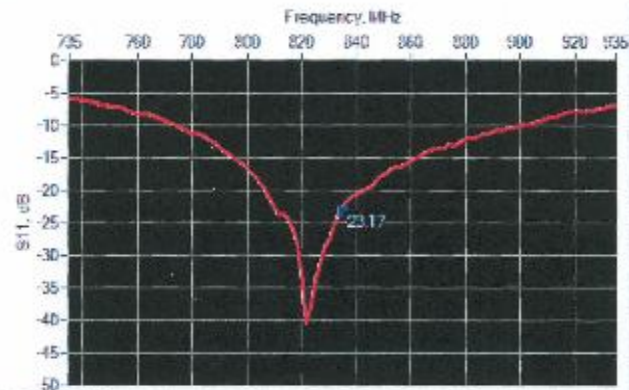


## SAR REFERENCE DIPOLE CALIBRATION REPORT

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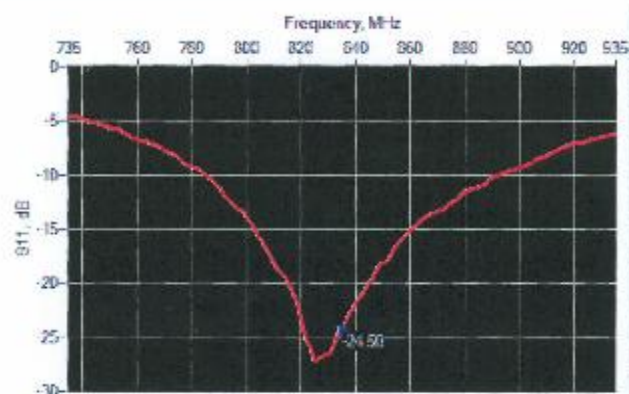
### 6 CALIBRATION MEASUREMENT RESULTS

#### 6.1 RETURN LOSS AND IMPEDANCE IN HEAD LIQUID



| Frequency (MHz) | Return Loss (dB) | Requirement (dB) | Impedance                   |
|-----------------|------------------|------------------|-----------------------------|
| 835             | -23.17           | -20              | $57.4 \Omega - 0.2 j\Omega$ |

#### 6.2 RETURN LOSS AND IMPEDANCE IN BODY LIQUID



| Frequency (MHz) | Return Loss (dB) | Requirement (dB) | Impedance                   |
|-----------------|------------------|------------------|-----------------------------|
| 835             | -24.50           | -20              | $55.0 \Omega + 3.9 j\Omega$ |

#### 6.3 MECHANICAL DIMENSIONS

| Frequency MHz | L mm            |          | h mm            |          | d mm           |          |
|---------------|-----------------|----------|-----------------|----------|----------------|----------|
|               | required        | measured | required        | measured | required       | measured |
| 300           | 420.0 $\pm$ 1 % |          | 250.0 $\pm$ 1 % |          | 6.35 $\pm$ 1 % |          |
| 450           | 290.0 $\pm$ 1 % |          | 156.7 $\pm$ 1 % |          | 6.35 $\pm$ 1 % |          |
| 750           | 176.0 $\pm$ 1 % |          | 100.0 $\pm$ 1 % |          | 6.35 $\pm$ 1 % |          |
| 835           | 161.0 $\pm$ 1 % | PASS     | 89.8 $\pm$ 1 %  | PASS     | 3.6 $\pm$ 1 %  | PASS     |

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|      |            |  |           |  |          |  |
|------|------------|--|-----------|--|----------|--|
| 900  | 149.0 ±1 % |  | 89.3 ±1 % |  | 3.6 ±1 % |  |
| 1450 | 89.1 ±1 %  |  | 51.7 ±1 % |  | 3.6 ±1 % |  |
| 1500 | 80.5 ±1 %  |  | 50.0 ±1 % |  | 3.6 ±1 % |  |
| 1640 | 79.0 ±1 %  |  | 45.7 ±1 % |  | 3.6 ±1 % |  |
| 1750 | 75.2 ±1 %  |  | 42.8 ±1 % |  | 3.6 ±1 % |  |
| 1800 | 72.0 ±1 %  |  | 41.7 ±1 % |  | 3.6 ±1 % |  |
| 1900 | 68.0 ±1 %  |  | 39.5 ±1 % |  | 3.6 ±1 % |  |
| 1950 | 66.3 ±1 %  |  | 38.5 ±1 % |  | 3.6 ±1 % |  |
| 2000 | 64.5 ±1 %  |  | 37.5 ±1 % |  | 3.6 ±1 % |  |
| 2100 | 61.0 ±1 %  |  | 35.7 ±1 % |  | 3.6 ±1 % |  |
| 2300 | 55.5 ±1 %  |  | 32.6 ±1 % |  | 3.6 ±1 % |  |
| 2450 | 51.5 ±1 %  |  | 30.4 ±1 % |  | 3.6 ±1 % |  |
| 2600 | 48.5 ±1 %  |  | 28.8 ±1 % |  | 3.6 ±1 % |  |
| 3000 | 41.5 ±1 %  |  | 25.0 ±1 % |  | 3.6 ±1 % |  |
| 3500 | 37.0 ±1 %  |  | 26.4 ±1 % |  | 3.6 ±1 % |  |
| 3700 | 34.7 ±1 %  |  | 26.4 ±1 % |  | 3.6 ±1 % |  |

## 7 VALIDATION MEASUREMENT

The IEEE Std. 1528, OET 65 Bulletin C and CEI/IEC 62209 standards state that the system validation measurements must be performed using a reference dipole meeting the fore mentioned return loss and mechanical dimension requirements. The validation measurement must be performed against a liquid filled flat phantom, with the phantom constructed as outlined in the fore mentioned standards. Per the standards, the dipole shall be positioned below the bottom of the phantom, with the dipole length centered and parallel to the longest dimension of the flat phantom, with the top surface of the dipole at the described distance from the bottom surface of the phantom.

### 7.1 HEAD LIQUID MEASUREMENT

| Frequency<br>MHz | Relative permittivity ( $\epsilon_r$ ) |          | Conductivity ( $\sigma$ ) S/m |          |
|------------------|----------------------------------------|----------|-------------------------------|----------|
|                  | required                               | measured | required                      | measured |
| 300              | 45.3 ±5 %                              |          | 0.87 ±5 %                     |          |
| 450              | 43.5 ±5 %                              |          | 0.87 ±5 %                     |          |
| 750              | 41.9 ±5 %                              |          | 0.89 ±5 %                     |          |
| 835              | 41.5 ±5 %                              | PASS     | 0.90 ±5 %                     | PASS     |
| 900              | 41.5 ±5 %                              |          | 0.97 ±5 %                     |          |
| 1450             | 40.5 ±5 %                              |          | 1.20 ±5 %                     |          |
| 1500             | 40.4 ±5 %                              |          | 1.23 ±5 %                     |          |
| 1640             | 40.2 ±5 %                              |          | 1.31 ±5 %                     |          |
| 1750             | 40.1 ±5 %                              |          | 1.37 ±5 %                     |          |
| 1800             | 40.0 ±5 %                              |          | 1.40 ±5 %                     |          |
| 1900             | 40.0 ±5 %                              |          | 1.40 ±5 %                     |          |
| 1950             | 40.0 ±5 %                              |          | 1.40 ±5 %                     |          |
| 2000             | 40.0 ±5 %                              |          | 1.40 ±5 %                     |          |

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|      |           |  |           |  |
|------|-----------|--|-----------|--|
| 2100 | 39.8 ±5 % |  | 1.49 ±5 % |  |
| 2300 | 39.5 ±5 % |  | 1.67 ±5 % |  |
| 2450 | 39.2 ±5 % |  | 1.80 ±5 % |  |
| 2600 | 39.0 ±5 % |  | 1.96 ±5 % |  |
| 3000 | 38.5 ±5 % |  | 2.40 ±5 % |  |
| 3500 | 37.9 ±5 % |  | 2.91 ±5 % |  |

## 7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

The IEEE Std. 1528 and CEI/IEC 62209 standards state that the system validation measurements should produce the SAR values shown below (for phantom thickness of 2 mm), within the uncertainty for the system validation. All SAR values are normalized to 1 W forward power. In bracket, the measured SAR is given with the used input power.

|                                           |                                                         |
|-------------------------------------------|---------------------------------------------------------|
| Software                                  | OPEN SAR V4                                             |
| Phantom                                   | SN 20/09 SAM71                                          |
| Probe                                     | SN 18/11 EPG122                                         |
| Liquid                                    | Head Liquid Values: $\epsilon_r$ : 42.3 $\sigma$ : 0.92 |
| Distance between dipole center and liquid | 15.0 mm                                                 |
| Area scan resolution                      | $dx=8mm/dy=8mm$                                         |
| Zoon Scan Resolution                      | $dx=8mm/dy=8mm/dz=5mm$                                  |
| Frequency                                 | 835 MHz                                                 |
| Input power                               | 20 dBm                                                  |
| Liquid Temperature                        | 21 °C                                                   |
| Lab Temperature                           | 21 °C                                                   |
| Lab Humidity                              | 45 %                                                    |

| Frequency<br>MHz | 1 g SAR (W/kg/W) |             | 10 g SAR (W/kg/W) |             |
|------------------|------------------|-------------|-------------------|-------------|
|                  | required         | measured    | required          | measured    |
| 300              | 2.85             |             | 1.94              |             |
| 450              | 4.58             |             | 3.06              |             |
| 750              | 8.49             |             | 5.55              |             |
| 835              | 9.56             | 9.77 (0.98) | 6.22              | 6.30 (0.63) |
| 900              | 10.9             |             | 6.99              |             |
| 1450             | 29               |             | 16                |             |
| 1500             | 30.5             |             | 16.8              |             |
| 1640             | 34.2             |             | 18.4              |             |
| 1750             | 36.4             |             | 19.3              |             |
| 1800             | 38.4             |             | 20.1              |             |
| 1900             | 39.7             |             | 20.5              |             |
| 1950             | 40.5             |             | 20.9              |             |
| 2000             | 41.1             |             | 21.1              |             |
| 2100             | 43.6             |             | 21.9              |             |
| 2300             | 48.7             |             | 23.3              |             |

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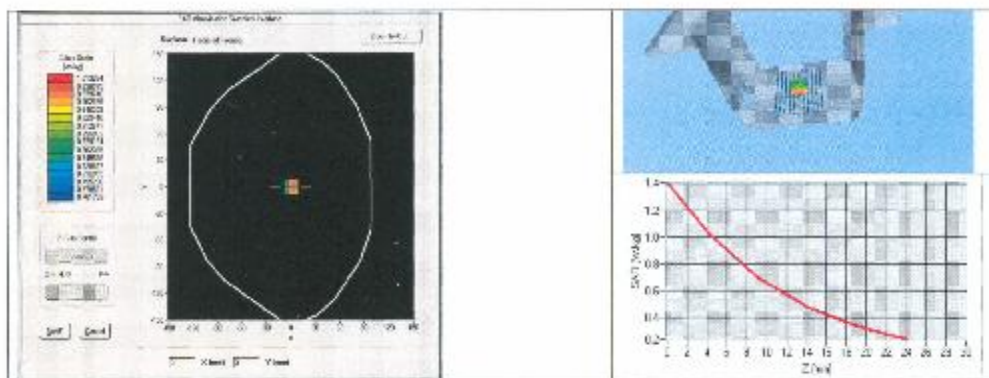
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Ref: ACR.240.1.14.SAT11.A

|      |      |  |      |  |
|------|------|--|------|--|
| 2450 | 52.4 |  | 24   |  |
| 2620 | 55.3 |  | 24.6 |  |
| 3020 | 63.8 |  | 25.7 |  |
| 3520 | 67.1 |  | 25   |  |



## 7.3 BODY LIQUID MEASUREMENT

| Frequency<br>MHz | Relative permittivity ( $\epsilon_r$ ) |          | Conductivity ( $\sigma$ ) S/m |          |
|------------------|----------------------------------------|----------|-------------------------------|----------|
|                  | required                               | measured | required                      | measured |
| 150              | 61.9 $\pm$ 5 %                         |          | 0.80 $\pm$ 5 %                |          |
| 300              | 58.2 $\pm$ 5 %                         |          | 0.92 $\pm$ 5 %                |          |
| 450              | 56.7 $\pm$ 5 %                         |          | 0.94 $\pm$ 5 %                |          |
| 750              | 55.5 $\pm$ 5 %                         |          | 0.96 $\pm$ 5 %                |          |
| 835              | 55.2 $\pm$ 5 %                         | PASS     | 0.97 $\pm$ 5 %                | PASS     |
| 900              | 55.0 $\pm$ 5 %                         |          | 1.05 $\pm$ 5 %                |          |
| 915              | 55.0 $\pm$ 5 %                         |          | 1.06 $\pm$ 5 %                |          |
| 1450             | 54.0 $\pm$ 5 %                         |          | 1.30 $\pm$ 5 %                |          |
| 1610             | 53.8 $\pm$ 5 %                         |          | 1.40 $\pm$ 5 %                |          |
| 1800             | 53.3 $\pm$ 5 %                         |          | 1.52 $\pm$ 5 %                |          |
| 1900             | 53.3 $\pm$ 5 %                         |          | 1.52 $\pm$ 5 %                |          |
| 2000             | 53.3 $\pm$ 5 %                         |          | 1.52 $\pm$ 5 %                |          |
| 2100             | 53.2 $\pm$ 5 %                         |          | 1.62 $\pm$ 5 %                |          |
| 2450             | 52.7 $\pm$ 5 %                         |          | 1.95 $\pm$ 5 %                |          |
| 2600             | 52.5 $\pm$ 5 %                         |          | 2.16 $\pm$ 5 %                |          |
| 3000             | 52.0 $\pm$ 5 %                         |          | 2.73 $\pm$ 5 %                |          |
| 3500             | 51.3 $\pm$ 5 %                         |          | 3.31 $\pm$ 5 %                |          |
| 5200             | 49.0 $\pm$ 10 %                        |          | 5.30 $\pm$ 10 %               |          |
| 5300             | 48.9 $\pm$ 10 %                        |          | 5.42 $\pm$ 10 %               |          |
| 5400             | 48.7 $\pm$ 10 %                        |          | 5.53 $\pm$ 10 %               |          |

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# SAR REFERENCE DIPOLE CALIBRATION REPORT

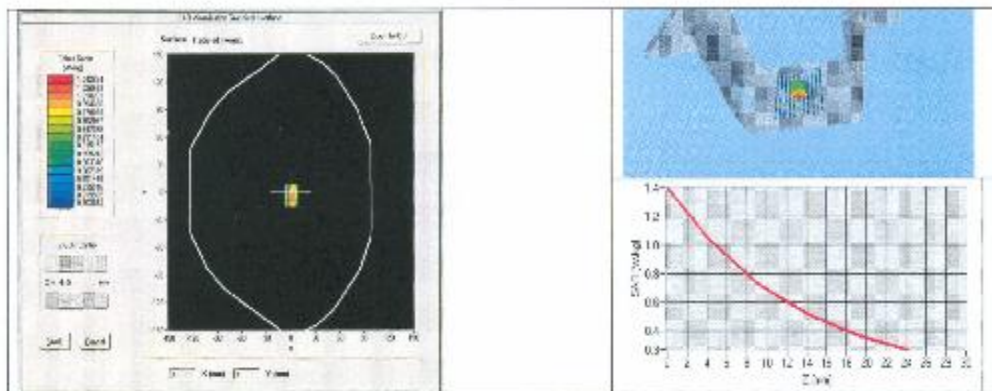
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|      |            |  |            |  |
|------|------------|--|------------|--|
| 5500 | 48.5 ±10 % |  | 5.65 ±10 % |  |
| 5600 | 48.5 ±10 % |  | 5.77 ±10 % |  |
| 5800 | 48.2 ±10 % |  | 6.00 ±10 % |  |

## 7.4 SAR MEASUREMENT RESULT WITH BODY LIQUID

|                                           |                                                              |
|-------------------------------------------|--------------------------------------------------------------|
| Software                                  | OPENSAR V4                                                   |
| Phantom                                   | SN 20:09 SAM71                                               |
| Probe                                     | SN 18:11 EPG122                                              |
| Liquid                                    | Body Liquid Values: $\epsilon_{ps}^1$ : 54.1 $\sigma$ : 0.97 |
| Distance between dipole center and liquid | 15.0 mm                                                      |
| Area scan resolution                      | $dx=8mm/dy=8mm$                                              |
| Zoon Scan Resolution                      | $dx=8mm/dy=8mm/dz=5mm$                                       |
| Frequency                                 | 835 MHz                                                      |
| Input power                               | 20 dBm                                                       |
| Liquid Temperature                        | 21 °C                                                        |
| Lab Temperature                           | 21 °C                                                        |
| Lab Humidity                              | 45 %                                                         |

| Frequency<br>MHz | 1 g SAR (W/kg/W) | 10 g SAR (W/kg/W) |
|------------------|------------------|-------------------|
|                  | measured         | measured          |
| 835              | 10.31 (1.03)     | 6.74 (0.67)       |



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# SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR 240114 SAT/UA

## 8 LIST OF EQUIPMENT

| Equipment Summary Sheet         |                      |                    |                                               |                                               |
|---------------------------------|----------------------|--------------------|-----------------------------------------------|-----------------------------------------------|
| Equipment Description           | Manufacturer / Model | Identification No. | Current Calibration Date                      | Next Calibration Date                         |
| SAM 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                                       |
| Calipers                        | Carrera              | CALIPER-01         | 12/2013                                       | 12/2016                                       |
| Reference Probe                 | Satimo               | EPG122 SN 18/11    | 10/2013                                       | 10/2014                                       |
| Multimeter                      | Keithley 2000        | 1188656            | 12/2013                                       | 12/2016                                       |
| Signal Generator                | Agilent E4438C       | MY49070581         | 12/2013                                       | 12/2016                                       |
| Amplifier                       | Aethercomm           | SN 046             | Characterized prior to test. No cal required. | Characterized prior to test. No cal required. |
| Power Meter                     | HP E4418A            | US38261498         | 12/2013                                       | 12/2016                                       |
| Power Sensor                    | HP ECP-E26A          | US37181460         | 12/2013                                       | 12/2016                                       |
| Directional Coupler             | Narda 4216-20        | 01386              | Characterized prior to test. No cal required. | Characterized prior to test. No cal required. |
| Temperature and Humidity Sensor | Control Company      | 11-861-9           | 8/2012                                        | 8/2015                                        |

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**SID1900 Dipole Calibration Certificate****SAR Reference Dipole Calibration Report**

Ref : ACR.240.4.14.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: 1900 MHZ  
SERIAL NO.: SN 09/13 DIP1G900-218

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 240.4.14.SATU.A

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

|                | 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 1900 MHz REFERENCE DIPOLE |
| Manufacturer                   | Satimo                            |
| Model                          | SID1900                           |
| Serial Number                  | SN 09/13 DIP1G900-218             |
| 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

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#### 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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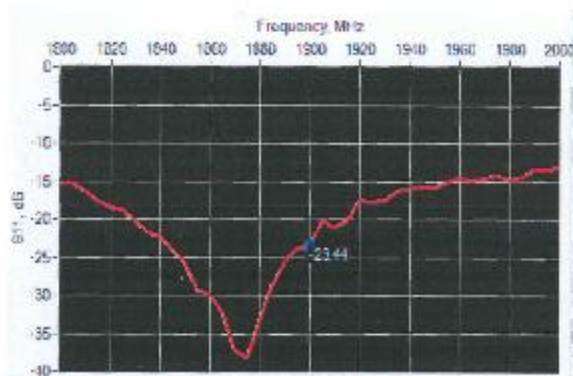


## SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR200414 SATIM A

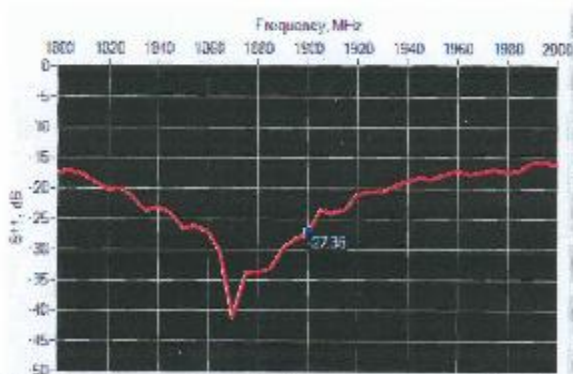
### 6 CALIBRATION MEASUREMENT RESULTS

#### 6.1 RETURN LOSS AND IMPEDANCE IN HEAD LIQUID



| Frequency (MHz) | Return Loss (dB) | Requirement (dB) | Impedance                   |
|-----------------|------------------|------------------|-----------------------------|
| 1900            | -23.44           | -20              | $55.4 \Omega + 5.2 j\Omega$ |

#### 6.2 RETURN LOSS AND IMPEDANCE IN BODY LIQUID



| Frequency (MHz) | Return Loss (dB) | Requirement (dB) | Impedance                   |
|-----------------|------------------|------------------|-----------------------------|
| 1900            | -27.36           | -20              | $51.7 \Omega + 4.4 j\Omega$ |

#### 6.3 MECHANICAL DIMENSIONS

| Frequency MHz | L mm             |          | h mm             |          | d mm            |          |
|---------------|------------------|----------|------------------|----------|-----------------|----------|
|               | required         | measured | required         | measured | required        | measured |
| 300           | $420.0 \pm 1 \%$ |          | $250.0 \pm 1 \%$ |          | $6.35 \pm 1 \%$ |          |
| 450           | $250.0 \pm 1 \%$ |          | $166.7 \pm 1 \%$ |          | $6.35 \pm 1 \%$ |          |
| 750           | $176.0 \pm 1 \%$ |          | $100.0 \pm 1 \%$ |          | $6.35 \pm 1 \%$ |          |
| 835           | $161.0 \pm 1 \%$ |          | $89.8 \pm 1 \%$  |          | $3.5 \pm 1 \%$  |          |

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# SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR200316SATU.A

|      |            |      |           |      |          |      |
|------|------------|------|-----------|------|----------|------|
| 900  | 149.3 ±1 % |      | 83.3 ±1 % |      | 3.6 ±1 % |      |
| 1450 | 89.1 ±1 %  |      | 51.7 ±1 % |      | 3.6 ±1 % |      |
| 1500 | 80.5 ±1 %  |      | 50.0 ±1 % |      | 3.6 ±1 % |      |
| 1640 | 79.0 ±1 %  |      | 45.7 ±1 % |      | 3.6 ±1 % |      |
| 1750 | 75.2 ±1 %  |      | 42.9 ±1 % |      | 3.6 ±1 % |      |
| 1800 | 72.0 ±1 %  |      | 41.7 ±1 % |      | 3.6 ±1 % |      |
| 1900 | 68.0 ±1 %  | PASS | 39.5 ±1 % | PASS | 3.6 ±1 % | PASS |
| 1950 | 66.3 ±1 %  |      | 38.5 ±1 % |      | 3.6 ±1 % |      |
| 2000 | 64.5 ±1 %  |      | 37.5 ±1 % |      | 3.6 ±1 % |      |
| 2100 | 61.0 ±1 %  |      | 35.7 ±1 % |      | 3.6 ±1 % |      |
| 2300 | 55.5 ±1 %  |      | 32.6 ±1 % |      | 3.6 ±1 % |      |
| 2450 | 51.5 ±1 %  |      | 30.4 ±1 % |      | 3.6 ±1 % |      |
| 2600 | 48.5 ±1 %  |      | 28.8 ±1 % |      | 3.6 ±1 % |      |
| 3000 | 41.5 ±1 %  |      | 25.0 ±1 % |      | 3.6 ±1 % |      |
| 3500 | 37.0 ±1 %  |      | 26.4 ±1 % |      | 3.6 ±1 % |      |
| 3700 | 34.7 ±1 %  |      | 26.4 ±1 % |      | 3.6 ±1 % |      |

## 7 VALIDATION MEASUREMENT

The IEEE Std. 1528, OET 65 Bulletin C and CEM/IEC 62209 standards state that the system validation measurements must be performed using a reference dipole meeting the fore mentioned return loss and mechanical dimension requirements. The validation measurement must be performed against a liquid filled flat phantom, with the phantom constructed as outlined in the fore mentioned standards. Per the standards, the dipole shall be positioned below the bottom of the phantom, with the dipole length centered and parallel to the longest dimension of the flat phantom, with the top surface of the dipole at the described distance from the bottom surface of the phantom.

### 7.1 HEAD LIQUID MEASUREMENT

| Frequency<br>MHz | Relative permittivity ( $\epsilon_r$ ) |          | Conductivity ( $\sigma$ ) S/m |          |
|------------------|----------------------------------------|----------|-------------------------------|----------|
|                  | required                               | measured | required                      | measured |
| 300              | 45.3 ±5 %                              |          | 0.87 ±5 %                     |          |
| 450              | 43.5 ±5 %                              |          | 0.87 ±5 %                     |          |
| 750              | 41.5 ±5 %                              |          | 0.89 ±5 %                     |          |
| 835              | 41.5 ±5 %                              |          | 0.90 ±5 %                     |          |
| 900              | 41.5 ±5 %                              |          | 0.97 ±5 %                     |          |
| 1450             | 40.5 ±5 %                              |          | 1.70 ±5 %                     |          |
| 1500             | 40.4 ±5 %                              |          | 1.23 ±5 %                     |          |
| 1540             | 40.2 ±5 %                              |          | 1.31 ±5 %                     |          |
| 1750             | 40.1 ±5 %                              |          | 1.37 ±5 %                     |          |
| 1800             | 40.0 ±5 %                              |          | 1.40 ±5 %                     |          |
| 1900             | 40.0 ±5 %                              | PASS     | 1.40 ±5 %                     | PASS     |
| 1950             | 40.0 ±5 %                              |          | 1.40 ±5 %                     |          |
| 2000             | 40.0 ±5 %                              |          | 1.40 ±5 %                     |          |

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# SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR-240-14 SATULA

|      |           |           |
|------|-----------|-----------|
| 2100 | 59.8 ±5 % | 1.49 ±5 % |
| 2300 | 59.5 ±5 % | 1.67 ±5 % |
| 2450 | 59.2 ±5 % | 1.80 ±5 % |
| 2600 | 59.0 ±5 % | 1.96 ±5 % |
| 3000 | 58.5 ±5 % | 2.40 ±5 % |
| 3500 | 57.9 ±5 % | 2.51 ±5 % |

## 7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

The IEEE Std. 1528 and CEI/IEC 62209 standards state that the system validation measurements should produce the SAR values shown below (for phantom thickness of 2 mm), within the uncertainty for the system validation. All SAR values are normalized to 1 W forward power. In bracket, the measured SAR is given with the used input power.

|                                           |                                                                 |
|-------------------------------------------|-----------------------------------------------------------------|
| Software                                  | OPENSAR V4                                                      |
| Phantom                                   | SN 2009 SAM71                                                   |
| Probe                                     | SN 18/11 EPG122                                                 |
| Liquid                                    | Head Liquid Values: $\epsilon_{\text{ps}}' : 41.1$ sigma : 1.42 |
| Distance between dipole center and liquid | 13.0 mm                                                         |
| Area scan resolution                      | $dx=8\text{mm}/dy=8\text{mm}$                                   |
| Zoom Scan Resolution                      | $dx=8\text{mm}/dy=8\text{mm}/dz=5\text{mm}$                     |
| Frequency                                 | 1900 MHz                                                        |
| Input power                               | 23 dBm                                                          |
| Liquid Temperature                        | 21 °C                                                           |
| Lab Temperature                           | 21 °C                                                           |
| Lab Humidity                              | 45 %                                                            |

| Frequency<br>MHz | 1 g SAR (W/kg/W) |              | 10 g SAR (W/kg/W) |              |
|------------------|------------------|--------------|-------------------|--------------|
|                  | required         | measured     | required          | measured     |
| 300              | 2.85             |              | 1.04              |              |
| 450              | 4.58             |              | 3.26              |              |
| 750              | 8.49             |              | 5.55              |              |
| 835              | 9.56             |              | 5.27              |              |
| 900              | 10.9             |              | 5.99              |              |
| 1450             | 29               |              | 16                |              |
| 1500             | 30.5             |              | 16.8              |              |
| 1640             | 34.2             |              | 18.4              |              |
| 1750             | 36.4             |              | 19.2              |              |
| 1800             | 38.4             |              | 20.1              |              |
| 1900             | 39.7             | 40.97 (4.04) | 20.5              | 20.62 (2.06) |
| 1950             | 40.5             |              | 20.9              |              |
| 2000             | 41.1             |              | 21.1              |              |
| 2100             | 43.6             |              | 21.9              |              |
| 2300             | 48.7             |              | 23.3              |              |

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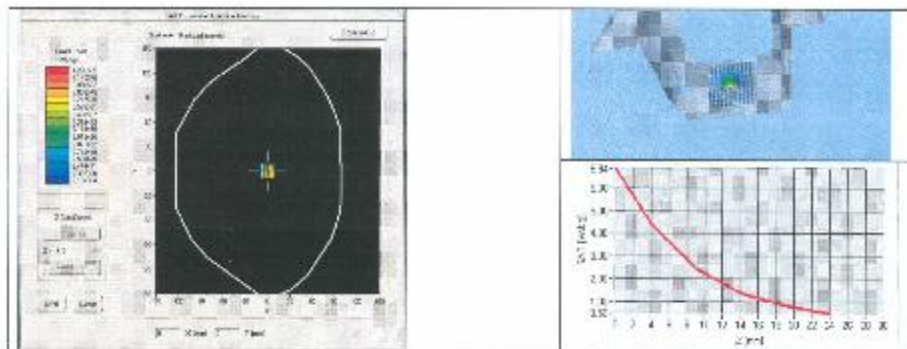
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# SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR260.4.14SATC.A

|      |      |  |      |  |
|------|------|--|------|--|
| 2450 | 52.4 |  | 24   |  |
| 2500 | 55.3 |  | 24.6 |  |
| 3000 | 63.8 |  | 25.7 |  |
| 3500 | 67.1 |  | 25   |  |



## 7.3 BODY LIQUID MEASUREMENT

| Frequency<br>MHz | Relative permittivity ( $\epsilon_r'$ ) |          | Conductivity ( $\sigma$ ) S/m |          |
|------------------|-----------------------------------------|----------|-------------------------------|----------|
|                  | required                                | measured | required                      | measured |
| 150              | 51.9 $\pm$ 5 %                          |          | 0.80 $\pm$ 5 %                |          |
| 300              | 58.7 $\pm$ 5 %                          |          | 0.93 $\pm$ 5 %                |          |
| 450              | 56.7 $\pm$ 5 %                          |          | 0.94 $\pm$ 5 %                |          |
| 750              | 55.5 $\pm$ 5 %                          |          | 0.96 $\pm$ 5 %                |          |
| 835              | 55.2 $\pm$ 5 %                          |          | 0.97 $\pm$ 5 %                |          |
| 900              | 55.0 $\pm$ 5 %                          |          | 1.05 $\pm$ 5 %                |          |
| 915              | 55.0 $\pm$ 5 %                          |          | 1.06 $\pm$ 5 %                |          |
| 1450             | 54.0 $\pm$ 5 %                          |          | 1.30 $\pm$ 5 %                |          |
| 1610             | 53.8 $\pm$ 5 %                          |          | 1.40 $\pm$ 5 %                |          |
| 1800             | 53.3 $\pm$ 5 %                          |          | 1.52 $\pm$ 5 %                |          |
| 1900             | 53.3 $\pm$ 5 %                          | PASS     | 1.52 $\pm$ 5 %                | PASS     |
| 2000             | 53.3 $\pm$ 5 %                          |          | 1.52 $\pm$ 5 %                |          |
| 2100             | 53.2 $\pm$ 5 %                          |          | 1.62 $\pm$ 5 %                |          |
| 2450             | 52.7 $\pm$ 5 %                          |          | 1.95 $\pm$ 5 %                |          |
| 2600             | 52.5 $\pm$ 5 %                          |          | 2.16 $\pm$ 5 %                |          |
| 3000             | 52.0 $\pm$ 5 %                          |          | 2.73 $\pm$ 5 %                |          |
| 3500             | 51.3 $\pm$ 5 %                          |          | 3.31 $\pm$ 5 %                |          |
| 5200             | 49.0 $\pm$ 10 %                         |          | 5.30 $\pm$ 10 %               |          |
| 5300             | 48.9 $\pm$ 10 %                         |          | 5.42 $\pm$ 10 %               |          |
| 5400             | 48.7 $\pm$ 10 %                         |          | 5.53 $\pm$ 10 %               |          |

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# SAR REFERENCE DIPOLE CALIBRATION REPORT

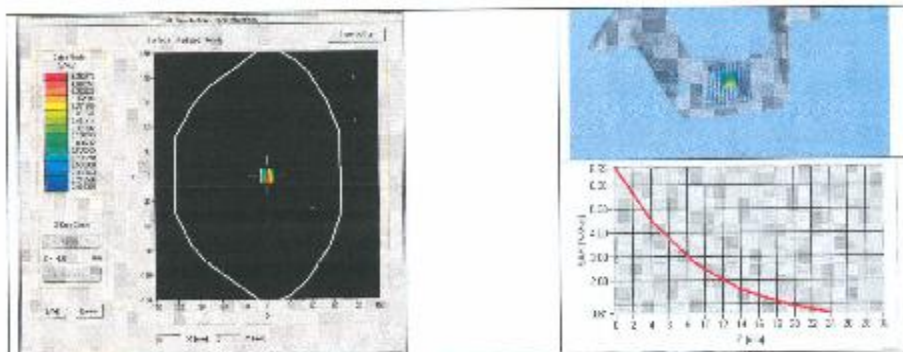
Ref: ACR 060 4 14 SAT/JJA

|      |            |  |            |  |
|------|------------|--|------------|--|
| 5500 | 48.6 ±10 % |  | 5.55 ±10 % |  |
| 5600 | 48.5 ±10 % |  | 5.77 ±10 % |  |
| 5800 | 48.2 ±10 % |  | 6.00 ±10 % |  |

## 7.4 SAR MEASUREMENT RESULT WITH BODY LIQUID

|                                           |                                                           |
|-------------------------------------------|-----------------------------------------------------------|
| Software                                  | OPENSAR V4                                                |
| Phantom                                   | SN 2009 SAM71                                             |
| Probe                                     | SN 18/11 EPG122                                           |
| Liquid                                    | Body Liquid Values: $\epsilon_{ps}^*$ : 54.2 sigma : 1.54 |
| Distance between dipole center and liquid | 10.0 mm                                                   |
| Area scan resolution                      | $dx=8mm/dy=8mm$                                           |
| Zona Scan Resolution                      | $dx=8mm/dy=8mm/dz=5mm$                                    |
| Frequency                                 | 1900 MHz                                                  |
| Input power                               | 20 dBm                                                    |
| Liquid Temperature                        | 21 °C                                                     |
| Lab Temperature                           | 21 °C                                                     |
| Lab Humidity                              | 45 %                                                      |

| Frequency<br>MHz | 1 g SAR (W/kg/W) | 10 g SAR (W/kg/W) |
|------------------|------------------|-------------------|
|                  | measured         | measured          |
| 1900             | 40.81 [4.08]     | 71.21 [2.12]      |



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## SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.249.4.14.SATD.5

## 8 LIST OF EQUIPMENT

| Equipment Summary Sheet         |                      |                    |                                               |                                               |
|---------------------------------|----------------------|--------------------|-----------------------------------------------|-----------------------------------------------|
| Equipment Description           | Manufacturer / Model | Identification No. | Current Calibration Date                      | Next Calibration Date                         |
| SAM Phantom                     | Satimo               | SN-20/06-SAM71     | Validated. No cal required.                   | Validated. No cal required.                   |
| CCMOSAR Test Bench              | Version 3            | NA                 | Validated. No cal required.                   | Validated. No cal required.                   |
| Network Analyzer                | Rhode & Schwarz ZVA  | SN100132           | 02/2013                                       | 02/2016                                       |
| Calipers                        | Carrera              | CALIPER-01         | 12/2013                                       | 12/2016                                       |
| Reference Probe                 | Satimo               | EPG122 SN 16/11    | 10/2013                                       | 10/2014                                       |
| Multimeter                      | Keithley 2000        | 1188656            | 12/2013                                       | 12/2016                                       |
| Signal Generator                | Agilent E4438C       | MY45070581         | 12/2013                                       | 12/2016                                       |
| Amplifier                       | Aethercomm           | SN 046             | Characterized prior to test. No cal required. | Characterized prior to test. No cal required. |
| Power Meter                     | HP E4418A            | US38261498         | 12/2013                                       | 12/2016                                       |
| Power Sensor                    | HP ECP-E28A          | US37181460         | 12/2013                                       | 12/2016                                       |
| Directional Coupler             | Narda 4216-20        | 01386              | Characterized prior to test. No cal required. | Characterized prior to test. No cal required. |
| Temperature and Humidity Sensor | Control Company      | 11 661-9           | 8/2012                                        | 8/2015                                        |

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**SID2450 Dipole Calibration Certificate****SAR Reference Dipole Calibration Report**

Ref : ACR.240.6.14.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: 2450 MHZ  
SERIAL NO.: SN 09/13 DIP2G450-220

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



08/28/14

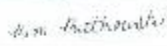
*Summary:*

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 6 14 SATJA

|               | 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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## SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR 240.6.14 SATU.A

### 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 2450 MHz REFERENCE DIPOLE |
| Manufacturer                   | Satimo                            |
| Model                          | SID2450                           |
| Serial Number                  | SN 09/13 DIP2G450-220             |
| 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

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#### 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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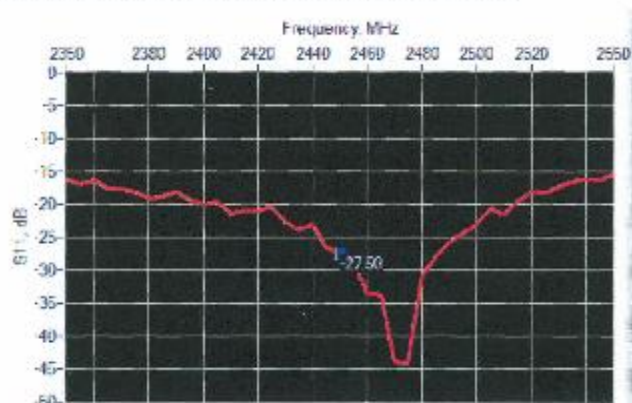


# SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR 246.6.14.SATU.A

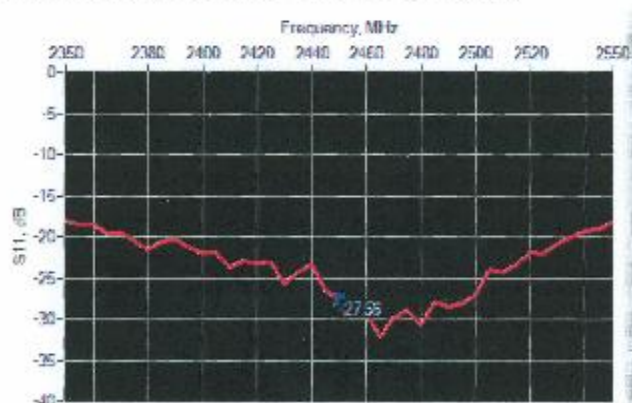
## 6 CALIBRATION MEASUREMENT RESULTS

### 6.1 RETURN LOSS AND IMPEDANCE IN HEAD LIQUID



| Frequency (MHz) | Return Loss (dB) | Requirement (dB) | Impedance                   |
|-----------------|------------------|------------------|-----------------------------|
| 2450            | -27.50           | -20              | $51.7 \Omega + 3.8 j\Omega$ |

### 6.2 RETURN LOSS AND IMPEDANCE IN BODY LIQUID



| Frequency (MHz) | Return Loss (dB) | Requirement (dB) | Impedance                   |
|-----------------|------------------|------------------|-----------------------------|
| 2450            | -27.56           | -20              | $54.3 \Omega + 0.9 j\Omega$ |

### 6.3 MECHANICAL DIMENSIONS

| Frequency MHz | L mm             |          | h mm             |          | d mm            |          |
|---------------|------------------|----------|------------------|----------|-----------------|----------|
|               | required         | measured | required         | measured | required        | measured |
| 300           | $420.0 \pm 1 \%$ |          | $250.0 \pm 1 \%$ |          | $6.35 \pm 1 \%$ |          |
| 450           | $290.0 \pm 1 \%$ |          | $166.7 \pm 1 \%$ |          | $6.35 \pm 1 \%$ |          |
| 750           | $176.0 \pm 1 \%$ |          | $100.0 \pm 1 \%$ |          | $6.35 \pm 1 \%$ |          |
| 835           | $161.0 \pm 1 \%$ |          | $89.8 \pm 1 \%$  |          | $3.6 \pm 1 \%$  |          |

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# SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.240.6.14.SATU.A

|      |             |      |            |      |           |      |
|------|-------------|------|------------|------|-----------|------|
| 900  | 149.0 ± 1 % |      | 83.3 ± 1 % |      | 3.6 ± 1 % |      |
| 1450 | 85.1 ± 1 %  |      | 51.7 ± 1 % |      | 3.6 ± 1 % |      |
| 1500 | 80.5 ± 1 %  |      | 50.0 ± 1 % |      | 3.6 ± 1 % |      |
| 1640 | 75.0 ± 1 %  |      | 45.7 ± 1 % |      | 3.6 ± 1 % |      |
| 1750 | 75.2 ± 1 %  |      | 42.9 ± 1 % |      | 3.6 ± 1 % |      |
| 1800 | 72.0 ± 1 %  |      | 41.7 ± 1 % |      | 3.6 ± 1 % |      |
| 1900 | 68.0 ± 1 %  |      | 39.5 ± 1 % |      | 3.6 ± 1 % |      |
| 1950 | 66.3 ± 1 %  |      | 38.5 ± 1 % |      | 3.6 ± 1 % |      |
| 2000 | 64.5 ± 1 %  |      | 37.5 ± 1 % |      | 3.6 ± 1 % |      |
| 2100 | 61.0 ± 1 %  |      | 35.7 ± 1 % |      | 3.6 ± 1 % |      |
| 2300 | 55.5 ± 1 %  |      | 32.5 ± 1 % |      | 3.6 ± 1 % |      |
| 2450 | 51.5 ± 1 %  | PASS | 30.4 ± 1 % | PASS | 3.6 ± 1 % | PASS |
| 2600 | 48.5 ± 1 %  |      | 28.8 ± 1 % |      | 3.6 ± 1 % |      |
| 3000 | 41.5 ± 1 %  |      | 25.0 ± 1 % |      | 3.6 ± 1 % |      |
| 3500 | 37.0 ± 1 %  |      | 26.4 ± 1 % |      | 3.6 ± 1 % |      |
| 3700 | 34.7 ± 1 %  |      | 26.4 ± 1 % |      | 3.6 ± 1 % |      |

## 7 VALIDATION MEASUREMENT

The IEEE Std. 1528, OET 65 Bulletin C and CEI/IEC 62209 standards state that the system validation measurements must be performed using a reference dipole meeting the fore mentioned return loss and mechanical dimension requirements. The validation measurement must be performed against a liquid filled flat phantom, with the phantom constructed as outlined in the fore mentioned standards. Per the standards, the dipole shall be positioned below the bottom of the phantom, with the dipole length centered and parallel to the longest dimension of the flat phantom, with the top surface of the dipole at the described distance from the bottom surface of the phantom.

### 7.1 HEAD LIQUID MEASUREMENT

| Frequency<br>MHz | Relative permittivity ( $\epsilon_r$ ) |          | Conductivity ( $\sigma$ ) S/m |          |
|------------------|----------------------------------------|----------|-------------------------------|----------|
|                  | required                               | measured | required                      | measured |
| 300              | 45.5 ± 5 %                             |          | 0.87 ± 5 %                    |          |
| 450              | 43.5 ± 5 %                             |          | 0.87 ± 5 %                    |          |
| 750              | 41.9 ± 5 %                             |          | 0.89 ± 5 %                    |          |
| 835              | 41.5 ± 5 %                             |          | 0.90 ± 5 %                    |          |
| 900              | 41.5 ± 5 %                             |          | 0.97 ± 5 %                    |          |
| 1450             | 40.5 ± 5 %                             |          | 1.20 ± 5 %                    |          |
| 1500             | 40.4 ± 5 %                             |          | 1.23 ± 5 %                    |          |
| 1640             | 40.2 ± 5 %                             |          | 1.31 ± 5 %                    |          |
| 1750             | 40.1 ± 5 %                             |          | 1.37 ± 5 %                    |          |
| 1800             | 40.0 ± 5 %                             |          | 1.40 ± 5 %                    |          |
| 1900             | 40.0 ± 5 %                             |          | 1.40 ± 5 %                    |          |
| 1950             | 40.0 ± 5 %                             |          | 1.40 ± 5 %                    |          |
| 2000             | 40.0 ± 5 %                             |          | 1.40 ± 5 %                    |          |

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# SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR 240.6.14.SATU.A

|      |           |      |           |      |
|------|-----------|------|-----------|------|
| 2100 | 35.8 ±5 % |      | 1.49 ±5 % |      |
| 2300 | 35.5 ±5 % |      | 1.67 ±5 % |      |
| 2450 | 35.2 ±5 % | PASS | 1.80 ±5 % | PASS |
| 2600 | 35.0 ±5 % |      | 1.96 ±5 % |      |
| 3000 | 38.5 ±5 % |      | 2.40 ±5 % |      |
| 3500 | 37.9 ±5 % |      | 2.91 ±5 % |      |

## 7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

The IEEE Std. 1528 and C61/IEC 62209 standards state that the system validation measurements should produce the SAR values shown below (for phantom thickness of 2 mm), within the uncertainty for the system validation. All SAR values are normalized to 1 W forward power. In bracket, the measured SAR is given with the used input power.

|                                           |                                                           |
|-------------------------------------------|-----------------------------------------------------------|
| Software                                  | OPENSAR V4                                                |
| Phantom                                   | SN 20/09 SAM71                                            |
| Probe                                     | SN 18/11 EPG122                                           |
| Liquid                                    | Head Liquid Values: $\epsilon_{ps}^1$ : 39.0 sigma : 1.77 |
| Distance between dipole center and liquid | 10.0 mm                                                   |
| Area scan resolution                      | $dx=8mm/dy=8mm$                                           |
| Zoon Scan Resolution                      | $dx=8mm/dy=8mm/dz=5mm$                                    |
| Frequency                                 | 2450 MHz                                                  |
| Input power                               | 20 dBm                                                    |
| Liquid Temperature                        | 21 °C                                                     |
| Lab Temperature                           | 21 °C                                                     |
| Lab Humidity                              | 45 %                                                      |

| Frequency<br>[MHz] | 1 g SAR (W/kg/W) |          | 10 g SAR (W/kg/W) |          |
|--------------------|------------------|----------|-------------------|----------|
|                    | required         | measured | required          | measured |
| 300                | 2.85             |          | 1.94              |          |
| 450                | 4.58             |          | 3.06              |          |
| 750                | 8.49             |          | 5.55              |          |
| 835                | 9.56             |          | 6.22              |          |
| 900                | 10.9             |          | 6.99              |          |
| 1450               | 29               |          | 16                |          |
| 1500               | 30.5             |          | 16.8              |          |
| 1640               | 34.2             |          | 18.4              |          |
| 1750               | 36.4             |          | 19.3              |          |
| 1800               | 38.4             |          | 20.1              |          |
| 1900               | 39.7             |          | 20.5              |          |
| 1950               | 40.5             |          | 20.9              |          |
| 2000               | 41.1             |          | 21.1              |          |
| 2100               | 43.6             |          | 21.9              |          |
| 2300               | 48.7             |          | 23.3              |          |

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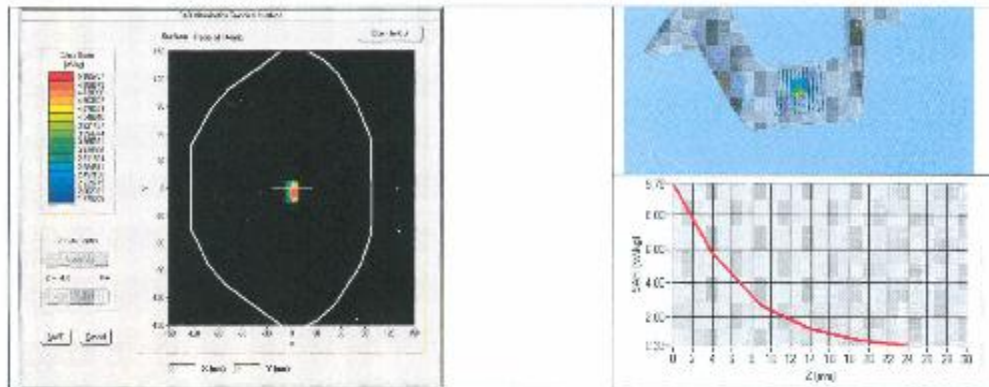
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# SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.249.6.14.SATU.A

|      |      |              |      |              |
|------|------|--------------|------|--------------|
| 2450 | 52.4 | 53.60 (5.36) | 24   | 23.77 (2.38) |
| 2600 | 55.3 |              | 24.6 |              |
| 3000 | 53.8 |              | 25.7 |              |
| 3500 | 57.1 |              | 25   |              |



## 7.3 BODY LIQUID MEASUREMENT

| Frequency<br>MHz | Relative permittivity ( $\epsilon_r'$ ) |          | Conductivity ( $\sigma$ ) S/m |          |
|------------------|-----------------------------------------|----------|-------------------------------|----------|
|                  | required                                | measured | required                      | measured |
| 150              | 61.9 $\pm$ 5 %                          |          | 0.80 $\pm$ 5 %                |          |
| 300              | 58.2 $\pm$ 5 %                          |          | 0.92 $\pm$ 5 %                |          |
| 450              | 56.7 $\pm$ 5 %                          |          | 0.94 $\pm$ 5 %                |          |
| 750              | 55.5 $\pm$ 5 %                          |          | 0.96 $\pm$ 5 %                |          |
| 835              | 55.2 $\pm$ 5 %                          |          | 0.97 $\pm$ 5 %                |          |
| 900              | 55.0 $\pm$ 5 %                          |          | 1.05 $\pm$ 5 %                |          |
| 915              | 55.0 $\pm$ 5 %                          |          | 1.06 $\pm$ 5 %                |          |
| 1450             | 54.0 $\pm$ 5 %                          |          | 1.30 $\pm$ 5 %                |          |
| 1610             | 53.8 $\pm$ 5 %                          |          | 1.40 $\pm$ 5 %                |          |
| 1800             | 53.3 $\pm$ 5 %                          |          | 1.52 $\pm$ 5 %                |          |
| 1900             | 53.3 $\pm$ 5 %                          |          | 1.52 $\pm$ 5 %                |          |
| 2000             | 53.3 $\pm$ 5 %                          |          | 1.52 $\pm$ 5 %                |          |
| 2100             | 53.2 $\pm$ 5 %                          |          | 1.62 $\pm$ 5 %                |          |
| 2450             | 52.7 $\pm$ 5 %                          | PASS     | 1.95 $\pm$ 5 %                | PASS     |
| 2600             | 52.5 $\pm$ 5 %                          |          | 2.16 $\pm$ 5 %                |          |
| 3000             | 52.0 $\pm$ 5 %                          |          | 2.73 $\pm$ 5 %                |          |
| 3500             | 51.3 $\pm$ 5 %                          |          | 3.31 $\pm$ 5 %                |          |
| 5200             | 49.0 $\pm$ 10 %                         |          | 5.30 $\pm$ 10 %               |          |
| 5300             | 48.9 $\pm$ 10 %                         |          | 5.42 $\pm$ 10 %               |          |
| 5400             | 48.7 $\pm$ 10 %                         |          | 5.53 $\pm$ 10 %               |          |

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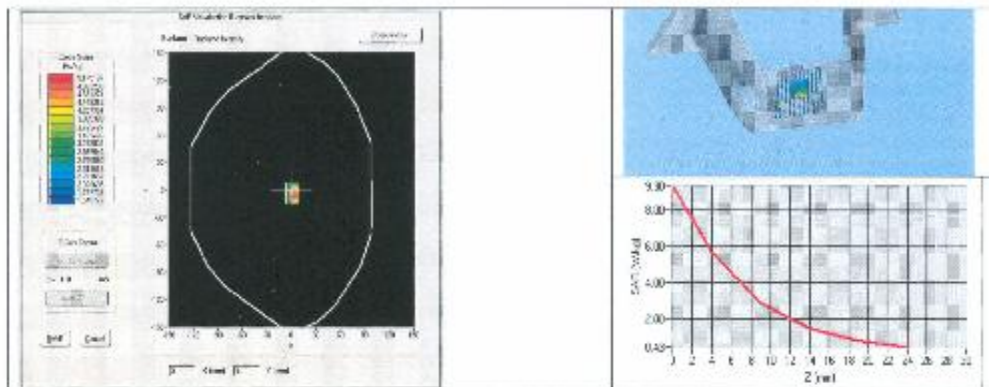
Ref: ACR.240.6.14.SATU.A

|      |            |  |            |
|------|------------|--|------------|
| 5500 | 48.6 ±10 % |  | 5.65 ±10 % |
| 5600 | 48.5 ±10 % |  | 5.77 ±10 % |
| 5800 | 48.2 ±10 % |  | 6.00 ±10 % |

## 7.4 SAR MEASUREMENT RESULT WITH BODY LIQUID

|                                           |                                                                  |
|-------------------------------------------|------------------------------------------------------------------|
| Software                                  | OPENSAR V4                                                       |
| Phantom                                   | SN 20/09 SAM7I                                                   |
| Probe                                     | SN 18/11 EPG122                                                  |
| Liquid                                    | Body Liquid Values: $\epsilon_{ps}' : 53.0$ $\sigma_{ps} : 1.93$ |
| Distance between dipole center and liquid | 10.0 mm                                                          |
| Area scan resolution                      | $dx=8mm/dy=8mm$                                                  |
| Zoom Scan Resolution                      | $dx=8mm/dy=8mm/dz=5mm$                                           |
| Frequency                                 | 2450 MHz                                                         |
| Input power                               | 20 dBm                                                           |
| Liquid Temperature                        | 21 °C                                                            |
| Lab Temperature                           | 21 °C                                                            |
| Lab Humidity                              | 45 %                                                             |

| Frequency<br>MHz | 1 g SAR (W/kg/W) | 10 g SAR (W/kg/W) |
|------------------|------------------|-------------------|
|                  | measured         | measured          |
| 2450             | 52.66 (5.27)     | 23.73 (2.37)      |



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## SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.240.6.14.SATU.A

## 8 LIST OF EQUIPMENT

| Equipment Summary Sheet         |                      |                    |                                               |                                               |
|---------------------------------|----------------------|--------------------|-----------------------------------------------|-----------------------------------------------|
| Equipment Description           | Manufacturer / Model | Identification No. | Current Calibration Date                      | Next Calibration Date                         |
| SAM 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                                       |
| Calipers                        | Carrera              | CALIPER-01         | 12/2013                                       | 12/2016                                       |
| Reference Probe                 | Satimo               | EPG122 SN 18/11    | 10/2013                                       | 10/2014                                       |
| Multimeter                      | Keithley 2000        | 1188656            | 12/2013                                       | 12/2016                                       |
| Signal Generator                | Agilent E4438C       | MY49070581         | 12/2013                                       | 12/2016                                       |
| Amplifier                       | Aethercomm           | SN 046             | Characterized prior to test. No cal required. | Characterized prior to test. No cal required. |
| Power Meter                     | HP E4418A            | US38261488         | 12/2013                                       | 12/2016                                       |
| Power Sensor                    | HP ECP-E26A          | US37181460         | 12/2013                                       | 12/2016                                       |
| Directional Coupler             | Narda 4216-20        | 01386              | Characterized prior to test. No cal required. | Characterized prior to test. No cal required. |
| Temperature and Humidity Sensor | Control Company      | 11-661-9           | 8/2012                                        | 8/2015                                        |

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**Calibration Certificate of Keithley 2000 Multimeter****KEITHLEY**

A Tektronix Company

A Greater Measure of Confidence

## TRACEABLE CALIBRATION

2000, 4014020  
Cal Date: 30-JAN-2013  
Cal Due: Lab: Kel**KEITHLEY**

KEITHLEY INSTRUMENTS, INC. • 28775 AUBORA RD, CLEVELAND, OHIO - USA • 419-248-0400 • Fax: 419-248-6168 • 1-888-KEITHLEY • www.keithley.com

Calibration Facility: This product was calibrated for Keithley Instruments by  
Tektronix (China) Co. Ltd., 1227 Chuan Qiao Road, Pudong New District, Shanghai, China 201206**Calibration Certificate**Certificate No: PCXPTG6FZX  
Manufacturer: Keithley  
Description: Multimeter, 6 1/2 digit  
Calibration Date: 30-JAN-2013Revision: 00  
Model: 2000  
Temperature: 23.0 °C  
Date Placed In Service: \_\_\_\_\_  
Serial No: 4014020  
Humidity: 46 %  
Due Date: \_\_\_\_\_

\* Optional customer entry fields: The due date may be established by adding the Keithley recommended cal interval stated in the product manual to the "Date placed in service"

**Initial Condition:** Not applicable, new product**Final Condition:** In Tolerance

- Keithley Instruments, Inc. certifies that the above instrument meets its published measurement specifications.
- This instrument has been calibrated using measurement standards traceable to the International System of Units (SI) through the PRC National Institute of Metrology (NIM), or other National Metrology Institutes (such as NIST, NPL, PTB, etc.).
- The policies and procedures used for the calibration of this product are based upon ANSI/NCSL Z540.1-1994 (R2002).
- The quality system used by the calibration facility is ISO 9001 registered.
- This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be made by the customer as needed.
- This calibration certificate shall not be reproduced, except in full, without the written approval of Keithley Instruments, Inc.

**Calibration Procedure Used:** MANIFEST:Product\_Dmm\_KeithleyDMM\_Full VERSION:107**Calibration Standards Used:**

| <u>Manufacturer/Model</u> | <u>Model Description</u>        | <u>ID Number</u> | <u>Due Date</u> |
|---------------------------|---------------------------------|------------------|-----------------|
| Fluke 5720A               | Calibrator                      | KI10138          | 18-Nov-2013     |
| Fluke 5725A               | Power Amplifier                 | KI5554           | 09-Jan-2014     |
| Keithley 3390             | Function/Arbitrary Waveform Gen | KI10261          | 16-Nov-2013     |

**Issued By:****Quality Director:**

Cui, Hu Wa

**Certified By:** Lin Qing Zhu**Date Issued:** 30-JAN-2013

2000 4014020



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PA-1061A



—End of the Report—