

# SAR TEST REPORT





Report No.: **SL13072601-SLX-008\_FCC,IC (SAR)**

Supersede Report No.: NONE

|   |   |  |
|---|---|--|
| Applicant   | : | Abbott Point of Care   |
| Product Name  | : | SDIO Wireless Module   |
| Model No.   | : | SX-SDMAN   |
| Test Standard                                       | : | 47CFR 2.1093, IEEE C95.1-1999, OET 65 C (Ed 01-01), RSS 102 Issue 4.0, IEEE 1528: 2003, IEC 62209-2: 2010  |
| Test Method   | : | IEEE 1528: 2003, IEC 62209-2: 2010<br>KDB 447498 D01 General RF Exposure Guidance v05r01<br>KDB 248227 SAR measurement procedures for 802.11 a/b/g TX<br>KDB 865664 SAR Measurement Requirements for 3 to 6 GHz v05r01 |
| FCC ID  | : | 2AAEX-SDABGN   |
| IC ID   | : | 7228C-SDABGN   |
| Dates of test                                       | : | Sep 30th - Oct 4th , 2013  |
| Issue Date  | : | 10/17/2013   |
| Test Result   | : | <input checked="" type="checkbox"/> Pass <input type="checkbox"/> Fail   |
| Equipment complied with the specification [X]       |   |  |
| Equipment did not comply with the specification [ ] |   |  |

This Test Report is Issued Under the Authority of:

|   |   |
|---|---|
|  |  |
| David Zhang   | Choon Sian Ooi  |
| Test Engineer   | Engineer Reviewer   |

Issued By:

SIEMIC Laboratories  
775 Montague Expressway, Milpitas, 95035 CA



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Test result presented in this test report is applicable to the representative sample only.

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|                 |                                 |
|-----------------|---------------------------------|
| Test report No. | SL13072601-SLX-008_FCC,IC (SAR) |
| Page            | 1 of 44                         |
| FCC ID          | 2AAEX-SDABGN                    |
| IC ID           | 7228C-SDABGN                    |

## Laboratory Introduction

SIEMIC, headquartered in the heart of Silicon Valley, with superior facilities in US and Asia, is one of the leading independent testing and certification facilities providing customers with one-stop shop services for Compliance Testing and Global Certifications.



In addition to testing and certification, SIEMIC provides initial design reviews and compliance management throughout a project. Our extensive experience with China, Asia Pacific, North America, European, and International compliance requirements, assures the fastest, most cost effective way to attain regulatory compliance for the global markets.

### Accreditations for Conformity Assessment

| Country/Region | Accreditation Body     | Scope                              |
|----------------|------------------------|------------------------------------|
| USA            | FCC, A2LA              | EMC , RF/Wireless , Telecom        |
| Canada         | IC, A2LA, NIST         | EMC, RF/Wireless , Telecom         |
| Taiwan         | BSMI , NCC , NIST      | EMC, RF, Telecom , Safety          |
| Hong Kong      | OFTA , NIST            | RF/Wireless , Telecom              |
| Australia      | NATA, NIST             | EMC, RF, Telecom , Safety          |
| Korea          | KCC/RRA, NIST          | EMI, EMS, RF , Telecom, Safety     |
| Japan          | VCCI, JATE, TELEC, RFT | EMI, RF/Wireless, Telecom          |
| Mexico         | NOM, COFETEL, Caniety  | Safety, EMC , RF/Wireless, Telecom |
| Europe         | A2LA, NIST             | EMC, RF, Telecom , Safety          |

### Accreditations for Product Certifications

| Country   | Accreditation Body | Scope                 |
|-----------|--------------------|-----------------------|
| USA       | FCC TCB, NIST      | EMC , RF , Telecom    |
| Canada    | IC FCB , NIST      | EMC , RF , Telecom    |
| Singapore | iDA, NIST          | EMC , RF , Telecom    |
| EU        | NB                 | EMC & R&TTE Directive |
| Japan     | MIC (RCB 208)      | RF , Telecom          |
| HongKong  | OFTA (US002)       | RF , Telecom          |

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|-----------------|---------------------------------|
| Test report No. | SL13072601-SLX-008_FCC,IC (SAR) |
| Page            | 2 of 44                         |
| FCC ID          | 2AAEX-SDABGN                    |
| IC ID           | 7228C-SDABGN                    |

## **CONTENTS**

|    |   |    |
|----|---|----|
| 1  | REPORT REVISION HISTORY .....                       | 3  |
| 2  | EXECUTIVE SUMMARY .....                             | 4  |
| 3  | CUSTOMER INFORMATION .....                          | 4  |
| 4  | TEST SITE INFORMATION .....                         | 4  |
| 5  | MODIFICATION .....                                  | 4  |
| 6  | EUT INFORMATION .....                               | 5  |
| 7  | ACCESSORIES/SOFTWARE AND CABLING DESCRIPTION .....  | 8  |
| 8  | EUT PHOTOS .....                                    | 9  |
| 9  | KDB CONSIDERATION .....                             | 11 |
| 10 | TEST SUMMARY .....                                  | 15 |
| 11 | SAR INTRODUCTION .....                              | 16 |
| 12 | SAR MEASUREMENT SETUP .....                         | 17 |
| 13 | MEASUREMENT UNCERTAINTY .....                       | 25 |
| 14 | LIQUID VALIDATION .....                             | 27 |
| 15 | SYSTEM VALIDATION AND SYSTEM VERIFICATION .....     | 29 |
| 16 | MEASUREMENTS, EXAMINATION AND DERIVED RESULTS ..... | 32 |
|    | ANNEX A. TEST INSTRUMENT .....                      | 39 |
|    | ANNEX B. USER MANUAL, BLOCK & CIRCUIT DIAGRAM ..... | 40 |
|    | ANNEX C. SIEMIC ACCREDITATION .....                 | 41 |

|                 |                                 |
|-----------------|---------------------------------|
| Test report No. | SL13072601-SLX-008_FCC,IC (SAR) |
| Page            | 3 of 44                         |
| FCC ID          | 2AAEX-SDABGN                    |
| IC ID           | 7228C-SDABGN                    |

## 1 Report Revision History

| Report No.                      | Report Version | Description | Issue Date |
|---------------------------------|----------------|-------------|------------|
| SL13072601-SLX-008_FCC,IC (SAR) | Original       | -           | 10/17/2013 |
|                                 |                |             |            |
|                                 |                |             |            |
|                                 |                |             |            |
|                                 |                |             |            |
|                                 |                |             |            |

|                 |                                 |
|-----------------|---------------------------------|
| Test report No. | SL13072601-SLX-008_FCC,IC (SAR) |
| Page            | 4 of 44                         |
| FCC ID          | 2AAEX-SDABGN                    |
| IC ID           | 7228C-SDABGN                    |

## 2 Executive Summary

The purpose of this test programme was to demonstrate compliance of the FCC, IC certified radio module, SDIO Wireless Module (FCC ID: 2AAEX-SDABGN, IC ID: 7228C-SDABGN), from Abbott Point of Care, and Model: SX-SDMAN, to be installed inside portable host unit of Abbott POC DragonFly Hand-held Blood Analyzer, against the current Stipulated Standards. The SAR was evaluated at Top and bottom position at 0cm separation distance in original grant, and in current report, is to evaluate the Right, Left and Front position at 0cm separation distance to phantom. The SDIO Wireless Module to be installed inside portable host unit of Abbott POC DragonFly Hand-held Blood Analyzer has demonstrated compliance with the 47 CFR Part 2 (2.1093), RSS 102 Issue 4.0, IEEE 1528: 2003 and IEC 62209-2: 2010, with 0cm separation distance to phantom.

## 3 Customer information

|                      |   |  |
|----------------------|---|--|
| Applicant Name       | : | Abbott Point of Care                                   |
| Applicant Address    | : | 400 College Road East, Princeton, New Jersey, US 08540 |
| Manufacturer Name    | : | Abbott Point of Care                                   |
| Manufacturer Address | : | 400 College Road East, Princeton, New Jersey, US 08540 |

## 4 Test site information

|                      |   |   |
|----------------------|---|---|
| Lab performing tests | : | SIEMIC Laboratories                         |
| Lab Address          | : | 775 Montague Expressway, Milpitas, CA 95035 |
| FCC Test Site No.    | : | 881796                                      |
| IC Test Site No.     | : | 4842D-2                                     |
| VCCI Test Site No.   | : | A0133                                       |

## 5 Modification

| Index | Item | Description | Note |
|-------|------|-------------|------|
| -     | -    | -           | -    |
|       |      |             |      |
|       |      |             |      |
|       |      |             |      |
|       |      |             |      |
|       |      |             |      |

|                 |                                 |
|-----------------|---------------------------------|
| Test report No. | SL13072601-SLX-008_FCC,IC (SAR) |
| Page            | 5 of 44                         |
| FCC ID          | 2AAEX-SDABGN                    |
| IC ID           | 7228C-SDABGN                    |

## 6 EUT Information

### 6.1 EUT Description

#### Product introduction

This test report is for the Portable Module Approval of the SX-SDMAN with SAR for the Abbott POC DragonFly Handheld Blood Analyzer Unit. The module SX-SDMAN contains BT and WLAN function. It has 2 TX diversity antennas. It's to be installed into handheld host unit: Abbott POC DragonFly Handheld Blood Analyzer.

The Abbott POC DragonFly Handheld Blood Analyzer is handheld device only; it's not designed to be worn onto human body. And there are no accessories or different battery options for it.

|   |   |                             |                 |                    |                  |
|---|---|-----------------------------|-----------------|--------------------|------------------|
| Product Name                                      | : | SDIO Wireless Module        |                 |                    |                  |
| Model No.   | : | SX-SDMAN                    |                 |                    |                  |
| Trade Name  | : | Abbott                      |                 |                    |                  |
| Serial No.  | : | PW100125BA                  |                 |                    |                  |
| Input Power                                       | : | 3.3VDC                      |                 |                    |                  |
| Power Adapter Manu/Model                          | : | N/A                         |                 |                    |                  |
| Power Adapter SN                                  | : | N/A                         |                 |                    |                  |
| Hardware version                                  | : | N/A                         |                 |                    |                  |
| Software version                                  | : | N/A                         |                 |                    |                  |
| Date of EUT received                              | : | Apr 23 <sup>rd</sup> , 2013 |                 |                    |                  |
| Equipment Class/ Category                         | : | DTS/UNII                    |                 |                    |                  |
| Clock Frequencies                                 | : | 26 MHz                      |                 |                    |                  |
| Port/Connectors                                   | : | SDIO                        |                 |                    |                  |
| FCC ID  | : | 2AAEX-SDABGN                |                 |                    |                  |
| IC ID   | : | 7228C-SDABGN                |                 |                    |                  |
| Rated, Measured conducted RF output Power and SAR | : | Mode                        | Max Rated Power | Measured Max Power | Highest 1g SAR   |
|   |   | 802.11b/g/n-2.4G            | 15dBm           | 13.25dBm           | 0.287 w/kg(body) |
|   |   | 802.11a                     | 16dBm           | 15.35dBm           | -                |
|   |   | 802.11n                     | 16dBm           | 16.88dBm           | 0.765w/kg(body)  |
| Wi-Fi Chipset                                     | : | -                           |                 |                    |                  |
| Bluetooth Chipset                                 | : | -                           |                 |                    |                  |
| IMEI  | : | -                           |                 |                    |                  |
| Classification per Standard                       | : | Portable                    |                 |                    |                  |
| Co-located TX                                     | : | N/A                         |                 |                    |                  |
| Antenna Separation distances                      | : | 8 cm                        |                 |                    |                  |

### 6.2 Radio Description

|                 |                      |
|-----------------|----------------------|
| Radio Manu      | Abbott Point of Care |
| Radio Model     | SX-SDMAN             |
| Radio Module SN | PW100125BA           |

|                 |                                 |
|-----------------|---------------------------------|
| Test report No. | SL13072601-SLX-008_FCC,IC (SAR) |
| Page            | 6 of 44                         |
| FCC ID          | 2AAEX-SDABGN                    |
| IC ID           | 7228C-SDABGN                    |

### Spec for Radio –

| Radio Type             | 802.11b  | 802.11g                                      | 802.11a                                      | 802.11n-20M  | 802.11n-40M                                  |
|------------------------|--|--|--|--|--|
| Operating Frequency    | 2412-2462MHz   | 2412-2462MHz                                 | 5180-5320MHz<br>5470-5725MHz<br>5725-5825MHz | 2412-2462MHz<br>5180-5320MHz<br>5470-5725MHz<br>5725-5825MHz | 5190-5310MHz<br>5510-5670MHz<br>5755-5795MHz |
| Modulation             | DSSS<br>(CCK, DQPSK,<br>DBPSK)   | OFDM-CCK<br>(BPSK, QPSK,<br>16QAM,<br>64QAM) | OFDM (BPSK,<br>QPSK,<br>16QAM,<br>64QAM)     | OFDM (BPSK,<br>QPSK,<br>16QAM,<br>64QAM)                     | OFDM (BPSK,<br>QPSK,<br>16QAM,<br>64QAM)     |
| Channel Spacing        | 5MHz   | 5MHz   | 20MHz  | 5MHz(2.4GHz),<br>20MHz (5GHz)                                | 40MHz  |
| Number of Channels     | 11   | 11   | 21   | 11(2.4GH)<br>21 (5GHz)                                       | 14 (5GHz)                                    |
| Antenna Type           | Embedded antenna: Laird Mini-NanoBlade                                 |  |  |  |  |
| Antenna Dimension      | 35mm * 12mm  |  |  |  |  |
| Antenna Gain           | Embedded antenna: 2.0-2.5 dBi (2.4-2.5GHz), 2.5-4.8 dBi (4.9-5.875GHz) |  |  |  |  |
| Antenna Connector Type | U.FL connector   |  |  |  |  |

### Channel list

| Type             |           | Channel No. | Frequency (MHz) | Available (Y/N) |
|------------------|-----------|-------------|-----------------|-----------------|
| 802.11b/g/n-HT20 | 2412-2462 | 1           | 2412            | Y               |
|                  |           | 2           | 2417            | Y               |
|                  |           | 3           | 2422            | Y               |
|                  |           | 4           | 2427            | Y               |
|                  |           | 5           | 2432            | Y               |
|                  |           | 6           | 2437            | Y               |
|                  |           | 7           | 2442            | Y               |
|                  |           | 8           | 2447            | Y               |
|                  |           | 9           | 2452            | Y               |
|                  |           | 10          | 2457            | Y               |
|                  |           | 11          | 2462            | Y               |
|                  | 2467-2472 | 12          | 2467            | -               |
|                  |           | 13          | 2472            | -               |
|                  | 2484      | 14          | 2484            | -               |

|                 |                                 |
|-----------------|---------------------------------|
| Test report No. | SL13072601-SLX-008_FCC,IC (SAR) |
| Page            | 7 of 44                         |
| FCC ID          | 2AAEX-SDABGN                    |
| IC ID           | 7228C-SDABGN                    |

| Type           |              | Channel No. | Frequency (MHz) | Available (Y/N) |
|----------------|--------------|-------------|-----------------|-----------------|
| 802.11a/n-HT20 | 5150-5250MHz | 36          | 5180            | Y               |
|                |              | 40          | 5200            | Y               |
|                |              | 44          | 5220            | Y               |
|                |              | 48          | 5240            | Y               |
|                | 5250-5350MHz | 52          | 5260            | Y               |
|                |              | 56          | 5280            | Y               |
|                |              | 60          | 5300            | Y               |
|                |              | 64          | 5320            | Y               |
|                | 5470-5725MHz | 100         | 5500            | Y               |
|                |              | 104         | 5520            | Y               |
|                |              | 108         | 5540            | Y               |
|                |              | 112         | 5560            | Y               |
|                |              | 116         | 5580            | Y               |
|                |              | 132         | 5660            | Y               |
|                |              | 136         | 5680            | Y               |
|                |              | 140         | 5700            | Y               |
|                | 5725-5825MHz | 149         | 5745            | Y               |
|                |              | 153         | 5765            | Y               |
|                |              | 157         | 5785            | Y               |
|                |              | 161         | 5805            | Y               |
|                |              | 165         | 5825            | Y               |

| Type         |              | Channel No. | Frequency (MHz) | Available (Y/N) |
|--------------|--------------|-------------|-----------------|-----------------|
| 802.11n-HT40 | 5150-5250MHz | 36,40       | 5190            | Y               |
|              |              | 40,44       | 5210            | Y               |
|              |              | 44,48       | 5230            | Y               |
|              | 5250-5350MHz | 52,56       | 5270            | Y               |
|              |              | 56,60       | 5290            | Y               |
|              |              | 60,64       | 5310            | Y               |
|              | 5470-5725MHz | 100,104     | 5510            | Y               |
|              |              | 104,108     | 5530            | Y               |
|              |              | 108,112     | 5550            | Y               |
|              |              | 112,116     | 5570            | Y               |
|              |              | 132,136     | 5670            | Y               |
|              | 5725-5825MHz | 149,153     | 5755            | Y               |
|              |              | 153,157     | 5775            | Y               |
|              |              | 157,161     | 5795            | Y               |



|                 |                                 |
|-----------------|---------------------------------|
| Test report No. | SL13072601-SLX-008_FCC,IC (SAR) |
| Page            | 8 of 44                         |
| FCC ID          | 2AAEX-SDABGN                    |
| IC ID           | 7228C-SDABGN                    |

## 7 Accessories/Software and cabling Description

### Accessories List

| Index | Accessories Description | Model | Serial No. | Manu | Note |
|-------|-------------------------|-------|------------|------|------|
| -     | -                       | -     | -          | -    | -    |
|       |                         |       |            |      |      |
|       |                         |       |            |      |      |
|       |                         |       |            |      |      |

### Battery options List

| Index | Battery option Description | Model | Serial No. | Manu | Note |
|-------|----------------------------|-------|------------|------|------|
| -     | -                          | -     | -          | -    | -    |
|       |                            |       |            |      |      |
|       |                            |       |            |      |      |
|       |                            |       |            |      |      |

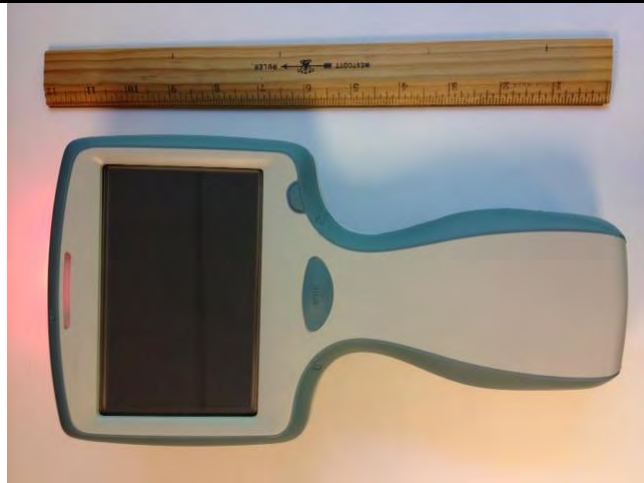
### Test Software Description

| Test Item | Software               | Description                                     |
|-----------|------------------------|---|
| SAR       | Hyper Terminal program | Set the EUT to different modulation and channel |

|                 |                                 |
|-----------------|---------------------------------|
| Test report No. | SL13072601-SLX-008_FCC,IC (SAR) |
| Page            | 9 of 44                         |
| FCC ID          | 2AAEX-SDABGN                    |
| IC ID           | 7228C-SDABGN                    |

## 8 EUT Photos

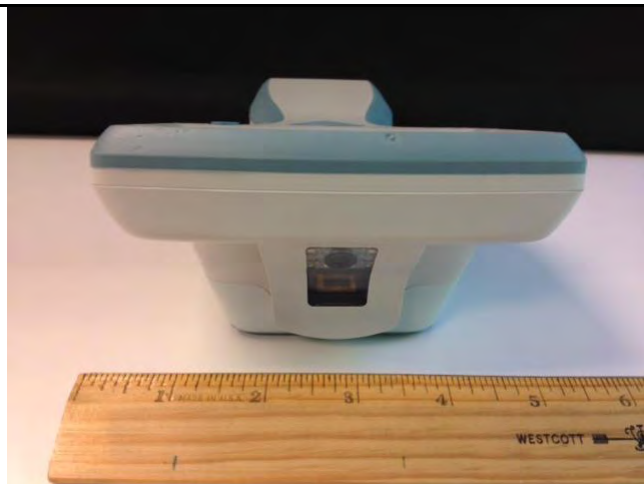
### 8.1 EUT Photos - External



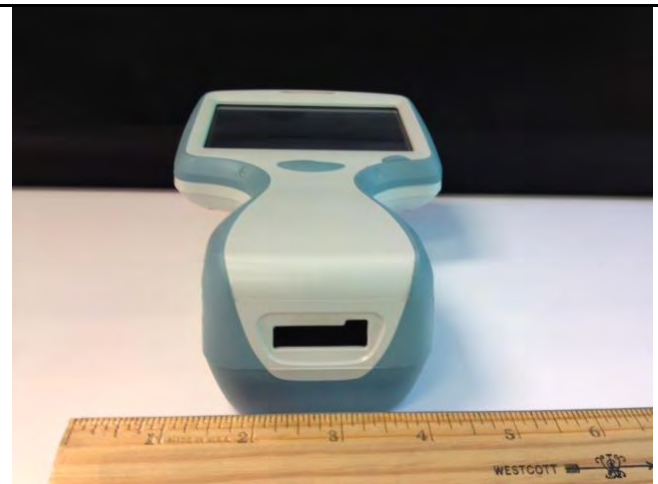
Top



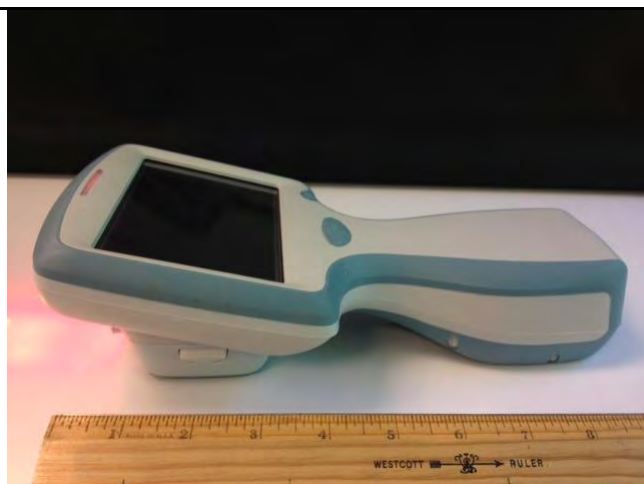
Bottom



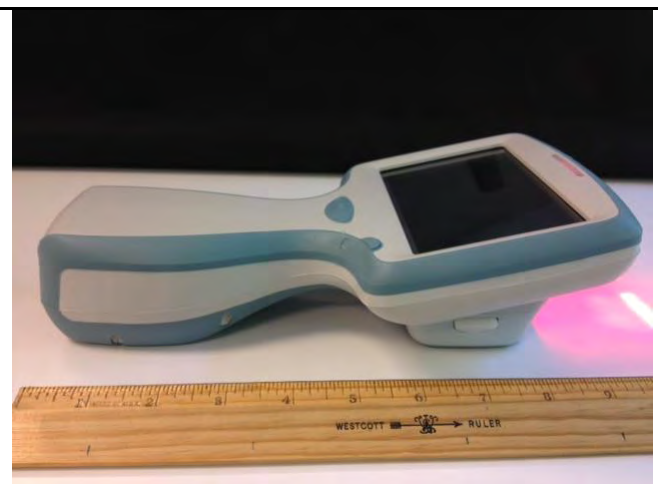
Front



Rear



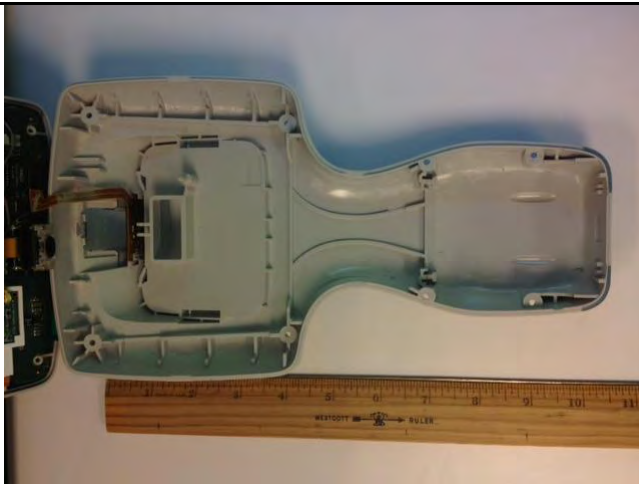
Left Side



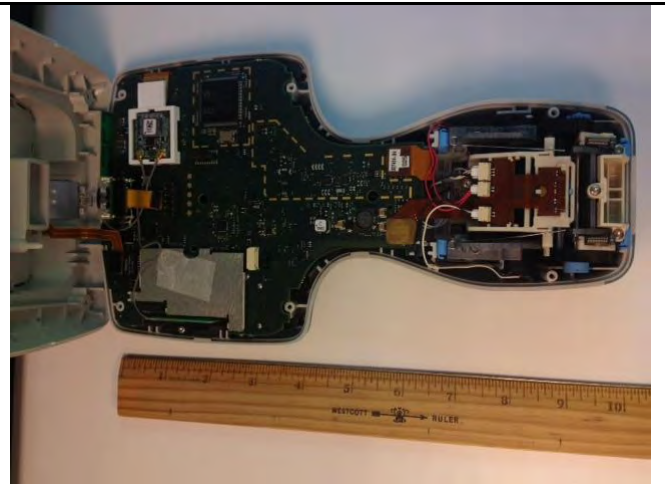
Right Side

|                 |                                 |
|-----------------|---------------------------------|
| Test report No. | SL13072601-SLX-008_FCC,IC (SAR) |
| Page            | 10 of 44                        |
| FCC ID          | 2AAEX-SDABGN                    |
| IC ID           | 7228C-SDABGN                    |

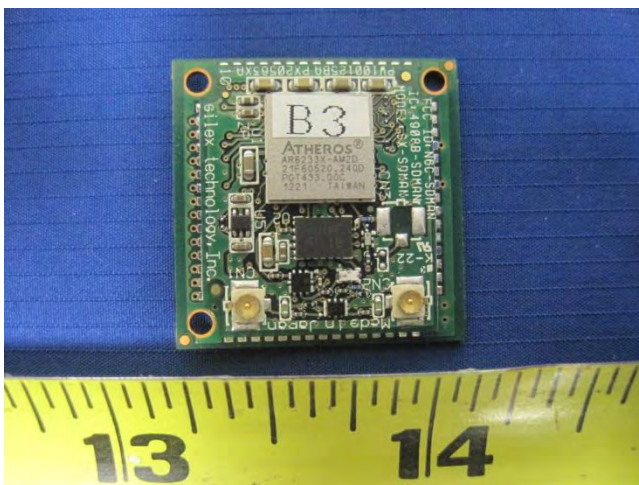
## 8.2 EUT Photos - Internal



EUT Cover view



EUT Cover off view



Radio Module - Top zoom in view



Radio Module - Bottom zoom in view

|                 |                                 |
|-----------------|---------------------------------|
| Test report No. | SL13072601-SLX-008_FCC,IC (SAR) |
| Page            | 11 of 44                        |
| FCC ID          | 2AAEX-SDABGN                    |
| IC ID           | 7228C-SDABGN                    |

## 9 KDB Consideration

| Item                          | Applicable  | Note                 |
|-------------------------------|---|----------------------|
| Applicable KDB                | <input checked="" type="checkbox"/> 447498 D01 General RF Exposure Guidance v05r01  | -                    |
| Exposure condition            | <input checked="" type="checkbox"/> Portable <input type="checkbox"/> Mobile <input type="checkbox"/> Mixed Mobile & Portable | -                    |
| Exposure limit                | <input checked="" type="checkbox"/> General/public <input type="checkbox"/> Occupational                                      | -                    |
| Operating Config              | <input checked="" type="checkbox"/> Standalone <input type="checkbox"/> Simultaneous Transmission                             | -                    |
| Enhanced Zoom Scan            | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No   | -                    |
| Volume scan post-processing   | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No   | -                    |
| Tune-up power                 | <input checked="" type="checkbox"/> Output power can't be more than 2dB lower than max tune-up power tolerance                | -                    |
| Scale SAR to tune-up          | <input checked="" type="checkbox"/> Scale SAR to the maximum tune-up tolerance limit  | See SAR result table |
| Antenna variation             | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> N/A  | -                    |
| List of body-worn accessories | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> N/A  | -                    |

### SAR Test exclusion

|   |  |                       |
|---|--|-----------------------|
| Testing of other required channels within the operating mode of a frequency band is not required when the reported 1-g or 10-g SAR for the mid-band or highest output power channel is: |  | Not applicable for IC |
| transmission band is $\leq 100$ MHz   | <input type="checkbox"/> $\leq 0.8$ W/kg or 2.0 W/kg, for 1-g or 10-g respectively |                       |
| transmission band between 100 MHz-200 MHz   | <input type="checkbox"/> $\leq 0.6$ W/kg or 1.5 W/kg, for 1-g or 10-g respectively |                       |
| transmission band is $\geq 200$ MHz   | <input type="checkbox"/> $\leq 0.4$ W/kg or 1.0 W/kg, for 1-g or 10-g respectively |                       |

| Item               | Applicable   | Note   |
|--------------------|--|--|
| Applicable KDB     | <input checked="" type="checkbox"/> 248227 SAR measurement procedures for 802.11 a/b/g TX  | -  |
| Power reduction    | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No  | -  |
| Test Reduction     | <input checked="" type="checkbox"/> SAR is not required for 802.11g if maximum output power is less than 1/4 dB higher than 802.11b.   | 802.11b has output 1/4dB higher than 802.11g/n-2.4GHz; 802.11a is not 1/4 dB higher than 802.11n. So no testing for 802.11g and 802.11a. |
| BW selection       | <input type="checkbox"/> Highest CH BW with highest output power. Lower BW is not required if power is 1/4 dB less high.   | 20MHz and 40MHz BW were tested.  |
| Data Rate          | <input checked="" type="checkbox"/> Each CH should be tested at the lowest data rate. Higher data rate and higher order modulation is not required if power is 1/4 dB less high. | See output power measurement result and SAR result   |
| Duty Cycle scaling | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No  | See SAR result table   |
| Switch diversity   | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No  | -  |
|                    | <input checked="" type="checkbox"/> Each antenna has 1g SAR $< 1.2$ W/kg, then the SAR only need to be measured with higher SAR antenna  | -  |
| MIMO               | <input type="checkbox"/> Transmit simultaneously<br><input type="checkbox"/> Each antenna is tested independently  | Not applicable   |

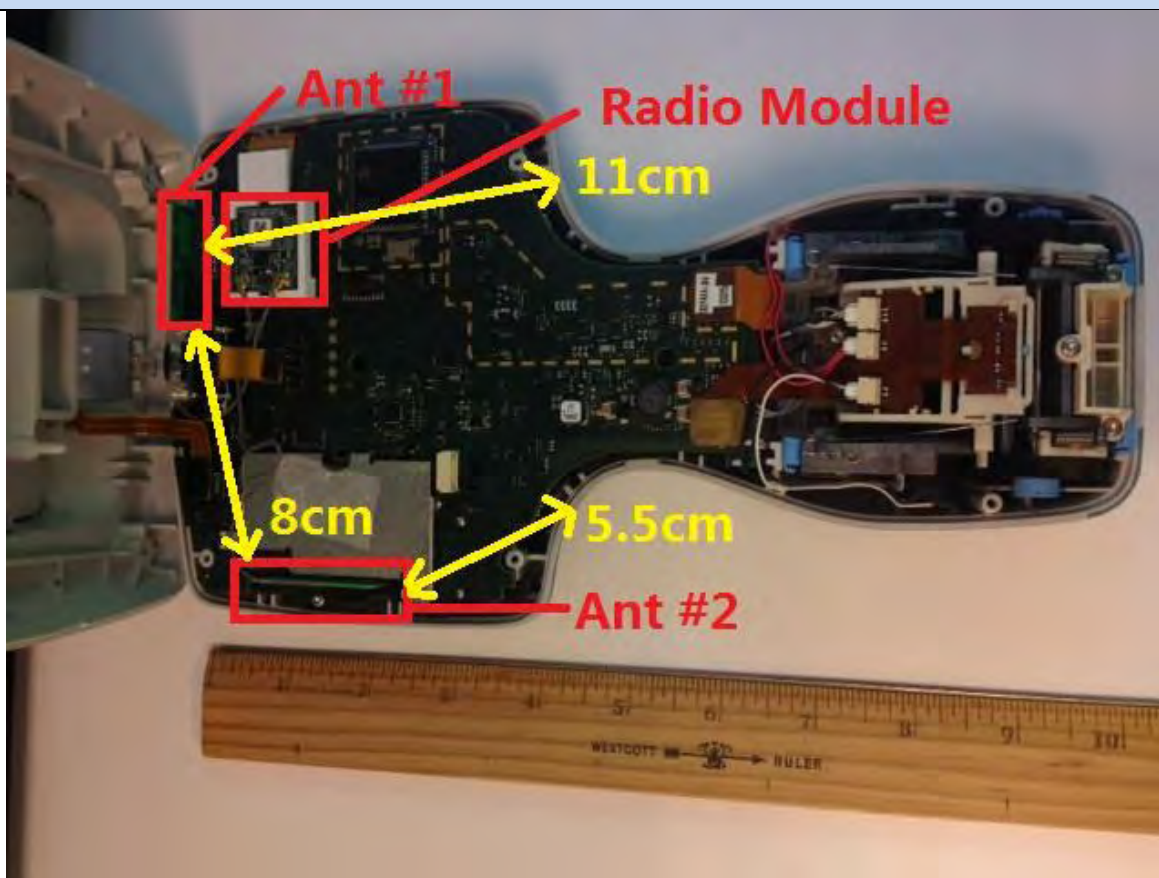


|                 |                                 |
|-----------------|---------------------------------|
| Test report No. | SL13072601-SLX-008_FCC,IC (SAR) |
| Page            | 12 of 44                        |
| FCC ID          | 2AAEX-SDABGN                    |
| IC ID           | 7228C-SDABGN                    |

### Simultaneous SAR Evaluation

| Test Case      | TX Ant1   | TX Ant2 | Tx Ant3 | The shortest distance between Ant & Ant2 (mm) |
|----------------|---|---------|---------|---|
| -              | -   | -       | -       | -   |
| -              | -   | -       | -       | -   |
| <b>Remark:</b> | N/A. EUT uses 2 TX diversity antennas, which won't transmit simultaneously. |         |         |   |

### Antenna Location & Separation distance



**Remark:**

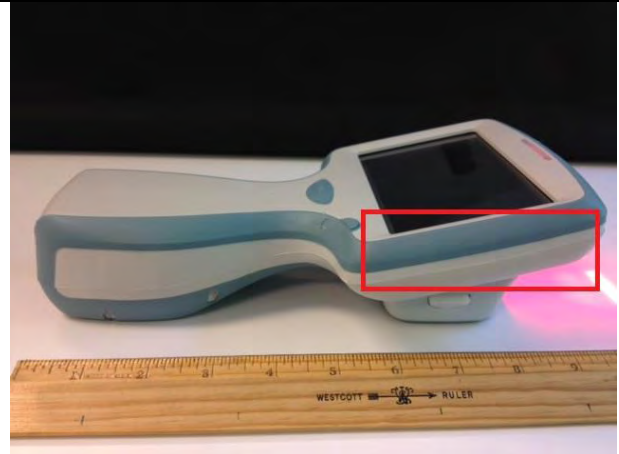
1. EUT uses 2 TX diversity antennas, which won't transmit simultaneously.
2. EUT is handheld device only, the hand will only touch the handle part. No other part will be in touch with human body.
3. The separation between 2 antennas is 8cm.
4. The separation between the Antenna #1 to the device handle part is 11 cm
5. The separation between the Antenna #2 to the device handle part is 5.5 cm.

|                 |                                 |
|-----------------|---------------------------------|
| Test report No. | SL13072601-SLX-008_FCC,IC (SAR) |
| Page            | 13 of 44                        |
| FCC ID          | 2AAEX-SDABGN                    |
| IC ID           | 7228C-SDABGN                    |

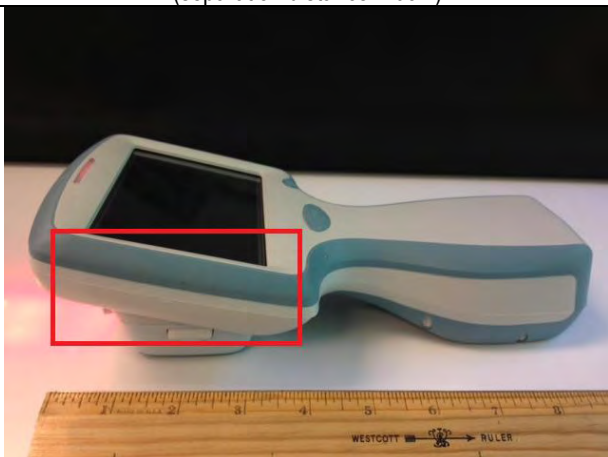
#### EUT Test Position for SAR



Front position against flat phantom (Ant #1 location)  
(separation distance – 0cm)



Right edge position against flat phantom (Ant #2 location)  
(separation distance – 0cm)



Left position against flat phantom (Ant #1 location)  
(separation distance – 0cm)

#### Remark:

- The Front, Right and left edge position was tested for SAR on following modes with higher output power,
  - 802.11b
  - 802.11a
  - 802.11n-HT40
 The separation distance is 0cm. For other position like Top , Bottom, was tested in report for original FCC/IC grant filing. Please refer to test report: SL13020802-SLX-002\_IC (RSS-102\_SAR) Rev1.0
- It's found that the front position is worst case. The low, mid and high channel of 802.11b mode, and 802.11n-HT40 mode were chosen for additional SAR measurement at this position.

|                 |                                 |
|-----------------|---------------------------------|
| Test report No. | SL13072601-SLX-008_FCC,IC (SAR) |
| Page            | 14 of 44                        |
| FCC ID          | 2AAEX-SDABGN                    |
| IC ID           | 7228C-SDABGN                    |

### EUT Test Setup Photos



**SAR Test System**



**Test setup – Front Position**



**Test setup – Right Position**



**Test setup – Left Position**

|                 |                                 |
|-----------------|---------------------------------|
| Test report No. | SL13072601-SLX-008_FCC,IC (SAR) |
| Page            | 15 of 44                        |
| FCC ID          | 2AAEX-SDABGN                    |
| IC ID           | 7228C-SDABGN                    |

## 10 Test Summary

| Test Item | Test standard |                 | Test Method/Procedure |  | Pass / Fail  |
|-----------|---------------|-----------------|-----------------------|--|--|
| SAR       | IC            | RSS 102 Issue 4 | IC                    | IEEE 1528 – 2003<br>IEC 62209-2: 2010<br>KDB 447498 D01 General RF Exposure Guidance v05r01<br>KDB 248227 SAR measurement procedures for 802.11 a/b/g TX | <input checked="" type="checkbox"/> Pass<br><input type="checkbox"/> N/A |



|                 |                                 |
|-----------------|---------------------------------|
| Test report No. | SL13072601-SLX-008_FCC,IC (SAR) |
| Page            | 16 of 44                        |
| FCC ID          | 2AAEX-SDABGN                    |
| IC ID           | 7228C-SDABGN                    |

## 11 SAR Introduction

### Introduction

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

### SAR Definition

Specific Absorption Rate is defined as the time derivative (rate) of the incremental energy (dW) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dV) of a given density ( $\rho$ ).

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

SAR is expressed in units of watts per kilogram (W/kg). SAR can be related to the electric field at a point by

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

Where:

$\sigma$  = conductivity of the tissue (S/m)  
 $\rho$  = mass density of the tissue (kg/m<sup>3</sup>)  
 $E$  = RMS electric field strength (V/m)

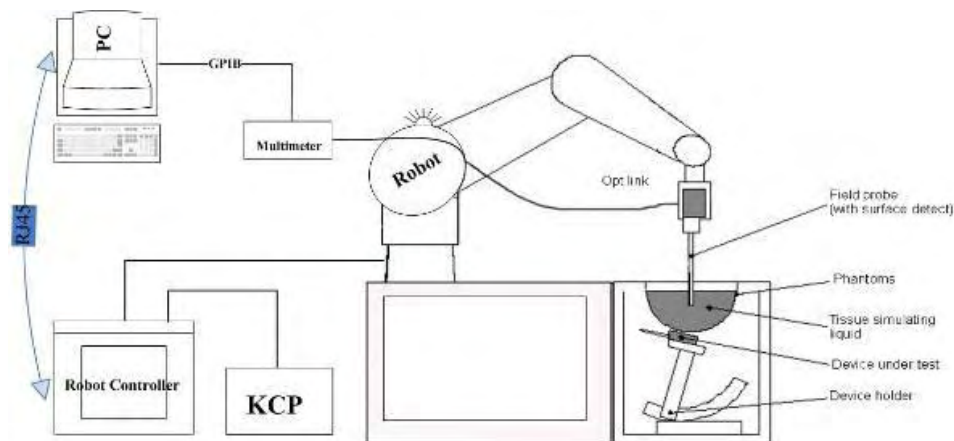
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|-----------------|---------------------------------|
| Test report No. | SL13072601-SLX-008_FCC,IC (SAR) |
| Page            | 17 of 44                        |
| FCC ID          | 2AAEX-SDABGN                    |
| IC ID           | 7228C-SDABGN                    |

## 12 SAR Measurement Setup

### Dosimetric Assessment System

These measurements were performed with the automated near-field scanning system OPENSAR from SATIMO. The system is based on a high precision robot (working range: 850 mm), which positions the probes with a positional repeatability of better than  $\pm 0.02$  mm. Special E- and H-field probes have been developed for measurements close to material discontinuity, the sensors of which are directly loaded with a Schottky diode and connected via highly resistive lines to the data acquisition unit.

### Measurement System Diagram



### The OPENSAR

- A standard high precision 6-axis robot (KUKA) with controller and software.
- KUKA Control Panel (KCP).
- A dosimetric probe, i.e., an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid. The probe is equipped with an optical surface detector system.
- A computer operating Windows XP.
- OPENSAR software.
- Remote control with teaches pendant and additional circuitry for robot safety such as warning lamps, etc.
- The SAM phantom enabling testing left-hand right-hand and body usage.
- The Position device for handheld EUT.
- Tissue simulating liquid mixed according to the given recipes.
- System validation dipoles to validate the proper functioning of the system.

|                 |                                 |
|-----------------|---------------------------------|
| Test report No. | SL13072601-SLX-008_FCC,IC (SAR) |
| Page            | 18 of 44                        |
| FCC ID          | 2AAEX-SDABGN                    |
| IC ID           | 7228C-SDABGN                    |

## EP100 Probe

The SAR measurements were conducted with dosimetric probe (manufactured by SATIMO), designed in the classical triangular configuration and optimized for dosimetric evaluation. The probe has been calibrated according to the procedure described in SAR standard with accuracy of better than  $\pm 10\%$ .



It is connected to the KRC box on the robot arm and provides an automatic detection of the phantom surface. The 3D file of the phantom is include in OpenSAR software. The Video Positioning System allow the system to take the automatic reference and to move the probe safely and accurately on the phantom.

| Parameter                                 | Description   |
|---|---|
| Frequency Range                           | 100 MHz to 6 GHz  |
| Linearity                                 | 0.25 dB (100 MHz to 6 GHz)  |
| Directivity                               | 0.25 dB in brain tissue (rotation around probe axis)<br>0.5 dB in brain tissue (rotation normal probe axis) |
| Dynamic                                   | 0.001W/kg to > 100W/kg  |
| Range Linearity                           | 0.25 dB   |
| Surface                                   | 0.2 mm repeatability in air and liquids   |
| Dimensions Overall length                 | 330 mm  |
| Tip length                                | 16 mm   |
| Body diameter                             | 8 mm  |
| Tip diameter                              | 2.6 mm  |
| Distance from probe tip to dipole centers | <1.5 mm   |

### E-Field Probe Calibration

Each probe is calibrated according to a dosimetric assessment procedure described in SAR standard with accuracy better than  $\pm 10\%$ . The spherical isotropy was evaluated with the procedure described in SAR standard and found to be better than  $\pm 0.25\text{dB}$ . The sensitivity parameters (NormX, NormY, NormZ), the diode compression parameter (DCP) and the conversion factor (ConvF) of the probe are tested.

The free space E-field from probe outputs is determined in a test chamber. This is performed in a TEM cell for frequencies bellow 0.8 GHz, and in a waveguide above 0.8 GHz for free space. For the free space calibration, the probe is placed in the volumetric center of the cavity and at the proper orientation with the field. E-field correlation calibration is performed in a flat phantom filled with the appropriate simulated brain tissue.

|                 |                                 |
|-----------------|---------------------------------|
| Test report No. | SL13072601-SLX-008_FCC,IC (SAR) |
| Page            | 19 of 44                        |
| FCC ID          | 2AAEX-SDABGN                    |
| IC ID           | 7228C-SDABGN                    |

## SAM Phantom

The SAM Phantom SAM29 is constructed of a fiberglass shell integrated in a wooden table. The shape of the shell is in compliance with the specification set in IEEE P1528 and CENELEC EN62209-1.

The phantom enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region.

A cover prevents the evaporation of the liquid.

Reference markings on the Phantom allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points in the robot.

Shell Thickness: 0.2 mm

Filling Volume: Approx. 25 liters

Dimensions (H x L x W): 810 x 1000 x 500 mm

Liquid is filled to at least 15mm from the bottom of Phantom.



## Device Holder

In combination with the Generic Twin Phantom V3.0, the Mounting Device enables the rotation of the mounted transmitter in spherical coordinates whereby the rotation points is the ear opening. The devices can be easily, accurately, and repeatedly positioned according to the FCC and CENELEC specifications. The device holder can be locked at different phantom locations (left head, right head, flat phantom).

*Note: A simulating human hand is not used due to the complex anatomical and geometrical structure of the hand that may produce infinite number of configurations [10]. To produce the worst-case condition. (the hand absorbs antenna output power), the hand is omitted during the tests.*



|                 |                                 |
|-----------------|---------------------------------|
| Test report No. | SL13072601-SLX-008_FCC,IC (SAR) |
| Page            | 20 of 44                        |
| FCC ID          | 2AAEX-SDABGN                    |
| IC ID           | 7228C-SDABGN                    |

## Data Evaluation

The OPENSAR software automatically executes the following procedure to calculate the field units from the microvolt readings at the probe connector. The parameters used in the valuation are stored in the configuration modules of the software:

|                  |                           |                   |
|------------------|---------------------------|-------------------|
| Probe Parameters | - Sensitivity             | Norm <sub>i</sub> |
|                  | - Conversion factor       | ConvFi            |
|                  | - Diode compression point | Dcpi              |
| Device Parameter | - Frequency               | f                 |
|                  | - Crest factor            | cf                |
| Media Parameters | - Conductivity            | σ                 |
|                  | - Density                 | ρ                 |

These parameters must be set correctly in the software. They can either be found in the component documents or are imported into the software from the configuration files issued for the OPENSAR components.

The first step of the evaluation is a linearization of the filtered input signal to account for the compression characteristics of the detector diode. The compensation depends on the input signal, the diode type and the DC-transmission factor from the diode to the evaluation electronics. If the exciting field is pulsed, the crest factor of the signal must be known to correctly compensate for peak power. The formula for each channel can be given as

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

Where  $V_i$  = Compensated signal of channel  $i$  ( $i = x, y, z$ )

$U_i$  = Input signal of channel  $i$  ( $i = x, y, z$ )

$cf$  = Crest factor of exciting field (DASY parameter)

$dcp_i$  = Diode compression point (DASY parameter)

From the compensated input signals the primary field data for each channel can be evaluated:

$$E_i \text{ probes: } E_i = \frac{V_i}{\sqrt{\text{Norm}_i \cdot \text{ConvFi}}}$$

$$H_i \text{ probes: } H_i = \sqrt{V_i} \cdot \frac{a_{i0} + a_{i1}f + a_{i2}f^2}{f}$$

Where  $V_i$  = Compensated signal of channel  $i$  ( $i = x, y, z$ )

$\text{Norm}_i$  = Sensor sensitivity of channel  $i$  ( $i = x, y, z$ )

$\mu\text{V}/(\text{V/m})^2$  for E-field Probes

$\text{ConvFi}$  = Sensitivity enhancement in solution

$a_{ij}$  = Sensor sensitivity factors for H-field probes

$f$  = Carrier frequency (GHz)

$E_i$  = Electric field strength of channel  $i$  in V/m

$H_i$  = Magnetic field strength of channel  $i$  in A/m

The RSS value of the field components gives the total field strength (Hermitian magnitude):

$$E_{\text{tot}} = \sqrt{E_x^2 + E_y^2 + E_z^2}$$

The primary field data are used to calculate the derived field units.

$$\text{SAR} = E_{\text{tot}}^2 \cdot \frac{\sigma}{\rho \cdot 1000}$$

where  $\text{SAR}$  = local specific absorption rate in mW/g

$E_{\text{tot}}$  = total field strength in V/m

$\sigma$  = conductivity in [mho/m] or [siemens/m]

$\rho$  = equivalent tissue density in g/cm<sup>3</sup>

Note that the density is normally set to 1 (or 1.06), to account for actual brain density rather than the density of the simulation liquid.

The power flow density is calculated assuming the excitation field as a free space field.

$$P_{\text{pw}} = \frac{E_{\text{tot}}^2}{3770} \quad \text{or} \quad P_{\text{pw}} = H_{\text{tot}}^2 \cdot 37.7$$

where  $P_{\text{pw}}$  = Equivalent power density of a plane wave in mW/cm<sup>2</sup>

$E_{\text{tot}}$  = total electric field strength in V/m

$H_{\text{tot}}$  = total magnetic field strength in A/m

|                 |                                 |
|-----------------|---------------------------------|
| Test report No. | SL13072601-SLX-008_FCC,IC (SAR) |
| Page            | 21 of 44                        |
| FCC ID          | 2AAEX-SDABGN                    |
| IC ID           | 7228C-SDABGN                    |

## SAR Evaluation – Peak Spatial - Average

The procedure for assessing the peak spatial-average SAR value consists of the following steps

- **Power Reference Measurement**

The reference and drift jobs are useful jobs for monitoring the power drift of the device under test in the batch process. Both jobs measure the field at a specified reference position, at a selectable distance from the phantom surface. The reference position can be either the selected section's grid reference point or a user point in this section. The reference job projects the selected point onto the phantom surface, orients the probe perpendicularly to the surface, and approaches the surface using the selected detection method.

- **Area Scan**

The area scan is used as a fast scan in two dimensions to find the area of high field values, before doing a finer measurement around the hot spot. The sophisticated interpolation routines implemented in OPENSAR software can find the maximum locations even in relatively coarse grids. The scan area is defined by an editable grid. This grid is anchored at the grid reference point of the selected section in the phantom. When the area scan's property sheet is brought-up, grid was at 15 mm by 15 mm and can be edited by a user.

- **Zoom Scan**

Zoom scans are used to assess the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g of simulated tissue. The default zoom scan measures 5 x 5 x 7 points within a cube whose base faces are centered on the maximum found in a preceding area scan job within the same procedure. If the preceding Area Scan job indicates more than one maximum, the number of Zoom Scans has to be enlarged accordingly (The default number inserted is 1).

- **Power Drift measurement**

The drift job measures the field at the same location as the most recent reference job within the same procedure, and with the same settings. The drift measurement gives the field difference in dB from the reading conducted within the last reference measurement. Several drift measurements are possible for one reference measurement. This allows a user to monitor the power drift of the device under test within a batch process. In the properties of the Drift job, the user can specify a limit for the drift and have OPENSAR software stop the measurements if this limit is exceeded.

## SAR Evaluation – Peak SAR

The procedure for spatial peak SAR evaluation has been implemented according to the IEEE1529 standard. It can be conducted for 1 g and 10 g. The OPENSAR system allows evaluations that combine measured data and robot positions, such as:

- Maximum search
- Extrapolation
- Boundary correction
- Peak search for averaged SAR

During a maximum search, global and local maximum searches are automatically performed in 2-D after each Area Scan measurement with at least 6 measurement points. It is based on the evaluation of the local SAR gradient calculated by the Quadratic Shepard's method. The algorithm will find the global maximum and all local maxima within -2 dB of the global maxima for all SAR distributions.

### Extrapolation

Extrapolation routines are used to obtain SAR values between the lowest measurement points and the inner phantom surface. The extrapolation distance is determined by the surface detection distance and the probe sensor offset. Several measurements at different distances are necessary for the extrapolation.

They are used in the Cube Scan to obtain SAR values between the lowest measurement points and the inner phantom surface. The routine uses the fourth order least square polynomial method for extrapolation. For a grid using 5x5x7 measurement points with 5mm resolution amounting to 343 measurement points, the uncertainty of the extrapolation routines is less than 1% for 1 g and 10 g cubes.



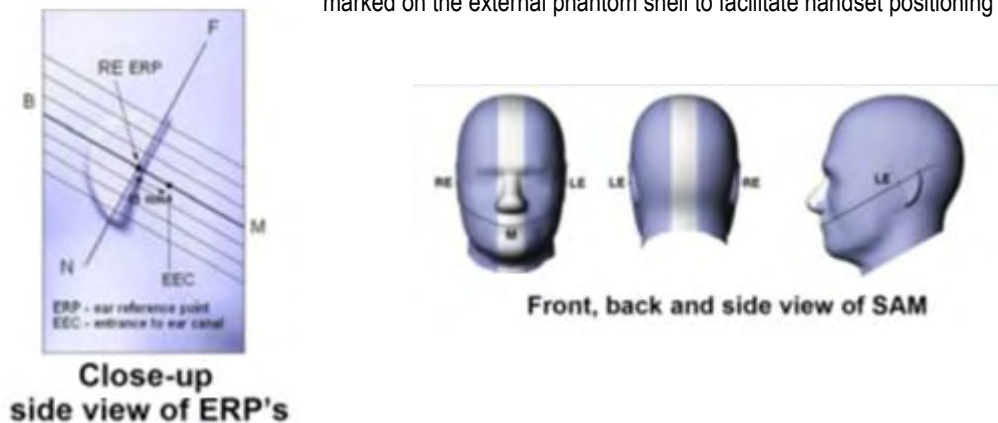
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|-----------------|---------------------------------|
| Test report No. | SL13072601-SLX-008_FCC,IC (SAR) |
| Page            | 22 of 44                        |
| FCC ID          | 2AAEX-SDABGN                    |
| IC ID           | 7228C-SDABGN                    |

## Device Reference Points

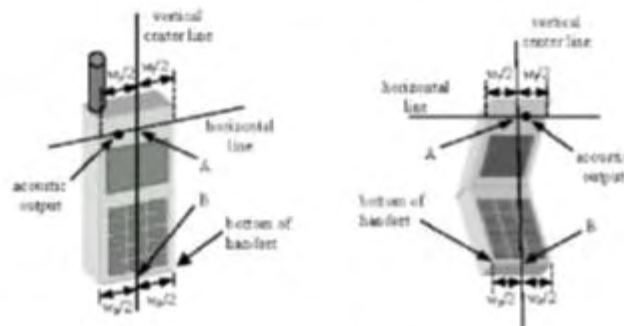
### Definition of Reference Points

#### Ear Reference Point

Figure 6.2 shows the front, back and side views of the SAM Phantom. The point "M" is the reference point for the center of the mouth, "LE" is the left ear reference point (ERP), and "RE" is the right ERP. The ERPs are 15mm posterior to the entrance to the ear canal (EEC) along the B-M line (Back-Mouth), as shown in Figure 6.1. The plane passing through the two ear canals and M is defined as the Reference Plane. The line N-F (Neck-Front) is perpendicular to the reference plane and passing through the RE (or LE) is called the Reference Pivoting Line (see Figure 6.1). Line B-M is perpendicular to the N-F line. Both N-F and B-M lines are marked on the external phantom shell to facilitate handset positioning [5].



Two imaginary lines on the device need to be established: the vertical centerline and the horizontal line. The test device is placed in a normal operating position with the "test device reference point" located along the "vertical centerline" on the front of the device aligned to the "ear reference point" (See Fig. 6.3). The "test device reference point" is then located at the same level as the center of the ear reference point. The test device is positioned so that the "vertical centerline" is bisecting the front surface of the device at its top and bottom edges, positioning the "ear reference point" on the outer surface of both the left and right head phantoms on the ear reference point.



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|-----------------|---------------------------------|
| Test report No. | SL13072601-SLX-008_FCC,IC (SAR) |
| Page            | 23 of 44                        |
| FCC ID          | 2AAEX-SDABGN                    |
| IC ID           | 7228C-SDABGN                    |

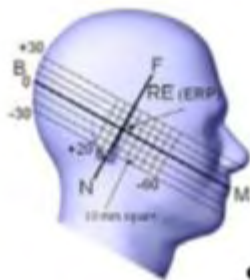
## Test Configuration – Positioning for Cheek / Touch

1. Position the device close to the surface of the phantom such that point A is on the (virtual) extension of the line passing through points RE and LE on the phantom (see Figure below), such that the plane defined by the vertical center line and the horizontal line of the device is approximately parallel to the sagittal plane of the phantom



**Front, Side and Top View of Cheek/Touch Position**

2. Translate the device towards the phantom along the line passing through RE and LE until the device touches the ear.
3. While maintaining the device in this plane, rotate it around the LE-RE line until the vertical centerline is in the plane normal to MB-NF including the line MB (called the reference plane).
4. Rotate the device around the vertical centerline until the device (horizontal line) is symmetrical with respect to the line NF.
5. While maintaining the vertical centerline in the reference plane, keeping point A on the line passing through RE and LE and maintaining the device contact with the ear, rotate the device about the line NF until any point on the device is in contact with a phantom point below the ear (cheek). See Figure below.



**Side view w/ relevant markings**



|                 |                                 |
|-----------------|---------------------------------|
| Test report No. | SL13072601-SLX-008_FCC,IC (SAR) |
| Page            | 24 of 44                        |
| FCC ID          | 2AAEX-SDABGN                    |
| IC ID           | 7228C-SDABGN                    |

## Test Configuration – Positioning for Ear / 15° Tilt

With the test device aligned in the Cheek/Touch Position”:

1. While maintaining the orientation of the device, retracted the device parallel to the reference plane far enough to enable a rotation of the device by 15 degrees.
2. Rotate the device around the horizontal line by 15 degrees.
3. While maintaining the orientation of the device, move the device parallel to the reference plane until any part of the device touches the head. (In this position, point A is located on the line RE-LE). The tilted position is obtained when the contact is on the pinna. If the contact is at any location other than the pinna, the angle of the device shall be reduced. The tilted position is obtained when any part of the device is in contact with the ear as well as a second part of the device is in contact with the head (see Figure below).



**Front, Side and Top View of Ear/15° Tilt Position**

## Test Position – Body Worn Configurations

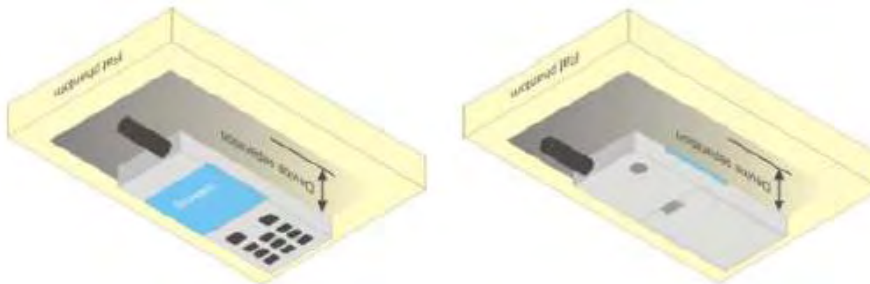
Body-worn operating configurations are tested with the accessories attached to the device and positioned against a flat phantom in a normal use configuration. A device with a headset output is tested with a headset connected to the device. Body dielectric parameters are used.

Accessories for Body-worn operation configurations are divided into two categories: those that do not contain metallic components and those that do contain metallic components. When multiple accessories that do not contain metallic components are supplied with the device, the device is tested with only the accessory that dictates the closest spacing to the body. Then, when multiple accessories that contain metallic components are supplied with the device, the device is tested with each accessory that contains a unique metallic component. If multiple accessories share an identical metallic component (i.e. the same metallic belt-clip used with different holsters with no other metallic components) only the accessory that dictates the closest spacing to the body is tested.

Body-worn accessories may not always be supplied or available as options for some devices intended to be authorized for body-worn use. In this case, a test configuration where a separation distance between the back of the device and the flat phantom is used. All test position spacing are documented.

Transmitters that are designed to operate in front of a person's face, as in push-to-talk configurations, are tested for SAR compliance with the front of the device positioned to face the flat phantom. For devices that are carried next to the body such as a shoulder, waist or chest-worn transmitters, SAR compliance is tested with the accessory(ies), including headsets and microphones, attached to the device and positioned against a flat phantom in a normal use configuration.

In all cases SAR measurements are performed to investigate the worst-case positioning. Worst-case positioning is then documented and used to perform Body SAR testing.



|                 |                                 |
|-----------------|---------------------------------|
| Test report No. | SL13072601-SLX-008_FCC,IC (SAR) |
| Page            | 25 of 44                        |
| FCC ID          | 2AAEX-SDABGN                    |
| IC ID           | 7228C-SDABGN                    |

### 13 Measurement Uncertainty

The component of uncertainty may generally be categorized according to the methods used to evaluate them. The evaluation of uncertainty by the statistical analysis of a series of observations is termed a Type A evaluation of uncertainty. The evaluation of uncertainty by means other than the statistical analysis of a series of observation is termed a Type B evaluation of uncertainty. Each component of uncertainty, however evaluated, is represented by an estimated standard deviation, termed standard uncertainty, which is determined by the positive square root of the estimated variance

A Type A evaluation of standard uncertainty may be based on any valid statistical method for treating data. This includes calculating the standard deviation of the mean of a series of independent observations; using the method of least squares to fit a curve to the data in order to estimate the parameter of the curve and their standard deviations; or carrying out an analysis of variance in order to identify and quantify random effects in certain kinds of measurement.

A type B evaluation of standard uncertainty is typically based on scientific judgment using all of the relevant information available. These may include previous measurement data, experience and specification, data provided in calibration reports and uncertainties assigned to reference data taken from handbooks. Broadly speaking, the uncertainty is either obtained from an outdoor source or obtained from an assumed distribution, such as the normal distribution, rectangular or triangular distributions indicated in Table below :

| Uncertainty Distribution           | Normal             | Rectangle      | Triangular     | U Shape        |
|------------------------------------|--------------------|----------------|----------------|----------------|
| Multi-plying Factor <sup>(a)</sup> | 1/k <sup>(b)</sup> | 1 / $\sqrt{3}$ | 1 / $\sqrt{6}$ | 1 / $\sqrt{2}$ |

(a) standard uncertainty is determined as the product of the multiplying factor and the estimated range of variations in the measured quantity

(b)  $k$  is the coverage factor

#### Standard Uncertainty for Assumed Distribution

The combined standard uncertainty of the measurement result represents the estimated standard deviation of the result. It is obtained by combining the individual standard uncertainties of both Type A and Type -sum-by taking the positive square root of the estimated variances.

Expanded uncertainty is a measure of uncertainty that defines an interval about the measurement result within which the measured value is confidently believed to lie. It is obtained by multiplying the combined standard uncertainty by a coverage factor. Typically, the coverage factor ranges from 2 to 3. Using a coverage factor allows the true value of a measured quantity to be specified with a defined probability within the specified uncertainty range. For purpose of this document, a coverage factor two is used, which corresponds to confidence interval of about 95 %.

|                 |                                 |
|-----------------|---------------------------------|
| Test report No. | SL13072601-SLX-008_FCC,IC (SAR) |
| Page            | 26 of 44                        |
| FCC ID          | 2AAEX-SDABGN                    |
| IC ID           | 7228C-SDABGN                    |

The COMOSAR Uncertainty Budget is show in below table:

**Uncertainty Budget of COMOSAR for frequency range 300 MHz to 6 GHz**

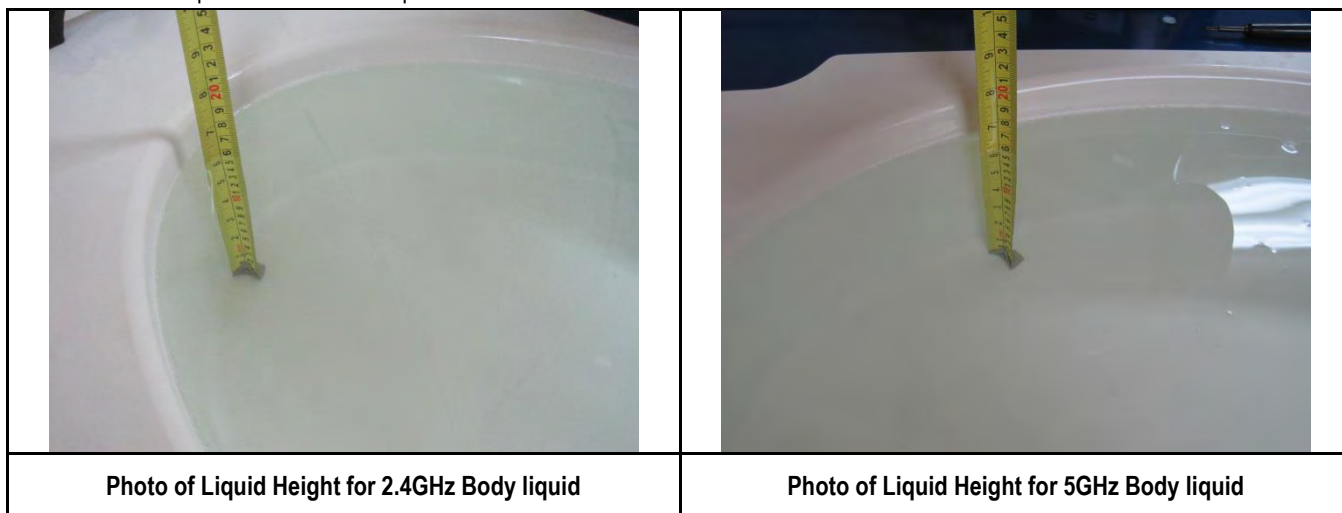
| Uncertainty Component  | Tolerances % | Probability Distribution | Divisor    | Ci (1g)        | Ci (10g)       | Uncertainty 1g(%) | Uncertainty 10g(%) |
|--|--------------|--------------------------|------------|----------------|----------------|-------------------|--------------------|
| <b>Measurement System Related</b>  |              |                          |            |                |                |                   |                    |
| Probe Calibration  | 6            | N                        | 1          | 1              | 1              | 6                 | 6                  |
| Axial Isotropy   | 3            | R                        | $\sqrt{3}$ | $\sqrt{1-C_p}$ | $\sqrt{1-C_p}$ | 1.22474           | 1.22474            |
| Hemispherical Isotropy   | 4            | R                        | $\sqrt{3}$ | $\sqrt{C_p}$   | $\sqrt{C_p}$   | 1.63299           | 1.63299            |
| Boundary Effect  | 1            | R                        | $\sqrt{3}$ | 1              | 1              | 0.57735           | 0.57735            |
| Linearity  | 5            | R                        | $\sqrt{3}$ | 1              | 1              | 2.88675           | 2.88675            |
| System Detection Limits  | 1            | R                        | $\sqrt{3}$ | 1              | 1              | 0.57735           | 0.57735            |
| Readout Electronics  | 0.5          | N                        | 1          | 1              | 1              | 0.5               | 0.5                |
| Response Time  | 0.2          | R                        | $\sqrt{3}$ | 1              | 1              | 0.11547           | 0.11547            |
| Integration Time   | 2            | R                        | $\sqrt{3}$ | 1              | 1              | 1.1547            | 1.1547             |
| RF Ambient Conditions  | 3            | R                        | $\sqrt{3}$ | 1              | 1              | 1.73205           | 1.73205            |
| Probe Positioner Mechanical Tolerances   | 2            | R                        | $\sqrt{3}$ | 1              | 1              | 1.1547            | 1.1547             |
| Probe Positioning with respect to Phantom Shell                                  | 1            | R                        | $\sqrt{3}$ | 1              | 1              | 0.57735           | 0.57735            |
| Extrapolation, Interpolation and integration Algorithms for Max. SAR Evaluation. | 1.5          | R                        | $\sqrt{3}$ | 1              | 1              | 0.86603           | 0.86603            |
| <b>Test Sample Related</b>   |              |                          |            |                |                |                   |                    |
| Test Sample Positioning  | 1.5          | N                        | 1          | 1              | 1              | 1.5               | 1.5                |
| Device Holder Uncertainty  | 5            | N                        | 1          | 1              | 1              | 5                 | 5                  |
| Output Power Variation – SAR Drift measurement                                   | 3            | R                        | $\sqrt{3}$ | 1              | 1              | 1.73205           | 1.73205            |
| <b>Phantom and Tissue Parameters Related</b>                                     |              |                          |            |                |                |                   |                    |
| Phantom Uncertainty (Shape and thickness Tolerances)                             | 4            | R                        | $\sqrt{3}$ | 1              | 1              | 2.3094            | 2.394              |
| Liquid Conductivity – deviation from target value                                | 5            | R                        | $\sqrt{3}$ | 0.64           | 0.43           | 1.84752           | 1.2413             |
| Liquid Conductivity – Measurement Uncertainty                                    | 2.5          | N                        | 1          | 0.64           | 0.43           | 1.6               | 1.075              |
| Liquid Permittivity – deviation from target value                                | 3            | R                        | $\sqrt{3}$ | 0.6            | 0.49           | 1.03923           | 0.8487             |
| Liquid Permittivity – Measurement Uncertainty                                    | 2.5          | N                        | 1          | 0.6            | 0.49           | 1.5               | 1.225              |
| <b>Combined Standard Uncertainty</b>   |              |                          |            |                |                | 9.66051 %         | 9.52428 %          |
| <b>Expanded Standard Uncertainty ( K=2 , confidence 95%)</b>                     |              |                          |            |                |                | 18.9346 %         | 18.6676 %          |

|                 |                                 |
|-----------------|---------------------------------|
| Test report No. | SL13072601-SLX-008_FCC,IC (SAR) |
| Page            | 27 of 44                        |
| FCC ID          | 2AAEX-SDABGN                    |
| IC ID           | 7228C-SDABGN                    |

## 14 Liquid Validation

### Liquid Validation

The dielectric parameters were checked prior to assessment using the HP85070C dielectric probe kit. The dielectric parameters measured are reported in each correspondent section.



### IEEE SCC-34/SC-2 P1528 recommended Tissue Dielectric Parameters

The head tissue dielectric parameters recommended by the IEEE SCC-34/SC-2 in P1528 have been incorporated in the following table. These head parameters are derived from planar layer models simulating the highest expected SAR for the dielectric properties and tissue thickness variations in a human head. Other head and body tissue parameters that have not been specified in P1528 are derived from the tissue dielectric parameters computed from the 4-Cole-Cole equations and extrapolated according to the head parameters specified in P1528

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

**Note:**  $\epsilon_r$  = relative permittivity,  $\sigma$  = conductivity and  $\rho = 1000 \text{ kg/m}^3$

|                 |                                 |
|-----------------|---------------------------------|
| Test report No. | SL13072601-SLX-008_FCC,IC (SAR) |
| Page            | 28 of 44                        |
| FCC ID          | 2AAEX-SDABGN                    |
| IC ID           | 7228C-SDABGN                    |

**Liquid Confirmation Result:**

| Frequency (MHz) | Target Permittivity               | Target Conductivity | Measured Permittivity               | Measured Conductivity | Permittivity Deviation | Conductivity Deviation | Limit            |
|-----------------|-----------------------------------|---------------------|-------------------------------------|-----------------------|------------------------|------------------------|------------------|
| 2412.0          | 52.75                             | 1.91                | 52.06                               | 1.83                  | -1.31                  | -4.35                  | 5                |
| 2437.0          | 52.72                             | 1.94                | 51.69                               | 1.93                  | -1.95                  | -0.30                  | 5                |
| 2450.0          | 52.70                             | 1.95                | 51.28                               | 1.93                  | -2.69                  | -1.03                  | 5                |
| 2462.0          | 52.68                             | 1.97                | 51.92                               | 1.90                  | -1.45                  | -3.41                  | 5                |
| Remark          | Measure Date<br>Relative Humidity | 9/30/2013<br>58%    | Temperature<br>Atmospheric Pressure |                       |                        |                        | 23°C<br>1019mbar |

| Frequency (MHz) | Target Permittivity               | Target Conductivity | Measured Permittivity               | Measured Conductivity | Permittivity Deviation | Conductivity Deviation | Limit            |
|-----------------|-----------------------------------|---------------------|-------------------------------------|-----------------------|------------------------|------------------------|------------------|
| 5200.0          | 49.01                             | 5.30                | 49.88                               | 5.47                  | 1.76                   | 3.16                   | 5                |
| 5230.0          | 48.97                             | 5.33                | 49.83                               | 5.49                  | 1.75                   | 2.86                   | 5                |
| 5270.0          | 48.92                             | 5.38                | 49.82                               | 5.49                  | 1.84                   | 1.97                   | 5                |
| 5500.0          | 48.61                             | 5.65                | 49.77                               | 5.52                  | 2.39                   | -2.35                  | 5                |
| 5510.0          | 48.59                             | 5.66                | 48.58                               | 5.83                  | -0.03                  | 2.98                   | 5                |
| 5550.0          | 48.54                             | 5.71                | 48.48                               | 5.90                  | -0.12                  | 3.36                   | 5                |
| 5670.0          | 48.38                             | 5.85                | 49.66                               | 5.64                  | 2.65                   | -3.62                  | 5                |
| 5755.0          | 48.26                             | 5.95                | 48.87                               | 5.71                  | 1.25                   | -4.06                  | 5                |
| 5800.0          | 48.20                             | 6.00                | 48.62                               | 5.80                  | 0.86                   | -3.39                  | 5                |
| Remark          | Measure Date<br>Relative Humidity | 10/04/2013<br>58%   | Temperature<br>Atmospheric Pressure |                       |                        |                        | 23°C<br>1019mbar |

|                 |                                 |
|-----------------|---------------------------------|
| Test report No. | SL13072601-SLX-008_FCC,IC (SAR) |
| Page            | 29 of 44                        |
| FCC ID          | 2AAEX-SDABGN                    |
| IC ID           | 7228C-SDABGN                    |

## 15 System Validation and System Verification

### 15.1 System Validation

The system validation procedure evaluates the system against reference SAR values and the performance of the probe, readout electronics, and software. The test setup utilizes a flat phantom and a reference dipole.

Thus, the system validation process does not include data scatter due to the use of anthropomorphic phantoms or uncertainty due to handset positioning variability. System validation should be performed annually, or when a new system is put into operation, or whenever modifications have been made to the system, such as a new software release, different readout electronics or different types of probes. The probe used in the test system to be validated should be properly calibrated.

System validation provides a means of system-level validation. The test system utilizes a flat phantom and a reference dipole. Thus, system validation verifies the system accuracy against its specifications but does not include the uncertainty due to the use of anthropomorphic phantoms, nor does it include the uncertainty due to handset positioning variability. This test is performed annually (e.g., after probe calibration), before measurements related to inter laboratory comparison and every time modifications have been made to the system, such as a new software release, different readout electronics, and for different types of probes.

System Validation procedure is at below,

- SAR evaluation:** A complete 1 g or 10 g averaged SAR measurement is performed. The reference dipole input power is adjusted to produce a 1 g averaged SAR value falling in the range of 0.4–10 W/kg. The 1 g or 10 g averaged SAR is measured at frequencies in reference table within the range to be used in compliance tests. The results are normalized to 1 W forward input power and compared with the reference SAR values shown in reference value. The differences from the reference values should be less than the tolerance specified for the SAR measurement system by the manufacturer or designer, i.e., within the expanded uncertainty for the system validation.
- Extrapolation routine:** Local SAR values are measured along a vertical axis directly above the reference dipole feed-point using the same test grid-point spacing as used for handset SAR evaluations. This measurement is repeated along another vertical axis with a 2 cm transverse offset from the reference dipole feed-point. SAR values at the phantom surface are extrapolated and compared with the numerical values given in reference table. The difference from the reference values should be less than the tolerance specified for the SAR measurement system by the manufacturer or designer, i.e., within the expanded uncertainty for system validation.
- Probe linearity:** The measurement in step a) is repeated using different reference dipole input power levels. The power levels are selected for each frequency to produce 1 g averaged SAR values of approximately 10 W/kg, 2 W/kg, and 0.4 W/kg. The measured SAR values are normalized to 1 W forward input power and compared with the 1 W normalized value from step a). The difference between these values should be less than the tolerance specified for the SAR measurement system by the manufacturer or designer, i.e., within the expanded uncertainty for the linearity component.
- Modulation response:** The measurements in step a) are repeated with pulse-modulated signals having a duty factor of 0.1 and pulse repetition rate of 10 Hz. The power is adjusted to produce a 1 g-averaged SAR of approximately 8 W/kg with the pulse modulated signal (corresponding to a peak spatial-average SAR of approximately 80 W/kg). The measured SAR values are normalized to 1 W forward input power and duty factor of 1, and compared with the 1 W normalized values from step a). The difference between these values should be less than the tolerance specified for the SAR measurement system by the manufacturer or designer, i.e., within the expanded uncertainty for system validation.
- System offset:** The measurements in step a) are repeated with a reference dipole input forward power that produces a 1 g or 10 g averaged SAR of approximately 0.05 W/kg. The measured SAR values are normalized to 1 W forward input power and compared with the 1 W normalized values from step a). The difference between these values should be less than the tolerance specified for the SAR measurement system by the manufacturer or designer, i.e., within the expanded uncertainty for system validation.
- Probe axial isotropy:** The center point of the probe's sensors is placed directly above the reference dipole center at a measurement distance of approximately 5–10 mm from the phantom inner surface. The probe (or reference dipole, if precise rotations are supported by the dipole fixture) is rotated around its axis  $\pm 180^\circ$  in steps no larger than  $15^\circ$ . The maximum and minimum SAR readings are recorded. The difference between these values should be less than the tolerance specified for the SAR measurement system by the manufacturer or designer, i.e., within the expanded uncertainty for the axial isotropy component.



|                 |                                 |
|-----------------|---------------------------------|
| Test report No. | SL13072601-SLX-008_FCC,IC (SAR) |
| Page            | 30 of 44                        |
| FCC ID          | 2AAEX-SDABGN                    |
| IC ID           | 7228C-SDABGN                    |

## Numerical reference SAR values (W/kg) for reference dipole and flat phantom

| Frequency (MHz) | 1 g SAR | 10 g SAR | Local SAR at surface (above feed-point) | Local SAR at surface ( $y = 2$ cm offset from feed-point) <sup>a</sup> |
|-----------------|---------|----------|---|--|
| 300             | 3.0     | 2.0      | 4.4                                     | 2.1  |
| 450             | 4.9     | 3.3      | 7.2                                     | 3.2  |
| 835             | 9.5     | 6.2      | 4.1                                     | 4.9  |
| 900             | 10.8    | 6.9      | 16.4                                    | 5.4  |
| 1450            | 29.0    | 16.0     | 50.2                                    | 6.5  |
| 1800            | 38.1    | 19.8     | 69.5                                    | 6.8  |
| 1900            | 39.7    | 20.5     | 72.1                                    | 6.6  |
| 2000            | 41.1    | 21.1     | 74.6                                    | 6.5  |
| 2450            | 52.4    | 24.0     | 104.2                                   | 7.7  |
| 3000            | 63.8    | 25.7     | 140.2                                   | 9.5  |

## Target and measurement SAR after Normalized

### System Validation Status

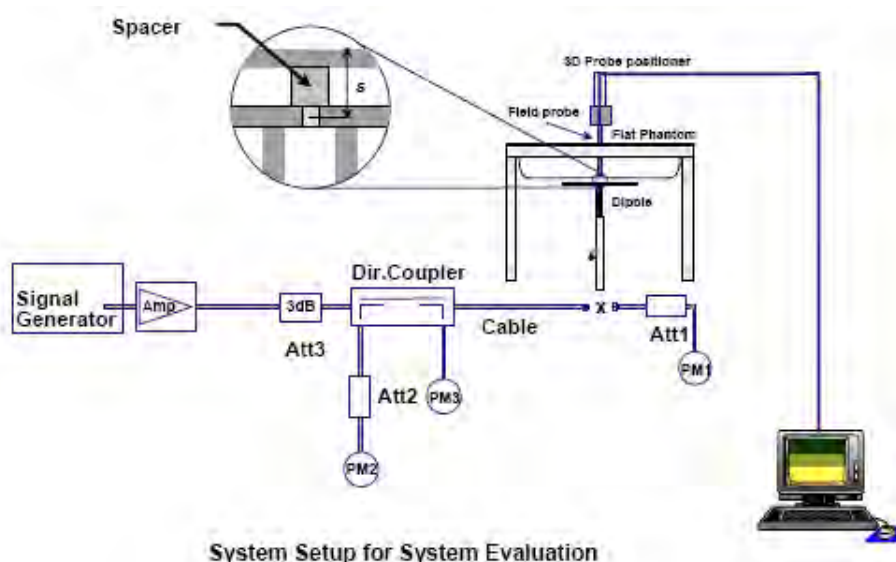
| Frequency (MHz) | Temp (oC) | Humidity (%) | Validation Date | Probe SN    | Validation Cycle | Validation Due |
|-----------------|-----------|--------------|-----------------|-------------|------------------|----------------|
| 835             | 21        | 58           | Oct 23rd, 2012  | 2611_EPG129 | 1 year           | Oct 23rd, 2013 |
| 900             | 21        | 58           | Oct 23rd, 2012  | 2611_EPG129 | 1 year           | Oct 23rd, 2013 |
| 1800            | 21        | 58           | Oct 23rd, 2012  | 2611_EPG129 | 1 year           | Oct 23rd, 2013 |
| 1900            | 21        | 58           | Oct 23rd, 2012  | 2611_EPG129 | 1 year           | Oct 23rd, 2013 |
| 2000            | 21        | 58           | Oct 23rd, 2012  | 2611_EPG129 | 1 year           | Oct 23rd, 2013 |
| 2450            | 21        | 58           | Oct 23rd, 2012  | 2611_EPG129 | 1 year           | Oct 23rd, 2013 |
| 5200            | 21        | 58           | Oct 23rd, 2012  | 2611_EPG129 | 1 year           | Oct 23rd, 2013 |
| 5500            | 21        | 58           | Oct 23rd, 2012  | 2611_EPG129 | 1 year           | Oct 23rd, 2013 |
| 5800            | 21        | 58           | Oct 23rd, 2012  | 2611_EPG129 | 1 year           | Oct 23rd, 2013 |

|                 |                                 |
|-----------------|---------------------------------|
| Test report No. | SL13072601-SLX-008_FCC,IC (SAR) |
| Page            | 31 of 44                        |
| FCC ID          | 2AAEX-SDABGN                    |
| IC ID           | 7228C-SDABGN                    |

## 15.2 System Verification

The system performance check verifies that the system operates within its specifications. System and operator errors can be detected and corrected. It is recommended that the system performance check be performed prior to any usage of the system in order to guarantee reproducible results. The system performance check uses normal SAR measurements in a simplified setup with a well characterized source. This setup was selected to give a high sensitivity to all parameters that might fail or vary over time. The system check does not intend to replace the calibration of the components, but indicates situations where the system uncertainty is exceeded due to drift or failure.

In the simplified setup for system evaluation, the DUT is replaced by a calibrated dipole and the power source is replaced by a continuous wave that comes from a signal generator. The calibrated dipole must be placed beneath the flat phantom section of the SAM twin phantom with the correct distance holder. The distance holder should touch the phantom surface with a light pressure at the reference marking and be oriented parallel to the long side of the phantom. The equipment setup is shown below:



System Setup for System Evaluation

Note: Equipment description

1. Signal Generator
2. Amplifier
3. Directional Coupler
4. Power Meter
5. Calibrated Dipole

### System Verification Results

| Measurement Date | Temp (oC) | Humidity (%) | Frequency (MHz) | Phantom/Liquid | Target SAR1g (W/kg) | Input Power (dBm) | Measured SAR1g (W/kg) | 1W Normalized SAR1g (W/kg) | Deviation (%) |
|------------------|-----------|--------------|-----------------|----------------|---------------------|-------------------|-----------------------|----------------------------|---------------|
| Sep 30th, 2013   | 23        | 58           | 2450            | Body           | 55.61               | 15.00             | 1.84                  | 58.14                      | 4.54          |
| Oct 4th, 2013    | 23        | 58           | 5200            | Body           | 162.43              | 15.00             | 4.92                  | 155.58                     | -4.21         |
| Oct 4th, 2013    | 23        | 58           | 5500            | Body           | 173.99              | 15.00             | 5.31                  | 168.06                     | -3.41         |
| Oct 4th, 2013    | 23        | 58           | 5800            | Body           | 184.02              | 15.00             | 5.63                  | 178.08                     | -3.23         |




|                 |                                 |
|-----------------|---------------------------------|
| Test report No. | SL13072601-SLX-008_FCC,IC (SAR) |
| Page            | 32 of 44                        |
| FCC ID          | 2AAEX-SDABGN                    |
| IC ID           | 7228C-SDABGN                    |

## 16 Measurements, Examination and Derived Results

### 16.1 Output Power Measurement Result

#### Requirement(s):

| Spec           | Item   | Requirement   | Applicable   |
|----------------|--|---|--|
| -              | -  | Time averaged conducted output power to be measured | <input checked="" type="checkbox"/>  |
| Test Setup     |                    |   |  |
| Test Procedure | FCC UNII Method SA-1 (trace averaging with the EUT transmitting at full power throughout each sweep) |   |  |
| Test Date      | 09/30/2013-10/4/2013   | Environmental condition                             | Temperature 22oC<br>Relative Humidity 56%<br>Atmospheric Pressure 1019mbar |
| Remark         | NONE   |   |  |
| Result         | <input checked="" type="checkbox"/> Pass <input type="checkbox"/> Fail                               |   |  |

#### Equipment Setting

| TEST            | RBW  | VBW   | SPAN            | Detector | SWEEP | Trace                 | NOTES                         |
|-----------------|------|-------|-----------------|----------|-------|-----------------------|-------------------------------|
| PK output power | 1MHz | ≥3MHz | ≥EBW or 99% OBW | RMS      | Auto  | Average on 100 traces | CH PW on 26 dB EBW or 99% OBW |

#### Data Rate setting

| Type         | Data Rate (Mbps) |
|--------------|------------------|
| 802.11b      | 1                |
| 802.11g      | 6                |
| 802.11a      | 6                |
| 802.11n-HT20 | 6.5              |
| 802.11n-HT40 | 13.5             |

Test Data    ☒ Yes      ☐ N/A

|                 |                                 |
|-----------------|---------------------------------|
| Test report No. | SL13072601-SLX-008_FCC,IC (SAR) |
| Page            | 33 of 44                        |
| FCC ID          | 2AAEX-SDABGN                    |
| IC ID           | 7228C-SDABGN                    |

## Output Power measurement result

### 2.4GHz band- 802.11b/g/n

| Ant Port | Data Rates (Mbps)   | CH (MHz) | 802.11b PW (dBm) | Rated Power for 802.11b (dBm) | 802.11g PW (dBm) | Rated Power for 802.11g (dBm) | 802.11n-HT20-2.4G PW (dBm) | Rated Power for 802.11n (dBm) |
|----------|---|----------|------------------|-------------------------------|------------------|-------------------------------|----------------------------|-------------------------------|
| Port1    | 1(802.11b)<br>6(802.11g)<br>6.5(802.11n)  | 2437     | 13.25*           | 13 +2/-2.5                    | 10.77            | 11.0+2/-2.5                   | 10.32                      | 10.0+2/-2.5                   |
|          |   | 2412     | 13.05            | 13 +2/-2.5                    | 8.73             | 8.0+2/-2.5                    | 9.93                       | 7.0+2/-2.5                    |
|          |   | 2462     | 13.23            | 13 +2/-2.5                    | 9.22             | 8.5+2/-2.5                    | 8.74                       | 7.5+2/-2.5                    |
| Port2    |   | 2437     | 13.13*           | 13 +2/-2.5                    | 11.47            | 11.0+2/-2.5                   | 10.41                      | 10.0+2/-2.5                   |
|          |   | 2412     | 13.04            | 13 +2/-2.5                    | 10.27            | 8.0+2/-2.5                    | 9.85                       | 7.0+2/-2.5                    |
|          |   | 2462     | 13.01            | 13 +2/-2.5                    | 9.52             | 8.5+2/-2.5                    | 8.18                       | 7.5+2/-2.5                    |
| Remark   | <ol style="list-style-type: none"> <li>Per KDB 248227 SAR measurement procedures for 802.11 a/b/g TX, since output power of 802.11g and 802.11n are not ¼ dB higher than 802.11b, than 802.11b mode will be tested to represent 2.4GHz band.</li> <li>Per KDB 248227, the lowest data rate mode was tested.</li> <li>Port1 and Port2 are TX diversity; their antennas are installed along different edge position. Both of them will be tested separately.</li> </ol> |          |                  |                               |                  |                               |                            |                               |

### 5GHz Band- 802.11n-HT40

| Ant Port | Data Rates (Mbps)   | Band   | CH (MHz)    | 802.11n-HT40PW (dBm) | Rated Power (dBm) |
|----------|---|--------|-------------|----------------------|-------------------|
| Port1    | 13.5(802.11n)   | 5.2GHz | 5190        | 10.64                | 9.5+2/-2.5        |
|          |   |        | 5210        | 14.03                | 14.0+2/-2.5       |
|          |   |        | 5230        | 16.63*               | 14.0+2/-2.5       |
|          |   | 5.3GHz | 5270        | 16.88*               | 14.0+2/-2.5       |
|          |   |        | 5290        | 15.21                | 14.0+2/-2.5       |
|          |   |        | 5310        | 14.21                | 11.5+2/-2.5       |
|          |   | 5.6GHz | 5510        | 15.71                | 14.0+2/-2.5       |
|          |   |        | 5530        | 16.05                | 14.0+2/-2.5       |
|          |   |        | 5550        | 15.89                | 14.0+2/-2.5       |
|          |   |        | 5570        | 16.06                | 14.0+2/-2.5       |
|          |   | 5.8GHz | 5670        | 16.86*               | 14.0+2/-2.5       |
|          |   |        | 5755        | 15.78*               | 13.0+2/-2.5       |
|          |   |        | 5775        | 15.55                | 13.0+2/-2.5       |
| 5795     | 15.51   |        | 13.0+2/-2.5 |                      |                   |
| Port2    | 13.5(802.11n)   | 5.2GHz | 5190        | 10.28                | 9.5+2/-2.5        |
|          |   |        | 5210        | 14.05                | 14.0+2/-2.5       |
|          |   |        | 5230        | 16.27*               | 14.0+2/-2.5       |
|          |   | 5.3GHz | 5270        | 16.52*               | 14.0+2/-2.5       |
|          |   |        | 5290        | 14.85                | 14.0+2/-2.5       |
|          |   |        | 5310        | 13.85                | 11.5+2/-2.5       |
|          |   | 5.6GHz | 5510        | 15.39                | 14.0+2/-2.5       |
|          |   |        | 5530        | 15.73                | 14.0+2/-2.5       |
|          |   |        | 5550        | 15.57                | 14.0+2/-2.5       |
|          |   |        | 5570        | 15.74                | 14.0+2/-2.5       |
|          |   | 5.8GHz | 5670        | 16.54*               | 14.0+2/-2.5       |
|          |   |        | 5755        | 15.46*               | 13.0+2/-2.5       |
|          |   |        | 5775        | 15.23                | 13.0+2/-2.5       |
| 5795     | 15.19   |        | 13.0+2/-2.5 |                      |                   |
| Remark   | 1. The channel with “*” are highest output power channel, which will be tested to find out worst SAR configuration.<br>2. Per KDB 248227, the lowest data rate mode was tested.<br>3. Port1 and Port2 are TX diversity; their antennas are installed along different edge position. Both of them will be tested separately. |        |             |                      |                   |

|                 |                                 |
|-----------------|---------------------------------|
| Test report No. | SL13072601-SLX-008_FCC,IC (SAR) |
| Page            | 34 of 44                        |
| FCC ID          | 2AAEX-SDABGN                    |
| IC ID           | 7228C-SDABGN                    |

### 5GHz Band- 802.11a/n-HT20

| Ant Port | Data Rates (Mbps)   | Band   | CH (MHz) | 802.11a PW (dBm) | Rated Power for 802.11a (dBm) | 802.11n-HT20PW (dBm) | Rated Power for 802.11n-HT20 (dBm) |
|----------|---|--------|----------|------------------|-------------------------------|----------------------|------------------------------------|
| Port1    | 6(802.11a)<br>6.5(802.11n)  | 5.2GHz | 5180     | 14.44            | 14.0+2/-2.5                   | 14.32                | 14.0+2/-2.5                        |
|          |   |        | 5200     | 14.61            | 14.0+2/-2.5                   | 14.62                | 14.0+2/-2.5                        |
|          |   |        | 5220     | 15.26            | 14.0+2/-2.5                   | 15.66                | 14.0+2/-2.5                        |
|          |   |        | 5240     | 15.35            | 14.0+2/-2.5                   | 15.80*               | 14.0+2/-2.5                        |
|          |   | 5.3GHz | 5260     | 14.97            | 14.0+2/-2.5                   | 15.53                | 14.0+2/-2.5                        |
|          |   |        | 5280     | 15.03            | 14.0+2/-2.5                   | 15.96                | 14.0+2/-2.5                        |
|          |   |        | 5300     | 14.92            | 14.0+2/-2.5                   | 15.93                | 14.0+2/-2.5                        |
|          |   |        | 5320     | 15.04            | 14.0+2/-2.5                   | 16.57*               | 14.0+2/-2.5                        |
|          |   | 5.6GHz | 5500     | 14.01            | 14.0+2/-2.5                   | 15.36                | 14.0+2/-2.5                        |
|          |   |        | 5520     | 14.03            | 14.0+2/-2.5                   | 15.56                | 14.0+2/-2.5                        |
|          |   |        | 5540     | 14.34            | 14.0+2/-2.5                   | 15.84                | 14.0+2/-2.5                        |
|          |   |        | 5560     | 14.18            | 14.0+2/-2.5                   | 15.56                | 14.0+2/-2.5                        |
|          |   |        | 5580     | 14.11            | 14.0+2/-2.5                   | 16.36                | 14.0+2/-2.5                        |
|          |   |        | 5660     | 14.72            | 14.0+2/-2.5                   | 16.34                | 14.0+2/-2.5                        |
|          |   |        | 5680     | 14.43            | 14.0+2/-2.5                   | 16.52                | 14.0+2/-2.5                        |
|          |   |        | 5700     | 14.05            | 14.0+2/-2.5                   | 16.54*               | 14.0+2/-2.5                        |
|          |   | 5.8GHz | 5745     | 13.28            | 13.0+2/-2.5                   | 15.75*               | 13.0+2/-2.5                        |
|          |   |        | 5765     | 13.08            | 13.0+2/-2.5                   | 15.53                | 13.0+2/-2.5                        |
|          |   |        | 5785     | 13.01            | 13.0+2/-2.5                   | 15.25                | 13.0+2/-2.5                        |
|          |   |        | 5805     | 13.25            | 13.0+2/-2.5                   | 15.53                | 13.0+2/-2.5                        |
|          |   |        | 5825     | 13.00            | 13.0+2/-2.5                   | 15.51                | 13.0+2/-2.5                        |
| Port2    | 6(802.11a)<br>6.5(802.11n)  | 5.2GHz | 5180     | 14.12            | 14.0+2/-2.5                   | 14.01                | 14.0+2/-2.5                        |
|          |   |        | 5200     | 14.29            | 14.0+2/-2.5                   | 14.21                | 14.0+2/-2.5                        |
|          |   |        | 5220     | 14.94            | 14.0+2/-2.5                   | 15.25                | 14.0+2/-2.5                        |
|          |   |        | 5240     | 15.03            | 14.0+2/-2.5                   | 15.39*               | 14.0+2/-2.5                        |
|          |   | 5.3GHz | 5260     | 14.65            | 14.0+2/-2.5                   | 15.13                | 14.0+2/-2.5                        |
|          |   |        | 5280     | 14.71            | 14.0+2/-2.5                   | 15.56                | 14.0+2/-2.5                        |
|          |   |        | 5300     | 14.60            | 14.0+2/-2.5                   | 15.53                | 14.0+2/-2.5                        |
|          |   |        | 5320     | 14.72            | 14.0+2/-2.5                   | 16.17*               | 14.0+2/-2.5                        |
|          |   | 5.6GHz | 5500     | 14.02            | 14.0+2/-2.5                   | 14.94                | 14.0+2/-2.5                        |
|          |   |        | 5520     | 4.01             | 14.0+2/-2.5                   | 15.14                | 14.0+2/-2.5                        |
|          |   |        | 5540     | 14.02            | 14.0+2/-2.5                   | 15.42                | 14.0+2/-2.5                        |
|          |   |        | 5560     | 14.05            | 14.0+2/-2.5                   | 15.14                | 14.0+2/-2.5                        |
|          |   |        | 5580     | 14.09            | 14.0+2/-2.5                   | 15.94                | 14.0+2/-2.5                        |
|          |   |        | 5660     | 14.40            | 14.0+2/-2.5                   | 15.92                | 14.0+2/-2.5                        |
|          |   |        | 5680     | 14.11            | 14.0+2/-2.5                   | 16.10                | 14.0+2/-2.5                        |
|          |   |        | 5700     | 14.03            | 14.0+2/-2.5                   | 16.14*               | 14.0+2/-2.5                        |
|          |   | 5.8GHz | 5745     | 13.73            | 13.0+2/-2.5                   | 15.38*               | 13.0+2/-2.5                        |
|          |   |        | 5765     | 13.57            | 13.0+2/-2.5                   | 15.16                | 13.0+2/-2.5                        |
|          |   |        | 5785     | 13.19            | 13.0+2/-2.5                   | 14.88                | 13.0+2/-2.5                        |
|          |   |        | 5805     | 13.43            | 13.0+2/-2.5                   | 15.16                | 13.0+2/-2.5                        |
|          |   |        | 5825     | 13.29            | 13.0+2/-2.5                   | 15.14                | 13.0+2/-2.5                        |
| Remark   | 1. The channel with “*” are highest output power channel, which will be tested to find out worst SAR configuration.<br>2. Per KDB 248227, the lowest data rate mode was tested.<br>3. Port1 and Port2 are TX diversity, their antennas are installed along different edge position. Both of them will be tested separately. |        |          |                  |                               |                      |                                    |

|                 |                                 |
|-----------------|---------------------------------|
| Test report No. | SL13072601-SLX-008_FCC,IC (SAR) |
| Page            | 35 of 44                        |
| FCC ID          | 2AAEX-SDABGN                    |
| IC ID           | 7228C-SDABGN                    |

#### Duty Cycle measurement

| Type               | ON time (uS) | Cycle time (uS) | Duty cycle | Crest factor |
|--------------------|--------------|-----------------|------------|--------------|
| 802.11b-1M         | 165.731      | 184.849         | 89.66%     | 1.115        |
| 802.11g-6M         | 303.687      | 334.348         | 90.83%     | 1.101        |
| 802.11a-6M         | 361.563      | 385.331         | 93.83%     | 1.066        |
| 802.11n-HT20-6.5M  | 300.641      | 332.024         | 90.55%     | 1.104        |
| 802.11n-HT40-13.5M | 267.134      | 292.425         | 91.35%     | 1.095        |

|                 |                                 |
|-----------------|---------------------------------|
| Test report No. | SL13072601-SLX-008_FCC,IC (SAR) |
| Page            | 36 of 44                        |
| FCC ID          | 2AAEX-SDABGN                    |
| IC ID           | 7228C-SDABGN                    |

#### Duty Cycle measurement

| Type               | ON time (uS) | Cycle time (uS) | Duty cycle | Crest factor |
|--------------------|--------------|-----------------|------------|--------------|
| 802.11b-1M         | 165.731      | 184.849         | 89.66%     | 1.115        |
| 802.11g-6M         | 303.687      | 334.348         | 90.83%     | 1.101        |
| 802.11a-6M         | 361.563      | 385.331         | 93.83%     | 1.066        |
| 802.11n-HT20-6.5M  | 300.641      | 332.024         | 90.55%     | 1.104        |
| 802.11n-HT40-13.5M | 267.134      | 292.425         | 91.35%     | 1.095        |

|                 |                                 |
|-----------------|---------------------------------|
| Test report No. | SL13072601-SLX-008_FCC,IC (SAR) |
| Page            | 37 of 44                        |
| FCC ID          | 2AAEX-SDABGN                    |
| IC ID           | 7228C-SDABGN                    |

## 16.2 SAR Measurement Result

### Requirement(s):

| Spec                | Item  | Requirement   | Applicable   |
|---------------------|---|---|--|
| RSS-102 Issue 4-SAR | 1   | SAR limit for devices used by the General public (Uncontrolled Environment) in localized Head and Trunk is 1.6 W/kg | <input checked="" type="checkbox"/>  |
|                     | 2   | SAR limit for Controlled Use Devices (Controlled Environment) in localized Head and Trunk is 8 W/kg                 | <input type="checkbox"/>   |
| Test Method         | IEEE 1528: 2003<br>IEC 62209-2: 2010<br>447498 D01 General RF Exposure Guidance v05r01<br>248227 SAR measurement procedures for 802.11 a/b/g TX<br>KDB 865664 SAR Measurement Requirements for 3 to 6 GHz v05r01  |   |  |
| Test Setup          | Refer to Section 6: SAR Measurement Setup   |   |  |
| Test Procedure      | <p><b>Steps:</b></p> <ol style="list-style-type: none"> <li>1. Use client test software to set EUT transmit RF power in cont-TX mode in the highest power channel</li> <li>2. Measure output power through spectrum analyzer</li> <li>3. Place the DUT in the positions selected</li> <li>4. Set scan area, grid size and other setting on the SATIMO software</li> <li>5. Make SAR measurement for the selected highest output power channel at each testing position</li> <li>6. Find out the position with highest SAR result</li> <li>7. Measure additional SAR for other modes at the highest SAR position</li> </ol> <p>SAR measurement system will proceed the following basic steps:</p> <ol style="list-style-type: none"> <li>1. Initial power reference measurement</li> <li>2. Area Scan</li> <li>3. Zoom Scan</li> <li>4. Power drift measurement</li> </ol> |   |  |
| Test Date           | 9/30/2013 – 10/4/2013   | Environmental condition   | Temperature 23oC<br>Relative Humidity 58%<br>Atmospheric Pressure 1019mbar |
| Remark              | The SAR was measurement at 2 cm separation distance and found the HT40 was worse case. So the testing in current report is to be performed at 0 cm separation distance. Refer to test report SL13020802-SLX-002_IC (RSS-102_SAR) Rev1.0.  |   |  |
| Result              | <input checked="" type="checkbox"/> Pass <input type="checkbox"/> Fail  |   |  |

Test Data ☒ Yes ☐ N/A

Test Plot ☒ Yes (Attached in separate document) ☐ N/A

|                 |                                 |
|-----------------|---------------------------------|
| Test report No. | SL13072601-SLX-008_FCC,IC (SAR) |
| Page            | 38 of 44                        |
| FCC ID          | 2AAEX-SDABGN                    |
| IC ID           | 7228C-SDABGN                    |

SAR Measurement result to determine the worst case position configuration


















| SAR Type          |   | Body SAR |                       |                             |                   |              |                 |                                   |                     |
|-------------------|---|----------|-----------------------|-----------------------------|-------------------|--------------|-----------------|-----------------------------------|---------------------|
| Freq Band         | Freq (MHz)  | Position | Rated Max Power (dBm) | Measured Output Power (dBm) | Raw SAR 1g (W/kg) | Crest factor | Power Drift (%) | Scaled SAR (Tune-up & Duty Cycle) | 1g SAR Limit (W/kg) |
| 802.11b           | 2437  | Front    | 15                    | 13.25                       | 0.257             | 1.115        | -2.52           | 0.287                             | 1.6                 |
| 802.11n-HT40-5.2G | 5230  | Front    | 16                    | 16.63                       | 0.507             | 1.095        | 2.81            | 0.555                             | 1.6                 |
| 802.11n-HT40-5.3G | 5270  | Front    | 16                    | 16.88                       | 0.484             | 1.095        | 1.17            | 0.530                             | 1.6                 |
| 802.11n-HT40-5.6G | 5670  | Front    | 16                    | 16.86                       | 0.489             | 1.095        | 1.52            | 0.535                             | 1.6                 |
| 802.11n-HT40-5.8G | 5755  | Front    | 15                    | 15.78                       | 0.383             | 1.095        | -2.61           | 0.419                             | 1.6                 |
| 802.11b           | 2437  | Right    | 15                    | 13.25                       | 0.233             | 1.115        | 4.59            | 0.260                             | 1.6                 |
| 802.11n-HT40-5.2G | 5230  | Right    | 16                    | 16.63                       | 0.363             | 1.095        | -1.53           | 0.397                             | 1.6                 |
| 802.11n-HT40-5.3G | 5270  | Right    | 16                    | 16.88                       | 0.489             | 1.095        | 1.52            | 0.535                             | 1.6                 |
| 802.11n-HT40-5.6G | 5670  | Right    | 16                    | 16.86                       | 0.699             | 1.095        | 2.05            | 0.765                             | 1.6                 |
| 802.11n-HT40-5.8G | 5755  | Right    | 15                    | 15.78                       | 0.506             | 1.095        | 1.79            | 0.554                             | 1.6                 |
| 802.11b           | 2437  | Left     | 15                    | 13.25                       | 0.016             | 1.115        | 2.45            | 0.018                             | 1.6                 |
| 802.11n-HT40-5.2G | 5230  | Left     | 16                    | 16.63                       | 0.029             | 1.095        | 3.45            | 0.032                             | 1.6                 |
| 802.11n-HT40-5.3G | 5270  | Left     | 16                    | 16.88                       | 0.021             | 1.095        | 1.54            | 0.023                             | 1.6                 |
| 802.11n-HT40-5.6G | 5670  | Left     | 16                    | 16.86                       | 0.016             | 1.095        | 4.82            | 0.018                             | 1.6                 |
| 802.11n-HT40-5.8G | 5755  | Left     | 15                    | 15.78                       | 0.031             | 1.095        | 2.75            | 0.034                             | 1.6                 |
| Note:             | 1. Separation distance : See page 14 (EUT position for SAR measurement)<br>2. The worst case configuration is Right position. |          |                       |                             |                   |              |                 |                                   |                     |

Additional SAR measurement on worst case position configuration

| SAR Type         |  | Body SAR |                       |                             |                   |              |                 |                                   |                     |
|------------------|--|----------|-----------------------|-----------------------------|-------------------|--------------|-----------------|-----------------------------------|---------------------|
| Freq Band        | Freq (MHz)   | Position | Rated Max Power (dBm) | Measured Output Power (dBm) | Raw SAR 1g (W/kg) | Crest Factor | Power Drift (%) | Scaled SAR (Tune-up & Duty Cycle) | 1g SAR Limit (W/kg) |
| 802.11b          | 2412   | Front    | 15                    | 13.15                       | 0.204             | 1.115        | 2.95            | 0.227                             | 1.6                 |
| 802.11b          | 2437   | Front    | 15                    | 13.25                       | 0.257             | 1.115        | -2.52           | 0.287                             | 1.6                 |
| 802.11b          | 2462   | Front    | 15                    | 13.23                       | 0.245             | 1.115        | -1.97           | 0.273                             | 1.6                 |
| 802.11-HT20-5.6G | 5510   | Right    | 16                    | 15.71                       | 0.653             | 1.095        | 1.64            | 0.715                             | 1.6                 |
| 802.11-HT20-5.6G | 5550   | Right    | 16                    | 15.89                       | 0.640             | 1.095        | -0.17           | 0.701                             | 1.6                 |
| 802.11-HT20-5.6G | 5670   | Right    | 16                    | 16.86                       | 0.699             | 1.095        | 2.05            | 0.765                             | 1.6                 |
| Note:            | 1. Separation distance : 0cm<br>2. Duty cycle scale is not necessary |          |                       |                             |                   |              |                 |                                   |                     |

|                 |                                 |
|-----------------|---------------------------------|
| Test report No. | SL13072601-SLX-008_FCC,IC (SAR) |
| Page            | 39 of 44                        |
| FCC ID          | 2AAEX-SDABGN                    |
| IC ID           | 7228C-SDABGN                    |

## Annex A. TEST INSTRUMENT

| Instrument   | Model                | Serial #             | Cal Date   | Cal Cycle | Cal Due    | In use  |
|--|----------------------|----------------------|------------|-----------|------------|---|
| <b>SAR</b>   |                      |                      |            |           |            |   |
| P C  | PV 3.06GHz           | 375052-AA1           | N/A        | N/A       | N/A        |    |
| Signal Generator                                   | 8665B-008            | 3744A01304           | 5/17/2013  | 1 Year    | 05/17/2014 |    |
| Multi-meter  | Multi-meter 2000     | 1259033              | 08/13/2013 | 1 Year    | 08/13/2014 |    |
| S-Parameter Network Analyzer                       | 8753ES               | US38161019           | 05/11/2013 | 1 Year    | 05/11/2014 |    |
| Power Meter  | 437B                 | 3038A03648           | 04/25/2013 | 1 Year    | 04/25/2014 |    |
| E-field PROBE                                      | EPG129               | SN26/11 EPG129       | 10/09/2012 | 1 Year    | 10/09/2013 |    |
| DIPOLE 2450  | DIPOLE 2450MHz       | SN 31/10 DIPJ138     | 06/13/2013 | 1 Year    | 06/13/2014 |    |
| WaveGuide 5/6 GHz                                  | Wave Guide<br>5/6GHz | SN 31/10<br>DIPWGA13 | 06/13/2013 | 1 Year    | 06/13/2014 |    |
| Communication Antenna                              | ANTA30               | SN 31/10 ANTA30      | N/A        | N/A       | N/A        |    |
| Laptop POSITIONING DEVICE                          | LSH63                | SN 31/10 LSH13       | N/A        | N/A       | N/A        |    |
| Mobile Phone POSITIONING DEVICE                    | MSH63                | SN 31/10 MSH63       | N/A        | N/A       | N/A        |    |
| DUMMY PROBE  | None                 | SN 31/10             | N/A        | N/A       | N/A        |  |
| SAM PHANTOM  | SAM77                | SN 31/10 SAM77       | N/A        | N/A       | N/A        |  |
| Elliptic Phantom                                   | ELLI17               | SN 31-10 ELLI17      | N/A        | N/A       | N/A        |  |
| PHANTOM TABLE                                      | N/A                  | N/A                  | N/A        | N/A       | N/A        |  |
| 6 AXIS ROBOT                                       | KR5                  | 949319               | N/A        | N/A       | N/A        |  |
| Medium Power Solid State Amplifier<br>(0.8~4.2GHz) | S41-25               | M629-0408            | N/A        | N/A       | N/A        |  |


















|                 |                                 |
|-----------------|---------------------------------|
| Test report No. | SL13072601-SLX-008_FCC,IC (SAR) |
| Page            | 40 of 44                        |
| FCC ID          | 2AAEX-SDABGN                    |
| IC ID           | 7228C-SDABGN                    |

## **Annex B. USER MANUAL, BLOCK & CIRCUIT DIAGRAM**

Please see attachment

|                 |                                 |
|-----------------|---------------------------------|
| Test report No. | SL13072601-SLX-008_FCC,IC (SAR) |
| Page            | 41 of 44                        |
| FCC ID          | 2AAEX-SDABGN                    |
| IC ID           | 7228C-SDABGN                    |

## Annex C. SIEMIC Accreditation

| Accreditations                          | Document  | Scope / Remark  |
|---|---|---|
| ISO 17025 (A2LA)                        |    | Please see the documents for the detailed scope   |
| ISO Guide 65 (A2LA)                     |    | Please see the documents for the detailed scope   |
| TCB Designation                         |   | <a href="#">A1</a> , <a href="#">A2</a> , <a href="#">A3</a> , <a href="#">A4</a> , <a href="#">B1</a> , <a href="#">B2</a> , <a href="#">B3</a> , <a href="#">B4</a> , C |
| FCC DoC Accreditation                   |    | FCC Declaration of Conformity Accreditation   |
| FCC Site Registration                   |    | 3 meter site  |
| FCC Site Registration                   |    | 10 meter site   |
| IC Site Registration                    |    | 3 meter site  |
| IC Site Registration                    |    | 10 meter site   |
| EU NB                                   |  | <b>Radio &amp; Telecommunications Terminal Equipment:</b><br>EN45001 – EN ISO/IEC 17025   |
|   |  | <b>Electromagnetic Compatibility:</b><br>EN45001 – EN ISO/IEC 17025   |
| Singapore iDA<br>CB(Certification Body) |  | <a href="#">Phase I</a> , <a href="#">Phase II</a>  |
| Vietnam MIC<br>CAB Accreditation        |  | Please see the document for the detailed scope  |
| HongKong OFCA                           |  | <b>(Phase II)</b> OFCA Foreign Certification Body for Radio and Telecom   |
|   |  | <b>(Phase I)</b> Conformity Assessment Body for Radio and Telecom   |
| Industry Canada CAB                     |  | <b>Radio:</b> Scope A – All Radio Standard Specification in Category I  |
|   |  | <b>Telecom:</b> CS-03 Part I, II, V, VI, VII, VIII  |

|                 |                                 |
|-----------------|---------------------------------|
| Test report No. | SL13072601-SLX-008_FCC,IC (SAR) |
| Page            | 42 of 44                        |
| FCC ID          | 2AAEX-SDABGN                    |
| IC ID           | 7228C-SDABGN                    |

|  |   |   |
|--|---|---|
| Japan Recognized Certification<br>Body Designation |    | <b>Radio</b> : A1. Terminal equipment for purpose of calling<br><b>Telecom</b> : B1. Specified radio equipment specified in Article 38-2, Paragraph 1, Item 1 of the Radio Law  |
| Korea CAB Accreditation                            |    | <b>EMI</b> : KCC Notice 2008-39, RRL Notice 2008-3: CA Procedures for EMI<br>KN22: Test Method for EMI<br><b>EMS</b> : KCC Notice 2008-38, RRL Notice 2008-4: CA Procedures for EMS<br>KN24, KN61000-4-2, -4-3, -4-4, -4-5, -4-6, -4-8, -4-11: Test Method for EMS<br><br><b>Radio</b> : RRL Notice 2008-26, RRL Notice 2008-2, RRL Notice 2008-10, RRL Notice 2007-49, RRL Notice 2007-20, RRL Notice 2007-21, RRL Notice 2007-80, RRL Notice 2004-68<br><br><b>Telecom</b> : President Notice 20664, RRL Notice 2007-30, RRL Notice 2008-7 with attachments 1, 3, 5, 6; President Notice 20664, RRL Notice 2008-7 with attachment 4 |
| Taiwan NCC CAB Recognition                         |  | LP0002, PSTN01, ADSL01, ID0002, IS6100, CNS14336, PLMN07, PLMN01, PLMN08  |
| Taiwan BSMI CAB Recognition                        |  | CNS 13438   |
| Japan VCCI   |  | R-3083: Radiation 3 meter site<br>C-3421: Main Ports Conducted Interference Measurement<br>T-1597: Telecommunication Ports Conducted Interference Measurement   |
| Australia CAB Recognition                          |  | <b>EMC</b> : AS/NZS CISPR 11, AS/NZS CISPR 14.1, AS/NZS CISPR22, AS/NZS 61000.6.3, AS/NZS 61000.6.4<br><br><b>Radiocommunications</b> : AS/NZS 4281, AS/NZS 4268, AS/NZS 4280.1, AS/NZS 4280.2, AS/NZS 4295, AS/NZS 4582, AS/NZS 4583, AS/NZS 4769.1, AS/NZS 4769.2, AS/NZS 4770, AS/NZS 4771<br><br><b>Telecommunications</b> : AS/ACIF S002:05, AS/ACIF S003:06, AS/ACIF S004:06, AS/ACIF S006:01, AS/ACIF S016:01, AS/ACIF S031:01, AS/ACIF S038:01, AS/ACIF S040:01, AS/ACIF S041:05, AS/ACIF S043.2:06, AS/ACIF S60950.1   |
| Australia NATA Recognition                         |  | AS/ACIF S002, AS/ACIF S003, AS/ACIF S004, AS/ACIF S006, AS/ACIF S016, AS/ACIF S031, AS/ACIF S038, AS/ACIF S040, AS/ACIF S041, AS/ACIF S043.2  |

|                 |                                 |
|-----------------|---------------------------------|
| Test report No. | SL13072601-SLX-008_FCC,IC (SAR) |
| Page            | 43 of 44                        |
| FCC ID          | 2AAEX-SDABGN                    |
| IC ID           | 7228C-SDABGN                    |

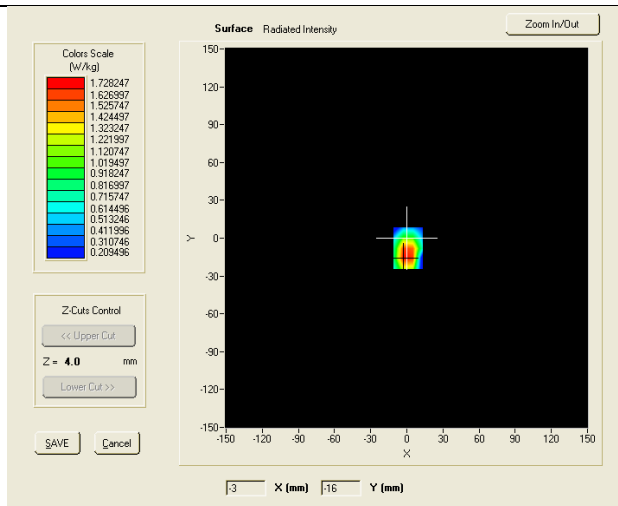
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## Attachment – SAR Test Plots

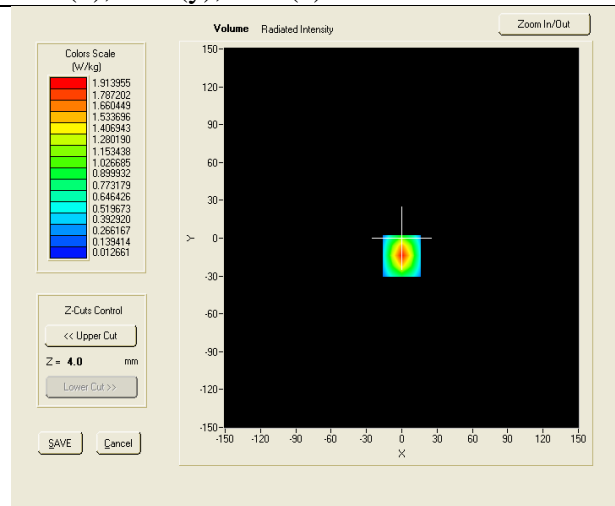
## System Verification Plots

|                     |   |      |         |      |
|---------------------|---|------|---------|------|
| Test specification: | System Verification                                 |      |         |      |
| Environ Conditions: | Temp(°C):   | 23   | Result: | Pass |
|                     | Humidity(%):  | 58   |         |      |
|                     | Atmospheric(mPa):                                   | 1009 |         |      |
| Mains Power:        | 3.3VDC  |      |         |      |
| Test Date:          | 10/10/2013  |      |         |      |
| Tested by:          | David Zhang   |      |         |      |
| Remarks:            | System Validation, dipole, CW signal, duty cycle =1 |      |         |      |

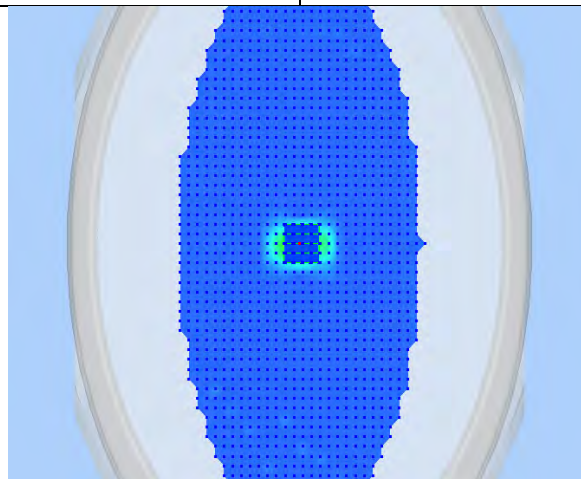
|                                   |                        |
|-----------------------------------|------------------------|
| Frequency (MHz)                   | 2450.000000            |
| Relative permittivity (real part) | 51.28                  |
| Conductivity (S/m)                | 1.93                   |
| Transmission Duty Factor          | 1.00                   |
| Probe SN                          | 2611_EPG129            |
| Conversion Factor (dB)            | 7.89                   |
| Area Scan Resolution              | 8 mm                   |
| Zoom Scan Resolution              | dx=4mm, dy=4mm, dz=2mm |
| Zoom Scan Size                    | 24x24x24 mm            |
| Measurement Drifts (%)            | -1.020                 |
| Highest Extrapolated SAR (W/Kg)   | 3.0730                 |
| SAR 1g (W/Kg)                     | 1.8384                 |
| Peak SAR Location                 | 28mm(x),0mm(y),4mm(z)  |



SURFACE SAR



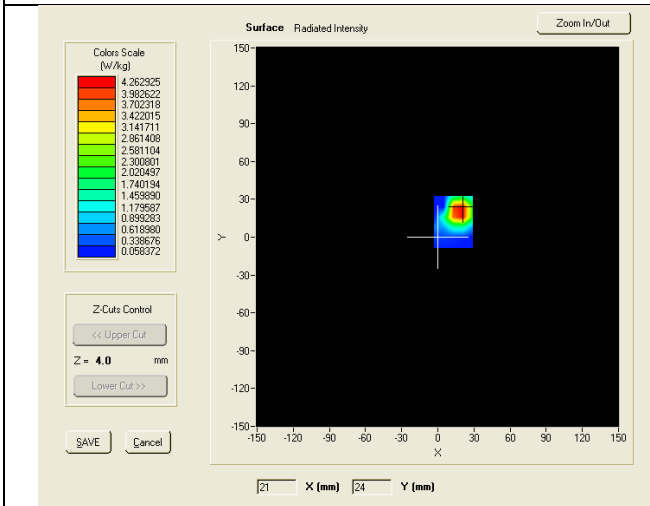
VOLUME SAR



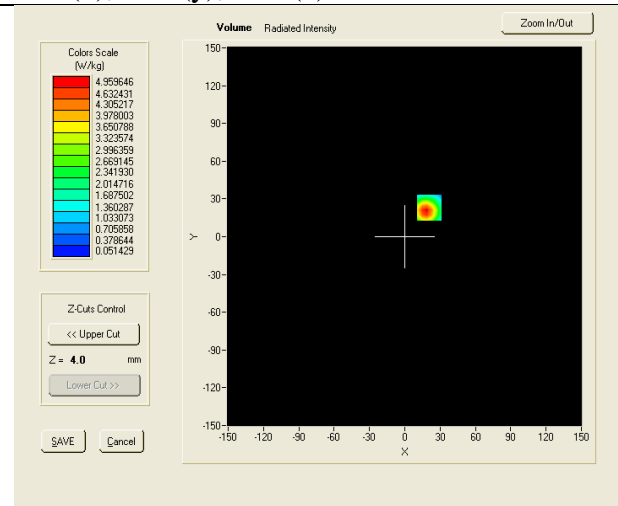
3D View Plot

|                     |   |      |         |      |
|---------------------|---|------|---------|------|
| Test specification: | System Verification                                 |      |         |      |
| Environ Conditions: | Temp(°C):   | 23   | Result: | Pass |
|                     | Humidity(%):  | 58   |         |      |
|                     | Atmospheric(mPa):                                   | 1009 |         |      |
| Mains Power:        | 3.3VDC  |      |         |      |
| Test Date:          | 10/10/2013  |      |         |      |
| Tested by:          | David Zhang   |      |         |      |
| Remarks:            | System Validation, dipole, CW signal, duty cycle =1 |      |         |      |

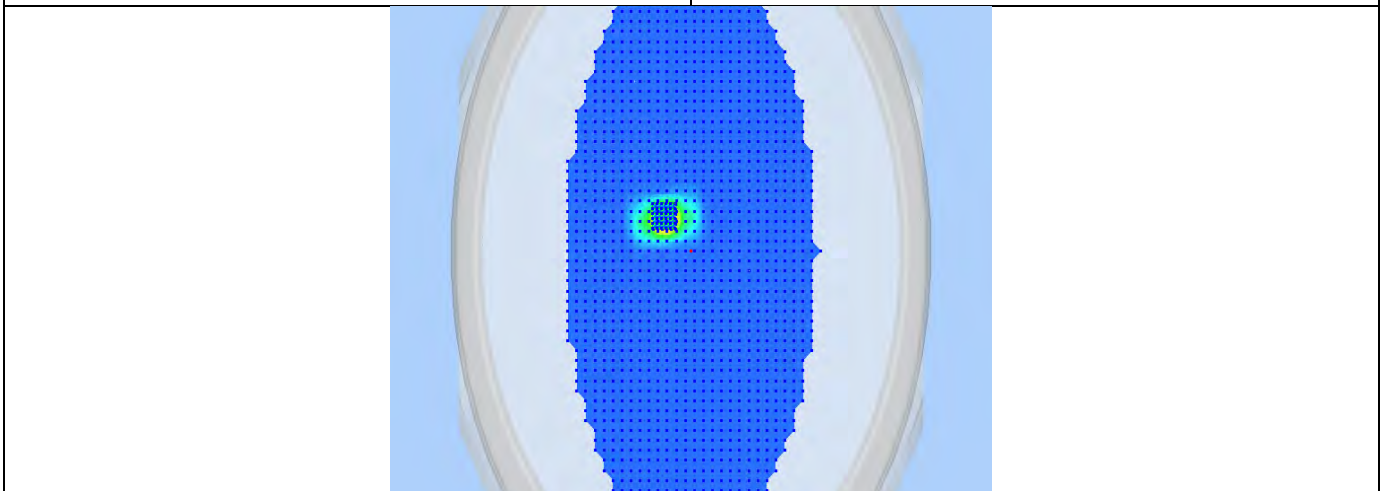
|                                   |                        |
|-----------------------------------|------------------------|
| Frequency (MHz)                   | 5200.000000            |
| Relative permittivity (real part) | 49.88                  |
| Conductivity (S/m)                | 5.47                   |
| Transmission Duty Factor          | 1.00                   |
| Probe SN                          | 2611_EPG129            |
| Conversion Factor (dB)            | 5.69                   |
| Area Scan Resolution              | 8 mm                   |
| Zoom Scan Resolution              | dx=4mm, dy=4mm, dz=2mm |
| Zoom Scan Size                    | 24x24x24 mm            |
| Measurement Drifts (%)            | 2.130                  |
| Highest Extrapolated SAR (W/Kg)   | 8.1870                 |
| SAR 1g (W/Kg)                     | 4.9231                 |
| Peak SAR Location                 | 13mm(x),0mm(y),4mm(z)  |



SURFACE SAR



VOLUME SAR

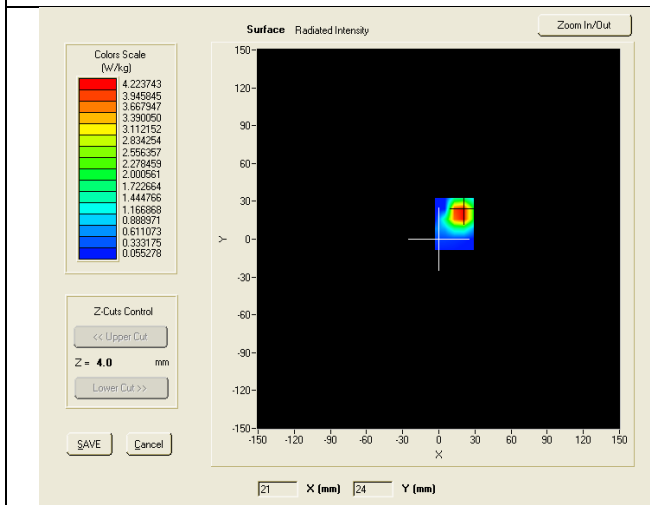


3D View Plot

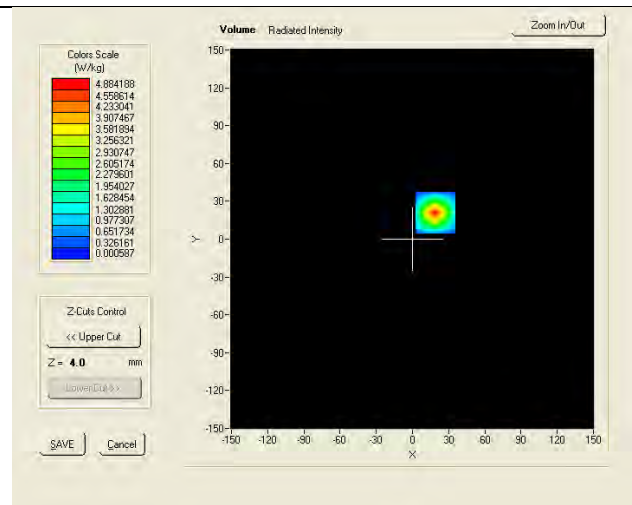


|                     |   |      |         |      |
|---------------------|---|------|---------|------|
| Test specification: | System Verification                                 |      |         |      |
| Environ Conditions: | Temp(°C):   | 23   | Result: | Pass |
|                     | Humidity(%):  | 58   |         |      |
|                     | Atmospheric(mPa):                                   | 1009 |         |      |
| Mains Power:        | 3.3VDC  |      |         |      |
| Test Date:          | 10/10/2013  |      |         |      |
| Tested by:          | David Zhang   |      |         |      |
| Remarks:            | System Validation, dipole, CW signal, duty cycle =1 |      |         |      |

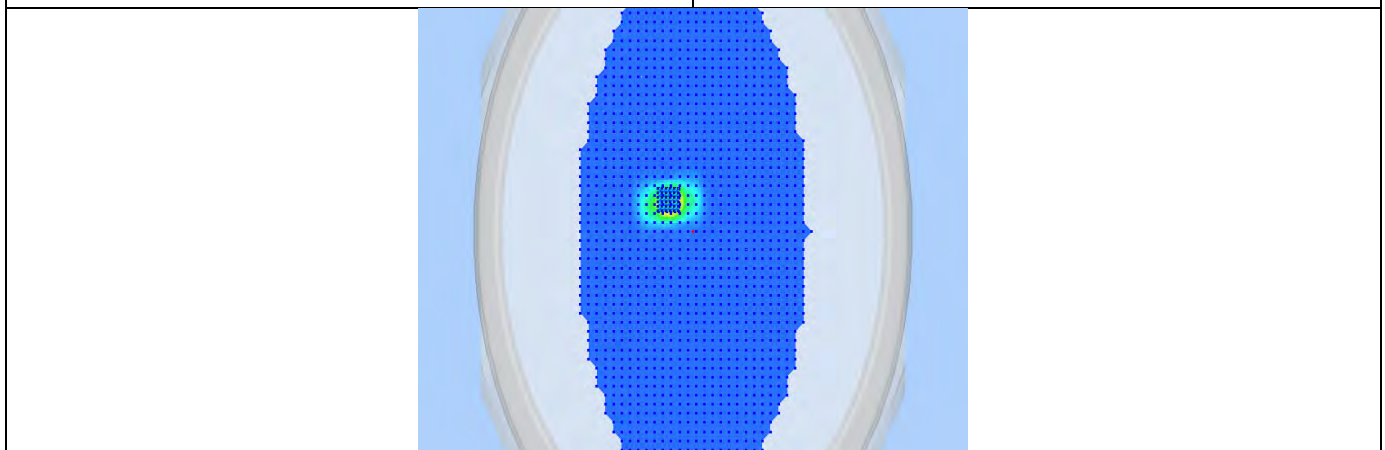
|                                   |                        |
|-----------------------------------|------------------------|
| Frequency (MHz)                   | 5500.000000            |
| Relative permittivity (real part) | 49.77                  |
| Conductivity (S/m)                | 5.52                   |
| Transmission Duty Factor          | 1.00                   |
| Probe SN                          | 2611_EPG129            |
| Conversion Factor (dB)            | 5.69                   |
| Area Scan Resolution              | 8 mm                   |
| Zoom Scan Resolution              | dx=4mm, dy=4mm, dz=2mm |
| Zoom Scan Size                    | 24x24x24 mm            |
| Measurement Drifts (%)            | 1.94                   |
| Highest Extrapolated SAR (W/Kg)   | 9.0130                 |
| SAR 1g (W/Kg)                     | 5.3145                 |
| Peak SAR Location                 | 21mm(x),22mm(y),4mm(z) |



SURFACE SAR



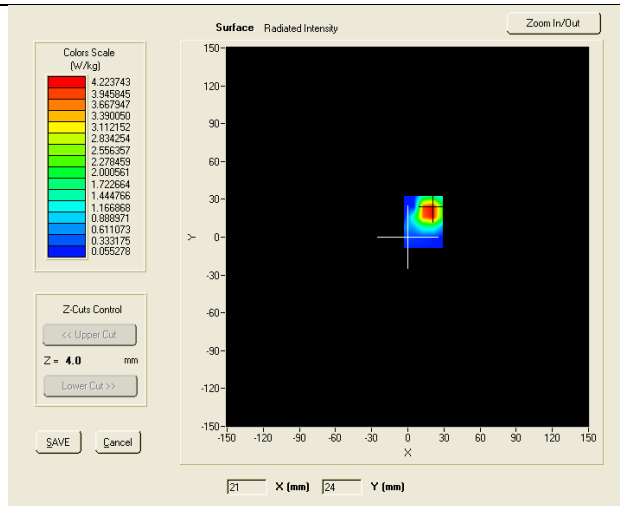
VOLUME SAR



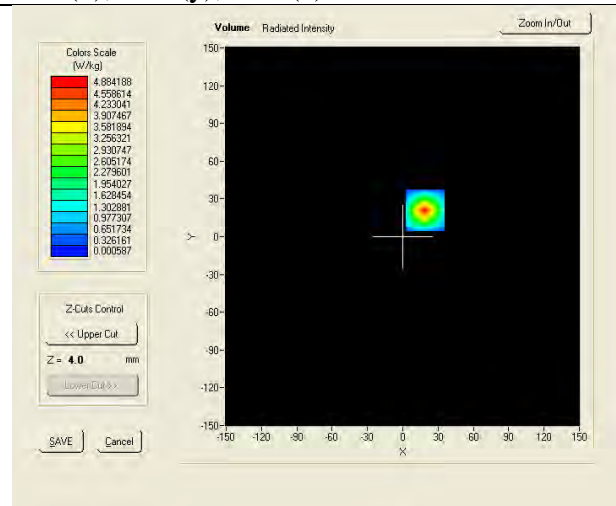
3D View

|                     |   |      |         |      |
|---------------------|---|------|---------|------|
| Test specification: | System Verification                                 |      |         |      |
| Environ Conditions: | Temp(°C):   | 23   | Result: | Pass |
|                     | Humidity(%):  | 58   |         |      |
|                     | Atmospheric(mPa):                                   | 1009 |         |      |
| Mains Power:        | 3.3VDC  |      |         |      |
| Test Date:          | 10/10/2013  |      |         |      |
| Tested by:          | David Zhang   |      |         |      |
| Remarks:            | System Validation, dipole, CW signal, duty cycle =1 |      |         |      |

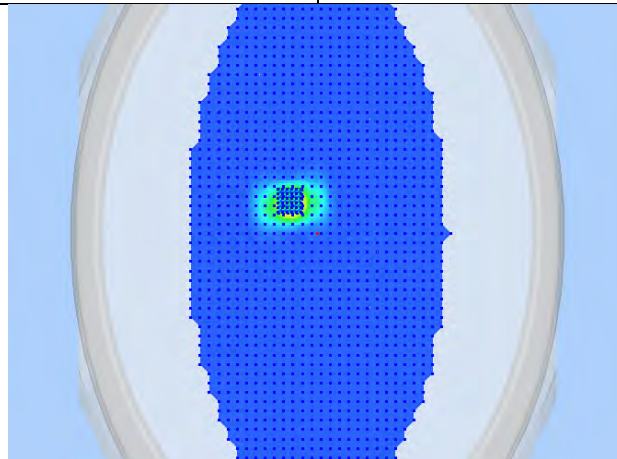
|                                   |                        |
|-----------------------------------|------------------------|
| Frequency (MHz)                   | 5800.000000            |
| Relative permittivity (real part) | 48.62                  |
| Conductivity (S/m)                | 5.80                   |
| Transmission Duty Factor          | 1.00                   |
| Probe SN                          | 2611_EPG129            |
| Conversion Factor (dB)            | 5.69                   |
| Area Scan Resolution              | 8 mm                   |
| Zoom Scan Resolution              | dx=4mm, dy=4mm, dz=2mm |
| Zoom Scan Size                    | 24x24x24 mm            |
| Measurement Drifts (%)            | 0.170                  |
| Highest Extrapolated SAR (W/Kg)   | 8.1369                 |
| SAR 1g (W/Kg)                     | 5.6315                 |
| Peak SAR Location                 | 13mm(x),0mm(y),4mm(z)  |



SURFACE SAR



VOLUME SAR

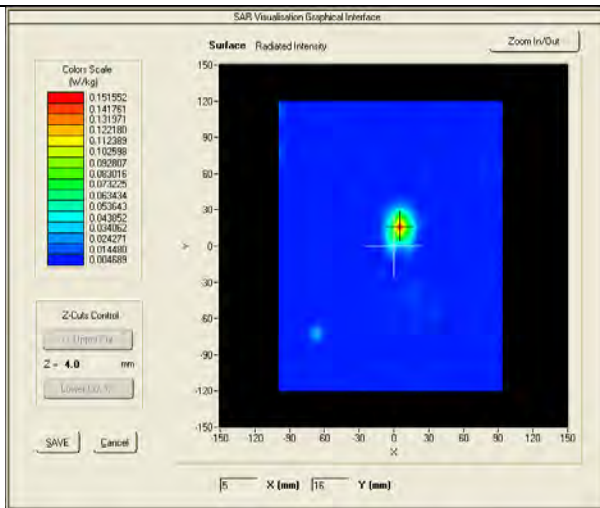


3D View Plot

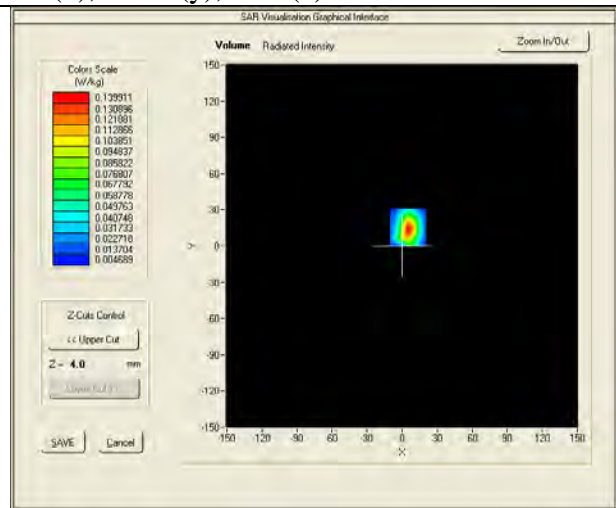
## SAR Measurement Plots – Determine worst case configuraiton

|                     |   |      |         |      |
|---------------------|---|------|---------|------|
| Test specification: | 802.11b-2437MHz-Body SAR-Front position |      |         |      |
| Environ Conditions: | Temp(°C):                               | 23   | Result: | Pass |
|                     | Humidity(%):                            | 58   |         |      |
|                     | Atmospheric(mPa):                       | 1009 |         |      |
| Mains Power:        | 3.3VDC                                  |      |         |      |
| Test Date:          | 10/10/2013                              |      |         |      |
| Tested by:          | David Zhang                             |      |         |      |
| Remarks:            | -                                       |      |         |      |

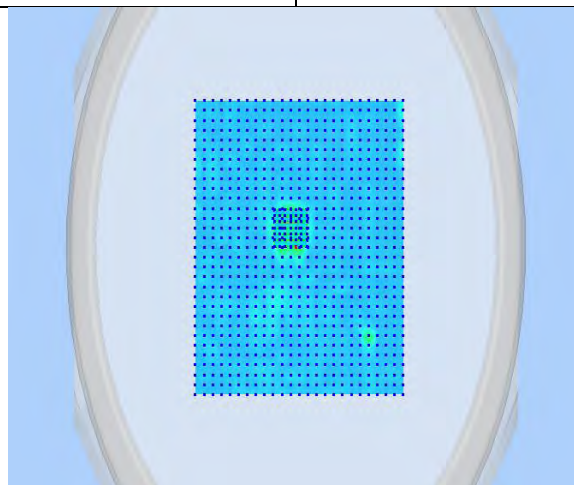
|                                   |                        |
|-----------------------------------|------------------------|
| Frequency (MHz)                   | 2437.000000            |
| Relative permittivity (real part) | 51.69                  |
| Conductivity (S/m)                | 1.93                   |
| Transmission Duty Factor          | 1.0                    |
| Probe SN                          | 2611_EPG129            |
| Conversion Factor (dB)            | 7.89                   |
| Area Scan Resolution              | 8 mm                   |
| Zoom Scan Resolution              | dx=5mm, dy=5mm, dz=4mm |
| Zoom Scan Size                    | 30x30x32 mm            |
| Measurement Drifts (%)            | -2.520                 |
| Highest Extrapolated SAR (W/Kg)   | 0.5636                 |
| SAR 1g (W/Kg)                     | 0.2569                 |
| Peak SAR Location                 | 5mm(x),16mm(y),4mm(z)  |



SURFACE SAR



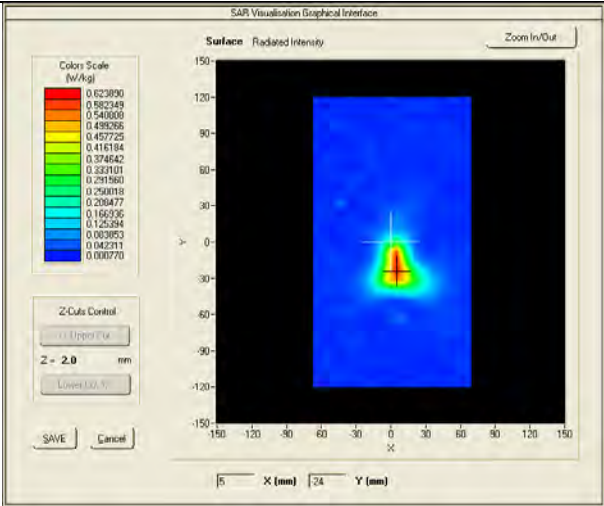
VOLUME SAR



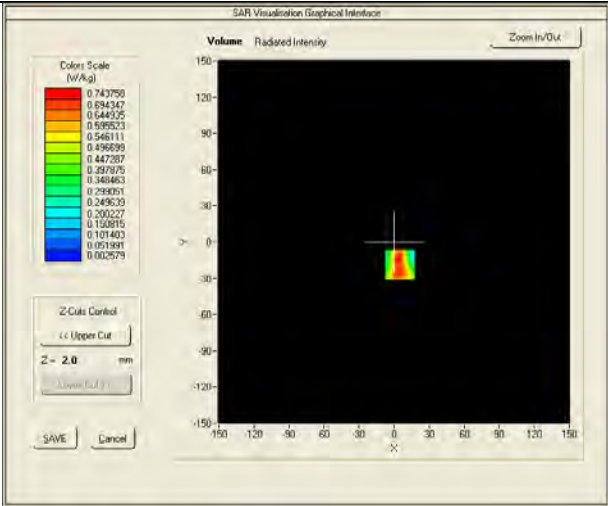
3D View Plot

|                     |  |      |         |      |
|---------------------|--|------|---------|------|
| Test specification: | 802.11n-HT40-5230MHz-Body SAR-Front position |      |         |      |
| Environ Conditions: | Temp(°C):                                    | 23   | Result: | Pass |
|                     | Humidity(%):                                 | 58   |         |      |
|                     | Atmospheric(mPa):                            | 1009 |         |      |
| Mains Power:        | 3.3VDC                                       |      |         |      |
| Test Date:          | 10/10/2013                                   |      |         |      |
| Tested by:          | David Zhang                                  |      |         |      |
| Remarks:            | -  |      |         |      |

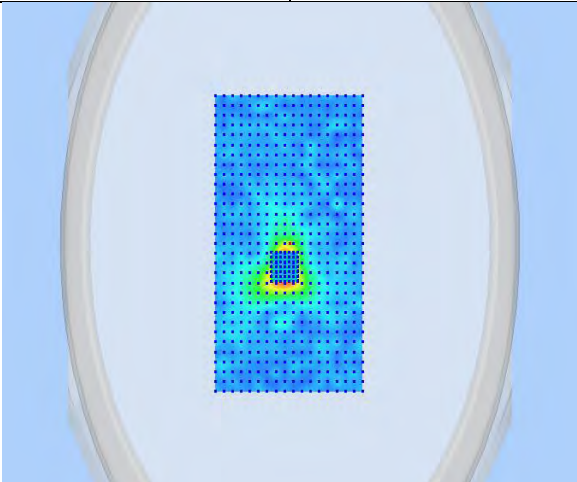
|                                   |                        |
|-----------------------------------|------------------------|
| Frequency (MHz)                   | 5230.000000            |
| Relative permittivity (real part) | 49.83                  |
| Conductivity (S/m)                | 5.49                   |
| Transmission Duty Factor          | 1.0                    |
| Probe SN                          | 2611_EPG129            |
| Conversion Factor (dB)            | 5.69                   |
| Area Scan Resolution              | 8 mm                   |
| Zoom Scan Resolution              | dx=4mm, dy=4mm, dz=2mm |
| Zoom Scan Size                    | 24x24x24 mm            |
| Measurement Drifts (%)            | 2.810                  |
| Highest Extrapolated SAR (W/Kg)   | 1.5071                 |
| SAR 1g (W/Kg)                     | 0.5056                 |
| Peak SAR Location                 | 5mm(x),-19mm(y),4mm(z) |



SURFACE SAR



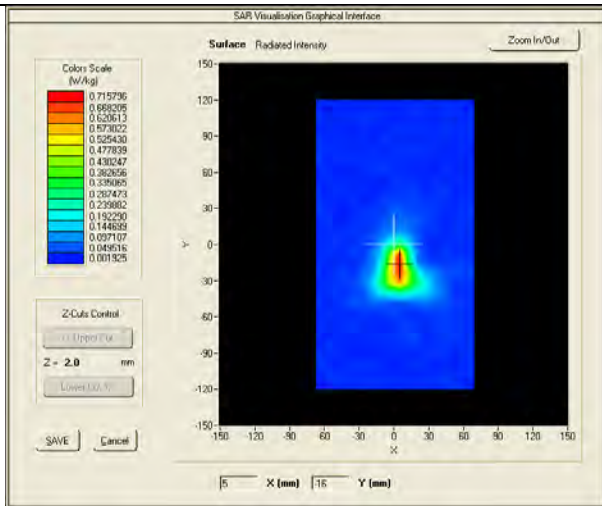
VOLUME SAR



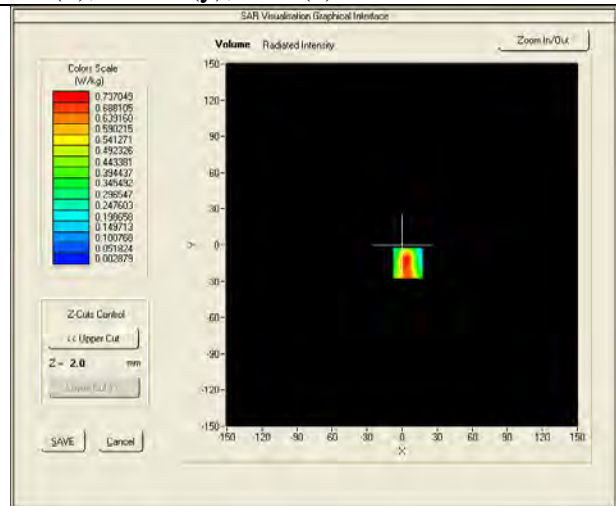
3D View Plot

|                     |  |      |         |      |
|---------------------|--|------|---------|------|
| Test specification: | 802.11n-HT40-5270MHz-Body SAR-Front position |      |         |      |
| Environ Conditions: | Temp(°C):                                    | 23   | Result: | Pass |
|                     | Humidity(%):                                 | 58   |         |      |
|                     | Atmospheric(mPa):                            | 1009 |         |      |
| Mains Power:        | 3.3VDC                                       |      |         |      |
| Test Date:          | 10/10/2013                                   |      |         |      |
| Tested by:          | David Zhang                                  |      |         |      |
| Remarks:            | -  |      |         |      |

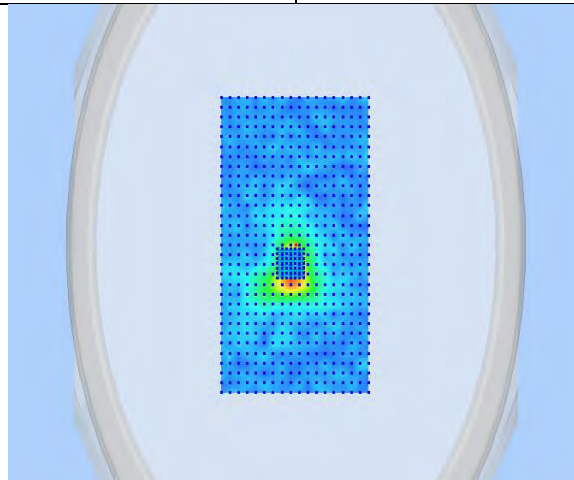
|                                   |                        |
|-----------------------------------|------------------------|
| Frequency (MHz)                   | 5270.000000            |
| Relative permittivity (real part) | 49.82                  |
| Conductivity (S/m)                | 5.49                   |
| Transmission Duty Factor          | 1.0                    |
| Probe SN                          | 2611_EPG129            |
| Conversion Factor (dB)            | 5.69                   |
| Area Scan Resolution              | 8 mm                   |
| Zoom Scan Resolution              | dx=4mm, dy=4mm, dz=2mm |
| Zoom Scan Size                    | 24x24x24 mm            |
| Measurement Drifts (%)            | 1.170                  |
| Highest Extrapolated SAR (W/Kg)   | 1.4639                 |
| SAR 1g (W/Kg)                     | 0.4835                 |
| Peak SAR Location                 | 5mm(x),-15mm(y),4mm(z) |



SURFACE SAR



VOLUME SAR

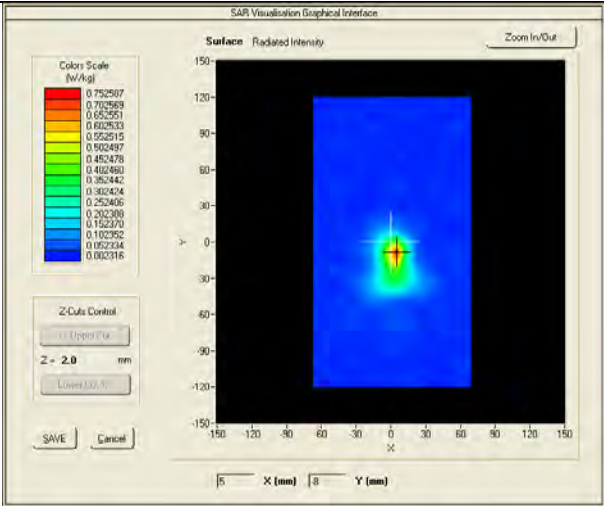


3D View Plot

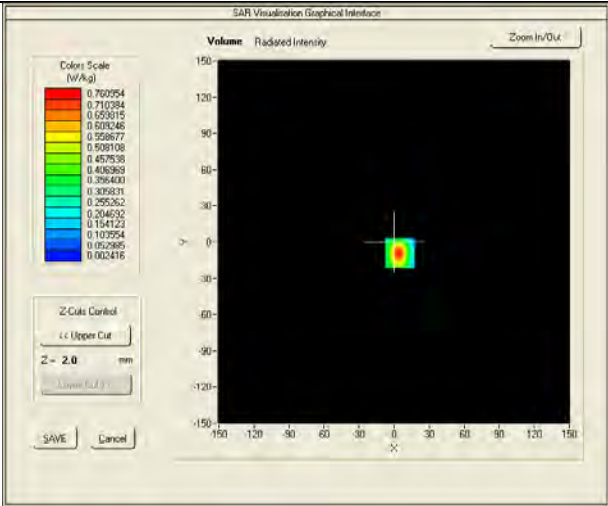


|                     |  |      |         |      |
|---------------------|--|------|---------|------|
| Test specification: | 802.11n-HT40-5670MHz-Body SAR-Front position |      |         |      |
| Environ Conditions: | Temp(°C):                                    | 23   | Result: | Pass |
|                     | Humidity(%):                                 | 58   |         |      |
|                     | Atmospheric(mPa):                            | 1009 |         |      |
| Mains Power:        | 3.3VDC                                       |      |         |      |
| Test Date:          | 10/10/2013                                   |      |         |      |
| Tested by:          | David Zhang                                  |      |         |      |
| Remarks:            | -  |      |         |      |

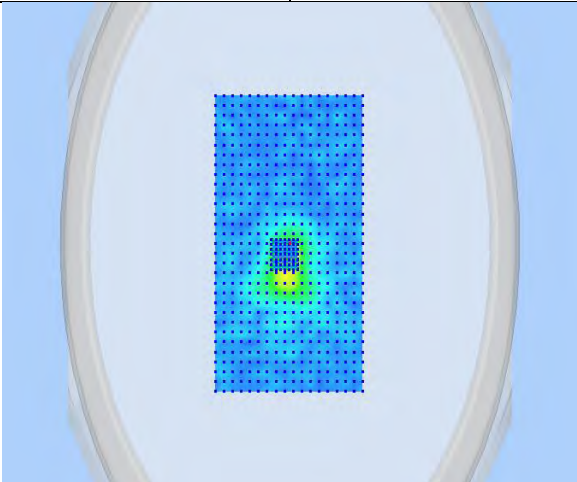
|                                   |                        |
|-----------------------------------|------------------------|
| Frequency (MHz)                   | 5670.000000            |
| Relative permittivity (real part) | 49.66                  |
| Conductivity (S/m)                | 5.64                   |
| Transmission Duty Factor          | 1.0                    |
| Probe SN                          | 2611_EPG129            |
| Conversion Factor (dB)            | 5.69                   |
| Area Scan Resolution              | 8 mm                   |
| Zoom Scan Resolution              | dx=4mm, dy=4mm, dz=2mm |
| Zoom Scan Size                    | 24x24x24 mm            |
| Measurement Drifts (%)            | 1.520                  |
| Highest Extrapolated SAR (W/Kg)   | 1.5376                 |
| SAR 1g (W/Kg)                     | 0.4885                 |
| Peak SAR Location                 | 5mm(x),-9mm(y),4mm(z)  |



SURFACE SAR



VOLUME SAR

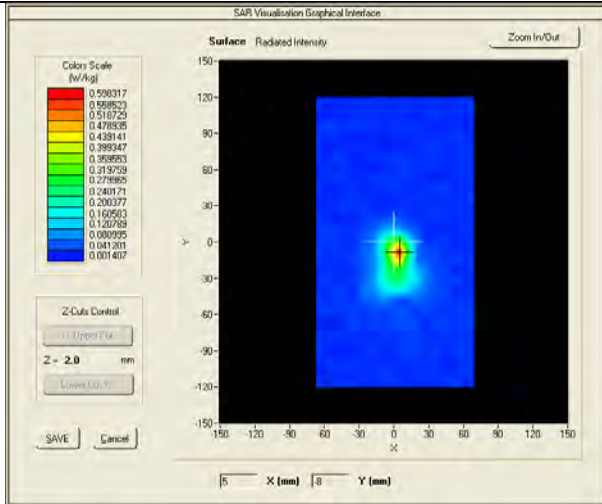


3D View Plot

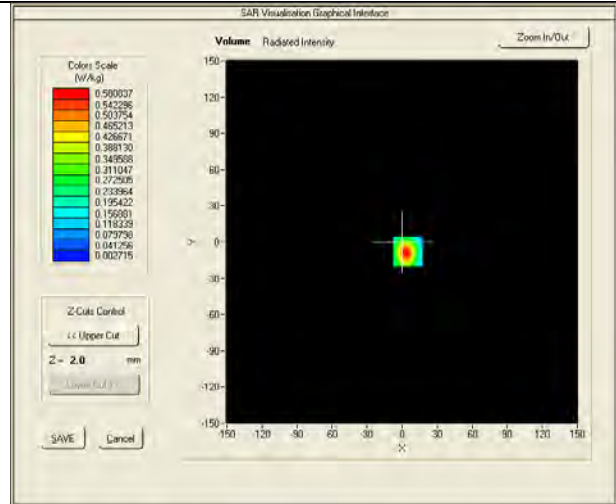


|                     |  |      |         |      |
|---------------------|--|------|---------|------|
| Test specification: | 802.11n-HT40-5755MHz-Body SAR-Front position |      |         |      |
| Environ Conditions: | Temp(°C):                                    | 23   | Result: | Pass |
|                     | Humidity(%):                                 | 58   |         |      |
|                     | Atmospheric(mPa):                            | 1009 |         |      |
| Mains Power:        | 3.3VDC                                       |      |         |      |
| Test Date:          | 10/10/2013                                   |      |         |      |
| Tested by:          | David Zhang                                  |      |         |      |
| Remarks:            | -  |      |         |      |

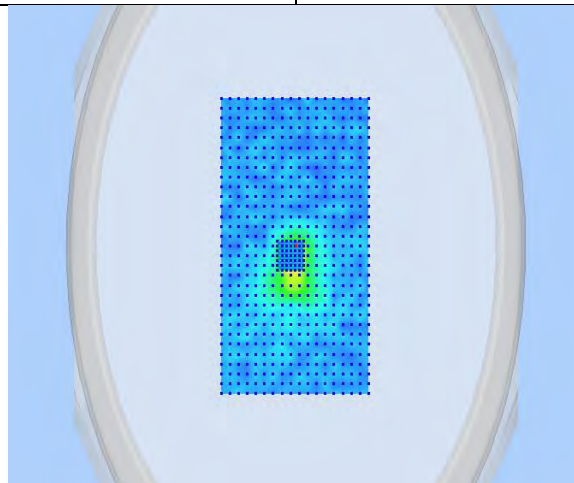
|                                   |                        |
|-----------------------------------|------------------------|
| Frequency (MHz)                   | 5755.000000            |
| Relative permittivity (real part) | 48.87                  |
| Conductivity (S/m)                | 5.71                   |
| Transmission Duty Factor          | 1.0                    |
| Probe SN                          | 2611_EPG129            |
| Conversion Factor (dB)            | 5.69                   |
| Area Scan Resolution              | 8 mm                   |
| Zoom Scan Resolution              | dx=4mm, dy=4mm, dz=2mm |
| Zoom Scan Size                    | 24x24x24 mm            |
| Measurement Drifts (%)            | -2.610                 |
| Highest Extrapolated SAR (W/Kg)   | 1.2245                 |
| SAR 1g (W/Kg)                     | 0.3828                 |
| Peak SAR Location                 | 5mm(x),-8mm(y),4mm(z)  |



SURFACE SAR



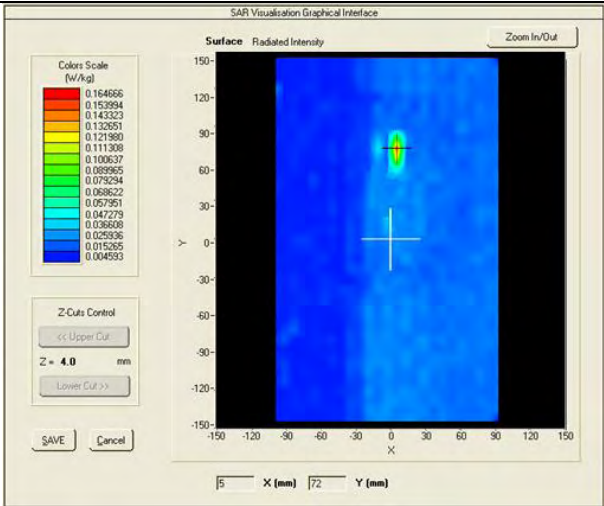
VOLUME SAR



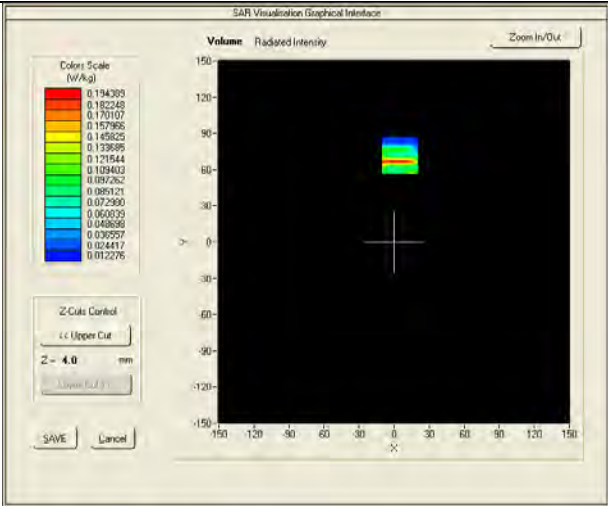
3D View Plot

|                     |  |      |         |      |
|---------------------|--|------|---------|------|
| Test specification: | 802.11b-2437MHz-Body SAR-Right- position |      |         |      |
| Environ Conditions: | Temp(°C):                                | 23   | Result: | Pass |
|                     | Humidity(%):                             | 58   |         |      |
|                     | Atmospheric(mPa):                        | 1009 |         |      |
| Mains Power:        | 3.3VDC                                   |      |         |      |
| Test Date:          | 10/10/2013                               |      |         |      |
| Tested by:          | David Zhang                              |      |         |      |
| Remarks:            | -  |      |         |      |

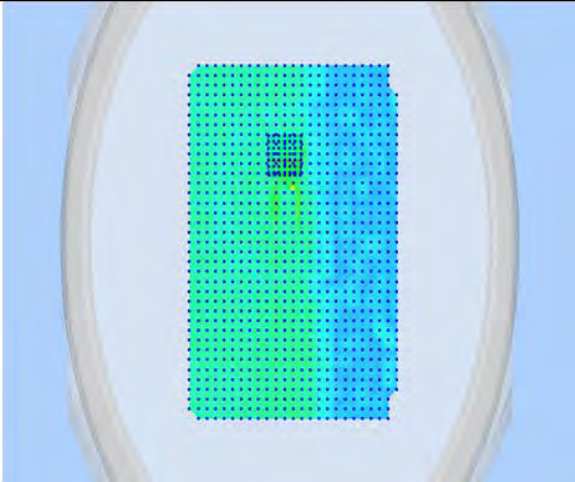
|                                   |                        |
|-----------------------------------|------------------------|
| Frequency (MHz)                   | 2437.000000            |
| Relative permittivity (real part) | 51.69                  |
| Conductivity (S/m)                | 1.93                   |
| Transmission Duty Factor          | 1.0                    |
| Probe SN                          | 2611_EPG129            |
| Conversion Factor (dB)            | 7.89                   |
| Area Scan Resolution              | 8 mm                   |
| Zoom Scan Resolution              | dx=5mm, dy=5mm, dz=4mm |
| Zoom Scan Size                    | 30x30x32 mm            |
| Measurement Drifts (%)            | 4.590                  |
| Highest Extrapolated SAR (W/Kg)   | 0.4913                 |
| SAR 1g (W/Kg)                     | 0.2331                 |
| Peak SAR Location                 | 5mm(x),72mm(y),4mm(z)  |



SURFACE SAR



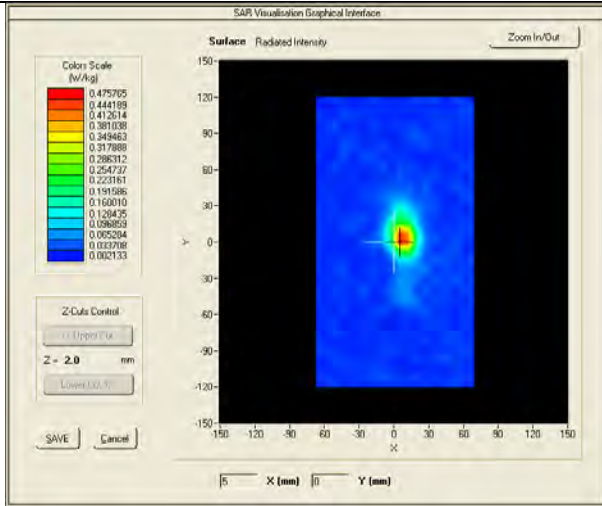
VOLUME SAR



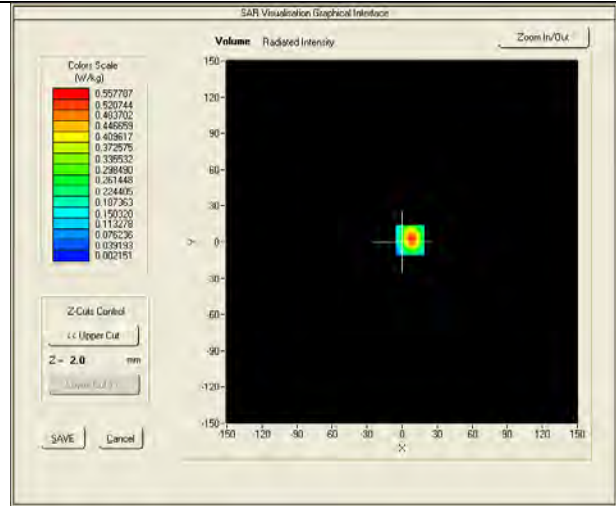
3D View Plot

|                     |   |      |         |      |
|---------------------|---|------|---------|------|
| Test specification: | 802.11n-HT40-5230MHz-Body SAR-Right- position |      |         |      |
| Environ Conditions: | Temp(°C):                                     | 23   | Result: | Pass |
|                     | Humidity(%):                                  | 58   |         |      |
|                     | Atmospheric(mPa):                             | 1009 |         |      |
| Mains Power:        | 3.3VDC  |      |         |      |
| Test Date:          | 10/10/2013                                    |      |         |      |
| Tested by:          | David Zhang                                   |      |         |      |
| Remarks:            | -   |      |         |      |

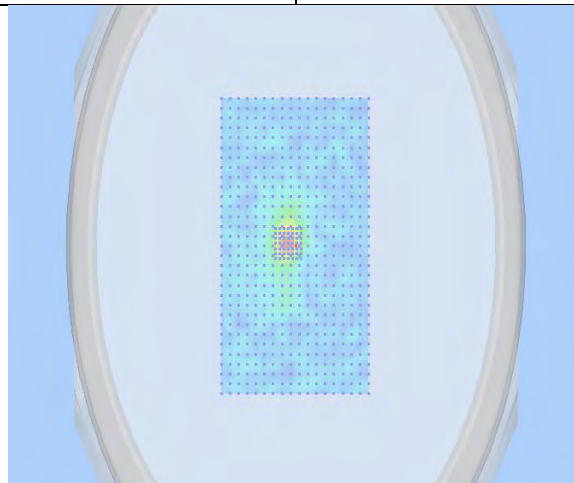
|                                   |                        |
|-----------------------------------|------------------------|
| Frequency (MHz)                   | 5230.000000            |
| Relative permittivity (real part) | 49.83                  |
| Conductivity (S/m)                | 5.49                   |
| Transmission Duty Factor          | 1.0                    |
| Probe SN                          | 2611_EPG129            |
| Conversion Factor (dB)            | 5.69                   |
| Area Scan Resolution              | 8 mm                   |
| Zoom Scan Resolution              | dx=4mm, dy=4mm, dz=2mm |
| Zoom Scan Size                    | 24x24x24 mm            |
| Measurement Drifts (%)            | -1.530                 |
| Highest Extrapolated SAR (W/Kg)   | 1.1294                 |
| SAR 1g (W/Kg)                     | 0.3626                 |
| Peak SAR Location                 | 7mm(x),2mm(y),4mm(z)   |



SURFACE SAR



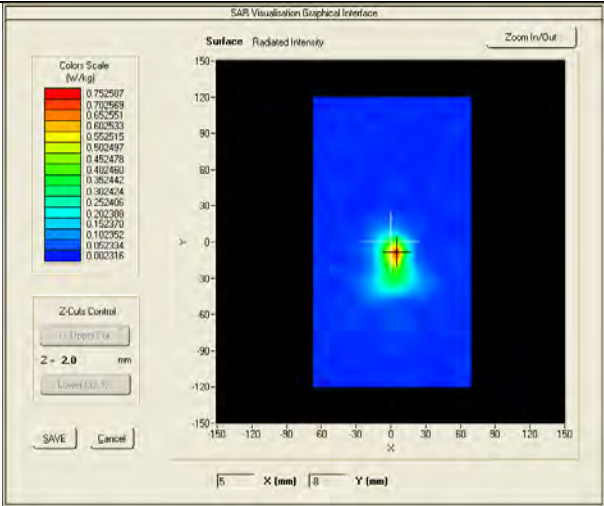
VOLUME SAR



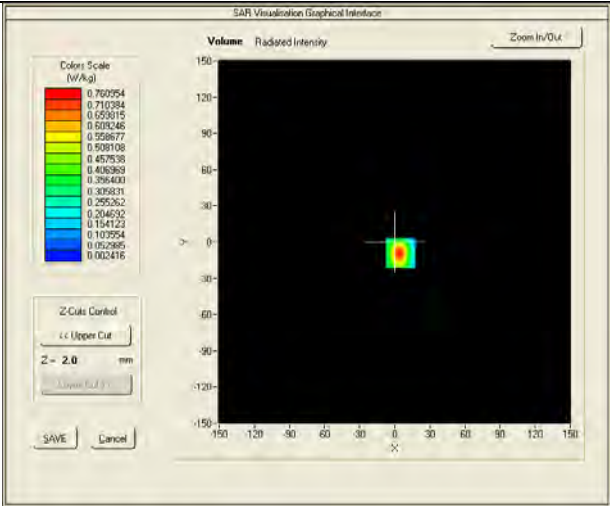
3D View Plot

|                     |   |      |         |      |
|---------------------|---|------|---------|------|
| Test specification: | 802.11n-HT40-5270MHz-Body SAR-Right- position |      |         |      |
| Environ Conditions: | Temp(°C):                                     | 23   | Result: | Pass |
|                     | Humidity(%):                                  | 58   |         |      |
|                     | Atmospheric(mPa):                             | 1009 |         |      |
| Mains Power:        | 3.3VDC  |      |         |      |
| Test Date:          | 10/10/2013                                    |      |         |      |
| Tested by:          | David Zhang                                   |      |         |      |
| Remarks:            | -   |      |         |      |

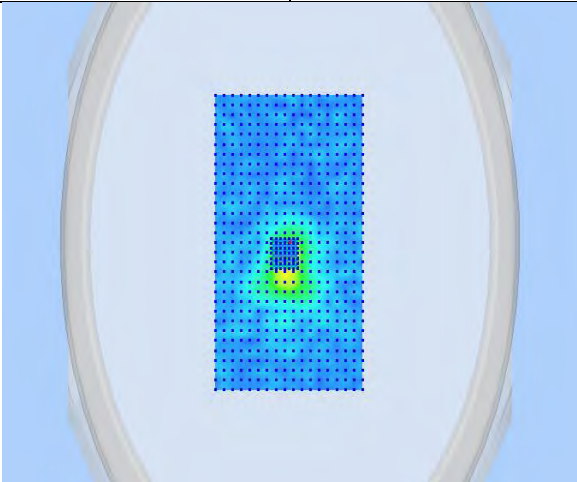
|                                   |                        |
|-----------------------------------|------------------------|
| Frequency (MHz)                   | 5270.000000            |
| Relative permittivity (real part) | 49.82                  |
| Conductivity (S/m)                | 5.49                   |
| Transmission Duty Factor          | 1.0                    |
| Probe SN                          | 2611_EPG129            |
| Conversion Factor (dB)            | 5.69                   |
| Area Scan Resolution              | 8 mm                   |
| Zoom Scan Resolution              | dx=4mm, dy=4mm, dz=2mm |
| Zoom Scan Size                    | 24x24x24 mm            |
| Measurement Drifts (%)            | 1.520                  |
| Highest Extrapolated SAR (W/Kg)   | 1.5376                 |
| SAR 1g (W/Kg)                     | 0.4885                 |
| Peak SAR Location                 | 5mm(x),-9mm(y),4mm(z)  |



SURFACE SAR



VOLUME SAR

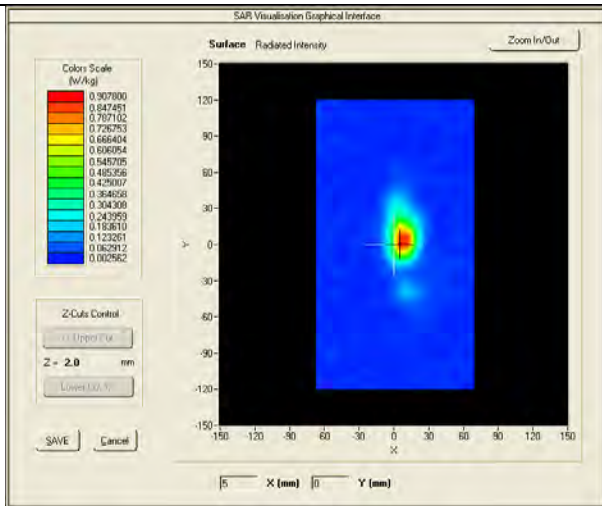


3D View Plot

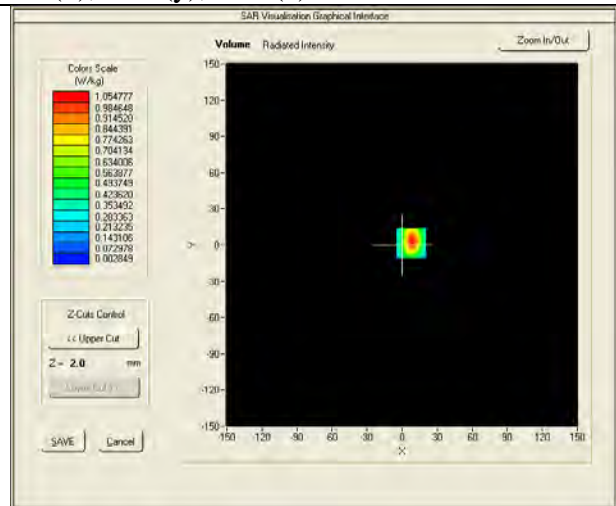


|                     |  |      |         |      |
|---------------------|--|------|---------|------|
| Test specification: | 802.11n-HT40-5670MHz-Body SAR-Right-position |      |         |      |
| Envirn Conditions:  | Temp(°C):                                    | 23   | Result: | Pass |
|                     | Humidity(%):                                 | 58   |         |      |
|                     | Atmospheric(mPa):                            | 1009 |         |      |
| Mains Power:        | 3.3VDC                                       |      |         |      |
| Test Date:          | 10/10/2013                                   |      |         |      |
| Tested by:          | David Zhang                                  |      |         |      |
| Remarks:            | -  |      |         |      |

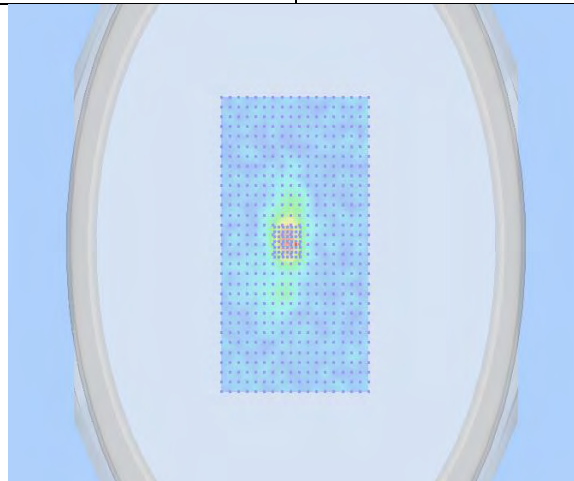
|                                   |                        |
|-----------------------------------|------------------------|
| Frequency (MHz)                   | 5670.000000            |
| Relative permittivity (real part) | 49.66                  |
| Conductivity (S/m)                | 5.64                   |
| Transmission Duty Factor          | 1.0                    |
| Probe SN                          | 2611_EPG129            |
| Conversion Factor (dB)            | 5.69                   |
| Area Scan Resolution              | 8 mm                   |
| Zoom Scan Resolution              | dx=4mm, dy=4mm, dz=2mm |
| Zoom Scan Size                    | 24x24x24 mm            |
| Measurement Drifts (%)            | 2.050                  |
| Highest Extrapolated SAR (W/Kg)   | 2.1579                 |
| SAR 1g (W/Kg)                     | 0.6991                 |
| Peak SAR Location                 | 8mm(x),2mm(y),4mm(z)   |



SURFACE SAR



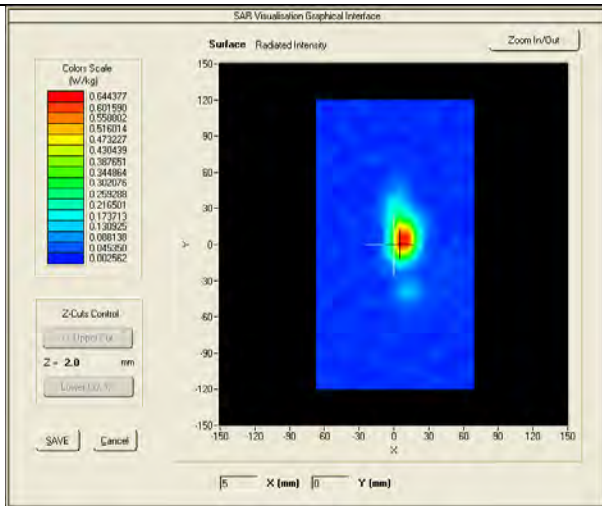
VOLUME SAR



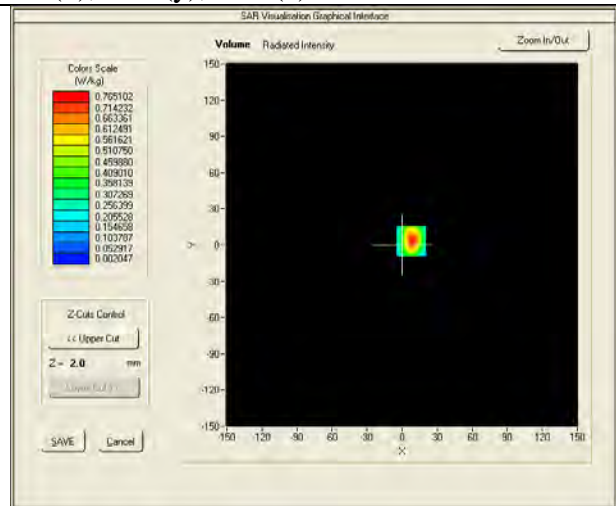
3D View Plot

|                     |  |      |         |      |
|---------------------|--|------|---------|------|
| Test specification: | 802.11n-HT40-5755MHz-Body SAR-Right-position |      |         |      |
| Environ Conditions: | Temp(°C):                                    | 23   | Result: | Pass |
|                     | Humidity(%):                                 | 58   |         |      |
|                     | Atmospheric(mPa):                            | 1009 |         |      |
| Mains Power:        | 3.3VDC                                       |      |         |      |
| Test Date:          | 10/10/2013                                   |      |         |      |
| Tested by:          | David Zhang                                  |      |         |      |
| Remarks:            | -  |      |         |      |

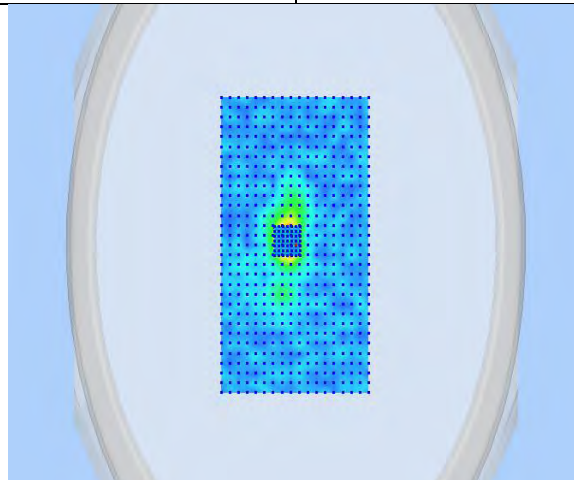
|                                   |                        |
|-----------------------------------|------------------------|
| Frequency (MHz)                   | 5755.000000            |
| Relative permittivity (real part) | 48.87                  |
| Conductivity (S/m)                | 5.71                   |
| Transmission Duty Factor          | 1.0                    |
| Probe SN                          | 2611_EPG129            |
| Conversion Factor (dB)            | 5.69                   |
| Area Scan Resolution              | 8 mm                   |
| Zoom Scan Resolution              | dx=4mm, dy=4mm, dz=2mm |
| Zoom Scan Size                    | 24x24x24 mm            |
| Measurement Drifts (%)            | 1.790                  |
| Highest Extrapolated SAR (W/Kg)   | 1.5593                 |
| SAR 1g (W/Kg)                     | 0.5063                 |
| Peak SAR Location                 | 8mm(x),3mm(y),4mm(z)   |



SURFACE SAR



VOLUME SAR

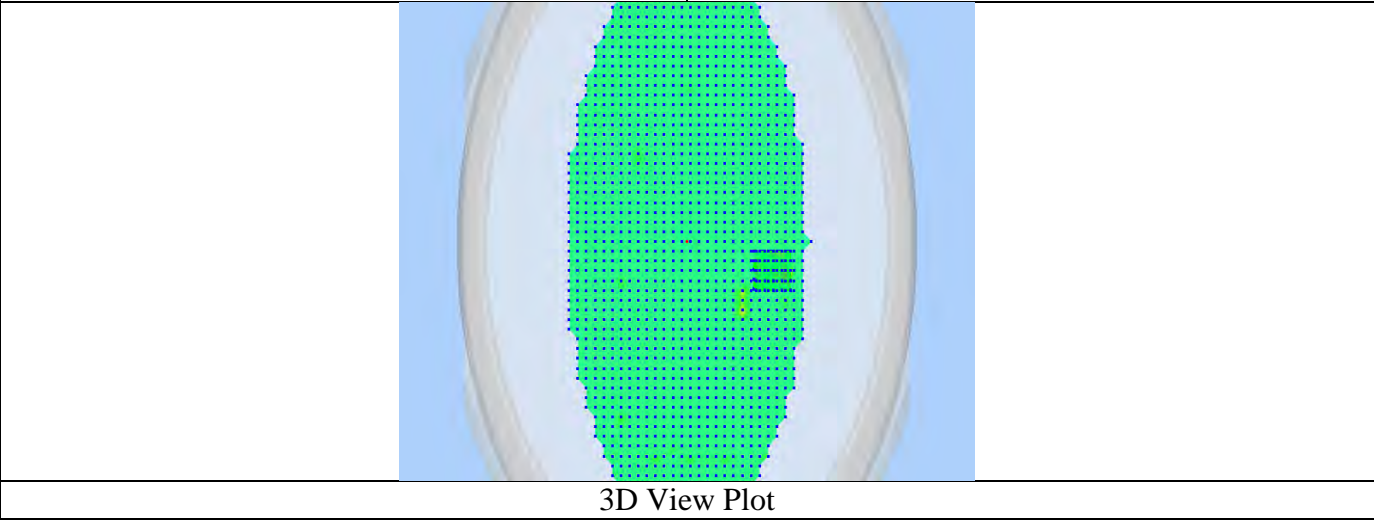
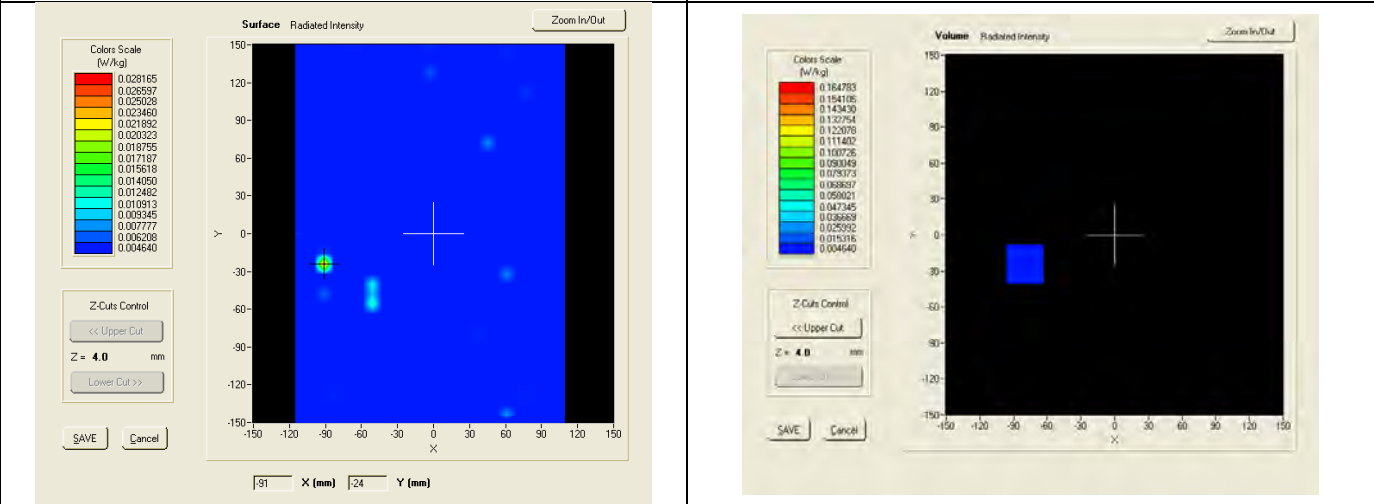


3D View Plot



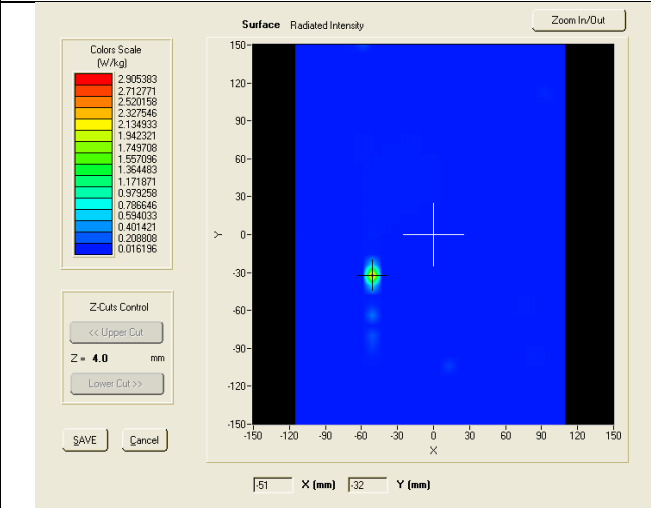
|                     |   |      |         |      |
|---------------------|---|------|---------|------|
| Test specification: | 802.11b-2437MHz-Body SAR-Left- position |      |         |      |
| Environ Conditions: | Temp(oC):                               | 23   | Result: | Pass |
|                     | Humidity(%):                            | 58   |         |      |
|                     | Atmospheric(mPa):                       | 1009 |         |      |
| Mains Power:        | 3.3VDC                                  |      |         |      |
| Test Date:          | 10/10/2013                              |      |         |      |
| Tested by:          | David Zhang                             |      |         |      |
| Remarks:            | -                                       |      |         |      |

|                                   |                        |
|-----------------------------------|------------------------|
| Frequency (MHz)                   | 2437.000000            |
| Relative permittivity (real part) | 51.69                  |
| Conductivity (S/m)                | 1.93                   |
| Transmission Duty Factor          | 1.0                    |
| Probe SN                          | 2611_EPG129            |
| Conversion Factor (dB)            | 7.89                   |
| Area Scan Resolution              | 8 mm                   |
| Zoom Scan Resolution              | dx=5mm, dy=5mm, dz=4mm |
| Zoom Scan Size                    | 30x30x32 mm            |
| Measurement Drifts (%)            | 2.450                  |
| Highest Extrapolated SAR (W/Kg)   | 0.0398                 |
| SAR 1g (W/Kg)                     | 0.0164                 |
| Peak SAR Location                 | 6mm(x),0mm(y),4mm(z)   |

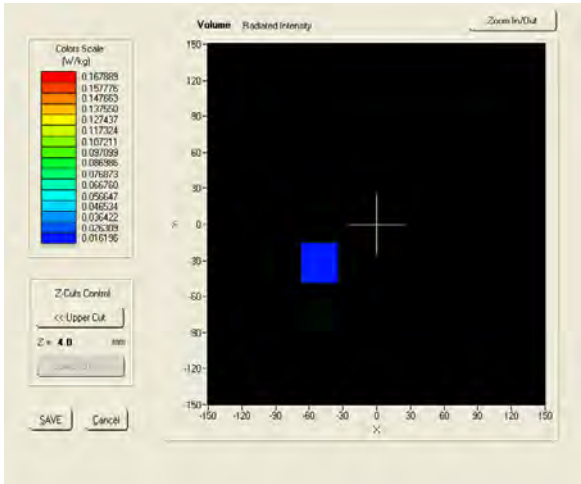


|                     |   |      |         |      |
|---------------------|---|------|---------|------|
| Test specification: | 802.11n-HT40-5230MHz-Body SAR-Left-position |      |         |      |
| Environ Conditions: | Temp(oC):                                   | 23   | Result: | Pass |
|                     | Humidity(%):                                | 58   |         |      |
|                     | Atmospheric(mPa):                           | 1009 |         |      |
| Mains Power:        | 3.3VDC                                      |      |         |      |
| Test Date:          | 10/10/2013                                  |      |         |      |
| Tested by:          | David Zhang                                 |      |         |      |
| Remarks:            | -   |      |         |      |

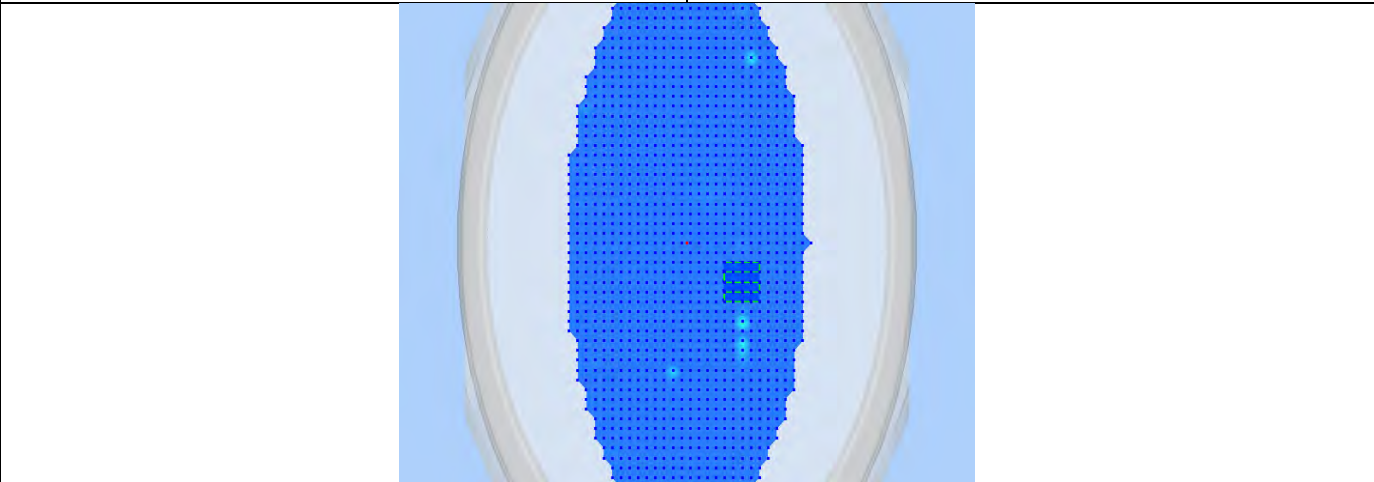
|                                   |                        |
|-----------------------------------|------------------------|
| Frequency (MHz)                   | 5230.000000            |
| Relative permittivity (real part) | 49.83                  |
| Conductivity (S/m)                | 5.49                   |
| Transmission Duty Factor          | 1.0                    |
| Probe SN                          | 2611_EPG129            |
| Conversion Factor (dB)            | 5.69                   |
| Area Scan Resolution              | 8 mm                   |
| Zoom Scan Resolution              | dx=4mm, dy=4mm, dz=2mm |
| Zoom Scan Size                    | 24x24x24 mm            |
| Measurement Drifts (%)            | 3.450                  |
| Highest Extrapolated SAR (W/Kg)   | 0.0683                 |
| SAR 1g (W/Kg)                     | 0.0293                 |
| Peak SAR Location                 | 13mm(x),0mm(y),4mm(z)  |



SURFACE SAR



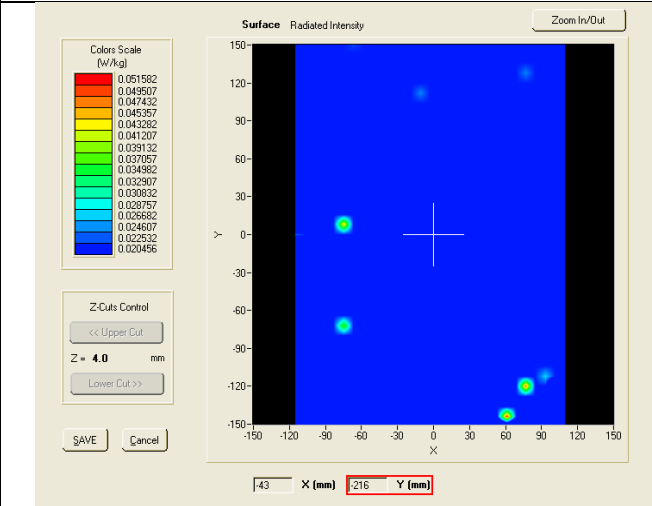
VOLUME SAR



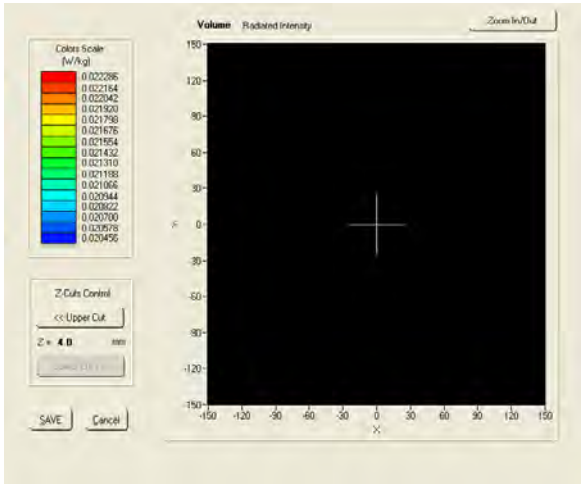
3D View Plot

|                     |   |      |         |      |
|---------------------|---|------|---------|------|
| Test specification: | 802.11n-HT40-5270MHz-Body SAR-Left-position |      |         |      |
| Environ Conditions: | Temp(oC):                                   | 23   | Result: | Pass |
|                     | Humidity(%):                                | 58   |         |      |
|                     | Atmospheric(mPa):                           | 1009 |         |      |
| Mains Power:        | 3.3VDC                                      |      |         |      |
| Test Date:          | 10/10/2013                                  |      |         |      |
| Tested by:          | David Zhang                                 |      |         |      |
| Remarks:            | -   |      |         |      |

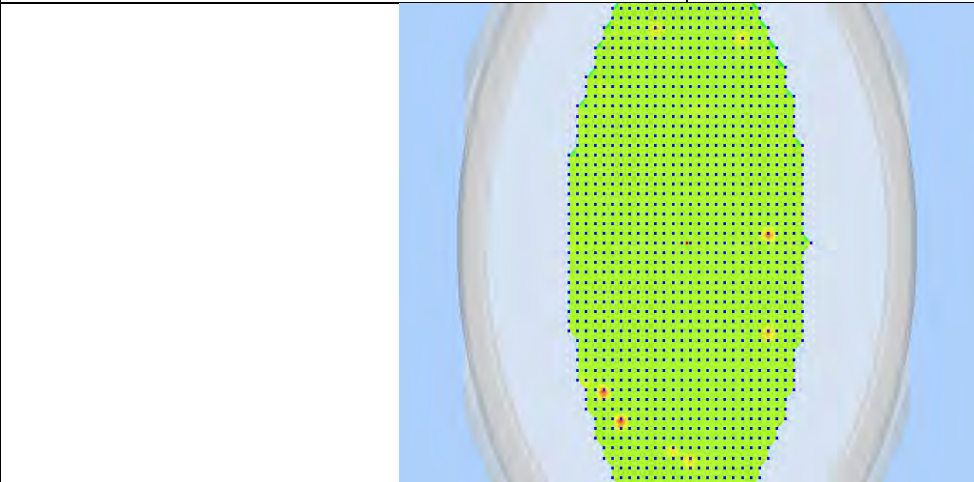
|                                   |                        |
|-----------------------------------|------------------------|
| Frequency (MHz)                   | 5270.000000            |
| Relative permittivity (real part) | 49.82                  |
| Conductivity (S/m)                | 5.49                   |
| Transmission Duty Factor          | 1.0                    |
| Probe SN                          | 2611_EPG129            |
| Conversion Factor (dB)            | 5.69                   |
| Area Scan Resolution              | 8 mm                   |
| Zoom Scan Resolution              | dx=4mm, dy=4mm, dz=2mm |
| Zoom Scan Size                    | 24x24x24 mm            |
| Measurement Drifts (%)            | 1.535                  |
| Highest Extrapolated SAR (W/Kg)   | 0.0485                 |
| SAR 1g (W/Kg)                     | 0.0208                 |
| Peak SAR Location                 | 13mm(x),0mm(y),4mm(z)  |



SURFACE SAR



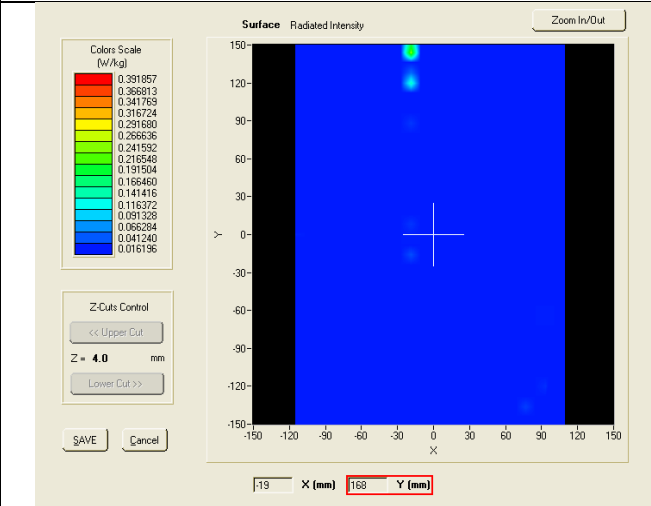
VOLUME SAR



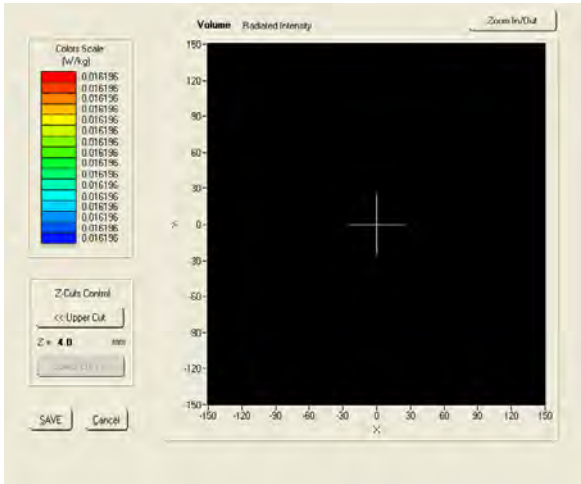
3D View Plot

|                     |   |      |         |      |
|---------------------|---|------|---------|------|
| Test specification: | 802.11n-HT40-5670MHz-Body SAR-Left-position |      |         |      |
| Environ Conditions: | Temp(oC):                                   | 23   | Result: | Pass |
|                     | Humidity(%):                                | 58   |         |      |
|                     | Atmospheric(mPa):                           | 1009 |         |      |
| Mains Power:        | 3.3VDC                                      |      |         |      |
| Test Date:          | 10/10/2013                                  |      |         |      |
| Tested by:          | David Zhang                                 |      |         |      |
| Remarks:            | -   |      |         |      |

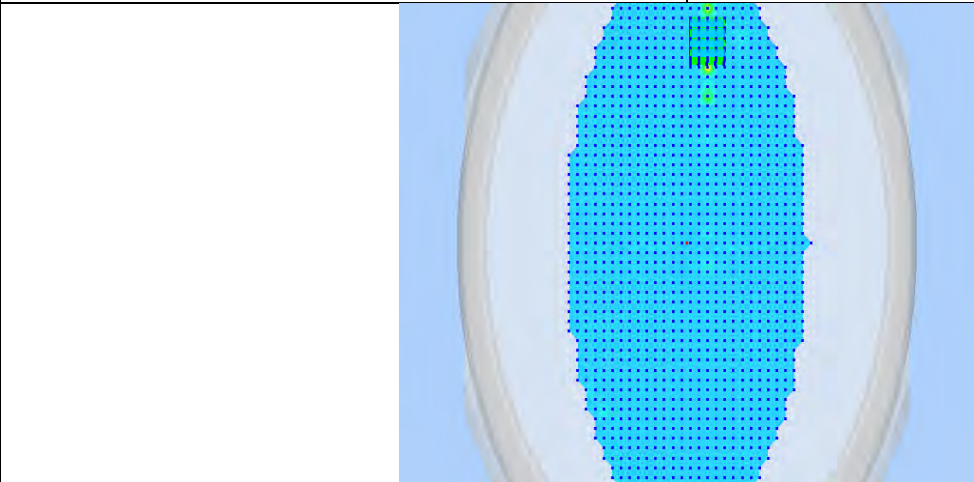
|                                   |                        |
|-----------------------------------|------------------------|
| Frequency (MHz)                   | 5670.000000            |
| Relative permittivity (real part) | 49.66                  |
| Conductivity (S/m)                | 5.64                   |
| Transmission Duty Factor          | 1.0                    |
| Probe SN                          | 2611_EPG129            |
| Conversion Factor (dB)            | 5.69                   |
| Area Scan Resolution              | 8 mm                   |
| Zoom Scan Resolution              | dx=4mm, dy=4mm, dz=2mm |
| Zoom Scan Size                    | 24x24x24 mm            |
| Measurement Drifts (%)            | 4.82                   |
| Highest Extrapolated SAR (W/Kg)   | 0.0466                 |
| SAR 1g (W/Kg)                     | 0.0162                 |
| Peak SAR Location                 | 13mm(x),0mm(y),4mm(z)  |



SURFACE SAR



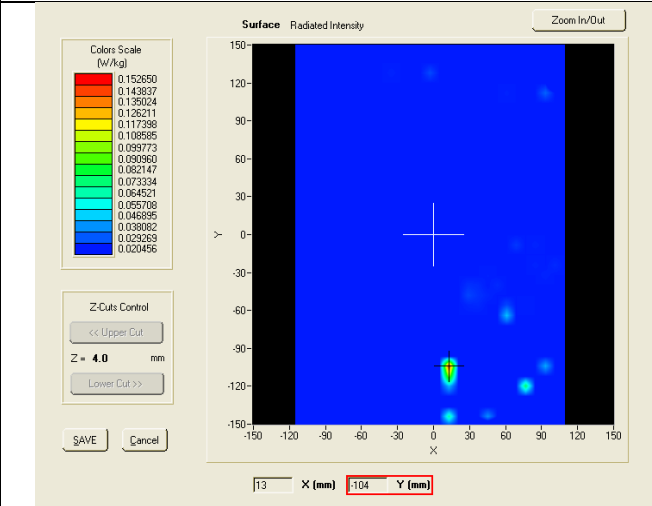
VOLUME SAR



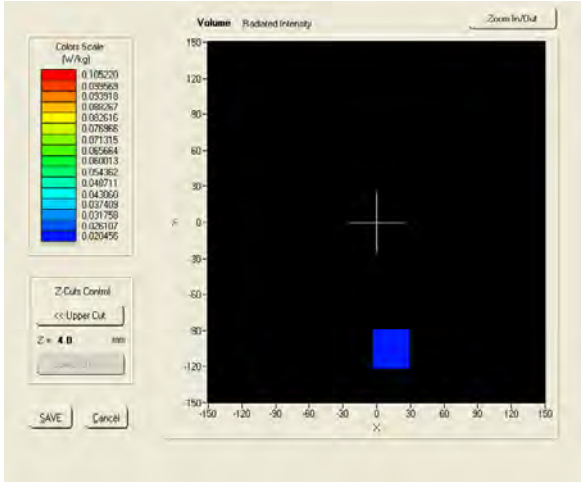
3D View Plot

|                     |   |      |         |      |
|---------------------|---|------|---------|------|
| Test specification: | 802.11n-HT40-5755MHz-Body SAR-Left-position |      |         |      |
| Environ Conditions: | Temp(oC):                                   | 23   | Result: | Pass |
|                     | Humidity(%):                                | 58   |         |      |
|                     | Atmospheric(mPa):                           | 1009 |         |      |
| Mains Power:        | 3.3VDC                                      |      |         |      |
| Test Date:          | 10/10/2013                                  |      |         |      |
| Tested by:          | David Zhang                                 |      |         |      |
| Remarks:            | -   |      |         |      |

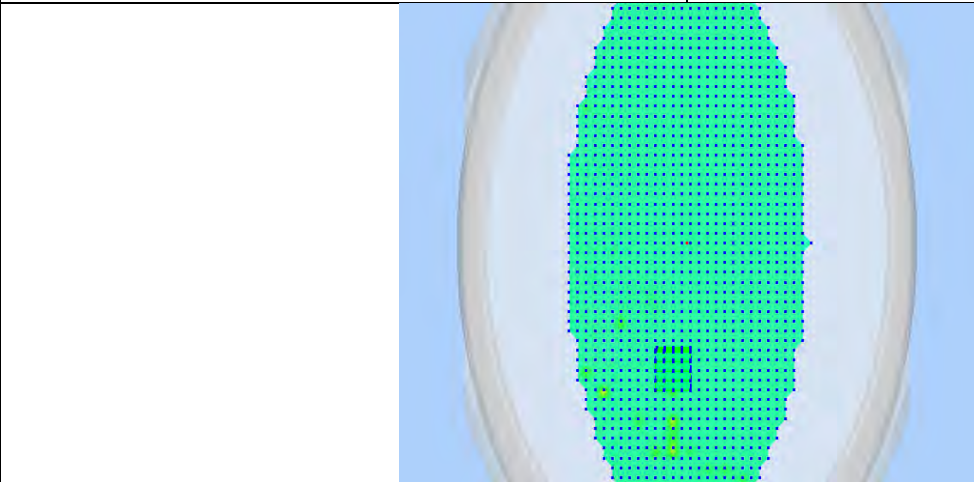
|                                   |                        |
|-----------------------------------|------------------------|
| Frequency (MHz)                   | 5755.000000            |
| Relative permittivity (real part) | 48.87                  |
| Conductivity (S/m)                | 5.71                   |
| Transmission Duty Factor          | 1.0                    |
| Probe SN                          | 2611_EPG129            |
| Conversion Factor (dB)            | 5.69                   |
| Area Scan Resolution              | 8 mm                   |
| Zoom Scan Resolution              | dx=4mm, dy=4mm, dz=2mm |
| Zoom Scan Size                    | 24x24x24 mm            |
| Measurement Drifts (%)            | 2.754                  |
| Highest Extrapolated SAR (W/Kg)   | 0.0867                 |
| SAR 1g (W/Kg)                     | 0.0313                 |
| Peak SAR Location                 | 13mm(x),0mm(y),4mm(z)  |



SURFACE SAR



VOLUME SAR



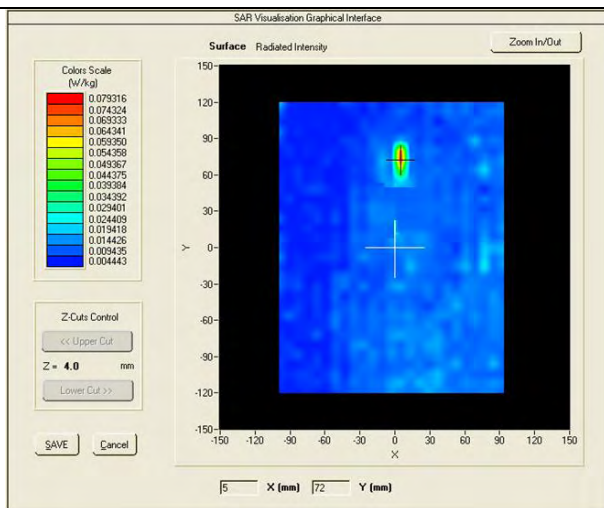
3D View Plot



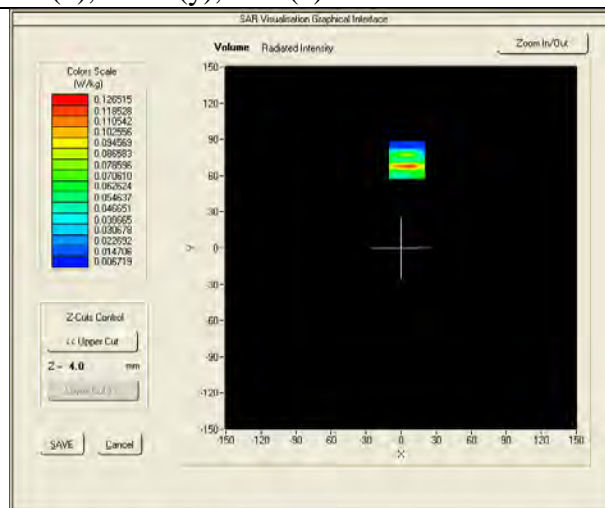
## SAR Measurement Plots – Additional measurement on worst configuration

|                     |   |      |         |      |
|---------------------|---|------|---------|------|
| Test specification: | 802.11b-2412MHz-Body SAR-Front-position |      |         |      |
| Environ Conditions: | Temp(°C):                               | 23   | Result: | Pass |
|                     | Humidity(%):                            | 58   |         |      |
|                     | Atmospheric(mPa):                       | 1009 |         |      |
| Mains Power:        | 3.3VDC                                  |      |         |      |
| Test Date:          | 10/10/2013                              |      |         |      |
| Tested by:          | David Zhang                             |      |         |      |
| Remarks:            | -                                       |      |         |      |

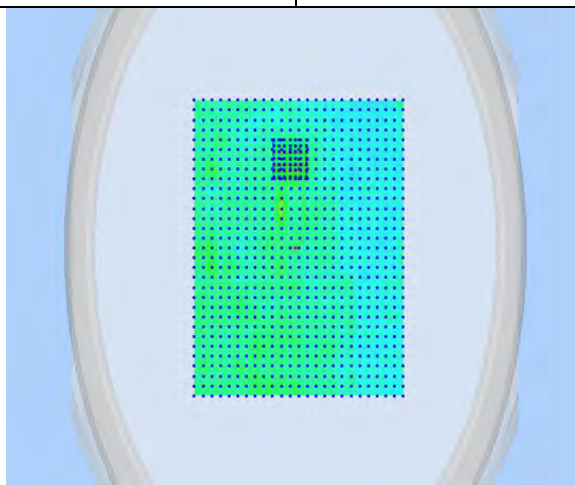
|                                   |                        |
|-----------------------------------|------------------------|
| Frequency (MHz)                   | 2412.000000            |
| Relative permittivity (real part) | 52.913                 |
| Conductivity (S/m)                | 1.949                  |
| Transmission Duty Factor          | 1.0                    |
| Probe SN                          | 2611_EPG129            |
| Conversion Factor (dB)            | 7.89                   |
| Area Scan Resolution              | 8 mm                   |
| Zoom Scan Resolution              | dx=5mm, dy=5mm, dz=4mm |
| Zoom Scan Size                    | 30x30x32 mm            |
| Measurement Drifts (%)            | 2.950                  |
| Highest Extrapolated SAR (W/Kg)   | 0.4677                 |
| SAR 1g (W/Kg)                     | 0.2044                 |
| Peak SAR Location                 | 5mm(x),73mm(y),4mm(z)  |



SURFACE SAR



VOLUME SAR

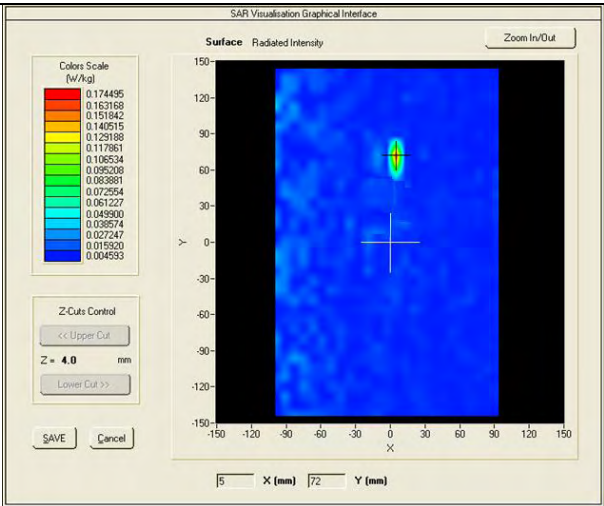


3D View Plot

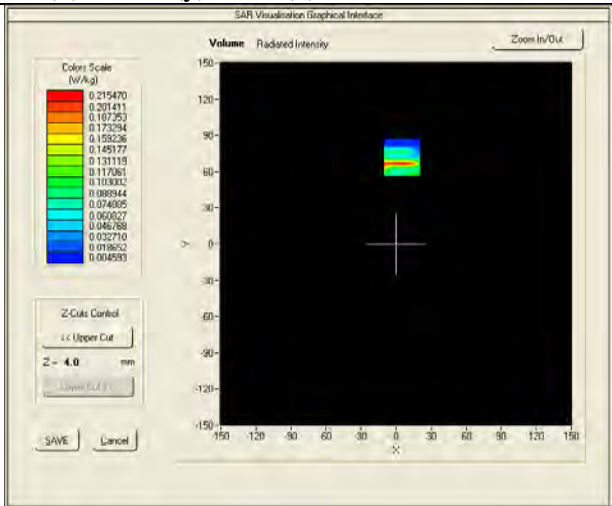


|                     |   |      |         |      |
|---------------------|---|------|---------|------|
| Test specification: | 802.11b-2462MHz-Body SAR-Front-position |      |         |      |
| Environ Conditions: | Temp(°C):                               | 23   | Result: | Pass |
|                     | Humidity(%):                            | 58   |         |      |
|                     | Atmospheric(mPa):                       | 1009 |         |      |
| Mains Power:        | 3.3VDC                                  |      |         |      |
| Test Date:          | 10/10/2013                              |      |         |      |
| Tested by:          | David Zhang                             |      |         |      |
| Remarks:            | -                                       |      |         |      |

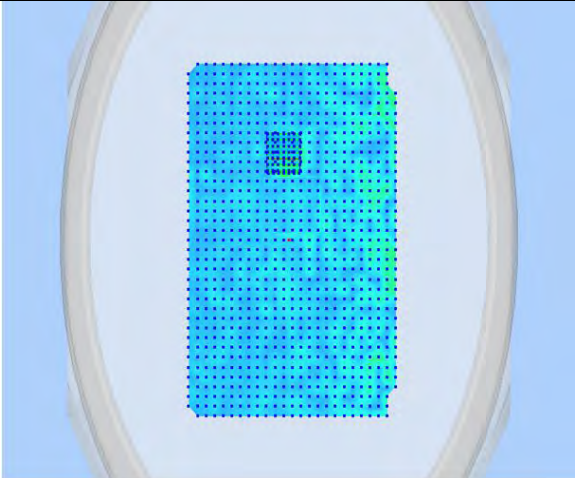
|                                   |                        |
|-----------------------------------|------------------------|
| Frequency (MHz)                   | 2462.000000            |
| Relative permittivity (real part) | 52.465                 |
| Conductivity (S/m)                | 1.963                  |
| Transmission Duty Factor          | 1.0                    |
| Probe SN                          | 2611_EPG129            |
| Conversion Factor (dB)            | 7.89                   |
| Area Scan Resolution              | 8 mm                   |
| Zoom Scan Resolution              | dx=5mm, dy=5mm, dz=4mm |
| Zoom Scan Size                    | 30x30x32 mm            |
| Measurement Drifts (%)            | -1.970                 |
| Highest Extrapolated SAR (W/Kg)   | 0.6427                 |
| SAR 1g (W/Kg)                     | 0.2452                 |
| Peak SAR Location                 | 5mm(x),72mm(y),4mm(z)  |



SURFACE SAR



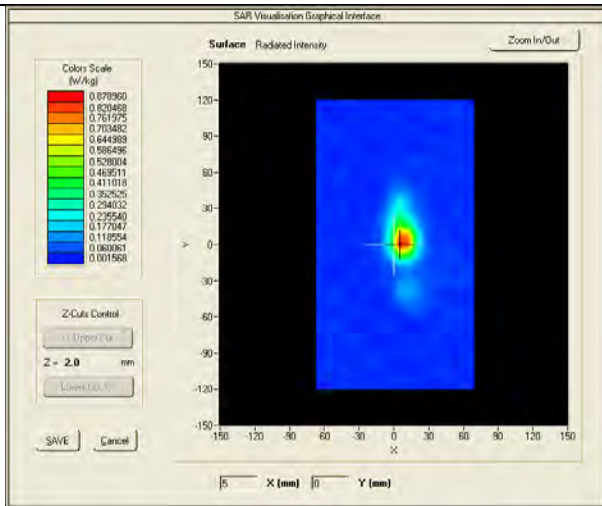
VOLUME SAR



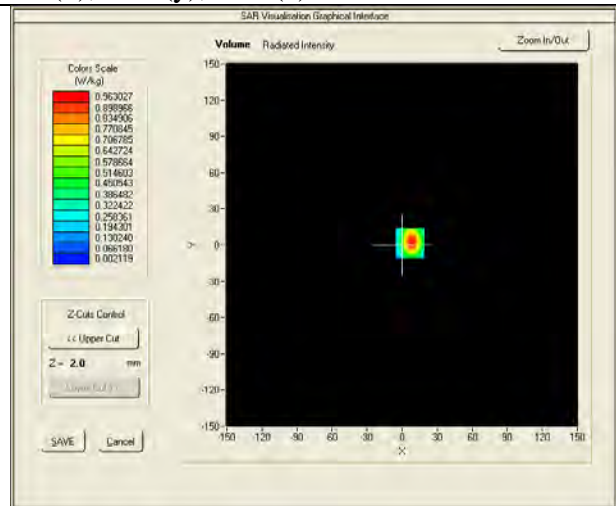
3D View Plot

|                     |   |      |         |      |
|---------------------|---|------|---------|------|
| Test specification: | 802.11n-HT40-5510MHz-Body SAR-Right- position |      |         |      |
| Environ Conditions: | Temp(°C):                                     | 23   | Result: | Pass |
|                     | Humidity(%):                                  | 58   |         |      |
|                     | Atmospheric(mPa):                             | 1009 |         |      |
| Mains Power:        | 3.3VDC  |      |         |      |
| Test Date:          | 10/10/2013                                    |      |         |      |
| Tested by:          | David Zhang                                   |      |         |      |
| Remarks:            | -   |      |         |      |

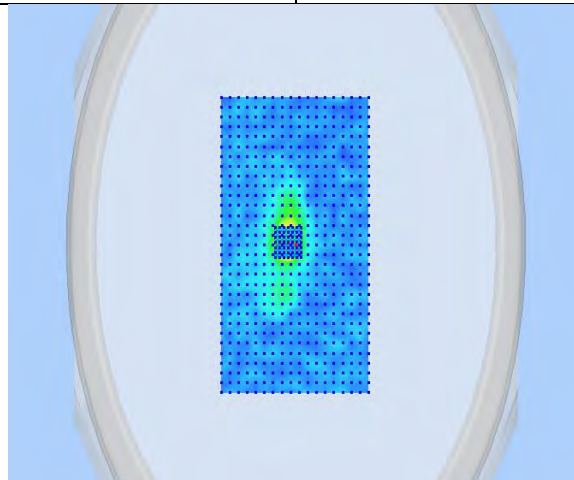
|                                   |                        |
|-----------------------------------|------------------------|
| Frequency (MHz)                   | 5510.000000            |
| Relative permittivity (real part) | 48.58                  |
| Conductivity (S/m)                | 5.83                   |
| Transmission Duty Factor          | 1.0                    |
| Probe SN                          | 2611_EPG129            |
| Conversion Factor (dB)            | 5.69                   |
| Area Scan Resolution              | 8 mm                   |
| Zoom Scan Resolution              | dx=4mm, dy=4mm, dz=2mm |
| Zoom Scan Size                    | 24x24x24 mm            |
| Measurement Drifts (%)            | 1.640                  |
| Highest Extrapolated SAR (W/Kg)   | 1.9430                 |
| SAR 1g (W/Kg)                     | 0.6528                 |
| Peak SAR Location                 | 7mm(x),2mm(y),4mm(z)   |



SURFACE SAR



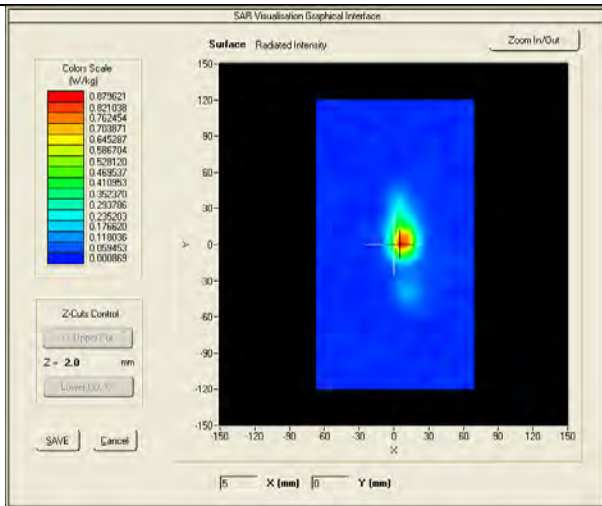
VOLUME SAR



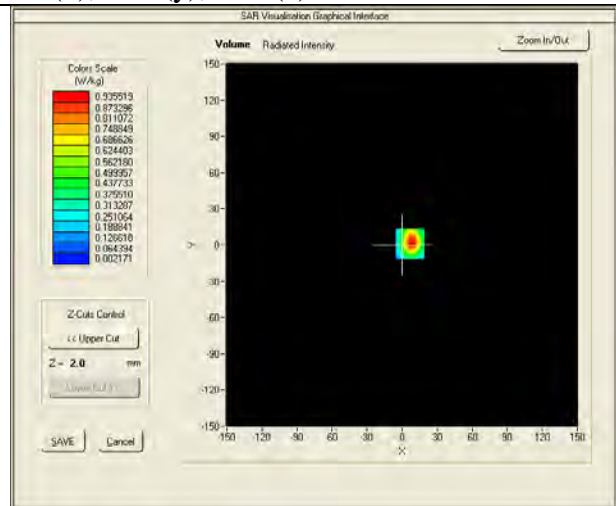
3D View Plot

|                     |   |      |         |      |
|---------------------|---|------|---------|------|
| Test specification: | 802.11n-HT40-5550MHz-Body SAR-Right- position |      |         |      |
| Environ Conditions: | Temp(°C):                                     | 23   | Result: | Pass |
|                     | Humidity(%):                                  | 58   |         |      |
|                     | Atmospheric(mPa):                             | 1009 |         |      |
| Mains Power:        | 3.3VDC  |      |         |      |
| Test Date:          | 10/10/2013                                    |      |         |      |
| Tested by:          | David Zhang                                   |      |         |      |
| Remarks:            | -   |      |         |      |

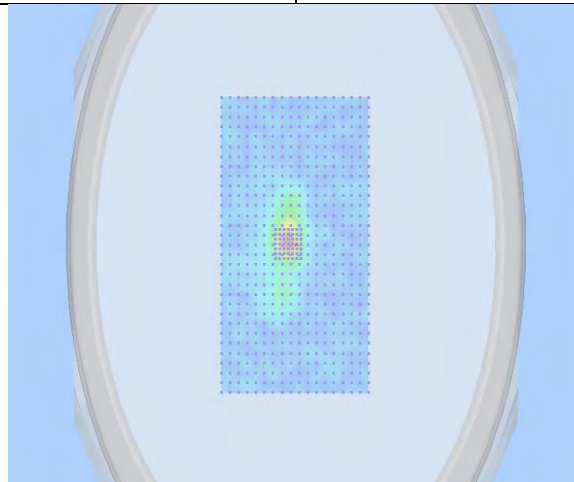
|                                   |                        |
|-----------------------------------|------------------------|
| Frequency (MHz)                   | 5550.000000            |
| Relative permittivity (real part) | 48.48                  |
| Conductivity (S/m)                | 5.90                   |
| Transmission Duty Factor          | 1.0                    |
| Probe SN                          | 2611_EPG129            |
| Conversion Factor (dB)            | 5.69                   |
| Area Scan Resolution              | 8 mm                   |
| Zoom Scan Resolution              | dx=4mm, dy=4mm, dz=2mm |
| Zoom Scan Size                    | 24x24x24 mm            |
| Measurement Drifts (%)            | -0.170                 |
| Highest Extrapolated SAR (W/Kg)   | 1.9044                 |
| SAR 1g (W/Kg)                     | 0.6397                 |
| Peak SAR Location                 | 7mm(x),1mm(y),4mm(z)   |



SURFACE SAR



VOLUME SAR



3D View Plot

## Annex C CALIBRATION REPORTS



### COMOSAR E-Field Probe Calibration Report

Ref : ACR.287.1.12.SATU.A

#### SIEMIC TESTING AND CERTIFICATION SERVICES

SHENZHEN, CHINA  
SATIMO COMOSAR DOSIMETRIC E-FIELD PROBE  
SERIAL NO.: SN 26/11 EPG129



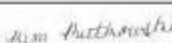
Calibrated at SATIMO US  
2105 Barrett Park Dr. - Kennesaw, GA 30144



10/09/2012

#### *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.

|                      | <i>Name</i>   | <i>Function</i> | <i>Date</i> | <i>Signature</i>  |
|----------------------|---------------|-----------------|-------------|---|
| <i>Prepared by :</i> | Jérôme LUC    | Product Manager | 10/13/2012  |  |
| <i>Checked by :</i>  | Jérôme LUC    | Product Manager | 10/13/2012  |  |
| <i>Approved by :</i> | Kim RUTKOWSKI | Quality Manager | 10/13/2012  |  |

|                       | <i>Customer Name</i>                            |
|-----------------------|---|
| <i>Distribution :</i> | SIEMIC Testing<br>and Certification<br>Services |

| <i>Issue</i> | <i>Date</i> | <i>Modifications</i> |
|--------------|-------------|----------------------|
| A            | 10/13/2012  | Initial release      |
|              |             |                      |
|              |             |                      |
|              |             |                      |



## TABLE OF CONTENTS

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

## 1 DEVICE UNDER TEST

| Device Under Test                        |   |
|--|---|
| Device Type                              | COMOSAR DOSIMETRIC E FIELD PROBE  |
| Manufacturer                             | Satimo  |
| Model                                    | SSE2  |
| Serial Number                            | SN 26/11 EPG129   |
| Product Condition (new / used)           | used  |
| Frequency Range of Probe                 | 0.7 GHz-6GHz  |
| Resistance of Three Dipoles at Connector | Dipole 1: R1=0.151 MΩ<br>Dipole 2: R2=0.215 MΩ<br>Dipole 3: R3=0.194 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               | 2 mm   |
| Maximum external diameter                  | 8 mm   |
| Probe Tip External Diameter                | 2.5 mm |
| Distance between dipoles / probe extremity | 1 mm   |

## 3 MEASUREMENT METHOD

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

### 3.1 LINEARITY

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



### 3.2 SENSITIVITY

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

### 3.3 LOWER DETECTION LIMIT

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

### 3.4 ISOTROPY

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

### 3.5 BOUNDARY EFFECT

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

## 4 MEASUREMENT UNCERTAINTY

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

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

|   |  |  |  |  |         |
|---|--|--|--|--|---------|
| Combined standard uncertainty                       |  |  |  |  | 5.831%  |
| Expanded uncertainty<br>95 % confidence level k = 2 |  |  |  |  | 11.662% |

## 5 CALIBRATION MEASUREMENT RESULTS

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

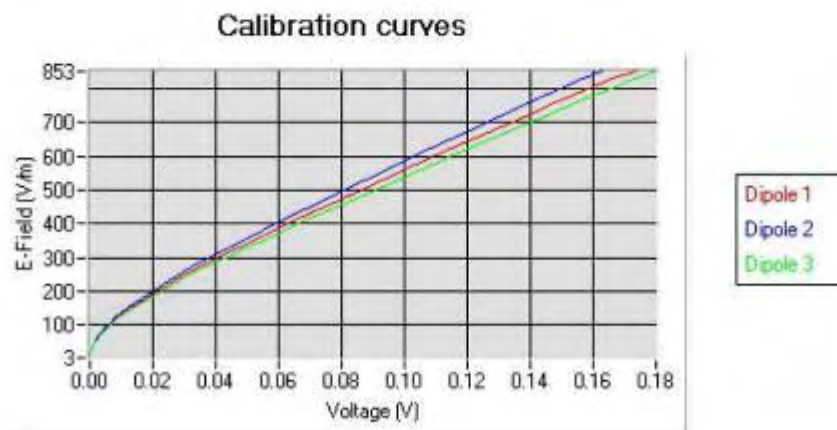
### 5.1 SENSITIVITY IN AIR

| 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 ( $\mu\text{V}/(\text{V}/\text{m})^2$ ) |
|---|---|---|
| 0.62  | 0.59  | 0.68  |

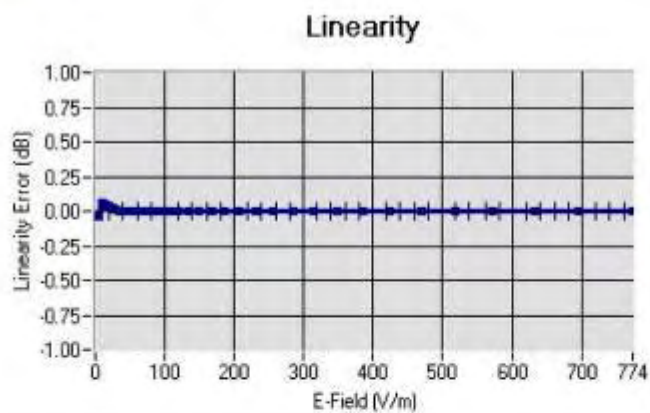
| DCP dipole 1<br>(mV) | DCP dipole 2<br>(mV) | DCP dipole 3<br>(mV) |
|----------------------|----------------------|----------------------|
| 110                  | 103                  | 104                  |

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

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



## 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                             | 41.43        | 0.90          | 7.78  |
| BL850  | 835                             | 54.07        | 0.98          | 8.00  |
| HL900  | 900                             | 41.99        | 0.97          | 7.47  |
| BL900  | 900                             | 53.46        | 1.04          | 7.75  |
| HL1800 | 1750                            | 39.09        | 1.39          | 7.50  |
| BL1800 | 1750                            | 53.98        | 1.52          | 7.79  |
| HL1900 | 1880                            | 40.08        | 1.41          | 8.03  |
| BL1900 | 1880                            | 54.23        | 1.52          | 8.29  |
| HL2000 | 1950                            | 40.67        | 1.43          | 7.31  |
| BL2000 | 1950                            | 53.76        | 1.50          | 7.46  |
| HL2450 | 2450                            | 38.66        | 1.83          | 7.67  |
| BL2450 | 2450                            | 52.46        | 1.98          | 7.89  |
| HL3500 | 3500                            | 36.93        | 2.88          | 6.96  |
| BL3500 | 3500                            | 51.43        | 3.14          | 7.23  |
| HL5200 | 5200                            | 35.73        | 4.22          | 5.51  |
| BL5200 | 5200                            | 49.33        | 5.11          | 5.69  |
| HL5400 | 5400                            | 35.09        | 4.43          | 6.40  |
| BL5400 | 5400                            | 49.75        | 5.64          | 6.58  |
| HL5600 | 5600                            | 35.01        | 5.02          | 6.17  |
| BL5600 | 5600                            | 49.34        | 5.99          | 6.31  |
| HL5800 | 5800                            | 34.77        | 5.55          | 6.14  |
| BL5800 | 5800                            | 47.96        | 6.01          | 6.34  |

LOWER DETECTION LIMIT: 9mW/kg

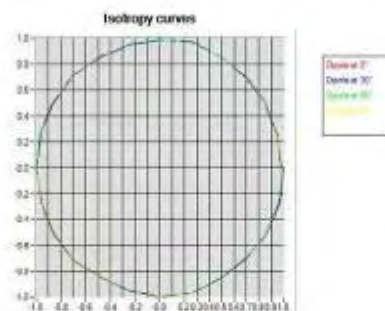
Page: 7/10

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#### 5.4 ISOTROPY

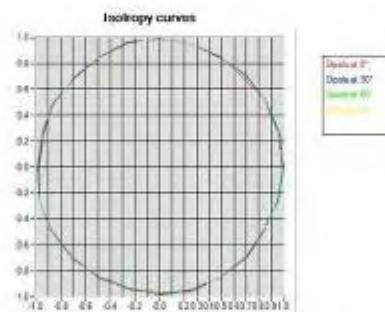
##### HL900 MHz

- Axial isotropy: 0.05 dB
- Hemispherical isotropy: 0.09 dB



##### HL1800 MHz

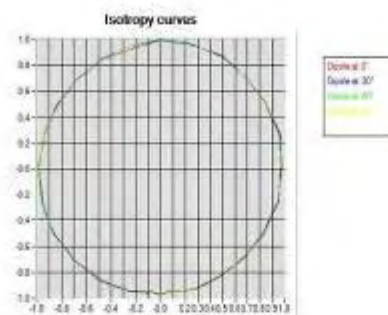
- Axial isotropy: 0.08 dB
- Hemispherical isotropy: 0.10 dB





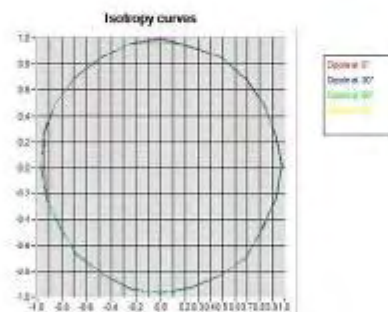
**HL2450 MHz**

- Axial isotropy: 0.07 dB
- Hemispherical isotropy: 0.11 dB



**HL5400 MHz**

- Axial isotropy: 0.10 dB
- Hemispherical isotropy: 0.15 dB



## 6 LIST OF EQUIPMENT

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





## **SAR Reference Dipole Calibration Report**

Ref : ACR.170.7.12.SATU.A

### **SIEMIC TESTING AND CERTIFICATION SERVICES**

**2206 RINGWOOD AVE.**

**SAN JOSE, CA 95131, USA**

### **SATIMO COMOSAR REFERENCE DIPOLE**

**FREQUENCY: 2450 MHZ**

**SERIAL NO.: SN 31/10 DIPJ138**

**Calibrated at SATIMO US**



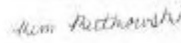
**2105 Barrett Park Dr. - Kennesaw, GA 30144**



**06/13/2012**

#### *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.

|                      | <i>Name</i>   | <i>Function</i> | <i>Date</i> | <i>Signature</i>  |
|----------------------|---------------|-----------------|-------------|---|
| <i>Prepared by :</i> | Jérôme LUC    | Product Manager | 6/18/2012   |  |
| <i>Checked by :</i>  | Jérôme LUC    | Product Manager | 6/18/2012   |  |
| <i>Approved by :</i> | Kim RUTKOWSKI | Quality Manager | 6/18/2012   |  |

|                       | <i>Customer Name</i>                            |
|-----------------------|---|
| <i>Distribution :</i> | SIEMIC Testing<br>and Certification<br>Services |

| <i>Issue</i> | <i>Date</i> | <i>Modifications</i> |
|--------------|-------------|----------------------|
| A            | 6/18/2012   | Initial release      |
|              |             |                      |
|              |             |                      |
|              |             |                      |

## TABLE OF CONTENTS

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

## 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 31/10 DIPJ138                  |
| Product Condition (new / used) | used                              |

A yearly calibration interval is recommended.

## 3 PRODUCT DESCRIPTION

### 3.1 GENERAL INFORMATION

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



**Figure 1** – Satimo COMOSAR Validation Dipole

## 4 MEASUREMENT METHOD

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

### 4.1 RETURN LOSS REQUIREMENTS

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

### 4.2 MECHANICAL REQUIREMENTS

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

## 5 MEASUREMENT UNCERTAINTY

All uncertainties listed below represent an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of  $k=2$ , traceable to the Internationally Accepted Guides to Measurement Uncertainty.

### 5.1 RETURN LOSS

The following uncertainties apply to the return loss measurement:

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

### 5.2 DIMENSION MEASUREMENT

The following uncertainties apply to the dimension measurements:

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

### 5.3 VALIDATION MEASUREMENT

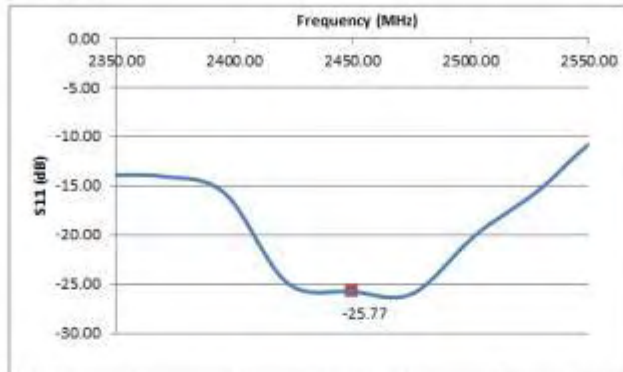
The guidelines outlined in the IEEE 1528, OET 65 Bulletin C, CENELEC EN50361 and CEI/IEC 62209 standards were followed to generate the measurement uncertainty for validation measurements.

| Scan Volume | Expanded Uncertainty |
|-------------|----------------------|
| 1 g         | 16.19 %              |
| 10 g        | 15.86 %              |



## 6 CALIBRATION MEASUREMENT RESULTS

### 6.1 RETURN LOSS



| Frequency (MHz) | Return Loss (dB) | Requirement (dB) |
|-----------------|------------------|------------------|
| 2450            | -25.77           | -20              |

### 6.2 MECHANICAL DIMENSIONS

| Frequency MHz | L mm       |          | h mm       |          | d mm      |          |
|---------------|------------|----------|------------|----------|-----------|----------|
|               | required   | measured | required   | measured | required  | measured |
| 300           | 420.0 ±1 % |          | 250.0 ±1 % |          | 6.35 ±1 % |          |
| 450           | 290.0 ±1 % |          | 166.7 ±1 % |          | 6.35 ±1 % |          |
| 750           | 176.0 ±1 % |          | 100.0 ±1 % |          | 6.35 ±1 % |          |
| 835           | 161.0 ±1 % |          | 89.8 ±1 %  |          | 3.6 ±1 %  |          |
| 900           | 149.0 ±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 %  |          | 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 %  | 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 MEASUREMENT CONDITION

|   |   |
|---|---|
| Software                                  | OPENSAR V4  |
| Phantom                                   | SN 20/09 SAM71  |
| Probe                                     | SN 18/11 EPG122                                       |
| Liquid                                    | Head Liquid Values: $\epsilon_p'$ : 39.0 sigma : 1.88 |
| Distance between dipole center and liquid | 10.0 mm   |
| Area scan resolution                      | dx=8mm/dy=8mm   |
| Zoon Scan Resolution                      | dx=8mm/dy=8m/dz=5mm                                   |
| Frequency                                 | 2450 MHz  |
| Input power                               | 20 dBm  |
| Liquid Temperature                        | 21 °C   |
| Lab Temperature                           | 21 °C   |
| Lab Humidity                              | 45 %  |

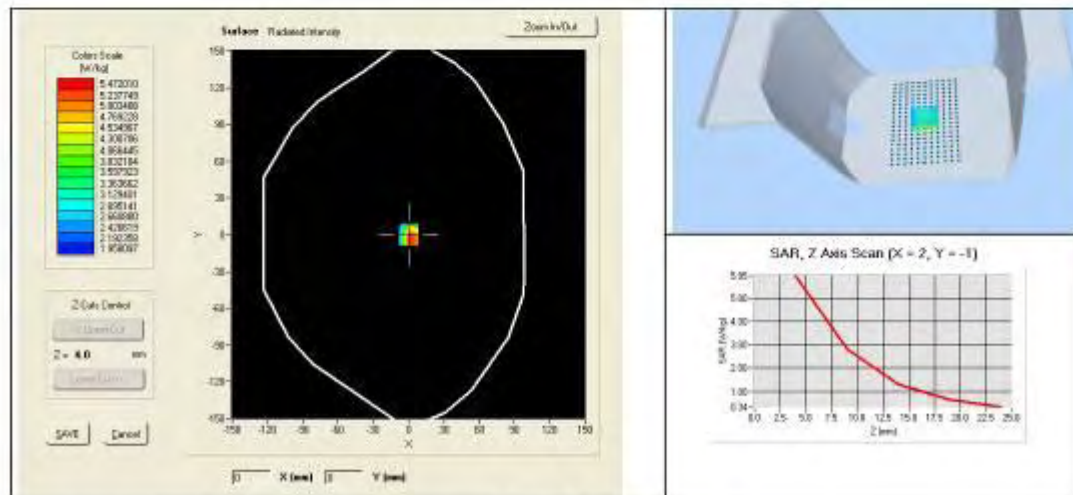
### 7.2 HEAD LIQUID MEASUREMENT

| Frequency<br>MHz | Relative permittivity ( $\epsilon_r'$ ) |          | Conductivity ( $\sigma$ ) S/m |          |
|------------------|---|----------|-------------------------------|----------|
|                  | required                                | measured | required                      | measured |
| 300              | 45.3 $\pm$ 5 %                          |          | 0.87 $\pm$ 5 %                |          |
| 450              | 43.5 $\pm$ 5 %                          |          | 0.87 $\pm$ 5 %                |          |
| 750              | 41.9 $\pm$ 5 %                          |          | 0.89 $\pm$ 5 %                |          |
| 835              | 41.5 $\pm$ 5 %                          |          | 0.90 $\pm$ 5 %                |          |
| 900              | 41.5 $\pm$ 5 %                          |          | 0.97 $\pm$ 5 %                |          |
| 1450             | 40.5 $\pm$ 5 %                          |          | 1.20 $\pm$ 5 %                |          |
| 1500             | 40.4 $\pm$ 5 %                          |          | 1.23 $\pm$ 5 %                |          |
| 1640             | 40.2 $\pm$ 5 %                          |          | 1.31 $\pm$ 5 %                |          |
| 1750             | 40.1 $\pm$ 5 %                          |          | 1.37 $\pm$ 5 %                |          |
| 1800             | 40.0 $\pm$ 5 %                          |          | 1.40 $\pm$ 5 %                |          |
| 1900             | 40.0 $\pm$ 5 %                          |          | 1.40 $\pm$ 5 %                |          |
| 1950             | 40.0 $\pm$ 5 %                          |          | 1.40 $\pm$ 5 %                |          |
| 2000             | 40.0 $\pm$ 5 %                          |          | 1.40 $\pm$ 5 %                |          |
| 2100             | 39.8 $\pm$ 5 %                          |          | 1.49 $\pm$ 5 %                |          |
| 2300             | 39.5 $\pm$ 5 %                          |          | 1.67 $\pm$ 5 %                |          |
| 2450             | 39.2 $\pm$ 5 %                          | PASS     | 1.80 $\pm$ 5 %                | PASS     |
| 2600             | 39.0 $\pm$ 5 %                          |          | 1.96 $\pm$ 5 %                |          |
| 3000             | 38.5 $\pm$ 5 %                          |          | 2.40 $\pm$ 5 %                |          |
| 3500             | 37.9 $\pm$ 5 %                          |          | 2.91 $\pm$ 5 %                |          |

### 7.3 MEASUREMENT RESULT

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.

| 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              |              |
| 2450             | 52.4             | 54.82 (5.48) | 24                | 24.50 (2.45) |
| 2600             | 55.3             |              | 24.6              |              |
| 3000             | 63.8             |              | 25.7              |              |
| 3500             | 67.1             |              | 25                |              |



## 8 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           | 02/2010                                       | 02/2013                                       |
| Calipers                        | Carrera              | CALIPER-01         | 12/2010                                       | 12/2013                                       |
| Reference Probe                 | Satimo               | EPG122 SN 18/11    | Characterized prior to test. No cal required. | Characterized prior to test. No cal required. |
| Multimeter                      | Keithley 2000        | 1188656            | 11/2010                                       | 11/2013                                       |
| Signal Generator                | Agilent E4438C       | MY49070581         | 12/2010                                       | 12/2013                                       |
| Amplifier                       | Aethercomm           | SN 046             | Characterized prior to test. No cal required. | Characterized prior to test. No cal required. |
| Power Meter                     | HP E4418A            | US38261498         | 11/2010                                       | 11/2013                                       |
| Power Sensor                    | HP ECP-E26A          | US37181460         | 11/2010                                       | 11/2013                                       |
| Directional Coupler             | Narda 4216-20        | 01386              | Characterized prior to test. No cal required. | Characterized prior to test. No cal required. |
| Temperature and Humidity Sensor | Control Company      | 11-661-9           | 3/2012  | 3/2014  |

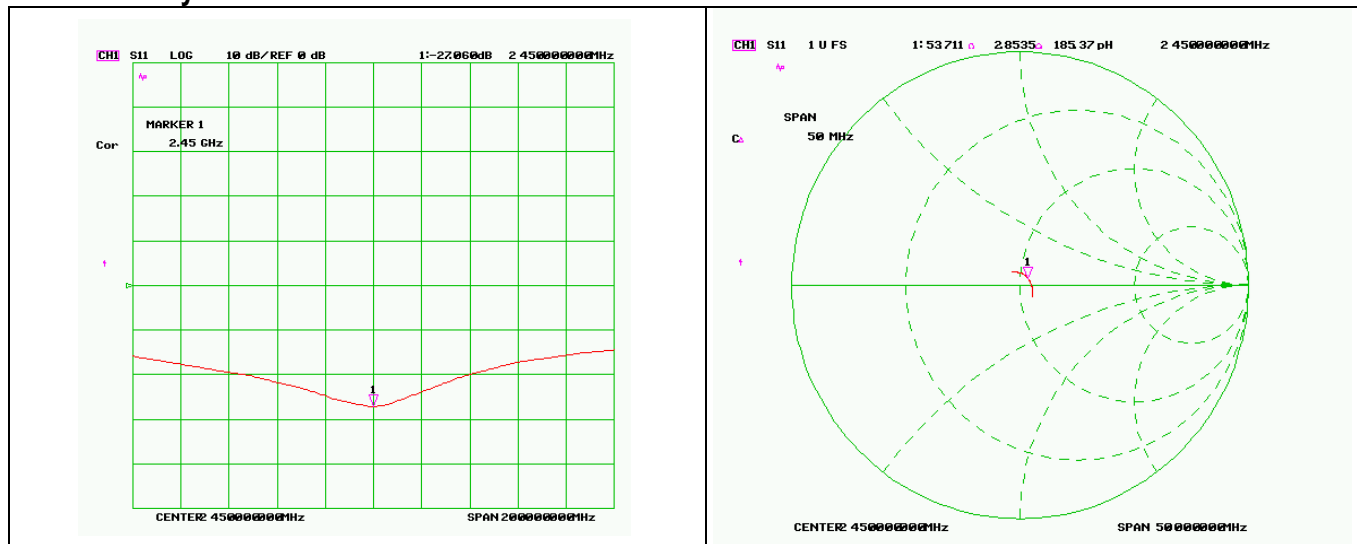
## SARTIMO Calibration Certificate-Extended Dipole Calibrations

According to KDB 450824 D02, Dipoles must be recalibrated at least once every three years; however, immediate re-calibration is required for following conditions. The test laboratory must ensure that the required supporting information and documentation have been included in the SAR report to qualify for extended 3-year calibration interval.

- 1) When the most recent return-loss, measured at least annually, deviates by more than 20% from the previous measurement (i.e. 0.2 of the dB value) or not meeting the required -20 dB return-loss specification
- 2) When the most recent measurement of the real or imaginary parts of the impedance, measured at least annually, deviates by more than 5 ohm from the previous measurement

### Dipole Verification plot: SID2450

2450MHz for Body:



### Summary results:

| SID 2450          |              |                             |                                  |                      |                |
|-------------------|--------------|-----------------------------|----------------------------------|----------------------|----------------|
| Return- Loss (dB) | Deviate (dB) | Real Impedance ( $\Omega$ ) | Imaginary Impedance ( $\Omega$ ) | Deviate ( $\Omega$ ) | Calibrate Date |
| -26.80            | -----        | -----                       | 50                               | -----                | 06/13/2013     |
| -27.06            | 0.26         | 53.711                      | 50                               | 3.711                | 06/10/2014     |

According to up table, the return loss is <-20dB, deviates by less than 20% from the previous measurement; the real Impedance are all within 5  $\Omega$  compared to the required Impedance (50  $\Omega$ ).





## **SAR Reference Waveguide Calibration Report**

Ref: ACR.170.9.12.SATU.A

### **SIEMIC TESTING AND CERTIFICATION SERVICES**

**2206 RINGWOOD AVE.**

**SAN JOSE, CA 95131, USA**

### **SATIMO COMOSAR REFERENCE WAVEGUIDE**

**FREQUENCY: 5000-6000 MHZ**

**SERIAL NO.: SN 31/10 WGA13**

**Calibrated at SATIMO US**



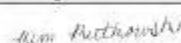
**2105 Barrett Park Dr. - Kennesaw, GA 30144**



**06/13/2013**

#### *Summary:*

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

|                      | <i>Name</i>   | <i>Function</i> | <i>Date</i> | <i>Signature</i>  |
|----------------------|---------------|-----------------|-------------|---|
| <i>Prepared by :</i> | Jérôme LUC    | Product Manager | 6/18/2013   |  |
| <i>Checked by :</i>  | Jérôme LUC    | Product Manager | 6/18/2013   |  |
| <i>Approved by :</i> | Kim RUTKOWSKI | Quality Manager | 6/18/2013   |  |

|                       | <i>Customer Name</i>                            |
|-----------------------|---|
| <i>Distribution :</i> | SIEMIC Testing<br>and Certification<br>Services |

| <i>Issue</i> | <i>Date</i> | <i>Modifications</i> |
|--------------|-------------|----------------------|
| A            | 6/18/2013   | Initial release      |
|              |             |                      |
|              |             |                      |
|              |             |                      |



## TABLE OF CONTENTS

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

## 1 INTRODUCTION

This document contains a summary of the requirements set forth by the IEEE 1528 and CEI/IEC 62209 standards for reference waveguides 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 5000-6000 MHz REFERENCE WAVEGUIDE |
| Manufacturer                   | Satimo                                    |
| Model                          | SWG5500                                   |
| Serial Number                  | SN 31/10 WGA13                            |
| Product Condition (new / used) | used                                      |

A yearly calibration interval is recommended.

## 3 PRODUCT DESCRIPTION

### 3.1 GENERAL INFORMATION

Satimo's COMOSAR Validation Waveguides are built in accordance to the IEEE 1528 and CEI/IEC 62209 standards.

## 4 MEASUREMENT METHOD

The IEEE 1528 and CEI/IEC 62209 standards provide requirements for reference waveguides 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 waveguide used for SAR system validation measurements and checks must have a return loss of -8 dB or better. The return loss measurement shall be performed with matching layer placed in the open end of the waveguide, with the waveguide and matching layer in direct contact with the phantom shell as outlined in the fore mentioned standards.

### 4.2 MECHANICAL REQUIREMENTS

The IEEE 1528 and CEI/IEC 62209 standards specify the mechanical dimensions of the validation waveguide, the specified dimensions are as shown in Section 6.2. Figure 1 shows how the dimensions relate to the physical construction of the waveguide.

## 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                        |

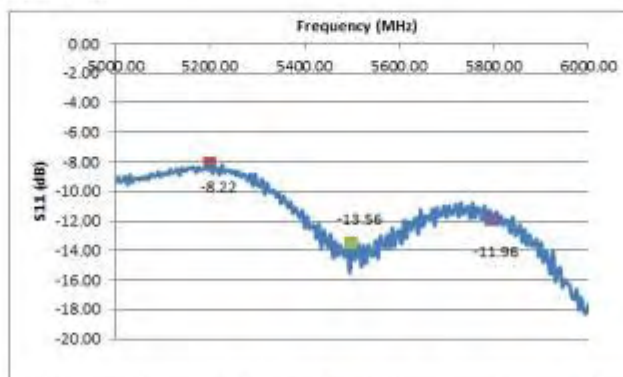
### 5.3 VALIDATION MEASUREMENT

The guidelines outlined in the IEEE 1528 and CEI/IEC 62209 standards were followed to generate the measurement uncertainty for validation measurements.

| Scan Volume | Expanded Uncertainty |
|-------------|----------------------|
| 1 g         | 16.19 %              |
| 10 g        | 15.86 %              |

## 6 CALIBRATION MEASUREMENT RESULTS

### 6.1 RETURN LOSS



| Frequency (MHz) | Return Loss (dB) | Requirement (dB) |
|-----------------|------------------|------------------|
| 5000-6000       | < -8.00          | -8               |

## 6.2 MECHANICAL DIMENSIONS

| Frequency (MHz) | L (mm)       |           | W (mm)       |           | L <sub>r</sub> (mm) |           | W <sub>r</sub> (mm) |           | T (mm)    |           |
|-----------------|--------------|-----------|--------------|-----------|---------------------|-----------|---------------------|-----------|-----------|-----------|
|                 | Require d    | Measure d | Require d    | Measure d | Require d           | Measure d | Require d           | Measure d | Require d | Measure d |
| 5200            | 40.39 ± 0.13 | PASS      | 20.19 ± 0.13 | PASS      | 81.03 ± 0.13        | PASS      | 61.98 ± 0.13        | PASS      | 5.3*      | PASS      |
| 5800            | 40.39 ± 0.13 | PASS      | 20.19 ± 0.13 | PASS      | 81.03 ± 0.13        | PASS      | 61.98 ± 0.13        | PASS      | 4.3*      | PASS      |

\* The tolerance for the matching layer is included in the return loss measurement.

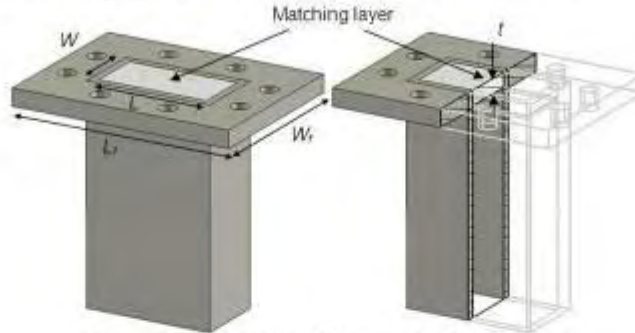


Figure 1: Validation Waveguide Dimensions

## 7 VALIDATION MEASUREMENT

The IEEE Std. 1528 and CEI/IEC 62209 standards state that the system validation measurements must be performed using a reference waveguide meeting the fore mentioned return loss and mechanical dimension requirements. The validation measurement must be performed with the matching layer placed in the open end of the waveguide, with the waveguide and matching layer in direct contact with the phantom shell.

### Measurement Condition

|  |  |
|--|--|
| Software                                     | OPENSAR V4   |
| Phantom                                      | SN 20/09 SAM71   |
| Probe  | SN 18/11 EPG122  |
| Liquid                                       | Head Liquid Values 5200 MHz: eps' :37.0 sigma : 4.61<br>Head Liquid Values 5500 MHz: eps' :34.7 sigma : 4.96<br>Head Liquid Values 5800 MHz: eps' :33.7 sigma : 5.62 |
| Distance between dipole waveguide and liquid | 0 mm   |
| Area scan resolution                         | dx=8mm/dy=8mm  |
| Zoon Scan Resolution                         | dx=4mm/dy=4m/dz=2mm  |
| Frequency                                    | 5200 MHz<br>5500 MHz<br>5800 MHz   |
| Input power                                  | 20 dBm   |
| Liquid Temperature                           | 21 °C  |
| Lab Temperature                              | 21 °C  |
| Lab Humidity                                 | 45 %   |



## 7.1 HEAD LIQUID MEASUREMENT

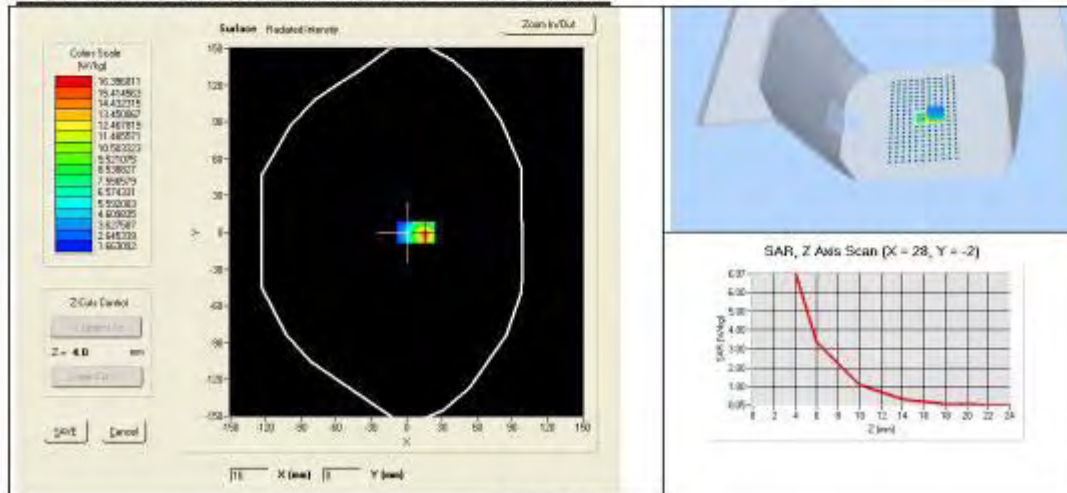
| Frequency<br>MHz | Relative permittivity ( $\epsilon_r$ ) |          | Conductivity ( $\sigma$ ) S/m |          |
|------------------|--|----------|-------------------------------|----------|
|                  | required                               | measured | required                      | measured |
| 5000             | 36.2 $\pm 10$ %                        |          | 4.45 $\pm 10$ %               |          |
| 5100             | 36.1 $\pm 10$ %                        |          | 4.56 $\pm 10$ %               |          |
| 5200             | 36.0 $\pm 10$ %                        | PASS     | 4.66 $\pm 10$ %               | PASS     |
| 5300             | 35.9 $\pm 10$ %                        |          | 4.76 $\pm 10$ %               |          |
| 5400             | 35.8 $\pm 10$ %                        |          | 4.86 $\pm 10$ %               |          |
| 5500             | 35.6 $\pm 10$ %                        | PASS     | 4.97 $\pm 10$ %               | PASS     |
| 5600             | 35.5 $\pm 10$ %                        |          | 5.07 $\pm 10$ %               |          |
| 5700             | 35.4 $\pm 10$ %                        |          | 5.17 $\pm 10$ %               |          |
| 5800             | 35.3 $\pm 10$ %                        | PASS     | 5.27 $\pm 10$ %               | PASS     |
| 5900             | 35.2 $\pm 10$ %                        |          | 5.38 $\pm 10$ %               |          |
| 6000             | 35.1 $\pm 10$ %                        |          | 5.48 $\pm 10$ %               |          |

## 7.2 MEASUREMENT RESULT

At those frequencies, the target SAR value can not be generic. Hereunder is the target SAR value defined by Satimo, within the uncertainty for the system validation. All SAR values are normalized to 1 W net power. In bracket, the measured SAR is given with the used input power.

| Frequency (MHz) | 1 g SAR (W/kg) |                | 10 g SAR (W/kg) |              |
|-----------------|----------------|----------------|-----------------|--------------|
|                 | required       | measured       | required        | measured     |
| 5200            | 159.00         | 161.46 (16.15) | 56.90           | 54.83 (5.48) |
| 5500            | 170.10         | 173.75 (17.37) | 59.20           | 59.63 (5.96) |
| 5800            | 181.20         | 183.99 (18.40) | 61.50           | 59.17 (5.92) |

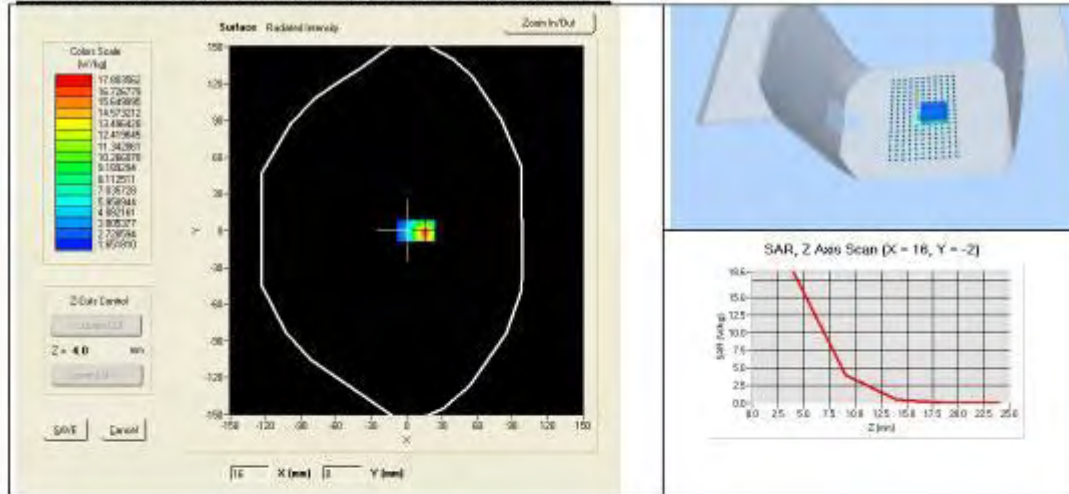
## SAR MEASUREMENT PLOTS @ 5200 MHz



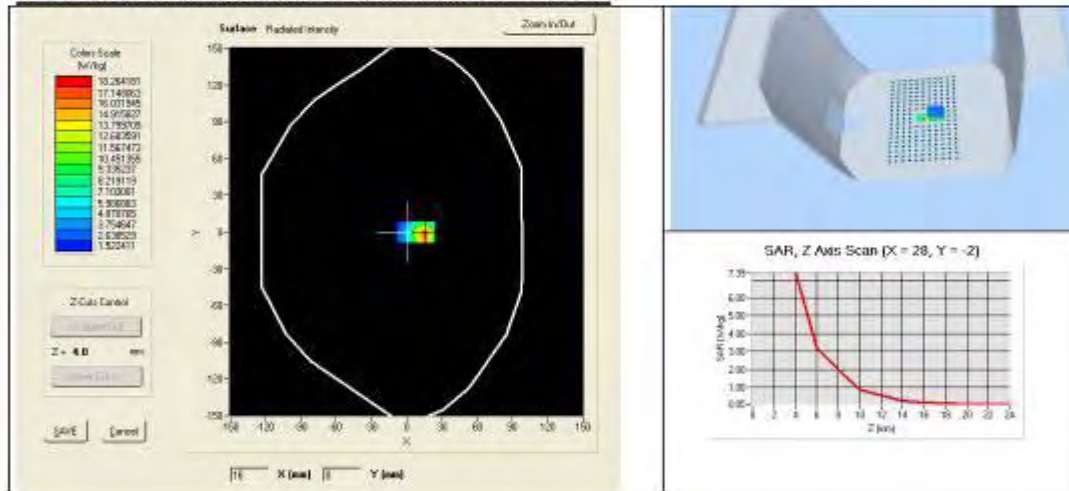
Page: 7/9

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## SAR MEASUREMENT PLOTS @ 5500 MHz



## SAR MEASUREMENT PLOTS @ 5800 MHz





## 8 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                                       |
| Calipers                        | Carrera              | CALIPER-01         | 12/2013                                       | 12/2016                                       |
| Reference Probe                 | Satimo               | EPG122 SN 18/11    | Characterized prior to test. No cal required. | Characterized prior to test. No cal required. |
| Multimeter                      | Keithley 2000        | 1188656            | 11/2010                                       | 11/2013                                       |
| Signal Generator                | Agilent E4438C       | MY49070581         | 12/2010                                       | 12/2013                                       |
| Amplifier                       | Aethercomm           | SN 046             | Characterized prior to test. No cal required. | Characterized prior to test. No cal required. |
| Power Meter                     | HP E4418A            | US38261498         | 11/2010                                       | 11/2013                                       |
| Power Sensor                    | HP ECP-E26A          | US37181460         | 11/2010                                       | 11/2013                                       |
| Directional Coupler             | Narda 4216-20        | 01386              | Characterized prior to test. No cal required. | Characterized prior to test. No cal required. |
| Temperature and Humidity Sensor | Control Company      | 11-661-9           | 3/2012  | 3/2014  |