



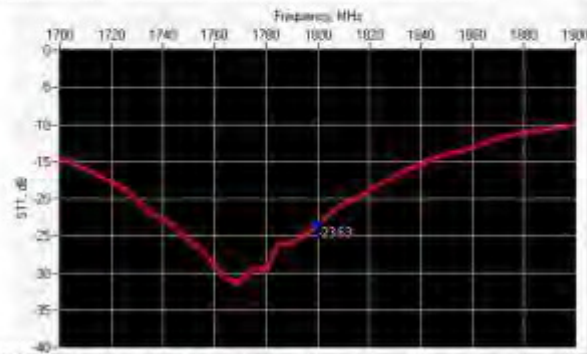
# SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.75.10.15.SATTJ.A

|      |        |
|------|--------|
| 10 g | 20.1 % |
|------|--------|

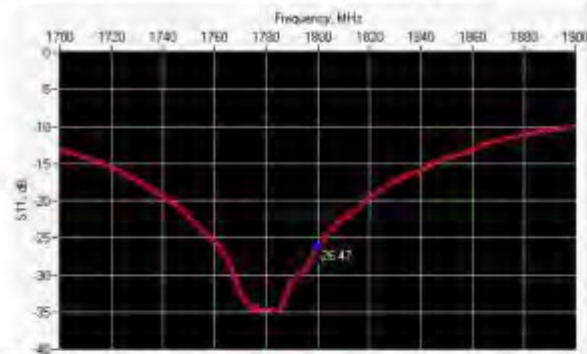
## 6 CALIBRATION MEASUREMENT RESULTS

### 6.1 RETURN LOSS AND IMPEDANCE IN HEAD LIQUID



| Frequency (MHz) | Return Loss (dB) | Requirement (dB) | Impedance                   |
|-----------------|------------------|------------------|-----------------------------|
| 1800            | -23.63           | -20              | $45.1 \Omega + 4.0 j\Omega$ |

### 6.2 RETURN LOSS AND IMPEDANCE IN BODY LIQUID



| Frequency (MHz) | Return Loss (dB) | Requirement (dB) | Impedance                   |
|-----------------|------------------|------------------|-----------------------------|
| 1800            | -26.47           | -20              | $45.5 \Omega - 0.3 j\Omega$ |

### 6.3 MECHANICAL DIMENSIONS

| Frequency MHz | L mm             |          | h mm             |          | d mm            |          |
|---------------|------------------|----------|------------------|----------|-----------------|----------|
|               | required         | measured | required         | measured | required        | measured |
| 300           | $420.0 \pm 1 \%$ |          | $250.0 \pm 1 \%$ |          | $6.35 \pm 1 \%$ |          |

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# SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACE-75-10 (3 SARIT) A

|      |            |      |            |      |           |      |
|------|------------|------|------------|------|-----------|------|
| 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 %  |      | 42.8 ±1 %  |      | 3.6 ±1 %  |      |
| 1800 | 72.0 ±1 %  | PASS | 41.7 ±1 %  | PASS | 3.6 ±1 %  | PASS |
| 1900 | 68.0 ±1 %  |      | 39.5 ±1 %  |      | 3.6 ±1 %  |      |
| 1950 | 66.3 ±1 %  |      | 38.5 ±1 %  |      | 3.6 ±1 %  |      |
| 2000 | 64.5 ±1 %  |      | 37.5 ±1 %  |      | 3.6 ±1 %  |      |
| 2100 | 61.0 ±1 %  |      | 35.7 ±1 %  |      | 3.6 ±1 %  |      |
| 2300 | 55.5 ±1 %  |      | 32.6 ±1 %  |      | 3.6 ±1 %  |      |
| 2450 | 51.5 ±1 %  |      | 30.4 ±1 %  |      | 3.6 ±1 %  |      |
| 2600 | 48.5 ±1 %  |      | 28.8 ±1 %  |      | 3.6 ±1 %  |      |
| 3000 | 41.5 ±1 %  |      | 25.0 ±1 %  |      | 3.6 ±1 %  |      |
| 3500 | 37.0 ±1 %  |      | 26.4 ±1 %  |      | 3.6 ±1 %  |      |
| 3700 | 34.7 ±1 %  |      | 26.4 ±1 %  |      | 3.6 ±1 %  |      |

## 7 VALIDATION MEASUREMENT

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

### 7.1 HEAD LIQUID MEASUREMENT

| Frequency<br>MHz | Relative permittivity (ε <sub>r</sub> ) |          | Conductivity (σ) S/m |          |
|------------------|-----------------------------------------|----------|----------------------|----------|
|                  | required                                | measured | required             | measured |
| 300              | 45.3 ±5 %                               |          | 0.87 ±5 %            |          |
| 450              | 43.5 ±5 %                               |          | 0.87 ±5 %            |          |
| 750              | 41.9 ±5 %                               |          | 0.88 ±5 %            |          |
| 835              | 41.5 ±5 %                               |          | 0.90 ±5 %            |          |
| 900              | 41.5 ±5 %                               |          | 0.97 ±5 %            |          |
| 1450             | 40.5 ±5 %                               |          | 1.20 ±5 %            |          |
| 1500             | 40.4 ±5 %                               |          | 1.23 ±5 %            |          |
| 1640             | 40.2 ±5 %                               |          | 1.31 ±5 %            |          |
| 1750             | 40.1 ±5 %                               |          | 1.37 ±5 %            |          |

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# SAR REFERENCE DIPOLE CALIBRATION REPORT

Rev: ACB-75.10 (3 SARIT) A

|      |           |      |           |      |
|------|-----------|------|-----------|------|
| 1800 | 40.0 ±5 % | PASS | 1.40 ±5 % | PASS |
| 1900 | 40.0 ±5 % |      | 1.40 ±5 % |      |
| 1950 | 40.0 ±5 % |      | 1.40 ±5 % |      |
| 2000 | 40.0 ±5 % |      | 1.40 ±5 % |      |
| 2100 | 39.8 ±5 % |      | 1.49 ±5 % |      |
| 2300 | 39.5 ±5 % |      | 1.67 ±5 % |      |
| 2450 | 39.2 ±5 % |      | 1.80 ±5 % |      |
| 2600 | 39.0 ±5 % |      | 1.96 ±5 % |      |
| 3000 | 38.5 ±5 % |      | 2.40 ±5 % |      |
| 3500 | 37.9 ±5 % |      | 2.91 ±5 % |      |

## 7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

The IEEE Std. 1528 and C63/IEC 62209 standards state that the system validation measurements should produce the SAR values shown below (for phantom thickness of 2 mm), within the uncertainty for the system validation. All SAR values are normalized to 1 W forward power. In bracket, the measured SAR is given with the used input power.

|                                           |                                                                                 |
|-------------------------------------------|---------------------------------------------------------------------------------|
| Software                                  | OPENSAR V4                                                                      |
| Phantom                                   | SN 20V09 SAM71                                                                  |
| Probe                                     | SN 18711 EPG122                                                                 |
| Liquid                                    | Head Liquid Values: $\epsilon_{\text{rms}} = 41.1$ $\sigma_{\text{rms}} = 1.39$ |
| Distance between dipole center and liquid | 10.0 mm                                                                         |
| Area scan resolution                      | $dx=8\text{mm}/dy=8\text{mm}$                                                   |
| Zoon Scan Resolution                      | $dx=8\text{mm}/dy=8\text{mm}/dz=5\text{mm}$                                     |
| Frequency                                 | 1800 MHz                                                                        |
| Input power                               | 20 dBm                                                                          |
| Liquid Temperature                        | 21 °C                                                                           |
| Lab Temperature                           | 21 °C                                                                           |
| Lab Humidity                              | 45 %                                                                            |

| Frequency<br>MHz | 1 g SAR (W/kg/W) |              | 10 g SAR (W/kg/W) |              |
|------------------|------------------|--------------|-------------------|--------------|
|                  | required         | measured     | required          | measured     |
| 300              | 2.85             |              | 1.94              |              |
| 450              | 4.58             |              | 3.06              |              |
| 750              | 8.49             |              | 5.55              |              |
| 835              | 9.56             |              | 6.22              |              |
| 900              | 10.9             |              | 6.98              |              |
| 1450             | 29               |              | 16                |              |
| 1500             | 30.5             |              | 16.8              |              |
| 1640             | 34.2             |              | 18.4              |              |
| 1750             | 36.4             |              | 19.3              |              |
| 1800             | 38.4             | 38.72 (3.87) | 20.1              | 20.37 (2.04) |

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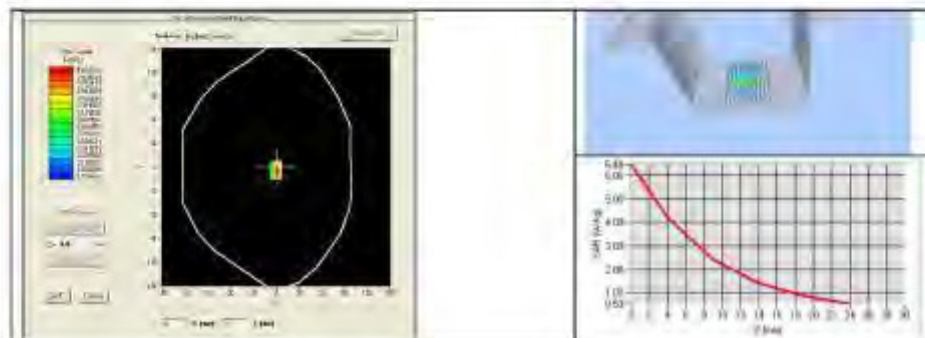
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# SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR-73.10 IS.SATJ.A

|      |      |  |      |  |
|------|------|--|------|--|
| 1900 | 39.7 |  | 20.5 |  |
| 1950 | 40.5 |  | 20.8 |  |
| 2000 | 41.1 |  | 21.1 |  |
| 2100 | 43.6 |  | 21.9 |  |
| 2300 | 48.7 |  | 23.3 |  |
| 2450 | 52.4 |  | 24   |  |
| 2600 | 55.3 |  | 24.6 |  |
| 3000 | 63.8 |  | 25.7 |  |
| 3500 | 67.1 |  | 25   |  |



## 7.3 BODY LIQUID MEASUREMENT

| Frequency<br>MHz | Relative permittivity ( $\epsilon_r$ ) |          | Conductivity ( $\sigma$ ) S/m |          |
|------------------|----------------------------------------|----------|-------------------------------|----------|
|                  | required                               | measured | required                      | measured |
| 150              | 61.9 $\pm$ 5 %                         |          | 0.80 $\pm$ 5 %                |          |
| 300              | 58.2 $\pm$ 5 %                         |          | 0.92 $\pm$ 5 %                |          |
| 450              | 56.7 $\pm$ 5 %                         |          | 0.94 $\pm$ 5 %                |          |
| 750              | 55.5 $\pm$ 5 %                         |          | 0.96 $\pm$ 5 %                |          |
| 835              | 55.2 $\pm$ 5 %                         |          | 0.97 $\pm$ 5 %                |          |
| 900              | 55.0 $\pm$ 5 %                         |          | 1.05 $\pm$ 5 %                |          |
| 915              | 55.0 $\pm$ 5 %                         |          | 1.06 $\pm$ 5 %                |          |
| 1450             | 54.0 $\pm$ 5 %                         |          | 1.30 $\pm$ 5 %                |          |
| 1610             | 53.8 $\pm$ 5 %                         |          | 1.40 $\pm$ 5 %                |          |
| 1800             | 53.3 $\pm$ 5 %                         | PASS     | 1.52 $\pm$ 5 %                | PASS     |
| 1900             | 53.3 $\pm$ 5 %                         |          | 1.52 $\pm$ 5 %                |          |
| 2000             | 53.3 $\pm$ 5 %                         |          | 1.52 $\pm$ 5 %                |          |
| 2100             | 53.2 $\pm$ 5 %                         |          | 1.62 $\pm$ 5 %                |          |
| 2450             | 52.7 $\pm$ 5 %                         |          | 1.95 $\pm$ 5 %                |          |

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# SAR REFERENCE DIPOLE CALIBRATION REPORT

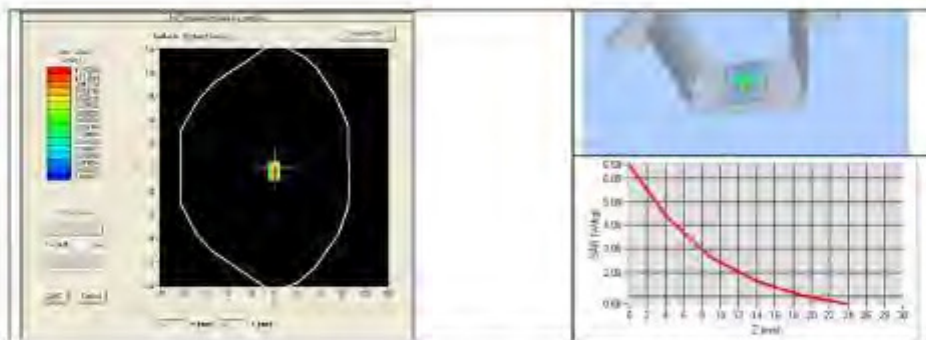
Ref: ACR-73.10.15.SAR11.A

|      |            |  |            |  |
|------|------------|--|------------|--|
| 2600 | 52.5 ±5 %  |  | 2.16 ±5 %  |  |
| 3000 | 52.0 ±5 %  |  | 2.73 ±5 %  |  |
| 3500 | 51.3 ±5 %  |  | 3.31 ±5 %  |  |
| 5200 | 49.0 ±10 % |  | 5.30 ±10 % |  |
| 5300 | 48.9 ±10 % |  | 5.42 ±10 % |  |
| 5400 | 48.7 ±10 % |  | 5.53 ±10 % |  |
| 5500 | 48.6 ±10 % |  | 5.65 ±10 % |  |
| 5600 | 48.5 ±10 % |  | 5.77 ±10 % |  |
| 5800 | 48.2 ±10 % |  | 6.00 ±10 % |  |

## 7.4 SAR MEASUREMENT RESULT WITH BODY LIQUID

|                                           |                                             |
|-------------------------------------------|---------------------------------------------|
| Software                                  | OPENSAR V4                                  |
| Phantom                                   | SN 20109 SAM71                              |
| Probe                                     | SN 18111 EPG122                             |
| Liquid                                    | Body Liquid Values: eps = 53.0 sigma = 1.52 |
| 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                                 | 1800 MHz                                    |
| Input power                               | 20 dBm                                      |
| Liquid Temperature                        | 21 °C                                       |
| Lab Temperature                           | 21 °C                                       |
| Lab Humidity                              | 45 %                                        |

| Frequency<br>MHz | 1 g SAR (W/kg/W) | 10 g SAR (W/kg/W) |
|------------------|------------------|-------------------|
|                  | measured         | measured          |
| 1800             | 40.42 (4.04)     | 21.53 (2.15)      |



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# SAR REFERENCE DIPOLE CALIBRATION REPORT

Rev: ACE-75.10 (5/5/11) A

## 8 LIST OF EQUIPMENT

| Equipment Summary Sheet         |                      |                    |                                               |                                               |
|---------------------------------|----------------------|--------------------|-----------------------------------------------|-----------------------------------------------|
| Equipment Description           | Manufacturer / Model | Identification No. | Current Calibration Date                      | Next Calibration Date                         |
| SAM Phantom                     | MVG                  | 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                 | MVG                  | EPG122 SN 18/11    | 10/2014                                       | 10/2015                                       |
| Multimeter                      | Keithley 2000        | 1188656            | 12/2013                                       | 12/2016                                       |
| Signal Generator                | Agilent E4438C       | MY49070581         | 12/2013                                       | 12/2016                                       |
| Amplifier                       | Aethercomm           | SN 046             | Characterized prior to test. No cal required. | Characterized prior to test. No cal required. |
| Power Meter                     | HP E4418A            | US38261498         | 12/2013                                       | 12/2016                                       |
| Power Sensor                    | HP ECP-E26A          | US37181460         | 12/2013                                       | 12/2016                                       |
| Directional Coupler             | Narda 4216-20        | 01386              | Characterized prior to test. No cal required. | Characterized prior to test. No cal required. |
| Temperature and Humidity Sensor | Control Company      | 11-661-9           | 8/2012                                        | 8/2015                                        |

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## SAR Reference Dipole Calibration Report

Ref: ACR.75.11.15.SAT11.A

**SHENZHEN BALUN TECHNOLOGY CO.,LTD.**  
**BLOCK B, FL 1, BAISHA SCIENCE AND TECHNOLOGY**  
**PARK, SHAHE XI ROAD,**  
**NANSHAN DISTRICT, SHENZHEN, GUANGDONG**  
**PROVINCE, P.R. CHINA 518055**  
**MVG COMOSAR REFERENCE DIPOLE**  
**FREQUENCY: 1900 MHZ**  
**SERIAL NO.: SN 25/13 DIP 1G900-249**

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



**03/16/2015**

### *Summary:*

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



## SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR-751115 SAR1/A

|               | Name          | Function        | Date      | Signature                                                                           |
|---------------|---------------|-----------------|-----------|-------------------------------------------------------------------------------------|
| Prepared by : | Jérôme LUC    | Product Manager | 3/16/2015 |  |
| Checked by :  | Jérôme LUC    | Product Manager | 3/16/2015 |  |
| Approved by : | Kim RUTKOWSKI | Quality Manager | 3/16/2015 |  |

|                | Customer Name                               |
|----------------|---------------------------------------------|
| Distribution : | SHENZHEN<br>BALUN<br>TECHNOLOGY<br>Co.,Ltd. |

| Issue | Date      | Modifications   |
|-------|-----------|-----------------|
| A     | 3/16/2015 | Initial release |
|       |           |                 |
|       |           |                 |
|       |           |                 |

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# SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR-7511ES SAR11 A

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## SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR-751115-SAT1/A

### 1 INTRODUCTION

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

### 2 DEVICE UNDER TEST

| Device Under Test              |                                   |
|--------------------------------|-----------------------------------|
| Device Type                    | COMOSAR 1900 MHz REFERENCE DIPOLE |
| Manufacturer                   | MVG                               |
| Model                          | SID1900                           |
| Serial Number                  | SN 25/13 DIP 1G900-249            |
| Product Condition (new / used) | Used                              |

A yearly calibration interval is recommended.

### 3 PRODUCT DESCRIPTION

#### 3.1 GENERAL INFORMATION

MVG's COMOSAR Validation Dipoles are built in accordance to the IEEE 1528, FCC KDBs and CEI/IEC 62209 standards. The product is designed for use with the COMOSAR test bench only.



**Figure 1 –MVG COMOSAR Validation Dipole**

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## SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR-75.11.15.5.611/A

### 4 MEASUREMENT METHOD

The IEEE 1528, FCC KDBs and CENELEC 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 CENELEC 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, FCC KDBs, CENELEC EN50361 and CENELEC 62209 standards were followed to generate the measurement uncertainty for validation measurements.

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

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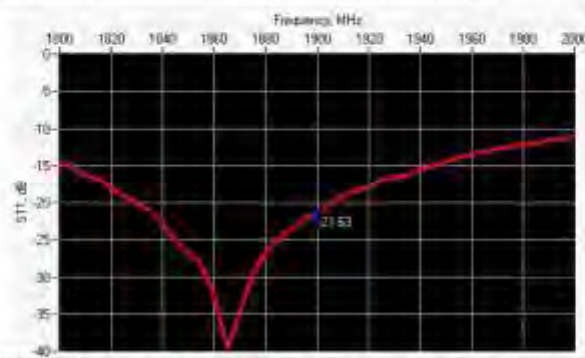
Ref: ACR-751115-SATF-A

10 g

20.1 %

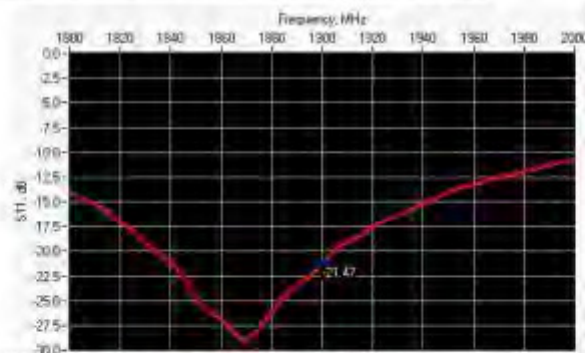
## 6 CALIBRATION MEASUREMENT RESULTS

### 6.1 RETURN LOSS AND IMPEDANCE IN HEAD LIQUID



| Frequency (MHz) | Return Loss (dB) | Requirement (dB) | Impedance                      |
|-----------------|------------------|------------------|--------------------------------|
| 1900            | -21.63           | -20              | 53.9 $\Omega$ + 7.7 j $\Omega$ |

### 6.2 RETURN LOSS AND IMPEDANCE IN BODY LIQUID



| Frequency (MHz) | Return Loss (dB) | Requirement (dB) | Impedance                      |
|-----------------|------------------|------------------|--------------------------------|
| 1900            | -21.47           | -20              | 48.9 $\Omega$ + 8.4 j $\Omega$ |

### 6.3 MECHANICAL DIMENSIONS

| Frequency MHz | L mm            |          | h mm            |          | d mm           |          |
|---------------|-----------------|----------|-----------------|----------|----------------|----------|
|               | required        | measured | required        | measured | required       | measured |
| 300           | 420.0 $\pm$ 1 % |          | 250.0 $\pm$ 1 % |          | 6.35 $\pm$ 1 % |          |

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# SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR-751115 SATU.A

|      |            |      |            |      |           |      |
|------|------------|------|------------|------|-----------|------|
| 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 %  | PASS | 39.5 ±1 %  | PASS | 3.6 ±1 %  | PASS |
| 1950 | 66.3 ±1 %  |      | 38.5 ±1 %  |      | 3.6 ±1 %  |      |
| 2000 | 64.5 ±1 %  |      | 37.5 ±1 %  |      | 3.6 ±1 %  |      |
| 2100 | 61.0 ±1 %  |      | 35.7 ±1 %  |      | 3.6 ±1 %  |      |
| 2300 | 55.5 ±1 %  |      | 32.6 ±1 %  |      | 3.6 ±1 %  |      |
| 2450 | 51.5 ±1 %  |      | 30.4 ±1 %  |      | 3.6 ±1 %  |      |
| 2600 | 48.5 ±1 %  |      | 28.8 ±1 %  |      | 3.6 ±1 %  |      |
| 3000 | 41.5 ±1 %  |      | 25.0 ±1 %  |      | 3.6 ±1 %  |      |
| 3500 | 37.0 ±1 %  |      | 26.4 ±1 %  |      | 3.6 ±1 %  |      |
| 3700 | 34.7 ±1 %  |      | 26.4 ±1 %  |      | 3.6 ±1 %  |      |

## 7 VALIDATION MEASUREMENT

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

### 7.1 HEAD LIQUID MEASUREMENT

| Frequency<br>MHz | Relative permittivity (ε <sub>r</sub> ) |          | Conductivity (σ) S/m |          |
|------------------|-----------------------------------------|----------|----------------------|----------|
|                  | required                                | measured | required             | measured |
| 300              | 45.3 ±5 %                               |          | 0.87 ±5 %            |          |
| 450              | 43.5 ±5 %                               |          | 0.87 ±5 %            |          |
| 750              | 41.9 ±5 %                               |          | 0.88 ±5 %            |          |
| 835              | 41.5 ±5 %                               |          | 0.90 ±5 %            |          |
| 900              | 41.5 ±5 %                               |          | 0.97 ±5 %            |          |
| 1450             | 40.5 ±5 %                               |          | 1.20 ±5 %            |          |
| 1500             | 40.4 ±5 %                               |          | 1.23 ±5 %            |          |
| 1640             | 40.2 ±5 %                               |          | 1.31 ±5 %            |          |
| 1750             | 40.1 ±5 %                               |          | 1.37 ±5 %            |          |

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# SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR-7311ES-SATU-A

|      |           |      |           |      |
|------|-----------|------|-----------|------|
| 1800 | 40.0 ±5 % |      | 1.40 ±5 % |      |
| 1900 | 40.0 ±5 % | PASS | 1.40 ±5 % | PASS |
| 1950 | 40.0 ±5 % |      | 1.40 ±5 % |      |
| 2000 | 40.0 ±5 % |      | 1.40 ±5 % |      |
| 2100 | 39.8 ±5 % |      | 1.49 ±5 % |      |
| 2300 | 39.5 ±5 % |      | 1.67 ±5 % |      |
| 2450 | 39.2 ±5 % |      | 1.80 ±5 % |      |
| 2600 | 39.0 ±5 % |      | 1.96 ±5 % |      |
| 3000 | 38.5 ±5 % |      | 2.40 ±5 % |      |
| 3500 | 37.9 ±5 % |      | 2.80 ±5 % |      |

## 7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

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

|                                           |                                                                               |
|-------------------------------------------|-------------------------------------------------------------------------------|
| Software                                  | OPENSAR V4                                                                    |
| Phantom                                   | SN 20/09 SAM71                                                                |
| Probe                                     | SN 18/11 EPG122                                                               |
| Liquid                                    | Head Liquid Values: $\epsilon_{\text{ps}} = 40.9$ $\sigma_{\text{ps}} = 1.43$ |
| Distance between dipole center and liquid | 10.0 mm                                                                       |
| Area scan resolution                      | $dx=8\text{mm}/dy=8\text{mm}$                                                 |
| Zoon Scan Resolution                      | $dx=8\text{mm}/dy=8\text{mm}/dz=5\text{mm}$                                   |
| Frequency                                 | 1900 MHz                                                                      |
| Input power                               | 20 dBm                                                                        |
| Liquid Temperature                        | 21 °C                                                                         |
| Lab Temperature                           | 21 °C                                                                         |
| Lab Humidity                              | 45 %                                                                          |

| Frequency<br>MHz | 1 g SAR (W/kg/W) |          | 10 g SAR (W/kg/W) |          |
|------------------|------------------|----------|-------------------|----------|
|                  | 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             |          | 6.98              |          |
| 1450             | 29               |          | 16                |          |
| 1500             | 30.5             |          | 16.8              |          |
| 1640             | 34.2             |          | 18.8              |          |
| 1750             | 36.4             |          | 19.3              |          |
| 1800             | 38.4             |          | 20.1              |          |

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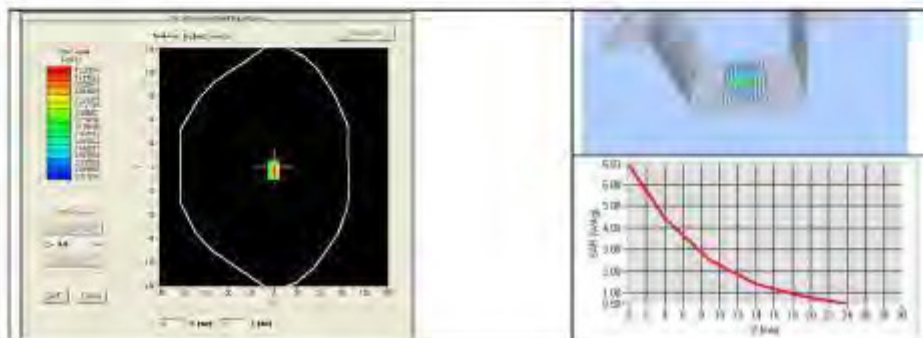
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# SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.75.1.1.15.SA11/A

|      |      |              |      |              |
|------|------|--------------|------|--------------|
| 1900 | 39.7 | 40.75 (4.06) | 20.5 | 20.82 (2.08) |
| 1950 | 40.5 |              | 20.9 |              |
| 2000 | 41.1 |              | 21.1 |              |
| 2100 | 43.6 |              | 21.9 |              |
| 2300 | 48.7 |              | 23.3 |              |
| 2450 | 52.4 |              | 24   |              |
| 2600 | 55.3 |              | 24.6 |              |
| 3000 | 63.8 |              | 25.7 |              |
| 3500 | 67.1 |              | 25   |              |



## 7.3 BODY LIQUID MEASUREMENT

| Frequency<br>MHz | Relative permittivity ( $\epsilon_r$ ) |          | Conductivity ( $\sigma$ ) S/m |          |
|------------------|----------------------------------------|----------|-------------------------------|----------|
|                  | required                               | measured | required                      | measured |
| 150              | 61.9 $\pm$ 5 %                         |          | 0.80 $\pm$ 5 %                |          |
| 300              | 58.2 $\pm$ 5 %                         |          | 0.92 $\pm$ 5 %                |          |
| 450              | 56.7 $\pm$ 5 %                         |          | 0.94 $\pm$ 5 %                |          |
| 750              | 55.5 $\pm$ 5 %                         |          | 0.96 $\pm$ 5 %                |          |
| 835              | 55.2 $\pm$ 5 %                         |          | 0.97 $\pm$ 5 %                |          |
| 900              | 55.0 $\pm$ 5 %                         |          | 1.05 $\pm$ 5 %                |          |
| 915              | 55.0 $\pm$ 5 %                         |          | 1.06 $\pm$ 5 %                |          |
| 1450             | 54.0 $\pm$ 5 %                         |          | 1.30 $\pm$ 5 %                |          |
| 1610             | 53.8 $\pm$ 5 %                         |          | 1.40 $\pm$ 5 %                |          |
| 1800             | 53.3 $\pm$ 5 %                         |          | 1.52 $\pm$ 5 %                |          |
| 1900             | 53.3 $\pm$ 5 %                         | PASS     | 1.52 $\pm$ 5 %                | PASS     |
| 2000             | 53.3 $\pm$ 5 %                         |          | 1.52 $\pm$ 5 %                |          |
| 2100             | 53.2 $\pm$ 5 %                         |          | 1.62 $\pm$ 5 %                |          |
| 2450             | 52.7 $\pm$ 5 %                         |          | 1.95 $\pm$ 5 %                |          |

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# SAR REFERENCE DIPOLE CALIBRATION REPORT

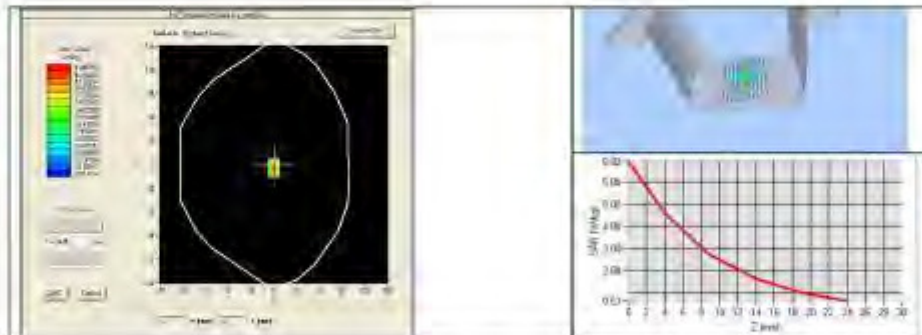
Ref: ACR-751115 SAR11A

|      |            |  |            |  |
|------|------------|--|------------|--|
| 2600 | 52.5 ±5 %  |  | 2.16 ±5 %  |  |
| 3000 | 52.0 ±5 %  |  | 2.73 ±5 %  |  |
| 3500 | 51.3 ±5 %  |  | 3.31 ±5 %  |  |
| 5200 | 49.0 ±10 % |  | 5.30 ±10 % |  |
| 5300 | 48.9 ±10 % |  | 5.42 ±10 % |  |
| 5400 | 48.7 ±10 % |  | 5.53 ±10 % |  |
| 5500 | 48.6 ±10 % |  | 5.65 ±10 % |  |
| 5600 | 48.5 ±10 % |  | 5.77 ±10 % |  |
| 5800 | 48.2 ±10 % |  | 6.00 ±10 % |  |

## 7.4 SAR MEASUREMENT RESULT WITH BODY LIQUID

|                                           |                                                                 |
|-------------------------------------------|-----------------------------------------------------------------|
| Software                                  | OPENSAR V4                                                      |
| Phantom                                   | SN 20109 SAM71                                                  |
| Probe                                     | SN 18/11 EPG122                                                 |
| Liquid                                    | Body Liquid Values: $\epsilon_{ps} = 53.9$ $\sigma_{ps} = 1.55$ |
| Distance between dipole center and liquid | 10.0 mm                                                         |
| Area scan resolution                      | $dx=8mm/dy=8mm$                                                 |
| Zoom Scan Resolution                      | $dx=8mm/dy=8mm/dz=5mm$                                          |
| Frequency                                 | 1900 MHz                                                        |
| Input power                               | 20 dBm                                                          |
| Liquid Temperature                        | 21 °C                                                           |
| Lab Temperature                           | 21 °C                                                           |
| Lab Humidity                              | 45 %                                                            |

| Frequency<br>MHz | 1 g SAR (W/kg/W) | 10 g SAR (W/kg/W) |
|------------------|------------------|-------------------|
|                  | measured         | measured          |
| 1900             | 42.06 (4.21)     | 21.87 (2.19)      |



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## SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR-751115-SAT/A

## 8 LIST OF EQUIPMENT

| Equipment Summary Sheet         |                      |                    |                                               |                                               |
|---------------------------------|----------------------|--------------------|-----------------------------------------------|-----------------------------------------------|
| Equipment Description           | Manufacturer / Model | Identification No. | Current Calibration Date                      | Next Calibration Date                         |
| SAM Phantom                     | MVG                  | SN-2009-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                 | MVG                  | EPG122-SN 18/11    | 10/2014                                       | 10/2015                                       |
| Multimeter                      | Keithley 2000        | 1188656            | 12/2013                                       | 12/2016                                       |
| Signal Generator                | Agilent E4438C       | MY49070681         | 12/2013                                       | 12/2016                                       |
| Amplifier                       | Aethercomm           | SN 046             | Characterized prior to test. No cal required. | Characterized prior to test. No cal required. |
| Power Meter                     | HP E4418A            | US38261498         | 12/2013                                       | 12/2016                                       |
| Power Sensor                    | HP ECP-E26A          | US37181480         | 12/2013                                       | 12/2016                                       |
| Directional Coupler             | Narda 4216-20        | 01386              | Characterized prior to test. No cal required. | Characterized prior to test. No cal required. |
| Temperature and Humidity Sensor | Control Company      | 11-661-9           | 8/2012                                        | 8/2015                                        |

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## SAR Reference Dipole Calibration Report

Ref: ACR.75.13.15.SATU.A

**SHENZHEN BALUN TECHNOLOGY CO.,LTD.**  
**BLOCK B, FL 1, BAISHA SCIENCE AND TECHNOLOGY**  
**PARK, SHAHE XI ROAD,**  
**NANSHAN DISTRICT, SHENZHEN, GUANGDONG**  
**PROVINCE, P.R. CHINA 518055**  
**MVG COMOSAR REFERENCE DIPOLE**  
**FREQUENCY: 2450 MHZ**  
**SERIAL NO.: SN 25/13 DIP 2G450-251**

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



**03/16/2015**

### *Summary:*

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





## SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR-7213 ES SAR/1A

|               | Name          | Function        | Date      | Signature            |
|---------------|---------------|-----------------|-----------|----------------------|
| Prepared by : | Jérôme LUC    | Product Manager | 3/16/2015 | <i>JS</i>            |
| Checked by :  | Jérôme LUC    | Product Manager | 3/16/2015 | <i>JS</i>            |
| Approved by : | Kim RUTKOWSKI | Quality Manager | 3/16/2015 | <i>Kim Rutkowski</i> |

|                | Customer Name                               |
|----------------|---------------------------------------------|
| Distribution : | SHENZHEN<br>BALUN<br>TECHNOLOGY<br>Co.,Ltd. |

| Issue | Date      | Modifications   |
|-------|-----------|-----------------|
| A     | 3/16/2015 | Initial release |
|       |           |                 |
|       |           |                 |
|       |           |                 |

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# SAR REFERENCE DIPOLE CALIBRATION REPORT

Rev: ACE-75.13.15.SA(1).A

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## SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR-75.13.F5.SA111.A

### 1 INTRODUCTION

This document contains a summary of the requirements set forth by the IEEE 1528, FCC KDBs 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                   | MVG                               |
| Model                          | SID2450                           |
| Serial Number                  | SN 25/13 DIP 2G450-251            |
| Product Condition (new / used) | Used                              |

A yearly calibration interval is recommended.

### 3 PRODUCT DESCRIPTION

#### 3.1 GENERAL INFORMATION

MVG's COMOSAR Validation Dipoles are built in accordance to the IEEE 1528, FCC KDBs and CEI/IEC 62209 standards. The product is designed for use with the COMOSAR test bench only.



**Figure 1 – MVG COMOSAR Validation Dipole**

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## SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR-7213 ES SAR/UKA

### 4 MEASUREMENT METHOD

The IEEE 1528, FCC KDBs and CENELEC 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 CENELEC 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, FCC KDBs, CENELEC EN50361 and CENELEC 62209 standards were followed to generate the measurement uncertainty for validation measurements.

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

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# SAR REFERENCE DIPOLE CALIBRATION REPORT

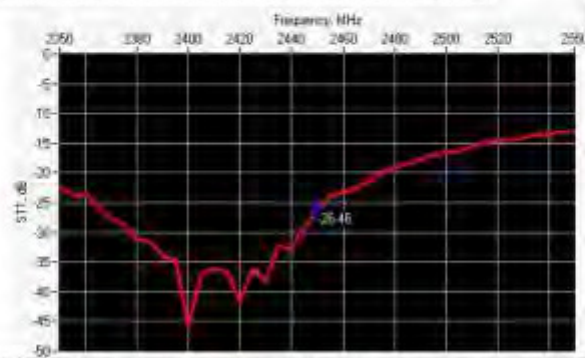
Ref: ACTR.75.13.F5.SA11F.A

10 g

20.1 %<sub>0</sub>

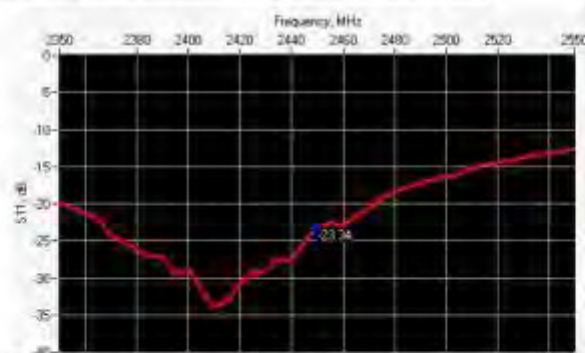
## 6 CALIBRATION MEASUREMENT RESULTS

### 6.1 RETURN LOSS AND IMPEDANCE IN HEAD LIQUID



| Frequency (MHz) | Return Loss (dB) | Requirement (dB) | Impedance                      |
|-----------------|------------------|------------------|--------------------------------|
| 2450            | -26.46           | -20              | 49.3 $\Omega$ - 4.7 j $\Omega$ |

### 6.2 RETURN LOSS AND IMPEDANCE IN BODY LIQUID



| Frequency (MHz) | Return Loss (dB) | Requirement (dB) | Impedance                      |
|-----------------|------------------|------------------|--------------------------------|
| 2450            | -23.34           | -20              | 53.4 $\Omega$ - 6.2 j $\Omega$ |

### 6.3 MECHANICAL DIMENSIONS

| Frequency MHz | L mm            |          | h mm            |          | d mm           |          |
|---------------|-----------------|----------|-----------------|----------|----------------|----------|
|               | required        | measured | required        | measured | required       | measured |
| 300           | 420.0 $\pm$ 1 % |          | 250.0 $\pm$ 1 % |          | 6.35 $\pm$ 1 % |          |

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# SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR-7213 ES SAT/FA

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

### 7.1 HEAD LIQUID MEASUREMENT

| Frequency<br>MHz | Relative permittivity (ε <sub>r</sub> ) |          | Conductivity (σ) S/m |          |
|------------------|-----------------------------------------|----------|----------------------|----------|
|                  | required                                | measured | required             | measured |
| 300              | 45.3 ±5 %                               |          | 0.87 ±5 %            |          |
| 450              | 43.5 ±5 %                               |          | 0.87 ±5 %            |          |
| 750              | 41.9 ±5 %                               |          | 0.88 ±5 %            |          |
| 835              | 41.5 ±5 %                               |          | 0.90 ±5 %            |          |
| 900              | 41.5 ±5 %                               |          | 0.97 ±5 %            |          |
| 1450             | 40.5 ±5 %                               |          | 1.20 ±5 %            |          |
| 1500             | 40.4 ±5 %                               |          | 1.23 ±5 %            |          |
| 1640             | 40.2 ±5 %                               |          | 1.31 ±5 %            |          |
| 1750             | 40.1 ±5 %                               |          | 1.37 ±5 %            |          |

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# SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR-72 13 03 SAR/1A

|      |           |      |           |      |
|------|-----------|------|-----------|------|
| 1800 | 40.0 ±5 % |      | 1.40 ±5 % |      |
| 1900 | 40.0 ±5 % |      | 1.40 ±5 % |      |
| 1950 | 40.0 ±5 % |      | 1.40 ±5 % |      |
| 2000 | 40.0 ±5 % |      | 1.40 ±5 % |      |
| 2100 | 39.8 ±5 % |      | 1.49 ±5 % |      |
| 2300 | 39.5 ±5 % |      | 1.67 ±5 % |      |
| 2450 | 39.2 ±5 % | PASS | 1.80 ±5 % | PASS |
| 2600 | 39.0 ±5 % |      | 1.96 ±5 % |      |
| 3000 | 38.5 ±5 % |      | 2.40 ±5 % |      |
| 3500 | 37.9 ±5 % |      | 2.80 ±5 % |      |

## 7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

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

|                                           |                                                                                 |
|-------------------------------------------|---------------------------------------------------------------------------------|
| Software                                  | OPENSAR V4                                                                      |
| Phantom                                   | SN 20/09 SAM71                                                                  |
| Probe                                     | SN 18/11 EPG122                                                                 |
| Liquid                                    | Head Liquid Values: $\epsilon_{\text{eff}} = 38.9$ $\sigma_{\text{eff}} = 1.79$ |
| Distance between dipole center and liquid | 10.0 mm                                                                         |
| Area scan resolution                      | $dx=8\text{mm}$ $dy=8\text{mm}$                                                 |
| Zoon Scan Resolution                      | $dz=5\text{mm}$ $dx=5\text{mm}$ $dy=5\text{mm}$                                 |
| Frequency                                 | 2450 MHz                                                                        |
| Input power                               | 20 dBm                                                                          |
| Liquid Temperature                        | 21 °C                                                                           |
| Lab Temperature                           | 21 °C                                                                           |
| Lab Humidity                              | 45 %                                                                            |

| Frequency<br>MHz | 1 g SAR (W/kg/W) |          | 10 g SAR (W/kg/W) |          |
|------------------|------------------|----------|-------------------|----------|
|                  | required         | measured | required          | measured |
| 300              | 2.85             |          | 1.94              |          |
| 450              | 4.58             |          | 3.06              |          |
| 750              | 8.49             |          | 5.55              |          |
| 835              | 9.56             |          | 6.22              |          |
| 900              | 10.9             |          | 6.98              |          |
| 1450             | 29               |          | 16                |          |
| 1500             | 30.5             |          | 16.8              |          |
| 1640             | 34.2             |          | 18.8              |          |
| 1750             | 36.4             |          | 19.3              |          |
| 1800             | 38.4             |          | 20.1              |          |

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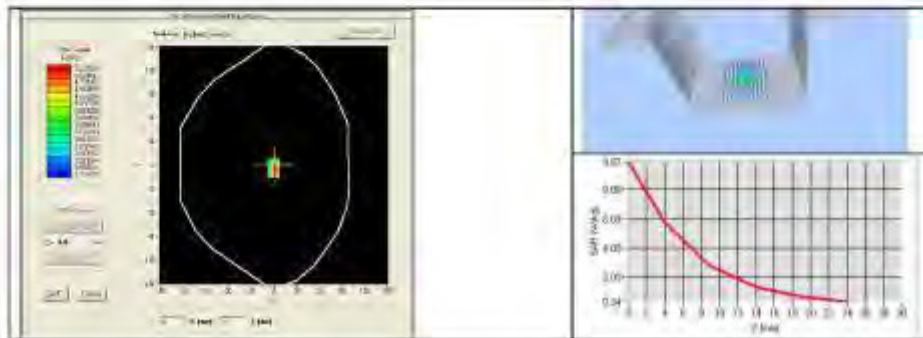
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# SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACTR.73.13.F5.SA111.A

|      |      |              |      |              |
|------|------|--------------|------|--------------|
| 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 | 54.29 (5.43) | 24   | 24.20 (2.42) |
| 2600 | 55.3 |              | 24.6 |              |
| 3000 | 63.8 |              | 25.7 |              |
| 3500 | 67.1 |              | 25   |              |



## 7.3 BODY LIQUID MEASUREMENT

| Frequency<br>MHz | Relative permittivity ( $\epsilon_r$ ) |          | Conductivity ( $\sigma$ ) S/m |          |
|------------------|----------------------------------------|----------|-------------------------------|----------|
|                  | required                               | measured | required                      | measured |
| 150              | 61.9 $\pm$ 5 %                         |          | 0.80 $\pm$ 5 %                |          |
| 300              | 58.2 $\pm$ 5 %                         |          | 0.92 $\pm$ 5 %                |          |
| 450              | 56.7 $\pm$ 5 %                         |          | 0.94 $\pm$ 5 %                |          |
| 750              | 55.5 $\pm$ 5 %                         |          | 0.96 $\pm$ 5 %                |          |
| 835              | 55.2 $\pm$ 5 %                         |          | 0.97 $\pm$ 5 %                |          |
| 900              | 55.0 $\pm$ 5 %                         |          | 1.05 $\pm$ 5 %                |          |
| 915              | 55.0 $\pm$ 5 %                         |          | 1.06 $\pm$ 5 %                |          |
| 1450             | 54.0 $\pm$ 5 %                         |          | 1.30 $\pm$ 5 %                |          |
| 1610             | 53.8 $\pm$ 5 %                         |          | 1.40 $\pm$ 5 %                |          |
| 1800             | 53.3 $\pm$ 5 %                         |          | 1.52 $\pm$ 5 %                |          |
| 1900             | 53.3 $\pm$ 5 %                         |          | 1.52 $\pm$ 5 %                |          |
| 2000             | 53.3 $\pm$ 5 %                         |          | 1.52 $\pm$ 5 %                |          |
| 2100             | 53.2 $\pm$ 5 %                         |          | 1.62 $\pm$ 5 %                |          |
| 2450             | 52.7 $\pm$ 5 %                         | PASS     | 1.95 $\pm$ 5 %                | PASS     |

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# SAR REFERENCE DIPOLE CALIBRATION REPORT

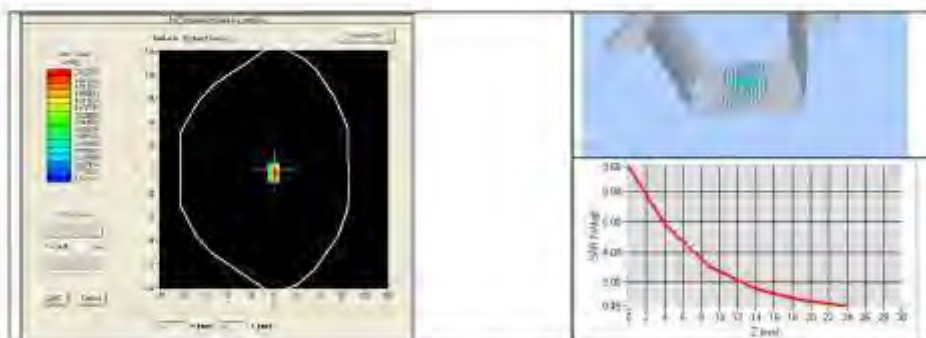
Ref: ACR-75.13.15.SATF.A

|      |            |  |            |  |
|------|------------|--|------------|--|
| 2600 | 52.5 ±5 %  |  | 2.16 ±5 %  |  |
| 3000 | 52.0 ±5 %  |  | 2.73 ±5 %  |  |
| 3500 | 51.3 ±5 %  |  | 3.31 ±5 %  |  |
| 5200 | 49.0 ±10 % |  | 5.30 ±10 % |  |
| 5300 | 48.9 ±10 % |  | 5.42 ±10 % |  |
| 5400 | 48.7 ±10 % |  | 5.53 ±10 % |  |
| 5500 | 48.6 ±10 % |  | 5.65 ±10 % |  |
| 5600 | 48.5 ±10 % |  | 5.77 ±10 % |  |
| 5800 | 48.2 ±10 % |  | 6.00 ±10 % |  |

## 7.4 SAR MEASUREMENT RESULT WITH BODY LIQUID

|                                           |                                                                 |
|-------------------------------------------|-----------------------------------------------------------------|
| Software                                  | OPENSAR V4                                                      |
| Phantom                                   | SN 20/09 SAM71                                                  |
| Probe                                     | SN 18/11 EPG122                                                 |
| Liquid                                    | Body Liquid Values: $\epsilon_{ps} = 52.7$ $\sigma_{ps} = 1.94$ |
| Distance between dipole center and liquid | 10.0 mm                                                         |
| Area scan resolution                      | $dx=8mm/dy=8mm$                                                 |
| Zoon Scan Resolution                      | $dx=5mm/dy=5m/dz=5mm$                                           |
| Frequency                                 | 2450 MHz                                                        |
| Input power                               | 20 dBm                                                          |
| Liquid Temperature                        | 21 °C                                                           |
| Lab Temperature                           | 21 °C                                                           |
| Lab Humidity                              | 45 %                                                            |

| Frequency<br>MHz | 1 g SAR (W/kg/W) | 10 g SAR (W/kg/W) |
|------------------|------------------|-------------------|
|                  | measured         | measured          |
| 2450             | 54.70 [5.47]     | 24.86 [2.48]      |



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## SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR-75.13.15.SATU.A

## 8 LIST OF EQUIPMENT

| Equipment Summary Sheet         |                      |                    |                                               |                                               |
|---------------------------------|----------------------|--------------------|-----------------------------------------------|-----------------------------------------------|
| Equipment Description           | Manufacturer / Model | Identification No. | Current Calibration Date                      | Next Calibration Date                         |
| SAM Phantom                     | MVG                  | 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                        | Garrera              | CALIPER-01         | 12/2013                                       | 12/2016                                       |
| Reference Probe                 | MVG                  | EPG122 SN 18/11    | 10/2014                                       | 10/2015                                       |
| Multimeter                      | Keithley 2000        | 1188666            | 12/2013                                       | 12/2016                                       |
| Signal Generator                | Agilent E4438C       | MY49070581         | 12/2013                                       | 12/2016                                       |
| Amplifier                       | Aethercomm           | SN 046             | Characterized prior to test. No cal required. | Characterized prior to test. No cal required. |
| Power Meter                     | HP E4418A            | US38261498         | 12/2013                                       | 12/2016                                       |
| Power Sensor                    | HP ECP-E26A          | US37181460         | 12/2013                                       | 12/2016                                       |
| Directional Coupler             | Narda 4216-20        | 01386              | Characterized prior to test. No cal required. | Characterized prior to test. No cal required. |
| Temperature and Humidity Sensor | Control Company      | 11-861-9           | 8/2012                                        | 8/2015                                        |

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## SAR Reference Dipole Calibration Report

Ref: ACR.75.14.15.SATU.A

**SHENZHEN BALUN TECHNOLOGY CO.,LTD.**  
**BLOCK B, FL 1, BAISHA SCIENCE AND TECHNOLOGY**  
**PARK, SHAHE XI ROAD,**  
**NANSHAN DISTRICT, SHENZHEN, GUANGDONG**  
**PROVINCE, P.R. CHINA 518055**  
**MVG COMOSAR REFERENCE DIPOLE**  
**FREQUENCY: 2600 MHZ**  
**SERIAL NO.: SN 25/13 DIP 2G600-254**

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



**03/16/2015**

### *Summary:*

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



## SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACE-75.14.15.5.011/A

|               | Name          | Function        | Date      | Signature                                                                           |
|---------------|---------------|-----------------|-----------|-------------------------------------------------------------------------------------|
| Prepared by : | Jérôme LUC    | Product Manager | 3/16/2015 |  |
| Checked by :  | Jérôme LUC    | Product Manager | 3/16/2015 |  |
| Approved by : | Kim RUTKOWSKI | Quality Manager | 3/16/2015 |  |

|                | Customer Name                               |
|----------------|---------------------------------------------|
| Distribution : | SHENZHEN<br>BALUN<br>TECHNOLOGY<br>Co.,Ltd. |

| Issue | Date      | Modifications   |
|-------|-----------|-----------------|
| A     | 3/16/2015 | Initial release |
|       |           |                 |
|       |           |                 |
|       |           |                 |

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# SAR REFERENCE DIPOLE CALIBRATION REPORT

Rev: ACE-75.14.15.5A(1).A

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## SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR-73.14.13.5A(1).A

### 1 INTRODUCTION

This document contains a summary of the requirements set forth by the IEEE 1528, FCC KDBs 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 2600 MHz REFERENCE DIPOLE |
| Manufacturer                   | MVG                               |
| Model                          | SID2600                           |
| Serial Number                  | SN 25/13 DIP 2G600-254            |
| Product Condition (new / used) | Used                              |

A yearly calibration interval is recommended.

### 3 PRODUCT DESCRIPTION

#### 3.1 GENERAL INFORMATION

MVG's COMOSAR Validation Dipoles are built in accordance to the IEEE 1528, FCC KDBs and CEI/IEC 62209 standards. The product is designed for use with the COMOSAR test bench only.



**Figure 1** – MVG COMOSAR Validation Dipole

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## SAR REFERENCE DIPOLE CALIBRATION REPORT

Rev: ACE-75.14 (5.5.01) / A

### 4 MEASUREMENT METHOD

The IEEE 1528, FCC KDBs and CEM/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 CEM/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, FCC KDBs, CENELEC EN50361 and CEM/IEC 62209 standards were followed to generate the measurement uncertainty for validation measurements.

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

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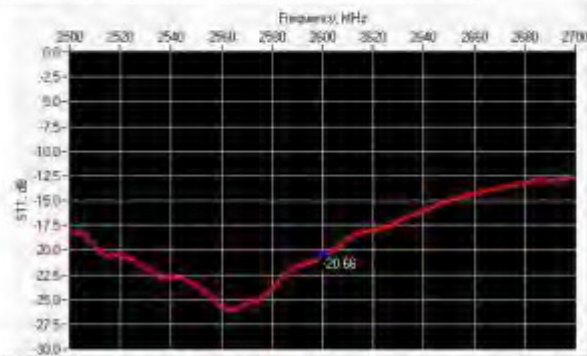
# SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.73.14.15.SATTJ.A

|      |        |
|------|--------|
| 10 g | 20.1 % |
|------|--------|

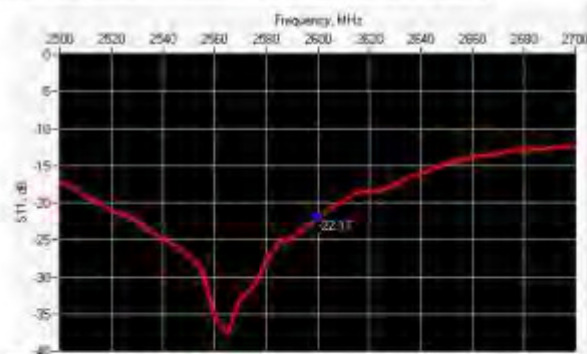
## 6 CALIBRATION MEASUREMENT RESULTS

### 6.1 RETURN LOSS AND IMPEDANCE IN HEAD LIQUID



| Frequency (MHz) | Return Loss (dB) | Requirement (dB) | Impedance                   |
|-----------------|------------------|------------------|-----------------------------|
| 2600            | -20.66           | -20              | $51.0 \Omega + 9.4 j\Omega$ |

### 6.2 RETURN LOSS AND IMPEDANCE IN BODY LIQUID



| Frequency (MHz) | Return Loss (dB) | Requirement (dB) | Impedance                   |
|-----------------|------------------|------------------|-----------------------------|
| 2600            | -22.17           | -20              | $47.9 \Omega + 7.5 j\Omega$ |

### 6.3 MECHANICAL DIMENSIONS

| Frequency MHz | L mm             |          | h mm             |          | d mm            |          |
|---------------|------------------|----------|------------------|----------|-----------------|----------|
|               | required         | measured | required         | measured | required        | measured |
| 300           | $420.0 \pm 1 \%$ |          | $250.0 \pm 1 \%$ |          | $6.35 \pm 1 \%$ |          |

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# SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACB-75.14.13.5.6111.A

|      |            |      |            |      |           |      |
|------|------------|------|------------|------|-----------|------|
| 450  | 290.0 ±1 % |      | 166.7 ±1 % |      | 6.35 ±1 % |      |
| 750  | 176.0 ±1 % |      | 100.0 ±1 % |      | 6.35 ±1 % |      |
| 835  | 161.0 ±1 % |      | 88.8 ±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 %  |      | 42.8 ±1 %  |      | 3.6 ±1 %  |      |
| 1800 | 72.0 ±1 %  |      | 41.7 ±1 %  |      | 3.6 ±1 %  |      |
| 1900 | 68.0 ±1 %  |      | 39.5 ±1 %  |      | 3.6 ±1 %  |      |
| 1950 | 66.3 ±1 %  |      | 38.5 ±1 %  |      | 3.6 ±1 %  |      |
| 2000 | 64.5 ±1 %  |      | 37.5 ±1 %  |      | 3.6 ±1 %  |      |
| 2100 | 61.0 ±1 %  |      | 35.7 ±1 %  |      | 3.6 ±1 %  |      |
| 2300 | 55.5 ±1 %  |      | 32.6 ±1 %  |      | 3.6 ±1 %  |      |
| 2450 | 51.5 ±1 %  |      | 30.4 ±1 %  |      | 3.6 ±1 %  |      |
| 2600 | 48.5 ±1 %  | PASS | 28.8 ±1 %  | PASS | 3.6 ±1 %  | PASS |
| 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, FCC KDBs and CEI/IEC 62209 standards state that the system validation measurements must be performed using a reference dipole meeting the fore mentioned return loss and mechanical dimension requirements. The validation measurement must be performed against a liquid filled flat phantom, with the phantom constructed as outlined in the fore mentioned standards. Per the standards, the dipole shall be positioned below the bottom of the phantom, with the dipole length centered and parallel to the longest dimension of the flat phantom, with the top surface of the dipole at the described distance from the bottom surface of the phantom.

### 7.1 HEAD LIQUID MEASUREMENT

| Frequency<br>MHz | Relative permittivity (ε <sub>r</sub> ) |          | Conductivity (σ) S/m |          |
|------------------|-----------------------------------------|----------|----------------------|----------|
|                  | required                                | measured | required             | measured |
| 300              | 45.3 ±5 %                               |          | 0.87 ±5 %            |          |
| 450              | 43.5 ±5 %                               |          | 0.87 ±5 %            |          |
| 750              | 41.9 ±5 %                               |          | 0.88 ±5 %            |          |
| 835              | 41.5 ±5 %                               |          | 0.90 ±5 %            |          |
| 900              | 41.5 ±5 %                               |          | 0.97 ±5 %            |          |
| 1450             | 40.5 ±5 %                               |          | 1.20 ±5 %            |          |
| 1500             | 40.4 ±5 %                               |          | 1.23 ±5 %            |          |
| 1640             | 40.2 ±5 %                               |          | 1.31 ±5 %            |          |
| 1750             | 40.1 ±5 %                               |          | 1.37 ±5 %            |          |

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# SAR REFERENCE DIPOLE CALIBRATION REPORT

Rev: ACE-75.14.13 SAR11.A

|      |           |      |           |      |
|------|-----------|------|-----------|------|
| 1800 | 40.0 ±5 % |      | 1.40 ±5 % |      |
| 1900 | 40.0 ±5 % |      | 1.40 ±5 % |      |
| 1950 | 40.0 ±5 % |      | 1.40 ±5 % |      |
| 2000 | 40.0 ±5 % |      | 1.40 ±5 % |      |
| 2100 | 39.8 ±5 % |      | 1.49 ±5 % |      |
| 2300 | 39.5 ±5 % |      | 1.67 ±5 % |      |
| 2450 | 39.2 ±5 % |      | 1.80 ±5 % |      |
| 2600 | 39.0 ±5 % | PASS | 1.96 ±5 % | PASS |
| 3000 | 38.5 ±5 % |      | 2.40 ±5 % |      |
| 3500 | 37.9 ±5 % |      | 2.95 ±5 % |      |

## 7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

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

|                                           |                                                                  |
|-------------------------------------------|------------------------------------------------------------------|
| Software                                  | OPENSAR V4                                                       |
| Phantom                                   | SN 20V09 SAM71                                                   |
| Probe                                     | SN 18/11 EPG122                                                  |
| Liquid                                    | Head Liquid Values: $\epsilon_{\text{rms}} = 38.2$ signifi. 1.03 |
| Distance between dipole center and liquid | 10.0 mm                                                          |
| Area scan resolution                      | $dx=8\text{mm}/dy=8\text{mm}$                                    |
| Zoon Scan Resolution                      | $dx=5\text{mm}/dy=5\text{mm}/dz=5\text{mm}$                      |
| Frequency                                 | 2600 MHz                                                         |
| Input power                               | 20 dBm                                                           |
| Liquid Temperature                        | 21 °C                                                            |
| Lab Temperature                           | 21 °C                                                            |
| Lab Humidity                              | 45 %                                                             |

| Frequency<br>MHz | 1 g SAR (W/kg/W) |          | 10 g SAR (W/kg/W) |          |
|------------------|------------------|----------|-------------------|----------|
|                  | required         | measured | required          | measured |
| 300              | 2.85             |          | 1.94              |          |
| 450              | 4.58             |          | 3.06              |          |
| 750              | 8.49             |          | 5.55              |          |
| 835              | 9.56             |          | 6.22              |          |
| 900              | 10.9             |          | 6.98              |          |
| 1450             | 29               |          | 16                |          |
| 1500             | 30.5             |          | 16.8              |          |
| 1640             | 34.2             |          | 18.4              |          |
| 1750             | 36.4             |          | 19.3              |          |
| 1800             | 38.4             |          | 20.1              |          |

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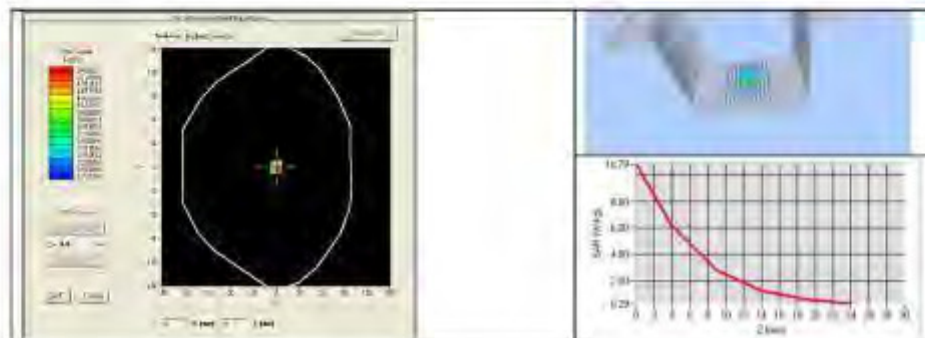
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# SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.73.14.15 SAR11.A

|      |      |              |      |              |
|------|------|--------------|------|--------------|
| 1900 | 39.7 |              | 20.5 |              |
| 1950 | 40.5 |              | 20.8 |              |
| 2000 | 41.1 |              | 21.1 |              |
| 2100 | 43.6 |              | 21.9 |              |
| 2300 | 48.7 |              | 23.3 |              |
| 2450 | 52.4 |              | 24   |              |
| 2600 | 55.3 | 57.37 (5.74) | 24.6 | 24.68 (2.47) |
| 3000 | 63.8 |              | 25.7 |              |
| 3500 | 67.1 |              | 25   |              |



## 7.3 BODY LIQUID MEASUREMENT

| Frequency<br>MHz | Relative permittivity ( $\epsilon_r'$ ) |          | Conductivity ( $\sigma$ ) S/m |          |
|------------------|-----------------------------------------|----------|-------------------------------|----------|
|                  | required                                | measured | required                      | measured |
| 150              | 61.9 $\pm$ 5 %                          |          | 0.80 $\pm$ 5 %                |          |
| 300              | 58.2 $\pm$ 5 %                          |          | 0.92 $\pm$ 5 %                |          |
| 450              | 56.7 $\pm$ 5 %                          |          | 0.94 $\pm$ 5 %                |          |
| 750              | 55.5 $\pm$ 5 %                          |          | 0.96 $\pm$ 5 %                |          |
| 835              | 55.2 $\pm$ 5 %                          |          | 0.97 $\pm$ 5 %                |          |
| 900              | 55.0 $\pm$ 5 %                          |          | 1.05 $\pm$ 5 %                |          |
| 915              | 55.0 $\pm$ 5 %                          |          | 1.06 $\pm$ 5 %                |          |
| 1450             | 54.0 $\pm$ 5 %                          |          | 1.30 $\pm$ 5 %                |          |
| 1610             | 53.8 $\pm$ 5 %                          |          | 1.40 $\pm$ 5 %                |          |
| 1800             | 53.3 $\pm$ 5 %                          |          | 1.52 $\pm$ 5 %                |          |
| 1900             | 53.3 $\pm$ 5 %                          |          | 1.52 $\pm$ 5 %                |          |
| 2000             | 53.3 $\pm$ 5 %                          |          | 1.52 $\pm$ 5 %                |          |
| 2100             | 53.2 $\pm$ 5 %                          |          | 1.62 $\pm$ 5 %                |          |
| 2450             | 52.7 $\pm$ 5 %                          |          | 1.95 $\pm$ 5 %                |          |

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# SAR REFERENCE DIPOLE CALIBRATION REPORT

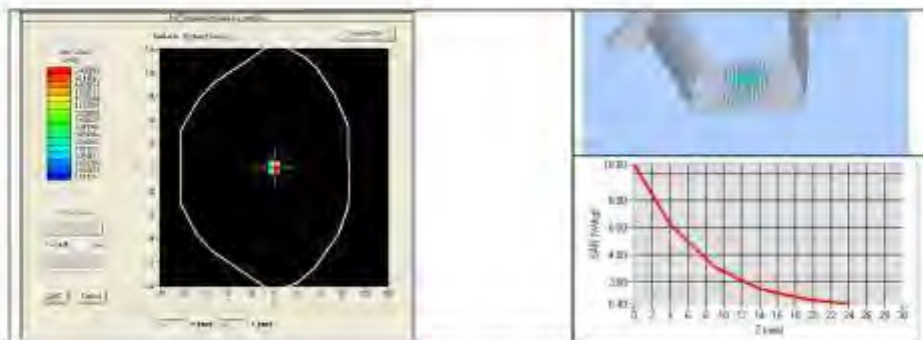
Ref: ACR-73.14.13.5ACIT1.A

|      |            |      |            |      |
|------|------------|------|------------|------|
| 2600 | 52.5 ±5 %  | PASS | 2.16 ±5 %  | PASS |
| 3000 | 52.0 ±5 %  |      | 2.73 ±5 %  |      |
| 3500 | 51.3 ±5 %  |      | 3.31 ±5 %  |      |
| 5200 | 49.0 ±10 % |      | 5.30 ±10 % |      |
| 5300 | 48.9 ±10 % |      | 5.42 ±10 % |      |
| 5400 | 48.7 ±10 % |      | 5.53 ±10 % |      |
| 5500 | 48.6 ±10 % |      | 5.65 ±10 % |      |
| 5600 | 48.5 ±10 % |      | 5.77 ±10 % |      |
| 5800 | 48.2 ±10 % |      | 6.00 ±10 % |      |

## 7.4 SAR MEASUREMENT RESULT WITH BODY LIQUID

|                                           |                                                                 |
|-------------------------------------------|-----------------------------------------------------------------|
| Software                                  | OPENSAR V4                                                      |
| Phantom                                   | SN 20109 SAM71                                                  |
| Probe                                     | SN 18111 EPG122                                                 |
| Liquid                                    | Body Liquid Values: $\epsilon_{ps} = 51.6$ $\sigma_{ps} = 2.21$ |
| Distance between dipole center and liquid | 10.0 mm                                                         |
| Area scan resolution                      | $dx=8mm/dy=8mm$                                                 |
| Zoom Scan Resolution                      | $dx=5mm/dy=5mm/dz=5mm$                                          |
| Frequency                                 | 2600 MHz                                                        |
| Input power                               | 20 dBm                                                          |
| Liquid Temperature                        | 21 °C                                                           |
| Lab Temperature                           | 21 °C                                                           |
| Lab Humidity                              | 45 %                                                            |

| Frequency<br>MHz | 1 g SAR (W/kg/W) | 10 g SAR (W/kg/W) |
|------------------|------------------|-------------------|
|                  | measured         | measured          |
| 2600             | 57.62 (5.76)     | 25.39 (2.54)      |



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## SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR-7514-15 SAR/1A

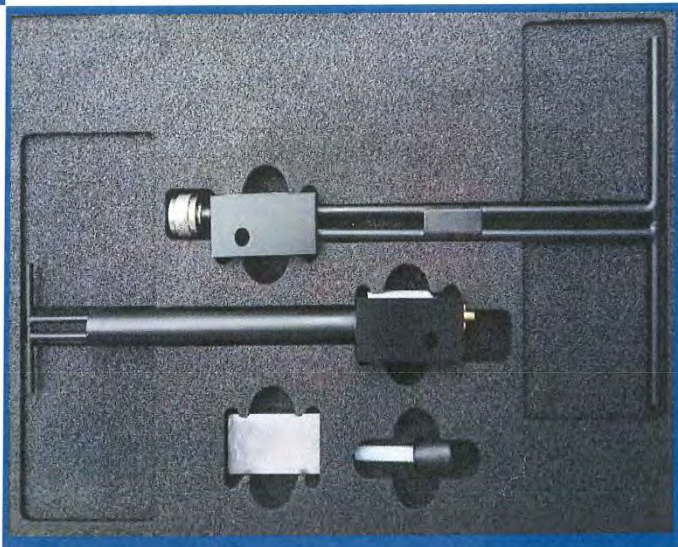
## 8 LIST OF EQUIPMENT

| Equipment Summary Sheet         |                      |                    |                                               |                                               |
|---------------------------------|----------------------|--------------------|-----------------------------------------------|-----------------------------------------------|
| Equipment Description           | Manufacturer / Model | Identification No. | Current Calibration Date                      | Next Calibration Date                         |
| SAM Phantom                     | MVG                  | SN-2009-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                 | MVG                  | EPG122 SN 16/11    | 10/2014                                       | 10/2015                                       |
| Multimeter                      | Keithley 2000        | 1188656            | 12/2013                                       | 12/2016                                       |
| Signal Generator                | Agilent E4438C       | MY49070681         | 12/2013                                       | 12/2016                                       |
| Amplifier                       | Aethercomm           | SN 046             | Characterized prior to test. No cal required. | Characterized prior to test. No cal required. |
| Power Meter                     | HP E4418A            | US38261498         | 12/2013                                       | 12/2016                                       |
| Power Sensor                    | HP ECP-E26A          | US37181480         | 12/2013                                       | 12/2016                                       |
| Directional Coupler             | Narda 4216-20        | 01386              | Characterized prior to test. No cal required. | Characterized prior to test. No cal required. |
| Temperature and Humidity Sensor | Control Company      | 11-661-9           | 8/2012                                        | 8/2015                                        |

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## F.8 SATIMO Dipole

**SAR***Dipole & Waveguide***Performance  
Measurement  
Report**ISSUED BY  
Shenzhen BALUN Technology Co., Ltd.FOR  
Validation Dipoles & Waveguide

Tested by:

Tu Lang  
(Engineer)

Approved by:

Liao Jianming  
(Technical Director)

Report No.: LW-SZ15C0264-701

EUT Type: SAR Validation Dipole and Waveguide

Model Name: DIP 0G450-252, DIP 0G750-253

DIP 0G835-246, DIP 0G900-247

DIP 1G800-248, DIP 1G900-249

DIP 2G000-250, DIP 2G450-251

DIP 2G600-25, SWG5500

Brand Name: SATIMO

Test Conclusion: Pass

Test Date: Mar. 1, 2016 ~ Mar. 3, 2016

Date of Issue: Mar. 31, 2016

NOTE: This test report can be duplicated completely for the legal use with the approval of the applicant; it shall not be reproduced except in full, without the written approval of Shenzhen BALUN Technology Co., Ltd. BALUN Laboratory. Any objections should be raised within thirty days from the date of issue. To validate the report, please visit BALUN website.

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TEL: +86-755-66850100, FAX: +86-755-61824271  
Email: info@baluntek.com  
www.baluntek.com





## 1 GENERAL INFORMATION

### 1.1 Introduction

This document contains a summary of the requirements set forth by the IEEE 1528, FCC KDB 865664 D01 for reference dipoles used for SAR measurement system validations. Instead of the typical annual calibration recommended by measurement standards, the reference dipoles were demonstrated that the SAR target, impedance and return loss have remain stable, so the longer calibration interval is acceptable.

### 1.2 General Description for Equipment under Test (EUT)

| Model            | Frequency | Serial Number             | Product Condition<br>(New/ Used) | Last Cal.<br>Date |
|------------------|-----------|---------------------------|----------------------------------|-------------------|
| <b>Dipole</b>    |           |                           |                                  |                   |
| DIP 0G450        | 450 MHz   | SN 25/13<br>DIP 0G450-252 | Used                             | 2015/03/16        |
| DIP 0G750        | 750 MHz   | SN 25/13<br>DIP 0G750-253 | Used                             | 2015/03/16        |
| DIP 0G835        | 835 MHz   | SN 25/13<br>DIP 0G835-246 | Used                             | 2015/03/16        |
| DIP 0G900        | 900 MHz   | SN 25/13<br>DIP 0G900-247 | Used                             | 2015/03/16        |
| DIP 1G800        | 1800 MHz  | SN 25/13<br>DIP 1G900-248 | Used                             | 2015/03/16        |
| DIP 1G900        | 1900 MHz  | SN 25/13<br>DIP 1G900-249 | Used                             | 2015/03/16        |
| DIP 2G000        | 2000 MHz  | SN 25/13<br>DIP 2G000-250 | Used                             | 2015/03/16        |
| DIP 2G450        | 2450 MHz  | SN 25/13<br>DIP 2G450-251 | Used                             | 2015/03/16        |
| DIP 2G600        | 2600 MHz  | SN 25/13<br>DIP 2G600-254 | Used                             | 2015/03/16        |
| <b>Waveguide</b> |           |                           |                                  |                   |
| SWG5500          | 5GHz-6GHz | SN 30/13<br>WGA24         | Used                             | 2015/03/16        |



### 1.3EUT Photos





DIP 0G835-246



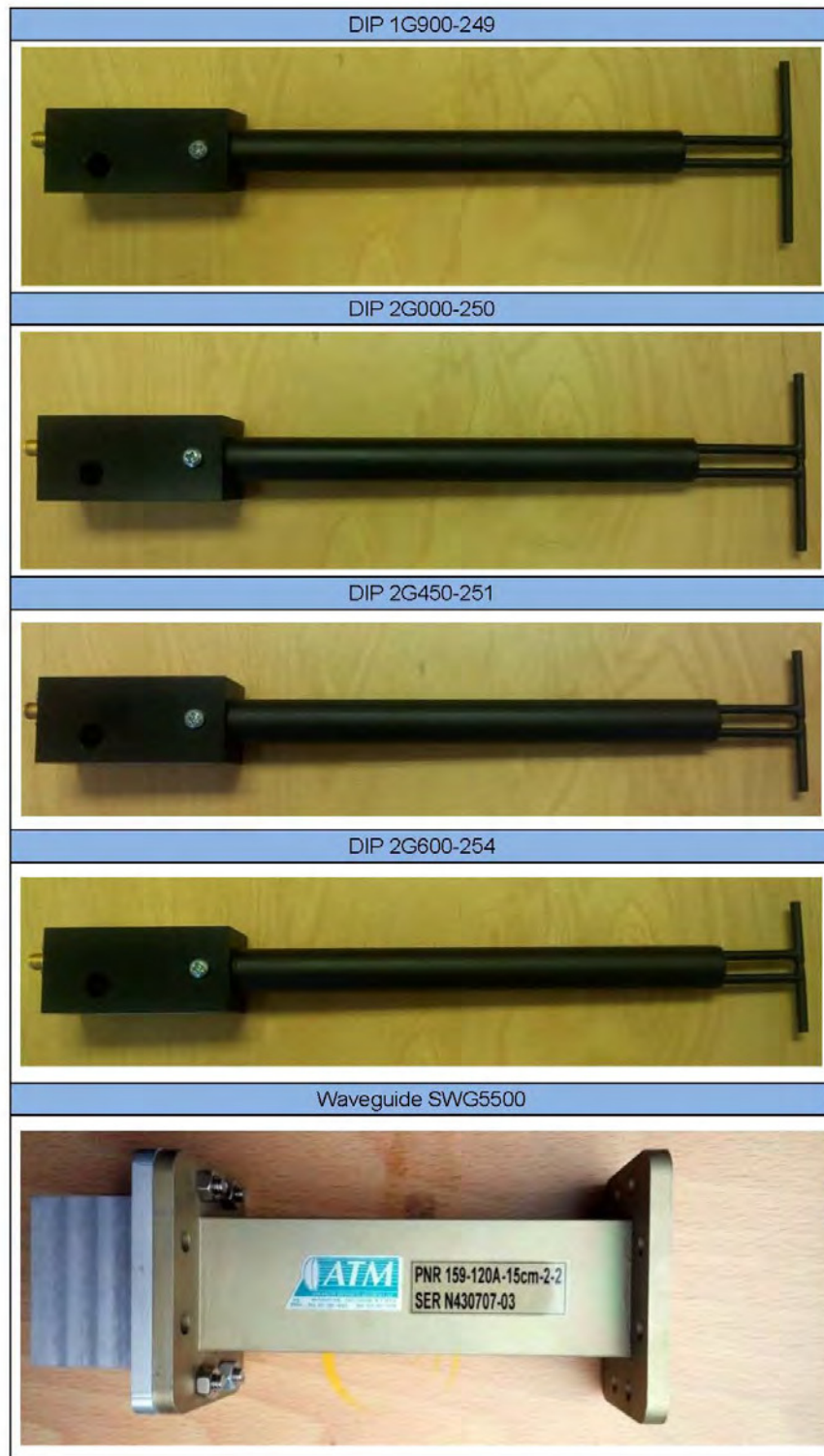
DIP 0G900-247



DIP 1G800-248







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## 2 SIMULATING LIQUID VERIFICATION

| Liquid Type | Fre (MHz) | Meas Conductivity ( $\sigma$ ) (S/m) | Meas Permittivity ( $\epsilon$ ) | Target Conductivity ( $\sigma$ ) (S/m) | Target Permittivity ( $\epsilon$ ) | Conductivity Tolerance (%) | Permittivity Tolerance (%) |
|-------------|-----------|--------------------------------------|----------------------------------|----------------------------------------|------------------------------------|----------------------------|----------------------------|
| Head        | 450       | 0.89                                 | 42.87                            | 0.87                                   | 43.50                              | 2.30                       | -1.45                      |
| Body        |           | 0.96                                 | 55.70                            | 0.94                                   | 56.70                              | 2.13                       | -1.76                      |
| Head        | 750       | 0.88                                 | 41.92                            | 0.89                                   | 41.94                              | -1.12                      | -0.05                      |
| Body        |           | 0.95                                 | 57.19                            | 0.96                                   | 55.53                              | -1.04                      | 2.99                       |
| Head        | 835       | 0.90                                 | 43.33                            | 0.90                                   | 41.50                              | 0.00                       | 4.41                       |
| Body        |           | 0.99                                 | 54.65                            | 0.97                                   | 55.20                              | 2.06                       | -1.00                      |
| Head        | 900       | 0.99                                 | 41.14                            | 0.97                                   | 41.50                              | 2.06                       | -0.87                      |
| Body        |           | 1.06                                 | 54.93                            | 1.05                                   | 55.00                              | 0.95                       | -0.13                      |
| Head        | 1800      | 1.41                                 | 39.56                            | 1.40                                   | 40.00                              | 0.71                       | -1.10                      |
| Body        |           | 1.51                                 | 54.69                            | 1.52                                   | 53.30                              | -0.66                      | 2.61                       |
| Head        | 1900      | 1.42                                 | 39.40                            | 1.40                                   | 40.00                              | 1.43                       | -1.50                      |
| Body        |           | 1.53                                 | 53.16                            | 1.52                                   | 53.30                              | 0.66                       | -0.26                      |
| Head        | 2000      | 1.43                                 | 38.96                            | 1.40                                   | 40.00                              | 2.14                       | -2.60                      |
| Body        |           | 1.55                                 | 51.53                            | 1.52                                   | 53.30                              | 1.97                       | -3.32                      |
| Head        | 2450      | 1.82                                 | 38.92                            | 1.80                                   | 39.20                              | 1.11                       | -0.71                      |
| Body        |           | 1.96                                 | 52.96                            | 1.95                                   | 52.70                              | 0.51                       | 0.49                       |
| Head        | 2600      | 1.98                                 | 38.10                            | 1.96                                   | 39.01                              | 1.02                       | -2.33                      |
| Body        |           | 2.15                                 | 53.51                            | 2.16                                   | 52.51                              | -0.46                      | 1.90                       |
| Head        | 5200      | 4.64                                 | 36.87                            | 4.66                                   | 35.99                              | -0.43                      | 2.45                       |
| Body        |           | 5.26                                 | 50.13                            | 5.30                                   | 49.01                              | -0.75                      | 2.29                       |
| Head        | 5400      | 4.83                                 | 36.43                            | 4.86                                   | 35.76                              | -0.62                      | 1.87                       |
| Body        |           | 5.51                                 | 50.02                            | 5.53                                   | 48.74                              | -0.36                      | 2.63                       |
| Head        | 5600      | 5.14                                 | 34.46                            | 5.07                                   | 35.53                              | 1.38                       | -3.01                      |
| Body        |           | 5.93                                 | 48.04                            | 5.77                                   | 48.47                              | 2.77                       | -0.89                      |
| Head        | 5800      | 5.31                                 | 34.33                            | 5.27                                   | 35.30                              | 0.76                       | -2.75                      |
| Body        |           | 6.07                                 | 47.14                            | 6.00                                   | 48.20                              | 1.17                       | -2.20                      |



### 3 DIPOLE IMPEDANCE AND RETURN LOSS

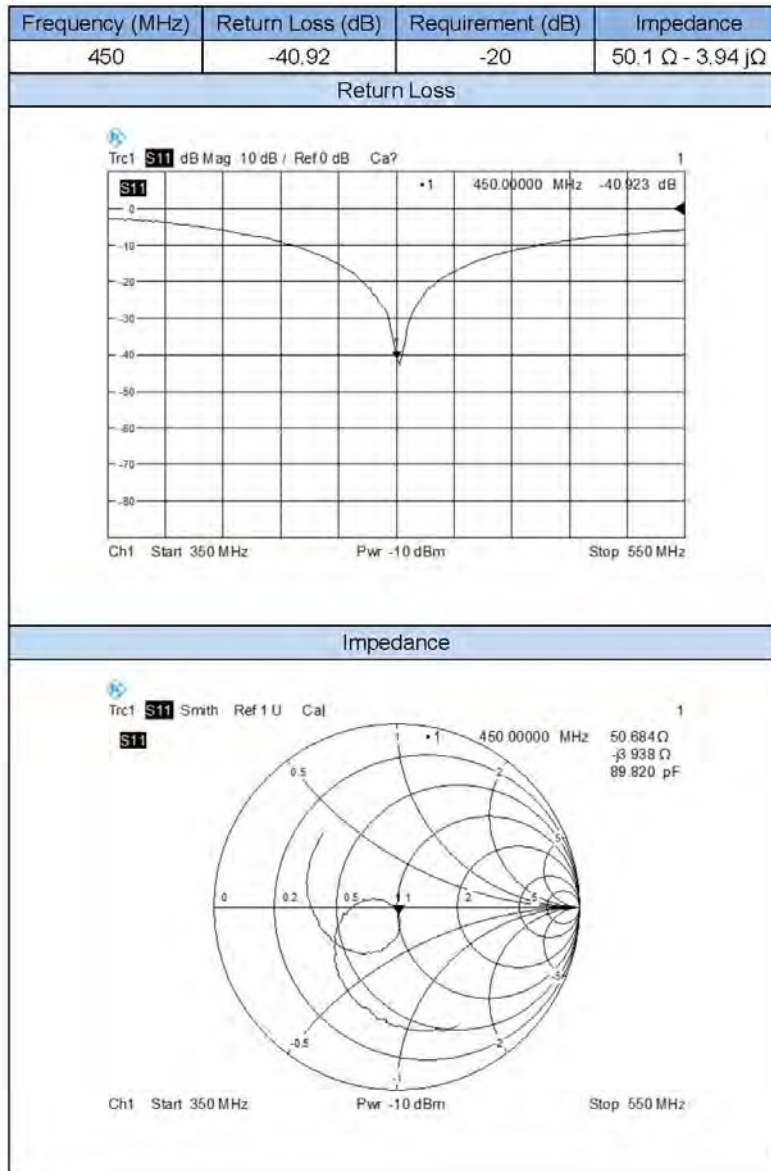
The dipoles are designed to have low return loss when presented against a flat phantom at the specified distance. A Vector Network Analyser was used to perform a return loss measurement on the specific dipole when in the measurement location against the phantom and the distance was specified by the manufacturer with a special, low loss and low relative permittivity spacer.

The impedance was measured at the SMA-connector with the network analyser.



### 3.1 DIP 0G450

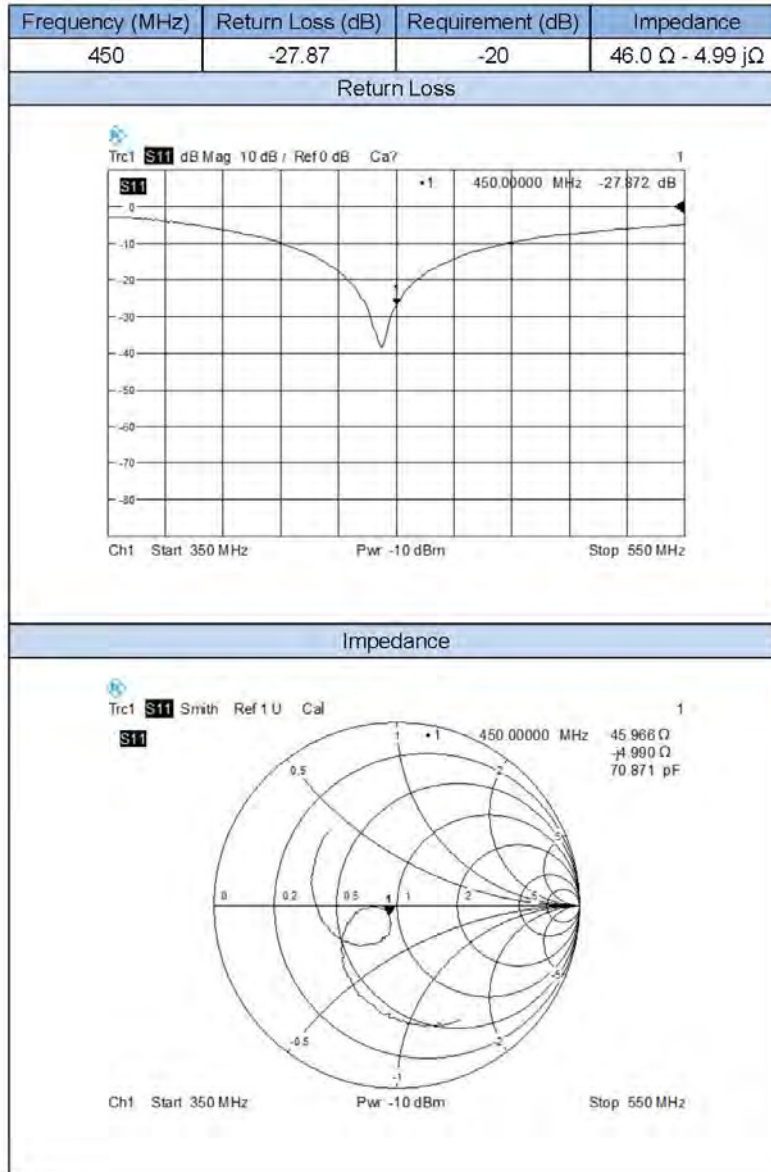
#### RETURN LOSS AND IMPEDANCE IN HEAD LIQUID







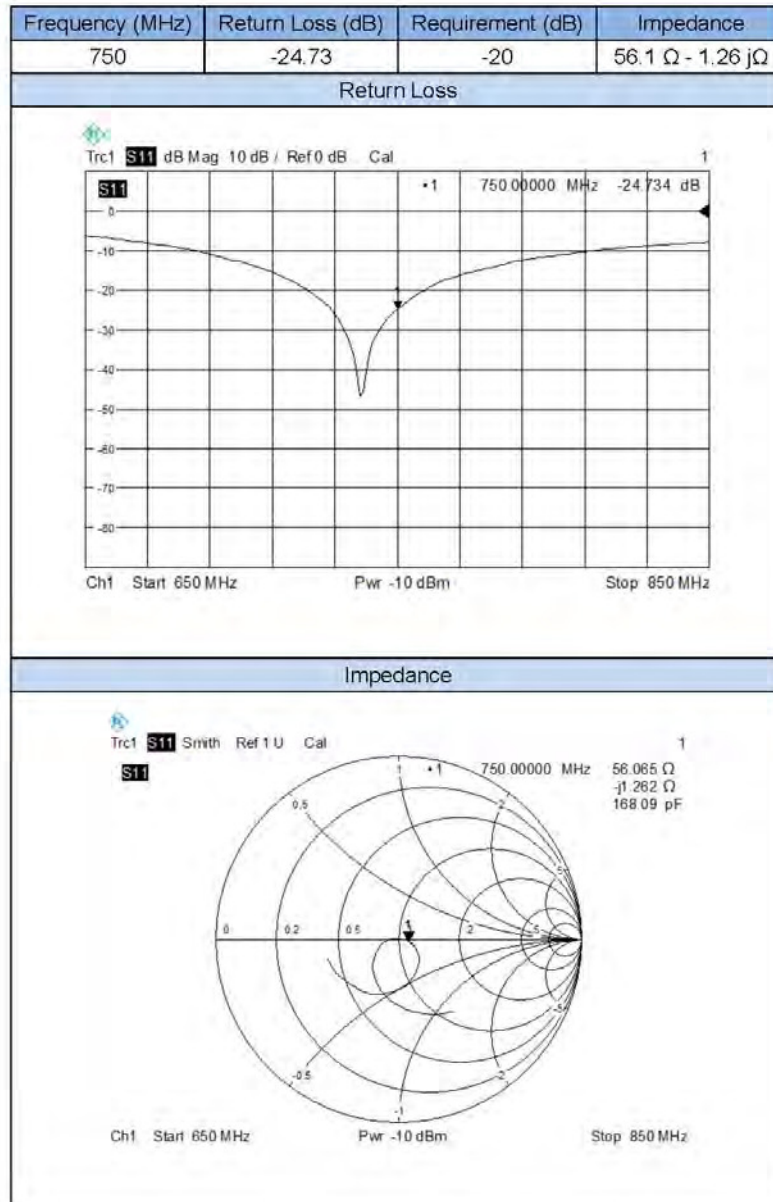
### RETURN LOSS AND IMPEDANCE IN BODY LIQUID





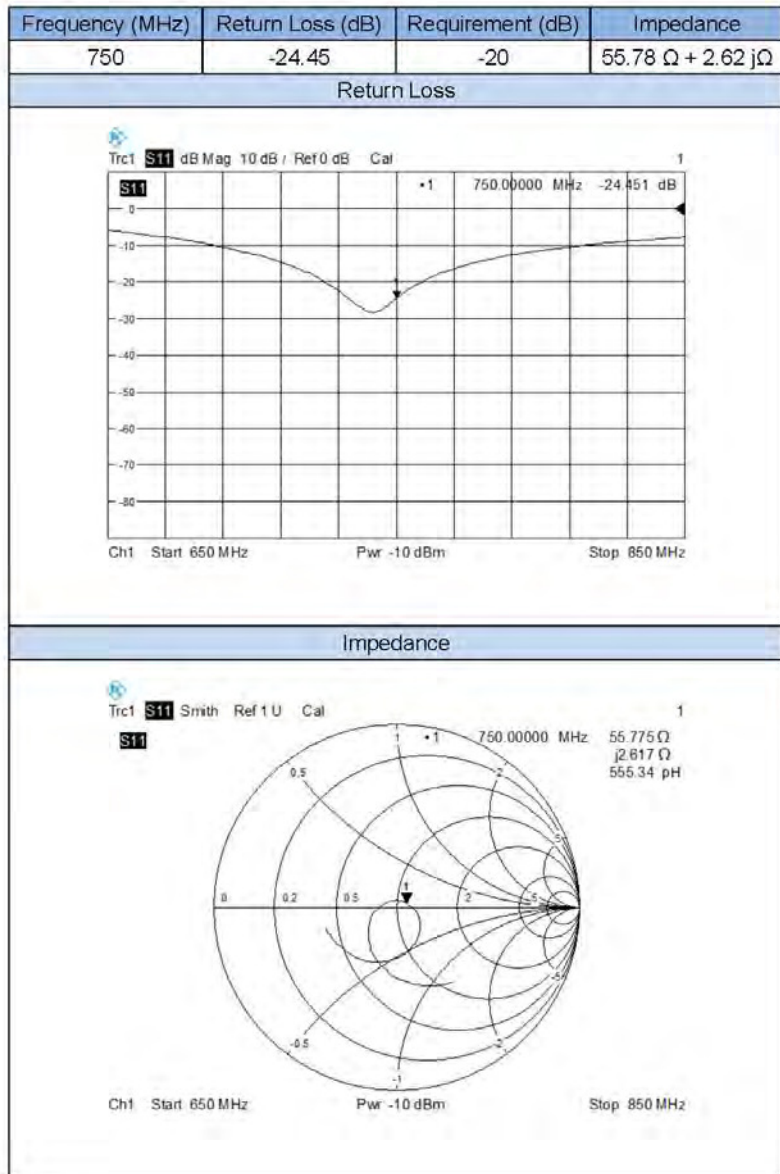
### 3.2 DIP 0G750

#### RETURN LOSS AND IMPEDANCE IN HEAD LIQUID





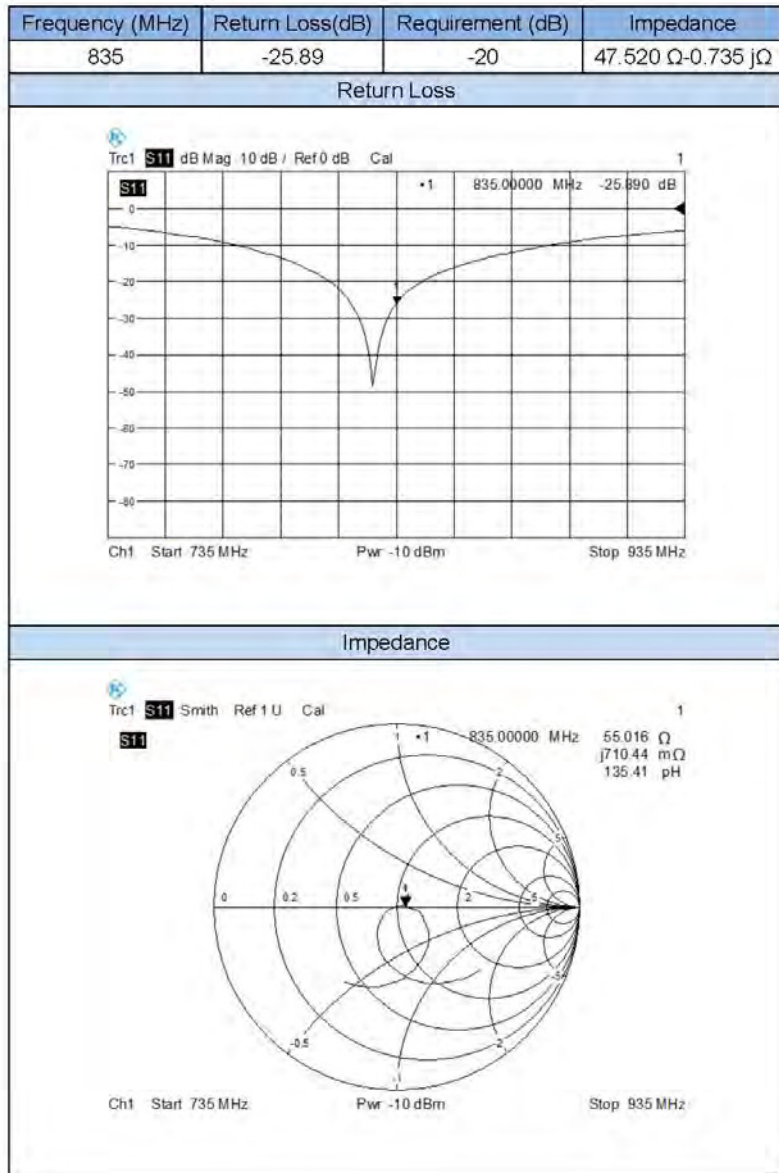
### RETURN LOSS AND IMPEDANCE IN BODY LIQUID





### 3.3 DIP 0G835

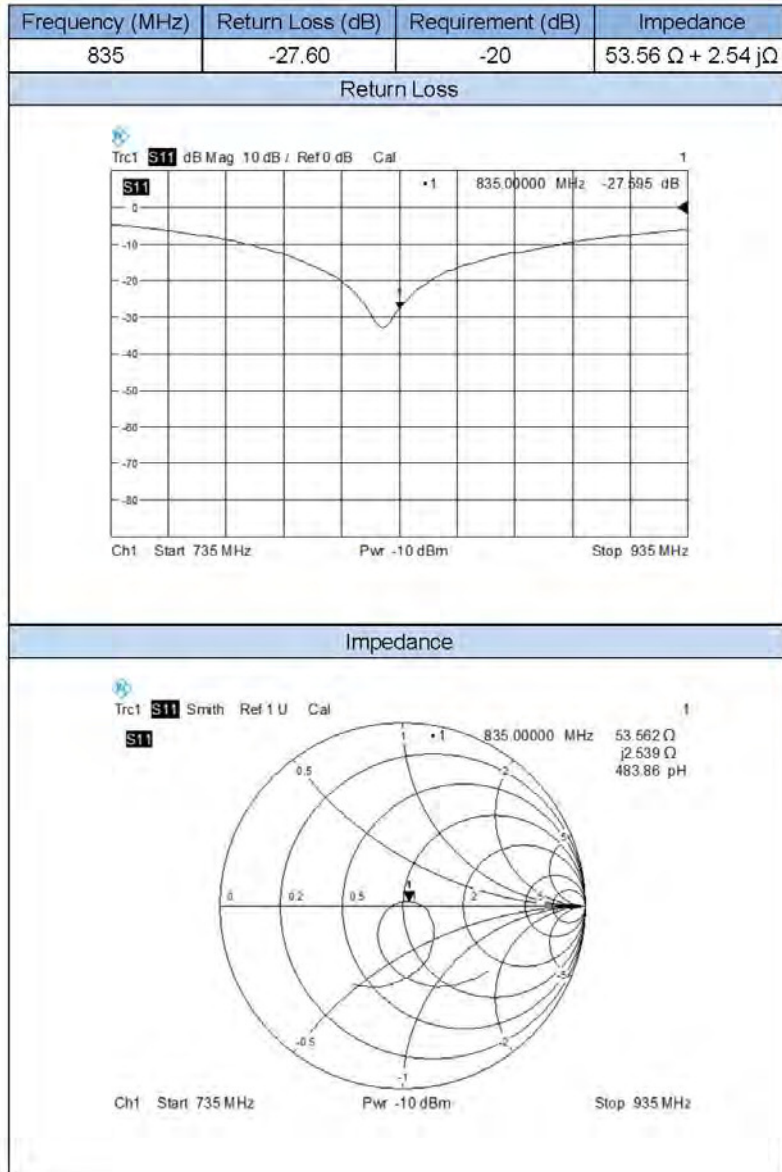
#### RETURN LOSS AND IMPEDANCE IN HEAD LIQUID







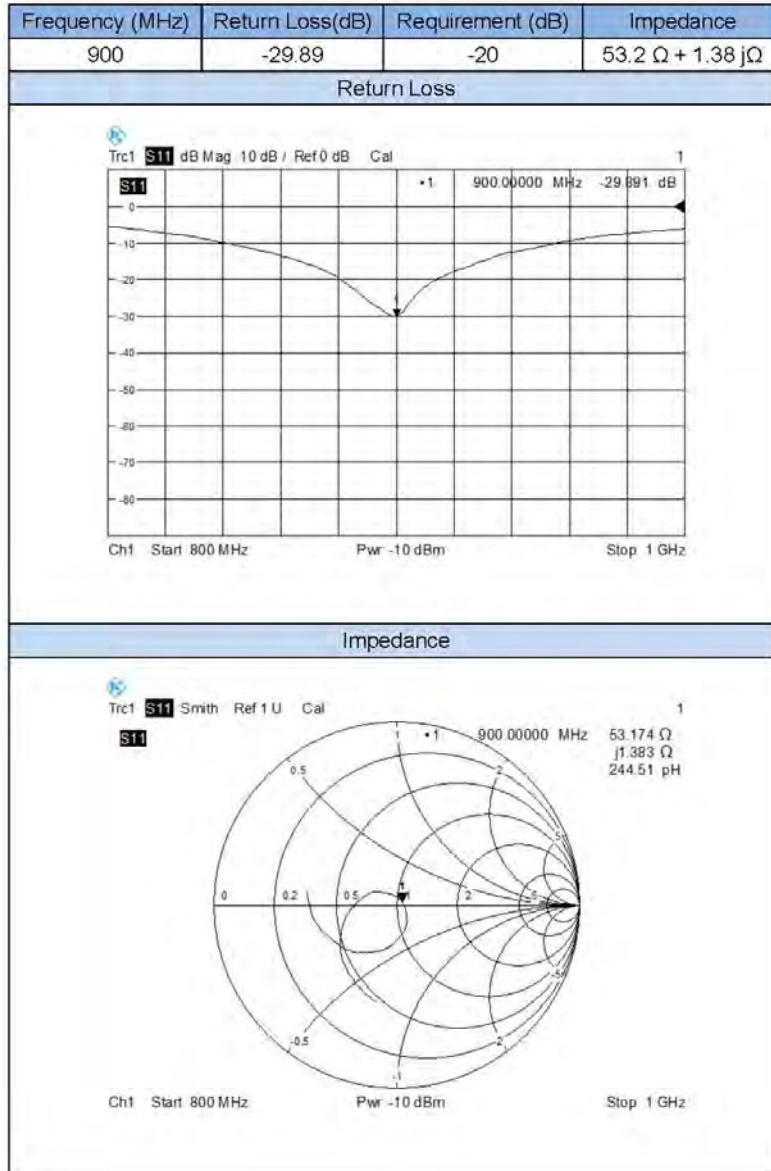
### RETURN LOSS AND IMPEDANCE IN BODY LIQUID





### 3.4 DIP 0G900

#### RETURN LOSS AND IMPEDANCE IN HEAD LIQUID

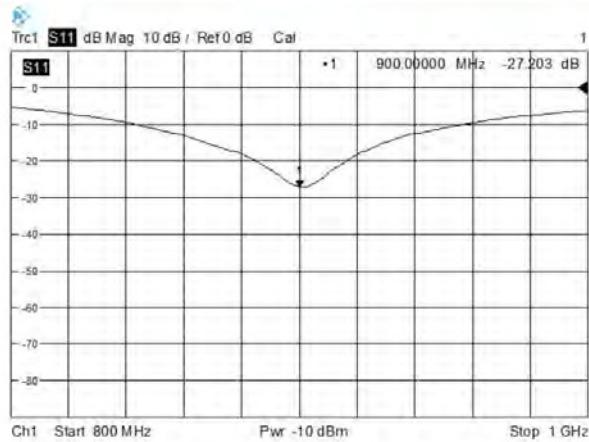




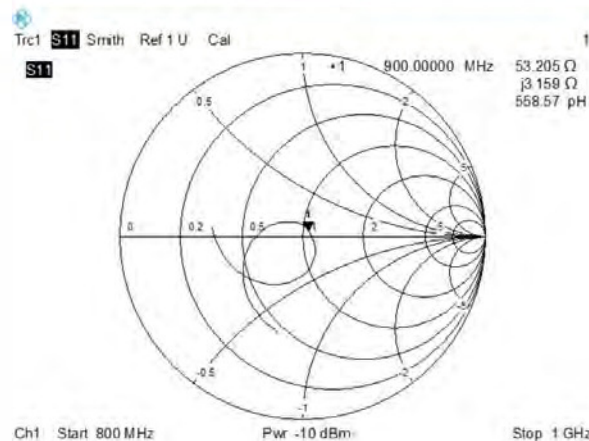
### RETURN LOSS AND IMPEDANCE IN BODY LIQUID

| Frequency (MHz) | Return Loss (dB) | Requirement (dB) | Impedance                    |
|-----------------|------------------|------------------|------------------------------|
| 900             | -27.20           | -20              | $53.2 \Omega + 3.16 j\Omega$ |

#### Return Loss



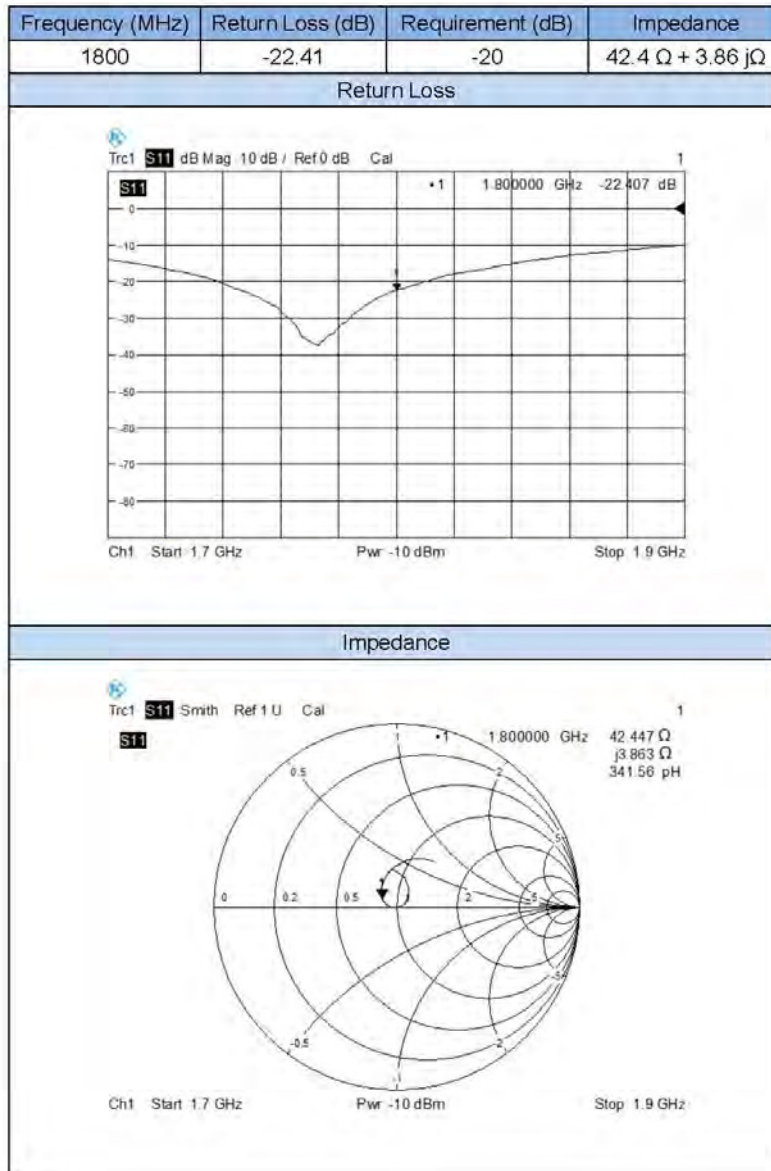
#### Impedance





### 3.5 DIP 1G800

#### RETURN LOSS AND IMPEDANCE IN HEAD LIQUID

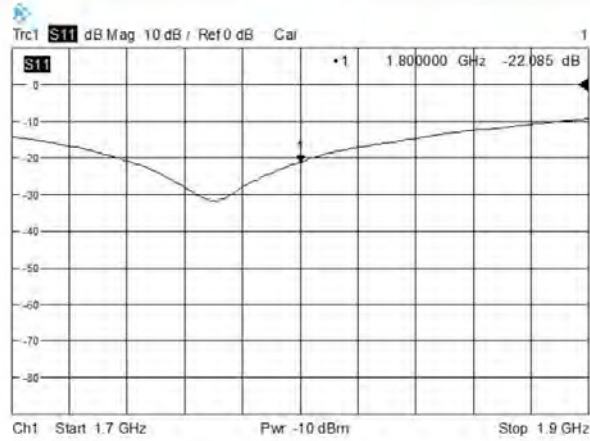




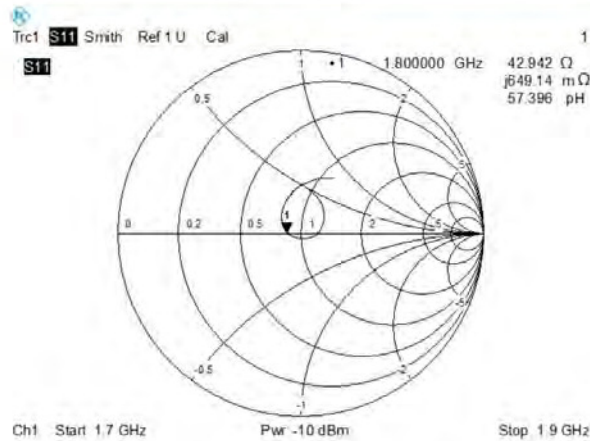
### RETURN LOSS AND IMPEDANCE IN BODY LIQUID

| Frequency (MHz) | Return Loss (dB) | Requirement (dB) | Impedance                    |
|-----------------|------------------|------------------|------------------------------|
| 1800            | -22.09           | -20              | $42.9 \Omega + 0.65 j\Omega$ |

#### Return Loss



#### Impedance





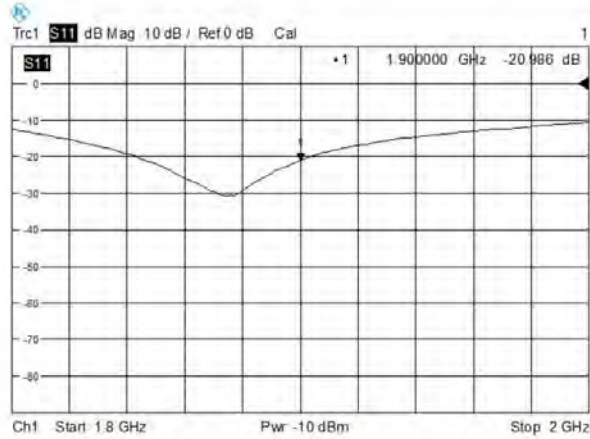


### 3.6 DIP 1G900

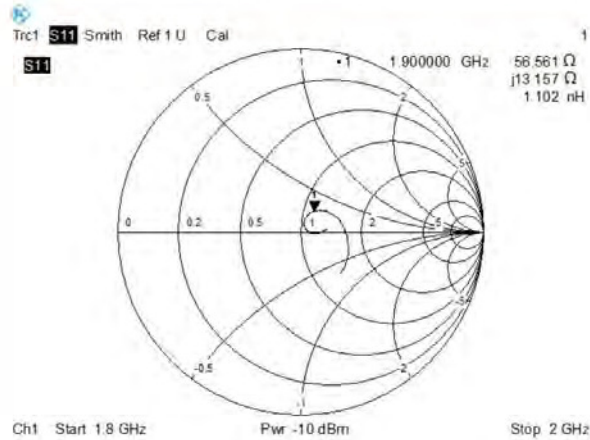
#### RETURN LOSS AND IMPEDANCE IN HEAD LIQUID

| Frequency (MHz) | Return Loss (dB) | Requirement (dB) | Impedance                     |
|-----------------|------------------|------------------|-------------------------------|
| 1900            | -20.99           | -20              | $56.6 \Omega + 13.16 j\Omega$ |

##### Return Loss

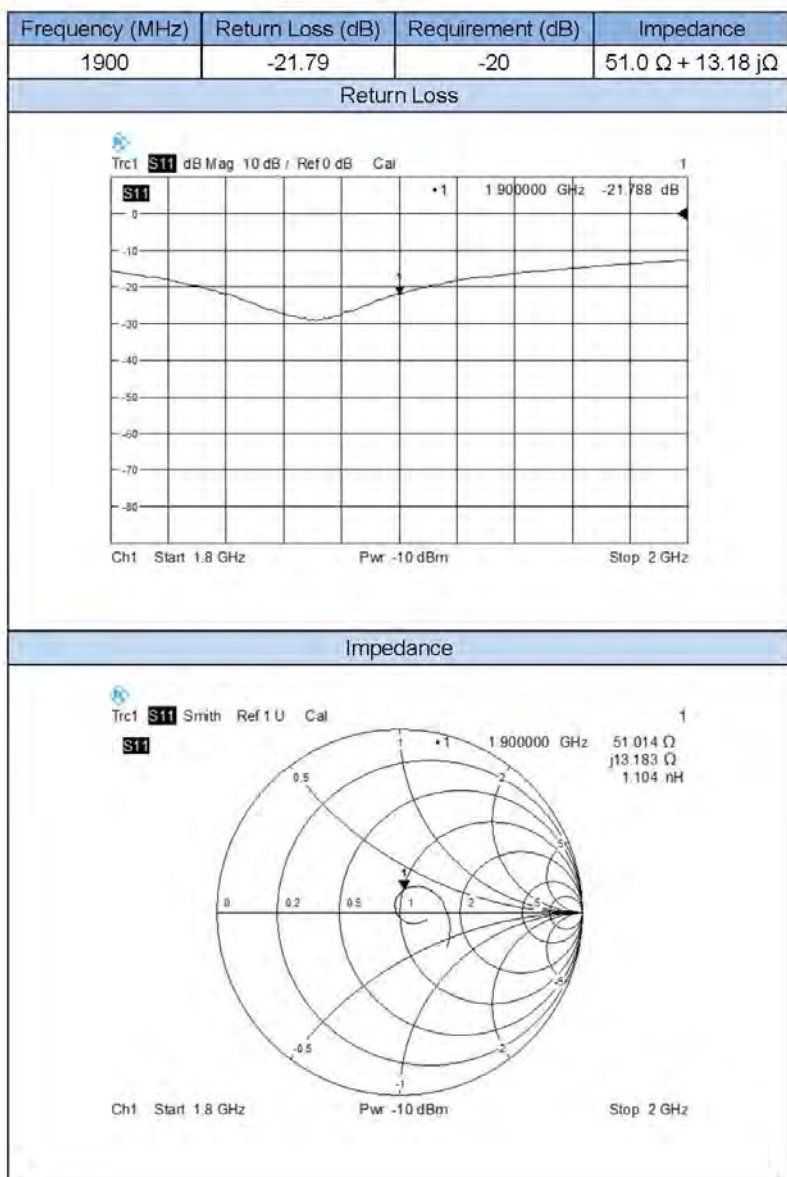


##### Impedance





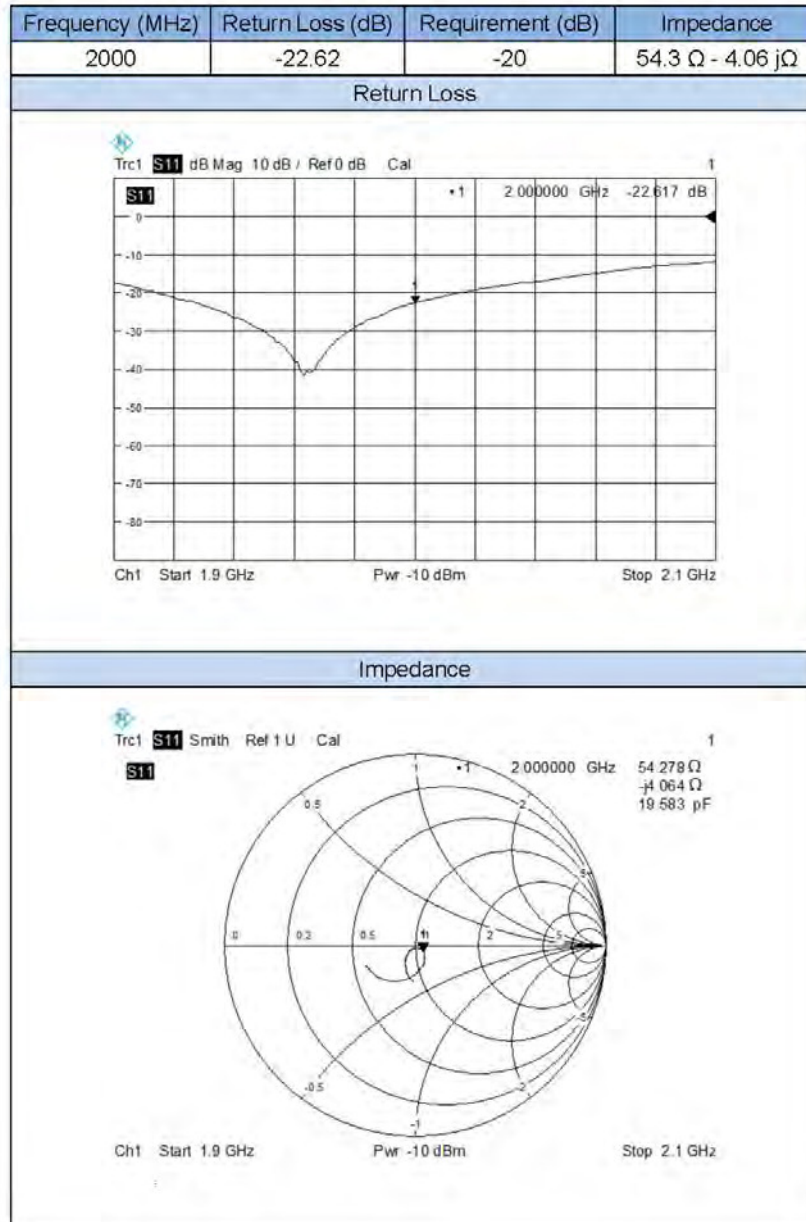
### RETURN LOSS AND IMPEDANCE IN BODY LIQUID





### 3.7 DIP 2G000

#### RETURN LOSS AND IMPEDANCE IN HEAD LIQUID

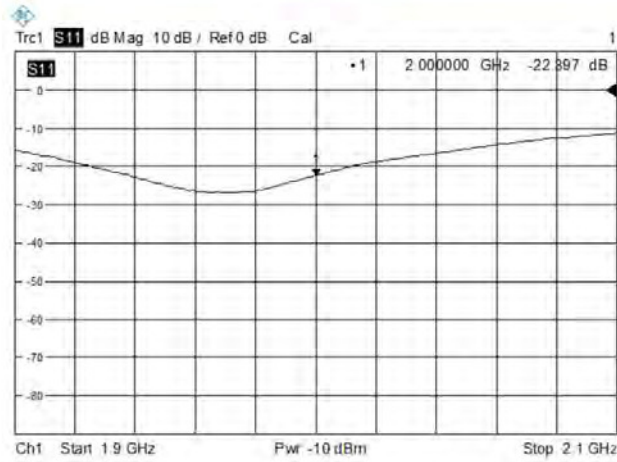




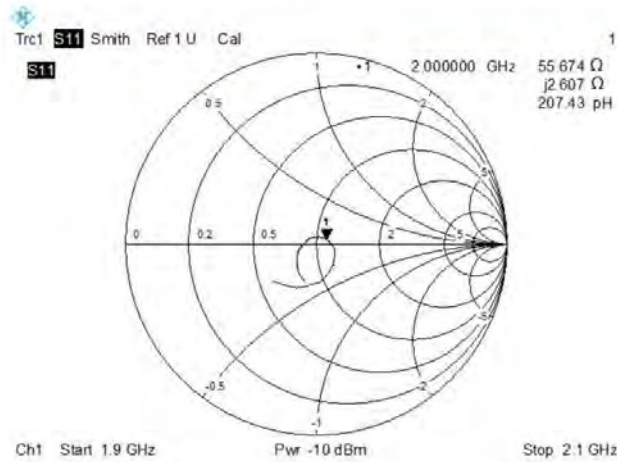
### RETURN LOSS AND IMPEDANCE IN BODY LIQUID

| Frequency (MHz) | Return Loss (dB) | Requirement (dB) | Impedance                       |
|-----------------|------------------|------------------|---------------------------------|
| 2000            | -22.40           | -20              | 55.7 $\Omega$ + 2.61 j $\Omega$ |

#### Return Loss



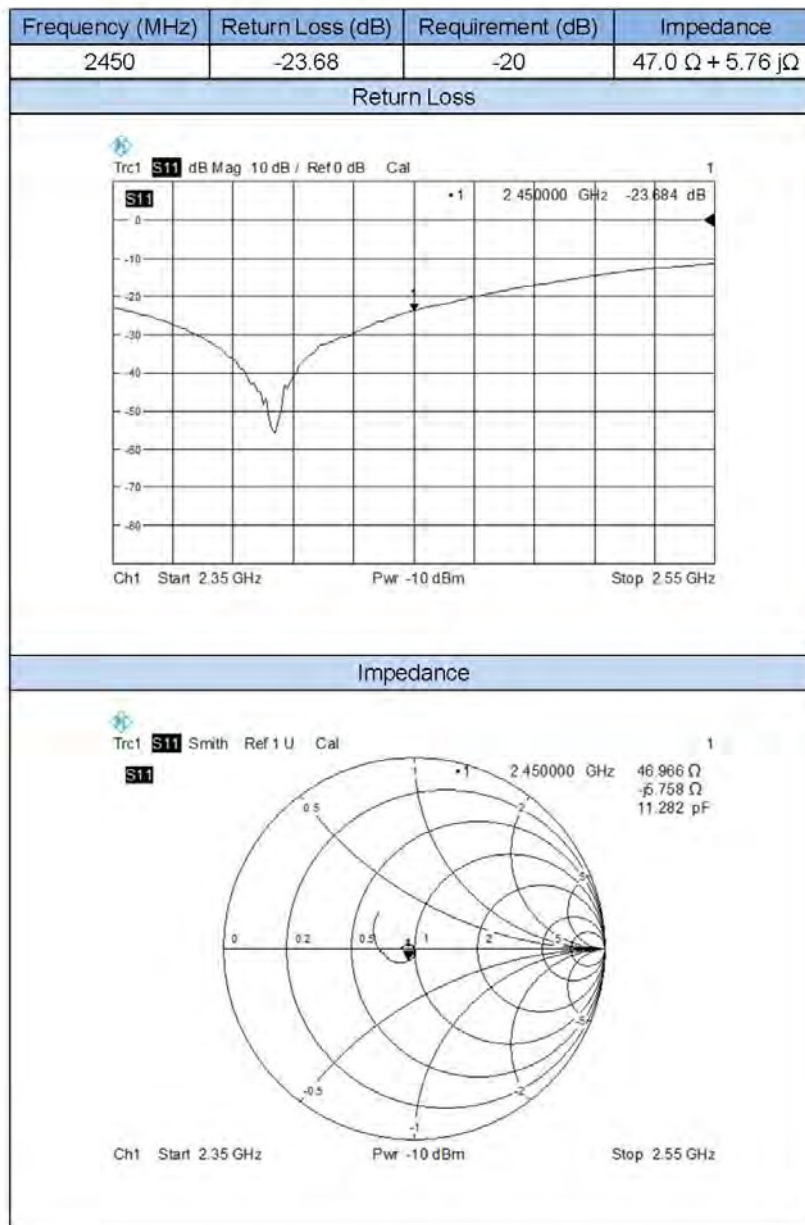
#### Impedance





### 3.8 DIP 2G450

#### RETURN LOSS AND IMPEDANCE IN HEAD LIQUID



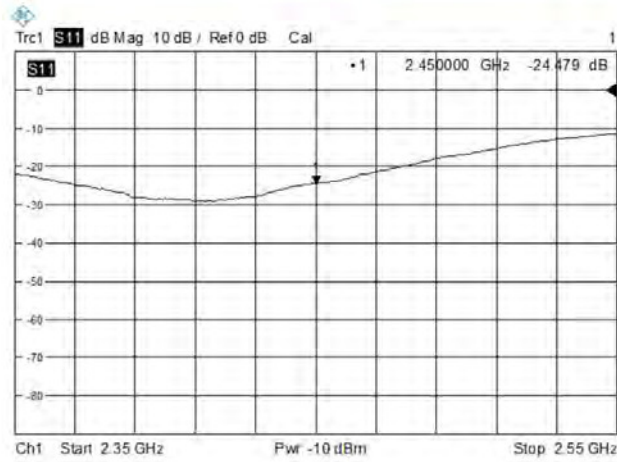




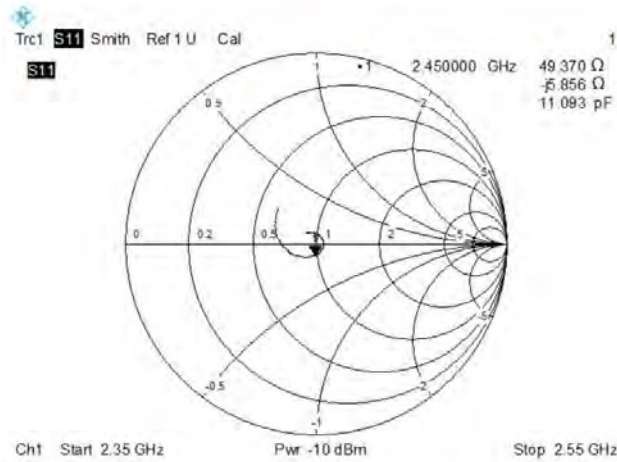
### RETURN LOSS AND IMPEDANCE IN BODY LIQUID

| Frequency (MHz) | Return Loss (dB) | Requirement (dB) | Impedance                       |
|-----------------|------------------|------------------|---------------------------------|
| 2450            | -24.48           | -20              | 49.4 $\Omega$ - 5.86 j $\Omega$ |

#### Return Loss



#### Impedance



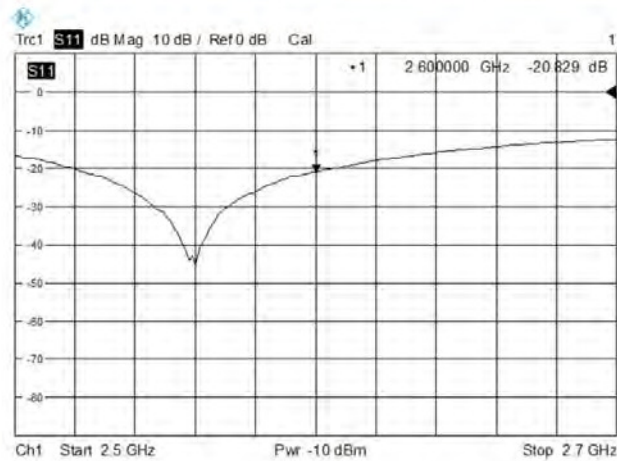


### 3.9 DIP 2G600

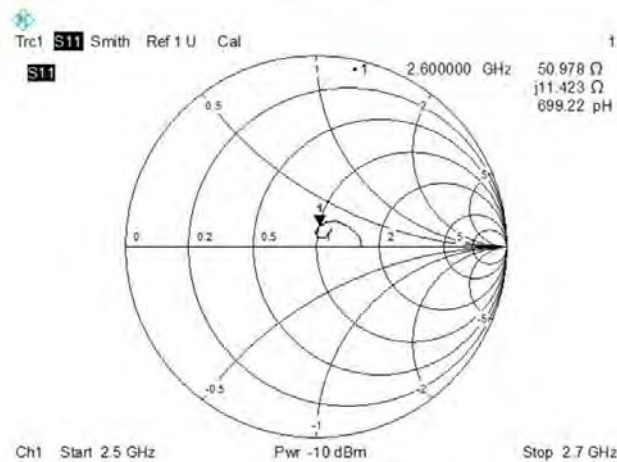
#### RETURN LOSS AND IMPEDANCE IN HEAD LIQUID

| Frequency (MHz) | Return Loss (dB) | Requirement (dB) | Impedance                     |
|-----------------|------------------|------------------|-------------------------------|
| 2600            | -20.83           | -20              | $51.0 \Omega + 11.42 j\Omega$ |

##### Return Loss



##### Impedance

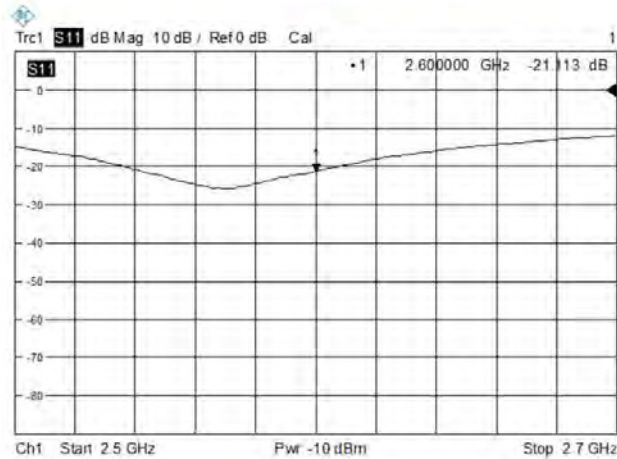




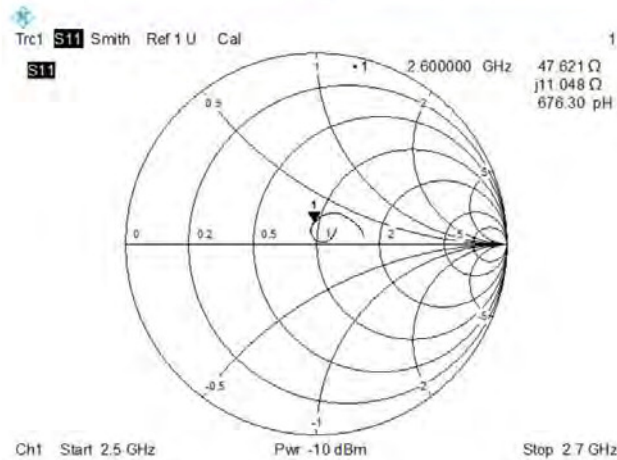
### RETURN LOSS AND IMPEDANCE IN BODY LIQUID

| Frequency (MHz) | Return Loss (dB) | Requirement (dB) | Impedance                        |
|-----------------|------------------|------------------|----------------------------------|
| 2600            | -21.11           | -20              | 47.6 $\Omega$ + 11.05 j $\Omega$ |

#### Return Loss



#### Impedance





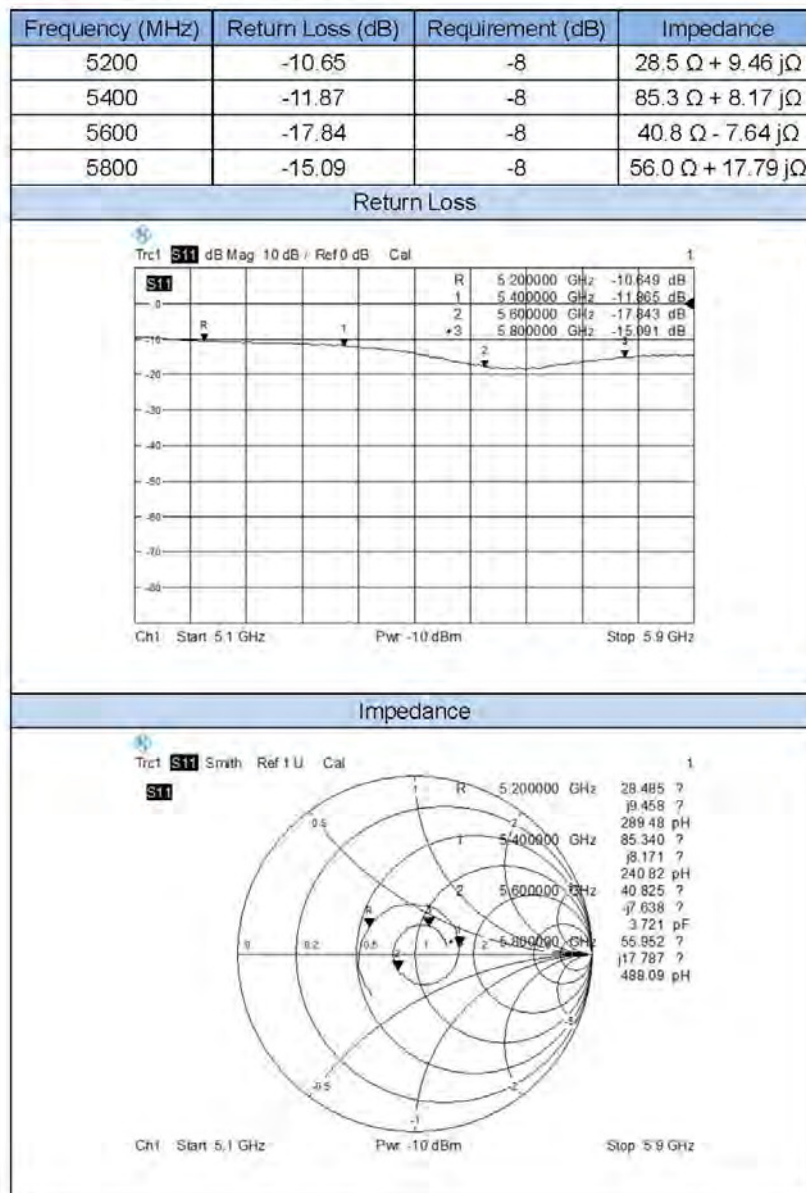
## 4 WAVEGUIDE IMPEDANCE AND RETURN LOSS

The waveguide are designed to have low return loss when presented against a flat phantom at the specified distance. A Vector Network Analyser was used to perform a return loss measurement on the specific waveguide when in the measurement location against the phantom and the distance was specified by the manufacturer with a special, low loss and low relative permittivity spacer.

The impedance was measured at the SMA-connector with the network analyser.

### 4.1 SWG5500

#### RETURN LOSS AND IMPEDANCE IN HEAD LIQUID

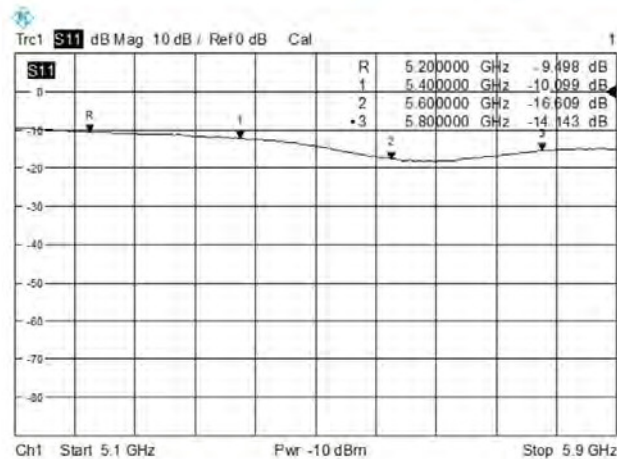




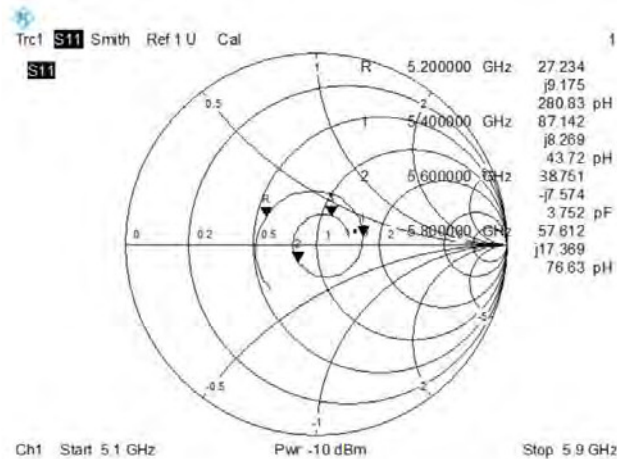
### RETURN LOSS AND IMPEDANCE IN BODY LIQUID

| Frequency (MHz) | Return Loss (dB) | Requirement (dB) | Impedance                     |
|-----------------|------------------|------------------|-------------------------------|
| 5200            | -9.50            | -8               | $27.2 \Omega + 9.18 j\Omega$  |
| 5400            | -10.10           | -8               | $87.1 \Omega + 8.27 j\Omega$  |
| 5600            | -16.60           | -8               | $38.8 \Omega - 7.57 j\Omega$  |
| 5800            | -14.14           | -8               | $57.6 \Omega + 17.37 j\Omega$ |

#### Return Loss



#### Impedance

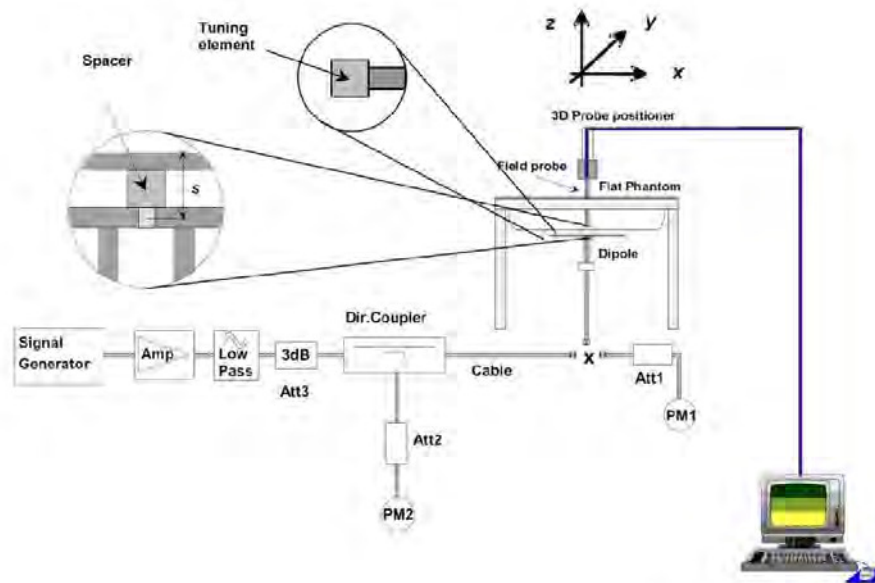






## 5 VALIDATION MEASUREMENT

The IEEE Std. 1528, FCC KDBs 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.





### 5.1 Dipole And Waveguide SAR Validation Measurement Result

| Freq.<br>(MHz) | Liquid<br>Type | Power<br>(mW) | 1 g<br>Measured<br>SAR<br>(W/kg) | Normaliz<br>ed SAR<br>(W/kg) | 10 g<br>Measured<br>SAR<br>(W/kg) | Normaliz<br>ed SAR<br>(W/kg) | 1 g<br>Targeted<br>SAR<br>(W/kg) | Tolerance<br>(%) | 10 g<br>Targeted<br>SAR<br>(W/kg) | Tolerance<br>(%) |
|----------------|----------------|---------------|----------------------------------|------------------------------|-----------------------------------|------------------------------|----------------------------------|------------------|-----------------------------------|------------------|
| 450            | Head           | 100           | 0.439                            | 4.39                         | 0.292                             | 2.92                         | 4.58                             | -4.15            | 3.06                              | -4.58            |
|                | Body           | 100           | 0.479                            | 4.79                         | 0.329                             | 3.29                         | 4.58                             | 4.59             | 3.06                              | 7.52             |
| 750            | Head           | 100           | 0.861                            | 8.61                         | 0.576                             | 5.76                         | 8.49                             | 1.41             | 5.55                              | 3.78             |
|                | Body           | 100           | 0.879                            | 8.79                         | 0.592                             | 5.92                         | 8.49                             | 3.53             | 5.55                              | 6.67             |
| 835            | Head           | 100           | 0.983                            | 9.83                         | 0.609                             | 6.09                         | 9.56                             | 2.82             | 6.22                              | -2.09            |
|                | Body           | 100           | 1.013                            | 10.13                        | 0.659                             | 6.59                         | 9.56                             | 5.96             | 6.22                              | 5.95             |
| 900            | Head           | 100           | 1.147                            | 11.47                        | 0.724                             | 7.24                         | 10.9                             | 5.23             | 6.99                              | 3.58             |
|                | Body           | 100           | 1.139                            | 11.39                        | 0.747                             | 7.47                         | 10.9                             | 4.50             | 6.99                              | 6.87             |
| 1800           | Head           | 100           | 3.892                            | 38.92                        | 1.964                             | 19.64                        | 38.40                            | 1.35             | 20.10                             | -2.29            |
|                | Body           | 100           | 3.911                            | 39.11                        | 1.989                             | 19.89                        | 38.40                            | 1.85             | 20.10                             | -1.04            |
| 1900           | Head           | 100           | 3.890                            | 38.90                        | 1.968                             | 19.68                        | 39.70                            | -2.02            | 20.50                             | -4.00            |
|                | Body           | 100           | 3.943                            | 39.43                        | 2.001                             | 20.01                        | 39.70                            | -0.68            | 20.50                             | -2.39            |
| 2000           | Head           | 100           | 4.029                            | 40.29                        | 2.094                             | 20.94                        | 41.10                            | -1.97            | 21.10                             | -0.76            |
|                | Body           | 100           | 4.197                            | 41.97                        | 2.185                             | 21.85                        | 41.10                            | 2.12             | 21.10                             | 3.55             |
| 2450           | Head           | 100           | 5.328                            | 53.28                        | 2.483                             | 24.83                        | 52.40                            | 1.68             | 24.00                             | 3.46             |
|                | Body           | 100           | 5.094                            | 50.94                        | 2.450                             | 24.50                        | 52.40                            | -2.79            | 24.00                             | 2.08             |
| 2600           | Head           | 100           | 5.323                            | 53.23                        | 2.515                             | 25.15                        | 55.30                            | -3.74            | 24.60                             | 2.24             |
|                | Body           | 100           | 5.174                            | 51.74                        | 2.377                             | 23.77                        | 55.30                            | -6.44            | 24.60                             | -3.37            |
| 5200           | Head           | 100           | 15.378                           | 153.78                       | 5.463                             | 54.62                        | 159.00                           | -3.28            | 56.90                             | -4.01            |
|                | Body           | 100           | 15.224                           | 152.24                       | 5.341                             | 53.41                        | 159.00                           | -4.25            | 56.90                             | -6.13            |
| 5400           | Head           | 100           | 15.876                           | 158.76                       | 5.517                             | 55.17                        | 166.40                           | -4.59            | 58.43                             | -5.58            |
|                | Body           | 100           | 15.762                           | 157.62                       | 5.615                             | 56.15                        | 166.40                           | -5.28            | 58.43                             | -3.90            |
| 5600           | Head           | 100           | 16.475                           | 164.75                       | 5.792                             | 57.92                        | 173.80                           | -5.21            | 59.97                             | -3.42            |
|                | Body           | 100           | 15.813                           | 158.13                       | 5.645                             | 56.45                        | 173.80                           | -9.02            | 59.97                             | -5.87            |
| 5800           | Head           | 100           | 17.688                           | 176.88                       | 5.984                             | 59.84                        | 181.20                           | -2.38            | 61.50                             | -2.70            |
|                | Body           | 100           | 16.953                           | 169.53                       | 5.836                             | 58.36                        | 181.20                           | -6.44            | 61.50                             | -5.11            |



## 5.2 DIP 0G450

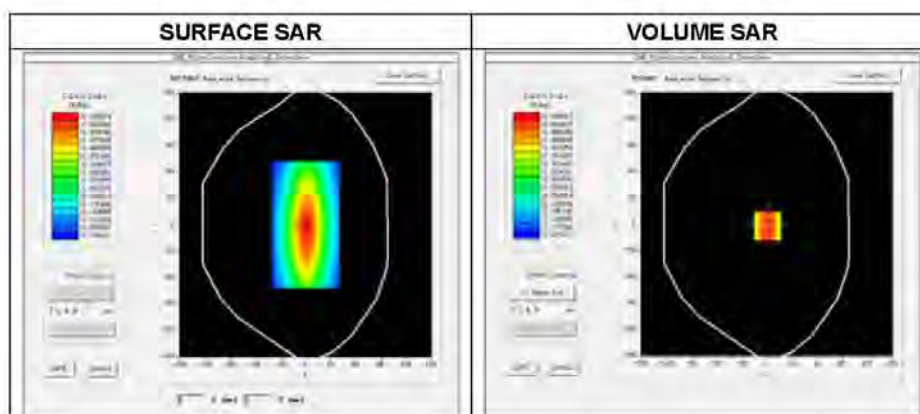
### 5.2.1 Dipole 450 MHz Validation Measurement for Head Tissue

#### System Performance Check Data(450 MHz Head)

Type: Phone measurement (Complete)  
 E-Field Probe: SN 34/15 EPGO265  
 Area scan resolution: dx=8mm, dy=8mm  
 Zoom scan resolution: dx=8mm, dy=8mm, dz=5mm  
 Date of measurement: 2016.03.01  
 Measurement duration: 14 minutes 46 seconds

#### Experimental conditions.

|                                   |                   |
|-----------------------------------|-------------------|
| Phantom File                      | surf_sam_plan.txt |
| Phantom                           | Validation plane  |
| Band                              | 450MHz            |
| Signal                            | CW                |
| Frequency (MHz)                   | 450.000000        |
| Relative permittivity (real part) | 42.872365         |
| Conductivity (S/m)                | 0.890236          |
| Power drift (%)                   | 1.350000          |
| Ambient Temperature:              | 21.6°C            |
| Liquid Temperature:               | 21.1°C            |
| ConvF:                            | 1.85              |
| Crest factor:                     | 1:1               |

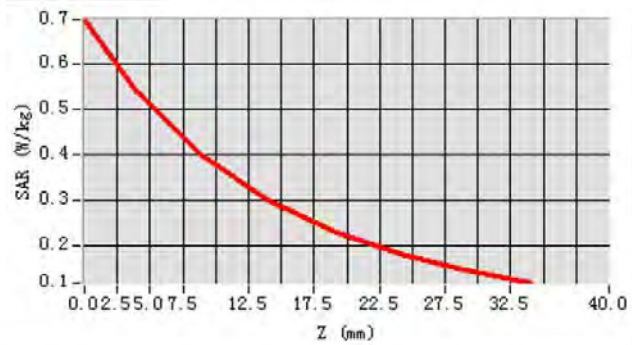




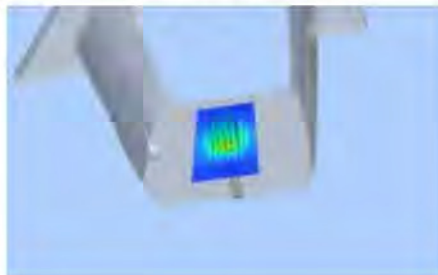
Maximum location: X=0.00, Y=0.00  
SAR Peak: 0.69 W/kg

|                |          |
|----------------|----------|
| SAR 10g (W/Kg) | 0.291862 |
| SAR 1g (W/Kg)  | 0.439023 |

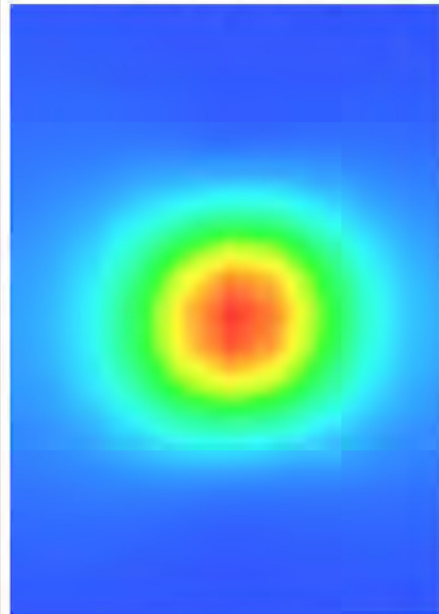
### Z Axis Scan



### 3D screen shot



### Hot spot position







### 5.2.2 Dipole 450 MHz Validation Measurement for Body Tissue

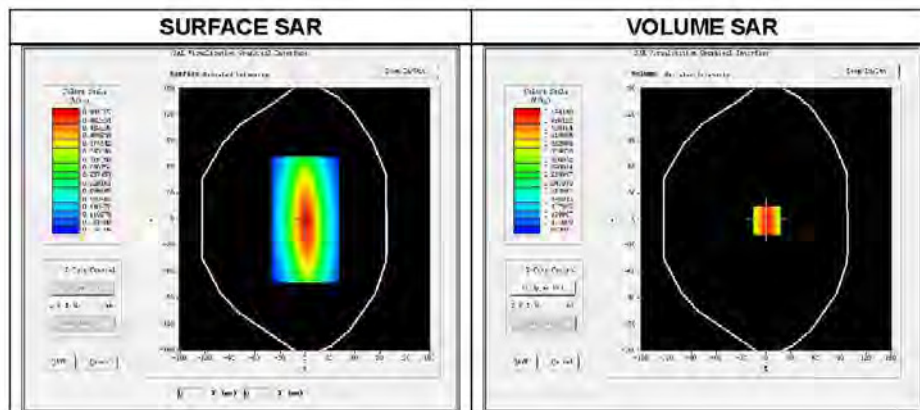
## System Performance Check Data(450 MHz Body)

Type: Phone measurement (Complete)  
E-Field Probe: SN 34/15 SSE2 EPGO265  
Area scan resolution: dx=8mm,dy=8mm  
Zoom scan resolution: dx=8mm, dy=8mm, dz=5mm  
Date of measurement: 2016.03.01  
Measurement duration: 13 minutes 52 seconds

### Experimental conditions.

1

|                                   |                   |
|-----------------------------------|-------------------|
| Phantom File                      | surf_sam_plan.txt |
| Phantom                           | Validation plane  |
| Band                              | 450MHz            |
| Signal                            | CW                |
| Frequency (MHz)                   | 450.000000        |
| Relative permittivity (real part) | 55.695599         |
| Conductivity (S/m)                | 0.955490          |
| Power drift (%)                   | -1.370000         |
| Ambient Temperature:              | 21.6°C            |
| Liquid Temperature:               | 21.1°C            |
| ConvF:                            | 1.90              |
| Crest factor:                     | 1:1               |

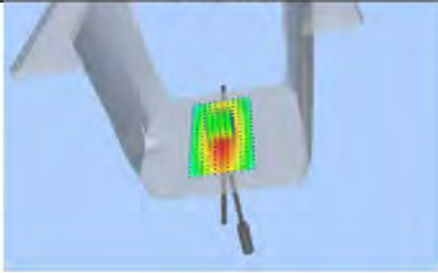
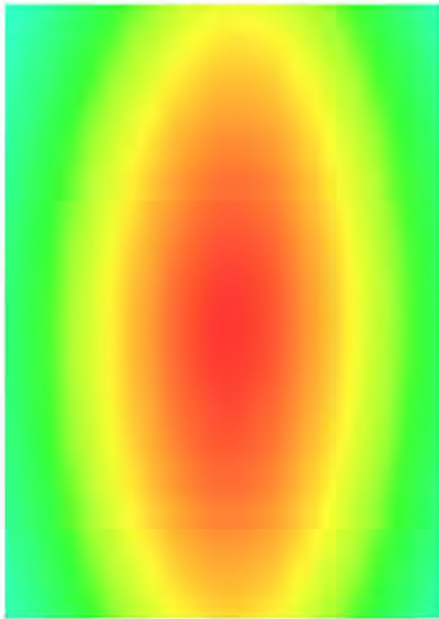






Maximum location: X=1.00, Y=-1.00  
SAR Peak: 0.66 W/kg

|                |          |
|----------------|----------|
| SAR 10g (W/Kg) | 0.328543 |
| SAR 1g (W/Kg)  | 0.478689 |

| <u>Z Axis Scan</u>                                                                |                                                                                     |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| 3D scene shot                                                                     | Hot spot position                                                                   |
|  |  |



### 5.3 DIP 0G750

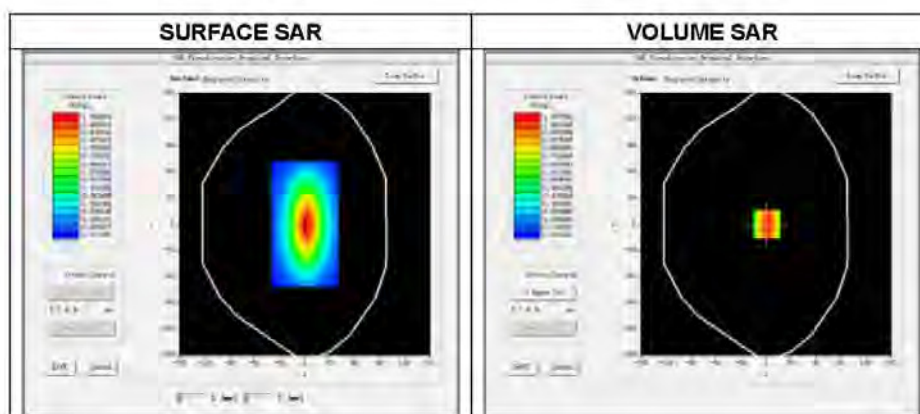
#### 5.3.1 Dipole 750 MHz Validation Measurement for Head Tissue

### System Performance Check Data(750 MHz Head)

Type: Phone measurement (Complete)  
E-Field Probe: SN 34/15 SSE2 EPGO265  
Area scan resolution: dx=8mm,dy=8mm  
Zoom scan resolution: dx=8mm, dy=8mm, dz=5mm  
Date of measurement: 2016.03.01  
Measurement duration: 13 minutes 27 seconds

#### Experimental conditions.

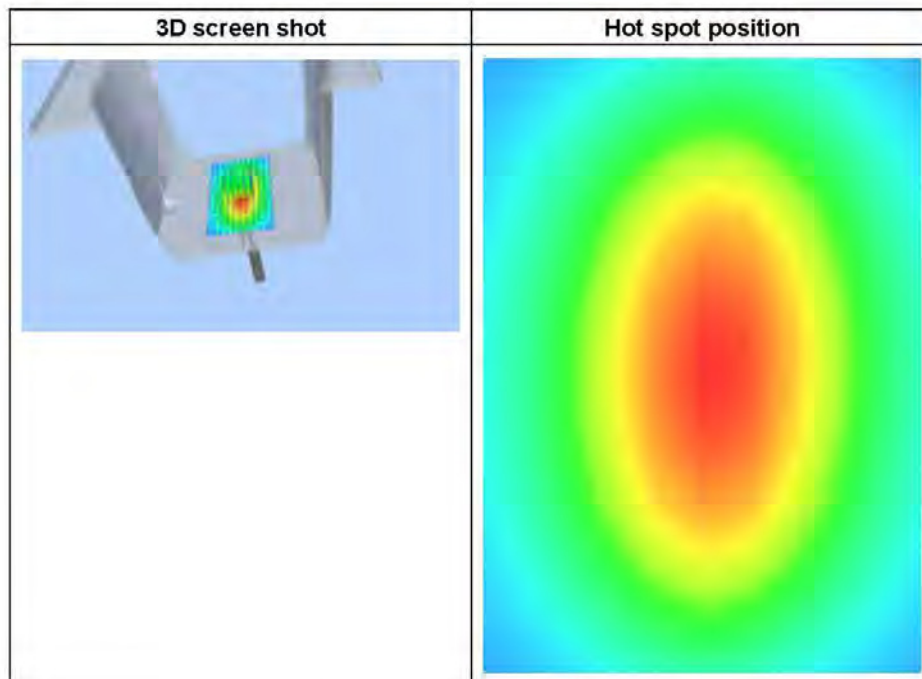
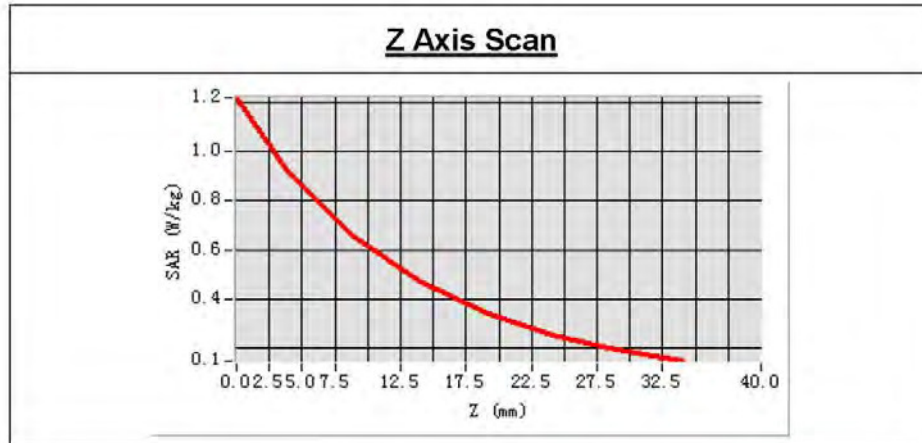
|                                   |                   |
|-----------------------------------|-------------------|
| Phantom File                      | surf_sam_plan.txt |
| Phantom                           | Validation plane  |
| Band                              | 750MHz            |
| Signal                            | CW                |
| Frequency (MHz)                   | 750MHz            |
| Relative permittivity (real part) | 41.923526         |
| Conductivity (S/m)                | 0.883686          |
| Power drift (%)                   | -3.100000         |
| Ambient Temperature:              | 21.6°C            |
| Liquid Temperature:               | 21.1°C            |
| ConvF:                            | 1.81              |
| Crest factor:                     | 1:1               |





Maximum location: X=1.00, Y=0.00  
SAR Peak: 1.28 W/kg

|                |          |
|----------------|----------|
| SAR 10g (W/Kg) | 0.576457 |
| SAR 1g (W/Kg)  | 0.861462 |





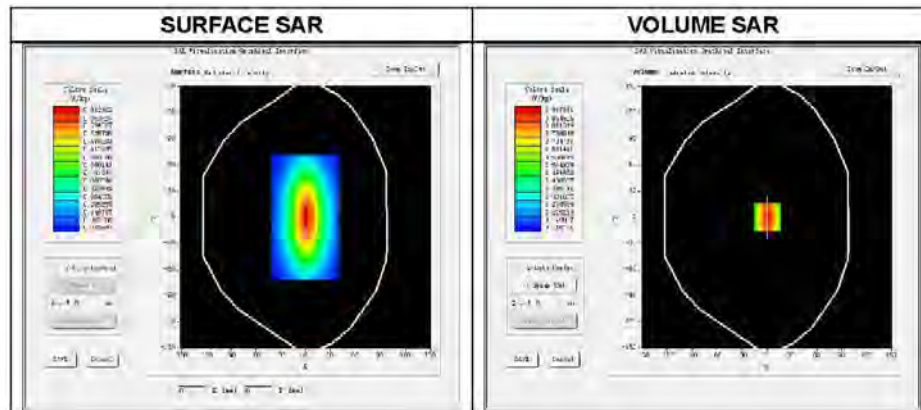
### 5.3.2 Dipole 750 MHz Validation Measurement for Body Tissue

## System Performance Check Data(750 MHz Body)

Type: Phone measurement (Complete)  
 E-Field Probe: SN 34/15 SSE2 EPGO265  
 Area scan resolution: dx=8mm,dy=8mm  
 Zoom scan resolution: dx=8mm, dy=8mm, dz=5mm  
 Date of measurement: 2016.03.01  
 Measurement duration: 13 minutes 27 seconds

### Experimental conditions.

|                                   |                   |
|-----------------------------------|-------------------|
| Phantom File                      | surf_sam_plan.txt |
| Phantom                           | Validation plane  |
| Band                              | 750MHz            |
| Signal                            | CW                |
| Frequency (MHz)                   | 750MHz            |
| Relative permittivity (real part) | 57.188739         |
| Conductivity (S/m)                | 0.946268          |
| Power drift (%)                   | -0.600000         |
| Ambient Temperature:              | 21.6°C            |
| Liquid Temperature:               | 21.1°C            |
| ConvF:                            | 1.88              |
| Crest factor:                     | 1:1               |

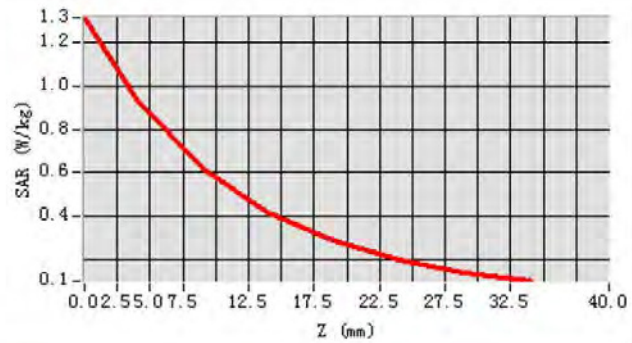




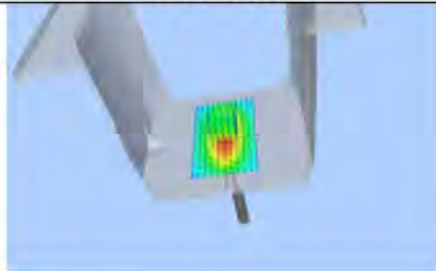
Maximum location: X=1.00, Y=0.00  
SAR Peak: 1.28 W/kg

|                |          |
|----------------|----------|
| SAR 10g (W/Kg) | 0.592395 |
| SAR 1g (W/Kg)  | 0.878736 |

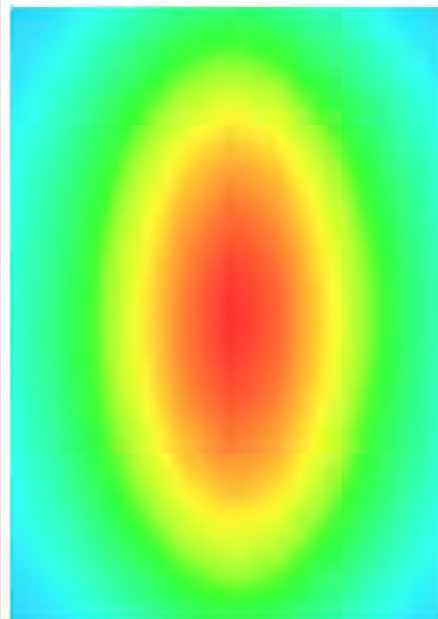
### Z Axis Scan



### 3D screen shot



### Hot spot position







## 5.4 DIP 0G835

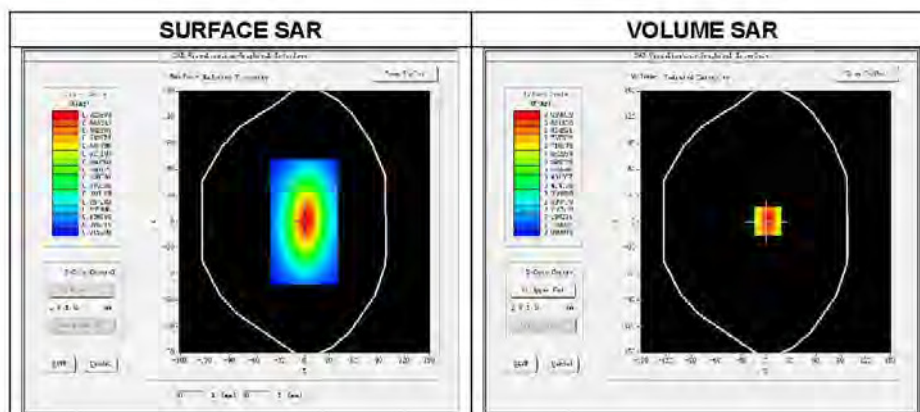
### 5.4.1 Dipole 835 MHz Validation Measurement for Head Tissue

#### System Performance Check Data(835 MHz Head)

Type: Phone measurement (Complete)  
 E-Field Probe: SN 34/15 SSE2 EPGO265  
 Area scan resolution: dx=8 mm,dy=8 mm  
 Zoom scan resolution: dx=8 mm, dy=8 mm, dz=5 mm  
 Date of measurement: 2016.03.01  
 Measurement duration: 14 minutes 2 seconds

#### Experimental conditions.

|                                   |                   |
|-----------------------------------|-------------------|
| Phantom File                      | surf_sam_plan.txt |
| Phantom                           | Validation plane  |
| Band                              | 835 MHz           |
| Signal                            | CW                |
| Frequency (MHz)                   | 835.000000        |
| Relative permittivity (real part) | 43.331142         |
| Conductivity (S/m)                | 0.897827          |
| Power drift (%)                   | -0.050000         |
| Ambient Temperature:              | 21.6°C            |
| Liquid Temperature:               | 21.1°C            |
| ConvF:                            | 2.04              |
| Crest factor:                     | 1.1               |

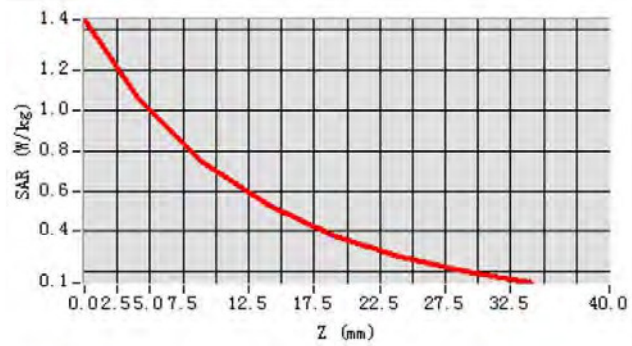




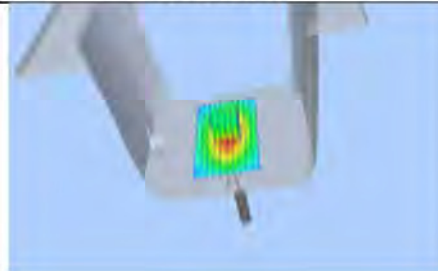
Maximum location: X=0.00, Y=0.00  
SAR Peak: 1.40 W/kg

|                 |          |
|-----------------|----------|
| SAR 10 g (W/Kg) | 0.609437 |
| SAR 1 g (W/Kg)  | 0.983275 |

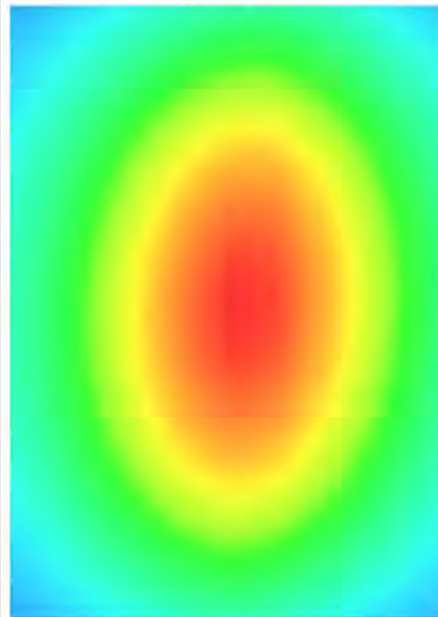
### Z Axis Scan



### 3D screen shot



### Hot spot position





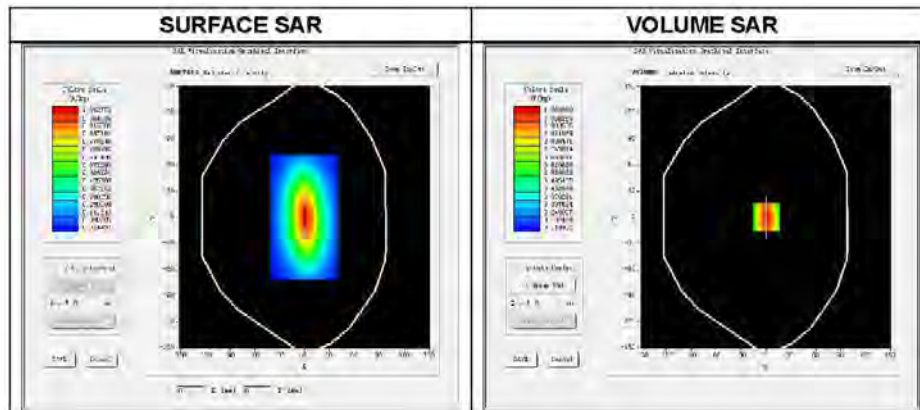
#### 5.4.2 Dipole 835 MHz Validation Measurement for Body Tissue

### System Performance Check Data(835 MHz Body)

Type: Phone measurement (Complete)  
E-Field Probe: SN 34/15 SSE2 EPGO265  
Area scan resolution: dx=8 mm,dy=8 mm  
Zoom scan resolution: dx=8 mm, dy=8 mm, dz=5 mm  
Date of measurement: 2016.03.01  
Measurement duration: 14 minutes 2 seconds

#### Experimental conditions.

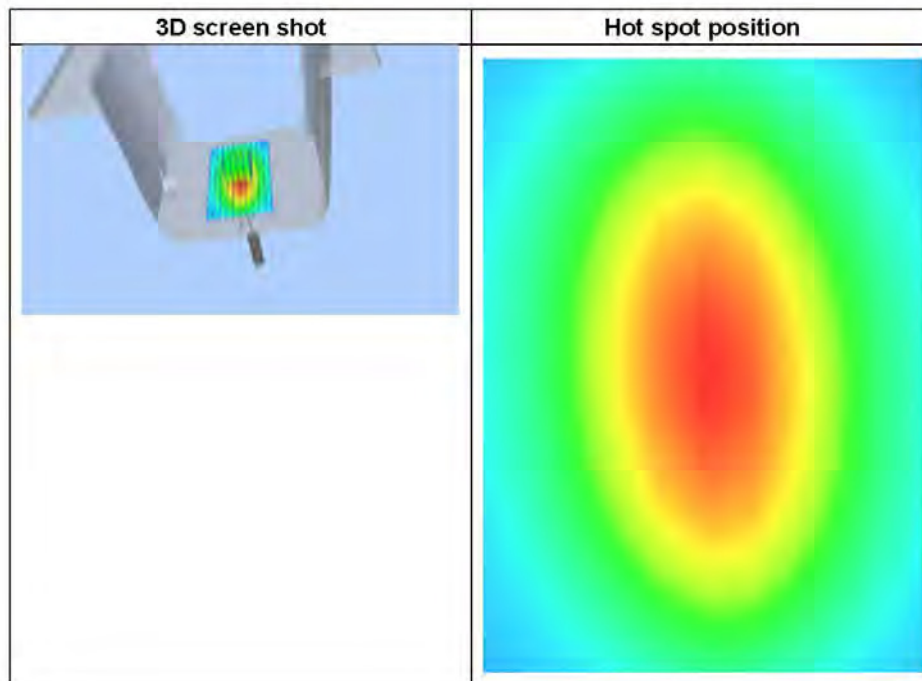
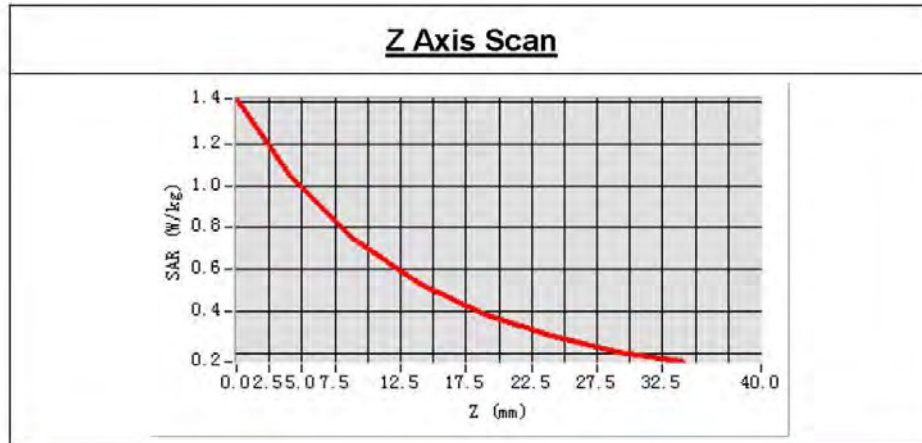
|                                   |                   |
|-----------------------------------|-------------------|
| Phantom File                      | surf_sam_plan.txt |
| Phantom                           | Validation plane  |
| Band                              | 835 MHz           |
| Signal                            | CW                |
| Frequency (MHz)                   | 835.000000        |
| Relative permittivity (real part) | 54.652059         |
| Conductivity (S/m)                | 0.991147          |
| Power drift (%)                   | 0.390000          |
| Ambient Temperature:              | 21.6°C            |
| Liquid Temperature:               | 21.1°C            |
| ConvF:                            | 2.12              |
| Crest factor:                     | 1:1               |





Maximum location: X=0.00, Y=0.00  
SAR Peak: 1.41 W/kg

|                 |          |
|-----------------|----------|
| SAR 10 g (W/Kg) | 0.659168 |
| SAR 1 g (W/Kg)  | 1.013364 |







## 5.5DIP 0G900

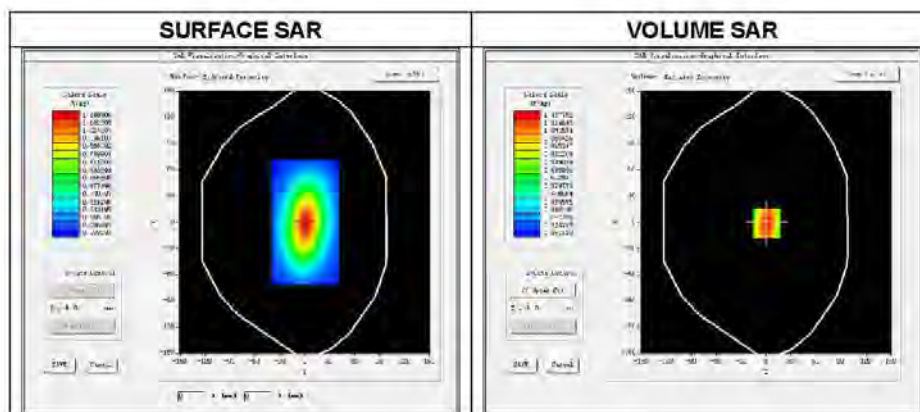
### 5.5.1 Dipole 900 MHz Validation Measurement for Head Tissue

#### System Performance Check Data(900 MHz Head)

Type: Phone measurement (Complete)  
E-Field Probe: SN 34/15 SSE2 EPG0265  
Area scan resolution: dx=8 mm,dy=8 mm  
Zoom scan resolution: dx=8 mm, dy=8 mm, dz=5 mm  
Date of measurement: 2016.03.01  
Measurement duration: 13 minutes 55 seconds

#### Experimental conditions.

|                                   |                   |
|-----------------------------------|-------------------|
| Phantom File                      | surf_sam_plan.txt |
| Phantom                           | Validation plane  |
| Band                              | 900 MHz           |
| Signal                            | CW                |
| Frequency (MHz)                   | 900.000000        |
| Relative permittivity (real part) | 41.140601         |
| Conductivity (S/m)                | 0.994278          |
| Power drift (%)                   | 0.420000          |
| Ambient Temperature:              | 21.6°C            |
| Liquid Temperature:               | 21.1°C            |
| ConvF:                            | 1.86              |
| Crest factor:                     | 1:1               |



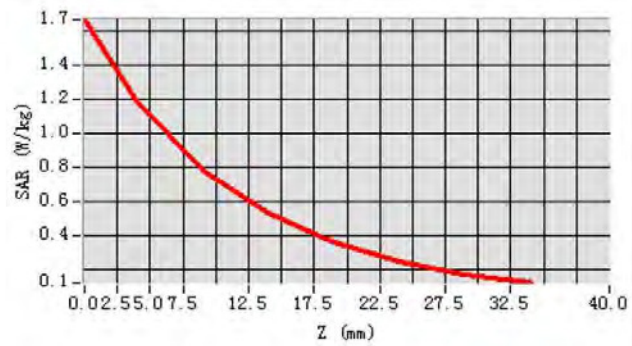




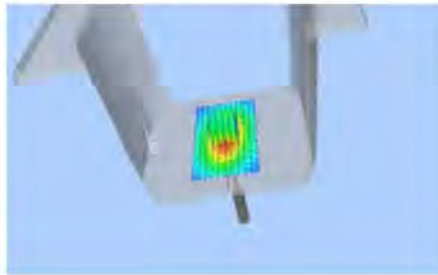
Maximum location: X=0.00, Y=0.00  
SAR Peak: 1.66 W/kg

|                 |          |
|-----------------|----------|
| SAR 10 g (W/Kg) | 0.723554 |
| SAR 1 g (W/Kg)  | 1.147184 |

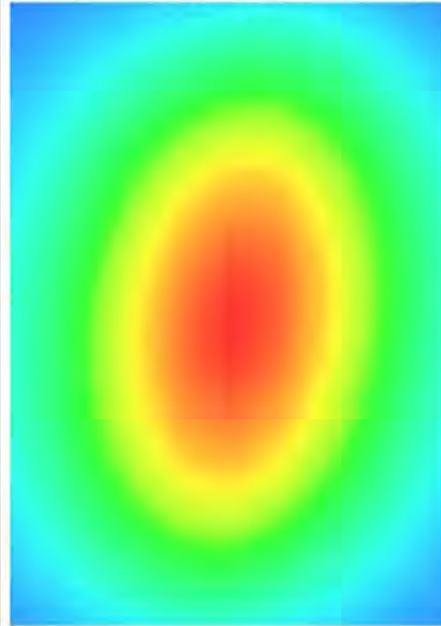
### Z Axis Scan



### 3D screen shot



### Hot spot position





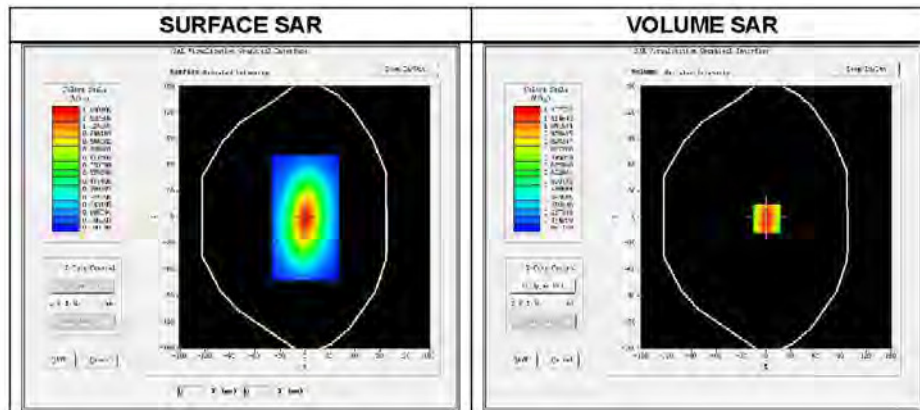
### 5.5.2 Dipole 900 MHz Validation Measurement for Body Tissue

## System Performance Check Data(900 MHz Body)

Type: Phone measurement (Complete)  
E-Field Probe: SN 34/15 SSE2 EPG0265  
Area scan resolution: dx=8 mm,dy=8 mm  
Zoom scan resolution: dx=8 mm, dy=8 mm, dz=5 mm  
Date of measurement: 2016.03.01  
Measurement duration: 13 minutes 55 seconds

### Experimental conditions.

|                                   |                   |
|-----------------------------------|-------------------|
| Phantom File                      | surf_sam_plan.txt |
| Phantom                           | Validation plane  |
| Band                              | 900 MHz           |
| Signal                            | CW                |
| Frequency (MHz)                   | 900.000000        |
| Relative permittivity (real part) | 54.932917         |
| Conductivity (S/m)                | 1.062623          |
| Power drift (%)                   | -0.290000         |
| Ambient Temperature:              | 21.6°C            |
| Liquid Temperature:               | 21.1°C            |
| ConvF:                            | 1.92              |
| Crest factor:                     | 1:1               |



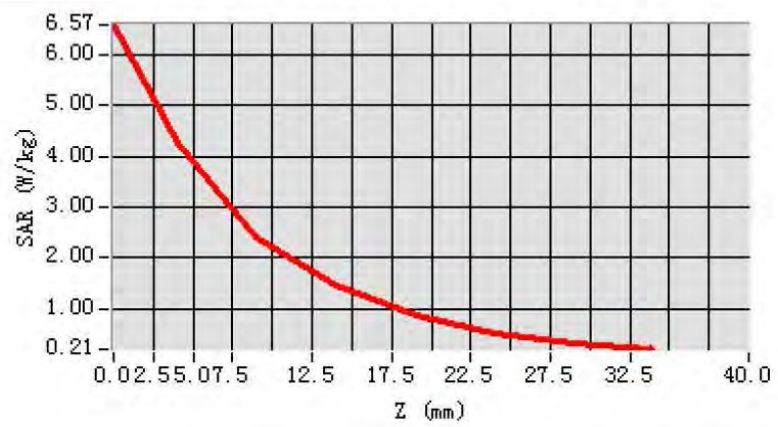


Maximum location: X=0.00, Y=0.00

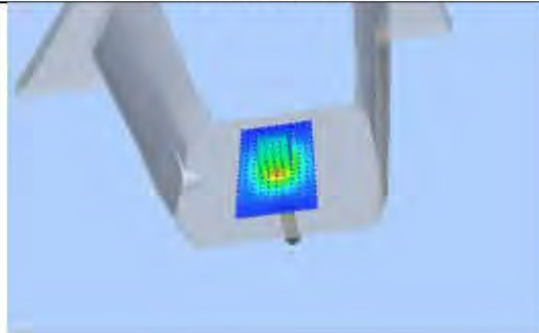
SAR Peak: 6.52 W/kg

|                 |          |
|-----------------|----------|
| SAR 10 g (W/Kg) | 1.989471 |
| SAR 1g (W/Kg)   | 3.911256 |

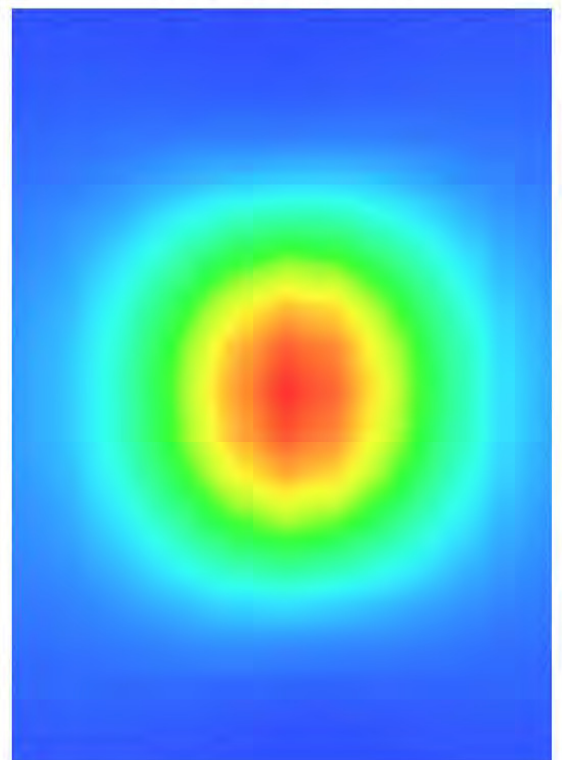
### Z Axis Scan



### 3D screen shot



### Hot spot position





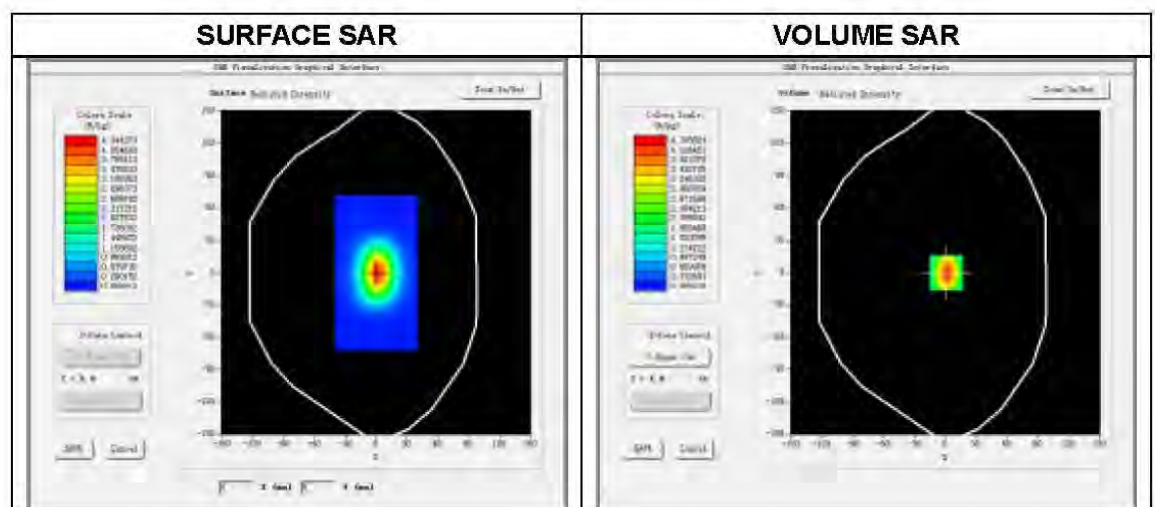
## 5.6.2 Dipole 1800 MHz Validation Measurement for Body Tissue

### System Performance Check Data(1800 MHz Body)

Type: Phone measurement (Complete)  
E-Field Probe: SN 34/15 SSE2 EPG0265  
Area scan resolution: dx=8mm,dy=8mm  
Zoom scan resolution: dx=8mm, dy=8mm, dz=5mm  
Date of measurement: 2016.03.02  
Measurement duration: 13 minutes 27 seconds

#### Experimental conditions.

|                                   |                   |
|-----------------------------------|-------------------|
| Phantom File                      | surf_sam_plan.txt |
| Phantom                           | Validation plane  |
| Band                              | 1800MHz           |
| Signal                            | CW                |
| Frequency (MHz)                   | 1800.000000       |
| Relative permittivity (real part) | 54.685214         |
| Conductivity (S/m)                | 1.508863          |
| Power drift (%)                   | 1.160000          |
| Ambient Temperature:              | 21.6°C            |
| Liquid Temperature:               | 21.1°C            |
| ConvF:                            | 2.08              |
| Crest factor:                     | 1.1               |





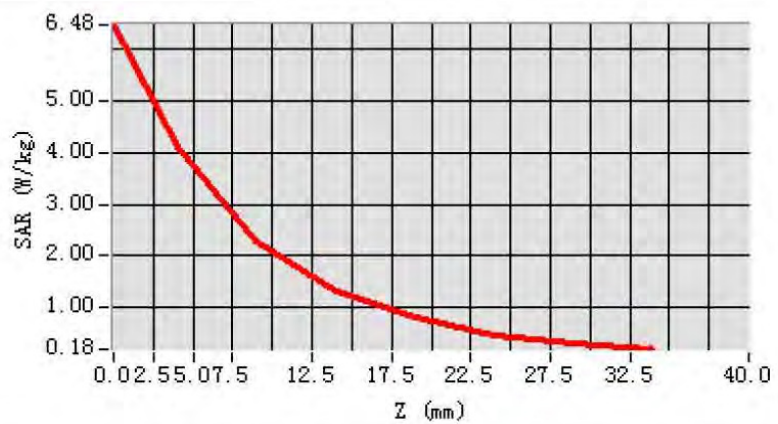


Maximum location: X=0.00, Y=0.00

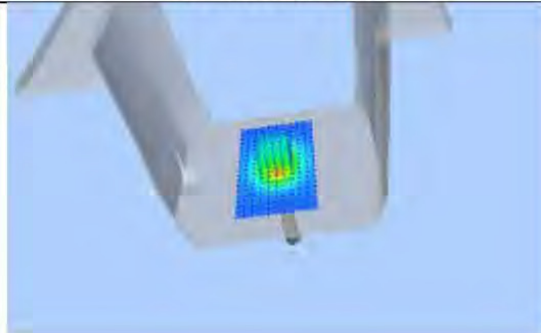
SAR Peak: 6.47 W/kg

|                 |          |
|-----------------|----------|
| SAR 10 g (W/Kg) | 1.964125 |
| SAR 1g (W/Kg)   | 3.892053 |

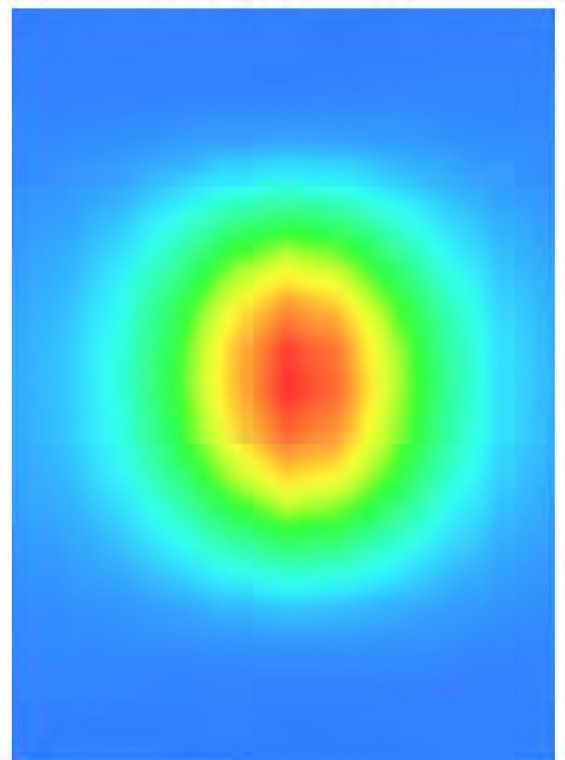
### Z Axis Scan



### 3D screen shot



### Hot spot position







## 5.6 DIP 1G800

### 5.6.1 Dipole 1800 MHz Validation Measurement for Head Tissue

## System Performance Check Data(1800 MHz Head)

Type: Phone measurement (Complete)

E-Field Probe: SN 34/15 SSE2 EPG0265

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

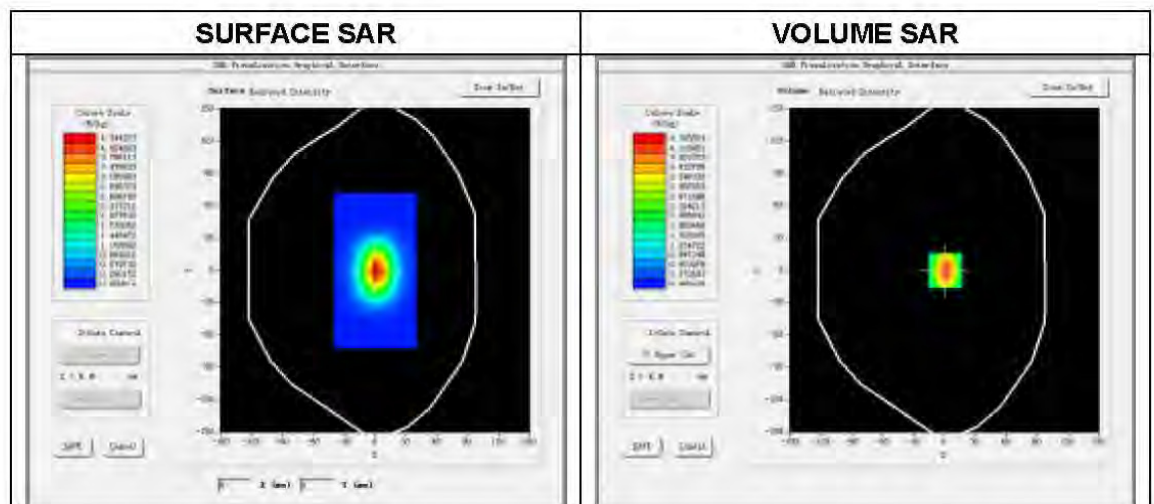
Zoom scan resolution: dx=8mm, dy=8mm, dz=5mm

Date of measurement: 2016.03.02

Measurement duration: 13 minutes 27 seconds

### Experimental conditions.

|                                   |                   |
|-----------------------------------|-------------------|
| Phantom File                      | surf_sam_plan.txt |
| Phantom                           | Validation plane  |
| Band                              | 1800MHz           |
| Signal                            | CW                |
| Frequency (MHz)                   | 1800.000000       |
| Relative permittivity (real part) | 39.562781         |
| Conductivity (S/m)                | 1.413274          |
| Power drift (%)                   | 1.160000          |
| Ambient Temperature:              | 21.6°C            |
| Liquid Temperature:               | 21.1°C            |
| ConvF:                            | 2.04              |
| Crest factor:                     | 1.1               |

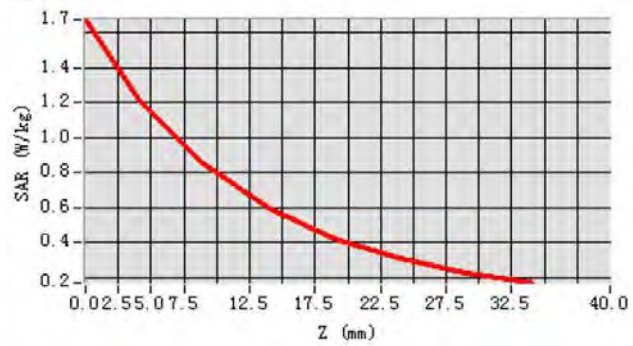




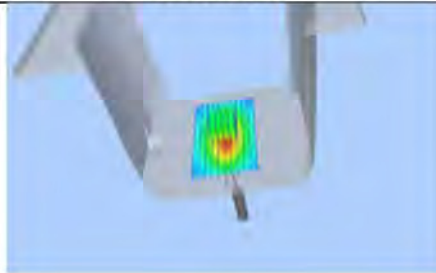
Maximum location: X=0.00, Y=0.00  
SAR Peak: 1.67 W/kg

|                 |          |
|-----------------|----------|
| SAR 10 g (W/Kg) | 0.746807 |
| SAR 1 g (W/Kg)  | 1.139340 |

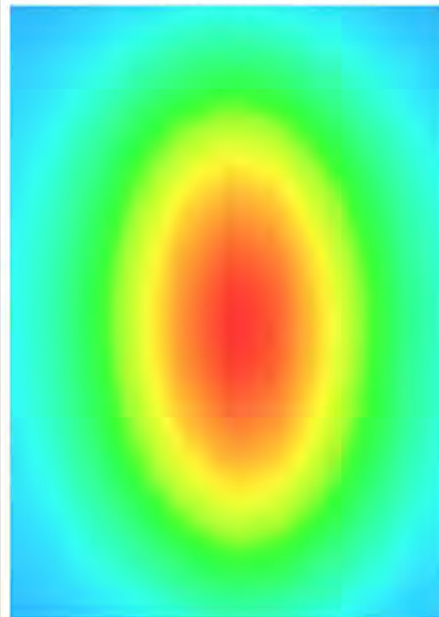
### Z Axis Scan



### 3D screen shot



### Hot spot position





## 5.7 DIP 1G900

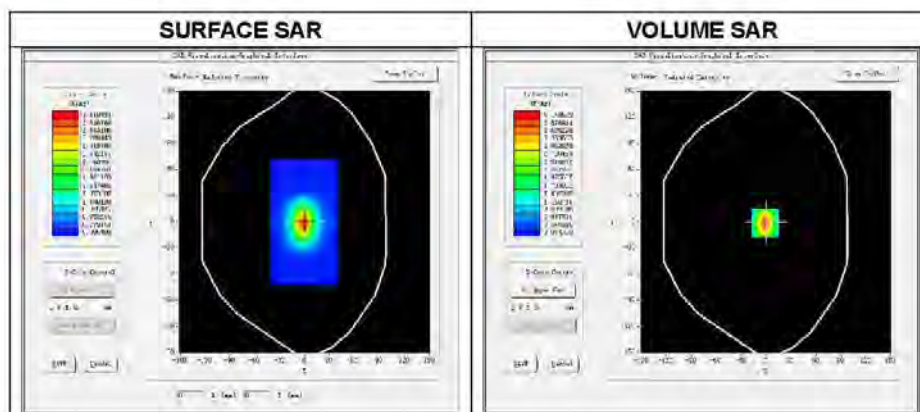
### 5.7.1 Dipole 1900 MHz Validation Measurement for Head Tissue

#### System Performance Check Data(1900 MHz Head)

Type: Phone measurement (Complete)  
E-Field Probe: SN 34/15 SSE2 EPGO265  
Area scan resolution: dx=8mm,dy=8mm  
Zoom scan resolution: dx=8mm, dy=8mm, dz=5mm  
Date of measurement: 2016.03.02  
Measurement duration: 13 minutes 20 seconds

#### Experimental conditions.

|                                   |                   |
|-----------------------------------|-------------------|
| Phantom File                      | surf_sam_plan.txt |
| Phantom                           | Validation plane  |
| Band                              | 1900MHz           |
| Signal                            | CW                |
| Frequency (MHz)                   | 1900.000000       |
| Relative permittivity (real part) | 39.402471         |
| Conductivity (S/m)                | 1.425793          |
| Power drift (%)                   | 1.260000          |
| Ambient Temperature:              | 21.8°C            |
| Liquid Temperature:               | 21.2°C            |
| ConvF:                            | 2.35              |
| Crest factor:                     | 1.1               |

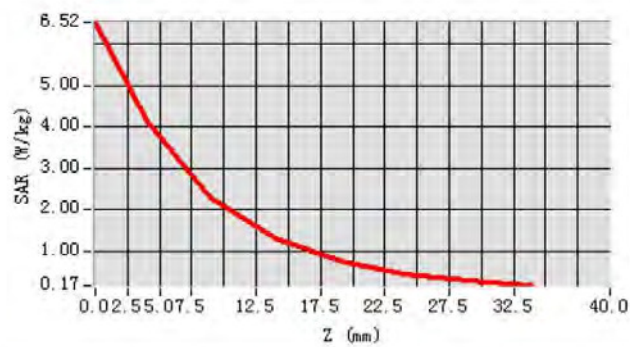




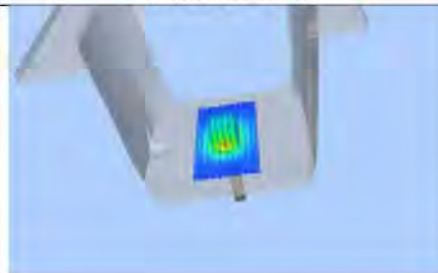
Maximum location: X=0.00, Y=0.00  
SAR Peak: 6.46W/kg

|                |          |
|----------------|----------|
| SAR 10g (W/Kg) | 1.967525 |
| SAR 1g (W/Kg)  | 3.890170 |

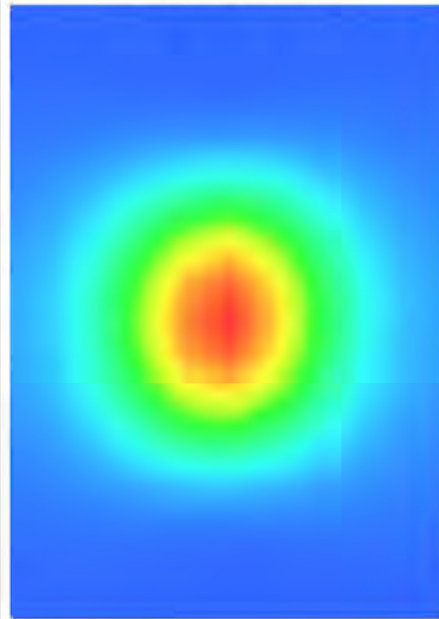
### Z Axis Scan



### 3D screen shot



### Hot spot position







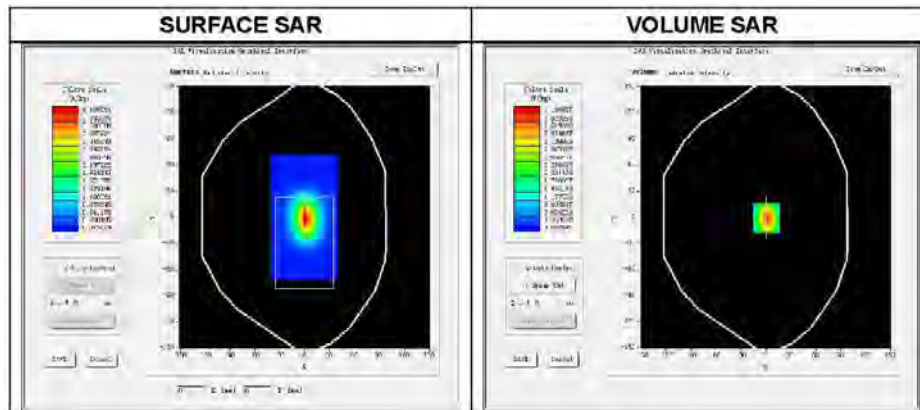
### 5.7.2 Dipole 1900 MHz Validation Measurement for Body Tissue

## System Performance Check Data(1900 MHz Body)

Type: Phone measurement (Complete)  
E-Field Probe: SN 34/15 SSE2 EPGO265  
Area scan resolution: dx=8mm,dy=8mm  
Zoom scan resolution: dx=8mm, dy=8mm, dz=5mm  
Date of measurement: 2016.03.02  
Measurement duration: 13 minutes 20 seconds

### Experimental conditions.

|                                   |                   |
|-----------------------------------|-------------------|
| Phantom File                      | surf_sam_plan.txt |
| Phantom                           | Validation plane  |
| Band                              | 1900 MHz          |
| Signal                            | CW                |
| Frequency (MHz)                   | 1900.000000       |
| Relative permittivity (real part) | 53.158287         |
| Conductivity (S/m)                | 1.534258          |
| Power drift (%)                   | 0.180000          |
| Ambient Temperature:              | 21.8°C            |
| Liquid Temperature:               | 21.2°C            |
| ConvF:                            | 2.42              |
| Crest factor:                     | 1:1               |





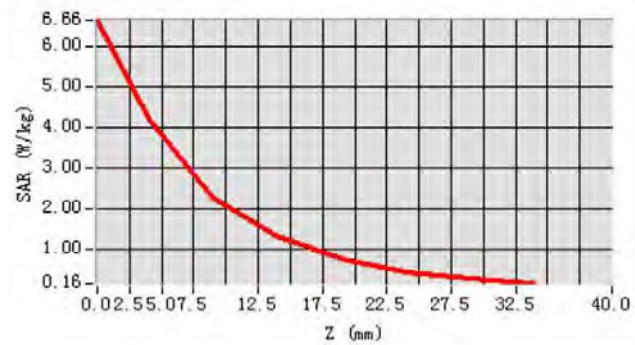


Maximum location: X=0.00, Y=0.00

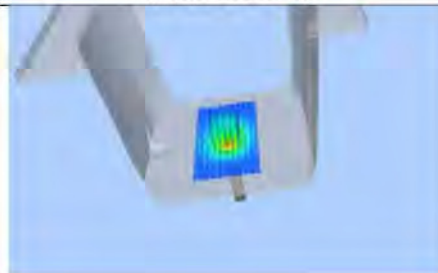
SAR Peak: 6.64W/kg

|                |          |
|----------------|----------|
| SAR 10g (W/Kg) | 2.001651 |
| SAR 1g (W/Kg)  | 3.943225 |

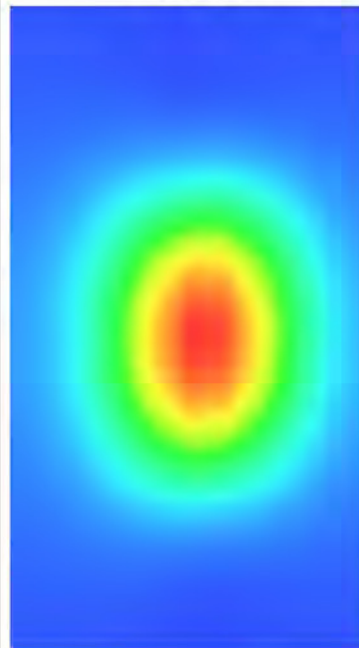
### Z Axis Scan



### 3D screen shot



### Hot spot position





## 5.8 DIP 2G000

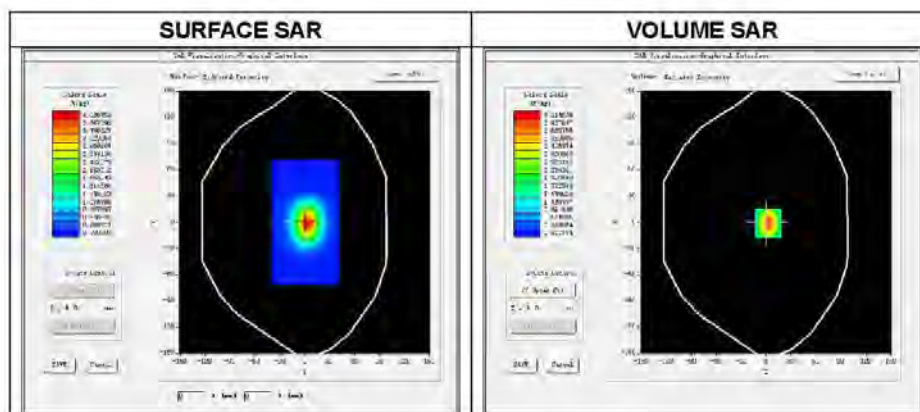
### 5.8.1 Dipole 2000 MHz Validation Measurement for Head Tissue

#### System Performance Check Data(2000 MHz Head)

Type: Phone measurement (Complete)  
E-Field Probe: SN 34/15 SSE2 EPG0265  
Area scan resolution: dx=8 mm,dy=8 mm  
Zoom scan resolution: dx=8 mm, dy=8 mm, dz=5 mm  
Date of measurement: 2016.03.02  
Measurement duration: 14 minutes 17 seconds

#### Experimental conditions.

|                                   |                   |
|-----------------------------------|-------------------|
| Phantom File                      | surf_sam_plan.txt |
| Phantom                           | Validation plane  |
| Band                              | 2000 MHz          |
| Signal                            | CW                |
| Frequency (MHz)                   | 2000.000000       |
| Relative permittivity (real part) | 38.957269         |
| Conductivity (S/m)                | 1.426154          |
| Power drift (%)                   | 1.20000           |
| Ambient Temperature:              | 21.8°C            |
| Liquid Temperature:               | 21.2°C            |
| ConvF:                            | 2.23              |
| Crest factor:                     | 1.1               |

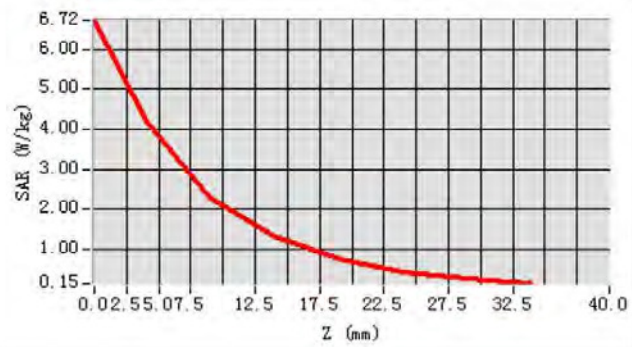




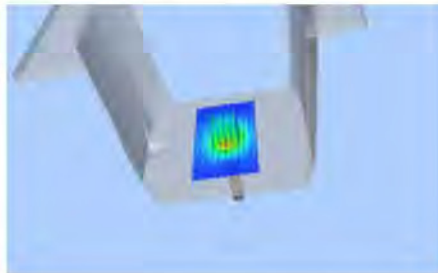
Maximum location: X=0.00, Y=0.00  
SAR Peak: 6.69 W/kg

|                 |          |
|-----------------|----------|
| SAR 10 g (W/Kg) | 2.094211 |
| SAR 1 g (W/Kg)  | 4.029382 |

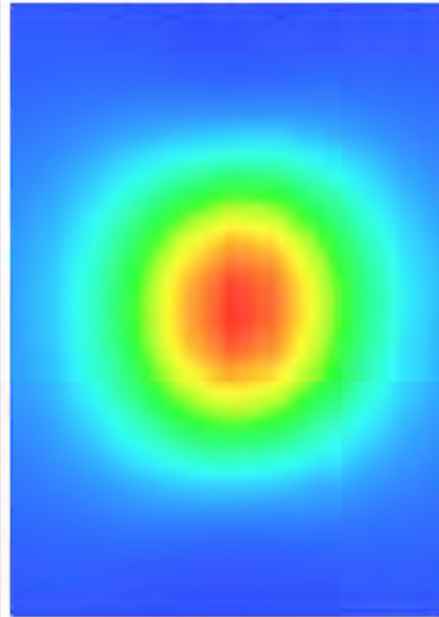
### Z Axis Scan



### 3D screen shot



### Hot spot position





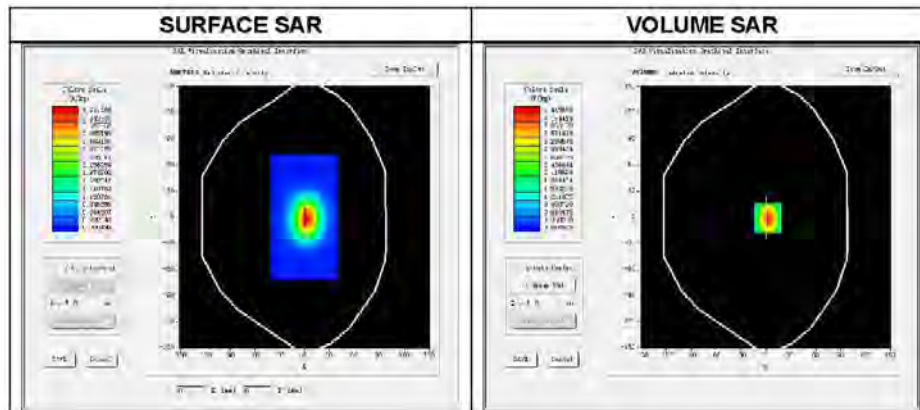
### 5.8.2 Dipole 2000 MHz Validation Measurement for Body Tissue

## System Performance Check Data(2000 MHz Body)

Type: Phone measurement (Complete)  
 E-Field Probe: SN 34/15 SSE2 EPGO265  
 Area scan resolution: dx=8 mm,dy=8 mm  
 Zoom scan resolution: dx=8 mm, dy=8 mm, dz=5 mm  
 Date of measurement: 2016.03.02  
 Measurement duration: 14 minutes 17 seconds

### Experimental conditions.

|                                   |                   |
|-----------------------------------|-------------------|
| Phantom File                      | surf_sam_plan.txt |
| Phantom                           | Validation plane  |
| Band                              | 2000 MHz          |
| Signal                            | CW                |
| Frequency (MHz)                   | 2000.000000       |
| Relative permittivity (real part) | 51.526653         |
| Conductivity (S/m)                | 1.551869          |
| Power drift (%)                   | 0.380000          |
| Ambient Temperature:              | 21.8°C            |
| Liquid Temperature:               | 21.2°C            |
| ConvF:                            | 2.32              |
| Crest factor:                     | 1:1               |



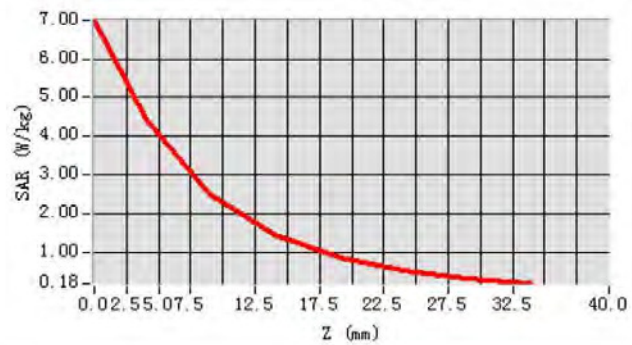




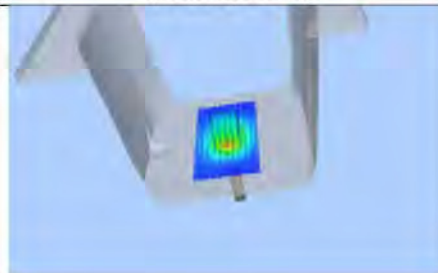
Maximum location: X=0.00, Y=0.00  
SAR Peak: 6.97 W/kg

|                 |          |
|-----------------|----------|
| SAR 10 g (W/Kg) | 2.185249 |
| SAR 1 g (W/Kg)  | 4.196616 |

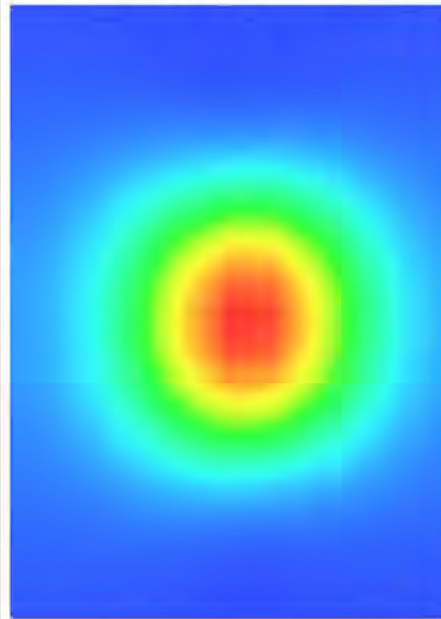
### Z Axis Scan



### 3D screen shot



### Hot spot position





## 5.9 DIP 2G450

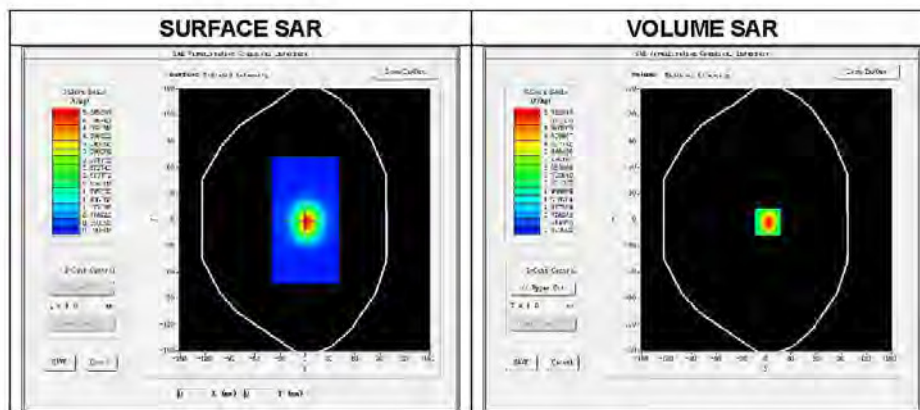
### 5.9.1 Dipole 2450 MHz Validation Measurement for Head Tissue

#### System Performance Check Data(2450 MHz Head)

Type: Phone measurement (Complete)  
 E-Field Probe: SN 34/15 SSE2 EPGO265  
 Area scan resolution: dx=8mm,dy=8mm  
 Zoom scan resolution: dx=5mm, dy=5mm, dz=5mm  
 Date of measurement: 2016.03.02  
 Measurement duration: 18 minutes 47 seconds

#### Experimental conditions.

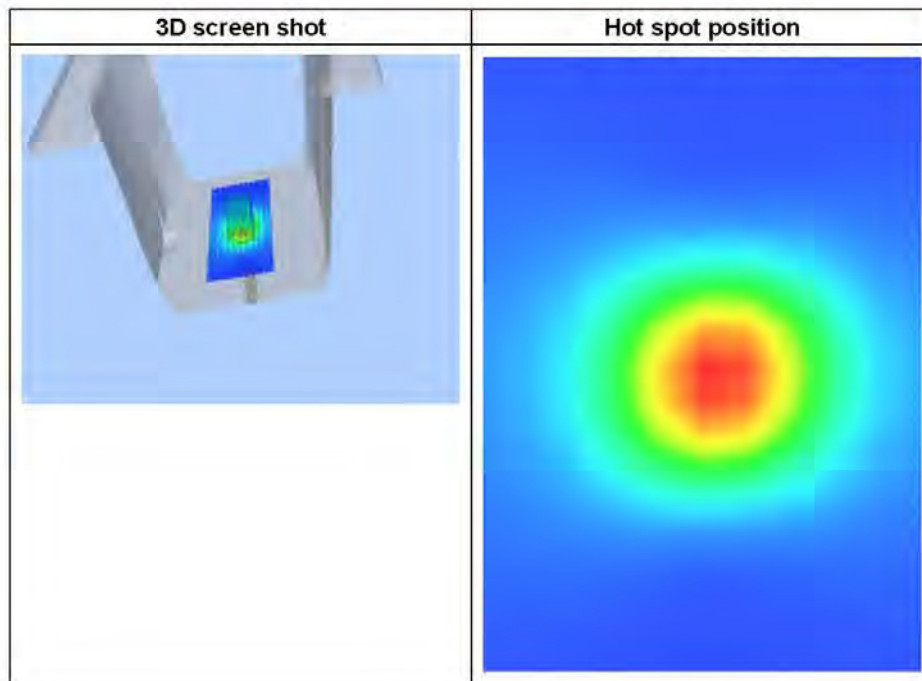
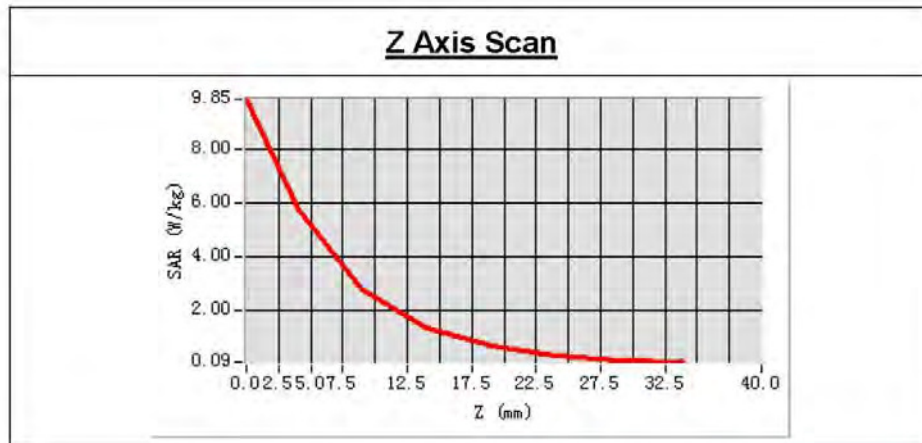
|                                   |                   |
|-----------------------------------|-------------------|
| Phantom File                      | surf_sam_plan.txt |
| Phantom                           | Validation plane  |
| Band                              | 2450MHz           |
| Signal                            | CW                |
| Frequency (MHz)                   | 2450.000000       |
| Relative permittivity (real part) | 38.916950         |
| Conductivity (S/m)                | 1.816079          |
| Power drift (%)                   | 2.570000          |
| Ambient Temperature:              | 21.8°C            |
| Liquid Temperature:               | 21.2°C            |
| ConvF:                            | 2.47              |
| Crest factor:                     | 1.1               |





Maximum location: X=0.00, Y=0.00  
SAR Peak: 9.52 W/kg

|                |          |
|----------------|----------|
| SAR 10g (W/Kg) | 2.483244 |
| SAR 1g (W/Kg)  | 5.328480 |





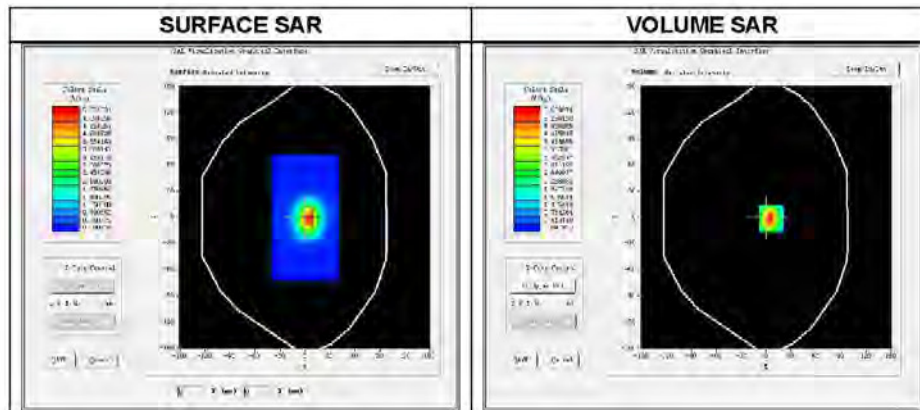
### 5.9.2 Dipole 2450 MHz Validation Measurement for Body Tissue

## System Performance Check Data(2450 MHz Body)

Type: Phone measurement (Complete)  
E-Field Probe: SN 34/15 SSE2 EPG0265  
Area scan resolution: dx=8 mm,dy=8 mm  
Zoom scan resolution: dx=5 mm, dy=5 mm, dz=5 mm  
Date of measurement: 2016.03.02  
Measurement duration: 19 minutes 58 seconds

### Experimental conditions.

|                                   |                   |
|-----------------------------------|-------------------|
| Phantom File                      | surf_sam_plan.txt |
| Phantom                           | Validation plane  |
| Band                              | 2450 MHz          |
| Signal                            | CW                |
| Frequency (MHz)                   | 2450.000000       |
| Relative permittivity (real part) | 52.962515         |
| Conductivity (S/m)                | 1.960472          |
| Power drift (%)                   | -0.560000         |
| Ambient Temperature:              | 21.8°C            |
| Liquid Temperature:               | 21.2°C            |
| ConvF:                            | 2.55              |
| Crest factor:                     | 1:1               |

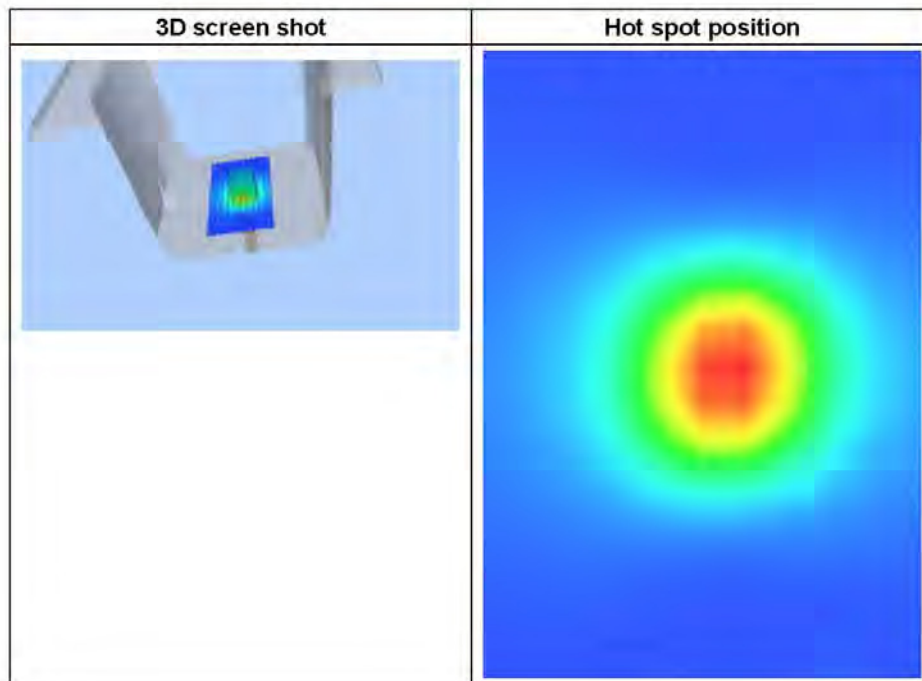
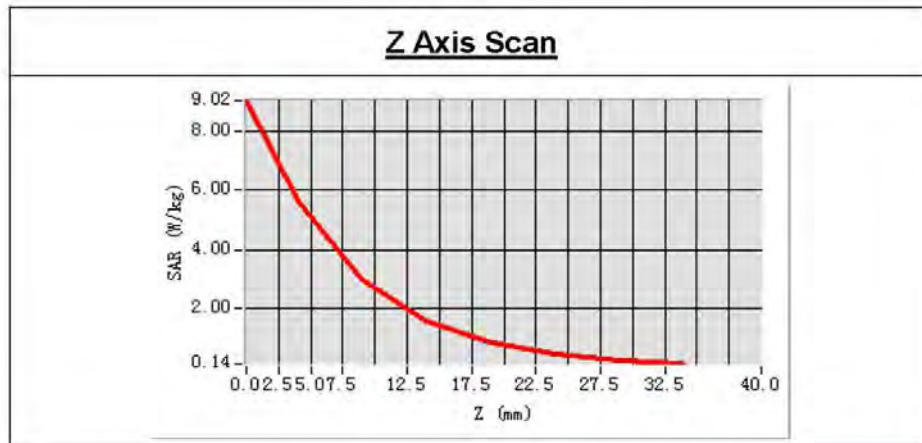






Maximum location: X=0.00, Y=0.00  
SAR Peak: 9.02 W/kg

|                 |          |
|-----------------|----------|
| SAR 10 g (W/Kg) | 2.450144 |
| SAR 1 g (W/Kg)  | 5.094052 |





## 5.10DIP 2G600

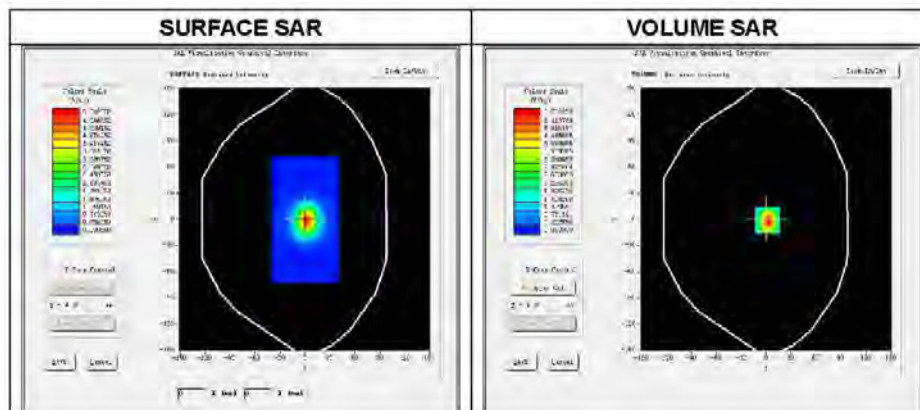
### 5.10.1 Dipole 2600 MHz Validation Measurement for Head Tissue

#### System Performance Check Data(2600 MHz Head)

Type: Phone measurement (Complete)  
E-Field Probe: SN 34/15 SSE2 EPGO265  
Area scan resolution: dx=8 mm,dy=8 mm  
Zoom scan resolution: dx=5 mm, dy=5 mm, dz=5 mm  
Date of measurement: 2016.03.03  
Measurement duration: 19 minutes 3 seconds

#### Experimental conditions.

|                                   |                   |
|-----------------------------------|-------------------|
| Phantom File                      | surf_sam_plan.txt |
| Phantom                           | Validation plane  |
| Band                              | 2600 MHz          |
| Signal                            | CW                |
| Frequency (MHz)                   | 2600.000000       |
| Relative permittivity (real part) | 38.097251         |
| Conductivity (S/m)                | 1.978736          |
| Power drift (%)                   | -0.050000         |
| Ambient Temperature:              | 21.8°C            |
| Liquid Temperature:               | 21.2°C            |
| ConvF:                            | 2.36              |
| Crest factor:                     | 1:1               |



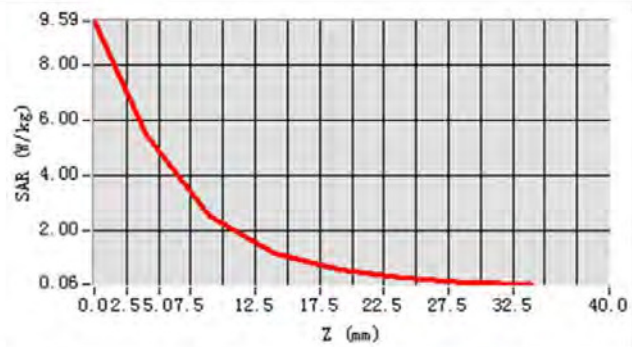


Maximum location: X=0.00, Y=0.00

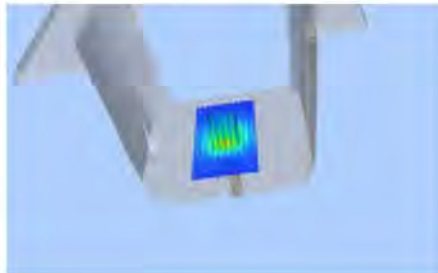
SAR Peak: 9.58 W/kg

|                 |          |
|-----------------|----------|
| SAR 10 g (W/Kg) | 2.514654 |
| SAR 1 g (W/Kg)  | 5.322832 |

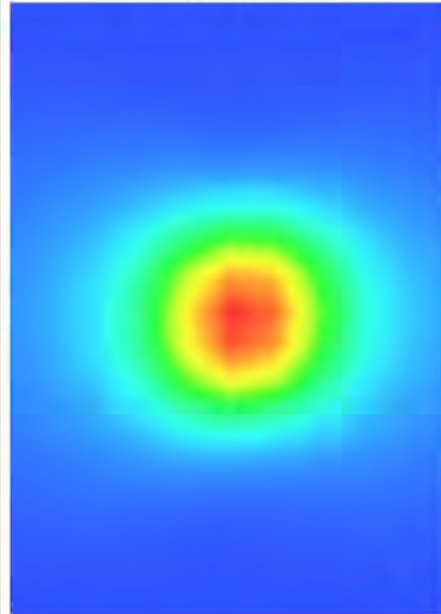
### Z Axis Scan



### 3D screen shot



### Hot spot position





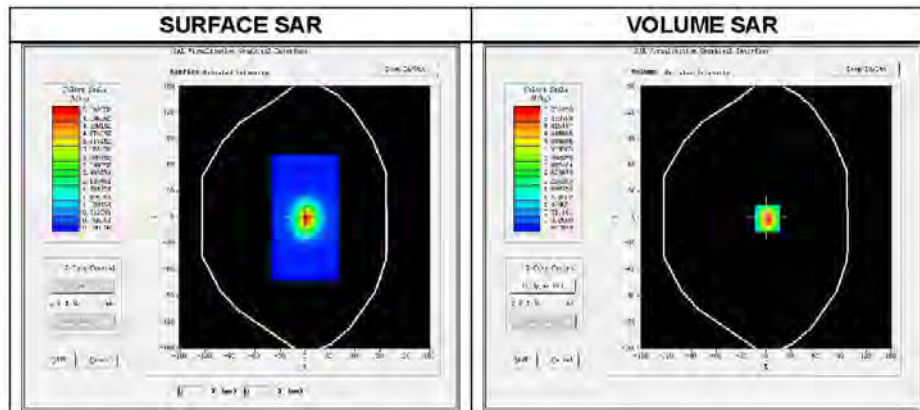
### 5.10.2 Dipole 2600 MHz Validation Measurement for Body Tissue

## System Performance Check Data(2600 MHz Body)

Type: Phone measurement (Complete)  
E-Field Probe: SN 34/15 SSE2 EPGO265  
Area scan resolution: dx=8 mm,dy=8 mm  
Zoom scan resolution: dx=5 mm, dy=5 mm, dz=5 mm  
Date of measurement: 2016.03.03  
Measurement duration: 19 minutes 1 seconds

### Experimental conditions.

|                                   |                   |
|-----------------------------------|-------------------|
| Phantom File                      | surf_sam_plan.txt |
| Phantom                           | Validation plane  |
| Band                              | 2600 MHz          |
| Signal                            | CW                |
| Frequency (MHz)                   | 2600.000000       |
| Relative permittivity (real part) | 53.509271         |
| Conductivity (S/m)                | 2.150646          |
| Power drift (%)                   | 0.180000          |
| Ambient Temperature:              | 21.8°C            |
| Liquid Temperature:               | 21.2°C            |
| ConvF:                            | 2.43              |
| Crest factor:                     | 1:1               |

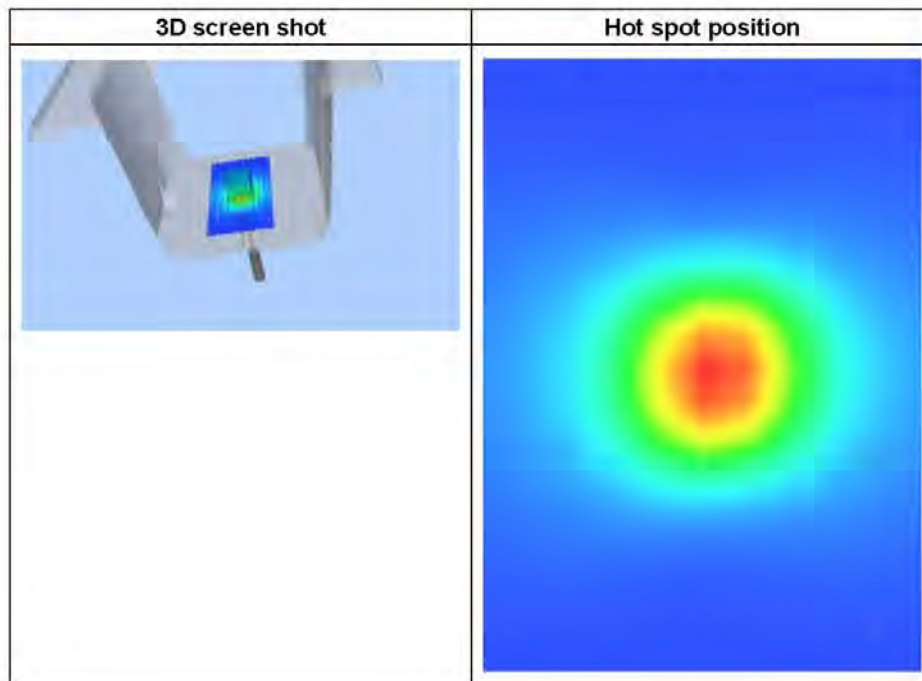
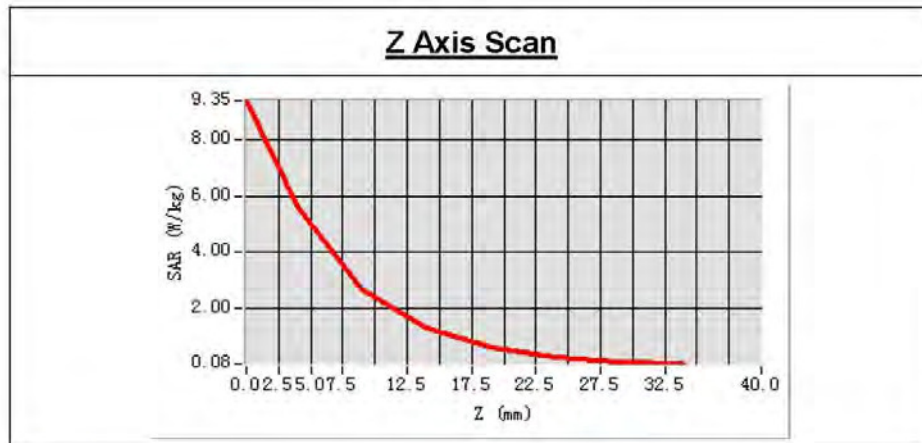






Maximum location: X=0.00, Y=0.00  
SAR Peak: 9.36 W/kg

|                 |          |
|-----------------|----------|
| SAR 10 g (W/Kg) | 2.376986 |
| SAR 1 g (W/Kg)  | 5.174332 |





## 5.11 SWG5500

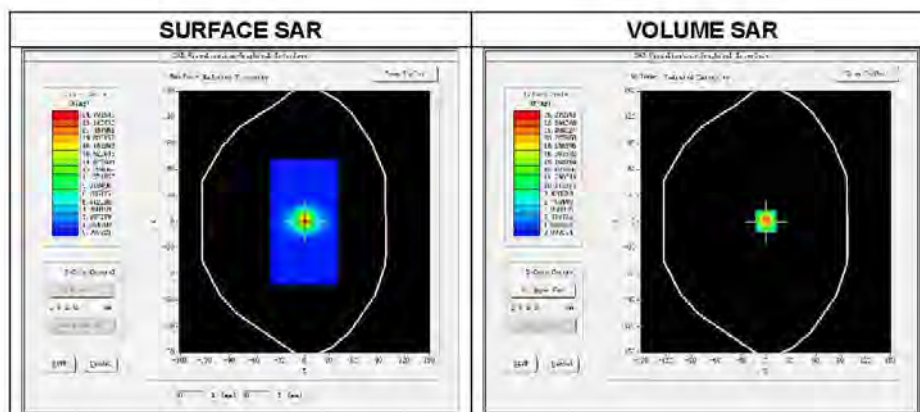
### 5.11.1 Waveguide 5 GHz Validation Measurement for Head Tissue

#### System Performance Check Data(5200 MHz Head)

Type: Phone measurement (Complete)  
E-Field Probe: SN 34/15 SSE2 EPGO265  
Area scan resolution: dx=8mm,dy=8mm  
Zoom scan resolution: dx=4mm, dy=4mm, dz=2mm  
Date of measurement: 2016.03.03  
Measurement duration: 29 minutes 32 seconds

#### Experimental conditions.

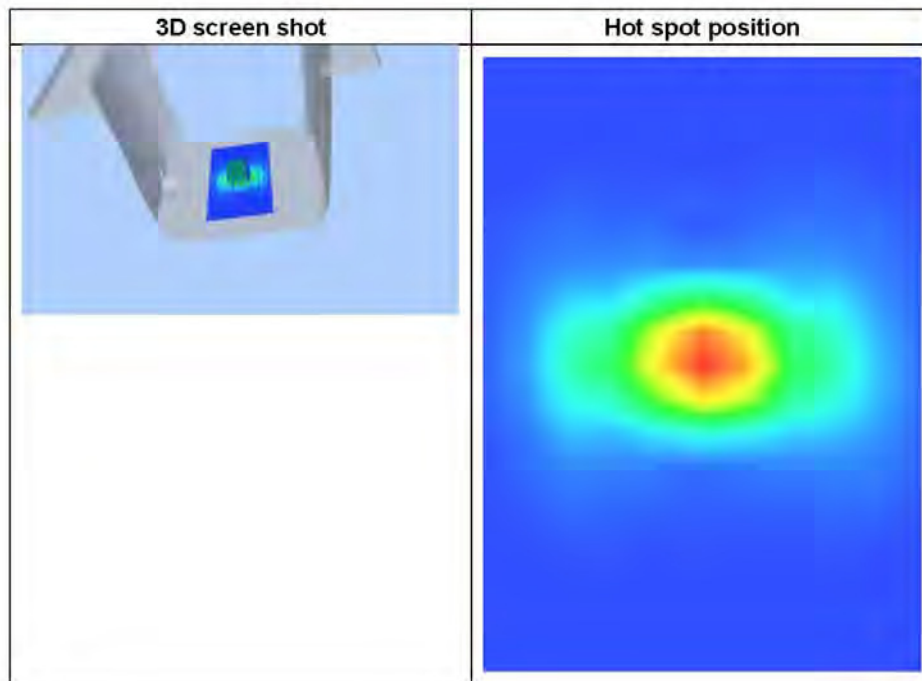
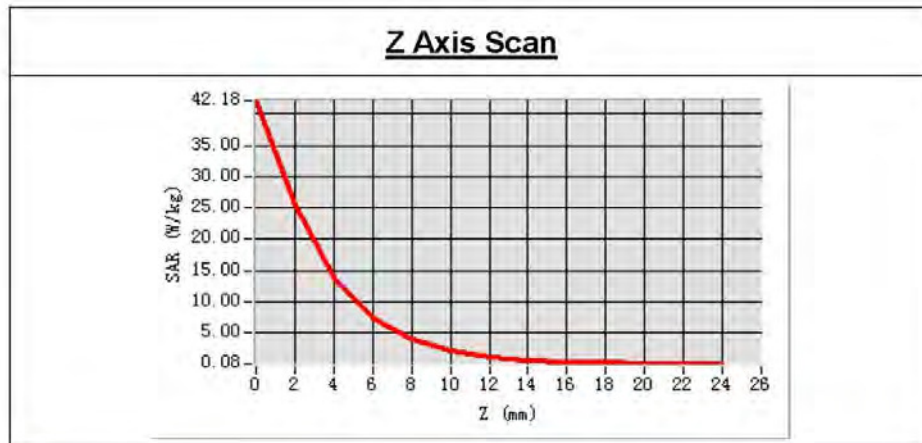
|                                   |                   |
|-----------------------------------|-------------------|
| Phantom File                      | surf_sam_plan.txt |
| Phantom                           | Validation plane  |
| Band                              | 5200 MHz          |
| Signal                            | CW                |
| Frequency (MHz)                   | 5200.000000       |
| Relative permittivity (real part) | 36.867518         |
| Conductivity (S/m)                | 4.644428          |
| Power drift (%)                   | 1.570000          |
| Ambient Temperature:              | 21.5°C            |
| Liquid Temperature:               | 21.0°C            |
| ConvF:                            | 1.81              |
| Crest factor:                     | 1:1               |





Maximum location: X=3.00, Y=1.00  
SAR Peak: 42.15 W/kg

|                |           |
|----------------|-----------|
| SAR 10g (W/Kg) | 5.4633244 |
| SAR 1g (W/Kg)  | 15.378286 |



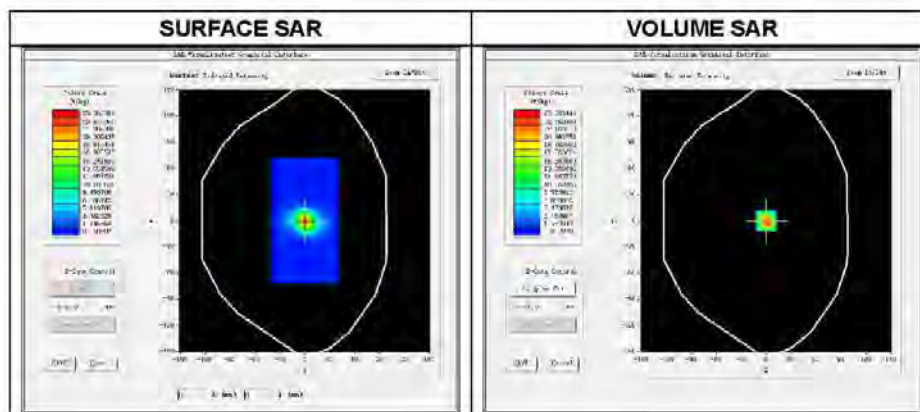


## System Performance Check Data(5400 MHz Head)

Type: Phone measurement (Complete)  
E-Field Probe: SN 34/15 SSE2 EPGO265  
Area scan resolution: dx=8mm,dy=8mm  
Zoom scan resolution: dx=4mm, dy=4mm, dz=2mm  
Date of measurement: 2016.03.03  
Measurement duration: 29 minutes 33 seconds

### Experimental conditions.

|                                   |                   |
|-----------------------------------|-------------------|
| Phantom File                      | surf_sam_plan.txt |
| Phantom                           | Validation plane  |
| Band                              | 5400 MHz          |
| Signal                            | CW                |
| Frequency (MHz)                   | 5400.000000       |
| Relative permittivity (real part) | 36.426257         |
| Conductivity (S/m)                | 4.831236          |
| Power drift (%)                   | 1.120000          |
| Ambient Temperature:              | 21.5°C            |
| Liquid Temperature:               | 21.0°C            |
| ConvF:                            | 2.04              |
| Crest factor:                     | 1:1               |

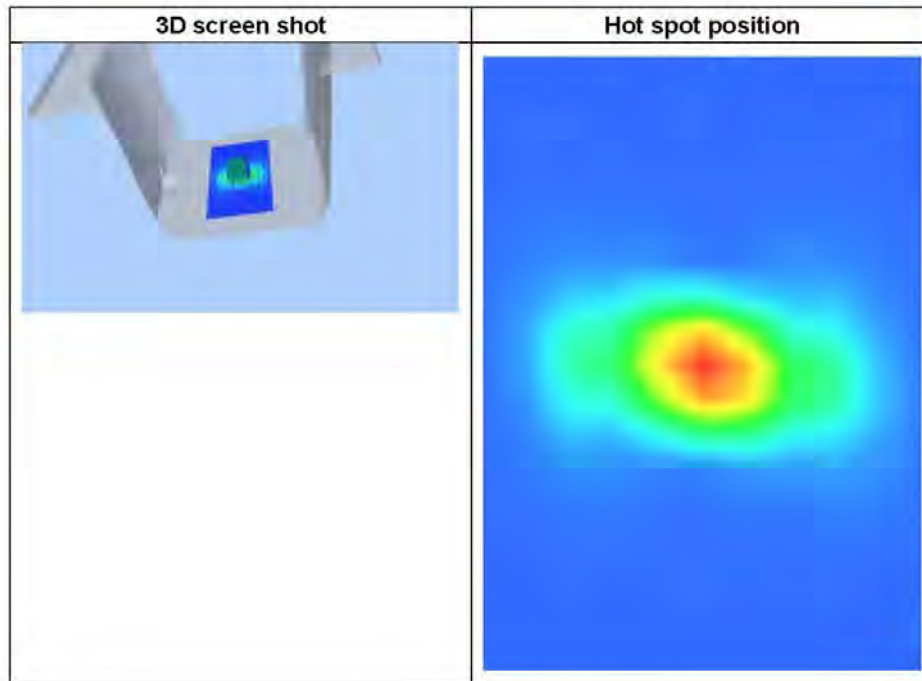
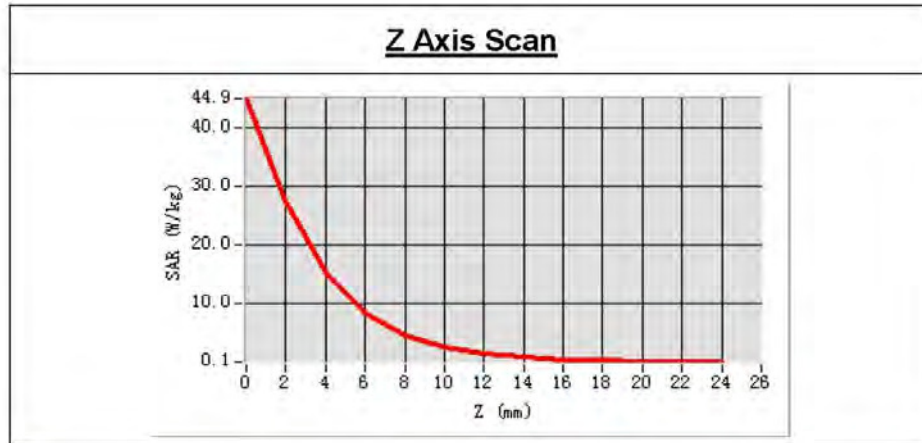






Maximum location: X=0.00, Y=0.00  
SAR Peak: 44.03 W/kg

|                |           |
|----------------|-----------|
| SAR 10g (W/Kg) | 5.517354  |
| SAR 1g (W/Kg)  | 15.876169 |



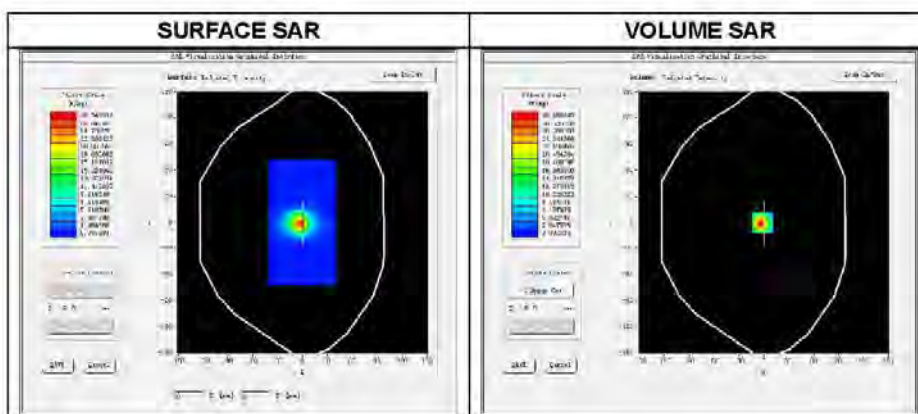


## System Performance Check Data(5600 MHz Head)

Type: Phone measurement (Complete)  
E-Field Probe: SN 34/15 SSE2 EPGO265  
Area scan resolution: dx=8mm,dy=8mm  
Zoom scan resolution: dx=4mm, dy=4mm, dz=2mm  
Date of measurement: 2016.03.03  
Measurement duration: 29 minutes 30 seconds

### Experimental conditions.

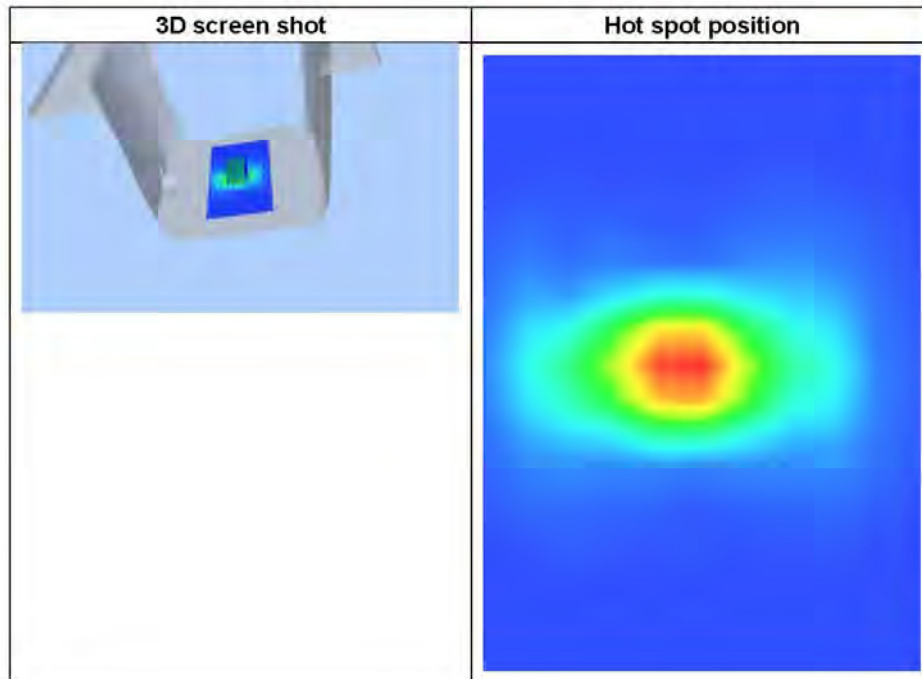
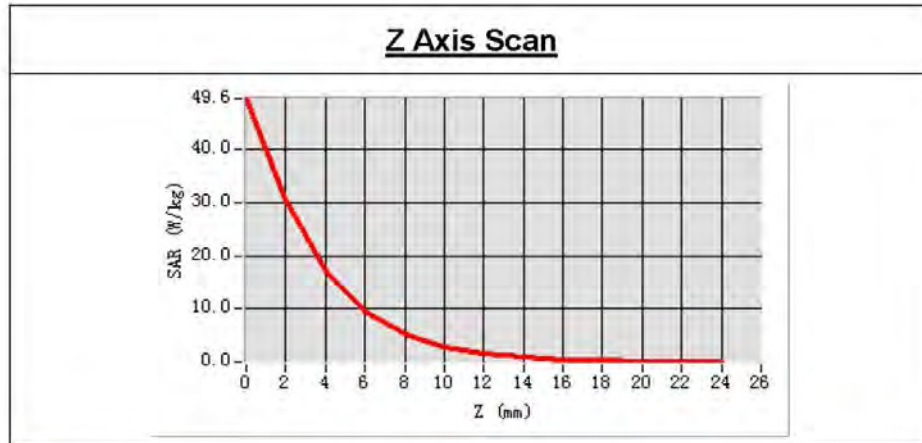
|                                   |                   |
|-----------------------------------|-------------------|
| Phantom File                      | surf_sam_plan.txt |
| Phantom                           | Validation plane  |
| Band                              | 5600 MHz          |
| Signal                            | CW                |
| Frequency (MHz)                   | 5600.000000       |
| Relative permittivity (real part) | 34.462351         |
| Conductivity (S/m)                | 5.137525          |
| Power drift (%)                   | 0.800000          |
| Ambient Temperature:              | 21.5°C            |
| Liquid Temperature:               | 21.0°C            |
| ConvF:                            | 2.08              |
| Crest factor:                     | 1:1               |





Maximum location: X=1.00, Y=1.00  
SAR Peak: 49.52 W/kg

|                |           |
|----------------|-----------|
| SAR 10g (W/Kg) | 5.791756  |
| SAR 1g (W/Kg)  | 16.475376 |



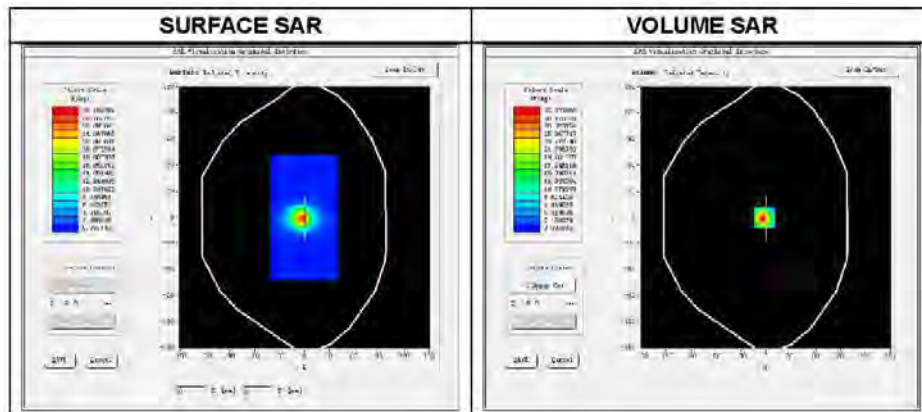


## System Performance Check Data(5800 MHz Head)

Type: Phone measurement (Complete)  
E-Field Probe: SN 34/15 SSE2 EPGO265  
Area scan resolution: dx=8mm,dy=8mm  
Zoom scan resolution: dx=4mm, dy=4mm, dz=2mm  
Date of measurement: 2016.03.03  
Measurement duration: 29 minutes 31 seconds

### Experimental conditions.

|                                   |                   |
|-----------------------------------|-------------------|
| Phantom File                      | surf_sam_plan.txt |
| Phantom                           | Validation plane  |
| Band                              | 5800 MHz          |
| Signal                            | CW                |
| Frequency (MHz)                   | 5800.000000       |
| Relative permittivity (real part) | 34.327163         |
| Conductivity (S/m)                | 5.305872          |
| Power drift (%)                   | 1.660000          |
| Ambient Temperature:              | 21.5°C            |
| Liquid Temperature:               | 21.0°C            |
| ConvF:                            | 1.88              |
| Crest factor:                     | 1:1               |



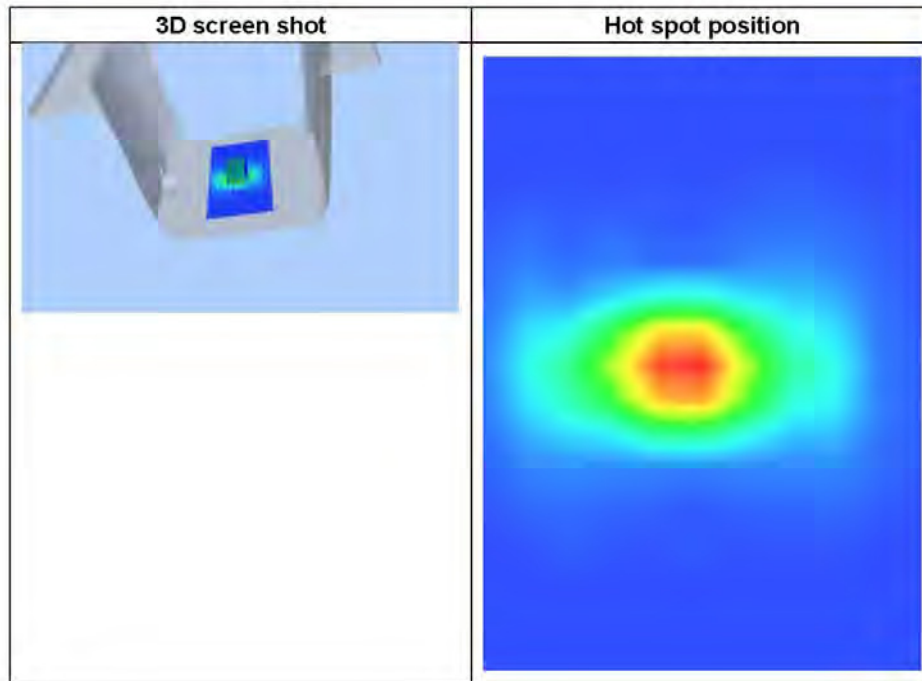
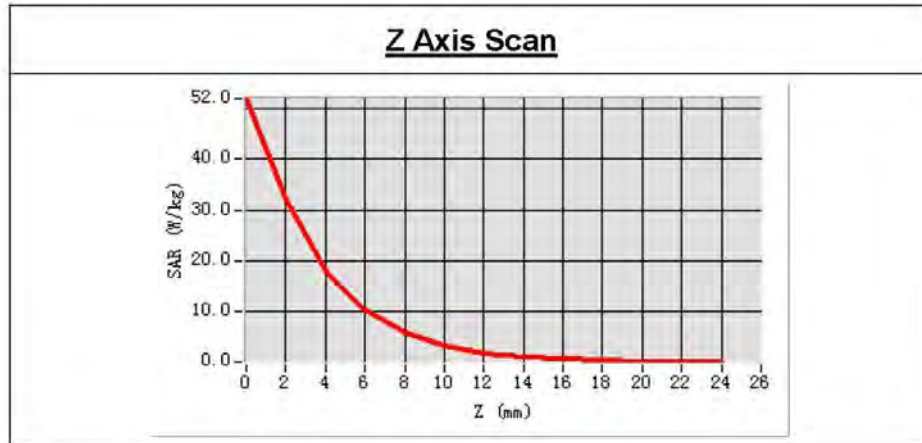




Maximum location: X=0.00, Y=0.00

SAR Peak: 51.16 W/kg

|                |           |
|----------------|-----------|
| SAR 10g (W/Kg) | 5.983526  |
| SAR 1g (W/Kg)  | 17.687528 |





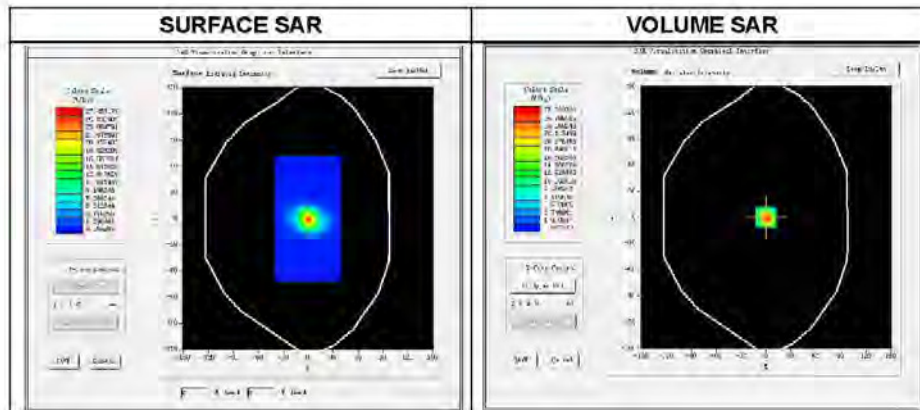
### 5.11.2 Waveguide 5 GHz Validation Measurement for Body Tissue

## System Performance Check Data(5200MHz Body)

Type: Phone measurement (Complete)  
E-Field Probe: SN 34/15 SSE2 EPG0265  
Area scan resolution: dx=8mm,dy=8mm  
Zoom scan resolution: dx=4mm, dy=4mm, dz=2mm  
Date of measurement: 2016.03.03  
Measurement duration: 29 minutes 32 seconds

### Experimental conditions.

|                                   |                   |
|-----------------------------------|-------------------|
| Phantom File                      | surf_sam_plan.txt |
| Phantom                           | Validation plane  |
| Band                              | 5200 MHz          |
| Signal                            | CW                |
| Frequency (MHz)                   | 5200.000000       |
| Relative permittivity (real part) | 50.126533         |
| Conductivity (S/m)                | 5.256854          |
| Power drift (%)                   | 2.320000          |
| Ambient Temperature:              | 21.5°C            |
| Liquid Temperature:               | 21.0°C            |
| ConvF:                            | 1.85              |
| Crest factor:                     | 1:1               |



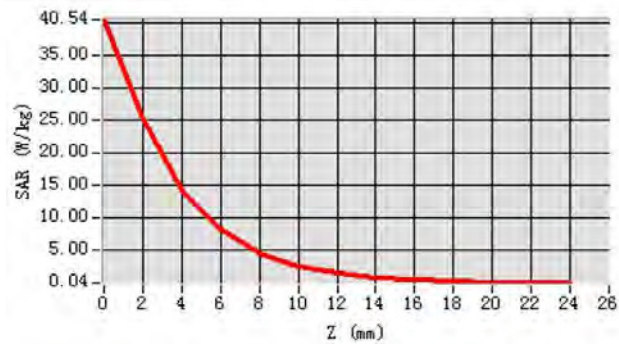


Maximum location: X=0.00, Y=0.00

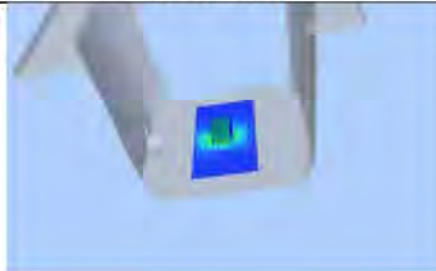
SAR Peak: 40.51 W/kg

|                |           |
|----------------|-----------|
| SAR 10g (W/Kg) | 5.340976  |
| SAR 1g (W/Kg)  | 15.223962 |

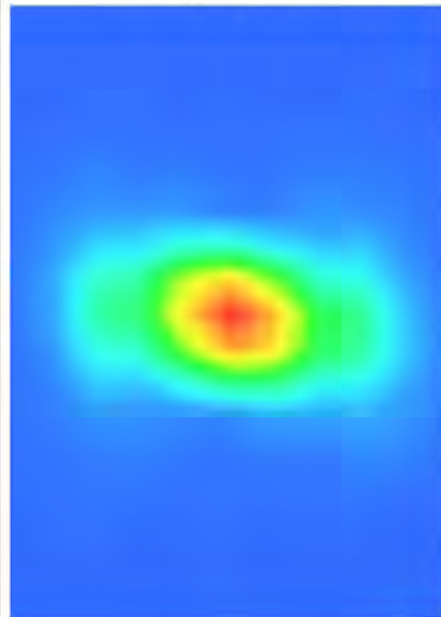
### Z Axis Scan



### 3D screen shot



### Hot spot position



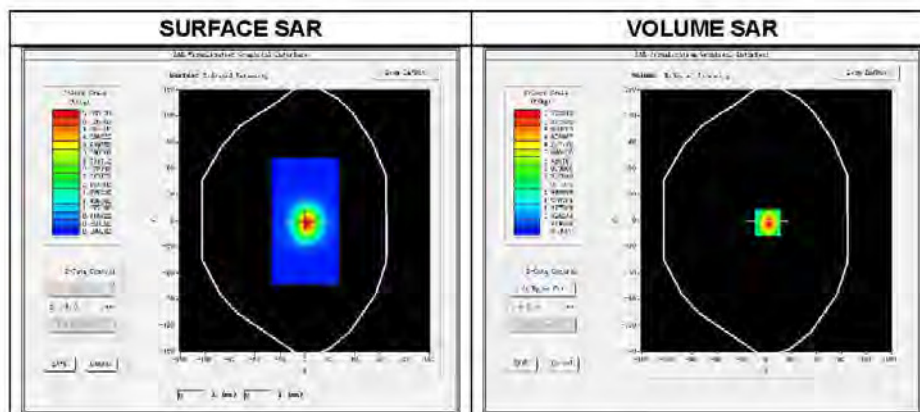


## System Performance Check Data (5400 MHz Body)

Type: Phone measurement (Complete)  
E-Field Probe: SN 34/15 SSE2 EPGO265  
Area scan resolution: dx=8mm,dy=8mm  
Zoom scan resolution: dx=4mm, dy=4mm, dz=2mm  
Date of measurement: 2016.03.03  
Measurement duration: 29 minutes 32 seconds

### Experimental conditions.

|                                   |                   |
|-----------------------------------|-------------------|
| Phantom File                      | surf_sam_plan.txt |
| Phantom                           | Validation plane  |
| Band                              | 5400 MHz          |
| Signal                            | CW                |
| Frequency (MHz)                   | 5400.000000       |
| Relative permittivity (real part) | 50.016325         |
| Conductivity (S/m)                | 5.513862          |
| Power drift (%)                   | 1.160000          |
| Ambient Temperature:              | 21.5°C            |
| Liquid Temperature:               | 21.0°C            |
| ConvF:                            | 2.11              |
| Crest factor:                     | 1:1               |

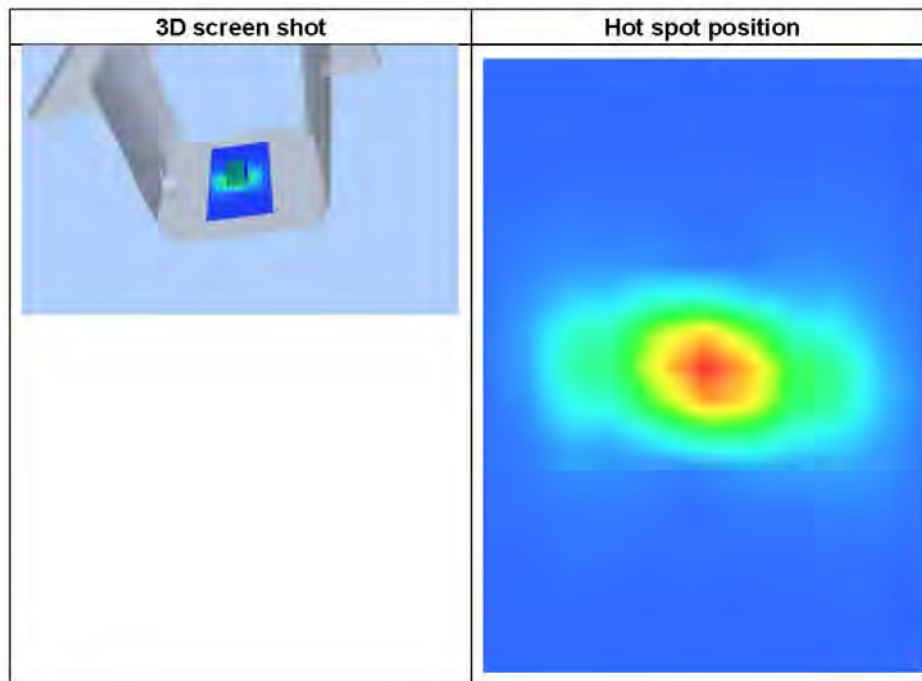
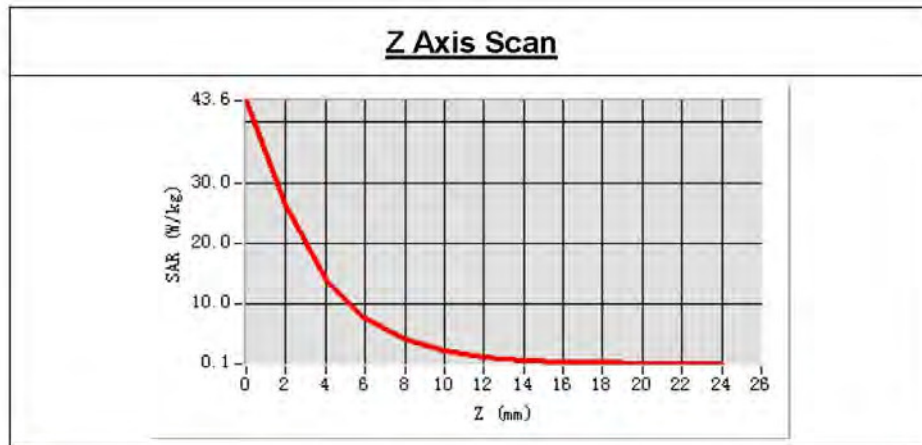






Maximum location: X=0.00, Y=0.00  
SAR Peak: 43.26 W/kg

|                |           |
|----------------|-----------|
| SAR 10g (W/Kg) | 5.615362  |
| SAR 1g (W/Kg)  | 15.762167 |



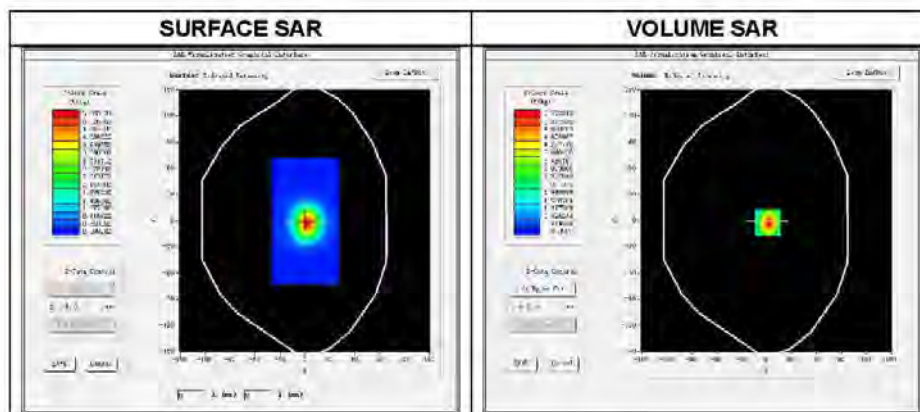


## System Performance Check Data (5600 MHz Body )

Type: Phone measurement (Complete)  
E-Field Probe: SN 34/15 SSE2 EPGO265  
Area scan resolution: dx=8mm,dy=8mm  
Zoom scan resolution: dx=4mm, dy=4mm, dz=2mm  
Date of measurement: 2016.03.03  
Measurement duration: 29 minutes 32 seconds

### Experimental conditions.

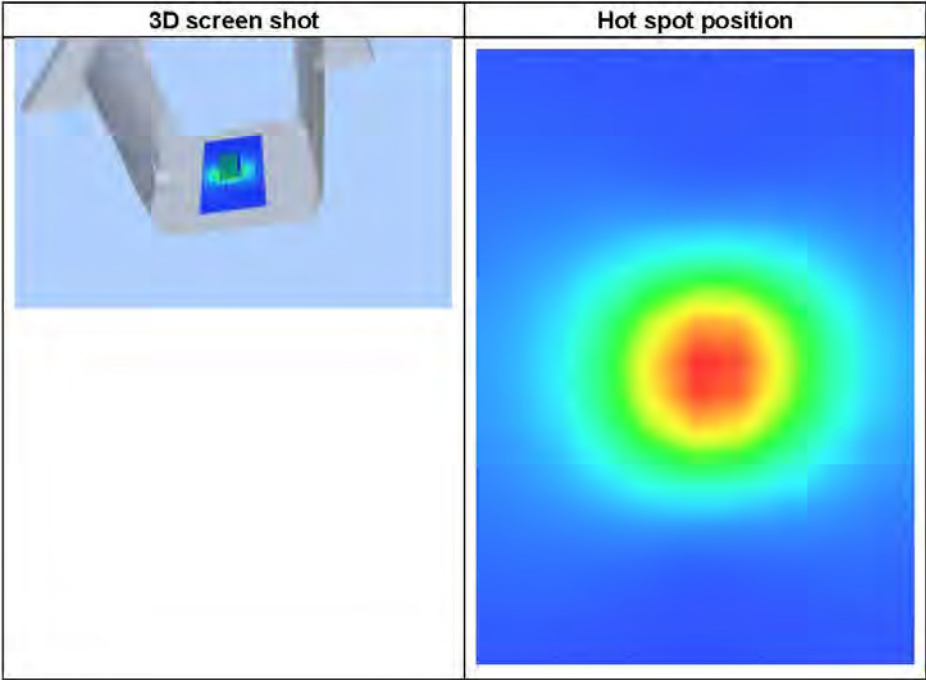
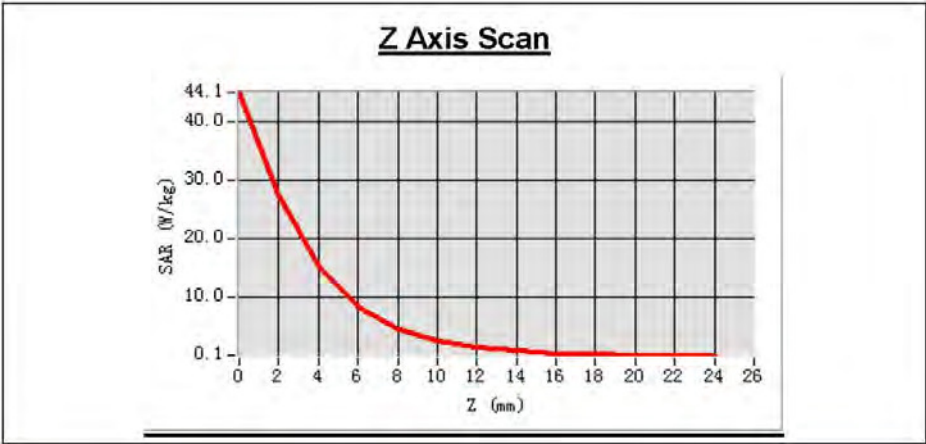
|                                   |                   |
|-----------------------------------|-------------------|
| Phantom File                      | surf_sam_plan.txt |
| Phantom                           | Validation plane  |
| Band                              | 5600 MHz          |
| Signal                            | CW                |
| Frequency (MHz)                   | 5600.000000       |
| Relative permittivity (real part) | 48.041782         |
| Conductivity (S/m)                | 5.932687          |
| Power drift (%)                   | 2.130000          |
| Ambient Temperature:              | 21.5°C            |
| Liquid Temperature:               | 21.0°C            |
| ConvF:                            | 2.15              |
| Crest factor:                     | 1:1               |





Maximum location: X=0.00, Y=0.00  
 SAR Peak: 52.10W/kg

|                |           |
|----------------|-----------|
| SAR 10g (W/Kg) | 5.645281  |
| SAR 1g (W/Kg)  | 15.812583 |



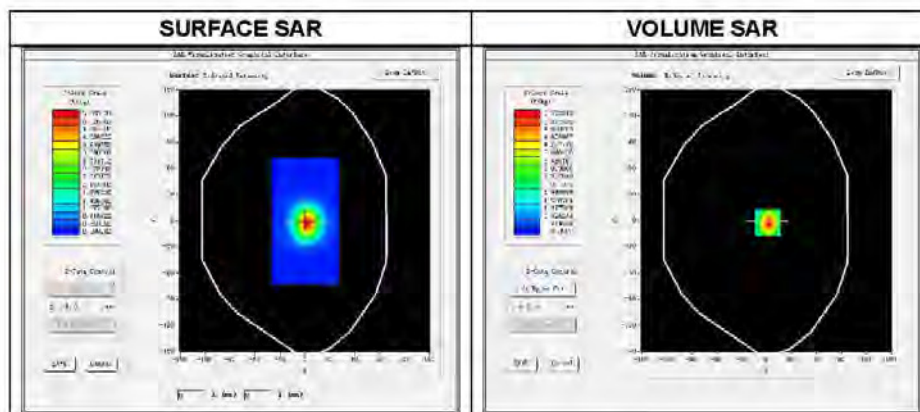


## System Performance Check Data (5800 MHz Body )

Type: Phone measurement (Complete)  
E-Field Probe: SN 34/15 SSE2 EPGO265  
Area scan resolution: dx=8mm,dy=8mm  
Zoom scan resolution: dx=4mm, dy=4mm, dz=2mm  
Date of measurement: 2016.03.03  
Measurement duration: 29 minutes 32 seconds

### Experimental conditions.

|                                   |                   |
|-----------------------------------|-------------------|
| Phantom File                      | surf_sam_plan.txt |
| Phantom                           | Validation plane  |
| Band                              | 5800 MHz          |
| Signal                            | CW                |
| Frequency (MHz)                   | 5800.000000       |
| Relative permittivity (real part) | 47.135215         |
| Conductivity (S/m)                | 6.071259          |
| Power drift (%)                   | 2.130000          |
| Ambient Temperature:              | 21.5°C            |
| Liquid Temperature:               | 21.0°C            |
| ConvF:                            | 1.93              |
| Crest factor:                     | 1:1               |

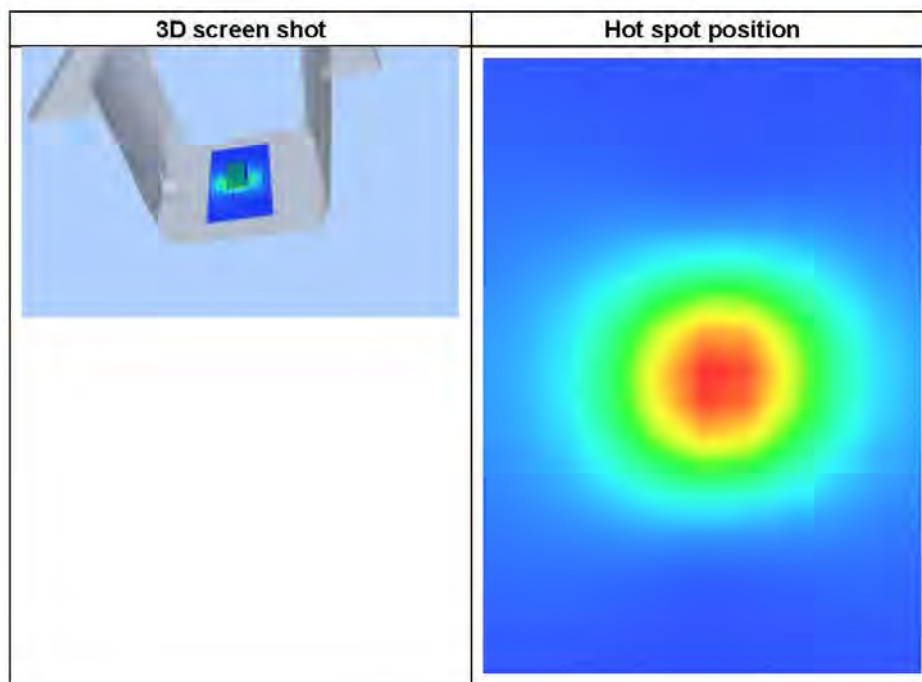
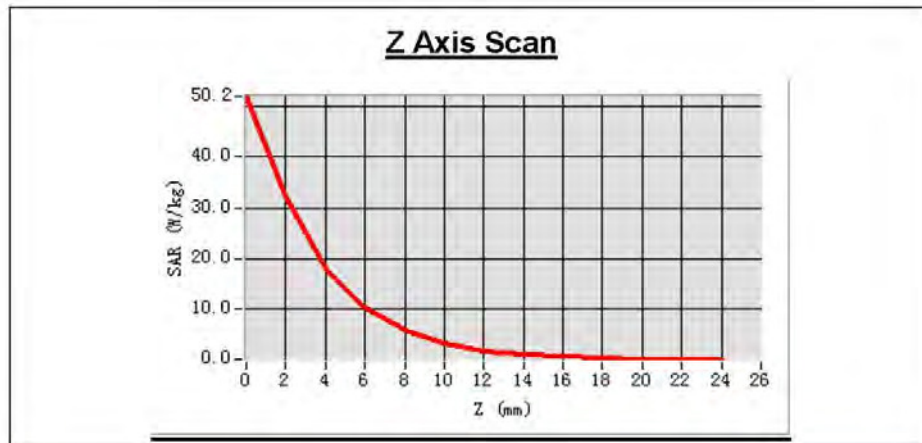






Maximum location: X=0.00, Y=0.00  
SAR Peak: 50.10W/kg

|                |           |
|----------------|-----------|
| SAR 10g (W/Kg) | 5.836267  |
| SAR 1g (W/Kg)  | 16.942574 |



--END OF REPORT--