

## MEASUREMENT 28

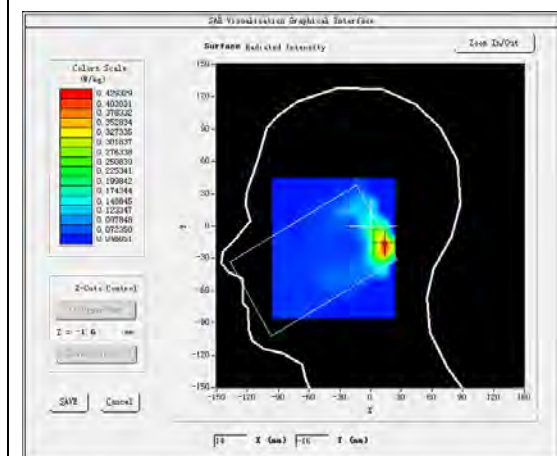
### A. Experimental conditions.

<b>Area Scan</b>	<u>dx=10mm dy=10mm, h= 2.00 mm</u>
<b>ZoomScan</b>	<u>7x7x12,dx=4mm dy=4mm dz=2mm</u>
<b>Phantom</b>	<u>Left head</u>
<b>Device Position</b>	<u>Cheek</u>
<b>Band</b>	<u>IEEE 802.11a U-NII</u>
<b>Channels</b>	<u>Middle</u>
<b>Signal</b>	<u>IEEE802.11a (Crest factor: 1.0)</u>

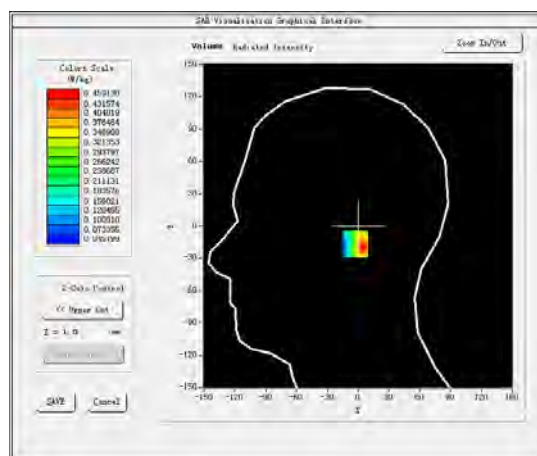
### B. SAR Measurement Results

<b>Frequency (MHz)</b>	5785.000000
<b>Relative permittivity (real part)</b>	34.864788
<b>Relative permittivity (imaginary part)</b>	15.875266
<b>Conductivity (S/m)</b>	5.102134
<b>Variation (%)</b>	0.470000

#### SURFACE SAR



#### VOLUME SAR

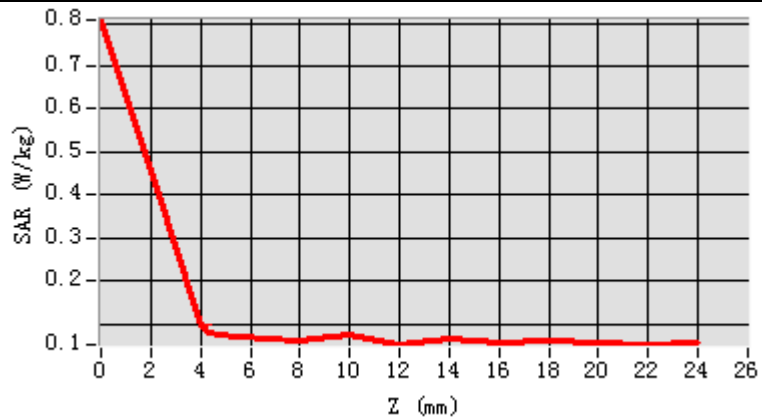


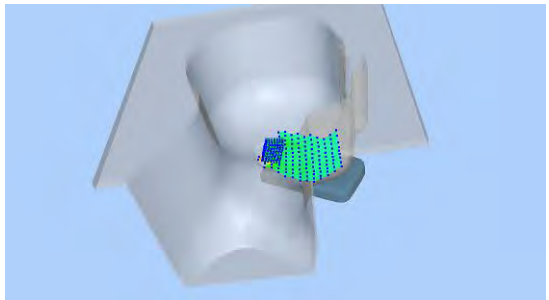
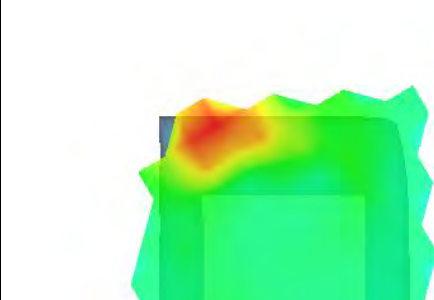
Maximum location: X=6.00, Y=-17.00

SAR Peak: 1.21 W/kg

<b>SAR 10g (W/Kg)</b>	0.192297
<b>SAR 1g (W/Kg)</b>	0.467597

<b>Z (m m)</b>	<b>0.00</b>	<b>2.00</b>	<b>4.00</b>	<b>6.00</b>	<b>8.00</b>	<b>10.0 0</b>	<b>12.0 0</b>	<b>14.0 0</b>	<b>16.0 0</b>	<b>18.0 0</b>	<b>20.0 0</b>	<b>22.0 0</b>
<b>SA R (W/ Kg)</b>	<b>0.80 71</b>	<b>0.45 91</b>	<b>0.09 26</b>	<b>0.05 00</b>	<b>0.06 18</b>	<b>0.07 36</b>	<b>0.05 36</b>	<b>0.06 57</b>	<b>0.05 51</b>	<b>0.06 20</b>	<b>0.05 45</b>	<b>0.05 20</b>



3D screen shot	Hot spot position
 <p>A 3D perspective view of a mechanical assembly. The assembly consists of a light blue base with a central rectangular cutout. A grey rectangular plate is positioned on top of the base. A grid of small, colored spheres (blue, green, and red) is overlaid on the grey plate, indicating a spatial distribution or measurement. The background is a solid light blue.</p>	 <p>A 3D visualization of a hot spot position. The assembly is shown in a light blue color. A large, irregularly shaped region is highlighted in a bright yellow and orange color, indicating the hot spot. This region is located on the top surface of the assembly, near the central cutout. The rest of the assembly is colored in a light blue-grey.</p>

## MEASUREMENT 29

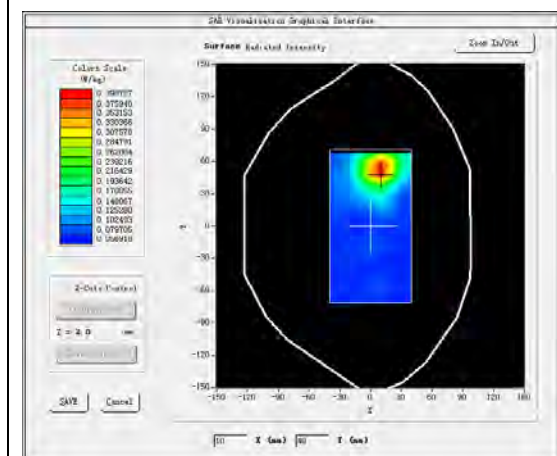
### A. Experimental conditions.

<b>Area Scan</b>	<u>dx=10mm dy=10mm, h= 2.00 mm</u>
<b>ZoomScan</b>	<u>7x7x12,dx=4mm dy=4mm dz=2mm</u>
<b>Phantom</b>	<u>Validation plane</u>
<b>Device Position</b>	<u>Body</u>
<b>Band</b>	<u>IEEE 802.11a U-NII</u>
<b>Channels</b>	<u>Middle</u>
<b>Signal</b>	<u>IEEE802.11a (Crest factor: 1.0)</u>

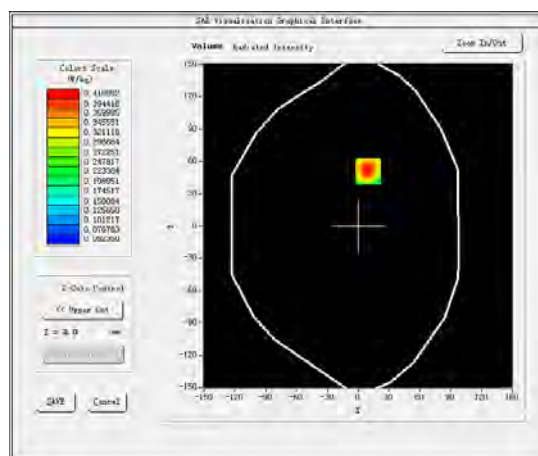
### B. SAR Measurement Results

<b>Frequency (MHz)</b>	5200.000000
<b>Relative permittivity (real part)</b>	49.909538
<b>Relative permittivity (imaginary part)</b>	18.225510
<b>Conductivity (S/m)</b>	5.265147
<b>Variation (%)</b>	0.950000

#### SURFACE SAR



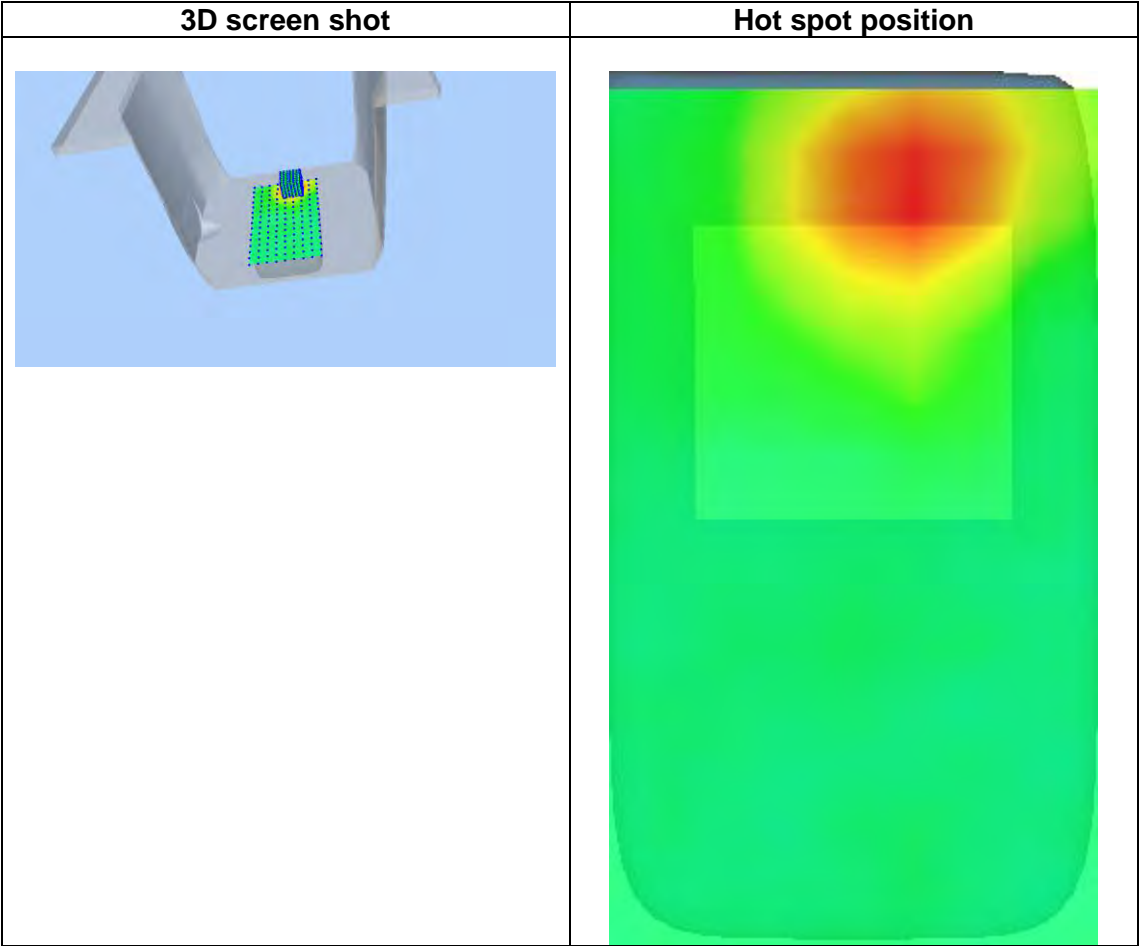
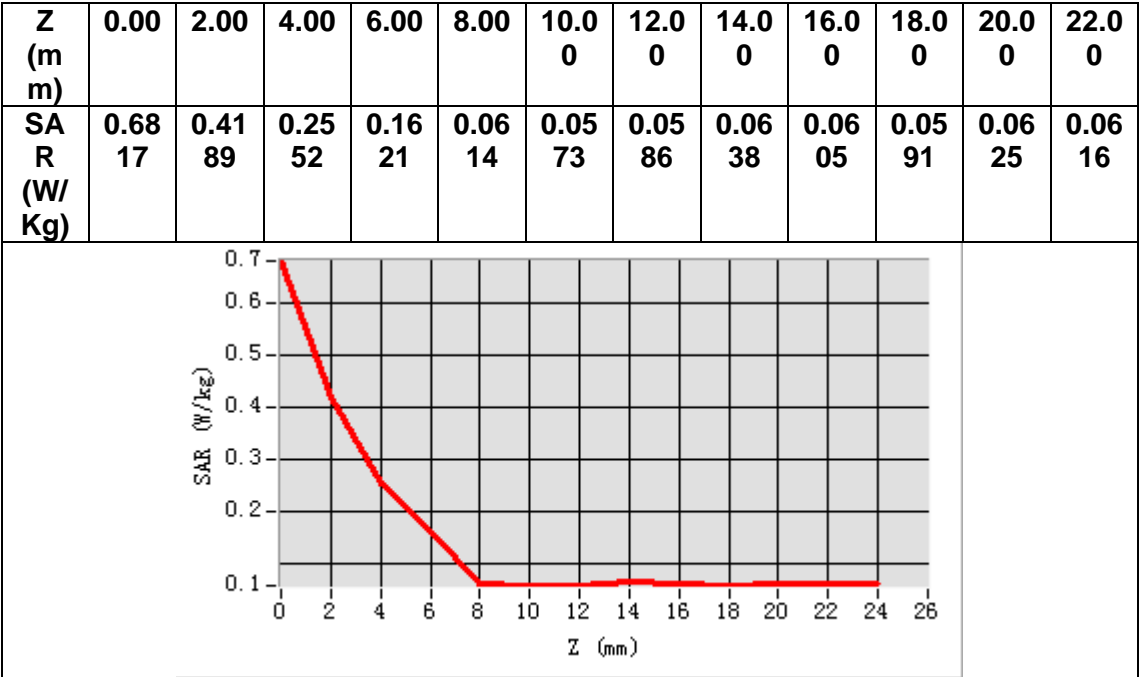
#### VOLUME SAR



Maximum location: X=10.00, Y=51.00

SAR Peak: 0.71 W/kg

<b>SAR 10g (W/Kg)</b>	0.117510
<b>SAR 1g (W/Kg)</b>	0.216326



## MEASUREMENT 30

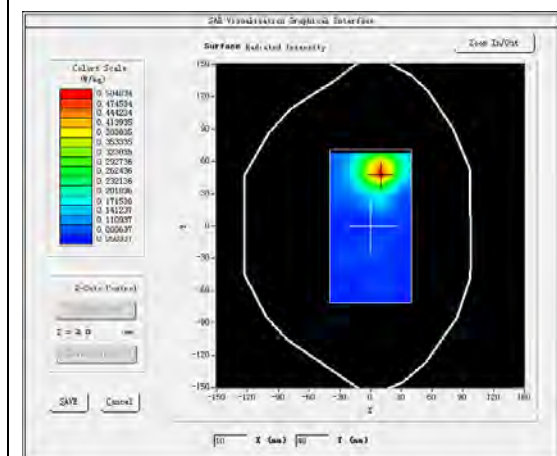
### A. Experimental conditions.

<b>Area Scan</b>	<u>dx=10mm dy=10mm, h= 2.00 mm</u>
<b>ZoomScan</b>	<u>7x7x12,dx=4mm dy=4mm dz=2mm</u>
<b>Phantom</b>	<u>Validation plane</u>
<b>Device Position</b>	<u>Body</u>
<b>Band</b>	<u>IEEE 802.11a U-NII</u>
<b>Channels</b>	<u>Middle</u>
<b>Signal</b>	<u>IEEE802.11a (Crest factor: 1.0)</u>

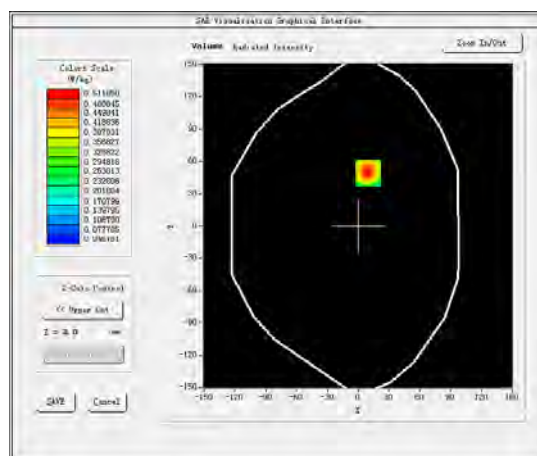
### B. SAR Measurement Results

<b>Frequency (MHz)</b>	5280.000000
<b>Relative permittivity (real part)</b>	49.975689
<b>Relative permittivity (imaginary part)</b>	18.237558
<b>Conductivity (S/m)</b>	5.349684
<b>Variation (%)</b>	0.210000

#### SURFACE SAR



#### VOLUME SAR

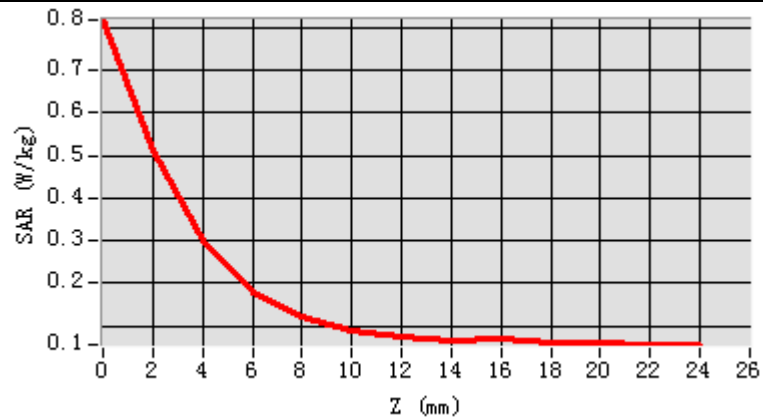


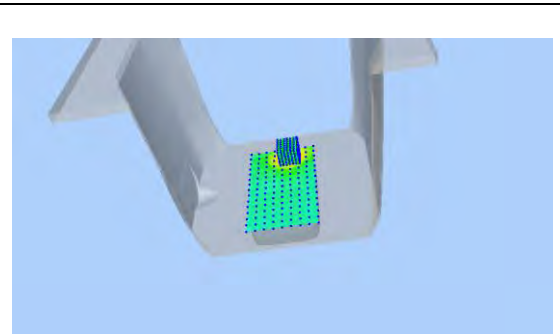
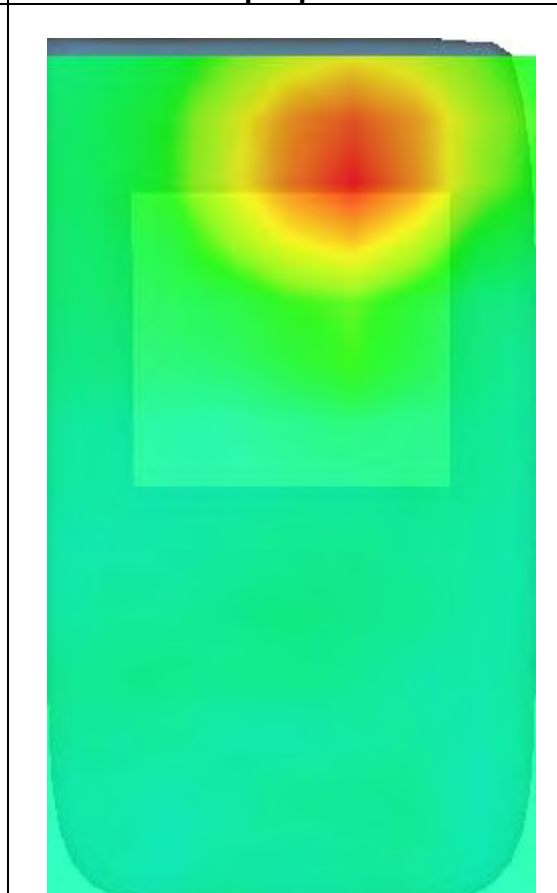
Maximum location: X=10.00, Y=49.00

SAR Peak: 0.85 W/kg

<b>SAR 10g (W/Kg)</b>	0.171167
<b>SAR 1g (W/Kg)</b>	0.225424

<b>Z (m m)</b>	<b>0.00</b>	<b>2.00</b>	<b>4.00</b>	<b>6.00</b>	<b>8.00</b>	<b>10.0 0</b>	<b>12.0 0</b>	<b>14.0 0</b>	<b>16.0 0</b>	<b>18.0 0</b>	<b>20.0 0</b>	<b>22.0 0</b>
<b>SA R (W/ Kg)</b>	<b>0.81 75</b>	<b>0.51 19</b>	<b>0.30 12</b>	<b>0.17 72</b>	<b>0.12 16</b>	<b>0.08 85</b>	<b>0.07 52</b>	<b>0.06 33</b>	<b>0.06 78</b>	<b>0.05 92</b>	<b>0.06 18</b>	<b>0.05 76</b>



3D screen shot	Hot spot position
 <p>A 3D rendering of a robotic arm holding a tray. The tray contains a grid of points, with a small cluster of points highlighted in red and yellow, indicating a hot spot.</p>	 <p>A heatmap visualization showing the hot spot position. The hot spot is located in the upper right quadrant of the image, indicated by a red and yellow circular area. The rest of the image is predominantly green and blue.</p>

## MEASUREMENT 31

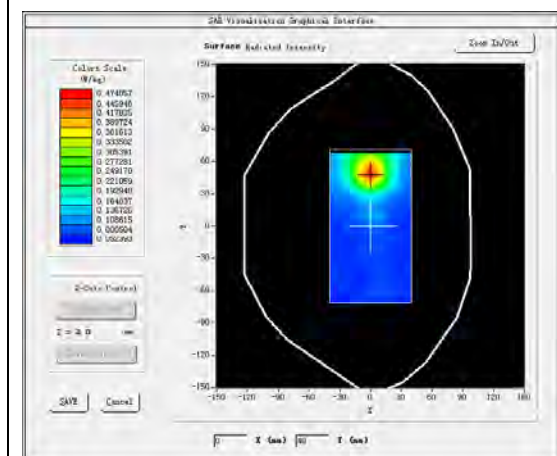
### A. Experimental conditions.

<b>Area Scan</b>	<u>dx=10mm dy=10mm, h= 2.00 mm</u>
<b>ZoomScan</b>	<u>7x7x12,dx=4mm dy=4mm dz=2mm</u>
<b>Phantom</b>	<u>Validation plane</u>
<b>Device Position</b>	<u>Body</u>
<b>Band</b>	<u>IEEE 802.11a U-NII</u>
<b>Channels</b>	<u>Middle</u>
<b>Signal</b>	<u>IEEE802.11a (Crest factor: 1.0)</u>

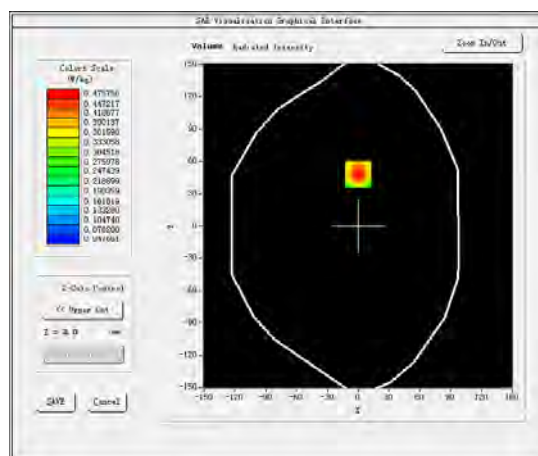
### B. SAR Measurement Results

<b>Frequency (MHz)</b>	5580.000000
<b>Relative permittivity (real part)</b>	49.975690
<b>Relative permittivity (imaginary part)</b>	18.237559
<b>Conductivity (S/m)</b>	5.653643
<b>Variation (%)</b>	-2.410000

#### SURFACE SAR



#### VOLUME SAR

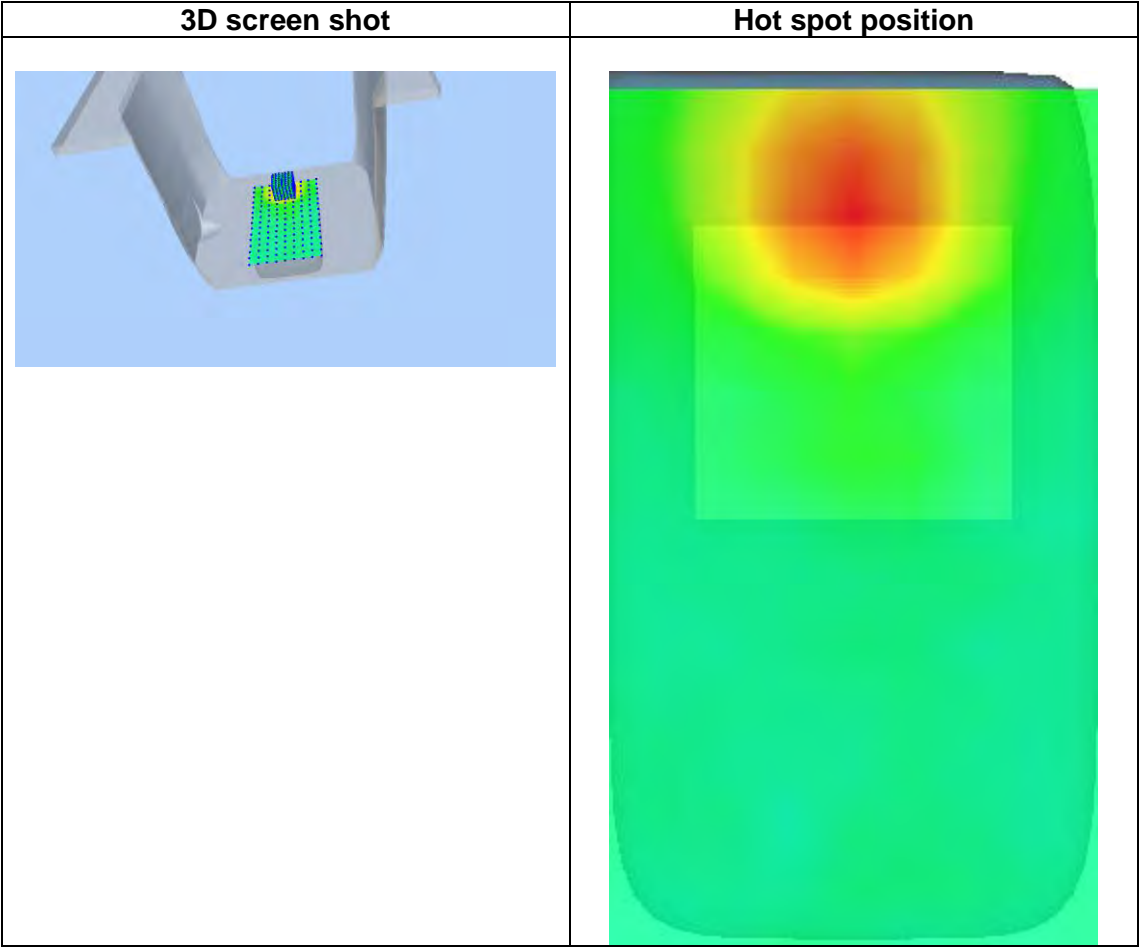
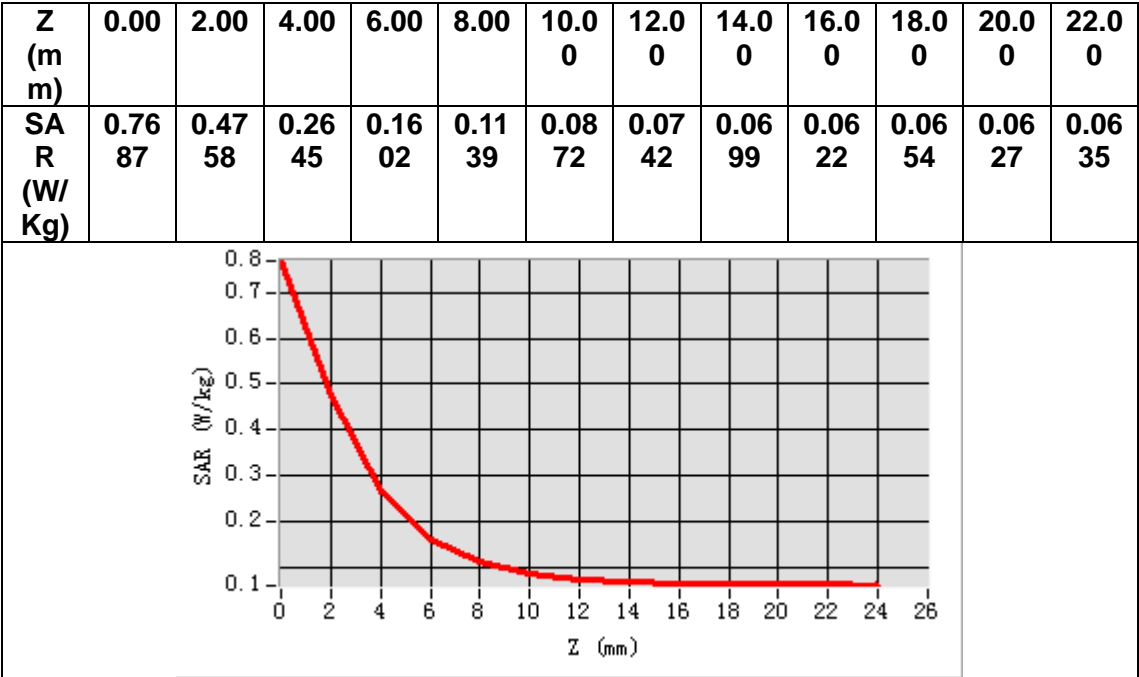


Maximum location: X=0.00, Y=48.00

SAR Peak: 0.81 W/kg

<b>SAR 10g (W/Kg)</b>	0.101596
<b>SAR 1g (W/Kg)</b>	0.171309







## MEASUREMENT 32

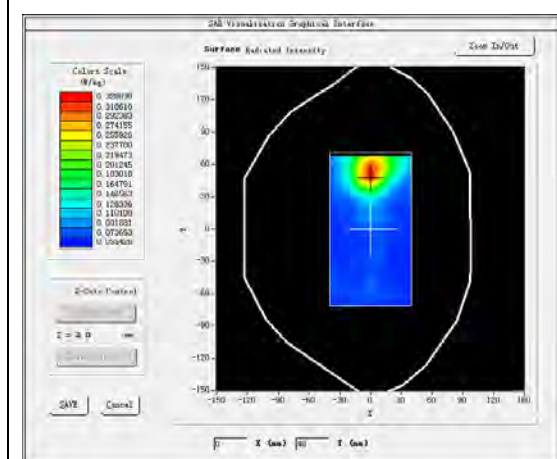
### A. Experimental conditions.

<b>Area Scan</b>	<u>dx=10mm dy=10mm, h= 2.00 mm</u>
<b>ZoomScan</b>	<u>7x7x12,dx=4mm dy=4mm dz=2mm</u>
<b>Phantom</b>	<u>Validation plane</u>
<b>Device Position</b>	<u>Body</u>
<b>Band</b>	<u>IEEE 802.11a U-NII</u>
<b>Channels</b>	<u>Middle</u>
<b>Signal</b>	<u>IEEE802.11a (Crest factor: 1.0)</u>

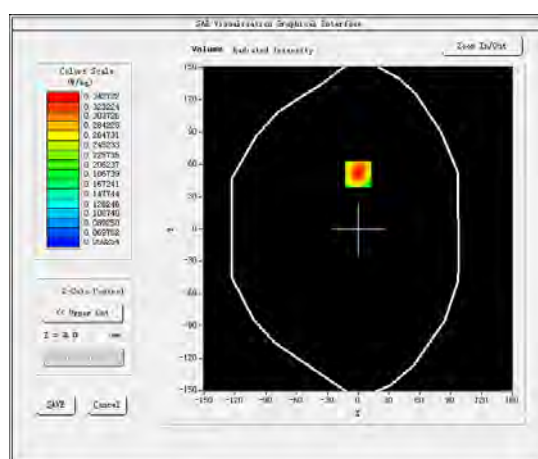
### B. SAR Measurement Results

<b>Frequency (MHz)</b>	5785.000000
<b>Relative permittivity (real part)</b>	48.668701
<b>Relative permittivity (imaginary part)</b>	18.596766
<b>Conductivity (S/m)</b>	5.976794
<b>Variation (%)</b>	0.210000

#### SURFACE SAR



#### VOLUME SAR

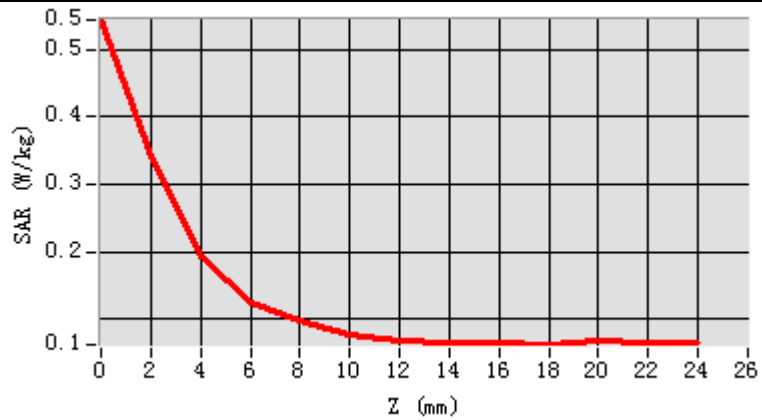


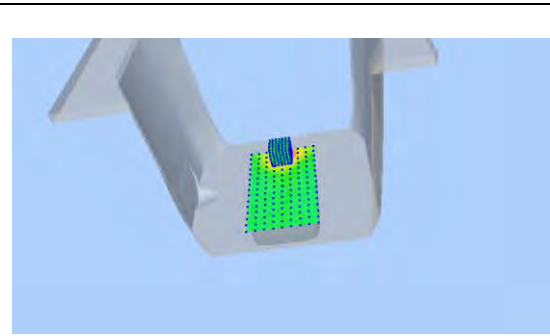
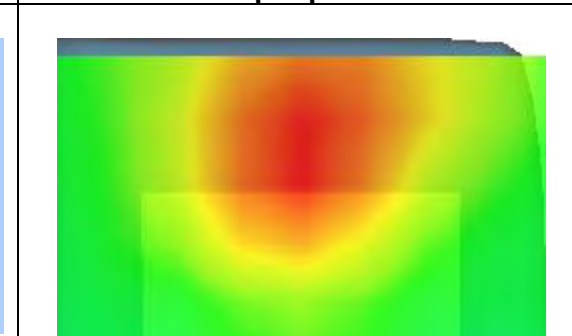
Maximum location: X=0.00, Y=51.00

SAR Peak: 0.57 W/kg

<b>SAR 10g (W/Kg)</b>	0.163585
<b>SAR 1g (W/Kg)</b>	0.202051

<b>Z (m m)</b>	<b>0.00</b>	<b>2.00</b>	<b>4.00</b>	<b>6.00</b>	<b>8.00</b>	<b>10.0 0</b>	<b>12.0 0</b>	<b>14.0 0</b>	<b>16.0 0</b>	<b>18.0 0</b>	<b>20.0 0</b>	<b>22.0 0</b>
<b>SA R (W/ Kg)</b>	<b>0.54 40</b>	<b>0.34 27</b>	<b>0.19 32</b>	<b>0.12 41</b>	<b>0.09 81</b>	<b>0.07 58</b>	<b>0.06 88</b>	<b>0.06 56</b>	<b>0.06 38</b>	<b>0.06 21</b>	<b>0.06 67</b>	<b>0.06 59</b>



3D screen shot	Hot spot position
 <p>A 3D perspective view of a robotic arm holding a grey tray. On the tray, there is a grid of small, colorful cubes. A specific area in the center of the grid is highlighted with a red and yellow glow, indicating a hot spot. The background is a solid light blue.</p>	 <p>A heatmap visualization of the hot spot position. The image shows a green rectangular area with a bright red and yellow circular region in the upper center, representing the high-temperature area. The rest of the area is a uniform green color.</p>

## 14. Appendix D. Calibration Certificate

Table of contents
E Field Probe - SN 08/16 EPGO287
E Field Probe - SN 07/15 EP247
835 MHz Dipole - SN 03/15 DIP 0G835-347
1800 MHz Dipole - SN 03/15 DIP 1G800-349
1900 MHz Dipole - SN 03/15 DIP 1G900-350
2300 MHz Dipole - SN 03/16 DIP 2G300-358
2450 MHz Dipole - SN 03/15 DIP 2G450-352
2600 MHz Dipole - SN 03/15 DIP 2G600-356
5000-6000 MHz Dipole - SN 13/14 WGA 33



## COMOSAR E-Field Probe Calibration Report

Ref : ACR.260.1.18.SATU.A

**SHENZHEN NTEK TESTING TECHNOLOGY  
CO., LTD.**

**BUILDING E, FENDA SCIENCE PARK, SANWEI  
COMMUNITY, XIXIANG STREET,  
BAO'AN DISTRICT, SHENZHEN GUANGDONG, CHINA  
MVG COMOSAR DOSIMETRIC E-FIELD PROBE  
SERIAL NO.: SN 08/16 EPGO287**

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



**Calibration Date: 09/17/2018**




### *Summary:*

This document presents the method and results from an accredited COMOSAR Dosimetric E-Field Probe calibration performed in MVG USA using the CALISAR / CALIBAIR test bench, for use with a COMOSAR system only. All calibration results are traceable to national metrology institutions.



## COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.260.1.18.SATU.A

	Name	Function	Date	Signature
Prepared by :	Jérôme LUC	Product Manager	9/17/2018	
Checked by :	Jérôme LUC	Product Manager	9/17/2018	
Approved by :	Kim RUTKOWSKI	Quality Manager	9/17/2018	

	Customer Name
Distribution :	SHENZHEN NTEK TESTING TECHNOLOGY CO., LTD.

Issue	Date	Modifications
A	9/17/2018	Initial release



COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.260.1.18.SATU.A

TABLE OF CONTENTS

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





## COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.260.1.18.SATU.A

**1 DEVICE UNDER TEST**

Device Under Test	
Device Type	COMOSAR DOSIMETRIC E FIELD PROBE
Manufacturer	MVG
Model	SSE2
Serial Number	SN 08/16 EPGO287
Product Condition (new / used)	Used
Frequency Range of Probe	0.15 GHz-6GHz
Resistance of Three Dipoles at Connector	Dipole 1: R1=0.209 MΩ Dipole 2: R2=0.196 MΩ Dipole 3: R3=0.197 MΩ

A yearly calibration interval is recommended.

**2 PRODUCT DESCRIPTION****2.1 GENERAL INFORMATION**

MVG's COMOSAR E field Probes are built in accordance to the IEEE 1528, OET 65 Bulletin C and CEI/IEC 62209 standards.



**Figure 1 – MVG COMOSAR Dosimetric E field Dipole**

Probe Length	330 mm
Length of Individual Dipoles	2 mm
Maximum external diameter	8 mm
Probe Tip External Diameter	2.5 mm
Distance between dipoles / probe extremity	1 mm

**3 MEASUREMENT METHOD**

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

**3.1 LINEARITY**

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





## COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.260.1.18.SATU.A

### 3.2 SENSITIVITY

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

### 3.3 LOWER DETECTION LIMIT

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

### 3.4 ISOTROPY

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

### 3.5 BOUNDARY EFFECT

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

## 4 MEASUREMENT UNCERTAINTY

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

Uncertainty analysis of the probe calibration in waveguide					
ERROR SOURCES	Uncertainty value (%)	Probability Distribution	Divisor	ci	Standard Uncertainty (%)
Incident or forward power	3.00%	Rectangular	$\sqrt{3}$	1	1.732%
Reflected power	3.00%	Rectangular	$\sqrt{3}$	1	1.732%
Liquid conductivity	5.00%	Rectangular	$\sqrt{3}$	1	2.887%
Liquid permittivity	4.00%	Rectangular	$\sqrt{3}$	1	2.309%
Field homogeneity	3.00%	Rectangular	$\sqrt{3}$	1	1.732%
Field probe positioning	5.00%	Rectangular	$\sqrt{3}$	1	2.887%
Field probe linearity	3.00%	Rectangular	$\sqrt{3}$	1	1.732%
Combined standard uncertainty					5.831%
Expanded uncertainty 95 % confidence level k = 2					12.0%

Page: 5/10

This document shall not be reproduced, except in full or in part, without the written approval of MVG.  
The information contained herein is to be used only for the purpose for which it is submitted and is not to be released in whole or part without written approval of MVG.



## COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.260.1.18.SATU.A

## 5 CALIBRATION MEASUREMENT RESULTS

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

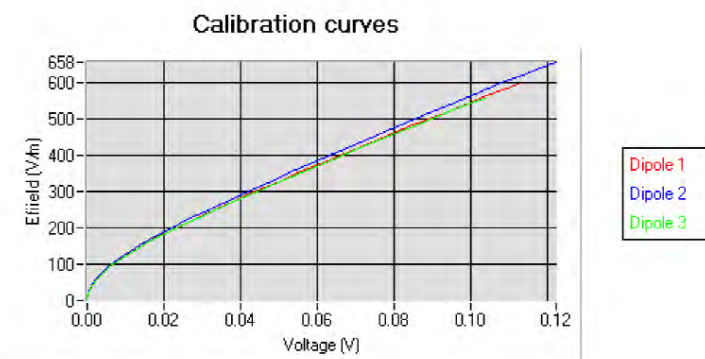
## 5.1 SENSITIVITY IN AIR

Normx dipole 1 ( $\mu\text{V}/(\text{V}/\text{m})^2$ )	Normy dipole 2 ( $\mu\text{V}/(\text{V}/\text{m})^2$ )	Normz dipole 3 ( $\mu\text{V}/(\text{V}/\text{m})^2$ )
0.66	0.75	0.58

DCP dipole 1 (mV)	DCP dipole 2 (mV)	DCP dipole 3 (mV)
93	93	98

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

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

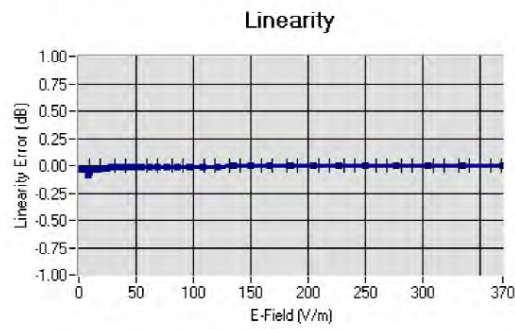




## COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.260.1.18.SATU.A

## 5.2 LINEARITY

Linearity:  $\pm 1.89\%$  ( $\pm 0.08\text{dB}$ )

## 5.3 SENSITIVITY IN LIQUID

Liquid	Frequency (MHz $\pm$ 100MHz)	Permittivity	Epsilon (S/m)	ConvF
HL750	750	40.03	0.93	1.45
BL750	750	56.83	1.00	1.49
HL850	835	42.19	0.90	1.50
BL850	835	54.67	1.01	1.56
HL900	900	42.08	1.01	1.51
HL1800	1800	41.68	1.46	1.71
BL1800	1800	53.86	1.46	1.77
HL1900	1900	38.45	1.45	2.03
BL1900	1900	53.32	1.56	2.07
HL2000	2000	38.26	1.38	1.76
HL2450	2450	37.50	1.80	2.00
BL2450	2450	53.22	1.89	2.08
HL2600	2600	39.80	1.99	2.12
BL2600	2600	52.52	2.23	2.19
HL5200	5200	35.64	4.67	2.55
BL5200	5200	48.64	5.51	2.62
HL5400	5400	36.44	4.87	2.53
BL5400	5400	46.52	5.77	2.59
HL5600	5600	36.66	5.17	2.64
BL5600	5600	46.79	5.77	2.73
HL5800	5800	35.31	5.31	2.72
BL5800	5800	47.04	6.10	2.81

LOWER DETECTION LIMIT: 7mW/kg

Page: 7/10

This document shall not be reproduced, except in full or in part, without the written approval of MVG.  
The information contained herein is to be used only for the purpose for which it is submitted and is not to be released in whole or part without written approval of MVG.





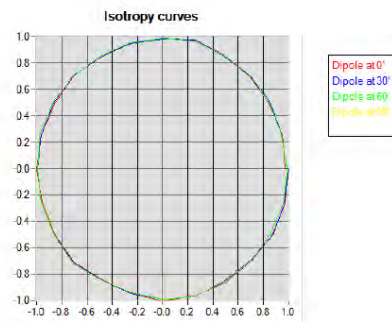
## COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.260.1.18.SATU.A

### 5.4 ISOTROPY

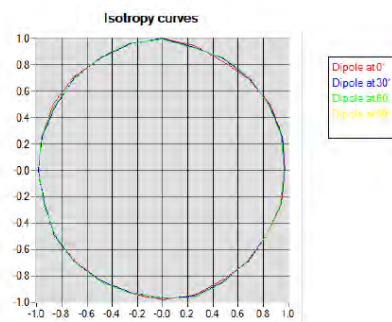
#### HL900 MHz

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



#### HL1800 MHz

- Axial isotropy: 0.06 dB
- Hemispherical isotropy: 0.08 dB



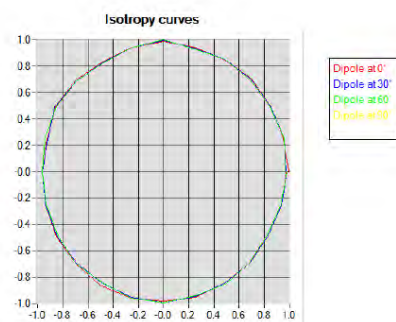


# COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.260.1.18.SATU.A

## HL5600 MHz

- Axial isotropy: 0.06 dB
- Hemispherical isotropy: 0.08 dB





**COMOSAR E-FIELD PROBE CALIBRATION REPORT**

Ref: ACR.260.1.18.SATU.A

**6 LIST OF EQUIPMENT**

Equipment Summary Sheet				
Equipment Description	Manufacturer / Model	Identification No.	Current Calibration Date	Next Calibration Date
Flat 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	02/2016	02/2019
Reference Probe	MVG	EP 94 SN 37/08	10/2017	10/2018
Multimeter	Keithley 2000	1188656	01/2017	01/2020
Signal Generator	Agilent E4438C	MY49070581	01/2017	01/2020
Amplifier	Aethercomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	HP E4418A	US38261498	01/2017	01/2020
Power Sensor	HP ECP-E26A	US37181460	01/2017	01/2020
Directional Coupler	Narda 4216-20	01386	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Waveguide	Mega Industries	069Y7-158-13-712	Validated. No cal required.	Validated. No cal required.
Waveguide Transition	Mega Industries	069Y7-158-13-701	Validated. No cal required.	Validated. No cal required.
Waveguide Termination	Mega Industries	069Y7-158-13-701	Validated. No cal required.	Validated. No cal required.
Temperature / Humidity Sensor	Control Company	150798832	11/2017	11/2020



## COMOSAR E-Field Probe Calibration Report

Ref : ACR.139.3.18.SATU.A

**Shenzhen NTEK Testing Technology Co., Ltd.**  
**BUILDING E, FENDA SCIENCE PARK,**  
**SANWEI COMMUNITY, XIXIANG STREET,**  
**BAO'AN DISTRICT, SHENZHEN, GUANGDONG, CHINA**  
**MVG COMOSAR DOSIMETRIC E-FIELD PROBE**  
**SERIAL NO.: SN 07/15 EP247**

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



**Calibration Date: 04/06/2018**

### *Summary:*




This document presents the method and results from an accredited COMOSAR Dosimetric E-Field Probe calibration performed in MVG USA using the CALISAR / CALIBAIR test bench, for use with a COMOSAR system only. All calibration results are traceable to national metrology institutions.





## COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.139.3.18.SATU.A

	Name	Function	Date	Signature
Prepared by :	Jérôme LUC	Product Manager	04/06/2018	
Checked by :	Jérôme LUC	Product Manager	04/06/2018	
Approved by :	Kim RUTKOWSKI	Quality Manager	04/06/2018	

	Customer Name
Distribution :	NTEK TESTING TECHNOLOGY CO., LTD.

Issue	Date	Modifications
A	04/06/2018	Initial release



## COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.139.3.18.SATU.A

## TABLE OF CONTENTS

1	Device Under Test .....	4
2	Product Description .....	4
2.1	General Information .....	4
3	Measurement Method .....	4
3.1	Linearity .....	4
3.2	Sensitivity .....	5
3.3	Lower Detection Limit .....	5
3.4	Isotropy .....	5
3.5	Boundary Effect .....	5
4	Measurement Uncertainty .....	5
5	Calibration Measurement Results .....	6
5.1	Sensitivity in air .....	6
5.2	Linearity .....	7
5.3	Sensitivity in liquid .....	7
5.4	Isotropy .....	8
6	List of Equipment .....	9



## COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.139.3.18.SATU.A

**1 DEVICE UNDER TEST**

Device Under Test	
Device Type	COMOSAR DOSIMETRIC E FIELD PROBE
Manufacturer	MVG
Model	SSE5
Serial Number	SN 07/15 EP247
Product Condition (new / used)	New
Frequency Range of Probe	0.7 GHz-3GHz
Resistance of Three Dipoles at Connector	Dipole 1: R1=0.181 MΩ Dipole 2: R2=0.167 MΩ Dipole 3: R3=0.175 MΩ

A yearly calibration interval is recommended.

**2 PRODUCT DESCRIPTION****2.1 GENERAL INFORMATION**

MVG's COMOSAR E field Probes are built in accordance to the IEEE 1528, OET 65 Bulletin C and CEI/IEC 62209 standards.



**Figure 1 – MVG COMOSAR Dosimetric E field Dipole**

Probe Length	330 mm
Length of Individual Dipoles	4.5 mm
Maximum external diameter	8 mm
Probe Tip External Diameter	5 mm
Distance between dipoles / probe extremity	2.7 mm

**3 MEASUREMENT METHOD**

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

**3.1 LINEARITY**

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



## COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.139.3.18.SATU.A

### 3.2 SENSITIVITY

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

### 3.3 LOWER DETECTION LIMIT

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

### 3.4 ISOTROPY

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

### 3.5 BOUNDARY EFFECT

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

## 4 MEASUREMENT UNCERTAINTY

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

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

Page: 5/9

This document shall not be reproduced, except in full or in part, without the written approval of MVG.  
The information contained herein is to be used only for the purpose for which it is submitted and is not to be released in whole or part without written approval of MVG.





## COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.139.3.18.SATU.A

Field probe linearity	3.00%	Rectangular	$\sqrt{3}$	1	1.732%
Combined standard uncertainty					5.831%
Expanded uncertainty 95 % confidence level k = 2					12.0%

## 5 CALIBRATION MEASUREMENT RESULTS

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

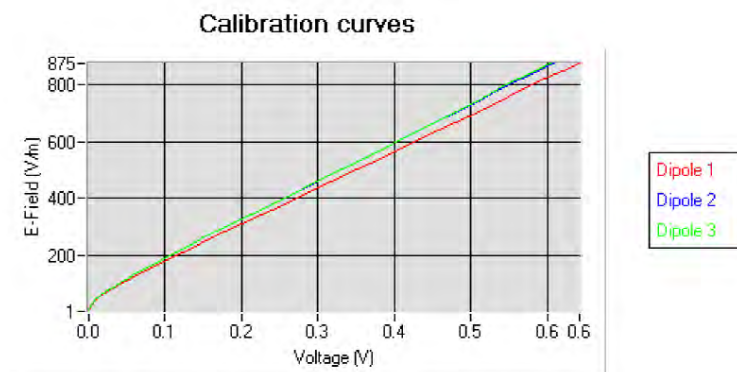
## 5.1 SENSITIVITY IN AIR

Normx dipole 1 ( $\mu\text{V}/(\text{V}/\text{m})^2$ )	Normy dipole 2 ( $\mu\text{V}/(\text{V}/\text{m})^2$ )	Normz dipole 3 ( $\mu\text{V}/(\text{V}/\text{m})^2$ )
6.82	6.16	6.12

DCP dipole 1 (mV)	DCP dipole 2 (mV)	DCP dipole 3 (mV)
95	93	90

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

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

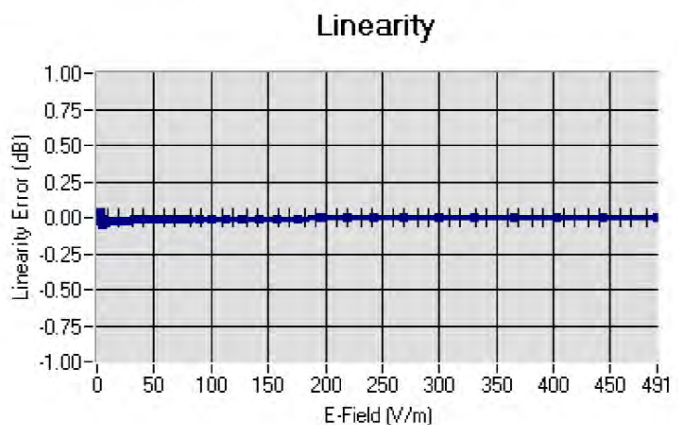




## COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.139.3.18.SATU.A

## 5.2 LINEARITY

Linearity:  $\pm 1.05\%$  ( $\pm 0.05\text{dB}$ )

## 5.3 SENSITIVITY IN LIQUID

Liquid	Frequency (MHz +/- 100MHz)	Permittivity	Epsilon (S/m)	ConvF
HL450	450	43.68	0.87	5.01
BL450	450	58.34	0.99	5.35
HL750	750	41.82	0.90	4.23
BL750	750	56.28	0.98	4.39
HL850	835	42.59	0.90	4.54
BL850	835	53.19	0.97	4.71
HL900	900	42.05	0.98	4.25
BL900	900	56.41	1.08	4.39
HL1750	1750	41.82	1.38	3.77
BL1750	1750	53.00	1.52	3.85
HL1900	1900	40.38	1.41	4.27
BL1900	1900	53.93	1.55	4.39
HL2300	2300	40.12	1.43	3.90
BL2300	2300	53.65	1.54	4.05
HL2450	2450	38.34	1.80	3.72
BL2450	2450	52.70	1.94	3.84
HL2600	2600	38.16	1.93	3.65
BL2600	2600	51.55	2.21	3.75

LOWER DETECTION LIMIT: 8mW/kg



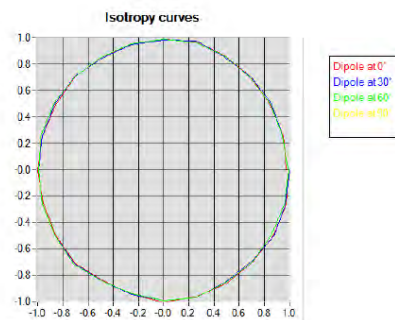
## COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.139.3.18.SATU.A

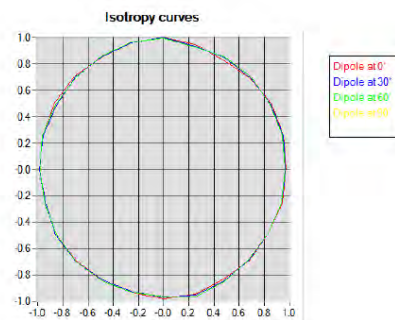
## 5.4 ISOTROPY

**HL900 MHz**

- Axial isotropy: 0.04 dB
- Hemispherical isotropy: 0.05 dB

**HL1750 MHz**

- Axial isotropy: 0.05 dB
- Hemispherical isotropy: 0.08 dB







## COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.139.3.18.SATU.A

## 6 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Description	Manufacturer / Model	Identification No.	Current Calibration Date	Next Calibration Date
Flat 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	02/2016	02/2019
Reference Probe	MVG	EP 94 SN 37/08	10/2017	10/2018
Multimeter	Keithley 2000	1188656	01/2017	01/2020
Signal Generator	Agilent E4438C	MY49070581	01/2017	01/2020
Amplifier	Aethercomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	HP E4418A	US38261498	01/2017	01/2020
Power Sensor	HP ECP-E26A	US37181460	01/2017	01/2020
Directional Coupler	Narda 4216-20	01386	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Waveguide	Mega Industries	069Y7-158-13-712	Validated. No cal required.	Validated. No cal required.
Waveguide Transition	Mega Industries	069Y7-158-13-701	Validated. No cal required.	Validated. No cal required.
Waveguide Termination	Mega Industries	069Y7-158-13-701	Validated. No cal required.	Validated. No cal required.
Temperature / Humidity Sensor	Control Company	150798832	10/2016	10/2018



## SAR Reference Dipole Calibration Report

Ref : ACR.109.2.18.SATU.A

### **SHENZHEN NTEK TESTING TECHNOLOGY CO., LTD.**

**BUILDING E, FENDA SCIENCE PARK, SANWEI  
COMMUNITY, XIXIANG STREET,  
BAO'AN DISTRICT, SHENZHEN GUANGDONG, CHINA  
MVG COMOSAR REFERENCE DIPOLE**

**FREQUENCY: 835 MHZ**

**SERIAL NO.: SN 03/15 DIP 0G835-347**

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



**Calibration Date: 04/19/2018**




#### *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.109.2.18.SATU.A

	<i>Name</i>	<i>Function</i>	<i>Date</i>	<i>Signature</i>
<i>Prepared by :</i>	Jérôme LUC	Product Manager	4/19/2018	
<i>Checked by :</i>	Jérôme LUC	Product Manager	4/19/2018	
<i>Approved by :</i>	Kim RUTKOWSKI	Quality Manager	4/19/2018	

	<i>Customer Name</i>
<i>Distribution :</i>	SHENZHEN NTEK TESTING TECHNOLOGY CO., LTD.

<i>Issue</i>	<i>Date</i>	<i>Modifications</i>
A	4/19/2018	Initial release