



SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.15.9.21.MVGB.B

7.1 HEAD LIQUID MEASUREMENT

| Frequency<br>MHz | Relative permittivity ( $\epsilon_r'$ ) |          | Conductivity ( $\sigma$ ) S/m |          |
|------------------|-----------------------------------------|----------|-------------------------------|----------|
|                  | required                                | measured | required                      | measured |
| 300              | 45.3 $\pm$ 10 %                         |          | 0.87 $\pm$ 10 %               |          |
| 450              | 43.5 $\pm$ 10 %                         |          | 0.87 $\pm$ 10 %               |          |
| 750              | 41.9 $\pm$ 10 %                         |          | 0.89 $\pm$ 10 %               |          |
| 835              | 41.5 $\pm$ 10 %                         |          | 0.90 $\pm$ 10 %               |          |
| 900              | 41.5 $\pm$ 10 %                         |          | 0.97 $\pm$ 10 %               |          |
| 1450             | 40.5 $\pm$ 10 %                         |          | 1.20 $\pm$ 10 %               |          |
| 1500             | 40.4 $\pm$ 10 %                         |          | 1.23 $\pm$ 10 %               |          |
| 1640             | 40.2 $\pm$ 10 %                         |          | 1.31 $\pm$ 10 %               |          |
| 1750             | 40.1 $\pm$ 10 %                         | 43.8     | 1.37 $\pm$ 10 %               | 1.30     |
| 1800             | 40.0 $\pm$ 10 %                         |          | 1.40 $\pm$ 10 %               |          |
| 1900             | 40.0 $\pm$ 10 %                         |          | 1.40 $\pm$ 10 %               |          |
| 1950             | 40.0 $\pm$ 10 %                         |          | 1.40 $\pm$ 10 %               |          |
| 2000             | 40.0 $\pm$ 10 %                         |          | 1.40 $\pm$ 10 %               |          |
| 2100             | 39.8 $\pm$ 10 %                         |          | 1.49 $\pm$ 10 %               |          |
| 2300             | 39.5 $\pm$ 10 %                         |          | 1.67 $\pm$ 10 %               |          |
| 2450             | 39.2 $\pm$ 10 %                         |          | 1.80 $\pm$ 10 %               |          |
| 2600             | 39.0 $\pm$ 10 %                         |          | 1.96 $\pm$ 10 %               |          |
| 3000             | 38.5 $\pm$ 10 %                         |          | 2.40 $\pm$ 10 %               |          |
| 3300             | 38.2 $\pm$ 10 %                         |          | 2.71 $\pm$ 10 %               |          |
| 3500             | 37.9 $\pm$ 10 %                         |          | 2.91 $\pm$ 10 %               |          |
| 3700             | 37.7 $\pm$ 10 %                         |          | 3.12 $\pm$ 10 %               |          |
| 3900             | 37.5 $\pm$ 10 %                         |          | 3.32 $\pm$ 10 %               |          |
| 4200             | 37.1 $\pm$ 10 %                         |          | 3.63 $\pm$ 10 %               |          |
| 4600             | 36.7 $\pm$ 10 %                         |          | 4.04 $\pm$ 10 %               |          |
| 4900             | 36.3 $\pm$ 10 %                         |          | 4.35 $\pm$ 10 %               |          |

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.

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|                                           |                                                          |
|-------------------------------------------|----------------------------------------------------------|
| Software                                  | OPENSAR V5                                               |
| Phantom                                   | SN 13/09 SAM68                                           |
| Probe                                     | SN 41/18 EPG0333                                         |
| Liquid                                    | Head Liquid Values: $\epsilon_s'$ : 43.8 $\sigma$ : 1.30 |
| Distance between dipole center and liquid | 10.0 mm                                                  |
| Area scan resolution                      | $dx=8mm/dy=8mm$                                          |
| Zoon Scan Resolution                      | $dx=8mm/dy=8mm/dz=5mm$                                   |
| Frequency                                 | 1750 MHz                                                 |
| Input power                               | 20 dBm                                                   |
| Liquid Temperature                        | 20 +/- 1 °C                                              |
| Lab Temperature                           | 20 +/- 1 °C                                              |
| Lab Humidity                              | 30-70 %                                                  |

| Frequency<br>MHz | 1 g SAR (W/kg/W) |              | 10 g SAR (W/kg/W) |              |
|------------------|------------------|--------------|-------------------|--------------|
|                  | required         | measured     | required          | measured     |
| 300              | 2.85             |              | 1.94              |              |
| 450              | 4.58             |              | 3.06              |              |
| 750              | 8.49             |              | 5.55              |              |
| 835              | 9.56             |              | 6.22              |              |
| 900              | 10.9             |              | 6.99              |              |
| 1450             | 29               |              | 16                |              |
| 1500             | 30.5             |              | 16.8              |              |
| 1640             | 34.2             |              | 18.4              |              |
| 1750             | 36.4             | 36.50 (3.65) | 19.3              | 19.18 (1.92) |
| 1800             | 38.4             |              | 20.1              |              |
| 1900             | 39.7             |              | 20.5              |              |
| 1950             | 40.5             |              | 20.9              |              |
| 2000             | 41.1             |              | 21.1              |              |
| 2100             | 43.6             |              | 21.9              |              |
| 2300             | 48.7             |              | 23.3              |              |
| 2450             | 52.4             |              | 24                |              |
| 2600             | 55.3             |              | 24.6              |              |
| 3000             | 63.8             |              | 25.7              |              |
| 3300             | -                |              | -                 |              |
| 3500             | 67.1             |              | 25                |              |
| 3700             | 67.4             |              | 24.2              |              |
| 3900             | -                |              | -                 |              |
| 4200             | -                |              | -                 |              |
| 4600             | -                |              | -                 |              |
| 4900             | -                |              | -                 |              |

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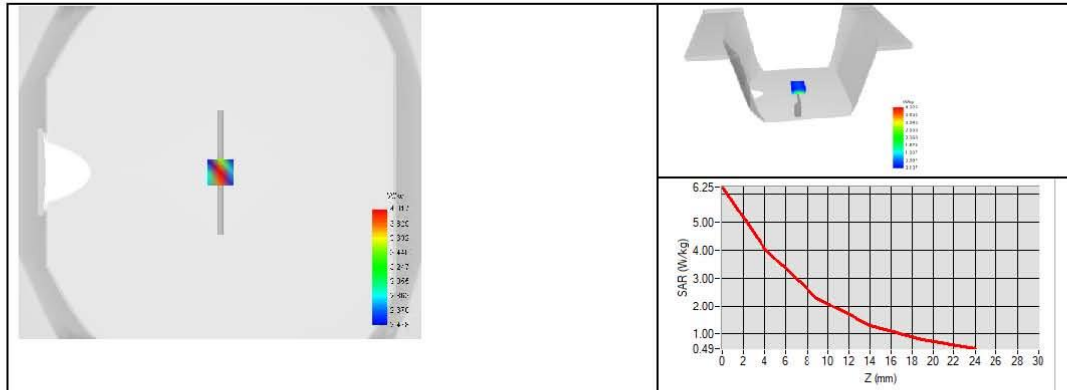
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7.3 BODY LIQUID MEASUREMENT

| Frequency<br>MHz | Relative permittivity ( $\epsilon_r'$ ) |          | Conductivity ( $\sigma$ ) S/m |          |
|------------------|-----------------------------------------|----------|-------------------------------|----------|
|                  | required                                | measured | required                      | measured |
| 150              | 61.9 $\pm$ 10 %                         |          | 0.80 $\pm$ 10 %               |          |
| 300              | 58.2 $\pm$ 10 %                         |          | 0.92 $\pm$ 10 %               |          |
| 450              | 56.7 $\pm$ 10 %                         |          | 0.94 $\pm$ 10 %               |          |
| 750              | 55.5 $\pm$ 10 %                         |          | 0.96 $\pm$ 10 %               |          |
| 835              | 55.2 $\pm$ 10 %                         |          | 0.97 $\pm$ 10 %               |          |
| 900              | 55.0 $\pm$ 10 %                         |          | 1.05 $\pm$ 10 %               |          |
| 915              | 55.0 $\pm$ 10 %                         |          | 1.06 $\pm$ 10 %               |          |
| 1450             | 54.0 $\pm$ 10 %                         |          | 1.30 $\pm$ 10 %               |          |
| 1610             | 53.8 $\pm$ 10 %                         |          | 1.40 $\pm$ 10 %               |          |
| 1750             | 53.4 $\pm$ 10 %                         | 55.6     | 1.49 $\pm$ 10 %               | 1.45     |
| 1800             | 53.3 $\pm$ 10 %                         |          | 1.52 $\pm$ 10 %               |          |
| 1900             | 53.3 $\pm$ 10 %                         |          | 1.52 $\pm$ 10 %               |          |
| 2000             | 53.3 $\pm$ 10 %                         |          | 1.52 $\pm$ 10 %               |          |
| 2100             | 53.2 $\pm$ 10 %                         |          | 1.62 $\pm$ 10 %               |          |
| 2300             | 52.9 $\pm$ 10 %                         |          | 1.81 $\pm$ 10 %               |          |
| 2450             | 52.7 $\pm$ 10 %                         |          | 1.95 $\pm$ 10 %               |          |
| 2600             | 52.5 $\pm$ 10 %                         |          | 2.16 $\pm$ 10 %               |          |
| 3000             | 52.0 $\pm$ 10 %                         |          | 2.73 $\pm$ 10 %               |          |
| 3300             | 51.6 $\pm$ 10 %                         |          | 3.08 $\pm$ 10 %               |          |
| 3500             | 51.3 $\pm$ 10 %                         |          | 3.31 $\pm$ 10 %               |          |
| 3700             | 51.0 $\pm$ 10 %                         |          | 3.55 $\pm$ 10 %               |          |
| 3900             | 50.8 $\pm$ 10 %                         |          | 3.78 $\pm$ 10 %               |          |
| 4200             | 50.4 $\pm$ 10 %                         |          | 4.13 $\pm$ 10 %               |          |
| 4600             | 49.8 $\pm$ 10 %                         |          | 4.60 $\pm$ 10 %               |          |
| 4900             | 49.4 $\pm$ 10 %                         |          | 4.95 $\pm$ 10 %               |          |
| 5200             | 49.0 $\pm$ 10 %                         |          | 5.30 $\pm$ 10 %               |          |
| 5300             | 48.9 $\pm$ 10 %                         |          | 5.42 $\pm$ 10 %               |          |
| 5400             | 48.7 $\pm$ 10 %                         |          | 5.53 $\pm$ 10 %               |          |
| 5500             | 48.6 $\pm$ 10 %                         |          | 5.65 $\pm$ 10 %               |          |
| 5600             | 48.5 $\pm$ 10 %                         |          | 5.77 $\pm$ 10 %               |          |
| 5800             | 48.2 $\pm$ 10 %                         |          | 6.00 $\pm$ 10 %               |          |

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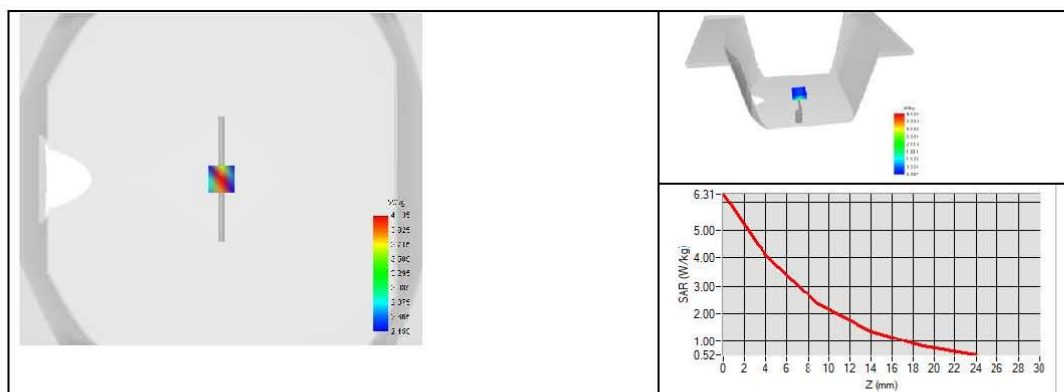
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**7.4 SAR MEASUREMENT RESULT WITH BODY LIQUID**

|                                           |                                                        |
|-------------------------------------------|--------------------------------------------------------|
| Software                                  | OPENSAR V5                                             |
| Phantom                                   | SN 13/09 SAM68                                         |
| Probe                                     | SN 41/18 EPG0333                                       |
| Liquid                                    | Body Liquid Values: $\epsilon_s^*$ : 55.6 sigma : 1.45 |
| Distance between dipole center and liquid | 10.0 mm                                                |
| Area scan resolution                      | dx=8mm/dy=8mm                                          |
| Zoon Scan Resolution                      | dx=8mm/dy=8mm/dz=5mm                                   |
| Frequency                                 | 1750 MHz                                               |
| Input power                               | 20 dBm                                                 |
| Liquid Temperature                        | 20 +/- 1 °C                                            |
| Lab Temperature                           | 20 +/- 1 °C                                            |
| Lab Humidity                              | 30-70 %                                                |

| Frequency<br>MHz | 1 g SAR (W/kg/W) | 10 g SAR (W/kg/W) |
|------------------|------------------|-------------------|
|                  | measured         | measured          |
| 1750             | 37.02 (3.70)     | 19.36 (1.94)      |





## SAR REFERENCE DIPOLE CALIBRATION REPORT

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## 8 LIST OF EQUIPMENT

| Equipment Summary Sheet            |                         |                    |                                               |                                               |
|------------------------------------|-------------------------|--------------------|-----------------------------------------------|-----------------------------------------------|
| Equipment Description              | Manufacturer / Model    | Identification No. | Current Calibration Date                      | Next Calibration Date                         |
| SAM Phantom                        | MVG                     | SN-13/09-SAM68     | Validated. No cal required.                   | Validated. No cal required.                   |
| COMOSAR Test Bench                 | Version 3               | NA                 | Validated. No cal required.                   | Validated. No cal required.                   |
| Network Analyzer                   | Rohde & Schwarz ZVM     | 100203             | 05/2019                                       | 05/2022                                       |
| Network Analyzer – Calibration kit | Rohde & Schwarz ZV-Z235 | 101223             | 05/2019                                       | 05/2022                                       |
| Calipers                           | Mitutoyo                | SN 0009732         | 10/2019                                       | 10/2022                                       |
| Reference Probe                    | MVG                     | EPGO333 SN 41/18   | 05/2020                                       | 05/2021                                       |
| Multimeter                         | Keithley 2000           | 1160271            | 02/2020                                       | 02/2023                                       |
| Signal Generator                   | Rohde & Schwarz SMB     | 106589             | 04/2019                                       | 04/2022                                       |
| Amplifier                          | Aethercomm              | SN 046             | Characterized prior to test. No cal required. | Characterized prior to test. No cal required. |
| Power Meter                        | NI-USB 5680             | 170100013          | 05/2019                                       | 05/2022                                       |
| Directional Coupler                | Narda 4216-20           | 01386              | Characterized prior to test. No cal required. | Characterized prior to test. No cal required. |
| Temperature / Humidity Sensor      | Testo 184 H1            | 44220687           | 05/2020                                       | 05/2023                                       |

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## SAR Reference Dipole Calibration Report

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Cancel and replace the report ACR.15.10.21.MVGB.A

### JIANYAN TESTING GROUP SHENZHEN CO.,LTD.

No.110~116, BUILDING B, JINYUAN BUSINESS BUILDING,  
XIXIANG ROAD, BAOAN DISTRICT,  
SHENZHEN, GUANGDONG, PR CHINA

### MVG COMOSAR REFERENCE DIPOLE

FREQUENCY: 1900 MHZ

SERIAL NO.: SN 50/20 DIP 1G900-511

### Calibrated at MVG

Z.I. de la pointe du diable

Technopôle Brest Iroise – 295 avenue Alexis de Rochon  
29280 PLOUZANE - FRANCE

Calibration date: 01/14/2021



Accreditations #2-6789 and #2-6814  
Scope available on [www.cofrac.fr](http://www.cofrac.fr)

### Summary:

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

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## SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.15.10.21.MVGB.B

|               | Name         | Function            | Date      | Signature           |
|---------------|--------------|---------------------|-----------|---------------------|
| Prepared by : | Jérôme LUC   | Technical Manager   | 1/15/2021 | <i>Jes</i>          |
| Checked by :  | Jérôme LUC   | Technical Manager   | 1/15/2021 | <i>Jes</i>          |
| Approved by : | Yann Toutain | Laboratory Director | 2/8/2021  | <i>Yann Toutain</i> |

2021.02.0  
8 17:53:07  
+01'00'

|                | Customer Name                                 |
|----------------|-----------------------------------------------|
| Distribution : | JianYan Testing<br>Group Shenzhen<br>Co.,Ltd. |

| Issue | Name       | Date      | Modifications                |
|-------|------------|-----------|------------------------------|
| A     | Jérôme LUC | 1/15/2021 | Initial release              |
| B     | Jérôme LUC | 2/8/2021  | Change customer name/address |
|       |            |           |                              |
|       |            |           |                              |

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## 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 50/20 DIP 1G900-511            |
| Product Condition (new / used) | New                               |

## 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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#### 4 MEASUREMENT METHOD

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

##### 4.1 RETURN LOSS REQUIREMENTS

The dipole used for SAR system validation measurements and checks must have a return loss of -20 dB or better. The return loss measurement shall be performed against a liquid filled flat phantom, with the phantom constructed as outlined in the fore mentioned standards. A direct method is used with a network analyser and its calibration kit, both with a valid ISO17025 calibration.

##### 4.2 MECHANICAL REQUIREMENTS

The IEEE Std. 1528 and CEI/IEC 62209 standards specify the mechanical components and dimensions of the validation dipoles, with the dimension's 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. A direct method is used with a ISO17025 calibrated caliper.

#### 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    | 0.08 LIN                            |

##### 5.2 DIMENSION MEASUREMENT

The following uncertainties apply to the dimension measurements:

| Length (mm) | Expanded Uncertainty on Length |
|-------------|--------------------------------|
| 0 - 300     | 0.20 mm                        |
| 300 - 450   | 0.44 mm                        |

##### 5.3 VALIDATION MEASUREMENT

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

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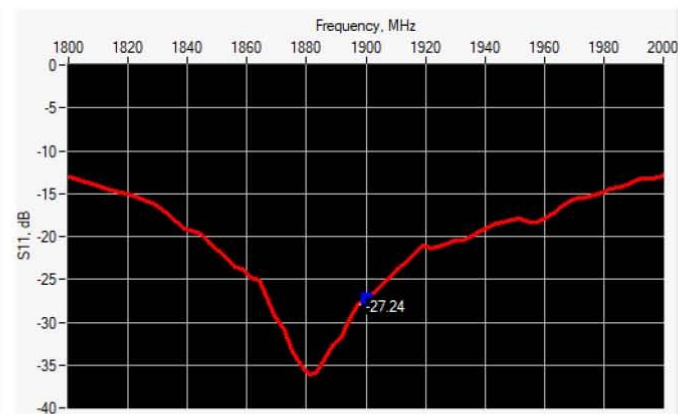
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| Scan Volume | Expanded Uncertainty |
|-------------|----------------------|
| 1 g         | 19 % (SAR)           |
| 10 g        | 19 % (SAR)           |

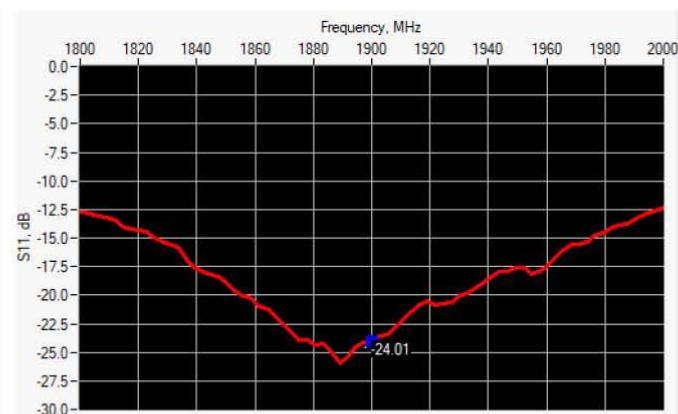
## 6 CALIBRATION MEASUREMENT RESULTS

### 6.1 RETURN LOSS AND IMPEDANCE IN HEAD LIQUID



| Frequency (MHz) | Return Loss (dB) | Requirement (dB) | Impedance                   |
|-----------------|------------------|------------------|-----------------------------|
| 1900            | -27.24           | -20              | $51.2 \Omega + 4.2 j\Omega$ |

### 6.2 RETURN LOSS AND IMPEDANCE IN BODY LIQUID



| Frequency (MHz) | Return Loss (dB) | Requirement (dB) | Impedance                   |
|-----------------|------------------|------------------|-----------------------------|
| 1900            | -24.01           | -20              | $46.6 \Omega + 5.3 j\Omega$ |

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## 6.3 MECHANICAL DIMENSIONS

| Frequency MHz | L mm        |          | h mm        |          | d mm       |          |
|---------------|-------------|----------|-------------|----------|------------|----------|
|               | required    | measured | required    | measured | required   | measured |
| 300           | 420.0 ±1 %. |          | 250.0 ±1 %. |          | 6.35 ±1 %. |          |
| 450           | 290.0 ±1 %. |          | 166.7 ±1 %. |          | 6.35 ±1 %. |          |
| 750           | 176.0 ±1 %. |          | 100.0 ±1 %. |          | 6.35 ±1 %. |          |
| 835           | 161.0 ±1 %. |          | 89.8 ±1 %.  |          | 3.6 ±1 %.  |          |
| 900           | 149.0 ±1 %. |          | 83.3 ±1 %.  |          | 3.6 ±1 %.  |          |
| 1450          | 89.1 ±1 %.  |          | 51.7 ±1 %.  |          | 3.6 ±1 %.  |          |
| 1500          | 80.5 ±1 %.  |          | 50.0 ±1 %.  |          | 3.6 ±1 %.  |          |
| 1640          | 79.0 ±1 %.  |          | 45.7 ±1 %.  |          | 3.6 ±1 %.  |          |
| 1750          | 75.2 ±1 %.  |          | 42.9 ±1 %.  |          | 3.6 ±1 %.  |          |
| 1800          | 72.0 ±1 %.  |          | 41.7 ±1 %.  |          | 3.6 ±1 %.  |          |
| 1900          | 68.0 ±1 %.  | 68.23    | 39.5 ±1 %.  | 39.22    | 3.6 ±1 %.  | 3.59     |
| 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 %.  |          |
| 3300          | -           |          | -           |          | -          |          |
| 3500          | 37.0 ±1 %.  |          | 26.4 ±1 %.  |          | 3.6 ±1 %.  |          |
| 3700          | 34.7 ±1 %.  |          | 26.4 ±1 %.  |          | 3.6 ±1 %.  |          |
| 3900          | -           |          | -           |          | -          |          |
| 4200          | -           |          | -           |          | -          |          |
| 4600          | -           |          | -           |          | -          |          |
| 4900          | -           |          | -           |          | -          |          |

## 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.

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**SAR REFERENCE DIPOLE CALIBRATION REPORT**

Ref: ACR.15.10.21.MVGB.B

**7.1 HEAD LIQUID MEASUREMENT**

| Frequency<br>MHz | Relative permittivity ( $\epsilon_r'$ ) |          | Conductivity ( $\sigma$ ) S/m |          |
|------------------|-----------------------------------------|----------|-------------------------------|----------|
|                  | required                                | measured | required                      | measured |
| 300              | 45.3 $\pm$ 10 %                         |          | 0.87 $\pm$ 10 %               |          |
| 450              | 43.5 $\pm$ 10 %                         |          | 0.87 $\pm$ 10 %               |          |
| 750              | 41.9 $\pm$ 10 %                         |          | 0.89 $\pm$ 10 %               |          |
| 835              | 41.5 $\pm$ 10 %                         |          | 0.90 $\pm$ 10 %               |          |
| 900              | 41.5 $\pm$ 10 %                         |          | 0.97 $\pm$ 10 %               |          |
| 1450             | 40.5 $\pm$ 10 %                         |          | 1.20 $\pm$ 10 %               |          |
| 1500             | 40.4 $\pm$ 10 %                         |          | 1.23 $\pm$ 10 %               |          |
| 1640             | 40.2 $\pm$ 10 %                         |          | 1.31 $\pm$ 10 %               |          |
| 1750             | 40.1 $\pm$ 10 %                         |          | 1.37 $\pm$ 10 %               |          |
| 1800             | 40.0 $\pm$ 10 %                         |          | 1.40 $\pm$ 10 %               |          |
| 1900             | 40.0 $\pm$ 10 %                         | 43.3     | 1.40 $\pm$ 10 %               | 1.41     |
| 1950             | 40.0 $\pm$ 10 %                         |          | 1.40 $\pm$ 10 %               |          |
| 2000             | 40.0 $\pm$ 10 %                         |          | 1.40 $\pm$ 10 %               |          |
| 2100             | 39.8 $\pm$ 10 %                         |          | 1.49 $\pm$ 10 %               |          |
| 2300             | 39.5 $\pm$ 10 %                         |          | 1.67 $\pm$ 10 %               |          |
| 2450             | 39.2 $\pm$ 10 %                         |          | 1.80 $\pm$ 10 %               |          |
| 2600             | 39.0 $\pm$ 10 %                         |          | 1.96 $\pm$ 10 %               |          |
| 3000             | 38.5 $\pm$ 10 %                         |          | 2.40 $\pm$ 10 %               |          |
| 3300             | 38.2 $\pm$ 10 %                         |          | 2.71 $\pm$ 10 %               |          |
| 3500             | 37.9 $\pm$ 10 %                         |          | 2.91 $\pm$ 10 %               |          |
| 3700             | 37.7 $\pm$ 10 %                         |          | 3.12 $\pm$ 10 %               |          |
| 3900             | 37.5 $\pm$ 10 %                         |          | 3.32 $\pm$ 10 %               |          |
| 4200             | 37.1 $\pm$ 10 %                         |          | 3.63 $\pm$ 10 %               |          |
| 4600             | 36.7 $\pm$ 10 %                         |          | 4.04 $\pm$ 10 %               |          |
| 4900             | 36.3 $\pm$ 10 %                         |          | 4.35 $\pm$ 10 %               |          |

**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.

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## SAR REFERENCE DIPOLE CALIBRATION REPORT

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|                                           |                                                         |
|-------------------------------------------|---------------------------------------------------------|
| Software                                  | OPENSAR V5                                              |
| Phantom                                   | SN 13/09 SAM68                                          |
| Probe                                     | SN 41/18 EPG0333                                        |
| Liquid                                    | Head Liquid Values: $\epsilon_p$ : 43.3 $\sigma$ : 1.41 |
| Distance between dipole center and liquid | 10.0 mm                                                 |
| Area scan resolution                      | $dx=8mm/dy=8mm$                                         |
| Zoon Scan Resolution                      | $dx=8mm/dy=8mm/dz=5mm$                                  |
| Frequency                                 | 1900 MHz                                                |
| Input power                               | 20 dBm                                                  |
| Liquid Temperature                        | 20 +/- 1 °C                                             |
| Lab Temperature                           | 20 +/- 1 °C                                             |
| Lab Humidity                              | 30-70 %                                                 |

| Frequency<br>MHz | 1 g SAR (W/kg/W) |              | 10 g SAR (W/kg/W) |              |
|------------------|------------------|--------------|-------------------|--------------|
|                  | required         | measured     | required          | measured     |
| 300              | 2.85             |              | 1.94              |              |
| 450              | 4.58             |              | 3.06              |              |
| 750              | 8.49             |              | 5.55              |              |
| 835              | 9.56             |              | 6.22              |              |
| 900              | 10.9             |              | 6.99              |              |
| 1450             | 29               |              | 16                |              |
| 1500             | 30.5             |              | 16.8              |              |
| 1640             | 34.2             |              | 18.4              |              |
| 1750             | 36.4             |              | 19.3              |              |
| 1800             | 38.4             |              | 20.1              |              |
| 1900             | 39.7             | 39.60 (3.96) | 20.5              | 20.33 (2.03) |
| 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              |              |
| 3300             | -                |              | -                 |              |
| 3500             | 67.1             |              | 25                |              |
| 3700             | 67.4             |              | 24.2              |              |
| 3900             | -                |              | -                 |              |
| 4200             | -                |              | -                 |              |
| 4600             | -                |              | -                 |              |
| 4900             | -                |              | -                 |              |

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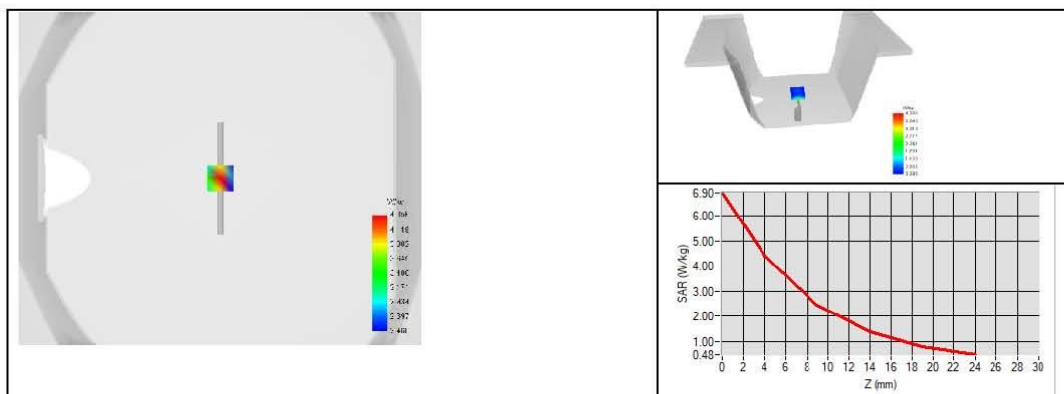
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7.3 BODY LIQUID MEASUREMENT

| Frequency<br>MHz | Relative permittivity ( $\epsilon_r'$ ) |          | Conductivity ( $\sigma$ ) S/m |          |
|------------------|-----------------------------------------|----------|-------------------------------|----------|
|                  | required                                | measured | required                      | measured |
| 150              | 61.9 $\pm$ 10 %                         |          | 0.80 $\pm$ 10 %               |          |
| 300              | 58.2 $\pm$ 10 %                         |          | 0.92 $\pm$ 10 %               |          |
| 450              | 56.7 $\pm$ 10 %                         |          | 0.94 $\pm$ 10 %               |          |
| 750              | 55.5 $\pm$ 10 %                         |          | 0.96 $\pm$ 10 %               |          |
| 835              | 55.2 $\pm$ 10 %                         |          | 0.97 $\pm$ 10 %               |          |
| 900              | 55.0 $\pm$ 10 %                         |          | 1.05 $\pm$ 10 %               |          |
| 915              | 55.0 $\pm$ 10 %                         |          | 1.06 $\pm$ 10 %               |          |
| 1450             | 54.0 $\pm$ 10 %                         |          | 1.30 $\pm$ 10 %               |          |
| 1610             | 53.8 $\pm$ 10 %                         |          | 1.40 $\pm$ 10 %               |          |
| 1800             | 53.3 $\pm$ 10 %                         |          | 1.52 $\pm$ 10 %               |          |
| 1900             | 53.3 $\pm$ 10 %                         | 55.0     | 1.52 $\pm$ 10 %               | 1.57     |
| 2000             | 53.3 $\pm$ 10 %                         |          | 1.52 $\pm$ 10 %               |          |
| 2100             | 53.2 $\pm$ 10 %                         |          | 1.62 $\pm$ 10 %               |          |
| 2300             | 52.9 $\pm$ 10 %                         |          | 1.81 $\pm$ 10 %               |          |
| 2450             | 52.7 $\pm$ 10 %                         |          | 1.95 $\pm$ 10 %               |          |
| 2600             | 52.5 $\pm$ 10 %                         |          | 2.16 $\pm$ 10 %               |          |
| 3000             | 52.0 $\pm$ 10 %                         |          | 2.73 $\pm$ 10 %               |          |
| 3300             | 51.6 $\pm$ 10 %                         |          | 3.08 $\pm$ 10 %               |          |
| 3500             | 51.3 $\pm$ 10 %                         |          | 3.31 $\pm$ 10 %               |          |
| 3700             | 51.0 $\pm$ 10 %                         |          | 3.55 $\pm$ 10 %               |          |
| 3900             | 50.8 $\pm$ 10 %                         |          | 3.78 $\pm$ 10 %               |          |
| 4200             | 50.4 $\pm$ 10 %                         |          | 4.13 $\pm$ 10 %               |          |
| 4600             | 49.8 $\pm$ 10 %                         |          | 4.60 $\pm$ 10 %               |          |
| 4900             | 49.4 $\pm$ 10 %                         |          | 4.95 $\pm$ 10 %               |          |
| 5200             | 49.0 $\pm$ 10 %                         |          | 5.30 $\pm$ 10 %               |          |
| 5300             | 48.9 $\pm$ 10 %                         |          | 5.42 $\pm$ 10 %               |          |
| 5400             | 48.7 $\pm$ 10 %                         |          | 5.53 $\pm$ 10 %               |          |
| 5500             | 48.6 $\pm$ 10 %                         |          | 5.65 $\pm$ 10 %               |          |
| 5600             | 48.5 $\pm$ 10 %                         |          | 5.77 $\pm$ 10 %               |          |
| 5800             | 48.2 $\pm$ 10 %                         |          | 6.00 $\pm$ 10 %               |          |

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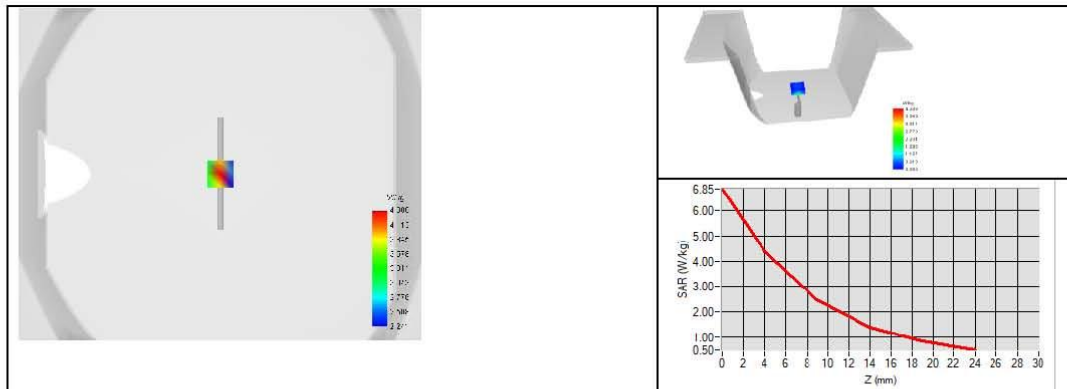
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**7.4 SAR MEASUREMENT RESULT WITH BODY LIQUID**

|                                           |                                                         |
|-------------------------------------------|---------------------------------------------------------|
| Software                                  | OPENSAR V5                                              |
| Phantom                                   | SN 13/09 SAM68                                          |
| Probe                                     | SN 41/18 EPG0333                                        |
| Liquid                                    | Body Liquid Values: $\epsilon_s$ : 55.0 $\sigma$ : 1.57 |
| Distance between dipole center and liquid | 10.0 mm                                                 |
| Area scan resolution                      | $dx=8mm/dy=8mm$                                         |
| Zoon Scan Resolution                      | $dx=8mm/dy=8mm/dz=5mm$                                  |
| Frequency                                 | 1900 MHz                                                |
| Input power                               | 20 dBm                                                  |
| Liquid Temperature                        | 20 +/- 1 °C                                             |
| Lab Temperature                           | 20 +/- 1 °C                                             |
| Lab Humidity                              | 30-70 %                                                 |

| Frequency<br>MHz | 1 g SAR (W/kg/W) | 10 g SAR (W/kg/W) |
|------------------|------------------|-------------------|
|                  | measured         | measured          |
| 1900             | 39.85 (3.99)     | 20.29 (2.03)      |



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## SAR REFERENCE DIPOLE CALIBRATION REPORT

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## 8 LIST OF EQUIPMENT

| Equipment Summary Sheet            |                         |                    |                                               |                                               |
|------------------------------------|-------------------------|--------------------|-----------------------------------------------|-----------------------------------------------|
| Equipment Description              | Manufacturer / Model    | Identification No. | Current Calibration Date                      | Next Calibration Date                         |
| SAM Phantom                        | MVG                     | SN-13/09-SAM68     | Validated. No cal required.                   | Validated. No cal required.                   |
| COMOSAR Test Bench                 | Version 3               | NA                 | Validated. No cal required.                   | Validated. No cal required.                   |
| Network Analyzer                   | Rohde & Schwarz ZVM     | 100203             | 05/2019                                       | 05/2022                                       |
| Network Analyzer – Calibration kit | Rohde & Schwarz ZV-Z235 | 101223             | 05/2019                                       | 05/2022                                       |
| Calipers                           | Mitutoyo                | SN 0009732         | 10/2019                                       | 10/2022                                       |
| Reference Probe                    | MVG                     | EPGO333 SN 41/18   | 05/2020                                       | 05/2021                                       |
| Multimeter                         | Keithley 2000           | 1160271            | 02/2020                                       | 02/2023                                       |
| Signal Generator                   | Rohde & Schwarz SMB     | 106589             | 04/2019                                       | 04/2022                                       |
| Amplifier                          | Aethercomm              | SN 046             | Characterized prior to test. No cal required. | Characterized prior to test. No cal required. |
| Power Meter                        | NI-USB 5680             | 170100013          | 05/2019                                       | 05/2022                                       |
| Directional Coupler                | Narda 4216-20           | 01386              | Characterized prior to test. No cal required. | Characterized prior to test. No cal required. |
| Temperature / Humidity Sensor      | Testo 184 H1            | 44220687           | 05/2020                                       | 05/2023                                       |

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## SAR Reference Dipole Calibration Report

Ref : ACR.15.13.21.MVGB.B

Cancel and replace the report ACR.15.13.21.MVGB.A

### JIANYAN TESTING GROUP SHENZHEN CO.,LTD.

No.110~116, BUILDING B, JINYUAN BUSINESS BUILDING,  
XIXIANG ROAD, BAOAN DISTRICT,  
SHENZHEN, GUANGDONG, PR CHINA

### MVG COMOSAR REFERENCE DIPOLE

FREQUENCY: 2450 MHZ

SERIAL NO.: SN 50/20 DIP 2G450-514

### Calibrated at MVG

Z.I. de la pointe du diable

Technopôle Brest Iroise – 295 avenue Alexis de Rochon  
29280 PLOUZANE - FRANCE

Calibration date: 01/14/2021



Accreditations #2-6789 and #2-6814  
Scope available on [www.cofrac.fr](http://www.cofrac.fr)

### Summary:

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