



## FCC SAR Compliance Test Report

For

GSM GLOBE.COM INC

8180 NW 36 Street Suite 317 Doral FL 33166.

Model : COMETA

Test Engineer: Zhao Junfei *zhao junfei*

Report Number: WSCT-A2LA-R&amp;E220900007A-SAR

Report Date: 17 October 2022

FCC ID: 2AEJACOMETA

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## Modified History

| REV.    | Modification Description    | Issued Date     | Remark        |
|---------|-----------------------------|-----------------|---------------|
| REV.1.0 | Initial Test Report Release | 17 October 2022 | Wang Fengbing |
|         |                             |                 |               |
|         |                             |                 |               |
|         |                             |                 |               |
|         |                             |                 |               |
|         |                             |                 |               |

## 1 General information

### 1.1 Notes

The test results of this test report relate exclusively to the test item specified in this test report. Shenzhen Timeway Testing Laboratories does not assume responsibility for any conclusions and generalisations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item. The test report is not to be reproduced or published in full without the prior written permission.

### 1.2 Application details

Date of receipt of test item: 2022-08-21  
Start of test: 2022-08-26  
End of test: 2022-08-28



### 1.3 Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for COMETA is as below:

| Band                                                        | Position               | MAX Reported SAR <sub>1g</sub> (W/kg) |
|-------------------------------------------------------------|------------------------|---------------------------------------|
| GSM850                                                      | Head                   | 0.667                                 |
|                                                             | Body & Hotspot<br>10mm | 0.422                                 |
| GSM1900                                                     | Head                   | <b>0.898</b>                          |
|                                                             | Body & Hotspot<br>10mm | 0.726                                 |
| UMTS Band II                                                | Head                   | 0.381                                 |
|                                                             | Body & Hotspot<br>10mm | 0.610                                 |
| UMTS Band V                                                 | Head                   | 0.450                                 |
|                                                             | Body & Hotspot<br>10mm | 0.387                                 |
| The highest simultaneous SAR is 1.328W/kg per KDB690783 D01 |                        |                                       |

The device is in compliance with Specific Absorption Rate ( SAR ) for general population/uncontrolled exposure limits of 1.6 W/Kg as averaged over any 1g tissue according to the FCC rule §2.1093, the ANSI/IEEE C95.1:2005, the NCRP Report Number 86 for uncontrolled environment, according to the Industry Canada Radio Standards Specification RSS-102 for General Population/Uncontrolled exposure, and had been tested in accordance with the measurement methods and procedures specified in IEEE Std 1528-2013.



## 1.4 EUT Information

Please Contact with WSCT  
www.wsct-cert.com

| Device Information:                     |                                                        |           |           |
|-----------------------------------------|--------------------------------------------------------|-----------|-----------|
| Product Type:                           | MOBILE PHONE                                           |           |           |
| Model:                                  | COMETA                                                 |           |           |
| Trade Name:                             | RAYO MOVIL                                             |           |           |
| Device Type:                            | Portable device                                        |           |           |
| Exposure Category:                      | uncontrolled environment / general population          |           |           |
| Production Unit or Identical Prototype: | Production Unit                                        |           |           |
| Antenna Type :                          | Internal Antenna                                       |           |           |
| Device Operating Configurations:        |                                                        |           |           |
| Supporting Mode(s) :                    | GSM850,PCS1900, UMTS Band II, ,UMTS Band V, BT         |           |           |
| Modulation:                             | GSM(GMSK),UMTS(QPSK/16QAM), BT(GFSK/π/4-DQPSK/ 8-DPSK) |           |           |
| Device Class :                          | Class B, No DTM Mode                                   |           |           |
| Operating Frequency Range(s)            | Band                                                   | TX(MHz)   | RX(MHz)   |
|                                         | GSM850                                                 | 824~849   | 869~894   |
|                                         | GSM1900                                                | 1850~1910 | 1930~1990 |
|                                         | UMTS Band II                                           | 1850~1910 | 1930~1990 |
|                                         | UMTS Band V                                            | 824~849   | 869~894   |
|                                         | BT                                                     | 2402~2480 |           |
| GPRS class level:                       | GPRS class 12                                          |           |           |
| Test Channels (low-mid-high):           | 128-190-251(GSM850)                                    |           |           |
|                                         | 512-661-810(GSM1900)                                   |           |           |
|                                         | 9262-9400-9538(UMTS Band II)                           |           |           |
|                                         | 4132-4182-4233(UMTS Band V)                            |           |           |
|                                         | 0-39-78(BT)<br>0-19-39(BLE)                            |           |           |
| Power Source:                           | 3.7 VDC/1800mAh(min/typ) Rechargeable Battery          |           |           |



## 2 Testing laboratory

|               |                                                                                                          |
|---------------|----------------------------------------------------------------------------------------------------------|
| Test Site     | World Standardization Certification & Testing Group (Shenzhen) Co., Ltd.                                 |
| Test Location | Building A-B, Baoshi Science & Technology Park, Baoshi Road, Bao'an District, Shenzhen, Guangdong, China |
| Telephone     | +86-755-26996192                                                                                         |
| Fax           | +86-755-86376605                                                                                         |

## 3 Test Environment

|                            | Required   | Actual    |
|----------------------------|------------|-----------|
| Ambient temperature:       | 18 – 25 °C | 22 ± 2 °C |
| Tissue Simulating liquid:  | 22 ± 2 °C  | 22 ± 2 °C |
| Relative humidity content: | 30 – 70 %  | 30 – 70 % |

## 4 Applicant and Manufacturer

|                        |                                             |
|------------------------|---------------------------------------------|
| Applicant/Client Name: | GSM GLOBE.COM INC                           |
| Applicant Address:     | 8180 NW 36 Street Suite 317 Doral FL 33166. |
| Manufacturer Name:     | GSM GLOBE.COM INC                           |
| Manufacturer Address:  | 8180 NW 36 Street Suite 317 Doral FL 33166. |



## 5 Test standard/s:

|                     |                                                                                                                                                                             |
|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ANSI Std C95.1-2005 | Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz.                                                                   |
| IEEE Std 1528-2013  | Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques |
| RSS-102             | Radio Frequency Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands (Issue 5 March 2015)                                                               |
| KDB447498 D01       | General RF Exposure Guidance v06                                                                                                                                            |
| KDB648474 D04       | Head set SAR v01r03                                                                                                                                                         |
| KDB941225 D06       | Hot Spot SAR V02r01                                                                                                                                                         |
| KDB941225 D01       | 3G SAR Measurement Procedures                                                                                                                                               |
| KDB248227 D01       | SAR meas for 802.11 a/b/g v02r02                                                                                                                                            |
| KDB865664 D01       | SAR Measurement 100 MHz to 6 GHz v01r04                                                                                                                                     |
| KDB865664 D02       | RF Exposure Reporting v01r02                                                                                                                                                |
| KDB 941225 D05      | SAR Evaluation Considerations for LTE Devices                                                                                                                               |
| KDB941225 D05A      | LTE Rel.10 KDB Inquiry Sheet v01r02                                                                                                                                         |



## 5.1 RF exposure limits

| Human Exposure                                         | Uncontrolled Environment<br>General Population | Controlled Environment<br>Occupational |
|--------------------------------------------------------|------------------------------------------------|----------------------------------------|
| <b>Spatial Peak SAR*</b><br>(Brain/Body/Arms/Legs)     | <b>1.60 mW/g</b>                               | 8.00 mW/g                              |
| <b>Spatial Average SAR**</b><br>(Whole Body)           | 0.08 mW/g                                      | 0.40 mW/g                              |
| <b>Spatial Peak SAR***</b><br>(Heads/Feet/Ankle/Wrist) | 4.00 mW/g                                      | 20.00 mW/g                             |

The limit applied in this test report is shown in bold letters

### Notes:

- \* The Spatial Peak value of the SAR averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.
- \*\* The Spatial Average value of the SAR averaged over the whole body.
- \*\*\* The Spatial Peak value of the SAR averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

**Uncontrolled Environments** are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure.

**Controlled Environments** are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation).

## 5.2 SAR Definition

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

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

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

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

where:

σ = conductivity of the tissue (S/m)

ρ = mass density of the tissue (kg/m<sup>3</sup>)

E = rms electric field strength (V/m)





## 6 SAR Measurement System

### 6.1 The Measurement System

Comosar is a system that is able to determine the SAR distribution inside a phantom of human being according to different standards. The Comosar system consists of the following items:

- Main computer to control all the system
- 6 axis robot
- Data acquisition system
- Miniature E-field probe
- Device holder
- Head simulating tissue

The following figure shows the system.



The EUT under test operating at the maximum power level is placed in the phone holder, under the phantom, which is filled with head simulating liquid. The E-Field probe measures the electric field inside the phantom. The OpenSAR software computes the results to give a SAR value in a 1g or 10g mass.



## 6.2 Robot

The COMOSAR system uses the high precision robots KR 6 R900 sixx type out of the newer series from Satimo SA (France). For the 6-axis controller COMOSAR system, the KUKA robot controller version from Satimo is used. The KR 6 R900 sixx robot series have many features that are important for our application:

- High precision (repeatability 0.02 mm)
- High reliability (industrial design)
- Jerk-free straight movements
- Low ELF interference (the closed metallic construction shields against motor control fields)
- 6-axis controller

## 6.3 Probe

For the measurements the Specific Dosimetric E-Field Probe SSE 5 with following specifications is used



Figure 1 – MVG COMOSAR Dosimetric E field Dipole

- Dynamic range: 0.01-100 W/kg

|                                            |        |
|--------------------------------------------|--------|
| 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 |

- Calibration range: 300MHz to 3GHz for head & body simulating liquid.

Angle between probe axis (evaluation axis) and surface normal line: less than 30°



Figure 2 – MVG COMOSAR Dosimetric E field Dipole

Dynamic range: 0.01-100 W/kg

|                                            |        |
|--------------------------------------------|--------|
| 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   |

- Calibration range: 5GHz to 6GHz for head & body simulating liquid.

Angle between probe axis (evaluation axis) and surface normal line: less than 30°



## 6.4 Measurement procedure

The following steps are used for each test position

- Establish a call with the maximum output power with a base station simulator. The connection between the mobile and the base station simulator is established via air interface.
- Measurement of the local E-field value at a fixed location. This value serves as a reference value for calculating a possible power drift.
- Measurement of the SAR distribution with a grid of 8 to 16 mm \* 8 to 16 mm and a constant distance to the inner surface of the phantom. Since the sensors can not directly measure at the inner phantom surface, the values between the sensors and the inner phantom surface are extrapolated. With these values the area of the maximum SAR is calculated by an interpolation scheme.
- Around this point, a cube of 30 \* 30 \* 30 mm or 32 \* 32 \* 32 mm is assessed by measuring 5 or 8 \* 5 or 8 \* 4 or 5 mm. With these data, the peak spatial-average SAR value can be calculated.

### Spatial Peak SAR Evaluation

The procedure for spatial peak SAR evaluation has been implemented according to the test standard. It can be conducted for 1g and 10g, as well as for user-specific masses. The SATIMO software includes all numerical procedures necessary to evaluate the spatial peak SAR value.

The base for the evaluation is a "cube" measurement. The measured volume must include the 1g and 10g cubes with the highest averaged SAR values. For that purpose, the center of the measured volume is aligned to the interpolated peak SAR value of a previously performed area scan.

The entire evaluation of the spatial peak values is performed within the post-processing engine. The system always gives the maximum values for the 1g and 10g cubes. The algorithm to find the cube with highest averaged SAR is divided into the following stages:

- (a) Extraction of the measured data (grid and values) from the Zoom Scan
- (b) Calculation of the SAR value at every measurement point based on all stored data (A/D values and measurement parameters)
- (c) Generation of a high-resolution mesh within the measured volume
- (d) Interpolation of all measured values from the measurement grid to the high-resolution grid
- (e) Extrapolation of the entire 3-D field distribution to the phantom surface over the distance from sensor to surface
- (f) Calculation of the averaged SAR within masses of 1g and 10g



### SAR Averaged Methods

In SATIMO, the interpolation and extrapolation are both based on the modified Quadratic Shepard's method. The interpolation scheme combines a least-square fitted function method and a weighted average method which are the two basic types of computational interpolation and approximation.

Extrapolation routines are used to obtain SAR values between the lowest measurement points and the inner phantom surface. The extrapolation distance is determined by the surface detection distance and the probe sensor offset. The uncertainty increases with the extrapolation distance. To keep the uncertainty within 1% for the 1 g and 10 g cubes, the extrapolation distance should not be larger than 5 mm.

### 6.5 Description of interpolation/extrapolation scheme

- The local SAR inside the phantom is measured using small dipole sensing elements inside a probe body. The probe tip must not be in contact with the phantom surface in order to minimise measurements errors, but the highest local SAR will occur at the surface of the phantom.
- An extrapolation is used to determine these highest local SAR values. The extrapolation is based on a fourth-order least-square polynomial fit of measured data. The local SAR value is then extrapolated from the liquid surface with a 1 mm step.
- The measurements have to be performed over a limited time (due to the duration of the battery) so the step of measurement is high. It could vary between 5 and 8 mm. To obtain an accurate assessment of the maximum SAR average over 10 grams and 1 gram requires a very fine resolution in the three dimensional scanned data array.



## 6.6 Phantom

For the measurements the Specific Anthropomorphic Mannequin (SAM) defined by the IEEE SCC-34/SC2 group is used. The phantom is a polyurethane shell integrated in a wooden table. The thickness of the phantom amounts to 2mm +/- 0.2mm. It enables the dosimetric evaluation of left and right phone usage and includes an additional flat phantom part for the simplified performance check. The phantom set-up includes a cover, which prevents the evaporation of the liquid.

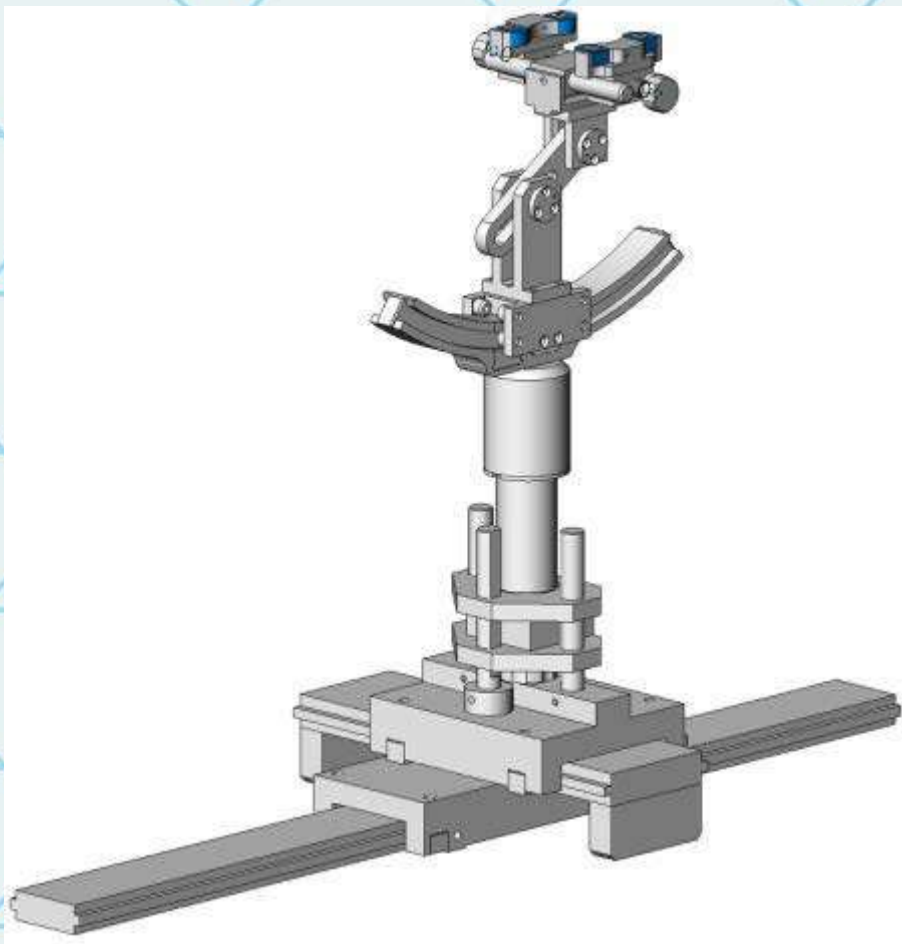


| System Material | Permittivity | Loss Tangent |
|-----------------|--------------|--------------|
| Delrin          | 3.7          | 0.005        |



## 6.7 Device Holder

The positioning system allows obtaining cheek and tilting position with a very good accuracy. In compliance with CENELEC, the tilt angle uncertainty is lower than 1°.



Device holder

| System Material | Permittivity | Loss Tangent |
|-----------------|--------------|--------------|
| Delrin          | 3.7          | 0.005        |



## 6.8 Video Positioning System

- The video positioning system is used in OpenSAR to check the probe. Which is composed of a camera, LED, mirror and mechanical parts. The camera is piloted by the main computer with firewire link.
- During the process, the actual position of the probe tip with respect to the robot arm is measured, as well as the probe length and the horizontal probe offset. The software then corrects all movements, such that the robot coordinates are valid for the probe tip.
- The repeatability of this process is better than 0.1 mm. If a position has been taught with an aligned probe, the same position will be reached with another aligned probe within 0.1 mm, even if the other probe has different dimensions. During probe rotations, the probe tip will keep its actual position.





## 6.9 Tissue simulating liquids: dielectric properties

For SAR measurement of the field distribution inside the phantom, the phantom must be filled with homogeneous tissue simulating liquid to a depth of at least 15 cm. For head SAR testing, the liquid height from the ear reference point (ERP) of the phantom to the liquid top surface is larger than 15 cm. For body SAR testing, the liquid height from the center of the flat phantom to the liquid top surface is larger than 15 cm. The simulating liquids should be checked at the beginning of a series of SAR measurements to determine if the dielectric parameters are within the tolerances of the specified target values. The measured conductivity and relative permittivity should be within  $\pm 5\%$  of the target values.

The following materials are used for producing the tissue-equivalent materials.

(Liquids used for tests are marked with ☒):

| Ingredients(% of weight) | Frequency (MHz)              |                                         |                                          |                                          |                                          |                                          |
|--------------------------|------------------------------|-----------------------------------------|------------------------------------------|------------------------------------------|------------------------------------------|------------------------------------------|
| frequency band           | <input type="checkbox"/> 750 | <input checked="" type="checkbox"/> 835 | <input checked="" type="checkbox"/> 1800 | <input checked="" type="checkbox"/> 1900 | <input checked="" type="checkbox"/> 2450 | <input checked="" type="checkbox"/> 2600 |
| Tissue Type              | Head                         | Head                                    | Head                                     | Head                                     | Head                                     | Head                                     |
| Water                    | 39.2                         | 41.45                                   | 52.64                                    | 55.242                                   | 62.7                                     | 55.242                                   |
| Salt (NaCl)              | 2.7                          | 1.45                                    | 0.36                                     | 0.306                                    | 0.5                                      | 0.306                                    |
| Sugar                    | 57.0                         | 56.0                                    | 0.0                                      | 0.0                                      | 0.0                                      | 0.0                                      |
| HEC                      | 0.0                          | 1.0                                     | 0.0                                      | 0.0                                      | 0.0                                      | 0.0                                      |
| Bactericide              | 0.0                          | 0.1                                     | 0.0                                      | 0.0                                      | 0.0                                      | 0.0                                      |
| Triton X-100             | 0.0                          | 0.0                                     | 0.0                                      | 0.0                                      | 36.8                                     | 0.0                                      |
| DGBE                     | 0.0                          | 0.0                                     | 47.0                                     | 44.542                                   | 0.0                                      | 44.452                                   |
| Ingredients(% of weight) | Frequency (MHz)              |                                         |                                          |                                          |                                          |                                          |
| frequency band           | <input type="checkbox"/> 750 | <input checked="" type="checkbox"/> 835 | <input checked="" type="checkbox"/> 1800 | <input checked="" type="checkbox"/> 1900 | <input checked="" type="checkbox"/> 2450 | <input checked="" type="checkbox"/> 2600 |
| Tissue Type              | Body                         | Body                                    | Body                                     | Body                                     | Body                                     | Body                                     |
| Water                    | 50.30                        | 52.4                                    | 69.91                                    | 69.91                                    | 73.2                                     | 64.493                                   |
| Salt (NaCl)              | 1.60                         | 1.40                                    | 0.13                                     | 0.13                                     | 0.04                                     | 0.024                                    |
| Sugar                    | 47.0                         | 45.0                                    | 0.0                                      | 0.0                                      | 0.0                                      | 0.0                                      |
| HEC                      | 0.0                          | 1.0                                     | 0.0                                      | 0.0                                      | 0.0                                      | 0.0                                      |
| Bactericide              | 0.0                          | 0.1                                     | 0.0                                      | 0.0                                      | 0.0                                      | 0.0                                      |
| Triton X-100             | 0.0                          | 0.0                                     | 0.0                                      | 0.0                                      | 0.0                                      | 0.0                                      |
| DGBE                     | 0.0                          | 0.0                                     | 29.96                                    | 29.96                                    | 26.7                                     | 32.252                                   |

Salt: 99+% Pure Sodium Chloride

Sugar: 98+% Pure Sucrose

Water: De-ionized, 16MΩ+ resistivity

HEC: Hydroxyethyl Cellulose

DGBE: 99+% Di(ethylene glycol) butyl ether, [2-(2-butoxyethoxy)ethanol]

Triton X-100(ultra pure): Polyethylene glycol mono [4-(1,1,3,3-tetramethylbutyl)phenyl]ether



## 6.10 Tissue simulating liquids: parameters

| Tissue Type  | Measured Frequency (MHz) | Target Tissue                    |                    |                                    |                    | Measured Tissue |                | Liquid Temp. | Test Date  |
|--------------|--------------------------|----------------------------------|--------------------|------------------------------------|--------------------|-----------------|----------------|--------------|------------|
|              |                          | Target Permittivity $\epsilon_r$ | Range of $\pm 5\%$ | Target Conductivity $\sigma$ (S/m) | Range of $\pm 5\%$ | $\epsilon_r$    | $\sigma$ (S/m) |              |            |
| 835MHz Head  | 825                      | 41.60                            | 39.52~43.68        | 0.90                               | 0.86~0.95          | 40.34           | 0.91           | 21.6°C       | 2022-08-26 |
|              | 835                      | 41.50                            | 39.43~43.58        | 0.90                               | 0.86~0.95          | 40.33           | 0.92           |              |            |
|              | 850                      | 41.50                            | 39.43~43.58        | 0.92                               | 0.87~0.97          | 40.11           | 0.94           |              |            |
| 835MHz Body  | 825                      | 55.20                            | 52.44~57.96        | 0.97                               | 0.92~1.02          | 54.04           | 0.98           |              |            |
|              | 835                      | 55.20                            | 52.44~57.96        | 0.97                               | 0.92~1.02          | 53.93           | 0.99           |              |            |
|              | 850                      | 55.20                            | 52.44~57.96        | 0.99                               | 0.94~1.04          | 53.69           | 1.01           |              |            |
| 1900MHz Head | 1850                     | 40.00                            | 38.00~42.00        | 1.40                               | 1.33~1.47          | 39.93           | 1.37           | 21.6°C       | 2022-08-28 |
|              | 1880                     | 40.00                            | 38.00~42.00        | 1.40                               | 1.33~1.47          | 39.91           | 1.40           |              |            |
|              | 1900                     | 40.00                            | 38.00~42.00        | 1.40                               | 1.33~1.47          | 39.98           | 1.41           |              |            |
|              | 1910                     | 40.00                            | 38.00~42.00        | 1.40                               | 1.33~1.47          | 39.97           | 1.42           |              |            |
| 1900MHz Body | 1850                     | 53.30                            | 50.64~55.97        | 1.52                               | 1.44~1.60          | 53.23           | 1.49           |              |            |
|              | 1880                     | 53.30                            | 50.64~55.97        | 1.52                               | 1.44~1.60          | 53.36           | 1.53           |              |            |
|              | 1900                     | 53.30                            | 50.64~55.97        | 1.52                               | 1.44~1.60          | 53.37           | 1.56           |              |            |
|              | 1910                     | 53.30                            | 50.64~55.97        | 1.52                               | 1.44~1.60          | 53.37           | 1.57           |              |            |

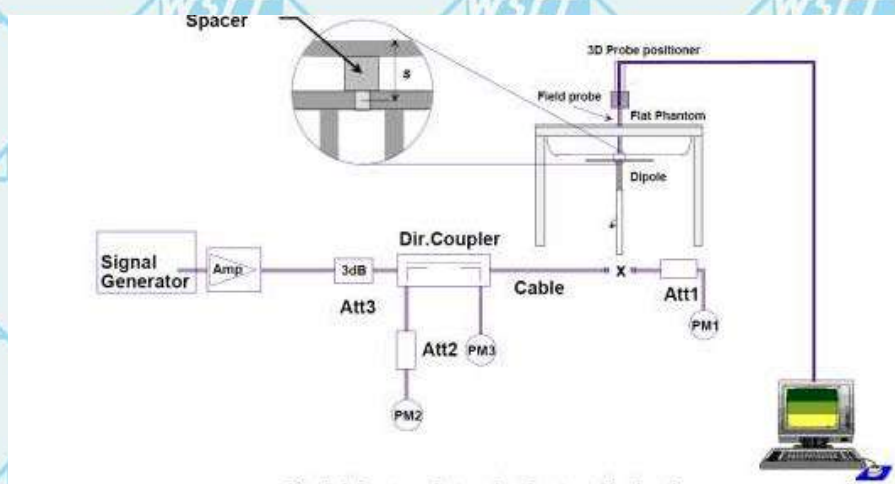


## 7 System Check

### 7.1 System check procedure

The System check is performed by using a System check dipole which is positioned parallel to the planar part of the SAM phantom at the reference point. The distance of the dipole to the SAM phantom is determined by a spacer. The dipole is connected to the signal source consisting of signal generator and amplifier via a directional coupler, N-connector cable and adaption to SMA. It is fed with a power of 100 mW. To adjust this power a power meter is used. The power sensor is connected to the cable before the System check to measure the power at this point and do adjustments at the signal generator. At the outputs of the directional coupler both return loss as well as forward power are controlled during the validation to make sure that emitted power at the dipole is kept constant. This can also be checked by the power drift measurement after the test (result on plot).

System check results have to be equal or near the values determined during dipole calibration (target SAR in table above) with the relevant liquids and test system.





## 7.2 System check results

The system Check is performed for verifying the accuracy of the complete measurement system and performance of the software. The following table shows System check results for all frequency bands and tissue liquids used during the tests (plot(s) see annex A).

| System Check | Target SAR (1W) (+/-10%) |                               |            |                                | Measured SAR (Normalized to 1W) |            | Liquid Temp. | Test Date  |
|--------------|--------------------------|-------------------------------|------------|--------------------------------|---------------------------------|------------|--------------|------------|
|              | 1-g (W/g)                | Range of $\pm 10\%$ 1-g (W/g) | 10-g (W/g) | Range of $\pm 10\%$ 10-g (W/g) | 1-g (W/g)                       | 10-g (W/g) |              |            |
| D835V2 Head  | 9.82                     | 8.84~10.80                    | 6.35       | 5.72~6.99                      | 9.700                           | 6.150      | 21.6°C       | 2022/08/26 |
| D1900V2 Head | 38.93                    | 35.04~42.82                   | 20.27      | 18.45~22.55                    | 39.980                          | 21.070     | 21.6°C       | 2022/08/28 |
| D835V2 Body  | 9.41                     | 8.47~10.35                    | 6.22       | 5.99~6.84                      | 10.150                          | 6.450      | 21.6°C       | 2022/08/26 |
| D1900V2 Body | 38.73                    | 34.86~42.60                   | 20.48      | 18.43~22.53                    | 39.330                          | 20.940     | 21.6°C       | 2022/08/28 |

Note: All SAR values are normalized to 1W forward power.

Note: 5G band system check USES standard waveguide, so the test results are standard en62209-2 table B2



## 8 SAR Test Test Configuration

### 8.1 GSM Test Configurations

SAR tests for GSM850 and GSM1900, a communication link is set up with a base station by air link. Using CMU200 the power level is set to “5” and “0” in SAR of GSM850 and GSM1900. The tests in the band of GSM 850 and GSM 1900 are performed in the mode of GPRS/EGPRS function. Since the GPRS class is 12 for this EUT, it has at most 4 timeslots in uplink and at most 4 timeslots in downlink, the maximum total timeslot is 5.

When SAR tests for EGPRS mode is necessary, GMSK modulation should be used to minimize SAR measurement error due to higher peak-to-average power (PAR) ratios inherent in 8-PSK.

### 8.2 UMTS Test Configuration

#### 1) Output Power Verification

Maximum output power is verified on the high, middle and low channels according to procedures described in section 5.2 of 3GPP TS 34.121, using the appropriate RMC or AMR with TPC (transmit power control) set to all “1”s for WCDMA/HSDPA or by applying the required inner loop power control procedures to maintain maximum output power while HSUPA is active. Results for all applicable physical channel configurations (DPDCH, DPDCHn and spreading codes, HSDPA, HSPA) are required in the SAR report. All configurations that are not supported by the Headset or cannot be measured due to technical or equipment limitations must be clearly identified.

#### 2) WCDMA

##### a. Head SAR Measurements

SAR for next to the ear head exposure is measured using a 12.2 kbps RMC with TPC bits configured to all “1”s. The 3G SAR test reduction procedure is applied to AMR configurations with 12.2 kbps RMC as the primary mode. Otherwise, SAR is measured for 12.2 kbps AMR in 3.4 kbps SRB (signaling radio bearer) using the highest reported SAR configuration in 12.2 kbps RMC for head exposure.

##### b. Body SAR Measurements

SAR for body-worn accessory configurations is measured using a 12.2 kbps RMC with TPC bits configured to all “1”s. The 3G SAR test reduction procedure is applied to other spreading codes and multiple DPDCHn configurations supported by the Headset with 12.2 kbps RMC as the primary mode

#### 3) HSDPA

SAR for body exposure configurations is measured according to the “Body SAR Measurements” procedures of 3G device. When the maximum output power and tune-up tolerance specified for production units in a secondary mode is  $\leq \frac{1}{4}$  dB higher than the primary mode or when the highest reported SAR of the primary mode is scaled by the ratio of specified maximum output power and tune-up tolerance of secondary to primary mode and the adjusted SAR is  $\leq 1.2$  W/kg, SAR measurement is not required for the secondary mode. This is referred to as the 3G SAR test reduction procedure in the following SAR test guidance, where the primary mode is identified in



the applicable wireless mode test procedures and the secondary mode is wireless mode being considered for SAR test reduction by that procedure. When the 3G SAR test reduction procedure is not satisfied, it is identified as "otherwise" in the applicable procedures; SAR measurement is required for the secondary mode.

Per KDB941225 D01, the 3G SAR test reduction procedure is applied to HSDPA body configurations with 12.2 kbps RMC as the primary mode. Otherwise, SAR is measured for HSDPA using the HSDPA body SAR procedures for the highest reported SAR body exposure configuration in 12.2 kbps RMC.

HSDPA should be configured according to UE category of a test device. The number of HS-DSCH/HS-PDSCHs, HARQ processes, minimum inter-TTI interval, transport block sizes and RV coding sequence are defined by the H-set. To maintain a consistent test configuration and stable transmission condition, QPSK is used in the H-set for SAR testing. HS-DPCCH should be configured with a CQI feedback cycle of 4ms with a CQI repetition factor of 2 to maintain a constant rate of active CQI slots. The  $\beta_c$  and  $\beta_d$  gain factors for DPCCH and DPDCH were set according to the values in the below table,  $\beta_{hs}$  is set automatically to the correct value when

$\Delta ACK, \Delta NACK, \Delta CQI = 8$ . The variation of the  $\beta_c / \beta_d$  ratio causes a power reduction at sub-tests 2 - 4.

| Sub-test <sup>a</sup> | $\beta_c$ <sup>a</sup> | $\beta_d$ <sup>a</sup> | $\beta_d$ (SF) <sup>a</sup> | $\beta_c / \beta_d$ <sup>a</sup> | $\beta_{hs}$ (1) <sup>a</sup> | CM(dB)(2) <sup>a</sup> | MPR (dB) <sup>a</sup> |
|-----------------------|------------------------|------------------------|-----------------------------|----------------------------------|-------------------------------|------------------------|-----------------------|
| 1 <sup>a</sup>        | 2/15 <sup>a</sup>      | 15/15 <sup>a</sup>     | 64 <sup>a</sup>             | 2/15 <sup>a</sup>                | 4/15 <sup>a</sup>             | 0.0 <sup>a</sup>       | 0 <sup>a</sup>        |
| 2 <sup>a</sup>        | 12/15(3) <sup>a</sup>  | 15/15(3) <sup>a</sup>  | 64 <sup>a</sup>             | 12/15(3) <sup>a</sup>            | 24/15 <sup>a</sup>            | 1.0 <sup>a</sup>       | 0 <sup>a</sup>        |
| 3 <sup>a</sup>        | 15/15 <sup>a</sup>     | 8/15 <sup>a</sup>      | 64 <sup>a</sup>             | 15/8 <sup>a</sup>                | 30/15 <sup>a</sup>            | 1.5 <sup>a</sup>       | 0.5 <sup>a</sup>      |
| 4 <sup>a</sup>        | 15/15 <sup>a</sup>     | 4/15 <sup>a</sup>      | 64 <sup>a</sup>             | 15/4 <sup>a</sup>                | 30/15 <sup>a</sup>            | 1.5 <sup>a</sup>       | 0.5 <sup>a</sup>      |

Note 1:  $\Delta ACK, \Delta NACK$  and  $\Delta CQI = 8$   $A_{hs} = \beta_{hs} / \beta_c = 30/15$   $\beta_{hs} = 30/15 * \beta_c$

Note 2: CM=1 for  $\beta_c / \beta_d = 12/15$ ,  $\beta_{hs} / \beta_c = 24/15$ . For all other combinations of DPDCH, DPCCH and HS-DPCCH the MPR is based on the relative CM difference. This is applicable for only UEs that support HSDPA in release 6 and later releases.

Note 3: For subtest 2 the  $\beta_c / \beta_d$  ratio of 12/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1, TF0) to  $\beta_c = 11/15$  and  $\beta_d = 15/15$

The measurements were performed with a Fixed Reference Channel (FRC) and H-Set 1 QPSK.:

| Parameter                        | Value       |
|----------------------------------|-------------|
| Nominal average inf. bit rate    | 534 kbit/s  |
| Inter-TTI Distance               | 3 TTI's     |
| Number of HARQ Processes         | 2 Processes |
| Information Bit Payload          | 3202 Bits   |
| MAC-d PDU size                   | 336 Bits    |
| Number Code Blocks               | 1 Block     |
| Binary Channel Bits Per TTI      | 4800 Bits   |
| Total Available SMLs in UE       | 19200 SMLs  |
| Number of SMLs per HARQ Process  | 9600 SMLs   |
| Coding Rate                      | 0.67        |
| Number of Physical Channel Codes | 5           |



#### 4) HSUPA

SAR for body exposure configurations is measured according to the "Body SAR Measurements" procedures of 3G device. When the maximum output power and tune-up tolerance specified for production units in a secondary mode is  $\leq \frac{1}{4}$  dB higher than the primary mode or when the highest reported SAR of the primary mode is scaled by the ratio of specified maximum output power and tune-up tolerance of secondary to primary mode and the adjusted SAR is  $\leq 1.2$  W/kg, SAR measurement is not required for the secondary mode.

Per KDB941225 D01v03, the 3G SAR test reduction procedure is applied to HSPA (HSUPA/HSDPA with RMC) body configurations with 12.2 kbps RMC as the primary mode. Otherwise, SAR is measured for HSPA using the HSPA body SAR procedures for the highest reported body exposure SAR configuration in 12.2 kbps RMC.

## 9 Detailed Test Results

### 9.1 Conducted Power measurements

The maximum conducted average power (Unit: dBm) including tune-up tolerance is shown as below.

#### 9.1.1 Conducted Power of GSM850

| GSM850(SIM1)  |            | Burst-Averaged output Power (dBm) |       |       | Division Factors | Source Based time Average Power(dBm) |              |              |
|---------------|------------|-----------------------------------|-------|-------|------------------|--------------------------------------|--------------|--------------|
|               |            | 128CH                             | 190CH | 251CH |                  | 128CH                                | 190CH        | 251CH        |
| GSM(CS)       |            | 33.35                             | 32.86 | 32.59 | -9.03            | 24.22                                | 23.83        | 23.56        |
| GPRS (GMSK)   | 1 Tx Slot  | 30.00                             | 31.37 | 30.53 | -9.03            | 20.97                                | 22.34        | 21.50        |
|               | 2 Tx Slots | 30.91                             | 31.07 | 30.55 | -6.02            | 24.89                                | 25.05        | 24.53        |
|               | 3 Tx Slots | 31.11                             | 30.40 | 30.32 | -4.26            | 26.85                                | 26.14        | 26.06        |
|               | 4 Tx Slots | 31.48                             | 30.15 | 30.95 | -3.01            | <b>28.47</b>                         | <b>27.14</b> | <b>27.94</b> |
| EGPRS (8-PSK) | 1 Tx Slot  | 27.88                             | 28.80 | 27.57 | -9.03            | 18.85                                | 19.77        | 18.54        |
|               | 2 Tx Slots | 27.89                             | 28.84 | 27.16 | -6.02            | 21.87                                | 22.82        | 21.14        |
|               | 3 Tx Slots | 28.19                             | 28.36 | 27.34 | -4.26            | 23.93                                | 24.10        | 23.08        |
|               | 4 Tx Slots | 27.77                             | 27.40 | 28.36 | -3.01            | 24.76                                | 24.39        | 25.35        |

Note: 1) The conducted power of GSM850 is measured with RMS detector.

2) Frame-averaged output power was calculated from the measured burst-averaged output power by converting the slot powers into linear units and calculating the energy over 8 timeslots.



3) The bolded GPRS 4Tx slots mode was selected for SAR testing according to the highest Source

Based time Average Power table.

4) channel /Frequency: 128/824.2; 190/836.6; 251/848.8

### 9.1.2 Conducted Power of GSM1900

| GSM1900(SIM1) |            | Burst-Averaged output Power (dBm) |       |       | Division Factors | Source Based time Average Power(dBm) |              |              |
|---------------|------------|-----------------------------------|-------|-------|------------------|--------------------------------------|--------------|--------------|
|               |            | 512CH                             | 661CH | 810CH |                  | 512CH                                | 661CH        | 810CH        |
| GSM(CS)       |            | 31.09                             | 31.50 | 31.38 | -9.03            | 22.06                                | 22.47        | 22.35        |
| GPRS (GMSK)   | 1 Tx Slot  | 27.91                             | 27.92 | 28.67 | -9.03            | 18.88                                | 18.89        | 19.64        |
|               | 2 Tx Slots | 28.81                             | 27.82 | 28.60 | -6.02            | 22.79                                | 21.80        | 22.58        |
|               | 3 Tx Slots | 27.68                             | 28.09 | 27.82 | -4.26            | 23.42                                | 23.83        | 23.56        |
|               | 4 Tx Slots | 28.43                             | 28.70 | 28.21 | -3.01            | <b>25.42</b>                         | <b>25.69</b> | <b>25.20</b> |
| EGPRS (8-PSK) | 1 Tx Slot  | 26.47                             | 25.51 | 26.71 | -9.03            | 17.44                                | 16.48        | 17.68        |
|               | 2 Tx Slots | 26.13                             | 25.64 | 26.49 | -6.02            | 20.11                                | 19.62        | 20.47        |
|               | 3 Tx Slots | 26.30                             | 26.81 | 26.92 | -4.26            | 22.04                                | 22.55        | 22.66        |
|               | 4 Tx Slots | 26.14                             | 26.54 | 26.08 | -3.01            | 23.13                                | 23.53        | 23.07        |

Note: 1) The conducted power of GSM1900 is measured with RMS detector.

2) Frame-averaged output power was calculated from the measured burst-averaged output power by converting the slot powers into linear units and calculating the energy over 8 timeslots.

3) The bolded GPRS 4Tx slots mode was selected for SAR testing according to the highest Source

Based time Average Power table.

4) channel /Frequency: 512/1850.2; 661/1880; 810/1909.8



### 9.1.3 Conducted Power of UMTS Band II

| UMTS Band II |              | Conducted Power (dBm) |        |        |
|--------------|--------------|-----------------------|--------|--------|
|              |              | 9262CH                | 9400CH | 9538CH |
| WCDMA        | 12.2kbps RMC | 23.06                 | 22.69  | 23.56  |
| HSDPA        | Subtest 1    | 23.22                 | 23.01  | 23.34  |
|              | Subtest 2    | 23.28                 | 22.71  | 22.73  |
|              | Subtest 3    | 23.50                 | 22.67  | 22.97  |
|              | Subtest 4    | 23.03                 | 23.39  | 23.07  |
| HSUPA        | Subtest 1    | 23.24                 | 22.75  | 23.19  |
|              | Subtest 2    | 23.23                 | 23.58  | 22.69  |
|              | Subtest 3    | 22.65                 | 22.97  | 22.68  |
|              | Subtest 4    | 23.08                 | 22.82  | 23.40  |
|              | Subtest 5    | 23.32                 | 23.05  | 22.88  |

Note: 1) channel /Frequency: 9262/1852.4, 9400/1880, 9538/1907.6

### 9.1.4 Conducted Power of UMTS Band V

| UMTS Band V |              | Conducted Power (dBm) |        |        |
|-------------|--------------|-----------------------|--------|--------|
|             |              | 4132CH                | 4182CH | 4233CH |
| WCDMA       | 12.2kbps RMC | 23.22                 | 23.42  | 22.66  |
| HSDPA       | Subtest 1    | 22.94                 | 23.57  | 22.89  |
|             | Subtest 2    | 23.53                 | 23.53  | 23.18  |
|             | Subtest 3    | 22.88                 | 22.70  | 22.79  |
|             | Subtest 4    | 23.49                 | 23.56  | 23.25  |
| HSUPA       | Subtest 1    | 23.11                 | 22.64  | 23.38  |
|             | Subtest 2    | 23.02                 | 23.06  | 22.92  |
|             | Subtest 3    | 23.12                 | 23.54  | 23.06  |
|             | Subtest 4    | 23.11                 | 22.96  | 22.96  |
|             | Subtest 5    | 22.79                 | 23.42  | 23.06  |

Note: 1) channel /Frequency: 4132/826.4, 4182/836.4, 4233/846.6



### 9.1.5 Conducted Power of BT

The maximum output power of BT is:

| Mode                      | 1Mbps   |          |          |
|---------------------------|---------|----------|----------|
| Channel / Frequency (MHz) | 0(2402) | 39(2441) | 78(2480) |
| Average Power(dBm)        | 8.68    | 10.13    | 7.40     |
| Mode                      | 2Mbps   |          |          |
| Channel / Frequency (MHz) | 0(2402) | 39(2441) | 78(2480) |
| Average Power(dBm)        | 3.64    | 5.52     | 2.75     |
| Mode                      | 3Mbps   |          |          |
| Channel / Frequency (MHz) | 0(2402) | 39(2441) | 78(2480) |
| Average Power(dBm)        | 7.79    | 9.13     | 6.66     |



## 9.1.6 Tune-up power tolerance

| Band    | Tune-up power tolerance(dBm) |          |                                   |
|---------|------------------------------|----------|-----------------------------------|
| GSM850  | GSM/GPRS (GMSK)              | GSM      | Max output power =33.00dBm±0.5dBm |
|         |                              | 1TXslots | Max output power =30.50dBm±0.5dBm |
|         |                              | 2TXslots | Max output power =30.50dBm±0.5dBm |
|         |                              | 3TXslots | Max output power =31.00dBm±0.5dBm |
| GSM850  | EGPRS (8-PSK)                | 4TXslots | Max output power =31.00dBm±0.5dBm |
|         |                              | 1TXslots | Max output power =28.00dBm±0.5dBm |
|         |                              | 2TXslots | Max output power =28.00dBm±0.5dBm |
|         |                              | 3TXslots | Max output power =28.00dBm±0.5dBm |
| GSM1900 | GSM/GPRS (GMSK)              | 4TXslots | Max output power =27.50dBm±0.5dBm |
|         |                              | GSM      | Max output power =31.00dBm±0.5dBm |
|         |                              | 1TXslots | Max output power =28.00dBm±0.5dBm |
|         |                              | 2TXslots | Max output power =28.50dBm±0.5dBm |
| GSM1900 | EGPRS (8-PSK)                | 3TXslots | Max output power =27.50dBm±0.5dBm |
|         |                              | 4TXslots | Max output power =28.00dBm±0.5dBm |
|         |                              | 1TXslots | Max output power =26.00dBm±0.5dBm |
|         |                              | 2TXslots | Max output power =26.00dBm±0.5dBm |
| WCDMA 2 | WCDMA 5                      | 3TXslots | Max output power =26.50dBm±0.5dBm |
|         |                              | 4TXslots | Max output power =26.00dBm±0.5dBm |
| BT      | 1Mbps Power                  |          | Max output power =9.0dBm±1.0dbm   |
|         | 2Mbps Power                  |          | Max output power =4.0dBm±1.0dbm   |
|         | 3Mbps Power                  |          | Max output power =8.0dBm±1.0dbm   |



## 9.2 SAR test results

### Notes:

1) Per KDB447498 D01v05 r02, the SAR test shall be performed at the high, middle and low frequency channels of each operating mode. If the scaled SAR measured at mid-band channel for each test configuration is at least 3.0 dB lower than the SAR limit ( $< 0.8 \text{ W/kg}$ ), testing at the high and low channels is optional.

2) Per KDB447498 D01v05r02, testing of other required channels within the operating mode of a frequency band is not required when the reported 1-g or 10-g SAR for the mid-band or highest output power channel is:  $\leq 0.8 \text{ W/kg}$  or  $2.0 \text{ W/kg}$ , for 1-g or 10-g respectively, when the transmission band is  $\leq 100 \text{ MHz}$ . When the maximum output power variation across the required test channels is  $> \frac{1}{2} \text{ dB}$ , instead of the middle channel, the highest output power channel must be used.

3) Per KDB447498 D01v05r02, All measurement SAR result is scaled-up to account for tune-up tolerance is compliant.

4) Per KDB648474 D04v01r02, body-worn accessory testing is typically associated with voice operations. Therefore, GSM voice was evaluated for body-worn with headset SAR.

5) Per KDB248227 D01v01r02, the procedures required to establish specific device operating configurations for testing the SAR of 802.11 a/b/g transmitters.

(1) For Headsets operating next to ear, hotspot mode or mini-tablet configurations, the initial test position procedures were applied. The test position with the highest extrapolated peak SAR will be used as the initial test position. When the reported SAR of initial test position is  $\leq 0.4 \text{ W/kg}$ , SAR testing for remaining test positions is not required. Otherwise, SAR is evaluated at the subsequent highest peak SAR positions until the reported SAR result is  $\leq 0.8 \text{ W/kg}$  or all test positions are measured.

(2) For WLAN 2.4 GHz, the highest measured maximum output power channel for DSSS was selected for SAR measurement. When the reported SAR is  $\leq 0.8 \text{ W/kg}$ , no further SAR testing is required. Otherwise, SAR is evaluated at the next highest measured output power channel. When any reported SAR is  $> 1.2 \text{ W/kg}$ , SAR is required for the third channel. For OFDM modes (802.11g/n), SAR is not required when the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and it is  $\leq 1.2 \text{ W/kg}$ .



(3) For WLAN 5 GHz, the initial test configuration was selected according to the transmission mode with the highest maximum output power. When the reported SAR of initial test configuration is  $> 0.8$  W/kg, SAR is required for the subsequent highest measured output power channel until the reported SAR result is  $\leq 1.2$  W/kg or all required channels are measured. For other transmission modes, SAR is not required when the highest reported SAR for initial test configuration is adjusted by the ratio of subsequent test configuration to initial test configuration specified maximum output power and it is  $\leq 1.2$  W/kg.

6) Per KDB865664 D01v01r04, for each frequency band, repeated SAR measurement is required only when the measured SAR is  $\geq 0.8$  W/Kg; if the deviation among the repeated measurement is  $\leq 20\%$ , and the measured SAR  $< 1.45$  W/Kg, only one repeated measurement is required.

7) Per KDB865664 D02v01r01, SAR plot is only required for the highest measured SAR in each exposure configuration, wireless mode and frequency band combination; Plots are also required when the measured SAR is  $> 1.5$  W/kg, or  $> 7.0$  W/kg for occupational exposure. The published RF exposure KDB procedures may require additional plots; for example, to support SAR to peak location separation ratio test exclusion and/or volume scan post-processing (Refer to appendix B for details).

8) Per KDB941225 D06v01r01, the DUT Dimension is bigger than 9 cm x 5 cm, so 10mm is chosen as the test separation distance for Hotspot mode. When the antenna-to-edge distance is greater than 2.5cm, such position does not need to be tested.

9) Per KDB 941225 D01, 3G SAR Measurement Procedures, The mode tested for SAR is referred to as the primary mode. The equivalent modes considered for SAR test reduction are denoted as secondary modes. Both primary and secondary modes must be in the same frequency band. When the maximum output power and tune-up tolerance specified for production units in a secondary mode is  $\leq 1/4$  dB higher than the primary mode or when the highest reported SAR of the primary mode is scaled by the ratio of specified maximum output power and tune-up tolerance of secondary to primary mode and the adjusted SAR is  $\leq 1.2$  W/kg, SAR measurement is not required for the secondary mode.

10) Per KDB 941225 D05, SAR Evaluation Considerations for LTE Devices

(1) QPSK with 1 RB and 50% RB allocation

Start with the largest channel bandwidth and measure SAR, using the RB offset and required test channel combination with the highest maximum output power among RB offsets at the upper edge, middle and lower edge of each required test channel. When the reported SAR is  $\leq 0.8$  W/kg, testing of the remaining RB offset configurations and required test channels is not required; otherwise, SAR is required for the remaining required test channels and only for the RB offset configuration with the highest output power for that channel. When the reported SAR of a required test channel is  $> 1.45$  W/kg, SAR is required for all three RB offset configurations for that required test channel.



#### (2) QPSK with 100% RB allocation

SAR is not required when the highest maximum output power for 100% RB allocation is less than the highest maximum output power in 50% and 1 RB allocations and the highest reported SAR for 1 RB and 50% RB allocation are  $\leq 0.8$  W/kg. Otherwise, SAR is measured for the highest output power channel; and if the reported SAR is  $> 1.45$  W/kg, the remaining required test channels must also be

tested.

#### (3) Higher order modulations

SAR is required only when the highest maximum output power for the configuration in the higher order modulation is  $> 1/2$  dB higher than the same configuration in QPSK or when the reported SAR for the QPSK configuration is  $> 1.45$  W/kg.

#### (4) Other channel bandwidth

SAR is required when the highest maximum output power of the smaller channel bandwidth is  $> 1/2$  dB higher than the equivalent channel configurations in the largest channel bandwidth configuration or the reported SAR of a configuration for the largest channel bandwidth is  $> 1.45$  W/kg.



### 9.2.1 Results overview of GSM850

| Test Position of Head                      | Test channel /Freq.(MHz) | Test Mode | SAR Value (W/kg) |       | Power Drift (%) | Conducted Power (dBm) | Tune-up Limit (dBm) | Scaled SAR <sub>1-g</sub> (W/kg) | Scaling Factor |
|--------------------------------------------|--------------------------|-----------|------------------|-------|-----------------|-----------------------|---------------------|----------------------------------|----------------|
|                                            |                          |           | 1-g              | 10-g  |                 |                       |                     |                                  |                |
| Left Head Touched                          | 128/824.2                | GPRS 4TS  | 0.667            | 0.448 | 3.670           | 33.35                 | 33.50               | <b>0.690</b>                     | 1.035          |
| Left Head Tilted 15°                       | 128/824.2                | GPRS 4TS  | 0.398            | 0.227 | 3.440           | 33.35                 | 33.50               | 0.412                            | 1.035          |
| Right Head Touched                         | 128/824.2                | GPRS 4TS  | 0.645            | 0.420 | 3.060           | 33.35                 | 33.50               | 0.668                            | 1.035          |
| Right Head Tilted 15°                      | 128/824.2                | GPRS 4TS  | 0.349            | 0.219 | 1.910           | 33.35                 | 33.50               | 0.361                            | 1.035          |
| Test Position of Body with 10mm            | Test channel /Freq.(MHz) | Test Mode | SAR Value (W/kg) |       | Power Drift (%) | Conducted Power (dBm) | Tune-up Limit (dBm) | Scaled SAR <sub>1-g</sub> (W/kg) | Scaling Factor |
|                                            |                          |           | 1-g              | 10-g  |                 |                       |                     |                                  |                |
| SAR Results for Hotspot Exposure Condition |                          |           |                  |       |                 |                       |                     |                                  |                |
| Front side                                 | 128/824.2                | GPRS 4TS  | 0.391            | 0.289 | 0.100           | 33.35                 | 33.50               | 0.405                            | 1.035          |
| Rear side                                  | 128/824.2                | GPRS 4TS  | 0.422            | 0.310 | 3.300           | 33.35                 | 33.50               | <b>0.437</b>                     | 1.035          |
| Top side                                   | 128/824.2                | GPRS 4TS  | 0.384            | 0.288 | -1.910          | 33.35                 | 33.50               | 0.397                            | 1.035          |
| Left side                                  | 128/824.2                | GPRS 4TS  | 0.394            | 0.286 | -2.160          | 33.35                 | 33.50               | 0.408                            | 1.035          |
| Right side                                 | 128/824.2                | GPRS 4TS  | 0.379            | 0.278 | -1.950          | 33.35                 | 33.50               | 0.392                            | 1.035          |



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## 9.2.2 Results overview of GSM1900

| Test Position of Head                      | Test channel /Freq.(MHz) | Test Mode | SAR Value (W/kg) |       | Power Drift (%) | Conducted Power (dBm) | Tune-up Limit (dBm) | Scaled SAR <sub>1-g</sub> (W/kg) | Scalig Factor |
|--------------------------------------------|--------------------------|-----------|------------------|-------|-----------------|-----------------------|---------------------|----------------------------------|---------------|
|                                            |                          |           | 1-g              | 10-g  |                 |                       |                     |                                  |               |
| Left Head Touched                          | 661/1880                 | GPRS 4TS  | 0.898            | 0.634 | -2.180          | 31.50                 | 32.00               | 1.008                            | 1.122         |
| Left Head Tilted 15°                       | 661/1880                 | GPRS 4TS  | 0.523            | 0.333 | -1.570          | 31.50                 | 32.00               | 0.587                            | 1.122         |
| Right Head Touched                         | 661/1880                 | GPRS 4TS  | 0.859            | 0.608 | 0.040           | 31.50                 | 32.00               | 0.964                            | 1.122         |
| Right Head Tilted 15°                      | 661/1880                 | GPRS 4TS  | 0.548            | 0.299 | 3.220           | 31.50                 | 32.00               | 0.615                            | 1.122         |
| Test Position of Body with 10mm            | Test channel /Freq.(MHz) | Test Mode | SAR Value (W/kg) |       | Power Drift (%) | Conducted Power (dBm) | Tune-up Limit (dBm) | Scaled SAR <sub>1-g</sub> (W/kg) | Scalig Factor |
|                                            |                          |           | 1-g              | 10-g  |                 |                       |                     |                                  |               |
| SAR Results for Hotspot Exposure Condition |                          |           |                  |       |                 |                       |                     |                                  |               |
| Front side                                 | 661/1880                 | GPRS 4TS  | 0.696            | 0.480 | -3.000          | 31.50                 | 32.00               | 0.781                            | 1.122         |
| Rear side                                  | 661/1880                 | GPRS 4TS  | 0.726            | 0.520 | 3.790           | 31.50                 | 32.00               | 0.815                            | 1.122         |
| Top side                                   | 661/1880                 | GPRS 4TS  | 0.705            | 0.485 | 2.680           | 31.50                 | 32.00               | 0.791                            | 1.122         |
| Left side                                  | 661/1880                 | GPRS 4TS  | 0.690            | 0.482 | 2.320           | 31.50                 | 32.00               | 0.774                            | 1.122         |
| Right side                                 | 661/1880                 | GPRS 4TS  | 0.695            | 0.494 | -0.400          | 31.50                 | 32.00               | 0.780                            | 1.122         |



### 9.2.3 Results overview of UMTS Band II

| Test Position of Head                      | Test channel /Freq.(MHz) | Test Mode | SAR Value (W/kg) |       | Power Drift (%) | Conducted Power (dBm) | Tune-up Limit (dBm) | Scaled SAR <sub>1-g</sub> (W/kg) | Scalig Factor |
|--------------------------------------------|--------------------------|-----------|------------------|-------|-----------------|-----------------------|---------------------|----------------------------------|---------------|
|                                            |                          |           | 1-g              | 10-g  |                 |                       |                     |                                  |               |
| Left Head Touched                          | 9538/1907.6              | RMC       | 0.381            | 0.238 | -1.970          | 23.58                 | 24.00               | <b>0.420</b>                     | 1.102         |
| Left Head Tilted 15°                       | 9538/1907.6              | RMC       | 0.222            | 0.129 | 2.020           | 23.58                 | 24.00               | 0.245                            | 1.102         |
| Right Head Touched                         | 9538/1907.6              | RMC       | 0.352            | 0.209 | -4.610          | 23.58                 | 24.00               | 0.388                            | 1.102         |
| Right Head Tilted 15°                      | 9538/1907.6              | RMC       | 0.198            | 0.115 | 0.300           | 23.58                 | 24.00               | 0.218                            | 1.102         |
| Test Position of Body with 10mm            | Test channel /Freq.(MHz) | Test Mode | SAR Value (W/kg) |       | Power Drift (%) | Conducted Power (dBm) | Tune-up Limit (dBm) | Scaled SAR <sub>1-g</sub> (W/kg) | Scalig Factor |
|                                            |                          |           | 1-g              | 10-g  |                 |                       |                     |                                  |               |
| SAR Results for Hotspot Exposure Condition |                          |           |                  |       |                 |                       |                     |                                  |               |
| Front side                                 | 9538/1907.6              | RMC       | 0.583            | 0.430 | -0.790          | 23.58                 | 24.00               | 0.642                            | 1.102         |
| Rear side                                  | 9538/1907.6              | RMC       | 0.610            | 0.456 | 3.110           | 23.58                 | 24.00               | <b>0.672</b>                     | 1.102         |
| Top side                                   | 9538/1907.6              | RMC       | 0.582            | 0.425 | -0.730          | 23.58                 | 24.00               | 0.641                            | 1.102         |
| Left side                                  | 9538/1907.6              | RMC       | 0.576            | 0.397 | 0.790           | 23.58                 | 24.00               | 0.635                            | 1.102         |
| Right side                                 | 9538/1907.6              | RMC       | 0.529            | 0.412 | 0.170           | 23.58                 | 24.00               | 0.583                            | 1.102         |



## 9.2.4 Results overview of UMTS Band V

| Test Position of Head                      | Test channel /Freq.(MHz) | Test Mode | SAR Value (W/kg) |       | Power Drift (%) | Conducted Power (dBm) | Tune-up Limit (dBm) | Scaled SAR <sub>1-g</sub> (W/kg) | Scalig Factor |
|--------------------------------------------|--------------------------|-----------|------------------|-------|-----------------|-----------------------|---------------------|----------------------------------|---------------|
|                                            |                          |           | 1-g              | 10-g  |                 |                       |                     |                                  |               |
| Left Head Touched                          | 4233/846.6               | RMC       | 0.450            | 0.331 | -2.830          | 23.57                 | 24.00               | <b>0.497</b>                     | 1.104         |
| Left Head Tilted 15°                       | 4233/846.6               | RMC       | 0.287            | 0.199 | -4.750          | 23.57                 | 24.00               | 0.317                            | 1.104         |
| Right Head Touched                         | 4233/846.6               | RMC       | 0.416            | 0.300 | 4.330           | 23.57                 | 24.00               | 0.459                            | 1.104         |
| Right Head Tilted 15°                      | 4233/846.6               | RMC       | 0.255            | 0.193 | 2.880           | 23.57                 | 24.00               | 0.282                            | 1.104         |
| Test Position of Body with 10mm            | Test channel /Freq.(MHz) | Test Mode | SAR Value (W/kg) |       | Power Drift (%) | Conducted Power (dBm) | Tune-up Limit (dBm) | Scaled SAR <sub>1-g</sub> (W/kg) | Scalig Factor |
|                                            |                          |           | 1-g              | 10-g  |                 |                       |                     |                                  |               |
| SAR Results for Hotspot Exposure Condition |                          |           |                  |       |                 |                       |                     |                                  |               |
| Front side                                 | 4233/846.6               | RMC       | 0.347            | 0.259 | -0.520          | 23.57                 | 24.00               | 0.383                            | 1.104         |
| Rear side                                  | 4233/846.6               | RMC       | 0.387            | 0.285 | -4.420          | 23.57                 | 24.00               | <b>0.427</b>                     | 1.104         |
| Top side                                   | 4233/846.6               | RMC       | 0.317            | 0.234 | -3.770          | 23.57                 | 24.00               | 0.350                            | 1.104         |
| Left side                                  | 4233/846.6               | RMC       | 0.315            | 0.224 | 0.720           | 23.57                 | 24.00               | 0.348                            | 1.104         |
| Right side                                 | 4233/846.6               | RMC       | 0.321            | 0.235 | -0.430          | 23.57                 | 24.00               | 0.354                            | 1.104         |



## 10 Multiple Transmitter Information

The SAR measurement positions of each side are as below:

| Mode          | Front side | Rear side | Left side | Right side | Top side | Bottom side |
|---------------|------------|-----------|-----------|------------|----------|-------------|
| 2G/3G Antenna | Yes        | Yes       | Yes       | Yes        | No       | Yes         |
| BT Antenna    | Yes        | Yes       | No        | Yes        | Yes      | No          |

1) Per KDB941225 D06v01r01, the DUT Dimension is bigger than 9 cm x 5 cm, so 10mm is chosen as the test separation distance for Hotspot mode. When the antenna-to-edge distance is greater than 2.5cm, such position does not need to be tested.



### 10.1.1 Stand-alone SAR test exclusion

The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances  $\leq$  50 mm are determined by:

$[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] \cdot [\sqrt{f(\text{GHz})}] \leq 3.0$  for 1-g SAR and  $\leq 7.5$  for 10-g extremity SAR, where

- $f(\text{GHz})$  is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- The result is rounded to one decimal place for comparison

When the minimum test separation distance is  $< 5$  mm, a distance of 5 mm is applied to determine SAR test exclusion.

a) Head position

| Mode | Pmax(dBm) | Pmax(mW) | Distance(mm) | f(GHz) | Calculation Result | exclusion Threshold | SAR test exclusion |
|------|-----------|----------|--------------|--------|--------------------|---------------------|--------------------|
| BT   | 6.5       | 4.47     | 5.00         | 2.45   | 1.40               | 3.00                | Yes                |

Body-Worn position

| Mode | Pmax(dBm) | Pmax(mW) | Distance(mm) | f(GHz) | Calculation Result | exclusion Threshold | SAR test exclusion |
|------|-----------|----------|--------------|--------|--------------------|---------------------|--------------------|
| BT   | 6.5       | 4.47     | 10.00        | 2.45   | 0.70               | 3.00                | Yes                |



When the standalone SAR test exclusion applies to an antenna that transmits simultaneously with other antennas, the standalone SAR must be estimated according to the following to determine simultaneous transmission SAR test exclusion

(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)]·[ $\sqrt{f(\text{GHz})/x}$ ] W/kg for test separation distances  $\leq 50$  mm, where  $x = 7.5$  for 1-g SAR.

When the minimum test separation distance is  $< 5$  mm, a distance of 5 mm is applied to determine SAR test exclusion.

| Mode | Position | Pmax(dBm) | Pmax(mW) | Distance(mm) | f(GHz) | X    | Estimated SAR(W/Kg) |
|------|----------|-----------|----------|--------------|--------|------|---------------------|
| BT   | Head     | 10.13     | 10.30    | 5.00         | 2.45   | 7.50 | 0.430               |
| BT   | Body     | 10.13     | 10.30    | 10.00        | 2.45   | 7.50 | 0.215               |

### 10.1.2 Simultaneous Transmission Possibilities

The Simultaneous Transmission Possibilities are as below:

| Simultaneous Transmission Possibilities |                   |      |      |         |  |
|-----------------------------------------|-------------------|------|------|---------|--|
| Simultaneous Tx Combination             | Configuration     | Head | Body | Hotspot |  |
| 1                                       | GSM/GPRS/UMTS     | YES  | YES  | NO      |  |
| 2                                       | GSM/GPRS/UMTS +BT | YES  | NO   | NO      |  |

Note: The device does not support simultaneous BT and Wi-Fi ,because the BT and Wi-Fi share the same antenna and can't transmit simultaneously.



### 10.1.3 SAR Summation Scenario

| Test Position |                       | Scaled SAR <sub>Max</sub> |       | $\Sigma_{1-g}$ SAR | SPLSP |
|---------------|-----------------------|---------------------------|-------|--------------------|-------|
|               |                       | GSM850                    | BT    |                    |       |
| Head          | Left Head Touched     | 0.667                     | 0.430 | 1.097              | NA    |
|               | Left Head Tilted 15°  | 0.398                     | 0.430 | 0.828              | NA    |
|               | Right Head Touched    | 0.632                     | 0.430 | 1.062              | NA    |
|               | Right Head Tilted 15° | 0.349                     | 0.430 | 0.779              | NA    |

Note: Simultaneous Tx Combination of GSM850 and BT

| Test Position |                       | Scaled SAR <sub>Max</sub> |       | $\Sigma_{1-g}$ SAR | SPLSP |
|---------------|-----------------------|---------------------------|-------|--------------------|-------|
|               |                       | GSM1900                   | BT    |                    |       |
| Head          | Left Head Touched     | 0.898                     | 0.430 | 1.328              | NA    |
|               | Left Head Tilted 15°  | 0.523                     | 0.430 | 0.953              | NA    |
|               | Right Head Touched    | 0.859                     | 0.430 | 1.289              | NA    |
|               | Right Head Tilted 15° | 0.548                     | 0.430 | 0.978              | NA    |

Note: Simultaneous Tx Combination of GSM1900 and BT

| Test Position |                       | Scaled SAR <sub>Max</sub> |       | $\Sigma_{1-g}$ SAR | SPLSP |
|---------------|-----------------------|---------------------------|-------|--------------------|-------|
|               |                       | UMTS Band II              | BT    |                    |       |
| Head          | Left Head Touched     | 0.381                     | 0.430 | 0.811              | NA    |
|               | Left Head Tilted 15°  | 0.222                     | 0.430 | 0.652              | NA    |
|               | Right Head Touched    | 0.343                     | 0.430 | 0.773              | NA    |
|               | Right Head Tilted 15° | 0.198                     | 0.430 | 0.628              | NA    |

Note: Simultaneous Tx Combination of UMTS Band II and BT

| Test Position |                       | Scaled SAR <sub>Max</sub> |       | $\Sigma_{1-g}$ SAR | SPLSP |
|---------------|-----------------------|---------------------------|-------|--------------------|-------|
|               |                       | UMTS Band V               | BT    |                    |       |
| Head          | Left Head Touched     | 0.450                     | 0.430 | 0.880              | NA    |
|               | Left Head Tilted 15°  | 0.287                     | 0.430 | 0.717              | NA    |
|               | Right Head Touched    | 0.415                     | 0.430 | 0.845              | NA    |
|               | Right Head Tilted 15° | 0.255                     | 0.430 | 0.685              | NA    |

Note: Simultaneous Tx Combination of UMTS Band V and BT

MAX.  $\Sigma SAR_{1g} = 1.223W/kg < 1.6 W/kg$ , so the Simultaneous SAR is not required for BT and GSM&UMTS&LTE antenna.



## 11 Measurement uncertainty evaluation

### 11.1 Measurement uncertainty evaluation for SAR test

The following table includes the uncertainty table of the IEEE 1528. The values are determined by Satimo. The breakdown of the individual uncertainties is as follows:

| Measurement Uncertainty evaluation for SAR test                                |              |                |            |                        |                         |                           |                            |                |
|--------------------------------------------------------------------------------|--------------|----------------|------------|------------------------|-------------------------|---------------------------|----------------------------|----------------|
| Uncertainty Component                                                          | Tol.<br>(±%) | Prob.<br>Dist. | Div.       | C <sub>i</sub><br>(1g) | C <sub>i</sub><br>(10g) | 1g U <sub>i</sub><br>(±%) | 10g U <sub>i</sub><br>(±%) | V <sub>i</sub> |
| <b>measurement system</b>                                                      |              |                |            |                        |                         |                           |                            |                |
| Probe Calibration                                                              | 5.8          | N              | 1          | 1                      | 1                       | 5.8                       | 5.8                        | ∞              |
| Axial Isotropy                                                                 | 3.5          | R              | $\sqrt{3}$ | $(1-C_p)^{1/2}$        | $(1-C_p)^{1/2}$         | 1.43                      | 1.43                       | ∞              |
| Hemispherical Isotropy                                                         | 5.9          | R              | $\sqrt{3}$ | $\sqrt{C_p}$           | $\sqrt{C_p}$            | 2.41                      | 2.41                       | ∞              |
| Boundary Effect                                                                | 1            | R              | $\sqrt{3}$ | 1                      | 1                       | 0.58                      | 0.58                       | ∞              |
| Linearity                                                                      | 4.7          | R              | $\sqrt{3}$ | 1                      | 1                       | 2.71                      | 2.71                       | ∞              |
| system Detection Limits                                                        | 1            | R              | $\sqrt{3}$ | 1                      | 1                       | 0.58                      | 0.58                       | ∞              |
| Modulation response                                                            | 3            | N              | 1          | 1                      | 1                       | 3.00                      | 3.00                       | ∞              |
| Readout Electronics                                                            | 0.5          | N              | 1          | 1                      | 1                       | 0.50                      | 0.50                       | ∞              |
| Response Time                                                                  | 0            | R              | $\sqrt{3}$ | 1                      | 1                       | 0.00                      | 0.00                       | ∞              |
| Integration Time                                                               | 1.4          | R              | $\sqrt{3}$ | 1                      | 1                       | 0.81                      | 0.81                       | ∞              |
| RF Ambient Conditions-Noise                                                    | 3            | R              | $\sqrt{3}$ | 1                      | 1                       | 1.73                      | 1.73                       | ∞              |
| RF Ambient Conditions-Reflections                                              | 3            | R              | $\sqrt{3}$ | 1                      | 1                       | 1.73                      | 1.73                       | ∞              |
| Probe Positioner Mechanical Tolerance                                          | 1.4          | R              | $\sqrt{3}$ | 1                      | 1                       | 0.81                      | 0.81                       | ∞              |
| Probe positioning with respect to Phantom Shell                                | 1.4          | R              | $\sqrt{3}$ | 1                      | 1                       | 0.81                      | 0.81                       | ∞              |
| Extrapolation, interpolation and Integration Algorithms for Max.SAR Evaluation | 2.3          | R              | $\sqrt{3}$ | 1                      | 1                       | 1.33                      | 1.33                       | ∞              |
| <b>Test sample Related</b>                                                     |              |                |            |                        |                         |                           |                            |                |
| Test Sample Positioning                                                        | 2.6          | N              | 1          | 1                      | 1                       | 2.60                      | 2.60                       | 11             |
| Device Holder Uncertainty                                                      | 3            | N              | 1          | 1                      | 1                       | 3.00                      | 3.00                       | 7              |
| Output Power Variation-SAR drift measurement                                   | 5            | R              | $\sqrt{3}$ | 1                      | 1                       | 2.89                      | 2.89                       | ∞              |
| SAR scaling                                                                    | 2            | R              | $\sqrt{3}$ | 1                      | 1                       | 1.15                      | 1.15                       | ∞              |



| Phantom and Tissue Parameters                                                        |     |     |            |      |      |       |       |          |
|--------------------------------------------------------------------------------------|-----|-----|------------|------|------|-------|-------|----------|
| Phantom Uncertainty<br>(shape and thickness tolerances)                              | 4   | R   | $\sqrt{3}$ | 1    | 1    | 2.31  | 2.31  | $\infty$ |
| Uncertainty in SAR correction for<br>deviation<br>(in permittivity and conductivity) | 2   | N   | 1          | 1    | 0.84 | 2.00  | 1.68  | $\infty$ |
| Liquid conductivity (meas.)                                                          | 2.5 | N   | 1          | 0.64 | 0.43 | 1.60  | 1.08  | 5        |
| Liquid conductivity (target.)                                                        | 5   | R   | $\sqrt{3}$ | 0.64 | 0.43 | 1.85  | 1.24  | 5        |
| Liquid Permittivity (meas.)                                                          | 2.5 | N   | 1          | 0.60 | 0.49 | 1.50  | 1.23  | $\infty$ |
| Liquid Permittivity (target.)                                                        | 5   | R   | $\sqrt{3}$ | 0.60 | 0.49 | 1.73  | 1.42  | $\infty$ |
| <b>Combined Standard Uncertainty</b>                                                 |     | Rss |            |      |      | 10.63 | 10.54 |          |
| <b>Expanded Uncertainty{95%<br/>CONFIDENCE INTERVAL}</b>                             |     | k   |            |      |      | 21.26 | 21.08 |          |



## 11.2 Measurement uncertainty evaluation for system check

The following table includes the uncertainty table of the IEEE 1528. The values are determined by Satimo. The breakdown of the individual uncertainties is as follows:

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| Uncertainty For System Performance Check                                        |              |                |            |                      |                       |                           |                            |                |
|---------------------------------------------------------------------------------|--------------|----------------|------------|----------------------|-----------------------|---------------------------|----------------------------|----------------|
| Uncertainty Component                                                           | Tol.<br>(±%) | Prob.<br>Dist. | Div.       | C <sub>i</sub><br>1g | C <sub>i</sub><br>10g | 1g<br>U <sub>i</sub> (±%) | 10g<br>U <sub>i</sub> (±%) | V <sub>i</sub> |
| <b>measurement system</b>                                                       |              |                |            |                      |                       |                           |                            |                |
| Probe Calibration                                                               | 5.8          | N              | 1          | 1                    | 1                     | 5.80                      | 5.80                       | ∞              |
| Axial Isotropy                                                                  | 3.5          | R              | $\sqrt{3}$ | $(1-C_p)^{1/2}$      | $(1-C_p)^{1/2}$       | 1.43                      | 1.43                       | ∞              |
| Hemispherical Isotropy                                                          | 5.9          | R              | $\sqrt{3}$ | $\sqrt{C_p}$         | $\sqrt{C_p}$          | 2.41                      | 2.41                       | ∞              |
| Boundary Effect                                                                 | 1            | R              | $\sqrt{3}$ | 1                    | 1                     | 0.58                      | 0.58                       | ∞              |
| Linearity                                                                       | 4.7          | R              | $\sqrt{3}$ | 1                    | 1                     | 2.71                      | 2.71                       | ∞              |
| system detection Limits                                                         | 1            | R              | $\sqrt{3}$ | 1                    | 1                     | 0.58                      | 0.58                       | ∞              |
| Modulation response                                                             | 0            | N              | 1          | 1                    | 1                     | 0.00                      | 0.00                       | ∞              |
| Readout Electronics                                                             | 0.5          | N              | 1          | 1                    | 1                     | 0.50                      | 0.50                       | ∞              |
| Response Time                                                                   | 0            | R              | $\sqrt{3}$ | 1                    | 1                     | 0.00                      | 0.00                       | ∞              |
| Integration Time                                                                | 1.4          | R              | $\sqrt{3}$ | 1                    | 1                     | 0.81                      | 0.81                       | ∞              |
| RF ambient Conditions - Noise                                                   | 3            | R              | $\sqrt{3}$ | 1                    | 1                     | 1.73                      | 1.73                       | ∞              |
| RF ambient Conditions – Reflections                                             | 3            | R              | $\sqrt{3}$ | 1                    | 1                     | 1.73                      | 1.73                       | ∞              |
| Probe positioned Mechanical Tolerance                                           | 1.4          | R              | $\sqrt{3}$ | 1                    | 1                     | 0.81                      | 0.81                       | ∞              |
| Probe positioning with respect to Phantom Shell                                 | 1.4          | R              | $\sqrt{3}$ | 1                    | 1                     | 0.81                      | 0.81                       | ∞              |
| Extrapolation, interpolation and integration Algorithms for Max. SAR Evaluation | 2.3          | R              | $\sqrt{3}$ | 1                    | 1                     | 1.33                      | 1.33                       | ∞              |
| <b>Dipole</b>                                                                   |              |                |            |                      |                       |                           |                            |                |
| Deviation of experimental source from numerical source                          | 4            | N              | 1          | 1                    | 1                     | 4.00                      | 4.00                       | ∞              |
| Input power and SAR drift measurement                                           | 5            | R              | $\sqrt{3}$ | 1                    | 1                     | 2.89                      | 2.89                       | ∞              |
| Dipole axis to liquid Distance                                                  | 2            | R              | $\sqrt{3}$ | 1                    | 1                     | 1.16                      | 1.16                       | ∞              |



| Phantom and Tissue Parameters                                                        |     |     |            |      |      |       |       |          |
|--------------------------------------------------------------------------------------|-----|-----|------------|------|------|-------|-------|----------|
| Phantom Uncertainty<br>(shape and thickness tolerances)                              | 4   | R   | $\sqrt{3}$ | 1    | 1    | 2.31  | 2.31  | $\infty$ |
| Uncertainty in SAR correction for<br>deviation<br>(in permittivity and conductivity) | 2   | N   | 1          | 1    | 0.84 | 2.00  | 1.68  | $\infty$ |
| Liquid conductivity (meas.)                                                          | 2.5 | N   | 1          | 0.64 | 0.43 | 1.60  | 1.08  | 5        |
| Liquid conductivity (target.)                                                        | 5   | R   | $\sqrt{3}$ | 0.64 | 0.43 | 1.85  | 1.24  | 5        |
| Liquid Permittivity (meas.)                                                          | 2.5 | N   | 1          | 0.60 | 0.49 | 1.50  | 1.23  | $\infty$ |
| Liquid Permittivity (target.)                                                        | 5   | R   | $\sqrt{3}$ | 0.60 | 0.49 | 1.73  | 1.41  | $\infty$ |
| <b>Combined Standard Uncertainty</b>                                                 |     | Rss |            |      |      | 10.28 | 9.98  |          |
| <b>Expanded Uncertainty<br/>(95% Confidence interval)</b>                            |     | k   |            |      |      | 20.57 | 19.95 |          |



## 12 Test equipment and ancillaries used for tests

To simplify the identification of the test equipment and/or ancillaries which were used, the reporting of the relevant test cases only refer to the test item number as specified in the table below.

|                                     | Manufacturer | Device Type                          | Type(Model)              | Serial number            | calibration |            |
|-------------------------------------|--------------|--------------------------------------|--------------------------|--------------------------|-------------|------------|
|                                     |              |                                      |                          |                          | Last Cal.   | Due Date   |
| <input checked="" type="checkbox"/> | SATIMO       | COMOSAR DOSIMETRIC E FIELD PROBE     | SSE5                     | SN 36/20 EPG0343         | 2020-12-10  | 2021-12-09 |
| <input type="checkbox"/>            | SATIMO       | COMOSAR 750 MHz REFERENCE DIPOLE     | SID750                   | SN 48/16<br>DIP0G750-444 | 2020-06-25  | 2023-06-24 |
| <input checked="" type="checkbox"/> | SATIMO       | COMOSAR 835 MHz REFERENCE DIPOLE     | SID835                   | SN 14/13<br>DIP0G835-235 | 2020-06-25  | 2023-06-24 |
| <input type="checkbox"/>            | SATIMO       | COMOSAR 900 MHz REFERENCE DIPOLE     | SID900                   | SN 14/13<br>DIP0G900-231 | 2020-06-25  | 2023-06-24 |
| <input checked="" type="checkbox"/> | SATIMO       | COMOSAR 1800 MHz REFERENCE DIPOLE    | SID1800                  | SN 14/13<br>DIP1G800-232 | 2020-06-25  | 2023-06-24 |
| <input checked="" type="checkbox"/> | SATIMO       | COMOSAR 1900 MHz REFERENCE DIPOLE    | SID1900                  | SN 14/13<br>DIP1G900-236 | 2020-06-25  | 2023-06-24 |
| <input checked="" type="checkbox"/> | SATIMO       | COMOSAR 2000 MHz REFERENCE DIPOLE    | SID2000                  | SN 14/13<br>DIP2G000-237 | 2020-06-25  | 2023-06-24 |
| <input checked="" type="checkbox"/> | SATIMO       | COMOSAR 2450 MHz REFERENCE DIPOLE    | SID2450                  | SN 14/13<br>DIP2G450-238 | 2020-06-25  | 2023-06-24 |
| <input checked="" type="checkbox"/> | SATIMO       | COMOSAR 2600 MHz REFERENCE DIPOLE    | SID2600                  | SN 28/14<br>DIP2G600-327 | 2020-06-25  | 2023-06-24 |
| <input checked="" type="checkbox"/> | SATIMO       | Software                             | OPENSAR                  | N/A                      | N/A         | N/A        |
| <input checked="" type="checkbox"/> | SATIMO       | Phantom                              | COMOSAR IEEE SAM PHANTOM | SN 14/13 SAM99           | N/A         | N/A        |
| <input checked="" type="checkbox"/> | R & S        | Universal Radio Communication Tester | CMU 200                  | 119733                   | 2021-11-05  | 2022-11-04 |
| <input checked="" type="checkbox"/> | R & S        | Universal Radio Communication Tester | CMW500                   | 144459                   | 2021-11-05  | 2022-11-04 |
| <input checked="" type="checkbox"/> | HP           | Network Analyser                     | 8753D                    | 3410A08889               | 2021-11-05  | 2022-11-04 |
| <input checked="" type="checkbox"/> | HP           | Signal Generator                     | E4421B                   | GB39340770               | 2021-11-05  | 2022-11-04 |
| <input checked="" type="checkbox"/> | Keithley     | Multimeter                           | Keithley 2000            | 4014539                  | 2021-11-05  | 2022-11-04 |
| <input checked="" type="checkbox"/> | SATIMO       | Amplifier                            | Power Amplifier          | MODU-023-A-0004          | 2021-11-05  | 2022-11-04 |
| <input checked="" type="checkbox"/> | Agilent      | Power Meter                          | E4418B                   | GB43312909               | 2021-11-05  | 2022-11-04 |
| <input checked="" type="checkbox"/> | Agilent      | Power Meter Sensor                   | E4412A                   | MY41500046               | 2021-11-05  | 2022-11-04 |
| <input checked="" type="checkbox"/> | SATIMO       | SATIMO                               | Opensar                  | OpenSAR V4_02_32         | N/A         | N/A        |



## Annex A: System performance verification

(Please See the SAR Measurement Plots of annex A.)

## Annex B: Measurement results

(Please See the SAR Measurement Plots of annex B.)

## Annex C: Calibration reports

(Please See the Calibration reports of annex C.)



## Annex A: System Check

**Tested Model : COMETA**

**Report Number:**

**WSCT-A2LA-R&E220900007A-SAR**

### I. RESULTS

| <u>TYPE</u> | <u>BAND</u> | <u>PARAMETERS</u>                                                                                |
|-------------|-------------|--------------------------------------------------------------------------------------------------|
| Validation  | CW835       | <u>Measurement 1</u> : Validation Plane with Dipole device position on Middle Channel in CW mode |
| Validation  | CW835       | <u>Measurement 2</u> : Validation Plane with Dipole device position on Middle Channel in CW mode |
| Validation  | CW1900      | <u>Measurement 3</u> : Validation Plane with Dipole device position on Middle Channel in CW mode |
| Validation  | CW1900      | <u>Measurement 4</u> : Validation Plane with Dipole device position on Middle Channel in CW mode |

## MEASUREMENT 1

### BODY

Type: Validation measurement (Complete)

Date of measurement: 26/8/2022

Measurement duration: 11 minutes 54 seconds

#### **A. Experimental conditions.**

|                               |                                                        |
|-------------------------------|--------------------------------------------------------|
| <b><u>Area Scan</u></b>       | <u>dx=8mm dy=8mm</u>                                   |
| <b><u>ZoomScan</u></b>        | <u>5x5x7, dx=8mm dy=8mm</u><br><u>dz=5mm, Complete</u> |
| <b><u>Phantom</u></b>         | <u>Validation plane</u>                                |
| <b><u>Device Position</u></b> | <u>Dipole</u>                                          |
| <b><u>Band</u></b>            | <u>CW835</u>                                           |
| <b><u>Channels</u></b>        | <u>Middle</u>                                          |
| <b><u>Signal</u></b>          | <u>CW (Crest factor: 1.0)</u>                          |

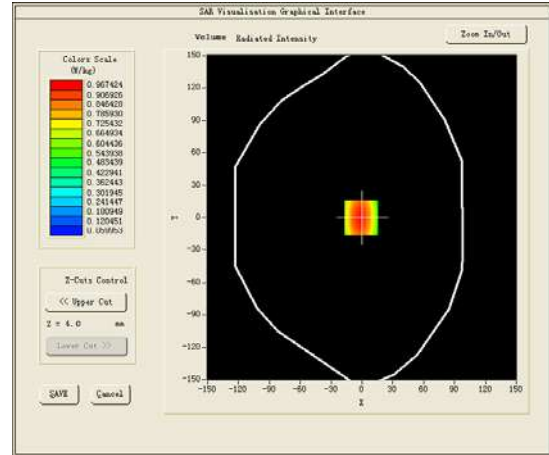
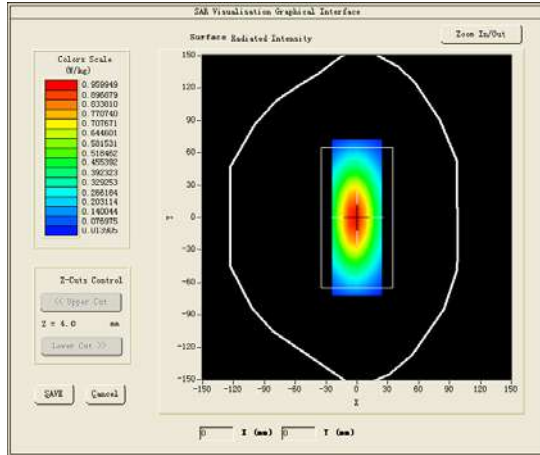
#### **B. SAR Measurement Results**

Middle Band SAR (Channel -1):

|                                               |            |
|-----------------------------------------------|------------|
| <b>Frequency (MHz)</b>                        | 835.000000 |
| <b>Relative permittivity (real part)</b>      | 53.927799  |
| <b>Relative permittivity (imaginary part)</b> | 21.281300  |
| <b>Conductivity (S/m)</b>                     | 0.987216   |
| <b>Variation (%)</b>                          | 0.120000   |

## SURFACE SAR

## VOLUME SAR

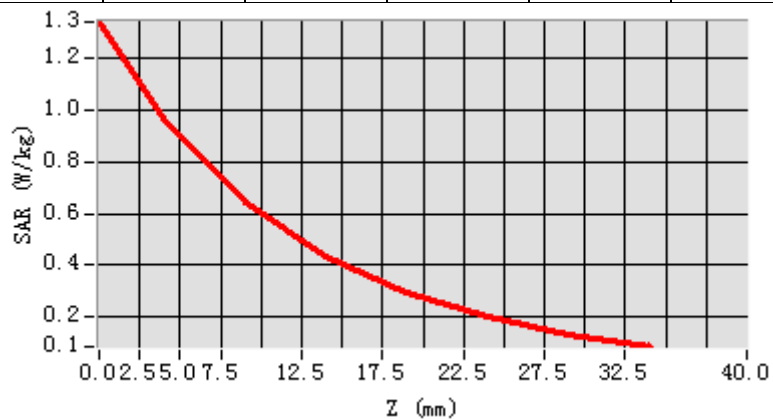


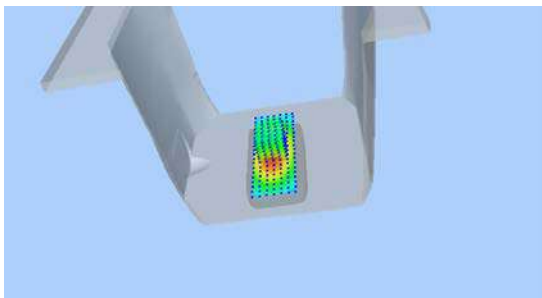
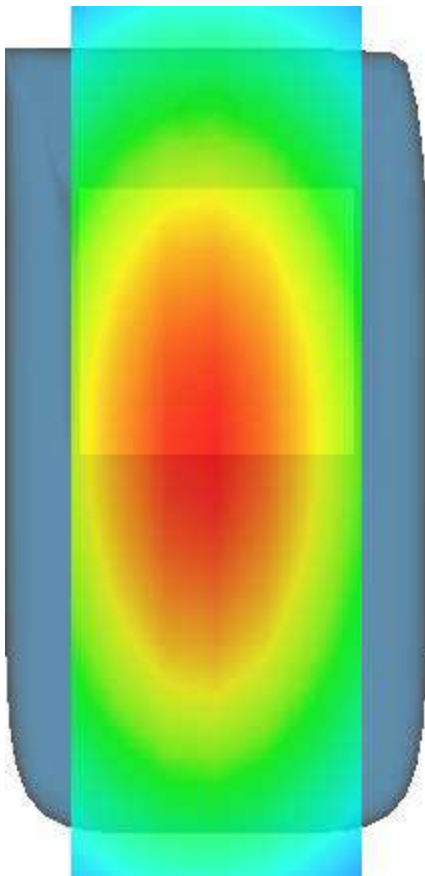
Maximum location: X=-1.00, Y=0.00

SAR Peak: 1.44 W/kg

|                |          |
|----------------|----------|
| SAR 10g (W/Kg) | 6.44746  |
| SAR 1g (W/Kg)  | 10.14583 |

| Z (mm)     | 0.00   | 4.00   | 9.00   | 14.00  | 19.00  | 24.00  | 29.00  |
|------------|--------|--------|--------|--------|--------|--------|--------|
| SAR (W/Kg) | 1.3418 | 0.9674 | 0.6426 | 0.4358 | 0.2947 | 0.1989 | 0.1326 |



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

## MEASUREMENT 2

### HEAD

Type: Validation measurement (Complete)

Date of measurement: 26/8/2022

Measurement duration: 11 minutes 54 seconds

#### A. Experimental conditions.

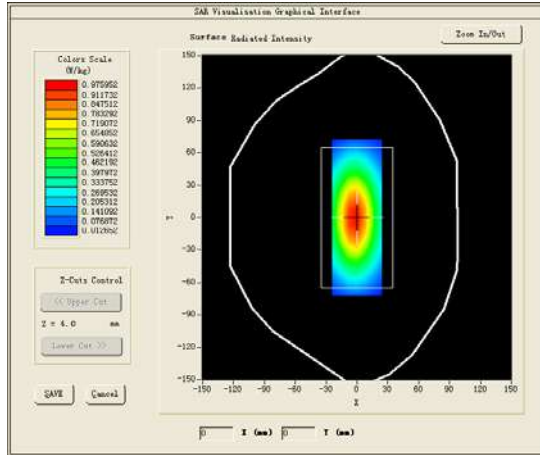
|                        |                                                        |
|------------------------|--------------------------------------------------------|
| <u>Area Scan</u>       | <u>dx=8mm dy=8mm</u>                                   |
| <u>ZoomScan</u>        | <u>5x5x7, dx=8mm dy=8mm</u><br><u>dz=5mm, Complete</u> |
| <u>Phantom</u>         | <u>Validation plane</u>                                |
| <u>Device Position</u> | <u>Dipole</u>                                          |
| <u>Band</u>            | <u>CW835</u>                                           |
| <u>Channels</u>        | <u>Middle</u>                                          |
| <u>Signal</u>          | <u>CW (Crest factor: 1.0)</u>                          |

#### B. SAR Measurement Results

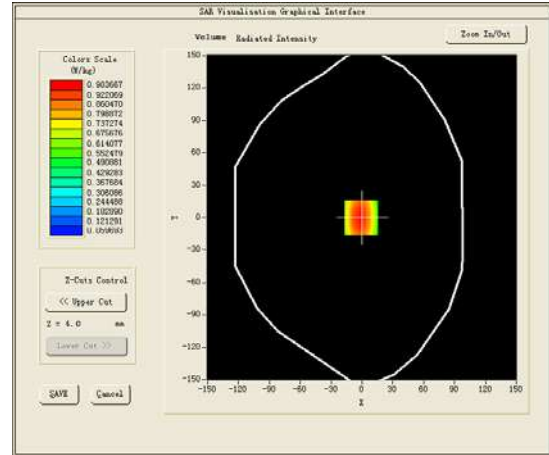
Middle Band SAR (Channel -1):

|                                               |            |
|-----------------------------------------------|------------|
| <b>Frequency (MHz)</b>                        | 835.000000 |
| <b>Relative permittivity (real part)</b>      | 40.328999  |
| <b>Relative permittivity (imaginary part)</b> | 19.880501  |
| <b>Conductivity (S/m)</b>                     | 0.922234   |
| <b>Variation (%)</b>                          | -0.070000  |

## SURFACE SAR



## VOLUME SAR

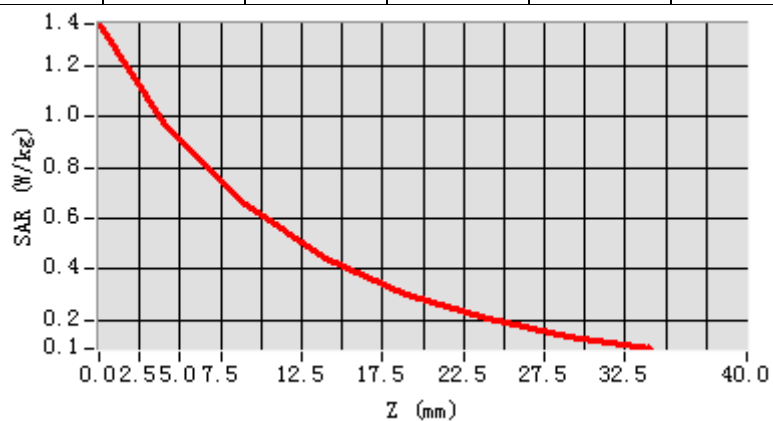


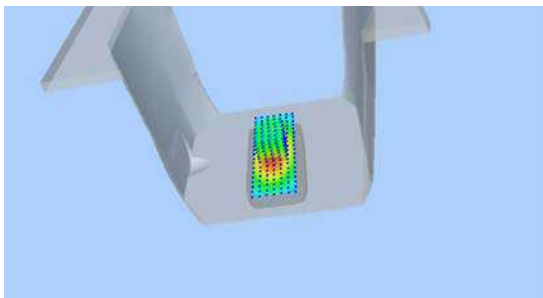
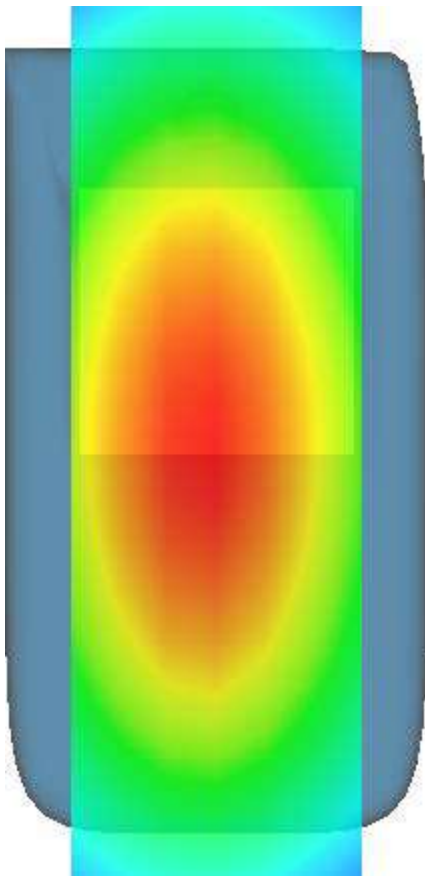
**Maximum location: X=-1.00, Y=0.00**

**SAR Peak: 1.37 W/kg**

|                       |         |
|-----------------------|---------|
| <b>SAR 10g (W/Kg)</b> | 6.15004 |
| <b>SAR 1g (W/Kg)</b>  | 9.70049 |

| Z (mm)     | 0.00   | 4.00   | 9.00   | 14.00  | 19.00  | 24.00  | 29.00  |
|------------|--------|--------|--------|--------|--------|--------|--------|
| SAR (W/Kg) | 1.3669 | 0.9837 | 0.6529 | 0.4412 | 0.2993 | 0.2017 | 0.1343 |



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

## MEASUREMENT 3

### BODY

Type: Validation measurement (Complete)

Date of measurement: 28/8/2022

Measurement duration: 10 minutes 57 seconds

### A. Experimental conditions.

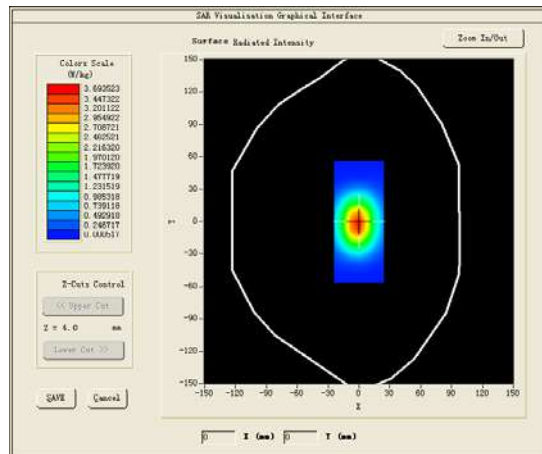
|                        |                                                        |
|------------------------|--------------------------------------------------------|
| <u>Area Scan</u>       | <u>dx=8mm dy=8mm</u>                                   |
| <u>ZoomScan</u>        | <u>5x5x7, dx=8mm dy=8mm</u><br><u>dz=5mm, Complete</u> |
| <u>Phantom</u>         | <u>Validation plane</u>                                |
| <u>Device Position</u> | <u>Dipole</u>                                          |
| <u>Band</u>            | <u>CW1900</u>                                          |
| <u>Channels</u>        | <u>Middle</u>                                          |
| <u>Signal</u>          | <u>CW (Crest factor: 1.0)</u>                          |

### B. SAR Measurement Results

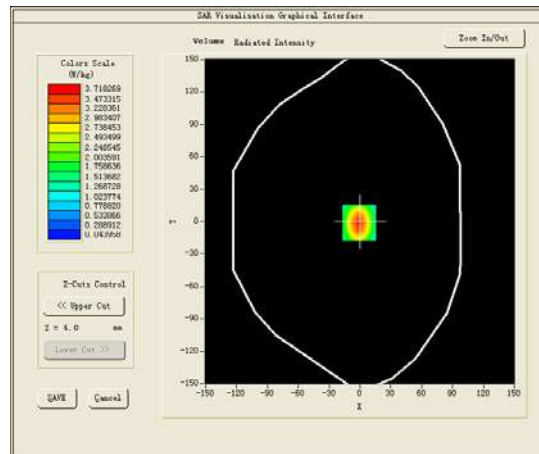
Middle Band SAR (Channel -1):

|                                               |             |
|-----------------------------------------------|-------------|
| <b>Frequency (MHz)</b>                        | 1900.000000 |
| <b>Relative permittivity (real part)</b>      | 53.365299   |
| <b>Relative permittivity (imaginary part)</b> | 14.757600   |
| <b>Conductivity (S/m)</b>                     | 1.557747    |
| <b>Variation (%)</b>                          | -0.450000   |

## SURFACE SAR



## VOLUME SAR

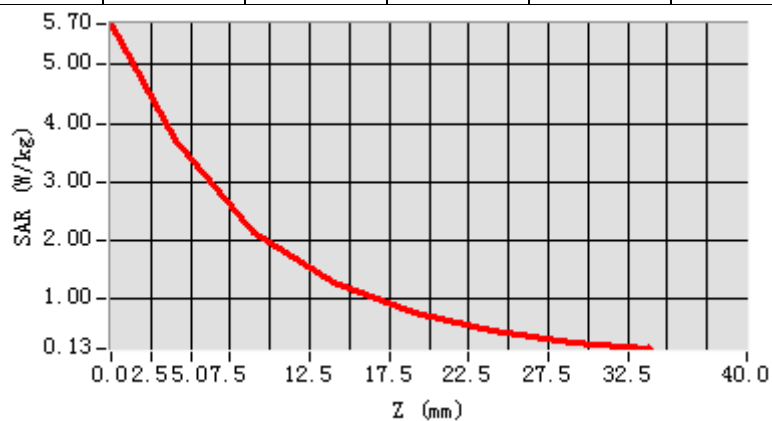


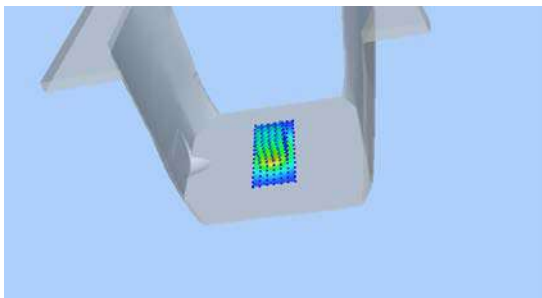
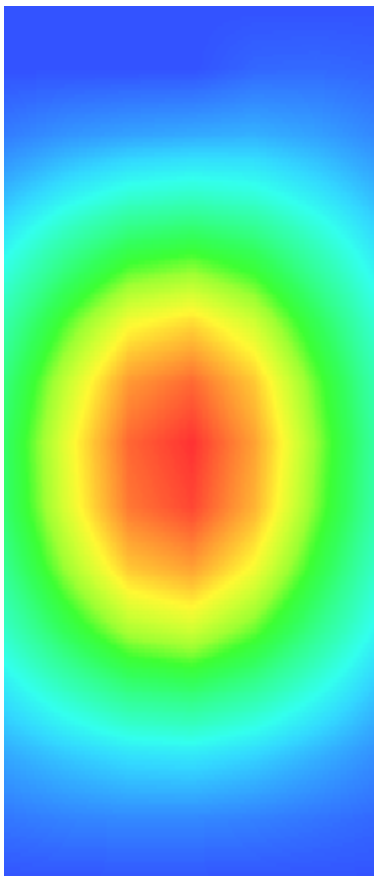
Maximum location: X=-1.00, Y=-1.00

SAR Peak: 6.26 W/kg

|                |          |
|----------------|----------|
| SAR 10g (W/Kg) | 20.93533 |
| SAR 1g (W/Kg)  | 39.32904 |

| Z (mm)     | 0.00   | 4.00   | 9.00   | 14.00  | 19.00  | 24.00  | 29.00  |
|------------|--------|--------|--------|--------|--------|--------|--------|
| SAR (W/Kg) | 5.7034 | 3.7183 | 2.1347 | 1.2560 | 0.7338 | 0.4260 | 0.2429 |



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

## MEASUREMENT 4

### HEAD

Type: Validation measurement (Complete)

Date of measurement: 28/8/2022

Measurement duration: 11 minutes 6 seconds

#### A. Experimental conditions.

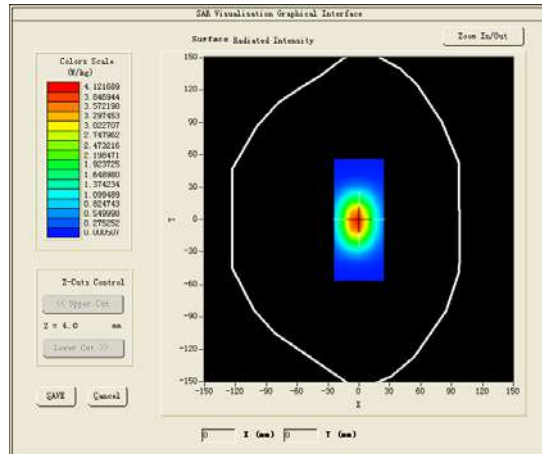
|                        |                                                        |
|------------------------|--------------------------------------------------------|
| <u>Area Scan</u>       | <u>dx=8mm dy=8mm</u>                                   |
| <u>ZoomScan</u>        | <u>5x5x7, dx=8mm dy=8mm</u><br><u>dz=5mm, Complete</u> |
| <u>Phantom</u>         | <u>Validation plane</u>                                |
| <u>Device Position</u> | <u>Dipole</u>                                          |
| <u>Band</u>            | <u>CW1900</u>                                          |
| <u>Channels</u>        | <u>Middle</u>                                          |
| <u>Signal</u>          | <u>CW (Crest factor: 1.0)</u>                          |

#### B. SAR Measurement Results

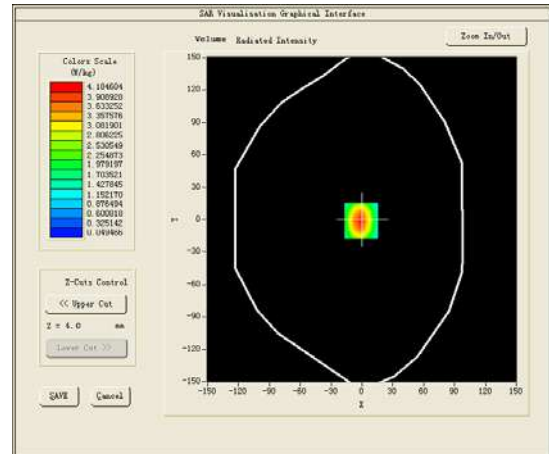
Middle Band SAR (Channel -1):

|                                               |             |
|-----------------------------------------------|-------------|
| <b>Frequency (MHz)</b>                        | 1900.000000 |
| <b>Relative permittivity (real part)</b>      | 39.976398   |
| <b>Relative permittivity (imaginary part)</b> | 13.386300   |
| <b>Conductivity (S/m)</b>                     | 1.412998    |
| <b>Variation (%)</b>                          | -0.040000   |

## SURFACE SAR



## VOLUME SAR

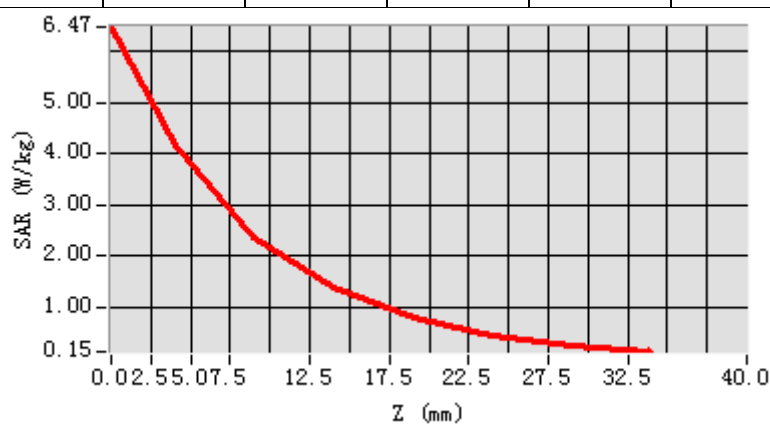


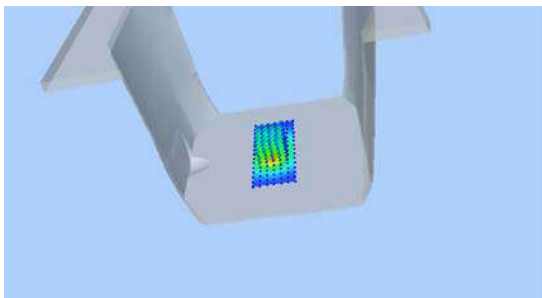
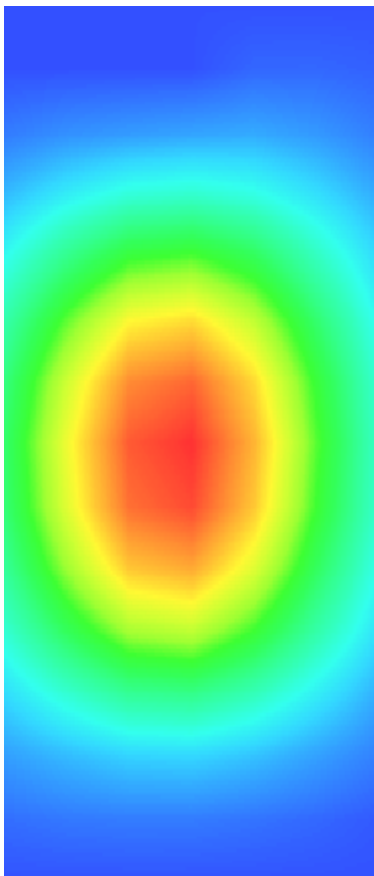
Maximum location: X=-1.00, Y=-1.00

SAR Peak: 6.48 W/kg

|                |          |
|----------------|----------|
| SAR 10g (W/Kg) | 21.07104 |
| SAR 1g (W/Kg)  | 39.97625 |

| Z (mm)     | 0.00   | 4.00   | 9.00   | 14.00  | 19.00  | 24.00  | 29.00  |
|------------|--------|--------|--------|--------|--------|--------|--------|
| SAR (W/Kg) | 6.4693 | 4.1846 | 2.3780 | 1.3892 | 0.8084 | 0.4680 | 0.2662 |



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

|                                                                                   |                                                           |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------|
|  | <b>Annex B: Measurement Results</b>                       |
|                                                                                   | <b>Tested Model : COMETA</b>                              |
|                                                                                   | <b>Report Number:<br/>WSCT-A2LA-R&amp;E220900007A-SAR</b> |

## MEASUREMENT 1

Type: Phone measurement (Complete)

Date of measurement: 26/8/2022

Measurement duration: 9 minutes 51 seconds

### A. Experimental conditions.

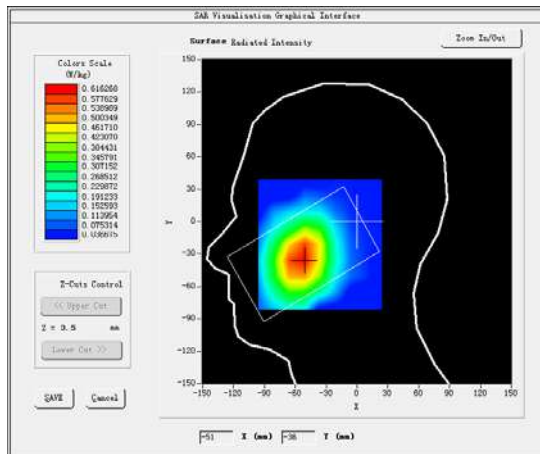
|                        |                                                        |
|------------------------|--------------------------------------------------------|
| <u>Area Scan</u>       | <u>dx=15mm dy=15mm</u>                                 |
| <u>ZoomScan</u>        | <u>5x5x7, dx=8mm dy=8mm</u><br><u>dz=5mm, Complete</u> |
| <u>Phantom</u>         | <u>Left head</u>                                       |
| <u>Device Position</u> | <u>Cheek</u>                                           |
| <u>Band</u>            | <u>GSM850</u>                                          |
| <u>Channels</u>        | <u>Middle</u>                                          |
| <u>Signal</u>          | <u>TDMA (Crest factor: 8.0)</u>                        |

### B. SAR Measurement Results

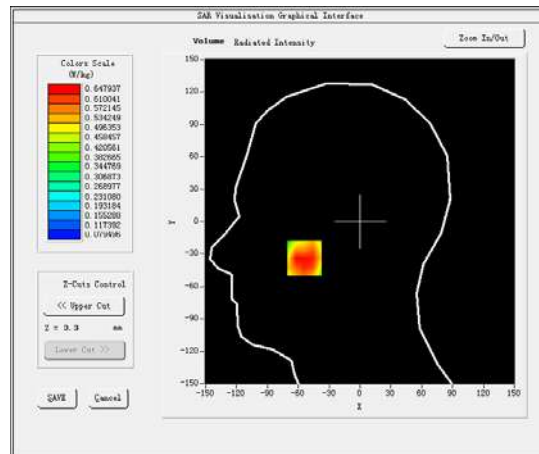
Middle Band SAR (Channel 190):

|                                               |            |
|-----------------------------------------------|------------|
| <b>Frequency (MHz)</b>                        | 836.600000 |
| <b>Relative permittivity (real part)</b>      | 41.556599  |
| <b>Relative permittivity (imaginary part)</b> | 20.378799  |
| <b>Conductivity (S/m)</b>                     | 1.021204   |
| <b>Variation (%)</b>                          | 3.670000   |

## SURFACE SAR



## VOLUME SAR

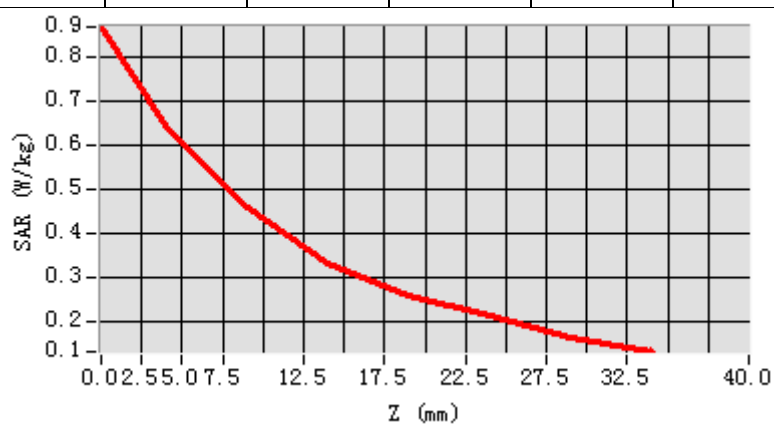


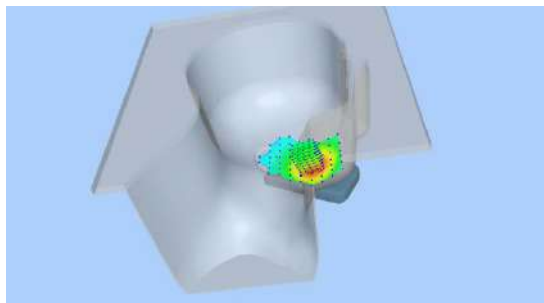
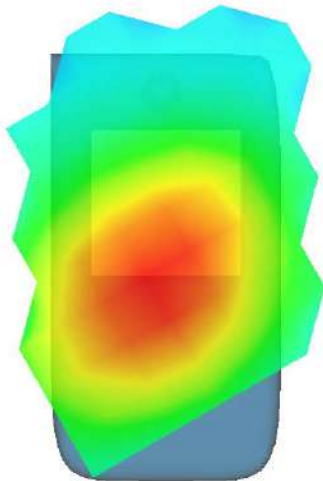
**Maximum location: X = -54.00, Y = -34.00**

**SAR Peak: 0.95 W/kg**

|                       |          |
|-----------------------|----------|
| <b>SAR 10g (W/Kg)</b> | 0.448336 |
| <b>SAR 1g (W/Kg)</b>  | 0.666698 |

| Z (mm)     | 0.00   | 4.00   | 9.00   | 14.00  | 19.00  | 24.00  | 29.00  |
|------------|--------|--------|--------|--------|--------|--------|--------|
| SAR (W/Kg) | 0.8702 | 0.6479 | 0.4601 | 0.3310 | 0.2564 | 0.2113 | 0.1635 |



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

## MEASUREMENT 2

Type: Phone measurement (Complete)

Date of measurement: 28/8/2022

Measurement duration: 9 minutes 43 seconds

### A. Experimental conditions.

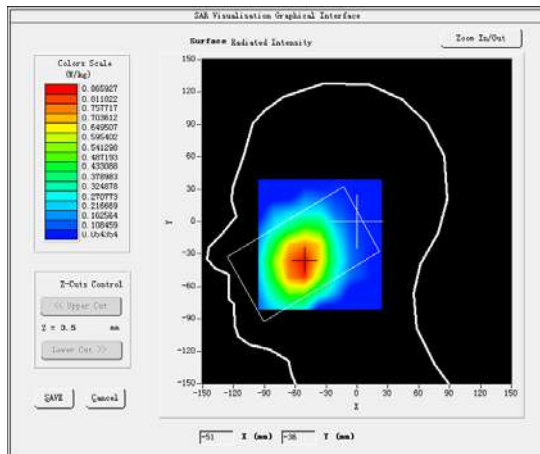
|                        |                                                        |
|------------------------|--------------------------------------------------------|
| <u>Area Scan</u>       | <u>dx=15mm dy=15mm</u>                                 |
| <u>ZoomScan</u>        | <u>5x5x7, dx=8mm dy=8mm</u><br><u>dz=5mm, Complete</u> |
| <u>Phantom</u>         | <u>Left head</u>                                       |
| <u>Device Position</u> | <u>Cheek</u>                                           |
| <u>Band</u>            | <u>GSM1900</u>                                         |
| <u>Channels</u>        | <u>Middle</u>                                          |
| <u>Signal</u>          | <u>TDMA (Crest factor: 8.0)</u>                        |

### B. SAR Measurement Results

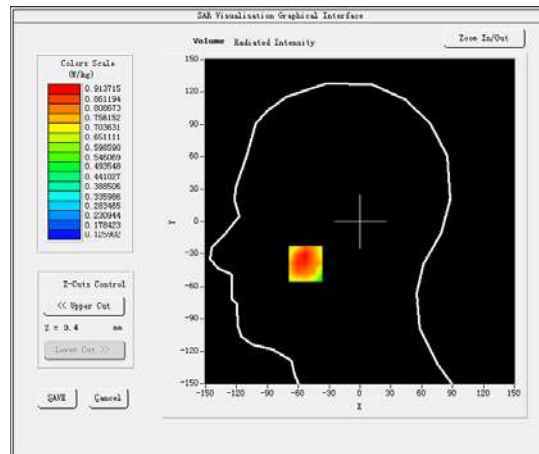
Middle Band SAR (Channel 512):

|                                               |             |
|-----------------------------------------------|-------------|
| <b>Frequency (MHz)</b>                        | 1850.200024 |
| <b>Relative permittivity (real part)</b>      | 40.296101   |
| <b>Relative permittivity (imaginary part)</b> | 14.186720   |
| <b>Conductivity (S/m)</b>                     | 1.377215    |
| <b>Variation (%)</b>                          | -2.180000   |

## SURFACE SAR



## VOLUME SAR

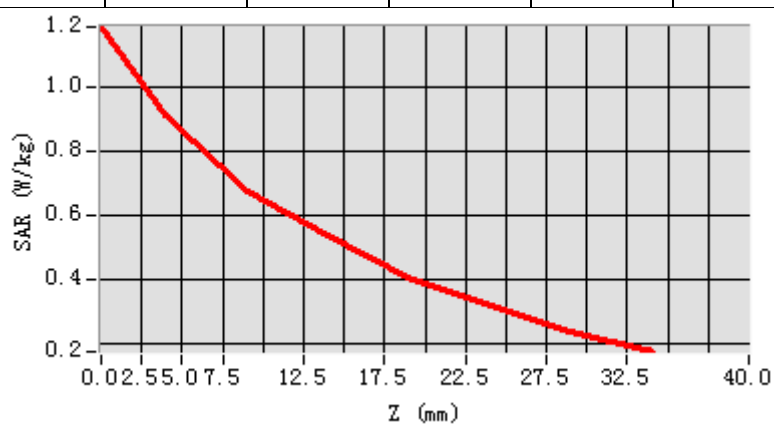


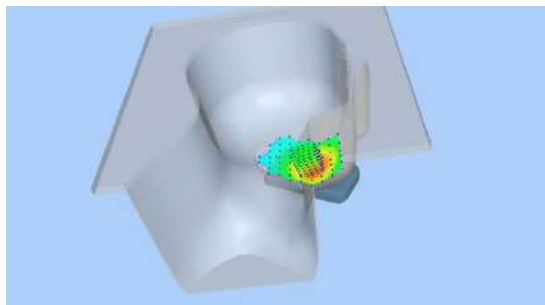
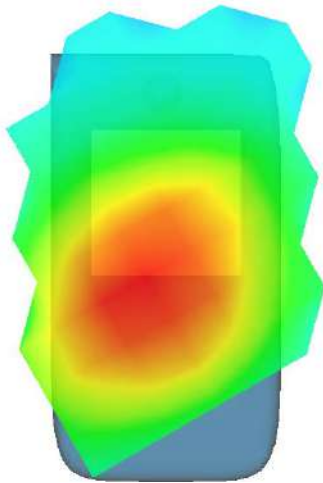
Maximum location: X = -53.00, Y = -39.00

SAR Peak: 1.26 W/kg

|                |          |
|----------------|----------|
| SAR 10g (W/Kg) | 0.633812 |
| SAR 1g (W/Kg)  | 0.898317 |

| Z (mm)     | 0.00   | 4.00   | 9.00   | 14.00  | 19.00  | 24.00  | 29.00  |
|------------|--------|--------|--------|--------|--------|--------|--------|
| SAR (W/Kg) | 1.1851 | 0.9137 | 0.6779 | 0.5410 | 0.4096 | 0.3199 | 0.2382 |



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

## MEASUREMENT 3

Type: Phone measurement (Complete)

Date of measurement: 28/8/2022

Measurement duration: 12 minutes 25 seconds

### A. Experimental conditions.

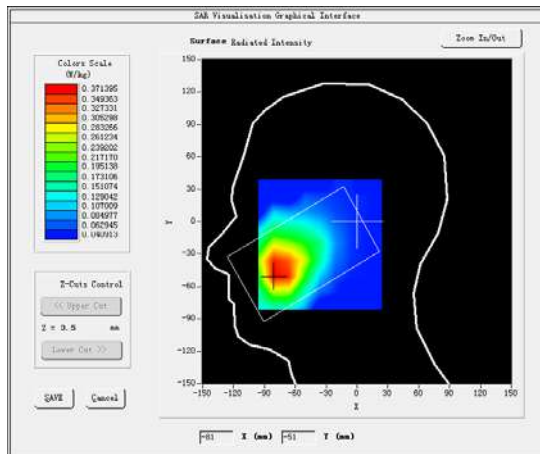
|                        |                                                        |
|------------------------|--------------------------------------------------------|
| <u>Area Scan</u>       | <u>dx=15mm dy=15mm</u>                                 |
| <u>ZoomScan</u>        | <u>5x5x7, dx=8mm dy=8mm</u><br><u>dz=5mm, Complete</u> |
| <u>Phantom</u>         | <u>Left head</u>                                       |
| <u>Device Position</u> | <u>Cheek</u>                                           |
| <u>Band</u>            | <u>BandII_UMTS</u>                                     |
| <u>Channels</u>        | <u>Middle</u>                                          |
| <u>Signal</u>          | <u>WCDMA (Crest factor: 1.0)</u>                       |

### B. SAR Measurement Results

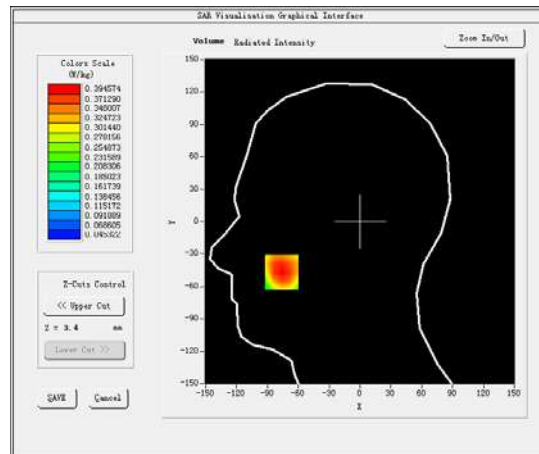
Middle Band SAR (Channel 9262):

|                                               |             |
|-----------------------------------------------|-------------|
| <b>Frequency (MHz)</b>                        | 1852.400000 |
| <b>Relative permittivity (real part)</b>      | 39.029900   |
| <b>Relative permittivity (imaginary part)</b> | 12.379100   |
| <b>Conductivity (S/m)</b>                     | 1.341069    |
| <b>Variation (%)</b>                          | -1.970000   |

## SURFACE SAR



## VOLUME SAR

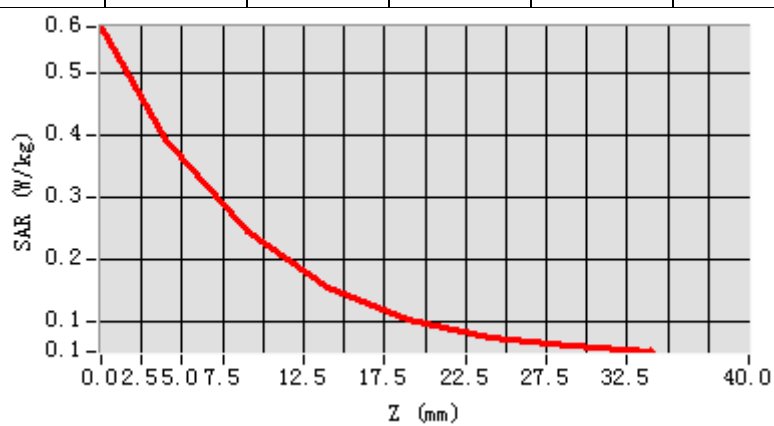


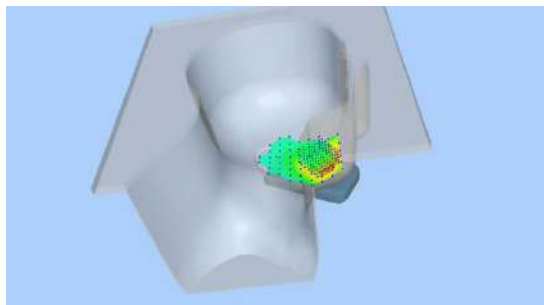
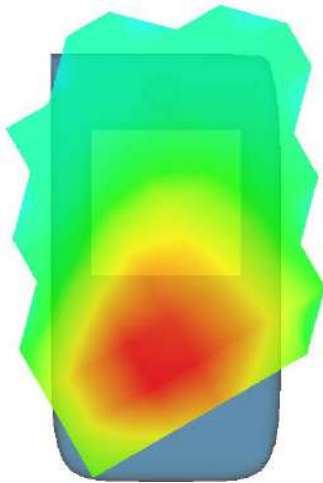
Maximum location: X=-76.00, Y=-47.00

SAR Peak: 0.58 W/kg

|                |          |
|----------------|----------|
| SAR 10g (W/Kg) | 0.238239 |
| SAR 1g (W/Kg)  | 0.381340 |

| Z (mm)     | 0.00   | 4.00   | 9.00   | 14.00  | 19.00  | 24.00  | 29.00  |
|------------|--------|--------|--------|--------|--------|--------|--------|
| SAR (W/Kg) | 0.5741 | 0.3946 | 0.2450 | 0.1563 | 0.1043 | 0.0761 | 0.0608 |



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

## MEASUREMENT 4

Towards-ground-middle

Type: Phone measurement (Complete)

Date of measurement: 28/8/2022

Measurement duration: 8 minutes 6 seconds

### A. Experimental conditions.

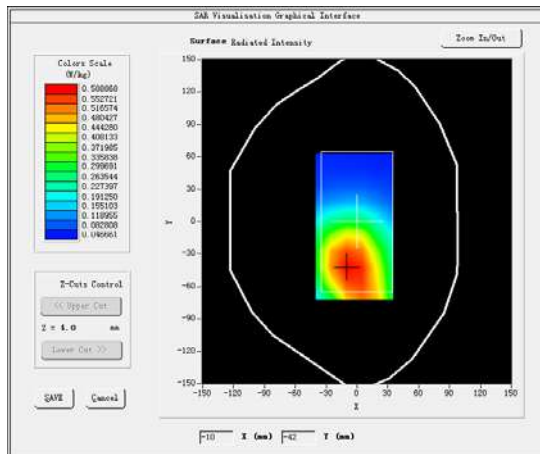
|                        |                                                        |
|------------------------|--------------------------------------------------------|
| <u>Area Scan</u>       | <u>dx=15mm dy=15mm</u>                                 |
| <u>ZoomScan</u>        | <u>5x5x7, dx=8mm dy=8mm</u><br><u>dz=5mm, Complete</u> |
| <u>Phantom</u>         | <u>Validation plane</u>                                |
| <u>Device Position</u> | <u>Body</u>                                            |
| <u>Band</u>            | <u>BandII_UMTS</u>                                     |
| <u>Channels</u>        | <u>Middle</u>                                          |
| <u>Signal</u>          | <u>WCDMA (Crest factor: 1.0)</u>                       |

### B. SAR Measurement Results

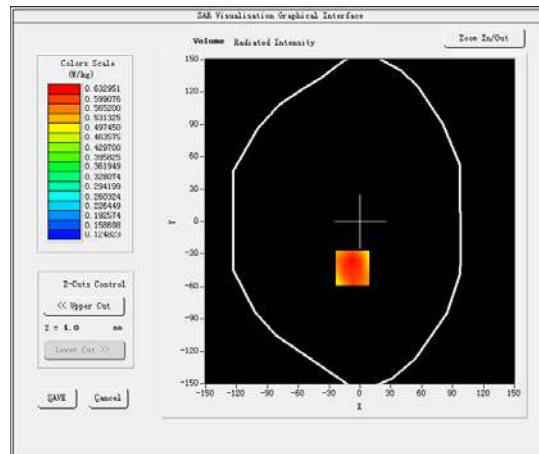
Middle Band SAR (Channel 9262):

|                                               |             |
|-----------------------------------------------|-------------|
| <b>Frequency (MHz)</b>                        | 1852.400000 |
| <b>Relative permittivity (real part)</b>      | 39.029900   |
| <b>Relative permittivity (imaginary part)</b> | 12.379100   |
| <b>Conductivity (S/m)</b>                     | 1.341069    |
| <b>Variation (%)</b>                          | 3.110000    |

## SURFACE SAR



## VOLUME SAR

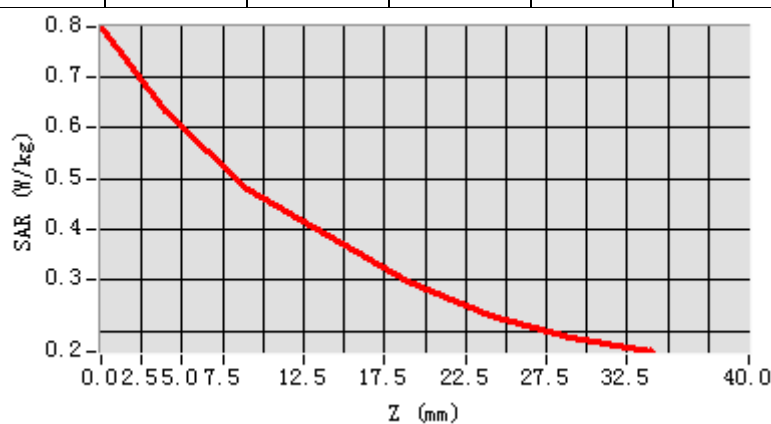


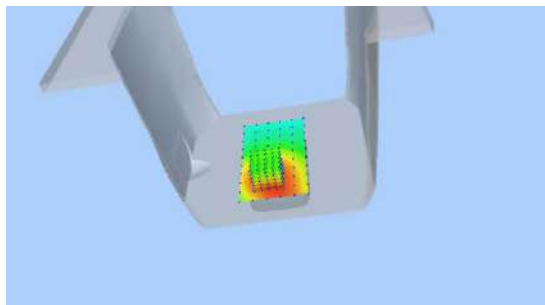
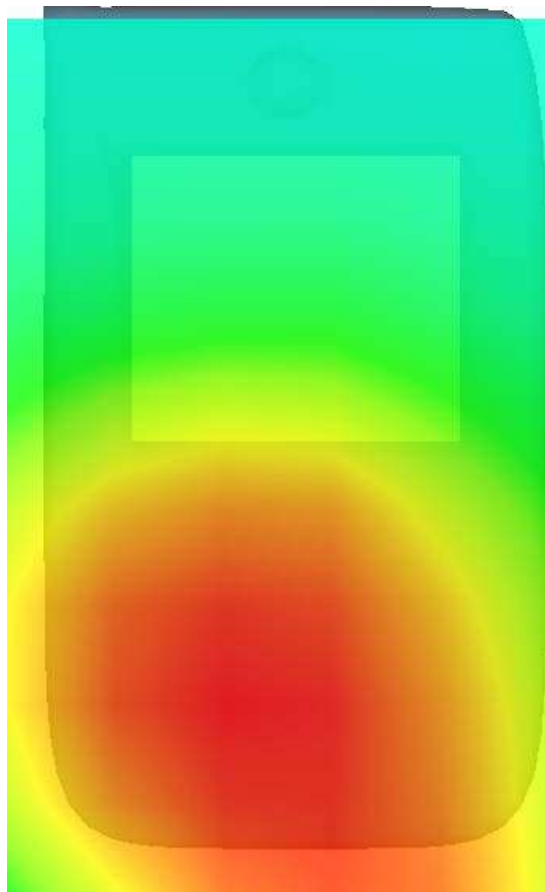
Maximum location: X=-7.00, Y=-43.00

SAR Peak: 0.79 W/kg

|                |          |
|----------------|----------|
| SAR 10g (W/Kg) | 0.455574 |
| SAR 1g (W/Kg)  | 0.610131 |

| Z (mm)     | 0.00   | 4.00   | 9.00   | 14.00  | 19.00  | 24.00  | 29.00  |
|------------|--------|--------|--------|--------|--------|--------|--------|
| SAR (W/Kg) | 0.7999 | 0.6330 | 0.4810 | 0.3863 | 0.2989 | 0.2305 | 0.1866 |



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

## MEASUREMENT 5

Type: Phone measurement (Complete)

Date of measurement: 26/8/2022

Measurement duration: 9 minutes 48 seconds

### A. Experimental conditions.

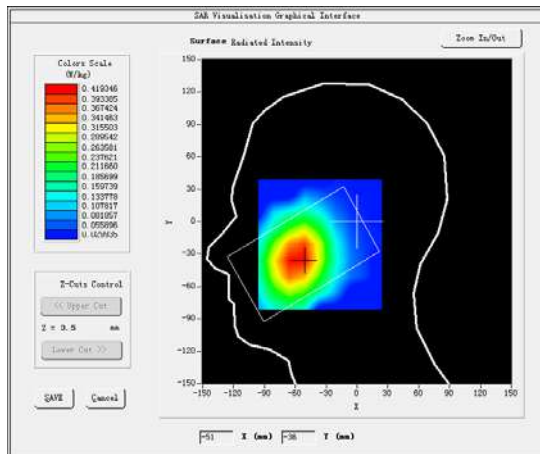
|                        |                                                      |
|------------------------|------------------------------------------------------|
| <u>Area Scan</u>       | <u>dx=15mm dy=15mm</u>                               |
| <u>ZoomScan</u>        | <u>5x5x7,dx=8mm dy=8mm</u><br><u>dz=5mm,Complete</u> |
| <u>Phantom</u>         | <u>Left head</u>                                     |
| <u>Device Position</u> | <u>Cheek</u>                                         |
| <u>Band</u>            | <u>Band5_WCDMA850</u>                                |
| <u>Channels</u>        | <u>Middle</u>                                        |
| <u>Signal</u>          | <u>WCDMA (Crest factor: 1.0)</u>                     |

### B. SAR Measurement Results

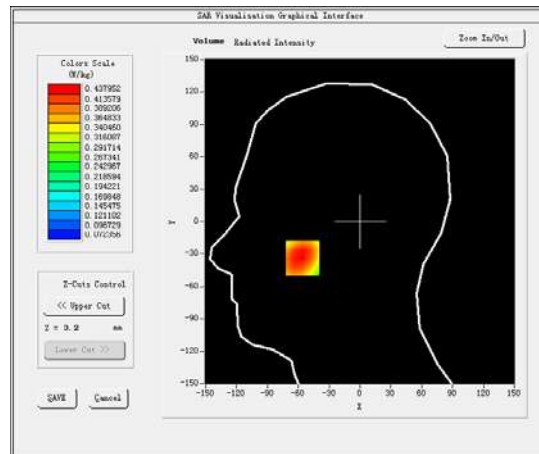
Middle Band SAR (Channel 4182):

|                                               |            |
|-----------------------------------------------|------------|
| <b>Frequency (MHz)</b>                        | 836.400024 |
| <b>Relative permittivity (real part)</b>      | 40.496941  |
| <b>Relative permittivity (imaginary part)</b> | 20.185080  |
| <b>Conductivity (S/m)</b>                     | 0.937933   |
| <b>Variation (%)</b>                          | -2.830000  |

## SURFACE SAR



## VOLUME SAR

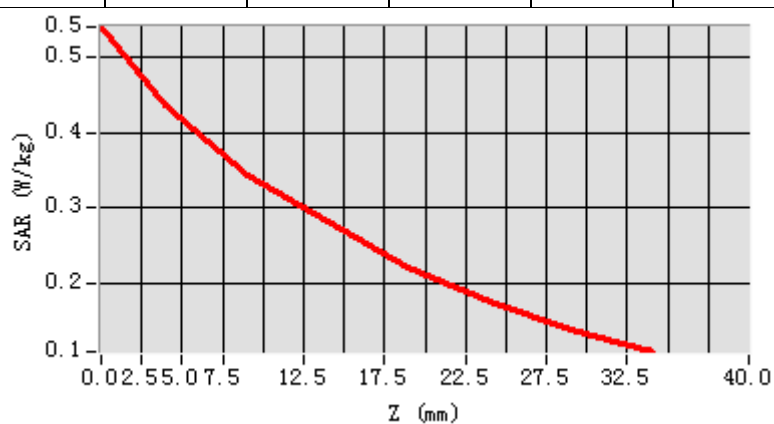


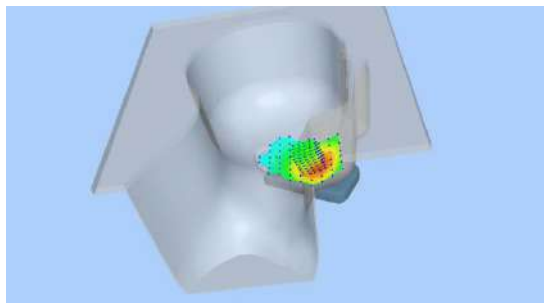
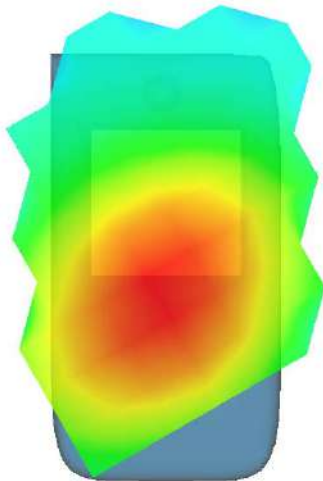
Maximum location: X = -56.00, Y = -34.00

SAR Peak: 0.57 W/kg

|                |          |
|----------------|----------|
| SAR 10g (W/Kg) | 0.331002 |
| SAR 1g (W/Kg)  | 0.449623 |

| Z (mm)     | 0.00   | 4.00   | 9.00   | 14.00  | 19.00  | 24.00  | 29.00  |
|------------|--------|--------|--------|--------|--------|--------|--------|
| SAR (W/Kg) | 0.5413 | 0.4380 | 0.3428 | 0.2812 | 0.2216 | 0.1750 | 0.1370 |



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

## MEASUREMENT 6

Towards-ground-middle

Type: Phone measurement (Complete)

Date of measurement: 26/8/2022

Measurement duration: 7 minutes 49 seconds

### A. Experimental conditions.

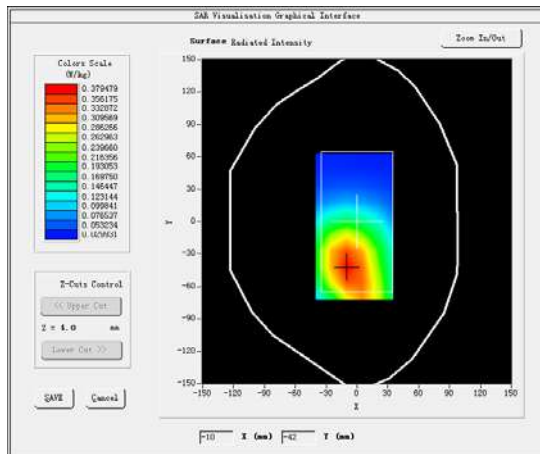
|                        |                                                        |
|------------------------|--------------------------------------------------------|
| <u>Area Scan</u>       | <u>dx=15mm dy=15mm</u>                                 |
| <u>ZoomScan</u>        | <u>5x5x7, dx=8mm dy=8mm</u><br><u>dz=5mm, Complete</u> |
| <u>Phantom</u>         | <u>Validation plane</u>                                |
| <u>Device Position</u> | <u>Body</u>                                            |
| <u>Band</u>            | <u>Band5_WCDMA850</u>                                  |
| <u>Channels</u>        | <u>Middle</u>                                          |
| <u>Signal</u>          | <u>WCDMA (Crest factor: 1.0)</u>                       |

### B. SAR Measurement Results

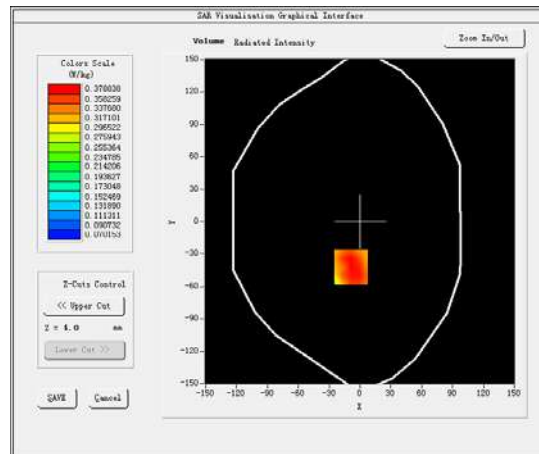
Middle Band SAR (Channel 4182):

|                                               |            |
|-----------------------------------------------|------------|
| <b>Frequency (MHz)</b>                        | 836.400024 |
| <b>Relative permittivity (real part)</b>      | 40.496941  |
| <b>Relative permittivity (imaginary part)</b> | 20.185080  |
| <b>Conductivity (S/m)</b>                     | 0.937933   |
| <b>Variation (%)</b>                          | -4.420000  |

## SURFACE SAR



## VOLUME SAR

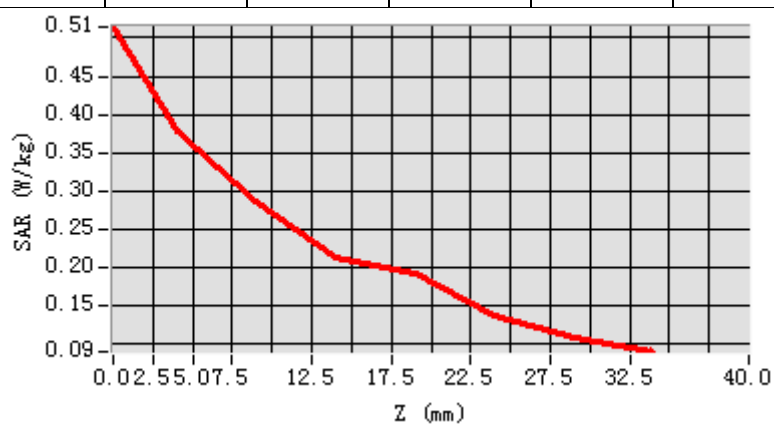


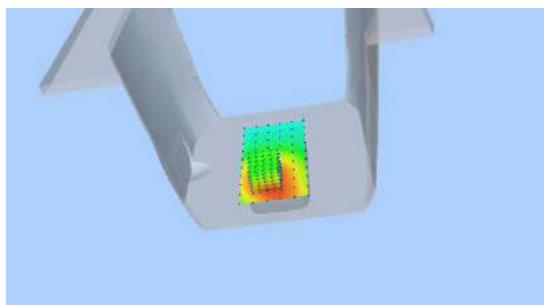
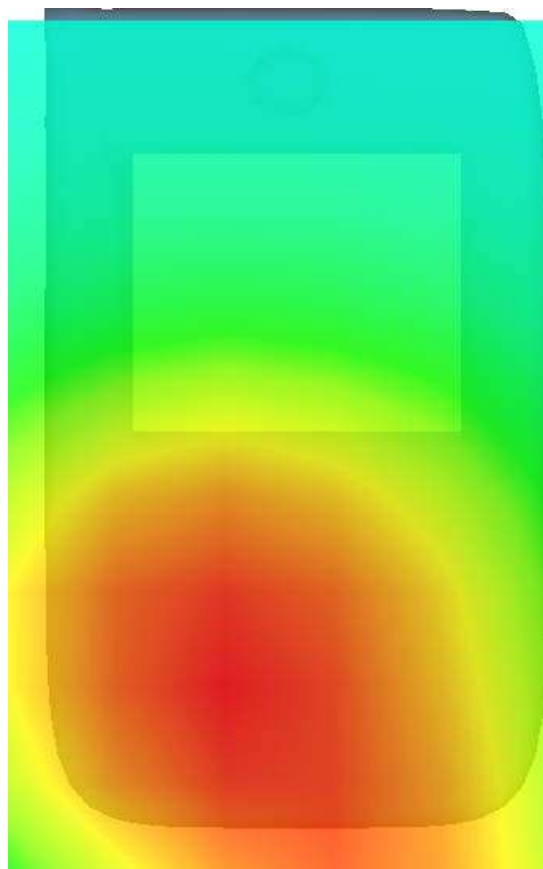
Maximum location: X=-9.00, Y=-42.00

SAR Peak: 0.49 W/kg

|                |          |
|----------------|----------|
| SAR 10g (W/Kg) | 0.284535 |
| SAR 1g (W/Kg)  | 0.387363 |

| Z (mm)     | 0.00   | 4.00   | 9.00   | 14.00  | 19.00  | 24.00  | 29.00  |
|------------|--------|--------|--------|--------|--------|--------|--------|
| SAR (W/Kg) | 0.5144 | 0.3788 | 0.2858 | 0.2141 | 0.1915 | 0.1388 | 0.1093 |



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

## MEASUREMENT 7

Towards-ground-middle

Type: Phone measurement (Complete)

Date of measurement: 26/8/2022

Measurement duration: 7 minutes 36 seconds

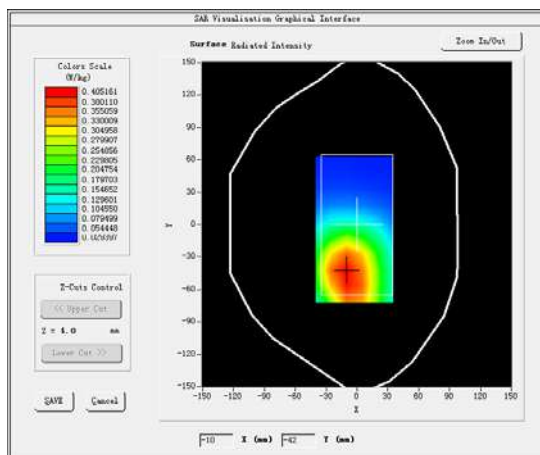
### A. Experimental conditions.

|                        |                                                        |
|------------------------|--------------------------------------------------------|
| <u>Area Scan</u>       | <u>dx=15mm dy=15mm</u>                                 |
| <u>ZoomScan</u>        | <u>5x5x7, dx=8mm dy=8mm</u><br><u>dz=5mm, Complete</u> |
| <u>Phantom</u>         | <u>Validation plane</u>                                |
| <u>Device Position</u> | <u>Cheek</u>                                           |
| <u>Band</u>            | <u>CUSTOM (GPRS850_4Tx)</u>                            |
| <u>Channels</u>        | <u>Middle</u>                                          |
| <u>Signal</u>          | <u>Duty Cycle: 2.00 (Crest factor: 2.0)</u>            |

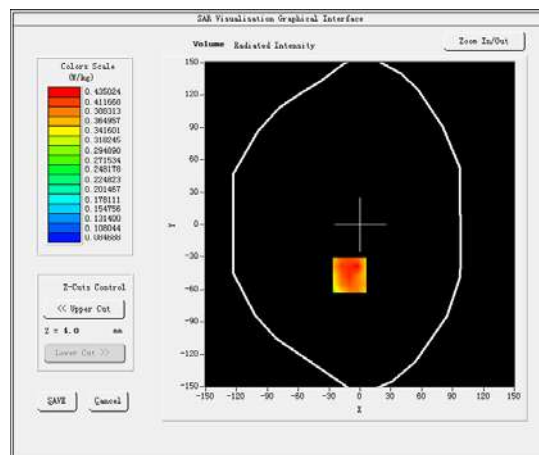
### B. SAR Measurement Results

|                                               |            |
|-----------------------------------------------|------------|
| <b>Frequency (MHz)</b>                        | 836.600000 |
| <b>Relative permittivity (real part)</b>      | 40.343300  |
| <b>Relative permittivity (imaginary part)</b> | 19.799101  |
| <b>Conductivity (S/m)</b>                     | 0.992155   |
| <b>Variation (%)</b>                          | 3.300000   |

## SURFACE SAR



## VOLUME SAR

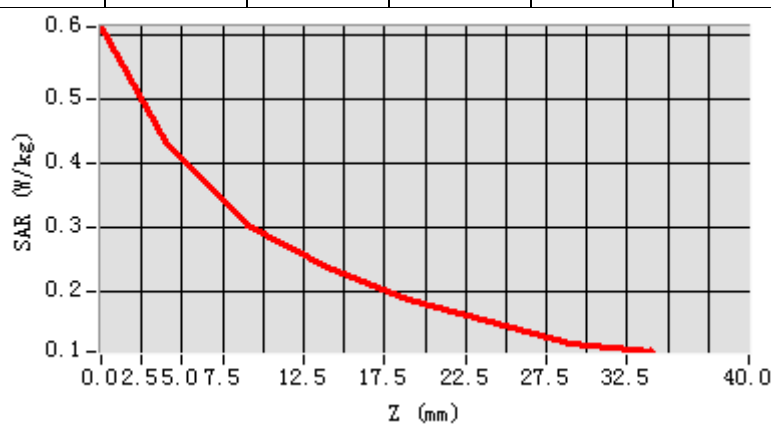


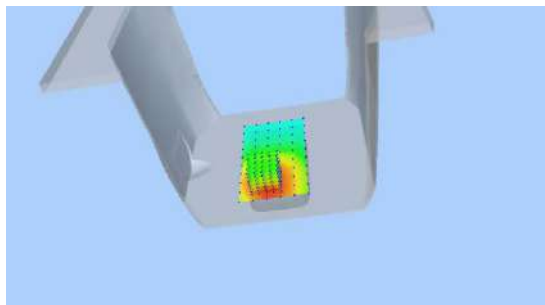
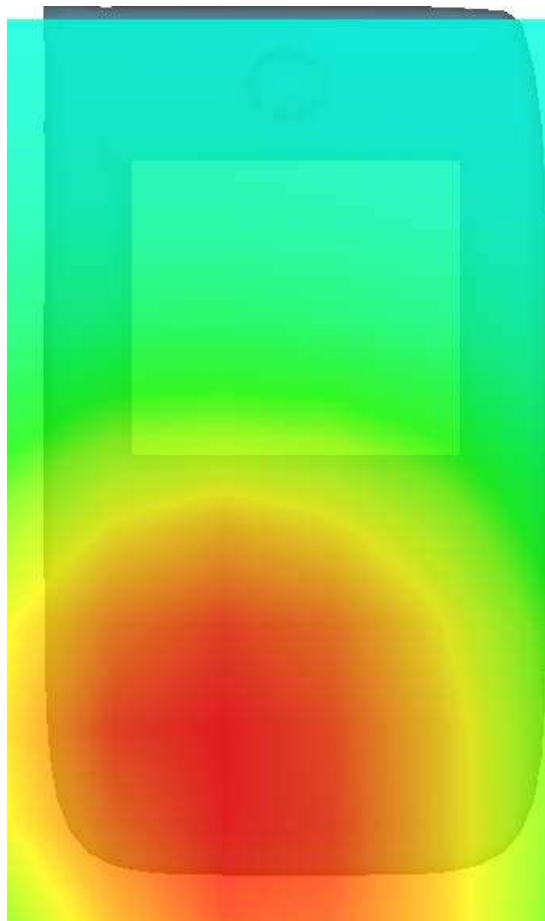
**Maximum location: X=-10.00, Y=-47.00**

**SAR Peak: 0.57 W/kg**

|                       |          |
|-----------------------|----------|
| <b>SAR 10g (W/Kg)</b> | 0.310487 |
| <b>SAR 1g (W/Kg)</b>  | 0.421535 |

| Z (mm)     | 0.00   | 4.00   | 9.00   | 14.00  | 19.00  | 24.00  | 29.00  |
|------------|--------|--------|--------|--------|--------|--------|--------|
| SAR (W/Kg) | 0.6140 | 0.4350 | 0.3031 | 0.2393 | 0.1870 | 0.1538 | 0.1202 |



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

## MEASUREMENT 8

Towards-ground-middle

Type: Phone measurement (Complete)

Date of measurement: 28/8/2022

Measurement duration: 7 minutes 34 seconds

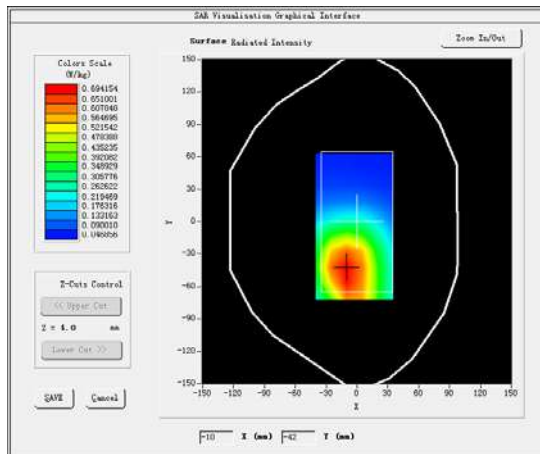
### A. Experimental conditions.

|                        |                                                        |
|------------------------|--------------------------------------------------------|
| <u>Area Scan</u>       | <u>dx=15mm dy=15mm</u>                                 |
| <u>ZoomScan</u>        | <u>5x5x7, dx=8mm dy=8mm</u><br><u>dz=5mm, Complete</u> |
| <u>Phantom</u>         | <u>Validation plane</u>                                |
| <u>Device Position</u> | <u>Cheek</u>                                           |
| <u>Band</u>            | <u>CUSTOM (GPRS1900_4Tx)</u>                           |
| <u>Channels</u>        | <u>Middle</u>                                          |
| <u>Signal</u>          | <u>Duty Cycle: 2.00 (Crest factor: 2.0)</u>            |

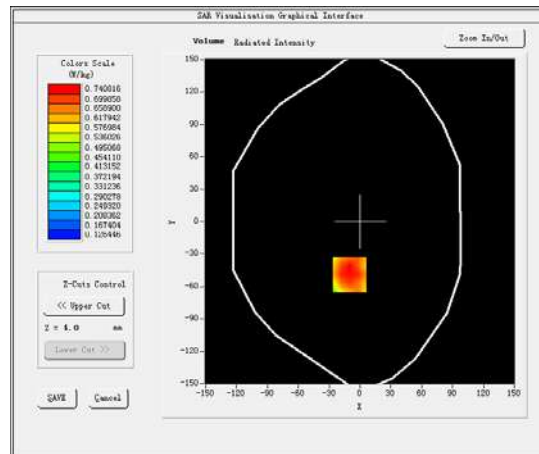
### B. SAR Measurement Results

|                                               |             |
|-----------------------------------------------|-------------|
| <b>Frequency (MHz)</b>                        | 1850.200024 |
| <b>Relative permittivity (real part)</b>      | 40.296101   |
| <b>Relative permittivity (imaginary part)</b> | 14.186720   |
| <b>Conductivity (S/m)</b>                     | 1.377215    |
| <b>Variation (%)</b>                          | 3.790000    |

## SURFACE SAR



## VOLUME SAR

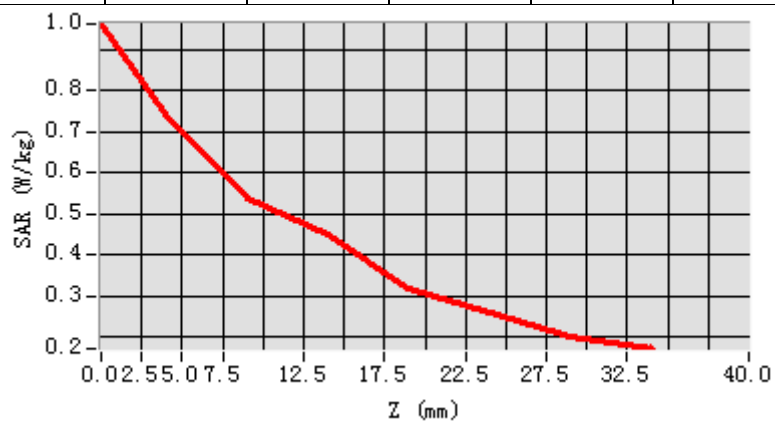


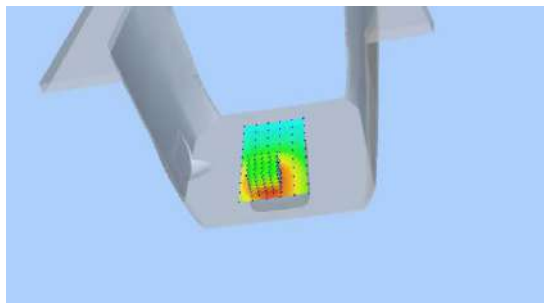
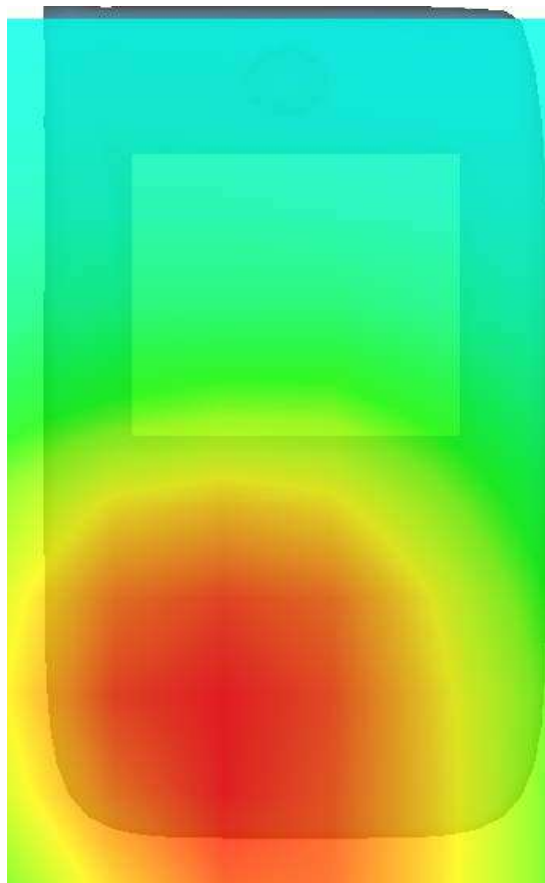
**Maximum location: X=-10.00, Y=-49.00**

**SAR Peak: 1.00 W/kg**

|                       |          |
|-----------------------|----------|
| <b>SAR 10g (W/Kg)</b> | 0.519561 |
| <b>SAR 1g (W/Kg)</b>  | 0.725655 |

| Z (mm)     | 0.00   | 4.00   | 9.00   | 14.00  | 19.00  | 24.00  | 29.00  |
|------------|--------|--------|--------|--------|--------|--------|--------|
| SAR (W/Kg) | 0.9618 | 0.7408 | 0.5381 | 0.4483 | 0.3170 | 0.2603 | 0.2027 |



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



## **Annex C: Calibration Reports**

**Tested Model : COMETA**

**Report Number:**

**WSCT-A2LA-R&E220900007A-SAR**



## SAR Reference Dipole Calibration Report

Ref : ACR.178.13.20.MVGB.A

**WORLD STANDARDIZATION CERTIFICATION  
& TESTING GROUP CO.,LTD**  
BLOCK A, BAO SHI SCIENCE PARK,BAO SHI ROAD,  
BAO'AN DISTRICT  
SHENZHEN 518108,P.R. CHINA  
**MVG COMOSAR REFERENCE DIPOLE**  
FREQUENCY: 835 MHZ  
SERIAL NO.: SN 14/13 DIP0G835-235

**Calibrated at MVG MVG**  
Z.I. de la pointe du diable  
Technopôle Brest Iroise – 295 avenue Alexis de Rochon  
29280 PLOUZANE - FRANCE

**Calibration date: 06/25/2020**



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.

|                      | <i>Name</i>  | <i>Function</i>     | <i>Date</i> | <i>Signature</i>                                                                    |
|----------------------|--------------|---------------------|-------------|-------------------------------------------------------------------------------------|
| <i>Prepared by :</i> | Jérôme LUC   | Technical Manager   | 6/26/2020   |  |
| <i>Checked by :</i>  | Jérôme LUC   | Technical Manager   | 6/26/2020   |  |
| <i>Approved by :</i> | Yann Toutain | Laboratory Director | 6/26/2020   |  |

|                       | <i>Customer Name</i>                                                     |
|-----------------------|--------------------------------------------------------------------------|
| <i>Distribution :</i> | World<br>Standardization<br>Certification &<br>Testing Group Co<br>.,Ltd |

| <i>Issue</i> | <i>Name</i> | <i>Date</i> | <i>Modifications</i> |
|--------------|-------------|-------------|----------------------|
| A            | Jérôme LUC  | 6/26/2020   | Initial release      |
|              |             |             |                      |
|              |             |             |                      |
|              |             |             |                      |

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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 835 MHz REFERENCE DIPOLE |
| Manufacturer                   | MVG                              |
| Model                          | SID835                           |
| Serial Number                  | SN 14/13 DIP0G835-235            |
| Product Condition (new / used) | Used                             |

## 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**

## 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

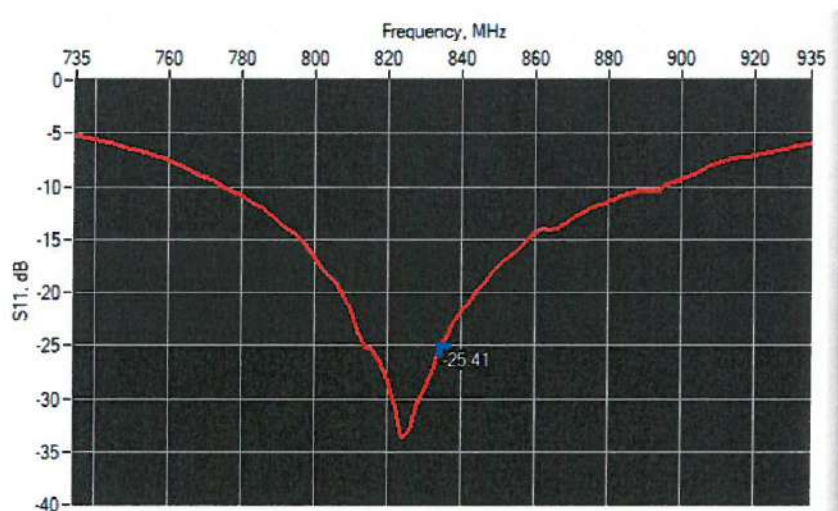
The guidelines outlined in the IEEE 1528, FCC KDBs, CENELEC EN50361 and CEI/IEC 62209 standards were followed to generate the measurement uncertainty for validation measurements.

| Scan Volume | Expanded Uncertainty |
|-------------|----------------------|
|-------------|----------------------|

|      |            |
|------|------------|
| 1 g  | 19 % (SAR) |
| 10 g | 19 % (SAR) |

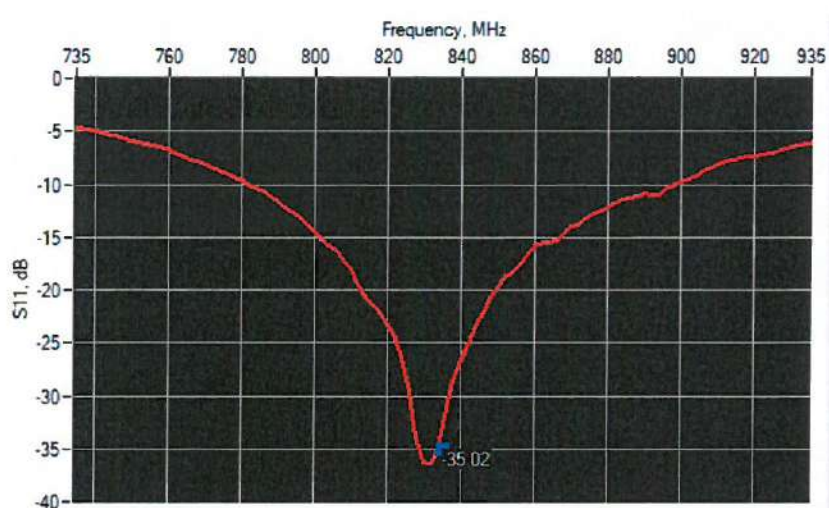
## 6 CALIBRATION MEASUREMENT RESULTS

### 6.1 RETURN LOSS AND IMPEDANCE IN HEAD LIQUID



| Frequency (MHz) | Return Loss (dB) | Requirement (dB) | Impedance                      |
|-----------------|------------------|------------------|--------------------------------|
| 835             | -25.41           | -20              | 54.8 $\Omega$ - 2.5 j $\Omega$ |

### 6.2 RETURN LOSS AND IMPEDANCE IN BODY LIQUID



| Frequency (MHz) | Return Loss (dB) | Requirement (dB) | Impedance                      |
|-----------------|------------------|------------------|--------------------------------|
| 835             | -35.02           | -20              | 51.5 $\Omega$ + 1.0 j $\Omega$ |

### 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 %.  |   | 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 ( $\epsilon_r$ ) |          | Conductivity ( $\sigma$ ) S/m |          |
|------------------|----------------------------------------|----------|-------------------------------|----------|
|                  | required                               | measured | required                      | measured |
| 300              | 45.3 ±10 %                             |          | 0.87 ±10 %                    |          |
| 450              | 43.5 ±10 %                             |          | 0.87 ±10 %                    |          |
| 750              | 41.9 ±10 %                             |          | 0.89 ±10 %                    |          |
| 835              | 41.5 ±10 %                             | 40.6     | 0.90 ±10 %                    | 0.89     |
| 900              | 41.5 ±10 %                             |          | 0.97 ±10 %                    |          |
| 1450             | 40.5 ±10 %                             |          | 1.20 ±10 %                    |          |
| 1500             | 40.4 ±10 %                             |          | 1.23 ±10 %                    |          |
| 1640             | 40.2 ±10 %                             |          | 1.31 ±10 %                    |          |

|      |            |  |            |  |
|------|------------|--|------------|--|
| 1750 | 40.1 ±10 % |  | 1.37 ±10 % |  |
| 1800 | 40.0 ±10 % |  | 1.40 ±10 % |  |
| 1900 | 40.0 ±10 % |  | 1.40 ±10 % |  |
| 1950 | 40.0 ±10 % |  | 1.40 ±10 % |  |
| 2000 | 40.0 ±10 % |  | 1.40 ±10 % |  |
| 2100 | 39.8 ±10 % |  | 1.49 ±10 % |  |
| 2300 | 39.5 ±10 % |  | 1.67 ±10 % |  |
| 2450 | 39.2 ±10 % |  | 1.80 ±10 % |  |
| 2600 | 39.0 ±10 % |  | 1.96 ±10 % |  |
| 3000 | 38.5 ±10 % |  | 2.40 ±10 % |  |
| 3500 | 37.9 ±10 % |  | 2.91 ±10 % |  |

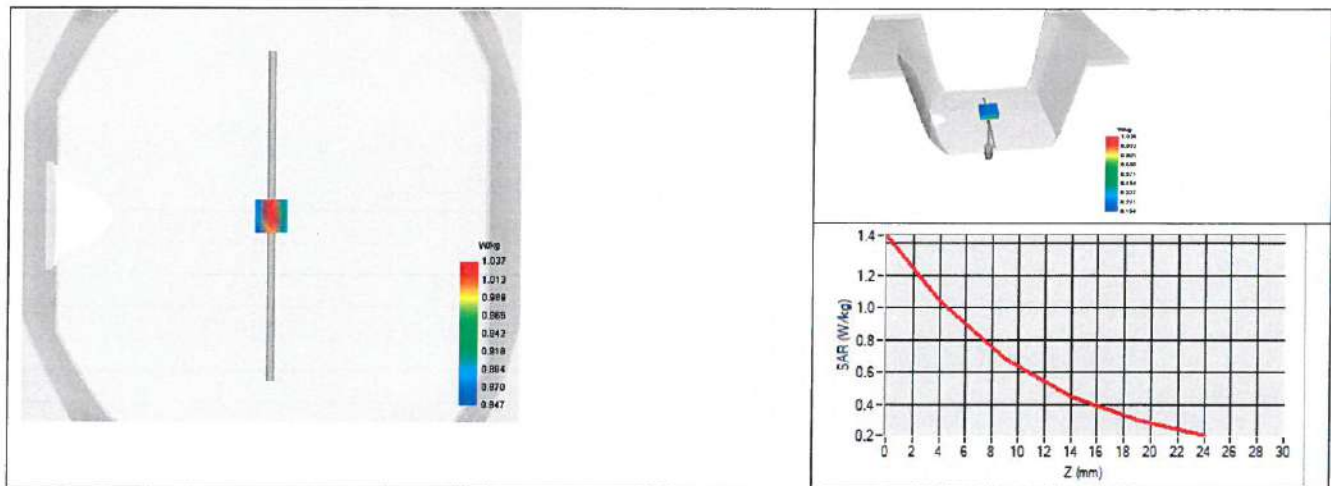
## 7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

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.

|                                           |                                                             |
|-------------------------------------------|-------------------------------------------------------------|
| Software                                  | OPENSAR V5                                                  |
| Phantom                                   | SN 13/09 SAM68                                              |
| Probe                                     | SN 41/18 EPGO333                                            |
| Liquid                                    | Head Liquid Values: $\epsilon_{ps}'$ : 40.6 $\sigma$ : 0.89 |
| Distance between dipole center and liquid | 15.0 mm                                                     |
| Area scan resolution                      | dx=8mm/dy=8mm                                               |
| Zoon Scan Resolution                      | dx=8mm/dy=8mm/dz=5mm                                        |
| Frequency                                 | 835 MHz                                                     |
| Input power                               | 20 dBm                                                      |
| Liquid Temperature                        | 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             | 9.84 (0.98) | 6.22              | 6.19 (0.62) |
| 900              | 10.9             |             | 6.99              |             |
| 1450             | 29               |             | 16                |             |
| 1500             | 30.5             |             | 16.8              |             |
| 1640             | 34.2             |             | 18.4              |             |
| 1750             | 36.4             |             | 19.3              |             |
| 1800             | 38.4             |             | 20.1              |             |
| 1900             | 39.7             |             | 20.5              |             |
| 1950             | 40.5             |             | 20.9              |             |

|      |      |  |      |  |
|------|------|--|------|--|
| 2000 | 41.1 |  | 21.1 |  |
| 2100 | 43.6 |  | 21.9 |  |
| 2300 | 48.7 |  | 23.3 |  |
| 2450 | 52.4 |  | 24   |  |
| 2600 | 55.3 |  | 24.6 |  |
| 3000 | 63.8 |  | 25.7 |  |
| 3500 | 67.1 |  | 25   |  |
| 3700 | 67.4 |  | 24.2 |  |



### 7.3 BODY LIQUID MEASUREMENT

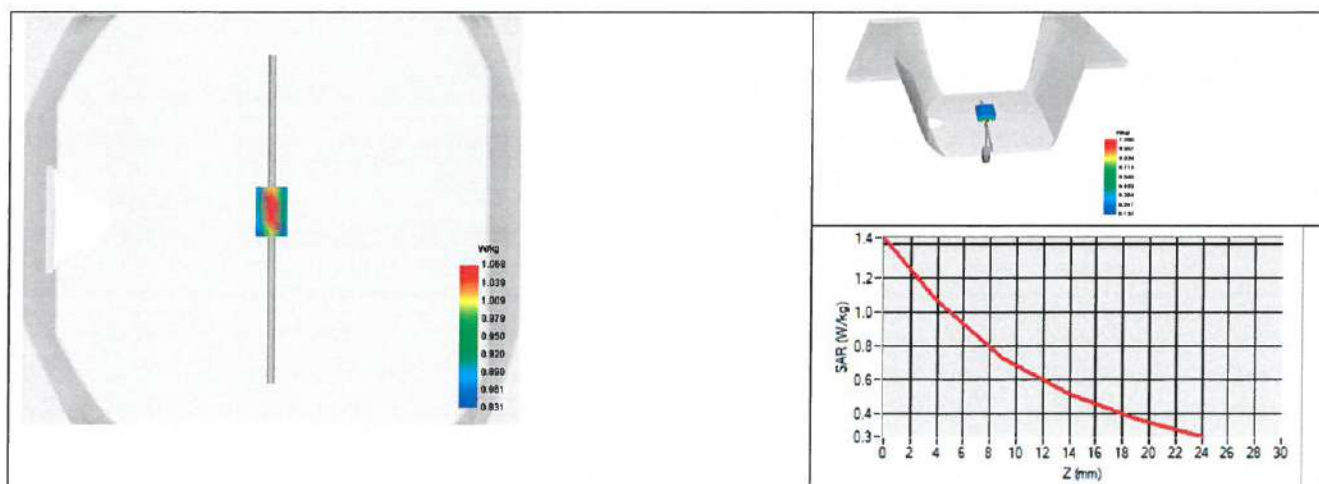
| Frequency<br>MHz | Relative permittivity ( $\epsilon_r'$ ) |          | Conductivity ( $\sigma$ ) S/m |          |
|------------------|-----------------------------------------|----------|-------------------------------|----------|
|                  | required                                | measured | 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 %                         | 52.3     | 0.97 $\pm$ 10 %               | 0.94     |
| 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 %                         |          | 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 ±10 % |  | 2.16 ±10 % |  |
| 3000 | 52.0 ±10 % |  | 2.73 ±10 % |  |
| 3500 | 51.3 ±10 % |  | 3.31 ±10 % |  |
| 3700 | 51.0 ±10 % |  | 3.55 ±10 % |  |
| 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 V5                                   |
| Phantom                                   | SN 13/09 SAM68                               |
| Probe                                     | SN 41/18 EPG0333                             |
| Liquid                                    | Body Liquid Values: eps' : 52.3 sigma : 0.94 |
| Distance between dipole center and liquid | 15.0 mm                                      |
| Area scan resolution                      | dx=8mm/dy=8mm                                |
| Zoon Scan Resolution                      | dx=8mm/dy=8mm/dz=5mm                         |
| Frequency                                 | 835 MHz                                      |
| Input power                               | 20 dBm                                       |
| Liquid Temperature                        | 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          |
| 835              | 10.09 (1.01)     | 6.54 (0.65)       |





## 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      | Control Company         | 150798832          | 11/2017                                       | 11/2020                                       |





## SAR Reference Dipole Calibration Report

Ref : ACR.178.16.20.MVGB.A

**WORLD STANDARDIZATION CERTIFICATION  
& TESTING GROUP CO.,LTD**  
BLOCK A, BAO SHI SCIENCE PARK,BAO SHI ROAD,  
BAO'AN DISTRICT  
SHENZHEN 518108,P.R. CHINA  
**MVG COMOSAR REFERENCE DIPOLE**  
FREQUENCY: 1900 MHZ  
SERIAL NO.: SN 14/13 DIP1G900-236

**Calibrated at MVG MVG**  
**Z.I. de la pointe du diable**  
**Technopôle Brest Iroise – 295 avenue Alexis de Rochon**  
**29280 PLOUZANE - FRANCE**

**Calibration date: 06/25/2020**



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.

|                      | <i>Name</i>  | <i>Function</i>     | <i>Date</i> | <i>Signature</i>                                                                    |
|----------------------|--------------|---------------------|-------------|-------------------------------------------------------------------------------------|
| <i>Prepared by :</i> | Jérôme LUC   | Technical Manager   | 6/26/2020   |  |
| <i>Checked by :</i>  | Jérôme LUC   | Technical Manager   | 6/26/2020   |  |
| <i>Approved by :</i> | Yann Toutain | Laboratory Director | 6/26/2020   |  |

|                       | <i>Customer Name</i>                                                     |
|-----------------------|--------------------------------------------------------------------------|
| <i>Distribution :</i> | World<br>Standardization<br>Certification &<br>Testing Group Co<br>.,Ltd |

| <i>Issue</i> | <i>Name</i> | <i>Date</i> | <i>Modifications</i> |
|--------------|-------------|-------------|----------------------|
| A            | Jérôme LUC  | 6/26/2020   | Initial release      |
|              |             |             |                      |
|              |             |             |                      |
|              |             |             |                      |

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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 14/13 DIP1G900-236             |
| Product Condition (new / used) | Used                              |

## 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**

## 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

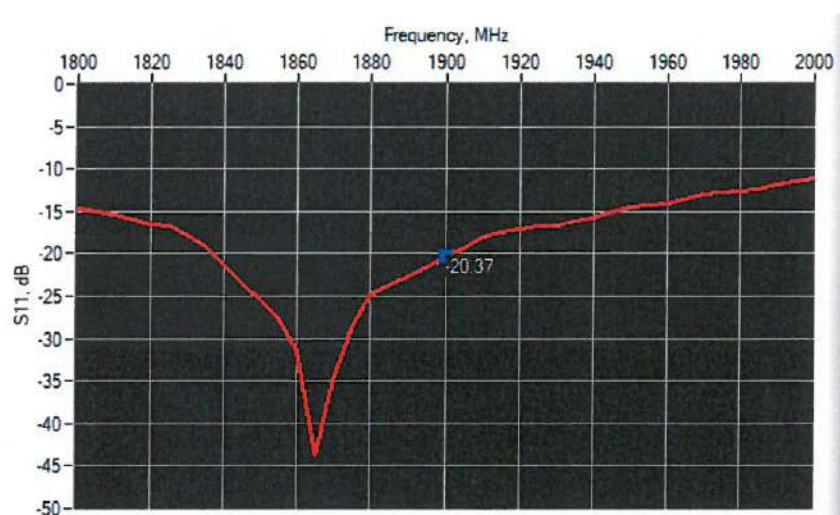
The guidelines outlined in the IEEE 1528, FCC KDBs, CENELEC EN50361 and CEI/IEC 62209 standards were followed to generate the measurement uncertainty for validation measurements.

| Scan Volume | Expanded Uncertainty |
|-------------|----------------------|
|-------------|----------------------|

|      |            |
|------|------------|
| 1 g  | 19 % (SAR) |
| 10 g | 19 % (SAR) |

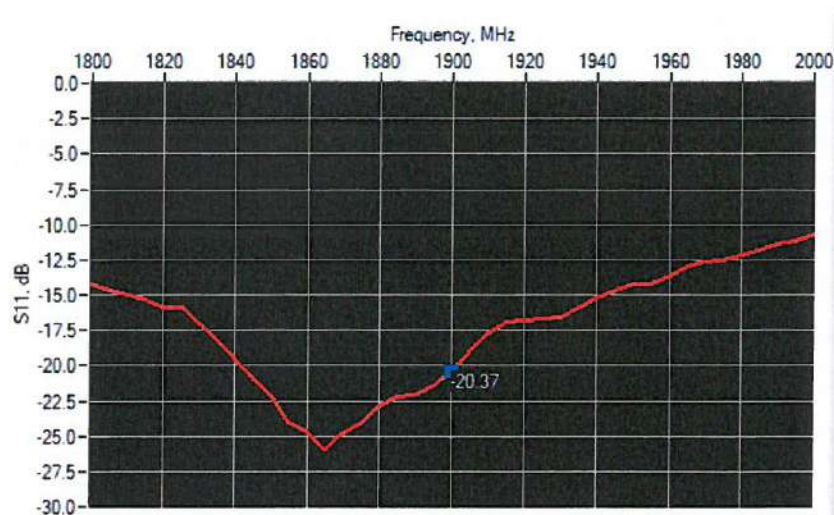
## 6 CALIBRATION MEASUREMENT RESULTS

### 6.1 RETURN LOSS AND IMPEDANCE IN HEAD LIQUID



| Frequency (MHz) | Return Loss (dB) | Requirement (dB) | Impedance                   |
|-----------------|------------------|------------------|-----------------------------|
| 1900            | -20.37           | -20              | $52.9 \Omega + 9.1 j\Omega$ |

### 6.2 RETURN LOSS AND IMPEDANCE IN BODY LIQUID



| Frequency (MHz) | Return Loss (dB) | Requirement (dB) | Impedance                   |
|-----------------|------------------|------------------|-----------------------------|
| 1900            | -20.37           | -20              | $49.3 \Omega + 9.5 j\Omega$ |

### 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 %.  | - | 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 ( $\epsilon_r'$ ) |          | Conductivity ( $\sigma$ ) S/m |          |
|------------------|-----------------------------------------|----------|-------------------------------|----------|
|                  | required                                | measured | required                      | measured |
| 300              | 45.3 ±10 %                              |          | 0.87 ±10 %                    |          |
| 450              | 43.5 ±10 %                              |          | 0.87 ±10 %                    |          |
| 750              | 41.9 ±10 %                              |          | 0.89 ±10 %                    |          |
| 835              | 41.5 ±10 %                              |          | 0.90 ±10 %                    |          |
| 900              | 41.5 ±10 %                              |          | 0.97 ±10 %                    |          |
| 1450             | 40.5 ±10 %                              |          | 1.20 ±10 %                    |          |
| 1500             | 40.4 ±10 %                              |          | 1.23 ±10 %                    |          |
| 1640             | 40.2 ±10 %                              |          | 1.31 ±10 %                    |          |

|      |            |      |            |      |
|------|------------|------|------------|------|
| 1750 | 40.1 ±10 % |      | 1.37 ±10 % |      |
| 1800 | 40.0 ±10 % |      | 1.40 ±10 % |      |
| 1900 | 40.0 ±10 % | 43.3 | 1.40 ±10 % | 1.41 |
| 1950 | 40.0 ±10 % |      | 1.40 ±10 % |      |
| 2000 | 40.0 ±10 % |      | 1.40 ±10 % |      |
| 2100 | 39.8 ±10 % |      | 1.49 ±10 % |      |
| 2300 | 39.5 ±10 % |      | 1.67 ±10 % |      |
| 2450 | 39.2 ±10 % |      | 1.80 ±10 % |      |
| 2600 | 39.0 ±10 % |      | 1.96 ±10 % |      |
| 3000 | 38.5 ±10 % |      | 2.40 ±10 % |      |
| 3500 | 37.9 ±10 % |      | 2.91 ±10 % |      |

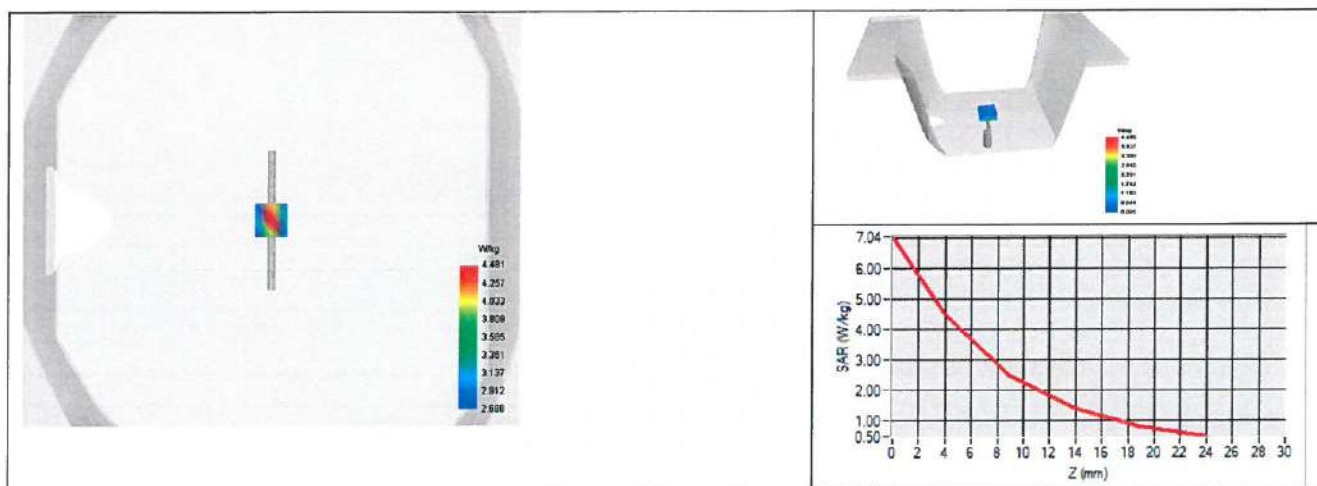
## 7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

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.

|                                           |                                                       |
|-------------------------------------------|-------------------------------------------------------|
| Software                                  | OPENSAR V5                                            |
| Phantom                                   | SN 13/09 SAM68                                        |
| Probe                                     | SN 41/18 EPGO333                                      |
| Liquid                                    | Head Liquid Values: $\epsilon$ : 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             | 40.59 (4.06) | 20.5              | 20.83 (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   |  |
| 3700 | 67.4 |  | 24.2 |  |



### 7.3 BODY LIQUID MEASUREMENT

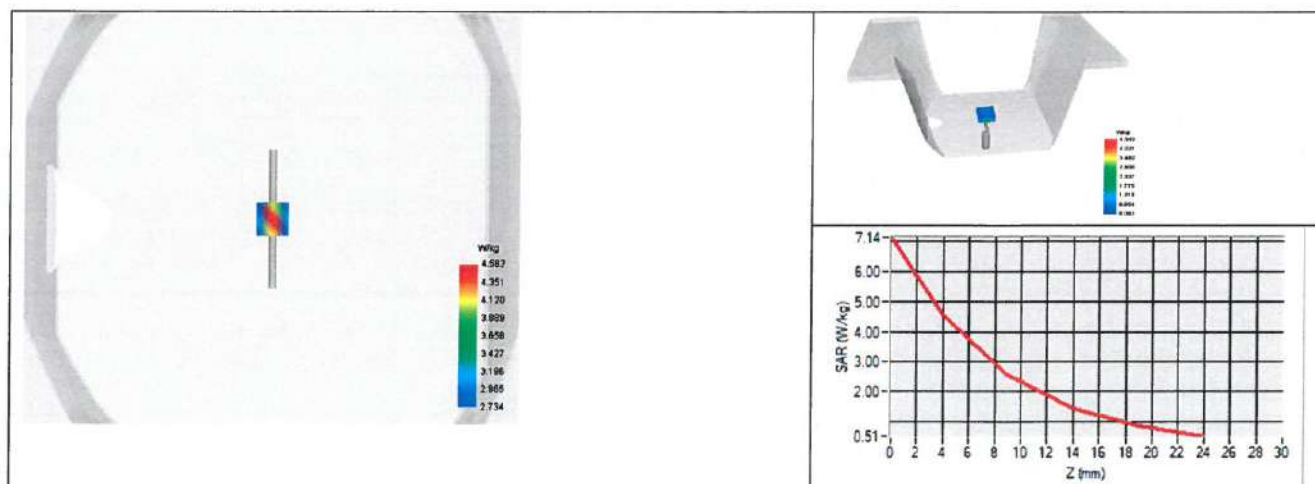
| Frequency<br>MHz | Relative permittivity ( $\epsilon_r'$ ) |          | Conductivity ( $\sigma$ ) S/m |          |
|------------------|-----------------------------------------|----------|-------------------------------|----------|
|                  | required                                | measured | 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 ±10 % |  | 2.16 ±10 % |  |
| 3000 | 52.0 ±10 % |  | 2.73 ±10 % |  |
| 3500 | 51.3 ±10 % |  | 3.31 ±10 % |  |
| 3700 | 51.0 ±10 % |  | 3.55 ±10 % |  |
| 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 V5                                                  |
| Phantom                                   | SN 13/09 SAM68                                              |
| Probe                                     | SN 41/18 EPG0333                                            |
| Liquid                                    | Body Liquid Values: $\epsilon_{ps}'$ : 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             | 41.48 (4.15)     | 21.01 (2.10)      |



## 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      | Control Company         | 150798832          | 11/2017                                       | 11/2020                                       |





## COMOSAR E-Field Probe Calibration Report

Ref : ACR.345.1.20.MVGB.A

**WORLD STANDARDIZATION CERTIFICATION  
& TESTING GROUP CO.,LTD**  
**BLOCK A, BAO SHI SCIENCE PARK,BAO SHI ROAD,**  
**BAO'AN DISTRICT**  
**SHENZHEN 518108,P.R. CHINA**  
**MVG COMOSAR DOSIMETRIC E-FIELD PROBE**  
**SERIAL NO.: SN 36/20 EPG0343**

**Calibrated at MVG**  
**Z.I. de la pointe du diable**  
**Technopôle Brest Iroise – 295 avenue Alexis de Rochon**  
**29280 PLOUZANE - FRANCE**

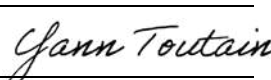
**Calibration date: 12/10/2021**



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 COMOSAR E-Field Probe calibration performed at MVG, using the CALIPROBE test bench, for use with a MVG COMOSAR system only. The test results covered by accreditation are traceable to the International System of Units (SI).

|                      | <i>Name</i>  | <i>Function</i>     | <i>Date</i> | <i>Signature</i>                                                                    |
|----------------------|--------------|---------------------|-------------|-------------------------------------------------------------------------------------|
| <i>Prepared by :</i> | Jérôme LUC   | Technical Manager   | 12/10/2021  |  |
| <i>Checked by :</i>  | Jérôme LUC   | Technical Manager   | 12/10/2021  |  |
| <i>Approved by :</i> | Yann Toutain | Laboratory Director | 12/10/2021  |  |

Mode d'emploi

2021.12.1  
0 10:06:31  
+01'00'

PHILIPS

|                       | <i>Customer Name</i>                                                    |
|-----------------------|-------------------------------------------------------------------------|
| <i>Distribution :</i> | World<br>Standardization<br>Certification &<br>Testing Group Co<br>,Ltd |

| <i>Issue</i> | <i>Name</i> | <i>Date</i> | <i>Modifications</i> |
|--------------|-------------|-------------|----------------------|
| A            | Jérôme LUC  | 12/10/2021  | Initial release      |
|              |             |             |                      |
|              |             |             |                      |
|              |             |             |                      |

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## 1 DEVICE UNDER TEST

| Device Under Test                        |                                                                         |
|------------------------------------------|-------------------------------------------------------------------------|
| Device Type                              | COMOSAR DOSIMETRIC E FIELD PROBE                                        |
| Manufacturer                             | MVG                                                                     |
| Model                                    | SSE2                                                                    |
| Serial Number                            | SN 36/20 EPGO343                                                        |
| Product Condition (new / used)           | New                                                                     |
| Frequency Range of Probe                 | 0.15 GHz-6GHz                                                           |
| Resistance of Three Dipoles at Connector | Dipole 1: R1=0.215 MΩ<br>Dipole 2: R2=0.220 MΩ<br>Dipole 3: R3=0.207 MΩ |

## 2 PRODUCT DESCRIPTION

### 2.1 GENERAL INFORMATION

MVG's COMOSAR E field Probes are built in accordance to the IEEE 1528, FCC KDB865664 D01, CENELEC EN62209 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, FCC KDB865664 D01, CENELEC EN62209 and CEI/IEC 62209 standards provide recommended practices for the probe calibrations, including the performance characteristics of interest and methods by which to assess their affect. All calibrations / measurements performed meet the fore mentioned standards.

### 3.1 LINEARITY

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

### 3.2 SENSITIVITY

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

### 3.3 LOWER DETECTION LIMIT

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

### 3.4 ISOTROPY

The axial isotropy was evaluated by exposing the probe to a reference wave from a standard dipole with the dipole mounted under the flat phantom in the test configuration suggested for system validations and checks. The probe was rotated along its main axis from 0 to 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°).

### 3.1 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.

The boundary effect uncertainty can be estimated according to the following uncertainty approximation formula based on linear and exponential extrapolations between the surface and  $d_{be} + d_{step}$  along lines that are approximately normal to the surface:

$$SAR_{uncertainty} [\%] = \Delta SAR_{be} \frac{(d_{be} + d_{step})^2}{2d_{step}} \frac{(e^{-d_{be}/\delta/2})}{\delta/2} \quad \text{for } (d_{be} + d_{step}) < 10 \text{ mm}$$

where

|                     |                                                                                                                                                                                                      |
|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| $SAR_{uncertainty}$ | is the uncertainty in percent of the probe boundary effect                                                                                                                                           |
| $d_{be}$            | is the distance between the surface and the closest <i>zoom-scan</i> measurement point, in millimetre                                                                                                |
| $\Delta_{step}$     | is the separation distance between the first and second measurement points that are closest to the phantom surface, in millimetre, assuming the boundary effect at the second location is negligible |
| $\delta$            | is the minimum penetration depth in millimetres of the head tissue-equivalent liquids defined in this standard, i.e., $\delta \approx 14$ mm at 3 GHz;                                               |
| $\Delta SAR_{be}$   | in percent of SAR is the deviation between the measured SAR value, at the distance $d_{be}$ from the boundary, and the analytical SAR value.                                                         |

The measured worst case boundary effect SARuncertainty[%] for scanning distances larger than 4mm is 1.0% Limit ,2%).

#### 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 (%) |
| Expanded uncertainty<br>95 % confidence level k = 2        |                       |                          |         |    | 14 %                     |

#### 5 CALIBRATION MEASUREMENT RESULTS

| Calibration Parameters |             |
|------------------------|-------------|
| Liquid Temperature     | 20 +/- 1 °C |
| Lab Temperature        | 20 +/- 1 °C |
| Lab Humidity           | 30-80 %     |

##### 5.1 SENSITIVITY IN AIR

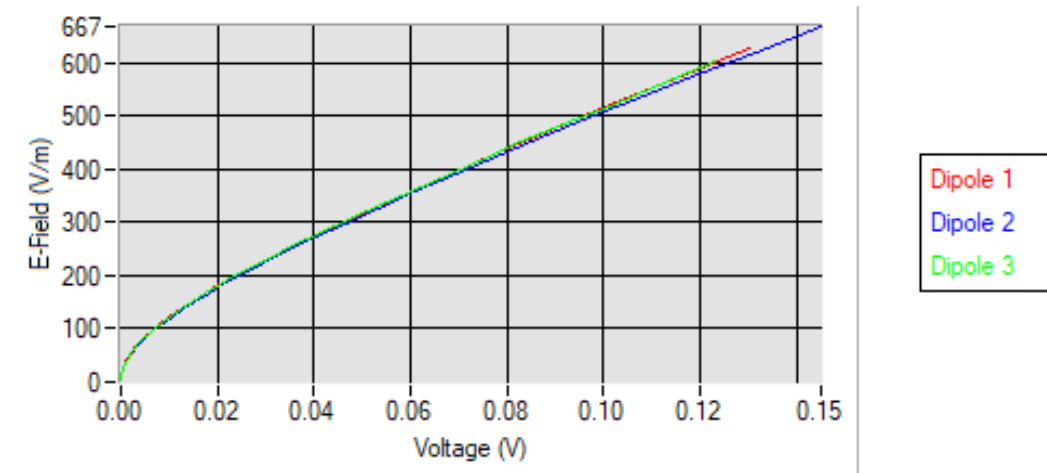
|                                            |                                            |                                            |
|--------------------------------------------|--------------------------------------------|--------------------------------------------|
| Normx dipole<br>1 (μV/(V/m) <sup>2</sup> ) | Normy dipole<br>2 (μV/(V/m) <sup>2</sup> ) | Normz dipole<br>3 (μV/(V/m) <sup>2</sup> ) |
| 0.72                                       | 0.72                                       | 0.72                                       |

|                      |                      |                      |
|----------------------|----------------------|----------------------|
| DCP dipole 1<br>(mV) | DCP dipole 2<br>(mV) | DCP dipole 3<br>(mV) |
| 112                  | 122                  | 112                  |

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

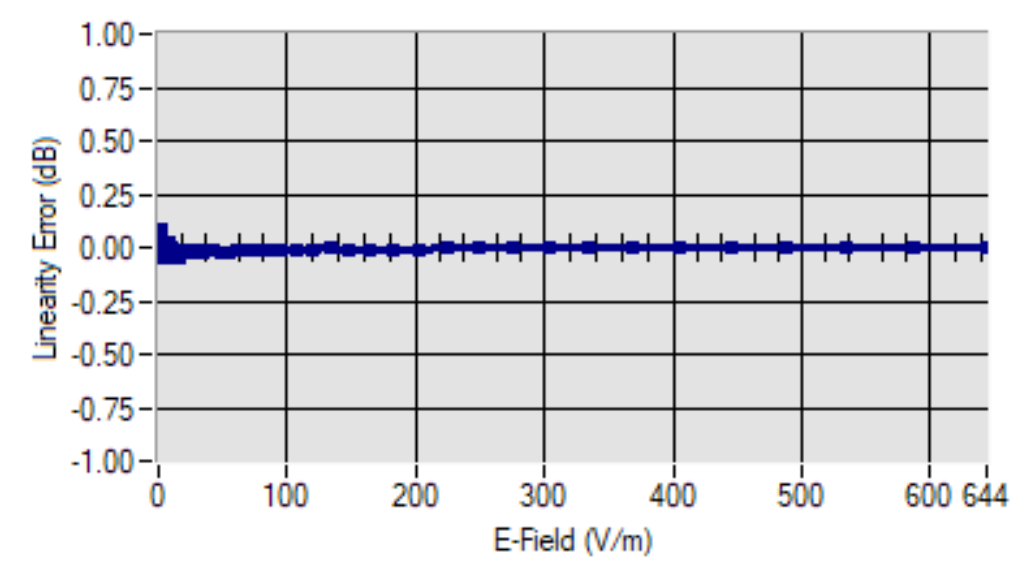
$$E = \sqrt{E_1^2 + E_2^2 + E_3^2}$$

### Calibration curves



## 5.2 LINEARITY

### Linearity



Linearity: +/- 1.86% (+/- 0.08dB)

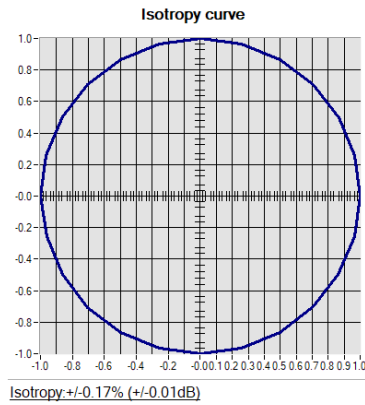
### 5.3 SENSITIVITY IN LIQUID

| <u>Liquid</u> | <u>Frequency<br/>(MHz +/-<br/>100MHz)</u> | <u>ConvF</u> |
|---------------|-------------------------------------------|--------------|
| HL750         | 750                                       | 1.73         |
| BL750         | 750                                       | 1.88         |
| HL850         | 835                                       | 1.81         |
| BL850         | 835                                       | 1.91         |
| HL900         | 900                                       | 1.83         |
| BL900         | 900                                       | 1.95         |
| HL1800        | 1800                                      | 1.99         |
| BL1800        | 1800                                      | 2.05         |
| HL1900        | 1900                                      | 2.18         |
| BL1900        | 1900                                      | 2.26         |
| HL2000        | 2000                                      | 2.24         |
| BL2000        | 2000                                      | 2.33         |
| HL2450        | 2450                                      | 2.18         |
| BL2450        | 2450                                      | 2.51         |
| HL2600        | 2600                                      | 2.04         |
| BL2600        | 2600                                      | 2.46         |
| HL3300        | 3300                                      | 2.15         |
| BL3300        | 3300                                      | 2.11         |
| HL3900        | 3900                                      | 2.31         |
| BL3900        | 3900                                      | 2.48         |
| HL4200        | 4200                                      | 2.60         |
| BL4200        | 4200                                      | 2.52         |
| HL4600        | 4600                                      | 2.50         |
| BL4600        | 4600                                      | 2.54         |
| HL4900        | 4900                                      | 2.48         |
| BL4900        | 4900                                      | 2.43         |
| HL5200        | 5200                                      | 1.96         |
| BL5200        | 5200                                      | 1.84         |
| HL5400        | 5400                                      | 2.27         |
| BL5400        | 5400                                      | 2.14         |
| HL5600        | 5600                                      | 2.49         |
| BL5600        | 5600                                      | 2.35         |
| HL5800        | 5800                                      | 2.46         |
| BL5800        | 5800                                      | 2.32         |

LOWER DETECTION LIMIT: 10mW/kg

## 5.4 ISOTROPY

### HL1800 MHz





## 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                   | Rohde & Schwarz ZVM     | 100203             | 05/2019                                       | 05/2022                                       |
| Network Analyzer – Calibration kit | Rohde & Schwarz ZV-Z235 | 101223             | 05/2019                                       | 05/2022                                       |
| 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. |
| 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      | Testo 184 H1            | 44220687           | 05/2020                                       | 05/2023                                       |