

# FCC SAR EVALUATION REPORT

**In accordance with the requirements of  
FCC 47 CFR Part 2(2.1093) and  
IEEE Std 1528-2013**

Product Name: ADVANCED AUTOMOTIVE DIAGNOSTICS  
ANALYZER

Model No.: D1 ProS2

Serial Model: D1 Max2

Brand Name: OTOFIX

Report No.: AiTSZ-250628024FW1

FCC ID: WQ8-DV2531

**Prepared for**

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## TEST RESULT CERTIFICATION

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### Product description

Product name ..... : ADVANCED AUTOMOTIVE DIAGNOSTICS ANALYZER  
Trademark ..... : OTOFIX  
Model and/or type reference : D1 ProS2  
Serial Model..... : D1 Max2  
FCC 47 CFR Part 2(2.1093)

**Standards** ..... : IEEE Std 1528-2013  
Published RF exposure KDB procedures

This device described above has been tested by Guangdong Asia Hongke Test Technology Limited. In accordance with the measurement methods and procedures specified in IEEE Std 1528-2013 and KDB 865664 D01. Testing has shown that this device is capable of compliance with localized specific absorption rate (SAR) specified in FCC 47 CFR Part 2(2.1093). The test results in this report apply only to the tested sample of the stated device/equipment. Other similar device/equipment will not necessarily produce the same results due to production tolerance and measurement uncertainties.

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Test Sample Number..... : AiTSZ-250628024-1

### Date of Test

Date (s) of performance of tests ..... : Jul. 02, 2025 ~ Jul. 04, 2025

Date of Issue..... : Jul. 09, 2025

Test Result..... : **Pass**



Reviewed by: \_\_\_\_\_  
Ken Zou



Approved by: \_\_\_\_\_  
Jack Li

※※ **Revision History** ※※

REV.	DESCRIPTION	ISSUED DATE	REMARK
Rev.1.0	Initial Test Report Release	Jul. 09, 2025	Jack Li

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## 1. General Information

### 1.1. RF exposure limits

(A).Limits for Occupational/Controlled Exposure (W/kg)

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.4	8.0	20.0

(B).Limits for General Population/Uncontrolled Exposure (W/kg)

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.08	1.6	4.0

NOTE: **Whole-Body SAR** is averaged over the entire body, **partial-body SAR** is averaged over any 1 gram of tissue defined as a tissue volume in the shape of a cube. **SAR for hands, wrists, feet and ankles** is averaged over any 10 grams of tissue defined as a tissue volume in the shape of a cube.

#### Occupational/Controlled Environments:

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

#### General Population/Uncontrolled Environments:

Are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure.

NOTE

TRUNK LIMIT

1.6 W/kg

APPLIED TO THIS EUT

## 1.2. Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing as follows.

Band	Max SAR Value Reported(W/kg)	
	1-g Body (Separation distance of 0mm)	Simultaneous SAR
2.4GHz WLAN	0.364	DTS+DSS: 0.531 NII+DSS: 0.774
5.2GHz WLAN	0.607	
5.8GHz WLAN	0.561	
Bluetooth	0.167	

NOTE: The Max SAR Summation is calculated based on the same configuration and test position.

This device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (1.6 W/kg) specified in FCC 47 CFR Part 2(2.1093), and had been tested in accordance with the measurement methods and procedures specified in IEEE Std 1528-2013 & KDB 865664 D01.

### 1.3. EUT Description

Device Information			
Product Name	ADVANCED AUTOMOTIVE DIAGNOSTICS ANALYZER		
Model Name	D1 ProS2		
Family Model	D1 Max2		
Model Difference	All models are same with electrical parameters and internal circuit structure, but only differ in model name for different software and functions.(this information provided by the customer)		
Device Phase	Identical Prototype		
Exposure Category	General population / Uncontrolled environment		
Antenna Type	PIFA antenna		
Battery Information	DC 3.85V by 11600mAh 44.66Wh Rechargeable Li-ion battery		
Hardware version	DV2531_MAIN_V1		
Software version	V01.01.00		
Device Operating Configurations			
Supporting Mode(s)	WLAN 2.4G/5.2G/5.8G, Bluetooth		
Test Modulation	WLAN(DSSS/OFDM), Bluetooth(GFSK, π/4DQPSK, 8DPSK)		
Operating Frequency Range(s)	Band	Tx (MHz)	Rx (MHz)
	WLAN 2.4G	2412-2462	
	WLAN 5.2G	5180-5240	
	WLAN 5.8G	5745-5825	
	Bluetooth	2402-2480	

#### 1.4. Test specification(s)

FCC 47 CFR Part 2(2.1093)
IEEE Std 1528-2013
KDB 865664 D01 SAR measurement 100 MHz to 6 GHz v01r04
KDB 865664 D02 RF Exposure Reporting v01r02
KDB 447498 D01 General RF Exposure Guidance v06
KDB 248227 D01 802.11 Wi-Fi SAR v02r02

#### 1.5. Ambient Condition

Ambient temperature	20°C – 24°C
Relative Humidity	30% – 70%

#### 1.6. Test Facility

##### Test Laboratory:

Guangdong Asia Hongke Test Technology Limited

B1/F, Building 11, Junfeng Industrial Park, Chongqing Road, Heping Community, Fuhai Street, Bao'an District, Shenzhen, Guangdong, China

The test facility is recognized, certified or accredited by the following organizations:

FCC-Registration No.: 251906 Designation Number: CN1376

Guangdong Asia Hongke Test Technology Limited has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files.

IC—Registration No.: 31737 CAB identifier: CN0165

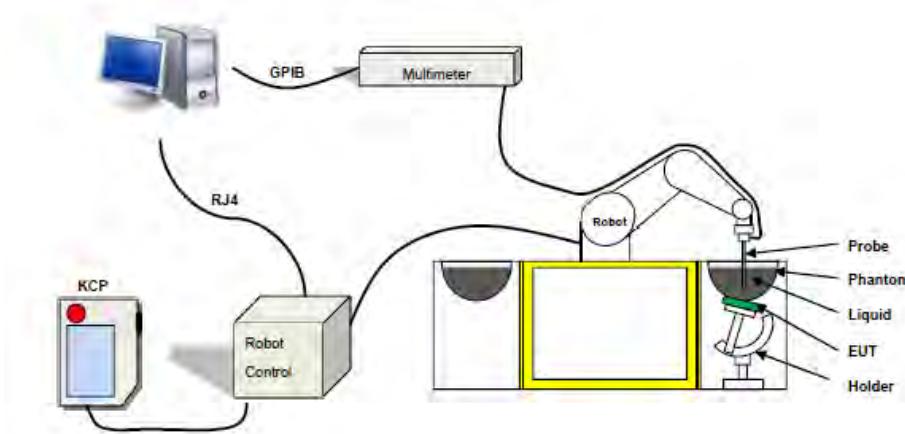
The 3m Semi-anechoic chamber of Guangdong Asia Hongke Test Technology Limited has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 31737c

A2LA-Lab Cert. No.: 7133.01

Guangdong Asia Hongke Test Technology Limited has been accredited by A2LA for technical competence in the field of electrical testing, and proved to be in compliance with ISO/IEC 17025: 2017 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing.

## 2. SAR Measurement System

### 2.1. SATIMO SAR Measurement Set-up Diagram



These measurements were performed with the automated near-field scanning system OPENSAR from SATIMO. The system is based on a high precision robot (working range: 901 mm), which positions the probes with a positional repeatability of better than  $\pm 0.03$  mm. The SAR measurements were conducted with dosimetric probe (manufactured by SATIMO), designed in the classical triangular configuration and optimized for dosimetric evaluation.

The first step of the field measurement is the evaluation of the voltages induced on the probe by the device under test. Probe diode detectors are nonlinear. Below the diode compression point, the output voltage is proportional to the square of the applied E-field; above the diode compression point, it is linear to the applied E-field. The compression point depends on the diode, and a calibration procedure is necessary for each sensor of the probe.

The Keithley multimeter reads the voltage of each sensor and send these three values to the PC. The corresponding E field value is calculated using the probe calibration factors, which are stored in the working directory. This evaluation includes linearization of the diode characteristics. The field calculation is done separately for each sensor. Each component of the E field is displayed on the "Dipole Area Scan Interface" and the total E field is displayed on the "3D Interface"

## 2.2. Robot

The SATIMO SAR system uses the high precision robots from KUKA. For the 6-axis controller system, the robot controller version (KUKA) from KUKA is used. The KUKA robot series have many features that are important for our application:



- High precision (repeatability  $\pm 0.03$  mm)
- High reliability (industrial design)
- Jerk-free straight movements
- Low ELF interference (the closed metallic construction shields against motor control fields)

## 2.3. Probe

This E-field detection probe is composed of three orthogonal dipoles linked to special Schottky diodes with low detection thresholds. The probe allows the measurement of electric fields in liquids such as the one defined in the IEEE and CENELEC standards.

For the measurements the Specific Dosimetric E-Field Probe EPGO 0523-403 with following specifications is used.



- Probe Length: 330 mm
- Length of Individual Dipoles: 2 mm
- Maximum external diameter: 8 mm
- Probe Tip External Diameter: 2.5 mm
- Distance between dipole/probe extremity: 1 mm
- Dynamic range: 0.01-100 W/kg
- Probe linearity: 3%
- Axial Isotropy: < 0.10 dB
- Spherical Isotropy: < 0.10 dB
- Calibration range: 150 MHz to 6 GHz for head & body simulating liquid.
- Angle between probe axis (evaluation axis) and surface normal line: less than 30°

### 2.3.1. E-Field Probe Calibration

Each probe needs to be calibrated according to a dosimetric assessment procedure with accuracy better than  $\pm 10\%$ . The spherical isotropy shall be evaluated and within  $\pm 0.25\text{dB}$ . The sensitivity parameters (Norm X, Norm Y, and Norm Z), the diode compression parameter (DCP) and the conversion factor (Conv F) of the probe are tested. The calibration data can be referred to appendix D of this report.

## 2.4. Phantoms

For the measurements the Elliptical 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. The Elliptical phantom has elliptic shape. The Elliptical phantom provide one reference point on its top part to position the probe tip correctly. The phantom set-up includes a cover, which prevents the evaporation of the liquid.



Elliptical

## 2.5. Technical Data

<b>Overall thickness</b>	2±0.2mm
<b>Internal Dimensions (Bottom part)</b>	600 mm (L) x 400 mm (W) 170 mm (H)
<b>External Dimensions</b>	1000 mm (L) x 500 mm (W) x 280 mm (H)
<b>Maximum volume</b>	35 L
<b>Material</b>	Fiberglass based
<b>Relative permittivity</b>	3.4
<b>Loss tangent</b>	0.02

The test, based on ultrasonic system, allows measuring the thickness with an accuracy of 10 µm.

## 2.6. Device Holder



The SAR in the phantom is approximately inversely proportional to the square of the distance between the source and the liquid surface.

**Material properties:** the positioning system is made of PETP. This material offers a low permittivity of 3.2 and low loss, with a loss tangent of 0.005 to minimize the influence of the DUT on measurement results.

**Mechanical properties:** 2 rows of rail to cover easily the surface of the phantom. The fixing plate is perfectly adapted to larger devices, such as a PC which can be positioned in all configurations.

**Accuracy and precision:** graduated scale available on each axis. The DUT is fixed with a specific adaptable grip.

## 2.7. Test Equipment List

This table gives a complete overview of the SAR measurement equipment.

Devices used during the test described are marked

	Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
					Last Cal.	Due Date
<input checked="" type="checkbox"/>	MVG	SAR Measurement system	SATIMO	N/A	N/A	N/A
<input checked="" type="checkbox"/>	MVG	OpenSAR	V5.3.15.8	N/A	N/A	N/A
<input checked="" type="checkbox"/>	MVG	E FIELD PROBE	SSE2	EPGO 0523-403	Sep. 11, 2024	Sep. 10, 2025
<input type="checkbox"/>	MVG	750 MHz Dipole	SID750	SN 03/15 DIP 0G750-355	Feb. 21, 2024	Feb. 20, 2027
<input type="checkbox"/>	MVG	835 MHz Dipole	SID835	SN 03/15 DIP 0G835-347	Feb. 21, 2024	Feb. 20, 2027
<input type="checkbox"/>	MVG	900 MHz Dipole	SID900	SN 03/15 DI P 0G900-348	Feb. 21, 2024	Feb. 20, 2027
<input type="checkbox"/>	MVG	1800 MHz Dipole	SID1800	SN 03/15 DIP 1G800-349	Feb. 21, 2024	Feb. 20, 2027
<input type="checkbox"/>	MVG	1900 MHz Dipole	SID1900	SN 03/15 DIP 1G900-350	Feb. 21, 2024	Feb. 20, 2027
<input type="checkbox"/>	MVG	2000 MHz Dipole	SID2000	SN 03/15 DIP 2G000-351	Feb. 21, 2024	Feb. 20, 2027
<input type="checkbox"/>	MVG	2300 MHz Dipole	SID2300	SN 03/16 DIP 2G300-358	Feb. 21, 2024	Feb. 20, 2027
<input checked="" type="checkbox"/>	MVG	2450 MHz Dipole	SID2450	SN 03/15 DIP 2G450-352	Feb. 21, 2024	Feb. 20, 2027
<input type="checkbox"/>	MVG	2600 MHz Dipole	SID2600	SN 03/15 DIP 2G600-356	Feb. 21, 2024	Feb. 20, 2027
<input checked="" type="checkbox"/>	MVG	5000 MHz Dipole	SWG5500	SN 13/14 WGA 33	Feb. 21, 2024	Feb. 20, 2027
<input checked="" type="checkbox"/>	MVG	Liquid measurement Kit	SCLMP	SN 21/15 OCPG 72	Sep. 23, 2024	Sep. 22, 2025
<input checked="" type="checkbox"/>	SCHAFFNER	Power Amplifier	CBA9429	T43605	NCR	NCR
<input checked="" type="checkbox"/>	KEITHLEY	Millivoltmeter	2000	4072790	Sep. 23, 2024	Sep. 22, 2025
<input type="checkbox"/>	R&S	Wideband radio communication tester	CMW500	116581	Sep. 23, 2024	Sep. 22, 2025
<input checked="" type="checkbox"/>	HP	Network Analyzer	8753D	3410J01136	Sep. 23,	Sep. 22,

					2024	2025
<input checked="" type="checkbox"/>	Agilent	PSG Analog Signal Generator	N5182A	MY50143009	Sep. 23, 2024	Sep. 22, 2025
<input checked="" type="checkbox"/>	Agilent	Power meter	E4419B	MY45102079	Sep. 25, 2024	Sep. 24, 2025
<input checked="" type="checkbox"/>	Agilent	Power sensor	8481A	MY41097697	Sep. 25, 2024	Sep. 24, 2025
<input checked="" type="checkbox"/>	Agilent	Power sensor	8481A	MY41097696	Sep. 25, 2024	Sep. 24, 2025
<input checked="" type="checkbox"/>	MCLI/USA	Directional Coupler	CB11-20	0D2L51502	Sep. 23, 2024	Sep. 22, 2025
<input checked="" type="checkbox"/>	MVG	Elliptical Phantom	SSM2	SN 20/11 ELLI20	NCR	NCR
<input checked="" type="checkbox"/>	MVG	Device Holder	SMPPD	SN 24/11 LSH15	NCR	NCR

### 3. SAR Measurement Procedures

The measurement procedures are as follows:

<Conducted power measurement>

- (a) For WWAN power measurement, use base station simulator to configure EUT WWAN transmission in conducted connection with RF cable, at maximum power in each supported wireless interface and frequency band.
- (b) Read the WWAN RF power level from the base station simulator.
- (c) For Wi-Fi/BT power measurement, use engineering software to configure EUT Wi-Fi/BT continuously transmission, at maximum RF power in each supported wireless interface and frequency band.
- (d) Connect EUT RF port through RF cable to the power meter, and measure Wi-Fi/BT output power.

<SAR measurement>

- (a) Use base station simulator to configure EUT WWAN transmission in radiated connection, and engineering software to configure EUT Wi-Fi/BT continuously transmission, at maximum RF power, in the highest power channel.
- (b) Place the EUT in the positions as Appendix A demonstrates.
- (c) Set scan area, grid size and other setting on the OPENSAR software.
- (d) Measure SAR results for the highest power channel on each testing position.
- (e) Find out the largest SAR result on these testing positions of each band.
- (f) Measure SAR results for other channels in worst SAR testing position if the reported SAR of highest power channel is larger than 0.8 W/kg.

According to the test standard, the recommended procedure for assessing the peak spatial-average SAR value consists of the following steps:

- (a) Power reference measurement
- (b) Area scan
- (c) Zoom scan
- (d) Power drift measurement

#### 3.1. Power Reference

The Power Reference Measurement and Power Drift Measurements are for monitoring the power drift of the device under test in the batch process. The minimum distance of probe sensors to surface determines the closest measurement point to phantom surface. This distance cannot be smaller than the distance of sensor calibration points to probe tip as defined in the probe properties.

#### 3.2. Area scan & Zoom scan

The area scan is a 2D scan to find the hot spot location on the DUT. The zoom scan is a 3D scan

above the hot spot to calculate the 1g and 10g SAR value.

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 cannot 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.

From the scanned SAR distribution, identify the position of the maximum SAR value, in addition identify the positions of any local maxima with SAR values within 2 dB of the maximum value that will not be within the zoom scan of other peaks; additional peaks shall be measured only when the primary peak is within 2 dB of the SAR compliance limit (e.g., 1 W/kg for 1,6 W/kg 1 g limit, or 1,26 W/kg for 2 W/kg, 10 g limit).

Area scan & Zoom scan scan parameters extracted from FCC KDB 865664 D01 SAR measurement 100 MHz to 6 GHz.

		$\leq 3$ GHz	$> 3$ GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface		$5 \pm 1$ mm	$\frac{1}{2} \cdot \delta \cdot \ln(2) \pm 0.5$ mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location		$30^\circ \pm 1^\circ$	$20^\circ \pm 1^\circ$
		$\leq 2$ GHz: $\leq 15$ mm $2 - 3$ GHz: $\leq 12$ mm	$3 - 4$ GHz: $\leq 12$ mm $4 - 6$ GHz: $\leq 10$ mm
Maximum area scan spatial resolution: $\Delta x_{\text{Area}}, \Delta y_{\text{Area}}$			When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be $\leq$ the corresponding x or y dimension of the test device with at least one measurement point on the test device.
Maximum zoom scan spatial resolution: $\Delta x_{\text{Zoom}}, \Delta y_{\text{Zoom}}$		$\leq 2$ GHz: $\leq 8$ mm $2 - 3$ GHz: $\leq 5$ mm*	$3 - 4$ GHz: $\leq 5$ mm* $4 - 6$ GHz: $\leq 4$ mm*
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{\text{Zoom}}(n)$		$3 - 4$ GHz: $\leq 4$ mm $4 - 5$ GHz: $\leq 3$ mm $5 - 6$ GHz: $\leq 2$ mm
	graded grid	$\Delta z_{\text{Zoom}}(1)$ : between 1 <sup>st</sup> two points closest to phantom surface $\Delta z_{\text{Zoom}}(n > 1)$ : between subsequent points	$3 - 4$ GHz: $\leq 3$ mm $4 - 5$ GHz: $\leq 2.5$ mm $5 - 6$ GHz: $\leq 2$ mm $\leq 1.5 \cdot \Delta z_{\text{Zoom}}(n-1)$
Minimum zoom scan volume	x, y, z	$\geq 30$ mm	$3 - 4$ GHz: $\geq 28$ mm $4 - 5$ GHz: $\geq 25$ mm $5 - 6$ GHz: $\geq 22$ mm
Note: $\delta$ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details.			
* When zoom scan is required and the <u>reported</u> SAR from the <i>area scan based 1-g SAR estimation</i> procedures of KDB 447498 is $\leq 1.4$ W/kg, $\leq 8$ mm, $\leq 7$ mm and $\leq 5$ mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.			

### **3.3. 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 averaged over 10 grams and 1 gram requires a very fine resolution in the three dimensional scanned data array.

### **3.4. Volumetric Scan**

The volumetric scan consists of a full 3D scan over a specific area. This 3D scan is useful for multi Tx SAR measurement. Indeed, it is possible with OpenSAR to add, point by point, several volumetric scans to calculate the SAR value of the combined measurement as it is defined in the standard IEEE1528 and IEC62209.

### **3.5. Power Drift**

All SAR testing is under the EUT installed full charged battery and transmit maximum output power. In OpenSAR measurement software, the power reference measurement and power drift measurement procedures are used for monitoring the power drift of EUT during SAR test. Both these procedures measure the field at a specified reference position before and after the SAR testing. The software will calculate the field difference in V/m. If the power drifts more than  $\pm 5\%$ , the SAR will be retested.

## 4. System Verification Procedure

### 4.1. Tissue Verification

The following tissue formulations are provided for reference only as some of the parameters have not been thoroughly verified. The composition of ingredients may be modified accordingly to achieve the desired target tissue parameters required for routine SAR evaluation.

Ingredients (% of weight)	Head Tissue									
	750	835	900	1800	1900	2000	2450	2600	5200	5800
Water	34.40	34.40	34.40	55.36	55.36	57.87	57.87	57.87	65.53	65.53
NaCl	0.79	0.79	0.79	0.35	0.35	0.16	0.16	0.16	0.00	0.00
1,2-Propanediol	64.81	64.81	64.81	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Triton X-100	0.00	0.00	0.00	30.45	30.45	19.97	19.97	19.97	24.24	24.24
DGBE	0.00	0.00	0.00	13.84	13.84	22.00	22.00	22.00	10.23	10.23

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 depth from the ear reference point (ERP) of the phantom to the liquid top surface is larger than 15 cm.



#### 4.1.1. Tissue Dielectric Parameter Check Results

The simulating liquids should be checked at the beginning of a series of SAR measurements to determine if the dielectric parameter are within the tolerances of the specified target values. The measured conductivity and relative permittivity should be within  $\pm 5\%$  of the target values.

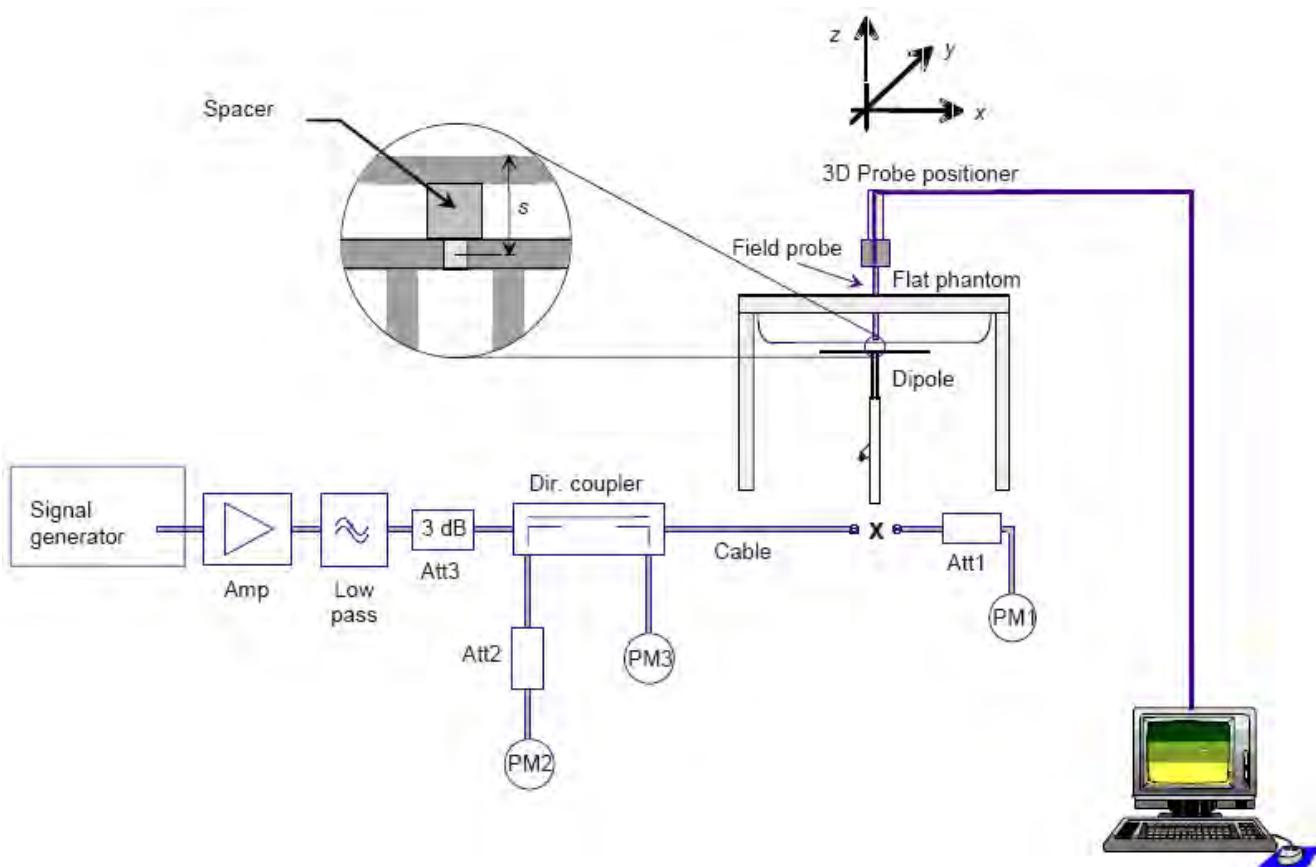
Tissue Type	Measured Frequency (MHz)	Target Tissue		Measured Tissue		Liquid Temp.	Test Date
		$\epsilon_r$ ( $\pm 5\%$ )	$\sigma$ (S/m) ( $\pm 5\%$ )	$\epsilon_r$	$\sigma$ (S/m)		
Head 2450	2450	39.20 (37.24~41.16)	1.80 (1.71~1.89)	40.41	1.82	21.0 °C	Jul. 02, 2025
Head 2450	2437	39.22 (37.26~41.18)	1.79 (1.70~1.88)	39.20	1.79	21.0 °C	Jul. 02, 2025
Head 2450	2412	39.27 (37.30~41.23)	1.77 (1.68~1.85)	39.22	1.77	21.0 °C	Jul. 02, 2025
Head 2450	2462	39.18 (37.22~41.14)	1.81 (1.72~1.90)	39.23	1.81	21.0 °C	Jul. 02, 2025
Head 5200	5190	36.01 (34.21~37.81)	4.65 (4.42~4.88)	36.00	4.65	21.2 °C	Jul. 03, 2025
Head 5200	5200	36.00 (34.20~37.80)	4.66 (4.43~4.89)	37.40	4.51	21.2 °C	Jul. 03, 2025
Head 5200	5230	35.97 (34.17~37.77)	4.69 (4.46~4.92)	34.48	4.55	21.2 °C	Jul. 03, 2025
Head 5800	5755	35.35 (33.58~37.11)	5.23 (4.96~5.49)	34.23	5.15	21.6 °C	Jul. 04, 2025
Head 5800	5795	35.31 (33.54~37.07)	5.27 (5.00~5.53)	35.32	5.27	21.6 °C	Jul. 04, 2025
Head 5800	5800	35.30 (33.54~37.07)	5.27 (5.01~5.53)	35.30	5.27	21.6 °C	Jul. 04, 2025

NOTE: The dielectric parameters of the tissue-equivalent liquid should be measured under similar ambient conditions and within 2 °C of the conditions expected during the SAR evaluation to satisfy protocol requirements.

## 4.2. System Verification Procedure

The system verification is performed for verifying the accuracy of the complete measurement system and performance of the software. 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 100mW (below 5GHz) or 50mW (above 5GHz). To adjust this power a power meter is used. The power sensor is connected to the cable before the system verification 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 system verification 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).

The system verification is shown as below picture:



#### 4.2.1. System Verification Results

Comparing to the original SAR value provided by SATIMO, the verification data should be within its specification of  $\pm 10\%$ . Below table shows the target SAR and measured SAR after normalized to 1W input power. The table below indicates the system performance verification can meet the variation criterion and the plots can be referred to Appendix B of this report.

System Verification	Power fed to reference dipole (mW)	Measured SAR Value		Measured SAR (Normalized to 1W)		Target SAR Value (1W)		Deviation (%)		Test Date
		1-g (W/Kg)	10-g (W/Kg)	1-g (W/Kg)	10-g (W/Kg)	1-g (W/Kg)	10-g (W/Kg)	1-g (W/Kg)	10-g (W/Kg)	
2450MHz	100	5.184	2.359	51.84	23.59	50.05	23.80	3.58%	-0.88%	Jul. 02, 2025
5200MHz	50	7.356	2.606	147.12	52.12	162.59	56.21	-9.51%	-7.28%	Jul. 03, 2025
5800MHz	50	8.211	2.812	164.21	56.23	182.2	61.32	-9.87%	-8.30%	Jul. 04, 2025

## 5. SAR measurement variabilit

Per KDB865664 D01 SAR measurement 100 MHz to 6 GHz, SAR measurement variability must be assessed for each frequency band, which is determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements. The additional measurements are repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device should be returned to ambient conditions (normal room temperature) with the battery fully charged before it is re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

- 1) Repeated measurement is not required when the original highest measured SAR is  $< 0.80 \text{ W/kg}$ ; steps 2) through 4) do not apply.
- 2) When the original highest measured SAR is  $\geq 0.80 \text{ W/kg}$ , repeat that measurement once.
- 3) Perform a second repeated measurement only if the ratio of largest to smallest SAR for the original and first repeated measurements is  $> 1.20$  or when the original or repeated measurement is  $\geq 1.45 \text{ W/kg}$  ( $\sim 10\%$  from the 1-g SAR limit).
- 4) Perform a third repeated measurement only if the original, first or second repeated measurement is  $\geq 1.5 \text{ W/kg}$  and the ratio of largest to smallest SAR for the original, first and second repeated measurements is  $> 1.20$ .

## 6. SAR Measurement Uncertainty

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of  $k=2$ .

Symbol	Uncertainty Component	Prob. Dist.	Unc. $a(x_i)$	Div. $q_i$	$u(x_i) = a(x_i)/q_i$	$C_i$	$u(y) = C_i * u(x_i)$	$v_i$
<b>Measurement system errors</b>								
CF	Probe calibration	N ( $k = 2$ )	5.72	2	2.86	1	2.86	$\infty$
CF <sub>drift</sub>	Probe calibration drift	R	0.15	$\sqrt{3}$	0.09	1	0.09	$\infty$
LIN	Probe linearity and detection limit	R	1.27	$\sqrt{3}$	0.73	1	0.73	$\infty$
BBS	Broadband signal	R	0.12	$\sqrt{3}$	0.07	1	0.07	$\infty$
ISO	Probe isotropy	R	0.16	$\sqrt{3}$	0.09	1	0.09	$\infty$
DAE	Other probe and data acquisition errors	N	2.4	1	2.40	1	2.40	$\infty$
AMB	RF ambient and noise	N	3.51	1	3.51	1	3.51	$\infty$
$\Delta_{xyz}$	Probe positioning errors	N	1.2	1	1.20	$2/\delta$	1.20	
DAT	Data processing errors	N	2.1	1	2.10	1	2.10	$\infty$
<b>Phantom and device (DUT or validation antenna) errors</b>								
LIQ( $\sigma$ )	Measurement of phantom conductivity( $\sigma$ )	N	4.1	1	4.1	$c_\epsilon, c_\sigma$	4.10	$\infty$
LIQ( $T_c$ )	Temperature effects (medium)	R	2.7	$\sqrt{3}$	1.56	$c_\epsilon, c_\sigma$	1.56	$\infty$
EPS	Shell permittivity	R	2.1	$\sqrt{3}$	1.21	See 8.4.2.3	0.30	$\infty$
DIS	Distance between the radiating element of the DUT and the phantom medium	N	0.7	1	0.7	2	1.40	$\infty$
$D_{xyz}$	Repeatability of positioning the DUT or source against the phantom	N	1.2	1	1.2	1	1.20	5
H	Device holder effects	N	3.8	1	3.8	1	3.80	
MOD	Effect of operating mode on probe sensitivity	R	3.42	$\sqrt{3}$	1.97	1	1.97	$\infty$
TAS	Time-average SAR	R	1.8	$\sqrt{3}$	1.04	1	1.04	$\infty$
RF <sub>drift</sub>	Variation in SAR due to drift in output of DUT	N	4.5	1	4.5	1	4.50	
VAL	Validation antenna uncertainty (validation measurement only)	N	1.4	1	1.4	1	1.40	
$P_{in}$	Uncertainty in accepted power (validation measurement only)	N	2.4	1	2.4	1	2.40	
<b>Corrections to the SAR result (if applied)</b>								
C( $\epsilon', \sigma$ )	Phantom deviation from target ( $\epsilon', \sigma$ )	N	3.7	1	3.7	1	3.70	
C(R)	SAR scaling	R	1.8	$\sqrt{3}$	1.04	1	1.04	
u( $\Delta$ SAR)	Combined uncertainty						10.84	
U	Expanded uncertainty and effective degrees of freedom					U =	21.68	

## 7. RF Exposure Positions

### 7.1. Generic device

The SAR evaluation shall be performed for surface of the DUT that are accessible during intended use, as indicated in Figure 7.1. Adjust the distance between the device surface and the flat phantom to 0mm.

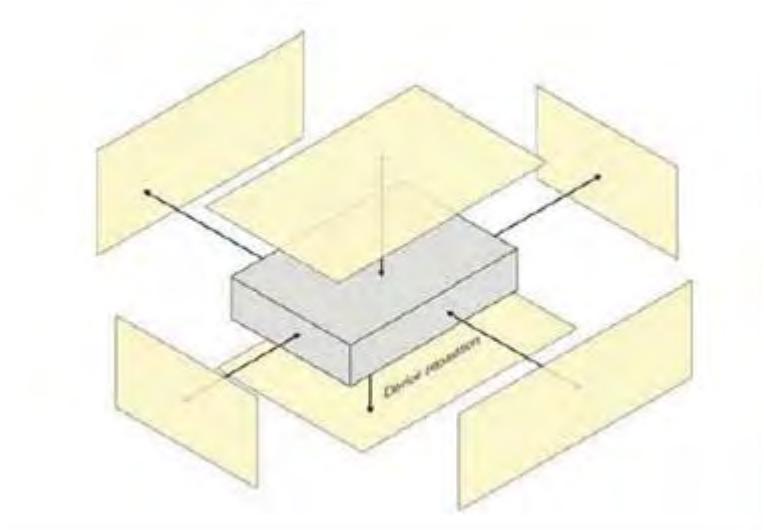


Figure 7.1 – Test positions for generic device

## 8. RF Output Power

### 8.1. Wi-Fi & BT Output Power

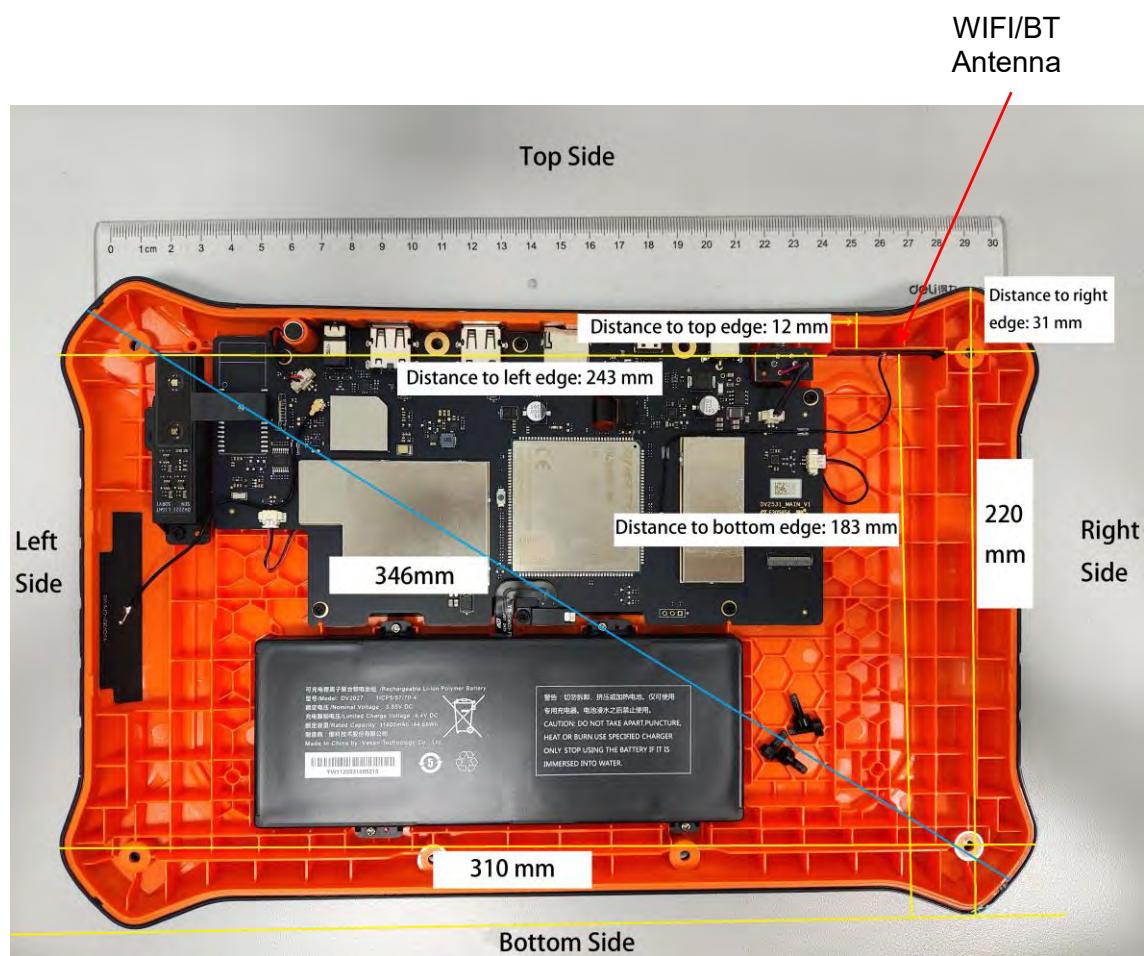
Mode	Channel	Frequency (MHz)	Tune-up (dBm)	Output Power (dBm)
802.11b	1	2412	13.00	12.22
	6	2437	13.00	12.39
	11	2462	13.00	12.64
802.11g	1	2412	14.00	13.63
	6	2437	14.00	13.51
	11	2462	14.00	13.73
802.11n (HT20)	1	2412	14.00	13.52
	6	2437	14.00	13.42
	11	2462	14.00	13.58
802.11n (H40)	3	2422	15.00	14.33
	6	2437	15.00	14.25
	9	2452	15.00	14.55

Mode	Frequency (MHz)	Tune-up (dBm)	Output Power (dBm)
802.11A	5180	13.00	12.93
	5200	13.00	12.40
	5240	13.00	12.56
802.11N20SISO	5180	12.50	11.73
	5200	12.50	11.17
	5240	12.50	12.35
802.11N40SISO	5190	14.00	13.53
	5230	14.00	13.14
802.11AC20SISO	5180	13.00	12.77
	5200	13.00	12.29
	5240	13.00	12.29
802.11AC40SISO	5190	13.50	13.41
	5230	13.50	13.23
802.11AC80SISO	5210	13.50	13.05

Mode	Frequency (MHz)	Tune-up (dBm)	Output Power (dBm)
802.11A	5745	14.00	13.47
	5785	14.00	13.64
	5825	14.00	13.68
802.11N20SISO	5745	14.00	13.23
	5785	14.00	13.47
	5825	14.00	13.53
802.11N40SISO	5755	14.50	13.52
	5795	14.50	14.27
802.11AC20SISO	5745	14.00	13.32
	5785	14.00	13.50
	5825	14.00	13.56
802.11AC40SISO	5755	14.50	13.60
	5795	14.50	14.37
802.11AC80SISO	5775	14.00	13.58

BR+EDR	Output Power (dBm)				
	Data Rates	Tune-up (dBm)	Channel		
			0CH	39CH	78CH
	1M	1.50/1.50/3.50	1.48	1.49	3.05
	2M	4.00/4.00/5.50	3.78	3.89	5.33
	3M	4.50/4.50/6.00	4.10	4.32	5.60

## 9. Antenna Location



Antenna information:

Distance of The Antenna to the EUT surface and edge (mm)						
Antennas	Front Side	Back Side	Top Side	Bottom Side	Left Side	Right Side
BT/WLAN	5	5	37	183	243	31

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

## 10. Stand-alone SAR test exclusion

Refer to FCC KDB 447498D01, the 1-g SAR and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances  $\leq 50$  mm are determined by:

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

- $f(\text{GHz})$  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.

Mode	P <sub>max</sub> (dBm)	P <sub>max</sub> (mW)	Distance (mm)	f (GHz)	Calculation Result	SAR Exclusion threshold	SAR test exclusion
Bluetooth	6.00	3.98	5	2.480	1.2	3	Yes

NOTE: Standalone SAR test exclusion for Bluetooth.

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

$[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] * [\sqrt{f(\text{GHz})/x}] \text{ W/kg}$  for test separation distances  $\leq 50$  mm, where  $x = 7.5$  for 1-g SAR and  $x = 18.75$  for 10-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	P <sub>max</sub> (dBm)	P <sub>max</sub> (mW)	Distance (mm)	f (GHz)	x	Estimated SAR (W/kg)
Bluetooth	Body	6.00	3.98	5	2.48	7.5	0.167

NOTE: Estimated SAR calculation for Bluetooth

## 11. SAR Measurement Results

< WLAN 2.4G >

Test Position of Body with 0mm	Test channel /Freq.	Mode	SAR Value (W/kg)		Power Drift (±5%)	Conducted power (dBm)	Tune-up power (dBm)	Scaled SAR 1g (W/Kg)	Date	Plot
			1g	10g						
Front Side	11/2462	802.11b	0.210	0.140	-3.25	12.64	13.00	0.228	2025/7/2	
Back Side	11/2462	802.11b	0.335	0.191	3.57	12.64	13.00	0.364	2025/7/2	3#
Back Side	1/2412	802.11b	0.287	0.165	0.12	12.22	13.00	0.343	2025/7/2	
Back Side	6/2437	802.11b	0.300	0.172	0.36	12.39	13.00	0.345	2025/7/2	
Back Side	9/2452	802.11n (H40)	0.293	0.208	2.01	14.55	15.00	0.325	2025/7/2	
Left Side	11/2462	802.11b	0.112	0.041	-0.34	12.64	13.00	0.122	2025/7/2	
Right Side	11/2462	802.11b	0.175	0.100	-1.12	12.64	13.00	0.190	2025/7/2	
Top Side	11/2462	802.11b	0.201	0.121	2.48	12.64	13.00	0.218	2025/7/2	
Bottom Side	11/2462	802.11b	0.152	0.087	2.01	12.64	13.00	0.165	2025/7/2	

< WLAN 5.2G >

Test Position of Body with 0mm	Test channel /Freq.	Mode	SAR Value (W/kg)		Power Drift (±5%)	Conducted power (dBm)	Tune-up power (dBm)	Scaled SAR 1g (W/Kg)	Date	Plot
			1g	10g						
Front Side	38/5190	802.11N40	0.336	0.159	0.80	13.53	14.00	0.374	2025/7/3	
Back Side	38/5190	802.11N40	0.545	0.213	1.92	13.53	14.00	0.607	2025/7/3	1#
Back Side	46/5230	802.11N40	0.471	0.185	1.45	13.14	14.00	0.574	2025/7/3	
Left Side	38/5190	802.11N40	0.185	0.047	-3.85	13.53	14.00	0.206	2025/7/3	
Right Side	38/5190	802.11N40	0.271	0.110	3.61	13.53	14.00	0.302	2025/7/3	
Top Side	38/5190	802.11N40	0.308	0.132	2.88	13.53	14.00	0.343	2025/7/3	
Bottom Side	38/5190	802.11N40	0.246	0.087	-3.55	13.53	14.00	0.274	2025/7/3	

< WLAN 5.8G >

Test Position of Body with 0mm	Test channel /Freq.	Mode	SAR Value (W/kg)		Power Drift (±5%)	Conducted power (dBm)	Tune-up power (dBm)	Scaled SAR 1g (W/Kg)	Date	Plot
			1g	10g						
Front Side	159/5795	802.11ac VHT40	0.336	0.165	-0.49	14.37	14.50	0.346	2025/7/4	
Back Side	159/5795	802.11ac VHT40	0.544	0.213	3.76	14.37	14.50	0.561	2025/7/4	2#
Back Side	151/5755	802.11ac	0.445	0.158	3.02	13.60	14.50	0.547	2025/7/4	

		VHT40									
Left Side	159/5795	802.11ac VHT40	0.213	0.055	-3.68	14.37	14.50	0.219	2025/7/4		
Right Side	159/5795	802.11ac VHT40	0.281	0.119	2.79	14.37	14.50	0.290	2025/7/4		
Top Side	159/5795	802.11ac VHT40	0.311	0.140	-1.39	14.37	14.50	0.320	2025/7/4		
Bottom Side	159/5795	802.11ac VHT40	0.254	0.098	-3.16	14.37	14.50	0.262	2025/7/4		

## 12. Simultaneous Transmission Analysis

No.	Simultaneous Tx	Body
1	DTS+DSS	Yes
2	NII+DSS	Yes

Exposure Position		DTS/NII	DSS	Simultaneous Tx SAR(W/Kg)
		SAR(W/Kg)	SAR(W/Kg)	
Body	Front Side	0.374	0.167	0.541
	Back Side	0.607	0.167	0.774
	Left Side	0.219	0.167	0.386
	Right Side	0.302	0.167	0.469
	Top Side	0.343	0.167	0.510
	Bottom Side	0.274	0.167	0.441

Note : The Simultaneous Tx is calculated based on the same configuration and test position.

## Appendix A. Photo documentation

Refer to appendix Test Setup photo-SAR

## Appendix B. System Check Plots

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**MEASUREMENT 1 System Performance Check - 2450MHz**

**MEASUREMENT 2 System Performance Check - 5200MHz**

**MEASUREMENT 3 System Performance Check - 5800MHz**

# MEASUREMENT 1

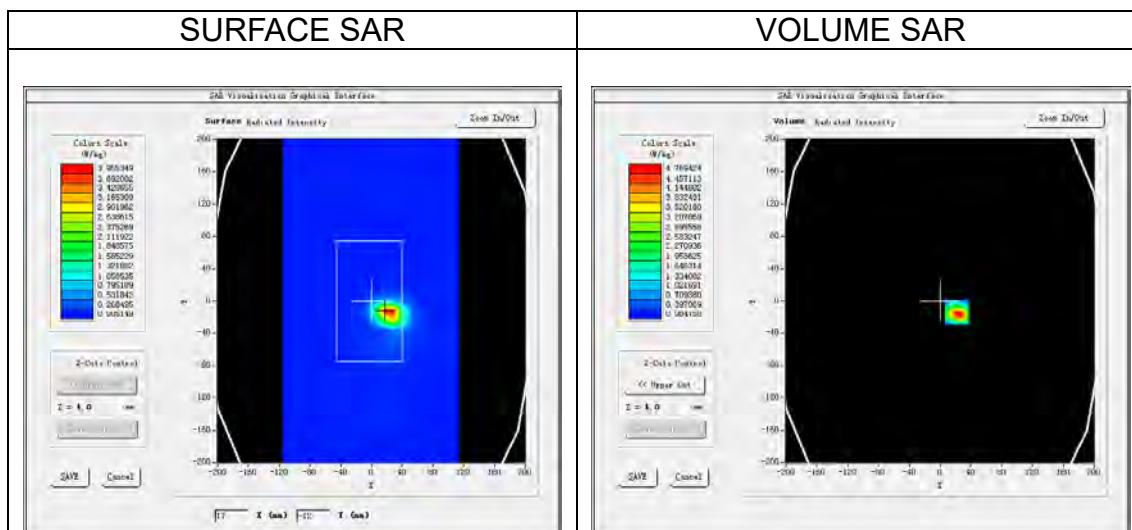
Date of measurement: 2/7/2025

## A. Experimental conditions.

Area Scan	dx=12mm dy=12mm, h= 5.00 mm
ZoomScan	7x7x7, dx=5mm dy=5mm dz=5mm
Phantom	ELLI
Device Position	Dipole
Band	CW2450
Channels	Middle
Signal	CW (Crest factor: 1.0)
ConvF	2.38

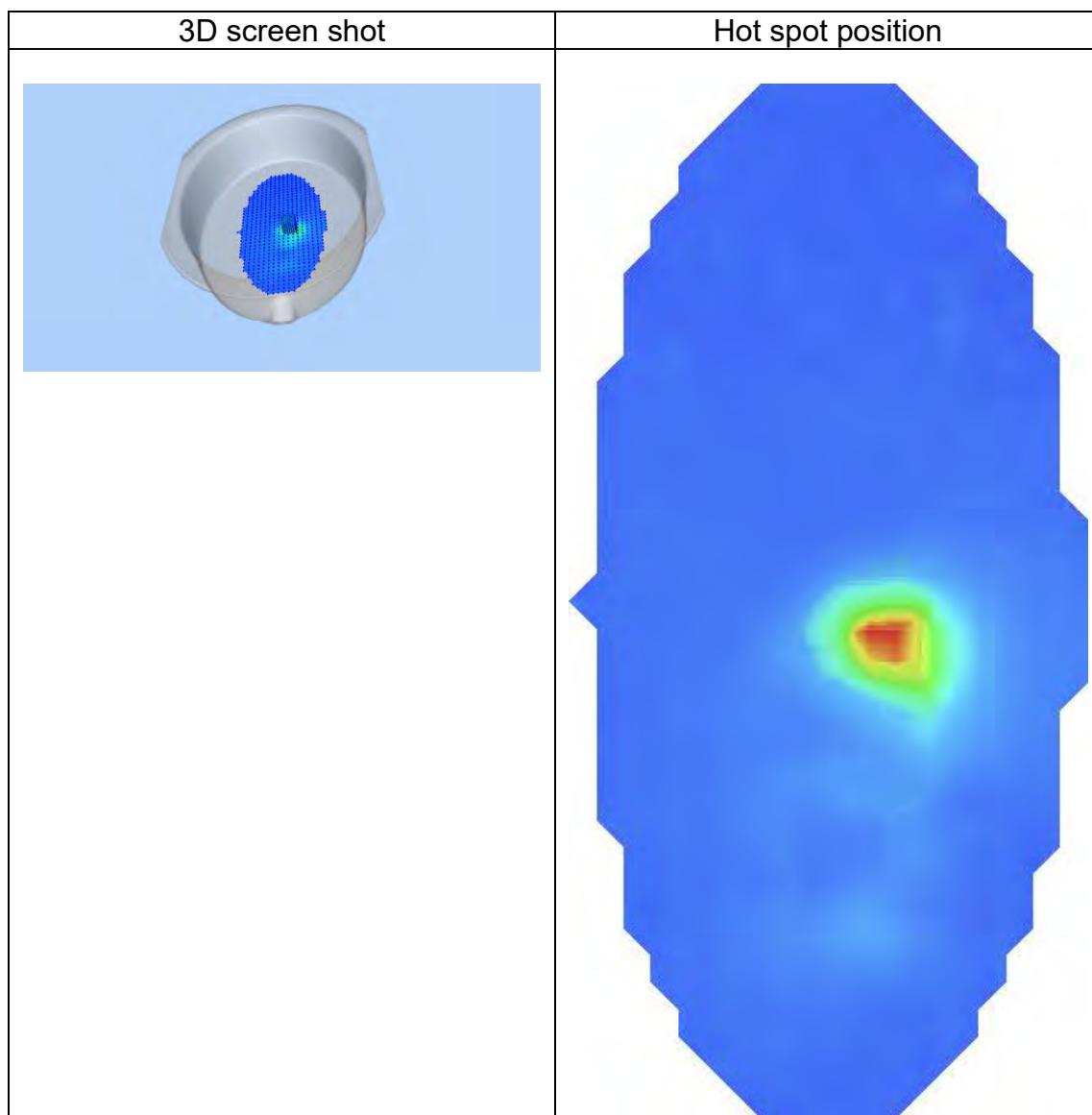
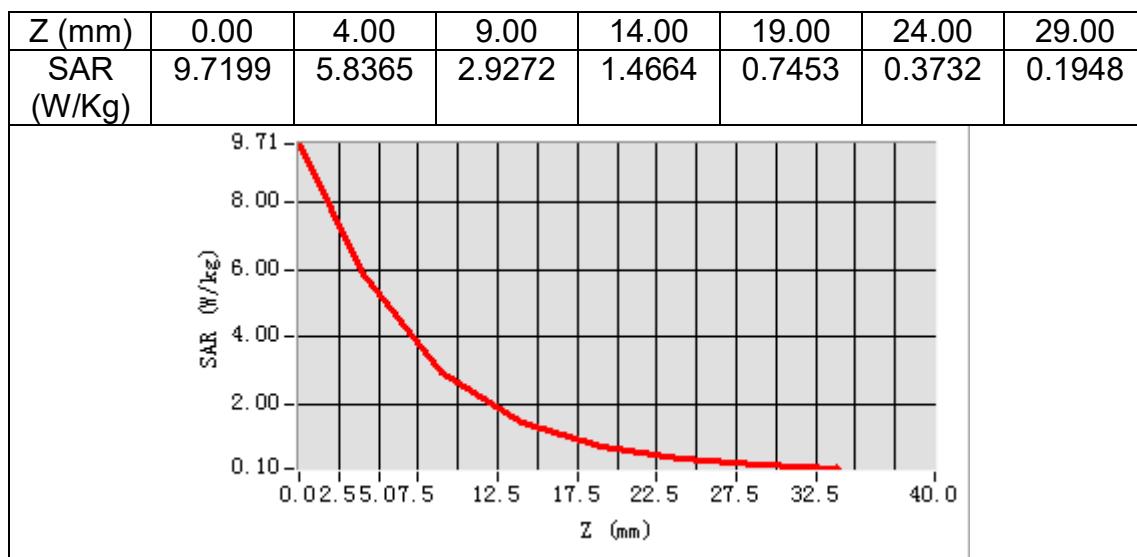
## B. SAR Measurement Results

Frequency (MHz)	2450.000000
Relative permittivity (real part)	40.408511
Relative permittivity (imaginary part)	13.399264
Conductivity (S/m)	1.823789
Variation (%)	2.360000



Maximum location: X=22.00, Y=-14.00  
SAR Peak: 6.79 W/kg

SAR 10g (W/Kg)	2.359425
SAR 1g (W/Kg)	5.183642
Horizontal validation criteria: minimum distance (mm)	14.58
Vertical validation criteria: SAR ratio M2/M1 (%)	50.15



## MEASUREMENT 2

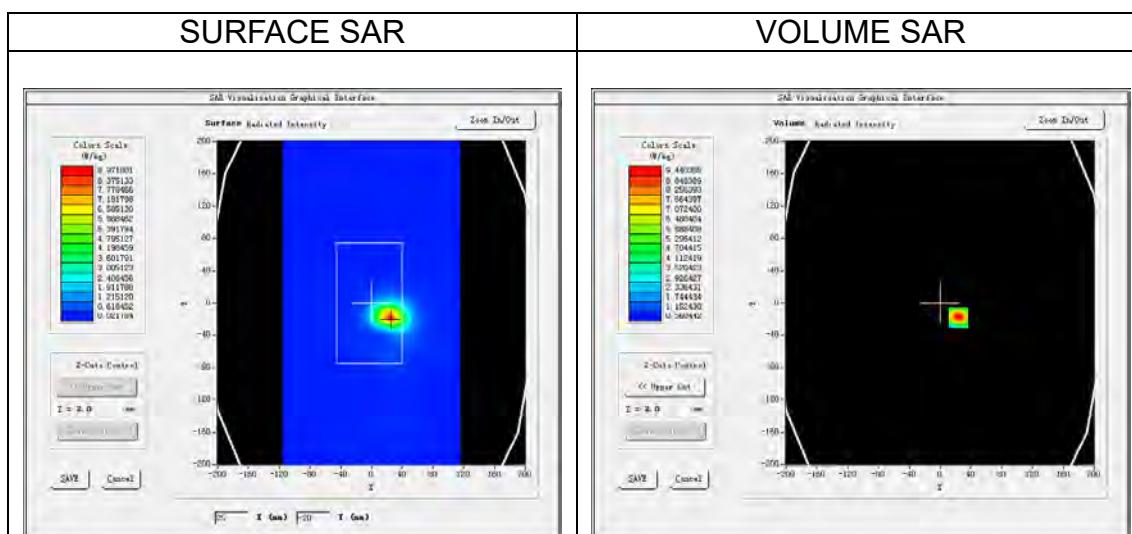
Date of measurement: 3/7/2025

### A. Experimental conditions.

Area Scan	dx=10mm dy=10mm, h= 2.00 mm
ZoomScan	7x7x12,dx=4mm dy=4mm dz=2mm
Phantom	ELLI
Device Position	Dipole
Band	CW5200
Channels	Middle
Signal	CW (Crest factor: 1.0)
ConvF	2.30

### B. SAR Measurement Results

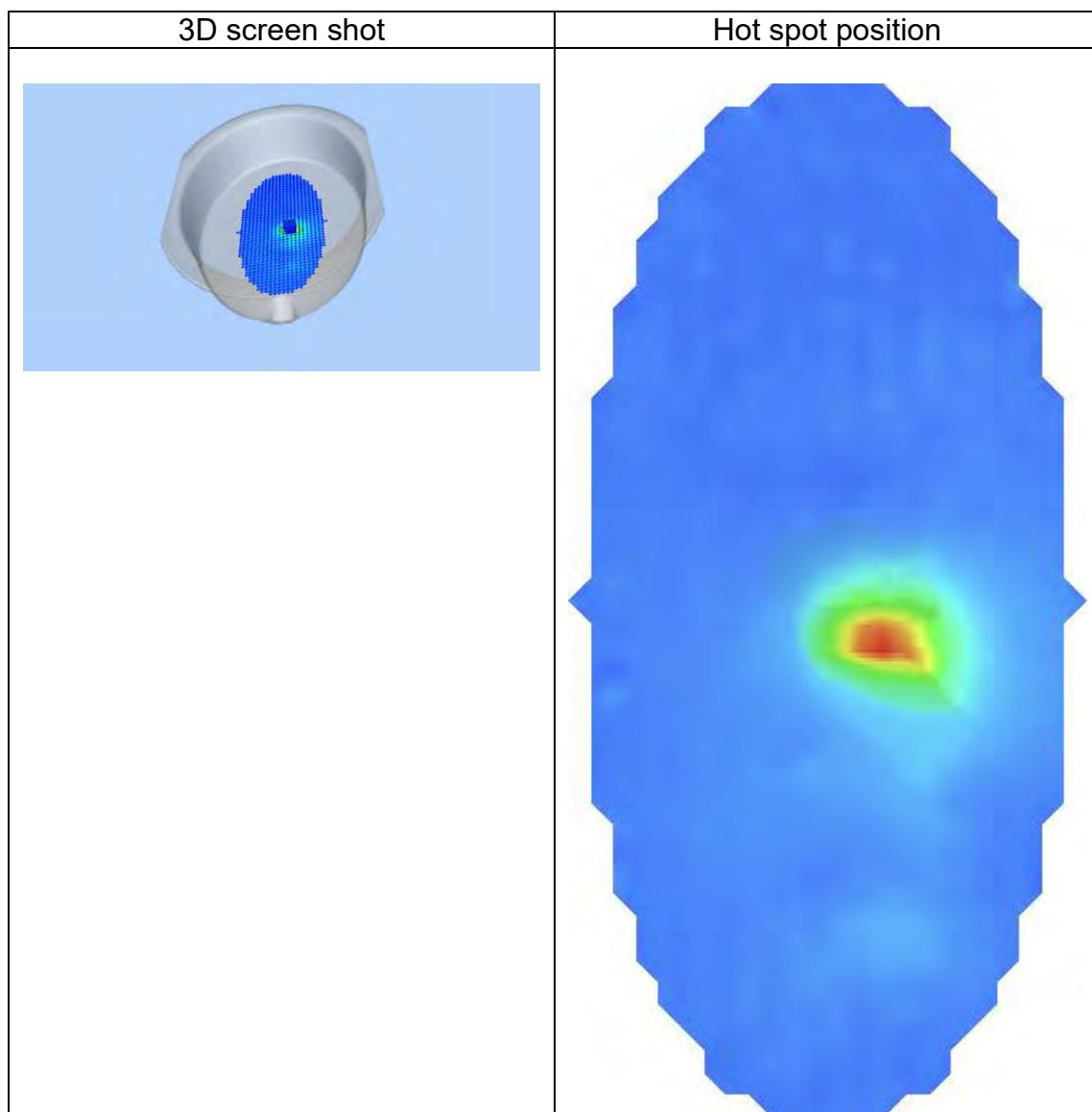
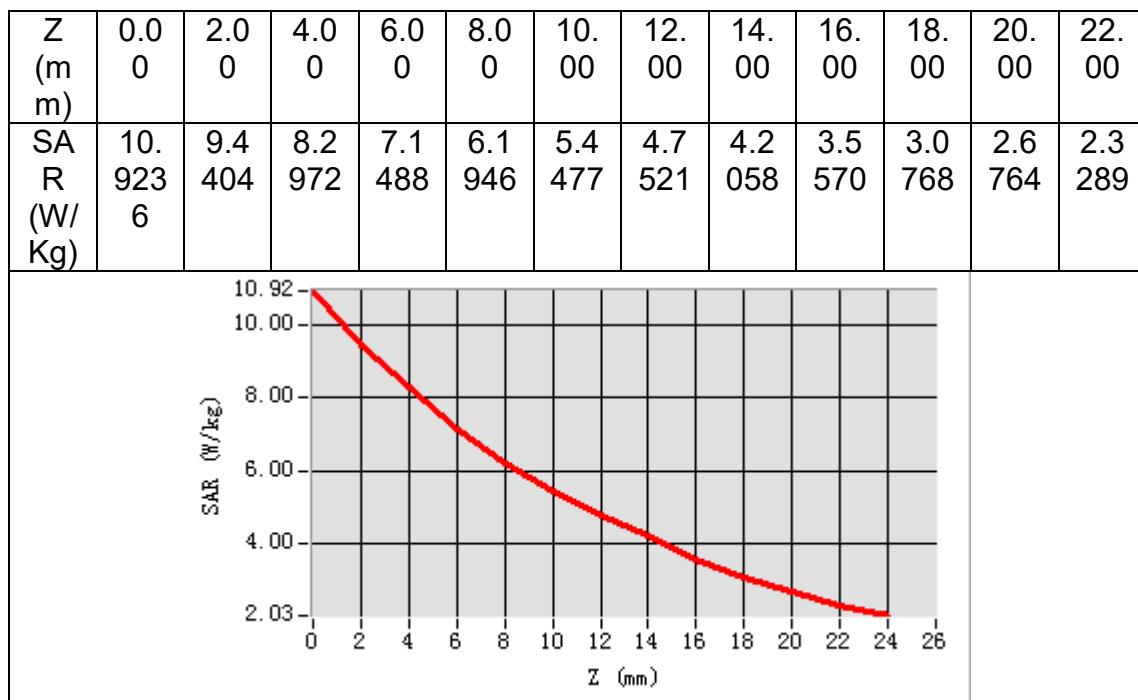
Frequency (MHz)	5200.000000
Relative permittivity (real part)	37.400000
Relative permittivity (imaginary part)	16.129999
Conductivity (S/m)	4.510778
Variation (%)	0.900000



Maximum location: X=24.00, Y=-18.00

SAR Peak: 11.03 W/kg

SAR 10g (W/Kg)	2.605720
SAR 1g (W/Kg)	7.356317
Horizontal validation criteria: minimum distance (mm)	14.64
Vertical validation criteria: SAR ratio M2/M1 (%)	87.89



## MEASUREMENT 3

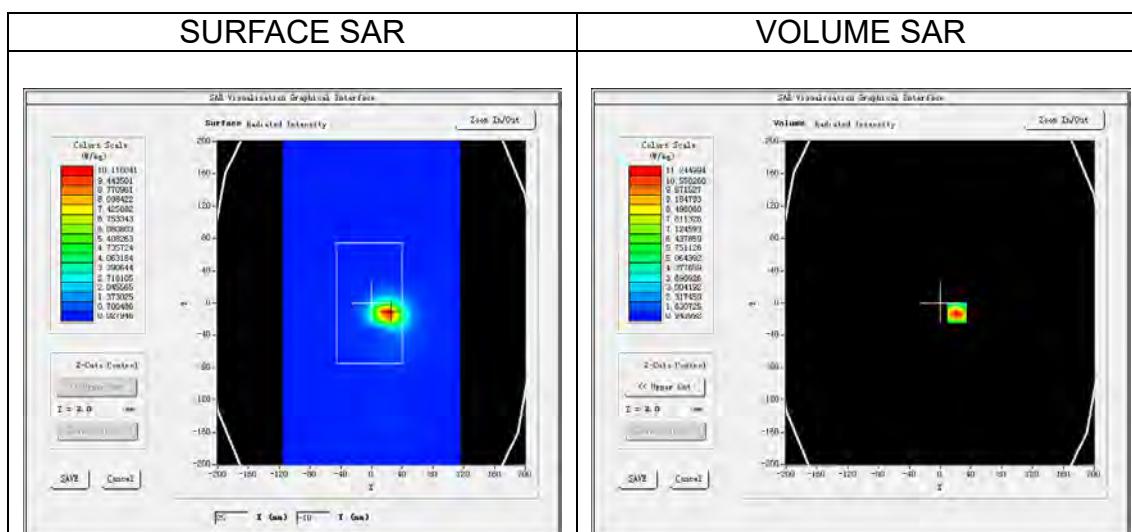
Date of measurement: 4/7/2025

### A. Experimental conditions.

Area Scan	dx=10mm dy=10mm, h= 2.00 mm
ZoomScan	7x7x12,dx=4mm dy=4mm dz=2mm
Phantom	ELLI
Device Position	Dipole
Band	CW5800
Channels	Middle
Signal	CW (Crest factor: 1.0)
ConvF	2.27

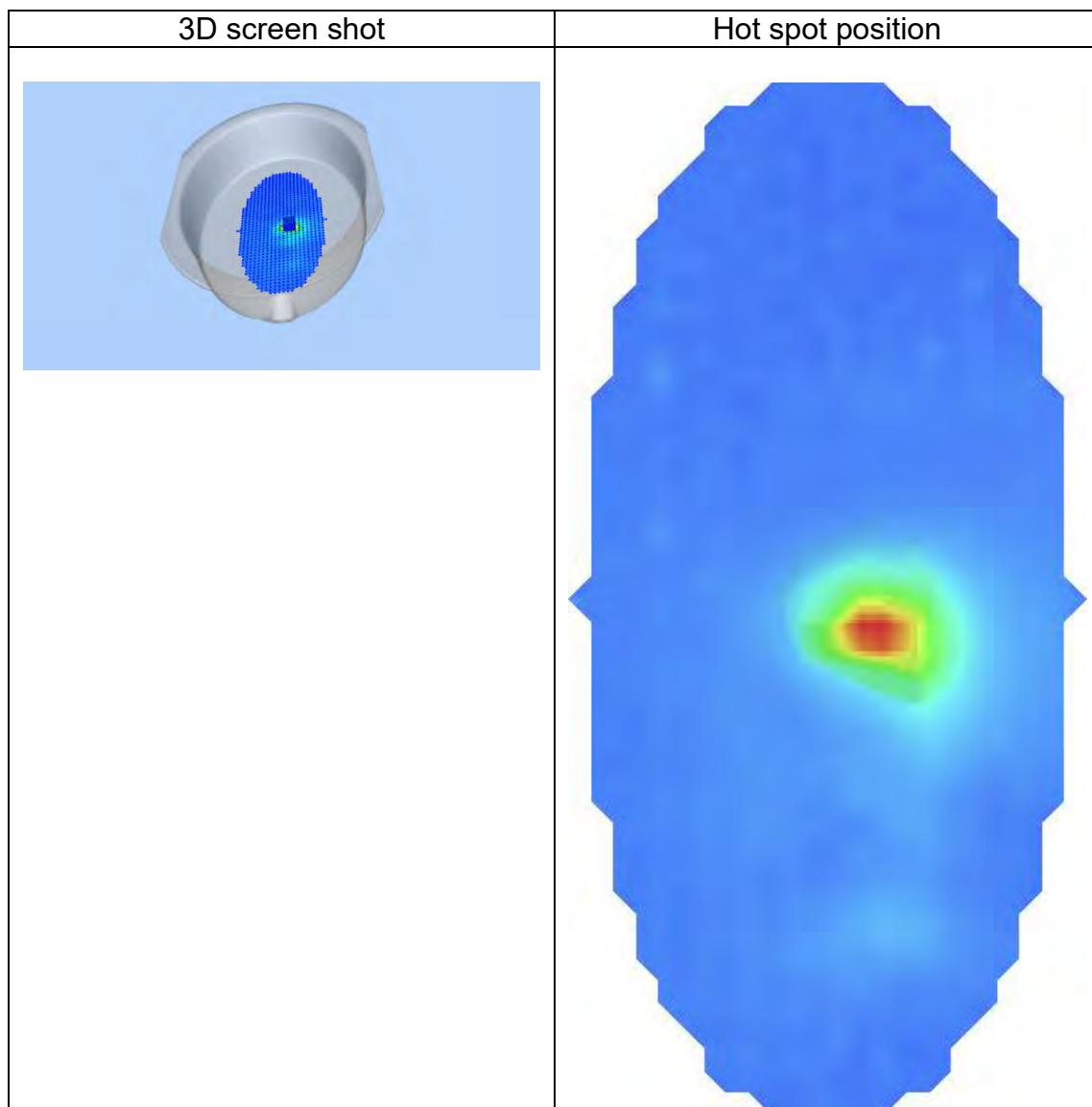
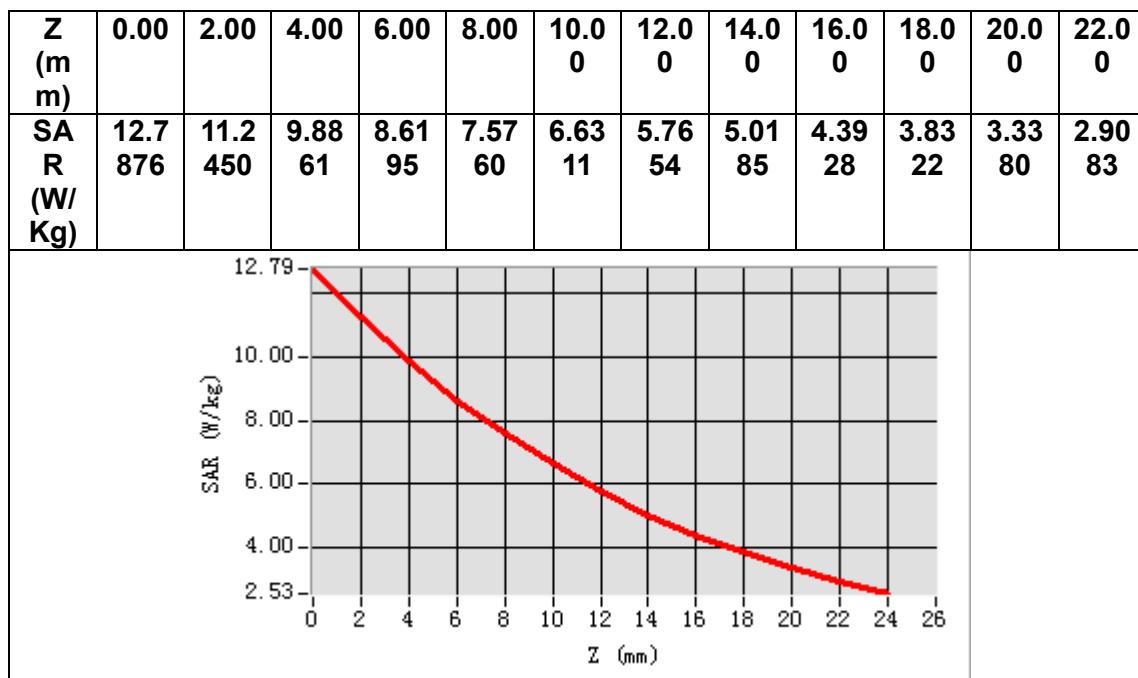
### B. SAR Measurement Results

Frequency (MHz)	5800.000000
Relative permittivity (real part)	35.299999
Relative permittivity (imaginary part)	16.360001
Conductivity (S/m)	5.271556
Variation (%)	0.970000



Maximum location: X=22.00, Y=-12.00  
SAR Peak: 13.05 W/kg

SAR 10g (W/Kg)	2.811746
SAR 1g (W/Kg)	8.210700
Horizontal validation criteria: minimum distance (mm)	14.54
Vertical validation criteria: SAR ratio M2/M1 (%)	87.92



## Appendix C. SAR Test Plots

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**MEASUREMENT 1 WLAN 5.2G Body**

**MEASUREMENT 2 WLAN 5.8G Body**

**MEASUREMENT 3 WLAN 2.4G Body**

# MEASUREMENT 1

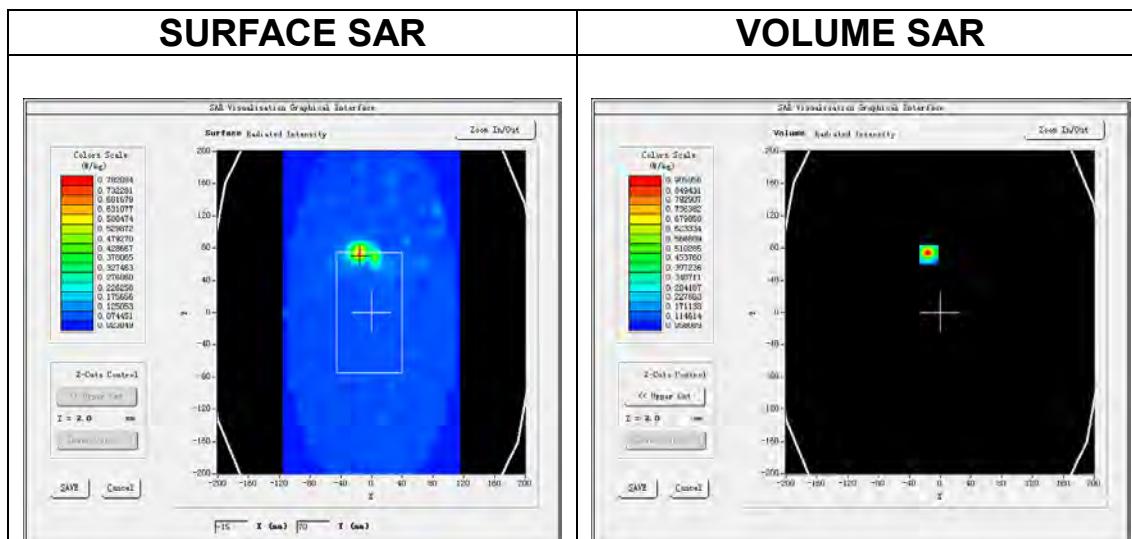
Date of measurement: 3/7/2025

## A. Experimental conditions.

<u>Area Scan</u>	<u>dx=10mm dy=10mm, h= 2.00 mm</u>
<u>ZoomScan</u>	<u>7x7x12, dx=4mm dy=4mm dz=2mm</u>
<u>Phantom</u>	<u>ELLI</u>
<u>Device Position</u>	<u>Body</u>
<u>Band</u>	<u>IEEE 802.11n U-NII</u>
<u>Channels</u>	<u>Low</u>
<u>Signal</u>	<u>IEEE802.n (Crest factor: 1.0)</u>
<u>ConvF</u>	<u>2.30</u>

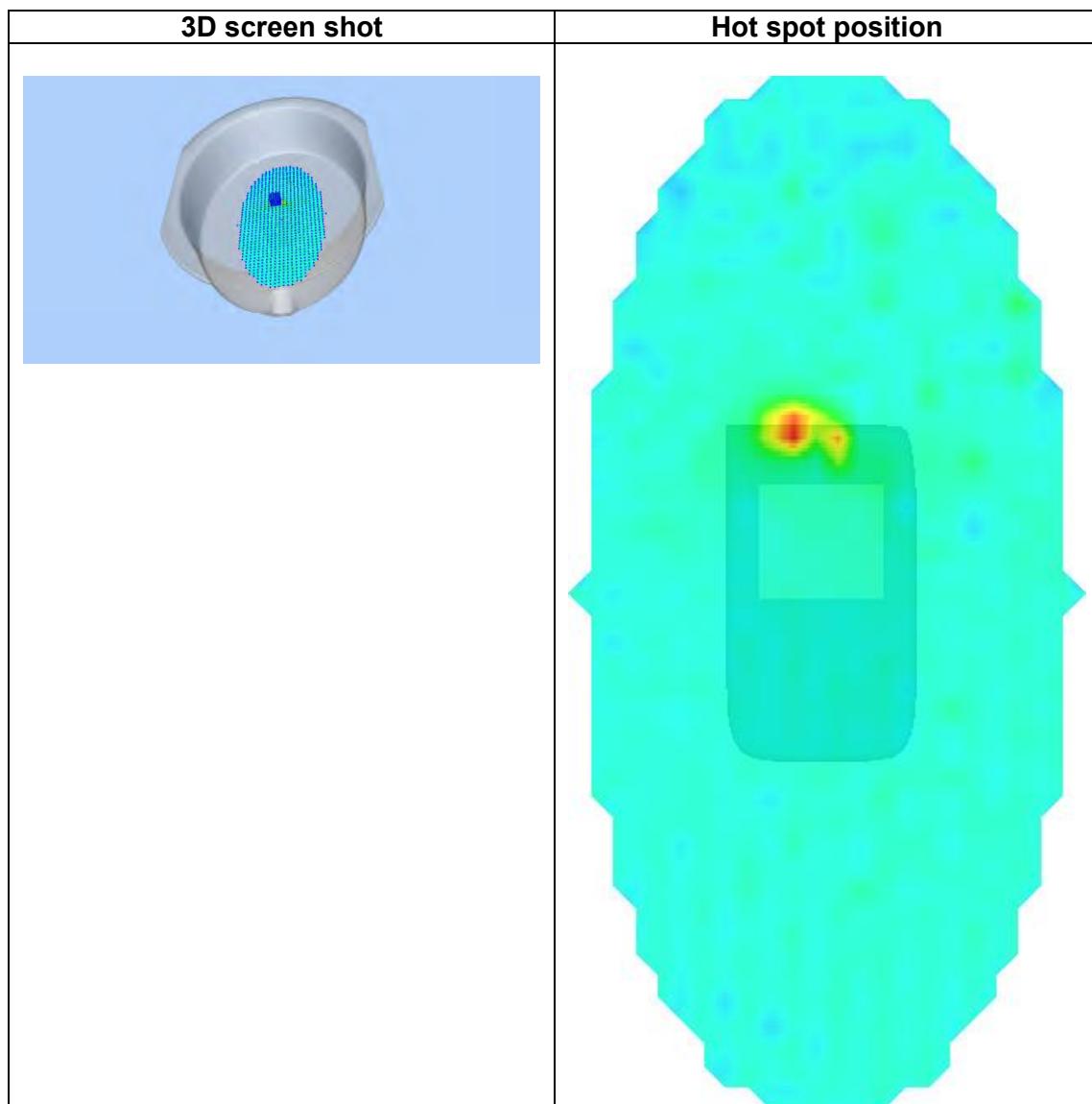
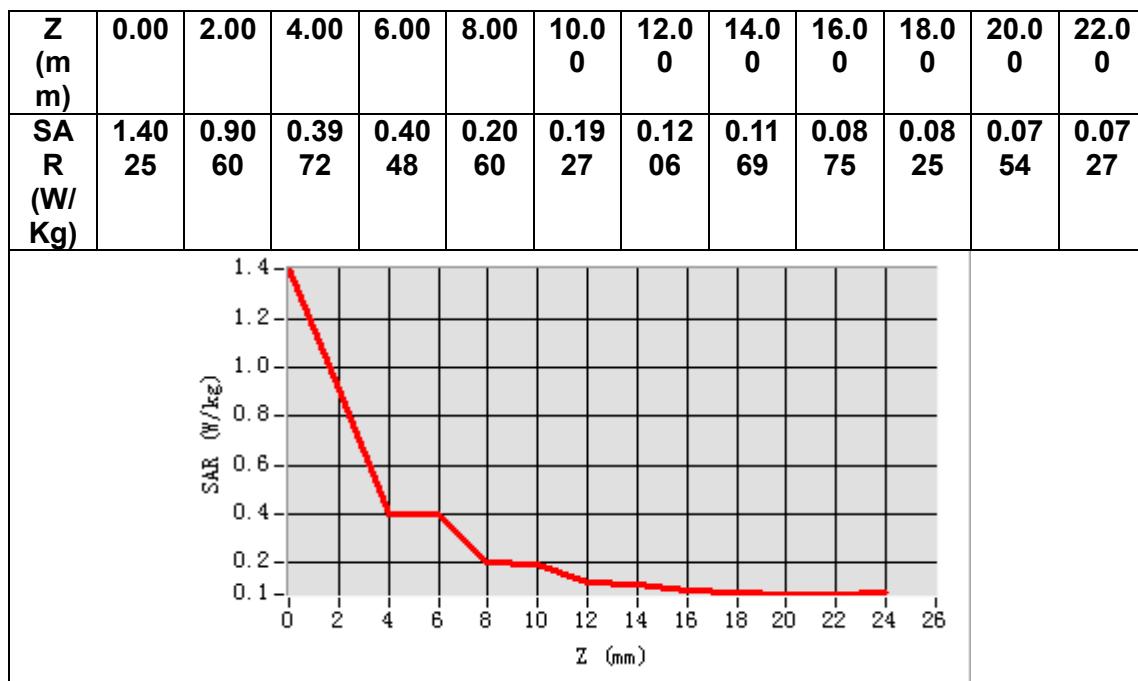
## B. SAR Measurement Results

<b>Frequency (MHz)</b>	5190.000000
<b>Relative permittivity (real part)</b>	36.000000
<b>Relative permittivity (imaginary part)</b>	16.128888
<b>Conductivity (S/m)</b>	4.650496
<b>Variation (%)</b>	1.920000



**Maximum location: X=-15.00, Y=72.00**  
**SAR Peak: 1.44 W/kg**

<b>SAR 10g (W/Kg)</b>	0.213222
<b>SAR 1g (W/Kg)</b>	0.544907



## MEASUREMENT 2

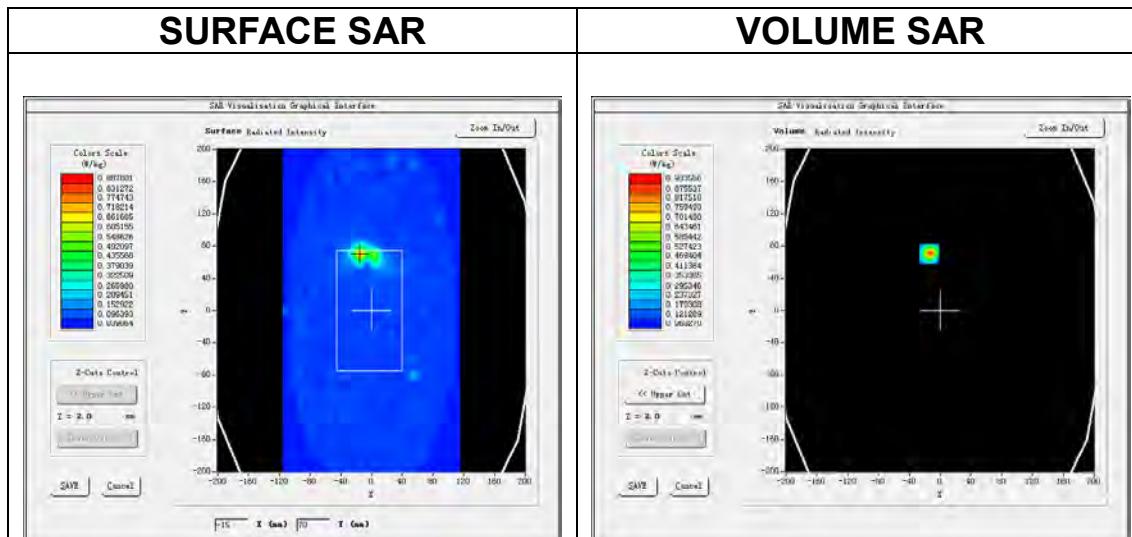
Date of measurement: 4/7/2025

### A. Experimental conditions.

<u>Area Scan</u>	<u>dx=10mm dy=10mm, h= 2.00 mm</u>
<u>ZoomScan</u>	<u>7x7x12, dx=4mm dy=4mm dz=2mm</u>
<u>Phantom</u>	<u>ELLI</u>
<u>Device Position</u>	<u>Body</u>
<u>Band</u>	<u>IEEE 802.11ac U-NII</u>
<u>Channels</u>	<u>High</u>
<u>Signal</u>	<u>IEEE802.ac (Crest factor: 1.0)</u>
<u>ConvF</u>	<u>2.27</u>

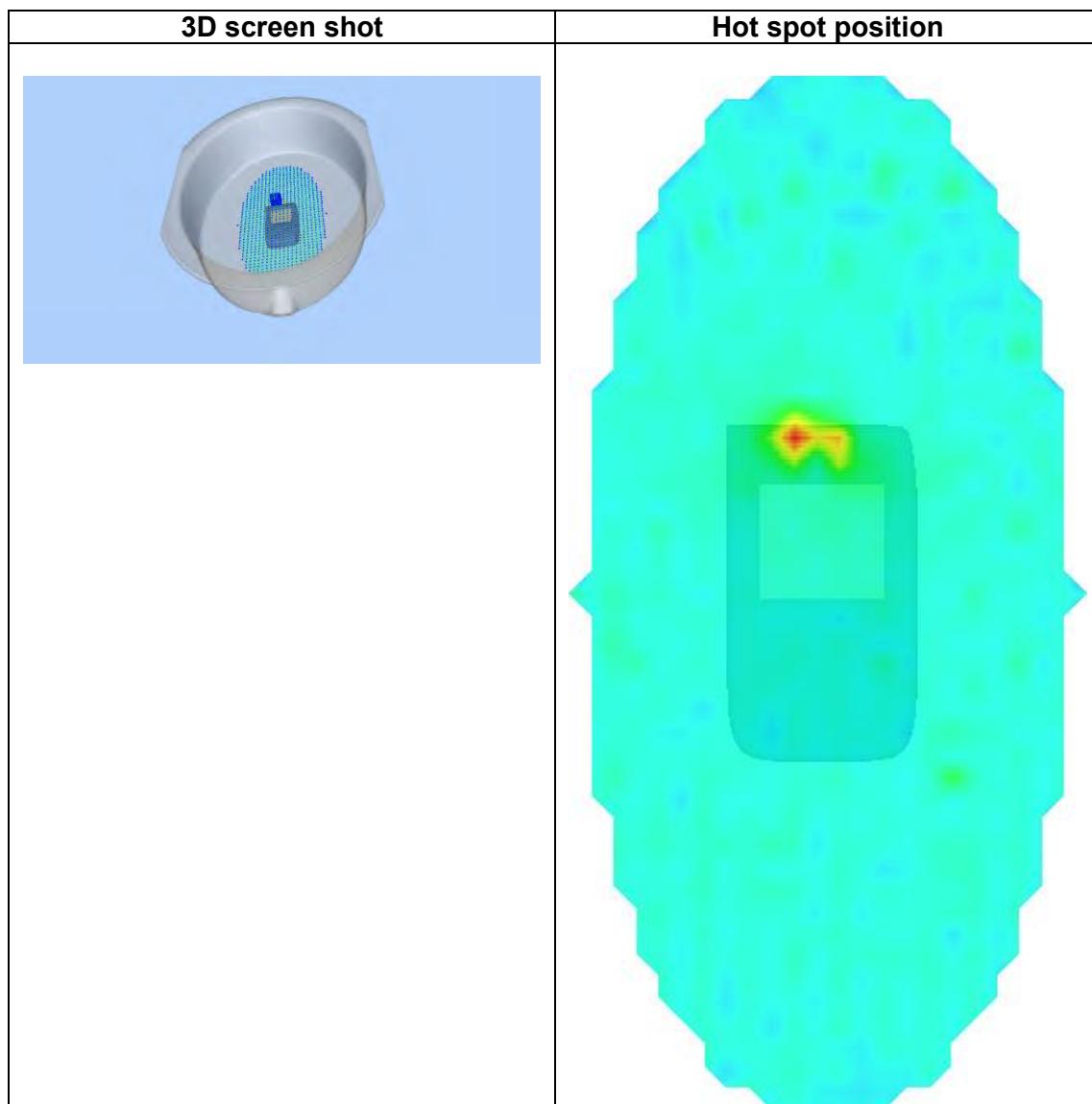
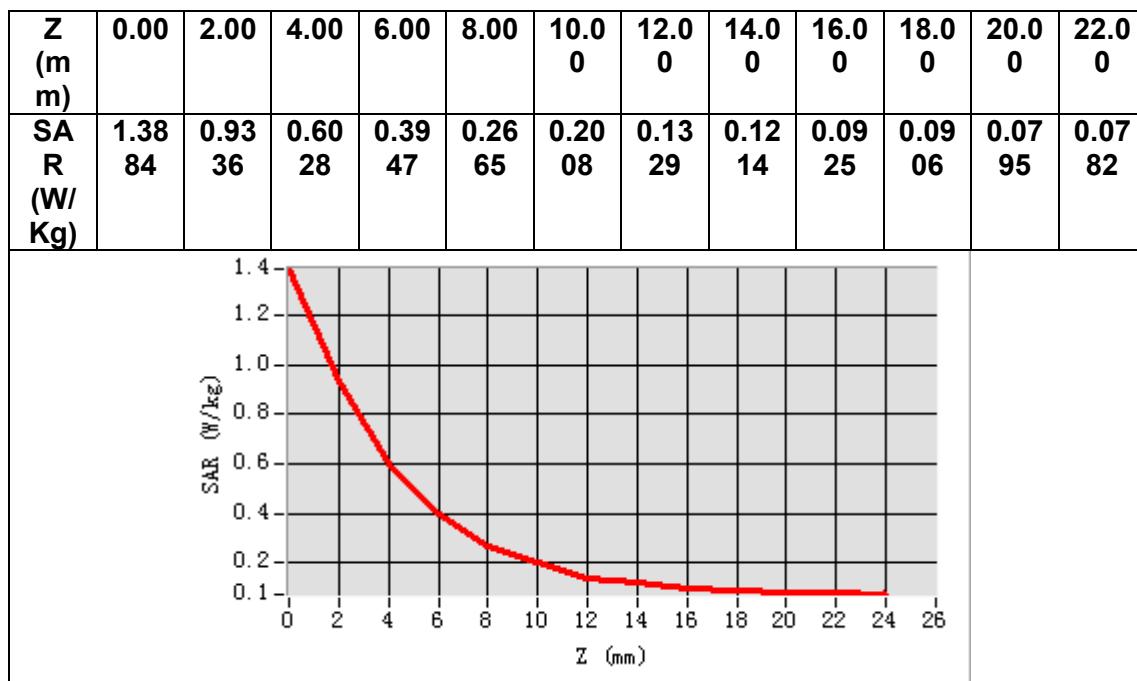
### B. SAR Measurement Results

<b>Frequency (MHz)</b>	5795.000000
<b>Relative permittivity (real part)</b>	35.315888
<b>Relative permittivity (imaginary part)</b>	16.355588
<b>Conductivity (S/m)</b>	5.265591
<b>Variation (%)</b>	3.760000



**Maximum location: X=-14.00, Y=70.00**  
**SAR Peak: 1.46 W/kg**

<b>SAR 10g (W/Kg)</b>	0.213251
<b>SAR 1g (W/Kg)</b>	0.543884



## MEASUREMENT 3

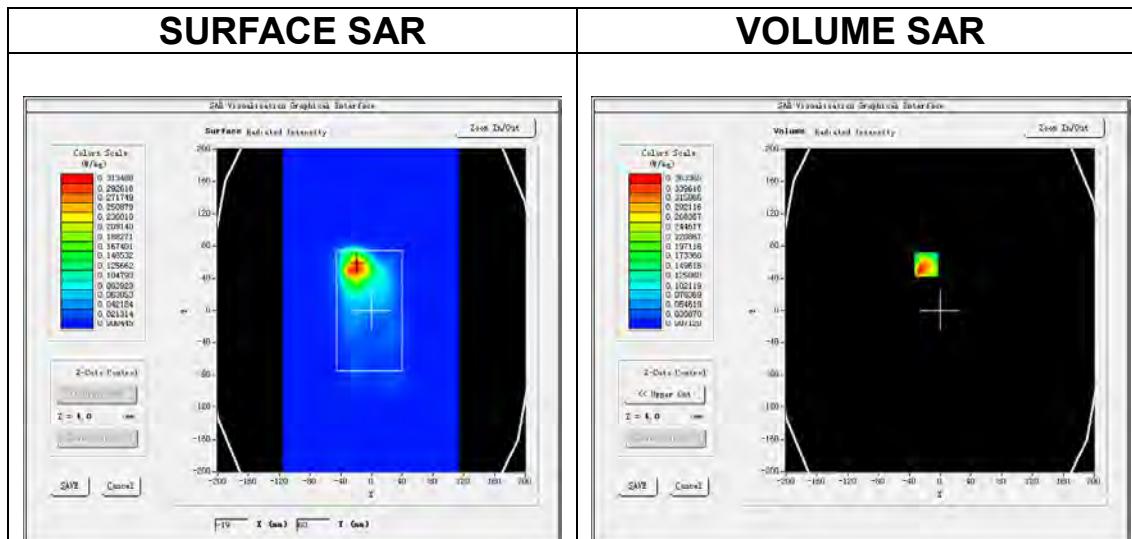
Date of measurement: 2/7/2025

### A. Experimental conditions.

<u>Area Scan</u>	<u>dx=12mm dy=12mm, h= 5.00 mm</u>
<u>ZoomScan</u>	<u>7x7x7, dx=5mm dy=5mm dz=5mm</u>
<u>Phantom</u>	<u>ELLI</u>
<u>Device Position</u>	<u>Body</u>
<u>Band</u>	<u>IEEE 802.11b ISM</u>
<u>Channels</u>	<u>High</u>
<u>Signal</u>	<u>IEEE802.b (Crest factor: 1.0)</u>
<u>ConvF</u>	<u>2.38</u>

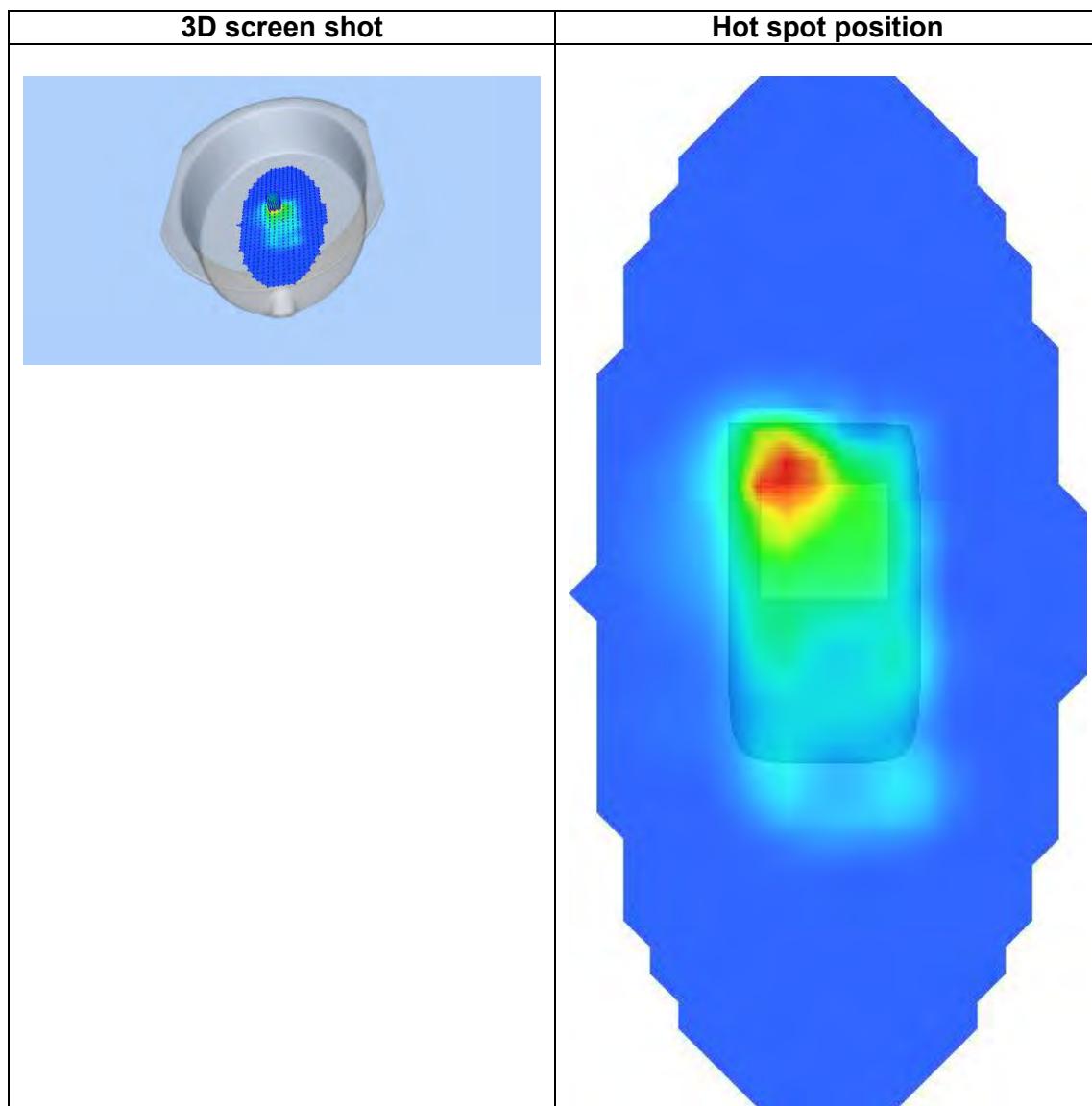
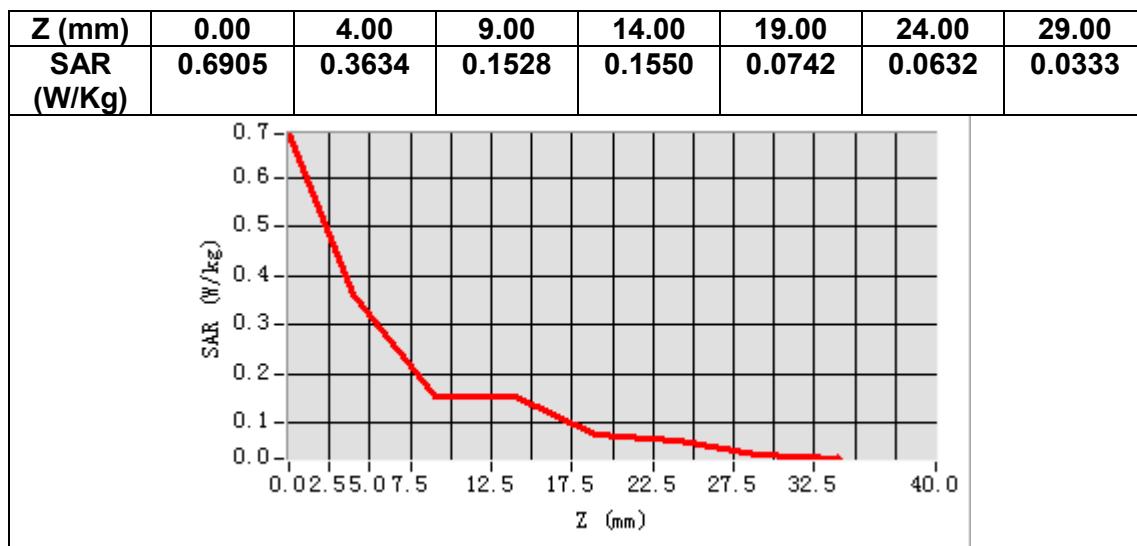
### B. SAR Measurement Results

<b>Frequency (MHz)</b>	2462.000000
<b>Relative permittivity (real part)</b>	39.227000
<b>Relative permittivity (imaginary part)</b>	13.208000
<b>Conductivity (S/m)</b>	1.806561
<b>Variation (%)</b>	3.570000



**Maximum location: X=-18.00, Y=57.00**  
**SAR Peak: 0.53 W/kg**

<b>SAR 10g (W/Kg)</b>	0.191329
<b>SAR 1g (W/Kg)</b>	0.335408



## Appendix D. Calibration Certificate

<b>Table of contents</b>
E Field Probe - EPG00523-403
2450 MHz Dipole - SN 03/15 DIP 2G450-352
5000-6000 MHz Dipole - SN 03/14 WGA33



## COMOSAR E-Field Probe Calibration Report

Ref : ACR.307.3.24.BES.A

**GUANGDONG ASIA HONGKE TEST  
TECHNOLOGY CO., LTD**  
NO.1/F,BUILDING B1, JUNFENG INDUSTRIAL PARK,  
CHONGQING ROAD, HEPING COMMUNITY,  
FUHAIHAI STREET, BAO'AN DISTRICT,SHENZHEN,  
GUANGDONG 518055, P.R.CHINA  
**MVG COMOSAR DOSIMETRIC E-FIELD PROBE**  
SERIAL NO.: SN 39/21 EPGO0523-403

Calibrated at MVG

Z.I. de la pointe du diable

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

Calibration date: 09/11/2024



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

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### 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).



## COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.307.3.24.BES.A

	Name	Function	Date	Signature
Prepared by :	Jérôme Le Gall	Measurement Responsible	09/10/2024	
Checked by :	Jérôme Luc	Technical Manager	09/10/2024	
Approved by :	Yann Toutain	Laboratory Director	09/11/2024	

	Customer Name
Distribution :	Shenzhen Asia Hongke

Issue	Name	Date	Modifications
A	Jérôme Luc	9/11/2024	Initial release



## COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR 307.3.24-BES A

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3.1	Boundary Effect .....	5
4	Measurement Uncertainty .....	6
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## COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.307.3.24.BES.A

**1 DEVICE UNDER TEST**

Device Under Test	
Device Type	COMOSAR DOSIMETRIC E FIELD PROBE
Manufacturer	MVG
Model	SSE2
Serial Number	SN 39/21 EPGO0523-403
Product Condition (new / used)	New
Frequency Range of Probe	0.15 GHz-6GHz
Resistance of Three Dipoles at Connector	Dipole 1: R1=0.199 MΩ Dipole 2: R2=0.218 MΩ Dipole 3: R3=0.210 MΩ

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

MVG's COMOSAR E field Probes are built in accordance to the IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards.

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

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 IEC/IEEE 62209-1528 and FCC KDB865664 D01 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:

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

where

$\text{SAR}_{\text{uncertainty}}$	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
$d_{step}$	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;
$\delta \text{SAR}_{\text{be}}$	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  $\text{SAR}_{\text{uncertainty}}[\%]$  for scanning distances larger than 4mm is 1.0% Limit ,2%).



## COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR 307 3.24-BES A

**4 MEASUREMENT UNCERTAINTY**

The guidelines outlined in the IEC/IEEE 62209-1528 and FCC KDB865664 D01 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 95 % confidence level $k = 2$					14 %

**5 CALIBRATION MEASUREMENT RESULTS**

Calibration Parameters		
Liquid Temperature	20 +/- 1 °C	
Lab Temperature	20 +/- 1 °C	
Lab Humidity	30-70 %	

**5.1 SENSITIVITY IN AIR**

Normx dipole 1 ( $\mu\text{V}/(\text{V}/\text{m})^2$ )	Normy dipole 2 ( $\mu\text{V}/(\text{V}/\text{m})^2$ )	Normz dipole 3 ( $\mu\text{V}/(\text{V}/\text{m})^2$ )
1.26	0.87	0.77

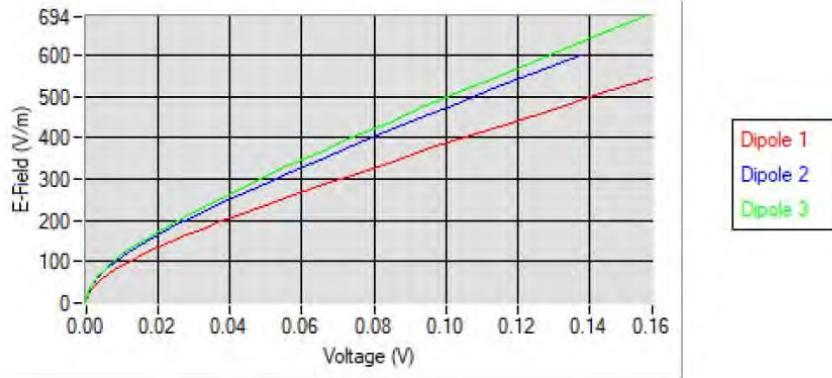
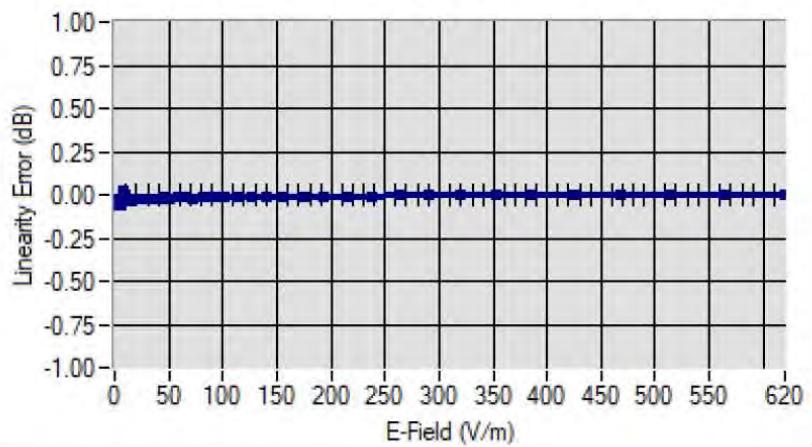
DCP dipole 1 (mV)	DCP dipole 2 (mV)	DCP dipole 3 (mV)
113	108	113

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

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

**COMOSAR E-FIELD PROBE CALIBRATION REPORT**

Ref: ACR 307.3.24.BES.A

**Calibration curves****5.2 LINEARITY****Linearity**Linearity: +/-1.42% (+/-0.06dB)



## COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR 307 3.24-BES A

**5.3 SENSITIVITY IN LIQUID**

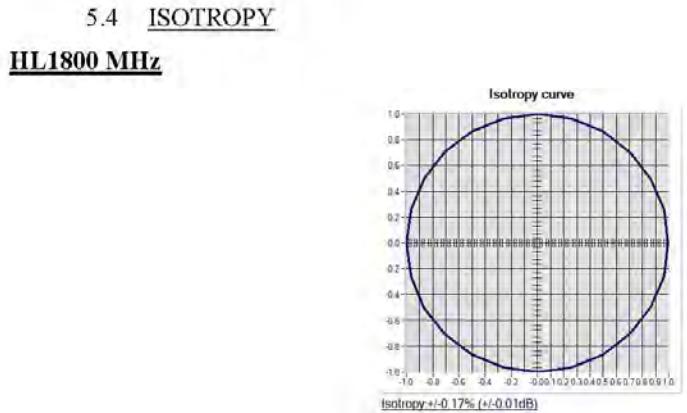
<u>Liquid</u>	<u>Frequency (MHz +/- 100MHz)</u>	<u>ConvF</u>
HL600	600	1.62
HL750	750	1.65
HL850	835	1.66
HL900	900	1.77
HL1500	1500	2.09
HL1750	1750	2.09
HL1800	1800	2.05
HL1900	1900	2.05
HL2000	2000	2.41
HL2100	2100	2.36
HL2300	2300	2.55
HL2450	2450	2.38
HL2600	2600	2.35
HL3300	3300	2.04
HL3500	3500	1.98
HL3700	3700	2.11
HL3900	3900	2.54
HL4200	4200	2.22
HL4600	4600	2.40
HL4900	4900	2.33
HL5200	5200	2.30
HL5400	5400	2.30
HL5600	5600	2.29
HL5800	5800	2.27

LOWER DETECTION LIMIT: 8mW/kg



## COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref. ACR.307.3.24.BES.A





## COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR 307.3.24-BES A

**6 LIST OF EQUIPMENT**

Equipment Summary Sheet				
Equipment Description	Manufacturer / Model	Identification No.	Current Calibration Date	Next Calibration Date
CALIPROBE Test Bench	Version 2	NA	Validated. No cal required.	Validated. No cal required.
Network Analyzer	Rohde & Schwarz ZVM	100203	08/2024	08/2027
Network Analyzer	Agilent 8753ES	MY40003210	10/2021	10/2024
Network Analyzer – Calibration kit	Rohde & Schwarz ZV-Z235	101223	05/2024	05/2027
Network Analyzer – Calibration kit	HP 85033D	3423A08186	06/2021	06/2027
Multimeter	Keithley 2000	1160271	02/2024	02/2027
Signal Generator	Rohde & Schwarz SMB	106589	04/2024	04/2027
Amplifier	MVG	MODU-023-C-0002	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	NI-USB 5680	170100013	06/2024	06/2027
Power Meter	Rohde & Schwarz NRVD	832839-056	11/2021	11/2024
Directional Coupler	Krytar 158020	131467	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Waveguide	MVG	SN 32/16 WG4_1	Validated. No cal required.	Validated. No cal required.
Liquid transition	MVG	SN 32/16 WGLIQ_0G900_1	Validated. No cal required.	Validated. No cal required.
Waveguide	MVG	SN 32/16 WG6_1	Validated. No cal required.	Validated. No cal required.
Liquid transition	MVG	SN 32/16 WGLIQ_1G500_1	Validated. No cal required.	Validated. No cal required.
Waveguide	MVG	SN 32/16 WG8_1	Validated. No cal required.	Validated. No cal required.
Liquid transition	MVG	SN 32/16 WGLIQ_1G800B_1	Validated. No cal required.	Validated. No cal required.
Liquid transition	MVG	SN 32/16 WGLIQ_1G800H_1	Validated. No cal required.	Validated. No cal required.
Waveguide	MVG	SN 32/16 WG10_1	Validated. No cal required.	Validated. No cal required.
Liquid transition	MVG	SN 32/16 WGLIQ_3G500_1	Validated. No cal required.	Validated. No cal required.

Page: 10/11

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## COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR 307.3.24-BES A

Waveguide	MVG	SN 32/16 WG12_1	Validated. No cal required.	Validated. No cal required.
Liquid transition	MVG	SN 32/16 WGLIQ_5G000_1	Validated. No cal required.	Validated. No cal required.
Temperature / Humidity Sensor	Testo 184 H1	44225320	06/2024	06/2027



## SAR Reference Dipole Calibration Report

Ref: ACR.53.29.24.BLS A

**GUANGDONG ASIA HONGKE TEST  
TECHNOLOGY CO., LTD**  
NO.1/F,BUILDING B1, JUNFENG INDUSTRIAL PARK,  
CHONGQING ROAD, HEPING COMMUNITY ,  
FUHAIHAI STREET, BAO'AN DISTRICT,SHENZHEN,  
GUANGDONG 518055, P.R.CHINA

**MVG COMOSAR REFERENCE DIPOLE**  
FREQUENCY: 2450MHZ  
SERIAL NO.: SN 03/15 DIP2G450-352

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

Calibration date: 02/21/2024



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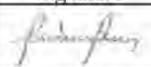
### Summary:

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.



## SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.31.29.24.BES.A

	Name	Function	Date	Signature
Prepared by:	Pedro Ruiz	Measurement Responsible	2/22/2024	
Checked & approved by:	Jérôme Luc	Technical Manager	2/22/2024	
Authorized by:	Yann Toutain	Laboratory Director	2/27/2024	

Yann  
Toutain ID: Date: 2024.02.27  
08:57:39 +01'00'

	Customer Name
Distribution :	Shenzhen Asia Hongke

Issue	Name	Date	Modifications
A	Pedro Ruiz	2/22/2024	Initial release

Page: 2/8

Template: ACR.0.0.0.N.VY.MVGR.JNUE\_SAR Reference Dipole v1

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## SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref. ACR 33/29/24/BES A

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## SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref. ACR 33.29/24-BES-A

## 1 INTRODUCTION

This document contains a summary of the requirements set forth by the IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards for reference dipoles used for SAR measurement system validations and the measurements that were performed to verify that the product complies with the fore mentioned standards.

## 2 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR 2450 MHz REFERENCE DIPOLE
Manufacturer	MVG
Model	SID2450
Serial Number	SN 03/15DIP2G450-352
Product Condition (new / used)	Used

## 3 PRODUCT DESCRIPTION

### 3.1 GENERAL INFORMATION

MVG's COMOSAR Validation Dipoles are built in accordance to the IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards. The product is designed for use with the COMOSAR test bench only.



Figure 1 – MVG COMOSAR Validation Dipole



## SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref. ACR.000.N.173.MVGB.SS1.E\_SAR Reference Dipole v1

**4 MEASUREMENT METHOD****4.1 MECHANICAL REQUIREMENTS**

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 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.

**4.2 S11 PARAMETER REQUIREMENTS**

The dipole used for SAR system validation measurements and checks must have a S11 of -20 dB or better. The S11 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.

**4.3 SAR REQUIREMENTS**

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 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.

**5 MEASUREMENT UNCERTAINTY****5.1 MECHANICAL DIMENSIONS**

For the measurement in the range 0-300mm, the estimated expanded uncertainty (k=2) in calibration for the dimension measurement in mm is +/-0.20 mm with respect to measurement conditions.

For the measurement in the range 300-450mm, the estimated expanded uncertainty (k=2) in calibration for the dimension measurement in mm is +/-0.44 mm with respect to measurement conditions.

**5.2 S11 PARAMETER**

The estimated expanded uncertainty (k=2) in calibration for the S11 parameter in linear is +/-0.08 with respect to measurement conditions.

**5.3 SAR**

The guidelines outlined in the IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards were followed to generate the measurement uncertainty for validation measurements.

The estimated expanded uncertainty (k=2) in calibration for the 1g and 10g SAR measurement in W/kg is +/-19% with respect to measurement conditions.

Page: 5/8

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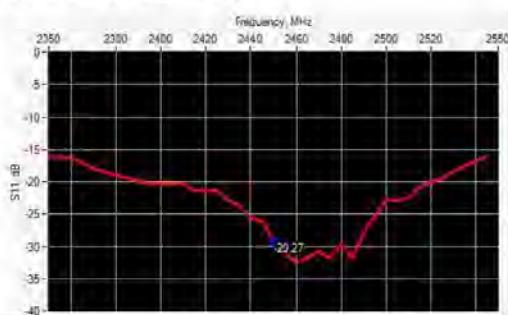


## SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR 33.29/24-BES-A

**6 CALIBRATION RESULTS****6.1 MECHANICAL DIMENSIONS**

L mm		h mm		d mm	
Measured	Required	Measured	Required	Measured	Required
-	51.50 +/- 2%	-	30.40 +/- 2%	-	3.60 +/- 2%

**6.2 S11 PARAMETER****6.2.1 S11 parameter in Head Liquid**

Frequency (MHz)	S11 parameter (dB)	Requirement (dB)	Impedance
2450	-29.27	-20	$53.6\Omega + 0.1j\Omega$

**6.3 SAR**

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 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.

**6.3.1 SAR with Head Liquid**

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 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.

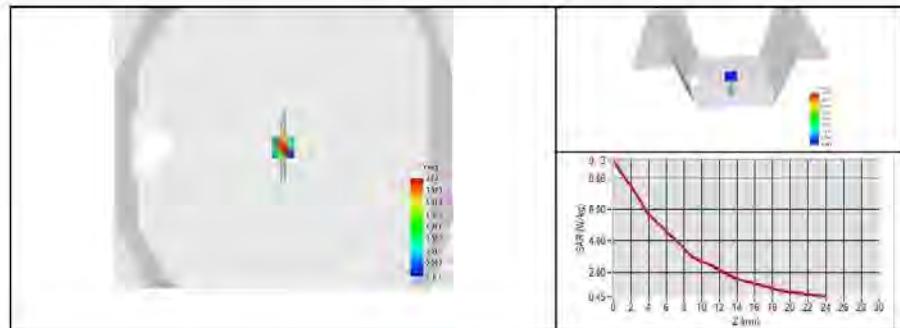


## SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR 33.29/24-BES-A

Software	OPENSAR V5
Phantom	SN 13/09 SAM68
Probe	3523-EPGO-429
Liquid	Head Liquid Values: $\epsilon_{\text{pr}}' = 42.1$ $\sigma = 1.83$
Distance between dipole center and liquid	10.0 mm
Area scan resolution	$dx=8\text{mm}/dy=8\text{mm}$
Zoon Scan Resolution	$dx=5\text{mm}/dy=5\text{mm}/dz=5\text{mm}$
Frequency	2450 MHz
Input power	20 dBm
Liquid Temperature	20 +/- 1 °C
Lab Temperature	20 +/- 1 °C
Lab Humidity	30-70 %

Frequency	1g SAR (W/kg)			10g SAR (W/kg)		
	Measured	Measured normalized to 1W	Target normalized to 1W	Measured	Measured normalized to 1W	Target normalized to 1W
2450 MHz	5.00	50.05	52.40	2.38	23.80	24.00





## SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref. ACR.000.N.17.5MVG.B.001.E\_SAR Reference Dipole v1

## 7 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	08/2021	08/2024
Network Analyzer – Calibration kit	Rohde & Schwarz ZV-Z235	101223	07/2022	07/2025
Calipers	Mitutoyo	SN 0009732	11/2022	11/2025
Reference Probe	MVG	3523-EPGO-429	11/2023	11/2024
Multimeter	Keithley 2000	4013982	02/2023	02/2026
Signal Generator	Rohde & Schwarz SMB	106589	03/2022	03/2025
Amplifier	MVG	MODU-023-C-0002	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	NI-USB 5680	170100013	06/2021	06/2024
Power Meter	Keysight U2000A	SN: MY62340002	10/2022	10/2025
Directional Coupler	Krytar 158020	131467	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Temperature / Humidity Sensor	Testo 184 H1	44225320	06/2021	06/2024

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## SAR Reference Waveguide Calibration Report

Ref: ACR.53.31.24.BES.A

**GUANGDONG ASIA HONGKE TEST  
TECHNOLOGY CO., LTD**  
NO.1/F,BUILDING B1, JUNFENG INDUSTRIAL PARK,  
CHONGQING ROAD, HEPING COMMUNITY ,  
FUHAIHAI STREET, BAO'AN DISTRICT,SHENZHEN,  
GUANGDONG 518055, P.R.CHINA  
**MVG COMOSAR REFERENCE WAVEGUIDE**  
**FREQUENCY: 5000-6000 MHZ**  
**SERIAL NO.: SN 13/14 WGA33**

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

Calibration date: 02/21/2024



Accreditations #2-6789 and #2-6914  
Scope available on [www.cofrac.fr](http://www.cofrac.fr)

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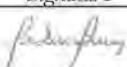
### Summary:

This document presents the method and results from an accredited SAR reference waveguide calibration performed at MVG, using the COMOSAR test bench. The test results covered by accreditation are traceable to the International System of Units (SI).



## SAR REFERENCE WAVEGUIDE CALIBRATION REPORT

Ref: ACE.33.3124.BE&amp;A

	Name	Function	Date	Signature
Prepared by:	Pedro Ruiz	Measurement Responsible	2/22/2024	
Checked & approved by:	Jérôme Luc	Technical Manager	2/22/2024	
Authorized by:	Yann Toutain	Laboratory Director	2/27/2024	

Yann  
Toutain ID  
Signature  
numérique de Yann  
Toutain ID  
date : 2024.02.27  
08:58:45 +0100

	Customer Name
Distribution :	Shenzhen Asia Hongke

Issue	Name	Date	Modifications
A	Pedro Ruiz	2/22/2024	Initial release

Page: 2/9

Template ACR.0000.N.YY.MVG.ISSUE\_SAR Reference Waveguide v1.

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## SAR REFERENCE WAVEGUIDE CALIBRATION REPORT

Ref: ACR-53.31/24 BES A

## 1 INTRODUCTION

This document contains a summary of the requirements set forth by the IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards for reference waveguides used for SAR measurement system validations and the measurements that were performed to verify that the product complies with the fore mentioned standards.

## 2 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR 5000-6000 MHz REFERENCE WAVEGUIDE
Manufacturer	MVG
Model	SWG5500
Serial Number	SN 13/14 WGA 33
Product Condition (new / used)	Used

## 3 PRODUCT DESCRIPTION

### 3.1 GENERAL INFORMATION

MVG's COMOSAR Validation Waveguides are built in accordance to the IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards.

## 4 MEASUREMENT METHOD

### 4.1 MECHANICAL REQUIREMENTS

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 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.

### 4.2 S11 PARAMETER REQUIREMENTS

The dipole used for SAR system validation measurements and checks must have a S11 of -8 dB or better. The S11 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.



## SAR REFERENCE WAVEGUIDE CALIBRATION REPORT

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#### 4.3 SAR REQUIREMENTS

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 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.

### 5 MEASUREMENT UNCERTAINTY

#### 5.1 MECHANICAL DIMENSIONS

The estimated expanded uncertainty ( $k=2$ ) in calibration for the dimension measurement in mm is  $+\/-0.20$  mm with respect to measurement conditions.

#### 5.2 S11 PARAMETER

The estimated expanded uncertainty ( $k=2$ ) in calibration for the S11 parameter in linear is  $+\/-0.08$  with respect to measurement conditions.

#### 5.3 SAR

The guidelines outlined in the IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards were followed to generate the measurement uncertainty for validation measurements.

The estimated expanded uncertainty ( $k=2$ ) in calibration for the 1g and 10g SAR measurement in W/kg is  $+\/-19\%$  with respect to measurement conditions.

### 6 CALIBRATION RESULTS

#### 6.1 MECHANICAL DIMENSIONS

Frequency (MHz)	L (mm)		W (mm)		L <sub>r</sub> (mm)		W <sub>r</sub> (mm)	
	Required	Measured	Required	Measured	Required	Measured	Required	Measured
5800	40.39 $\pm$ 0.13	-	20.19 $\pm$ 0.13	-	81.03 $\pm$ 0.13	-	61.98 $\pm$ 0.13	-

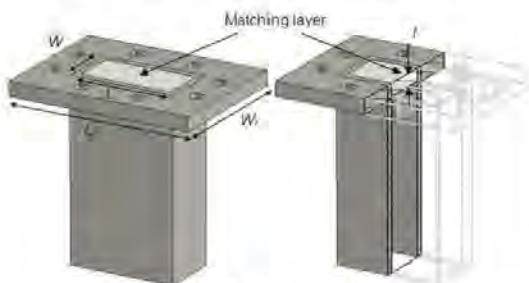
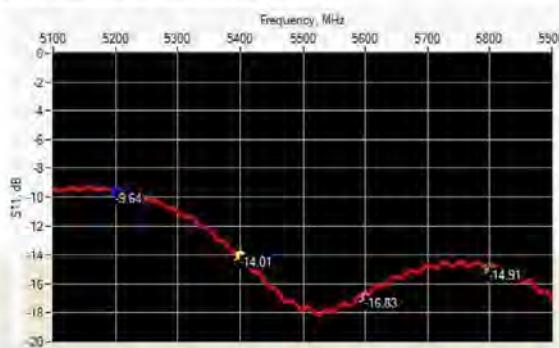


Figure 1: Validation Waveguide Dimensions



## SAR REFERENCE WAVEGUIDE CALIBRATION REPORT

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6.2 S11 PARAMETER6.2.1 S11 parameter In Head Liquid

Frequency (MHz)	S11 parameter (dB)	Requirement (dB)	Impedance
5200	-9.64	-8	$25.80 \Omega - 6.58 j\Omega$
5400	-14.01	-8	$51.53 \Omega + 20.60 j\Omega$
5600	-16.83	-8	$44.12 \Omega - 12.35 j\Omega$
5800	-14.91	-8	$38.53 \Omega + 11.21 j\Omega$

6.3 SAR

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards state that the system validation measurements must be performed using a reference waveguide meeting the fore mentioned return loss and mechanical dimension requirements. The validation measurement must be performed with the matching layer placed in the open end of the waveguide, with the waveguide and matching layer in direct contact with the phantom shell.

6.3.1 SAR With Head Liquid

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

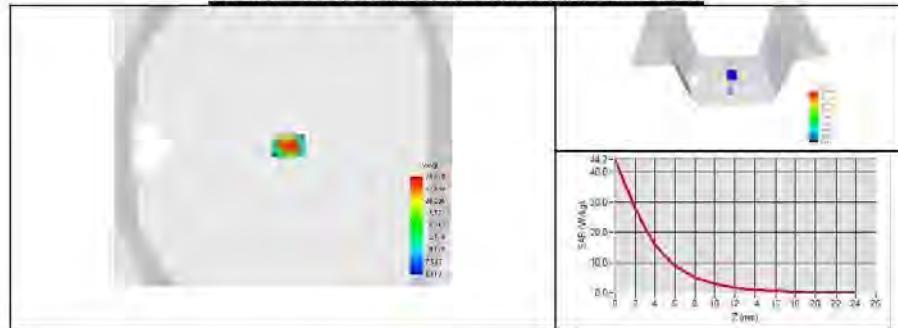


## SAR REFERENCE WAVEGUIDE CALIBRATION REPORT

Ref: ACR.53.31/24 BES A

Software	OPENSAR V5
Phantom	SN 13/09 SAM68
Probe	3523-EPGO-429
Liquid	Head Liquid Values 5200 MHz: $\epsilon' = 34.16$ sigma : 4.42 Head Liquid Values 5400 MHz: $\epsilon' = 33.63$ sigma : 4.64 Head Liquid Values 5600 MHz: $\epsilon' = 33.12$ sigma : 4.87 Head Liquid Values 5800 MHz: $\epsilon' = 32.57$ sigma : 5.12
Distance between dipole waveguide and liquid	0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoon Scan Resolution	dx=4mm/dy=4m/dz=2mm
Frequency	5200 MHz 5400 MHz 5600 MHz 5800 MHz
Input power	20 dBm
Liquid Temperature	20 +/- 1 °C
Lab Temperature	20 +/- 1 °C
Lab Humidity	30-70 %

Frequency (MHz)	1 g SAR (W/kg)			10 g SAR (W/kg)		
	Measured	Measured normalized to 1W	Target normalized to 1W	Measured	Measured normalized to 1W	Target normalized to 1W
5200	16.26	162.59	159.00	5.62	56.21	56.90
5400	15.98	159.81	166.40	5.50	55.00	58.43
5600	17.91	179.15	173.80	6.10	61.01	59.97
5800	18.22	182.20	181.20	6.13	61.32	61.50

SAR MEASUREMENT PLOTS @ 5200 MHz


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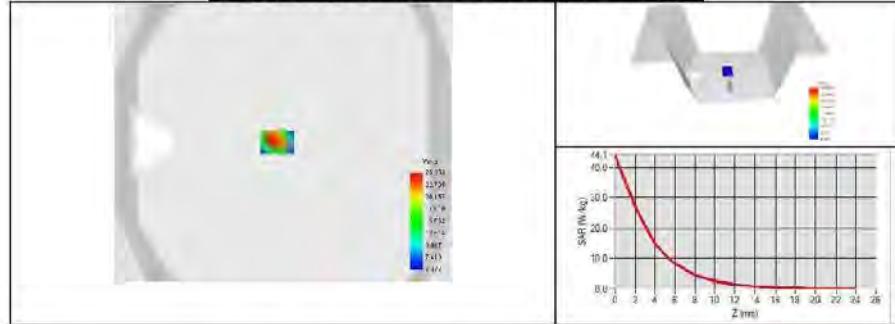
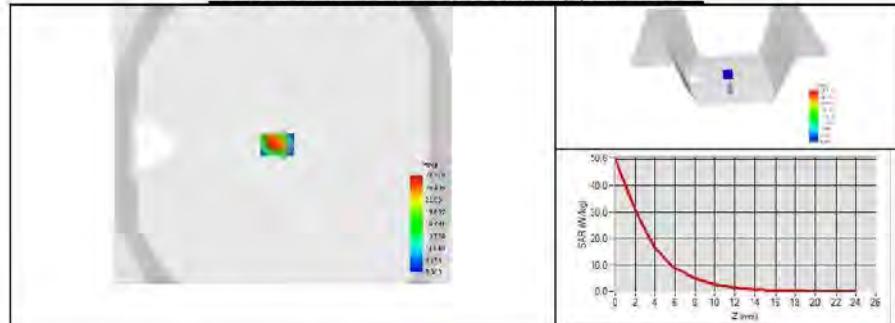
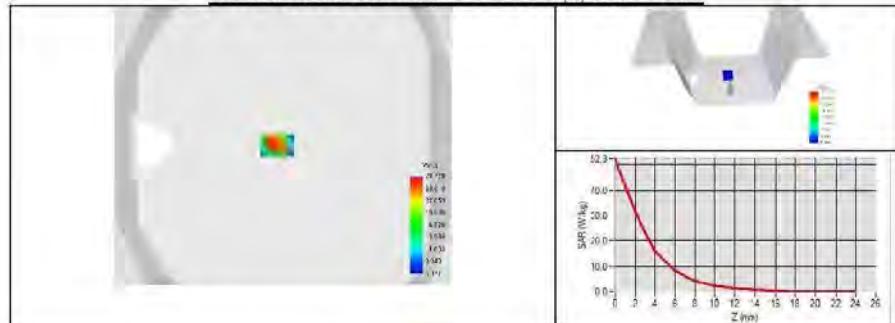
Template : ACR.53.31/24 BES A - SAR Reference Waveguide v1

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## SAR REFERENCE WAVEGUIDE CALIBRATION REPORT

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SAR MEASUREMENT PLOTS @ 5400 MHzSAR MEASUREMENT PLOTS @ 5600 MHzSAR MEASUREMENT PLOTS @ 5800 MHz



## SAR REFERENCE WAVEGUIDE CALIBRATION REPORT

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## 7 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	08/2021	08/2024
Network Analyzer – Calibration kit	Rohde & Schwarz ZV-Z235	101223	07/2022	07/2025
Calipers	Mitutoyo	SN 0009732	11/2022	11/2025
Reference Probe	MVG	3623-EPGO-431	11/2023	11/2024
Multimeter	Keithley 2000	4013982	02/2023	02/2026
Signal Generator	Rohde & Schwarz SMB	106589	03/2022	03/2025
Amplifier	MVG	MODU-023-C-0002	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	NI-USB 5680	170100013	06/2021	06/2024
Power Meter	Keysight U2000A	SN: MY62340002	10/2022	10/2025
Directional Coupler	Krytar 158020	131467	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Temperature / Humidity Sensor	Testo 184 H1	44225320	06/2021	06/2024

## Appendix E. Justification of the extended calibration

If dipoles are verified in return loss (<-20dB, within 20% of prior calibration for below 3GHz, and <-8dB, within 20% of prior calibration for 5GHz to 6GHz), and in impedance (within 5 ohm of prior calibration), the annual calibration is not necessary and the calibration interval can be extended.

<Head 2450MHz>

Return Loss (dB)	Delta (%)	Impedance	Delta(ohm)	Date of Measurement
-29.27	-	53.6	-	Feb. 21, 2024
-29.39	0.41	53.742	0.142	Feb. 20, 2025

The return loss is <-20dB, within 20% of prior calibration; the impedance is within 5 ohm of prior calibration. Therefore the verification result should support extended calibration.

<Head 5200MHz>

Return Loss (dB)	Delta (%)	Impedance	Delta(ohm)	Date of Measurement
-9.64	-	25.80	-	Feb. 21, 2024
-9.1819	4.75	25.891	0.091	Feb. 20, 2025

The return loss is <-20dB, within 20% of prior calibration; the impedance is within 5 ohm of prior calibration. Therefore the verification result should support extended calibration.

<Head 5800MHz>

Return Loss (dB)	Delta (%)	Impedance	Delta(ohm)	Date of Measurement
-14.91	-	38.53	-	Feb. 21, 2024
-14.349	3.76	38.715	0.185	Feb. 20, 2025

The return loss is <-20dB, within 20% of prior calibration; the impedance is within 5 ohm of prior calibration. Therefore the verification result should support extended calibration.

END OF THE REPORT\*\*\*