

CE SAR EVALUATION REPORT

**In accordance with the requirements of
EN50360, EN50566, EN62209-1/-2, EN62479 and COUNCIL
RECOMMENDATION 1999/519/EC**

Product Name : Flip phone

Trademark : HAMTOD

Model Name : T8

Family Model : T10, T6, T9, T3, T2, T1

Report No. : S24071705603001

Prepared for

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Product description

Product name.....: Flip phone
Trademark: HAMTOD
Model and/or type reference ..: T8
Family Model.....: T10, T6, T9, T3, T2, T1
EN 50360:2017;
EN 50566:2017;

Standards.....: EN 62209-1:2016;
EN 62209-2:2010;
EN 62479:2010;

This device described above has been tested by Shenzhen NTEK. In accordance with the measurement methods and procedures specified in EN62209. Testing has shown that this device is capable of compliance with localized specific absorption rate (SAR) specified in COUNCIL 1999/519/EC. 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 S240717056004

Date of Test

Date (s) of performance of tests Jul. 19, 2024 ~ Jul. 26, 2024

Date of Issue..... Aug. 22, 2024

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

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※ ※ Revision History ※ ※

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TABLE OF CONTENTS

1. General Information	6
1.1. RF exposure limits.....	6
1.2. Statement of Compliance	7
1.3. EUT Description	7
1.4. Test specification(s)	9
1.5. Ambient Condition.....	9
2. SAR Measurement System	10
2.1. SATIMO SAR Measurement Set-up Diagram	10
2.2. Robot	11
2.3. E-Field Probe.....	12
2.3.1. E-Field Probe Calibration	12
2.4. SAM phantoms	13
2.4.1. Technical Data	14
2.5. Device Holder	15
2.6. Test Equipment List	16
3. SAR Measurement Procedures	18
3.1. Power Reference	18
3.2. Area scan & Zoom scan.....	18
3.3. Description of interpolation/extrapolation scheme	19
3.4. Volumetric Scan	19
3.5. Power Drift	19
4. System Verification Procedure	20
4.1. Tissue Verification	20
4.1.1. Tissue Dielectric Parameter Check Results	21
4.2. System Verification Procedure	22
4.2.1. System Verification Results.....	23
5. SAR Measurement Uncertainty	24
6. RF Exposure Positions	26
6.1. Ear and handset reference point	26
6.2. Definition of the cheek position	26
6.3. Definition of the tilt position	27
6.4. Body-worn device	28
7. RF Output Power	29
7.1. GSM Conducted Power	29
7.2. WCDMA Conducted Power	29
7.3. LTE Conducted Power	30
7.4. Bluetooth Output Power.....	33
8. SAR Results	33
8.1. SAR measurement results.....	33
8.1.1. SAR measurement Result of GSM900.....	33

8.1.2.	SAR measurement Result of GSM1800.....	34
8.1.3.	SAR measurement Result of WCDMA Band1.....	35
8.1.4.	SAR measurement Result of WCDMA Band8.....	36
8.1.5.	SAR measurement Result of LTE Band 1	37
8.1.6.	SAR measurement Result of LTE Band 3	38
8.1.7.	SAR measurement Result of LTE Band 7	39
8.1.8.	SAR measurement Result of LTE Band 8	40
8.1.9.	SAR measurement Result of LTE Band 20	41
8.2.	Simultaneous Transmission Analysis	42
8.3.	Exposure Conditions	42
9.	Appendix A. Photo documentation.....	43
10.	Appendix B. System Check Plots	45
11.	Appendix C. Plots of High SAR Measurement.....	54
12.	Appendix D. Calibration Certificate	91

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	10.0	20.0

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

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.08	2.0	4.0

NOTE: **Whole-Body SAR** is averaged over the entire body, **partial-body SAR** is averaged over any 10 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
HEAD AND TRUNK LIMIT
2.0 W/kg
APPLIED TO THIS EUT

1.2. Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for T8 are as follows.

Max SAR Value(W/kg)		
RF Exposure Conditions	10-g Head	10-g Body & Hotspot (Separation distance of 5mm)
	0.931	1.676
Max Simultaneous Tx	0.931	1.676

NOTE: 1. The Max Simultaneous Tx is calculated based on the same configuration and test position.

2. This device is in compliance with Specific Absorption Rate (SAR) for general population / uncontrolled exposure limits 2.0 W/kg for head and body specified in COUNCIL RECOMMENDATION 1999/519/EC, and had been tested in accordance with the measurement methods and procedures specified in EN 62209-1:2016 & EN 62209-2:2010.

1.3. EUT Description

Device Information			
Product Name	Flip phone		
Trademark	HAMTOD		
Model Name	T8		
Family Model	T10, T6, T9, T3, T2, T1		
Model Difference	All the model are the same circuit and RF module, except the appearance		
Device Phase	Identical Prototype		
Exposure Category	General population / Uncontrolled environment		
Antenna Type	IFA Antenna		
Battery Information	DC 3.8V, 1500mAh, 5.7Wh		
Hardware version	L500_BM_V1.0		
Software version	L500B_HY_T8_EU_V04		
Device Operating Configurations			
Supporting Mode(s)	GSM 900/1800, WCDMA Band 1/8, LTE Band1/3/7/8/20,Bluetooth		
Test Modulation	GSM(GMSK/8PSK), WCDMA(QPSK), LTE(QPSK/16-QAM), Bluetooth(GFSK, $\pi/4$ -DQPSK, 8DPSK)		
Device Class	B		
Operating Frequency Range(s)	Band	Tx (MHz)	Rx (MHz)
	GSM 900	880-915	925-960
	GSM 1800	1710-1785	1805-1880
	WCDMA Band 1	1920-1980	2110-2170
	WCDMA Band 8	880-915	925-960
	LTE Band 1	1920-1980	2110-2170
	LTE Band 3	1710-1785	1805-1880

	LTE Band 7	2500-2570	2620-2690
	LTE Band 8	880- 915	925– 960
	LTE Band 20	832-862	791-821
	Bluetooth	2402-2480	
GPRS Multislot Class(12)	Max Number of Timeslots in Uplink		4
	Max Number of Timeslots in Downlink		4
	Max Total Timeslot		5
Power Class	4, tested with power level 5(GSM 900)		
	1, tested with power level 0(GSM 1800)		
	3, tested with power control “all 1”(WCDMA Band 1)		
	3, tested with power control “all 1”(WCDMA Band 8)		
	3, tested with power control all Max.(LTE Band 1)		
	3, tested with power control all Max.(LTE Band 3)		
	3, tested with power control all Max.(LTE Band 7)		
	3, tested with power control all Max.(LTE Band 8)		
	3, tested with power control all Max.(LTE Band 20)		

1.4. Test specification(s)

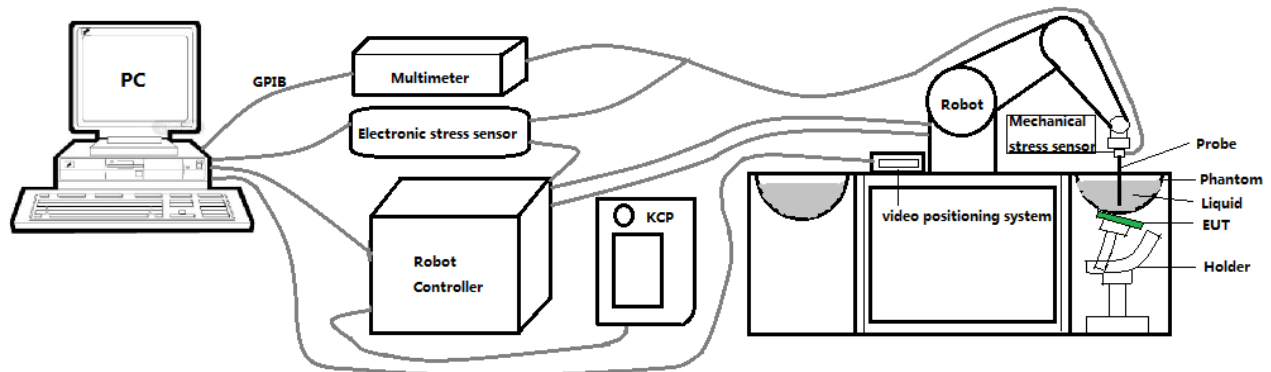
EN 50360:2017	Product standard to demonstrate the compliance of wireless communication devices, with the basic restrictions and exposure limit values related to human exposure to electromagnetic fields in the frequency range from 300 MHz to 6 GHz: devices used next to the ear
EN 50566:2017	Product standard to demonstrate the compliance of wireless communication devices with the basic restrictions and exposure limit values related to human exposure to electromagnetic fields in the frequency range from 30 MHz to 6 GHz: hand-held and body mounted devices in close proximity to the human body
EN 62209-1:2016	Measurement procedure for the assessment of specific absorption rate of human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices - Part 1: Devices used next to the ear (Frequency range of 300 MHz to 6 GHz)
EN 62209-2:2010	Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices – Human models, instrumentation, and procedures –Part 2: Procedure to determine the Specific Absorption Rate (SAR) in the head and body for 30MHz to 6GHz Handheld and Body-Mounted Devices used in close proximity to the body
EN 62479:2010	Assessment of the compliance of low-power electronic and electrical equipment with the restrictions related to human exposure to electromagnetic fields(10 MHz to 300 GHz)

1.5. Ambient Condition

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

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 ± 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 ± 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. E-Field 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 3423-EPGO-426 with following specifications is used



- Dynamic range: 0.01-100 W/kg
- Tip Diameter : 2.5 mm
- Distance between probe tip and sensor center: 1 mm
- Distance between sensor center and the inner phantom surface: 2 mm (repeatability better than ± 1 mm).
- Probe linearity: ± 0.06 dB
- Axial isotropy: ± 0.01 dB
- Hemispherical Isotropy: ± 0.01 dB
- Calibration range: 650MHz to 5900MHz for head & body simulating liquid.
- Lower detection limit: 8mW/kg

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 ± 0.25 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. SAM phantoms

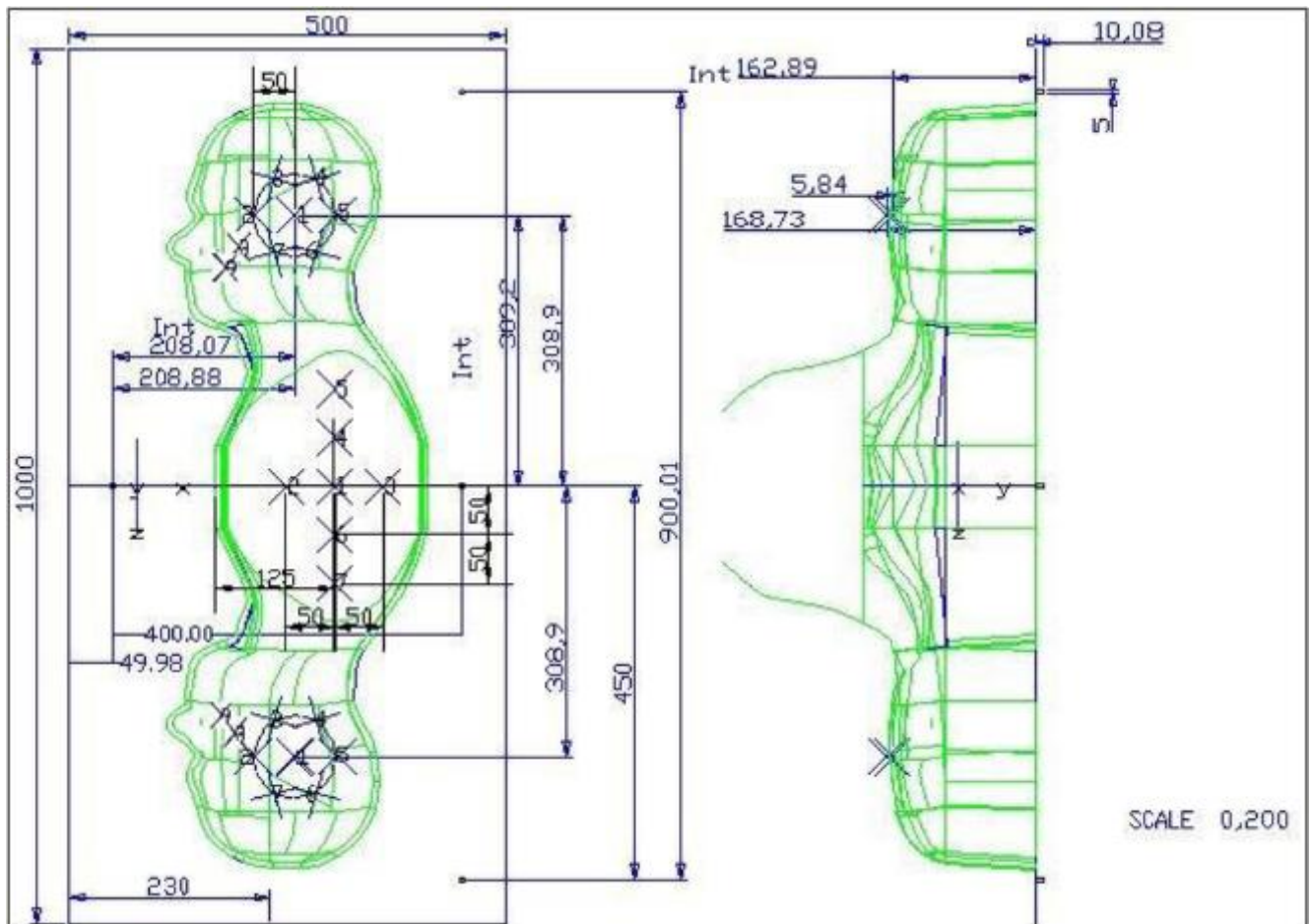
Photo of SAM phantom SN 16/15 SAM119



The SAM phantom is used to measure the SAR relative to people exposed to electro-magnetic field radiated by mobile phones.

2.4.1. Technical Data

Serial Number	Shell thickness	Filling volume	Dimensions	Positionner Material	Permittivity	Loss Tangent
SN 16/15 SAM119	2 mm ±0.2 mm	27 liters	Length:1000 mm Width:500 mm Height:200 mm	Gelcoat with fiberglass	3.4	0.02

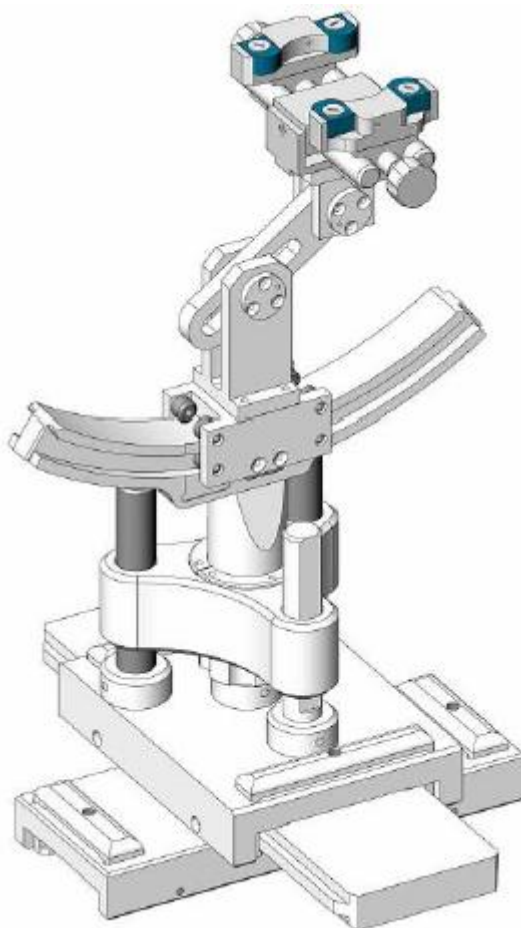


Serial Number	Left Head(mm)		Right Head(mm)		Flat Part(mm)	
SN 16/15 SAM119	2	2.02	2	2.08	1	2.09
	3	2.05	3	2.06	2	2.06
	4	2.07	4	2.07	3	2.08
	5	2.08	5	2.08	4	2.10
	6	2.05	6	2.07	5	2.10
	7	2.05	7	2.05	6	2.07
	8	2.07	8	2.06	7	2.07
	9	2.08	9	2.06	-	-

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

2.5. 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 degree.



Serial Number	Holder Material	Permittivity	Loss Tangent
SN 16/15 MSH100	Delrin	3.7	0.005

2.6. 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
☒	MVG	E FIELD PROBE	SSE2	3423-EPGO-426	Sep. 18, 2023	Sep. 17, 2024
☐	MVG	750 MHz Dipole	SID750	SN 03/15 DIP 0G750-355	Feb. 22, 2024	Feb. 21, 2027
☐	MVG	835 MHz Dipole	SID835	SN 03/15 DIP 0G835-347	Feb. 22, 2024	Feb. 21, 2027
☒	MVG	900 MHz Dipole	SID900	SN 03/15 DIP 0G900-348	Feb. 22, 2024	Feb. 21, 2027
☒	MVG	1800 MHz Dipole	SID1800	SN 03/15 DIP 1G800-349	Feb. 22, 2024	Feb. 21, 2027
☐	MVG	1900 MHz Dipole	SID1900	SN 03/15 DIP 1G900-350	Feb. 22, 2024	Feb. 21, 2027
☒	MVG	2000 MHz Dipole	SID2000	SN 03/15 DIP 2G000-351	Feb. 22, 2024	Feb. 21, 2027
☐	MVG	2300 MHz Dipole	SID2300	SN 03/16 DIP 2G300-358	Feb. 22, 2024	Feb. 21, 2027
☐	MVG	2450 MHz Dipole	SID2450	SN 03/15 DIP 2G450-352	Feb. 22, 2024	Feb. 21, 2027
☒	MVG	2600 MHz Dipole	SID2600	SN 03/15 DIP 2G600-356	Feb. 22, 2024	Feb. 21, 2027
☐	MVG	3500 MHz Dipole	SID3500	SN 09/12 DIP 3G500-360	Feb. 22, 2024	Feb. 21, 2027
☐	MVG	3700 MHz Dipole	SID3700	SN 09/12 DIP 3G/700-361	Feb. 22, 2024	Feb. 21, 2027
☐	MVG	5000 MHz Dipole	SWG5500	SN 13/14 WGA 33	Feb. 22, 2024	Feb. 21, 2027
☒	MVG	Liquid measurement Kit	SCLMP	SN 21/15 OCPG 72	NCR	NCR
☒	MVG	Power Amplifier	N.A	AMPLISAR_28/14_003	NCR	NCR
☒	KEITHLEY	Millivoltmeter	2000	4072790	NCR	NCR
☒	R&S	Universal radio communication tester	CMU200	105747	Apr. 26, 2024	Apr. 25, 2025

☒	R&S	Wideband radio communication tester	CMW500	103917	Apr. 26, 2024	Apr. 25, 2025
☒	HP	Network Analyzer	8753D	3410J01136	Apr. 26, 2024	Apr. 25, 2025
☒	Agilent	MXG Vector Signal Generator	N5182A	MY47070317	Apr. 25, 2024	Apr. 24, 2025
☒	Agilent	Power meter	E4419B	MY45102538	Apr. 25, 2024	Apr. 24, 2025
☒	Agilent	Power sensor	E9301A	MY41495644	Apr. 25, 2024	Apr. 24, 2025
☒	Agilent	Power sensor	E9301A	US39212148	Apr. 25, 2024	Apr. 24, 2025
☒	MCLI/USA	Directional Coupler	CB11-20	0D2L51502	Apr. 26, 2024	Apr. 25, 2027
☒	N/A	Thermometer	N/A	LES-085	Mar. 27, 2023	Mar. 26, 2026
☒	MVG	SAM Phantom	SSM2	SN 16/15 SAM119	NCR	NCR
☒	MVG	Device Holder	SMPPD	SN 16/15 MSH100	NCR	NCR

3. SAR Measurement Procedures

The measurement procedures are as follows:

- (a) Use base station simulator (if applicable) or engineering software to transmit RF power continuously (continuous Tx) in the middle channel.
- (b) Keep EUT to radiate maximum output power or 100% duty factor (if applicable)
- (c) Measure output power through RF cable and power meter.
- (d) Place the EUT in the positions as setup photos demonstrates.
- (e) Set scan area, grid size and other setting on the OPENSAR software.
- (f) Measure SAR transmitting at the middle channel for all applicable exposure positions.
- (g) Identify the exposure position and device configuration resulting the highest SAR
- (h) Measure SAR at the lowest and highest channels at the worst exposure position and device configuration.

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).

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 using to determinate this 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 to a full 3D scan over a specific area. This 3D scan is useful form multi Tx SAR measurement. Indeed, it is possible with OpenSAR to add, point by point, several volumetric scan to calculate the SAR value of the combined measurement as it is define in the standard IEEE1528 and IEC62209.

3.5. Power Drift

All SAR testing is under the EUT install 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.

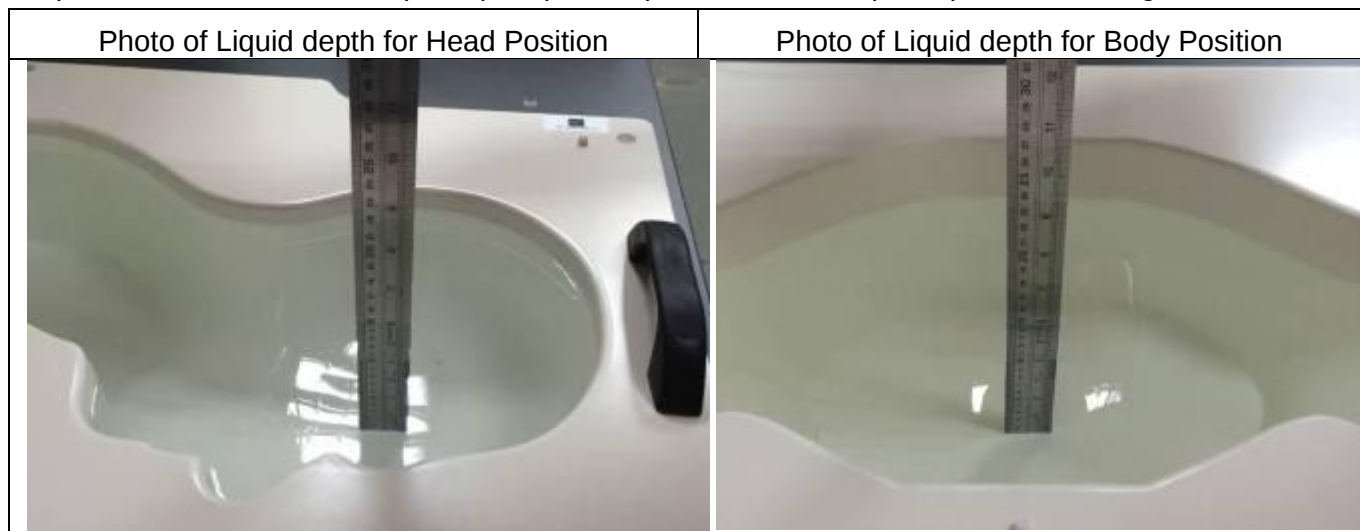
4. System Verification Procedure

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	5000
Frequency Band (MHz)	750	835	900	1800	1900	2000	2450	2600	5000
Water	34.40	34.40	34.40	55.36	55.36	71.88	71.88	71.88	65.53
NaCl	0.79	0.79	0.79	0.35	0.35	0.16	0.16	0.16	0.00
1,2-Propanediol	64.81	64.81	64.81	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	17.24
DGBE	0.00	0.00	0.00	13.84	13.84	7.99	7.99	7.99	0.00

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 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.

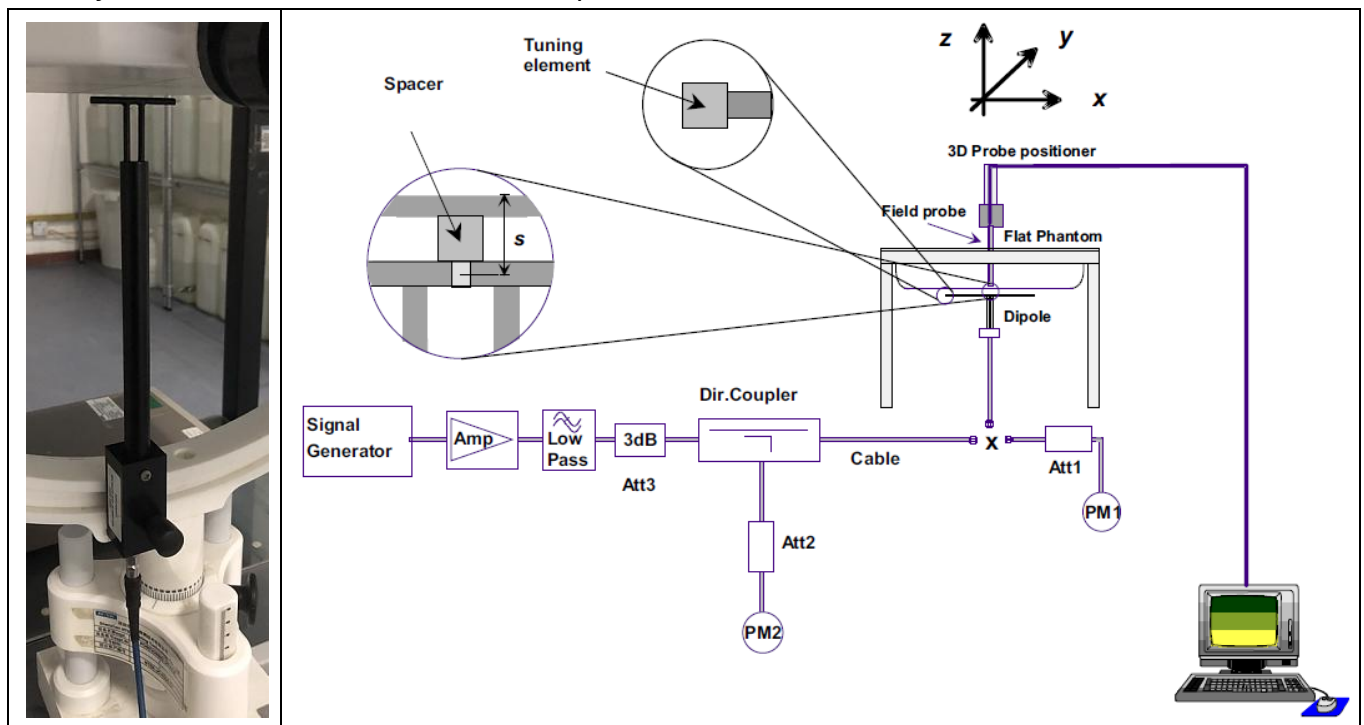
Tissue Type	Measured Frequency (MHz)	Target Tissue		Measured Tissue		Liquid Temp.	Test Date
		$\epsilon_r (\pm 5\%)$	σ (S/m) ($\pm 5\%$)	ϵ_r	σ (S/m)		
Head 900	900	41.50 (39.43~43.58)	0.97 (0.92~1.02)	41.14	0.98	21.6 °C	Jul. 24, 2024
Head 1800	1800	40.00 (38.00~42.00)	1.40 (1.33~1.47)	38.89	1.38	21.7 °C	Jul. 25, 2024
Head 2000	2000	40.00 (38.00~42.00)	1.40 (1.33~1.47)	38.82	1.44	21.6 °C	Jul. 26, 2024
Head 2600	2600	39.01 (37.06~40.96)	1.96 (1.86~2.06)	39.13	2.01	21.4 °C	Jul. 19, 2024

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 100mW (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	Target SAR (1W) ($\pm 10\%$)		Measured SAR (Normalized to 1W)		Liquid Temp.	Test Date
	1-g (W/Kg)	10-g (W/Kg)	1-g (W/Kg)	10-g (W/Kg)		
900MHz	10.63 (9.57~11.69)	7.01 (6.31~7.71)	10.29	7.12	21.6 °C	Jul. 24, 2024
1800MHz	37.06 (33.35~40.77)	20.01 (18.01~22.01)	35.60	18.40	21.7 °C	Jul. 25, 2024
2000MHz	38.27 (34.44~42.10)	19.79 (17.81~21.77)	40.37	19.60	21.6 °C	Jul. 26, 2024
2600MHz	54.16 (48.74~59.58)	24.85 (22.37~27.34)	57.05	24.68	21.4 °C	Jul. 19, 2024

5. SAR Measurement Uncertainty

The following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in IEEE 1528: 2003. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k=2$.

Uncertainty Component	Tol. (±%)	Prob. Dist.	Div.	Ci (1 g)	Ci (10 g)	1 g Ui (±%)	10 g Ui (±%)	Vi
Measurement System								
Probe Calibration	5.8	N	1	1	1	5.80	5.80	∞
Axial Isotropy	3.5	R	$\sqrt{3}$	0.97	0.97	1.98	1.98	∞
Hemispherical Isotropy	5.9	R	$\sqrt{3}$	0.28	0.28	0.96	0.96	∞
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	∞
Test sample Related								
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 (shape and thickness tolerances)	4	R	$\sqrt{3}$	1	1	2.31	2.31	∞
Uncertainty in SAR correction for deviation (in permittivity and conductivity)	2	N	1	1	0.84	2.00	1.68	∞
Liquid Conductivity (temperature uncertainty)	2.5	N	1	0.78	0.71	1.95	1.78	∞
Liquid conductivity - measurement uncertainty	1.59	N	1	0.23	0.26	0.37	0.41	99

Liquid permittivity (temperature uncertainty)	2.5	N	1	0.78	0.71	1.95	1.78	∞
Liquid permittivity - measurement uncertainty	1.65	N	1	0.23	0.26	0.38	0.43	99
Combined Standard Uncertainty		RSS				10.19	10.02	
Expanded Uncertainty (95% Confidence interval)		k				20.38	20.04	

6. RF Exposure Positions

6.1. Ear and handset reference point

Figure 6.1.1 shows the front, back, and side views of the SAM phantom. The center-of-mouth reference point is labeled “M”, the left ear reference point (ERP) is marked “LE”, and the right ERP is marked “RE”.

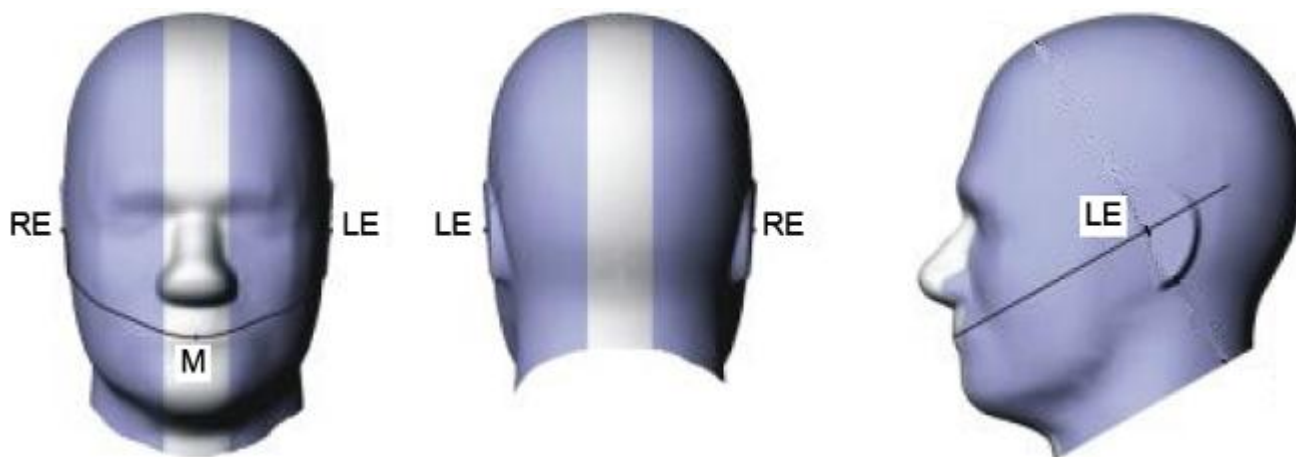


Fig 6.1.1 Front, back, and side views of SAM phantom

6.2. Definition of the cheek position

1. Define two imaginary lines on the handset, the vertical centerline and the horizontal line. The vertical centerline passes through two points on the front side of the handset: the midpoint of the width w_t of the handset at the level of the acoustic output (point A in Figure 6.2.1 and Figure 6.2.2), and the midpoint of the width w_b of the bottom of the handset (point B). The horizontal line is perpendicular to the vertical centerline and passes through the center of the acoustic output (see Figure 6.2.1). The two lines intersect at point A. Note that for many handsets, point A coincides with the center of the acoustic output; however, the acoustic output may be located elsewhere on the horizontal line. Also note that the vertical centerline is not necessarily parallel to the front face of the handset (see Figure 6.2.2), especially for clamshell handsets, handsets with flip covers, and other irregularly-shaped handsets.
2. Position the handset close to the surface of the phantom such that point A is on the (virtual) extension of the line passing through points RE and LE on the phantom (see Figure 6.2.3), such that the plane defined by the vertical centerline and the horizontal line of the handset is approximately parallel to the sagittal plane of the phantom.
3. Translate the handset towards the phantom along the line passing through RE and LE until handset point A touches the pinna at the ERP
4. While maintaining the handset in this plane, rotate it around the LE-RE line until the vertical centerline is in the plane normal to the plane containing B-M and N-F lines, i.e., the Reference Plane.
5. Rotate the handset around the vertical centerline until the handset (horizontal line) is parallel to the N-F line.

6. While maintaining the vertical centerline in the Reference Plane, keeping point A on the line passing through RE and LE, and maintaining the handset contact with the pinna, rotate the handset about the N-F line until any point on the handset is in contact with a phantom point below the pinna on the cheek. See Figure 6.2.3. The actual rotation angles should be documented in the test report.

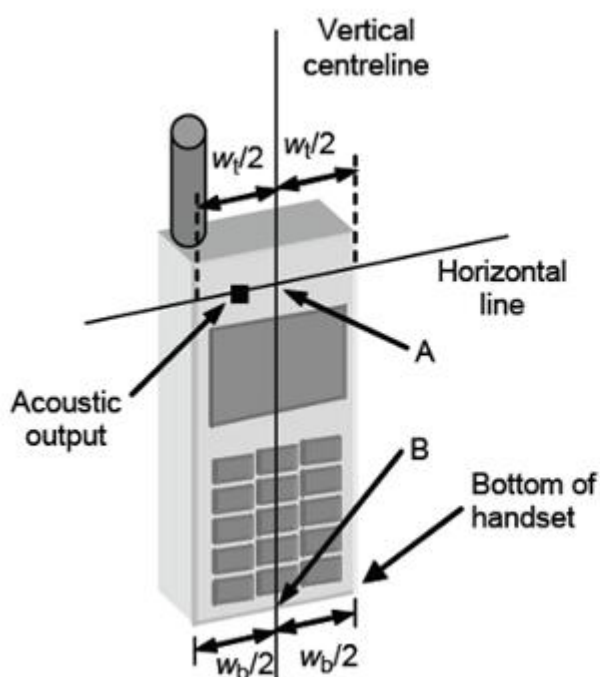


Fig 6.2.1 Handset vertical and horizontal reference lines—"fixed case"

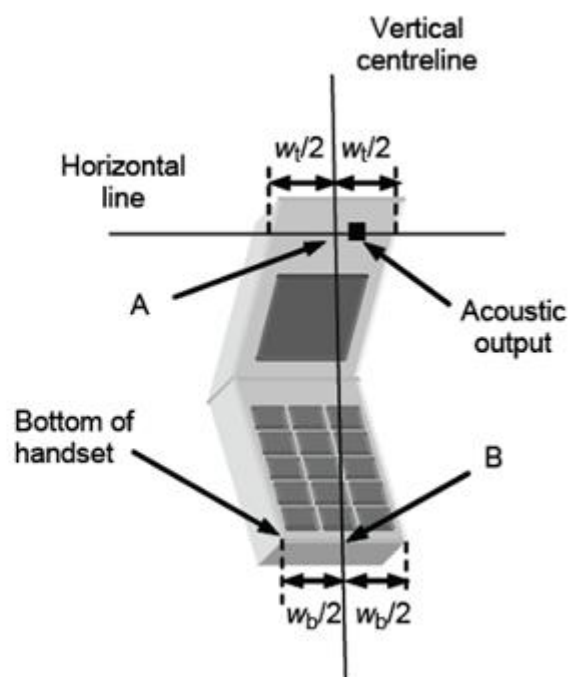


Fig 6.2.2 Handset vertical and horizontal reference lines—"clam-shell case"

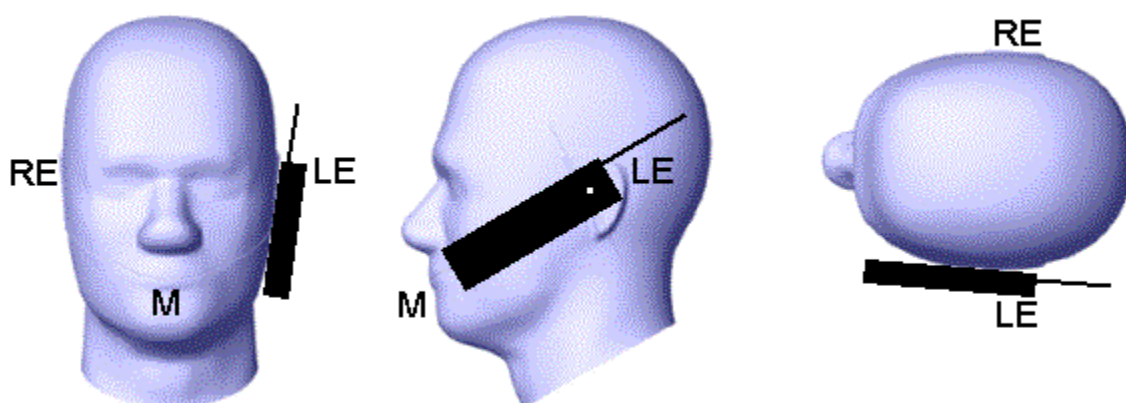


Fig 6.2.3 cheek or touch position. The reference points for the right ear (RE), left ear (LE), and mouth (M), which establish the Reference Plane for handset positioning, are indicated.

6.3. Definition of the tilt position

1. While maintaining the orientation of the handset, retract the handset parallel to the reference plane far enough away from the phantom to enable a rotation of the device by 15 degree.

2. Rotate the Handset around the horizontal line by 15 degree (see Figure 6.3.1).
3. While maintaining the orientation of the handset, move the handset towards the phantom on a line passing through RE and LE until any part of the handset touches the ear. The tilt position is obtained when the contact is on the pinna. If the contact is at any location other than the pinna, e.g., the antenna with the back of the phantom head, the angle of the handset shall be reduced. In this case, the tilt position is obtained if any part of the handset is in contact with the pinna as well as a second part of the handset is in contact with the phantom, e.g., the antenna with the back of the head.

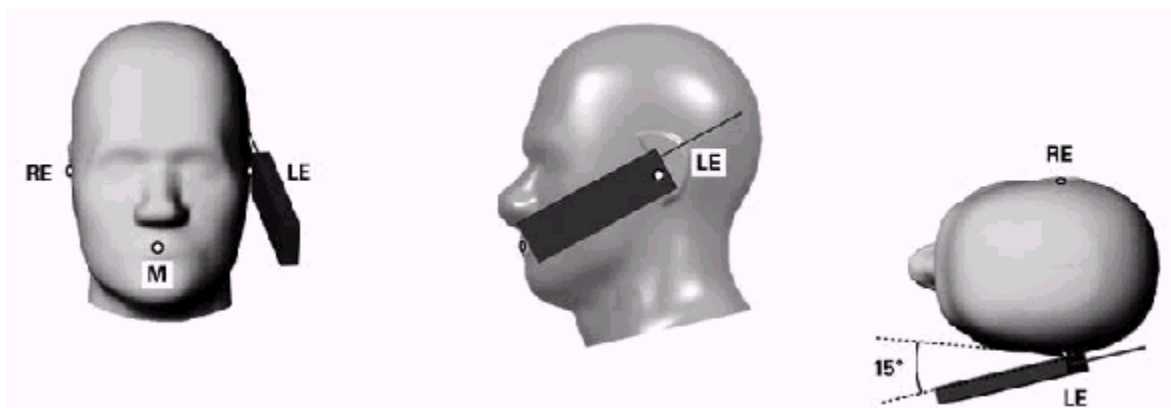


Figure 6.3.1 – Tilt position of the wireless device on the left side of SAM

6.4. Body-worn device

A typical example of a body-worn device is a mobile phone, wireless enabled PDA or other battery operated wireless device with the ability to transmit while mounted on a person's body using a carry accessory approved by the wireless device manufacturer. The device shall be positioned as intended at the distance to the outer surface of the phantom that corresponds to the specified distance (See figure 6.1). Adjust the distance between the device surface and the flat phantom to 5mm.

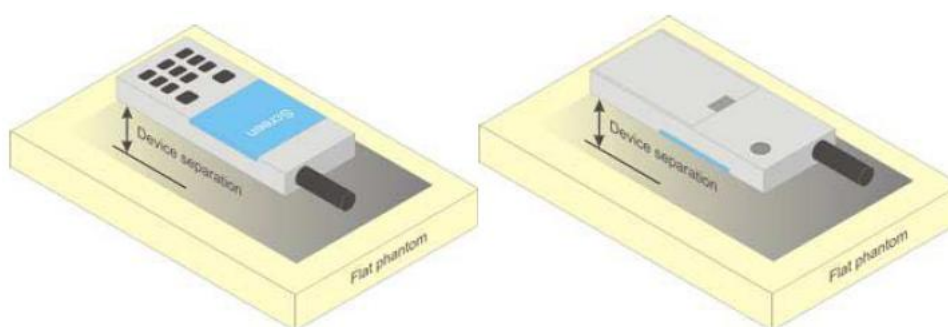


Figure 6.1 – Test positions for Body-worn device

7. RF Output Power

7.1. GSM Conducted Power

Band GSM900	Burst-Averaged output Power (dBm)				Frame-Averaged output Power (dBm)			
Tx Channel	Tune-up	975	38	124	Tune-up	975	38	124
Frequency (MHz)		880.2	897.6	914.8		880.2	897.6	914.8
GSM (GMSK)	33.00	32.67	32.45	32.68	23.97	23.64	23.42	23.65
Band GSM1800	Burst-Averaged output Power (dBm)				Frame-Averaged output Power (dBm)			
Tx Channel	Tune-up	512	698	885	Tune-up	512	698	885
Frequency (MHz)		1710.2	1747.4	1784.8		1710.2	1747.4	1784.8
GSM (GMSK)	29.50	29.23	29.13	29.08	20.47	20.20	20.10	20.05

7.2. WCDMA Conducted Power

WCDMA Band1	Burst-Averaged output Power (dBm)			
Tx Channel	Tune-up (dBm)	9612	9750	9888
Frequency (MHz)		1922.4	1950	1977.6
RMC12.2K	23.00	22.58	22.55	22.34
HSDPA Sub 1	22.50	21.72	22.21	22.27
HSDPA Sub 2	22.50	21.19	21.77	22.06
HSDPA Sub 3	22.00	21.06	21.66	21.66
HSDPA Sub 4	22.00	20.51	21.57	21.52
HSUPA Sub 1	22.50	21.42	22.10	22.12
HSUPA Sub 2	22.50	21.43	22.20	22.24
HSUPA Sub 3	22.00	21.03	21.91	21.92
HSUPA Sub 4	22.50	21.35	22.14	22.21
HSUPA Sub 5	22.50	21.11	21.84	22.14
WCDMA Band 8	Burst-Averaged output Power (dBm)			
Tx Channel	Tune-up (dBm)	2712	2788	2863
Frequency (MHz)		882.4	897.6	912.6
RMC12.2K	23.00	22.87	22.70	22.59
HSDPA Sub 1	22.00	21.22	21.64	21.13
HSDPA Sub 2	21.50	20.73	21.48	20.97
HSDPA Sub 3	21.50	20.38	21.22	20.70
HSDPA Sub 4	21.00	20.42	20.98	20.16
HSUPA Sub 1	21.50	21.29	21.45	21.08
HSUPA Sub 2	22.00	21.09	21.61	21.01

HSUPA Sub 3	21.50	20.49	21.33	20.76
HSUPA Sub 4	22.00	20.93	21.56	21.03
HSUPA Sub 5	22.00	20.86	21.50	20.70

7.3. LTE Conducted Power

Band	Bandwidth (MHz)	UL Channel	RB Size	RB Position	Modulation	Tune-up	Power (dBm)
Band1	5	18025	1	#0	QPSK	23.50	22.94
Band1	5	18025	8	#0	QPSK	23.50	23.09
Band1	5	18025	25	#0	QPSK	23.50	21.99
Band1	5	18300	1	#0	QPSK	23.50	23.06
Band1	5	18300	8	#0	QPSK	23.50	23.28
Band1	5	18300	25	#0	QPSK	23.50	22.05
Band1	5	18575	1	#0	QPSK	23.50	22.89
Band1	5	18575	8	#0	QPSK	23.50	22.91
Band1	5	18575	25	#0	QPSK	23.50	21.88
Band1	20	18100	1	#0	QPSK	23.50	22.94
Band1	20	18100	18	#0	QPSK	23.50	23.06
Band1	20	18100	100	#0	QPSK	23.50	22.17
Band1	20	18300	1	#0	QPSK	23.50	23.04
Band1	20	18300	18	#0	QPSK	23.50	23.29
Band1	20	18300	100	#0	QPSK	23.50	22.08
Band1	20	18500	1	#0	QPSK	23.50	22.89
Band1	20	18500	18	#0	QPSK	23.50	23.18
Band1	20	18500	100	#0	QPSK	23.50	22.03
Band20	5	24175	1	#0	QPSK	24.00	22.96
Band20	5	24175	8	#0	QPSK	24.00	23.15
Band20	5	24175	25	#0	QPSK	24.00	22.25
Band20	5	24300	1	#0	QPSK	24.00	23.45
Band20	5	24300	8	#0	QPSK	24.00	23.44
Band20	5	24300	25	#0	QPSK	24.00	22.38
Band20	5	24425	1	#0	QPSK	24.00	23.25
Band20	5	24425	8	#0	QPSK	24.00	23.31
Band20	5	24425	25	#0	QPSK	24.00	22.40
Band20	20	24250	1	#0	QPSK	24.00	22.99
Band20	20	24250	18	#0	QPSK	24.00	23.24
Band20	20	24250	100	#0	QPSK	24.00	22.36
Band20	20	24300	1	#0	QPSK	24.00	23.16

Band20	20	24300	18	#0	QPSK	24.00	23.35
Band20	20	24300	100	#0	QPSK	24.00	22.47
Band20	20	24350	1	#0	QPSK	24.00	23.41
Band20	20	24350	18	#0	QPSK	24.00	23.56
Band20	20	24350	100	#0	QPSK	24.00	22.46
Band3	1.4	19207	1	#0	QPSK	23.50	22.57
Band3	1.4	19207	5	#0	QPSK	23.50	22.58
Band3	1.4	19207	6	#0	QPSK	23.50	21.71
Band3	1.4	19575	1	#0	QPSK	23.50	22.34
Band3	1.4	19575	5	#0	QPSK	23.50	22.52
Band3	1.4	19575	6	#0	QPSK	23.50	21.37
Band3	1.4	19943	1	#0	QPSK	23.50	22.89
Band3	1.4	19943	5	#0	QPSK	23.50	23.11
Band3	1.4	19943	6	#0	QPSK	23.50	21.98
Band3	5	19225	1	#0	QPSK	23.50	22.54
Band3	5	19225	8	#0	QPSK	23.50	22.57
Band3	5	19225	25	#0	QPSK	23.50	21.59
Band3	5	19575	1	#0	QPSK	23.50	22.27
Band3	5	19575	8	#0	QPSK	23.50	22.37
Band3	5	19575	25	#0	QPSK	23.50	21.28
Band3	5	19925	1	#0	QPSK	23.50	23.01
Band3	5	19925	8	#0	QPSK	23.50	22.95
Band3	5	19925	25	#0	QPSK	23.50	22.02
Band3	20	19300	1	#0	QPSK	23.50	22.50
Band3	20	19300	18	#0	QPSK	23.50	22.57
Band3	20	19300	100	#0	QPSK	23.50	21.43
Band3	20	19575	1	#0	QPSK	23.50	22.41
Band3	20	19575	18	#0	QPSK	23.50	22.53
Band3	20	19575	100	#0	QPSK	23.50	21.47
Band3	20	19850	1	#0	QPSK	23.50	22.81
Band3	20	19850	18	#0	QPSK	23.50	22.87
Band3	20	19850	100	#0	QPSK	23.50	21.96
Band7	5	20775	1	#0	QPSK	23.00	21.95
Band7	5	20775	8	#0	QPSK	23.00	22.10
Band7	5	20775	25	#0	QPSK	23.00	21.19
Band7	5	21100	1	#0	QPSK	23.00	22.09
Band7	5	21100	8	#0	QPSK	23.00	22.11
Band7	5	21100	25	#0	QPSK	23.00	21.22
Band7	5	21425	1	#0	QPSK	23.00	22.32

Band7	5	21425	8	#0	QPSK	23.00	22.58
Band7	5	21425	25	#0	QPSK	23.00	21.54
Band7	20	20850	1	#0	QPSK	23.00	22.03
Band7	20	20850	18	#0	QPSK	23.00	22.16
Band7	20	20850	100	#0	QPSK	23.00	21.17
Band7	20	21100	1	#0	QPSK	23.00	21.75
Band7	20	21100	18	#0	QPSK	23.00	21.98
Band7	20	21100	100	#0	QPSK	23.00	21.20
Band7	20	21350	1	#0	QPSK	23.00	22.03
Band7	20	21350	18	#0	QPSK	23.00	22.19
Band7	20	21350	100	#0	QPSK	23.00	21.29
Band8	1.4	21457	1	#0	QPSK	23.50	22.83
Band8	1.4	21457	5	#0	QPSK	23.50	22.99
Band8	1.4	21457	6	#0	QPSK	23.50	21.87
Band8	1.4	21625	1	#0	QPSK	23.50	22.84
Band8	1.4	21625	5	#0	QPSK	23.50	23.06
Band8	1.4	21625	6	#0	QPSK	23.50	21.85
Band8	1.4	21793	1	#0	QPSK	23.50	22.81
Band8	1.4	21793	5	#0	QPSK	23.50	22.88
Band8	1.4	21793	6	#0	QPSK	23.50	21.99
Band8	5	21475	1	#0	QPSK	23.50	22.94
Band8	5	21475	8	#0	QPSK	23.50	22.86
Band8	5	21475	25	#0	QPSK	23.50	22.08
Band8	5	21625	1	#0	QPSK	23.50	22.83
Band8	5	21625	8	#0	QPSK	23.50	23.03
Band8	5	21625	25	#0	QPSK	23.50	21.99
Band8	5	21775	1	#0	QPSK	23.50	22.87
Band8	5	21775	8	#0	QPSK	23.50	23.06
Band8	5	21775	25	#0	QPSK	23.50	21.96
Band8	10	21500	1	#0	QPSK	23.50	22.80
Band8	10	21500	12	#0	QPSK	23.50	23.05
Band8	10	21500	50	#0	QPSK	23.50	21.91
Band8	10	21625	1	#0	QPSK	23.50	22.70
Band8	10	21625	12	#0	QPSK	23.50	22.83
Band8	10	21625	50	#0	QPSK	23.50	21.96
Band8	10	21750	1	#0	QPSK	23.50	22.84
Band8	10	21750	12	#0	QPSK	23.50	23.00
Band8	10	21750	50	#0	QPSK	23.50	22.00

7.4. Bluetooth Output Power

BR+EDR	Data Rates	Tune - up(dBm)	Output Power (dBm)
	GFSK DH5	3.00	2.71
	Pi/4 DQPSK DH5	2.00	1.59
	8DPSK DH5	2.00	1.47

NOTE: Power measurement results of Bluetooth. Refer to EN 62479, the available power of this EUT is 3.00dBm (2.00mW), the power is less than the low-power exclusion level defined in 4.2 (P max: 20mW), So Bluetooth stand-alone SAR is not required

8. SAR Results

8.1. SAR measurement results

8.1.1. SAR measurement Result of GSM900

Test Position	Test channel /Freq.	Test Mode	Separation distance (mm)	SAR Value (W/kg)		Power Drift (±5%)	Conducted power (dBm)	Tune-up power (dBm)	Scaled SAR 10g (W/Kg)	Date
				1g	10g					
Head										
Left Cheek	38/897.6	GSM Voice	0	1.360	0.820	1.23	32.45	33.00	0.931	2024/7/24
Left Tilt 15 Degree	38/897.6	GSM Voice	0	0.811	0.489	1.72	32.45	33.00	0.555	2024/7/24
Right Cheek	38/897.6	GSM Voice	0	1.163	0.687	-0.69	32.45	33.00	0.780	2024/7/24
Right Tilt 15 Degree	38/897.6	GSM Voice	0	0.542	0.324	-2.64	32.45	33.00	0.368	2024/7/24
Left Cheek	975/880.2	GSM Voice	0	1.266	0.762	0.77	32.67	33.00	0.822	2024/7/24
Left Cheek	124/914.8	GSM Voice	0	1.312	0.814	4.37	32.68	33.00	0.876	2024/7/24
Body										
Front Side	38/897.6	GSM Voice	5	0.679	0.434	1.93	32.45	33.00	0.493	2024/7/24
Back Side	38/897.6	GSM Voice	5	2.190	1.429	-0.42	32.45	33.00	1.622	2024/7/24

Left Side	38/897.6	GSM Voice	5	0.372	0.238	-3.51	32.45	33.00	0.270	2024/7/24
Right Side	38/897.6	GSM Voice	5	0.832	0.537	-0.50	32.45	33.00	0.610	2024/7/24
Top Side	38/897.6	GSM Voice	5	0.767	0.475	2.06	32.45	33.00	0.539	2024/7/24
Bottom Side	38/897.6	GSM Voice	5	0.088	0.055	-0.25	32.45	33.00	0.062	2024/7/24
Back Side	975/880.2	GSM Voice	5	1.781	1.159	0.55	32.67	33.00	1.250	2024/7/24
Back Side	124/914.8	GSM Voice	5	2.395	1.557	-2.13	32.68	33.00	1.676	2024/7/24

8.1.2. SAR measurement Result of GSM1800

Test Position	Test channel /Freq.	Test Mode	Separation distance (mm)	SAR Value (W/kg)		Power Drift (±5%)	Conducted power (dBm)	Tune-up power (dBm)	Scaled SAR 10g (W/Kg)	Date
				1g	10g					
Head										
Left Cheek	698/1747.4	GSM Voice	0	0.172	0.095	-4.38	29.13	29.50	0.103	2024/7/25
Left Tilt 15 Degree	698/1747.4	GSM Voice	0	0.089	0.048	2.10	29.13	29.50	0.052	2024/7/25
Right Cheek	698/1747.4	GSM Voice	0	0.163	0.090	0.19	29.13	29.50	0.098	2024/7/25
Right Tilt 15 Degree	698/1747.4	GSM Voice	0	0.086	0.046	2.95	29.13	29.50	0.050	2024/7/25
Left Cheek	512/1710.2	GSM Voice	0	0.159	0.088	4.20	29.23	29.50	0.094	2024/7/25
Left Cheek	885/1784.8	GSM Voice	0	0.181	0.099	4.23	29.08	29.50	0.109	2024/7/25
Body										
Front Side	698/1747.4	GSM Voice	5	0.241	0.144	-2.90	29.13	29.50	0.157	2024/7/25
Back Side	698/1747.4	GSM Voice	5	1.050	0.496	-0.51	29.13	29.50	0.540	2024/7/25
Left	698/1747.4	GSM Voice	5	0.082	0.049	3.49	29.13	29.50	0.053	2024/7/25

Side										
Right Side	698/1747.4	GSM Voice	5	0.219	0.122	-3.33	29.13	29.50	0.133	2024/7/25
Top Side	698/1747.4	GSM Voice	5	0.207	0.118	3.11	29.13	29.50	0.128	2024/7/25
Bottom Side	698/1747.4	GSM Voice	5	0.031	0.021	-2.12	29.13	29.50	0.023	2024/7/25
Back Side	512/1710.2	GSM Voice	5	0.916	0.441	-0.95	29.23	29.50	0.469	2024/7/25
Back Side	885/1784.8	GSM Voice	5	1.081	0.512	1.48	29.08	29.50	0.564	2024/7/25

8.1.3. SAR measurement Result of WCDMA Band1

Test Position	Test channel /Freq.	Test Mode	Separation distance (mm)	SAR Value (W/kg)		Power Drift (±5%)	Conducted power (dBm)	Tune-up power (dBm)	Scaled SAR 10g (W/Kg)	Date
				1g	10g					
Head										
Left Cheek	9750/1950	RMC12.2K	0	0.256	0.134	-3.55	22.55	23.00	0.149	2024/7/26
Left Tilt 15 Degree	9750/1950	RMC12.2K	0	0.149	0.076	0.65	22.55	23.00	0.084	2024/7/26
Right Cheek	9750/1950	RMC12.2K	0	0.242	0.120	1.35	22.55	23.00	0.133	2024/7/26
Right Tilt 15 Degree	9750/1950	RMC12.2K	0	0.124	0.064	3.47	22.55	23.00	0.071	2024/7/26
Left Cheek	9612/1922.4	RMC12.2K	0	0.228	0.116	2.96	22.58	23.00	0.128	2024/7/26
Left Cheek	9888/1977.6	RMC12.2K	0	0.224	0.117	2.56	22.34	23.00	0.136	2024/7/26
Body										
Front Side	9750/1950	RMC12.2K	5	0.204	0.104	-2.09	22.55	23.00	0.115	2024/7/26
Back Side	9750/1950	RMC12.2K	5	0.340	0.180	-3.38	22.55	23.00	0.200	2024/7/26
Left Side	9750/1950	RMC12.2K	5	0.085	0.044	-1.14	22.55	23.00	0.049	2024/7/26

Right Side	9750/1950	RMC12.2K	5	0.122	0.062	1.43	22.55	23.00	0.069	2024/7/26
Top Side	9750/1950	RMC12.2K	5	0.116	0.060	0.72	22.55	23.00	0.067	2024/7/26
Bottom Side	9750/1950	RMC12.2K	5	0.017	0.015	3.80	22.55	23.00	0.017	2024/7/26
Back Side	9612/1922.4	RMC12.2K	5	0.309	0.160	2.53	22.58	23.00	0.176	2024/7/26
Back Side	9888/1977.6	RMC12.2K	5	0.320	0.164	-1.02	22.34	23.00	0.191	2024/7/26

8.1.4. SAR measurement Result of WCDMA Band8

Test Position	Test channel /Freq.	Test Mode	Separation distance (mm)	SAR Value (W/kg)		Power Drift (±5%)	Conducted power (dBm)	Tune-up power (dBm)	Scaled SAR 10g (W/Kg)	Date
				1g	10g					
Head										
Left Cheek	2788/897.6	RMC12.2K	0	0.631	0.390	-4.32	22.70	23.00	0.418	2024/7/24
Left Tilt 15 Degree	2788/897.6	RMC12.2K	0	0.331	0.196	1.21	22.70	23.00	0.210	2024/7/24
Right Cheek	2788/897.6	RMC12.2K	0	0.591	0.358	-0.39	22.70	23.00	0.384	2024/7/24
Right Tilt 15 Degree	2788/897.6	RMC12.2K	0	0.279	0.166	3.23	22.70	23.00	0.178	2024/7/24
Left Cheek	2712/882.4	RMC12.2K	0	0.554	0.342	-1.39	22.87	23.00	0.352	2024/7/24
Left Cheek	2863/912.6	RMC12.2K	0	0.612	0.366	-1.30	22.59	23.00	0.402	2024/7/24
Body										
Front Side	2788/897.6	RMC12.2K	5	0.325	0.204	-1.33	22.70	23.00	0.219	2024/7/24
Back Side	2788/897.6	RMC12.2K	5	1.015	0.672	-1.15	22.70	23.00	0.720	2024/7/24
Left Side	2788/897.6	RMC12.2K	5	0.152	0.098	1.97	22.70	23.00	0.105	2024/7/24
Right Side	2788/897.6	RMC12.2K	5	0.355	0.228	0.51	22.70	23.00	0.244	2024/7/24

Top Side	2788/897.6	RMC12.2K	5	0.112	0.073	-3.11	22.70	23.00	0.078	2024/7/24
Bottom Side	2788/897.6	RMC12.2K	5	0.020	0.018	3.14	22.70	23.00	0.019	2024/7/24
Back Side	2712/882.4	RMC12.2K	5	0.863	0.571	0.36	22.87	23.00	0.588	2024/7/24
Back Side	2863/912.6	RMC12.2K	5	1.005	0.645	2.01	22.59	23.00	0.709	2024/7/24

8.1.5. SAR measurement Result of LTE Band 1

Test Position	Test channel /Freq.	Test Mode	Separation distance (mm)	SAR Value (W/kg)		Power Drift (±5%)	Conducted power (dBm)	Tune-up power (dBm)	Scaled SAR 10g (W/Kg)	Date
				1g	10g					
Head										
Left Cheek	18300/1950	20M QPSK(1,0)	0	0.287	0.151	0.01	23.04	23.50	0.168	2024/7/26
Left Tilt 15 Degree	18300/1950	20M QPSK(1,0)	0	0.161	0.081	2.66	23.04	23.50	0.090	2024/7/26
Right Cheek	18300/1950	20M QPSK(1,0)	0	0.255	0.127	-1.30	23.04	23.50	0.141	2024/7/26
Right Tilt 15 Degree	18300/1950	20M QPSK(1,0)	0	0.134	0.068	0.50	23.04	23.50	0.076	2024/7/26
Left Cheek	18100/1930	20M QPSK(1,0)	0	0.246	0.126	2.15	22.94	23.50	0.143	2024/7/26
Left Cheek	18500/1970	20M QPSK(1,0)	0	0.254	0.134	-0.32	22.89	23.50	0.154	2024/7/26
Body										
Front Side	18300/1950	20M QPSK(1,0)	5	0.264	0.136	-2.34	23.04	23.50	0.151	2024/7/26
Back Side	18300/1950	20M QPSK(1,0)	5	0.433	0.227	-2.65	23.04	23.50	0.252	2024/7/26
Left Side	18300/1950	20M QPSK(1,0)	5	0.087	0.044	2.00	23.04	23.50	0.049	2024/7/26
Right Side	18300/1950	20M QPSK(1,0)	5	0.152	0.077	-2.09	23.04	23.50	0.086	2024/7/26

Top Side	18300/1950	20M QPSK(1,0)	5	0.147	0.073	0.89	23.04	23.50	0.081	2024/7/26
Bottom Side	18300/1950	20M QPSK(1,0)	5	0.009	0.007	3.80	23.04	23.50	0.008	2024/7/26
Back Side	18100/1930	20M QPSK(1,0)	5	0.394	0.198	-2.99	22.94	23.50	0.225	2024/7/26
Back Side	18500/1970	20M QPSK(1,0)	5	0.398	0.209	1.71	22.89	23.50	0.241	2024/7/26

8.1.6. SAR measurement Result of LTE Band 3

Test Position	Test channel /Freq.	Test Mode	Separation distance (mm)	SAR Value (W/kg)		Power Drift (±5%)	Conducted power (dBm)	Tune-up power (dBm)	Scaled SAR 10g (W/Kg)	Date
				1g	10g					
Head										
Left Cheek	19575/1747.5	20M QPSK(1,0)	0	0.379	0.202	1.91	22.41	23.50	0.260	2024/7/25
Left Tilt 15 Degree	19575/1747.5	20M QPSK(1,0)	0	0.212	0.113	-3.94	22.41	23.50	0.145	2024/7/25
Right Cheek	19575/1747.5	20M QPSK(1,0)	0	0.348	0.185	-1.14	22.41	23.50	0.238	2024/7/25
Right Tilt 15 Degree	19575/1747.5	20M QPSK(1,0)	0	0.187	0.100	-2.08	22.41	23.50	0.129	2024/7/25
Left Cheek	19300/1720	20M QPSK(1,0)	0	0.328	0.166	-0.62	22.50	23.50	0.209	2024/7/25
Left Cheek	19850/1775	20M QPSK(1,0)	0	0.331	0.171	1.09	22.81	23.50	0.200	2024/7/25
Body										
Front Side	19575/1747.5	20M QPSK(1,0)	5	1.007	0.460	0.10	22.41	23.50	0.591	2024/7/25
Back Side	19575/1747.5	20M QPSK(1,0)	5	1.549	0.729	-2.47	22.41	23.50	0.937	2024/7/25
Left Side	19575/1747.5	20M QPSK(1,0)	5	0.310	0.146	-2.58	22.41	23.50	0.188	2024/7/25
Right Side	19575/1747.5	20M QPSK(1,0)	5	0.480	0.226	-0.77	22.41	23.50	0.290	2024/7/25
Top Side	19575/1747.5	20M QPSK(1,0)	5	0.480	0.215	1.98	22.41	23.50	0.276	2024/7/25

Bottom Side	19575/1747.5	20M QPSK(1,0)	5	0.093	0.044	-2.99	22.41	23.50	0.057	2024/7/25
Back Side	19300/1720	20M QPSK(1,0)	5	1.456	0.685	-2.36	22.50	23.50	0.862	2024/7/25
Back Side	19850/1775	20M QPSK(1,0)	5	1.503	0.672	0.85	22.81	23.50	0.788	2024/7/25

8.1.7. SAR measurement Result of LTE Band 7

Test Position	Test channel /Freq.	Test Mode	Separation distance (mm)	SAR Value (W/kg)		Power Drift (±5%)	Conducted power (dBm)	Tune-up power (dBm)	Scaled SAR 10g (W/Kg)	Date
				1g	10g					
Head										
Left Cheek	21100/2535	20M QPSK(1,0)	0	0.375	0.153	0.34	21.75	23.00	0.204	2024/7/19
Left Tilt 15 Degree	21100/2535	20M QPSK(1,0)	0	0.192	0.078	3.14	21.75	23.00	0.104	2024/7/19
Right Cheek	21100/2535	20M QPSK(1,0)	0	0.321	0.124	0.57	21.75	23.00	0.165	2024/7/19
Right Tilt 15 Degree	21100/2535	20M QPSK(1,0)	0	0.160	0.065	-0.18	21.75	23.00	0.087	2024/7/19
Left Cheek	20850/2510	20M QPSK(1,0)	0	0.399	0.168	1.38	22.03	23.00	0.210	2024/7/19
Left Cheek	21350/2560	20M QPSK(1,0)	0	0.377	0.150	0.87	22.03	23.00	0.188	2024/7/19
Body										
Front Side	21100/2535	20M QPSK(1,0)	5	0.280	0.131	-3.70	21.75	23.00	0.175	2024/7/19
Back Side	21100/2535	20M QPSK(1,0)	5	0.431	0.208	4.69	21.75	23.00	0.277	2024/7/19
Left Side	21100/2535	20M QPSK(1,0)	5	0.099	0.045	-2.99	21.75	23.00	0.060	2024/7/19
Right Side	21100/2535	20M QPSK(1,0)	5	0.129	0.060	2.15	21.75	23.00	0.080	2024/7/19
Top Side	21100/2535	20M QPSK(1,0)	5	0.147	0.068	-2.00	21.75	23.00	0.091	2024/7/19
Bottom Side	21100/2535	20M QPSK(1,0)	5	0.013	0.011	2.05	21.75	23.00	0.015	2024/7/19

Back Side	20850/2510	20M QPSK(1,0)	5	0.422	0.202	1.14	22.03	23.00	0.253	2024/7/19
Back Side	21350/2560	20M QPSK(1,0)	5	0.418	0.198	3.73	22.03	23.00	0.248	2024/7/19

8.1.8. SAR measurement Result of LTE Band 8

Test Position	Test channel /Freq.	Test Mode	Separation distance (mm)	SAR Value (W/kg)		Power Drift (±5%)	Conducted power (dBm)	Tune-up power (dBm)	Scaled SAR 10g (W/Kg)	Date
				1g	10g					
Head										
Left Cheek	21625/897.5	10M QPSK(1,0)	0	0.711	0.440	0.58	22.70	23.50	0.529	2024/7/24
Left Tilt 15 Degree	21625/897.5	10M QPSK(1,0)	0	0.389	0.231	0.42	22.70	23.50	0.278	2024/7/24
Right Cheek	21625/897.5	10M QPSK(1,0)	0	0.660	0.388	-1.20	22.70	23.50	0.466	2024/7/24
Right Tilt 15 Degree	21625/897.5	10M QPSK(1,0)	0	0.337	0.202	0.92	22.70	23.50	0.243	2024/7/24
Left Cheek	21500/885	10M QPSK(1,0)	0	0.624	0.386	0.95	22.80	23.50	0.454	2024/7/24
Left Cheek	21750/910	10M QPSK(1,0)	0	0.674	0.399	3.74	22.84	23.50	0.464	2024/7/24
Body										
Front Side	21625/897.5	10M QPSK(1,0)	5	0.730	0.454	0.41	22.70	23.50	0.546	2024/7/24
Back Side	21625/897.5	10M QPSK(1,0)	5	1.159	0.759	-1.85	22.70	23.50	0.913	2024/7/24
Left Side	21625/897.5	10M QPSK(1,0)	5	0.290	0.184	0.32	22.70	23.50	0.221	2024/7/24
Right Side	21625/897.5	10M QPSK(1,0)	5	0.359	0.235	-1.51	22.70	23.50	0.283	2024/7/24
Top Side	21625/897.5	10M QPSK(1,0)	5	0.371	0.241	-2.53	22.70	23.50	0.290	2024/7/24
Bottom Side	21625/897.5	10M QPSK(1,0)	5	0.046	0.029	-1.65	22.70	23.50	0.035	2024/7/24
Back Side	21500/885	10M QPSK(1,0)	5	1.043	0.649	-0.79	22.80	23.50	0.763	2024/7/24

Back Side	21750/910	10M QPSK(1,0)	5	1.066	0.651	-1.13	22.84	23.50	0.758	2024/7/24
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8.1.9. SAR measurement Result of LTE Band 20

Test Position	Test channel /Freq.	Test Mode	Separation distance (mm)	SAR Value (W/kg)		Power Drift (±5%)	Conducted power (dBm)	Tune-up power (dBm)	Scaled SAR 10g (W/Kg)	Date
				1g	10g					
Head										
Left Cheek	24300/847	20M QPSK(1,0)	0	0.729	0.455	2.81	23.16	24.00	0.552	2024/7/24
Left Tilt 15 Degree	24300/847	20M QPSK(1,0)	0	0.366	0.224	1.44	23.16	24.00	0.272	2024/7/24
Right Cheek	24300/847	20M QPSK(1,0)	0	0.679	0.407	-0.95	23.16	24.00	0.494	2024/7/24
Right Tilt 15 Degree	24300/847	20M QPSK(1,0)	0	0.345	0.211	-2.91	23.16	24.00	0.256	2024/7/24
Left Cheek	24250/842	20M QPSK(1,0)	0	0.650	0.394	0.10	22.99	24.00	0.497	2024/7/24
Left Cheek	24350/852	20M QPSK(1,0)	0	0.687	0.424	-1.11	23.41	24.00	0.486	2024/7/24
Body										
Front Side	24300/847	20M QPSK(1,0)	5	0.766	0.497	2.80	23.16	24.00	0.603	2024/7/24
Back Side	24300/847	20M QPSK(1,0)	5	1.277	0.845	-3.48	23.16	24.00	1.025	2024/7/24
Left Side	24300/847	20M QPSK(1,0)	5	0.268	0.177	1.10	23.16	24.00	0.215	2024/7/24
Right Side	24300/847	20M QPSK(1,0)	5	0.409	0.271	2.31	23.16	24.00	0.329	2024/7/24
Top Side	24300/847	20M QPSK(1,0)	5	0.421	0.273	-2.39	23.16	24.00	0.331	2024/7/24
Bottom Side	24300/847	20M QPSK(1,0)	5	0.064	0.042	2.13	23.16	24.00	0.051	2024/7/24
Back Side	24250/842	20M QPSK(1,0)	5	1.162	0.738	-2.77	22.99	24.00	0.931	2024/7/24
Back Side	24350/852	20M QPSK(1,0)	5	1.188	0.755	2.32	23.41	24.00	0.865	2024/7/24

8.2. Simultaneous Transmission Analysis

Refer to EN 62209-2:2010 Annex K, the secondary transmitter SAR test exclusion thresholds are determined by:

$$P_{\text{available}} = P_{\text{th},m} \left(\frac{\text{SAR}_{\text{lim}} - \text{SAR}_1}{\text{SAR}_{\text{lim}}} \right)$$

$P_{\text{th},m}$ is the threshold exclusion power level taken from Annex B of EN 62479.

Mode	P_{max} (dBm)	P_{max} (mW)	$P_{\text{th},m}$ (mW)	SAR_{lim} (W/Kg)	SAR_1 (W/Kg)	Calculation Result (mW)	Simultaneous Transmission Exclusion
Bluetooth	3.00	2.00	20	2	1.676	3.24	YES

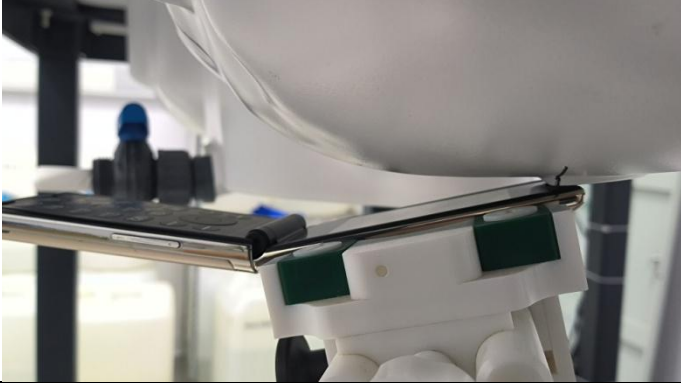
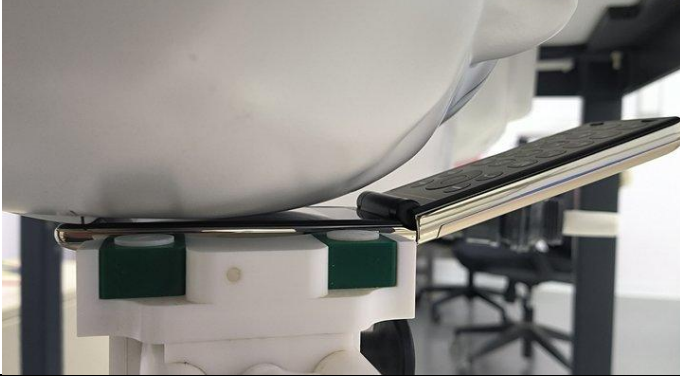
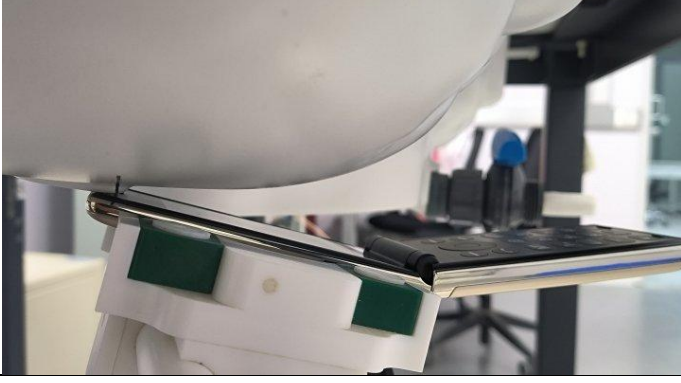
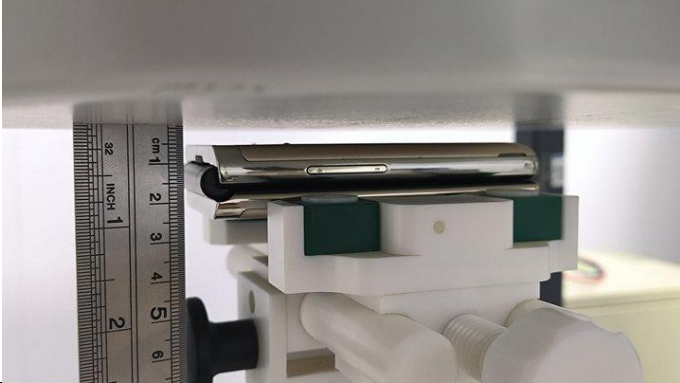
8.3. Exposure Conditions

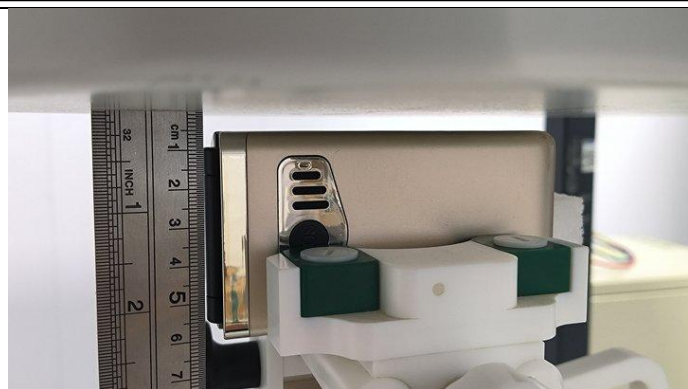
Exposure Position		WWAN	Bluetooth	Simultaneous Tx SAR(W/Kg)
		SAR(W/Kg)	SAR(W/Kg)	
Head	Left Cheek	0.931	/	0.931
	Left Tilt 15 Degree	0.555	/	0.555
	Right Cheek	0.780	/	0.780
	Right Tilt 15 Degree	0.368	/	0.368
Member	Front Side	0.603	/	0.603
	Back Side	1.676	/	1.676
	Left Side	0.270	/	0.270
	Right Side	0.610	/	0.610
	Top Side	0.539	/	0.539
	Bottom Side	0.062	/	0.062

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

9. Appendix A. Photo documentation

Test Positions

Left Cheek 	Left Tilt 15 Degree 
Right Cheek 	Right Tilt 15 Degree 
Front Side (Separation distance of 5mm) 	Back Side (Separation distance of 5mm) 
Left Side (Separation distance of 5mm) 	Right Side (Separation distance of 5mm) 



Top Side
(Separation distance of 5mm)



Bottom Side
(Separation distance of 5mm)



10. Appendix B. System Check Plots

Table of contents
MEASUREMENT 1 System Performance Check - 900MHz
MEASUREMENT 2 System Performance Check - 1800MHz
MEASUREMENT 3 System Performance Check - 2000MHz
MEASUREMENT 4 System Performance Check - 2600MHz

MEASUREMENT 1

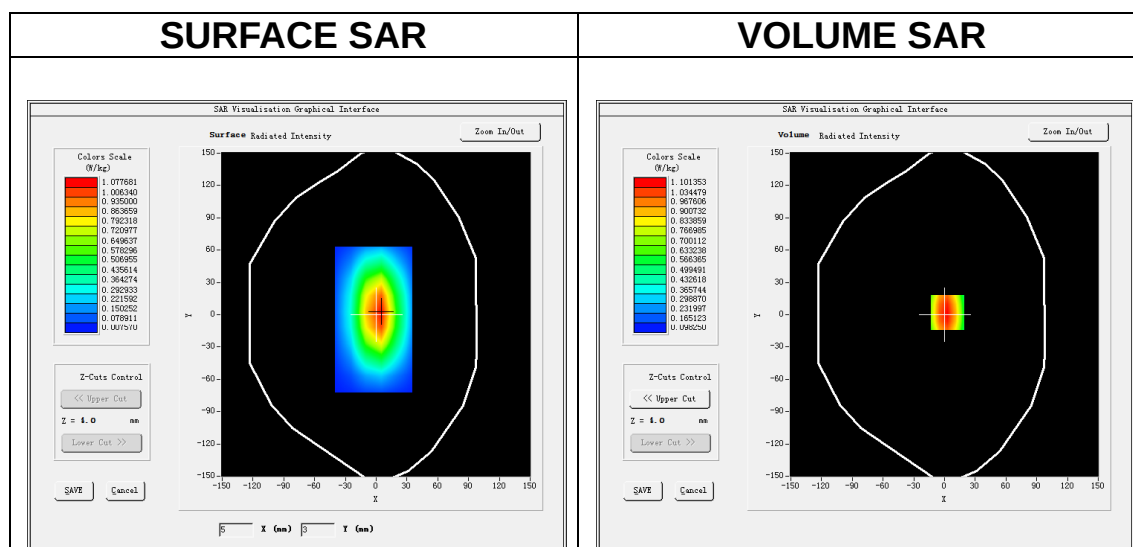
Date of measurement: 24/7/2024

A. Experimental conditions.

<u>Area Scan</u>	<u>dx=15mm dy=15mm, h= 5.00 mm</u>
<u>ZoomScan</u>	<u>5x5x7,dx=8mm dy=8mm dz=5mm</u>
<u>Phantom</u>	<u>Validation plane</u>
<u>Device Position</u>	<u>Dipole</u>
<u>Band</u>	<u>CW900</u>
<u>Channels</u>	<u>Middle</u>
<u>Signal</u>	<u>CW (Crest factor: 1.0)</u>
<u>ConvF</u>	<u>2.23</u>

B. SAR Measurement Results

Frequency (MHz)	900.000000
Relative permittivity (real part)	41.140564
Relative permittivity (imaginary part)	19.667307
Conductivity (S/m)	0.983365
Variation (%)	1.970000

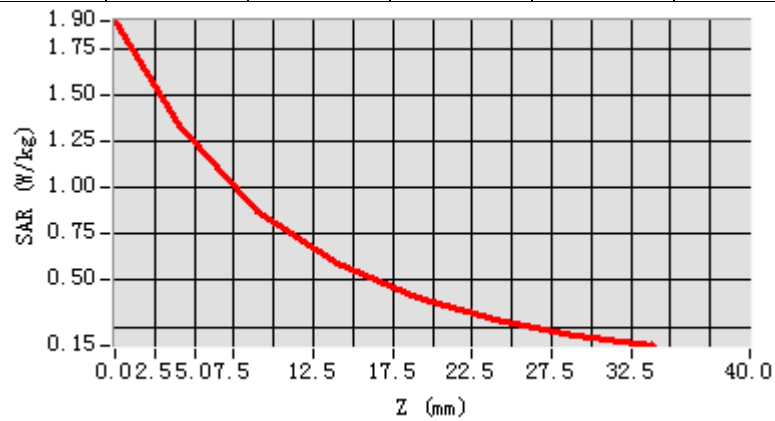


Maximum location: X=3.00, Y=3.00

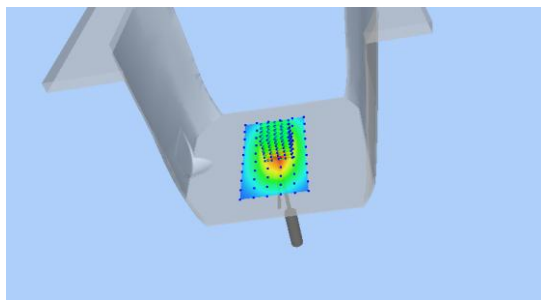
SAR Peak: 1.90 W/kg

SAR 10g (W/Kg)	0.712191
SAR 1g (W/Kg)	1.029231

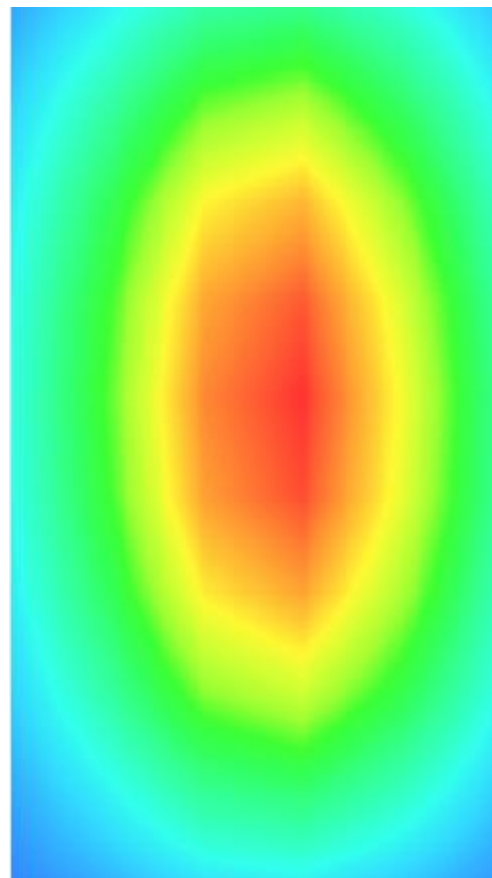
Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	1.9106	1.3570	0.8644	0.5829	0.4286	0.2347	0.2023



3D screen shot



Hot spot position



MEASUREMENT 2

Date of measurement: 25/7/2024

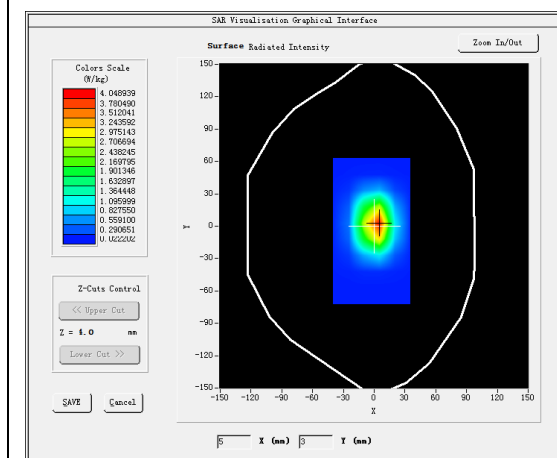
A. Experimental conditions.

<u>Area Scan</u>	<u>dx=15mm dy=15mm, h= 5.00 mm</u>
<u>ZoomScan</u>	<u>5x5x7,dx=8mm dy=8mm dz=5mm</u>
<u>Phantom</u>	<u>Validation plane</u>
<u>Device Position</u>	<u>Dipole</u>
<u>Band</u>	<u>CW1800</u>
<u>Channels</u>	<u>Middle</u>
<u>Signal</u>	<u>CW (Crest factor: 1.0)</u>
<u>ConvF</u>	<u>2.45</u>

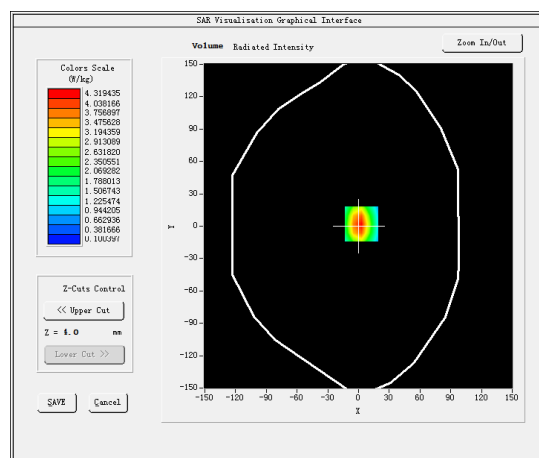
B. SAR Measurement Results

Frequency (MHz)	1800.000000
Relative permittivity (real part)	38.890183
Relative permittivity (imaginary part)	13.761942
Conductivity (S/m)	1.376194
Variation (%)	-2.520000

SURFACE SAR



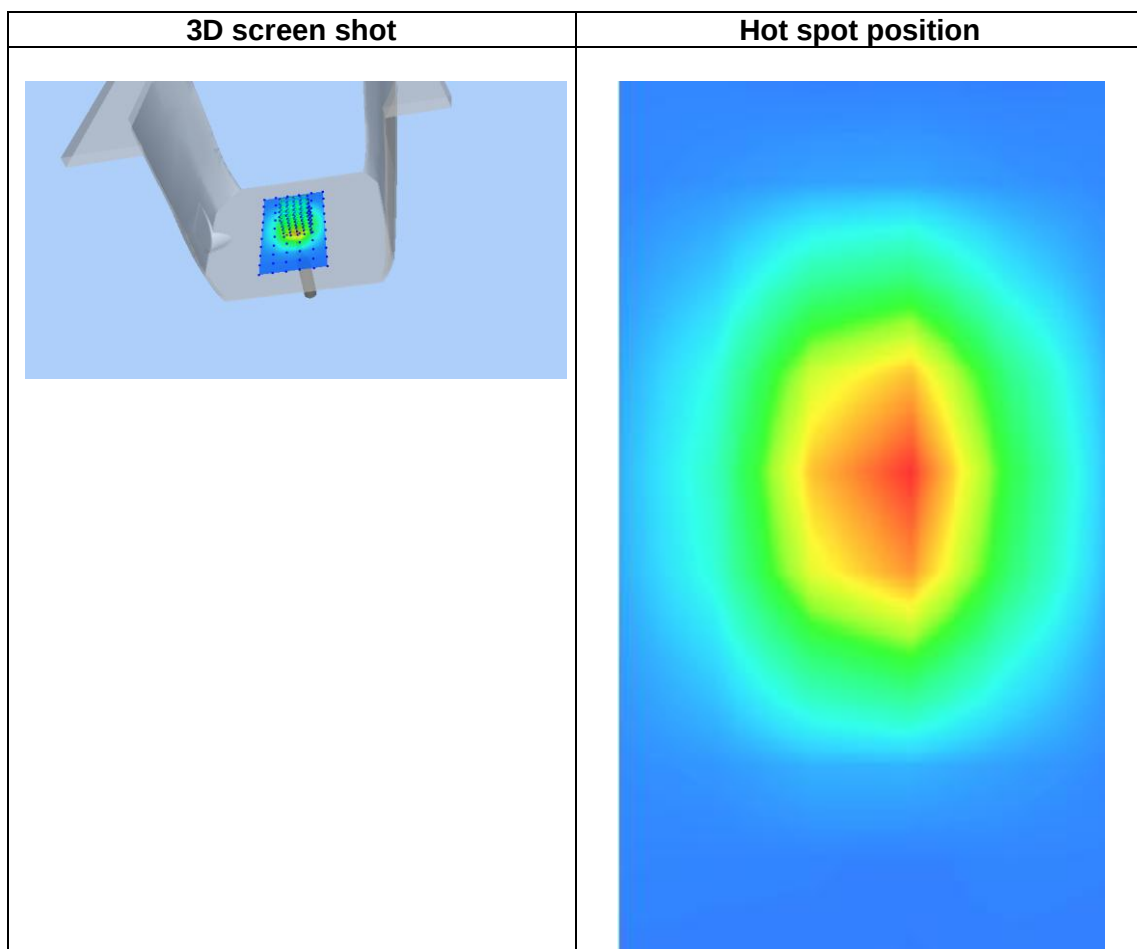
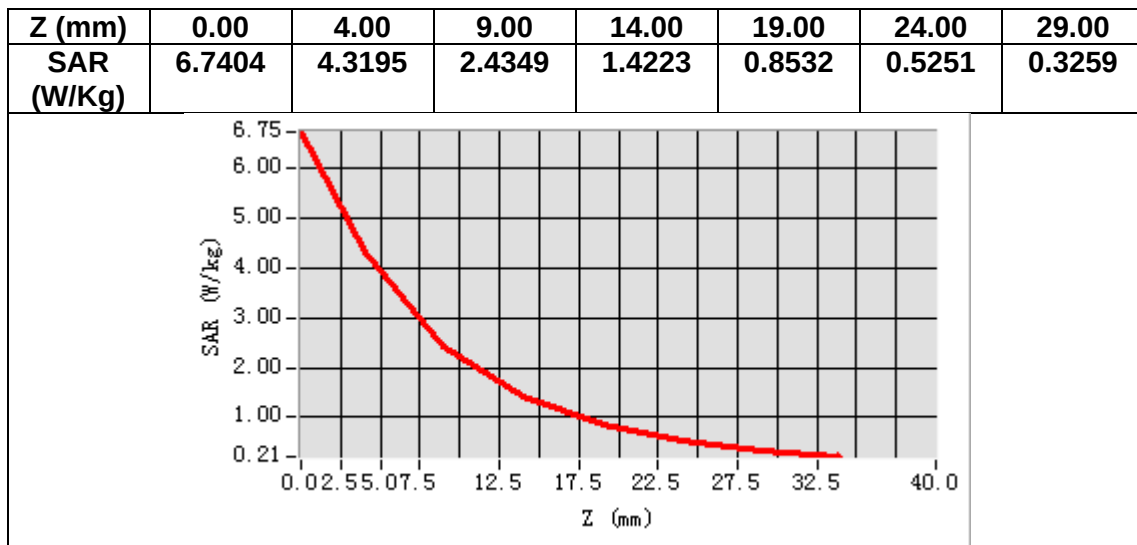
VOLUME SAR



Maximum location: X=3.00, Y=2.00

SAR Peak: 6.82 W/kg

SAR 10g (W/Kg)	1.840296
SAR 1g (W/Kg)	3.560160



MEASUREMENT 3

Date of measurement: 26/7/2024

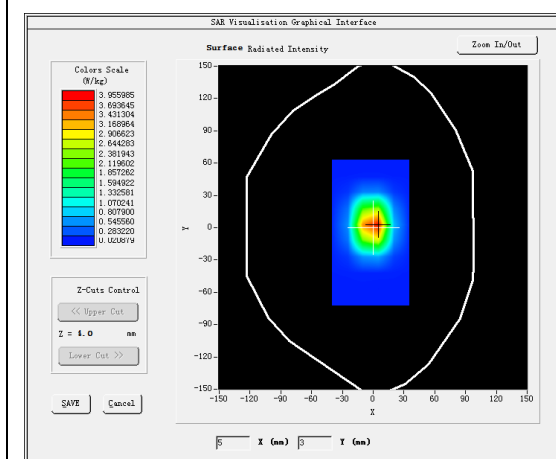
A. Experimental conditions.

<u>Area Scan</u>	<u>dx=15mm dy=15mm, h= 5.00 mm</u>
<u>ZoomScan</u>	<u>5x5x7,dx=8mm dy=8mm dz=5mm</u>
<u>Phantom</u>	<u>Validation plane</u>
<u>Device Position</u>	<u>Dipole</u>
<u>Band</u>	<u>CW2000</u>
<u>Channels</u>	<u>Middle</u>
<u>Signal</u>	<u>CW (Crest factor: 1.0)</u>
<u>ConvF</u>	<u>2.83</u>

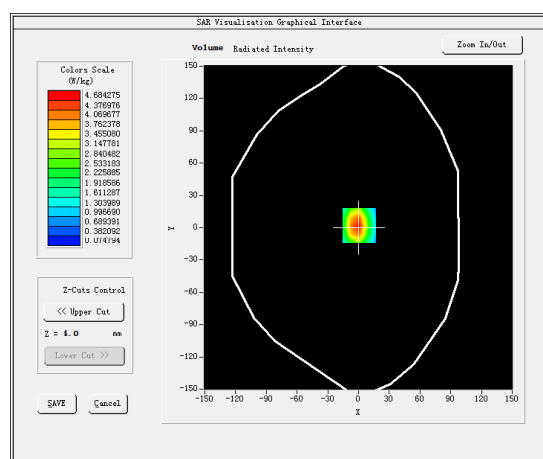
B. SAR Measurement Results

Frequency (MHz)	2000.000000
Relative permittivity (real part)	38.820816
Relative permittivity (imaginary part)	12.977350
Conductivity (S/m)	1.441928
Variation (%)	2.050000

SURFACE SAR



VOLUME SAR

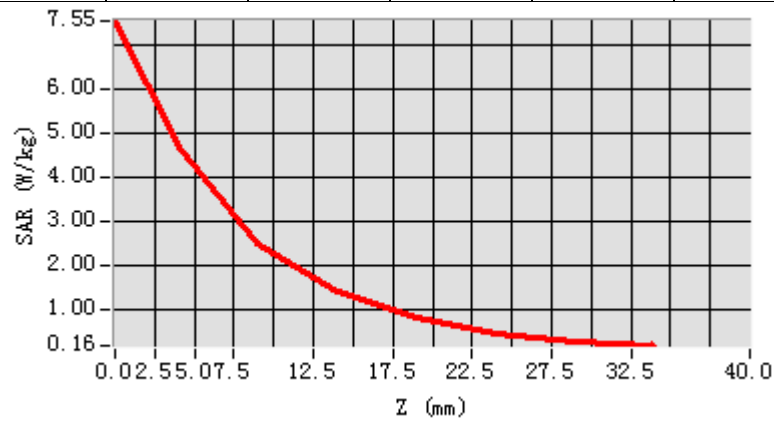


Maximum location: X=1.00, Y=2.00

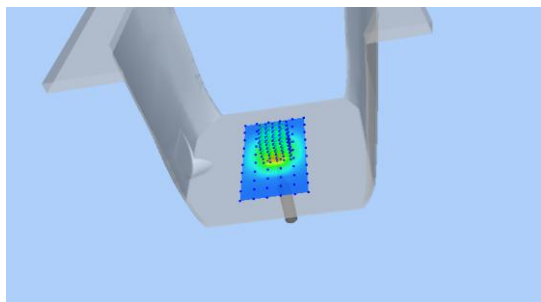
SAR Peak: 7.65 W/kg

SAR 10g (W/Kg)	1.960384
SAR 1g (W/Kg)	4.037097

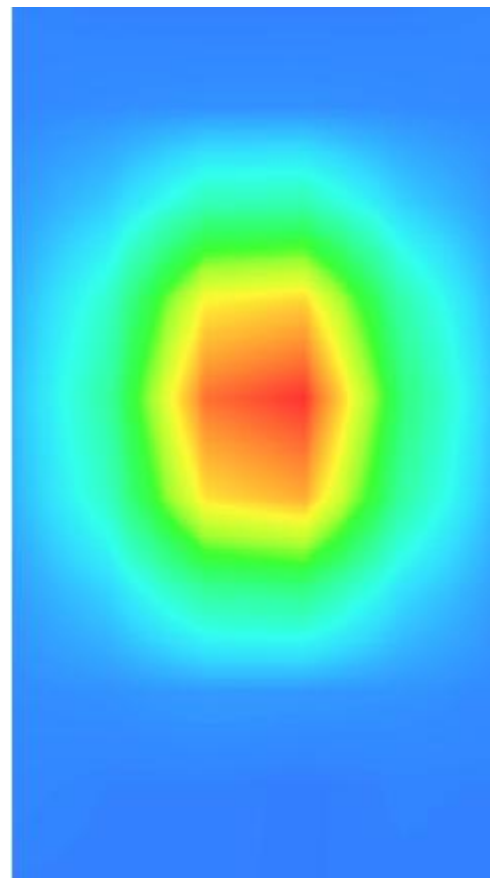
Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	7.5474	4.6812	2.5037	1.3805	0.7778	0.4439	0.2686



3D screen shot



Hot spot position



MEASUREMENT 4

Date of measurement: 19/7/2024

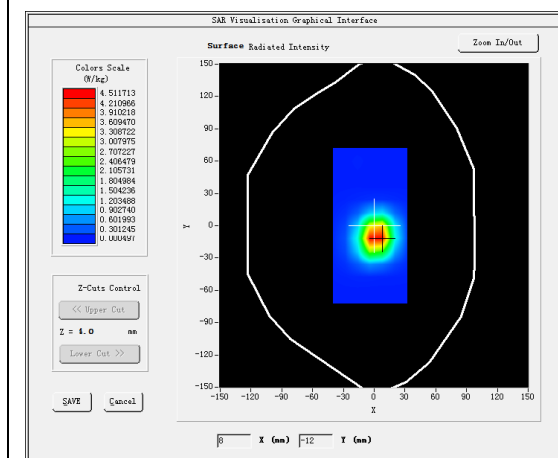
A. Experimental conditions.

<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>Validation plane</u>
<u>Device Position</u>	<u>Dipole</u>
<u>Band</u>	<u>CW2600</u>
<u>Channels</u>	<u>Middle</u>
<u>Signal</u>	<u>CW (Crest factor: 1.0)</u>
<u>ConvF</u>	<u>2.65</u>

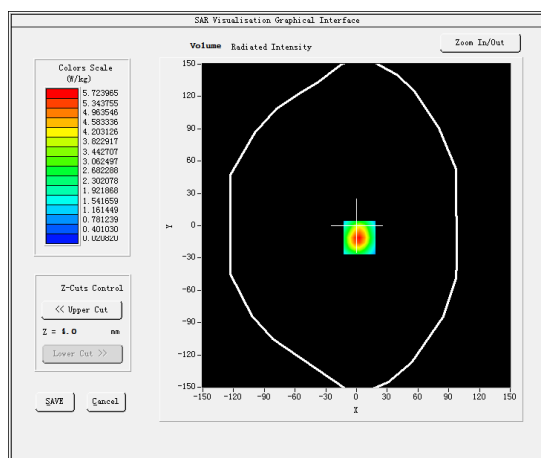
B. SAR Measurement Results

Frequency (MHz)	2600.000000
Relative permittivity (real part)	39.125963
Relative permittivity (imaginary part)	13.908930
Conductivity (S/m)	2.009068
Variation (%)	1.570000

SURFACE SAR



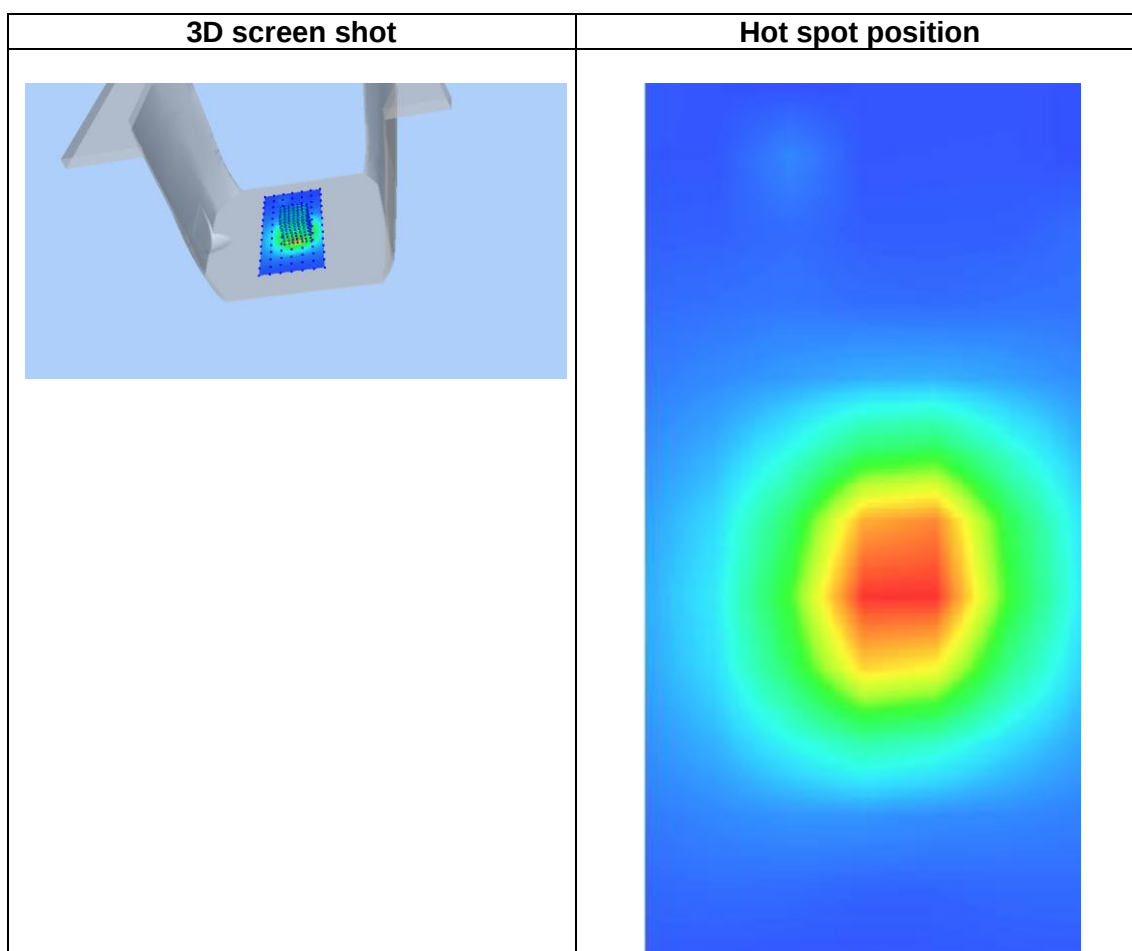
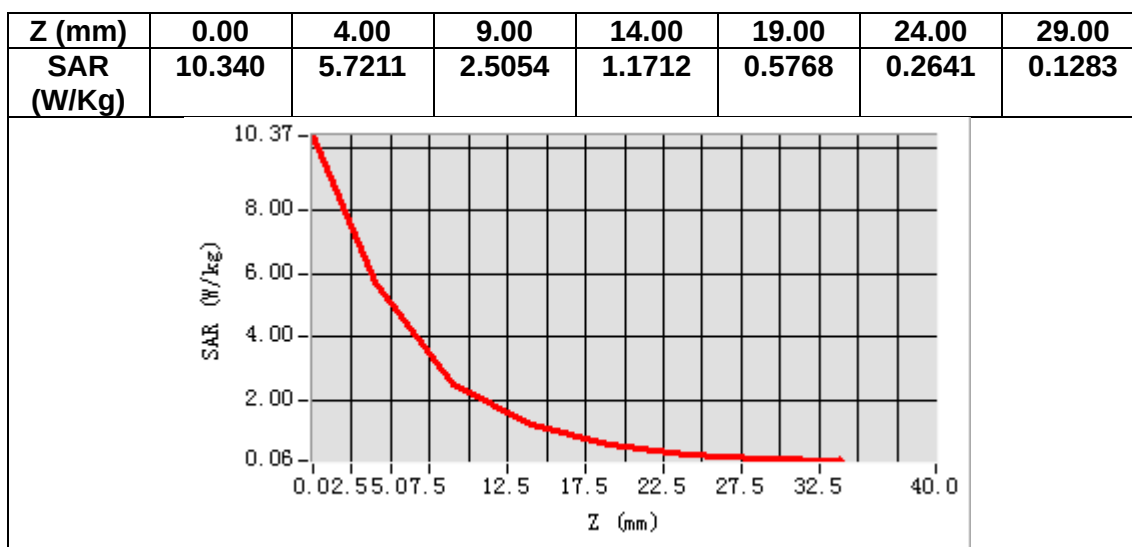
VOLUME SAR



Maximum location: X=3.00, Y=-11.00

SAR Peak: 10.29 W/kg

SAR 10g (W/Kg)	2.468172
SAR 1g (W/Kg)	5.705128



11. Appendix C. Plots of High SAR Measurement

Table of contents
MEASUREMENT 1 GSM 900 Head
MEASUREMENT 2 GSM 900 Body
MEASUREMENT 3 GSM 1800 Head
MEASUREMENT 4 GSM 1800 Body
MEASUREMENT 5 WCDMA Band 1 Head
MEASUREMENT 6 WCDMA Band 1 Body
MEASUREMENT 7 WCDMA Band 8 Head
MEASUREMENT 8 WCDMA Band 8 Body
MEASUREMENT 9 LTE Band 1 Head
MEASUREMENT 10 LTE Band 1 Body
MEASUREMENT 11 LTE Band 3 Head
MEASUREMENT 12 LTE Band 3 Body
MEASUREMENT 13 LTE Band 7 Head
MEASUREMENT 14 LTE Band 7 Body
MEASUREMENT 15 LTE Band 8 Head
MEASUREMENT 16 LTE Band 8 Body
MEASUREMENT 17 LTE Band 20 Head
MEASUREMENT 18 LTE Band 20 Body

MEASUREMENT 1

Date of measurement: 24/7/2024

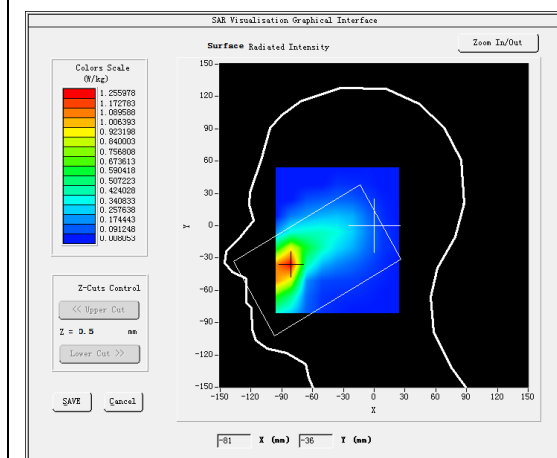
A. Experimental conditions.

<u>Area Scan</u>	<u>dx=15mm dy=15mm, h= 5.00 mm</u>
<u>ZoomScan</u>	<u>5x5x7,dx=8mm dy=8mm dz=5mm</u>
<u>Phantom</u>	<u>Left head</u>
<u>Device Position</u>	<u>Cheek</u>
<u>Band</u>	<u>GSM900</u>
<u>Channels</u>	<u>Middle</u>
<u>Signal</u>	<u>TDMA (Crest factor: 4.0)</u>
<u>ConvF</u>	<u>2.23</u>

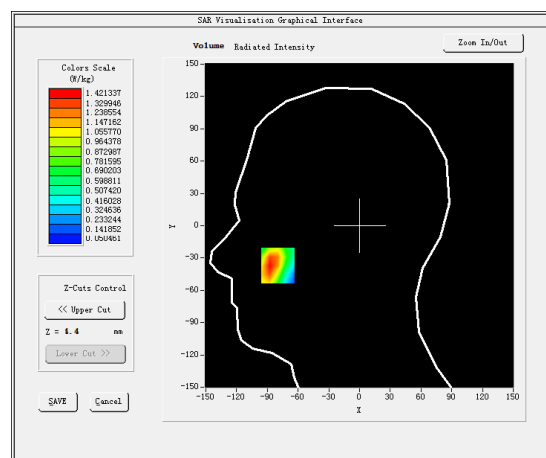
B. SAR Measurement Results

Frequency (MHz)	897.600000
Relative permittivity (real part)	41.220924
Relative permittivity (imaginary part)	19.721127
Conductivity (S/m)	0.983427
Variation (%)	1.230000

SURFACE SAR



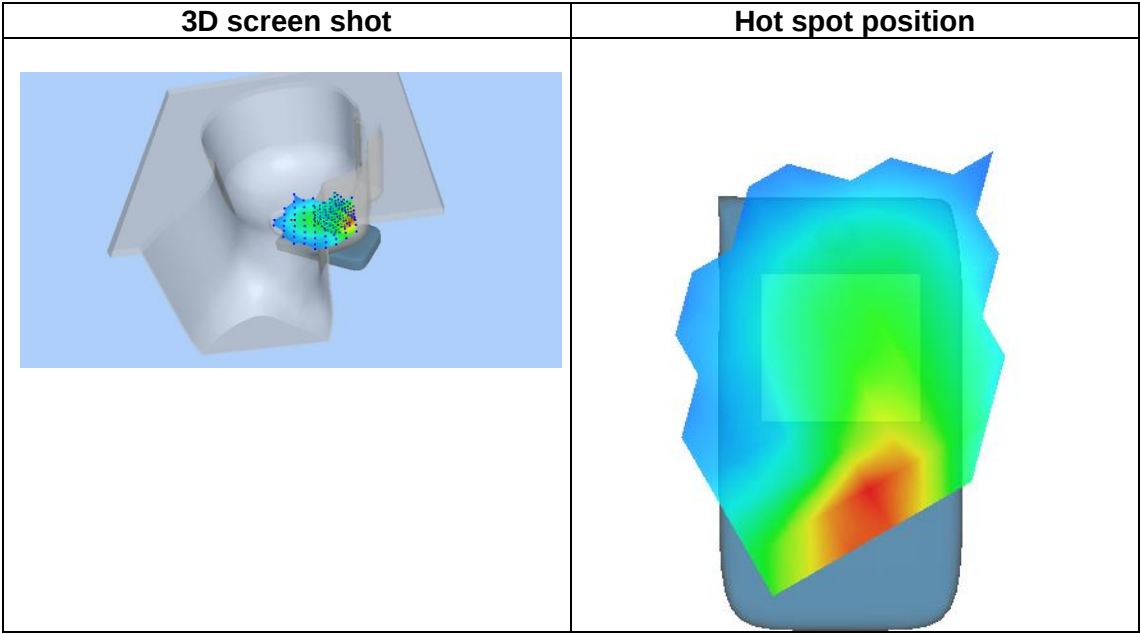
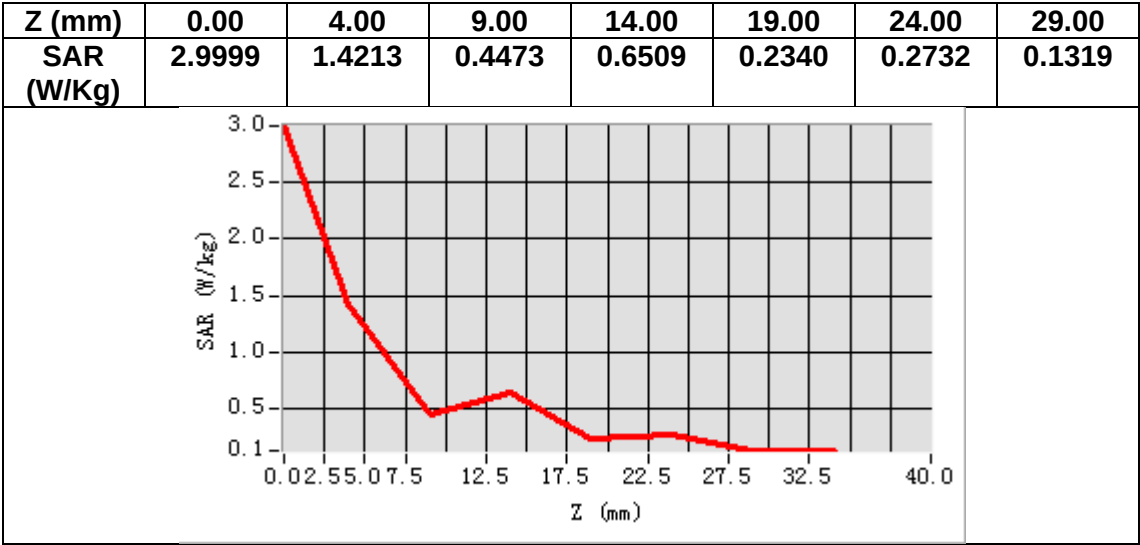
VOLUME SAR



Maximum location: X=-80.00, Y=-37.00

SAR Peak: 1.99 W/kg

SAR 10g (W/Kg)	0.820209
SAR 1g (W/Kg)	1.360368



MEASUREMENT 2

Date of measurement: 24/7/2024

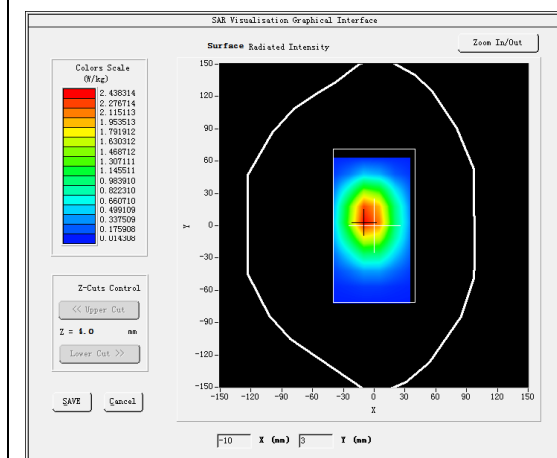
A. Experimental conditions.

<u>Area Scan</u>	<u>dx=15mm dy=15mm, h= 5.00 mm</u>
<u>ZoomScan</u>	<u>5x5x7, dx=8mm dy=8mm dz=5mm</u>
<u>Phantom</u>	<u>Validation plane</u>
<u>Device Position</u>	<u>Body</u>
<u>Band</u>	<u>GSM900</u>
<u>Channels</u>	<u>High</u>
<u>Signal</u>	<u>TDMA (Crest factor: 4.0)</u>
<u>ConvF</u>	<u>2.23</u>

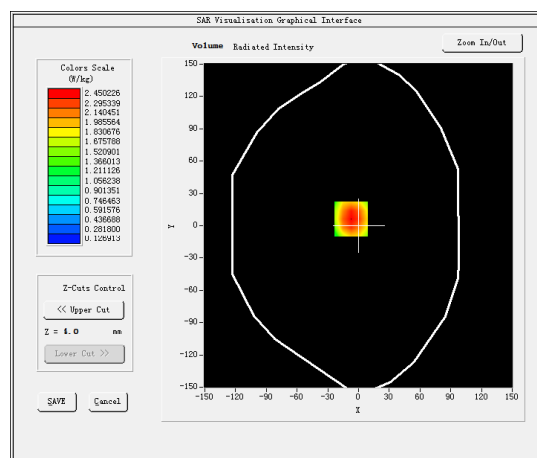
B. SAR Measurement Results

Frequency (MHz)	914.800000
Relative permittivity (real part)	41.022083
Relative permittivity (imaginary part)	19.750128
Conductivity (S/m)	1.003745
Variation (%)	-2.130000

SURFACE SAR



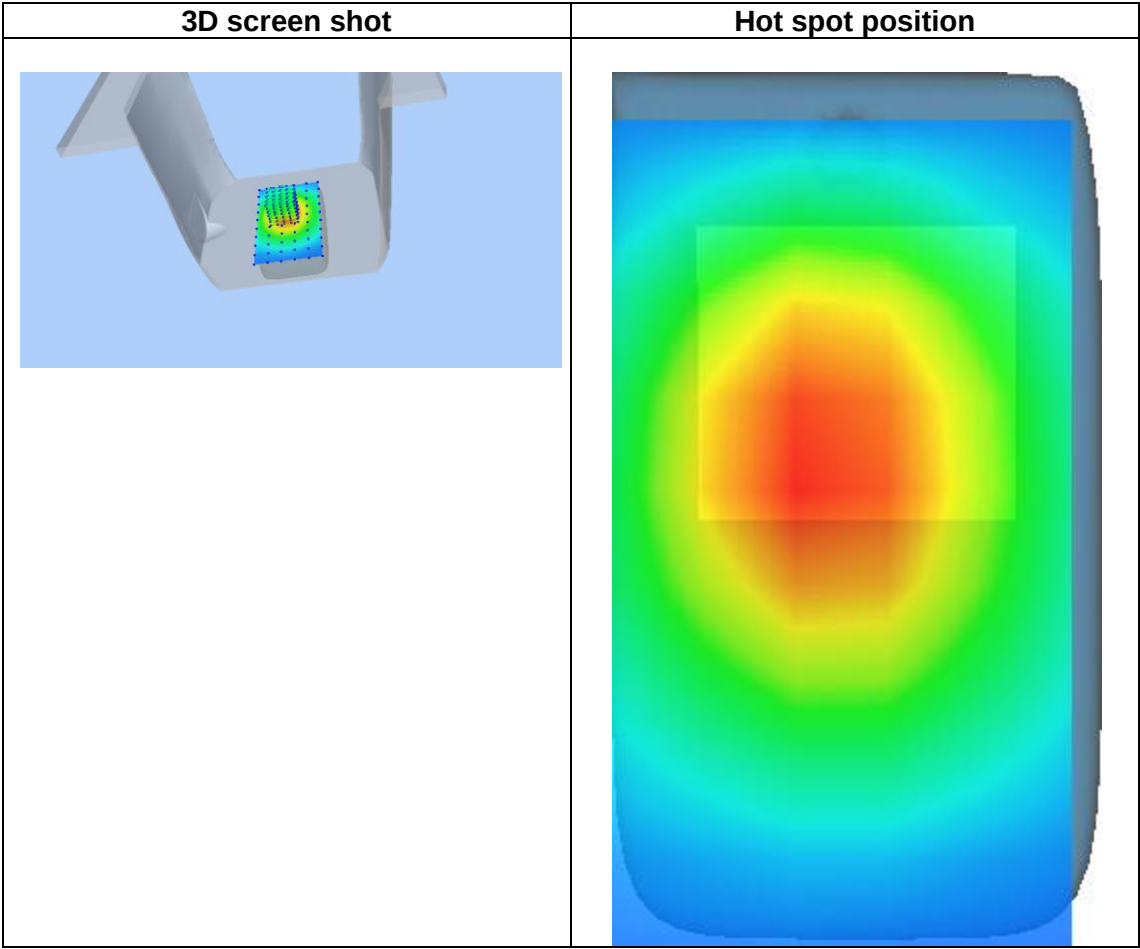
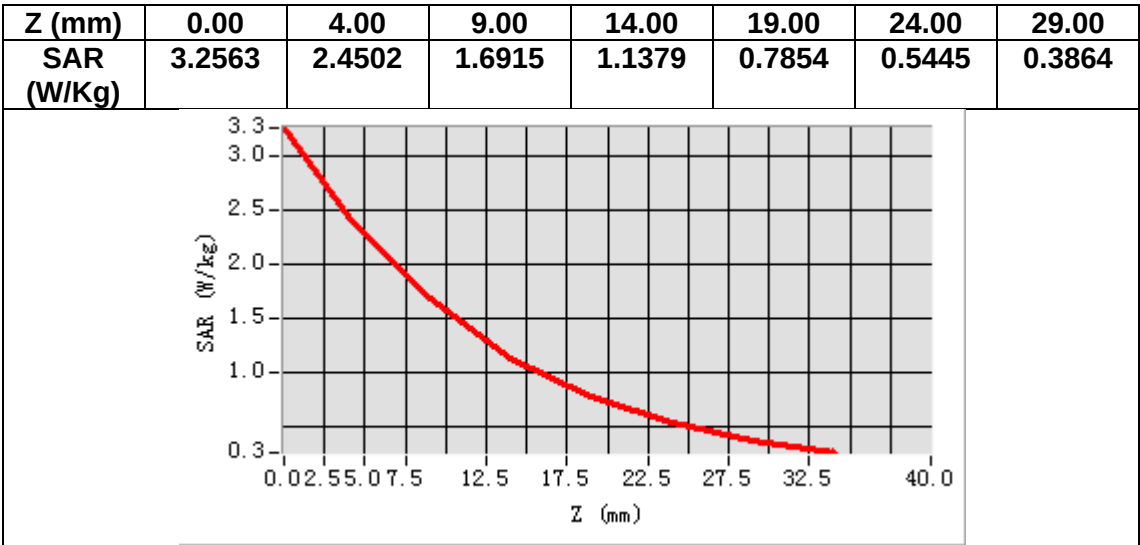
VOLUME SAR



Maximum location: X=-7.00, Y=6.00

SAR Peak: 3.36 W/kg

SAR 10g (W/Kg)	1.557295
SAR 1g (W/Kg)	2.395354



MEASUREMENT 3

Date of measurement: 25/7/2024

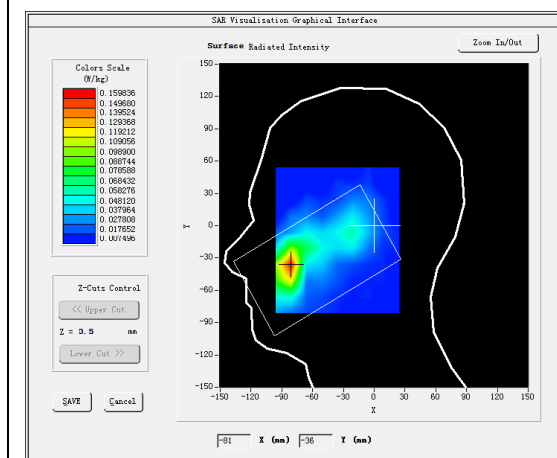
A. Experimental conditions.

<u>Area Scan</u>	<u>dx=15mm dy=15mm, h= 5.00 mm</u>
<u>ZoomScan</u>	<u>5x5x7,dx=8mm dy=8mm dz=5mm</u>
<u>Phantom</u>	<u>Left head</u>
<u>Device Position</u>	<u>Cheek</u>
<u>Band</u>	<u>GSM1800</u>
<u>Channels</u>	<u>High</u>
<u>Signal</u>	<u>TDMA (Crest factor: 4.0)</u>
<u>ConvF</u>	<u>2.45</u>

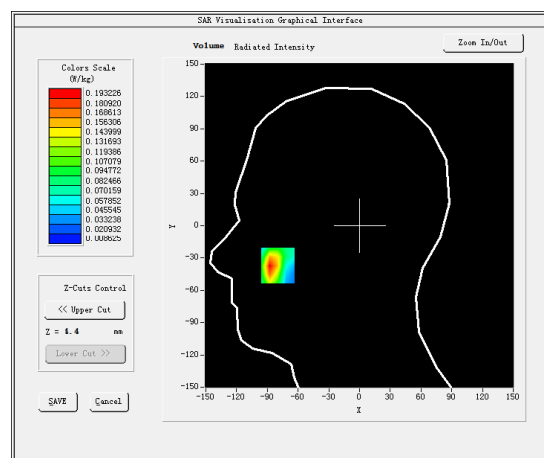
B. SAR Measurement Results

Frequency (MHz)	1784.800000
Relative permittivity (real part)	38.964302
Relative permittivity (imaginary part)	13.725002
Conductivity (S/m)	1.360910
Variation (%)	4.230000

SURFACE SAR



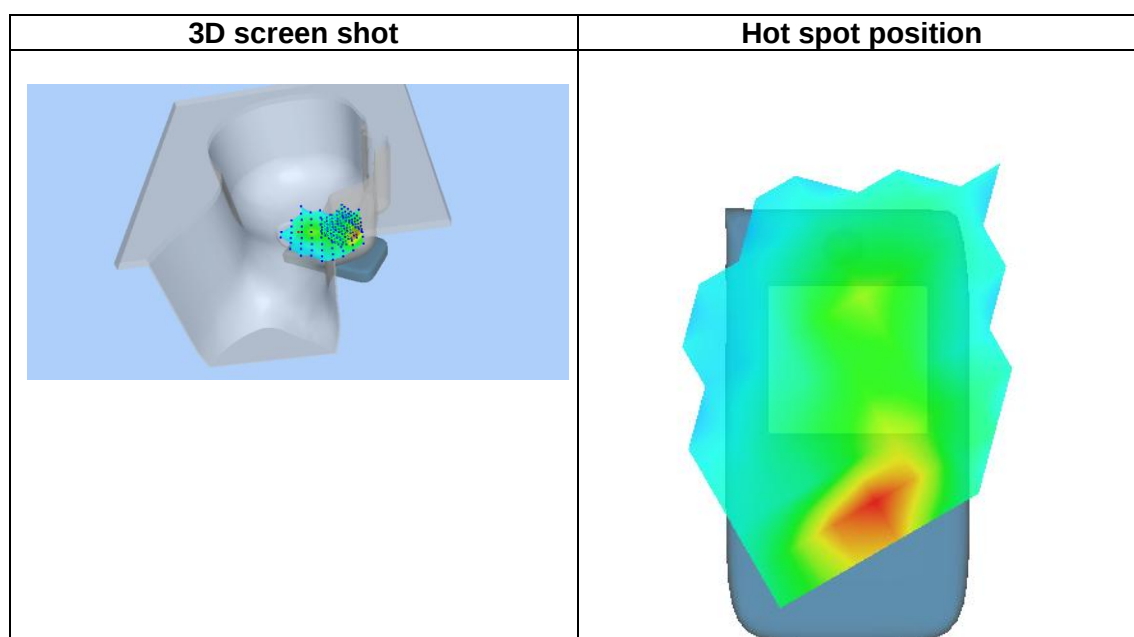
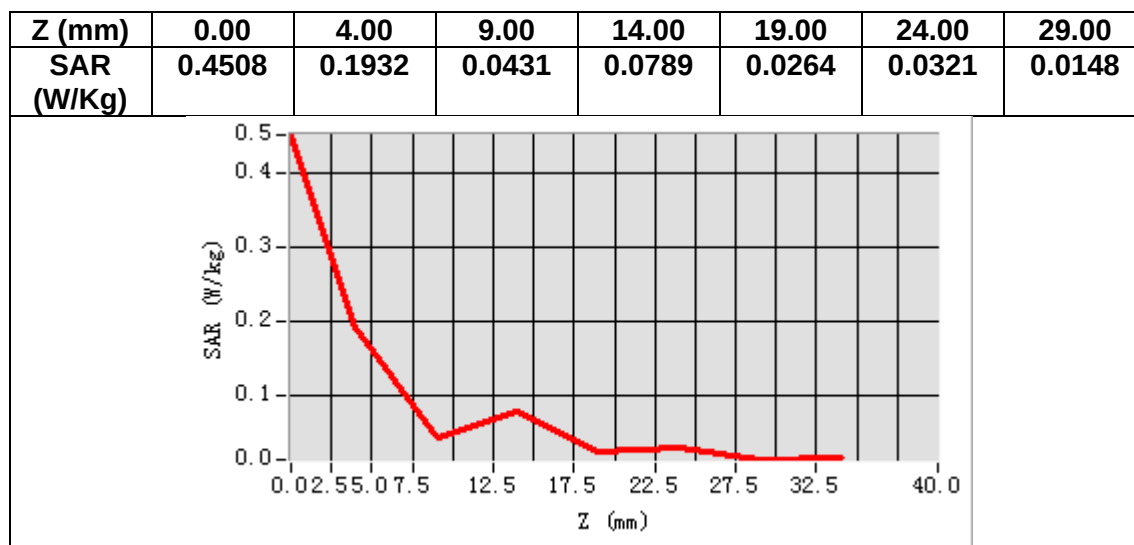
VOLUME SAR



Maximum location: X=-80.00, Y=-37.00

SAR Peak: 0.28 W/kg

SAR 10g (W/Kg)	0.099189
SAR 1g (W/Kg)	0.180936



MEASUREMENT 4

Date of measurement: 25/7/2024

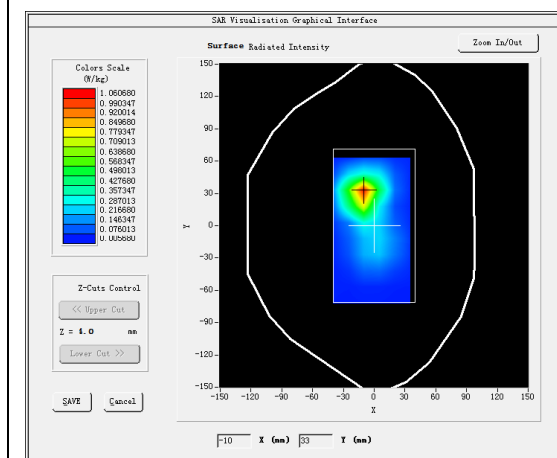
A. Experimental conditions.

<u>Area Scan</u>	<u>dx=15mm dy=15mm, h= 5.00 mm</u>
<u>ZoomScan</u>	<u>5x5x7, dx=8mm dy=8mm dz=5mm</u>
<u>Phantom</u>	<u>Validation plane</u>
<u>Device Position</u>	<u>Body</u>
<u>Band</u>	<u>GSM1800</u>
<u>Channels</u>	<u>High</u>
<u>Signal</u>	<u>TDMA (Crest factor: 4.0)</u>
<u>ConvF</u>	<u>2.45</u>

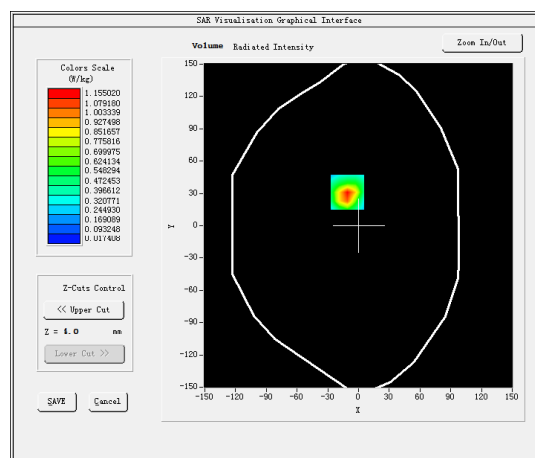
B. SAR Measurement Results

Frequency (MHz)	1784.800000
Relative permittivity (real part)	38.964302
Relative permittivity (imaginary part)	13.725002
Conductivity (S/m)	1.360910
Variation (%)	1.480000

SURFACE SAR



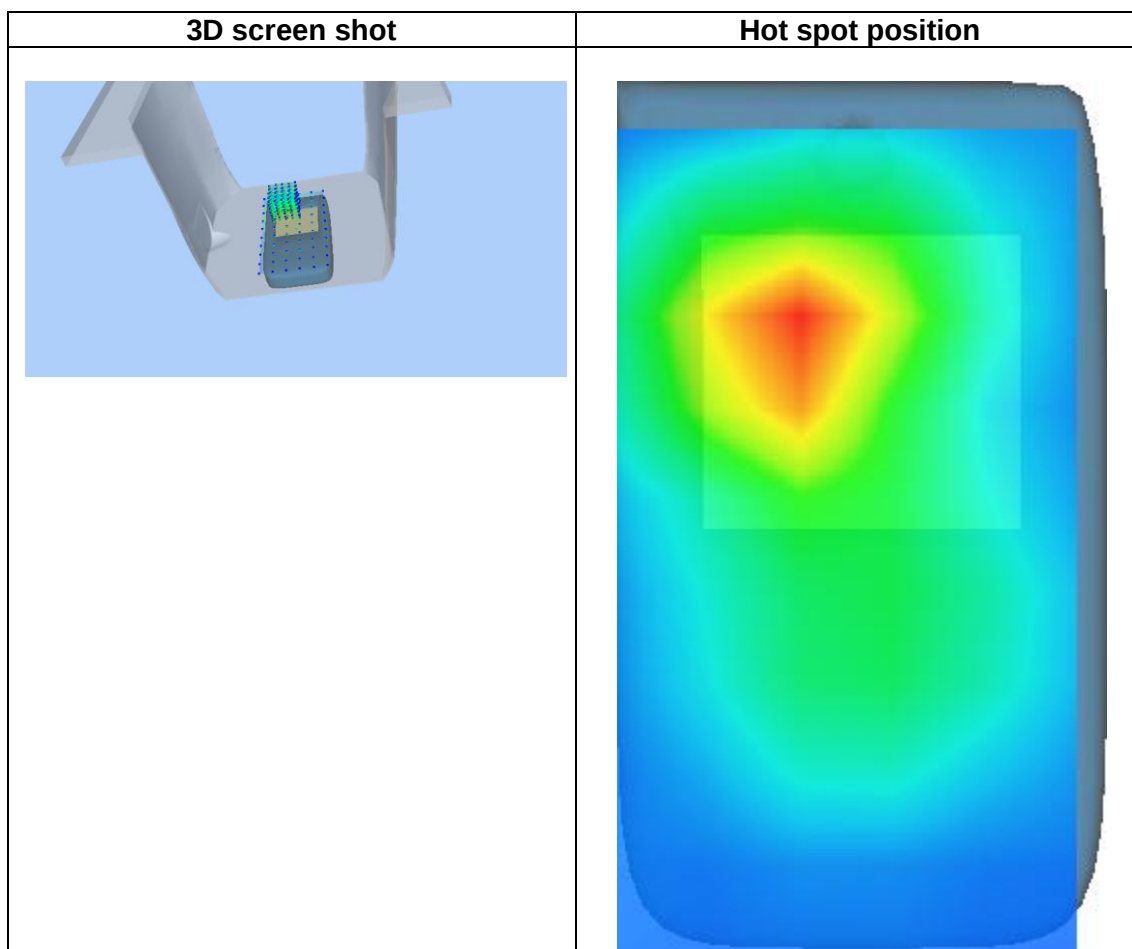
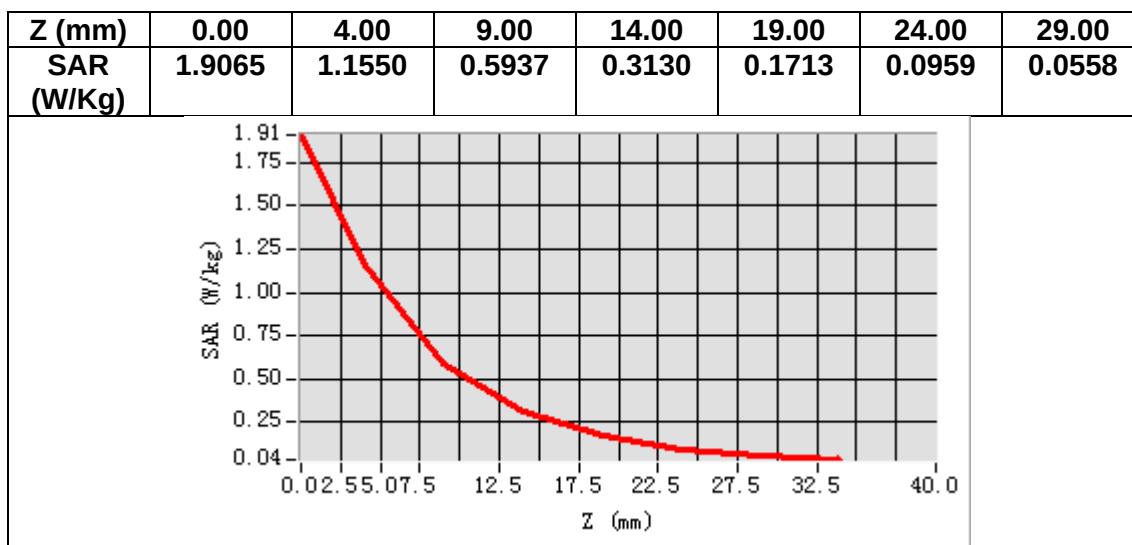
VOLUME SAR



Maximum location: X=-11.00, Y=31.00

SAR Peak: 1.94 W/kg

SAR 10g (W/Kg)	0.511941
SAR 1g (W/Kg)	1.081453



MEASUREMENT 5

Date of measurement: 26/7/2024

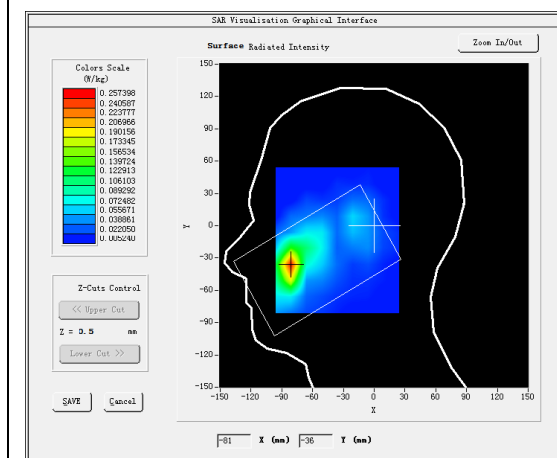
A. Experimental conditions.

<u>Area Scan</u>	<u>dx=15mm dy=15mm, h= 5.00 mm</u>
<u>ZoomScan</u>	<u>5x5x7,dx=8mm dy=8mm dz=5mm</u>
<u>Phantom</u>	<u>Left head</u>
<u>Device Position</u>	<u>Cheek</u>
<u>Band</u>	<u>Band1 UMTS</u>
<u>Channels</u>	<u>Middle</u>
<u>Signal</u>	<u>WCDMA (Crest factor: 1.0)</u>
<u>ConvF</u>	<u>2.83</u>

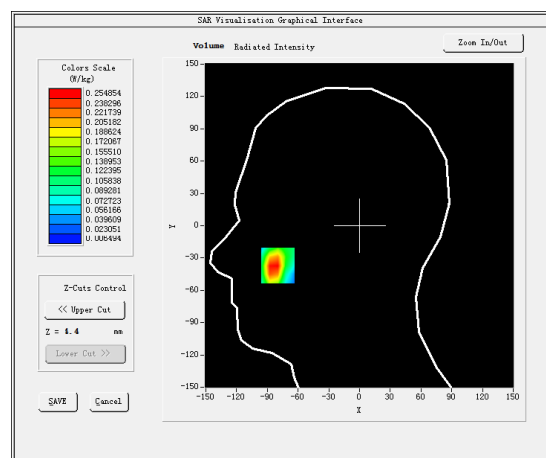
B. SAR Measurement Results

Frequency (MHz)	1950.000000
Relative permittivity (real part)	38.953915
Relative permittivity (imaginary part)	12.937650
Conductivity (S/m)	1.401579
Variation (%)	-3.550000

SURFACE SAR



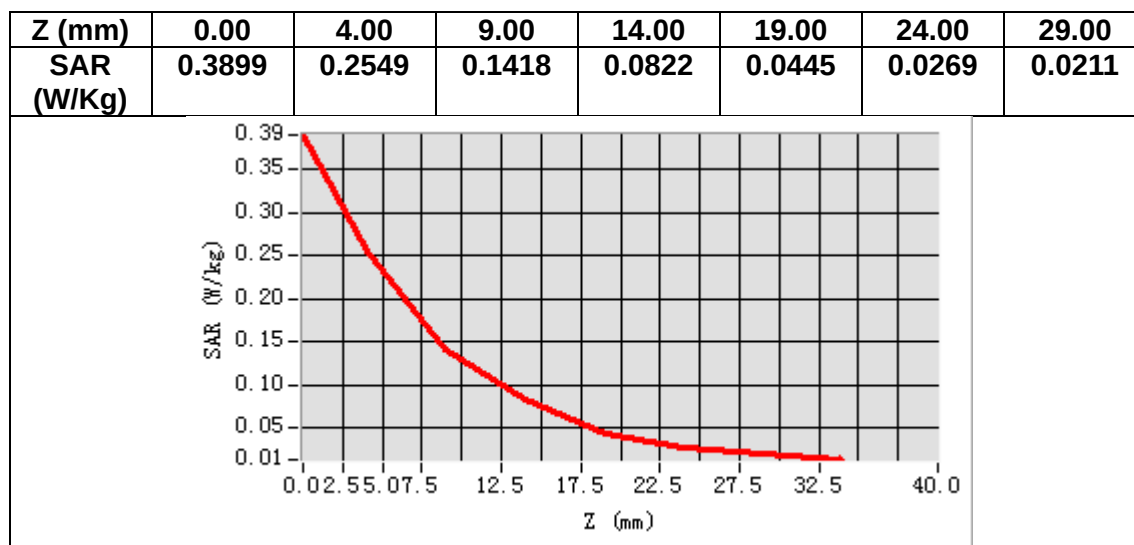
VOLUME SAR



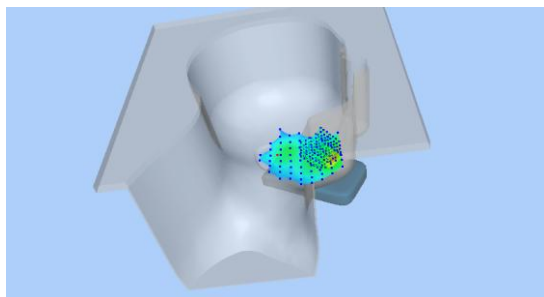
Maximum location: X=-80.00, Y=-37.00

SAR Peak: 0.41 W/kg

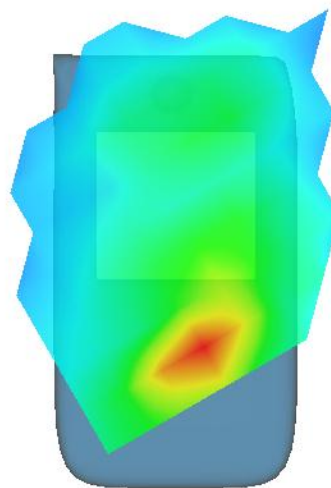
SAR 10g (W/Kg)	0.134489
SAR 1g (W/Kg)	0.255842



3D screen shot



Hot spot position



MEASUREMENT 6

Date of measurement: 26/7/2024

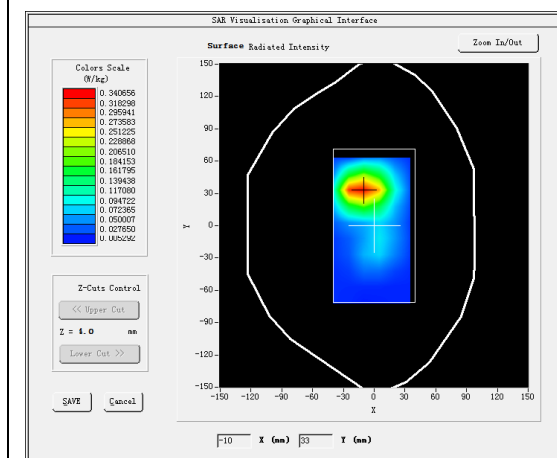
A. Experimental conditions.

<u>Area Scan</u>	<u>dx=15mm dy=15mm, h= 5.00 mm</u>
<u>ZoomScan</u>	<u>5x5x7,dx=8mm dy=8mm dz=5mm</u>
<u>Phantom</u>	<u>Validation plane</u>
<u>Device Position</u>	<u>Body</u>
<u>Band</u>	<u>Band1 UMTS</u>
<u>Channels</u>	<u>Middle</u>
<u>Signal</u>	<u>WCDMA (Crest factor: 1.0)</u>
<u>ConvF</u>	<u>2.83</u>

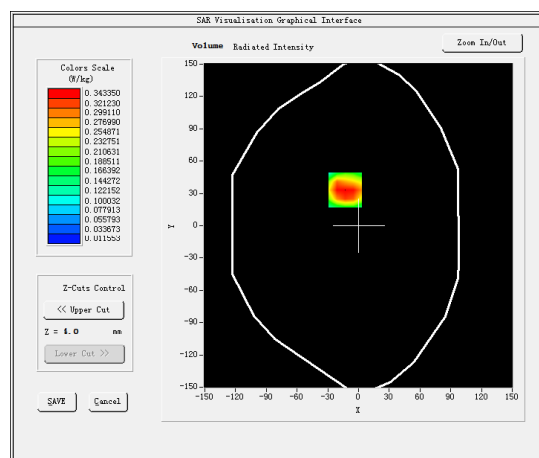
B. SAR Measurement Results

Frequency (MHz)	1950.000000
Relative permittivity (real part)	38.953915
Relative permittivity (imaginary part)	12.937650
Conductivity (S/m)	1.401579
Variation (%)	-3.380000

SURFACE SAR



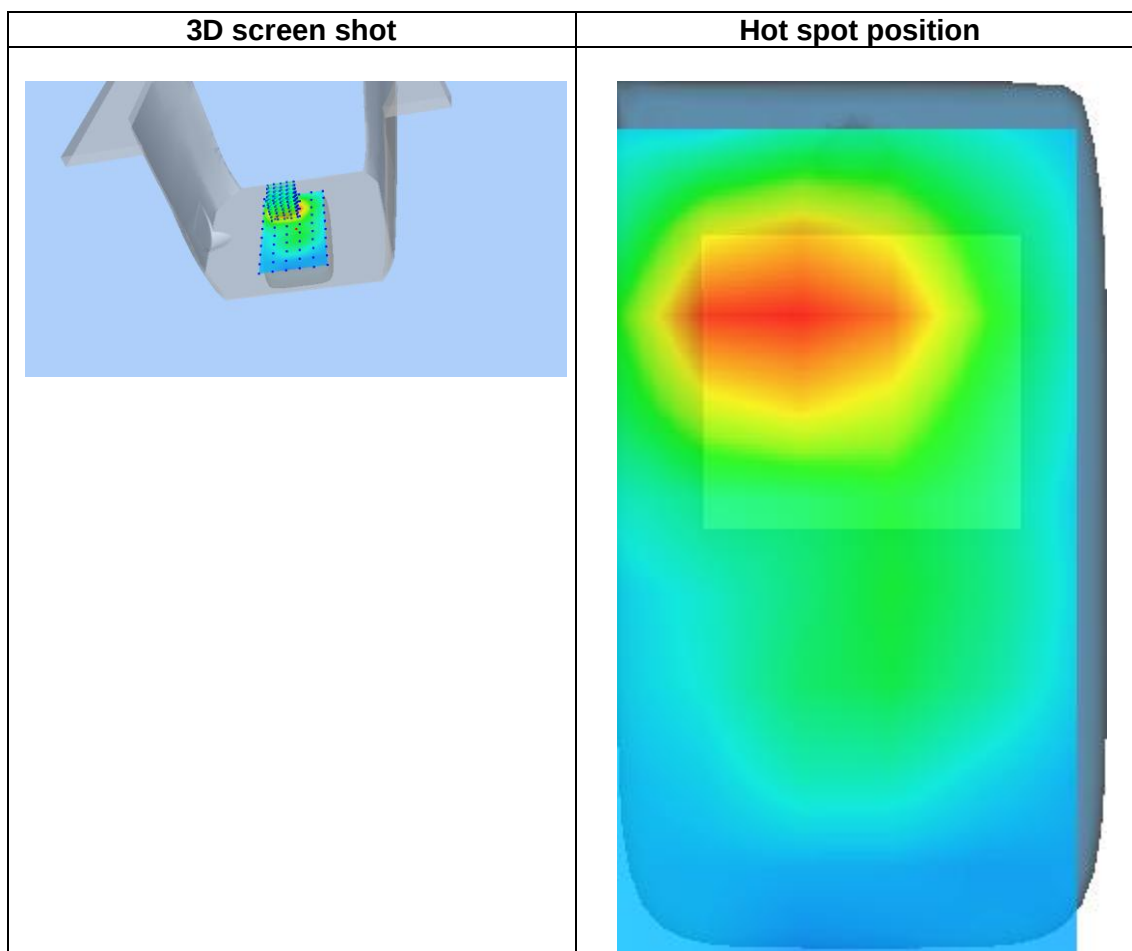
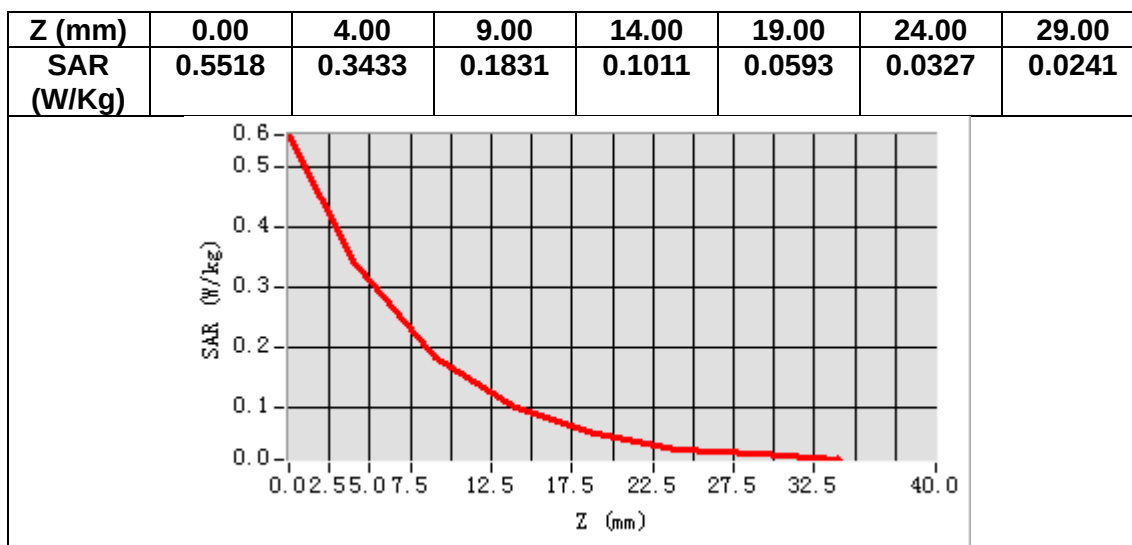
VOLUME SAR



Maximum location: X=-13.00, Y=33.00

SAR Peak: 0.58 W/kg

SAR 10g (W/Kg)	0.179529
SAR 1g (W/Kg)	0.339696



MEASUREMENT 7

Date of measurement: 24/7/2024

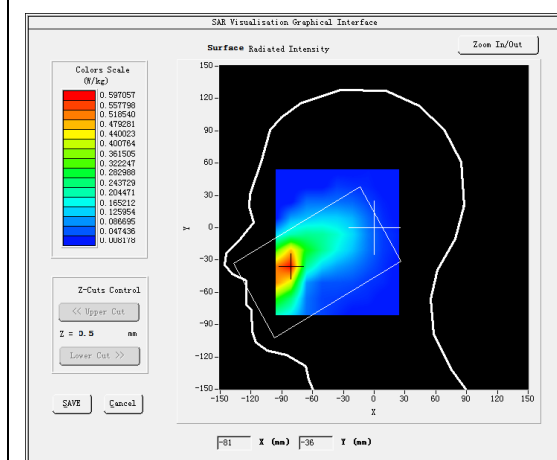
A. Experimental conditions.

<u>Area Scan</u>	<u>dx=15mm dy=15mm, h= 5.00 mm</u>
<u>ZoomScan</u>	<u>5x5x7,dx=8mm dy=8mm dz=5mm</u>
<u>Phantom</u>	<u>Left head</u>
<u>Device Position</u>	<u>Cheek</u>
<u>Band</u>	<u>Band8 WCDMA900</u>
<u>Channels</u>	<u>Middle</u>
<u>Signal</u>	<u>WCDMA (Crest factor: 1.0)</u>
<u>ConvF</u>	<u>2.23</u>

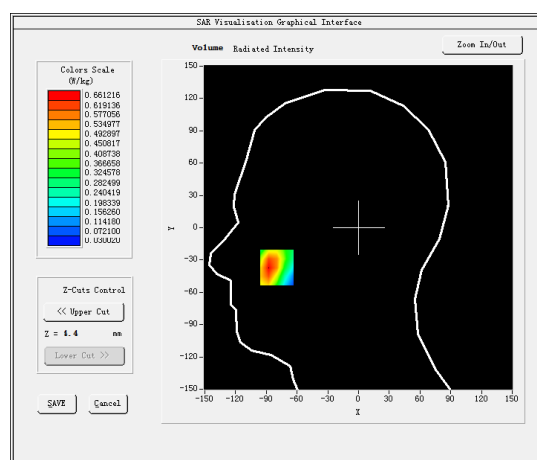
B. SAR Measurement Results

Frequency (MHz)	897.600000
Relative permittivity (real part)	41.220924
Relative permittivity (imaginary part)	19.721127
Conductivity (S/m)	0.983427
Variation (%)	-4.320000

SURFACE SAR



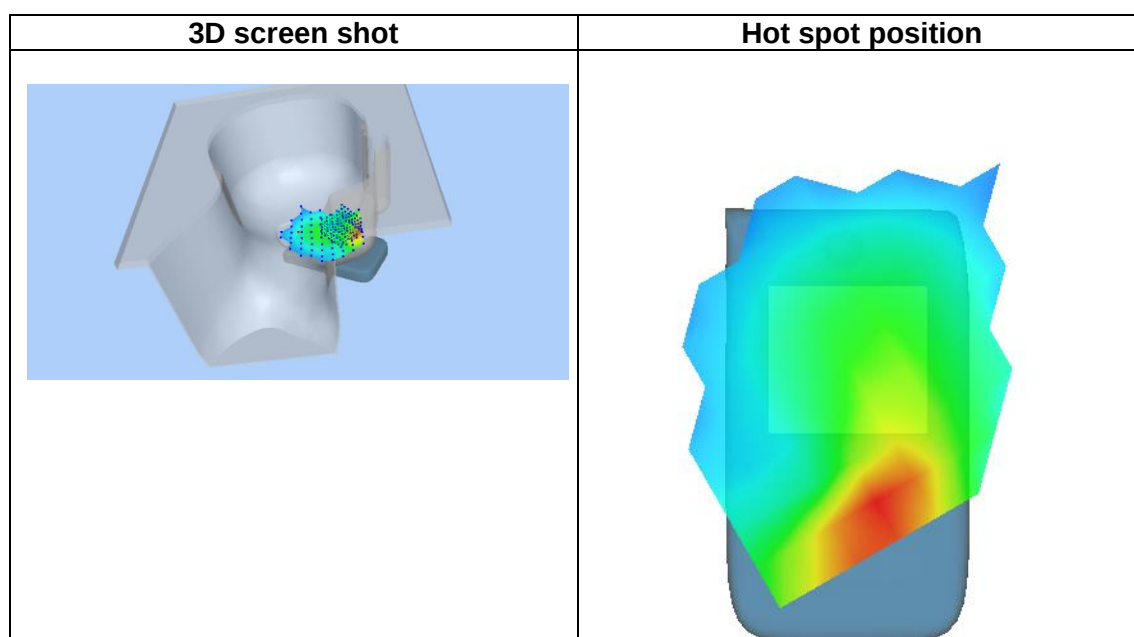
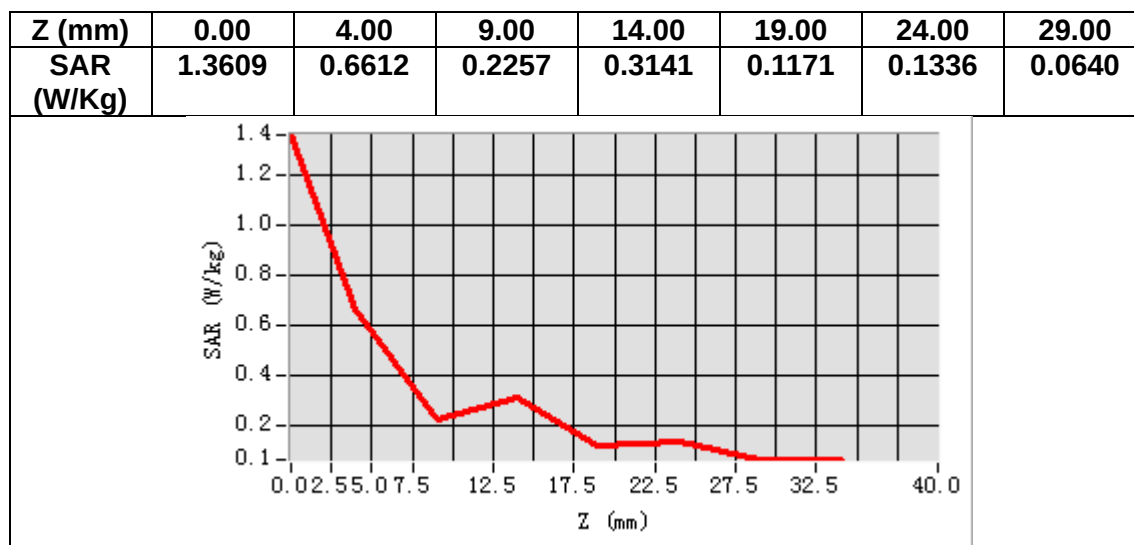
VOLUME SAR



Maximum location: X=-80.00, Y=-37.00

SAR Peak: 0.88 W/kg

SAR 10g (W/Kg)	0.390077
SAR 1g (W/Kg)	0.631132



MEASUREMENT 8

Date of measurement: 24/7/2024

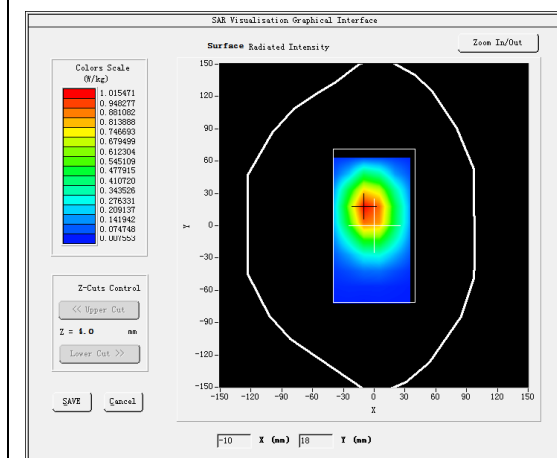
A. Experimental conditions.

<u>Area Scan</u>	<u>dx=15mm dy=15mm, h= 5.00 mm</u>
<u>ZoomScan</u>	<u>5x5x7, dx=8mm dy=8mm dz=5mm</u>
<u>Phantom</u>	<u>Validation plane</u>
<u>Device Position</u>	<u>Body</u>
<u>Band</u>	<u>Band8 WCDMA900</u>
<u>Channels</u>	<u>Middle</u>
<u>Signal</u>	<u>WCDMA (Crest factor: 1.0)</u>
<u>ConvF</u>	<u>2.23</u>

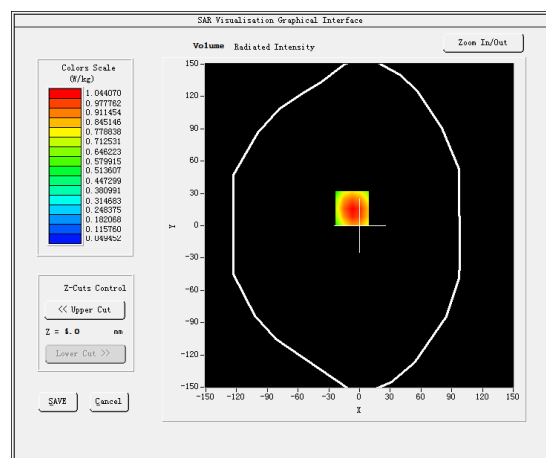
B. SAR Measurement Results

Frequency (MHz)	897.600000
Relative permittivity (real part)	41.220924
Relative permittivity (imaginary part)	19.721127
Conductivity (S/m)	0.983427
Variation (%)	-1.150000

SURFACE SAR



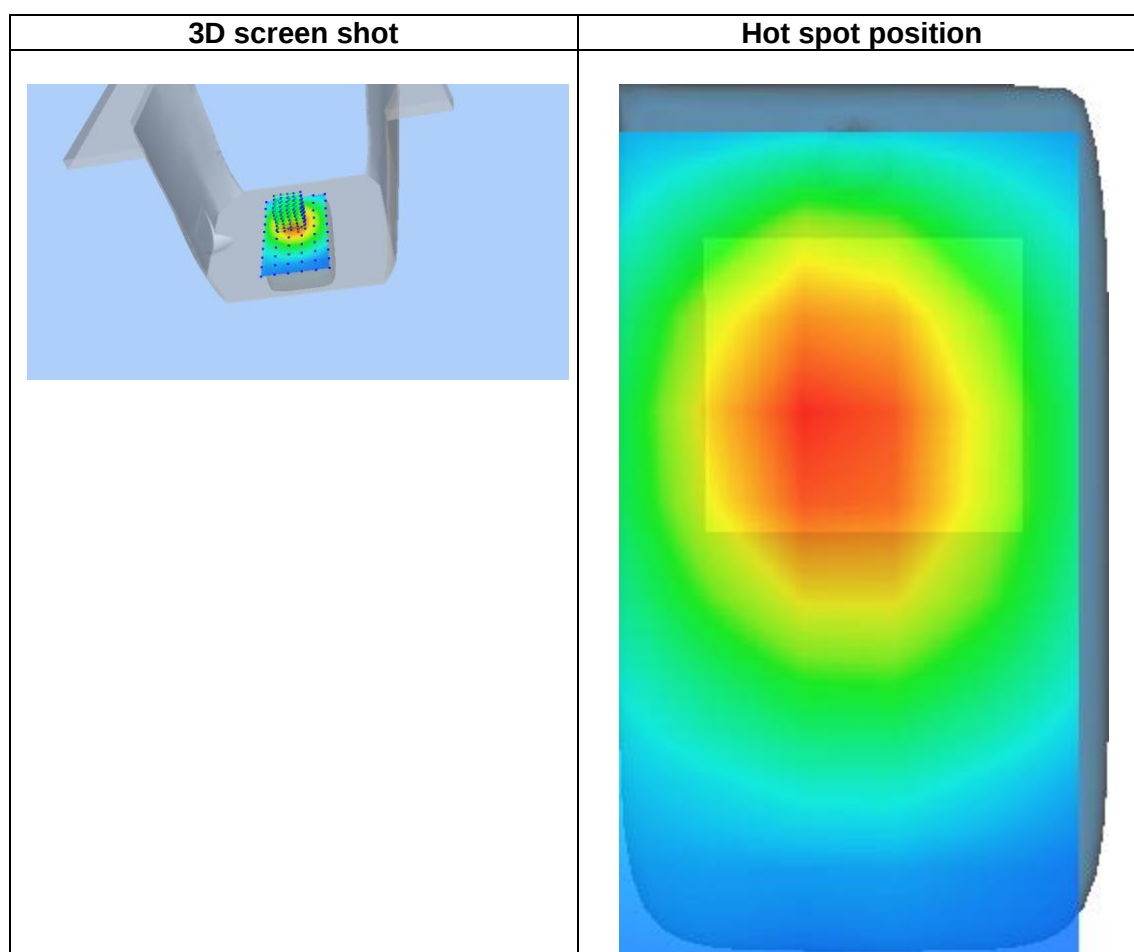
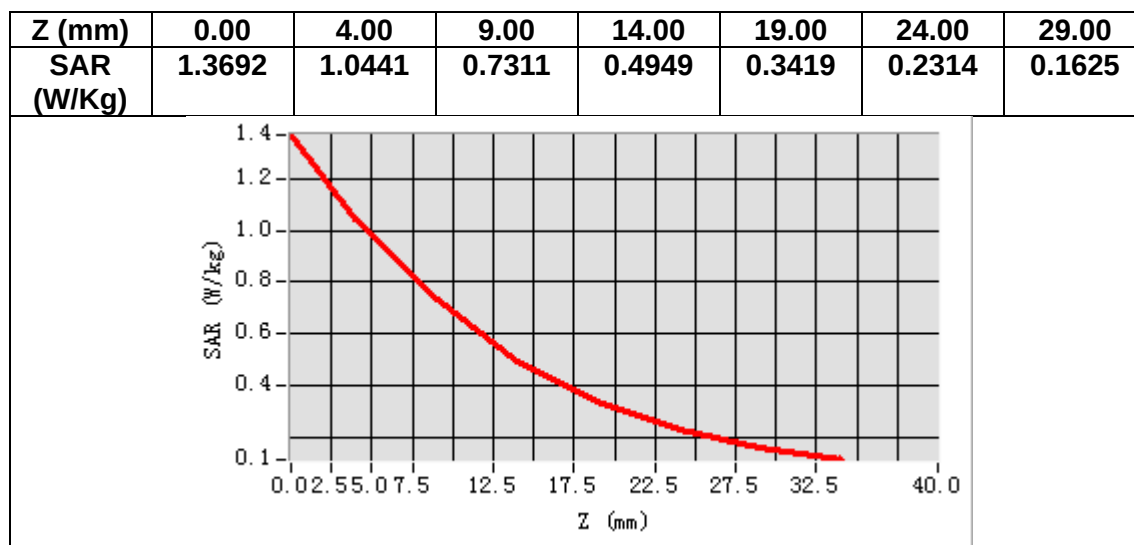
VOLUME SAR



Maximum location: X=-7.00, Y=16.00

SAR Peak: 1.38 W/kg

SAR 10g (W/Kg)	0.671538
SAR 1g (W/Kg)	1.014572



MEASUREMENT 9

Date of measurement: 26/7/2024

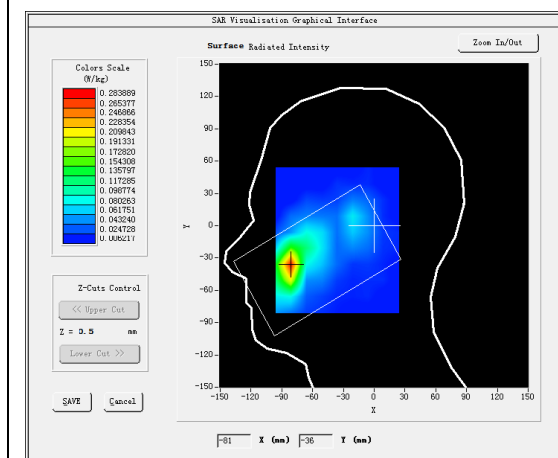
A. Experimental conditions.

<u>Area Scan</u>	<u>dx=15mm dy=15mm, h= 5.00 mm</u>
<u>ZoomScan</u>	<u>5x5x7,dx=8mm dy=8mm dz=5mm</u>
<u>Phantom</u>	<u>Left head</u>
<u>Device Position</u>	<u>Cheek</u>
<u>Band</u>	<u>LTE band 1</u>
<u>Channels</u>	<u>Middle</u>
<u>Signal</u>	<u>LTE (Crest factor: 1.0)</u>
<u>ConvF</u>	<u>2.83</u>

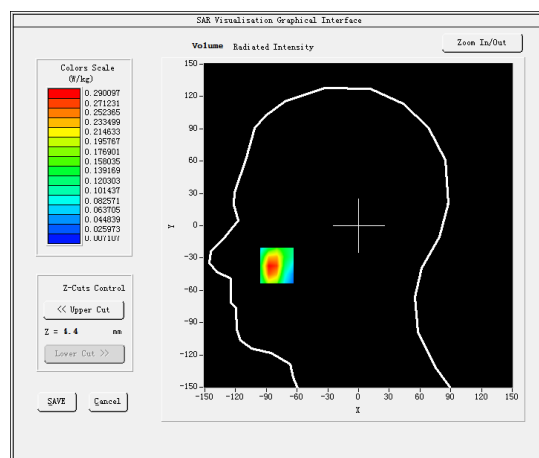
B. SAR Measurement Results

Frequency (MHz)	1950.000000
Relative permittivity (real part)	38.953915
Relative permittivity (imaginary part)	12.937650
Conductivity (S/m)	1.401579
Variation (%)	0.010000

SURFACE SAR



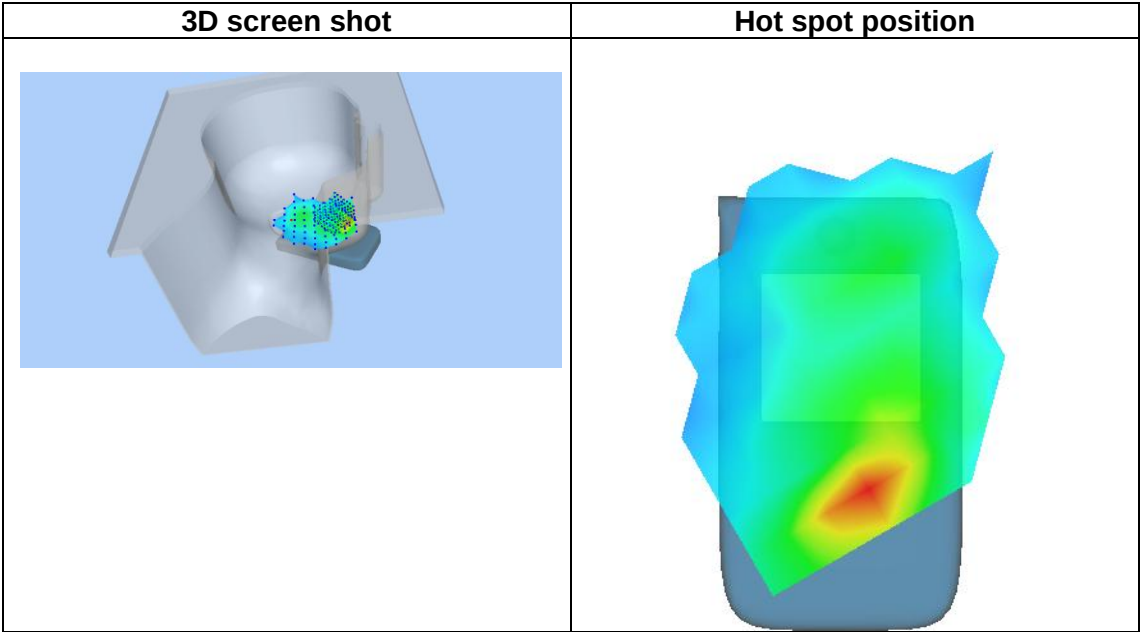
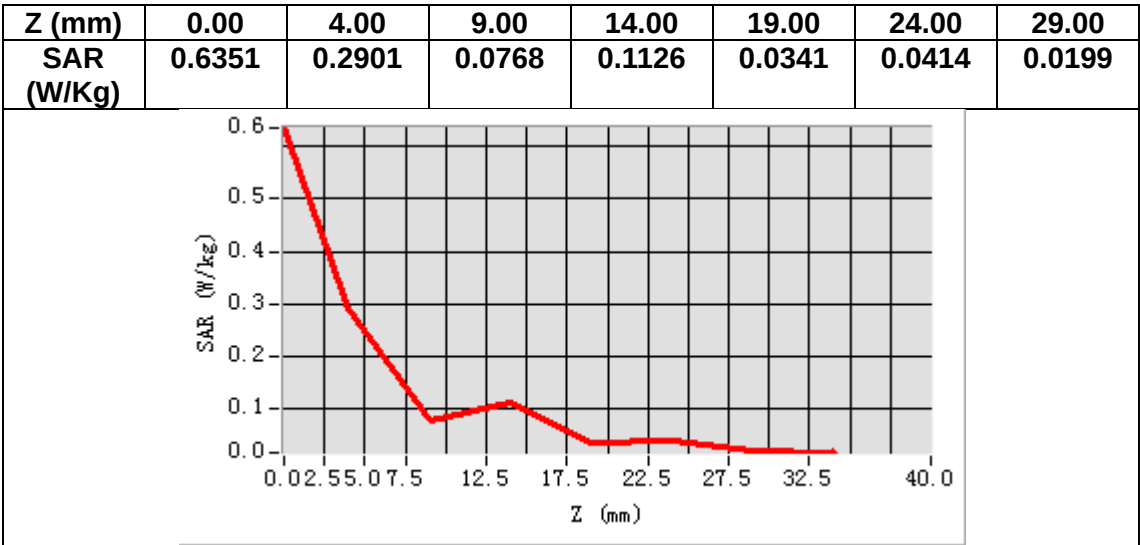
VOLUME SAR



Maximum location: X=-80.00, Y=-37.00

SAR Peak: 0.45 W/kg

SAR 10g (W/Kg)	0.150882
SAR 1g (W/Kg)	0.287241



MEASUREMENT 10

Date of measurement: 26/7/2024

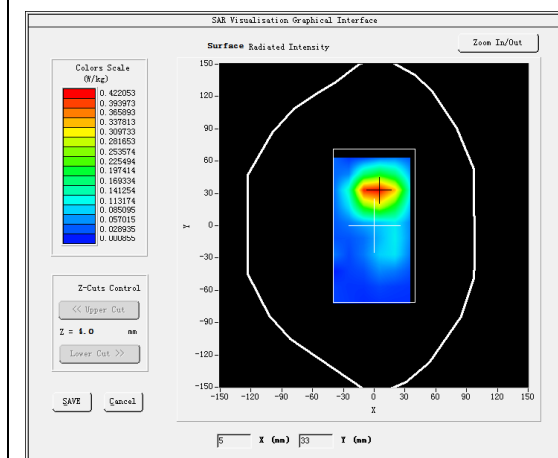
A. Experimental conditions.

<u>Area Scan</u>	<u>dx=15mm dy=15mm, h= 5.00 mm</u>
<u>ZoomScan</u>	<u>5x5x7,dx=8mm dy=8mm dz=5mm</u>
<u>Phantom</u>	<u>Validation plane</u>
<u>Device Position</u>	<u>Body</u>
<u>Band</u>	<u>LTE band 1</u>
<u>Channels</u>	<u>Middle</u>
<u>Signal</u>	<u>LTE (Crest factor: 1.0)</u>
<u>ConvF</u>	<u>2.83</u>

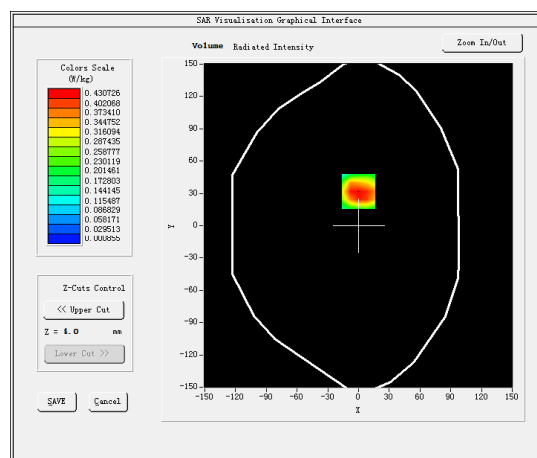
B. SAR Measurement Results

Frequency (MHz)	1950.000000
Relative permittivity (real part)	38.953915
Relative permittivity (imaginary part)	12.937650
Conductivity (S/m)	1.401579
Variation (%)	-2.650000

SURFACE SAR



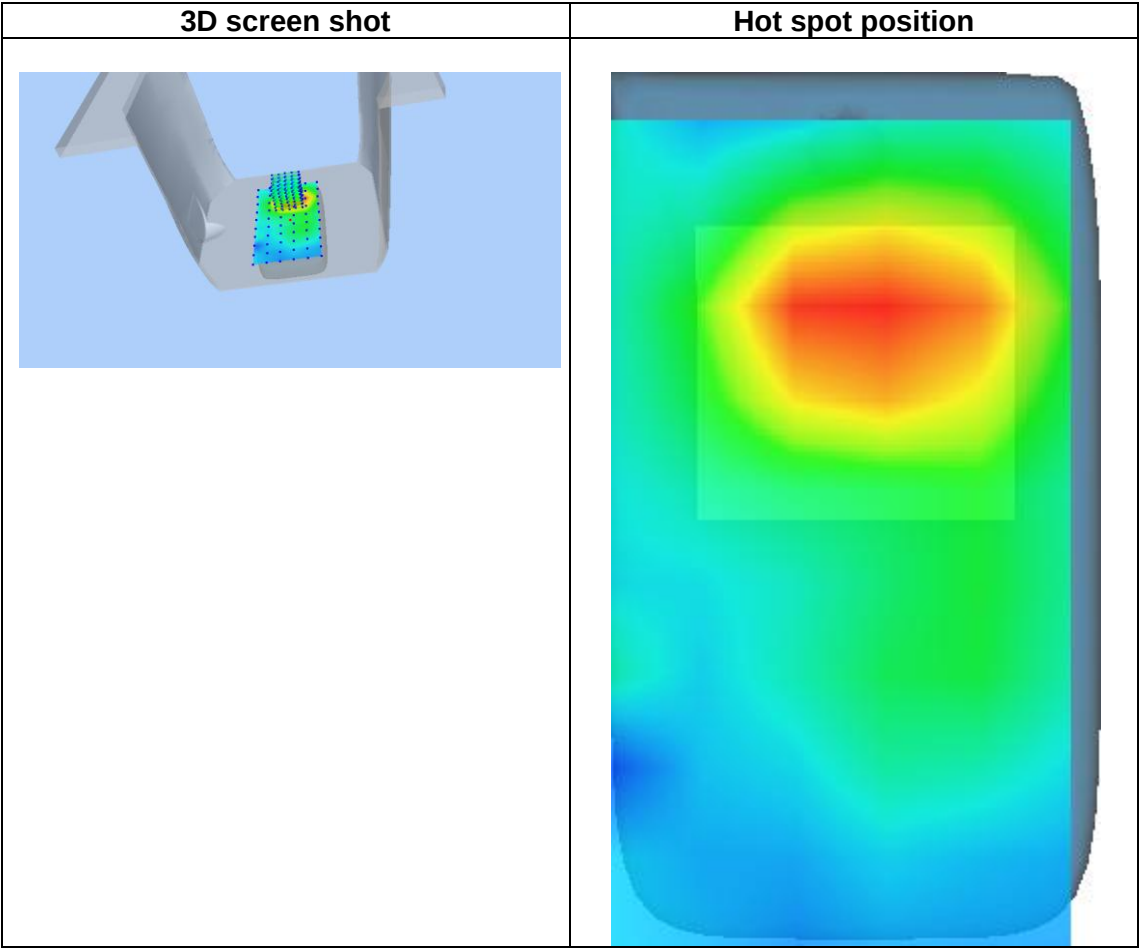
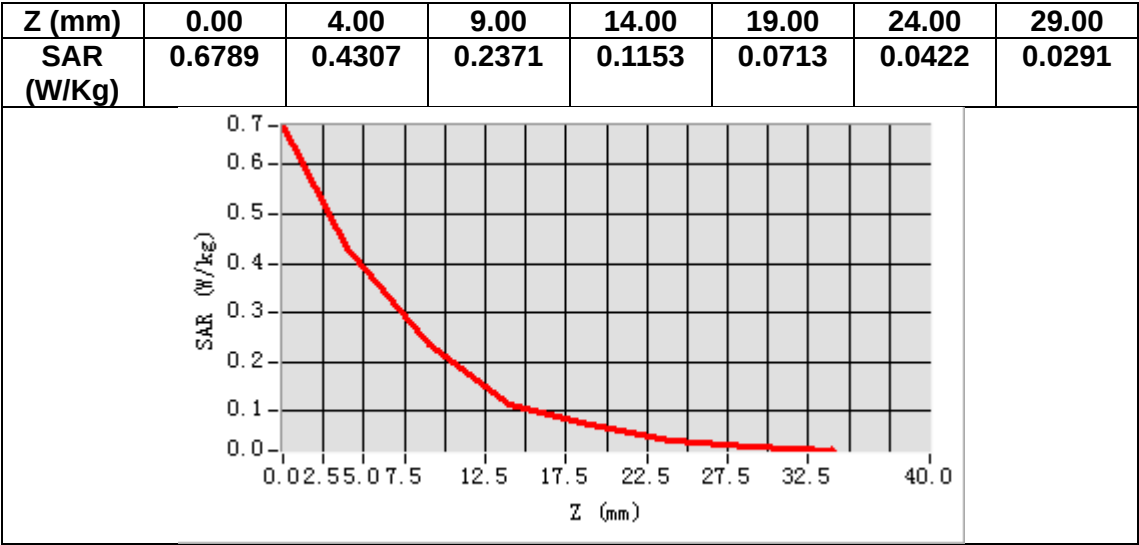
VOLUME SAR



Maximum location: X=0.00, Y=32.00

SAR Peak: 0.75 W/kg

SAR 10g (W/Kg)	0.226509
SAR 1g (W/Kg)	0.432893



MEASUREMENT 11

Date of measurement: 25/7/2024

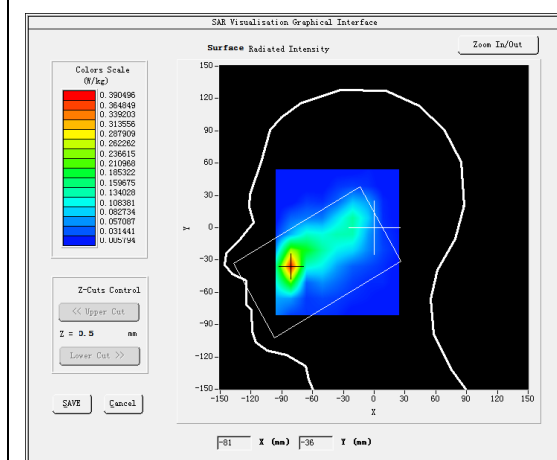
A. Experimental conditions.

<u>Area Scan</u>	<u>dx=15mm dy=15mm, h= 5.00 mm</u>
<u>ZoomScan</u>	<u>5x5x7,dx=8mm dy=8mm dz=5mm</u>
<u>Phantom</u>	<u>Left head</u>
<u>Device Position</u>	<u>Cheek</u>
<u>Band</u>	<u>LTE band 3</u>
<u>Channels</u>	<u>Middle</u>
<u>Signal</u>	<u>LTE (Crest factor: 1.0)</u>
<u>ConvF</u>	<u>2.45</u>

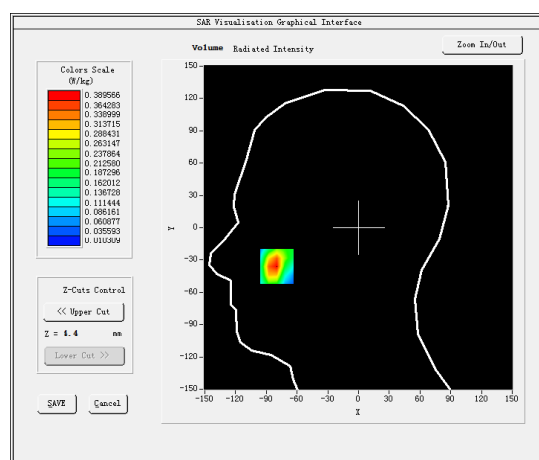
B. SAR Measurement Results

Frequency (MHz)	1747.500000
Relative permittivity (real part)	39.244083
Relative permittivity (imaginary part)	13.728342
Conductivity (S/m)	1.332412
Variation (%)	1.910000

SURFACE SAR



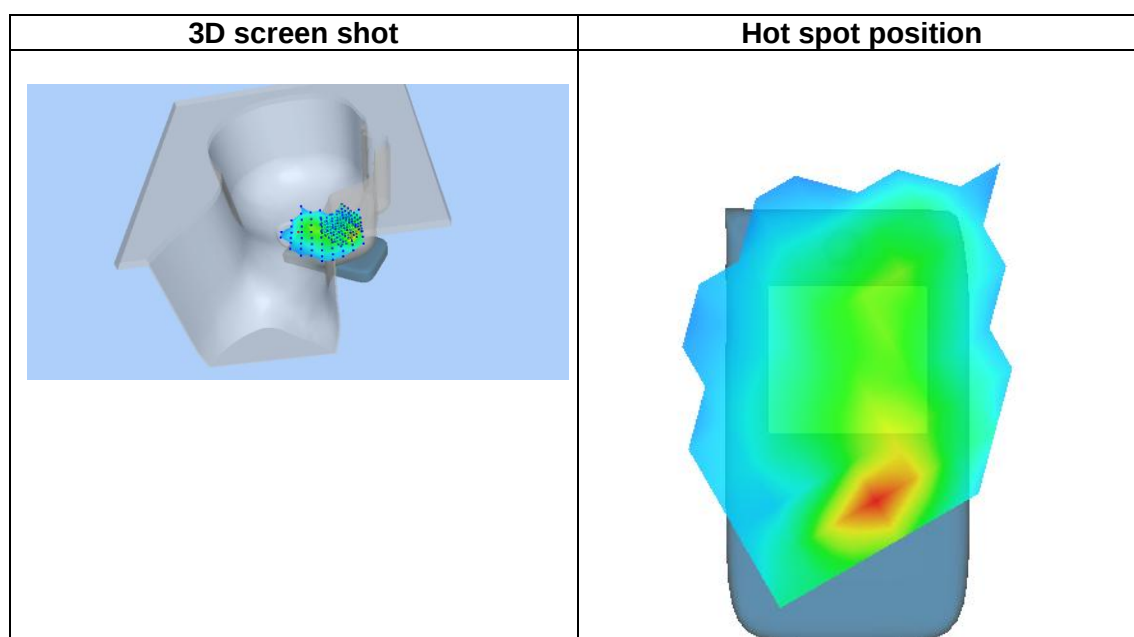
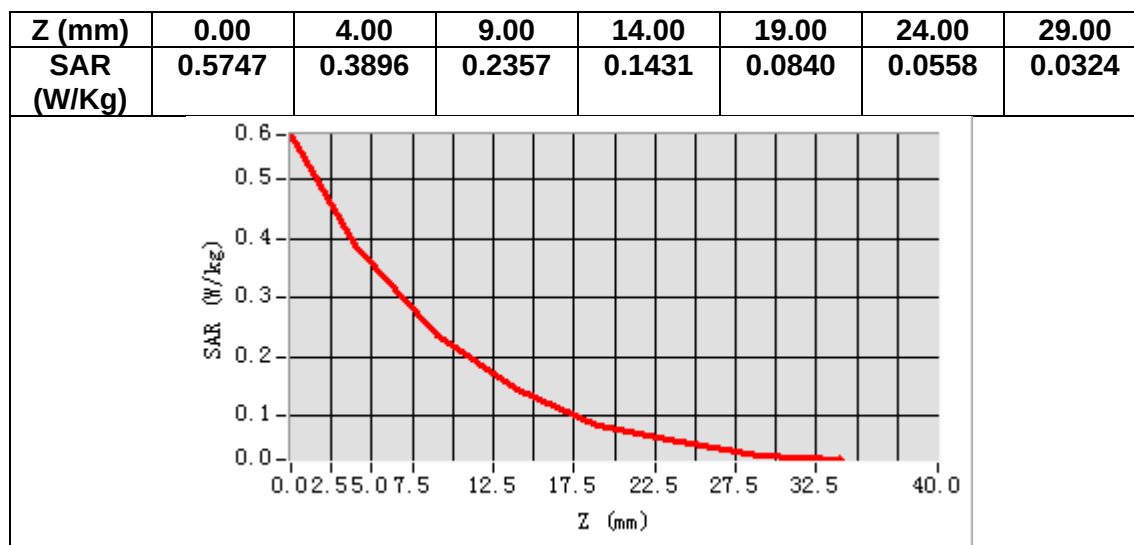
VOLUME SAR



Maximum location: X=-80.00, Y=-36.00

SAR Peak: 0.60 W/kg

SAR 10g (W/Kg)	0.201565
SAR 1g (W/Kg)	0.378525



MEASUREMENT 12

Date of measurement: 25/7/2024

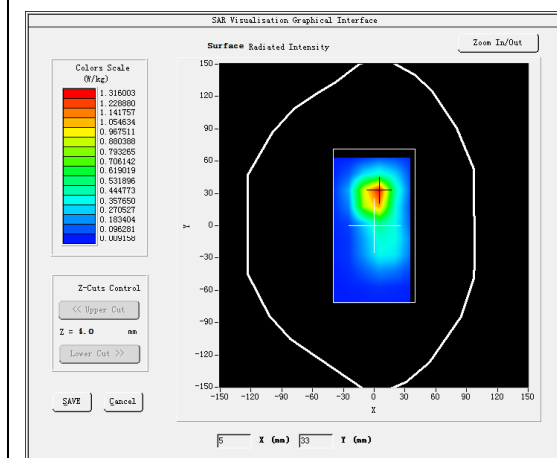
A. Experimental conditions.

<u>Area Scan</u>	<u>dx=15mm dy=15mm, h= 5.00 mm</u>
<u>ZoomScan</u>	<u>5x5x7, dx=8mm dy=8mm dz=5mm</u>
<u>Phantom</u>	<u>Validation plane</u>
<u>Device Position</u>	<u>Body</u>
<u>Band</u>	<u>LTE band 3</u>
<u>Channels</u>	<u>Middle</u>
<u>Signal</u>	<u>LTE (Crest factor: 1.0)</u>
<u>ConvF</u>	<u>2.45</u>

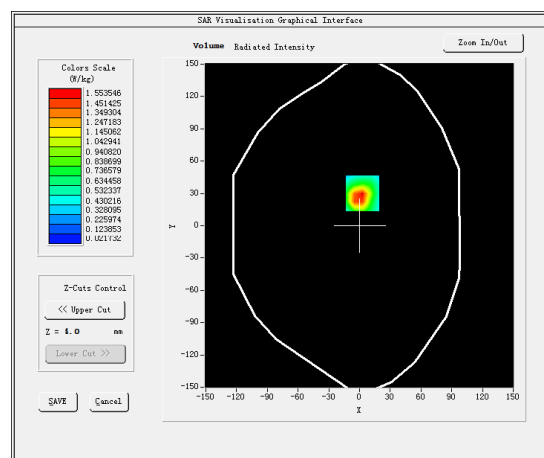
B. SAR Measurement Results

Frequency (MHz)	1747.500000
Relative permittivity (real part)	39.244083
Relative permittivity (imaginary part)	13.728342
Conductivity (S/m)	1.332412
Variation (%)	-2.470000

SURFACE SAR



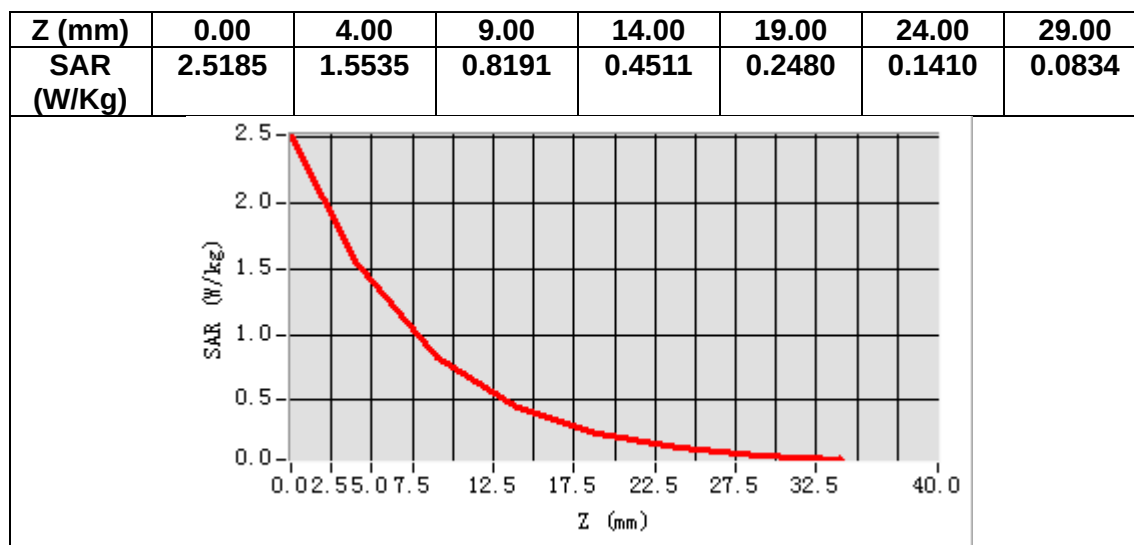
VOLUME SAR



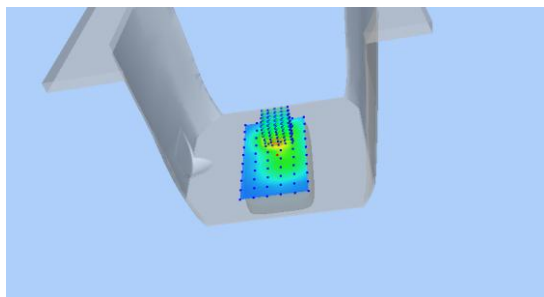
Maximum location: X=3.00, Y=30.00

SAR Peak: 2.74 W/kg

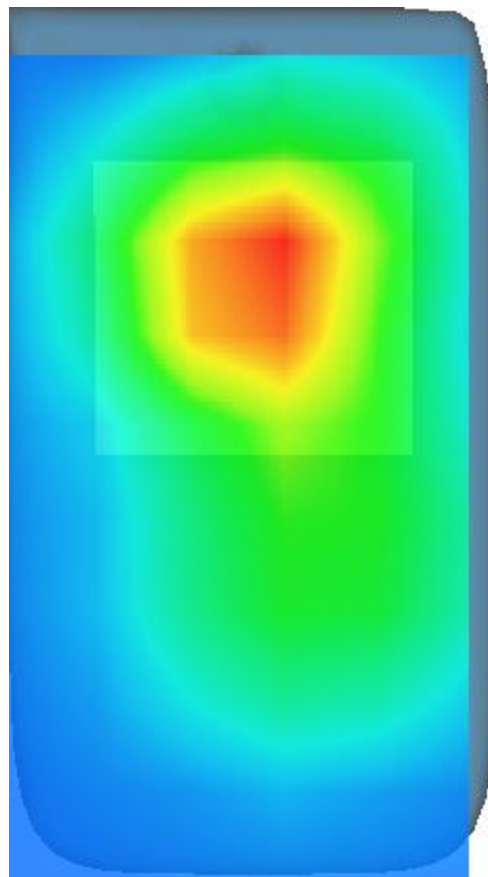
SAR 10g (W/Kg)	0.729358
SAR 1g (W/Kg)	1.548570



3D screen shot



Hot spot position



MEASUREMENT 13

Date of measurement: 19/7/2024

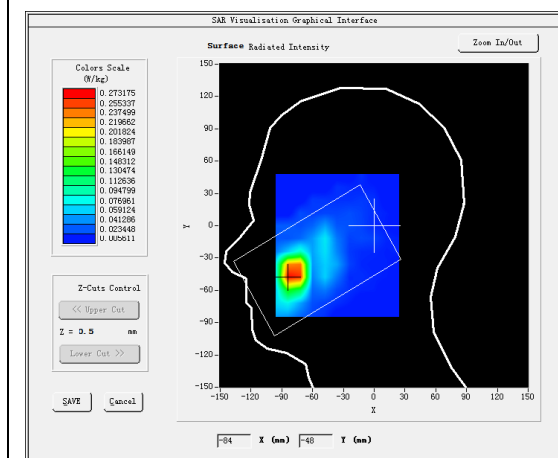
A. Experimental conditions.

<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>Left head</u>
<u>Device Position</u>	<u>Cheek</u>
<u>Band</u>	<u>LTE band 7</u>
<u>Channels</u>	<u>Low</u>
<u>Signal</u>	<u>LTE (Crest factor: 1.0)</u>
<u>ConvF</u>	<u>2.65</u>

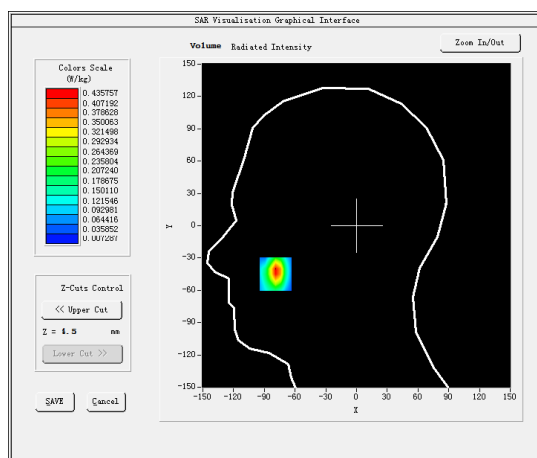
B. SAR Measurement Results

Frequency (MHz)	2510.000000
Relative permittivity (real part)	39.576363
Relative permittivity (imaginary part)	13.719530
Conductivity (S/m)	1.913112
Variation (%)	1.380000

SURFACE SAR



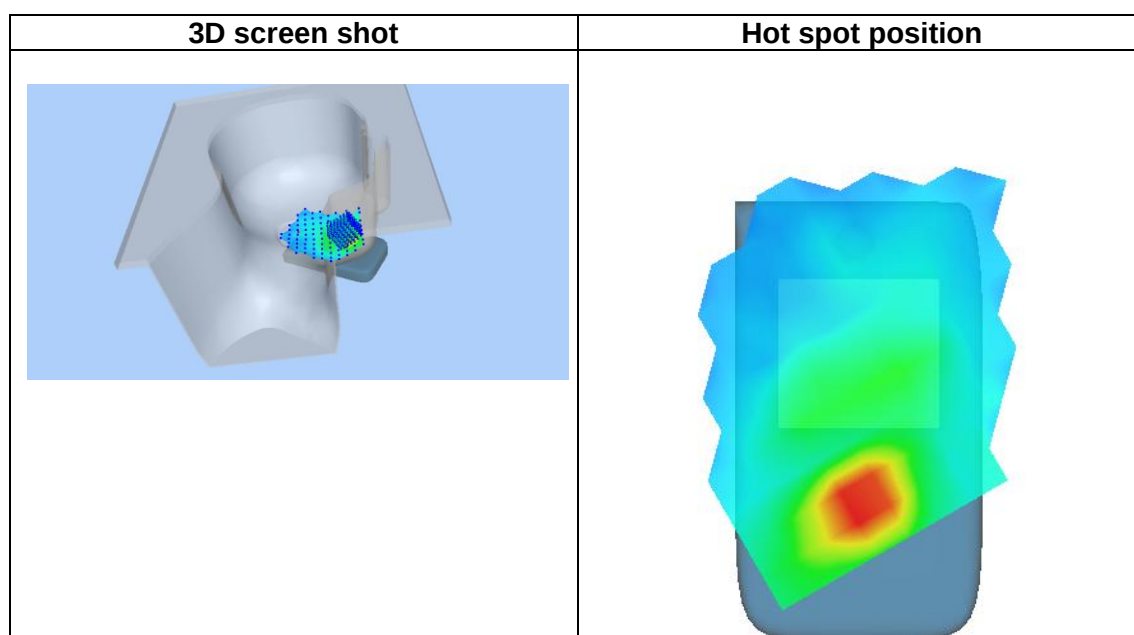
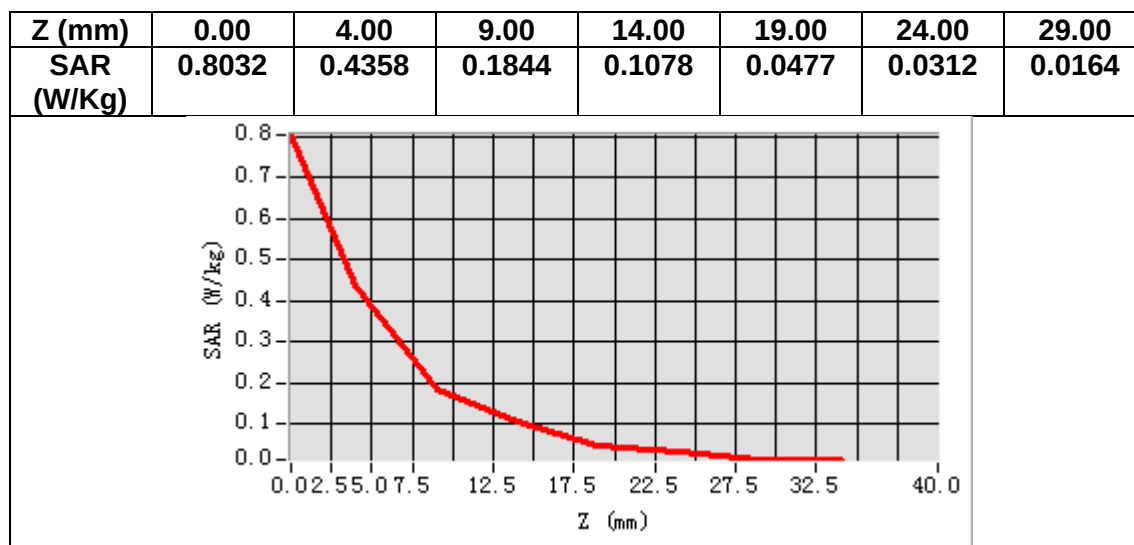
VOLUME SAR



Maximum location: X=-79.00, Y=-45.00

SAR Peak: 0.75 W/kg

SAR 10g (W/Kg)	0.168238
SAR 1g (W/Kg)	0.398781



MEASUREMENT 14

Date of measurement: 19/7/2024

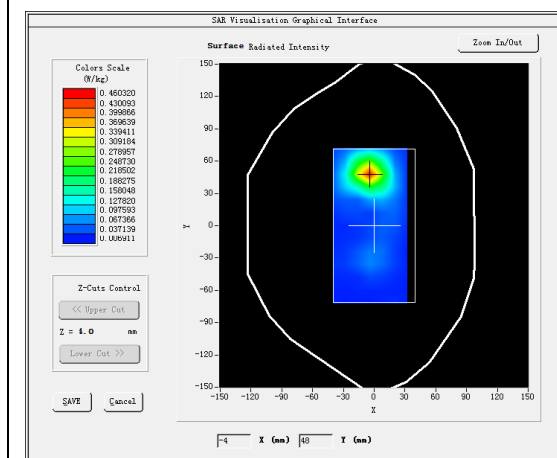
A. Experimental conditions.

<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>Validation plane</u>
<u>Device Position</u>	<u>Body</u>
<u>Band</u>	<u>LTE band 7</u>
<u>Channels</u>	<u>Middle</u>
<u>Signal</u>	<u>LTE (Crest factor: 1.0)</u>
<u>ConvF</u>	<u>2.65</u>

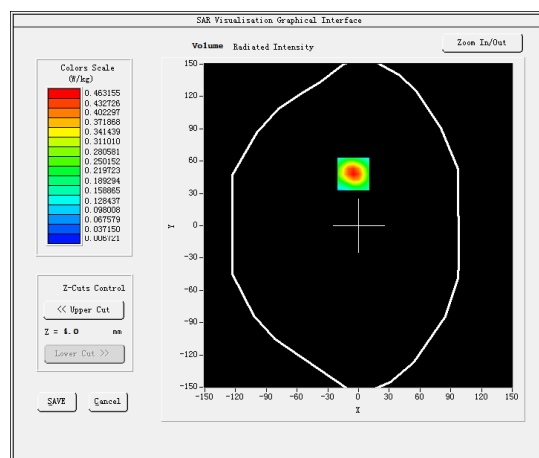
B. SAR Measurement Results

Frequency (MHz)	2535.000000
Relative permittivity (real part)	39.461262
Relative permittivity (imaginary part)	13.776830
Conductivity (S/m)	1.940237
Variation (%)	4.689999

SURFACE SAR



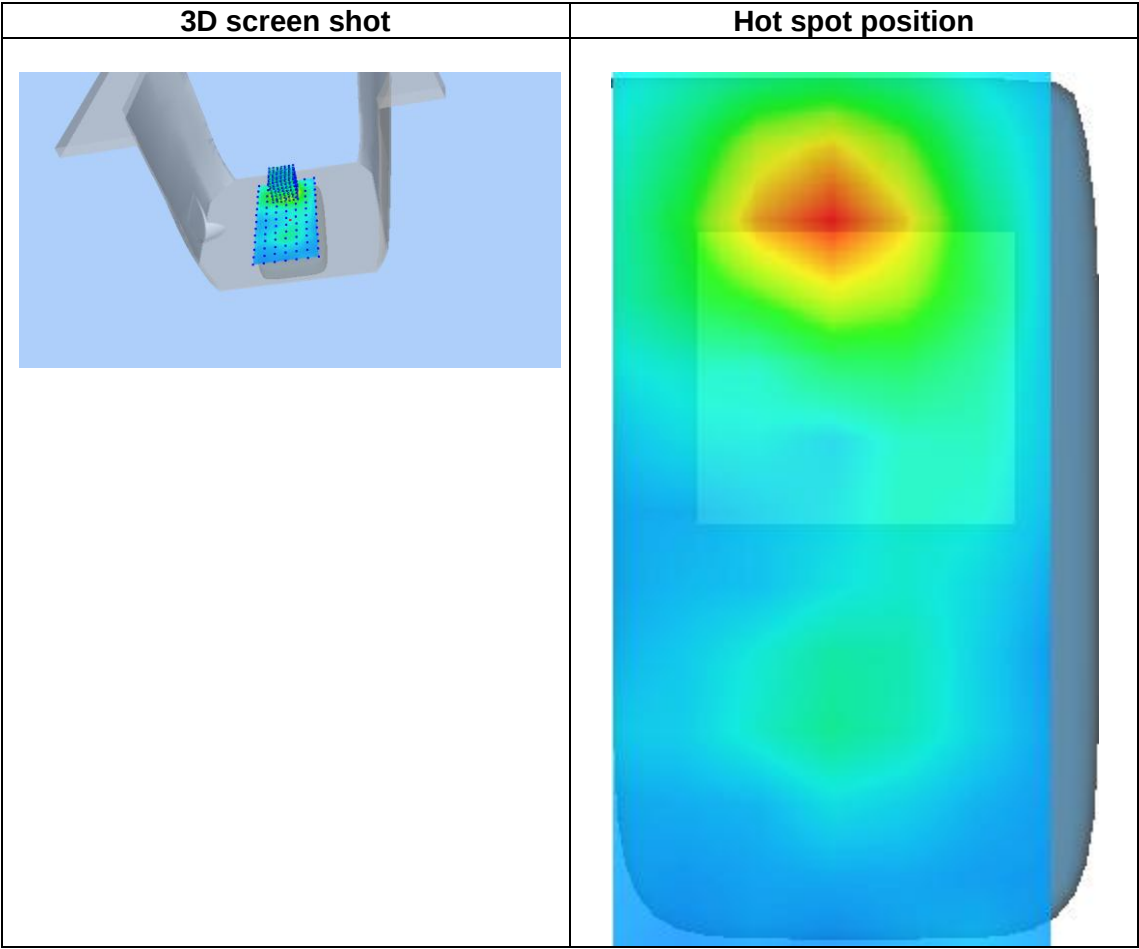
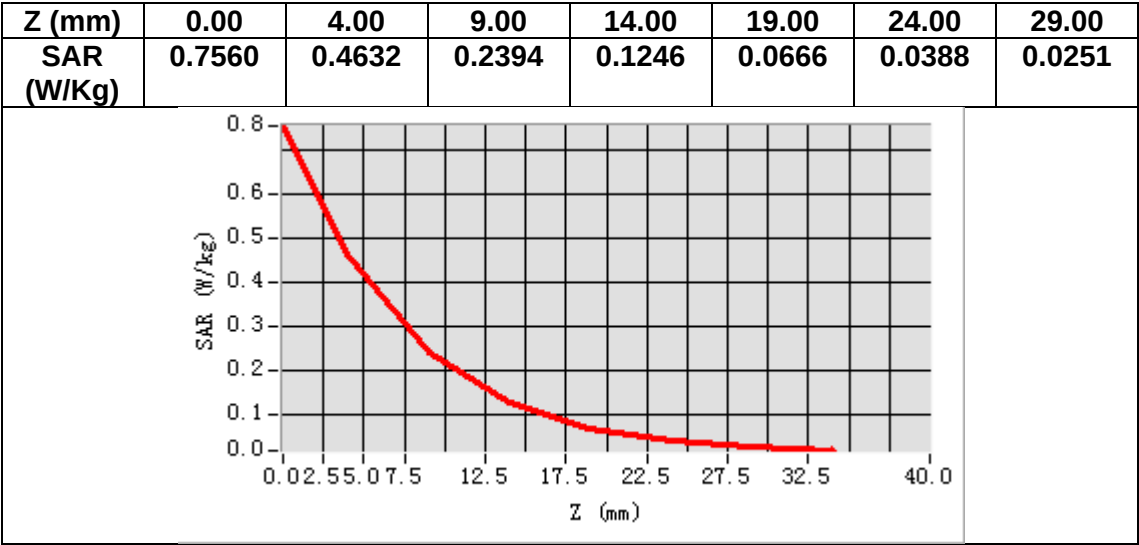
VOLUME SAR



Maximum location: X=-5.00, Y=48.00

SAR Peak: 0.75 W/kg

SAR 10g (W/Kg)	0.208289
SAR 1g (W/Kg)	0.431213



MEASUREMENT 15

Date of measurement: 24/7/2024

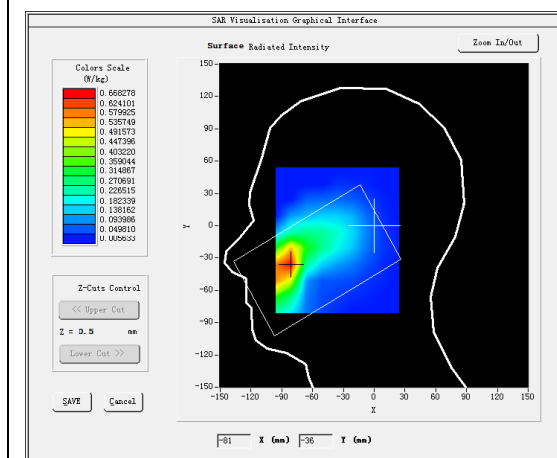
A. Experimental conditions.

<u>Area Scan</u>	<u>dx=15mm dy=15mm, h= 5.00 mm</u>
<u>ZoomScan</u>	<u>5x5x7,dx=8mm dy=8mm dz=5mm</u>
<u>Phantom</u>	<u>Left head</u>
<u>Device Position</u>	<u>Cheek</u>
<u>Band</u>	<u>LTE band 8</u>
<u>Channels</u>	<u>Middle</u>
<u>Signal</u>	<u>LTE (Crest factor: 1.0)</u>
<u>ConvF</u>	<u>2.23</u>

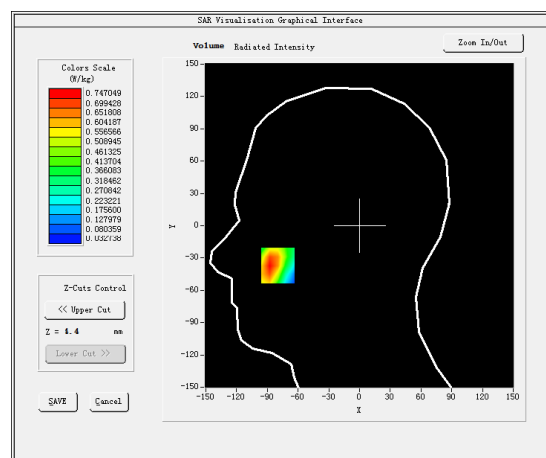
B. SAR Measurement Results

Frequency (MHz)	897.500000
Relative permittivity (real part)	41.235565
Relative permittivity (imaginary part)	19.681707
Conductivity (S/m)	0.980805
Variation (%)	0.580000

SURFACE SAR



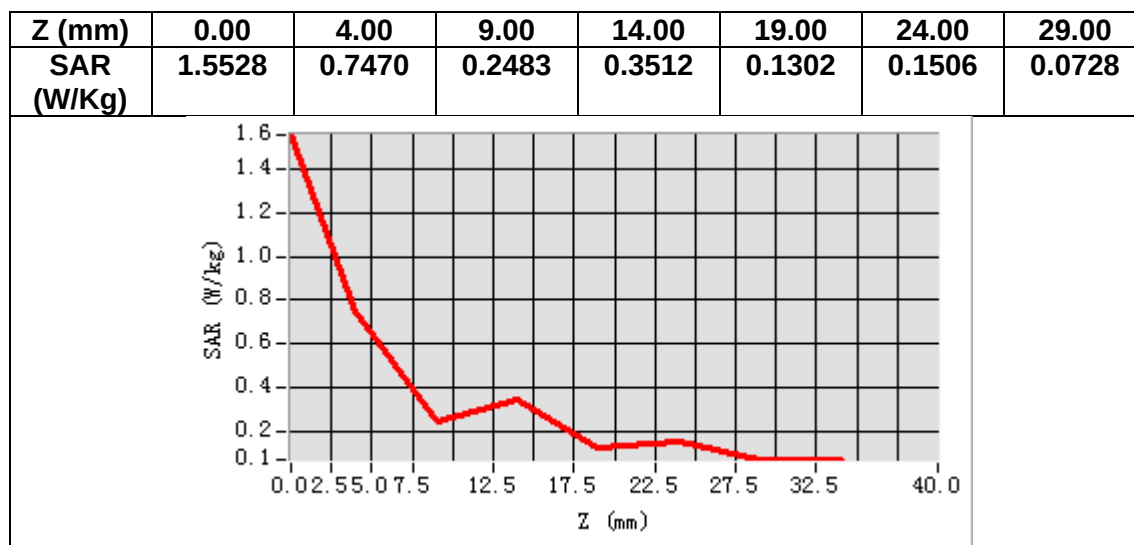
VOLUME SAR



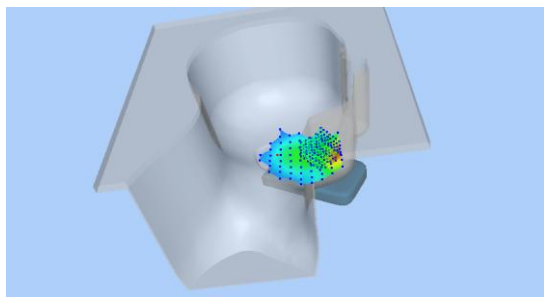
Maximum location: X=-80.00, Y=-37.00

SAR Peak: 1.00 W/kg

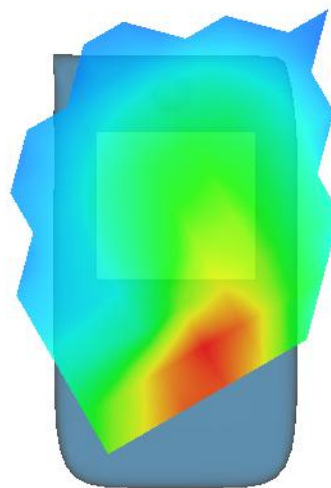
SAR 10g (W/Kg)	0.439634
SAR 1g (W/Kg)	0.711050



3D screen shot



Hot spot position



MEASUREMENT 16

Date of measurement: 24/7/2024

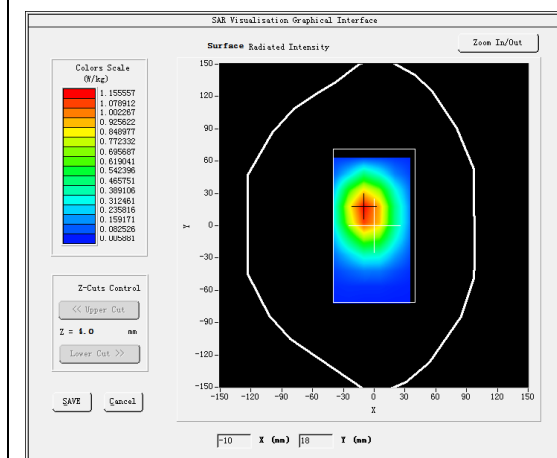
A. Experimental conditions.

<u>Area Scan</u>	<u>dx=15mm dy=15mm, h= 5.00 mm</u>
<u>ZoomScan</u>	<u>5x5x7,dx=8mm dy=8mm dz=5mm</u>
<u>Phantom</u>	<u>Validation plane</u>
<u>Device Position</u>	<u>Body</u>
<u>Band</u>	<u>LTE band 8</u>
<u>Channels</u>	<u>Middle</u>
<u>Signal</u>	<u>LTE (Crest factor: 1.0)</u>
<u>ConvF</u>	<u>2.23</u>

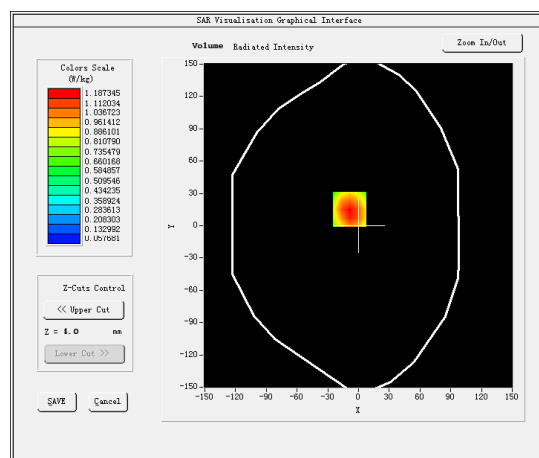
B. SAR Measurement Results

Frequency (MHz)	897.500000
Relative permittivity (real part)	41.235565
Relative permittivity (imaginary part)	19.681707
Conductivity (S/m)	0.980805
Variation (%)	-1.850000

SURFACE SAR



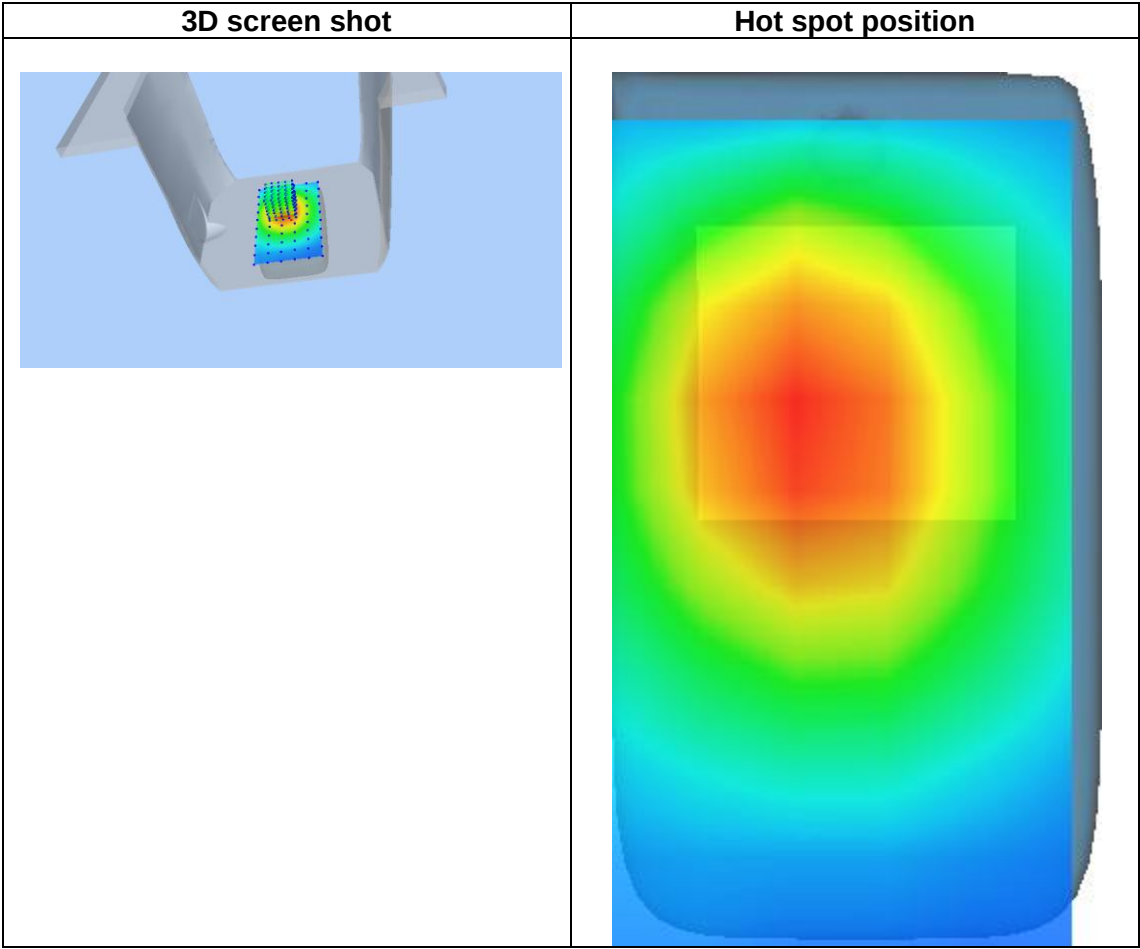
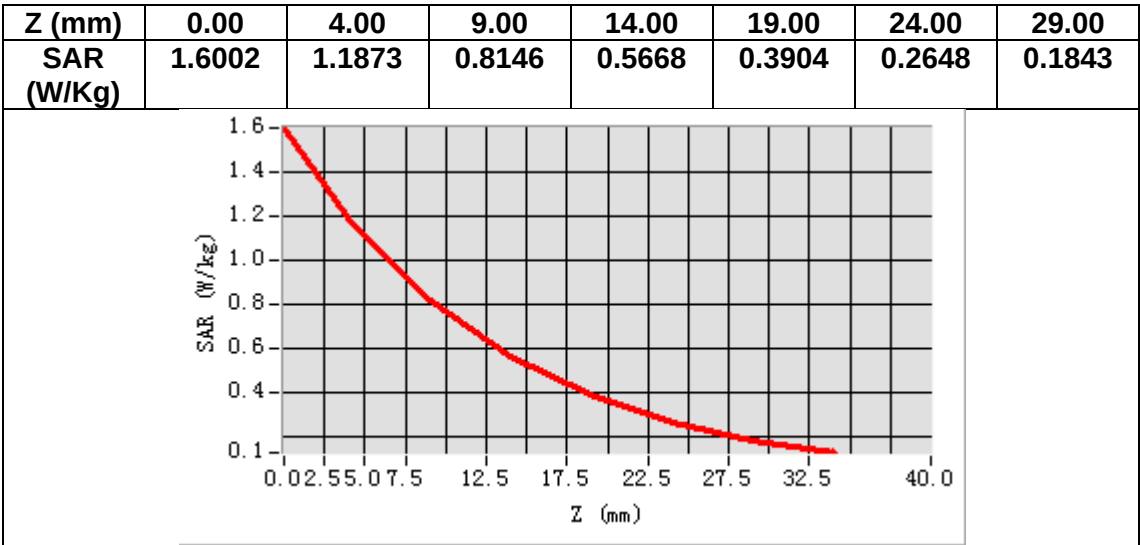
VOLUME SAR



Maximum location: X=-9.00, Y=15.00

SAR Peak: 1.60 W/kg

SAR 10g (W/Kg)	0.759196
SAR 1g (W/Kg)	1.159169



MEASUREMENT 17

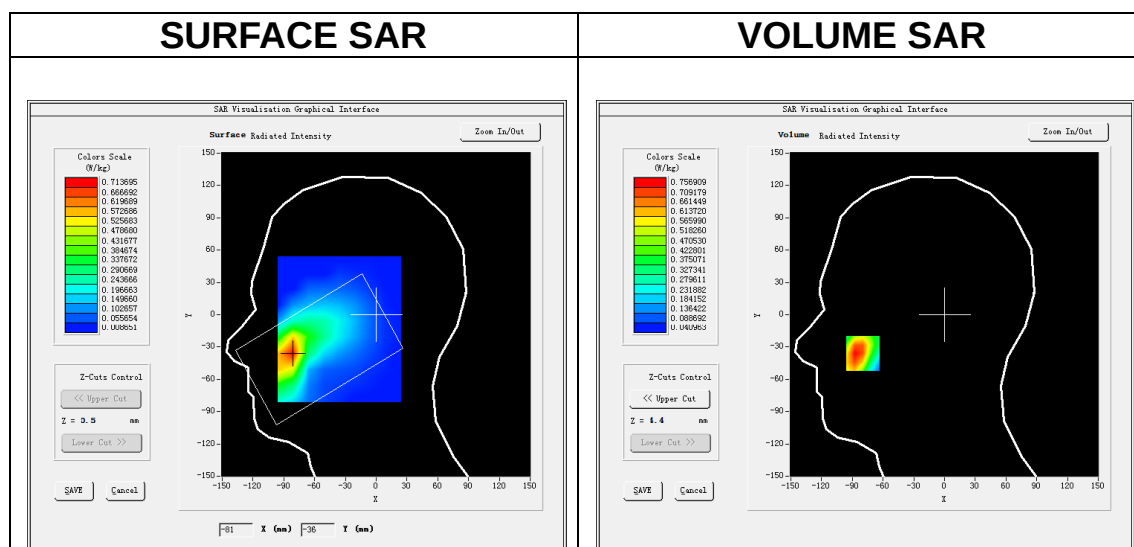
Date of measurement: 24/7/2024

A. Experimental conditions.

<u>Area Scan</u>	<u>dx=15mm dy=15mm, h= 5.00 mm</u>
<u>ZoomScan</u>	<u>5x5x7,dx=8mm dy=8mm dz=5mm</u>
<u>Phantom</u>	<u>Left head</u>
<u>Device Position</u>	<u>Cheek</u>
<u>Band</u>	<u>LTE band 20</u>
<u>Channels</u>	<u>Middle</u>
<u>Signal</u>	<u>LTE (Crest factor: 1.0)</u>
<u>ConvF</u>	<u>2.23</u>

B. SAR Measurement Results

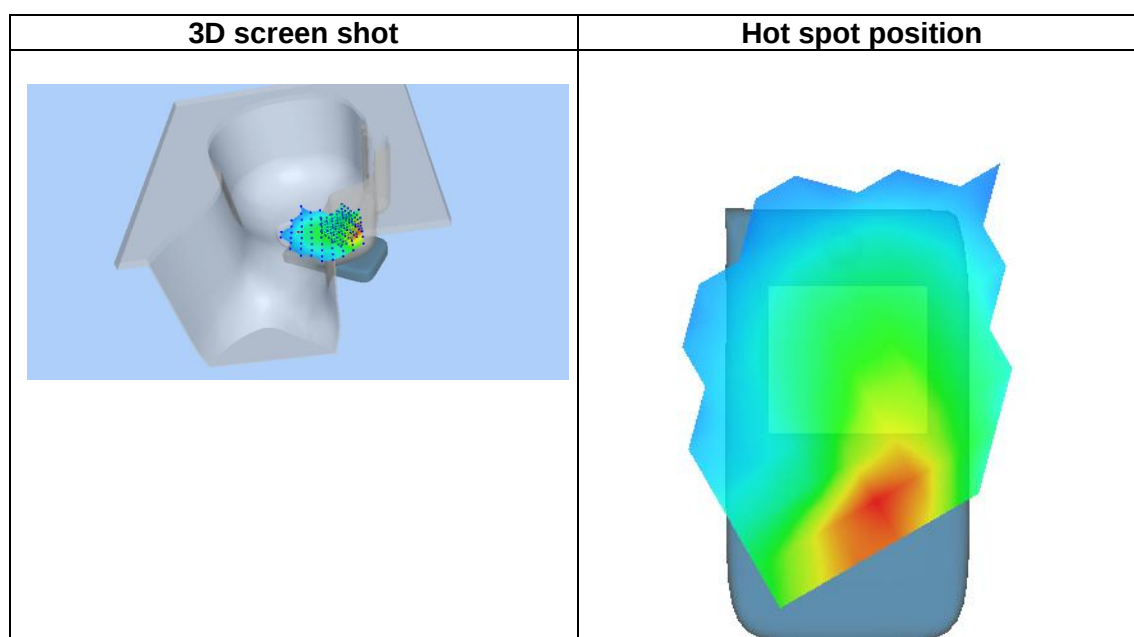
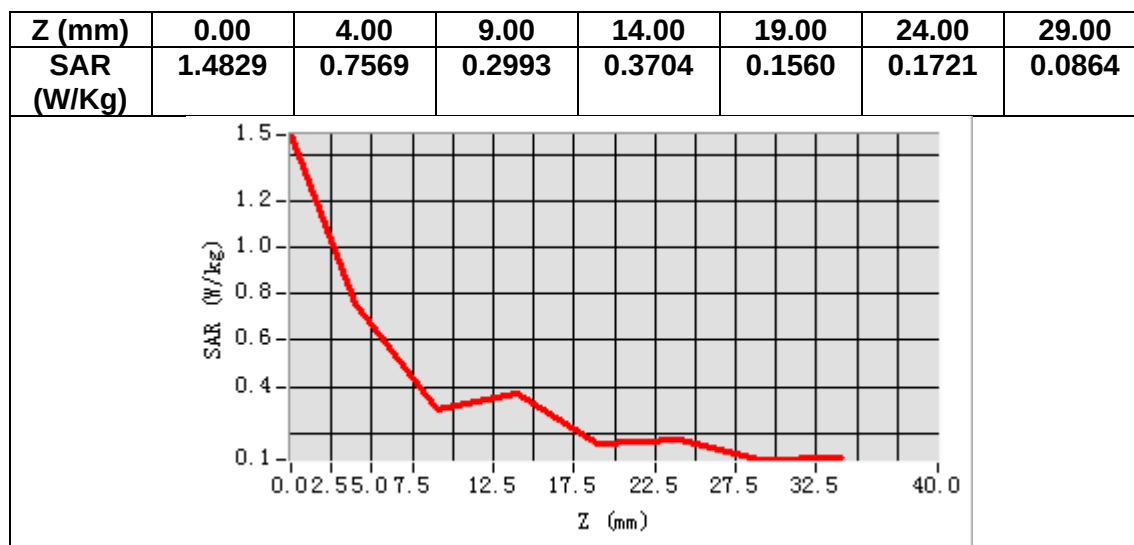
Frequency (MHz)	847.000000
Relative permittivity (real part)	41.854362
Relative permittivity (imaginary part)	19.466806
Conductivity (S/m)	0.916021
Variation (%)	2.810000



Maximum location: X=-80.00, Y=-36.00

SAR Peak: 1.05 W/kg

SAR 10g (W/Kg)	0.455085
SAR 1g (W/Kg)	0.728771



MEASUREMENT 18

Date of measurement: 24/7/2024

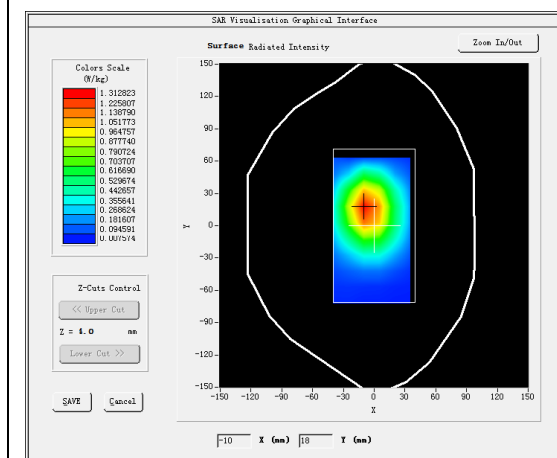
A. Experimental conditions.

<u>Area Scan</u>	<u>dx=15mm dy=15mm, h= 5.00 mm</u>
<u>ZoomScan</u>	<u>5x5x7, dx=8mm dy=8mm dz=5mm</u>
<u>Phantom</u>	<u>Validation plane</u>
<u>Device Position</u>	<u>Body</u>
<u>Band</u>	<u>LTE band 20</u>
<u>Channels</u>	<u>Middle</u>
<u>Signal</u>	<u>LTE (Crest factor: 1.0)</u>
<u>ConvF</u>	<u>2.23</u>

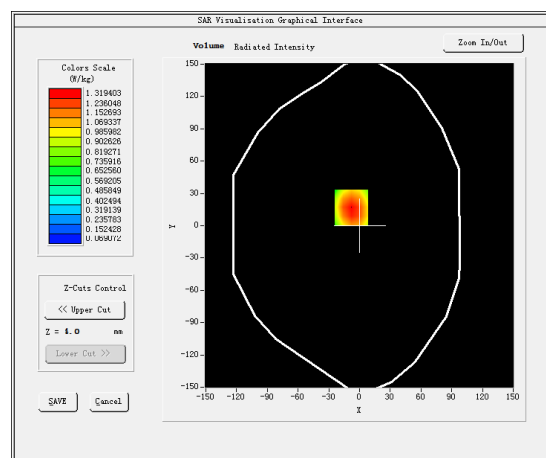
B. SAR Measurement Results

Frequency (MHz)	847.000000
Relative permittivity (real part)	41.854362
Relative permittivity (imaginary part)	19.466806
Conductivity (S/m)	0.916021
Variation (%)	-3.480000

SURFACE SAR



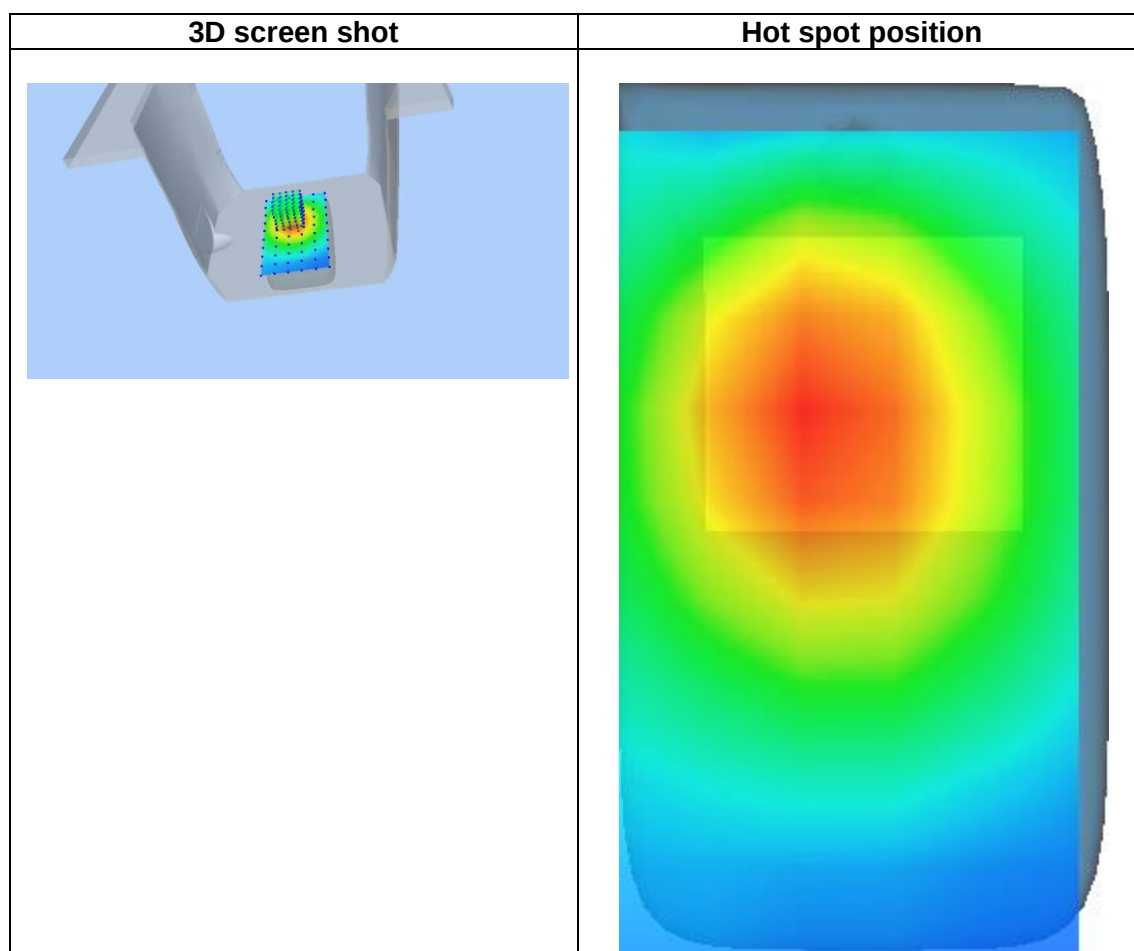
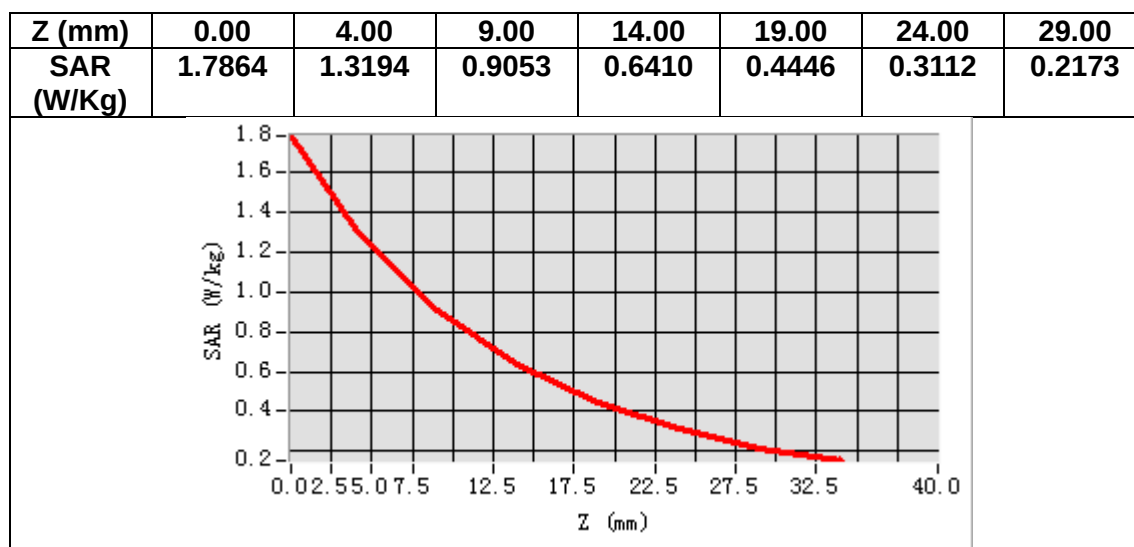
VOLUME SAR



Maximum location: X=-8.00, Y=17.00

SAR Peak: 1.80 W/kg

SAR 10g (W/Kg)	0.845203
SAR 1g (W/Kg)	1.276703



12. Appendix D. Calibration Certificate

Table of contents
E Field Probe - 3423-EPGO-426
900 MHz Dipole - SN 03/15 DIP 0G900-348
1800 MHz Dipole - SN 03/15 DIP 1G800-349
2000 MHz Dipole - SN 03/15 DIP 2G000-351
2600 MHz Dipole - SN 03/15 DIP 2G600-356



COMOSAR E-Field Probe Calibration Report

Ref : ACR.261.11.23.BES.A

SHENZHEN NTEK TESTING TECHNOLOGY CO., LTD.

BUILDING E, FENDA SCIENCE PARK, SANWEI
COMMUNITY, XIXIANG STREET,
BAO'AN DISTRICT, SHENZHEN GUANGDONG, CHINA
MVG COMOSAR DOSIMETRIC E-FIELD PROBE
SERIAL NO.: 3423-EPGO-426

Calibrated at MVG

Z.I. de la pointe du diable

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

Calibration date: 09/18/2023



Accreditations #2-6789
Scope available on www.cofrac.fr

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Summary:

This document presents the method and results from an accredited COMOSAR Dosimetric 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.261.11.23.BES.A

	<i>Name</i>	<i>Function</i>	<i>Date</i>	<i>Signature</i>
<i>Prepared by :</i>	Cyrille ONNEE	Measurement Responsible	9/18/2023	
<i>Checked & approved by:</i>	Jérôme Luc	Technical Manager	9/18/2023	
<i>Authorized by:</i>	Yann Toutain	Laboratory Director	9/19/2023	

Yann
Toutain ID

Signature
numérique de
Yann Toutain ID
Date: 2023.09.19
09:08:14 +02'00'

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

<i>Issue</i>	<i>Name</i>	<i>Date</i>	<i>Modifications</i>
A	Cyrille ONNEE	9/18/2023	Initial release



COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.261.11.23.BES.A

TABLE OF CONTENTS

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



COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.261.11.23.BES.A

1 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR DOSIMETRIC E FIELD PROBE
Manufacturer	MVG
Model	SSE2
Serial Number	3423-EPGO-426
Product Condition (new / used)	New
Frequency Range of Probe	0.15 GHz-7.5GHz
Resistance of Three Dipoles at Connector	Dipole 1: R1=0.261 MΩ Dipole 2: R2=0.213 MΩ Dipole 3: R3=0.233 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 effect. All calibrations / measurements performed meet the fore-mentioned standards.

3.1 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 for frequency range 600-7500MHz and using the calorimeter cell method (transfer method) as outlined in the standards for frequency 150-450 MHz.



COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.261.11.23.BES.A

3.2 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.

3.3 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°).

3.4 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:

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

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
Δ_{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
δ	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;
ΔSAR_{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%).



COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.261.11.23.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 a SAR probe calibration using the waveguide or calorimetric cell technique depending on the frequency.

The estimated expanded uncertainty (k=2) in calibration for SAR (W/kg) is +/-11% for the frequency range 150-450MHz.

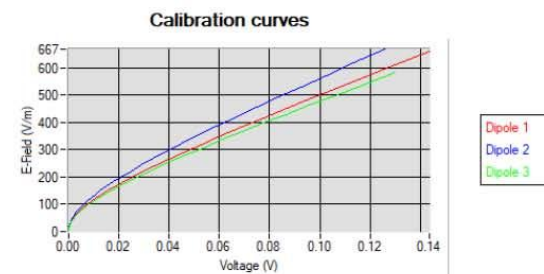
The estimated expanded uncertainty (k=2) in calibration for SAR (W/kg) is +/-14% for the frequency range 600-7500MHz.

5 CALIBRATION RESULTS

Ambient condition	
Liquid Temperature	20 +/- 1 °C
Lab Temperature	20 +/- 1 °C
Lab Humidity	30-70 %

5.1 CALIBRATION IN AIR

The following curve represents the measurement in waveguide of the voltage picked up by the probe toward the E-field generated inside the waveguide.



From this curve, the sensitivity in air is calculated using the below formula.

$$E^2 = \sum_{i=1}^3 \frac{V_i (1 + V_i / DCP_i)}{Norm_i}$$

where

V_i =voltage readings on the 3 channels of the probe

DCP_i =diode compression point given below for the 3 channels of the probe

$Norm_i$ =dipole sensitivity given below for the 3 channels of the probe



COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.261.11.23.BES.A

Normx dipole 1 ($\mu\text{V}/(\text{V}/\text{m})^2$)	Normy dipole 2 ($\mu\text{V}/(\text{V}/\text{m})^2$)	Normz dipole 3 ($\mu\text{V}/(\text{V}/\text{m})^2$)
0.78	0.62	0.85

DCP dipole 1 (mV)	DCP dipole 2 (mV)	DCP dipole 3 (mV)
105	108	107

5.2 CALIBRATION IN LIQUID

The calorimeter cell or the waveguide is used to determine the calibration in liquid using the formula below.

$$\text{ConvF} = \frac{E_{\text{liquid}}^2}{E_{\text{air}}^2}$$

The E-field in the liquid is determined from the SAR measurement according to the below formula.

$$E_{\text{liquid}}^2 = \frac{\rho \text{ SAR}}{\sigma}$$

where

σ =the conductivity of the liquid

ρ =the volumetric density of the liquid

SAR=the SAR measured from the formula that depends on the setup used. The SAR formulas are given below

For the calorimeter cell (150-450 MHz), the formula is:

$$\text{SAR} = c \frac{dT}{dt}$$

where

c =the specific heat for the liquid

dT/dt =the temperature rises over the time

For the waveguide setup (600-75000 MHz), the formula is:

$$\text{SAR} = \frac{4P_W}{ab\delta} e^{-\frac{2z}{\delta}}$$

where

a =the larger cross-sectional of the waveguide

b =the smaller cross-sectional of the waveguide

δ =the skin depth for the liquid in the waveguide

P_W =the power delivered to the liquid

Page: 7/10

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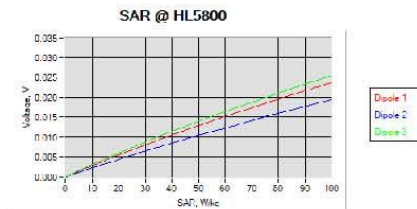
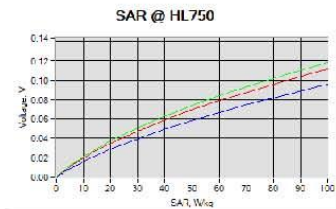
COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.261.11.23.BES.A

The below table summarize the ConvF for the calibrated liquid. The curves give examples for the measured SAR depending on the voltage in some liquid.

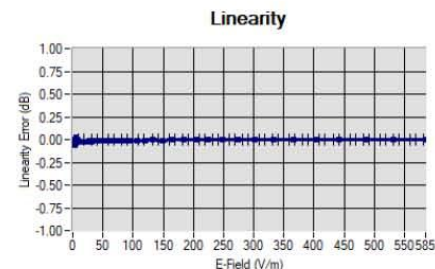
Liquid	Frequency (MHz*)	ConvF
HL750	750	2.37
HL850	835	2.32
HL900	900	2.23
HL1800	1800	2.45
HL1900	1900	2.63
HL2000	2000	2.83
HL2300	2300	2.81
HL2450	2450	2.85
HL2600	2600	2.65
HL3300	3300	2.21
HL3500	3500	2.20
HL3700	3700	2.11
HL3900	3900	2.40
HL4200	4200	2.40
HL4600	4600	2.33
HL4900	4900	2.37
HL5200	5200	2.07
HL5400	5400	2.11
HL5600	5600	2.20
HL5800	5800	2.04

(*) Frequency validity is ± 50 MHz below 600 MHz, ± 100 MHz from 600 MHz to 6 GHz and ± 700 MHz above 6 GHz

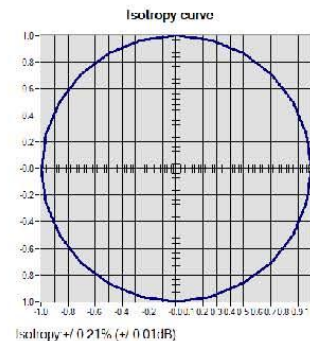


6 VERIFICATION RESULTS

The figures below represent the measured linearity and axial isotropy for this probe. The probe specification is ± 0.2 dB for linearity and ± 0.15 dB for axial isotropy.



Linearity: $\pm 1.42\%$ (± 0.06 dB)



Isotropy: $\pm 0.21\%$ (± 0.01 dB)



COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.261.11.23.BES.A

7 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	08/2021	08/2024
Network Analyzer	Agilent 8753ES	MY40003210	10/2019	10/2023
Network Analyzer – Calibration kit	HP 85033D	3423A08186	06/2021	06/2027
Network Analyzer – Calibration kit	Rohde & Schwarz ZV-Z235	101223	07/2022	07/2025
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.
Fluoroptic Thermometer	LumaSense Luxtron 812	94264	09/2022	09/2025
Coaxial cell	MVG	SN 32/16 COAXCELL_1	Validated. No cal required.	Validated. No cal required.
Waveguide	MVG	SN 32/16 WG2_1	Validated. No cal required.	Validated. No cal required.
Liquid transition	MVG	SN 32/16 WGLIQ_0G600_1	Validated. No cal required.	Validated. No cal required.

Page: 9/10

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COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.261.11.23.BES.A

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.
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.
Waveguide	MVG	SN 32/16 WG14_1	Validated. No cal required.	Validated. No cal required.
Liquid transition	MVG	SN 32/16 WGLIQ_7G000_1	Validated. No cal required.	Validated. No cal required.
Temperature / Humidity Sensor	Testo 184 H1	44225320	06/2021	06/2024



SAR Reference Dipole Calibration Report

Ref : ACR.53.25.24.BES.A

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CO., LTD.**

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

FREQUENCY: 900 MHZ

SERIAL NO.: SN 03/15DIP0G900-348

Calibrated at MVG

Z.I. de la pointe du diable

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

Calibration date: 21/02/2024



Accreditations #2-6789 and #2-6814
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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.53.25.24.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

Signature
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Yann Toutain ID
Date : 2024.02.27
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	Customer Name
Distribution :	SHENZHEN NTEK TESTING TECHNOLOGY CO., LTD.

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



SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.53.25.24.BES.A

TABLE OF CONTENTS

1	Introduction.....	4
2	Device Under Test	4
3	Product Description	4
3.1	General Information	4
4	Measurement Method	5
4.1	Mechanical Requirements	5
4.2	S11 parameter Requirements	5
4.3	SAR Requirements	5
5	Measurement Uncertainty	5
5.1	Mechanical dimensions	5
5.2	S11 Parameter	5
5.3	SAR	5
6	Calibration Results.....	6
6.1	Mechanical Dimensions	6
6.2	S11 parameter	6
6.3	SAR	6
7	List of Equipment	8



SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.53.25.24.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 900 MHz REFERENCE DIPOLE
Manufacturer	MVG
Model	SID900
Serial Number	SN 03/15DIP0G900-348
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.53.25.24.BES.A

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 $\pm 19\%$ with respect to measurement conditions.

Page: 5/8

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.53.25.24.BES.A

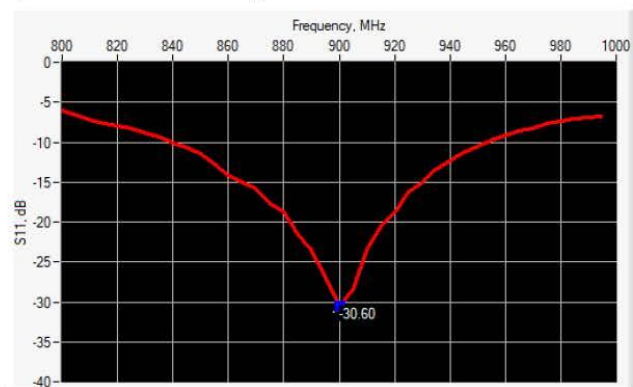
6 CALIBRATION RESULTS

6.1 MECHANICAL DIMENSIONS

L mm		h mm		d mm	
Measured	Required	Measured	Required	Measured	Required
-	149.00 +/- 2%	-	83.30 +/- 2%	-	3.60 +/- 2%

6.2 S11 PARAMETER

6.2.1 S11 parameter in Head Liquid



Frequency (MHz)	S11 parameter (dB)	Requirement (dB)	Impedance
900	-30.60	-20	$51.5\Omega + 2.6j\Omega$

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.

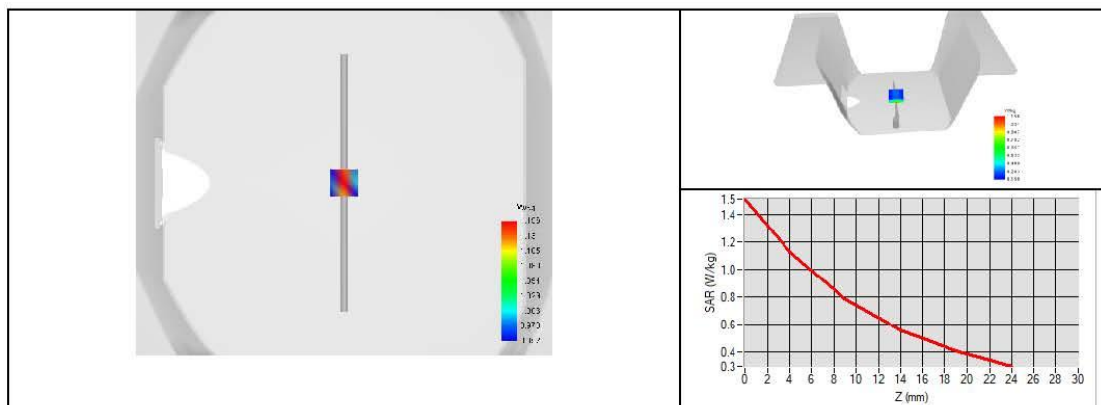


SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.53.25.24.BES.A

Software	OPENSAR V5
Phantom	SN 13/09 SAM68
Probe	3523-EPGO-429
Liquid	Head Liquid Values: ϵ_s' : 44.6 σ : 0.92
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	900 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
900 MHz	1.06	10.63	10.90	0.70	7.01	6.99





SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.53.25.24.BES.A

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



SAR Reference Dipole Calibration Report

Ref : ACR.53.26.24.BES.A

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CO., LTD.**

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

FREQUENCY: 1800 MHZ

SERIAL NO.: SN 03/15DIP1G800-349

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 #2-6814
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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.53.26.24.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

Signature
numérique de
Yann Toutain ID
Date : 2024.02.27
08:56:12 +01'00'

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

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



SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.53.26.24.BES.A

TABLE OF CONTENTS

1	Introduction.....	4
2	Device Under Test	4
3	Product Description	4
3.1	General Information	4
4	Measurement Method	5
4.1	Mechanical Requirements	5
4.2	S11 parameter Requirements	5
4.3	SAR Requirements	5
5	Measurement Uncertainty	5
5.1	Mechanical dimensions	5
5.2	S11 Parameter	5
5.3	SAR	5
6	Calibration Results.....	6
6.1	Mechanical Dimensions	6
6.2	S11 parameter	6
6.3	SAR	6
7	List of Equipment	8



SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.53.26.24.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 1800 MHz REFERENCE DIPOLE
Manufacturer	MVG
Model	SID1800
Serial Number	SN 03/15DIP1G800-349
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.53.26.24.BES.A

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 $\pm 19\%$ with respect to measurement conditions.



SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.53.26.24.BES.A

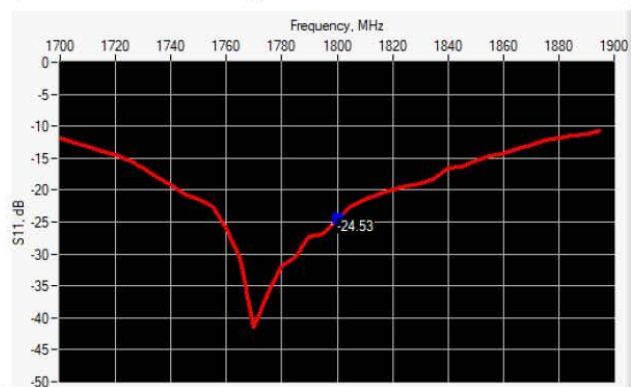
6 CALIBRATION RESULTS

6.1 MECHANICAL DIMENSIONS

L mm		h mm		d mm	
Measured	Required	Measured	Required	Measured	Required
-	72.00 +/- 2%	-	41.70 +/- 2%	-	3.60 +/- 2%

6.2 S11 PARAMETER

6.2.1 S11 parameter in Head Liquid



Frequency (MHz)	S11 parameter (dB)	Requirement (dB)	Impedance
1800	-24.53	-20	$44.8\Omega + 2.0j\Omega$

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.

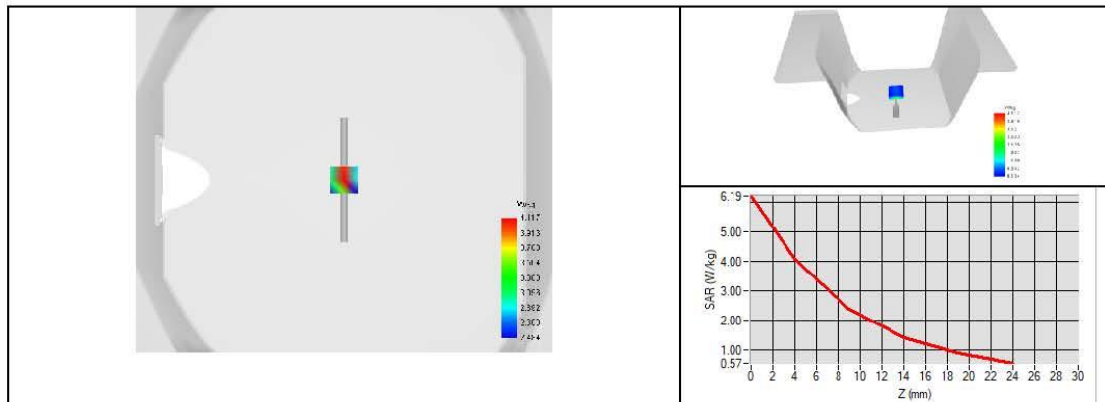


SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.53.26.24.BES.A

Software	OPENSAR V5
Phantom	SN 13/09 SAM68
Probe	3523-EPGO-429
Liquid	Head Liquid Values: ϵ_s' : 42.7 σ : 1.36
Distance between dipole center and liquid	10.0 mm
Area scan resolution	$dx=8\text{mm}/dy=8\text{mm}$
Zoon Scan Resolution	$dx=8\text{mm}/dy=8\text{mm}/dz=5\text{mm}$
Frequency	1800 MHz
Input power	20 dBm
Liquid Temperature	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
1800 MHz	3.71	37.06	38.40	2.00	20.01	20.10





SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.53.26.24.BES.A

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



SAR Reference Dipole Calibration Report

Ref : ACR.53.28.24.BES.A

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

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

FREQUENCY: 2000 MHZ

SERIAL NO.: SN 03/15DIP2G000-351

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 #2-6814
Scope available on www.cofrac.fr

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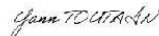
Summary:

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.53.28.24.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	

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Toutain IDSignature numérique
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Date : 2024.02.27
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	Customer Name
Distribution :	SHENZHEN NTEK TESTING TECHNOLOGY CO., LTD.

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



SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.53.28.24.BES.A

TABLE OF CONTENTS

1	Introduction.....	4
2	Device Under Test	4
3	Product Description	4
3.1	General Information	4
4	Measurement Method	5
4.1	Mechanical Requirements	5
4.2	S11 parameter Requirements	5
4.3	SAR Requirements	5
5	Measurement Uncertainty	5
5.1	Mechanical dimensions	5
5.2	S11 Parameter	5
5.3	SAR	5
6	Calibration Results.....	6
6.1	Mechanical Dimensions	6
6.2	S11 parameter	6
6.3	SAR	6
7	List of Equipment	8



SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.53.28.24.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 2000 MHz REFERENCE DIPOLE
Manufacturer	MVG
Model	SID2000
Serial Number	SN 03/15DIP2G000-351
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.53.28.24.BES.A

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 $\pm 19\%$ with respect to measurement conditions.



SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.53.28.24.BES.A

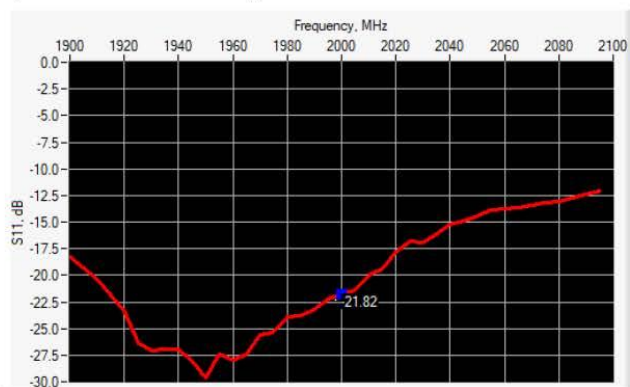
6 CALIBRATION RESULTS

6.1 MECHANICAL DIMENSIONS

L mm		h mm		d mm	
Measured	Required	Measured	Required	Measured	Required
-	64.50 +/- 2%	-	37.50 +/- 2%	-	3.60 +/- 2%

6.2 S11 PARAMETER

6.2.1 S11 parameter in Head Liquid



Frequency (MHz)	S11 parameter (dB)	Requirement (dB)	Impedance
2000	-21.82	-20	$58.3\Omega + 2.9j\Omega$

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.

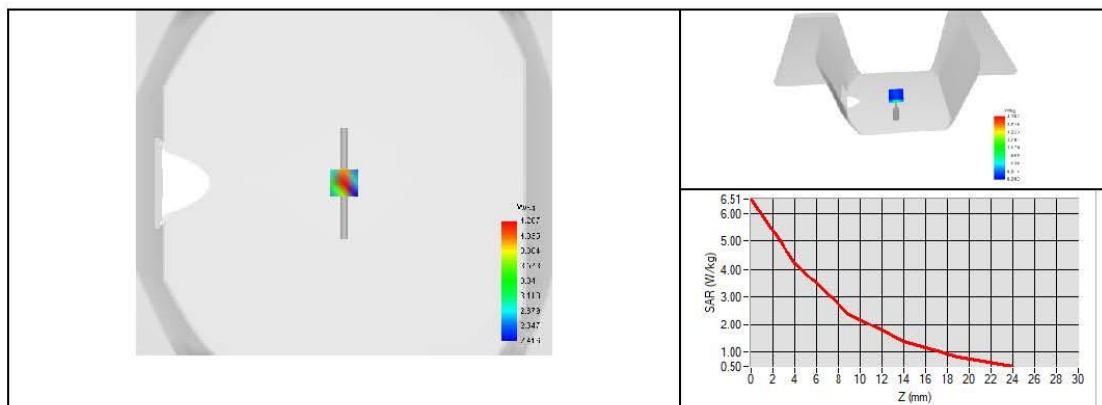


SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.53.28.24.BES.A

Software	OPENSAR V5
Phantom	SN 13/09 SAM68
Probe	3523-EPGO-429
Liquid	Head Liquid Values: ϵ_s' : 42.6 σ : 1.46
Distance between dipole center and liquid	10.0 mm
Area scan resolution	$dx=8mm/dy=8mm$
Zoon Scan Resolution	$dx=5mm/dy=5mm/dz=5mm$
Frequency	2000 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
2000 MHz	3.83	38.27	41.10	1.98	19.79	21.10





SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.53.28.24.BES.A

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



SAR Reference Dipole Calibration Report

Ref : ACR.53.30.24.BES.A

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

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

FREQUENCY: 2600 MHZ

SERIAL NO.: SN 03/15DIP2G600-356

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 #2-6814
Scope available on www.cofrac.fr

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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.53.30.24.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	

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Date: 2024.02.27
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	Customer Name
Distribution :	SHENZHEN NTEK TESTING TECHNOLOGY CO., LTD.

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



SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.53.30.24.BES.A

TABLE OF CONTENTS

1	Introduction.....	4
2	Device Under Test	4
3	Product Description	4
3.1	General Information	4
4	Measurement Method	5
4.1	Mechanical Requirements	5
4.2	S11 parameter Requirements	5
4.3	SAR Requirements	5
5	Measurement Uncertainty	5
5.1	Mechanical dimensions	5
5.2	S11 Parameter	5
5.3	SAR	5
6	Calibration Results.....	6
6.1	Mechanical Dimensions	6
6.2	S11 parameter	6
6.3	SAR	6
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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.53.30.24.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 2600 MHz REFERENCE DIPOLE
Manufacturer	MVG
Model	SID2600
Serial Number	SN 03/15DIP2G600-356
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.53.30.24.BES.A

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 $\pm 19\%$ with respect to measurement conditions.



SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.53.30.24.BES.A

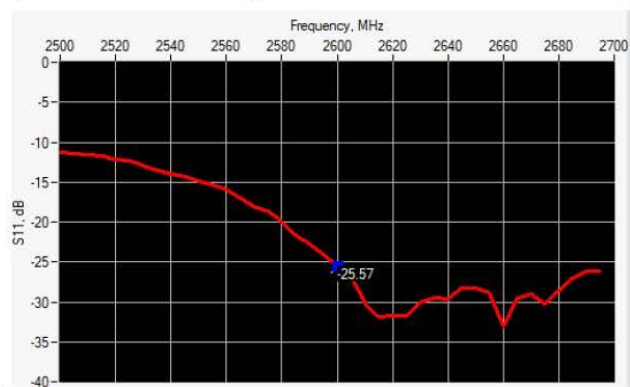
6 CALIBRATION RESULTS

6.1 MECHANICAL DIMENSIONS

L mm		h mm		d mm	
Measured	Required	Measured	Required	Measured	Required
-	48.50 +/- 2%	-	28.80 +/- 2%	-	3.60 +/- 2%

6.2 S11 PARAMETER

6.2.1 S11 parameter in Head Liquid



Frequency (MHz)	S11 parameter (dB)	Requirement (dB)	Impedance
2600	-25.57	-20	$54.5\Omega - 3.2j\Omega$

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.

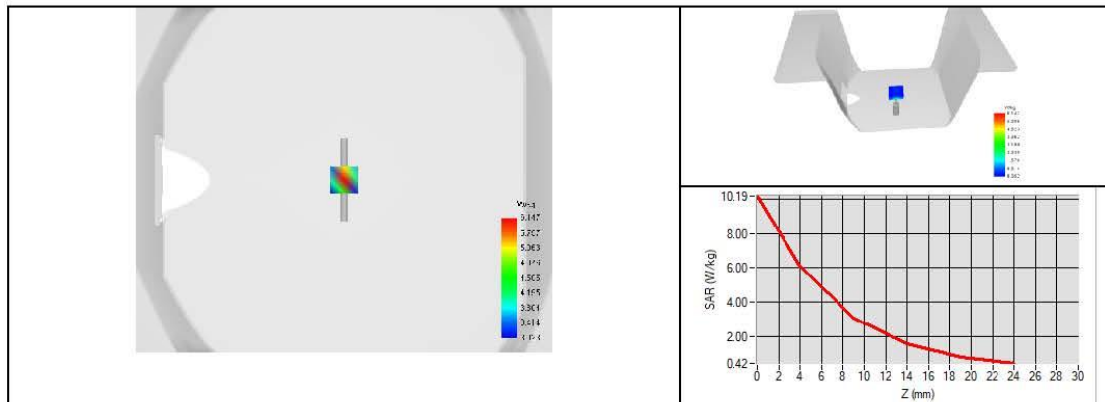


SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.53.30.24.BES.A

Software	OPENSAR V5
Phantom	SN 13/09 SAM68
Probe	3523-EPGO-429
Liquid	Head Liquid Values: $\epsilon_s' : 41.3$ $\sigma : 1.95$
Distance between dipole center and liquid	10.0 mm
Area scan resolution	$dx=8mm/dy=8mm$
Zoon Scan Resolution	$dx=5mm/dy=5mm/dz=5mm$
Frequency	2600 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
2600 MHz	5.42	54.16	55.30	2.49	24.85	24.60





SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.53.30.24.BES.A

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

Page: 8/8

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END