FCC SAR EVALUATION REPORT

In accordance with the requirements of FCC 47 CFR Part 2(2.1093), ANSI/IEEE C95.1-1992 and IEEE Std 1528-2013

Product Name：	Mobile Phone
Trademark：	ulefone
Model Name：	GQ3110
Family Model：	Note 15, Note 15 Pro, Note 15P, Note 15T, Note 15 Plus, Note 15 Lite
FCC ID：	2AOWK-3110
Report No.：	STR230223002006E

Prepared for

Shenzhen Gotron Electronic CO.,LTD.

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TEST RESULT CERTIFICATION

Applicant's name..................: Shenzhen Gotron Electronic CO.,LTD.

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Manufacturer's Name...........: Shenzhen Gotron Electronic CO.,LTD.

Address ....: 7B01, Building A, Block 1, Anhongji Tianyao Plaza, Longhua District, Shenzhen City, Guangdong Province China

Product description

Product name.........................: Mobile Phone

Trademark ....: ulefone

Model Name ....: GQ3110

Family Model.........................: Note 15, Note 15 Pro, Note 15P, Note 15T, Note 15 Plus, Note 15 Lite

Standards.............................: FCC 47 CFR Part 2(2.1093)
ANSI/IEEE C95.1-1992
IEEE Std 1528-2013
Published RF exposure KDB procedures

This device described above has been tested by Shenzhen NTEK. In accordance with the measurement methods and procedures specified in IEEE Std 1528-2013 and KDB 865664 D01. Testing has shown that this device is capable of compliance with localized specific absorption rate (SAR) specified in FCC 47 CFR Part 2(2.1093) and ANSI/IEEE C95.1-1992. 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 T230223001R003

Date of Test

Date (s) of performance of tests.............: Feb. 24, 2023 ~ Mar. 08, 2023

Date of Issue ....: Apr. 10, 2023

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

Prepared By (Test Engineer) : Jacob. chen
(Jacob Chen)

Approved By (Lab Manager) : Alex
(Alex Li)

※ ※ Revision History ※ ※

REV.	DESCRIPTION	ISSUED DATE	REMARK
Rev.1.0	Initial Test Report Release	Apr. 10, 2023	Jacob Chen

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1. General Information

1.1. RF exposure limits

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

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

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

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

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

Occupational/Controlled Environments:

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

General Population/Uncontrolled Environments:

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

NOTE HEAD AND TRUNK LIMIT 1.6 W/kg APPLIED TO THIS EUT

1.2. Statement of Compliance

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

RF Exposure Conditions		Equipment Class -Highest Reported SAR (W/kg)			
		PCE	DTS	NII	DSS
1-g Head		0.697	0.420	N/A	N/A
1-g Body-Worn (Separation distance of 10mm)		0.712	0.275	N/A	N/A
1-g Hotspot (Separation distance of 10mm)		0.712	0.275	N/A	N/A
Max Simultaneous Tx	Head	1.117	1.117	N/A	0.829
	Body-Worn	0.987	0.987	N/A	0.778
	Hotspot	0.987	0.987	N/A	0.778

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

This device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (1.6 W/kg) specified in FCC 47 CFR Part 2(2.1093) and ANSI/IEEE C95.1-1992, and had been tested in accordance with the measurement methods and procedures specified in IEEE Std 1528-2013 & KDB 865664 D01.

1.3. EUT Description

Device Information	
Product Name	Mobile Phone
Trade Name	ulefone
Model Name	GQ3110
Family Model	Note 15, Note 15 Pro, Note 15P, Note 15T, Note 15 Plus, Note 15 Lite
Model Difference	N/A
Device Phase	Identical Prototype
Exposure Category	General population / Uncontrolled environment
Antenna	PIFA Antenna
Battery Information	N/A
Hardware version	G2231F-MW-V1.1
Software version	GQ3110DH1_Ulefone_EEA
Device Operating Configurations	
Supporting Mode(s)	GSM 850/1900, WCDMA Band 2/5, WLAN 2.4G, Bluetooth, GPS, FM
Test Modulation	GSM(GMSK/8PSK), WCDMA(QPSK), LTE(QPSK/16-QAM), WLAN(DSSS/OFDM), Bluetooth(GFSK, π/4-DQPSK,

<table>
<tr><td></td><td colspan="3">8DPSK) , GPS(BPSK), FM(FM)</td></tr>
<tr><td>Device Class</td><td colspan="3">B</td></tr>
<tr><td rowspan="8">Operating Frequency Range(s)</td><td>Band</td><td>Tx (MHz)</td><td>Rx (MHz)</td></tr>
<tr><td>GSM 850</td><td>824-849</td><td>869-894</td></tr>
<tr><td>GSM 1900</td><td>1850-1910</td><td>1930-1990</td></tr>
<tr><td>WCDMA Band 2</td><td>1850-1910</td><td>1930-1990</td></tr>
<tr><td>WCDMA Band 5</td><td>824-849</td><td>869-894</td></tr>
<tr><td>Bluetooth</td><td colspan="2">2402-2480</td></tr>
<tr><td>FM</td><td>N/A</td><td>87.5-108</td></tr>
<tr><td>GPS</td><td>N/A</td><td>1575.42</td></tr>
<tr><td rowspan="3">GPRS Multislot Class(12)</td><td colspan="2">Max Number of Timeslots in Uplink</td><td>4</td></tr>
<tr><td colspan="2">Max Number of Timeslots in Downlink</td><td>4</td></tr>
<tr><td colspan="2">Max Total Timeslot</td><td>5</td></tr>
<tr><td rowspan="4">Power Class</td><td colspan="3">4, tested with power level 5(GSM 850)</td></tr>
<tr><td colspan="3">1, tested with power level 0(GSM 1900)</td></tr>
<tr><td colspan="3">3, tested with power control “all 1”(WCDMA Band 2)</td></tr>
<tr><td colspan="3">3, tested with power control “all 1”(WCDMA Band 5)</td></tr>
</table>

1.4. Test specification(s)

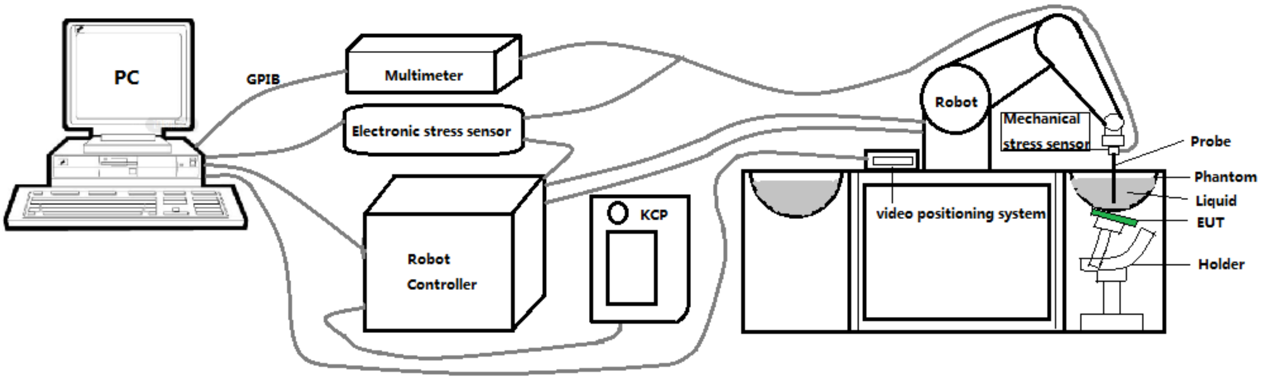
FCC 47 CFR Part 2(2.1093)
ANSI/IEEE C95.1-1992
IEEE Std 1528-2013
KDB 865664 D01 SAR measurement 100 MHz to 6 GHz
KDB 865664 D02 RF Exposure Reporting
KDB 447498 D01 General RF Exposure Guidance
KDB 248227 D01 802.11 Wi-Fi SAR
KDB 941225 D01 3G SAR Procedures
KDB 941225 D06 Hotspot SAR
KDB 648474 D04 Handset SAR

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 SN 08/16 EPGO287 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: ±0.08 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 ±10%. The spherical isotropy shall be evaluated and within ±0.25dB. 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.

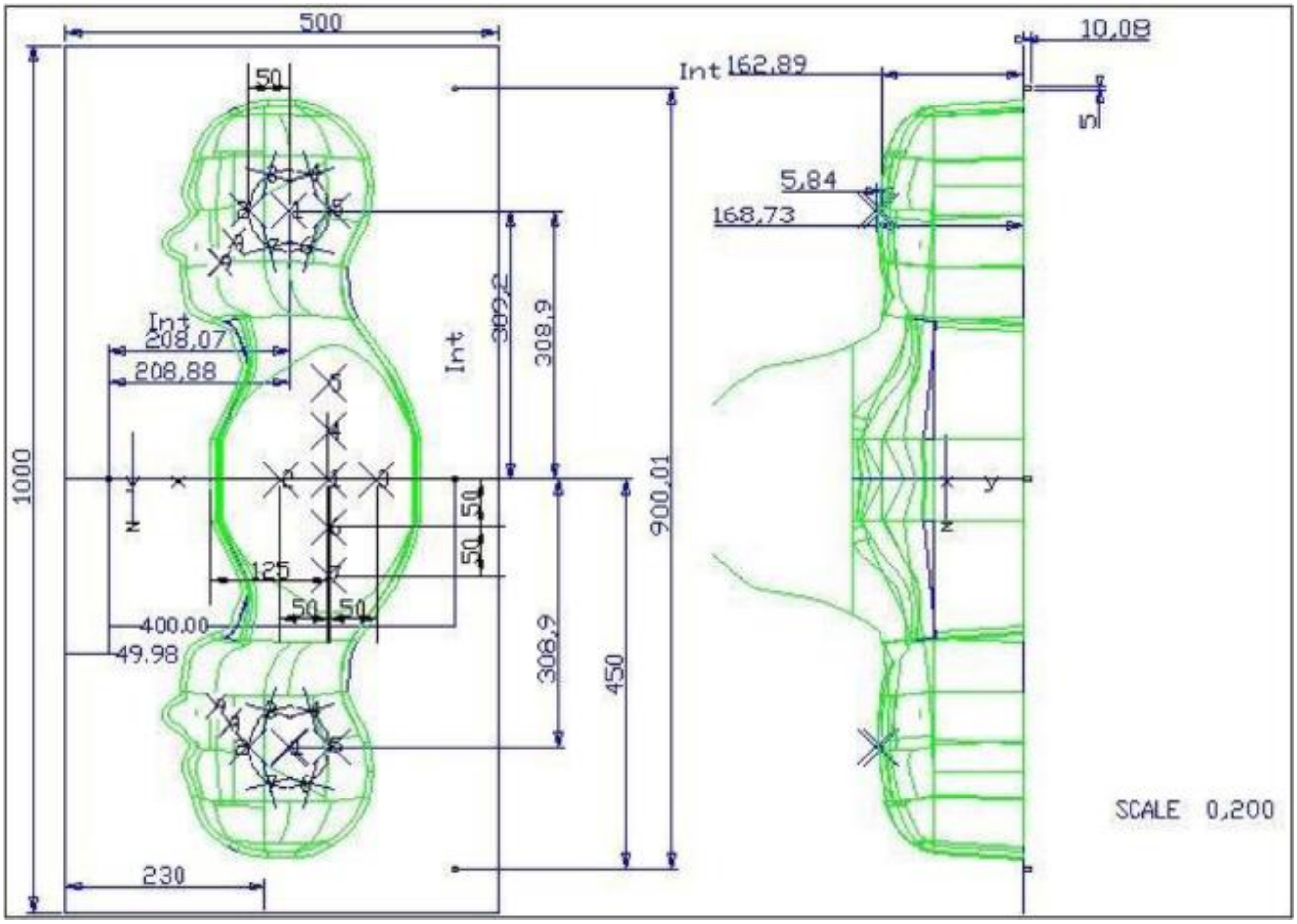
2.4. SAM phantoms

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

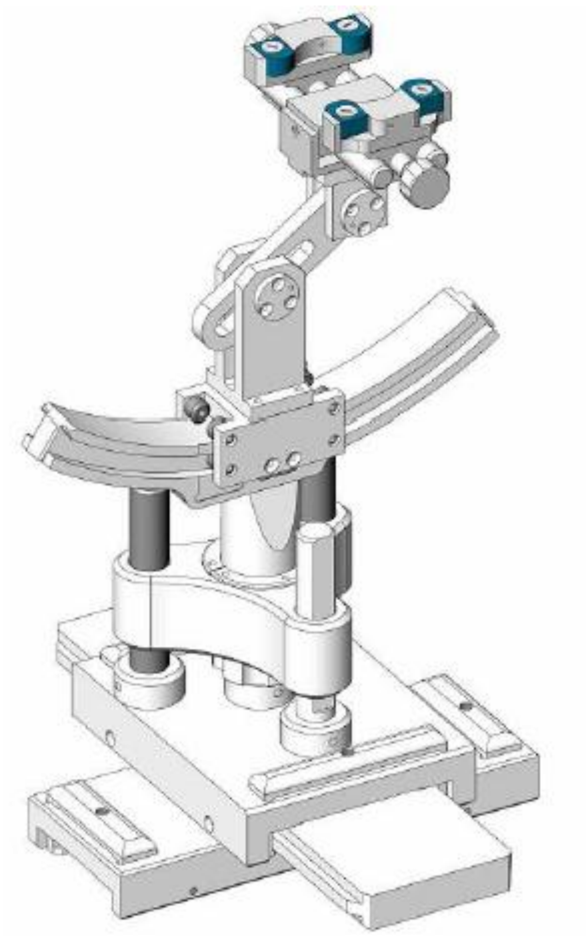


Serial Number	Left Head(mm)		Right Head(mm)		Flat Part(mm)	
SN 16/15 SAM119	2	2.02	2	2.08	1	2.09
	3	2.05	3	2.06	2	2.06
	4	2.07	4	2.07	3	2.08
	5	2.08	5	2.08	4	2.10
	6	2.05	6	2.07	5	2.10
	7	2.05	7	2.05	6	2.07
	8	2.07	8	2.06	7	2.07
	9	2.08	9	2.06	-	-

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	SN 08/16 EPGO287	Jan. 10, 2023	Jan. 09, 2024
☐	MVG	750 MHz Dipole	SID750	SN 03/15 DIP 0G750-355	Mar. 01, 2021	Feb. 28, 2024
☒	MVG	835 MHz Dipole	SID835	SN 03/15 DIP 0G835-347	Mar. 01, 2021	Feb. 28, 2024
☐	MVG	900 MHz Dipole	SID900	SN 03/15 DIP 0G900-348	Mar. 01, 2021	Feb. 28, 2024
☐	MVG	1800 MHz Dipole	SID1800	SN 03/15 DIP 1G800-349	Mar. 01, 2021	Feb. 28, 2024
☒	MVG	1900 MHz Dipole	SID1900	SN 03/15 DIP 1G900-350	Mar. 01, 2021	Feb. 28, 2024
☐	MVG	2000 MHz Dipole	SID2000	SN 03/15 DIP 2G000-351	Mar. 01, 2021	Feb. 28, 2024
☐	MVG	2300 MHz Dipole	SID2300	SN 03/16 DIP 2G300-358	Mar. 01, 2021	Feb. 28, 2024
☒	MVG	2450 MHz Dipole	SID2450	SN 03/15 DIP 2G450-352	Mar. 01, 2021	Feb. 28, 2024
☐	MVG	2600 MHz Dipole	SID2600	SN 03/15 DIP 2G600-356	Mar. 01, 2021	Feb. 28, 2024
☐	MVG	5000 MHz Dipole	SWG5500	SN 13/14 WGA 33	Mar. 01, 2021	Feb. 28, 2024
☒	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	117858	Jun. 17, 2022	Jun. 16, 2023
☐	R&S	Wideband radio communication tester	CMW500	103917	Jun. 17, 2022	Jun. 16, 2023
☒	HP	Network Analyzer	8753D	3410J01136	Jun. 17, 2022	Jun. 16, 2023

☒	Agilent	MXG Vector Signal Generator	N5182A	MY47070317	Jun. 16, 2022	Jun. 15, 2023
☒	Agilent	Power meter	E4419B	MY45102538	Jun. 17, 2022	Jun. 16, 2023
☒	Agilent	Power sensor	E9301A	MY41495644	Jun. 17, 2022	Jun. 16, 2023
☒	Agilent	Power sensor	E9301A	US39212148	Jun. 17, 2022	Jun. 16, 2023
☒	MCLI/USA	Directional Coupler	CB11-20	0D2L51502	Jul. 17, 2020	Jul. 16, 2023

3. SAR Measurement Procedures

The measurement procedures are as follows:

<Conducted power measurement>

(a) For WWAN power measurement, use base station simulator to configure EUT WWAN transmission in conducted connection with RF cable, at maximum power in each supported wireless interface and frequency band.

(b) Read the WWAN RF power level from the base station simulator.

(c) For WLAN/Bluetooth power measurement, use engineering software to configure EUT WLAN/Bluetooth continuously transmission, at maximum RF power in each supported wireless interface and frequency band.

(d) Connect EUT RF port through RF cable to the power meter, and measure WLAN/Bluetooth output power.

<SAR measurement>

(a) Use base station simulator to configure EUT WWAN transmission in radiated connection, and engineering software to configure EUT WLAN/Bluetooth continuously transmission, at maximum RF power, in the highest power channel.

(b) Place the EUT in the positions as Appendix A demonstrates.

(c) Set scan area, grid size and other setting on the OPENSAR software.

(d) Measure SAR results for the highest power channel on each testing position.

(e) Find out the largest SAR result on these testing positions of each band.

(f) Measure SAR results for other channels in worst SAR testing position if the reported SAR of highest power channel is larger than 0.8 W/kg.

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

(a) Power reference measurement

(b) Area scan

(c) Zoom scan

(d) Power drift measurement

3.1. Power Reference

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

3.2. Area scan & Zoom scan

The area scan is a 2D scan to find the hot spot location on the DUT. The zoom scan is a 3D scan above the hot spot to calculate the 1g and 10g SAR value.

Measurement of the SAR distribution with a grid of 8 to 16 mm * 8 to 16 mm and a constant distance to the inner surface of the phantom. Since the sensors cannot directly measure at the inner phantom surface, the values between the sensors and the inner phantom surface are extrapolated. With these values the area of the maximum SAR is calculated by an interpolation scheme. Around this point, a cube of 30 * 30 *30 mm or 32 * 32 * 32 mm is assessed by measuring 5 or 8 * 5 or 8 * 4 or 5 mm. With these data, the peak spatial-average SAR value can be calculated.

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

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

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

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 ±5%, the SAR will be retested.

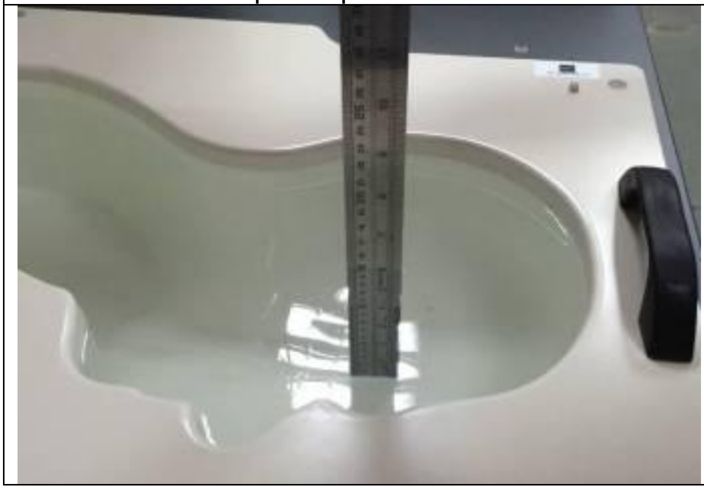
4. System Verification Procedure

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									
Frequency Band (MHz)	750	835	900	1800	1900	2000	2450	2600	5200	5800
Water	34.40	34.40	34.40	55.36	55.36	57.87	57.87	57.87	65.53	65.53
NaCl	0.79	0.79	0.79	0.35	0.35	0.16	0.16	0.16	0.00	0.00
1,2-Propanediol	64.81	64.81	64.81	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Triton X-100	0.00	0.00	0.00	30.45	30.45	19.97	19.97	19.97	24.24	24.24
DGBE	0.00	0.00	0.00	13.84	13.84	22.00	22.00	22.00	10.23	10.23
Ingredients (% of weight)	Body Tissue									
Frequency Band (MHz)	750	835	900	1800	1900	2000	2450	2600	5200	5800
Water	50.30	50.30	50.30	69.91	69.91	71.88	71.88	71.88	79.54	79.54
NaCl	0.60	0.60	0.60	0.13	0.13	0.16	0.16	0.16	0.00	0.00
1,2-Propanediol	49.10	49.10	49.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Triton X-100	0.00	0.00	0.00	9.99	9.99	19.97	19.97	19.97	11.24	11.24
DGBE	0.00	0.00	0.00	19.97	19.97	7.99	7.99	7.99	9.22	9.22

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.

Photo of Liquid depth for Head Position	Photo of Liquid depth for Body Position
	

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 of the dielectric parameter are within the tolerances of the specified target values. The measured conductivity and relative permittivity should be within ±5% of the target values.

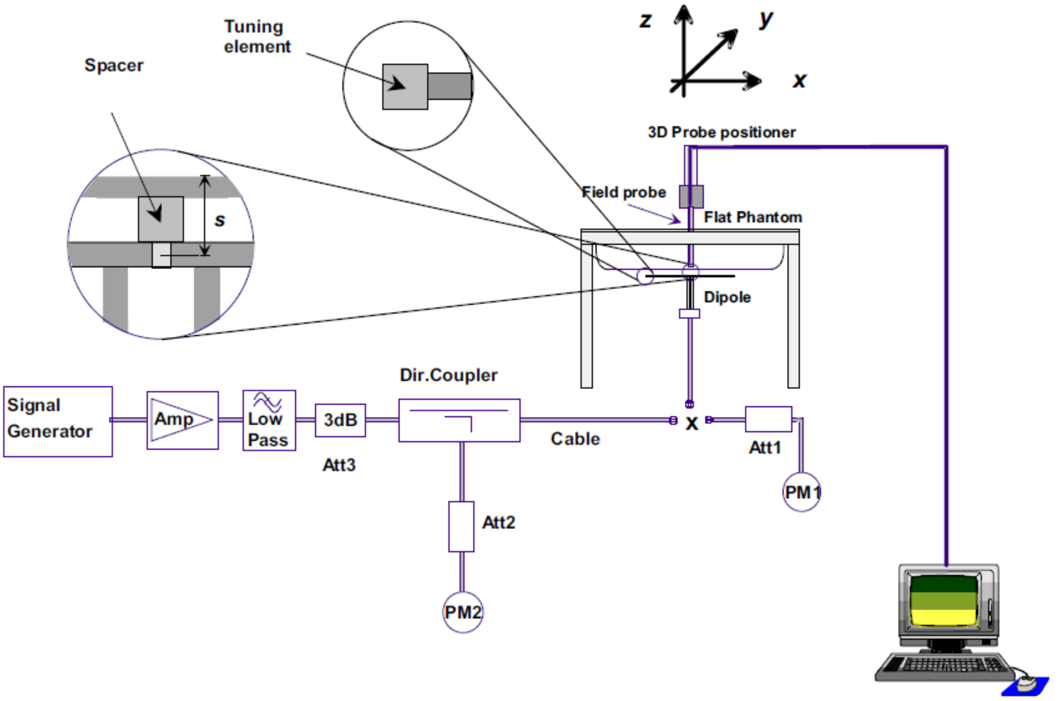
Tissue Type	Measured Frequency (MHz)	Target Tissue		Measured Tissue		Liquid Temp.	Test Date
		εr (±5%)	σ (S/m) (±5%)	εr	σ (S/m)		
Head 850	835	41.50 (39.43~43.58)	0.90 (0.86~0.95)	41.44	0.92	21.7 °C	Feb. 27, 2023
Head 1900	1900	40.00 (38.00~42.00)	1.40 (1.33~1.47)	38.85	1.43	21.5 °C	Feb. 24, 2023
Head 2450	2450	39.20 (37.24~41.16)	1.80 (1.71~1.89)	38.64	1.83	21.4 °C	Mar. 08, 2023

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 ±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) (±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)		
835MHz	9.84 (8.86~10.82)	6.22 (5.60~6.84)	10.31	5.80	21.7 °C	Feb. 27, 2023
1900MHz	40.37 (36.34~44.40)	20.48 (18.44~22.52)	38.87	19.00	21.5 °C	Feb. 24, 2023
2450MHz	53.69 (48.33~59.05)	23.94 (21.55~26.33)	55.64	23.50	21.4 °C	Mar. 08, 2023

5. SAR Measurement variability and uncertainty

5.1. SAR measurement variability

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

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

5.2. SAR measurement uncertainty

Per KDB865664 D01 SAR Measurement 100 MHz to 6 GHz, when the highest measured 1-g SAR within a frequency band is < 1.5 W/kg, the extensive SAR measurement uncertainty analysis described in IEEE Std 1528-2013 is not required in SAR reports submitted for equipment approval. The equivalent ratio (1.5/1.6) is applied to extremity and occupational exposure conditions.

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.

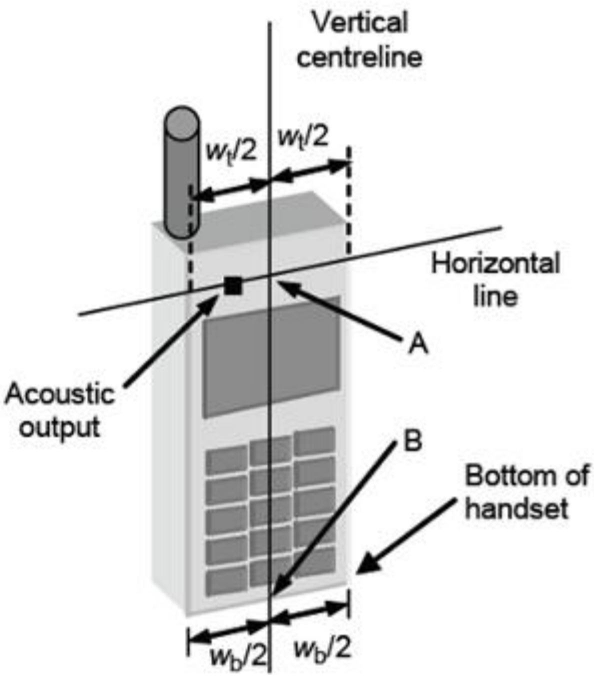


Fig 6.2.1 Handset vertical and horizontal reference lines—"fixed case

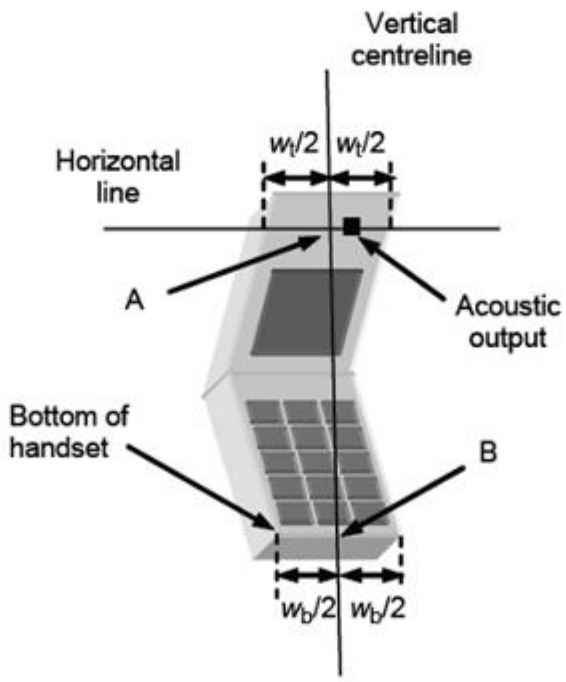


Fig 6.2.2 Handset vertical and horizontal reference lines—"clam-shell case"

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.

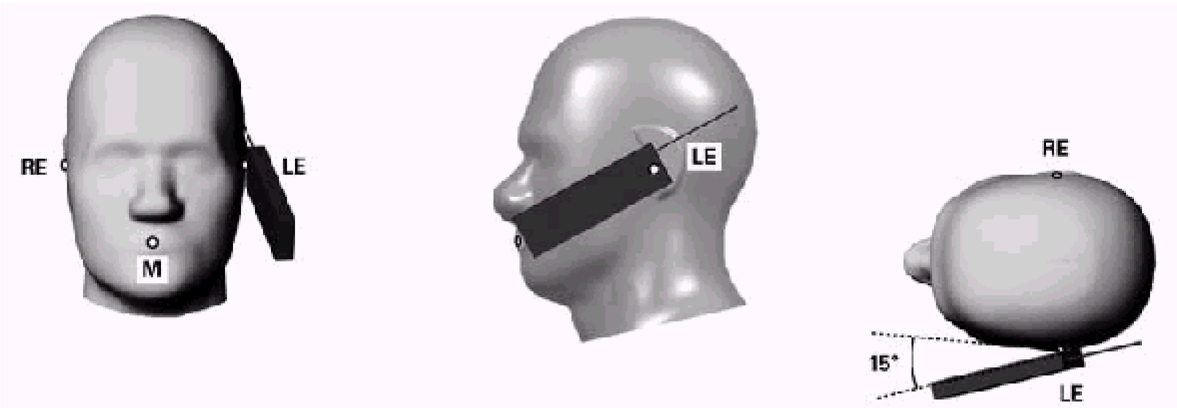


Figure 6.3.1 – Tilt position of the wireless device on the left side of SAM

6.4. Body Worn Accessory

1. Body-worn operating configurations are tested with the belt-clips and holsters attached to the device and positioned against a flat phantom in a normal use configuration (see Figure 6.4.1). Per KDB 648474 D04, body-worn accessory exposure is typically related to voice mode operations when handsets are carried in body-worn accessories. The body-worn accessory procedures in FCC KDB 447498 D01 should be used to test for body-worn accessory SAR compliance, without a headset connected to it. This enables the test results for such configuration to be compatible with that required for hotspot mode when the body-worn accessory test separation distance is greater than or equal to that required for hotspot mode, when applicable. When the reported SAR for body-worn accessory, measured without a headset connected to the handset is < 1.2 W/kg, the highest reported SAR configuration for that wireless mode and frequency band should be repeated for that body-worn accessory with a handset attached to the handset.
2. Accessories for body-worn operation configurations are divided into two categories: those that do not contain metallic components and those that do contain metallic components and those that do contain metallic components. When multiple accessories that do not contain metallic components are supplied with the device, the device is tested with only the accessory that dictates the closest

spacing to the body. Then multiple accessories that contain metallic components are test with the device with each accessory. If multiple accessories share an identical metallic component (i.e. the same metallic belt-chip used with different holsters with no other metallic components) only the accessory that dictates the closest spacing to the body is tested.

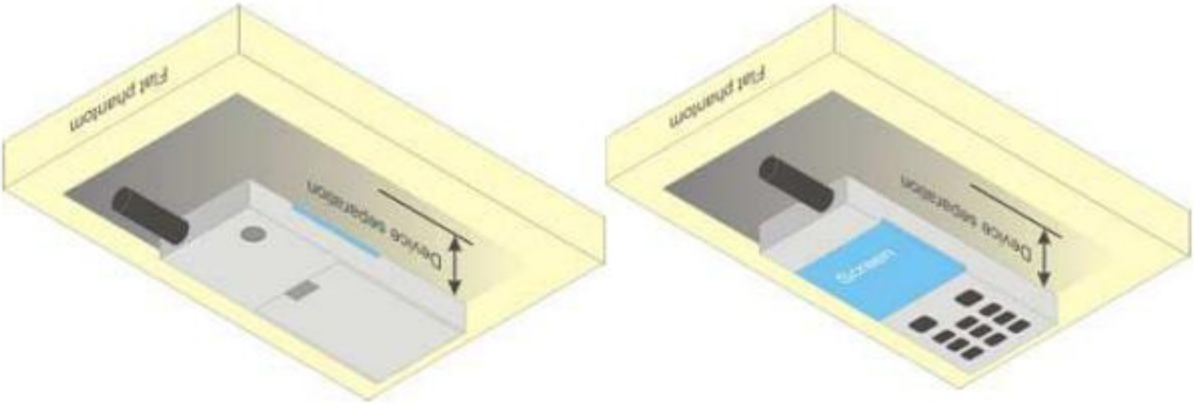


Figure 6.4.1 – Test positions for body-worn devices

7. RF Output Power

7.1. GSM Conducted Power

Band GSM850	Burst-Averaged output Power (dBm)				Frame-Averaged output Power (dBm)			
Tx Channel	Tune-up	128	189	251	Tune-up	128	189	251
Frequency (MHz)	(dBm)	824.2	836.4	848.8	(dBm)	824.2	836.4	848.8
GSM (GMSK)	33.00	32.45	32.38	32.54	23.97	23.42	23.35	23.51
GPRS(GMSK, 1 TS)	33.00	32.50	32.57	32.63	23.97	23.47	23.54	23.60
GPRS(GMSK, 2 TS)	32.00	31.70	31.58	31.70	25.98	25.68	25.56	25.68
GPRS(GMSK, 3 TS)	30.00	29.57	29.40	29.53	25.74	25.31	25.14	25.27
GPRS(GMSK, 4 TS)	28.50	28.32	28.10	28.22	25.49	25.31	25.09	25.21
Band GSM1900	Burst-Averaged output Power (dBm)				Frame-Averaged output Power (dBm)			
Tx Channel	Tune-up	512	661	810	Tune-up	512	661	810
Frequency (MHz)	(dBm)	1850.2	1880.0	1909.8	(dBm)	1850.2	1880.0	1909.8
GSM (GMSK)	28.50	28.21	27.63	27.28	19.47	19.18	18.60	18.25
GPRS(GMSK, 1 TS)	28.50	28.19	27.60	27.22	19.47	19.16	18.57	18.19
GPRS(GMSK, 2 TS)	27.50	27.29	26.70	26.33	21.48	21.27	20.68	20.31
GPRS(GMSK, 3 TS)	26.00	25.50	24.86	24.47	21.74	21.24	20.60	20.21
GPRS(GMSK, 4 TS)	24.50	24.34	23.68	23.31	21.49	21.33	20.67	20.30

Note: The frame-averaged power is linearly scaled the maximum burst averaged power over 8 time slots.
The calculated method are shown as below:
Frame-averaged power = Maximum burst averaged power (1 TS) - 9.03 dB
Frame-averaged power = Maximum burst averaged power (2 TS) - 6.02 dB
Frame-averaged power = Maximum burst averaged power (3 TS) - 4.26 dB
Frame-averaged power = Maximum burst averaged power (4 TS) - 3.01 dB

7.2. WCDMA Conducted Power

WCDMA Band 2	Burst-Averaged output Power (dBm)			
Tx Channel	Tune-up (dBm)	9262	9400	9538
Frequency (MHz)		1852.4	1880	1907.6
RMC 12.2Kbps	22.50	22.26	22.23	21.92
HSDPA Subtest-1	21.50	21.20	21.36	20.97
HSDPA Subtest-2	21.00	20.91	20.94	20.48
HSDPA Subtest-3	20.00	19.63	19.77	19.34
HSDPA Subtest-4	20.00	19.27	19.74	19.37
HSUPA Subtest-1	21.50	19.75	21.25	20.70
HSUPA Subtest-2	21.50	20.92	21.18	20.91
HSUPA Subtest-3	20.50	19.67	20.07	19.43
HSUPA Subtest-4	21.50	21.16	21.34	20.90
HSUPA Subtest-5	21.00	19.87	20.55	20.17
WCDMA Band 5	Burst-Averaged output Power (dBm)			
Tx Channel	Tune-up (dBm)	4132	4182	4233
Frequency (MHz)		826.4	836.4	846.6
RMC 12.2Kbps	22.50	22.27	22.37	22.04
HSDPA Subtest-1	21.50	21.31	21.39	20.97
HSDPA Subtest-2	21.50	21.00	21.01	20.23
HSDPA Subtest-3	20.00	19.39	19.88	19.62
HSDPA Subtest-4	20.50	20.15	19.48	19.50
HSUPA Subtest-1	21.50	20.60	21.08	20.85
HSUPA Subtest-2	21.50	21.27	21.10	20.79
HSUPA Subtest-3	20.50	19.59	20.43	19.96
HSUPA Subtest-4	21.50	21.34	21.39	21.00
HSUPA Subtest-5	21.00	19.74	20.74	20.37

7.3. WLAN & Bluetooth Output Power

Mode	Channel	Frequency (MHz)	Tune-up	Output Power (dBm)
802.11b	1	2412	15.50	15.35
	6	2437	15.50	15.43
	11	2462	15.50	15.36
802.11g	1	2412	14.00	13.53
	6	2437	14.00	12.98
	11	2462	14.00	13.83

802.11n (HT20)	1	2412	13.00	11.16
	6	2437	13.00	12.32
	11	2462	13.00	12.85
802.11n (HT40)	3	2422	13.00	12.69
	6	2437	13.00	12.66
	9	2452	13.00	12.54

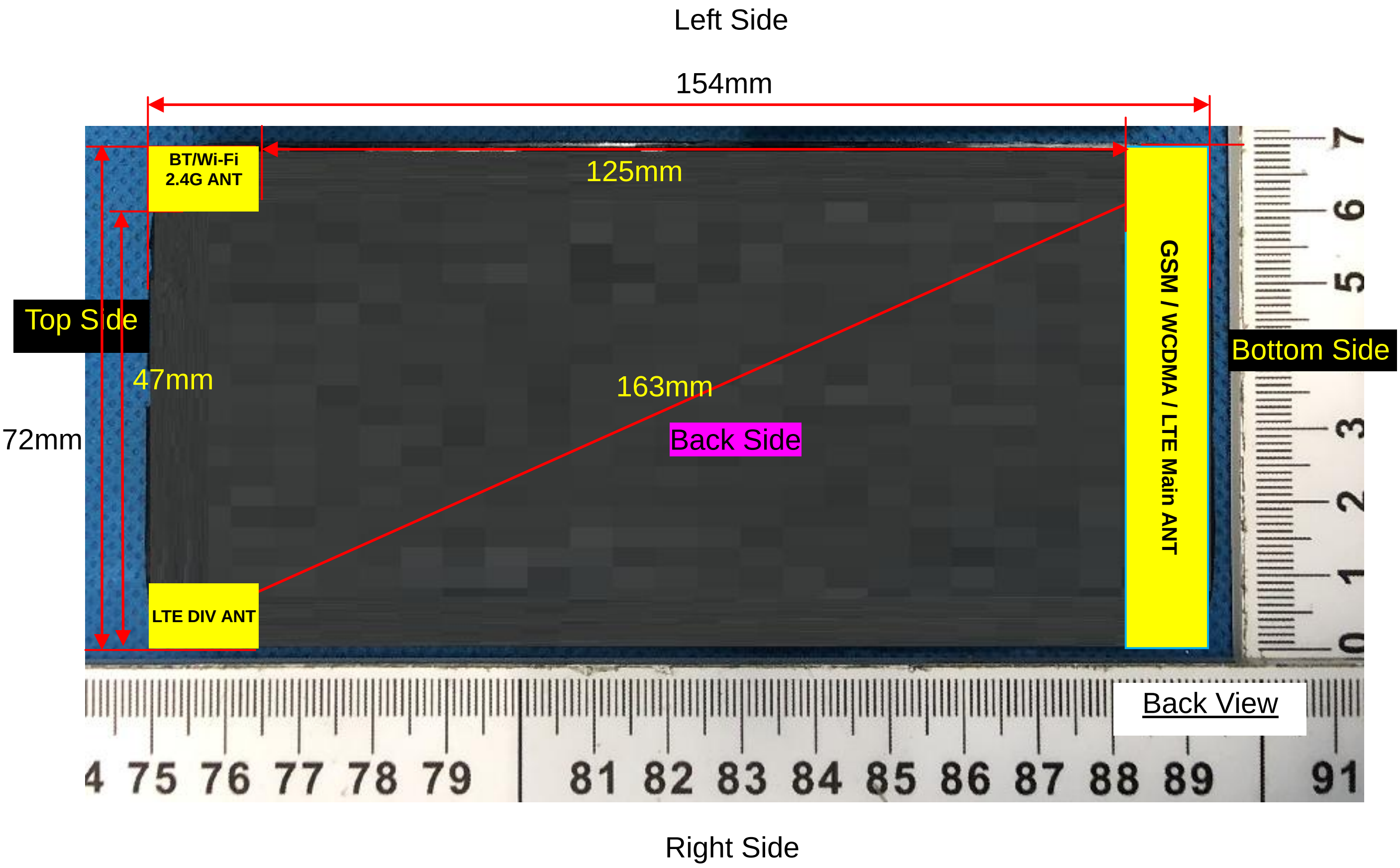
NOTE: Power measurement results of WLAN 2.4G.

BR+EDR	Output Power (dBm)				
	Channel	Tune-up (dBm)	Data Rates		
			1M	2M	3M
	0CH	5.00	4.80	4.63	4.72
	39CH	5.00	4.97	4.74	4.85
	78CH	5.00	4.15	3.92	4.02

BLE	Channel	Tune-up (dBm)	Output Power (dBm)
			1M
	0CH	5.00	4.88
	19CH	5.00	5.00
	39CH	5.00	4.17

NOTE: Power measurement results of Bluetooth.

8. Antenna Location



Note: Since the confidentiality request of EUT，the antenna location example diagram see as above.

Distance of the Antenna to the EUT surface/edge						
Antennas	Front Side	Back Side	Left Side	Right Side	Top Side	Bottom Side
WWAN Main ANT	≤ 25mm	≤ 25mm	≤ 25mm	≤ 25mm	> 25mm	≤ 25mm
WLAN & Bluetooth	≤ 25mm	≤ 25mm	≤ 25mm	> 25mm	≤ 25mm	>25mm
Positions for SAR tests						
Antennas	Front Side	Back Side	Left Side	Right Side	Top Side	Bottom Side
WWAN Main ANT	Yes	Yes	Yes	Yes	NO	Yes
WLAN & Bluetooth	Yes	Yes	Yes	NO	Yes	NO

9. Stand-alone SAR test exclusion

Refer to FCC KDB 447498D01, the 1-g SAR and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:
[(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)]·[$\sqrt{f_{(GHZ)}}$] ≤ 3.0 for 1-g SAR and ≤ 7.5 for 10-g extremity SAR, where:

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

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

Mode	P_{max} (dBm)	P_{max} (mW)	Distance (mm)	f (GHz)	Calculation Result	SAR Exclusion threshold	SAR test exclusion
Bluetooth	5.00	3.16	5	2.480	0.9	3.0	Yes

NOTE: Standalone SAR test exclusion for Bluetooth.

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

[(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] * [$\sqrt{f_{(GHZ)}}$/x] W/kg for test separation distances ≤ 50mm, where x = 7.5 for 1-g SAR and x = 18.75 for 10-g SAR.

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

Mode	Position	P_{max} (dBm)	P_{max} (mW)	Distance (mm)	f (GHz)	x	Estimated SAR (W/Kg)
Bluetooth	Head	5.00	3.16	5	2.48	7.5	0.132
Bluetooth	Body	5.00	3.16	10	2.48	7.5	0.066

NOTE: Estimated SAR calculation for Bluetooth

10. SAR Results

10.1. SAR measurement results

10.1.1. SAR measurement Result of GSM850

Test Position of Head	Test channel /Freq.	Mode	SAR Value (W/kg)		Power Drift(%)	Conducted Power (dBm)	Tune-up Power (dBm)	Scaled SAR 1-g (W/Kg)	Date	Plot
			1-g	10-g						
Left Cheek	189/836.4	GPRS(GMSK 2TS)	0.633	0.430	-0.78	31.58	32.00	0.697	2023/2/27	1#
Left Tilt 15 Degree	189/836.4	GPRS(GMSK 2TS)	0.321	0.207	0.62	31.58	32.00	0.354	2023/2/27	
Right Cheek	189/836.4	GPRS(GMSK 2TS)	0.591	0.385	0.07	31.58	32.00	0.651	2023/2/27	
Right Tilt 15 Degree	189/836.4	GPRS(GMSK 2TS)	0.274	0.184	0.49	31.58	32.00	0.302	2023/2/27	

NOTE: Head SAR test results of GSM850.

Test Position of Body-Worn with 0mm	Test channel /Freq.	Mode	SAR Value (W/kg)		Power Drift(%)	Conducted Power (dBm)	Tune-up Power (dBm)	Scaled SAR 1-g (W/Kg)	Date	Plot
			1-g	10-g						
Front Side	189/836.4	GPRS(GMSK 2TS)	0.372	0.244	3.42	31.58	32.00	0.410	2023/2/27	
Back Side	189/836.4	GPRS(GMSK 2TS)	0.577	0.394	0.80	31.58	32.00	0.636	2023/2/27	2#

NOTE: Body-Worn SAR test results of GSM850

Test Position of Hotspot with 10mm	Test channel /Freq.	Test Mode	SAR Value (W/kg)		Power Drift (±5%)	Conducted power (dBm)	Tune-up power (dBm)	Scaled SAR 1g (W/Kg)	Date	Plot
			1g	10g						
Front Side	189/836.4	GPRS(GMSK 2TS)	0.372	0.244	3.42	31.58	32.00	0.410	2023/2/27	
Back Side	189/836.4	GPRS(GMSK 2TS)	0.577	0.394	0.80	31.58	32.00	0.636	2023/2/27	2#
Left Side	189/836.4	GPRS(GMSK 2TS)	0.177	0.118	2.39	31.58	32.00	0.195	2023/2/27	
Right Side	189/836.4	GPRS(GMSK 2TS)	0.174	0.119	2.38	31.58	32.00	0.192	2023/2/27	

Bottom Side	189/836.4	GPRS(GMSK 2TS)	0.290	0.190	1.30	31.58	32.00	0.319	2023/2/27	

NOTE: Hotspot SAR test results of GSM850

10.1.2. SAR measurement Result of GSM1900

Test Position of Head	Test channel /Freq.	Mode	SAR Value (W/kg)		Power Drift(%)	Conducted Power (dBm)	Tune-up Power (dBm)	Scaled SAR 1-g (W/Kg)	Date	Plot
			1-g	10-g						
Left Cheek	661/1880	GPRS(GMSK 3TS)	0.481	0.262	0.15	24.86	26.00	0.625	2023/2/24	3#
Left Tilt 15 Degree	661/1880	GPRS(GMSK 3TS)	0.272	0.147	-0.02	24.86	26.00	0.354	2023/2/24	
Right Cheek	661/1880	GPRS(GMSK 3TS)	0.454	0.235	0.92	24.86	26.00	0.590	2023/2/24	
Right Tilt 15 Degree	661/1880	GPRS(GMSK 3TS)	0.218	0.116	-0.23	24.86	26.00	0.283	2023/2/24	

NOTE: Head SAR test results of GSM1900

Test Position of Body-Worn with 0mm	Test channel /Freq.	Mode	SAR Value (W/kg)		Power Drift(%)	Conducted Power (dBm)	Tune-up Power (dBm)	Scaled SAR 1-g (W/Kg)	Date	Plot
			1-g	10-g						
Front Side	661/1880	GPRS(GMSK 3TS)	0.348	0.174	3.48	24.86	26.00	0.452	2023/2/24	
Back Side	661/1880	GPRS(GMSK 3TS)	0.548	0.289	-2.05	24.86	26.00	0.712	2023/2/24	4#

NOTE: Body-Worn SAR test results of GSM1900

Test Position of Hotspot with 10mm	Test channel /Freq.	Test Mode	SAR Value (W/kg)		Power Drift (±5%)	Conducted power (dBm)	Tune-up power (dBm)	Scaled SAR 1g (W/Kg)	Date	Plot
			1g	10g						
Front Side	661/1880	GPRS(GMSK 3TS)	0.348	0.174	3.48	24.86	26.00	0.452	2023/2/24	
Back Side	661/1880	GPRS(GMSK 3TS)	0.548	0.289	-2.05	24.86	26.00	0.712	2023/2/24	4#
Left Side	661/1880	GPRS(GMSK 3TS)	0.165	0.084	3.33	24.86	26.00	0.215	2023/2/24	
Right Side	661/1880	GPRS(GMSK	0.174	0.092	0.52	24.86	26.00	0.226	2023/2/24	

		3TS)							
Bottom Side	661/1880	GPRS(GMSK 3TS)	0.295	0.152	-1.72	24.86	26.00	0.384	2023/2/24	

NOTE: Hotspot SAR test results of GSM1900

10.1.3. SAR measurement Result of WCDMA Band 2

Test Position of Head	Test channel /Freq	Mode	SAR Value (W/kg)		Power Drift(%)	Conducted Power (dBm)	Tune-up Power (dBm)	Scaled SAR 1-g (W/Kg)	Date	Plot
			1-g	10-g						
Left Cheek	9400/1880	RMC12.2K	0.359	0.209	-0.84	22.23	22.50	0.382	2023/2/24	5#
Left Tilt 15 Degree	9400/1880	RMC12.2K	0.187	0.108	0.03	22.23	22.50	0.199	2023/2/24	
Right Cheek	9400/1880	RMC12.2K	0.337	0.192	0.33	22.23	22.50	0.359	2023/2/24	
Right Tilt 15 Degree	9400/1880	RMC12.2K	0.175	0.102	0.46	22.23	22.50	0.186	2023/2/24	

NOTE: Head SAR test results of WCDMA Band 2

Test Position of Body-Worn with 0mm	Test channel /Freq.	Mode	SAR Value (W/kg)		Power Drift(%)	Conducted Power (dBm)	Tune-up Power (dBm)	Scaled SAR 1-g (W/Kg)	Date	Plot
			1-g	10-g						
Front Side	9400/1880	RMC12.2K	0.330	0.169	-0.67	22.23	22.50	0.351	2023/2/24	
Back Side	9400/1880	RMC12.2K	0.503	0.265	1.12	22.23	22.50	0.535	2023/2/24	6#

NOTE: Body-Worn SAR test results of WCDMA Band 2

Test Position of Hotspot with 10mm	Test channel /Freq.	Test Mode	SAR Value (W/kg)		Power Drift (±5%)	Conducted power (dBm)	Tune-up power (dBm)	Scaled SAR 1g (W/Kg)	Date	Plot
			1g	10g						
Front Side	9400/1880	RMC12.2K	0.330	0.169	-0.67	22.23	22.50	0.351	2023/2/24	
Back Side	9400/1880	RMC12.2K	0.503	0.265	1.12	22.23	22.50	0.535	2023/2/24	6#
Left Side	9400/1880	RMC12.2K	0.153	0.079	2.46	22.23	22.50	0.163	2023/2/24	
Right Side	9400/1880	RMC12.2K	0.159	0.081	2.28	22.23	22.50	0.169	2023/2/24	
Bottom Side	9400/1880	RMC12.2K	0.260	0.136	-3.38	22.23	22.50	0.277	2023/2/24	

NOTE: Hotspot SAR test results of WCDMA Band 2

10.1.4. SAR measurement Result of WCDMA Band 5

Test Position of Head	Test channel /Freq	Mode	SAR Value (W/kg)		Power Drift(%)	Conducted Power (dBm)	Tune-up Power (dBm)	Scaled SAR 1-g (W/Kg)	Date	Plot
			1-g	10-g						
Left Cheek	4182/836.4	RMC12.2K	0.286	0.211	-0.44	22.37	22.50	0.295	2023/2/27	7#
Left Tilt 15 Degree	4182/836.4	RMC12.2K	0.147	0.106	3.14	22.37	22.50	0.151	2023/2/27	
Right Cheek	4182/836.4	RMC12.2K	0.253	0.183	-2.95	22.37	22.50	0.261	2023/2/27	
Right Tilt 15 Degree	4182/836.4	RMC12.2K	0.115	0.084	2.68	22.37	22.50	0.118	2023/2/27	

NOTE: Head SAR test results of WCDMA Band 5

Test Position of Body-Worn with 0mm	Test channel /Freq.	Mode	SAR Value (W/kg)		Power Drift(%)	Conducted Power (dBm)	Tune-up Power (dBm)	Scaled SAR 1-g (W/Kg)	Date	Plot
			1-g	10-g						
Front Side	4182/836.4	RMC12.2K	0.168	0.121	1.05	22.37	22.50	0.173	2023/2/27	
Back Side	4182/836.4	RMC12.2K	0.267	0.198	-0.56	22.37	22.50	0.275	2023/2/27	8#

NOTE: Body-Worn SAR test results of WCDMA Band 5

Test Position of Hotspot with 10mm	Test channel /Freq.	Test Mode	SAR Value (W/kg)		Power Drift (±5%)	Conducted power (dBm)	Tune-up power (dBm)	Scaled SAR 1g (W/Kg)	Date	Plot
			1g	10g						
Front Side	4182/836.4	RMC12.2K	0.168	0.121	1.05	22.37	22.50	0.173	2023/2/27	
Back Side	4182/836.4	RMC12.2K	0.267	0.198	-0.56	22.37	22.50	0.275	2023/2/27	8#
Left Side	4182/836.4	RMC12.2K	0.087	0.065	-1.69	22.37	22.50	0.090	2023/2/27	
Right Side	4182/836.4	RMC12.2K	0.084	0.062	-3.34	22.37	22.50	0.087	2023/2/27	
Bottom Side	4182/836.4	RMC12.2K	0.140	0.103	2.59	22.37	22.50	0.144	2023/2/27	

NOTE: Hotspot SAR test results of WCDMA Band 5

10.1.5. SAR measurement Result of WLAN2.4G

Test Position of Head	Test channel /Freq.	Mode	SAR Value (W/kg)		Power Drift(%)	Conducted Power (dBm)	Tune-up Power (dBm)	Scaled SAR 1-g (W/Kg)	Date	Plot
			1-g	10-g						
Left	6/2437	802.11b	0.413	0.196	0.99	15.43	15.50	0.420	2023/3/08	9#

Cheek										
Left Tilt 15 Degree	6/2437	802.11b	0.224	0.102	-1.71	15.43	15.50	0.228	2023/3/08	
Right Cheek	6/2437	802.11b	0.360	0.162	2.41	15.43	15.50	0.366	2023/3/08	
Right Tilt 15 Degree	6/2437	802.11b	0.163	0.074	-2.47	15.43	15.50	0.166	2023/3/08	

NOTE: Head SAR test results of WLAN2.4G

Test Position of Body-Worn with 10mm	Test channel /Freq.	Mode	SAR Value (W/kg)		Power Drift(%)	Conducted Power (dBm)	Tune-up Power (dBm)	Scaled SAR 1-g (W/Kg)	Date	Plot
			1-g	10-g						
Front Side	6/2437	802.11b	0.174	0.080	0.95	15.43	15.50	0.177	2023/3/08	
Back Side	6/2437	802.11b	0.271	0.130	-0.36	15.43	15.50	0.275	2023/3/08	10#

NOTE: Body-worn SAR test results of WLAN2.4G

Test Position of Hotspot with 10mm	Test channel /Freq.	Test Mode	SAR Value (W/kg)		Power Drift (±5%)	Conducted power (dBm)	Tune-up power (dBm)	Scaled SAR 1g (W/Kg)	Date	Plot
			1g	10g						
Front Side	6/2437	802.11b	0.174	0.080	0.95	15.43	15.50	0.177	2023/3/08	
Back Side	6/2437	802.11b	0.271	0.130	-0.36	15.43	15.50	0.275	2023/3/08	10#
Left Side	6/2437	802.11b	0.093	0.043	-2.32	15.43	15.50	0.095	2023/3/08	
Top Side	6/2437	802.11b	0.090	0.041	-0.54	15.43	15.50	0.091	2023/3/08	

NOTE: Hotspot SAR test results of WLAN2.4G

10.2. SAR Summation Scenario

Per KDB 447498 D01, simultaneous transmission SAR is compliant if,

1) Scalar SAR summation < 1.6W/kg.

2) SPLSR = $(SAR_1 + SAR_2)^{1.5}$ / (min. separation distance, mm), and the peak separation distance is determined from the square root of $[(x_1-x_2)^2 + (y_1-y_2)^2 + (z_1-z_2)^2]$, where (x_1, y_1, z_1) and (x_2, y_2, z_2) are the coordinates of the extrapolated peak SAR locations in the zoom scan. If SPLSR ≤ 0.04, simultaneously transmission SAR measurement is not necessary.

Test Position		Scaled SAR_{MAX}		∑1-g SAR (W/Kg)	SPLSR	Remark
		WWAN	DTS			
Head	Left Cheek	0.697	0.420	1.117	N/A	N/A

	Left Tilt 15 Degree	0.354	0.228	0.582	N/A	N/A
	Right Cheek	0.651	0.366	1.017	N/A	N/A
	Right Tilt 15 Degree	0.302	0.166	0.468	N/A	N/A
Body-Worn	Front Side	0.452	0.177	0.629	N/A	N/A
	Back Side	0.712	0.275	0.987	N/A	N/A

Test Position		Scaled SAR_{MAX}		∑1-g SAR (W/Kg)	SPLSR	Remark
		WWAN	DSS			
Head	Left Cheek	0.697	0.132	0.829	N/A	N/A
	Left Tilt 15 Degree	0.354	0.132	0.486	N/A	N/A
	Right Cheek	0.651	0.132	0.783	N/A	N/A
	Right Tilt 15 Degree	0.302	0.132	0.434	N/A	N/A
Body-Worn	Front Side	0.452	0.066	0.518	N/A	N/A
	Back Side	0.712	0.066	0.778	N/A	N/A

11. Appendix A. Photo documentation

Refer to appendix Test Setup photo---SAR

12. Appendix B. System Check Plots

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MEASUREMENT 1

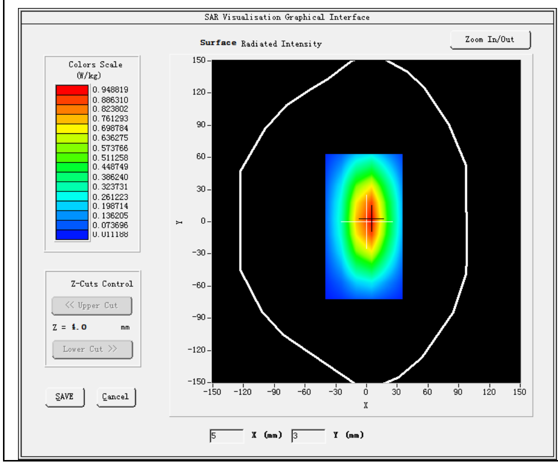
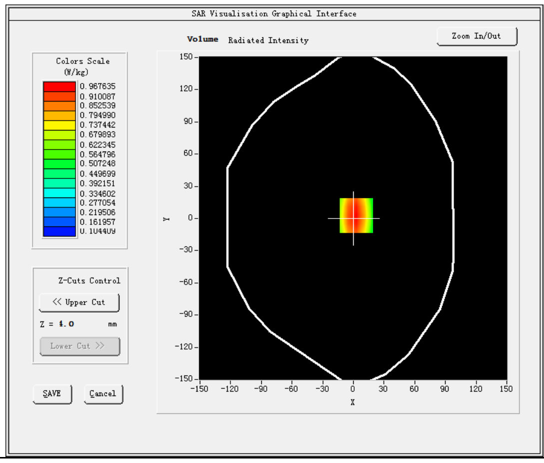
Date of measurement: 27/2/2023

A. Experimental conditions.

Area Scan	dx=15mm dy=15mm, h= 5.00 mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm
Phantom	Validation plane
Device Position	Dipole
Band	CW835
Channels	Middle
Signal	CW (Crest factor: 1.0)
ConvF	1.50

B. SAR Measurement Results

Frequency (MHz)	835.000000
Relative permittivity (real part)	41.441097
Relative permittivity (imaginary part)	19.819841
Conductivity (S/m)	0.919420
Variation (%)	1.260000

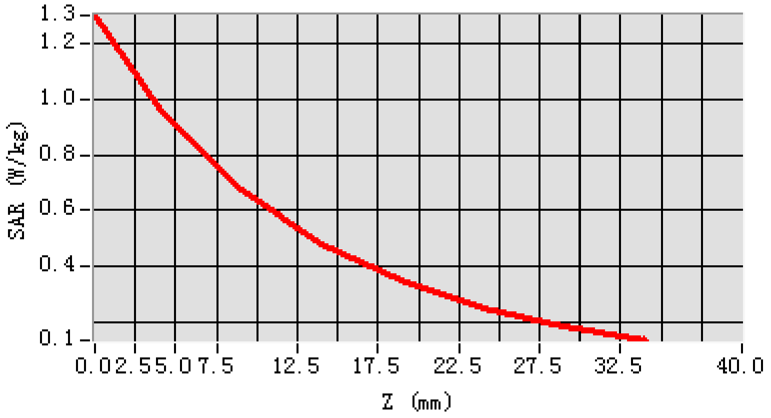
SURFACE SAR	VOLUME SAR
	

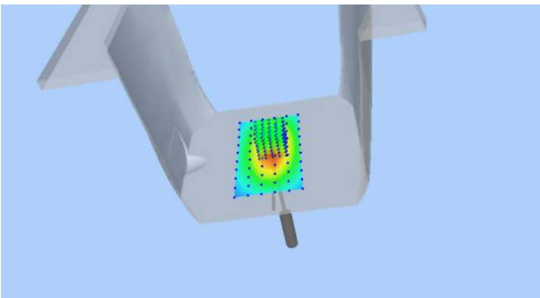
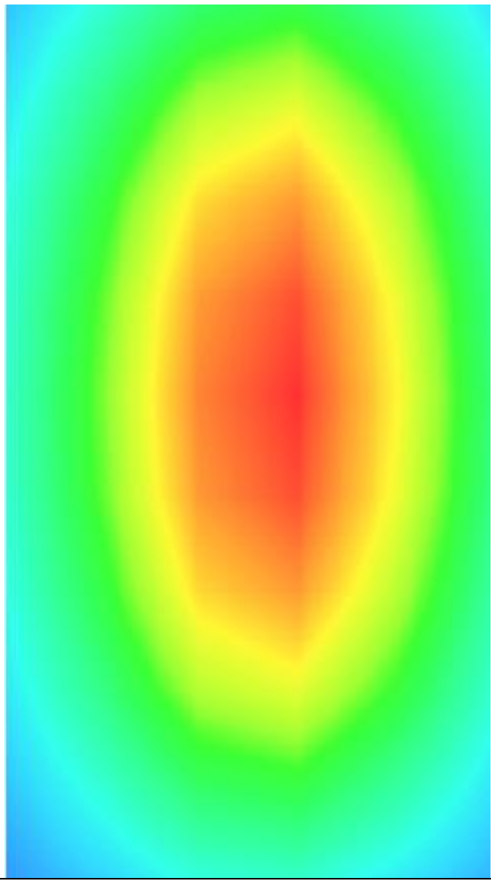
Maximum location: X=3.00, Y=3.00

SAR Peak: 1.30 W/kg

SAR 10g (W/Kg)	0.580142
SAR 1g (W/Kg)	1.031105

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	1.3058	0.9601	0.6764	0.4831	0.3479	0.2550	0.1874



3D screen shot	Hot spot position
	

MEASUREMENT 2

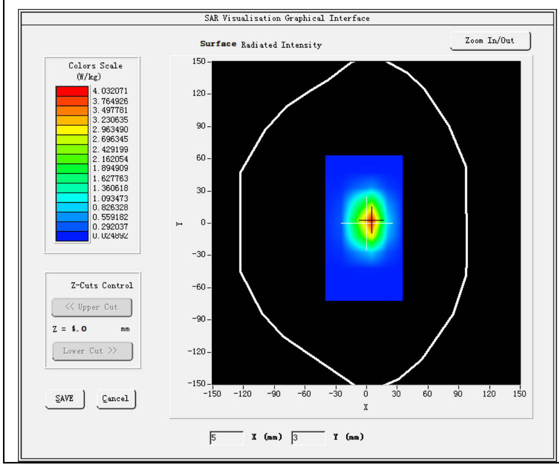
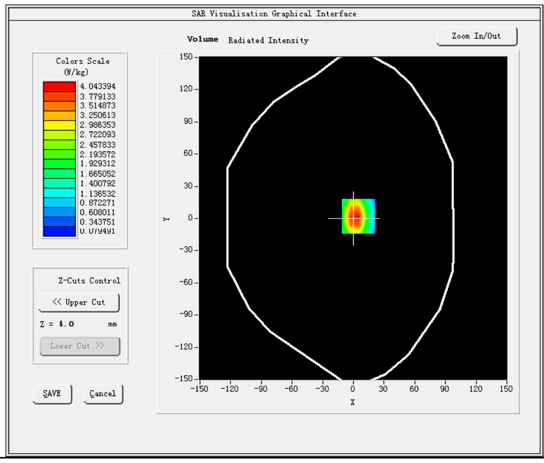
Date of measurement: 24/2/2023

A. Experimental conditions.

Area Scan	dx=15mm dy=15mm, h= 5.00 mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm
Phantom	Validation plane
Device Position	Dipole
Band	CW1900
Channels	Middle
Signal	CW (Crest factor: 1.0)
ConvF	1.91

B. SAR Measurement Results

Frequency (MHz)	1900.000000
Relative permittivity (real part)	38.845711
Relative permittivity (imaginary part)	13.547294
Conductivity (S/m)	1.429992
Variation (%)	-2.640000

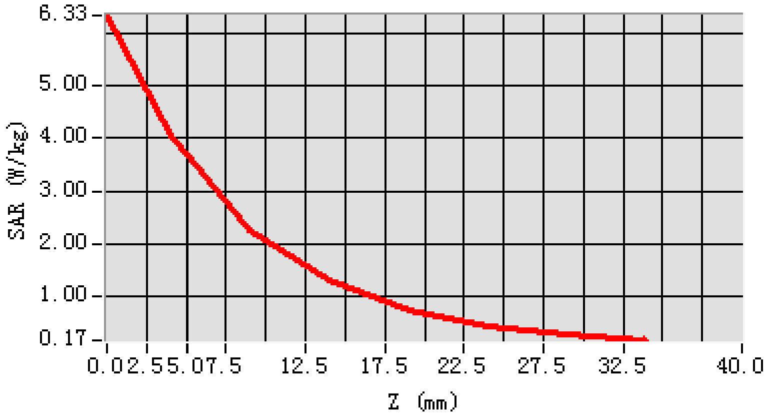
SURFACE SAR	VOLUME SAR
	

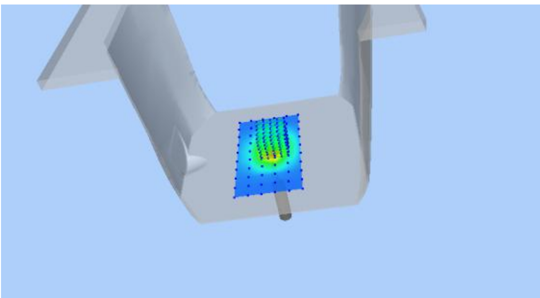
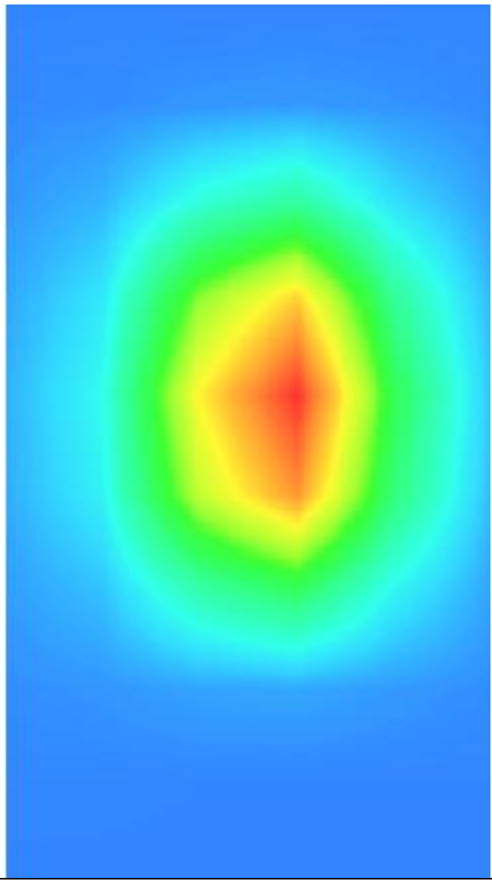
Maximum location: X=5.00, Y=2.00

SAR Peak: 6.70 W/kg

SAR 10g (W/Kg)	1.900042
SAR 1g (W/Kg)	3.887104

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	6.3290	4.0442	2.2687	1.3026	0.7620	0.4503	0.2772



3D screen shot	Hot spot position
	

MEASUREMENT 3

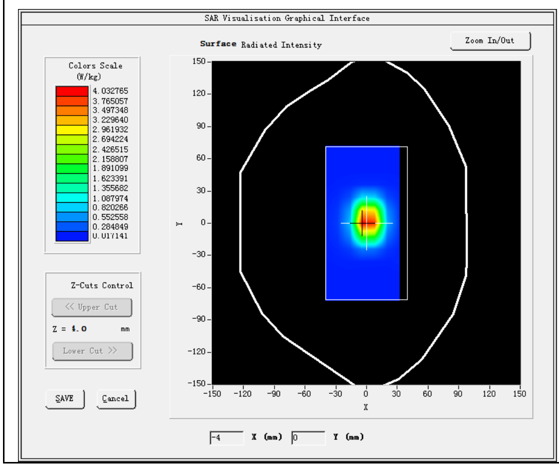
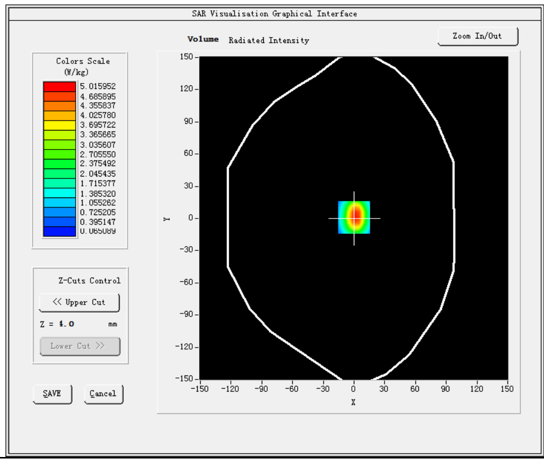
Date of measurement: 8/3/2023

A. Experimental conditions.

Area Scan	dx=12mm dy=12mm, h= 5.00 mm
ZoomScan	7x7x7,dx=5mm dy=5mm dz=5mm
Phantom	Validation plane
Device Position	Dipole
Band	CW2450
Channels	Middle
Signal	CW (Crest factor: 1.0)
ConvF	1.98

B. SAR Measurement Results

Frequency (MHz)	2450.000000
Relative permittivity (real part)	38.640497
Relative permittivity (imaginary part)	13.448411
Conductivity (S/m)	1.830478
Variation (%)	-2.350000

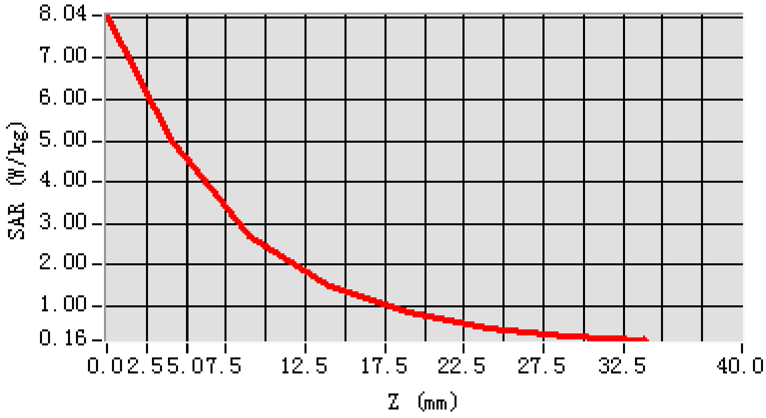
SURFACE SAR	VOLUME SAR
	

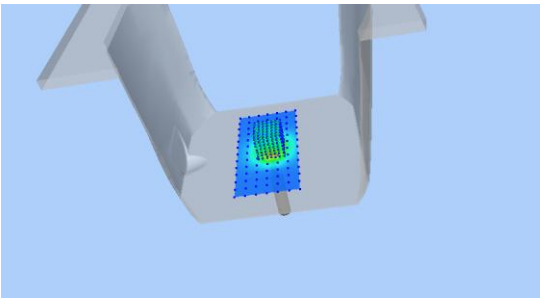
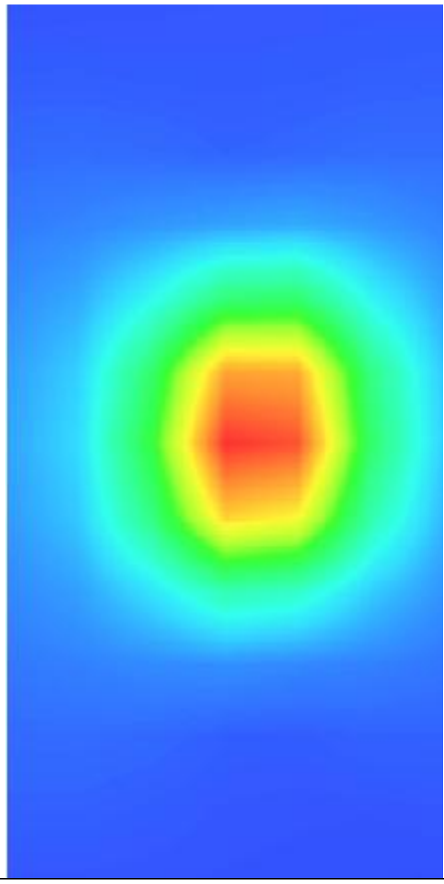
Maximum location: X=0.00, Y=1.00

SAR Peak: 8.14 W/kg

SAR 10g (W/Kg)	2.350042
SAR 1g (W/Kg)	5.564310

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	8.0385	5.0179	2.6935	1.4806	0.8349	0.4619	0.2663



3D screen shot	Hot spot position
	

13. Appendix C. Plots of High SAR Measurement

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MEASUREMENT 1

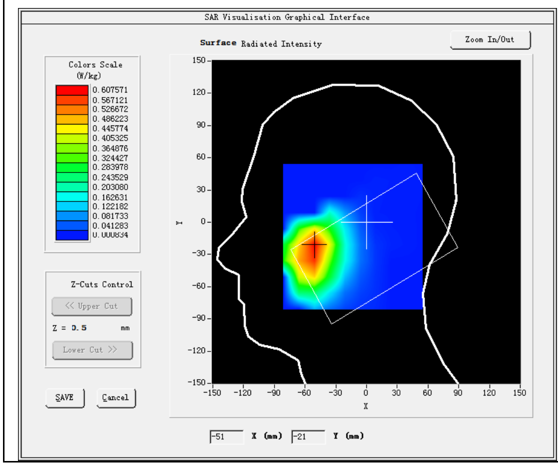
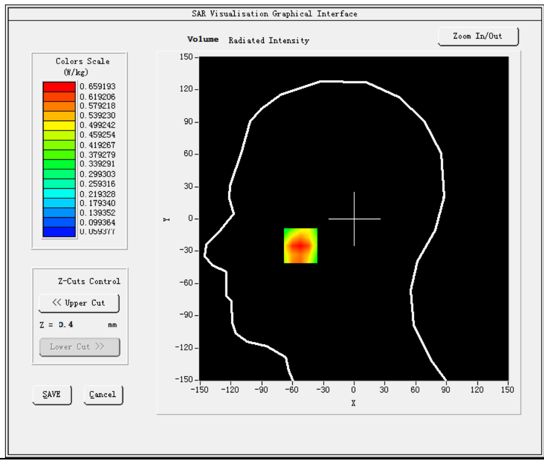
Date of measurement: 27/2/2023

A. Experimental conditions.

Area Scan	dx=15mm dy=15mm, h= 5.00 mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm
Phantom	Left head
Device Position	Cheek
Band	GSM850
Channels	Middle
Signal	TDMA (Crest factor: 8.0)
ConvF	1.50

B. SAR Measurement Results

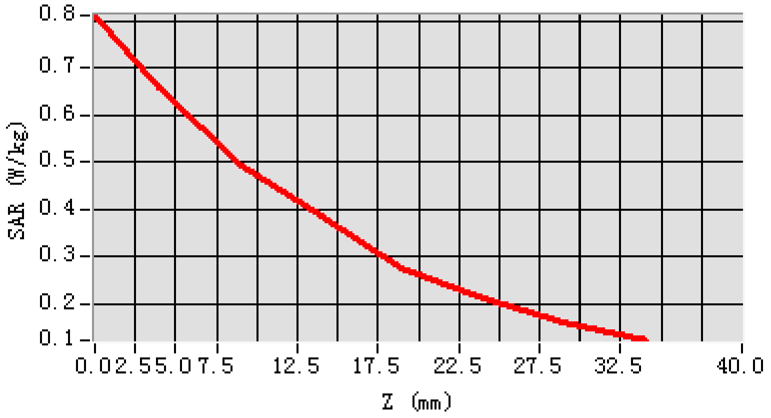
Frequency (MHz)	836.400000
Relative permittivity (real part)	41.356758
Relative permittivity (imaginary part)	19.845680
Conductivity (S/m)	0.922163
Variation (%)	-0.780000

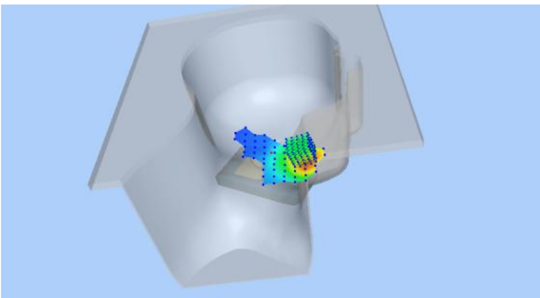
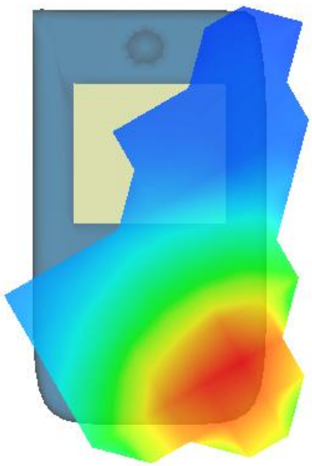
SURFACE SAR	VOLUME SAR
	

Maximum location: X=-52.00, Y=-25.00
SAR Peak: 0.90 W/kg

SAR 10g (W/Kg)	0.429813
SAR 1g (W/Kg)	0.632993

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	0.8111	0.6592	0.4932	0.3868	0.2728	0.2102	0.1608



3D screen shot	Hot spot position
	

MEASUREMENT 2

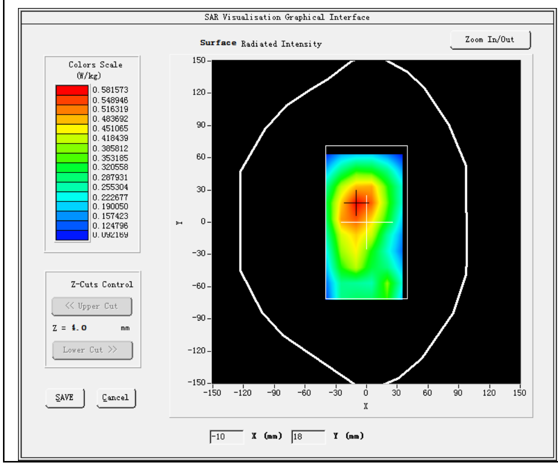
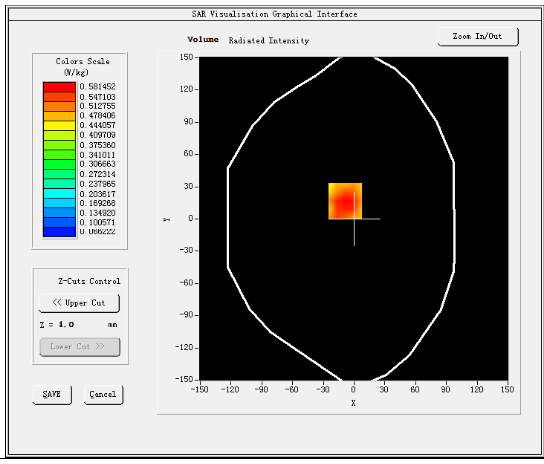
Date of measurement: 27/2/2023

A. Experimental conditions.

Area Scan	dx=15mm dy=15mm, h= 5.00 mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm
Phantom	Validation plane
Device Position	Body
Band	GSM850
Channels	Middle
Signal	TDMA (Crest factor: 8.0)
ConvF	1.50

B. SAR Measurement Results

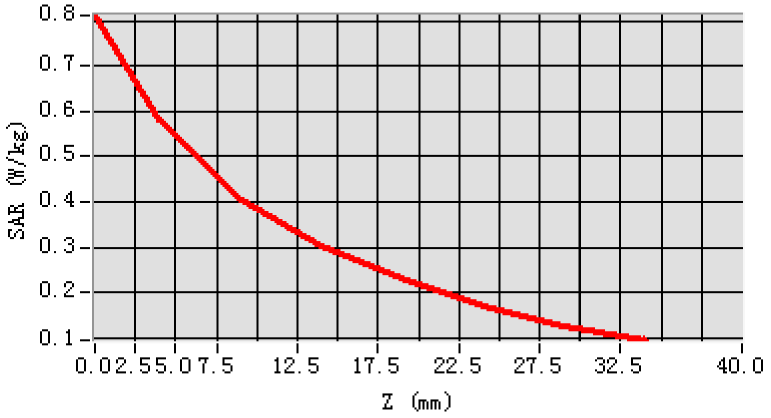
Frequency (MHz)	836.400000
Relative permittivity (real part)	41.356758
Relative permittivity (imaginary part)	19.845680
Conductivity (S/m)	0.922163
Variation (%)	0.800000

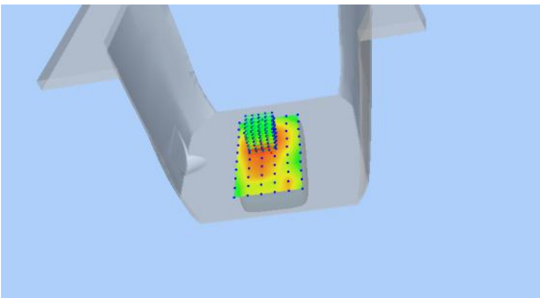
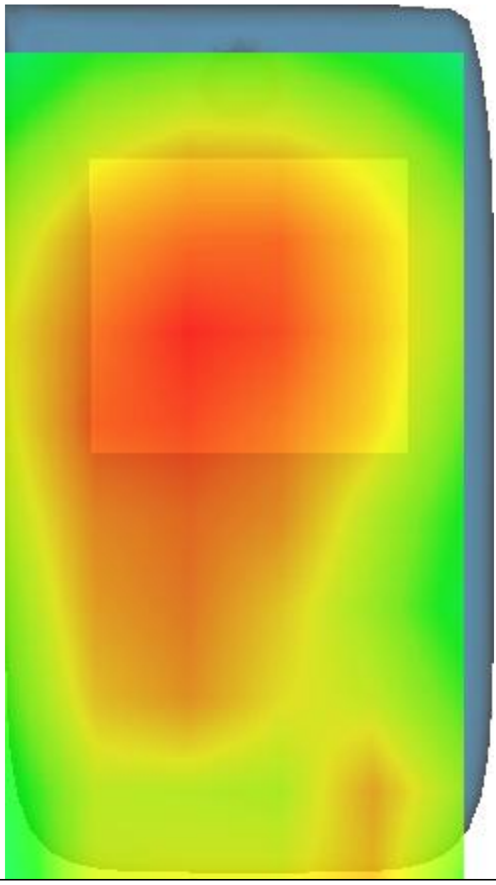
SURFACE SAR	VOLUME SAR
	

Maximum location: X=-9.00, Y=17.00
SAR Peak: 0.81 W/kg

SAR 10g (W/Kg)	0.394141
SAR 1g (W/Kg)	0.577397

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	0.8113	0.5815	0.4041	0.3017	0.2325	0.1723	0.1263



3D screen shot	Hot spot position
	

MEASUREMENT 3

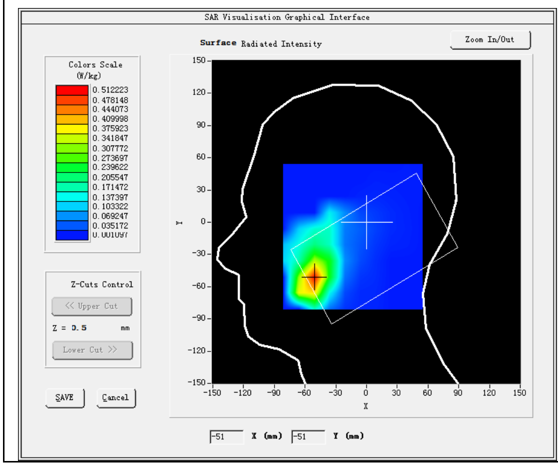
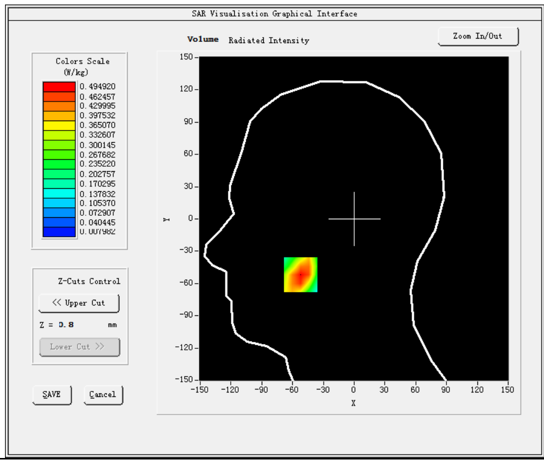
Date of measurement: 24/2/2023

A. Experimental conditions.

Area Scan	dx=15mm dy=15mm, h= 5.00 mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm
Phantom	Left head
Device Position	Cheek
Band	GSM1900
Channels	Middle
Signal	TDMA (Crest factor: 8.0)
ConvF	1.91

B. SAR Measurement Results

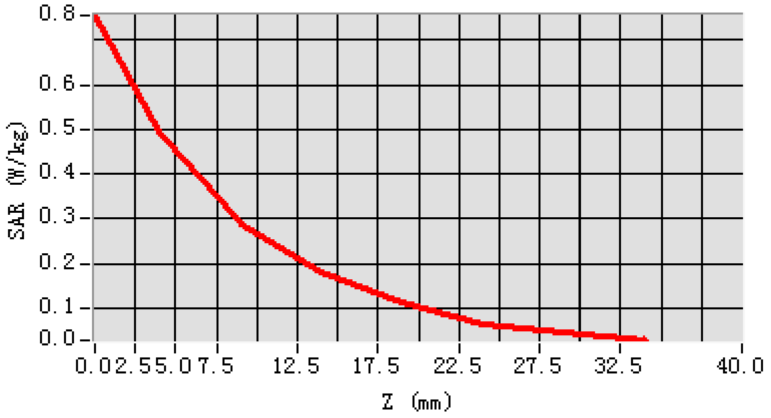
Frequency (MHz)	1880.000000
Relative permittivity (real part)	38.932110
Relative permittivity (imaginary part)	13.565094
Conductivity (S/m)	1.416799
Variation (%)	0.150000

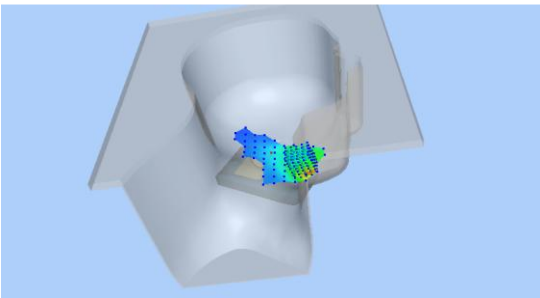
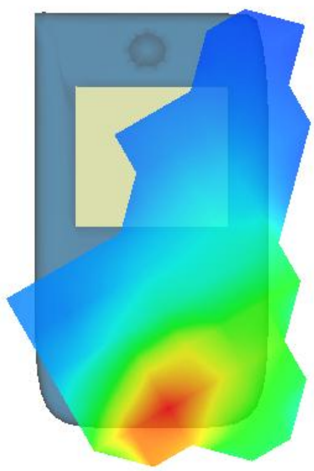
SURFACE SAR	VOLUME SAR
	

Maximum location: X=-52.00, Y=-52.00
SAR Peak: 0.80 W/kg

SAR 10g (W/Kg)	0.261524
SAR 1g (W/Kg)	0.480541

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	0.7551	0.4949	0.2885	0.1790	0.1116	0.0665	0.0453



3D screen shot	Hot spot position
	

MEASUREMENT 4

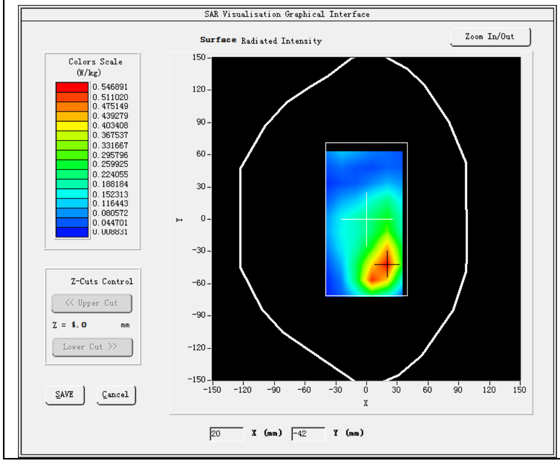
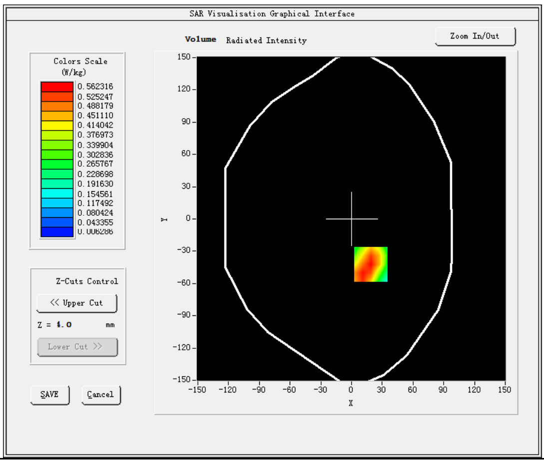
Date of measurement: 24/2/2023

A. Experimental conditions.

Area Scan	dx=15mm dy=15mm, h= 5.00 mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm
Phantom	Validation plane
Device Position	Body
Band	GSM1900
Channels	Middle
Signal	TDMA (Crest factor: 8.0)
ConvF	1.91

B. SAR Measurement Results

Frequency (MHz)	1880.000000
Relative permittivity (real part)	38.932110
Relative permittivity (imaginary part)	13.565094
Conductivity (S/m)	1.416799
Variation (%)	-2.050000

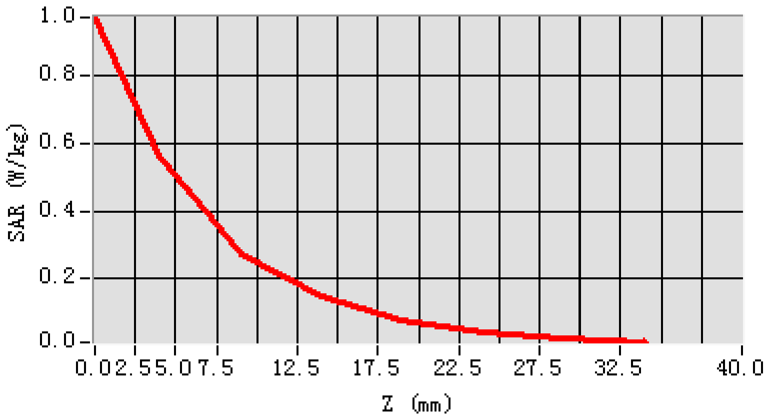
SURFACE SAR	VOLUME SAR
	

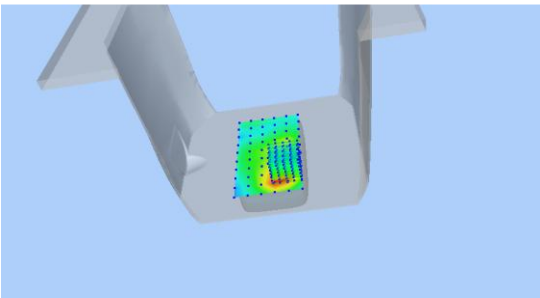
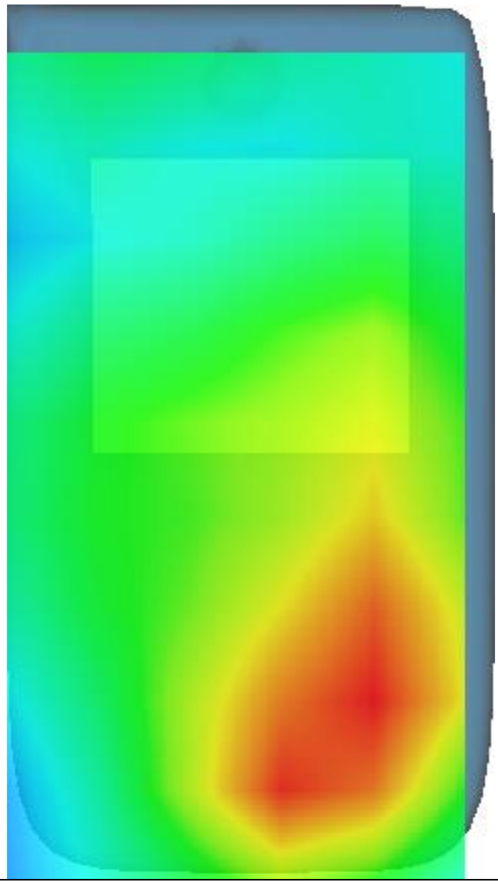
Maximum location: X=19.00, Y=-42.00

SAR Peak: 0.96 W/kg

SAR 10g (W/Kg)	0.288736
SAR 1g (W/Kg)	0.547784

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	0.9683	0.5623	0.2720	0.1479	0.0798	0.0441	0.0249



3D screen shot	Hot spot position
	

MEASUREMENT 5

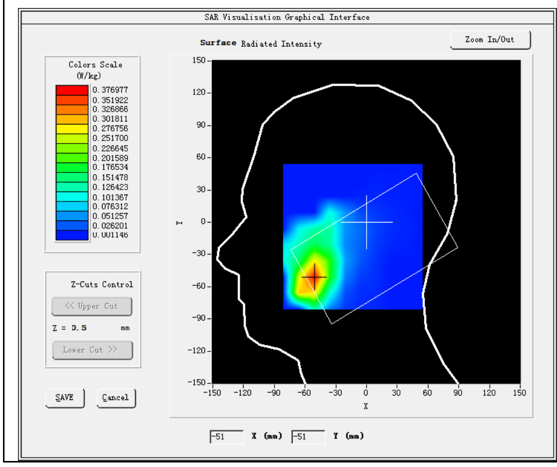
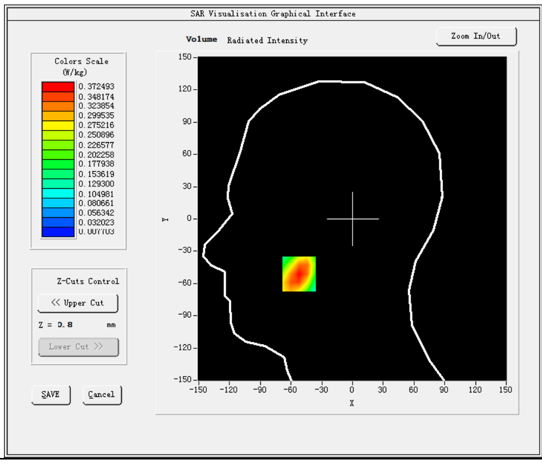
Date of measurement: 24/2/2023

A. Experimental conditions.

Area Scan	dx=15mm dy=15mm, h= 5.00 mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm
Phantom	Left head
Device Position	Cheek
Band	Band2_WCDMA1900
Channels	Middle
Signal	WCDMA (Crest factor: 1.0)
ConvF	1.91

B. SAR Measurement Results

Frequency (MHz)	1880.000000
Relative permittivity (real part)	38.932110
Relative permittivity (imaginary part)	13.565094
Conductivity (S/m)	1.416799
Variation (%)	-0.840000

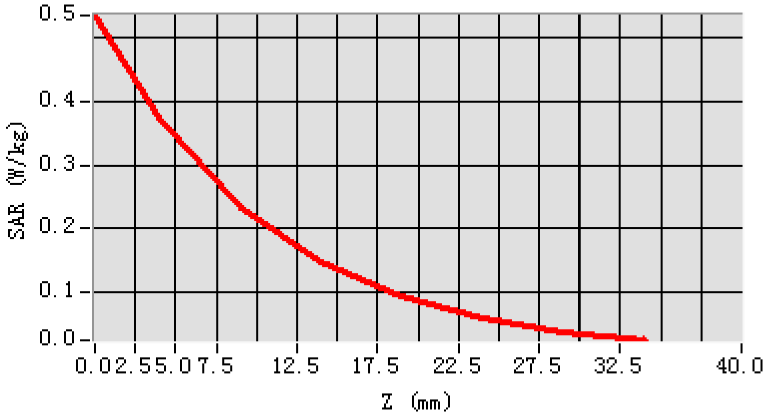
SURFACE SAR	VOLUME SAR
	

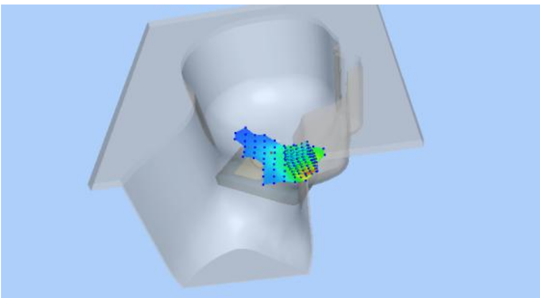
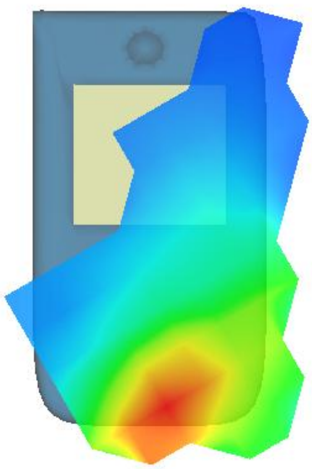
Maximum location: X=-52.00, Y=-51.00

SAR Peak: 0.54 W/kg

SAR 10g (W/Kg)	0.208603
SAR 1g (W/Kg)	0.358847

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	0.5340	0.3725	0.2340	0.1496	0.0935	0.0604	0.0391



3D screen shot	Hot spot position
	

MEASUREMENT 6

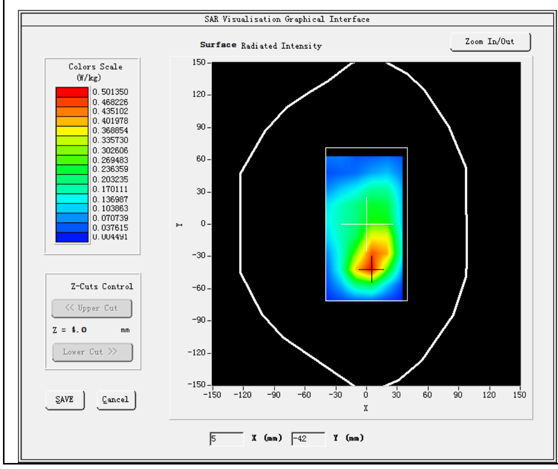
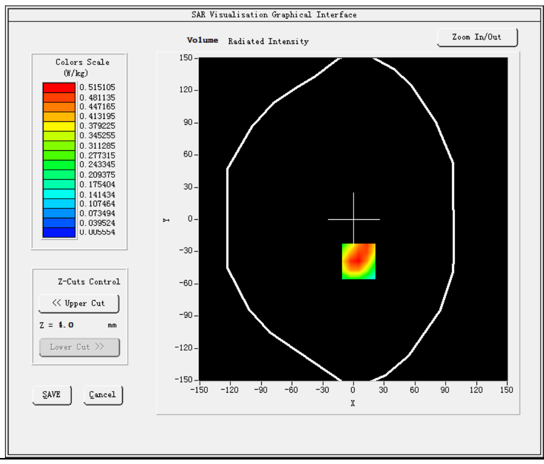
Date of measurement: 24/2/2023

A. Experimental conditions.

Area Scan	dx=15mm dy=15mm, h= 5.00 mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm
Phantom	Validation plane
Device Position	Body
Band	Band2_WCDMA1900
Channels	Middle
Signal	WCDMA (Crest factor: 1.0)
ConvF	1.91

B. SAR Measurement Results

Frequency (MHz)	1880.000000
Relative permittivity (real part)	38.932110
Relative permittivity (imaginary part)	13.565094
Conductivity (S/m)	1.416799
Variation (%)	1.120000

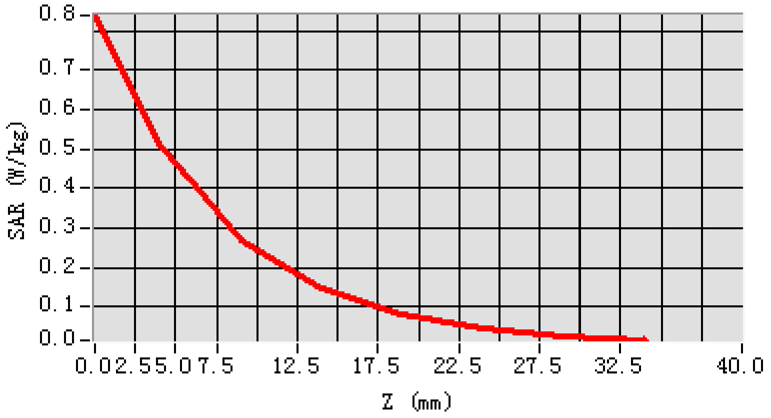
SURFACE SAR	VOLUME SAR
	

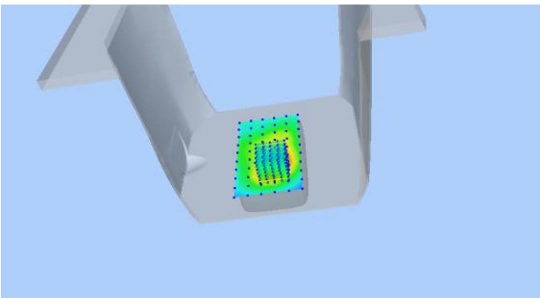
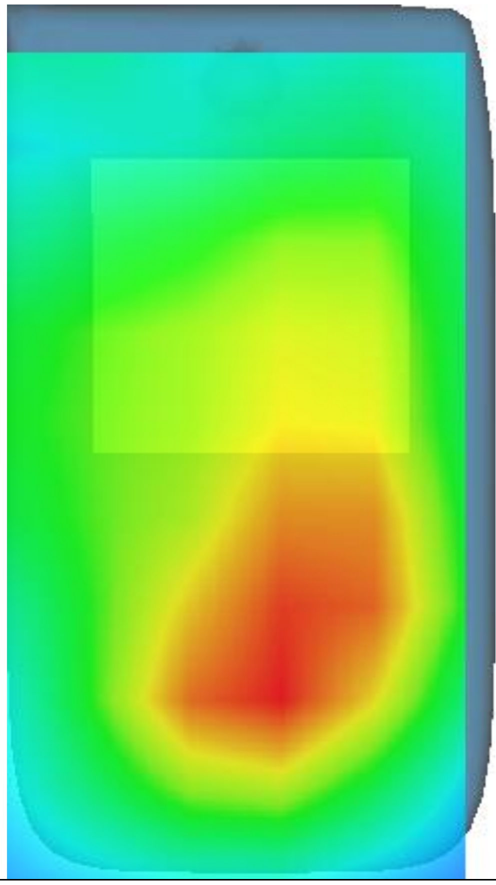
Maximum location: X=5.00, Y=-39.00

SAR Peak: 0.83 W/kg

SAR 10g (W/Kg)	0.265164
SAR 1g (W/Kg)	0.503193

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	0.8399	0.5151	0.2694	0.1453	0.0795	0.0441	0.0251



3D screen shot	Hot spot position
	

MEASUREMENT 7

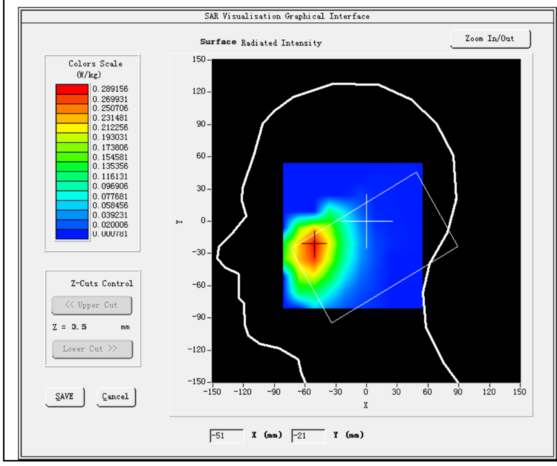
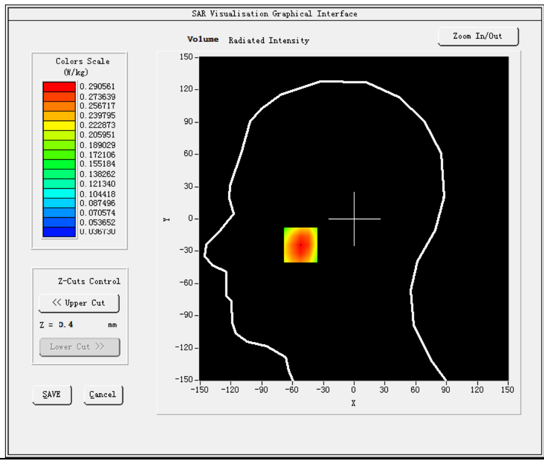
Date of measurement: 27/2/2023

A. Experimental conditions.

Area Scan	dx=15mm dy=15mm, h= 5.00 mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm
Phantom	Left head
Device Position	Cheek
Band	Band5_WCDMA850
Channels	Middle
Signal	WCDMA (Crest factor: 1.0)
ConvF	1.50

B. SAR Measurement Results

Frequency (MHz)	836.400000
Relative permittivity (real part)	41.356758
Relative permittivity (imaginary part)	19.845680
Conductivity (S/m)	0.922163
Variation (%)	-0.440000

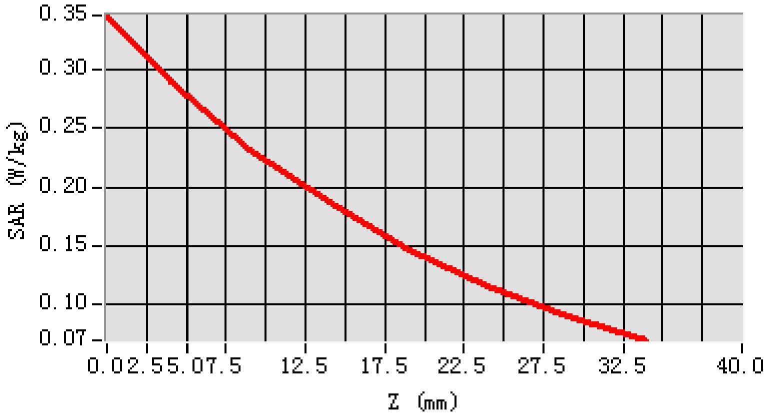
SURFACE SAR	VOLUME SAR
	

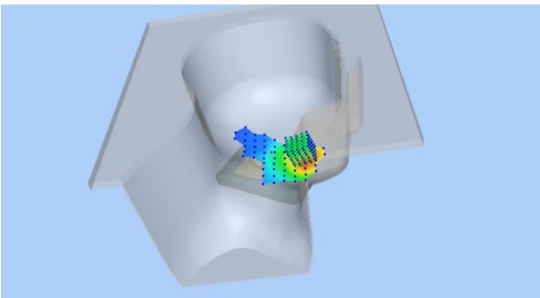
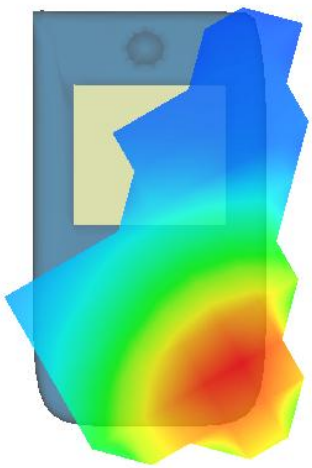
Maximum location: X=-52.00, Y=-24.00

SAR Peak: 0.35 W/kg

SAR 10g (W/Kg)	0.210868
SAR 1g (W/Kg)	0.286228

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	0.3465	0.2906	0.2321	0.1874	0.1466	0.1147	0.0892



3D screen shot	Hot spot position
	

MEASUREMENT 8

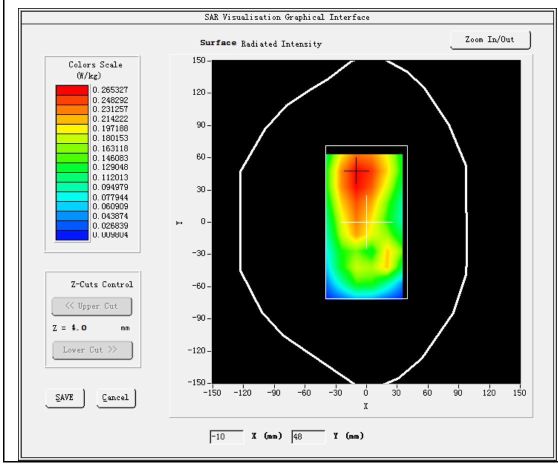
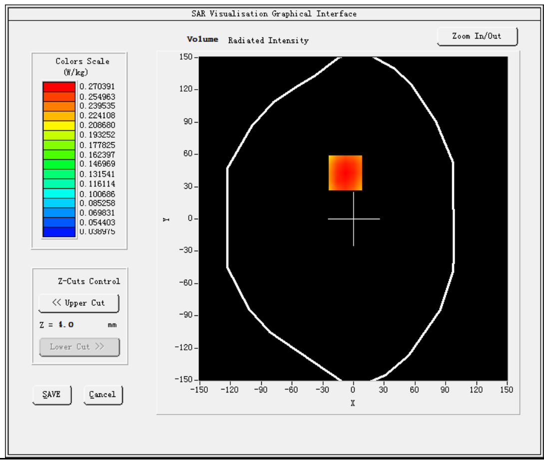
Date of measurement: 27/2/2023

A. Experimental conditions.

Area Scan	dx=15mm dy=15mm, h= 5.00 mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm
Phantom	Validation plane
Device Position	Body
Band	Band5_WCDMA850
Channels	Middle
Signal	WCDMA (Crest factor: 1.0)
ConvF	1.50

B. SAR Measurement Results

Frequency (MHz)	836.400000
Relative permittivity (real part)	41.356758
Relative permittivity (imaginary part)	19.845680
Conductivity (S/m)	0.922163
Variation (%)	-0.560000

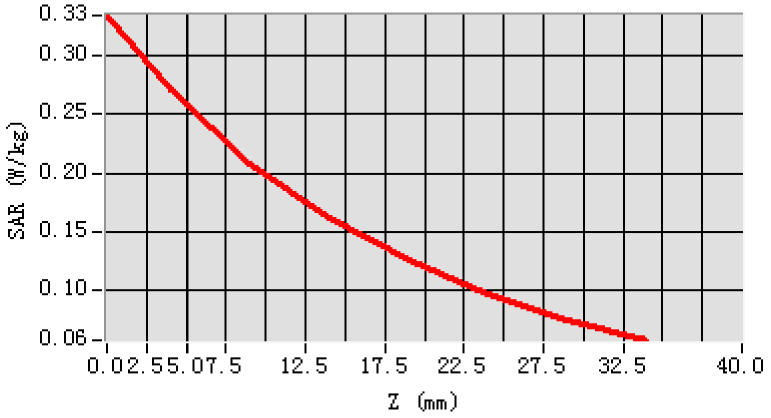
SURFACE SAR	VOLUME SAR
	

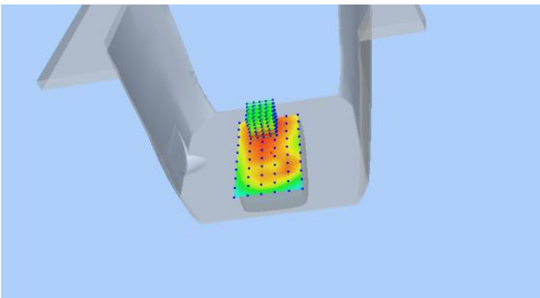
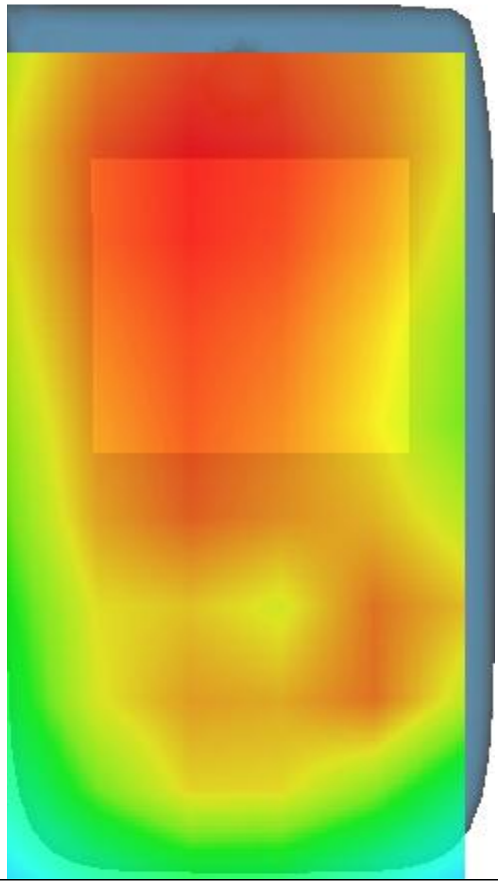
Maximum location: X=-8.00, Y=43.00

SAR Peak: 0.34 W/kg

SAR 10g (W/Kg)	0.198181
SAR 1g (W/Kg)	0.266908

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	0.3336	0.2704	0.2085	0.1619	0.1254	0.0967	0.0749



3D screen shot	Hot spot position
	

MEASUREMENT 9

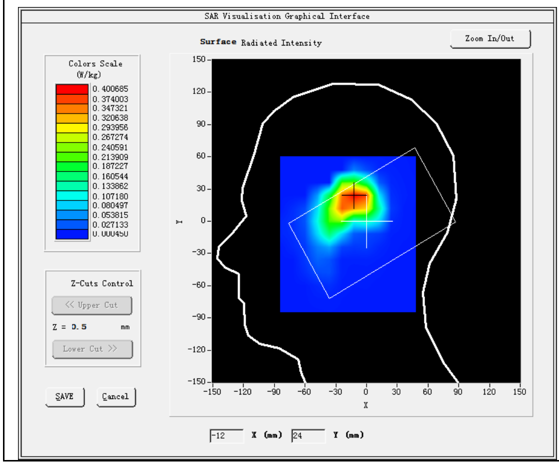
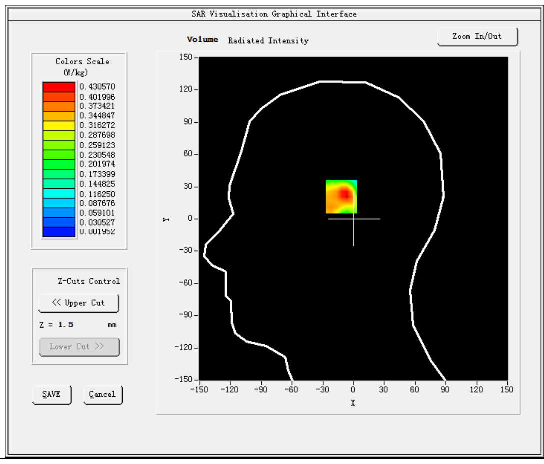
Date of measurement: 8/3/2023

A. Experimental conditions.

Area Scan	dx=12mm dy=12mm, h= 5.00 mm
ZoomScan	7x7x7,dx=5mm dy=5mm dz=5mm
Phantom	Left head
Device Position	Cheek
Band	IEEE 802.11b ISM
Channels	Middle
Signal	IEEE802.b (Crest factor: 1.0)
ConvF	1.98

B. SAR Measurement Results

Frequency (MHz)	2437.000000
Relative permittivity (real part)	38.692596
Relative permittivity (imaginary part)	13.366911
Conductivity (S/m)	1.809731
Variation (%)	0.990000

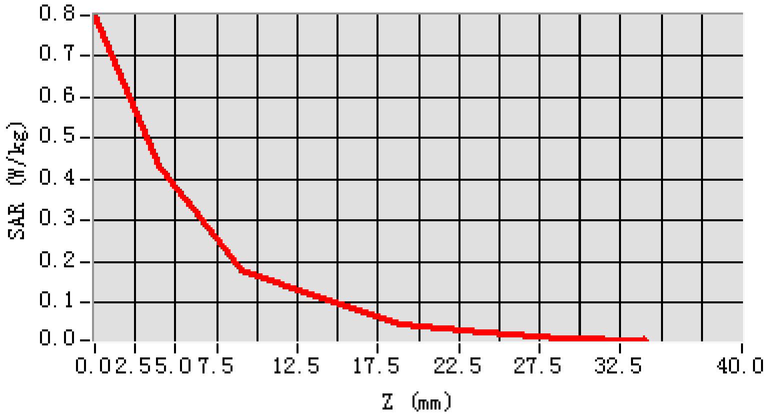
SURFACE SAR	VOLUME SAR
	

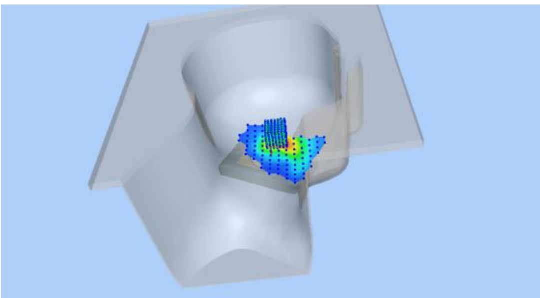
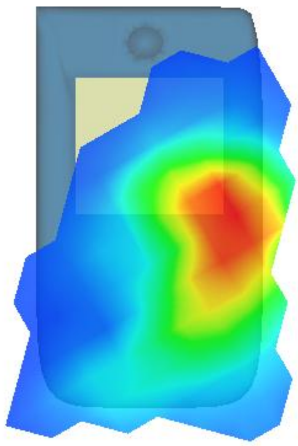
Maximum location: X=-10.00, Y=22.00

SAR Peak: 0.75 W/kg

SAR 10g (W/Kg)	0.195814
SAR 1g (W/Kg)	0.413443

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	0.7977	0.4306	0.1802	0.1094	0.0476	0.0282	0.0127



3D screen shot	Hot spot position
	

MEASUREMENT 10

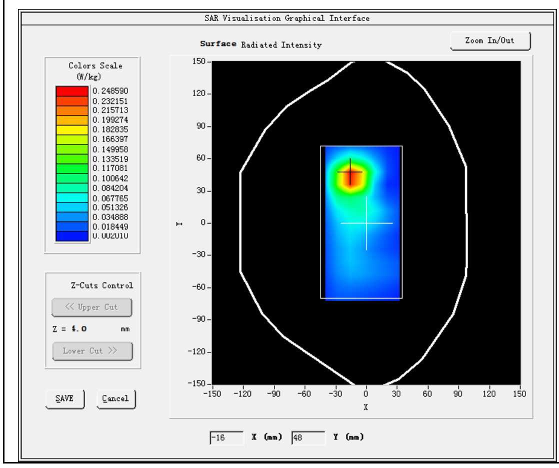
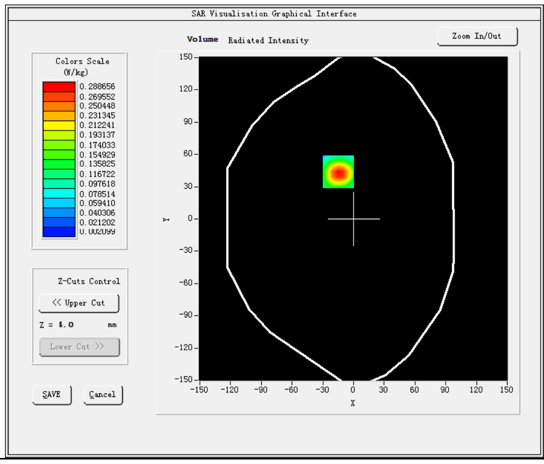
Date of measurement: 8/3/2023

A. Experimental conditions.

Area Scan	dx=12mm dy=12mm, h= 5.00 mm
ZoomScan	7x7x7,dx=5mm dy=5mm dz=5mm
Phantom	Validation plane
Device Position	Body
Band	IEEE 802.11b ISM
Channels	Middle
Signal	IEEE802.b (Crest factor: 1.0)
ConvF	1.98

B. SAR Measurement Results

Frequency (MHz)	2437.000000
Relative permittivity (real part)	38.692596
Relative permittivity (imaginary part)	13.366911
Conductivity (S/m)	1.809731
Variation (%)	-0.360000

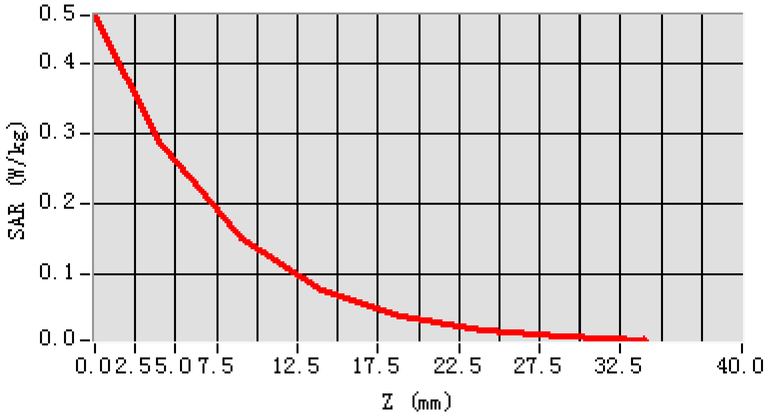
SURFACE SAR	VOLUME SAR
	

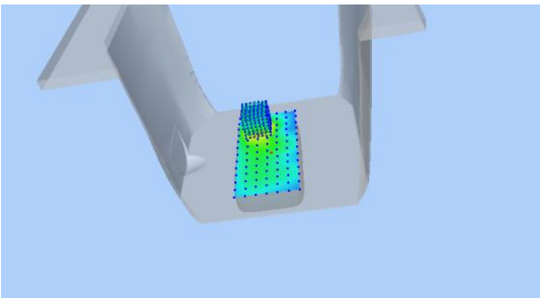
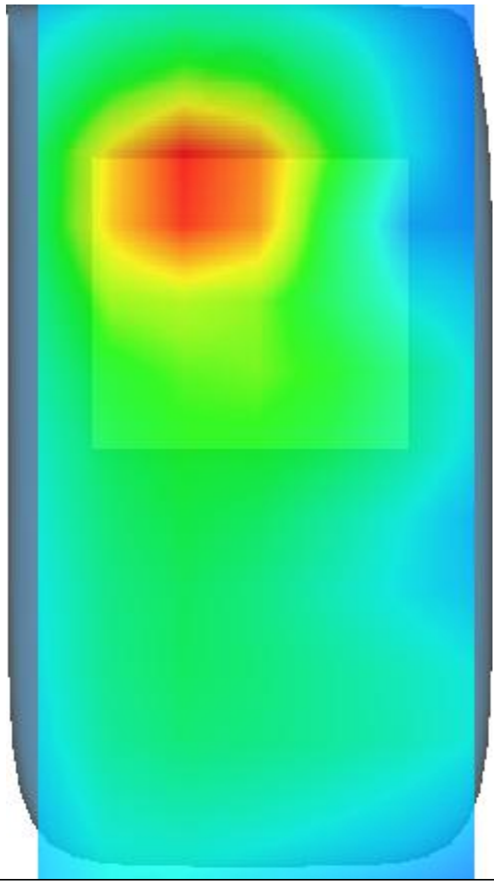
Maximum location: X=-15.00, Y=44.00

SAR Peak: 0.47 W/kg

SAR 10g (W/Kg)	0.130427
SAR 1g (W/Kg)	0.270808

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	0.4689	0.2887	0.1499	0.0764	0.0393	0.0202	0.0106



3D screen shot	Hot spot position
	

14. Appendix D. Calibration Certificate

COMOSAR E-Field Probe Calibration Report

Ref : ACR.60.1.21.MVGB.A

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

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

Calibration date: 01/10/2023

Accreditations #2-6789 and #2-6814
Scope available on www.cofrac.fr

Summary:

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

COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.60.1.21.MVGB.A

	Name	Function	Date	Signature
Prepared by :	Jérôme Luc	Technical Manager	1/10/2023	JS
Checked by :	Jérôme Luc	Technical Manager	1/10/2023	JS
Approved by :	Yann Toutain	Laboratory Director	1/10/2023	Yann Toutain 2023.01.10 11:27:33 +01'00'

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

Issue	Name	Date	Modifications
A	Jérôme Luc	1/10/2023	Initial release

TABLE OF CONTENTS

1 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR DOSIMETRIC E FIELD PROBE
Manufacturer	MVG
Model	SSE2
Serial Number	SN 08/16 EPGO287
Product Condition (new / used)	Used
Frequency Range of Probe	0.15 GHz-6GHz
Resistance of Three Dipoles at Connector	Dipole 1: R1=0.211 MΩ Dipole 2: R2=0.199 MΩ Dipole 3: R3=0.199 MΩ

2 PRODUCT DESCRIPTION

2.1 GENERAL INFORMATION

MVG's COMOSAR E field Probes are built in accordance to the IEEE 1528, FCC KDB865664 D01, CENELEC EN62209 and CEI/IEC 62209 standards.

Figure 1 – *MVG COMOSAR Dosimetric E field Dipole*

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

3 MEASUREMENT METHOD

The IEEE 1528, FCC KDB865664 D01, CENELEC EN62209 and CEI/IEC 62209 standards provide recommended practices for the probe calibrations, including the performance characteristics of interest and methods by which to assess their affect. All calibrations / measurements performed meet the fore mentioned standards.

3.1 LINEARITY

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

3.2 SENSITIVITY

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

3.3 LOWER DETECTION LIMIT

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

3.4 ISOTROPY

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

3.1 BOUNDARY EFFECT

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

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

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

where

$SAR_{uncertainty}$	is the uncertainty in percent of the probe boundary effect
d_{be}	is the distance between the surface and the closest *zoom-scan* 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%).

4 MEASUREMENT UNCERTAINTY

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

Uncertainty analysis of the probe calibration in waveguide					
ERROR SOURCES	Uncertainty value (%)	Probability Distribution	Divisor	ci	Standard Uncertainty (%)
Expanded uncertainty 95 % confidence level k = 2					14 %

5 CALIBRATION MEASUREMENT RESULTS

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

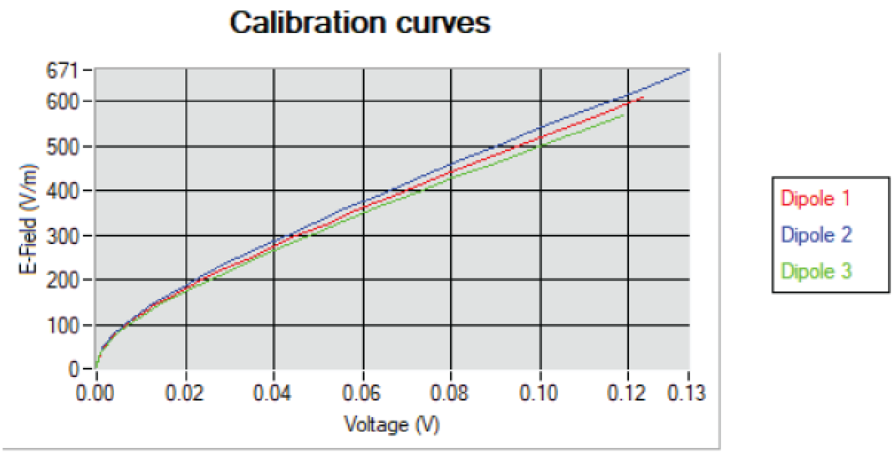
5.1 SENSITIVITY IN AIR

Normx dipole 1 (μV/(V/m)^2)	Normy dipole 2 (μV/(V/m)^2)	Normz dipole 3 (μV/(V/m)^2)
0.72	0.66	0.77

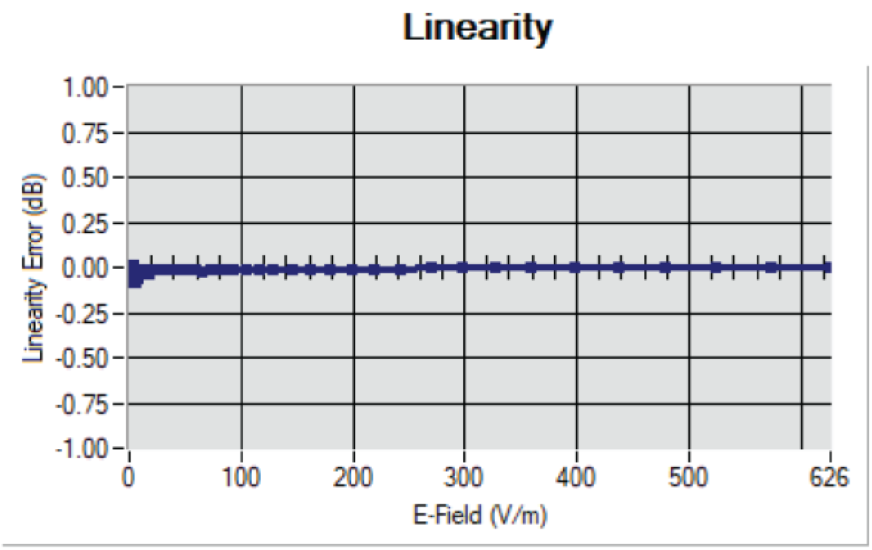
DCP dipole 1 (mV)	DCP dipole 2 (mV)	DCP dipole 3 (mV)
107	110	110

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

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



5.2 LINEARITY



Linearity:+/-1.90% (+/-0.08dB)

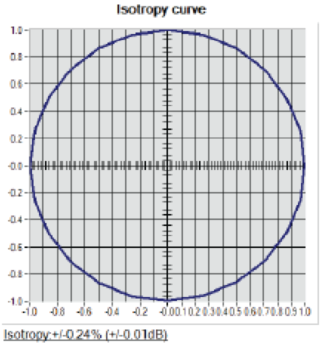
5.3 SENSITIVITY IN LIQUID

Liquid	Frequency (MHz +/- 100MHz)	ConvF
HL750	750	1.49
HL850	835	1.50
HL900	900	1.61
HL1800	1800	1.73
HL1900	1900	1.91
HL2000	2000	1.97
HL2300	2300	1.92
HL2450	2450	1.98
HL2600	2600	1.87
HL3300	3300	1.79
HL3500	3500	1.85
HL3700	3700	1.79
HL3900	3900	2.07
HL4200	4200	2.21
HL4600	4600	2.25
HL4900	4900	2.05
HL5200	5200	1.80
HL5400	5400	2.05
HL5600	5600	2.16
HL5800	5800	2.07

LOWER DETECTION LIMIT: 8mW/kg

5.4 ISOTROPY

HL1800 MHz



6 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Description	**Manufacturer / Model**	**Identification No.**	**Current Calibration Date**	**Next Calibration Date**
Flat Phantom	MVG	SN-20/09-SAM71	Validated. No cal required.	Validated. No cal required.
COMOSAR Test Bench	Version 3	NA	Validated. No cal required.	Validated. No cal required.
Network Analyzer	Rohde & Schwarz ZVM	100203	05/2022	05/2025
Network Analyzer – Calibration kit	Rohde & Schwarz ZV-Z235	101223	05/2022	05/2025
Multimeter	Keithley 2000	1160271	02/2022	02/2025
Signal Generator	Rohde & Schwarz SMB	106589	04/2022	04/2025
Amplifier	Aethercomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	NI-USB 5680	170100013	05/2022	05/2025
Directional Coupler	Narda 4216-20	01386	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Waveguide	Mega Industries	069Y7-158-13-712	Validated. No cal required.	Validated. No cal required.
Waveguide Transition	Mega Industries	069Y7-158-13-701	Validated. No cal required.	Validated. No cal required.
Waveguide Termination	Mega Industries	069Y7-158-13-701	Validated. No cal required.	Validated. No cal required.
Temperature / Humidity Sensor	Testo 184 H1	44220687	05/2020	05/2023

SAR Reference Dipole Calibration Report

Ref : ACR.60.3.21.MVGB.A

SHENZHEN NTEK TESTING TECHNOLOGY CO., LTD.
BUILDING E, FENDA SCIENCE PARK, SANWEI COMMUNITY, XIXIANG STREET,
BAO'AN DISTRICT, SHENZHEN GUANGDONG, CHINA
MVG COMOSAR REFERENCE DIPOLE
FREQUENCY: 835 MHZ
SERIAL NO.: SN 03/15 DIP0G835-347

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

Calibration date: 03/01/2021

Accreditations #2-6789 and #2-6814
Scope available on www.cofrac.fr

Summary:

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

SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.60.3.21.MVGB.A

	Name	Function	Date	Signature
Prepared by :	Jérôme Luc	Technical Manager	3/1/2021	
Checked by :	Jérôme Luc	Technical Manager	3/1/2021	
Approved by :	Yann Toutain	Laboratory Director	3/1/2021	Yann Toutain

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

Issue	Name	Date	Modifications
A	Jérôme Luc	3/1/2021	Initial release