

MEASUREMENT 15

Date of measurement: 21/4/2024

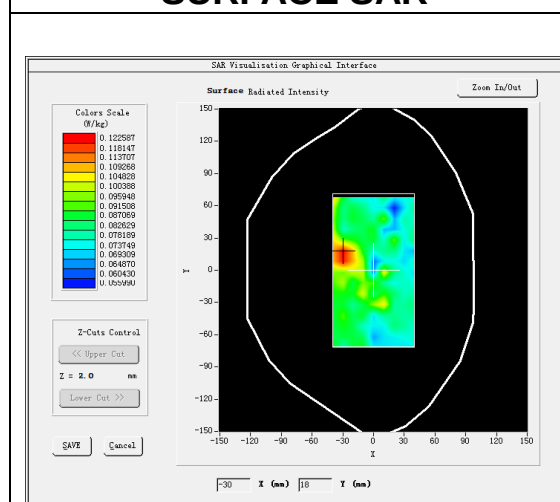
A. Experimental conditions.

<u>Area Scan</u>	<u>dx=10mm dy=10mm, h= 2.00 mm</u>
<u>ZoomScan</u>	<u>7x7x12,dx=4mm dy=4mm dz=2mm</u>
<u>Phantom</u>	<u>Validation plane</u>
<u>Device Position</u>	<u>Body</u>
<u>Band</u>	<u>IEEE 802.11ax U-NII</u>
<u>Channels</u>	<u>Middle</u>
<u>Signal</u>	<u>IEEE802.11ax (Crest factor: 1.0)</u>
<u>ConvF</u>	<u>2.07</u>

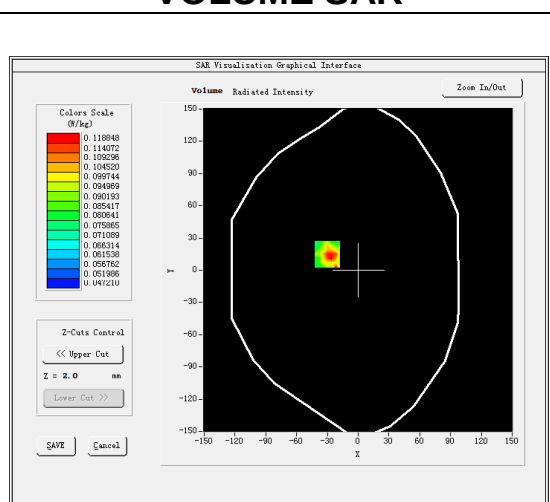
B. SAR Measurement Results

Frequency (MHz)	5250.000000
Relative permittivity (real part)	34.346088
Relative permittivity (imaginary part)	15.734910
Conductivity (S/m)	4.589349
Variation (%)	-3.709999

SURFACE SAR



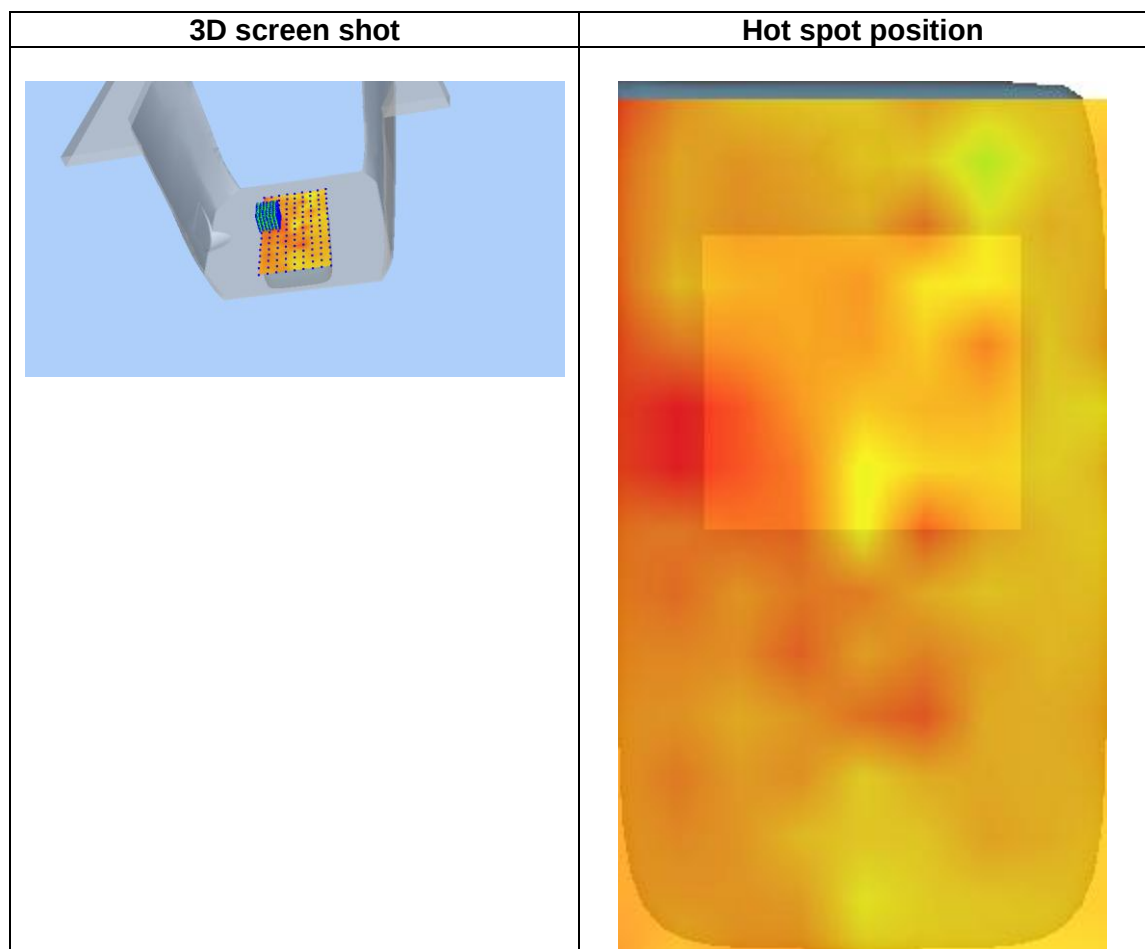
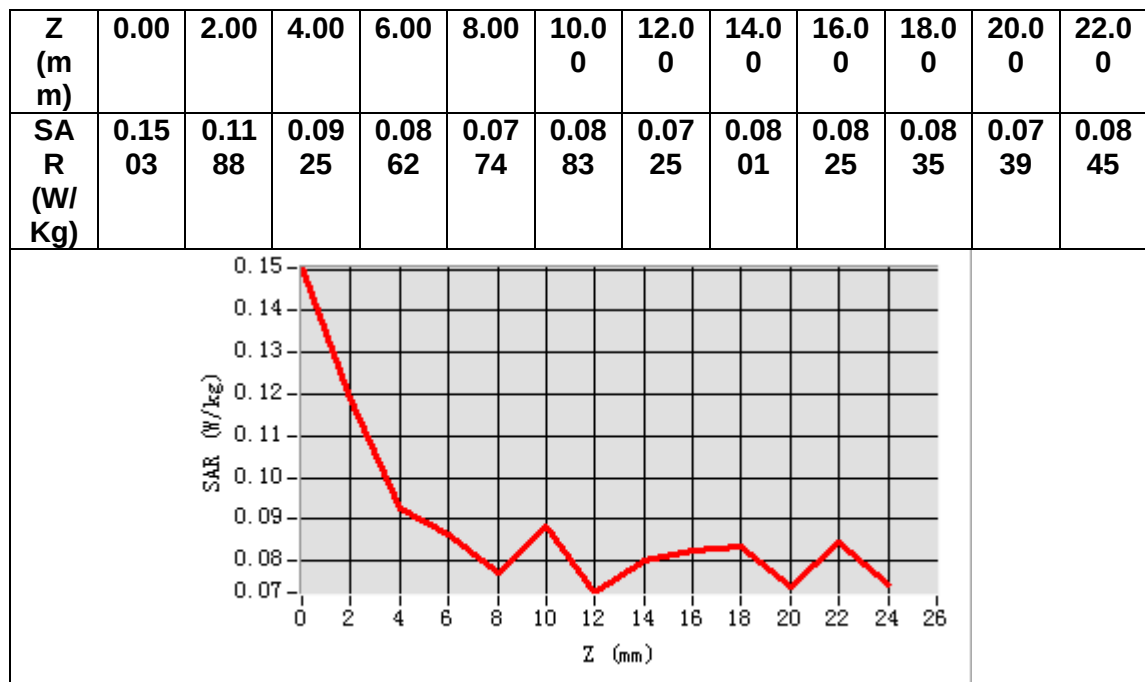
VOLUME SAR



Maximum location: X=-30.00, Y=15.00

SAR Peak: 0.18 W/kg

SAR 10g (W/Kg)	0.085111
SAR 1g (W/Kg)	0.097013



MEASUREMENT 16

Date of measurement: 22/4/2024

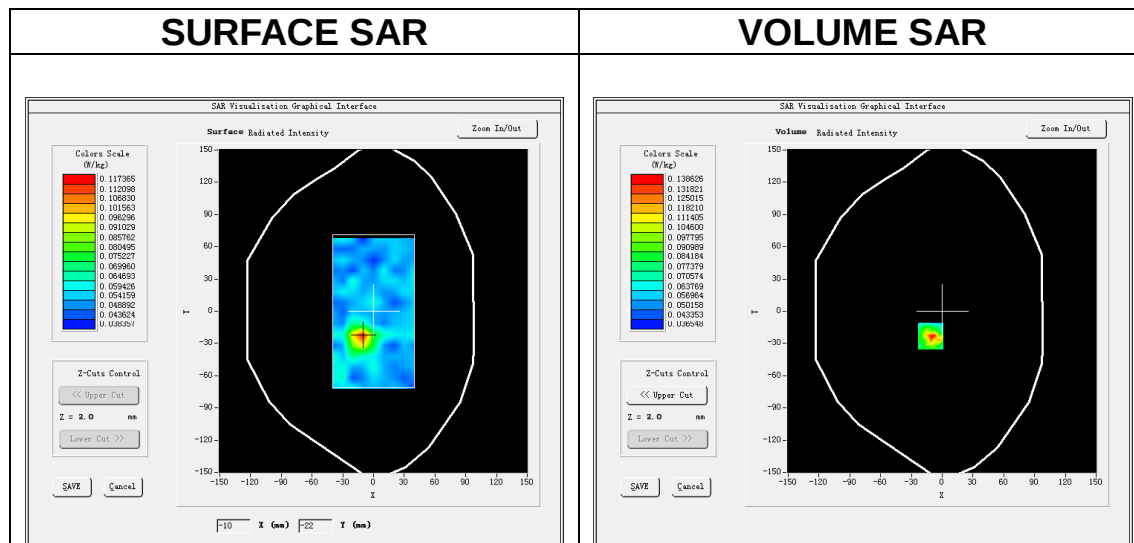
A. Experimental conditions.

<u>Area Scan</u>	<u>dx=10mm dy=10mm, h= 2.00 mm</u>
<u>ZoomScan</u>	<u>7x7x12,dx=4mm dy=4mm dz=2mm</u>
<u>Phantom</u>	<u>Validation plane</u>
<u>Device Position</u>	<u>Body</u>
<u>Band</u>	<u>IEEE 802.11ac U-NII</u>
<u>Channels</u>	<u>Middle</u>
<u>Signal</u>	<u>IEEE802.11ac (Crest factor: 1.0)</u>
<u>ConvF</u>	<u>2.11</u>

B. SAR Measurement Results

Frequency (MHz)	5290.000000
Relative permittivity (real part)	34.252480
Relative permittivity (imaginary part)	15.579937
Conductivity (S/m)	4.578770
Variation (%)	0.470000

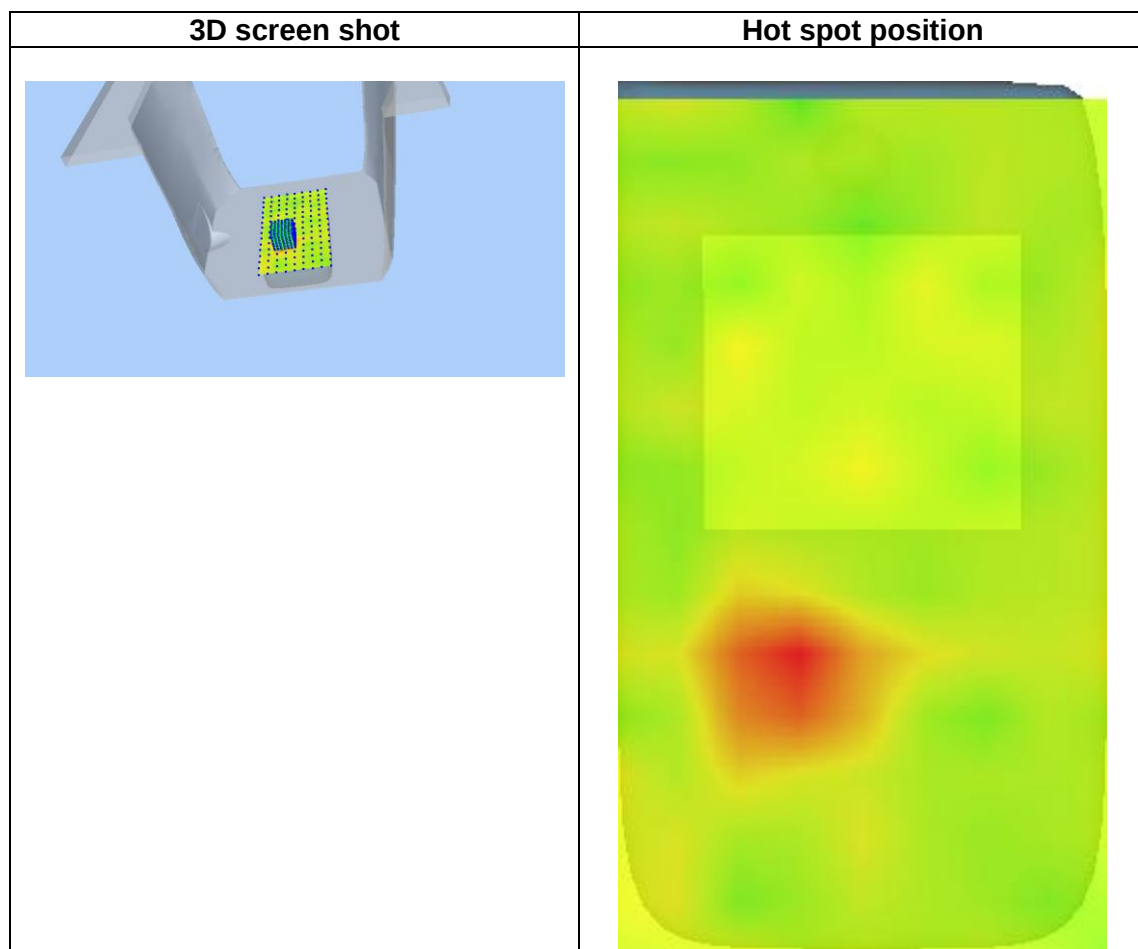
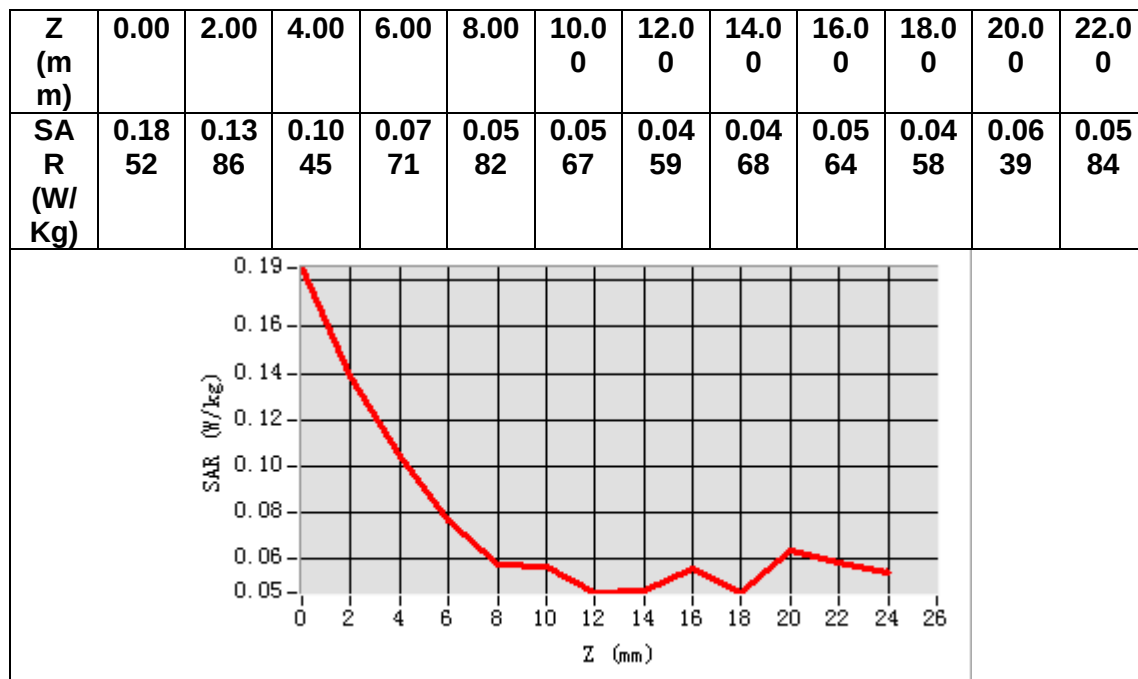
SURFACE SAR



Maximum location: X=-11.00, Y=-23.00

SAR Peak: 0.23 W/kg

SAR 10g (W/Kg)	0.066901
SAR 1g (W/Kg)	0.093147



MEASUREMENT 17

Date of measurement: 22/4/2024

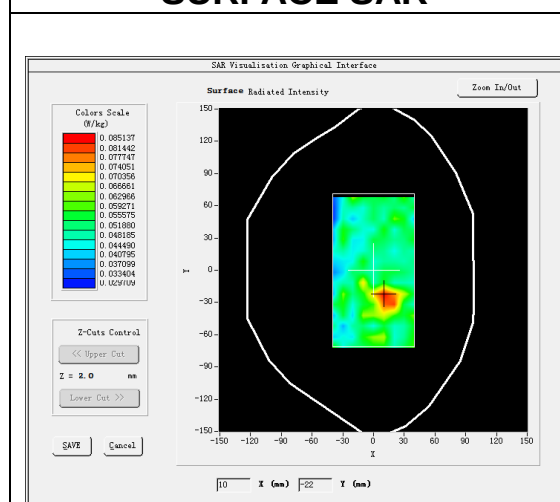
A. Experimental conditions.

<u>Area Scan</u>	<u>dx=10mm dy=10mm, h= 2.00 mm</u>
<u>ZoomScan</u>	<u>7x7x12,dx=4mm dy=4mm dz=2mm</u>
<u>Phantom</u>	<u>Validation plane</u>
<u>Device Position</u>	<u>Body</u>
<u>Band</u>	<u>IEEE 802.11ac U-NII</u>
<u>Channels</u>	<u>Middle</u>
<u>Signal</u>	<u>IEEE802.11ac (Crest factor: 1.0)</u>
<u>ConvF</u>	<u>2.11</u>

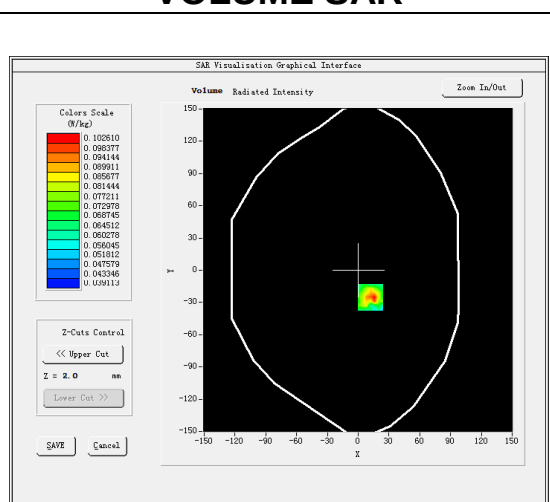
B. SAR Measurement Results

Frequency (MHz)	5290.000000
Relative permittivity (real part)	34.252480
Relative permittivity (imaginary part)	15.579937
Conductivity (S/m)	4.578770
Variation (%)	0.260000

SURFACE SAR



VOLUME SAR

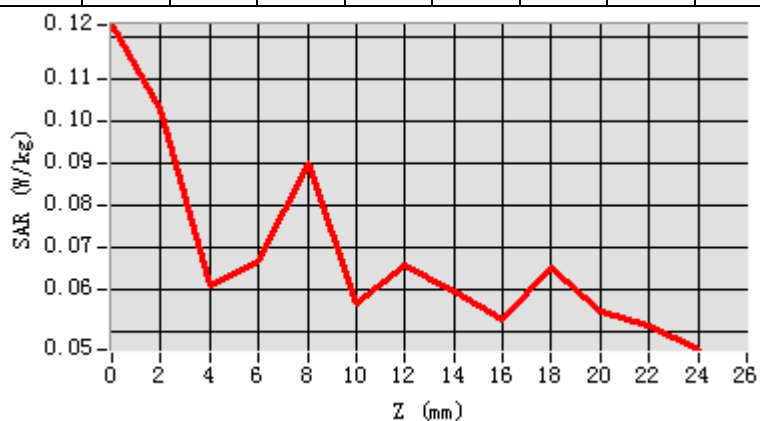


Maximum location: X=12.00, Y=-25.00

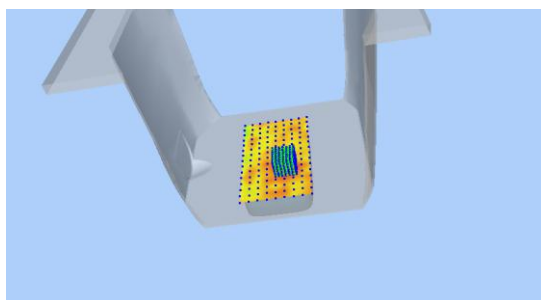
SAR Peak: 0.16 W/kg

SAR 10g (W/Kg)	0.065259
SAR 1g (W/Kg)	0.079121

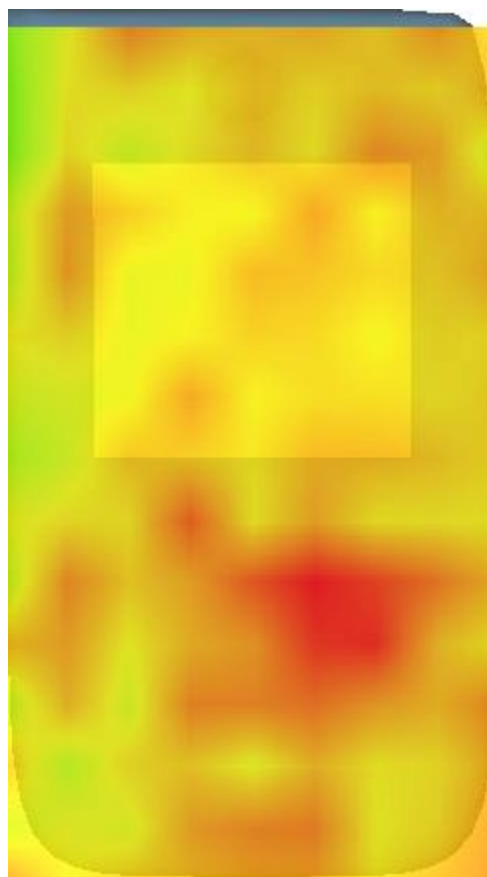
Z (m m)	0.00	2.00	4.00	6.00	8.00	10.0 0	12.0 0	14.0 0	16.0 0	18.0 0	20.0 0	22.0 0
SAR (W/ Kg)	0.12 26	0.10 26	0.06 10	0.06 68	0.08 97	0.05 67	0.06 58	0.05 96	0.05 28	0.06 53	0.05 47	0.05 16



3D screen shot



Hot spot position



MEASUREMENT 18

Date of measurement: 22/4/2024

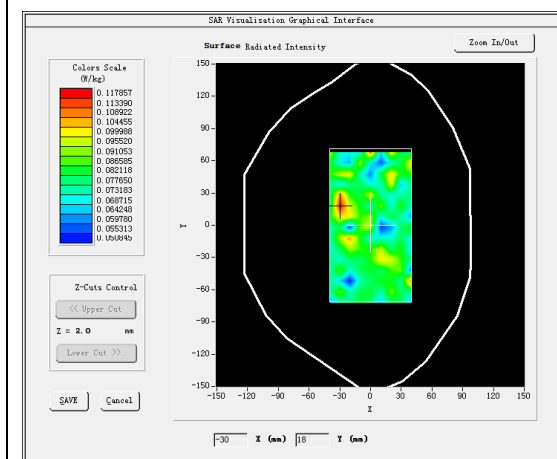
A. Experimental conditions.

<u>Area Scan</u>	<u>dx=10mm dy=10mm, h= 2.00 mm</u>
<u>ZoomScan</u>	<u>7x7x12,dx=4mm dy=4mm dz=2mm</u>
<u>Phantom</u>	<u>Validation plane</u>
<u>Device Position</u>	<u>Body</u>
<u>Band</u>	<u>IEEE 802.11ac U-NII</u>
<u>Channels</u>	<u>Middle</u>
<u>Signal</u>	<u>IEEE802.11ac (Crest factor: 1.0)</u>
<u>ConvF</u>	<u>2.11</u>

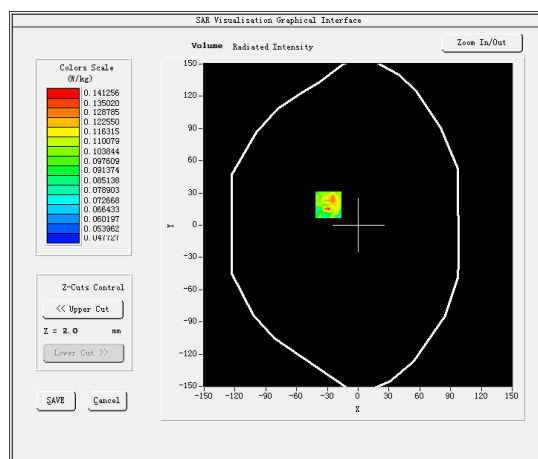
B. SAR Measurement Results

Frequency (MHz)	5290.000000
Relative permittivity (real part)	34.252480
Relative permittivity (imaginary part)	15.579937
Conductivity (S/m)	4.578770
Variation (%)	2.650000

SURFACE SAR



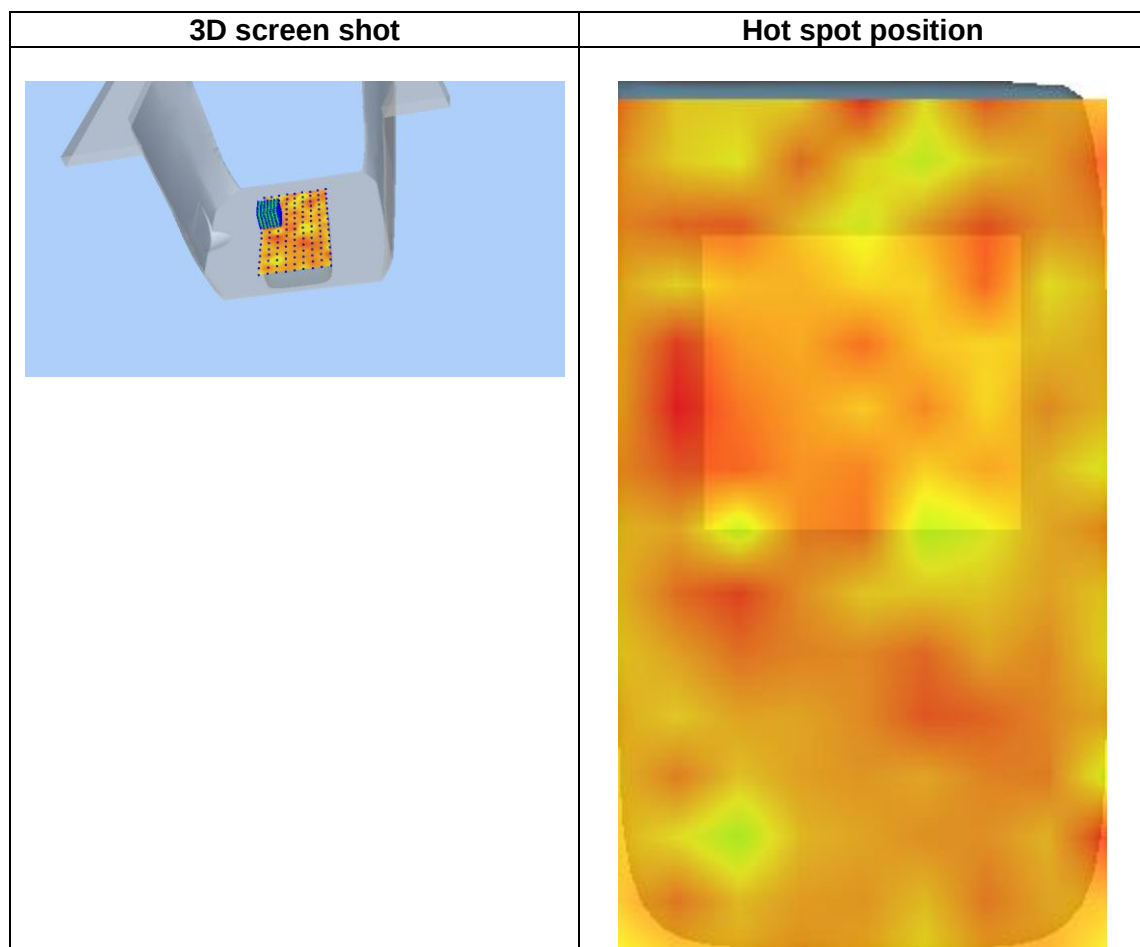
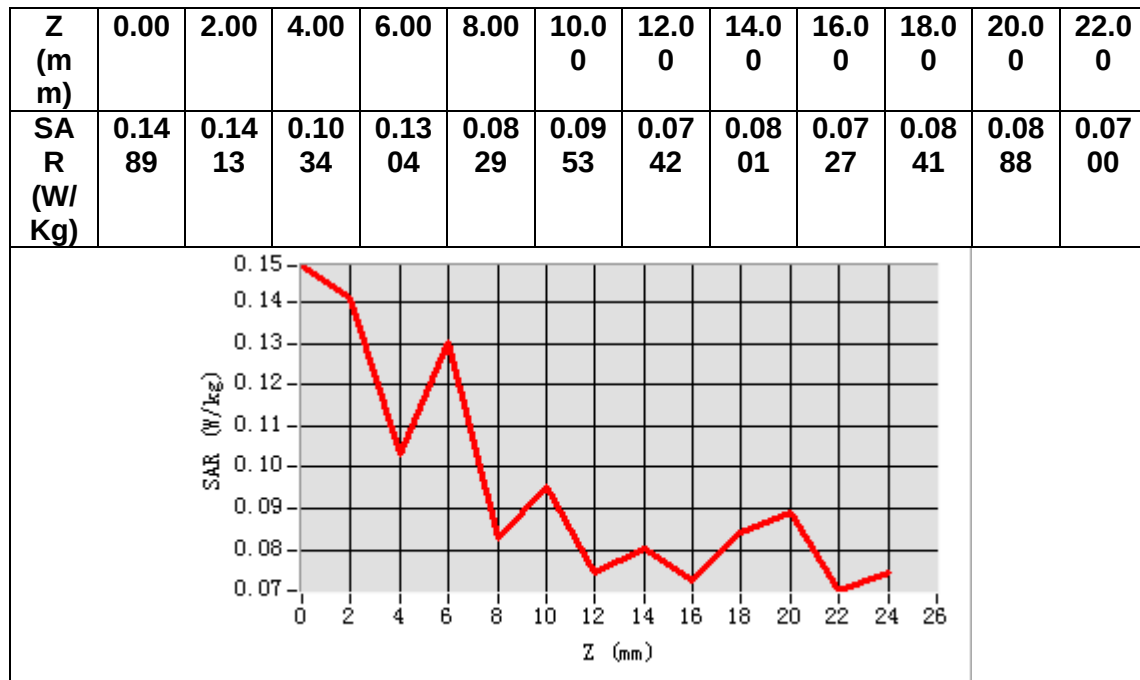
VOLUME SAR



Maximum location: X=-29.00, Y=19.00

SAR Peak: 0.22 W/kg

SAR 10g (W/Kg)	0.087973
SAR 1g (W/Kg)	0.099076



MEASUREMENT 19

Date of measurement: 23/4/2024

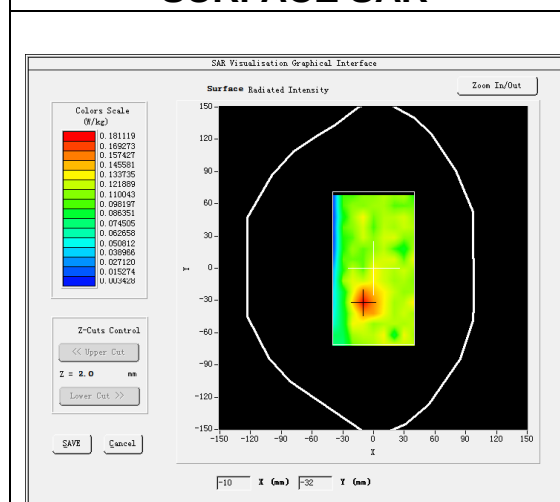
A. Experimental conditions.

<u>Area Scan</u>	<u>dx=10mm dy=10mm, h= 2.00 mm</u>
<u>ZoomScan</u>	<u>7x7x12,dx=4mm dy=4mm dz=2mm</u>
<u>Phantom</u>	<u>Validation plane</u>
<u>Device Position</u>	<u>Body</u>
<u>Band</u>	<u>IEEE 802.11ax U-NII</u>
<u>Channels</u>	<u>Middle</u>
<u>Signal</u>	<u>IEEE802.11ax (Crest factor: 1.0)</u>
<u>ConvF</u>	<u>2.20</u>

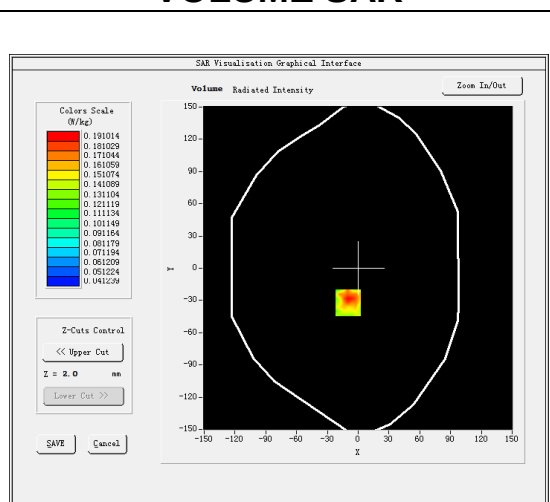
B. SAR Measurement Results

Frequency (MHz)	5570.000000
Relative permittivity (real part)	34.498300
Relative permittivity (imaginary part)	15.850670
Conductivity (S/m)	4.904902
Variation (%)	0.640000

SURFACE SAR



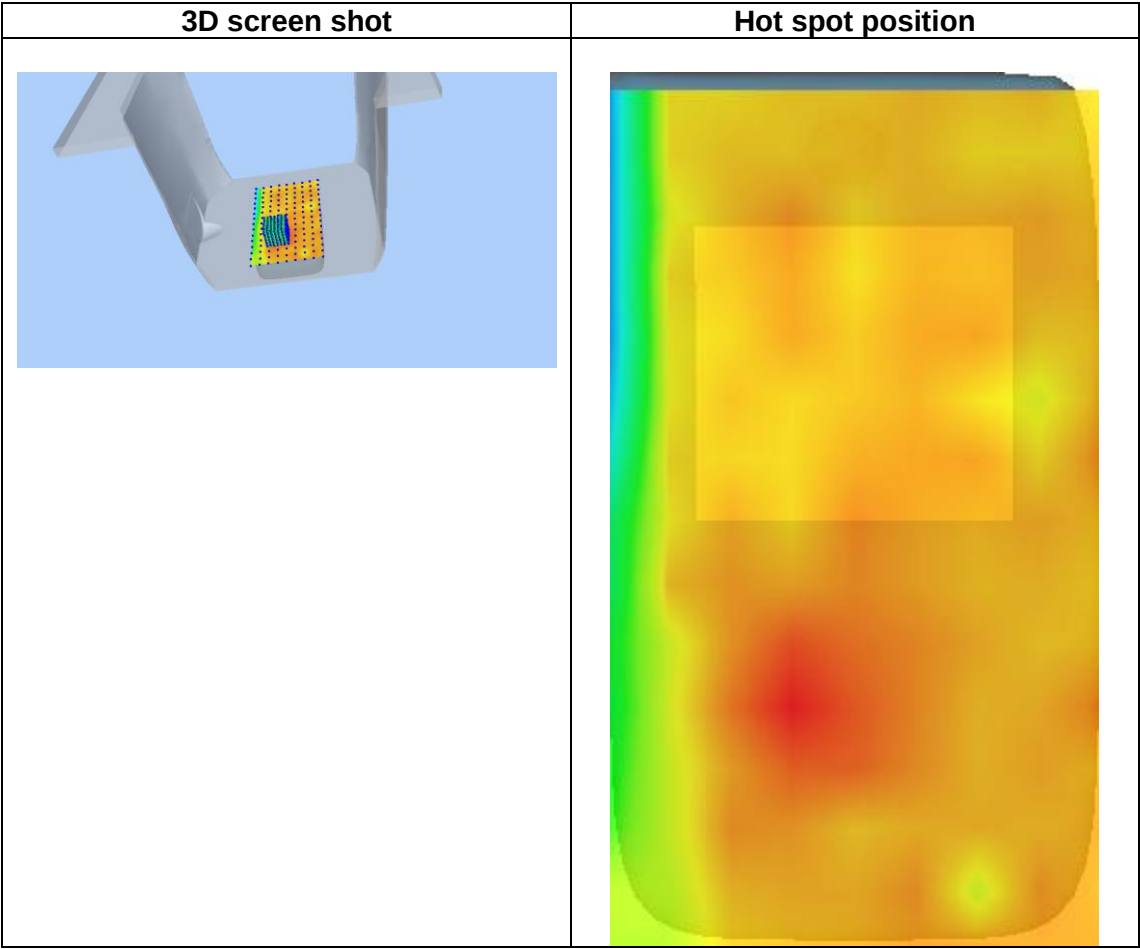
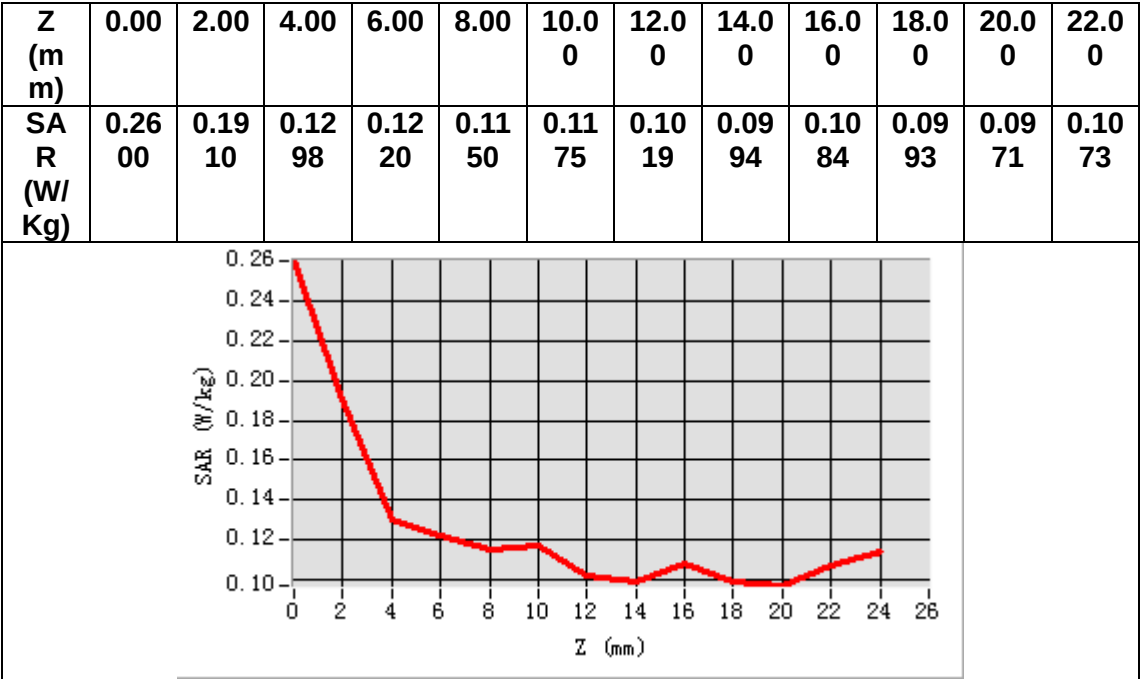
VOLUME SAR



Maximum location: X=-10.00, Y=-32.00

SAR Peak: 0.29 W/kg

SAR 10g (W/Kg)	0.122589
SAR 1g (W/Kg)	0.153530



MEASUREMENT 20

Date of measurement: 23/4/2024

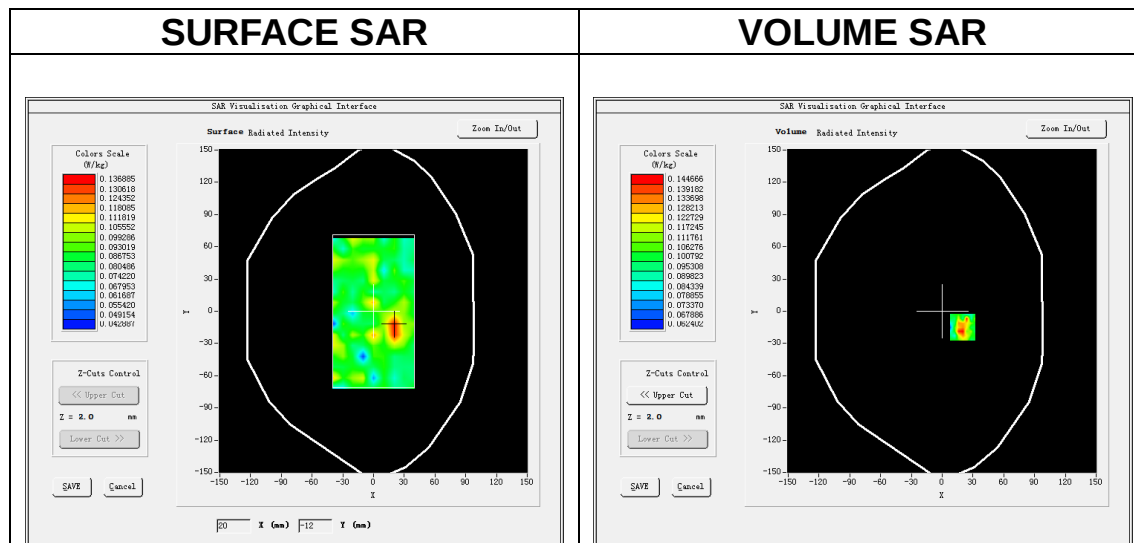
A. Experimental conditions.

<u>Area Scan</u>	<u>dx=10mm dy=10mm, h= 2.00 mm</u>
<u>ZoomScan</u>	<u>7x7x12,dx=4mm dy=4mm dz=2mm</u>
<u>Phantom</u>	<u>Validation plane</u>
<u>Device Position</u>	<u>Body</u>
<u>Band</u>	<u>IEEE 802.11ax U-NII</u>
<u>Channels</u>	<u>Middle</u>
<u>Signal</u>	<u>IEEE802.11ax (Crest factor: 1.0)</u>
<u>ConvF</u>	<u>2.20</u>

B. SAR Measurement Results

Frequency (MHz)	5570.000000
Relative permittivity (real part)	34.498300
Relative permittivity (imaginary part)	15.850670
Conductivity (S/m)	4.904902
Variation (%)	0.600000

SURFACE SAR

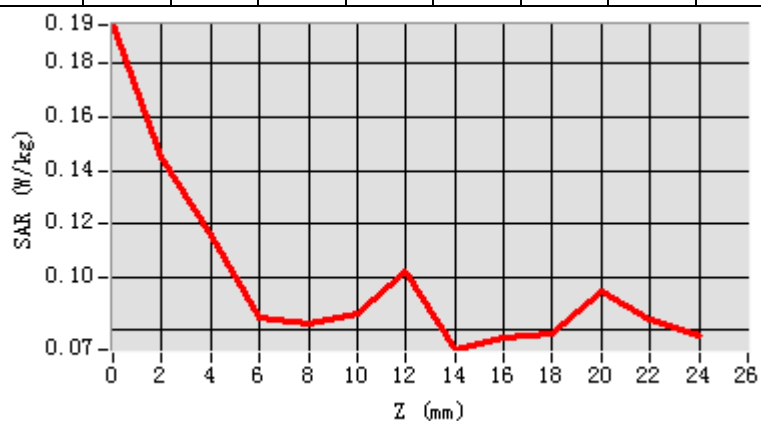


Maximum location: X=20.00, Y=-15.00

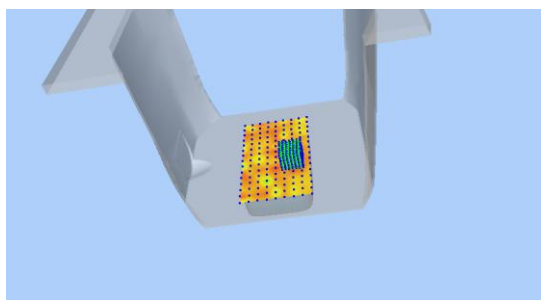
SAR Peak: 0.23 W/kg

SAR 10g (W/Kg)	0.091245
SAR 1g (W/Kg)	0.115383

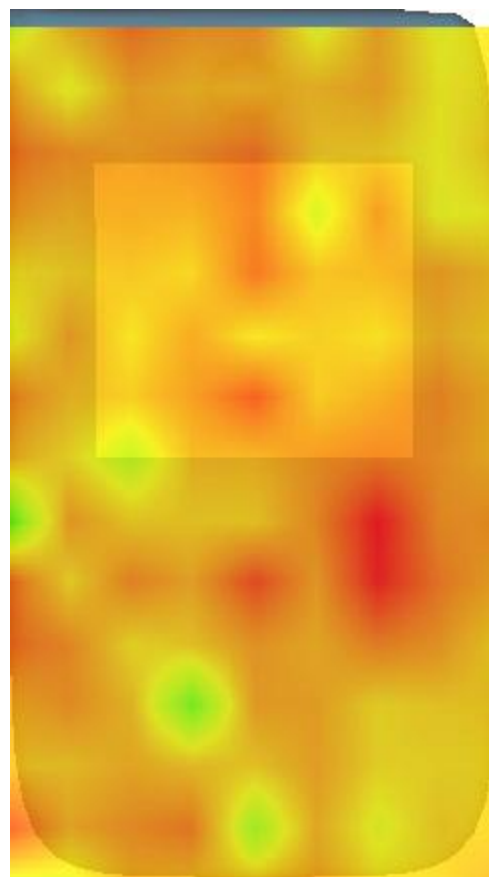
Z (m m)	0.00	2.00	4.00	6.00	8.00	10.0 0	12.0 0	14.0 0	16.0 0	18.0 0	20.0 0	22.0 0
SAR (W/ Kg)	0.19 47	0.14 47	0.11 60	0.08 49	0.08 22	0.08 61	0.10 22	0.07 27	0.07 74	0.07 88	0.09 45	0.08 42



3D screen shot



Hot spot position



MEASUREMENT 21

Date of measurement: 23/4/2024

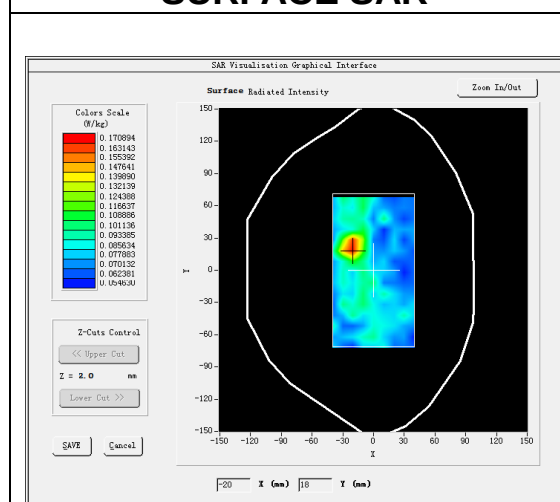
A. Experimental conditions.

<u>Area Scan</u>	<u>dx=10mm dy=10mm, h= 2.00 mm</u>
<u>ZoomScan</u>	<u>7x7x12,dx=4mm dy=4mm dz=2mm</u>
<u>Phantom</u>	<u>Validation plane</u>
<u>Device Position</u>	<u>Body</u>
<u>Band</u>	<u>IEEE 802.11ac U-NII</u>
<u>Channels</u>	<u>Middle</u>
<u>Signal</u>	<u>IEEE802.11ac (Crest factor: 1.0)</u>
<u>ConvF</u>	<u>2.20</u>

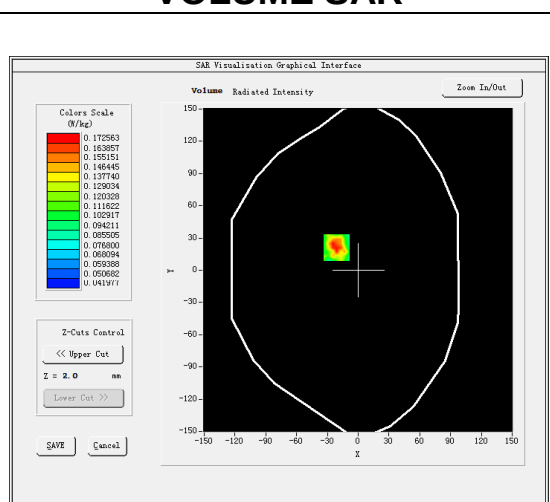
B. SAR Measurement Results

Frequency (MHz)	5570.000000
Relative permittivity (real part)	34.498300
Relative permittivity (imaginary part)	15.850670
Conductivity (S/m)	4.904902
Variation (%)	-4.810000

SURFACE SAR



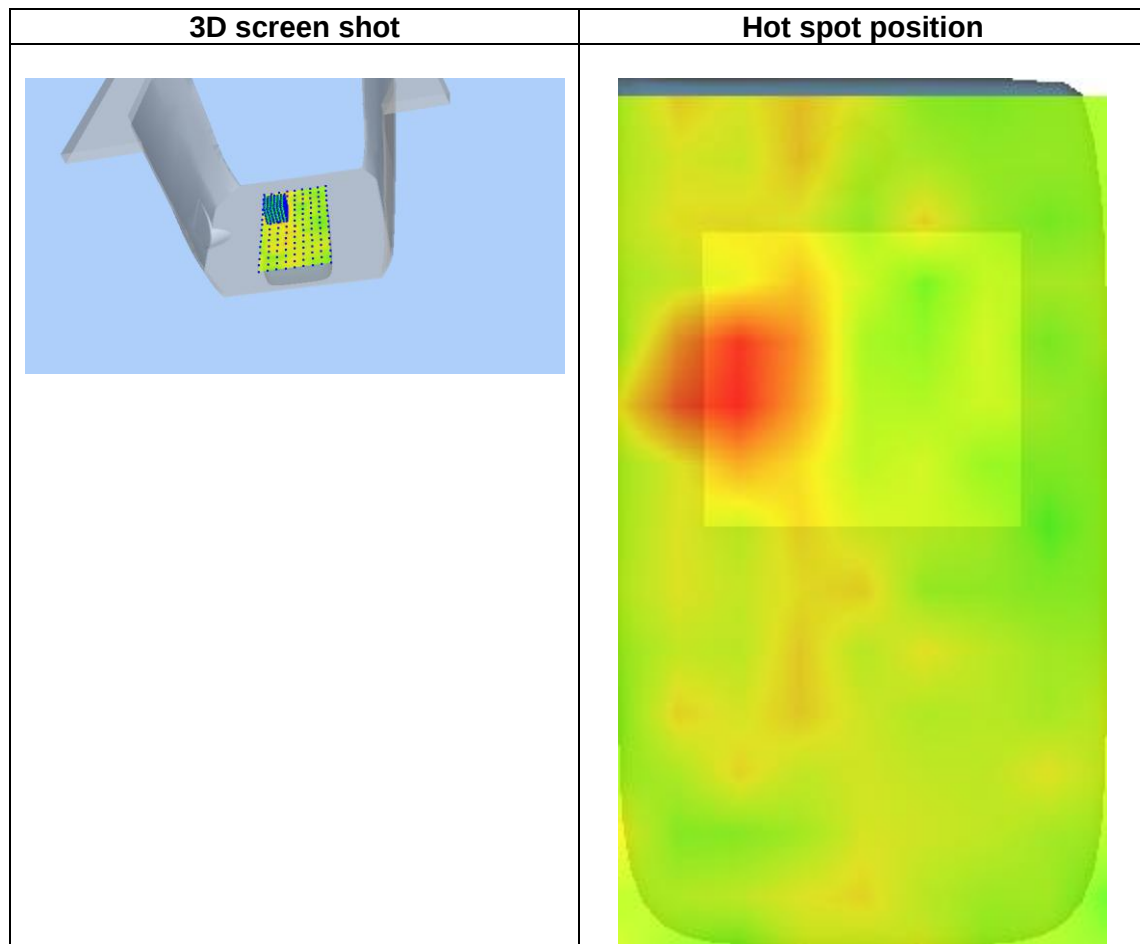
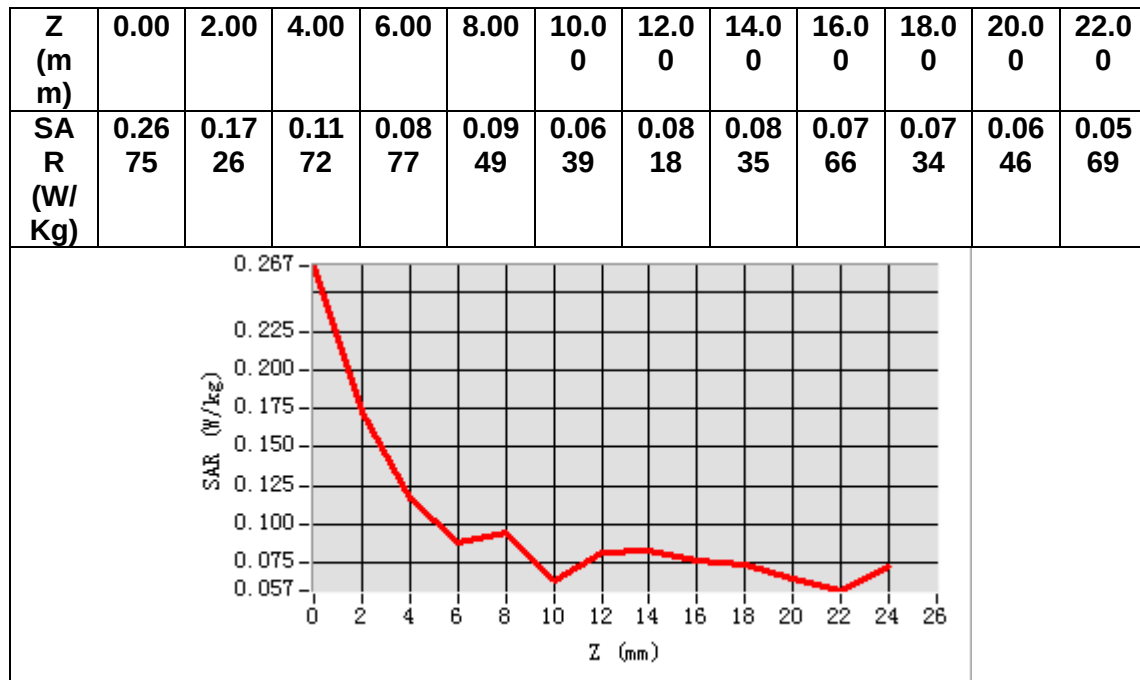
VOLUME SAR



Maximum location: X=-21.00, Y=21.00

SAR Peak: 0.30 W/kg

SAR 10g (W/Kg)	0.090395
SAR 1g (W/Kg)	0.126961



MEASUREMENT 22

Date of measurement: 20/4/2024

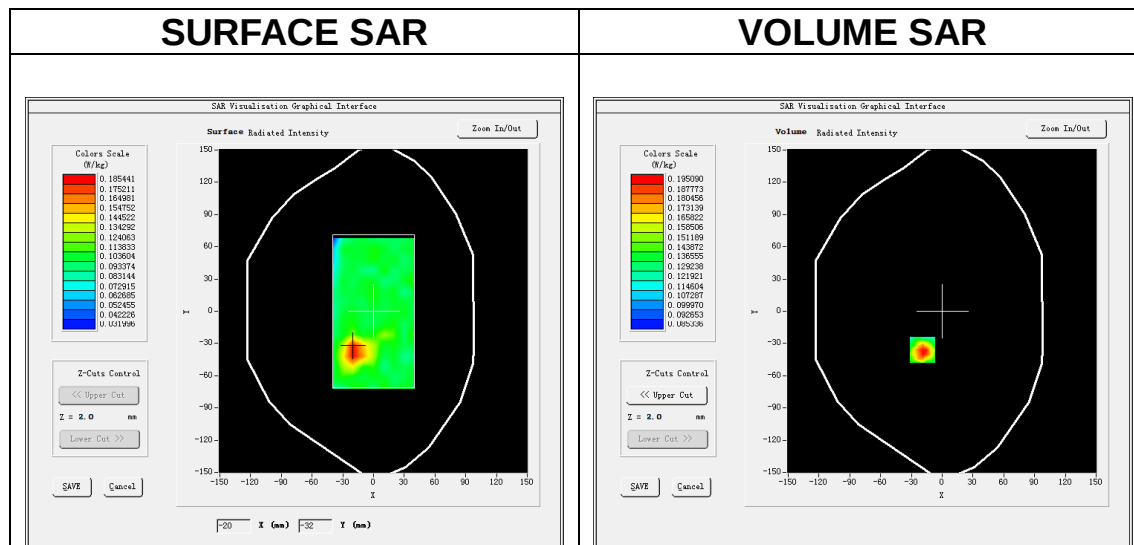
A. Experimental conditions.

<u>Area Scan</u>	<u>dx=10mm dy=10mm, h= 2.00 mm</u>
<u>ZoomScan</u>	<u>7x7x12,dx=4mm dy=4mm dz=2mm</u>
<u>Phantom</u>	<u>Validation plane</u>
<u>Device Position</u>	<u>Body</u>
<u>Band</u>	<u>IEEE 802.11ac U-NII</u>
<u>Channels</u>	<u>Middle</u>
<u>Signal</u>	<u>IEEE802.11ac (Crest factor: 1.0)</u>
<u>ConvF</u>	<u>2.04</u>

B. SAR Measurement Results

Frequency (MHz)	5775.000000
Relative permittivity (real part)	34.004556
Relative permittivity (imaginary part)	16.034719
Conductivity (S/m)	5.144472
Variation (%)	0.959999

SURFACE SAR

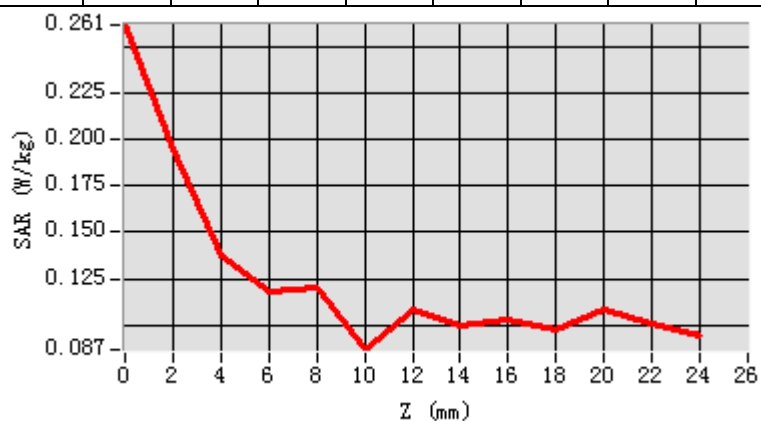


Maximum location: X=-19.00, Y=-36.00

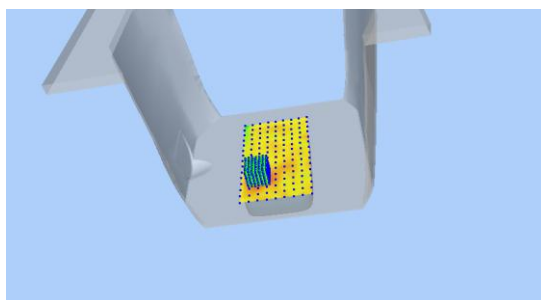
SAR Peak: 0.27 W/kg

SAR 10g (W/Kg)	0.120598
SAR 1g (W/Kg)	0.151886

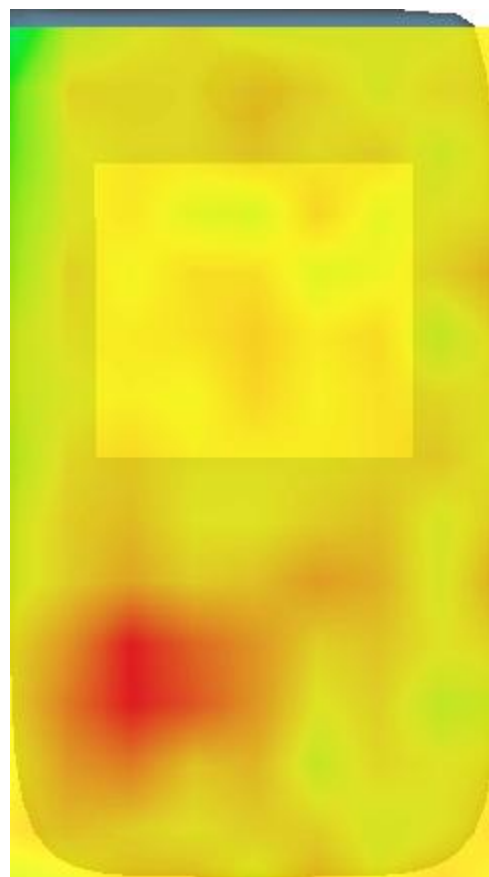
Z (m m)	0.00	2.00	4.00	6.00	8.00	10.0 0	12.0 0	14.0 0	16.0 0	18.0 0	20.0 0	22.0 0
SAR (W/ Kg)	0.26 13	0.19 51	0.13 72	0.11 79	0.11 99	0.08 71	0.10 81	0.10 00	0.10 36	0.09 74	0.10 89	0.10 14



3D screen shot



Hot spot position



MEASUREMENT 23

Date of measurement: 20/4/2024

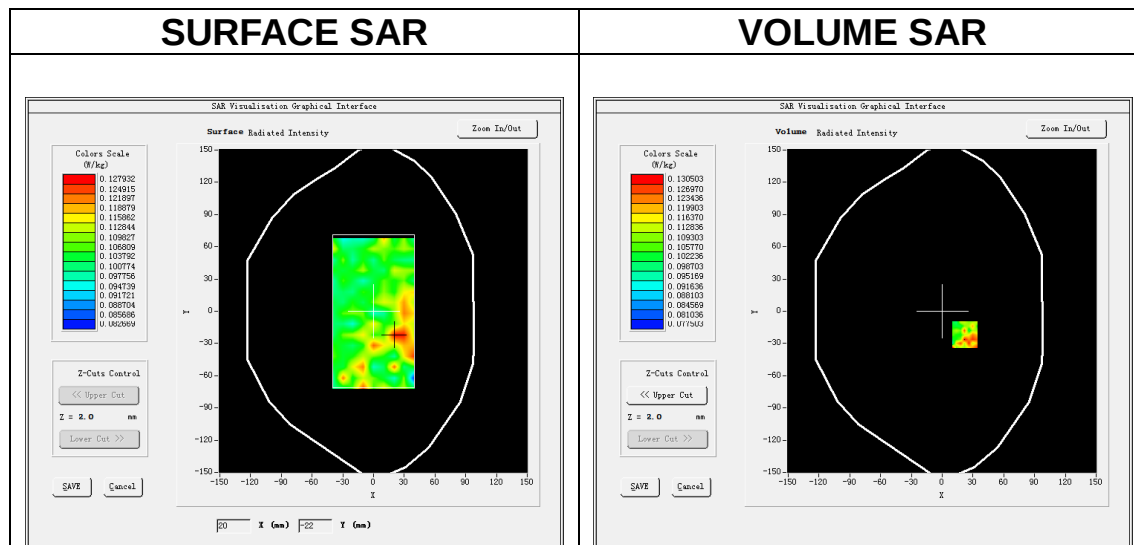
A. Experimental conditions.

<u>Area Scan</u>	<u>dx=10mm dy=10mm, h= 2.00 mm</u>
<u>ZoomScan</u>	<u>7x7x12,dx=4mm dy=4mm dz=2mm</u>
<u>Phantom</u>	<u>Validation plane</u>
<u>Device Position</u>	<u>Body</u>
<u>Band</u>	<u>IEEE 802.11ac U-NII</u>
<u>Channels</u>	<u>Middle</u>
<u>Signal</u>	<u>IEEE802.11ac (Crest factor: 1.0)</u>
<u>ConvF</u>	<u>2.04</u>

B. SAR Measurement Results

Frequency (MHz)	5775.000000
Relative permittivity (real part)	34.004556
Relative permittivity (imaginary part)	16.034719
Conductivity (S/m)	5.144472
Variation (%)	2.660000

SURFACE SAR

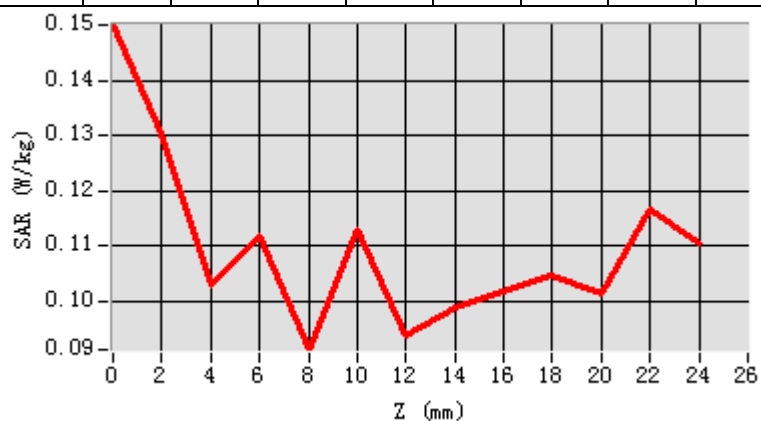


Maximum location: X=22.00, Y=-22.00

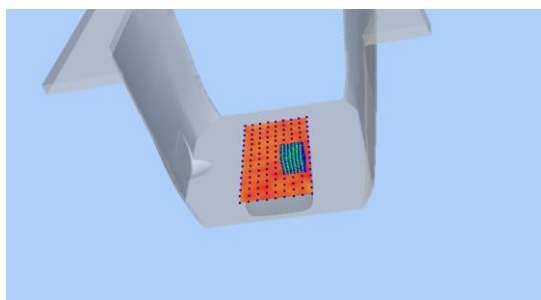
SAR Peak: 0.17 W/kg

SAR 10g (W/Kg)	0.108472
SAR 1g (W/Kg)	0.115273

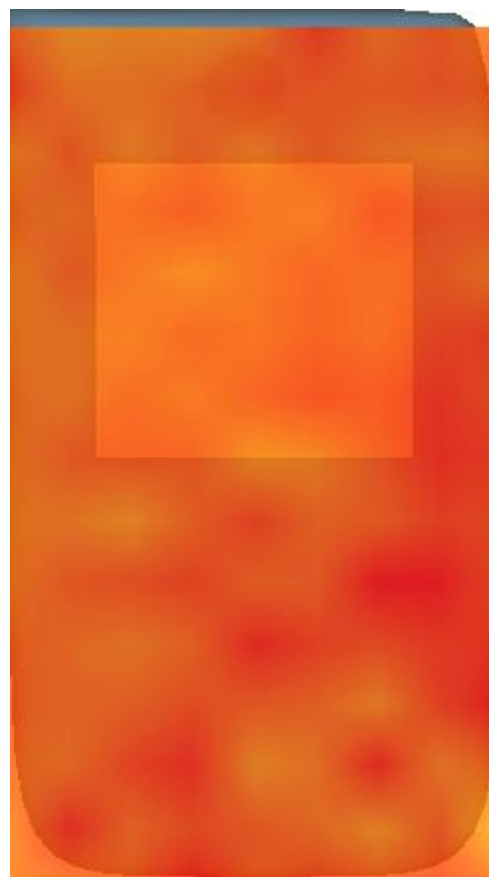
Z (m m)	0.00	2.00	4.00	6.00	8.00	10.0 0	12.0 0	14.0 0	16.0 0	18.0 0	20.0 0	22.0 0
SAR (W/ Kg)	0.15 01	0.13 05	0.10 29	0.11 21	0.09 12	0.11 29	0.09 36	0.09 90	0.10 17	0.10 48	0.10 15	0.11 66



3D screen shot



Hot spot position



MEASUREMENT 24

Date of measurement: 20/4/2024

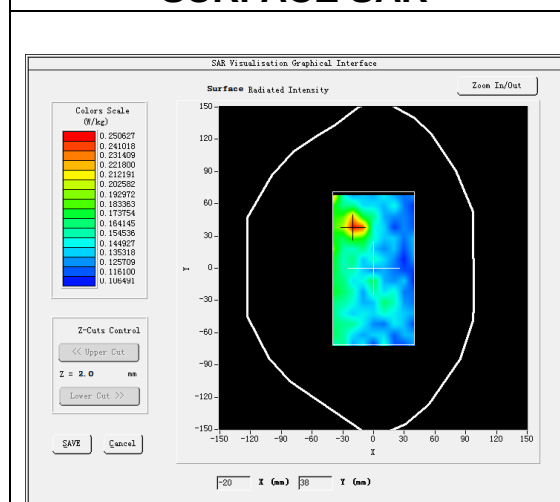
A. Experimental conditions.

<u>Area Scan</u>	<u>dx=10mm dy=10mm, h= 2.00 mm</u>
<u>ZoomScan</u>	<u>7x7x12,dx=4mm dy=4mm dz=2mm</u>
<u>Phantom</u>	<u>Validation plane</u>
<u>Device Position</u>	<u>Body</u>
<u>Band</u>	<u>IEEE 802.11ac U-NII</u>
<u>Channels</u>	<u>Middle</u>
<u>Signal</u>	<u>IEEE802.11ac (Crest factor: 1.0)</u>
<u>ConvF</u>	<u>2.04</u>

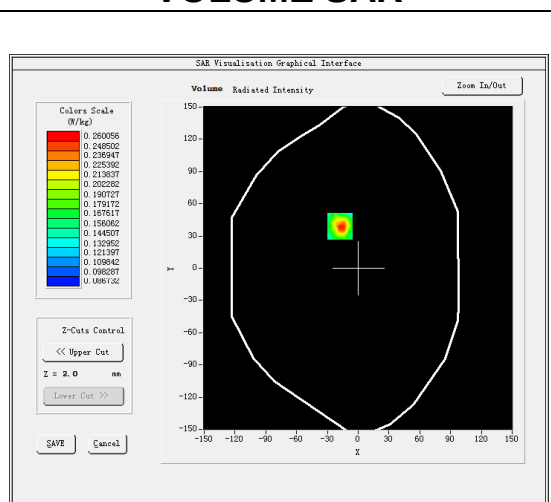
B. SAR Measurement Results

Frequency (MHz)	5775.000000
Relative permittivity (real part)	34.004556
Relative permittivity (imaginary part)	16.034719
Conductivity (S/m)	5.144472
Variation (%)	-2.590000

SURFACE SAR



VOLUME SAR

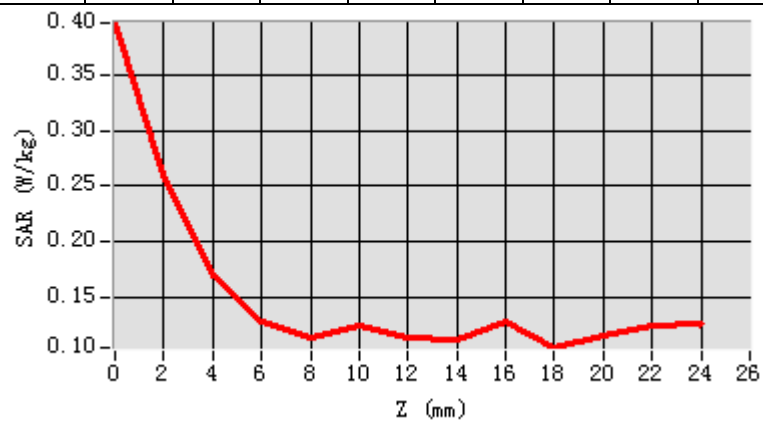


Maximum location: X=-18.00, Y=39.00

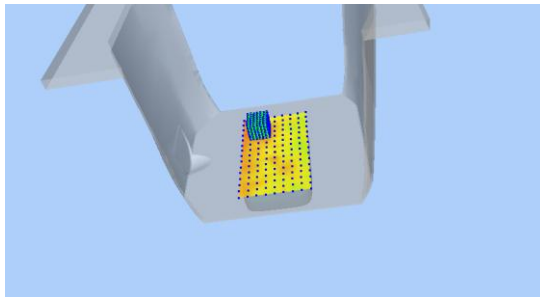
SAR Peak: 0.42 W/kg

SAR 10g (W/Kg)	0.137831
SAR 1g (W/Kg)	0.192748

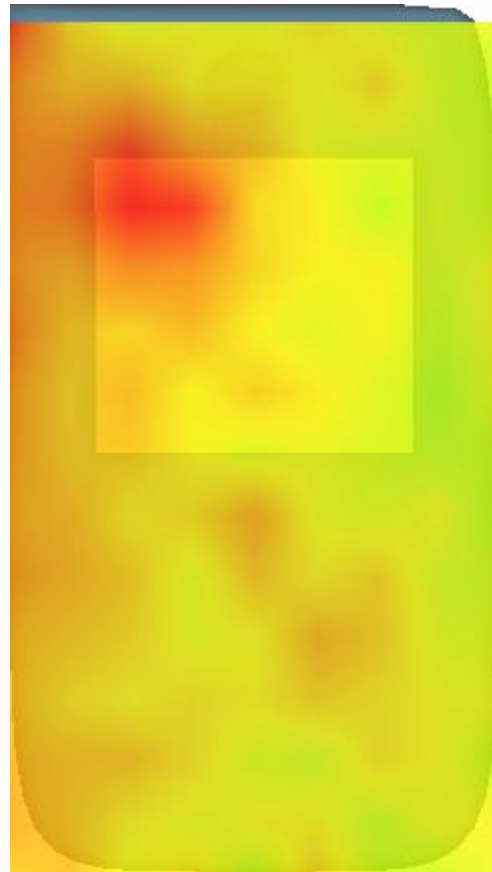
Z (m m)	0.00	2.00	4.00	6.00	8.00	10.0 0	12.0 0	14.0 0	16.0 0	18.0 0	20.0 0	22.0 0
SAR (W/ Kg)	0.39 69	0.26 01	0.17 00	0.12 90	0.11 36	0.12 48	0.11 43	0.11 20	0.12 78	0.10 49	0.11 62	0.12 43



3D screen shot



Hot spot position



MEASUREMENT 25

Date of measurement: 28/4/2024

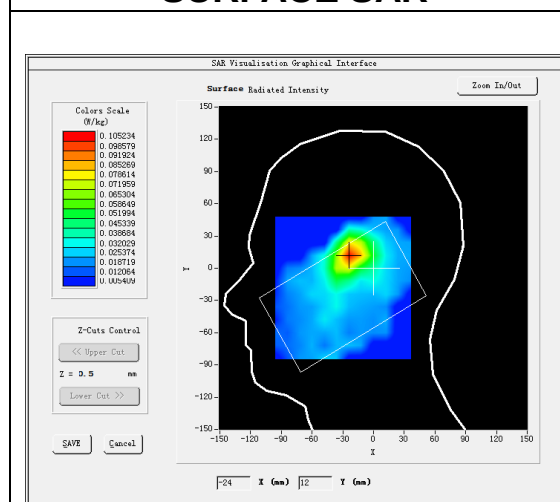
A. Experimental conditions.

<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>IEEE 802.11b ISM</u>
<u>Channels</u>	<u>Low</u>
<u>Signal</u>	<u>IEEE802.11b (Crest factor: 1.0)</u>
<u>ConvF</u>	<u>2.85</u>

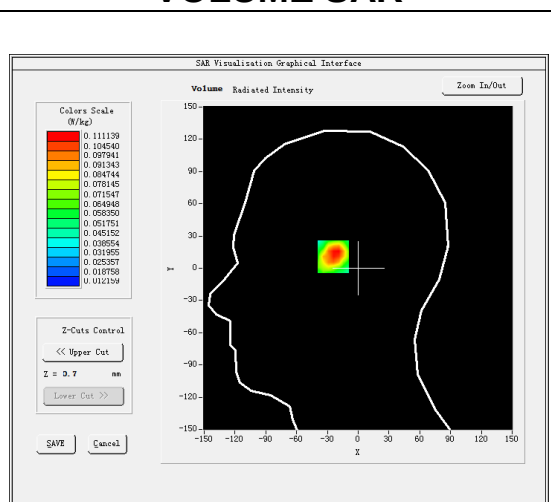
B. SAR Measurement Results

Frequency (MHz)	2412.000000
Relative permittivity (real part)	37.623814
Relative permittivity (imaginary part)	12.864978
Conductivity (S/m)	1.723907
Variation (%)	4.599998

SURFACE SAR



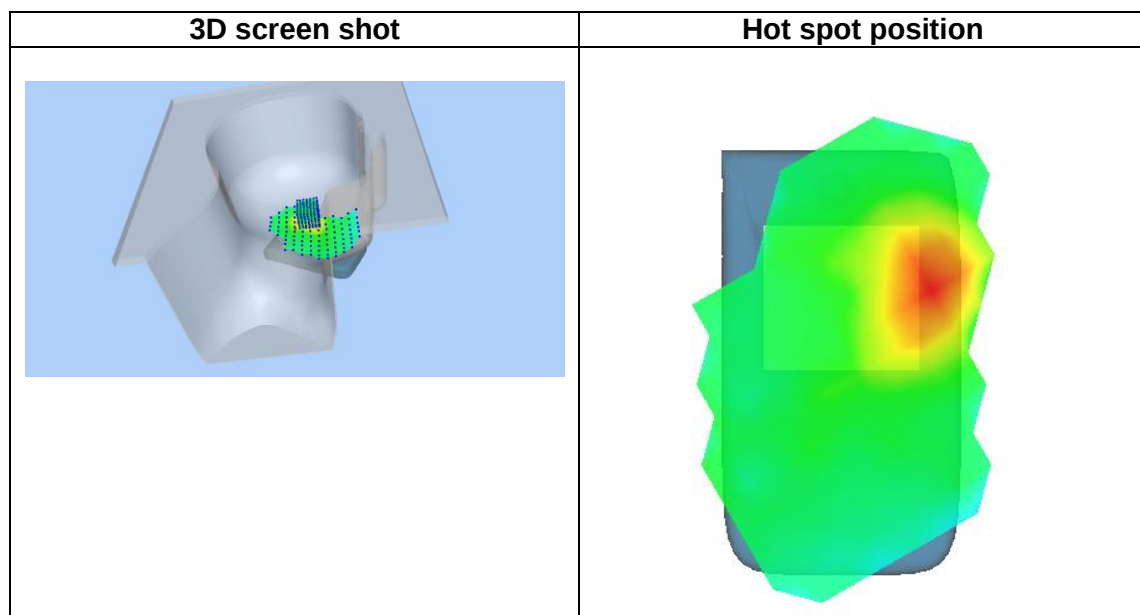
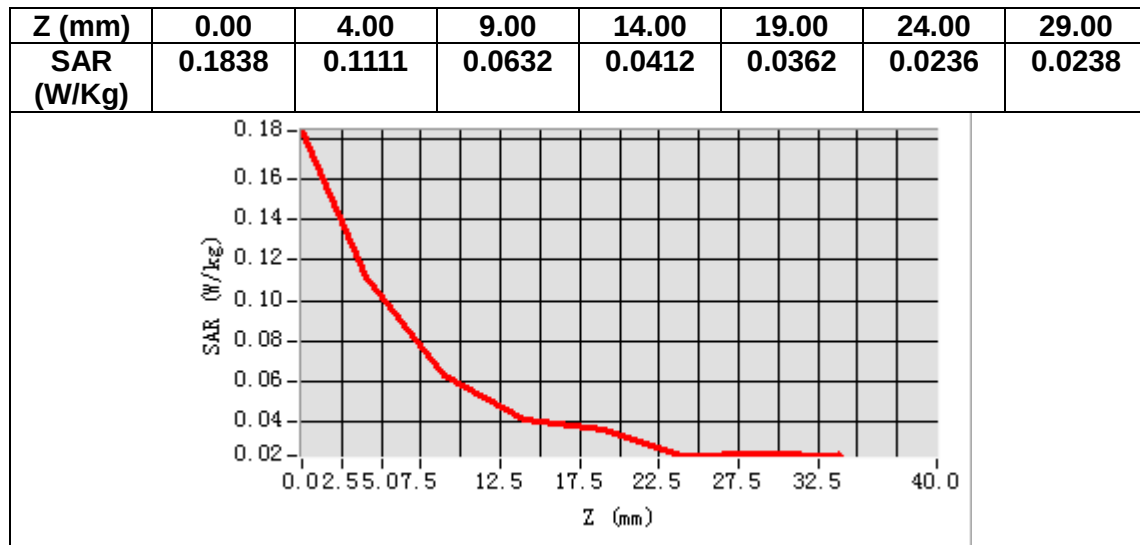
VOLUME SAR



Maximum location: X=-23.00, Y=12.00

SAR Peak: 0.18 W/kg

SAR 10g (W/Kg)	0.062184
SAR 1g (W/Kg)	0.106432



MEASUREMENT 26

Date of measurement: 28/4/2024

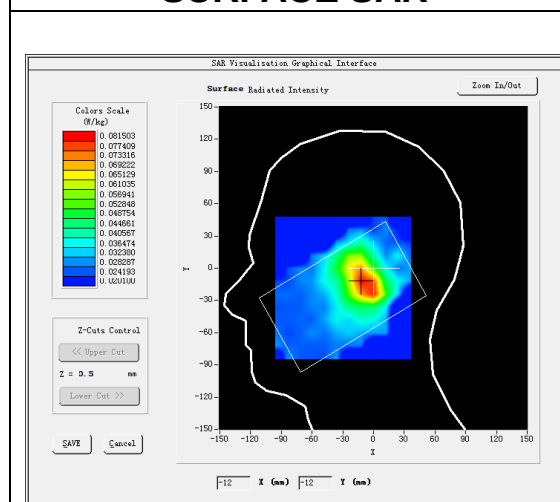
A. Experimental conditions.

<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>IEEE 802.11b ISM</u>
<u>Channels</u>	<u>High</u>
<u>Signal</u>	<u>IEEE802.11b (Crest factor: 1.0)</u>
<u>ConvF</u>	<u>2.85</u>

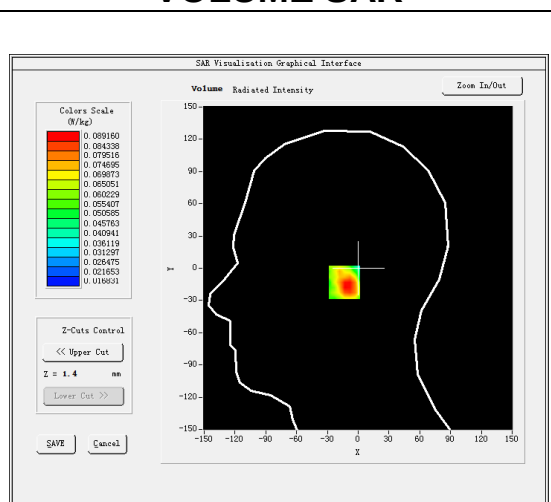
B. SAR Measurement Results

Frequency (MHz)	2462.000000
Relative permittivity (real part)	37.503114
Relative permittivity (imaginary part)	12.975078
Conductivity (S/m)	1.774702
Variation (%)	2.510000

SURFACE SAR



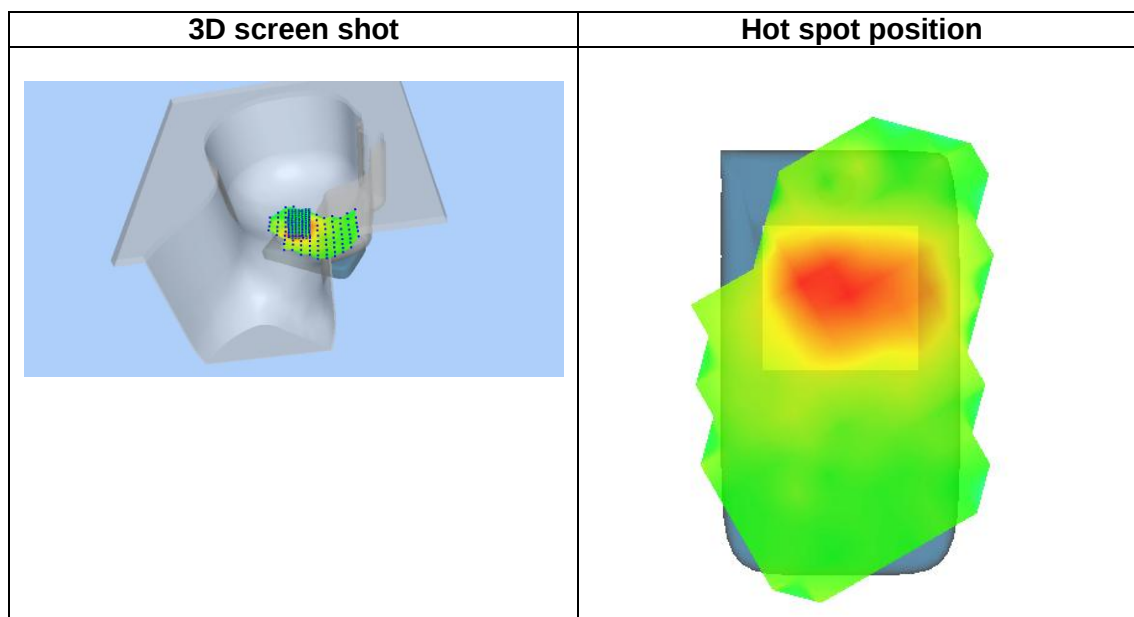
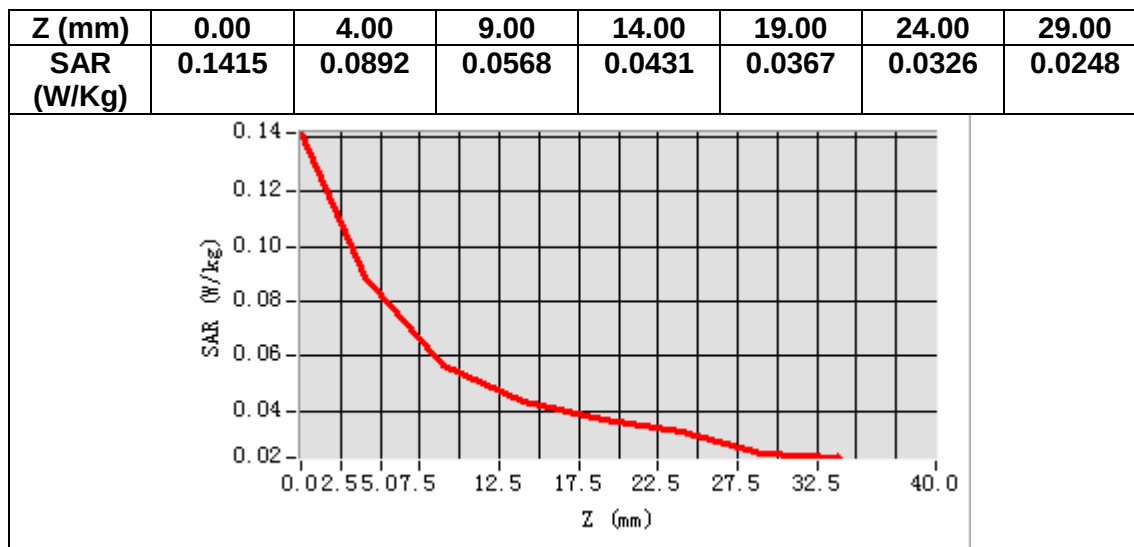
VOLUME SAR



Maximum location: X=-9.00, Y=-13.00

SAR Peak: 0.15 W/kg

SAR 10g (W/Kg)	0.054947
SAR 1g (W/Kg)	0.086864



MEASUREMENT 27

Date of measurement: 28/4/2024

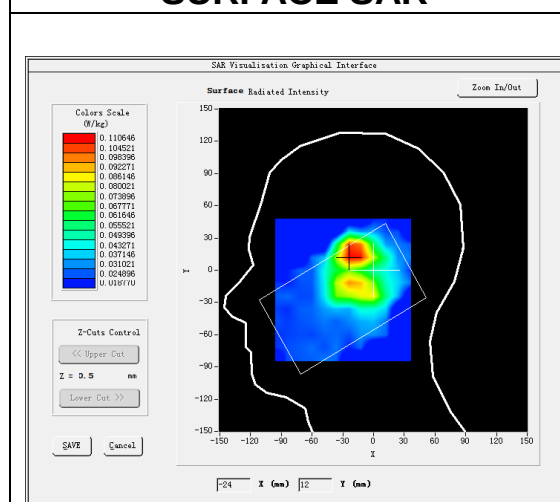
A. Experimental conditions.

<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>IEEE 802.11ax</u>
<u>Channels</u>	<u>High</u>
<u>Signal</u>	<u>IEEE802.11ax (Crest factor: 1.0)</u>
<u>ConvF</u>	<u>2.85</u>

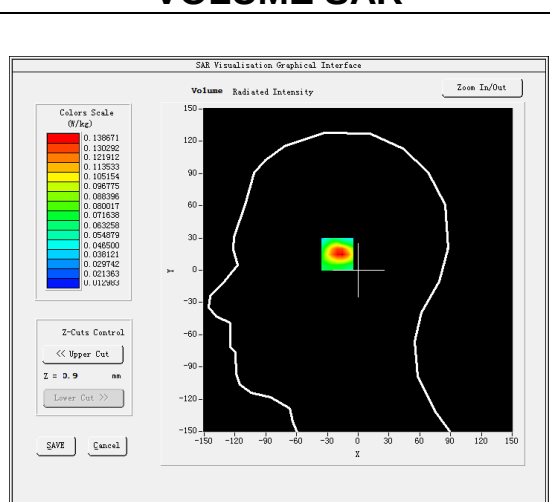
B. SAR Measurement Results

Frequency (MHz)	2462.000000
Relative permittivity (real part)	37.503114
Relative permittivity (imaginary part)	12.975078
Conductivity (S/m)	1.774702
Variation (%)	0.700000

SURFACE SAR



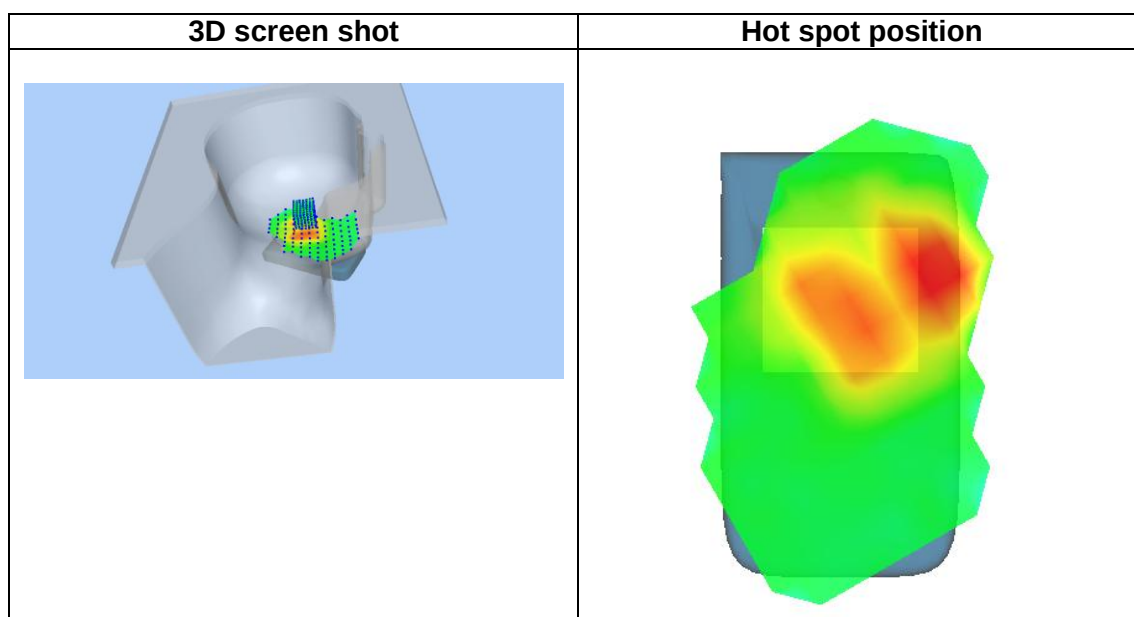
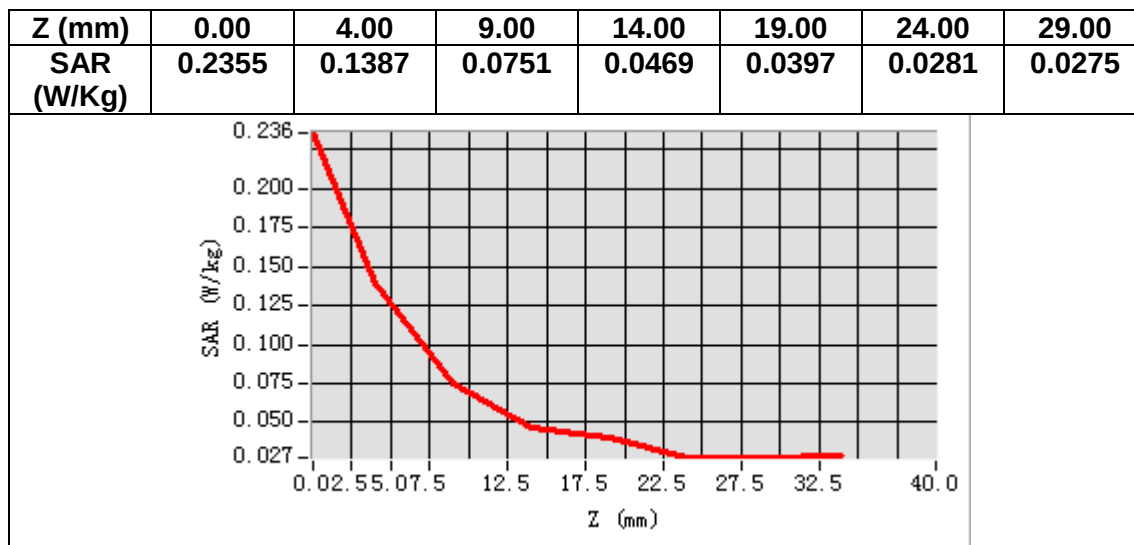
VOLUME SAR



Maximum location: X=-19.00, Y=16.00

SAR Peak: 0.23 W/kg

SAR 10g (W/Kg)	0.068967
SAR 1g (W/Kg)	0.128448



MEASUREMENT 28

Date of measurement: 28/4/2024

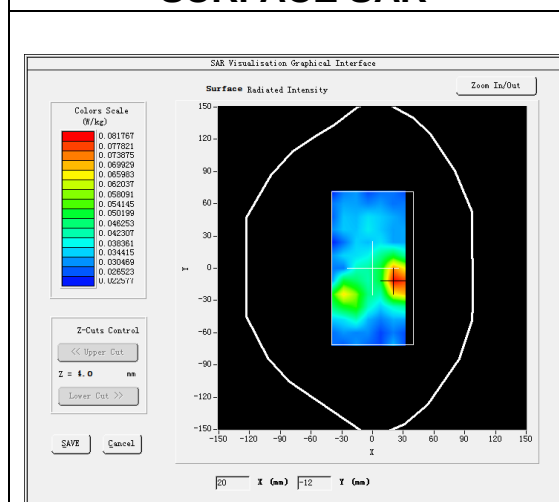
A. Experimental conditions.

<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>IEEE 802.11ax</u>
<u>Channels</u>	<u>High</u>
<u>Signal</u>	<u>IEEE802.11ax (Crest factor: 1.0)</u>
<u>ConvF</u>	<u>2.85</u>

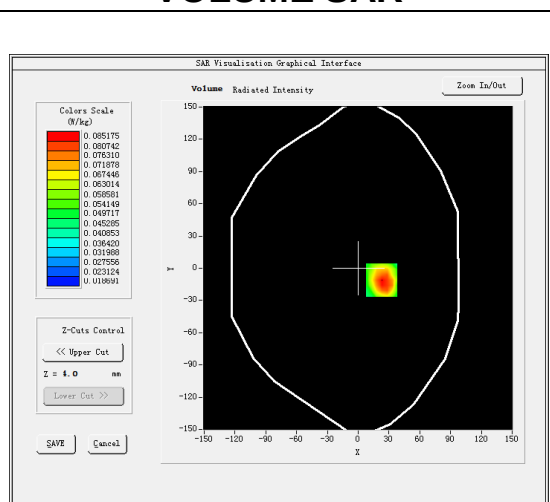
B. SAR Measurement Results

Frequency (MHz)	2462.000000
Relative permittivity (real part)	37.503114
Relative permittivity (imaginary part)	12.975078
Conductivity (S/m)	1.774702
Variation (%)	2.200000

SURFACE SAR



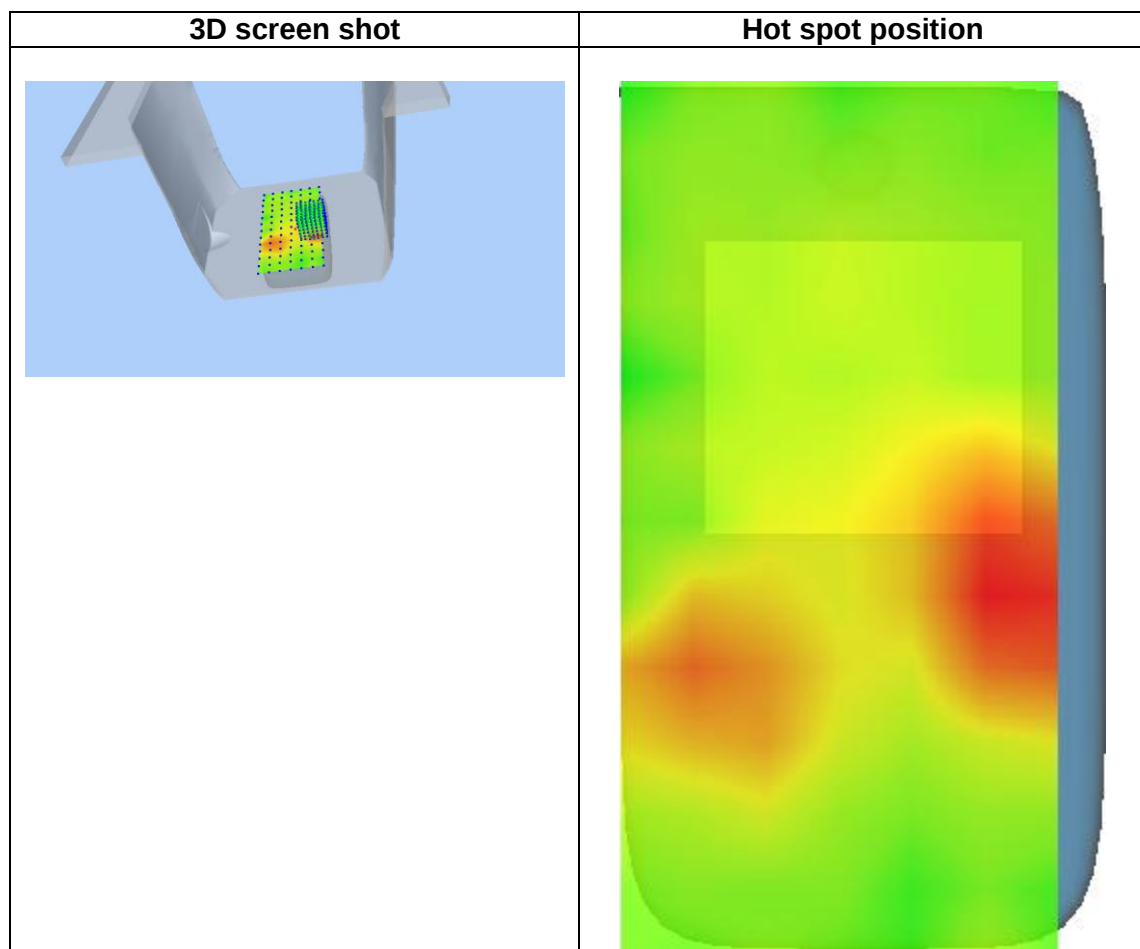
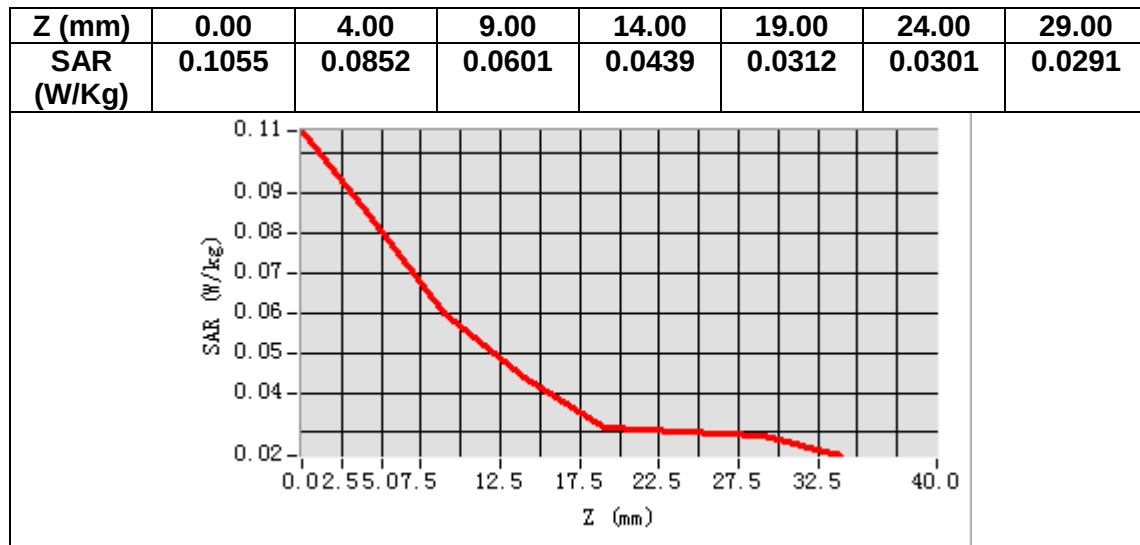
VOLUME SAR



Maximum location: X=23.00, Y=-11.00

SAR Peak: 0.12 W/kg

SAR 10g (W/Kg)	0.052672
SAR 1g (W/Kg)	0.077872



MEASUREMENT 29

Date of measurement: 28/4/2024

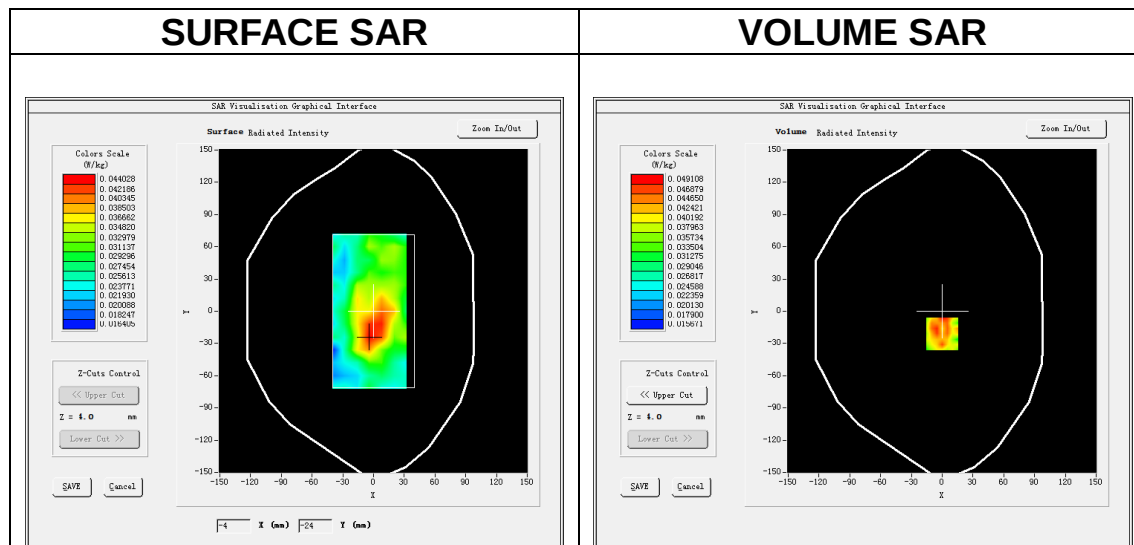
A. Experimental conditions.

<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>IEEE 802.11b ISM</u>
<u>Channels</u>	<u>Low</u>
<u>Signal</u>	<u>IEEE802.11b (Crest factor: 1.0)</u>
<u>ConvF</u>	<u>2.85</u>

B. SAR Measurement Results

Frequency (MHz)	2412.000000
Relative permittivity (real part)	37.623814
Relative permittivity (imaginary part)	12.864978
Conductivity (S/m)	1.723907
Variation (%)	1.010000

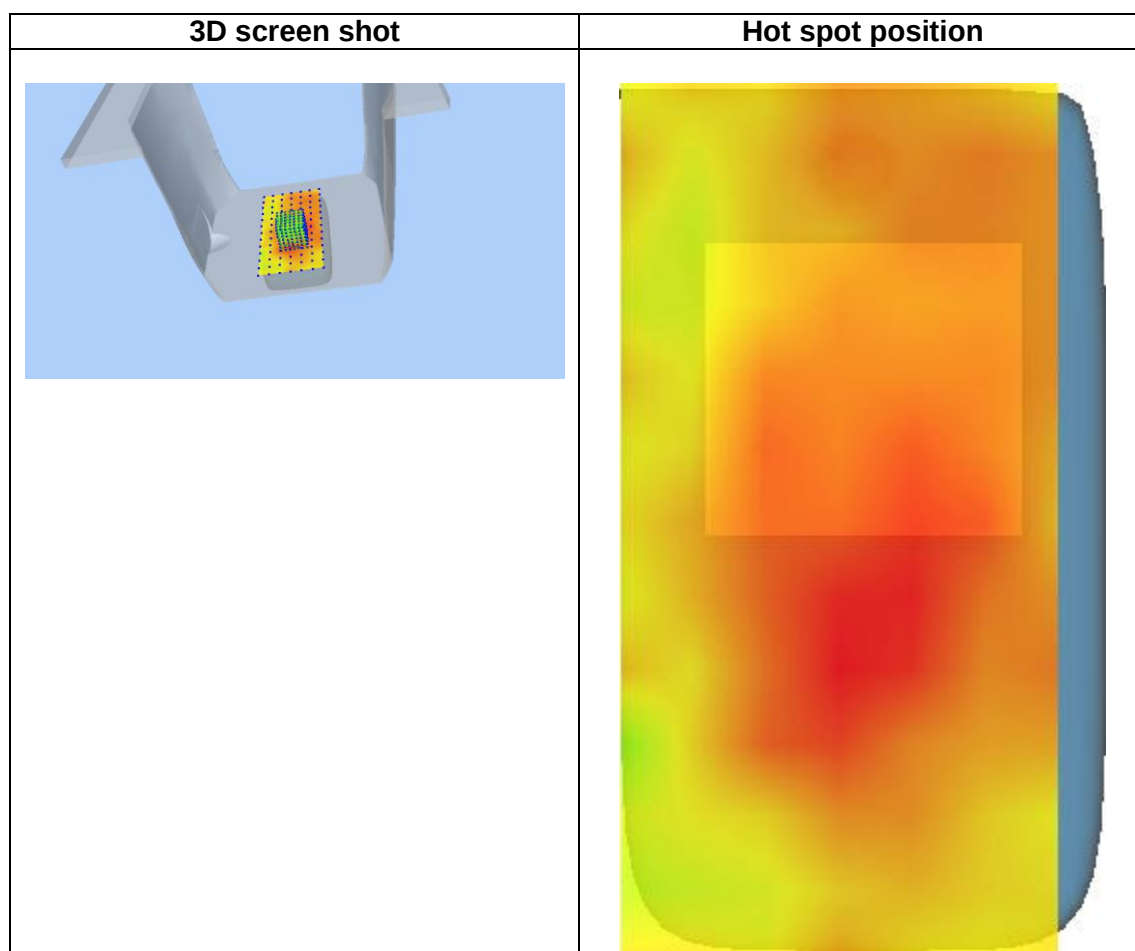
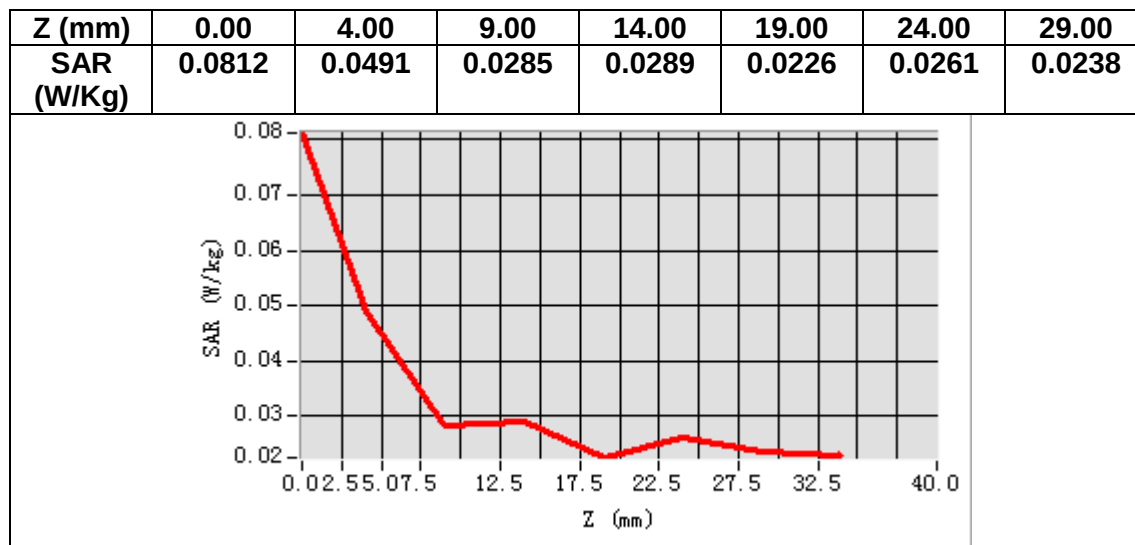
SURFACE SAR



Maximum location: X=0.00, Y=-21.00

SAR Peak: 0.08 W/kg

SAR 10g (W/Kg)	0.034516
SAR 1g (W/Kg)	0.044228



MEASUREMENT 30

Date of measurement: 28/4/2024

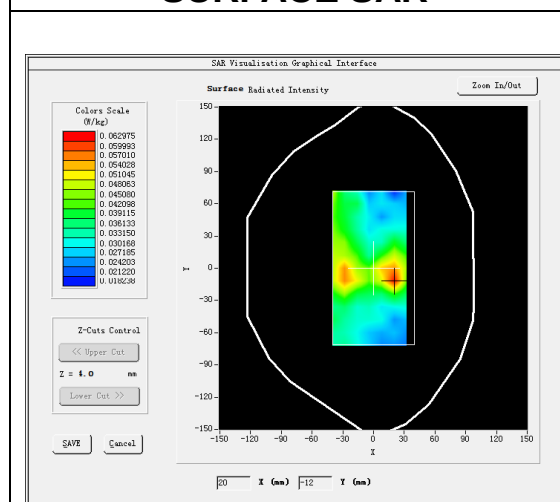
A. Experimental conditions.

<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>IEEE 802.11b ISM</u>
<u>Channels</u>	<u>High</u>
<u>Signal</u>	<u>IEEE802.11b (Crest factor: 1.0)</u>
<u>ConvF</u>	<u>2.85</u>

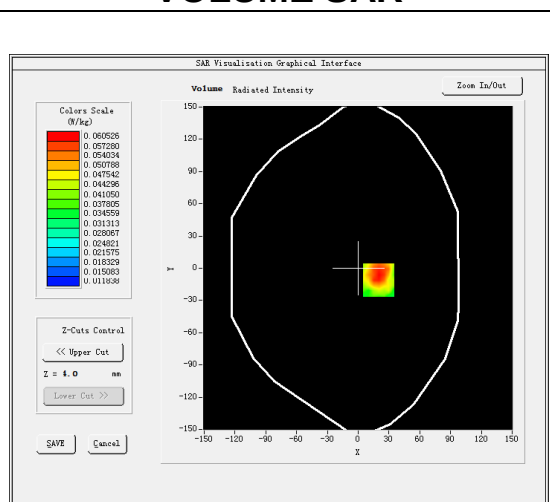
B. SAR Measurement Results

Frequency (MHz)	2462.000000
Relative permittivity (real part)	37.503114
Relative permittivity (imaginary part)	12.975078
Conductivity (S/m)	1.774702
Variation (%)	-0.810000

SURFACE SAR



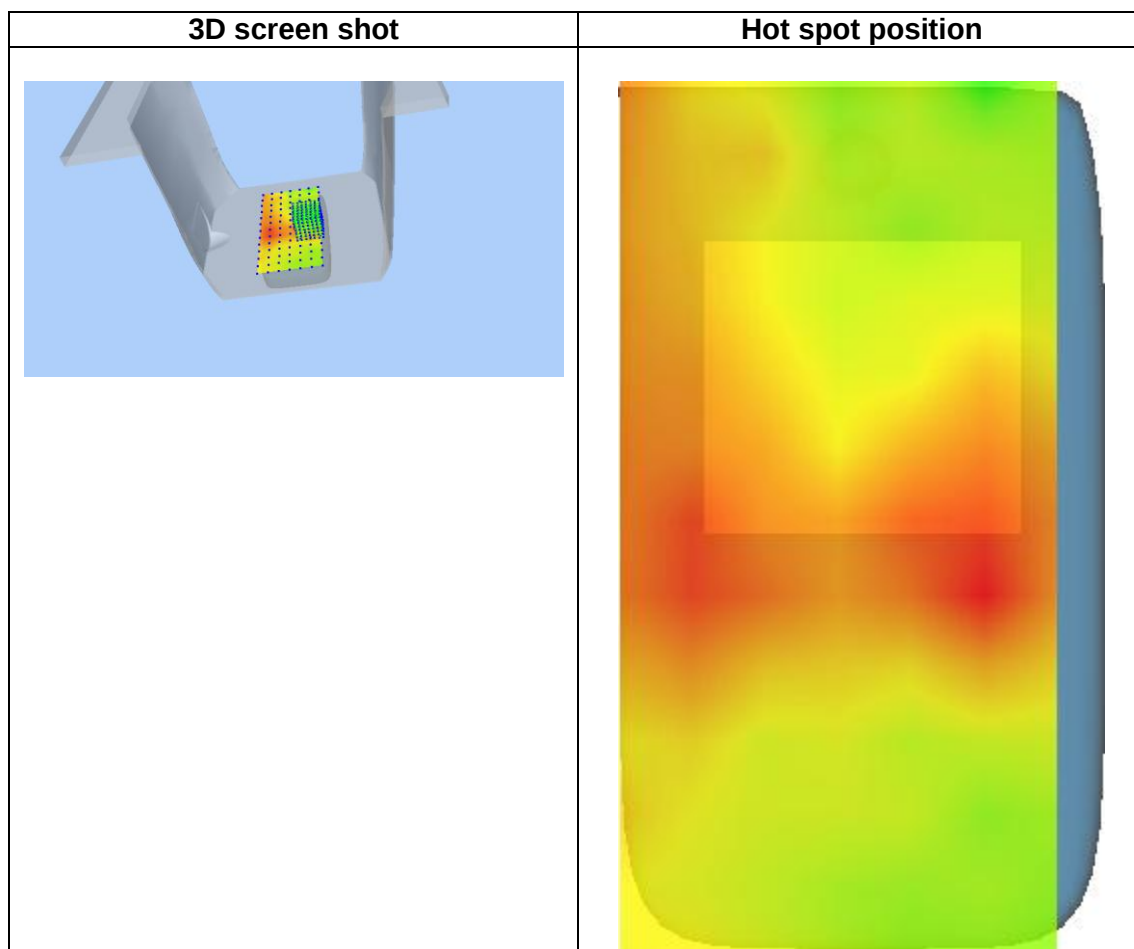
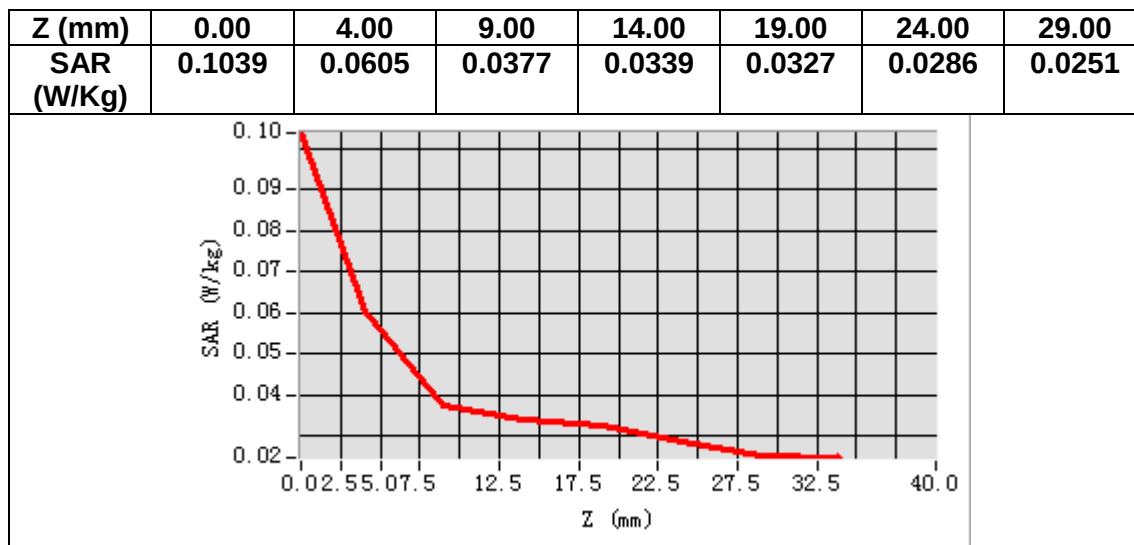
VOLUME SAR



Maximum location: X=20.00, Y=-11.00

SAR Peak: 0.09 W/kg

SAR 10g (W/Kg)	0.041413
SAR 1g (W/Kg)	0.059395



14. Appendix D. Calibration Certificate

Table of contents
E Field Probe - 3423-EPGO-426
2450 MHz Dipole - SN 03/15 DIP 2G450-352
5000-6000 MHz Dipole - SN 13/14 WGA 33



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 IDSignature
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

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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

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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 0.01 W/kg to 100 W/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:

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

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.

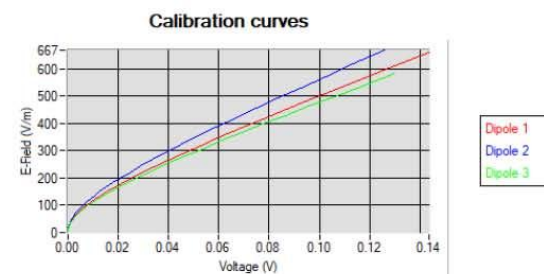
The estimated expanded uncertainty (k=2) in calibration for SAR (W/kg) is +/-14% for the frequency range 600-7500MHz.

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

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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



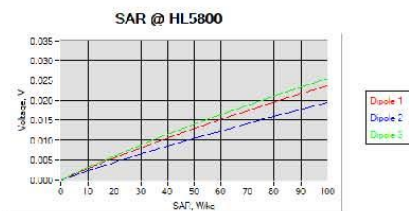
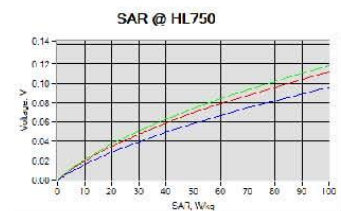
COMOSAR E-FIELD PROBE CALIBRATION REPORT

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.

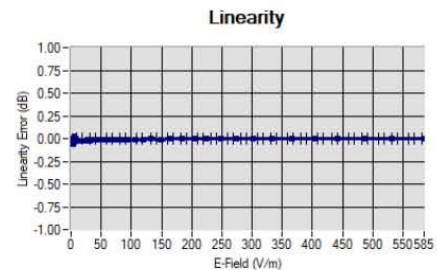
Liquid	Frequency (MHz*)	ConvF
HL750	750	2.37
HL850	835	2.32
HL900	900	2.23
HL1800	1800	2.45
HL1900	1900	2.63
HL2000	2000	2.83
HL2300	2300	2.81
HL2450	2450	2.85
HL2600	2600	2.65
HL3300	3300	2.21
HL3500	3500	2.20
HL3700	3700	2.11
HL3900	3900	2.40
HL4200	4200	2.40
HL4600	4600	2.33
HL4900	4900	2.37
HL5200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

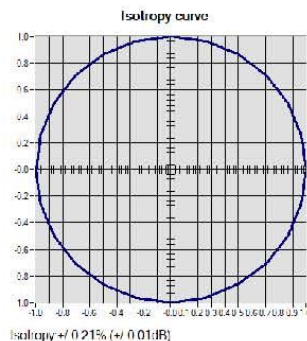


6 VERIFICATION RESULTS

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.

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Template_ACR.DDD.N.YY.MVGB.ISSUE_COMOSAR Probe vL

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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.53.29.24.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: 2450 MHZ

SERIAL NO.: SN 03/15DIP2G450-352

Calibrated at MVG

Z.I. de la pointe du diable

Technopôle Brest Iroise – 295 avenue Alexis de Rochon

29280 PLOUZANE - FRANCE

Calibration date: 02/21/2024



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.53.29.24.BES.A

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

Yann
Toutain ID

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

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

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