MEASUREMENT 12

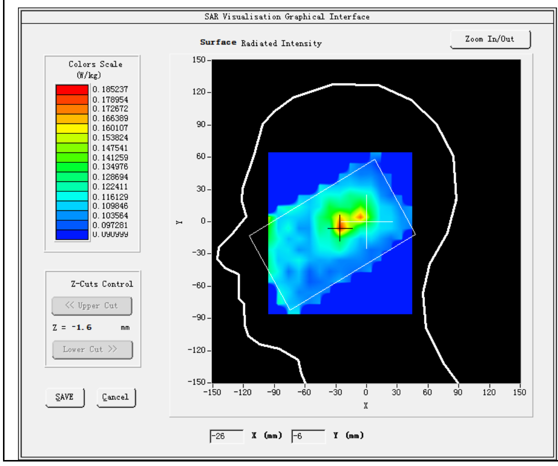
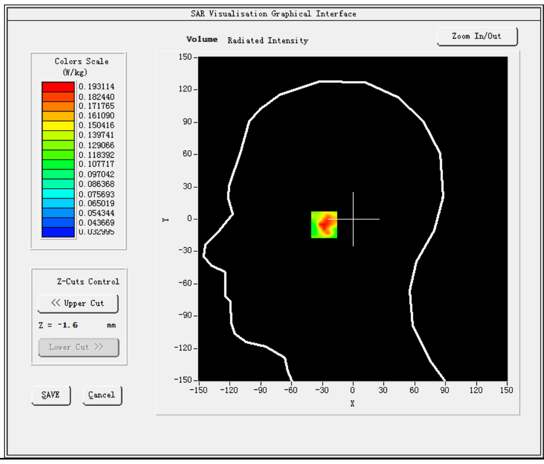
Date of measurement: 27/3/2024

A. Experimental conditions.

Area Scan	dx=10mm dy=10mm, h= 2.00 mm
ZoomScan	7x7x12,dx=4mm dy=4mm dz=2mm
Phantom	Left head
Device Position	Cheek
Band	IEEE 802.11a U-NII
Channels	Middle
Signal	IEEE802.11a (Crest factor: 1.0)
ConvF	2.04

B. SAR Measurement Results

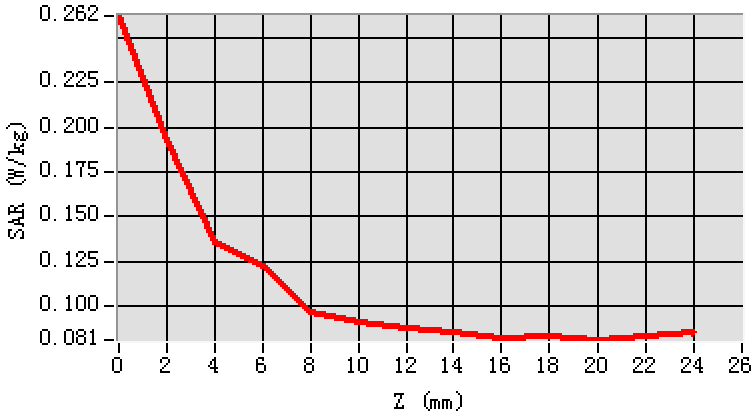
Frequency (MHz)	5785.000000
Relative permittivity (real part)	34.133007
Relative permittivity (imaginary part)	16.008299
Conductivity (S/m)	5.144889
Variation (%)	-2.420000

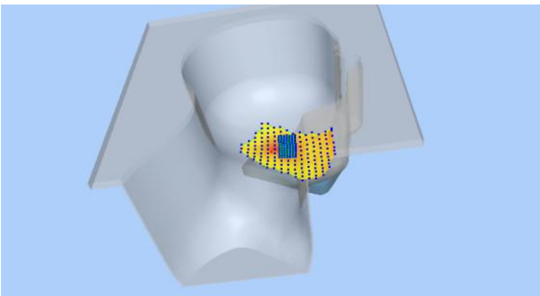
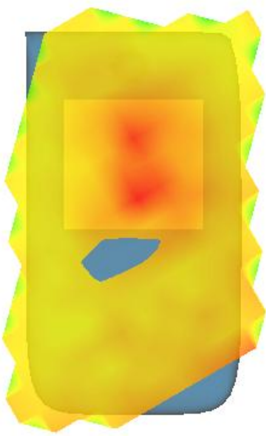
SURFACE SAR	VOLUME SAR
	

Maximum location: X=-25.00, Y=-5.00
SAR Peak: 0.38 W/kg

SAR 10g (W/Kg)	0.118395
SAR 1g (W/Kg)	0.181065

Z (mm)	0.00	2.00	4.00	6.00	8.00	10.00	12.00	14.00	16.00	18.00	20.00	22.00
SAR (W/Kg)	0.2622	0.1931	0.1363	0.1224	0.0963	0.0916	0.0874	0.0858	0.0818	0.0837	0.0811	0.0838



3D screen shot	Hot spot position
	

MEASUREMENT 13

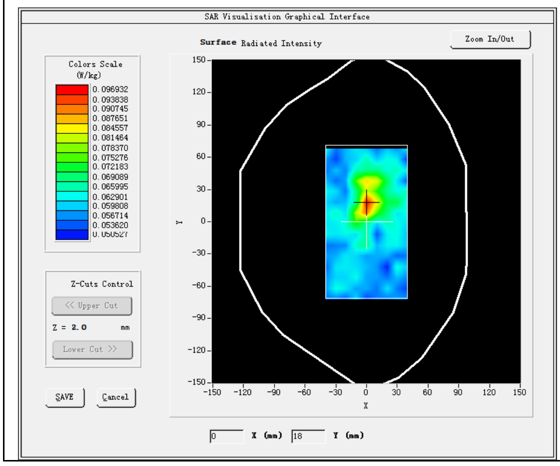
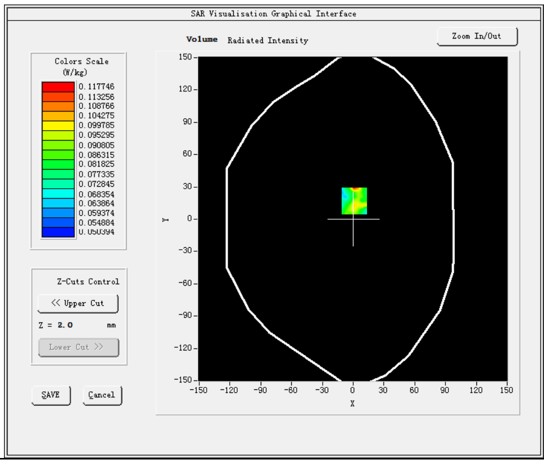
Date of measurement: 26/3/2024

A. Experimental conditions.

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

B. SAR Measurement Results

Frequency (MHz)	5240.000000
Relative permittivity (real part)	34.471382
Relative permittivity (imaginary part)	15.619897
Conductivity (S/m)	4.547126
Variation (%)	1.970000

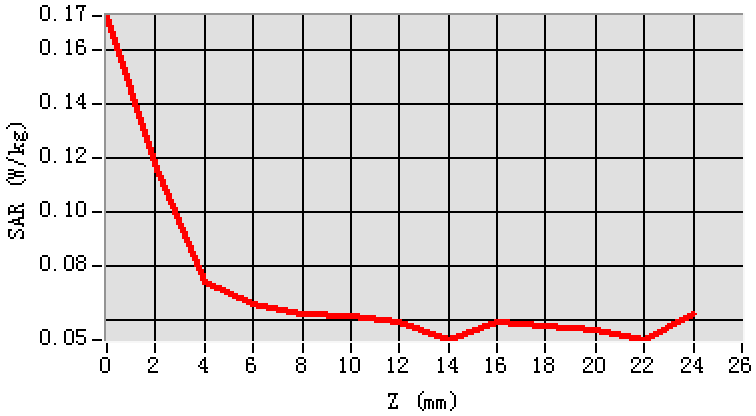
SURFACE SAR	VOLUME SAR
	

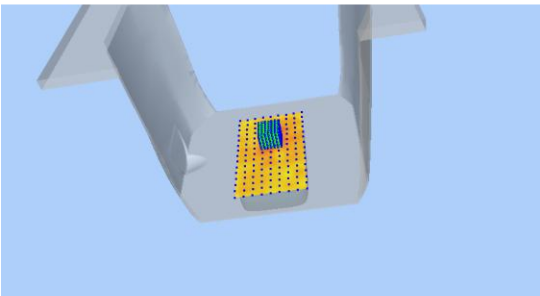
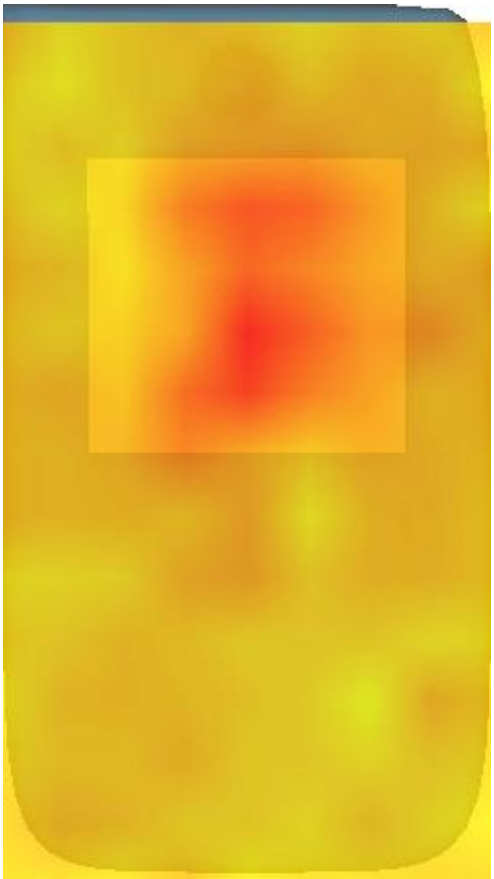
Maximum location: X=1.00, Y=17.00

SAR Peak: 0.18 W/kg

SAR 10g (W/Kg)	0.066775
SAR 1g (W/Kg)	0.082120

Z (mm)	0.00	2.00	4.00	6.00	8.00	10.00	12.00	14.00	16.00	18.00	20.00	22.00
SAR (W/Kg)	0.1727	0.1177	0.0735	0.0657	0.0615	0.0610	0.0587	0.0522	0.0592	0.0572	0.0558	0.0525



3D screen shot	Hot spot position
	

MEASUREMENT 14

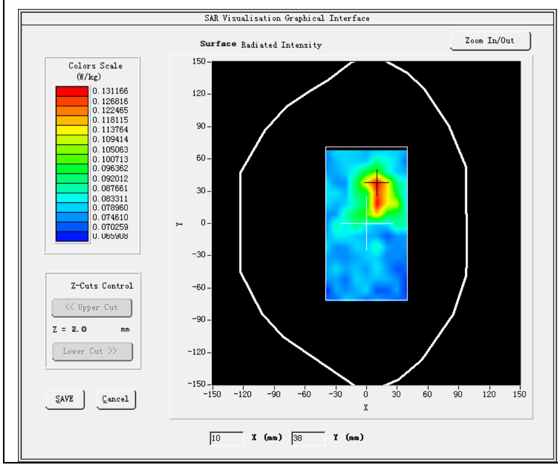
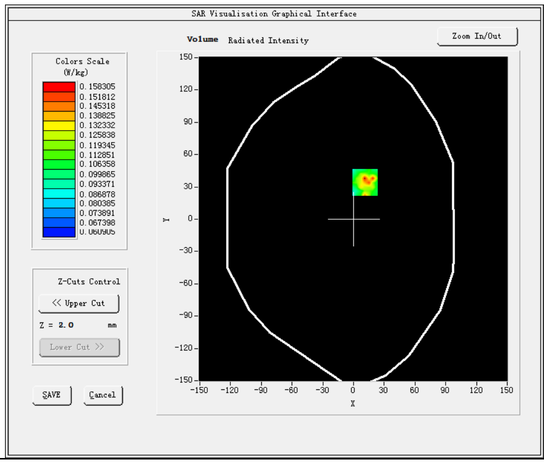
Date of measurement: 27/3/2024

A. Experimental conditions.

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

B. SAR Measurement Results

Frequency (MHz)	5785.000000
Relative permittivity (real part)	34.133007
Relative permittivity (imaginary part)	16.008299
Conductivity (S/m)	5.144889
Variation (%)	-4.680000

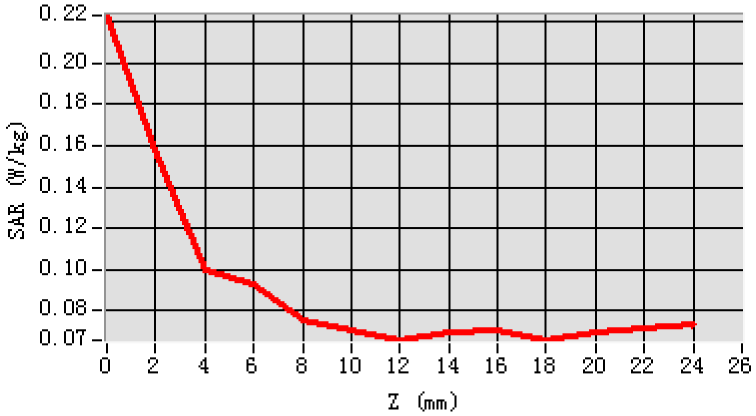
SURFACE SAR	VOLUME SAR
	

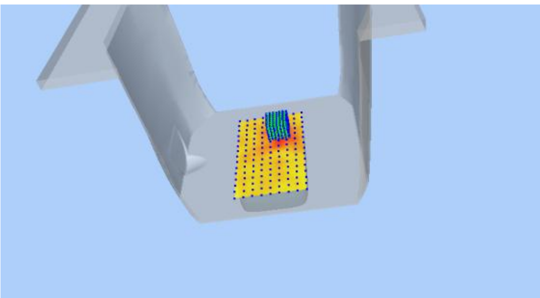
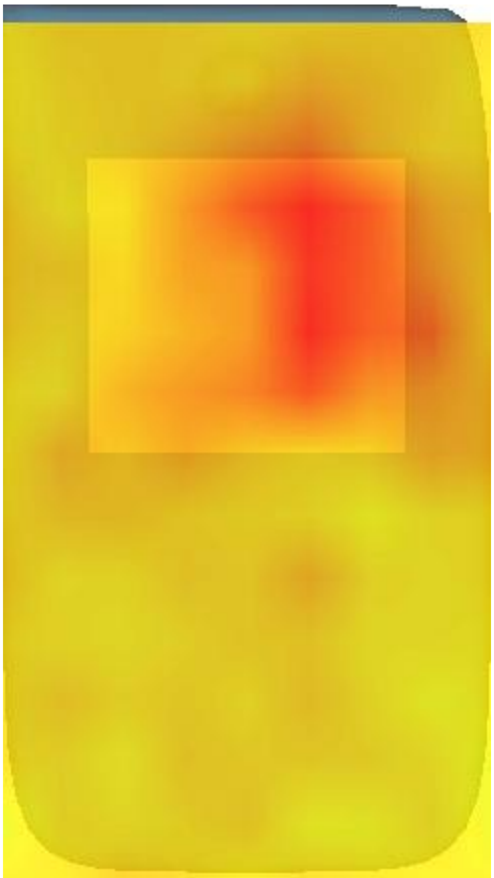
Maximum location: X=11.00, Y=34.00

SAR Peak: 0.25 W/kg

SAR 10g (W/Kg)	0.084915
SAR 1g (W/Kg)	0.108536

Z (mm)	0.00	2.00	4.00	6.00	8.00	10.00	12.00	14.00	16.00	18.00	20.00	22.00
SAR (W/Kg)	0.2232	0.1583	0.0997	0.0934	0.0758	0.0710	0.0658	0.0701	0.0708	0.0662	0.0700	0.0719



3D screen shot	Hot spot position
	

MEASUREMENT 15

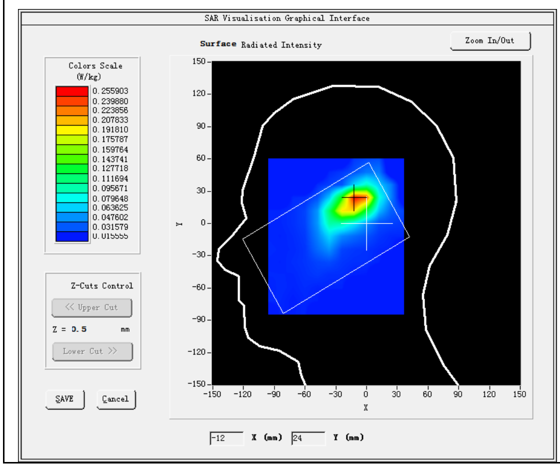
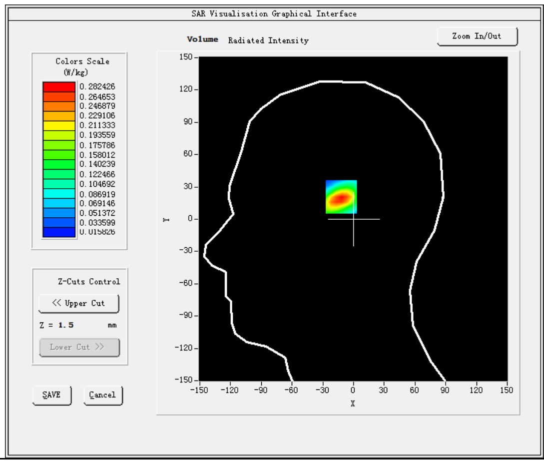
Date of measurement: 24/3/2024

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	IEEE802.11b (Crest factor: 1.0)
ConvF	2.85

B. SAR Measurement Results

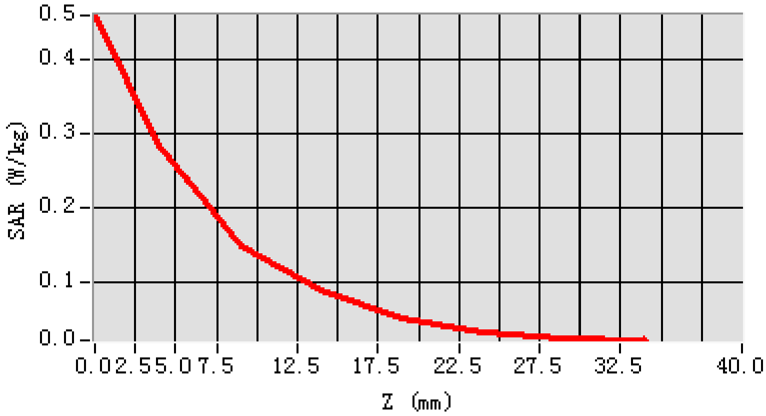
Frequency (MHz)	2437.000000
Relative permittivity (real part)	37.626736
Relative permittivity (imaginary part)	12.841736
Conductivity (S/m)	1.738628
Variation (%)	-4.220000

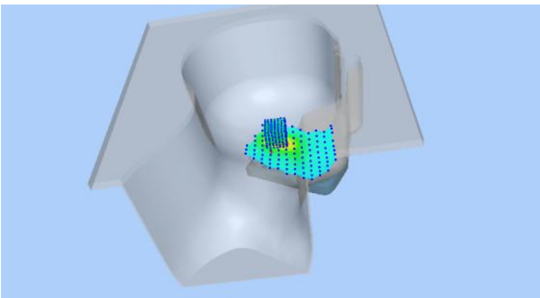
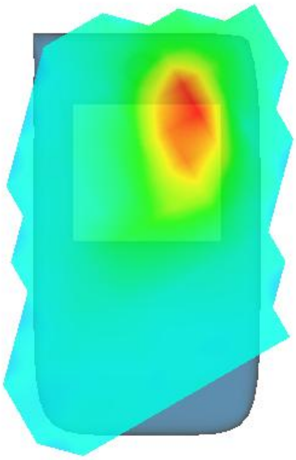
SURFACE SAR	VOLUME SAR
	

Maximum location: X=-10.00, Y=22.00
SAR Peak: 0.47 W/kg

SAR 10g (W/Kg)	0.128570
SAR 1g (W/Kg)	0.259809

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	0.4590	0.2824	0.1487	0.0885	0.0499	0.0308	0.0234



3D screen shot	Hot spot position
	

MEASUREMENT 16

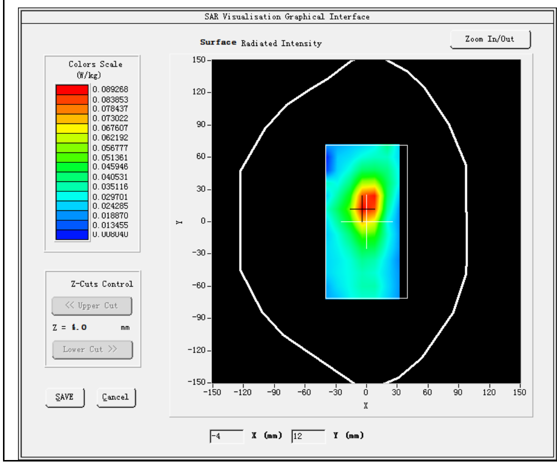
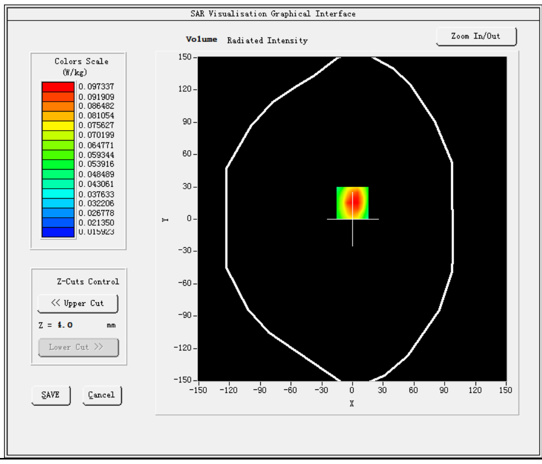
Date of measurement: 24/3/2024

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	IEEE802.11b (Crest factor: 1.0)
ConvF	2.85

B. SAR Measurement Results

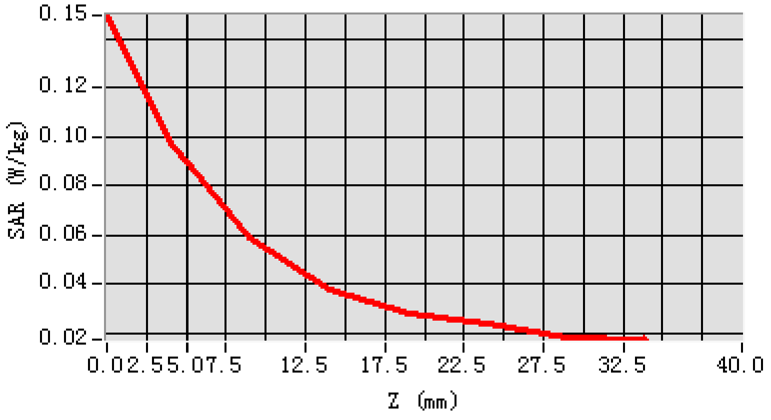
Frequency (MHz)	2437.000000
Relative permittivity (real part)	37.626736
Relative permittivity (imaginary part)	12.841736
Conductivity (S/m)	1.738628
Variation (%)	1.230000

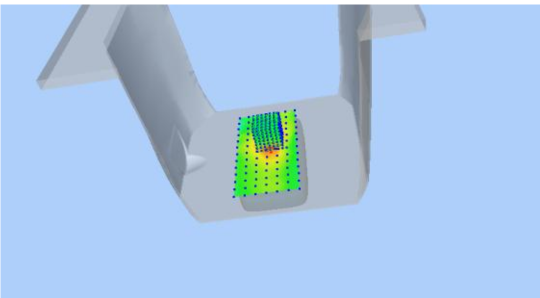
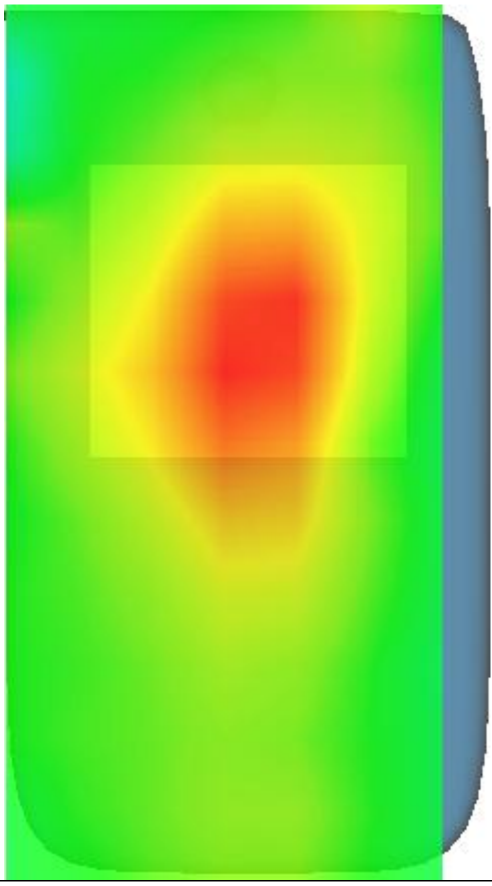
SURFACE SAR	VOLUME SAR
	

Maximum location: X=0.00, Y=15.00
SAR Peak: 0.15 W/kg

SAR 10g (W/Kg)	0.055649
SAR 1g (W/Kg)	0.093895

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	0.1495	0.0973	0.0591	0.0381	0.0276	0.0237	0.0178



3D screen shot	Hot spot position
	

MEASUREMENT 17

Date of measurement: 22/3/2024

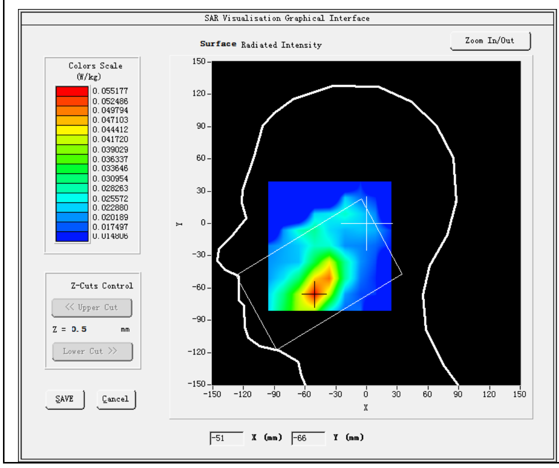
A. Experimental conditions.

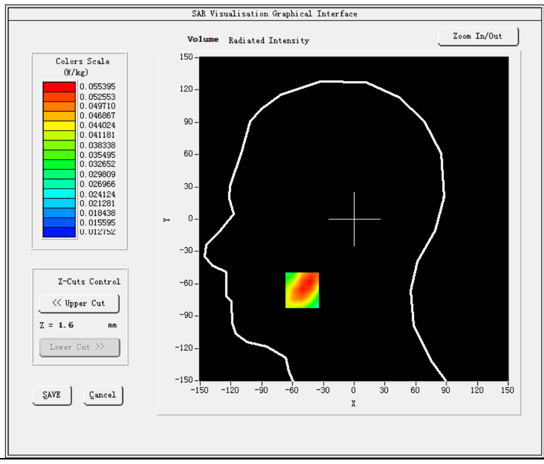
Area Scan	dx=15mm dy=15mm, h= 5.00 mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm
Phantom	Left head
Device Position	Cheek
Band	LTE band 2
Channels	Middle
Signal	LTE (Crest factor: 1.0)
ConvF	2.63

B. SAR Measurement Results

Frequency (MHz)	1880.000000
Relative permittivity (real part)	38.828300
Relative permittivity (imaginary part)	13.629750
Conductivity (S/m)	1.423552
Variation (%)	-2.850000

SURFACE SAR | **VOLUME SAR**



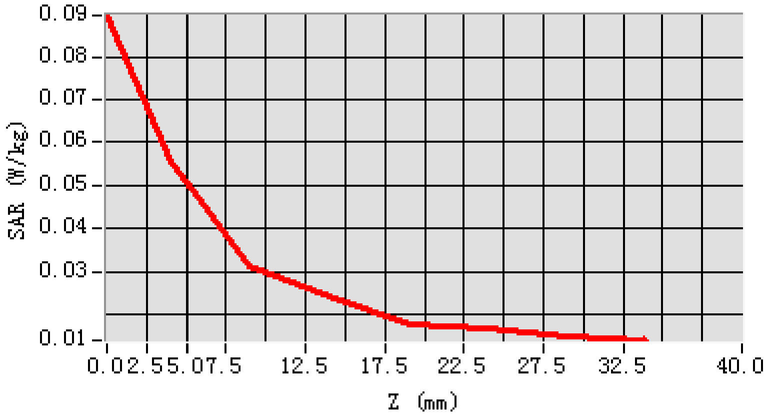


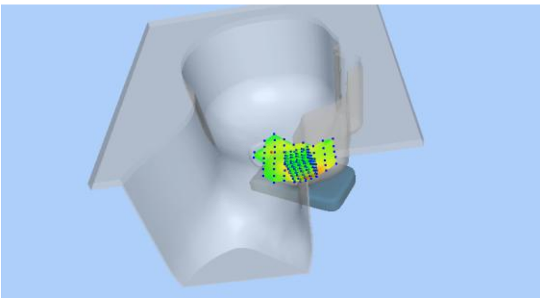
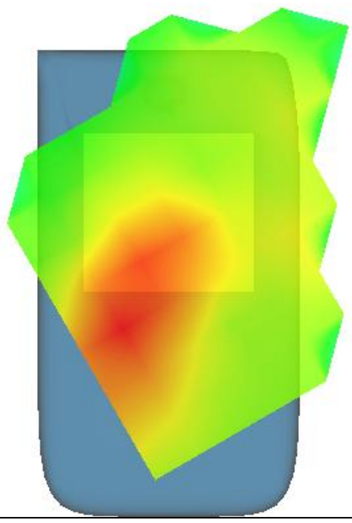
Maximum location: X=-51.00, Y=-66.00

SAR Peak: 0.08 W/kg

SAR 10g (W/Kg)	0.034655
SAR 1g (W/Kg)	0.053950

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	0.0897	0.0554	0.0314	0.0240	0.0175	0.0167	0.0146



3D screen shot	Hot spot position
	

MEASUREMENT 18

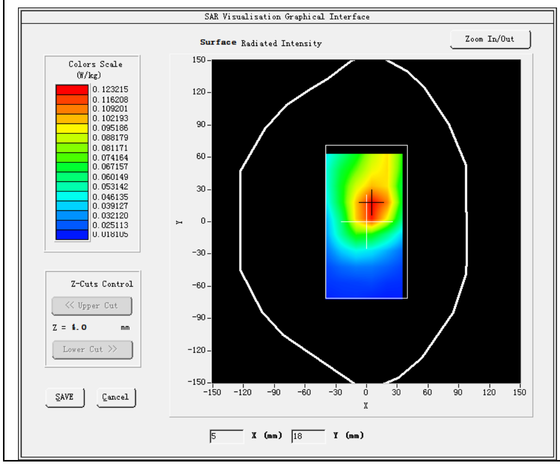
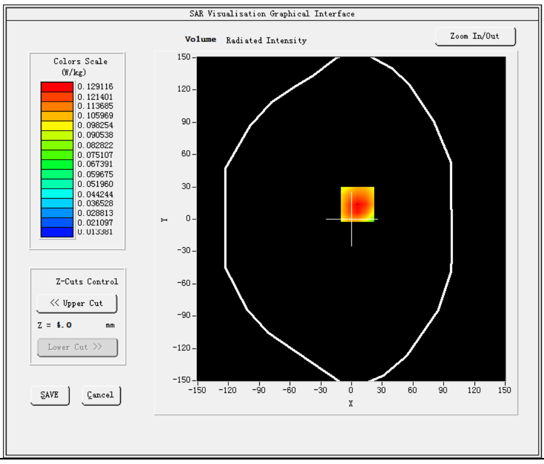
Date of measurement: 22/3/2024

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	LTE band 2
Channels	Middle
Signal	LTE (Crest factor: 1.0)
ConvF	2.63

B. SAR Measurement Results

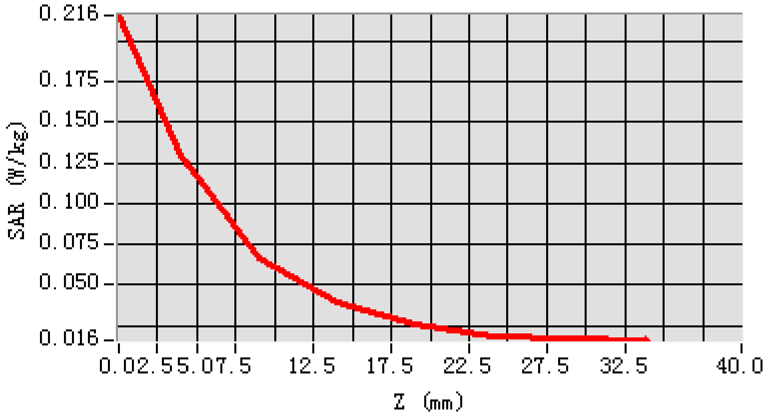
Frequency (MHz)	1880.000000
Relative permittivity (real part)	38.828300
Relative permittivity (imaginary part)	13.629750
Conductivity (S/m)	1.423552
Variation (%)	-1.420000

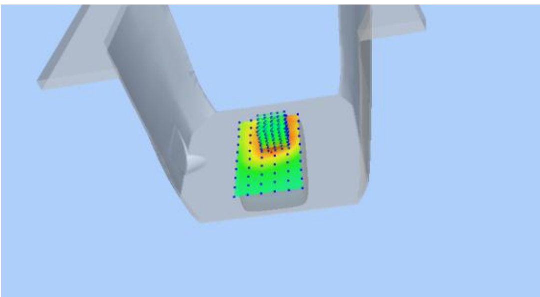
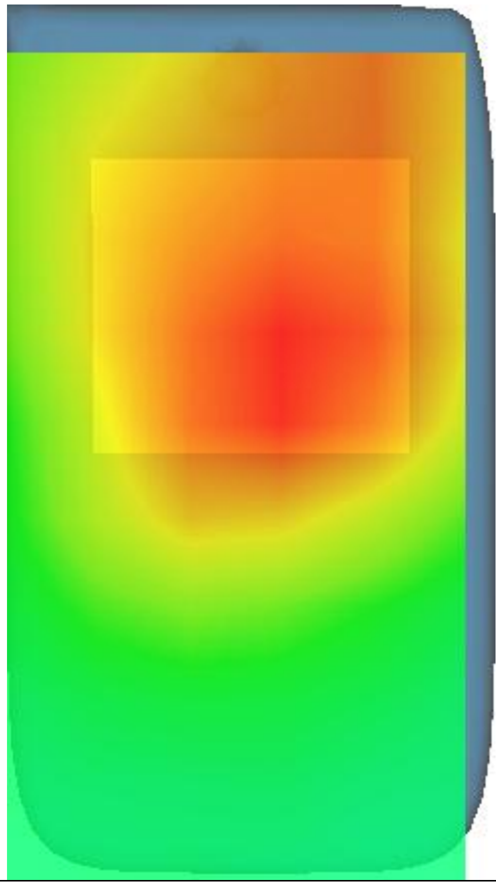
SURFACE SAR	VOLUME SAR
	

Maximum location: X=6.00, Y=14.00
SAR Peak: 0.22 W/kg

SAR 10g (W/Kg)	0.072369
SAR 1g (W/Kg)	0.129624

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	0.2156	0.1291	0.0672	0.0394	0.0263	0.0191	0.0167



3D screen shot	Hot spot position
	

MEASUREMENT 19

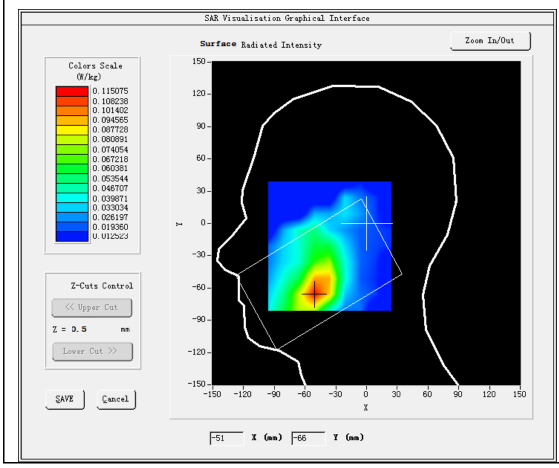
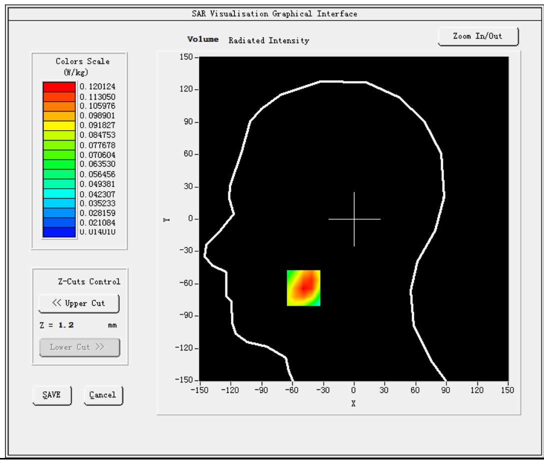
Date of measurement: 21/3/2024

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	LTE band 4
Channels	Middle
Signal	LTE (Crest factor: 1.0)
ConvF	2.45

B. SAR Measurement Results

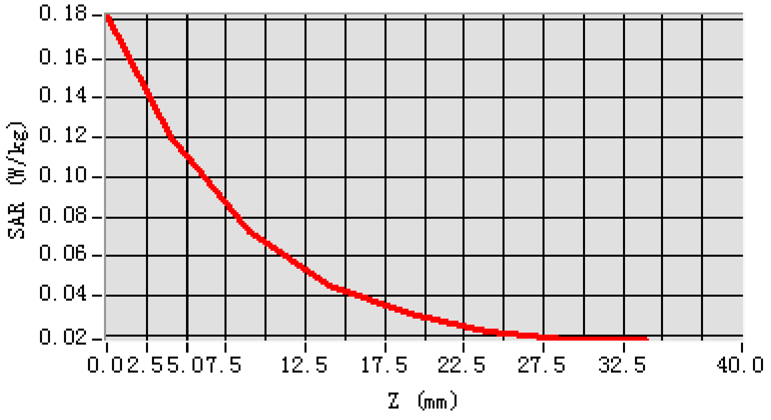
Frequency (MHz)	1732.500000
Relative permittivity (real part)	39.516483
Relative permittivity (imaginary part)	13.738655
Conductivity (S/m)	1.322346
Variation (%)	1.110000

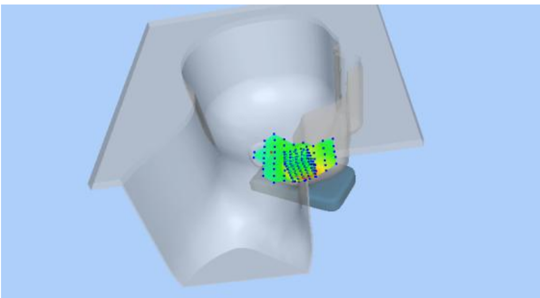
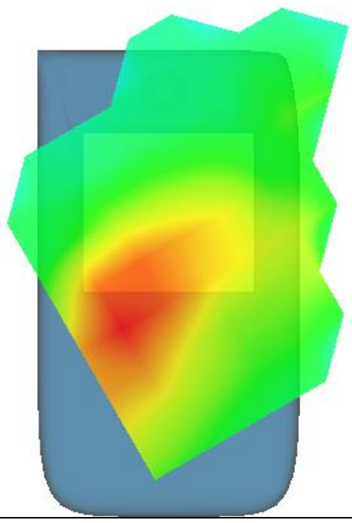
SURFACE SAR	VOLUME SAR
	

Maximum location: X=-49.00, Y=-64.00
SAR Peak: 0.19 W/kg

SAR 10g (W/Kg)	0.067936
SAR 1g (W/Kg)	0.117240

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	0.1818	0.1201	0.0721	0.0454	0.0306	0.0218	0.0177



3D screen shot	Hot spot position
	

MEASUREMENT 20

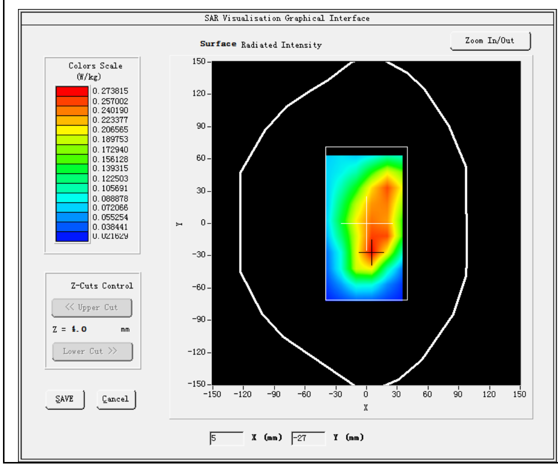
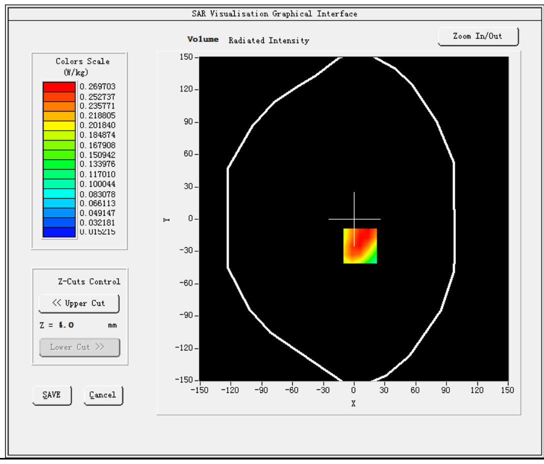
Date of measurement: 21/3/2024

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	LTE band 4
Channels	Middle
Signal	LTE (Crest factor: 1.0)
ConvF	2.45

B. SAR Measurement Results

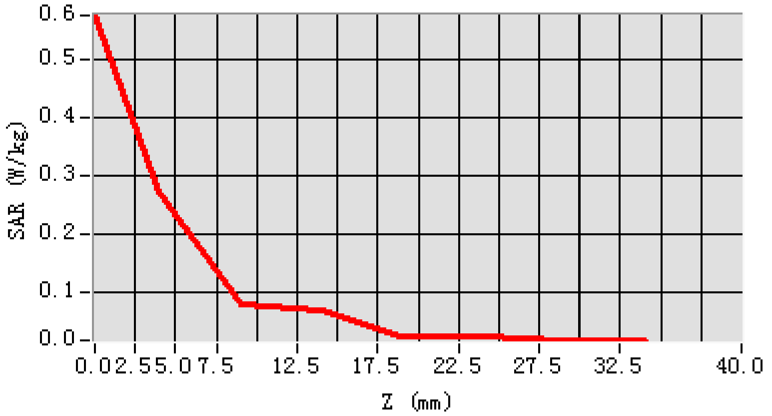
Frequency (MHz)	1732.500000
Relative permittivity (real part)	39.516483
Relative permittivity (imaginary part)	13.738655
Conductivity (S/m)	1.322346
Variation (%)	4.130000

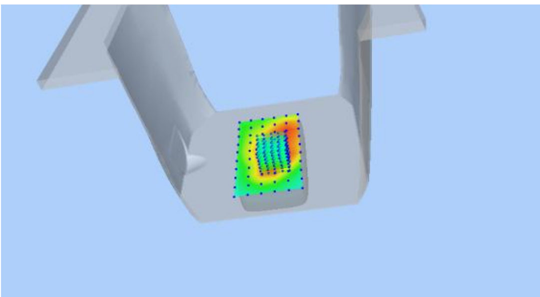
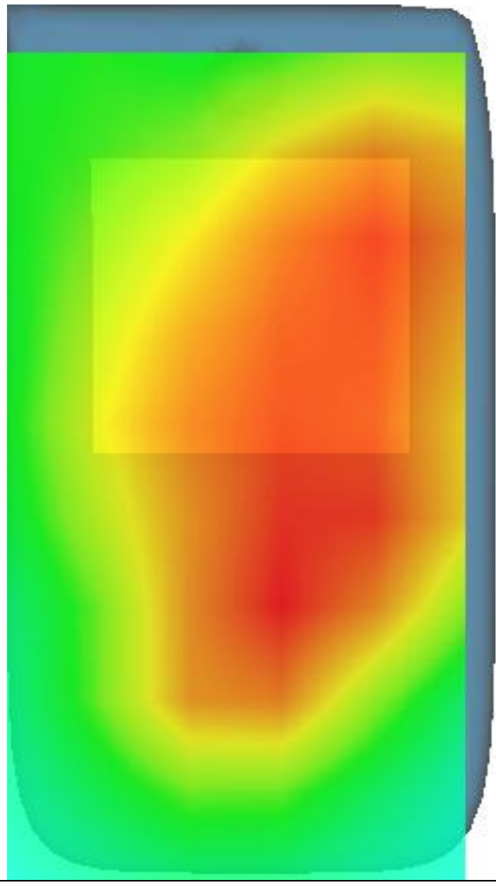
SURFACE SAR	VOLUME SAR
	

Maximum location: X=6.00, Y=-25.00
SAR Peak: 0.46 W/kg

SAR 10g (W/Kg)	0.141355
SAR 1g (W/Kg)	0.264356

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	0.5742	0.2697	0.0788	0.0696	0.0245	0.0242	0.0167



3D screen shot	Hot spot position
	

MEASUREMENT 21

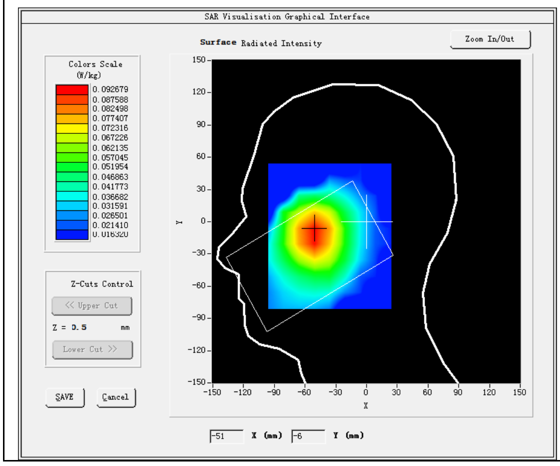
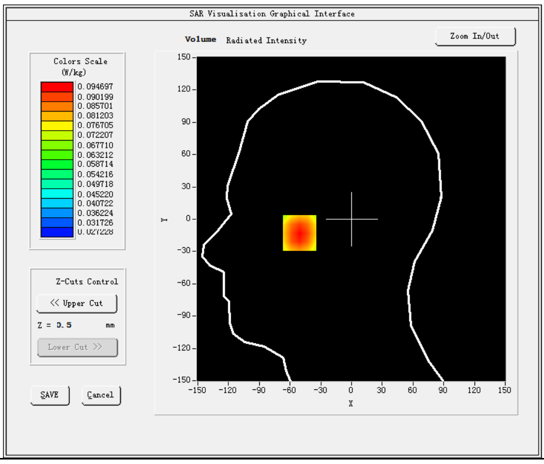
Date of measurement: 8/4/2024

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	LTE band 5
Channels	Middle
Signal	LTE (Crest factor: 1.0)
ConvF	2.32

B. SAR Measurement Results

Frequency (MHz)	836.500000
Relative permittivity (real part)	41.009068
Relative permittivity (imaginary part)	19.084080
Conductivity (S/m)	0.886880
Variation (%)	-0.700000

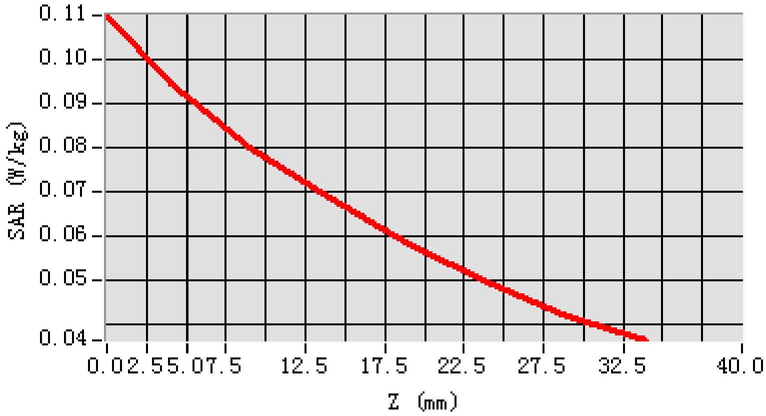
SURFACE SAR	VOLUME SAR
	

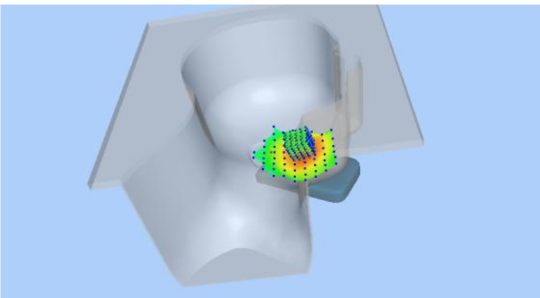
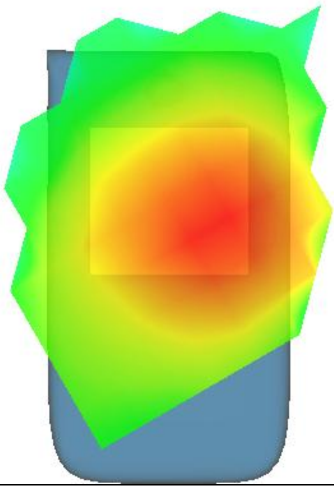
Maximum location: X=-51.00, Y=-11.00

SAR Peak: 0.11 W/kg

SAR 10g (W/Kg)	0.074043
SAR 1g (W/Kg)	0.092620

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	0.1100	0.0947	0.0798	0.0686	0.0580	0.0495	0.0417



3D screen shot	Hot spot position
	

MEASUREMENT 22

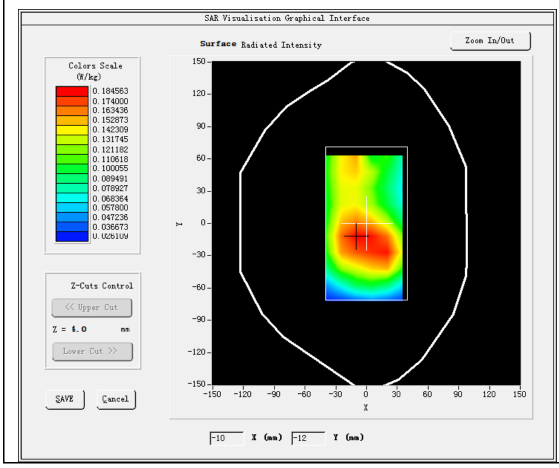
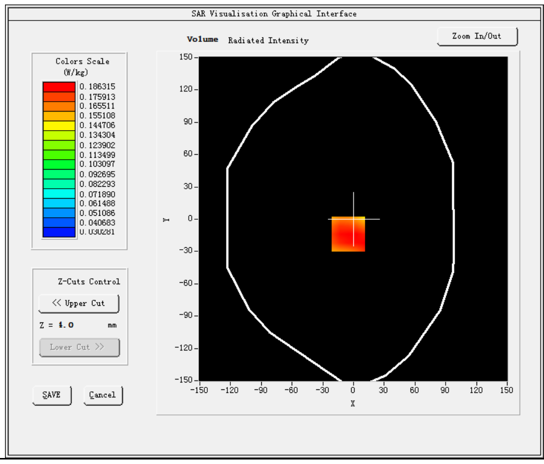
Date of measurement: 8/4/2024

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	LTE band 5
Channels	Middle
Signal	LTE (Crest factor: 1.0)
ConvF	2.32

B. SAR Measurement Results

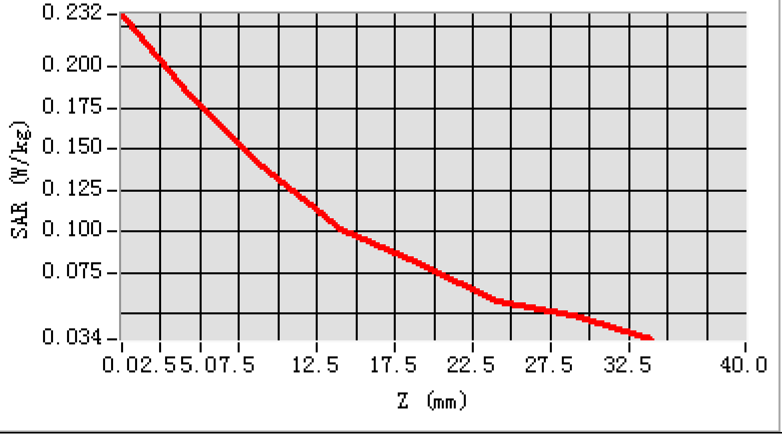
Frequency (MHz)	836.500000
Relative permittivity (real part)	41.009068
Relative permittivity (imaginary part)	19.084080
Conductivity (S/m)	0.886880
Variation (%)	0.460000

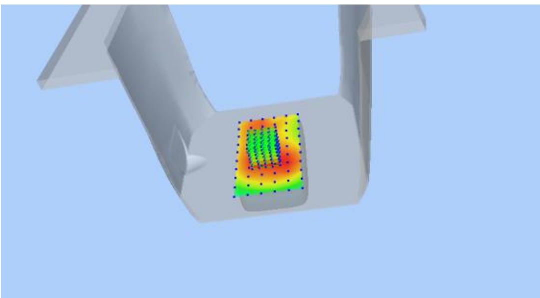
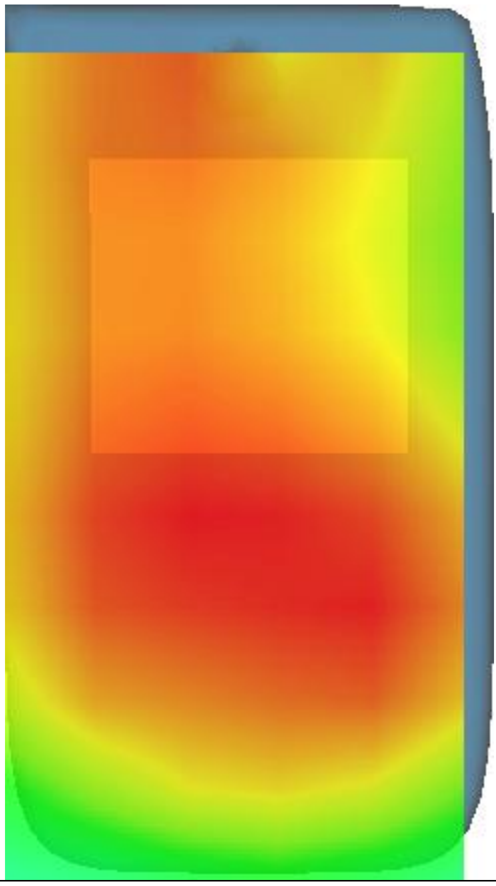
SURFACE SAR	VOLUME SAR
	

Maximum location: X=-5.00, Y=-14.00
SAR Peak: 0.32 W/kg

SAR 10g (W/Kg)	0.132789
SAR 1g (W/Kg)	0.192171

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	0.2320	0.1863	0.1396	0.1018	0.0804	0.0571	0.0483



3D screen shot	Hot spot position
	

MEASUREMENT 23

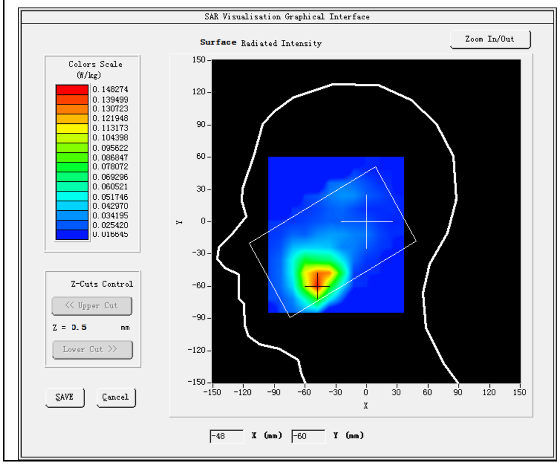
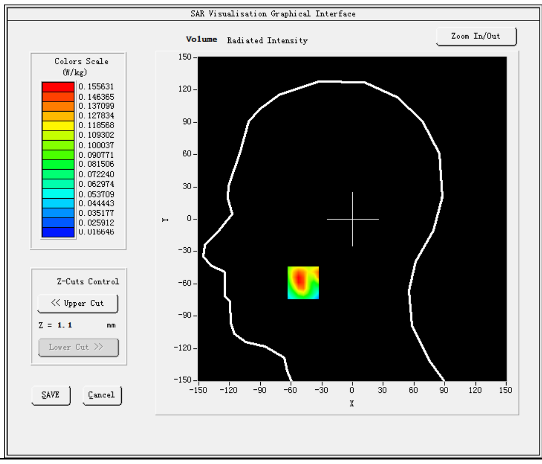
Date of measurement: 25/3/2024

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	LTE band 7
Channels	Middle
Signal	LTE (Crest factor: 1.0)
ConvF	2.65

B. SAR Measurement Results

Frequency (MHz)	2535.000000
Relative permittivity (real part)	38.969021
Relative permittivity (imaginary part)	13.309774
Conductivity (S/m)	1.874459
Variation (%)	3.630000

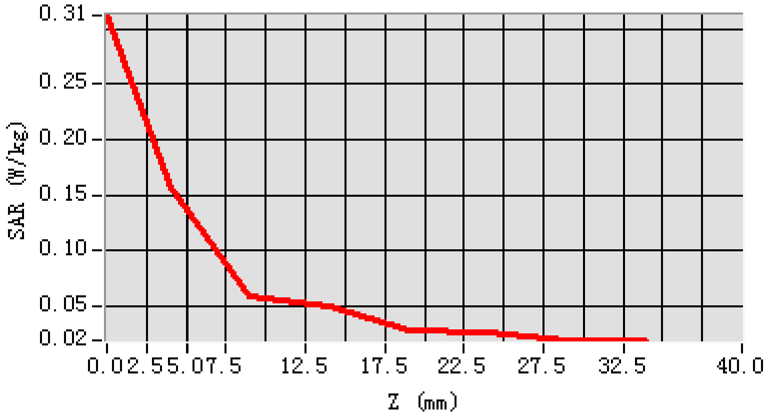
SURFACE SAR	VOLUME SAR
	

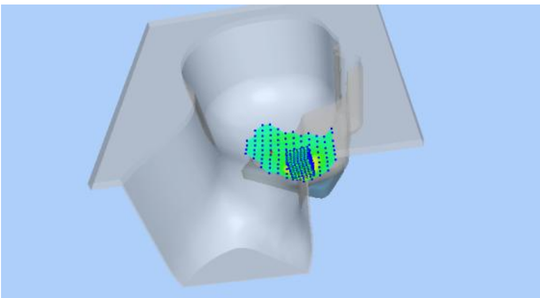
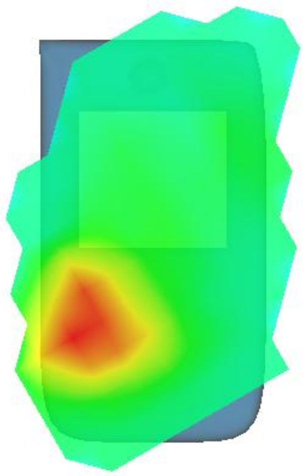
Maximum location: X=-48.00, Y=-59.00

SAR Peak: 0.26 W/kg

SAR 10g (W/Kg)	0.077639
SAR 1g (W/Kg)	0.146986

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	0.3120	0.1556	0.0588	0.0492	0.0278	0.0262	0.0194



3D screen shot	Hot spot position
	

MEASUREMENT 24

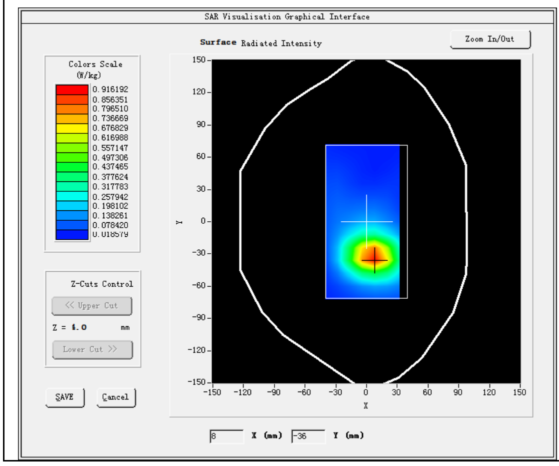
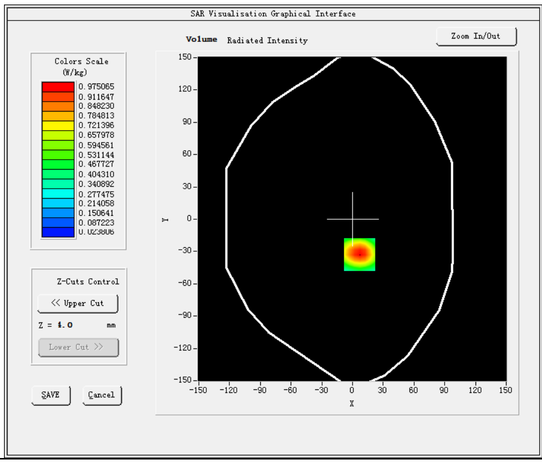
Date of measurement: 25/3/2024

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	LTE band 7
Channels	Low
Signal	LTE (Crest factor: 1.0)
ConvF	2.65

B. SAR Measurement Results

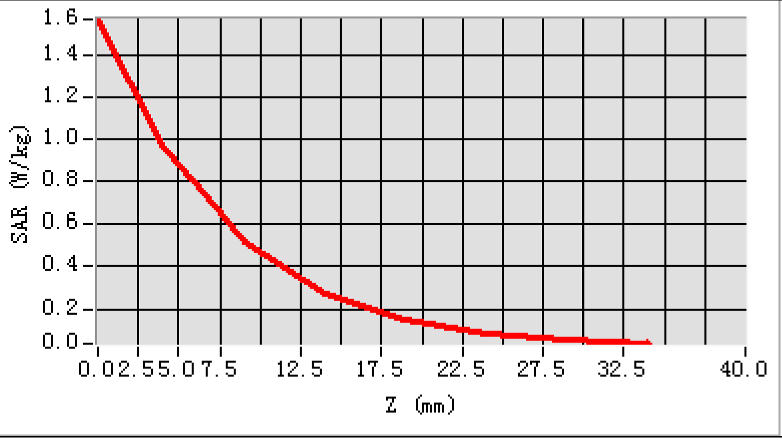
Frequency (MHz)	2510.000000
Relative permittivity (real part)	39.084122
Relative permittivity (imaginary part)	13.252474
Conductivity (S/m)	1.847984
Variation (%)	2.320000

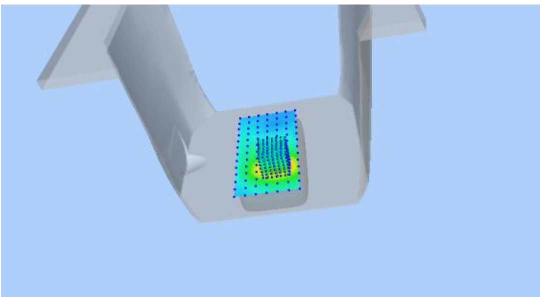
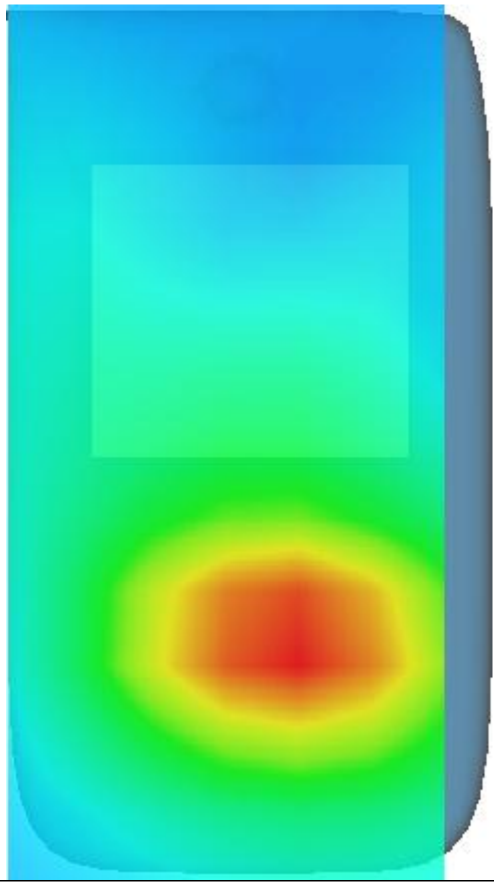
SURFACE SAR	VOLUME SAR
	

Maximum location: X=7.00, Y=-33.00
SAR Peak: 1.57 W/kg

SAR 10g (W/Kg)	0.476361
SAR 1g (W/Kg)	0.917570

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	1.5668	0.9751	0.5172	0.2738	0.1492	0.0856	0.0534



3D screen shot	Hot spot position
	

MEASUREMENT 25

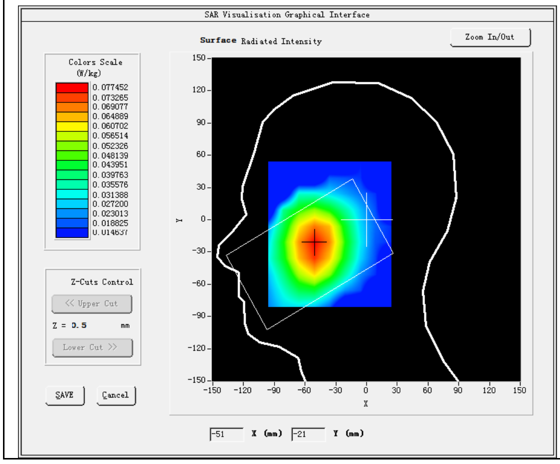
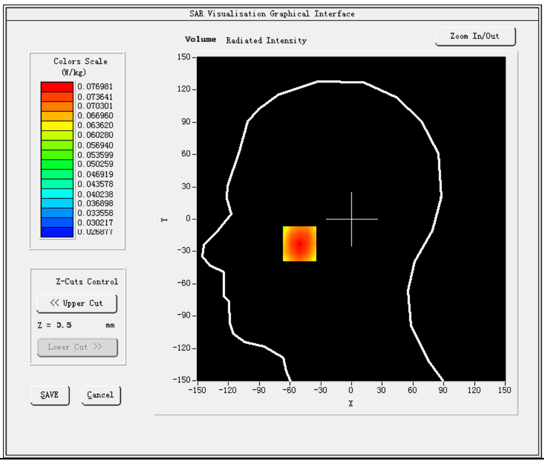
Date of measurement: 30/3/2024

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	LTE band 12
Channels	Middle
Signal	LTE (Crest factor: 1.0)
ConvF	2.37

B. SAR Measurement Results

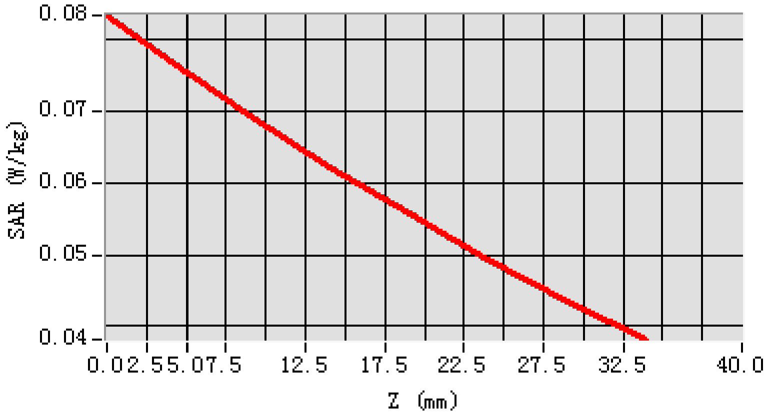
Frequency (MHz)	707.500000
Relative permittivity (real part)	41.427540
Relative permittivity (imaginary part)	21.802214
Conductivity (S/m)	0.856948
Variation (%)	0.700000

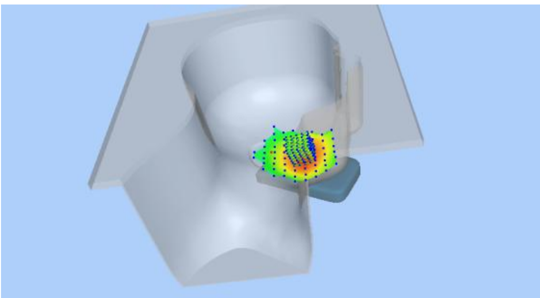
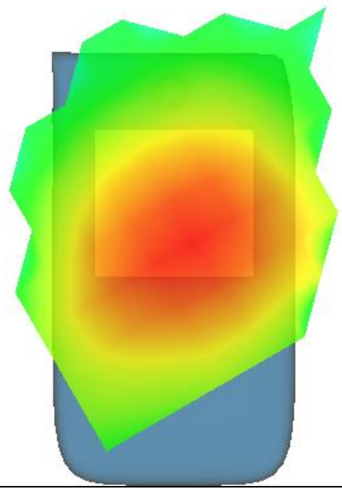
SURFACE SAR	VOLUME SAR
	

Maximum location: X=-51.00, Y=-23.00
SAR Peak: 0.08 W/kg

SAR 10g (W/Kg)	0.064403
SAR 1g (W/Kg)	0.075178

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	0.0835	0.0770	0.0696	0.0622	0.0558	0.0493	0.0433



3D screen shot	Hot spot position
	

MEASUREMENT 26

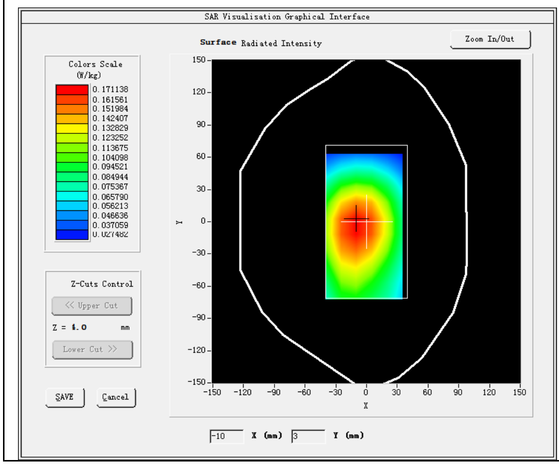
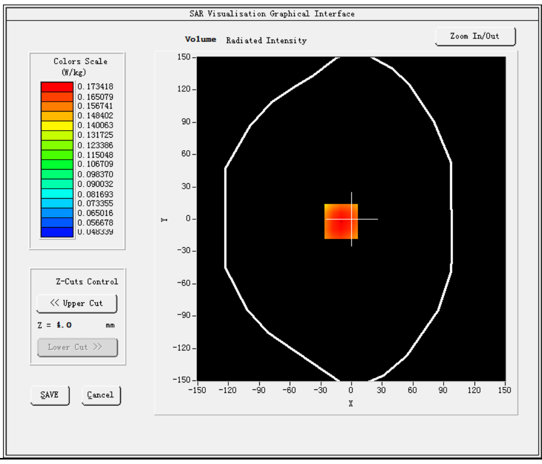
Date of measurement: 30/3/2024

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	LTE band 12
Channels	Middle
Signal	LTE (Crest factor: 1.0)
ConvF	2.37

B. SAR Measurement Results

Frequency (MHz)	707.500000
Relative permittivity (real part)	41.427540
Relative permittivity (imaginary part)	21.802214
Conductivity (S/m)	0.856948
Variation (%)	0.390000

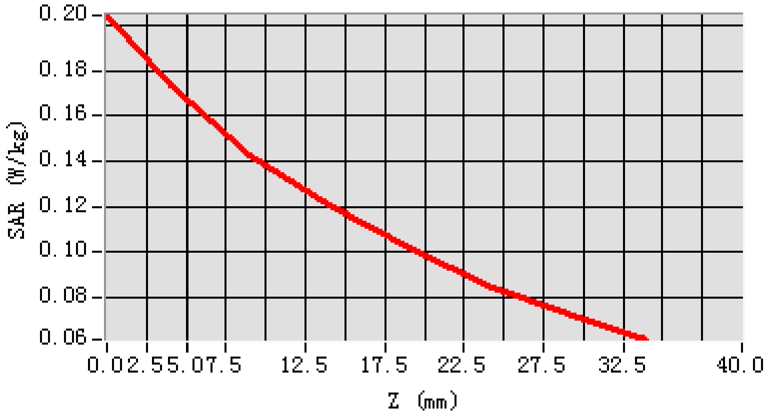
SURFACE SAR	VOLUME SAR
	

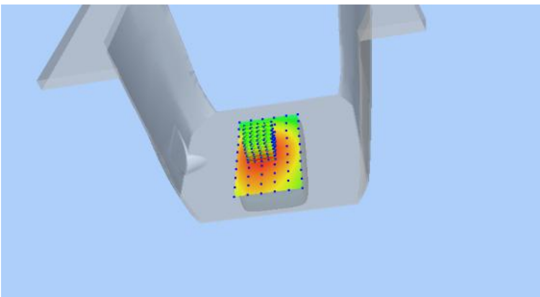
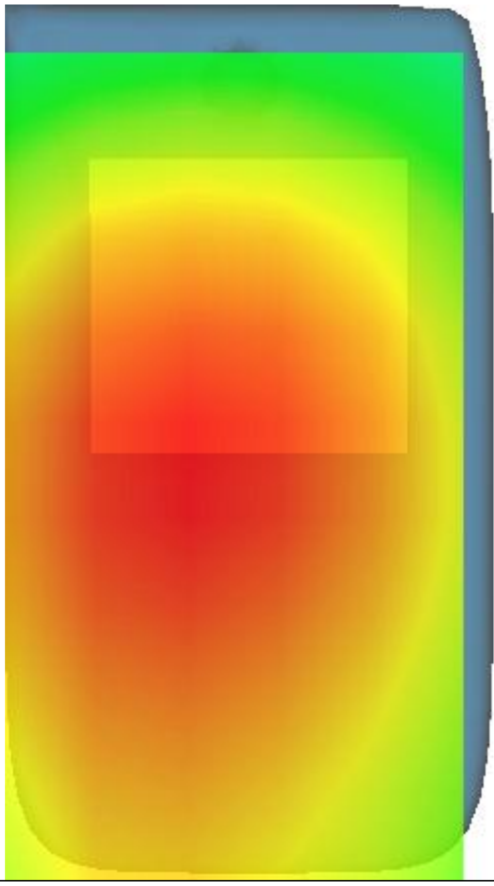
Maximum location: X=-10.00, Y=-2.00

SAR Peak: 0.20 W/kg

SAR 10g (W/Kg)	0.136497
SAR 1g (W/Kg)	0.169689

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	0.2043	0.1734	0.1428	0.1205	0.1018	0.0849	0.0732



3D screen shot	Hot spot position
	

MEASUREMENT 27

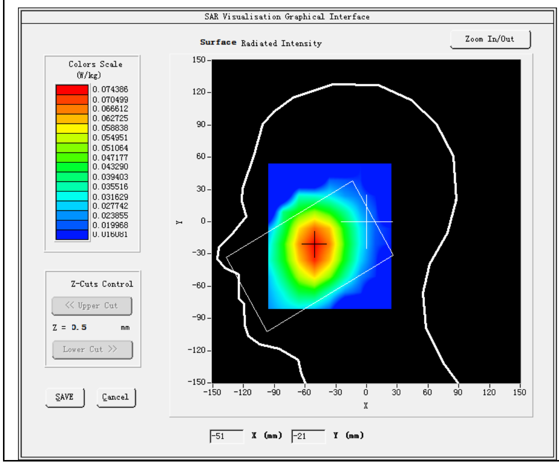
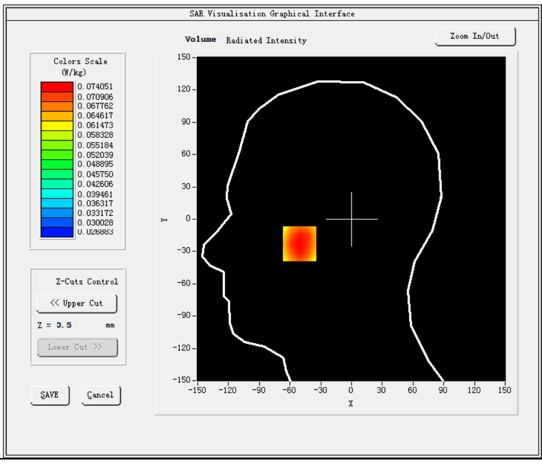
Date of measurement: 30/3/2024

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	LTE band 17
Channels	Middle
Signal	LTE (Crest factor: 1.0)
ConvF	2.37

B. SAR Measurement Results

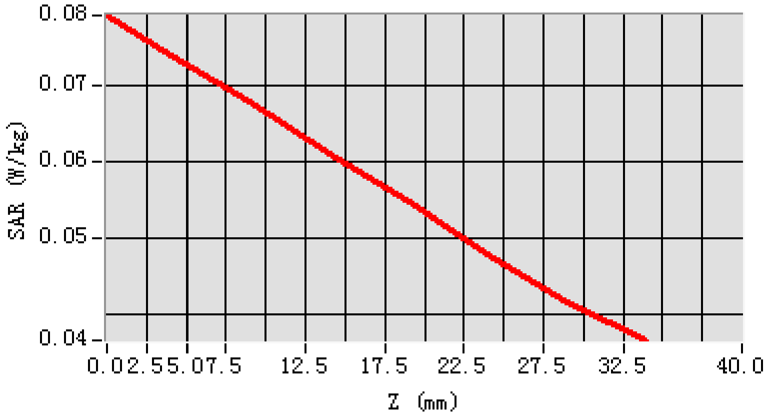
Frequency (MHz)	710.000000
Relative permittivity (real part)	41.412189
Relative permittivity (imaginary part)	21.742662
Conductivity (S/m)	0.857627
Variation (%)	-1.840000

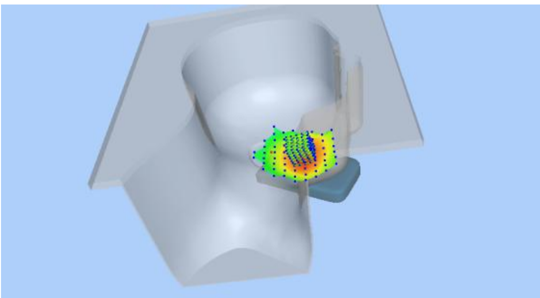
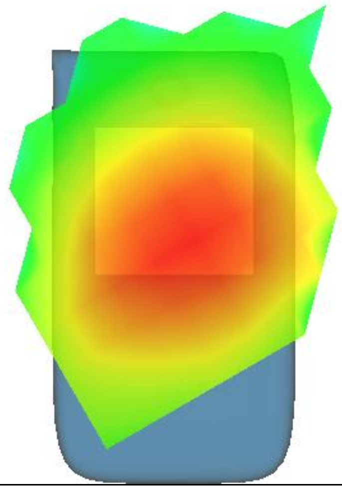
SURFACE SAR	VOLUME SAR
	

Maximum location: X=-51.00, Y=-23.00
SAR Peak: 0.09 W/kg

SAR 10g (W/Kg)	0.062376
SAR 1g (W/Kg)	0.073306

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	0.0793	0.0741	0.0679	0.0612	0.0547	0.0479	0.0414



3D screen shot	Hot spot position
	

MEASUREMENT 28

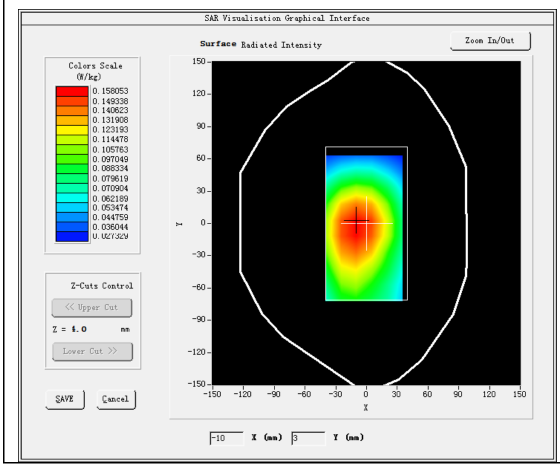
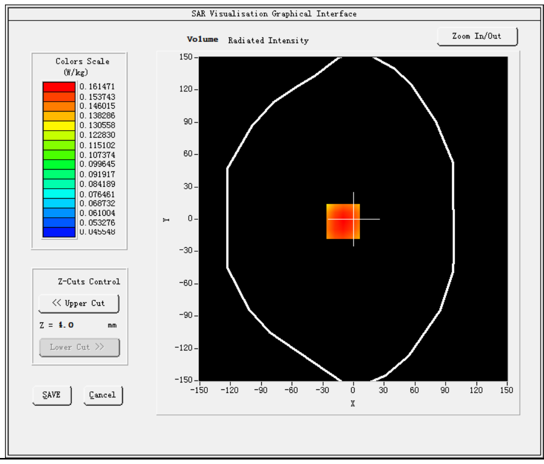
Date of measurement: 30/3/2024

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	LTE band 17
Channels	Middle
Signal	LTE (Crest factor: 1.0)
ConvF	2.37

B. SAR Measurement Results

Frequency (MHz)	710.000000
Relative permittivity (real part)	41.412189
Relative permittivity (imaginary part)	21.742662
Conductivity (S/m)	0.857627
Variation (%)	0.520000

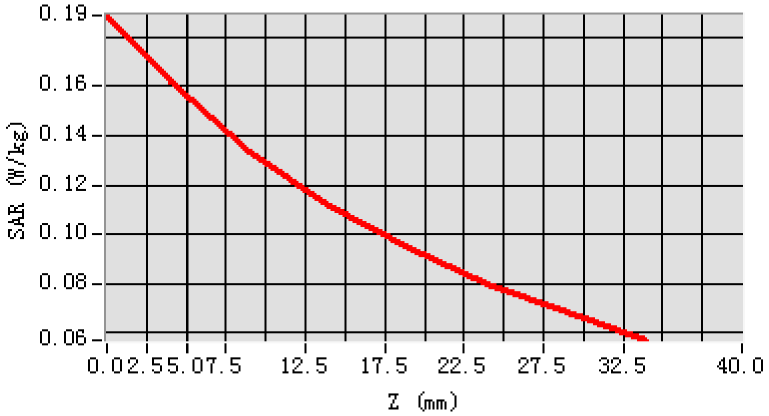
SURFACE SAR	VOLUME SAR
	

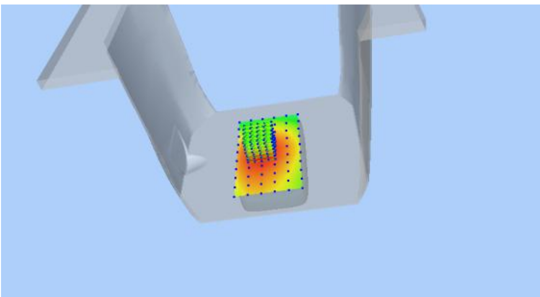
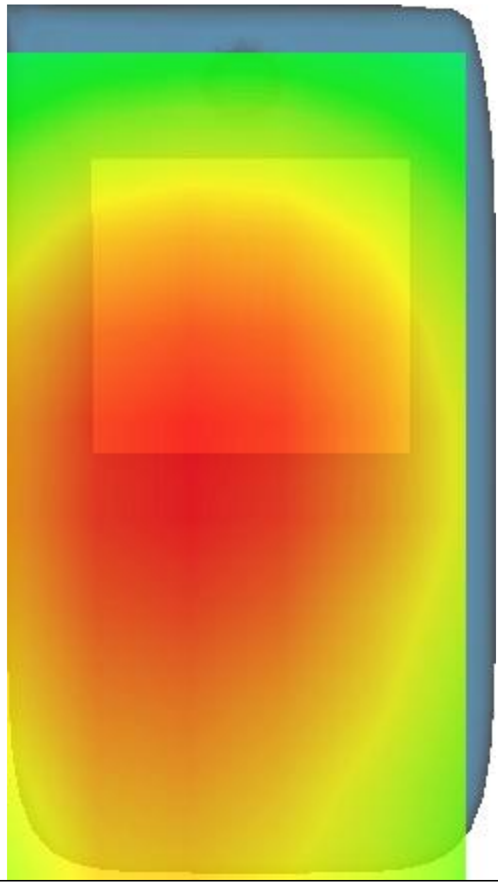
Maximum location: X=-10.00, Y=-2.00

SAR Peak: 0.19 W/kg

SAR 10g (W/Kg)	0.126332
SAR 1g (W/Kg)	0.157305

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	0.1885	0.1615	0.1335	0.1119	0.0942	0.0795	0.0682



3D screen shot	Hot spot position
	

MEASUREMENT 29

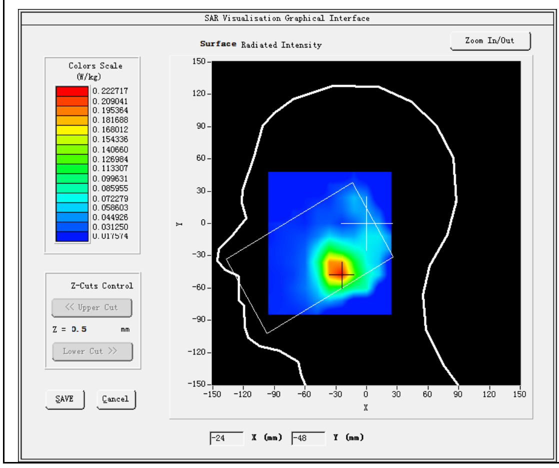
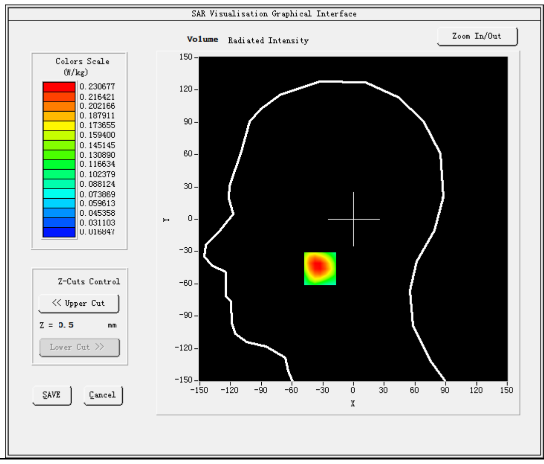
Date of measurement: 25/3/2024

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	LTE band 41
Channels	Middle
Signal	LTE (Crest factor: 1.0)
ConvF	2.65

B. SAR Measurement Results

Frequency (MHz)	2593.000000
Relative permittivity (real part)	38.687523
Relative permittivity (imaginary part)	13.473374
Conductivity (S/m)	1.940914
Variation (%)	2.150000

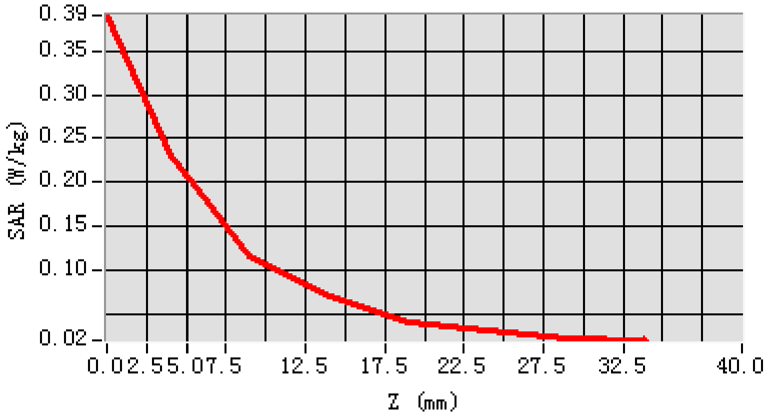
SURFACE SAR	VOLUME SAR
	

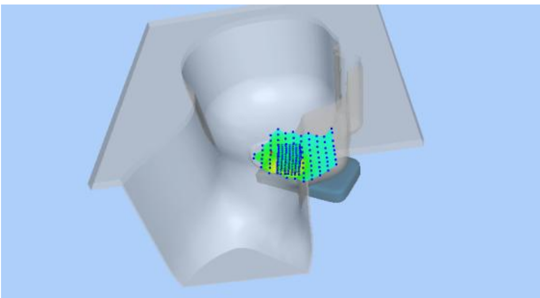
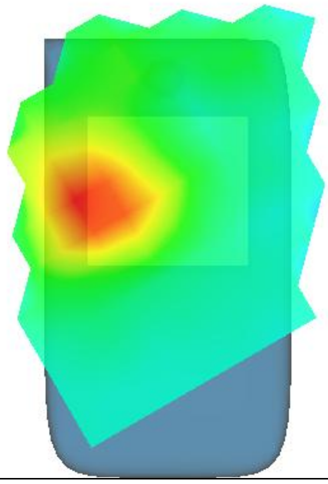
Maximum location: X=-26.00, Y=-46.00

SAR Peak: 0.38 W/kg

SAR 10g (W/Kg)	0.120052
SAR 1g (W/Kg)	0.222188

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	0.3910	0.2307	0.1149	0.0700	0.0396	0.0311	0.0229



3D screen shot	Hot spot position
	

MEASUREMENT 30

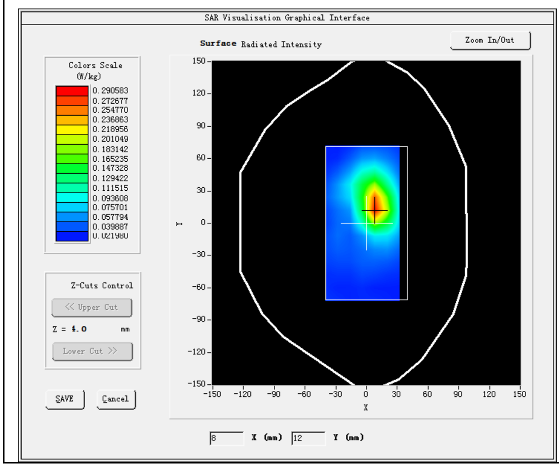
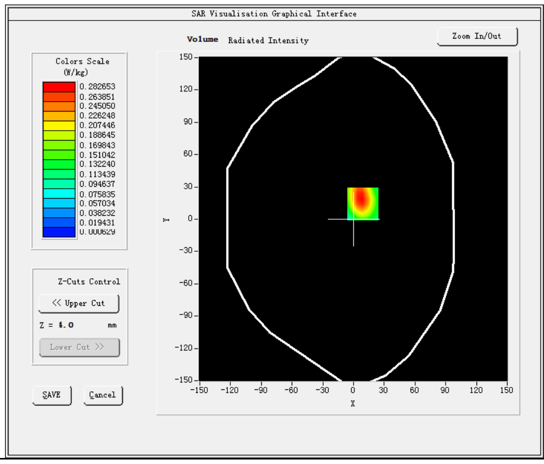
Date of measurement: 25/3/2024

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	LTE band 41
Channels	Middle
Signal	LTE (Crest factor: 1.0)
ConvF	2.65

B. SAR Measurement Results

Frequency (MHz)	2593.000000
Relative permittivity (real part)	38.687523
Relative permittivity (imaginary part)	13.473374
Conductivity (S/m)	1.940914
Variation (%)	-2.809999

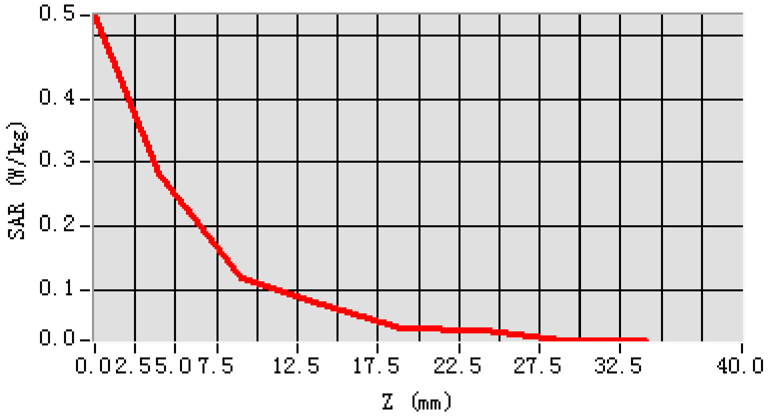
SURFACE SAR	VOLUME SAR
	

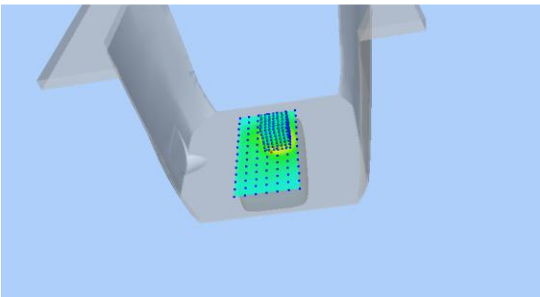
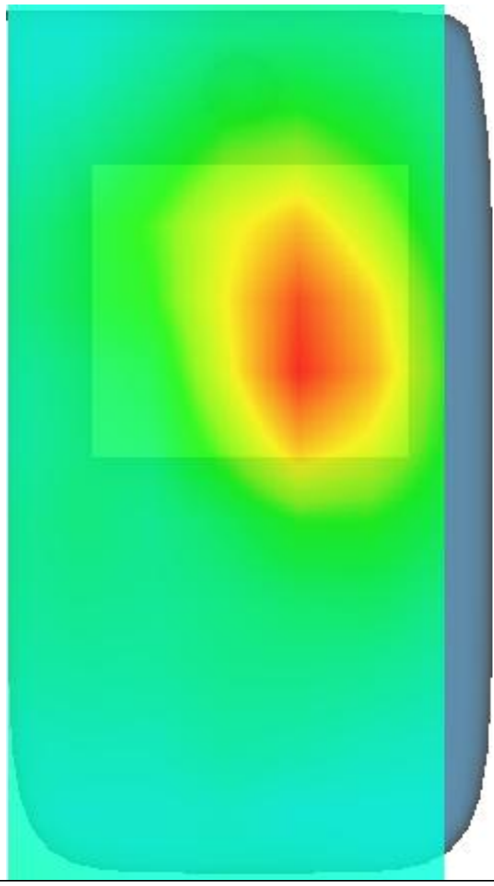
Maximum location: X=9.00, Y=14.00

SAR Peak: 0.48 W/kg

SAR 10g (W/Kg)	0.137533
SAR 1g (W/Kg)	0.267458

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	0.5321	0.2827	0.1176	0.0781	0.0372	0.0356	0.0206



3D screen shot	Hot spot position
	

14. Appendix D. Calibration Certificate

Table of contents
E Field Probe - 3423-EPGO-426
750 MHz Dipole - SN 03/15 DIP 0G750-355
835 MHz Dipole - SN 03/15 DIP 0G835-347
1800 MHz Dipole - SN 03/15 DIP 1G800-349
1900 MHz Dipole - SN 03/15 DIP 1G900-350
2450 MHz Dipole - SN 03/15 DIP 2G450-352
2600 MHz Dipole - SN 03/15 DIP 2G600-356
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

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).

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

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

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

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

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1 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR DOSIMETRIC E FIELD PROBE
Manufacturer	MVG
Model	SSE2
Serial Number	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.

3.2 LINEARITY

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

3.3 ISOTROPY

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

3.4 BOUNDARY EFFECT

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

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

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

where

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

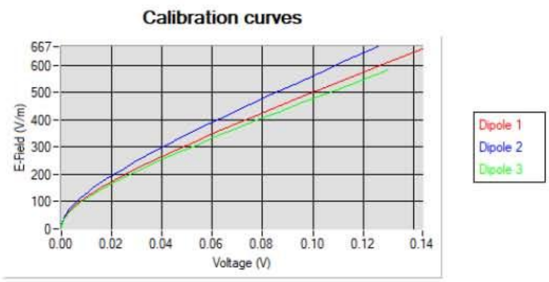
The estimated expanded uncertainty (k=2) in calibration for SAR (W/kg) is +/-11% for the frequency range 150-450MHz.
The estimated expanded uncertainty (k=2) in calibration for SAR (W/kg) is +/-14% for the frequency range 600-7500MHz.

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
Vi=voltage readings on the 3 channels of the probe
DCPi=diode compression point given below for the 3 channels of the probe
Normi=dipole sensitivity given below for the 3 channels of the probe

Normx dipole 1 (µV/(V/m)^2)	Normy dipole 2 (µV/(V/m)^2)	Normz dipole 3 (µV/(V/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.

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

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

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

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:

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

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:

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

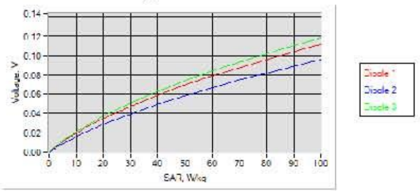
where
a=the larger cross-sectional of the waveguide
b=the smaller cross-sectional of the waveguide
δ=the skin depth for the liquid in the waveguide
Pw=the power delivered to the liquid

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.

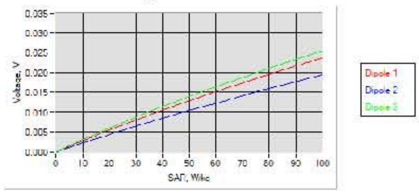
Liquid	Frequency (MHz*)	ConvF
HL750	750	2.37
HL850	835	2.32
HL900	900	2.23
HL1800	1800	2.45
HL1900	1900	2.63
HL2000	2000	2.83
HL2300	2300	2.81
HL2450	2450	2.85
HL2600	2600	2.65
HL3300	3300	2.21
HL3500	3500	2.20
HL3700	3700	2.11
HL3900	3900	2.40
HL4200	4200	2.40
HL4600	4600	2.33
HL4900	4900	2.37
HL5200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

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

SAR @ HL750

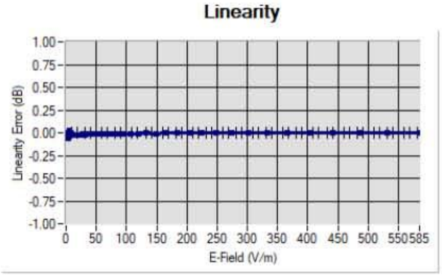


SAR @ HL5800



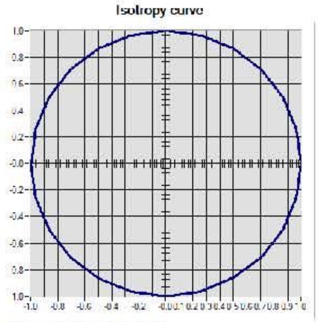
6 VERIFICATION RESULTS

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:+/-1.42% (+/-0.06dB)

Isotropy curve



Isotropy:+/-0.21% (+/-0.01dB)

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.

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.53.23.24.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: 750 MHZ
SERIAL NO.: SN 03/15DIP0G750-355

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

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.

	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

Yann Toutain ID Signature numérique de Yann Toutain ID Date : 2024.02.27 08:54:37 +01'00'

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

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

TABLE OF CONTENTS

1 INTRODUCTION

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

2 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR 750 MHz REFERENCE DIPOLE
Manufacturer	MVG
Model	SID750
Serial Number	SN 03/15DIP0G750-355
Product Condition (new / used)	Used

3 PRODUCT DESCRIPTION

3.1 GENERAL INFORMATION

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

Figure 1 – *MVG COMOSAR Validation Dipole*

4 MEASUREMENT METHOD

4.1 MECHANICAL REQUIREMENTS

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards specify the mechanical components and dimensions of the validation dipoles, with the dimension's frequency and phantom shell thickness dependent. The COMOSAR test bench employs a 2 mm phantom shell thickness therefore the dipoles sold for use with the COMOSAR test bench comply with the requirements set forth for a 2 mm phantom shell thickness. A direct method is used with a ISO17025 calibrated caliper.

4.2 S11 PARAMETER REQUIREMENTS

The dipole used for SAR system validation measurements and checks must have a S11 of -20 dB or better. The S11 measurement shall be performed against a liquid filled flat phantom, with the phantom constructed as outlined in the fore mentioned standards. A direct method is used with a network analyser and its calibration kit, both with a valid ISO17025 calibration.

4.3 SAR REQUIREMENTS

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards provide requirements for reference dipoles used for system validation measurements. The following measurements were performed to verify that the product complies with the fore-mentioned standards.

5 MEASUREMENT UNCERTAINTY

5.1 MECHANICAL DIMENSIONS

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

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

5.2 S11 PARAMETER

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

5.3 SAR

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

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