MEASUREMENT 21

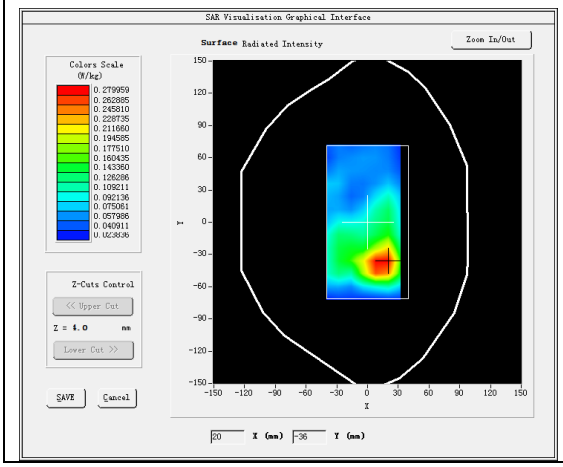
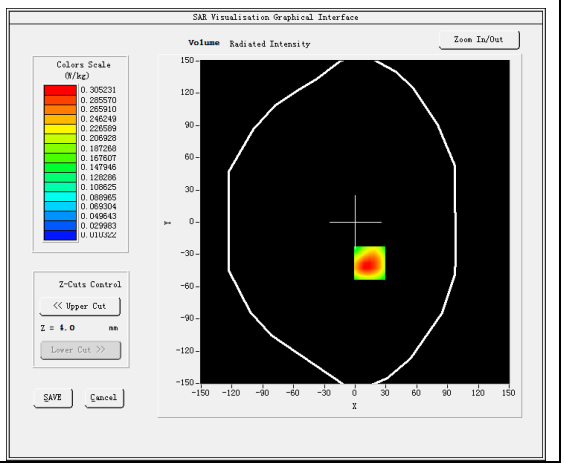
Date of measurement: 17/10/2024

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: 1.6)
ConvF	2.51

B. SAR Measurement Results

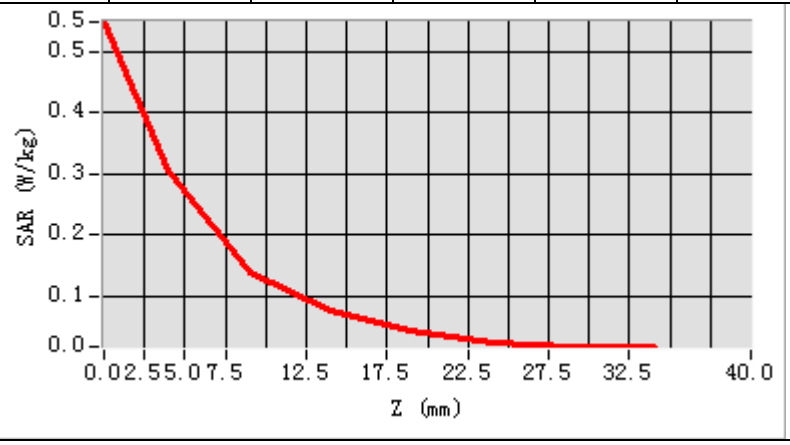
Frequency (MHz)	2593.000000
Relative permittivity (real part)	38.964241
Relative permittivity (imaginary part)	14.030588
Conductivity (S/m)	2.021184
Variation (%)	0.700000

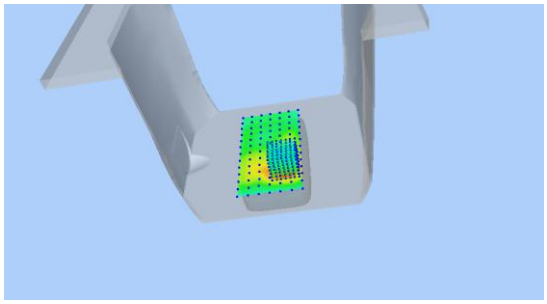
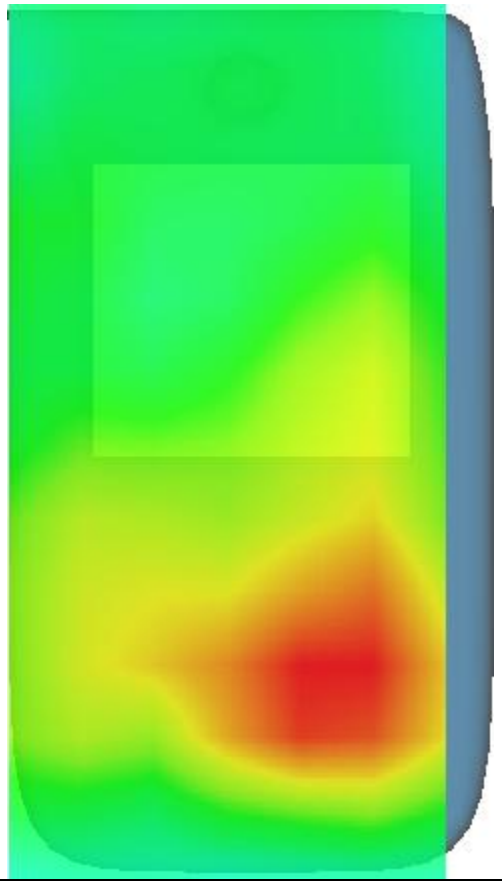
SURFACE SAR	VOLUME SAR
	

Maximum location: X=14.00, Y=-38.00
SAR Peak: 0.53 W/kg

SAR 10g (W/Kg)	0.152980
SAR 1g (W/Kg)	0.302161

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	0.5492	0.3052	0.1388	0.0757	0.0440	0.0256	0.0190



3D screen shot	Hot spot position
	

MEASUREMENT 22

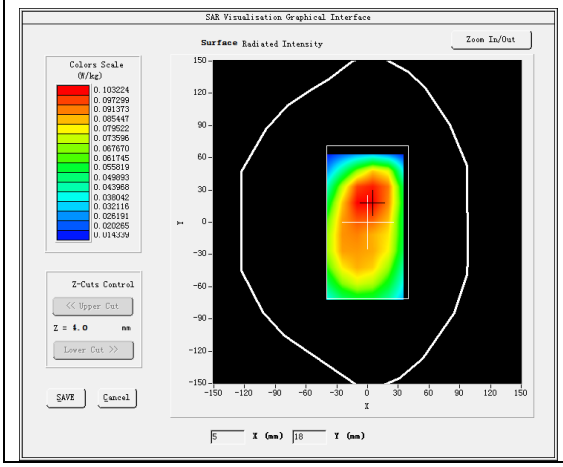
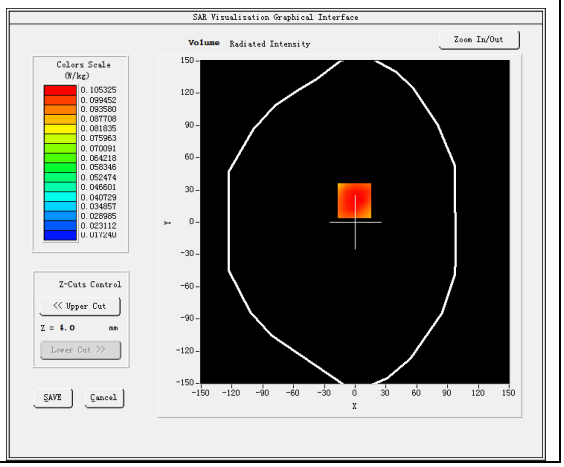
Date of measurement: 14/10/2024

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	FDDBand71
Channels	Middle
Signal	(Crest factor: 1.0)
ConvF	2.42

B. SAR Measurement Results

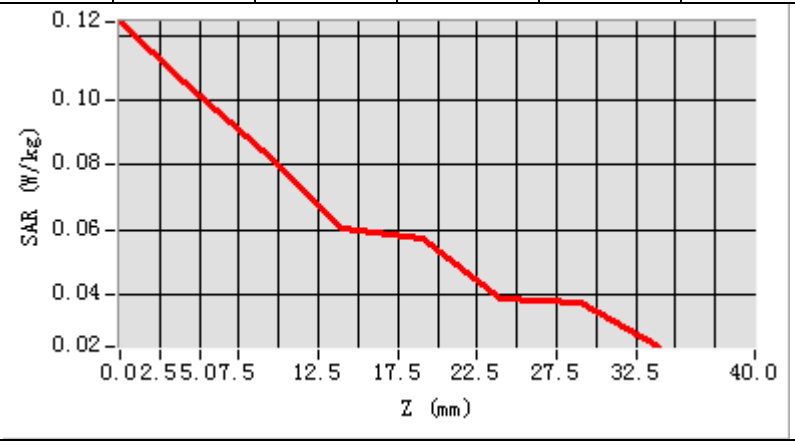
Frequency (MHz)	683.000000
Relative permittivity (real part)	41.377583
Relative permittivity (imaginary part)	22.598246
Conductivity (S/m)	0.857478
Variation (%)	-0.260000

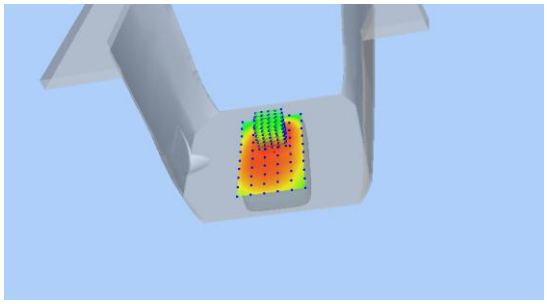
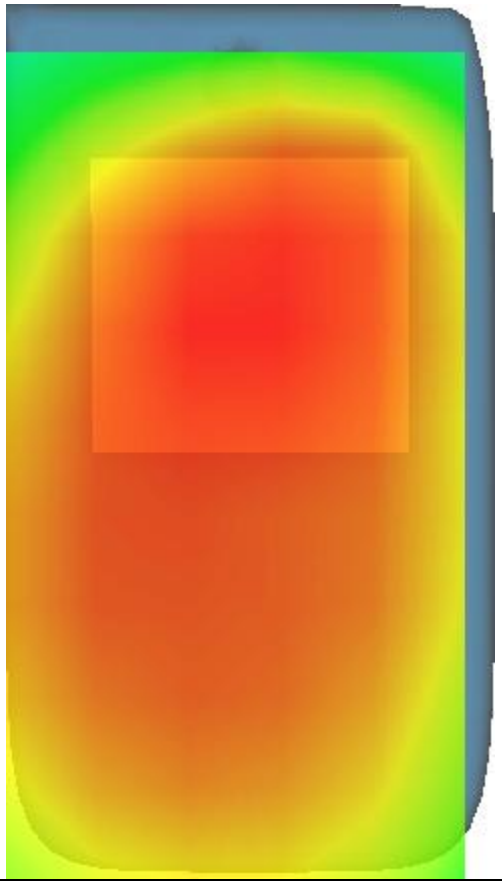
SURFACE SAR	VOLUME SAR
	

Maximum location: X=-1.00, Y=20.00
SAR Peak: 0.13 W/kg

SAR 10g (W/Kg)	0.081358
SAR 1g (W/Kg)	0.103633

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	0.1241	0.1053	0.0847	0.0606	0.0573	0.0389	0.0377



3D screen shot	Hot spot position
	

MEASUREMENT 23

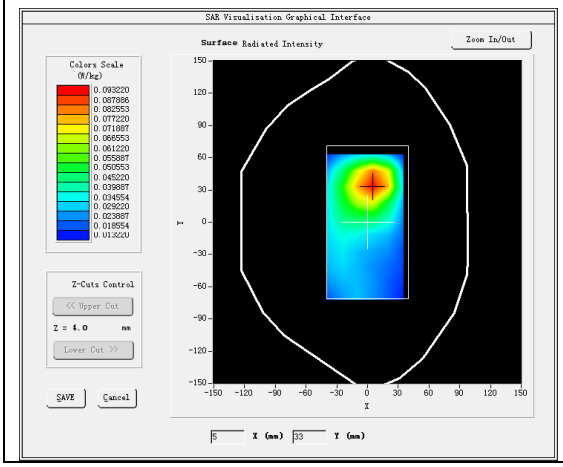
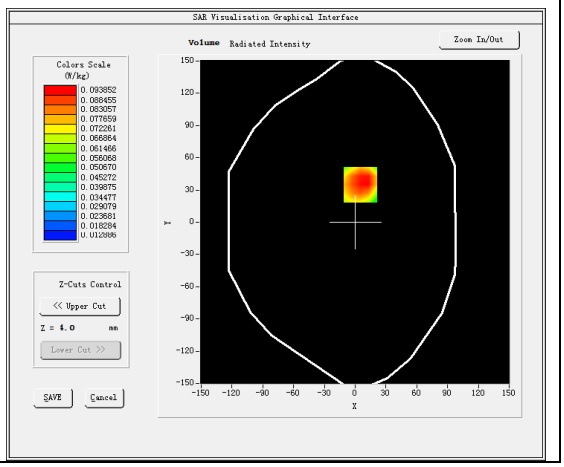
Date of measurement: 15/10/2024

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	FDDBand26A
Channels	Middle
Signal	(Crest factor: 1.0)
ConvF	2.34

B. SAR Measurement Results

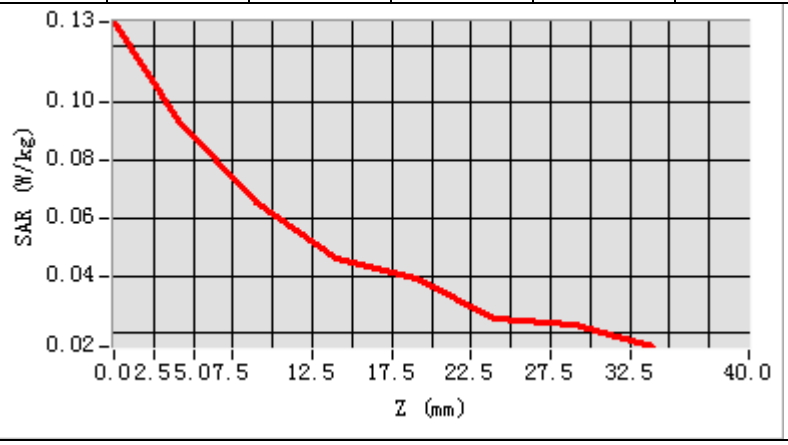
Frequency (MHz)	819.000000
Relative permittivity (real part)	42.147469
Relative permittivity (imaginary part)	19.713531
Conductivity (S/m)	0.896966
Variation (%)	0.910000

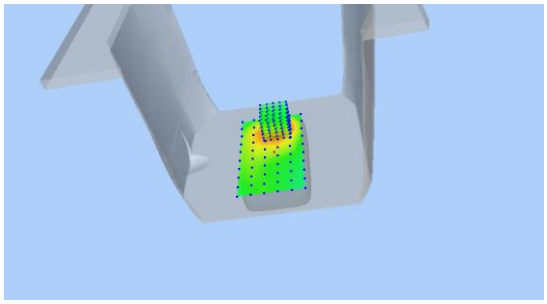
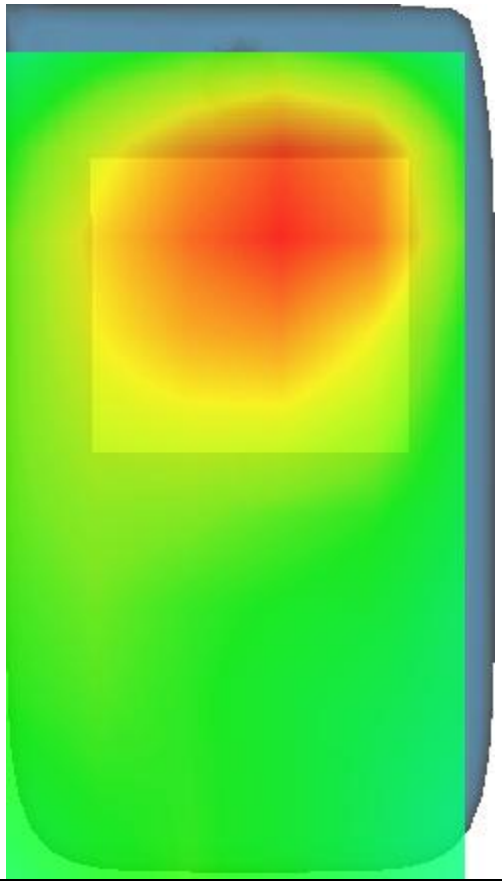
SURFACE SAR	**VOLUME SAR**
	

Maximum location: X=5.00, Y=35.00
SAR Peak: 0.13 W/kg

SAR 10g (W/Kg)	0.062941
SAR 1g (W/Kg)	0.092394

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	0.1282	0.0939	0.0657	0.0457	0.0390	0.0254	0.0228



3D screen shot	Hot spot position
	

MEASUREMENT 24

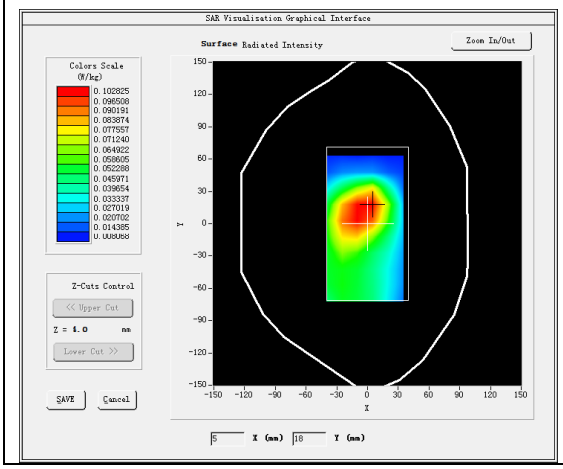
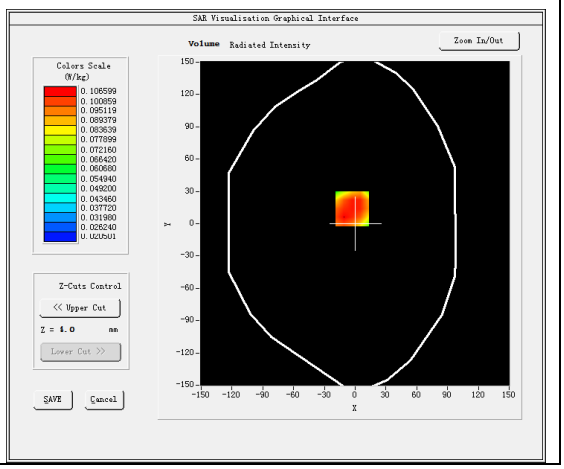
Date of measurement: 15/10/2024

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	FDDBand26B
Channels	Middle
Signal	(Crest factor: 1.0)
ConvF	2.34

B. SAR Measurement Results

Frequency (MHz)	831.500000
Relative permittivity (real part)	41.931519
Relative permittivity (imaginary part)	19.719481
Conductivity (S/m)	0.910930
Variation (%)	-0.220000

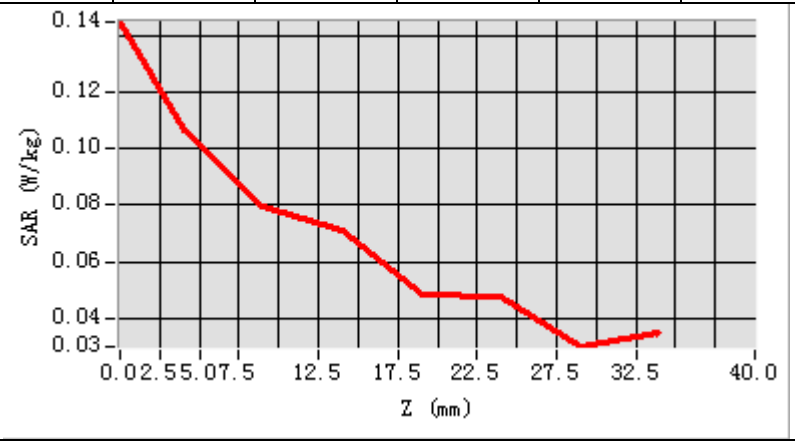
SURFACE SAR	**VOLUME SAR**
	

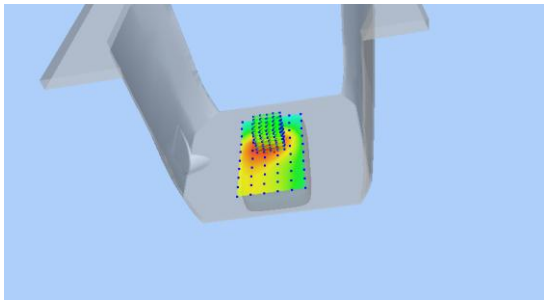
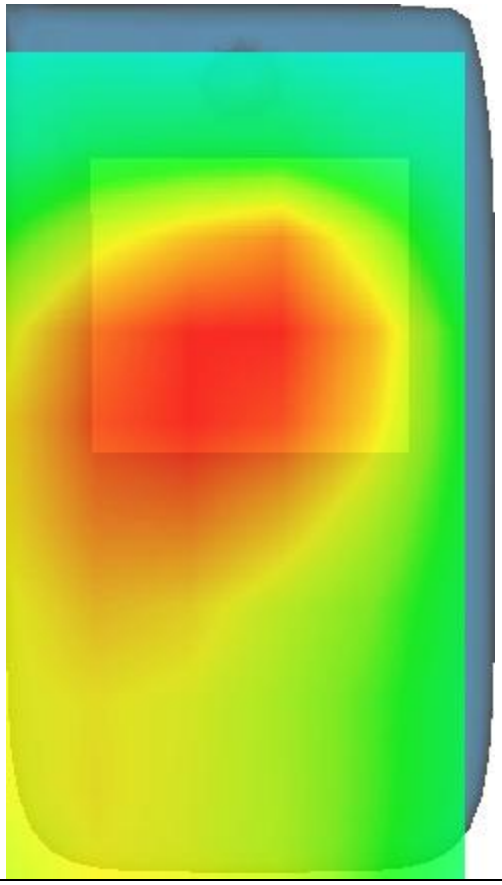
Maximum location: X=-3.00, Y=14.00

SAR Peak: 0.13 W/kg

SAR 10g (W/Kg)	0.081318
SAR 1g (W/Kg)	0.104880

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	0.1450	0.1066	0.0795	0.0712	0.0485	0.0479	0.0299



3D screen shot	Hot spot position
	

MEASUREMENT 25

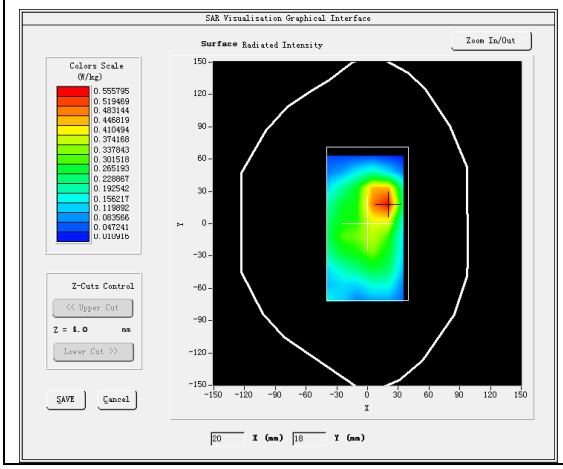
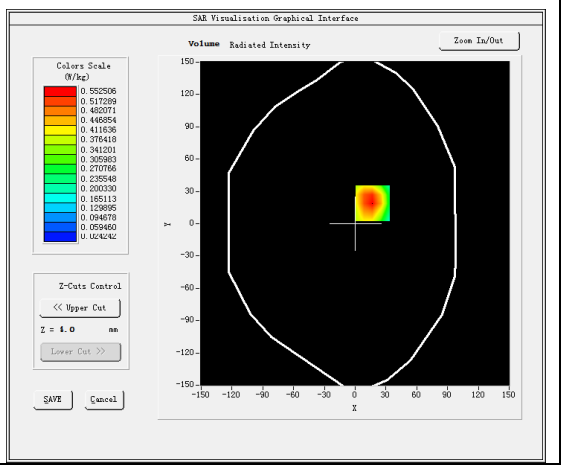
Date of measurement: 22/10/2024

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	FDDBand66
Channels	Middle
Signal	(Crest factor: 1.0)
ConvF	2.51

B. SAR Measurement Results

Frequency (MHz)	1745.000000
Relative permittivity (real part)	39.651207
Relative permittivity (imaginary part)	13.620289
Conductivity (S/m)	1.320411
Variation (%)	-2.400000

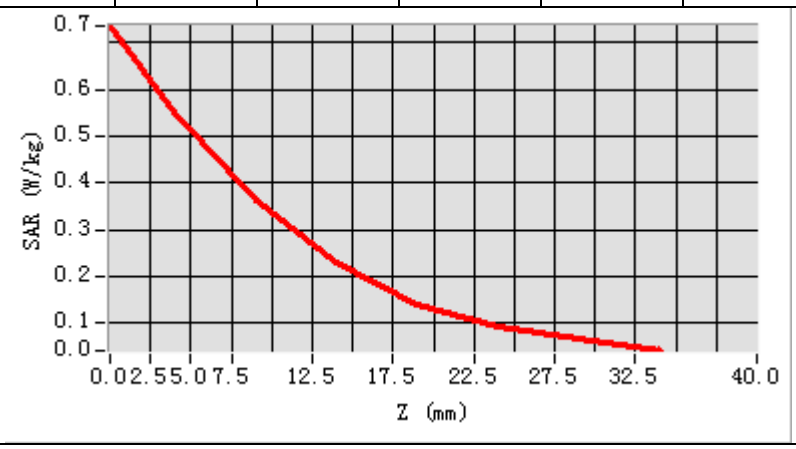
SURFACE SAR	VOLUME SAR
	

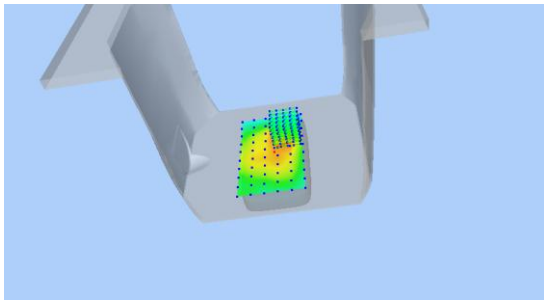
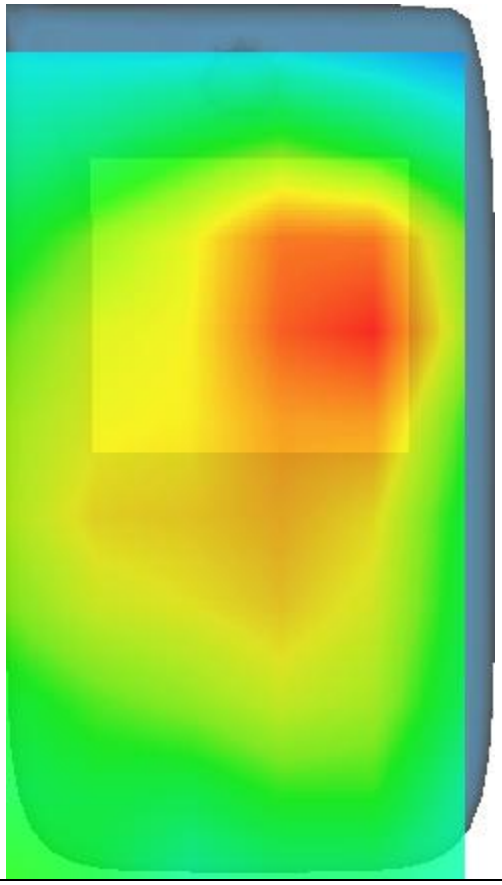
Maximum location: X=17.00, Y=19.00

SAR Peak: 0.77 W/kg

SAR 10g (W/Kg)	0.319533
SAR 1g (W/Kg)	0.523507

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	0.7362	0.5525	0.3640	0.2293	0.1381	0.0931	0.0657



3D screen shot	Hot spot position
	

MEASUREMENT 26

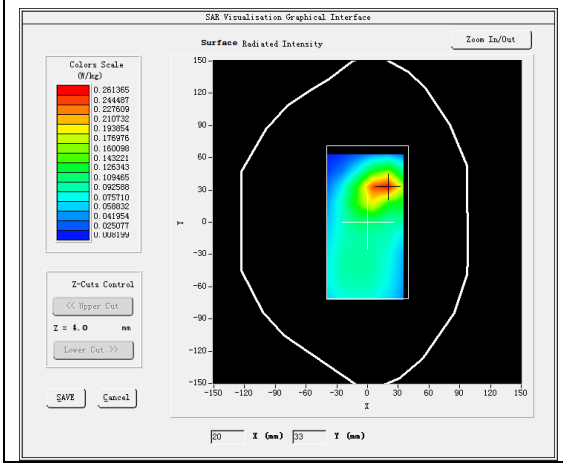
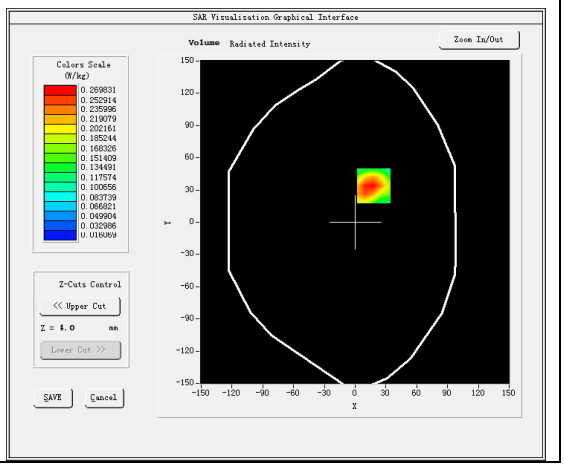
Date of measurement: 15/10/2024

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	SA_n5
Channels	Middle
Signal	(Crest factor: 1.0)
ConvF	2.34

B. SAR Measurement Results

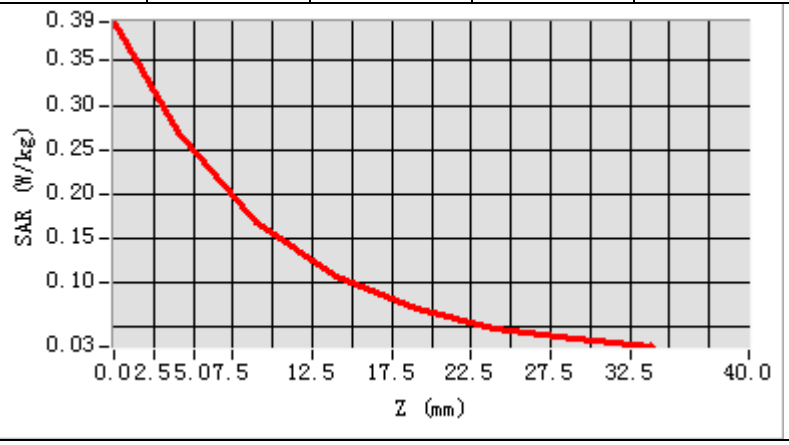
Frequency (MHz)	836.500000
Relative permittivity (real part)	41.880817
Relative permittivity (imaginary part)	19.729731
Conductivity (S/m)	0.916884
Variation (%)	0.130000

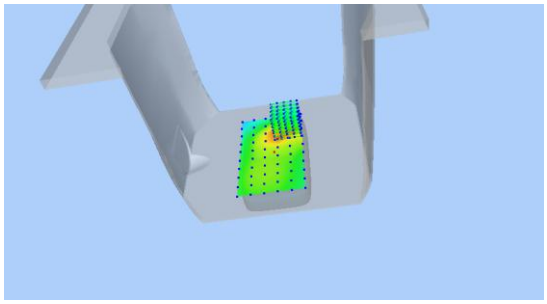
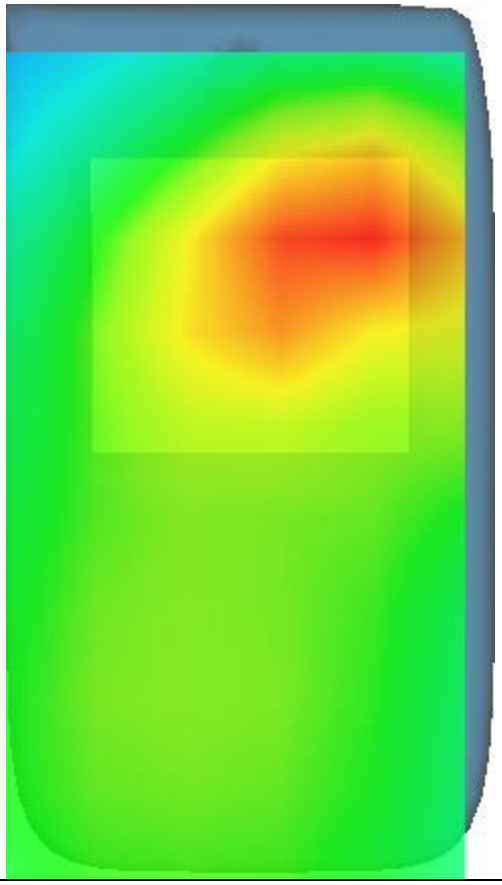
SURFACE SAR	VOLUME SAR
	

Maximum location: X=18.00, Y=34.00
SAR Peak: 0.00 W/kg

SAR 10g (W/Kg)	0.148112
SAR 1g (W/Kg)	0.273028

Z (mm)	0.00	4.00	9.00	14.00	19.00	19.00
SAR (W/Kg)	0.3941	0.2698	0.1676	0.1070	0.1070	0.1070



3D screen shot	Hot spot position
	

MEASUREMENT 27

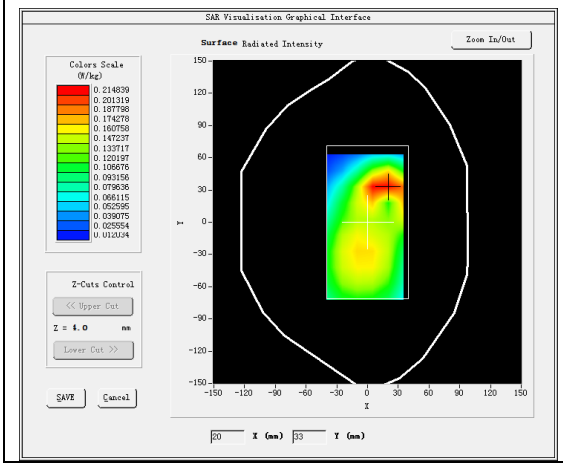
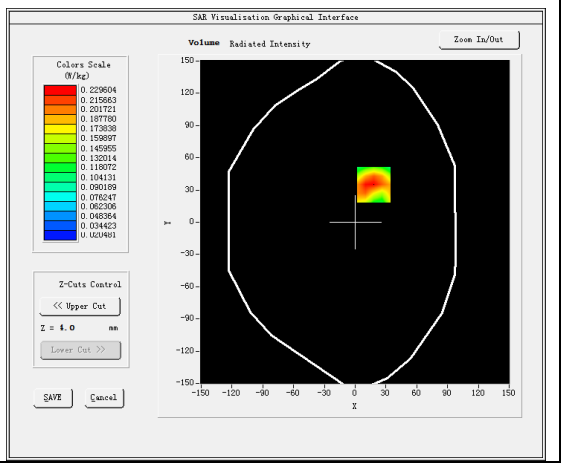
Date of measurement: 14/10/2024

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	SA_n12
Channels	Middle
Signal	(Crest factor: 1.0)
ConvF	2.42

B. SAR Measurement Results

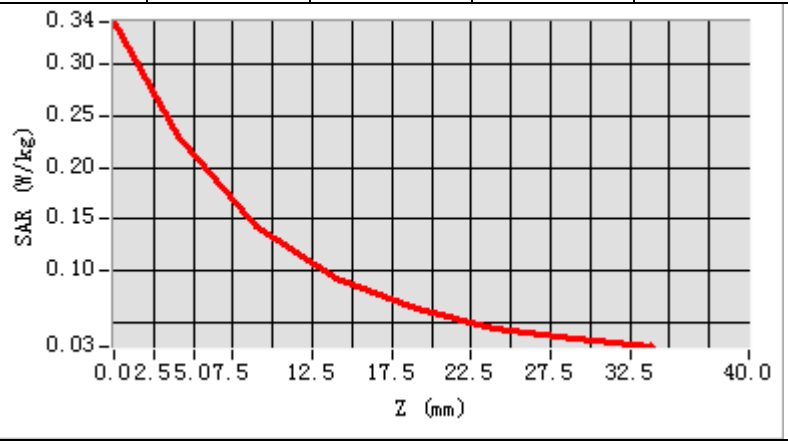
Frequency (MHz)	707.500000
Relative permittivity (real part)	41.079533
Relative permittivity (imaginary part)	21.855495
Conductivity (S/m)	0.859042
Variation (%)	-3.550000

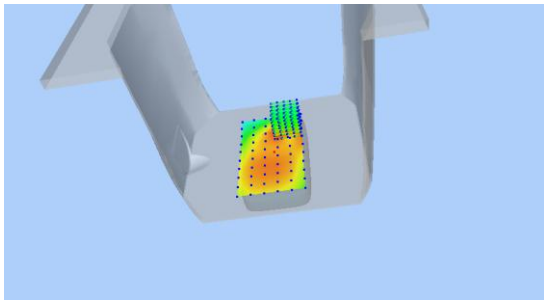
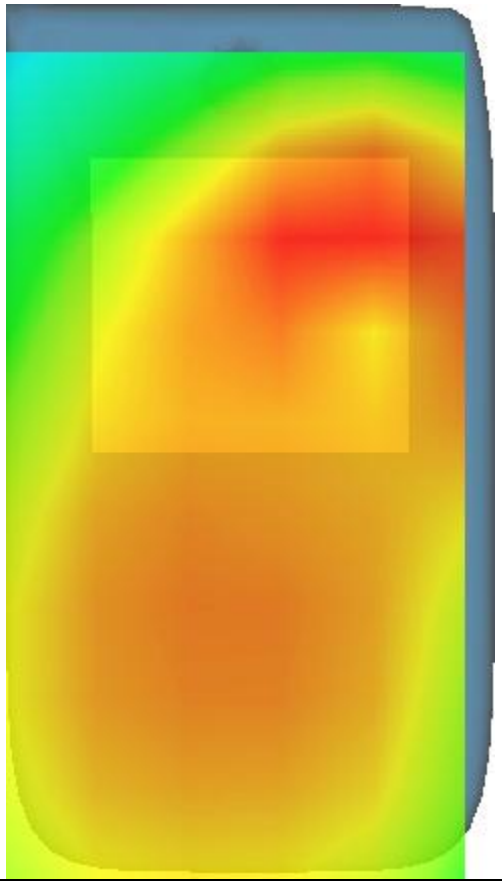
SURFACE SAR	**VOLUME SAR**
	

Maximum location: X=18.00, Y=35.00
SAR Peak: 0.00 W/kg

SAR 10g (W/Kg)	0.135388
SAR 1g (W/Kg)	0.222162

Z (mm)	0.00	4.00	9.00	14.00	14.00	14.00
SAR (W/Kg)	0.3408	0.2296	0.1419	0.0910	0.0910	0.0910



3D screen shot	Hot spot position
	

MEASUREMENT 28

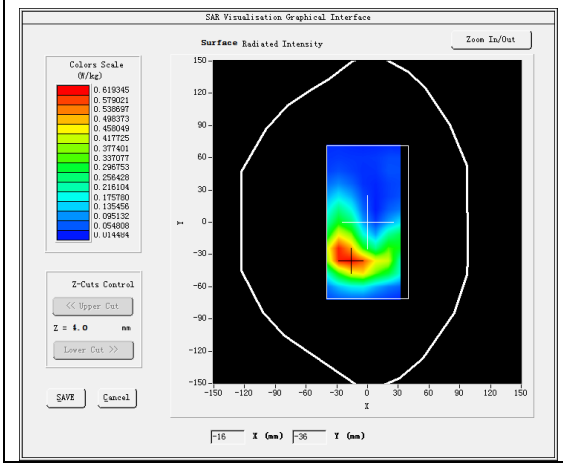
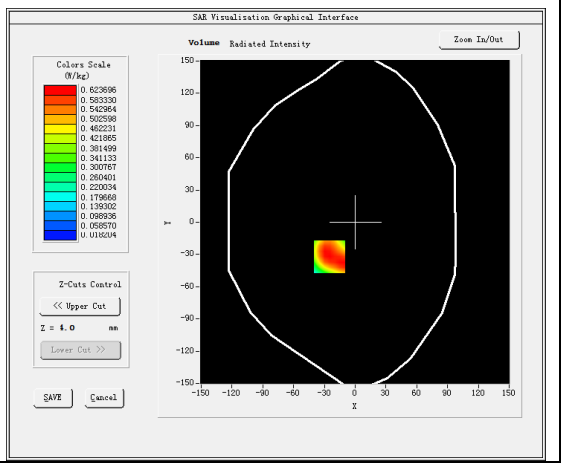
Date of measurement: 17/10/2024

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	SA_n7
Channels	Middle
Signal	(Crest factor: 1.0)
ConvF	2.51

B. SAR Measurement Results

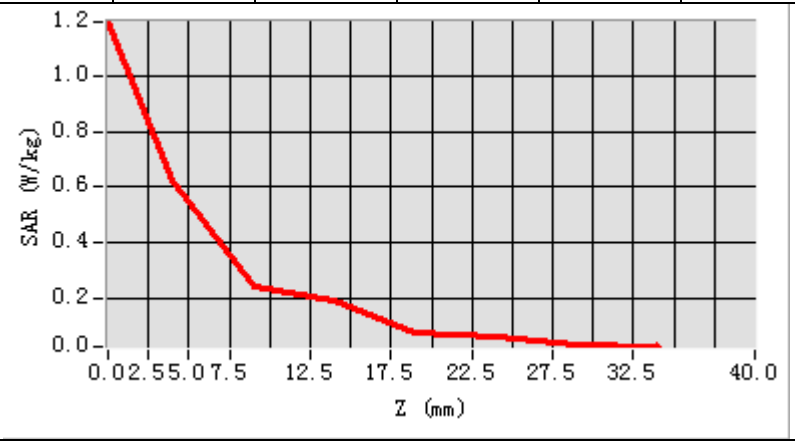
Frequency (MHz)	2535.000000
Relative permittivity (real part)	39.245743
Relative permittivity (imaginary part)	13.866988
Conductivity (S/m)	1.952934
Variation (%)	0.000000

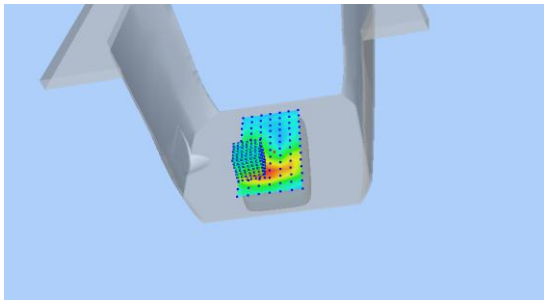
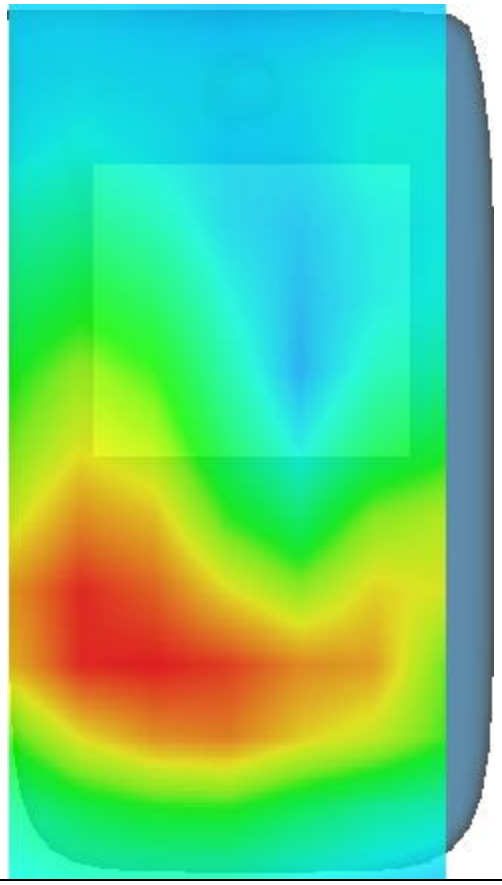
SURFACE SAR	VOLUME SAR
	

Maximum location: X=-25.00, Y=-32.00
SAR Peak: 0.97 W/kg

SAR 10g (W/Kg)	0.335619
SAR 1g (W/Kg)	0.590514

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	1.1911	0.6237	0.2448	0.1936	0.0779	0.0637	0.0347



3D screen shot	Hot spot position
	

MEASUREMENT 29

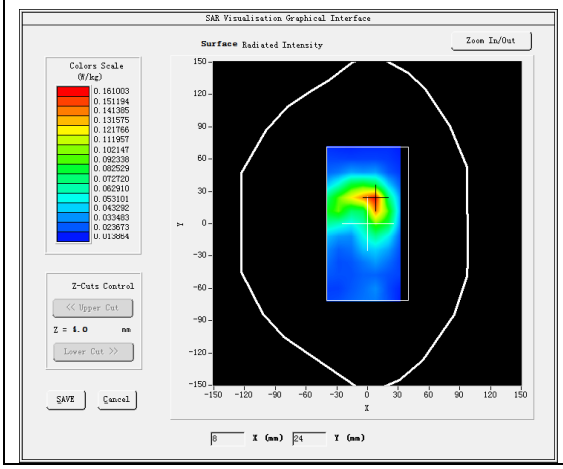
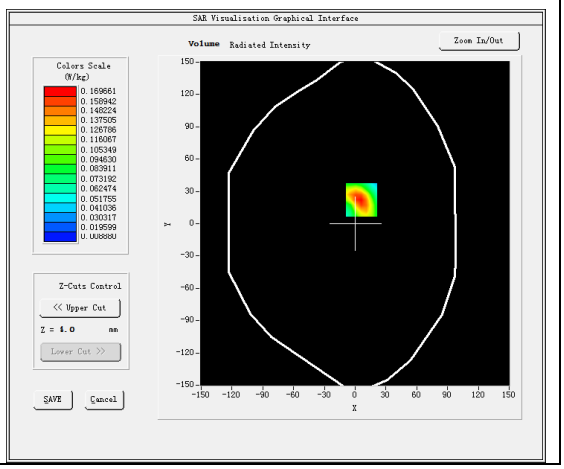
Date of measurement: 17/10/2024

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	SA_n41
Channels	Middle
Signal	(Crest factor: 1.6)
ConvF	2.51

B. SAR Measurement Results

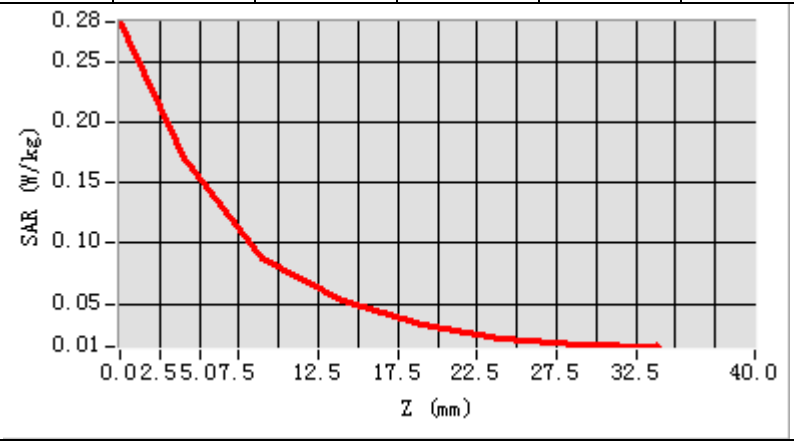
Frequency (MHz)	2592.990000
Relative permittivity (real part)	38.964242
Relative permittivity (imaginary part)	14.030588
Conductivity (S/m)	2.021176
Variation (%)	-1.450000

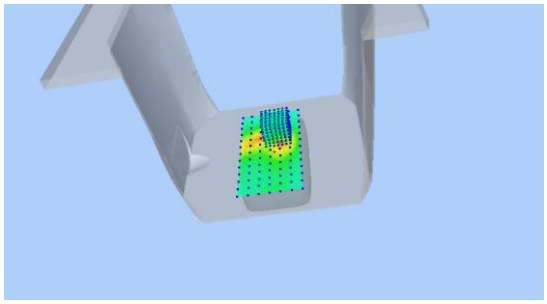
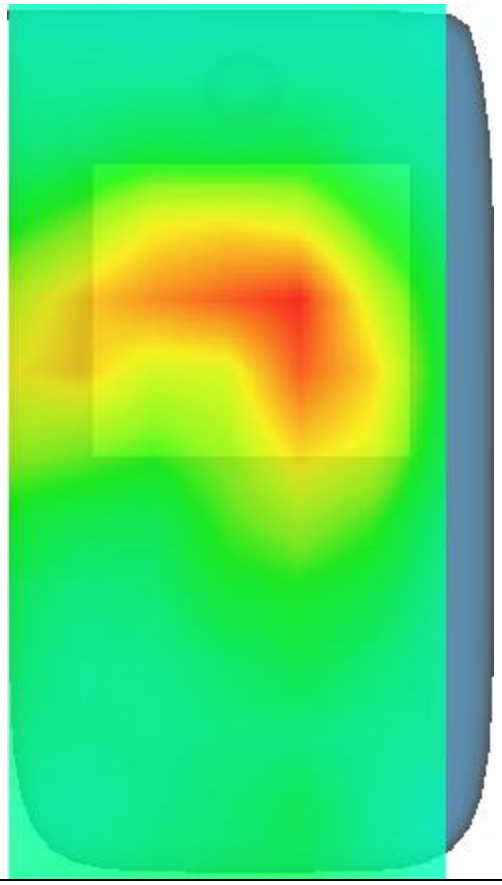
SURFACE SAR	VOLUME SAR
	

Maximum location: X=6.00, Y=22.00
SAR Peak: 0.28 W/kg

SAR 10g (W/Kg)	0.082254
SAR 1g (W/Kg)	0.158666

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	0.2830	0.1697	0.0874	0.0526	0.0323	0.0211	0.0169



3D screen shot	Hot spot position
	

MEASUREMENT 30

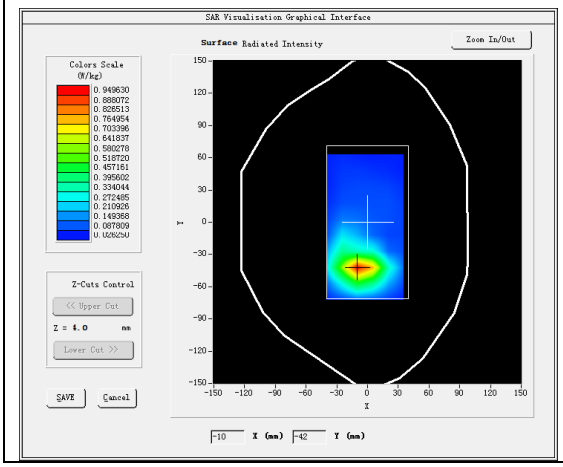
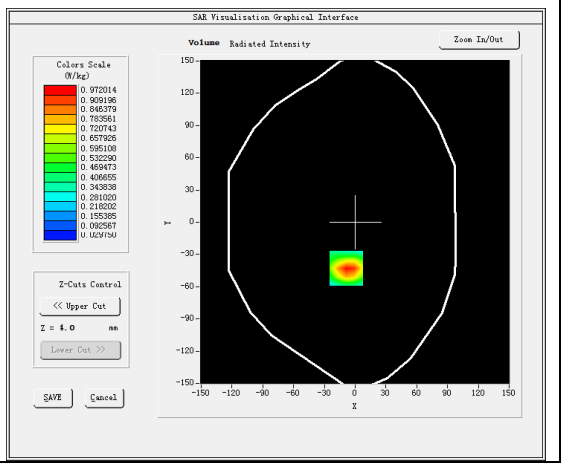
Date of measurement: 16/10/2024

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	SA_n2
Channels	Middle
Signal	(Crest factor: 1.0)
ConvF	2.57

B. SAR Measurement Results

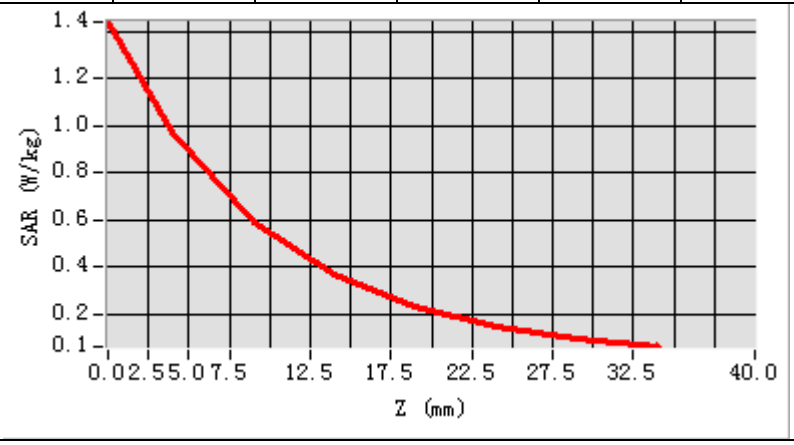
Frequency (MHz)	1880.000000
Relative permittivity (real part)	38.657154
Relative permittivity (imaginary part)	13.872347
Conductivity (S/m)	1.448890
Variation (%)	-1.920000

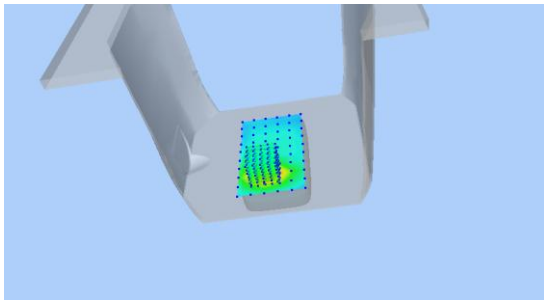
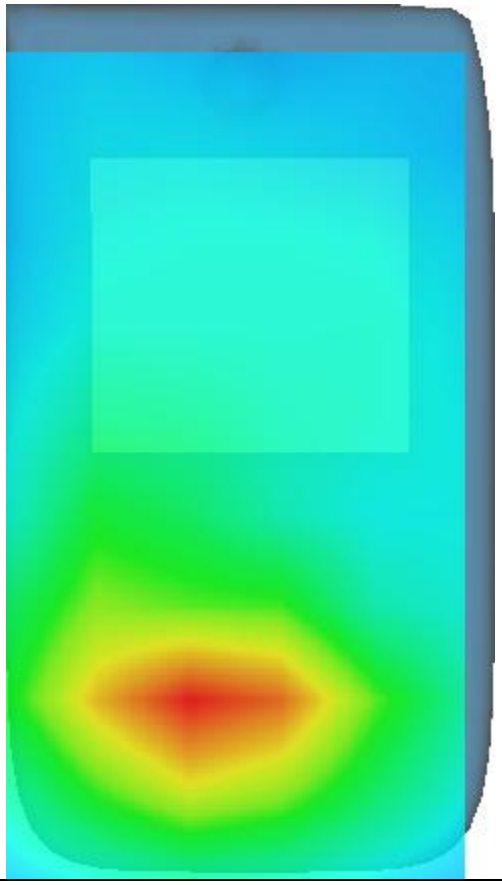
SURFACE SAR	**VOLUME SAR**
	

Maximum location: X=-9.00, Y=-43.00
SAR Peak: 1.46 W/kg

SAR 10g (W/Kg)	0.219280
SAR 1g (W/Kg)	0.521237

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	1.4425	0.9720	0.5894	0.3640	0.2319	0.1456	0.0948



3D screen shot	Hot spot position
	

MEASUREMENT 31

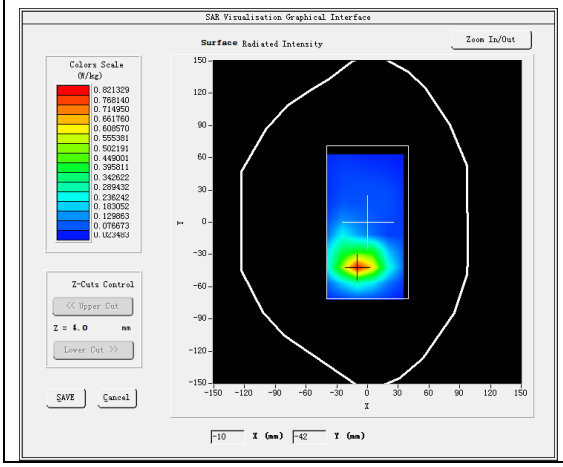
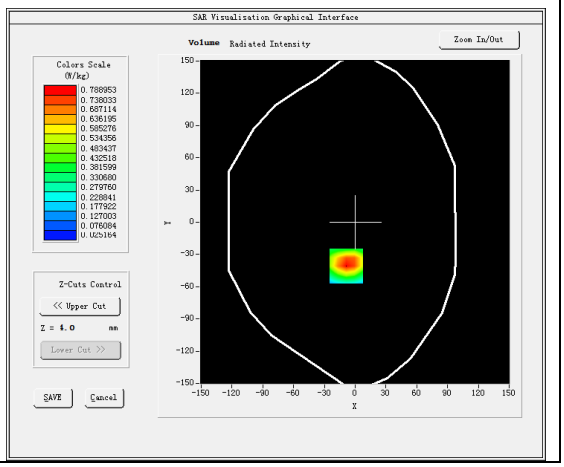
Date of measurement: 16/10/2024

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	SA_n25
Channels	Middle
Signal	(Crest factor: 1.0)
ConvF	2.57

B. SAR Measurement Results

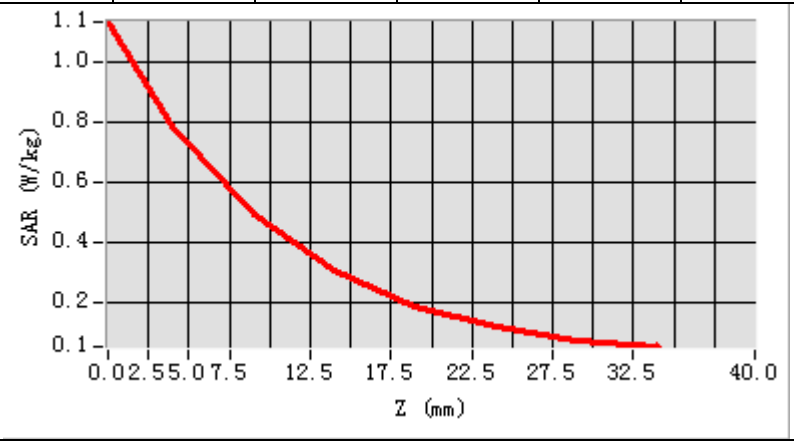
Frequency (MHz)	1882.500000
Relative permittivity (real part)	38.657254
Relative permittivity (imaginary part)	13.901147
Conductivity (S/m)	1.453828
Variation (%)	2.070000

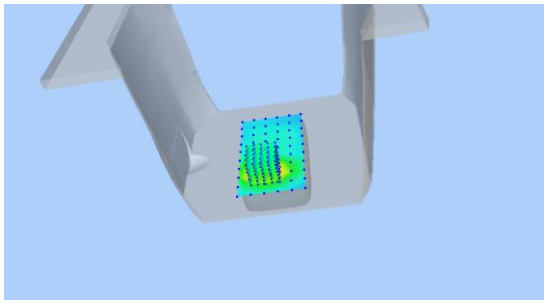
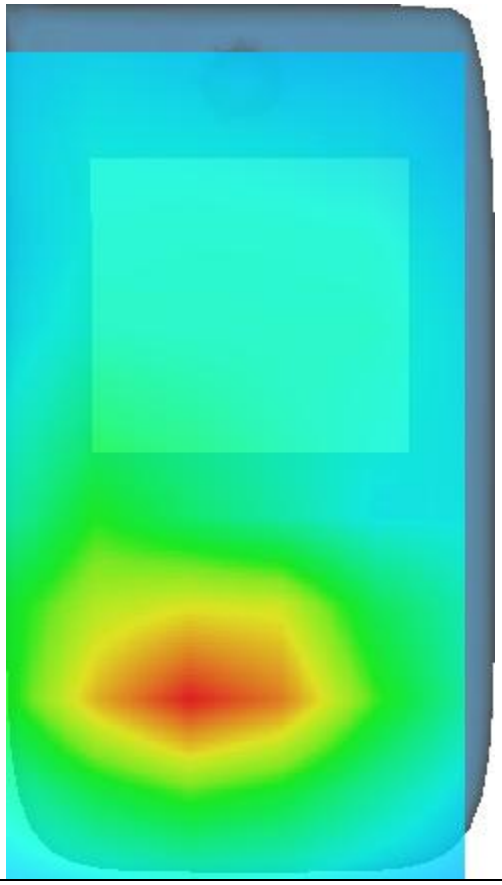
SURFACE SAR	VOLUME SAR
	

Maximum location: X=-9.00, Y=-41.00
SAR Peak: 1.20 W/kg

SAR 10g (W/Kg)	0.321947
SAR 1g (W/Kg)	0.536244

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	1.1365	0.7890	0.4933	0.3109	0.1909	0.1249	0.0768



3D screen shot	Hot spot position
	

MEASUREMENT 32

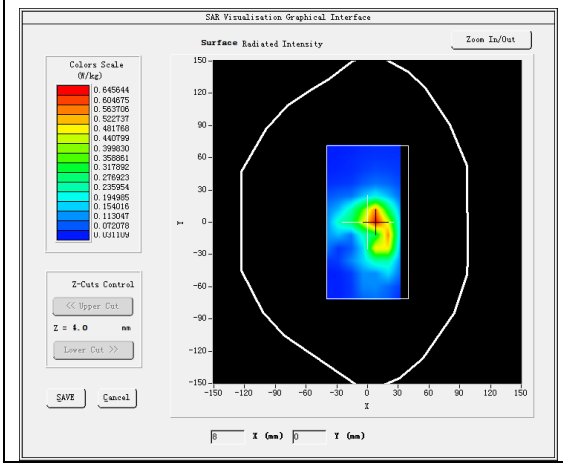
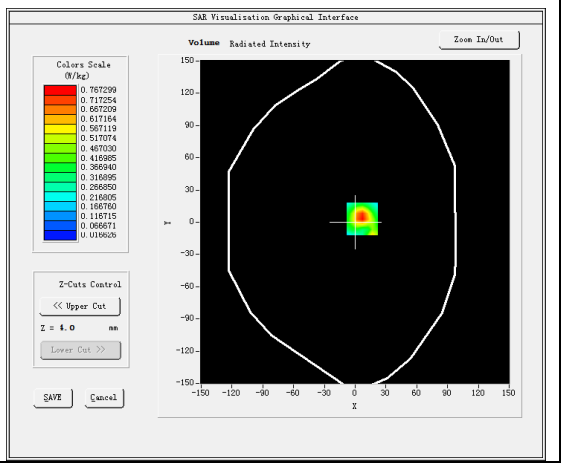
Date of measurement: 19/10/2024

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	SA_n78
Channels	Middle
Signal	(Crest factor: 1.6)
ConvF	2.15

B. SAR Measurement Results

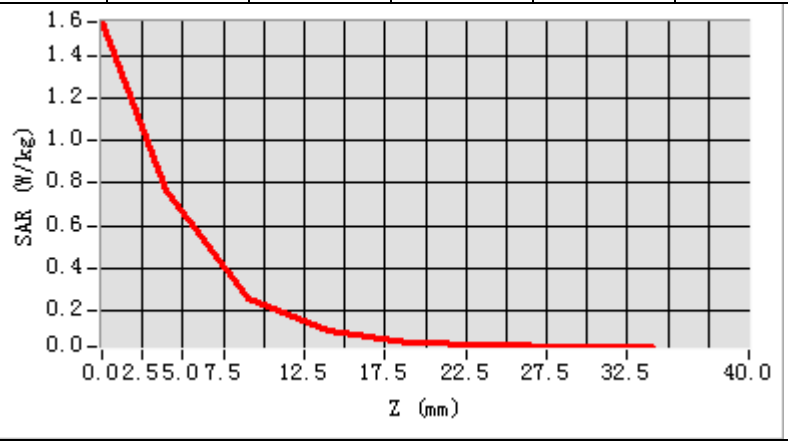
Frequency (MHz)	3549.990000
Relative permittivity (real part)	37.389992
Relative permittivity (imaginary part)	14.691346
Conductivity (S/m)	2.897452
Variation (%)	1.400000

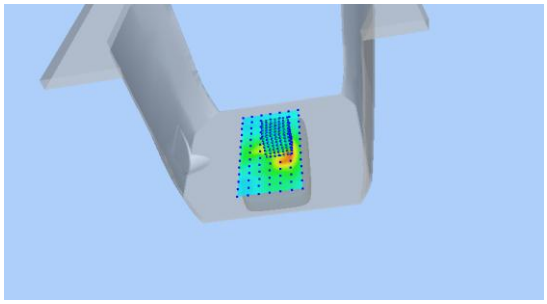
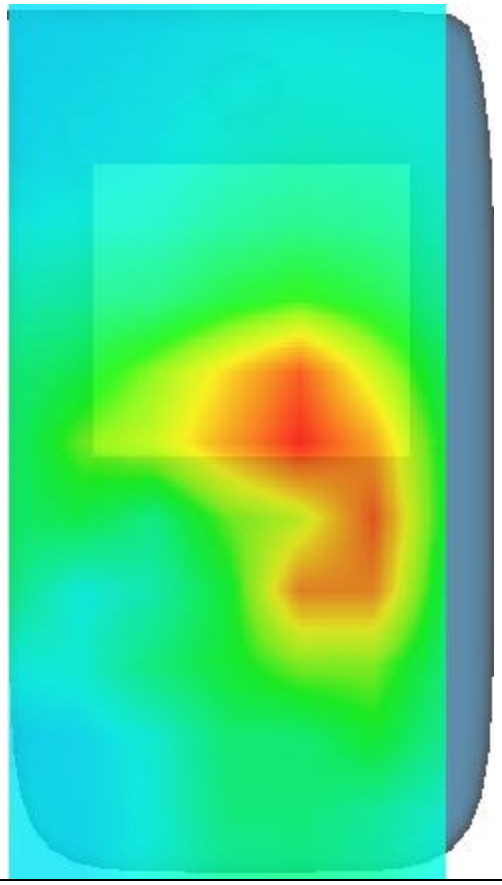
SURFACE SAR	**VOLUME SAR**
	

Maximum location: X=7.00, Y=3.00
SAR Peak: 1.55 W/kg

SAR 10g (W/Kg)	0.283578
SAR 1g (W/Kg)	0.569278

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	1.5627	0.7673	0.2590	0.0992	0.0489	0.0354	0.0311



3D screen shot	Hot spot position
	

MEASUREMENT 33

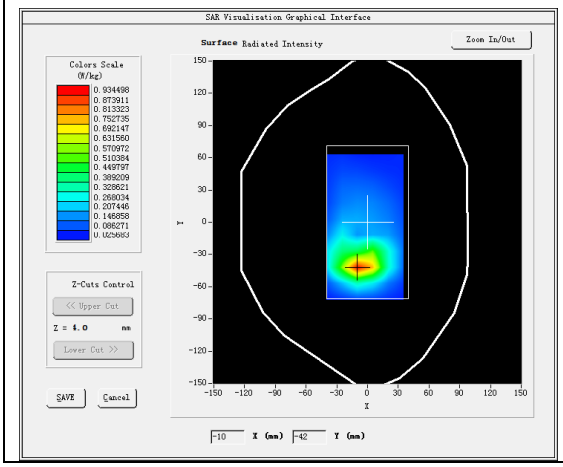
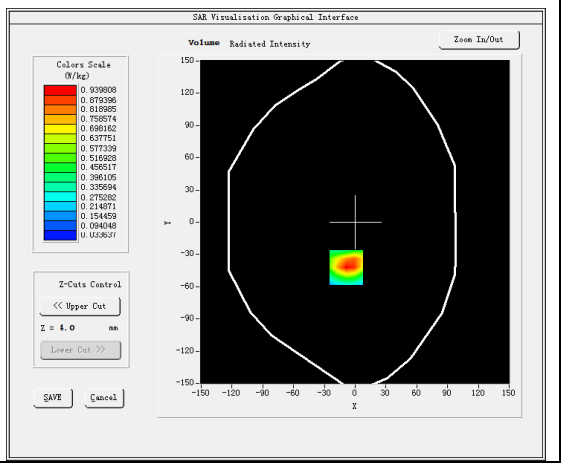
Date of measurement: 22/10/2024

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	SA_n66
Channels	Middle
Signal	(Crest factor: 1.0)
ConvF	2.51

B. SAR Measurement Results

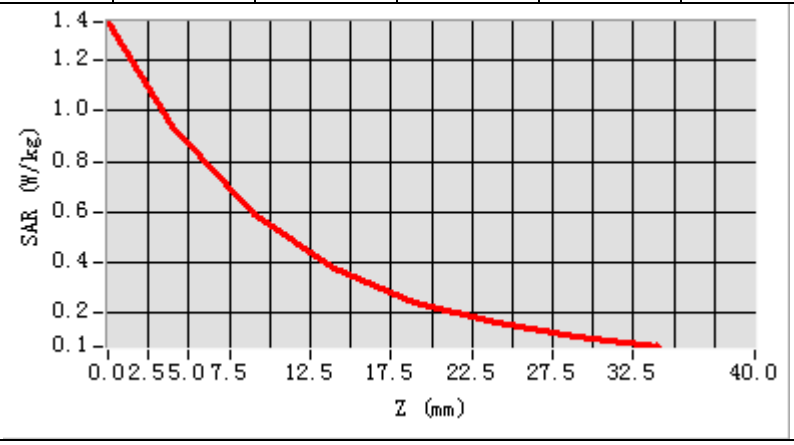
Frequency (MHz)	1745.000000
Relative permittivity (real part)	39.651207
Relative permittivity (imaginary part)	13.620289
Conductivity (S/m)	1.320411
Variation (%)	-1.160000

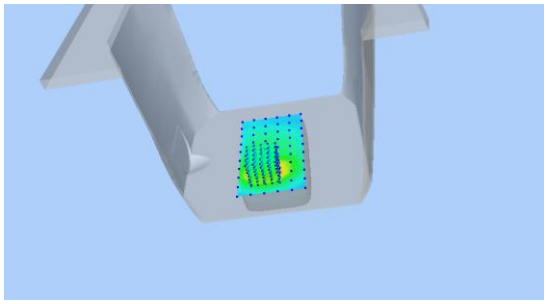
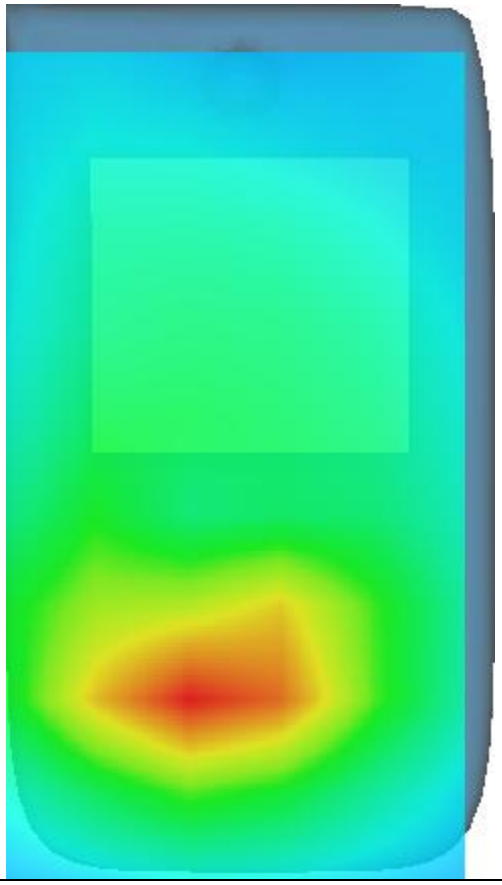
SURFACE SAR	**VOLUME SAR**
	

Maximum location: X=-9.00, Y=-42.00
SAR Peak: 1.42 W/kg

SAR 10g (W/Kg)	0.212687
SAR 1g (W/Kg)	0.573663

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	1.3509	0.9398	0.5931	0.3774	0.2466	0.1597	0.1068



3D screen shot	Hot spot position
	

MEASUREMENT 34

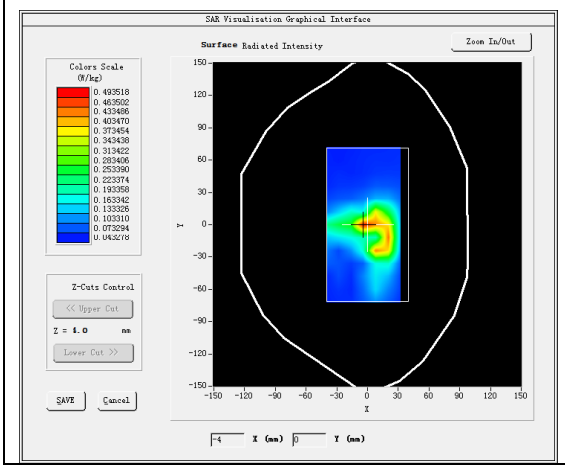
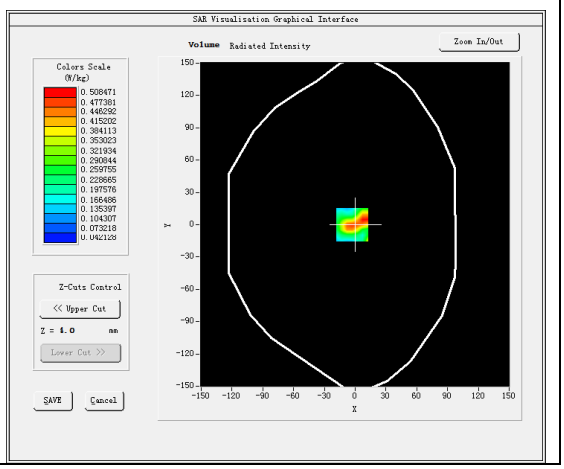
Date of measurement: 20/10/2024

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	SA_n77
Channels	Middle
Signal	(Crest factor: 1.6)
ConvF	2.11

B. SAR Measurement Results

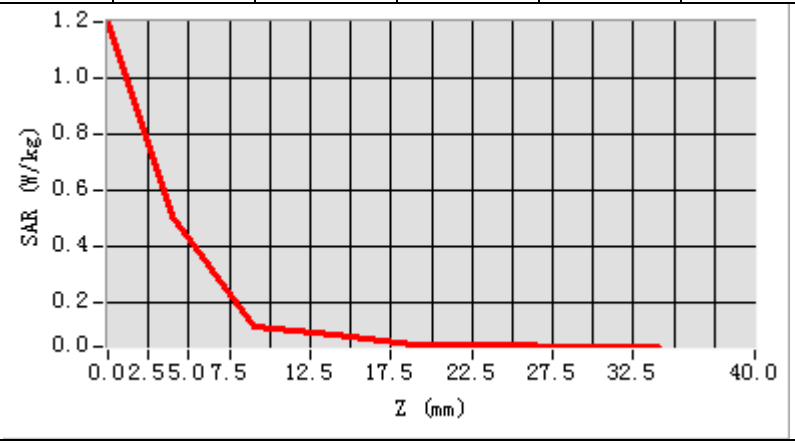
Frequency (MHz)	3750.000000
Relative permittivity (real part)	36.850162
Relative permittivity (imaginary part)	15.001224
Conductivity (S/m)	3.125255
Variation (%)	-0.230000

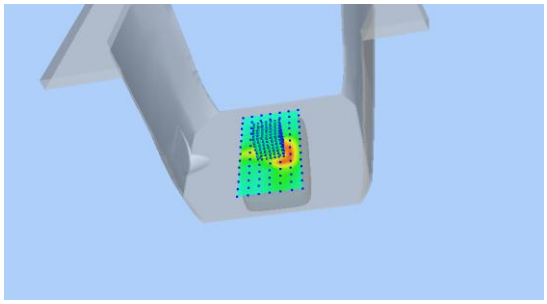
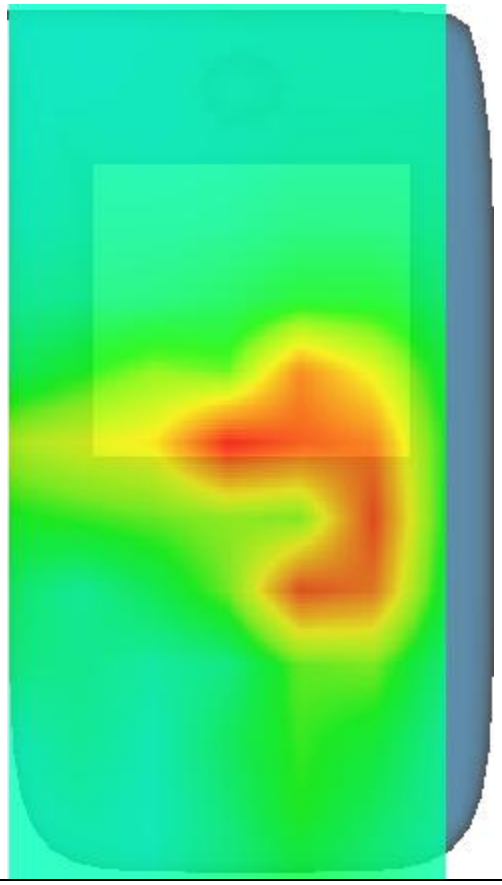
SURFACE SAR	VOLUME SAR
	

Maximum location: X=-3.00, Y=0.00
SAR Peak: 1.02 W/kg

SAR 10g (W/Kg)	0.201472
SAR 1g (W/Kg)	0.475613

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	1.1972	0.5085	0.1115	0.0830	0.0496	0.0481	0.0441



3D screen shot	Hot spot position
	

15. Appendix D. Calibration Certificate

Table of contents
E Field Probe - SN 08/16 EPGO287
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
3300 MHz Dipole - SN 03/21 DIP 3G300-359
3500 MHz Dipole - SN 09/12 DIP 3G500-360
3700 MHz Dipole - SN 09/12 DIP 3G700-361
5000-6000 MHz Dipole - SN 13/14 WGA 33

COMOSAR E-Field Probe Calibration Report

Ref : ACR.278.12.24.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 DOSIMETRIC E-FIELD PROBE

SERIAL NO.: 4024-EPGO-442

Calibrated at MVG

Z.I. de la pointe du diable

Technopôle Brest Iroise – 295 avenue Alexis de Rochon

29280 PLOUZANE - FRANCE

Calibration date: 10/04/2024

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).

COMOSAR E-FIELD PROBE CALIBRATION REPORT Ref: ACR.278.12.24.BES.A

	Name	*Function*	*Date*	*Signature*
Prepared by :	Cyrille ONNEE	Measurement Responsible	10/4/2024	
Checked & approved by:	Pedro Ruiz	Technical Manager	10/4/2024	
Authorized by:	Pedro Ruiz	Laboratory Director	10/4/2024 Assinado por: Pedro RUIZ 29093B31C46F428...	

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

Issue	*Name*	*Date*	*Modifications*
A	Cyrille ONNEE	10/4/2024	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	4024-EPGO-442
Product Condition (new / used)	New
Frequency Range of Probe	0.15 GHz-7.5GHz
Resistance of Three Dipoles at Connector	Dipole 1: R1=0.206 MΩ Dipole 2: R2=0.223 MΩ Dipole 3: R3=0.235 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:

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

where

$\mathrm{SAR}_{\mathrm{uncertainty}}$	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;
$\Delta\mathrm{SAR}_{be}$	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%).

3.5 PROBE MODULATION RESPONSE

MVG's probe were evaluated experimentally with various modulated signal and the deviation from CW response were found neglectable in the used power range of the probe. So the correction to taking into account the linearization parameters for different modulation is null, therefore the CW factor given in this report can be used whatever the measured modulation

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.

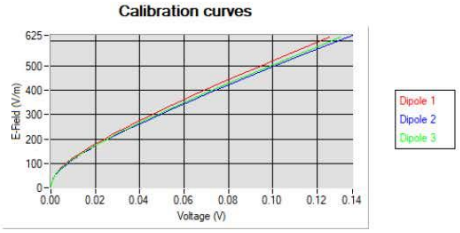
The estimated expanded uncertainty (k=2) in calibration for SAR (W/kg) is +/-11% for the frequency range 150-450MHz.
The estimated expanded uncertainty (k=2) in calibration for SAR (W/kg) is +/-14% for the frequency range 600-7500MHz.

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.

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

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)
0.73	0.79	0.78

DCP dipole 1 (mV)	DCP dipole 2 (mV)	DCP dipole 3 (mV)
105	109	103

5.2 CALIBRATION IN LIQUID

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

$$ConvF = \frac{E^2_{liquid}}{E^2_{air}}$$

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

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

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:

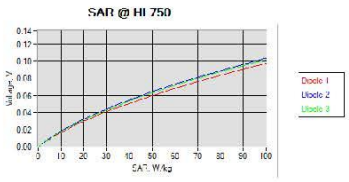
$$SAR = \frac{4P_W}{ab\delta} e^{\frac{-2z}{\delta}}$$

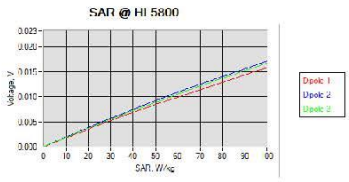
where
a=the larger cross-sectional of the waveguide
b=the smaller cross-sectional of the waveguide
δ=the skin depth for the liquid in the waveguide
Pw=the power delivered to the liquid

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	2.42
HL850	835	2.34
HL900	900	2.24
HL1800	1800	2.51
HL1900	1900	2.57
HL2000	2000	2.64
HL2300	2300	2.73
HL2450	2450	2.74
HL2600	2600	2.51
HL3300	3300	2.11
HL3500	3500	2.15
HL3700	3700	2.08
HL3900	3900	2.27
HL4200	4200	2.39
HL4600	4600	2.30
HL4900	4900	2.13
HL5200	5200	1.89
HL5400	5400	1.97
HL5600	5600	1.88
HL5800	5800	1.90

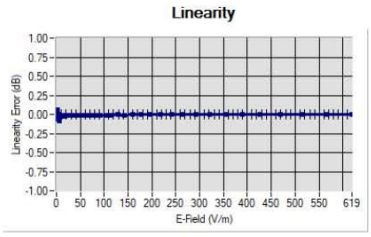
(*) Frequency validity is +/-50MHz below 600MHz, +/-100MHz from 600MHz to 6GHz and +/-700MHz above 6GHz



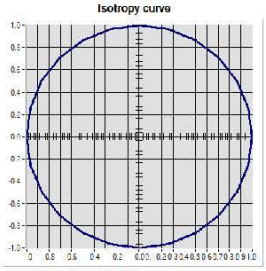


6 VERIFICATION RESULTS

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



Isotropy +/-0.12% (+/-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	08/2026
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	06/2026
USB Sensor	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	44235403	02/2024	02/2027

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.

SAR REFERENCE DIPOLE CALIBRATION REPORT

REF : ACR.53.23.24.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 08:54:37 +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.

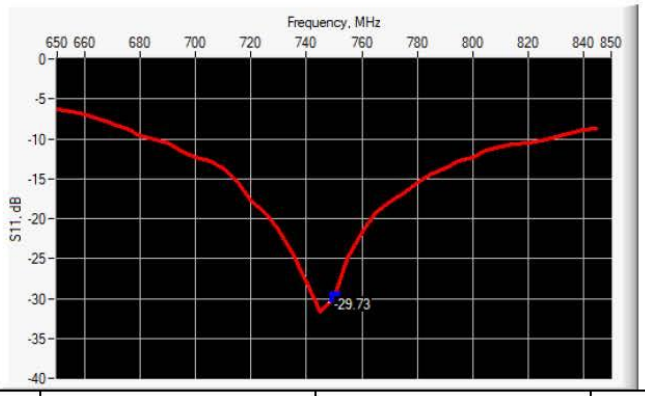
6 CALIBRATION RESULTS

6.1 MECHANICAL DIMENSIONS

L mm		h mm		d mm	
Measured	**Required**	**Measured**	**Required**	**Measured**	**Required**
-	176.00 +/- 2%	-	100.00 +/- 2%	-	6.35 +/- 2%

6.2 S11 PARAMETER

6.2.1 S11 parameter in Head Liquid



Frequency (MHz)	S11 parameter (dB)	Requirement (dB)	Impedance
750	-29.73	-20	52.5Ω + 2.2jΩ

6.3 SAR

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards state that the system validation measurements must be performed using a reference dipole meeting the fore mentioned return loss and mechanical dimension requirements. The validation measurement must be performed against a liquid filled flat phantom, with the phantom constructed as outlined in the fore mentioned standards. Per the standards, the dipole shall be positioned below the bottom of the phantom, with the dipole length centered and parallel to the longest dimension of the flat phantom, with the top surface of the dipole at the described distance from the bottom surface of the phantom.

6.3.1 SAR with Head Liquid

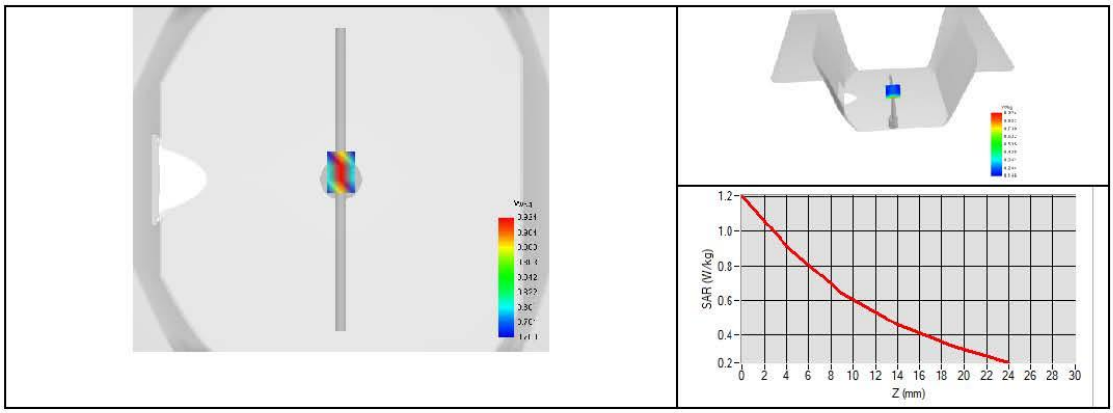
The IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards state that the system validation measurements should produce the SAR values shown below (for phantom thickness of 2 mm), within the uncertainty for the system validation. All SAR values are normalized to 1 W forward power. In bracket, the measured SAR is given with the used input power.

SAR REFERENCE DIPOLE CALIBRATION REPORT

REF : ACR.53.23.24.BES.A

Software	OPENSAR V5
Phantom	SN 13/09 SAM68
Probe	3523-EPGO-429
Liquid	Head Liquid Values: eps' : 45.0 sigma : 0.87
Distance between dipole center and liquid	15.0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoon Scan Resolution	dx=8mm/dy=8mm/dz=5mm
Frequency	750 MHz
Input power	20 dBm
Liquid Temperature	20 +/- 1 °C
Lab Temperature	20 +/- 1 °C
Lab Humidity	30-70 %

Frequency	1g SAR (W/kg)			10g SAR (W/kg)		
	Measured	Measured normalized to 1W	Target normalized to 1W	Measured	Measured normalized to 1W	Target normalized to 1W
750 MHz	0.86	8.60	8.49	0.58	5.78	5.55



7 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Description	**Manufacturer / Model**	**Identification No.**	**Current Calibration Date**	**Next Calibration Date**
SAM Phantom	MVG	SN 13/09 SAM68	Validated. No cal required.	Validated. No cal required.
COMOSAR Test Bench	Version 3	NA	Validated. No cal required.	Validated. No cal required.
Network Analyzer	Rohde & Schwarz ZVM	100203	08/2021	08/2024
Network Analyzer – Calibration kit	Rohde & Schwarz ZV-Z235	101223	07/2022	07/2025
Calipers	Mitutoyo	SN 0009732	11/2022	11/2025
Reference Probe	MVG	3523-EPGO-429	11/2023	11/2024
Multimeter	Keithley 2000	4013982	02/2023	02/2026
Signal Generator	Rohde & Schwarz SMB	106589	03/2022	03/2025
Amplifier	MVG	MODU-023-C-0002	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	NI-USB 5680	170100013	06/2021	06/2024
Power Meter	Keysight U2000A	SN: MY62340002	10/2022	10/2025
Directional Coupler	Krytar 158020	131467	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Temperature / Humidity Sensor	Testo 184 H1	44225320	06/2021	06/2024

SAR Reference Dipole Calibration Report

Ref : ACR.53.24.24.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: 835 MHZ

SERIAL NO.: SN 03/15DIP0G835-347

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.

SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref : ACR.53.24.24.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 08:55:11 +01'00'

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

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

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