SAR TEST REPORT

Product Name: NAUTIZ X2-V

Model Name: NAUTIZ X2-V

FCC ID: YY3-B1424222

Issued For	:	Handheld Group AB Strandgatan 40, 531 60, Lidköping
Issued By	:	Shenzhen LGT Test Service Co., Ltd. Room 205, Building 13, Zone B, Chen Hsong Industrial Park, No.177 Renmin West Road, Jinsha Community, Kengzi Street, Pingshan New District, Shenzhen, China

Report Number:	LGT23J048HA01
Sample Received Date:	Oct.24, 2023
Date of Test:	Nov.01, 2023 ~ Nov. 07, 2023
Date of Issue:	Nov. 07, 2023
Max. SAR (1g):	Body: 0.755 W/kg

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Revision History

Rev.	Issue Date	Contents
00	Nov. 07, 2023	Initial Issue

TEST REPORT CERTIFICATION

Applicant	Handheld Group AB
Address	Strandgatan 40, 531 60, Lidköping
Manufacture	Handheld Group AB
Address	Strandgatan 40, 531 60, Lidköping
Product Name	NAUTIZ X2-V
Trademark	Handheld
Model Name	NAUTIZ X2-V
Sample number	LGT2310072

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
ANSI/IEEE Std. C95.1-1992 FCC 47 CFR Part 2 (2.1093) IEEE 1528: 2013	PASS

Prepared by:

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Approved by:

Vita Li
Manager

1. General Information

Environmental evaluation measurements of specific absorption rate (SAR) distributions in emulated human head and body tissues exposed to radio frequency (RF) radiation from wireless portable devices for compliance with the rules and regulations of the U.S. Federal Communications Commission (FCC).

1.1 EUT Description

Product Name	NAUTIZ X2-V	
Trademark	Handheld	
Model Name	NAUTIZ X2-V	
Series Model	N/A	
Model Difference	N/A	
Device Category	Portable	
Product stage	Production unit	
RF Exposure Environment	General Population / Uncontrolled	
Hardware Version	N/A	
Software Version	N/A	
Frequency Range	WLAN 802.11b/g/n20: 2412 MHz ~ 2462 MHz WLAN 802.11n40: 2422 MHz ~ 2452 MHz WLAN 802.11a/n20/n40/ac80: 5150 ~ 5250 MHz WLAN 802.11a/n20/n40/ac80: 5250 ~ 5350 MHz WLAN 802.11a/n20/n40/ac80: 5470 ~ 5725 MHz WLAN 802.11a/n20/n40/ac80: 5725 ~ 5850 MHz Bluetooth: 2402 ~ 2480 MHz	
Max. Reported SAR(1g): (Limit:1.6W/kg) Test distance: 10mm	Mode	Body Worn and Hotspot (W/ kg)
	2.4G WLAN	0.209
	Bluetooth	0.140
	5.2G WLAN	0.592
	5.3G WLAN	0.755
	5.6G WLAN	0.721
	5.8G WLAN	0.744
Battery	Rated Voltage:3.85V Charge Limit Voltage:4.4V Capacity: 4000mAh	
Operating Mode:	2.4G WLAN: 802.11b(DSSS): CCK, DQPSK, DBPSK 802.11g(OFDM): BPSK, QPSK,16-QAM,64-QAM 802.11n(OFDM): BPSK, QPSK,16-QAM,64-QAM 5G WLAN: 802.11a(OFDM): BPSK, QPSK,16-QAM,64-QAM 802.11n(OFDM): BPSK, QPSK,16-QAM,64-QAM 802.11ac (OFDM): BPSK, QPSK,16-QAM,64-QAM,256-QAM Bluetooth: GFSK +π/4DQPSK+8DPSK BLE: GFSK	
Antenna Specification	Bluetooth/WLAN: FPC Antenna	
Operating Mode	Maximum continuous output	

1.2 Test Environment

Ambient conditions in the SAR laboratory:

Items	Required
Temperature (℃)	18-25
Humidity (%RH)	30-70

1.3 Test Factory

Company Name:	Shenzhen LGT Test Service Co., Ltd.
Address:	Room 205, Building 13, Zone B, Chen Hsong Industrial Park, No.177 Renmin West Road, Jinsha Community, Kengzi Street, Pingshan New District, Shenzhen, China
Registration number:	746540
Accreditation Certificate	FCC Registration No.: 746540
	A2LA Certificate No.: 6727.01
	IC Registration No.: CN0136

2. Test Standards and Limits

No.	Identity	Document Title
1	47 CFR Part 2	Frequency Allocations and Radio Treaty Matters; General Rules and Regulations
2	ANSI/IEEE Std. C95.1-1992	IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz
3	IEEE Std. 1528-2013	Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques
4	FCC KDB 447498 D04 v01	RF Exposure Procedures and Equipment Authorization Policies for Mobile and Portable Devices
5	FCC KDB 865664 D01 v01r04	SAR Measurement 100 MHz to 6 GHz
6	FCC KDB 865664 D02 v01r02	RF Exposure Reporting
7	FCC KDB 941225 D06 v02r01	Hotspot Mode SAR
8	FCC KDB 648474 D04 v01r03	SAR Evaluation Considerations for Wireless Handsets
9	FCC KDB 248227 D01 Wi-Fi SAR v02r02	SAR Considerations for 802.11 Devices

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

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

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

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

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

Population/Uncontrolled Environments:
Are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure.

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

NOTE GENERAL POPULATION/UNCONTROLLED EXPOSURE PARTIAL BODY LIMIT 1.6 W/kg

3. SAR Measurement System

3.1 Definition of Specific Absorption Rate (SAR)

SAR is related to the rate at which energy is absorbed per unit mass in an object exposed to a radio field. The SAR distribution in a biological body is complicated and is usually carried out by experimental techniques or numerical modeling. The standard recommends limits for two tiers of groups, occupational/controlled and general population/uncontrolled, based on a person's awareness and ability to exercise control over his or her exposure. In general, occupational/controlled exposure limits are higher than the limits for general population/uncontrolled.

The SAR definition is the time derivative (rate) of the incremental energy (dW) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dv) of a given density (ρ). The equation description is as below:

$$\mathbf{SAR} = \frac{d}{dt}\left(\frac{dW}{dm}\right) = \frac{d}{dt}\left(\frac{dW}{\rho dv}\right)$$

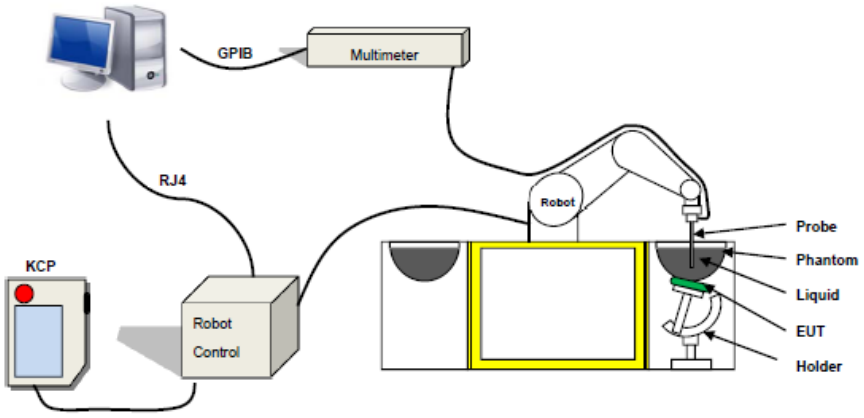
SAR is expressed in units of Watts per kilogram (W/kg) SAR measurement can be related to the electrical field in the tissue by

$$\mathbf{SAR} = \frac{\sigma E^2}{\rho}$$

Where: σ is the conductivity of the tissue;
ρ is the mass density of the tissue and E is the RMS electrical field strength.

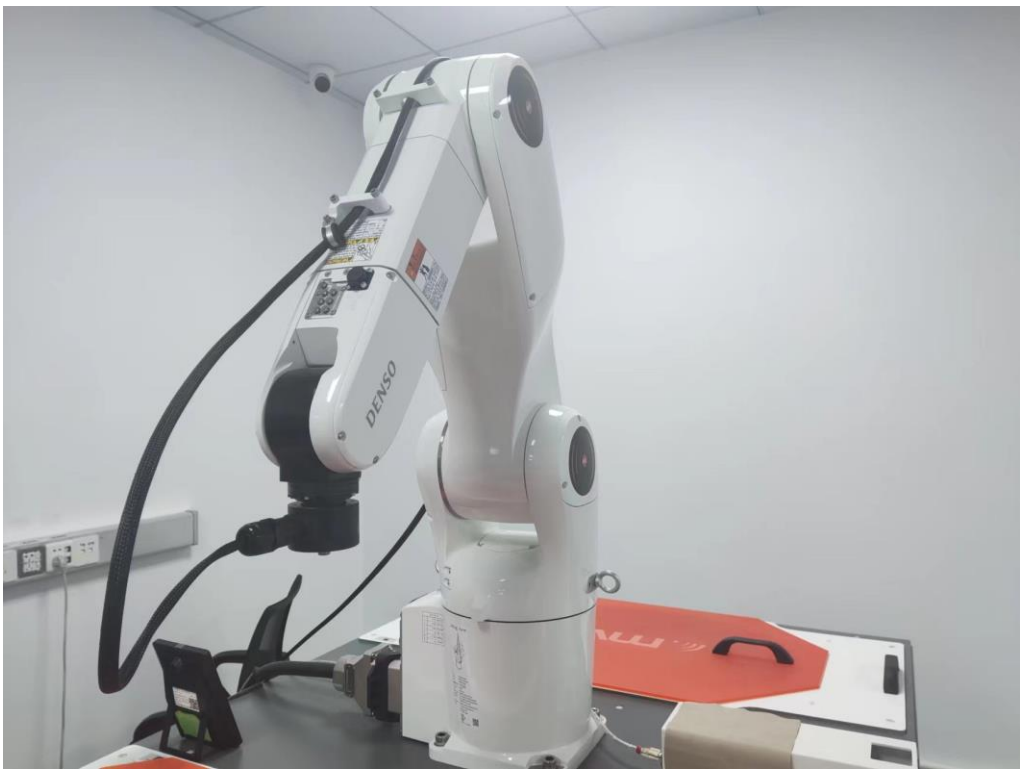
3.2 SAR System

MVG SAR System Diagram:



COMOSAR is a system that is able to determine the SAR distribution inside a phantom of human being according to different standards. The COMOSAR system consists of the following items:
- Main computer to control all the system
- 6 axis robot
- Data acquisition system
- Miniature E-field probe
- Phone holder
- Head simulating tissue

The following figure shows the system.



The EUT under test operating at the maximum power level is placed in the phone holder, under the phantom, which is filled with head simulating liquid. The E-Field probe measures the electric field inside the phantom. The OpenSAR software computes the results to give a SAR value in a 1g or 1g mass.

3.2.1 Probe

For the measurements the Specific Dosimetric E-Field Probe SN 04/22 EPGO364 with following specifications is used
- Probe Length: 330 mm
- Length of Individual Dipoles: 2mm
- Maximum external diameter: 8 mm
- Probe Tip External Diameter: 2.5 mm
- Distance between dipole/probe extremity: 1 mm
- Dynamic range: 0.01-100 W/kg
- Probe linearity: 3%
- Axial Isotropy: ＜0.10 dB
- Spherical Isotropy: ＜0.10 dB
- Calibration range: 600 MHz to 6 GHz for head & body simulating liquid.
-Angle between probe axis (evaluation axis) and surface normal line: less than 30°

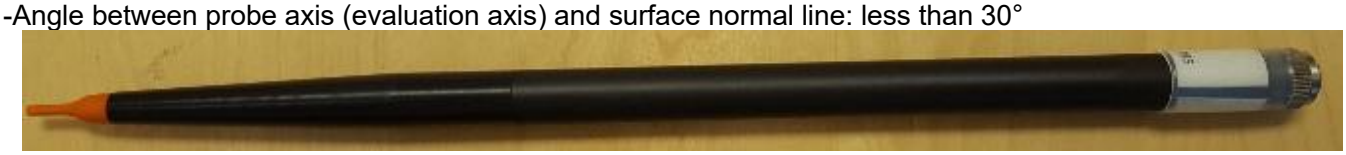


Figure 1-MVG COMOSAR Dosimetric E field Probe

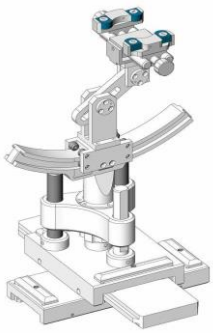
3.2.2 Phantom

For the measurements the Specific Anthropomorphic Mannequin (SAM) defined by the IEEE SCC-34/SC2 group is used. The phantom is a polyurethane shell integrated in a wooden table. The thickness of the phantom amounts to 2mm +/- 0.2mm. It enables the dosimetric evaluation of left and right phone usage and includes an additional flat phantom part for the simplified performance check. The phantom set-up includes a cover, which prevents the evaporation of the liquid.

Figure-SN 06/22 SAM 148

Figure-SN 06/22 ELLI 51

3.2.3 Device Holder



The SAR in the phantom is approximately inversely proportional to the square of the distance between the source and the liquid surface. For a source at 5 mm distance, a positioning uncertainty of ± 0.5 mm would produce a SAR uncertainty of ± 20 %. Accurate device positioning is therefore crucial for accurate and repeatable measurements. The positions in which the devices must be measured are defined by the standards.

4. Tissue Simulating Liquids

4.1 Simulating Liquids Parameter Check

The simulating liquids should be checked at the beginning of a series of SAR measurements to determine of the dielectric parameters are within the tolerances of the specified target values

The uncertainty due to the liquid conductivity and permittivity arises from two different sources. The first source of error is the deviation of the liquid conductivity from its target value (max _ 5 %) and the second source of error arises from the measurement procedures used to assess conductivity. The uncertainty shall be assessed using a rectangular probability For 1 g averaging, the maximum weighting coefficient for SAR is 0,5.

IEEE SCC-34/SC-2 RECOMMENDED TISSUE DIELECTRIC PARAMETERS
The head and body tissue dielectric parameters recommended by the IEEE SCC-34/SC-2 have been incorporated in the following table.

Frequency	εr	σ 10g S/m
300	45.3	0.87
450	43.5	0.87
750	41.9	0.89
835	41.5	0.90
900	41.5	0.97
1450	40.5	1.20
1800 to 2000	40.0	1.40
2100	39.8	1.49
2450	39.2	1.80
2600	39.0	1.96
3000	38.5	2.40
3500	37.9	2.91
4000	37.4	3.43
4500	36.8	3.94
5000	36.2	4.45
5200	36.0	4.66
5400	35.8	4.86
5600	35.5	5.07
5800	35.3	5.27

LIQUID MEASUREMENT RESULTS

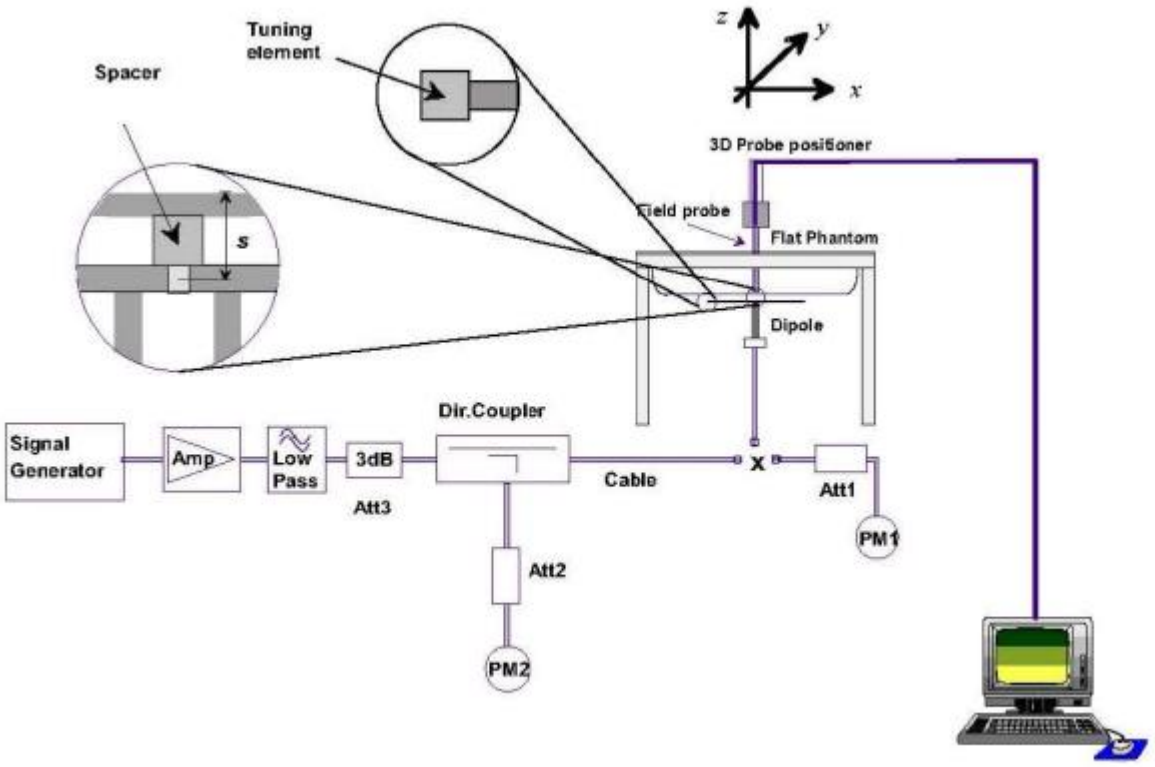
Date	Ambient		Simulating Liquid		Parameters	Target	Measured	Deviation %	Limited %
	Temp. [°C]	Humidity %	Frequency (MHz)	Temp. [°C]					
2023-11-01	20.7	50	2450	20.3	Permittivity	39.20	39.80	1.53	±5
					Conductivity	1.80	1.83	1.67	±5
2023-11-02	23.4	59	5200	23.1	Permittivity	36.00	36.15	0.42	±5
					Conductivity	4.66	4.59	-1.50	±5
2023-11-03	23.7	48	5300	23.4	Permittivity	35.90	36.76	2.40	±5
					Conductivity	4.76	4.78	0.42	±5
2023-11-06	20.4	58	5600	20.0	Permittivity	35.55	36.82	3.57	±5
					Conductivity	5.07	5.05	-0.39	±5
2023-11-07	23.9	43	5800	23.6	Permittivity	35.30	36.56	3.57	±5
					Conductivity	5.27	5.26	-0.19	±5

5. SAR System Validation

5.1 Validation System

Each MVG system is equipped with one or more system validation kits. These units, together with the predefined measurement procedures within the MVG software, enable the user to conduct the system performance check and system validation. System kit includes a dipole, and dipole device holder.

The system check verifies that the system operates within its specifications. It's performed daily or before every SAR measurement. The system check uses normal SAR measurement in the flat section of the phantom with a matched dipole at a specified distance. The system validation setup is shown as below.



5.2 Validation Result

Comparing to the original SAR value provided by MVG, the validation data should be within its specification of ±10 %.

Date	Freq.	Power	Power drift	Tested Value	Normalized SAR	Target SAR	Tolerance
	(MHz)	(mW)	(%)	(W/Kg)	(W/kg)	1g(W/kg)	(%)
2023-11-01	2450	100	2.17	5.430	54.30	54.28	0.04
2023-11-02	5200	100	0.88	7.781	77.81	80.97	-3.90
2023-11-03	5300	100	-1.73	8.002	80.02	84.61	-5.42
2023-11-06	5600	100	0.49	7.857	78.57	80.96	-2.95
2023-11-07	5800	100	1.65	7.534	75.34	81.67	-7.75

Note:

1. The tolerance limit of System validation ±10%.
2. The dipole input power (forward power) was 100 mW.
3. The results are normalized to 1 W input power.

6. SAR Evaluation Procedures

The procedure for assessing the average SAR value consists of the following steps:

The following steps are used for each test position

- Establish a call with the maximum output power with a base station simulator. The connection between the mobile and the base station simulator is established via air interface

- Measurement of the local E-field value at a fixed location. This value serves as a reference value for calculating a possible power drift.

- Measurement of the SAR distribution with a grid of 8 to 16mm * 8 to16 mm and a constant distance to the inner surface of the phantom. Since the sensors cannot directly measure at the inner phantom surface, the values between the sensors and the inner phantom surface are extrapolated. With these values the area of the maximum SAR is calculated by an interpolation scheme.

- Around this point, a cube of 30 * 30 * 30 mm or 32 * 32 * 32 mm is assessed by measuring 5 or 8 * 5 or 8*4 or 5 mm. With these data, the peak spatial-average SAR value can be calculated.

➢ Area Scan& Zoom Scan

First Area Scan is used to locate the approximate location(s) of the local peak SAR value(s). The measurement grid within an Area Scan is defined by the grid extent, grid step size and grid offset. Next, in order to determine the EM field distribution in a three-dimensional spatial extension, Zoom Scan is required. The Zoom Scan is performed around the highest E-field value to determine the averaged SAR-distribution over 10 g. Area scan and zoom scan resolution setting follows KDB 865664 D01 quoted below.

When the 1-g SAR of the highest peak is within 2 dB of the SAR limit, additional zoom scans are required for other peaks within 2 dB of the highest peak that have not been included in any zoom scan to ensure there is no increase in SAR.

7. EUT Antenna Location Sketch

It is a NAUTIZ X2-V, support WLAN/BT mode.

Top side

Bottom side
(Back view)

Antenna Separation Distance(cm)						
ANT	Back Side	Front Side	Left Side	Right Side	Top Side	Bottom Side
WLAN/BT	≤0.5	≤0.5	5.5	≤0.5	≤0.5	12.5

Note 1: The antenna information refer the manufacturer provide report, applicable only to the tested sample identified in the report.

7.1 SAR test exclusion consider table

The WLAN/BT SAR evaluation of Maximum power (dBm) summing tolerance.

Exposure Position	Wireless Interface	BT	2.4G WLAN	5.2G WLAN	5.3G WLAN	5.6G WLAN	5.8G WLAN
	Calculated Frequency (GHz)	2.441	2.437	5.2	5.32	5.67	5.825
	Maximum Turn-up power (dBm)	3	13	12	12	13.5	12.5
	Maximum rated power(mW)	2.00	19.95	15.85	15.85	22.39	17.78
Back Side	Separation distance (cm)	≤0.5	≤0.5	≤0.5	≤0.5	≤0.5	≤0.5
	exclusion threshold(mW)	2.75	2.76	1.50	1.47	1.40	1.37
	Testing required?	NO	YES	YES	YES	YES	YES
Front Side	Separation distance (cm)	≤0.5	≤0.5	≤0.5	≤0.5	≤0.5	≤0.5
	exclusion threshold(mW)	2.75	2.76	1.50	1.47	1.40	1.37
	Testing required?	NO	YES	YES	YES	YES	YES
Right Side	Separation distance (cm)	≤0.5	≤0.5	≤0.5	≤0.5	≤0.5	≤0.5
	exclusion threshold(mW)	2.75	2.76	1.50	1.47	1.40	1.37
	Testing required?	NO	YES	YES	YES	YES	YES
Left Edge	Separation distance (cm)	5.5	5.5	5.5	5.5	5.5	5.5
	exclusion threshold(mW)	262.84	262.96	212.63	211.27	207.53	205.97
	Testing required?	NO	NO	NO	NO	NO	NO
Top Edge	Separation distance (cm)	≤0.5	≤0.5	≤0.5	≤0.5	≤0.5	≤0.5
	exclusion threshold(mW)	2.75	2.76	1.50	1.47	1.40	1.37
	Testing required?	NO	YES	YES	YES	YES	YES
Bottom Edge	Separation distance (cm)	12.5	12.5	12.5	12.5	12.5	12.5
	exclusion threshold(mW)	1252.04	1252.25	1159.04	1156.34	1148.85	1145.69
	Testing required?	NO	NO	NO	NO	NO	NO

Note：

1. maximum power is the source-based time-average power and represents the maximum RF output power among production units.
2. Per KDB 447498 D04, for larger devices, the test separation distance of adjacent edge configuration is determined by the closest separation between the antenna and the user.
3. Per KDB 447498 D04, if the maximum time-averaged power available does not exceed 1 mW. This stand-alone SAR exemption test.
4. Per KDB 447498 D04, the available maximum time-averaged power or effective radiated power (ERP), whichever is greater, is less than or equal to the threshold Pth (mW) described in the following formula. This method shall only be used at separation distances (cm) from 0.5 centimeters to 40 centimeters and at frequencies from 0.3 GHz to 6 GHz (inclusive). Pth is given by:

$$P_{th}\ (\text{mW}) = \begin{cases} ERP_{20\ cm}(d/20\ \text{cm})^{x} & d \le 20\ \text{cm} \\ ERP_{20\ cm} & 20\ \text{cm} < d \le 40\ \text{cm} \end{cases}$$

Where

$$x = -\log_{10}\left(\frac{60}{ERP_{20\ cm}\sqrt{f}}\right) \text{ and } f \text{ is in GHz;}$$

and

$$ERP_{20\ cm}\ (\text{mW}) = \begin{cases} 2040f & 0.3\ \text{GHz} \le f < 1.5\ \text{GHz} \\ 3060 & 1.5\ \text{GHz} \le f \le 6\ \text{GHz} \end{cases}$$

d = the separation distance (cm);

5. Per KDB 447498 D04, An alternative to the SAR-based exemption is using below table and the minimum separation distance (R in meters) from the body of a nearby person for the frequency (f in MHz) at which the source operates, the ERP (watts) is no more than the calculated value prescribed for that frequency. For the exemption in below table to apply, R must be at least λ/2π, where λ is the free-space operating wavelength in meters. If the ERP of a single RF source is not easily obtained, then the available maximum time-averaged power may be used in lieu of ERP if the physical dimensions of the radiating structure(s) do not exceed the electrical length of λ/4 or if the antenna gain is less than that of a half-wave dipole (1.64 linear value).

RF Source frequency (MHz)	Threshold ERP (watts)
0.3-1.34	1,920 R^2.
1.34-30	3,450 R^2/f^2.
30-300	3.83 R^2.
300-1,500	0.0128 R^2f.
1,500-100,000	19.2R^2.

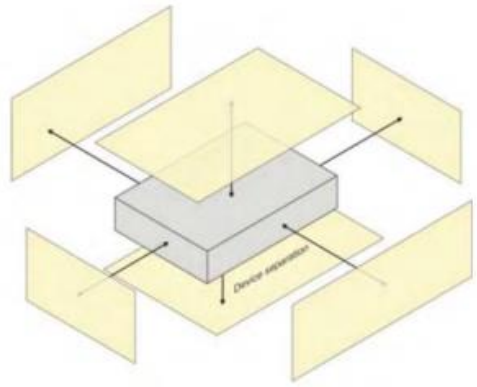
6. Per KDB 248227 D01, choose the highest output power channel to test SAR and determine further SAR exclusion 8.for each frequency band ,testing at higher data rates and higher order modulations is not required when the maximum average output power for each of each of these configurations is less than 1/4db higher than those measured at the lower data rate than 11b mode ,thus the SAR can be excluded.

8. EUT Test Position

This EUT was tested in Back Side, Front Side, Right Side and Top Side.

8.1 Body-worn Position Conditions

For handsets that support hotspot mode operations, with wireless router capabilities and various web browsing function, the relevant hand and body exposure condition are tested according to the hotspot SAR procedures in KDB 941225. A test separation distance of 10 mm is required between the phantom and all surface and edges with a transmitting antenna located within 25 mm form that surface or edge. When form factor of a handset is smaller than 9cm x 5cm, a test separation distance of 5mm (instead of 10mm) is required for testing hotspot mode. When the separate distance required for body-worn accessory testing is larger than or equal to that tested for hotspot mode, in the same wireless mode and for the same surface of the phone, the hotspot mode SAR data may be used to support body-worn accessory SAR compliance for that particular configuration (surface).



9. Uncertainty

9.1 Measurement Uncertainty

The following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in IEEE 1528: 2013.This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

Symbol	Uncertainty Component	Prob. Dist.	Unc. $a(x_i)$	Div. q_i	$u(x_i) = a(x_i)/q_i$	C_i	$u(y) = C_i * u(x_i)$	v_i
Measurement system errors								
CF	Probe calibration	N (k = 2)	5.8	2	2.90	1	2.90	∞
CF_{drift}	Probe calibration drift	R	0.12	√3	0.07	1	0.07	∞
LIN	Probe linearity and detection limit	R	1.91	√3	1.10	1	1.10	∞
BBS	Broadband signal	R	0.15	√3	0.09	1	0.09	∞
ISO	Probe isotropy	R	0.18	√3	0.10	1	0.10	∞
DAE	Other probe and data acquisition errors	N	2.7	1	2.70	1	2.70	∞
AMB	RF ambient and noise	N	1.73	1	1.73	1	1.73	∞
Δ_{xyz}	Probe positioning errors	N	0.81	1	0.81	2/δ	0.81	
DAT	Data processing errors	N	2.5	1	2.50	1	2.50	∞
Phantom and device (DUT or validation antenna) errors								
LIQ(σ)	Measurement of phantom conductivity(σ)	N	4.4	1	4.4	cε, cσ	4.40	∞
$LIQ(T_c)$	Temperature effects (medium)	R	2.9	√3	1.67	cε, cσ	1.67	∞
EPS	Shell permittivity	R	3.4	√3	1.96	See 8.4.2.3	0.49	∞
DIS	Distance between the radiating element of the DUT and the phantom medium	N	0.8	1	0.8	2	1.60	∞
D_{xyz}	Repeatability of positioning the DUT or source against the phantom	N	1.5	1	1.5	1	1.50	5
H	Device holder effects	N	3	1	3	1	3.00	
MOD	Effect of operating mode on probe sensitivity	R	3.59	√3	2.07	1	2.07	∞
TAS	Time-average SAR	R	1.73	√3	1.00	1	1.00	∞
RF_{drift}	Variation in SAR due to drift in output of DUT	N	2.89	1	2.89	1	2.89	
VAL	Validation antenna uncertainty (validation measurement only)	N	1.45	1	1.45	1	1.45	
P_{in}	Uncertainty in accepted power (validation measurement only)	N	2.5	1	2.5	1	2.50	
Corrections to the SAR result (if applied)								
$C(\varepsilon', \sigma)$	Phantom deviation from target (ε', σ)	N	2.31	1	2.31	1	2.31	
C(R)	SAR scaling	R	1.15	√3	0.66	1	0.66	
u(ΔSAR)	Combined uncertainty						9.53	
U	Expanded uncertainty and effective degrees of freedom					U =	19.06	

10. Conducted Power Measurement

10.1 Test Result:

2.4G WLAN

2.4GWIFI				
Mode	Channel Number	Frequency (MHz)	Output Power (dBm)	Output Power (mW)
802.11b	1	2412	12.62	18.28
	6	2437	12.74	18.79
	11	2462	12.39	17.34
802.11g	1	2412	12.67	18.49
	6	2437	12.77	18.92
	11	2462	12.19	16.56
802.11 n-HT20	1	2412	12.34	17.14
	6	2437	12.17	16.48
	11	2462	12.09	16.18
802.11 n-HT40	3	2422	12.57	18.07
	6	2437	12.77	18.92
	9	2452	12.52	17.86

Bluetooth

BT				
Mode	Channel Number	Frequency (MHz)	Average Power (dBm)	Output Power (mW)
GFSK(1Mbps)	0	2402	2.01	1.59
	39	2441	2.87	1.94
	78	2480	2.69	1.86
π/4-QPSK(2Mbps)	0	2402	-1.45	0.72
	39	2441	-0.66	0.86
	78	2480	-0.08	0.98
8DPSK(3Mbps)	0	2402	-1.22	0.76
	39	2441	-0.64	0.86
	78	2480	-0.23	0.95

BLE

BLE				
Mode	Channel Number	Frequency (MHz)	Average Power (dBm)	Output Power (mW)
GFSK(1Mbps)	0	2402	-0.11	0.97
	19	2440	-0.24	0.95
	39	2480	0.59	1.15
GFSK(2Mbps)	0	2402	-0.69	0.85
	19	2440	-0.17	0.96
	39	2480	-0.07	0.98

WLAN (5.2Gband)

5.2G WLAN				
Mode	Channel Number	Frequency (MHz)	Output Power (dBm)	Output Power (mW)
802.11a20	36	5180	11.44	13.93
	40	5200	11.79	15.10
	48	5240	11.19	13.15
802.11 n-HT20	36	5180	11.18	13.12
	40	5200	11.38	13.74
	48	5240	11.39	13.77
802.11 n-HT40	38	5190	11.25	13.34
	46	5230	11.44	13.93
802.11 ac-VHT20	36	5180	8.88	7.73
	40	5200	8.43	6.97
	48	5240	7.58	5.73
802.11 ac-VHT40	38	5190	8.31	6.78
	46	5230	8.01	6.32
802.11ac-VHT80	42	5210	11.44	13.93

WLAN (5.3Gband)

5.3G WLAN				
Mode	Channel Number	Frequency (MHz)	Output Power (dBm)	Output Power (mW)
802.11a20	52	5260	11.28	13.43
	60	5300	11.23	13.27
	64	5320	11.65	14.62
802.11 n-HT20	52	5260	11.04	12.71
	60	5300	11.00	12.59
	64	5320	11.11	12.91
802.11 n-HT40	54	5270	11.40	13.80
	62	5310	11.06	12.76
802.11 ac-VHT20	52	5260	7.27	5.33
	60	5300	7.39	5.48
	64	5320	7.28	5.35
802.11 ac-VHT40	54	5270	7.45	5.56
	62	5310	7.59	5.74
802.11ac-VHT80	58	5290	11.28	13.43

WLAN (5.6G band)

5.6G WLAN				
Mode	Channel Number	Frequency (MHz)	Output Power (dBm)	Output Power (mW)
802.11a20	100	5500	10.23	10.54
	116	5580	11.84	15.28
	140	5700	12.57	18.07
802.11 n-HT20	100	5500	10.29	10.69
	116	5580	11.68	14.72
	140	5700	12.85	19.28
802.11 n-HT40	102	5510	10.02	10.05
	110	5550	10.62	11.53
	134	5670	12.99	19.91
802.11 ac-VHT20	100	5500	6.56	4.53
	116	5580	7.8	6.03
	140	5700	11.03	12.68
802.11 ac-VHT40	102	5510	6.09	4.06
	110	5550	5.47	3.52
	134	5670	10.47	11.14
802.11ac-VHT80	106	5530	10.91	12.33
	122	5610	11.75	14.96
	138	5690	10.23	10.54

WLAN (5.8G band)

5.8G WLAN				
Mode	Channel Number	Frequency (MHz)	Output Power (dBm)	Output Power (mW)
802.11a20	149	5745	11.68	14.72
	157	5785	12.07	16.11
	165	5825	12.12	16.29
802.11 n-HT20	149	5745	11.60	14.45
	157	5785	11.92	15.56
	165	5825	12.00	15.85
802.11 n-HT40	151	5755	11.63	14.55
	159	5795	11.91	15.52
802.11 ac-VHT20	149	5745	11.26	13.37
	157	5785	11.7	14.79
	165	5825	11.36	13.68
802.11 ac-VHT40	151	5755	11.35	13.65
	159	5795	11.04	12.71
802.11ac-VHT80	155	5775	11.68	14.72

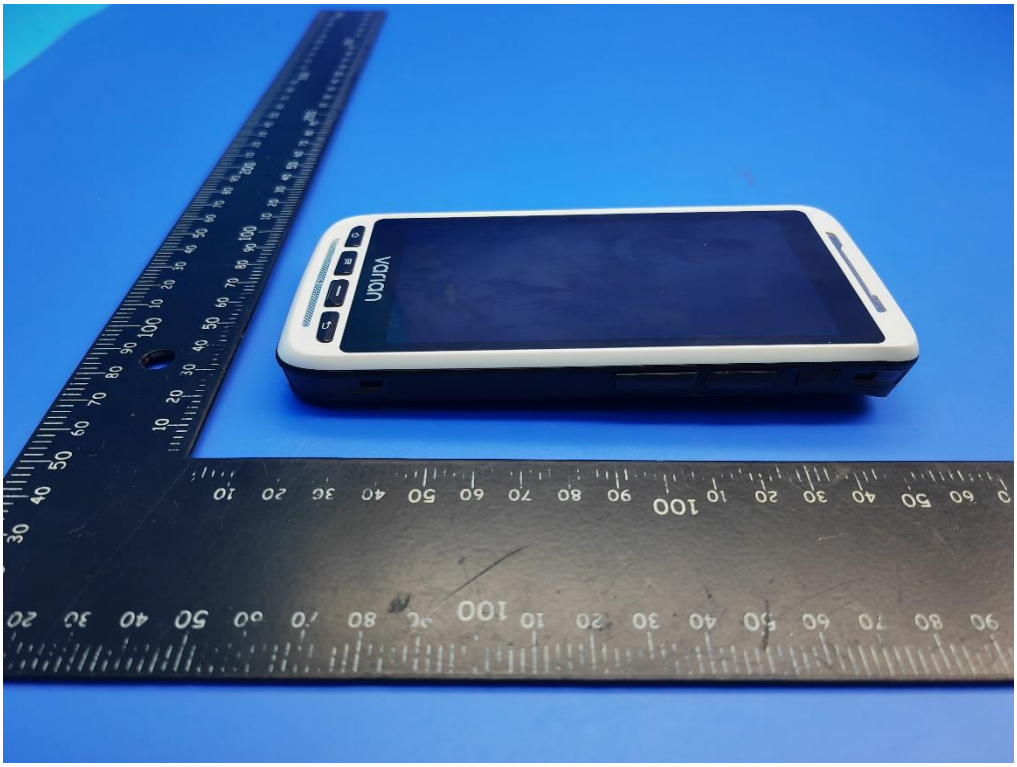
11. EUT and Test Setup Photo

11.1 EUT Photos

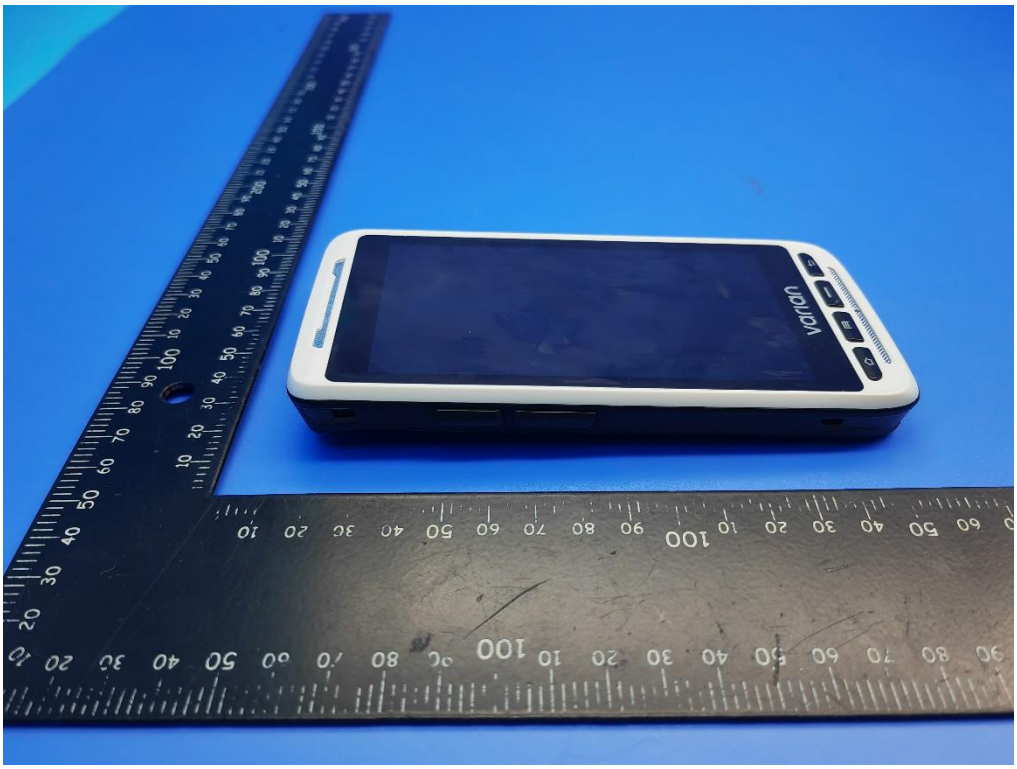
Front side

Back side

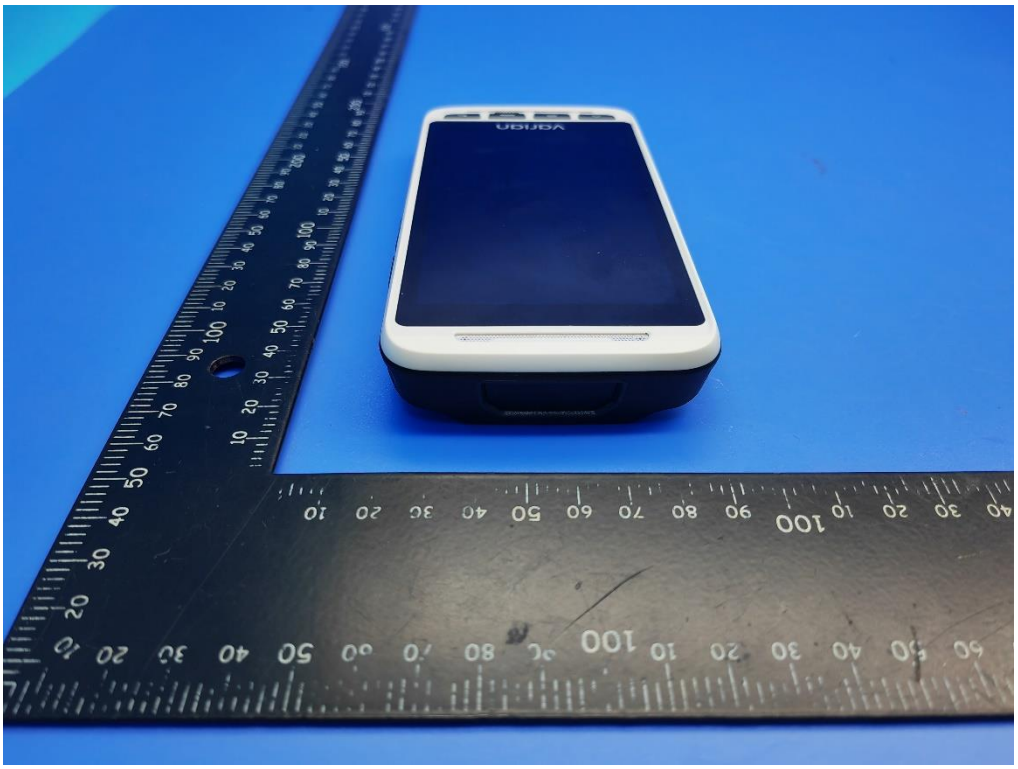
Right Edge



Left Edge



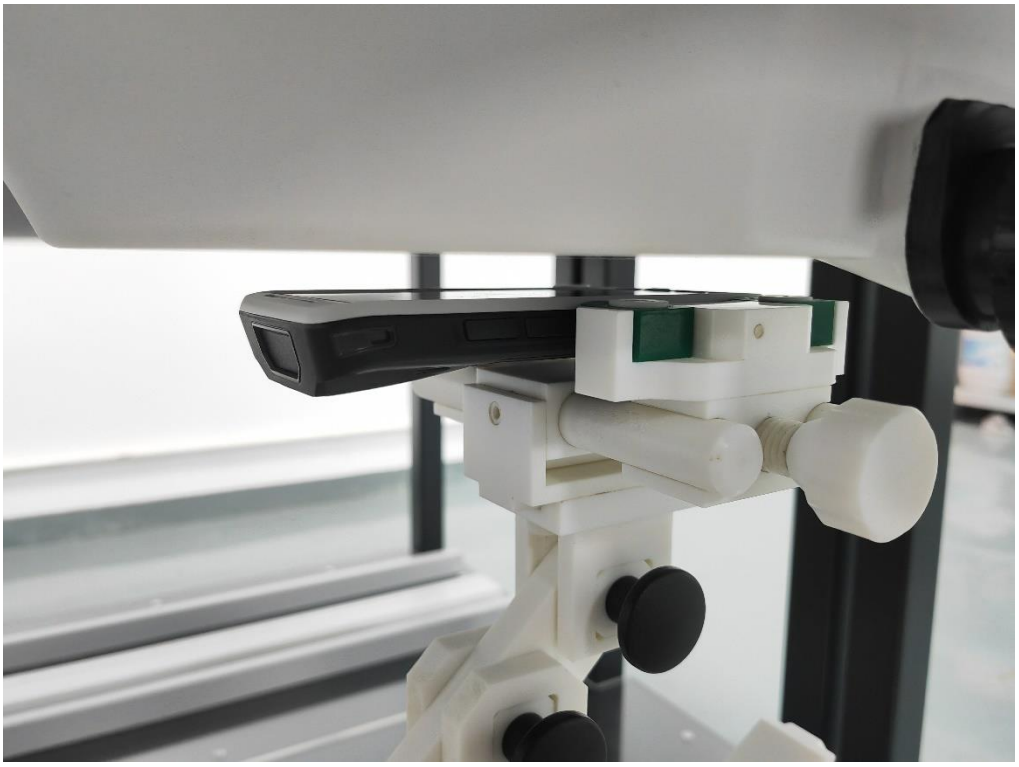
Top Edge



Bottom Edge

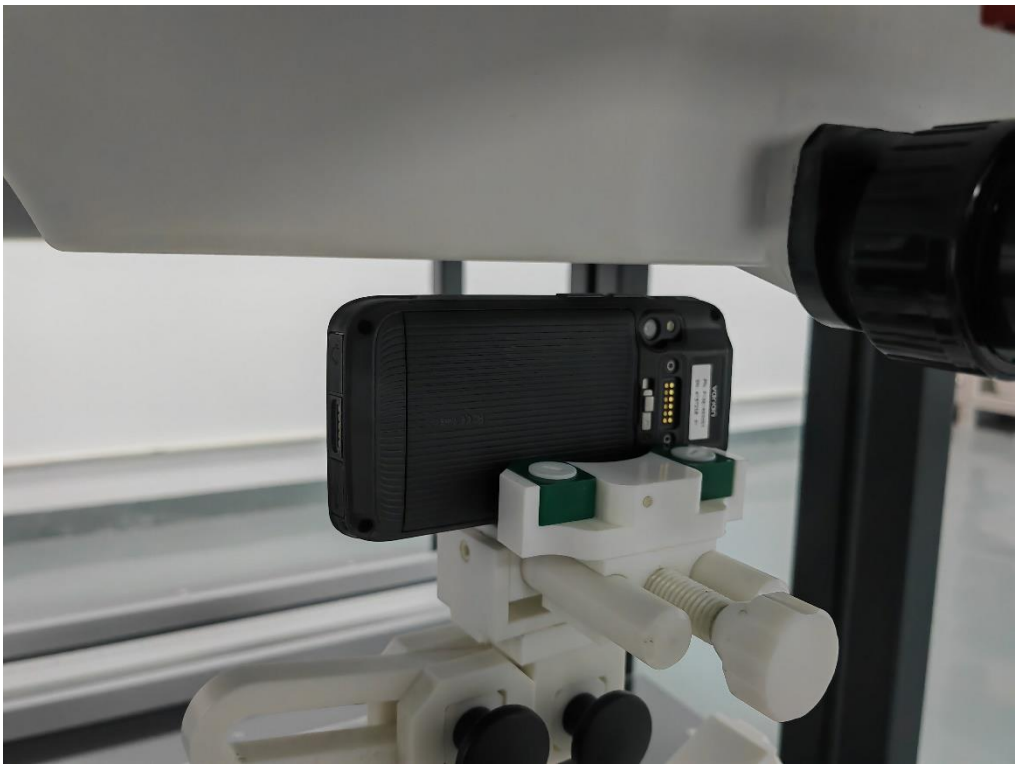
11.2 Setup Photos

Body Front side (separation distance is 10mm)



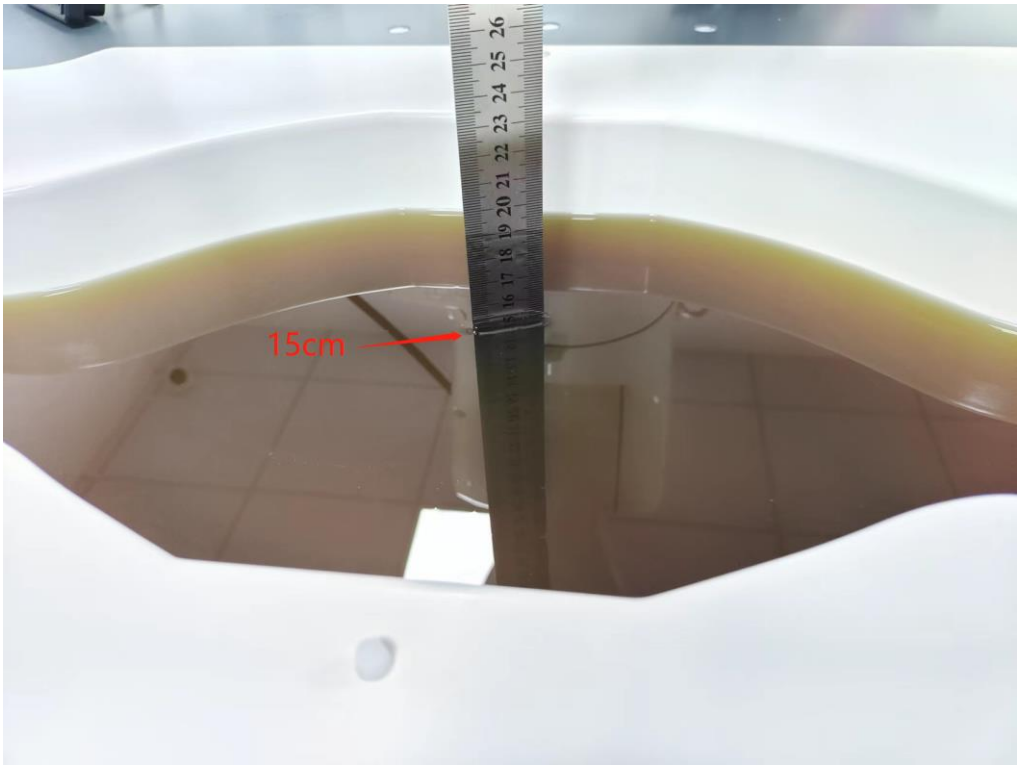
Body Back side (separation distance 10mm)

Body Right side (separation distance is 10mm)



Body Top side (separation distance is 10mm)

Liquid depth (15 cm)



12. SAR Result Summary

12.1 Body-worn and Hotspot SAR

Band	Model	Test Position	Freq.	SAR (1g) (W/kg)	Power Drift (%)	Max. Turn-up Power(dBm)	Meas. Output Power(dBm)	Scaled SAR (W/Kg)	Meas. No.
2.4GHz WLAN	802.11b	Front Side	2437	0.150	-3.31	13.00	12.74	0.159	/
		Back Side	2437	0.197	-0.76	13.00	12.74	**0.209**	**1**
		Right Side	2437	0.099	-3.86	13.00	12.74	0.105	/
		Top Side	2437	0.192	-3.67	13.00	12.74	0.204	/
BT	GFSK	Front Side	2441	0.087	-2.52	3.00	2.87	0.090	/
		Back Side	2441	0.110	0.84	3.00	2.87	0.113	/
		Right Side	2441	0.069	-0.50	3.00	2.87	0.071	/
		Top Side	2441	0.136	3.24	3.00	2.87	**0.140**	**2**
5.2GHz WLAN	802.11a	Front Side	5200	0.399	3.61	12.00	11.79	0.419	/
		Back Side	5200	0.402	3.40	12.00	11.79	0.422	/
		Right Side	5200	0.110	-3.72	12.00	11.79	0.115	/
		Top Side	5200	0.564	3.34	12.00	11.79	**0.592**	**3**
5.3GHz WLAN	802.11a	Front Side	5320	0.493	3.55	12.00	11.65	0.534	/
		Back Side	5320	0.409	-1.80	12.00	11.65	0.443	/
		Right Side	5320	0.188	2.99	12.00	11.65	0.204	/
		Top Side	5260	0.624	0.67	12.00	11.28	0.737	/
		Top Side	5300	0.578	-1.71	12.00	11.23	0.690	/
		Top Side	5320	0.697	3.65	12.00	11.65	**0.755**	**4**
5.6GHz WLAN	802.11n-HT40	Front Side	5670	0.455	-1.51	13.50	12.99	0.512	/
		Back Side	5670	0.366	-0.76	13.50	12.99	0.412	/
		Right Side	5670	0.177	-3.06	13.50	12.99	0.199	/
		Top Side	5670	0.641	-1.45	13.50	12.99	**0.721**	**5**
5.8GHz WLAN	802.11a	Front Side	5825	0.471	-0.16	12.50	12.12	0.514	/
		Back Side	5825	0.401	-3.55	12.50	12.12	0.438	/
		Right Side	5825	0.178	1.34	12.50	12.12	0.194	/
		Top Side	5825	0.682	-2.46	12.50	12.12	**0.744**	**6**

Note:

1. The test separation of all above table is 10mm.
2. Per KDB 447498 D04, the reported SAR is the measured SAR value adjusted for maximum tune-up tolerance.
   a. Tune-up scaling Factor = tune-up limit power (mW) / EUT RF power (mW), where tune-up limit is the maximum rated power among all production units.
   b. Scaled SAR(W/kg) = Measured SAR(W/kg) *Tune-up Scaling Factor
3. When the user enables the personal Wireless router functions for the handsets, actual operations include simultaneous transmission of both the Wi-Fi transmitting frequency and thus cannot be evaluated for SAR under actual use conditions. The “Portable Hotspot” feature on the handset was NOT activated, to ensure the SAR measurements were evaluated for a single transmission frequency RF signal.
4. The Bluetooth and WLAN can’t simultaneous transmission at the same time.

13. Equipment List

Kind of Equipment	Manufacturer	Type No.	Serial No.	Last Calibration	Calibrated Until
2450MHz Dipole	MVG	DIP2G450	SN 06/22 DIP2G450-645	2022.02.11	2025.02.10
5000MHz Dipole	MVG	DIP5G000	SN 06/22 DIP5G000-653	2022.02.11	2025.02.10
E-Field Probe	MVG	EPGO364	SN 04/22 EPGO364	2023.02.10	2024.02.09
Liquid Calibration Kit	MVG	OCPG 87	SN 06/22 OCPG87	2023.02.10	2024.02.09
Antenna	MVG	ANTA 73	SN 06/22 ANTA 73	N/A	N/A
Ellipsoid Phantom	MVG	ELLI 51	SN 06/22 ELLI 51	N/A	N/A
Phantom	MVG	SAM 148	SN 06/22 SAM148	N/A	N/A
Phone holder	MVG	MSH 117	SN 06/22 MSH 117	N/A	N/A
Laptop holder	MVG	LSH 36	SN 06/22 LSH 38	N/A	N/A
Directional coupler	SHW	SHWDCP	202303280013	N/A	N/A
Network Analyzer	Agilent	E5071C	MY46418070	2023.03.27	2024.03.26
Multi Meter	Keithley	DMM6500	DMM6500	2023.03.27	2024.03.26
Signal Generator	Keithley	N5182B	MY59100717	2023.04.07	2024.04.06
Wireless Communication Test Set	R&S	CMW500	137737	2023.04.14	2024.04.13
Power Sensor	R&S	Z11	116184	2023.03.27	2024.03.26
Temperature hygrometer	N/A	ST-W2318	N/A	2023.04.24	2024.04.23
Thermograph	N/A	TP101	N/A	2023.04.25	2024.04.24

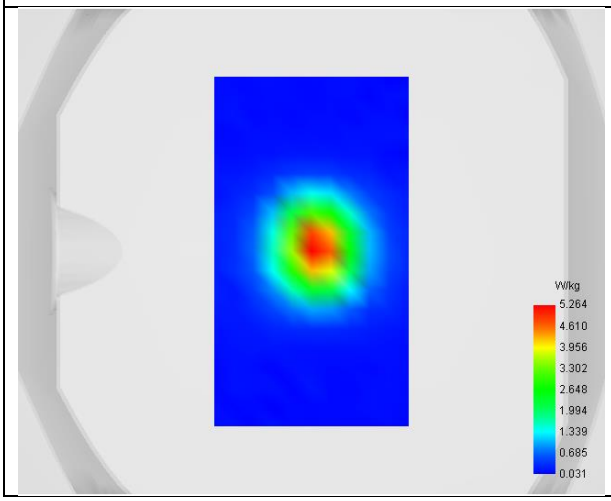
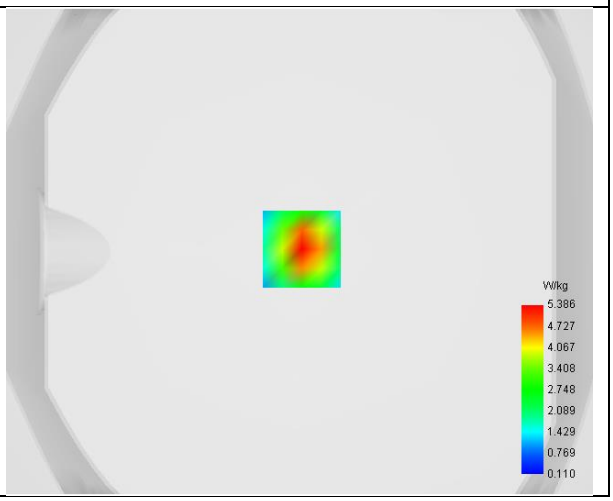
Appendix A. System Validation Plots

System Performance Check Data (2450MHz)

Type: Phone measurement (Complete)
Area scan resolution: dx=8mm, dy=8mm
Zoom scan resolution: dx=8mm, dy=8mm, dz=5mm
Date of measurement: 2023-11-01

Experimental conditions.

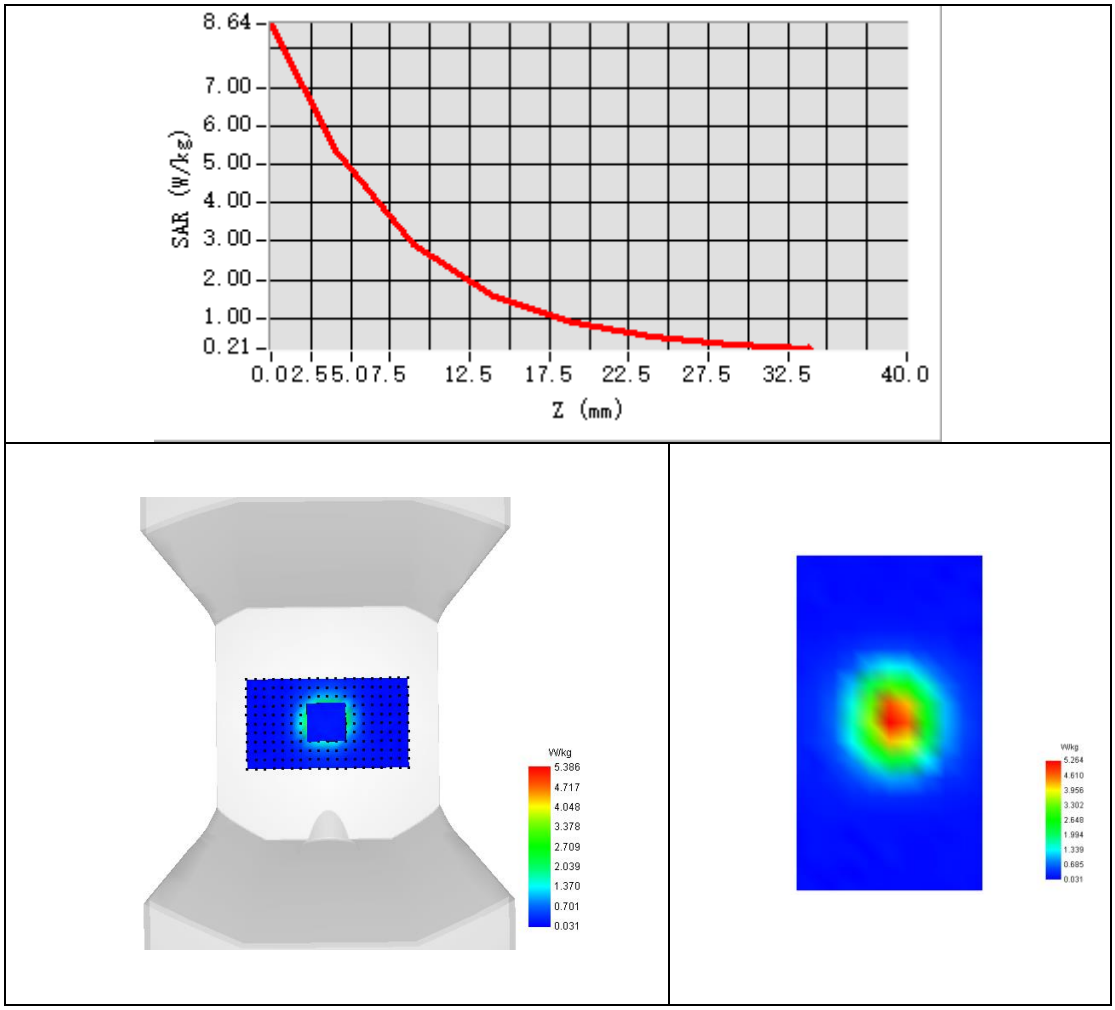
Phantom	Validation plane
Device Position	Dipole
Band	CW2450
Channels	Middle
Signal	CW
Frequency (MHz)	2450.000
Relative permittivity	39.80
Conductivity (S/m)	1.83
Probe	SN 04/22 EPGO364
ConvF	2.33
Crest factor:	1:1

SURFACE	VOLUME SAR
	

Maximum location: X=1.00, Y=1.00 ; SAR Peak: 8.64 W/kg

SAR 10g (W/Kg)	2.364
SAR 1g (W/Kg)	5.430

Z Axis Scan

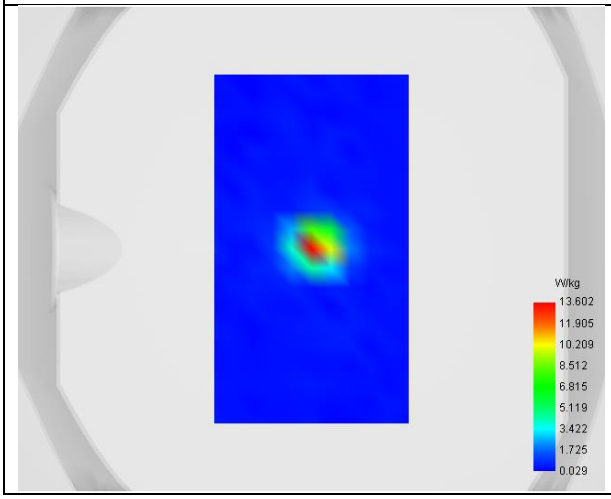
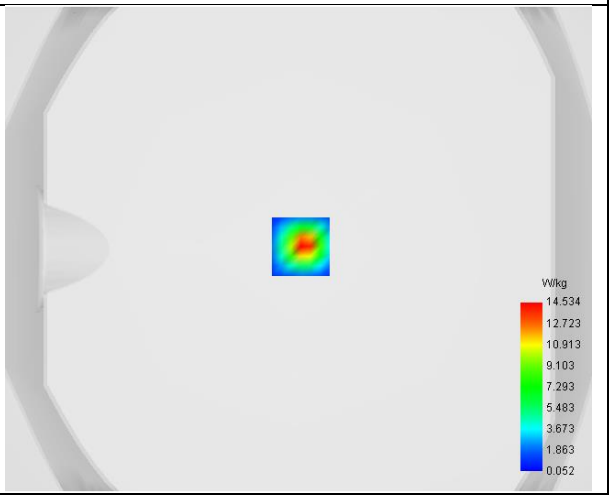

8.64
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.21
SAR (W/kg)
0.0 2.5 5.0 7.5 12.5 17.5 22.5 27.5 32.5 40.0
Z (mm)
W/kg
5.386
4.717
4.048
3.378
2.709
2.039
1.370
0.701
0.031

System Performance Check Data (5200MHz)

Type: Phone measurement (Complete)
Area scan resolution: dx=8mm, dy=8mm
Zoom scan resolution: dx=4mm dy=4mm dz=2mm
Date of measurement: 2023-11-02

Experimental conditions.

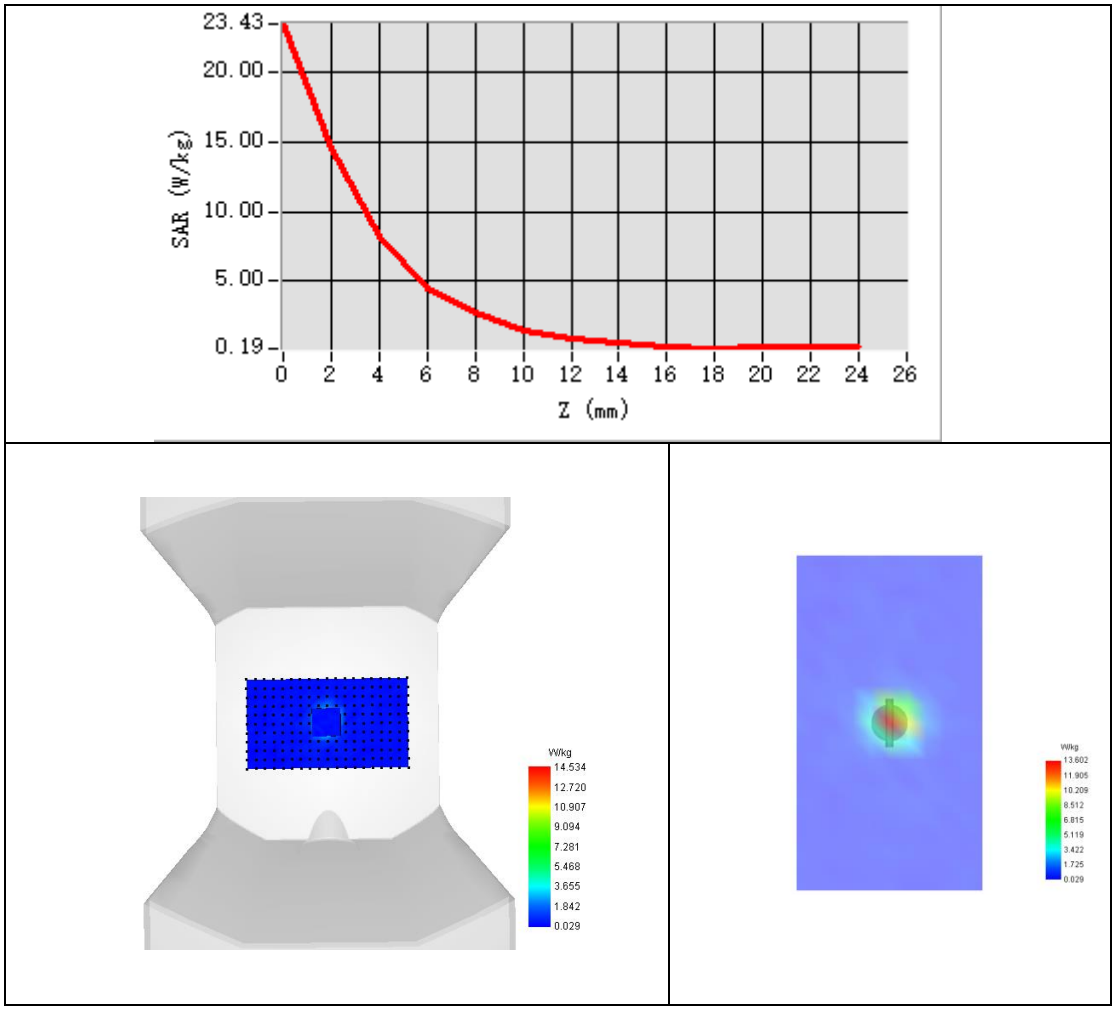
Phantom	Validation plane
Device Position	Dipole
Band	CW5200
Channels	Middle
Signal	CW
Frequency (MHz)	5200.000
Relative permittivity	36.15
Conductivity (S/m)	4.59
Probe	SN 04/22 EPGO364
ConvF	1.95
Crest factor:	1:1

SURFACE	VOLUME SAR
	

Maximum location: X=1.00, Y=1.00 ; SAR Peak: 24.74 W/kg

SAR 10g (W/Kg)	2.193
SAR 1g (W/Kg)	7.781

Z Axis Scan

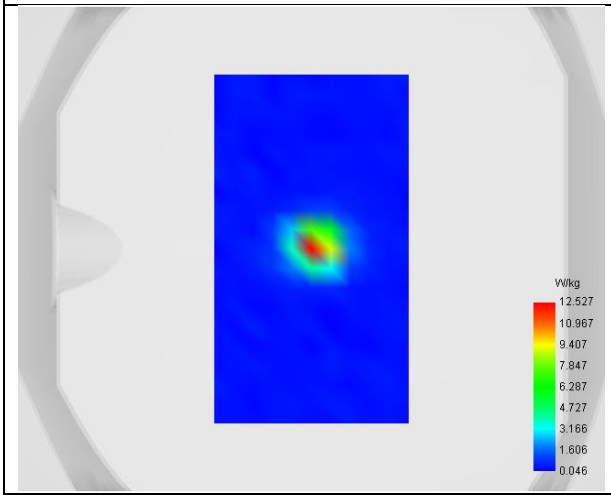
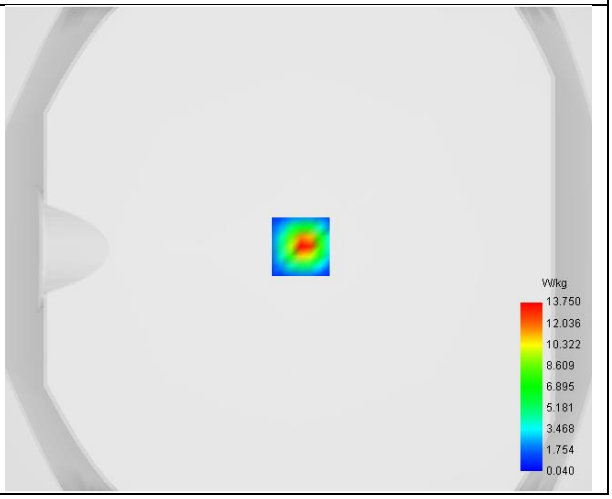

23.43
20.00
15.00
10.00
5.00
0.19
SAR (W/kg)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
Z (mm)
W/kg
14.534
12.720
10.907
9.094
7.281
5.468
3.655
1.842
0.029
W/kg
13.602
11.905
10.209
8.512
6.815
5.119
3.422
1.725
0.029

System Performance Check Data (5400MHz)

Type: Phone measurement (Complete)
Area scan resolution: dx=8mm, dy=8mm
Zoom scan resolution: dx=4mm dy=4mm dz=2mm
Date of measurement: 2023-11-03

Experimental conditions.

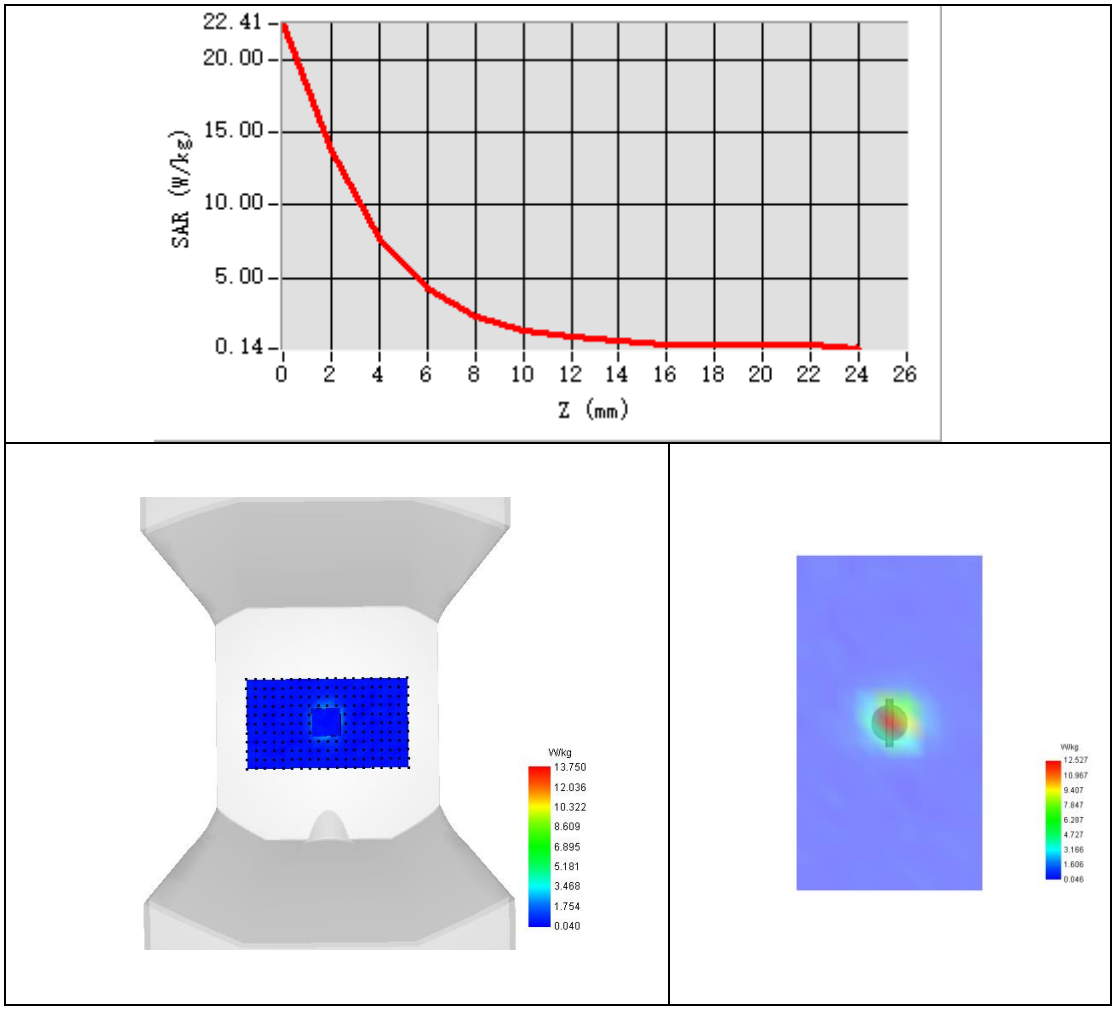
Phantom	Validation plane
Device Position	Dipole
Band	CW5400
Channels	Middle
Signal	CW
Frequency (MHz)	5400.000
Relative permittivity	36.76
Conductivity (S/m)	4.78
Probe	SN 04/22 EPGO364
ConvF	1.85
Crest factor:	1:1

SURFACE	VOLUME SAR
	

Maximum location: X=1.00, Y=1.00 ; SAR Peak: 22.86 W/kg

SAR 10g (W/Kg)	2.215
SAR 1g (W/Kg)	8.002

Z Axis Scan

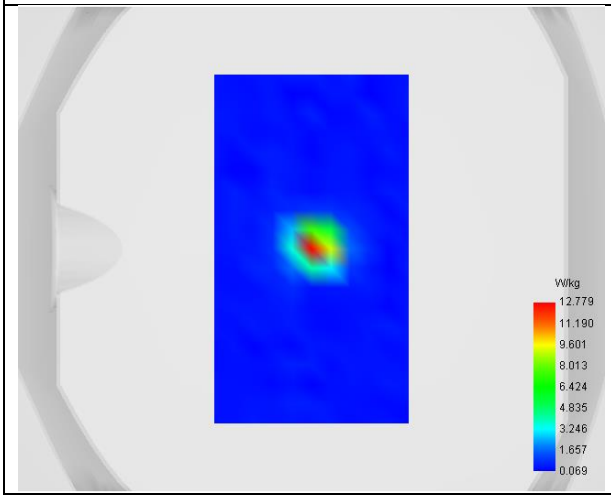
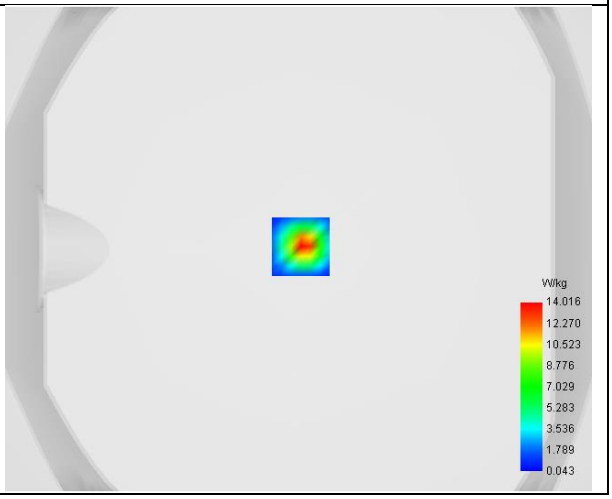

22.41
20.00
15.00
10.00
5.00
0.14
SAR (W/kg)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
Z (mm)
W/kg
13.750
12.036
10.322
8.609
6.895
5.181
3.468
1.754
0.040
W/kg
12.527
10.967
9.407
7.847
6.287
4.727
3.166
1.606
0.046

System Performance Check Data (5600MHz)

Type: Phone measurement (Complete)
Area scan resolution: dx=8mm, dy=8mm
Zoom scan resolution: dx=4mm dy=4mm dz=2mm
Date of measurement: 2023-11-06

Experimental conditions.

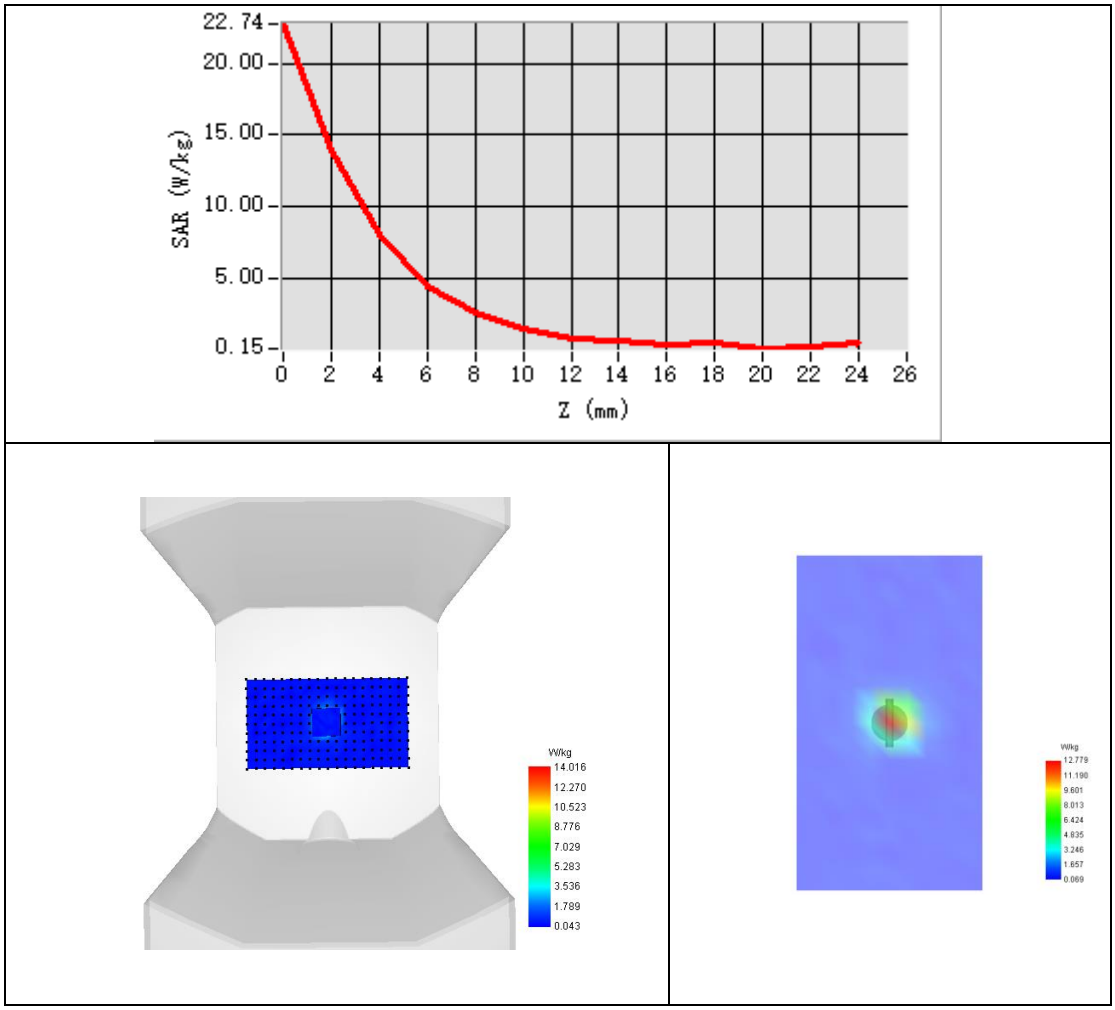
Phantom	Validation plane
Device Position	Dipole
Band	CW5600
Channels	Middle
Signal	CW
Frequency (MHz)	5600.000
Relative permittivity	36.82
Conductivity (S/m)	5.05
Probe	SN 04/22 EPGO364
ConvF	1.86
Crest factor:	1:1

SURFACE	VOLUME SAR
	

Maximum location: X=1.00, Y=1.00 ; SAR Peak: 23.19 W/kg

SAR 10g (W/Kg)	2.225
SAR 1g (W/Kg)	7.857

Z Axis Scan

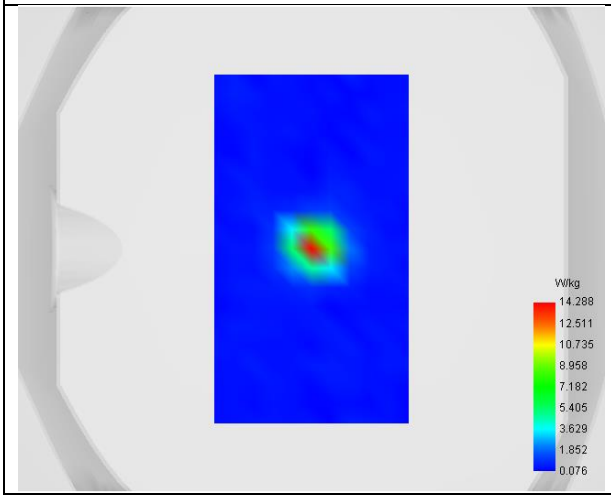
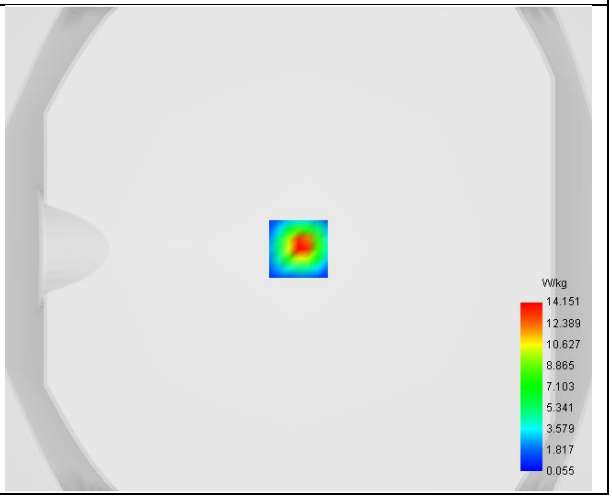

22.74
20.00
15.00
10.00
5.00
0.15
SAR (W/kg)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
Z (mm)
W/kg
14.016
12.270
10.523
8.776
7.029
5.283
3.536
1.789
0.043
W/kg
12.779
11.190
9.601
8.013
6.424
4.835
3.246
1.657
0.069

System Performance Check Data (5800MHz)

Type: Phone measurement (Complete)
Area scan resolution: dx=8mm, dy=8mm
Zoom scan resolution: dx=4mm dy=4mm dz=2mm
Date of measurement: 2023-11-07

Experimental conditions.

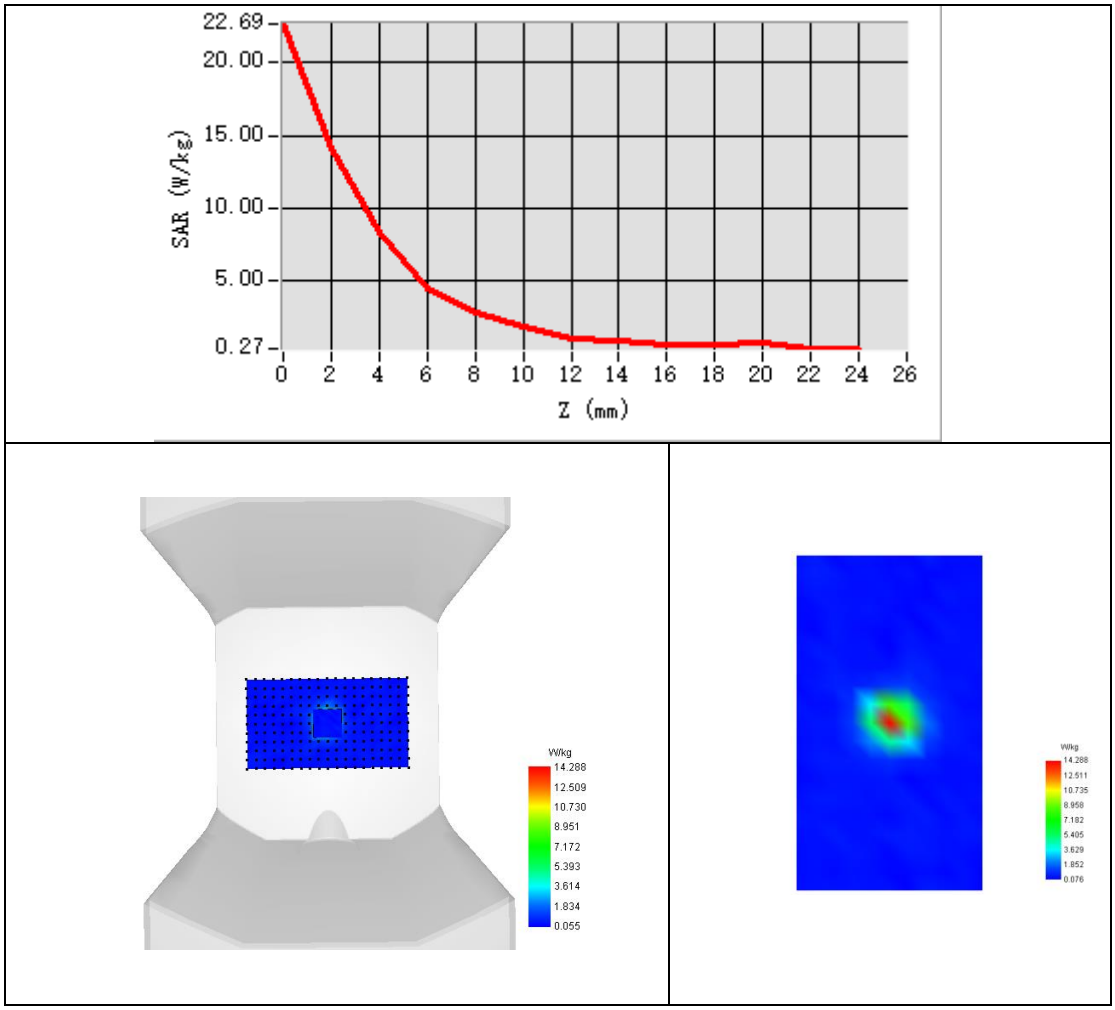
Phantom	Validation plane
Device Position	Dipole
Band	CW5800
Channels	Middle
Signal	CW
Frequency (MHz)	5800.000
Relative permittivity	36.56
Conductivity (S/m)	5.26
Probe	SN 04/22 EPGO364
ConvF	1.73
Crest factor:	1:1

SURFACE	VOLUME SAR
	

Maximum location: X=0.00, Y=0.00 ; SAR Peak: 24.28 W/kg

SAR 10g (W/Kg)	2.176
SAR 1g (W/Kg)	7.534

Z Axis Scan


22.69
20.00
15.00
10.00
5.00
0.27
SAR (W/kg)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
Z (mm)
W/kg
14.288
12.509
10.730
8.951
7.172
5.393
3.614
1.834
0.055

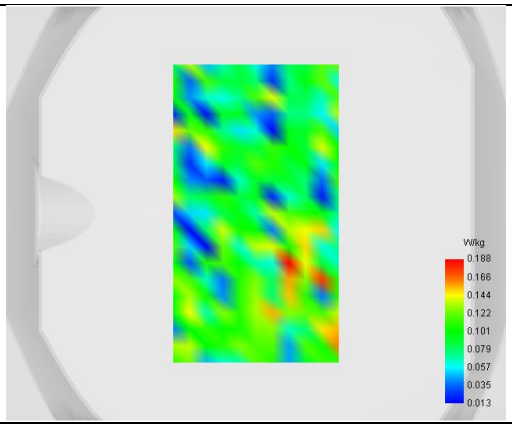
Appendix B. SAR Test Plots

Plot 1:

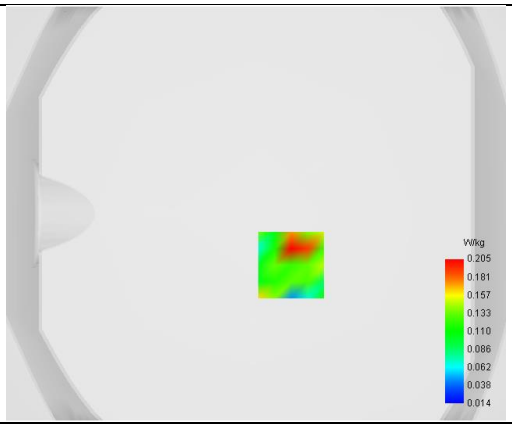
Test Date	2023-11-01
Area Scan	dx=8mm, dy=8mm
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm
Phantom	Validation plane
Device Position	Back Side
Band	IEEE 802.11b ISM
Signal	IEEE 802.11
Frequency	2437
SAR 10g (W/Kg)	0.107
SAR 1g (W/Kg)	0.197
ConvF	2.33
Relative permittivity	39.80
Conductivity (S/m)	1.83

Maximum location: X=17.00, Y=-25.00 ; SAR Peak: 0.40 W/kg

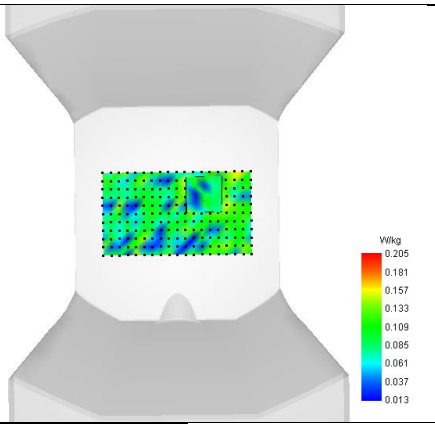
SURFACE SAR



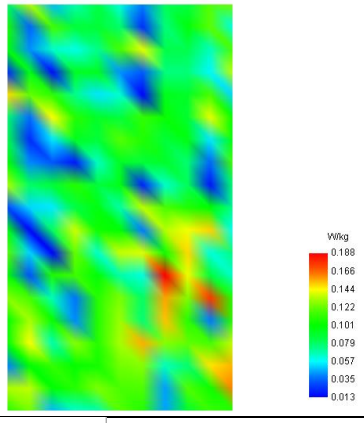
VOLUME SAR

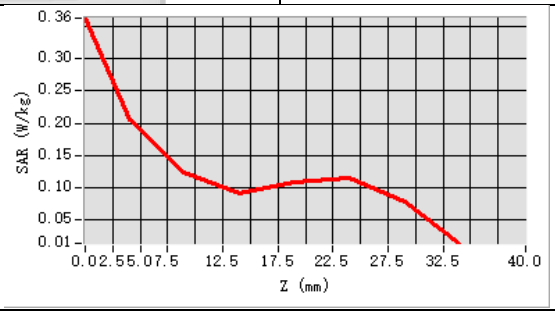


3D screen shot



Hot spot position



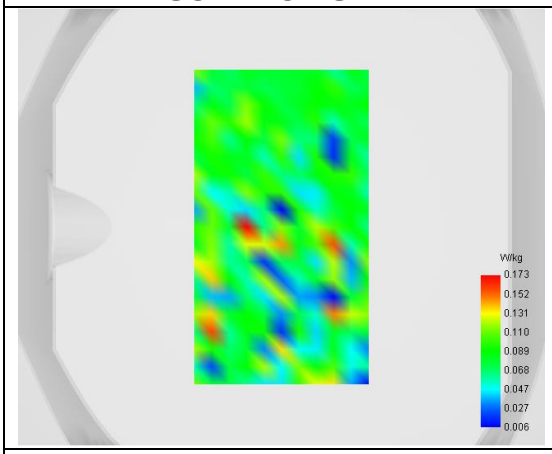


Plot 2:

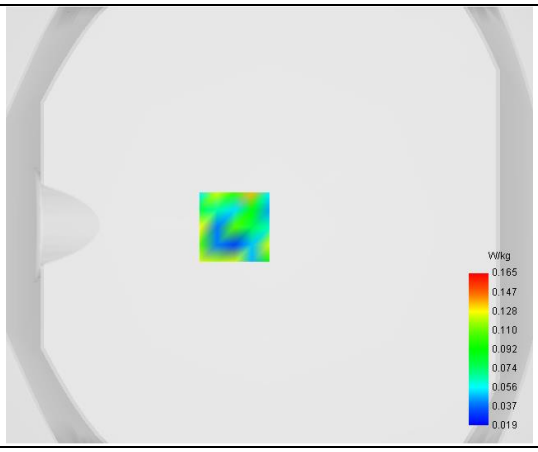
Test Date	2023-11-01
Area Scan	dx=8mm, dy=8mm
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm
Phantom	Validation plane
Device Position	Top Side
Band	Bluetooth
Signal	GFSK
Frequency	2441
SAR 10g (W/Kg)	0.080
SAR 1g (W/Kg)	0.136
ConvF	2.33
Relative permittivity	39.80
Conductivity (S/m)	1.83

Maximum location: X=-16.00, Y=-1.00 ; SAR Peak: 0.43 W/kg

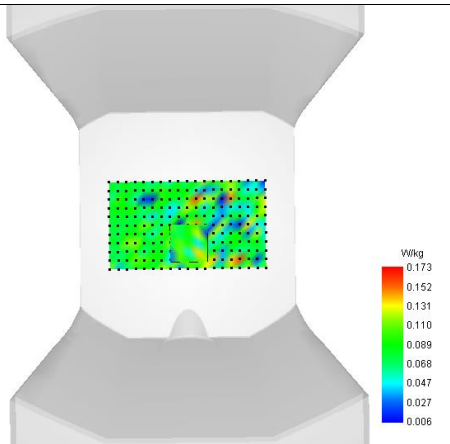
SURFACE SAR



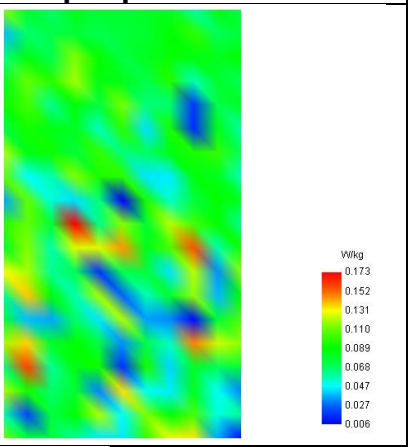
VOLUME SAR

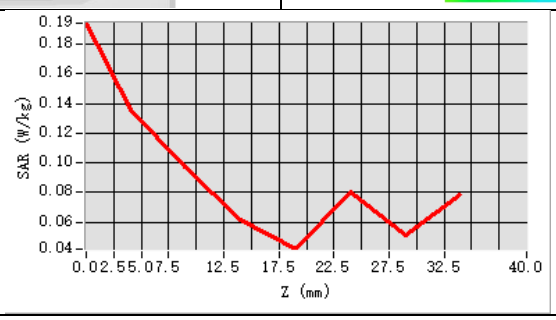


3D screen shot



Hot spot position



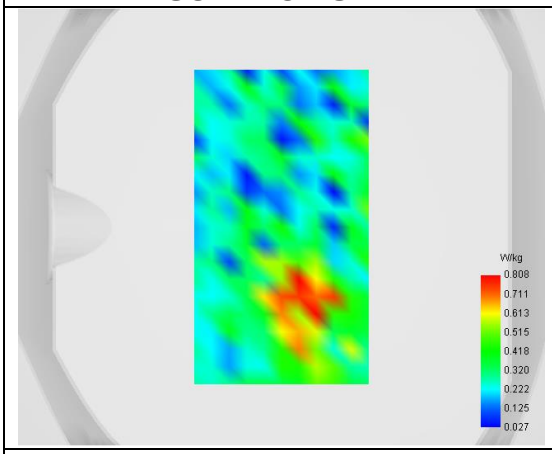


Plot 3:

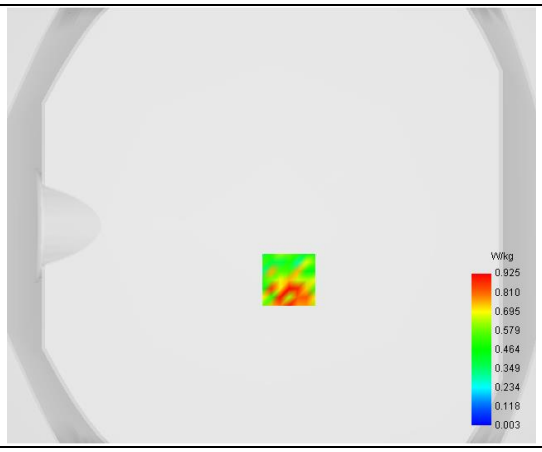
Test Date	2023-11-02
Area Scan	dx=8mm, dy=8mm
Zoom Scan	7x7x12,dx=4mm dy=4mm dz=2mm
Phantom	Validation plane
Device Position	Top Side
Band	IEEE 802.11a U-NII
Signal	IEEE 802.11
Frequency	5200
SAR 10g (W/Kg)	0.274
SAR 1g (W/Kg)	0.564
ConvF	1.95
Relative permittivity	36.15
Conductivity (S/m)	4.59

Maximum location: X=8.00, Y=-25.00 ; SAR Peak: 2.08 W/kg

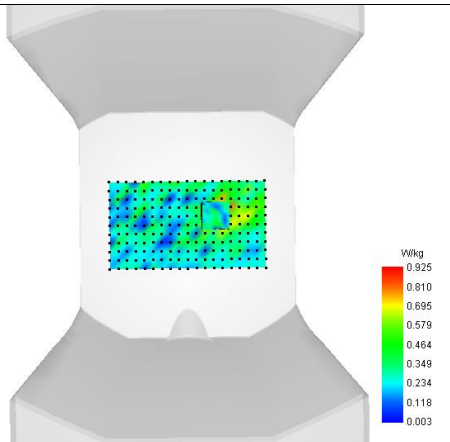
SURFACE SAR



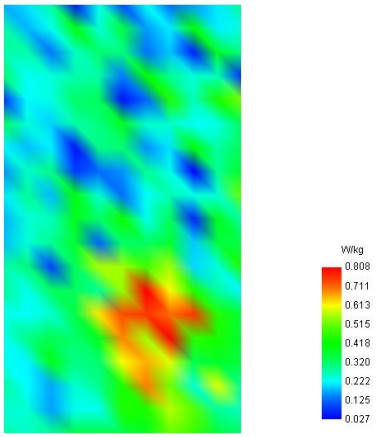
VOLUME SAR

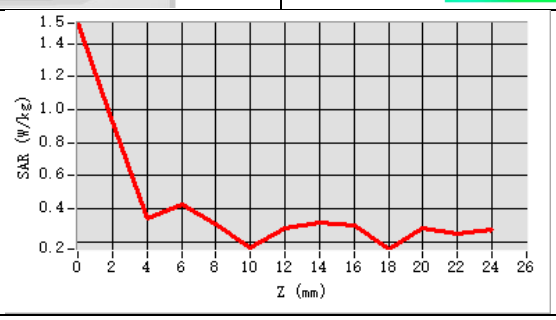


3D screen shot



Hot spot position



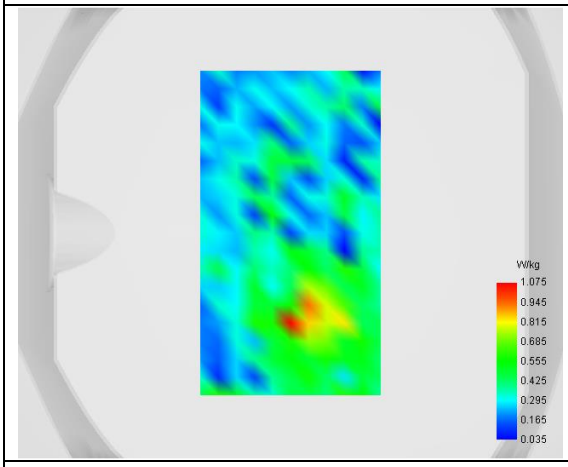


Plot 4:

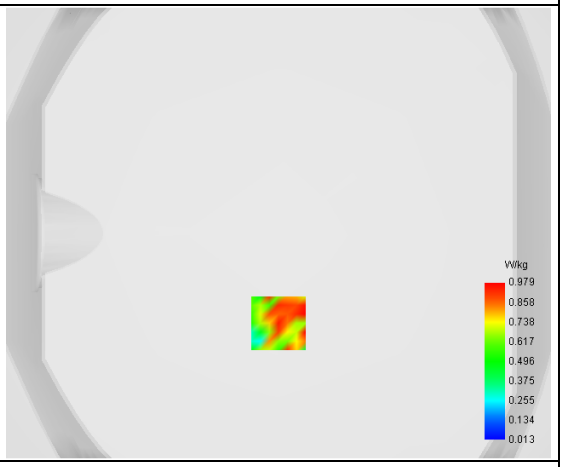
Test Date	2023-11-03
Area Scan	dx=8mm, dy=8mm
Zoom Scan	7x7x12,dx=4mm dy=4mm dz=2mm
Phantom	Validation plane
Device Position	Top Side
Band	IEEE 802.11a U-NII
Signal	IEEE 802.11
Frequency	5320
SAR 10g (W/Kg)	0.271
SAR 1g (W/Kg)	0.697
ConvF	1.85
Relative permittivity	36.76
Conductivity (S/m)	4.78

Maximum location: X=0.00, Y=-40.00 ; SAR Peak: 2.54 W/kg

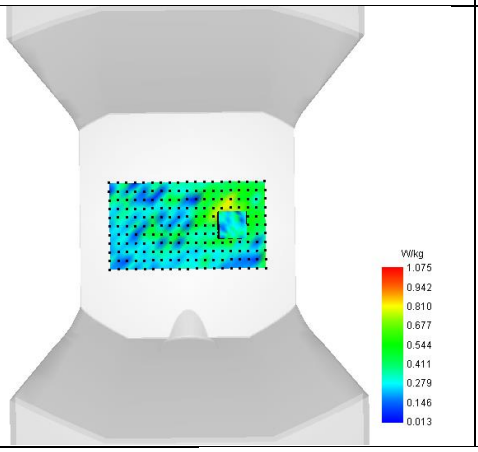
SURFACE SAR



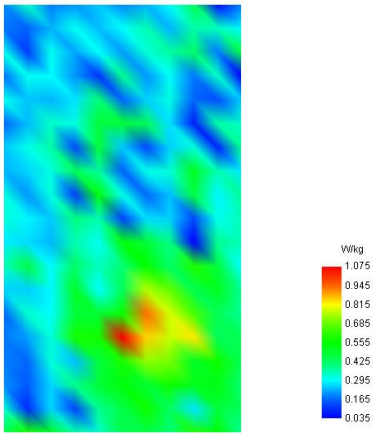
VOLUME SAR

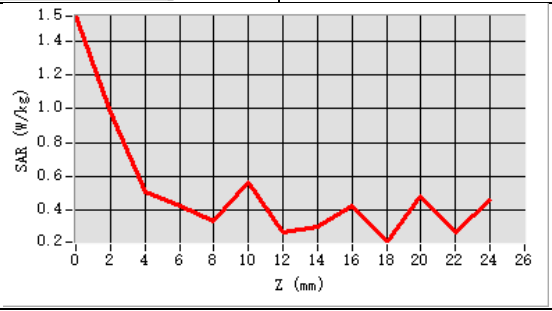


3D screen shot



Hot spot position

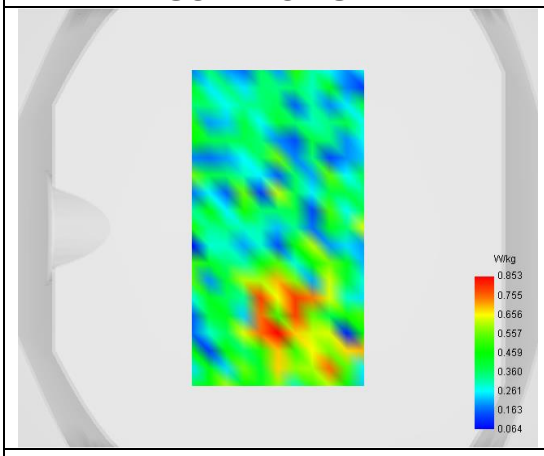
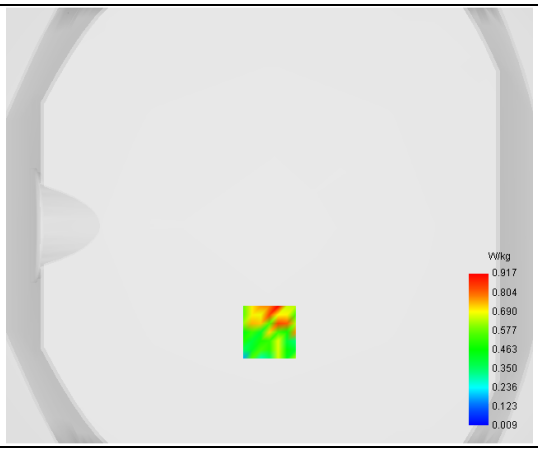
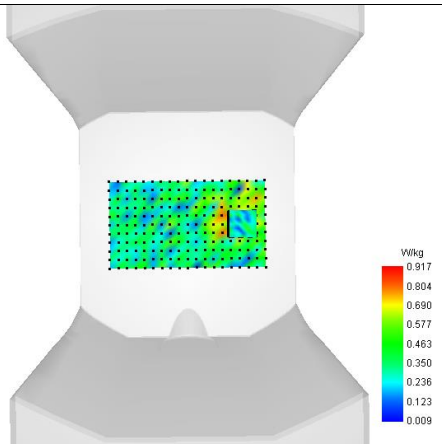
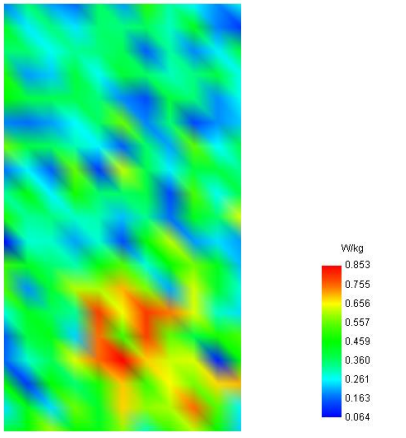
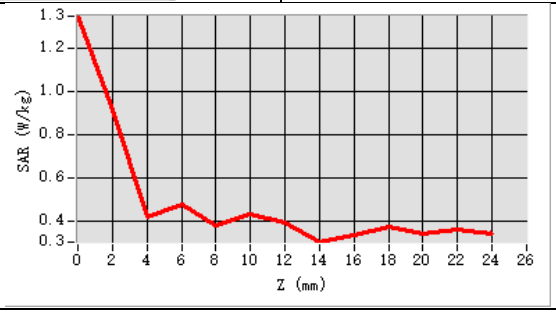




Plot 5:

Test Date	2023-11-06
Area Scan	dx=8mm, dy=8mm
Zoom Scan	7x7x12,dx=4mm dy=4mm dz=2mm
Phantom	Validation plane
Device Position	Top Side
Band	IEEE 802.11n U-NII
Signal	IEEE 802.11
Frequency	5670
SAR 10g (W/Kg)	0.285
SAR 1g (W/Kg)	0.641
ConvF	1.86
Relative permittivity	36.82
Conductivity (S/m)	5.05

Maximum location: X=0.00, Y=-49.00 ; SAR Peak: 2.58 W/kg

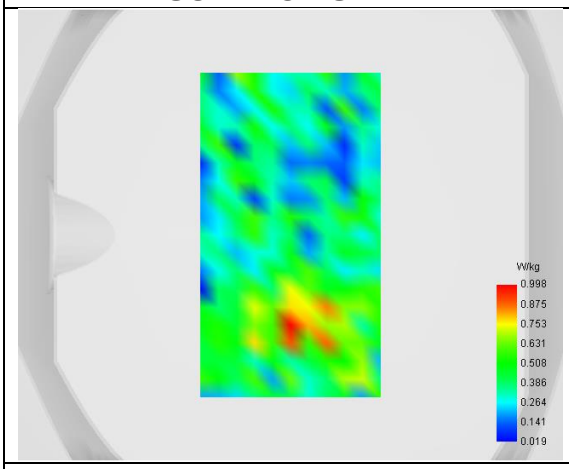
SURFACE SAR	VOLUME SAR
	
3D screen shot	**Hot spot position**
	
	

Plot 6:

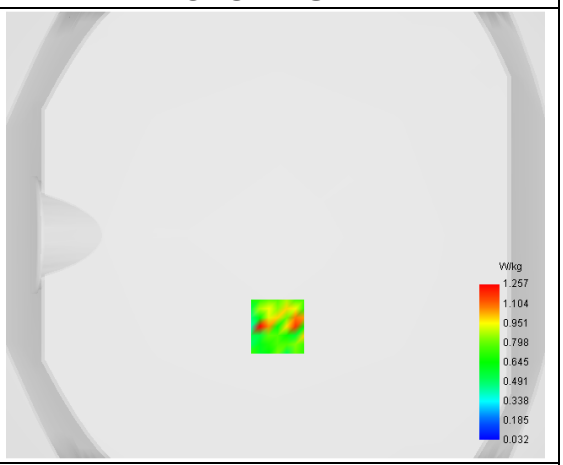
Test Date	2023-11-07
Area Scan	dx=8mm, dy=8mm
Zoom Scan	7x7x12,dx=4mm dy=4mm dz=2mm
Phantom	Validation plane
Device Position	Top Side
Band	IEEE 802.11a U-NII
Signal	IEEE 802.11
Frequency	5825
SAR 10g (W/Kg)	0.315
SAR 1g (W/Kg)	0.682
ConvF	1.73
Relative permittivity	36.56
Conductivity (S/m)	5.26

Maximum location: X=1.00, Y=-41.00 ; SAR Peak: 2.95 W/kg

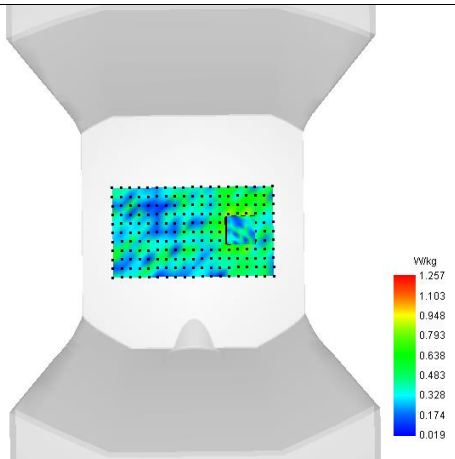
SURFACE SAR



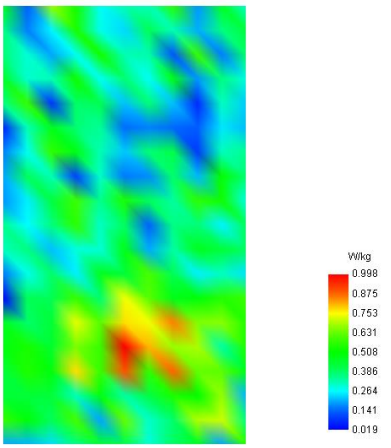
VOLUME SAR

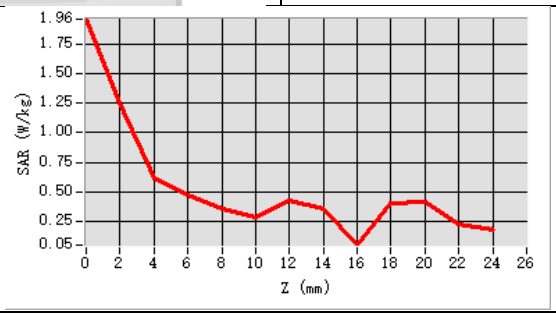


3D screen shot



Hot spot position





Appendix C. Probe Calibration and Dipole Calibration Report

Refer the appendix Calibration Report.

※※※※※END OF THE REPORT※※※※※