SAR Test Report

Report No.: AGC01895160801FH01

FCC ID	:	2AF3Z-X1
PRODUCT DESIGNATION	:	Audio Player
BRAND NAME	:	Echobox
MODEL NAME	:	Explorer
CLIENT	:	Echobox Audio, LLC
DATE OF ISSUE	:	July 04,2017
STANDARD(S)	:	IEEE Std. 1528:2013 FCC 47CFR § 2.1093 IEEE/ANSI C95.1:2005
REPORT VERSION	:	V1.0

Attestation of Global Compliance(Shenzhen) Co., Ltd.

Report Revise Record

Report Version	Revise Time	Issued Date	Valid Version	Notes
V1.0	/	July 04,2017	Valid	Original Report

Test Report Certification

Applicant Name	Echobox Audio, LLC
Applicant Address	10900 NE 4th Street Suite 1430, Bellevue WA 98004
Manufacturer Name	Echobox Audio, LLC
Manufacturer Address	10900 NE 4th Street Suite 1430, Bellevue WA 98004
Product Designation	Audio Player
Brand Name	Echobox
Model Name	Explorer
Different Description	N/A
EUT Voltage	DC3.7V by battery
Applicable Standard	IEEE Std. 1528:2013 FCC 47CFR § 2.1093 IEEE/ANSI C95.1:2005
Test Date	June 27,2017
Performed Location	Attestation of Global Compliance(Shenzhen) Co., Ltd. 2 F, Building 2, No.1-No.4, Chaxi Sanwei Technical Industrial Park, Gushu, Xixiang Street, Bao'an District, Shenzhen, China
Report Template	AGCRT- US -2.4G/SAR (2016-01-01)

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July 04,2017

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1. SUMMARY OF MAXIMUM SAR VALUE

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

Frequency Band	Highest Reported 1g-SAR(W/Kg)	SAR Test Limit (W/Kg)
	Body part (with 0mm separation)	
WIFI 2.4G	0.159	1.6
SAR Test Result	PASS	

This device is compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (1.6W/Kg) specified in IEEE Std. 1528:2013; FCC 47CFR § 2.1093; IEEE/ANSI C95.1:2005 and the following specific FCC Test Procedures:

- KDB 447498 D01 General RF Exposure Guidance v06
- KDB 865664 D01 SAR measurement 100 MHz to 6 GHz v01r04
- KDB 248227 D01 802 11 Wi-Fi SAR v02r02

2. GENERAL INFORMATION

2.1. EUT Description

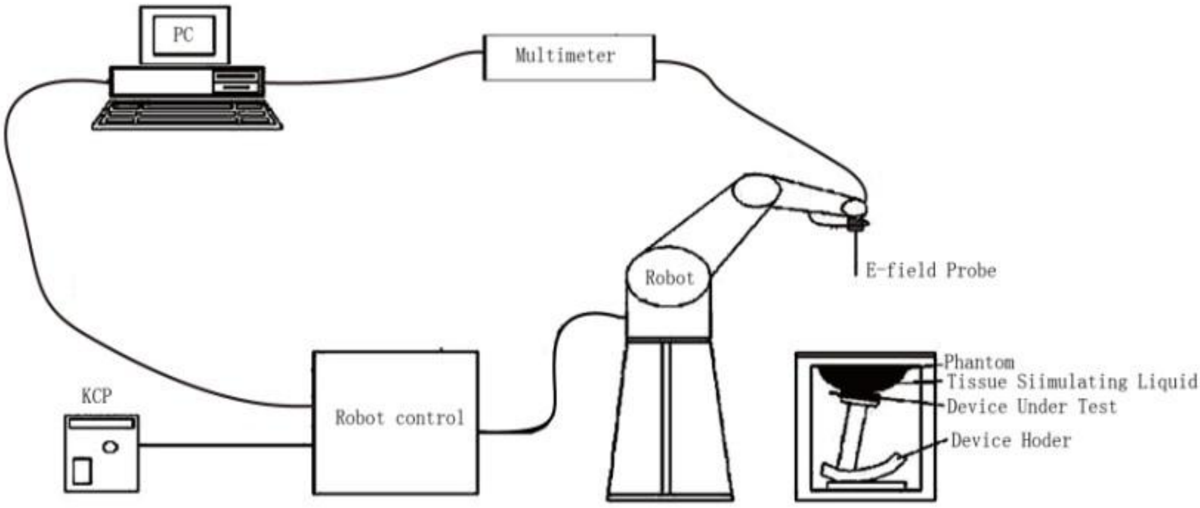
General Information	
Product Designation	Audio Player
Test Model	Explorer
Hardware Version	V1.3
Software Version	1.0
Device Category	Portable
RF Exposure Environment	Uncontrolled
Antenna Type	Internal
Bluetooth	
Bluetooth Version	☐V2.0 ☐V2.1 ☐V2.1+EDR ☐V3.0 ☐V3.0+HS ☐V4.0 ☒V4.1
Operation Frequency	2402~2480MHz
Type of modulation	☒GFSK ☒Π/4-DQPSK ☒8-DPSK
Output Power	-11.16dBm
Antenna Gain	3.36dBi
WIFI	
WIFI Specification	☐802.11a ☒802.11b ☒802.11g ☒802.11n(20) ☐802.11n(40)
Operation Frequency	2412~2462MHz
Output Power	IEEE 802.11b:15.11dBm; IEEE 802.11g:10.86dBm; IEEE 802.11n(20):8.33dBm
Antenna Gain	3.36dBi
Li-ion Battery	
Brand Name	N/A
Model Name	805080
Manufacturer Name	DONGGUAN YONGBANG AMPEREX TECHNOLOGY CO., LTD.
Manufacturer Address	NO.49, Kylin ling Road, Shahu, Tangxia Town, Dongguan, China
Capacitance	4000mAh
Rated Voltage/ Charging Voltage	DC3.7V/ DC4.2V

Note: The sample used for testing is end product.

Product	Type	
	☒ Production unit	☐ Identical Prototype

3. SAR MEASUREMENT SYSTEM

3.1. The SATIMO system used for performing compliance tests consists of following items



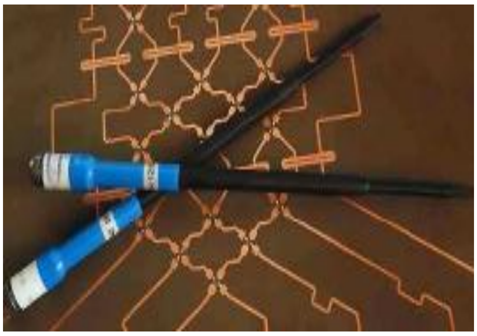
The COMOSAR system for performing compliance tests consists of the following items:

- The PC. It controls most of the bench devices and stores measurement data.A computer running WinXP and the Opensar software.
- The E-Field probe. The probe is a 3-axis system made of 3 distinct dipoles. Each dipole returns a voltage in function of the ambient electric field.
- The Keithley multimeter measures each probe dipole voltages.
- The SAM phantom simulates a human head. The measurement of the electric field is made inside the phantom.
- The liquids simulate the dielectric properties of the human head tissues.
- The network emulator controls the mobile phone under test.
- The validation dipoles are used to measure a reference SAR. They are used to periodically check the bench to make sure that there is no drift of the system characteristics over time.
- The phantom, the device holder and other accessories according to the targeted measurement.

3.2. COMOSAR E-Field Probe

The SAR measurement is conducted with the dosimetric probe manufactured by SATIMO. The probe is specially designed and calibrated for use in liquid with high permittivity. The dosimetric probe has special calibration in liquid at different frequency. SATIMO conducts the probe calibration in compliance with international and national standards (e.g. IEEE 1528 and relevant KDB files.)Under ISO17025.The calibration data are in Appendix D.

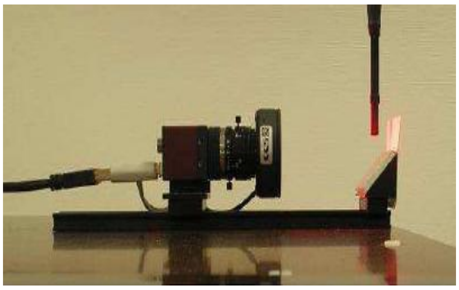
Isotropic E-Field Probe Specification

<table>
<tr><td>Model</td><td colspan="2">SSE5</td></tr>
<tr><td>Manufacture</td><td colspan="2">MVG</td></tr>
<tr><td>Identification No.</td><td colspan="2">SN 14/16 EP308</td></tr>
<tr><td>Frequency</td><td>0.3GHz-3.7GHz
Linearity:±0.08dB(300MHz -3.7GHz)</td><td rowspan="3"></td></tr>
<tr><td>Dynamic Range</td><td>0.01W/Kg-100W/Kg
Linearity:±0.08dB</td></tr>
<tr><td>Dimensions</td><td>Overall length:330mm
Length of individual dipoles:4.5mm
Maximum external diameter:8mm
Probe Tip external diameter:5mm
Distance between dipoles/ probe extremity:2.7mm</td></tr>
<tr><td>Application</td><td colspan="2">High precision dosimetric measurements in any exposure scenario (e.g., very strong gradient fields). Only probe which enables compliance testing for frequencies up to 3 GHz with precision of better 30%.</td></tr>
</table>

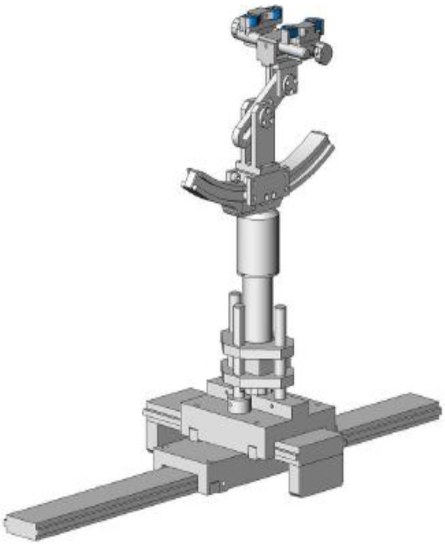
3.3. Robot

<table>
<tr><td>The COMOSAR system uses the KUKA robot from SATIMO SA (France).For the 6-axis controller COMOSAR system, the KUKA robot controller version from SATIMO is used.
The XL robot series have many features that are important for our application:
- High precision (repeatability 0.02 mm)
- High reliability (industrial design)
- Jerk-free straight movements
- Low ELF interference (the closed metallic construction shields against motor control fields)
- 6-axis controller</td><td>
</td></tr>
</table>

3.4. Video Positioning System

The video positioning system is used in OpenSAR to check the probe. Which is composed of a camera, LED, mirror and mechanical parts.The camera is piloted by the main computer with firewire link. During the process, the actual position of the probe tip with respect to the robot arm is measured, as well as the probe length and the horizontal probe offset. The software then corrects all movements, such that the robot coordinates are valid for the probe tip. The repeatability of this process is better than 0.1 mm. If a position has been taught with an aligned probe, the same position will be reached with another aligned probe within 0.1 mm, even if the other probe has different dimensions. During probe rotations, the probe tip will keep its actual position.	

3.5. Device Holder

The COMOSAR device holder is designed to cope with different positions given in the standard. It has two scales for the device rotation (with respect to the body axis) and the device inclination (with respect to the line between the ear reference points). The rotation center for both scales is the ear reference point (EPR). Thus the device needs no repositioning when changing the angles. The COMOSAR device holder has been made out of low-loss POM material having the following dielectric parameters: relative permittivity εr =3 and loss tangent δ = 0.02. The amount of dielectric material has been reduced in the closest vicinity of the device, since measurements have suggested that the influence of the clamp on the test results could thus be lowered.	

3.6. SAM Twin Phantom

<table>
<tr>
<td>The SAM twin phantom is a fiberglass shell phantom with 2mm shell thickness (except the ear region where shell thickness increases to 6mm). It has three measurement areas:
 Left head
 Right head
 Flat phantom</td>
<td></td>
</tr>
</table>

The bottom plate contains three pair of bolts for locking the device holder. The device holder positions are adjusted to the standard measurement positions in the three sections. A white cover is provided to tap the phantom during off-periods to prevent water evaporation and changes in the liquid parameters. On the phantom top, three reference markers are provided to identify the phantom position with respect to the robot.

4. SAR MEASUREMENT PROCEDURE

4.1. Specific Absorption Rate (SAR)

SAR is related to the rate at which energy is absorbed per unit mass in 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 occupational/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 given mass density (ρ). The equation description is as below:

$$\mathrm{SAR} = \frac{\mathrm{d}}{\mathrm{d}t}\left(\frac{\mathrm{d}W}{\mathrm{d}m}\right) = \frac{\mathrm{d}}{\mathrm{d}t}\left(\frac{\mathrm{d}W}{\rho \mathrm{d}V}\right)$$

SAR is expressed in units of Watts per kilogram (W/Kg)
SAR can be obtained using either of the following equations:

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

$$\mathrm{SAR} = c_h \left.\frac{\mathrm{d}T}{\mathrm{d}t}\right|_{t=0}$$

Where

SAR	is the specific absorption rate in watts per kilogram;
E	is the r.m.s. value of the electric field strength in the tissue in volts per meter;
σ	is the conductivity of the tissue in siemens per metre;
ρ	is the density of the tissue in kilograms per cubic metre;
c_h	is the heat capacity of the tissue in joules per kilogram and Kelvin;
$\frac{dT}{dt} \mid t=0$	is the initial time derivative of temperature in the tissue in kelvins per second

4.2. SAR Measurement Procedure

Step 1: Power Reference Measurement

The Power Reference Measurement and Power Drift Measurement are for monitoring the power drift of the device under test in the batch process. The minimum distance of probe sensors to surface is 2.7mm This distance cannot be smaller than the distance os sensor calibration points to probe tip as `defined in the probe properties,

Step 2: Area Scan

The Area Scan is used as a fast scan in two dimensions to find the area of high field values, before doing a fine measurement around the hot spot. The sophisticated interpolation routines implemented in SATIMO software can find the maximum locations even in relatively coarse grids. When an Area Scan has measured all reachable points, it computes the field maximal found in the scanned area, within a range of the global maximum. The range (in db) is specified in the standards for compliance testing. For example, a 2db range is required in IEEE Standard 1528, whereby 3db is a requirement when compliance is assessed in accordance with the ARIB standard (Japan) If one Zoom Scan follows the Area Scan, then only the absolute maximum will be taken as reference. For cases where multiple maximum are detected, the number of Zoom Scan has to be increased accordingly.

Area Scan Parameters extracted from KDB 865664 D01 SAR Measurement 100MHz to 6GHz

	≤ 3 GHz	> 3 GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface	5 ± 1 mm	½·δ·ln(2) ± 0.5 mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location	30° ± 1°	20° ± 1°
Maximum area scan spatial resolution: Δx_{Area}, Δy_{Area}	≤ 2 GHz: ≤ 15 mm 2 – 3 GHz: ≤ 12 mm	3 – 4 GHz: ≤ 12 mm 4 – 6 GHz: ≤ 10 mm
	When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device.	

Step 3: Zoom Scan

Zoom Scan are used to assess the peak spatial SAR value within a cubic average volume containing 1g abd 10g of simulated tissue. The Zoom Scan measures points(refer to table below) within a cube whose base faces are centered on the maxima found in a preceding area scan job within the same procedure. When the measurement is done, the Zoom Scan evaluates the averaged SAR for 1g and 10g and displays these values next to the job’s label.

Zoom Scan Parameters extracted from KDB865664 d01 SAR Measurement 100MHz to 6GHz

Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}			≤ 2 GHz: ≤ 8 mm 2 – 3 GHz: ≤ 5 mm*	3 – 4 GHz: ≤ 5 mm* 4 – 6 GHz: ≤ 4 mm*
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{Zoom}(n)$		≤ 5 mm	3 – 4 GHz: ≤ 4 mm 4 – 5 GHz: ≤ 3 mm 5 – 6 GHz: ≤ 2 mm
	graded grid	$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface	≤ 4 mm	3 – 4 GHz: ≤ 3 mm 4 – 5 GHz: ≤ 2.5 mm 5 – 6 GHz: ≤ 2 mm
		$\Delta z_{Zoom}(n>1)$: between subsequent points	$\leq 1.5 \cdot \Delta z_{Zoom}(n-1)$	
Minimum zoom scan volume	x, y, z		≥ 30 mm	3 – 4 GHz: ≥ 28 mm 4 – 5 GHz: ≥ 25 mm 5 – 6 GHz: ≥ 22 mm

Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details.

* When zoom scan is required and the _reported_ SAR from the *area scan based 1-g SAR estimation* procedures of KDB 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.

Step 4: Power Drift Measurement

The Power Drift Measurement measures the field at the same location as the most recent power reference measurement within the same procedure, and with the same settings. The Power Drift Measurement gives the field difference in dB from the reading conducted within the same settings. This allows a user to monitor the power drift of the device under test within a batch process. The measurement procedure is the same as Step 1.

5. TISSUE SIMULATING LIQUID

For SAR measurement of the field distribution inside the phantom, the phantom must be filled with homogeneous tissue simulating liquid to a depth of at least 15cm. For head SAR testing the liquid height from the ear reference point (ERP) of the phantom to the liquid top surface is larger than 15cm For body SAR testing, the liquid height from the center of the flat phantom to the liquid top surface is larger than 15cm.The nominal dielectric values of the tissue simulating liquids in the phantom and the tolerance of 5% are listed in 5.2

5.1. The composition of the tissue simulating liquid

Ingredient (% Weight) / Frequency (MHz)	Water	Nacl	Polysorbate 20	DGBE	1,2 Propanediol	Triton X-100
2450 Body	70	1	0.0	9	0.0	20

5.2. Tissue Dielectric Parameters for Head and Body Phantoms

The head tissue dielectric parameters recommended by the IEEE 1528 have been incorporated in the following table. These head parameters are derived from planar layer models simulating the highest expected SAR for the dielectric properties and tissue thickness variations in a human head. Other head and body tissue parameters that have not been specified in IEEE 1528 are derived from the tissue dielectric parameters computed from the 4-Cole-Cole equations described in Reference [12] and extrapolated according to the head parameters specified in IEEE 1528.

Target Frequency (MHz)	head		body	
	εr	σ (S/m)	εr	σ (S/m)
300	45.3	0.87	58.2	0.92
450	43.5	0.87	56.7	0.94
835	41.5	0.90	55.2	0.97
900	41.5	0.97	55.0	1.05
915	41.5	1.01	55.0	1.06
1450	40.5	1.20	54.0	1.30
1610	40.3	1.29	53.8	1.40
1800 – 2000	40.0	1.40	53.3	1.52
2450	39.2	1.80	**52.7**	**1.95**
3000	38.5	2.40	52.0	2.73

(εr = relative permittivity, σ = conductivity and ρ = 1000 kg/m3)

5.3. Tissue Calibration Result

The dielectric parameters of the liquids were verified prior to the SAR evaluation using SATIMO Dielectric Probe Kit and R&S Network Analyzer ZVL6.

Tissue Stimulant Measurement for 2450MHz					
	Fr. (MHz)	Dielectric Parameters (±5%)		Tissue Temp [oC]	Test time
		εr52.7(50.065-55.335)	δ[s/m]1.95(1.8525-2.0475)		
Body	2412	54.12	1.87	21.4	June 27,2017
	2437	53.57	1.90		
	2450	52.94	1.92		
	2462	52.37	1.94		

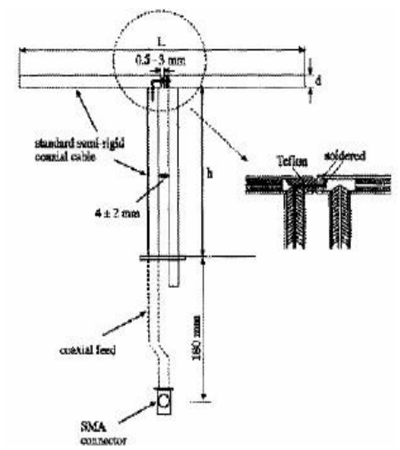
6. SAR SYSTEM CHECK PROCEDURE

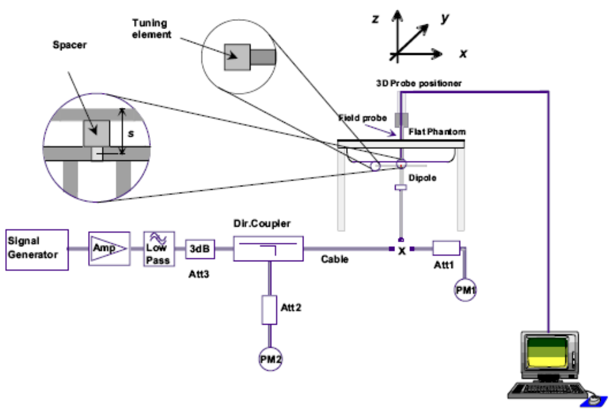
6.1. SAR System Check Procedures

SAR system check is required to confirm measurement accuracy, according to the tissue dielectric media, probe calibration points and other system operating parameters required for measuring the SAR of a test device. The system verification must be performed for each frequency band and within the valid range of each probe calibration point required for testing the device. The same SAR probe(s) and tissue-equivalent media combinations used with each specific SAR system for system verification must be used for device testing. When multiple probe calibration points are required to cover substantially large transmission bands, independent system verifications are required for each probe calibration point. A system verification must be performed before each series of SAR measurements using the same probe calibration point and tissue-equivalent medium. Additional system verification should be considered according to the conditions of the tissue-equivalent medium and measured tissue dielectric parameters, typically every three to four days when the liquid parameters are remeasured or sooner when marginal liquid parameters are used at the beginning of a series of measurements.

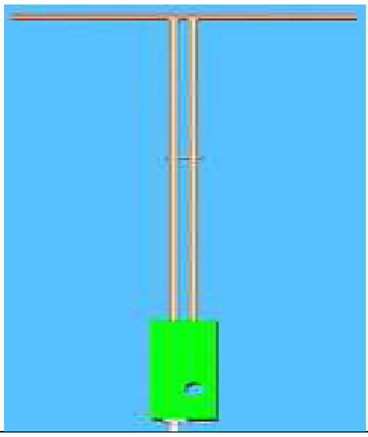
Each SATIMO system is equipped with one or more system check kits. These units, together with the predefined measurement procedures within the SATIMO software, enable the user to conduct the system check and system validation. System kit includes a dipole, and dipole device holder.

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 check setup is shown as below.





6.2. SAR System Check
6.2.1. Dipoles



The dipoles used is based on the IEEE-1528 standard, and is complied with mechanical and electrical specifications in line with the requirements of IEEE. the table below provides details for the mechanical and electrical
Specifications for the dipoles.

Frequency	L (mm)	h (mm)	d (mm)
2450MHz	51.5	30.4	3.6

6.2.2. System Check Result

System Performance Check at 2450MHz for Body								
Validation Kit: SN 29/15DIP 2G450-393								
Frequency [MHz]	Target Value(W/Kg)		Reference Result (± 10%)		Normalized to 1W(W/Kg)		Tissue Temp. [°C]	Test time
	1g	10g	1g	10g	1g	10g		
2450	49.92	23.16	44.928-54.912	20.844-25.476	49.83	22.60	21.4	June 27,2017

Note:
(1) We use a CW signal of 18dBm for system check, and then all SAR value are normalized to 1W forward power. The result must be within ±10% of target value.

7. EUT TEST POSITION

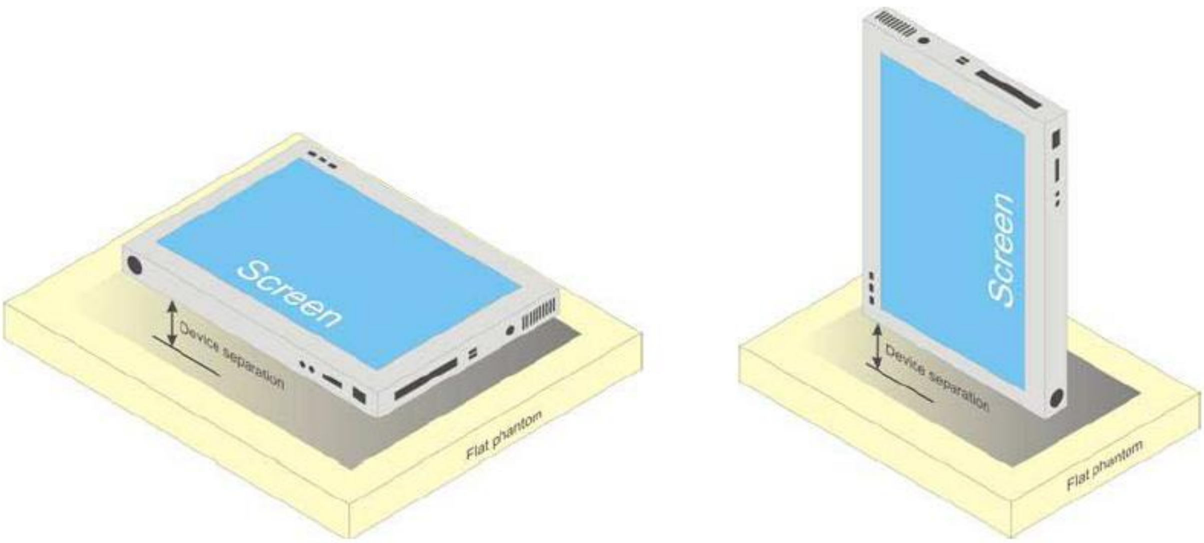
According to EN 62209-2 Section 6.1.4.6.The EUT is tested in **Body back, Body front and 2 edges**

7.1. Body Worn Position

(1) To position the EUT parallel to the phantom surface.

(2) To adjust the EUT parallel to the flat phantom.

(3) To adjust the distance between the EUT surface and the flat phantom to **0mm.**



8. SAR EXPOSURE LIMITS

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

Type Exposure	Uncontrolled Environment Limit (W/kg)
Spatial Peak SAR (1g cube tissue for brain or body)	1.60
Spatial Average SAR (Whole body)	0.08
Spatial Peak SAR (Limbs)	4.0

9. TEST EQUIPMENT LIST

Equipment description	Manufacturer/ Model	Identification No.	Current calibration date	Next calibration date
SAR Probe	MVG	SN 14/16 EP308	12/05/2016	12/04/2017
TISSUE Probe	SATIMO	SN 23/16 OCPG 75	07/05/2016	07/04/2017
Phantom	SATIMO	SN_4511_SAM90	Validated. No cal required.	Validated. No cal required.
Liquid	SATIMO	-	Validated. No cal required.	Validated. No cal required.
Comm Tester	Agilent-8960	GB46310822	03/02/2017	03/01/2018
Multimeter	Keithley 2000	1188656	03/02/2017	03/01/2018
Dipole	SATIMO SID2450	SN29/15 DIP 2G450-393	07/05/2016	07/04/2019
Signal Generator	Agilent-E4438C	US41461365	03/02/2017	03/01/2018
Vector Analyzer	Agilent / E4440A	US40420298	07/02/2016	07/01/2017
Network Analyzer	Rhode & Schwarz ZVL6	SN100132	03/02/2017	03/01/2018
Attenuator	Warison /WATT-6SR1211	N/A	N/A	N/A
Attenuator	Mini-circuits / VAT-10+	N/A	N/A	N/A
Amplifier	EM30180	SN060552	03/02/2017	03/01/2018
Directional Couple	Werlatone/ C5571-10	SN99463	07/02/2016	07/01/2017
Directional Couple	Werlatone/ C6026-10	SN99482	07/02/2016	07/01/2017
Power Sensor	NRP-Z21	1137.6000.02	10/10/2016	10/09/2017
Power Sensor	NRP-Z23	US38261498	03/02/2017	03/01/2018
Power Viewer	R&S	V2.3.1.0	N/A	N/A

Note: Per KDB 865664 Dipole SAR Validation, AGC Lab has adopted 3 years calibration intervals. On annual basis, every measurement dipole has been evaluated and is in compliance with the following criteria:

1. There is no physical damage on the dipole;
2. System validation with specific dipole is within 10% of calibrated value;
3. Return-loss is within 20% of calibrated measurement;
4. Impedance is within 5Ω of calibrated measurement.

10. MEASUREMENT UNCERTAINTY

SATIMO Uncertainty-SN 14/16 EP308 Measurement uncertainty for DUT averaged over 1 gram / 10 gram.(Head)									
Uncertainty Component	Sec.	Tol (+- %)	Prob. Dist.	Div.	Ci (1g)	Ci (10g)	1g Ui (+-%)	10g Ui (+-%)	Vi
Measurement System									
Probe calibration	E.2.1	5.831	N	1	1	1	5.83	5.83	∞
Probe Modulation	E2.5	3.0	R	$\sqrt{3}$	1	1	1.73	1.73	∞
Axial Isotropy	E.2.2	0.6	R	$\sqrt{3}$	1	1	0.36	0.35	∞
Hemispherical Isotropy	E.2.2	0.9	R	$\sqrt{3}$	1	1	0.52	0.52	∞
Boundary effect	E.2.3	1.0	R	$\sqrt{3}$	1	1	0.58	0.58	∞
Linearity	E.2.4	1.91	R	$\sqrt{3}$	1	1	0.69	0.69	∞
System detection limits	E.2.4	1.0	R	$\sqrt{3}$	1	1	0.58	0.58	∞
Readout Electronics	E.2.6	0.02	N	□ 1	1	1	0.02	0.02	∞
Response Time	E.2.7	3.0	R	$\sqrt{3}$	1	1	1.73	1.73	∞
Integration Time	E.2.8	2.0	R	$\sqrt{3}$	1	1	1.15	1.15	∞
RF Ambient Noise	E.6.1	3.0	R	$\sqrt{3}$	1	1	1.73	1.73	∞
RF Ambient Reflection	E.6.1	3.0	R	$\sqrt{3}$	1	1	1.73	1.73	∞
Probe Positioner	E.6.2	2.0	R	$\sqrt{3}$	1	1	1.15	1.15	∞
Probe Positioning	E.6.3	0.05	R	$\sqrt{3}$	1	1	0.03	0.03	∞
Post-processing	E.5	5.0	R	$\sqrt{3}$	1	1	2.89	2.89	∞
Test sample Related									
Device Positioning	E.4.2	0.03	N	1	1	1	3.60	3.60	∞
Device Holder	E.4.1	5	N	1	1	1	2.90	2.90	∞
Measurement SAR Drift	E.2.9	0.65	R	$\sqrt{3}$	1	1	2.89	2.89	∞
Power Scaling	E.6.5	5	R	$\sqrt{3}$	1	1	0.00	0.00	∞
Phantom and set-up									
Phantom Uncertainty	E.3.1	0.05	R	$\sqrt{3}$	1	1	0.03	0.03	∞
Uncertainty in SAR correction for deviations in permittivity and conductivity	E.3.2	1.9	N	1	1	0.84	1.90	1.60	∞
Liquid Conductivity(Meas.)	E.3.3	5	N	1	0.78	0.71	3.90	3.55	M
Liquid Permittivity(Meas.)	E.3.3	5	N	1	0.23	0.26	1.15	1.30	M

Liquid Conductivity-temperature uncertainty	E.3.4	5	R	$\sqrt{3}$	0.78	0.71	2.25	2.05	∞
Liquid Permittivity-temperature uncertainty	E.3.4	5	R	$\sqrt{3}$	0.23	0.26	0.66	0.75	∞
Combined Standard Uncertainty			RSS				10.39	10.118	∞
Expanded Uncertainty (95% Confidence interval)			k				20.86	20.315	

SATIMO Uncertainty-SN 14/16 EP308 System validation uncertainty for Dipole averaged over 1 gram / 10 gram.(Head)									
Uncertainty Component	Sec.	Tol (+- %)	Prob. Dist.	Div.	Ci (1g)	Ci (10g)	1g Ui (+-%)	10g Ui (+-%)	Vi
Measurement System									
Probe calibration	E.2.1	5.831	N	1	1	1	5.83	5.83	∞
Probe Modulation	E.2.5	3.0	R	$\sqrt{3}$	1	1	1.73	1.73	∞
Axial Isotropy	E.2.2	0.6	R	$\sqrt{3}$	1	1	1.44	1.44	∞
Hemispherical Isotropy	E.2.2	0.9	R	$\sqrt{3}$	1	1	0.52	0.52	∞
Boundary effect	E.2.3	1.0	R	$\sqrt{3}$	1	1	0.58	0.58	∞
Linearity	E.2.4	1.2	R	$\sqrt{3}$	1	1	0.69	0.69	∞
System detection limits	E.2.4	1.0	R	$\sqrt{3}$	1	1	0.58	0.58	∞
Readout Electronics	E.2.6	0.02	N	□ 1	1	1	0.02	0.02	∞
Response Time	E.2.7	3.0	R	$\sqrt{3}$	1	1	1.73	1.73	∞
Integration Time	E.2.8	2.0	R	$\sqrt{3}$	1	1	1.15	1.15	∞
RF Ambient Noise	E.6.1	3.0	R	$\sqrt{3}$	1	1	1.73	1.73	∞
RF Ambient Reflection	E.6.1	3.0	R	$\sqrt{3}$	1	1	1.73	1.73	∞
Probe Positioner	E.6.1	2.0	R	$\sqrt{3}$	1	1	1.15	1.15	∞
Probe Positioning	E.6.2	0.05	R	$\sqrt{3}$	1	1	0.03	0.03	∞
Post-processing	E.6.3	5.0	R	$\sqrt{3}$	1	1	2.89	2.89	∞
System validation source (dipole)									
Deviation of exp. dipole	E6.4	5	R	1	1	1	5.00	5.00	∞
Dipole Axis to Liquid Dist.	8,E.6.6	5.0	R	$\sqrt{3}$	1	1	2.89	2.89	∞
Input power & SAR drift	8,6.6.4	1	R	$\sqrt{3}$	1	1	0.58	0.58	∞

Phantom and set-up									
Phantom Uncertainty	E.3.1	0.05	R	$\sqrt{3}$	1	1	0.03	0.03	∞
Uncertainty in SAR correction for deviations in permittivity and conductivity	E.3.2	1.9	N	1	1	0.84	1.90	1.60	∞
Liquid Conductivity(Meas.)	E.3.3	5	N	1	0.78	0.71	3.90	3.55	M
Liquid Permittivity(Meas.)	E.3.3	5	N	1	0.23	0.26	1.15	1.30	M
Liquid Conductivity-temperature uncertainty	E.3.4	5	R	$\sqrt{3}$	0.78	0.71	2.25	2.05	∞
Liquid Permittivity-temperature uncertainty	E.3.4	5	R	$\sqrt{3}$	0.23	0.26	0.66	0.75	∞
Combined Standard Uncertainty			RSS				11.17	10.920	∞
Expanded Uncertainty (95% Confidence interval)			k				20.879	20.333	

SATIMO Uncertainty-SN 14/16 EP308 System Check uncertainty for Dipole averaged over 1 gram / 10 gram.(Head)									
Uncertainty Component	Sec.	Tol (+- %)	Prob. Dist.	Div.	Ci (1g)	Ci (10g)	1g Ui (+-%)	10g Ui (+-%)	Vi
Measurement System									
Modulation response	E.2.5	3.0	R	$\sqrt{3}$	0	0	0.00	0.00	∞
Boundary effect	E.2.3	1.0	R	$\sqrt{3}$	0	0	0.00	0.00	∞
System detection limits	E.2.4	1.0	R	$\sqrt{3}$	0	0	0.00	0.00	∞
Readout Electronics	E.2.6	0.02	N	□ 1	0	0	0.00	0.00	∞
Response Time	E.2.7	3.0	R	$\sqrt{3}$	0	0	0.00	0.00	∞
Integration Time	E.2.8	2.0	R	$\sqrt{3}$	0	0	0.00	0.00	∞
RF Ambient Noise	E.6.1	3.0	R	$\sqrt{3}$	0	0	0.00	0.00	∞
RF Ambient Reflection	E.6.1	3.0	R	$\sqrt{3}$	0	0	0.00	0.00	∞
Probe Positioner	E.6.1	2.0	R	$\sqrt{3}$	1	1	1.15	1.15	∞
Probe Positioning	E.6.2	0.05	R	$\sqrt{3}$	1	1	0.03	0.03	∞
Post-processing	E.6.3	5.0	R	$\sqrt{3}$	0	0	0.00	0.00	∞
Field source									

Deviation of exp. dipole	E6.4	5	R	1	1	1	5.00	5.00	∞
Dipole Axis to Liquid Dist.	8,E.6.6	4.7	R	$\sqrt{3}$	1	1	2.71	2.71	∞
Input power & SAR drift	8,6.6.4	1	R	$\sqrt{3}$	1	1	0.58	0.58	∞
Phantom and set-up									
Phantom Uncertainty	E.3.1	0.05	R	$\sqrt{3}$	1	1	0.03	0.03	∞
Uncertainty in SAR correction for deviations in permittivity and conductivity	E.3.2	1.9	N	1	1	0.84	1.90	1.60	∞
Liquid Conductivity(Meas.)	E.3.3	5	N	1	0.78	0.71	3.90	3.55	M
Liquid Permittivity(Meas.)	E.3.3	5	N	1	0.23	0.26	1.15	1.30	M
Liquid Conductivity-temperature uncertainty	E.3.4	5	R	$\sqrt{3}$	0.78	0.71	2.25	2.05	∞
Liquid Permittivity-temperature uncertainty	E.3.4	5	R	$\sqrt{3}$	0.23	0.26	0.66	0.75	∞
Combined Standard Uncertainty			RSS				7.076	6.667	∞
Expanded Uncertainty (95% Confidence interval)			k				14.152	13.334	

11. CONDUCTED POWER MEASUREMENT

WIFI

Mode	Data Rate (Mbps)	Channel	Frequency(MHz)	Maximum Output Power (dBm)
802.11b	1	01	2412	15.05
		06	2437	14.86
		11	2462	**15.11**
802.11g	6	01	2412	10.86
		06	2437	10.79
		11	2462	10.54
802.11n(20)	6.5	01	2412	8.12
		06	2437	8.33
		11	2462	8.06

12. TEST RESULTS

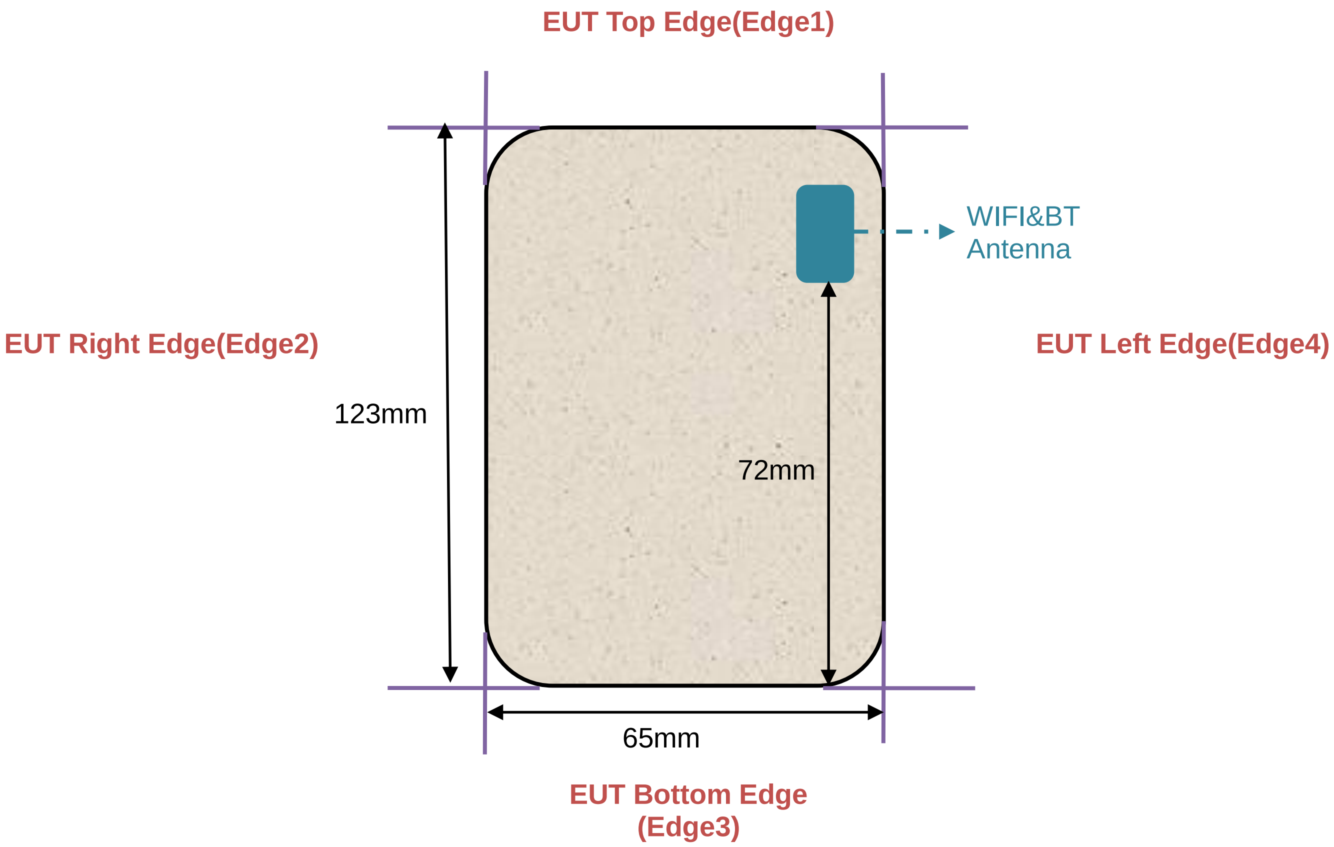
12.1. SAR Test Results Summary
12.1.1. Test position and configuration

Body SAR was performed with the device 0mm from the phantom.

12.1.2. Operation Mode

1. Per KDB 447498 D01 v06 ,for each exposure position, if the highest 1-g SAR is ≤ 0.8 W/kg, testing for low and high channel is optional.
2. Per KDB 865664 D01 v01r04,for each frequency band, if the measured SAR is ≥0.8W/Kg, testing for repeated SAR measurement is required , that the highest measured SAR is only to be tested. When the SAR results are near the limit, the following procedures are required for each device to verify these types of SAR measurement related variation concerns by repeating the highest measured SAR configuration in each frequency band.
   (1) When the original highest measured SAR is ≥0.8W/Kg, repeat that measurement once.
   (2) Perform a second repeated measurement only if the ratio of largest to smallest SAR for the original and first repeated measurements is >1.20 or when the original or repeated measurement is ≥1.45 W/Kg.
   (3) Perform a third repeated measurement only if the original, first and second repeated measurement is ≥1.5 W/Kg and ratio of largest to smallest SAR for the original, first and second measurement is ≥ 1.20.
3. Maximum Scaling SAR in order to calculate the Maximum SAR values to test under the standard Peak Power, Calculation method is as follows:
   Maximum Scaling SAR =tested SAR (Max.) ×[maximum turn-up power (mw)/ maximum measurement output power(mw)]
4. According to KDB 447498 D01, annex A, SAR is not required for bluetooth because its maximum output power is less than 10 mW.
5. Bluetooth and WIFI have same antennas, and cannot transmit simultaneously;

12.1.3. Antenna Location: (back view)



12.1.4. SAR Test Results Summary

SAR MEASUREMENT									
Depth of Liquid (cm):>15				Relative Humidity (%): 50.8					
Product: Audio Player									
Test Mode: 802.11b									
Position	**Mode**	**Ch.**	**Fr. (MHz)**	**Power Drift (<±5%)**	**SAR (1g) (W/kg)**	**Max. Tune-up Power (dBm)**	**Meas. output Power (dBm)**	**Scaled SAR (W/Kg)**	**Limit W/kg**
Body back	DTS	06	2437	0.01	0.080	15.50	15.05	0.089	1.6
Body front	DTS	06	2437	1.33	0.049	15.50	14.86	0.057	1.6
Edge 2 (Right)	DTS	06	2437	0.05	0.013	15.50	15.11	0.014	1.6
Edge 4 (Left)	DTS	06	2437	0.36	**0.137**	15.50	14.86	**0.159**	1.6

Note:

- When the 1-g Reported SAR is ≤ 0.8 W/kg, testing for low and high channel is optional. Refer to KDB 447498.
- The test separation of all above tableis 0mm.

SAR Test Exclusion Consideration for Adjacent Edges

Per KDB 447498 D01 cl. 4.3.1:

a) For 100 MHz to 6 GHz and *test separation distances* ≤ 50 mm, the 1-g and 10-g *SAR test exclusion thresholds* are determined by the following:

[(*max. power of channel, including tune-up tolerance, mW*) / (*min. test separation distance, mm*)] · [√f(GHz)] ≤ 3.0

b) For 100 MHz to 6 GHz and *test separation distances* > 50 mm, the 1-g and 10-g *SAR test exclusion thresholds* are determined by the following:

1) {[Power allowed at *numeric threshold* for 50 mm in step a)] + [(test separation distance – 50 mm)·(f(MHz)/150)]} mW, for 100 MHz to 1500 MHz

2) {[Power allowed at *numeric threshold* for 50 mm in step a)] + [(test separation distance – 50 mm)·10]} mW, for > 1500 MHz and ≤ 6 GHz

Edge 3(Bottom)

SAR test exclusion threshold

= (Power allowed at numeric threshold for 50 mm in step 1)+(test separation distance - 50 mm) x 10 mW

= 95.598 + (72-50) x 10 mW

= 315.598 mW.

Conclusion

Since the Maximum Tune-up Power(**35.481mW)** is less than the SAR Exclusion Threshold for bottom edge, SAR evaluation for these adjacent edges are not required.

APPENDIX A. SAR SYSTEM CHECK DATA

Test Laboratory: AGC Lab **Date: June 27,2017**

System Check Body 2450 MHz

DUT: Dipole 2450 MHz Type: SID 2450

Communication System CW; Communication System Band: D2450 (2450.0 MHz); Duty Cycle: 1:1; Conv.F=5.33

Frequency: 2450 MHz; Medium parameters used: f = 2450 MHz; σ=1.92 mho/m; εr =52.94; ρ= 1000 kg/m³ ;

Phantom section: Flat Section; Input Power=18dBm

Ambient temperature (℃):21.9, Liquid temperature (℃): 21.4

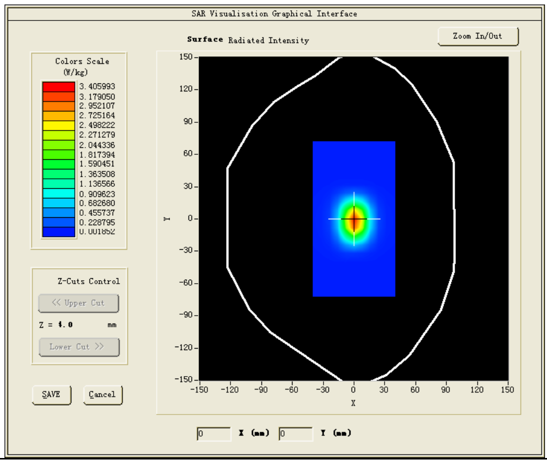
SATIMO Configuration

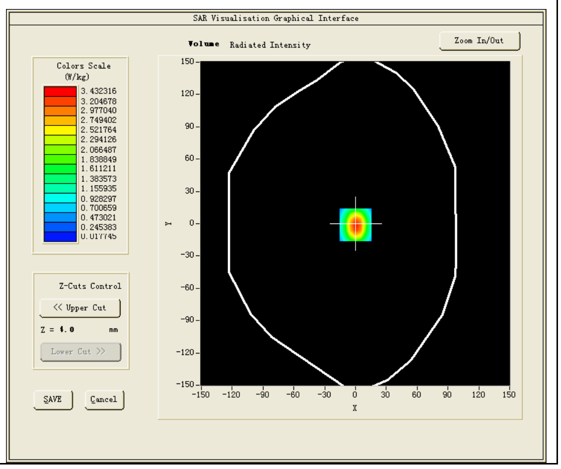
- Probe: SSE5; Calibrated: 12/05/2016; Serial No.: SN 14/16 EP308
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Phantom: SAM twin phantom
- Measurement SW: OpenSAR V4_02_32

Configuration/System Check 2450MHz Body/Area Scan: Measurement grid: dx=8mm, dy=8mm

Configuration/System Check 2450MHz Body/Zoom Scan: Measurement grid: dx=5mm,dy=5mm, dz=5mm

SURFACE SAR	VOLUME SAR



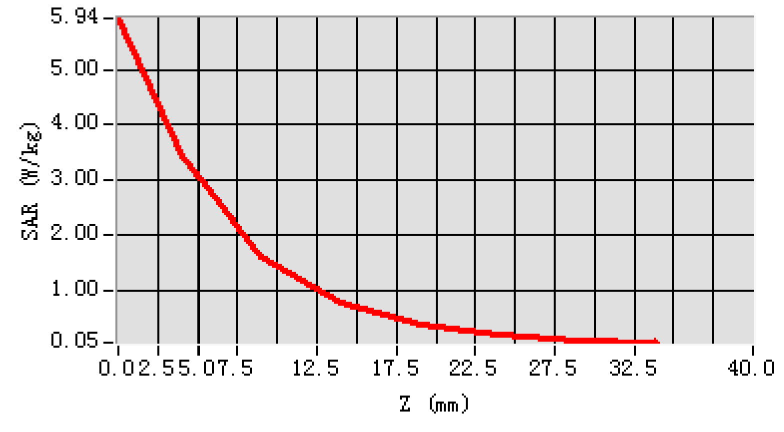


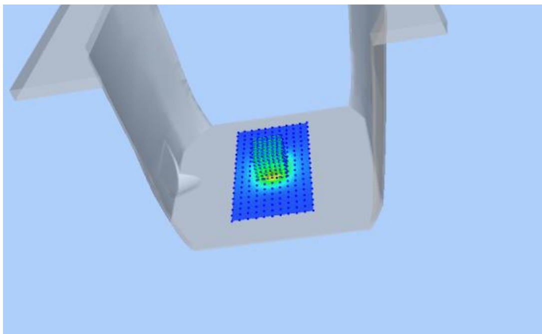
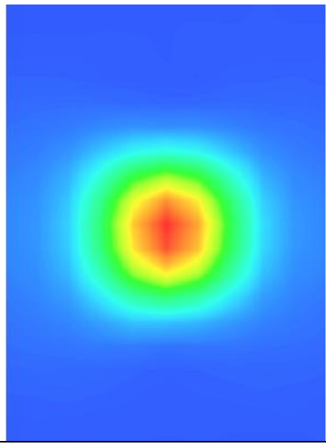
Maximum location: X=0.00, Y=-1.00

SAR Peak: 5.92 W/kg

SAR 10g (W/Kg)	1.425694
SAR 1g (W/Kg)	3.144152

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	5.9363	3.4329	1.6210	0.7881	0.3872	0.1942	0.0971



3D screen shot	Hot spot position
	

APPENDIX B. SAR MEASUREMENT DATA

Test Laboratory: AGC Lab **Date: June 27,2017**
802.11b Mid-Body-Worn- Back
DUT: Audio Player; Type: Explorer

Communication System: Wi-Fi; Communication System Band: 802.11b; Duty Cycle: 1:1; Conv.F=5.33;

Frequency: 2437MHz; Medium parameters used: f = 2450 MHz; σ= 1.90mho/m; εr =53.57; ρ= 1000 kg/m³ ;

Phantom section: Flat Section

Ambient temperature (℃):21.9, Liquid temperature (℃): 21.4

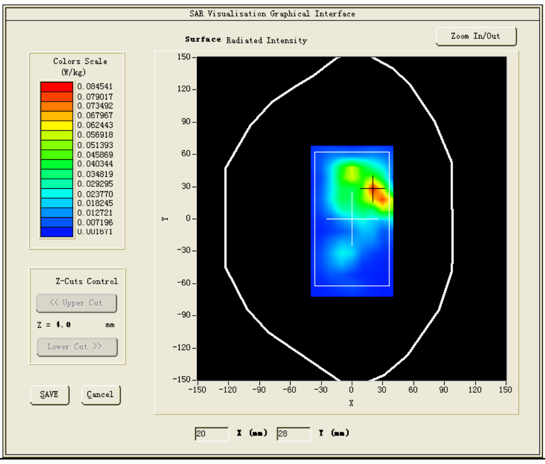
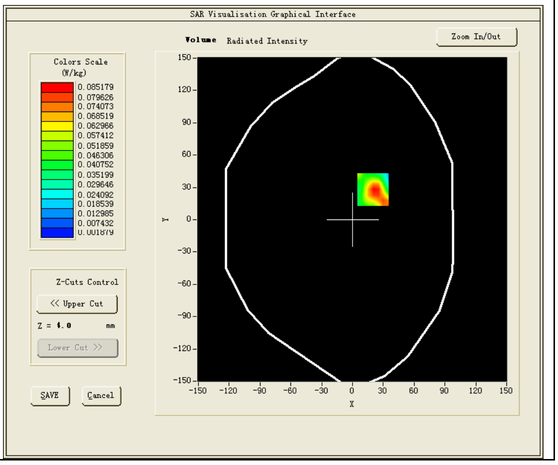
SATIMO Configuration:

- Probe: SSE5; Calibrated: 12/05/2016; Serial No.: SN 14/16 EP308
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Phantom: SAM twin phantom
- Measurement SW: OpenSAR V4_02_32

Configuration/802.11b Mid- Body- Back /Area Scan: Measurement grid: dx=10mm, dy=10mm

Configuration/802.11b Mid- Body- Back /Zoom Scan: Measurement grid: dx=8mm,dy=8mm, dz=5mm;

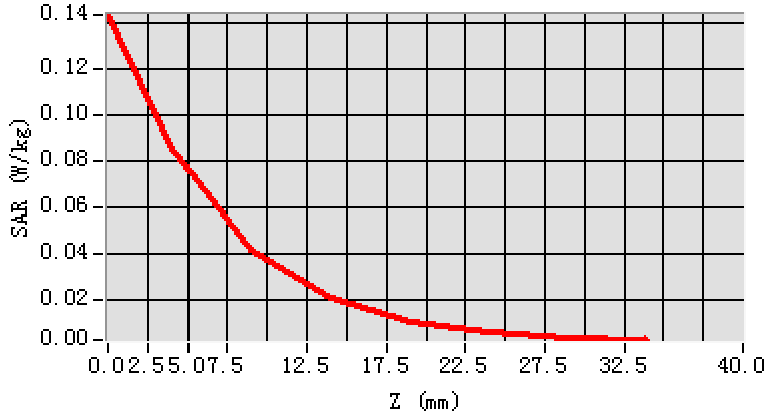
Area Scan	sam_direct_droit2_surf10mm.txt
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm
Phantom	Validation plane
Device Position	Body Back
Band	2450MHz
Channels	Middle
Signal	Crest factor: 1.0

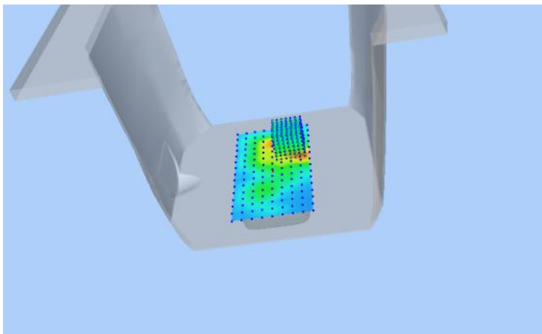
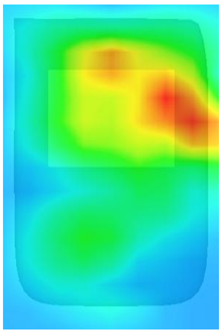
SURFACE SAR	VOLUME SAR
	

Maximum location: X=20.00, Y=28.00
SAR Peak: 0.15 W/kg

SAR 10g (W/Kg)	0.038909
SAR 1g (W/Kg)	0.079812

Z (mm)	**0.00**	**4.00**	**9.00**	**14.00**	**19.00**	**24.00**	**29.00**
SAR (W/Kg)	**0.1431**	**0.0852**	**0.0422**	**0.0212**	**0.0110**	**0.0064**	**0.0041**



3D screen shot	**Hot spot position**
	

Test Laboratory: AGC Lab **Date: June 27,2017**
802.11b Mid-Body- Worn- Front
DUT: Audio Player; Type: Explorer

Communication System: Wi-Fi; Communication System Band: 802.11b; Duty Cycle: 1:1; Conv.F=5.33;

Frequency: 2437MHz; Medium parameters used: f = 2450 MHz; σ= 1.90mho/m; εr =53.57; ρ= 1000 kg/m³ ;

Phantom section: Flat Section

Ambient temperature (℃):21.9, Liquid temperature (℃): 21.4

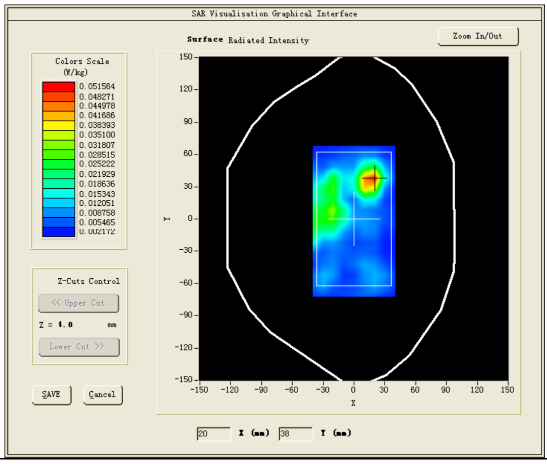
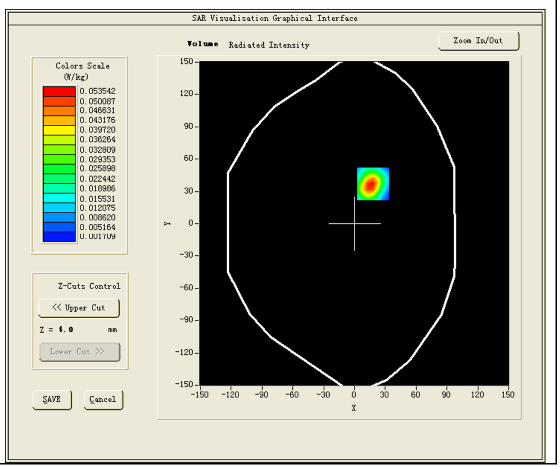
SATIMO Configuration:

- Probe: SSE5; Calibrated: 12/05/2016; Serial No.: SN 14/16 EP308
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Phantom: SAM twin phantom
- Measurement SW: OpenSAR V4_02_32

Configuration/802.11b Mid- Body- Front /Area Scan: Measurement grid: dx=10mm, dy=10mm

Configuration/802.11b Mid- Body- Front /Zoom Scan: Measurement grid: dx=8mm,dy=8mm, dz=5mm;

Area Scan	sam_direct_droit2_surf10mm.txt
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm
Phantom	Validation plane
Device Position	Body Front
Band	2450MHz
Channels	Middle
Signal	Crest factor: 1.0

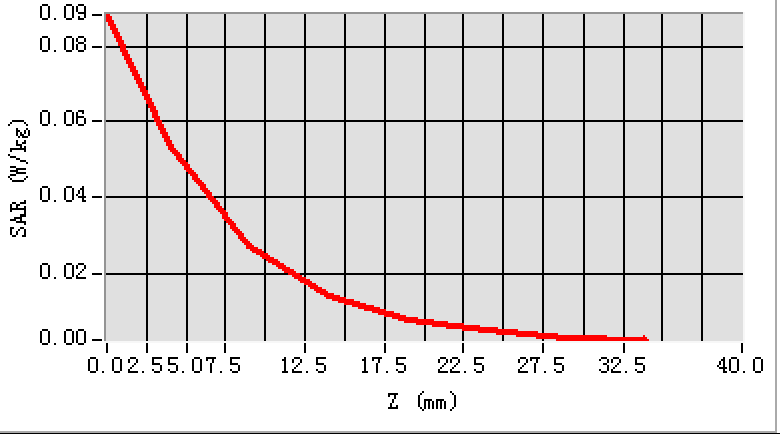
SURFACE SAR	VOLUME SAR
	

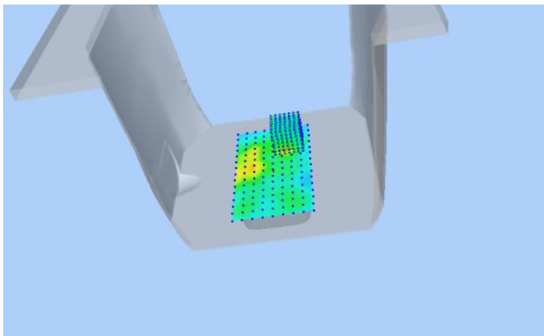
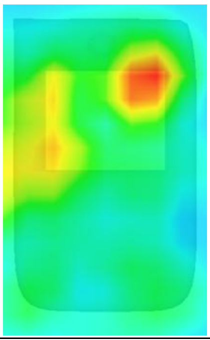
Maximum location: X=18.00, Y=37.00

SAR Peak: 0.09 W/kg

SAR 10g (W/Kg)	0.022870
SAR 1g (W/Kg)	0.049214

Z (mm)	**0.00**	**4.00**	**9.00**	**14.00**	**19.00**	**24.00**	**29.00**
SAR (W/Kg)	**0.0883**	**0.0535**	**0.0274**	**0.0141**	**0.0077**	**0.0048**	**0.0032**



3D screen shot	**Hot spot position**
	

Test Laboratory: AGC Lab **Date: June 27,2017**
802.11b Mid- Edge 2
DUT: Audio Player; Type: Explorer

Communication System: Wi-Fi; Communication System Band: 802.11b; Duty Cycle: 1:1; Conv.F=5.33;

Frequency: 2437MHz; Medium parameters used: f = 2450 MHz; σ= 1.90mho/m; εr =53.57; ρ= 1000 kg/m³ ;

Phantom section: Flat Section

Ambient temperature (℃):21.9, Liquid temperature (℃): 21.4

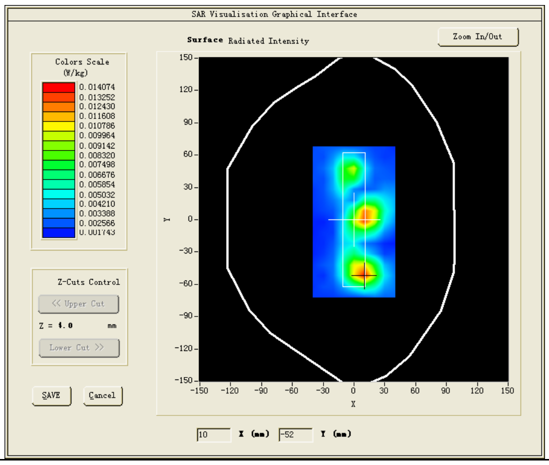
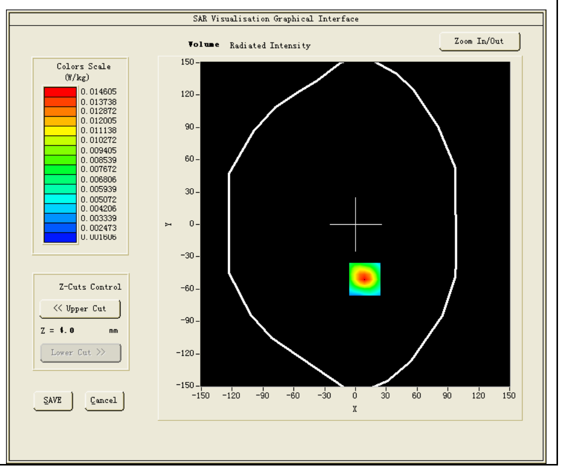
SATIMO Configuration:

- Probe: SSE5; Calibrated: 12/05/2016; Serial No.: SN 14/16 EP308
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Phantom: SAM twin phantom
- Measurement SW: OpenSAR V4_02_32

Configuration/802.11b Mid- Edge 2 /Area Scan: Measurement grid: dx=10mm, dy=10mm

Configuration/802.11b Mid- Edge 2/Zoom Scan: Measurement grid: dx=8mm,dy=8mm, dz=5mm;

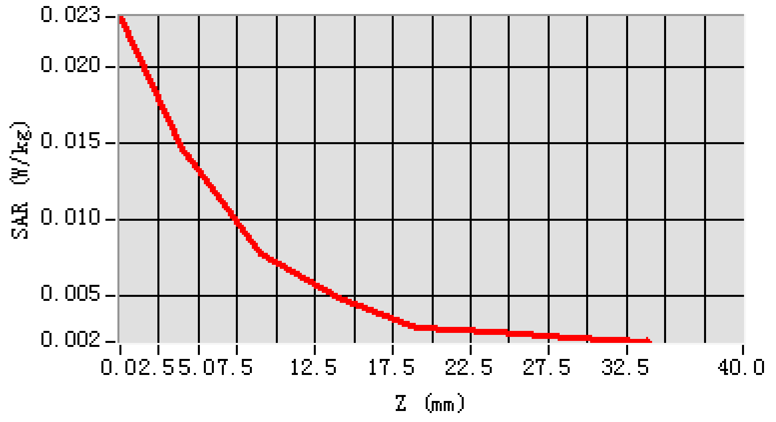
Area Scan	sam_direct_droit2_surf10mm.txt
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm
Phantom	Validation plane
Device Position	Edge 2
Band	2450MHz
Channels	Middle
Signal	Crest factor: 1.0

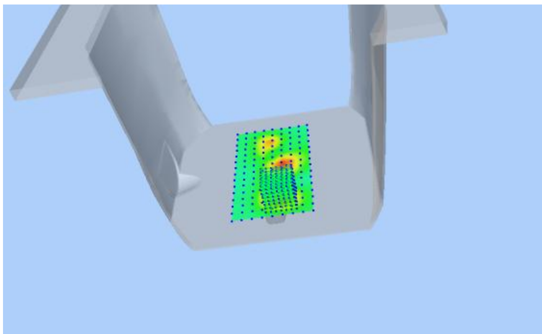
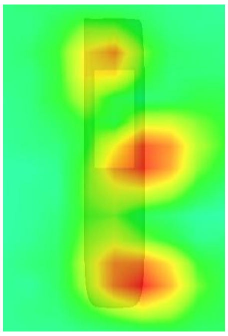
SURFACE SAR	VOLUME SAR
	

Maximum location: X=9.00, Y=-51.00
SAR Peak: 0.02 W/kg

SAR 10g (W/Kg)	0.007100
SAR 1g (W/Kg)	0.013410

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	0.0233	0.0146	0.0078	0.0048	0.0028	0.0025	0.0022



3D screen shot	Hot spot position
	

Test Laboratory: AGC Lab **Date: June 27,2017**
802.11b Mid- Edge 4
DUT: Audio Player; Type: Explorer

Communication System: Wi-Fi; Communication System Band: 802.11b; Duty Cycle: 1:1; Conv.F=5.33;

Frequency: 2437MHz; Medium parameters used: f = 2450 MHz; σ= 1.90mho/m; εr =53.57; ρ= 1000 kg/m³ ;

Phantom section: Flat Section

Ambient temperature (℃):21.9, Liquid temperature (℃): 21.4

SATIMO Configuration:

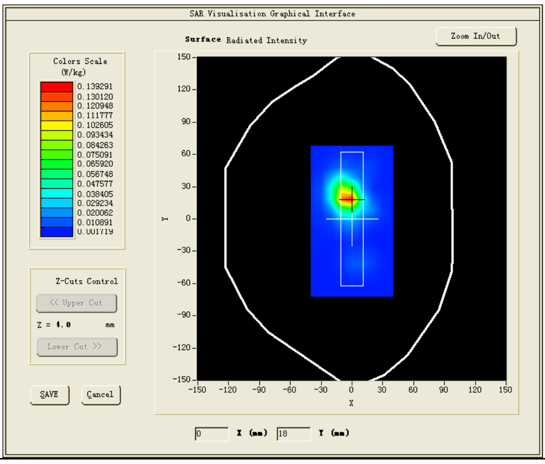
- Probe: SSE5; Calibrated: 12/05/2016; Serial No.: SN 14/16 EP308
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Phantom: SAM twin phantom
- Measurement SW: OpenSAR V4_02_32

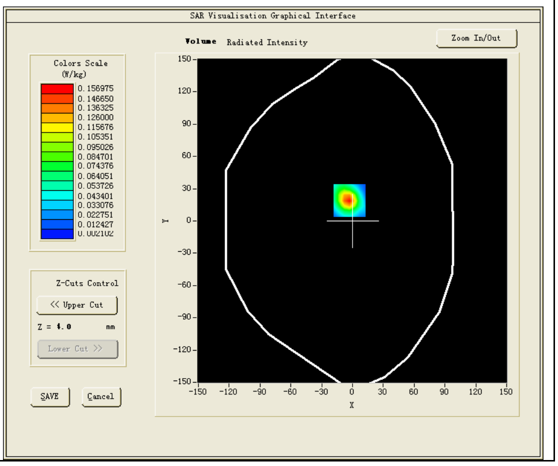
Configuration/802.11b Mid- Edge 4 /Area Scan: Measurement grid: dx=10mm, dy=10mm

Configuration/802.11b Mid- Edge 4/Zoom Scan: Measurement grid: dx=8mm,dy=8mm, dz=5mm;

Area Scan	sam_direct_droit2_surf10mm.txt
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm
Phantom	Validation plane
Device Position	Edge 4
Band	2450MHz
Channels	Middle
Signal	Crest factor: 1.0

SURFACE SAR	VOLUME SAR

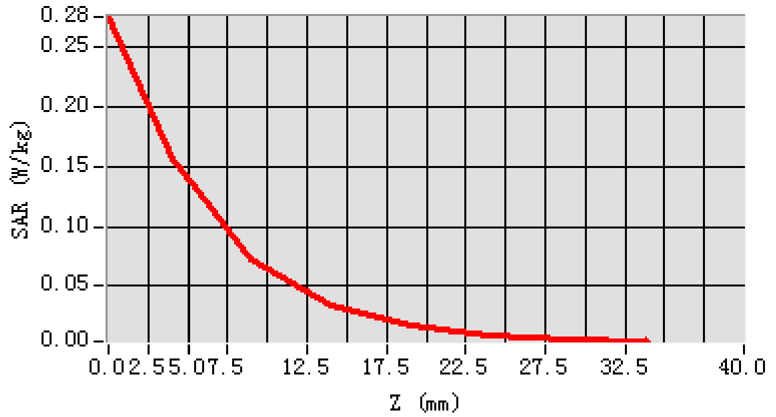


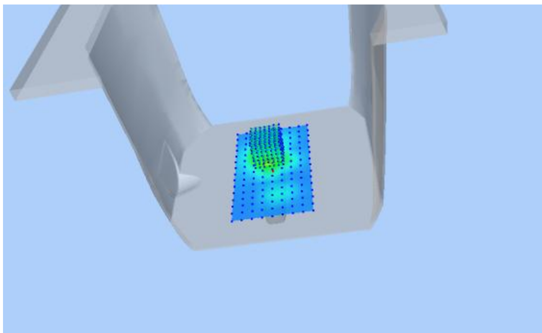
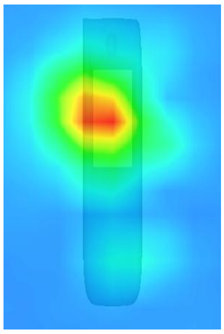


Maximum location: X=-3.00, Y=19.00
SAR Peak: 0.27 W/kg

SAR 10g (W/Kg)	0.056212
SAR 1g (W/Kg)	0.136638

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	0.2759	0.1570	0.0720	0.0332	0.0162	0.0088	0.0049



3D screen shot	Hot spot position
	

APPENDIX C. TEST SETUP PHOTOGRAPHS

Body Back 0mm

Body Front 0mm

Edge 2 (Right) 0mm

Edge 4 (Left) 0mm

DEPTH OF THE LIQUID IN THE PHANTOM—ZOOM IN

Note：The position used in the measurement were according to IEEE 1528-2013

2450MHz body


APPENDIX D. CALIBRATION DATA

Refer to Attached files.