FCC SAR TEST REPORT

APPLICANT	**:**	ShenZhen Gospell Smarthome Electronic Co., Ltd.
PRODUCT NAME	**:**	WiFi Borescope Camera
MODEL NAME	**:**	GD9001
TRADE NAME	**:**	N/A
BRAND NAME	**:**	N/A
FCC ID	**:**	TW5GD9001
STANDARD(S)	**:**	47 CFR 2.1093 IEEE 1528-2013
ISSUE DATE	**:**	2017-10-19

SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd.

DIRECTORY

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Change History		
Issue	Date	Reason for change
1.0	2017-10-19	First edition

TEST REPORT DECLARATION

Applicant	ShenZhen Gospell Smarthome Electronic Co., Ltd.		
Applicant Address	5Floor/Block 2, Vision (SZ) Park, Hi-Tech Industrial Park, Shenzhen, China		
Manufacturer	ShenZhen Gospell Smarthome Electronic Co., Ltd.		
Manufacturer Address	East of 01st-04st Floor,Block A,No.1 Industrial park,Fenghuanggang,South of No.1 Baotian Road,Xixiang street,Bao'an District,Shenzhen City,Guangdong Province 518126,P.R.China		
Product Name	WiFi Borescope Camera		
Model Name	GD9001		
Brand Name	N/A		
HW Version	GD9001M04		
SW Version	N/A		
Test Standards	47 CFR 2.1093; IEEE 1528-2013;		
Test Date	2017-10-18		
The Highest Reported 1g-SAR(W/kg)	Body-worn	0.690W/kg	Limit(W/kg): 1.6W/kg

Tested by : Peng Fuwei

Peng Fuwei

Approved by : Peng Huarui

Peng Huarui

1.TECHNICAL INFORMATION

Note: the Following data is based on the information by the applicant.

1.1 Identification of Applicant

Company Name:	ShenZhen Gospell Smarthome Electronic Co., Ltd.
Address:	5Floor/Block 2, Vision (SZ) Park, Hi-Tech Industrial Park, Shenzhen, China

1.2 Identification of Manufacturer

Company Name:	ShenZhen Gospell Smarthome Electronic Co., Ltd.
Address:	East of 01st-04st Floor,Block A,No.1 Industrial park,Fenghuanggang,South of No.1 Baotian Road,Xixiang street,Bao'an District,Shenzhen City,Guangdong Province 518126,P.R.China

1.3 Equipment Under Test (EUT)

Model Name:	GD9001
Trade Name:	N/A
Brand Name:	N/A
Hardware Version:	GD9001M04
Software Version:	N/A
Tx Frequency Bands:	802.11 b/g/n: 2412-2462 MHz;
Uplink Modulations:	Wi-Fi 802.11b: DSSS; Wi-Fi 802.11g/n: OFDM;
Antenna type:	Fixed Internal Antenna
Development Stage:	Identical prototype
Hotspot mode	No support

1.3.1 Photographs of the EUT

Please refer to the External Photos for the Photos of the EUT

1.3.2 Identification of all used EUT

The EUT identity consists of numerical and letter characters, the letter character indicates the test sample, and the Following two numerical characters indicate the software version of the test sample.

EUT Identity	Hardware Version	Software Version
1#	GD9001M04	N/A

1.4 Applied Reference Documents

Leading reference documents for testing:

No.	Identity	Document Title
1	**IEEE 1528-2013**	IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques
2	**KDB 447498 D01v06**	General RF Exposure Guidance
3	**KDB 248227 D01v02r02**	SAR Measurement Guidance for IEEE 802.11 Transmitters
4	**KDB 865664 D01v01r04**	SAR Measurement 100 MHz to 6 GHz
5	**KDB 865664 D02v01r02**	SAR Reporting
6	**KDB 648474 D04v01r03**	Handset SAR

1.5 Device Category and SAR Limits

This device belongs to portable device category because its radiating structure is allowed to be used within 20 centimeters of the body of the user. Limit for General Population/Uncontrolled exposure should be applied for this device, it is 1.6 W/kg as averaged over any 1 gram of tissue.

2. SPECIFIC ABSORPTION RATE (SAR)

2.1 Introduction

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 Low than the limits for general population/uncontrolled.

2.2 SAR Definition

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:

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

SAR is expressed in units of Watts per kilogram (W/kg)

SAR measurement can be either related to the temperature elevation in tissue by,

$$\mathbf{SAR} = \mathbf{C}\left(\frac{\boldsymbol{\delta}\mathbf{T}}{\boldsymbol{\delta}\mathbf{t}}\right)$$

Where C is the specific head capacity, $\delta\mathrm{T}$ is the temperature rise and $\delta\mathrm{t}$ the exposure duration, or related to the electrical field in the tissue by

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

Where σ is the conductivity of the tissue, ρ is the mass density of the tissue and $|\mathrm{E}|$ is the rms electrical field strength.

However for evaluating SAR of low power transmitter, electrical field measurement is typically applied.

3. SAR MEASUREMENT SETUP

3.1 The Measurement System

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 10g mass.

3.2 Probe

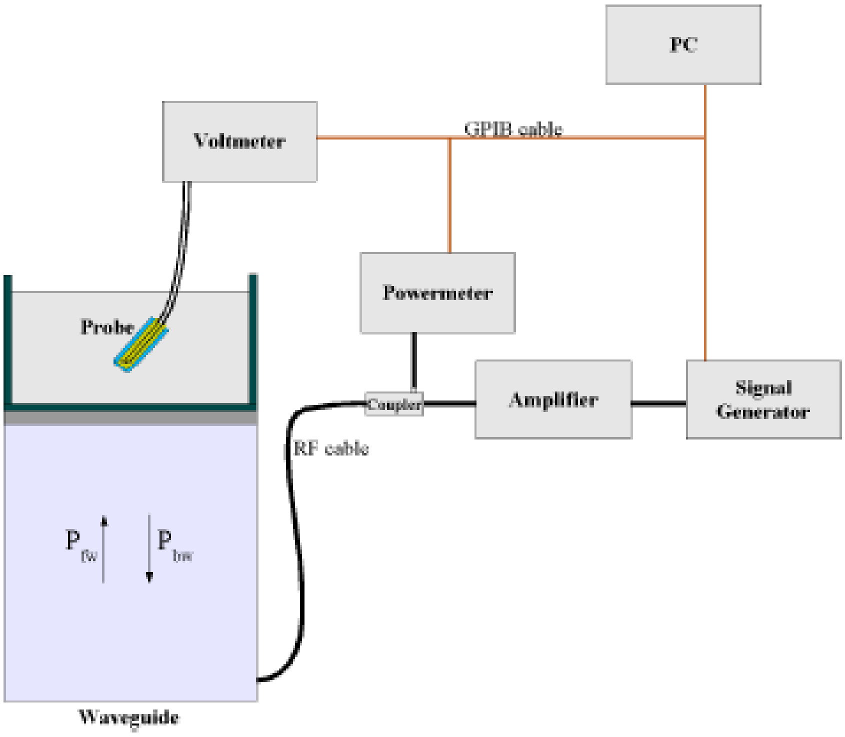
For the measurements the Specific Dosimetric E-Field Probe SN 37/08 EP80 with Following specifications is used

- Dynamic range: 0.01-100 W/kg
- Tip Diameter: 6.5 mm

- Distance between probe tip and sensor center: 2.5mm
- Distance between sensor center and the inner phantom surface: 4 mm
  (repeatability better than +/- 1mm)
- Probe linearity: <0.25 dB
- Axial Isotropy: <0.25 dB
- Spherical Isotropy: <0.25 dB
- Calibration range: 835to 2500MHz for head & body simulating liquid.

Angle between probe axis (evaluation axis) and surface normal line: less than 30°

Probe calibration is realized, in compliance with CENELEC EN 62209 and IEEE 1528 std, with CALISAR, Antennessa proprietary calibration system. The calibration is performed with the EN 622091 annex technique using reference guide at the five frequencies.



$$SAR = \frac{4\left(P_{fw} - P_{bw}\right)}{ab\delta}\cos^2\left(\pi\frac{y}{a}\right)e^{(2z/\delta)}$$

Where :
Pfw = Forward Power
Pbw = Backward Power
a and b = Waveguide dimensions
ı = Skin depth

Keithley configuration:

Rate = Medium; Filter =ON; RDGS=10; FILTER TYPE =MOVING AVERAGE; RANGE AUTO
After each calibration, a SAR measurement is performed on a validation dipole and compared with a NPL calibrated probe, to verify it.

The calibration factors, CF(N), for the 3 sensors corresponding to dipole 1, dipole 2 and dipole 3 are:

CF(N)=SAR(N)/Vlin(N) (N=1,2,3)

The linearised output voltage Vlin(N) is obtained from the displayed output voltage V(N) using

Vlin(N)=V(N)*(1+V(N)/DCP(N)) (N=1,2,3)

Where DCP is the diode compression point in mV.

3.3 Probe Calibration Process

3.3.1 Dosimetric Assessment Procedure

Each E-Probe/Probe Amplifier combination has unique calibration parameters. SATIMO Probe calibration procedure is conducted to determine the proper amplifier settings to enter in the probe parameters. The amplifier settings are determined for a given frequency by subjecting the probe to a known E-field density (1 mW/cm^2) using an with CALISAR, Antenna proprietary calibration system.

3.3.2 Free Space Assessment Procedure

The free space E-field from amplified probe outputs is determined in a test chamber. This calibration can be performed in a TEM cell if the frequency is below 1 GHz and in a waveguide or other methodologies above 1 GHz for free space. For the free space calibration, the probe is placed in the volumetric center of the cavity and at the proper orientation with the field. The probe is rotated 360 degrees until the three channels show the maximum reading. The power density readings equates to 1 mW/cm^2.

3.3.3 Temperature Assessment Procedure

E-field temperature correlation calibration is performed in a flat phantom filled with the appropriate simulating head tissue. The E-field in the medium correlates with the temperature rise in the dielectric medium. For temperature correlation calibration a RF transparent thermistor-based temperature probe is used in conjunction with the E-field probe.

Where:

δt = exposure time (30 seconds),

$\mathbf{SAR} = \mathbf{C}\left(\frac{\delta T}{\delta t}\right)$

C = heat capacity of tissue (brain or muscle),

δT = temperature increase due to RF exposure.

SAR is proportional to ΔT/Δt, the initial rate of tissue heating, before thermal diffusion takes place. The electric field in the simulated tissue can be used to estimate SAR by equating the thermally derived SAR to that with the E- field component.

Where:

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

σ = simulated tissue conductivity,

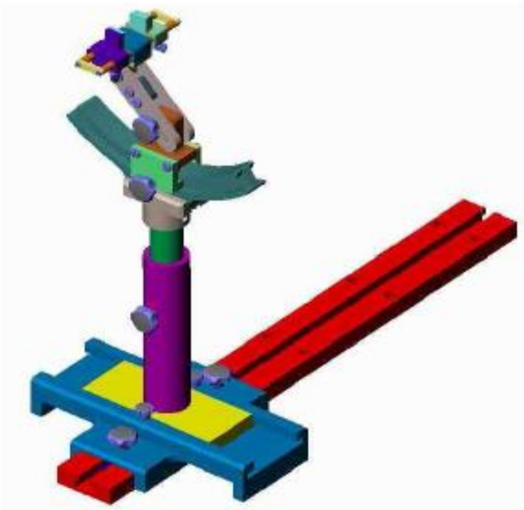
ρ = Tissue density (1.25 g/cm^3 for brain tissue)

3.4 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.

3.5 Device Holder

The positioning system allows obtaining cheek and tilting position with a very good accuracy. In compliance with CENELEC, the tilt angle uncertainty is Low than 1°.



Device holder

System Material	Permittivity	Loss Tangent
Delrin	3.7	0.005

4. TISSUE SIMULATING LIQUIDS

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 15 cm. For head SAR testing, the liquid height from the ear reference point (ERP) of the phantom to the liquid top surface is larger than 15 cm. For body SAR testing, the liquid height from the center of the flat phantom to the liquid top surface is larger than 15 cm. The nominal dielectric values of the tissue simulating liquids in the phantom and the tolerance of 5% are listed in below table.

The following table gives the recipes for tissue simulating liquids

Frequency Band (MHz)	2450	2450
Tissue Type	Head	Body
Ingredients (% by weight)		
Deionised Water	62.70	73.20
Salt(NaCl)	0.50	0.10
Sugar	0.00	0.00
Tween 20	0.00	0.00
HEC	0.00	0.00
Bactericide	0.00	0.00
Triton X-100	36.80	0.00
DGBE	0.00	26.70
Diethylenglycol monohexylether	0.00	0.00
Measured dielectric parameters		
Dielectric Constant	39.20	52.70
Conductivity (S/m)	1.80	1.95

Note: Please refer to the validation results for dielectric parameters of each frequency band.

The dielectric properties of the tissue simulating liquids were verified prior to the SAR evaluation using an Agilent 85033E Dielectric Probe Kit and an Agilent Network Analyzer.

Table 1: Dielectric Performance of Tissue Simulating Liquid

Temperature: 22.0~23.8°C, humidity: 54~60%.						
Date	**Freq.(MHz)**	**Liquid Parameters**	**Meas.**	**Target**	**Delta(%)**	**Limit±(%)**
2017/10/18	Body 2450	Relative Permittivity(εr):	52.48	52.70	-0.42	5
		Conductivity(σ):	1.96	1.95	0.51	5
2017/10/18	Head 2450	Relative Permittivity(εr):	39.23	39.20	0.08	5
		Conductivity(σ):	1.82	1.80	1.11	5

5. UNCERTAINTY ASSESSMENT

The Following table includes the uncertainty table of the IEEE 1528. The values are determined by Antennessa.

5.1 UNCERTAINTY EVALUATION FOR EUT SAR TEST

a	b	c	d	e= f(d,k)	f	g	h= c*f/e	i= c*g/e	k
Uncertainty Component	Sec.	Tol (+- %)	Prob. Dist.	Div.	Ci (1g)	Ci (10g)	1g Ui (+-%)	10g Ui (+-%)	Vi
Measurement System									
Probe calibration	E.2.1	5.83	N	1	1	1	5.83	5.83	∞
Axial Isotropy	E.2.2	3.5	R	$\sqrt{3}$	1	1	2.02	2.02	∞
Hemispherical Isotropy	E.2.2	5.9	R	$\sqrt{3}$	1	1	3.41	3.41	∞
Boundary effect	E.2.3	1.0	R	$\sqrt{3}$	1	1	0.58	0.58	∞
Linearity	E.2.4	4.7	R	$\sqrt{3}$	1	1	2.71	2.71	∞
System detection limits	E.2.5	1.0	R	$\sqrt{3}$	1	1	0.58	0.58	∞
Readout Electronics	E.2.6	0.5	N	1	1	1	0.5	0.5	∞
Reponse Time	E.2.7	3.0	R	$\sqrt{3}$	1	1	3.0	3.0	∞
Integration Time	E.2.8	1.4	R	$\sqrt{3}$	1	1	0.81	0.81	∞
RF ambient Conditions	E.6.1	3.0	R	$\sqrt{3}$	1	1	1.73	1.73	∞
Probe positioner Mechanical Tolerance	E.6.2	1.4	R	$\sqrt{3}$	1	1	0.81	0.81	∞
Probe positioning with respect to Phantom Shell	E.6.3	1.4	R	$\sqrt{3}$	1	1	0.81	0.81	∞
Extrapolation, interpolation and integration Algoritms for Max. SAR Evaluation	E.5.2	2.3	R	$\sqrt{3}$	1	1	1.33	1.33	∞
Test sample Related									
Test sample positioning	E.4.2.1	2.6	N	1	1	1	2.6	2.6	N-1
Device Holder Uncertainty	E.4.1.1	3.0	N	1	1	1	3.0	3.0	N-1
Output power Power drift -	6.6.2	5.0	R	$\sqrt{3}$	1	1	2.89	2.89	∞

SAR drift measurement									
Phantom and Tissue Parameters									
Phantom Uncertainty (Shape and thickness tolerances)	E.3.1	4.0	R	$\sqrt{3}$	1	1	2.31	2.31	∞
Liquid conductivity - deviation from target value	E.3.2	2.0	R	$\sqrt{3}$	0.64	0.43	1.69	1.13	∞
Liquid conductivity - measurement uncertainty	E.3.3	2.5	N	1	0.64	0.43	3.20	2.15	M
Liquid permittivity - deviation from target value	E.3.2	2.5	R	$\sqrt{3}$	0.6	0.49	1.28	1.04	∞
Liquid permittivity - measurement uncertainty	E.3.3	5.0	N	1	0.6	0.49	6.00	4.90	M
Liquid conductivity –temperature uncertainty	E.3.4		R	$\sqrt{3}$	0.78	0.41			∞
Liquid permittivity –temperature uncertainty	E.3.4		R	$\sqrt{3}$	0.23	0.26			∞
Combined Standard Uncertainty			RSS				11.55	12.07	
Expanded Uncertainty (95% Confidence interval)			K=2				±23.20	±24.17	

5.2 UNCERTAINTY FOR SYSTEM PERFORMANCE CHECK

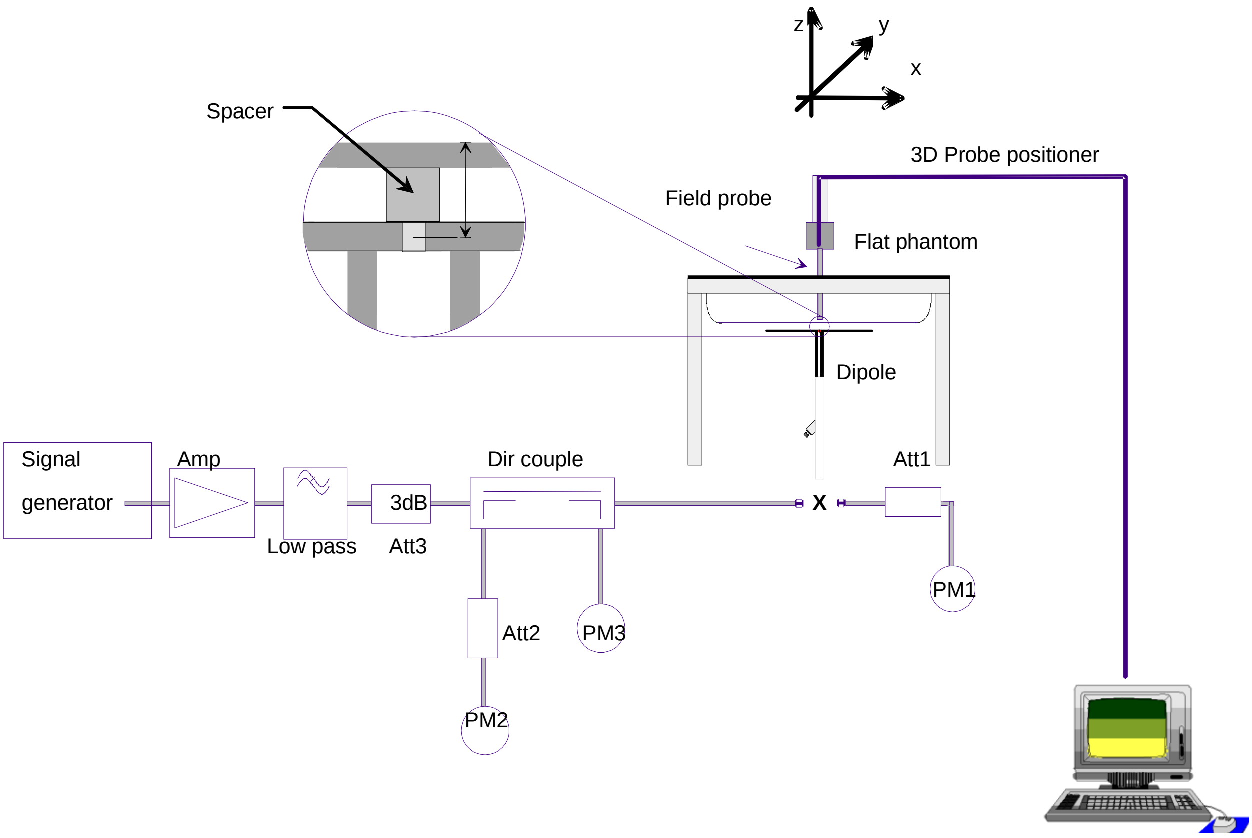
a	b	c	d	e= f(d,k)	f	g	h= c*f/e	i= c*g/e	k
Uncertainty Component	Sec.	Tol (+-%)	Prob. Dist.	Div.	Ci (1g)	Ci (10g)	1g Ui (+-%)	10g Ui (+-%)	Vi
Measurement System									
Probe calibration	E.2.1	4.76	N	1	1	1	4.76	4.7	∞
Axial Isotropy	E.2.2	2.5	R	$\sqrt{3}$	1	1	1.44	1.4	∞
Hemispherical Isotropy	E.2.2	4.0	R	$\sqrt{3}$	1	1	2.31	2.3	∞
Boundary effect	E.2.3	1.0	R	$\sqrt{3}$	1	1	0.58	0.5	∞
Linearity	E.2.4	5.0	R	$\sqrt{3}$	1	1	2.89	2.8	∞
System detection limits	E.2.5	1.0	R	$\sqrt{3}$	1	1	0.58	0.5	∞

Readout Electronics	E.2.6	0.02	N	1	1	1	0.02	0.0	∞
Reponse Time	E.2.7	3.0	R	$\sqrt{3}$	1	1	1.73	1.7	∞
Integration Time	E.2.8	2.0	R	$\sqrt{3}$	1	1	1.15	1.1	∞
RF ambient Conditions	E.6.1	3.0	R	$\sqrt{3}$	1	1	1.73	1.7	∞
Probe positioner Mechanical Tolerance	E.6.2	2.0	R	$\sqrt{3}$	1	1	1.15	1.1 5	∞
Probe positioning with respect to Phantom Shell	E.6.3	0.05	R	$\sqrt{3}$	1	1	0.03	0.0 3	∞
Extrapolation, interpolation and integration Algoritms for Max. SAR Evaluation	E.5.2	5.0	R	$\sqrt{3}$	1	1	2.89	2.8 9	∞
Dipole									
Dipole axis to liquid Distance	8,E.4. 2	1.00	N	$\sqrt{3}$	1	1	0.58	0.5 8	∞
Input power and SAR drift measurement	8,6.6. 2	4.04	R	$\sqrt{3}$	1	1	2.33	2.3 3	∞
Phantom and Tissue Parameters									
Phantom Uncertainty (Shape and thickness tolerances)	E.3.1	0.05	R	$\sqrt{3}$	1	1	0.03	0.0 3	∞
Liquid conductivity - deviation from target value	E.3.2	4.57	R	$\sqrt{3}$	0.64	0.43	1.69	1.1 3	∞
Liquid conductivity - measurement uncertainty	E.3.3	5.00	N	$\sqrt{3}$	0.64	0.43	1.85	1.2 4	M
Liquid permittivity - deviation from target value	E.3.2	3.69	R	$\sqrt{3}$	0.6	0.49	1.28	1.0 4	∞
Liquid permittivity - measurement uncertainty	E.3.3	10.0 0	N	$\sqrt{3}$	0.6	0.49	3.46	2.8 3	M
Combined Standard Uncertainty			RSS				8.83	8.3 7	
Expanded Uncertainty (95% Confidence interval)			K=2				17.66	16. 73	

6. SAR MEASUREMENT EVALUATION

6.1 System Setup

In the simplified setup for system evaluation, the DUT is replaced by a calibrated dipole and the power source is replaced by a continuous wave which comes from a signal generator. The calibrated dipole must be placed beneath the flat phantom section of the SAM twin phantom with the correct distance holder. The distance holder should touch the phantom surface with a light pressure at the reference marking and be oriented parallel to the long side of the phantom. The system check verifies that the system operates within its specifications. It is performed daily or before every SAR measurement. The system check uses normal SAR measurements in the flat section of the phantom with a matched dipole at a specified distance. The system verification setup is shown as below



The validation dipole is placed beneath the flat phantom with the specific spacer in place. The distance spacer is touch the phantom surface with a light pressure at the reference marking and be oriented parallel to the long side of the phantom. The power meter PM1 measures the forward power at the location of the system check dipole connector. The signal generator is adjusted for the desired forward power at the dipole connector and the power meter PM2 is read at that level.

After connecting the cable to the dipole, the signal generator is readjusted for the same reading at power meter PM2.

6.2 Validation Results

After system check testing, the SAR result will be normalized to 1W forward input power and compared with the reference SAR value derived from validation dipole certificate report. The deviation of system check should be within 10 %.

Frequency	2450MHz (Head)	2450MHz (Body)
Target value 1W (1g)	23.86 W/Kg	56.13 W/Kg
Test value (100 mW input power)	2.374 W/Kg	5.556 W/Kg
Normalized to 1W value(1g)	23.74 W/Kg	55.56 W/Kg

Note: System checks the specific test data please see Annex C.

7. OPERATIONAL CONDITIONS DURING TEST

7.1 Body-worn Configurations

The body-worn configurations shall be tested with the supplied accessories (belt-clips, holsters, etc.) attached to the device in normal use configuration.

For body-worn and other configurations a flat phantom shall be used which is comprised of material with electrical properties similar to the corresponding tissues.

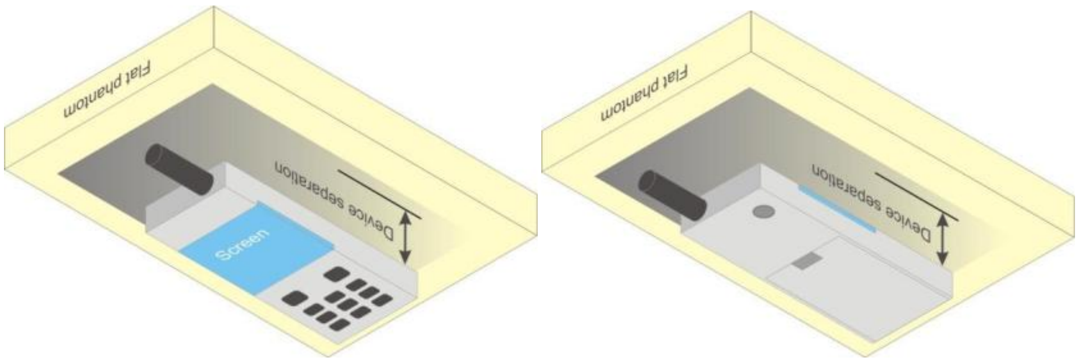


Illustration for Body Worn Position

7.2 Measurement procedure

The Following steps are used for each test position

1. 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.
2. Measurement of the local E-field value at a fixed location. This value serves as a reference value for calculating a possible power drift.
3. 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.
4. 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.

7.3 Description of interpolation/extrapolation scheme

The local SAR inside the phantom is measured using small dipole sensing elements inside a probe body. The probe tip must not be in contact with the phantom surface in order to minimize measurements errors, but the highest local SAR will occur at the surface of the phantom.

An extrapolation is using to determinate this highest local SAR values. The extrapolation is based on a fourth-order least-square polynomial fit of measured data. The local SAR value is then extrapolated from the liquid surface with a 1mm step.

The measurements have to be performed over a limited time (due to the duration of the battery) so the step of measurement is high. It could vary between 5 and 8 mm. To obtain an accurate assessment of the maximum SAR averaged over 10 grams and 1 gram requires a very fine resolution in the three dimensional scanned data array.

8. MEASUREMENT OF CONDUCTED OUTPUT POWER

1. Wi-Fi 2.4GHz Average output power

Band	Channel	Frequency (MHz)	Output Power(dBm)		
			802.11b (DSSS)	802.11g (OFDM)	802.11n20 (OFDM)
Wi-Fi 2.4GHz	1	2412	16.80	15.04	14.76
	6	2437	16.29	14.45	14.16
	11	2462	15.71	14.31	13.83

Band	Channel	Frequency (MHz)	Output Power(dBm)
			802.11n40 (OFDM)
Wi-Fi 2.4GHz	3	2422	13.70
	6	2437	13.03
	9	2452	13.12

9. TEST RESULTS LIST

Summary of Measurement Results (WLAN 2.4GHz 802.11b Band)

Temperature: 21.0~23.8°C, humidity: 54~60%.					
Phantom Configurations	Device Test Positions	Device Test channel	SAR(W/Kg), 1g Peak	Scaling Factor	Scaled SAR (W/Kg), 1g
Body (0mm Separation)	Back upward	6	0.081	1.047	0.085
	Face upward		0.659		0.690
	Left Edge		0.329		0.344
	Right Edge		0.302		0.316
	Bottom		0.046		0.048

Notes:

1. Adjust SAR for OFDM is 0.690*15.05/16.80=0.618W/Kg<1.2, so SAR is not required for OFDM modes.

2. SAR is measured for 2.4 GHz 802.11b DSSS using either the fixed test position or, when applicable, the initial test position procedure. SAR test reduction is determined according to the following:

   1) When the reported SAR of the highest measured maximum output power channel for the exposure configuration is ≤ 0.8 W/kg, no further SAR testing is required for 802.11b DSSS in that exposure configuration.

   2) When the reported SAR is > 0.8 W/kg, SAR is required for that position using the next highest measured output power channel. When any reported SAR is > 1.2 W/kg, SAR is required for the third channel; i.e., all channels require testing.

3. 2.4 GHz 802.11 g/n OFDM are additionally evaluated for SAR if the highest reported SAR for 802.11b, adjusted by the ratio of the OFDM to DSSS specified maximum output power, is > 1.2 W/kg. When SAR is required for OFDM modes in 2.4 GHz band, the Initial Test Configuration Procedures should be followed.

4. For held-to-ear and hotspot operations, the initial test position procedures were applied. The test position with the highest extrapolated peak SAR will be used as the initial test position. When reported SAR for the initial test position is ≤ 0.4 W/kg, no additional testing for the remaining test positions was required. Otherwise, SAR is evaluated at the subsequent highest

peak SAR positions until the reported SAR result is ≤ 0.8 W/kg or all test positions are measured.

5. Justification for test configurations for WLAN per KDB Publication 248227 D01DR02-41929 for 2.4 GHz Wi-Fi single transmission chain operations, the highest measured maximum output power channel for DSSS was selected for SAR measurement. SAR for OFDM modes (2.4 GHz 802.11g/n) was not required due to the maximum allowed powers and the highest reported DSSS SAR.
6. During test, the duty cycle of the EUT was setting to 100%
7. Scaling Factor calculation

Band	Tune-up power tolerance(dBm)	SAR test channel Power (dBm)	Scaling Factor
WiFi 2.4GHz	Max output power =16.5(+0.5 -2)	16.80	1.047

10. REPEATED SAR MEASUREMENT

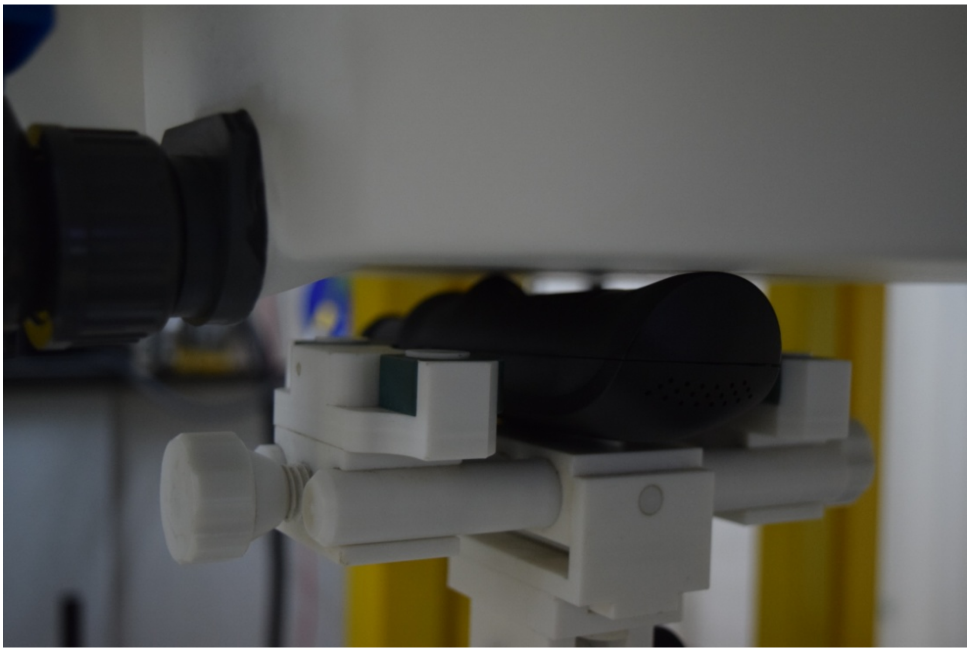
In accordance with published RF Exposure KDB procedure 865664 D01 SAR measurement 100 MHz to 6 GHz. These additional measurements are repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device should be returned to ambient conditions (normal room temperature) with the battery fully charged before it is re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

1) Repeated measurement is not required when the original highest measured SAR is < 0.80 W/kg; steps 2) through 4) do not apply.
2) When the original highest measured SAR is ≥ 0.80 W/kg, repeat that measurement once.
3) 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 (~ 10% from the 1-g SAR limit).
4) Perform a third repeated measurement only if the original, first or second repeated measurement is ≥1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.

ANNEX A SETUP PHOTOS

1. EUT Back Position

2. EUT Face Position



3. EUT Left Position

4. EUT Right Position

5. Bottom Position

6. Liquid Level Photo

MEASUREMENT 1

Type: Phone measurement (Complete)

Area Scan resolution: dx=8mm,dy=8mm

Zoom scan resolution: dx=8mm, dy=8mm, dz=5mm

Date of measurement: 2017.10.18

Measurement duration: 13 minutes 45 seconds

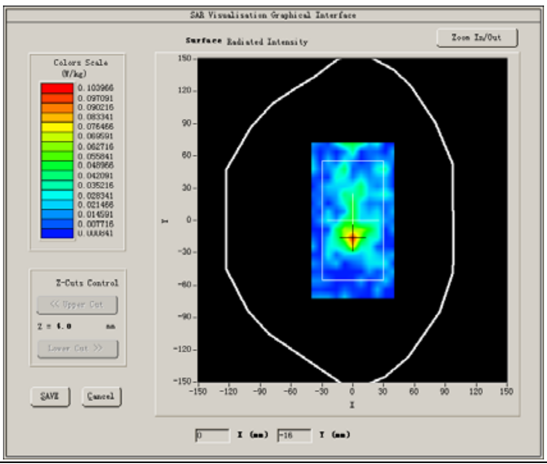
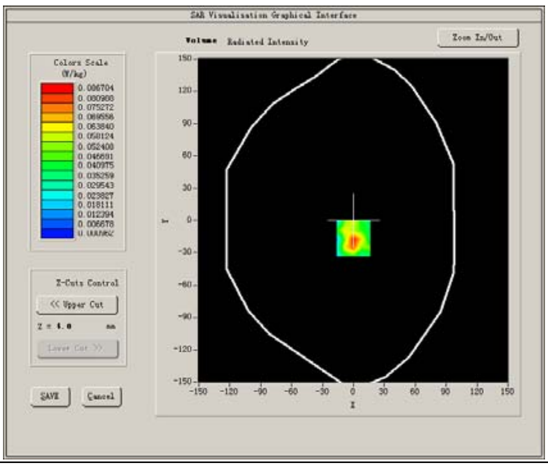
A. Experimental conditions.

Area Scan	surf_sam_plan.txt, h= 5.00 mm
Phantom	Validation plane
Device Position	Body
Band	IEEE 802.11b ISM
Channels	Middle
Signal	DSSS

B. SAR Measurement Results

Middleer Band SAR (Channel 6):

Frequency (MHz)	2437.000000
Relative permittivity (real part)	39.400002
Conductivity (S/m)	1.788081
Power drift (%)	-3.450000
Ambient Temperature:	22.6°C
Liquid Temperature:	22.7°C
ConvF:	4.82
Crest factor:	1:1

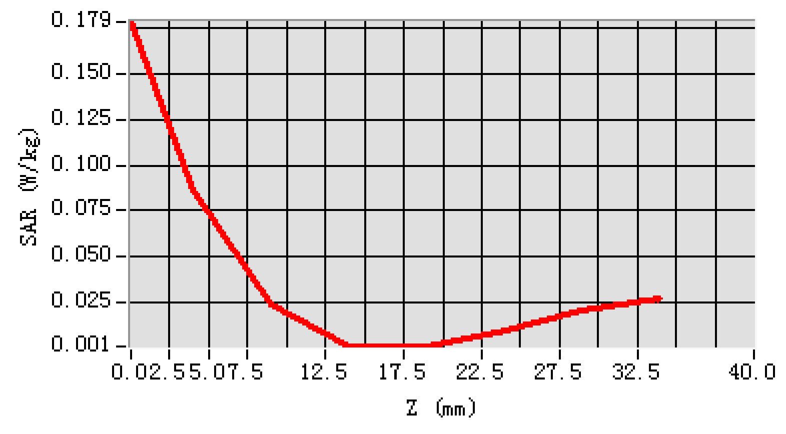
SURFACE SAR	VOLUME SAR
	

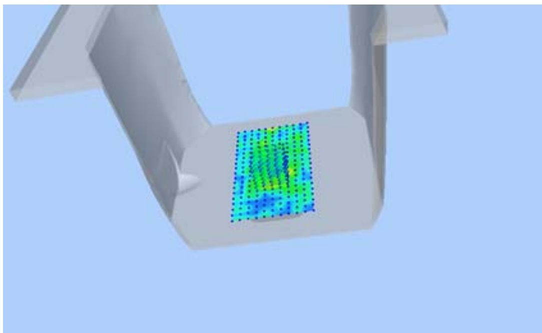
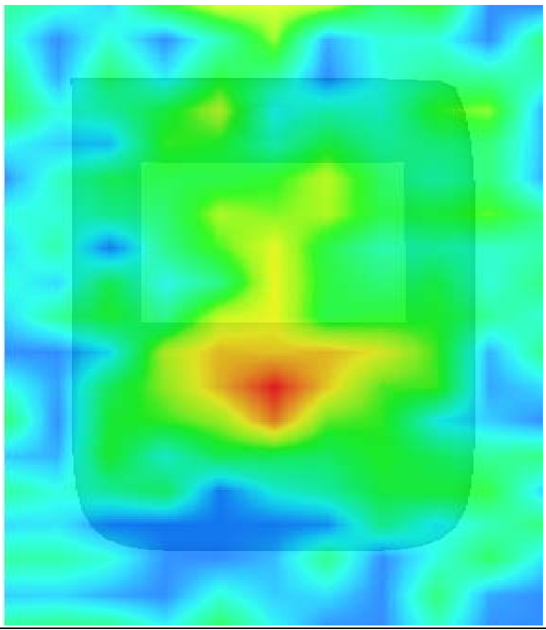
Maximum location: X=0.00, Y=-17.00

SAR Peak: 0.19 W/kg

SAR 10g (W/Kg)	0.034382
SAR 1g (W/Kg)	0.080582

Z (mm)	**0.00**	**4.00**	**9.00**	**14.00**	**19.00**	**24.00**	**29.00**
SAR (W/Kg)	**0.1786**	**0.0867**	**0.0240**	**0.0010**	**0.0010**	**0.0092**	**0.0208**



3D screen shot	**Hot spot position**
	

MEASUREMENT 2

Type: Phone measurement (Complete)

Area Scan resolution: dx=8mm,dy=8mm

Zoom scan resolution: dx=8mm, dy=8mm, dz=5mm

Date of measurement: 2017.10.18

Measurement duration: 13 minutes 28 seconds

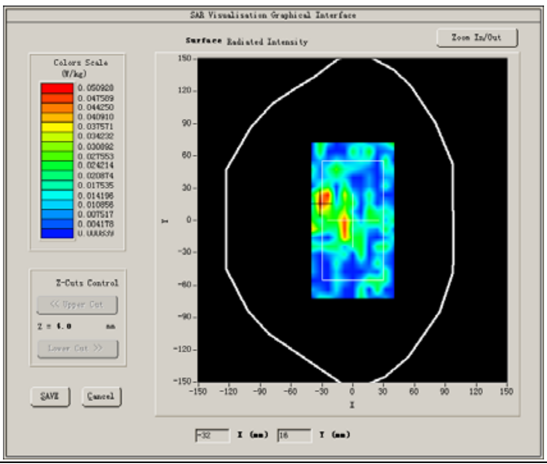
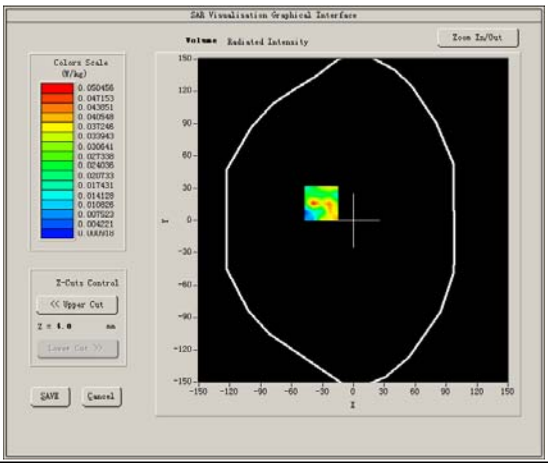
A. Experimental conditions.

Area Scan	surf_sam_plan.txt, h= 5.00 mm
Phantom	Validation plane
Device Position	Body
Band	IEEE 802.11b ISM
Channels	Middle
Signal	DSSS

B. SAR Measurement Results

Middle Band SAR (Channel 6)

Frequency (MHz)	2437.000000
Relative permittivity (real part)	39.400002
Conductivity (S/m)	1.788081
Power drift (%)	-3.450000
Ambient Temperature:	22.6°C
Liquid Temperature:	22.7°C
ConvF:	4.82
Crest factor:	1:1

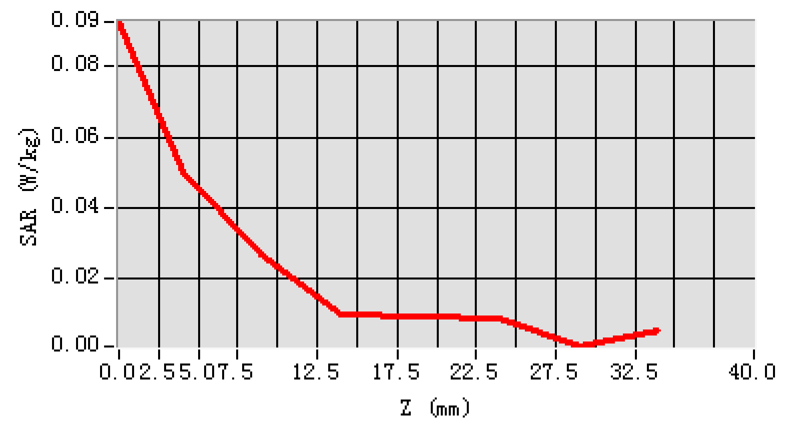
SURFACE SAR	VOLUME SAR
	

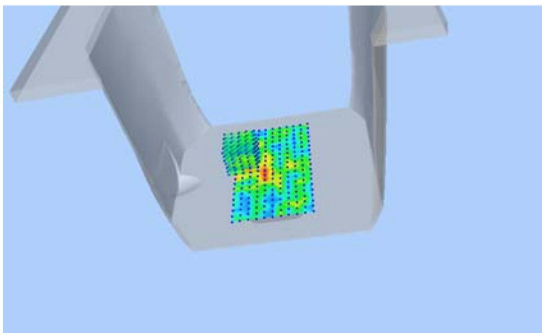
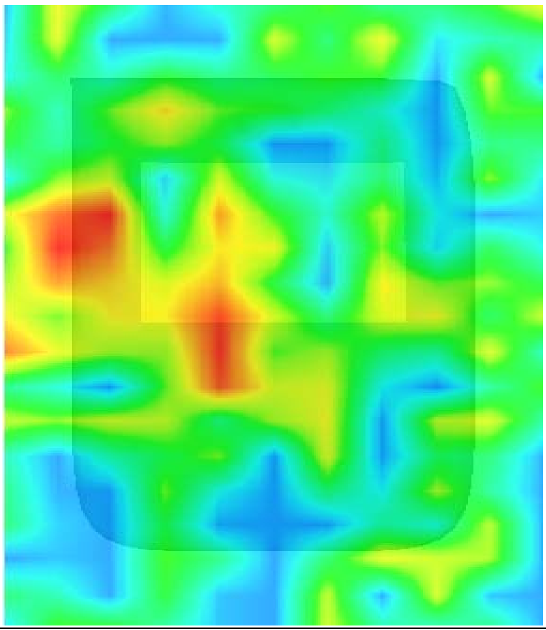
Maximum location: X=-31.00, Y=16.00

SAR Peak: 0.14 W/kg

SAR 10g (W/Kg)	0.023152
SAR 1g (W/Kg)	0.045678

Z (mm)	**0.00**	**4.00**	**9.00**	**14.00**	**19.00**	**24.00**	**29.00**
SAR (W/Kg)	**0.0927**	**0.0505**	**0.0270**	**0.0098**	**0.0092**	**0.0089**	**0.0010**



3D screen shot	**Hot spot position**
	

MEASUREMENT 3

Type: Phone measurement (Complete)

Area Scan resolution: dx=8mm,dy=8mm

Zoom scan resolution: dx=8mm, dy=8mm, dz=5mm

Date of measurement: 2017.10.18

Measurement duration: 13 minutes 43 seconds

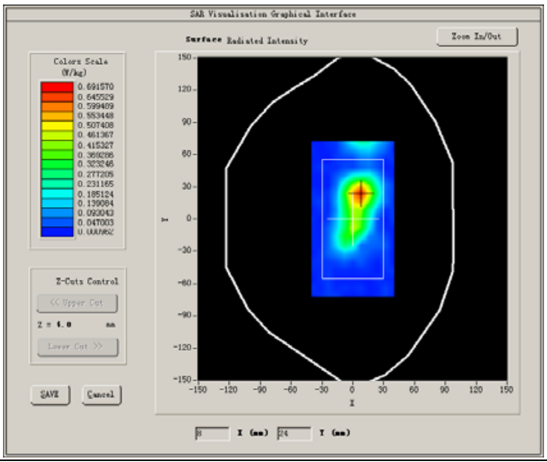
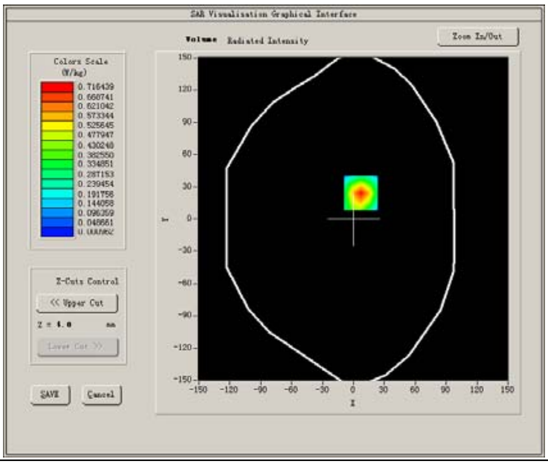
A. Experimental conditions.

Area Scan	surf_sam_plan.txt, h= 5.00 mm
Phantom	Validation plane
Device Position	Body
Band	IEEE 802.11b ISM
Channels	Middle
Signal	DSSS

B. SAR Measurement Results

Middle Band SAR (Channel 6)

Frequency (MHz)	2437.000000
Relative permittivity (real part)	39.400002
Conductivity (S/m)	1.788081
Power drift (%)	-3.450000
Ambient Temperature:	22.6°C
Liquid Temperature:	22.7°C
ConvF:	4.82
Crest factor:	1:1

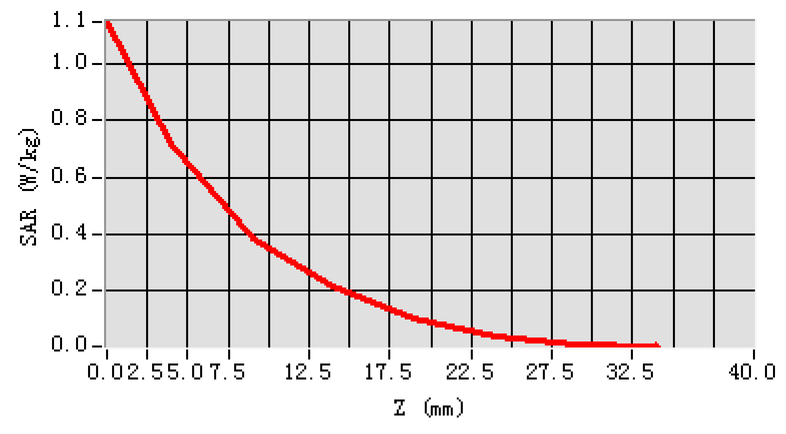
SURFACE SAR	VOLUME SAR
	

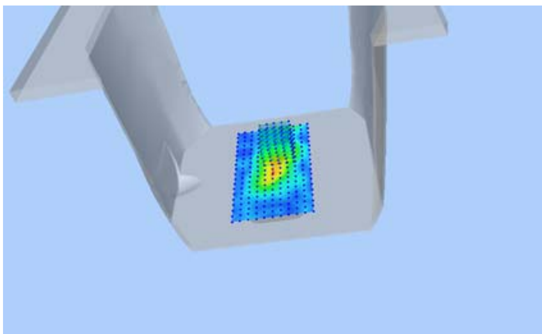
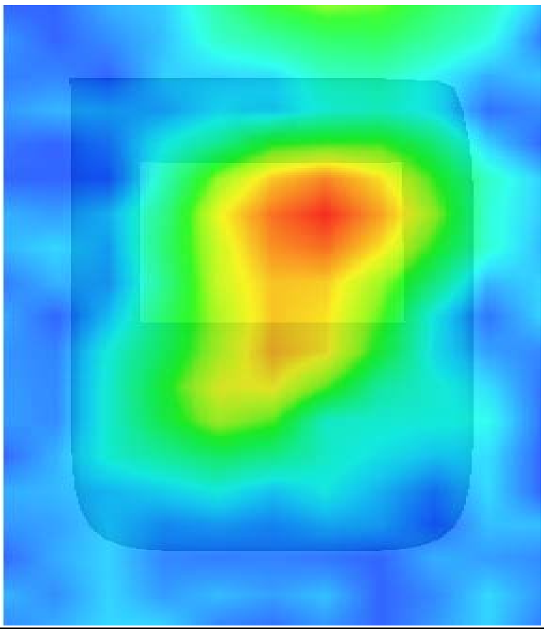
Maximum location: X=7.00, Y=24.00

SAR Peak: 1.14 W/kg

SAR 10g (W/Kg)	0.316828
SAR 1g (W/Kg)	0.658829

Z (mm)	**0.00**	**4.00**	**9.00**	**14.00**	**19.00**	**24.00**	**29.00**
SAR (W/Kg)	**1.1463**	**0.7164**	**0.3819**	**0.2158**	**0.1033**	**0.0408**	**0.0098**



3D screen shot	**Hot spot position**
	

MEASUREMENT 4

Type: Phone measurement (Complete)

Area Scan resolution: dx=8mm,dy=8mm

Zoom scan resolution: dx=8mm, dy=8mm, dz=5mm

Date of measurement: 2017.10.18

Measurement duration: 13 minutes 30 seconds

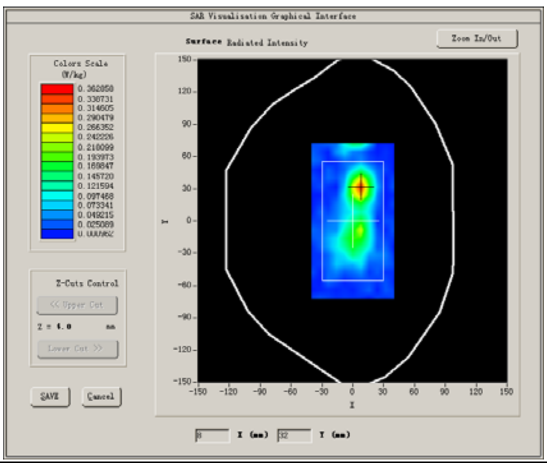
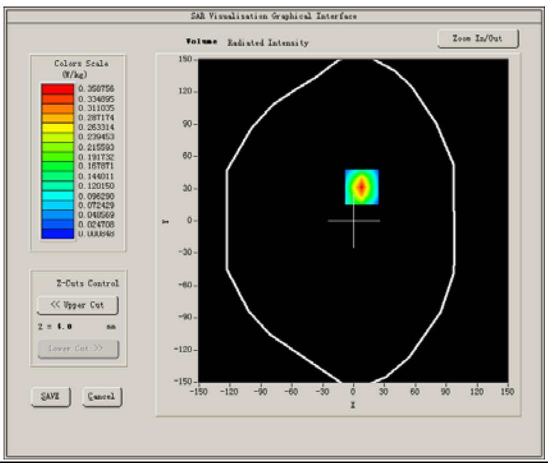
A. Experimental conditions.

Area Scan	surf_sam_plan.txt, h= 5.00 mm
Phantom	Validation plane
Device Position	Body
Band	IEEE 802.11b ISM
Channels	Middle
Signal	DSSS

B. SAR Measurement Results

Middle Band SAR (Channel 6)

Frequency (MHz)	2437.000000
Relative permittivity (real part)	39.400002
Conductivity (S/m)	1.788081
Power drift (%)	-3.450000
Ambient Temperature:	22.6°C
Liquid Temperature:	22.7°C
ConvF:	4.82
Crest factor:	1:1

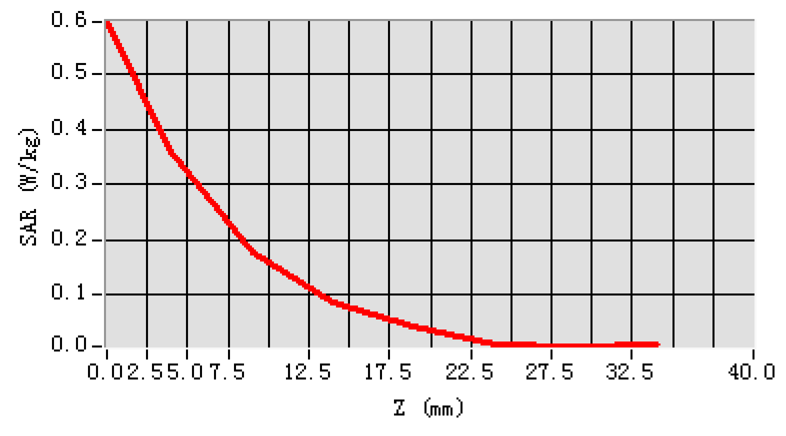
SURFACE SAR	VOLUME SAR
	

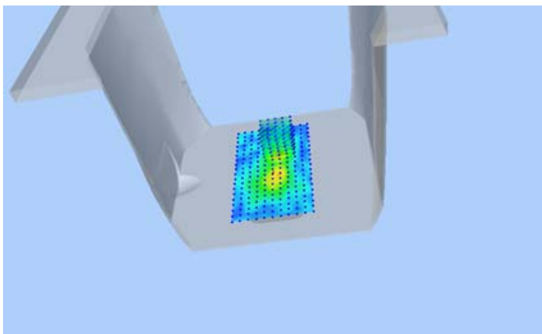
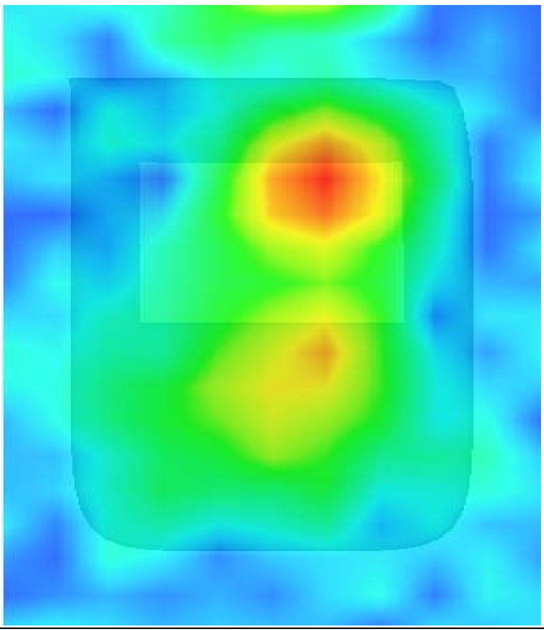
Maximum location: X=8.00, Y=32.00

SAR Peak: 0.60 W/kg

SAR 10g (W/Kg)	0.140906
SAR 1g (W/Kg)	0.328538

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	0.5960	0.3588	0.1793	0.0878	0.0426	0.0100	0.0068



3D screen shot	Hot spot position
	

MEASUREMENT 5

Type: Phone measurement (Complete)

Area Scan resolution: dx=8mm,dy=8mm

Zoom scan resolution: dx=8mm, dy=8mm, dz=5mm

Date of measurement: 2017.10.18

Measurement duration: 13 minutes 32 seconds

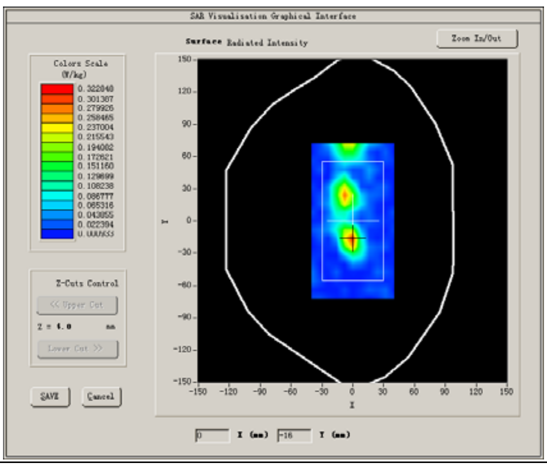
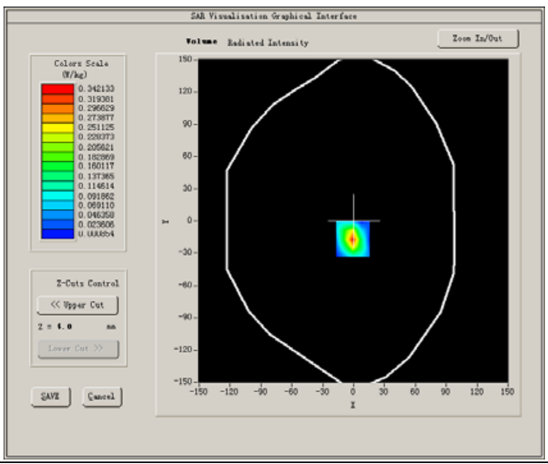
A. Experimental conditions.

Area Scan	surf_sam_plan.txt, h= 5.00 mm
Phantom	Validation plane
Device Position	Body
Band	IEEE 802.11b ISM
Channels	Middle
Signal	DSSS

B. SAR Measurement Results

Middle Band SAR (Channel 6)

Frequency (MHz)	2437.000000
Relative permittivity (real part)	39.400002
Conductivity (S/m)	1.788081
Power drift (%)	-3.450000
Ambient Temperature:	22.6°C
Liquid Temperature:	22.7°C
ConvF:	4.82
Crest factor:	1:1

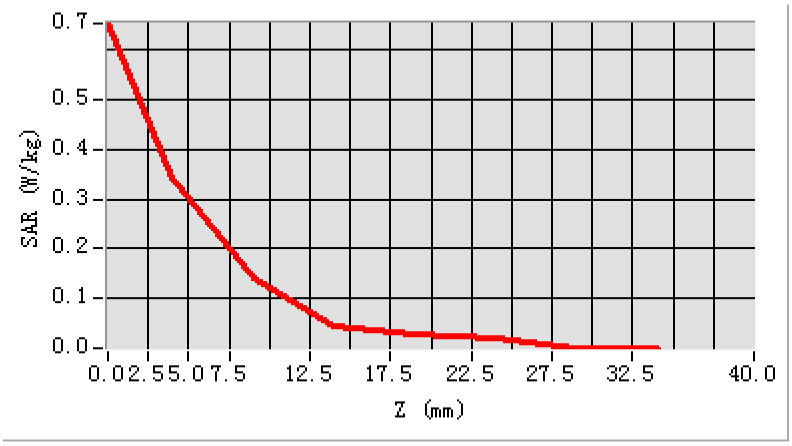
SURFACE SAR	VOLUME SAR
	

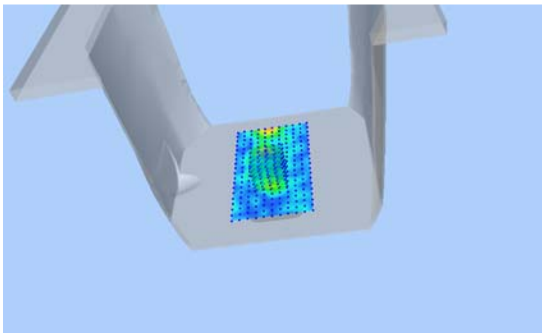
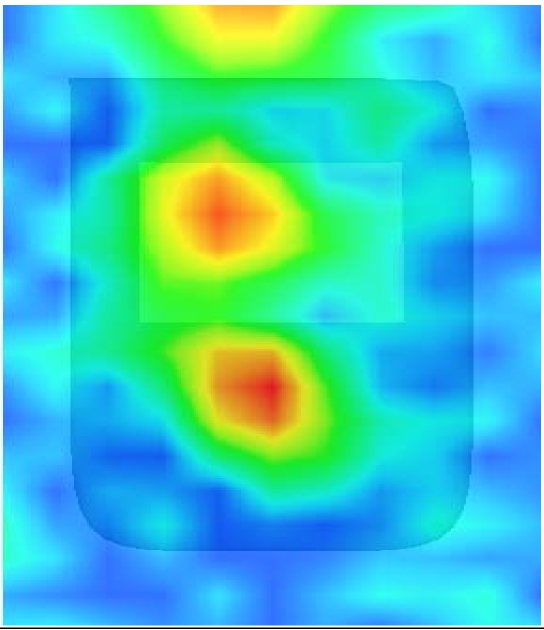
Maximum location: X=-1.00, Y=-17.00

SAR Peak: 0.64 W/kg

SAR 10g (W/Kg)	0.108842
SAR 1g (W/Kg)	0.302337

Z (mm)	**0.00**	**4.00**	**9.00**	**14.00**	**19.00**	**24.00**	**29.00**
SAR (W/Kg)	**0.6516**	**0.3421**	**0.1435**	**0.0468**	**0.0289**	**0.0191**	**0.0010**



3D screen shot	**Hot spot position**
	

ANNEX C SYSTEM CHECK DATA

System Performance Check Data(2450MHz Head)

Type: Phone measurement (Complete)

Area scan resolution: dx=8mm,dy=8mm

Zoom scan resolution: dx=8mm, dy=8mm, dz=5mm

Date of measurement: 2017.10.18

Measurement duration: 13 minutes 31 seconds

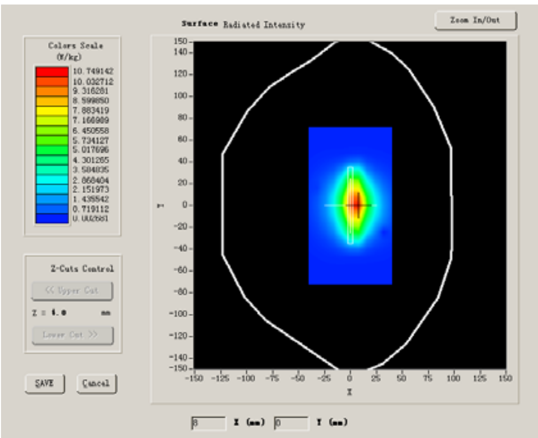
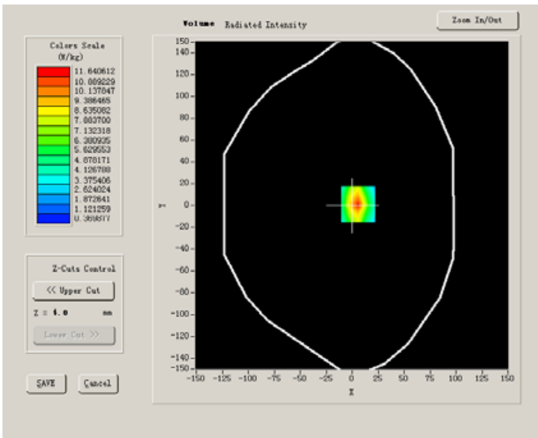
A. Experimental conditions.

Phantom File	surf_sam_plan.txt
Phantom	Flat
Device Position	
Band	2450MHz
Channels	
Signal	CW

B. SAR Measurement Results

Band SAR

Frequency (MHz)	2450.000000
Relative permittivity (real part)	39.284446
Conductivity (S/m)	1.836061
Power Drift (%)	1.080000
Ambient Temperature:	22.0°C
Liquid Temperature:	21.8°C
ConvF:	4.74
Crest factor:	1:1

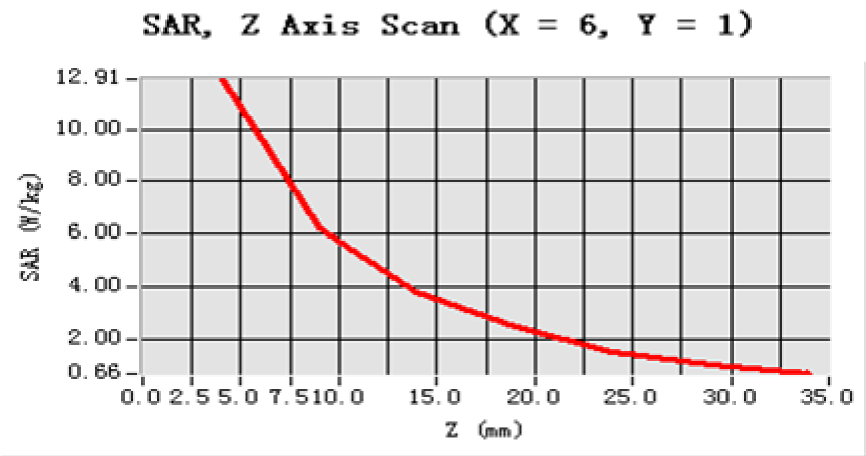
SURFACE SAR	**VOLUME SAR**
	

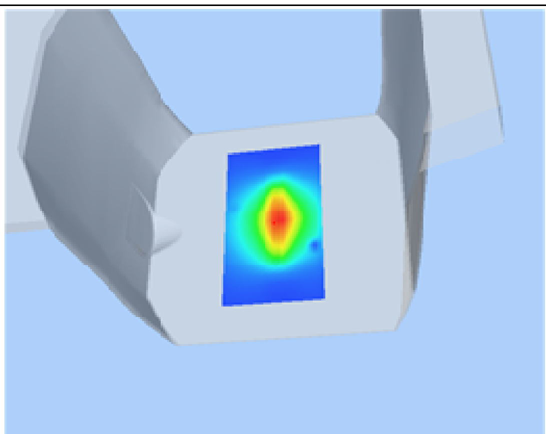
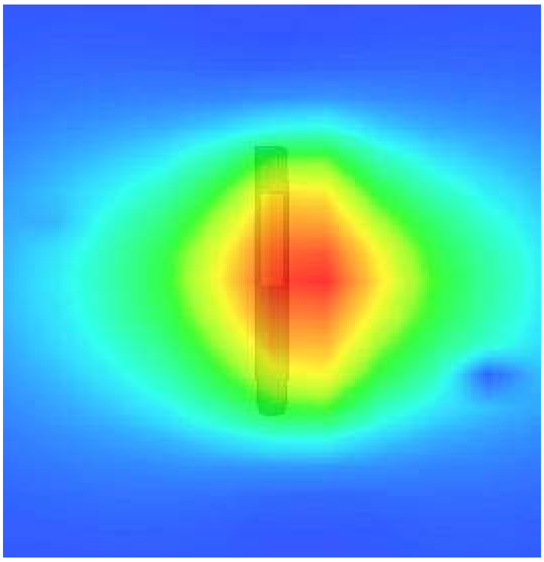
Maximum location: X=6.00, Y=1.00

SAR 10g (W/Kg)	2.377250
SAR 1g (W/Kg)	5.326074

Z Axis Scan

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	0.0000	12.9615	6.2096	3.8187	2.4504	1.5036	1.0219



3D sceen shot	Hot spot position
	

REPORT No. : SZ17090151S01

System Performance Check Data(2450MHz Body)

Type: Phone measurement (Complete)

Area scan resolution: dx=8mm,dy=8mm

Zoom scan resolution: dx=8mm, dy=8mm, dz=5mm

Date of measurement: 2017.10.18

Measurement duration: 13 minutes 31 seconds

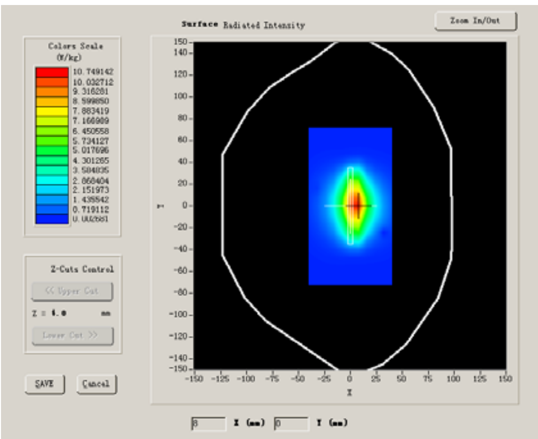
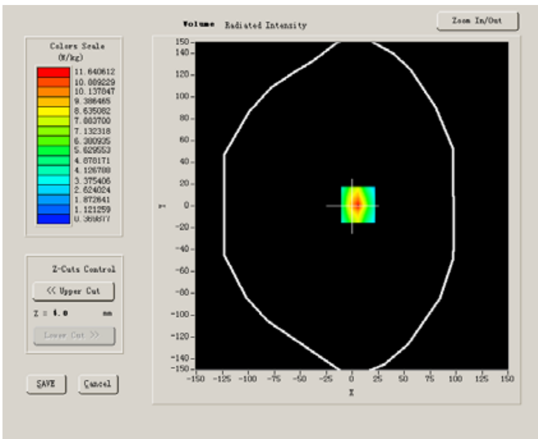
A. Experimental conditions.

Phantom File	surf_sam_plan.txt
Phantom	Flat
Device Position	
Band	2450MHz
Channels	
Signal	CW

B. SAR Measurement Results

Band SAR

Frequency (MHz)	2450.000000
Relative permittivity (real part)	52.884446
Conductivity (S/m)	1.966143
Power Drift (%)	1.080000
Ambient Temperature:	22.0°C
Liquid Temperature:	21.8°C
ConvF:	4.93
Crest factor:	1:1

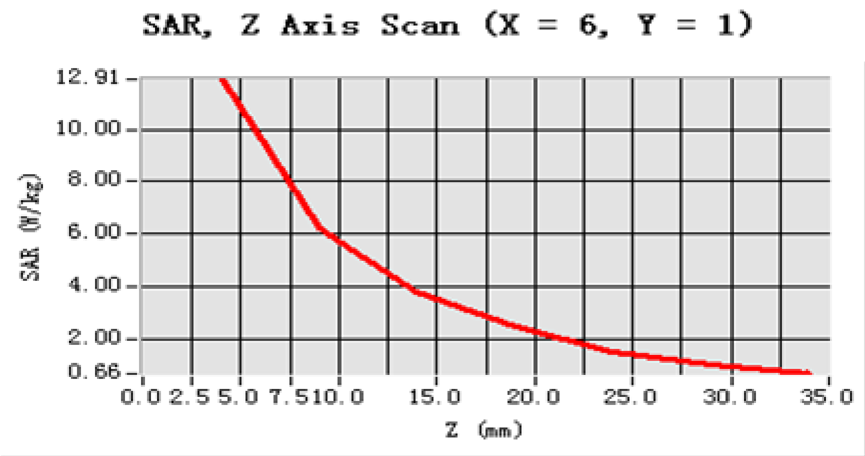
SURFACE SAR	VOLUME SAR
	

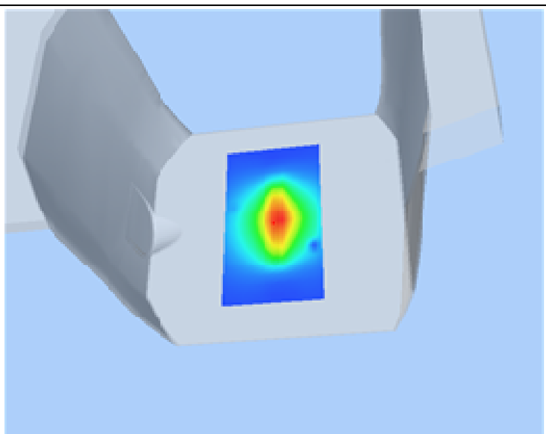
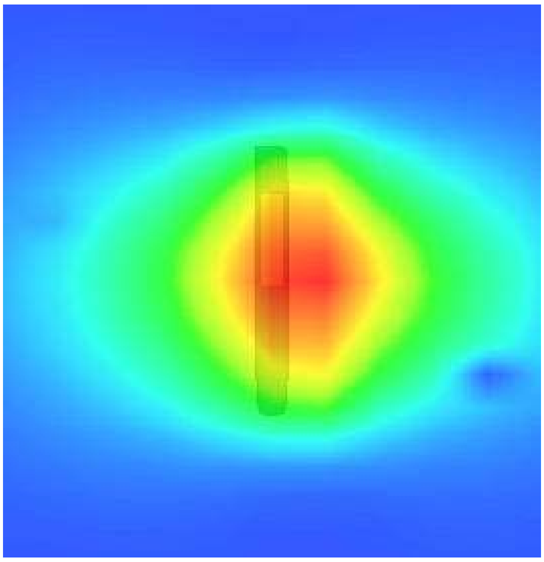
Maximum location: X=6.00, Y=1.00

SAR 10g (W/Kg)	2.377250
SAR 1g (W/Kg)	5.081074

Z Axis Scan

Z (mm)	**0.00**	**4.00**	**9.00**	**14.00**	**19.00**	**24.00**	**29.00**
SAR (W/Kg)	**0.0000**	**12.9615**	**6.2096**	**3.8187**	**2.4504**	**1.5036**	**1.0219**



3D sceen shot	**Hot spot position**
	

MORLAB GROUP
FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block67, BaoAn District, ShenZhen, GuangDong Province, P. R. China
Tel: 86-755-36698555 Http://www.morlab.com
Fax: 86-755-36698525 E-mail: service@morlab.cn

ANNEX D GENERAL INFORMATION

1. Identification of the Responsible Testing Laboratory

Company Name:	Shenzhen Morlab Communications Technology Co., Ltd.
Department:	Morlab Laboratory
Address:	FL.3, Building A, FeiYang Science Park, No.8 LongChang Road, Block 67, BaoAn District, ShenZhen, GuangDong Province, P. R. China
Responsible Test Lab Manager:	Mr. Su Feng
Telephone:	+86 755 36698555
Facsimile:	+86 755 36698525

2. Identification of the Responsible Testing Location

Name:	Shenzhen Morlab Communications Technology Co., Ltd. Morlab Laboratory
Address:	FL.3, Building A, FeiYang Science Park, No.8 LongChang Road, Block 67, BaoAn District, ShenZhen, GuangDong Province, P. R. China

4. List of Test Equipments

No.	Instrument	Type	Cal. Date	Cal. Due
1	PC	Dell (Pentium IV 2.4GHz, SN:X10-23533)	(n.a)	(n.a)
2	Network Emulator	Aglient (8960, SN:10752)	2017-5-24	1year
3	Network Emulator	Rohde&Schwarz (CMW500,SN:124534)	2017-5-25	1year
4	Network Analyzer	Agilent(E5071B ,SN:MY42404762)	2017-5-25	1year
5	Voltmeter	Keithley (2000, SN:1000572)	2017-7-8	1year
6	Synthetizer	Rohde&Schwarz (SML_03, SN:101868)	2017-8-24	1year
7	Signal Generator	Rohde&Schwarz (SMP_02)	2017-7-8	1year
8	Power Amplifier	PRANA (Ap32 SV125AZ)	2017-7-8	1year
9	Power Meter	Agilent (E4416A, SN:MY45102093)	2017-7-8	1year
10	Power Sensor	Agilent (N8482A, SN:MY41091706)	2017-7-8	1year
11	Power Meter	Rohde&Schwarz (NRVD, SN:101066)	2017-7-8	1year
12	Power Sensor	MA2411B	2017-7-8	1year
13	Directional coupler	Giga-tronics(SN:1829112)	2017-7-24	1year
14	Probe	Satimo (SN:SN 37/08 EP80)	2017-7-5	1year
15	Dielectric Probe Kit	Agilent (85033E)	2017-7-5	1year
16	Phantom	Satimo (SN:SN_36_08_SAM62)	N/A	N/A
17	Liquid	Satimo(Last Calibration: 2017-10-18)	N/A	N/A
18	Dipole 2450MHz	Satimo (SN 30/13 DIP2G450-263)	2017-7-5	1year
19	Thermo meter	KTJ(mode-01)	2017-5-10	1year

***** END OF REPORT *****

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