FCC SAR TEST REPORT

Report No.: STS1905168H01

Issued for

Lightbug Ltd

Unit 46, Easton Business Centre, Bristol, BS5 0HE,UK

Product Name:	Lightbug Zero
Brand Name:	Lightbug
Model Name:	Zero
Series Model:	N/A
FCC ID:	2ATB2-ZERO
Test Standard:	ANSI/IEEE Std. C95.1
	FCC 47 CFR Part 2 (2.1093)
	IEEE 1528: 2013
Max. Report SAR (1g):	Body: 0.914 W/kg

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Test Report Certification

Applicant's name ..... : Lightbug Ltd

Address ..... : Unit 46, Easton Business Centre, Bristol, BS5 0HE,UK

Manufacture's Name ..... : Lightbug Ltd

Address ..... : Unit 46, Easton Business Centre, Bristol, BS5 0HE,UK

Product description

Product name ..... : Lightbug Zero

Brand name ..... : Lightbug

Model name ..... : Zero

Series Model..... : N/A

Standards ..... : ANSI/IEEE Std. C95.1-1992
FCC 47 CFR Part 2 (2.1093)
IEEE 1528: 2013

The device was tested by Shenzhen STS Test Services Co., Ltd. in accordance with the measurement methods and procedures specified in KDB 865664 The test results in this report apply only to the tested sample of the stated device/equipment. Other similar device/equipment will not necessarily produce the same results due to production tolerance and measurement uncertainties.

Date of Test ..... :

Date (s) of performance of tests..... : 22 Apr. 2020~27 Apr. 2020

Date of Issue..... : 29 Apr. 2020

Test Result..... : **Pass**

Testing Engineer **:** Aaron Bu

(Aaron Bu)

Technical Manager **:** Jason Lu

(Jason Lu)

Authorized Signatory **:** Vita Li

(Vita Li)

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Revision History

Rev.	Issue Date	Report No.	Effect Page	Contents
00	29 Apr. 2020	STS1905168H01	ALL	Initial Issue
Note: **Format version** of the report -V01				

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	Lightbug Zero		
Brand Name	Lightbug		
Model Name	Zero		
Series Model	N/A		
Model Difference	N/A		
Battery	Rated Voltage: 3.7V Charge Limit: 4.2V Capacity: 850mAh		
Hardware Version	5		
Software Version	63		
Frequency Range	GSM 850: 824.2~848.8MHz PCS1900: 1850.2~1909.8MHz CAT-M Band 2: 1850~1910MHz CAT-M Band 4: 1710~1755MHz CAT-M Band 5: 824~849MHz CAT-M Band 12: 699~716MHz CAT-M Band 13: 777~787MHz WLAN802.11b/g/n(HT20): 2412~2462MHz		
Max. Reported SAR(1g): (Limit:1.6W/kg)	Band	Mode	Body SAR
	PCB	GSM 850	0.328
	PCB	GSM 1900	0.580
	PCB	CAT-M Band 2	0.914
	PCB	CAT-M Band 4	0.721
	PCB	CAT-M Band 5	0.099
	PCB	CAT-M Band 12	0.086
	PCB	CAT-M Band 13	0.163
	DTS	WLAN	0.065
1-g Sum SAR			0.979
FCC Equipment Class	Licensed Portable Transmitter Held to Ear (PCB) Digital Transmission System (DTS)		
Operating Mode:	GSM: GPRS; EGPRS Class 12 CAT-M: QPSK, 16QAM WLAN: 802.11 b/g/n(HT20)		
Antenna Specification:	GSM, CAT-M: Internal Antenna WLAN: Monopole Antenna		
Note: 1. The EUT battery must be fully charged and checked periodically during the test to ascertain uniform power			

1.2 Test Environment

Ambient conditions in the SAR laboratory:

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

1.3 Test Factory

ShenZhen STS Test Services Co.,Ltd.

A 1/F, Building B, Zhuoke Science Park, No.190 Chongqing Road, HepingShequ, Fuyong Sub-District, Bao'an District, Shenzhen, Guang Dong, China

FCC test Firm Registration No.: 625569

IC Registration No.: 12108A

A2LA Certificate No.: 4338.01

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 D01 v06	Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies
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 648474 D04 v01r03	SAR Evaluation Considerations for Wireless Handsets
8	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:

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

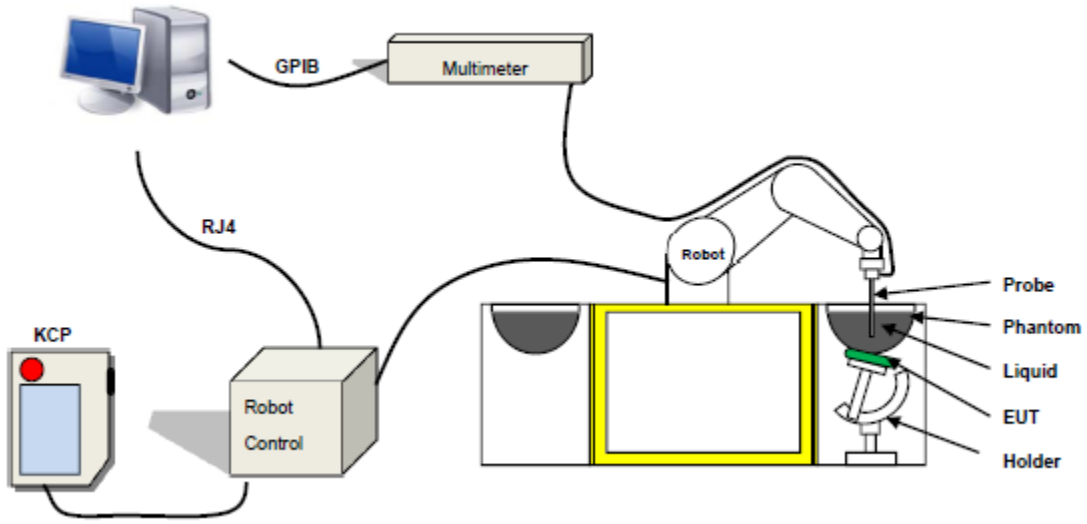
SAR is expressed in units of Watts per kilogram (W/kg) SAR measurement can be related to the electrical field in the tissue by

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

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 Open SAR software computes the results to give a SAR value in a 1g or 10g mass.

3.2.1 Probe

For the measurements the Specific Dosimetric E-Field Probe SN 41/18 EPG0334 with following specifications is used

- Probe Length: 330 mm
- Length of Individual Dipoles: 2 mm
- 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: 450 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 Dipole

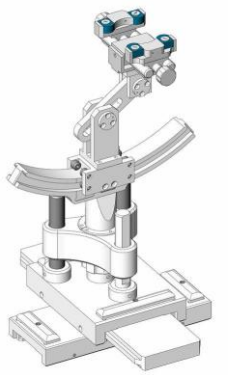
3.2.2 Phantom

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.

SN 32/14 SAM115

SN 32/14 SAM116

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. Tissue Simulating Liquids

4.1 Simulating Liquids Parameter Check

The head tissue dielectric parameters recommended by the IEEE SCC-34/SC-2 in P1528 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 P1528 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 P1528.

Head Tissue

Frequency (MHz)	cellulose	DGBE	HEC	NaCl	Preventol	Sugar	X100	Water	Conductivity	Permittivity
	%	%	%	%	%	%	%	%	σ	εr
750	0.2	/	/	1.4	0.2	57.0	/	41.1	0.89	41.9
835	0.2	/	/	1.4	0.2	57.9	/	40.3	0.90	41.5
900	0.2	/	/	1.4	0.2	57.9	/	40.3	0.97	41.5
1800	/	44.5	/	0.3	/	/	30.45	55.2	1.4	40.0
1900	/	44.5	/	0.3	/	/	30.45	55.2	1.4	40.0
2000	/	44.5	/	0.3	/	/	/	55.2	1.4	40.0
2450	/	44.9	/	0.1	/	/	/	55.0	1.80	39.2
2600	/	45.0	/	0.1	/	/	/	54.9	1.96	39.0

Body Tissue

Frequency (MHz)	cellulose	DGBE	HEC	NaCl	Preventol	Sugar	X100	Water	Conductivity	Permittivity
	%	%	%	%	%	%	%	%	σ	εr
750	0.2	/	/	0.9	0.1	47.2	/	51.7	0.96	55.5
835	0.2	/	/	0.9	0.1	48.2	/	50.8	0.97	55.2
900	0.2	/	/	0.9	0.1	48.2	/	50.8	1.05	55.0
1800	/	29.4	/	0.4	/	/	30.45	70.2	1.52	53.3
1900	/	29.4	/	0.4	/	/	30.45	70.2	1.52	53.3
2000	/	29.4	/	0.4	/	/	/	70.2	1.52	53.3
2450	/	31.3	/	0.1	/	/	/	68.6	1.95	52.7
2600	/	31.7	/	0.1	/	/	/	68.2	2.16	52.3

Tissue dielectric parameters for head and body phantoms				
Frequency	εr		σ S/m	
	Head	Body	Head	Body
300	45.3	58.2	0.87	0.92
450	43.5	56.7	0.87	0.94
900	41.5	55.0	0.97	1.05
1450	40.5	54.0	1.20	1.30
1800	40.0	53.3	1.40	1.52
2450	39.2	52.7	1.80	1.95
3000	38.5	52.0	2.40	2.73
5800	35.3	48.2	5.27	6.00

LIQUID MEASUREMENT RESULTS

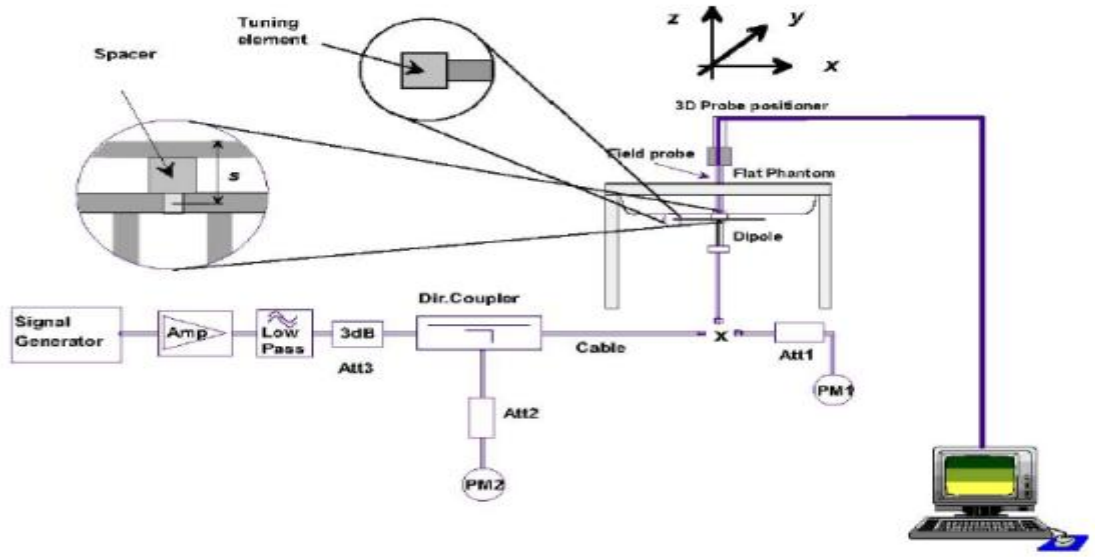
Date	Ambient condition		Simulating Liquid		Parameters	Target	Measured	Deviation [%]	Limited [%]
	Temp. [°C]	Humidity [%]	Frequency	Temp. [°C]					
2020-04-22	23.0	50	750 MHz	22.7	Permittivity:	41.9	41.93	0.07	±10
					Conductivity:	0.88	0.86	-1.79	±10
2020-04-23	23.1	53	835 MHz	22.8	Permittivity:	41.5	41.60	0.23	±10
					Conductivity:	0.9	0.91	1.17	±10
2020-04-24	23.2	52	1800 MHz	22.9	Permittivity:	40	40.93	2.32	±10
					Conductivity:	1.4	1.42	1.12	±10
2020-04-26	23.5	50	1900 MHz	23.2	Permittivity:	40	39.89	-0.27	±10
					Conductivity:	1.4	1.41	0.50	±10
2020-04-27	23.2	48	2450 MHz	22.8	Permittivity:	39.2	39.36	0.42	±10
					Conductivity:	1.8	1.77	-1.53	±10

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 %.

Freq.(MHz)	Power(mW)	Tested Value (W/Kg)	Normalized SAR (W/kg/W)	Target (W/Kg/W)	Tolerance(%)	Date
750	100	0.853	8.53	8.49	0.47	2020-04-22
835	100	0.977	9.77	9.56	2.20	2020-04-23
1800	100	3.745	37.45	38.4	-2.47	2020-04-24
1900	100	4.107	41.07	39.7	3.45	2020-04-26
2450	100	5.098	50.98	52.4	-2.71	2020-04-27

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

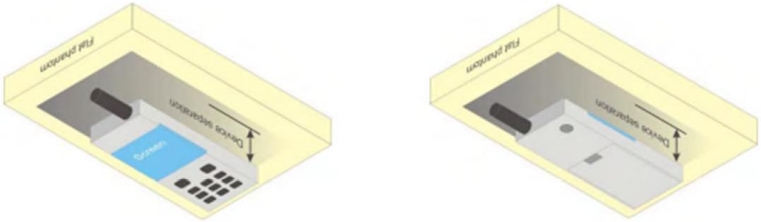
First Area Scan is used to locate the approximate location(s) of the local peak SAR value(s). The measurement grid within an Area Scan is defined by the grid extent, grid step size and grid offset. Next, in order to determine the EM field distribution in a three-dimensional spatial extension, Zoom Scan 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 Test Position

This EUT was tested in Front Face and Rear Face.

Body-worn Position Conditions:

Body-worn accessory exposure is typically related to voice mode operations when handsets are carried in body-worn accessories. The body-worn accessory procedures in KDB Publication 447498 D01 should be used to test for body-worn accessory SAR compliance, without a headset connected to it. When the same wireless transmission configuration is used for testing body-worn accessory and hotspot mode SAR, respectively, in voice and data mode, SAR results for the most conservative *test separation distance* configuration may be used to support both SAR conditions. When the *reported* SAR for a body-worn accessory, measured without a headset connected to the handset, is > 1.2 W/kg, the highest *reported* SAR configuration for that wireless mode and frequency band should be repeated for the body-worn accessory with a headset attached to the handset.



8. Uncertainty

8.1 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.

Uncertainty Component	Tol (+- %)	Prob. Dist.	Div.	Ci (1g)	Ci (10g)	1g Ui (+-%)	10g Ui (+-%)	vi
Measurement System								
Probe calibration	5.831	N	1	1	1	5.83	5.83	∞
Axial Isotropy	0.695	R	$\sqrt{3}$	√0.5	√0.5	0.28	0.28	∞
Hemispherical Isotropy	1.045	R	$\sqrt{3}$	√0.5	√0.5	0.43	0.43	∞
Boundary effect	1.0	R	$\sqrt{3}$	1	1	0.58	0.58	∞
Linearity	0.685	R	$\sqrt{3}$	1	1	0.40	0.40	∞
System detection limits	1.0	R	$\sqrt{3}$	1	1	0.58	0.58	∞
Modulation response	3.0	R	$\sqrt{3}$	1	1	1.73	1.73	∞
Readout Electronics	0.021	N	1	1	1	0.021	0.021	∞
Response Time	0	R	$\sqrt{3}$	1	1	0	0	∞
Integration Time	1.4	R	$\sqrt{3}$	1	1	0.81	0.81	∞
RF ambient conditions-Noise	3.0	R	$\sqrt{3}$	1	1	1.73	1.73	∞
RF ambient conditions-reflections	3.0	R	$\sqrt{3}$	1	1	1.73	1.73	∞
Probe positioner mechanical tolerance	1.4	R	$\sqrt{3}$	1	1	0.81	0.81	∞
Probe positioning with respect to phantom shell	1.4	R	$\sqrt{3}$	1	1	0.81	0.81	∞
Post-processing	2.3	R	$\sqrt{3}$	1	1	1.33	1.33	∞
Test sample Related								
Test sample positioning	2.6	N	1	1	1	2.6	2.6	∞
Device holder uncertainty	3	N	1	1	1	3	3	∞
SAR drift measurement	5	R	$\sqrt{3}$	1	1	2.89	2.89	∞
SAR scaling	5	R	$\sqrt{3}$	1	1	2.89	2.89	∞
Phantom and tissue parameters								
Phantom uncertainty（shape and thickness uncertainty）	4	R	$\sqrt{3}$	1	1	2.31	2.31	∞
Uncertainty in SAR correction for deviations in permittivity and conductivity	1.9	N	1	1	0.84	1.90	1.60	∞
Liquid conductivity （temperature uncertainty）	2.5	R	$\sqrt{3}$	0.78	0.71	1.13	1.02	∞
Liquid conductivity （measured）	4	N	1	0.78	0.71	3.12	2.84	M
Liquid permittivity （temperature uncertainty）	2.5	R	$\sqrt{3}$	0.23	0.26	0.33	0.38	∞
Liquid permittivity （measured）	5	N	1	0.23	0.26	1.15	1.30	M
Combined Standard Uncertainty		RSS				9.79	9.59	
Expanded Uncertainty (95% Confidence interval)		K=2				19.58	19.18	

8.2 System validation Uncertainty

Uncertainty Component	Tol (+- %)	Prob. Dist.	Div.	Ci (1g)	Ci (10g)	1g Ui (+-%)	10g Ui (+-%)	vi
Measurement System								
Probe calibration	5.831	N	1	1	1	5.83	5.83	∞
Axial Isotropy	0.695	R	$\sqrt{3}$	1	1	0.40	0.40	∞
Hemispherical Isotropy	1.045	R	$\sqrt{3}$	0	0	0.00	0.00	∞
Boundary effect	1.0	R	$\sqrt{3}$	1	1	0.58	0.58	∞
Linearity	0.685	R	$\sqrt{3}$	1	1	0.40	0.40	∞
System detection limits	1.0	R	$\sqrt{3}$	1	1	0.58	0.58	∞
Modulation response	3.0	R	$\sqrt{3}$	0	0	0.00	0.00	∞
Readout Electronics	0.021	N	1	1	1	0.021	0.021	∞
Response Time	0.0	R	$\sqrt{3}$	0	0	0.00	0.00	∞
Integration Time	1.4	R	$\sqrt{3}$	0	0	0.00	0.00	∞
RF ambient conditions-Noise	3.0	R	$\sqrt{3}$	1	1	1.73	1.73	∞
RF ambient conditions-reflections	3.0	R	$\sqrt{3}$	1	1	1.73	1.73	∞
Probe positioner mechanical tolerance	1.4	R	$\sqrt{3}$	1	1	0.81	0.81	∞
Probe positioning with respect to phantom shell	1.4	R	$\sqrt{3}$	1	1	0.81	0.81	∞
Post-Processing	2.3	R	$\sqrt{3}$	1	1	1.33	1.33	∞
System validation source								
Deviation of experimental dipole from numerical dipole	5.0	N	1	1	1	5.00	5.00	∞
Input power and SAR drift measurement	5.0	R	$\sqrt{3}$	1	1	2.89	2.89	∞
Other source contribution Uncertainty	2.0	R	$\sqrt{3}$	1	1	1.15	1.15	∞
Phantom and set-up								
Phantom uncertainty（shape and thickness uncertainty）	4.0	R	$\sqrt{3}$	1	1	2.31	2.31	∞
Uncertainty in SAR correction for deviations in permittivity and conductivity	1.9	N	1	1	0.84	1.90	1.60	∞
Liquid conductivity （temperature uncertainty）	2.5	R	$\sqrt{3}$	0.78	0.71	1.13	1.02	∞
Liquid conductivity （measured）	4	N	1	0.78	0.71	3.12	2.84	M
Liquid permittivity （temperature uncertainty）	2.5	R	$\sqrt{3}$	0.23	0.26	0.33	0.38	∞
Liquid permittivity （measured）	5	N	1	0.23	0.26	1.15	1.30	M
Combined Standard Uncertainty		RSS				9.718	9.517	
Expanded Uncertainty (95% Confidence interval)		K=2				19.44	19.04	

9. Conducted Power Measurement

9.1 Test Result

Burst Average Power (dBm)						
Band	GSM 850			PCS 1900		
Channel	128	190	251	512	661	810
Frequency (MHz)	824.2	836.6	848.8	1850.2	1880.0	1909.8
GSM(GMSK, 1-Slot)	-	-	-	-	-	-
GPRS (GMSK, 1-Slot)	32.14	31.83	31.39	28.54	28.84	28.20
GPRS (GMSK, 2-Slot)	31.69	31.38	30.97	28.05	28.42	27.80
GPRS (GMSK, 3-Slot)	31.21	30.96	30.52	27.65	27.94	27.31
GPRS (GMSK, 4-Slot)	30.78	30.52	30.02	27.23	27.47	26.86
EGPRS(8PSK, 1-Slot)	27.72	27.55	27.19	23.60	23.46	24.95
EGPRS(8PSK, 2-Slot)	27.00	26.82	26.43	22.84	22.73	24.23
EGPRS(8PSK, 3-Slot)	26.27	26.06	25.65	22.11	21.97	23.51
EGPRS(8PSK, 4-Slot)	25.52	25.31	24.87	21.40	21.19	22.79
Remark: GPRS, CS4 coding scheme. EGPRS, MCS5 coding scheme. Multi-Slot Class 8, Support Max 4 downlink, 1 uplink, 5 working link Multi-Slot Class 10, Support Max 4 downlink, 2 uplink, 5 working link Multi-Slot Class 12, Support Max 4 downlink, 4 uplink, 5 working link						

Fram- Average Power(dBm)						
Band	GSM 850			PCS 1900		
Channel	128	190	251	512	661	810
Frequency (MHz)	824.2	836.6	848.8	1850.2	1880.0	1909.8
GSM(GMSK, 1-Slot)	-	-	-	-	-	-
GPRS (GMSK, 1-Slot)	23.11	22.80	22.36	19.51	19.81	19.17
GPRS (GMSK, 2-Slot)	25.67	25.36	24.95	22.03	22.40	21.78
GPRS (GMSK, 3-Slot)	26.95	26.70	26.26	23.39	23.68	23.05
GPRS (GMSK, 4-Slot)	27.77	27.51	27.01	24.22	24.46	23.85
EGPRS(8PSK, 1-Slot)	18.69	18.52	18.16	14.57	14.43	15.92
EGPRS(8PSK, 2-Slot)	20.98	20.80	20.41	16.82	16.71	18.21
EGPRS(8PSK, 3-Slot)	22.01	21.80	21.39	17.85	17.71	19.25
EGPRS(8PSK, 4-Slot)	22.51	22.30	21.86	18.39	18.18	19.78
Remark : 1. SAR testing was performed on the maximum frame-averaged power mode. 2. The frame-averaged power is linearly proportion to the slot number configured and it is linearly scaled the maximum Burst - averaged power based on time slots. The calculated method is shown as below: Frame-averaged power = Burst averaged power (1 TX Slot) – 9.03 dB Frame-averaged power = Burst averaged power (2 TX Slots) – 6.02 dB Frame-averaged power = Burst averaged power (3 TX Slots) - 4.26 dB Frame-averaged power = Burst averaged power (4 TX Slots) – 3.01 dB						

WLAN

Mode	Channel Number	Frequency (MHz)	Average Power (dBm)
802.11b	1	2412	17.15
	6	2437	16.56
	11	2462	15.33
802.11g	1	2412	17.43
	6	2437	16.73
	11	2462	15.79
802.11n(HT 20)	1	2412	17.36
	6	2437	16.62
	11	2462	15.60

CAT-M Conducted Power

General Note:

1. Anritsu CMW500 base station simulator was used to setup the connection with EUT; the frequency band, channel bandwidth, RB allocation configuration, modulation type are set in the base station simulator to configure EUT transmitting at maximum power and at different configurations which are requested to be reported to FCC, for conducted power measurement and SAR testing.
2. Per KDB 941225 D05, when a properly configured base station simulator is used for the SAR and power measurements, spectrum plots for each RB allocation and offset configuration is not required.
3. Per KDB 941225 D05, start with the largest channel bandwidth and measure SAR for QPSK with 1 RB allocation, using the RB offset and required test channel combination with the highest maximum output power for RB offsets at the upper edge, middle and lower edge of each required test channel.
4. Per KDB 941225 D05, 50% RB allocation for QPSK SAR testing follows 1RB QPSK allocation procedure.
5. Per KDB 941225 D05, For QPSK with 100% RB allocation, SAR is not required when the highest maximum output power for 100 % RB allocation is less than the highest maximum output power in 50% and 1 RB allocations and the highest reported SAR for 1 RB and 50% RB allocation are $\leqslant$ 0.8 W/kg. Otherwise, SAR is measured for the highest output power channel; and if the reported SAR is > 1.45 W/kg, the remaining required test channels must also be tested.
6. Per KDB 941225 D05, 16QAM output power for each RB allocation configuration is > not ½ dB higher than the same configuration in QPSK and the reported SAR for the QPSK configuration is $\leqslant$ 1.45 W/kg; Per KDB 941225 D05, 16QAM SAR testing is not required.
7. Per KDB 941225 D05, Smaller bandwidth output power for each RB allocation configuration is > not ½ dB higher than the same configuration in the largest supported bandwidth, and the reported SAR for the largest supported bandwidth is $\leqslant$ 1.45 W/kg; Per KDB 941225 D05, smaller bandwidth SAR testing is not required.

CAT-M Band 2

Band 2 Maximum Average Power [dBm]						
BW [MHz]	**RB Size**	**RB Offset**	**Mod**	**Lowest**	**Middle**	**Highest**
1.4	1	0	QPSK	21.95	21.83	22.03
1.4	6	0		21.72	21.57	21.82
1.4	1	0	16-QAM	21.66	21.57	21.74
1.4	5	0		21.38	21.34	21.44
3	1	0	QPSK	21.62	21.58	21.66
3	6	0		21.40	21.32	21.43
3	1	0	16-QAM	21.33	21.3	21.43
3	5	0		21.11	21.06	21.22
5	1	0	QPSK	21.43	21.49	21.41
5	6	0		21.19	21.27	21.15
5	1	0	16-QAM	21.2	21.27	21.14
5	5	0		20.94	21.04	20.92
10	1	0	QPSK	21.67	21.59	21.7
10	6	0		21.44	21.39	21.42
10	1	0	16-QAM	21.38	21.31	21.42
10	5	0		21.13	21.04	21.2
15	1	0	QPSK	21.82	21.74	21.9
15	6	0		21.53	21.53	21.69
15	1	0	16-QAM	21.61	21.48	21.67
15	5	0		21.32	21.27	21.43
20	1	0	QPSK	22.09	22.13	22.28
20	6	0		21.85	21.84	22.03
20	1	0	16-QAM	21.82	21.84	22.05
20	5	0		21.62	21.54	21.84

CAT-M BAND 4

Band 4 Maximum Average Power [dBm]						
BW [MHz]	**RB Size**	**RB Offset**	**Mod**	**Lowest**	**Middle**	**Highest**
1.4	1	0	QPSK	21.86	21.93	22.08
1.4	6	0		21.57	21.65	21.87
1.4	1	0	16-QAM	21.6	21.7	21.8
1.4	5	0		21.37	21.46	21.51
3	1	0	QPSK	22.45	22.41	22.48
3	6	0		22.2	22.16	22.19
3	1	0	16-QAM	22.23	22.19	22.25
3	5	0		22	21.91	21.99
5	1	0	QPSK	21.86	21.9	21.83
5	6	0		21.57	21.67	21.61
5	1	0	16-QAM	21.61	21.66	21.63
5	5	0		21.39	21.41	21.35
10	1	0	QPSK	22.48	22.59	22.45
10	6	0		22.22	22.38	22.23
10	1	0	16-QAM	22.22	22.32	22.17
10	5	0		21.95	22.12	21.96
15	1	0	QPSK	23.3	23.28	22.79
15	6	0		23.09	23	22.53
15	1	0	16-QAM	23.03	23.03	22.54
15	5	0		22.82	22.82	22.31
20	1	0	QPSK	23.6	23.71	23.67
20	6	0		23.38	23.45	23.44
20	1	0	16-QAM	23.35	23.49	23.45
20	5	0		23.13	23.24	23.24

CAT-M BAND 5

Band 5 Maximum Average Power [dBm]						
BW [MHz]	**RB Size**	**RB Offset**	**Mod**	**Lowest**	**Middle**	**Highest**
1.4	1	0	QPSK	23.77	23.74	23.85
1.4	6	0		23.57	23.54	23.65
1.4	1	0	16-QAM	23.5	23.46	23.61
1.4	5	0		23.24	23.16	23.39
3	1	0	QPSK	23.4	23.39	23.42
3	6	0		23.2	23.12	23.22
3	1	0	16-QAM	23.19	23.18	23.21
3	5	0		22.99	22.95	22.97
5	1	0	QPSK	24.12	23.96	23.89
5	6	0		23.91	23.67	23.63
5	1	0	16-QAM	23.91	23.75	23.62
5	5	0		23.67	23.55	23.4
10	1	0	QPSK	24.55	24.58	24.65
10	6	0		24.31	24.32	24.42
10	1	0	16-QAM	24.34	24.32	24.35
10	5	0		24.11	24.06	24.09

CAT-M BAND 12

Band 12 Maximum Average Power [dBm]						
BW [MHz]	**RB Size**	**RB Offset**	**Mod**	**Lowest**	**Middle**	**Highest**
1.4	1	0	QPSK	24.16	23.94	23.9
1.4	6	0		23.94	23.68	23.63
1.4	1	0	16-QAM	23.93	23.7	23.68
1.4	5	0		23.7	23.49	23.38
3	1	0	QPSK	23.85	23.82	23.68
3	6	0		23.61	23.54	23.42
3	1	0	16-QAM	23.56	23.57	23.48
3	5	0		23.32	23.34	23.2
5	1	0	QPSK	23.74	23.66	23.71
5	6	0		23.44	23.39	23.42
5	1	0	16-QAM	23.47	23.44	23.47
5	5	0		23.19	23.15	23.21
10	1	0	QPSK	24.38	24.43	24.27
10	6	0		24.14	24.15	24.04
10	1	0	16-QAM	24.09	24.18	23.98
10	5	0		23.8	23.88	23.76

CAT-M BAND 13

Band 13 Maximum Average Power [dBm]						
BW [MHz]	**RB Size**	**RB Offset**	**Mod**	**Lowest**	**Middle**	**Highest**
5	1	0	QPSK	22.82	22.64	22.76
5	1	12		22.53	22.44	22.47
5	1	0	16-QAM	22.54	22.37	22.49
5	1	12		22.3	22.07	22.22
10	1	0	QPSK	N/A	23.15	N/A
10	1	24		N/A	22.86	N/A
10	1	0	16-QAM	N/A	22.89	N/A
10	1	24		N/A	22.67	N/A

9.2 SAR Test Exclusions Applied

Per FCC KDB 447498D01, the 1-g SAR and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:
[(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)]·[√f(GHZ)] ≤ 3.0 for 1-g SAR and ≤ 7.5 for 10-g extremity SAR, where:

- f(GHZ) is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- The result is rounded to one decimal place for comparison

When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion.

$$\frac{Max\ Power\ of\ Channel\ (mW)}{Test\ Separation\ Dist\ (mm)} * \sqrt{Frequency(GHz)} \leq 3.0$$

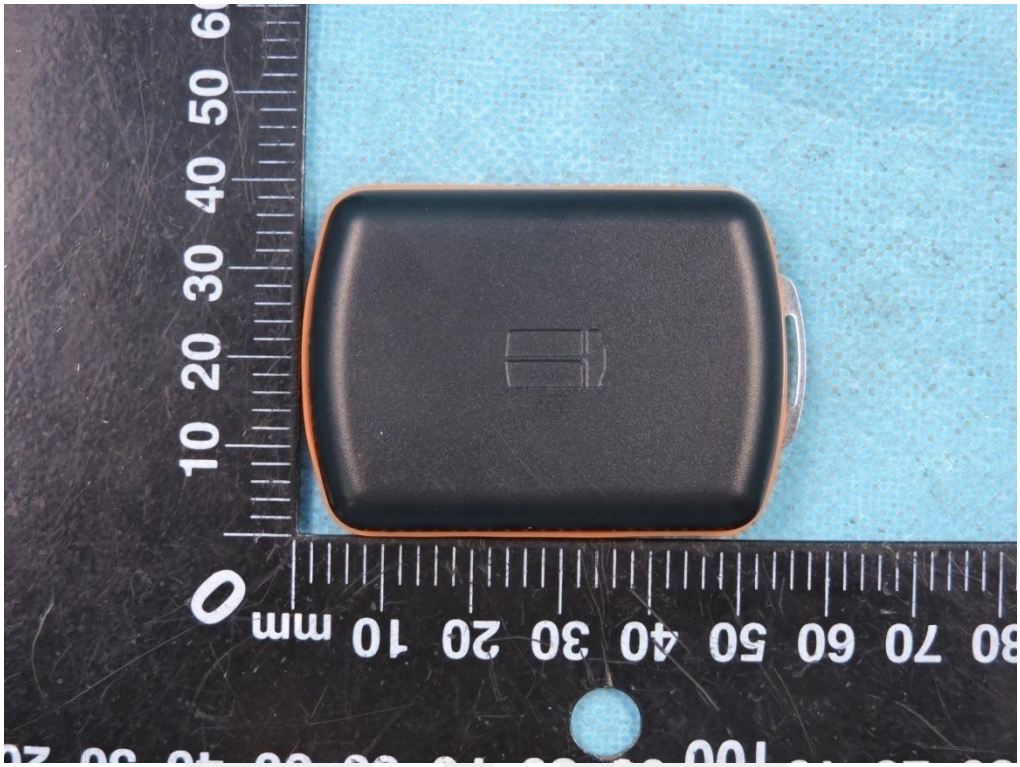
Based on the maximum conducted power of **2.4 GHz WLAN Body** (rounded to the nearest mW) and the antenna to user separation distance,

2.4 GHz WLAN SAR was required; [(63.096/10)* √2.462] = **9.90** > 3.0.

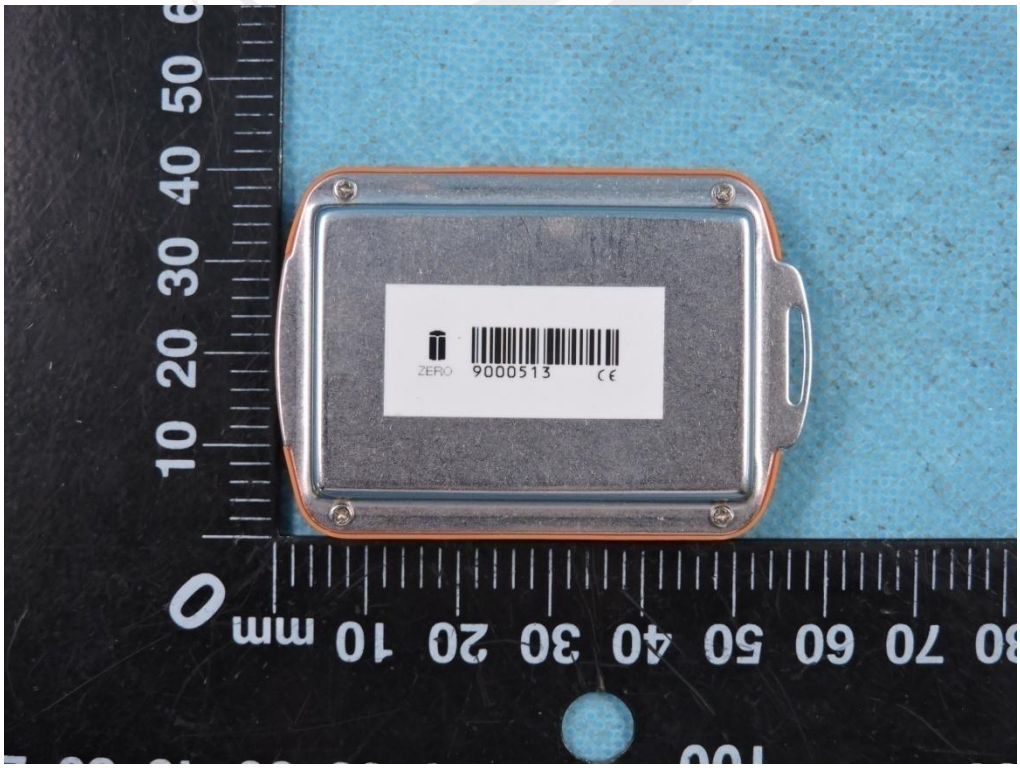
10. EUT and Test Setup Photo

10.1 EUT Photo

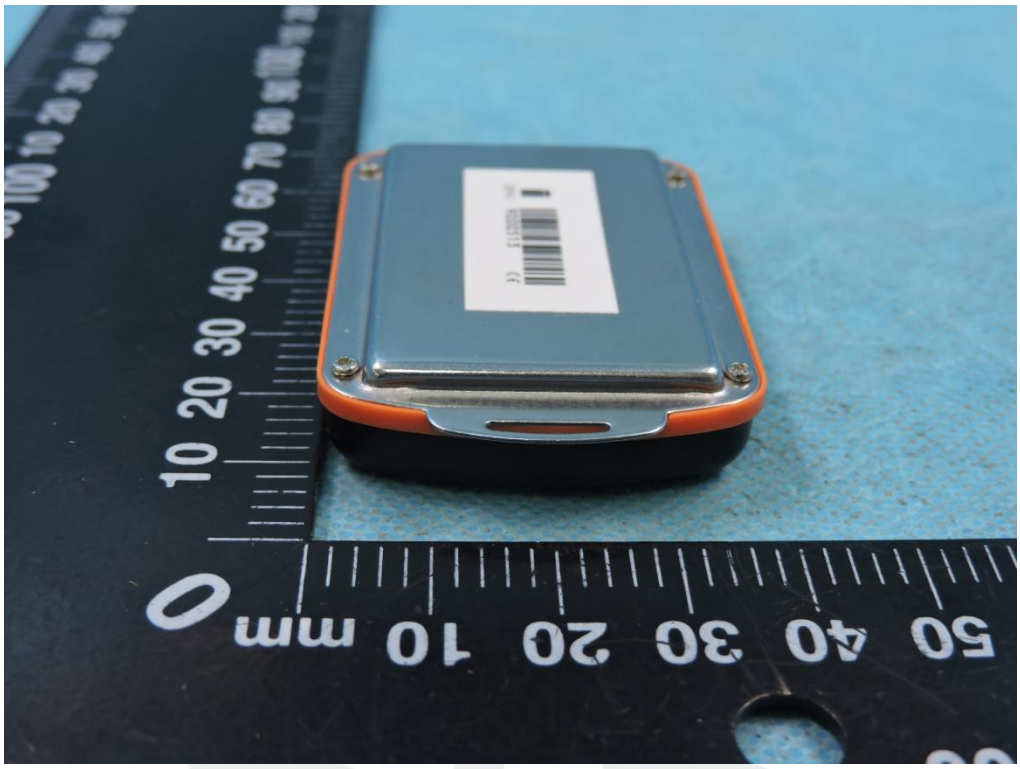
Front side



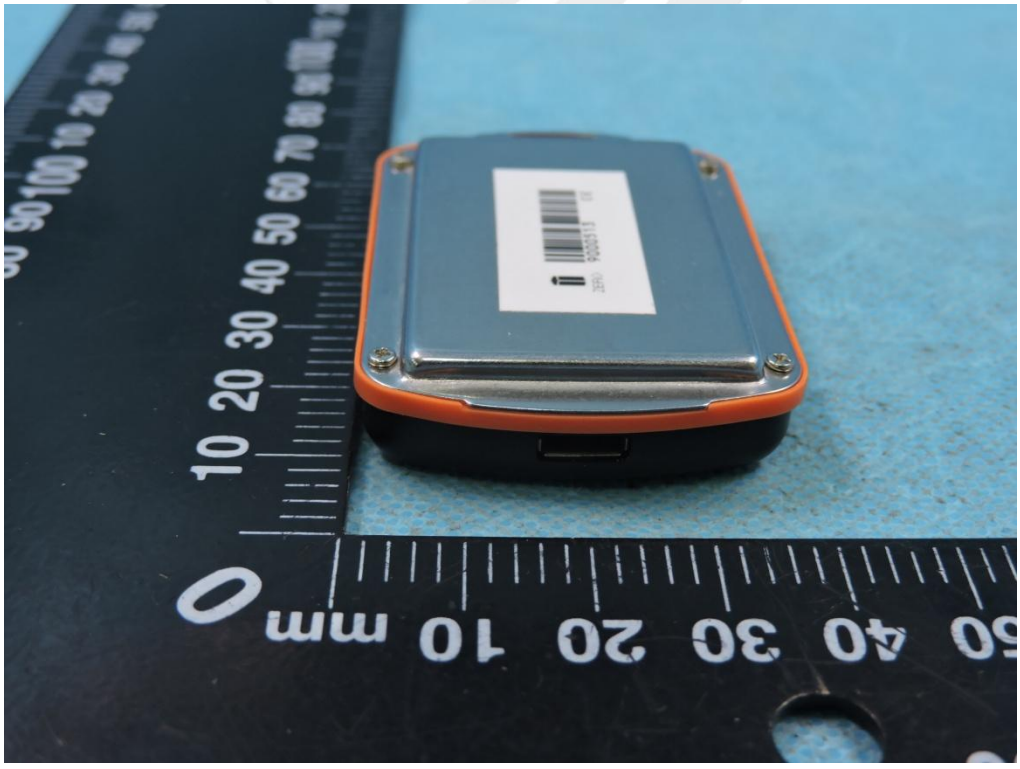
Back side



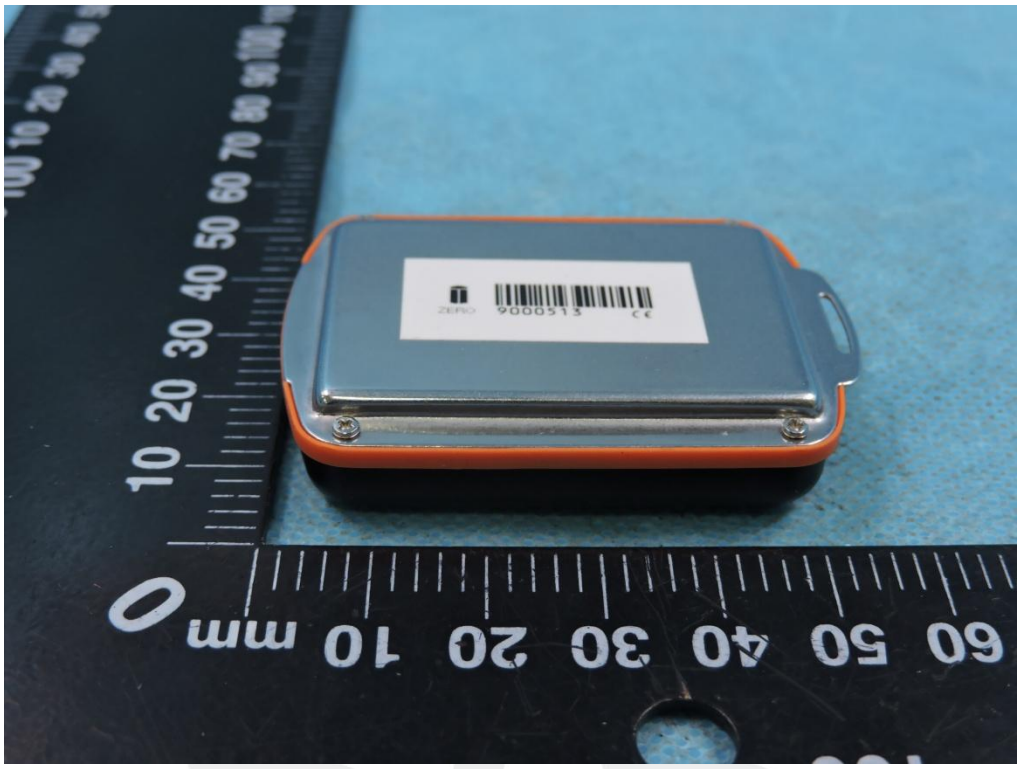
Top side



Bottom side



Left side



Right side

10.2 Setup Photo

Body Front side(separation distance is 5mm)

Body Back side(separation distance is 5mm)

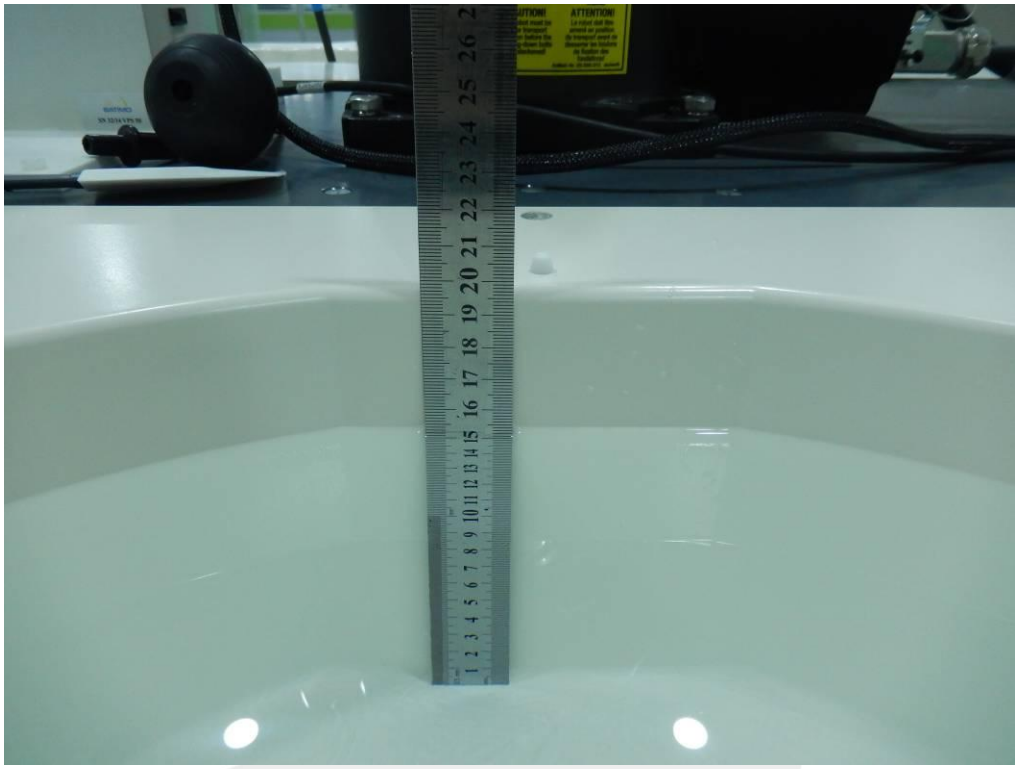
Body left side(separation distance is 5mm)

Body right side(separation distance is 5mm)

Body top side(separation distance is 5mm)

Body Bottom side(separation distance is 5mm)

Liquid depth (15 cm)



11. SAR Result Summary

11.1 Body SAR

Band	Mode	Test Position	Ch.	Result 1g (W/Kg)	Power Drift(%)	Max.Turn-up Power(dBm)	Meas.Output Power(dBm)	Scaled SAR (W/Kg)	Meas. No.
GSM 850	GPRS Data-4 Slot	Front side	128	0.312	-3.78	31	30.78	**0.328**	1
		Back side	128	0.110	-2.77	31	30.78	0.116	/
		Left side	128	0.037	-1.89	31	30.78	0.039	/
		Right side	128	0.054	-0.59	31	30.78	0.057	/
		Top side	128	0.073	-2.49	31	30.78	0.077	/
		Bottom side	128	0.135	-0.87	31	30.78	0.142	/
GSM1900	GPRS Data-4 Slot	Front side	661	0.513	1.37	28	27.47	**0.580**	2
		Back side	661	0.111	-3.54	31	30.78	0.117	/
		Left side	661	0.049	-0.28	31	30.78	0.052	/
		Right side	661	0.066	1.54	31	30.78	0.069	/
		Top side	661	0.129	-0.50	31	30.78	0.136	
		Bottom side	661	0.105	-1.35	31	30.78	0.110	/

Band	Mode	Test Position	Ch.	Result 1g (W/Kg)	Power Drift(%)	Max.Turn-up Power(dBm)	Meas.Output Power(dBm)	Duty cycle(%)	Scaled SAR (W/Kg)	Meas. No.
WLAN	802.11g	Front side	1	0.021	1.38	18	17.43	100	0.024	/
		Back side	1	0.030	1.78	18	17.43	100	**0.065**	3
		Left side	1	0.012	-1.46	18	17.43	100	0.014	/
		Right side	1	0.015	-0.99	18	17.43	100	0.017	/
		Top side	1	0.019	-3.48	18	17.43	100	0.022	/
		Bottom side	1	0.017	0.85	18	17.43	100	0.019	/

Note:

1. The test separation of all above table is 5mm.
2. Per KDB 447498 D01, 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. For WWAN: Scaled SAR(W/kg)= Measured SAR(W/kg)*Tune-up Scaling Factor

Band	BW (MHz)	Mod.	RB Size	RB offset	Test Position	Ch.	Result 1g (W/Kg)	Power Drift(%)	Max. Turn-up Power(dBm)	Meas. Output Power(dBm)	Scaled SAR (W/Kg)	Meas. No.
CAT-M Band 2	20M	QPSK	1	0	Front side	18700	0.714	-3.52	23	22.09	0.880	/
			1	0	Front side	18900	0.681	-1.28	23	22.13	0.832	/
			1	0	Front side	19100	0.774	-1.00	23	22.28	**0.914**	4
			6	0	Front side	19100	0.629	-3.22	23	22.03	0.786	/
			1	0	Back Side	19100	0.467	-0.24	23	22.28	0.551	/
			6	0	Back Side	19100	0.328	0.90	23	22.03	0.410	/
			1	0	Left Side	19100	0.299	-2.28	23	22.28	0.353	/
			6	0	Left Side	19100	0.217	-2.10	23	22.03	0.271	/
			1	0	Right Side	19100	0.322	3.01	23	22.28	0.380	/
			6	0	Right Side	19100	0.309	0.38	23	22.03	0.386	/
			1	0	Top side	19100	0.401	3.27	23	22.28	0.473	/
			6	0	Top side	19100	0.372	-3.35	23	22.03	0.465	/
			1	0	Bottom Side	19100	0.294	1.60	23	22.28	0.347	/
			6	0	Bottom Side	19100	0.247	-1.92	23	22.03	0.309	/
CAT-M Band 4	20M	QPSK	1	0	Front side	20175	0.674	2.99	24	23.71	**0.721**	/
			6	0	Front side	20175	0.622	-3.23	24	23.45	0.706	/
			1	0	Back Side	20175	0.234	-1.82	24	23.71	0.250	/
			6	0	Back Side	20175	0.176	-1.58	24	23.45	0.200	/
			1	0	Left Side	20175	0.139	-2.05	24	23.71	0.149	/
			6	0	Left Side	20175	0.127	1.49	24	23.45	0.144	/
			1	0	Right Side	20175	0.158	-2.75	24	23.71	0.169	/
			6	0	Right Side	20175	0.142	-2.26	24	23.45	0.161	/
			1	0	Top side	20175	0.196	1.39	24	23.71	0.210	/
			6	0	Top side	20175	0.181	3.92	24	23.45	0.205	/
			1	0	Bottom Side	20175	0.233	2.62	24	23.71	0.249	/
			6	0	Bottom Side	20175	0.216	1.68	24	23.45	0.245	/
CAT-M Band 5	10M	QPSK	1	0	Front side	20600	0.089	-3.97	25	24.65	0.096	/
			6	0	Front side	20600	0.074	-1.22	25	24.42	0.085	/
			1	0	Back Side	20600	0.091	-1.76	25	24.65	**0.099**	/
			6	0	Back Side	20600	0.082	2.75	25	24.42	0.094	/
			1	0	Left Side	20600	0.032	-0.33	25	24.65	0.035	/
			6	0	Left Side	20600	0.024	1.27	25	24.42	0.027	/
			1	0	Right Side	20600	0.027	-2.25	25	24.65	0.029	/
			6	0	Right Side	20600	0.022	-0.84	25	24.42	0.025	/
			1	0	Top side	20600	0.020	-1.45	25	24.65	0.022	/
			6	0	Top side	20600	0.014	-3.67	25	24.42	0.016	/
			1	0	Bottom Side	20600	0.015	3.14	25	24.65	0.016	/
			6	0	Bottom Side	20600	0.009	-4.00	25	24.42	0.010	/

CAT-M Band 12	10M	QPSK	1	0	Front side	23095	0.045	0.51	25	24.43	0.051	/
			6	0	Front side	23095	0.029	-0.98	25	24.15	0.035	/
			1	0	Back Side	23095	0.075	-2.86	25	24.43	**0.086**	/
			6	0	Back Side	23095	0.070	1.30	25	24.15	0.085	/
			1	0	Left Side	23095	0.024	-3.60	25	24.43	0.027	/
			6	0	Left Side	23095	0.018	-0.24	25	24.15	0.022	/
			1	0	Right Side	23095	0.029	3.14	25	24.43	0.033	/
			6	0	Right Side	23095	0.017	-3.06	25	24.15	0.021	/
			1	0	Top side	23095	0.024	-2.72	25	24.43	0.027	/
			6	0	Top side	23095	0.018	3.56	25	24.15	0.022	/
			1	0	Bottom Side	23095	0.031	-2.54	25	24.43	0.035	/
			6	0	Bottom Side	23095	0.023	3.35	25	24.15	0.028	/
CAT-M Band 13	10M	QPSK	1	0	Front side	23230	0.114	-3.52	24	23.15	0.139	/
			6	0	Front side	23230	0.102	-0.39	23	22.86	0.105	/
			1	0	Back Side	23230	0.134	-2.21	24	23.15	**0.163**	/
			6	0	Back Side	23230	0.117	-2.51	23	22.86	0.121	/
			1	0	Left Side	23230	0.082	-1.36	24	23.15	0.100	/
			6	0	Left Side	23230	0.077	-3.35	23	22.86	0.080	/
			1	0	Right Side	23230	0.063	-1.39	24	23.15	0.077	/
			6	0	Right Side	23230	0.057	1.17	23	22.86	0.059	/
			1	0	Top side	23230	0.042	-2.41	24	23.15	0.051	/
			6	0	Top side	23230	0.033	-1.45	23	22.86	0.034	/
			1	0	Bottom Side	23230	0.030	-2.63	24	23.15	0.036	/
			6	0	Bottom Side	23230	0.024	-3.29	23	22.86	0.025	/

Repeated SAR

Band	BW (MHz)	Test Position	Ch.	Result 1g (W/Kg)	Power Drift(%)	Max.Turn-up Power(dBm)	Meas.Output Power(dBm)	Scaled SAR (W/Kg)	Meas. No.
CAT-M Band 2	20M	Front side	19100	0.761	-2.87	23	22.28	0.898	/

11.3 repeated SAR measurement

Band	BW (MHz)	Test Position	Ch.	Original Measured SAR 1g(mW/g)	1 st Repeated SAR 1g	Ratio	Original Measured SAR 1g(mW/g)	2nd Repeated SAR 1g	Ratio
CAT-M Band 2	20M	Front side	19100	0.774	0.761	1.02	-	-	-

Note:

1. Per KDB 865664 D01,for each frequency band ,repeated SAR measurement is required only when the measured SAR is≥0.8W/Kg.
2. Per KDB 865664 D01,if the ratio of largest to smallest SAR for the original and first repeated measurement is≤1.2and the measured SAR＜1.45W/Kg, only one repeated measurement is required.
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 ≥ 1.45W/Kg
4. The ratio is the difference in percentage between original and repeated measured SAR.

Simultaneous Multi-band Transmission Evaluation:

Application Simultaneous Transmission information:

Position	Simultaneous State
Body	1. GSM + WLAN
	2. CAT-M + WLAN

NOTE:

1. Bluetooth and WLAN can't simultaneous transmission at the same time.
2. For simultaneous transmission at head and body exposure position, 2 transmitters simultaneous transmission was the worst state.
3. Based upon KDB 447498 D01, BT SAR is excluded as below table.
4. If the test separation distance is <5mm, 5mm is used for excluded SAR calculation.
5. For minimum test separation distance≦50mm,Bluetooth standalone SAR is excluded according to [(max. power of channel, including tune-up tolerance, mW)/ (min. test separation distance, mm)·[√f (GHz) /x] ≦3.0 for 1-g SAR and ≦7.5 for 10-g extremity SAR
6. The reported SAR summation is calculated based on the same configuration and test position.
7. KDB 447498 / 4.3.2 (2) when standalone SAR test exclusion applies to an antenna that transmits simultaneously with other antennas, the standalone SAR must be estimated according to following to determine simultaneous transmission SAR test exclusion:
   a) (max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)]·[√f (GHz) /x] W/kg for test separation distances≤ 50 mm;
   Where x = 7.5 for 1-g SAR, and x = 18.75 for 10-g SAR.
   b) 0.4W/Kg for 1-g SAR and 1.0W/Kg for 10-g SAR, when the separation distance is >50mm.

Simultaneous Mode	Position	Mode	Max. 1-g SAR (W/kg)	1-g Sum SAR (W/kg)
GSM + WLAN	Body	GSM Data	0.580	0.645
		WLAN	0.065	
CAT-M + WLAN	Body	CAT-M RMC	0.914	0.979
		WLAN	0.065	

Simultaneous transmission SAR test exclusion is determined for each operating configuration and exposure condition according to the reported standalone SAR of each applicable simultaneous transmitting antenna.

When the sum of SAR 1g of all simultaneously transmitting antennas in an operating mode and exposure condition combination is within the SAR limit (SAR-1g 1.6 W/kg), the simultaneous transmission SAR is not required. When the sum of SAR 1g is greater than the SAR limit (SAR-1g 1.6 W/kg), SAR test exclusion is determined by the SPLSR.

13. Equipment List

Kind of Equipment	Manufacturer	Type No.	Serial No.	Last Calibration	Calibrated Until
750MHz Dipole	MVG	SID750	SN 30/14 DIP0G750-331	2017.08.15	2020.08.14
835MHz Dipole	MVG	SID835	SN 30/14 DIP0G835-332	2017.08.15	2020.08.14
1800MHz Dipole	MVG	SID1800	SN 30/14 DIP1G800-329	2017.08.15	2020.08.14
1900MHz Dipole	MVG	SID1900	SN 30/14 DIP1G900-333	2017.08.15	2020.08.14
2450MHzDipole	MVG	SID2450	SN 30/14 DIP2G450-335	2017.08.15	2020.08.14
E-Field Probe	MVG	SSE2	SN 41/18 EPGO334	2019.06.04	2020.06.03
Dielectric Probe Kit	MVG	SCLMP	SN 32/14 OCPG67	2019.11.25	2020.11.24
Antenna	MVG	ANTA3	SN 07/13 ZNTA52	N/A	N/A
Phantom1	MVG	SAM	SN 32/14 SAM115	N/A	N/A
Phantom2	MVG	SAM	SN 32/14 SAM116	N/A	N/A
Phone holder	MVG	N/A	SN 32/14 MSH97	N/A	N/A
Laptop holder	MVG	N/A	SN 32/14 LSH29	N/A	N/A
Attenuator	Agilent	99899	DC-18GHz	N/A	N/A
Directional coupler	Narda	4226-20	3305	N/A	N/A
Network Analyzer	Agilent	8753ES	US38432810	2019.10.11	2020.10.10
Multi Meter	Keithley	Multi Meter 2000	4050073	2019.10.11	2020.10.10
Signal Generator	Agilent	N5182A	MY50140530	2019.10.09	2020.10.08
Wireless Communication Test Set	Agilent	8960-E5515C	MY48360751	2019.10.09	2020.10.08
Wireless Communication Test Set	R&S	CMW500	117239	2019.10.09	2020.10.08
Power Amplifier	DESAY	ZHL-42W	9638	2019.10.09	2020.10.08
Power Meter	R&S	NRP	100510	2019.10.16	2020.10.15
Power Meter	Agilent	E4419B	QB43312265	2019.10.12	2020.10.11
Power Sensor	R&S	NRP-Z11	101919	2019.10.12	2020.10.11
Power Sensor	HP	E9300A	US39210170	2019.10.09	2020.10.08
Temperature hygrometer	SuWei	SW-108	N/A	2019.10.13	2020.10.12
Thermograph	Elitech	RC-4	S/N EF7176501537	2019.10.11	2020.10.10

Note:
Per KDB 865664 D01, Dipole SAR Validation Verification, STS 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
Return-loss in within 20% of calibrated measurement

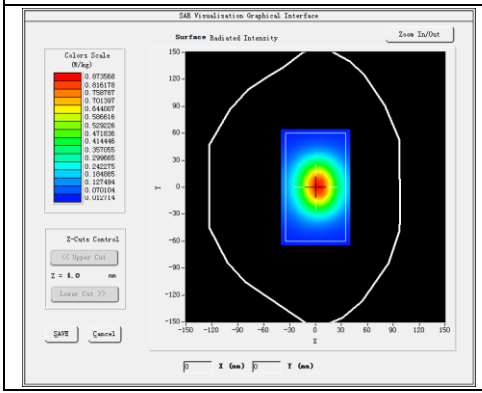
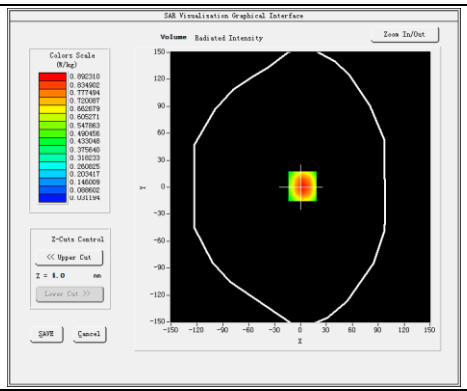
Appendix A. System Validation Plots

System Performance Check Data (750MHz Head)

Type: Phone measurement (Complete)
Area scan resolution: dx=8mm, dy=8mm
Zoom scan resolution: dx=8mm, dy=8mm, dz=5mm
Date of measurement: 2020-04-22
Measurement duration: 13 minutes 25 seconds

Experimental conditions

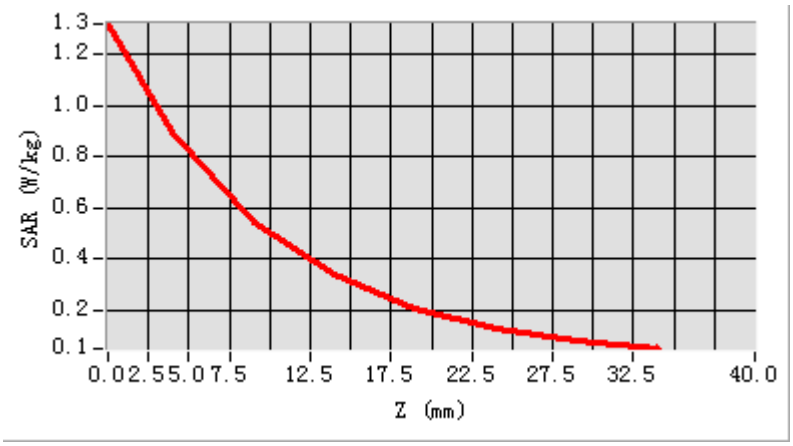
Phantom	Validation plane
Device Position	-
Band	750MHz
Channels	-
Signal	CW
Frequency (MHz)	750MHz
Relative permittivity	41.93
Conductivity (S/m)	0.86
Power drift (%)	-0.20
Probe	SN 41/18 EPGO334
ConvF	1.43
Crest factor	1:1

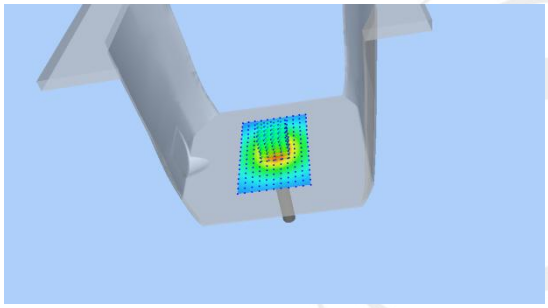
SURFACE SAR	VOLUME SAR
	

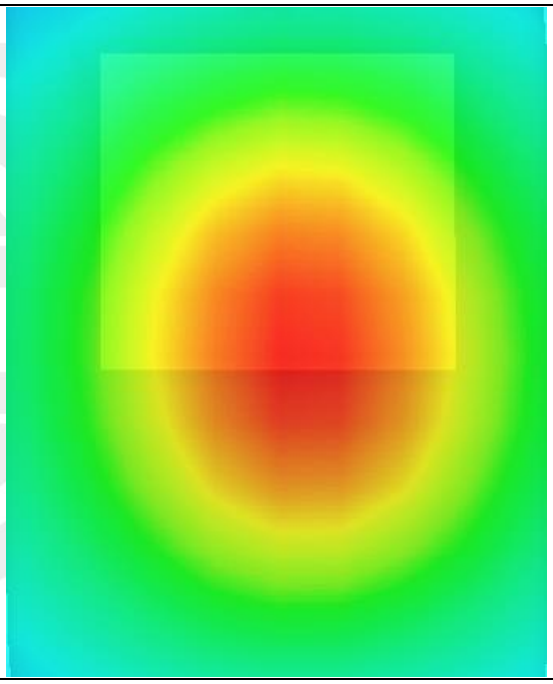
Maximum location: X=2.00, Y=1.00

SAR 10g (W/Kg)	0.535218
SAR 1g (W/Kg)	0.853248

Z Axis Scan


1.3
1.2
1.0
0.8
0.6
0.4
0.2
0.1
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)





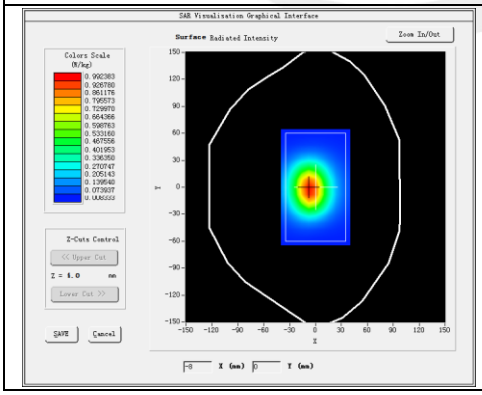
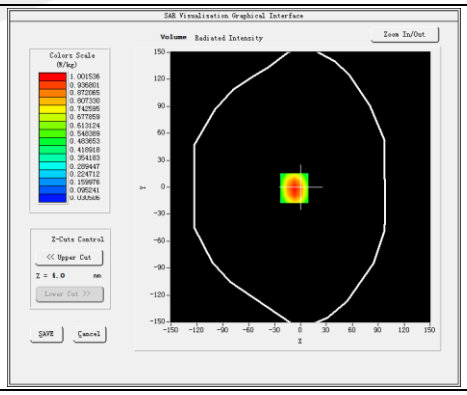
System Performance Check Data (835MHz Head)

Type: Phone measurement (Complete)

Area scan resolution: dx=8mm, dy=8mm
Zoom scan resolution: dx=8mm, dy=8mm, dz=5mm
Date of measurement: 2020-04-23
Measurement duration: 13 minutes 27 seconds

Experimental conditions

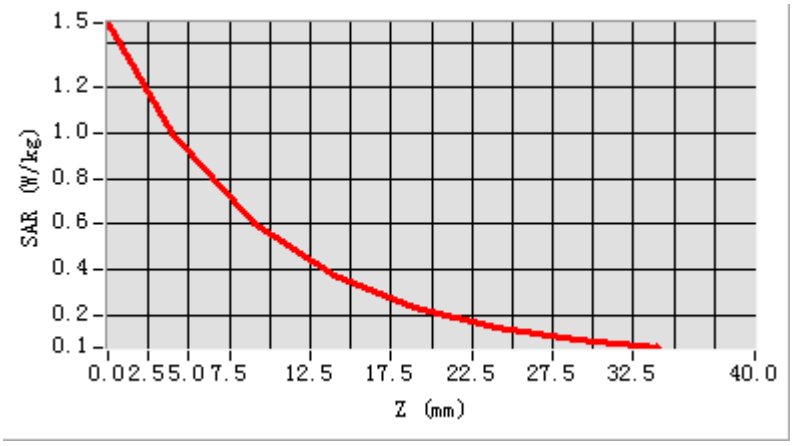
Phantom	Validation plane
Device Position	-
Band	835MHz
Channels	-
Signal	CW
Frequency (MHz)	835MHz
Relative permittivity	41.60
Conductivity (S/m)	0.91
Power drift (%)	0.07
Probe	SN 41/18 EPGO334
ConvF:	1.48
Crest factor:	1:1

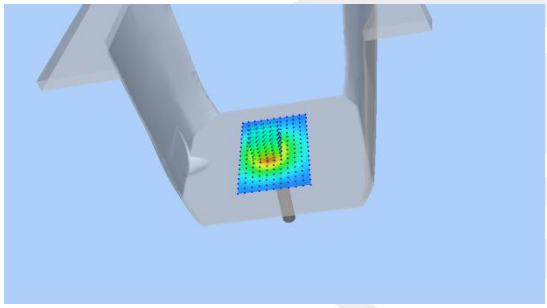
SURFACE SAR	VOLUME SAR
	

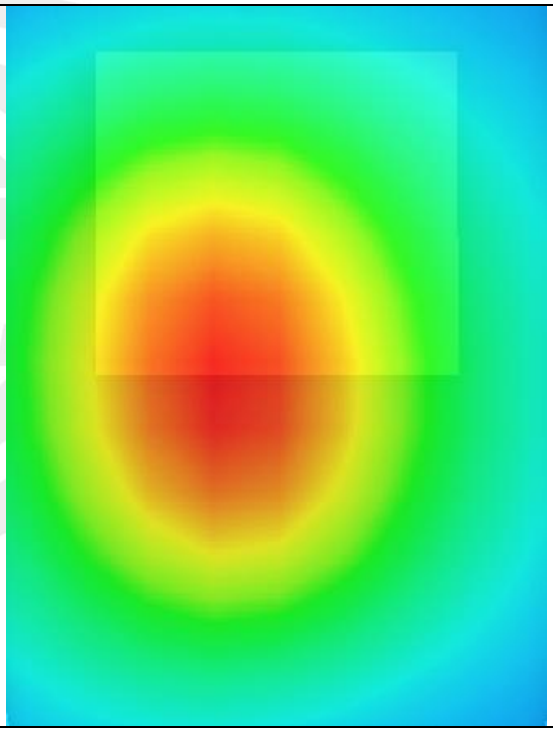
Maximum location: X=-7.00, Y=-1.00

SAR 10g (W/Kg)	0.621024
SAR 1g (W/Kg)	0.977421

Z Axis Scan


SAR (W/kg)
1.5
1.2
1.0
0.8
0.6
0.4
0.2
0.1
0.0 2.5 5.0 7.5 12.5 17.5 22.5 27.5 32.5 40.0
Z (mm)



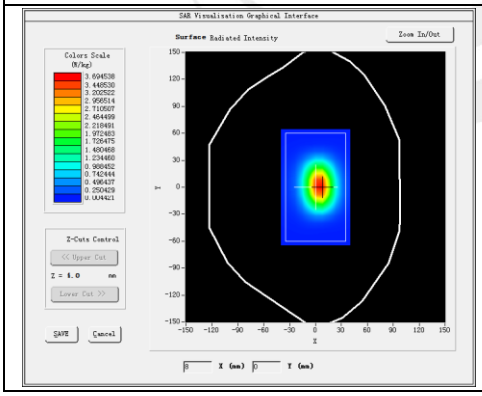
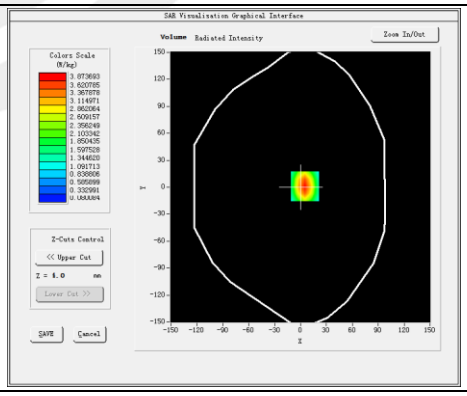


System Performance Check Data(1800MHz Head)

Type: Phone measurement (Complete)
Area scan resolution: dx=8mm, dy=8mm
Zoom scan resolution: dx=8mm, dy=8mm, dz=5mm
Date of measurement: 2020-04-24

Experimental conditions.

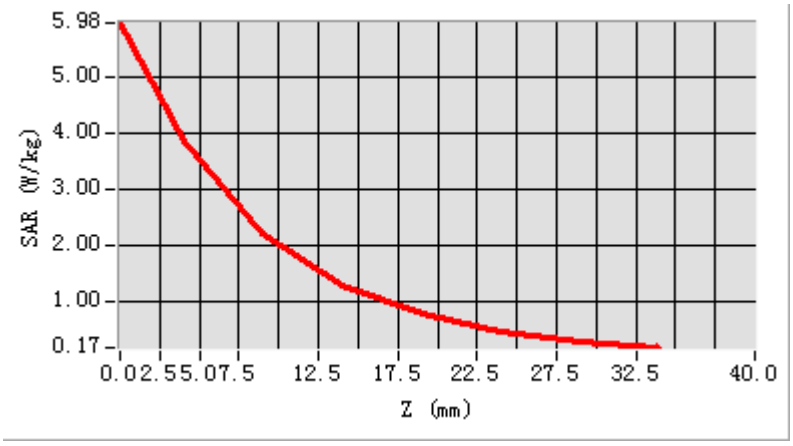
Phantom	Validation plane
Device Position	-
Band	1800MHz
Channels	-
Signal	CW
Frequency (MHz)	1800MHz
Relative permittivity	40.93
Conductivity (S/m)	1.42
Power drift (%)	0.23
Probe	SN 41/18 EPGO334
ConvF	1.60
Crest factor:	1:1

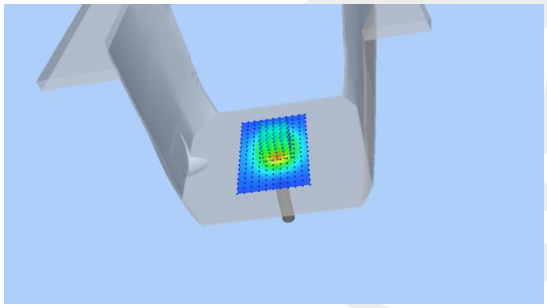
SURFACE SAR	VOLUME SAR
	

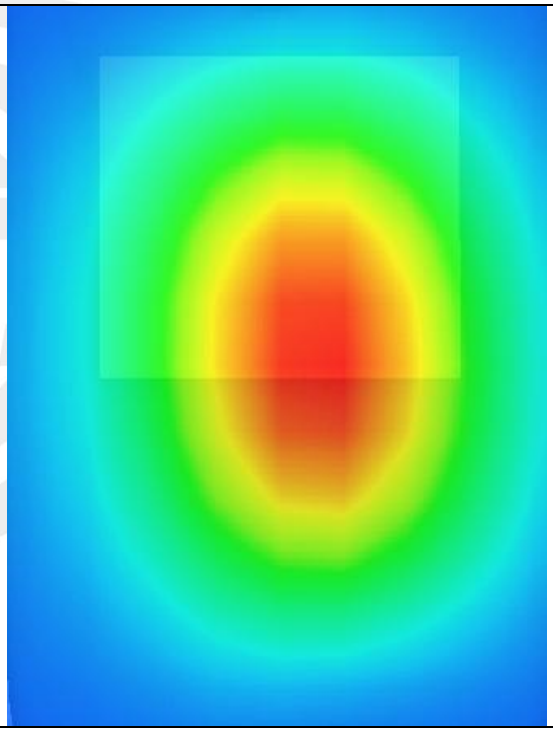
Maximum location: X=5.00, Y=1.00

SAR 10g (W/Kg)	2.021559
SAR 1g (W/Kg)	3.744825

Z Axis Scan


5.98
5.00
4.00
3.00
2.00
1.00
0.17
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)



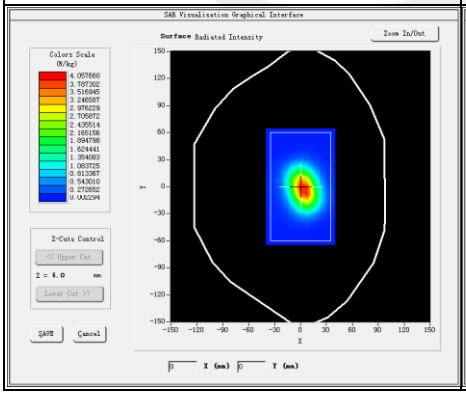
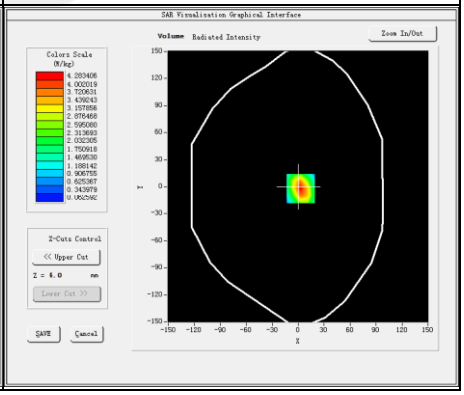


System Performance Check Data (1900MHz Head)

Type: Phone measurement (Complete)
Area scan resolution: dx=8mm, dy=8mm
Zoom scan resolution: dx=8mm, dy=8mm, dz=5mm
Date of measurement: 2020-04-26
Measurement duration: 14 minutes 12 seconds

Experimental conditions.

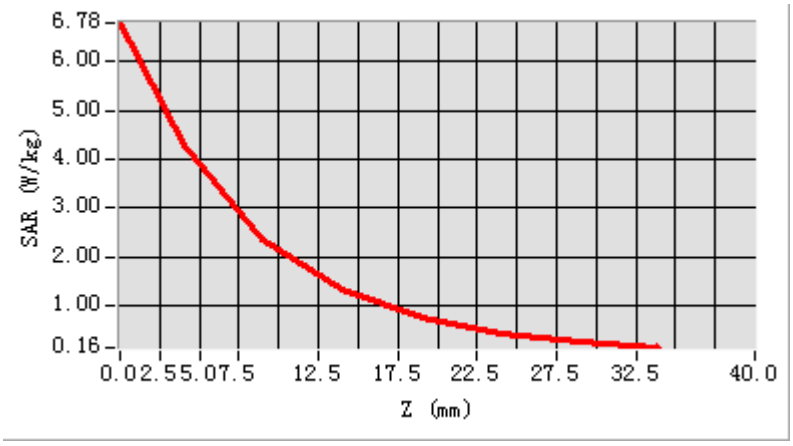
Phantom	Validation plane
Device Position	-
Band	1900MHz
Channels	-
Signal	CW
Frequency (MHz)	1900MHz
Relative permittivity	39.89
Conductivity (S/m)	1.41
Power drift (%)	0.46
Probe	SN 41/18 EPGO334
ConvF:	1.84
Crest factor:	1:1

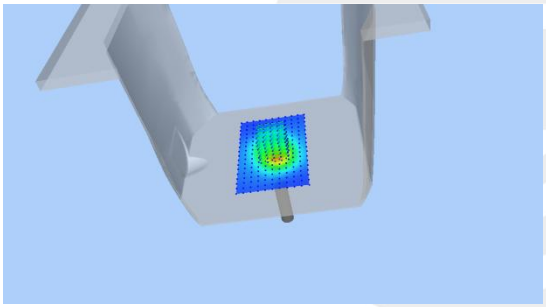
SURFACE SAR	VOLUME SAR
	

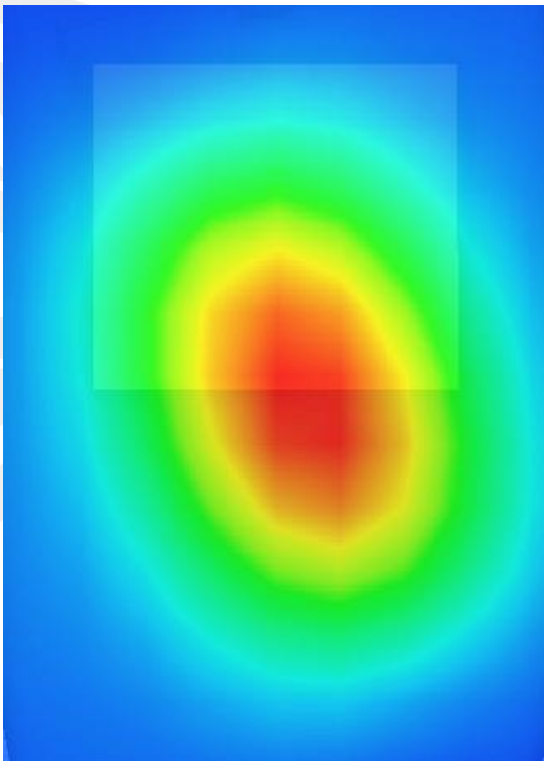
Maximum location: X=3.00, Y=-2.00

SAR 10g (W/Kg)	2.095321
SAR 1g (W/Kg)	4.107245

Z Axis Scan


6.78
6.00
5.00
4.00
3.00
2.00
1.00
0.16
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)



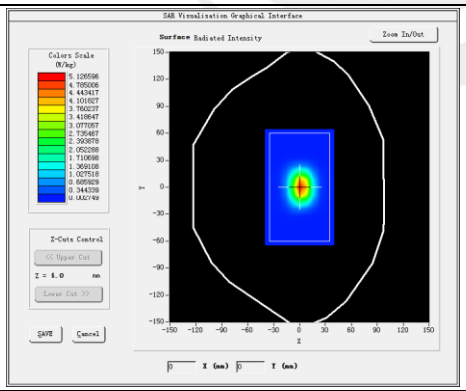
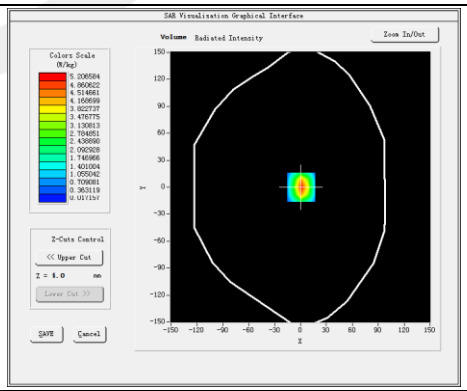


System Performance Check Data (2450MHz Head)

Type: Phone measurement (Complete)
Area scan resolution: dx=8mm, dy=8mm
Zoom scan resolution: dx=8mm, dy=8mm, dz=5mm
Date of measurement: 2020-04-27
Measurement duration: 13 minutes 51seconds

Experimental conditions.

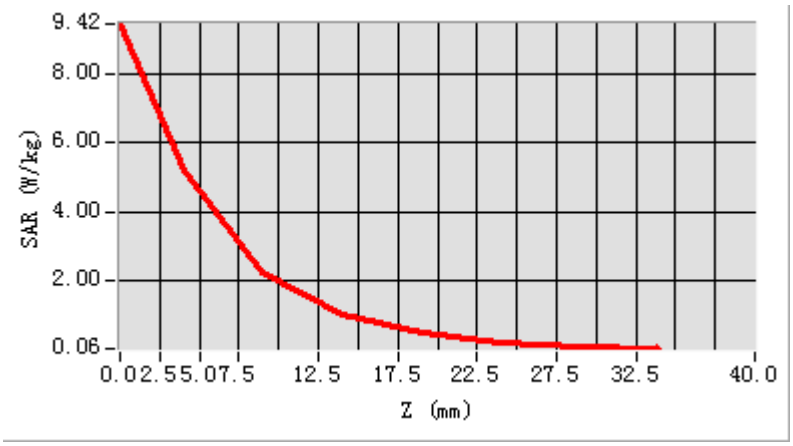
Device Position	Validation plane
Band	2450 MHz
Channels	-
Signal	CW
Frequency (MHz)	2450
Relative permittivity	39.36
Conductivity (S/m)	1.77
Power drift (%)	-0.38
Probe	SN 41/18 EPGO334
ConvF	1.97
Crest factor:	1:1

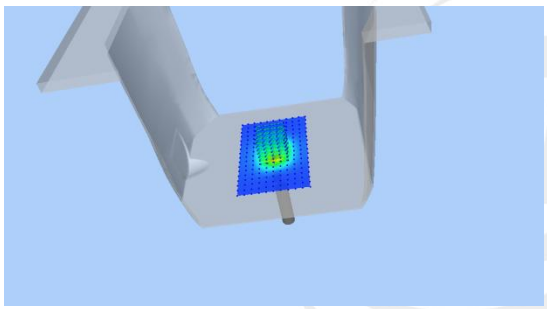
SURFACE SAR	VOLUME SAR
	

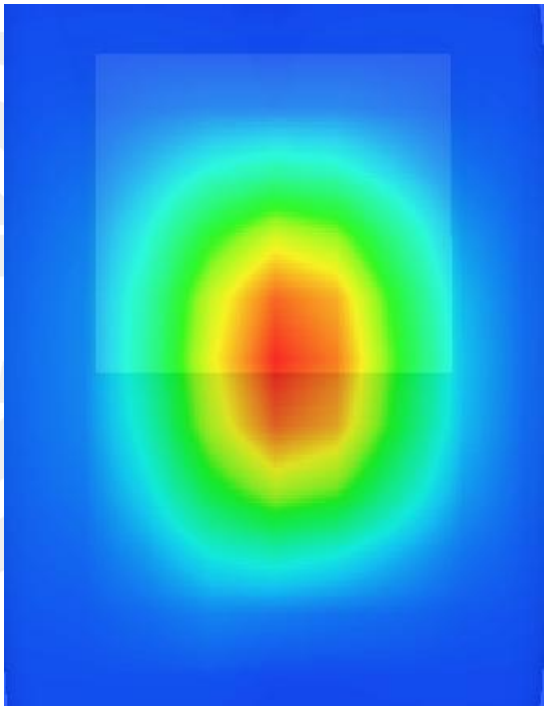
Maximum location: X=1.00, Y=0.00

SAR 10g (W/Kg)	2.489526
SAR 1g (W/Kg)	5.098354

Z Axis Scan


9.42
8.00
6.00
4.00
2.00
0.06
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)





Appendix B. SAR Test Plots

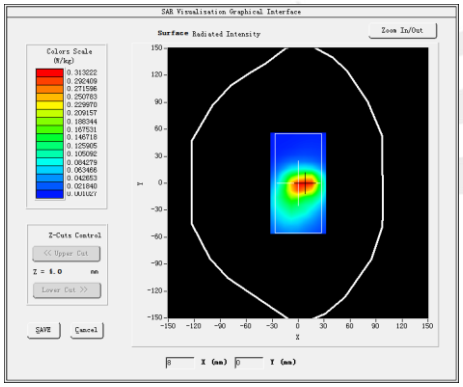
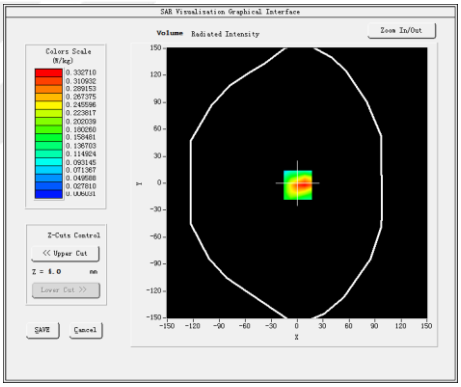
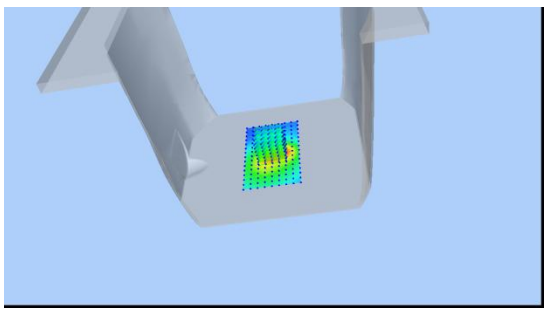
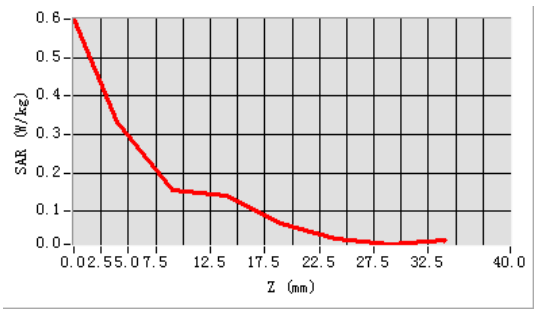
Plot 1: DUT: Lightbug Zero; EUT Model: Zero

Test Date	2020-04-23
Probe	SN 41/18 EPGO334
ConvF	1.53
Area Scan	dx=8mm, dy=8mm, h= 5.00 mm
Zoom Scan	5x5x7, dx=8mm, dy=8mm, dz=5mm, Complete/ndx=8mm, dy=8mm, h= 5.00 mm
Phantom	Validation plane
Device Position	Front Side
Band	GPRS 850
Channels	Low
Signal	Duty Cycle: 2.00 (Crest factor: 2.0)
Frequency (MHz)	824.2
Relative permittivity (real part)	41.5
Conductivity (S/m)	0.90

Maximum location: X=1.00, Y=-2.00

SAR Peak: 0.48 W/kg

SAR 10g (W/Kg)	0.173337
SAR 1g (W/Kg)	0.311504

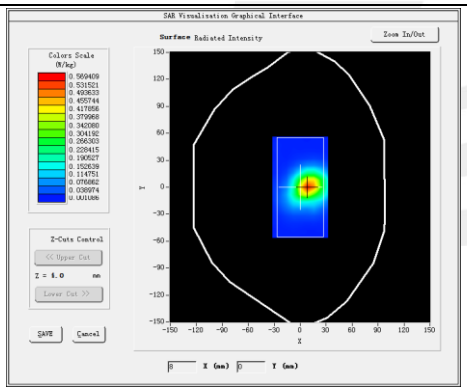
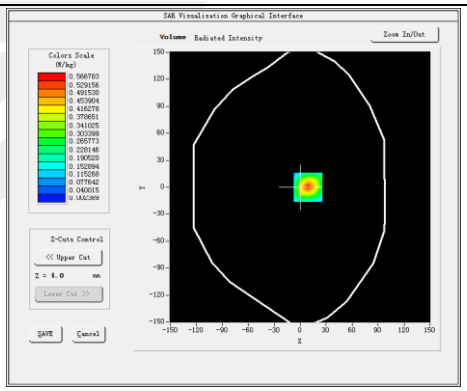
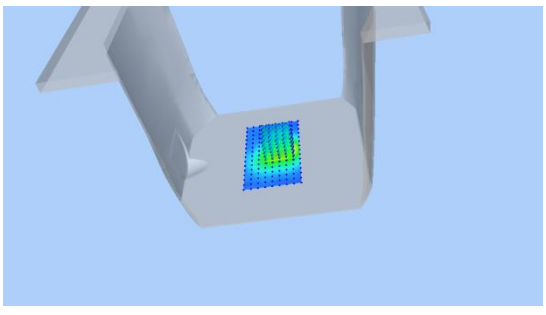
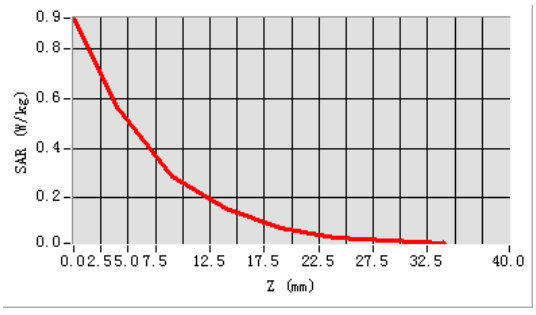
SURFACE SAR	VOLUME SAR
	
3D screen shot	**Z Axis Scan**
	

Plot 2: DUT: Lightbug Zero; EUT Model: Zero

Test Date	2020-04-26
Probe	SN 41/18 EPGO334
ConvF	1.84
Area Scan	dx=8mm, dy=8mm, h= 5.00 mm
Zoom Scan	5x5x7, dx=8mm, dy=8mm, dz=5mm, Complete/ndx=8mm, dy=8mm, h= 5.00 mm
Phantom	Validation plane
Device Position	Front Side
Band	GPRS 1900
Channels	Middle
Signal	Duty Cycle: 1:2.00 (Crest factor: 2.0)
Frequency (MHz)	1880.0
Relative permittivity (real part)	40
Conductivity (S/m)	1.4

Maximum location: X=9.00, Y=0.00
SAR Peak: 0.92 W/kg

SAR 10g (W/Kg)	0.247635
SAR 1g (W/Kg)	0.513111

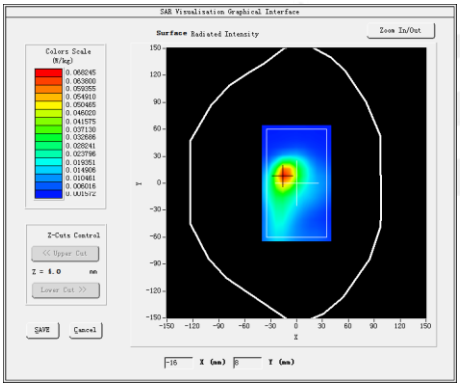
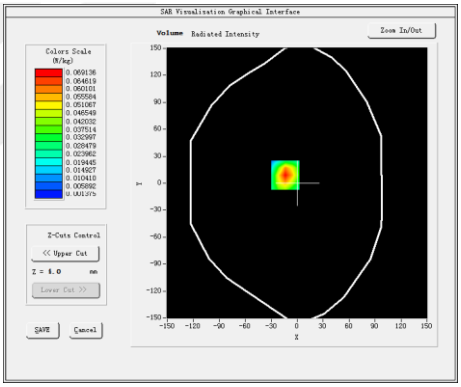
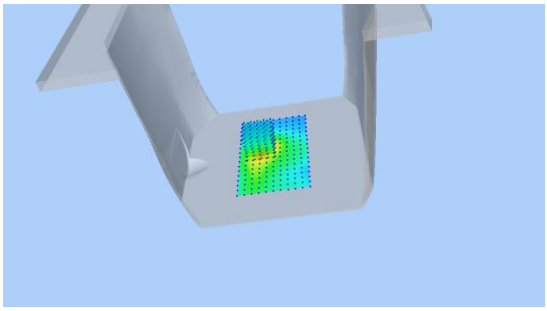
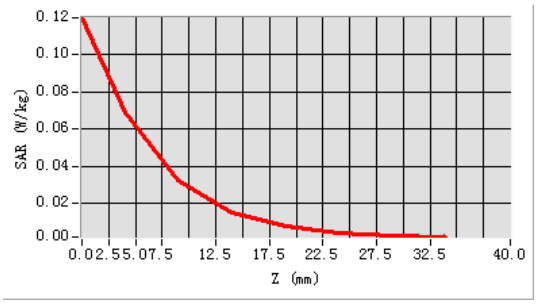
SURFACE SAR	VOLUME SAR
	
3D screen shot	**Z Axis Scan**
	

Plot 3: DUT: Lightbug Zero; EUT Model: Zero

Test Date	2020-04-27
Probe	SN 41/18 EPGO334
ConvF	2.02
Area Scan	dx=8mm, dy=8mm, h= 5.00 mm
Zoom Scan	5x5x7, dx=8mm, dy=8mm, dz=5mm, Complete/ndx=8mm, dy=8mm, h= 5.00 mm
Phantom	Validation plane
Device Position	Back Side
Band	IEEE 802.11b ISM
Channels	Low
Signal	IEEE802.b (Crest factor: 1.0)
Frequency (MHz)	2412
Relative permittivity (real part)	39.20
Conductivity (S/m)	1.80

Maximum location: X=-14.00, Y=9.00
SAR Peak: 0.12 W/kg

SAR 10g (W/Kg)	0.030133
SAR 1g (W/Kg)	0.064720

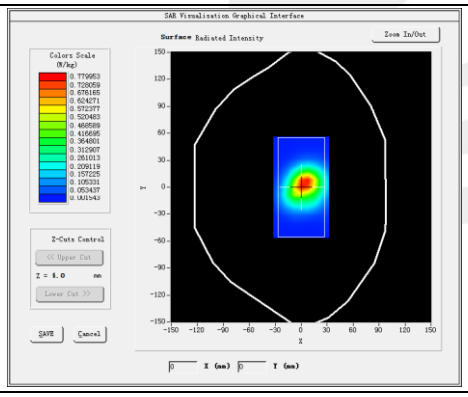
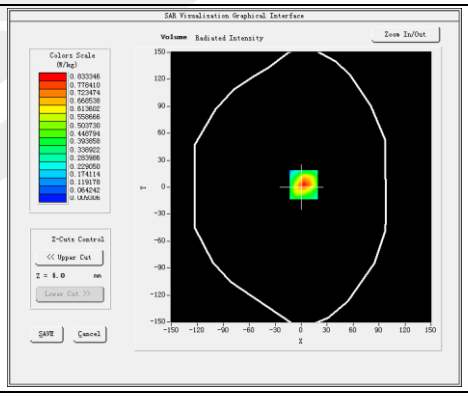
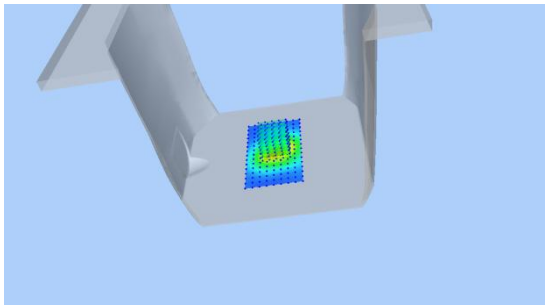
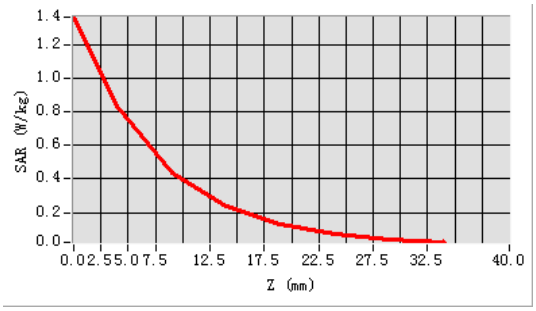
SURFACE SAR	VOLUME SAR
	
3D	**Z Axis Scan**
	

Plot 4: DUT: Lightbug Zero; EUT Model: Zero

Test Date	2020-04-26
Probe	SN 41/18 EPGO334
ConvF	1.88
Area Scan	dx=8mm, dy=8mm, h= 5.00 mm
Zoom Scan	5x5x7, dx=8mm, dy=8mm, dz=5mm, Complete/ndx=8mm, dy=8mm, h= 5.00 mm
Phantom	Validation plane
Device Position	Front Side
Band	CAT-M Band 2(RB 1)
Channels	High
Signal	CAT-M (Crest factor: 1.0)
Frequency (MHz)	1900
Relative permittivity (real part)	40.0
Conductivity (S/m)	1.40

Maximum location: X=3.00, Y=3.00
SAR Peak: 1.35 W/kg

SAR 10g (W/Kg)	0.383125
SAR 1g (W/Kg)	0.773513

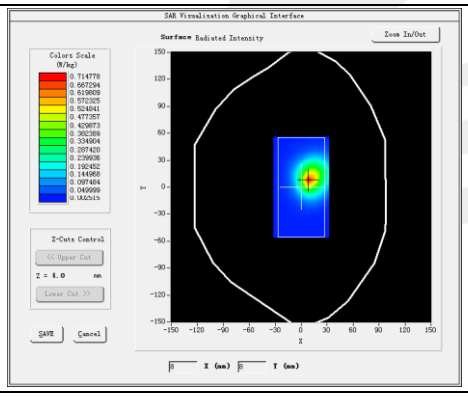
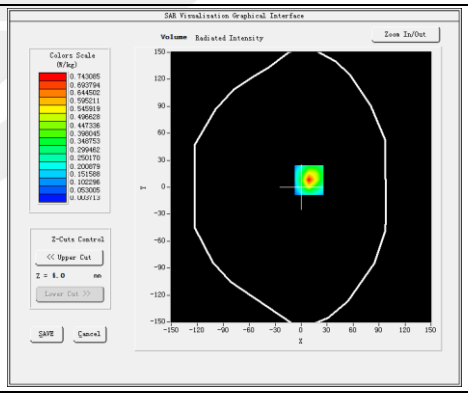
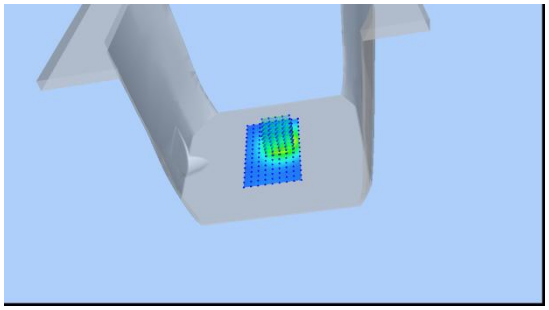
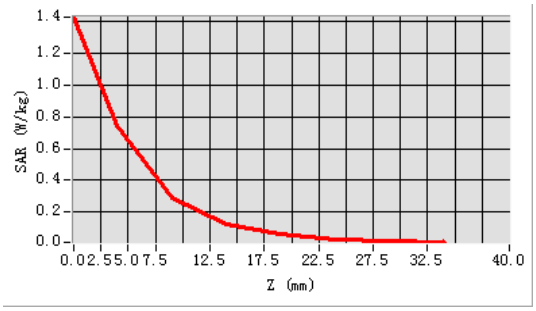
SURFACE SAR	VOLUME SAR
	
3D screen shot	**Z Axis Scan**
	

Plot 5: DUT: Lightbug Zero; EUT Model: Zero

Test Date	2020-04-24
Probe	SN 41/18 EPGO334
ConvF	1.66
Area Scan	dx=8mm, dy=8mm, h= 5.00 mm
Zoom Scan	5x5x7, dx=8mm, dy=8mm, dz=5mm, Complete/ndx=8mm, dy=8mm, h= 5.00 mm
Phantom	Validation plane
Device Position	Front Side
Band	CAT-M Band 4 (RB 1)
Channels	Middle
Signal	CAT-M (Crest factor: 1.0)
Frequency (MHz)	1732.5
Relative permittivity (real part)	40.0
Conductivity (S/m)	1.40

Maximum location: X=9.00, Y=8.00
SAR Peak: 1.40 W/kg

SAR 10g (W/Kg)	0.284376
SAR 1g (W/Kg)	0.673538

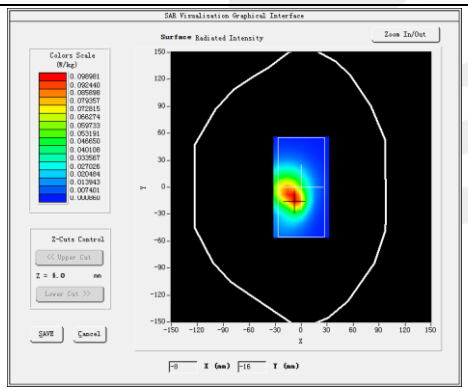
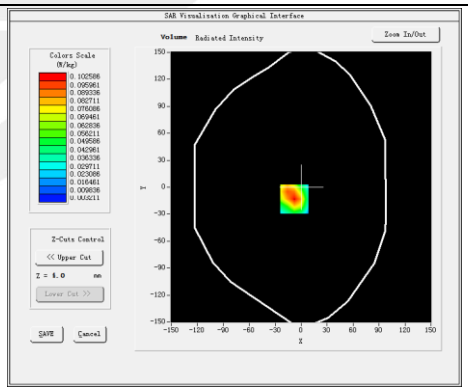
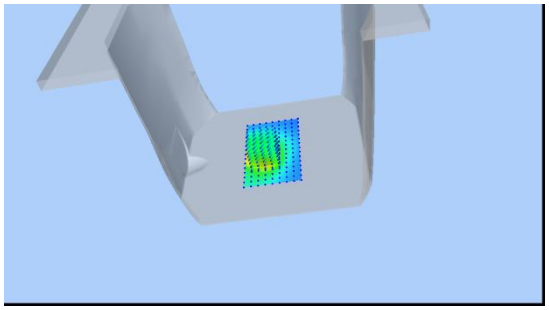
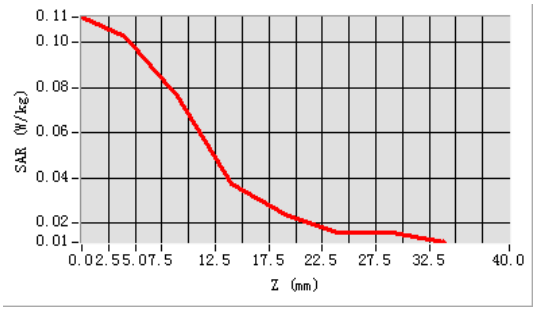
SURFACE SAR	VOLUME SAR
	
3D screen shot	**Z Axis Scan**
	

Plot 6: DUT: Lightbug Zero; EUT Model: Zero

Test Date	2020-04-23
Probe	SN 41/18 EPGO334
ConvF	1.53
Area Scan	dx=8mm, dy=8mm, h= 5.00 mm
Zoom Scan	5x5x7, dx=8mm, dy=8mm, dz=5mm, Complete/ndx=8mm, dy=8mm, h= 5.00 mm
Phantom	Validation plane
Device Position	Back Side
Band	CAT-M Band 5 (RB 1)
Channels	High
Signal	CAT-M (Crest factor: 1.0)
Frequency (MHz)	844.0
Relative permittivity (real part)	41.50
Conductivity (S/m)	0.90

Maximum location: X=-8.00, Y=-13.00
SAR Peak: 0.13 W/kg

SAR 10g (W/Kg)	0.056939
SAR 1g (W/Kg)	0.091051

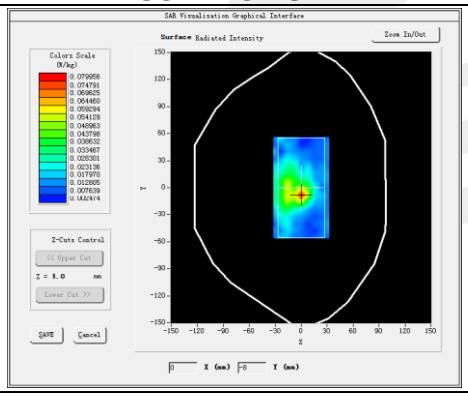
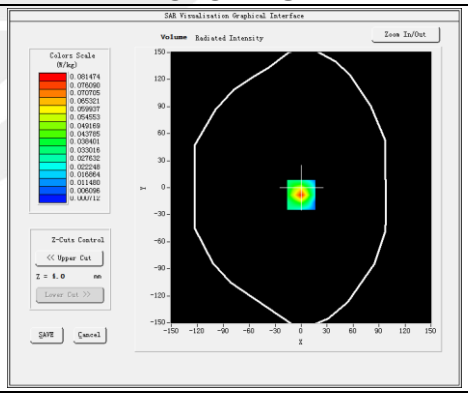
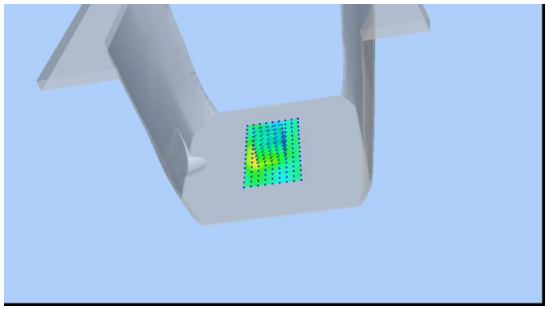
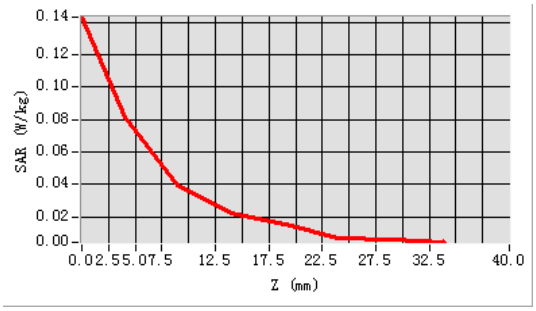
SURFACE SAR	VOLUME SAR
	
3D screen shot	**Z Axis Scan**
	

Plot 7: DUT: Lightbug Zero; EUT Model: Zero

Test Date	2017-04-20
Probe	SN 41/18 EPGO334
ConvF	1.92
Area Scan	dx=8mm, dy=8mm, h= 5.00 mm
Zoom Scan	5x5x7, dx=8mm, dy=8mm, dz=5mm, Complete/ndx=8mm, dy=8mm, h= 5.00 mm
Phantom	Validation plane
Device Position	Back Side
Band	CAT-M Band 12 (RB 1)
Channels	Middle
Signal	CAT-M (Crest factor: 1.0)
Frequency (MHz)	707.5
Relative permittivity (real part)	41.90
Conductivity (S/m)	0.88

Maximum location: X=0.00, Y=-8.00
SAR Peak: 0.14 W/kg

SAR 10g (W/Kg)	0.035087
SAR 1g (W/Kg)	0.075055

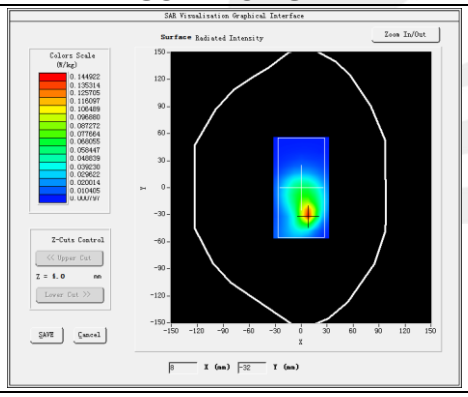
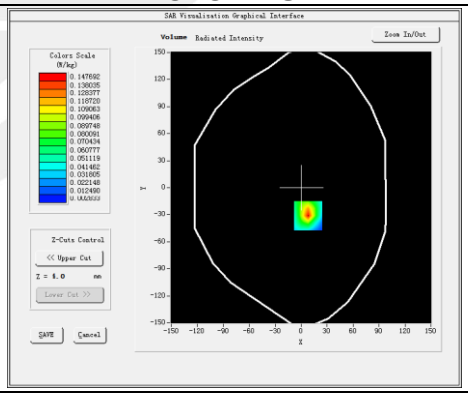
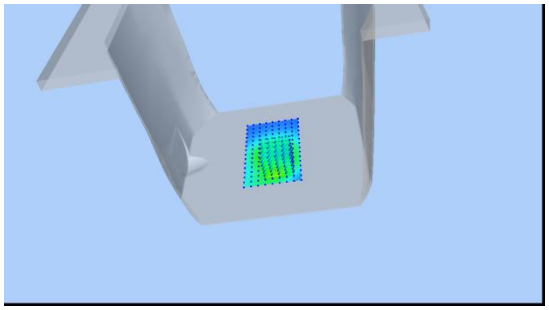
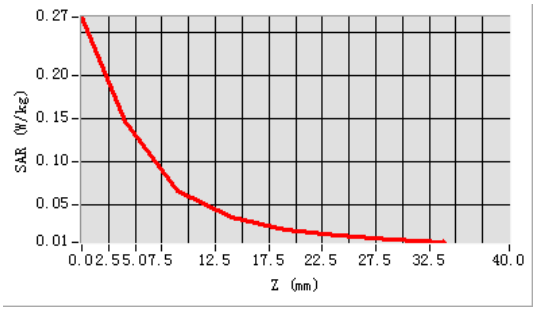
SURFACE SAR	VOLUME SAR
	
3D screen shot	**Z Axis Scan**
	

Plot 8: DUT: Lightbug Zero; EUT Model: Zero

Test Date	2020-04-22
Probe	SN 41/18 EPGO334
ConvF	1.49
Area Scan	dx=8mm, dy=8mm, h= 5.00 mm
Zoom Scan	5x5x7, dx=8mm, dy=8mm, dz=5mm, Complete/ndx=8mm, dy=8mm, h= 5.00 mm
Phantom	Validation plane
Device Position	Back Side
Band	CAT-M Band 13 (RB 1)
Channels	Middle
Signal	CAT-M (Crest factor: 1.0)
Frequency (MHz)	782
Relative permittivity (real part)	41.90
Conductivity (S/m)	0.88

Maximum location: X=8.00, Y=-31.00
SAR Peak: 0.26 W/kg

SAR 10g (W/Kg)	0.062659
SAR 1g (W/Kg)	0.134162

SURFACE SAR	VOLUME SAR
	
3D screen shot	**Z Axis Scan**
	

Appendix C. Probe Calibration and Dipole Calibration Report

Refer the appendix Calibration Report.

※※※※※END OF THE REPORT※※※※※