



FCC SAR TEST REPORT

Report No: STS1711167H01

Issued for

Shenzhen Feasycom Technology Co.,LTD
Room 2004A, 20th Floor, Huichao Technology Building, Jinhai Road, Xixiang, Baoan District, Shenzhen, China.

Product Name:	Long Range Bluetooth Transceiver
Brand Name:	Feasycom
Model Name:	FSC-BP109
Series Model:	N/A
FCC ID:	2AMWO-FSC-BP109
Test Standard:	ANSI/IEEE Std. C95.1
	FCC 47 CFR Part 2 (2.1093)
	IEEE 1528: 2013
Max. Report SAR (1g):	Body: 0.706 W/kg

Any reproduction of this document must be done in full. No single part of this document may be reproduced without permission from STS, All Test Data Presented in this report is only applicable to presented Test sample.





Test Report Certification

Applicant's name : Shenzhen Feasycom Technology Co.,LTD
Address : Room 2004A, 20th Floor, Huichao Technology Building, Jinhai Road, Xixiang, Baoan District, Shenzhen, China.
Manufacture's Name..... : Shenzhen Feasycom Technology Co.,LTD
Address : Room 2004A, 20th Floor, Huichao Technology Building, Jinhai Road, Xixiang, Baoan District, Shenzhen, China.

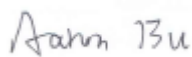
Product description

Product name : Long Range Bluetooth Transceiver
Brand name : Feasycom
Model name : FSC-BP109
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 Nov. 2017
Date of Issue..... : 23 Nov. 2017
Test Result..... : **Pass**

Testing Engineer : 

(Aaron Bu)

Technical Manager : 

(John Zou)

Authorized Signatory : 

(Vita Li)





Table of Contents

1.General Information	4
1.1 EUT Description	4
1.3 Test Factory	5
2.Test Standards And Limits	6
3. SAR Measurement System	7
3.1 Definition Of Specific Absorption Rate (SAR)	7
3.2 SAR System	7
4. Tissue Simulating Liquids	10
4.1 Simulating Liquids Parameter Check	10
5. SAR System Validation	12
5.1 Validation System	12
5.2 Validation Result	12
5.3 SAR system Validation	13
6. SAR Evaluation Procedures	14
7. EUT Test Position	15
7.1 Hotspot mode exposure position condition	15
7.2 USB connector Orientations Implemented on Laptop Computers	15
7.3 Simple Dongle Test Procedures	15
7.4 Dongles with Swivel or Rotating Connectors	16
7.5 SAR TEST EXCLUSION CONSIDER TABLE	17
8. Uncertainty	18
8.1 Measurement Uncertainty	18
8.2 System validation Uncertainty	19
9. Conducted Power Measurement	20
9.1 Test Result	20
9.3 SAR Test Exclusions Applied	21
10. EUT And Test Setup Photo	22
10.1 EUT Photo	22
10.2 Setup Photo	25
11. SAR Result Summary	29
12. Equipment List	30
Appendix A. System Validation Plots	31
Appendix B. SAR Test Plots	33
Appendix C. Probe Calibration And Dipole Calibration Report	38



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	Long Range Bluetooth Transceiver			
Brand Name	Feasycom			
Model Name	FSC-BP109			
Series Model	N/A			
FCC ID	2AMWO-FSC-BP109			
Model Difference	N/A			
Device Category	Portable			
Product stage	Production unit			
Exposure Environment	General Population / Uncontrolled			
Hardware Version	V1.2			
Software Version	V2.1.1			
Frequency Range	Bluetooth:2402~ 2480MHz			
Max. Reported SAR(1g) (Limit:1.6W/kg)	Band	Mode	Test Position	Body Worn (W/kg)
	DTS	Bluetooth ^{Note}	Horizontal- Up	0.706
			Horizontal- Down	0.423
			Bend 90	0.329
			Vertical-Front	0.413
			Vertical-Back	0.375
FCC Equipment Class	Digital Transmission System (DTS)			
Operating Mode	Bluetooth: V4.0 + EDR (GFSK, $\pi/4$ DQPSK, 8DPSK) ; BLE			
Antenna Specification	BT: Dipole 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 (°C)	18-25
Humidity (%RH)	30-70

1.3 Test Factory

Shenzhen STS Test Services Co., Ltd.

Add. : 1/F., Building B, Zhuoke Science Park, No.190, Chongqing Road,
Fuyong Street, Bao'an District, Shenzhen, Guangdong, China

CNAS Registration No.: L7649

FCC 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	KDB 447498 D02 v02r01	SAR Measurement Procedures for USB dongle transmitters
6	FCC KDB 865664 D01 v01r04	SAR Measurement 100 MHz to 6 GHz
7	FCC KDB 865664 D02 v01r02	RF Exposure Reporting

(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

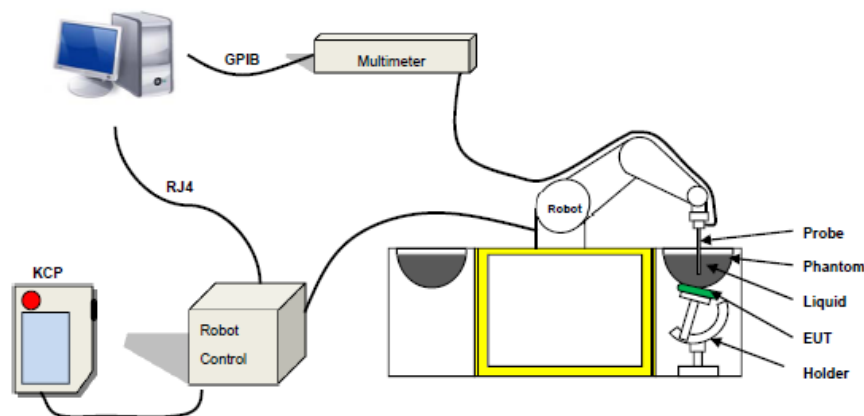
$$SAR = \frac{\sigma E^2}{\rho}$$

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 OpenSAR 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 14/16 EP309 with following specifications is used

- Dynamic range: 0.01-100 W/kg
- Tip Diameter: 5 mm
- Length of Individual Dipoles: 4.5 mm
- Maximum external diameter: 8 mm
- Distance between dipole/probe extremity: 8 mm (repeatability better than +/- 2.7mm)
- Probe linearity: $0 \pm 2.27\%$ ($\pm 0.10\text{dB}$)
- Axial Isotropy: $< 0.10\text{ dB}$
- Spherical Isotropy: $< 0.10\text{ dB}$
- Calibration range: 400 MHz to 3 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.

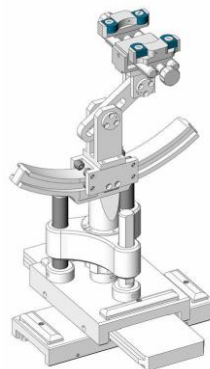
SN 32/14 SAM115



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

4.1 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.

Frequency (MHz)	Bactericide	DGBE	HEC	NaCl	Sucrose	1,2-Propanediol	X100	Water	Conductivity	Permittivity
	%	%	%	%	%	%	%	%	σ	ϵ_r
750	/	/	/	0.79	/	64.81	/	34.40	0.97	41.8
835	/	/	/	0.79	/	64.81	/	34.40	0.97	41.8
900	/	/	/	0.79	/	64.81	/	34.40	0.97	41.8
1800	/	13.84	/	0.35	/	/	30.45	55.36	1.38	41.0
1900	/	13.84	/	0.35	/	/	30.45	55.36	1.38	41.0
2000	/	7.99	/	0.16	/	/	19.97	71.88	1.55	41.1
2450	/	7.99	/	0.16	/	/	19.97	71.88	1.88	40.3
2600	/	7.99	/	0.16	/	/	19.97	71.88	1.88	40.3

Tissue dielectric parameters for head and body phantoms				
Frequency	ϵ_r		σ S/m	
	Head	Body	Head	Body
300	45.3	58.2	0.87	0.92
450	43.5	58.7	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		Body Simulating Liquid		Parameters	Target	Measured	Deviation [%]	Limited [%]
	Temp. [°C]	Humidity [%]	Frequency	Temp. [°C]					
2017-11-22	22.1	59	2450 MHz	21.7	Permittivity:	52.70	52.13	-1.08	± 5
					Conductivity	1.95	2.01	3.19	± 5

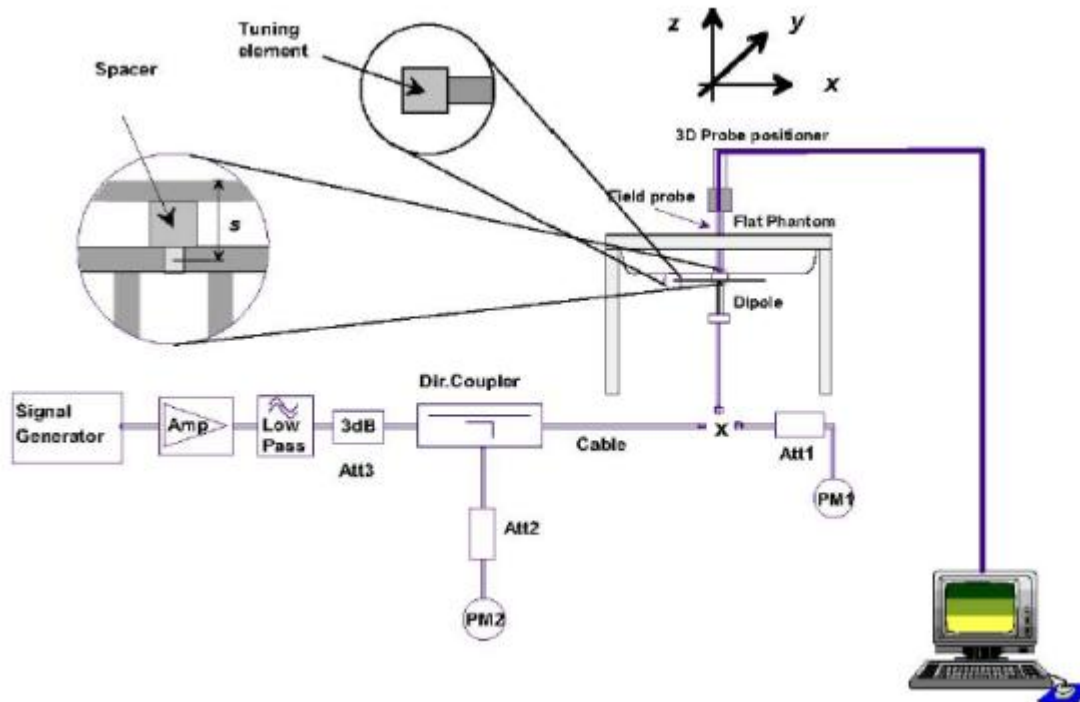


5. SAR System Validation

5.1 Validation System

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

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



5.2 Validation Result

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

Freq.(MHz)	Power(mW)	Tested Value (W/Kg)	Normalized SAR (W/kg)	Target(W/Kg)	Tolerance(%)	Date
2450 Body	100	5.340	53.40	55.65	-4.04	2017-11-22

Note: The tolerance limit of System validation $\pm 10\%$.



5.3 SAR system Validation

SAR probe and tissue dielectric parameters are as shown below.

Test Data	Probe S/N	Tested Freq (MHz)	Tissue Type	Cond.	Perm	CW validation			Mod. validation		
						Sensitivity	Probe Linearity	Probe Isotropy	Mod. Type	Duty Factor	Peak to average power ratio
2017-11-23	SN 14/16 EP309	2450	body	2.01	52.13	PASS	PASS	PASS	OFDM	PASS	PASS
2017-11-23	SN 14/16 EP309	2450	body	2.01	52.13	PASS	PASS	PASS	DSSS	PASS	PASS
2017-11-23	SN 14/16 EP309	2450	body	2.01	52.13	PASS	PASS	PASS	GFSK	PASS	PASS





6. SAR Evaluation Procedures

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

- 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 to 16 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 D01v01r01 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.

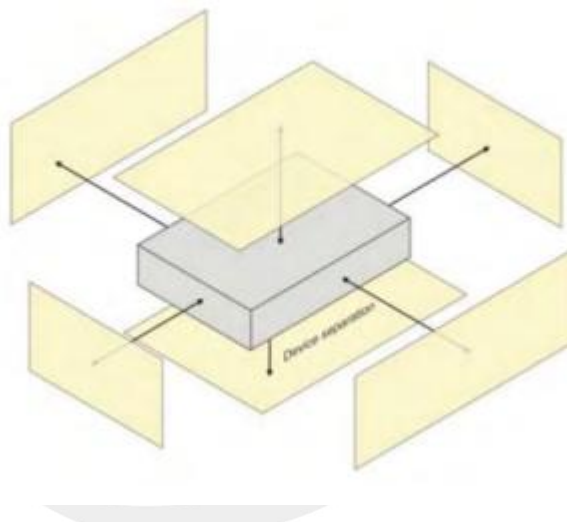
7. EUT Test Position

According to KDB 447498 D02, USB connector orientations on laptop computers, which is tested for SAR compliance in body-worn accessory and other use configurations described in the following subsections.

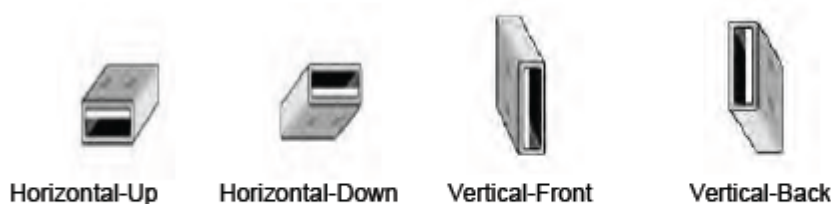
7.1 Hotspot mode exposure position condition

For handsets that support hotspot mode operations, with wireless router capabilities and various web browsing function, the relevant hand and body exposure condition are tested according to the hotspot SAR procedures in KDB 941225. A test separation distance of 10 mm is required between the phantom and all surface and edges with a transmitting antenna located within 25 mm from that surface or edge.

When form factor of a handset is smaller than 9cm x 5cm, a test separation distance of 5mm (instead of 10mm) is required for testing hotspot mode. When the separate distance required for body-worn accessory testing is larger than or equal to that tested for hotspot mode, in the same wireless mode and for the same surface of the phone, the hotspot mode SAR data may be used to support body-worn accessory SAR compliance for that particular configuration(surface).



7.2 USB connector Orientations Implemented on Laptop Computers



Note: These are USB connector orientations on laptop computers; USB dongles have the reverse configuration for plugging into the corresponding laptop computers.

7.3 Simple Dongle Test Procedures

Test all USB orientations [see figure below: (A) Horizontal-Up, (B) Horizontal-Down, (C) Vertical-Front, and (D) Vertical-Back] with a device-to-phantom separation distance of 5 mm or less, according to KDB Publication 447498 D01 requirements. These test orientations are intended for the exposure conditions found in typical laptop/notebook/netbook or tablet computers with either horizontal or vertical USB connector configurations at various locations in the keyboard section of the computer. Current generation portable host computers should be used to establish the required SAR measurement separation distance. The same test separation distance must be used to test all frequency

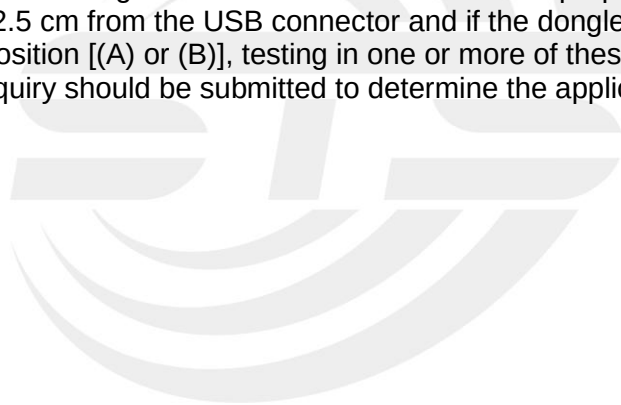


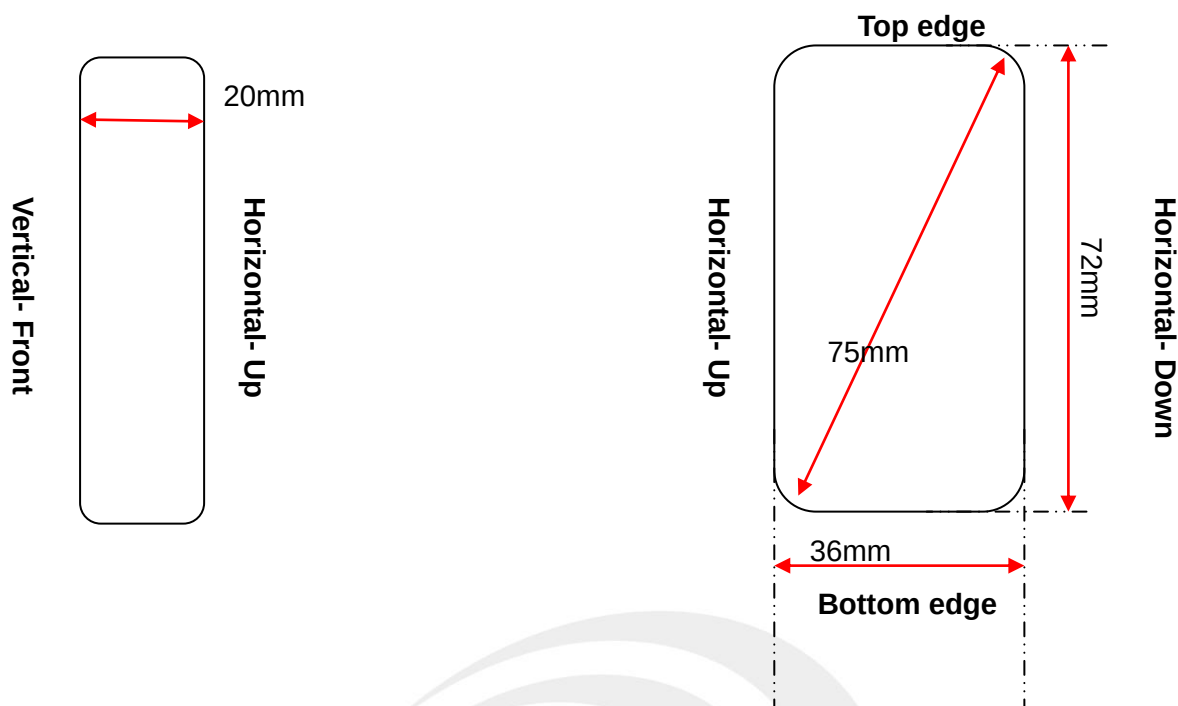
bands and modes in each USB orientation. The typical Horizontal-Up USB connection (A), found in the majority of host computers, must be tested using an appropriate host computer. A host computer with either Vertical-Front (C) or Vertical-Back (D) USB connection should be used to test one of the vertical USB orientations. If a suitable host computer is not available for testing the Horizontal-Down (B) or the remaining Vertical USB orientation, a high quality USB cable, 12 inches or less, may be used for testing these other orientations. It must be documented that the USB cable does not influence the radiating characteristics and output power of the transmitter.

7.4 Dongles with Swivel or Rotating Connectors

A swivel or rotating USB connector may enable the dongle to connect in different orientations to host computers. When the antenna is built-in within the housing of a dongle, a swivel or rotating connector may allow the antenna to assume different positions. The combination of these possible configurations must be considered to determine the SAR test requirements. When the antenna is located near the tip of a dongle, it may operate at closer proximity to users in certain connector orientations where dongle tip testing may be required.

The 5 mm test separation distance used for testing simple dongles has been established based on the overall host platform (laptop/notebook/netbook) and device variations, and varying user operating configurations and exposure conditions expected for a peripheral device. The same test distance should generally apply to dongles with swivel or rotating connectors. The procedures described for simple dongles should be used to position the four surfaces of the dongle at 5 mm from the phantom to evaluate SAR. At least one of the horizontal and one of the vertical positions should be tested using an applicable host computer. If the antenna is within 1 cm from the tip of the dongle (the end without the USB connector), the tip of the dongle should also be tested at 5 mm perpendicular to the phantom. For antennas located within 2.5 cm from the USB connector and if the dongle can be positioned at 45° to 90° from the horizontal position [(A) or (B)], testing in one or more of these configurations may need to be considered. A KDB inquiry should be submitted to determine the applicable test configurations.





7.5 SAR TEST EXCLUSION CONSIDER TABLE

According with FCC KDB 447498 D01, appendix A, <SAR test exclusion thresholds for 100MHz~6GHz and≤50mm>table, this device SAR test configurations consider as following:

Band	Test position configurations				
	Vertical- Front	Vertical- Back	Horizontal- Up	Horizontal- Down	Top edge
	<5mm	<5mm	<5mm	<5mm	<5mm
BT	Yes	Yes	Yes	Yes	Yes



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 $k=2$.

NO	Source	Tol(%)	Prob. Dist.	Div. k	ci (1g)	ci (10g)	1gUi	10gUi	Veff
Measurement System									
1	Probe calibration	5.8	N	1	1	1	5.8	5.8	∞
2	Axial isotropy	3.5	R	√3	$\frac{(1-cp)1}{2}$	$\frac{(1-cp)1}{2}$	1.43	1.43	∞
3	Hemispherical isotropy	5.9	R	√3	√Cp	√Cp	2.41	2.41	∞
4	Boundary effect	1.0	R	√3	1	1	0.58	0.58	∞
5	Linearity	4.7	R	√3	1	1	2.71	2.71	∞
6	System Detection limits	1.0	R	√3	1	1	0.58	0.58	∞
7	Readout electronics	0.5	N	1	1	1	0.50	0.50	∞
8	Response time	0	R	√3	1	1	0	0	∞
9	Integration time	1.4	R	√3	1	1	0.81	0.81	∞
10	Ambient noise	3.0	R	√3	1	1	1.73	1.73	∞
11	Ambient reflections	3.0	R	√3	1	1	1.73	1.73	∞
12	Probe positioner mech. restrictions	1.4	R	√3	1	1	0.81	0.81	∞
13	Probe positioning with respect to phantom shell	1.4	R	√3	1	1	0.81	0.81	∞
14	Max.SAR evaluation	1.0	R	√3	1	1	0.6	0.6	∞
Test sample related									
15	Device positioning	2.6	N	1	1	1	2.6	2.6	11
16	Device holder	3	N	1	1	1	3.0	3.0	7
17	Drift of output power	5.0	R	√3	1	1	2.89	2.89	∞
Phantom and set-up									
18	Phantom uncertainty	4.0	R	√3	1	1	2.31	2.31	∞
19	Liquid conductivity (target)	2.5	N	1	0.78	0.71	1.95	1.78	5
20	Liquid conductivity (meas)	4	N	1	0.23	0.26	0.92	1.04	5
21	Liquid Permittivity (target)	2.5	N	1	0.78	0.71	1.95	1.78	∞
22	Liquid Permittivity (meas)	5.0	N	1	0.23	0.26	1.15	1.30	∞
Combined standard			RSS	$U_c = \sqrt{\sum_{i=1}^n C_i^2 U_i^2}$			10.63%	10.54%	
Expanded uncertainty (P=95%)		$U = k U_c, k=2$					21.26%	21.08%	



8.2 System validation Uncertainty

NO	Source	Tol(%)	Prob. Dist.	Div. k	ci (1g)	ci (10g)	1gUi	10gUi	Veff
Measurement System□									
1	Probe calibration	5.8	N	1	1	1	5.8	5.8	∞
2	Axial isotropy	3.5	R	√3	$\frac{(1-cp)1}{2}$	$\frac{(1-cp)1}{2}$	1.43	1.43	∞
3	Hemispherical isotropy	5.9	R	√3	√Cp	√Cp	2.41	2.41	∞
4	Boundary effect	1.0	R	√3	1	1	0.58	0.58	∞
5	Linearity	4.7	R	√3	1	1	2.71	2.71	∞
6	System Detection limits	1.0	R	√3	1	1	0.58	0.58	∞
7	Modulation response	0	N	1	1	1	0	0	∞
8	Readout electronics	0.5	N	1	1	1	0.50	0.50	∞
9	Response time	0	R	√3	1	1	0	0	∞
10	Integration time	1.4	R	√3	1	1	0.81	0.81	∞
11	Ambient noise	3.0	R	√3	1	1	1.73	1.73	∞
12	Ambient reflections	3.0	R	√3	1	1	1.73	1.73	∞
13	Probe positioner mech. restrictions	1.4	R	√3	1	1	0.81	0.81	∞
14	Probe positioning with respect to phantom shell	1.4	R	√3	1	1	0.81	0.81	∞
15	Max.SAR evaluation	1.0	R	√3	1	1	0.6	0.6	∞
Dipole									
16	Deviation of experimental source from	4	N	1	1	1	4.00	4.00	∞
17	Input power and SAR drift mea.	5	R	√3	1	1	2.89	2.89	∞
18	Dipole Axis to liquid Distance	2	R	√3	1	1			∞
Phantom and set-up									
19	Phantom uncertainty	4.0	R	√3	1	1	2.31	2.31	∞
20	Uncertainty in SAR correction for deviation(in	2.0	N	1	1	0.84	2	1.68	∞
21	Liquid conductivity (target)	2	N	1	1	0.84	2.00	1.68	∞
22	Liquid conductivity (temperature uncertainty)	2.5	N	1	0.78	0.71	1.95	1.78	5
23	Liquid conductivity (meas)	4	N	1	0.23	0.26	0.92	1.04	5
24	Liquid Permittivity (target)	2.5	N	1	0.78	0.71	1.95	1.78	∞
25	Liquid Permittivity (temperature uncertainty)	2.5	N	1	0.78	0.71	1.95	1.78	5
26	Liquid Permittivity (meas)	5.0	N	1	0.23	0.26	1.15	1.30	∞
Combined standard			RSS	$U_c = \sqrt{\sum_{i=1}^n C_i^2 U_i^2}$			10.15%	10.05%	
Expanded uncertainty (P=95%)		$U = k U_{c,k=2}$					20.29%	20.10%	



9. Conducted Power Measurement

9.1 Test Result

Bluetooth

Mode	Channel Number	Frequency (MHz)	Average Power (dBm)
GFSK(1Mbps)	0	2402	15.31
	39	2441	15.33
	78	2480	15.39
$\pi/4$ -DQPSK(2Mbps)	0	2402	14.72
	39	2441	15.24
	78	2480	15.38
8DPSK(3Mbps)	0	2402	15.31
	39	2441	14.76
	78	2480	15.39

BLE

Mode	Channel Number	Frequency (MHz)	Average Power (dBm)
GFSK(1Mbps)	0	2402	17.35
	19	2440	17.20
	39	2480	17.15

9.2 Tune-up Power

Mode	BT(AVG)
GFSK	15±1dBm
$\pi/4$ -DQPSK	15±1dBm
8DPSK	15±1dBm

Mode	BT(AVG)
GFSK	17±1dBm



9.3 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:

$[(\text{max. power of channel, including tune-up tolerance, mW})/(\text{min. test separation distance, mm})] \cdot [\sqrt{f(\text{GHz})}] \leq 3.0$ for 1-g SAR and ≤ 7.5 for 10-g extremity SAR, where:

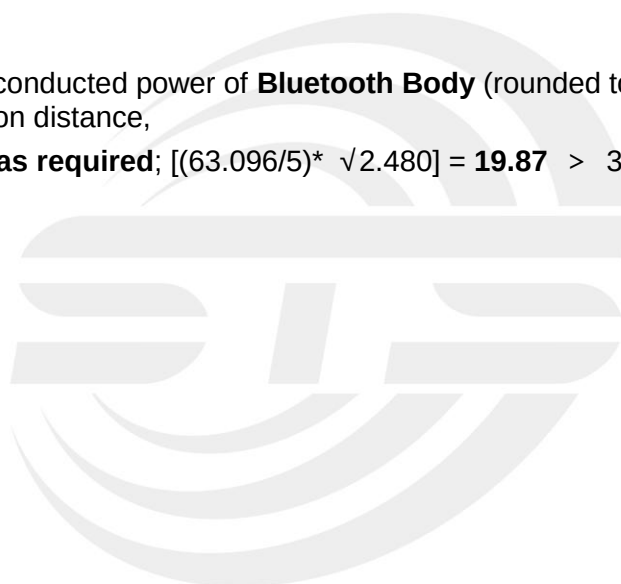
- $f(\text{GHz})$ is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- The result is rounded to one decimal place for comparison

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

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

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

Bluetooth Body SAR was required; $[(63.096/5) * \sqrt{2.480}] = 19.87 > 3.0$.



10. EUT And Test Setup Photo

10.1 EUT Photo

Antenna



Front side



Back side



Top side



Bottom side



Left side

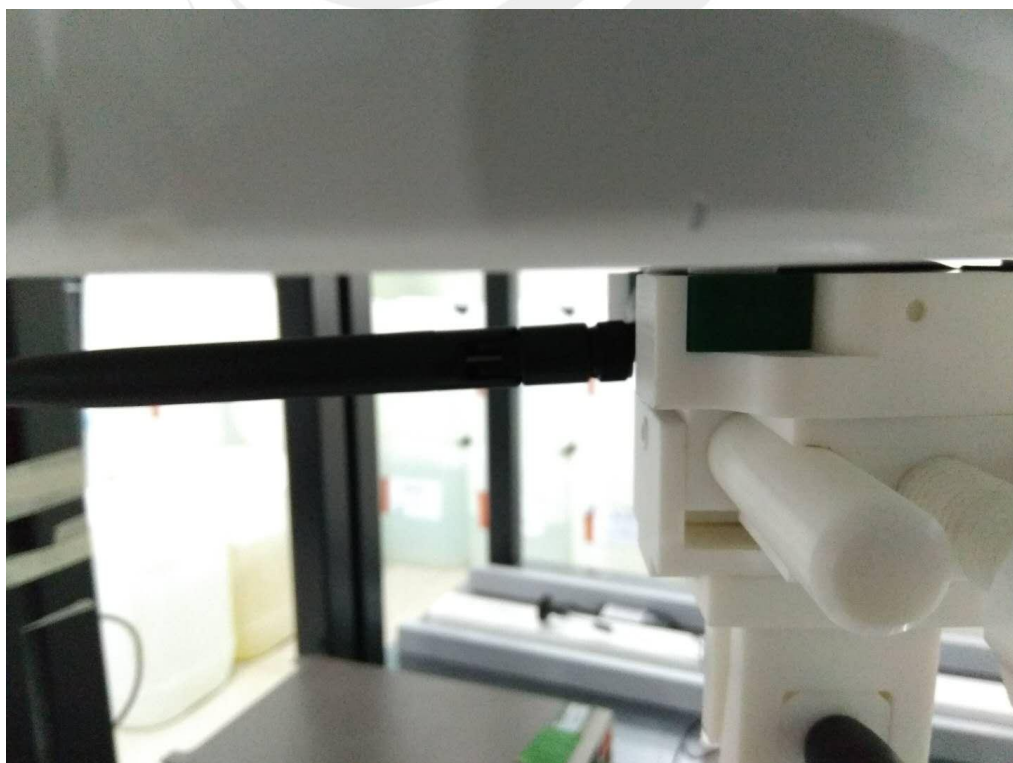


Right side

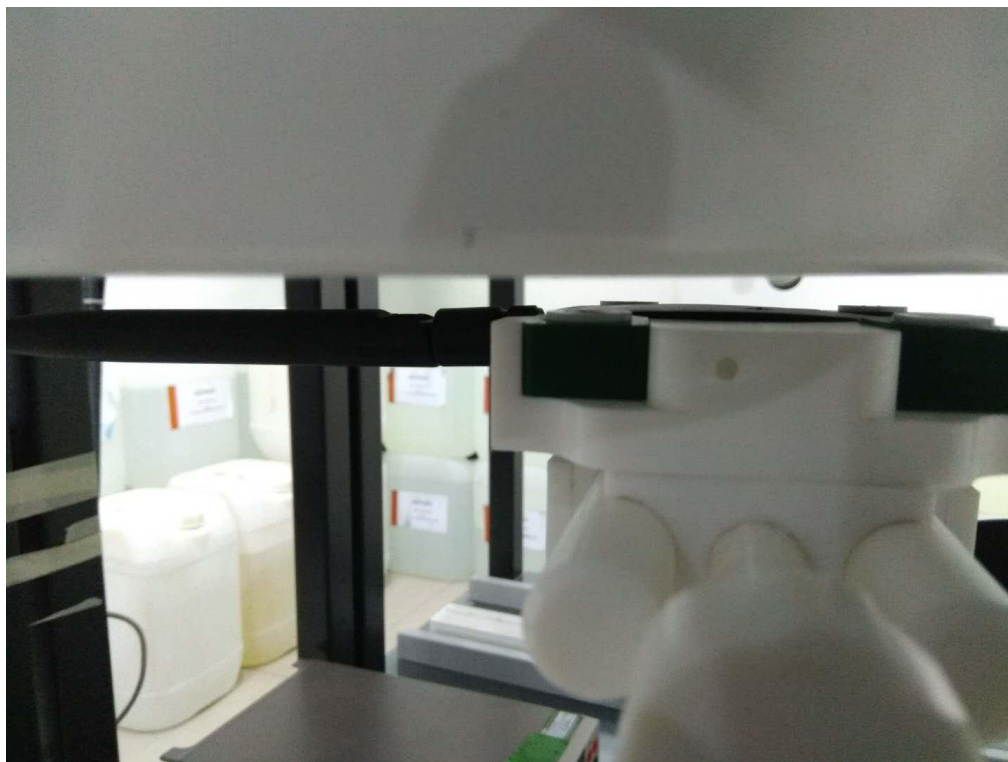


10.2 Setup Photo

.Horizontal- Up side (separation distance is 5mm)



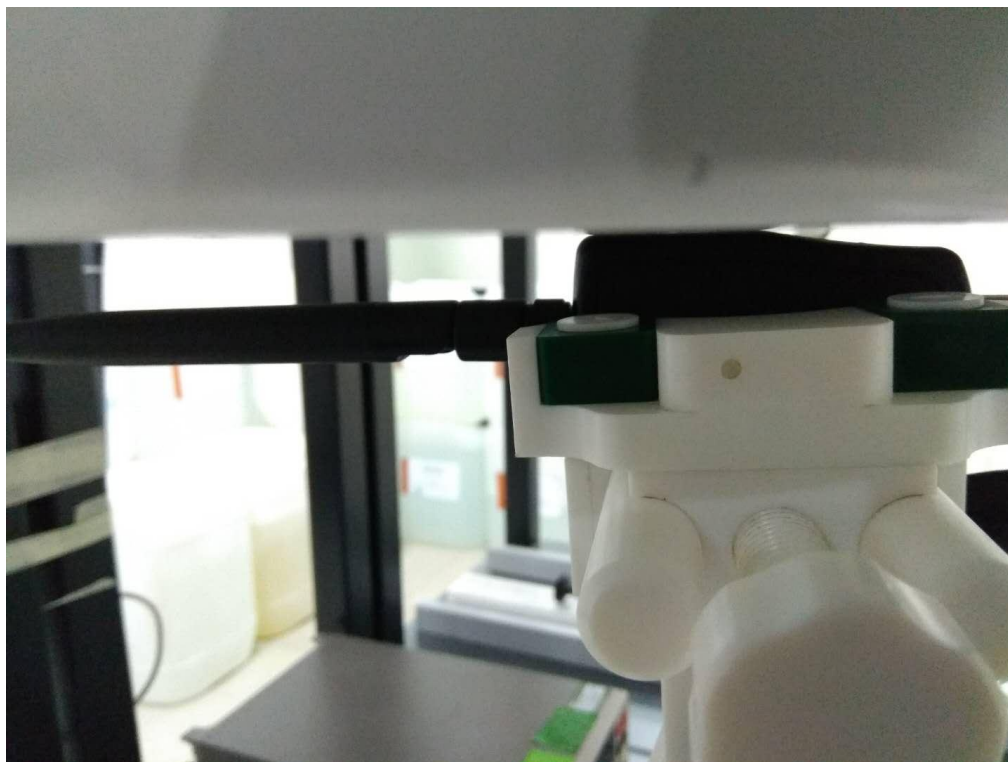
Horizontal- Down side (separation distance is 5mm)



Vertical-Front side (separation distance is 5mm)



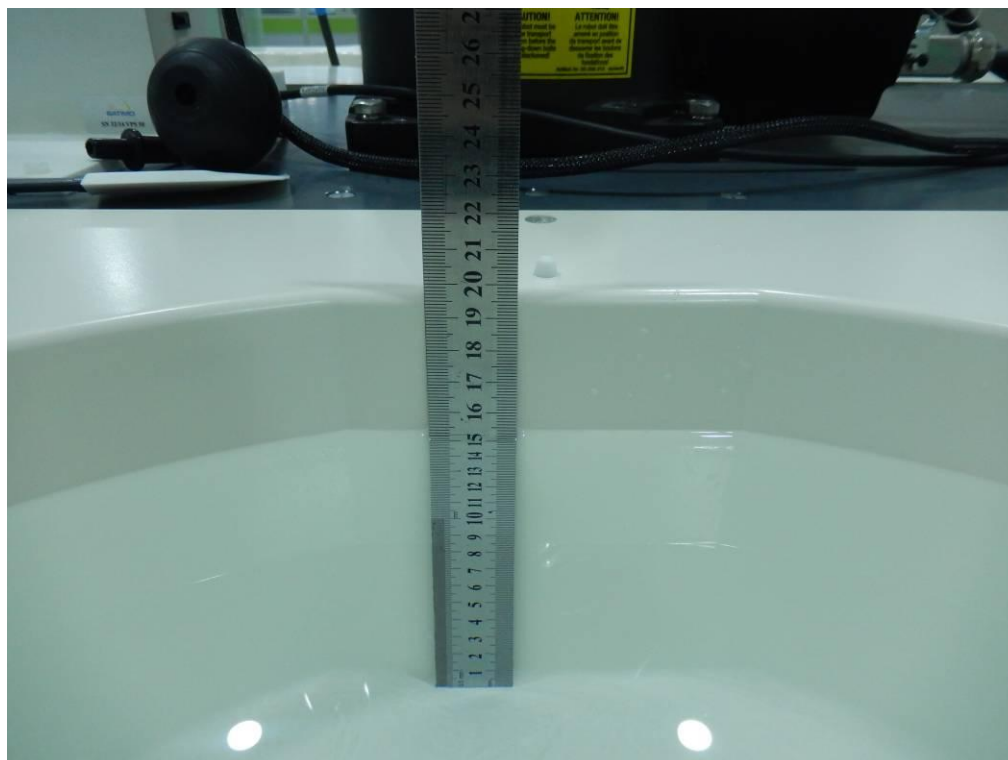
Vertical-Back side (separation distance is 5mm)



Bend 90° (separation distance is 5mm)



Liquid depth (15 cm)





11. SAR Result Summary

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.
Bluetooth	GFSK	Horizontal- Up	0	0.608	3.88	18	17.35	0.706	1
		Horizontal-Down	0	0.364	-3.89	18	17.35	0.423	2
		Vertical-Front	0	0.283	-3.55	18	17.35	0.329	3
		Vertical-Back	0	0.356	0.73	18	17.35	0.413	4
		Bend 90	0	0.323	2.91	18	17.35	0.375	5

Note:

1. The test separation of all above table is 5mm.
2. Per KDB 447498 D01v05r01, 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
3. Per KDB865664 D01, Repeated measurement is not required when the original highest measured SAR is <0.80 W/kg



12. Equipment List

Kind of Equipment	Manufacturer	Type No.	Serial No.	Last Calibration	Calibrated Until
2450MHzDipole	SATIMO	SID2450	SN 30/14 DIP2G450-335	2017.08.15	2020.08.14
E-Field Probe	MVG	SSE5	SN 14/16 EP309	2016.12.05	2017.12.04
Dielectric Probe Kit	MVG	SCLMP	SN 32/14 OCPG67	2016.12.05	2017.12.04
Antenna	MVG	ANTA3	SN 07/13 ZNTA52	N/A	N/A
Phantom1	MVG	SAM	SN 32/14 SAM115	2014.09.01	N/A
Phantom2	MVG	SAM	SN 32/14 SAM116	2014.09.01	N/A
Phone holder	MVG	N/A	SN 32/14 MSH97	2014.09.01	N/A
Laptop holder	MVG	N/A	SN 32/14 LSH29	2014.09.01	N/A
Network Analyzer	Agilent	8753ES	US38432810	2017.03.16	2018.03.15
Multi Meter	Keithley	Multi Meter 2000	4050073	2017.10.15	2018.10.14
Signal Generator	Agilent	N5182A	MY50140530	2017.10.15	2018.10.14
Wireless Communication Test Set	Agilent	8960-E5515C	MY48360751	2017.10.15	2018.10.14
Power Amplifier	DESAY	ZHL-42W	9638	2017.10.15	2018.10.14
Power Meter	R&S	NRP	100510	2017.10.15	2018.10.14
Power Meter	Agilent	E4418B	GB43312526	2017.10.15	2018.10.14
Power Sensor	R&S	NRP-Z11	101919	2017.10.15	2018.10.14
Power Sensor	Agilent	E9301A	MY41497725	2017.10.15	2018.10.14
9dB Attenuator	Agilent	99899	DC-18GHz	2017.05.10	2018.05.09
11dB Attenuator	Agilent	8494B	DC-18GHz	2017.05.10	2018.05.09
110dB Attenuator	Agilent	8494B	DC-18GHz	2017.05.10	2018.05.09
Dual Directional Coupler	Agilent	SHWPD1- 1080S	N/A	2017.05.09	2018.05.08
Temperature & Humidity	MiEO	HH660	N/A	2017.10.18	2018.10.17



Appendix A. System Validation Plots

System Performance Check Data (2450MHz Body)

Type: Phone measurement (Complete)

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

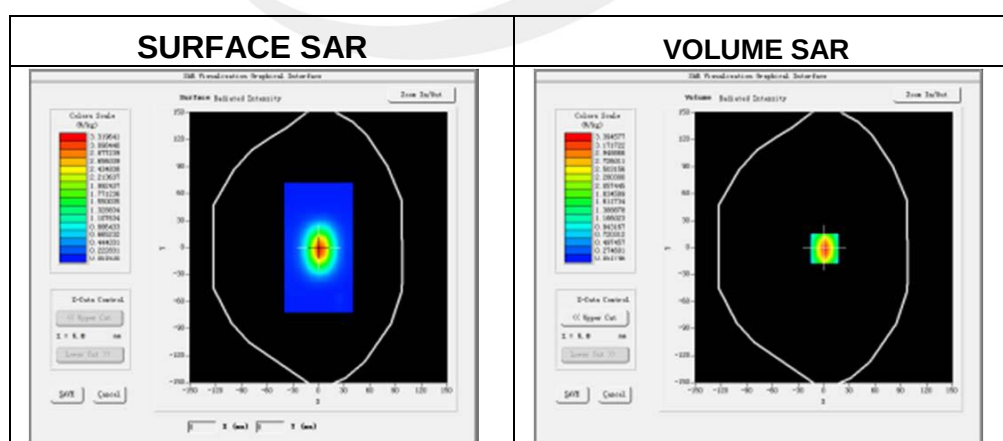
Zoom scan resolution: dx=8mm, dy=8mm, dz=5mm

Date of measurement: 2017-11-22

Measurement duration: 14 minutes 23 seconds

Experimental conditions.

Device Position	Validation plane
Band	2450 MHz
Channels	-
Signal	CW
Frequency (MHz)	2450
Relative permittivity	52.13
Conductivity (S/m)	2.01
Power drift (%)	-0.07
Probe	SN 14/16 EP309
ConvF	5.24
Crest factor:	1:1

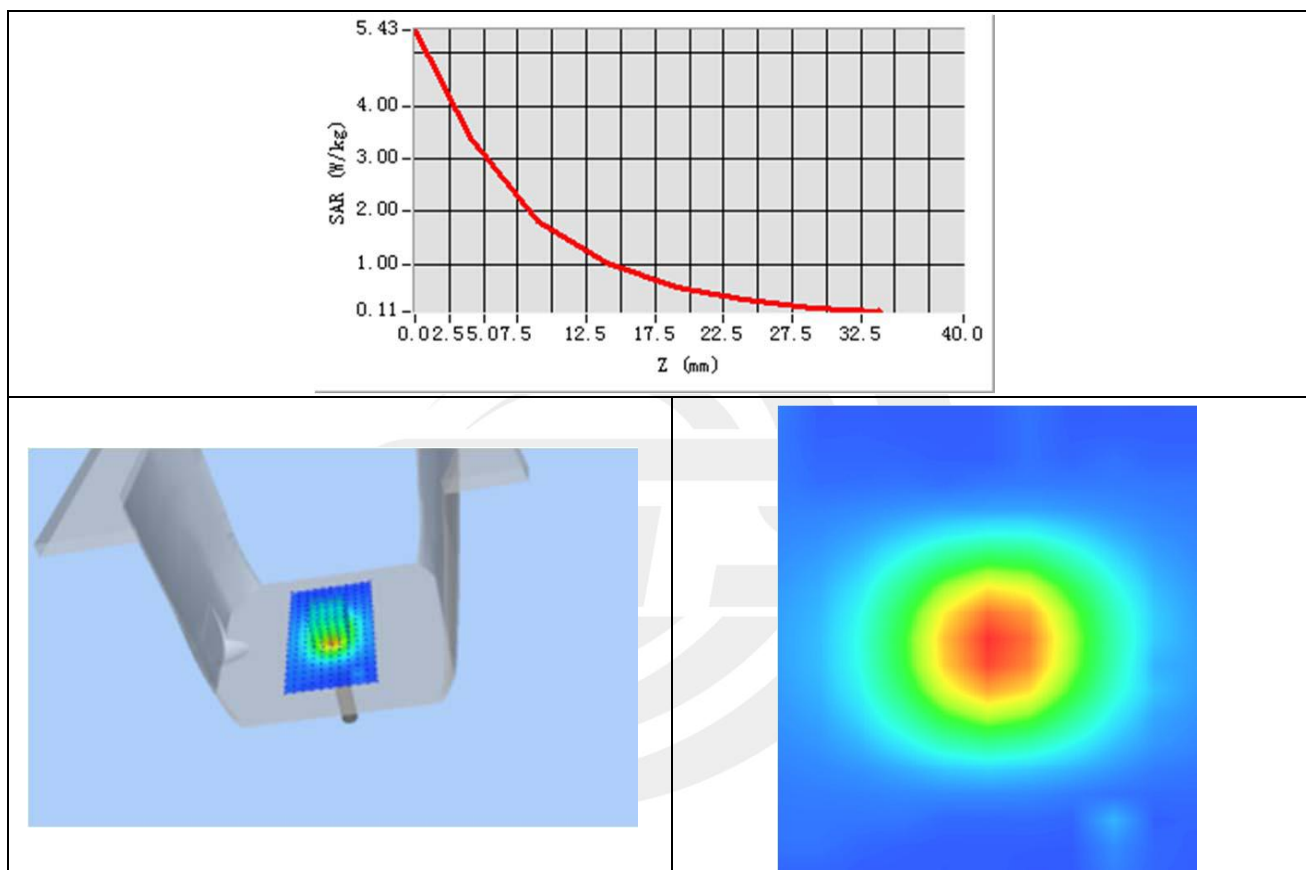




Maximum location: X=3.00, Y=1.00

SAR 10g (W/Kg)	2.353118
SAR 1g (W/Kg)	5.339947

Z Axis Scan



Appendix B. SAR Test Plots

Plot 1: DUT: Long Range Bluetooth Transceiver; EUT Model: FSC-BP109

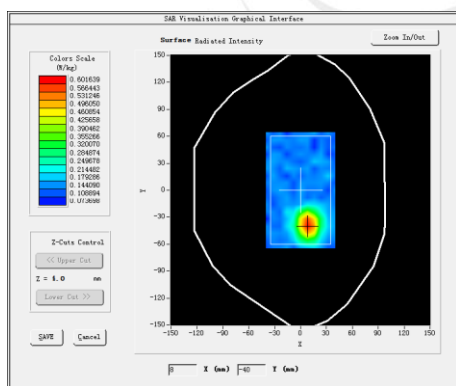
Test Date	2017-11-22
Probe	SN 14/16 EP309
ConvF	5.24
Area Scan	dx=8mm dy=8mm, h= 5.00 mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm, Complete/ndx=8mm dy=8mm, h= 5.00 mm
Phantom	Validation plane
Device Position	Horizontal- Up side
Band	Bluetooth
Channels	Low
Signal	Bluetooth (Crest factor: 1.0)
Frequency (MHz)	2402
Relative permittivity (real part)	52.70
Conductivity (S/m)	1.95
Variation (%)	3.88

Maximum location: X=9.00, Y=-39.00

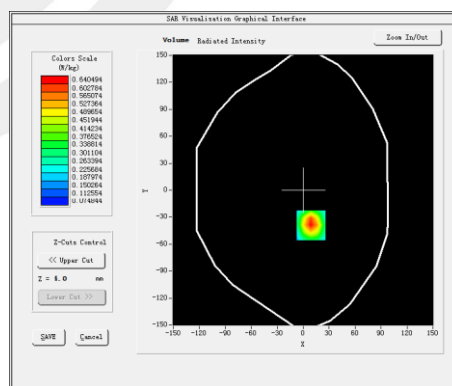
SAR Peak: 1.04 W/kg

SAR 10g (W/Kg)	0.334365
SAR 1g (W/Kg)	0.607796

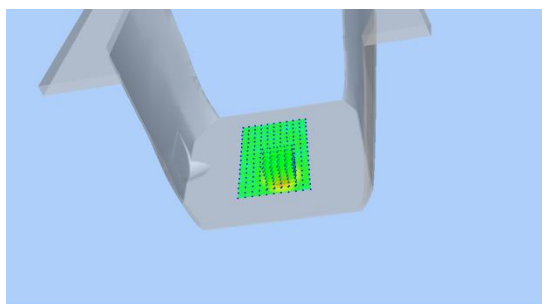
SURFACE SAR



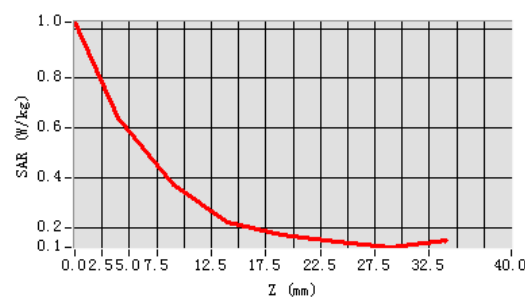
VOLUME SAR



3D screen shot



Z Axis Scan



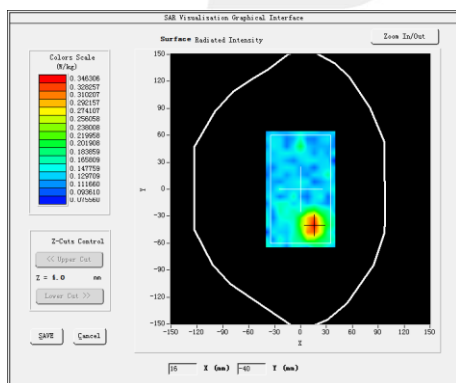
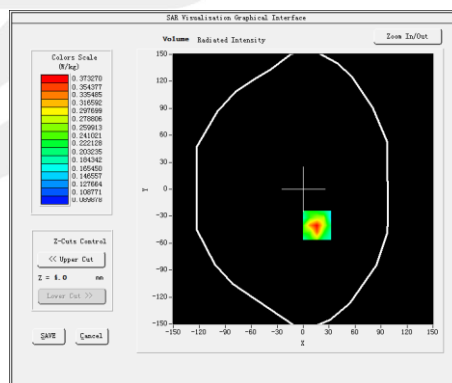
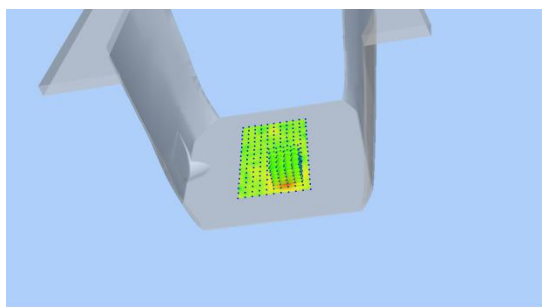
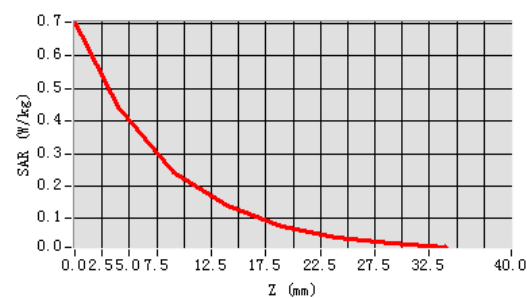
Plot 2: DUT: Long Range Bluetooth Transceiver; EUT Model: FSC-BP109

Test Date	2017-11-22
Probe	SN 14/16 EP309
ConvF	5.24
Area Scan	dx=8mm dy=8mm, h= 5.00 mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm, Complete/ndx=8mm dy=8mm, h= 5.00 mm
Phantom	Validation plane
Device Position	Horizontal- Down side
Band	Bluetooth
Channels	Low
Signal	Bluetooth (Crest factor: 1.0)
Frequency (MHz)	2402
Relative permittivity (real part)	52.70
Conductivity (S/m)	1.95
Variation (%)	-3.89

Maximum location: X=16.00, Y=-40.00

SAR Peak: 0.68 W/kg

SAR 10g (W/Kg)	0.224742
SAR 1g (W/Kg)	0.364343

SURFACE SAR

VOLUME SAR

3D screen shot

Z Axis Scan


Plot 3: DUT: Long Range Bluetooth Transceiver; EUT Model: FSC-BP109

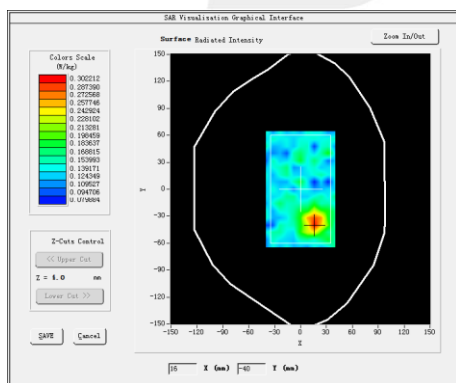
Test Date	2017-11-22
Probe	SN 14/16 EP309
ConvF	5.24
Area Scan	dx=8mm dy=8mm, h= 5.00 mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm, Complete/ndx=8mm dy=8mm, h= 5.00 mm
Phantom	Validation plane
Device Position	Vertical- Front
Band	Bluetooth
Channels	Low
Signal	Bluetooth (Crest factor: 1.0)
Frequency (MHz)	2402
Relative permittivity (real part)	52.70
Conductivity (S/m)	1.95
Variation (%)	-3.55

Maximum location: X=17.00, Y=-39.00

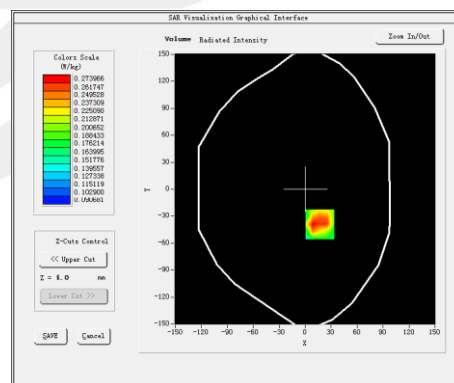
SAR Peak: 0.49 W/kg

SAR 10g (W/Kg)	0.194561
SAR 1g (W/Kg)	0.282986

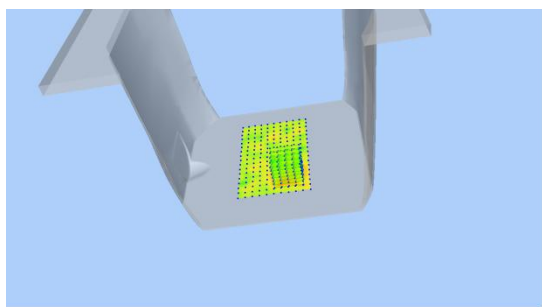
SURFACE SAR



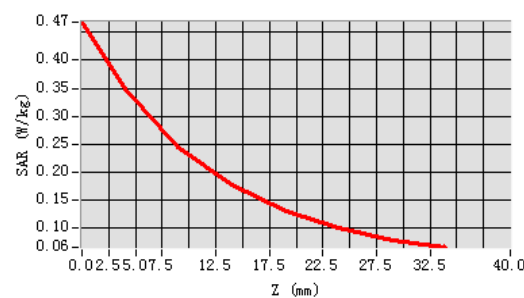
VOLUME SAR



3D screen shot



Z Axis Scan



Plot 4: DUT: Long Range Bluetooth Transceiver; EUT Model: FSC-BP109

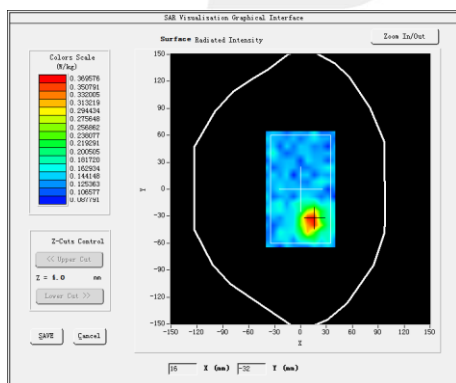
Test Date	2017-11-22
Probe	SN 14/16 EP309
ConvF	5.24
Area Scan	dx=8mm dy=8mm, h= 5.00 mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm, Complete/ndx=8mm dy=8mm, h= 5.00 mm
Phantom	Validation plane
Device Position	Vertical- Back
Band	Bluetooth
Channels	Low
Signal	Bluetooth (Crest factor: 1.0)
Frequency (MHz)	2402
Relative permittivity (real part)	52.70
Conductivity (S/m)	1.95
Variation (%)	0.73

Maximum location: X=13.00, Y=-33.00

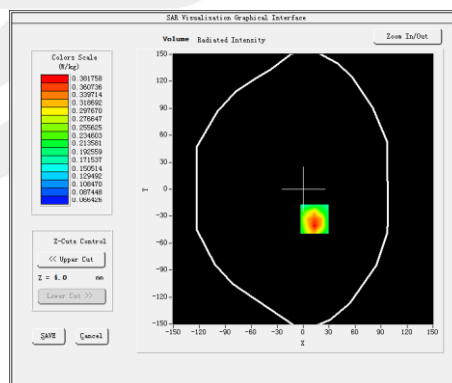
SAR Peak: 0.57 W/kg

SAR 10g (W/Kg)	0.225682
SAR 1g (W/Kg)	0.355698

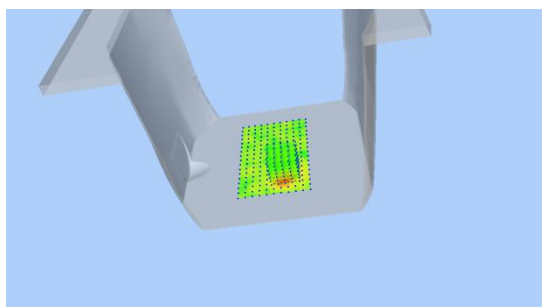
SURFACE SAR



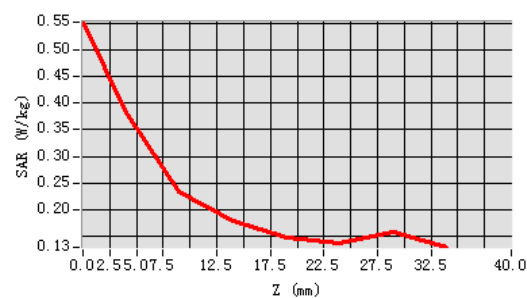
VOLUME SAR



3D screen shot



Z Axis Scan



Plot 5: DUT: Long Range Bluetooth Transceiver; EUT Model: FSC-BP109

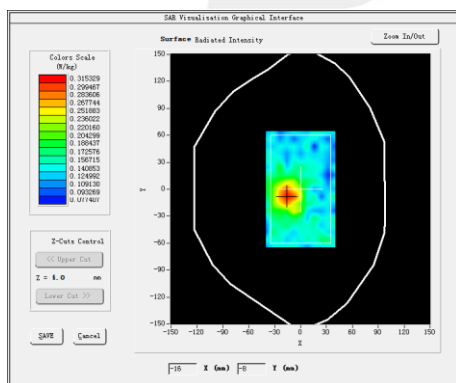
Test Date	2017-11-22
Probe	SN 14/16 EP309
ConvF	5.24
Area Scan	dx=8mm dy=8mm, h= 5.00 mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm, Complete/ndx=8mm dy=8mm, h= 5.00 mm
Phantom	Validation plane
Device Position	Bend 90°
Band	Bluetooth
Channels	Low
Signal	Bluetooth (Crest factor: 1.0)
Frequency (MHz)	2402
Relative permittivity (real part)	52.70
Conductivity (S/m)	1.95
Variation (%)	2.91

Maximum location: X=-14.00, Y=-7.00

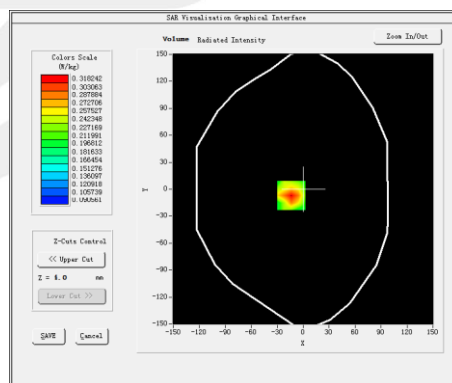
SAR Peak: 0.55 W/kg

SAR 10g (W/Kg)	0.214246
SAR 1g (W/Kg)	0.323171

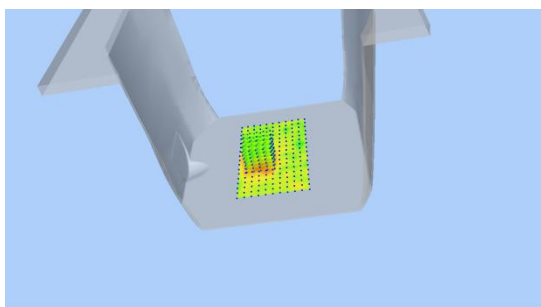
SURFACE SAR



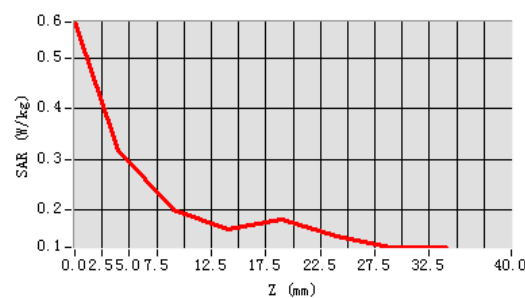
VOLUME SAR



3D screen shot



Z Axis Scan





Appendix C. Probe Calibration And Dipole Calibration Report

Refer the appendix Calibration Report.

※※※※※END OF THE REPORT※※※※※

