FCC SAR TEST REPORT

ISSUED BY
Shenzhen BALUN Technology Co., Ltd.

FOR

Wireless USB Adapter

ISSUED TO
Shenzhen Ogemray Technology Co., Ltd.

3/F~4/F, NO.5 Bldg, Dongwu Industrial Park, Donghuan 1st Road, Longhua Town, Shenzhen, China.

Tested by: Tu Lang
Tu Lang
(Engineer)
Date Sep. 25, 2015

Approved by:
Wei Yanquan
(Chief Engineer)
Date Sep. 25, 2015

Report No.:	BL-SZ1590076-701
EUT Type:	Wireless USB Adapter
Model Name:	GWF-5B06
Brand Name:	N/A
FCC ID:	YWTWF7610U5B
Test Standard:	FCC 47 CFR Part .1093 ANSI C95.1: 1992 IEEE 1528: 2013
Maximum SAR:	Body (1 g): 0.416 W/kg
Test Conclusion:	Pass
Test Date:	Sep. 20, 2015 ~ Sep. 21, 2015
Date of Issue:	Sep. 25, 2015

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Revision History

Version	Issue Date	Revisions
Rev. 01	Sep. 25, 2015	Initial Issue

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1 GENERAL INFORMATION

1.1 Identification of the Testing Laboratory

Company Name	Shenzhen BALUN Technology Co., Ltd.
Address	Block B, 1st FL, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China.
Phone Number	+86 755 6685 0100
Fax Number	+86 755 6182 4271

1.2 Identification of the Responsible Testing Location

Test Location	Shenzhen BALUN Technology Co., Ltd.
Address	Block B, 1st FL, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China.
Accreditation Certificate	The laboratory has been listed by Industry Canada to perform electromagnetic emission measurements. The recognition numbers of test site are 11524A-1. The laboratory has been listed by US Federal Communications Commission to perform electromagnetic emission measurements. The recognition numbers of test site are 832625. The laboratory has met the requirements of the IAS Accreditation Criteria for Testing Laboratories (AC89), has demonstrated compliance with ISO/IEC Standard 17025:2005. The accreditation certificate number is TL-588. The laboratory is a testing organization accredited by China National Accreditation Service for Conformity Assessment (CNAS) according to ISO/IEC 17025. The accreditation certificate number is L6791.
Description	All measurement facilities used to collect the measurement data are located at Block B, FL 1, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China 518055

1.3 Test Environment Condition

Ambient Temperature	20 to 23 ℃
Ambient Relative Humidity	35 to 50 %
Ambient Pressure	100 to 102 kPa

1.4 Announce

(1) The test report reference to the report template version v1.1.

(2) The test report is invalid if not marked with the signatures of the persons responsible for preparing and approving the test report.

(3) The test report is invalid if there is any evidence and/or falsification.

(4) The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein.

(5) This document may not be altered or revised in any way unless done so by BALUN and all revisions are duly noted in the revisions section.

(6) Content of the test report, in part or in full, cannot be used for publicity and/or promotional purposes without prior written approval from the laboratory.

2 PRODUCT INFORMATION

2.1 Applicant

Applicant	Shenzhen Ogemray Technology Co., Ltd.
Address	3/F~4/F, NO.5 Bldg, Dongwu Industrial Park, Donghuan 1st Road, Longhua Town, Shenzhen, China.

2.2 Manufacturer

Manufacturer	Shenzhen Ogemray Technology Co., Ltd.
Address	3/F~4/F, NO.5 Bldg, Dongwu Industrial Park, Donghuan 1st Road, Longhua Town, Shenzhen, China.

2.3 General Description for Equipment under Test (EUT)

EUT Type	Wireless USB Adapter
EUT Model Name	GWF-5B06
Hardware Version	N/A
Software Version	N/A
Dimensions	65.75 mm×22.8 mm×8.5 mm
Weight	3.4 g
Network and Wireless connectivity	WLAN

2.4 Technical Information

The requirement for the following technical information of the EUT was tested in this report:

Operating Mode	2.4G WLAN; 5G WLAN	
Frequency Range	802.11b/g	2400~2483.5 MHz
	802.11n (HT20/HT40)	2400~2483.5 MHz
	802.11a	5150 MHz~ 5250 MHz
		5725 MHz~ 5850 MHz
	802.11n (HT20/HT40)	5150 MHz~ 5250 MHz
		5725 MHz~ 5850 MHz
	802.11ac (HT20/HT40/ HT80)	5150 MHz~ 5250 MHz
		5725 MHz~ 5850 MHz
Antenna Type	WLAN: PCB antenna	
Exposure Category	General Population/Uncontrolled exposure	
Environment	Uncontrolled	
EUT Stage	Portable Device; Production Unit	
EUT Stage	Portable Device	
Product	Type	

	☒ Production unit	☐ Identical prototype

3 SUMMARY OF TEST RESULTS

3.1 Test Standards

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 v05r02	Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies
5	FCC KDB 447498 D02 v02	SAR Measurement Procedures for USB Dongle Transmitters
6	FCC KDB 248227 D01 v02r01	SAR GUIDANCE FOR IEEE 802.11 (Wi-Fi) Transmitters
7	FCC KDB 865664 D01 v01r04	SAR Measurement 100 MHz to 6 GHz
8	FCC KDB 865664 D02 v01r01	RF Exposure Reporting

3.2 Device Category and SAR Limit

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

Table of Exposure Limits:

Body Position	SAR Value (W/Kg)	
	General Population/ Uncontrolled Exposure	Occupational/ Controlled Exposure
Whole-Body SAR (averaged over the entire body)	0.08	0.4
Partial-Body SAR (averaged over any 1 gram of tissue)	1.60	8.0
SAR for hands, wrists, feet and ankles (averaged over any 10 grams of tissue)	4.0	20.0

NOTE:

General Population/Uncontrolled: Locations where there is the exposure of individuals who have no knowledge or control of their exposure. General population/uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity.

Occupational/Controlled: Locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. This exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means.

3.3 Test Result Summary

3.3.1 Highest SAR (1 g Value)

Frequency Band		Maximum Measurement SAR (W/kg)	Maximum Report SAR (W/kg)
2.4G WIFI	WLAN 802.11b	0.229	0.232
	WLAN 802.11g	0.208	0.210
	WLAN802.11n(HT-20)	0.214	0.217
5G WIFI	WLAN 802.11a	0.397	0.406
	WLAN 802.11ac(HT-20)	0.396	0.416
	WLAN 802.11ac(HT-40)	0.154	0.156
	WLAN 802.11ac(HT-80)	0.109	0.111
	WLAN 802.11n(HT-20)	0.143	0.145
	WLAN 802.11n(HT-40)	0.093	0.095
Test Verdict		Pass	

3.4 Test Uncertainty

3.4.1 Measurement uncertainly evaluation for SAR test

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. The system measurement uncertainty frequency range is from 300 MHz to 3 GHz.

Uncertainty Component	Tol (+- %)	Prob. Dist.	Div.	Ci (1g)	Ci (10g)	1g Ui (+-%)	10g Ui (+-%)	Vi
Measurement System								
Probe calibration	5.8	N	1	1	1	5.80	5.80	∞
Axial Isotropy	3.5	R	$\sqrt{3}$	0.7	0.7	1.41	1.41	∞
Hemispherical Isotropy	5.9	R	$\sqrt{3}$	0.7	0.7	2.38	2.38	∞
Boundary effect	1.0	R	$\sqrt{3}$	1	1	0.58	0.58	∞
Linearity	4.7	R	$\sqrt{3}$	1	1	2.71	2.71	∞
System detection limits	1.0	R	$\sqrt{3}$	1	1	0.58	0.58	∞
Readout Electronics	0.5	N	1	1	1	0.50	0.50	∞
Reponse Time	0.0	R	$\sqrt{3}$	1	1	0.00	0.00	∞
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	∞
Extrapolation, interpolation and integration Algoritms for Max. SAR Evaluation	2.3	R	$\sqrt{3}$	1	1	1.33	1.33	∞
Test sample Related								
Test sample positioning	2.6	N	1	1	1	2.60	2.60	N−1
Device Holder Uncertainty	1.0	N	1	1	1	1.00	1.00	N−1
Output power Variation - SAR drift measurement	5.0	R	$\sqrt{3}$	1	1	2.89	2.89	∞
SAR scaling	2.00	R	$\sqrt{3}$	1	1	1.15	1.15	∞
Phantom and Tissue Parameters								
Phantom Uncertainty (Shape and thickness tolerances)	4.0	R	$\sqrt{3}$	1	1	2.31	2.31	∞
Liquid conductivity (deviation from target values)	2.5	N	$\sqrt{3}$	0.64	0.43	0.92	0.62	∞
Liquid conductivity - measurement uncertainty	5.0	N	1	0.64	0.43	3.20	2.15	M
Liquid permittivity (deviation from target values)	2.5	N	$\sqrt{3}$	0.60	0.49	0.87	0.71	∞
Liquid permittivity - measurement uncertainty	5.0	N	1	0.60	0.49	3.00	2.45	M
Combined Standard Uncertainty		RSS				10.14	9.67	
Expanded Uncertainty (95% Confidence interval)		k				20.29	19.35	

3.4.2 Measurement uncertainly evaluation for system check

This measurement uncertainty budget is suggested by IEEE P1528 and determined by Schmid & Partner Engineering AG. The break down of the individual uncertainties is as follows:

Uncertainty Component	Tol (+- %)	Prob. Dist.	Div.	Ci (1g)	Ci (10g)	1g Ui (+-%)	10g Ui (+-%)	Vi
Measurement System								
Probe calibration	5.8	N	1	1	1	5.80	5.80	∞
Axial Isotropy	3.5	R	$\sqrt{3}$	0.7	0.7	1.41	1.41	∞
Hemispherical Isotropy	5.9	R	$\sqrt{3}$	0.7	0.7	2.38	2.38	∞
Boundary effect	1.0	R	$\sqrt{3}$	1	1	0.58	0.58	∞
Probe Linearity	4.7	R	$\sqrt{3}$	1	1	2.71	2.71	∞
System detection limits	1.0	R	$\sqrt{3}$	1	1	0.58	0.58	∞
Readout Electronics	0.5	N	1	1	1	0.50	0.50	∞
Reponse Time	0.0	R	$\sqrt{3}$	1	1	0.00	0.00	∞
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	∞
Extrapolation, interpolation and integration Algoritms for Max. SAR Evaluation	2.3	R	$\sqrt{3}$	1	1	1.33	1.33	∞
Dipole								
Deviation of experimental dipole	5.5	R	$\sqrt{3}$	1	1	3.20	3.20	∞
Dipole axis to liquid distance	2.0	R	1	1	1	1.20	1.20	∞
Power drift	4.7	R	$\sqrt{3}$	1	1	2.70	2.70	∞
Phantom and Tissue Parameters								
Phantom Uncertainty (Shape and thickness tolerances)	4.0	R	$\sqrt{3}$	1	1	2.31	2.31	∞
Liquid conductivity (deviation from target values)	2.5	N	$\sqrt{3}$	0.64	0.43	0.92	0.62	∞
Liquid conductivity - measurement uncertainty	5.0	N	1	0.64	0.43	3.20	2.15	M
Liquid permittivity (deviation from target values)	2.5	N	$\sqrt{3}$	0.60	0.49	0.87	0.71	∞
Liquid permittivity - measurement uncertainty	5.0	N	1	0.60	0.49	3.00	2.45	M
Combined Standard Uncertainty		RSS				10.18	9.73	
Expanded Uncertainty (95% Confidence interval)		k				20.36	19.45	

4 SAR MEASUREMENT SYSTEM

4.1 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:

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

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

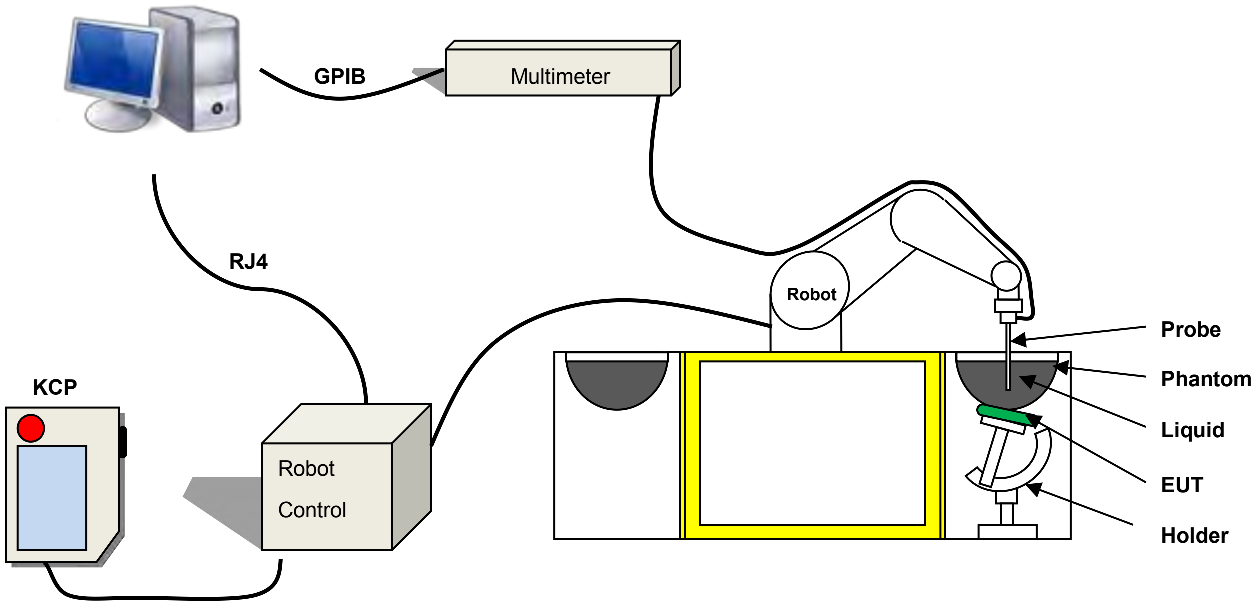
$$\mathrm{SAR} = \frac{\sigma E^2}{\rho}$$

Where: σ is the conductivity of the tissue,

ρ is the mass density of the tissue and E is the RMS electrical field strength.

4.2 SATIMO SAR System

4.2.1 SATIMO SAR System Diagram



These measurements were performed with the automated near-field scanning system OPENSAR from SATIMO. The system is based on a high precision robot (working range: 850 mm), which positions the probes with a positional repeatability of better than ± 0.02 mm. Special E- and H-field probes have been developed for measurements close to material discontinuity, the sensors of which are directly loaded with a Schottky diode and connected via highly resistive lines to the data acquisition unit.

The SAR measurements were conducted with dosimetric probe (manufactured by SATIMO), designed in the classical triangular configuration and optimized for dosimetric evaluation. The probe has been calibrated according to the procedure described in SAR standard with accuracy of better than ±10%. The spherical isotropy was evaluated with the procedure described in SAR standard and found to be better than ±0.25 dB. The phantom used was the SAM Phantom as described in FCC supplement C, IEEE P1528 and CENELEC EN62209-1/-2.

4.2.2 Robot

The SATIMO SAR system uses the high precision robots from KUKA. For the 6-axis controller system, the robot controller version (KUKA) from KUKA is used. The KUKA robot series have many features that are important for our application:

- High precision (repeatability ±0.035 mm)
- High reliability (industrial design)
- Jerk-free straight movements
- Low ELF interference (the closed metallic construction shields against motor control fields)

4.2.3 E-Field Probe

For the measurements the Specific Dosimetric E-Field Probe SN 27/14 SSE2 EPG 210 with following specifications is used

- Dynamic range: 0.01-100 W/kg
- Tip Diameter : 2.5 mm
- Distance between probe tip and sensor center: 1.0mm
- Distance between sensor center and the inner phantom surface: 4 mm

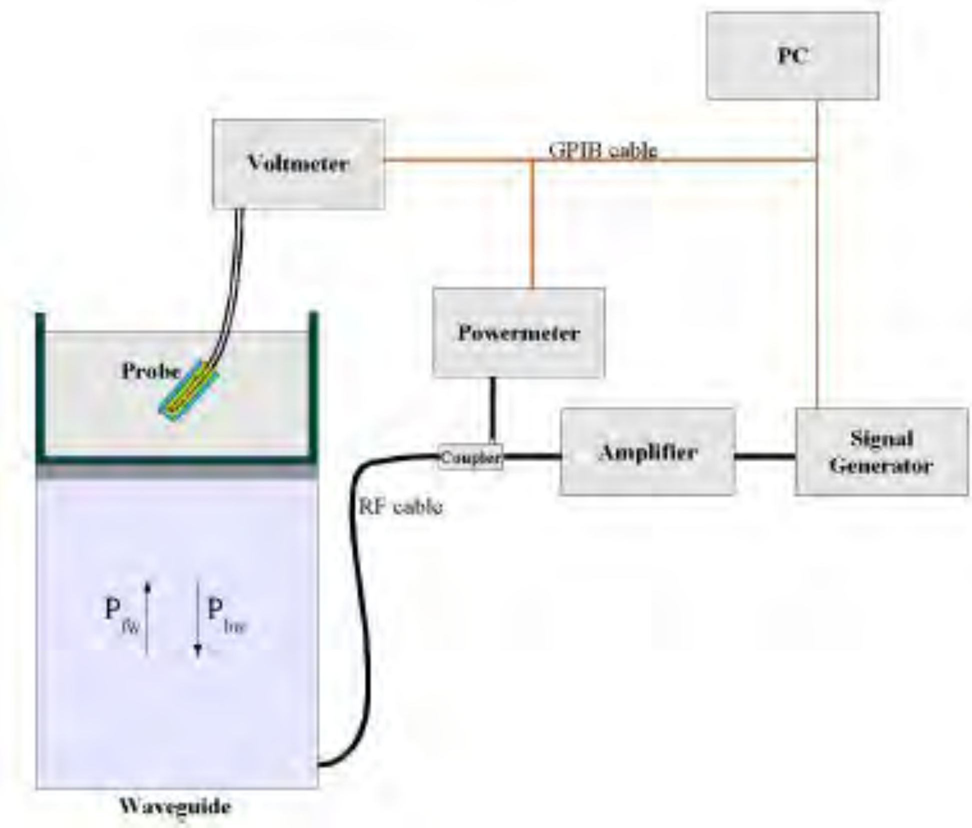
(repeatability better than +/- 1mm)

- Probe linearity: +/- 0.06 dB
- Axial Isotropy: ＜0.15 dB
- Spherical Isotropy: ＜0.15 dB
- Calibration range: 750MHz to 2600MHz for head & body simulating liquid.

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

E-Field Probe Calibration Process

Probe calibration is realized, in compliance with CENELEC EN 62209-1/-2 and IEEE 1528 std, with CALISAR, Antennessa proprietary calibration system. The calibration is performed with the EN 62209-1/2 annexe technique using reference guide at the five frequencies.



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

Where :

Pfw = Forward Power

Pbw = Backward Power

a and b = Waveguide dimensions

ı = Skin depth

Keithley configuration:

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

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

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

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

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

Where the DCP is the diode compression point in mV.

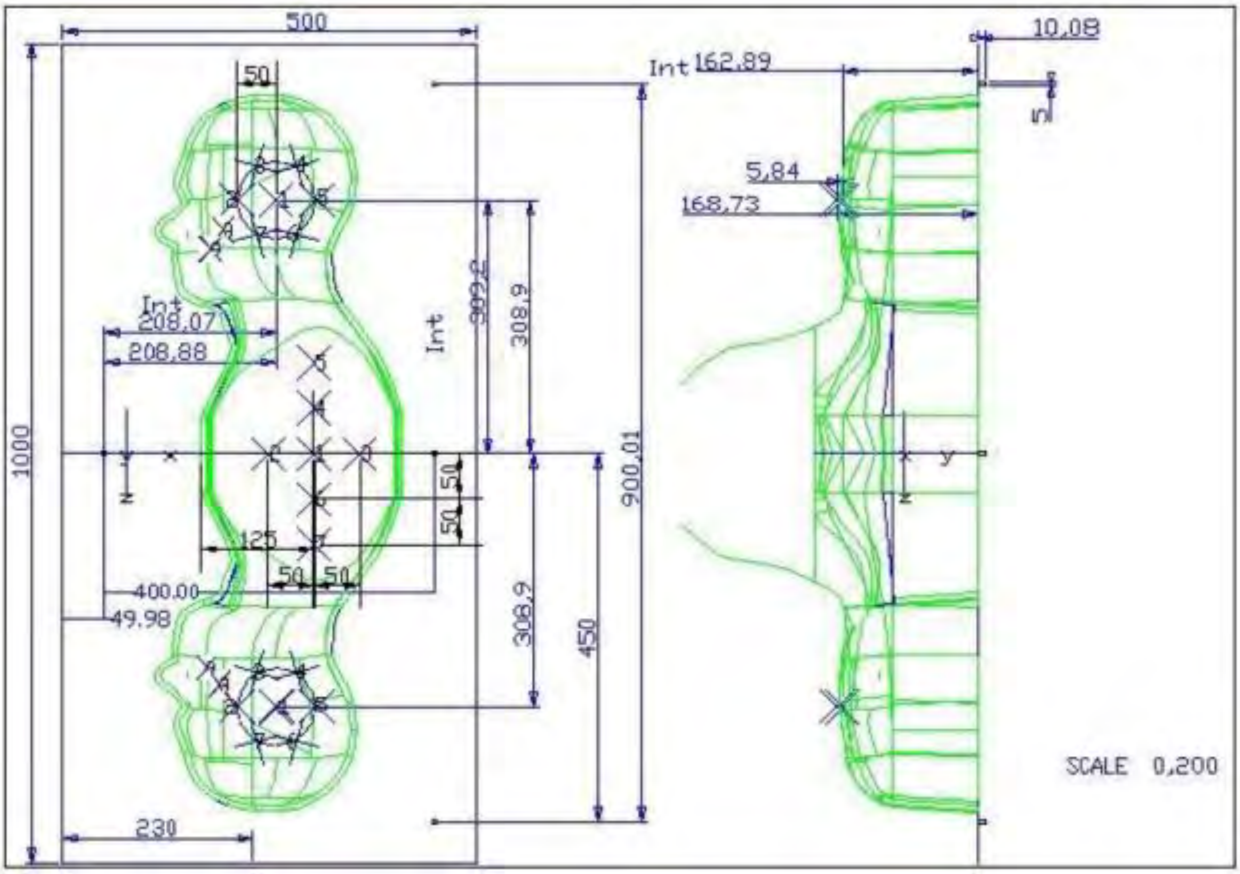
4.2.4 Phantoms

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.

Photo of Phantom SN 30/13 SAM103

Photo of Phantom SN 30/13 SAM104

Serial Number	Positionner Material	Permittivity	Loss Tangent
SN 30/13 SAM103	Gelcoat with fiberglass	3.4	0.02
SN 30/13 SAM104	Gelcoat with fiberglass	3.4	0.02



Serial Number	Left Head		Right Head		Flat Part	
SN 30/13 SAM103	2	2.00	2	2.03	1	2.09
	3	2.02	3	2.05	2	2.10
	4	2.04	4	2.04	3	2.09
	5	2.04	5	2.07	4	2.11
	6	2.02	6	2.07	5	2.11
	7	2.01	7	2.09	6	2.09
	8	2.04	8	2.10	7	2.11
	9	2.02	9	2.09	-	-
SN 30/13 SAM104	2	2.05	2	2.06	1	2.03
	3	2.08	3	2.03	2	2.03
	4	2.05	4	2.03	3	2.01
	5	2.06	5	2.02	4	2.03
	6	2.08	6	2.02	5	2.03
	7	2.06	7	2.04	6	2.00
	8	2.07	8	2.04	7	1.98
	9	2.07	9	2.05	-	-

4.2.5 Device Holder

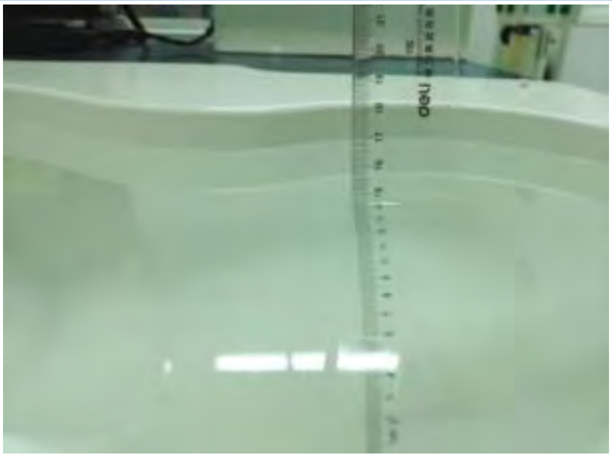
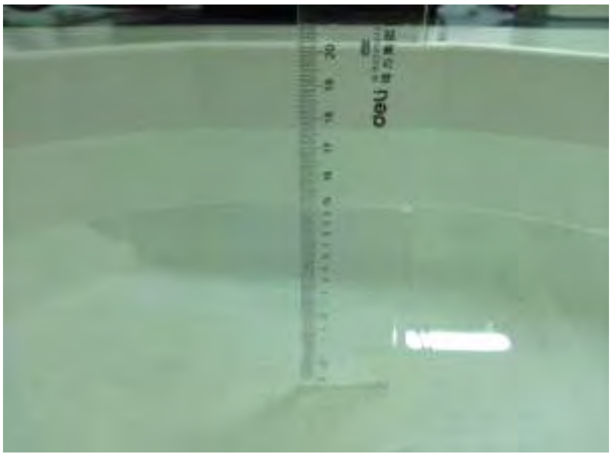
The SAR in the phantom is approximately inversely proportional to the square of the distance between the source and the liquid surface. For a source at 5 mm distance, a positioning uncertainty of ± 0.5 mm would produce a SAR uncertainty of ± 20 %. Accurate device positioning is therefore crucial for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

Serial Number	Holder Material	Permittivity	Loss Tangent
SN 25/13 MSH87	Deirin	3.7	0.005
SN 25/13 MSH88	Deirin	3.7	0.005

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

4.2.6 Simulating Liquid

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

Head Liquid Depth	Body Liquid Depth
	

The following table gives the recipes for tissue simulating liquid.

Frequency (MHz)	Water %	Sugar %	Cellulose %	Salt %	Preventol %	DGBE %	Conductivity σ	Permittivity ε
Head(Reference IEEE1528)								
750	41.1	57.0	0.2	1.4	0.2	0	0.89	41.9
835	40.3	57.9	0.2	1.4	0.2	0	0.90	41.5
900	40.3	57.9	0.2	1.4	0.2	0	0.97	41.5
1800, 1900, 2000	55.2	0	0	0.3	0	44.5	1.4	40.0
2450	55.0	0	0	0.1	0	44.9	1.80	39.2
2600	54.9	0	0	0.1	0	45.0	1.96	39.0
Body(From instrument manufacturer: SATIMO)								
750	51.7	47.2	0	0.9	0.1	0	0.96	55.5
835	50.8	48.2	0	0.9	0.1	0	0.97	55.2
900	50.8	48.2	0	0.9	0.1	0	1.05	55.0
1800, 1900, 2000	70.2	0	0	0.4	0	29.4	1.52	53.3
2450	68.6	0	0	0.1	0	31.3	1.95	52.7
2600	68.2	0	0	0.1	0	31.7	2.16	52.5

Frequency (MHz)	Water %	Triton X-100 %	Salt %	Hexyl Carbitol %	Conductivity σ	Permittivity ε
5200	65.53	17.24	0	17.24	4.66	36.0
5800	65.53	17.24	0	17.24	5.07	35.3

5 SYSTEM VERIFICATION

5.1 Antenna Port Test Requirement

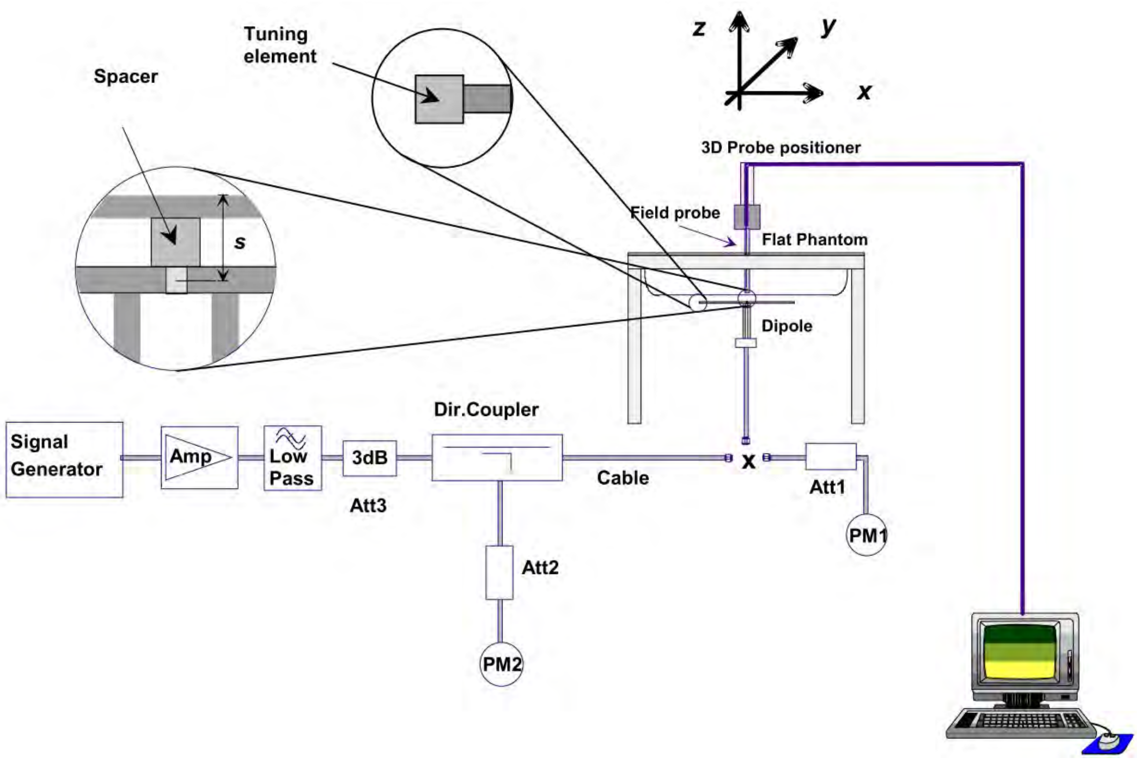
The SATIMO SAR system is equipped with one or more system validation kits. These units together with the predefined measurement procedures within the SATIMO software enable the user to conduct the system performance check and system validation. System validation kit includes a dipole, tripod holder to fix it underneath the flat phantom and a corresponding distance holder.

5.2 Purpose of System Check

The system performance check verifies that the system operates within its specifications. System and operator errors can be detected and corrected. It is recommended that the system performance check be performed prior to any usage of the system in order to guarantee reproducible results. The system performance check uses normal SAR measurements in a simplified setup with a well characterized source. This setup was selected to give a high sensitivity to all parameters that might fail or vary over time. The system check does not intend to replace the calibration of the components, but indicates situations where the system uncertainty is exceeded due to drift or failure.

5.3 System Check Setup

In the simplified setup for system evaluation, the EUT is replaced by a calibrated dipole and the power source is replaced by a continuous wave that comes from a signal generator. The calibrated dipole must be placed beneath the flat phantom section of the SAM twin phantom with the correct distance holder. The distance holder should touch the phantom surface with a light pressure at the reference marking and be oriented parallel to the long side of the phantom. The equipment setup is shown below:



6 EUT TEST POSITION CONFIGURATUONS

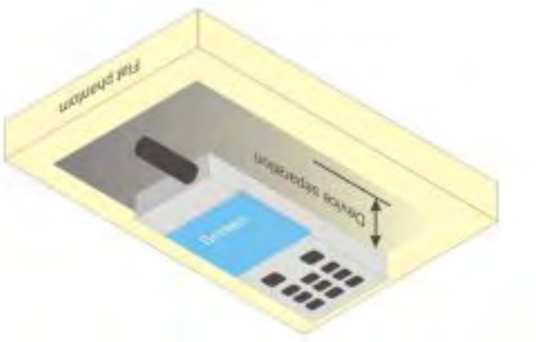
According to KDB 447498 D02, USB connector orientations on laptop computers, which is tested for SAR compliance in body-worn accessory and other use configurations described in the following subsections

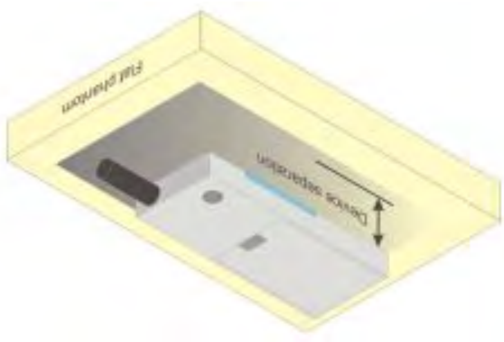
6.1 Body-worn Position Conditions

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 447498 are used to test for body-worn accessory SAR compliance, without a headset connected to it. This enables the test results for such configuration to be compatible with that required for hotspot mode when the body-worn accessory test separation distance is greater than or equal to that required for hotspot mode. 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 that body-worn accessory with a headset attached to the handset.

Body-worn accessories that do not contain metallic or conductive components may be tested according to worst-case exposure configurations, typically according to the smallest test separation distance required for the group of body-worn accessories with similar operating and exposure characteristics. All body-worn accessories containing metallic components are tested in conjunction with the host device.

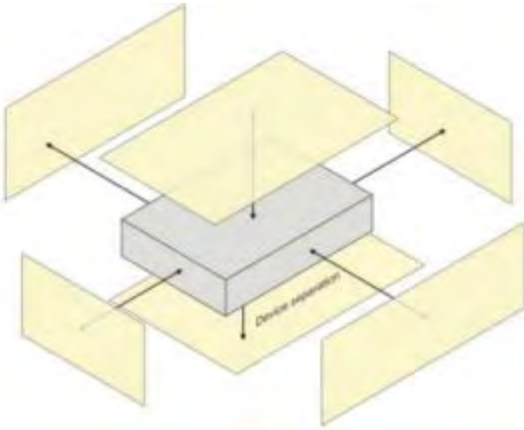
Body-worn accessory SAR compliance is based on a single minimum test separation distance for all wireless and operating modes applicable to each body-worn accessory used by the host, and according to the relevant voice and/or data mode transmissions and operations. If a body-worn accessory supports voice only operations in its normal and expected use conditions, testing of data mode for body-worn compliance is not required. A conservative minimum test separation distance for supporting off-the-shelf body-worn accessories that may be acquired by users of consumer handsets is used to test for body-worn accessory SAR compliance. This distance is determined by the handset manufacturer, according to the requirements of Supplement C 01-01. Devices that are designed to operate on the body of users using lanyards and straps, or without requiring additional body-worn accessories, will be tested using a conservative minimum test separation distance <= 5 mm to support compliance.



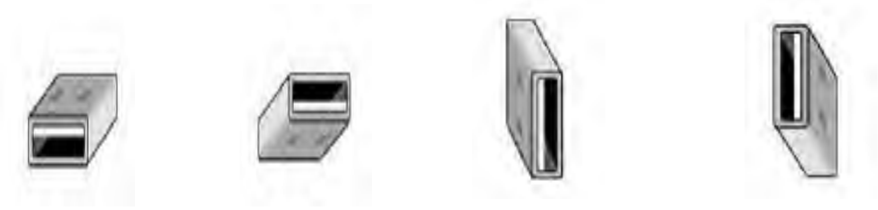


6.2 Hotspot Mode Exposure Position Conditions

For handsets that support hotspot mode operations, with wireless router capabilities and various web browsing functions, the relevant hand and body exposure conditions 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 surfaces and edges with a transmitting antenna located within 25 mm from that surface or edge. When the form factor of a handset is smaller than 9 cm x 5 cm, a test separation distance of 5 mm (instead of 10 mm) is required for testing hotspot mode. When the separation 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).



6.3 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.

6.4 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 447498 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.

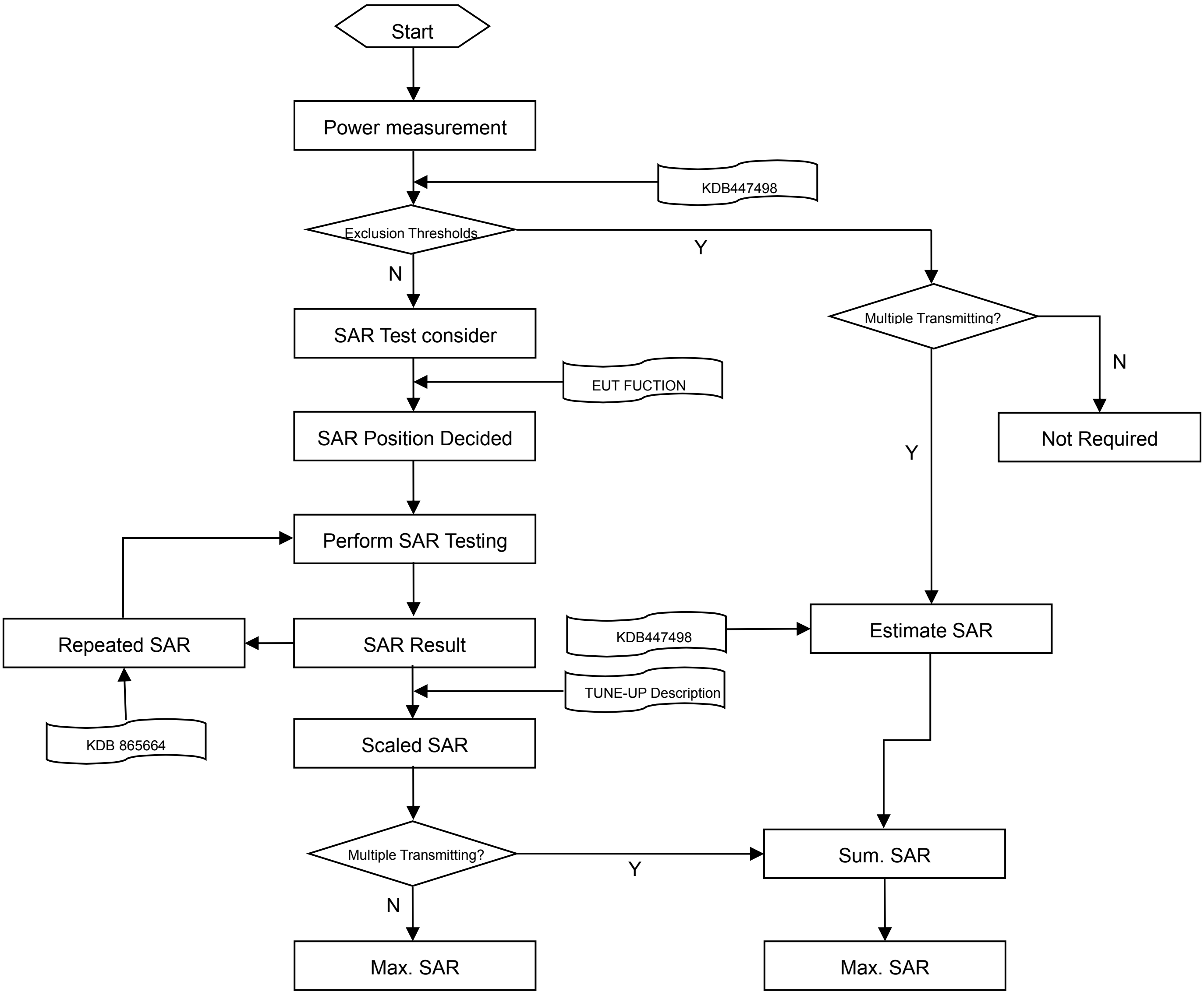
6.5 Dongles with Swivel or Rotating Connectors

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 45º to 90º 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 SAR MEASUREMENT PROCEDURES

7.1 SAR Measurement Process Diagram



7.2 SAR Scan General Requirements

Probe boundary effect error compensation is required for measurements with the probe tip closer than half a probe tip diameter to the phantom surface. Both the probe tip diameter and sensor offset distance must satisfy measurement protocols; to ensure probe boundary effect errors are minimized and the higher fields closest to the phantom surface can be correctly measured and extrapolated to the phantom surface for computing 1-g SAR. Tolerances of the post-processing algorithms must be verified by the test laboratory for the scan resolutions used in the SAR measurements, according to the reference distribution functions specified in IEEE Std 1528-2013.

<table>
<tr><th colspan="3"></th><th>≤3GHz</th><th>>3GHz</th></tr>
<tr><td colspan="3">Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface</td><td>5±1 mm</td><td>½·δ·ln(2)±0.5 mm</td></tr>
<tr><td colspan="3">Maximum probe angle from probe axis to phantom surface normal at the measurement location</td><td>30°±1°</td><td>20°±1°</td></tr>
<tr><td colspan="3" rowspan="2">Maximum area scan spatial resolution: Δx Area , Δy Area</td><td>≤ 2 GHz: ≤ 15 mm
2 – 3 GHz: ≤ 12 mm</td><td>3–4 GHz: ≤ 12 mm
4 – 6 GHz: ≤ 10 mm</td></tr>
<tr><td colspan="2">When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device.</td></tr>
<tr><td colspan="3">Maximum zoom scan spatial resolution: Δx Zoom , Δy Zoom</td><td>≤ 2 GHz: ≤ 8 mm
2 –3 GHz: ≤ 5 mm*</td><td>3–4 GHz: ≤ 5 mm*
4 – 6 GHz: ≤ 4 mm*</td></tr>
<tr><td rowspan="7">Maximum zoom scan spatial resolution, normal to phantom surface</td><td colspan="2" rowspan="3">uniform grid: Δz Zoom (n)</td><td rowspan="3">≤ 5 mm</td><td>3–4 GHz: ≤ 4 mm</td></tr>
<tr><td>4–5 GHz: ≤ 3 mm</td></tr>
<tr><td>5–6 GHz: ≤ 2 mm</td></tr>
<tr><td rowspan="4">graded grid</td><td rowspan="3">Δz Zoom (1): between 1st two points closest to phantom surface</td><td rowspan="3">≤ 4 mm</td><td>3–4 GHz: ≤ 3 mm</td></tr>
<tr><td>4–5 GHz: ≤ 2.5 mm</td></tr>
<tr><td>5–6 GHz: ≤ 2 mm</td></tr>
<tr><td>Δz Zoom (n>1): between subsequent points</td><td colspan="2">≤ 1.5·Δz Zoom (n-1)</td></tr>
<tr><td rowspan="3">Minimum zoom scan volume</td><td colspan="2" rowspan="3">x, y, z</td><td rowspan="3">≥30 mm</td><td>3–4 GHz: ≥ 28 mm</td></tr>
<tr><td>4–5 GHz: ≥ 25 mm</td></tr>
<tr><td>5–6 GHz: ≥ 22 mm</td></tr>
<tr><td colspan="5">Note:
1. δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details.
2. * When zoom scan is required and the reported SAR from the area scan based 1-g SAR estimation procedures of KDB 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.</td></tr>
</table>

7.3 SAR Measurement Procedure

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.
-

7.4 Area & Zoom Scan Procedures

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 D01v01r03 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.

8 CONDUCTED RF OUPUT POWER

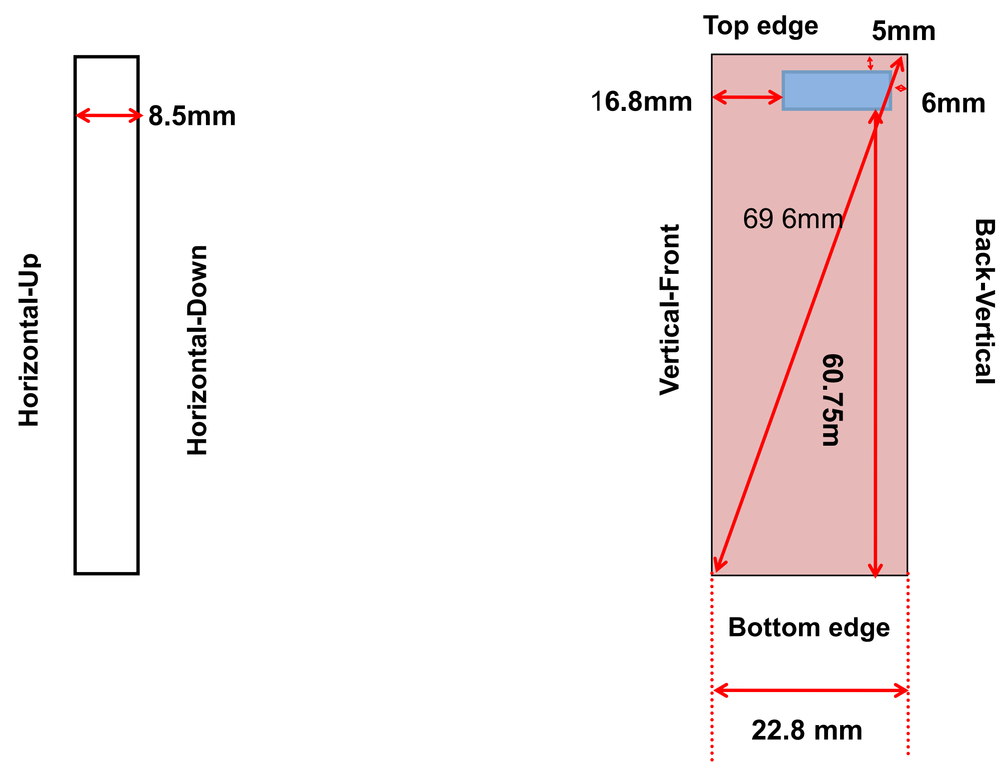
WLAN 2.4G						
Mode	802.11b			802.11g		
Channel	1	6	11	1	6	11
Frequency (MHz)	2412	2437	2467	2412	2437	2462
Peak Power (dBm)	14.47	14.48	**14.94**	**13.95**	11.01	12.65
Mode	802.11n(HT-20)			802.11n(HT-40)		
Channel	1	6	11	3	6	9
Frequency (MHz)	2412	2437	2462	2422	2437	2452
Peak Power (dBm)	**14.13**	12.77	13.68	9.19	9.02	7.56

WLAN 5G						
Mode	802.11a					
Band(MHz)	5150~5250			5725~5850		
Channel	36	40	48	149	157	165
Frequency (MHz)	5180	5200	5240	5745	5785	5825
Peak Power (dBm)	12.02	12.75	11.15	13.67	13.44	**13.90**
Mode	802.11ac(HT-20)					
Band(MHz)	5150~5250			5725~5850		
Channel	36	40	48	149	157	165
Frequency (MHz)	5180	5200	5240	5745	5785	5825
Peak Power (dBm)	12.14	12.69	11.23	**13.79**	13.39	13.75
Mode	802.11ac(HT-40)					
Band(MHz)	5150~5250			5725~5850		
Channel	38		46	151		159
Frequency (MHz)	5190		5230	5755		5795
Peak Power (dBm)	12.94		**13.15**	10.34		10.48
Mode	802.11ac(HT-80)					
Band(MHz)	5150~5250			5725~5850		
Channel	42			155		
Frequency (MHz)	5210			5775		
Peak Power (dBm)	12.66			**13.32**		
Mode	802.11n(HT-20)					
Band(MHz)	5150~5250			5725~5850		
Channel	36	40	48	149	157	165
Frequency (MHz)	5180	5200	5240	5745	5785	5825
Peak Power (dBm)	11.03	**11.83**	10.94	11.35	11.77	11.25
Mode	802.11n(HT-40)					
Band(MHz)	5150~5250			5725~5850		
Channel	38		46	151		159
Frequency (MHz)	5190		5230	5755		5795
Peak Power (dBm)	9.82		**10.53**	10.19		10.37

Tune Up Procedure

Mode	Range(dBm)
2.4G IEEE 802.11b	14.40~15.00
2.4G IEEE 802.11g	14.00~14.00
2.4G IEEE 802.11n(HT-20)	12.60~14.20
2.4G IEEE 802.11n(HT-40)	7.50~9.20
5G IEEE 802.11a	11.10~14.00
5G IEEE 802.11ac(HT-20)	10.30~14.00
5G IEEE 802.11ac(HT-40)	12.60~13.20
5G IEEE 802.11ac(HT-80)	12.60~13.40
5G IEEE 802.11n(HT-20)	10.90~11.90
5G IEEE 802.11n(HT-40)	9.80~10.60

9 EUT ANTENNA LOCATION SKETCH



9.1 SAR Test Exclusion Consider Table

According with FCC KDB 447498 D01v05r02, Appendix A, <SAR Test Exclusion Thresholds for 100 MHz – 6 GHz and ≤ 50 mm> Table, this Device SAR test configurations consider as following :

Band	Mode	Max. Peak Power		Test Position Configurations					
		dBm	mW	Head	Horizontal-Up/ Horizontal-Down	Vertical-front	Vertical-Back	Top Edge	Bottom Edge
	Distance to User			<5mm	<5mm	16.8mm	6mm	5mm	60.75mm
WLAN 2.4 G	802.11b	14.94	31.19	No	Yes	Yes	Yes	Yes	No
	802.11g	13.95	24.83	No	Yes	Yes	Yes	Yes	No
	802.11n(HT20)	14.13	25.88	No	Yes	Yes	Yes	Yes	No
	802.11n(HT40)	9.19	8.30	No	No	No	No	No	No
WLAN 5 G	802.11a	13.90	24.55	No	Yes	Yes	Yes	Yes	No
	802.11ac(HT-20)	13.79	23.93	No	Yes	Yes	Yes	Yes	No
	802.11ac(HT-40)	13.15	20.65	No	Yes	Yes	Yes	Yes	No
	802.11ac(HT-80)	13.32	21.48	No	Yes	Yes	Yes	Yes	No
	802.11n(HT-20)	11.83	15.24	No	Yes	Yes	Yes	Yes	No
	802.11n(HT-40)	10.53	11.30	No	Yes	Yes	Yes	Yes	No

10 TEST RESULTS

10.1 Body SAR (5mm separation)

Band	Mode	Position	Ch.	Freq. (MHz)	Power Drift	Meas. SAR (W/Kg)	Meas. Power (dBm)	Max. tune-up Power(dBm)	Scaling Factor	Scaled SAR (W/Kg)	Meas. No.
WLAN 802.11b	DATA	Horizontal-Up	11	2467	-0.07	0.208	14.94	15.00	1.014	0.211	1#
		Horizontal-Down	11	2467	0.34	**0.229**	14.94	15.00	1.014	**0.232**	2#
		Vertical-Front	11	2467	-1.06	0.106	14.94	15.00	1.014	0.107	3#
		Vertical-Back	11	2467	-0.98	0.103	14.94	15.00	1.014	0.104	4#
		Top edge	11	2467	-0.61	0.044	14.94	15.00	1.014	0.045	5#
WLAN 802.11g	DATA	Horizontal-UP	1	2412	0.72	0.179	13.95	14.00	1.012	0.181	6#
		Horizontal-Down	1	2412	2.13	**0.208**	13.95	14.00	1.012	**0.210**	7#
		Vertical-Front	1	2412	-0.47	0.099	13.95	14.00	1.012	0.100	8#
		Vertical-Back	1	2412	-0.23	0.090	13.95	14.00	1.012	0.091	9#
		Top edge	1	2412	2.62	0.028	13.95	14.00	1.012	0.028	10#
WLAN 802.11 n(HT-20)	DATA	Horizontal-UP	1	2412	0.18	0.147	14.13	14.20	1.016	0.149	11#
		Horizontal-Down	1	2412	4.97	**0.214**	14.13	14.20	1.016	**0.217**	12#
		Vertical-Front	1	2412	-3.04	0.088	14.13	14.20	1.016	0.089	13#
		Vertical-Back	1	2412	0.25	0.076	14.13	14.20	1.016	0.077	14#
		Top edge	1	2412	-2.73	0.024	14.13	14.20	1.016	0.024	15#
WLAN 802.11a	DATA	Horizontal-UP	165	5825	-4.84	0.282	13.90	14.00	1.023	0.289	16#
		Horizontal-Down	165	5825	-2.57	**0.397**	13.90	14.00	1.023	**0.406**	17#
		Vertical-Front	165	5825	0.08	0.163	13.90	14.00	1.023	0.167	18#
		Vertical-Back	165	5825	-3.77	0.208	13.90	14.00	1.023	0.213	19#
		Top edge	165	5825	-0.37	0.108	13.90	14.00	1.023	0.111	20#
WLAN 802.11ac (HT-20)	DATA	Horizontal-UP	149	5745	-3.94	0.270	13.79	14.00	1.050	0.283	21#
		Horizontal-Down	149	5745	-2.23	**0.396**	13.79	14.00	1.050	**0.416**	22#
		Vertical-Front	149	5745	-1.88	0.157	13.79	14.00	1.050	0.165	23#
		Vertical-Back	149	5745	-3.46	0.134	13.79	14.00	1.050	0.141	24#
		Top edge	149	5745	-4.08	0.078	13.79	14.00	1.050	0.082	25#
WLAN 802.11ac (HT-40)	DATA	Horizontal-UP	46	5230	-4.24	0.080	13.15	13.20	1.012	0.081	26#
		Horizontal-Down	46	5230	-0.97	**0.154**	13.15	13.20	1.012	**0.156**	27#
		Vertical-Front	46	5230	-2.39	0.093	13.15	13.20	1.012	0.094	28#
		Vertical-Back	46	5230	-3.7	0.091	13.15	13.20	1.012	0.092	29#
		Top edge	46	5230	-0.87	0.040	13.15	13.20	1.012	0.040	30#
WLAN 802.11ac (HT-80)	DATA	Horizontal-UP	155	5775	-1.75	0.131	13.32	13.40	1.019	0.133	31#
		Horizontal-Down	155	5775	-3.59	0.379	13.32	13.40	1.019	0.386	32#
		Vertical-Front	155	5775	-3.67	0.158	13.32	13.40	1.019	0.161	33#
		Vertical-Back	155	5775	-4.24	0.150	13.32	13.40	1.019	0.153	34#
		Top edge	155	5775	-4.09	0.095	13.32	13.40	1.019	0.097	35#

Band	Mode	Position	Ch.	Freq. (MHz)	Power Drift	Meas. SAR (W/Kg)	Meas. Power (dBm)	Max. tune-up Power(dBm)	Scaling Factor	Scaled SAR (W/Kg)	Meas. No.
WLAN 802.11n (HT-20)	DATA	Horizontal-UP	40	5200	-0.18	0.063	11.83	11.90	1.016	0.064	36#
		Horizontal-Down	40	5200	-1.82	**0.109**	11.83	11.90	1.016	**0.111**	37#
		Vertical-Front	40	5200	-1.73	0.099	11.83	11.90	1.016	0.101	38#
		Vertical-Back	40	5200	-3.98	0.080	11.83	11.90	1.016	0.081	39#
		Top edge	40	5200	-3.59	0.039	11.83	11.90	1.016	0.040	40#
WLAN 802.11n (HT-40)	DATA	Horizontal-UP	46	5230	0.11	0.019	10.53	10.60	1.016	0.019	41#
		Horizontal-Down	46	5230	-3.99	**0.143**	10.53	10.60	1.016	**0.145**	42#
		Vertical-Front	46	5230	3.51	0.095	10.53	10.60	1.016	0.097	43#
		Vertical-Back	46	5230	-3.66	0.092	10.53	10.60	1.016	0.093	44#
		Top edge	46	5230	-3.37	0.031	10.53	10.60	1.016	0.032	45#

10.2 SAR Measurement Variability

According to KDB 865664 D01 v01r03, SAR measurement variability was assessed for each frequency band, which is determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements. When both head and body tissue-equivalent media are required for SAR measurements in a frequency band, the variability measurement procedures should be applied to the tissue medium with the highest measured SAR, using the highest measured SAR configuration for that tissue-equivalent medium. Alternatively, if the highest measured SAR for both head and body tissue-equivalent media are ≤ 1.45 W/kg and the ratio of these highest SAR values, i.e., largest divided by smallest value, is ≤ 1.10, the highest SAR configuration for either head or body tissue-equivalent medium may be used to perform the repeated measurement. These additional measurements are repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device should be returned to ambient conditions (normal room temperature) with the battery fully charged before it is re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

SAR repeated measurement procedure:

1. When the highest measured SAR is < 0.80 W/kg, repeated measurement is not required.
2. When the highest measured SAR is >= 0.80 W/kg, repeat that measurement once.
3. If the ratio of largest to smallest SAR for the original and first repeated measurements is > 1.20, or when the original or repeated measurement is >= 1.45 W/kg, perform a second repeated measurement.
4. If the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20, and the original, first or second repeated measurement is >= 1.5 W/kg, perform a third repeated measurement.

The highest measured SAR is 0.396 W/kg, which is less than 0.80 W/kg, repeated measurement is not required

11 TEST EQUIPMENTS LIST

Description	Manufacturer	Model	Serial No.	Cal. Date	Cal. Due
PC	Dell	N/A	N/A	N/A	N/A
2450MHz Dipole	SATIMO	SID 2450	S/N 25/13 DIP 2G450-251	2015/03/16	2016/03/15
Waveguide	SATIMO	WGA24	S/N 30/13 DIP WGA24	2015/03/16	2016/03/15
E-Field Probe	SATIMO	SSE2	S/N 27/14 EPG 210	2015/07/16	2016/07/15
Antenna	SATIMO	ANTA3	SN 17/13 ZNTA45	N/A	N/A
Phantom1	SATIMO	SAM	SN 30/13 SAM013	N/A	N/A
Phantom2	SATIMO	SAM	SN 30/13 SAM014	N/A	N/A
Dielectric Probe Kit	SATIMO	SCLMP	SN 25/13 OCPG56	2015/08/17	2016/08/16
MultiMeter	Keithley	MultiMeter 2000	4024022	2014/12/13	2015/12/12
Signal Generator	R&S	SMF100A	1167.0000k02/104260	2015/07/07	2016/07/06
Power Meter 1	Agilent	5738A	11290	2014/10/18	2015/10/17
Power Meter 2	Agilent	E4419B	GB40201833	2014/11/03	2015/11/02
Power Sensor	R&S	NRP-Z21	103971	2014/11/03	2015/11/02
Power Amplifier	SATIMO	6552B	22374	N/A	N/A
Network Analyzer	Agilent	5071C	EMY46103472	2014/11/03	2015/11/02
Attenuator	COM-MW	ZA-S1-31	1305003187	N/A	N/A
Directional coupler	AA-MCS	AAMCS-UDC	000272	N/A	N/A
Laptop 1	Lenovo	Thinkpad X200	N/A	N/A	N/A
Laptop 2	Lenovo	Thinkpad T500	N/A	N/A	N/A

ANNEX A SIMULATING LIQUID VERIFICATION RESULT

The dielectric parameters of the liquids were verified prior to the SAR evaluation using an SATIMO SCLMP Dielectric Probe Kit

Date	Liquid Type	Freq. (MHz)	Temp. (℃)	Meas. Conductivity (σ)	Meas. Permittivity (ε)	Target conductivity (σ)	Target Permittivity (ε)	Conductivity tolerance (%)	Permittivity tolerance (%)
2015.9.20	Body	2450	22.1	1.91	53.27	1.95	52.70	-2.05	1.08
2015.9.20	Body	5200	22.4	5.26	50.13	5.30	49.01	-0.75	2.29
2015.9.21	Body	5800	22.0	6.08	48.04	6.00	48.20	1.33	-0.33
Note: The tolerance limit of Conductivity and Permittivity is± 5%.									

ANNEX B SYSTEM CHECK RESULT

Comparing to the original SAR value provided by SATIMO, the validation data should be within its specification of 10%(for 1 g).

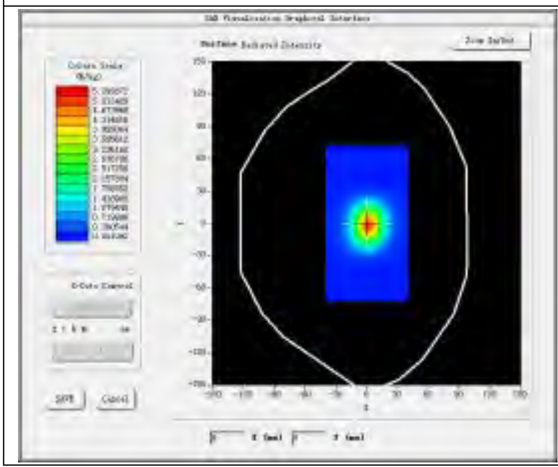
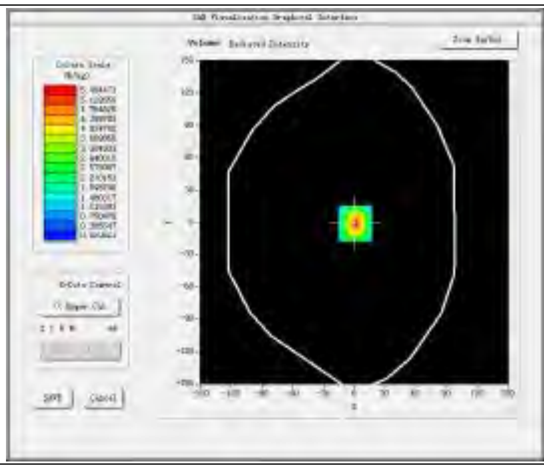
Date	Liquid Type	Freq. (MHz)	Power (mW)	Measured SAR (W/kg)	Normalized SAR (W/kg)	Dipole SAR (W/kg)	Tolerance (%)	Targeted SAR(W/kg)	Tolerance (%)
2015.9.20	Body	2450	100	5.387	53.87	54.70	-1.52	52.40	2.81
2015.9.20	Body	5200	100	16.325	163.25	155.12	5.24	165.00	-1.06
2015.9.21	Body	5800	100	16.944	169.44	173.19	-2.17	165.00	2.69
Note: The tolerance limit of System validation ±10%.									

System Performance Check Data(2450MHz Body)

Type: Phone measurement (Complete)
E-Field Probe: SN 27/14 SSE2 EPG 210
Area scan resolution: dx=8mm,dy=8mm
Zoom scan resolution: dx=5mm, dy=5mm, dz=5mm
Date of measurement: 2015.09.20
Measurement duration: 14 minutes 46 seconds

Experimental conditions.

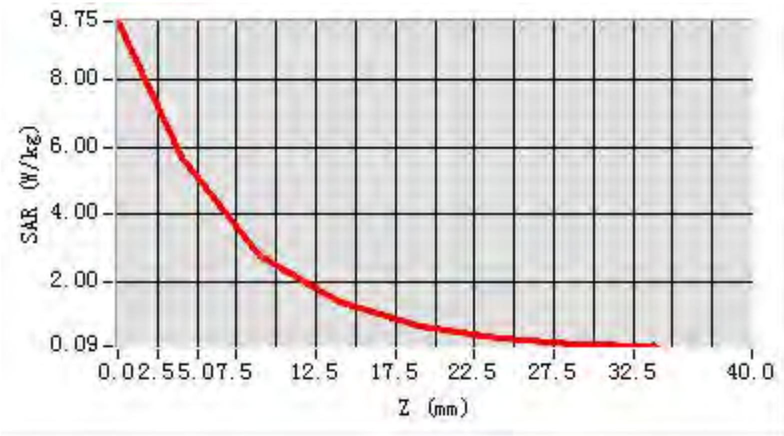
Phantom File	surf_sam_plan.txt
Phantom	Validation plane
Device Position	-
Band	2450MHz
Channels	-
Signal	CW
Frequency (MHz)	2450.000000
Relative permittivity (real part)	53.270000
Relative permittivity	11.982563
Conductivity (S/m)	1.9134592
Power drift (%)	0.370000
Ambient Temperature:	22.6°C
Liquid Temperature:	22.1°C
ConvF:	26.09
Crest factor:	1:1

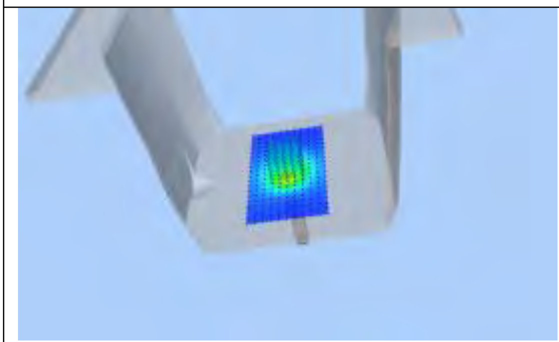
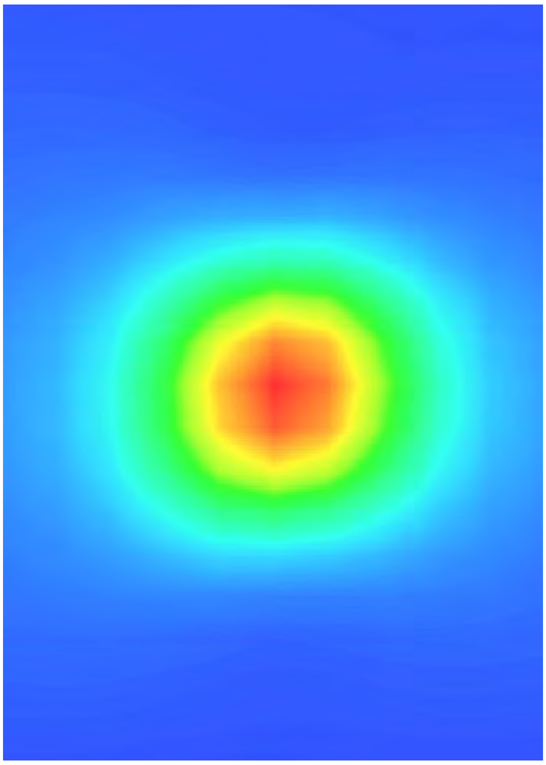
SURFACE SAR	VOLUME SAR
	

Maximum location: X=1.00, Y=-1.00
SAR Peak: 9.75 W/kg

SAR 10g (W/Kg)	2.290312
SAR 1g (W/Kg)	5.386953

Z Axis Scan



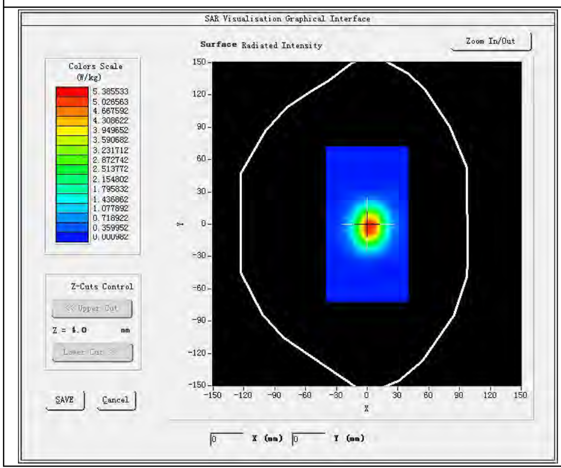
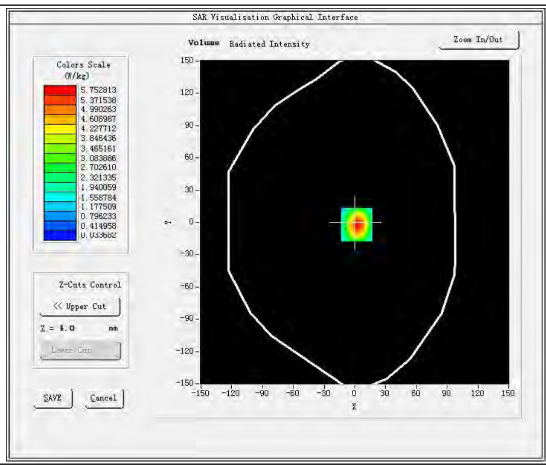
3D screen shot	Hot spot position
	

System Performance Check Data(5200MHz Body)

Type: Phone measurement (Complete)
E-Field Probe: SN 27/14 SSE2 EPG 210
Area scan resolution: dx=8mm,dy=8mm
Zoom scan resolution: dx=4mm, dy=4mm, dz=2mm
Date of measurement: 2015.09.20
Measurement duration: 29 minutes 32 seconds

Experimental conditions.

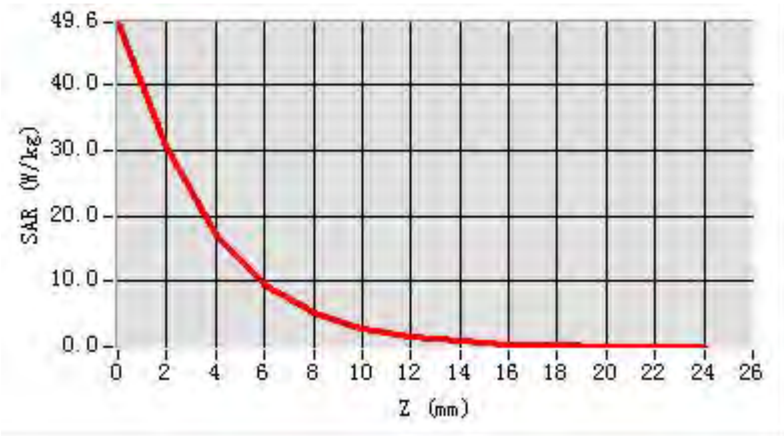
Phantom File	surf_sam_plan.txt
Phantom	Validation plane
Band	5200 MHz
Signal	CW
Frequency (MHz)	5200.000000
Relative permittivity (real part)	50.1307510
Relative permittivity	13.269150
Conductivity (S/m)	5.264048
Power drift (%)	2.480000
Ambient Temperature:	22.5°C
Liquid Temperature:	22.4°C
ConvF:	22.88
Crest factor:	1:1

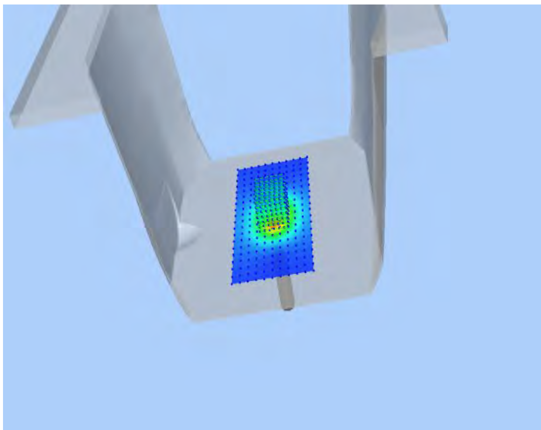
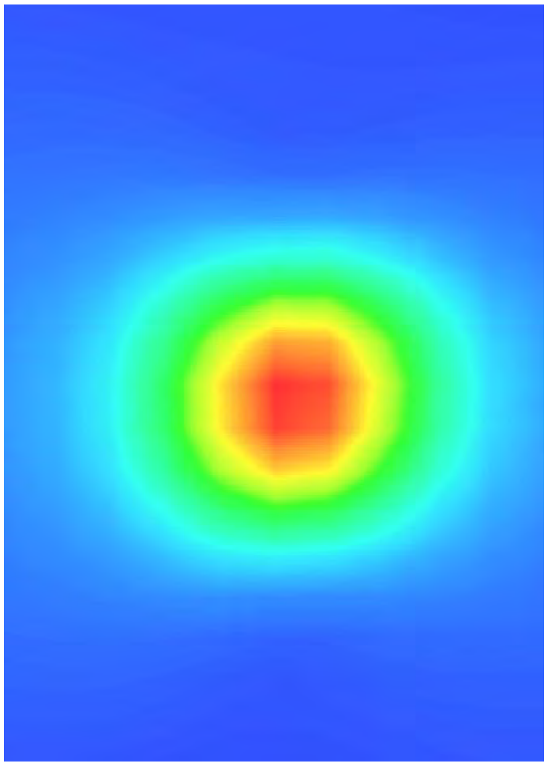
SURFACE SAR	VOLUME SAR
	

Maximum location: X=3.00, Y=1.00
SAR Peak: 49.60 W/kg

SAR 10g (W/Kg)	5.346128
SAR 1g (W/Kg)	16.325210

Z Axis Scan



3D screen shot	Hot spot position
	

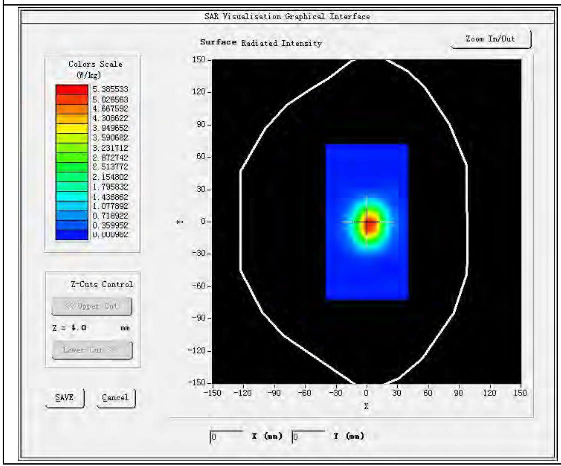
System Performance Check Data(5800MHz Body)

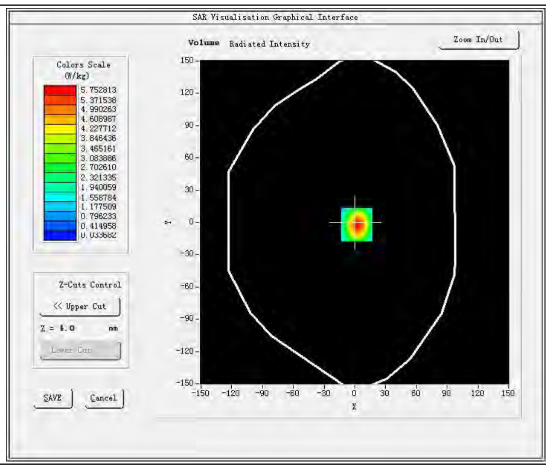
Type: Phone measurement (Complete)
E-Field Probe: SN 27/14 SSE2 EPG 210
Area scan resolution: dx=8mm,dy=8mm
Zoom scan resolution: dx=4mm, dy=4mm, dz=2mm
Date of measurement: 2015.09.21
Measurement duration: 29 minutes 32 seconds

Experimental conditions.

Phantom File	surf_sam_plan.txt
Phantom	Validation plane
Band	5800 MHz
Signal	CW
Frequency (MHz)	5800.000000
Relative permittivity (real part)	48.041780
Relative permittivity	13.269150
Conductivity (S/m)	6.0789587
Power drift (%)	2.130000
Ambient Temperature:	22.5°C
Liquid Temperature:	22.0°C
ConvF:	23.20
Crest factor:	1:1

SURFACE SAR	VOLUME SAR

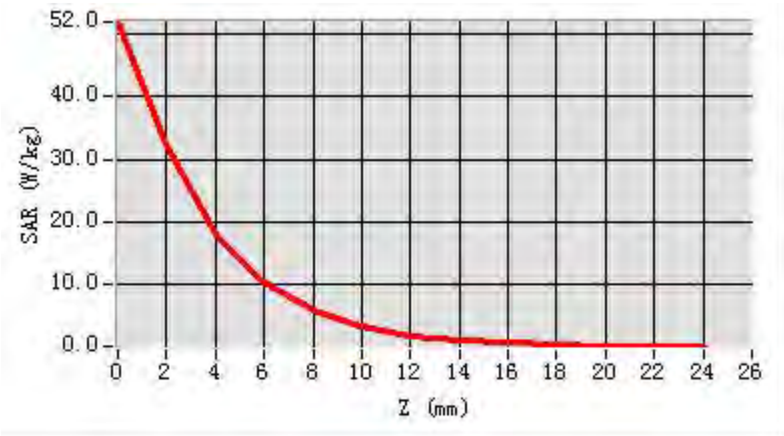


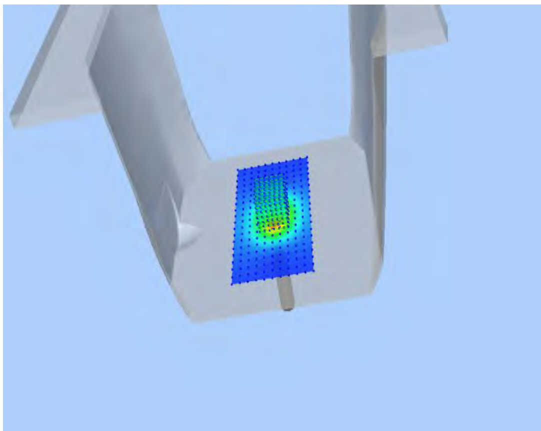
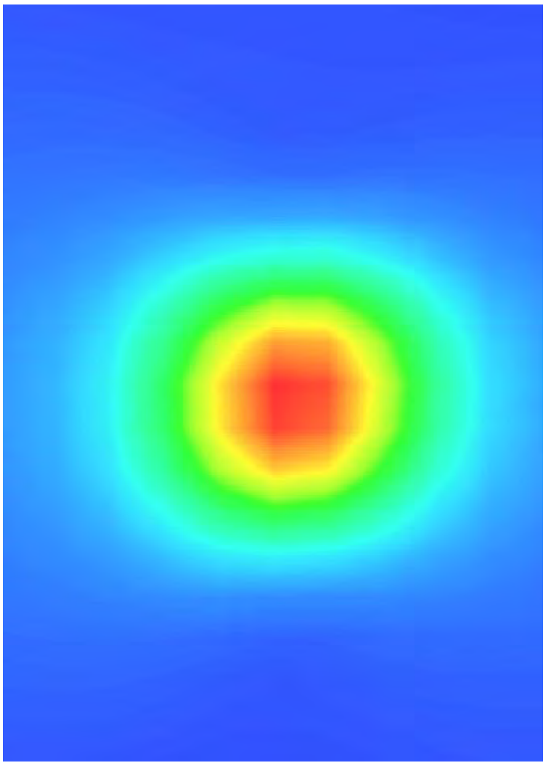


Maximum location: X=3.00, Y=1.00
SAR Peak: 52.10W/kg

SAR 10g (W/Kg)	6.215448
SAR 1g (W/Kg)	16.943850

Z Axis Scan



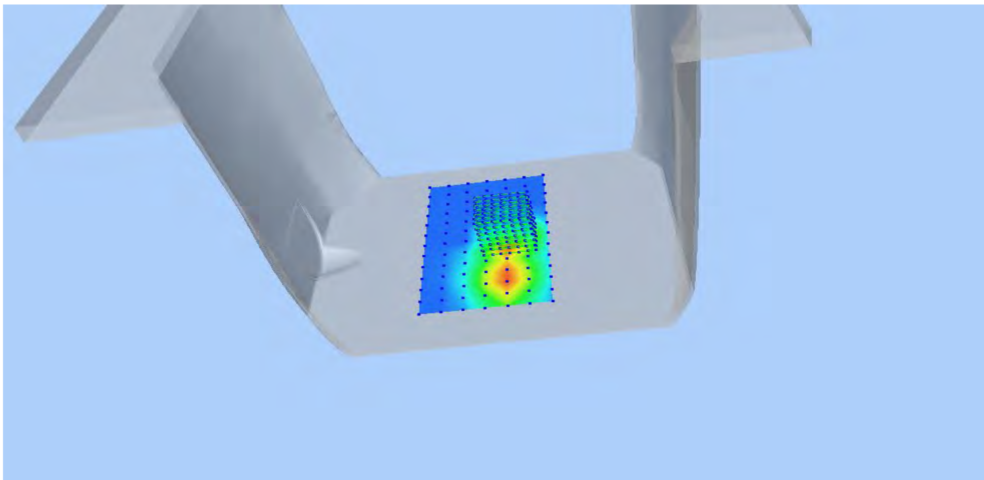
3D screen shot	Hot spot position
	

ANNEX C TEST DATA

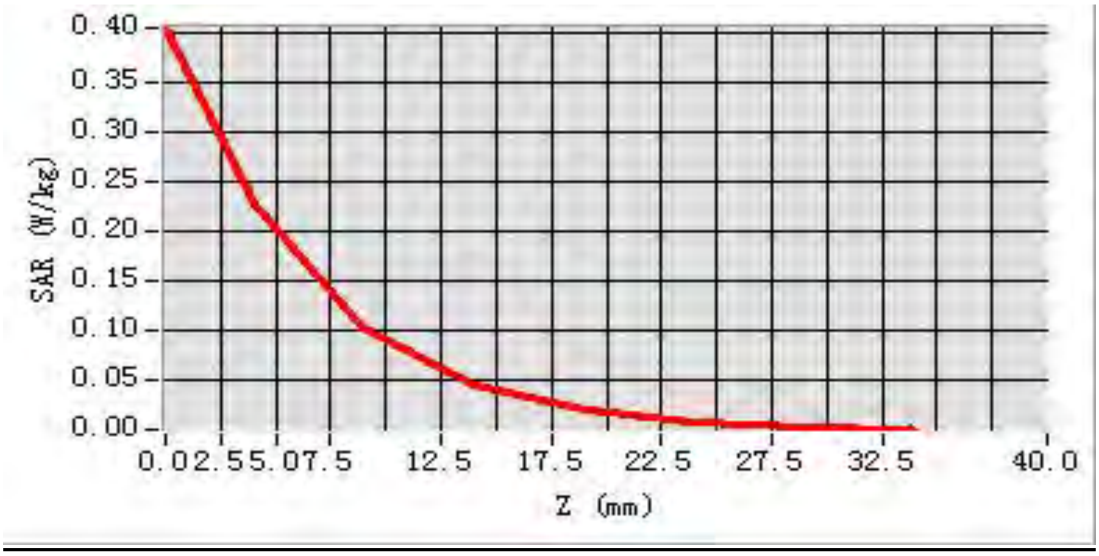
MEAS. 1 Body Plane with Horizontal-Up Side on High Channel in IEEE 802.11b mode

Test Date:	20/9/2015
Signal:	WLAN, f=2467.0 MHz, Duty Cycle: 1:1.0
Liquid Parameters:	Permittivity: 52.68; Conductivity: 1.97 S/m
Test condition:	Ambient Temperature: 22.5°C, Liquid Temperature: 22.1°C
Probe:	SN 27/14 SSE2 EPG 210, ConvF: 26.09
Area Scan:	sam_direct_droit2_surf12mm.txt, h= 5.00 mm
Zoom Scan:	5x5x7,dx=5mm, dy=5mm, dz=5mm,Complete
Maximum location:	X=8.000000, Y=0.000000
SAR 10g (W/Kg):	0.088621
SAR 1g (W/Kg):	0.207955
Power drift (%):	-0.07

3D screen shot



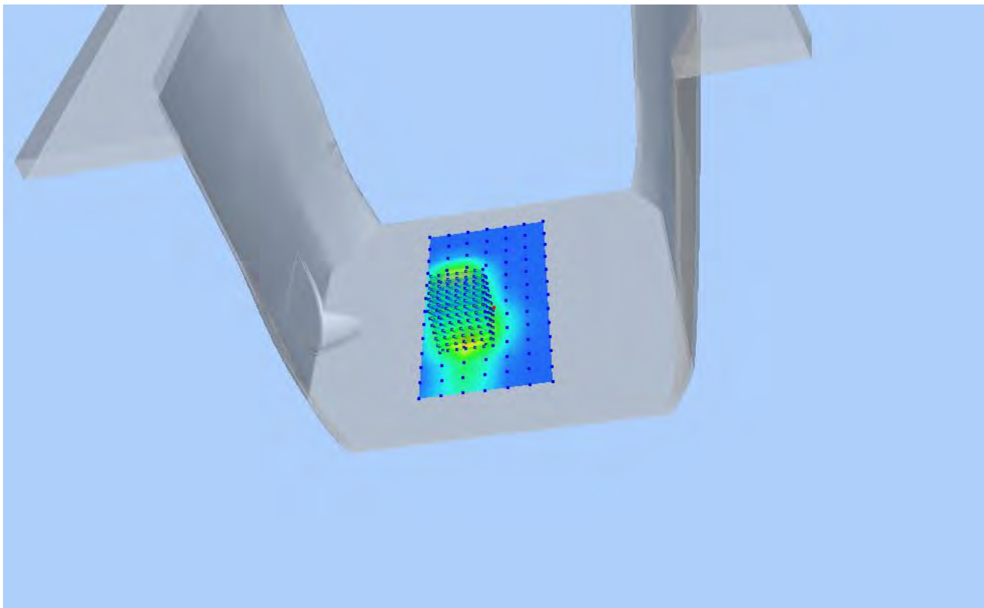
Z Axis Scan



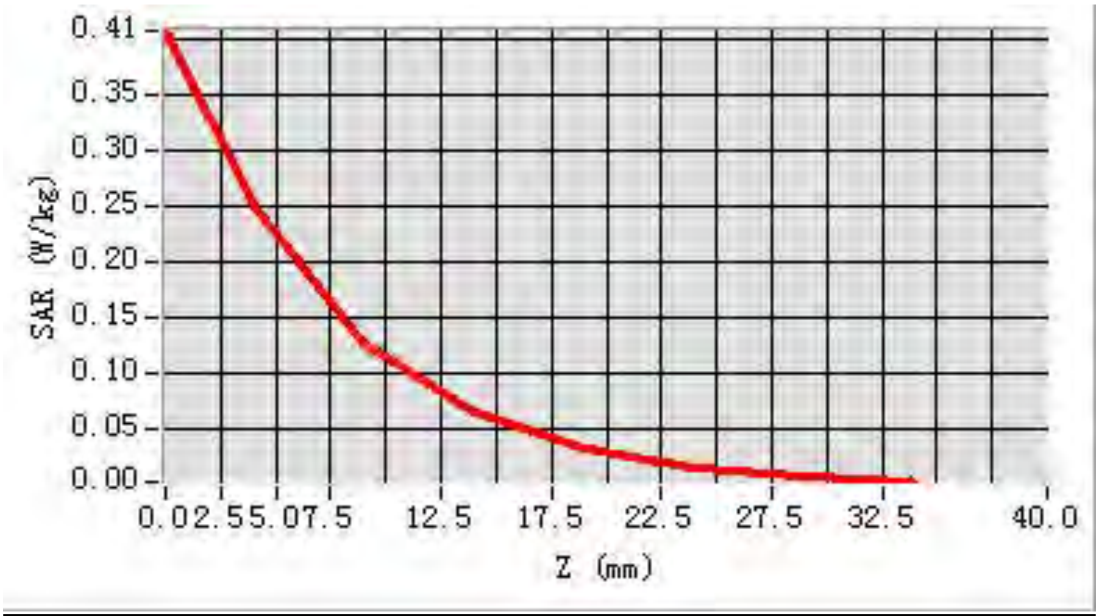
MEAS. 2 Body Plane with Horizontal-Down Side on High Channel in IEEE 802.11b mode

Test Date:	20/9/2015
Signal:	WLAN, f=2467.0 MHz, Duty Cycle: 1:1.0
Liquid Parameters:	Permittivity: 52.68; Conductivity: 1.97 S/m
Test condition:	Ambient Temperature: 22.5°C, Liquid Temperature: 22.1°C
Probe:	SN 27/14 SSE2 EPG 210, ConvF: 26.09
Area Scan:	sam_direct_droit2_surf12mm.txt, h= 5.00 mm
Zoom Scan:	5x5x7,dx=5mm, dy=5mm, dz=5mm,Complete
Maximum location:	X=-16.000000, Y=-24.000000
SAR 10g (W/Kg):	0.107041
SAR 1g (W/Kg):	0.229025
Power drift (%):	0.34

3D screen shot



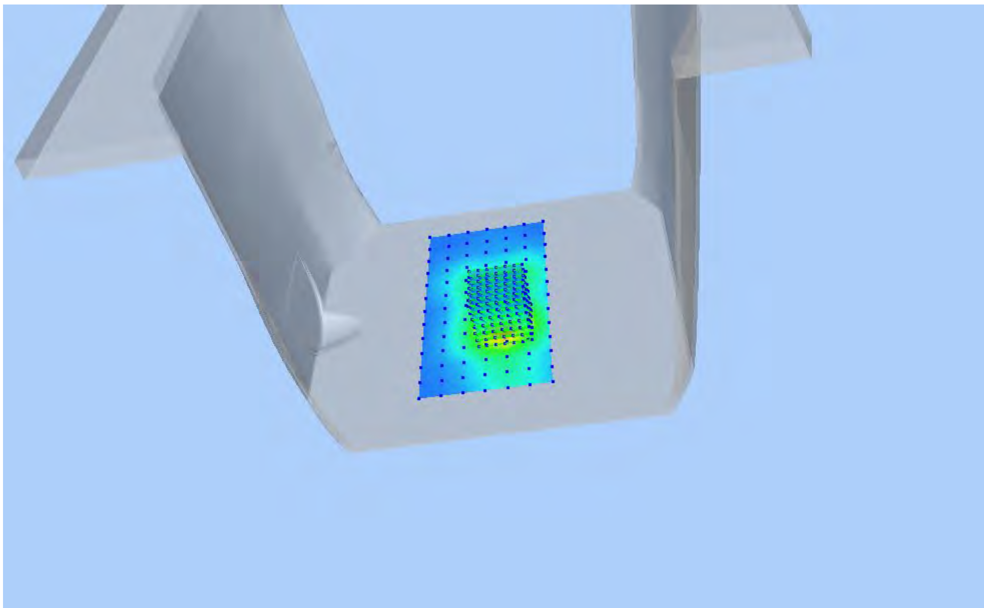
Z Axis Scan



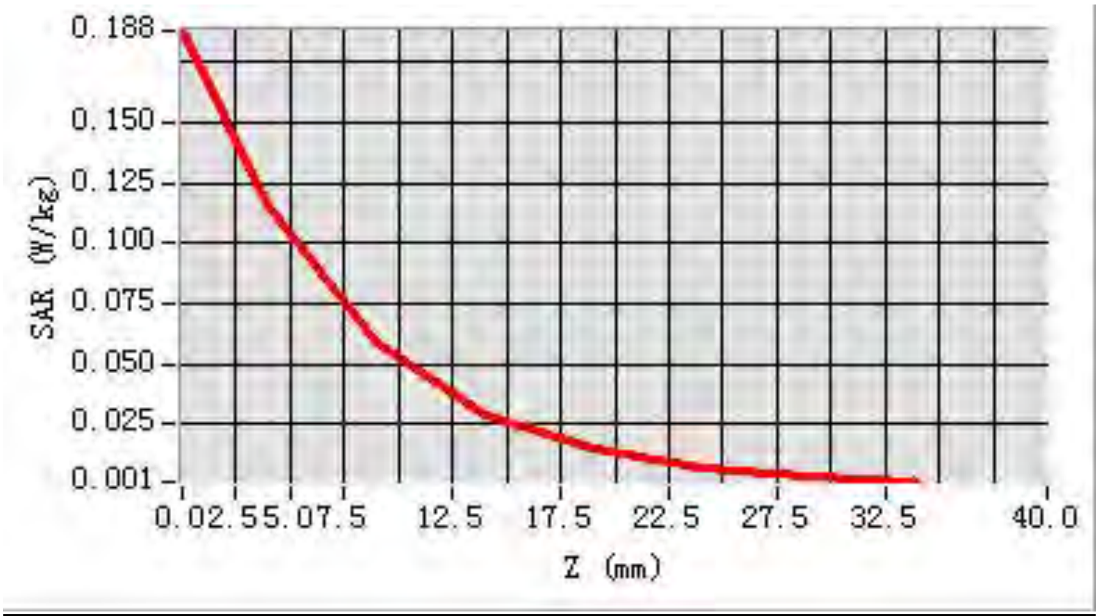
MEAS. 3 Body Plane with Vertical-Front Side on High Channel in IEEE 802.11b mode

Test Date:	20/9/2015
Signal:	WLAN, f=2467.0 MHz, Duty Cycle: 1:1.0
Liquid Parameters:	Permittivity: 52.68; Conductivity: 1.97 S/m
Test condition:	Ambient Temperature: 22.5°C, Liquid Temperature: 22.1°C
Probe:	SN 27/14 SSE2 EPG 210, ConvF: 26.09
Area Scan:	sam_direct_droit2_surf12mm.txt, h= 5.00 mm
Zoom Scan:	5x5x7,dx=5mm, dy=5mm, dz=5mm,Complete
Maximum location:	X=8.000000, Y=-24.000000
SAR 10g (W/Kg):	0.050667
SAR 1g (W/Kg):	0.106420
Power drift (%):	-1.06

3D screen shot



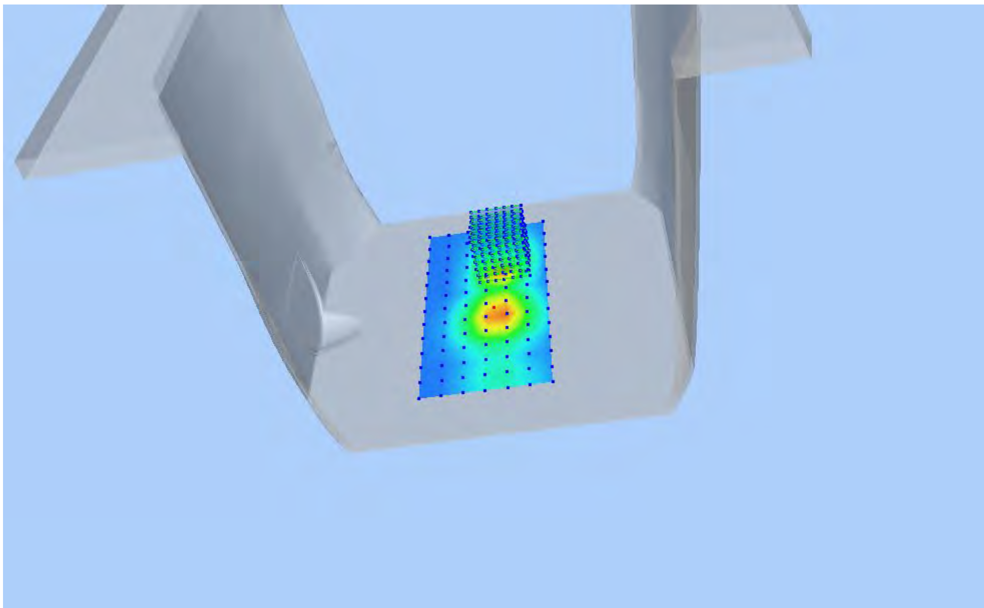
Z Axis Scan



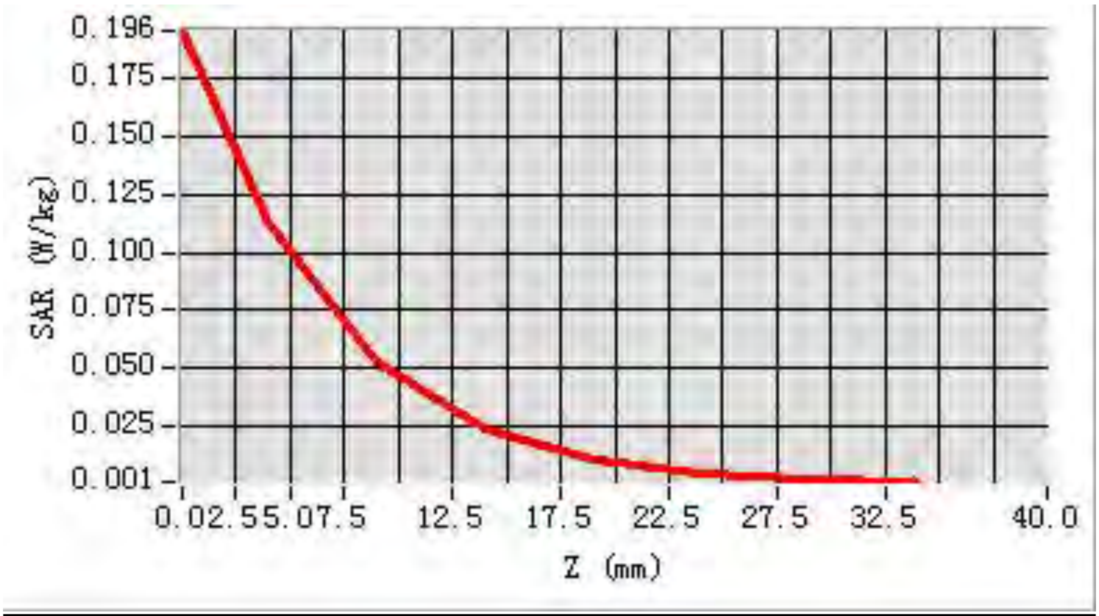
MEAS. 4 Body Plane with Vertical-Back Side on High Channel in IEEE 802.11b mode

Test Date:	20/9/2015
Signal:	WLAN, f=2467.0 MHz, Duty Cycle: 1:1.0
Liquid Parameters:	Permittivity: 52.68; Conductivity: 1.97 S/m
Test condition:	Ambient Temperature: 22.5°C, Liquid Temperature: 22.1°C
Probe:	SN 27/14 SSE2 EPG 210, ConvF: 26.09
Area Scan:	sam_direct_droit2_surf12mm.txt, h= 5.00 mm
Zoom Scan:	5x5x7,dx=5mm, dy=5mm, dz=5mm,Complete
Maximum location:	X=8.000000, Y=36.000000
SAR 10g (W/Kg):	0.043026
SAR 1g (W/Kg):	0.102931
Power drift (%):	-0.98

3D screen shot



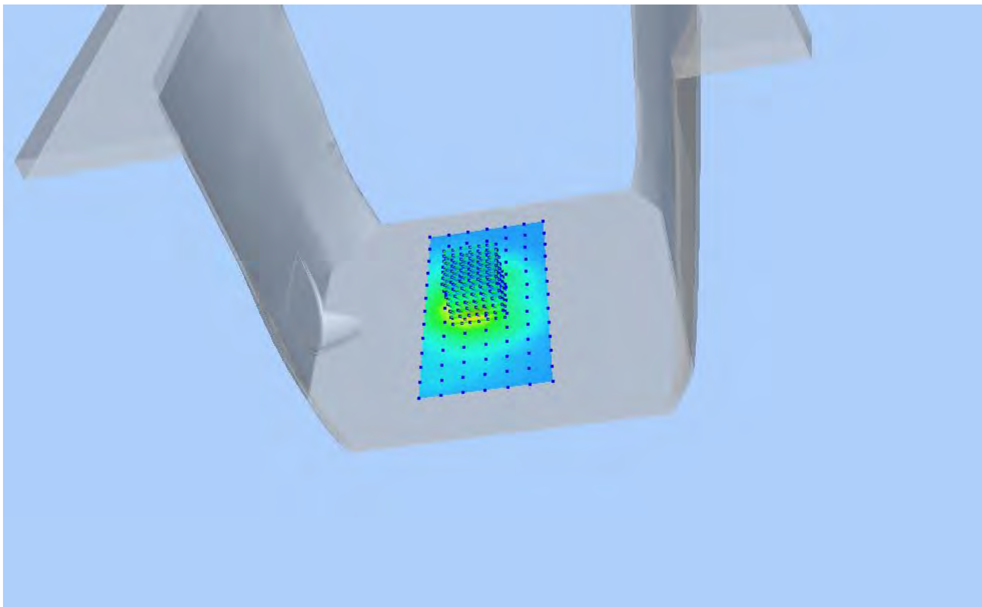
Z Axis Scan



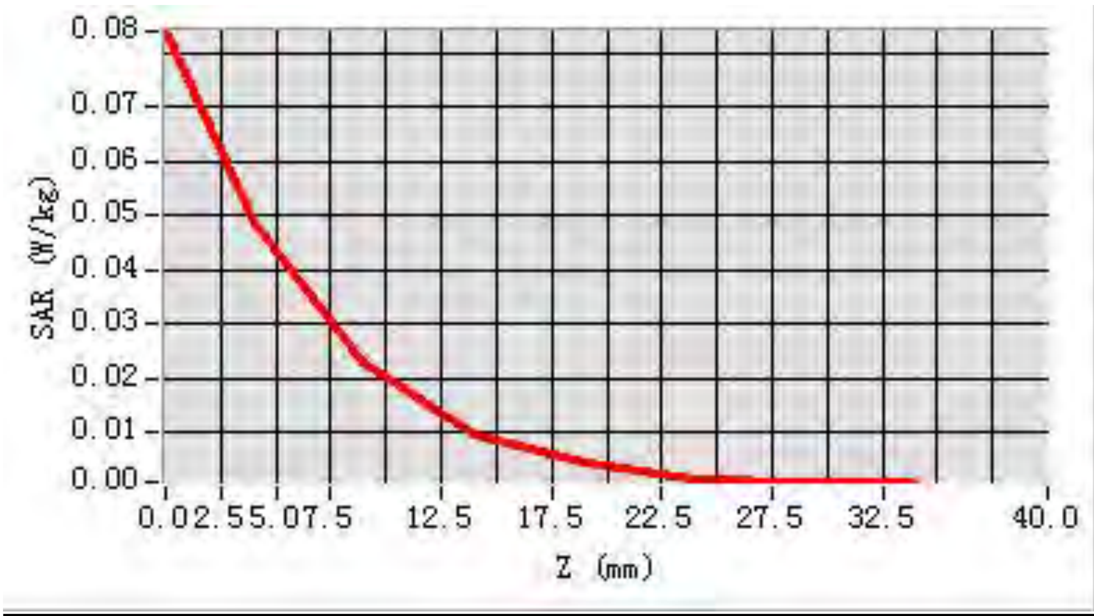
MEAS. 5 Body Plane with Top edge on High Channel in IEEE 802.11b mode

Test Date:	20/9/2015
Signal:	WLAN, f=2467.0 MHz, Duty Cycle: 1:1.0
Liquid Parameters:	Permittivity: 52.68; Conductivity: 1.97 S/m
Test condition:	Ambient Temperature: 22.5°C, Liquid Temperature: 22.1°C
Probe:	SN 27/14 SSE2 EPG 210, ConvF: 26.09
Area Scan:	sam_direct_droit2_surf12mm.txt, h= 5.00 mm
Zoom Scan:	5x5x7,dx=5mm, dy=5mm, dz=5mm,Complete
Maximum location:	X=-4.000000, Y=0.000000
SAR 10g (W/Kg):	0.018990
SAR 1g (W/Kg):	0.043893
Power drift (%):	-0.61

3D screen shot



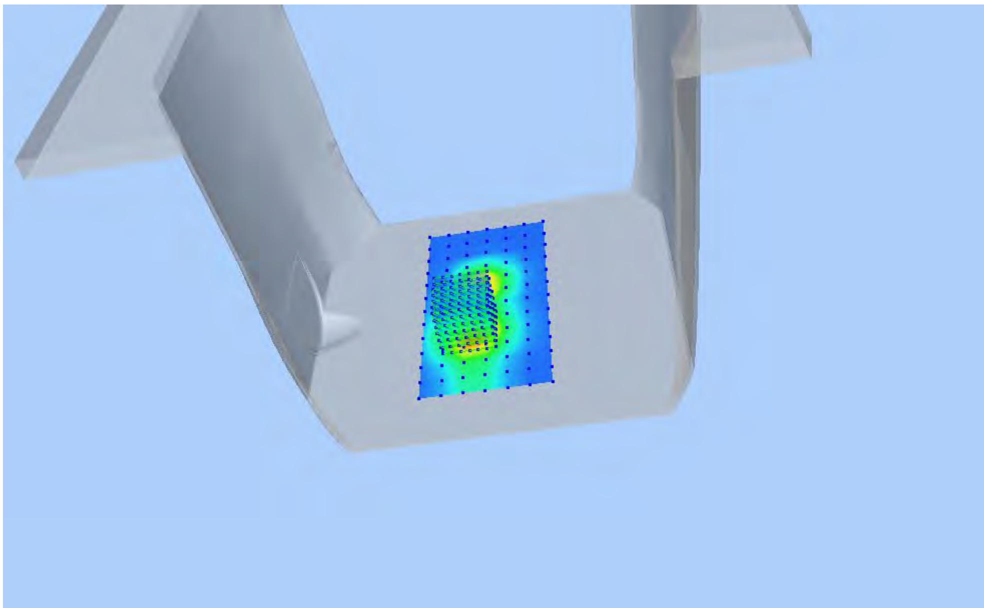
Z Axis Scan



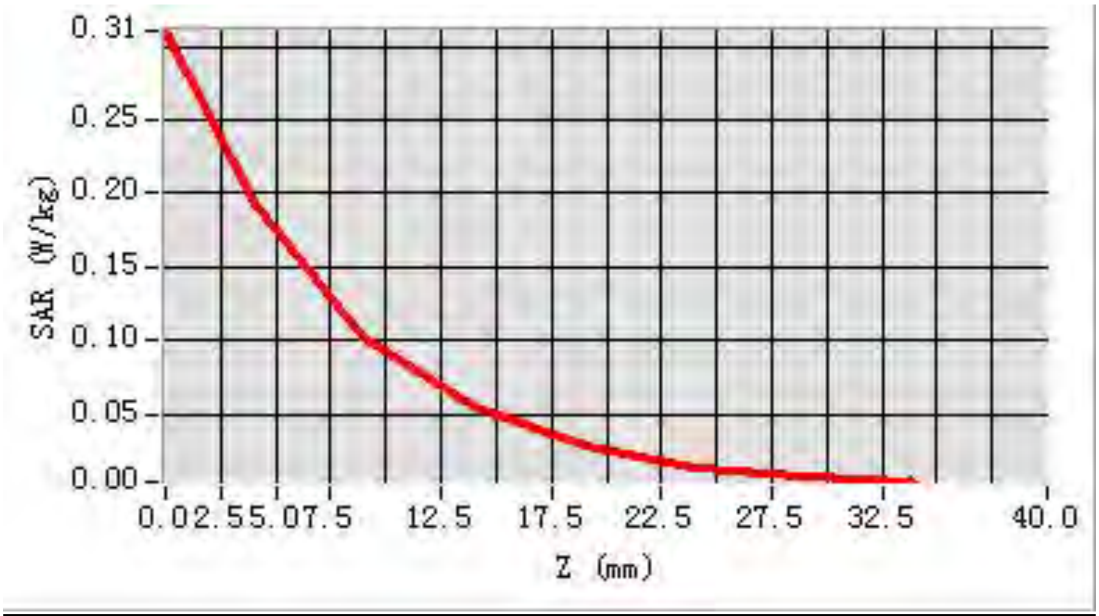
MEAS. 6 Body Plane with Horizontal-Up Side on Low Channel in IEEE 802.11g mode

Test Date:	20/9/2015
Signal:	WLAN, f=2412.0 MHz, Duty Cycle: 1:1.0
Liquid Parameters:	Permittivity: 52.75; Conductivity: 1.91 S/m
Test condition:	Ambient Temperature: 22.5°C, Liquid Temperature: 22.1°C
Probe:	SN 27/14 SSE2 EPG 210, ConvF: 26.09
Area Scan:	sam_direct_droit2_surf12mm.txt, h= 5.00 mm
Zoom Scan:	5x5x7,dx=5mm, dy=5mm, dz=5mm,Complete
Maximum location:	X=-16.000000, Y=-24.000000
SAR 10g (W/Kg):	0.085369
SAR 1g (W/Kg):	0.179418
Power drift (%):	0.72

3D screen shot



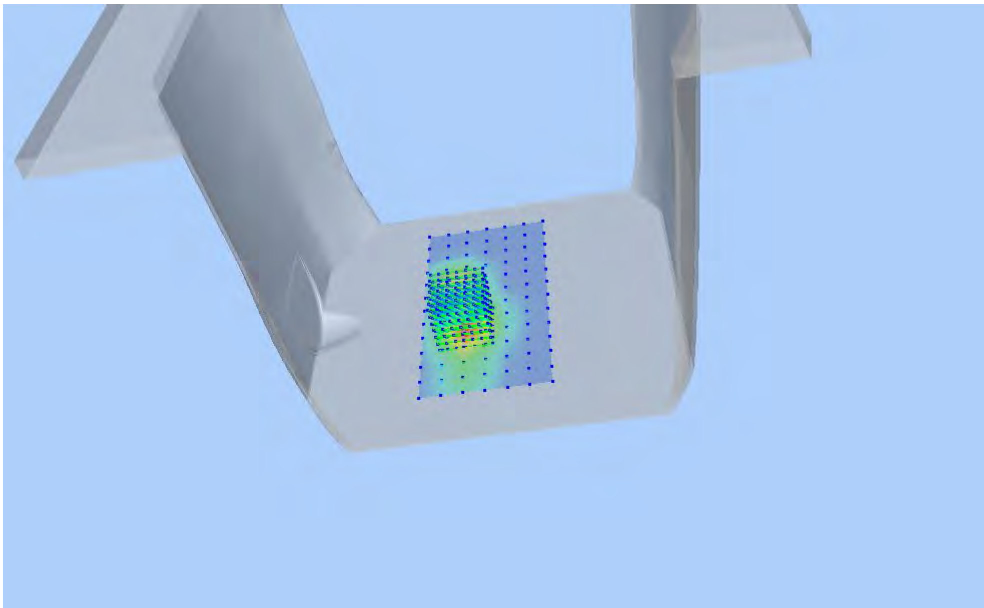
Z Axis Scan



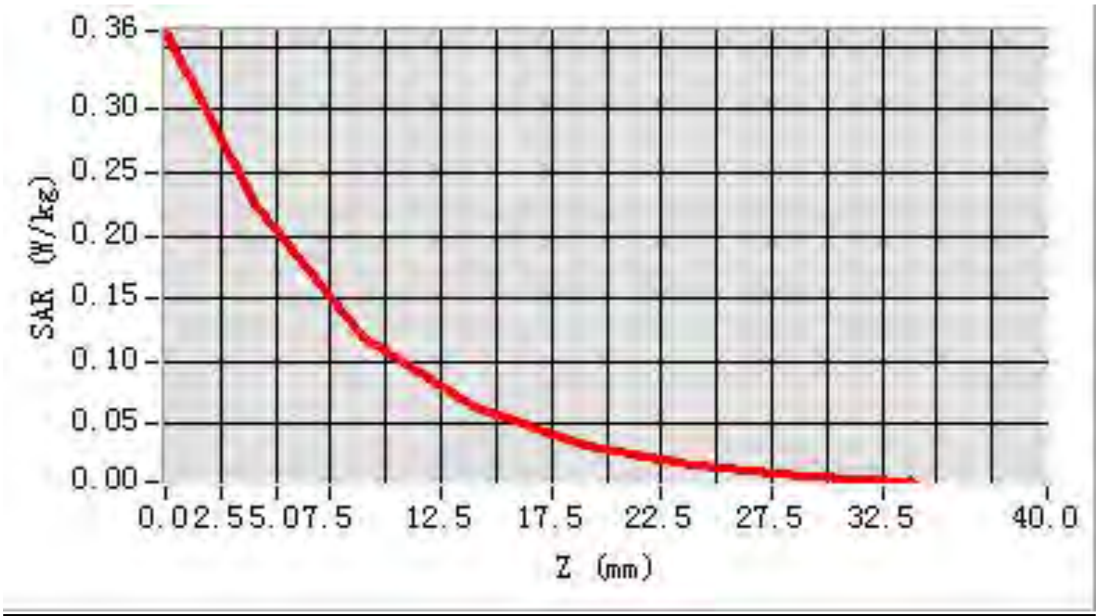
MEAS. 7 Body Plane with Horizontal-Down Side on Low Channel in IEEE 802.11g mode

Test Date:	20/9/2015
Signal:	WLAN, f=2412.0 MHz, Duty Cycle: 1:1.0
Liquid Parameters:	Permittivity: 52.75; Conductivity: 1.91 S/m
Test condition:	Ambient Temperature: 22.5°C, Liquid Temperature: 22.1°C
Probe:	SN 27/14 SSE2 EPG 210, ConvF: 26.09
Area Scan:	sam_direct_droit2_surf12mm.txt, h= 5.00 mm
Zoom Scan:	5x5x7,dx=5mm, dy=5mm, dz=5mm,Complete
Maximum location:	X=-16.000000, Y=-24.000000
SAR 10g (W/Kg):	0.099249
SAR 1g (W/Kg):	0.207982
Power drift (%):	2.13

3D screen shot



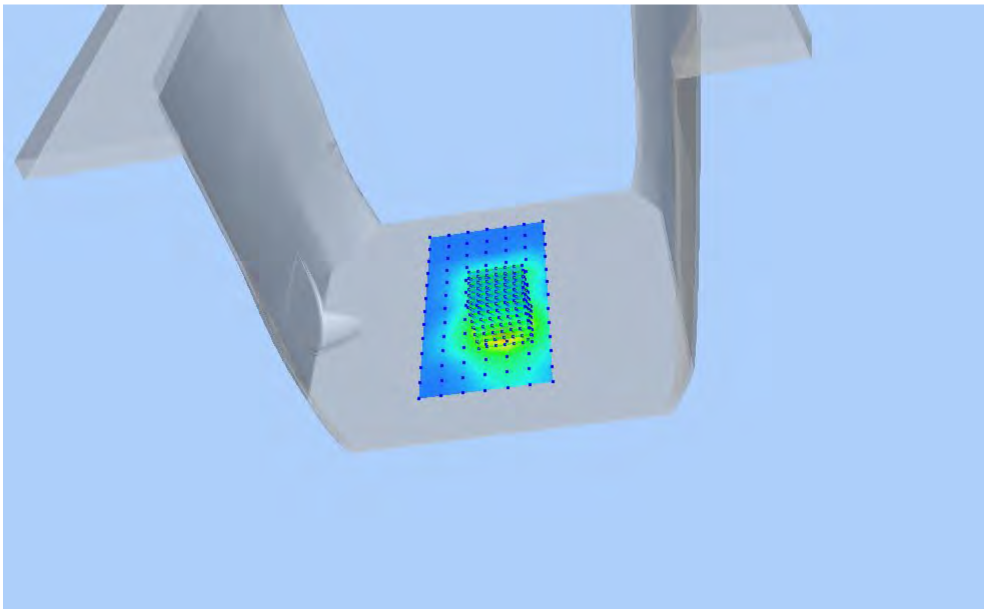
Z Axis Scan



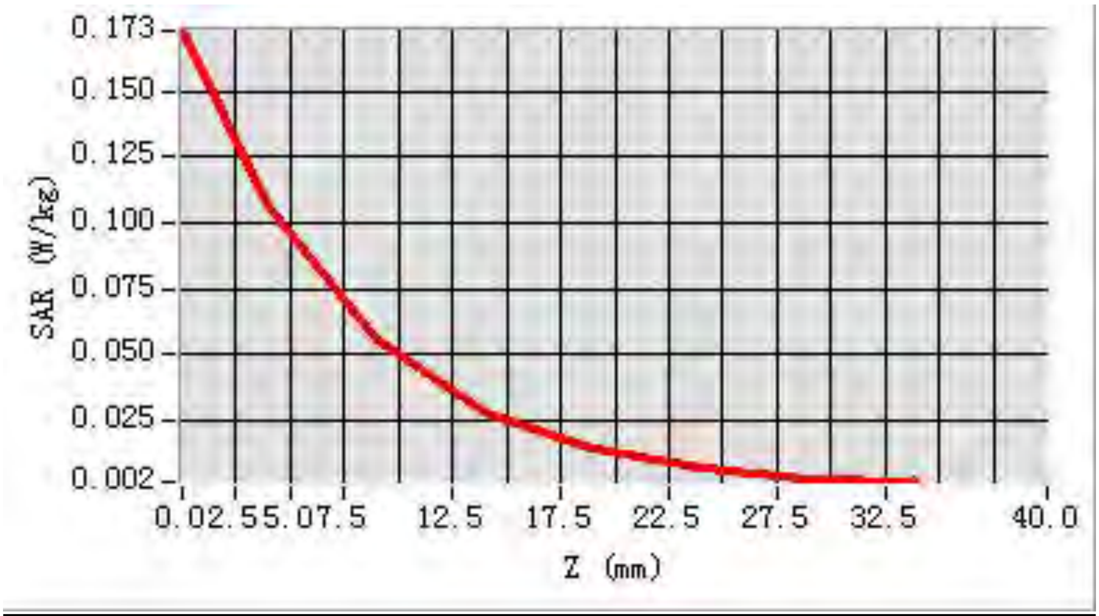
MEAS. 8 Body Plane with Vertical-Front Side on Low Channel in IEEE 802.11g mode

Test Date:	20/9/2015
Signal:	WLAN, f=2412.0 MHz, Duty Cycle: 1:1.0
Liquid Parameters:	Permittivity: 52.75; Conductivity: 1.91 S/m
Test condition:	Ambient Temperature: 22.5°C, Liquid Temperature: 22.1°C
Probe:	SN 27/14 SSE2 EPG 210, ConvF: 26.09
Area Scan:	sam_direct_droit2_surf12mm.txt, h= 5.00 mm
Zoom Scan:	5x5x7,dx=5mm, dy=5mm, dz=5mm,Complete
Maximum location:	X=8.000000, Y=-24.000000
SAR 10g (W/Kg):	0.047703
SAR 1g (W/Kg):	0.098739
Power drift (%):	-0.47

3D screen shot



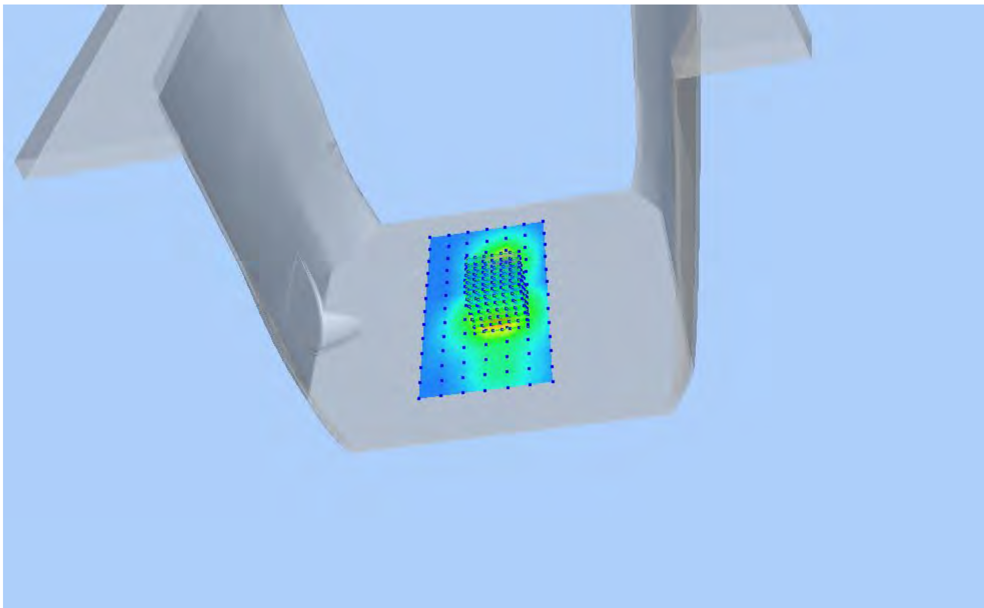
Z Axis Scan



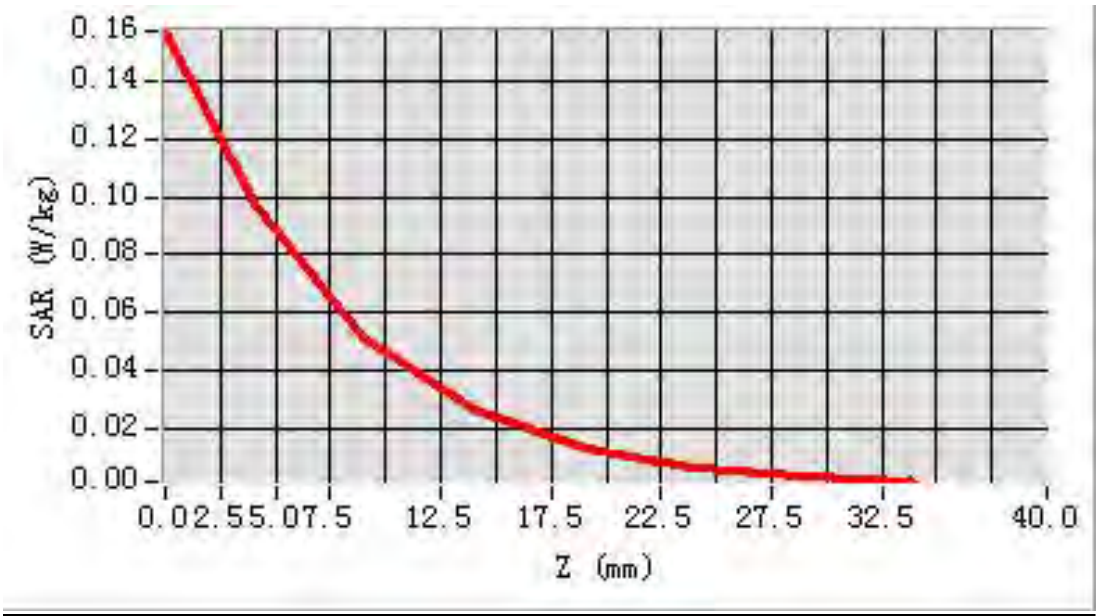
MEAS. 9 Body Plane with Vertical-Back Side on Low Channel in IEEE 802.11g mode

Test Date:	20/9/2015
Signal:	WLAN, f=2412.0 MHz, Duty Cycle: 1:1.0
Liquid Parameters:	Permittivity: 52.75; Conductivity: 1.91 S/m
Test condition:	Ambient Temperature: 22.5°C, Liquid Temperature: 22.1°C
Probe:	SN 27/14 SSE2 EPG 210, ConvF: 26.09
Area Scan:	sam_direct_droit2_surf12mm.txt, h= 5.00 mm
Zoom Scan:	5x5x7,dx=5mm, dy=5mm, dz=5mm,Complete
Maximum location:	X=8.000000, Y=-12.000000
SAR 10g (W/Kg):	0.043372
SAR 1g (W/Kg):	0.089679
Power drift (%):	-0.23

3D screen shot



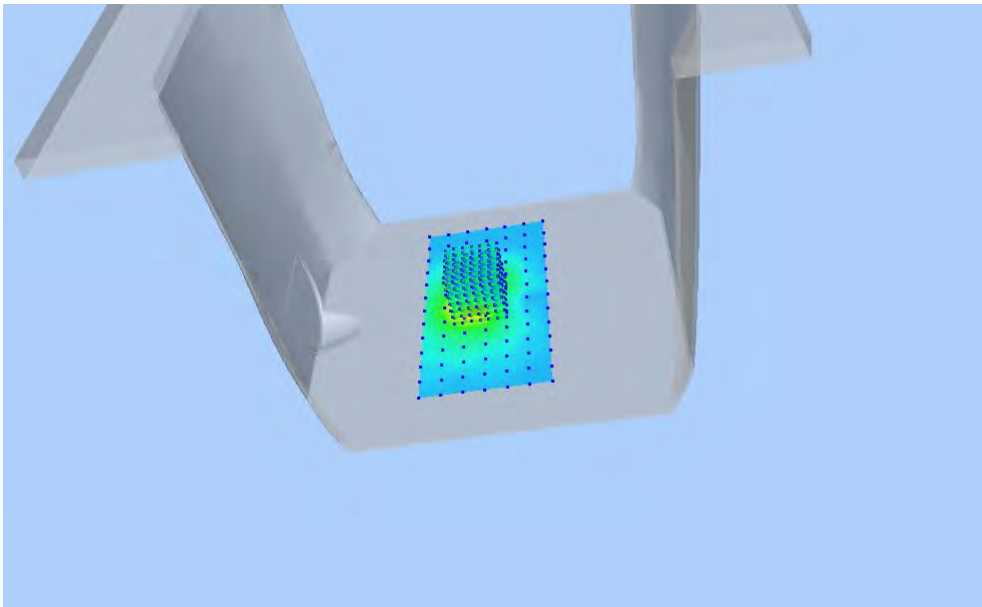
Z Axis Scan



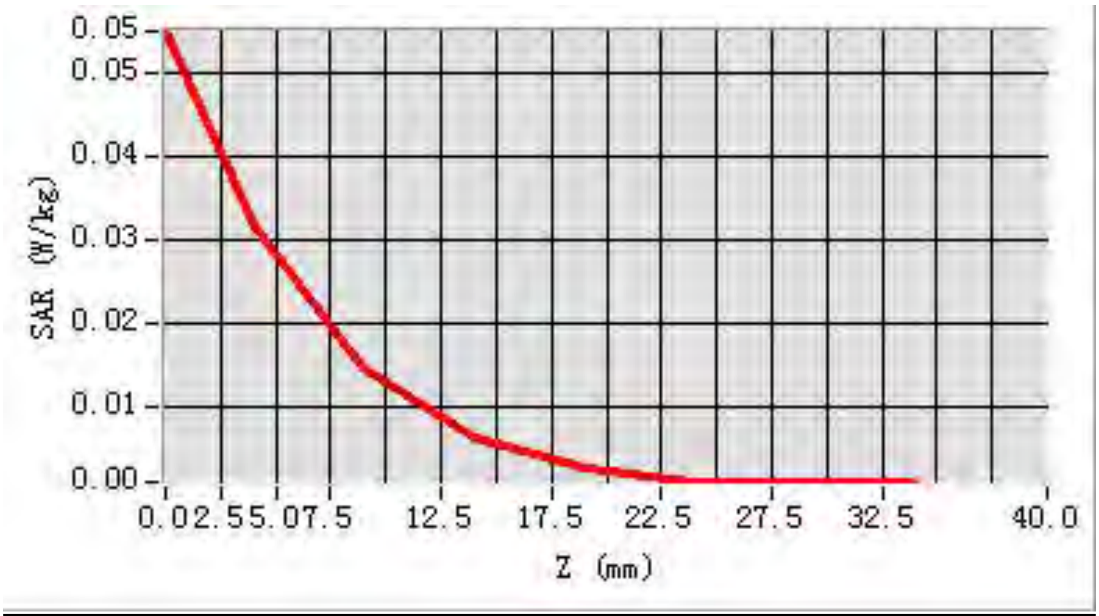
MEAS. 10 Body Plane with Top edge on Low Channel in IEEE 802.11g mode

Test Date:	20/9/2015
Signal:	WLAN, f=2412.0 MHz, Duty Cycle: 1:1.0
Liquid Parameters:	Permittivity: 52.75; Conductivity: 1.91 S/m
Test condition:	Ambient Temperature: 22.5°C, Liquid Temperature: 22.1°C
Probe:	SN 27/14 SSE2 EPG 210, ConvF: 26.09
Area Scan:	sam_direct_droit2_surf12mm.txt, h= 5.00 mm
Zoom Scan:	5x5x7,dx=5mm, dy=5mm, dz=5mm,Complete
Maximum location:	X=-4.000000, Y=0.000000
SAR 10g (W/Kg):	0.012156
SAR 1g (W/Kg):	0.028217
Power drift (%):	2.62

3D screen shot



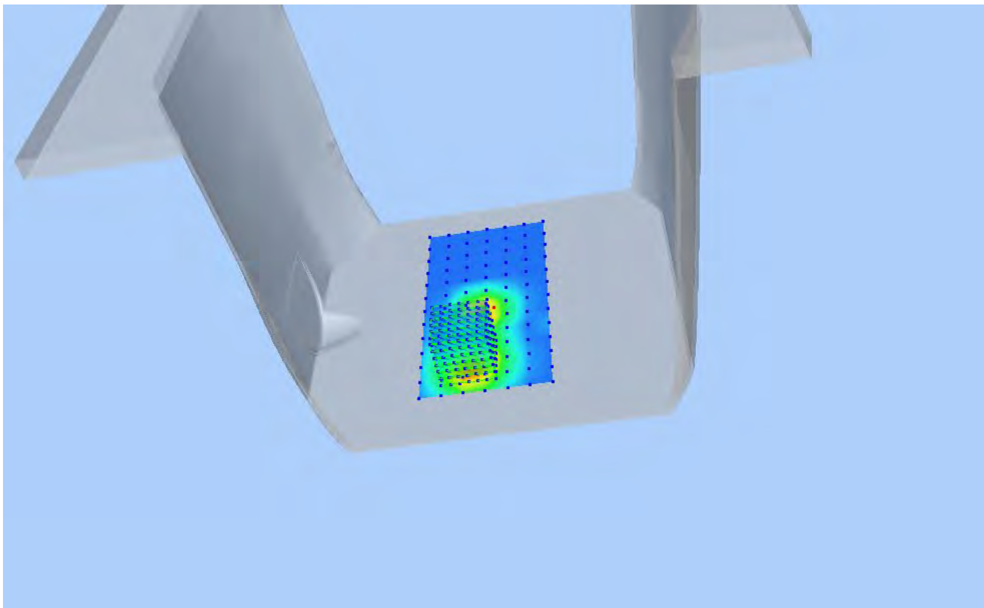
Z Axis Scan



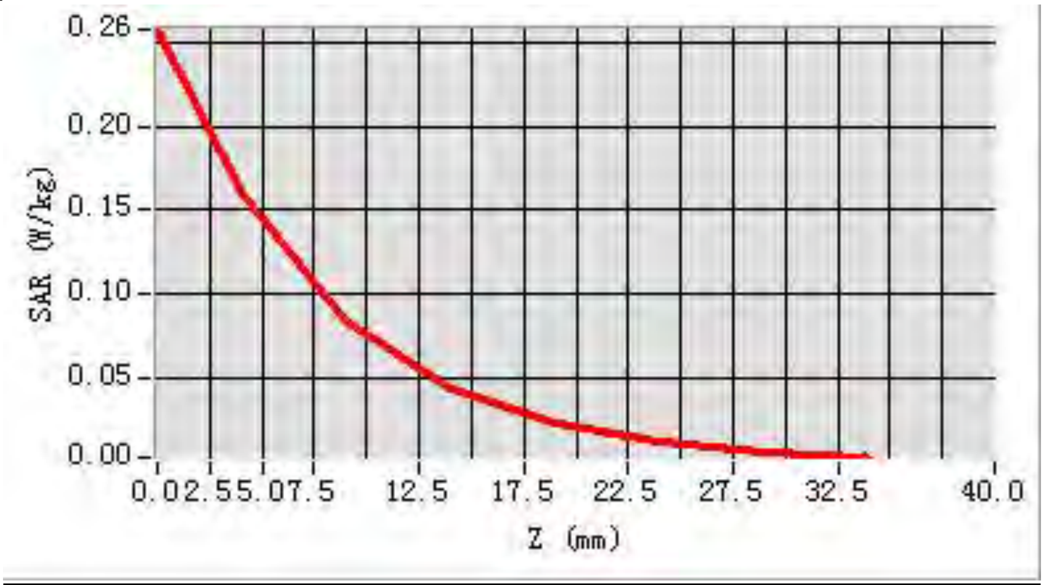
MEAS. 11 Body Plane with Horizontal-Up Side on Low Channel in IEEE 802.11n(HT-20) mode

Test Date:	20/9/2015
Signal:	WLAN, f=2412.0 MHz, Duty Cycle: 1:1.0
Liquid Parameters:	Permittivity: 52.75; Conductivity: 1.91 S/m
Test condition:	Ambient Temperature: 22.5°C, Liquid Temperature: 22.1°C
Probe:	SN 27/14 SSE2 EPG 210, ConvF: 26.09
Area Scan:	sam_direct_droit2_surf12mm.txt, h= 5.00 mm
Zoom Scan:	5x5x7,dx=5mm, dy=5mm, dz=5mm,Complete
Maximum location:	X=-16.000000, Y=-48.000000
SAR 10g (W/Kg):	0.070028
SAR 1g (W/Kg):	0.146661
Power drift (%):	0.18

3D screen shot



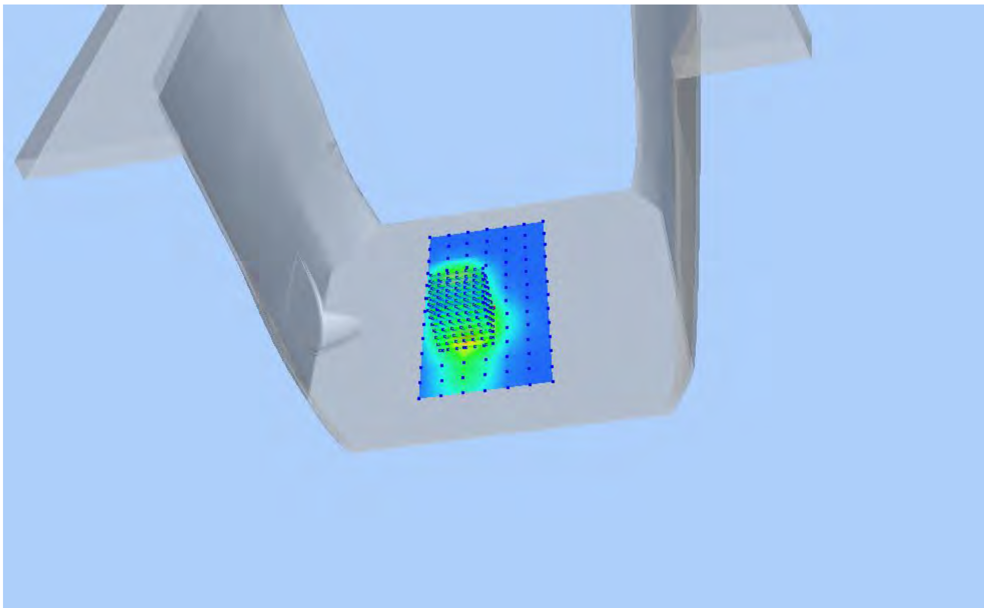
Z Axis Scan



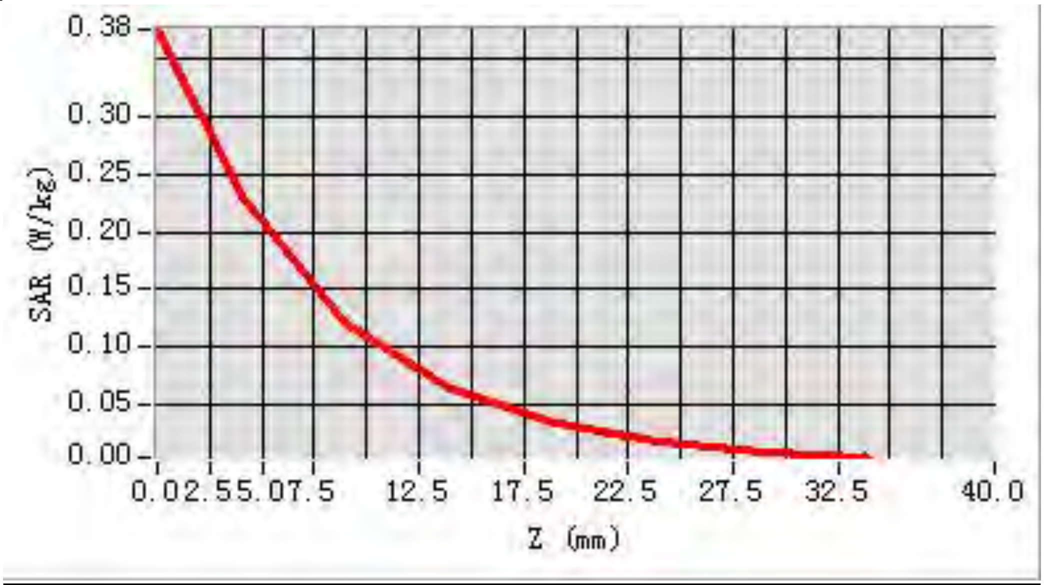
MEAS. 12 Body Plane with Horizontal-Down Side on Low Channel in IEEE 802.11n(HT-20) mode

Test Date:	20/9/2015
Signal:	WLAN, f=2412.0 MHz, Duty Cycle: 1:1.0
Liquid Parameters:	Permittivity: 52.75; Conductivity: 1.91 S/m
Test condition:	Ambient Temperature: 22.5°C, Liquid Temperature: 22.1°C
Probe:	SN 27/14 SSE2 EPG 210, ConvF: 26.09
Area Scan:	sam_direct_droit2_surf12mm.txt, h= 5.00 mm
Zoom Scan:	5x5x7,dx=5mm, dy=5mm, dz=5mm,Complete
Maximum location:	X=-16.000000, Y=-24.000000
SAR 10g (W/Kg):	0.101516
SAR 1g (W/Kg):	0.214048
Power drift (%):	4.97

3D screen shot

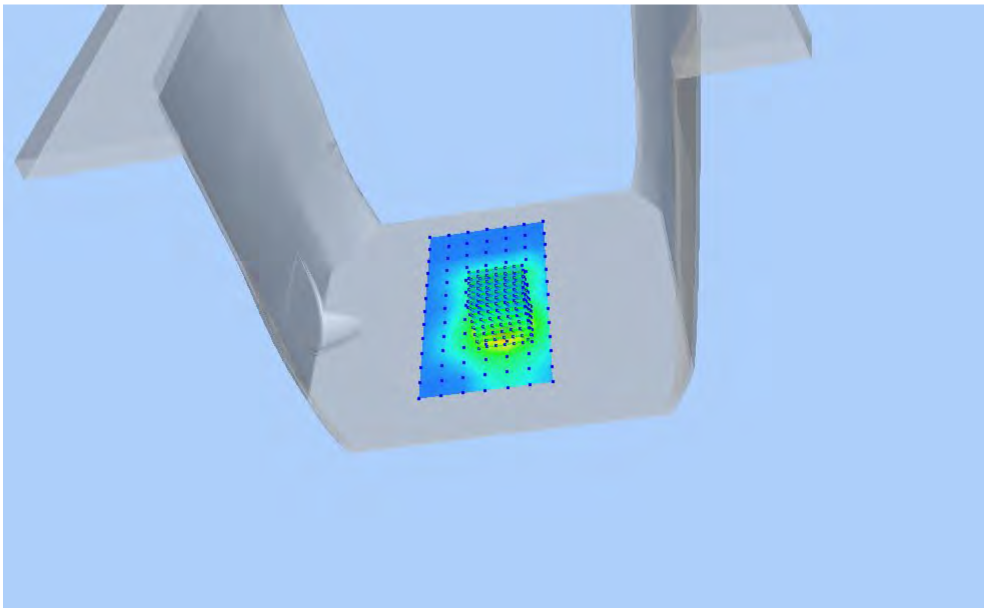


Z Axis Scan

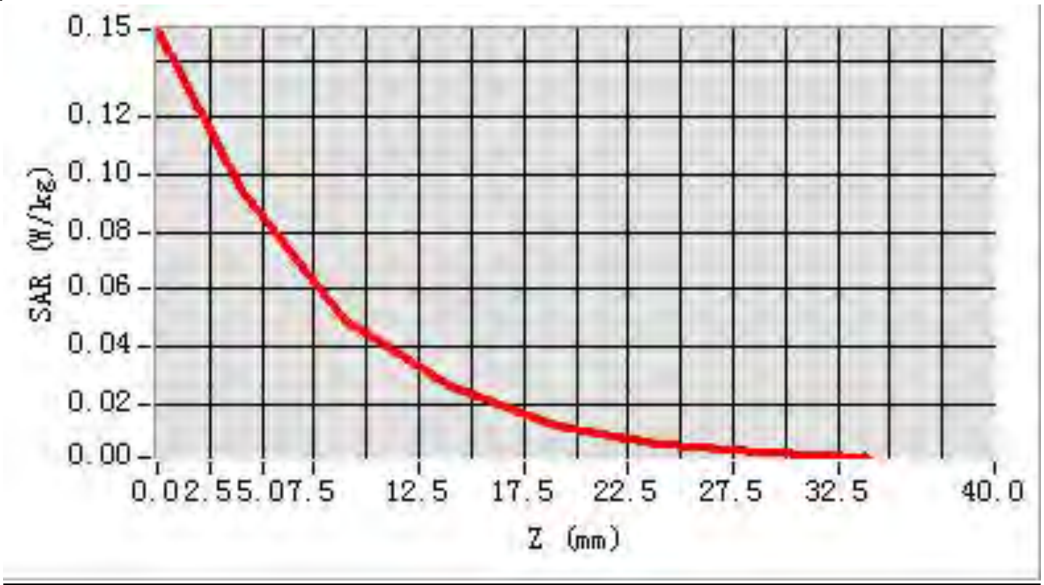


MEAS. 13 Body Plane with Vertical-Front Side on Low Channel in IEEE 802.n(HT-20) mode

Test Date: 20/9/2015
Signal: WLAN, f=2412.0 MHz, Duty Cycle: 1:1.0
Liquid Parameters: Permittivity: 52.75; Conductivity: 1.91 S/m
Test condition: Ambient Temperature: 22.5°C, Liquid Temperature: 22.1°C
Probe: SN 27/14 SSE2 EPG 210, ConvF: 26.09
Area Scan: sam_direct_droit2_surf12mm.txt, h= 5.00 mm
Zoom Scan: 5x5x7,dx=5mm, dy=5mm, dz=5mm,Complete
Maximum location: X=8.000000, Y=-24.000000
SAR 10g (W/Kg): 0.042708
SAR 1g (W/Kg): 0.087611
Power drift (%): -3.04
3D screen shot



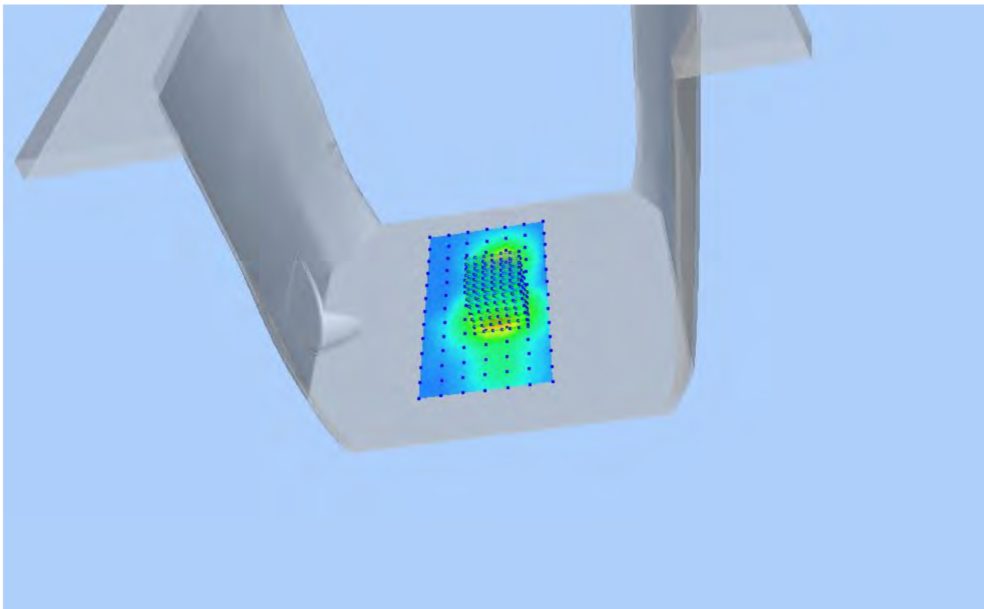
Z Axis Scan



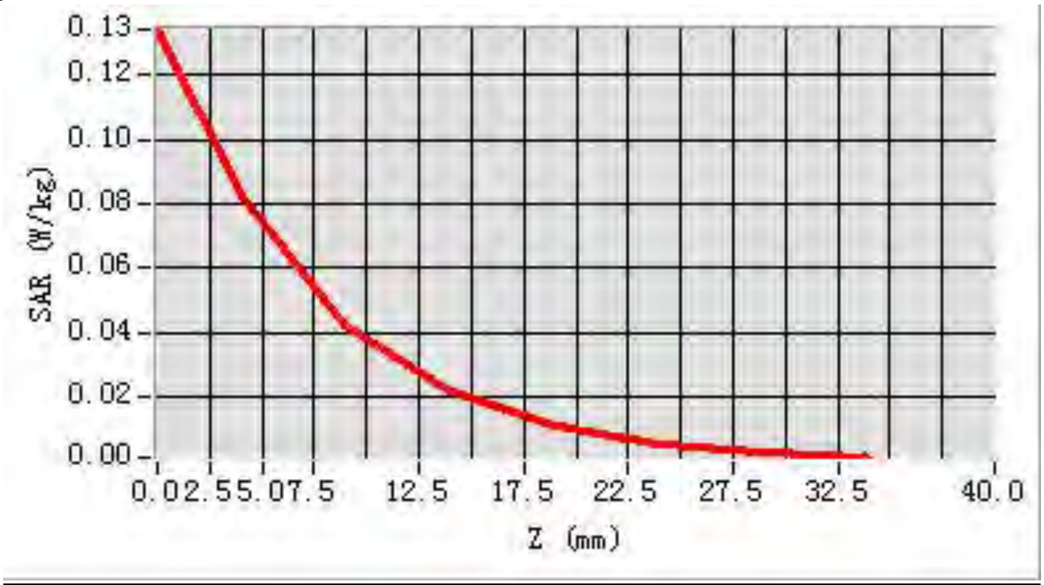
MEAS. 14 Body Plane with Vertical-Back Side on Low Channel in IEEE 802.11n (HT-20) mode

Test Date:	20/9/2015
Signal:	WLAN, f=2412.0 MHz, Duty Cycle: 1:1.0
Liquid Parameters:	Permittivity: 52.75; Conductivity: 1.91 S/m
Test condition:	Ambient Temperature: 22.5°C, Liquid Temperature: 22.1°C
Probe:	SN 27/14 SSE2 EPG 210, ConvF: 26.09
Area Scan:	sam_direct_droit2_surf12mm.txt, h= 5.00 mm
Zoom Scan:	5x5x7,dx=5mm, dy=5mm, dz=5mm,Complete
Maximum location:	X=8.000000, Y=-12.000000
SAR 10g (W/Kg):	0.036420
SAR 1g (W/Kg):	0.076012
Power drift (%):	0.25

3D screen shot

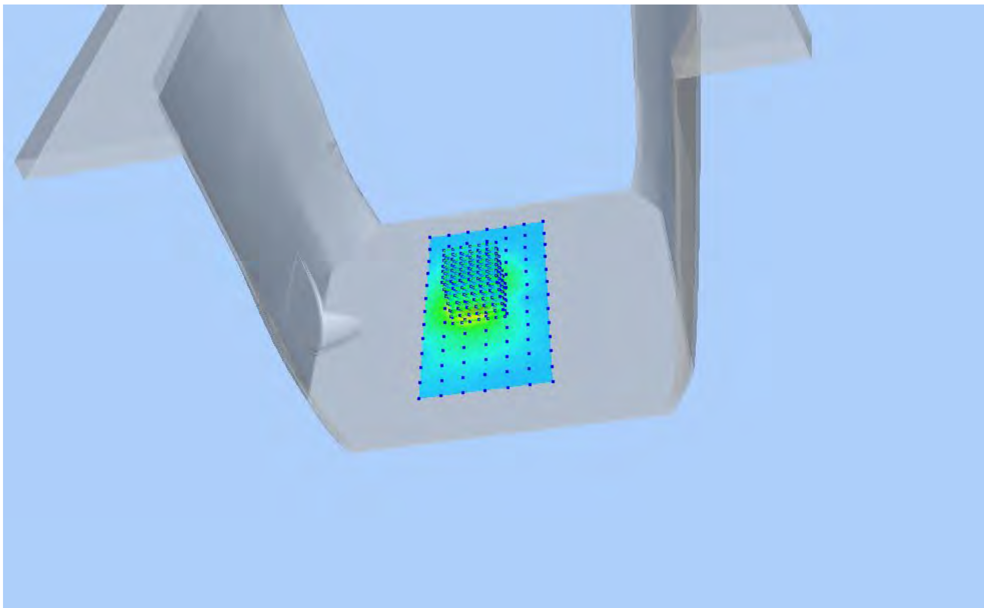


Z Axis Scan

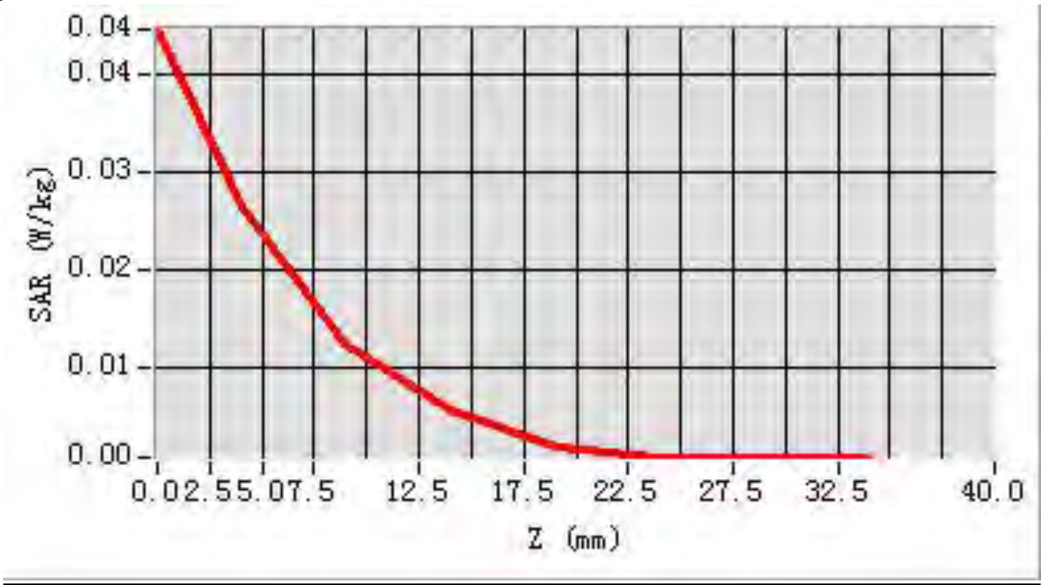


MEAS. 15 Body Plane with Top edge on Low Channel in IEEE 802.11n (HT-20) mode

Test Date: 20/9/2015
Signal: WLAN, f=2412.0 MHz, Duty Cycle: 1:1.0
Liquid Parameters: Permittivity: 52.75; Conductivity: 1.91 S/m
Test condition: Ambient Temperature: 22.5°C, Liquid Temperature: 22.1°C
Probe: SN 27/14 SSE2 EPG 210, ConvF: 26.09
Area Scan: sam_direct_droit2_surf12mm.txt, h= 5.00 mm
Zoom Scan: 5x5x7,dx=5mm, dy=5mm, dz=5mm,Complete
Maximum location: X=-4.000000, Y=0.000000
SAR 10g (W/Kg): 0.010142
SAR 1g (W/Kg): 0.023868
Power drift (%): -2.73
3D screen shot



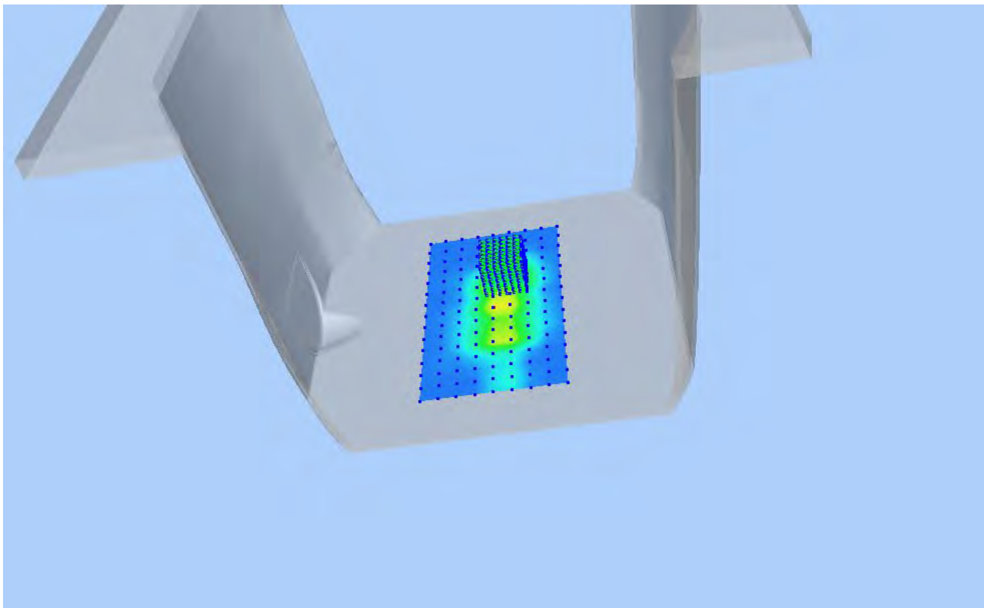
Z Axis Scan



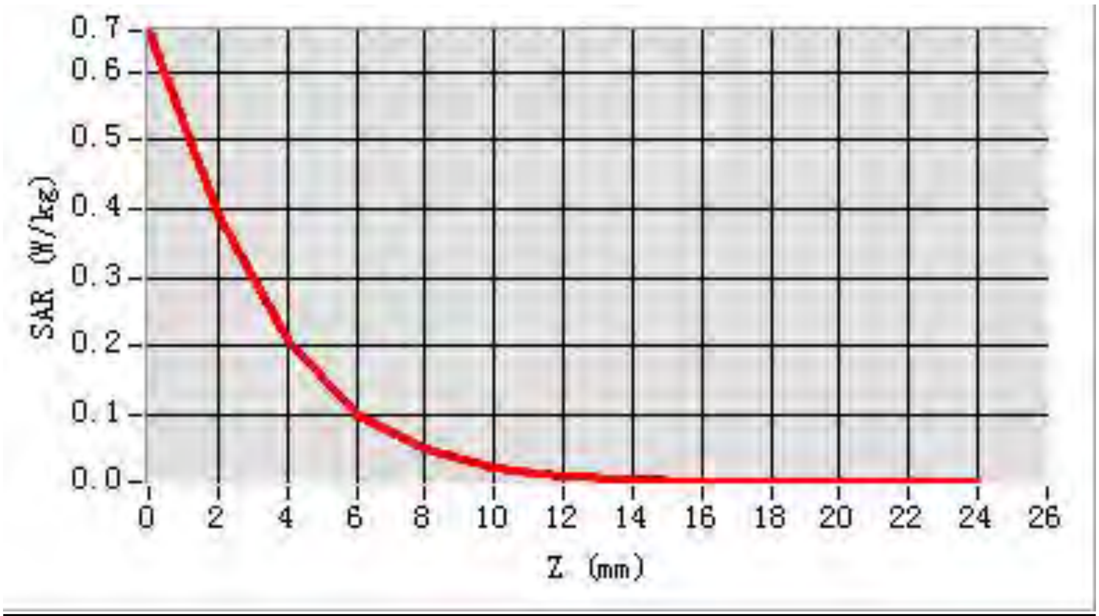
MEAS. 16 Body Plane with Horizontal-Up Side on 165 Channel in IEEE 802.11a mode

Test Date:	21/9/2015
Signal:	WLAN, f=5825.0 MHz, Duty Cycle: 1:1.0
Liquid Parameters:	Permittivity: 48.04; Conductivity: 6.02 S/m
Test condition:	Ambient Temperature: 22.5°C, Liquid Temperature: 22.1°C
Probe:	EPG 210, ConvF: 23.20
Area Scan:	sam_direct_droit2_surf10mm.txt, h= 5.00 mm
Zoom Scan:	5x5x7,dx=4mm, dy=4mm, dz=2mm,Complete
Maximum location:	X=10.000000, Y=18.000000
SAR 10g (W/Kg):	0.074218
SAR 1g (W/Kg):	0.2820311
Power drift (%):	-4.84

3D screen shot



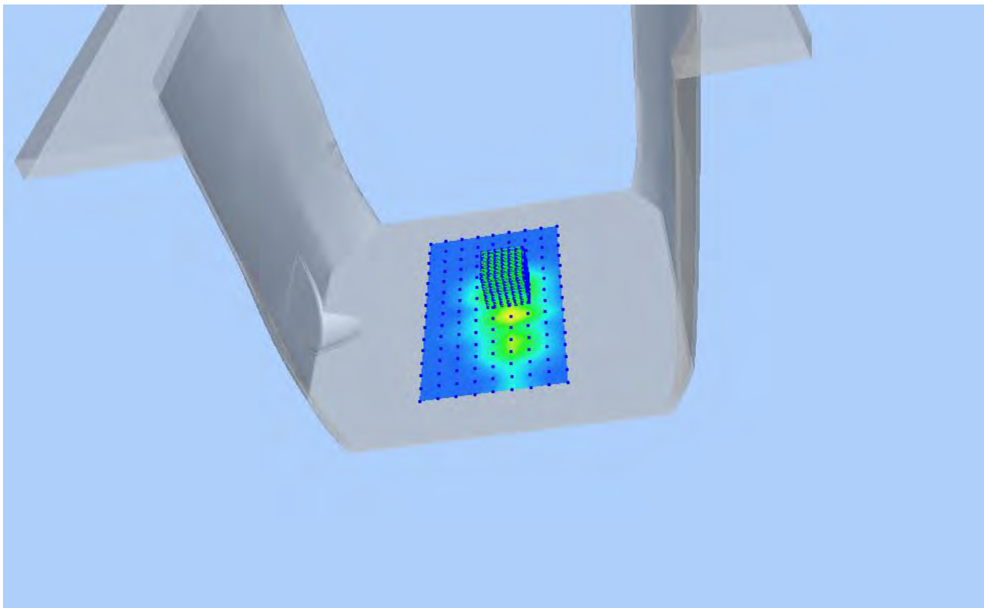
Z Axis Scan



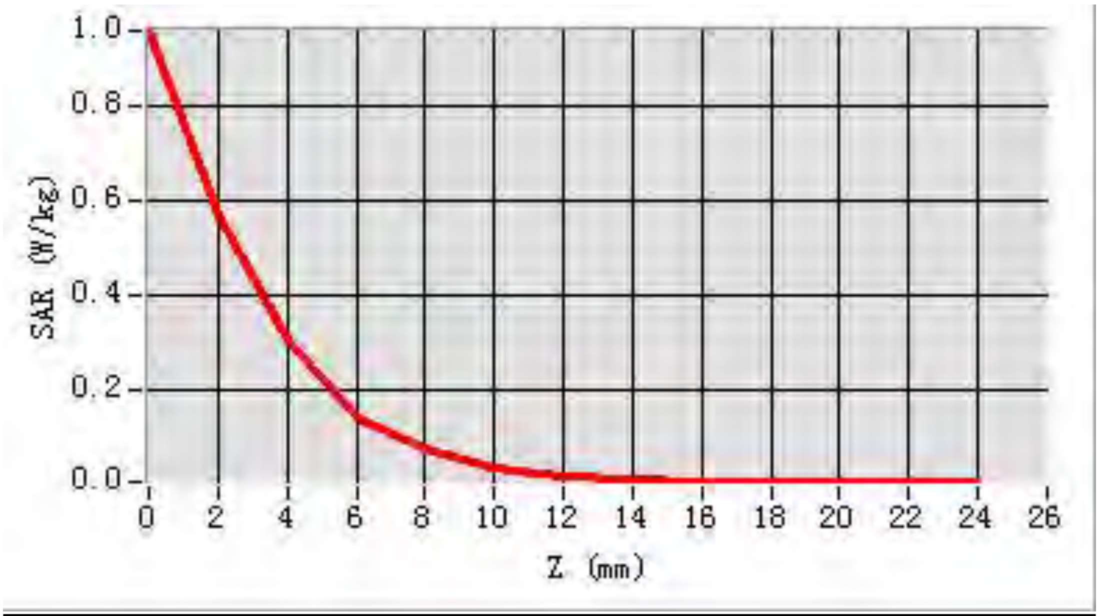
MEAS. 17 Body Plane with Horizontal-Down Side on 165 Channel in IEEE 802.11a mode

Test Date:	21/9/2015
Signal:	WLAN, f=5825.0 MHz, Duty Cycle: 1:1.0
Liquid Parameters:	Permittivity: 48.04; Conductivity: 6.02 S/m
Test condition:	Ambient Temperature: 22.5°C, Liquid Temperature: 22.1°C
Probe:	EPG 210, ConvF: 23.20
Area Scan:	sam_direct_droit2_surf10mm.txt, h= 5.00 mm
Zoom Scan:	5x5x7,dx=4mm, dy=4mm, dz=2mm,Complete
Maximum location:	X=10.000000, Y=8.000000
SAR 10g (W/Kg):	0.103298
SAR 1g (W/Kg):	0.397230
Power drift (%):	-2.57

3D screen shot



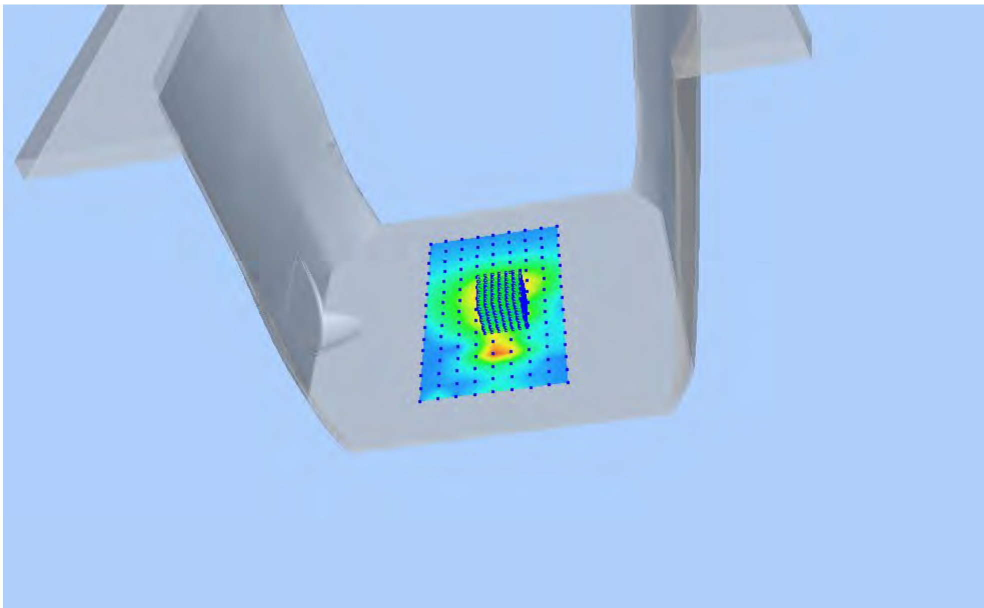
Z Axis Scan



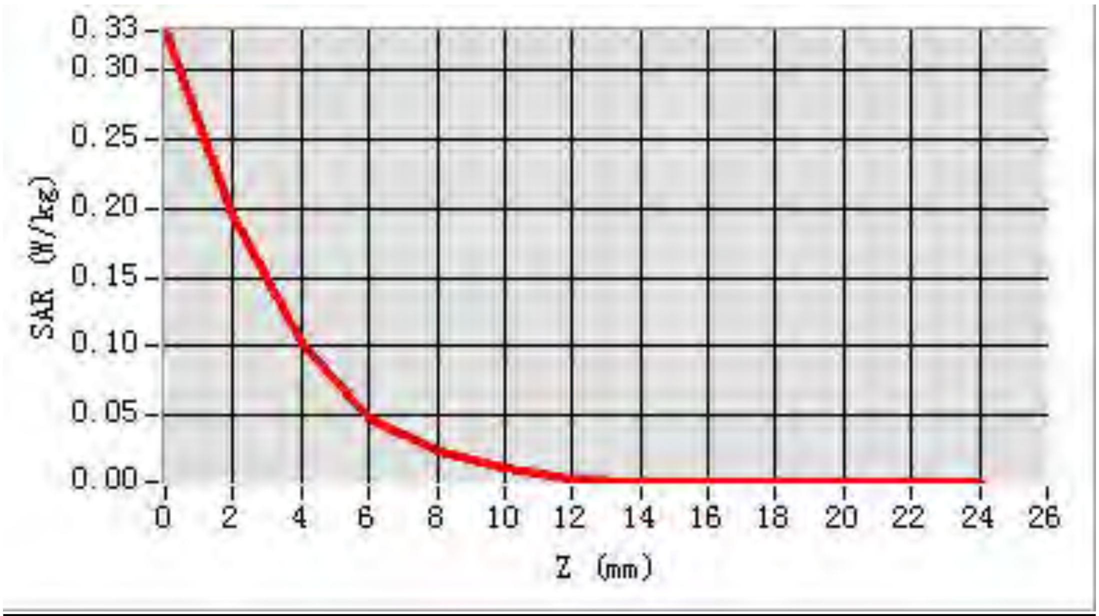
MEAS. 18 Body Plane with Vertical-Front Side on 165 Channel in IEEE 802.11a mode

Test Date:	21/9/2015
Signal:	WLAN, f=5825.0 MHz, Duty Cycle: 1:1.0
Liquid Parameters:	Permittivity: 48.04; Conductivity: 6.02 S/m
Test condition:	Ambient Temperature: 22.5°C, Liquid Temperature: 22.1°C
Probe:	EPG 210, ConvF: 23.20
Area Scan:	sam_direct_droit2_surf10mm.txt, h= 5.00 mm
Zoom Scan:	5x5x7,dx=4mm, dy=4mm, dz=2mm,Complete
Maximum location:	X=10.000000, Y=-12.000000
SAR 10g (W/Kg):	0.038050
SAR 1g (W/Kg):	0.163526
Power drift (%):	0.08

3D screen shot



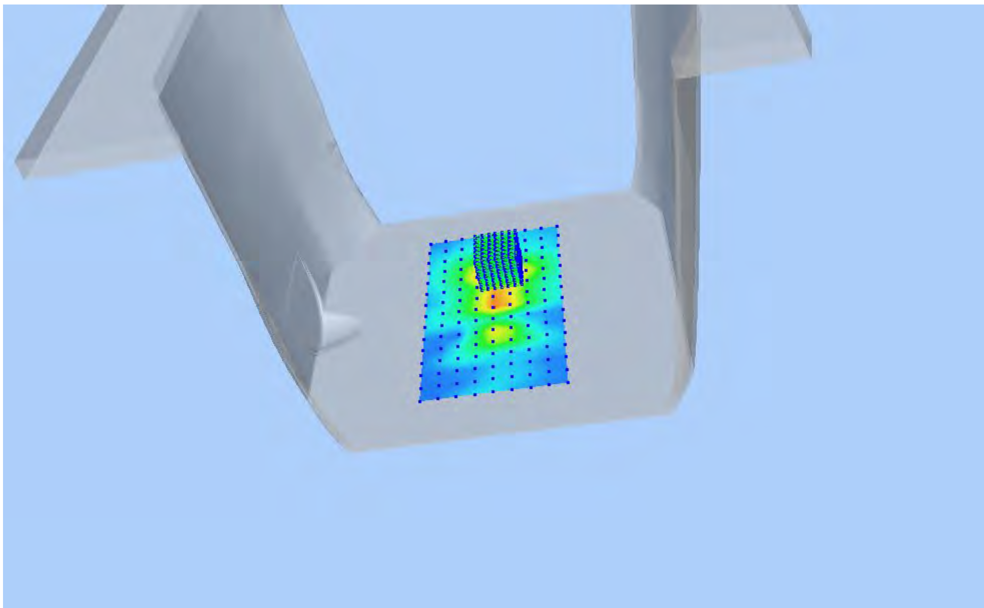
Z Axis Scan



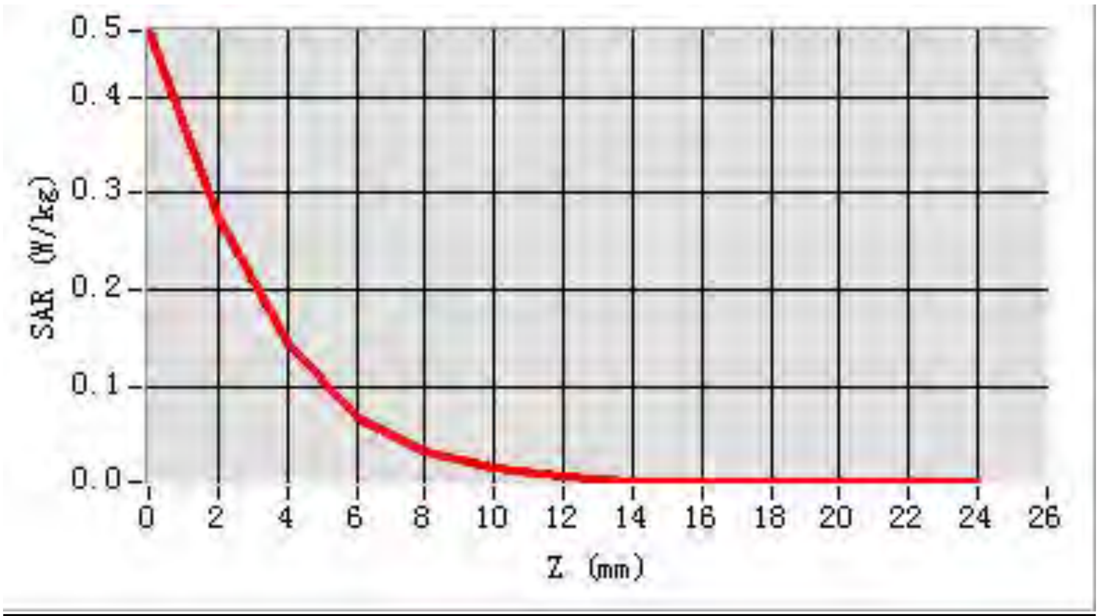
MEAS. 19 Body Plane with Vertical-Back Side on 165 Channel in IEEE 802.11a mode

Test Date:	21/9/2015
Signal:	WLAN, f=5825.0 MHz, Duty Cycle: 1:1.0
Liquid Parameters:	Permittivity: 48.04; Conductivity: 6.02 S/m
Test condition:	Ambient Temperature: 22.5°C, Liquid Temperature: 22.1°C
Probe:	SN 27/14 SSE2 EPG 210, ConvF: 23.20
Area Scan:	sam_direct_droit2_surf10mm.txt, h= 5.00 mm
Zoom Scan:	5x5x7,dx=4mm, dy=4mm, dz=2mm,Complete
Maximum location:	X=0.000000, Y=28.000000
SAR 10g (W/Kg):	0.059675
SAR 1g (W/Kg):	0.208612
Power drift (%):	-3.77

3D screen shot



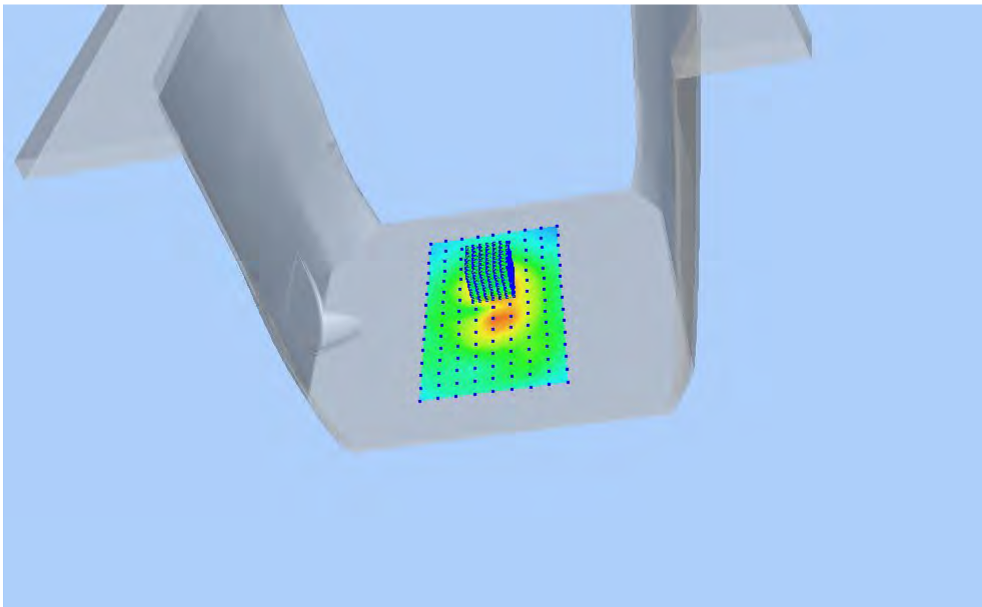
Z Axis Scan



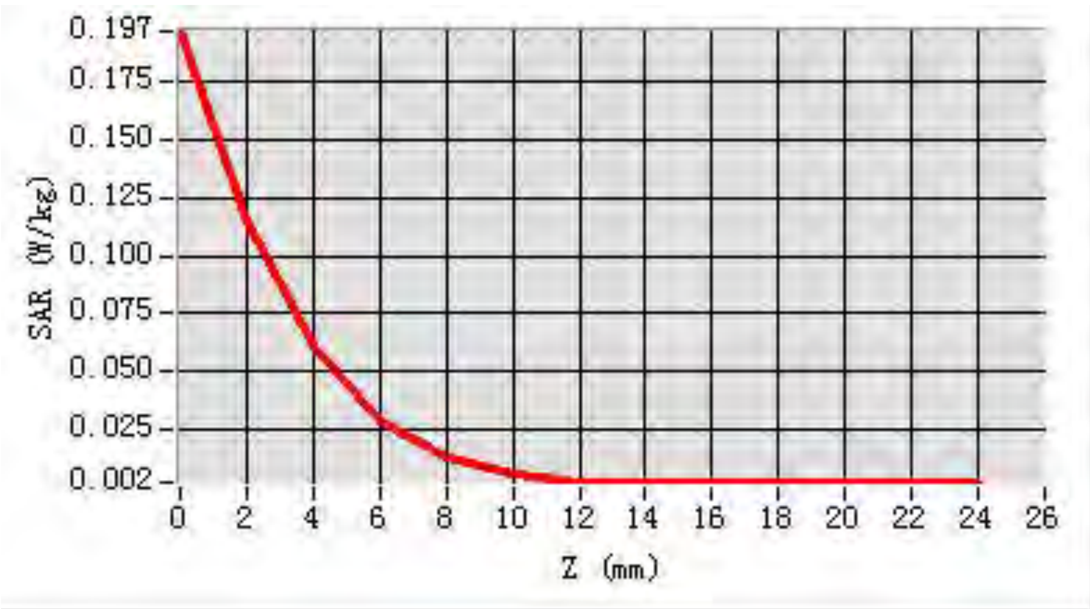
MEAS. 20 Body Plane with Top edge on 165 Channel in IEEE 802.11a mode

Test Date:	21/9/2015
Signal:	WLAN, f=5825.0 MHz, Duty Cycle: 1:1.0
Liquid Parameters:	Permittivity: 48.04; Conductivity: 6.02 S/m
Test condition:	Ambient Temperature: 22.5°C, Liquid Temperature: 22.1°C
Probe:	SN 27/14 SSE2 EPG 210, ConvF: 23.20
Area Scan:	sam_direct_droit2_surf10mm.txt, h= 5.00 mm
Zoom Scan:	5x5x7,dx=4mm, dy=4mm, dz=2mm,Complete
Maximum location:	X=0.000000, Y=18.000000
SAR 10g (W/Kg):	0.089050
SAR 1g (W/Kg):	0.108457571
Power drift (%):	-0.37

3D screen shot



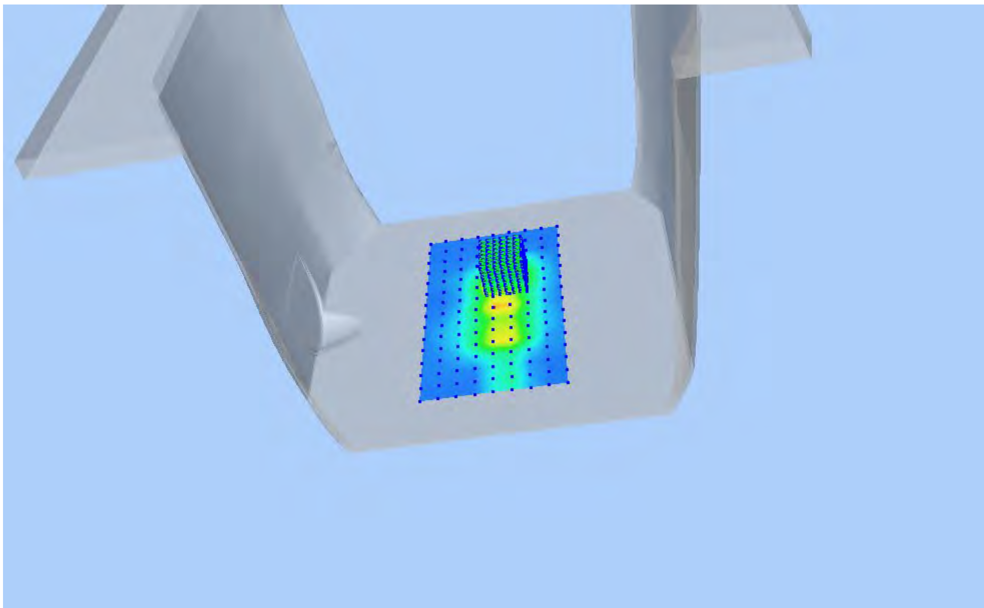
Z Axis Scan



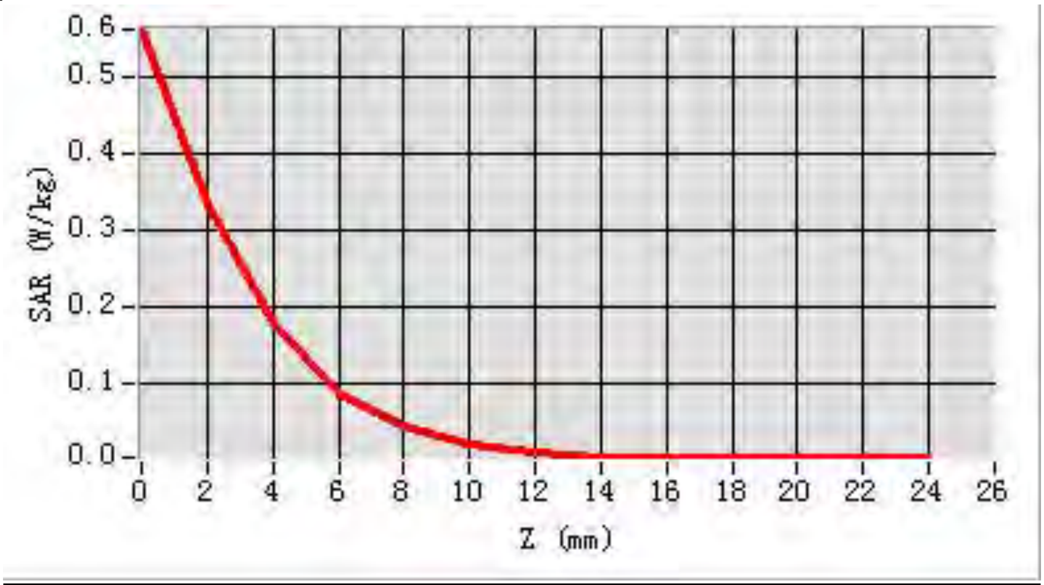
MEAS. 21 Body Plane with Horizontal-Up Side on 149 Channel in IEEE 802.11ac(HT-20) mode

Test Date:	21/9/2015
Signal:	WLAN, f=5745.0 MHz, Duty Cycle: 1:1.0
Liquid Parameters:	Permittivity: 48.19; Conductivity: 5.91 S/m
Test condition:	Ambient Temperature: 22.5°C, Liquid Temperature: 22.1°C
Probe:	SN 27/14 SSE2 EPG 210, ConvF: 23.20
Area Scan:	sam_direct_droit2_surf10mm.txt, h= 5.00 mm
Zoom Scan:	5x5x7,dx=4mm, dy=4mm, dz=2mm,Complete
Maximum location:	X=10.000000, Y=18.000000
SAR 10g (W/Kg):	0.165619
SAR 1g (W/Kg):	0.2703
Power drift (%):	-3.94

3D screen shot



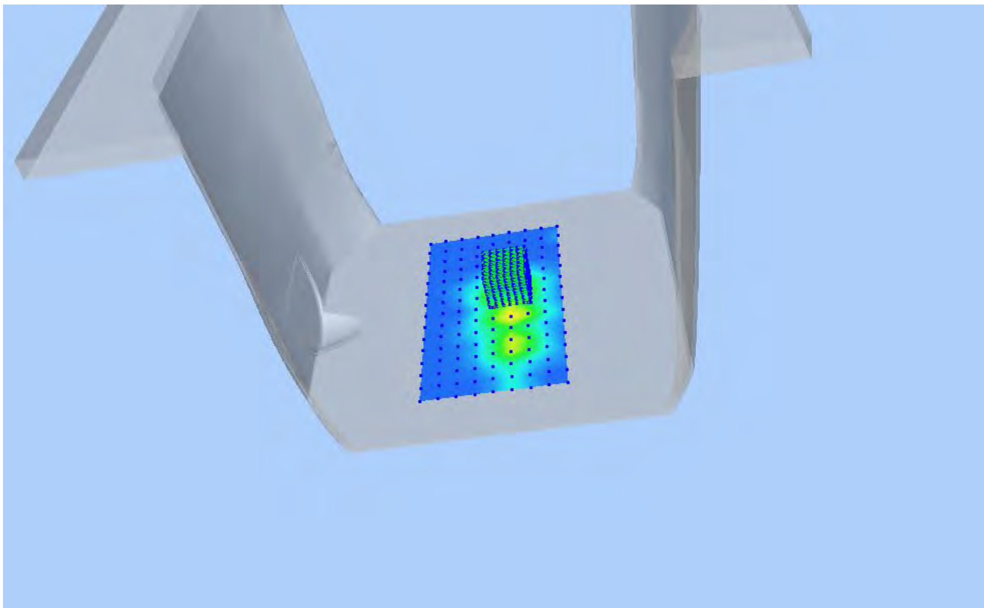
Z Axis Scan



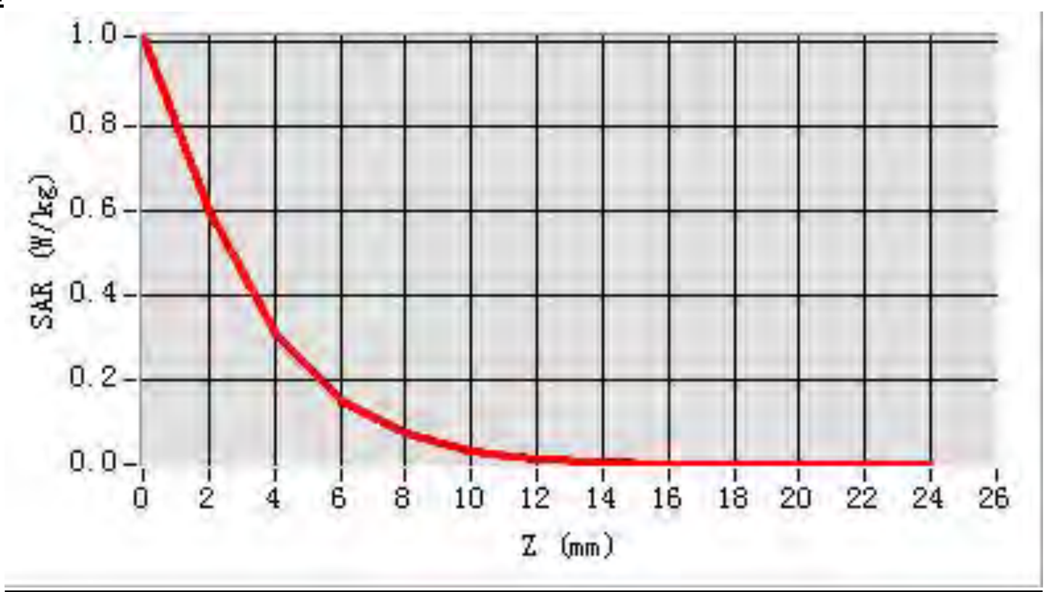
MEAS. 22 Body Plane with Horizontal-Down Side on 149 Channel in IEEE 802.11ac(HT-20) mode

Test Date:	21/9/2015
Signal:	WLAN, f=5745.0 MHz, Duty Cycle: 1:1.0
Liquid Parameters:	Permittivity: 48.19; Conductivity: 5.91 S/m
Test condition:	Ambient Temperature: 22.5°C, Liquid Temperature: 22.1°C
Probe:	SN 27/14 SSE2 EPG 210, ConvF: 23.20
Area Scan:	sam_direct_droit2_surf10mm.txt, h= 5.00 mm
Zoom Scan:	5x5x7,dx=4mm, dy=4mm, dz=2mm,Complete
Maximum location:	X=10.000000, Y=8.000000
SAR 10g (W/Kg):	0.110268
SAR 1g (W/Kg):	0.396495
Power drift (%):	-2.23

3D screen shot



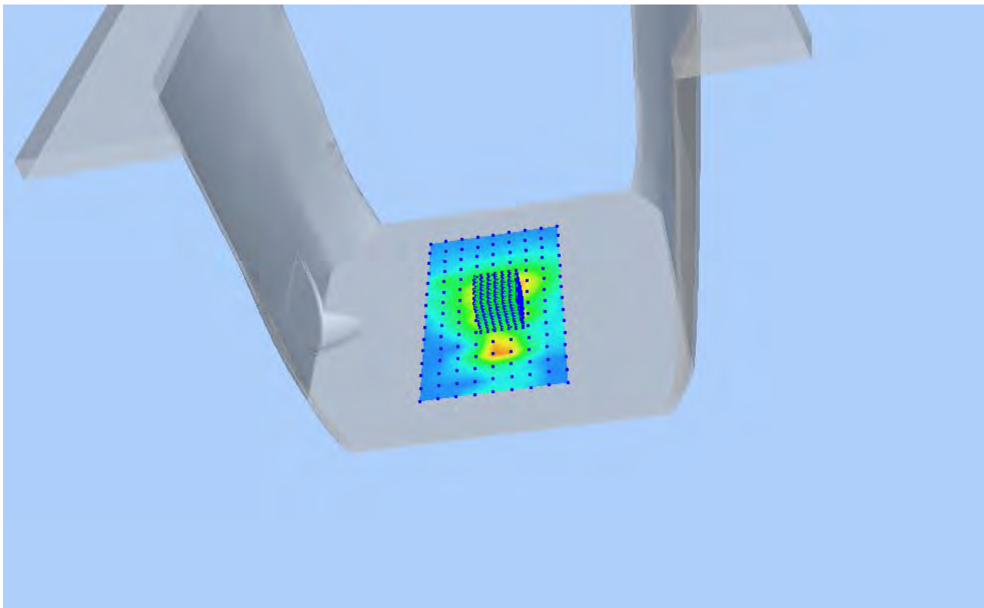
Z Axis Scan



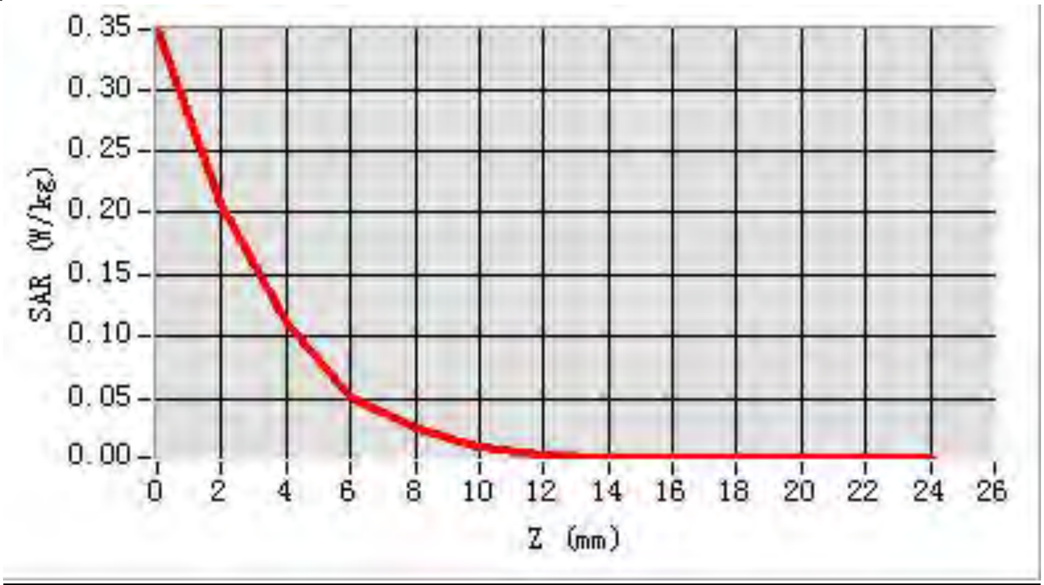
MEAS. 23 Body Plane with Vertical-Front Side on 149 Channel in IEEE 802.11ac(HT-20) mode

Test Date:	21/9/2015
Signal:	WLAN, f=5745.0 MHz, Duty Cycle: 1:1.0
Liquid Parameters:	Permittivity: 48.19; Conductivity: 5.91 S/m
Test condition:	Ambient Temperature: 22.5°C, Liquid Temperature: 22.1°C
Probe:	SN 27/14 SSE2 EPG 210, ConvF: 23.20
Area Scan:	sam_direct_droit2_surf10mm.txt, h= 5.00 mm
Zoom Scan:	5x5x7,dx=4mm, dy=4mm, dz=2mm,Complete
Maximum location:	X=0.000000, Y=-12.000000
SAR 10g (W/Kg):	0.538890
SAR 1g (W/Kg):	0.157135
Power drift (%):	-1.88

3D screen shot



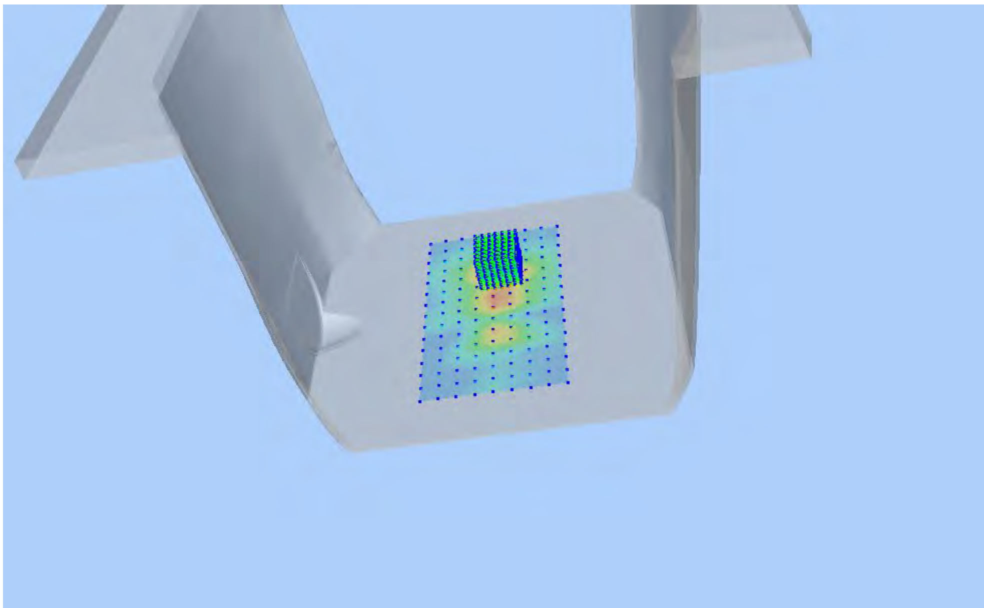
Z Axis Scan



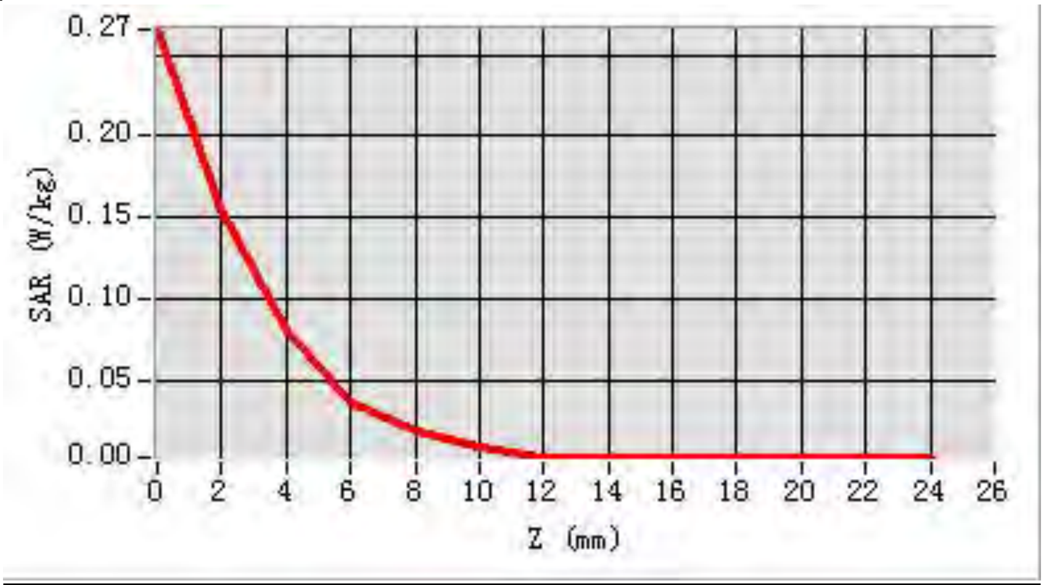
MEAS. 24 Body Plane with Vertical-Back Side on 149 Channel in IEEE 802.11ac(HT-20) mode

Test Date:	21/9/2015
Signal:	WLAN, f=5745.0 MHz, Duty Cycle: 1:1.0
Liquid Parameters:	Permittivity: 48.19; Conductivity: 5.91 S/m
Test condition:	Ambient Temperature: 22.5°C, Liquid Temperature: 22.1°C
Probe:	SN 27/14 SSE2 EPG 210, ConvF: 23.20
Area Scan:	sam_direct_droit2_surf10mm.txt, h= 5.00 mm
Zoom Scan:	5x5x7,dx=4mm, dy=4mm, dz=2mm,Complete
Maximum location:	X=0.000000, Y=28.000000
SAR 10g (W/Kg):	0.035447
SAR 1g (W/Kg):	0.13492
Power drift (%):	-3.46

3D screen shot



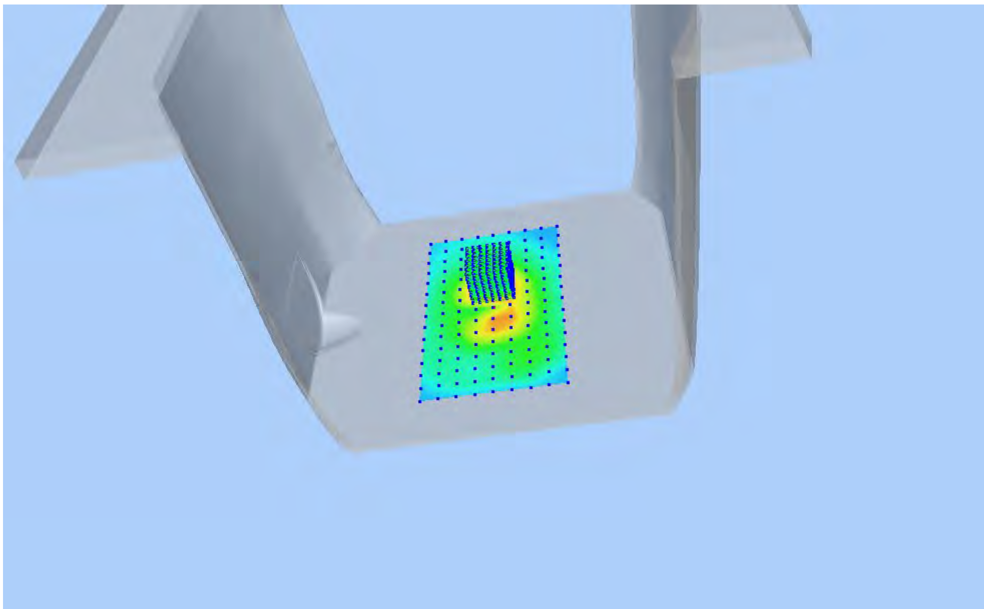
Z Axis Scan



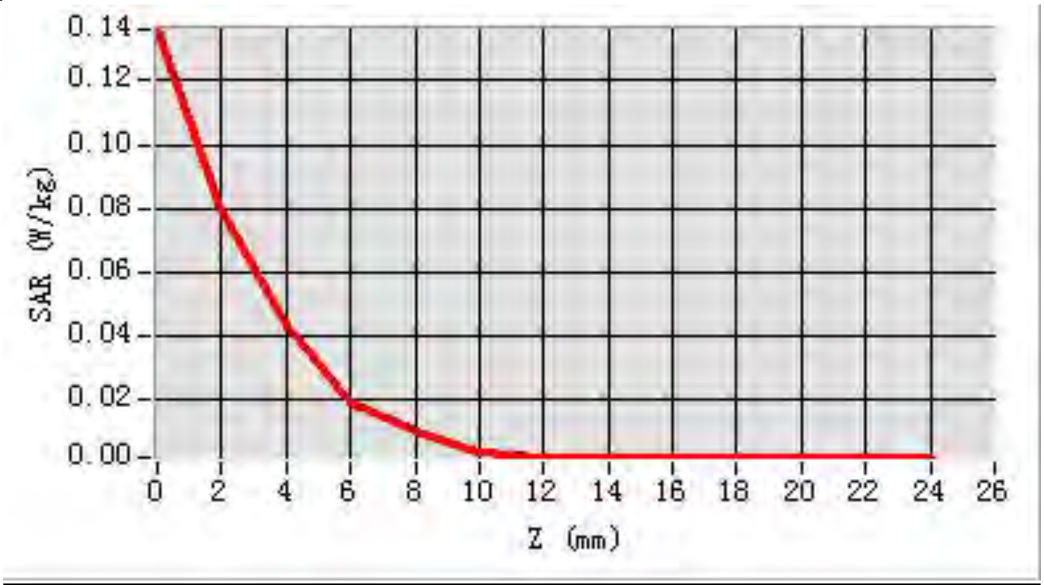
MEAS. 25 Body Plane with Top edge on 149 Channel in IEEE 802.11ac(HT-20) mode

Test Date:	21/9/2015
Signal:	WLAN, f=5745.0 MHz, Duty Cycle: 1:1.0
Liquid Parameters:	Permittivity: 48.19; Conductivity: 5.91 S/m
Test condition:	Ambient Temperature: 22.5°C, Liquid Temperature: 22.1°C
Probe:	SN 27/14 SSE2 EPG 210, ConvF: 23.20
Area Scan:	sam_direct_droit2_surf10mm.txt, h= 5.00 mm
Zoom Scan:	5x5x7,dx=4mm, dy=4mm, dz=2mm,Complete
Maximum location:	X=0.000000, Y=18.000000
SAR 10g (W/Kg):	0.023467
SAR 1g (W/Kg):	0.078173
Power drift (%):	-4.08

3D screen shot



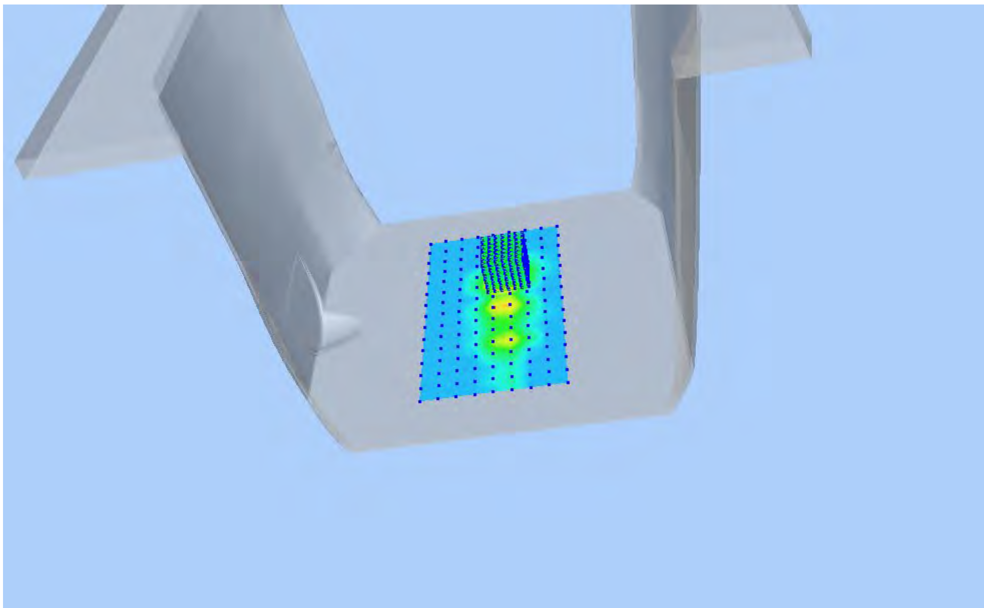
Z Axis Scan



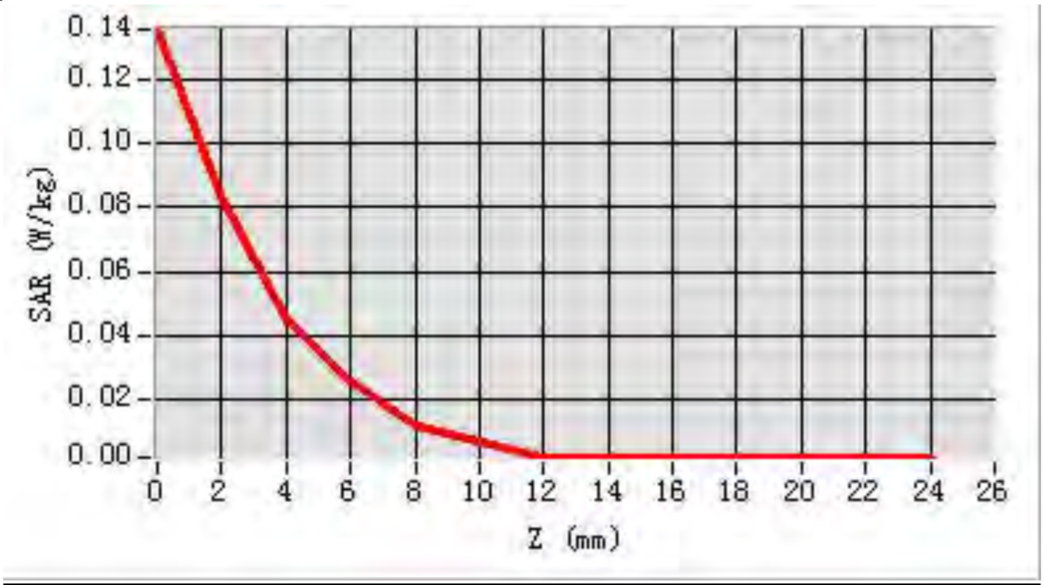
MEAS. 26 Body Plane with Horizontal-Up Side on 46 Channel in IEEE 802.11ac(HT-40) mode

Test Date:	20/9/2015
Signal:	WLAN, f=5230.0 MHz, Duty Cycle: 1:1.0
Liquid Parameters:	Permittivity: 48.91; Conductivity: 5.31 S/m
Test condition:	Ambient Temperature: 22.5°C, Liquid Temperature: 22.1°C
Probe:	SN 27/14 SSE2 EPG 210, ConvF: 22.88
Area Scan:	sam_direct_droit2_surf10mm.txt, h= 5.00 mm
Zoom Scan:	5x5x7,dx=4mm, dy=4mm, dz=2mm,Complete
Maximum location:	X=10.000000, Y=28.000000
SAR 10g (W/Kg):	0.017206
SAR 1g (W/Kg):	0.080415
Power drift (%):	-4.24

3D screen shot



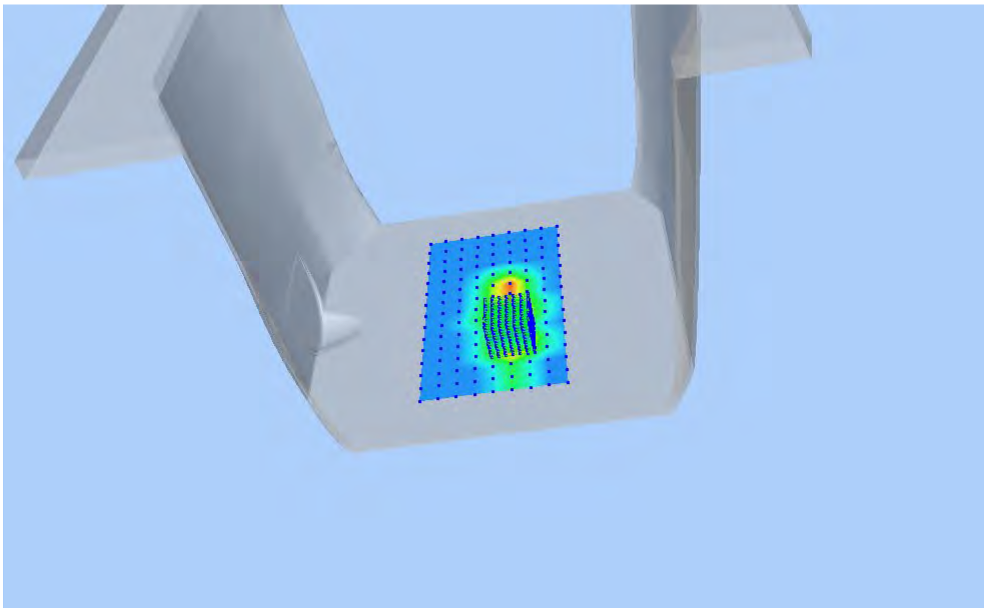
Z Axis Scan



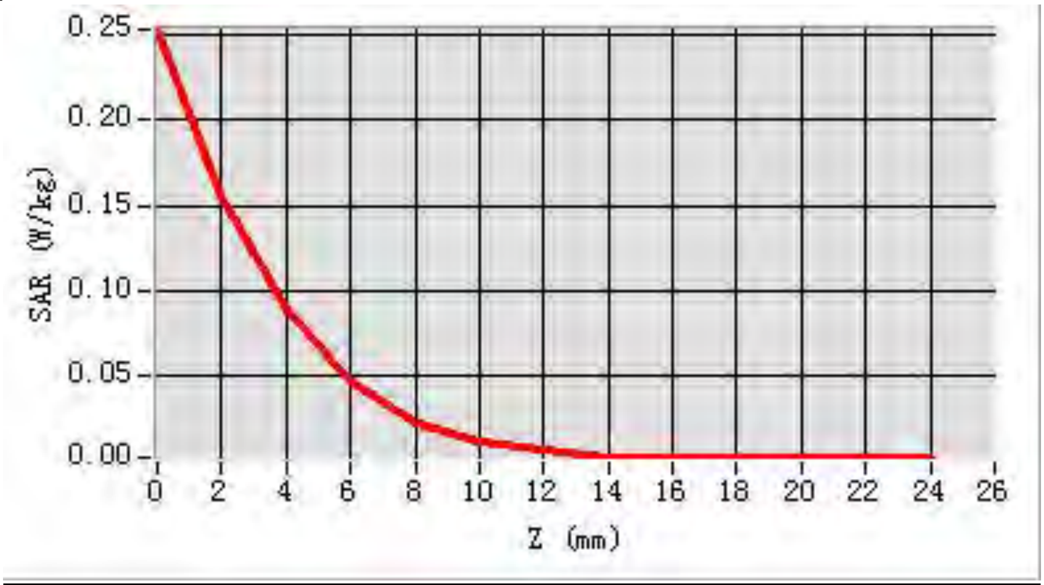
MEAS. 27 Body Plane with Horizontal-Down Side on 46 Channel in IEEE 802.11ac(HT-40) mode

Test Date:	20/9/2015
Signal:	WLAN, f=5230.0 MHz, Duty Cycle: 1:1.0
Liquid Parameters:	Permittivity: 48.91; Conductivity: 5.31 S/m
Test condition:	Ambient Temperature: 22.5°C, Liquid Temperature: 22.1°C
Probe:	SN 27/14 SSE2 EPG 210, ConvF: 22.88
Area Scan:	sam_direct_droit2_surf10mm.txt, h= 5.00 mm
Zoom Scan:	5x5x7,dx=4mm, dy=4mm, dz=2mm,Complete
Maximum location:	X=10.000000, Y=-32.000000
SAR 10g (W/Kg):	0.031113
SAR 1g (W/Kg):	0.154136
Power drift (%):	-0.97

3D screen shot



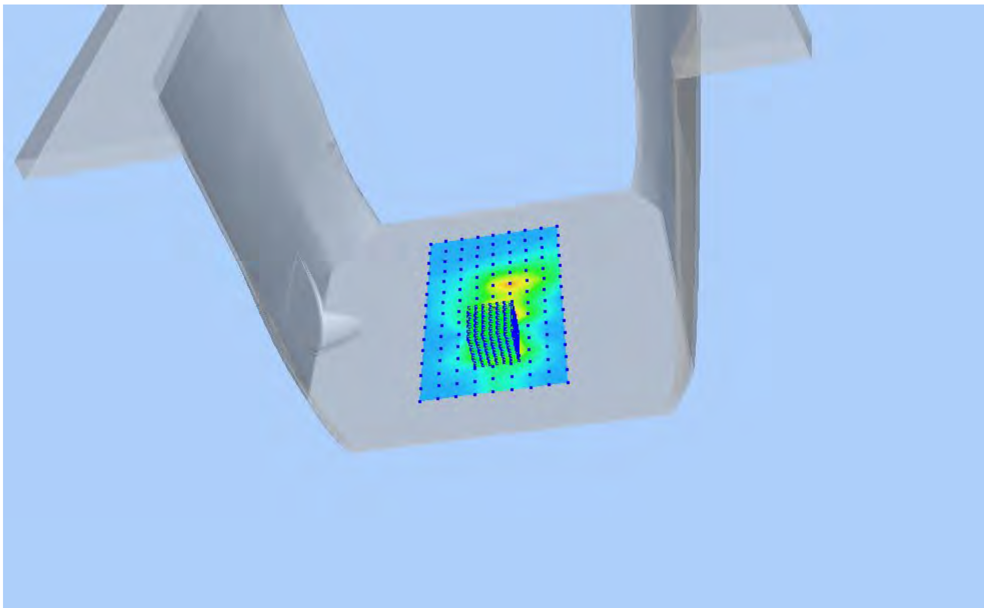
Z Axis Scan



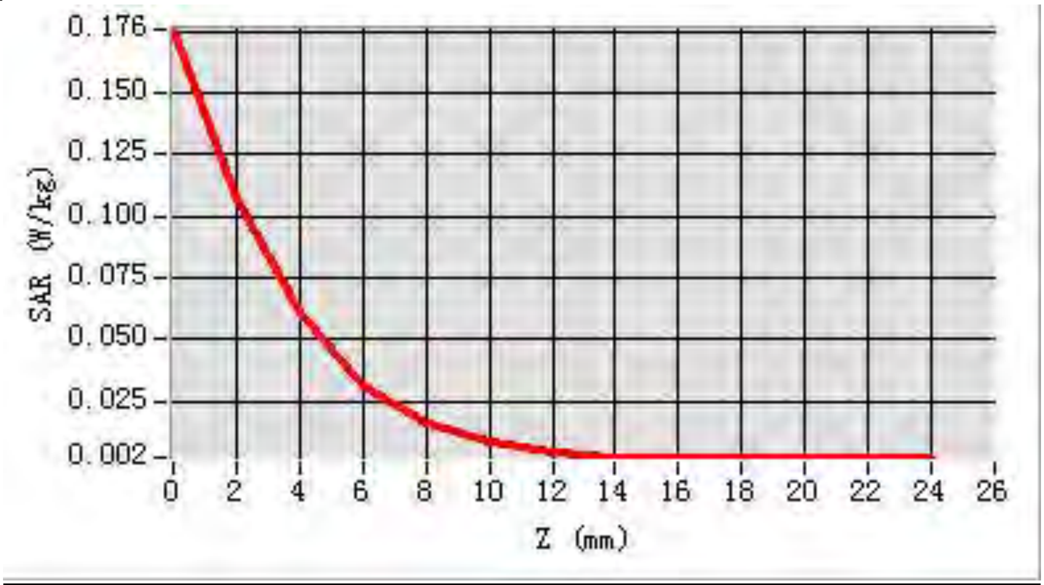
MEAS. 28 Body Plane with Vertical-Front Side on 46 Channel in IEEE 802.11ac(HT-40) mode

Test Date:	20/9/2015
Signal:	WLAN, f=5230.0 MHz, Duty Cycle: 1:1.0
Liquid Parameters:	Permittivity: 48.91; Conductivity: 5.31 S/m
Test condition:	Ambient Temperature: 22.5°C, Liquid Temperature: 22.1°C
Probe:	SN 27/14 SSE2 EPG 210, ConvF: 22.88
Area Scan:	sam_direct_droit2_surf10mm.txt, h= 5.00 mm
Zoom Scan:	5x5x7,dx=4mm, dy=4mm, dz=2mm,Complete
Maximum location:	X=0.000000, Y=-42.000000
SAR 10g (W/Kg):	0.020532
SAR 1g (W/Kg):	0.0928720
Power drift (%):	-2.39

3D screen shot



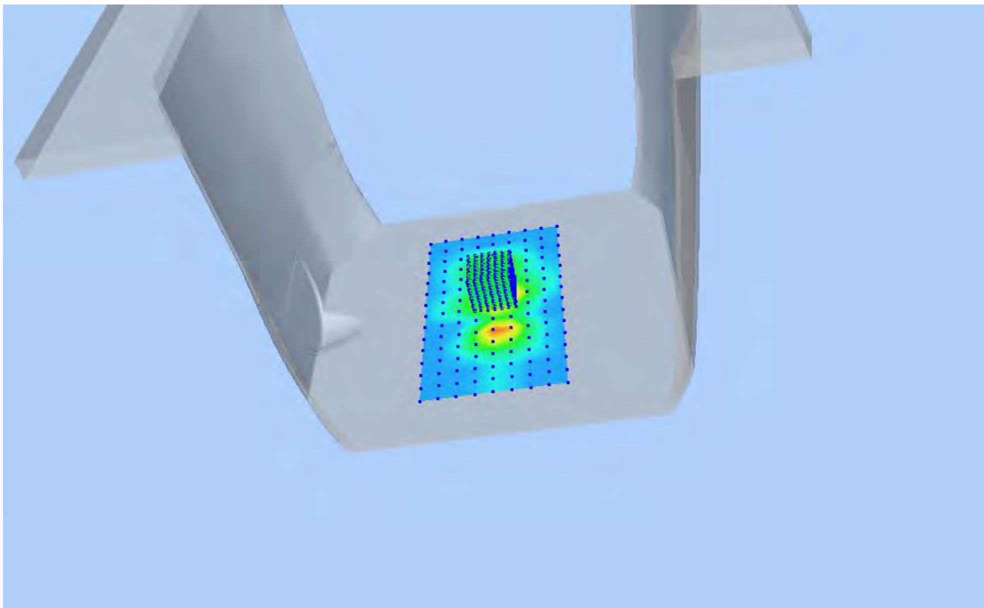
Z Axis Scan



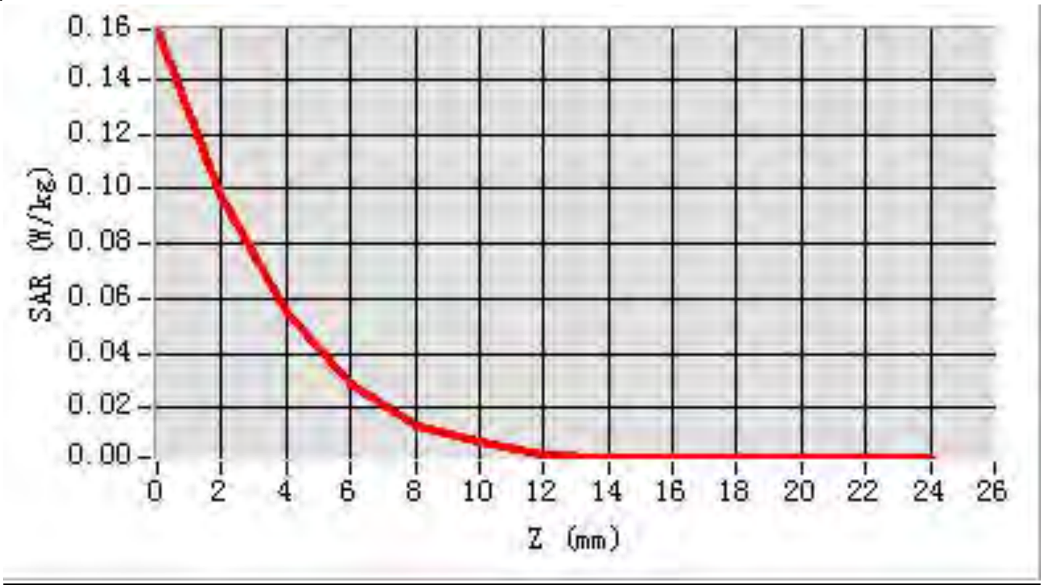
MEAS. 29 Body Plane with Vertical-Back Side on 46 Channel in IEEE 802.11ac(HT-40) mode

Test Date:	20/9/2015
Signal:	WLAN, f=5230.0 MHz, Duty Cycle: 1:1.0
Liquid Parameters:	Permittivity: 48.91; Conductivity: 5.31 S/m
Test condition:	Ambient Temperature: 22.5°C, Liquid Temperature: 22.1°C
Probe:	SN 27/14 SSE2 EPG 210, ConvF: 22.88
Area Scan:	sam_direct_droit2_surf10mm.txt, h= 5.00 mm
Zoom Scan:	5x5x7,dx=4mm, dy=4mm, dz=2mm,Complete
Maximum location:	X=0.000000, Y=8.000000
SAR 10g (W/Kg):	0.021457
SAR 1g (W/Kg):	0.091124
Power drift (%):	-3.70

3D screen shot



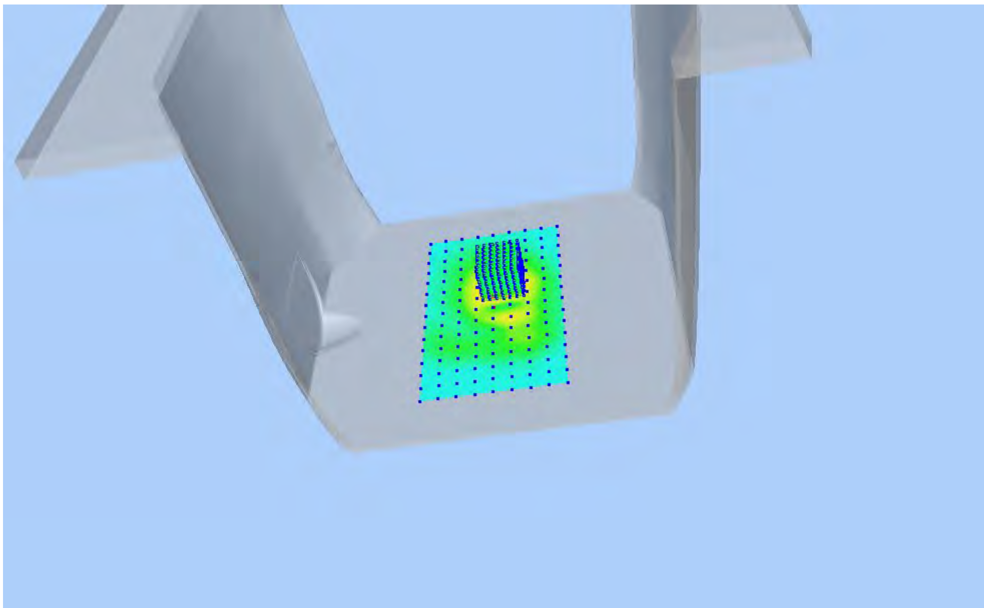
Z Axis Scan



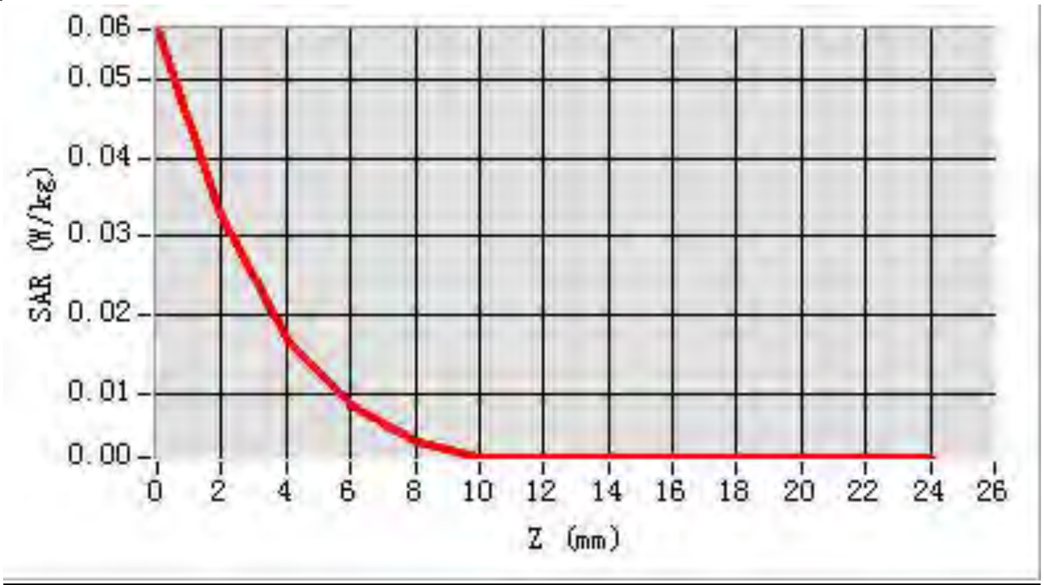
MEAS. 30 Body Plane with Top edge on 46 Channel in IEEE 802.11ac(HT-40) mode

Test Date:	20/9/2015
Signal:	WLAN, f=5230.0 MHz, Duty Cycle: 1:1.0
Liquid Parameters:	Permittivity: 48.91; Conductivity: 5.31 S/m
Test condition:	Ambient Temperature: 22.5°C, Liquid Temperature: 22.1°C
Probe:	SN 27/14 SSE2 EPG 210, ConvF: 22.88
Area Scan:	sam_direct_droit2_surf10mm.txt, h= 5.00 mm
Zoom Scan:	5x5x7,dx=4mm, dy=4mm, dz=2mm,Complete
Maximum location:	X=10.000000, Y=18.000000
SAR 10g (W/Kg):	0.008839
SAR 1g (W/Kg):	0.040088
Power drift (%):	-0.87

3D screen shot



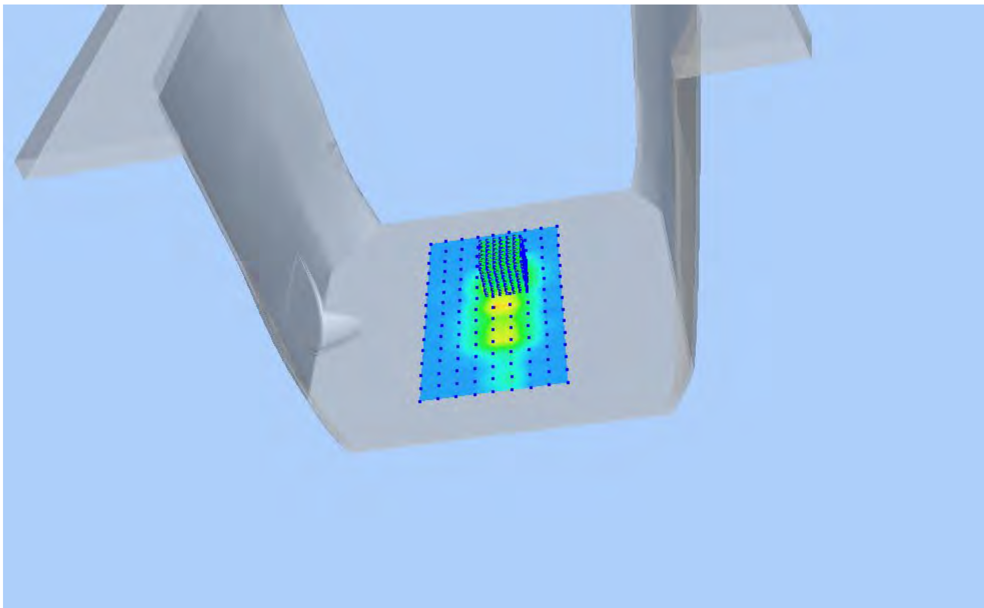
Z Axis Scan



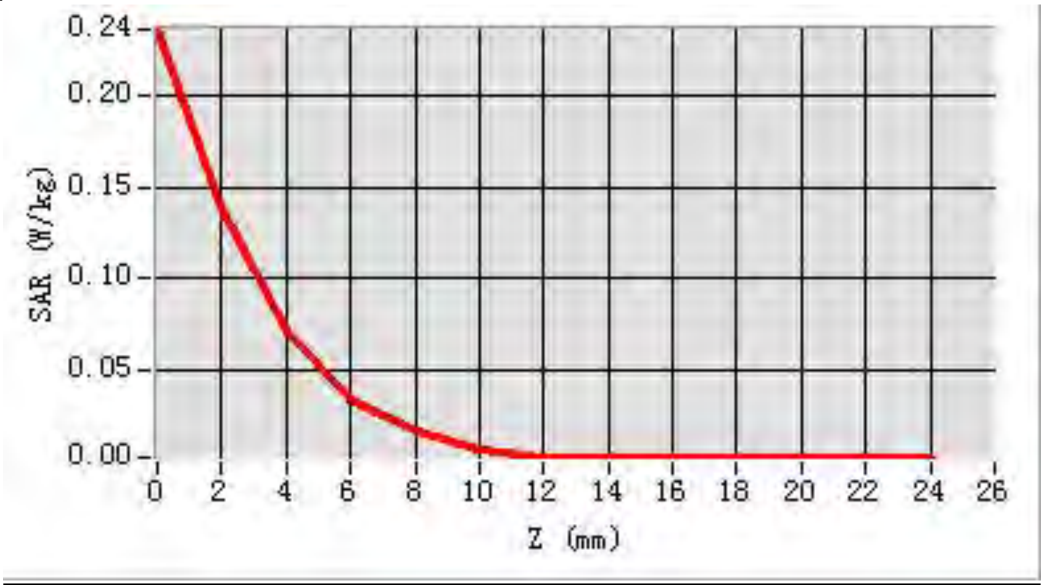
MEAS. 31 Body Plane with Horizontal-Up Side on 155 Channel in IEEE 802.11ac(HT-80) mode

Test Date:	21/9/2015
Signal:	WLAN, f=5775.0 MHz, Duty Cycle: 1:1.0
Liquid Parameters:	Permittivity: 48.08; Conductivity: 5.92 S/m
Test condition:	Ambient Temperature: 22.5°C, Liquid Temperature: 22.1°C
Probe:	SN 27/14 SSE2 EPG 210, ConvF: 23.20
Area Scan:	sam_direct_droit2_surf10mm.txt, h= 5.00 mm
Zoom Scan:	5x5x7,dx=4mm, dy=4mm, dz=2mm,Complete
Maximum location:	X=10.000000, Y=18.000000
SAR 10g (W/Kg):	0.057335
SAR 1g (W/Kg):	0.131024
Power drift (%):	-1.75

3D screen shot



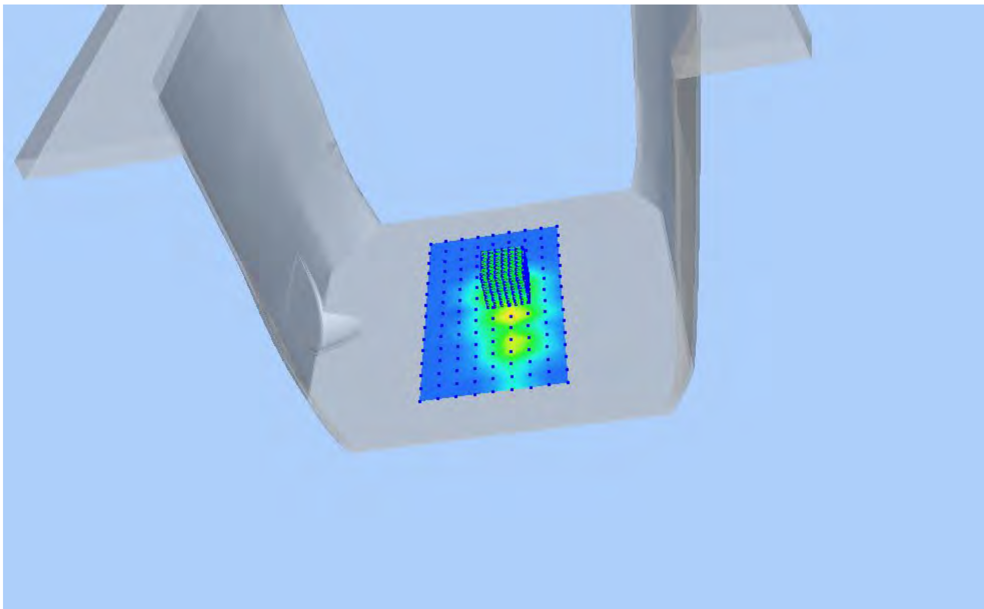
Z Axis Scan



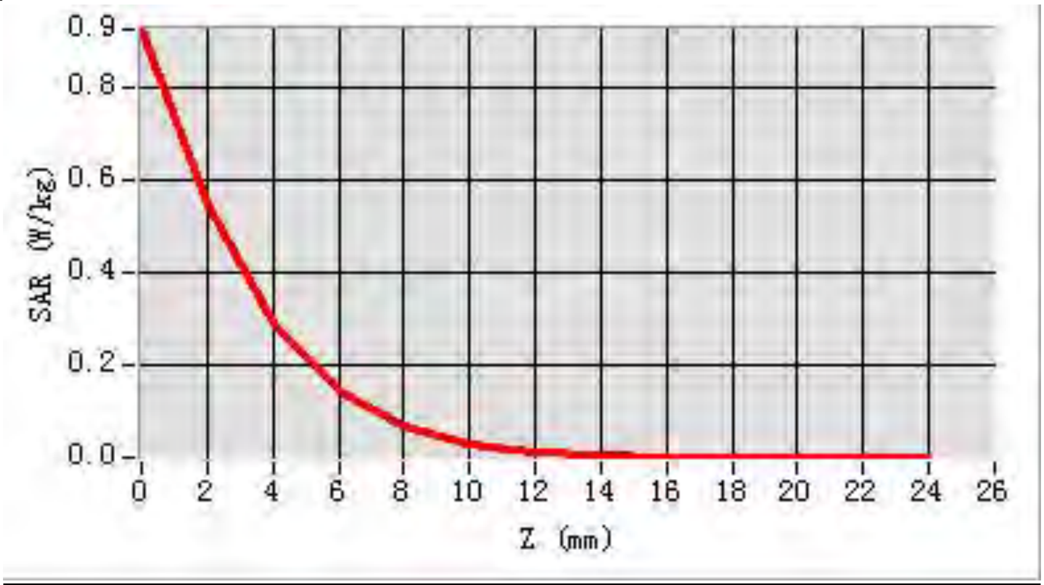
MEAS. 32 Body Plane with Horizontal-Down Side on 155 Channel in IEEE 802.11ac(HT-80) mode

Test Date:	21/9/2015
Signal:	WLAN, f=5775.0 MHz, Duty Cycle: 1:1.0
Liquid Parameters:	Permittivity: 48.08; Conductivity: 5.92 S/m
Test condition:	Ambient Temperature: 22.5°C, Liquid Temperature: 22.1°C
Probe:	SN 27/14 SSE2 EPG 210, ConvF: 23.20
Area Scan:	sam_direct_droit2_surf10mm.txt, h= 5.00 mm
Zoom Scan:	5x5x7,dx=4mm, dy=4mm, dz=2mm,Complete
Maximum location:	X=10.000000, Y=8.000000
SAR 10g (W/Kg):	0.101521
SAR 1g (W/Kg):	0.379671
Power drift (%):	-3.59

3D screen shot



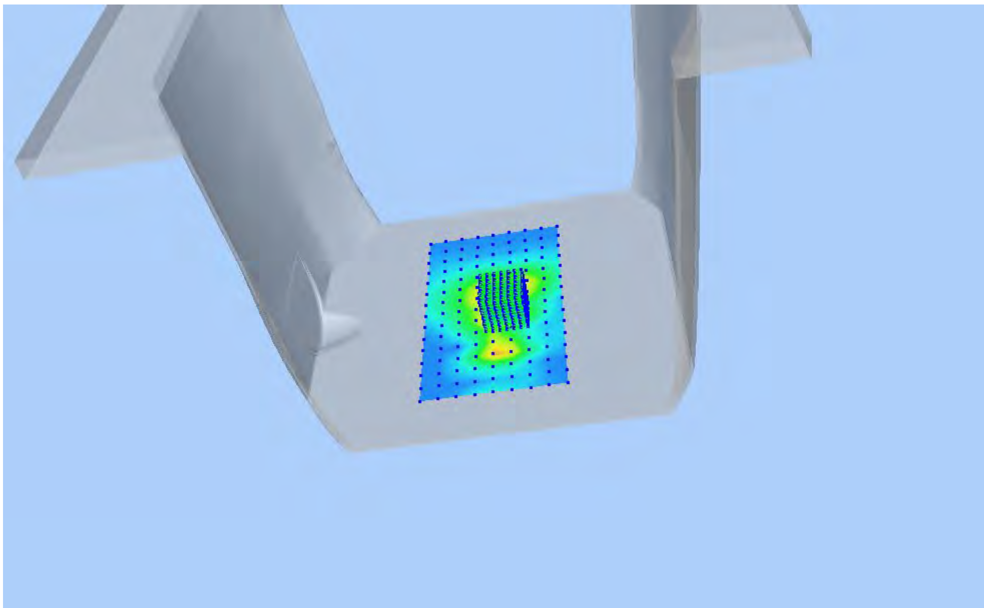
Z Axis Scan



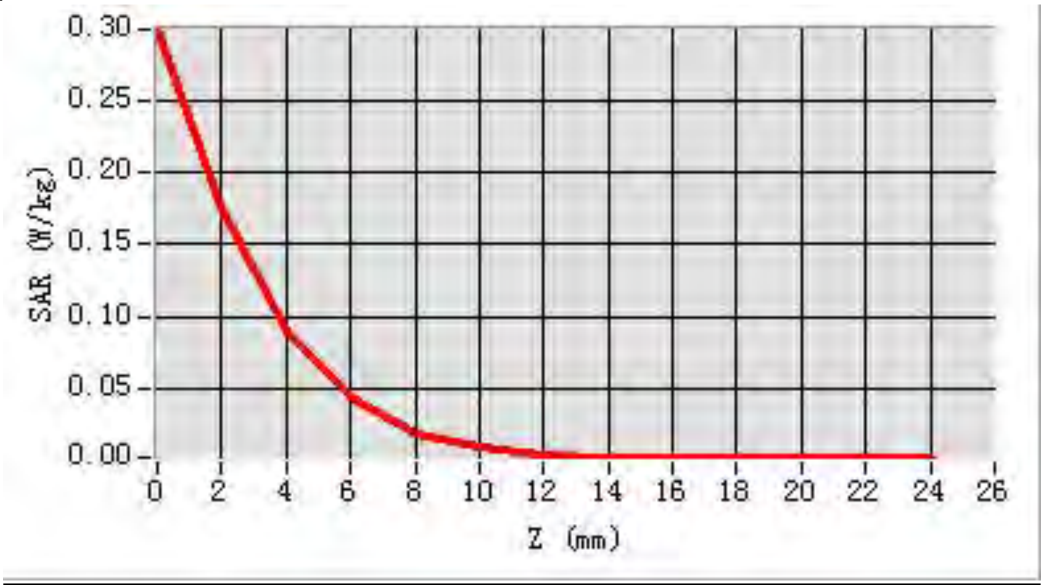
MEAS. 33 Body Plane with Vertical-Front Side on 155 Channel in IEEE 802.11ac(HT-80) mode

Test Date:	21/9/2015
Signal:	WLAN, f=5775.0 MHz, Duty Cycle: 1:1.0
Liquid Parameters:	Permittivity: 48.08; Conductivity: 5.92 S/m
Test condition:	Ambient Temperature: 22.5°C, Liquid Temperature: 22.1°C
Probe:	SN 27/14 SSE2 EPG 210, ConvF: 23.20
Area Scan:	sam_direct_droit2_surf10mm.txt, h= 5.00 mm
Zoom Scan:	5x5x7,dx=4mm, dy=4mm, dz=2mm,Complete
Maximum location:	X=10.000000, Y=-12.000000
SAR 10g (W/Kg):	0.034993
SAR 1g (W/Kg):	0.1581944
Power drift (%):	-3.67

3D screen shot



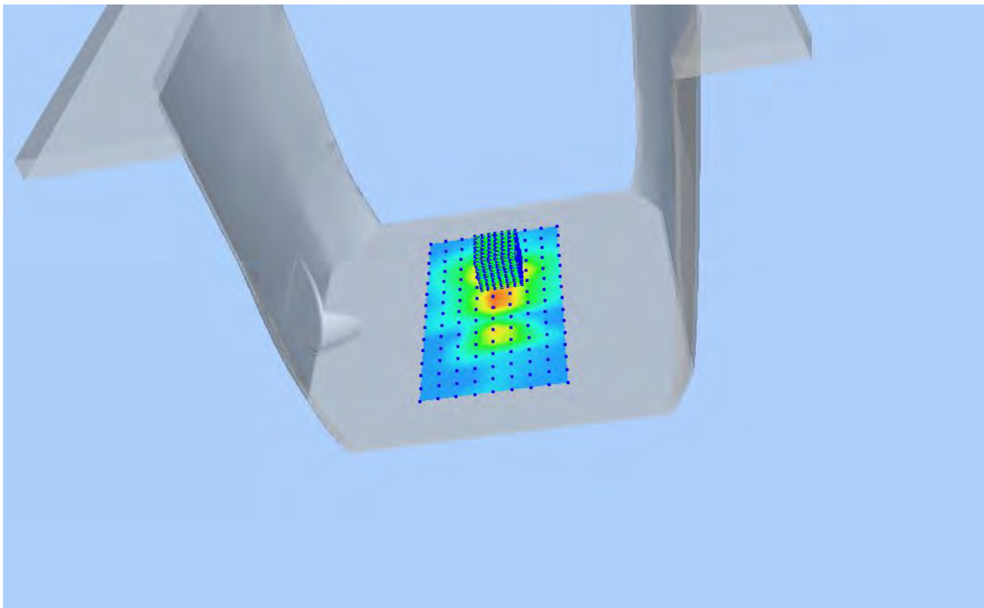
Z Axis Scan



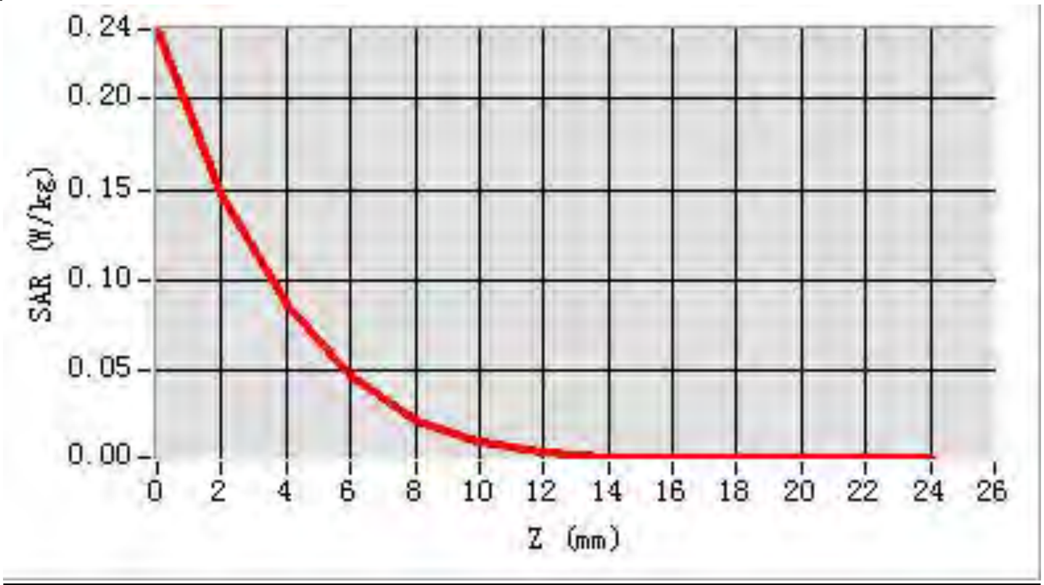
MEAS. 34 Body Plane with Vertical-Back Side on 155 Channel in IEEE 802.11ac(HT-80) mode

Test Date:	21/9/2015
Signal:	WLAN, f=5775.0 MHz, Duty Cycle: 1:1.0
Liquid Parameters:	Permittivity: 48.08; Conductivity: 5.92 S/m
Test condition:	Ambient Temperature: 22.5°C, Liquid Temperature: 22.1°C
Probe:	SN 27/14 SSE2 EPG 210, ConvF: 23.20
Area Scan:	sam_direct_droit2_surf10mm.txt, h= 5.00 mm
Zoom Scan:	5x5x7,dx=4mm, dy=4mm, dz=2mm,Complete
Maximum location:	X=0.000000, Y=28.000000
SAR 10g (W/Kg):	0.030094
SAR 1g (W/Kg):	0.1501306
Power drift (%):	-4.24

3D screen shot



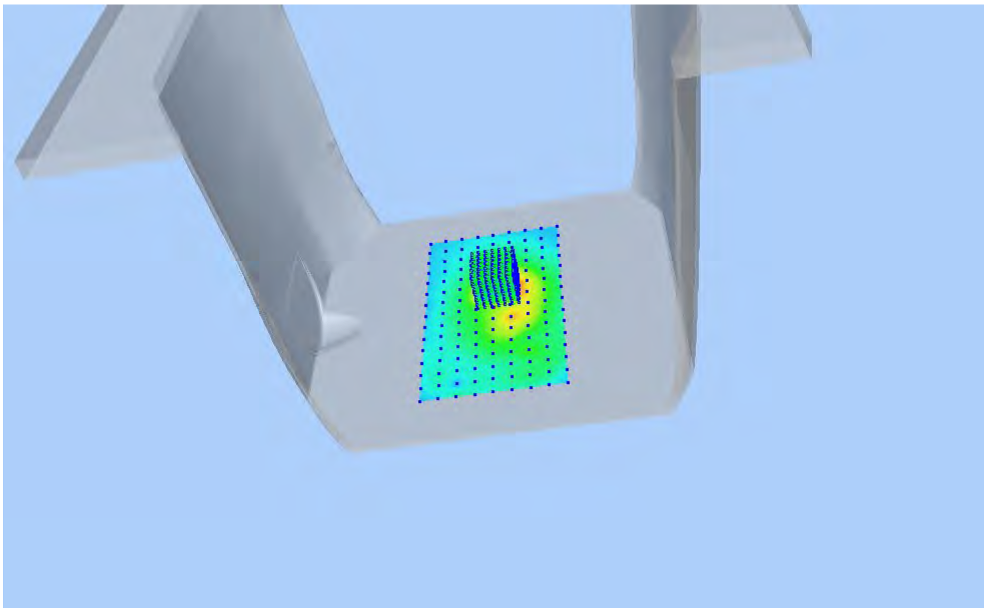
Z Axis Scan



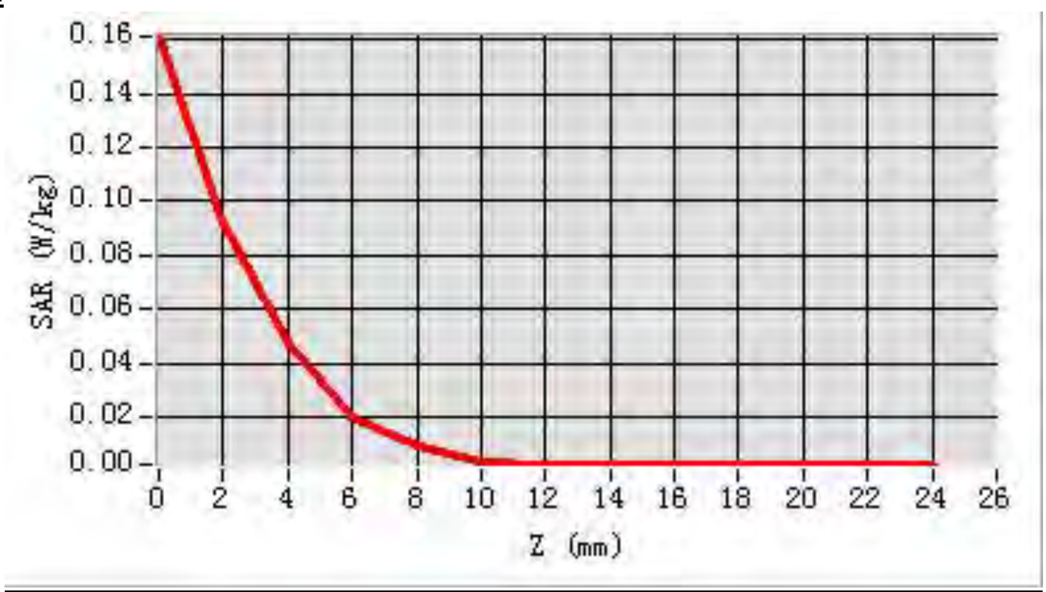
MEAS. 35 Body Plane with Top edge on 155 Channel in IEEE 802.11ac(HT-80) mode

Test Date:	21/9/2015
Signal:	WLAN, f=5775.0 MHz, Duty Cycle: 1:1.0
Liquid Parameters:	Permittivity: 48.08; Conductivity: 5.92 S/m
Test condition:	Ambient Temperature: 22.5°C, Liquid Temperature: 22.1°C
Probe:	SN 27/14 SSE2 EPG 210, ConvF: 23.20
Area Scan:	sam_direct_droit2_surf10mm.txt, h= 5.00 mm
Zoom Scan:	5x5x7,dx=4mm, dy=4mm, dz=2mm,Complete
Maximum location:	X=0.000000, Y=8.000000
SAR 10g (W/Kg):	0.021061
SAR 1g (W/Kg):	0.095934
Power drift (%):	-4.09

3D screen shot



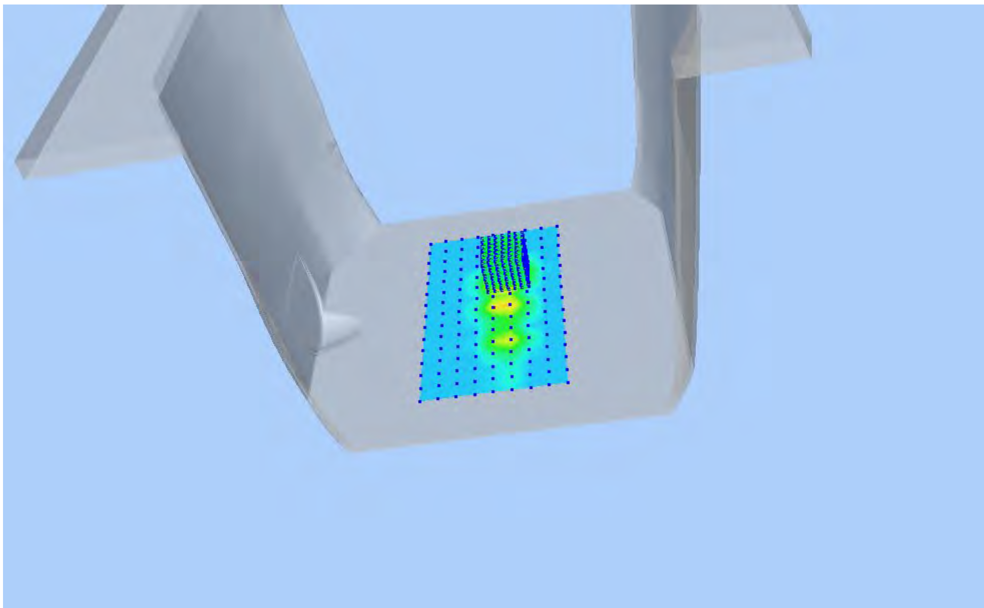
Z Axis Scan



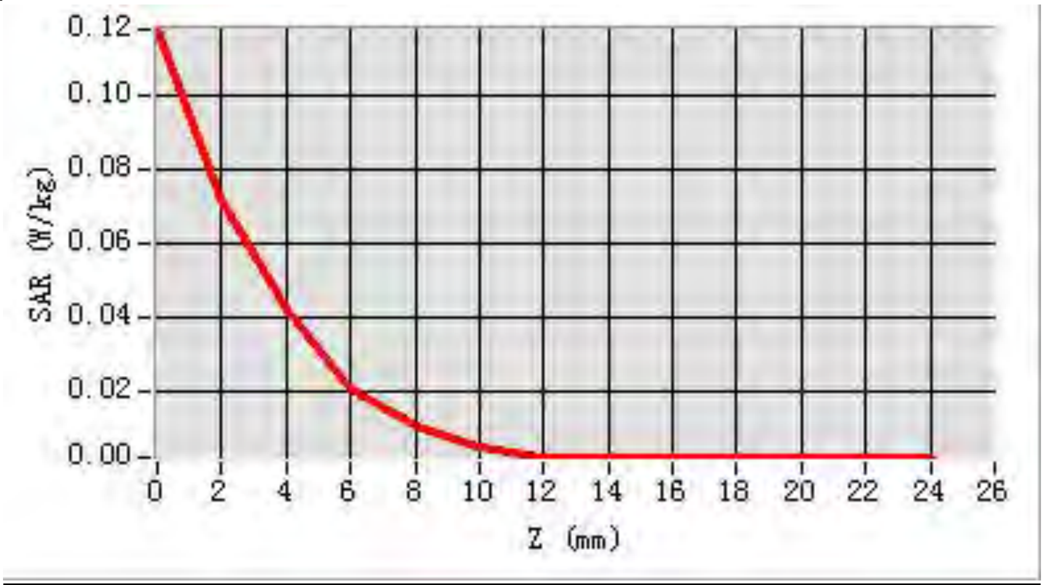
MEAS. 36 Body Plane with Horizontal-UP Side on 40 Channel in IEEE 802.11n(HT-20) mode

Test Date:	20/9/2015
Signal:	WLAN, f=5200.0 MHz, Duty Cycle: 1:1.0
Liquid Parameters:	Permittivity: 49.12; Conductivity: 5.29 S/m
Test condition:	Ambient Temperature: 22.5°C, Liquid Temperature: 22.1°C
Probe:	SN 27/14 SSE2 EPG 210, ConvF: 22.88
Area Scan:	sam_direct_droit2_surf10mm.txt, h= 5.00 mm
Zoom Scan:	5x5x7,dx=4mm, dy=4mm, dz=2mm,Complete
Maximum location:	X=10.000000, Y=28.000000
SAR 10g (W/Kg):	0.014422
SAR 1g (W/Kg):	0.062884
Power drift (%):	-0.18

3D screen shot



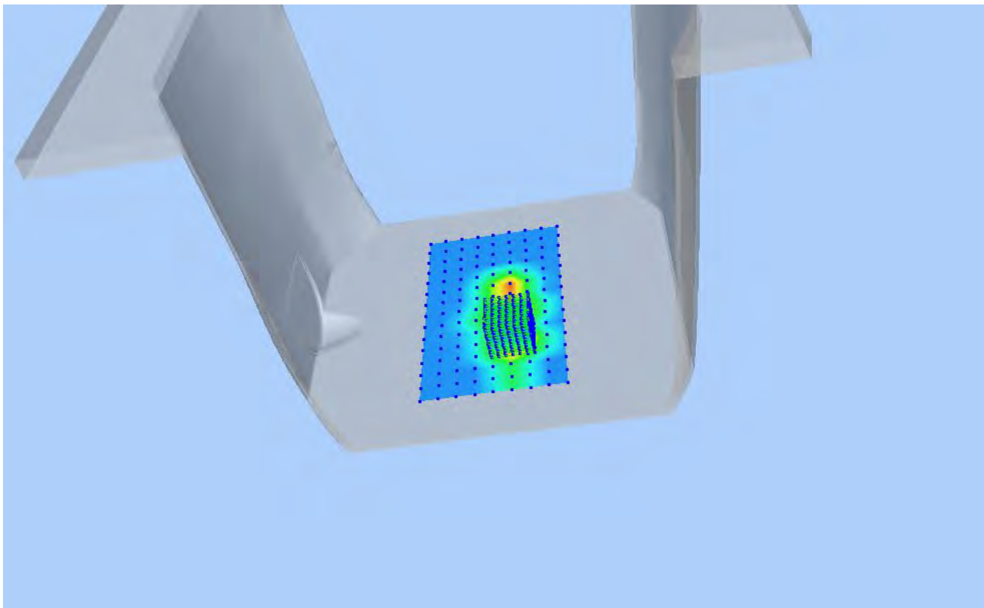
Z Axis Scan



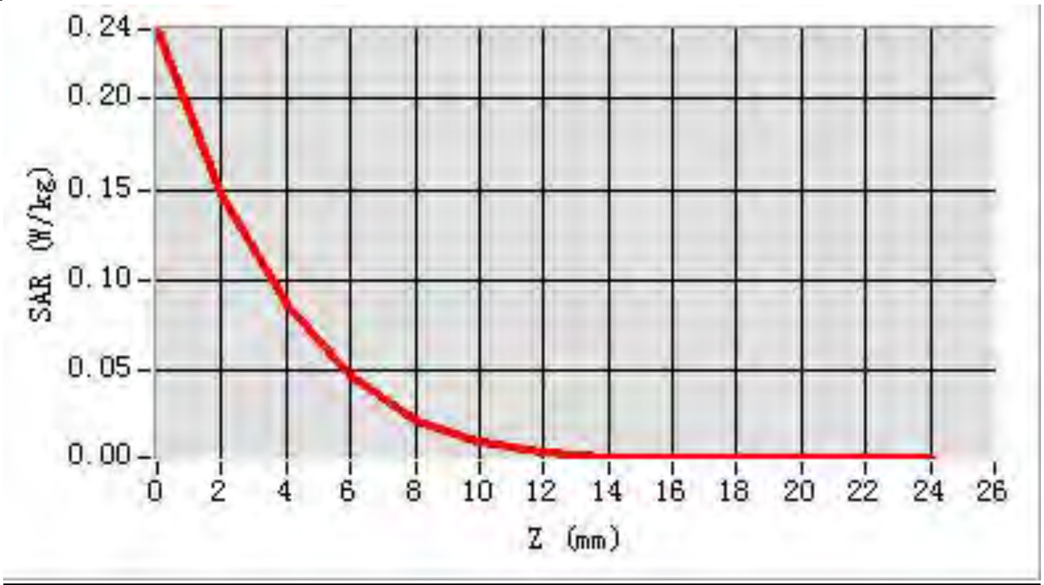
MEAS. 37 Body Plane with Horizontal-Down Side on 40 Channel in IEEE 802.11n(HT-20) mode

Test Date:	20/9/2015
Signal:	WLAN, f=5200.0 MHz, Duty Cycle: 1:1.0
Liquid Parameters:	Permittivity: 49.12; Conductivity: 5.29 S/m
Test condition:	Ambient Temperature: 22.5°C, Liquid Temperature: 22.1°C
Probe:	SN 27/14 SSE2 EPG 210, ConvF: 22.88
Area Scan:	sam_direct_droit2_surf10mm.txt, h= 5.00 mm
Zoom Scan:	5x5x7,dx=4mm, dy=4mm, dz=2mm,Complete
Maximum location:	X=10.000000, Y=-32.000000
SAR 10g (W/Kg):	0.029756
SAR 1g (W/Kg):	0.1091491
Power drift (%):	-1.82

3D screen shot

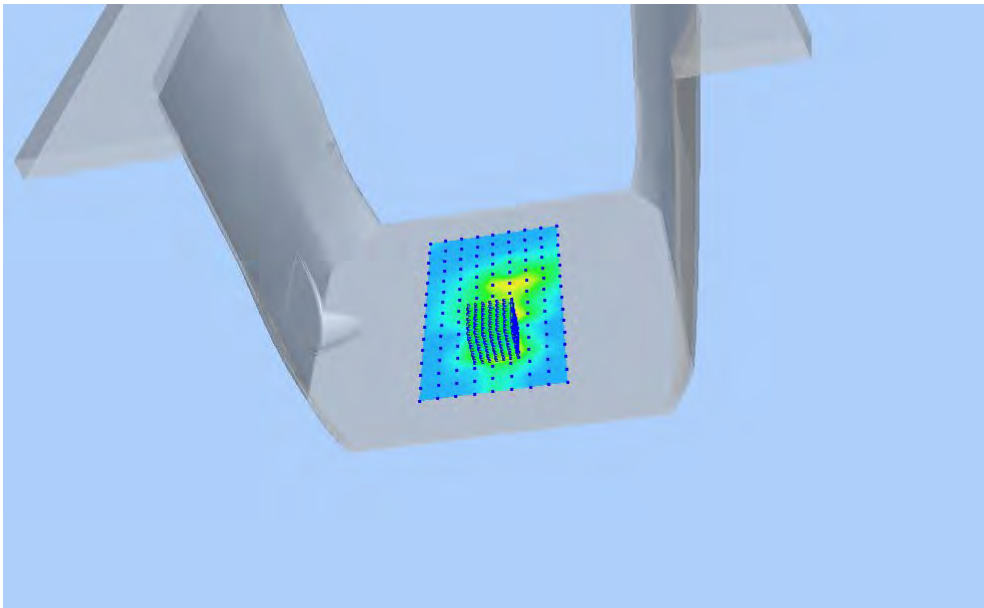


Z Axis Scan

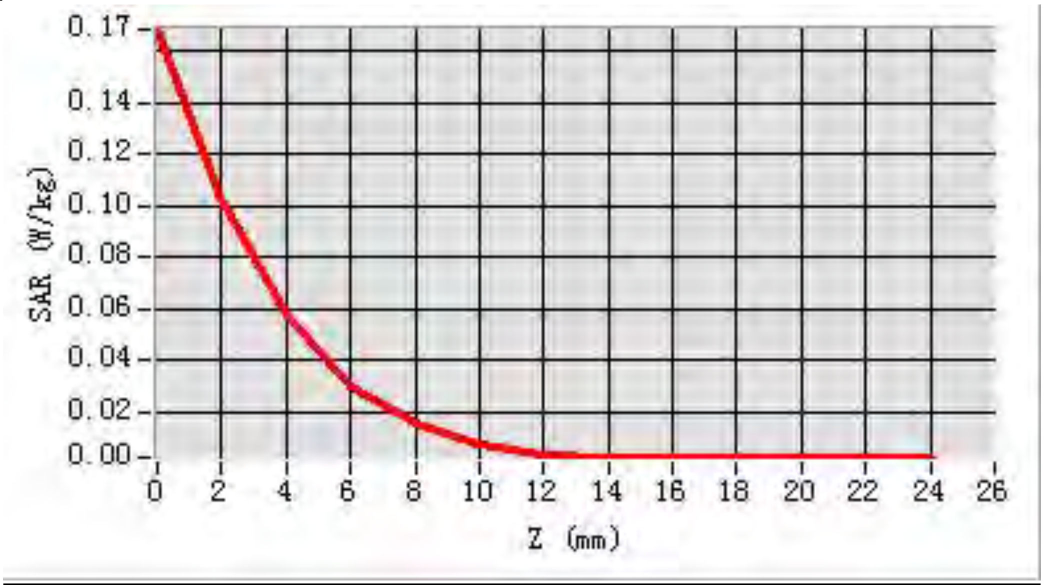


MEAS. 38 Body Plane with Vertical-Front Side on 40 Channel in IEEE 802.11n(HT-20) mode

Test Date: 20/9/2015
Signal: WLAN, f=5200.0 MHz, Duty Cycle: 1:1.0
Liquid Parameters: Permittivity: 49.12; Conductivity: 5.29 S/m
Test condition: Ambient Temperature: 22.5°C, Liquid Temperature: 22.1°C
Probe: SN 27/14 SSE2 EPG 210, ConvF: 22.88
Area Scan: sam_direct_droit2_surf10mm.txt, h= 5.00 mm
Zoom Scan: 5x5x7,dx=4mm, dy=4mm, dz=2mm,Complete
Maximum location: X=0.000000, Y=-32.000000
SAR 10g (W/Kg): 0.019354
SAR 1g (W/Kg): 0.0994560
Power drift (%): -1.73
3D screen shot



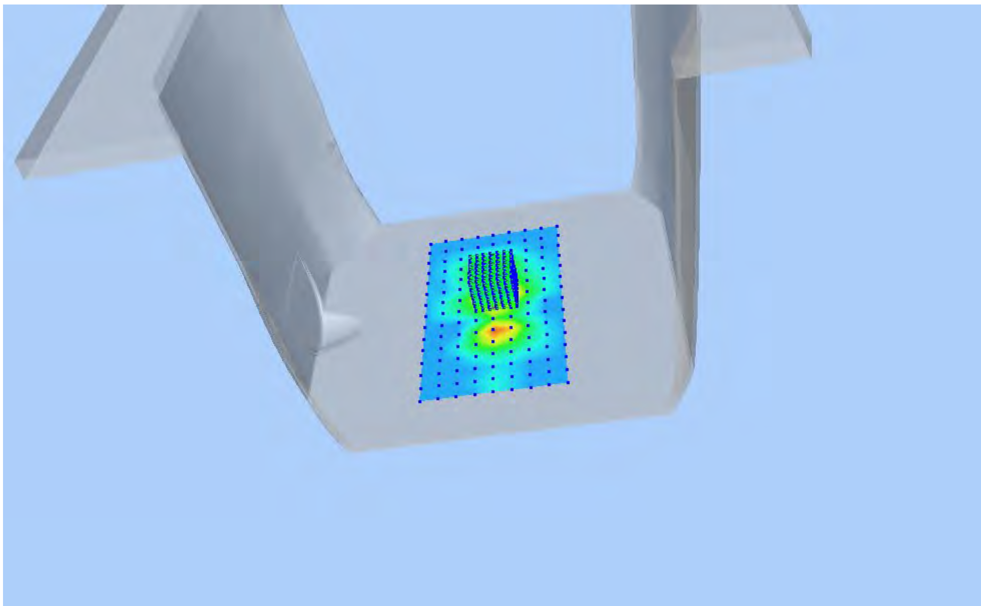
Z Axis Scan



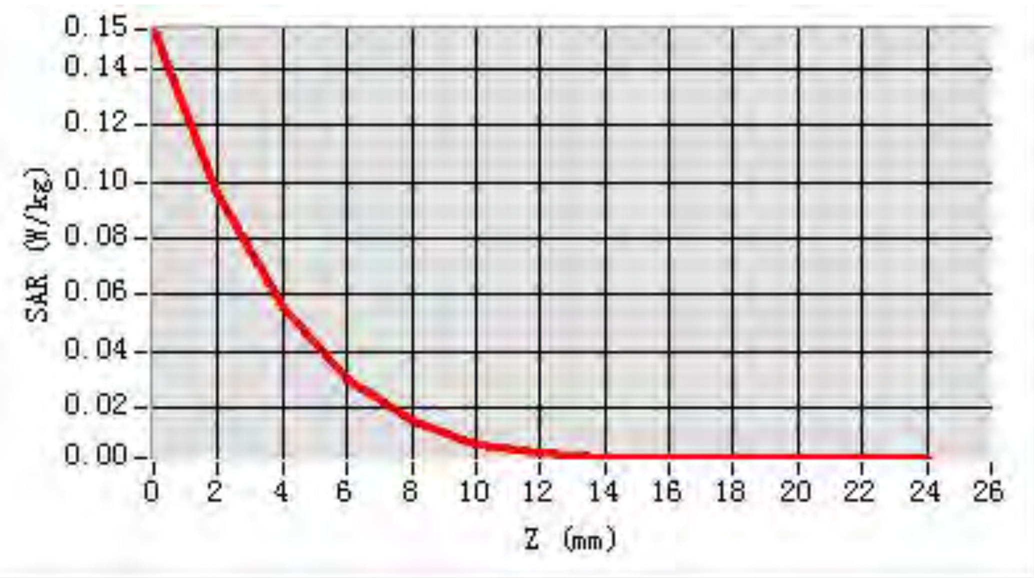
MEAS. 39 Body Plane with Vertical-Back Side on 40 Channel in IEEE 802.11n(HT-20) mode

Test Date:	20/9/2015
Signal:	WLAN, f=5200.0 MHz, Duty Cycle: 1:1.0
Liquid Parameters:	Permittivity: 49.12; Conductivity: 5.29 S/m
Test condition:	Ambient Temperature: 22.5°C, Liquid Temperature: 22.1°C
Probe:	SN 27/14 SSE2 EPG 210, ConvF: 22.88
Area Scan:	sam_direct_droit2_surf10mm.txt, h= 5.00 mm
Zoom Scan:	5x5x7,dx=4mm, dy=4mm, dz=2mm,Complete
Maximum location:	X=0.000000, Y=8.000000
SAR 10g (W/Kg):	0.021130
SAR 1g (W/Kg):	0.0801982
Power drift (%):	-3.98

3D screen shot



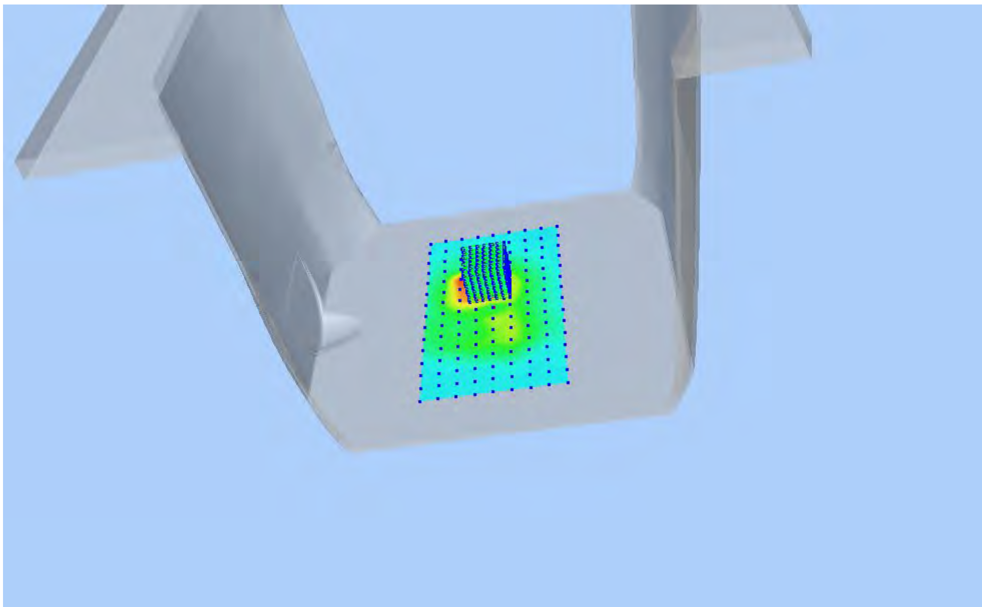
Z Axis Scan



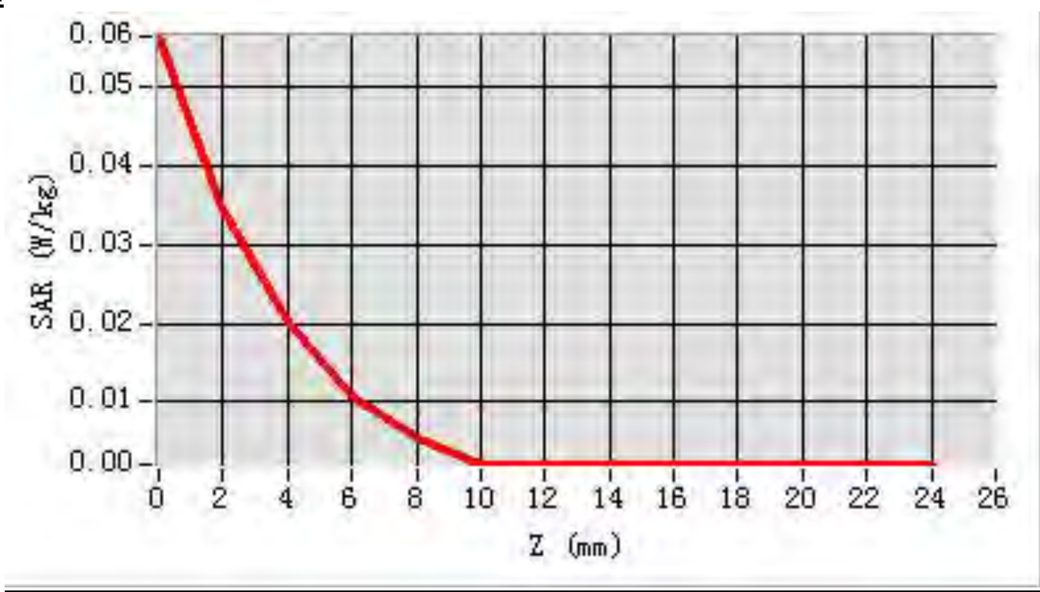
MEAS. 40 Body Plane with Top edge on 40 Channel in IEEE 802.11n(HT-20) mode

Test Date:	20/9/2015
Signal:	WLAN, f=5200.0 MHz, Duty Cycle: 1:1.0
Liquid Parameters:	Permittivity: 49.12; Conductivity: 5.29 S/m
Test condition:	Ambient Temperature: 22.5°C, Liquid Temperature: 22.1°C
Probe:	SN 27/14 SSE2 EPG 210, ConvF: 22.88
Area Scan:	sam_direct_droit2_surf10mm.txt, h= 5.00 mm
Zoom Scan:	5x5x7,dx=4mm, dy=4mm, dz=2mm,Complete
Maximum location:	X=0.000000, Y=18.000000
SAR 10g (W/Kg):	0.009342
SAR 1g (W/Kg):	0.039152
Power drift (%):	-3.59

3D screen shot



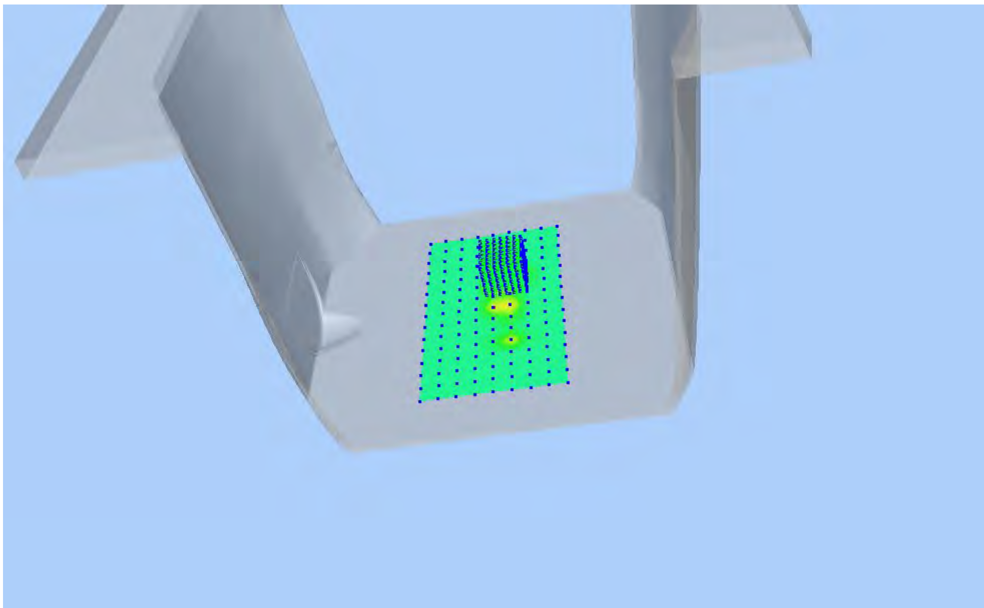
Z Axis Scan



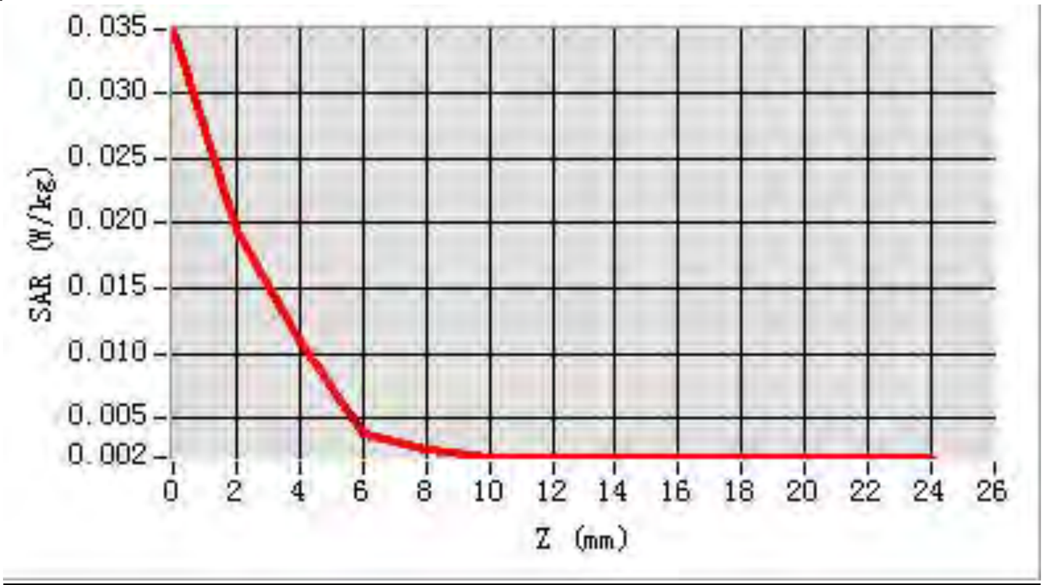
MEAS. 41 Body Plane with Horizontal-Up Side on 46 Channel in IEEE 802.11n(HT-40) mode

Test Date:	20/9/2015
Signal:	WLAN, f=5230.0 MHz, Duty Cycle: 1:1.0
Liquid Parameters:	Permittivity: 48.89; Conductivity: 5.33 S/m
Test condition:	Ambient Temperature: 22.5°C, Liquid Temperature: 22.1°C
Probe:	SN 27/14 SSE2 EPG 210, ConvF: 22.88
Area Scan:	sam_direct_droit2_surf10mm.txt, h= 5.00 mm
Zoom Scan:	5x5x7,dx=4mm, dy=4mm, dz=2mm,Complete
Maximum location:	X=10.000000, Y=18.000000
SAR 10g (W/Kg):	0.004680
SAR 1g (W/Kg):	0.019384
Power drift (%):	0.11

3D screen shot



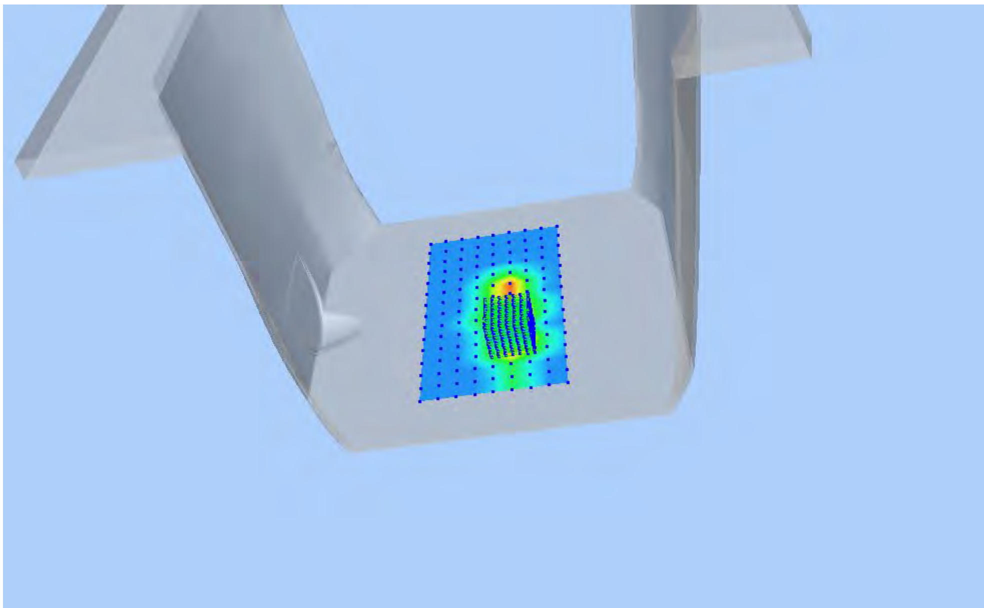
Z Axis Scan



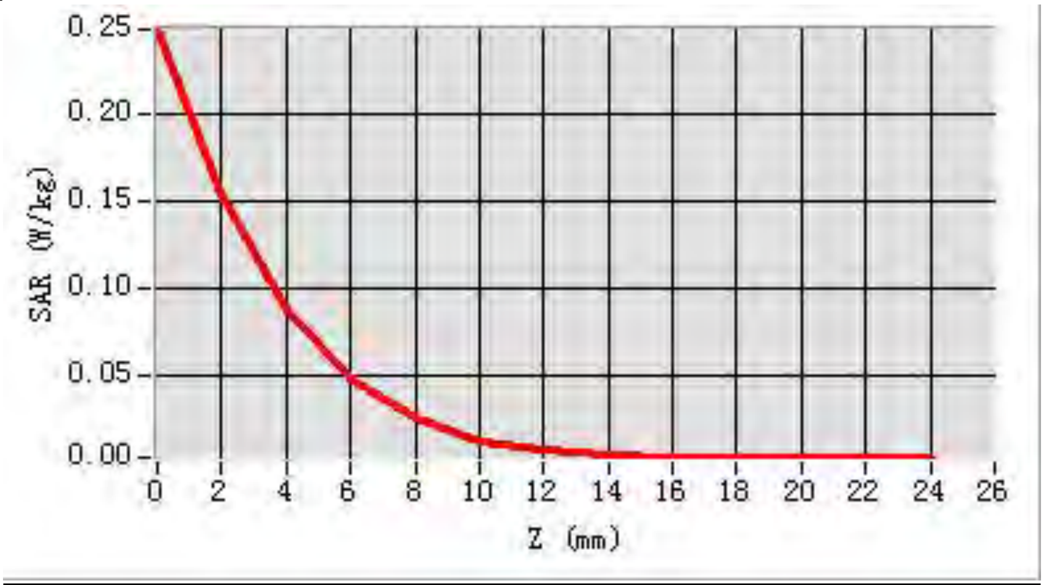
MEAS. 42 Body Plane with Horizontal-Down Side on 46 Channel in IEEE 802.11n(HT-40) mode

Test Date:	20/9/2015
Signal:	WLAN, f=5230.0 MHz, Duty Cycle: 1:1.0
Liquid Parameters:	Permittivity: 48.89; Conductivity: 5.33 S/m
Test condition:	Ambient Temperature: 22.5°C, Liquid Temperature: 22.1°C
Probe:	SN 27/14 SSE2 EPG 210, ConvF: 22.88
Area Scan:	sam_direct_droit2_surf10mm.txt, h= 5.00 mm
Zoom Scan:	5x5x7,dx=4mm, dy=4mm, dz=2mm,Complete
Maximum location:	X=10.000000, Y=-32.000000
SAR 10g (W/Kg):	0.030873
SAR 1g (W/Kg):	0.1430633
Power drift (%):	-3.99

3D screen shot



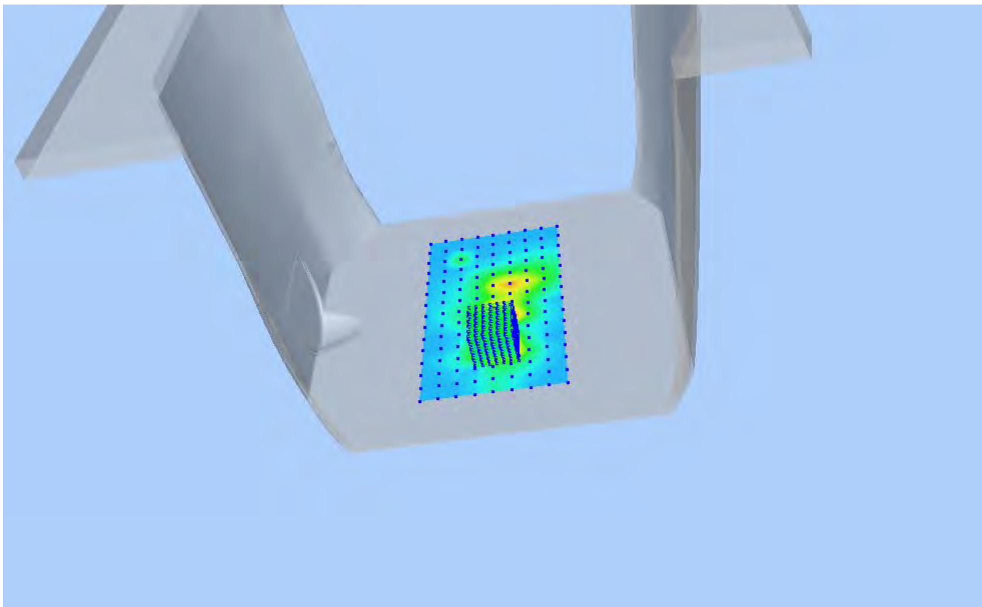
Z Axis Scan



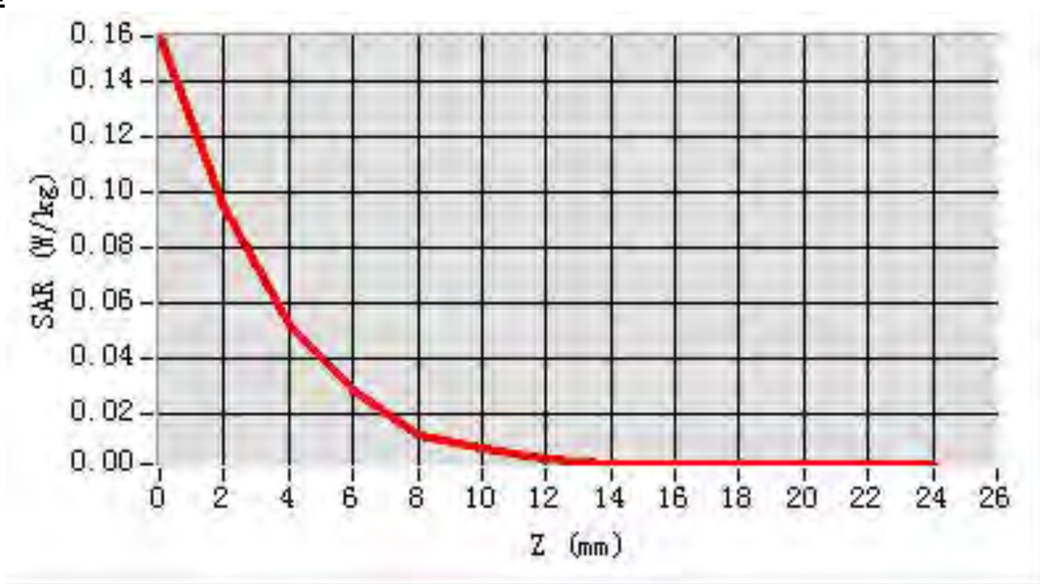
MEAS. 43 Body Plane with Vertical-Front Side on 46 Channel in IEEE 802.11n(HT-40) mode

Test Date:	20/9/2015
Signal:	WLAN, f=5230.0 MHz, Duty Cycle: 1:1.0
Liquid Parameters:	Permittivity: 48.89; Conductivity: 5.33 S/m
Test condition:	Ambient Temperature: 22.5°C, Liquid Temperature: 22.1°C
Probe:	SN 27/14 SSE2 EPG 210, ConvF: 22.88
Area Scan:	sam_direct_droit2_surf10mm.txt, h= 5.00 mm
Zoom Scan:	5x5x7,dx=4mm, dy=4mm, dz=2mm,Complete
Maximum location:	X=0.000000, Y=-42.000000
SAR 10g (W/Kg):	0.018130
SAR 1g (W/Kg):	0.094956
Power drift (%):	3.51

3D screen shot



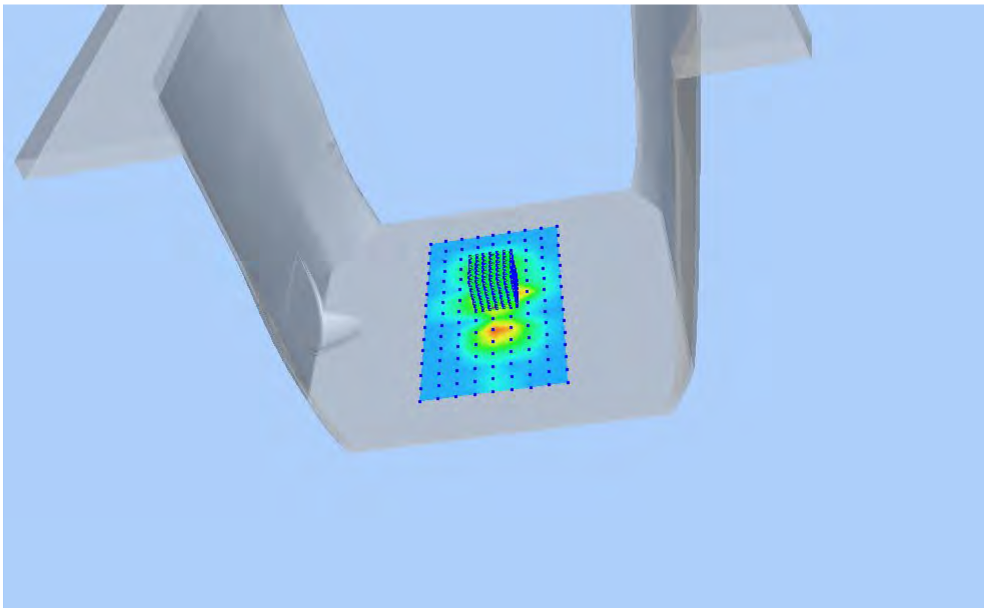
Z Axis Scan



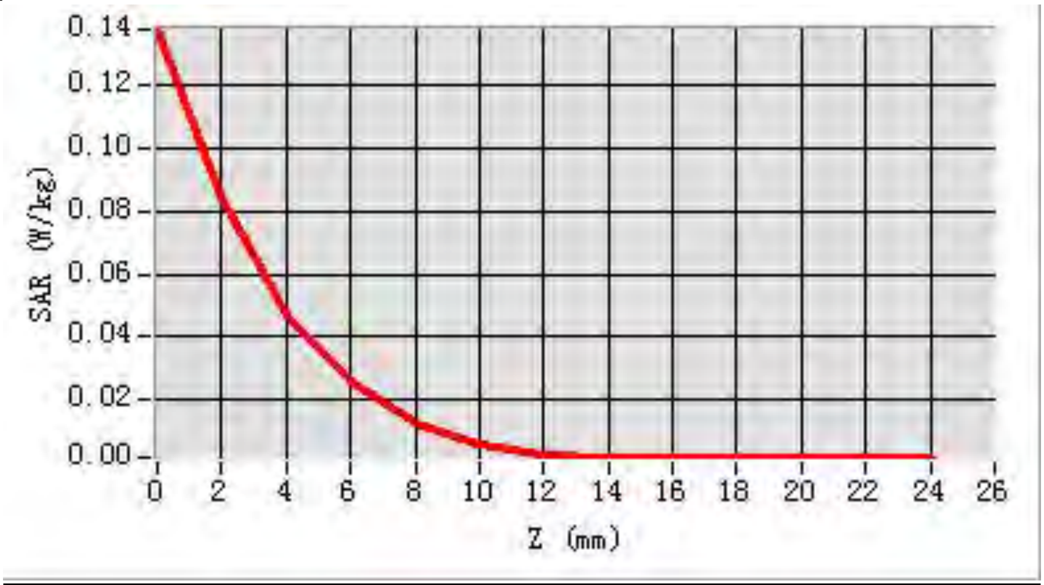
MEAS. 44 Body Plane with Vertical-Back Side on 46 Channel in IEEE 802.11n(HT-40) mode

Test Date:	20/9/2015
Signal:	WLAN, f=5230.0 MHz, Duty Cycle: 1:1.0
Liquid Parameters:	Permittivity: 48.89; Conductivity: 5.33 S/m
Test condition:	Ambient Temperature: 22.5°C, Liquid Temperature: 22.1°C
Probe:	SN 27/14 SSE2 EPG 210, ConvF: 22.88
Area Scan:	sam_direct_droit2_surf10mm.txt, h= 5.00 mm
Zoom Scan:	5x5x7,dx=4mm, dy=4mm, dz=2mm,Complete
Maximum location:	X=0.000000, Y=8.000000
SAR 10g (W/Kg):	0.018717
SAR 1g (W/Kg):	0.092266
Power drift (%):	-3.66

3D screen shot



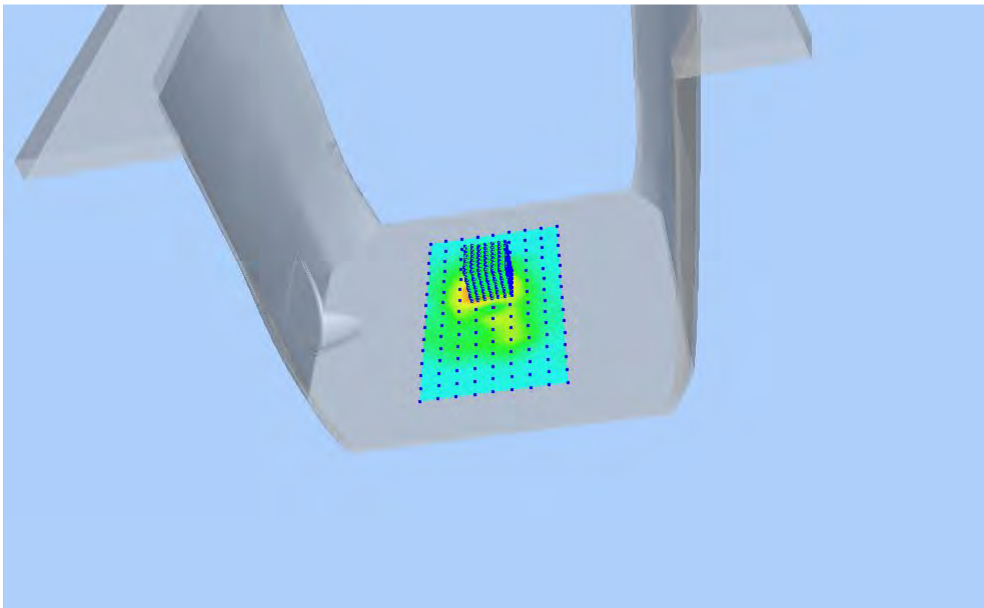
Z Axis Scan



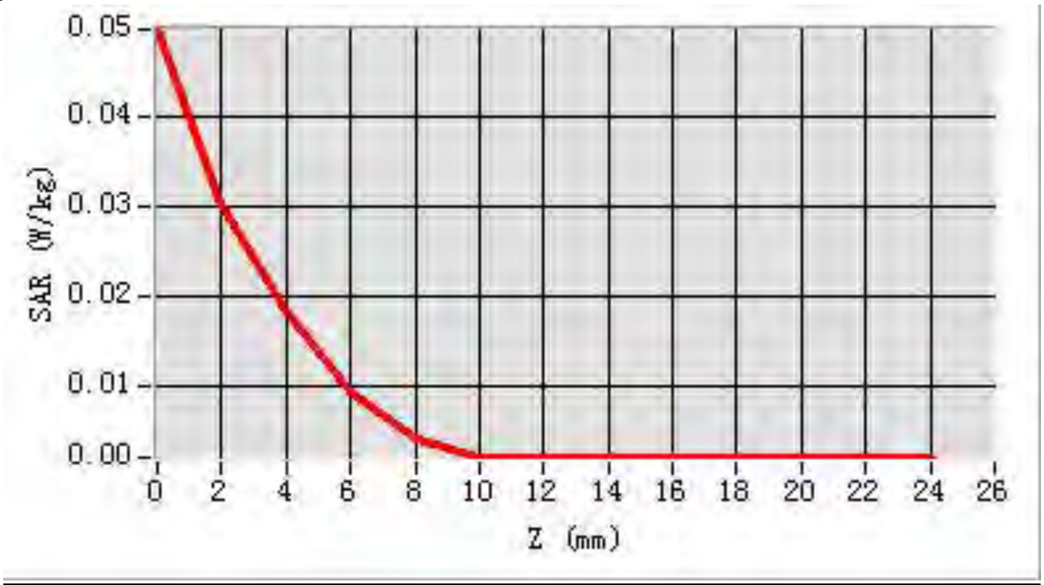
MEAS. 45 Body Plane with Top edge on 46 Channel in IEEE 802.11n(HT-40) mode

Test Date:	20/9/2015
Signal:	WLAN, f=5230.0 MHz, Duty Cycle: 1:1.0
Liquid Parameters:	Permittivity: 48.89; Conductivity: 5.33 S/m
Test condition:	Ambient Temperature: 22.5°C, Liquid Temperature: 22.1°C
Probe:	SN 27/14 SSE2 EPG 210, ConvF: 22.88
Area Scan:	sam_direct_droit2_surf10mm.txt, h= 5.00 mm
Zoom Scan:	5x5x7,dx=4mm, dy=4mm, dz=2mm,Complete
Maximum location:	X=0.000000, Y=18.000000
SAR 10g (W/Kg):	0.008846
SAR 1g (W/Kg):	0.0310711
Power drift (%):	-3.37

3D screen shot



Z Axis Scan



ANNEX D EUT EXTERNAL PHOTOS

Please refer the document “ EUT EXTERNAL PHOTOS. PDF”.

ANNEX E SAR TEST SETUP PHOTOS

Please refer the document “SAR TEST SETUP PHOTOS. PDF”.

ANNEX E CALIBRATION REPORT

F.1 E-Field Probe

SATIMO

受控文件

COMOSAR E-Field Probe Calibration Report

Ref : ACR.155.1.14.SATU.A

SHENZHEN BALUN TECHNOLOGY Co.,Ltd.
BLOCK B, FL 1, BAISHA SCIENCE AND TECHNOLOGY PARK, SHAHE XI ROAD,
NANSHAN DISTRICT, SHENZHEN, GUANGDONG PROVINCE, P.R. CHINA 518055
SATIMO COMOSAR DOSIMETRIC E-FIELD PROBE
SERIAL NO.: SN 27/14 EPG210

Calibrated at SATIMO US
2105 Barrett Park Dr. - Kennesaw, GA 30144

ilac-MRA
ACCREDITED

07/16/2015

Summary:

This document presents the method and results from an accredited COMOSAR Dosimetric E-Field Probe calibration performed in SATIMO USA using the CALISAR / CALIBAIR test bench, for use with a SATIMO COMOSAR system only. All calibration results are traceable to national metrology institutions.

	Name	*Function*	*Date*	*Signature*
Prepared by :	Jérôme LUC	Product Manager	07/16/2015	
Checked by :	Jérôme LUC	Product Manager	07/16/2015	
Approved by :	Kim RUTKOWSKI	Quality Manager	07/16/2015	

	Customer Name
Distribution :	ChangNing (Shenzhen) Electronics Co., Ltd.

Issue	*Date*	*Modifications*
A	07/16/2015	Initial release

F.2 Dielectric Probe

Dielectric Probe Calibration Report

Ref : ACR.219.12.13.SATU.A

SHENZHEN BALUN TECHNOLOGY CO., LTD.
ROOM 601, EAST TOWER, NANSHAN SOFTWARE PARK,
10128 SHENNAN ROAD, SHENZHEN, 518084, CHINA
SATIMO LIMESAR DIELECTRIC PROBE
FREQUENCY: 0.3-6 GHZ
SERIAL NO.: SN 25/13 OCPG56

Calibrated at SATIMO US
2105 Barrett Park Dr. - Kennesaw, GA 30144

ACCREDITED
Calibration CERT #2246.02

17/08/2015

Summary:

This document presents the method and results from an accredited Dielectric Probe calibration performed in SATIMO USA using the LIMESAR test bench. All calibration results are traceable to national metrology institutions.

	Name	*Function*	*Date*	*Signature*
Prepared by :	Jérôme LUC	Product Manager	8/17/2015	JS
Checked by :	Jérôme LUC	Product Manager	8/17/2015	JS
Approved by :	Kim RUTKOWSKI	Quality Manager	8/17/2015	Kim Rutkowski

	Customer Name
Distribution :	Shenzhen BALUN Technology Co., Ltd.

Issue	*Date*	*Modifications*
A	8/17/2015	Initial release

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1 INTRODUCTION

This document contains a summary of the suggested methods and requirements set forth by the IEEE 1528 and CEI/IEC 62209 standards for liquid permittivity measurements and the measurements that were performed to verify that the product complies with the fore mentioned standards.

2 DEVICE UNDER TEST

Device Under Test	
Device Type	LIMESAR DIELECTRIC PROBE
Manufacturer	Satimo
Model	SCLMP
Serial Number	SN 25/13 OCPG56
Product Condition (new / used)	New

A yearly calibration interval is recommended.

3 PRODUCT DESCRIPTION

3.1 GENERAL INFORMATION

Satimo's Dielectric Probes are built in accordance to the IEEE 1528 and CEI/IEC 62209 standards. The product is designed for use with the LIMESAR test bench only.

Figure 1 – *Satimo LIMESAR Dielectric Probe*

4 MEASUREMENT METHOD

The IEEE 1528-2003, OET 65 Bulletin C and CEI/IEC 62209-1 & 2 standards outline techniques for dielectric property measurements. The LIMESAR test bench employs one of the methods outlined in the standards, using a contact probe or open-ended coaxial transmission-line probe and vector network analyzer. The standards recommend the measurement of two reference materials that have well established and stable dielectric properties to validate the system, one for the calibration and one for checking the calibration. The LIMESAR test bench uses De-ionized water as the reference for the calibration and either DMS or Methanol as the reference for checking the calibration. The following measurements were performed to verify that the product complies with the fore mentioned standards.

4.1 LIQUID PERMITTIVITY MEASUREMENTS

The permittivity of a liquid with well established dielectric properties was measured and the measurement results compared to the values provided in the fore mentioned standards.

5 MEASUREMENT UNCERTAINTY

All uncertainties listed below represent an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2, traceable to the Internationally Accepted Guides to Measurement Uncertainty.

5.1 DIELECTRIC PERMITTIVITY MEASUREMENT

The following uncertainties apply to the Dielectric Permittivity measurement:

Uncertainty analysis of Permittivity Measurement					
ERROR SOURCES	**Uncertainty value (+/-%)**	**Probability Distribution**	**Divisor**	**ci**	**Standard Uncertainty (+/-%)**
Repeatability (n repeats, mid-band)	4.00%	N	1	1	4.000%
Deviation from reference liquid	5.00%	R	√3	1	2.887%
Network analyser-drift, linearity	2.00%	R	√3	1	1.155%
Test-port cable variations	0.00%	U	√2	1	0.000%
Combined standard uncertainty					5.066%
Expanded uncertainty (confidence level of 95%, k = 2)					10.0%

Uncertainty analysis of Conductivity Measurement					
ERROR SOURCES	**Uncertainty value (+/-%)**	**Probability Distribution**	**Divisor**	**ci**	**Standard Uncertainty (+/-%)**
Repeatability (n repeats, mid-band)	3.50%	N	1	1	3.500%
Deviation from reference liquid	3.00%	R	√3	1	1.732%
Network analyser-drift, linearity	2.00%	R	√3	1	1.155%
Test-port cable variations	0.00%	U	√2	1	0.000%
Combined standard uncertainty					4.072%
Expanded uncertainty (confidence level of 95%, k = 2)					8.1%

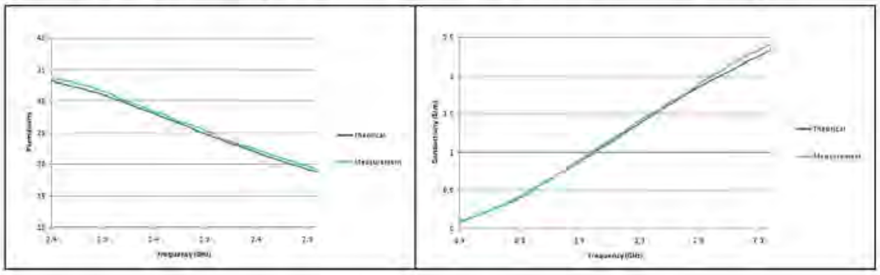
6 CALIBRATION MEASUREMENT RESULTS

Measurement Condition

Software	LIMESAR
Liquid Temperature	21°C
Lab Temperature	21°C
Lab Humidity	44%

6.1 LIQUID PERMITTIVITY MEASUREMENT

A liquid of known characteristics (methanol at 20°C) is measured with the probe and the results (complex permittivity ε'+jε'') are compared with the well-known theoretical values for this liquid.



7 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Description	**Manufacturer / Model**	**Identification No.**	**Current Calibration Date**	**Next Calibration Date**
LIMESAR Test Bench	Version 3	NA	Validated. No cal required.	Validated. No cal required.
Network Analyzer	Rhode & Schwarz ZVA	SN100132	02/2012	02/2015
Methanol CAS 67-56-1	Alpha Aesar	Lot D13W011	Validated. No cal required.	Validated. No cal required.
Temperature and Humidity Sensor	Control Company	11-661-9	3/2015	3/2017

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1 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR DOSIMETRIC E FIELD PROBE
Manufacturer	Satimo
Model	SSE2
Serial Number	SN 27/14 EPG210
Product Condition (new / used)	New
Frequency Range of Probe	0.3 GHz-6GHz
Resistance of Three Dipoles at Connector	Dipole 1: R1=0.197 MΩ Dipole 2: R2=0.220 MΩ Dipole 3: R3=0.241 MΩ

A yearly calibration interval is recommended.

2 PRODUCT DESCRIPTION

2.1 GENERAL INFORMATION

Satimo's COMOSAR E field Probes are built in accordance to the IEEE 1528, OET 65 Bulletin C and CEI/IEC 62209 standards.

Figure 1 – *Satimo COMOSAR Dosimetric E field Dipole*

Probe Length	330 mm
Length of Individual Dipoles	2 mm
Maximum external diameter	8 mm
Probe Tip External Diameter	2.5 mm
Distance between dipoles / probe extremity	1 mm

3 MEASUREMENT METHOD

The IEEE 1528, OET 65 Bulletin C, CENELEC EN50361 and CEI/IEC 62209 standards provide recommended practices for the probe calibrations, including the performance characteristics of interest and methods by which to assess their affect. All calibrations / measurements performed meet the fore mentioned standards.

3.1 LINEARITY

The evaluation of the linearity was done in free space using the waveguide, performing a power sweep to cover the SAR range 0.01W/kg to 100W/kg.

3.2 SENSITIVITY

The sensitivity factors of the three dipoles were determined using a two step calibration method (air and tissue simulating liquid) using waveguides as outlined in the standards.

3.3 LOWER DETECTION LIMIT

The lower detection limit was assessed using the same measurement set up as used for the linearity measurement. The required lower detection limit is 10 mW/kg.

3.4 ISOTROPY

The axial isotropy was evaluated by exposing the probe to a reference wave from a standard dipole with the dipole mounted under the flat phantom in the test configuration suggested for system validations and checks. The probe was rotated along its main axis from 0 - 360 degrees in 15 degree steps. The hemispherical isotropy is determined by inserting the probe in a thin plastic box filled with tissue-equivalent liquid, with the plastic box illuminated with the fields from a half wave dipole. The dipole is rotated about its axis (0°–180°) in 15° increments. At each step the probe is rotated about its axis (0°–360°).

3.5 BOUNDARY EFFECT

The boundary effect is defined as the deviation between the SAR measured data and the expected exponential decay in the liquid when the probe is oriented normal to the interface. To evaluate this effect, the liquid filled flat phantom is exposed to fields from either a reference dipole or waveguide. With the probe normal to the phantom surface, the peak spatial average SAR is measured and compared to the analytical value at the surface.

4 MEASUREMENT UNCERTAINTY

The guidelines outlined in the IEEE 1528, OET 65 Bulletin C, CENELEC EN50361 and CEI/IEC 62209 standards were followed to generate the measurement uncertainty associated with an E-field probe calibration using the waveguide technique. All uncertainties listed below represent an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2, traceable to the Internationally Accepted Guides to Measurement Uncertainty.

Uncertainty analysis of the probe calibration in waveguide					
ERROR SOURCES	**Uncertainty value (%)**	**Probability Distribution**	**Divisor**	**ci**	**Standard Uncertainty (%)**
Incident or forward power	3.00%	Rectangular	$\sqrt{3}$	1	1.732%
Reflected power	3.00%	Rectangular	$\sqrt{3}$	1	1.732%
Liquid conductivity	5.00%	Rectangular	$\sqrt{3}$	1	2.887%
Liquid permittivity	4.00%	Rectangular	$\sqrt{3}$	1	2.309%
Field homogeneity	3.00%	Rectangular	$\sqrt{3}$	1	1.732%
Field probe positioning	5.00%	Rectangular	$\sqrt{3}$	1	2.887%
Field probe linearity	3.00%	Rectangular	$\sqrt{3}$	1	1.732%

Combined standard uncertainty					5.831%
Expanded uncertainty 95 % confidence level k = 2					12.0%

5 CALIBRATION MEASUREMENT RESULTS

Calibration Parameters	
Liquid Temperature	21 °C
Lab Temperature	21 °C
Lab Humidity	45 %

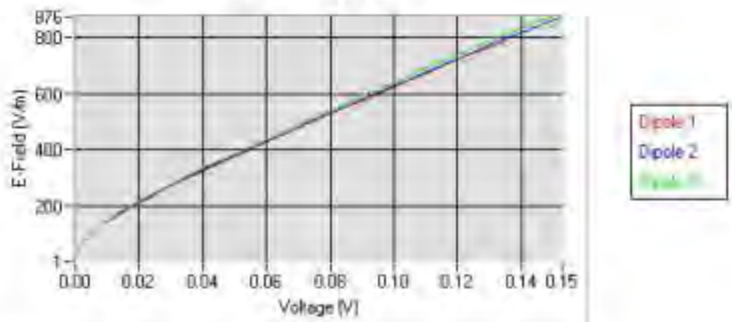
5.1 SENSITIVITY IN AIR

Normx dipole 1 ($\mu V/(V/m)^2$)	Normy dipole 2 ($\mu V/(V/m)^2$)	Normz dipole 3 ($\mu V/(V/m)^2$)
0.44	0.54	0.52

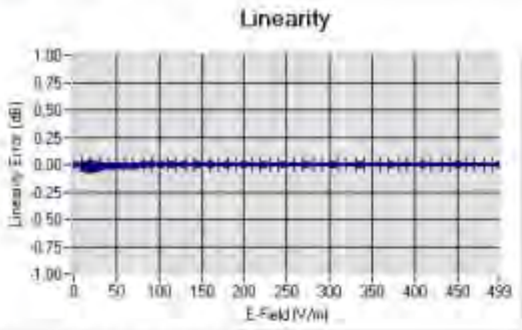
DCP dipole 1 (mV)	DCP dipole 2 (mV)	DCP dipole 3 (mV)
90	90	90

Calibration curves ei=f(V) (i=1,2,3) allow to obtain H-field value using the formula:

$$E = \sqrt{E_1^2 + E_2^2 + E_3^2}$$



5.2 LINEARITY



Linearity:I+/-1.25% (+/-0.05dB)

5.3 SENSITIVITY IN LIQUID

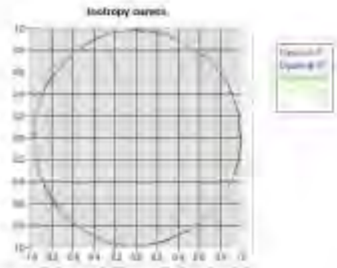
Liquid	Frequency (MHz +/- 100MHz)	Permittivity	Epsilon (S/m)	ConvF
HL450	450	43.02	0.85	30.15
BL450	450	57.52	0.96	31.02
HL750	750	42.30	0.88	22.51
BL750	750	54.79	0.96	23.36
HL850	835	43.03	0.87	23.67
BL850	835	53.35	0.96	24.58
HL900	900	42.29	0.96	23.35
BL900	900	56.82	1.06	24.10
HL1800	1800	40.93	1.36	23.21
BL1800	1800	52.57	1.47	23.69
HL1900	1900	40.92	1.45	26.70
BL1900	1900	53.60	1.52	27.47
HL2000	2000	39.36	1.44	25.28
BL2000	2000	52.17	1.53	26.28
HL2450	2450	39.12	1.78	25.25
BL2450	2450	52.17	1.90	26.09
HL2600	2600	38.46	1.92	25.94
BL2600	2600	51.76	2.19	26.66
HL5200	5200	36.47	4.91	22.36
BL5200	5200	51.18	4.84	22.88
HL5400	5400	36.83	5.02	25.63
BL5400	5400	48.35	5.81	26.47
HL5600	5600	35.39	5.49	24.82
BL5600	5600	49.03	6.17	25.66
HL5800	5800	34.91	5.76	22.60
BL5800	5800	47.18	6.32	23.20

LOWER DETECTION LIMIT: 7mW/kg

5.4 ISOTROPY

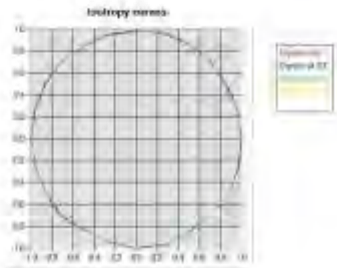
HL900 MHz

- Axial isotropy: 0.04 dB
- Hemispherical isotropy: 0.07 dB



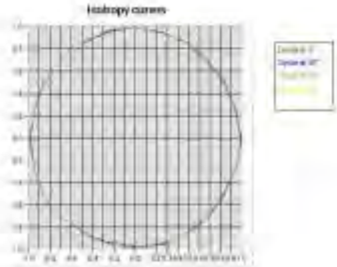
HL1800 MHz

- Axial isotropy: 0.04 dB
- Hemispherical isotropy: 0.08 dB



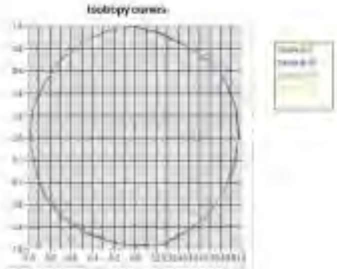
HL2450 MHz

- Axial isotropy: 0.06 dB
- Hemispherical isotropy: 0.08 dB



HL5800 MHz

- Axial isotropy: 0.09 dB
- Hemispherical isotropy: 0.11 dB



6 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Description	**Manufacturer / Model**	**Identification No.**	**Current Calibration Date**	**Next Calibration Date**
Flat Phantom	Satimo	SN-20/09-SAM71	Validated. No cal required.	Validated. No cal required.
COMOSAR Test Bench	Version 3	NA	Validated. No cal required.	Validated. No cal required.
Network Analyzer	Rhode & Schwarz ZVA	SN100132	02/2013	02/2016
Reference Probe	Satimo	EP 94 SN 37/08	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Multimeter	Keithley 2000	1188656	12/2013	12/2016
Signal Generator	Agilent E4438C	MY49070581	12/2013	12/2016
Amplifier	Aethercomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	HP E4418A	US38261498	12/2013	12/2016
Power Sensor	HP ECP-E26A	US37181460	12/2013	12/2016
Directional Coupler	Narda 4216-20	01386	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Waveguide	Mega Industries	069Y7-158-13-712	Validated. No cal required.	Validated. No cal required.
Waveguide Transition	Mega Industries	069Y7-158-13-701	Validated. No cal required.	Validated. No cal required.
Waveguide Termination	Mega Industries	069Y7-158-13-701	Validated. No cal required.	Validated. No cal required.
Temperature / Humidity Sensor	Control Company	11-661-9	8/2013	8/2016

F.3 2450 MHz Dipole

SAR Reference Dipole Calibration Report

Ref : ACR.75.13.15.SATU.A

SHENZHEN BALUN TECHNOLOGY CO.,LTD.
BLOCK B, FL 1, BAISHA SCIENCE AND TECHNOLOGY PARK, SHAHE XI ROAD,
NANSHAN DISTRICT, SHENZHEN, GUANGDONG PROVINCE, P.R. CHINA 518055
MVG COMOSAR REFERENCE DIPOLE
FREQUENCY: 2450 MHZ
SERIAL NO.: SN 25/13 DIP 2G450-251

Calibrated at MVG US
2105 Barrett Park Dr. - Kennesaw, GA 30144

03/16/2015

Summary:

This document presents the method and results from an accredited SAR reference dipole calibration performed in MVG USA using the COMOSAR test bench. All calibration results are traceable to national metrology institutions.

SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.75.13.15.SATU.A

	Name	Function	Date	Signature
Prepared by :	Jérôme LUC	Product Manager	3/16/2015	JS
Checked by :	Jérôme LUC	Product Manager	3/16/2015	JS
Approved by :	Kim RUTKOWSKI	Quality Manager	3/16/2015	Kim Rutkowski

	Customer Name
Distribution :	SHENZHEN BALUN TECHNOLOGY Co.,Ltd.

Issue	Date	Modifications
A	3/16/2015	Initial release

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1 INTRODUCTION

This document contains a summary of the requirements set forth by the IEEE 1528, FCC KDBs and CEI/IEC 62209 standards for reference dipoles used for SAR measurement system validations and the measurements that were performed to verify that the product complies with the fore mentioned standards.

2 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR 2450 MHz REFERENCE DIPOLE
Manufacturer	MVG
Model	SID2450
Serial Number	SN 25/13 DIP 2G450-251
Product Condition (new / used)	Used

A yearly calibration interval is recommended.

3 PRODUCT DESCRIPTION

3.1 GENERAL INFORMATION

MVG's COMOSAR Validation Dipoles are built in accordance to the IEEE 1528, FCC KDBs and CEI/IEC 62209 standards. The product is designed for use with the COMOSAR test bench only.

Figure 1 – *MVG COMOSAR Validation Dipole*

4 MEASUREMENT METHOD

The IEEE 1528, FCC KDBs and CEI/IEC 62209 standards provide requirements for reference dipoles used for system validation measurements. The following measurements were performed to verify that the product complies with the fore mentioned standards.

4.1 RETURN LOSS REQUIREMENTS

The dipole used for SAR system validation measurements and checks must have a return loss of -20 dB or better. The return loss measurement shall be performed against a liquid filled flat phantom, with the phantom constucted as outlined in the fore mentioned standards.

4.2 MECHANICAL REQUIREMENTS

The IEEE Std. 1528 and CEI/IEC 62209 standards specify the mechanical components and dimensions of the validation dipoles, with the dimensions frequency and phantom shell thickness dependent. The COMOSAR test bench employs a 2 mm phantom shell thickness therefore the dipoles sold for use with the COMOSAR test bench comply with the requirements set forth for a 2 mm phantom shell thickness.

5 MEASUREMENT UNCERTAINTY

All uncertainties listed below represent an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2, traceable to the Internationally Accepted Guides to Measurement Uncertainty.

5.1 RETURN LOSS

The following uncertainties apply to the return loss measurement:

Frequency band	Expanded Uncertainty on Return Loss
400-6000MHz	0.1 dB

5.2 DIMENSION MEASUREMENT

The following uncertainties apply to the dimension measurements:

Length (mm)	Expanded Uncertainty on Length
3 - 300	0.05 mm

5.3 VALIDATION MEASUREMENT

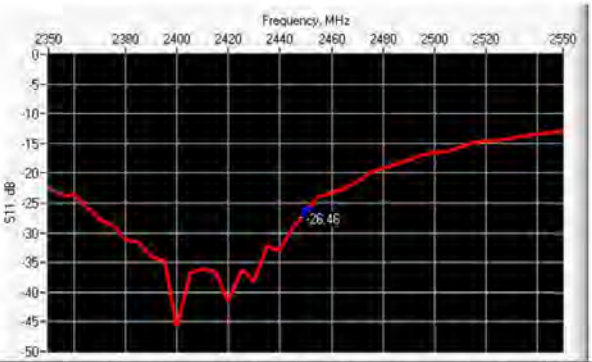
The guidelines outlined in the IEEE 1528, FCC KDBs, CENELEC EN50361 and CEI/IEC 62209 standards were followed to generate the measurement uncertainty for validation measurements.

Scan Volume	Expanded Uncertainty
1 g	20.3 %

10 g	20.1 %

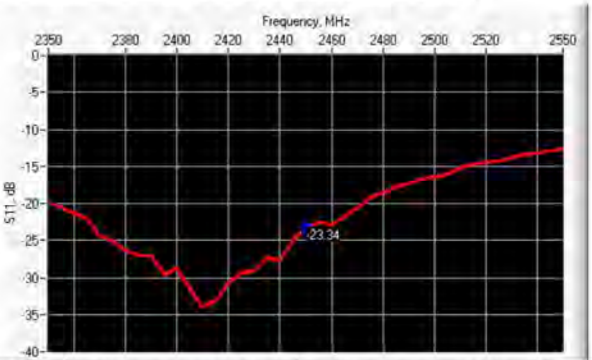
6 CALIBRATION MEASUREMENT RESULTS

6.1 RETURN LOSS AND IMPEDANCE IN HEAD LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
2450	-26.46	-20	49.3 Ω - 4.7 jΩ

6.2 RETURN LOSS AND IMPEDANCE IN BODY LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
2450	-23.34	-20	53.4 Ω - 6.2 jΩ

6.3 MECHANICAL DIMENSIONS

Frequency MHz	L mm		h mm		d mm	
	required	measured	required	measured	required	measured
300	420.0 ±1 %.		250.0 ±1 %.		6.35 ±1 %.	

450	290.0 ±1 %.		166.7 ±1 %.		6.35 ±1 %.	
750	176.0 ±1 %.		100.0 ±1 %.		6.35 ±1 %.	
835	161.0 ±1 %.		89.8 ±1 %.		3.6 ±1 %.	
900	149.0 ±1 %.		83.3 ±1 %.		3.6 ±1 %.	
1450	89.1 ±1 %.		51.7 ±1 %.		3.6 ±1 %.	
1500	80.5 ±1 %.		50.0 ±1 %.		3.6 ±1 %.	
1640	79.0 ±1 %.		45.7 ±1 %.		3.6 ±1 %.	
1750	75.2 ±1 %.		42.9 ±1 %.		3.6 ±1 %.	
1800	72.0 ±1 %.		41.7 ±1 %.		3.6 ±1 %.	
1900	68.0 ±1 %.		39.5 ±1 %.		3.6 ±1 %.	
1950	66.3 ±1 %.		38.5 ±1 %.		3.6 ±1 %.	
2000	64.5 ±1 %.		37.5 ±1 %.		3.6 ±1 %.	
2100	61.0 ±1 %.		35.7 ±1 %.		3.6 ±1 %.	
2300	55.5 ±1 %.		32.6 ±1 %.		3.6 ±1 %.	
2450	51.5 ±1 %.	PASS	30.4 ±1 %.	PASS	3.6 ±1 %.	PASS
2600	48.5 ±1 %.		28.8 ±1 %.		3.6 ±1 %.	
3000	41.5 ±1 %.		25.0 ±1 %.		3.6 ±1 %.	
3500	37.0±1 %.		26.4 ±1 %.		3.6 ±1 %.	
3700	34.7±1 %.		26.4 ±1 %.		3.6 ±1 %.	

7 VALIDATION MEASUREMENT

The IEEE Std. 1528, FCC KDBs and CEI/IEC 62209 standards state that the system validation measurements must be performed using a reference dipole meeting the fore mentioned return loss and mechanical dimension requirements. The validation measurement must be performed against a liquid filled flat phantom, with the phantom constructed as outlined in the fore mentioned standards. Per the standards, the dipole shall be positioned below the bottom of the phantom, with the dipole length centered and parallel to the longest dimension of the flat phantom, with the top surface of the dipole at the described distance from the bottom surface of the phantom.

7.1 HEAD LIQUID MEASUREMENT

Frequency MHz	Relative permittivity (ε_r')		Conductivity (σ) S/m	
	required	measured	required	measured
300	45.3 ±5 %		0.87 ±5 %	
450	43.5 ±5 %		0.87 ±5 %	
750	41.9 ±5 %		0.89 ±5 %	
835	41.5 ±5 %		0.90 ±5 %	
900	41.5 ±5 %		0.97 ±5 %	
1450	40.5 ±5 %		1.20 ±5 %	
1500	40.4 ±5 %		1.23 ±5 %	
1640	40.2 ±5 %		1.31 ±5 %	
1750	40.1 ±5 %		1.37 ±5 %	

1800	40.0 ±5 %		1.40 ±5 %	
1900	40.0 ±5 %		1.40 ±5 %	
1950	40.0 ±5 %		1.40 ±5 %	
2000	40.0 ±5 %		1.40 ±5 %	
2100	39.8 ±5 %		1.49 ±5 %	
2300	39.5 ±5 %		1.67 ±5 %	
2450	39.2 ±5 %	PASS	1.80 ±5 %	PASS
2600	39.0 ±5 %		1.96 ±5 %	
3000	38.5 ±5 %		2.40 ±5 %	
3500	37.9 ±5 %		2.91 ±5 %	

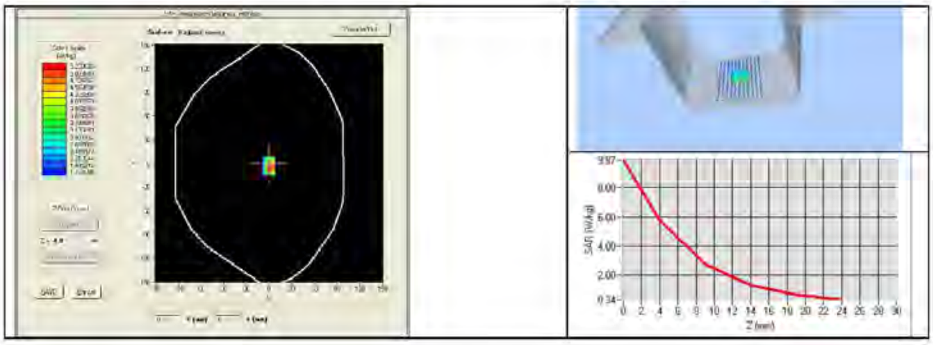
7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

The IEEE Std. 1528 and CEI/IEC 62209 standards state that the system validation measurements should produce the SAR values shown below (for phantom thickness of 2 mm), within the uncertainty for the system validation. All SAR values are normalized to 1 W forward power. In bracket, the measured SAR is given with the used input power.

Software	OPENSAR V4
Phantom	SN 20/09 SAM71
Probe	SN 18/11 EPG122
Liquid	Head Liquid Values: eps' : 38.9 sigma : 1.79
Distance between dipole center and liquid	10.0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoon Scan Resolution	dx=5mm/dy=5m/dz=5mm
Frequency	2450 MHz
Input power	20 dBm
Liquid Temperature	21 °C
Lab Temperature	21 °C
Lab Humidity	45 %

Frequency MHz	1 g SAR (W/kg/W)		10 g SAR (W/kg/W)	
	required	measured	required	measured
300	2.85		1.94	
450	4.58		3.06	
750	8.49		5.55	
835	9.56		6.22	
900	10.9		6.99	
1450	29		16	
1500	30.5		16.8	
1640	34.2		18.4	
1750	36.4		19.3	
1800	38.4		20.1	

1900	39.7		20.5	
1950	40.5		20.9	
2000	41.1		21.1	
2100	43.6		21.9	
2300	48.7		23.3	
2450	52.4	54.29 (5.43)	24	24.20 (2.42)
2600	55.3		24.6	
3000	63.8		25.7	
3500	67.1		25	



7.3 BODY LIQUID MEASUREMENT

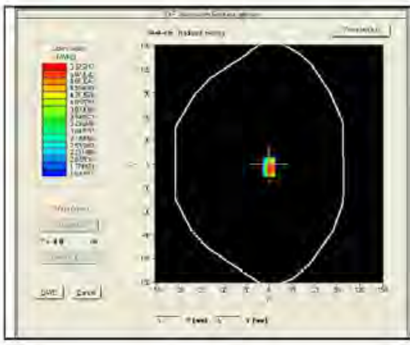
Frequency MHz	Relative permittivity (εr')		Conductivity (σ) S/m	
	required	measured	required	measured
150	61.9 ±5 %		0.80 ±5 %	
300	58.2 ±5 %		0.92 ±5 %	
450	56.7 ±5 %		0.94 ±5 %	
750	55.5 ±5 %		0.96 ±5 %	
835	55.2 ±5 %		0.97 ±5 %	
900	55.0 ±5 %		1.05 ±5 %	
915	55.0 ±5 %		1.06 ±5 %	
1450	54.0 ±5 %		1.30 ±5 %	
1610	53.8 ±5 %		1.40 ±5 %	
1800	53.3 ±5 %		1.52 ±5 %	
1900	53.3 ±5 %		1.52 ±5 %	
2000	53.3 ±5 %		1.52 ±5 %	
2100	53.2 ±5 %		1.62 ±5 %	
2450	52.7 ±5 %	PASS	1.95 ±5 %	PASS

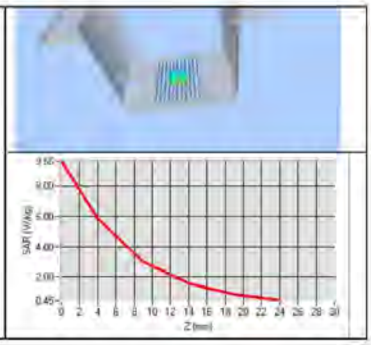
2600	52.5 ±5 %		2.16 ±5 %	
3000	52.0 ±5 %		2.73 ±5 %	
3500	51.3 ±5 %		3.31 ±5 %	
5200	49.0 ±10 %		5.30 ±10 %	
5300	48.9 ±10 %		5.42 ±10 %	
5400	48.7 ±10 %		5.53 ±10 %	
5500	48.6 ±10 %		5.65 ±10 %	
5600	48.5 ±10 %		5.77 ±10 %	
5800	48.2 ±10 %		6.00 ±10 %	

7.4 SAR MEASUREMENT RESULT WITH BODY LIQUID

Software	OPENSAR V4
Phantom	SN 20/09 SAM71
Probe	SN 18/11 EPG122
Liquid	Body Liquid Values: eps' : 52.7 sigma : 1.94
Distance between dipole center and liquid	10.0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoon Scan Resolution	dx=5mm/dy=5m/dz=5mm
Frequency	2450 MHz
Input power	20 dBm
Liquid Temperature	21 °C
Lab Temperature	21 °C
Lab Humidity	45 %

Frequency MHz	1 g SAR (W/kg/W)	10 g SAR (W/kg/W)
	measured	measured
2450	54.70 (5.47)	24.86 (2.49)





8 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Description	**Manufacturer / Model**	**Identification No.**	**Current Calibration Date**	**Next Calibration Date**
SAM Phantom	MVG	SN-20/09-SAM71	Validated. No cal required.	Validated. No cal required.
COMOSAR Test Bench	Version 3	NA	Validated. No cal required.	Validated. No cal required.
Network Analyzer	Rhode & Schwarz ZVA	SN100132	02/2013	02/2016
Calipers	Carrera	CALIPER-01	12/2013	12/2016
Reference Probe	MVG	EPG122 SN 18/11	10/2014	10/2015
Multimeter	Keithley 2000	1188656	12/2013	12/2016
Signal Generator	Agilent E4438C	MY49070581	12/2013	12/2016
Amplifier	Aethercomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	HP E4418A	US38261498	12/2013	12/2016
Power Sensor	HP ECP-E26A	US37181460	12/2013	12/2016
Directional Coupler	Narda 4216-20	01386	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Temperature and Humidity Sensor	Control Company	11-661-9	8/2012	8/2015

F.4 Waveguide

SAR Reference Waveguide Calibration Report

Ref : ACR.75.15.15.SATU.A

SHENZHEN BALUN TECHNOLOGY CO.,LTD.
BLOCK B, FL 1, BAISHA SCIENCE AND TECHNOLOGY PARK, SHAHE XI ROAD,
NANSHAN DISTRICT, SHENZHEN, GUANGDONG PROVINCE, P.R. CHINA 518055
MVG COMOSAR REFERENCE WAVEGUIDE
FREQUENCY: 5000-6000 MHZ
SERIAL NO.: SN 30/13 WGA24

Calibrated at MVG US
2105 Barrett Park Dr. - Kennesaw, GA 30144

ACCREDITED

03/16/2015

Summary:

This document presents the method and results from an accredited SAR reference waveguide calibration performed in MVG USA using the COMOSAR test bench. All calibration results are traceable to national metrology institutions.

SAR REFERENCE WAVEGUIDE CALIBRATION REPORT

Ref: ACR.75.15.14.SATU.A

	Name	Function	Date	Signature
Prepared by :	Jérôme LUC	Product Manager	3/16/2015	JS
Checked by :	Jérôme LUC	Product Manager	3/16/2015	JS
Approved by :	Kim RUTKOWSKI	Quality Manager	3/16/2015	Kim Rutkowski

	Customer Name
Distribution :	SHENZHEN BALUN TECHNOLOGY Co.,Ltd.

Issue	Date	Modifications
A	3/16/2015	Initial release

Page: 2/13

SAR REFERENCE WAVEGUIDE CALIBRATION REPORT

Ref: ACR.75.15.14.SATU.A

TABLE OF CONTENTS

1 INTRODUCTION

This document contains a summary of the requirements set forth by the IEEE 1528 and CEI/IEC 62209 standards for reference waveguides used for SAR measurement system validations and the measurements that were performed to verify that the product complies with the fore mentioned standards.

2 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR 5000-6000 MHz REFERENCE WAVEGUIDE
Manufacturer	MVG
Model	SWG5500
Serial Number	SN 30/13 WGA24
Product Condition (new / used)	Used

A yearly calibration interval is recommended.

3 PRODUCT DESCRIPTION

3.1 GENERAL INFORMATION

MVG's COMOSAR Validation Waveguides are built in accordance to the IEEE 1528 and CEI/IEC 62209 standards.

4 MEASUREMENT METHOD

The IEEE 1528 and CEI/IEC 62209 standards provide requirements for reference waveguides used for system validation measurements. The following measurements were performed to verify that the product complies with the fore mentioned standards.

4.1 RETURN LOSS REQUIREMENTS

The waveguide used for SAR system validation measurements and checks must have a return loss of -8 dB or better. The return loss measurement shall be performed with matching layer placed in the open end of the waveguide, with the waveguide and matching layer in direct contact with the phantom shell as outlined in the fore mentioned standards.

4.2 MECHANICAL REQUIREMENTS

The IEEE 1528 and CEI/IEC 62209 standards specify the mechanical dimensions of the validation waveguide, the specified dimensions are as shown in Section 6.2. Figure 1 shows how the dimensions relate to the physical construction of the waveguide.

5 MEASUREMENT UNCERTAINTY

All uncertainties listed below represent an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2, traceable to the Internationally Accepted Guides to Measurement Uncertainty.

5.1 RETURN LOSS

The following uncertainties apply to the return loss measurement:

Frequency band	Expanded Uncertainty on Return Loss
400-6000MHz	0.1 dB

5.2 DIMENSION MEASUREMENT

The following uncertainties apply to the dimension measurements:

Length (mm)	Expanded Uncertainty on Length
3 - 300	0.05 mm

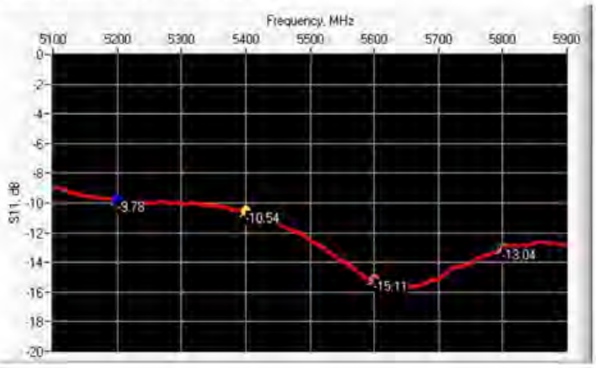
5.3 VALIDATION MEASUREMENT

The guidelines outlined in the IEEE 1528 and CEI/IEC 62209 standards were followed to generate the measurement uncertainty for validation measurements.

Scan Volume	Expanded Uncertainty
1 g	20.3 %
10 g	20.1 %

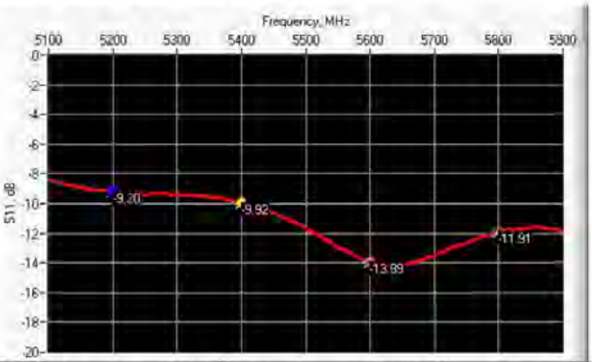
6 CALIBRATION MEASUREMENT RESULTS

6.1 RETURN LOSS IN HEAD LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
5200	-9.78	-8	26.6 Ω + 9.1 jΩ
5400	-10.54	-8	89.7 Ω + 12.3 jΩ
5600	-15.11	-8	38.1 Ω - 9.8 jΩ
5800	-13.04	-8	54.0 Ω + 23.4 jΩ

6.2 RETURN LOSS IN BODY LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
5200	-9.20	-8	25.7 Ω + 10.6 jΩ
5400	-9.92	-8	95.8 Ω + 8.8 jΩ
5600	-13.89	-8	35.3 Ω - 9.2 jΩ
5800	-11.91	-8	56.0 Ω + 27.2 jΩ

6.3 MECHANICAL DIMENSIONS

Frequency (MHz)	L (mm)		W (mm)		L_f (mm)		W_f (mm)		T (mm)	
	Required	Measured	Required	Measured	Required	Measured	Required	Measured	Required	Measured
5200	40.39 ± 0.13	PASS	20.19 ± 0.13	PASS	81.03 ± 0.13	PASS	61.98 ± 0.13	PASS	5.3*	PASS
5800	40.39 ± 0.13	PASS	20.19 ± 0.13	PASS	81.03 ± 0.13	PASS	61.98 ± 0.13	PASS	4.3*	PASS

* The tolerance for the matching layer is included in the return loss measurement.

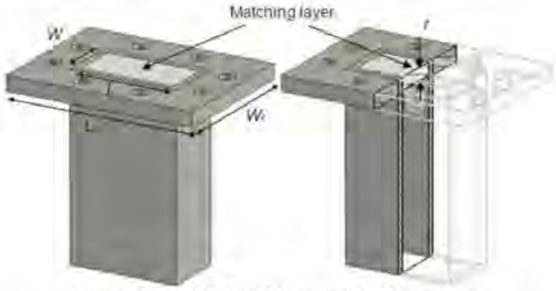


Figure 1: Validation Waveguide Dimensions

7 VALIDATION MEASUREMENT

The IEEE Std. 1528 and CEI/IEC 62209 standards state that the system validation measurements must be performed using a reference waveguide meeting the fore mentioned return loss and mechanical dimension requirements. The validation measurement must be performed with the matching layer placed in the open end of the waveguide, with the waveguide and matching layer in direct contact with the phantom shell.

7.1 HEAD LIQUID MEASUREMENT

Frequency MHz	Relative permittivity (ε_r')		Conductivity (σ) S/m	
	required	measured	required	measured
5000	36.2 ±10 %		4.45 ±10 %	
5100	36.1 ±10 %		4.56 ±10 %	
5200	36.0 ±10 %	PASS	4.66 ±10 %	PASS
5300	35.9 ±10 %		4.76 ±10 %	
5400	35.8 ±10 %	PASS	4.86 ±10 %	PASS
5500	35.6 ±10 %		4.97 ±10 %	
5600	35.5 ±10 %	PASS	5.07 ±10 %	PASS
5700	35.4 ±10 %		5.17 ±10 %	
5800	35.3 ±10 %	PASS	5.27 ±10 %	PASS
5900	35.2 ±10 %		5.38 ±10 %	
6000	35.1 ±10 %		5.48 ±10 %	

7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

At those frequencies, the target SAR value can not be generic. Hereunder is the target SAR value defined by MVG, within the uncertainty for the system validation. All SAR values are normalized to 1 W net power. In bracket, the measured SAR is given with the used input power.

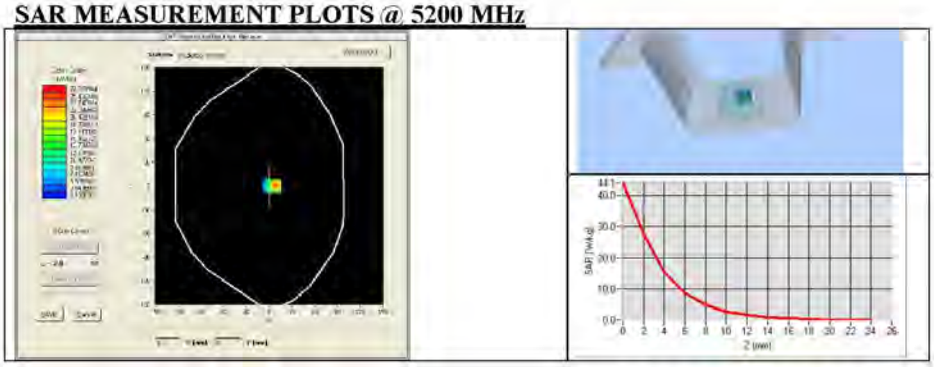
SAR REFERENCE WAVEGUIDE CALIBRATION REPORT

Ref: ACR.75.15.14.SATU.A

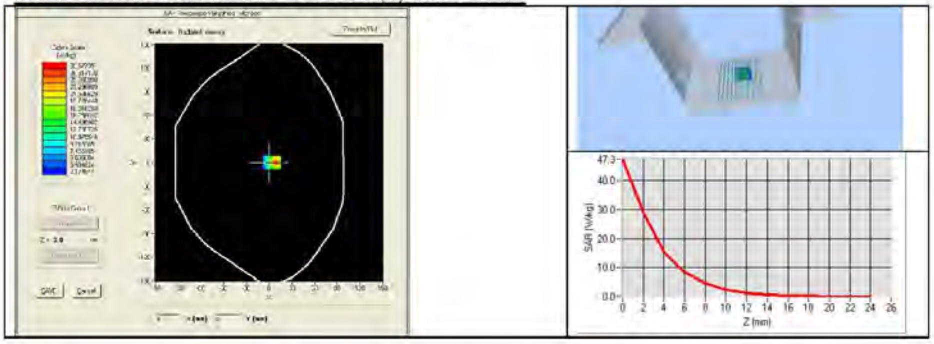
Software	OPENSAR V4
Phantom	SN 20/09 SAM71
Probe	SN 18/11 EPG122
Liquid	Head Liquid Values 5200 MHz: eps' :36.44 sigma : 4.79 Head Liquid Values 5400 MHz: eps' :35.99 sigma : 4.91 Head Liquid Values 5600 MHz: eps' :35.22 sigma : 5.18 Head Liquid Values 5800 MHz: eps' :34.95 sigma : 5.42
Distance between dipole waveguide and liquid	0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoon Scan Resolution	dx=4mm/dy=4m/dz=2mm
Frequency	5200 MHz 5400 MHz 5600 MHz 5800 MHz
Input power	20 dBm
Liquid Temperature	21 °C
Lab Temperature	21 °C
Lab Humidity	45 %

Frequency (MHz)	1 g SAR (W/kg)		10 g SAR (W/kg)	
	required	measured	required	measured
5200	159.00	157.80 (15.78)	56.90	55.01 (5.50)
5400	166.40	162.69 (16.27)	58.43	56.17 (5.62)
5600	173.80	171.22 (17.12)	59.97	58.57 (5.86)
5800	181.20	179.53 (17.95)	61.50	60.55 (6.05)

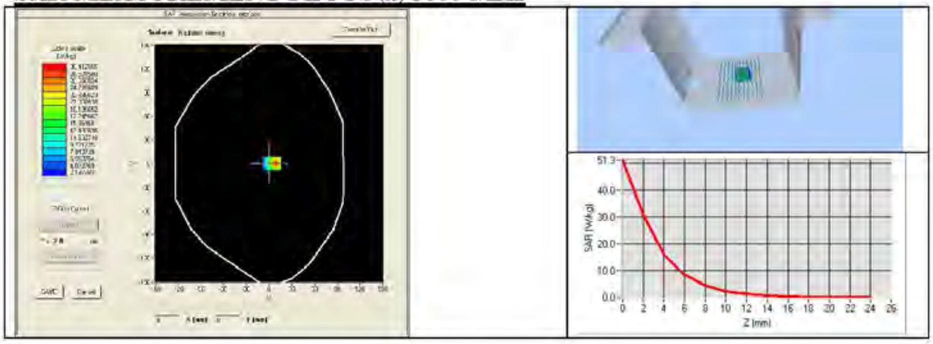
SAR MEASUREMENT PLOTS @ 5200 MHz



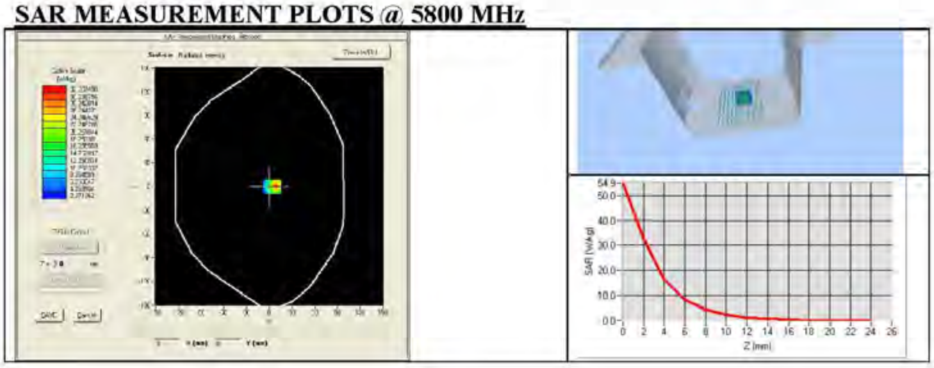
SAR MEASUREMENT PLOTS @ 5400 MHz



SAR MEASUREMENT PLOTS @ 5600 MHz



SAR MEASUREMENT PLOTS @ 5800 MHz



7.3 BODY LIQUID MEASUREMENT

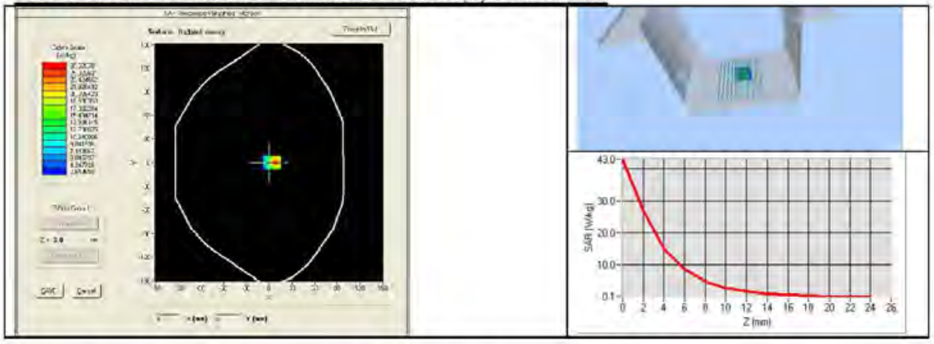
Frequency MHz	Relative permittivity (ε_r')		Conductivity (σ) S/m	
	required	measured	required	measured
5200	49.0 ±10 %	PASS	5.30 ±10 %	PASS
5300	48.9 ±10 %		5.42 ±10 %	
5400	48.7 ±10 %	PASS	5.53 ±10 %	PASS
5500	48.6 ±10 %		5.65 ±10 %	
5600	48.5 ±10 %	PASS	5.77 ±10 %	PASS
5800	48.2 ±10 %	PASS	6.00 ±10 %	PASS

7.4 SAR MEASUREMENT RESULT WITH BODY LIQUID

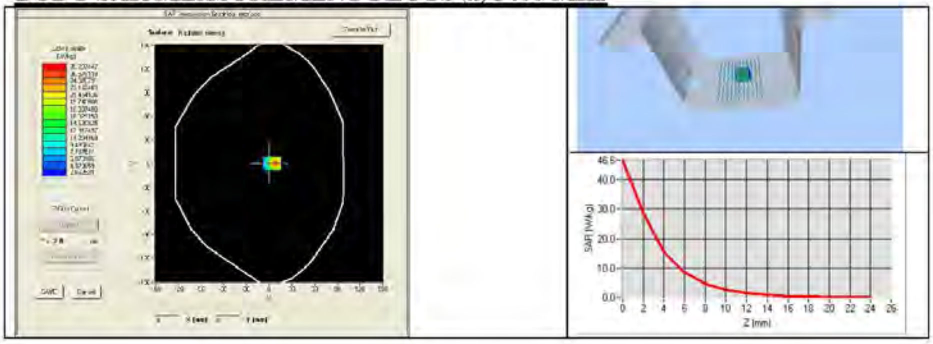
Software	OPENSAR V4
Phantom	SN 20/09 SAM71
Probe	SN 18/11 EPG122
Liquid	Body Liquid Values 5200 MHz: eps' :50.70 sigma : 5.11 Body Liquid Values 5400 MHz: eps' :50.01 sigma : 5.64 Body Liquid Values 5600 MHz: eps' :49.34 sigma : 5.85 Body Liquid Values 5800 MHz: eps' :48.54 sigma : 6.22
Distance between dipole waveguide and liquid	0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoon Scan Resolution	dx=4mm/dy=4m/dz=2mm
Frequency	5200 MHz 5400 MHz 5600 MHz 5800 MHz
Input power	20 dBm
Liquid Temperature	21 °C
Lab Temperature	21 °C
Lab Humidity	45 %

Frequency (MHz)	1 g SAR (W/kg)	10 g SAR (W/kg)
	measured	measured
5200	155.12 (15.51)	54.66 (5.47)
5400	162.06 (16.21)	56.46 (5.65)
5600	167.13 (16.71)	57.78 (5.78)
5800	173.19 (17.32)	59.30 (5.93)

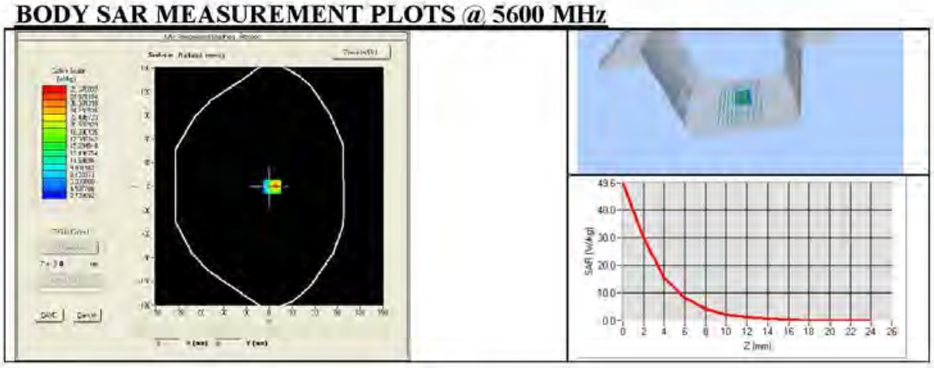
BODY SAR MEASUREMENT PLOTS @ 5200 MHz



BODY SAR MEASUREMENT PLOTS @ 5400 MHz



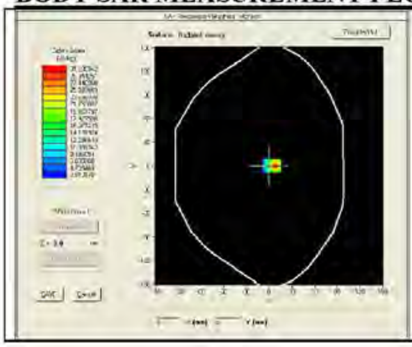
BODY SAR MEASUREMENT PLOTS @ 5600 MHz

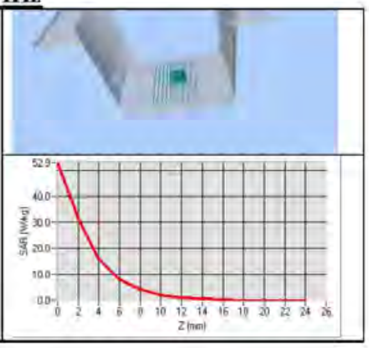


SAR REFERENCE WAVEGUIDE CALIBRATION REPORT

Ref: ACR.75.15.14.SATU.A

BODY SAR MEASUREMENT PLOTS @ 5800 MHz





SAR REFERENCE WAVEGUIDE CALIBRATION REPORT

Ref: ACR.75.15.14.SATU.A

8 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Description	**Manufacturer / Model**	**Identification No.**	**Current Calibration Date**	**Next Calibration Date**
Flat Phantom	MVG	SN-20/09-SAM71	Validated. No cal required.	Validated. No cal required.
COMOSAR Test Bench	Version 3	NA	Validated. No cal required.	Validated. No cal required.
Network Analyzer	Rhode & Schwarz ZVA	SN100132	02/2013	02/2016
Calipers	Carrera	CALIPER-01	12/2013	12/2016
Reference Probe	MVG	EPG122 SN 18/11	10/2014	10/2015
Multimeter	Keithley 2000	1188656	12/2013	12/2016
Signal Generator	Agilent E4438C	MY49070581	12/2013	12/2016
Amplifier	Aethercomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	HP E4418A	US38261498	12/2013	12/2016
Power Sensor	HP ECP-E26A	US37181460	12/2013	12/2016
Directional Coupler	Narda 4216-20	01386	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Temperature and Humidity Sensor	Control Company	11-661-9	8/2012	8/2015

--END OF REPORT--