

FCC

SAR

TEST REPORT

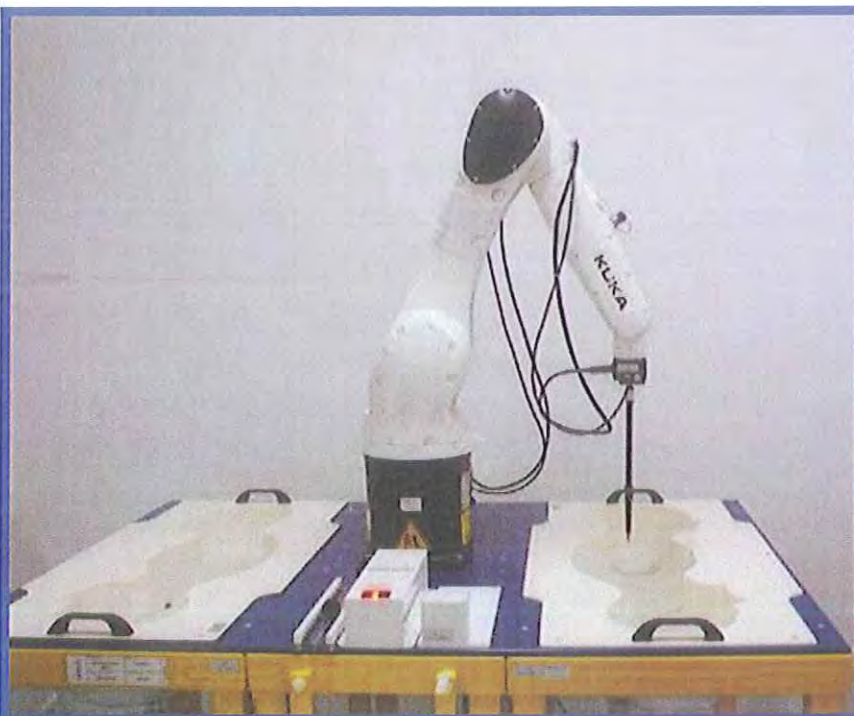
ISSUED BY
Shenzhen BALUN Technology Co., Ltd.



FOR
PIXI 4-7 4G android

ISSUED TO
TCL Communication Ltd

5F, C-Tower, No. 232, Liang Jing Road, Zhang Jiang High-Tech Park,
Pudong Area, Shanghai, 201203, P. R. China



Tested by:

Tu Lang
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Date

Sep. 07, 2016

Approved by:

Wei Yanquan
Wei Yanquan
(Chief Engineer)

Date

Sep. 07, 2016

Report No.: BL-SZ1660207-701

EUT Type: PIXI 4-7 4G android

Model Name: 9015J

Brand Name: alcatel

FCC ID: 2ACCJB067

Test Standard: FCC 47 CFR Part 2.1093

ANSI C95.1: 1999

IEEE 1528: 2013

Maximum SAR: Head (1 g): 0.984 W/kg

Body (1 g): 0.979 W/kg

Test Conclusion: Pass

Test Date: Aug. 11, 2016 ~ Aug. 19, 2016

Date of Issue: Sep. 07, 2016

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Revision History

Version	Issue Date	Revisions Content
<u>Rev. 01</u>	<u>Aug. 24, 2016</u>	<u>Initial Issue</u>
<u>Rev. 02</u>	<u>Aug. 31, 2016</u>	<u>Removed section 10.2</u> <u>Added sensor location in section 9</u> <u>Added the description for proximity sensor</u> <u>triggering in section 10.1</u>
<u>Rev.03</u>	<u>Sep. 07, 2016</u>	<u>Removed the SAR test for LTE Band 28.</u>

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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 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°C
Ambient Relative Humidity	35 to 49%
Ambient Pressure	100 to 102KPa

1.4 Announce

- (1) The test report reference to the report template version v2.2.
- (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 Information

Applicant	TCL Communication Ltd
Address	5F, C-Tower, No. 232, Liang Jing Road, ZhangJiang High-Tech Park, Pudong Area, Shanghai, 201203, P. R. China

2.2 Manufacturer Information

Manufacturer	TCL Communication Ltd
Address	5F, C-Tower, No. 232, Liang Jing Road, ZhangJiang High-Tech Park, Pudong Area, Shanghai, 201203, P. R. China

2.3 Factory Information

Factory	TCL Communication Ltd
Address	5F, C-Tower, No. 232, Liang Jing Road, ZhangJiang High-Tech Park, Pudong Area, Shanghai, 201203, P. R. China

2.4 General Description for Equipment under Test (EUT)

EUT Type	PIXI 4-7 4G android
Model Name Under Test	9015J
Series Model Name	N/A
Description of Model Name Differentiation	N/A
Hardware Version	V3.0B
Software Version	N/A
Dimensions (Approx.)	190.2x106x9.1mm
Weight (Approx.)	267g
Network and Wireless connectivity	2G Network GSM 850/900/1800/1900, GPRS Class 12, EDGE Class 12; 3G Network WCDMA Band 1/ 2/ 5/ 8, HSDPA, HSUPA; 4G Network FDD LTE Band 2/3/4/7/17/28 TDD LTE Band 40; 2.4G WLAN, Bluetooth, FM, GPS, GLONASS

2.5 Ancillary Equipment

Ancillary Equipment 1	Battery	
	Brand Name	ALCATEL
	Model No.	TLp040HC
	Serial No.	N/A
	Capacitance	4000 mAh
	Rated Voltage	3.8 V
	Limit Charge Voltage	4.35 V
Ancillary Equipment 2	Charger 1	
	Brand Name	ALCATEL ONETOUCH or alcatel
	Model No.	UC13US
	Serial No.	N/A
	Rated Input	100-240 V~, 0.35 A, 50/60 Hz
	Rated Output	5 V=, 2 A
Ancillary Equipment 3	Charger 2	
	Brand Name	ALCATEL ONETOUCH or alcatel
	Model No.	UC13US
	Serial No.	N/A
	Rated Input	100-240 V~, 0.35 A, 50/60 Hz
	Rated Output	5 V=, 2 A
Ancillary Equipment 4	USB Cable 1	
	Length (Approx.)	0.8 m
Ancillary Equipment 5	USB Cable 2	
	Length (Approx.)	0.8 m
Ancillary Equipment 6	Earphone 1	
	Length (Approx.)	1.5 m

2.6 Technical Information

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

Operating Mode	GSM, WCDMA, LTE, 2.4G WLAN, Bluetooth		
Frequency Range	GSM 850	TX: 824 MHz ~ 849 MHz	RX: 869 MHz ~ 894 MHz
	GSM 1900	TX: 1850 MHz ~ 1910 MHz	RX: 1930 MHz ~ 1990 MHz
	WCDMA Band 2	TX: 1850 MHz ~ 1910 MHz	RX: 1930 MHz ~ 1990 MHz
	WCDMA Band 5	TX: 824 MHz ~ 849 MHz	RX: 869 MHz ~ 894 MHz
	LTE Band 2	TX: 1850 MHz ~ 1910 MHz	RX: 1930 MHz ~ 1990 MHz
	LTE Band 4	TX: 1710 MHz ~ 1755 MHz	RX: 2110 MHz ~ 2155 MHz
	LTE Band 7	TX: 2500 MHz ~ 2570 MHz	RX: 2620 MHz ~ 2690 MHz
	LTE Band 17	TX: 704 MHz ~ 716 MHz	RX: 734 MHz ~ 746 MHz
	802.11b/g /n(HT20/HT40)	2400~2483.5 MHz	
	Bluetooth	2400~2483.5 MHz	
Antenna Type	WWAN: PIFA Antenna WLAN: PIFA Antenna Bluetooth: PIFA Antenna		
Hotspot Function	Support		
Power Reduction	Support		
Exposure Category	General Population/Uncontrolled exposure		
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. C95.1-1999	IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz
3	IEEE Std. 1528-2013	Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques
4	FCC KDB 447498 D01 v06	Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies
5	FCC KDB 941225 D01 v03r01	3G SAR MEAUREMENT PROCEDURES
6	FCC KDB 941225 D05 v02r04	SAR Evaluation Considerations for LTE Devices
7	FCC KDB 941225 D06 v02r01	SAR Evaluation Procedures for Portable Devices with Wireless Router Capabilities
8	FCC KDB 865664 D01 v01r04	SAR Measurement 100 MHz to 6 GHz
9	FCC KDB 865664 D02 v01r02	RF Exposure Reporting
10	FCC KDB 648474 D04 v01r03	SAR Evaluation Considerations for Wireless Handsets
11	KDB 616217 D04 v01r02	SAR Evaluation Considerations for laptop, notebook, netbook and tablet computers

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)

Band	Maximum Scaled SAR (W/kg)			Maximum Report SAR (W/kg)			Limit (W/kg)
	Head	Body		Head	Body		
	Proximity Sensory on	Proximity Sensory on	Proximity Sensory off		Proximity Sensory on	Proximity Sensory off	
GSM 850	0.518	0.631	0.363	0.984	0.979	0.591	1.6
GSM 1900	0.374	0.564	0.218				
WCDMA Band 2	0.632	0.979	0.420				
WCDMA Band 5	0.351	0.549	0.374				
LTE Band 2	0.473	0.733	0.367				
LTE Band 4	0.532	0.835	0.591				
LTE Band 7	0.984	0.510	0.227				
LTE Band 17	0.367	0.458	0.154				
2.4G WLAN	0.290	0.592	N/A				
Verdict	Pass						
Note: 1. Power reduction is not applicable for WLAN. 2. The proximity sensor is only used for power reduction is 2G/3G/4G antenna.							

3.3.2 Highest Simultaneous SAR

Position	Simultaneous Configuration	Simultaneous SAR (W/kg)	Limit (W/kg)	Verdict
Head (Proximity Sensory on)	LTE QPSK + 2.4G WLAN	1.274	1.6	Pass
Body (Proximity Sensory on)	LTE QPSK + 2.4G WLAN	1.571	1.6	Pass

3.4 Test Uncertainty

According to KDB 865664 D01, When the highest measured 1 g SAR within a frequency band is < 1.5 W/kg, the extensive SAR measurement uncertainty analysis is not required in SAR reports submitted for equipment approval.

The maximum 1 g SAR for the EUT in this report is 0.984 W/kg, which is lower than 1.5 W/kg, so the the extensive SAR measurement uncertainty analysis is not required in this report.

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:

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

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

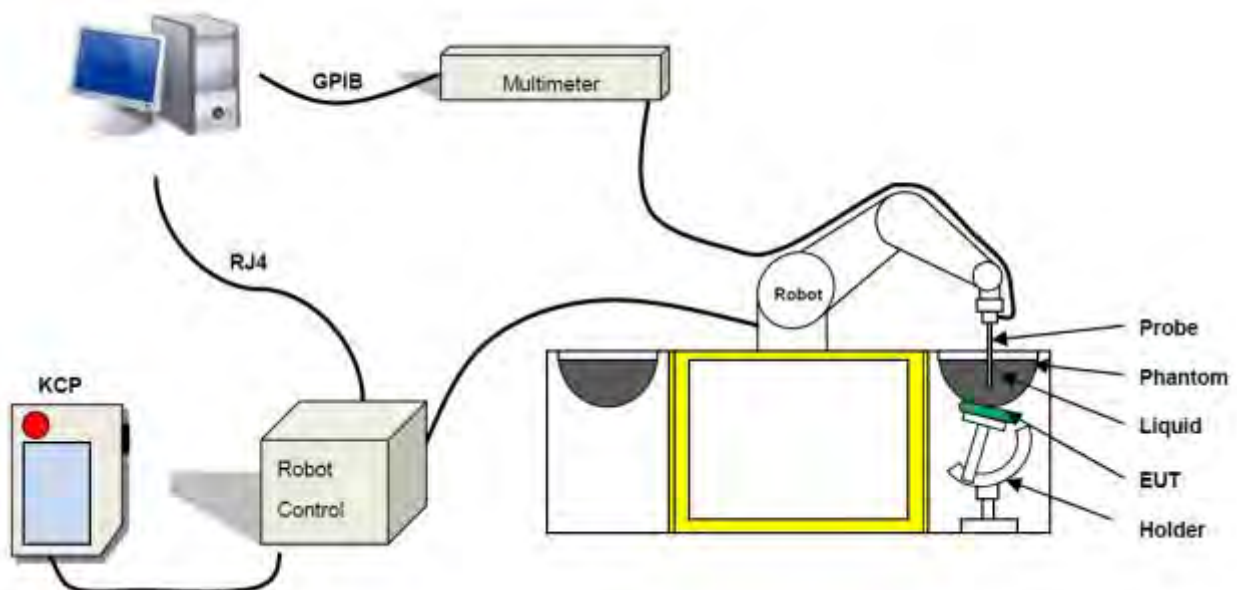
$$\text{SAR} = \frac{\sigma E^2}{\rho}$$

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 $\pm 10\%$. 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.

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 34/15 EPGO 265 with following specifications is used

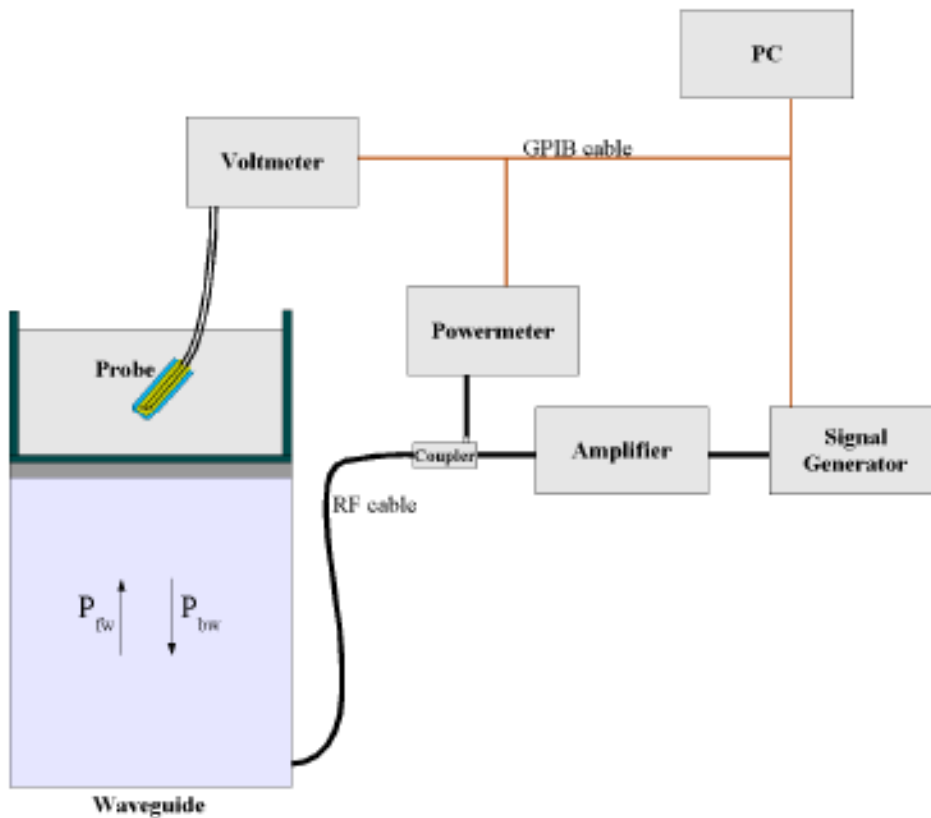
- Dynamic range: 0.01-100 W/kg
- Tip Diameter : 2.5 mm
- Lower detection limit : 7 mW/kg
(repeatability better than ± 1 mm)
- Probe linearity: ± 0.07 dB
- Calibration range: 450 MHz to 5800 MHz for head & body simulating liquid.

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 IEC62209-1/2 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 :

- P_{fw} = Forward Power
- P_{bw} = Backward Power
- a and b = Waveguide Dimensions
- l = 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:

$$CF(N) = SAR(N) / V_{lin}(N) \quad (N=1,2,3)$$

The linearised output voltage $V_{lin}(N)$ is obtained from the displayed output voltage $V(N)$ using

$$V_{lin}(N) = V(N) * (1 + V(N) / DCP(N)) \quad (N=1,2,3)$$

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.

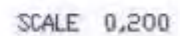
Photo of Phantom SN 30/13 SAM103



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



SN 30/13 SAM103

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.

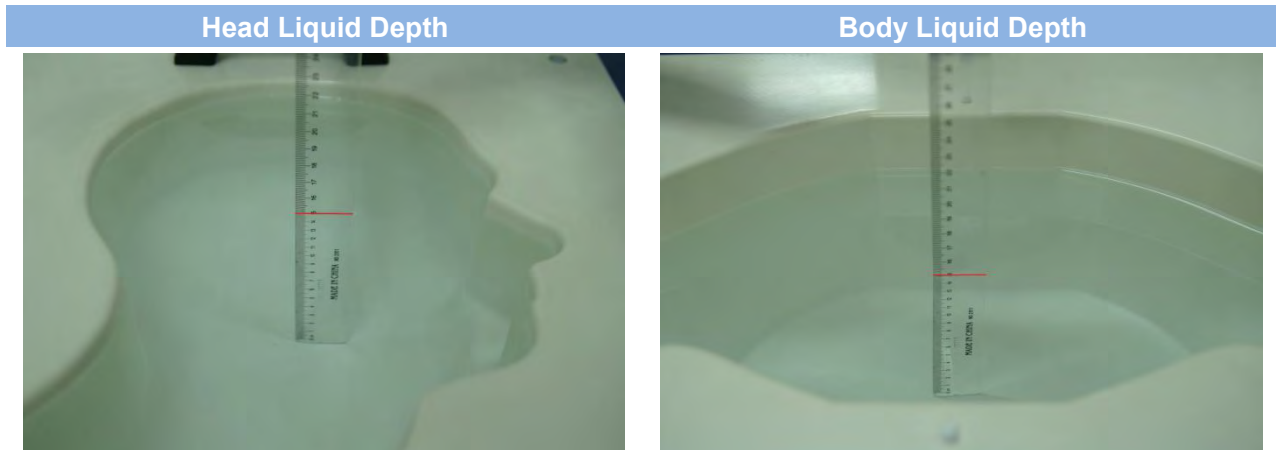


Serial Number	Holder Material	Permittivity	Loss Tangent
SN 25/13 MSH87	Deirin	3.7	0.005
SN 25/13 MSH88	Deirin	3.7	0.005

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%.



The following table gives the recipes for tissue simulating liquid and the theoretical Conductivity/Permittivity.

Head (Reference IEEE1528)								
Frequency (MHz)	Water (%)	Sugar (%)	Cellulose (%)	Salt (%)	Preventol (%)	DGBE (%)	Conductivity σ (S/m)	Permittivity ε
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
Frequency(MHz)	Water (%)	Hexyl Carbitol (%)			Triton X-100 (%)		Conductivity σ (S/m)	Permittivity ε
5200	62.52	17.24			17.24		4.66	36.0
5800	62.52	17.24			17.24		5.27	35.3
Body (From instrument manufacturer)								
Frequency (MHz)	Water (%)	Sugar (%)	Cellulose (%)	Salt (%)	Preventol (%)	DGBE (%)	Conductivity σ (S/m)	Permittivity ε
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	DGBE (%)	Salt (%)	Conductivity σ (S/m)	Permittivity ϵ
5200	78.60	21.40	/	5.54	47.86
5800	78.50	21.40	0.1	6.0	48.20

5 SYSTEM VERIFICATION

5.1 Antenna Port Test Requirement

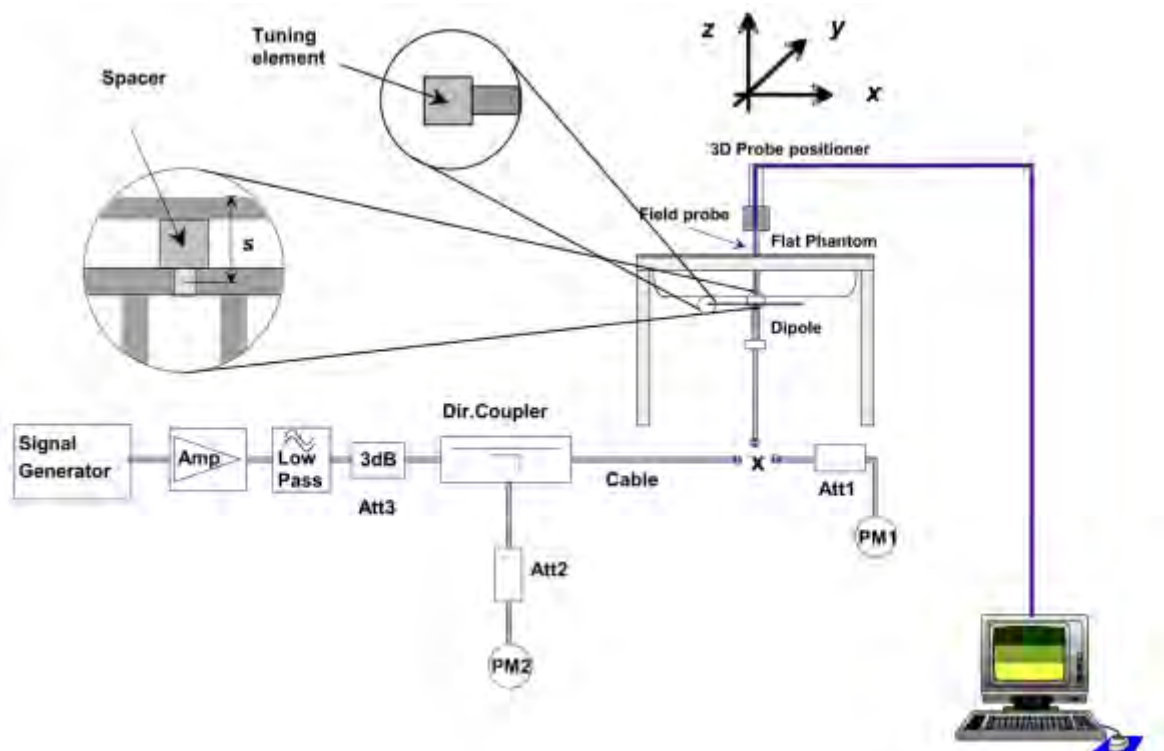
The SATIMO SAR system is equipped with one or more system validation kits. These units together with the predefined measurement procedures within the SATIMO software enable the user to conduct the system performance check and system validation. System validation kit includes a dipole, tripod holder to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

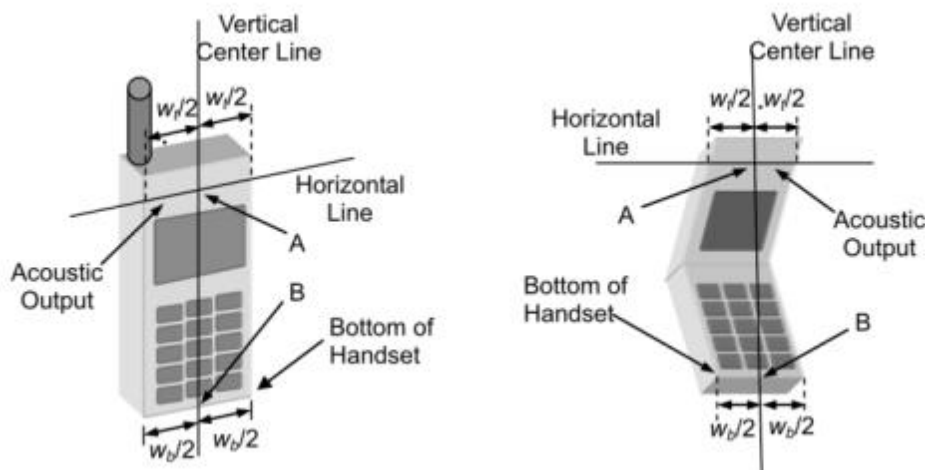
According to KDB 648474 D04 Handset, handsets are tested for SAR compliance in head, body-worn accessory and other use configurations described in the following subsections.

6.1 Head Exposure Conditions

Head exposure is limited to next to the ear voice mode operations. Head SAR compliance is tested according to the test positions defined in IEEE Std 1528-2013 using the SAM phantom illustrated as below.

6.1.1 Define two imaginary lines on the handset

- The vertical center line passes through two points on the front side of the handset - the midpoint of the width w_t of the handset at the level of the acoustic output, and the midpoint of the width w_b of the bottom of the handset.
- The horizontal line is perpendicular to the vertical centerline and passes through the center of the acoustic output. The horizontal line is also tangential to the face of the handset at point A.
- The two lines intersect at point A. Note that for many handsets, point A coincides with the center of the acoustic output; however, the acoustic output may be located elsewhere on the horizontal line. Also note that the vertical centerline is not necessarily parallel to the front face of the handset, especially for clamshell handsets, handsets with flip covers, and other irregularly shaped handsets.



6.1.2 Cheek Position

- To position the device with the vertical center line of the body of the device and the horizontal line crossing the center piece in a plane parallel to the sagittal plane of the phantom. While maintaining the device in this plane, align the vertical center line with the reference plane containing the three ear and mouth reference point (M: Mouth, RE: Right Ear, and LE: Left Ear) and align the center of the ear piece with the line RE-LE.
- To move the device towards the phantom with the ear piece aligned with the line LE-RE until the phone touched the ear. While maintaining the device in the reference plane and maintaining the phone contact with the ear, move the bottom of the phone until any point on the front side is in contact with the cheek of the phantom or until contact with the ear is lost.



6.1.3 Tilted Position

- To position the device in the “cheek” position described above.
- While maintaining the device the reference plane described above and pivoting against the ear, moves it outward away from the mouth by an angle of 15 degrees or until contact with the ear is lost.



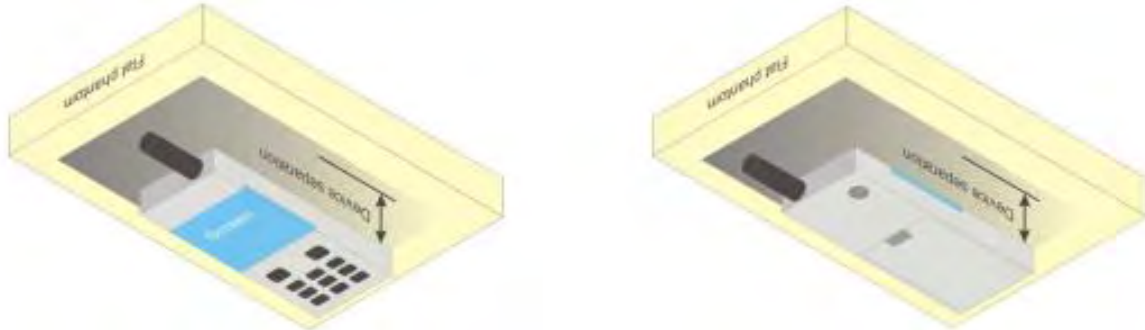
6.2 Body-worn Position Conditions

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 $> 1.2 \text{ W/kg}$, 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.

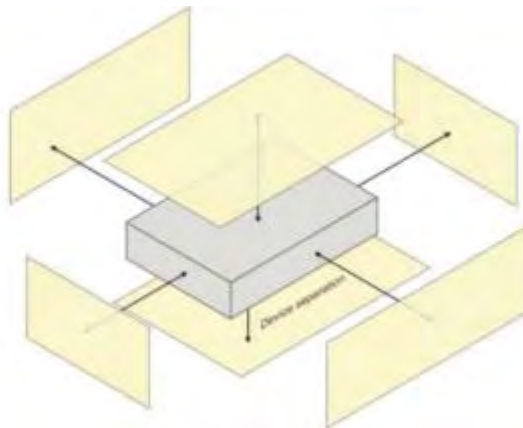
Body-worn accessory SAR compliance is based on a single minimum test separation distance for all wireless and operating modes applicable to each body-worn accessory used by the host, and according to the relevant voice and/or data mode transmissions and operations. If a body-worn accessory supports voice 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.



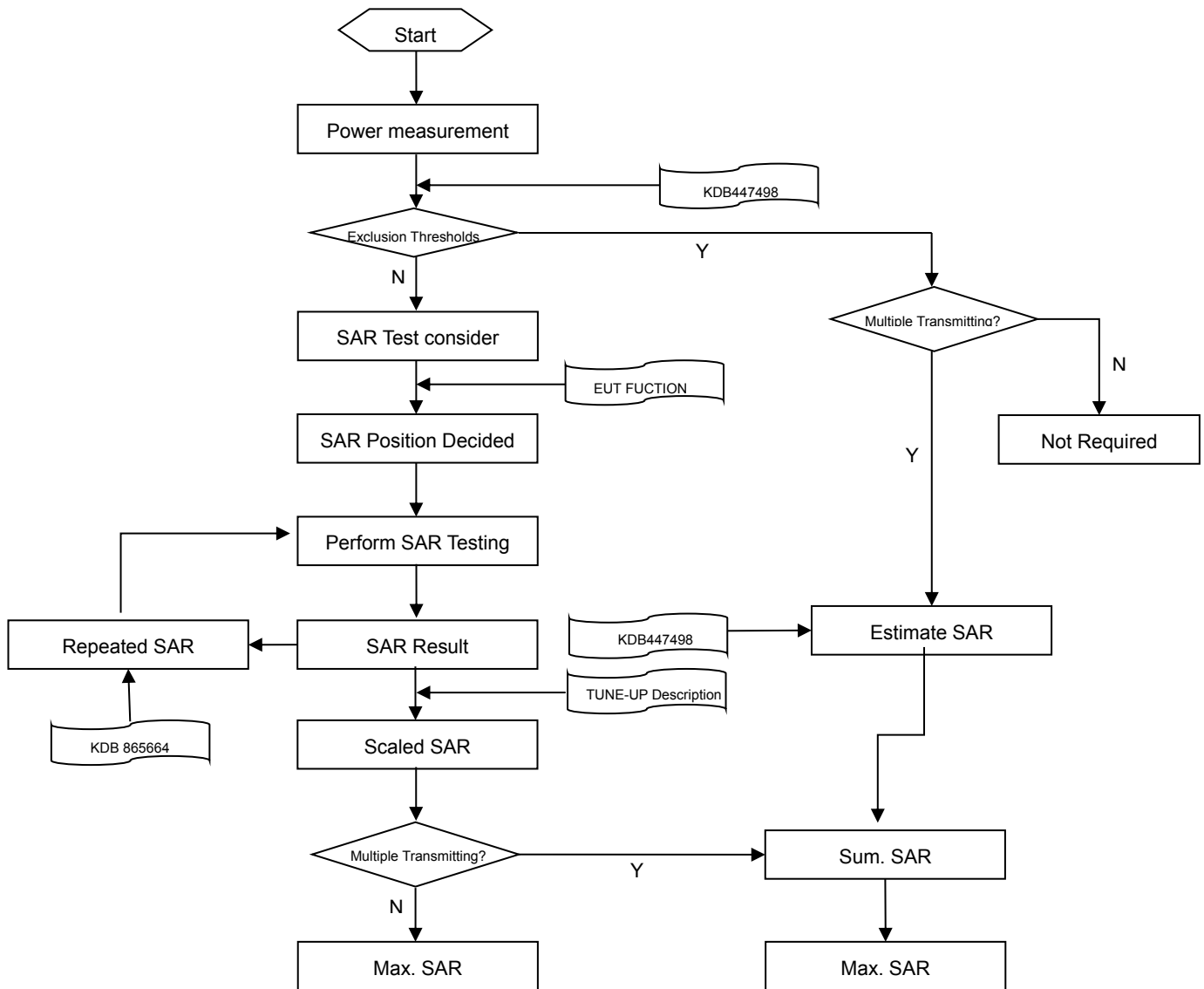
6.3 Hotspot Mode Exposure Position Conditions

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).



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.

			≤3GHz	>3GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface			5±1 mm	$\frac{1}{2} \cdot \delta \cdot \ln(2) \pm 0.5$ mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location			30°±1°	20°±1°
Maximum area scan spatial resolution: Δx Area , Δy Area			≤ 2 GHz: ≤ 15 mm 2 – 3 GHz: ≤ 12 mm	3–4 GHz: ≤ 12 mm 4 – 6 GHz: ≤ 10 mm
			When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device.	
Maximum zoom scan spatial resolution: Δx Zoom , Δy Zoom			≤ 2 GHz: ≤ 8 mm 2 – 3 GHz: ≤ 5 mm*	3–4 GHz: ≤ 5 mm* 4 – 6 GHz: ≤ 4 mm*
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: Δz Zoom (n)		≤ 5 mm	3–4 GHz: ≤ 4 mm
				4–5 GHz: ≤ 3 mm
				5–6 GHz: ≤ 2 mm
	graded grid	Δ z Zoom (1): between 1st two points closest to phantom surface	≤ 4 mm	3–4 GHz: ≤ 3 mm
				4–5 GHz: ≤ 2.5 mm
				5–6 GHz: ≤ 2 mm
	Δ z Zoom (n>1): between subsequent points		≤ 1.5·Δz Zoom (n-1)	
Minimum zoom scan volume	x, y, z		≥30 mm	3–4 GHz: ≥ 28 mm
				4–5 GHz: ≥ 25 mm
				5–6 GHz: ≥ 22 mm

Note:

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.

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 to 16 mm and a constant distance to the inner surface of the phantom. Since the sensors cannot directly measure at the inner phantom surface, the values between the sensors and the inner phantom surface are extrapolated. With these values the area of the maximum SAR is calculated by an interpolation scheme.
- Around this point, a cube of 30 * 30 * 30 mm or 32 * 32 * 32 mm is assessed by measuring 5 or 8 * 5 or 8*4 or 5 mm. With these data, the peak spatial-average SAR value can be calculated.

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 D01 quoted below.

When the 1-g SAR of the highest peak is within 2 dB of the SAR limit, additional zoom scans are required for other peaks within 2 dB of the highest peak that have not been included in any zoom scan to ensure there is no increase in SAR.

8 CONDUCTED RF OUTPUT POWER

8.1 GSM

GSM 850 Band	Burst Average Power(dBm)			Frame-averaged power(dBm)		
Channel	128	190	251	128	190	251
GSM (GMSK, 1-Slot)	32.13	32.09	32.09	23.13	23.09	23.09
GPRS (GMSK, 1-Slot)	32.66	32.65	32.55	23.66	23.65	23.55
GPRS (GMSK, 2-Slots)	30.02	31.79	31.69	24.02	25.79	25.69
GPRS (GMSK, 3-Slots)	29.99	30.06	29.91	25.73	25.80	25.65
GPRS (GMSK, 4-Slots)	28.87	28.90	28.86	25.87	25.90	25.86
EGPRS (8PSK, 1-Slot)	30.10	30.04	29.97	21.10	21.04	20.97
EGPRS (8PSK, 2-Slots)	29.19	29.07	29.04	23.19	23.07	23.04
EGPRS (8PSK, 3-Slots)	26.30	27.37	27.13	22.04	23.11	22.87
EGPRS (8PSK, 4-Slots)	25.95	25.92	25.94	22.95	22.92	22.94
GSM 1900 Band	Burst Average Power(dBm)			Frame-averaged power(dBm)		
Channel	512	661	810	512	661	810
GSM (GMSK, 1-Slot)	29.50	29.30	29.36	20.50	20.30	20.36
GPRS (GMSK, 1-Slot)	30.30	30.15	30.09	21.30	21.15	21.09
GPRS (GMSK, 2-Slots)	29.52	29.34	29.28	23.52	23.34	23.28
GPRS (GMSK, 3-Slots)	26.69	27.60	27.51	22.43	23.34	23.25
GPRS (GMSK, 4-Slots)	26.68	26.55	26.46	23.68	23.55	23.46
EGPRS (8PSK, 1-Slot)	30.42	30.34	30.38	21.42	21.34	21.38
EGPRS (8PSK, 2-Slots)	29.17	29.29	28.90	23.17	23.29	22.90
EGPRS (8PSK, 3-Slots)	27.27	26.61	27.01	23.01	22.35	22.75
EGPRS (8PSK, 4-Slots)	25.93	25.60	25.28	22.93	22.60	22.28

Note:

- SAR testing was performed on the maximum frame-Peaked power mode.
- The frame-averaged power is linearly proportion to the slot number configured and it is linearly scaled the maximum burst-averaged power based on time slots. The calculated method is shown as below:

Frame-averaged power = Burst averaged power (1 Tx Slot) - 9 dB

Frame-averaged power = Burst averaged power (2 Tx Slots) - 6 dB

Frame-averaged power = Burst averaged power (3 Tx Slots) - 4.26 dB

Frame-averaged power = Burst averaged power (4 Tx Slots) - 3 dB

8.2 WCDMA

WCDMA Band	Band 2			Band 5		
Channel	9262	9400	9538	4132	4182	4233
RMC 12.2Kbps	22.27	22.19	22.26	22.47	22.50	22.57
HSDPA Subtest-1	21.27	21.17	21.14	21.45	21.46	21.50
HSDPA Subtest-2	21.32	21.17	21.17	21.49	21.52	21.54
HSDPA Subtest-3	20.81	20.73	20.71	21.03	21.05	21.08
HSDPA Subtest-4	20.84	20.67	20.63	20.99	21.02	21.03
HSUPA Subtest-1	19.33	19.27	19.19	19.47	19.50	19.26
HSUPA Subtest-2	19.31	19.20	19.18	19.52	19.49	19.51
HSUPA Subtest-3	20.31	20.16	20.14	20.49	20.50	20.47
HSUPA Subtest-4	18.87	18.69	18.61	18.90	19.96	18.96
HSUPA Subtest-5	21.27	21.43	21.58	21.42	21.57	21.14

8.3 LTE

FDD LTE Band 2							
Bandwidth (MHz)	RB Set	Power (dBm)					
		QPSK			16QAM		
	Channel	18700	18900	19100	18700	18900	19100
20MHz	1 (RB_Pos:0)	21.67	21.65	21.51	21.22	21.09	20.89
	1 (RB_Pos:50)	21.31	21.54	21.48	20.85	20.96	20.88
	1 (RB_Pos:99)	21.63	21.42	21.21	21.17	20.88	20.68
	50 (RB_Pos:0)	20.72	20.60	20.53	19.76	19.61	19.51
	50 (RB_Pos:25)	20.44	20.53	20.52	19.51	19.56	19.50
	50 (RB_Pos:50)	20.39	20.52	20.38	19.50	19.52	19.45
	100 (RB_Pos:0)	20.60	20.56	20.51	19.71	19.55	19.51
Bandwidth (MHz)	RB Set	Power (dBm)					
		QPSK			16QAM		
	Channel	18675	18900	19125	18675	18900	19125
15MHz	1 (RB_Pos:0)	21.71	21.66	21.59	20.64	21.00	20.95
	1 (RB_Pos:38)	21.62	21.57	21.53	20.56	20.89	20.92
	1 (RB_Pos:74)	21.39	21.47	21.39	20.37	20.78	20.81
	36 (RB_Pos:0)	20.74	20.64	20.61	19.74	19.67	19.58
	36 (RB_Pos:20)	20.73	20.60	20.55	19.75	19.63	19.54
	36 (RB_Pos:39)	20.45	20.57	20.46	19.54	19.60	19.53
	75 (RB_Pos:0)	20.73	20.62	20.60	19.74	19.62	19.57
Bandwidth (MHz)	RB Set	Power (dBm)					
		QPSK			16QAM		
	Channel	18650	18900	19150	18650	18900	19150
10MHz	1 (RB_Pos:0)	21.63	21.61	21.52	20.55	20.94	20.61
	1 (RB_Pos:25)	21.65	21.55	21.45	20.59	20.89	20.54
	1 (RB_Pos:49)	21.33	21.50	21.24	20.30	20.80	20.36
	25 (RB_Pos:0)	20.64	20.54	20.52	19.66	19.59	19.63
	25 (RB_Pos:12)	20.66	20.53	20.55	19.69	19.56	19.63
	25 (RB_Pos:25)	20.65	20.51	20.51	19.67	19.54	19.67
	50 (RB_Pos:0)	20.65	20.54	20.54	19.63	19.56	19.60
Bandwidth (MHz)	RB Set	Power (dBm)					
		QPSK			16QAM		
	Channel	18625	18900	19175	18625	18900	19175
5MHz	1 (RB_Pos:0)	21.62	21.55	21.59	20.83	21.03	20.71
	1 (RB_Pos:13)	21.64	21.54	21.58	20.83	21.02	20.65
	1 (RB_Pos:24)	21.58	21.46	21.55	20.78	20.94	20.66
	12 (RB_Pos:0)	20.68	20.58	20.63	19.75	19.71	19.68
	12 (RB_Pos:6)	20.68	20.57	20.60	19.74	19.71	19.70
	12 (RB_Pos:13)	20.66	20.52	20.64	19.72	19.70	19.69
	25 (RB_Pos:0)	20.64	20.54	20.59	19.66	19.59	19.55
Bandwidth (MHz)	RB Set	Power (dBm)					
		QPSK			16QAM		

	Channel	18615	18900	19185	18615	18900	19185
3.0MHz	1 (RB_Pos:0)	21.54	21.50	21.48	20.47	20.83	20.60
	1 (RB_Pos:8)	21.58	21.52	21.49	20.51	20.84	20.60
	1 (RB_Pos:14)	21.54	21.46	21.45	20.47	20.80	20.56
	8 (RB_Pos:0)	20.65	20.54	20.61	19.76	19.65	19.67
	8 (RB_Pos:3)	20.68	20.54	20.63	19.77	19.64	19.67
	8 (RB_Pos:7)	20.66	20.53	20.64	19.74	19.63	19.67
	15 (RB_Pos:0)	20.63	20.49	20.60	19.65	19.54	19.57
Bandwidth (MHz)	RB Set	Power (dBm)					
		QPSK			16QAM		
	Channel	18607	18900	19193	18607	18900	19193
1.4MHz	1 (RB_Pos:0)	21.54	21.49	21.46	20.65	20.83	20.57
	1 (RB_Pos:3)	21.55	21.50	21.51	20.71	20.86	20.62
	1 (RB_Pos:5)	21.57	21.47	21.48	20.68	20.81	20.60
	3 (RB_Pos:0)	21.57	21.53	21.57	20.60	20.70	20.77
	3 (RB_Pos:1)	21.60	21.51	21.59	20.64	20.65	20.77
	3 (RB_Pos:3)	21.59	21.52	21.59	20.65	20.65	20.74
	6 (RB_Pos:0)	20.58	20.50	20.59	19.70	19.43	19.76
FDD LTE Band 4							
Bandwidth (MHz)	RB Set	Power (dBm)					
		QPSK			16QAM		
	Channel	20050	20175	20300	20050	20175	20300
20MHz	1 (RB_Pos:0)	20.91	21.57	21.73	20.21	20.74	20.93
	1 (RB_Pos:50)	21.35	21.67	21.25	20.64	20.85	20.60
	1 (RB_Pos:99)	21.30	21.30	20.95	20.70	20.76	20.26
	50 (RB_Pos:0)	19.80	20.28	20.42	18.73	19.40	19.42
	50 (RB_Pos:25)	19.96	20.32	20.20	19.14	19.36	19.19
	50 (RB_Pos:50)	20.10	20.17	20.06	19.25	19.31	19.05
	100 (RB_Pos:0)	20.09	20.33	20.23	19.02	19.45	19.19
Bandwidth (MHz)	RB Set	Power (dBm)					
		QPSK			16QAM		
	Channel	20025	20175	20325	20025	20175	20325
15MHz	1 (RB_Pos:0)	20.88	21.67	21.49	19.76	20.64	20.70
	1 (RB_Pos:38)	21.11	21.54	20.81	19.75	20.76	20.48
	1 (RB_Pos:74)	21.20	21.15	20.51	20.01	20.70	20.23
	36 (RB_Pos:0)	19.98	20.37	20.35	18.74	19.31	19.15
	36 (RB_Pos:20)	20.06	20.22	20.12	18.70	19.35	19.11
	36 (RB_Pos:39)	20.39	20.38	20.05	19.16	19.58	18.91
	75 (RB_Pos:0)	20.25	20.44	20.21	18.88	19.35	19.26
Bandwidth (MHz)	RB Set	Power (dBm)					
		QPSK			16QAM		
	Channel	20000	20175	20350	20000	20175	20350
10MHz	1 (RB_Pos:0)	20.84	21.43	21.15	19.90	20.77	19.99

	1 (RB_Pos:25)	21.13	21.54	21.60	20.03	21.11	20.00
	1 (RB_Pos:49)	20.80	21.19	20.71	19.87	20.91	19.62
	25 (RB_Pos:0)	20.11	20.55	20.45	19.13	19.45	19.42
	25 (RB_Pos:12)	20.32	20.54	20.54	19.08	19.84	19.20
	25 (RB_Pos:25)	19.98	20.43	20.15	19.23	19.38	19.20
	50 (RB_Pos:0)	20.38	20.78	20.08	19.37	19.77	19.54
Bandwidth (MHz)	RB Set	Power (dBm)					
		QPSK			16QAM		
	Channel	19975	20175	20375	19975	20175	20375
5MHz	1 (RB_Pos:0)	20.73	21.46	21.28	20.00	20.86	20.00
	1 (RB_Pos:13)	20.85	21.40	20.73	19.90	20.95	19.92
	1 (RB_Pos:24)	21.00	21.42	20.79	20.11	20.84	19.87
	12 (RB_Pos:0)	19.91	20.50	19.72	18.97	19.40	19.09
	12 (RB_Pos:6)	19.83	20.25	19.93	18.91	19.36	18.90
	12 (RB_Pos:13)	19.76	20.50	20.08	19.10	19.62	18.64
	25 (RB_Pos:0)	19.78	20.46	19.75	18.82	19.53	18.61
Bandwidth (MHz)	RB Set	Power (dBm)					
		QPSK			16QAM		
	Channel	19965	20175	20385	19965	20175	20385
3.0MHz	1 (RB_Pos:0)	20.67	21.33	20.86	19.64	20.77	19.86
	1 (RB_Pos:8)	20.79	21.44	20.84	19.74	20.80	19.77
	1 (RB_Pos:14)	20.75	21.40	20.77	19.72	20.75	19.77
	8 (RB_Pos:0)	19.84	20.50	19.96	18.95	19.58	18.97
	8 (RB_Pos:3)	19.88	20.49	19.94	18.99	19.59	18.99
	8 (RB_Pos:7)	19.89	20.49	19.93	18.99	19.58	18.95
	15 (RB_Pos:0)	19.84	20.44	19.92	18.87	19.50	18.87
Bandwidth (MHz)	RB Set	Power (dBm)					
		QPSK			16QAM		
	Channel	19957	20175	20393	19957	20175	20393
1.4MHz	1 (RB_Pos:0)	20.78	21.44	20.81	19.88	20.81	19.85
	1 (RB_Pos:3)	20.76	21.46	20.86	19.94	20.84	19.89
	1 (RB_Pos:5)	20.80	21.45	20.82	19.93	20.81	19.88
	3 (RB_Pos:0)	20.81	21.50	20.91	19.87	20.70	20.08
	3 (RB_Pos:1)	20.82	21.49	20.91	19.88	20.66	20.06
	3 (RB_Pos:3)	20.82	21.51	20.91	19.91	20.68	20.07
	6 (RB_Pos:0)	19.77	20.44	19.89	18.91	19.35	19.03

FDD LTE Band 7							
Bandwidth (MHz)	RB Set	Power (dBm)					
		QPSK			16QAM		
	Channel	20850	21100	21350	20850	21100	21350
20MHz	1 (RB_Pos:0)	21.45	21.26	21.22	20.79	20.61	20.60
	1 (RB_Pos:50)	21.58	21.13	20.71	21.07	20.72	20.26
	1 (RB_Pos:99)	21.41	21.10	21.23	20.97	20.57	20.55
	50 (RB_Pos:0)	20.63	20.21	20.16	19.70	19.42	19.31
	50 (RB_Pos:25)	20.60	20.29	19.90	19.67	19.38	19.09
	50 (RB_Pos:50)	20.55	20.26	19.97	19.62	19.30	19.21
	100 (RB_Pos:0)	20.57	20.29	20.08	19.66	19.34	19.29
Bandwidth (MHz)	RB Set	Power (dBm)					
		QPSK			16QAM		
	Channel	20825	21100	21375	20825	21100	21375
15MHz	1 (RB_Pos:0)	21.43	21.30	21.11	20.27	20.60	20.43
	1 (RB_Pos:38)	21.56	21.19	20.64	20.47	20.63	20.18
	1 (RB_Pos:74)	21.45	21.16	21.10	20.41	20.51	20.41
	36 (RB_Pos:0)	20.65	20.28	19.86	19.69	19.43	19.01
	36 (RB_Pos:20)	20.71	20.34	19.79	19.70	19.40	18.99
	36 (RB_Pos:39)	20.67	20.30	19.93	19.65	19.38	19.13
	75 (RB_Pos:0)	20.72	20.33	19.86	19.71	19.37	19.09
Bandwidth (MHz)	RB Set	Power (dBm)					
		QPSK			16QAM		
	Channel	20800	21100	21400	20800	21100	21400
10MHz	1 (RB_Pos:0)	21.11	21.20	20.56	19.97	20.48	19.59
	1 (RB_Pos:25)	21.43	21.25	20.57	20.40	20.63	19.75
	1 (RB_Pos:49)	21.50	21.16	20.66	20.43	20.55	19.79
	25 (RB_Pos:0)	20.33	20.28	19.66	19.49	19.38	18.92
	25 (RB_Pos:12)	20.52	20.28	19.73	19.63	19.36	18.99
	25 (RB_Pos:25)	20.61	20.25	19.84	19.67	19.33	19.12
	50 (RB_Pos:0)	20.53	20.29	19.73	19.65	19.35	18.97
Bandwidth (MHz)	RB Set	Power (dBm)					
		QPSK			16QAM		
	Channel	20775	21100	21425	20775	21100	21425
5MHz	1 (RB_Pos:0)	21.70	21.24	21.14	20.72	20.76	20.20
	1 (RB_Pos:13)	21.37	21.23	20.79	20.45	20.76	19.93
	1 (RB_Pos:24)	21.65	21.13	21.10	20.75	20.66	20.15
	12 (RB_Pos:0)	20.36	20.34	19.89	19.53	19.52	19.08
	12 (RB_Pos:6)	20.33	20.31	19.87	19.48	19.48	19.07
	12 (RB_Pos:13)	20.55	20.28	20.05	19.79	19.45	19.25
	25 (RB_Pos:0)	20.41	20.25	19.93	19.60	19.34	19.06
FDD LTE Band 17							
Bandwidth	RB Set	Power (dBm)					

(MHz)		QPSK			16QAM		
	Channel	23780	23790	23800	23780	23790	23800
10MHz	1 (RB_Pos:0)	21.56	21.64	21.62	20.54	21.01	20.74
	1 (RB_Pos:25)	21.51	21.64	21.45	20.53	20.96	20.53
	1 (RB_Pos:49)	21.19	21.60	21.29	20.11	20.89	20.36
	25 (RB_Pos:0)	20.53	20.79	20.55	19.82	19.67	19.73
	25 (RB_Pos:12)	20.32	20.63	20.51	20.03	19.59	19.65
	25 (RB_Pos:25)	20.61	20.36	20.43	19.55	19.53	19.56
	50 (RB_Pos:0)	20.61	20.74	20.53	19.41	19.60	19.61
Bandwidth (MHz)	RB Set	Power (dBm)					
		QPSK			16QAM		
	Channel	23755	23790	23825	23755	23790	23825
5MHz	1 (RB_Pos:0)	21.64	21.54	21.49	20.72	21.11	20.56
	1 (RB_Pos:13)	21.71	21.45	21.44	20.84	20.99	20.48
	1 (RB_Pos:24)	21.55	21.43	21.29	20.69	20.93	20.39
	12 (RB_Pos:0)	20.63	20.56	20.51	19.77	19.76	19.59
	12 (RB_Pos:6)	20.65	20.51	20.46	19.79	19.70	19.55
	12 (RB_Pos:13)	20.60	20.48	20.40	19.75	19.68	19.49
	25 (RB_Pos:0)	20.58	20.48	20.41	19.65	19.59	19.41

8.4 WIFI

8.4.1 2.4GWIFI

Band (GHz)	Mode	Channel	Freq. (MHz)	Avg. Power (dBm)	SAR Test Require.
2.4 (2.4~2.4835)	802.11b	1	2412	9.39	No
		6	2437	9.96	Yes
		11	2462	9.83	No
	802.11g	1	2412	9.11	No
		6	2437	9.80	No
		11	2462	9.72	No
	802.11n(HT20)	1	2412	9.40	No
		6	2437	9.46	No
		11	2462	9.40	No
	802.11n(HT40)	3	2422	8.02	No
		6	2437	9.89	No
		9	2452	8.53	No

8.5 Bluetooth

Mode	GFSK			$\pi/4$ -DQPSK		
Channel	0	39	78	0	39	78
Frequency (MHz)	2402	2441	2480	2402	2441	2480
Peak Power (dBm)	2.85	4.57	1.67	2.19	3.70	1.07
Mode	8-DPSK			BLE		
Channel	0	39	78	0	19	39
Frequency (MHz)	2402	2441	2480	2402	2440	2480
Peak Power (dBm)	2.27	3.88	1.24	-3.94	-1.96	-4.02

8.6 Power Reduction List

When the human body approach the device, the proximity sensor is triggered for 2G/3G/4G power reduction.

GSM 850 Band	Burst Average Power(dBm)			Frame-averaged power(dBm)		
Channel	128	190	251	128	190	251
GSM (GMSK, 1-Slot)	28.96	28.95	28.88	19.96	19.95	19.88
GPRS (GMSK, 1-Slot)	32.57	30.47	32.43	23.57	21.47	23.43
GPRS (GMSK, 2-Slots)	30.53	30.48	30.41	24.53	24.48	24.41
GPRS (GMSK, 3-Slots)	28.44	28.42	28.39	24.18	24.16	24.13
GPRS (GMSK, 4-Slots)	26.86	26.87	26.72	23.86	23.87	23.72
EGPRS (8PSK, 1-Slot)	24.37	24.33	24.30	15.37	15.33	15.30
EGPRS (8PSK, 2-Slots)	21.37	21.27	21.28	15.37	15.27	15.28
EGPRS (8PSK, 3-Slots)	19.49	19.51	18.29	15.23	15.25	14.03
EGPRS (8PSK, 4-Slots)	18.22	18.05	17.88	15.22	15.05	14.88
GSM 1900 Band	Burst Average Power(dBm)			Frame-averaged power(dBm)		
Channel	512	661	810	512	661	810
GSM (GMSK, 1-Slot)	22.71	22.43	22.30	13.71	13.43	13.30
GPRS (GMSK, 1-Slot)	30.27	30.03	29.92	21.27	21.03	20.92
GPRS (GMSK, 2-Slots)	28.26	28.03	27.90	22.26	22.03	21.90
GPRS (GMSK, 3-Slots)	26.25	25.98	25.86	21.99	21.72	21.60
GPRS (GMSK, 4-Slots)	24.72	24.45	24.34	21.72	21.45	21.34
EGPRS (8PSK, 1-Slot)	23.24	23.17	22.71	14.24	14.17	13.71
EGPRS (8PSK, 2-Slots)	19.89	19.65	19.17	13.89	13.65	13.17
EGPRS (8PSK, 3-Slots)	17.97	17.60	17.11	13.71	13.34	12.85
EGPRS (8PSK, 4-Slots)	15.98	16.46	15.75	12.98	13.46	12.75
Note:						
3. SAR testing was performed on the maximum frame-Peaked power mode.						
4. The frame-averaged power is linearly proportion to the slot number configured and it is linearly scaled the maximum burst-averaged power based on time slots. The calculated method is shown as below:						
Frame-averaged power = Burst averaged power (1 Tx Slot) - 9 dB						
Frame-averaged power = Burst averaged power (2 Tx Slots) - 6 dB						
Frame-averaged power = Burst averaged power (3 Tx Slots) - 4.26 dB						
Frame-averaged power = Burst averaged power (4 Tx Slots) - 3 dB						

WCDMA Band	Band 2			Band 5		
Channel	9262	9400	9538	4132	4182	4233
RMC 12.2Kbps	14.92	14.89	14.76	16.69	16.73	16.72
HSDPA Subtest-1	14.95	14.80	14.68	16.61	16.68	16.74
HSDPA Subtest-2	14.95	14.83	14.68	16.67	16.72	16.72
HSDPA Subtest-3	14.43	14.29	14.20	16.17	16.24	16.23
HSDPA Subtest-4	14.40	14.27	14.20	16.15	16.19	16.19
HSUPA Subtest-1	12.73	12.85	12.69	14.23	14.74	14.69
HSUPA Subtest-2	12.94	12.82	12.70	14.34	14.71	14.69
HSUPA Subtest-3	13.96	13.83	13.70	15.11	15.68	15.59
HSUPA Subtest-4	12.38	12.32	12.15	14.16	14.39	14.72
HSUPA Subtest-5	14.02	14.94	14.65	16.65	16.94	16.78

FDD LTE Band 2							
Bandwidth (MHz)	RB Set	Power (dBm)					
		QPSK			16QAM		
	Channel	18700	18900	19100	18700	18900	19100
20MHz	1 (RB_Pos:0)	13.94	14.05	13.93	14.56	14.43	14.25
	1 (RB_Pos:50)	13.89	13.89	13.84	14.51	14.28	14.14
	1 (RB_Pos:99)	13.96	13.86	13.92	14.53	14.23	14.24
	50 (RB_Pos:0)	14.00	13.93	13.85	14.06	13.94	13.78
	50 (RB_Pos:25)	13.97	13.87	13.81	13.99	13.88	13.77
	50 (RB_Pos:50)	13.96	13.82	13.82	13.99	13.83	13.76
	100 (RB_Pos:0)	13.98	13.88	13.80	14.01	13.89	13.79
Bandwidth (MHz)	RB Set	Power (dBm)					
		QPSK			16QAM		
	Channel	18675	18900	19125	18675	18900	19125
15MHz	1 (RB_Pos:0)	14.27	13.97	13.88	14.12	14.24	14.11
	1 (RB_Pos:38)	14.20	13.88	13.79	14.08	14.14	14.06
	1 (RB_Pos:74)	14.17	13.78	13.83	14.05	14.04	14.09
	36 (RB_Pos:0)	14.24	13.88	13.83	14.16	13.88	13.73
	36 (RB_Pos:20)	14.25	13.86	13.78	14.15	13.87	13.71
	36 (RB_Pos:39)	14.16	13.81	13.78	14.07	13.81	13.69
	75 (RB_Pos:0)	14.21	13.89	13.80	14.09	13.87	13.71
Bandwidth (MHz)	RB Set	Power (dBm)					
		QPSK			16QAM		
	Channel	18650	18900	19150	18650	18900	19150
10MHz	1 (RB_Pos:0)	14.34	14.18	14.04	14.21	14.46	14.01
	1 (RB_Pos:25)	14.38	14.14	14.00	14.23	14.40	13.99
	1 (RB_Pos:49)	14.33	14.09	14.05	14.21	14.35	14.01
	25 (RB_Pos:0)	14.29	14.09	13.98	14.29	14.10	14.02
	25 (RB_Pos:12)	14.31	14.05	13.99	14.31	14.07	14.04
	25 (RB_Pos:25)	14.31	14.04	14.00	14.30	14.05	14.05
	50 (RB_Pos:0)	14.31	14.10	14.01	14.26	14.08	13.99

Bandwidth (MHz)	RB Set	Power (dBm)					
		QPSK			16QAM		
	Channel	18625	18900	19175	18625	18900	19175
5MHz	1 (RB_Pos:0)	14.32	14.23	14.22	14.45	14.67	14.23
	1 (RB_Pos:13)	14.35	14.21	14.26	14.46	14.65	14.27
	1 (RB_Pos:24)	14.33	14.20	14.26	14.48	14.63	14.27
	12 (RB_Pos:0)	14.31	14.22	14.18	14.36	14.31	14.19
	12 (RB_Pos:6)	14.31	14.21	14.20	14.36	14.30	14.21
	12 (RB_Pos:13)	14.30	14.20	14.19	14.37	14.29	14.20
	25 (RB_Pos:0)	14.27	14.17	14.16	14.28	14.19	14.07
Bandwidth (MHz)	RB Set	Power (dBm)					
		QPSK			16QAM		
	Channel	18615	18900	19185	18615	18900	19185
3.0MHz	1 (RB_Pos:0)	14.21	14.16	14.11	14.08	14.45	14.11
	1 (RB_Pos:8)	14.29	14.21	14.19	14.15	14.49	14.16
	1 (RB_Pos:14)	14.23	14.13	14.12	14.10	14.42	14.09
	8 (RB_Pos:0)	14.28	14.20	14.20	14.35	14.24	14.20
	8 (RB_Pos:3)	14.32	14.18	14.23	14.37	14.24	14.20
	8 (RB_Pos:7)	14.29	14.19	14.23	14.34	14.22	14.20
	15 (RB_Pos:0)	14.26	14.12	14.16	14.25	14.14	14.08
Bandwidth (MHz)	RB Set	Power (dBm)					
		QPSK			16QAM		
	Channel	18607	18900	19193	18607	18900	19193
1.4MHz	1 (RB_Pos:0)	14.24	14.17	14.11	14.26	14.47	14.12
	1 (RB_Pos:3)	14.29	14.22	14.23	14.34	14.48	14.21
	1 (RB_Pos:5)	14.25	14.16	14.14	14.29	14.45	14.15
	3 (RB_Pos:0)	14.25	14.19	14.20	14.26	14.35	14.31
	3 (RB_Pos:1)	14.27	14.20	14.20	14.26	14.30	14.34
	3 (RB_Pos:3)	14.28	14.19	14.19	14.29	14.34	14.31
	6 (RB_Pos:0)	14.19	14.14	14.19	14.30	14.03	14.29
FDD LTE Band 4							
Bandwidth (MHz)	RB Set	Power (dBm)					
		QPSK			16QAM		
	Channel	20050	20175	20300	20050	20175	20300
20MHz	1 (RB_Pos:0)	13.92	14.27	14.55	14.41	14.80	14.96
	1 (RB_Pos:50)	14.13	14.36	14.19	14.63	14.84	14.63
	1 (RB_Pos:99)	14.36	14.33	13.90	14.88	14.81	14.30
	50 (RB_Pos:0)	14.02	14.36	14.44	14.01	14.39	14.44
	50 (RB_Pos:25)	14.10	14.36	14.23	14.13	14.38	14.23
	50 (RB_Pos:50)	14.23	14.36	14.02	14.27	14.39	14.02
	100 (RB_Pos:0)	14.09	14.33	14.21	14.12	14.35	14.22
Bandwidth (MHz)	RB Set	Power (dBm)					
		QPSK			16QAM		

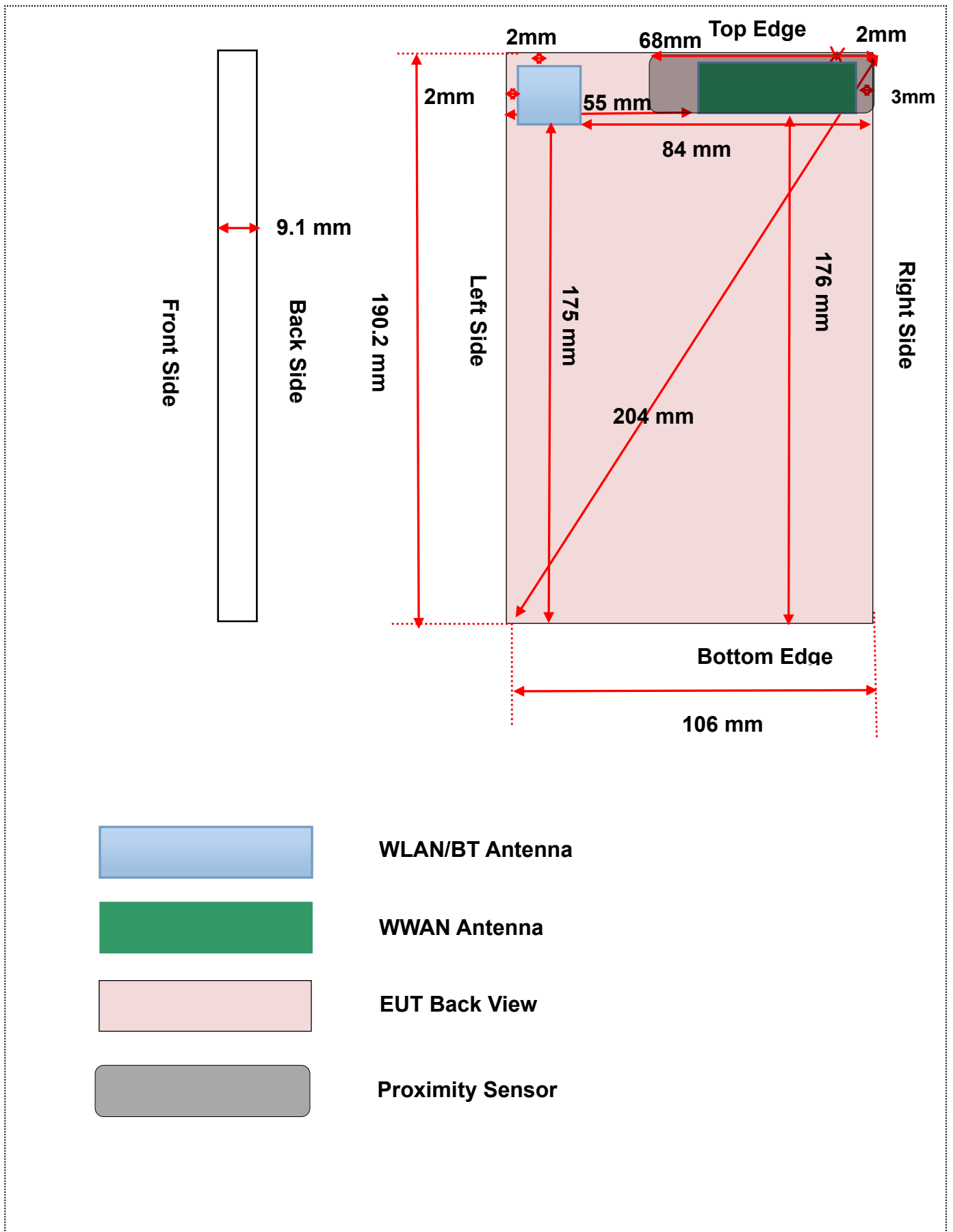
	Channel	20025	20175	20325	20025	20175	20325
15MHz	1 (RB_Pos:0)	13.84	14.38	14.47	13.79	14.72	14.85
	1 (RB_Pos:38)	13.97	14.43	14.08	13.93	14.75	14.47
	1 (RB_Pos:74)	14.17	14.37	13.87	14.12	14.70	14.23
	36 (RB_Pos:0)	13.88	14.36	14.27	13.87	14.40	14.22
	36 (RB_Pos:20)	14.03	14.40	14.11	14.02	14.44	14.06
	36 (RB_Pos:39)	14.11	14.35	13.94	14.10	14.40	13.90
	75 (RB_Pos:0)	14.02	14.38	14.12	14.02	14.40	14.11
Bandwidth (MHz)	RB Set	Power (dBm)					
		QPSK			16QAM		
	Channel	20000	20175	20350	20000	20175	20350
10MHz	1 (RB_Pos:0)	13.77	14.37	14.12	13.76	14.71	14.13
	1 (RB_Pos:25)	13.86	14.42	13.90	13.84	14.75	13.93
	1 (RB_Pos:49)	14.06	14.41	13.73	14.03	14.75	13.75
	25 (RB_Pos:0)	13.83	14.33	13.99	13.86	14.37	14.08
	25 (RB_Pos:12)	13.90	14.34	13.88	13.92	14.37	13.97
	25 (RB_Pos:25)	14.01	14.36	13.82	14.03	14.39	13.90
	50 (RB_Pos:0)	13.94	14.37	13.93	13.93	14.38	13.94
Bandwidth (MHz)	RB Set	Power (dBm)					
		QPSK			16QAM		
	Channel	19975	20175	20375	19975	20175	20375
5MHz	1 (RB_Pos:0)	13.87	14.34	13.96	13.97	14.85	13.98
	1 (RB_Pos:13)	13.90	14.38	13.90	14.02	14.89	13.92
	1 (RB_Pos:24)	13.91	14.39	13.82	14.04	14.88	13.88
	12 (RB_Pos:0)	13.80	14.38	13.89	13.90	14.51	13.92
	12 (RB_Pos:6)	13.84	14.38	13.85	13.94	14.53	13.89
	12 (RB_Pos:13)	13.86	14.40	13.84	13.96	14.53	13.85
	25 (RB_Pos:0)	13.81	14.35	13.83	13.83	14.41	13.75
Bandwidth (MHz)	RB Set	Power (dBm)					
		QPSK			16QAM		
	Channel	19965	20175	20385	19965	20175	20385
3.0MHz	1 (RB_Pos:0)	13.65	14.32	13.73	13.63	14.67	13.78
	1 (RB_Pos:8)	13.77	14.39	13.74	13.71	14.73	13.78
	1 (RB_Pos:14)	13.71	14.33	13.65	13.65	14.68	13.68
	8 (RB_Pos:0)	13.77	14.34	13.81	13.88	14.43	13.83
	8 (RB_Pos:3)	13.80	14.36	13.81	13.92	14.46	13.84
	8 (RB_Pos:7)	13.79	14.38	13.78	13.92	14.46	13.79
	15 (RB_Pos:0)	13.76	14.32	13.77	13.80	14.37	13.71
Bandwidth (MHz)	RB Set	Power (dBm)					
		QPSK			16QAM		
	Channel	19957	20175	20393	19957	20175	20393
1.4MHz	1 (RB_Pos:0)	13.70	14.34	13.71	13.82	14.73	13.76
	1 (RB_Pos:3)	13.76	14.42	13.78	13.91	14.75	13.80
	1 (RB_Pos:5)	13.72	14.34	13.69	13.87	14.70	13.76

	3 (RB_Pos:0)	13.76	14.42	13.83	13.86	14.62	13.98
	3 (RB_Pos:1)	13.76	14.41	13.83	13.82	14.58	13.99
	3 (RB_Pos:3)	13.79	14.44	13.81	13.88	14.63	13.96
	6 (RB_Pos:0)	13.67	14.30	13.72	13.84	14.21	13.88

FDD LTE Band 7							
Bandwidth (MHz)	RB Set	Power (dBm)					
		QPSK			16QAM		
	Channel	20850	21100	21350	20850	21100	21350
20MHz	1 (RB_Pos:0)	14.26	14.29	14.26	14.75	14.78	14.64
	1 (RB_Pos:50)	14.27	13.92	14.27	14.73	14.43	14.66
	1 (RB_Pos:99)	14.34	14.10	14.36	14.81	14.59	14.72
	50 (RB_Pos:0)	14.22	14.13	14.29	14.23	14.14	14.25
	50 (RB_Pos:25)	14.23	13.97	14.25	14.24	14.00	14.22
	50 (RB_Pos:50)	14.27	14.03	14.31	14.29	14.04	14.28
	100 (RB_Pos:0)	14.22	14.06	14.28	14.24	14.06	14.28
Bandwidth (MHz)	RB Set	Power (dBm)					
		QPSK			16QAM		
	Channel	20825	21100	21375	20825	21100	21375
15MHz	1 (RB_Pos:0)	14.23	14.23	14.22	14.18	14.56	14.62
	1 (RB_Pos:38)	14.22	13.96	14.21	14.16	14.27	14.61
	1 (RB_Pos:74)	14.27	14.11	14.24	14.21	14.43	14.60
	36 (RB_Pos:0)	14.22	14.03	14.17	14.21	14.07	14.14
	36 (RB_Pos:20)	14.25	13.95	14.22	14.23	14.02	14.17
	36 (RB_Pos:39)	14.26	13.98	14.21	14.24	14.04	14.17
	75 (RB_Pos:0)	14.26	14.00	14.21	14.24	14.02	14.19
Bandwidth (MHz)	RB Set	Power (dBm)					
		QPSK			16QAM		
	Channel	20800	21100	21400	20800	21100	21400
10MHz	1 (RB_Pos:0)	14.15	14.11	14.13	14.12	14.43	14.18
	1 (RB_Pos:25)	14.18	13.96	14.15	14.13	14.27	14.18
	1 (RB_Pos:49)	14.18	14.05	14.14	14.17	14.37	14.15
	25 (RB_Pos:0)	14.16	13.97	14.15	14.20	14.01	14.22
	25 (RB_Pos:12)	14.19	13.88	14.14	14.20	13.92	14.23
	25 (RB_Pos:25)	14.20	13.93	14.15	14.22	13.97	14.23
	50 (RB_Pos:0)	14.20	13.94	14.16	14.18	13.96	14.19
Bandwidth (MHz)	RB Set	Power (dBm)					
		QPSK			16QAM		
	Channel	20775	21100	21425	20775	21100	21425
5MHz	1 (RB_Pos:0)	14.29	13.98	14.21	14.37	14.47	14.25
	1 (RB_Pos:13)	14.28	13.92	14.21	14.40	14.39	14.25
	1 (RB_Pos:24)	14.27	13.95	14.21	14.39	14.41	14.26
	12 (RB_Pos:0)	14.24	13.95	14.17	14.31	14.09	14.20
	12 (RB_Pos:6)	14.22	13.90	14.19	14.29	14.03	14.21

	12 (RB_Pos:13)	14.24	13.94	14.18	14.32	14.08	14.20
	25 (RB_Pos:0)	14.20	13.89	14.11	14.21	13.96	14.05
FDD LTE Band 17							
Bandwidth (MHz)	RB Set	Power (dBm)					
		QPSK			16QAM		
	Channel	23780	23790	23800	23780	23790	23800
10MHz	1 (RB_Pos:0)	17.83	17.98	17.92	17.79	18.27	18.03
	1 (RB_Pos:25)	17.85	17.89	17.78	17.79	18.19	17.78
	1 (RB_Pos:49)	17.76	17.77	17.66	17.64	18.07	17.68
	25 (RB_Pos:0)	17.91	17.89	17.89	17.94	17.95	17.99
	25 (RB_Pos:12)	17.87	17.82	17.82	17.89	17.84	17.90
	25 (RB_Pos:25)	17.82	17.78	17.77	17.82	17.78	17.83
	50 (RB_Pos:0)	17.89	17.84	17.83	17.85	17.87	17.85
Bandwidth (MHz)	RB Set	Power (dBm)					
		QPSK			16QAM		
	Channel	23755	23790	23825	23755	23790	23825
5MHz	1 (RB_Pos:0)	17.95	17.93	17.89	18.02	18.45	17.88
	1 (RB_Pos:13)	18.07	17.87	17.84	18.17	18.35	17.83
	1 (RB_Pos:24)	17.95	17.85	17.74	18.06	18.30	17.78
	12 (RB_Pos:0)	17.95	17.92	17.86	18.03	18.07	17.88
	12 (RB_Pos:6)	17.97	17.88	17.82	18.08	18.00	17.84
	12 (RB_Pos:13)	17.96	17.86	17.79	18.05	17.97	17.81
	25 (RB_Pos:0)	17.92	17.84	17.77	17.95	17.90	17.70

9 EUT ANTENNA LOCATION SKETCH



10 SAR Test Exclusion Consider Table

According with FCC KDB 447498 D01, 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	Front/ Back	Left Edge	Right Edge	Bottom Edge	Top Edge
GSM 850	Distance to User			<5mm	<5 mm	55 mm	<5 mm	176 mm	<5mm
	Voice 191	32.25	1678.804	Yes	Yes	Yes	Yes	No	Yes
	Data 191	30.90	1230.269	No	Yes	Yes	Yes	No	Yes
GSM 1900	Distance to User			<5mm	<5 mm	55 mm	<5 mm	176 mm	<5mm
	Voice 158	29.60	912.011	Yes	Yes	Yes	Yes	No	Yes
	Data 158	29.65	922.571	No	Yes	Yes	Yes	No	Yes
WCDMA Band 2	Distance to User			<5mm	<5 mm	55 mm	<5 mm	176 mm	<5mm
	RMC 158	22.40	173.78	Yes	Yes	Yes	Yes	No	Yes
WCDMA Band 5	Distance to User			<5mm	<5 mm	55 mm	<5 mm	176 mm	<5mm
	RMC 191	22.70	186.31	Yes	Yes	No	Yes	No	Yes
LTE Band 2	Distance to User			<5mm	<5 mm	55 mm	<5 mm	176 mm	<5mm
	QPSK 158	21.80	151.36	Yes	Yes	No	Yes	No	Yes
LTE Band 4	Distance to User			<5mm	<5 mm	55 mm	<5 mm	176 mm	<5mm
	QPSK 164	21.85	153.11	Yes	Yes	No	Yes	No	Yes
LTE Band 7	Distance to User			<5mm	<5 mm	55 mm	<5 mm	176 mm	<5mm
	QPSK 144	21.70	147.91	Yes	Yes	Yes	Yes	No	Yes
LTE Band 17	Distance to User			<5mm	<5 mm	55 mm	<5 mm	176 mm	<5mm
	QPSK 170	21.75	149.62	Yes	Yes	No	Yes	No	Yes
WLAN 2.4 G	Distance to User			<5mm	<5mm	<5mm	84mm	175 mm	<5mm
	802.11b	10.05	10.12	Yes	Yes	Yes	Yes	No	Yes
	802.11g	9.95	9.89	Yes	Yes	Yes	Yes	No	Yes
	802.11n(HT20)	9.60	9.12	Yes	Yes	Yes	Yes	No	Yes
	802.11n(HT40)	10.00	10.00	Yes	Yes	Yes	Yes	No	Yes
Bluetooth	Distance to User			<5mm	<5mm	<5mm	84mm	175 mm	<5mm
	Bluetooth BR/EDR	5.70	3.715	No	No	No	No	No	No
	Bluetooth BLE	-1.85	0.653	No	No	No	No	No	No

Note:

- Maximum power is the source-based time-average power and represents the maximum RF output power among production units.
- Per KDB 447498 D01, for larger devices, the test separation distance of adjacent edge configuration is determined by the closest separation between the antenna and the user.
- Per KDB 447498 D01, standalone SAR test exclusion threshold is applied; If the distance of the antenna to the user is < 5mm, 5mm is used to determine SAR exclusion threshold.
- Per KDB 447498 D01, the 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:

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

SAR and ≤ 7.5 for 10-g extremity SAR

- a. $f(\text{GHz})$ is the RF channel transmit frequency in GHz
- b. Power and distance are rounded to the nearest mW and mm before calculation
- c. The result is rounded to one decimal place for comparison
- d. For < 50 mm distance, we just calculate mW of the exclusion threshold value (3.0) to do compare.

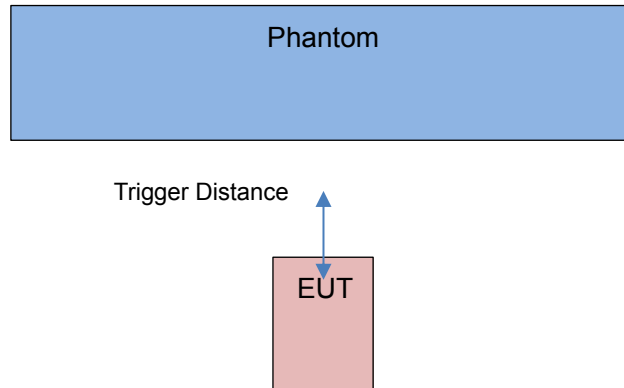
This formula is $[3.0] / [\sqrt{f(\text{GHz})}] \cdot [(\text{min. test separation distance, mm})] = \text{exclusion threshold of mW}$.

5. Per KDB 447498 D01, at 100 MHz to 6 GHz and for test separation distances > 50 mm, the SAR test exclusion threshold is determined according to the following:
 - a. $[\text{Threshold at 50 mm in step 1}) + (\text{test separation distance} - 50 \text{ mm}) \cdot (f(\text{MHz})/150)]$ mW, at 100 MHz to 1500 MHz
 - b. $[\text{Threshold at 50 mm in step 1}) + (\text{test separation distance} - 50 \text{ mm}) \cdot 10]$ mW at > 1500 MHz and ≤ 6 GHz
6. Per KDB 941225 D01, RMC 12.2kbps setting is used to evaluate SAR. If HSDPA /HSUPA /DC-HSDPA output power is $< 0.25\text{dB}$ higher than RMC12.2Kbps, or reported SAR with RMC 12.2kbps setting is $\leq 1.2\text{W/kg}$, HSDPA/HSUPA/DC-HSDPA SAR evaluation can be excluded.
7. Per KDB 248227 D01, choose the highest output power channel to test SAR and determine further SAR exclusion.8. For each frequency band, testing at higher data rates and higher order modulations is not required when the maximum average output power for each of these configurations is less than $1/4\text{dB}$ higher than those measured at the lowest data rate
8. Apply the test exclusion rule in KDB 248227 D01 v02 11g, 11n-HT20 and HT40 output power is less than $1/4\text{dB}$ higher than 11b mode, thus the SAR can be excluded.

10.1 Proximity Sensor Triggering Test

10.1.1 Procedures for determining antenna and proximity sensor coverage

Proximity sensor triggering distance testing was performed according to the procedures outlined in KDB 616217 D04 section 6.2, and EUT moving further away from the phantom and EUT moving toward the phantom were both assessed, and the shortest triggering distances were reported and used for SAR assessment.



Distance in mm	0-10	11	12	13	14	15	16	17	18
Back Side	On	On	On	On	On	On	On	Off	Off
Left Side	Off	Off	Off	Off	Off	Off	Off	Off	Off
Right Side	On	On	On	On	On	On	On	Off	Off
Top Side	On	On	On	On	On	On	On	Off	Off
Bottom Side	Off	Off	Off	Off	Off	Off	Off	Off	Off

Note: Power reduction is only applicable for 2G/ 3G/ 4G.

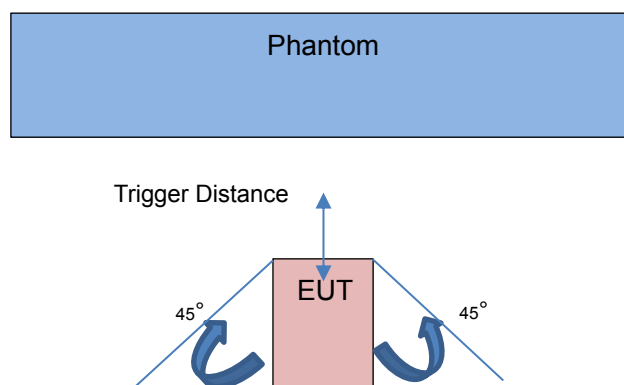
10.1.2 Procedures for determining antenna and proximity sensor coverage

Not apply

10.1.3 Procedures for determining tablet tilt angle influences to proximity sensor triggering

The influence of table tilt angles to proximity sensor triggering was determined by positioning each tablet edge that contains a transmitting antenna, perpendicular to the flat phantom, at 16 mm separation for the right edge and top edge.

Rotating the tablet around the edge next to the phantom in $\leq 10^\circ$ increments until the tablet is $\pm 45^\circ$ from the vertical position at 0° , and the maximum output power remains in the reduced mode.



For verification of compliance of power reduction scheme, additional SAR test with EUT transmitting at full RF power at a separation of “the triggering distance – 1 mm”

EUT Sides	Additional SAR test Distance in mm
Back Side	15
Right Side	15
Top Side	15

11 TEST RESULTS

11.1 GSM 850

Proximity Sensory State	Mode	Position	Dist. (mm)	Ch.	Freq. (MHz)	Power Drift (%)	1 g Meas. SAR (W/Kg)	Meas. Power (dBm)	Max. tune-up Power(dBm)	Scaling Factor	1 g Scaled SAR (W/Kg)	Meas. No.
Head												
ON	Voice	Left Cheek	0	128	824.2	1.59	0.291	28.96	29.05	1.02	0.297	/
		Left Tilt	0	128	824.2	-1.60	0.258	28.96	29.05	1.02	0.263	/
		Right Cheek	0	128	824.2	-2.53	0.507	28.96	29.05	1.02	0.518	1#
		Right Tilt	0	128	824.2	0.28	0.332	28.96	29.05	1.02	0.339	/
Body												
ON	Voice	Back Side	0	128	824.2	1.56	0.612	28.96	29.05	1.02	0.625	/
	DATA 2 slots	Back Side	0	128	824.2	1.02	0.614	30.53	30.65	1.03	0.631	2#
		Right Edge	0	128	824.2	3.00	0.214	30.53	30.65	1.03	0.220	/
		Top Edge	0	128	824.2	2.89	0.323	30.53	30.65	1.03	0.332	/
OFF	Voice	Back Side	15	128	824.2	1.57	0.159	32.13	32.25	1.03	0.163	/
	DATA 4 slots	Back Side	15	190	836.6	-3.10	0.354	31.79	31.9	1.03	0.363	3#
		Left Edge	15	190	836.6	4.30	0.224	31.79	31.9	1.03	0.230	/
		Right Edge	15	190	836.6	3.63	0.259	31.79	31.9	1.03	0.266	/
		Top Edge	15	190	836.6	2.90	0.191	31.79	31.9	1.03	0.196	/

11.2 GSM 1900

Proximity Sensory State	Mode	Position	Dist. (mm)	Ch.	Freq. (MHz)	Power Drift (%)	1 g Meas. SAR (W/Kg)	Meas. Power (dBm)	Max. tune-up Power(dBm)	Scaling Factor	1 g Scaled SAR (W/Kg)	Meas. No.
Head												
ON	Voice	Left Cheek	0	512	1850.2	2.60	0.312	22.71	22.80	1.02	0.319	/
		Left Tilt	0	512	1850.2	1.90	0.235	22.71	22.80	1.02	0.240	/
		Right Cheek	0	512	1850.2	-0.76	0.366	22.71	22.80	1.02	0.374	4#
		Right Tilt	0	512	1850.2	2.80	0.298	22.71	22.80	1.02	0.304	/
Body												
ON	Voice	Back Side	0	512	1850.2	2.10	0.550	22.71	22.80	1.02	0.562	/
	DATA 2 slots	Back Side	0	512	1850.2	-0.46	0.552	28.26	28.35	1.02	0.564	5#
		Right Edge	0	512	1850.2	2.13	0.083	28.26	28.35	1.02	0.085	/
		Top Edge	0	512	1850.2	-0.43	0.296	28.26	28.35	1.02	0.302	/
OFF	Voice	Back Side	15	512	1850.2	-0.67	0.197	26.68	26.80	1.03	0.203	/
	DATA 4 slots	Back Side	15	512	1850.2	-1.36	0.212	26.68	26.80	1.03	0.218	6#
		Left Edge	15	512	1850.2	-2.70	0.015	26.68	26.80	1.03	0.015	/
		Right Edge	15	512	1850.2	-3.84	0.054	26.68	26.80	1.03	0.056	/
		Top Edge	15	512	1850.2	3.62	0.201	26.68	26.80	1.03	0.207	/

11.3WCDMA Band 2

Proximity Sensory State	Mode	Position	Dist. (mm)	Ch.	Freq. (MHz)	Power Drift (%)	1 g Meas. SAR (W/Kg)	Meas. Power (dBm)	Max. tune-up Power(dBm)	Scaling Factor	1 g Scaled SAR (W/Kg)	Meas. No.
Head												
ON	RMC	Left Cheek	0	9262	1852.4	0.22	0.461	14.95	15.05	1.02	0.472	/
		Left Tilt	0	9262	1852.4	0.62	0.354	14.95	15.05	1.02	0.362	/
		Right Cheek	0	9262	1852.4	0.05	0.618	14.95	15.05	1.02	0.632	7#
		Right Tilt	0	9262	1852.4	1.22	0.528	14.95	15.05	1.02	0.540	/
Body												
ON	RMC	Back Side	0	9262	1852.4	-1.42	0.910	14.95	15.05	1.02	0.931	/
			0	9400	1880.0	-1.87	0.911	14.89	15.05	1.04	0.945	/
			0	9538	1907.6	-1.35	0.926	14.76	15.05	1.07	0.979	8#
		Right Edge	0	9262	1852.4	4.10	0.150	14.95	15.05	1.02	0.153	/
		Top Edge	0	9262	1852.4	2.33	0.522	14.95	15.05	1.02	0.534	/
OFF		Back Side	15	9262	1852.4	-0.68	0.408	22.27	22.40	1.03	0.420	9#
		Left Edge	15	9262	1852.4	1.45	0.076	22.27	22.40	1.03	0.078	/
		Right Edge	15	9262	1852.4	3.60	0.115	22.27	22.40	1.03	0.118	/
		Top Edge	15	9262	1852.4	1.46	0.388	22.27	22.40	1.03	0.400	/

11.4WCDMA Band 5

Proximity Sensory State	Mode	Position	Dist. (mm)	Ch.	Freq. (MHz)	Power Drift (%)	1 g Meas. SAR (W/Kg)	Meas. Power (dBm)	Max. tune-up Power(dBm)	Scaling Factor	1 g Scaled SAR (W/Kg)	Meas. No.
Head												
ON	RMC	Left Cheek	0	4182	836.4	2.60	0.181	16.94	17.05	1.03	0.186	/
		Left Tilt	0	4182	836.4	3.20	0.126	16.94	17.05	1.03	0.129	/
		Right Cheek	0	4182	836.4	-0.19	0.342	16.94	17.05	1.03	0.351	10#
		Right Tilt	0	4182	836.4	2.31	0.221	16.94	17.05	1.03	0.227	/
Body												
ON	RMC	Back Side	0	4182	836.4	-0.17	0.535	16.94	17.05	1.03	0.549	11#
		Right Edge	0	4182	836.4	3.51	0.168	16.94	17.05	1.03	0.172	/
		Top Edge	0	4182	836.4	2.81	0.322	16.94	17.05	1.03	0.330	/
OFF		Back Side	15	4233	846.6	-0.94	0.363	22.57	22.70	1.03	0.374	12#
		Left Edge	15	4233	836.4	2.16	0.066	22.57	22.70	1.03	0.068	/
		Right Edge	15	4233	846.6	4.12	0.076	22.57	22.70	1.03	0.078	/
		Top Edge	15	4233	836.4	4.50	0.244	22.57	22.70	1.03	0.251	/

11.5LTE Band 2

Mode	Proximity Sensory State	Position	Dist. (mm)	Ch.	Freq. (MHz)	RB Numb.	RB Start	Power Drift (%)	1 g Meas. SAR (W/Kg)	Meas. Power (dBm)	Max. tune-up Power (dBm)	Scaling Factor	1 g Scaled SAR (W/Kg)	Meas. No.
Head														
QPSK	ON	Left Cheek	0	18900	1880.0	1	Low	-2.36	0.355	14.05	14.15	1.02	0.363	
				18700	1860.0	50	Low	3.22	0.283	14.00	14.10	1.02	0.290	
		Left Tilt	0	18900	1880.0	1	Low	-2.36	0.267	14.05	14.15	1.02	0.273	
				18700	1860.0	50	Low	-3.65	0.216	14.00	14.10	1.02	0.221	
		Right Cheek	0	18900	1880.0	1	Low	0.30	0.462	14.05	14.15	1.02	0.473	13#
				18700	1860.0	50	Low	-0.23	0.357	14.00	14.10	1.02	0.365	
		Right Tilt	0	18900	1880.0	1	Low	0.73	0.378	14.05	14.15	1.02	0.387	
				18700	1860.0	50	Low	-3.56	0.301	14.00	14.10	1.02	0.308	
Body														
QPSK	ON	Back Side	0	18900	1880.0	1	Low	-2.11	0.716	14.05	14.15	1.02	0.733	14#
				18700	1860.0	50	Low	-0.39	0.698	14.00	14.10	1.02	0.714	/
		Right Edge	0	18900	1880.0	1	Low	2.10	0.122	14.05	14.15	1.02	0.125	/
				18700	1860.0	50	Low	1.98	0.120	14.00	14.10	1.02	0.123	/
		Top Edge	0	18900	1880.0	1	Low	2.71	0.410	14.05	14.15	1.02	0.420	/
				18700	1860.0	50	Low	3.45	0.403	14.00	14.10	1.02	0.412	/
	OFF	Back Side	15	18700	1860.0	1	Low	-1.59	0.356	21.67	21.80	1.03	0.367	15#
						50	Low	1.56	0.289	21.67	21.80	1.03	0.298	/
		Left Edge	15	18700	1860.0	1	Low	2.36	0.059	21.67	21.80	1.03	0.061	/
						50	Low	-4.12	0.047	21.67	21.80	1.03	0.048	/
		Right Edge	15	18700	1860.0	1	Low	2.36	0.089	21.67	21.80	1.03	0.092	/
						50	Low	-0.48	0.071	21.67	21.80	1.03	0.073	/
		Top Edge	15	18700	1860.0	1	Low	-0.12	0.338	21.67	21.80	1.03	0.348	/
						50	Low	1.30	0.266	21.67	21.80	1.03	0.274	/

11.6LTE Band 4

Mode	Proximity Sensory State	Position	Dist. (mm)	Ch.	Freq. (MHz)	RB Numb.	RB Start	Power Drift (%)	1 g Meas. SAR (W/Kg)	Meas. Power (dBm)	Max. tune-up Power (dBm)	Scaling Factor	1 g Scaled SAR (W/Kg)	Meas. No.
Head														
QPSK	ON	Left Cheek	0	20300	1745.0	1	Low	2.33	0.290	14.55	14.65	1.02	0.297	/
						50	Low	-1.23	0.245	14.44	14.55	1.03	0.251	/
		Left Tilt	0	20300	1745.0	1	Low	1.73	0.196	14.55	14.65	1.02	0.201	/
						50	Low	4.21	0.146	14.44	14.55	1.03	0.150	/
		Right Cheek	0	20300	1745.0	1	Low	-0.08	0.520	14.55	14.65	1.02	0.532	16#
						50	Low	2.10	0.417	14.44	14.55	1.03	0.428	/
		Right Tilt	0	20300	1745.0	1	Low	-4.17	0.230	14.55	14.65	1.02	0.235	/
						50	Low	2.31	0.184	14.44	14.55	1.03	0.189	/
Body														
QPSK	ON	Back Side	0	20300	1745.0	1	Low	-1.73	0.816	14.55	14.65	1.02	0.835	17#
				20050	1720.0	1	Low	-3.62	0.677	13.92	14.65	1.18	0.801	/
				20175	1732.5	1	Low	-2.09	0.749	14.27	14.65	1.09	0.817	/
				20300	1745.0	50	Low	2.36	0.583	14.44	14.55	1.03	0.598	/
		Right Edge	0	20300	1745.0	1	Low	2.31	0.165	14.55	14.65	1.02	0.169	/
						50	Low	0.12	0.157	14.44	14.55	1.03	0.161	/
		Top Edge	0	20300	1745.0	1	Low	-1.23	0.406	14.55	14.65	1.02	0.415	/
						50	Low	-0.23	0.361	14.44	14.55	1.03	0.370	/
	OFF	Back Side	15	20300	1745.0	1	Low	-1.23	0.575	21.73	21.85	1.03	0.591	18#
						50	Low	-2.36	0.460	20.42	20.55	1.03	0.474	/
		Left Edge	15	20300	1745.0	1	Low	1.47	0.068	21.73	21.85	1.03	0.070	/
						50	Low	2.36	0.053	20.42	20.55	1.03	0.055	/
		Right Edge	15	20300	1745.0	1	Low	3.22	0.176	21.73	21.85	1.03	0.181	/
						50	Low	-2.36	0.135	20.42	20.55	1.03	0.139	/
		Top Edge	15	20300	1745.0	1	Low	1.73	0.401	21.73	21.85	1.03	0.412	/
						50	Low	4.21	0.311	20.42	20.55	1.03	0.320	/

11.7LTE Band 7

Mode	Proximity Sensory State	Position	Dist. (mm)	Ch.	Freq. (MHz)	RB Numb.	RB Start	Power Drift (%)	1 g Meas. SAR (W/Kg)	Meas. Power (dBm)	Max. tune-up Power (dBm)	Scaling Factor	1 g Scaled SAR (W/Kg)	Meas. No.
Head														
QPSK	ON	Left Cheek	0	21350	2560.0	1	High	-1.25	0.459	14.36	14.45	1.02	0.469	/
						50	High	-2.33	0.445	14.31	14.40	1.02	0.454	/
		Left Tilt	0	21350	2560.0	1	High	2.00	0.411	14.36	14.45	1.02	0.420	/
						50	High	-1.23	0.396	14.31	14.40	1.02	0.404	/
		Right Cheek	0	21350	2560.0	1	High	2.04	0.864	14.36	14.45	1.02	0.882	/
				20850	2510.0	1	High	0.83	0.876	14.34	14.45	1.03	0.898	/
				21100	2535.0	1	High	-0.38	0.897	14.10	14.45	1.08	0.984	19#
				21350	2560.0	50	High	1.57	0.791	14.31	14.40	1.02	0.808	/
				20850	2510.0	50	High	3.00	0.806	14.27	14.40	1.03	0.830	/
				21100	2535.0	50	High	2.89	0.813	14.03	14.40	1.09	0.885	/
		Right Tilt	0	21350	2560.0	1	High	-2.33	0.698	14.36	14.45	1.02	0.713	/
						50	High	2.11	0.674	14.31	14.40	1.02	0.688	/
Body														
QPSK	ON	Back Side	0	21350	2560.0	1	High	-2.81	0.500	14.36	14.45	1.02	0.510	20#
						50	High	-1.81	0.468	14.31	14.40	1.02	0.478	/
		Right Edge	0	21350	2560.0	1	High	1.70	0.098	14.36	14.45	1.02	0.100	/
						50	High	2.85	0.089	14.31	14.40	1.02	0.091	/
		Top Edge	0	21350	2560.0	1	High	4.00	0.488	14.36	14.45	1.02	0.498	/
						50	High	-2.36	0.475	14.31	14.40	1.02	0.485	/
	OFF	Back Side	15	20850	2510.0	1	Mid	-2.47	0.221	21.58	21.70	1.03	0.227	21#
						50	Low	3.66	0.183	20.63	20.75	1.03	0.188	/
		Left Edge	15	20850	2510.0	1	Mid	-0.22	0.032	21.58	21.70	1.03	0.033	/
						50	Low	-0.15	0.029	20.63	20.75	1.03	0.030	/
		Right Edge	15	20850	2510.0	1	Mid	0.27	0.065	21.58	21.70	1.03	0.067	/
						50	Low	0.39	0.061	20.63	20.75	1.03	0.063	/
		Top Edge	15	20850	2510.0	1	Mid	-0.51	0.141	21.58	21.70	1.03	0.145	/
						50	Low	0.64	0.137	20.63	20.75	1.03	0.141	/

11.8LTE Band 17

Mode	Proximity Sensory State	Position	Dist. (mm)	Ch.	Freq. (MHz)	RB Numb.	RB Start	Power Drift (%)	1 g Meas. SAR (W/Kg)	Meas. Power (dBm)	Max. tune-up Power (dBm)	Scaling Factor	1 g Scaled SAR (W/Kg)	Meas. No.
Head														
QPSK	ON	Left Cheek	0	23790	710.0	1	Low	2.36	0.137	17.98	18.10	1.03	0.141	/
						25	Low	-1.73	0.113	17.89	18.00	1.03	0.116	/
		Left Tilt	0	23790	710.0	1	Low	4.21	0.075	17.98	18.10	1.03	0.077	/
						25	Low	2.13	0.064	17.89	18.00	1.03	0.066	/
		Right Cheek	0	23790	710.0	1	Low	-1.98	0.357	17.98	18.10	1.03	0.367	22#
						25	Low	2.36	0.301	17.89	18.00	1.03	0.309	/
		Right Tilt	0	23790	710.0	1	Low	3.33	0.171	17.98	18.10	1.03	0.176	/
						25	Low	1.23	0.142	17.89	18.00	1.03	0.146	/
Body														
QPSK	ON	Back Side	0	23790	710.0	1	Low	-1.27	0.446	17.98	18.10	1.03	0.458	23#
						25	Low	2.23	0.432	17.89	18.00	1.03	0.443	/
						25	Low	3.21	0.072	17.89	18.00	1.03	0.074	/
		Right Edge	0	23790	710.0	1	Low	2.36	0.405	17.98	18.10	1.03	0.416	/
						25	Low	-2.36	0.386	17.89	18.00	1.03	0.396	/
		Top Edge	0	23790	710.0	1	Low	1.66	0.269	17.98	18.10	1.03	0.277	/
						25	Low	4.11	0.258	17.89	18.00	1.03	0.265	/
	OFF	Back Side	15	23790	710.0	1	Low	-0.85	0.150	21.64	21.75	1.03	0.154	24#
						25	Low	2.35	0.115	20.79	20.90	1.03	0.118	/
		Left Edge	15	23790	710.0	1	Low	-2.36	0.057	21.64	21.75	1.03	0.058	/
						25	Low	3.12	0.049	20.79	20.90	1.03	0.050	/
		Right Edge	15	23790	710.0	1	Low	1.23	0.069	21.64	21.75	1.03	0.071	/
						25	Low	-2.31	0.051	20.79	20.90	1.03	0.052	/
		Top Edge	15	23790	710.0	1	Low	2.15	0.077	21.64	21.75	1.03	0.079	/
25	Low					4.13	0.063	20.79	20.90	1.03	0.065	/		

11.10 WIFI 2.4GHz

Mode	Position	Dist. (mm)	Ch.	Freq. (MHz)	Power Drift (%)	1 g Meas. SAR (W/Kg)	Meas. Power (dBm)	Max. tune-up Power(dBm)	Scaling Factor	1 g Scaled SAR (W/Kg)	Meas. No.
Head											
802.11 b	Left Cheek	0	6	2437	-1.05	0.284	9.96	10.05	1.02	0.290	25#
	Left Tilt	0	6	2437	2.36	0.172	9.96	10.05	1.02	0.176	/
	Right Cheek	0	6	2437	2.81	0.140	9.96	10.05	1.02	0.143	/
	Right Tilt	0	6	2437	-1.36	0.123	9.96	10.05	1.02	0.126	/
Body											
802.11 b	Back Side	0	6	2437	-1.78	0.580	9.96	10.05	1.02	0.592	26#
	Left Edge	0	6	2437	1.20	0.251	9.96	10.05	1.02	0.256	/
	Right Edge	0	6	2437	0.56	0.076	9.96	10.05	1.02	0.078	/
	Top Edge	0	6	2437	0.78	0.369	9.96	10.05	1.02	0.377	/

12 SAR Measurement Variability

According to KDB 865664 D01, 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.

Frequency Band (MHz)	Wireless Band	RF Exposure Conditions	Test Position	Highest Measured SAR (W/kg)	Repeated SAR (Yes/No)	Highest Measured SAR (W/kg)	Largest to Smallest SAR Ratio
1750	LTE Band 4	Body	Back Side	0.816	0.805	0.816	1.01
	LTE Band 4	Body	Back Side	0.749	0.737	0.749	1.02
1900	WCDMA Band 2	Body	Back Side	0.910	0.902	0.910	1.02
	WCDMA Band 2	Body	Back Side	0.911	0.905	0.911	1.02
	WCDMA Band 2	Body	Back Side	0.926	0.918	0.926	1.02
2600	LTE Band 7	Head	Right Cheek	0.864	0.859	0.864	1.02
	LTE Band 7	Head	Right Cheek	0.876	0.864	0.876	1.02
	LTE Band 7	Head	Right Cheek	0.897	0.890	0.897	1.02
	LTE Band 7	Head	Right Cheek	0.791	0.789	0.791	1.02
	LTE Band 7	Head	Right Cheek	0.806	0.798	0.806	1.02
	LTE Band 7	Head	Right Cheek	0.813	0.806	0.813	1.02

Note: The ratio of largest to smallest SAR for the original and first repeated measurements is < 1.20 , the second repeated measurement is not required.

13 SIMULTANEOUS TRANSMISSION

Simultaneous transmission SAR test exclusion is determined for each operating configuration and exposure condition according to the reported standalone SAR of each applicable simultaneous transmitting antenna. When the sum of SAR 1g of all simultaneously transmitting antennas in an operating mode and exposure condition combination is within the SAR limit (SAR 1g 1.6 W/kg), the simultaneous transmission SAR is not required. When the sum of SAR 1g is greater than the SAR limit (SAR 1g 1.6 W/kg), SAR test exclusion is determined by the SAR to Peak Location Ratio (SPLSR).

13.1 Simultaneous Transmission Mode Consider

NO.	Mode	2.4G WLAN & 2.4G Bluetooth	
		Head	Body
1	GSM (Voice)	+ 2.4G WLAN	+ 2.4G WLAN
		--	+ Bluetooth
2	GSM (Data)	--	+ 2.4G WLAN
		--	+ Bluetooth
3	WCDMA RMC	+ 2.4G WLAN	+ 2.4G WLAN
		--	+ Bluetooth
4	LTE	+ 2.4G WLAN	+ 2.4G WLAN
		--	+ Bluetooth
Note:			
1. 2G&3G&4G share the same antenna and can't transmit simultaneously.			
2. The Bluetooth and 2.4G WLAN share the same antenna, can't transmitting together.			
3. 2.4G WLAN can transmit simultaneously with each WWAN.			
4. 2.4G WLAN supports hotspot mode.			

13.2 Estimated SAR Calculation

According to KDB 447498 D01 when standalone SAR test exclusion applies to an antenna that transmits simultaneously with other antennas, the standalone SAR was estimated according to following formula to result in substantially conservative SAR values of ≤ 0.4 W/kg to determine simultaneous transmission SAR test exclusion.

$$\text{Estimated SAR} = \frac{\text{Max. Tune Up Power (mw)}}{\text{Min Test Separation Distance}} * \frac{\sqrt{f_{\text{GHz}}}}{x} \quad (\text{where } x = 7.5 \text{ for 1-g SAR})$$

If the minimum test separation distance is < 5 mm, a distance of 5 mm is used for estimated SAR calculation. When the test separation distance is > 50 mm, the 0.4 W/kg is used for SAR-1g.

Band	Mode	Position	Antenna To user (mm)	SAR Testing	Max. Tune-up Power (dBm)	Max. Tune-up Power (mW)	Frequency (GHz)	Calculation Distance/Gap (mm)	Estimated SAR (W/kg)
Bluetooth	GFSK	Right Cheek	5	NO	4.57	2.86	2441	5	0.119
		Left Cheek	5	NO	4.57	2.86	2441	5	0.119
		Front side	10	NO	4.57	2.86	2441	10	0.060
		Back Side	10	NO	4.57	2.86	2441	10	0.060
		Right Edge	10	NO	4.57	2.86	2441	10	0.060
		Top Edge	10	NO	4.57	2.86	2441	10	0.060

13.3 Sum SAR of Simultaneous Transmission

13.3.1 Sum Head SAR of Simultaneous Transmission

Simultaneous Mode	Mode	Max. 1g SAR (W/kg)	1g Sum SAR (W/kg)	SPLSR (Yes/No)
GSM Voice + 2.4G WLAN	GSM Voice	0.518	0.808	No
	2.4G WLAN	0.290		
WCDMA RMC +2.4G WLAN	WCDMA RMC	0.632	0.922	No
	2.4G WLAN	0.290		
LTE QPSK + 2.4G WLAN	LTE QPSK	0.984	1.274	No
	2.4G WLAN	0.290		

13.3.2 Sum Body SAR of Simultaneous Transmission (Proximity Sensory on)

Simultaneous Mode	Mode	Max. 1g SAR (W/kg)	1g Sum SAR (W/kg)	SPLSR (Yes/No)
GSM Data + 2.4G WLAN	GSM	0.631	1.223	No
	2.4G WLAN	0.592		
GSM Data + Bluetooth	GSM	0.631	0.691	No
	Bluetooth	0.060		
WCDMA RMC +2.4G WLAN	WCDMA RMC	0.979	1.571	No
	2.4G WLAN	0.592		
WCDMA RMC + Bluetooth	WCDMA RMC	0.979	1.039	No
	Bluetooth	0.060		
LTE QPSK + 2.4G WLAN	LTE QPSK	0.835	1.427	No
	2.4G WLAN	0.592		
LTE QPSK + Bluetooth	LTE QPSK	0.835	0.895	No
	Bluetooth	0.060		

14 TEST EQUIPMENTS LIST

Description	Manufacturer	Model	Serial No.	Cal. Date	Cal. Due
PC	Dell	N/A	N/A	N/A	N/A
750MHz Dipole	SATIMO	SID 750	S/N 25/13 DIP 0G750-253	2015/03/16	2018/03/15
835MHz Dipole	SATIMO	SID 835	S/N 25/13 DIP 0G835-246	2015/03/16	2018/03/15
1800MHz Dipole	SATIMO	SID 1900	S/N 25/13 DIP 1G800-248	2015/03/16	2018/03/15
1900MHz Dipole	SATIMO	SID 1900	S/N 25/13 DIP 1G900-249	2015/03/16	2018/03/15
2450MHz Dipole	SATIMO	SID 2450	S/N 25/13 DIP 2G450-251	2015/03/16	2018/03/15
2600MHz Dipole	SATIMO	SID 2600	SN 25/13 DIP 2G600-254	2015/03/16	2018/03/15
E-Field Probe	MVG	SSE2	S/N 34/15 EPGO 265	2015/10/12	2016/10/11
Antenna	SATIMO	ANTA3	SN 17/13 ZNTA45	N/A	N/A
Phantom1	SATIMO	SAM	SN 30/13 SAM103	N/A	N/A
Phantom2	SATIMO	SAM	SN 30/13 SAM104	N/A	N/A
Dielectric Probe Kit	SATIMO	SCLMP	SN 25/13 OCPG56	2016/09/15	2017/09/14
MultiMeter	Keithley	MultiMeter 2000	4024022	2016/07/13	2017/07/12
Signal Generator	R&S	SMF100A	1167.0000k02/104260	2016/07/13	2017/07/12
Power Meter	Agilent	E4419B	GB40201833	2016/07/13	2017/07/12
Power Sensor	R&S	NRP-Z21	103971	2016/07/13	2017/07/12
Power Amplifier	SATIMO	6552B	22374	N/A	N/A
Wireless Communication Test Set	R&S	CMW 500	138884	2016/07/13	2017/07/12
Network Analyzer	R&S	ZVL-6	101380	2016/07/13	2017/07/12
Attenuator	COM-MW	ZA-S1-31	1305003187	N/A	N/A
Directional coupler	AA-MCS	AAMCS-UDC	000272	N/A	N/A

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

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

ANNEX A SIMULATING LIQUID VERIFICATION RESULT

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

Date	Liquid Type	Fre. (MHz)	Temp. (°C)	Meas. Conductivity (σ) (S/m)	Meas. Permittivity (ϵ)	Target Conductivity (σ) (S/m)	Target Permittivity (ϵ)	Conductivity Tolerance (%)	Permittivity Tolerance (%)
2016.08.11	Head	750	20.8	0.89	42.41	0.89	41.90	0.00	1.22
2016.08.12	Body	750	20.1	0.94	57.19	0.96	55.73	-2.08	2.62
2016.08.11	Head	835	20.8	0.88	41.22	0.90	41.50	-2.22	-0.67
2016.08.12	Body	835	20.1	0.99	53.86	0.97	55.20	2.06	-2.43
2016.08.15	Head	1800	20.1	1.44	39.59	1.40	40.00	2.86	-1.02
2016.08.15	Body	1800	20.1	1.51	52.56	1.52	53.30	-0.66	-1.39
2016.08.16	Head	1900	20.0	1.40	39.54	1.40	40.00	0.00	-1.15
2016.08.17	Body	1900	20.2	1.49	54.16	1.52	53.30	-1.97	1.61
2016.08.18	Head	2450	20.3	1.83	39.74	1.80	39.20	1.67	1.38
2016.08.19	Body	2450	20.8	2.00	51.59	1.95	52.70	2.56	-2.11
2016.08.18	Head	2600	20.3	2.02	38.61	1.96	39.00	3.06	-1.00
2016.08.19	Body	2600	20.8	2.12	50.68	2.16	52.50	-1.85	-3.47

Note: The tolerance limit of Conductivity and Permittivity is $\pm 5\%$.

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 (%)
2016.08.11	Head	750	100	0.890	8.90	8.60	3.49	8.49	4.83
2016.08.12	Body	750	100	0.893	8.93	8.91	0.22	8.49	5.18
2016.08.11	Head	835	100	0.903	9.03	9.81	-7.95	9.56	-5.54
2016.08.12	Body	835	100	1.023	10.23	10.53	-2.85	9.56	7.01
2016.08.15	Head	1800	100	4.110	41.10	38.72	6.15	38.40	7.03
2016.08.15	Body	1800	100	4.111	41.11	40.42	1.71	38.40	7.06
2016.08.16	Head	1900	100	3.943	39.43	40.75	-3.24	39.70	-0.68
2016.08.17	Body	1900	100	4.155	41.55	42.06	-1.21	39.70	4.66
2016.08.18	Head	2450	100	5.203	52.03	54.29	-4.16	52.40	-0.71
2016.08.19	Body	2450	100	5.294	52.94	54.70	-3.22	52.40	1.03
2016.08.18	Head	2600	100	5.640	56.40	57.37	-1.69	55.30	1.99
2016.08.19	Body	2600	100	5.773	57.73	57.62	0.19	55.30	4.39

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

System Performance Check Data(750 MHz Head)

Type: Phone measurement (Complete)

E-Field Probe: SN 34/15 SSE2 EPGO265

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

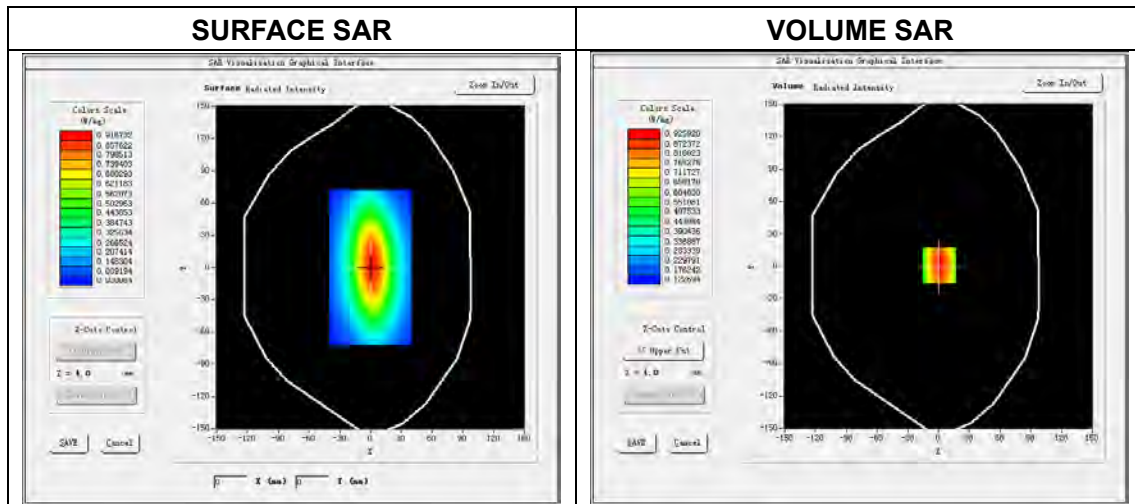
Zoom scan resolution: dx=8 mm, dy=8 mm, dz=5 mm

Date of measurement: 2016.08.11

Measurement duration: 14 minutes 10 seconds

Experimental conditions.

Phantom File	surf_sam_plan.txt
Phantom	Validation plane
Band	750 MHz
Signal	CW
Frequency (MHz)	750.000000
Relative permittivity (real part)	42.410350
Conductivity (S/m)	0.890139
Power drift (%)	0.270000
Ambient Temperature:	21.9C
Liquid Temperature:	20.8C
ConvF:	1.81
Crest factor:	1:1

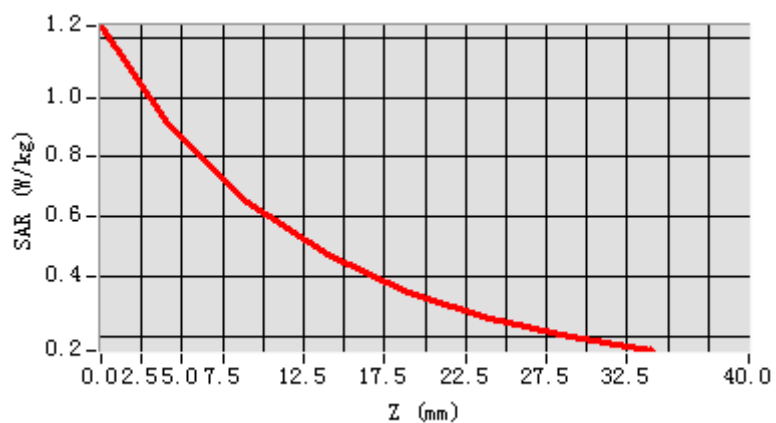


Maximum location: X=1.00, Y=1.00

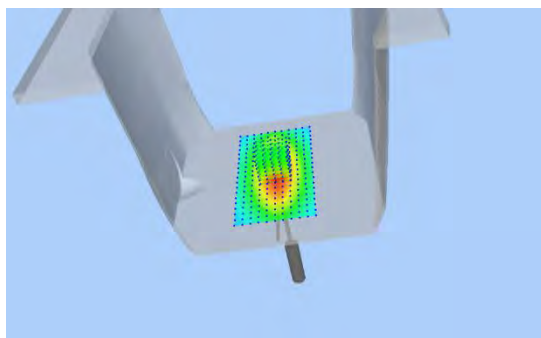
SAR Peak: 1.24W/kg

SAR 10 g (W/Kg)	0.599015
SAR 1 g (W/Kg)	0.889570

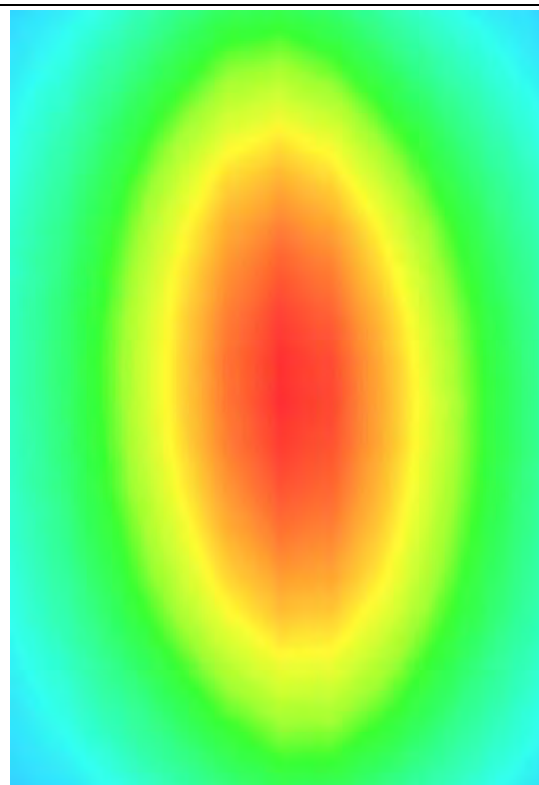
Z Axis Scan



3D screen shot



Hot spot position



System Performance Check Data(750 MHz Body)

Type: Phone measurement (Complete)

E-Field Probe: SN 34/15 SSE2 EPGO265

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

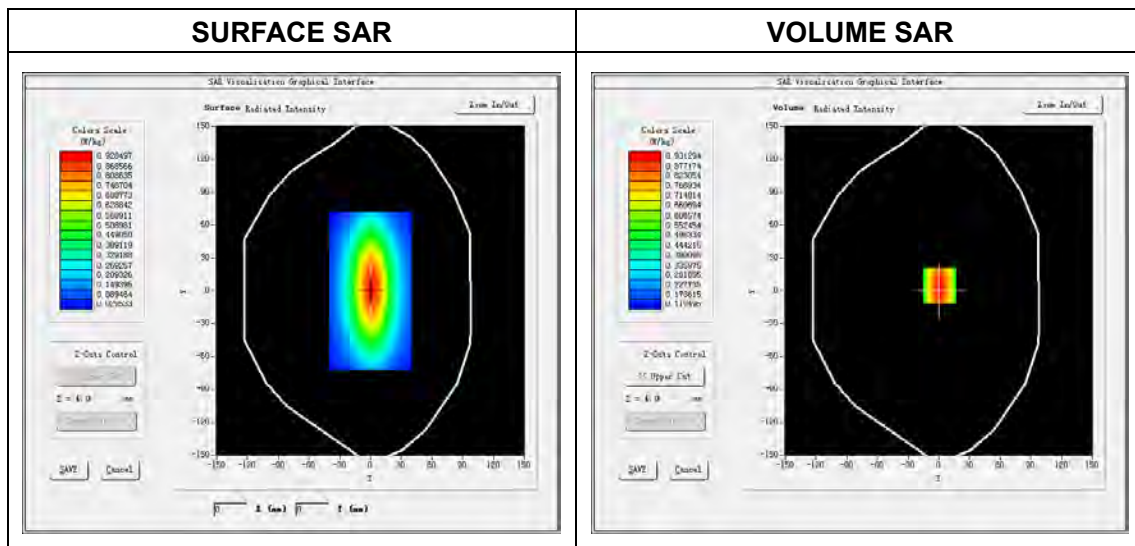
Zoom scan resolution: dx=8 mm, dy=8 mm, dz=5 mm

Date of measurement: 2016.08.12

Measurement duration: 14 minutes 6 seconds

Experimental conditions.

Phantom File	surf_sam_plan.txt
Phantom	Validation plane
Band	750 MHz
Signal	CW
Frequency (MHz)	750.000000
Relative permittivity (real part)	57.190350
Conductivity (S/m)	0.940139
Power drift (%)	-2.890000
Ambient Temperature:	21.6C
Liquid Temperature:	20.1C
ConvF:	1.88
Crest factor:	1:1

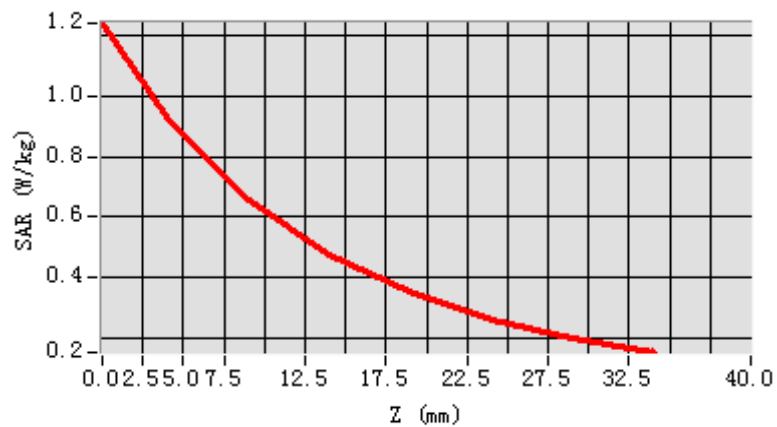


Maximum location: X=1.00, Y=5.00

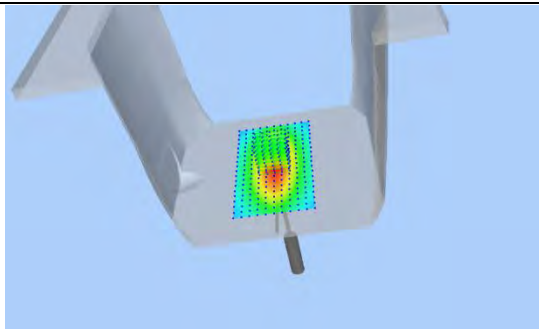
SAR Peak: 1.24 W/kg

SAR 10 g (W/Kg)	0.600718
SAR 1 g (W/Kg)	0.893236

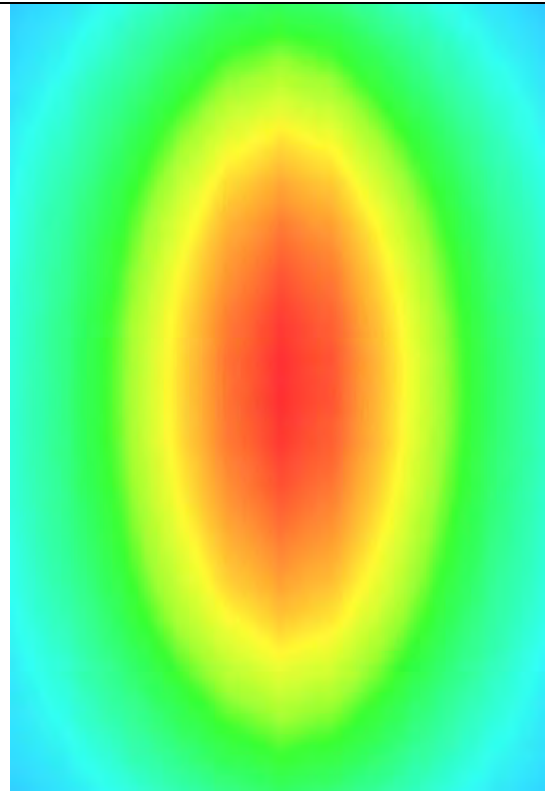
Z Axis Scan



3D screen shot



Hot spot position



System Performance Check Data(835MHz Head)

Type: Phone measurement (Complete)

E-Field Probe: SN 34/15 SSE2 EPGO265

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

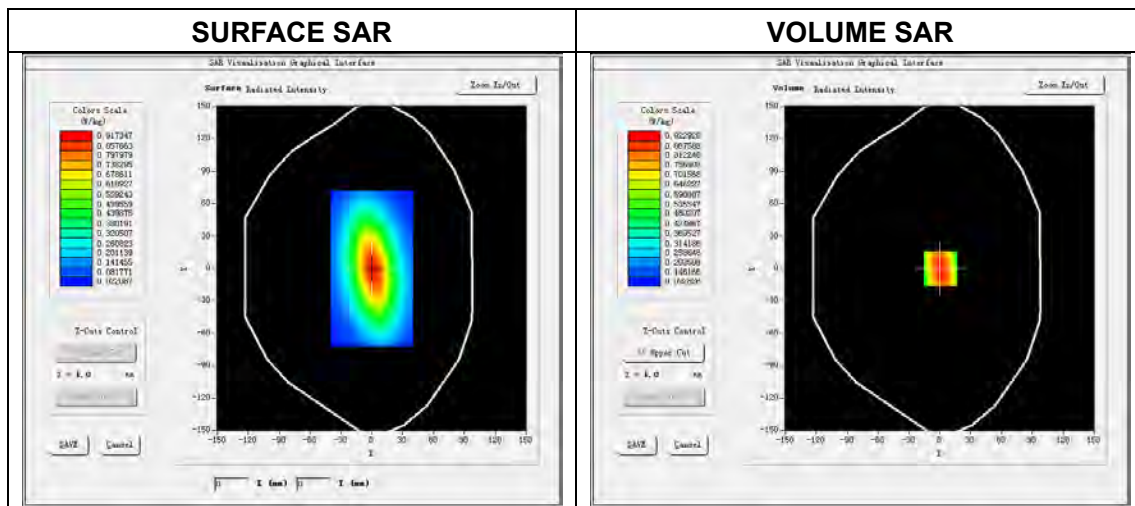
Zoom scan resolution: dx=8 mm, dy=8 mm, dz=5 mm

Date of measurement: 2016.08.11

Measurement duration: 13 minutes 40 seconds

Experimental conditions.

Phantom File	surf_sam_plan.txt
Phantom	Validation plane
Band	835 MHz
Signal	CW
Frequency (MHz)	835.000000
Relative permittivity (real part)	41.217350
Conductivity (S/m)	0.880139
Power drift (%)	0.270000
Ambient Temperature:	21.9C
Liquid Temperature:	20.8C
ConvF:	2.04
Crest factor:	1:1

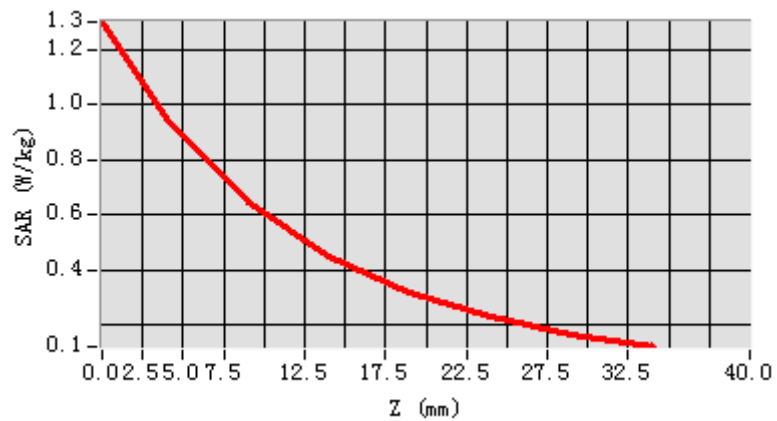


Maximum location: X=1.00, Y=0.00

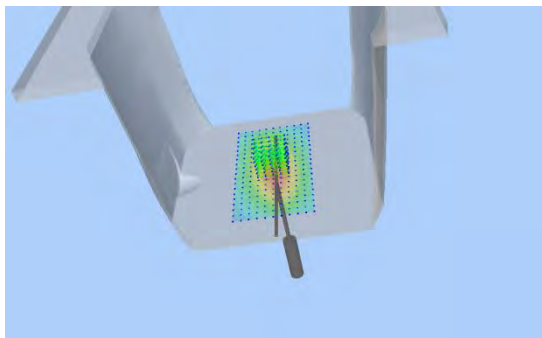
SAR Peak: 1.26 W/kg

SAR 10 g (W/Kg)	0.585918
SAR 1 g (W/Kg)	0.902506

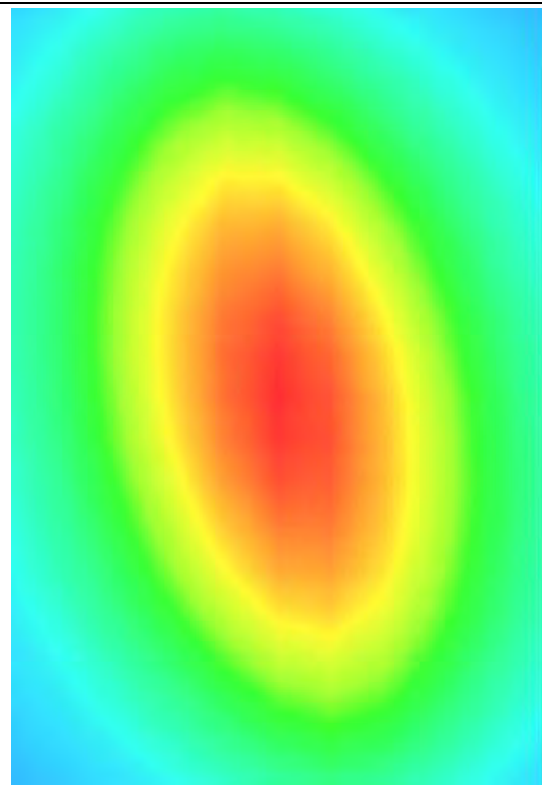
Z Axis Scan



3D screen shot



Hot spot position



System Performance Check Data(835MHz Body)

Type: Phone measurement (Complete)

E-Field Probe: SN 34/15 SSE2 EPGO265

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

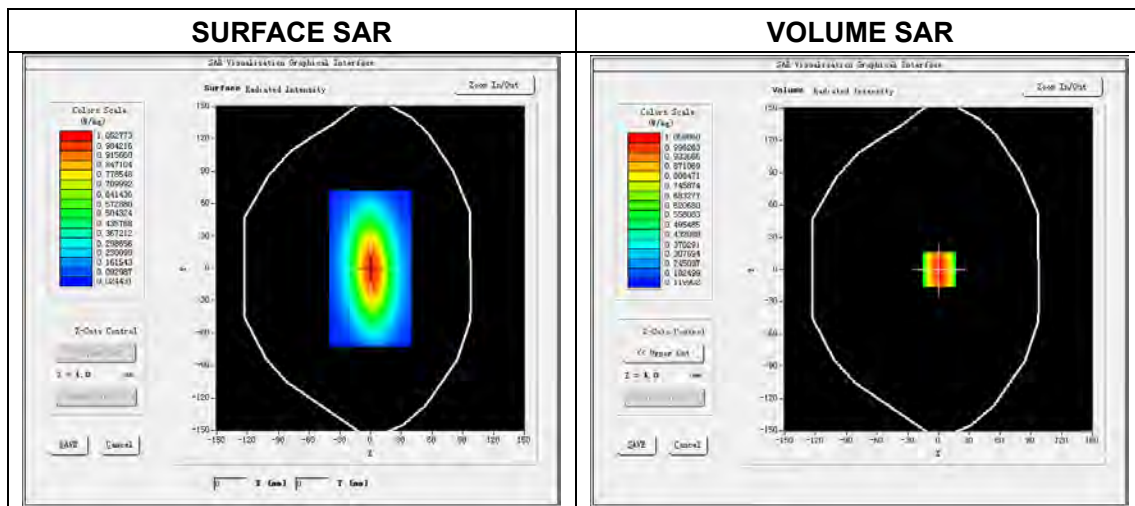
Zoom scan resolution: dx=8 mm, dy=8 mm, dz=5 mm

Date of measurement: 2016.08.12

Measurement duration: 14 minutes 0 seconds

Experimental conditions.

Phantom File	surf_sam_plan.txt
Phantom	Validation plane
Band	835 MHz
Signal	CW
Frequency (MHz)	835.000000
Relative permittivity (real part)	53.857350
Conductivity (S/m)	0.990139
Power drift (%)	0.390000
Ambient Temperature:	21.6C
Liquid Temperature:	20.1C
ConvF:	2.12
Crest factor:	1:1

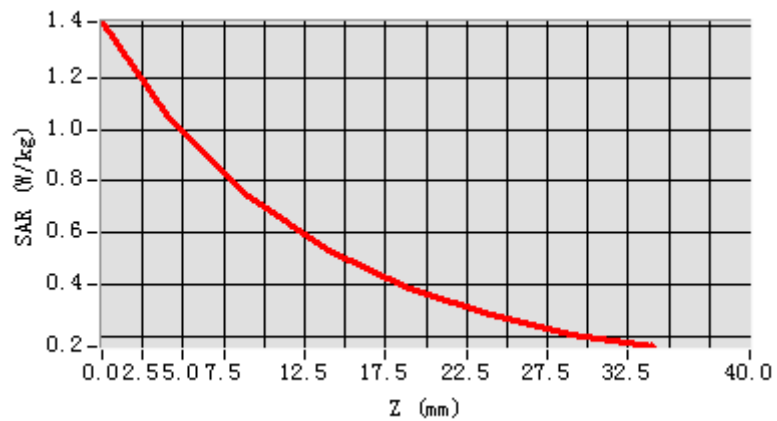


Maximum location: X=1.00, Y=0.00

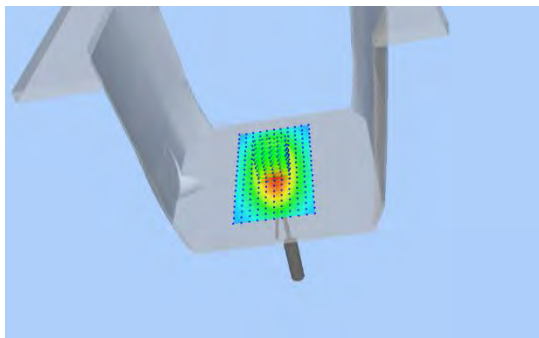
SAR Peak: 1.41 W/kg

SAR 10 g (W/Kg)	0.679168
SAR 1 g (W/Kg)	1.023364

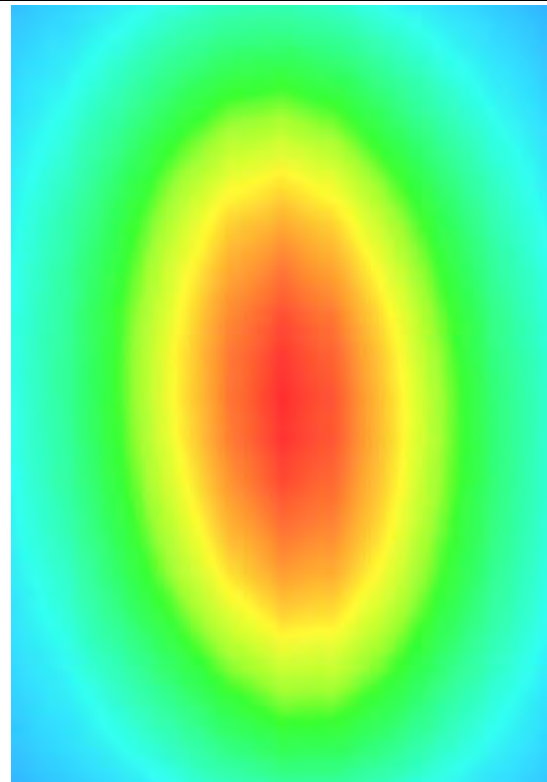
Z Axis Scan



3D screen shot



Hot spot position



System Performance Check Data(1800MHz Head)

Type: Phone measurement (Complete)

E-Field Probe: SN 34/15 SSE2 EPGO265

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

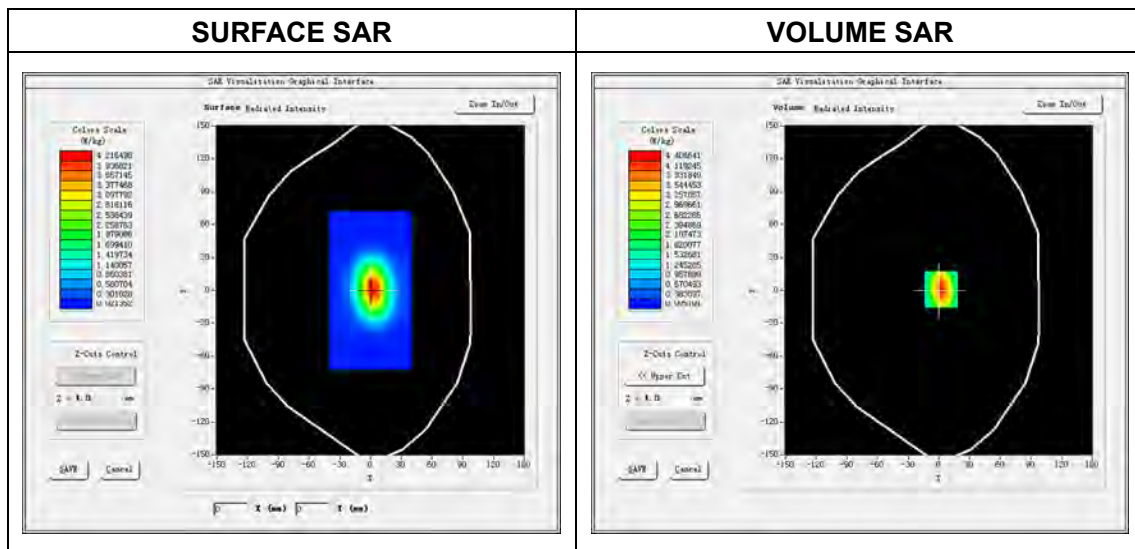
Zoom scan resolution: dx=8 mm, dy=8 mm, dz=5 mm

Date of measurement: 2016.08.15

Measurement duration: 14 minutes 02 seconds

Experimental conditions.

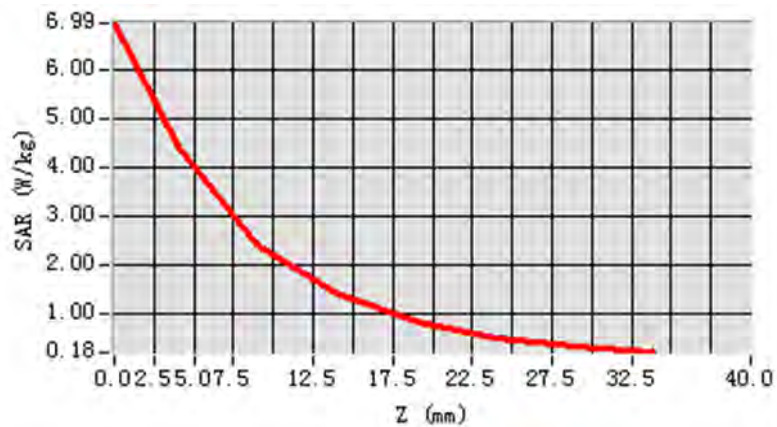
Phantom File	surf_sam_plan.txt
Phantom	Validation plane
Band	1800 MHz
Signal	CW
Frequency (MHz)	1800.000000
Relative permittivity (real part)	39.593498
Conductivity (S/m)	1.441610
Power drift (%)	0.770000
Ambient Temperature:	21.7C
Liquid Temperature:	20.1C
ConvF:	2.04
Crest factor:	1:1



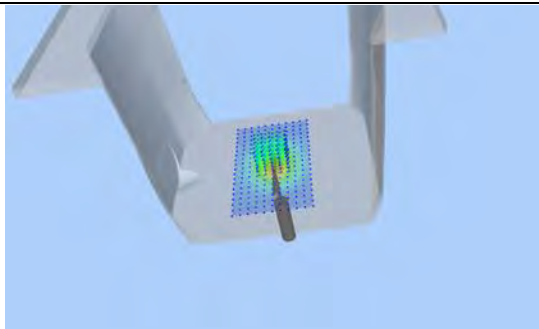
Maximum location: X=2.00, Y=1.00
SAR Peak: 6.95 W/kg

SAR 10 g (W/Kg)	2.105522
SAR 1 g (W/Kg)	4.110127

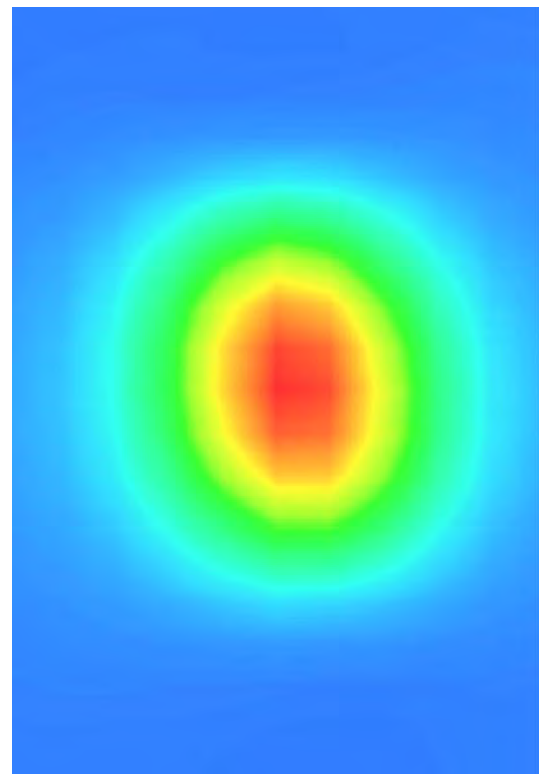
Z Axis Scan



3D screen shot



Hot spot position



System Performance Check Data(1800MHz Body)

Type: Phone measurement (Complete)

E-Field Probe: SN 34/15 SSE2 EPGO265

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

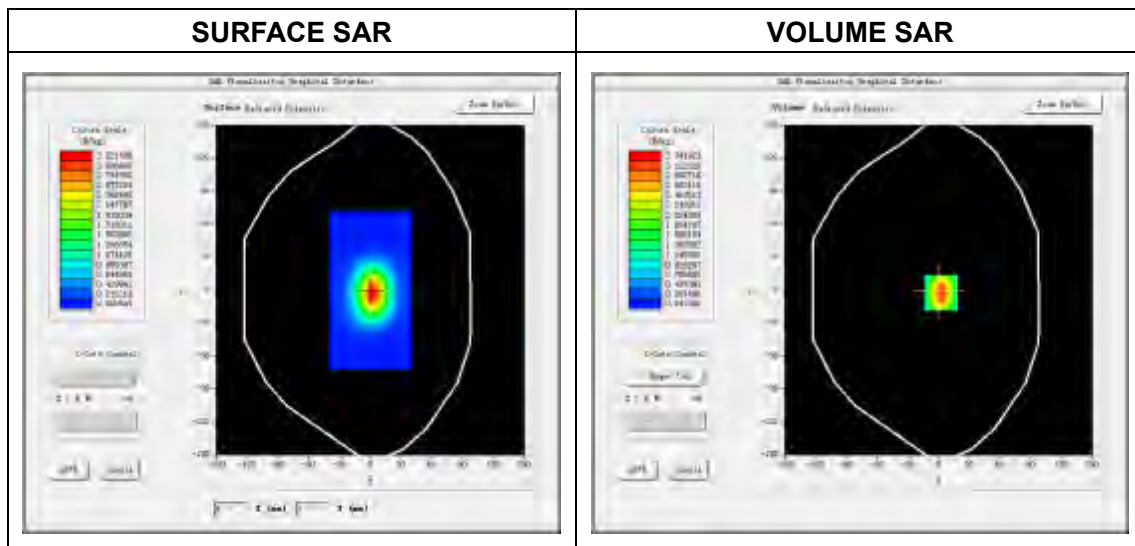
Zoom scan resolution: dx=8mm, dy=8mm, dz=5mm

Date of measurement: 2016.08.15

Measurement duration: 14 minutes 46 seconds

Experimental conditions.

Phantom File	surf_sam_plan.txt
Phantom	Validation plane
Band	1800MHz
Signal	CW
Frequency (MHz)	1800.000000
Relative permittivity (real part)	52.562143
Conductivity (S/m)	1.513568
Power drift (%)	0.310000
Ambient Temperature:	21.7C
Liquid Temperature:	20.1C
ConvF:	2.08
Crest factor:	1:1

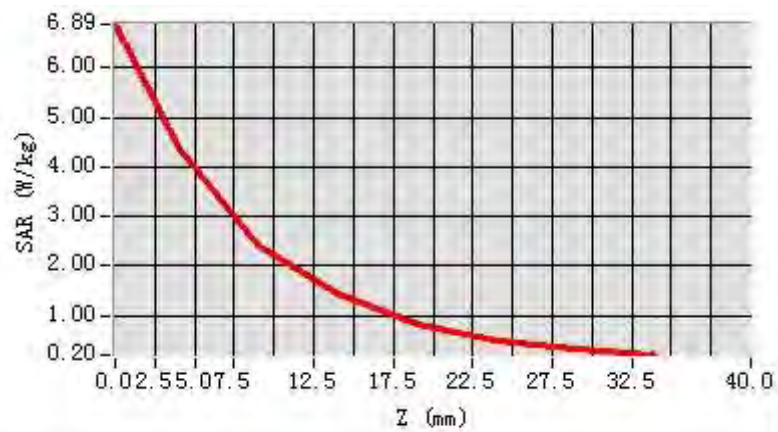


Maximum location: X=2.00, Y=2.00

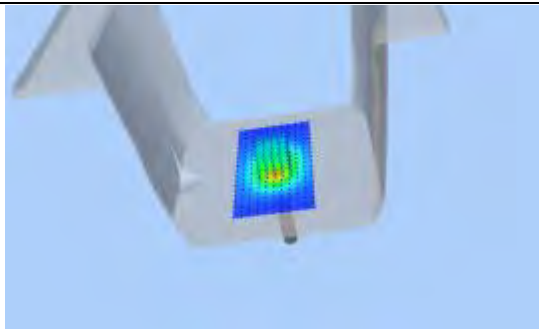
SAR Peak: 6.83 W/kg

SAR 10 g (W/Kg)	1.985632
SAR 1g (W/Kg)	4.110863

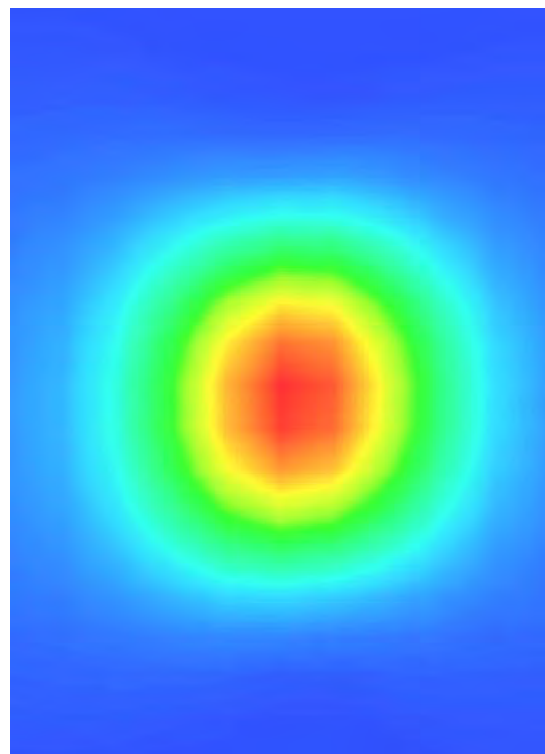
Z Axis Scan



3D screen shot



Hot spot position



System Performance Check Data(1900MHz Head)

Type: Phone measurement (Complete)

E-Field Probe: SN 34/15 SSE2 EPGO265

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

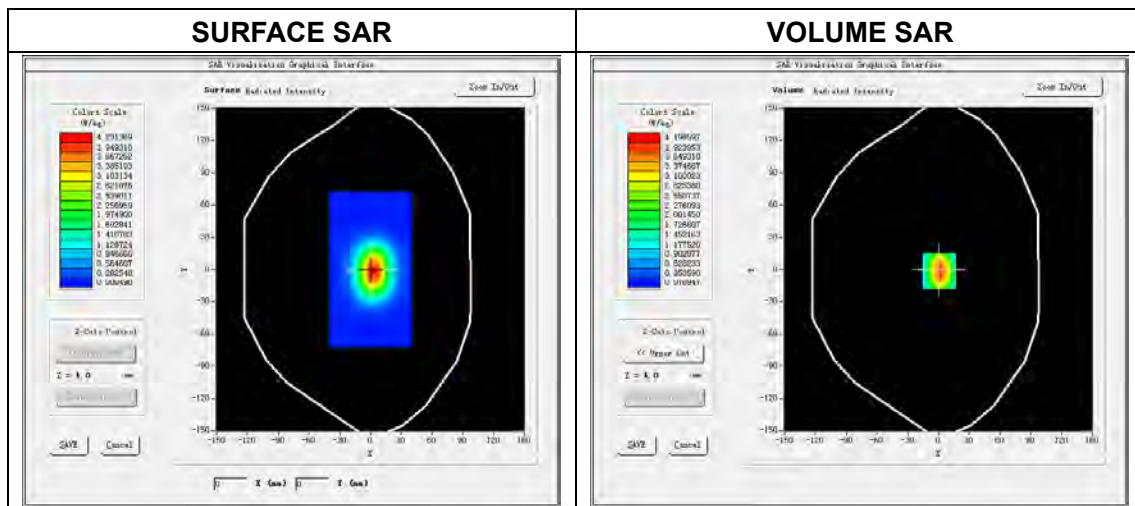
Zoom scan resolution: dx=8 mm, dy=8 mm, dz=5 mm

Date of measurement: 2016.08.16

Measurement duration: 13 minutes 56 seconds

Experimental conditions.

Phantom File	surf_sam_plan.txt
Phantom	Validation plane
Band	1900 MHz
Signal	CW
Frequency (MHz)	1900.000000
Relative permittivity (real part)	39.543498
Conductivity (S/m)	1.401610
Power drift (%)	-0.280000
Ambient Temperature:	21.5C
Liquid Temperature:	20.0C
ConvF:	2.35
Crest factor:	1:1

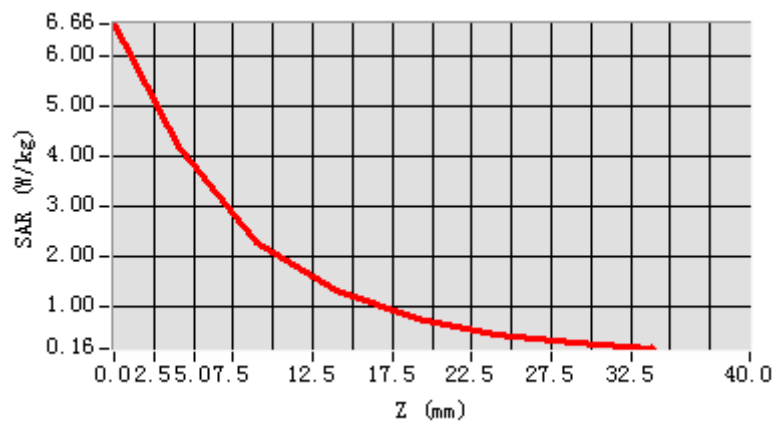


Maximum location: X=1.00, Y=1.00

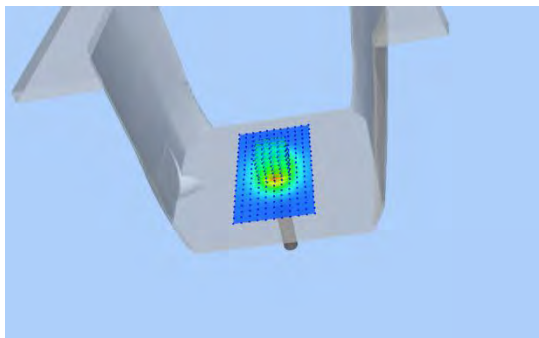
SAR Peak: 6.64 W/kg

SAR 10 g (W/Kg)	2.001651
SAR 1 g (W/Kg)	3.943225

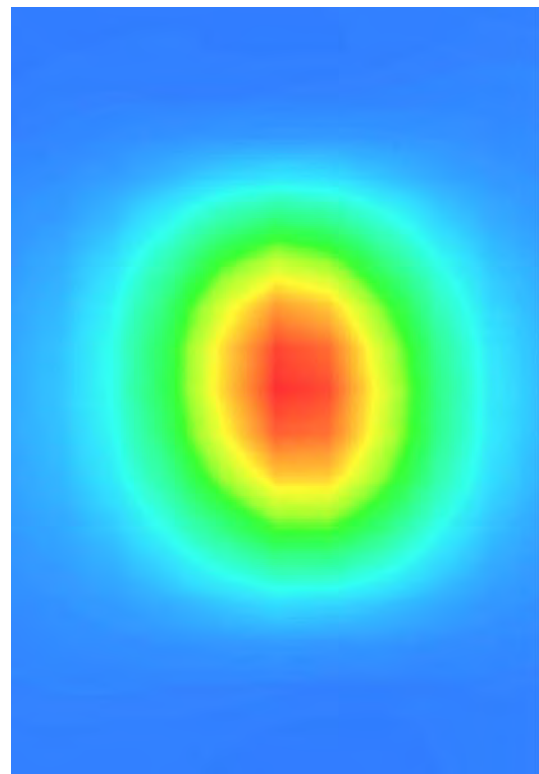
Z Axis Scan



3D screen shot



Hot spot position



System Performance Check Data(1900MHz Body)

Type: Phone measurement (Complete)

E-Field Probe: SN 34/15 SSE2 EPGO265

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

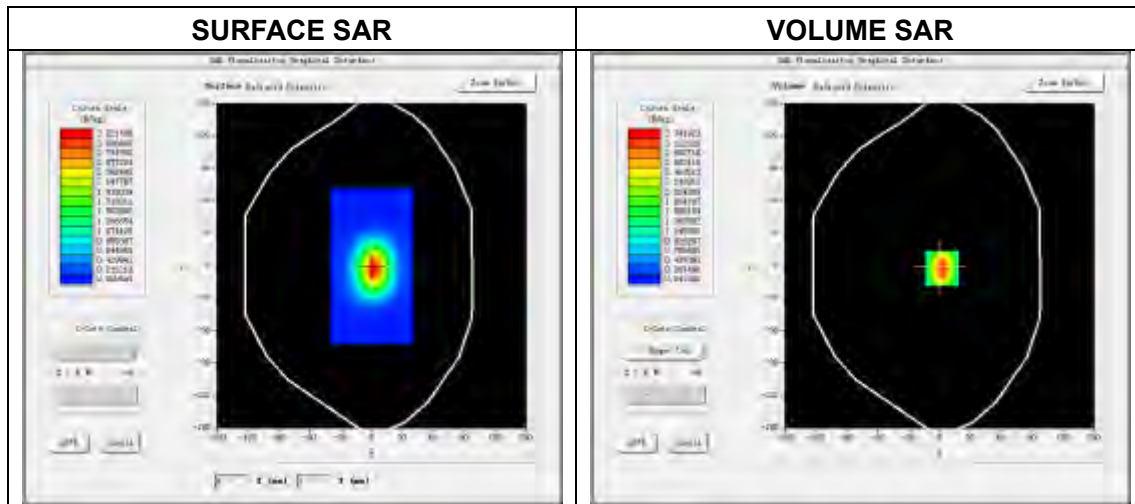
Zoom scan resolution: dx=8mm, dy=8mm, dz=5mm

Date of measurement: 2016.08.17

Measurement duration: 13 minutes 15 seconds

Experimental conditions.

Phantom File	surf_sam_plan.txt
Phantom	Validation plane
Band	1900MHz
Signal	CW
Frequency (MHz)	1900.000000
Relative permittivity (real part)	54.162742
Conductivity (S/m)	1.490311
Power drift (%)	0.180000
Ambient Temperature:	21.4C
Liquid Temperature:	20.2C
ConvF:	2.42
Crest factor:	1:1

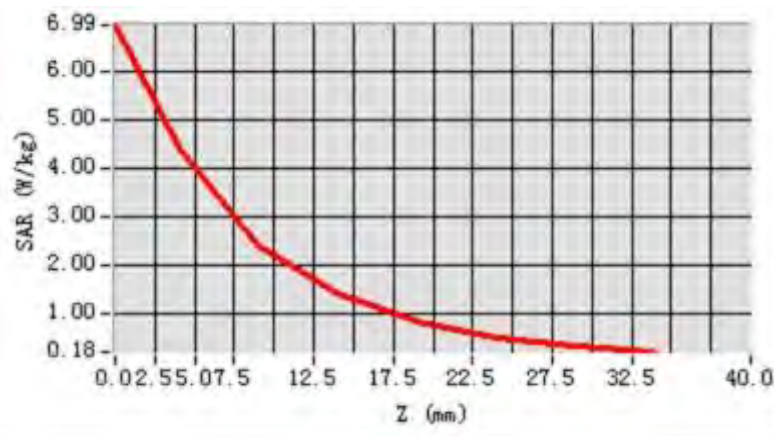


Maximum location: X=2.00, Y=-1.00

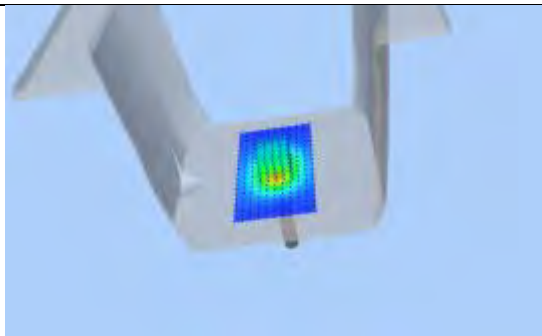
SAR Peak: 6.97W/kg

SAR 10g (W/Kg)	2.043586
SAR 1g (W/Kg)	4.154731

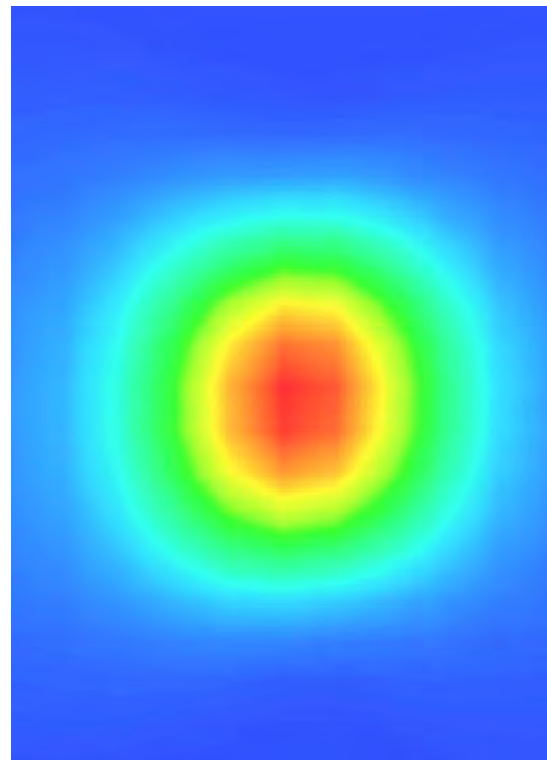
Z Axis Scan



3D screen shot



Hot spot position



System Performance Check Data(2450MHz Head)

Type: Phone measurement (Complete)

E-Field Probe: SN 34/15 SSE2 EPGO265

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

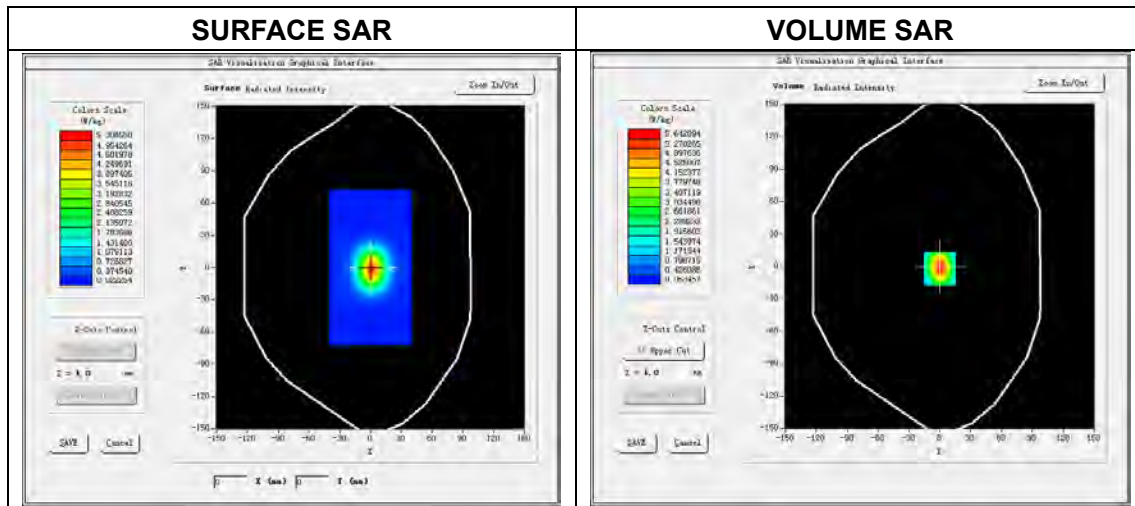
Zoom scan resolution: dx=5 mm, dy=5 mm, dz=5 mm

Date of measurement: 2016.08.18

Measurement duration: 16 minutes 37 seconds

Experimental conditions.

Phantom File	surf_sam_plan.txt
Phantom	Validation plane
Band	2450 MHz
Signal	CW
Frequency (MHz)	2450.000000
Relative permittivity (real part)	39.736301
Conductivity (S/m)	1.827346
Power drift (%)	-1.480000
Ambient Temperature:	21.5C
Liquid Temperature:	20.3C
ConvF:	2.47
Crest factor:	1:1

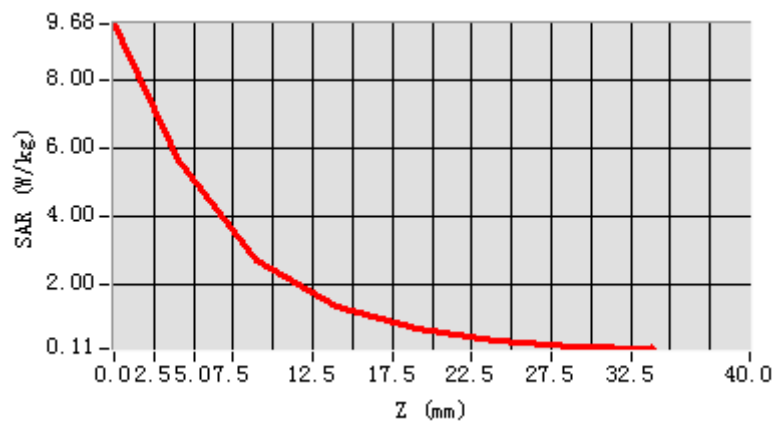


Maximum location: X=0.00, Y=-2.00

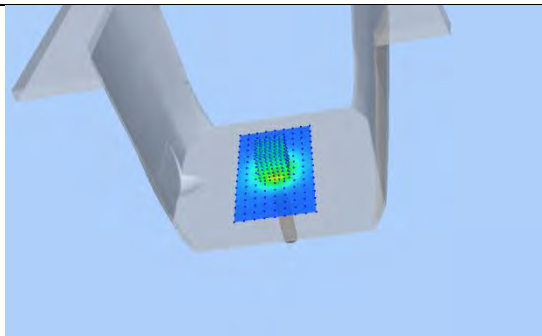
SAR Peak: 9.58 W/kg

SAR 10 g (W/Kg)	2.372915
SAR 1 g (W/Kg)	5.202994

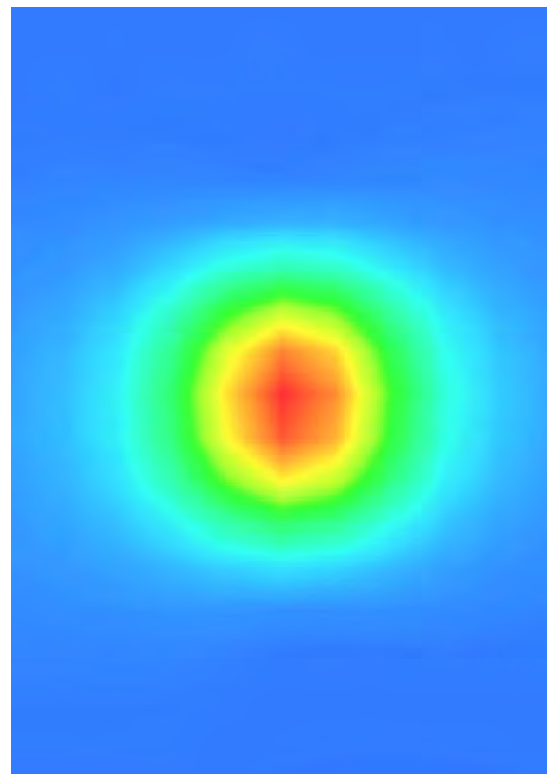
Z Axis Scan



3D screen shot



Hot spot position



System Performance Check Data(2450MHz Body)

Type: Phone measurement (Complete)

E-Field Probe: SN 34/15 SSE2 EPGO265

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

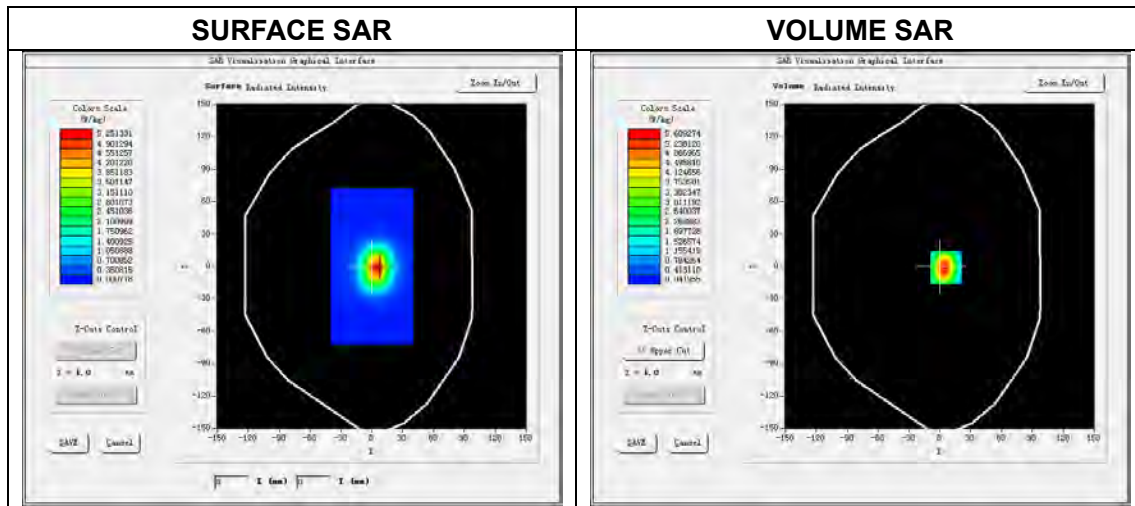
Zoom scan resolution: dx=5mm, dy=5mm, dz=5mm

Date of measurement: 2016.08.19

Measurement duration: 16 minutes 41 seconds

Experimental conditions.

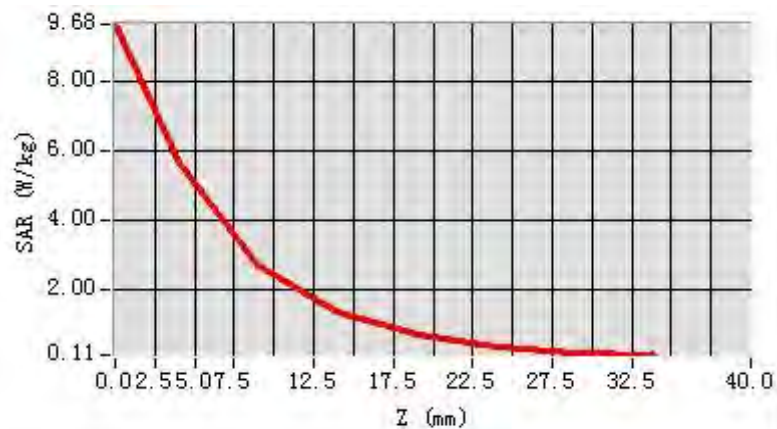
Phantom File	surf_sam_plan.txt
Phantom	Validation plane
Band	2450MHz
Signal	CW
Frequency (MHz)	2450.000000
Relative permittivity (real part)	51.593145
Conductivity (S/m)	1.995198
Power drift (%)	0.100000
Ambient Temperature:	21.9C
Liquid Temperature:	20.8C
ConvF:	2.55
Crest factor:	1:1



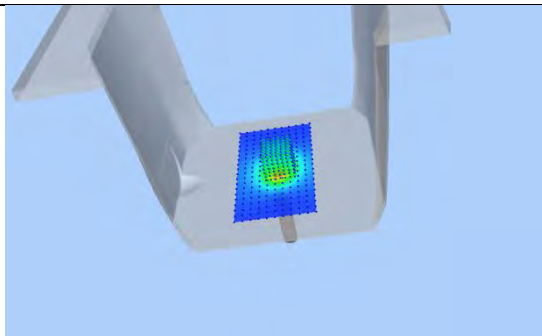
Maximum location: X=5.00, Y=-1.00
SAR Peak: 9.05W/kg

SAR 10g (W/Kg)	2.450144
SAR 1g (W/Kg)	5.294052

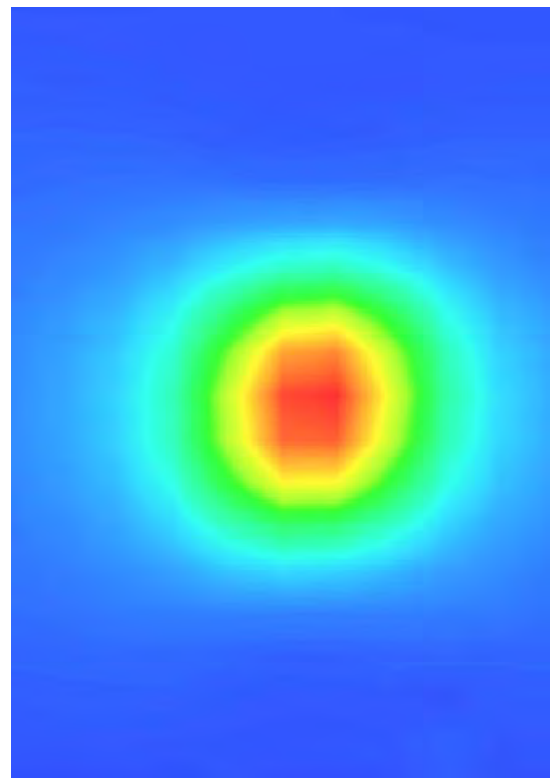
Z Axis Scan



3D screen shot



Hot spot position



System Performance Check Data(2600MHz Head)

Type: Phone measurement (Complete)

E-Field Probe: SN 34/15 SSE2 EPGO265

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

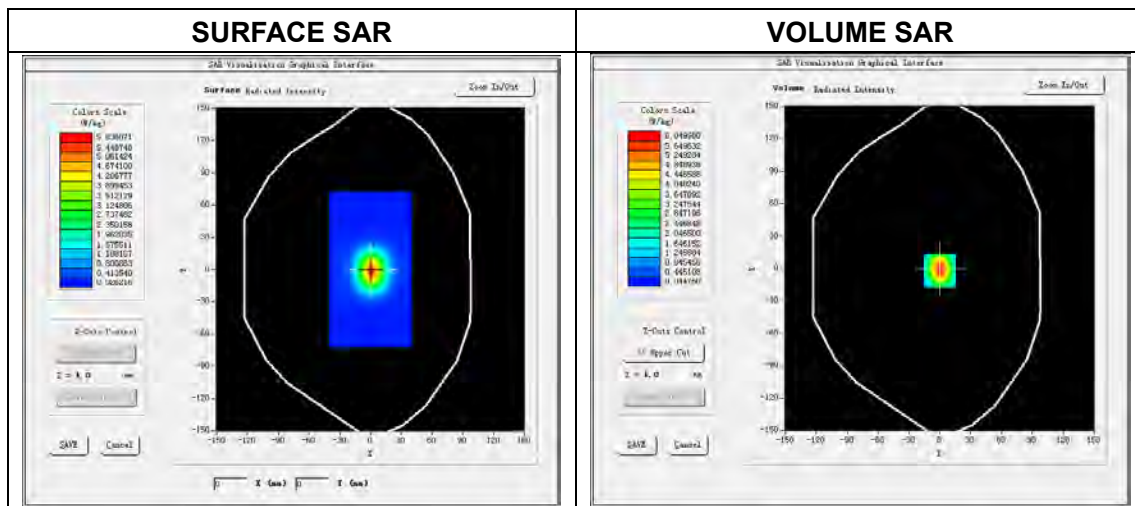
Zoom scan resolution: dx=5 mm, dy=5 mm, dz=5 mm

Date of measurement: 2016.08.18

Measurement duration: 16 minutes 38 seconds

Experimental conditions.

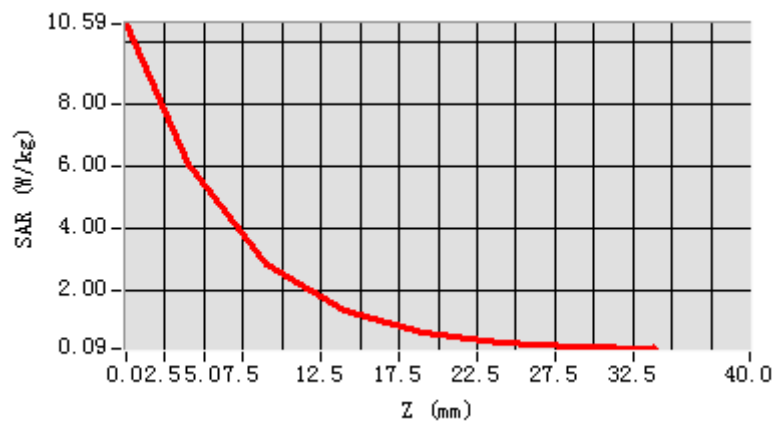
Phantom File	surf_sam_plan.txt
Phantom	Validation plane
Band	2600 MHz
Signal	CW
Frequency (MHz)	2600.000000
Relative permittivity (real part)	38.610600
Conductivity (S/m)	2.023363
Power drift (%)	-1.870000
Ambient Temperature:	21.5C
Liquid Temperature:	20.3C
ConvF:	2.36
Crest factor:	1:1



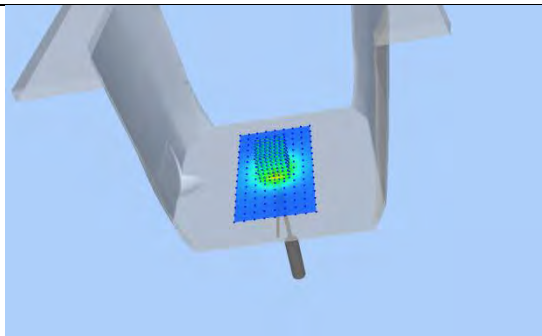
Maximum location: X=0.00, Y=-2.00
SAR Peak: 10.48 W/kg

SAR 10 g (W/Kg)	2.469851
SAR 1 g (W/Kg)	5.639507

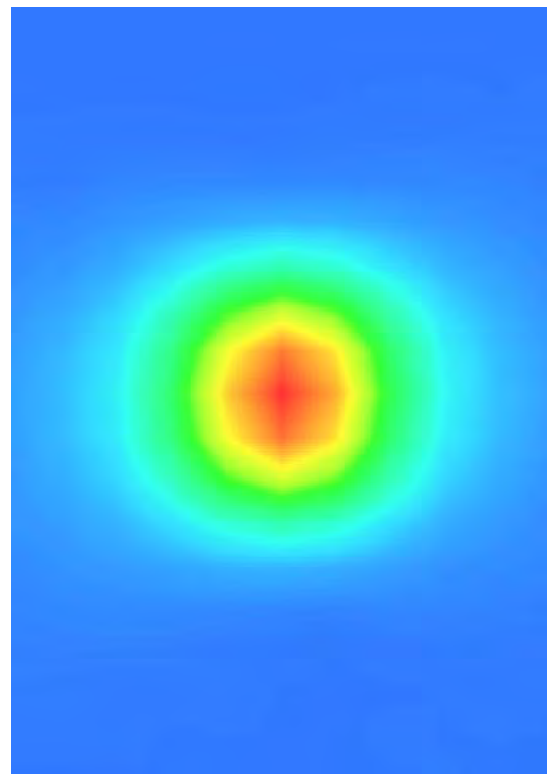
Z Axis Scan



3D screen shot



Hot spot position



System Performance Check Data(2600MHz Body)

Type: Phone measurement (Complete)

E-Field Probe: SN 34/15 SSE2 EPGO265

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

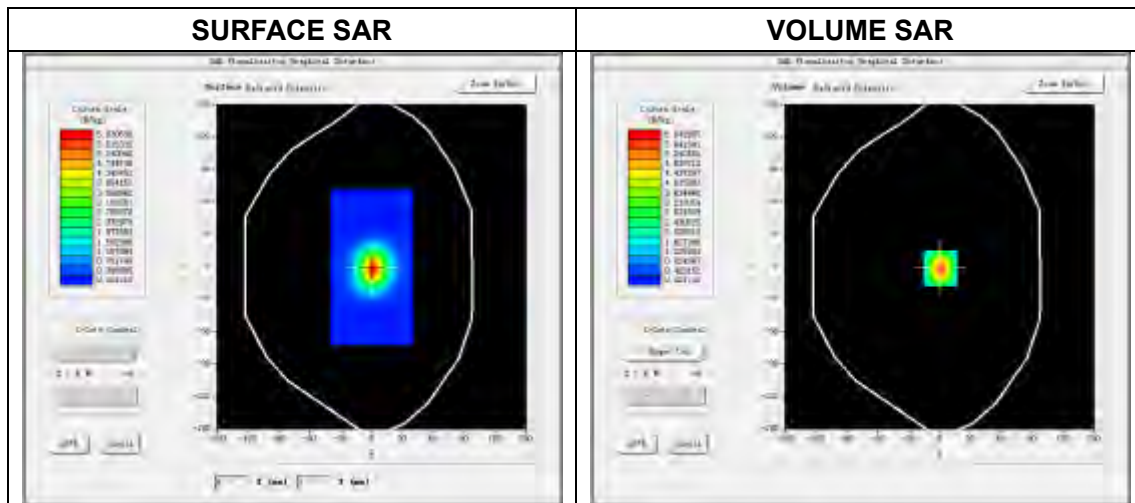
Zoom scan resolution: dx=5mm, dy=5mm, dz=5mm

Date of measurement: 2016.08.19

Measurement duration: 16 minutes 36 seconds

Experimental conditions.

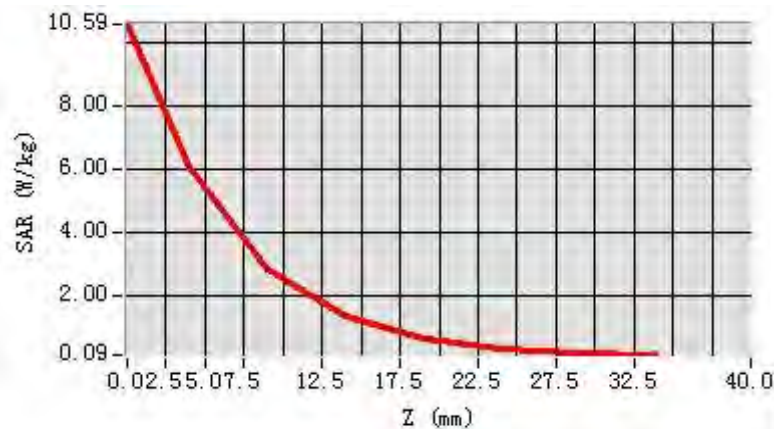
Phantom File	surf_sam_plan.txt
Phantom	Validation plane
Band	2600MHz
Signal	CW
Frequency (MHz)	2600.000000
Relative permittivity (real part)	50.681294
Conductivity (S/m)	2.124310
Power drift (%)	-0.180000
Ambient Temperature:	21.9C
Liquid Temperature:	20.8C
ConvF:	2.43
Crest factor:	1:1



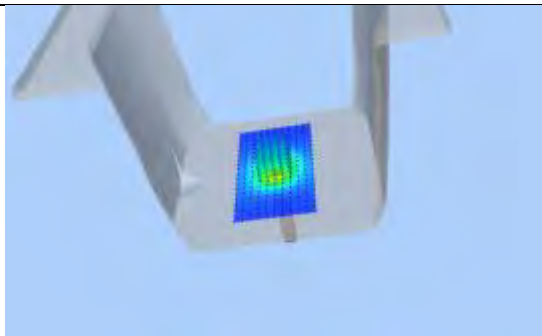
Maximum location: X=1.00, Y=-1.00
SAR Peak: 10.48W/kg

SAR 10g (W/Kg)	2.518637
SAR 1g (W/Kg)	5.773184

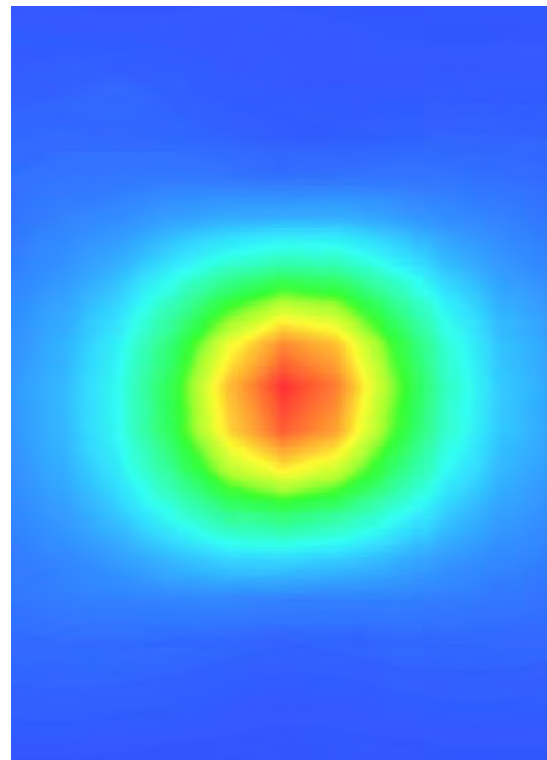
Z Axis Scan



3D screen shot



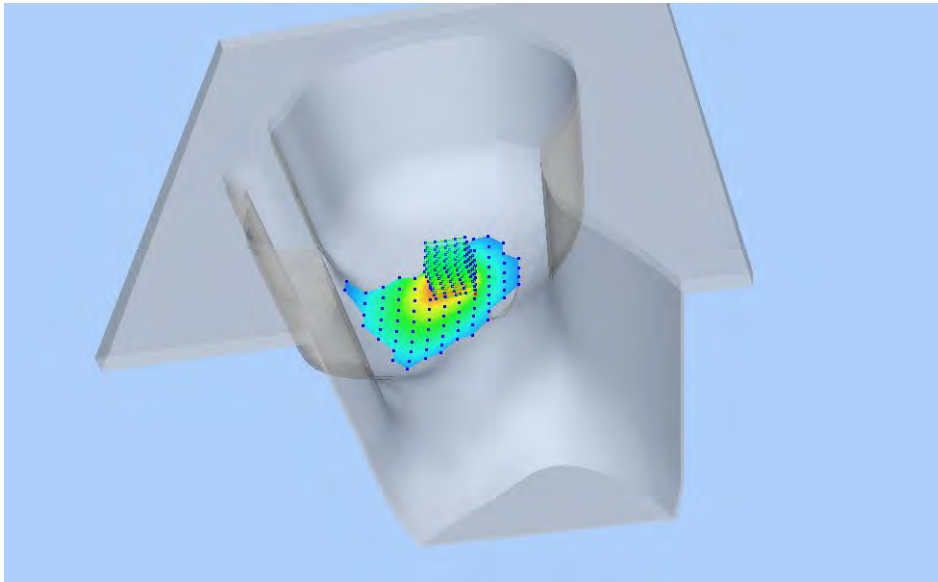
Hot spot position



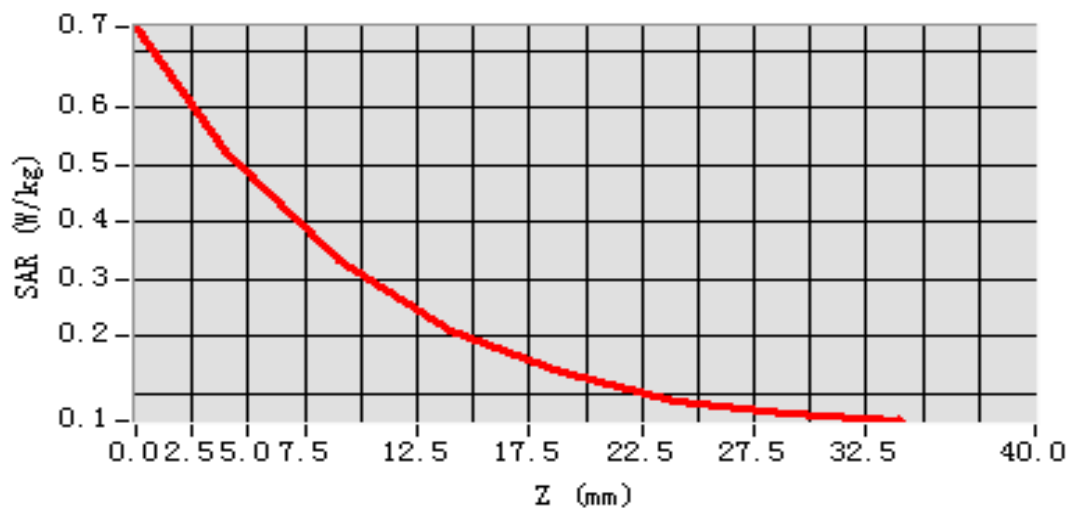
ANNEX C TEST DATA

MEAS. 1 Right Head with Cheek on Low Channel in GSM 850 mode

Test Date: 11/8/2016
Measurement duration: 8 minutes 22 seconds
Signal: GSM, f=824.2 MHz, Duty Cycle: 1:8.3
Liquid Parameters: Permittivity: 41.45; Conductivity: 0.87 S/m
Test condition: Ambient Temperature: 21.9°C, Liquid Temperature: 20.8°C
Probe: SN 34/15 SSE2 EPGO265, ConvF: 2.04
Area Scan: sam_direct_droit2_surf12mm.txt, h= 5.00 mm
Zoom Scan: 5x5x7,dx=8mm, dy=8mm, dz=5mm,Complete
Maximum location: X=-12.000000, Y=12.000000
SAR 10g (W/Kg): 0.306174
SAR 1g (W/Kg): 0.506600
Power drift (%): -2.53
3D screen shot



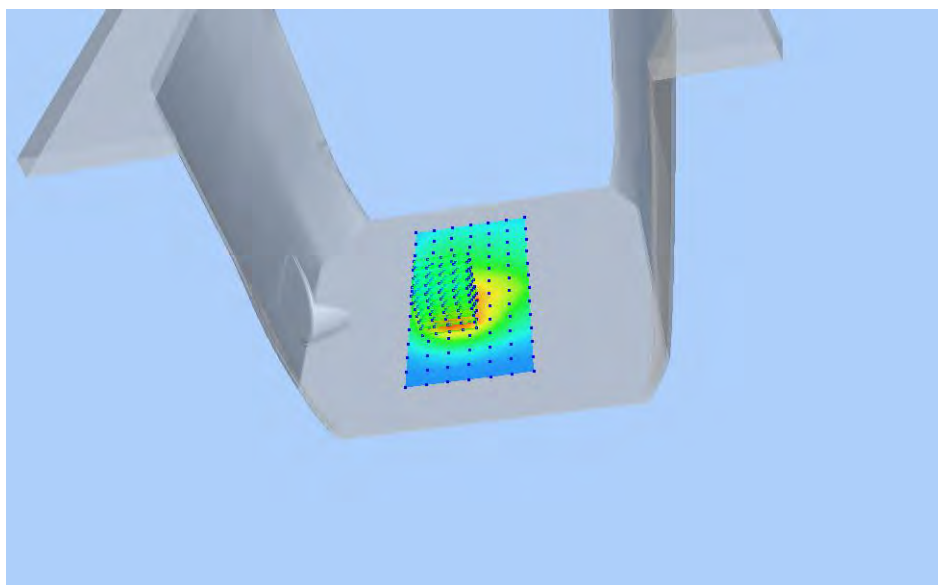
Z Axis Scan



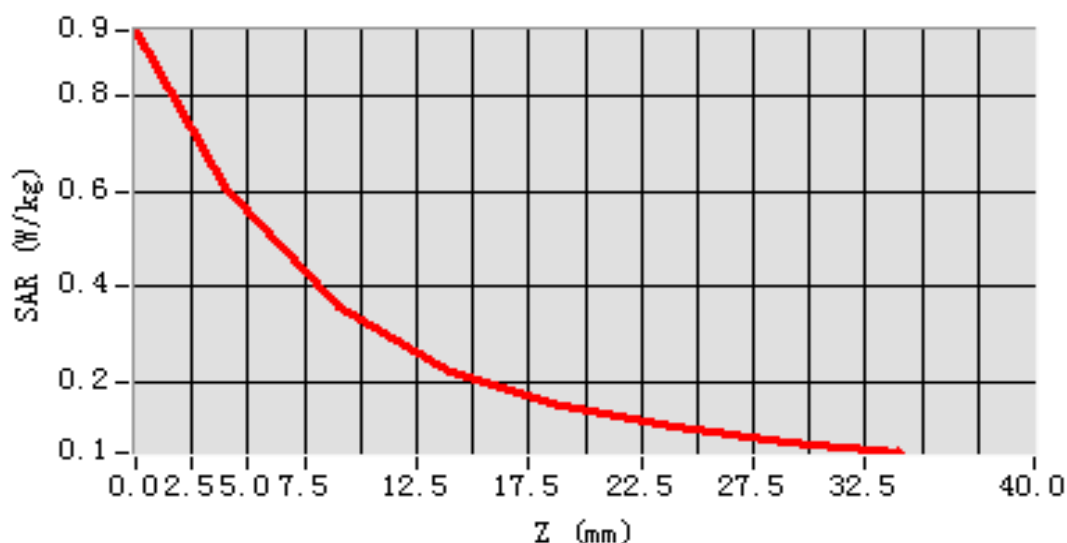
MEAS. 2 Body Plane with Back-0mm on Low Channel in GPRS 850-2 slots

mode

Test Date: 12/8/2016
Measurement duration: 8 minutes 10 seconds
Signal: GPRS, f=824.2 MHz, Duty Cycle: 1:4.0
Liquid Parameters: Permittivity: 53.02; Conductivity: 0.99 S/m
Test condition: Ambient Temperature: 21.6°C, Liquid Temperature: 20.1°C
Probe: SN 34/15 SSE2 EPG0265, ConvF: 2.12
Area Scan: sam_direct_droit2_surf12mm.txt, h= 5.00 mm
Zoom Scan: 5x5x7,dx=8mm, dy=8mm, dz=5mm,Complete
Maximum location: X=-16.000000, Y=-12.000000
SAR 10g (W/Kg): 0.357617
SAR 1g (W/Kg): 0.613996
Power drift (%): 1.02
3D screen shot



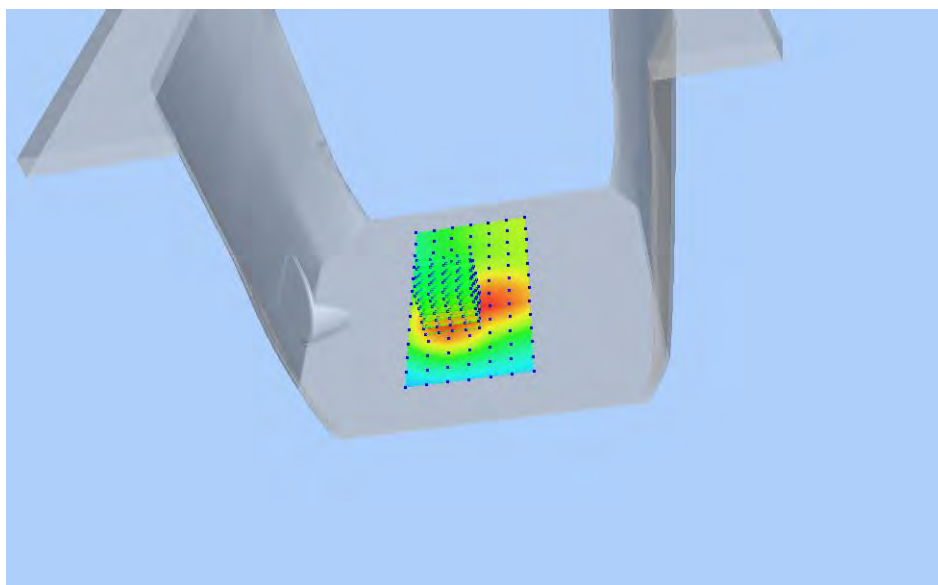
Z Axis Scan



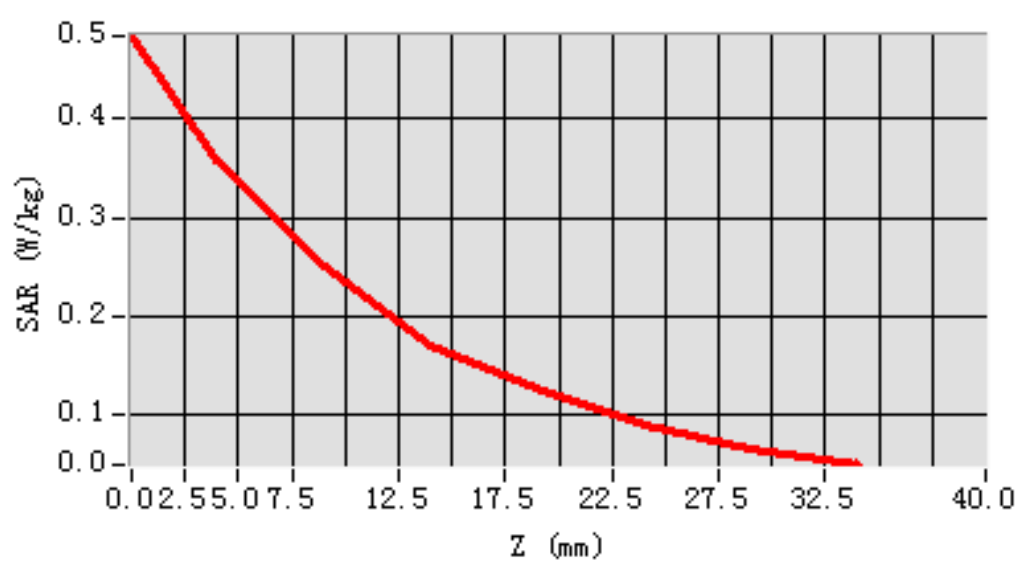
MEAS. 3 Body Plane with Back-15mm on Middle Channel in GPRS 850-4 slots

mode

Test Date: 12/8/2016
Measurement duration: 8 minutes 25 seconds
Signal: GPRS, f=836.6 MHz, Duty Cycle: 1:2.0
Liquid Parameters: Permittivity: 52.93; Conductivity: 1.00 S/m
Test condition: Ambient Temperature: 21.6°C, Liquid Temperature: 20.1°C
Probe: SN 34/15 SSE2 EPGO265, ConvF: 2.12
Area Scan: sam_direct_droit2_surf12mm.txt, h= 5.00 mm
Zoom Scan: 5x5x7,dx=8mm, dy=8mm, dz=5mm,Complete
Maximum location: X=-16.000000, Y=-12.000000
SAR 10g (W/Kg): 0.237907
SAR 1g (W/Kg): 0.354206
Power drift (%): -3.10
3D screen shot

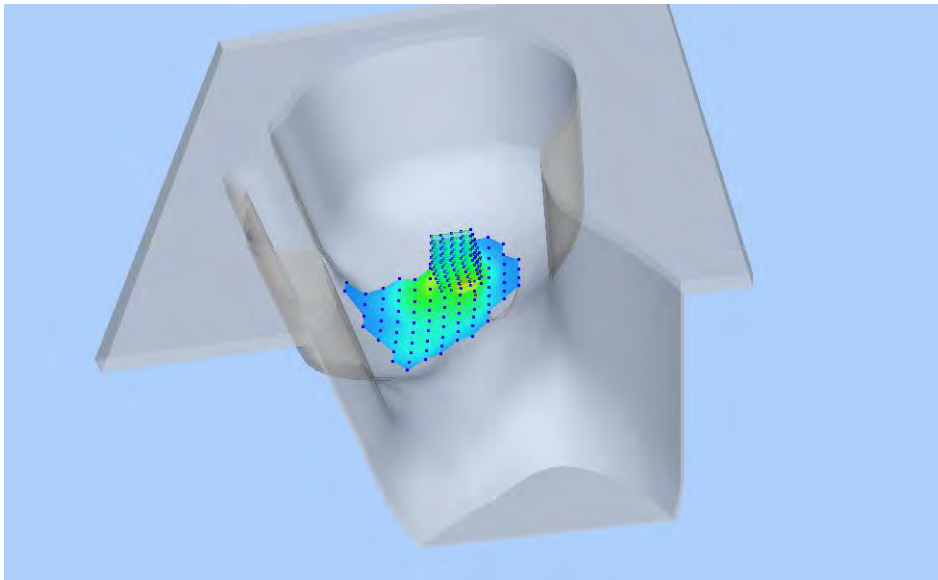


Z Axis Scan

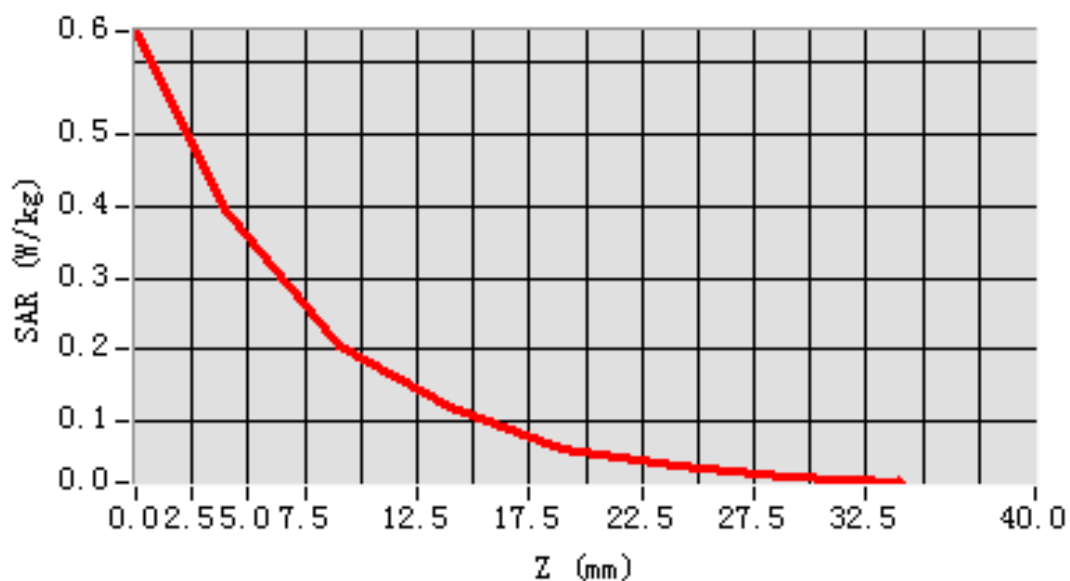


MEAS. 4 Right Head with Cheek on Low Channel in GSM 1900 mode

Test Date: 16/8/2016
Measurement duration: 8 minutes 21 seconds
Signal: GSM, f=1850.2 MHz, Duty Cycle: 1:8.3
Liquid Parameters: Permittivity: 39.99; Conductivity: 1.35 S/m
Test condition: Ambient Temperature: 21.5°C, Liquid Temperature: 20.0°C
Probe: SN 34/15 SSE2 EPGO265, ConvF: 2.35
Area Scan: sam_direct_droit2_surf12mm.txt, h= 5.00 mm
Zoom Scan: 5x5x7,dx=8mm, dy=8mm, dz=5mm,Complete
Maximum location: X=-12.000000, Y=24.000000
SAR 10g (W/Kg): 0.165019
SAR 1g (W/Kg): 0.365650
Power drift (%): -0.76
3D screen shot



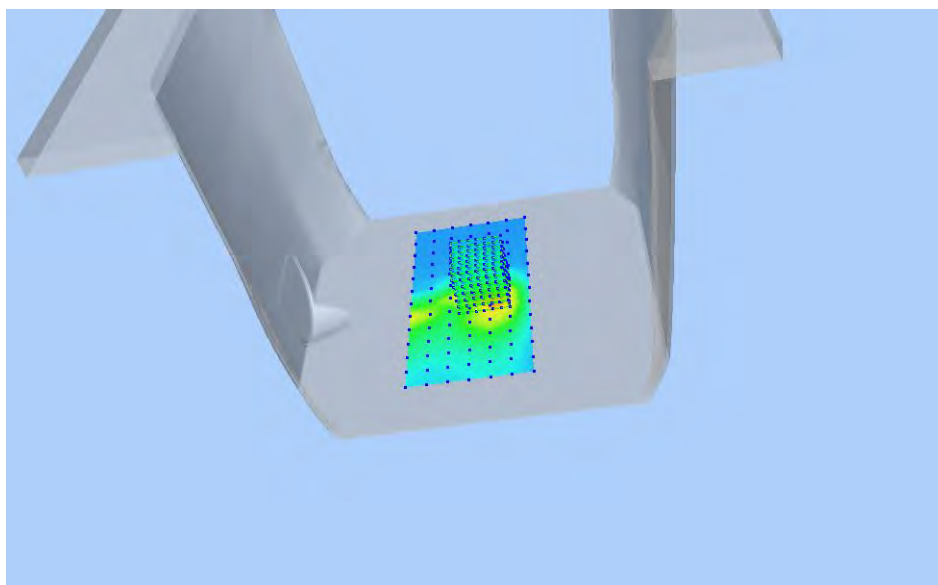
Z Axis Scan



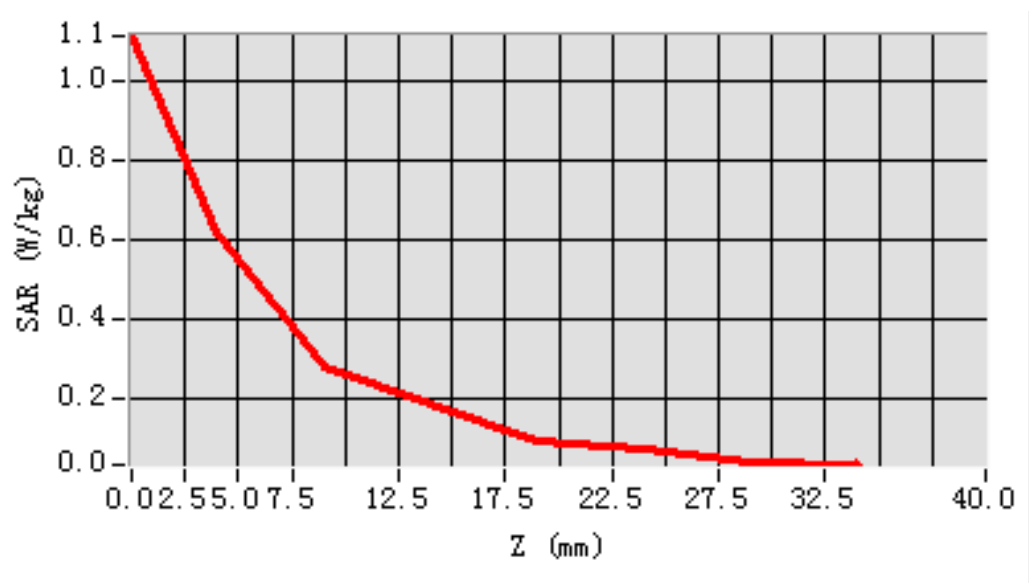
MEAS. 5 Body Plane with Back-0mm on Low Channel in GPRS 1900-2 slots

mode

Test Date: 17/8/2016
Measurement duration: 16 minutes 53 seconds
Signal: GPRS, f=1850.2 MHz, Duty Cycle: 1:4.0
Liquid Parameters: Permittivity: 53.63; Conductivity: 1.47 S/m
Test condition: Ambient Temperature: 21.4°C, Liquid Temperature: 20.2°C
Probe: SN 34/15 SSE2 EPGO265, ConvF: 2.42
Area Scan: sam_direct_droit2_surf12mm.txt, h= 5.00 mm
Zoom Scan: 7x7x7,dx=5mm, dy=5mm, dz=5mm,Complete
Maximum location: X=8.000000, Y=0.000000
SAR 10g (W/Kg): 0.261451
SAR 1g (W/Kg): 0.551898
Power drift (%): -0.46
3D screen shot



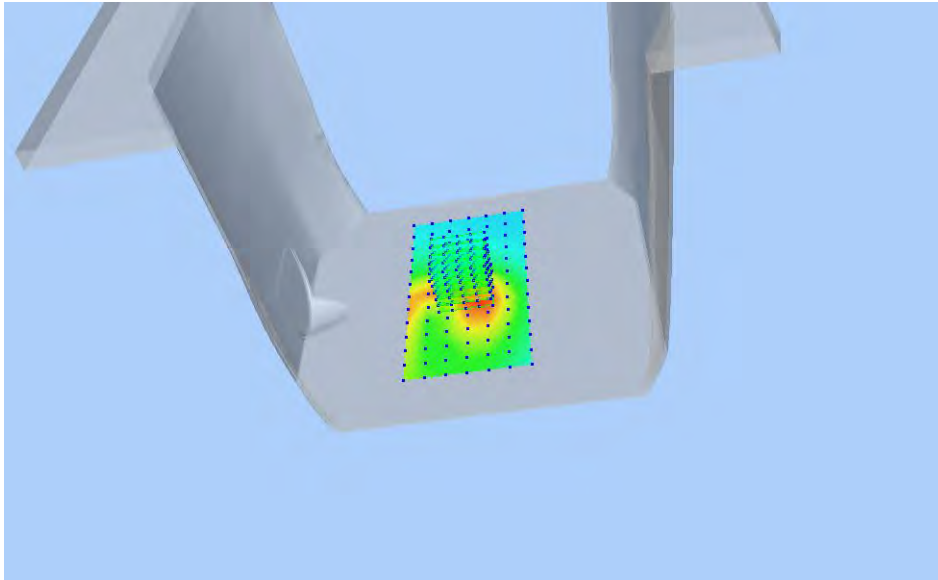
Z Axis Scan



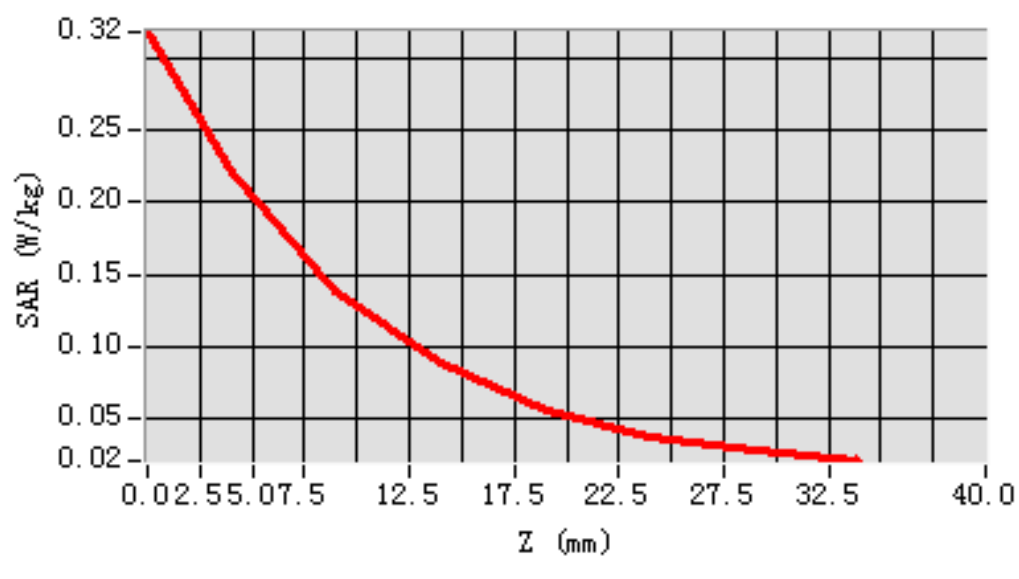
MEAS. 6 Body Plane with Back-15mm on Low Channel in GPRS 1900-4 slots

mode

Test Date: 17/8/2016
Measurement duration: 9 minutes 55 seconds
Signal: GPRS, f=1850.2 MHz, Duty Cycle: 1:2.0
Liquid Parameters: Permittivity: 53.63; Conductivity: 1.47 S/m
Test condition: Ambient Temperature: 21.4°C, Liquid Temperature: 20.2°C
Probe: SN 34/15 SSE2 EPGO265, ConvF: 2.42
Area Scan: sam_direct_droit2_surf12mm.txt, h= 5.00 mm
Zoom Scan: 5x5x7,dx=8mm, dy=8mm, dz=5mm,Complete
Maximum location: X=-4.000000, Y=0.000000
SAR 10g (W/Kg): 0.121241
SAR 1g (W/Kg): 0.211657
Power drift (%): -1.36
3D screen shot

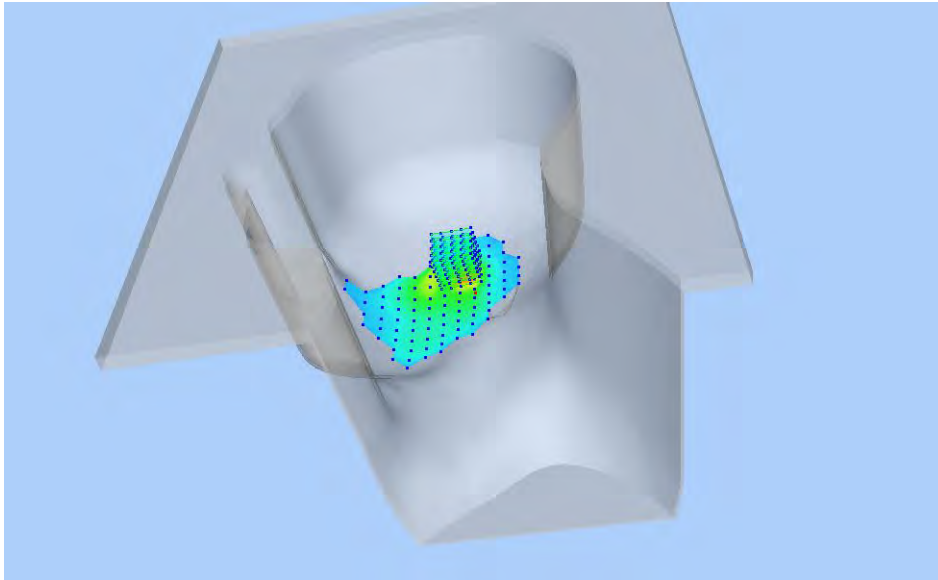


Z Axis Scan

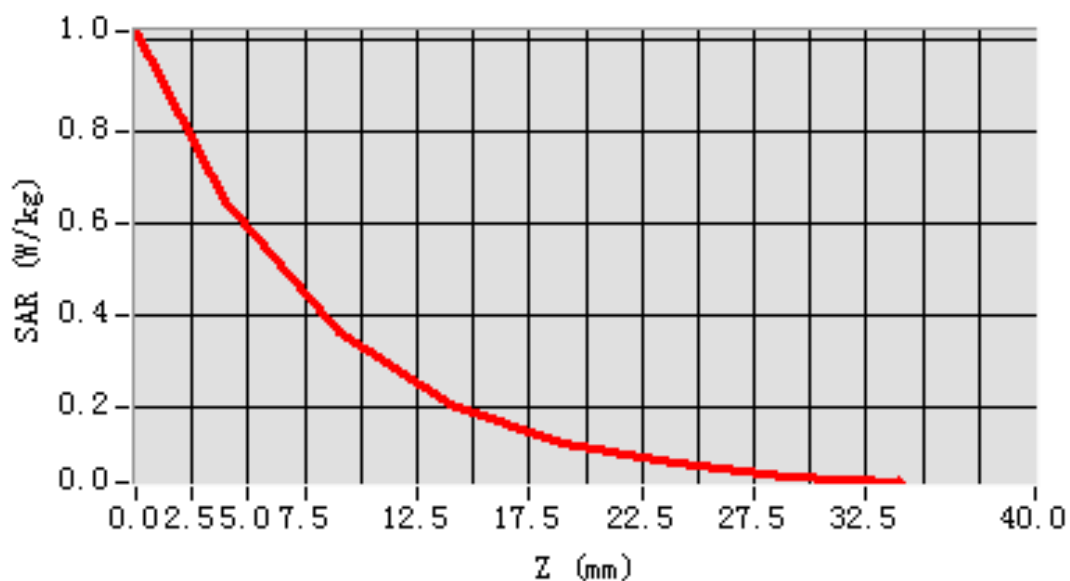


MEAS. 7 Right Head with Cheek on Low Channel in WCDMA Band 2 mode

Test Date: 16/8/2016
Measurement duration: 8 minutes 21 seconds
Signal: WCDMA, f=1852.4 MHz, Duty Cycle: 1:1.0
Liquid Parameters: Permittivity: 39.97; Conductivity: 1.36 S/m
Test condition: Ambient Temperature: 21.5°C, Liquid Temperature: 20.0°C
Probe: SN 34/15 SSE2 EPGO265, ConvF: 2.35
Area Scan: sam_direct_droit2_surf12mm.txt, h= 5.00 mm
Zoom Scan: 5x5x7,dx=8mm, dy=8mm, dz=5mm,Complete
Maximum location: X=-12.000000, Y=24.000000
SAR 10g (W/Kg): 0.292701
SAR 1g (W/Kg): 0.618357
Power drift (%): 0.05
3D screen shot



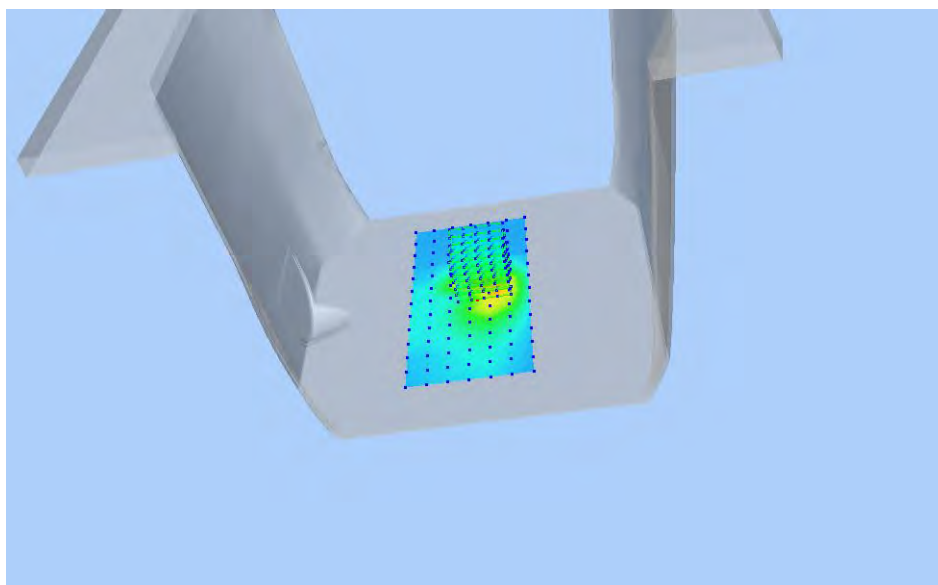
Z Axis Scan



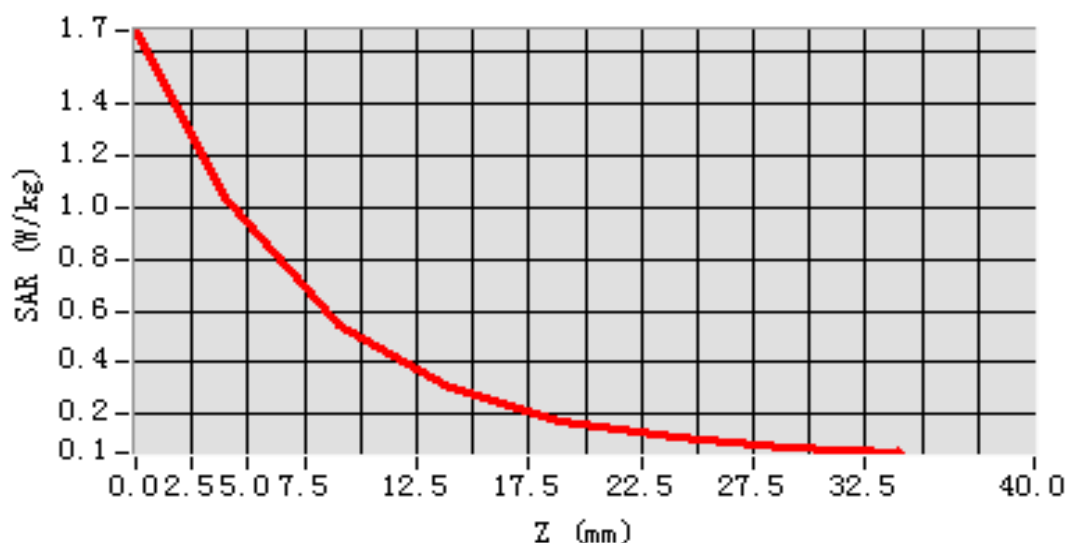
MEAS. 8 Body Plane with Back-0mm on High Channel in WCDMA Band 2

mode

Test Date: 17/8/2016
Measurement duration: 11 minutes 33 seconds
Signal: WCDMA, f=1907.6 MHz, Duty Cycle: 1:1.0
Liquid Parameters: Permittivity: 54.02; Conductivity: 1.50 S/m
Test condition: Ambient Temperature: 21.4°C, Liquid Temperature: 20.2°C
Probe: SN 34/15 SSE2 EPG0265, ConvF: 2.42
Area Scan: sam_direct_droit2_surf12mm.txt, h= 5.00 mm
Zoom Scan: 5x5x7,dx=8mm, dy=8mm, dz=5mm,Complete
Maximum location: X=8.000000, Y=12.000000
SAR 10g (W/Kg): 0.429151
SAR 1g (W/Kg): 0.925565
Power drift (%): -1.35
3D screen shot



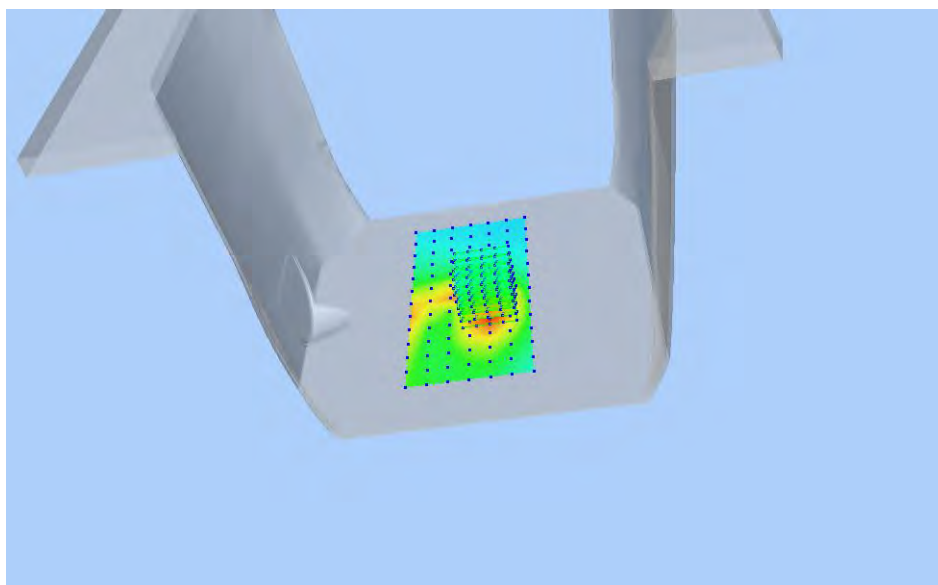
Z Axis Scan



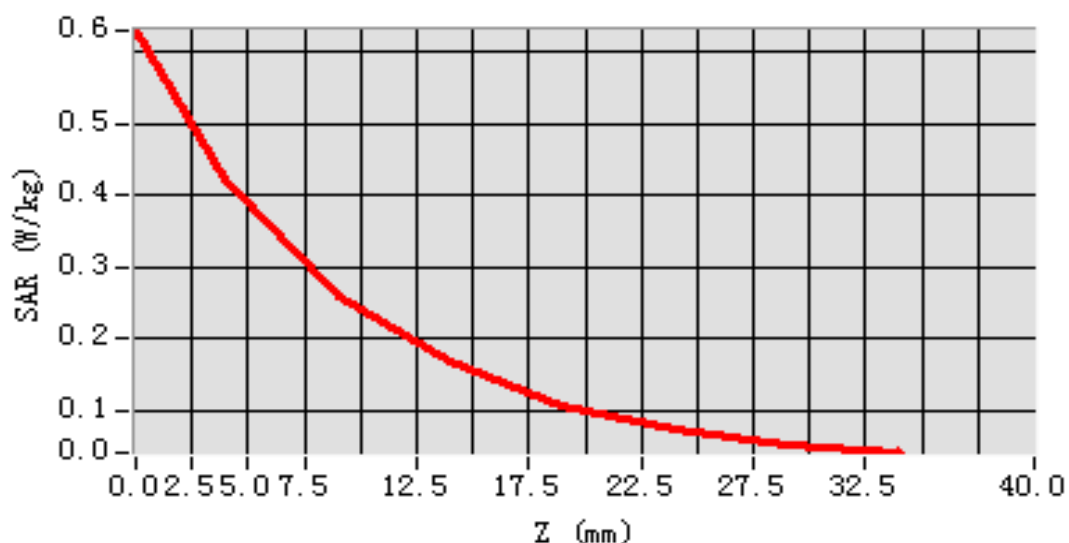
MEAS. 9 Body Plane with Back-15mm on Low Channel in WCDMA Band 2

mode

Test Date: 17/8/2016
Measurement duration: 11 minutes 49 seconds
Signal: WCDMA, f=1852.4 MHz, Duty Cycle: 1:1.0
Liquid Parameters: Permittivity: 54.51; Conductivity: 1.47 S/m
Test condition: Ambient Temperature: 21.4°C, Liquid Temperature: 20.2°C
Probe: SN 34/15 SSE2 EPGO265, ConvF: 2.42
Area Scan: sam_direct_droit2_surf12mm.txt, h= 5.00 mm
Zoom Scan: 5x5x7,dx=8mm, dy=8mm, dz=5mm,Complete
Maximum location: X=8.000000, Y=-12.000000
SAR 10g (W/Kg): 0.238597
SAR 1g (W/Kg): 0.407579
Power drift (%): -0.68
3D screen shot

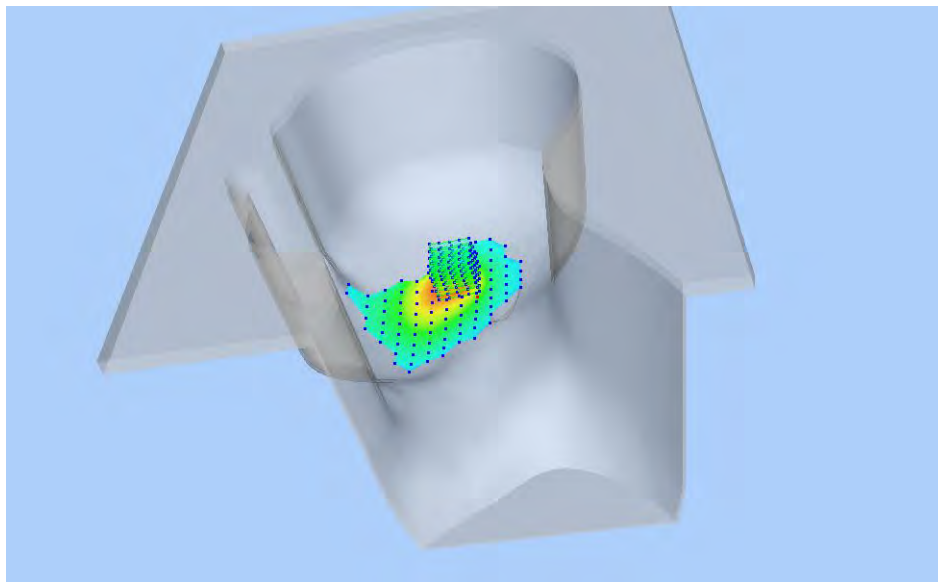


Z Axis Scan

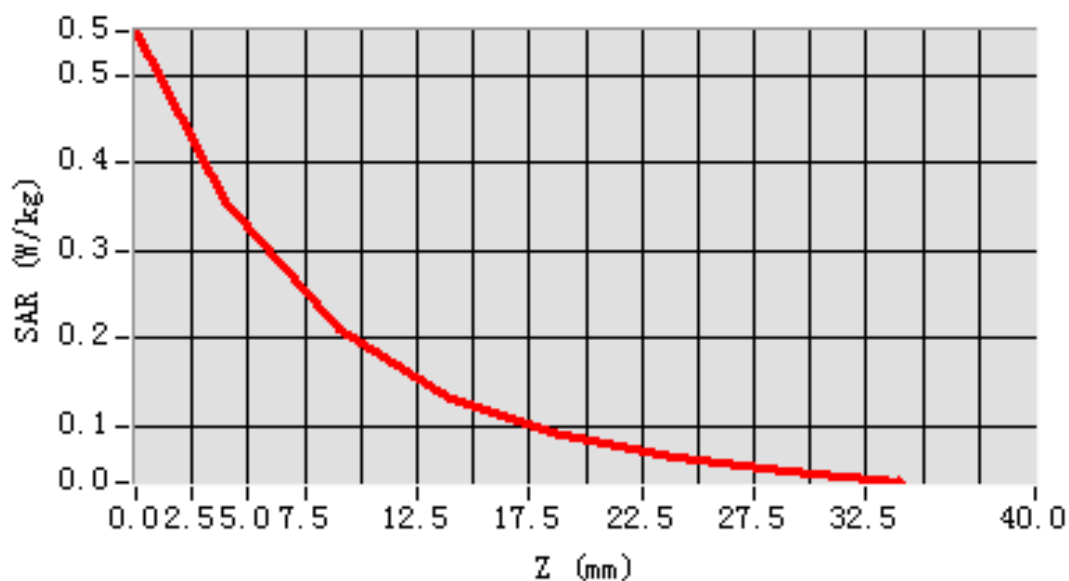


MEAS. 10 Right Head with Cheek on Middle Channel in WCDMA Band 5 mode

Test Date: 11/8/2016
Measurement duration: 8 minutes 24 seconds
Signal: WCDMA, f=836.4 MHz, Duty Cycle: 1:1.0
Liquid Parameters: Permittivity: 41.19; Conductivity: 0.90 S/m
Test condition: Ambient Temperature: 21.9°C, Liquid Temperature: 20.8°C
Probe: SN 34/15 SSE2 EPGO265, ConvF: 2.04
Area Scan: sam_direct_droit2_surf12mm.txt, h= 5.00 mm
Zoom Scan: 5x5x7,dx=8mm, dy=8mm, dz=5mm,Complete
Maximum location: X=-12.000000, Y=12.000000
SAR 10g (W/Kg): 0.203667
SAR 1g (W/Kg): 0.341514
Power drift (%): -0.19
3D screen shot



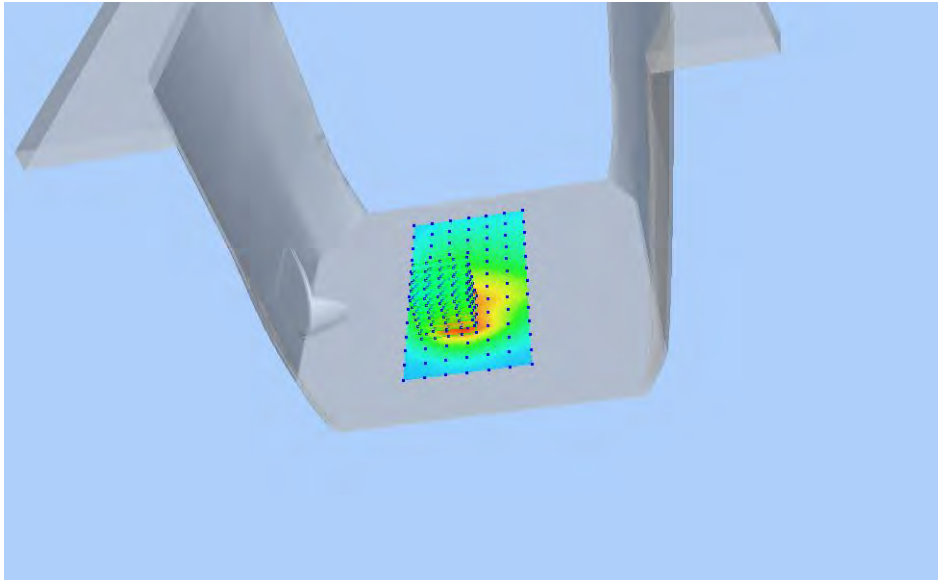
Z Axis Scan



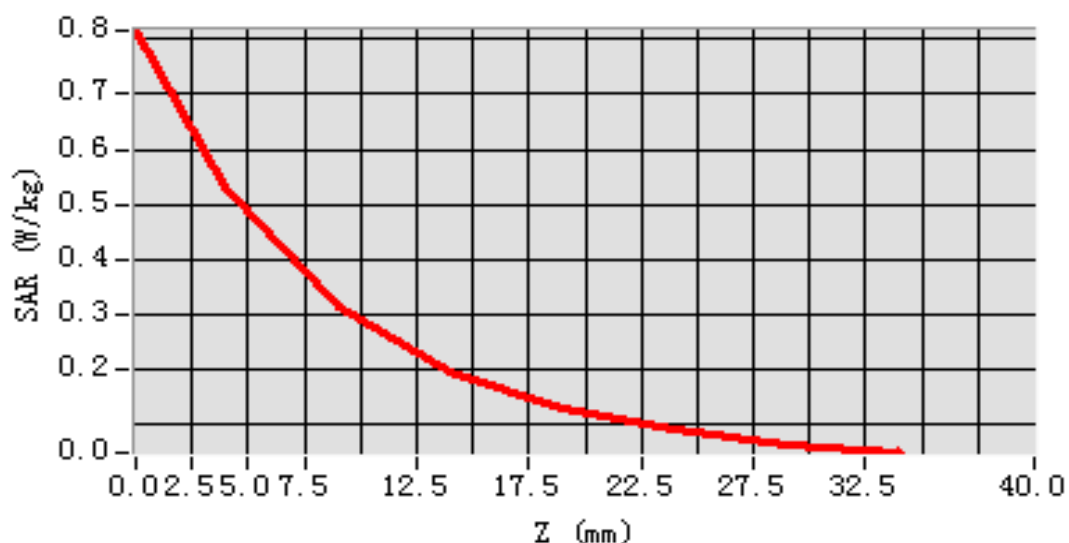
MEAS. 11 Body Plane with Back-0mm on Middle Channel in WCDMA Band 5

mode

Test Date: 12/8/2016
Measurement duration: 8 minutes 13 seconds
Signal: WCDMA, f=836.4 MHz, Duty Cycle: 1:1.0
Liquid Parameters: Permittivity: 52.92; Conductivity: 1.00 S/m
Test condition: Ambient Temperature: 21.6°C, Liquid Temperature: 20.1°C
Probe: SN 34/15 SSE2 EPGO265, ConvF: 2.12
Area Scan: sam_direct_droit2_surf12mm.txt, h= 5.00 mm
Zoom Scan: 5x5x7,dx=8mm, dy=8mm, dz=5mm,Complete
Maximum location: X=-16.000000, Y=-24.000000
SAR 10g (W/Kg): 0.312337
SAR 1g (W/Kg): 0.534506
Power drift (%): -0.17
3D screen shot



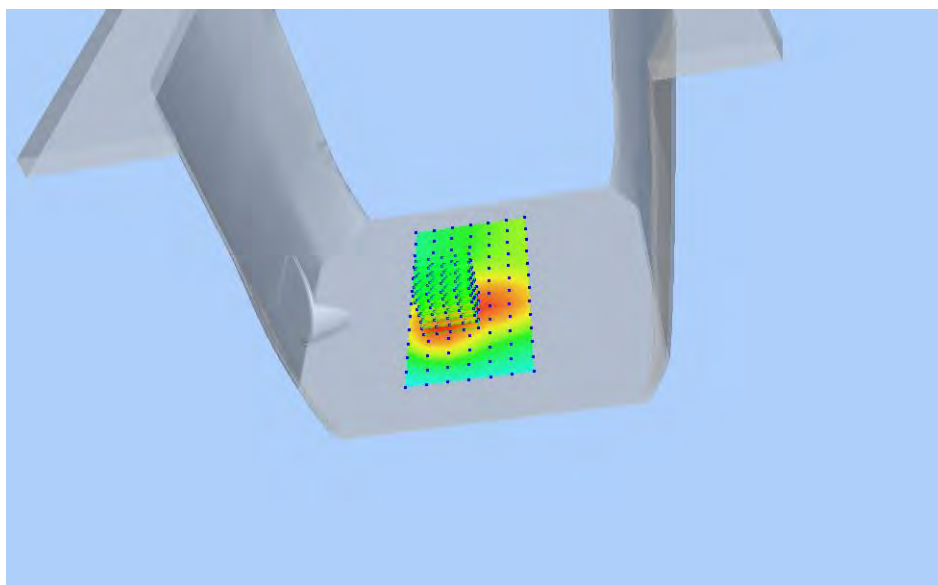
Z Axis Scan



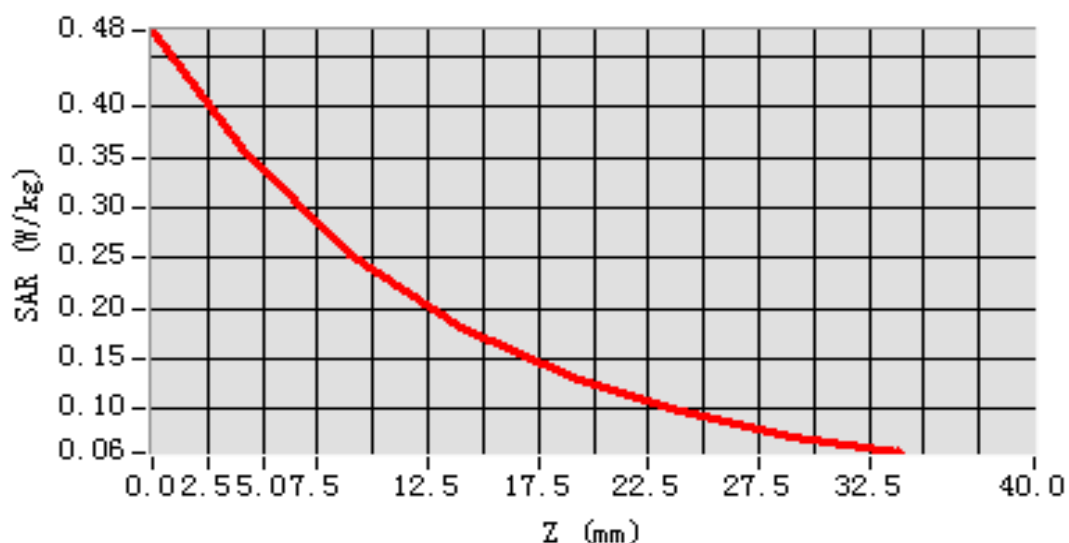
MEAS. 12 Body Plane with Back-15mm on High Channel in WCDMA Band 5

mode

Test Date: 12/8/2016
Measurement duration: 8 minutes 16 seconds
Signal: WCDMA, f=846.6 MHz, Duty Cycle: 1:1.0
Liquid Parameters: Permittivity: 52.30; Conductivity: 1.01 S/m
Test condition: Ambient Temperature: 21.6°C, Liquid Temperature: 20.1°C
Probe: SN 34/15 SSE2 EPGO265, ConvF: 2.12
Area Scan: sam_direct_droit2_surf12mm.txt, h= 5.00 mm
Zoom Scan: 5x5x7,dx=8mm, dy=8mm, dz=5mm,Complete
Maximum location: X=-16.000000, Y=-12.000000
SAR 10g (W/Kg): 0.243563
SAR 1g (W/Kg): 0.363241
Power drift (%): -0.94
3D screen shot

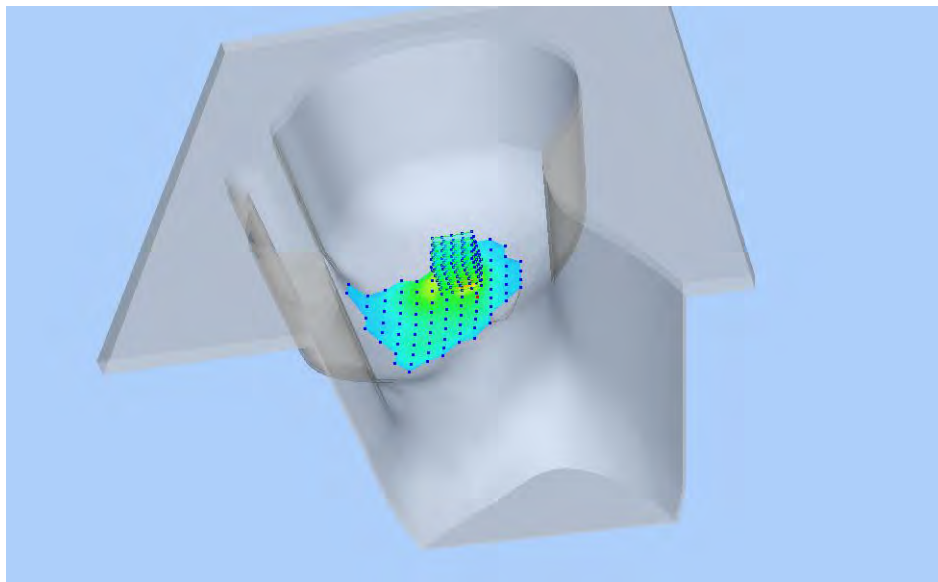


Z Axis Scan

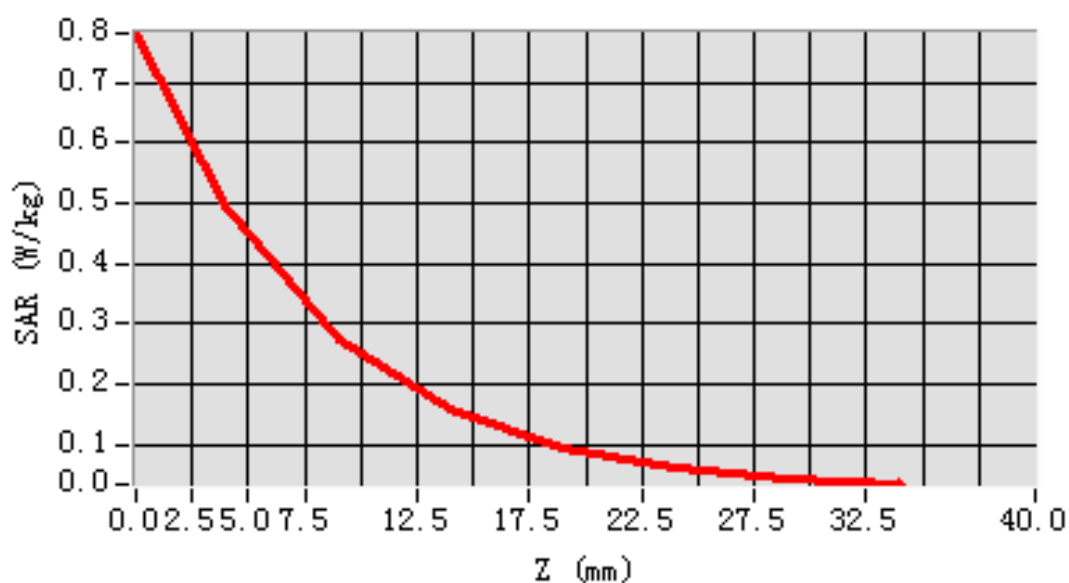


MEAS. 13 Right Head with Cheek on Middle Channel in LTE Band 2 mode

Test Date: 16/8/2016
Measurement duration: 8 minutes 21 seconds
Signal: LTE, f=1880.0 MHz, Duty Cycle: 1:1.0
Liquid Parameters: Permittivity: 39.62; Conductivity: 1.38 S/m
Test condition: Ambient Temperature: 21.5°C, Liquid Temperature: 20.0°C
Probe: SN 34/15 SSE2 EPG0265, ConvF: 2.35
Area Scan: sam_direct_droit2_surf12mm.txt, h= 5.00 mm
Zoom Scan: 5x5x7,dx=8mm, dy=8mm, dz=5mm,Complete
Maximum location: X=-12.000000, Y=24.000000
SAR 10g (W/Kg): 0.220433
SAR 1g (W/Kg): 0.462433
Power drift (%): 0.30
3D screen shot

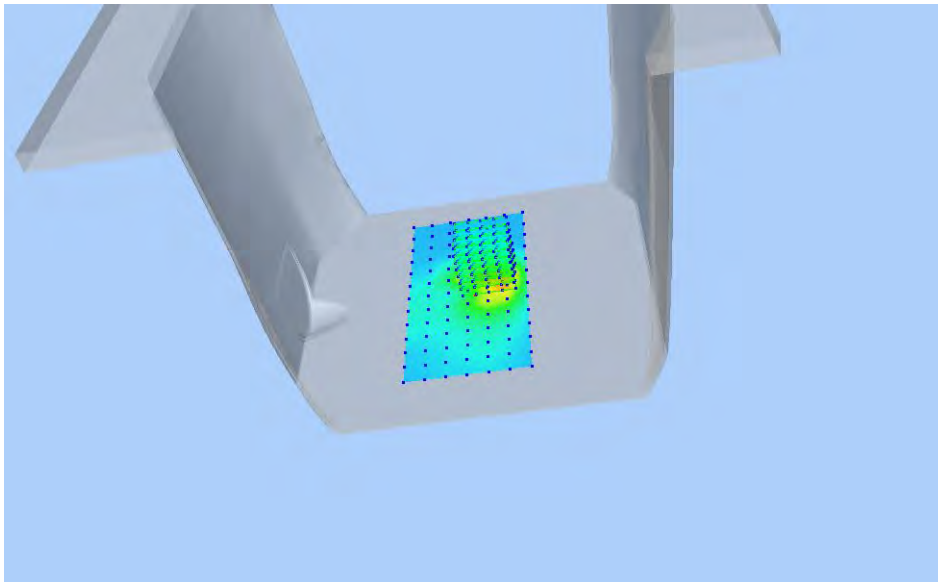


Z Axis Scan

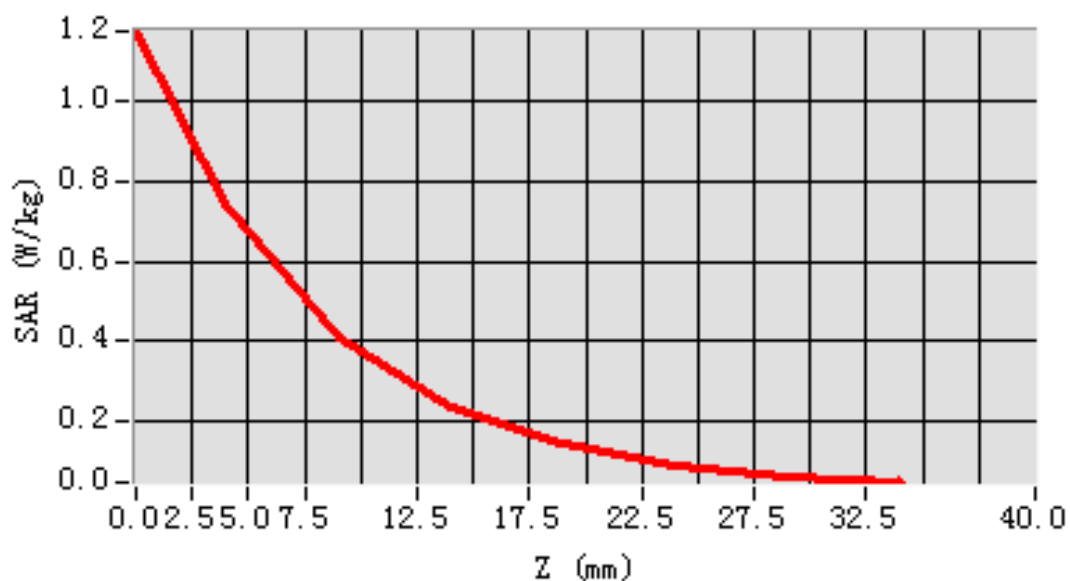


MEAS. 14 Body Plane with Back-0mm on Middle Channel in LTE Band 2 mode

Test Date: 17/8/2016
Measurement duration: 12 minutes 3 seconds
Signal: LTE, f=1880.0 MHz, Duty Cycle: 1:1.0
Liquid Parameters: Permittivity: 54.22; Conductivity: 1.49 S/m
Test condition: Ambient Temperature: 21.4°C, Liquid Temperature: 20.2°C
Probe: SN 34/15 SSE2 EPGO265, ConvF: 2.42
Area Scan: sam_direct_droit2_surf12mm.txt, h= 5.00 mm
Zoom Scan: 5x5x7,dx=8mm, dy=8mm, dz=5mm,Complete
Maximum location: X=8.000000, Y=12.000000
SAR 10g (W/Kg): 0.344566
SAR 1g (W/Kg): 0.716278
Power drift (%): -2.11
3D screen shot

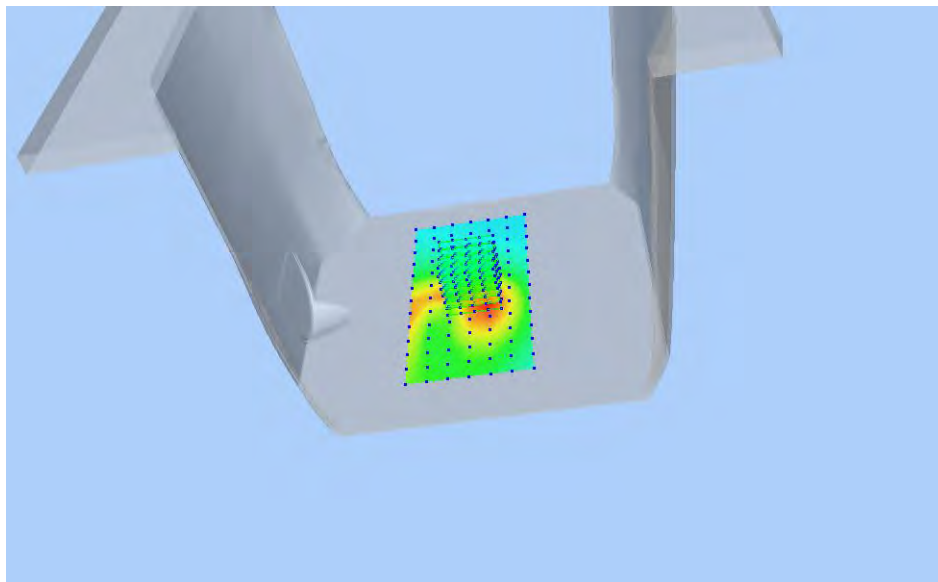


Z Axis Scan

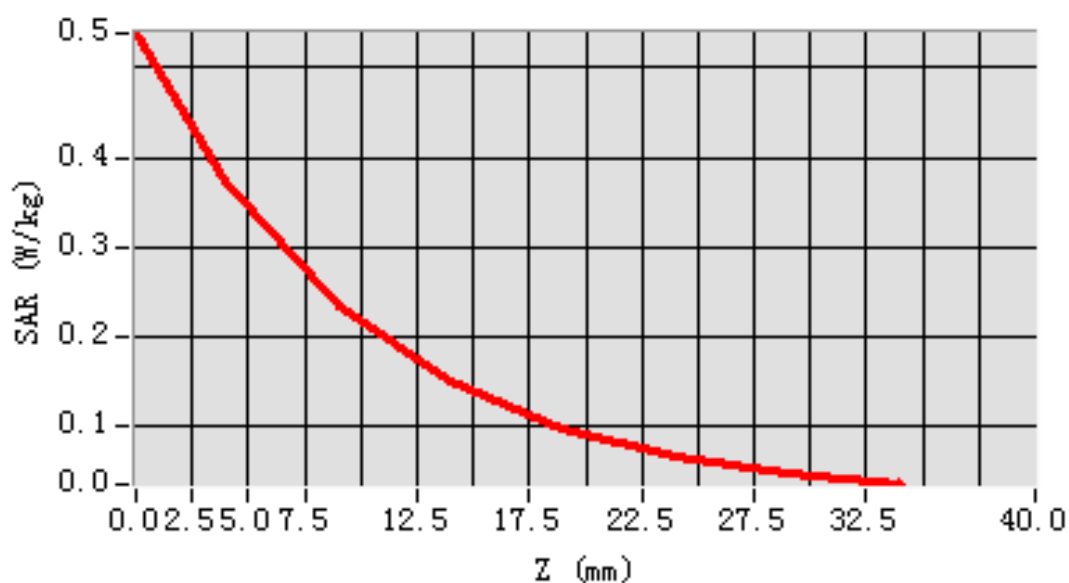


MEAS. 15 Body Plane with Back-15mm on Low Channel in LTE Band 2 mode

Test Date: 17/8/2016
Measurement duration: 10 minutes 33 seconds
Signal: LTE, f=1860 MHz, Duty Cycle: 1:1.0
Liquid Parameters: Permittivity: 54.34; Conductivity: 1.48 S/m
Test condition: Ambient Temperature: 21.4°C, Liquid Temperature: 20.2°C
Probe: SN 34/15 SSE2 EPGO265, ConvF: 2.42
Area Scan: sam_direct_droit2_surf12mm.txt, h= 5.00 mm
Zoom Scan: 5x5x7,dx=8mm, dy=8mm, dz=5mm,Complete
Maximum location: X=-4.000000, Y=0.000000
SAR 10g (W/Kg): 0.209480
SAR 1g (W/Kg): 0.356300
Power drift (%): -1.59
3D screen shot

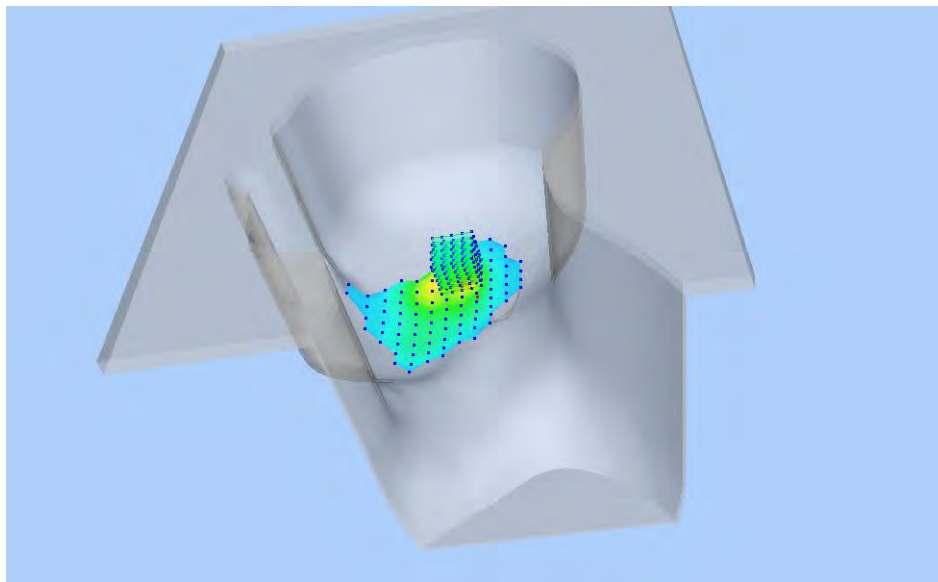


Z Axis Scan

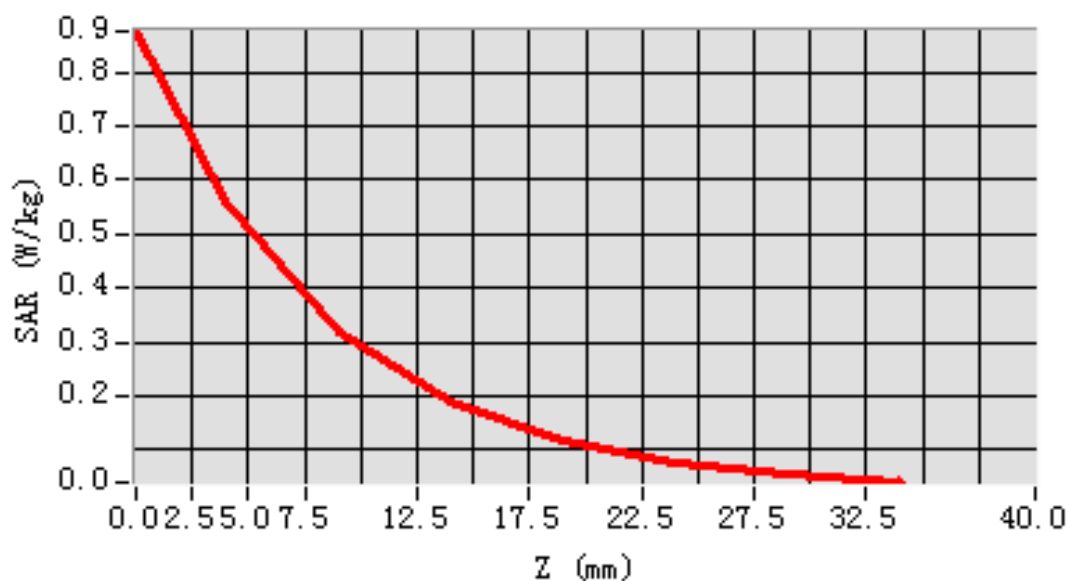


MEAS. 16 Right Head with Cheek on High Channel in LTE Band 4 mode

Test Date: 15/8/2016
Measurement duration: 8 minutes 20 seconds
Signal: LTE, f=1745.0 MHz, Duty Cycle: 1:1.0
Liquid Parameters: Permittivity: 40.10; Conductivity: 1.37 S/m
Test condition: Ambient Temperature: 21.7°C, Liquid Temperature: 20.1°C
Probe: SN 34/15 SSE2 EPGO265, ConvF: 2.04
Area Scan: sam_direct_droit2_surf12mm.txt, h= 5.00 mm
Zoom Scan: 5x5x7,dx=8mm, dy=8mm, dz=5mm,Complete
Maximum location: X=-12.000000, Y=24.000000
SAR 10g (W/Kg): 0.257255
SAR 1g (W/Kg): 0.519918
Power drift (%): -0.08
3D screen shot

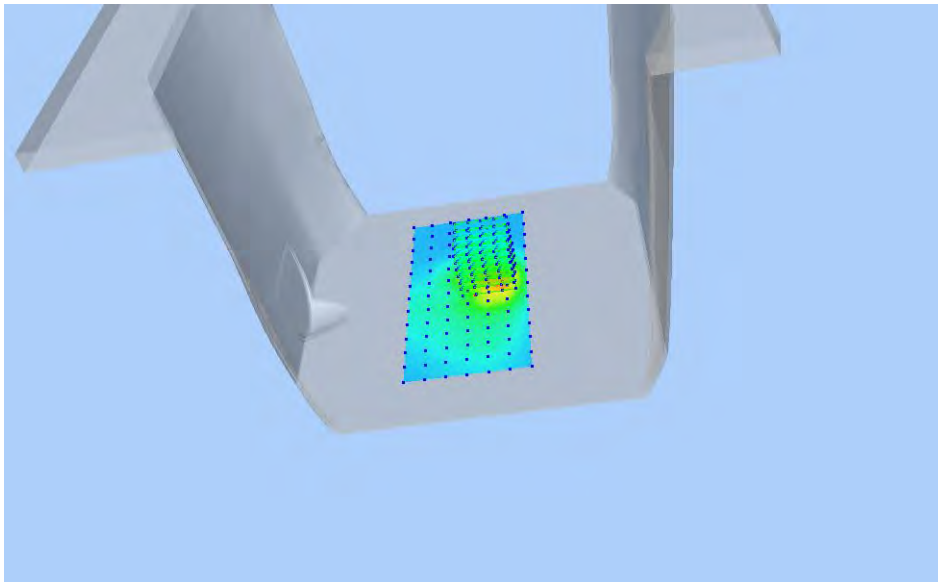


Z Axis Scan

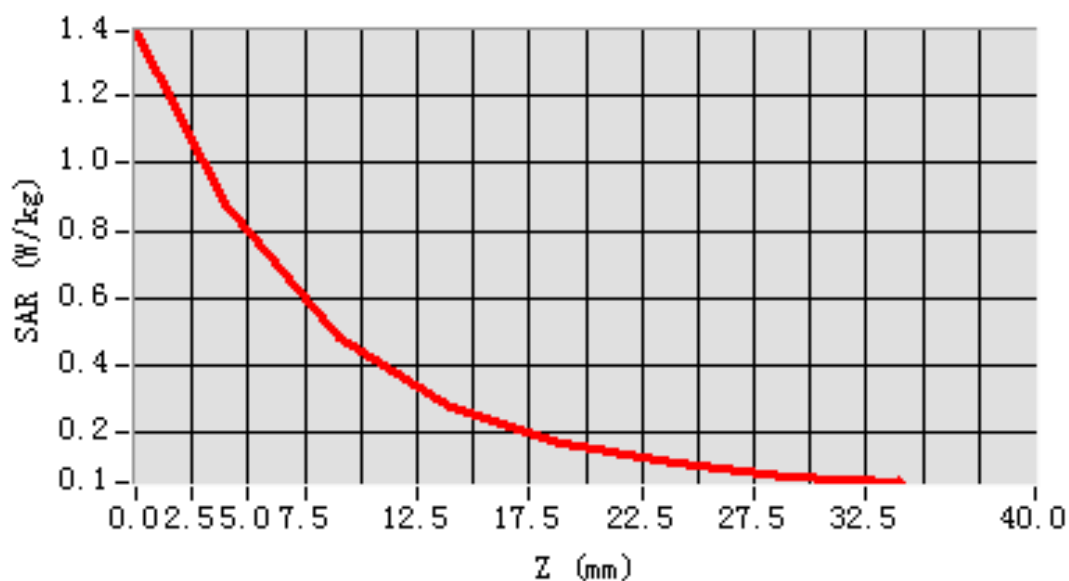


MEAS. 17 Body Plane with Back-0mm on High Channel in LTE Band 4 mode

Test Date: 15/8/2016
Measurement duration: 12 minutes 2 seconds
Signal: LTE, f=1745.0 MHz, Duty Cycle: 1:1.0
Liquid Parameters: Permittivity: 53.15; Conductivity: 1.45 S/m
Test condition: Ambient Temperature: 21.7°C, Liquid Temperature: 20.1°C
Probe: SN 34/15 SSE2 EPGO265, ConvF: 2.08
Area Scan: sam_direct_droit2_surf12mm.txt, h= 5.00 mm
Zoom Scan: 5x5x7,dx=8mm, dy=8mm, dz=5mm,Complete
Maximum location: X=8.000000, Y=12.000000
SAR 10g (W/Kg): 0.405618
SAR 1g (W/Kg): 0.815531
Power drift (%): -1.73
3D screen shot

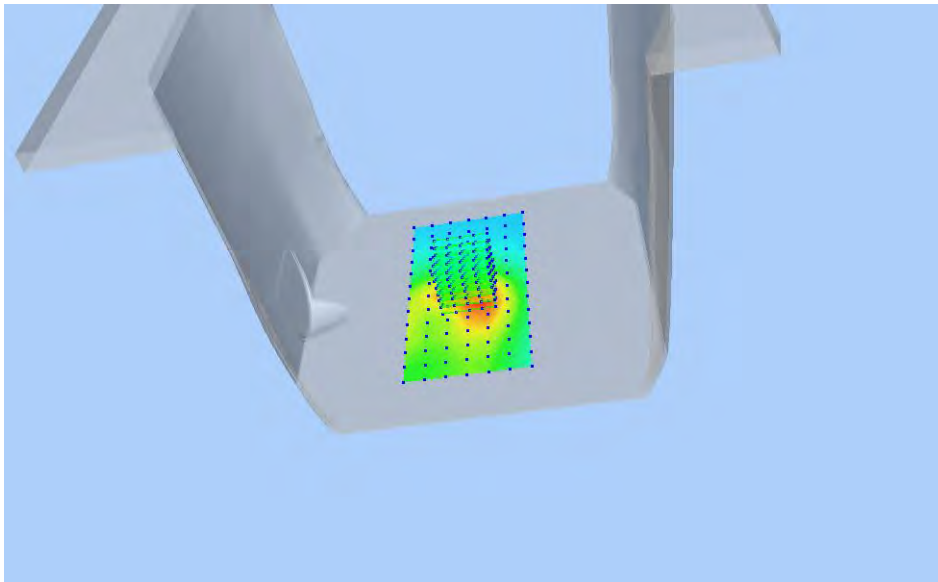


Z Axis Scan

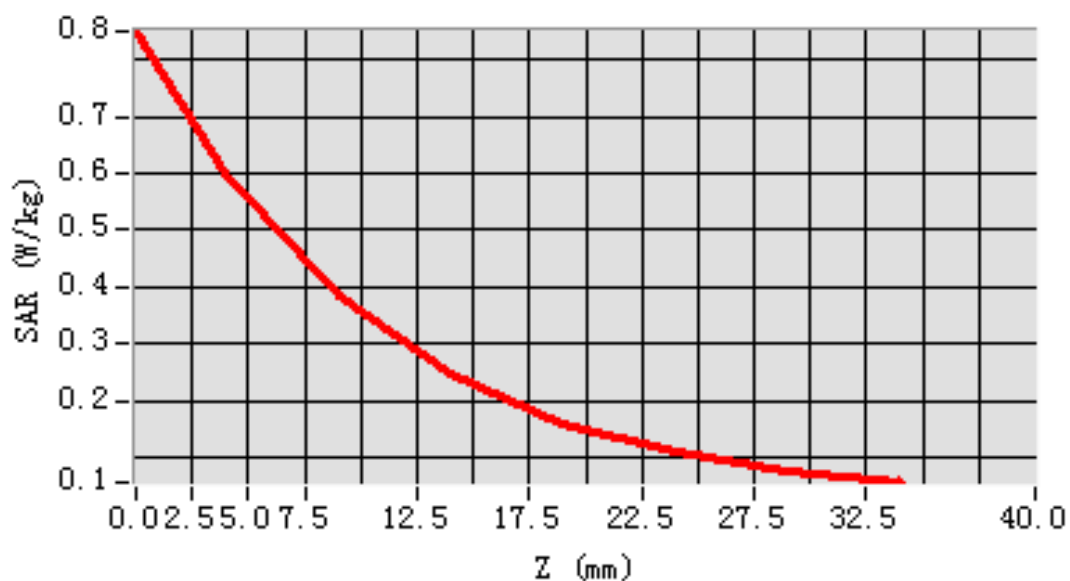


MEAS. 18 Body Plane with Back-15mm on High Channel in LTE Band 4 mode

Test Date: 15/8/2016
Measurement duration: 10 minutes 13 seconds
Signal: LTE, f=1745.0 MHz, Duty Cycle: 1:1.0
Liquid Parameters: Permittivity: 53.15; Conductivity: 1.45 S/m
Test condition: Ambient Temperature: 21.7°C, Liquid Temperature: 20.1°C
Probe: SN 34/15 SSE2 EPGO265, ConvF: 2.08
Area Scan: sam_direct_droit2_surf12mm.txt, h= 5.00 mm
Zoom Scan: 5x5x7,dx=8mm, dy=8mm, dz=5mm,Complete
Maximum location: X=-4.000000, Y=0.000000
SAR 10g (W/Kg): 0.342912
SAR 1g (W/Kg): 0.575003
Power drift (%): -1.23
3D screen shot

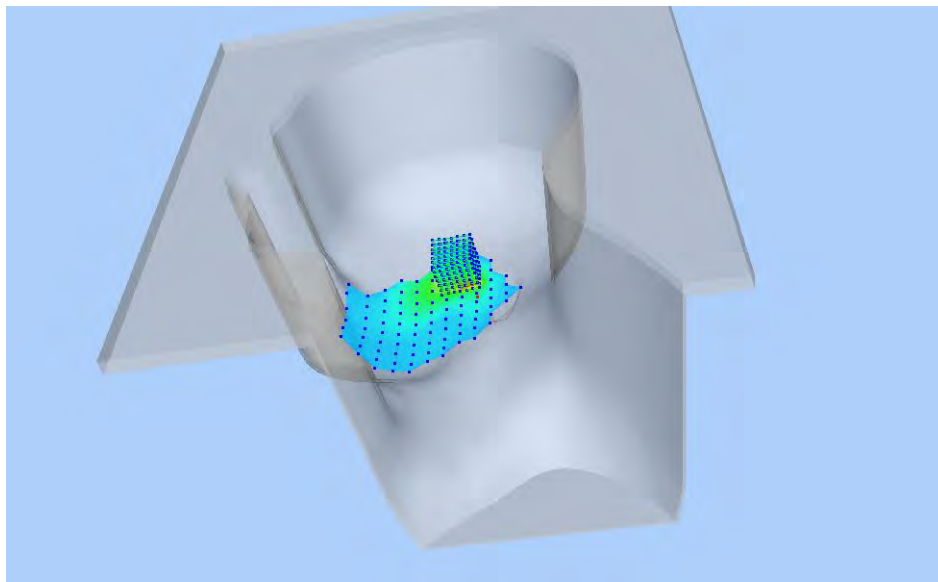


Z Axis Scan

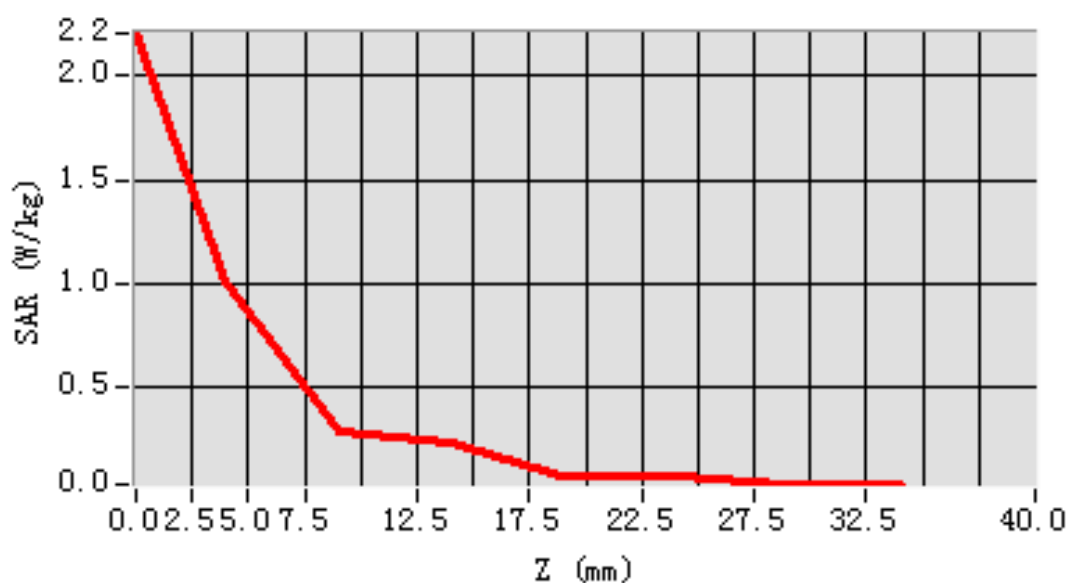


MEAS. 19 Right Head with Cheek on Middle Channel in LTE Band 7 mode

Test Date: 18/8/2016
Measurement duration: 12 minutes 46 seconds
Signal: LTE, f=2535.0 MHz, Duty Cycle: 1:1.0
Liquid Parameters: Permittivity: 38.81; Conductivity: 1.95 S/m
Test condition: Ambient Temperature: 21.5°C, Liquid Temperature: 20.3°C
Probe: SN 34/15 SSE2 EPGO265, ConvF: 2.36
Area Scan: sam_direct_droit2_surf12mm.txt, h= 5.00 mm
Zoom Scan: 7x7x7,dx=5mm, dy=5mm, dz=5mm,Complete
Maximum location: X=-12.000000, Y=24.000000
SAR 10g (W/Kg): 0.349295
SAR 1g (W/Kg): 0.896989
Power drift (%): -0.38
3D screen shot

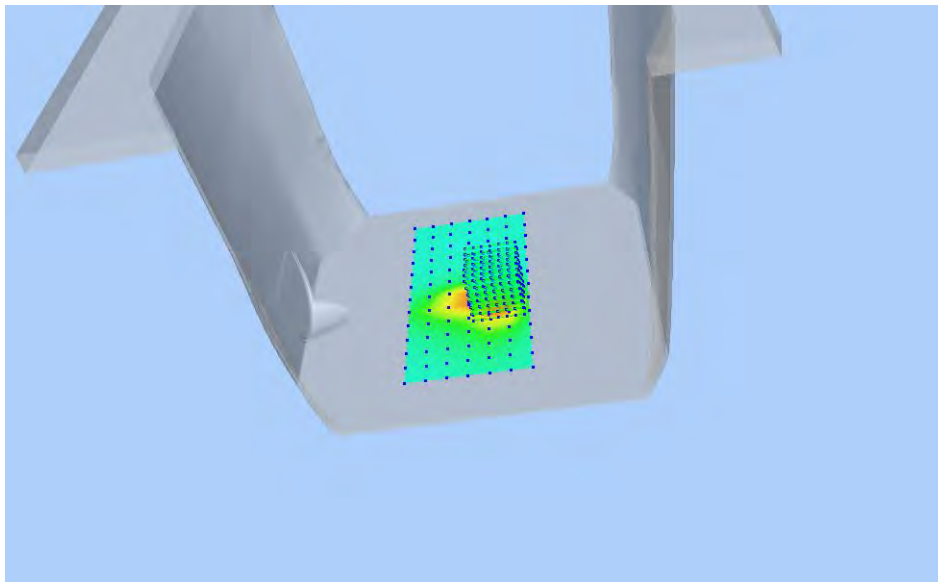


Z Axis Scan

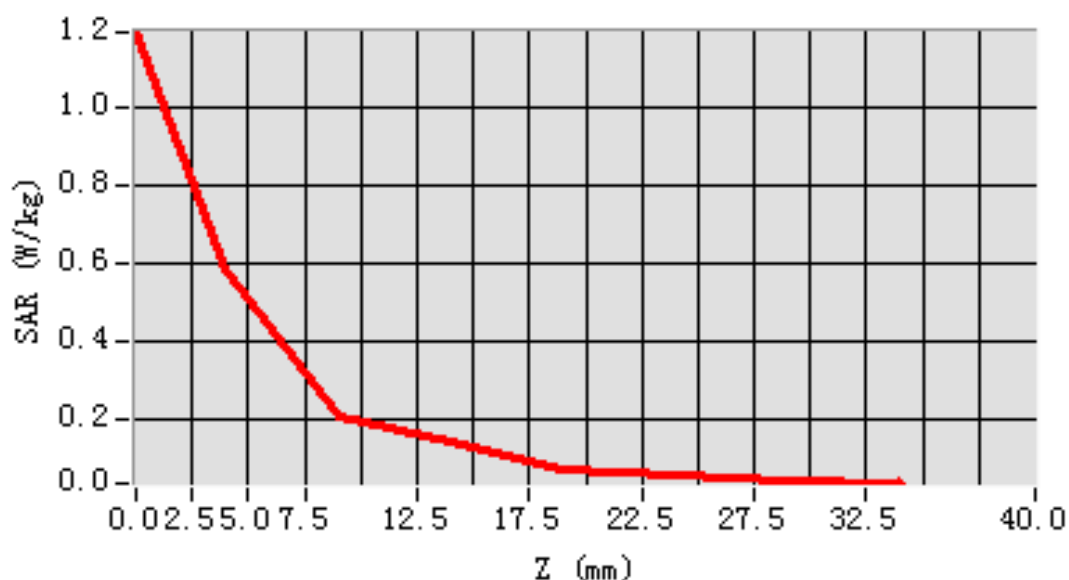


MEAS. 20 Body Plane with Back-0mm on High Channel in LTE Band 7 mode

Test Date: 19/8/2016
Measurement duration: 10 minutes 21 seconds
Signal: LTE, f=2560.0 MHz, Duty Cycle: 1:1.0
Liquid Parameters: Permittivity: 50.72; Conductivity: 2.08 S/m
Test condition: Ambient Temperature: 21.9°C, Liquid Temperature: 20.8°C
Probe: SN 34/15 SSE2 EPGO265, ConvF: 2.43
Area Scan: sam_direct_droit2_surf12mm.txt, h= 5.00 mm
Zoom Scan: 7x7x7,dx=5mm, dy=5mm, dz=5mm,Complete
Maximum location: X=16.000000, Y=-8.000000
SAR 10g (W/Kg): 0.221699
SAR 1g (W/Kg): 0.499720
Power drift (%): -2.81
3D screen shot

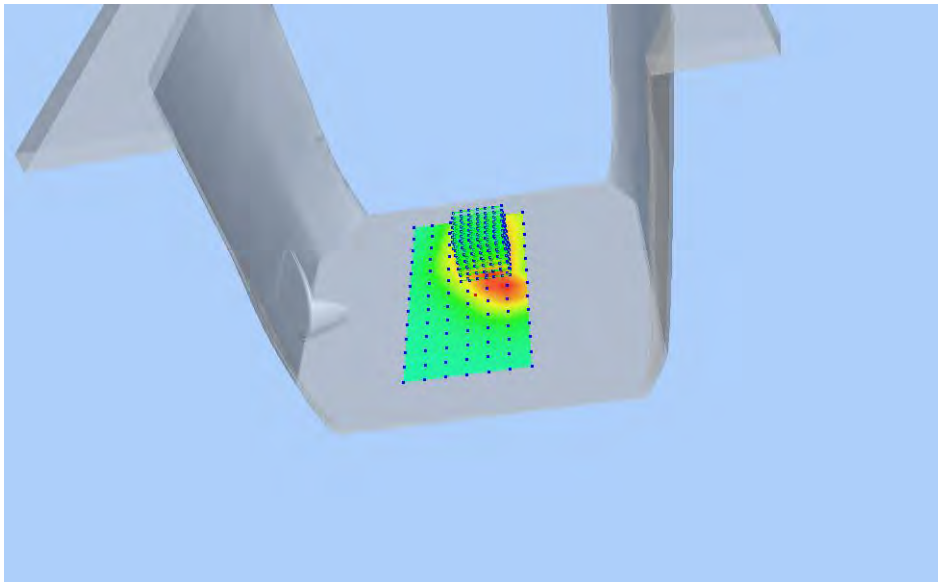


Z Axis Scan

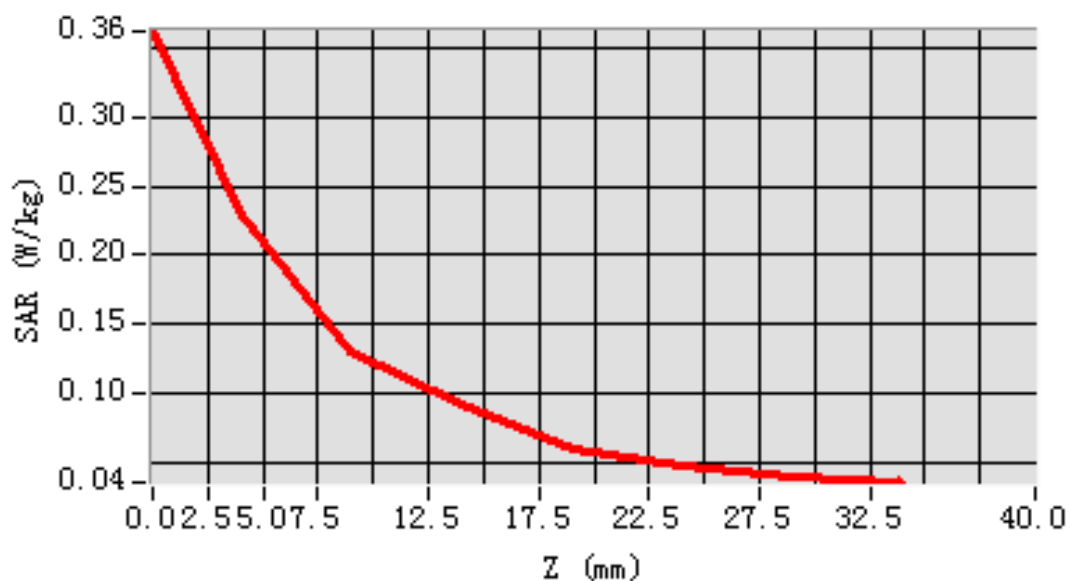


MEAS. 21 Body Plane with Back-15mm on Low Channel in LTE Band 7 mode

Test Date: 19/8/2016
Measurement duration: 17 minutes 17 seconds
Signal: LTE, f=2510.0 MHz, Duty Cycle: 1:1.0
Liquid Parameters: Permittivity: 50.97; Conductivity: 2.04 S/m
Test condition: Ambient Temperature: 21.9°C, Liquid Temperature: 20.8°C
Probe: SN 34/15 SSE2 EPGO265, ConvF: 2.43
Area Scan: sam_direct_droit2_surf12mm.txt, h= 5.00 mm
Zoom Scan: 7x7x7,dx=5mm, dy=5mm, dz=5mm,Complete
Maximum location: X=8.000000, Y=24.000000
SAR 10g (W/Kg): 0.137843
SAR 1g (W/Kg): 0.221422
Power drift (%): -2.47
3D screen shot

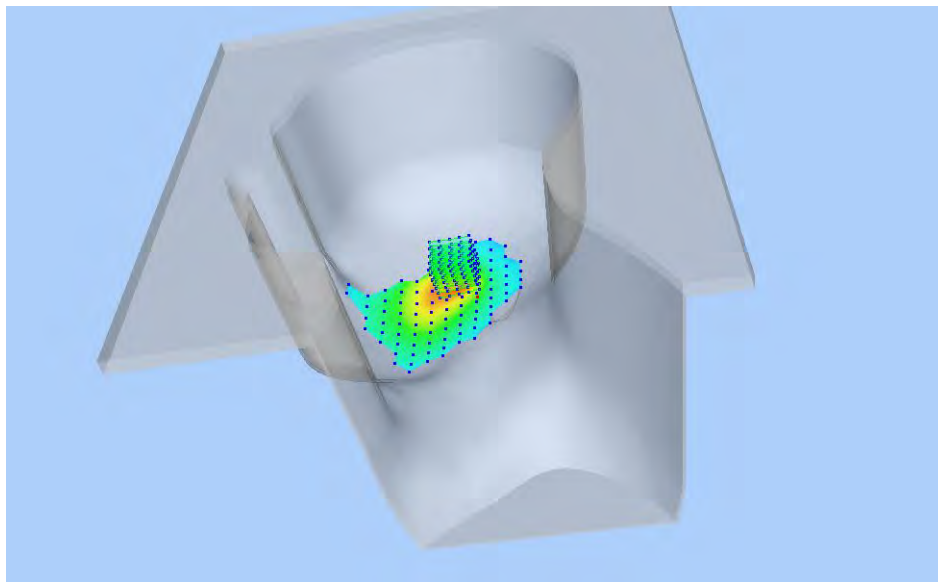


Z Axis Scan

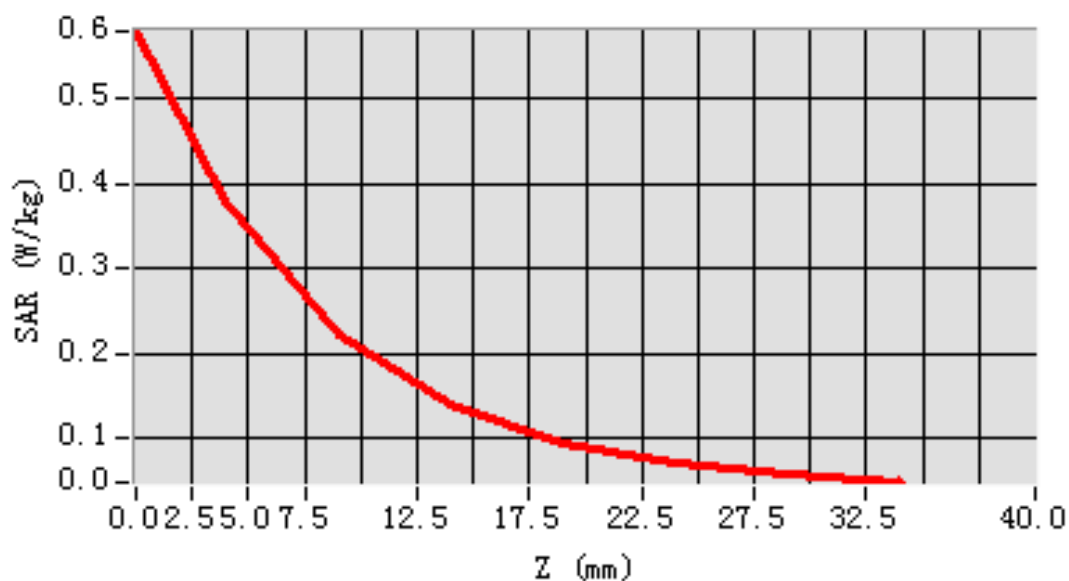


MEAS. 22 Right Head with Cheek on Middle Channel in LTE Band 17 mode

Test Date: 11/8/2016
Measurement duration: 8 minutes 28 seconds
Signal: LTE, f=710.0 MHz, Duty Cycle: 1:1.0
Liquid Parameters: Permittivity: 43.18; Conductivity: 0.87 S/m
Test condition: Ambient Temperature: 21.9°C, Liquid Temperature: 20.8°C
Probe: SN 34/15 SSE2 EPGO265, ConvF: 1.81
Area Scan: sam_direct_droit2_surf12mm.txt, h= 5.00 mm
Zoom Scan: 5x5x7,dx=8mm, dy=8mm, dz=5mm,Complete
Maximum location: X=-12.000000, Y=24.000000
SAR 10g (W/Kg): 0.208915
SAR 1g (W/Kg): 0.356536
Power drift (%): 1.98
3D screen shot

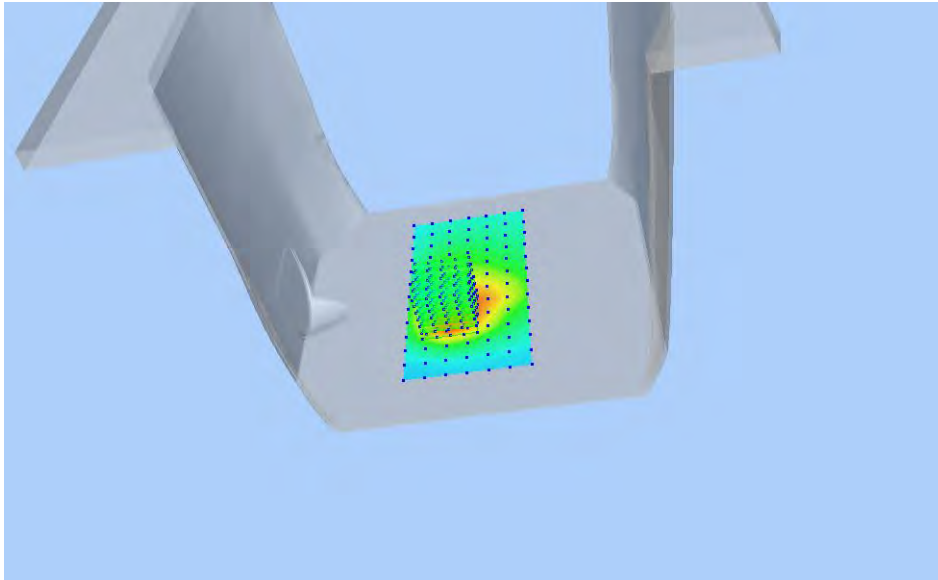


Z Axis Scan

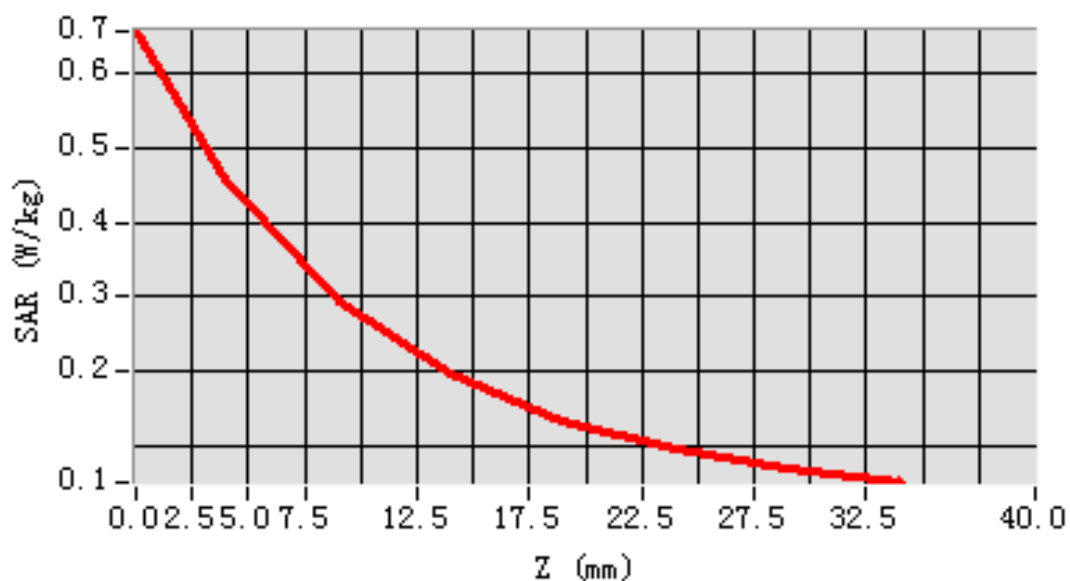


MEAS. 23 Body Plane with Back-0mm on Middle Channel in LTE Band 17 mode

Test Date: 12/8/2016
Measurement duration: 8 minutes 20 seconds
Signal: LTE, f=710.0 MHz, Duty Cycle: 1:1.0
Liquid Parameters: Permittivity: 57.31; Conductivity: 0.92 S/m
Test condition: Ambient Temperature: 21.6°C, Liquid Temperature: 20.1°C
Probe: SN 34/15 SSE2 EPGO265, ConvF: 1.88
Area Scan: sam_direct_droit2_surf12mm.txt, h= 5.00 mm
Zoom Scan: 5x5x7,dx=8mm, dy=8mm, dz=5mm,Complete
Maximum location: X=-16.000000, Y=-24.000000
SAR 10g (W/Kg): 0.283163
SAR 1g (W/Kg): 0.446481
Power drift (%): -1.27
3D screen shot



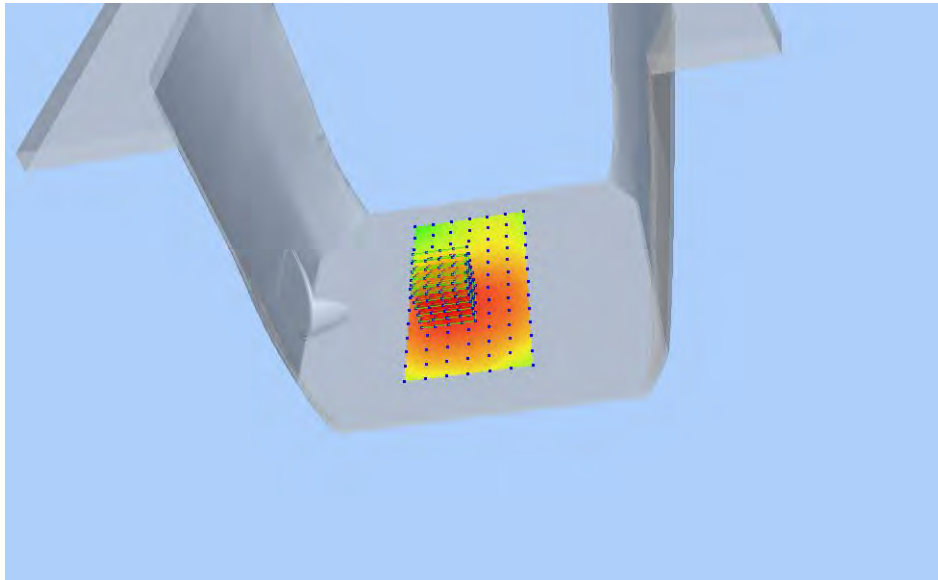
Z Axis Scan



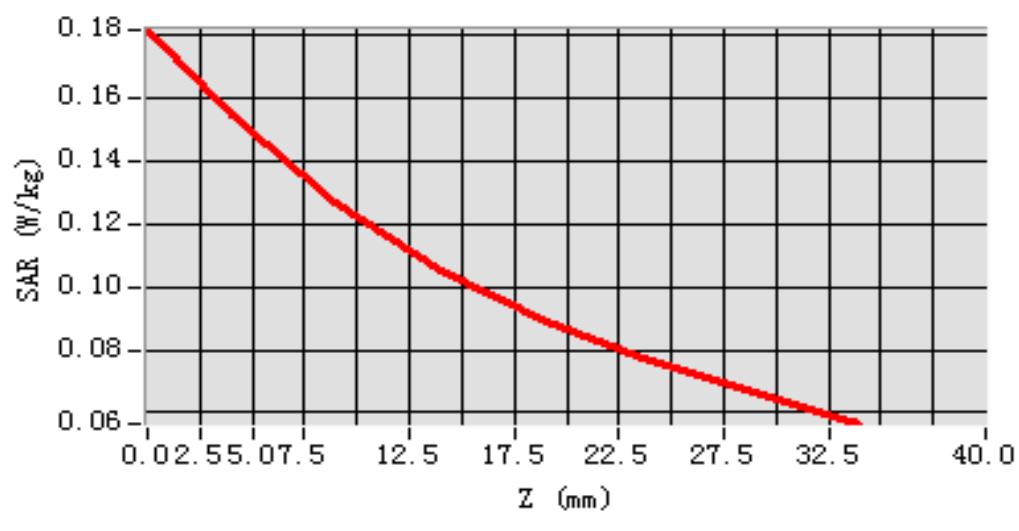
MEAS. 24 Body Plane with Back-15mm on Middle Channel in LTE Band 17

mode

Test Date: 12/8/2016
Measurement duration: 11 minutes 34 seconds
Signal: LTE, f=710.0 MHz, Duty Cycle: 1:1.0
Liquid Parameters: Permittivity: 57.31; Conductivity: 0.92 S/m
Test condition: Ambient Temperature: 21.6°C, Liquid Temperature: 20.1°C
Probe: SN 34/15 SSE2 EPGO265, ConvF: 1.88
Area Scan: sam_direct_droit2_surf12mm.txt, h= 5.00 mm
Zoom Scan: 5x5x7,dx=8mm, dy=8mm, dz=5mm,Complete
Maximum location: X=-16.000000, Y=-12.000000
SAR 10g (W/Kg): 0.121874
SAR 1g (W/Kg): 0.150475
Power drift (%): -0.85
3D screen shot

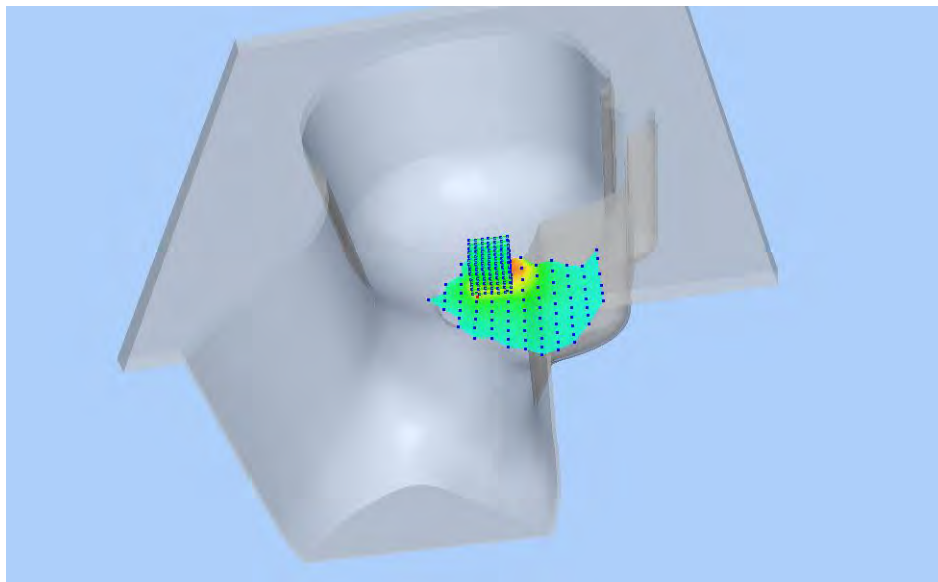


Z Axis Scan

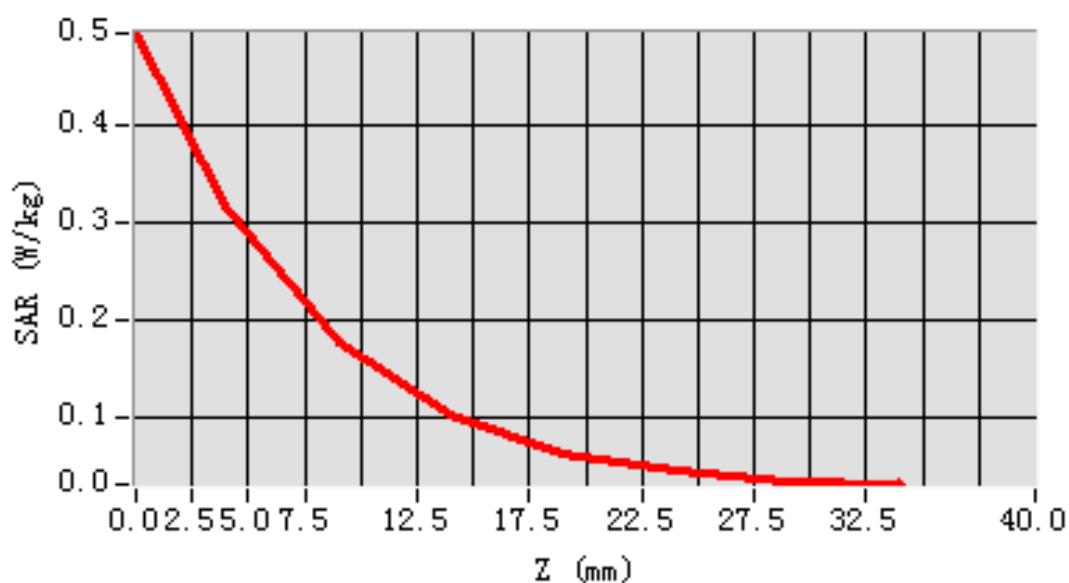


MEAS. 25 Left Head with Cheek on Middle Channel in IEEE 802.b mode

Test Date: 18/8/2016
Measurement duration: 12 minutes 49 seconds
Signal: WLAN, f=2437.0 MHz, Duty Cycle: 1:1.0
Liquid Parameters: Permittivity: 39.87; Conductivity: 1.82 S/m
Test condition: Ambient Temperature: 21.5°C, Liquid Temperature: 20.3°C
Probe: SN 34/15 SSE2 EPGO265, ConvF: 2.47
Area Scan: sam_direct_droit2_surf12mm.txt, h= 5.00 mm
Zoom Scan: 7x7x7,dx=5mm, dy=5mm, dz=5mm, Complete
Maximum location: X=-12.000000, Y=12.000000
SAR 10g (W/Kg): 0.150264
SAR 1g (W/Kg): 0.283737
Power drift (%): -1.05
3D screen shot

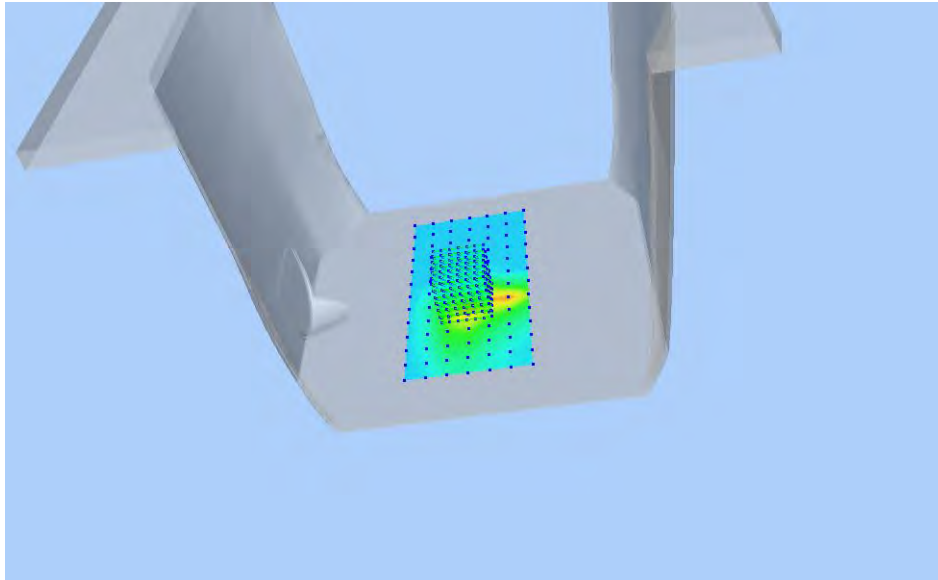


Z Axis Scan

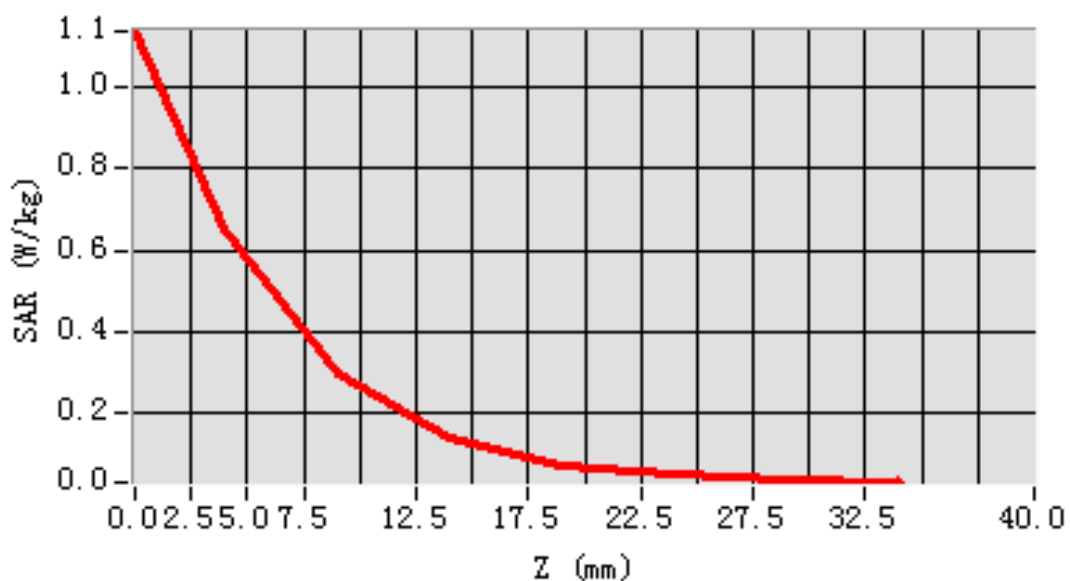


MEAS. 26 Body Plane with Back-0mm on Middle Channel in IEEE 802.b mode

Test Date: 19/8/2016
Measurement duration: 14 minutes 24 seconds
Signal: WLAN, f=2437.0 MHz, Duty Cycle: 1:1.0
Liquid Parameters: Permittivity: 51.62; Conductivity: 1.99 S/m
Test condition: Ambient Temperature: 21.9°C, Liquid Temperature: 20.8°C
Probe: SN 34/15 SSE2 EPGO265, ConvF: 2.55
Area Scan: sam_direct_droit2_surf12mm.txt, h= 5.00 mm
Zoom Scan: 7x7x7,dx=5mm, dy=5mm, dz=5mm,Complete
Maximum location: X=-4.000000, Y=-12.000000
SAR 10g (W/Kg): 0.256186
SAR 1g (W/Kg): 0.580067
Power drift (%): -1.78
3D screen shot



Z Axis Scan



ANNEX D EUT EXTERNAL PHOTOS

Please refer the document “BL-SZ1660207-AW.pdf”.

ANNEX E SAR TEST SETUP PHOTOS

Please refer the document “BL-SZ1660207-AS.pdf”.

ANNEX F CALIBRATION REPORT

F.1 E-Field Probe



COMOSAR E-Field Probe Calibration Report

Ref : ACR.299.1.15.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 DOSIMETRIC E-FIELD PROBE
SERIAL NO.: SN 34/15 EPG0265

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



Calibration Date: 10/12/2015

Summary:

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



COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.299.1.15.SATU.A

	Name	Function	Date	Signature
Prepared by :	Jérôme LUC	Product Manager	10/26/2015	<i>JS</i>
Checked by :	Jérôme LUC	Product Manager	10/26/2015	<i>JS</i>
Approved by :	Kim RUTKOWSKI	Quality Manager	10/26/2015	<i>Kim Rutkowski</i>

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

Issue	Date	Modifications
A	10/26/2015	Initial release

Page: 2/10

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COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.299.1.15.SATU.A

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COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.299.1.15.SATU.A

1 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR DOSIMETRIC E FIELD PROBE
Manufacturer	MVG
Model	SSE2
Serial Number	SN 34/15 EPGO265
Product Condition (new / used)	New
Frequency Range of Probe	0.45 GHz-6GHz
Resistance of Three Dipoles at Connector	Dipole 1: R1=0.192 MΩ Dipole 2: R2=0.230 MΩ Dipole 3: R3=0.205 MΩ

A yearly calibration interval is recommended.

2 PRODUCT DESCRIPTION

2.1 GENERAL INFORMATION

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



Figure 1 – MVG 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.

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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%

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COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.299.1.15.SATU.A

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 %

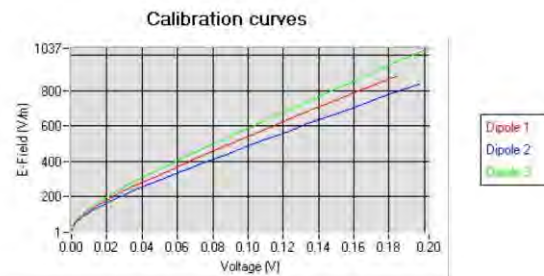
5.1 SENSITIVITY IN AIR

Normx dipole 1 ($\mu\text{V}/(\text{V}/\text{m})^2$)	Normy dipole 2 ($\mu\text{V}/(\text{V}/\text{m})^2$)	Normz dipole 3 ($\mu\text{V}/(\text{V}/\text{m})^2$)
0.72	0.81	0.85

DCP dipole 1 (mV)	DCP dipole 2 (mV)	DCP dipole 3 (mV)
92	90	95

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

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



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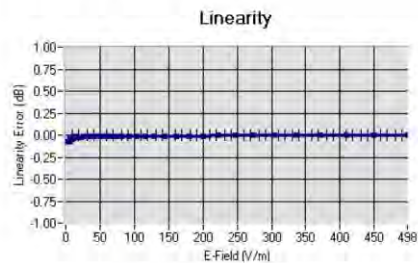
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COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.299.1.15.SATU.A

5.2 LINEARITY



Linearity: $\pm 1.61\%$ ($\pm 0.07\text{dB}$)

5.3 SENSITIVITY IN LIQUID

Liquid	Frequency (MHz $\pm 100\text{MHz}$)	Permittivity	Epsilon (S/m)	ConvF
HL450	450	44.12	0.88	1.85
BL450	450	58.92	1.00	1.90
HL750	750	42.24	0.90	1.81
BL750	750	56.85	0.99	1.88
HL850	835	43.02	0.90	2.04
BL850	835	53.72	0.98	2.12
HL900	900	42.47	0.99	1.86
BL900	900	56.97	1.09	1.92
HL1800	1800	42.24	1.40	2.04
BL1800	1800	53.53	1.53	2.08
HL1900	1900	40.79	1.42	2.35
BL1900	1900	54.47	1.57	2.42
HL2000	2000	40.52	1.44	2.23
BL2000	2000	54.18	1.56	2.32
HL2450	2450	38.73	1.81	2.47
BL2450	2450	53.23	1.96	2.55
HL2600	2600	38.54	1.95	2.36
BL2600	2600	52.07	2.23	2.43
HL5200	5200	36.80	4.84	1.81
BL5200	5200	51.21	5.16	1.85
HL5400	5400	36.35	4.96	2.04
BL5400	5400	50.51	5.70	2.11
HL5600	5600	35.57	5.23	2.08
BL5600	5600	49.83	5.91	2.15
HL5800	5800	35.30	5.47	1.88
BL5800	5800	49.03	6.28	1.93

LOWER DETECTION LIMIT: 7mW/kg

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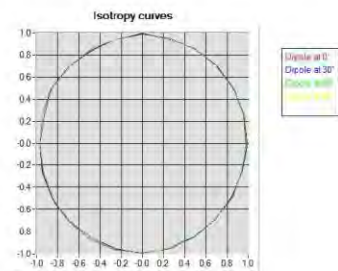
COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.299.1.15.SATU.A

5.4 ISOTROPY

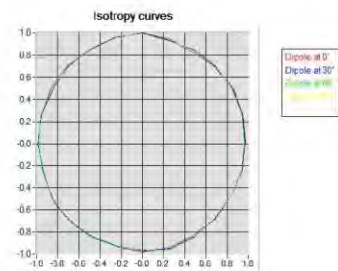
HL900 MHz

- Axial isotropy: 0.04 dB
- Hemispherical isotropy: 0.06 dB



HL1800 MHz

- Axial isotropy: 0.04 dB
- Hemispherical isotropy: 0.06 dB



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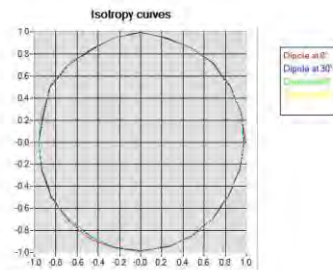


COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.299.1.15.SATU.A

HL5600 MHz

- Axial isotropy: 0.06 dB
- Hemispherical isotropy: 0.09 dB



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COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.299.1.15.SATU.A

6 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
Reference Probe	MVG	EP 94 SN 37/08	10/2015	10/2016
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.

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SAR Reference Dipole Calibration Report

Ref: ACR.75.7.15.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: 750 MHZ
SERIAL NO.: SN 25/13 DIP 0G750-253

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: BAL-75-1-13-SKIT-1-A

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

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

Issue	Date	Modifications
A	3/16/2015	Initial release

Page: 2/11

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR-75-7 IS SARU A

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR-75.7 IS SA(II) A

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 750 MHz REFERENCE DIPOLE
Manufacturer	MVG
Model	SID750
Serial Number	SN 25/13 DIP 0G750-253
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

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Rd/ ACIL75-1-13 S&CT/A

4 MEASUREMENT METHOD

The IEEE 1528, FCC KDBs and CEM/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 constructed as outlined in the fore mentioned standards.

4.2 MECHANICAL REQUIREMENTS

The IEEE Std. 1528 and CEM/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 CEM/IEC 62209 standards were followed to generate the measurement uncertainty for validation measurements.

Scan Volume	Expanded Uncertainty
1 g	20.3 %

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SAR REFERENCE DIPOLE CALIBRATION REPORT

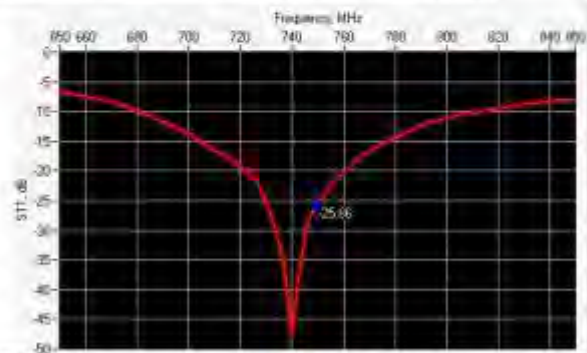
Ref: ACR-75.7.15.SA111.A

10 g

20.1 %

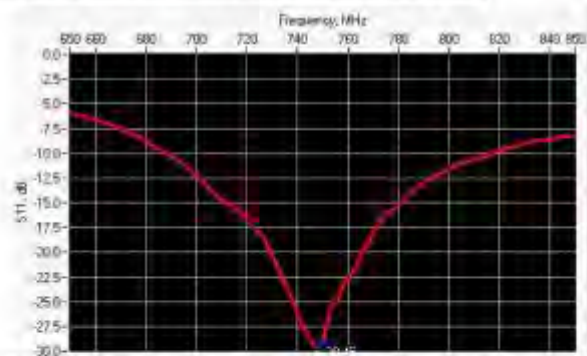
6 CALIBRATION MEASUREMENT RESULTS

6.1 RETURN LOSS AND IMPEDANCE IN HEAD LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
750	-25.86	-20	$54.5 \Omega - 2.7 j\Omega$

6.2 RETURN LOSS AND IMPEDANCE IN BODY LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
750	-29.45	-20	$52.6 \Omega + 2.3 j\Omega$

6.3 MECHANICAL DIMENSIONS

Frequency MHz	L mm		h mm		d mm	
	required	measured	required	measured	required	measured
300	$420.0 \pm 1 \%$		$250.0 \pm 1 \%$		$6.35 \pm 1 \%$	

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: AICL75-1-13 SARTEL-A

450	290.0 ±1 %		166.7 ±1 %		6.35 ±1 %	
750	176.0 ±1 %	PASS	100.0 ±1 %	PASS	6.35 ±1 %	PASS
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 %		42.8 ±1 %		3.6 ±1 %	
1800	72.0 ±1 %		41.7 ±1 %		3.6 ±1 %	
1900	68.0 ±1 %		39.5 ±1 %		3.6 ±1 %	
1850	66.3 ±1 %		38.5 ±1 %		3.6 ±1 %	
2000	64.5 ±1 %		37.5 ±1 %		3.6 ±1 %	
2100	61.0 ±1 %		36.7 ±1 %		3.6 ±1 %	
2300	55.5 ±1 %		32.6 ±1 %		3.6 ±1 %	
2450	51.5 ±1 %		30.4 ±1 %		3.6 ±1 %	
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 CE/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 %	PASS	0.88 ±5 %	PASS
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 %	

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.75.7.15.SATU.A

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 %		1.80 ±5 %	
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: ϵ_{ps} : 41.8 σ : 0.90
Distance between dipole center and liquid	15.0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoon Scan Resolution	dx=8mm/dy=8m/dz=5mm
Frequency	750 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	8.60 (0.86)	5.55	5.65 (0.56)
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	

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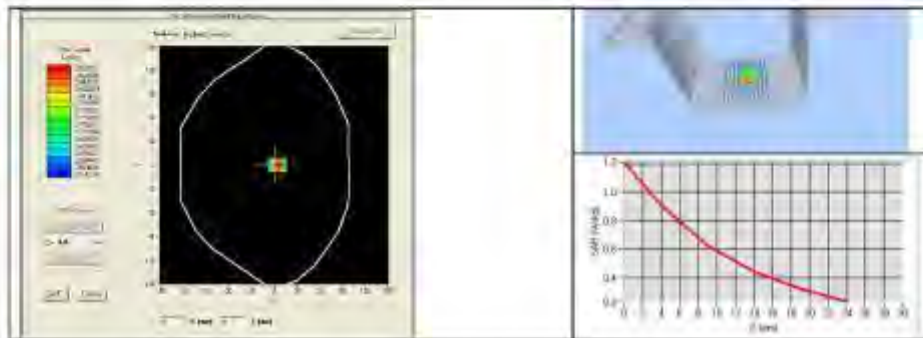
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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.75.7 IS SAR11.A

1900	39.7		20.5	
1950	40.5		20.8	
2000	41.1		21.1	
2100	43.6		21.9	
2300	48.7		23.3	
2450	52.4		24	
2600	55.3		24.6	
3000	63.8		25.7	
3500	67.1		25	



7.3 BODY LIQUID MEASUREMENT

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

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SAR REFERENCE DIPOLE CALIBRATION REPORT

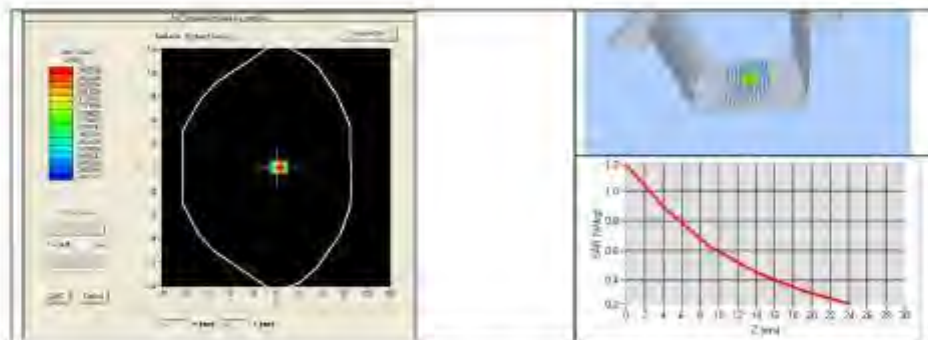
Ref: ACR.75.7 (SAR) A

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 20109 SAM71
Probe	SN 18111 EPG122
Liquid	Body Liquid Values: eps = 56.3 sigma = 0.98
Distance between dipole center and liquid	15.0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoon Scan Resolution	dx=8mm/dy=8mm/dz=5mm
Frequency	750 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
750	8.91 (0.89)	5.91 (0.59)



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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR-75.7 (SAR) A

8 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Description	Manufacturer / Model	Identification No.	Current Calibration Date	Next Calibration Date
SAM Phantom	MVG	SN-2009-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	MY49070681	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

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SAR Reference Dipole Calibration Report

Ref: ACR-75.8.15-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: 835 MHZ
SERIAL NO.: SN 25/13 DIP 0G835-246

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: BAL-75.8.15.SAR11-A

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

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

Issue	Date	Modifications
A	3/16/2015	Initial release

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: AUCF75.8.F5.SA11J.A

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACP-75.8.15.SAT1/A

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 835 MHz REFERENCE DIPOLE
Manufacturer	MVG
Model	SID835
Serial Number	SN 25/13 DIP 0G835-246
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

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACCE75.8.15.SAR/1.6

4 MEASUREMENT METHOD

The IEEE 1528, FCC KDBs and CENELEC 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 constructed as outlined in the fore mentioned standards.

4.2 MECHANICAL REQUIREMENTS

The IEEE Std. 1528 and CENELEC 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 CENELEC 62209 standards were followed to generate the measurement uncertainty for validation measurements.

Scan Volume	Expanded Uncertainty
1 g	20.3 %

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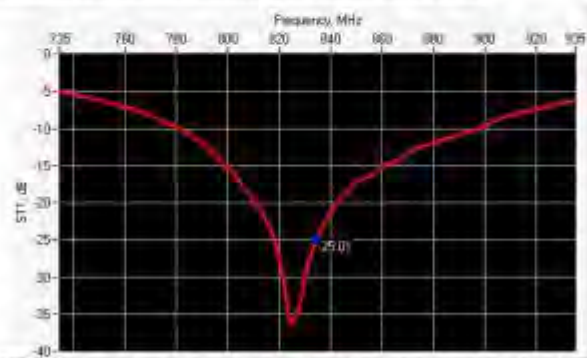
Ref: ACR.75.8.15.SATU.R

10 g

20.1 %

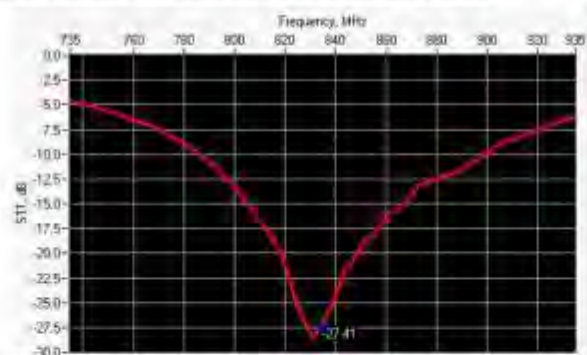
6 CALIBRATION MEASUREMENT RESULTS

6.1 RETURN LOSS AND IMPEDANCE IN HEAD LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
835	-25.01	-20	$55.9 \Omega + 0.9 j\Omega$

6.2 RETURN LOSS AND IMPEDANCE IN BODY LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
835	-27.41	-20	$52.1 \Omega + 3.8 j\Omega$

6.3 MECHANICAL DIMENSIONS

Frequency MHz	L mm		h mm		d mm	
	required	measured	required	measured	required	measured
800	$420.0 \pm 1 \%$		$250.0 \pm 1 \%$		$6.35 \pm 1 \%$	

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Rd / AICL 75.8.15 SAR1/A

450	290.0 ±1 %		166.7 ±1 %		6.35 ±1 %	
750	176.0 ±1 %		100.0 ±1 %		6.35 ±1 %	
835	161.0 ±1 %	PASS	89.8 ±1 %	PASS	3.6 ±1 %	PASS
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 %		30.4 ±1 %		3.6 ±1 %	
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/EC 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	41.8 ±5 %		0.88 ±5 %	
835	41.5 ±5 %	PASS	0.90 ±5 %	PASS
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 %	

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: AICL75.8.F3.SA111.A

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 %		1.80 ±5 %	
2600	39.0 ±5 %		1.96 ±5 %	
3000	38.5 ±5 %		2.40 ±5 %	
3500	37.9 ±5 %		2.80 ±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: $\mu\text{ps} = -42.1$ sigma : 0.92
Distance between dipole center and liquid	15.0 mm
Area scan resolution	$d_x=8\text{mm}/d_y=8\text{mm}$
Zoon Scan Resolution	$d_x=8\text{mm}/d_y=8\text{mm}/d_z=5\text{mm}$
Frequency	835 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	9.81 (0.98)	6.22	6.31 (0.83)
900	10.9		6.98	
1450	29		16	
1500	30.5		16.8	
1640	34.2		18.4	
1750	36.4		19.3	
1800	38.4		20.1	

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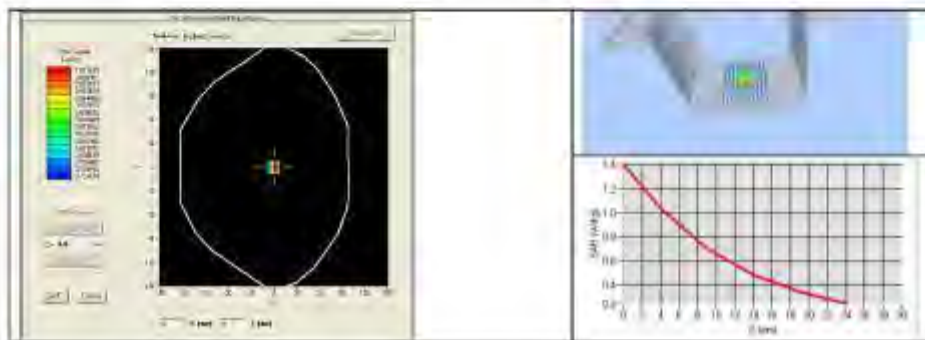
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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR 75.8.F5.SA(1) A

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		24	
2600	55.3		24.6	
3000	63.8		25.7	
3500	67.1		25	



7.3 BODY LIQUID MEASUREMENT

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

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.75.8.15.SAR11.A

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 20109 SAM71
Probe	SN 18111 EPG122
Liquid	Body Liquid Values: $\epsilon_{ps} = 53.8$ $\sigma_{ps} = 0.98$
Distance between dipole center and liquid	15.0 mm
Area scan resolution	$dx=8mm/dy=8mm$
Zoom Scan Resolution	$dx=8mm/dy=8mm/dz=5mm$
Frequency	835 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
835	10.53 (1.05)	6.89 (0.69)



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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR-75.8.15.SA/TJ-A

8 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Description	Manufacturer / Model	Identification No.	Current Calibration Date	Next Calibration Date
SAM Phantom	MVG	SN-2009-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	MY49070681	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

Page: 11/11

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SAR Reference Dipole Calibration Report

Ref: ACR.75.10.15.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: 1800 MHZ
SERIAL NO.: SN 25/13 DIP 1G800-248

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: ACE-75-10 (SAR) / A
---	--	--------------------------

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

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

Issue	Date	Modifications
A	3/16/2015	Initial release

Page: 2/11

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR-75.10 IS.SA(II).A

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Rev: ACR-75.10 15.SA(1) A

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 1800 MHz REFERENCE DIPOLE
Manufacturer	MVG
Model	SID1800
Serial Number	SN 25/13 DIP 1G800-248
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

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACS-75.10.03.5-011.1.A

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 constructed 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 %

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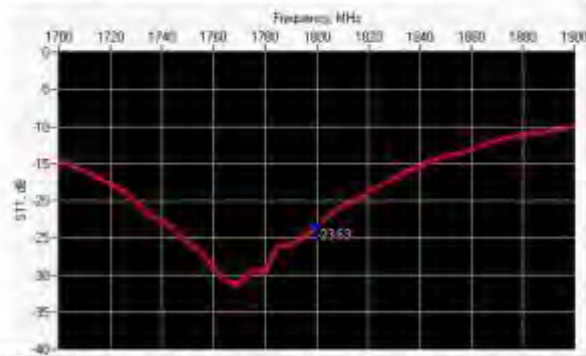
SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR-75.10 FS.SATTA

10 g	20.1 %
------	--------

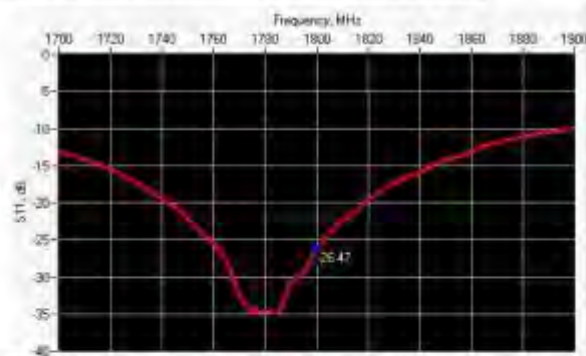
6 CALIBRATION MEASUREMENT RESULTS

6.1 RETURN LOSS AND IMPEDANCE IN HEAD LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
1800	-23.63	-20	$45.1 \Omega + 4.0 j\Omega$

6.2 RETURN LOSS AND IMPEDANCE IN BODY LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
1800	-26.47	-20	$45.5 \Omega - 0.3 j\Omega$

6.3 MECHANICAL DIMENSIONS

Frequency MHz	L mm		h mm		d mm	
	required	measured	required	measured	required	measured
300	$420.0 \pm 1 \%$		$250.0 \pm 1 \%$		$6.35 \pm 1 \%$	

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACC-75-10 (3 S&C) / A

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 %		42.8 ±1 %		3.6 ±1 %	
1800	72.0 ±1 %	PASS	41.7 ±1 %	PASS	3.6 ±1 %	PASS
1900	68.0 ±1 %		39.5 ±1 %		3.6 ±1 %	
1850	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 %		30.4 ±1 %		3.6 ±1 %	
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 CE/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 %		0.88 ±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 %	

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACB-75.10 (3 SAR)/A

1800	40.0 ±5 %	PASS	1.40 ±5 %	PASS
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 %		1.80 ±5 %	
2600	39.0 ±5 %		1.96 ±5 %	
3000	38.5 ±5 %		2.40 ±5 %	
3500	37.9 ±5 %		2.95 ±5 %	

7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

The IEEE Std. 1528 and C61/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 20V09 SAM71
Probe	SN 18/11 EPG122
Liquid	Head Liquid Values: $\rho_{\text{PS}} = 41.1 \text{ g/cm}^3$; $\rho_{\text{LIQ}} = 1.39$
Distance between dipole center and liquid	10.0 mm
Area scan resolution	$dx=8\text{mm}/dy=8\text{mm}$
Zoon Scan Resolution	$dx=8\text{mm}/dy=8\text{mm}/dz=5\text{mm}$
Frequency	1800 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		6.98	
1450	29		16	
1500	30.5		16.8	
1640	34.2		18.4	
1750	36.4		19.3	
1800	38.4	38.72 (3.87)	20.1	20.37 (2.04)

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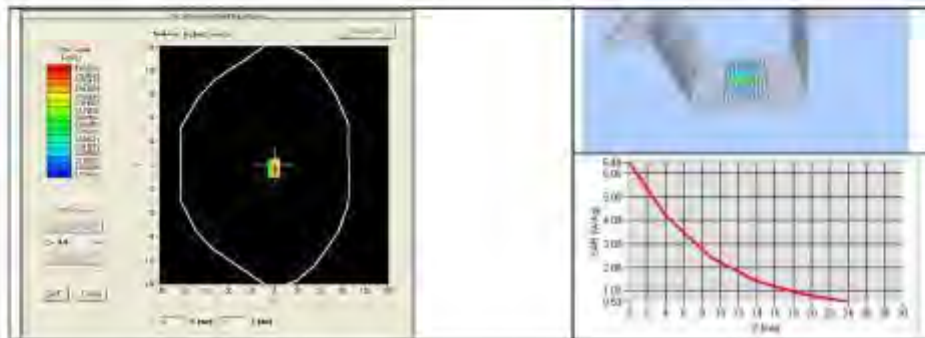
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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR-75.10 FS.SACITJ.A

1900	39.7		20.5	
1950	40.5		20.8	
2000	41.1		21.1	
2100	43.6		21.9	
2300	48.7		23.3	
2450	52.4		24	
2600	55.3		24.6	
3000	63.8		25.7	
3500	67.1		25	



7.3 BODY LIQUID MEASUREMENT

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

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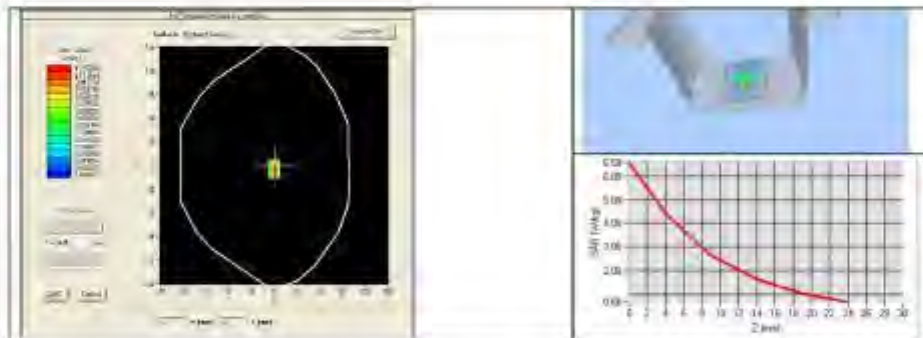
Ref: ACR-75.10 15 SAR11.A

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 20109 SAM71
Probe	SN 18111 EPG122
Liquid	Body Liquid Values: eps = 53.0 sigma = 1.52
Distance between dipole center and liquid	10.0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoon Scan Resolution	dx=8mm/dy=8m/dz=5mm
Frequency	1800 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
1800	40.42 (4.04)	21.53 (2.15)



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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACS-75-10 (3 S&IT) / A

8 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Description	Manufacturer / Model	Identification No.	Current Calibration Date	Next Calibration Date
SAM Phantom	MVG	SN-2009-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	MY49070681	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

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SAR Reference Dipole Calibration Report

Ref: ACR.75.11.15.SAT11.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: 1900 MHZ
SERIAL NO.: SN 25/13 DIP 1G900-249

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 MVJ USA using the COMOSAR test bench. All calibration results are traceable to national metrology institutions.



SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR-751115-SAR1-A

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

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

Issue	Date	Modifications
A	3/16/2015	Initial release

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR-7511ES SAR1/A

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7	Validation measurement	7
7.1	Head Liquid Measurement	7
7.2	SAR Measurement Result With Head Liquid	8
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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR-75.1.15.S&T/A

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 1900 MHz REFERENCE DIPOLE
Manufacturer	MVG
Model	SID1900
Serial Number	SN 25/13 DIP 1G900-249
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

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR-751135-SATU-A

4 MEASUREMENT METHOD

The IEEE 1528, FCC KDBs and CENELEC 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 constructed as outlined in the fore mentioned standards.

4.2 MECHANICAL REQUIREMENTS

The IEEE Std. 1528 and CENELEC 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 CENELEC 62209 standards were followed to generate the measurement uncertainty for validation measurements.

Scan Volume	Expanded Uncertainty
1 g	20.3 %

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SAR REFERENCE DIPOLE CALIBRATION REPORT

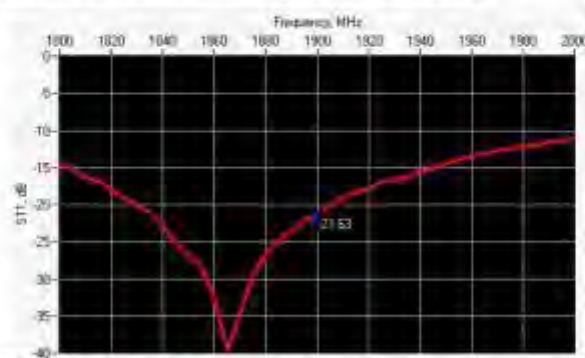
Ref: ACR.75.1.13.SA/TJ.A

10 g

20.1 %

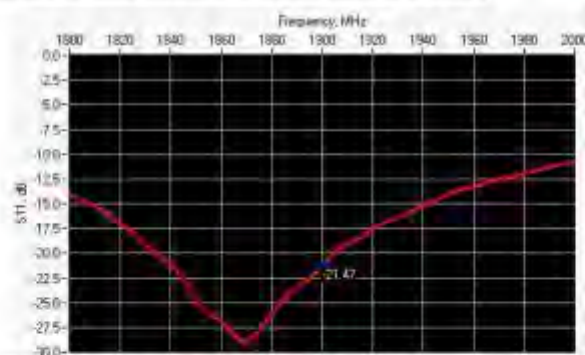
6 CALIBRATION MEASUREMENT RESULTS

6.1 RETURN LOSS AND IMPEDANCE IN HEAD LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
1900	-21.63	-20	53.9 Ω + 7.7 j Ω

6.2 RETURN LOSS AND IMPEDANCE IN BODY LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
1900	-21.47	-20	48.9 Ω + 8.4 j Ω

6.3 MECHANICAL DIMENSIONS

Frequency MHz	L mm		h mm		d mm	
	required	measured	required	measured	required	measured
300	420.0 $\pm$ 1 %		250.0 $\pm$ 1 %		6.35 $\pm$ 1 %	

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR-751115 SATJ-A

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 %	PASS	39.5 ±1 %	PASS	3.6 ±1 %	PASS
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 %		30.4 ±1 %		3.6 ±1 %	
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/EC 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	41.8 ±5 %		0.88 ±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 %	

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR-751135 SAR/FA

1800	40.0 ±5 %		1.40 ±5 %	
1900	40.0 ±5 %	PASS	1.40 ±5 %	PASS
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 %		1.80 ±5 %	
2600	39.0 ±5 %		1.96 ±5 %	
3000	38.5 ±5 %		2.40 ±5 %	
3500	37.9 ±5 %		2.80 ±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: $\rho_{\text{HS}} = 409 \text{ g/cm}^3$, $\sigma_{\text{HS}} = 1.43$
Distance between dipole center and liquid	10.0 mm
Area scan resolution	$dx=8\text{mm}/dy=8\text{mm}$
Zoon Scan Resolution	$dx=8\text{mm}/dy=8\text{mm}/dz=5\text{mm}$
Frequency	1900 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		6.95	
1450	29		16	
1500	30.5		16.8	
1640	34.2		18.4	
1750	36.4		19.3	
1800	38.4		20.1	

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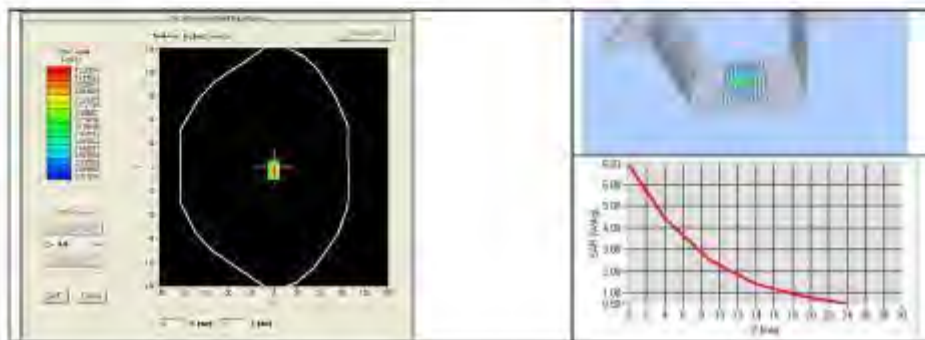
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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.75.1.13.5.1/1.1

1900	39.7	40.75 (4.06)	20.5	20.82 (2.08)
1950	40.5		20.9	
2000	41.1		21.1	
2100	43.6		21.9	
2300	48.7		23.3	
2450	52.4		24	
2600	55.3		24.6	
3000	63.8		25.7	
3500	67.1		25	



7.3 BODY LIQUID MEASUREMENT

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

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SAR REFERENCE DIPOLE CALIBRATION REPORT

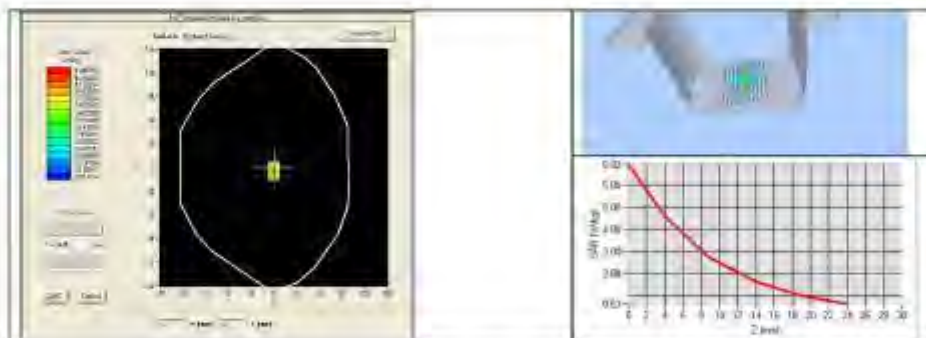
Ref: ACR-751115 SATIFA

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 20109 SAM71
Probe	SN 18/11 EPG122
Liquid	Body Liquid Values: $\epsilon_{ps} = 53.9$ $\sigma_{ps} = 1.55$
Distance between dipole center and liquid	10.0 mm
Area scan resolution	$dx=8mm/dy=8mm$
Zoon Scan Resolution	$dx=8mm/dy=8m/dz=5mm$
Frequency	1900 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
1900	42.06 (4.21)	21.87 (2.19)



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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR-751115-SAT/F-A

8 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Description	Manufacturer / Model	Identification No.	Current Calibration Date	Next Calibration Date
SAM Phantom	MVG	SN-2009-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	MY49070681	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

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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-7513 ES SAR1/A

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

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

Issue	Date	Modifications
A	3/16/2015	Initial release

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR-75.13.15 SAR11.A

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR-75.13.F5.S&ITJ.A

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

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR-7513 ES SAR/TA

4 MEASUREMENT METHOD

The IEEE 1528, FCC KDBs and CENELEC 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 constructed as outlined in the fore mentioned standards.

4.2 MECHANICAL REQUIREMENTS

The IEEE Std. 1528 and CENELEC 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 CENELEC 62209 standards were followed to generate the measurement uncertainty for validation measurements.

Scan Volume	Expanded Uncertainty
1 g	20.3 %

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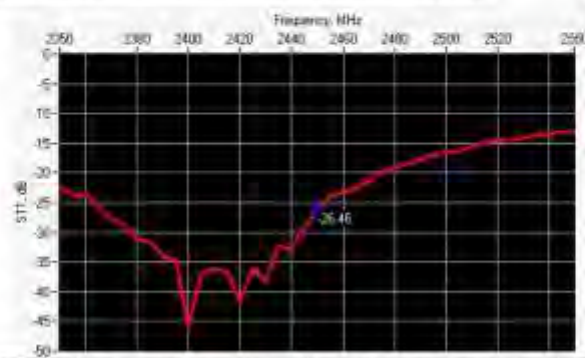
Ref: ACR-75.13.F5.SA11/A

10 g

20.1 %

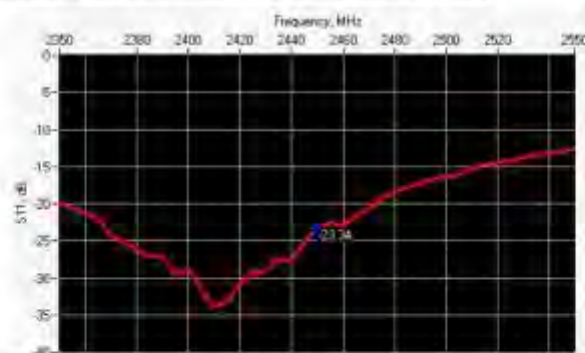
6 CALIBRATION MEASUREMENT RESULTS

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 j Ω

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 j Ω

6.3 MECHANICAL DIMENSIONS

Frequency MHz	L mm		h mm		d mm	
	required	measured	required	measured	required	measured
300	420.0 $\pm$ 1 %		250.0 $\pm$ 1 %		6.35 $\pm$ 1 %	

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR-7513 ES 5401/A

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/EC 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	41.8 ±5 %		0.88 ±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 %	

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR-75.13 ES SAR/TA

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 %		2.80 ±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 20V09 SAM71
Probe	SN 18/11 EPG122
Liquid	Head Liquid Values: $\mu\text{m} = 38.9$ $\sigma_{\text{m} = 1.79}$
Distance between dipole center and liquid	10.0 mm
Area scan resolution	$dx=8\text{mm}$ $dy=8\text{mm}$
Zoon Scan Resolution	$dx=5\text{mm}/dy=5\text{mm}/dz=5\text{mm}$
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		6.98	
1450	29		16	
1500	30.5		16.8	
1640	34.2		18.4	
1750	36.4		19.3	
1800	38.4		20.1	

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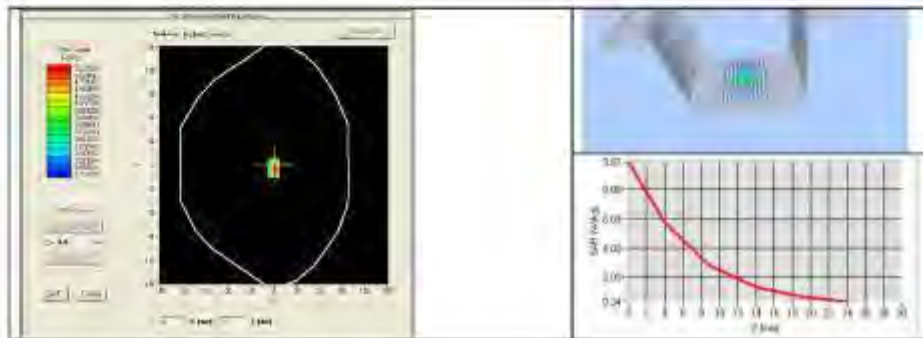
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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR-75.13.F5.S&ITJ.A

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

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SAR REFERENCE DIPOLE CALIBRATION REPORT

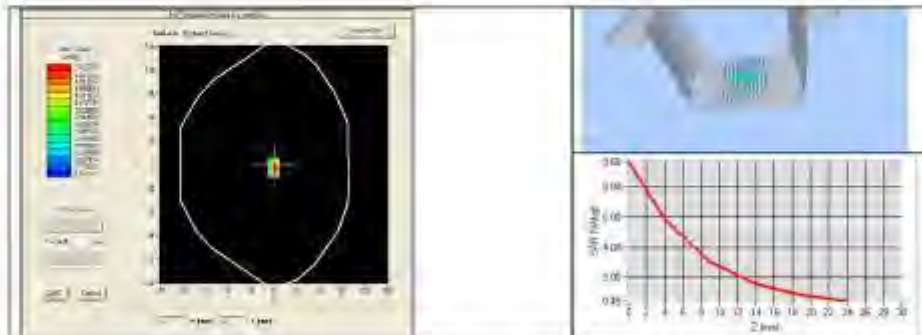
Ref: ACR-75.13.15.SATF.A

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: $\epsilon_{ps} = 52.7$ $\sigma = 1.94$
Distance between dipole center and liquid	10.0 mm
Area scan resolution	$dx=8mm/dy=8mm$
Zoom Scan Resolution	$dx=5mm/dy=5mm/dz=5mm$
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 [2.48]



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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR-75.13.13.SATU.A

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	Garrera	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	11-861-9	8/2012	8/2015

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SAR Reference Dipole Calibration Report

Ref: ACR.75.14.15.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: 2600 MHZ
SERIAL NO.: SN 25/13 DIP 2G600-254

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: ACE-75.14 15 SAR/1. A

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

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

Issue	Date	Modifications
A	3/16/2015	Initial release

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR-75.14.13.S&ITJ.A

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Rev: ACR-75.14.13.5(11) A

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 2600 MHz REFERENCE DIPOLE
Manufacturer	MVG
Model	SID2600
Serial Number	SN 25/13 DIP 2G600-254
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

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACS-75.14.03.5.0111.A

4 MEASUREMENT METHOD

The IEEE 1528, FCC KDBs and CEM/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 constructed as outlined in the fore mentioned standards.

4.2 MECHANICAL REQUIREMENTS

The IEEE Std. 1528 and CEM/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 CEM/IEC 62209 standards were followed to generate the measurement uncertainty for validation measurements.

Scan Volume	Expanded Uncertainty
1 g	20.3 %

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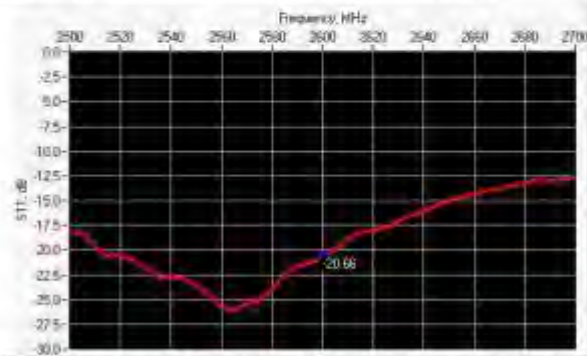
SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.73.14.13.SATTJ.A

10 g	20.1 %
------	--------

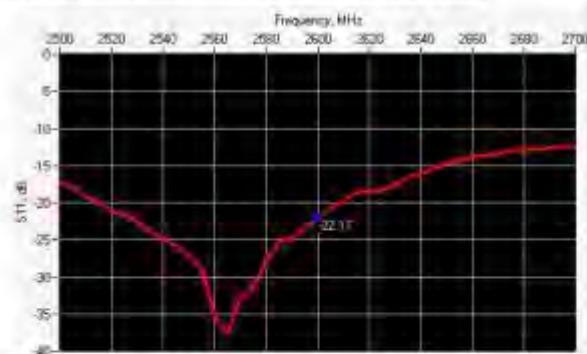
6 CALIBRATION MEASUREMENT RESULTS

6.1 RETURN LOSS AND IMPEDANCE IN HEAD LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
2600	-20.66	-20	$51.0 \Omega + 9.4 j\Omega$

6.2 RETURN LOSS AND IMPEDANCE IN BODY LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
2600	-22.17	-20	$47.9 \Omega + 7.5 j\Omega$

6.3 MECHANICAL DIMENSIONS

Frequency MHz	L mm		h mm		d mm	
	required	measured	required	measured	required	measured
300	$420.0 \pm 1 \%$		$250.0 \pm 1 \%$		$6.35 \pm 1 \%$	

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACC-75.14.13.5.0111.A

450	290.0 ±1 %		166.7 ±1 %		6.35 ±1 %	
750	176.0 ±1 %		100.0 ±1 %		6.35 ±1 %	
835	161.0 ±1 %		88.8 ±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 %		42.8 ±1 %		3.6 ±1 %	
1800	72.0 ±1 %		41.7 ±1 %		3.6 ±1 %	
1900	68.0 ±1 %		39.5 ±1 %		3.6 ±1 %	
1850	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 %		30.4 ±1 %		3.6 ±1 %	
2600	48.5 ±1 %	PASS	28.8 ±1 %	PASS	3.6 ±1 %	PASS
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 %		0.88 ±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 %	

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACB-75.14.13 SAR/1.1

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 %		1.80 ±5 %	
2600	39.0 ±5 %	PASS	1.96 ±5 %	PASS
3000	38.5 ±5 %		2.40 ±5 %	
3500	37.9 ±5 %		2.95 ±5 %	

7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

The IEEE Std. 1528 and C61/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 20V09 SAM71
Probe	SN 18/11 EPG122
Liquid	Head Liquid Values: $\rho_{\text{PS}} = 38.2 \text{ g/cm}^3 \pm 1.93$
Distance between dipole center and liquid	10.0 mm
Area scan resolution	$\Delta x=8\text{mm}$ $\Delta y=8\text{mm}$
Zoon Scan Resolution	$\Delta x=5\text{mm}$ $\Delta y=5\text{mm}$ $\Delta z=5\text{mm}$
Frequency	2600 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		6.98	
1450	29		16	
1500	30.5		16.8	
1640	34.2		18.4	
1750	36.4		19.3	
1800	38.4		20.1	

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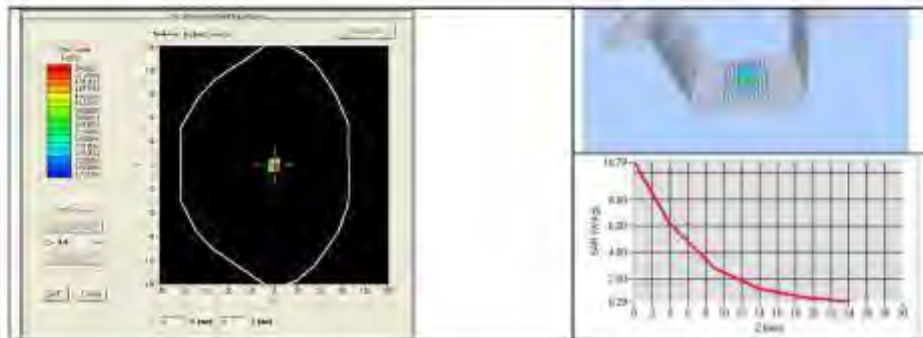
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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.75.14.15.SA(1).A

1900	39.7		20.5	
1950	40.5		20.8	
2000	41.1		21.1	
2100	43.6		21.9	
2300	48.7		23.3	
2450	52.4		24	
2600	55.3	57.37 (5.74)	24.6	24.68 (2.47)
3000	63.8		25.7	
3500	67.1		25	



7.3 BODY LIQUID MEASUREMENT

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

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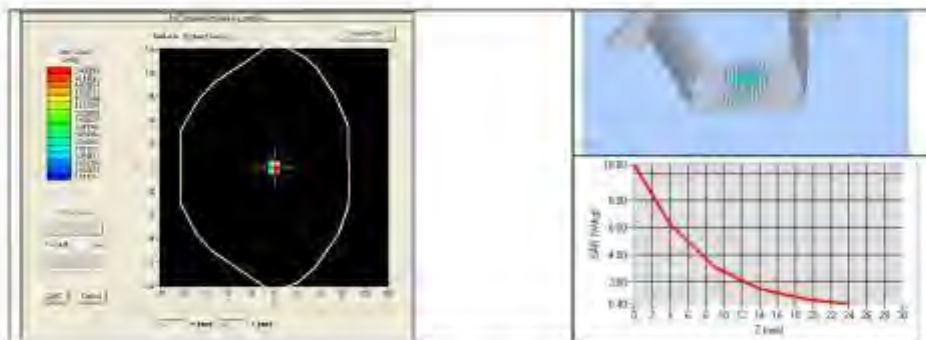
Ref: ACR-75.14.13.5(CT) A

2600	52.5 ±5 %	PASS	2.16 ±5 %	PASS
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 20109 SAM71
Probe	SN 18/11 EPG122
Liquid	Body Liquid Values: eps = 51.6 sigma = 2.21
Distance between dipole center and liquid	10.0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoom Scan Resolution	dx=5mm/dy=5mm/dz=5mm
Frequency	2600 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
2600	57.62 (5.76)	25.39 (2.54)



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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR-75-14-15 SAR/1-A

8 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Description	Manufacturer / Model	Identification No.	Current Calibration Date	Next Calibration Date
SAM Phantom	MVG	SN-2009-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	MY49070681	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	US37181480	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

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F.8 SATIMO Dipole Measurement

Please refer the document “SATIMO Dipole Measurement Report.pdf”.

--END OF REPORT--