
SAR Test Report

Report No.: AGC10576170701FH01

FCC ID : 2AM8GCHAMELEON

APPLICATION PURPOSE : Original Equipment

PRODUCT DESIGNATION : IP54 - IP 67 Rugged Handheld, Desktop & Tablet Devices

BRAND NAME : LAXTON

MODEL NAME : Chameleon, LAXTAB2000,LAXHND2000,LAXDSK2000,LAXBIO2000,
LAXCAM2000, LAXSIG2000, LAXSCN2000, LAXACS2000, LAX80x,
LAX50x, Chameleon 5, Chameleon 8, Chameleon Q, Chameleon C,
Chameleon 50x, Chameleon 80x, Chameleon Q0x, Chameleon C0x

CLIENT : GUANGZHOU LIE DUN ELECTRONICS TECHNOLOGY CO. LIMITED

DATE OF ISSUE : July 10,2017

STANDARD(S) : IEEE Std. 1528:2013
FCC 47CFR § 2.1093
IEEE/ANSI C95.1:2005

REPORT VERSION : V1.0

Attestation of Global Compliance(Shenzhen) Co., Ltd.

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Report Revise Record

Report Version	Revise Time	Issued Date	Valid Version	Notes
V1.0	/	July 10,2017	Valid	Original Report

Test Report Certification

Applicant Name	GUANGZHOU LIE DUN ELECTRONICS TECHNOLOGY CO. LIMITED
Applicant Address	No.4 plant of No.43 South International Trade Avenue, Hualong Town, Panyu District, Guangzhou
Manufacturer Name	GUANGZHOU LIE DUN ELECTRONICS TECHNOLOGY CO. LIMITED
Manufacturer Address	No.4 plant of No.43 South International Trade Avenue, Hualong Town, Panyu District, Guangzhou
Product Designation	IP54 - IP 67 Rugged Handheld, Desktop & Tablet Devices
Brand Name	LAXTON
Model Name	Chameleon, LAXTAB2000,LAXHND2000,LAXDSK2000,LAXBIO2000, LAXCAM2000, LAXSIG2000, LAXSCN2000, LAXACS2000, LAX80x, LAX50x, Chameleon 5, Chameleon 8, Chameleon Q, Chameleon C, Chameleon 50x, Chameleon 80x, Chameleon Q0x, Chameleon C0x
Different Description	All the models are the same, only different in model names and appearance. The test model is Chameleon
EUT Voltage	DC3.7V by battery
Applicable Standard	IEEE Std. 1528:2013 FCC 47CFR § 2.1093 IEEE/ANSI C95.1:2005
Test Date	July 02,2017 to July 09,2017
Performed Location	Attestation of Global Compliance(Shenzhen) Co., Ltd. 2 F, Building 2, No.1-No.4, Chaxi Sanwei Technical Industrial Park, Gushu, Xixiang Street, Bao'an District, Shenzhen, China
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SUN Yin

Tested By _____
Sun Yin (Yin Cheng) July 09,2017

Angela Li

Checked By _____
Angela Li(Li Jiao) July 10,2017

Forrest Lei

Authorized By _____
Forrest Lei(Lei Yonggang) July 10,2017
Authorized Officer

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1. SUMMARY OF MAXIMUM SAR VALUE

The maximum results of Specific Absorption Rate (SAR) found during testing for EUT are as follows:

Frequency Band	Highest Reported 1g-SAR(W/Kg)	SAR Test Limit (W/Kg)
	Body-worn (with 0mm separation)	
GSM 850	0.627	1.6
PCS 1900	0.739	
UMTS Band II	0.711	
UMTS Band V	0.601	
WIFI 2.4G	0.202	
Simultaneous Reported SAR	0.829	
SAR Test Result	PASS	

This device is compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (1.6W/Kg) specified in IEEE Std. 1528:2013; FCC 47CFR § 2.1093; IEEE/ANSI C95.1:2005 and the following specific FCC Test Procedures:

- KDB 447498 D01 General RF Exposure Guidance v06
- KDB 648474 D04 Handset SAR v01r03
- KDB 865664 D01 SAR Measurement 100MHz to 6GHz v01r04
- KDB 941225 D01 3G SAR Procedures v03r01
- KDB 941225 D06 Hotspot Mode v02r01
- KDB 248227 D01 802 11 Wi-Fi SAR v02r02
- KDB 616217 D04 SAR for laptop and tablets v01r02

2. GENERAL INFORMATION

2.1. EUT Description

General Information	
Product Designation	IP54 - IP 67 Rugged Handheld, Desktop & Tablet Devices
Test Model	Chameleon
Hardware Version	V1.3
Software Version	V1.3
Device Category	Portable
RF Exposure Environment	Uncontrolled
Antenna Type	Internal
GPRS & EGPRS	
Support Band	<input checked="" type="checkbox"/> GSM 850 <input checked="" type="checkbox"/> PCS 1900 <input type="checkbox"/> GSM 900 <input type="checkbox"/> DCS 1800
GPRS & EGPRS Type	Class B
GPRS & EGPRS Class	Class 33(1Tx+5Rx, 2Tx+4Rx, 3Tx+3Rx, 4Tx+2Rx)
TX Frequency Range	GSM 850 : 820-850MHz;; PCS 1900: 1850-1910MHz;
RX Frequency Range	GSM 850 : 869~894MHz; PCS 1900: 1930~1990MHz
Release Version	R99
Type of modulation	GMSK for GPRS; GMSK & 8-PSK for EGPRS
Antenna Gain	1.0dBi
Max. Average Power	GSM850: 30.80dBm ;PCS1900: 26.53dBm
WCDMA	
Support Band	<input checked="" type="checkbox"/> UMTS FDD Band II <input checked="" type="checkbox"/> UMTS FDD Band V <input type="checkbox"/> UMTS FDD Band I <input type="checkbox"/> UMTS FDD Band VIII
HS Type	HSPA(HSUPA/HSDPA)
TX Frequency Range	WCDMA FDD Band II: 1850-1910MHz;WCDMA FDD Band V: 820-850MHz
RX Frequency Range	WCDMA FDD Band II: 1930-1990MHz;WCDMA FDD Band V: 869-894MHz
Release Version	Rel-6
Type of modulation	HSDPA:QPSK/16QAM; HSUPA:BPSK; WCDMA:QPSK
Antenna Gain	1.0dBi
Max. Average Power	Band II: 19.74dBm; Band V: 19.84dBm

EUT Description(Continue)

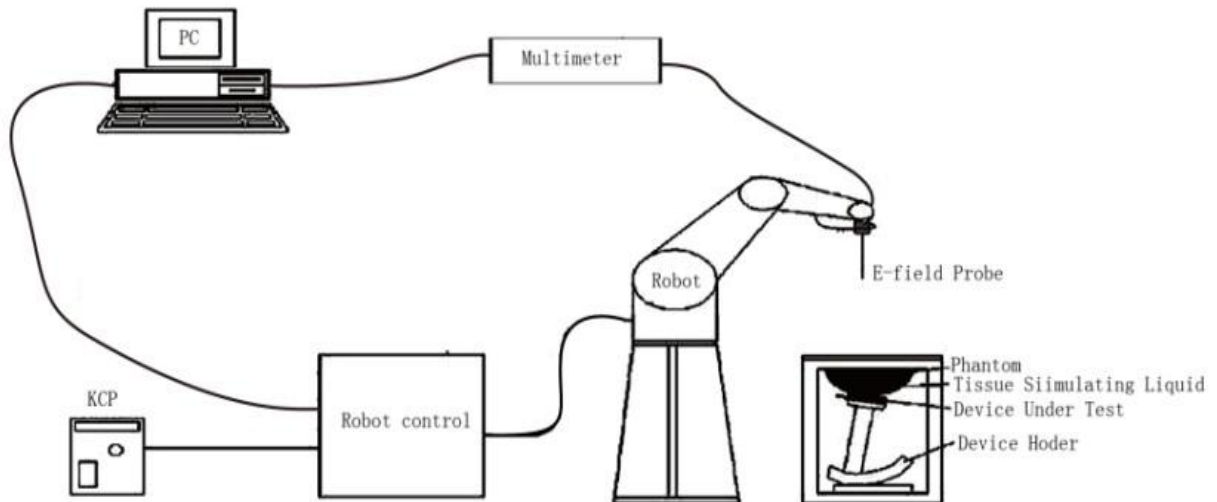
Bluetooth	
Bluetooth Version	<input type="checkbox"/> V2.0 <input type="checkbox"/> V2.1 <input type="checkbox"/> V2.1+EDR <input checked="" type="checkbox"/> V3.0 <input type="checkbox"/> V3.0+HS <input checked="" type="checkbox"/> V4.0 <input type="checkbox"/> V4.1
Operation Frequency	2402~2480MHz
Type of modulation	<input checked="" type="checkbox"/> GFSK <input checked="" type="checkbox"/> II/4-DQPSK <input checked="" type="checkbox"/> 8-DPSK
Max. Peak Power	2.890dBm
Antenna Gain	0.7dBi
WIFI	
WIFI Specification	<input type="checkbox"/> 802.11a <input checked="" type="checkbox"/> 802.11b <input checked="" type="checkbox"/> 802.11g <input checked="" type="checkbox"/> 802.11n(20) <input checked="" type="checkbox"/> 802.11n(40)
Operation Frequency	2412~2462MHz
Avg. Burst Power	11b: 14.68dBm,11g: 12.29dBm,11n(20): 12.23dBm,11n(40): 12.00dBm
Antenna Gain	0.7dBi
Accessories	
Battery	Brand name: SHIRUI Model No. : 4890108P-1S2P Voltage and Capacitance: 3.7 V & 13000mAh
Adapter	Brand name: BOYAXUAN Model No. : BYX-0505000M Input: AC 100-240V, 50/60Hz, 0.8A Output: DC 5V, 5A
Earphone	Brand name: N/A Model No. : N/A

Note:1.CMU200 can measure the average power and Peak power at the same time
2.The sample used for testing is end product.

Product	Type
	<input checked="" type="checkbox"/> Production unit <input type="checkbox"/> Identical Prototype

3. SAR MEASUREMENT SYSTEM

3.1. The SATIMO system used for performing compliance tests consists of following items



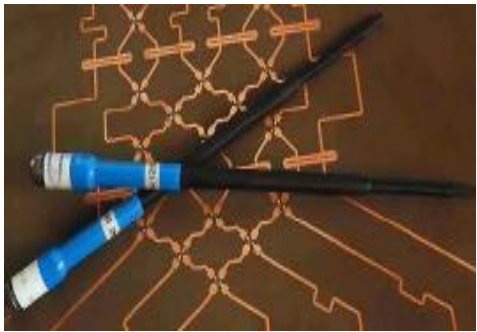
The COMOSAR system for performing compliance tests consists of the following items:

- The PC. It controls most of the bench devices and stores measurement data. A computer running WinXP and the Opensar software.
- The E-Field probe. The probe is a 3-axis system made of 3 distinct dipoles. Each dipole returns a voltage in function of the ambient electric field.
- The Keithley multimeter measures each probe dipole voltages.
- The SAM phantom simulates a human head. The measurement of the electric field is made inside the phantom.
- The liquids simulate the dielectric properties of the human head tissues.
- The network emulator controls the mobile phone under test.
- The validation dipoles are used to measure a reference SAR. They are used to periodically check the bench to make sure that there is no drift of the system characteristics over time.
- The phantom, the device holder and other accessories according to the targeted measurement.

3.2. COMOSAR E-Field Probe

The SAR measurement is conducted with the dosimetric probe manufactured by SATIMO. The probe is specially designed and calibrated for use in liquid with high permittivity. The dosimetric probe has special calibration in liquid at different frequency. SATIMO conducts the probe calibration in compliance with international and national standards (e.g. IEEE 1528 and relevant KDB files.) The calibration data are in Appendix D.

Isotropic E-Field Probe Specification

Model	SSE5	
Manufacture	MVG	
Identification No.	SN 19/15 EP253	
Frequency	0.4GHz-3GHz Linearity:±0.05dB(400MHz-3GHz)	
Dynamic Range	0.01W/Kg-100W/Kg Linearity:±0.05dB	
Dimensions	Overall length:330mm Length of individual dipoles:4.5mm Maximum external diameter:8mm Probe Tip external diameter:5mm Distance between dipoles/ probe extremity:2.7mm	
Application	High precision dosimetric measurements in any exposure scenario (e.g., very strong gradient fields). Only probe which enables compliance testing for frequencies up to 3 GHz with precision of better 30%.	

3.3. Robot

The COMOSAR system uses the KUKA robot from SATIMO SA (France).For the 6-axis controller COMOSAR system, the KUKA robot controller version from SATIMO is used.

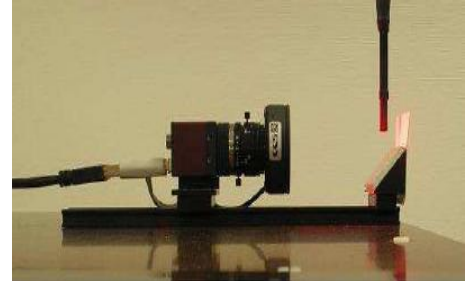
The XL robot series have many features that are important for our application:

- High precision (repeatability 0.02 mm)
- High reliability (industrial design)
- Jerk-free straight movements
- Low ELF interference (the closed metallic construction shields against motor control fields)
- 6-axis controller



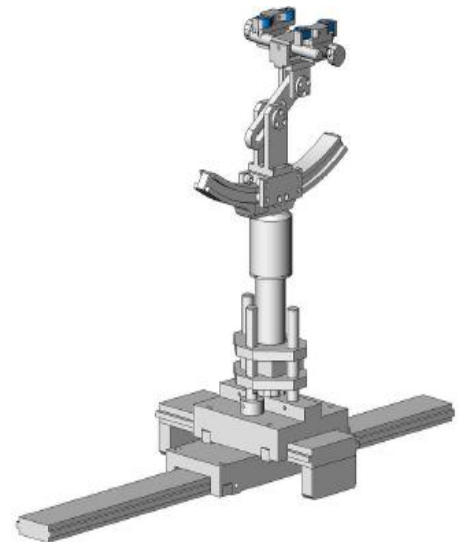
3.4. Video Positioning System

The video positioning system is used in OpenSAR to check the probe. Which is composed of a camera, LED, mirror and mechanical parts. The camera is piloted by the main computer with firewire link. During the process, the actual position of the probe tip with respect to the robot arm is measured, as well as the probe length and the horizontal probe offset. The software then corrects all movements, such that the robot coordinates are valid for the probe tip. The repeatability of this process is better than 0.1 mm. If a position has been taught with an aligned probe, the same position will be reached with another aligned probe within 0.1 mm, even if the other probe has different dimensions. During probe rotations, the probe tip will keep its actual position.



3.5. Device Holder

The COMOSAR device holder is designed to cope with different positions given in the standard. It has two scales for the device rotation (with respect to the body axis) and the device inclination (with respect to the line between the ear reference points). The rotation center for both scales is the ear reference point (EPR). Thus the device needs no repositioning when changing the angles. The COMOSAR device holder has been made out of low-loss POM material having the following dielectric parameters: relative permittivity $\epsilon_r = 3$ and loss tangent $\delta = 0.02$. The amount of dielectric material has been reduced in the closest vicinity of the device, since measurements have suggested that the influence of the clamp on the test results could thus be lowered.



3.6. ELLI39 Phantom

The Flat phantom is a fiberglass shell phantom with 2mm \pm 0.2 mm shell thickness. It has only one measurement area for Flat phantom



4. SAR MEASUREMENT PROCEDURE

4.1. Specific Absorption Rate (SAR)

SAR is related to the rate at which energy is absorbed per unit mass in 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 occupational/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 given mass density (ρ). The equation description is as below:

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

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

SAR can be obtained using either of the following equations:

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

$$SAR = c_h \left. \frac{dT}{dt} \right|_{t=0}$$

Where

SAR	is the specific absorption rate in watts per kilogram;
E	is the r.m.s. value of the electric field strength in the tissue in volts per meter;
σ	is the conductivity of the tissue in siemens per metre;
ρ	is the density of the tissue in kilograms per cubic metre;
c_h	is the heat capacity of the tissue in joules per kilogram and Kelvin;

$\left. \frac{dT}{dt} \right|_{t=0}$ is the initial time derivative of temperature in the tissue in kelvins per second

4.2. SAR Measurement Procedure

Step 1: Power Reference Measurement

The Power Reference Measurement and Power Drift Measurement are for monitoring the power drift of the device under test in the batch process. The minimum distance of probe sensors to surface is 2.7mm This distance cannot be smaller than the distance os sensor calibration points to probe tip as `defined in the probe properties,

Step 2: Area Scan

The Area Scan is used as a fast scan in two dimensions to find the area of high field values, before doing a fine measurement around the hot spot. The sophisticated interpolation routines implemented in SATIMO software can find the maximum locations even in relatively coarse grids. When an Area Scan has measured all reachable points, it computes the field maximal found in the scanned area, within a range of the global maximum. The range (in db) is specified in the standards for compliance testing. For example, a 2db range is required in IEEE Standard 1528, whereby 3db is a requirement when compliance is assessed in accordance with the ARIB standard (Japan) If one Zoom Scan follows the Area Scan, then only the absolute maximum will be taken as reference. For cases where multiple maximum are detected, the number of Zoom Scan has to be increased accordingly.

Area Scan Parameters extracted from KDB 865664 D01 SAR Measurement 100MHz to 6GHz

	≤ 3 GHz	> 3 GHz
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.	

Step 3: Zoom Scan

Zoom Scan are used to assess the peak spatial SAR value within a cubic average volume containing 1g abd 10g of simulated tissue. The Zoom Scan measures points(refer to table below) within a cube whose base faces are centered on the maxima found in a preceding area scan job within the same procedure. When the measurement is done, the Zoom Scan evaluates the averaged SAR for 1g and 10g and displays these values next to the job's label.

Zoom Scan Parameters extracted from KDB865664 d01 SAR Measurement 100MHz to 6GHz

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: $\Delta z_{Zoom}(n)$	≤ 5 mm	3 – 4 GHz: ≤ 4 mm 4 – 5 GHz: ≤ 3 mm 5 – 6 GHz: ≤ 2 mm
	graded grid	$\Delta z_{Zoom}(1)$: between 1 st two points closest to phantom surface	≤ 4 mm
		$\Delta z_{Zoom}(n>1)$: between subsequent points	$\leq 1.5 \cdot \Delta z_{Zoom}(n-1)$
Minimum zoom scan volume	x, y, z	≥ 30 mm	3 – 4 GHz: ≥ 28 mm 4 – 5 GHz: ≥ 25 mm 5 – 6 GHz: ≥ 22 mm
<p>Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details.</p> <p>* When zoom scan is required and the <i>reported</i> SAR from the <i>area scan based I-g SAR estimation</i> 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 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.</p>			

Step 4: Power Drift Measurement

The Power Drift Measurement measures the field at the same location as the most recent power reference measurement within the same procedure, and with the same settings. The Power Drift Measurement gives the field difference in dB from the reading conducted within the same settings. This allows a user to monitor the power drift of the device under test within a batch process. The measurement procedure is the same as Step 1.

4.3. RF Exposure Conditions

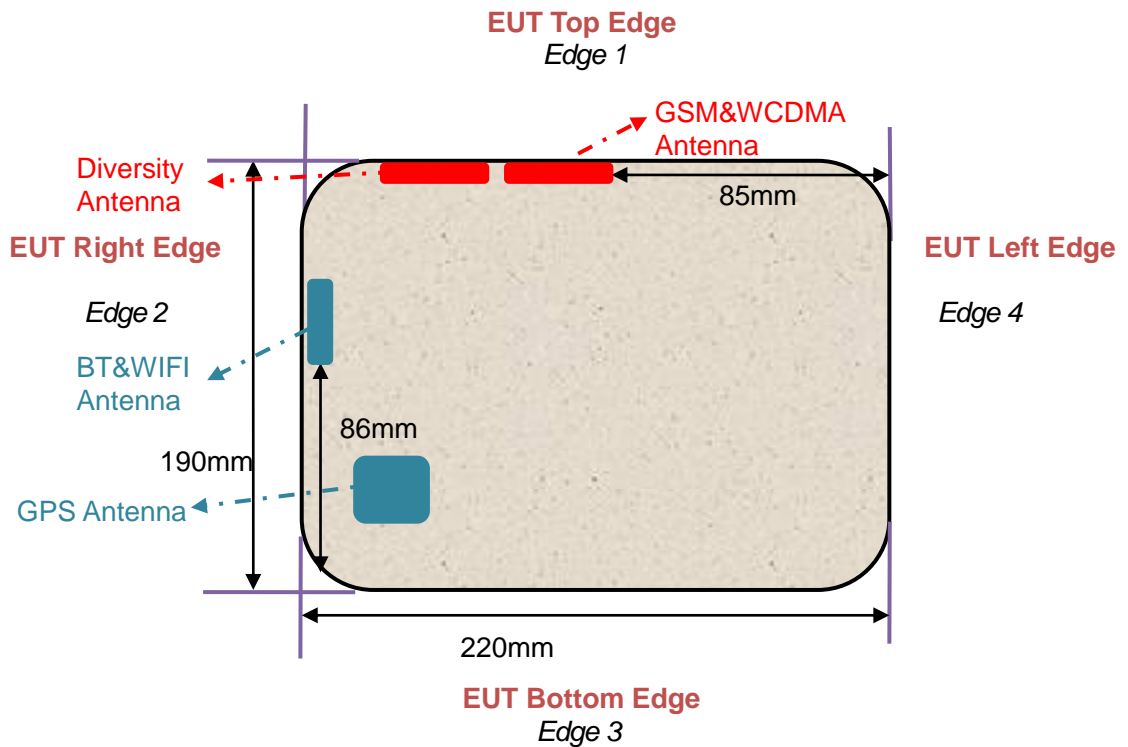
Test Configuration and setting:

The EUT is a model of GSM Portable Mobile Station (MS). It supports GPRS/EGPRS, HSDPA/HSUPA, BT, WIFI, and support hot spot mode.

For WWAN SAR testing, the device was controlled by using a base station emulator. Communication between the device and the emulator were established by air link. The distance between the EUT and the antenna is larger than 50cm, and the output power radiated from the emulator antenna is at least 30db smaller than the output power of EUT.

For WLAN testing, the EUT is configured with the WLAN continuous TX tool through engineering command.

Antenna Location: (the back view)



5. TISSUE 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 15cm. For head SAR testing the liquid height from the ear reference point (ERP) of the phantom to the liquid top surface is larger than 15cm For body SAR testing, the liquid height from the center of the flat phantom to the liquid top surface is larger than 15cm. The nominal dielectric values of the tissue simulating liquids in the phantom and the tolerance of 5% are listed in 5.2

5.1. The composition of the tissue simulating liquid

Ingredient (% Weight) Frequency (MHz)	Water	Nacl	Polysorbate 20	DGBE	1,2 Propanediol	Triton X-100
835 Body	54.00	1	0.0	15	0.0	30
1900 Body	70	1	0.0	9	0.0	20
2450 Body	70	1	0.0	9	0.0	20

5.2. Tissue Dielectric Parameters for Head and Body Phantoms

The head tissue dielectric parameters recommended by the IEEE 1528 have been incorporated in the following table. These head parameters are derived from planar layer models simulating the highest expected SAR for the dielectric properties and tissue thickness variations in a human head. Other head and body tissue parameters that have not been specified in IEEE 1528 are derived from the tissue dielectric parameters computed from the 4-Cole-Cole equations described in Reference [12] and extrapolated according to the head parameters specified in IEEE 1528.

Target Frequency (MHz)	head		body	
	ϵ_r	σ (S/m)	ϵ_r	σ (S/m)
300	45.3	0.87	58.2	0.92
450	43.5	0.87	56.7	0.94
835	41.5	0.90	55.2	0.97
900	41.5	0.97	55.0	1.05
915	41.5	1.01	55.0	1.06
1450	40.5	1.20	54.0	1.30
1610	40.3	1.29	53.8	1.40
1800 – 2000	40.0	1.40	53.3	1.52
2450	39.2	1.80	52.7	1.95
3000	38.5	2.40	52.0	2.73

(ϵ_r = relative permittivity, σ = conductivity and $\rho = 1000$ kg/m³)

5.3. Tissue Calibration Result

The dielectric parameters of the liquids were verified prior to the SAR evaluation using SATIMO Dielectric Probe Kit and R&S Network Analyzer ZVL6.

Tissue Stimulant Measurement for 835MHz					
	Fr. (MHz)	Dielectric Parameters ($\pm 5\%$)		Tissue Temp [$^{\circ}$ C]	Test time
		ϵ_r 55.20(52.44-57.96)	δ [s/m]0.97(0.9215-1.0185)		
Body	824.2	56.43	0.94	21.2	July 09,2017
	826.4	55.81	0.96		
	835	55.35	0.96		
	836.6	54.79	0.97		
	846.6	54.32	0.98		
	848.8	53.69	0.99		

Tissue Stimulant Measurement for 1900MHz					
	Fr. (MHz)	Dielectric Parameters ($\pm 5\%$)		Tissue Temp [$^{\circ}$ C]	Test time
		ϵ_r 53.30(50.635-55.965)	δ [s/m]1.52(1.444-1.596)		
Body	1850.2	55.00	1.46	21.3	July 02,2017
	1852.4	54.51	1.48		
	1880	53.63	1.51		
	1900	53.22	1.52		
	1907.6	52.79	1.54		
	1909.8	52.31	1.56		

Tissue Stimulant Measurement for 2450MHz					
	Fr. (MHz)	Dielectric Parameters ($\pm 5\%$)		Tissue Temp [$^{\circ}$ C]	Test time
		ϵ_r 52.7(50.065-55.335)	δ [s/m]1.95(1.8525-2.0475)		
Body	2412	54.10	1.88	21.2	July 06,2017
	2437	53.67	1.90		
	2450	53.05	1.92		
	2462	52.41	1.94		

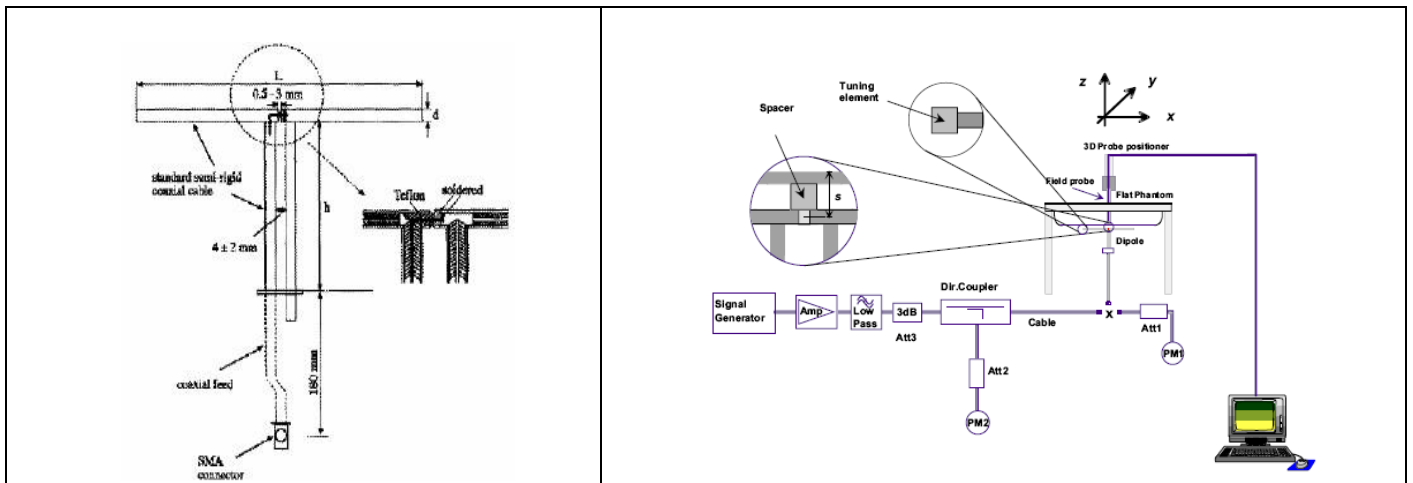
6. SAR SYSTEM CHECK PROCEDURE

6.1. SAR System Check Procedures

SAR system check is required to confirm measurement accuracy, according to the tissue dielectric media, probe calibration points and other system operating parameters required for measuring the SAR of a test device. The system verification must be performed for each frequency band and within the valid range of each probe calibration point required for testing the device. The same SAR probe(s) and tissue-equivalent media combinations used with each specific SAR system for system verification must be used for device testing. When multiple probe calibration points are required to cover substantially large transmission bands, independent system verifications are required for each probe calibration point. A system verification must be performed before each series of SAR measurements using the same probe calibration point and tissue-equivalent medium. Additional system verification should be considered according to the conditions of the tissue-equivalent medium and measured tissue dielectric parameters, typically every three to four days when the liquid parameters are remeasured or sooner when marginal liquid parameters are used at the beginning of a series of measurements.

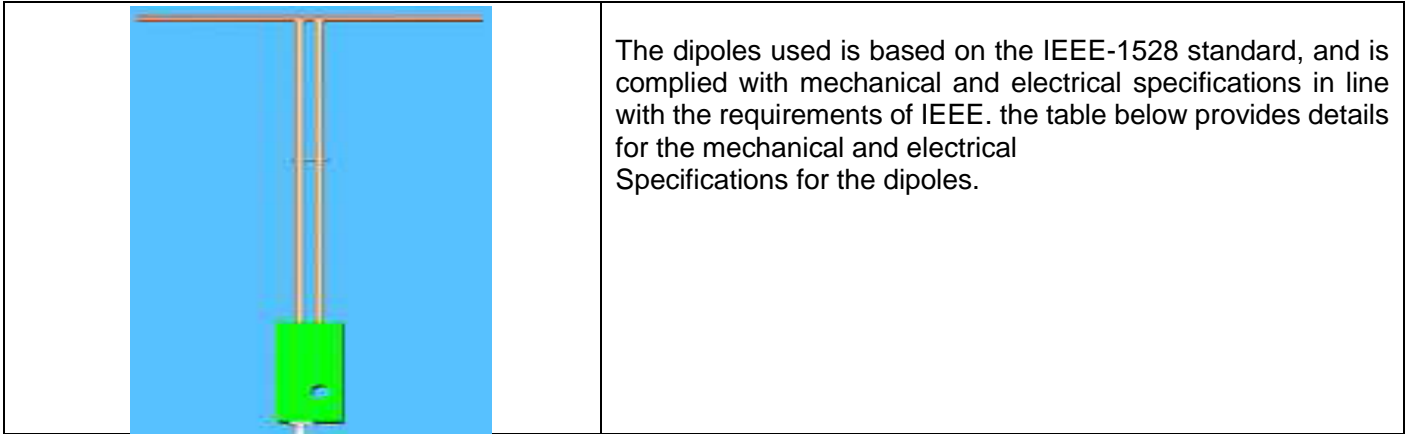
Each SATIMO system is equipped with one or more system check kits. These units, together with the predefined measurement procedures within the SATIMO software, enable the user to conduct the system check and system validation. System kit includes a dipole, and dipole device holder.

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



6.2. SAR System Check

6.2.1. Dipoles



Frequency	L (mm)	h (mm)	d (mm)
835MHz	161.0	89.8	3.6
1900MHz	68	39.5	3.6
2450MHz	51.5	30.4	3.6

6.2.2. System Check Result

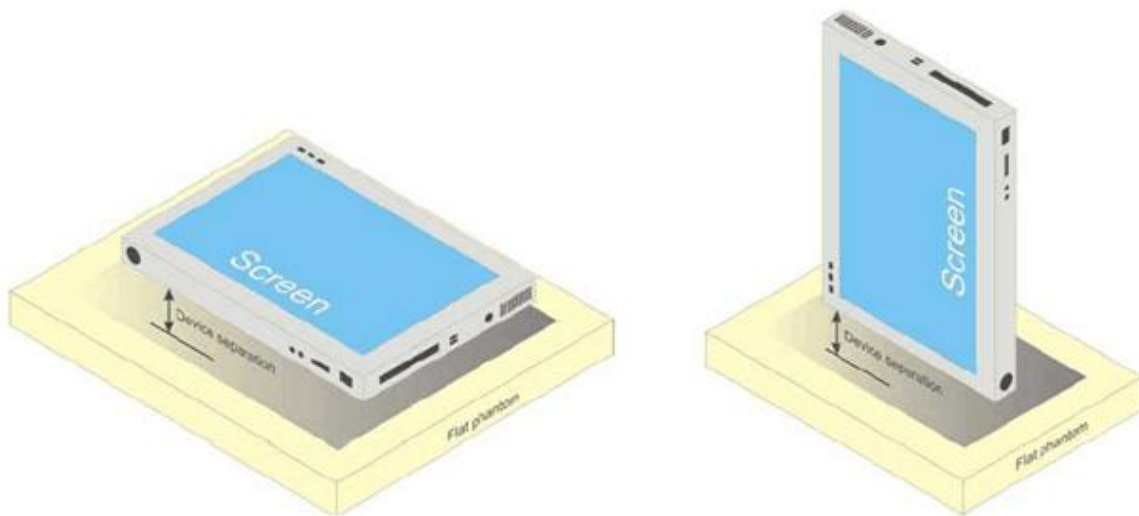
System Performance Check at 835MHz&1900MHz &2450MHz for Body								
Validation Kit: SN29/15 DIP 0G835-383&SN 29/15 DIP 1G900-389& SN 29/15DIP 2G450-393								
Frequency [MHz]	Target Value(W/Kg)		Reference Result ($\pm 10\%$)		Tested Value(W/Kg)		Tissue Temp. [°C]	Test time
	1g	10g	1g	10g	1g	10g		
835	9.85	6.45	8.865-10.835	5.805-7.095	9.98	6.37	21.2	July 09,2017
1900	39.38	20.86	35.442-43.318	18.774-22.946	41.99	19.89	21.3	July 02,2017
2450	49.92	23.16	44.928-54.912	20.844-25.476	53.50	23.54	21.2	July 06,2017

7. EUT TEST POSITION

This EUT was tested in **Body back, Body front and 4 edges**.

7.1. Body Worn Position

- (1) To position the EUT parallel to the phantom surface.
- (2) To adjust the EUT parallel to the flat phantom.
- (3) To adjust the distance between the EUT (back, front and 4edges) surface at the flat phantom to **0mm**.



8. SAR EXPOSURE LIMITS

Limits for General Population/Uncontrolled Exposure (W/kg)

Type Exposure	Uncontrolled Environment Limit (W/kg)
Spatial Peak SAR (1g cube tissue for brain or body)	1.60
Spatial Average SAR (Whole body)	0.08
Spatial Peak SAR (Limbs)	4.0

9. TEST EQUIPMENT LIST

Equipment description	Manufacturer/ Model	Identification No.	Current calibration date	Next calibration date
SAR Probe	MVG	SN 19/15 EP253	10/06/2016	10/05/2017
Phantom	SATIMO	SN_2316_ELLI39	N/A	N/A
Liquid	SATIMO	-	Validated. No cal required.	Validated. No cal required.
Comm Tester	Agilent-8960	GB46310822	03/02/2017	03/01/2018
Multimeter	Keithley 2000	1188656	03/02/2017	03/01/2018
Dipole	SATIMO SID835	SN29/15 DIP 0G835-383	07/05/2016	07/04/2019
Dipole	SATIMO SID1900	SN 29/15 DIP 1G900-389	07/05/2016	07/04/2019
Dipole	SATIMO SID2450	SN29/15 DIP 2G450-393	07/05/2016	07/04/2019
Signal Generator	Agilent-E4438C	US41461365	03/02/2017	03/01/2018
Vector Analyzer	Agilent / E4440A	US41421290	03/02/2017	03/01/2018
Network Analyzer	Rhode & Schwarz ZVL6	SN100132	03/02/2017	03/01/2018
Attenuator	Warison /WATT-6SR1211	N/A	N/A	N/A
Attenuator	Mini-circuits / VAT-10+	N/A	N/A	N/A
Amplifier	EM30180	SN060552	03/02/2017	03/01/2018
Directional Couple	Werlatone/ C5571-10	SN99463	06/20/2017	06/19/2018
Directional Couple	Werlatone/ C6026-10	SN99482	06/20/2017	06/19/2018
Power Sensor	NRP-Z21	1137.6000.02	10/10/2016	10/09/2017
Power Sensor	NRP-Z23	US38261498	03/02/2017	03/01/2018
Power Viewer	R&S	V2.3.1.0	N/A	N/A

Note: Per KDB 865664 Dipole SAR Validation, AGC 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 is within 20% of calibrated measurement;
4. Impedance is within 5Ω of calibrated measurement.

10. MEASUREMENT UNCERTAINTY

Per KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz, when the highest measured 1-g SAR within a frequency band is < 1.5 W/Kg, the extensive SAR measurement uncertainty analysis described in IEEE 1528-2013 is not required in SAR reports submitted for equipment approval.

11. CONDUCTED POWER MEASUREMENT

GSM BAND

Mode	Frequency(MHz)	Avg. Burst Power(dBm)	Duty cycle Factor(dBm)	Frame Power(dBm)
Maximum Power <1>				
GPRS 850 (1 Slot)	824.2	30.73	-9	21.73
	836.6	30.75	-9	21.75
	848.8	30.80	-9	21.80
GPRS 850 (2 Slot)	824.2	27.62	-6	21.62
	836.6	27.39	-6	21.39
	848.8	27.51	-6	21.51
GPRS 850 (3 Slot)	824.2	25.66	-4.26	21.40
	836.6	25.40	-4.26	21.14
	848.8	25.68	-4.26	21.42
GPRS 850 (4 Slot)	824.2	24.36	-3	21.36
	836.6	24.49	-3	21.49
	848.8	24.73	-3	21.73
EGPRS 850 (1 Slot)	824.2	23.24	-9	14.24
	836.6	23.45	-9	14.45
	848.8	23.42	-9	14.42
EGPRS 850 (2 Slot)	824.2	20.52	-6	14.52
	836.6	20.47	-6	14.47
	848.8	20.47	-6	14.47
EGPRS 850 (3 Slot)	824.2	19.51	-4.26	15.25
	836.6	19.50	-4.26	15.24
	848.8	19.71	-4.26	15.45
EGPRS 850 (4 Slot)	824.2	18.18	-3	15.18
	836.6	18.10	-3	15.10
	848.8	18.33	-3	15.33

GSM BAND CONTINUE

Mode	Frequency(MHz)	Avg. Burst Power(dBm)	Duty cycle Factor(dBm)	Frame Power(dBm)
Maximum Power <1>				
GPRS1900 (1 Slot)	1850.2	26.41	-9	17.41
	1880	26.41	-9	17.41
	1909.8	26.53	-9	17.53
GPRS1900 (2 Slot)	1850.2	23.38	-6	17.38
	1880	23.21	-6	17.21
	1909.8	23.56	-6	17.56
GPRS1900 (3 Slot)	1850.2	21.43	-4.26	17.17
	1880	21.26	-4.26	17.00
	1909.8	21.44	-4.26	17.18
GPRS1900 (4 Slot)	1850.2	20.52	-3	17.52
	1880	20.23	-3	17.23
	1909.8	20.45	-3	17.45
EGPRS1900 (1 Slot)	1850.2	22.21	-9	13.21
	1880	22.67	-9	13.67
	1909.8	22.79	-9	13.79
EGPRS1900 (2 Slot)	1850.2	20.59	-6	14.59
	1880	20.48	-6	14.48
	1909.8	20.64	-6	14.64
EGPRS1900 (3 Slot)	1850.2	19.83	-4.26	15.57
	1880	19.77	-4.26	15.51
	1909.8	19.97	-4.26	15.71
EGPRS1900 (4 Slot)	1850.2	19.18	-3	16.18
	1880	19.14	-3	16.14
	1909.8	19.23	-3	16.23

Note 1:

The Frame Power (Source-based time-averaged Power) is scaled the maximum burst average power based on time slots. The calculated methods are show as following:

Frame Power = Max burst power (1 Up Slot) – 9 dB

Frame Power = Max burst power (2 Up Slot) – 6 dB

Frame Power = Max burst power (3 Up Slot) – 4.26 dB

Frame Power = Max burst power (4 Up Slot) – 3 dB

UMTS BAND

HSDPA Setup Configuration:

- The EUT was connected to Base Station Agilent E5515C referred to the Setup Configuration.
- The RF path losses were compensated into the measurements.
- A call was established between EUT and Based Station with following setting:
 - (1) Set Gain Factors(β_c and β_d) parameters set according to each
 - (2) Set RMC 12.2Kbps+HSDPA mode.
 - (3) Set Cell Power=-86dBm
 - (4) Set HS-DSCH Configuration Type to FRC (H-set 1, QPSK)
 - (5) Select HSDPA Uplink Parameters
 - (6) Set Delta ACK, Delta NACK and Delta CQI=8
 - (7) Set Ack - Nack Repetition Factor to 3
 - (8) Set CQI Feedback Cycle (k) to 4ms
 - (9) Set CQI Repetition Factor to 2
 - (10) Power Ctrl Mode=All Up bits
- The transmitted maximum output power was recorded.

Table C.10.2.4: β values for transmitter characteristics tests with HS-DPCCH

Sub-test	β_c (Note5)	β_d	β_d (SF)	β_c/β_d	β_{HS} (Note1, Note 2)	CM (dB) (Note 3)	MPR (dB) (Note 3)
1	2/15	15/15	64	2/15	4/15	0.0	0.0
2	12/15(Note 4)	15/15(Note 4)	64	12/15(Note 4)	24/15	1.0	0.0
3	15/15	8/15	64	15/8	30/15	1.5	0.5
4	15/15	4/15	64	15/4	30/15	1.5	0.5

Note 1: ΔACK , $\Delta NACK$ and $\Delta CQI = 30/15$ with $\beta_{hs} = 30/15 * \beta_c$.

Note 2: For the HS-DPCCH power mask requirement test in clause 5.2C, 5.7A, and the Error Vector Magnitude (EVM) with HS-DPCCH test in clause 5.13.1A, and HSDPA EVM with phase discontinuity in clause 5.13.1AA, ΔACK and $\Delta NACK = 30/15$ with $\beta_{hs} = 30/15 * \beta_c$, and $\Delta CQI = 24/15$ with $\beta_{hs} = 24/15 * \beta_c$.

Note 3: CM = 1 for $\beta_c/\beta_d = 12/15$, $\square_{hs}/\square_c = 24/15$. For all other combinations of DPDCH, DPCCH and HS-DPCCH the MPR is based on the relative CM difference. This is applicable for only UEs that support HSDPA in release 6 and later releases.

Note 4: For subtest 2 the \square_c/\square_d ratio of 12/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1, TF1) to $\square_c = 11/15$ and $\square_d = 15/15$.

HSUPA Setup Configuration:

- The EUT was connected to Base Station Agilent E5515C referred to the Setup Configuration.
- The RF path losses were compensated into the measurements.
- A call was established between EUT and Base Station with following setting * :
 - (1) Call Configs = 5.2B, 5.9B, 5.10B, and 5.13.2B with QPSK
 - (2) Set the Gain Factors (β_c and β_d) and parameters (AG Index) were set according to each specific sub-test in the following table, C11.1.3, quoted from the TS 34.121
 - (3) Set Cell Power = -86 dBm
 - (4) Set Channel Type = 12.2k + HSPA
 - (5) Set UE Target Power
 - (6) Power Ctrl Mode= Alternating bits
 - (7) Set and observe the E-TFCI
 - (8) Confirm that E-TFCI is equal to the target E-TFCI of 75 for sub-test 1, and other subtest's E-TFCI
- The transmitted maximum output power was recorded.

Table C.11.1.3: β values for transmitter characteristics tests with HS-DPCCH and E-DCH

Sub-test	β_c	β_d	β_d (SF)	β_c/β_d	β_{HS} (Note 1)	β_{ec}	β_{ed} (Note 4) (Note 5)	β_{ed} (SF)	β_{ed} (Code s)	CM (dB) (Note 2)	MPR (dB) (Note 2) (Note 6)	AG Index (Note 5)	E-TF CI
1	11/15 (Note 3)	15/15 (Note 3)	64	11/15 (Note 3)	22/15	209/225	1309/225	4	1	1.0	0.0	20	75
2	6/15	15/15	64	6/15	12/15	12/15	94/75	4	1	3.0	2.0	12	67
3	15/15	9/15	64	15/9	30/15	30/15	β_{ed1} : 47/15 β_{ed2} : 47/15	4 4	2	2.0	1.0	15	92
4	2/15	15/15	64	2/15	4/15	2/15	56/75	4	1	3.0	2.0	17	71
5	15/15	0	-	-	5/15	5/15	47/15	4	1	1.0	0.0	12	67

Note 1: For sub-test 1 to 4, ΔACK , $\Delta NACK$ and $\Delta CQI = 30/15$ with $\beta_{hs} = 30/15 * \beta_c$. For sub-test 5, ΔACK , $\Delta NACK$ and $\Delta CQI = 5/15$ with $\beta_{hs} = 5/15 * \beta_c$.

Note 2: CM = 1 for $\beta_c/\beta_d = 12/15$, $\beta_{hs}/\beta_c = 24/15$. For all other combinations of DPDCH, DPCCH, HS DPCCH, E-DPDCH and E-DPCCH the MPR is based on the relative CM difference.

Note 3: For subtest 1 the β_c/β_d ratio of 11/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1, TF1) to $\beta_c = 10/15$ and $\beta_d = 15/15$.

Note 4: In case of testing by UE using E-DPDCH Physical Layer category 1, Sub-test 3 is omitted according to TS25.306 Table 5.1g.

Note 5: β_{ed} cannot be set directly; it is set by Absolute Grant Value.

Note 6: For subtests 2, 3 and 4, UE may perform E-DPDCH power scaling at max power which could results in slightly smaller MPR values.

UMTS BAND II

Mode	Frequency (MHz)	Avg. Burst Power (dBm)
HSDPA Subtest 1	1852.4	19.59
	1880	19.46
	1907.6	19.74
HSDPA Subtest 2	1852.4	19.73
	1880	19.69
	1907.6	19.49
HSDPA Subtest 3	1852.4	19.37
	1880	19.61
	1907.6	19.56
HSDPA Subtest 4	1852.4	19.45
	1880	19.07
	1907.6	19.46
HSUPA Subtest 1	1852.4	19.68
	1880	19.58
	1907.6	19.48
HSUPA Subtest 2	1852.4	19.50
	1880	19.56
	1907.6	19.43
HSUPA Subtest 3	1852.4	19.41
	1880	19.35
	1907.6	19.57
HSUPA Subtest 4	1852.4	19.65
	1880	19.35
	1907.6	19.60
HSUPA Subtest 5	1852.4	19.67
	1880	19.58
	1907.6	19.48

UMTS BAND V

Mode	Frequency (MHz)	Avg. Burst Power (dBm)
HSDPA Subtest 1	826.4	19.84
	836.6	19.45
	846.6	19.42
HSDPA Subtest 2	826.4	19.62
	836.6	19.49
	846.6	19.44
HSDPA Subtest 3	826.4	19.39
	836.6	19.57
	846.6	19.69
HSDPA Subtest 4	826.4	19.23
	836.6	19.22
	846.6	19.34
HSUPA Subtest 1	826.4	19.43
	836.6	19.54
	846.6	19.40
HSUPA Subtest 2	826.4	19.42
	836.6	19.34
	846.6	19.50
HSUPA Subtest 3	826.4	19.50
	836.6	19.28
	846.6	19.64
HSUPA Subtest 4	826.4	19.14
	836.6	19.67
	846.6	19.65
HSUPA Subtest 5	826.4	19.39
	836.6	19.41
	846.6	19.60

According to 3GPP 25.101 sub-clause 6.2.2 , the maximum output power is allowed to be reduced by following the table.

Table 6.1aA: UE maximum output power with HS-DPCCH and E-DCH

UE Transmit Channel Configuration	CM(db)	MPR(db)
For all combinations of ,DPDCH,DPCCH HS-DPDCH,E-DPDCH and E-DPCCH	$0 \leq CM \leq 3.5$	$MAX(CM-1,0)$
Note: CM=1 for $\beta_d/\beta_{d'}=12/15$, $\beta_{ns}/\beta_c=24/15$.For all other combinations of DPDCH, DPCCH, HS-DPCCH, E-DPDCH and E-DPCCH the MPR is based on the relative CM difference.		

The device supports MPR to solve linearity issues (ACLR or SEM) due to the higher peak-to average ratios (PAR) of the HSUPA signal. This prevents saturating the full range of the TX DAC inside of device and provides a reduced power output to the RF transceiver chip according to the Cubic Metric (a function of the combinations of DPDCH, DPCCH, HS-DPCCH, E-DPDCH and E-DPCCH).

When E-DPDCH channels are present the beta gains on those channels are reduced firsts to try to get the power under the allowed limit. If the beta gains are lowered as far as possible, then a hard limiting is applied at the maximum allowed level.

The SW currently recalculates the cubic metric every time the beta gains on the E-DPDCH are reduced. The cubic metric will likely get lower each time this is done .However, there is no reported reduction of maximum output power in the HSUPA mode since the device also provides a compensation for the power back-off by increasing the gain of TX_AGC in the transceiver (PA) device.

The end effect is that the DUT output power is identical to the case where there is no MPR in the device.

WIFI

Mode	Data Rate (Mbps)	Channel	Frequency(MHz)	Avg. Burst Power(dBm)
802.11b	1	01	2412	13.82
		06	2437	14.32
		11	2462	14.68
802.11g	6	01	2412	10.37
		06	2437	12.09
		11	2462	12.29
802.11n(20)	6.5	01	2412	10.68
		06	2437	11.99
		11	2462	12.23
802.11n(40)	13.5	03	2422	11.77
		06	2437	12.00
		09	2452	11.73

Bluetooth_V3.0

Modulation	Channel	Frequency(MHz)	Peak Power (dBm)
GFSK	0	2402	2.063
	39	2441	2.707
	78	2480	2.301
$\pi/4$ -DQPSK	0	2402	1.234
	39	2441	2.890
	78	2480	2.109
8-DPSK	0	2402	1.122
	39	2441	2.781
	78	2480	2.032

Bluetooth_V4.0

Modulation	Channel	Frequency(MHz)	Peak Power (dBm)
GFSK	0	2402	-2.867
	19	2440	-1.567
	39	2480	-1.657

12. TEST RESULTS

12.1. SAR Test Results Summary

12.1.1. Test position and configuration

Body SAR was performed with the device 0mm from the phantom.

12.1.2. Operation Mode

1. Per KDB 447498 D01 v06 ,for each exposure position, if the highest 1-g SAR is ≤ 0.8 W/kg, testing for low and high channel is optional.
2. Per KDB 865664 D01 v01r04,for each frequency band, if the measured SAR is ≥ 0.8 W/Kg, testing for repeated SAR measurement is required , that the highest measured SAR is only to be tested. When the SAR results are near the limit, the following procedures are required for each device to verify these types of SAR measurement related variation concerns by repeating the highest measured SAR configuration in each frequency band.
 - (1) When the original highest measured SAR is ≥ 0.8 W/Kg, repeat that measurement once.
 - (2) Perform a second repeated measurement only if the ratio of largest to smallest SAR for the original and first repeated measurements is >1.20 or when the original or repeated measurement is ≥ 1.45 W/Kg.
 - (3) Perform a third repeated measurement only if the original, first and second repeated measurement is ≥ 1.5 W/Kg and ratio of largest to smallest SAR for the original, first and second measurement is ≥ 1.20 .
3. Per KDB 648474 D04 v01r03,when the reported SAR for a body-worn accessory measured without a headset connected to the handset is ≤ 1.2 W/Kg, SAR testing with a headset connected is not required.
4. Per KDB 248227 D01v02r02,for 2.4GHz 802.11g/n SAR testing is not required when the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg.
5. Per KDB 941225 D06 V02r01, When the same wireless mode transmission configurations for voice and data are required for SAR measurements, the more conservative configuration with a smaller separation distance should be tested for the overlapping SAR configurations.
6. Maximum Scaling SAR in order to calculate the Maximum SAR values to test under the standard Peak Power, Calculation method is as follows:
Maximum Scaling SAR =tested SAR (Max.) \times [maximum turn-up power (mw)/ maximum measurement output power(mw)]
8. Proximity sensor, just for avoiding the wrong operation in the phone screen when call, and has no influence on output power or SAR resu

12.1.3. Test Result

SAR MEASUREMENT									
Depth of Liquid (cm):>15					Relative Humidity (%): 52.7				
Product: IP54 - IP 67 Rugged Handheld, Desktop & Tablet Devices									
Test Mode: GSM850 with GMSK modulation									
Position	Mode	Ch.	Fr. (MHz)	Power Drift (<±5%)	SAR (1g) (W/kg)	Max. Tune-up Power (dBm)	Meas. output Power (dBm)	Scaled SAR (W/Kg)	Limit (W/kg)
Body back	GPRS-1 slot	190	836.6	-0.83	0.592	31.00	30.75	0.627	1.6
Body front	GPRS-1 slot	190	836.6	1.55	0.450	31.00	30.75	0.477	1.6
Edge 1 (Top)	GPRS-1 slot	190	836.6	-1.63	0.404	31.00	30.75	0.428	1.6
Edge 2(Right)	GPRS-1 slot	190	836.6	0.92	0.150	31.00	30.75	0.159	1.6
Edge 3(Bottom)	GPRS-1 slot	190	836.6	-0.63	0.030	31.00	30.75	0.032	1.6
Edge 4(Left)	GPRS-1 slot	190	836.6	0.92	0.072	31.00	30.75	0.076	1.6

Note:

- When the 1-g Reported SAR is ≤ 0.8 W/kg, testing for low and high channel is optional. Refer to KDB 447498.
- The test separation for body is 0mm of all above table.

SAR MEASUREMENT									
Depth of Liquid (cm):>15					Relative Humidity (%): 52.9				
Product: IP54 - IP 67 Rugged Handheld, Desktop & Tablet Devices									
Test Mode: PCS1900 with GMSK modulation									
Position	Mode	Ch.	Fr. (MHz)	Power Drift (<±5%)	SAR (1g) (W/kg)	Max. Tune-up Power (dBm)	Meas. output Power (dBm)	Scaled SAR (W/Kg)	Limit (W/kg)
Body back	GPRS-2 slot	661	1880.0	-0.25	0.362	23.56	23.21	0.392	1.6
Body front	GPRS-2 slot	661	1880.0	1.22	0.301	23.56	23.21	0.326	1.6
Edge 1 (Top)	GPRS-2 slot	661	1880.0	1.55	0.682	23.56	23.21	0.739	1.6
Edge 2(Right)	GPRS-2 slot	661	1880.0	0.02	0.196	23.56	23.21	0.212	1.6
Edge 3(Bottom)	GPRS-2 slot	661	1880.0	-1.33	0.011	23.56	23.21	0.012	1.6
Edge 4(Left)	GPRS-2 slot	661	1880.0	-0.02	0.005	23.56	23.21	0.005	1.6

Note:

- When the 1-g Reported SAR is ≤ 0.8 W/kg, testing for low and high channel is optional. Refer to KDB 447498.
- The test separation for body is 0mm of all above table.

SAR MEASUREMENT									
Depth of Liquid (cm):>15					Relative Humidity (%): 52.9				
Product: IP54 - IP 67 Rugged Handheld, Desktop & Tablet Devices									
Test Mode: WCDMA Band II with QPSK modulation									
Position	Mode	Ch.	Fr. (MHz)	Power Drift (<±5%)	SAR (1g) (W/kg)	Max. Tune-up Power (dBm)	Meas. output Power (dBm)	Scaled SAR (W/Kg)	Limit (W/kg)
Body back	HSDPASubtest 1	9400	1880	-0.23	0.307	19.80	19.46	0.332	1.6
Body front	HSDPASubtest 1	9400	1880	1.55	0.194	19.80	19.46	0.210	1.6
Edge 1 (Top)	HSDPASubtest 1	9400	1880	1.55	0.657	19.80	19.46	0.711	1.6
Edge 2(Right)	HSDPASubtest 1	9400	1880	0.02	0.478	19.80	19.46	0.517	1.6
Edge 3(Bottom)	HSDPASubtest 1	9400	1880	-0.22	0.011	19.80	19.46	0.012	1.6
Edge 4(Left)	HSDPASubtest 1	9400	1880	-0.23	0.015	19.80	19.46	0.016	1.6

Note:

- When the 1-g Reported SAR is ≤ 0.8 W/kg, testing for low and high channel is optional. Refer to KDB 447498.
- The test separation for body is 0mm of all above table.

SAR MEASUREMENT									
Depth of Liquid (cm):>15					Relative Humidity (%): 52.7				
Product: IP54 - IP 67 Rugged Handheld, Desktop & Tablet Devices									
Test Mode: WCDMA Band V with QPSK modulation									
Position	Mode	Ch.	Fr. (MHz)	Power Drift (<±5%)	SAR (1g) (W/kg)	Max. Tune-up Power (dBm)	Meas. output Power (dBm)	Scaled SAR (W/Kg)	Limit (W/kg)
Body back	HSDPASubtest 1	4183	836.6	-0.73	0.483	19.90	19.45	0.536	1.6
Body front	HSDPASubtest 1	4183	836.6	1.45	0.344	19.90	19.45	0.382	1.6
Edge 1 (Top)	HSDPASubtest 1	4183	836.6	-1.56	0.542	19.90	19.45	0.601	1.6
Edge 2(Right)	HSDPASubtest 1	4183	836.6	0.83	0.148	19.90	19.45	0.164	1.6
Edge 3(Bottom)	HSDPASubtest 1	4183	836.6	-1.55	0.101	19.90	19.45	0.112	1.6
Edge 4(Left)	HSDPASubtest 1	4183	836.6	0.83	0.048	19.90	19.45	0.053	1.6

Note:

- When the 1-g Reported SAR is ≤ 0.8 W/kg, testing for low and high channel is optional. Refer to KDB 447498.
- The test separation for body is 0mm of all above table.

SAR MEASUREMENT									
Depth of Liquid (cm):>15					Relative Humidity (%): 52.6				
Product: IP54 - IP 67 Rugged Handheld, Desktop & Tablet Devices									
Test Mode:802.11b									
Position	Mode	Ch.	Fr. (MHz)	Power Drift (<±5%)	SAR (1g) (W/kg)	Max. Tune-up Power (dBm)	Meas. output Power (dBm)	Scaled SAR (W/Kg)	Limit (W/kg)
Body back	DTS	6	2437	0.27	0.186	14.68	14.32	0.202	1.6
Body front	DTS	6	2437	-1.25	0.132	14.68	14.32	0.143	1.6
Edge 1 (Top)	DTS	6	2437	0.26	0.003	14.68	14.32	0.003	1.6
Edge 2(Right)	DTS	6	2437	-1.63	0.174	14.68	14.32	0.189	1.6
Edge 3(Bottom)	DTS	6	2437	-0.26	0.023	14.68	14.32	0.025	1.6
Edge 4(Left)	DTS	6	2437	0.28	0.031	14.68	14.32	0.034	1.6

Note:

- According to KDB248227, SAR is not required for 802.11n HT20/HT40 channels when the maximum average output power is less than 1/4 dB higher than that measured on the corresponding 802.11a/b channels.
- All of above "DTS" means data transmitters.
- The test separation for body is 0mm of all above table.

Simultaneous Multi-band Transmission Evaluation:
Application Simultaneous Transmission information:

NO	Simultaneous state	Portable Handset	
		Body-worn	Hotspot
1	GSM (Data) + Bluetooth(data)	Yes	Yes
2	GSM (Data) + WLAN 2.4GHz (data)	Yes	Yes
3	WCDMA (Data) + Bluetooth(data)	Yes	Yes
4	WCDMA (Data) + WLAN 2.4GHz (data)	Yes	Yes

NOTE:

1. WIFI and BT share the same antenna, and cannot transmit simultaneously.
2. Simultaneous with every transmitter must be the same test position.
3. KDB 447498 D01, BT SAR is excluded as below table.
4. KDB 447498 D01, for handsets the test separation distance is determined by the smallest distance between the outer surface of the device and the user; which is 0mm for body-worn SAR.
5. According to KDB 447498 D01 4.3.1, Standalone SAR test exclusion is as follow:
For 100 MHz to 6 GHz and test separation distances ≤ 50 mm, the 1-g and 10-g SAR test exclusion thresholds are determined by the following:

$$[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] \cdot [\sqrt{f(\text{GHz})}] \leq 3.0$$
for 1-g SAR, and ≤ 7.5 for 10-g extremity SAR³⁰, where
 - f(GHz) is the RF channel transmit frequency in GHz
 - Power and distance are rounded to the nearest mW and mm before calculation³¹
 - The result is rounded to one decimal place for comparison
 - The values 3.0 and 7.5 are referred to as numeric thresholds in step b) below
The test exclusions are applicable only when the minimum test separation distance is ≤ 50 mm, and for transmission frequencies between 100 MHz and 6 GHz. When the minimum test separation distance is < 5 mm, a distance of 5 mm according to 4.1 f) is applied to determine SAR test exclusion.
6. If the test separation distance is < 5 mm, 5mm is used for excluded SAR calculation.
7. According to KDB 447498 D01 4.3.2, simultaneous transmission SAR test exclusion is as follow:
 - (1) 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.
 - (2) Any transmitters and antennas should be considered when calculating simultaneous mode.
 - (3) For mobile phone and PC, it's the sum of all transmitters and antennas at the same mode with same position in each applicable exposure condition
 - (4) When the standalone SAR test exclusion of section 4.3.2 is applied to an antenna that transmits simultaneously with other antennas, the standalone SAR must be estimated according to the following to det

$$(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm}) \cdot [\sqrt{f(\text{GHz})} / x] \text{ W/kg}$$
for test separation distances ≤ 50 mm;
where $x = 7.5$ for 1-g SAR, and $x = 18.75$ for 10-g SAR.
8. When the sum of SAR is larger than the limit, SAR test exclusion is determined by the SAR to peak location separation ratio. The simultaneous transmitting antennas in each operating mode and exposure condition combination must be considered one pair at a time to determine the SAR to peak location separation ratio to qualify for test exclusion. The ratio is determined by $(\text{SAR}_1 + \text{SAR}_2) \cdot 1.5 / R_i$, rounded to two decimal digits, and must be ≤ 0.04 for all antenna pairs in the configuration to qualify for 1-g SAR test exclusion.

Estimated SAR		Max Power including Tune-up Tolerance		Separation Distance (mm)	Estimated SAR (W/kg)
		dBm	mW		
BT	Body	3	1.995	0	0.083

Sum of the SAR for GSM 850 & Wi-Fi & BT:

RF Exposure Conditions	Test Position	Simultaneous Transmission Scenario			Σ1-g SAR (W/Kg)	SPLSR (Yes/No)
		GSM 850	Wi-Fi DTS Band	Bluetooth		
Body-worn	Rear	0.627	0.202		0.829	No
	Front	0.477	0.143		0.620	No
	Edge 1	0.428	0.003		0.431	No
	Edge 2	0.159	0.189		0.348	No
	Edge 3	0.032	0.025		0.057	No
	Edge 4	0.076	0.034		0.110	No
	Rear	0.627		0.083	0.710	No
	Front	0.477		0.083	0.560	No
	Edge 1	0.428		0.083	0.511	No
	Edge 2	0.159		0.083	0.242	No
	Edge 3	0.032		0.083	0.115	No
	Edge 4	0.076		0.083	0.159	No

Note:

- According to KDB 447498 D01 General RF Exposure Guidance, when the simultaneous transmission SAR is less than 1.6 W/Kg, SPLSR assessment is not required.
- SPLSR mean is "The SAR to Peak Location Separation Ratio "

Sum of the SAR for PCS 1900 & Wi-Fi & BT:

RF Exposure Conditions	Test Position	Simultaneous Transmission Scenario			Σ1-g SAR (W/Kg)	SPLSR (Yes/No)
		PCS 1900	Wi-Fi DTS Band	Bluetooth		
Body-worn	Rear	0.392	0.202		0.594	No
	Front	0.326	0.143		0.469	No
	Edge 1	0.739	0.003		0.742	No
	Edge 2	0.212	0.189		0.401	No
	Edge 3	0.012	0.025		0.037	No
	Edge 4	0.005	0.034		0.039	No
	Rear	0.392		0.083	0.475	No
	Front	0.326		0.083	0.409	No
	Edge 1	0.739		0.083	0.822	No
	Edge 2	0.212		0.083	0.295	No
	Edge 3	0.012		0.083	0.095	No
	Edge 4	0.005		0.083	0.088	No

Note:

- According to KDB 447498 D01 General RF Exposure Guidance, when the simultaneous transmission SAR is less than 1.6 W/Kg, SPLSR assessment is not required.
- SPLSR mean is "The SAR to Peak Location Separation Ratio "

Sum of the SAR for WCDMA Band II&Wi-Fi & BT:

RF Exposure Conditions	Test Position	Simultaneous Transmission Scenario			Σ1-g SAR (W/Kg)	SPLSR (Yes/No)
		WCDMA Band II	Wi-Fi DTS Band	Bluetooth		
Body-worn	Rear	0.332	0.202		0.534	No
	Front	0.210	0.143		0.353	No
	Edge 1	0.711	0.003		0.714	No
	Edge 2	0.517	0.189		0.706	No
	Edge 3	0.012	0.025		0.037	No
	Edge 4	0.016	0.034		0.050	No
	Rear	0.332		0.083	0.415	No
	Front	0.210		0.083	0.293	No
	Edge 1	0.711		0.083	0.794	No
	Edge 2	0.517		0.083	0.600	No
	Edge 3	0.012		0.083	0.095	No
	Edge 4	0.016		0.083	0.099	No

Note:

- According to KDB 447498 D01 General RF Exposure Guidance, when the simultaneous transmission SAR is less than 1.6 W/Kg, SPLSR assessment is not required.
- SPLSR mean is "The SAR to Peak Location Separation Ratio "

Sum of the SAR for WCDMA Band V &Wi-Fi & BT:

RF Exposure Conditions	Test Position	Simultaneous Transmission Scenario			Σ1-g SAR (W/Kg)	SPLSR (Yes/No)
		WCDMA Band V	Wi-Fi DTS Band	Bluetooth		
Body-worn	Rear	0.536	0.202		0.738	No
	Front	0.382	0.143		0.525	No
	Edge 1	0.601	0.003		0.604	No
	Edge 2	0.164	0.189		0.353	No
	Edge 3	0.112	0.025		0.137	No
	Edge 4	0.053	0.034		0.087	No
	Rear	0.536		0.083	0.619	No
	Front	0.382		0.083	0.465	No
	Edge 1	0.601		0.083	0.684	No
	Edge 2	0.164		0.083	0.247	No
	Edge 3	0.112		0.083	0.195	No
	Edge 4	0.053		0.083	0.136	No

Note:

- According to KDB 447498 D01 General RF Exposure Guidance, when the simultaneous transmission SAR is less than 1.6 W/Kg, SPLSR assessment is not required.
- SPLSR mean is "The SAR to Peak Location Separation Ratio "

APPENDIX A. SAR SYSTEM CHECK DATA

Test Laboratory: AGC Lab

Date: July 09,2017

System Check Body 835 MHz

DUT: Dipole 835 MHz Type: SID 835

Communication System CW; Communication System Band: D835 (835.0 MHz); Duty Cycle: 1:1; Conv.F=5.94

Frequency: 835 MHz; Medium parameters used: $f = 835$ MHz; $\sigma=0.96$ mho/m; $\epsilon_r = 55.35$; $\rho = 1000$ kg/m³ ;

Phantom section: Flat Section; Input Power=18dBm

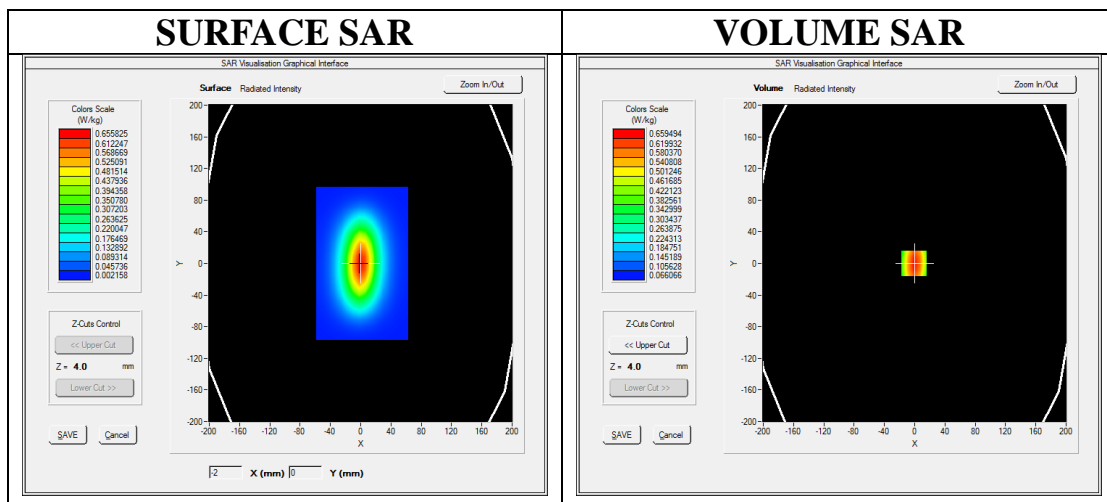
Ambient temperature (°C):21.8, Liquid temperature (°C): 21.2

SATIMO Configuration

- Probe: SSE5; Calibrated: 10/06/2016; Serial No.: SN 19/15 EP253
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Phantom: ELLI39 Phantom
- Measurement SW: OpenSAR V4_02_35

Configuration/System Check 835MHz Body/Area Scan: Measurement grid: dx=8mm, dy=8mm

Configuration/System Check 835MHz Body/Zoom Scan: Measurement grid: dx=8mm,dy=8mm, dz=5mm

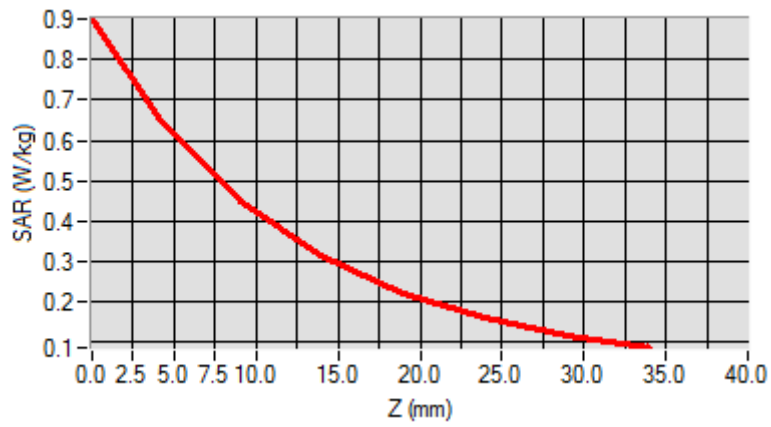


Maximum location: X=-1.00, Y=0.00

SAR Peak: 0.89 W/kg

SAR 10g (W/Kg)	0.402130
SAR 1g (W/Kg)	0.629557

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	0.9000	0.6575	0.4481	0.3126	0.2203	0.1593	0.1157



3D screen shot	Hot spot position

Test Laboratory: AGC Lab
System Check Body 1900MHz
DUT: Dipole 1900 MHz; Type: SID 1900

Date: July 02,2017

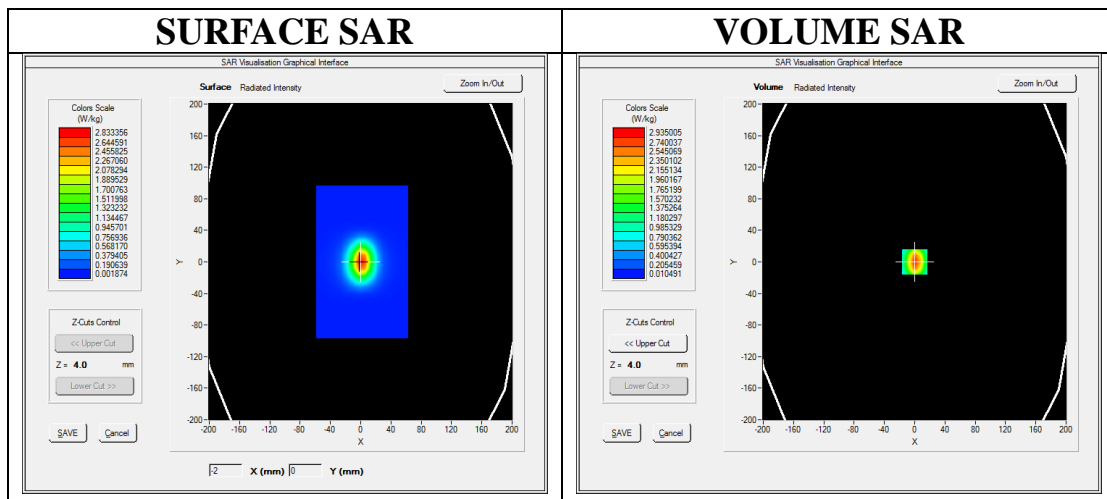
Communication System: CW; Communication System Band: D1900 (1900.0 MHz); Duty Cycle:1:1; Conv.F=5.30
Frequency: 1900 MHz; Medium parameters used: $f = 1900$ MHz; $\sigma=1.52$ mho/m; $\epsilon_r =53.22$; $\rho= 1000$ kg/m³ ;
Phantom section: Flat Section; Input Power=18dBm
Ambient temperature (°C):22.1, Liquid temperature (°C): 21.3

SATIMO Configuration:

- Probe: SSE5; Calibrated: 10/06/2016; Serial No.: SN 19/15 EP253
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Phantom: ELLI39 Phantom
- Measurement SW: OpenSAR V4_02_35

Configuration/System Check 1900MHz Body/Area Scan: Measurement grid: dx=8mm, dy=8mm

Configuration/System Check 1900MHz Body/Zoom Scan: Measurement grid: dx=8mm,dy=8mm, dz=5mm

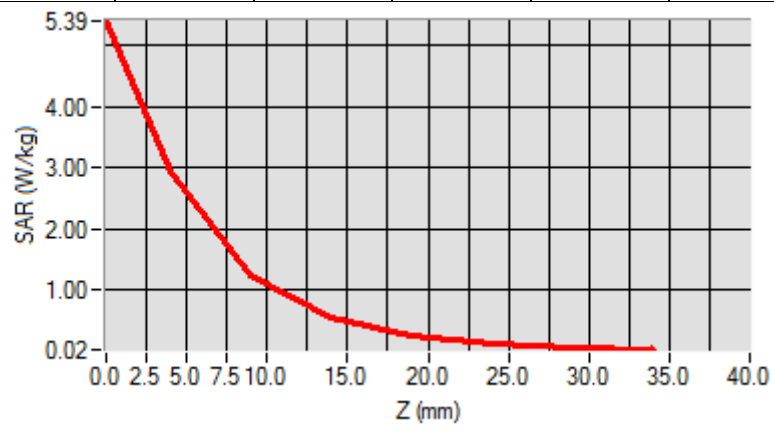


Maximum location: X=1.00, Y=1.00

SAR Peak: 5.35 W/kg

SAR 10g (W/Kg)	1.255102
SAR 1g (W/Kg)	2.649517

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	5.3933	2.9357	1.2352	0.5402	0.2381	0.1067	0.0485



3D screen shot	Hot spot position

Test Laboratory: AGC Lab
System Check Body 2450 MHz

Date: July 06,2017

DUT: Dipole 2450 MHz Type: SID 2450

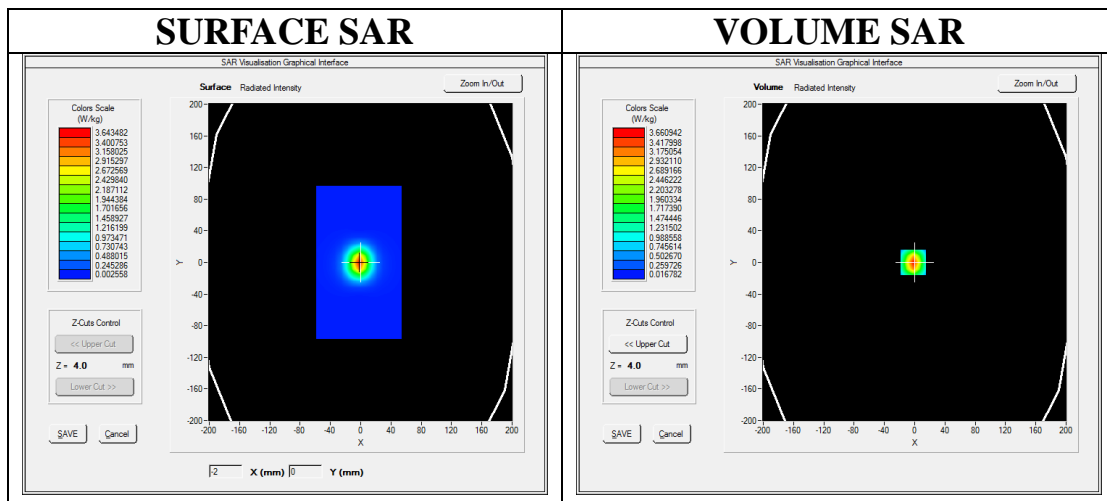
Communication System CW; Communication System Band: D2450 (2450.0 MHz); Duty Cycle: 1:1; Conv.F=4.74
Frequency: 2450 MHz; Medium parameters used: $f = 2450$ MHz; $\sigma = 1.92$ mho/m; $\epsilon_r = 53.05$; $\rho = 1000$ kg/m³ ;
Phantom section: Flat Section; Input Power=18dBm
Ambient temperature (°C):21.9, Liquid temperature (°C): 21.2

SATIMO Configuration

- Probe: SSE5; Calibrated: 10/06/2016; Serial No.: SN 19/15 EP253
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Phantom: ELLI39 Phantom
- Measurement SW: OpenSAR V4_02_35

Configuration/System Check 2450MHz Body/Area Scan: Measurement grid: dx=8mm, dy=8mm

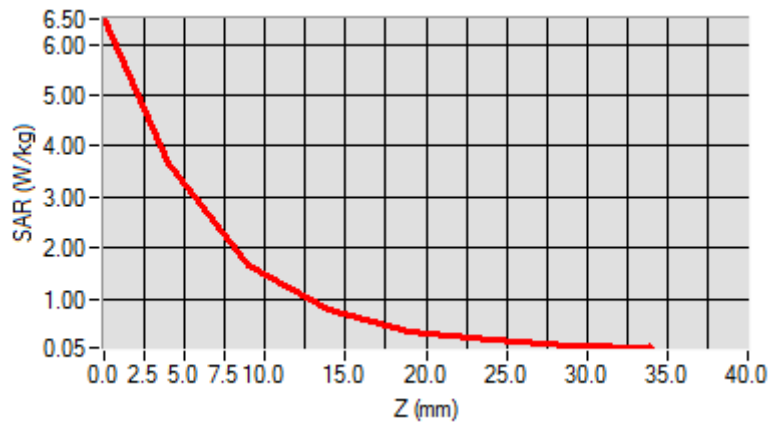
Configuration/System Check 2450MHz Body/Zoom Scan: Measurement grid: dx=5mm,dy=5mm, dz=5mm



Maximum location: X=-1.00, Y=1.00
SAR Peak: 6.21 W/kg

SAR 10g (W/Kg)	1.485130
SAR 1g (W/Kg)	3.375932

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	6.4941	3.6578	1.6485	0.7827	0.3738	0.1802	0.0868



3D screen shot	Hot spot position

APPENDIX B. SAR MEASUREMENT DATA

Test Laboratory: AGC Lab

Date: July 09,2017

GPRS 850 Mid- Body- Back (1up)

DUT: IP54 - IP 67 Rugged Handheld, Desktop & Tablet Devices ; Type: Chameleon

Communication System: GPRS-1 Slot; Communication System Band: GSM 850; Duty Cycle: 1:8;Conv.F=5.94;
Frequency: 836.6 MHz; Medium parameters used: $f = 835$ MHz; $\sigma = 0.97$ mho/m; $\epsilon_r = 54.79$; $\rho = 1000$ kg/m³ ;
Phantom section: Flat Section
Ambient temperature (°C): 21.8, Liquid temperature (°C): 21.2

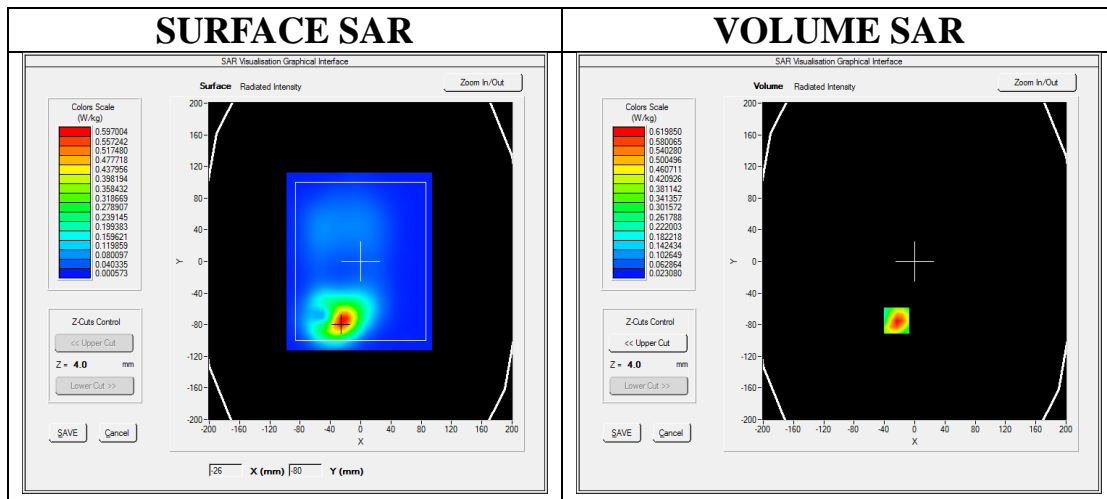
SATIMO Configuration:

- Probe: SSE5; Calibrated: 10/06/2016; Serial No.: SN 19/15 EP253
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Phantom: ELLI39 Phantom
- Measurement SW: OpenSAR V4_02_35

Configuration/GPRS 850 Mid-Body-Back/Area Scan: Measurement grid: dx=8mm, dy=8mm

Configuration/GPRS 850 Mid-Body-Back/Zoom Scan: Measurement grid: dx=8mm,dy=8mm, dz=5mm;

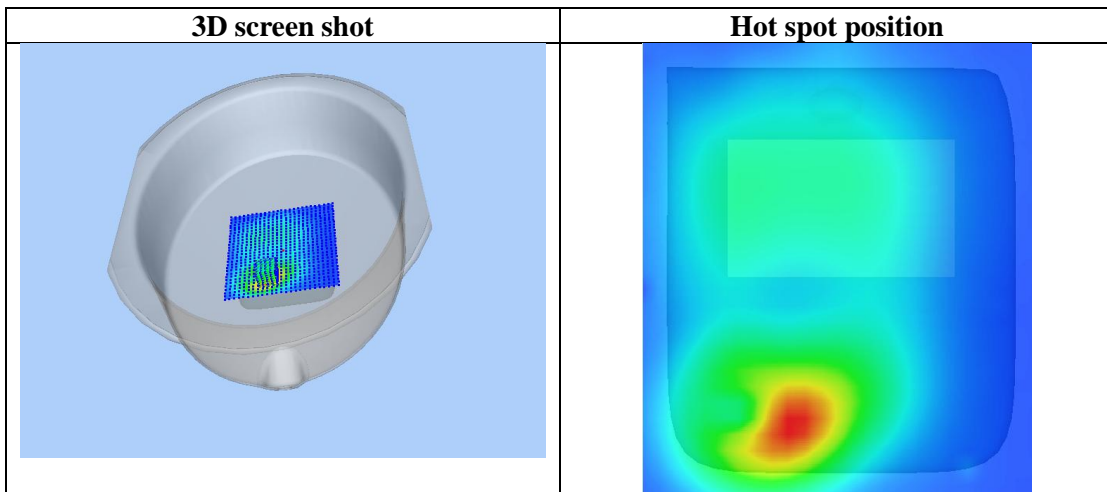
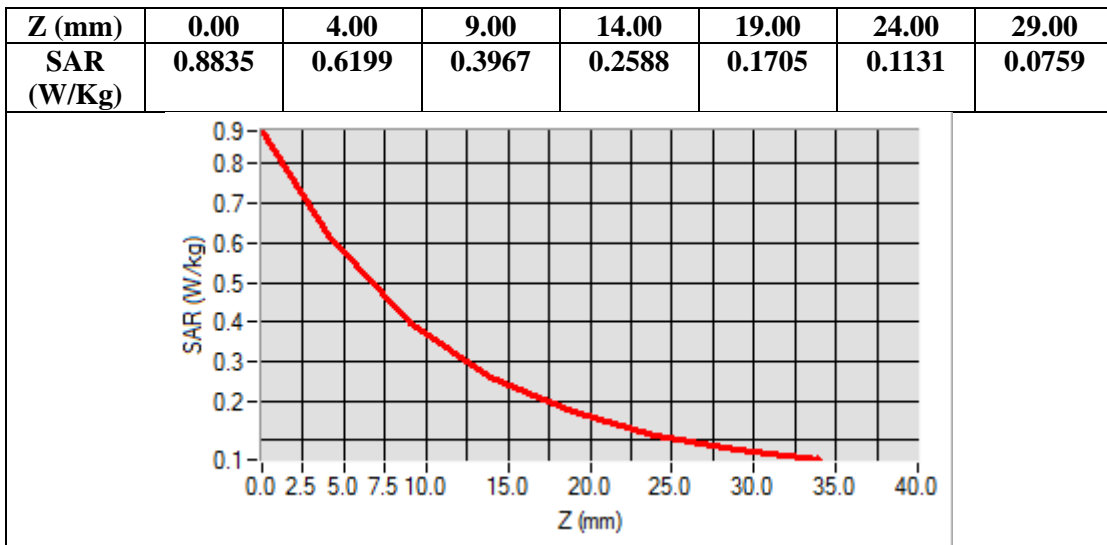
Area Scan	dx=8mm dy=8mm, h= 5.00 mm
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete
Phantom	ELLI
Device Position	Body Back
Band	GSM 850
Channels	Middle
Signal	TDMA (Crest factor: 8.0)



Maximum location: X=-24.00, Y=-75.00

SAR Peak: 0.89 W/kg

SAR 10g (W/Kg)	0.356949
SAR 1g (W/Kg)	0.592398



Test Laboratory: AGC Lab
GPRS 1900 Mid-Edge 1 (2up)

Date: July 02,2017

DUT: IP54 - IP 67 Rugged Handheld, Desktop & Tablet Devices ; Type: Chameleon

Communication System: GPRS-2Slot; Communication System Band: PCS 1900; Duty Cycle: 1:4.2; Conv.F=5.30;
Frequency: 1880 MHz; Medium parameters used: $f = 1900$ MHz; $\sigma = 1.51$ mho/m; $\epsilon_r = 53.63$; $\rho = 1000$ kg/m³ ;
Phantom section: Flat Section
Ambient temperature (°C): 22.1, Liquid temperature (°C): 21.3

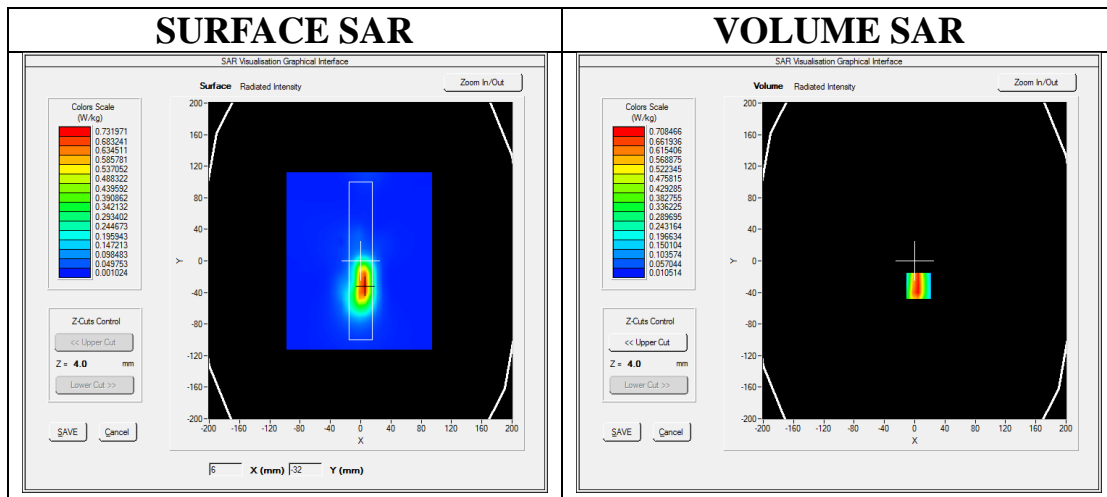
SATIMO Configuration:

- Probe: SSE5; Calibrated: 10/06/2016; Serial No.: SN 19/15 EP253
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Phantom: ELLI39 Phantom
- Measurement SW: OpenSAR V4_02_35

Configuration/GPRS1900 Mid-Edge 1/Area Scan: Measurement grid: dx=8mm, dy=8mm

Configuration/GPRS1900 Mid-Edge 1/Zoom Scan: Measurement grid: dx=8mm,dy=8mm, dz=5mm;

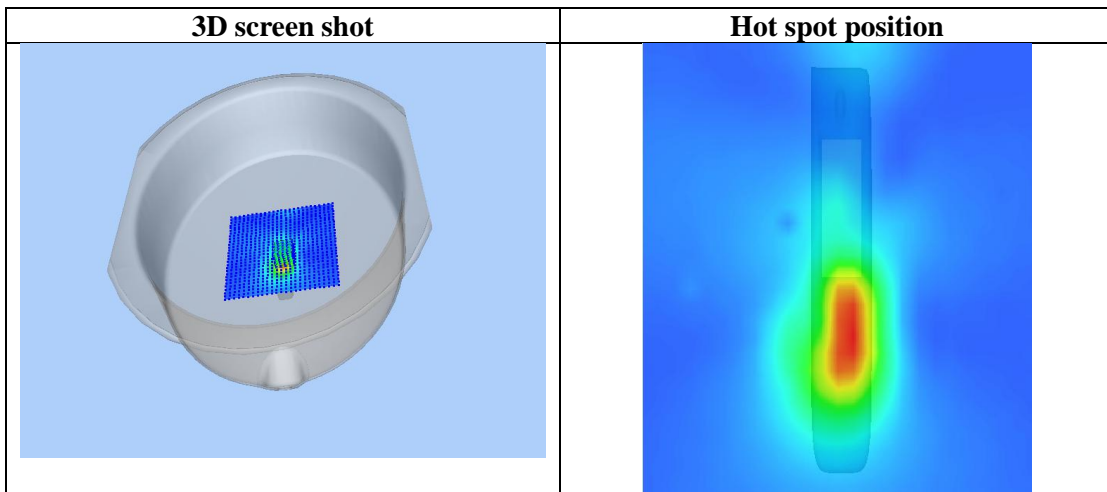
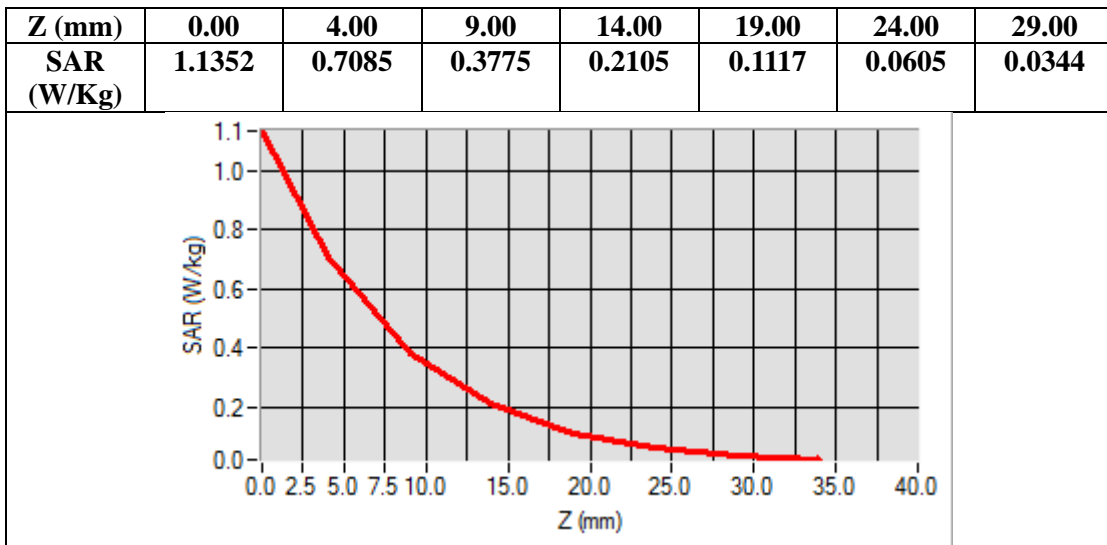
Area Scan	dx=8mm dy=8mm, h= 5.00 mm
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete
Phantom	ELLI
Device Position	Edge 1
Band	PCS 1900
Channels	Middle
Signal	TDMA (Crest factor: 4.0)



Maximum location: X=5.00, Y=-32.00

SAR Peak: 1.19 W/kg

SAR 10g (W/Kg)	0.338786
SAR 1g (W/Kg)	0.682444



Test Laboratory: AGC Lab

Date: July 02,2017

WCDMA Band II Mid- Edge 1 (HSDPASubtest 1)

DUT: IP54 - IP 67 Rugged Handheld, Desktop & Tablet Devices ; Type: Chameleon

Communication System: UMTS; Communication System Band: Band II UTRA/FDD ;Duty Cycle:1:1; Conv.F=5.30;
Frequency: 1880 MHz; Medium parameters used: $f = 1900$ MHz; $\sigma=1.51$ mho/m; $\epsilon_r = 53.63$; $\rho= 1000$ kg/m³ ;
Phantom section: Flat Section
Ambient temperature (°C): 22.1, Liquid temperature (°C): 21.3

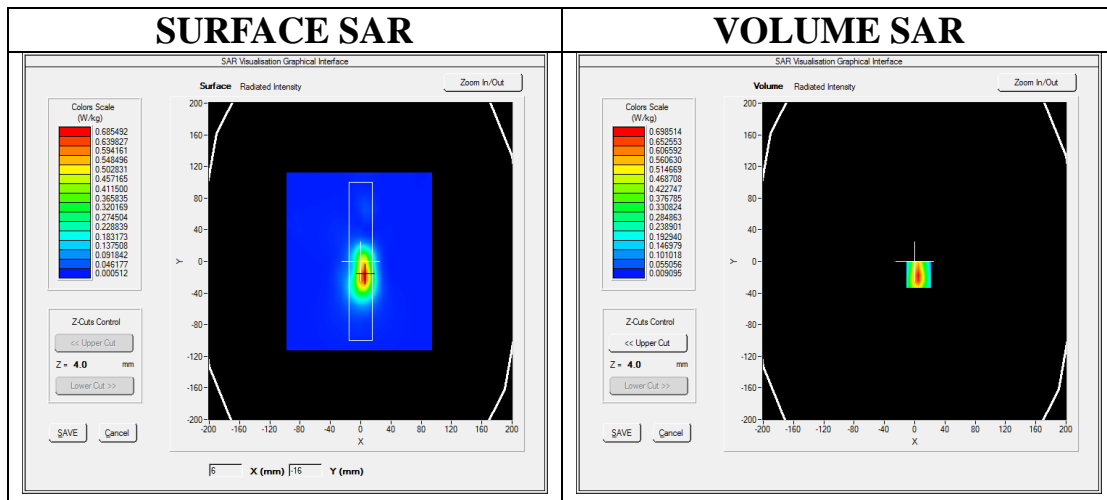
SATIMO Configuration:

- Probe: SSE5; Calibrated: 10/06/2016; Serial No.: SN 19/15 EP253
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Phantom: ELLI39 Phantom
- Measurement SW: OpenSAR V4_02_35

Configuration/ WCDMA band II Mid- Edge 1/Area Scan: Measurement grid: dx=8mm, dy=8mm

Configuration/ WCDMA band II Mid- Edge 1/Zoom Scan: Measurement grid: dx=8mm,dy=8mm, dz=5mm;

Area Scan	dx=8mm dy=8mm, h= 5.00 mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete
Phantom	ELLI
Device Position	Edge 1
Band	WCDMA band II
Channels	Middle
Signal	CDMA (Crest factor: 1.0)

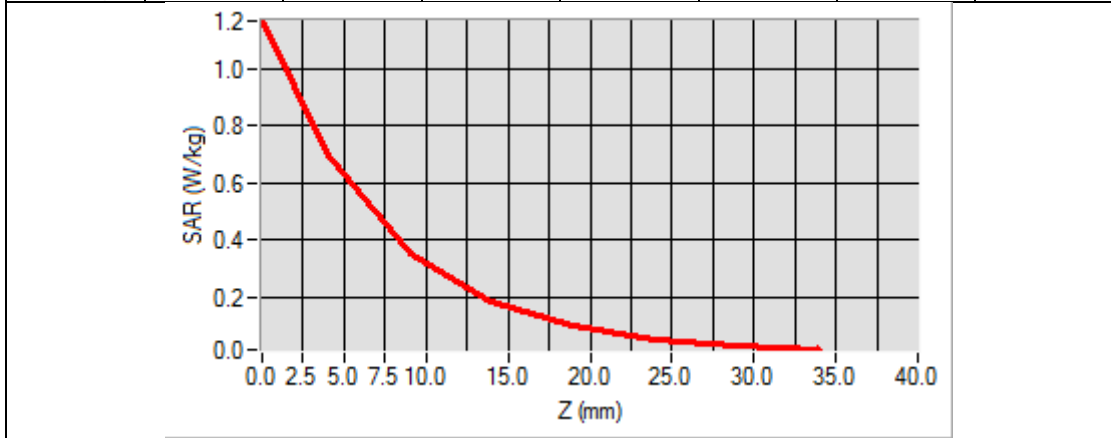


Maximum location: X=5.00, Y=-17.00

SAR Peak: 1.18 W/kg

SAR 10g (W/Kg)	0.314767
SAR 1g (W/Kg)	0.657154

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	1.1678	0.6985	0.3522	0.1858	0.1007	0.0554	0.0313



3D screen shot	Hot spot position
<p>A 3D perspective view of a white bowl. A blue grid is overlaid on the bottom surface, with a small red and yellow area indicating the hot spot location.</p>	<p>A 2D heatmap showing the distribution of SAR. A vertical, elongated hot spot is visible in the center, with a color gradient from blue (low SAR) to red (high SAR).</p>

Test Laboratory: AGC Lab

Date: July 09,2017

WCDMA Band V Mid- Edge 1 (HSDPASubtest 1)

DUT: IP54 - IP 67 Rugged Handheld, Desktop & Tablet Devices ; Type: Chameleon

Communication System: UMTS; Communication System Band: BAND V UTRA/FDD ; Duty Cycle:1: 1; Conv.F=5.94
Frequency: 836.6 MHz; Medium parameters used: $f = 835\text{MHz}$; $\sigma=0.97\text{ mho/m}$; $\epsilon_r = 54.79$; $\rho = 1000\text{kg/m}^3$;
Phantom section: Flat Section
Ambient temperature ($^{\circ}\text{C}$): 21.8, Liquid temperature ($^{\circ}\text{C}$): 21.2

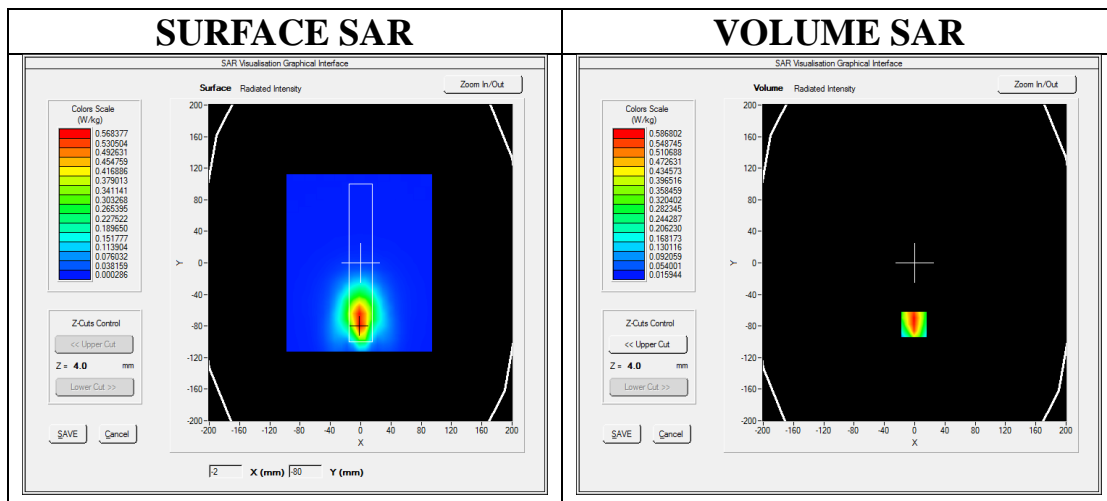
SATIMO Configuration:

- Probe: SSE5; Calibrated: 10/06/2016; Serial No.: SN 19/15 EP253
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Phantom: ELLI39 Phantom
- Measurement SW: OpenSAR V4_02_35

Configuration/ WCDMA Band V Mid- Edge 1 /Area Scan: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$

Configuration/ WCDMA Band V Mid- Edge 1 /Zoom Scan: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$;

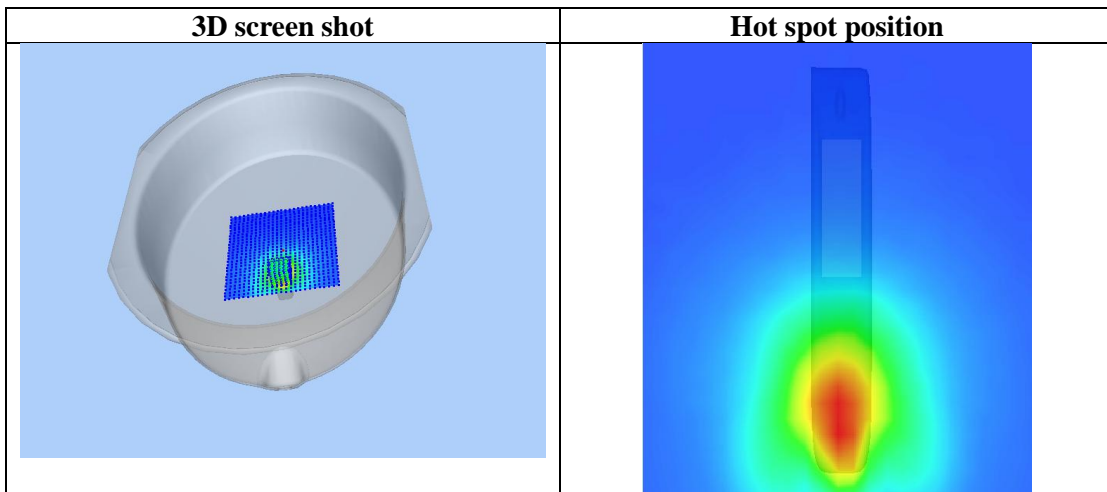
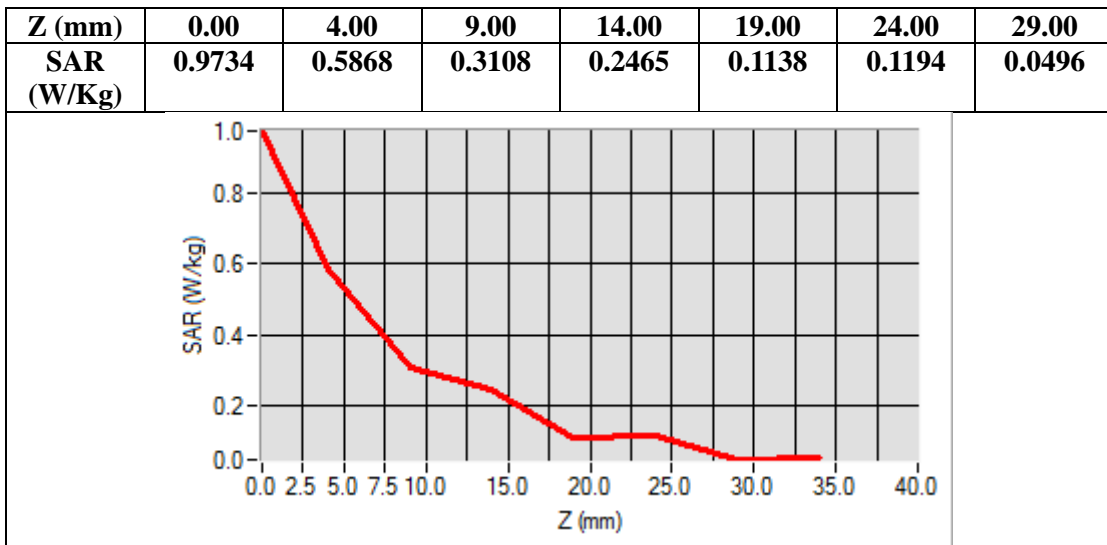
Area Scan	$dx=8\text{mm}$ $dy=8\text{mm}$, $h= 5.00\text{ mm}$
Zoom Scan	$5 \times 5 \times 7$, $dx=8\text{mm}$ $dy=8\text{mm}$ $dz=5\text{mm}$, Complete
Phantom	ELLI
Device Position	Edge 1
Band	WCDMA Band V
Channels	Middle
Signal	CDMA (Crest factor: 1.0)



Maximum location: $X=-1.00$, $Y=-78.00$

SAR Peak: 0.85 W/kg

SAR 10g (W/Kg)	0.327658
SAR 1g (W/Kg)	0.541646



WIFI MODE

Test Laboratory: AGC Lab

Date: July 06,2017

802.11b Mid-Body-Worn- Back

DUT: IP54 - IP 67 Rugged Handheld, Desktop & Tablet Devices ; Type: Chameleon

Communication System: Wi-Fi; Communication System Band: 802.11b; Duty Cycle: 1:1; Conv.F=4.74;
Frequency: 2437 MHz; Medium parameters used: $f = 2450$ MHz; $\sigma = 1.90$ mho/m; $\epsilon_r = 53.67$; $\rho = 1000$ kg/m³ ;
Phantom section: Flat Section
Ambient temperature (°C):21.9, Liquid temperature (°C): 21.2

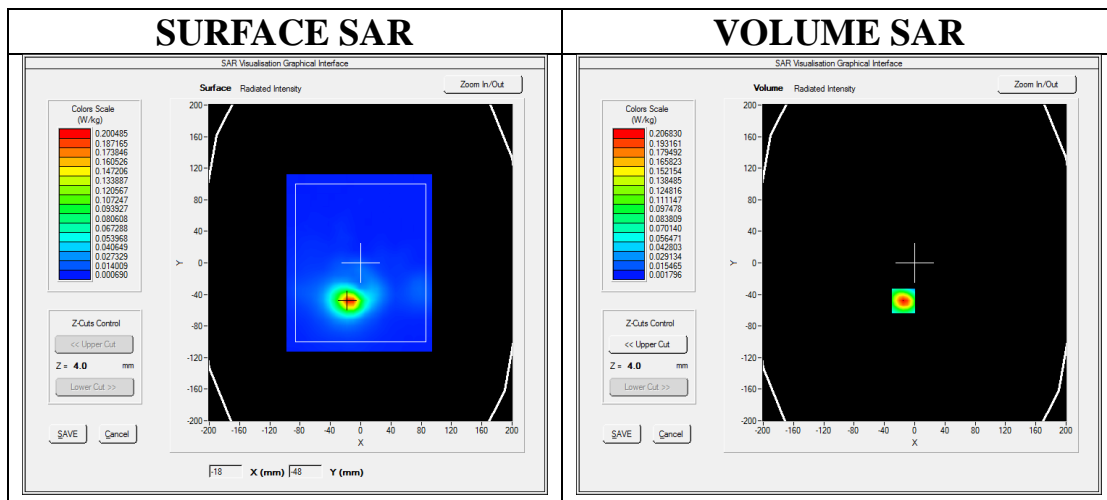
SATIMO Configuration:

- Probe: SSE5; Calibrated: 10/06/2016; Serial No.: SN 19/15 EP253
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Phantom: ELLI39 Phantom
- Measurement SW: OpenSAR V4_02_35

Configuration/802.11b Mid- Body- Back /Area Scan: Measurement grid: dx=8mm, dy=8mm

Configuration/802.11b Mid- Body- Back /Zoom Scan: Measurement grid: dx=5mm,dy=5mm, dz=5mm;

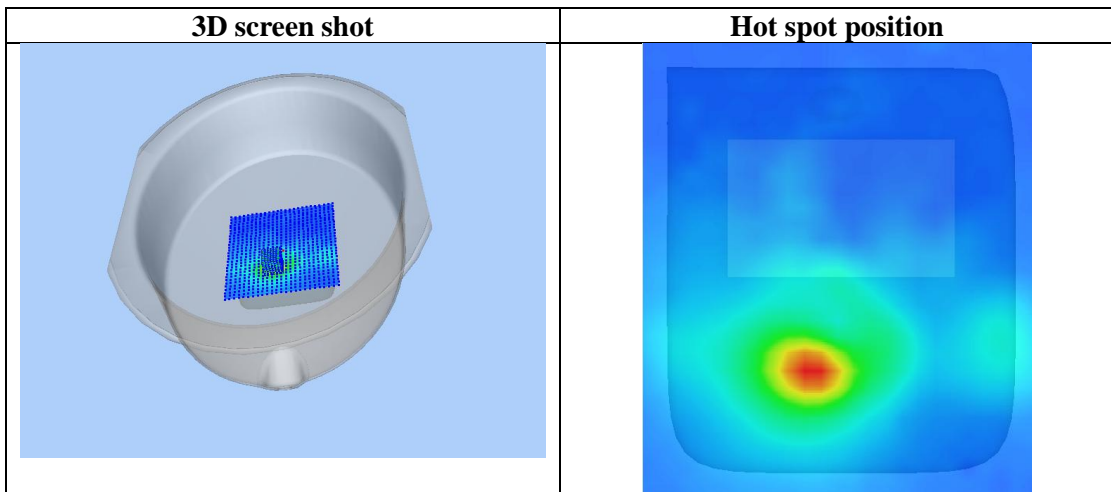
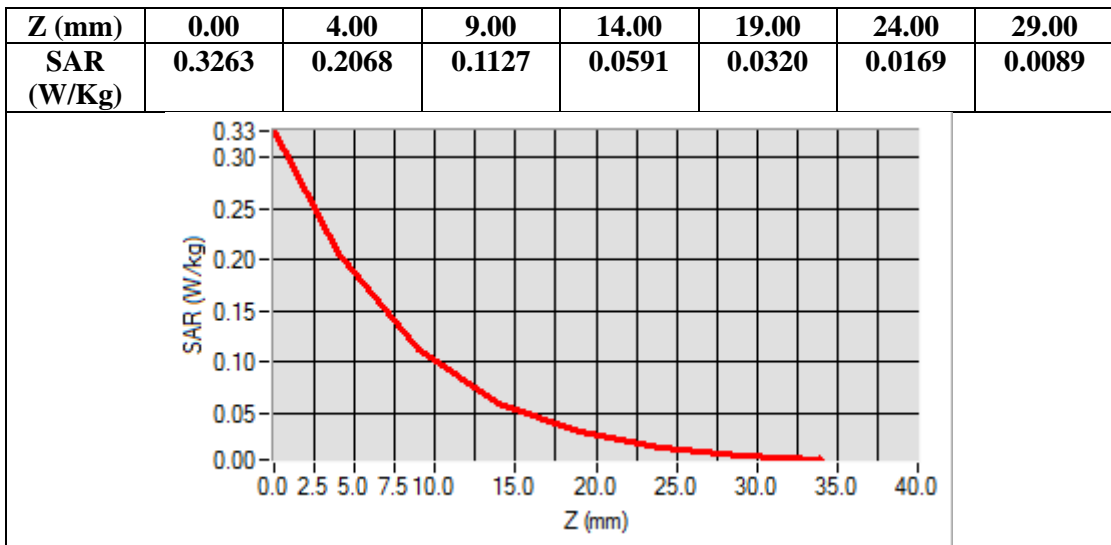
Area Scan	dx=8mm dy=8mm, h= 5.00 mm
ZoomScan	7x7x7,dx=5mm dy=5mm dz=5mm
Phantom	ELLI
Device Position	Body Back
Band	2450MHz
Channels	Middle
Signal	Crest factor: 1.0



Maximum location: X=-15.00, Y=-48.00

SAR Peak: 0.32 W/kg

SAR 10g (W/Kg)	0.091868
SAR 1g (W/Kg)	0.186219



APPENDIX C. TEST SETUP PHOTOGRAPHS
Test Setup Photographs
Body Back 0mm



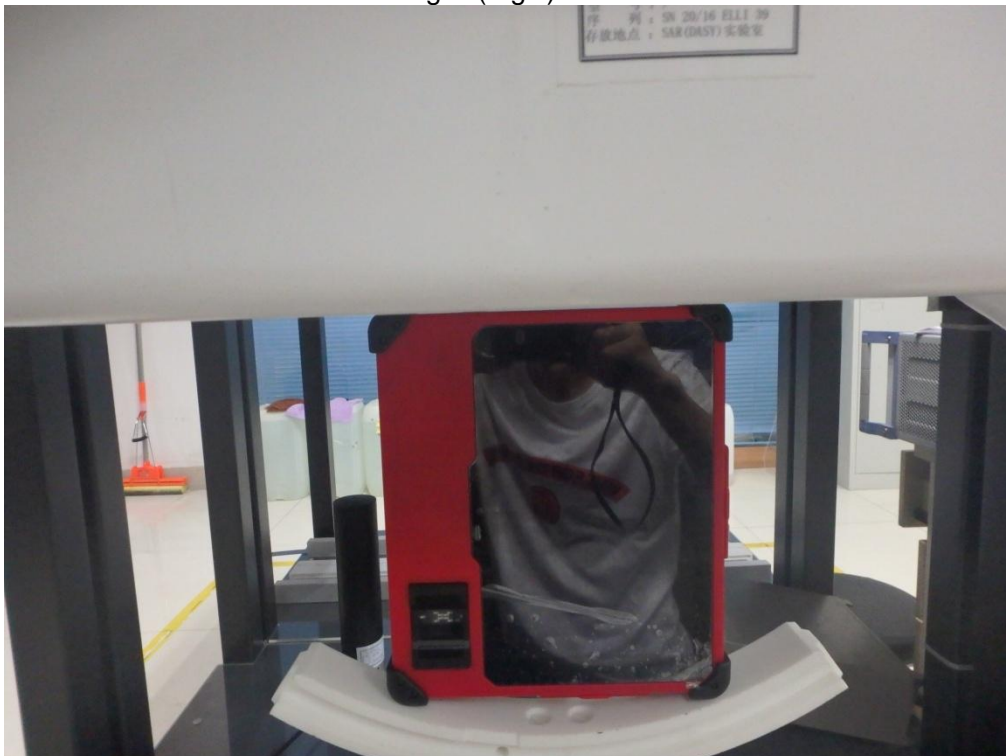
Body Front 0mm



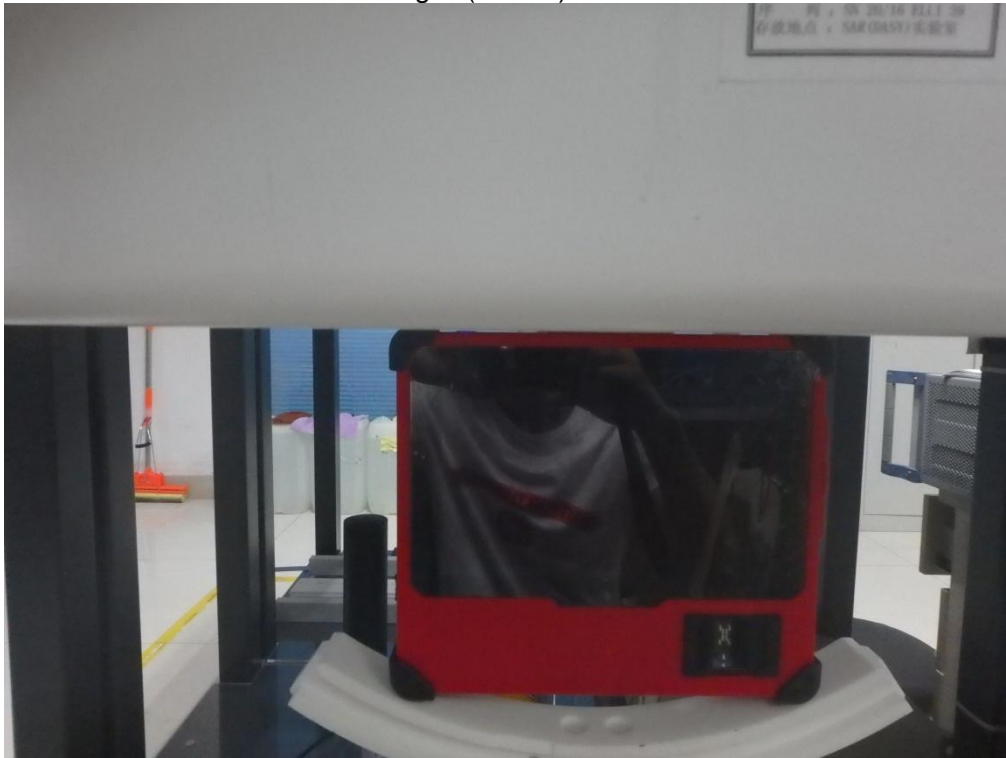
Edge 1(Top) 0mm



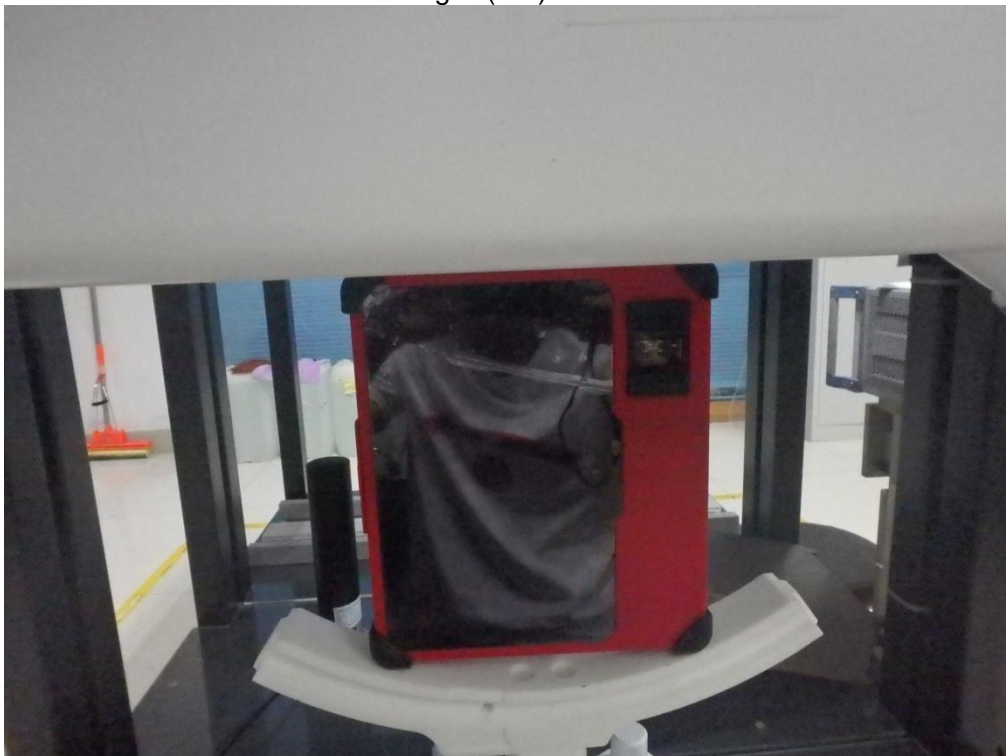
Edge 2(Right) 0mm



Edge 3(Bottom) 0mm

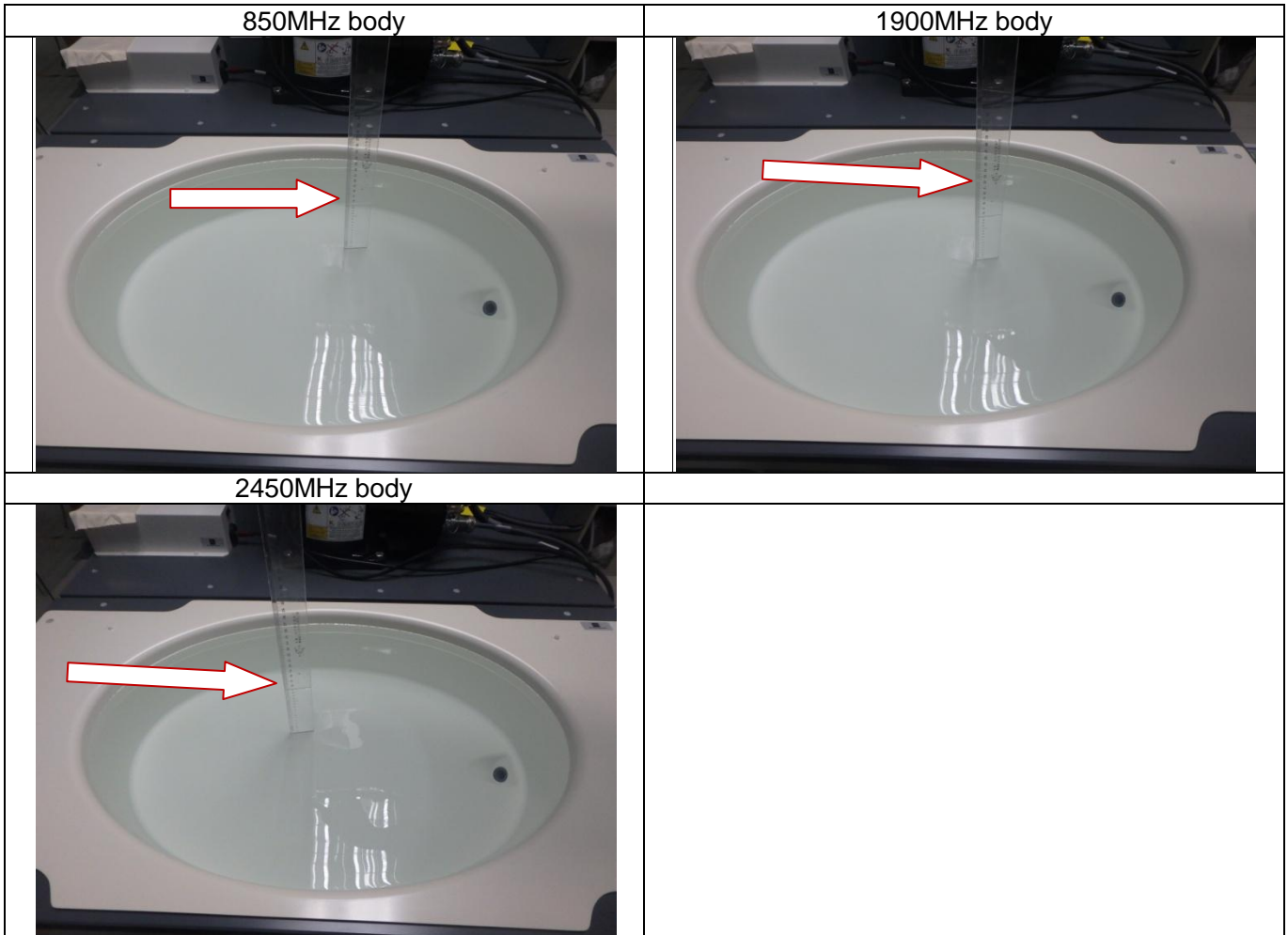


Edge 4(Left) 0mm



DEPTH OF THE LIQUID IN THE PHANTOM—ZOOM IN

Note : The position used in the measurement were according to IEEE 1528-2013



APPENDIX D. CALIBRATION DATA

Refer to Attached files.