NVLAP TESTING
NVLAP LAB CODE 600142-0

FCC SAR Compliance Test Report

For

INFINIX MOBILITY LIMITED

RMS 05-15, 13A/F SOUTH TOWER WORLD FINANCE CTR HARBOUR CITY 17 CANTON RD TST KLN HONG KONG

Model: X609B

Test Engineer:	Zhuang Jianan Zhuang Jianan
Report Number:	FCC18080068A-SAR
Report Date:	Oct. 16, 2018
FCC ID:	2AIZN-X609B
Check By:	Lily Zhao Lily Zhao
Approved By:	Wang Fengbing Wang Fengbing
Prepared By:	World Standardization Certification & Testing Group Co.,Ltd. Building A-B, Baoshi Science & Technology Park, Baoshi Road, Bao'an District, Shenzhen, Guangdong, China Tel: +86-755-26996192 Fax: +86-755-86376605

World Standardization Certification & Testing Group Co.,Ltd. WSCT

Table of contents

Modified History

REV.	Modification Description	Issued Date	Remark
REV.1.0	Initial Test Report Relesse	Oct. 16, 2018	Wang Fengbing

1 General information

1.1 Notes

The test results of this test report relate exclusively to the test item specified in this test report. World Standardization Certification & Testing Group Co.,Ltd does not assume responsibility for any conclusions and generalisations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item. The test report is not to be reproduced or published in full without the prior written permission.

1.2 Application details

Date of receipt of test item: 2018-08-31
Start of test: 2018-10-09
End of test: 2018-10-10

1.3 Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for X609B is as below:

Band	Position	MAX Reported SAR_{1g} (W/kg)
GSM850	Head	0.460
	Body & Hotspot 10mm	0.143
GSM1900	Head	0.764
	Body & Hotspot 10mm	0.308
UMTS Band II	Head	**0.794**
	Body & Hotspot 10mm	**0.784**
UMTS Band V	Head	0.210
	Body & Hotspot 10mm	0.341
Wi-Fi 2450	Head	0.347
	Body & Hotspot 10mm	0.102
The highest simultaneous SAR is 1.111W/kg per KDB690783 D01		

The device is in compliance with Specific Absorption Rate （SAR）for general population/uncontraolled exposure limits of 1.6 W/Kg as averaged over any 1g tissue according to the FCC rule §2.1093, the ANSI/IEEE C95.1:2005, the NCRP Report Number 86 for uncontrolled environment, according to the Industry Canada Radio Standards Specification RSS-102 for General Population/Uncontrolled exposure, and had been tested in accordance with the measurement methods and procedures specified in IEEE Std 1528-2013.

1.4 EUT Information

Device Information:			
Product Type:	Mobile Phone		
Model:	X609B		
Brand Name:	Infinix		
Device Type:	Portable device		
Exposure Category:	uncontrolled environment / general population		
Production Unit or Identical Prototype:	Production Unit		
Hardware version:	V2.0		
Software version :	X609B-H8025C-GO-180911V46		
Antenna Type :	Internal Antenna		
Device Operating Configurations:			
Supporting Mode(s) :	GSM850/1900, UMTS Band II /V,Wi-Fi , BT		
Modulation:	GSM(GMSK),UMTS(QPSK/16QAM), WiFi(OFDM/CCK),BT(GFSK/π/4-DQPSK/ 8-DPSK), BLE(GFSK)		
Device Class :	Class B, No DTM Mode		
Operating Frequency Range(s)	Band	TX(MHz)	RX(MHz)
	GSM850	824~849	869~894
	GSM1900	1850~1910	1930~1990
	UMTS Band II	1850~1910	1930~1990
	UMTS Band V	824~840	869~894
	Wi-Fi	2412~2462	2412~2462
	BT	2402~2480	2402~2480
GPRS class level:	GPRS class 12		
Test Channels (low-mid-high):	128-190-251(GSM850)		
	512-661-810(GSM1900)		
	9262-9400-9538(UMTS Band II)		
	4132-4182-4233(UMTS Band V)		
	1-6-11 (Wi-Fi)		
	0-39-78(BT) 0-19-39(BLE)		
Power Source:	3.85 VDC/3550mAh/3650mAh(min/typ) Rechargeable Battery		

2 Testing laboratory

Test Site	World Standardization Certification & Testing (Shenzhen) Co.,Ltd.
Test Location	Building A-B, Baoshi Science & Technology Park, Baoshi Road, Bao'an District, Shenzhen, Guangdong, China
Telephone	+86-755-26996192
Fax	+86-755-86376605

3 Test Environment

	Required	Actual
Ambient temperature:	18 – 25 °C	22 ± 2 °C
Tissue Simulating liquid:	22 ± 2 °C	22 ± 2 °C
Relative humidity content:	30 – 70 %	30 – 70 %

4 Applicant and Manufacturer

Applicant/Client Name:	INFINIX MOBILITY LIMITED
Applicant Address:	RMS 05-15, 13A/F SOUTH TOWER WORLD FINANCE CTR HARBOUR CITY 17 CANTON RD TST KLN HONG KONG
Manufacturer Name:	INFINIX MOBILITY LIMITED
Manufacturer Address:	RMS 05-15, 13A/F SOUTH TOWER WORLD FINANCE CTR HARBOUR CITY 17 CANTON RD TST KLN HONG KONG

5 Test standard/s:

ANSI Std C95.1-2005	Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz.
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
RSS-102	Radio Frequency Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands (Issue 5 March 2015)
KDB447498 D01	General RF Exposure Guidance v06
KDB648474 D04	Head set SAR v01r03
KDB941225 D06	Hot Spot SAR V02r01
KDB941225 D01	3G SAR Measurement Procedures
KDB248227 D01	SAR meas for 802.11 a/b/g v01r02
KDB865664 D01	SAR Measurement 100 MHz to 6 GHz v01r04
KDB865664 D02	RF Exposure Reporting v01r02

5.1 RF exposure limits

Human Exposure	Uncontrolled Environment General Population	Controlled Environment Occupational
Spatial Peak SAR* (Brain/Body/Arms/Legs)	**1.60 mW/g**	8.00 mW/g
Spatial Average SAR** (Whole Body)	0.08 mW/g	0.40 mW/g
Spatial Peak SAR*** (Heads/Feet/Ankle/Wrist)	4.00 mW/g	20.00 mW/g

The limit applied in this test report is shown in bold letters

Notes:

* The Spatial Peak value of the SAR averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

** The Spatial Average value of the SAR averaged over the whole body.

*** The Spatial Peak value of the SAR averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

Uncontrolled Environments are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure.

Controlled Environments are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation.

5.2 SAR Definition

Specific Absorption Rate is defined as 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).

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

SAR is expressed in units of watts per kilogram (W/kg). SAR can be related to the electric field at a point by

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

where:

σ = conductivity of the tissue (S/m)

ρ = mass density of the tissue (kg/m^3)

E = rms electric field strength (V/m)

6 SAR Measurement System

6.1 The Measurement System

Comosar is a system that is able to determine the SAR distribution inside a phantom of human being according to different standards. The Comosar system consists of the following items:

- Main computer to control all the system
- 6 axis robot
- Data acquisition system
- Miniature E-field probe
- Device holder
- Head simulating tissue

The following figure shows the system.

The EUT under test operating at the maximum power level is placed in the phone holder, under the phantom, which is filled with head simulating liquid. The E-Field probe measures the electric field inside the phantom. The OpenSAR software computes the results to give a SAR value in a 1g or 10g mass.

6.2 Robot

The COMOSAR system uses the high precision robots KR 6 R900 sixx type out of the newer series from Satimo SA (France).For the 6-axis controller COMOSAR system, the KUKA robot controller version from Satimo is used. The KR 6 R900 sixx 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

6.3 Probe

For the measurements the Specific Dosimetric E-Field Probe SSE 5 with following specifications is used

- Dynamic range: 0.01-100 W/kg
- Tip Diameter : 5 mm
- Distance between probe tip and sensor center: 2.5mm
- Distance between sensor center and the inner phantom surface: 4 mm (repeatability better than +/- 1mm)
- Probe linearity: ＜0.25 dB
- Axial Isotropy: ＜0.25 dB
- Spherical Isotropy: ＜0.50 dB
- Calibration range: 300 to 3G for head & body simulating liquid.

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

6.4 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 16 mm * 8 to 16 mm and a constant distance to the inner surface of the phantom.Since the sensors can not 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.

6.5 Description of interpolation/extrapolation scheme

- The local SAR inside the phantom is measured using small dipole sensing elements inside a probe body.The probe tip must not be in contact with the phantom surface in order to minimise measurements errors,but the highest local SAR will occur at the surface of the phantom.

- An extrapolation is using to determinate this highest local SAR values.
  The extrapolation is based on afourth-order least-square polynomial fit of measured data.The local SAR value is then extrapolated from the liquid surface with a 1 mm step.

- The measurements have to be performed over a limited time(due to the duration of the battery) so the step of measurement is high.It could vary between 5 and 8 mm.To obtain an accurate assessment of the maximum SAR average over 10 grams and 1gram requires a very fine resolution in the three dimensional scanned data array.

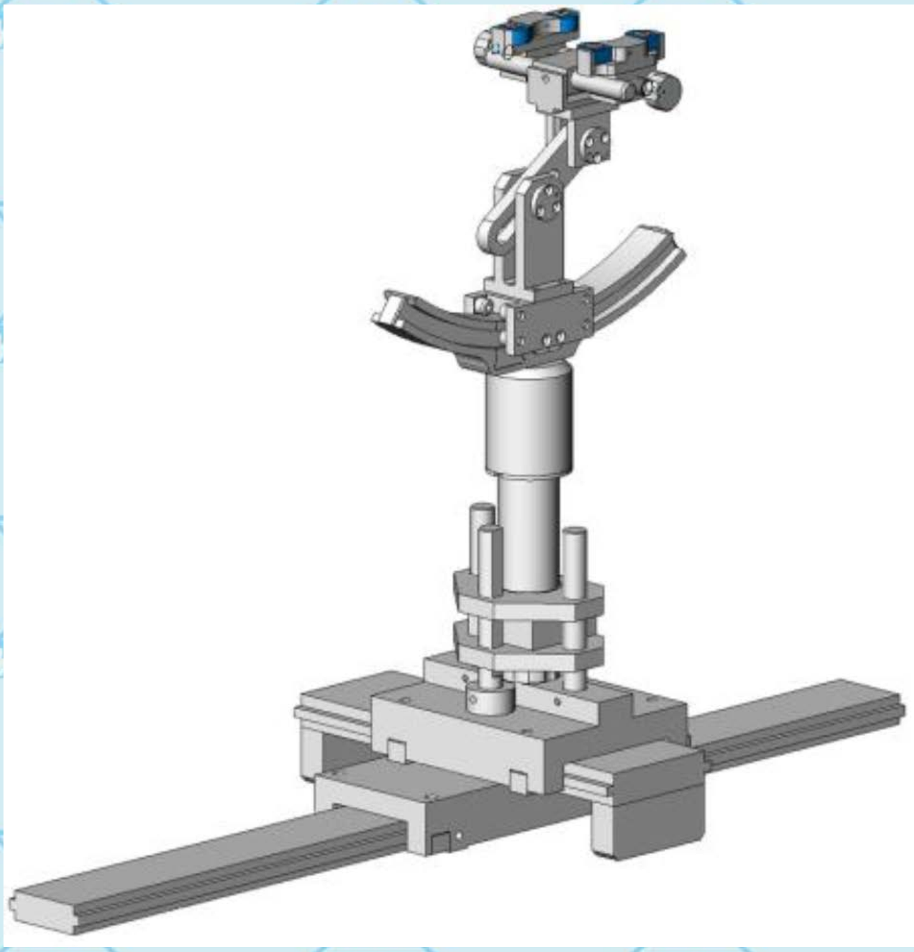
6.6 Phantom

For the measurements the Specific Anthropomorphic Mannequin (SAM) defined by the IEEE SCC-34/SC2 group is used. The phantom is a polyurethane shell integrated in a wooden table. The thickness of the phantom amounts to 2mm +/- 0.2mm. It enables the dosimetric evaluation of left and right phone usage and includes an additional flat phantom part for the simplified performance check. The phantom set-up includes a cover, which prevents the evaporation of the liquid.

System Material	Permittivity	Loss Tangent
Delrin	3.7	0.005

6.7 Device Holder

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°.



Device holder

System Material	Permittivity	Loss Tangent
Delrin	3.7	0.005

6.8 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.

6.9 Tissue simulating liquids: dielectric properties

The following materials are used for producing the tissue-equivalent materials.

(Liquids used for tests are marked with☒):

Ingredients(% of weight)	**Frequency (MHz)**				
frequency band	☐ 450	☒ 835	☐ 1800	☒ 1900	☒ 2450
Tissue Type	Head	Head	Head	Head	Head
Water	38.56	41.45	52.64	55.242	62.7
Salt (NaCl)	3.95	1.45	0.36	0.306	0.5
Sugar	56.32	56.0	0.0	0.0	0.0
HEC	0.98	1.0	0.0	0.0	0.0
Bactericide	0.19	0.1	0.0	0.0	0.0
Triton X-100	0.0	0.0	0.0	0.0	36.8
DGBE	0.0	0.0	47.0	44.542	0.0
Ingredients(% of weight)	**Frequency (MHz)**				
frequency band	☐ 450	☒ 835	☐ 1800	☒ 1900	☒ 2450
Tissue Type	Body	Body	Body	Body	Body
Water	51.16	52.4	69.91	69.91	73.2
Salt (NaCl)	1.49	1.40	0.13	0.13	0.04
Sugar	46.78	45.0	0.0	0.0	0.0
HEC	0.52	1.0	0.0	0.0	0.0
Bactericide	0.05	0.1	0.0	0.0	0.0
Triton X-100	0.0	0.0	0.0	0.0	0.0
DGBE	0.0	0.0	29.96	29.96	26.7

Salt: 99+% Pure Sodium Chloride
Sugar: 98+% Pure Sucrose
Water: De-ionized, 16MΩ+ resistivity
HEC: Hydroxyethyl Cellulose
DGBE: 99+% Di(ethylene glycol) butyl ether, [2-(2-butoxyethoxy)ethanol]
Triton X-100(ultra pure): Polyethylene glycol mono [4-(1,1,3,3-tetramethylbutyl)phenyl]ether

6.10 Tissue simulating liquids: parameters

Tissue Type	Measured Frequency (MHz)	Target Tissue		Measured Tissue		Liquid Temp.	Test Date
		ε_r (+/-5%)	σ (S/m) (+/-5%)	ε_r	σ (S/m)		
835MHz Head	825	41.50 (39.43~43.58)	0.90 (0.86~0.95)	40.56	0.94	21.6°C	2018/10/10
	835	41.50 (39.43~43.58)	0.90 (0.86~0.95)	40.44	0.95		
	850	41.50 (39.43~43.58)	0.90 (0.86~0.95)	40.33	0.95		
835MHz Body	825	55.20 (52.44~57.96)	0.97 (0.92~1.02)	53.86	0.95	21.6°C	2018/10/10
	835	55.20 (52.44~57.96)	0.97 (0.92~1.02)	53.76	0.96		
	850	55.20 (52.44~57.96)	0.97 (0.92~1.02)	53.50	0.98		
1900MHz Head	1850	40.00 (38.00~42.00)	1.40 (1.33~1.47)	40.54	1.38	21.6°C	2018/10/09
	1880	40.00 (38.00~42.00)	1.40 (1.33~1.47)	40.66	1.37		
	1900	40.00 (38.00~42.00)	1.40 (1.33~1.47)	39.88	1.41		
	1910	40.00 (38.00~42.00)	1.40 (1.33~1.47)	39.54	1.44		
1900MHz Body	1850	53.30 (50.64~55.97)	1.52 (1.44~1.60)	52.62	1.49	21.6°C	2018/10/09
	1880	53.30 (50.64~55.97)	1.52 (1.44~1.60)	51.47	1.57		
	1900	53.30 (50.64~55.97)	1.52 (1.44~1.60)	52.70	1.52		
	1910	53.30 (50.64~55.97)	1.52 (1.44~1.60)	53.63	1.54		
2450MHz Head	2410	39.30 (37.34~41.26)	1.76 (1.67~1.85)	39.29	1.88	21.6°C	2018/10/10
	2435	39.20 (37.24~41.16)	1.79 (1.70~1.88)	39.25	1.87		
	2450	39.20 (37.24~41.16)	1.80 (1.71~1.89)	39.27	1.85		
	2460	39.20 (37.24~41.16)	1.81 (1.72~1.90)	39.27	1.83		

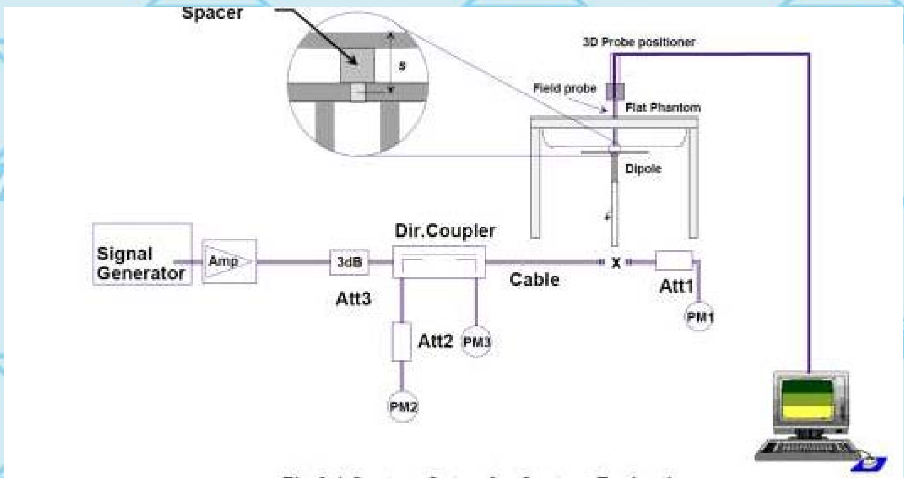
2450MHz Body	2410	52.80 (50.16~55.44)	1.91 (1.81~2.01)	53.23	1.91	21.6°C	2018/10/10
	2435	52.70 (50.07~55.34)	1.94 (1.84~2.04)	53.05	1.90		
	2450	52.70 (50.07~55.34)	1.95 (1.85~2.05)	53.05	2.03		
	2460	52.70 (50.07~55.34)	1.96 (1.86~2.06)	53.01	2.04		
ε_r= Relative permittivity, σ= Conductivity							

7 System Check

7.1 System check procedure

The System check is performed by using a System check dipole which is positioned parallel to the planar part of the SAM phantom at the reference point. The distance of the dipole to the SAM phantom is determined by a spacer. The dipole is connected to the signal source consisting of signal generator and amplifier via a directional coupler, N-connector cable and adaption to SMA. It is fed with a power of 100 mW. To adjust this power a power meter is used. The power sensor is connected to the cable before the System check to measure the power at this point and do adjustments at the signal generator. At the outputs of the directional coupler both return loss as well as forward power are controlled during the validation to make sure that emitted power at the dipole is kept constant. This can also be checked by the power drift measurement after the test (result on plot).

System check results have to be equal or near the values determined during dipole calibration (target SAR in table above) with the relevant liquids and test system.



7.2 System check results

The system Check is performed for verifying the accuracy of the complete measurement system and performance of the software.The following table shows System check results for all frequency bands and tissue liquids used during the tests (plot(s) see annex A).

System Check	Target SAR (1W) (+/-10%)		Measured SAR (Normalized to 1W)		Liquid Temp.	Test Date
	1-g (mW/g)	10-g (mW/g)	1-g (mW/g)	10-g (mW/g)		
D835V2 Head	9.82 (8.83~10.80)	6.35 (5.71~6.98)	9.120	6.720	21.6°C	2018/10/10
D1900V2 Head	38.93 (35.93~43.92	20.5 (18.45~22.55)	37.820	20.630	21.6°C	2018/10/09
D2450V2 Head	53.41 (48.06~58.75)	23.95 (21.55~26.34)	51.240	24.800	21.6°C	2018/10/10
D835V2 Body	9.41 (8.46~10.35)	6.22 (5.59~6.84)	8.460	6.300	21.6°C	2018/10/10
D1900V2 Body	38.73 (34.85~42.60)	20.48 (18.62~22.75)	37.200	20.470	21.6°C	2018/10/09
D2450V2 Body	51.39 (46.25~56.52)	23.63 (21.26~23.47)	47.280	23.290	21.6°C	2018/10/10
Note: All SAR values are normalized to 1W forward power.						

8 SAR Test Test Configuration

8.1 GSM Test Configurations

SAR tests for GSM850 and GSM1900, a communication link is set up with a base station by air link. Using CMU200 the power lever is set to “5”and “0” in SAR of GSM850 and GSM1900. The tests in the band of GSM 850 and GSM 1900 are performed in the mode of GPRS/EGPRS function. Since the GPRS class is 12 for this EUT, it has at most 4 timeslots in uplink and at most 4 timeslots in downlink, the maximum total timeslot is 5.

8.2 Wi-Fi Test Configuration

For the 802.11b/g SAR tests, a communication link is set up with the test mode software for Wi-Fi mode test. The Absolute Radio Frequency Channel Number(ARFCN) is allocated to 1 ,6 and 11 respectively in the case of 2450 MHz.During the test,at the each test frequency channel, the EUT is operated at the RF continuous emission mode. Each channel should be tested at the lowest data rate. 802.11b/g operating modes are tested independently according to the service requirements in each frquency band. 802.11b/g modes are tested on channel 1, 6, 11; however,if output power reduction is necessary for channels 1 and/or 11 to meet restricted band requirements the highest output channel closest to each of these channels must be tested instead.

SAR is not required for 802.11g/n channels when the maximum average output power is less than 0.25dB higher than that measured on the corresponding 802.11b channels.

Mode	Band	GHz	Channel	“Default Test Channels”	
				802.11b	802.11g
802.11b/g	2.4 GHz	2412	1#	√	∆
		2437	6	√	∆
		2462	11#	√	∆

Notes:

√ = “default test channels”

∆= possible 802.11g channels with maximum average output ¼ dB the “default test channels”

= when output power is reduced for channel 1 and /or 11 to meet restricted band requirements the highest output channels closest to each of these channels should be tested.

802.11 Test Channels per FCC Requirements

9 Detailed Test Results

9.1 Conducted Power measurements

The output power was measured using an integrated RF connector and attached RF cable.

9.1.1 Conducted Power of GSM850

GSM850(SIM1)		Burst-Averaged output Power (dBm)			Division Factors	Source Based time Average Power(dBm)		
		128CH	190CH	251CH		128CH	190CH	251CH
GSM(CS)		33.08	33.06	33.15	-9.03	24.05	24.03	24.12
GPRS (GMSK)	1 Tx Slot	32.42	32.38	32.46	-9.03	23.39	23.35	23.43
	2 Tx Slots	31.61	31.65	31.68	-6.02	25.59	25.63	25.66
	3 Tx Slots	30.66	30.62	30.76	-4.26	26.40	26.36	26.50
	4 Tx Slots	29.88	29.80	29.92	-3.01	**26.87**	**26.79**	**26.91**

GSM850(SIM2)		Burst-Averaged output Power (dBm)			Division Factors	Source Based time Average Power(dBm)		
		128CH	190CH	251CH		128CH	190CH	251CH
GSM(CS)		32.95	33.01	33.03	-9.03	23.92	23.98	24.00
GPRS (GMSK)	1 Tx Slot	32.66	32.62	32.78	-9.03	23.63	23.59	23.75
	2 Tx Slots	31.47	31.55	31.56	-6.02	25.45	25.53	25.54
	3 Tx Slots	30.38	30.42	30.45	-4.26	26.12	26.16	26.19
	4 Tx Slots	29.82	29.78	29.88	-3.01	**26.81**	**26.77**	**26.87**

Note: 1) The conducted power of GSM850 is measured with RMS detector.

2) Source Based time Average Power was calculated from the measured burst-averaged output power by converting the slot powers into linear units and calculating the energy over 8 timeslots.

3)The bolded GPRS 4Tx slots mode was selected for SAR testing according the highest Source Based time Average Power table.

4) channel /Frequency: 128/824.2; 190/836.6; 251/848.8

5) For Dual SIM Operation, when the power of deviation of SIM1 and SIM2 not more than 0.5dB, which tested SIM1 mode first,and then tested SIM2 mode at the worst position from SIM1 mode .

9.1.2 Conducted Power of GSM1900

GSM1900(SIM1)		Burst-Averaged output Power (dBm)			Division Factors	Source Based time Average Power(dBm)		
		512CH	661CH	810CH		512CH	661CH	810CH
GSM(CS)		29.92	29.91	29.97	-9.03	20.89	20.88	20.94
GPRS (GMSK)	1 Tx Slot	29.39	29.43	29.48	-9.03	20.36	20.40	20.45
	2 Tx Slots	28.59	28.67	28.69	-6.02	22.57	22.65	22.67
	3 Tx Slots	27.52	27.55	27.58	-4.26	23.26	23.29	23.32
	4 Tx Slots	26.85	26.88	26.95	-3.01	**23.84**	**23.87**	**23.94**

GSM1900(SIM2)		Burst-Averaged output Power (dBm)			Division Factors	Source Based time Average Power(dBm)		
		512CH	661CH	810CH		512CH	661CH	810CH
GSM(CS)		29.86	29.90	29.95	-9.03	20.83	20.87	20.92
GPRS (GMSK)	1 Tx Slot	29.60	29.67	29.71	-9.03	20.57	20.64	20.68
	2 Tx Slots	28.51	28.52	28.55	-6.02	22.49	22.50	22.53
	3 Tx Slots	27.36	27.39	27.44	-4.26	23.10	23.13	23.18
	4 Tx Slots	26.80	26.77	26.86	-3.01	**23.79**	**23.76**	**23.85**

Note: 1) The conducted power of GSM1900 is measured with RMS detector.

2) Source Based time Average Power was calculated from the measured burst-averaged output power by converting the slot powers into linear units and calculating the energy over 8 timeslots.

3)The bolded GPRS 4Tx slots mode was selected for SAR testing according the highest Source Based time Average Power table.

4) channel /Frequency: 512/1850.2; 661/1880; 810/1909.8

5) For Dual SIM Operation, when the power of deviation of SIM1 and SIM2 not more than 0.5dB, which tested SIM1 mode first,and then tested SIM2 mode at the worst position from SIM1 mode .

9.1.3 Conducted Power of UMTS Band II

UMTS Band II		Conducted Power (dBm)		
		9262CH	9400CH	9538CH
WCDMA	12.2kbps RMC	21.95	21.90	**21.98**
HSDPA	Subtest 1	21.62	21.71	21.75
	Subtest 2	21.45	21.39	21.48
	Subtest 3	20.95	20.96	20.98
	Subtest 4	20.86	20.76	20.88
HSUPA	Subtest 1	21.62	21.68	21.79
	Subtest 2	21.55	21.57	21.65
	Subtest 3	21.46	21.48	21.59
	Subtest 4	20.92	21.80	20.94
	Subtest 5	21.08	21.22	21.35

Note: 1) channel /Frequency: 9262/1852.4, 9400/1880, 9538/1907.6

9.1.4 Conducted Power of UMTS Band V

UMTS Band V		Conducted Power (dBm)		
		4132CH	4182CH	4233CH
WCDMA	12.2kbps RMC	22.23	22.20	**22.32**
HSDPA	Subtest 1	22.12	22.10	22.16
	Subtest 2	21.85	21.82	21.89
	Subtest 3	21.73	21.68	21.87
	Subtest 4	21.60	21.52	21.71
HSUPA	Subtest 1	21.89	21.83	21.95
	Subtest 2	22.01	22.05	21.98
	Subtest 3	21.84	21.77	22.00
	Subtest 4	21.68	21.70	21.86
	Subtest 5	21.92	21.98	22.10

Note: 1) channel /Frequency: 4132/826.4, 4182/836.4, 4233/846.6

9.1.5 Conducted Power of Wi-Fi 2.4G

Mode	802.11b		
Channel / Frequency (MHz)	1(2412)	6(2437)	11(2462)
Average Power(dBm)	14.03	**14.09**	14.06
Mode	802.11g		
Channel / Frequency (MHz)	1(2412)	6(2437)	11(2462)
Average Power(dBM)	13.52	13.61	13.49
Mode	802.11n(HT20)		
Channel / Frequency (MHz)	1(2412)	6(2437)	11(2462)
Average Power(dBM)	13.12	13.17	13.09
Mode	802.11n(HT40)		
Channel / Frequency (MHz)	1(2412)	6(2437)	11(2462)
Average Power(dBm)	12.06	12.21	12.17

Note:

<KDB 248227 D01, SAR Guidance for Wi-Fi Transmitters>

(1) For handsets operating next to ear, hotspot mode or mini-tablet configurations, the initial test position procedures were applied. The test position with the highest extrapolated peak SAR will be used as the initial test position. When the reported SAR of initial test position is <= 0.4 W/kg, SAR testing for remaining test positions is not required. Otherwise, SAR is evaluated at the subsequent highest peak SAR positions until the reported SAR result is <= 0.8 W/kg or all test positions are measured.

(2) For Wi-Fi 2.4 GHz, the highest measured maximum output power channel for DSSS was selected for SAR measurement. When the reported SAR is <= 0.8 W/kg, no further SAR testing is required. Otherwise, SAR is evaluated at the next highest measured output power channel. When any reported SAR is > 1.2 W/kg, SAR is required for the third channel. For OFDM modes (802.11g/n), SAR is not required when the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and it is <= 1.2 W/kg.

9.1.6 Conducted Power of BT

The maximum output power of BT is:

Mode	1Mbps		
Channel / Frequency (MHz)	0(2402)	39(2441)	78(2480)
Average Power(dBm)	1.03	1.29	1.94
Mode	2Mbps		
Channel / Frequency (MHz)	0(2402)	39(2441)	78(2480)
Average Power(dBm)	0.34	0.51	0.99
Mode	3Mbps		
Channel / Frequency (MHz)	0(2402)	39(2441)	78(2480)
Average Power(dBm)	0.36	0.51	1.01

The maximum output power of BLE is:

Mode	1Mbps		
Channel / Frequency (MHz)	0(2402)	39(2440)	78(2480)
Average Power(dBm)	1.00	1.73	2.11

9.1.7 Tune-up power tolerance

Band	Tune-up power tolerance(dBm)		
GSM850	GSM/GPRS (GMSK)	GSM	Max output power =33.0dBm±0.5dBm
		1TXslots	Max output power =32.0dBm±0.5dBm
		2TXslots	Max output power =31.5dBm±0.5dBm
		3TXslots	Max output power =30.5dBm±0.5dBm
		4TXslots	Max output power =29.5dBm±0.5dBm
GSM1900	GSM/GPRS (GMSK)	GSM	Max output power =29.5dBm±0.5dBm
		1TXslots	Max output power =29.0dBm±0.5dBm
		2TXslots	Max output power =28.5dBm±0.5dBm
		3TXslots	Max output power =27.5dBm±0.5dBm
		4TXslots	Max output power =26.5dBm±0.5dBm
WCDMA 2	Max output power =21.0dbm±1.0dbm		
WCDMA 5	Max output power =21.5dbm±1.0dbm		
2.4G Wi-Fi	802.11b		Max output power =13.5±1.0dbm
	802.11g		Max output power =13.0±1.0dbm
	802.11n (HT20)		Max output power =12.5±1.0dbm
	802.11n (HT40)		Max output power =11.5±1.0dbm
BT	1Mbps Power		Max output power =1.0dBm±1dbm
	2Mbps Power		Max output power =0.0dBm±1dbm
	3Mbps Power		Max output power =0.5dBm±1dbm
BLE	1Mbps Power		Max output power =1.5dBm±1dbm

9.2 SAR test results

Notes:

1) Per KDB447498 D01v05 r02,the SAR test shall be performed at the high, middle and low frequency channels of each operating mode. If the scaled SAR measured at mid-band channel for each test configuration is at least 3.0 dB lower than the SAR limit (< 0.8 W/kg), testing at the high and low channels is optional.

2) Per KDB447498 D01v05r02, testing of other required channels within the operating mode of a frequency band is not required when the reported 1-g or 10-g SAR for the mid-band or highest output power channel is: ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz. When the maximum output power variation across the required test channels is > ½ dB, instead of the middle channel, the highest output power channel must be used.

3) Per KDB447498 D01v05r02, All measurement SAR result is scaled-up to account for tune-up tolerance is compliant.

4) Per KDB648474 D04v01r02, body-worn accessory testing is typically associated with voice operations. Therefore, GSM voice was evaluated for body-worn with headset SAR.

5)Per KDB248227 D01v01r02, the procedures required to establish specific device operating configurations for testing the SAR of 802.11 a/b/g transmitters.

6) Per KDB865664 D01v01r04,for each frequency band,repeated SAR measurement is required only when the measured SAR is ≥0.8W/Kg; if the deviation among the repeated measurement is ≤20%,and the measured SAR <1.45W/Kg,only one repeated measurement is required.

7) Per KDB865664 D02v01r01, SAR plot is only required for the highest measured SAR in each exposure configuration, wireless mode and frequency band combination; Plots are also required when the measured SAR is > 1.5 W/kg, or > 7.0 W/kg for occupational exposure. The published RF exposure KDB procedures may require additional plots; for example, to support SAR to peak location separation ratio test exclusion and/or volume scan post-processing(Refer to appendix B for details).

8) Per KDB941225 D06v01r01, the DUT Dimension is bigger than 9 cm x 5 cm, so 10mm is chosen as the test separation distance for Hotspot mode. When the antenna-to-edge distance is greater than 2.5cm,such position does not need to be tested.

9) KDB 941225 D01, 3G SAR Measurement Procedures ,The mode tested for SAR is referred to as the primary mode. The equivalent modes considered for SAR test reduction are denoted as secondary modes. Both primary and secondary modes must be in the same frequency band. When the maximum output power and tune-up tolerance specified for production units in a secondary mode is≤ 1/4 dB higher than the primary mode or when the highest reported SAR of the primary mode is scaled by the ratio of specified maximum output power and tune-up tolerance of secondary to primary mode and the adjusted SAR is ≤1.2 W/kg, SAR measurement is not required for the secondary mode.

9.2.1 Results overview of GSM850

Test Position of Head	Test channel /Freq.(MHz)	Test Mode	SAR Value (W/kg)		Power Drift (%)	Conducted Power (dBm)	Tune-up Limit (dBm)	Scaled SAR_{1-g} (W/kg)	Scaling Factor
			1-g	10-g					
Left Hand Touched	251/848.8	GPRS 4TS	0.369	0.249	0.510	29.920	30.000	0.376	1.019
Left Hand Tilted 15°	251/848.8	GPRS 4TS	0.336	0.197	2.450	29.920	30.000	0.342	1.019
Right Hand Touched	251/848.8	GPRS 4TS	0.452	0.283	-0.300	29.920	30.000	**0.460**	1.019
Right Hand Tilted 15°	251/848.8	GPRS 4TS	0.333	0.199	1.580	29.920	30.000	0.339	1.019
Test Position of Body with 10mm	**Test channel /Freq.(MHz)**	**Test Mode**	**SAR Value (W/kg)**		**Power Drift (%)**	**Conducted Power (dBm)**	**Tune-up Limit (dBm)**	**Scaled SAR_{1-g} (W/kg)**	**Scaling Factor**
			1-g	**10-g**					
SAR Results for Hotspot Exposure Condition									
Front side	251/848.8	GPRS 4TS	0.140	0.103	3.000	29.920	30.000	**0.143**	1.019
Rear side	251/848.8	GPRS 4TS	0.096	0.067	-1.430	29.920	30.000	0.098	1.019
Top side	251/848.8	GPRS 4TS	0.061	0.037	-3.940	29.920	30.000	0.062	1.019
Right side	251/848.8	GPRS 4TS	0.059	0.041	-4.020	29.920	30.000	0.060	1.019

9.2.2 Results overview of GSM1900

Test Position of Head	Test channel /Freq.(MHz)	Test Mode	SAR Value (W/kg)		Power Drift (%)	Conducted Power (dBm)	Tune-up Limit (dBm)	Scaled SAR_{1-g} (W/kg)	Scalig Factor
			1-g	10-g					
Left Hand Touched	810/1909.8	GPRS 4TS	0.522	0.210	-1.200	26.950	27.000	0.528	1.012
Left Hand Tilted 15°	810/1909.8	GPRS 4TS	0.719	0.279	-2.650	26.950	27.000	0.727	1.012
Right Hand Touched	810/1909.8	GPRS 4TS	0.519	0.213	1.920	26.950	27.000	0.525	1.012
Right Hand Tilted 15°	810/1909.8	GPRS 4TS	0.755	0.327	4.000	26.950	27.000	**0.764**	1.012
Test Position of Body with 10mm	**Test channel /Freq.(MHz)**	**Test Mode**	**SAR Value (W/kg)**		**Power Drift (%)**	**Conducted Power (dBm)**	**Tune-up Limit (dBm)**	**Scaled SAR_{1-g} (W/kg)**	**Scalig Factor**
			1-g	**10-g**					
SAR Results for Hotspot Exposure Condition									
Front side	810/1909.8	GPRS 4TS	0.218	0.097	-0.740	26.950	27.000	0.221	1.012
Rear side	810/1909.8	GPRS 4TS	0.304	0.132	-0.400	26.950	27.000	**0.308**	1.012
Top side	810/1909.8	GPRS 4TS	0.214	0.098	-1.170	26.950	27.000	0.216	1.012
Right side	810/1909.8	GPRS 4TS	0.035	0.018	-4.450	26.950	27.000	0.035	1.012

9.2.3 Results overview of UMTS Band II

Test Position of Head	Test channel /Freq.(MHz)	Test Mode	SAR Value (W/kg)		Power Drift (%)	Conducted Power (dBm)	Tune-up Limit (dBm)	Scaled SAR$_{1-g}$ (W/kg)	Scalig Factor
			1-g	10-g					
Left Hand Touched	9538/1907.6	RMC	0.424	0.182	0.100	21.980	22.000	0.426	1.005
Left Hand Tilted 15°	9538/1907.6	RMC	0.790	0.498	-2.610	21.980	22.000	**0.794**	1.005
Right Hand Touched	9538/1907.6	RMC	0.313	0.141	0.410	21.980	22.000	0.314	1.005
Right Hand Tilted 15°	9538/1907.6	RMC	0.545	0.236	0.330	21.980	22.000	0.548	1.005
Test Position of Body with 10mm	**Test channel /Freq.(MHz)**	**Test Mode**	**SAR Value (W/kg)**		**Power Drift (%)**	**Conducted Power (dBm)**	**Tune-up Limit (dBm)**	**Scaled SAR$_{1-g}$ (W/kg)**	**Scalig Factor**
			1-g	**10-g**					
SAR Results for Hotspot Exposure Condition									
Front side	9538/1907.6	RMC	0.123	0.057	-1.680	21.980	22.000	0.124	1.005
Rear side	9538/1907.6	RMC	0.240	0.108	-0.570	21.980	22.000	0.241	1.005
Top side	9538/1907.6	RMC	0.780	0.349	-2.640	21.980	22.000	**0.784**	1.005
Right side	9538/1907.6	RMC	0.155	0.070	-0.160	21.980	22.000	0.156	1.005

9.2.4 Results overview of UMTS Band V

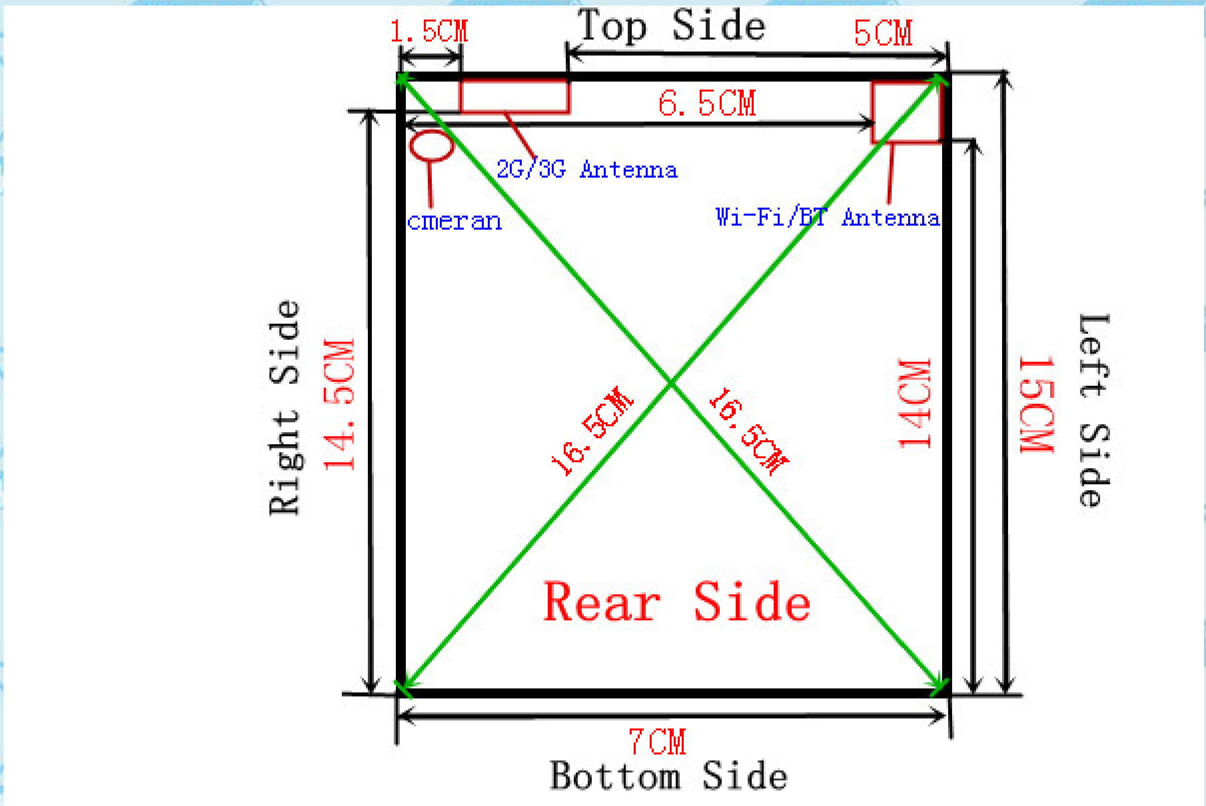
Test Position of Head	Test channel /Freq.(MHz)	Test Mode	SAR Value (W/kg)		Power Drift (%)	Conducted Power (dBm)	Tune-up Limit (dBm)	Scaled SAR_{1-g} (W/kg)	Scalig Factor
			1-g	10-g					
Left Hand Touched	4233/846.6	RMC	0.110	0.074	-0.790	22.320	22.500	0.115	1.042
Left Hand Tilted 15°	4233/846.6	RMC	0.201	0.120	0.140	22.320	22.500	**0.210**	1.042
Right Hand Touched	4233/846.6	RMC	0.122	0.080	-0.180	22.320	22.500	0.127	1.042
Right Hand Tilted 15°	4233/846.6	RMC	0.171	0.101	-0.430	22.320	22.500	0.178	1.042
Test Position of Body with 10mm	**Test channel /Freq.(MHz)**	**Test Mode**	**SAR Value (W/kg)**		**Power Drift (%)**	**Conducted Power (dBm)**	**Tune-up Limit (dBm)**	**Scaled SAR_{1-g} (W/kg)**	**Scalig Factor**
			1-g	**10-g**					
SAR Results for Hotspot Exposure Condition									
Front side	4233/846.6	RMC	0.070	0.052	1.400	22.320	22.500	0.073	1.042
Rear side	4233/846.6	RMC	0.091	0.067	-0.910	22.320	22.500	0.095	1.042
Top side	4233/846.6	RMC	0.327	0.175	-0.910	22.320	22.500	**0.341**	1.042
Right side	4233/846.6	RMC	0.074	0.048	-2.100	22.320	22.500	0.077	1.042

9.2.5 Results overview of Wi-Fi 2.4G

Test Position of Head	Test channel /Freq.(MHz)	Test Mode	SAR Value (W/kg)		Power Drift (%)	Conducted Power (dBm)	Tune-up Limit (dBm)	Scaled SAR_{1-g} (W/kg)	Scaling Factor
			1-g	10-g					
Left Hand Touched	6/2437	802.11b	0.164	0.073	1.180	14.090	14.500	0.180	1.099
Left Hand Tilted 15°	6/2437	802.11b	0.118	0.050	-2.150	14.090	14.500	0.130	1.099
Right Hand Touched	6/2437	802.11b	0.266	0.110	-0.310	14.090	14.500	0.292	1.099
Right Hand Tilted 15°	6/2437	802.11b	0.316	0.129	0.300	14.090	14.500	**0.347**	1.099
Test Position of Body with 10mm	**Test channel /Freq.(MHz)**	**Test Mode**	**SAR Value (W/kg)**		**Power Drift (%)**	**Conducted Power (dBm)**	**Tune-up Limit (dBm)**	**Scaled SAR_{1-g} (W/kg)**	**Scaling Factor**
			1-g	**10-g**					
SAR Results for Hotspot Exposure Condition									
Front side	6/2437	802.11b	0.091	0.041	-1.010	14.090	14.500	0.100	1.099
Rear side	6/2437	802.11b	0.093	0.040	0.180	14.090	14.500	**0.102**	1.099
Top side	6/2437	802.11b	0.048	0.022	-2.650	14.090	14.500	0.053	1.099
Left side	6/2437	802.11b	0.019	0.009	0.460	14.090	14.500	0.021	1.099

10 Multiple Transmitter Information

The SAR measurement positions of each side are as below:



Mode	Front Side	Rear Side	Left Side	Right Side	Top Side	Bottom Side
2G/3G Antenna	Yes	Yes	No	Yes	Yes	No
Wi-Fi	Yes	Yes	Yes	No	Yes	No

1) Per KDB941225 D06v01r01, the DUT Dimension is bigger than 9 cm x 5 cm, so 10mm is chosen as the test separation distance for Hotspot mode. When the antenna-to-edge distance is greater than 2.5cm,such position does not need to be tested.

10.1.1 Stand-alone SAR test exclusion

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:

[(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] · [√f(GHz)] ≤ 3.0 for 1-g SAR and ≤ 7.5 for 10-g extremity SAR,where

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

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

Head position

Mode	Pmax(dBm)	Pmax(mW)	Distance(mm)	f(GHz)	Calculation Result	exclusion Threshold	SAR test exclusion
BLE	2.50	1.78	5.00	2.45	0.56	3.00	Yes

Body-Worn position

Mode	Pmax(dBm)	Pmax(mW)	Distance(mm)	f(GHz)	Calculation Result	exclusion Threshold	SAR test exclusion
BLE	2.50	1.78	10.00	2.45	0.28	3.00	Yes

When the standalone SAR test exclusion applies to an antenna that transmits simultaneously with other antennas, the standalone SAR must be estimated according to the following to determine simultaneous transmission SAR test exclusion

(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)]·[√f(GHz)/x] W/kg for test separation distances ≤ 50 mm, where x = 7.5 for 1-g SAR.

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

Mode	**Position**	**Pmax(dBm)**	**Pmax(mW)**	**Distance(mm)**	**f(GHz)**	**X**	**Estimated SAR(W/Kg)**
BLE	Head	2.50	1.78	5.00	2.45	7.50	0.074
BLE	Body	2.50	1.78	10.00	2.45	7.50	0.037

10.1.2 Simultaneous Transmission Possibilities

The Simultaneous Transmission Possibilities are as below:

Simultaneous Transmission Possibilities				
Simultaneous Tx Combination	Configuration	Head	Body	Hotspot
1	GSM/GPRS/UMTS +Wi-Fi	YES	YES	YES
2	GSM/GPRS/UMTS +BLE	YES	NO	NO

Note: The device does not support simultaneous BT and Wi-Fi ,because the BT and Wi-Fi share the same antenna and can't transmit simultaneously.

10.1.3 SAR Summation Scenario

Test Position		Scaled SAR_{Max} GSM850	Scaled SAR_{Max} Wi-Fi	$\sum_{1\text{-}g}$ SAR	SPLSP
Head	Left Head Touched	0.376	0.180	0.556	NA
	Left Head Tilted 15°	0.342	0.130	0.472	NA
	Right Head Touched	0.460	0.292	**0.752**	NA
	Right Head Tilted 15°	0.339	0.347	0.686	NA
Body Hotspot	Front side	0.143	0.100	0.243	NA
	Rear side	0.098	0.102	0.200	NA
	Bottom side	0.062	0.053	0.115	NA
	Right side	0.060	/	0.060	NA
	Left side	/	0.021	0.021	NA

Note: Simultaneous Tx Combination of GSM850 and Wi-Fi

Test Position		Scaled SAR_{Max} GSM1900	Scaled SAR_{Max} Wi-Fi	$\sum_{1\text{-}g}$ SAR	SPLSP
Head	Left Head Touched	0.528	0.180	0.708	NA
	Left Head Tilted 15°	0.727	0.130	0.857	NA
	Right Head Touched	0.525	0.292	0.817	NA
	Right Head Tilted 15°	0.764	0.347	**1.111**	NA
Body Hotspot	Front side	0.221	0.100	0.321	NA
	Rear side	0.308	0.102	0.410	NA
	Bottom side	0.216	0.053	0.269	NA
	Right side	0.035	/	0.035	NA
	Left side	/	0.021	0.021	NA

Note: Simultaneous Tx Combination of GSM1900 and Wi-Fi

Test Position		Scaled SAR_{Max} UMTS Band II	Scaled SAR_{Max} Wi-Fi	$\sum_{1\text{-}g}$ SAR	SPLSP
Head	Left Head Touched	0.426	0.180	0.606	NA
	Left Head Tilted 15°	0.794	0.130	**0.924**	NA
	Right Head Touched	0.314	0.292	0.606	NA
	Right Head Tilted 15°	0.548	0.347	0.895	NA
Body Hotspot	Front side	0.124	0.100	0.224	NA
	Rear side	0.241	0.102	0.343	NA
	Bottom side	0.784	0.053	0.837	NA
	Right side	0.156	/	0.156	NA
	Left side	/	0.021	0.021	NA

Note: Simultaneous Tx Combination of UMTS Band II and Wi-Fi

Test Position		Scaled SAR_{Max} UMTS Band V	Scaled SAR_{Max} Wi-Fi	$\sum_{1\text{-}g}$ SAR	SPLSP
Head	Left Head Touched	0.115	0.180	0.295	NA
	Left Head Tilted 15°	0.210	0.130	0.340	NA
	Right Head Touched	0.127	0.292	0.419	NA
	Right Head Tilted 15°	0.178	0.347	**0.525**	NA
Body Hotspot	Front side	0.073	0.100	0.173	NA
	Rear side	0.095	0.102	0.197	NA
	Bottom side	0.341	0.053	0.394	NA
	Right side	0.077	/	0.077	NA
	Left side	/	0.021	0.021	NA

Note: Simultaneous Tx Combination of UMTS Band V and Wi-Fi

MAX.$\sum SAR_{1g}$ = 1.111W/kg<1.6 W/kg, so the Simultaneous SAR is not required for Wi-Fi and GSM&UMTS antenna.

Test Position		Scaled SAR_{Max}		$\sum_{1\text{-}g}$ SAR	SPLSP
		GSM850	BT		
Head	Left Head Touched	0.376	0.074	0.450	NA
	Left Head Tilted 15°	0.342	0.074	0.416	NA
	Right Head Touched	0.460	0.074	**0.534**	NA
	Right Head Tilted 15°	0.339	0.074	0.413	NA
Body Hotspot	Front side	0.143	0.037	0.180	NA
	Rear side	0.098	0.037	0.135	NA
	Bottom side	0.062	0.037	0.099	NA
	Right side	0.060	/	0.060	NA
	Left side	/	0.037	0.037	NA

Note: Simultaneous Tx Combination of GSM850 and BT

Test Position		Scaled SAR_{Max}		$\sum_{1\text{-}g}$ SAR	SPLSP
		GSM1900	BT		
Head	Left Head Touched	0.528	0.074	0.602	NA
	Left Head Tilted 15°	0.727	0.074	0.801	NA
	Right Head Touched	0.525	0.074	0.599	NA
	Right Head Tilted 15°	0.764	0.074	**0.838**	NA
Body Hotspot	Front side	0.221	0.037	0.258	NA
	Rear side	0.308	0.037	0.345	NA
	Bottom side	0.216	0.037	0.253	NA
	Right side	0.035	/	0.035	NA
	Left side	/	0.037	0.037	NA

Note: Simultaneous Tx Combination of GSM1900 and BT

Test Position		Scaled SAR_{Max}		$\sum_{1\text{-}g}$ SAR	SPLSP
		UMTS Band II	BT		
Head	Left Head Touched	0.426	0.074	0.500	NA
	Left Head Tilted 15°	0.794	0.074	**0.868**	NA
	Right Head Touched	0.314	0.074	0.388	NA
	Right Head Tilted 15°	0.548	0.074	0.622	NA
Body Hotspot	Front side	0.124	0.037	0.161	NA
	Rear side	0.241	0.037	0.278	NA
	Bottom side	0.784	0.037	0.821	NA
	Right side	0.156	/	0.156	NA
	Left side	/	0.037	0.037	NA

Note: Simultaneous Tx Combination of UMTS Band II and BT

Test Position		Scaled SAR_{Max}		$\sum_{1\text{-}g}$ SAR	SPLSP
		UMTS Band V	BT		
Head	Left Head Touched	0.115	0.074	0.189	NA
	Left Head Tilted 15°	0.210	0.074	**0.284**	NA
	Right Head Touched	0.127	0.074	0.201	NA
	Right Head Tilted 15°	0.178	0.074	0.252	NA
Body Hotspot	Front side	0.073	0.037	0.110	NA
	Rear side	0.095	0.037	0.132	NA
	Bottom side	0.341	0.037	0.378	NA
	Right side	0.077	/	0.077	NA
	Left side	/	0.037	0.037	NA

Note: Simultaneous Tx Combination of UMTS Band V and BT

MAX.$\sum SAR_{1g}$ = 0.868W/kg<1.6 W/kg, so the Simultaneous SAR is not required for BT and GSM&UMTS antenna.

11 Measurement uncertainty evaluation

11.1 Measurement uncertainty evaluation for SAR test

The following table includes the uncertainty table of the IEEE 1528. The values are determined by Satimo.The breakdown of the individual uncertainties is as follows:

Measurement Uncertainty evaluation for SAR test								
Uncertainty Component	Tol. (±%)	Prob. Dist.	Div.	C_i (1g)	C_i (10g)	1g U_i (±%)	10g U_i (±%)	V_i
measurement system								
Probe Calibration	5.8	N	1	1	1	5.8	5.8	∞
Axial Isotropy	3.5	R	$\sqrt{3}$	$(1-C_p)^{1/2}$	$(1-C_p)^{1/2}$	1.43	1.43	∞
Hemispherical Isotropy	5.9	R	$\sqrt{3}$	$\sqrt{C_p}$	$\sqrt{C_p}$	2.41	2.41	∞
Boundary Effect	1	R	$\sqrt{3}$	1	1	0.58	0.58	∞
Linearity	4.7	R	$\sqrt{3}$	1	1	2.71	2.71	∞
system Detection Limits	1	R	$\sqrt{3}$	1	1	0.58	0.58	∞
Modulation response	3	N	1	1	1	3.00	3.00	∞
Readout Electronics	0.5	N	1	1	1	0.50	0.50	∞
Response Time	0	R	$\sqrt{3}$	1	1	0.00	0.00	∞
Integration Time	1.4	R	$\sqrt{3}$	1	1	0.81	0.81	∞
RF Ambient Conditions-Noise	3	R	$\sqrt{3}$	1	1	1.73	1.73	∞
RF Ambient Conditions-Reflections	3	R	$\sqrt{3}$	1	1	1.73	1.73	∞
Probe Positioner Mechanical Tolerance	1.4	R	$\sqrt{3}$	1	1	0.81	0.81	∞
Probe positioning with respect to Phantom Shell	1.4	R	$\sqrt{3}$	1	1	0.81	0.81	∞
Extrapolation, interpolation and Integration Algorithms for Max.SAR Evaluation	2.3	R	$\sqrt{3}$	1	1	1.33	1.33	∞
Test sample Related								
Test Sample Positioning	2.6	N	1	1	1	2.60	2.60	11
Device Holder Uncertainty	3	N	1	1	1	3.00	3.00	7
Output Power Variation-SAR drift measurement	5	R	$\sqrt{3}$	1	1	2.89	2.89	∞
SAR scaling	2	R	$\sqrt{3}$	1	1	1.15	1.15	∞

Phantom and Tissue Parameters								
Phantom Uncertainty (shape and thickness tolerances)	4	R	$\sqrt{3}$	1	1	2.31	2.31	∞
Uncertainty in SAR correction for deviation (in permittivity and conductivity)	2	N	1	1	0.84	2.00	1.68	∞
Liquid conductivity（meas.）	2.5	N	1	0.64	0.43	1.60	1.08	5
Liquid conductivity (target.)	5	R	$\sqrt{3}$	0.64	0.43	1.85	1.24	5
Liquid Permittivity（meas.）	2.5	N	1	0.60	0.49	1.50	1.23	∞
Liquid Permittivity (target.)	5	R	$\sqrt{3}$	0.60	0.49	1.73	1.42	∞
Combined Standard Uncertainly		Rss				10.63	10.54	
Expanded Uncertainty{95% CONFIDENCE INTERRVAL}		k				21.26	21.08	

11.2 Measurement uncertainty evaluation for system check

The following table includes the uncertainty table of the IEEE 1528. The values are determined by Satimo.The breakdown of the individual uncertainties is as follows:

Uncertainty For System Performance Check								
Uncertainty Component	Tol. (±%)	Prob. Dist.	Div.	C_i 1g	C_i 10g	1g U_i(±%)	10g U_i (±%)	V_i
measurement system								
Probe Calibration	5.8	N	1	1	1	5.80	5.80	∞
Axial Isotropy	3.5	R	$\sqrt{3}$	$(1-C_p)^{1/2}$	$(1-C_p)^{1/2}$	1.43	1.43	∞
Hemispherical Isotropy	5.9	R	$\sqrt{3}$	$\sqrt{C_p}$	$\sqrt{C_p}$	2.41	2.41	∞
Boundary Effect	1	R	$\sqrt{3}$	1	1	0.58	0.58	∞
Linearity	4.7	R	$\sqrt{3}$	1	1	2.71	2.71	∞
system detection Limits	1	R	$\sqrt{3}$	1	1	0.58	0.58	∞
Modulation response	0	N	1	1	1	0.00	0.00	∞
Readout Electronics	0.5	N	1	1	1	0.50	0.50	∞
Response Time	0	R	$\sqrt{3}$	1	1	0.00	0.00	∞
Integration Time	1.4	R	$\sqrt{3}$	1	1	0.81	0.81	∞
RF ambient Conditions - Noise	3	R	$\sqrt{3}$	1	1	1.73	1.73	∞
RF ambient Conditions – Reflections	3	R	$\sqrt{3}$	1	1	1.73	1.73	∞
Probe positioned Mechanical Tolerance	1.4	R	$\sqrt{3}$	1	1	0.81	0.81	∞
Probe positioning with respect to Phantom Shell	1.4	R	$\sqrt{3}$	1	1	0.81	0.81	∞
Extrapolation, interpolation and integration Algorithms for Max. SAR Evaluation	2.3	R	$\sqrt{3}$	1	1	1.33	1.33	∞
Dipole								
Deviation of experimental source from numerical source	4	N	1	1	1	4.00	4.00	∞
Input power and SAR drift measurement	5	R	$\sqrt{3}$	1	1	2.89	2.89	∞
Dipole axis to liquid Distance	2	R	$\sqrt{3}$	1	1	1.16	1.16	∞

Phantom and Tissue Parameters								
Phantom Uncertainty (shape and thickness tolerances)	4	R	$\sqrt{3}$	1	1	2.31	2.31	∞
Uncertainty in SAR correction for deviation (in permittivity and conductivity)	2	N	1	1	0.84	2.00	1.68	∞
Liquid conductivity（meas.）	2.5	N	1	0.64	0.43	1.60	1.08	5
Liquid conductivity (target.)	5	R	$\sqrt{3}$	0.64	0.43	1.85	1.24	5
Liquid Permittivity（meas.）	2.5	N	1	0.60	0.49	1.50	1.23	∞
Liquid Permittivity (target.)	5	R	$\sqrt{3}$	0.60	0.49	1.73	1.41	∞
Combined Standard Uncertainty		Rss				10.28	9.98	
Expanded Uncertainty (95% Confidence interval)		k				20.57	19.95	

12 Test equipment and ancillaries used for tests

To simplify the identification of the test equipment and/or ancillaries which were used, the reporting of the relevant test cases only refer to the test item number as specified in the table below.

	Manufacturer	Device Type	Type(Model)	Serial number	calibration	
					Last Cal.	Due Date
☒	SATIMO	COMOSAR DOSIMETRIC E FIELD PROBE	SSE5	SN 07/15 EP252	2017-11-27	2018-11-26
☒	SATIMO	COMOSAR 835 MHz REFERENCE DIPOLE	SID835	SN 14/13 DIP0G835-235	2018-07-25	2019-07-24
☐	SATIMO	COMOSAR 900 MHz REFERENCE DIPOLE	SID900	SN 14/13 DIP0G900-231	2018-07-25	2019-07-24
☐	SATIMO	COMOSAR 1800 MHz REFERENCE DIPOLE	SID1800	SN 14/13 DIP1G800-232	2018-07-25	2019-07-24
☒	SATIMO	COMOSAR 1900 MHz REFERENCE DIPOLE	SID1900	SN 14/13 DIP1G900-236	2018-07-25	2019-07-24
☐	SATIMO	COMOSAR 2000 MHz REFERENCE DIPOLE	SID2000	SN 14/13 DIP2G000-237	2018-07-25	2019-07-24
☒	SATIMO	COMOSAR 2450 MHz REFERENCE DIPOLE	SID2450	SN 14/13 DIP2G450-238	2018-07-25	2019-07-24
☐	SATIMO	COMOSAR 2600 MHz REFERENCE DIPOLE	SID2600	SN 28/14 DIP2G600-327	2018-07-25	2019-07-24
☒	SATIMO	Software	OPENSAR	N/A	N/A	N/A
☒	SATIMO	Phantom	COMOSAR IEEE SAM PHANTOM	SN 14/13 SAM99	N/A	N/A
☒	R & S	Universal Radio Communication Tester	CMU 200	117528	2017-10-16	2018-10-15
☒	HP	Network Analyser	8753D	3410A08889	2017-10-18	2018-10-17
☒	HP	Signal Generator	E4421B	GB39340770	2017-10-15	2018-10-14
☒	Keithley	Multimeter	Keithley 2000	4014539	2017-10-15	2018-10-14
☒	SATIMO	Amplifier	Power Amplifier	MODU-023-A-0004	2017-10-15	2018-10-14
☒	Agilent	Power Meter	E4418B	GB43312909	2017-10-15	2018-10-14
☒	Agilent	Power Meter Sensor	E4412A	MY41500046	2017-10-15	2018-10-14
☒	Agilent	Power Meter	E4417A	GB41291826	2017-10-15	2018-10-14
☒	Agilent	Power Meter Sensor	8481H	MY41091215	2017-10-15	2018-10-14
☒	SATIMO	DAE	SUPR72	SN 42/13	2017-10-15	2018-10-14

Annex A: System performance verification

(**Please See the SAR Measurement Plots of annex A.**)

Annex B: Measurement results

(**Please See the SAR Measurement Plots of annex B.**)

Annex C: Calibration reports

(Please See the Calibration reports of annex C.)

Annex D: Photo documentation

(Please See the Photo documentation of annex D.)

	Annex A: System Check
	Tested Model : X609B
	Report Number: FCC18080068A-SAR

I. RESULTS

TYPE	BAND	PARAMETERS
Validation	**CW835**	Measurement 1: Validation Plane with Dipole device position on Middle Channel in CW mode
Validation	**CW835**	Measurement 2: Validation Plane with Dipole device position on Middle Channel in CW mode
Validation	**CW1900**	Measurement 3: Validation Plane with Dipole device position on Middle Channel in CW mode
Validation	**CW1900**	Measurement 4: Validation Plane with Dipole device position on Middle Channel in CW mode
Validation	**CW2450**	Measurement 5: Validation Plane with Dipole device position on Middle Channel in CW mode
Validation	**CW2450**	Measurement 6: Validation Plane with Dipole device position on Middle Channel in CW mode

MEASUREMENT 1

BODY

Type: Validation measurement (Complete)

Date of measurement: 10/10/2018

Measurement duration: 11 minutes 38 seconds

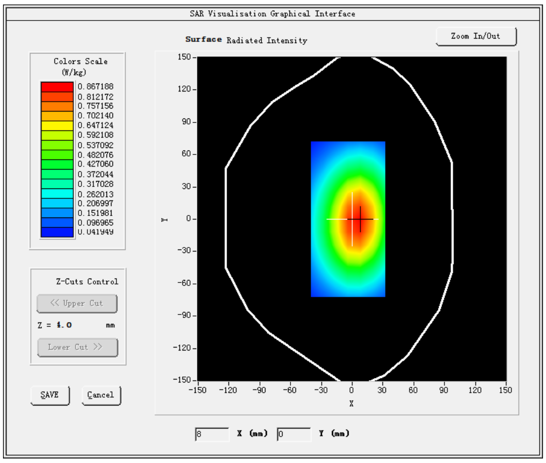
A. Experimental conditions.

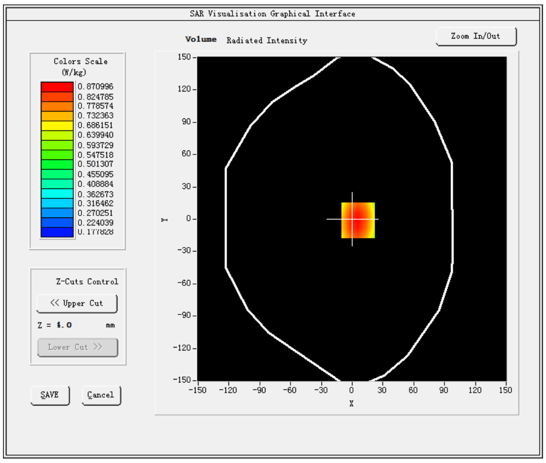
Area Scan	dx=8mm dy=8mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete
Phantom	Validation plane
Device Position	Dipole
Band	CW835
Channels	Middle
Signal	CW (Crest factor: 1.0)

B. SAR Measurement Results

Middle Band SAR (Channel -1):

Frequency (MHz)	835.000000
Relative permittivity (real part)	53.458401
Relative permittivity (imaginary part)	20.503000
Conductivity (S/m)	0.951111
Variation (%)	-1.520000

<table>
<tr><th>SURFACE SAR</th><th>VOLUME SAR</th></tr>
<tr><td>


</td><td>


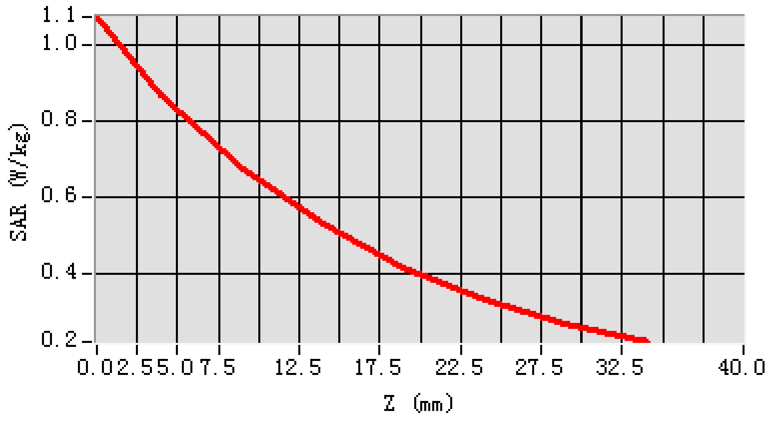
</td></tr>
</table>

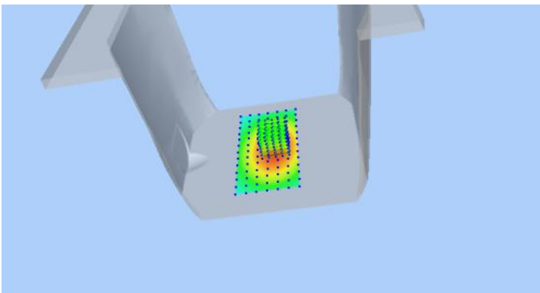
Maximum location: X=6.00, Y=-1.00

SAR Peak: 1.08 W/kg

SAR 10g (W/Kg)	0.629766
SAR 1g (W/Kg)	0.846036

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	1.0747	0.8710	0.6744	0.5294	0.4173	0.3335	0.2689



3D screen shot	Hot spot position
	

MEASUREMENT 2

HEAD

Type: Validation measurement (Complete)

Date of measurement: 10/10/2018

Measurement duration: 11 minutes 38 seconds

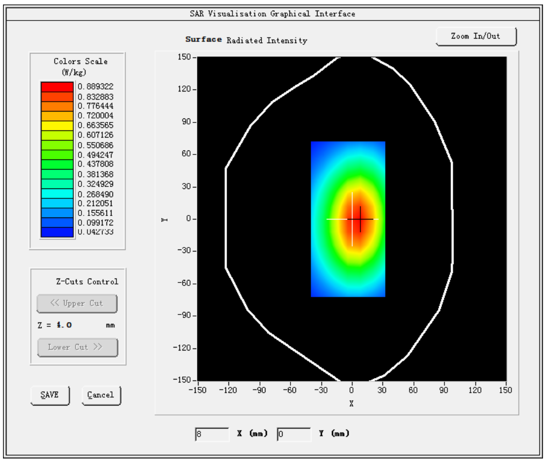
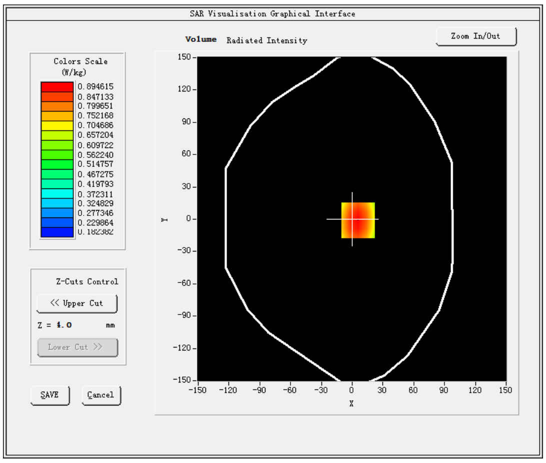
A. Experimental conditions.

Area Scan	dx=8mm dy=8mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete
Phantom	Validation plane
Device Position	Dipole
Band	CW835
Channels	Middle
Signal	CW (Crest factor: 1.0)

B. SAR Measurement Results

Middle Band SAR (Channel -1):

Frequency (MHz)	835.000000
Relative permittivity (real part)	40.441299
Relative permittivity (imaginary part)	20.606899
Conductivity (S/m)	0.955931
Variation (%)	-1.660000

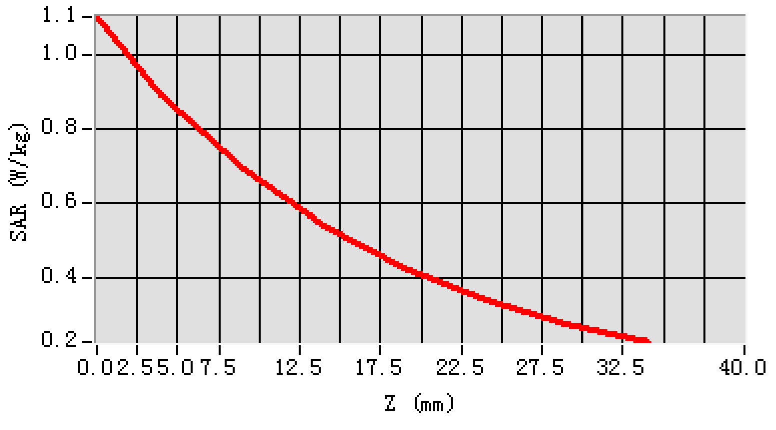
SURFACE SAR	VOLUME SAR
	

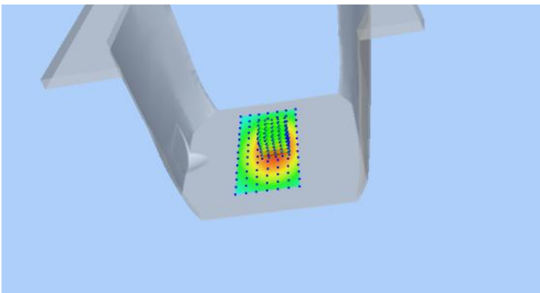
Maximum location: X=6.00, Y=-1.00

SAR Peak: 1.11 W/kg

SAR 10g (W/Kg)	0.671843
SAR 1g (W/Kg)	0.912096

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	1.1043	0.8946	0.6925	0.5438	0.4287	0.3424	0.2762



3D screen shot	Hot spot position
	

MEASUREMENT 3

BODY

Type: Validation measurement (Complete)

Date of measurement: 9/10/2018

Measurement duration: 9 minutes 55 seconds

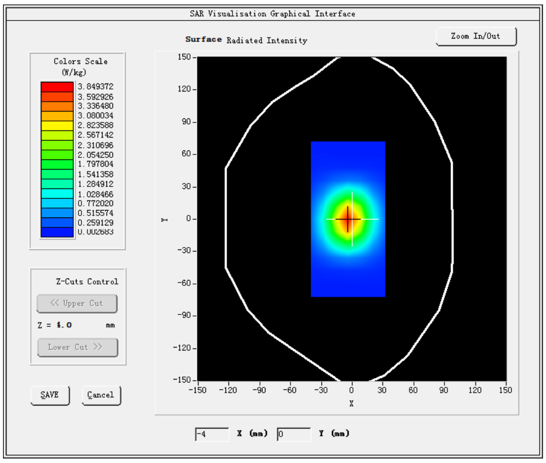
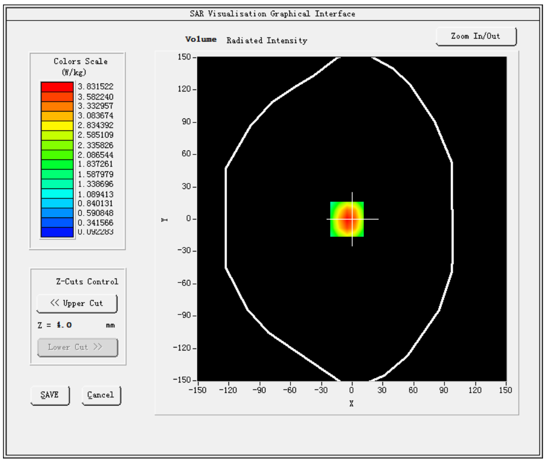
A. Experimental conditions.

Area Scan	dx=8mm dy=8mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete
Phantom	Validation plane
Device Position	Dipole
Band	CW1900
Channels	Middle
Signal	CW (Crest factor: 1.0)

B. SAR Measurement Results

Middle Band SAR (Channel -1):

Frequency (MHz)	1900.000000
Relative permittivity (real part)	52.199100
Relative permittivity (imaginary part)	14.615200
Conductivity (S/m)	1.542716
Variation (%)	-0.660000

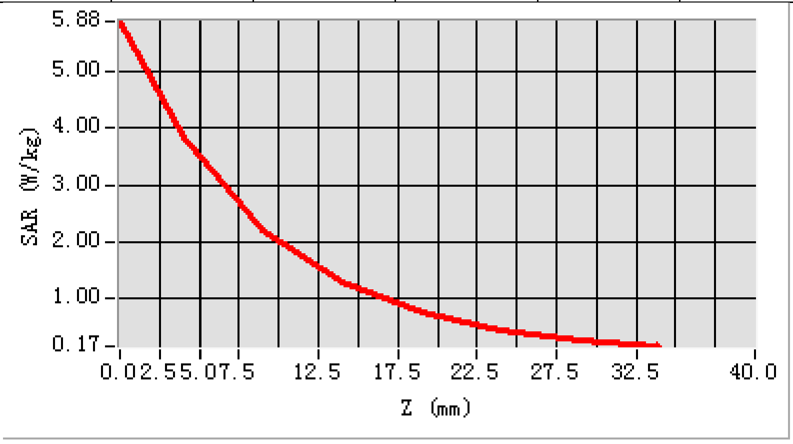
SURFACE SAR	VOLUME SAR
	

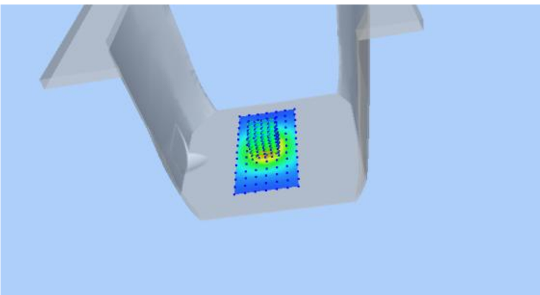
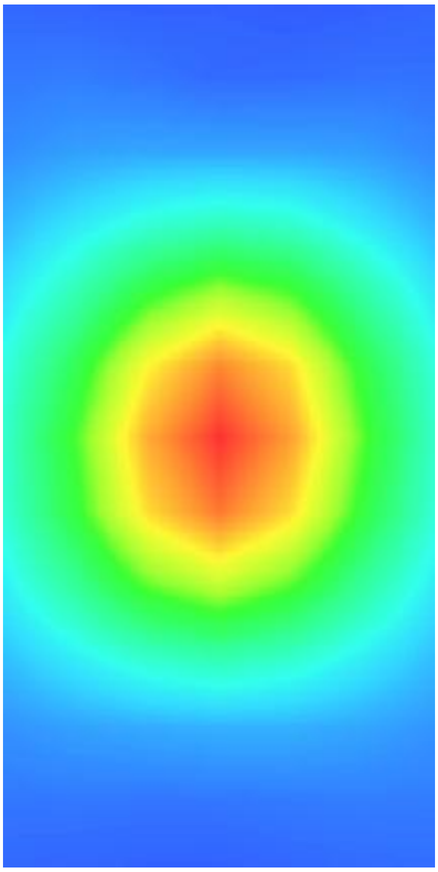
Maximum location: X=-5.00, Y=0.00

SAR Peak: 5.90 W/kg

SAR 10g (W/Kg)	2.047070
SAR 1g (W/Kg)	3.720274

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	5.8752	3.8315	2.2043	1.3005	0.7705	0.4595	0.2763



3D screen shot	Hot spot position
	

MEASUREMENT 4

HEAD

Type: Validation measurement (Complete)

Date of measurement: 9/10/2018

Measurement duration: 9 minutes 56 seconds

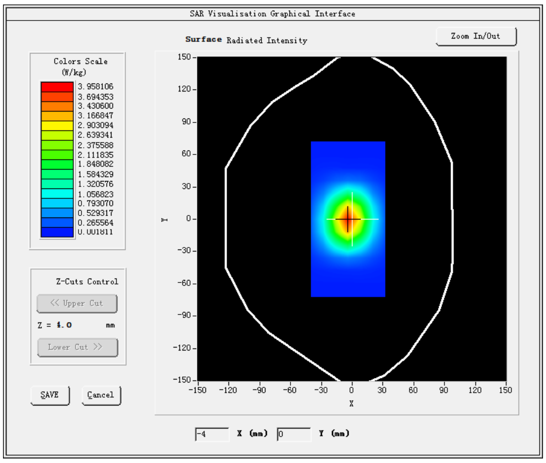
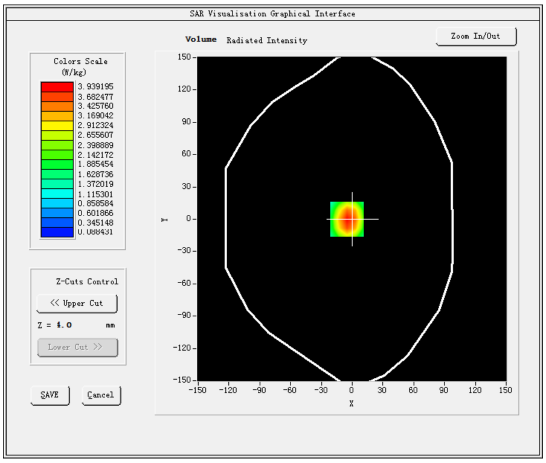
A. Experimental conditions.

Area Scan	dx=8mm dy=8mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete
Phantom	Validation plane
Device Position	Dipole
Band	CW1900
Channels	Middle
Signal	CW (Crest factor: 1.0)

B. SAR Measurement Results

Middle Band SAR (Channel -1):

Frequency (MHz)	1900.000000
Relative permittivity (real part)	39.880501
Relative permittivity (imaginary part)	13.326500
Conductivity (S/m)	1.406686
Variation (%)	-0.860000

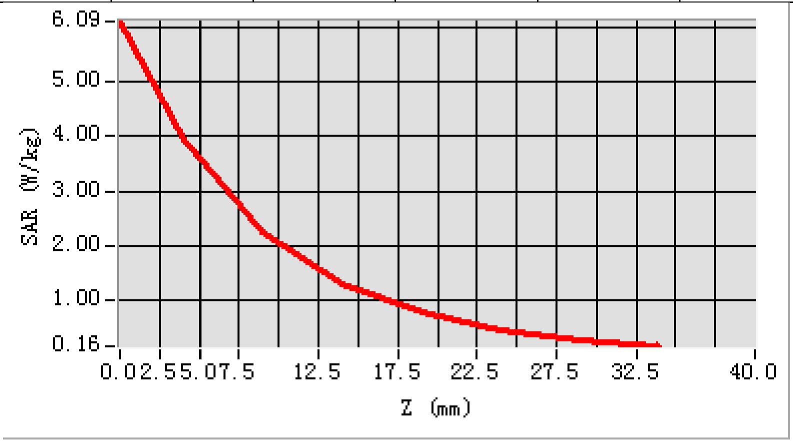
SURFACE SAR	VOLUME SAR
	

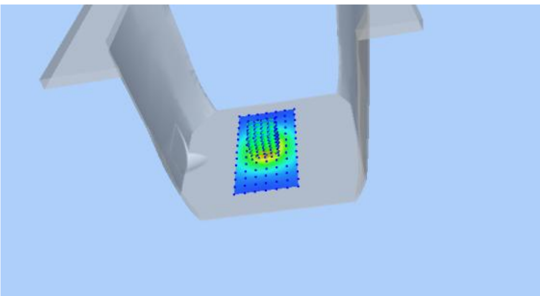
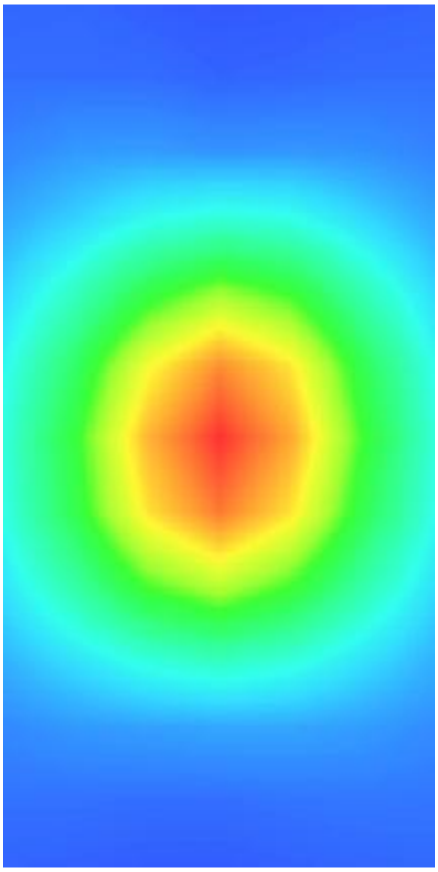
Maximum location: X=-5.00, Y=0.00

SAR Peak: 6.12 W/kg

SAR 10g (W/Kg)	2.063282
SAR 1g (W/Kg)	3.782124

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	6.0938	3.9392	2.2387	1.3105	0.7704	0.4580	0.2736



3D screen shot	Hot spot position
	

MEASUREMENT 5

BODY

Type: Validation measurement (Complete)

Date of measurement: 10/10/2018

Measurement duration: 9 minutes 58 seconds

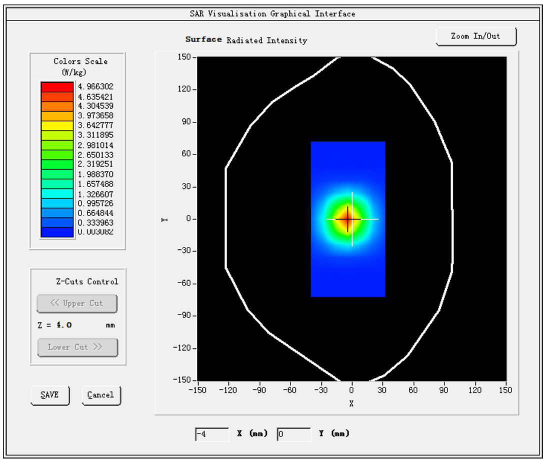
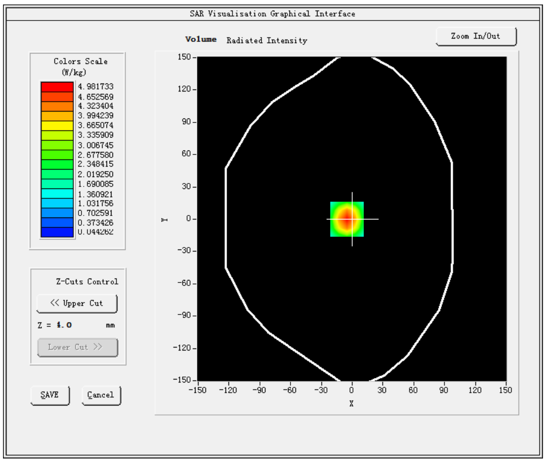
A. Experimental conditions.

Area Scan	dx=8mm dy=8mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete
Phantom	Validation plane
Device Position	Dipole
Band	CW2450
Channels	Middle
Signal	CW (Crest factor: 1.0)

B. SAR Measurement Results

Middle Band SAR (Channel -1):

Frequency (MHz)	2450.000000
Relative permittivity (real part)	52.735699
Relative permittivity (imaginary part)	14.017300
Conductivity (S/m)	1.907910
Variation (%)	-0.880000

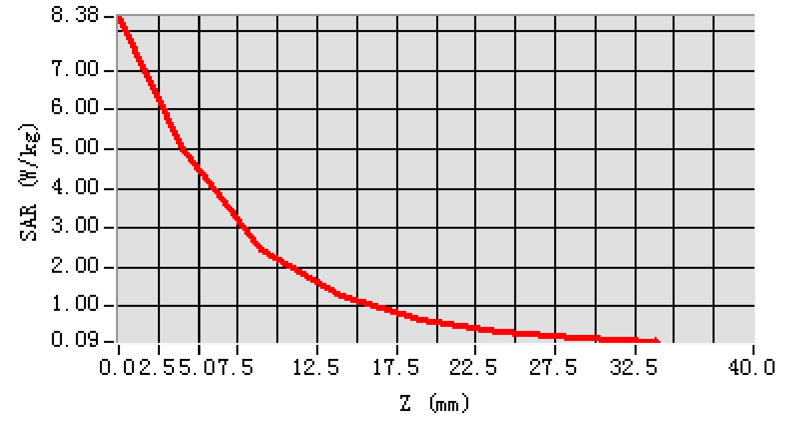
SURFACE SAR	VOLUME SAR
	

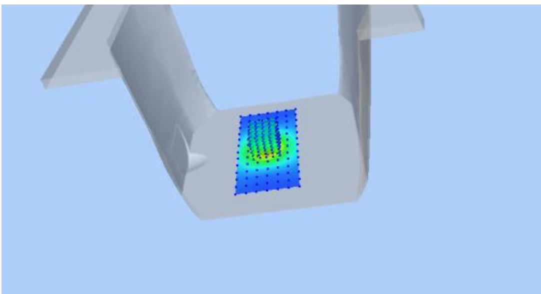
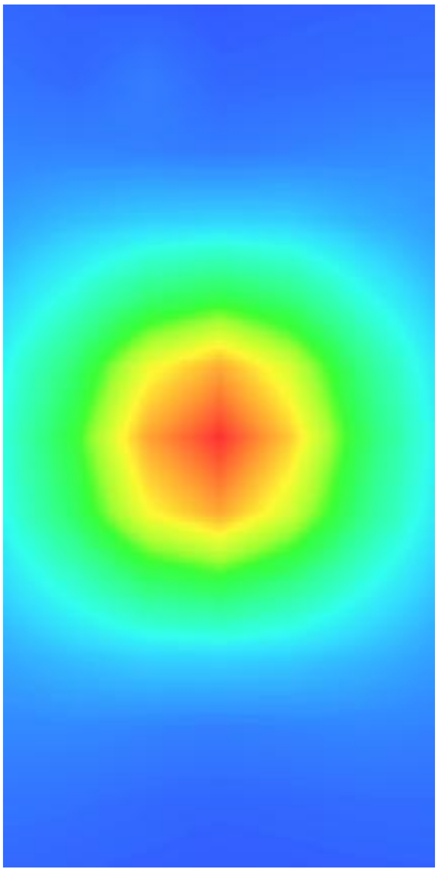
Maximum location: X=-5.00, Y=0.00

SAR Peak: 8.28 W/kg

SAR 10g (W/Kg)	2.328959
SAR 1g (W/Kg)	4.728068

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	8.3759	4.9817	2.4673	1.2566	0.6401	0.3301	0.1714



3D screen shot	Hot spot position
	

MEASUREMENT 6

HEAD

Type: Validation measurement (Complete)

Date of measurement: 10/10/2018

Measurement duration: 9 minutes 57 seconds

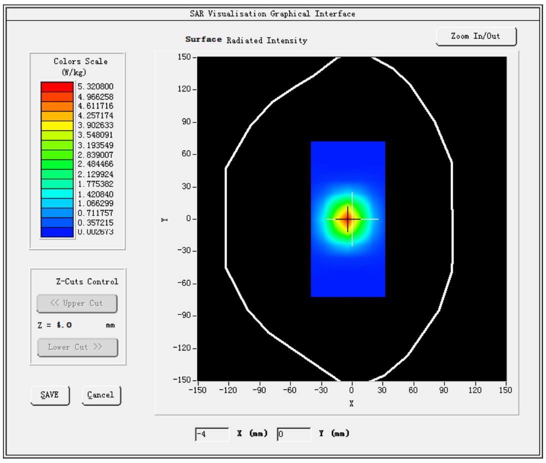
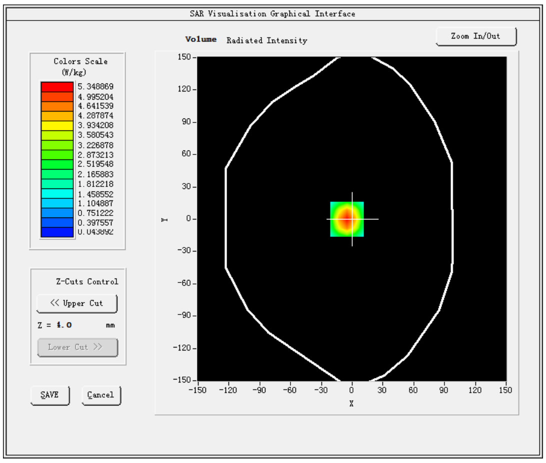
A. Experimental conditions.

Area Scan	dx=8mm dy=8mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete
Phantom	Validation plane
Device Position	Dipole
Band	CW2450
Channels	Middle
Signal	CW (Crest factor: 1.0)

B. SAR Measurement Results

Middle Band SAR (Channel -1):

Frequency (MHz)	2450.000000
Relative permittivity (real part)	39.270901
Relative permittivity (imaginary part)	13.557900
Conductivity (S/m)	1.845381
Variation (%)	-0.750000

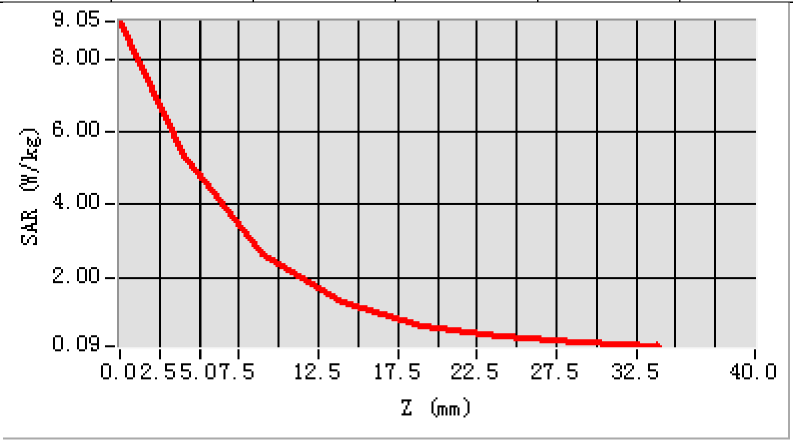
SURFACE SAR	VOLUME SAR
	

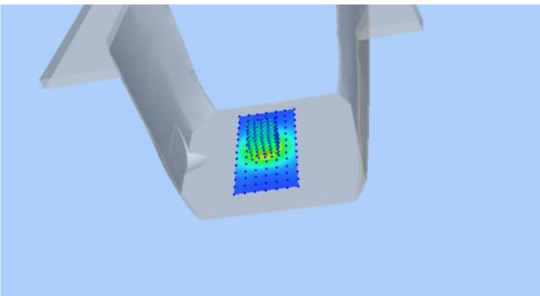
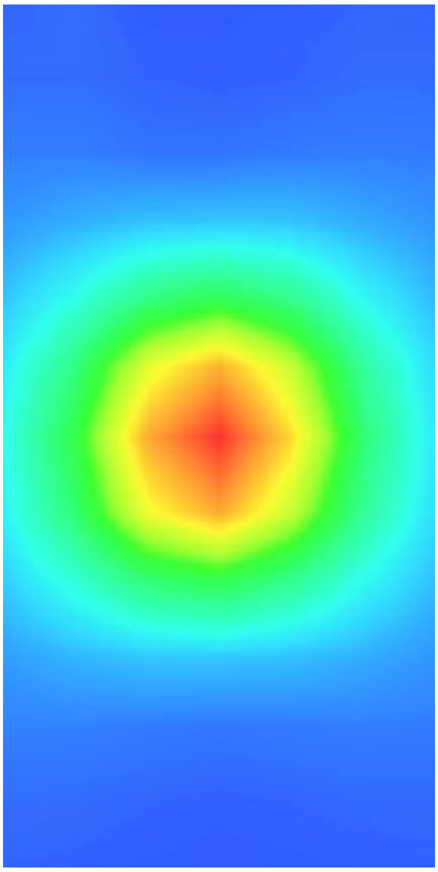
Maximum location: X=-5.00, Y=0.00

SAR Peak: 8.94 W/kg

SAR 10g (W/Kg)	2.480377
SAR 1g (W/Kg)	5.123599

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	9.0545	5.3489	2.6192	1.3223	0.6676	0.3420	0.1765



3D screen shot	Hot spot position
	

Annex B: Measurement Results

Tested Model : X609B

Report Number: FCC18080068A-SAR

MEASUREMENT 1

Type: Phone measurement (Complete)

Date of measurement: 9/10/2018

Measurement duration: 8 minutes 16 seconds

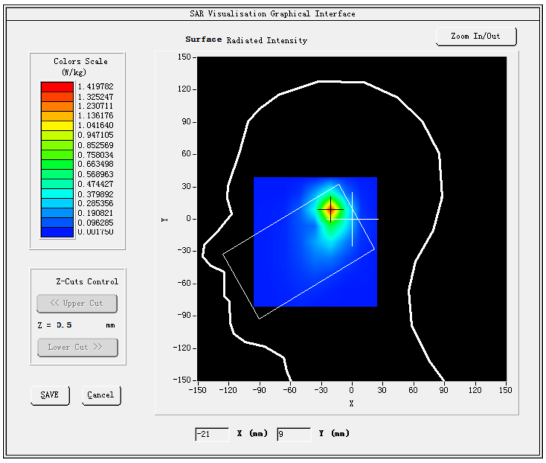
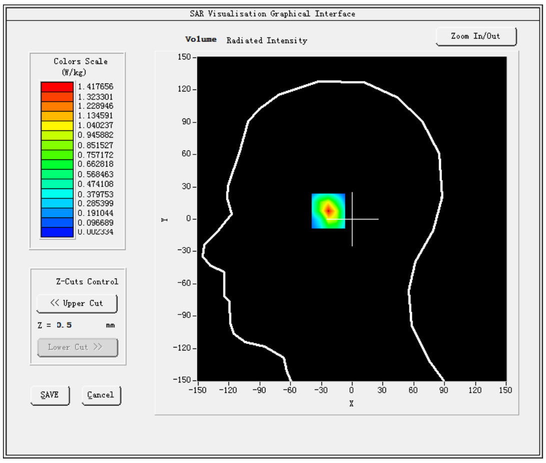
A. Experimental conditions.

Area Scan	dx=15mm dy=15mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Comp lete
Phantom	Left head
Device Position	Tilt
Band	Band2 WCDMA1900
Channels	High
Signal	Duty cycle:1:1
Conversion factor	5.17

B. SAR Measurement Results

Higher Band SAR (Channel 9538):

Frequency (MHz)	1907.599976
Relative permittivity (real part)	53.436062
Relative permittivity (imaginary part)	14.644520
Conductivity (S/m)	1.551994
Variation (%)	-2.610000

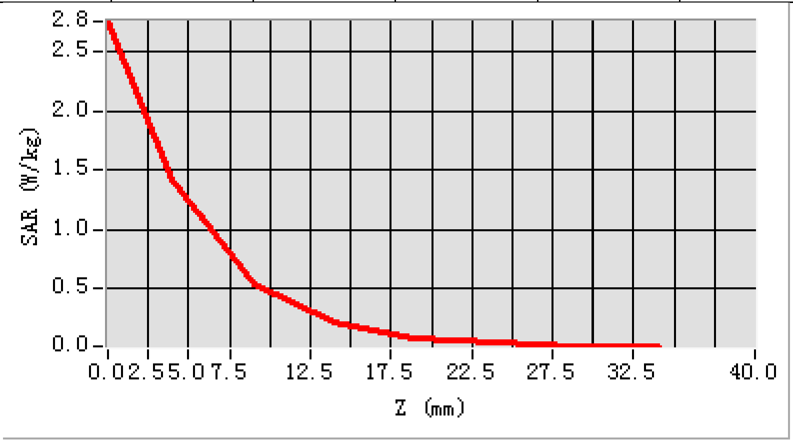
SURFACE SAR	VOLUME SAR
	

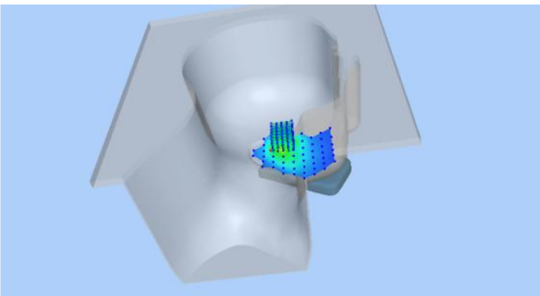
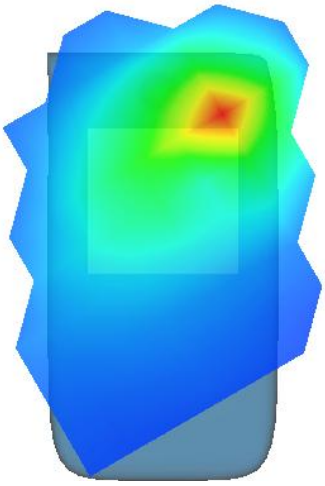
Maximum location: X=-21.00, Y=9.00

SAR Peak: 2.71 W/kg

SAR 10g (W/Kg)	0.497639
SAR 1g (W/Kg)	0.789881

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	2.7615	1.4177	0.5256	0.2067	0.0811	0.0336	0.0142



3D screen shot	Hot spot position
	

MEASUREMENT 2

Top-side-high

Type: Phone measurement (Complete)

Date of measurement: 9/10/2018

Measurement duration: 10 minutes 42 seconds

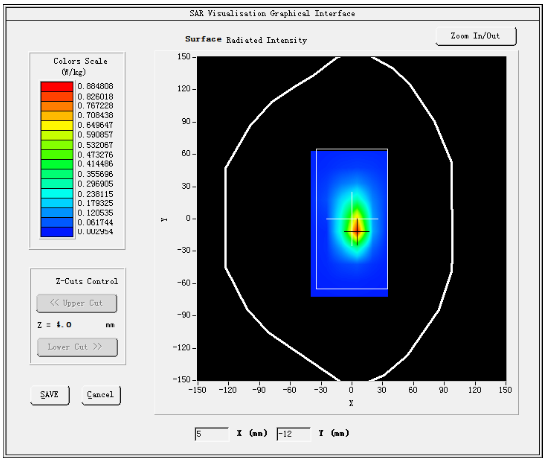
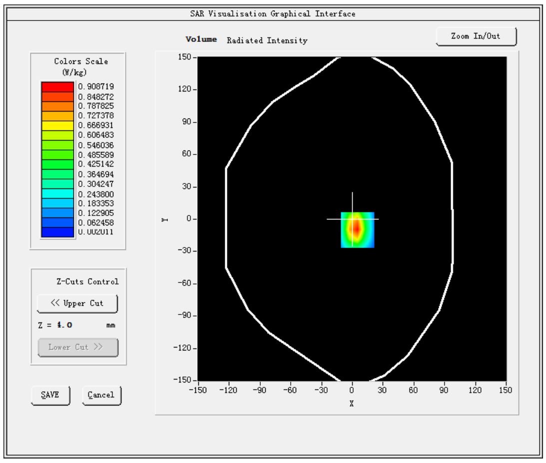
A. Experimental conditions.

Area Scan	dx=15mm dy=15mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete
Phantom	Validation plane
Device Position	Body
Band	Band2 WCDMA1900
Channels	High
Signal	Duty cycle:1:1
Conversion factor	5.28

B. SAR Measurement Results

Higher Band SAR (Channel 9538):

Frequency (MHz)	1907.599976
Relative permittivity (real part)	53.436062
Relative permittivity (imaginary part)	14.644520
Conductivity (S/m)	1.551994
Variation (%)	-2.640000

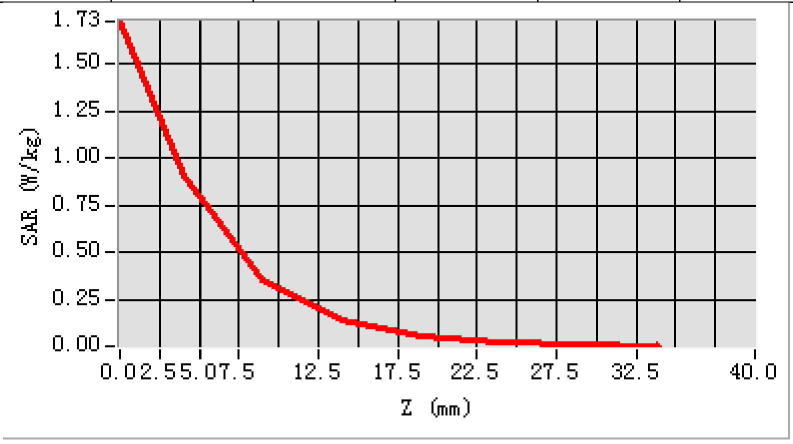
SURFACE SAR	VOLUME SAR
	

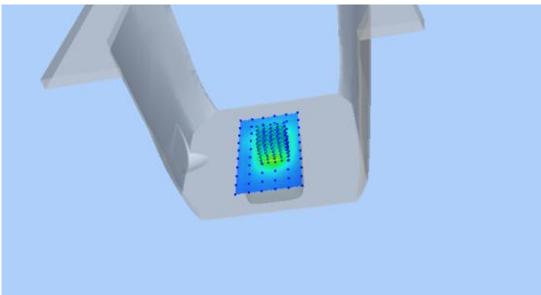
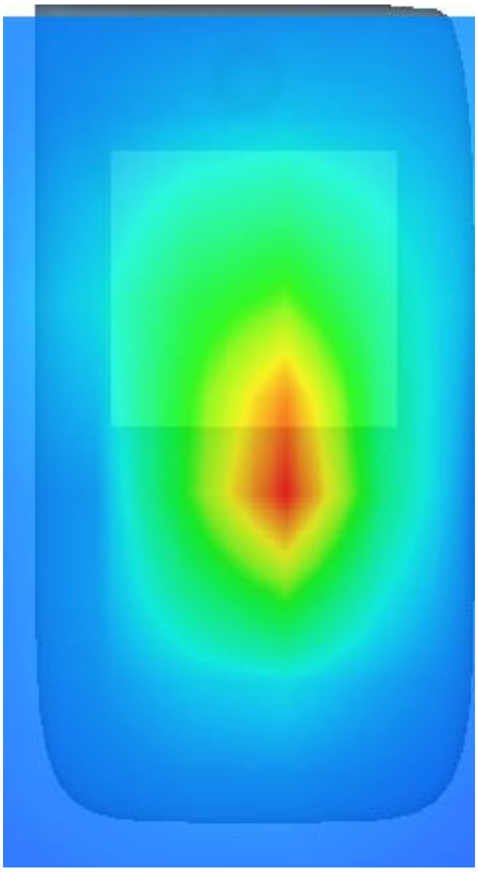
Maximum location: X=5.00, Y=-10.00

SAR Peak: 1.76 W/kg

SAR 10g (W/Kg)	0.348948
SAR 1g (W/Kg)	0.779592

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	1.7255	0.9087	0.3558	0.1424	0.0576	0.0241	0.0105



3D screen shot	Hot spot position
	

MEASUREMENT 3

Type: Phone measurement (Complete)

Date of measurement: 10/10/2018

Measurement duration: 8 minutes 14 seconds

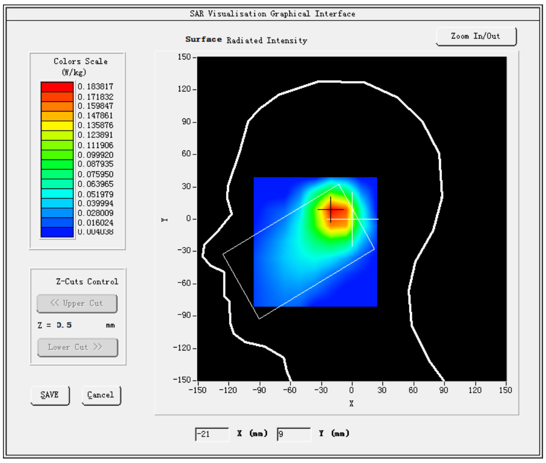
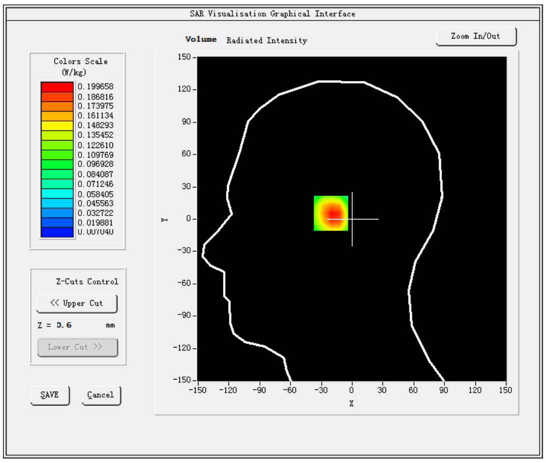
A. Experimental conditions.

Area Scan	dx=15mm dy=15mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete
Phantom	Left head
Device Position	Tilt
Band	Band5_WCDMA850
Channels	High
Signal	Duty cycle:1:1
Conversion factor	5.54

B. SAR Measurement Results

Higher Band SAR (Channel 4233):

Frequency (MHz)	846.599976
Relative permittivity (real part)	40.520279
Relative permittivity (imaginary part)	20.197941
Conductivity (S/m)	0.949976
Variation (%)	0.140000

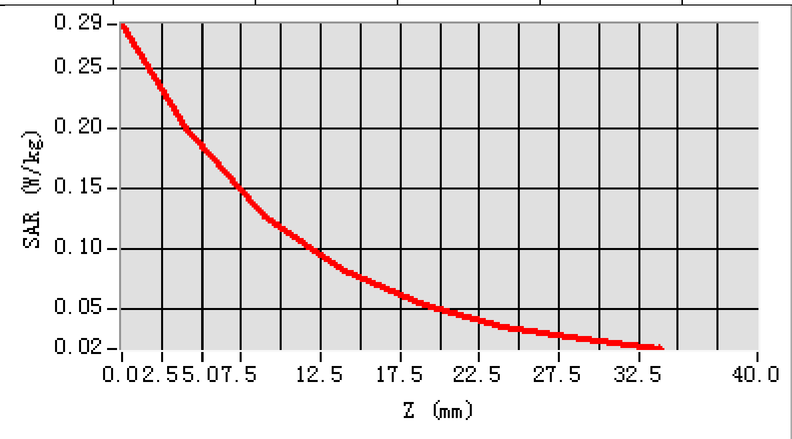
SURFACE SAR	VOLUME SAR
	

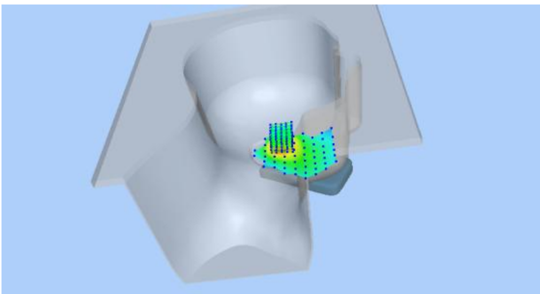
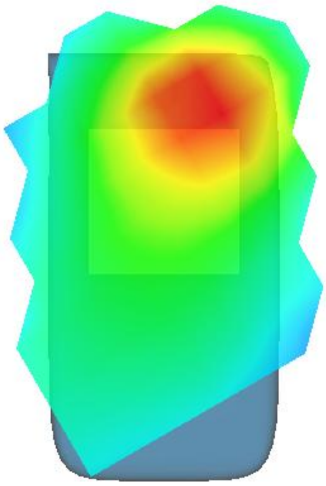
Maximum location: X=-17.00, Y=6.00

SAR Peak: 0.30 W/kg

SAR 10g (W/Kg)	0.119898
SAR 1g (W/Kg)	0.201017

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	0.2867	0.1997	0.1262	0.0816	0.0532	0.0357	0.0243



3D screen shot	Hot spot position
	

MEASUREMENT 4

Top-side-high

Type: Phone measurement (Complete)

Date of measurement: 10/10/2018

Measurement duration: 11 minutes 1 seconds

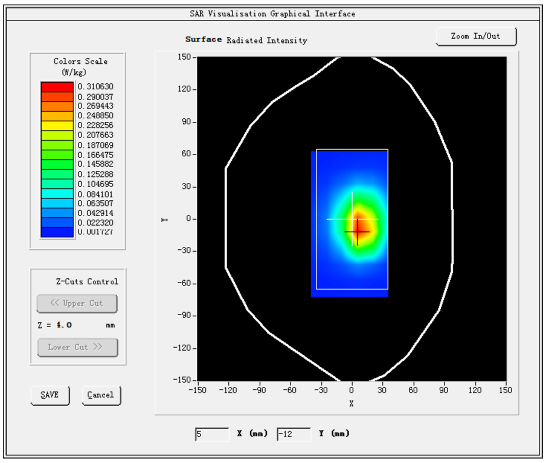
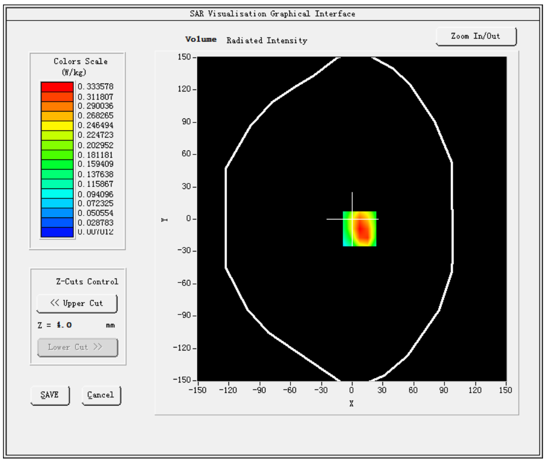
A. Experimental conditions.

Area Scan	dx=15mm dy=15mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete
Phantom	Validation plane
Device Position	Body
Band	Band5 WCDMA850
Channels	High
Signal	Duty cycle:1:1
Conversion factor	5.75

B. SAR Measurement Results

Higher Band SAR (Channel 4233):

Frequency (MHz)	846.599976
Relative permittivity (real part)	53.564419
Relative permittivity (imaginary part)	20.772900
Conductivity (S/m)	0.977019
Variation (%)	-0.910000

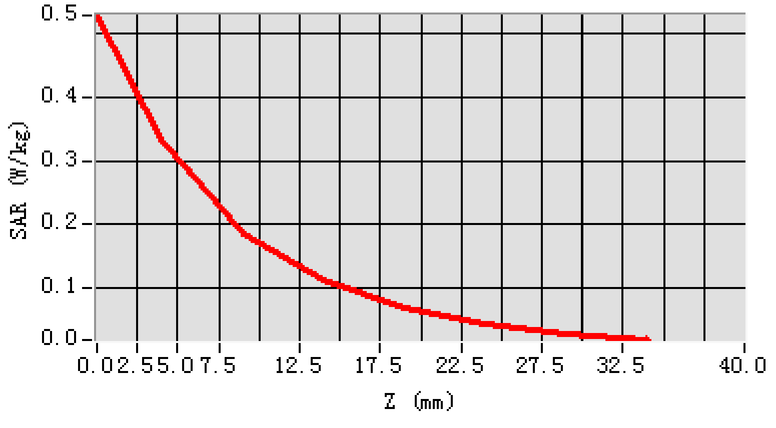
SURFACE SAR	VOLUME SAR
	

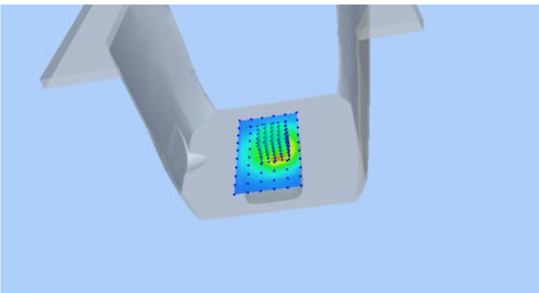
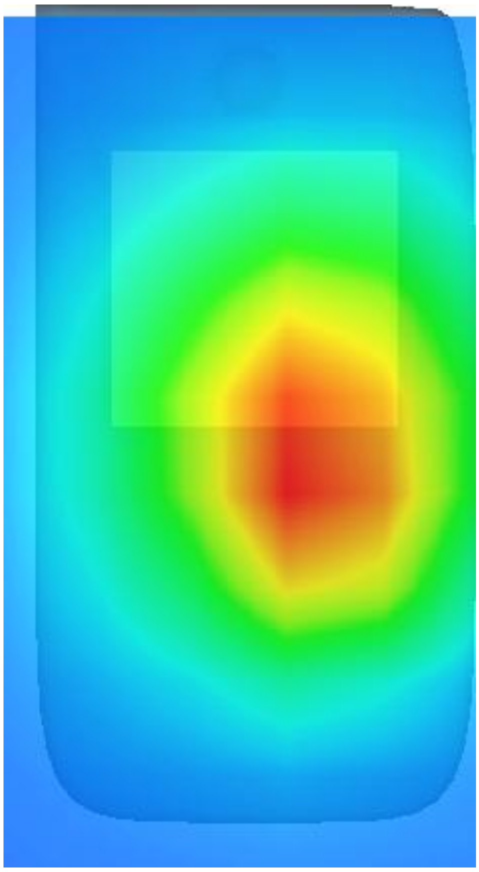
Maximum location: X=7.00, Y=-9.00

SAR Peak: 0.58 W/kg

SAR 10g (W/Kg)	0.174979
SAR 1g (W/Kg)	0.327070

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	0.5281	0.3336	0.1863	0.1125	0.0695	0.0442	0.0284



3D screen shot	Hot spot position
	

MEASUREMENT 5

Type: Phone measurement (Complete)

Date of measurement: 10/10/2018

Measurement duration: 8 minutes 31 seconds

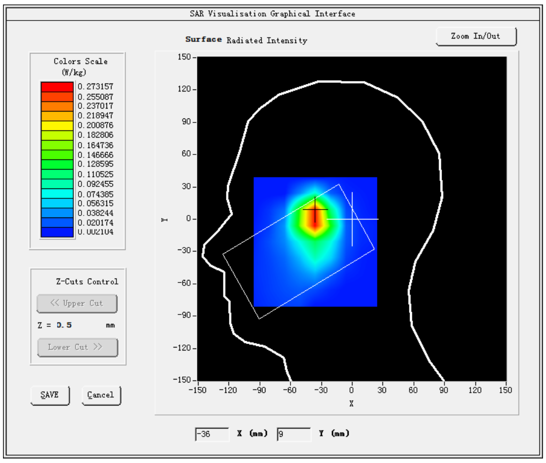
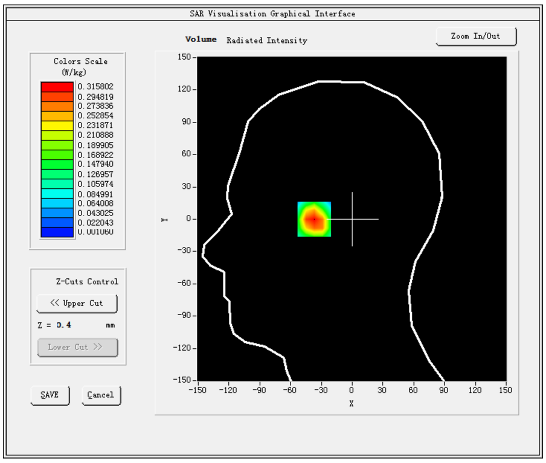
A. Experimental conditions.

Area Scan	dx=12mm dy=12mm
ZoomScan	7x7x7,dx=5mm dy=5mm dz=5mm,Complete
Phantom	Right head
Device Position	Tilt
Band	IEEE 802.11b ISM
Channels	Middle
Signal	Duty cycle:1:1
Conversion factor	4.83

B. SAR Measurement Results

Middle Band SAR (Channel 6):

Frequency (MHz)	2437.000000
Relative permittivity (real part)	40.745499
Relative permittivity (imaginary part)	13.560400
Conductivity (S/m)	1.839694
Variation (%)	0.300000

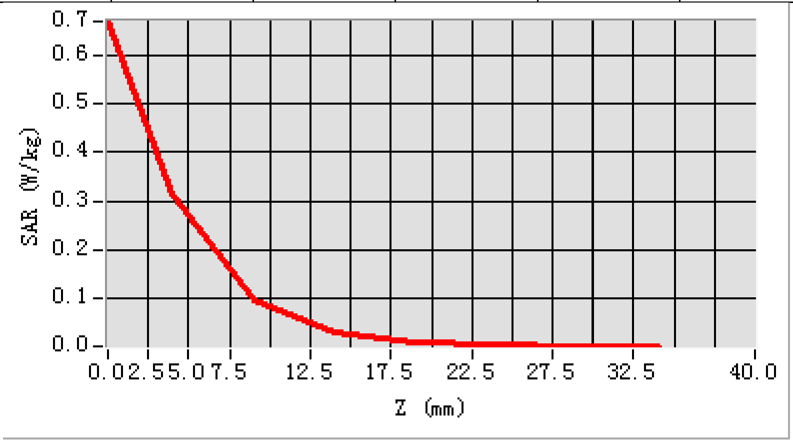
SURFACE SAR	VOLUME SAR
	

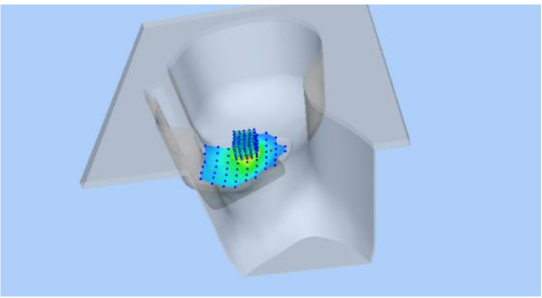
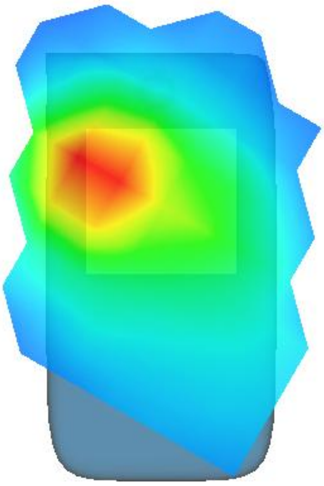
Maximum location: X=-37.00, Y=3.00

SAR Peak: 0.67 W/kg

SAR 10g (W/Kg)	0.128768
SAR 1g (W/Kg)	0.316344

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	0.6692	0.3158	0.0942	0.0292	0.0098	0.0038	0.0019



3D screen shot	Hot spot position
	

MEASUREMENT 6

Rear-side-middle

Type: Phone measurement (Complete)

Date of measurement: 10/10/2018

Measurement duration: 12 minutes 0 seconds

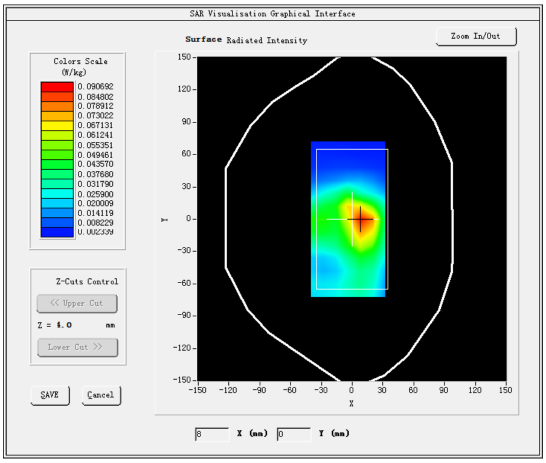
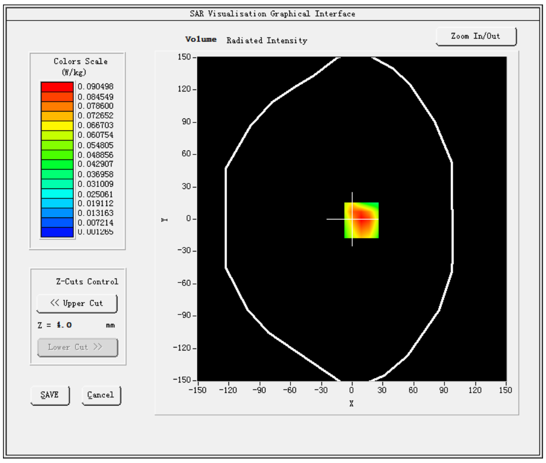
A. Experimental conditions.

Area Scan	dx=12mm dy=12mm
ZoomScan	7x7x7,dx=5mm dy=5mm dz=5mm,Complete
Phantom	Validation plane
Device Position	Body
Band	IEEE 802.11b ISM
Channels	Middle
Signal	Duty cycle:1:1
Conversion factor	5.02

B. SAR Measurement Results

Middle Band SAR (Channel 6):

Frequency (MHz)	2437.000000
Relative permittivity (real part)	53.066399
Relative permittivity (imaginary part)	14.968200
Conductivity (S/m)	2.030686
Variation (%)	0.180000

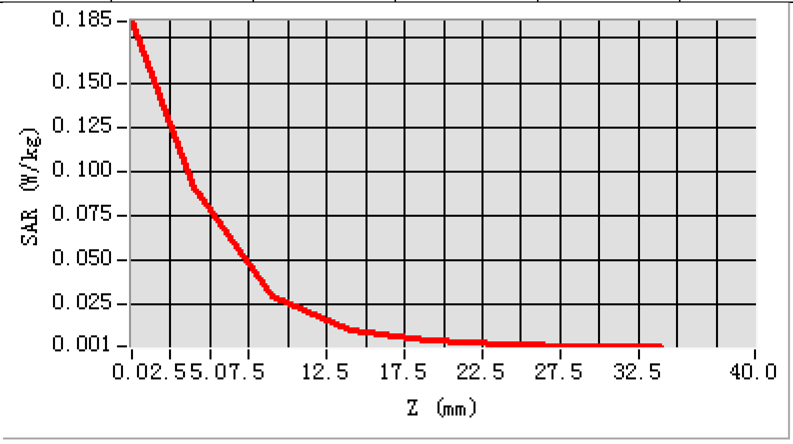
<table>
<tr><th>SURFACE SAR</th><th>VOLUME SAR</th></tr>
<tr><td>
</td><td>
</td></tr>
</table>

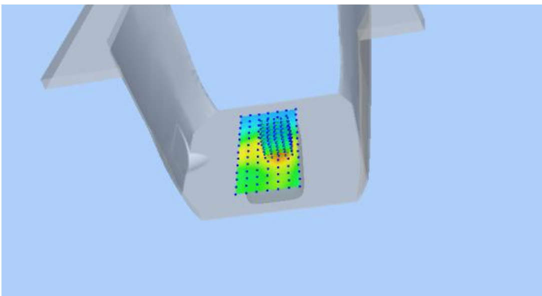
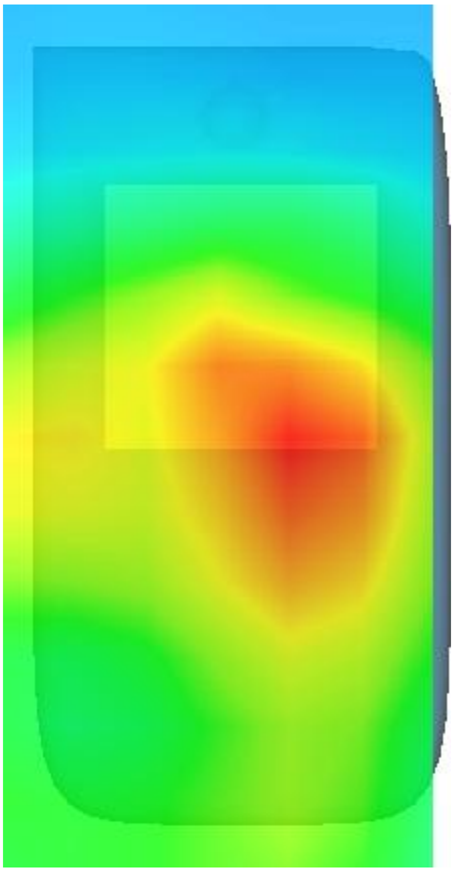
Maximum location: X=9.00, Y=-1.00

SAR Peak: 0.19 W/kg

SAR 10g (W/Kg)	0.040210
SAR 1g (W/Kg)	0.093122

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	0.1845	0.0905	0.0301	0.0106	0.0042	0.0022	0.0015



3D screen shot	Hot spot position
	

MEASUREMENT 7

Type: Phone measurement (Complete)

Date of measurement: 10/10/2018

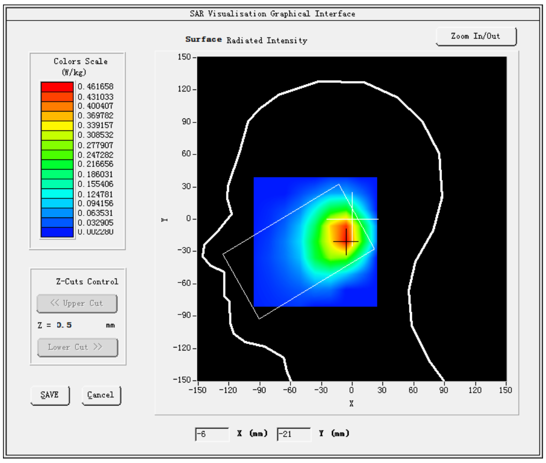
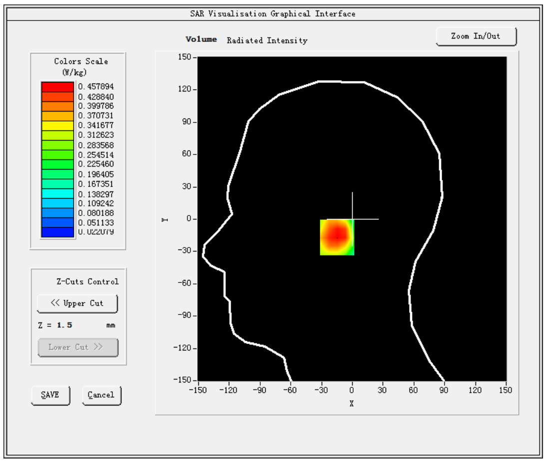
Measurement duration: 8 minutes 12 seconds

A. Experimental conditions.

Area Scan	dx=15mm dy=15mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete
Phantom	Right head
Device Position	Cheek
Band	CUSTOM (GPRS850_4Tx)
Channels	High
Signal	Duty Cycle: 2.00 (Crest factor: 2.0)
Conversion factor	5.54

B. SAR Measurement Results

Frequency (MHz)	848.799988
Relative permittivity (real part)	40.316360
Relative permittivity (imaginary part)	19.583300
Conductivity (S/m)	0.923461
Variation (%)	-0.300000

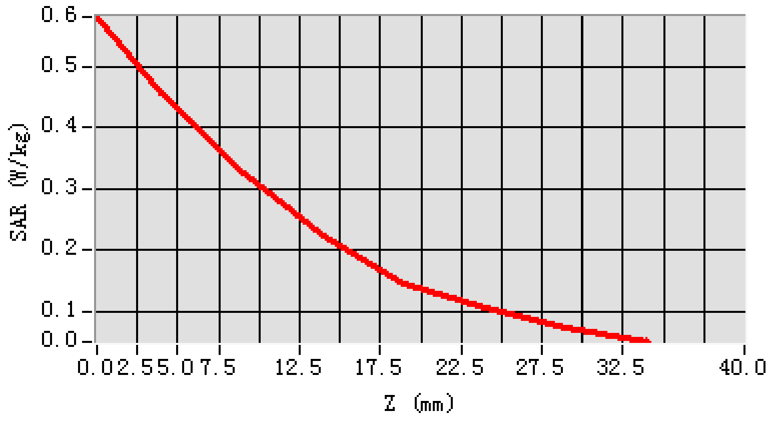
SURFACE SAR	VOLUME SAR
	

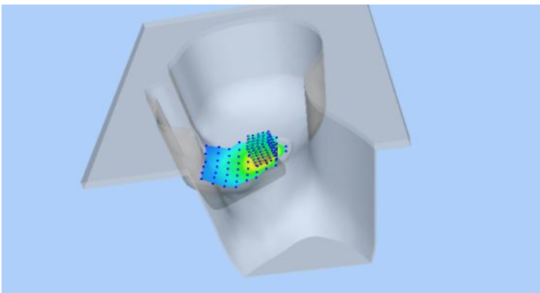
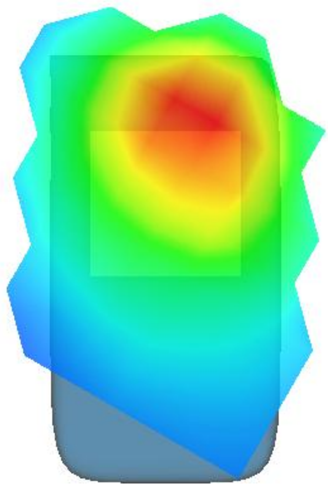
Maximum location: X=-7.00, Y=-17.00

SAR Peak: 0.69 W/kg

SAR 10g (W/Kg)	0.283200
SAR 1g (W/Kg)	0.452477

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	0.5812	0.4579	0.3238	0.2249	0.1445	0.1063	0.0728



3D screen shot	Hot spot position
	

MEASUREMENT 8

Front-side-high

Type: Phone measurement (Complete)

Date of measurement: 10/10/2018

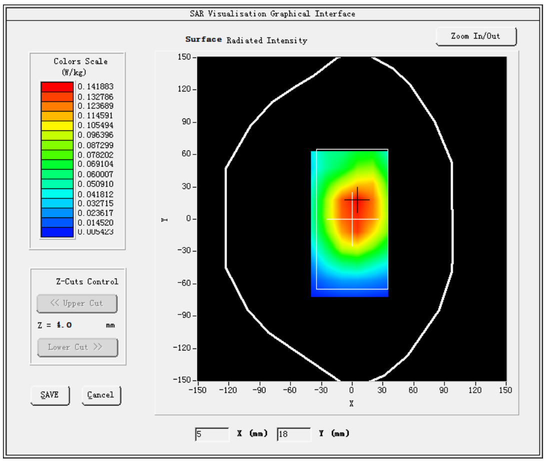
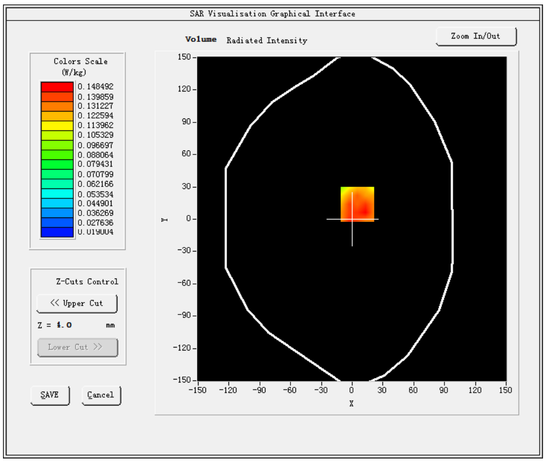
Measurement duration: 10 minutes 41 seconds

A. Experimental conditions.

Area Scan	dx=15mm dy=15mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete
Phantom	Validation plane
Device Position	Body
Band	CUSTOM (GPRS850_4Tx)
Channels	High
Signal	Duty Cycle: 2.00 (Crest factor: 2.0)
Conversion factor	5.75

B. SAR Measurement Results

Frequency (MHz)	848.799988
Relative permittivity (real part)	53.555580
Relative permittivity (imaginary part)	20.793921
Conductivity (S/m)	0.980549
Variation (%)	3.000000

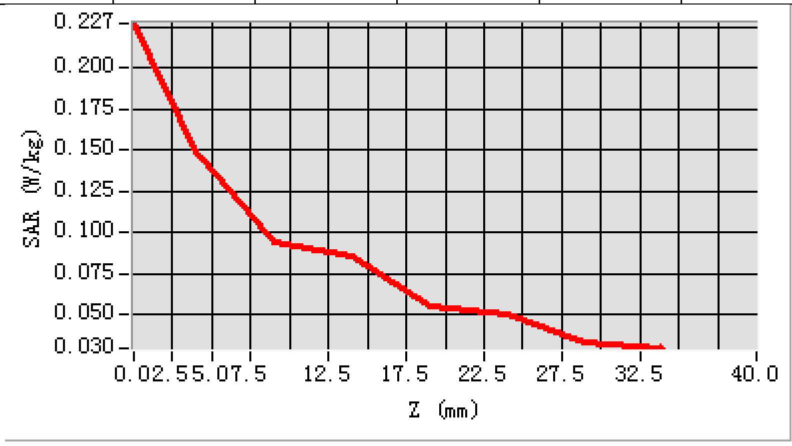
SURFACE SAR	VOLUME SAR
	

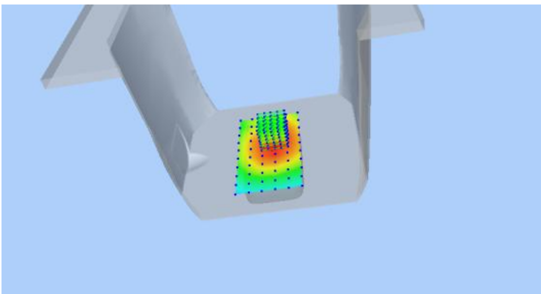
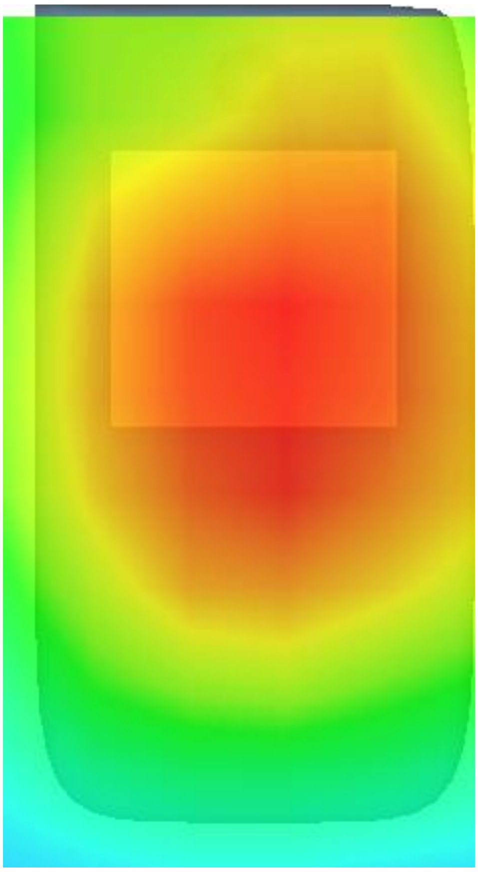
Maximum location: X=5.00, Y=14.00

SAR Peak: 0.20 W/kg

SAR 10g (W/Kg)	0.102930
SAR 1g (W/Kg)	0.140438

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	0.2270	0.1485	0.0938	0.0854	0.0558	0.0503	0.0329



3D screen shot	Hot spot position
	

MEASUREMENT 9

Type: Phone measurement (Complete)

Date of measurement: 9/10/2018

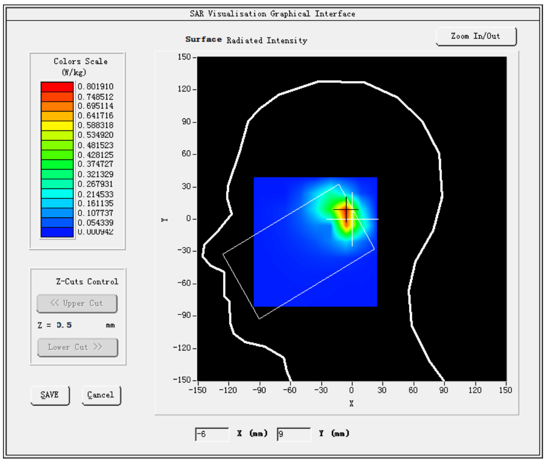
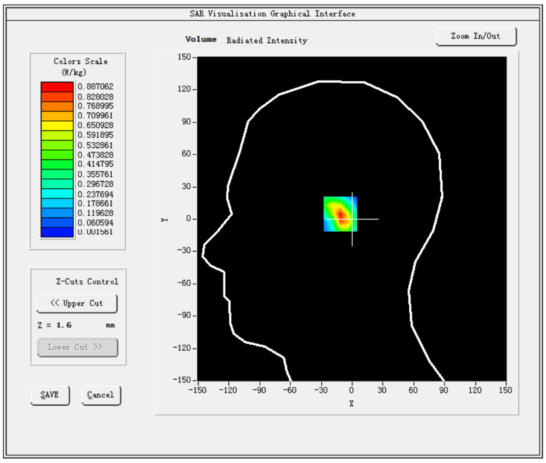
Measurement duration: 8 minutes 5 seconds

A. Experimental conditions.

Area Scan	dx=15mm dy=15mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete
Phantom	Right head
Device Position	Tilt
Band	CUSTOM (GPRS1900_4Tx)
Channels	High
Signal	Duty Cycle: 2.00 (Crest factor: 2.0)
Conversion factor	5.17

B. SAR Measurement Results

Frequency (MHz)	1909.800049
Relative permittivity (real part)	41.160301
Relative permittivity (imaginary part)	12.775800
Conductivity (S/m)	1.334361
Variation (%)	4.000000

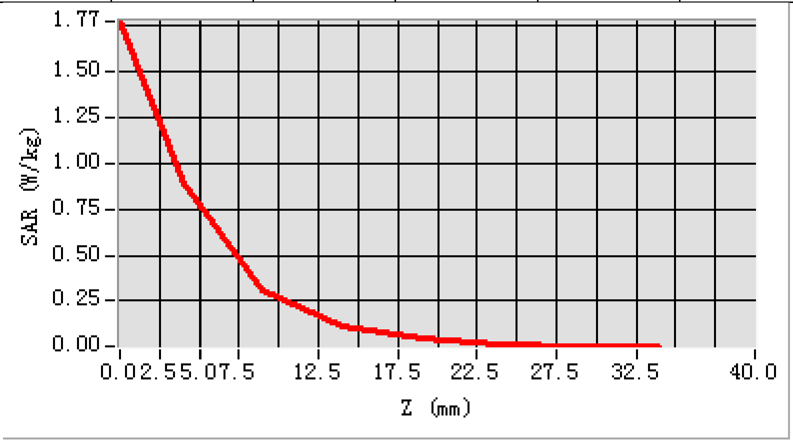
SURFACE SAR	VOLUME SAR
	

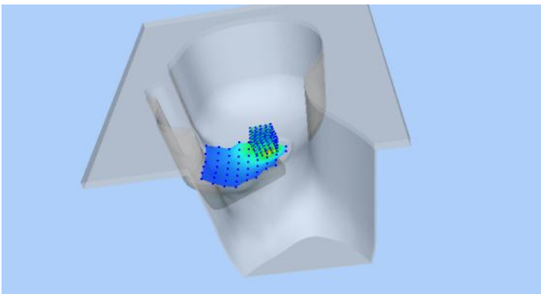
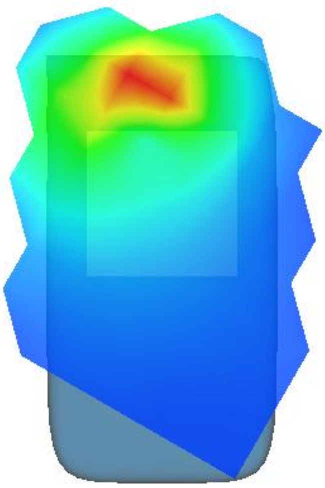
Maximum location: X=-6.00, Y=5.00

SAR Peak: 1.83 W/kg

SAR 10g (W/Kg)	0.327375
SAR 1g (W/Kg)	0.754860

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	1.7748	0.8871	0.3096	0.1156	0.0445	0.0184	0.0077



3D screen shot	Hot spot position
	

MEASUREMENT 10

Rear-side-high

Type: Phone measurement (Complete)

Date of measurement: 9/10/2018

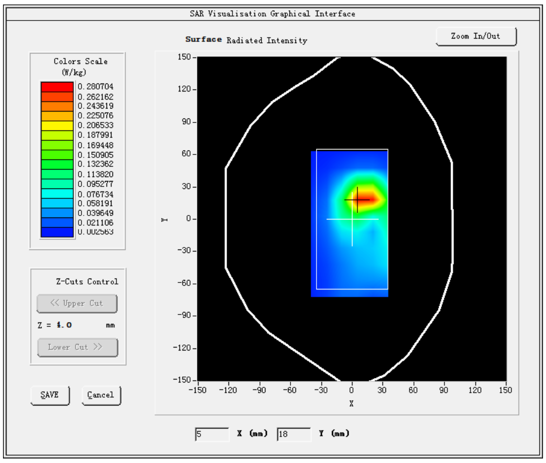
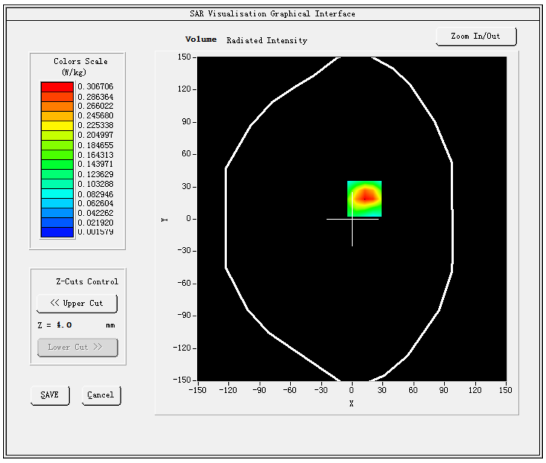
Measurement duration: 11 minutes 26 seconds

A. Experimental conditions.

Area Scan	dx=15mm dy=15mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete
Phantom	Validation plane
Device Position	Body
Band	CUSTOM (GPRS1900_4Tx)
Channels	High
Signal	Duty Cycle: 2.00 (Crest factor: 2.0)
Conversion factor	5.28

B. SAR Measurement Results

Frequency (MHz)	1909.800049
Relative permittivity (real part)	53.614719
Relative permittivity (imaginary part)	14.542180
Conductivity (S/m)	1.542925
Variation (%)	-0.400000

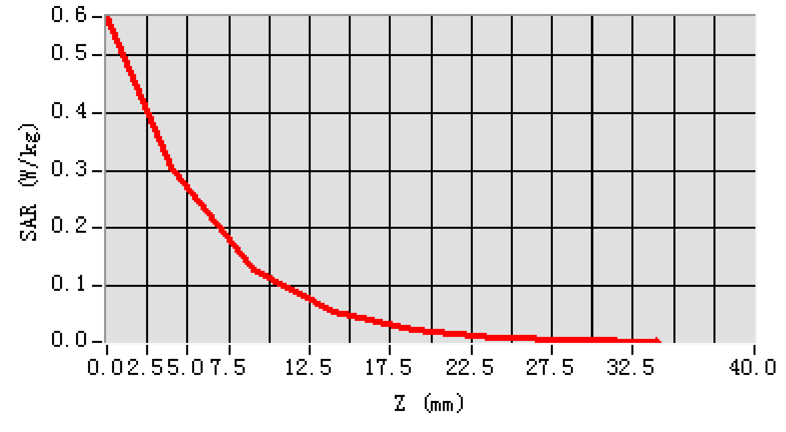
SURFACE SAR	VOLUME SAR
	

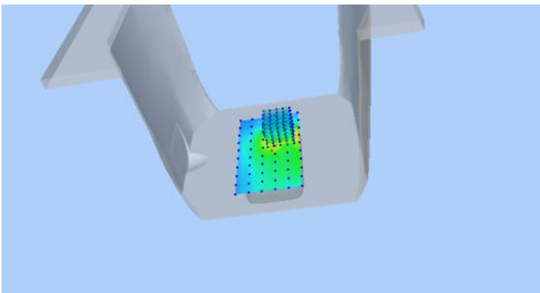
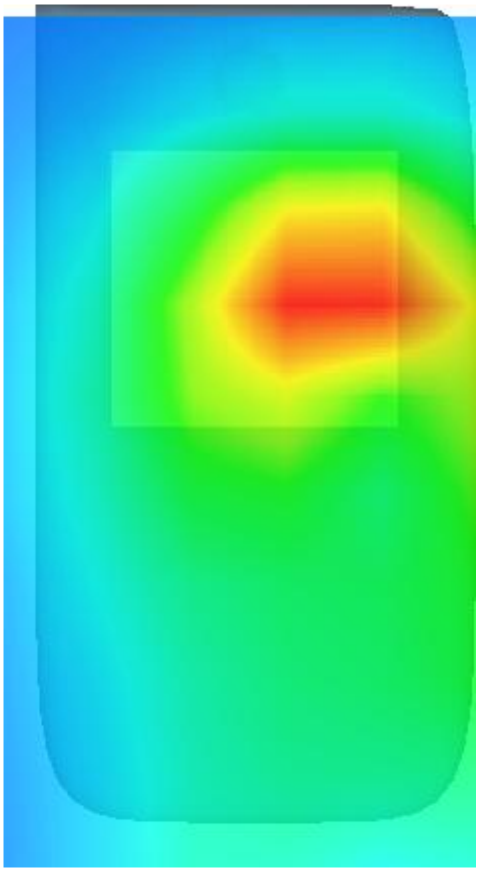
Maximum location: X=12.00, Y=19.00

SAR Peak: 0.59 W/kg

SAR 10g (W/Kg)	0.132201
SAR 1g (W/Kg)	0.303883

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	0.5677	0.3067	0.1273	0.0564	0.0247	0.0109	0.0050



3D screen shot	Hot spot position
	

SATIMO	**Annex C: Calibration Reports**
	Tested Model : X609B
	Report Number: FCC18080068A-SAR

SAR Reference Dipole Calibration Report

Ref : ACR.176.1.15.SATU.A

WORLD STANDARDIZATION CERTIFICATION
& TESTING GROUP CO .,LTD
BLOCK A-B, BAO SHI SCIENCE PARK,BAO SHI ROAD,
BAO'AN DISTRICT
SHENZHEN 518108,P.R. CHINA

MVG COMOSAR REFERENCE DIPOLE

FREQUENCY: 835 MHZ

SERIAL NO.: SN 14/13 DIP 0G835-235

Calibrated at MVG US

2105 Barrett Park Dr. - Kennesaw, GA 30144

Calibration Date: 7/25/2018

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.

	Name	Function	Date	Signature
Prepared by :	Jérôme LUC	Product Manager	7/25/2018	JS
Checked by :	Jérôme LUC	Product Manager	7/25/2018	JS
Approved by :	Kim RUTKOWSKI	Quality Manager	7/25/2018	Kim Rutkowski

	Customer Name
Distribution :	WORLD STANDARDIZATION CERTIFICATION & TESTING GROUP CO .,LTD

Issue	Date	Modifications
A	7/25/2018	Initial release

TABLE OF CONTENTS

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 14/13 DIP 0G835-235
Product Condition (new / used)	Used

A yearly calibration interval is recommended.

3 PRODUCT DESCRIPTION

3.1 GENERAL INFORMATION

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

Figure 1 – *MVG COMOSAR Validation Dipole*

4 MEASUREMENT METHOD

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

4.1 RETURN LOSS REQUIREMENTS

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

4.2 MECHANICAL REQUIREMENTS

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

5 MEASUREMENT UNCERTAINTY

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

5.1 RETURN LOSS

The following uncertainties apply to the return loss measurement:

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

5.2 DIMENSION MEASUREMENT

The following uncertainties apply to the dimension measurements:

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

5.3 VALIDATION MEASUREMENT

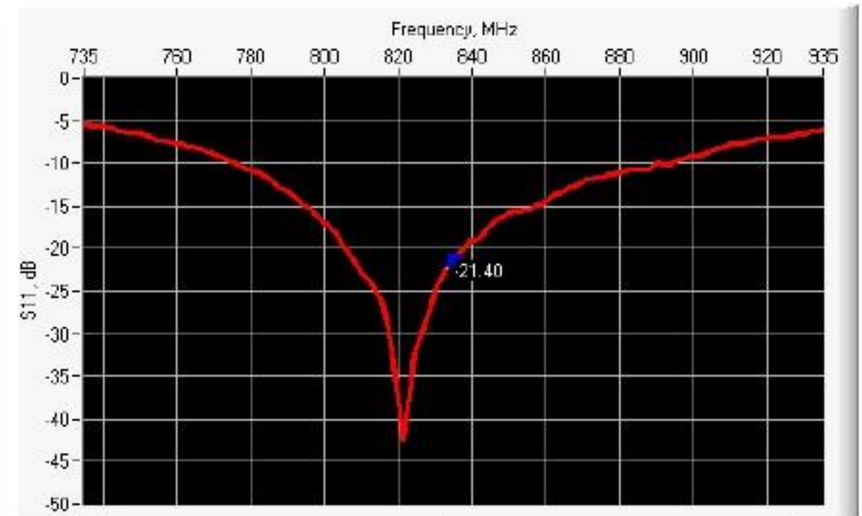
The guidelines outlined in the IEEE 1528, FCC KDBs, CENELEC EN50361 and CEI/IEC 62209 standards were followed to generate the measurement uncertainty for validation measurements.

Scan Volume	Expanded Uncertainty
1g	20.3 %

10 g	20.1 %

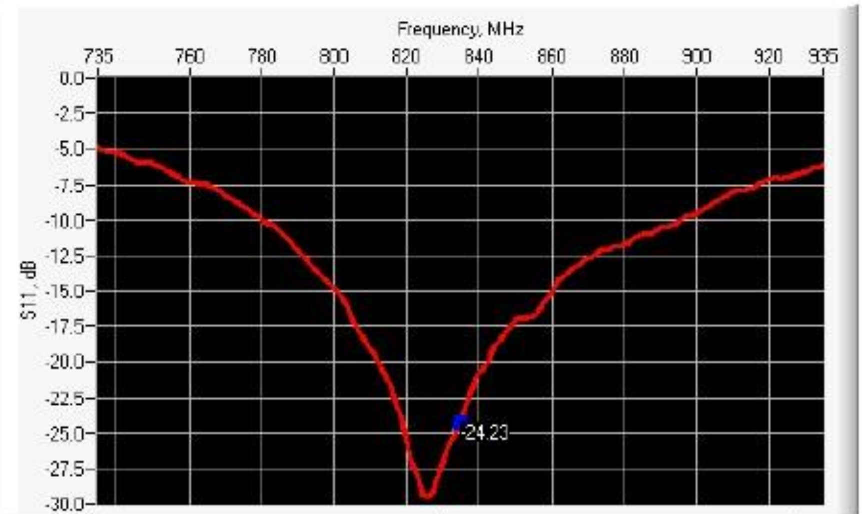
6 CALIBRATION MEASUREMENT RESULTS

6.1 RETURN LOSS AND IMPEDANCE IN HEAD LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
835	-21.40	-20	59.2 Ω - 1.5 j

6.2 RETURN LOSS AND IMPEDANCE IN BODY LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
835	-24.23	-20	56.3 Ω + 1.7 j

6.3 MECHANICAL DIMENSIONS

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

450	290.0 ±1 %.		166.7 ±1 %.		6.35 ±1 %.	
750	176.0 ±1 %.		100.0 ±1 %.		6.35 ±1 %.	
835	161.0 ±1 %.	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/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 (′)		Conductivity (σ) S/m	
	required	measured	required	measured
300	45.3 ±5 %		0.87 ±5 %	
450	43.5 ±5 %		0.87 ±5 %	
750	41.9 ±5 %		0.89 ±5 %	
835	41.5 ±5 %	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 %	

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 %	

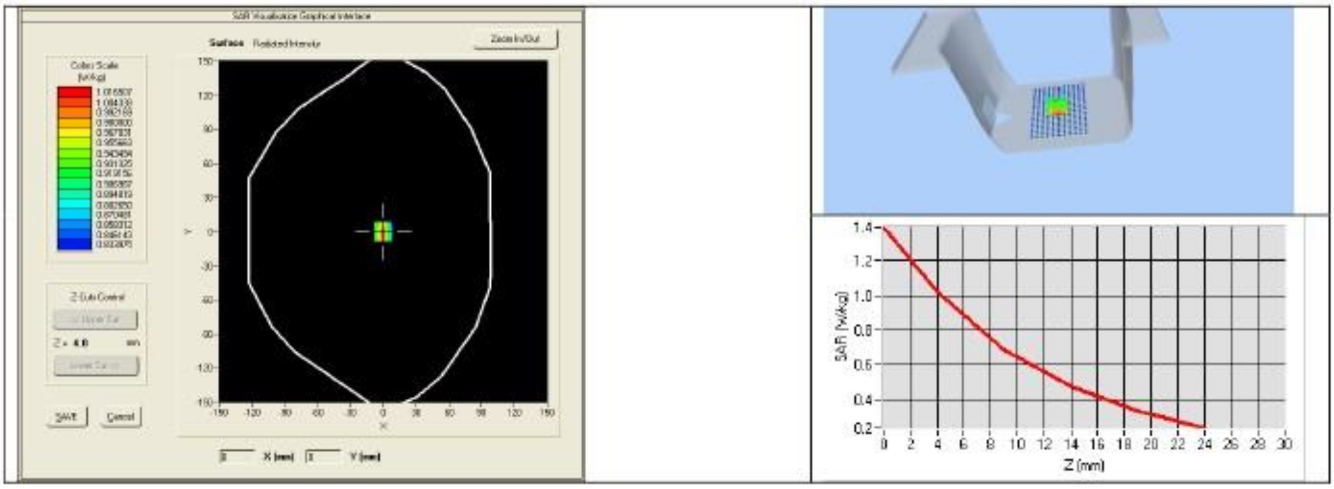
7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

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: eps' : 42.3 sigma : 0.92
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	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	9.82 (0.98)	6.22	6.35 (0.63)
900	10.9		6.99	
1450	29		16	
1500	30.5		16.8	
1640	34.2		18.4	
1750	36.4		19.3	
1800	38.4		20.1	

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



7.3 BODY LIQUID MEASUREMENT

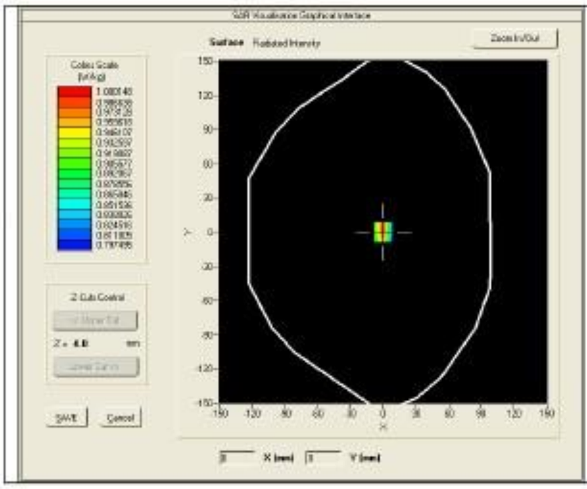
Frequency MHz	Relative permittivity (ε')		Conductivity (σ) S/m	
	required	measured	required	measured
150	61.9 ±5 %		0.80 ±5 %	
300	58.2 ±5 %		0.92 ±5 %	
450	56.7 ±5 %		0.94 ±5 %	
750	55.5 ±5 %		0.96 ±5 %	
835	55.2 ±5 %	PASS	0.97 ±5 %	PASS
900	55.0 ±5 %		1.05 ±5 %	
915	55.0 ±5 %		1.06 ±5 %	
1450	54.0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

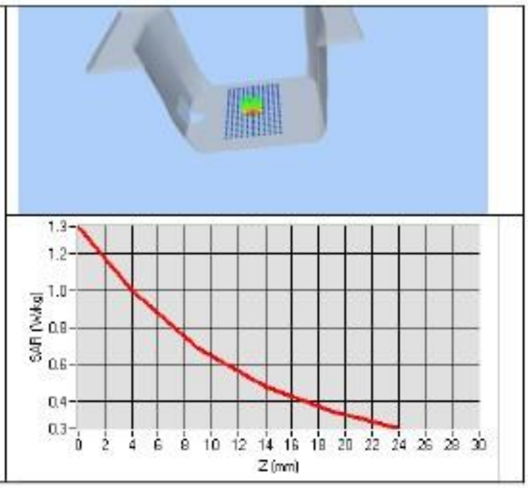
2600	52.5 ±5 %		2.16 ±5 %	
3000	52.0 ±5 %		2.73 ±5 %	
3500	51.3 ±5 %		3.31 ±5 %	
5200	49.0 ±10 %		5.30 ±10 %	
5300	48.9 ±10 %		5.42 ±10 %	
5400	48.7 ±10 %		5.53 ±10 %	
5500	48.6 ±10 %		5.65 ±10 %	
5600	48.5 ±10 %		5.77 ±10 %	
5800	48.2 ±10 %		6.00 ±10 %	

7.4 SAR MEASUREMENT RESULT WITH BODY LIQUID

Software	OPENSAR V4
Phantom	SN 20/09 SAM71
Probe	SN 18/11 EPG122
Liquid	Body Liquid Values: eps' : 53.3 sigma : 0.97
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	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	9.41 (0.94)	6.22 (0.62)





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	02/2016	02/2019
Calipers	Carrera	CALIPER-01	12/2016	12/2019
Reference Probe	MVG	EPG122 SN 18/11	01/2017	01/2020
Multimeter	Keithley 2000	1188656	01/2017	01/2020
Signal Generator	Agilent E4438C	MY49070581	012017	01/2020
Amplifier	Aethercomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	HP E4418A	US38261498	01/2017	01/2020
Power Sensor	HP ECP-E26A	US37181460	01/2017	01/2020
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	11/2017	11/2020

SAR Reference Dipole Calibration Report

Ref : ACR.176.4.15.SATU.A

WORLD STANDARDIZATION CERTIFICATION
& TESTING GROUP CO .,LTD
BLOCK A-B, BAO SHI SCIENCE PARK,BAO SHI ROAD,
BAO'AN DISTRICT
SHENZHEN 518108,P.R. CHINA

MVG COMOSAR REFERENCE DIPOLE

FREQUENCY: 1900 MHZ

SERIAL NO.: SN 14/13 DIP 1G900-236

Calibrated at MVG US

2105 Barrett Park Dr. - Kennesaw, GA 30144

Calibration Date: 7/25/2018

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.

	Name	Function	Date	Signature
Prepared by :	Jérôme LUC	Product Manager	7/25/2018	JS
Checked by :	Jérôme LUC	Product Manager	7/25/2018	JS
Approved by :	Kim RUTKOWSKI	Quality Manager	7/25/2018	Kim Rutkowski

	Customer Name
Distribution :	WORLD STANDARDIZATION CERTIFICATION & TESTING GROUP CO.,LTD

Issue	*Date*	*Modifications*
A	7/25/2018	Initial release

TABLE OF CONTENTS

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 14/13 DIP 1G900-236
Product Condition (new / used)	Used

A yearly calibration interval is recommended.

3 PRODUCT DESCRIPTION

3.1 GENERAL INFORMATION

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

Figure 1 – *MVG COMOSAR Validation Dipole*

4 MEASUREMENT METHOD

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

4.1 RETURN LOSS REQUIREMENTS

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

4.2 MECHANICAL REQUIREMENTS

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

5 MEASUREMENT UNCERTAINTY

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

5.1 RETURN LOSS

The following uncertainties apply to the return loss measurement:

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

5.2 DIMENSION MEASUREMENT

The following uncertainties apply to the dimension measurements:

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

5.3 VALIDATION MEASUREMENT

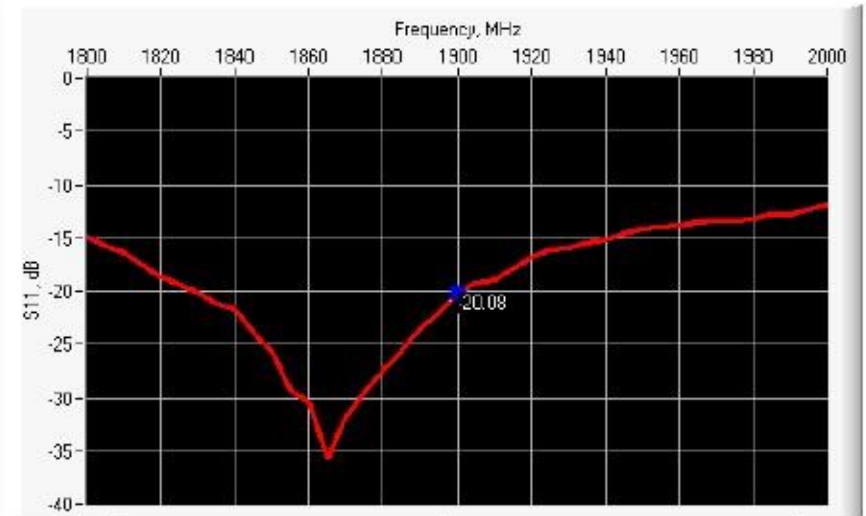
The guidelines outlined in the IEEE 1528, FCC KDBs, CENELEC EN50361 and CEI/IEC 62209 standards were followed to generate the measurement uncertainty for validation measurements.

Scan Volume	Expanded Uncertainty
1g	20.3 %

10 g	20.1 %

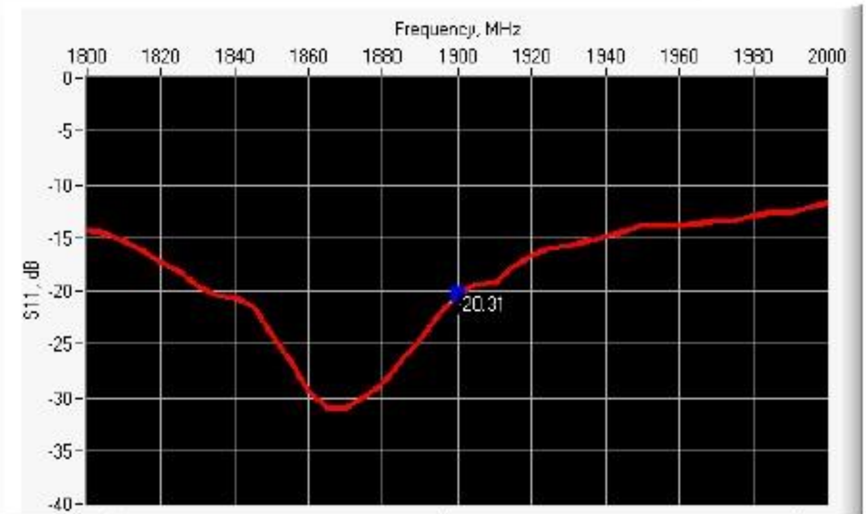
6 CALIBRATION MEASUREMENT RESULTS

6.1 RETURN LOSS AND IMPEDANCE IN HEAD LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
1900	-20.08	-20	54.9 Ω + 9.2 j

6.2 RETURN LOSS AND IMPEDANCE IN BODY LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
1900	-20.31	-20	49.7 Ω + 9.7 j

6.3 MECHANICAL DIMENSIONS

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

450	290.0 ±1 %.		166.7 ±1 %.		6.35 ±1 %.	
750	176.0 ±1 %.		100.0 ±1 %.		6.35 ±1 %.	
835	161.0 ±1 %.		89.8 ±1 %.		3.6 ±1 %.	
900	149.0 ±1 %.		83.3 ±1 %.		3.6 ±1 %.	
1450	89.1 ±1 %.		51.7 ±1 %.		3.6 ±1 %.	
1500	80.5 ±1 %.		50.0 ±1 %.		3.6 ±1 %.	
1640	79.0 ±1 %.		45.7 ±1 %.		3.6 ±1 %.	
1750	75.2 ±1 %.		42.9 ±1 %.		3.6 ±1 %.	
1800	72.0 ±1 %.		41.7 ±1 %.		3.6 ±1 %.	
1900	68.0 ±1 %.	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/IEC 62209 standards state that the system validation measurements must be performed using a reference dipole meeting the fore mentioned return loss and mechanical dimension requirements. The validation measurement must be performed against a liquid filled flat phantom, with the phantom constructed as outlined in the fore mentioned standards. Per the standards, the dipole shall be positioned below the bottom of the phantom, with the dipole length centered and parallel to the longest dimension of the flat phantom, with the top surface of the dipole at the described distance from the bottom surface of the phantom.

7.1 HEAD LIQUID MEASUREMENT

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

1800	40.0 ±5 %		1.40 ±5 %	
1900	40.0 ±5 %	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 %		2.91 ±5 %	

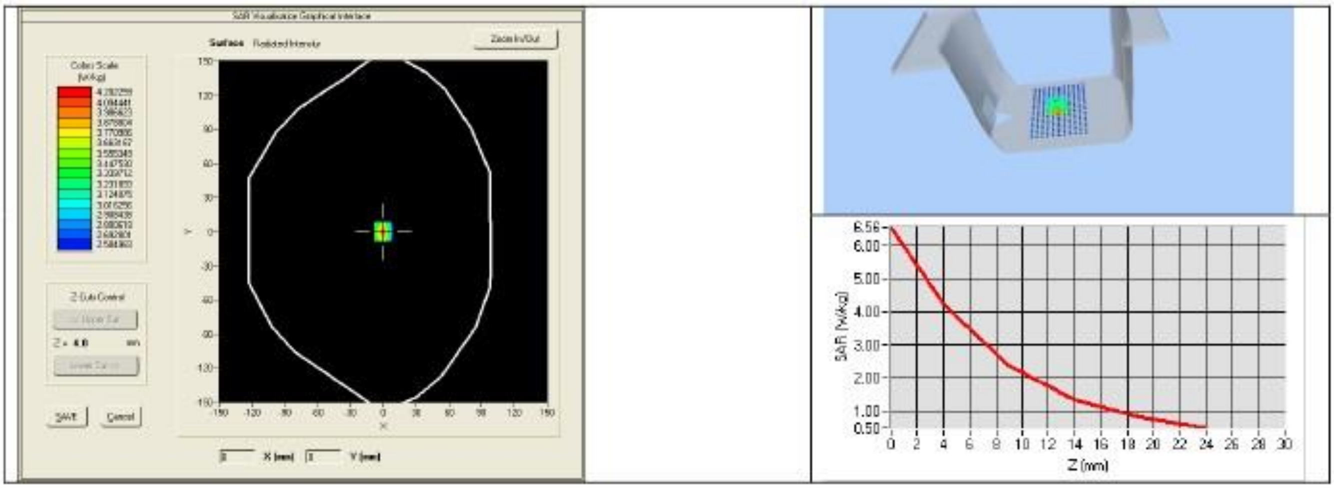
7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

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

Software	OPENSAR V4
Phantom	SN 20/09 SAM71
Probe	SN 18/11 EPG122
Liquid	Head Liquid Values: eps' : 40.4 sigma : 1.41
Distance between dipole center and liquid	10.0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoon Scan Resolution	dx=8mm/dy=8mm/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)	
	required	measured	required	measured
300	2.85		1.94	
450	4.58		3.06	
750	8.49		5.55	
835	9.56		6.22	
900	10.9		6.99	
1450	29		16	
1500	30.5		16.8	
1640	34.2		18.4	
1750	36.4		19.3	
1800	38.4		20.1	

1900	39.7	38.93 (3.89)	20.5	20.27 (2.03)
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

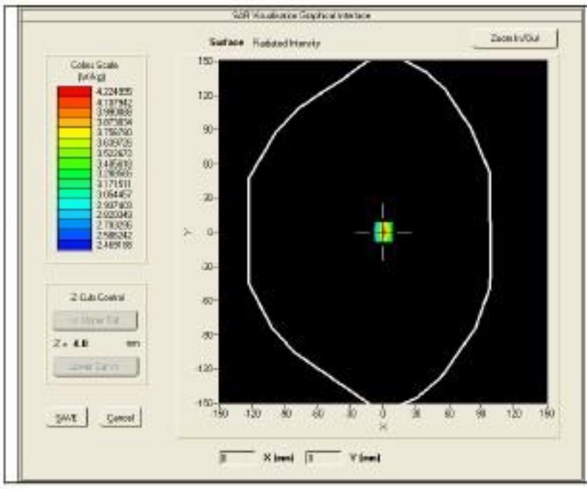
Frequency MHz	Relative permittivity (ε_r')		Conductivity (σ) S/m	
	required	measured	required	measured
150	61.9 ±5 %		0.80 ±5 %	
300	58.2 ±5 %		0.92 ±5 %	
450	56.7 ±5 %		0.94 ±5 %	
750	55.5 ±5 %		0.96 ±5 %	
835	55.2 ±5 %		0.97 ±5 %	
900	55.0 ±5 %		1.05 ±5 %	
915	55.0 ±5 %		1.06 ±5 %	
1450	54.0 ±5 %	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

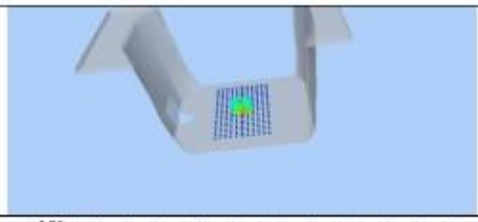
2600	52.5 ±5 %		2.16 ±5 %	
3000	52.0 ±5 %		2.73 ±5 %	
3500	51.3 ±5 %		3.31 ±5 %	
5200	49.0 ±10 %		5.30 ±10 %	
5300	48.9 ±10 %		5.42 ±10 %	
5400	48.7 ±10 %		5.53 ±10 %	
5500	48.6 ±10 %		5.65 ±10 %	
5600	48.5 ±10 %		5.77 ±10 %	
5800	48.2 ±10 %		6.00 ±10 %	

7.4 SAR MEASUREMENT RESULT WITH BODY LIQUID

Software	OPENSAR V4
Phantom	SN 20/09 SAM71
Probe	SN 18/11 EPG122
Liquid	Body Liquid Values: eps' : 53.9 sigma : 1.55
Distance between dipole center and liquid	10.0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoon Scan Resolution	dx=8mm/dy=8mm/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	38.73 (3.87)	20.48 (2.05)





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	02/2016	02/2019
Calipers	Carrera	CALIPER-01	12/2016	12/2019
Reference Probe	MVG	EPG122 SN 18/11	01/2017	01/2020
Multimeter	Keithley 2000	1188656	01/2017	01/2020
Signal Generator	Agilent E4438C	MY49070581	01/2017	01/2020
Amplifier	Aethercomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	HP E4418A	US38261498	01/2017	01/2020
Power Sensor	HP ECP-E26A	US37181460	01/2017	01/2020
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	11/2017	11/2020

SAR Reference Dipole Calibration Report

Ref : ACR.176.6.15.SATU.A

WORLD STANDARDIZATION CERTIFICATION & TESTING GROUP CO .,LTD

BLOCK A-B, BAO SHI SCIENCE PARK,BAO SHI ROAD, BAO'AN DISTRICT

SHENZHEN 518108,P.R. CHINA

MVG COMOSAR REFERENCE DIPOLE

FREQUENCY: 2450 MHZ

SERIAL NO.: SN 14/13 DIP 2G450-238

Calibrated at MVG US

2105 Barrett Park Dr. - Kennesaw, GA 30144

Calibration CERT #2246-02

Calibration Date: 7/25/2018

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.

	Name	Function	Date	Signature
Prepared by :	Jérôme LUC	Product Manager	7/25/2018	
Checked by :	Jérôme LUC	Product Manager	7/25/2018	
Approved by :	Kim RUTKOWSKI	Quality Manager	7/25/2018	

	Customer Name
Distribution :	WORLD STANDARDIZATION CERTIFICATION & TESTING GROUP CO.,LTD

Issue	Date	Modifications
A	7/25/2018	Initial release

TABLE OF CONTENTS

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 14/13 DIP 2G450-238
Product Condition (new / used)	Used

A yearly calibration interval is recommended.

3 PRODUCT DESCRIPTION

3.1 GENERAL INFORMATION

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

Figure 1 – *MVG COMOSAR Validation Dipole*

4 MEASUREMENT METHOD

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

4.1 RETURN LOSS REQUIREMENTS

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

4.2 MECHANICAL REQUIREMENTS

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

5 MEASUREMENT UNCERTAINTY

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

5.1 RETURN LOSS

The following uncertainties apply to the return loss measurement:

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

5.2 DIMENSION MEASUREMENT

The following uncertainties apply to the dimension measurements:

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

5.3 VALIDATION MEASUREMENT

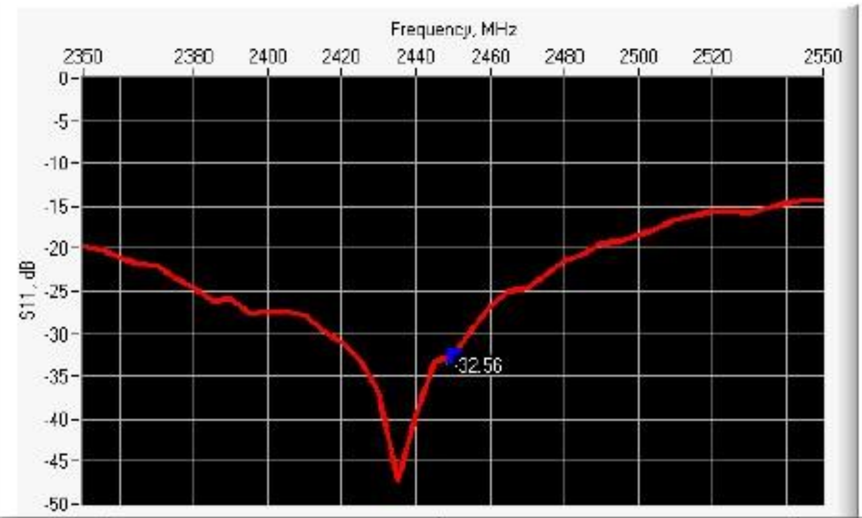
The guidelines outlined in the IEEE 1528, FCC KDBs, CENELEC EN50361 and CEI/IEC 62209 standards were followed to generate the measurement uncertainty for validation measurements.

Scan Volume	Expanded Uncertainty
1g	20.3 %

10 g	20.1 %

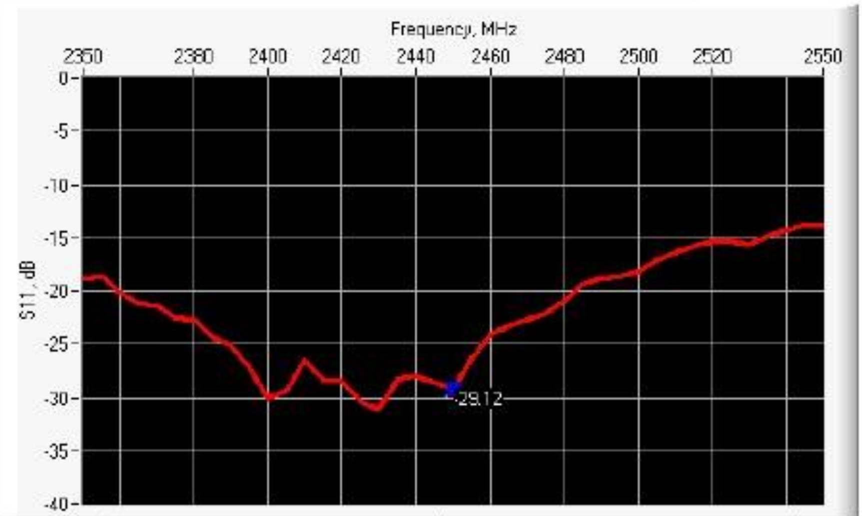
6 CALIBRATION MEASUREMENT RESULTS

6.1 RETURN LOSS AND IMPEDANCE IN HEAD LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
2450	-32.56	-20	48.3 Ω - 1.6 j

6.2 RETURN LOSS AND IMPEDANCE IN BODY LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
2450	-29.12	-20	0.0 Ω + 11.0 j

6.3 MECHANICAL DIMENSIONS

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

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

7 VALIDATION MEASUREMENT

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

7.1 HEAD LIQUID MEASUREMENT

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

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

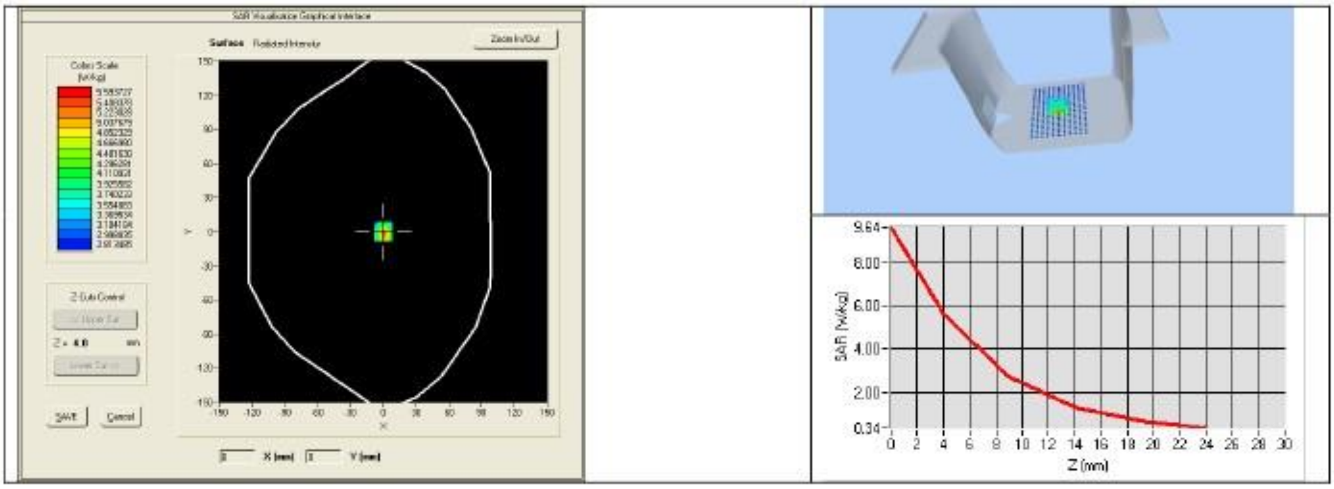
7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

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

Software	OPENSAR V4
Phantom	SN 20/09 SAM71
Probe	SN 18/11 EPG122
Liquid	Head Liquid Values: eps' : 38.3 sigma : 1.80
Distance between dipole center and liquid	10.0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoon 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)	
	required	measured	required	measured
300	2.85		1.94	
450	4.58		3.06	
750	8.49		5.55	
835	9.56		6.22	
900	10.9		6.99	
1450	29		16	
1500	30.5		16.8	
1640	34.2		18.4	
1750	36.4		19.3	
1800	38.4		20.1	

1900	39.7		20.5	
1950	40.5		20.9	
2000	41.1		21.1	
2100	43.6		21.9	
2300	48.7		23.3	
2450	52.4	53.41 (5.34)	24	23.95 (2.40)
2600	55.3		24.6	
3000	63.8		25.7	
3500	67.1		25	



7.3 BODY LIQUID MEASUREMENT

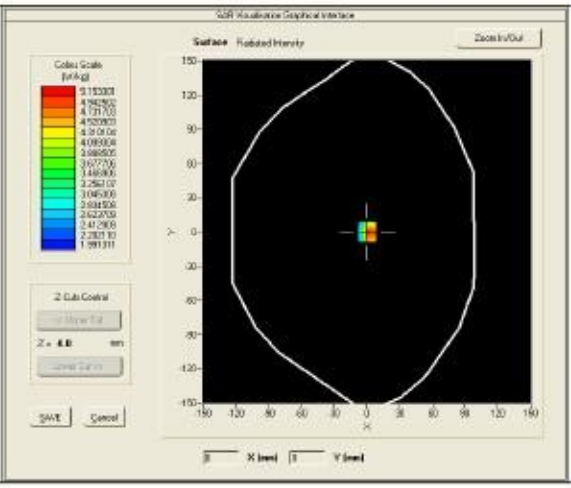
Frequency MHz	Relative permittivity (′)		Conductivity (σ) S/m	
	required	measured	required	measured
150	61.9 ±5 %		0.80 ±5 %	
300	58.2 ±5 %		0.92 ±5 %	
450	56.7 ±5 %		0.94 ±5 %	
750	55.5 ±5 %		0.96 ±5 %	
835	55.2 ±5 %		0.97 ±5 %	
900	55.0 ±5 %		1.05 ±5 %	
915	55.0 ±5 %		1.06 ±5 %	
1450	54.0 ±5 %		1.30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

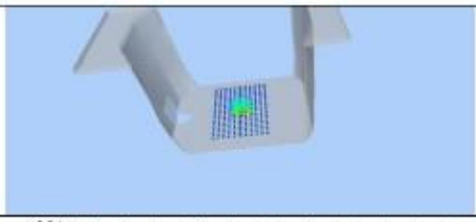
2600	52.5 ±5 %		2.16 ±5 %	
3000	52.0 ±5 %		2.73 ±5 %	
3500	51.3 ±5 %		3.31 ±5 %	
5200	49.0 ±10 %		5.30 ±10 %	
5300	48.9 ±10 %		5.42 ±10 %	
5400	48.7 ±10 %		5.53 ±10 %	
5500	48.6 ±10 %		5.65 ±10 %	
5600	48.5 ±10 %		5.77 ±10 %	
5800	48.2 ±10 %		6.00 ±10 %	

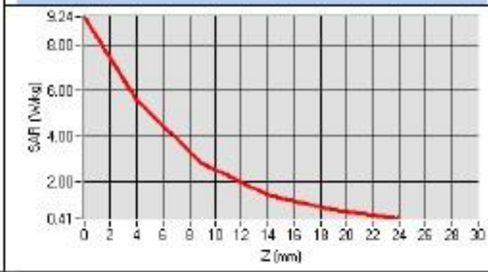
7.4 SAR MEASUREMENT RESULT WITH BODY LIQUID

Software	OPENSAR V4
Phantom	SN 20/09 SAM71
Probe	SN 18/11 EPG122
Liquid	Body Liquid Values: eps' : 52.7 sigma : 1.94
Distance between dipole center and liquid	10.0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoon Scan Resolution	dx=5mm/dy=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	51.39 (5.14)	23.63 (2.36)







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	02/2016	02/2019
Calipers	Carrera	CALIPER-01	12/2016	12/2019
Reference Probe	MVG	EPG122 SN 18/11	01/2017	01/2020
Multimeter	Keithley 2000	1188656	01/2017	01/2020
Signal Generator	Agilent E4438C	MY49070581	01/2017	01/2020
Amplifier	Aethercomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	HP E4418A	US38261498	01/2017	01/2020
Power Sensor	HP ECP-E26A	US37181460	01/2017	01/2020
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	11/2017	11/2020

COMOSAR E-Field Probe Calibration Report

Ref : ACR.331.3.17.SATU.A

WORLD STANDARDIZATION CERTIFICATION & TESTING GROUP CO .,LTD

BLOCK A, BAO SHI SCIENCE PARK,BAO SHI ROAD, BAO'AN DISTRICT

SHENZHEN 518108,P.R. CHINA

MVG COMOSAR DOSIMETRIC E-FIELD PROBE

SERIAL NO.: SN 07/15 EP252

Calibrated at MVG US

2105 Barrett Park Dr. - Kennesaw, GA 30144

Calibration CERT #2246-02

Calibration Date: 11/27/2017

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.

	Name	*Function*	*Date*	*Signature*
Prepared by :	Jérôme LUC	Product Manager	11/27/2017	
Checked by :	Jérôme LUC	Product Manager	11/27/2017	
Approved by :	Kim RUTKOWSKI	Quality Manager	11/27/2017	Kim Rutkowski

	Customer Name
Distribution :	World Standardization Certification & Testing Group Co .,Ltd

Issue	*Date*	*Modifications*
A	11/27/2017	Initial release

TABLE OF CONTENTS

1 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR DOSIMETRIC E FIELD PROBE
Manufacturer	MVG
Model	SSE5
Serial Number	SN 07/15 EP252
Product Condition (new / used)	New
Frequency Range of Probe	0.7 GHz-3GHz
Resistance of Three Dipoles at Connector	Dipole 1: R1=0.202 MΩ Dipole 2: R2=0.233 MΩ Dipole 3: R3=0.206 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	4.5 mm
Maximum external diameter	8 mm
Probe Tip External Diameter	5 mm
Distance between dipoles / probe extremity	2.7 mm

3 MEASUREMENT METHOD

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

3.1 LINEARITY

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

3.2 SENSITIVITY

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

3.3 LOWER DETECTION LIMIT

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

3.4 ISOTROPY

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

3.5 BOUNDARY EFFECT

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

4 MEASUREMENT UNCERTAINTY

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

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

Field probe linearity	3.00%	Rectangular	$\sqrt{3}$	1	1.732%
Combined standard uncertainty					5.831%
Expanded uncertainty 95 % confidence level k = 2					12.0%

5 CALIBRATION MEASUREMENT RESULTS

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

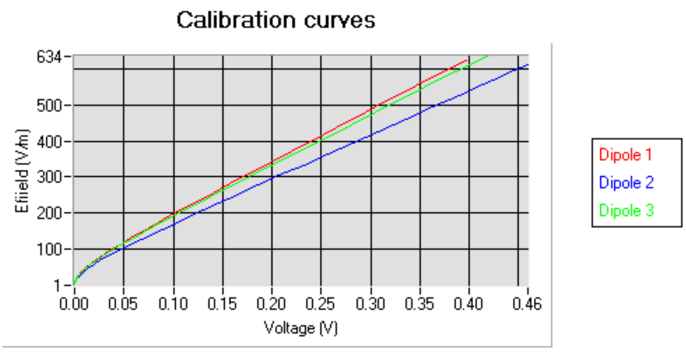
5.1 SENSITIVITY IN AIR

Normx dipole 1 ($\mu V/(V/m)^2$)	Normy dipole 2 ($\mu V/(V/m)^2$)	Normz dipole 3 ($\mu V/(V/m)^2$)
5.11	6.67	5.81

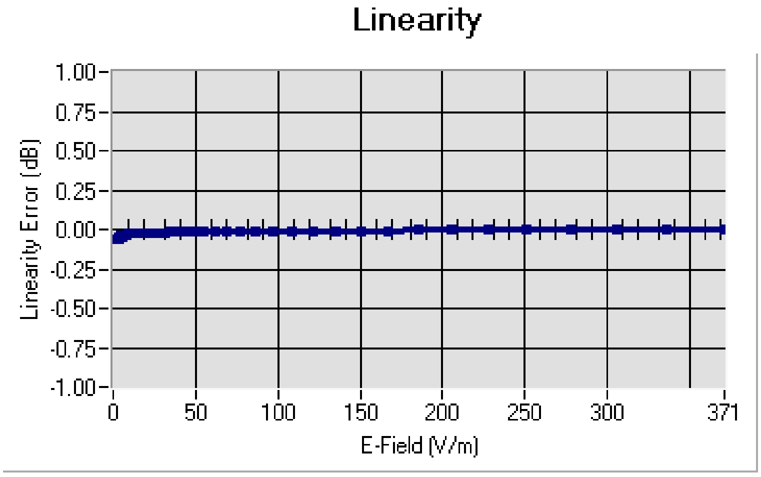
DCP dipole 1 (mV)	DCP dipole 2 (mV)	DCP dipole 3 (mV)
99	99	95

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

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



5.2 LINEARITY



Linearity: +/-1.35% (+/-0.06dB)

5.3 SENSITIVITY IN LIQUID

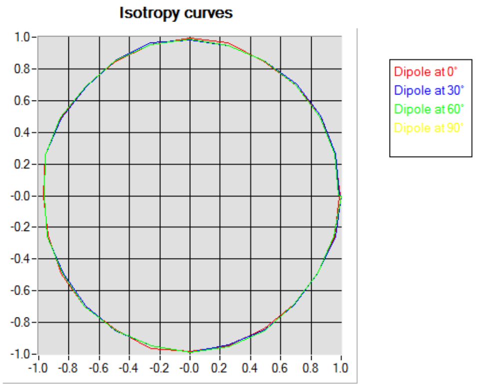
Liquid	Frequency (MHz +/- 100MHz)	Permittivity	Epsilon (S/m)	ConvF
HL750	750	42.09	0.91	5.38
BL750	750	55.69	0.95	5.54
HL850	835	42.71	0.89	5.54
BL850	835	57.52	1.03	5.75
HL900	900	41.94	0.93	5.53
BL900	900	52.87	1.09	5.74
HL1800	1800	40.62	1.39	4.65
BL1800	1800	53.22	1.47	4.80
HL1900	1900	41.22	1.37	5.17
BL1900	1900	50.99	1.52	5.28
HL2000	2000	40.39	1.36	5.00
BL2000	2000	54.39	1.54	5.14
HL2300	2300	38.10	1.74	4.89
BL2300	2300	53.33	1.85	4.93
HL2450	2450	40.46	1.87	4.83
BL2450	2450	54.62	1.95	5.02
HL2600	2600	38.46	2.01	4.51
BL2600	2600	51.98	2.16	4.66

LOWER DETECTION LIMIT: 8mW/kg

5.4 ISOTROPY

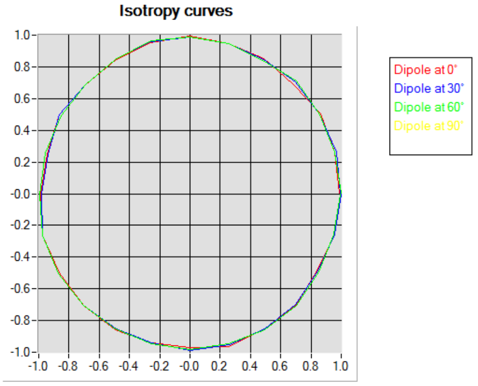
HL900 MHz

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



HL1800 MHz

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



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	02/2016	02/2019
Reference Probe	MVG	EP 94 SN 37/08	10/2017	10/2018
Multimeter	Keithley 2000	1188656	01/2017	01/2020
Signal Generator	Agilent E4438C	MY49070581	01/2017	01/2020
Amplifier	Aethercomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	HP E4418A	US38261498	01/2017	01/2020
Power Sensor	HP ECP-E26A	US37181460	01/2017	01/2020
Directional Coupler	Narda 4216-20	01386	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Waveguide	Mega Industries	069Y7-158-13-712	Validated. No cal required.	Validated. No cal required.
Waveguide Transition	Mega Industries	069Y7-158-13-701	Validated. No cal required.	Validated. No cal required.
Waveguide Termination	Mega Industries	069Y7-158-13-701	Validated. No cal required.	Validated. No cal required.
Temperature / Humidity Sensor	Control Company	150798832	11/2017	11/2020