

FCC SAR EVALUATION REPORT

**In accordance with the requirements of
FCC 47 CFR Part 2(2.1093), ANSI/IEEE C95.1-1992 and
IEEE Std 1528-2013**

Product Name : Ellume.lab

Trademark : N/A

Model Name : E-ELR-P-02

Family Model : N/A

Report No. : S19122601206001

FCC ID : 2AWR4EELR-P-02

Prepared for

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TEST RESULT CERTIFICATION

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Product description

Product name.....: Ellume.lab

Trademark: N/A

Model Name: E-ELR-P-02

Family Model.....: N/A

FCC 47 CFR Part 2(2.1093)

ANSI/IEEE C95.1-1992

Standards: IEEE Std 1528-2013

Published RF exposure KDB procedures

This device described above has been tested by Shenzhen NTEK. In accordance with the measurement methods and procedures specified in IEEE Std 1528-2013 and KDB 865664 D01. Testing has shown that this device is capable of compliance with localized specific absorption rate (SAR) specified in FCC 47 CFR Part 2(2.1093) and ANSI/IEEE C95.1-1992. The test results in this report apply only to the tested sample of the stated device/equipment. Other similar device/equipment will not necessarily produce the same results due to production tolerance and measurement uncertainties.

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Date of Test

Date (s) of performance of tests: Mar. 18, 2020 ~ Mar. 20, 2020

Date of Issue: Apr. 13, 2020

Test Result: **Pass**

Prepared By : 
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※ ※ Revision History ※ ※

REV.	DESCRIPTION	ISSUED DATE	REMARK
Rev.1.0	Initial Test Report Release	Apr. 13, 2020	Cheng Jiawen

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1. General Information

1.1. RF exposure limits

(A).Limits for Occupational/Controlled Exposure (W/kg)

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.4	8.0	20.0

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

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.08	1.6	4.0

NOTE: **Whole-Body SAR** is averaged over the entire body, **partial-body SAR** is averaged over any 1 gram of tissue defined as a tissue volume in the shape of a cube. **SAR for hands, wrists, feet and ankles** is averaged over any 10 grams of tissue defined as a tissue volume in the shape of a cube.

Occupational/Controlled Environments:

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

General Population/Uncontrolled Environments:

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

NOTE
 TRUNK LIMIT
 1.6 W/kg
 APPLIED TO THIS EUT

1.2. Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for E-ELR-P-02 are as follows.

Band	Max Reported SAR Value(W/kg)	
	1-g Body (Separation distance of 0mm)	Max Simultaneous Tx
GSM 850	1.199	1.516
GSM 1900	0.104	
WCDMA Band 2	1.195	
WCDMA Band 5	1.131	
LTE Band 2	0.793	
LTE Band 5	1.111	
LTE Band 7	0.577	
WLAN 2.4G	0.317	

Note: The Max Simultaneous Tx is calculated based on the same configuration and test position. This device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (1.6 W/kg) specified in FCC 47 CFR Part 2(2.1093) and ANSI/IEEE C95.1-1992, and had been tested in accordance with the measurement methods and procedures specified in IEEE Std 1528-2013 & KDB 865664 D01.

1.3. EUT Description

Device Information			
Product Name	Ellume.lab		
Trade Name	N/A		
Model Name	E-ELR-P-02		
Family Model	N/A		
FCC ID	2AWR4EELR-P-02		
Device Phase	Identical Prototype		
Exposure Category	General population / Uncontrolled environment		
Antenna	FPC Antenna		
Battery Information	DC 3.8V, 5000mAh		
Device Operating Configurations			
Supporting Mode(s)	GSM 850/1900, WCDMA Band 2/5, LTE Band 2/5/7, WLAN 2.4G, Bluetooth		
Test Modulation	GSM(GMSK), WCDMA(QPSK), LTE(QPSK/16QAM), WLAN(DSSS/OFDM), Bluetooth(GFSK, $\pi/4$ -DQPSK, 8DPSK)		
Device Class	B		
Operating Frequency Range(s)	Band	Tx (MHz)	Rx (MHz)

	GSM 850	824-849	869-894
	GSM 1900	1850-1910	1930-1990
	WCDMA Band 2	1850-1910	1930-1990
	WCDMA Band 5	824-849	869-894
	LTE Band 2	1850-1910	1930-1990
	LTE Band 5	824-849	869-894
	LTE Band 7	2500-2570	2620-2690
	WLAN 2.4G	2412-2462	
	Bluetooth	2402-2480	
GPRS Multislot Class(12)	Max Number of Timeslots in Uplink		4
	Max Number of Timeslots in Downlink		4
	Max Total Timeslot		5
Power Class	4, tested with power level 5(GSM 850)		
	1, tested with power level 0(GSM 1900)		
	3, tested with power control "all 1"(WCDMA Band 2)		
	3, tested with power control "all 1"(WCDMA Band 5)		
	3, tested with power control all Max.(LTE Band 2)		
	3, tested with power control all Max.(LTE Band 5)		
	3, tested with power control all Max.(LTE Band 7)		
Test Channels (low-mid-high)	128-189-251(GSM 850)		
	512-661-810(GSM 1900)		
	9262-9400-9538(WCDMA Band 2)		
	4132-4182-4233(WCDMA Band 5)		
	18607-18900-19193(LTE Band 2 BW=1.4MHz)		
	18615-18900-19185(LTE Band 2 BW=3MHz)		
	18625-18900-19175(LTE Band 2 BW=5MHz)		
	18650-18900-19150(LTE Band 2 BW=10MHz)		
	18675-18900-19125(LTE Band 2 BW=15MHz)		
	18700-18900-19100(LTE Band 2 BW=20MHz)		
	20407-20525-20643(LTE Band 5 BW=1.4MHz)		
	20415-20525-20635(LTE Band 5 BW=3MHz)		
	20425-20525-20625(LTE Band 5 BW=5MHz)		
	20450-20525-20600(LTE Band 5 BW=10MHz)		
	20775-21100-21425(LTE Band 7 BW=5MHz)		
	20800-21100-21400(LTE Band 7 BW=10MHz)		
	20825-21100-21375(LTE Band 7 BW=15MHz)		
	20850-21100-21350(LTE Band 7 BW=20MHz)		
	1-3-6-9-11(WLAN 2.4G)		

1.4. Test specification(s)

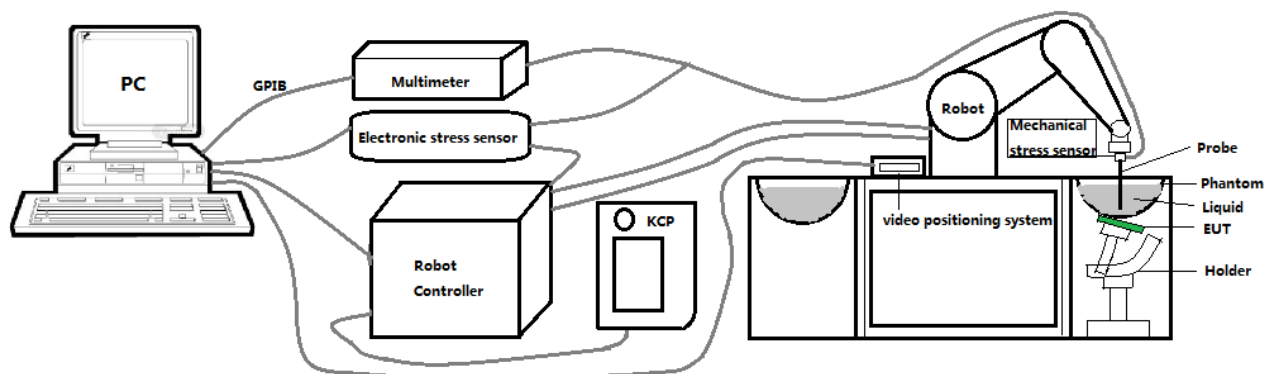
FCC 47 CFR Part 2(2.1093)
ANSI/IEEE C95.1-1992
IEEE Std 1528-2013
KDB 865664 D01 SAR measurement 100 MHz to 6 GHz
KDB 865664 D02 RF Exposure Reporting
KDB 447498 D01 General RF Exposure Guidance
KDB 248227 D01 802.11 Wi-Fi SAR
KDB 941225 D01 3G SAR Procedures
KDB 941225 D05 SAR for LTE Devices
KDB 616217 D04 SAR for laptop and tablets

1.5. Ambient Condition

Ambient temperature	20°C – 24°C
Relative Humidity	30% – 70%

2. SAR Measurement System

2.1. SATIMO SAR Measurement Set-up Diagram



These measurements were performed with the automated near-field scanning system OPENSAR from SATIMO. The system is based on a high precision robot (working range: 901 mm), which positions the probes with a positional repeatability of better than ± 0.03 mm. The SAR measurements were conducted with dosimetric probe (manufactured by SATIMO), designed in the classical triangular configuration and optimized for dosimetric evaluation.

The first step of the field measurement is the evaluation of the voltages induced on the probe by the device under test. Probe diode detectors are nonlinear. Below the diode compression point, the output voltage is proportional to the square of the applied E-field; above the diode compression point, it is linear to the applied E-field. The compression point depends on the diode, and a calibration procedure is necessary for each sensor of the probe.

The Keithley multimeter reads the voltage of each sensor and send these three values to the PC. The corresponding E field value is calculated using the probe calibration factors, which are stored in the working directory. This evaluation includes linearization of the diode characteristics. The field calculation is done separately for each sensor. Each component of the E field is displayed on the "Dipole Area Scan Interface" and the total E field is displayed on the "3D Interface"

2.2. Robot

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



- High precision (repeatability ± 0.03 mm)
- High reliability (industrial design)
- Jerk-free straight movements
- Low ELF interference (the closed metallic construction shields against motor control fields)

2.3. E-Field Probe

This E-field detection probe is composed of three orthogonal dipoles linked to special Schottky diodes with low detection thresholds. The probe allows the measurement of electric fields in liquids such as the one defined in the IEEE and CENELEC standards.

For the measurements the Specific Dosimetric E-Field Probe SN 41/18 EPGO330 with following specifications is used



- Dynamic range: 0.01-100 W/kg
 - Tip Diameter: 2.5 mm
 - Distance between probe tip and sensor center: 1 mm
 - Distance between sensor center and the inner phantom surface: 2 mm (repeatability better than ± 1 mm).
 - Probe linearity: ± 0.10 dB
 - Axial isotropy: 0.06 dB
 - Hemispherical Isotropy: 0.09 dB
 - Calibration range: 650MHz to 5900MHz for head & body simulating liquid.
 - Lower detection limit: 9mW/kg
- Angle between probe axis (evaluation axis) and surface normal line: less than 30° .

2.3.1. E-Field Probe Calibration

Each probe needs to be calibrated according to a dosimetric assessment procedure with accuracy better than $\pm 10\%$. The spherical isotropy shall be evaluated and within ± 0.25 dB. The sensitivity parameters (Norm X, Norm Y, and Norm Z), the diode compression parameter (DCP) and the conversion factor (Conv F) of the probe are tested. The calibration data can be referred to appendix D of this report.

2.4. SAM phantoms

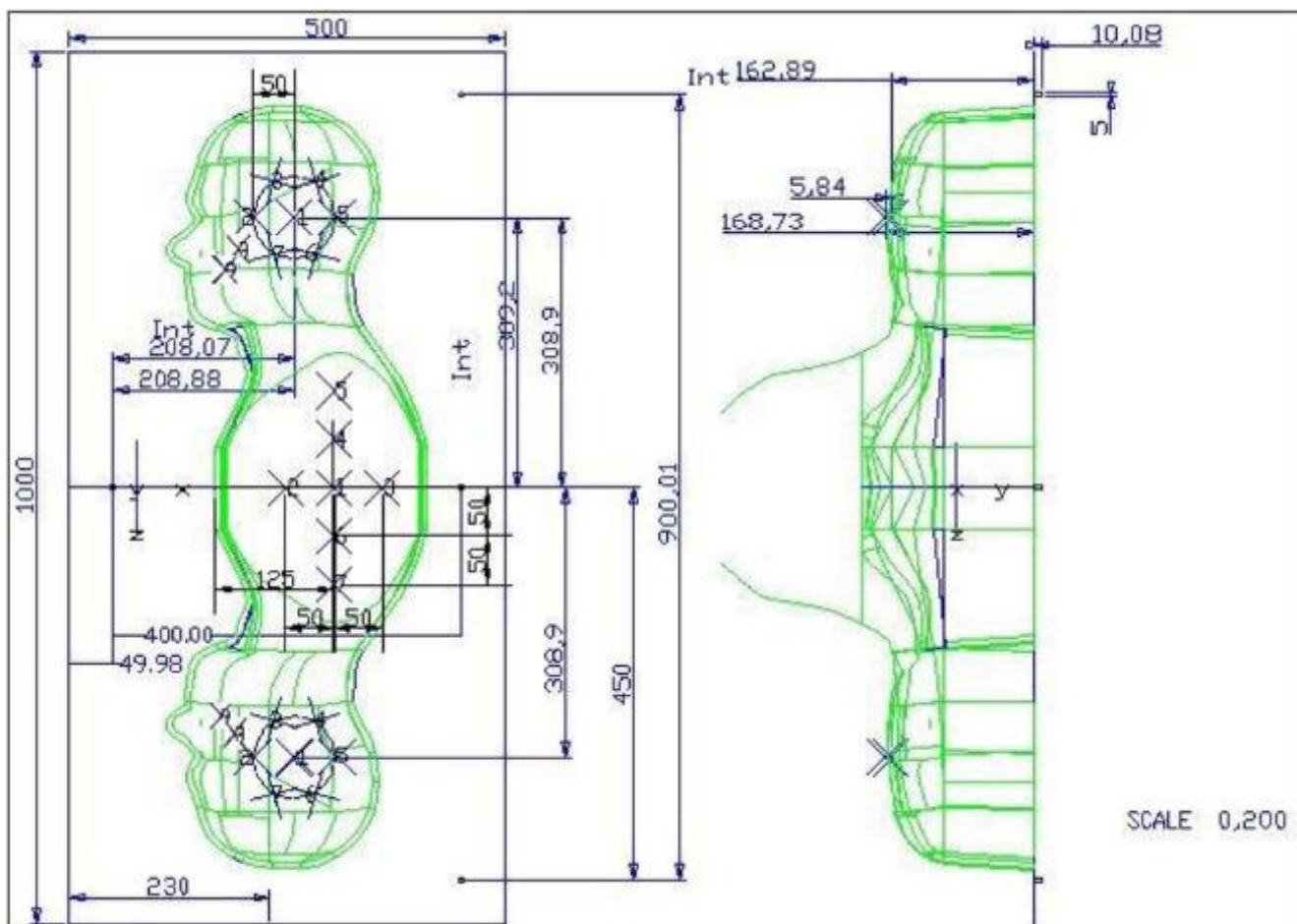
Photo of SAM phantom SN 16/15 SAM119



The SAM phantom is used to measure the SAR relative to people exposed to electro-magnetic field radiated by mobile phones.

2.4.1. Technical Data

Serial Number	Shell thickness	Filling volume	Dimensions	Positionner Material	Permittivity	Loss Tangent
SN 16/15 SAM119	2 mm $\pm$ 0.2 mm	27 liters	Length:1000 mm Width:500 mm Height:200 mm	Gelcoat with fiberglass	3.4	0.02

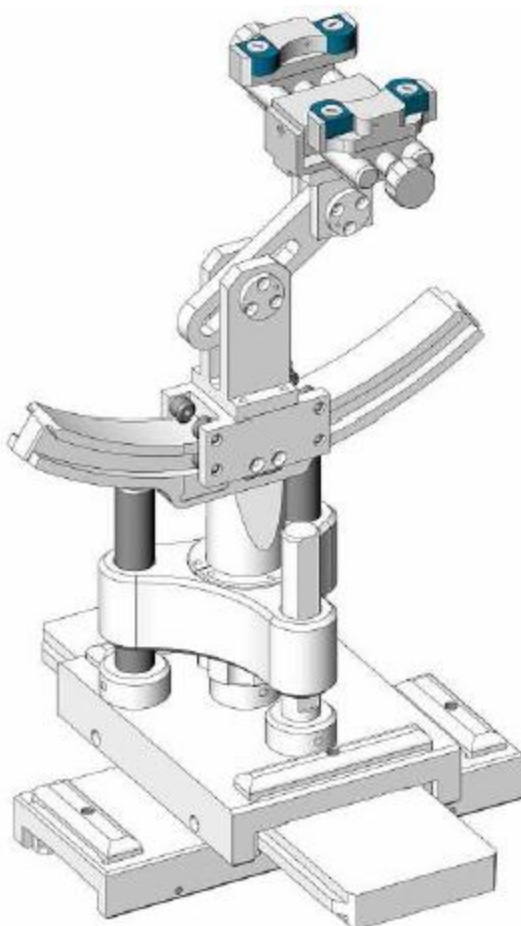


Serial Number	Left Head(mm)		Right Head(mm)		Flat Part(mm)	
SN 16/15 SAM119	2	2.02	2	2.08	1	2.09
	3	2.05	3	2.06	2	2.06
	4	2.07	4	2.07	3	2.08
	5	2.08	5	2.08	4	2.10
	6	2.05	6	2.07	5	2.10
	7	2.05	7	2.05	6	2.07
	8	2.07	8	2.06	7	2.07
	9	2.08	9	2.06	-	-

The test, based on ultrasonic system, allows measuring the thickness with an accuracy of 10 μ m.

2.5. 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 degree.



Serial Number	Holder Material	Permittivity	Loss Tangent
SN 16/15 MSH100	Delrin	3.7	0.005

2.6. Test Equipment List

This table gives a complete overview of the SAR measurement equipment.

Devices used during the test described are marked ☒

	Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
					Last Cal.	Due Date
☒	MVG	E FIELD PROBE	SSE2	SN 41/18 EPG0330	May 21, 2019	May 20, 2020
☐	MVG	750 MHz Dipole	SID750	SN 03/15 DIP 0G750-355	Apr. 19, 2018	Apr. 18, 2021
☒	MVG	835 MHz Dipole	SID835	SN 03/15 DIP 0G835-347	Apr. 19, 2018	Apr. 18, 2021
☐	MVG	900 MHz Dipole	SID900	SN 03/15 DIP 0G900-348	Apr. 19, 2018	Apr. 18, 2021
☐	MVG	1800 MHz Dipole	SID1800	SN 03/15 DIP 1G800-349	Apr. 19, 2018	Apr. 18, 2021
☒	MVG	1900 MHz Dipole	SID1900	SN 03/15 DIP 1G900-350	Apr. 19, 2018	Apr. 18, 2021
☐	MVG	2000 MHz Dipole	SID2000	SN 03/15 DIP 2G000-351	Apr. 19, 2018	Apr. 18, 2021
☒	MVG	2450 MHz Dipole	SID2450	SN 03/15 DIP 2G450-352	Apr. 19, 2018	Apr. 18, 2021
☒	MVG	2600 MHz Dipole	SID2600	SN 03/15 DIP 2G600-356	Apr. 19, 2018	Apr. 18, 2021
☐	MVG	5000 MHz Dipole	SWG5500	SN 13/14 WGA 33	Apr. 19, 2018	Apr. 18, 2021
☒	MVG	Liquid measurement Kit	SCLMP	SN 21/15 OCPG 72	NCR	NCR
☒	MVG	Power Amplifier	N.A	AMPLISAR_28/14_003	NCR	NCR
☒	KEITHLEY	Millivoltmeter	2000	4072790	NCR	NCR
☒	R&S	Universal radio communication tester	CMU200	117858	Aug. 06, 2019	Aug. 05, 2020
☒	R&S	Wideband radio communication tester	CMW500	103917	Aug. 28, 2019	Aug. 27, 2020
☒	HP	Network Analyzer	8753D	3410J01136	Aug. 06, 2019	Aug. 05, 2020
☒	Agilent	PSG Analog Signal Generator	E8257D	MY51110112	Aug. 06, 2019	Aug. 05, 2020

☒	Agilent	Power meter	E4419B	MY45102538	Aug. 06, 2019	Aug. 05, 2020
☒	Agilent	Power sensor	E9301A	MY41495644	Aug. 06, 2019	Aug. 05, 2020
☒	Agilent	Power sensor	E9301A	US39212148	Aug. 06, 2019	Aug. 05, 2020
☒	MCLI/USA	Directional Coupler	CB11-20	0D2L51502	Aug. 06, 2019	Aug. 05, 2020

3. SAR Measurement Procedures

The measurement procedures are as follows:

<Conducted power measurement>

- (a) For WWAN power measurement, use base station simulator to configure EUT WWAN transmission in conducted connection with RF cable, at maximum power in each supported wireless interface and frequency band.
- (b) Read the WWAN RF power level from the base station simulator.
- (c) For WLAN/Bluetooth power measurement, use engineering software to configure EUT WLAN/Bluetooth continuously transmission, at maximum RF power in each supported wireless interface and frequency band.
- (d) Connect EUT RF port through RF cable to the power meter, and measure WLAN/Bluetooth output power.

<SAR measurement>

- (a) Use base station simulator to configure EUT WWAN transmission in radiated connection, and engineering software to configure EUT WLAN/Bluetooth continuously transmission, at maximum RF power, in the highest power channel.
- (b) Place the EUT in the positions as Appendix A demonstrates.
- (c) Set scan area, grid size and other setting on the OPENSAR software.
- (d) Measure SAR results for the highest power channel on each testing position.
- (e) Find out the largest SAR result on these testing positions of each band.
- (f) Measure SAR results for other channels in worst SAR testing position if the reported SAR of highest power channel is larger than 0.8 W/kg.

According to the test standard, the recommended procedure for assessing the peak spatial-average SAR value consists of the following steps:

- (a) Power reference measurement
- (b) Area scan
- (c) Zoom scan
- (d) Power drift measurement

3.1. Power Reference

The Power Reference Measurement and Power Drift Measurements are for monitoring the power drift of the device under test in the batch process. The minimum distance of probe sensors to surface determines the closest measurement point to phantom surface. This distance cannot be smaller than the distance of sensor calibration points to probe tip as defined in the probe properties.

3.2. Area scan & Zoom scan

The area scan is a 2D scan to find the hot spot location on the DUT. The zoom scan is a 3D scan above the hot spot to calculate the 1g and 10g SAR value.

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

From the scanned SAR distribution, identify the position of the maximum SAR value, in addition identify the positions of any local maxima with SAR values within 2 dB of the maximum value that will not be within the zoom scan of other peaks; additional peaks shall be measured only when the primary peak is within 2 dB of the SAR compliance limit (e.g., 1 W/kg for 1,6 W/kg 1 g limit, or 1,26 W/kg for 2 W/kg, 10 g limit).

Area scan & Zoom scan scan parameters extracted from FCC KDB 865664 D01 SAR measurement 100 MHz to 6 GHz.

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

Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details.

* When zoom scan is required and the *reported* SAR from the *area scan based 1-g SAR estimation* procedures of KDB 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.

3.3. 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 a fourth-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 averaged over 10 grams and 1 gram requires a very fine resolution in the three dimensional scanned data array.

3.4. Volumetric Scan

The volumetric scan consists to a full 3D scan over a specific area. This 3D scan is useful form multi Tx SAR measurement. Indeed, it is possible with OpenSAR to add, point by point, several volumetric scan to calculate the SAR value of the combined measurement as it is define in the standard IEEE1528 and IEC62209.

3.5. Power Drift

All SAR testing is under the EUT install full charged battery and transmit maximum output power. In OpenSAR measurement software, the power reference measurement and power drift measurement procedures are used for monitoring the power drift of EUT during SAR test. Both these procedures measure the field at a specified reference position before and after the SAR testing. The software will calculate the field difference in V/m. If the power drifts more than $\pm 5\%$, the SAR will be retested.

4. System Verification Procedure

4.1. Tissue Verification

The following tissue formulations are provided for reference only as some of the parameters have not been thoroughly verified. The composition of ingredients may be modified accordingly to achieve the desired target tissue parameters required for routine SAR evaluation.

Ingredients (% of weight)	Head Tissue									
Frequency Band (MHz)	750	835	900	1800	1900	2000	2450	2600	5200	5800
Water	34.40	34.40	34.40	55.36	55.36	57.87	57.87	57.87	65.53	65.53
NaCl	0.79	0.79	0.79	0.35	0.35	0.16	0.16	0.16	0.00	0.00
1,2-Propanediol	64.81	64.81	64.81	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Triton X-100	0.00	0.00	0.00	30.45	30.45	19.97	19.97	19.97	24.24	24.24
DGBE	0.00	0.00	0.00	13.84	13.84	22.00	22.00	22.00	10.23	10.23
Ingredients (% of weight)	Body Tissue									
Frequency Band (MHz)	750	835	900	1800	1900	2000	2450	2600	5200	5800
Water	50.30	50.30	50.30	69.91	69.91	71.88	71.88	71.88	79.54	79.54
NaCl	0.60	0.60	0.60	0.13	0.13	0.16	0.16	0.16	0.00	0.00
1,2-Propanediol	49.10	49.10	49.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Triton X-100	0.00	0.00	0.00	9.99	9.99	19.97	19.97	19.97	11.24	11.24
DGBE	0.00	0.00	0.00	19.97	19.97	7.99	7.99	7.99	9.22	9.22

For SAR measurement of the field distribution inside the phantom, the phantom must be filled with homogeneous tissue simulating liquid to a depth of at least 15 cm. For head SAR testing, the liquid depth from the ear reference point (ERP) of the phantom to the liquid top surface is larger than 15 cm.

Photo of Liquid depth for Head Position	Photo of Liquid depth for Body Position
	

4.1.1. Tissue Dielectric Parameter Check Results

The simulating liquids should be checked at the beginning of a series of SAR measurements to determine if the dielectric parameters are within the tolerances of the specified target values. The measured conductivity and relative permittivity should be within $\pm 5\%$ of the target values.

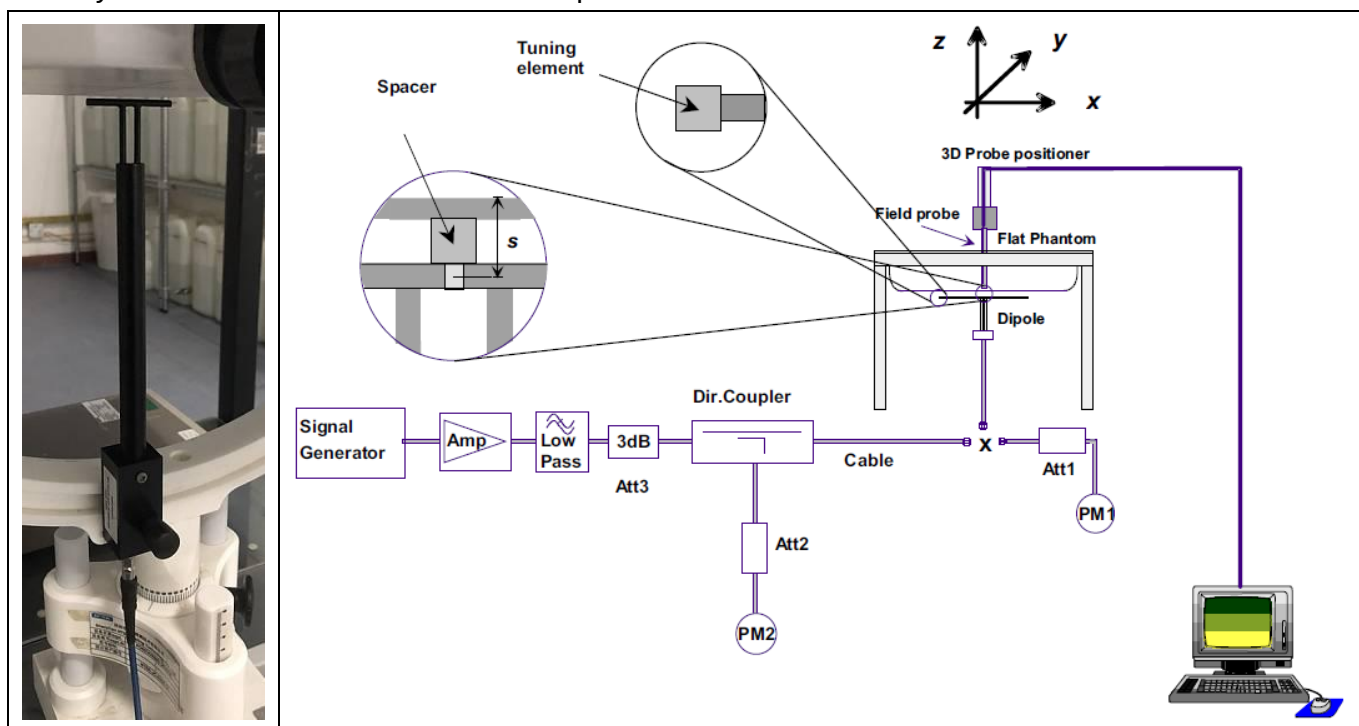
Tissue Type	Measured Frequency (MHz)	Target Tissue		Measured Tissue		Liquid Temp.	Test Date
		$\epsilon_r (\pm 5\%)$	σ (S/m) ($\pm 5\%$)	ϵ_r	σ (S/m)		
Body 850	835	55.20 (52.44~57.96)	0.97 (0.92~1.02)	54.32	1.01	21.3 °C	Mar. 19, 2020
Body 1900	1900	53.30 (50.64~55.97)	1.52 (1.44~1.60)	52.50	1.57	21.4 °C	Mar. 18, 2020
Body 2450	2450	52.70 (50.07~55.34)	1.95 (1.85~2.05)	51.88	2.02	21.5 °C	Mar. 20, 2020
Body 2600	2600	52.51 (49.88~55.14)	2.16 (2.05~2.27)	52.60	2.21	21.2 °C	Mar. 20, 2020

NOTE: The dielectric parameters of the tissue-equivalent liquid should be measured under similar ambient conditions and within 2 °C of the conditions expected during the SAR evaluation to satisfy protocol requirements.

4.2. System Verification Procedure

The system verification is performed for verifying the accuracy of the complete measurement system and performance of the software. 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 100mW (below 5GHz) or 100mW (above 5GHz). To adjust this power a power meter is used. The power sensor is connected to the cable before the system verification 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 system verification 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).

The system verification is shown as below picture:



4.2.1. System Verification Results

Comparing to the original SAR value provided by SATIMO, the verification data should be within its specification of $\pm 10\%$. Below table shows the target SAR and measured SAR after normalized to 1W input power. The table below indicates the system performance verification can meet the variation criterion and the plots can be referred to Appendix B of this report.

System Verification	Target SAR (1W) ($\pm 10\%$)		Measured SAR (Normalized to 1W)		Liquid Temp.	Test Date
	1-g (W/Kg)	10-g (W/Kg)	1-g (W/Kg)	10-g (W/Kg)		
835MHz Body	9.83 (8.85~10.81)	6.45 (5.81~7.10)	9.50	6.72	21.3 °C	Mar. 19, 2020
1900MHz Body	39.02 (35.12~42.92)	20.57 (18.51~22.63)	39.22	21.89	21.4 °C	Mar. 18, 2020
2450MHz Body	52.90 (47.61~58.19)	24.09 (21.68~26.50)	50.28	22.98	21.5 °C	Mar. 20, 2020
2600MHz Body	52.49 (47.24~57.74)	23.74 (21.37~26.11)	52.00	23.39	21.2 °C	Mar. 20, 2020

5. SAR Measurement variability and uncertainty

5.1. SAR measurement variability

Per KDB865664 D01 SAR measurement 100 MHz to 6 GHz, SAR measurement variability must be assessed for each frequency band, which is determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements. The additional measurements are repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device should be returned to ambient conditions (normal room temperature) with the battery fully charged before it is re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

- 1) Repeated measurement is not required when the original highest measured SAR is < 0.80 W/kg; steps 2) through 4) do not apply.
- 2) When the original highest measured SAR is ≥ 0.80 W/kg, repeat that measurement once.
- 3) Perform a second repeated measurement only if the ratio of largest to smallest SAR for the original and first repeated measurements is > 1.20 or when the original or repeated measurement is ≥ 1.45 W/kg ($\sim 10\%$ from the 1-g SAR limit).
- 4) Perform a third repeated measurement only if the original, first or second repeated measurement is ≥ 1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20 .

5.2. SAR measurement uncertainty

Per KDB865664 D01 SAR Measurement 100 MHz to 6 GHz, when the highest measured 1-g SAR within a frequency band is < 1.5 W/kg, the extensive SAR measurement uncertainty analysis described in IEEE Std 1528-2013 is not required in SAR reports submitted for equipment approval. The equivalent ratio (1.5/1.6) is applied to extremity and occupational exposure conditions.

6. RF Exposure Positions

6.1. Tablet host platform exposure conditions

Refer to KDB616217 D04, when the modular approach is used, transmitters and modules must be initially tested for standalone operations in generic host conditions according to the following minimum test separation distance and antenna installation requirements for incorporation in the tablet platform. The separation distance required for incorporation in qualified hosts is described in KDB 447498; item 5) of section 4.1 and item 1) of section 5.2.2 etc.

- ≤ 5 mm between the antenna and user for both back surface and edge exposure conditions
- the antennas used by the host must have been tested for equipment approval or qualify for SAR test exclusion
- the antenna polarization, physical orientation, rotation and installation configurations used by the host must have been tested for compliance or qualify for test exclusion
- when the *SAR Test Exclusion Threshold* in KDB 447498 applies, a *test separation distance* of 5 mm is required to determine test exclusion for the tablet platform

The antennas embedded in tablets are typically ≤ 5 mm from the outer housing. The required antenna to user test separation distance is a “not to exceed test” distance required to apply the modular approach. Instead of the typical zero gap tablet edge test requirement between the edge of a tablet and the user, when an antenna has been tested at ≤ 5 mm according to the modular approach it can be incorporated into tablets with at least twice the tested distance from the outer housing of the tablet edge; otherwise, the tablet edge zero gap test requirement applies. When the dedicated host approach is applied, the back surface and edges of the tablet should be tested for SAR compliance with the tablet touching the phantom.

7. RF Output Power

7.1. GSM Conducted Power

Band GSM850	Burst-Averaged output Power (dBm)				Frame-Averaged output Power (dBm)			
Tx Channel	Tune-up	128	189	251	Tune-up	128	189	251
Frequency (MHz)	(dBm)	824.2	836.4	848.8	(dBm)	824.2	836.4	848.8
GSM (GMSK)	34.00	33.20	33.26	33.20	24.97	24.17	24.23	24.17
GPRS(GMSK, 1 TS)	34.00	33.26	33.30	33.29	24.97	24.23	24.27	24.26
GPRS(GMSK, 2 TS)	33.00	32.65	32.61	32.69	26.98	26.63	26.59	26.67
GPRS(GMSK, 3 TS)	31.00	30.76	30.68	30.93	26.74	26.50	26.42	26.67
GPRS(GMSK, 4 TS)	30.00	29.35	29.24	29.53	26.99	26.34	26.23	26.52
Band GSM1900	Burst-Averaged output Power (dBm)				Frame-Averaged output Power (dBm)			
Tx Channel	Tune-up	512	661	810	Tune-up	512	661	810
Frequency (MHz)	(dBm)	1850.2	1880.0	1909.8	(dBm)	1850.2	1880.0	1909.8
GSM (GMSK)	31.00	30.66	30.56	30.23	21.97	21.63	21.53	21.20
GPRS(GMSK, 1 TS)	31.00	30.67	30.54	30.22	21.97	21.64	21.51	21.19
GPRS(GMSK, 2 TS)	31.00	30.05	29.97	29.72	24.98	24.03	23.95	23.70
GPRS(GMSK, 3 TS)	29.00	27.85	28.04	28.01	24.74	23.59	23.78	23.75
GPRS(GMSK, 4 TS)	27.00	26.55	26.77	26.78	23.99	23.54	23.76	23.77

Note: The frame-averaged power is linearly scaled the maximum burst averaged power over 8 time slots.

The calculated method are shown as below:

Frame-averaged power = Maximum burst averaged power (1 TS) - 9.03 dB

Frame-averaged power = Maximum burst averaged power (2 TS) - 6.02 dB

Frame-averaged power = Maximum burst averaged power (3 TS) - 4.26 dB

Frame-averaged power = Maximum burst averaged power (4 TS) - 3.01 dB

7.2. WCDMA Conducted Power

Band	WCDMA Band 2			
Tx Channel	Tune-up	9262	9400	9538
Frequency (MHz)		1852.4	1880	1907.6
RMC 12.2Kbps	24.00	23.66	23.53	23.28
HSDPA Subtest-1	23.00	22.72	22.58	22.52
HSDPA Subtest-2	22.00	21.60	21.85	21.59
HSDPA Subtest-3	22.00	21.01	21.11	21.11
HSDPA Subtest-4	21.00	20.84	20.87	20.99
HSUPA Subtest-1	23.00	22.09	22.08	22.07
HSUPA Subtest-2	23.00	22.65	22.43	22.38
HSUPA Subtest-3	22.00	21.58	21.29	21.25

HSUPA Subtest-4	23.00	22.72	22.56	22.51
HSUPA Subtest-5	22.00	21.57	21.77	21.56
Band	WCDMA Band 5			
Tx Channel	Tune-up	4132	4182	4233
Frequency (MHz)		826.4	836.4	846.6
RMC 12.2Kbps	24.00	23.03	23.10	22.93
HSDPA Subtest-1	23.00	22.14	22.22	22.09
HSDPA Subtest-2	22.00	21.53	21.55	21.54
HSDPA Subtest-3	21.00	20.40	20.94	20.30
HSDPA Subtest-4	21.00	20.32	20.68	20.59
HSUPA Subtest-1	22.00	21.87	21.87	21.68
HSUPA Subtest-2	23.00	22.08	22.04	21.88
HSUPA Subtest-3	21.00	20.67	20.96	21.00
HSUPA Subtest-4	23.00	22.10	22.23	22.08
HSUPA Subtest-5	22.00	21.42	21.30	21.16

7.3. LTE Conducted Power

Band	Band Width	Modulation	RB Configuration		Tune-up	Channel/Frequency(MHz)		
			RB Size	RB Offset		18607/1850.7	18900/1880	19193/1909.3
LTE Band 2	1.4MHz	QPSK	1	0	24.00	23.62	23.44	23.54
			1	2	24.00	23.74	23.59	23.67
			1	5	24.00	23.62	23.41	23.55
			3	0	24.00	23.58	23.46	23.41
			3	1	24.00	23.60	23.48	23.44
			3	2	24.00	23.58	23.49	23.41
		16QAM	6	0	23.00	22.67	22.51	22.62
			1	0	23.00	22.58	22.52	22.13
			1	2	23.00	22.67	22.62	22.28
			1	5	23.00	22.57	22.50	22.12
			3	0	23.00	22.69	22.63	22.45
			3	1	23.00	22.68	22.64	22.47
			3	2	23.00	22.66	22.62	22.49
			6	0	22.00	21.71	21.55	21.60
Band	Band Width	Modulation	RB Configuration		Tune-up	Channel/Frequency(MHz)		
			RB Size	RB Offset		18615/1851.5	18900/1880	19185/1908.5

LTE Band 2	3MHz	QPSK	1	0	24.00	23.73	23.52	23.55
			1	7	24.00	23.98	23.86	23.94
			1	14	24.00	23.67	23.51	23.65
			8	0	23.00	22.65	22.52	22.55
			8	4	23.00	22.70	22.58	22.60
			8	7	23.00	22.65	22.50	22.57
			15	0	23.00	22.59	22.47	22.47
		16QAM	1	0	24.00	22.88	22.59	22.19
			1	7	24.00	23.07	22.87	22.46
			1	14	24.00	22.81	22.54	22.25
			8	0	22.00	21.58	21.49	21.38
			8	4	22.00	21.61	21.45	21.44
			8	7	22.00	21.58	21.41	21.42
			15	0	22.00	21.55	21.36	21.43
Band	Band Width	Modulation	RB Configuration		Tune-up	Channel/Frequency(MHz)		
			RB Size	RB Offset		18625/1852.5	18900/1880	19175/1907.5
LTE Band 2	5MHz	QPSK	1	0	24.00	23.58	23.45	23.36
			1	12	24.00	24.00	23.81	23.66
			1	24	24.00	23.50	23.42	23.51
			12	0	23.00	22.57	22.46	22.44
			12	6	23.00	22.65	22.52	22.49
			12	11	23.00	22.58	22.48	22.43
			25	0	23.00	22.63	22.46	22.43
		16QAM	1	0	24.00	22.92	22.62	22.47
			1	12	24.00	23.10	22.91	22.92
			1	24	24.00	22.84	22.57	22.52
			12	0	22.00	21.55	21.39	21.40
			12	6	22.00	21.59	21.44	21.48
			12	11	22.00	21.51	21.38	21.44
			25	0	22.00	21.50	21.46	21.34
Band	Band Width	Modulation	RB Configuration		Tune-up	Channel/Frequency(MHz)		
			RB Size	RB Offset		18650/1855	18900/1880	19150/1905
LTE Band 2	10MHz	QPSK	1	0	24.00	23.73	23.56	23.43
			1	24	24.00	23.38	23.64	23.56
			1	49	24.00	23.55	23.51	23.55
			25	0	23.00	22.57	22.53	22.48

			25	12	23.00	22.54	22.48	22.43
			25	24	23.00	22.58	22.46	22.46
			50	0	23.00	22.56	22.48	22.46
		16QAM	1	0	23.00	22.65	22.27	22.68
			1	24	23.00	22.70	22.37	22.77
			1	49	23.00	22.54	22.18	22.67
			25	0	22.00	21.51	21.47	21.42
			25	12	22.00	21.47	21.43	21.40
			25	24	22.00	21.50	21.42	21.42
			50	0	22.00	21.52	21.41	21.42
Band	Band Width	Modulation	RB Configuration		Tune-up	Channel/Frequency(MHz)		
			RB Size	RB Offset		18675/1857.5	18900/1880	19125/1902.5
LTE Band 2	15MHz	QPSK	1	0	24.00	23.56	23.42	23.32
			1	37	24.00	23.78	23.71	23.67
			1	74	24.00	23.32	23.35	23.43
			36	0	23.00	22.67	22.63	22.62
			36	18	23.00	22.68	22.63	22.56
			36	37	23.00	22.57	22.58	22.59
			75	0	23.00	22.68	22.63	22.64
		16QAM	1	0	23.00	22.81	22.50	22.37
			1	37	23.00	22.97	22.80	22.75
			1	74	23.00	22.71	22.34	22.38
			36	0	22.00	21.61	21.62	21.46
			36	18	22.00	21.62	21.59	21.40
			36	37	22.00	21.56	21.55	21.44
			75	0	22.00	21.52	21.51	21.53
Band	Band Width	Modulation	RB Configuration		Tune-up	Channel/Frequency(MHz)		
			RB Size	RB Offset		18700/1860	18900/1880	19100/1900
LTE Band 2	20MHz	QPSK	1	0	24.00	23.40	23.26	23.26
			1	49	24.00	23.65	23.67	23.66
			1	99	24.00	23.21	23.12	23.41
			50	0	23.00	22.39	22.53	22.49
			50	24	23.00	22.48	22.49	22.45
			50	49	23.00	22.37	22.48	22.45
			100	0	23.00	22.42	22.50	22.48
		16QAM	1	0	23.00	22.61	22.41	22.33

			1	49	23.00	22.84	22.73	22.68
			1	99	23.00	22.46	22.25	22.32
			50	0	22.00	21.44	21.47	21.51
			50	24	22.00	21.52	21.45	21.46
			50	49	22.00	21.42	21.38	21.41
			100	0	22.00	21.39	21.45	21.44

Band	Band Width	Modulation	RB Configuration		Tune-up	Channel/Frequency(MHz)		
			RB Size	RB Offset		20407/824.7	20525/836.5	20643/848.3
LTE Band 5	1.4MHz	QPSK	1	0	24.00	23.22	23.41	23.03
			1	2	24.00	23.30	23.55	23.17
			1	5	24.00	23.22	23.41	23.02
			3	0	24.00	23.11	23.36	23.14
			3	1	24.00	23.13	23.34	23.13
			3	2	24.00	23.08	23.31	23.08
			6	0	23.00	22.29	22.33	22.05
		16QAM	1	0	23.00	21.86	22.31	22.16
			1	2	23.00	22.01	22.43	22.27
			1	5	23.00	21.88	22.29	22.16
			3	0	23.00	22.16	22.42	22.29
			3	1	23.00	22.18	22.43	22.28
			3	2	23.00	22.18	22.38	22.28
			6	0	22.00	21.35	21.49	21.25

Band	Band Width	Modulation	RB Configuration		Tune-up	Channel/Frequency(MHz)		
			RB Size	RB Offset		20415/825.5	20525/836.5	20635/847.5
LTE Band 5	3MHz	QPSK	1	0	24.00	23.26	23.38	23.19
			1	7	24.00	23.57	23.58	23.47
			1	14	24.00	23.25	23.40	23.15
			8	0	23.00	22.22	22.37	22.15
			8	4	23.00	22.23	22.43	22.18
			8	7	23.00	22.28	22.42	22.13
			15	0	23.00	22.16	22.35	22.15
		16QAM	1	0	23.00	22.43	22.45	21.99
			1	7	23.00	22.75	22.81	22.09
			1	14	23.00	22.46	22.45	21.87
			8	0	22.00	21.21	21.38	21.15

			8	4	22.00	21.23	21.42	21.17
			8	7	22.00	21.25	21.44	21.14
			15	0	22.00	21.20	21.34	21.26
Band	Band Width	Modulation	RB Configuration		Tune-up	Channel/Frequency(MHz)		
			RB Size	RB Offset		20425/826.5	20525/836.5	20625/846.5
LTE Band 5	5MHz	QPSK	1	0	24.00	23.15	23.28	23.18
			1	12	24.00	23.59	23.71	23.54
			1	24	24.00	23.23	23.27	23.08
			12	0	23.00	22.14	22.29	22.15
			12	6	23.00	22.26	22.39	22.15
			12	11	23.00	22.16	22.38	22.10
			25	0	23.00	22.19	22.37	22.17
		16QAM	1	0	24.00	22.27	22.46	22.56
			1	12	24.00	22.53	22.84	23.03
			1	24	24.00	22.40	22.46	22.46
			12	0	22.00	21.12	21.39	21.25
			12	6	22.00	21.28	21.47	21.24
			12	11	22.00	21.16	21.45	21.17
			25	0	22.00	21.23	21.37	21.21
Band	Band Width	Modulation	RB Configuration		Tune-up	Channel/Frequency(MHz)		
			RB Size	RB Offset		20450/829	20525/836.5	20600/844
LTE Band 5	10MHz	QPSK	1	0	24.00	23.19	23.33	23.36
			1	24	24.00	23.43	23.53	23.38
			1	49	24.00	23.34	23.28	23.12
			25	0	23.00	22.26	22.35	22.35
			25	12	23.00	22.29	22.39	22.25
			25	24	23.00	22.29	22.41	22.16
			50	0	23.00	22.31	22.36	22.29
		16QAM	1	0	23.00	22.42	22.43	22.08
			1	24	23.00	22.68	22.54	22.11
			1	49	23.00	22.66	22.37	21.89
			25	0	22.00	21.30	21.37	21.40
			25	12	22.00	21.35	21.37	21.26
			25	24	22.00	21.38	21.45	21.22
			50	0	22.00	21.40	21.44	21.29

Band	Band Width	Modulation	RB Configuration		Tune-up	Channel/Frequency(MHz)		
			RB Size	RB Offset		20775/2502.5	21100/2535	21425/2567.5
LTE Band 7	5MHz	QPSK	1	0	25.00	24.32	24.00	23.99
			1	12	25.00	24.58	24.40	24.41
			1	24	25.00	24.29	23.99	24.07
			12	0	24.00	23.28	23.09	22.94
			12	6	24.00	23.35	23.09	23.05
			12	11	24.00	23.28	23.01	22.97
			25	0	24.00	23.32	23.06	22.99
		16QAM	1	0	25.00	23.59	23.20	23.10
			1	12	25.00	24.04	23.56	23.50
			1	24	25.00	23.59	23.21	23.04
			12	0	23.00	22.28	21.99	22.02
			12	6	23.00	22.34	22.06	22.04
			12	11	23.00	22.27	21.93	21.96
			25	0	23.00	22.25	22.07	21.92
Band	Band Width	Modulation	RB Configuration		Tune-up	Channel/Frequency(MHz)		
			RB Size	RB Offset		20800/2505	21100/2535	21400/2565
LTE Band 7	10MHz	QPSK	1	0	25.00	24.34	24.08	24.06
			1	24	25.00	24.45	24.21	24.24
			1	49	25.00	24.29	24.05	24.12
			25	0	24.00	23.28	23.09	23.02
			25	12	24.00	23.33	23.08	23.02
			25	24	24.00	23.40	23.09	23.00
			50	0	24.00	23.35	23.08	22.97
		16QAM	1	0	24.00	23.56	23.11	22.76
			1	24	24.00	23.70	23.26	22.88
			1	49	24.00	23.55	23.13	22.74
			25	0	23.00	22.25	22.08	21.99
			25	12	23.00	22.29	22.03	21.99
			25	24	23.00	22.38	22.05	21.95
			50	0	23.00	22.33	22.11	21.95
Band	Band Width	Modulation	RB Configuration		Tune-up	Channel/Frequency(MHz)		
			RB Size	RB Offset		20825/2507.5	21100/2535	21375/2562.5

LTE Band 7	15MHz	QPSK	1	0	25.00	24.32	24.07	23.96
			1	37	25.00	24.62	24.31	24.29
			1	74	25.00	24.15	23.95	24.02
			36	0	24.00	23.41	23.21	23.15
			36	18	24.00	23.46	23.16	23.19
			36	37	24.00	23.47	23.13	23.15
			75	0	24.00	23.46	23.21	23.18
		16QAM	1	0	24.00	23.54	23.11	22.95
			1	37	24.00	23.79	23.46	23.38
			1	74	24.00	23.43	23.04	22.94
			36	0	23.00	22.34	22.18	22.01
			36	18	23.00	22.38	22.16	22.04
			36	37	23.00	22.41	22.10	22.01
			75	0	23.00	22.39	22.10	22.09
Band	Band Width	Modulation	RB Configuration		Tune-up	Channel/Frequency(MHz)		
			RB Size	RB Offset		20850/2510	21100/2535	21350/2560
LTE Band 7	20MHz	QPSK	1	0	25.00	24.20	23.91	23.79
			1	49	25.00	24.49	24.19	24.19
			1	99	25.00	24.03	23.91	23.86
			50	0	24.00	23.24	23.20	23.03
			50	24	24.00	23.33	23.09	23.07
			50	49	24.00	23.41	23.10	23.04
			100	0	24.00	23.29	23.09	22.98
		16QAM	1	0	24.00	23.21	23.08	22.92
			1	49	24.00	23.53	23.41	23.22
			1	99	24.00	23.12	23.02	22.83
			50	0	23.00	22.24	22.17	21.97
			50	24	23.00	22.32	22.11	21.98
			50	49	23.00	22.39	22.09	21.99
			100	0	23.00	22.30	22.13	21.99

7.4. WLAN & Bluetooth Output Power

7.4.1. Output Power Results Of WLAN

Mode	Channel	Frequency (MHz)	Tune-up	Output Power (dBm)
802.11b	1	2412	13.50	12.55
	6	2437	13.50	12.93

	11	2462	13.50	13.43
802.11g	1	2412	11.00	10.08
	6	2437	11.00	10.64
	11	2462	11.00	10.87
802.11n HT20	1	2412	12.00	10.29
	6	2437	12.00	10.79
	11	2462	12.00	11.21
802.11n HT40	3	2422	12.00	11.18
	6	2437	12.00	10.80
	9	2452	12.00	10.49

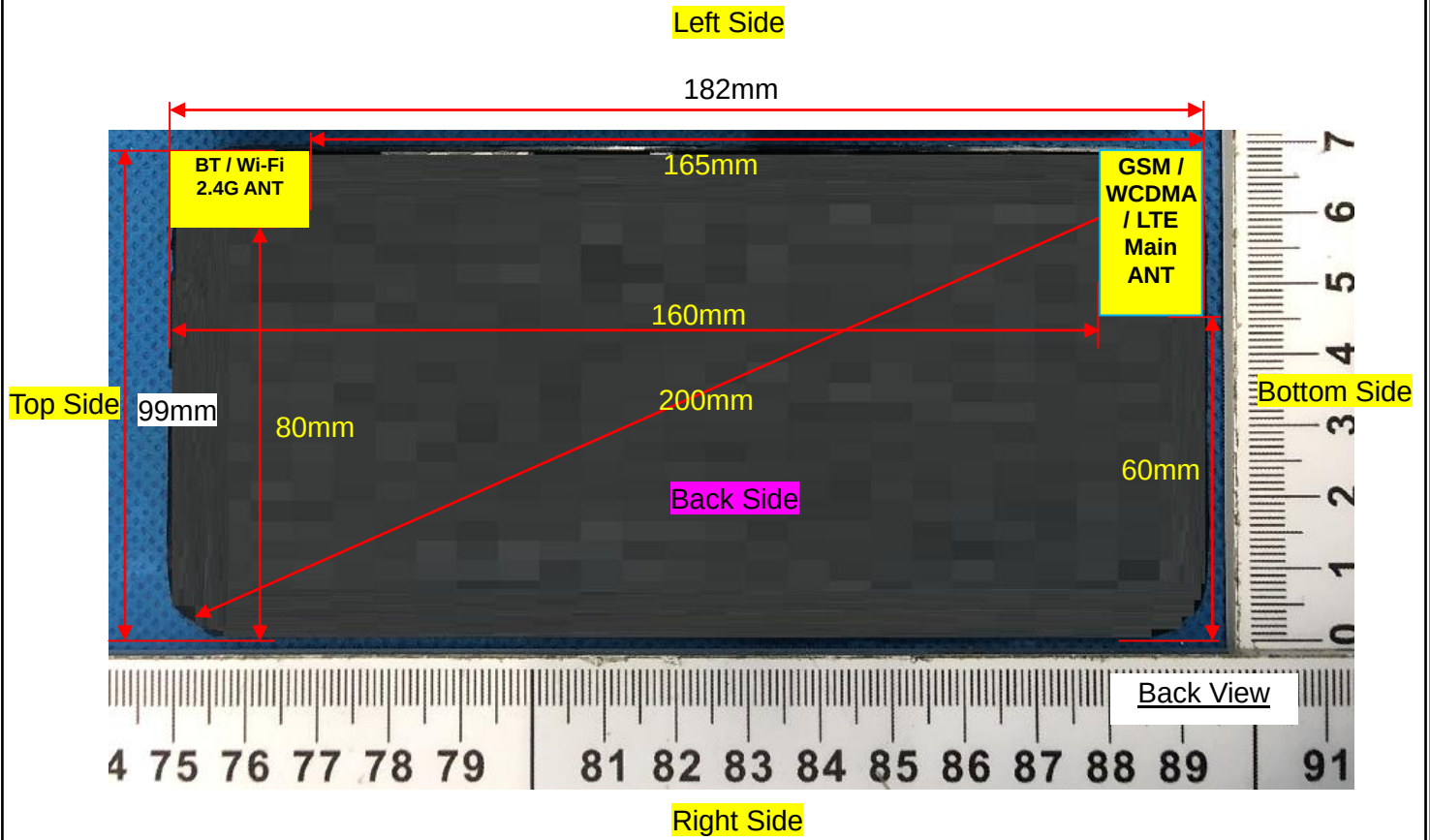
NOTE: Power measurement results of WLAN 2.4G.

7.4.2. Output Power Results Of Bluetooth

BR+EDR	Output Power (dBm)				
	Channel	Tune-up	Data Rates		
			1M	2M	3M
	0CH	5.00	4.45	3.80	4.26
	39CH	6.00	5.06	5.26	5.21
	78CH	4.00	3.91	3.22	3.07

BLE	Channel	Tune-up	Output Power (dBm)
	0CH	5.00	4.38
	19CH	6.00	5.03
	39CH	4.00	3.90

8. Antenna Location



Distance of the Antenna to the EUT surface/edge						
Antennas	Front Side	Back Side	Left Side	Right Side	Top Side	Bottom Side
WWAN Main	5mm	5mm	5mm	60mm	160mm	5mm
WLAN & Bluetooth	5mm	5mm	5mm	80mm	5mm	165mm

Positions for SAR tests		
Test separation distances ≤ 50 mm		
Exposure Positions	Tune-up Maximum power of WLAN 2.4G	
	13.5dBm	
Front Side	Antenna to user(mm)	5
	SAR exclusion threshold	7.0
	SAR testing required?	YES
Back Side	Antenna to user(mm)	5
	SAR exclusion threshold	7.0
	SAR testing required?	YES
Left Side	Antenna to user(mm)	5
	SAR exclusion threshold	7.0
	SAR testing required?	YES
Top Side	Antenna to user(mm)	5
	SAR exclusion threshold	7.0
	SAR testing required?	YES
Exposure Positions	Tune-up Maximum power of GSM850	
	34dBm	
Front Side	Antenna to user(mm)	5
	SAR exclusion threshold	462.8
	SAR testing required?	YES
Back Side	Antenna to user(mm)	5
	SAR exclusion threshold	462.8
	SAR testing required?	YES
Left Side	Antenna to user(mm)	5
	SAR exclusion threshold	462.8
	SAR testing required?	YES
Bottom Side	Antenna to user(mm)	5
	SAR exclusion threshold	462.8
	SAR testing required?	YES
Exposure Positions	Tune-up Maximum power of GSM1900	
	31dBm	
Front Side	Antenna to user(mm)	5
	SAR exclusion threshold	348.0
	SAR testing required?	YES
Back Side	Antenna to user(mm)	5
	SAR exclusion threshold	348.0
	SAR testing required?	YES
Left Side	Antenna to user(mm)	5

	SAR exclusion threshold	348.0
	SAR testing required?	YES
Bottom Side	Antenna to user(mm)	5
	SAR exclusion threshold	348.0
	SAR testing required?	YES
Exposure Positions	Tune-up Maximum power of WCDMA Band 2	
	24dBm	
Front Side	Antenna to user(mm)	5
	SAR exclusion threshold	69.4
	SAR testing required?	YES
Back Side	Antenna to user(mm)	5
	SAR exclusion threshold	69.4
	SAR testing required?	YES
Left Side	Antenna to user(mm)	5
	SAR exclusion threshold	69.4
	SAR testing required?	YES
Bottom Side	Antenna to user(mm)	5
	SAR exclusion threshold	69.4
	SAR testing required?	YES
Exposure Positions	Tune-up Maximum power of WCDMA Band 5	
	24dBm	
Front Side	Antenna to user(mm)	5
	SAR exclusion threshold	46.2
	SAR testing required?	YES
Back Side	Antenna to user(mm)	5
	SAR exclusion threshold	46.2
	SAR testing required?	YES
Left Side	Antenna to user(mm)	5
	SAR exclusion threshold	46.2
	SAR testing required?	YES
Bottom Side	Antenna to user(mm)	5
	SAR exclusion threshold	46.2
	SAR testing required?	YES
Exposure Positions	Tune-up Maximum power of LTE Band 2	
	24dBm	
Front Side	Antenna to user(mm)	5
	SAR exclusion threshold	69.4
	SAR testing required?	YES
Back Side	Antenna to user(mm)	5
	SAR exclusion threshold	69.4

	SAR testing required?	YES
Left Side	Antenna to user(mm)	5
	SAR exclusion threshold	69.4
	SAR testing required?	YES
Bottom Side	Antenna to user(mm)	5
	SAR exclusion threshold	69.4
	SAR testing required?	YES
Exposure Positions	Tune-up Maximum power of LTE Band 5	
	24dBm	
Front Side	Antenna to user(mm)	5
	SAR exclusion threshold	46.3
	SAR testing required?	YES
Back Side	Antenna to user(mm)	5
	SAR exclusion threshold	46.3
	SAR testing required?	YES
Left Side	Antenna to user(mm)	5
	SAR exclusion threshold	46.3
	SAR testing required?	YES
Bottom Side	Antenna to user(mm)	5
	SAR exclusion threshold	46.3
	SAR testing required?	YES
Exposure Positions	Tune-up Maximum power of LTE Band 7	
	25dBm	
Front Side	Antenna to user(mm)	5
	SAR exclusion threshold	101.3
	SAR testing required?	YES
Back Side	Antenna to user(mm)	5
	SAR exclusion threshold	101.3
	SAR testing required?	YES
Left Side	Antenna to user(mm)	5
	SAR exclusion threshold	101.3
	SAR testing required?	YES
Bottom Side	Antenna to user(mm)	5
	SAR exclusion threshold	101.3
	SAR testing required?	YES

NOTE: Refer to section 4.3.1 of KDB 447498 D01.

Positions for SAR tests		
Test separation distances > 50 mm		
Exposure Positions	Tune-up Maximum power of WLAN 2.4G	
	13.5dBm	22.4mW
Right Side	Antenna to user(mm)	80
	SAR exclusion threshold(mW)	396
	SAR testing required?	NO
Bottom Side	Antenna to user(mm)	165
	SAR exclusion threshold(mW)	1246
	SAR testing required?	NO
Exposure Positions	Tune-up Maximum power of GSM850	
	34dBm	2511.9mW
Right Side	Antenna to user(mm)	60
	SAR exclusion threshold(mW)	220
	SAR testing required?	YES
Top Side	Antenna to user(mm)	160
	SAR exclusion threshold(mW)	776
	SAR testing required?	YES
Exposure Positions	Tune-up Maximum power of GSM1900	
	31dBm	1258.9mW
Right Side	Antenna to user(mm)	60
	SAR exclusion threshold(mW)	209
	SAR testing required?	YES
Top Side	Antenna to user(mm)	160
	SAR exclusion threshold(mW)	1209
	SAR testing required?	YES
Exposure Positions	Tune-up Maximum power of WCDMA Band 2	
	24dBm	251.2mW
Right Side	Antenna to user(mm)	60
	SAR exclusion threshold(mW)	209
	SAR testing required?	YES
Top Side	Antenna to user(mm)	160
	SAR exclusion threshold(mW)	1209
	SAR testing required?	NO
Exposure Positions	Tune-up Maximum power of WCDMA Band 5	
	24dBm	251.2mW
Right Side	Antenna to user(mm)	60
	SAR exclusion threshold(mW)	220
	SAR testing required?	YES

Top Side	Antenna to user(mm)	160
	SAR exclusion threshold(mW)	776
	SAR testing required?	NO
Exposure Positions	Tune-up Maximum power of LTE Band 2	
	24dBm	251.2mW
Right Side	Antenna to user(mm)	60
	SAR exclusion threshold(mW)	209
	SAR testing required?	YES
Top Side	Antenna to user(mm)	160
	SAR exclusion threshold(mW)	1209
	SAR testing required?	NO
Exposure Positions	Tune-up Maximum power of LTE Band 5	
	24dBm	251.2mW
Right Side	Antenna to user(mm)	60
	SAR exclusion threshold(mW)	220
	SAR testing required?	YES
Top Side	Antenna to user(mm)	160
	SAR exclusion threshold(mW)	776
	SAR testing required?	NO
Exposure Positions	Tune-up Maximum power of LTE Band 7	
	25dBm	316.2mW
Right Side	Antenna to user(mm)	60
	SAR exclusion threshold(mW)	196
	SAR testing required?	YES
Top Side	Antenna to user(mm)	160
	SAR exclusion threshold(mW)	1196
	SAR testing required?	NO

NOTE: Refer to section 4.3.1 of KDB 447498 D01.

9. Stand-alone SAR test exclusion

Refer to FCC KDB 447498D01, the 1-g SAR and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:

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

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

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

Mode	P_{max} (dBm)	P_{max} (mW)	Distance (mm)	f (GHz)	Calculation Result	SAR Exclusion threshold	SAR test exclusion
Bluetooth	6.00	3.98	5	2.480	1.25	3.0	Yes

NOTE: Standalone SAR test exclusion for Bluetooth

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

$[(\text{max. power of channel, including tune-up tolerance, mW})/(\text{min. test separation distance, mm})] \cdot [\sqrt{f_{(\text{GHz})}}/x] \text{ W/kg}$ for test separation distances $\leq 50\text{mm}$, where $x = 7.5$ for 1-g SAR and $x = 18.75$ for 10-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	P_{max} (dBm)	P_{max} (mW)	Distance (mm)	f (GHz)	x	Estimated SAR (W/Kg)
Bluetooth	Body	6.00	3.98	5	2.480	7.5	0.167

NOTE: Estimated SAR calculation for Bluetooth.

10. SAR Results

10.1. SAR measurement results

10.1.1. SAR measurement Result of GSM850

Test Position of Body with 0mm	Test channel /Freq.	Test Mode	SAR Value (W/kg)		Power Drift (±5%)	Conducted power (dBm)	Tune-up power (dBm)	Scaled SAR 1g (W/Kg)
			1g	10g				
Front Side	189/836.4	GPRS(GMSK 4TS)	0.938	0.555	-3.13	29.24	30.00	1.117
Back Side	189/836.4	GPRS(GMSK 4TS)	0.656	0.353	-4.94	29.24	30.00	0.781
Left Side	189/836.4	GPRS(GMSK 4TS)	0.349	0.105	4.70	29.24	30.00	0.416
Right Side	189/836.4	GPRS(GMSK 4TS)	0.194	0.065	-3.21	29.24	30.00	0.231
Top Side	189/836.4	GPRS(GMSK 4TS)	0.014	0.009	-3.21	29.24	30.00	0.017
Bottom Side	189/836.4	GPRS(GMSK 4TS)	0.361	0.193	1.51	29.24	30.00	0.430
Front Side	128/824.2	GPRS(GMSK 4TS)	1.032	0.656	-0.58	29.35	30.00	1.199
Front Side Repeated	128/824.2	GPRS(GMSK 4TS)	1.014	0.636	-4.38	29.35	30.00	1.178
Front Side	251/848.8	GPRS(GMSK 4TS)	0.862	0.462	4.78	29.53	30.00	0.961

NOTE: Body SAR test results of GSM850

10.1.2. SAR measurement Result of GSM1900

Test Position of Body with 0mm	Test channel /Freq.	Test Mode	SAR Value (W/kg)		Power Drift (±5%)	Conducted power (dBm)	Tune-up power (dBm)	Scaled SAR 1g (W/Kg)
			1g	10g				
Back Side	661/1880	GPRS(GMSK 2TS)	0.066	0.036	-3.67	29.97	31.00	0.084
Front Side	661/1880	GPRS(GMSK 2TS)	0.082	0.047	-2.76	29.97	31.00	0.104
Left Side	661/1880	GPRS(GMSK 2TS)	0.065	0.042	-2.60	29.97	31.00	0.082
Right Side	661/1880	GPRS(GMSK 2TS)	0.037	0.022	-0.97	29.97	31.00	0.047

Top Side	661/1880	GPRS(GMSK 2TS)	0.013	0.009	0.13	29.97	31.00	0.016
Bottom Side	661/1880	GPRS(GMSK 2TS)	0.030	0.016	-3.99	29.97	31.00	0.038

NOTE: Body SAR test results of GSM1900

10.1.3. SAR measurement Result of WCDMA Band 2

Test Position of Body with 0mm	Test channel /Freq.	Test Mode	SAR Value (W/kg)		Power Drift (±5%)	Conducted power (dBm)	Tune-up power (dBm)	Scaled SAR 1g (W/Kg)
			1g	10g				
Front Side	9400/1880	RMC12.2K	1.072	0.604	-1.06	23.53	24.00	1.195
Front Side Repeated	9400/1880	RMC12.2K	1.055	0.588	3.33	23.53	24.00	1.176
Back Side	9400/1880	RMC12.2K	0.646	0.319	1.60	23.53	24.00	0.720
Left Side	9400/1880	RMC12.2K	0.676	0.327	1.04	23.53	24.00	0.753
Right Side	9400/1880	RMC12.2K	0.194	0.091	-4.13	23.53	24.00	0.216
Bottom Side	9400/1880	RMC12.2K	0.313	0.155	2.64	23.53	24.00	0.349
Front Side	9262/1852.4	RMC12.2K	0.944	0.529	-1.71	23.66	24.00	1.021
Front Side	9538/1907.6	RMC12.2K	0.943	0.528	4.15	23.28	24.00	1.113

NOTE: Body SAR test results of WCDMA Band 2

10.1.4. SAR measurement Result of WCDMA Band 5

Test Position of Body with 0mm	Test channel /Freq.	Test Mode	SAR Value (W/kg)		Power Drift (±5%)	Conducted power (dBm)	Tune-up power (dBm)	Scaled SAR 1g (W/Kg)
			1g	10g				
Front Side	4182/836.4	RMC12.2K	0.928	0.609	-2.49	23.50	24.00	1.041
Back Side	4182/836.4	RMC12.2K	0.632	0.315	-0.61	23.50	24.00	0.709
Left Side	4182/836.4	RMC12.2K	0.648	0.314	-3.74	23.50	24.00	0.727
Right Side	4182/836.4	RMC12.2K	0.174	0.081	1.49	23.50	24.00	0.195
Bottom Side	4182/836.4	RMC12.2K	0.317	0.155	3.16	23.50	24.00	0.356
Front Side	4132/826.4	RMC12.2K	1.008	0.664	-0.44	23.50	24.00	1.131
Front Side Repeated	4132/826.4	RMC12.2K	0.999	0.660	-3.35	23.50	24.00	1.121
Front Side	4233/846.6	RMC12.2K	0.961	0.627	-0.25	23.50	24.00	1.078

NOTE: Body SAR test results of WCDMA Band 5

10.1.5. SAR measurement Result of LTE Band 2

Test	Test channel	Test Mode	SAR Value	Power	Conduc	Tune-u	Scaled
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Position of Body with 0mm	/Freq.		(W/kg)		Drift (±5%)	ted power (dBm)	p power (dBm)	SAR 1g (W/Kg)
			1g	10g				
1RB								
Front Side	18900/1880	20M QPSK(1,49)	0.735	0.352	-2.85	23.67	24.00	0.793
Back Side	18900/1880	20M QPSK(1,49)	0.355	0.126	-3.33	23.67	24.00	0.383
Left Side	18900/1880	20M QPSK(1,49)	0.567	0.259	-3.37	23.67	24.00	0.612
Right Side	18900/1880	20M QPSK(1,49)	0.139	0.058	-3.17	23.67	24.00	0.150
Bottom Side	18900/1880	20M QPSK(1,49)	0.295	0.139	0.31	23.67	24.00	0.318
50%RB								
Front Side	18900/1880	1.4M QPSK(3,1)	0.656	0.311	-3.65	23.48	24.00	0.739
Back Side	18900/1880	1.4M QPSK(3,1)	0.299	0.120	-5.31	23.48	24.00	0.337
Left Side	18900/1880	1.4M QPSK(3,1)	0.505	0.200	1.31	23.48	24.00	0.569
Right Side	18900/1880	1.4M QPSK(3,1)	0.111	0.049	3.30	23.48	24.00	0.125
Bottom Side	18900/1880	1.4M QPSK(3,1)	0.255	0.106	4.29	23.48	24.00	0.287

NOTE: Body SAR test results of LTE Band 2

10.1.6. SAR measurement Result of LTE Band 5

Test Position of Body with 0mm	Test channel /Freq.	Test Mode	SAR Value (W/kg)		Power Drift (±5%)	Conducted power (dBm)	Tune-up power (dBm)	Scaled SAR 1g (W/Kg)
			1g	10g				
1RB								
Front Side	20525/836.5	10M QPSK(1,24)	0.908	0.500	-0.21	23.53	24.00	1.012
Back Side	20525/836.5	10M QPSK(1,24)	0.632	0.404	4.08	23.53	24.00	0.704
Left Side	20525/836.5	10M QPSK(1,24)	0.643	0.351	-0.47	23.53	24.00	0.716
Right Side	20525/836.5	10M QPSK(1,24)	0.091	0.013	-4.26	23.53	24.00	0.101
Bottom Side	20525/836.5	10M QPSK(1,24)	0.347	0.189	0.90	23.53	24.00	0.387
Front Side	20450/829	10M QPSK(1,24)	0.974	0.532	0.34	23.43	24.00	1.111

Front Side Repeated	20450/829	10M QPSK(1,24)	0.965	0.528	0.97	23.43	24.00	1.100
Front Side	20600/844	10M QPSK(1,24)	0.905	0.493	-0.39	23.38	24.00	1.044
50%RB								
Front Side	20525/836.5	1.4M QPSK(3,0)	0.593	0.372	4.04	23.36	24.00	0.687
Back Side	20525/836.5	1.4M QPSK(3,0)	0.638	0.427	-3.95	23.36	24.00	0.739
Left Side	20525/836.5	1.4M QPSK(3,0)	0.572	0.318	-1.33	23.36	24.00	0.663
Right Side	20525/836.5	1.4M QPSK(3,0)	0.148	0.091	0.14	23.36	24.00	0.171
Bottom Side	20525/836.5	1.4M QPSK(3,0)	0.296	0.178	0.86	23.36	24.00	0.343
100%RB								
Front Side	20525/836.5	10M QPSK(50,0)	0.439	0.237	0.13	22.36	23.00	0.509

NOTE: Body SAR test results of LTE Band 5

10.1.7. SAR measurement Result of LTE Band 7

Test Position of Body with 0mm	Test channel /Freq.	Test Mode	SAR Value (W/kg)		Power Drift (±5%)	Conduc ted power (dBm)	Tune-u p power (dBm)	Scaled SAR 1g (W/Kg)
			1g	10g				
1RB								
Front Side	21100/2535	20M QPSK(1,49)	0.479	0.196	-2.33	24.19	25.00	0.577
Back Side	21100/2535	20M QPSK(1,49)	0.407	0.165	-4.64	24.19	25.00	0.490
Left Side	21100/2535	20M QPSK(1,49)	0.365	0.149	-0.61	24.19	25.00	0.440
Right Side	21100/2535	20M QPSK(1,49)	0.013	0.008	-2.40	24.19	25.00	0.016
Bottom Side	21100/2535	20M QPSK(1,49)	0.178	0.074	4.49	24.19	25.00	0.214
50%RB								
Front Side	21100/2535	20M QPSK(50,49)	0.444	0.185	3.35	23.10	24.00	0.546
Back Side	21100/2535	20M	0.358	0.141	2.99	23.10	24.00	0.440

		QPSK(50,49)						
Left Side	21100/2535	20M QPSK(50,49)	0.317	0.127	-0.06	23.10	24.00	0.390
Right Side	21100/2535	20M QPSK(50,49)	0.095	0.008	-1.75	23.10	24.00	0.117
Bottom Side	21100/2535	20M QPSK(50,49)	0.164	0.066	3.21	23.10	24.00	0.202

NOTE: Body SAR test results of LTE Band 7

10.1.8. SAR measurement Result of WLAN 2.4G

Test Position of Body with 0mm	Test channel /Freq.	Test Mode	SAR Value (W/kg)		Power Drift (±5%)	Conducted power (dBm)	Tune-up power (dBm)	Scaled SAR 1g (W/Kg)
			1g	10g				
Front Side	6/2437	802.11b	0.278	0.198	-0.32	12.93	13.50	0.317
Back Side	6/2437	802.11b	0.151	0.123	-4.08	12.93	13.50	0.172
Left Side	6/2437	802.11b	0.113	0.046	0.03	12.93	13.50	0.129
Top Side	6/2437	802.11b	0.167	0.065	-2.82	12.93	13.50	0.190

NOTE: Body SAR test results of WLAN 2.4G

10.2. SAR Summation Scenario

Per KDB 447498 D01, simultaneous transmission SAR is compliant if,

- Scalar SAR summation < 1.6W/kg.
- $SPLSR = (SAR_1 + SAR_2)^{1.5} / (\text{min. separation distance, mm})$, and the peak separation distance is determined from the square root of $[(x_1 - x_2)^2 + (y_1 - y_2)^2 + (z_1 - z_2)^2]$, where (x_1, y_1, z_1) and (x_2, y_2, z_2) are the coordinates of the extrapolated peak SAR locations in the zoom scan. If $SPLSR \leq 0.04$, simultaneously transmission SAR measurement is not necessary.

Test Position		Scaled SAR _{MAX}		Σ 1-g SAR (W/Kg)	SPLSR	Remark
		GSM 850	WLAN 2.4G			
Body	Front Side	1.199	0.317	1.516	N/A	N/A
	Back Side	0.781	0.172	0.953	N/A	N/A
	Left Side	0.416	0.129	0.545	N/A	N/A
	Right Side	0.231	N/A	0.231	N/A	N/A
	Top Side	0.017	0.190	0.207	N/A	N/A
	Bottom Side	0.430	N/A	0.430	N/A	N/A

NOTE: 1-g SAR Simultaneous Tx Combination of GSM850 and WLAN 2.4G.

Test Position		Scaled SAR _{MAX}		Σ 1-g SAR (W/Kg)	SPLSR	Remark
		GSM 1900	WLAN 2.4G			

Body	Front Side	0.084	0.317	0.401	N/A	N/A
	Back Side	0.104	0.172	0.276	N/A	N/A
	Left Side	0.082	0.129	0.211	N/A	N/A
	Right Side	0.047	N/A	0.047	N/A	N/A
	Top Side	0.016	0.190	0.206	N/A	N/A
	Bottom Side	0.038	N/A	0.038	N/A	N/A

NOTE: 1-g SAR Simultaneous Tx Combination of GSM1900 and WLAN 2.4G.

Test Position		Scaled SAR _{MAX}		Σ 1-g SAR (W/Kg)	SPLSR	Remark
		WCDMA Band 2	WLAN 2.4G			
Body	Front Side	1.195	0.317	1.512	N/A	N/A
	Back Side	0.720	0.172	0.892	N/A	N/A
	Left Side	0.753	0.129	0.882	N/A	N/A
	Right Side	0.216	N/A	0.216	N/A	N/A
	Top Side	N/A	0.190	0.190	N/A	N/A
	Bottom Side	0.349	N/A	0.349	N/A	N/A

NOTE: 1-g SAR Simultaneous Tx Combination of WCDMA Band 2 and WLAN 2.4G.

Test Position		Scaled SAR _{MAX}		Σ 1-g SAR (W/Kg)	SPLSR	Remark
		WCDMA Band 5	WLAN 2.4G			
Body	Front Side	1.131	0.317	1.448	N/A	N/A
	Back Side	0.709	0.172	0.881	N/A	N/A
	Left Side	0.727	0.129	0.856	N/A	N/A
	Right Side	0.195	N/A	0.195	N/A	N/A
	Top Side	N/A	0.190	0.190	N/A	N/A
	Bottom Side	0.356	N/A	0.356	N/A	N/A

NOTE: 1-g SAR Simultaneous Tx Combination of WCDMA Band 5 and WLAN 2.4G.

Test Position		Scaled SAR _{MAX}		Σ 1-g SAR (W/Kg)	SPLSR	Remark
		LTE Band 2	WLAN 2.4G			
Body	Front Side	0.793	0.317	1.110	N/A	N/A
	Back Side	0.383	0.172	0.555	N/A	N/A
	Left Side	0.612	0.129	0.741	N/A	N/A
	Right Side	0.150	N/A	0.150	N/A	N/A
	Top Side	N/A	0.190	0.190	N/A	N/A
	Bottom Side	0.318	N/A	0.318	N/A	N/A

NOTE: 1-g SAR Simultaneous Tx Combination of LTE Band 2 and WLAN 2.4G.

Test Position		Scaled SAR _{MAX}		Σ 1-g SAR (W/Kg)	SPLSR	Remark
		LTE Band 5	WLAN 2.4G			

Body	Front Side	1.111	0.317	1.428	N/A	N/A
	Back Side	0.739	0.172	0.911	N/A	N/A
	Left Side	0.716	0.129	0.845	N/A	N/A
	Right Side	0.171	N/A	0.171	N/A	N/A
	Top Side	N/A	0.190	0.190	N/A	N/A
	Bottom Side	0.387	N/A	0.387	N/A	N/A

NOTE: 1-g SAR Simultaneous Tx Combination of LTE Band 5 and WLAN 2.4G.

Test Position		Scaled SAR _{MAX}		Σ 1-g SAR (W/Kg)	SPLSR	Remark
		LTE Band 7	WLAN 2.4G			
Body	Front Side	0.577	0.317	0.894	N/A	N/A
	Back Side	0.490	0.172	0.662	N/A	N/A
	Left Side	0.440	0.129	0.569	N/A	N/A
	Right Side	0.117	N/A	0.117	N/A	N/A
	Top Side	N/A	0.190	0.190	N/A	N/A
	Bottom Side	0.214	N/A	0.214	N/A	N/A

NOTE: 1-g SAR Simultaneous Tx Combination of LTE Band 7 and WLAN 2.4G.

Test Position		Scaled SAR _{MAX}		Σ 1-g SAR (W/Kg)	SPLSR	Remark
		GSM 850	Bluetooth			
Body	Front Side	1.199	0.167	1.366	N/A	N/A
	Back Side	0.781	0.167	0.948	N/A	N/A
	Left Side	0.416	0.167	0.583	N/A	N/A
	Right Side	0.231	N/A	0.231	N/A	N/A
	Top Side	0.017	0.167	0.184	N/A	N/A
	Bottom Side	0.430	N/A	0.430	N/A	N/A

NOTE: 1-g SAR Simultaneous Tx Combination of GSM850 and Bluetooth.

Test Position		Scaled SAR _{MAX}		Σ 1-g SAR (W/Kg)	SPLSR	Remark
		GSM 1900	Bluetooth			
Body	Front Side	0.084	0.167	0.251	N/A	N/A
	Back Side	0.104	0.167	0.271	N/A	N/A
	Left Side	0.082	0.167	0.249	N/A	N/A
	Right Side	0.047	N/A	0.047	N/A	N/A
	Top Side	0.016	0.167	0.183	N/A	N/A
	Bottom Side	0.038	N/A	0.038	N/A	N/A

NOTE: 1-g SAR Simultaneous Tx Combination of GSM1900 and Bluetooth.

Test Position		Scaled SAR _{MAX}		Σ 1-g SAR (W/Kg)	SPLSR	Remark
		WCDMA Band 2	Bluetooth			

Body	Front Side	1.195	0.167	1.362	N/A	N/A
	Back Side	0.720	0.167	0.887	N/A	N/A
	Left Side	0.753	0.167	0.920	N/A	N/A
	Right Side	0.216	N/A	0.216	N/A	N/A
	Top Side	N/A	0.167	0.167	N/A	N/A
	Bottom Side	0.349	N/A	0.349	N/A	N/A

NOTE: 1-g SAR Simultaneous Tx Combination of WCDMA Band 2 and Bluetooth.

Test Position		Scaled SAR _{MAX}		Σ 1-g SAR (W/Kg)	SPLSR	Remark
		WCDMA Band 5	Bluetooth			
Body	Front Side	1.131	0.167	1.298	N/A	N/A
	Back Side	0.709	0.167	0.876	N/A	N/A
	Left Side	0.727	0.167	0.894	N/A	N/A
	Right Side	0.195	N/A	0.195	N/A	N/A
	Top Side	N/A	0.167	0.167	N/A	N/A
	Bottom Side	0.356	N/A	0.356	N/A	N/A

NOTE: 1-g SAR Simultaneous Tx Combination of WCDMA Band 5 and Bluetooth.

Test Position		Scaled SAR _{MAX}		Σ 1-g SAR (W/Kg)	SPLSR	Remark
		LTE Band 2	Bluetooth			
Body	Front Side	0.793	0.167	0.960	N/A	N/A
	Back Side	0.383	0.167	0.550	N/A	N/A
	Left Side	0.612	0.167	0.779	N/A	N/A
	Right Side	0.150	N/A	0.150	N/A	N/A
	Top Side	N/A	0.167	0.167	N/A	N/A
	Bottom Side	0.318	N/A	0.318	N/A	N/A

NOTE: 1-g SAR Simultaneous Tx Combination of LTE Band 2 and Bluetooth.

Test Position		Scaled SAR _{MAX}		Σ 1-g SAR (W/Kg)	SPLSR	Remark
		LTE Band 5	Bluetooth			
Body	Front Side	1.111	0.167	1.278	N/A	N/A
	Back Side	0.739	0.167	0.906	N/A	N/A
	Left Side	0.716	0.167	0.883	N/A	N/A
	Right Side	0.171	N/A	0.171	N/A	N/A
	Top Side	N/A	0.167	0.167	N/A	N/A
	Bottom Side	0.387	N/A	0.387	N/A	N/A

NOTE: 1-g SAR Simultaneous Tx Combination of LTE Band 5 and Bluetooth.

Test Position		Scaled SAR _{MAX}		Σ 1-g SAR (W/Kg)	SPLSR	Remark
		LTE Band 7	Bluetooth			
Body	Front Side	0.577	0.167	0.744	N/A	N/A

	Back Side	0.490	0.167	0.657	N/A	N/A
	Left Side	0.440	0.167	0.607	N/A	N/A
	Right Side	0.117	N/A	0.117	N/A	N/A
	Top Side	N/A	0.167	0.167	N/A	N/A
	Bottom Side	0.214	N/A	0.214	N/A	N/A

NOTE: 1-g SAR Simultaneous Tx Combination of LTE Band 7 and Bluetooth.

11. Appendix A. Photo documentation

Refer to appendix Test Setup photo---SAR

12. Appendix B. System Check Plots

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MEASUREMENT 1 System Performance Check - SID835
MEASUREMENT 2 System Performance Check - SID1900
MEASUREMENT 3 System Performance Check - SID2450
MEASUREMENT 4 System Performance Check - SID2600

MEASUREMENT 1

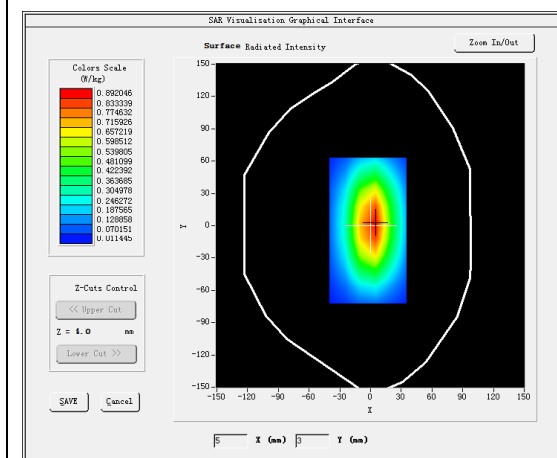
A. Experimental conditions.

<u>Area Scan</u>	<u>dx=15mm dy=15mm, h= 5.00 mm</u>
<u>ZoomScan</u>	<u>5x5x7,dx=8mm dy=8mm dz=5mm</u>
<u>Phantom</u>	<u>Validation plane</u>
<u>Device Position</u>	<u>Dipole</u>
<u>Band</u>	<u>CW835</u>
<u>Channels</u>	<u>Middle</u>
<u>Signal</u>	<u>CW (Crest factor: 1.0)</u>

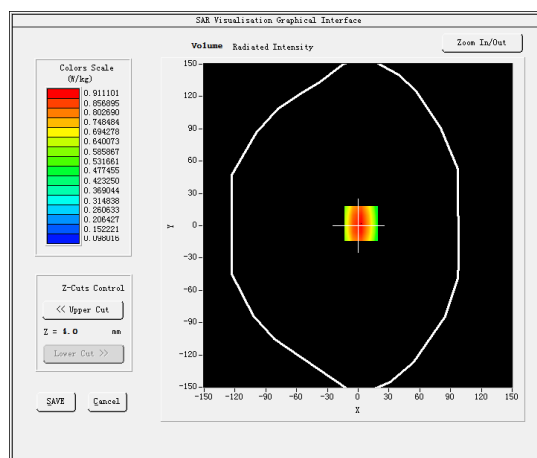
B. SAR Measurement Results

Frequency (MHz)	835.000000
Relative permittivity (real part)	54.321111
Relative permittivity (imaginary part)	21.793359
Conductivity (S/m)	1.011236
Variation (%)	-1.200000

SURFACE SAR



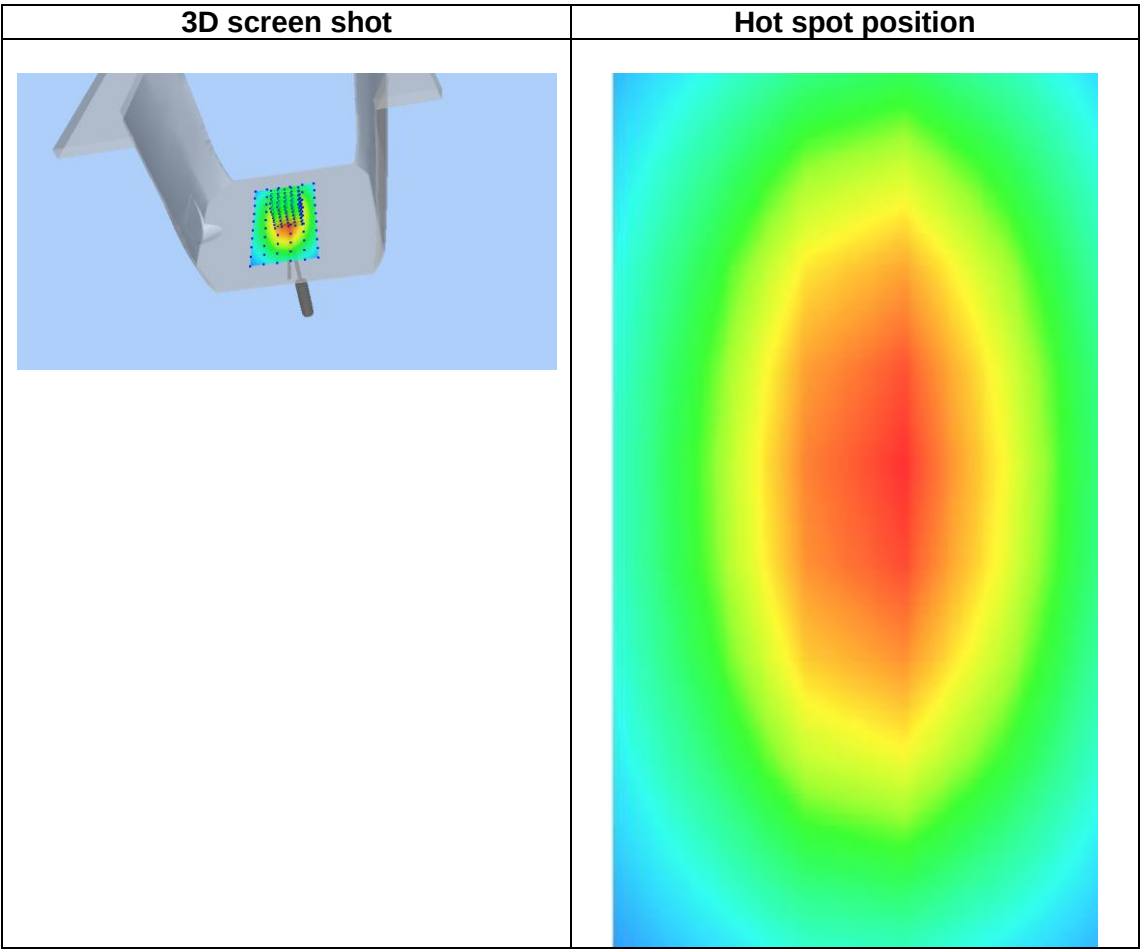
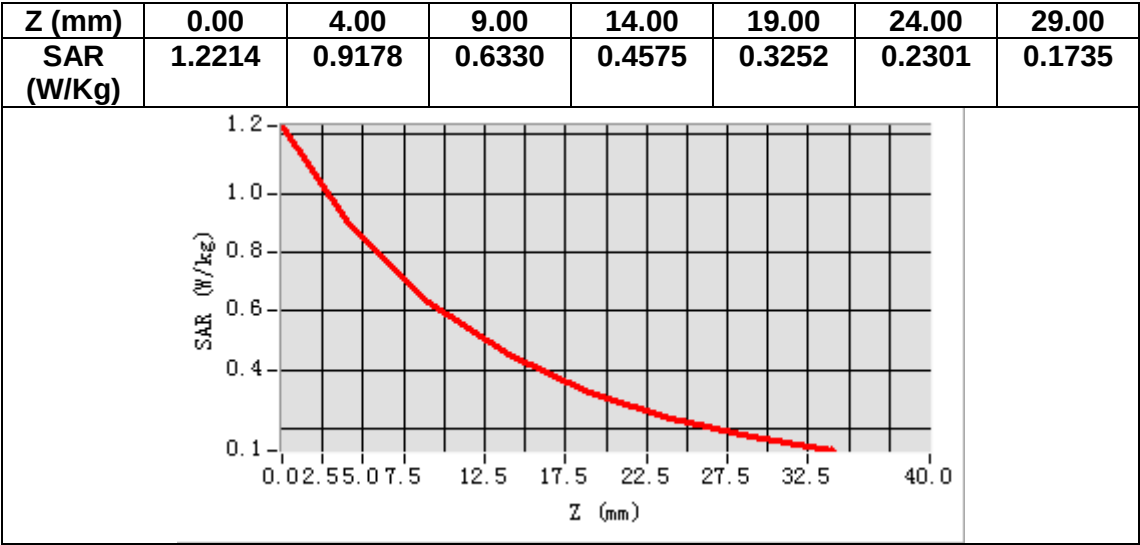
VOLUME SAR



Maximum location: X=3.00, Y=2.00

SAR Peak: 1.23 W/kg

SAR 10g (W/Kg)	0.672123
SAR 1g (W/Kg)	0.950356



MEASUREMENT 2

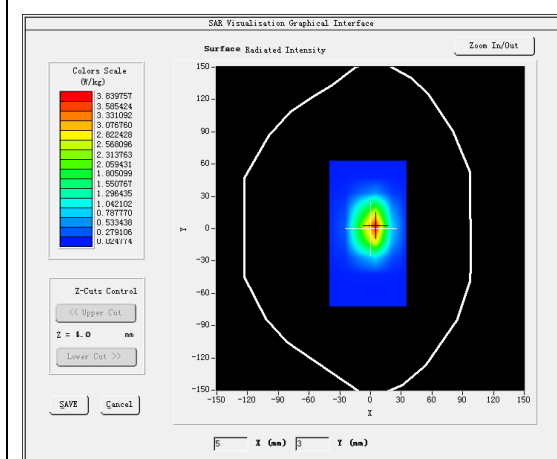
A. Experimental conditions.

<u>Area Scan</u>	<u>dx=15mm dy=15mm, h= 5.00 mm</u>
<u>ZoomScan</u>	<u>5x5x7,dx=8mm dy=8mm dz=5mm</u>
<u>Phantom</u>	<u>Validation plane</u>
<u>Device Position</u>	<u>Dipole</u>
<u>Band</u>	<u>CW1900</u>
<u>Channels</u>	<u>Middle</u>
<u>Signal</u>	<u>CW (Crest factor: 1.0)</u>

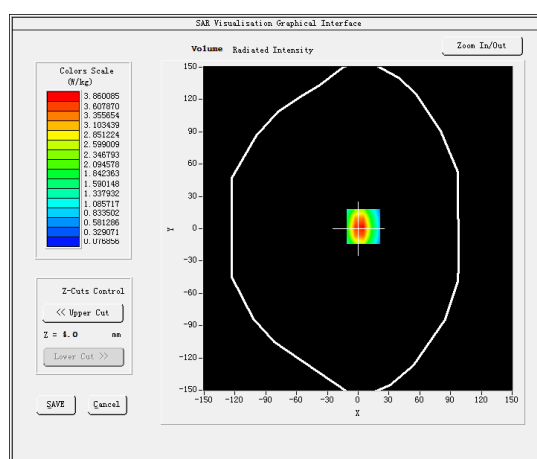
B. SAR Measurement Results

Frequency (MHz)	1900.000000
Relative permittivity (real part)	52.503335
Relative permittivity (imaginary part)	14.853503
Conductivity (S/m)	1.569566
Variation (%)	3.460000

SURFACE SAR



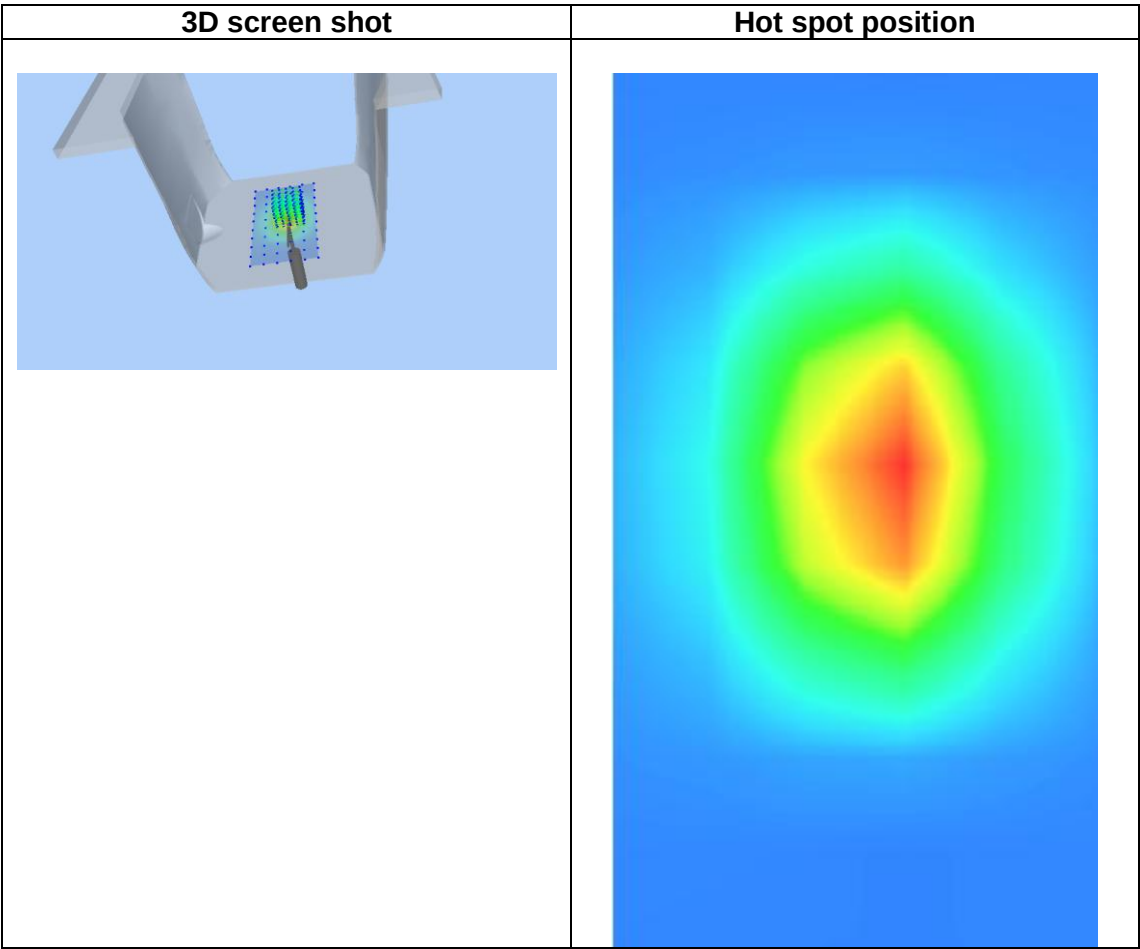
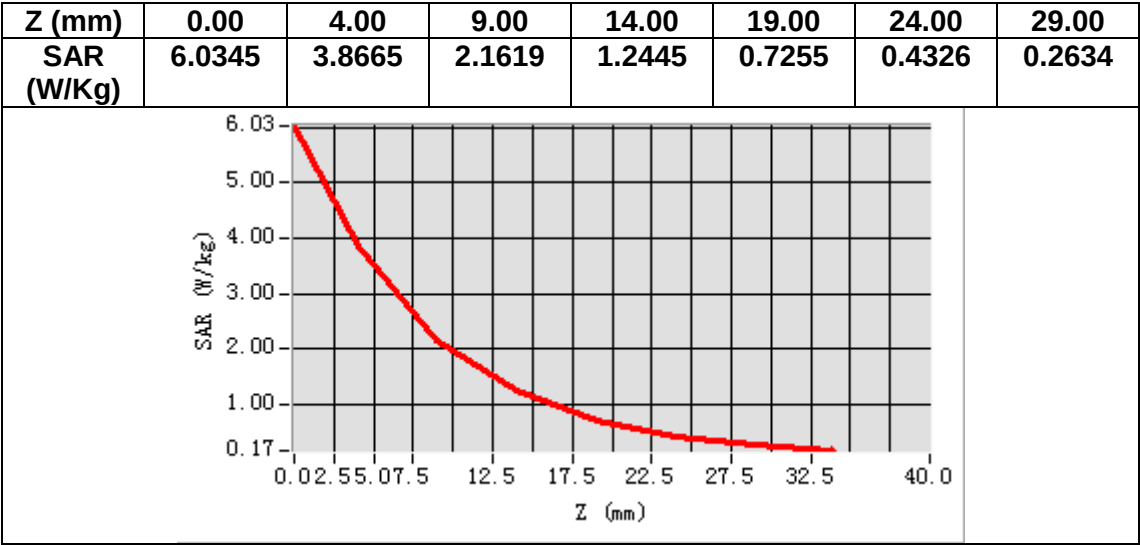
VOLUME SAR



Maximum location: X=5.00, Y=2.00

SAR Peak: 6.39 W/kg

SAR 10g (W/Kg)	2.189329
SAR 1g (W/Kg)	3.922402



MEASUREMENT 3

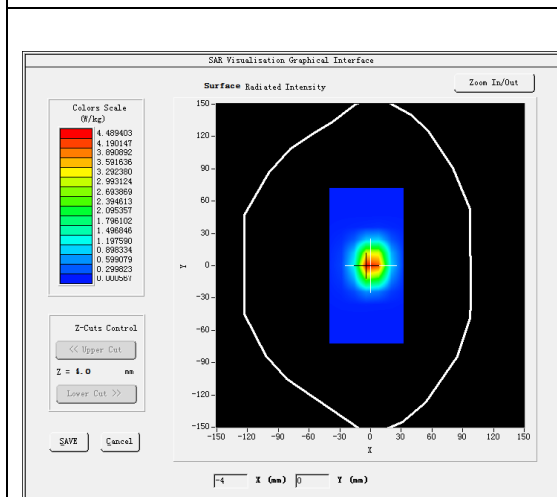
A. Experimental conditions.

<u>Area Scan</u>	<u>dx=12mm dy=12mm, h= 5.00 mm</u>
<u>ZoomScan</u>	<u>7x7x7,dx=5mm dy=5mm dz=5mm</u>
<u>Phantom</u>	<u>Validation plane</u>
<u>Device Position</u>	<u>Dipole</u>
<u>Band</u>	<u>CW2450</u>
<u>Channels</u>	<u>Middle</u>
<u>Signal</u>	<u>CW (Crest factor: 1.0)</u>

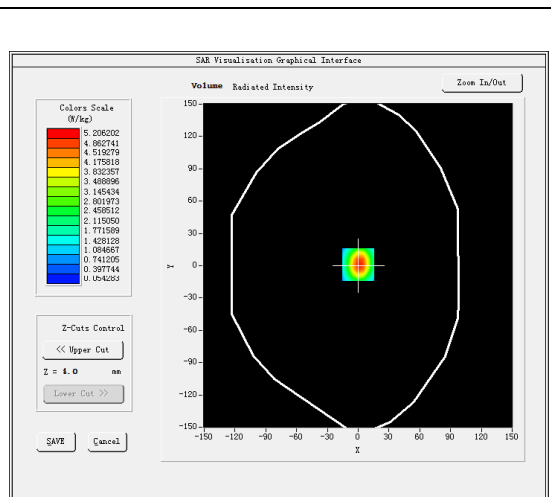
B. SAR Measurement Results

Frequency (MHz)	2450.000000
Relative permittivity (real part)	51.881497
Relative permittivity (imaginary part)	14.833566
Conductivity (S/m)	2.022816
Variation (%)	-1.450000

SURFACE SAR



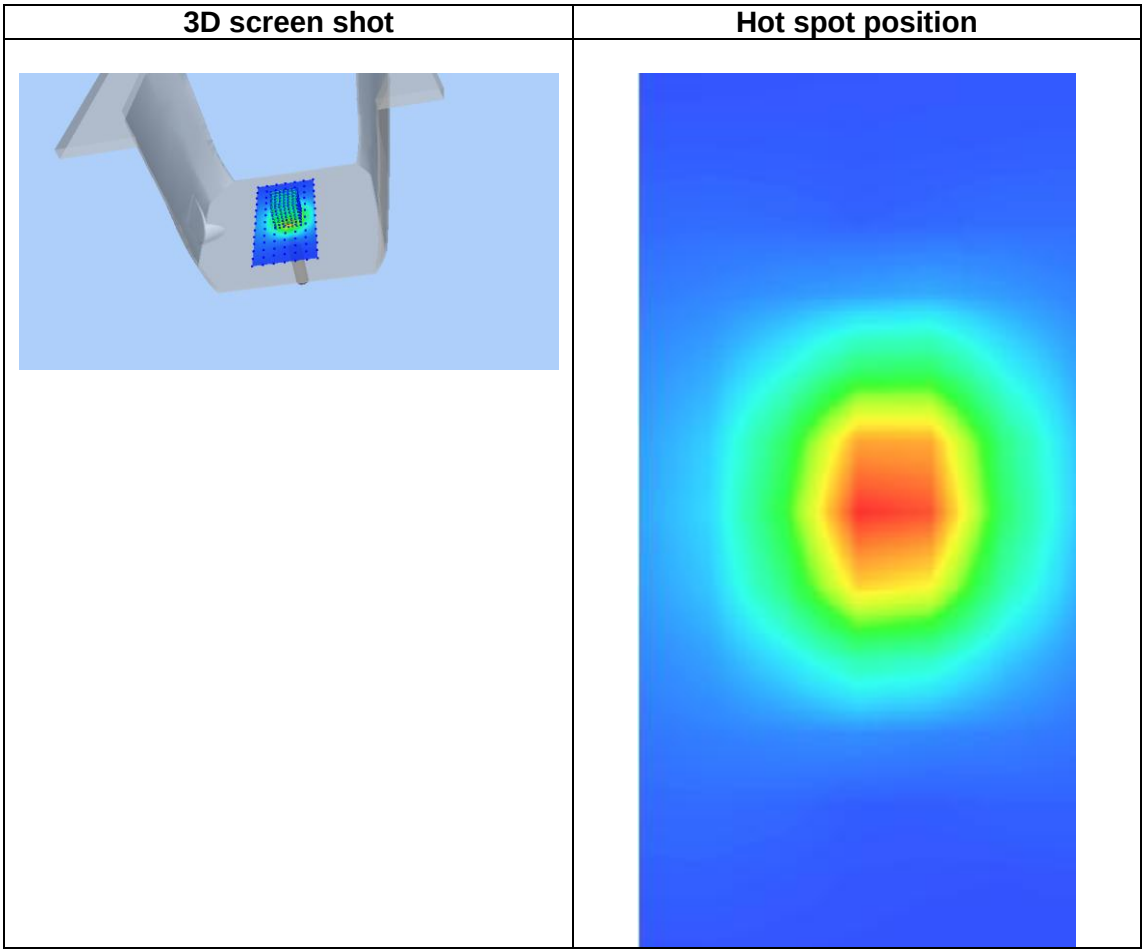
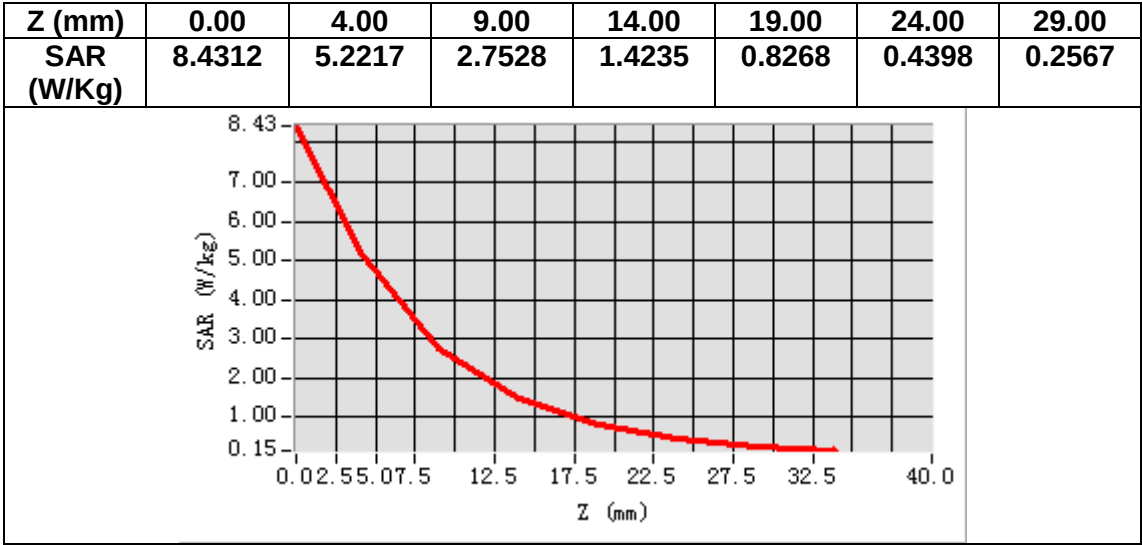
VOLUME SAR



Maximum location: X=0.00, Y=1.00

SAR Peak: 8.46 W/kg

SAR 10g (W/Kg)	2.298285
SAR 1g (W/Kg)	5.028270



MEASUREMENT 4

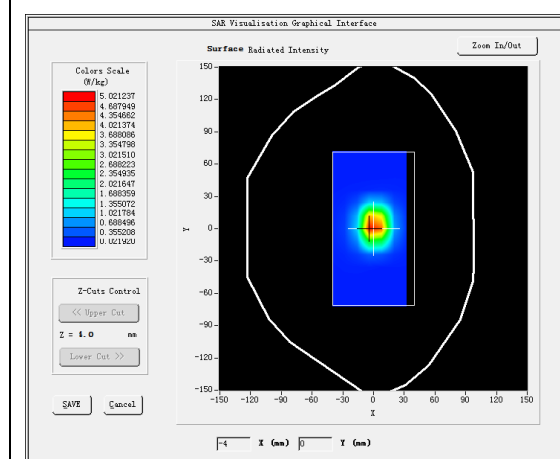
A. Experimental conditions.

<u>Area Scan</u>	<u>dx=12mm dy=12mm, h= 5.00 mm</u>
<u>ZoomScan</u>	<u>7x7x7,dx=5mm dy=5mm dz=5mm</u>
<u>Phantom</u>	<u>Validation plane</u>
<u>Device Position</u>	<u>Dipole</u>
<u>Band</u>	<u>CW2600</u>
<u>Channels</u>	<u>Middle</u>
<u>Signal</u>	<u>CW (Crest factor: 1.0)</u>

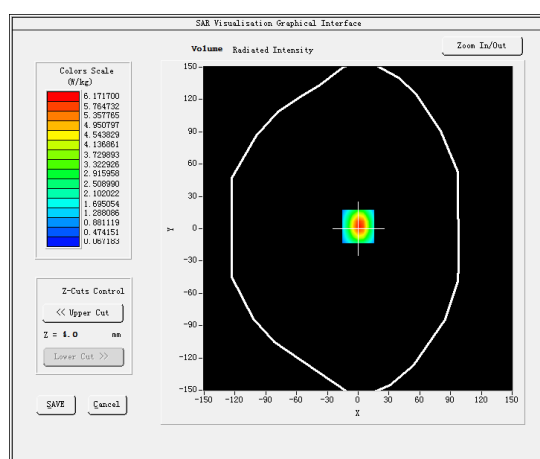
B. SAR Measurement Results

Frequency (MHz)	2600.000000
Relative permittivity (real part)	52.602866
Relative permittivity (imaginary part)	15.280101
Conductivity (S/m)	2.213465
Variation (%)	3.220000

SURFACE SAR



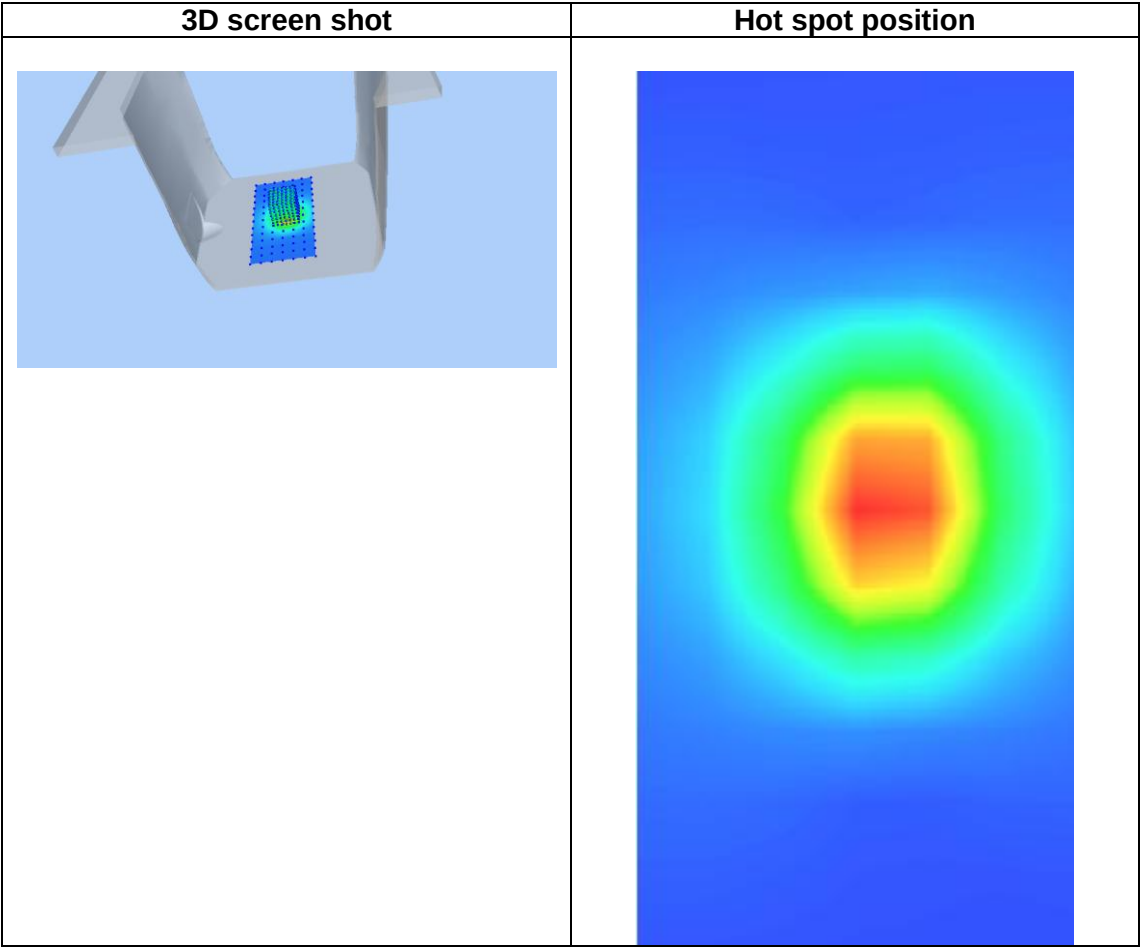
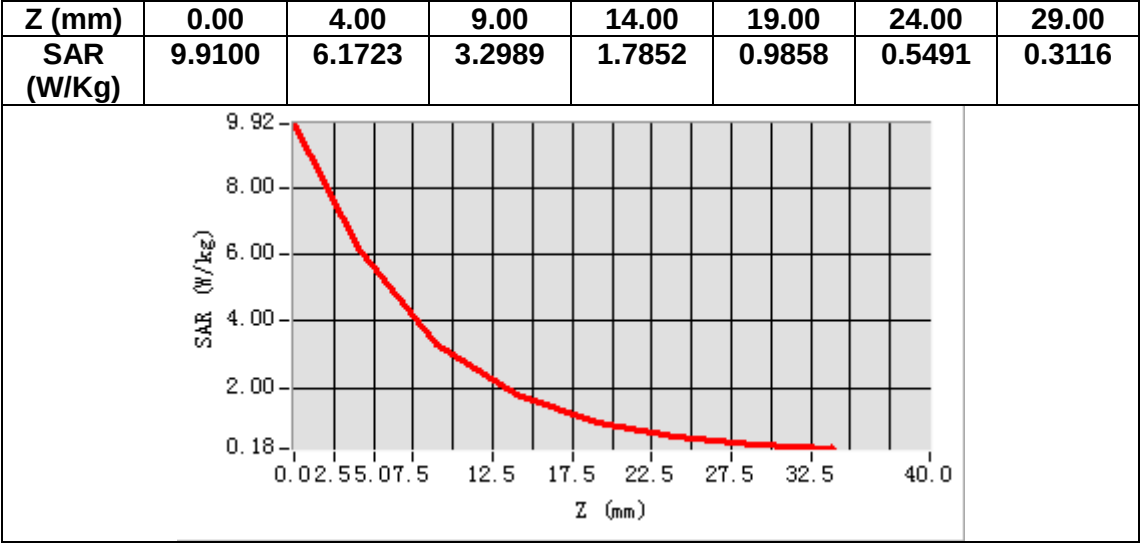
VOLUME SAR



Maximum location: X=0.00, Y=2.00

SAR Peak: 9.99 W/kg

SAR 10g (W/Kg)	2.339324
SAR 1g (W/Kg)	5.200188



13. Appendix C. Plots of High SAR Measurement

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MEASUREMENT 1 GSM 850
MEASUREMENT 2 GSM 1900
MEASUREMENT 3 WCDMA Band 2
MEASUREMENT 4 WCDMA Band 5
MEASUREMENT 5 WLAN 2.4G
MEASUREMENT 6 LTE Band 2
MEASUREMENT 7 LTE Band 5
MEASUREMENT 8 LTE Band 7

MEASUREMENT 1

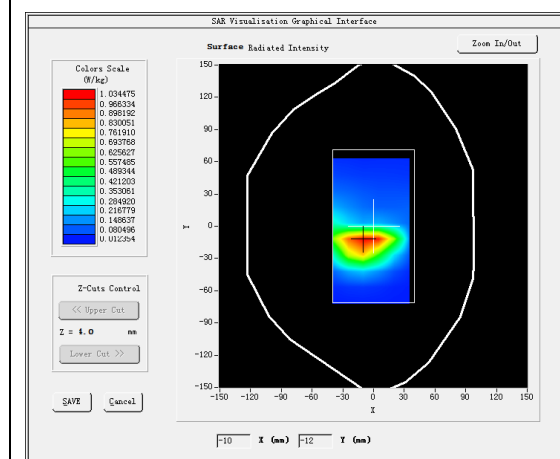
A. Experimental conditions.

<u>Area Scan</u>	<u>dx=15mm dy=15mm, h= 5.00 mm</u>
<u>ZoomScan</u>	<u>5x5x7,dx=8mm dy=8mm dz=5mm</u>
<u>Phantom</u>	<u>Validation plane</u>
<u>Device Position</u>	<u>Body</u>
<u>Band</u>	<u>GSM850</u>
<u>Channels</u>	<u>Low</u>
<u>Signal</u>	<u>TDMA (Crest factor: 2.0)</u>

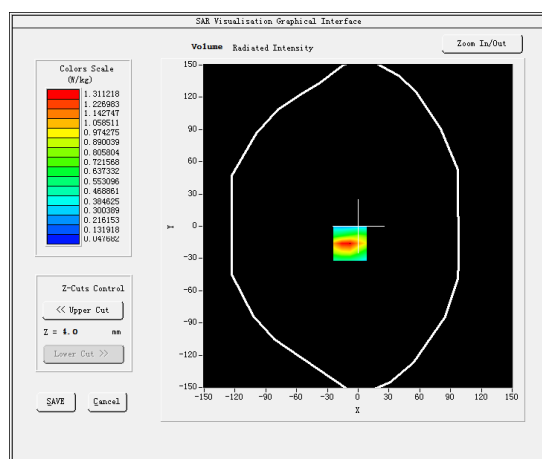
B. SAR Measurement Results

Frequency (MHz)	824.200000
Relative permittivity (real part)	54.408161
Relative permittivity (imaginary part)	21.789419
Conductivity (S/m)	0.997713
Variation (%)	-0.580000

SURFACE SAR



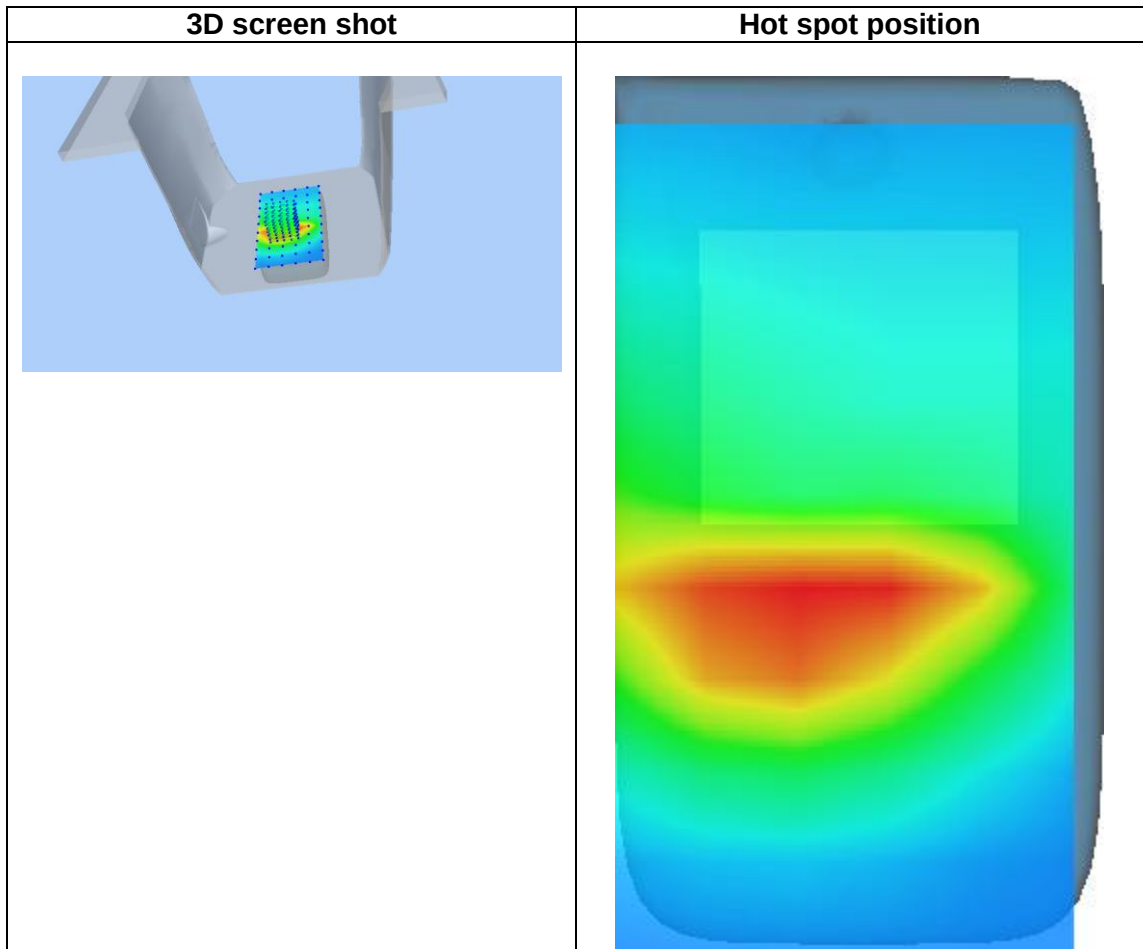
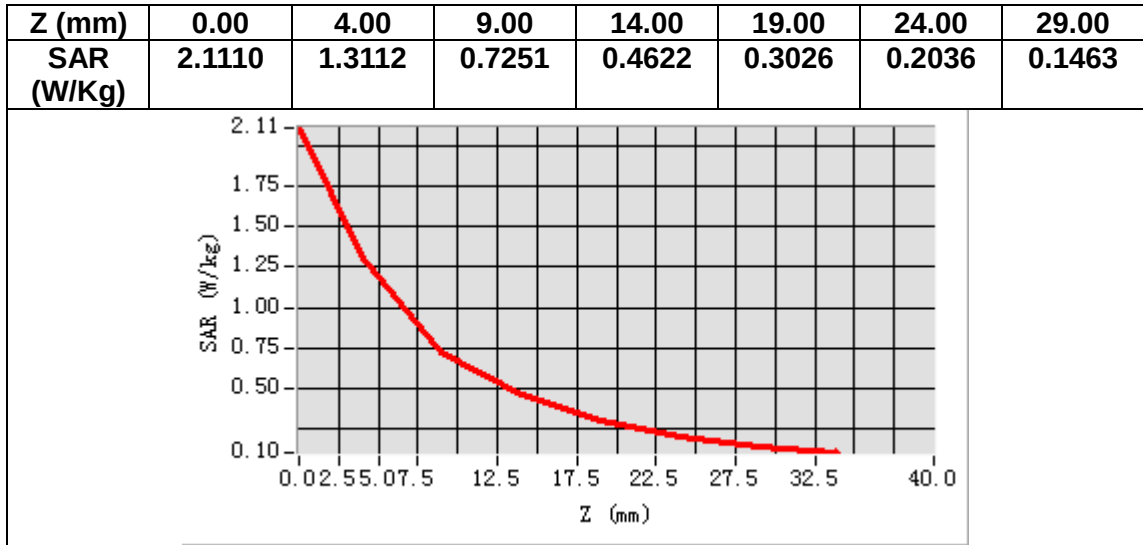
VOLUME SAR



Maximum location: X=-8.00, Y=-16.00

SAR Peak: 2.19 W/kg

SAR 10g (W/Kg)	0.655588
SAR 1g (W/Kg)	1.032328



MEASUREMENT 2

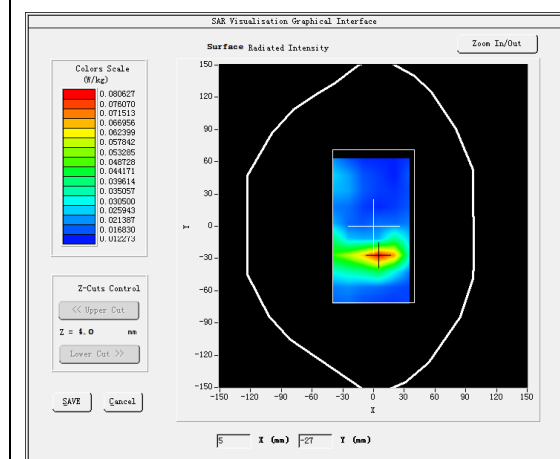
A. Experimental conditions.

<u>Area Scan</u>	<u>dx=15mm dy=15mm, h= 5.00 mm</u>
<u>ZoomScan</u>	<u>5x5x7,dx=8mm dy=8mm dz=5mm</u>
<u>Phantom</u>	<u>Validation plane</u>
<u>Device Position</u>	<u>Body</u>
<u>Band</u>	<u>GSM1900</u>
<u>Channels</u>	<u>Middle</u>
<u>Signal</u>	<u>TDMA (Crest factor: 4.0)</u>

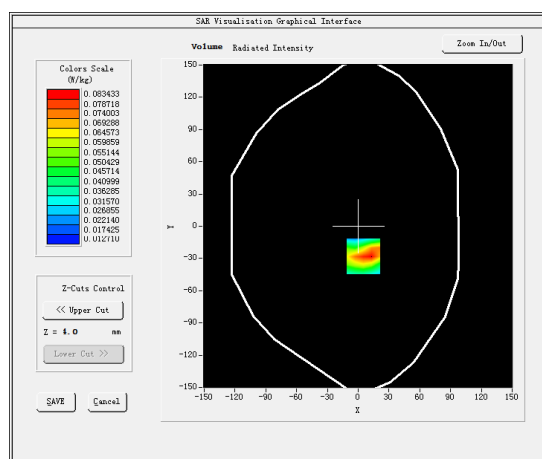
B. SAR Measurement Results

Frequency (MHz)	1880.000000
Relative permittivity (real part)	52.578899
Relative permittivity (imaginary part)	14.937700
Conductivity (S/m)	1.560160
Variation (%)	-2.760000

SURFACE SAR



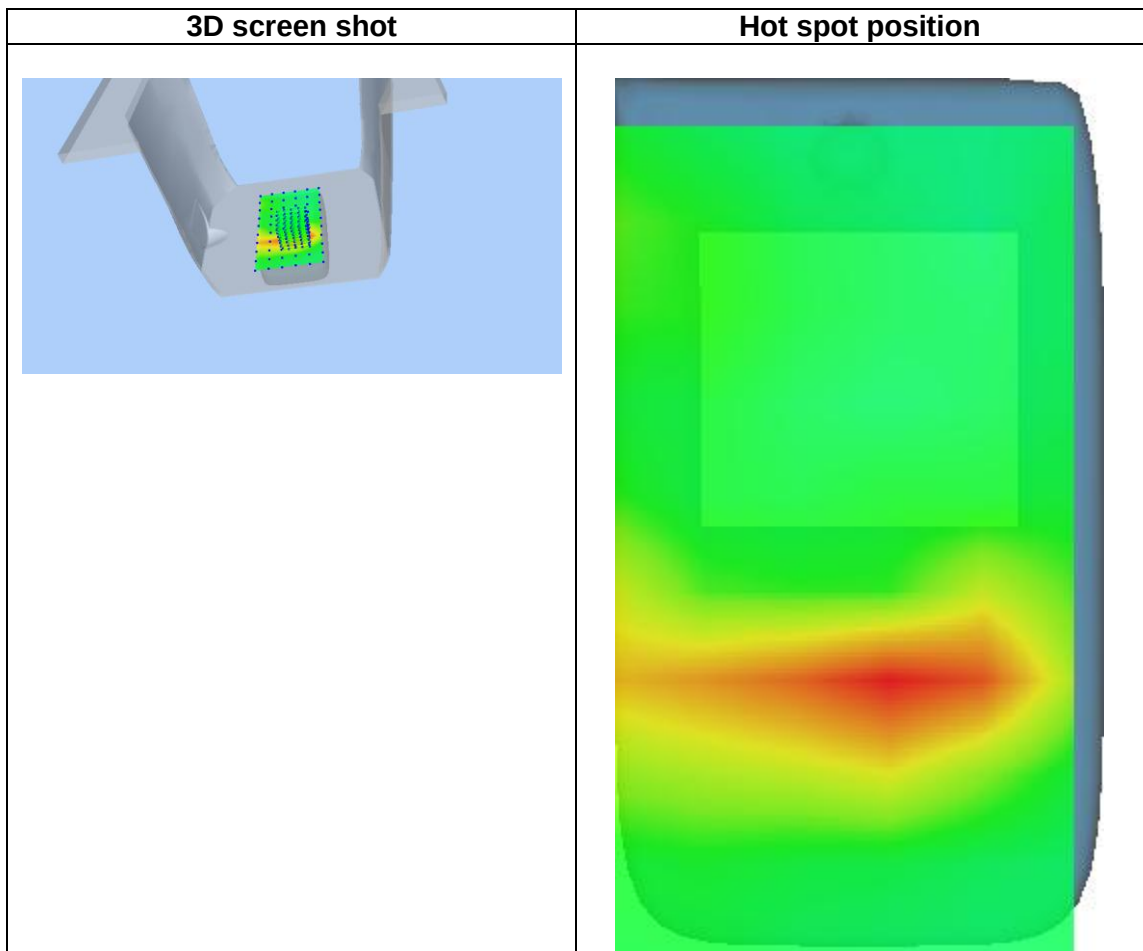
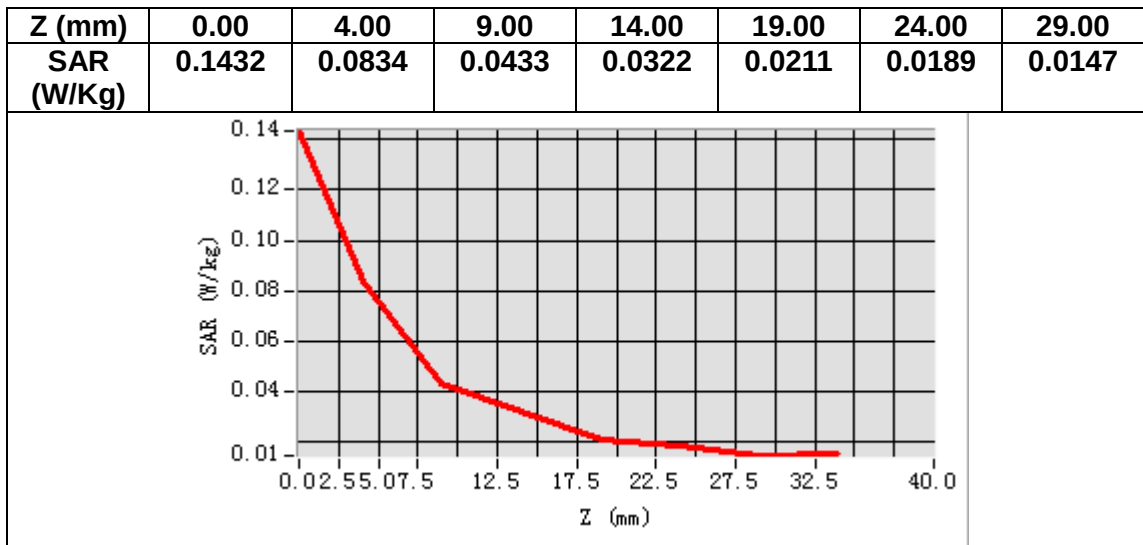
VOLUME SAR



Maximum location: X=5.00, Y=-28.00

SAR Peak: 0.14 W/kg

SAR 10g (W/Kg)	0.046537
SAR 1g (W/Kg)	0.082046



MEASUREMENT 3

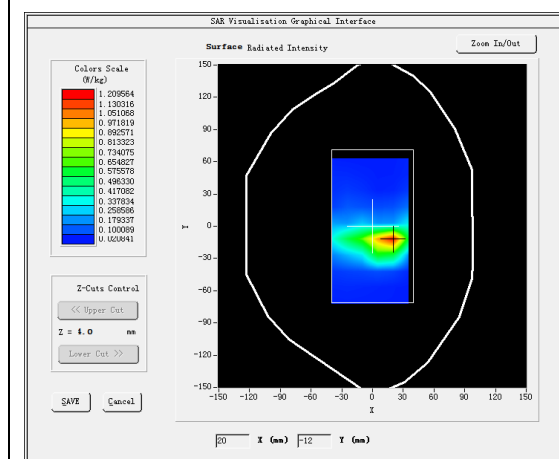
A. Experimental conditions.

<u>Area Scan</u>	<u>dx=15mm dy=15mm, h= 5.00 mm</u>
<u>ZoomScan</u>	<u>5x5x7,dx=8mm dy=8mm dz=5mm</u>
<u>Phantom</u>	<u>Validation plane</u>
<u>Device Position</u>	<u>Body</u>
<u>Band</u>	<u>Band2_WCDMA1900</u>
<u>Channels</u>	<u>Middle</u>
<u>Signal</u>	<u>WCDMA (Crest factor: 1.0)</u>

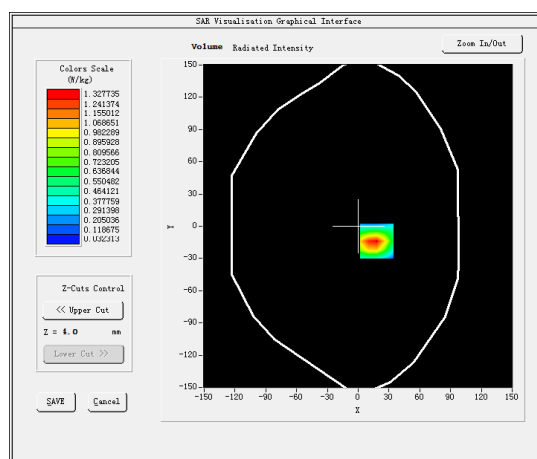
B. SAR Measurement Results

Frequency (MHz)	1880.000000
Relative permittivity (real part)	52.578899
Relative permittivity (imaginary part)	14.937700
Conductivity (S/m)	1.560160
Variation (%)	-1.060000

SURFACE SAR



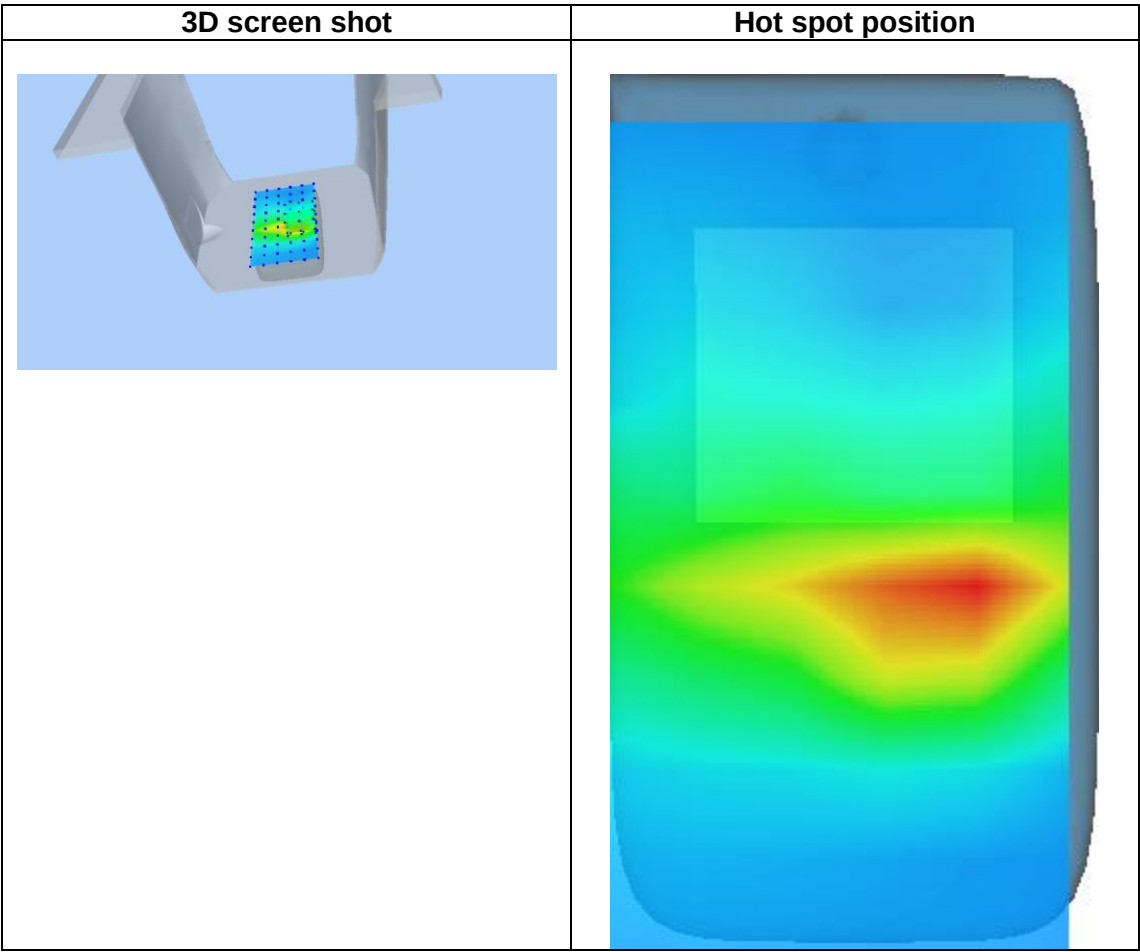
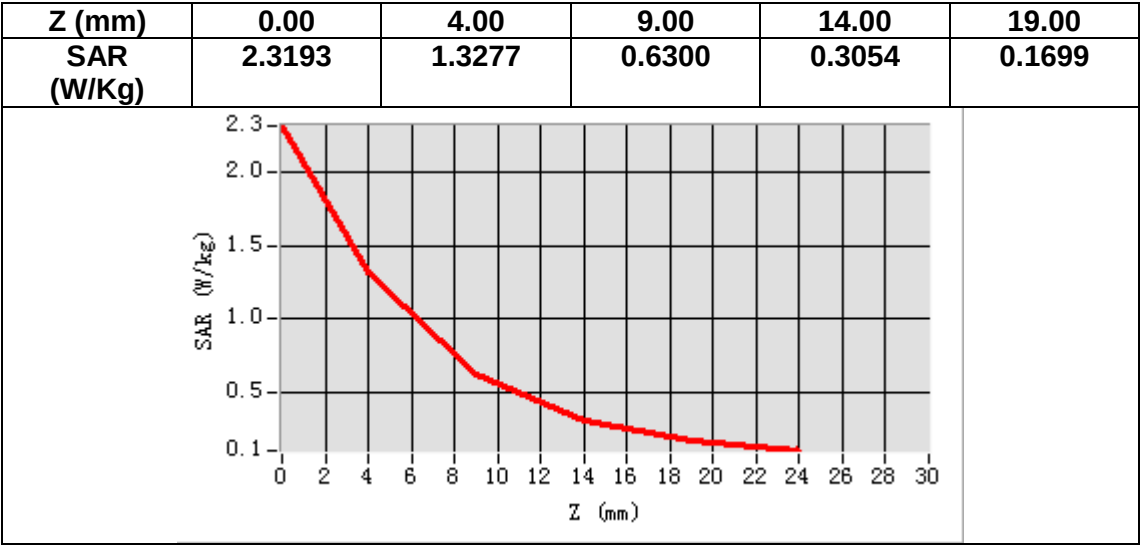
VOLUME SAR



Maximum location: X=18.00, Y=-14.00

SAR Peak: 2.38 W/kg

SAR 10g (W/Kg)	0.604301
SAR 1g (W/Kg)	1.072035



MEASUREMENT 4

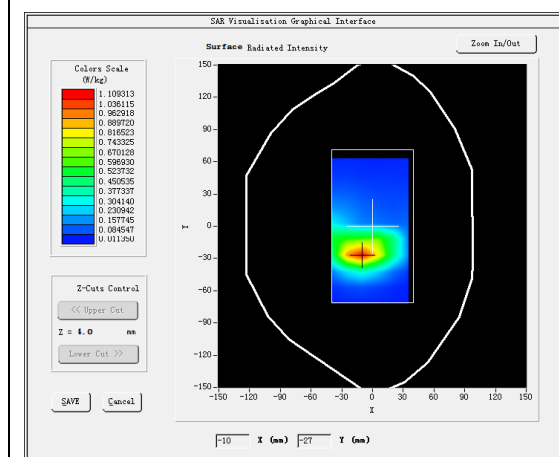
A. Experimental conditions.

<u>Area Scan</u>	<u>dx=15mm dy=15mm, h= 5.00 mm</u>
<u>ZoomScan</u>	<u>5x5x7,dx=8mm dy=8mm dz=5mm</u>
<u>Phantom</u>	<u>Validation plane</u>
<u>Device Position</u>	<u>Body</u>
<u>Band</u>	<u>Band5 WCDMA850</u>
<u>Channels</u>	<u>Low</u>
<u>Signal</u>	<u>WCDMA (Crest factor: 1.0)</u>

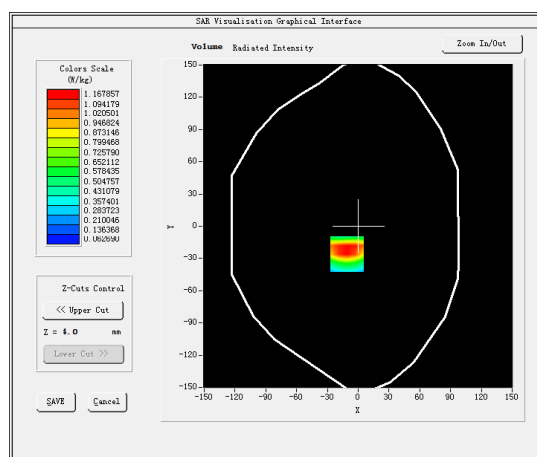
B. SAR Measurement Results

Frequency (MHz)	826.400000
Relative permittivity (real part)	54.384200
Relative permittivity (imaginary part)	21.735600
Conductivity (S/m)	0.884136
Variation (%)	-0.440000

SURFACE SAR



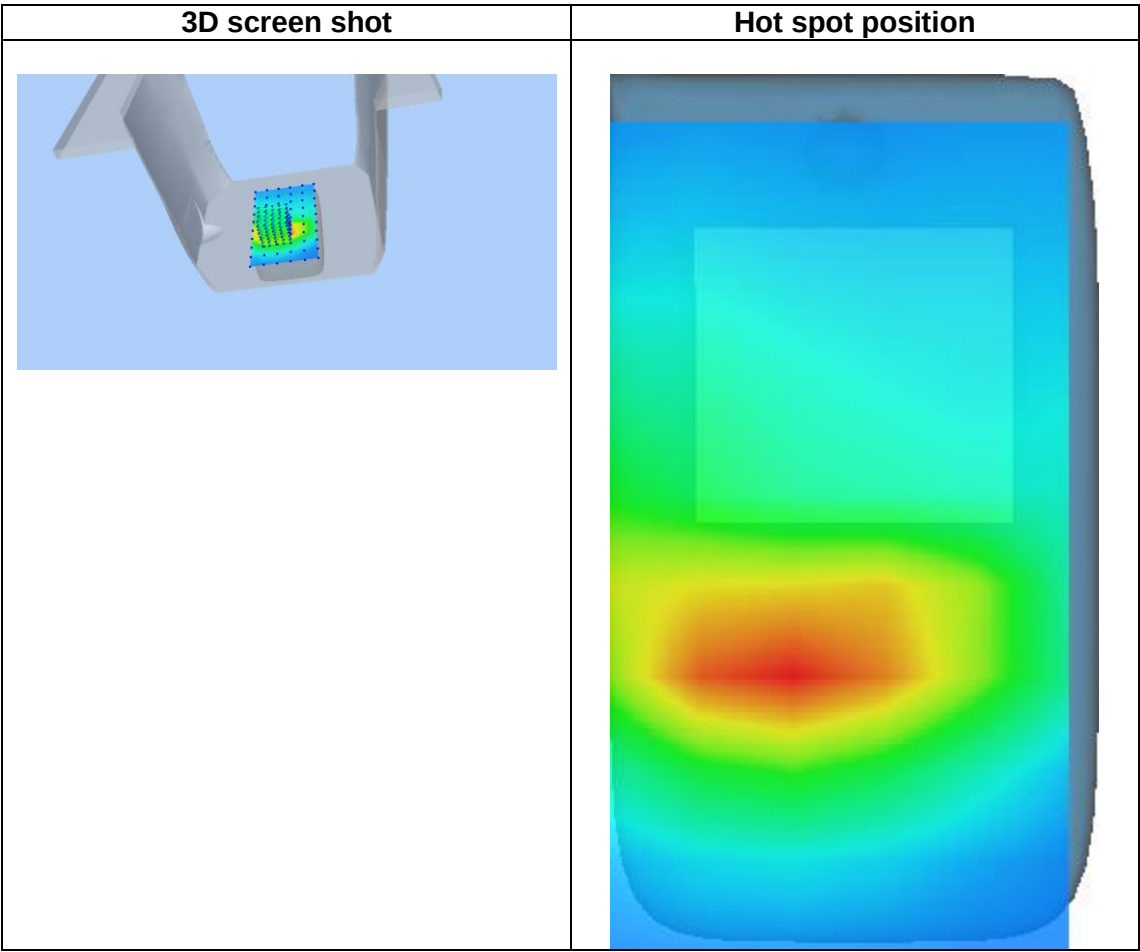
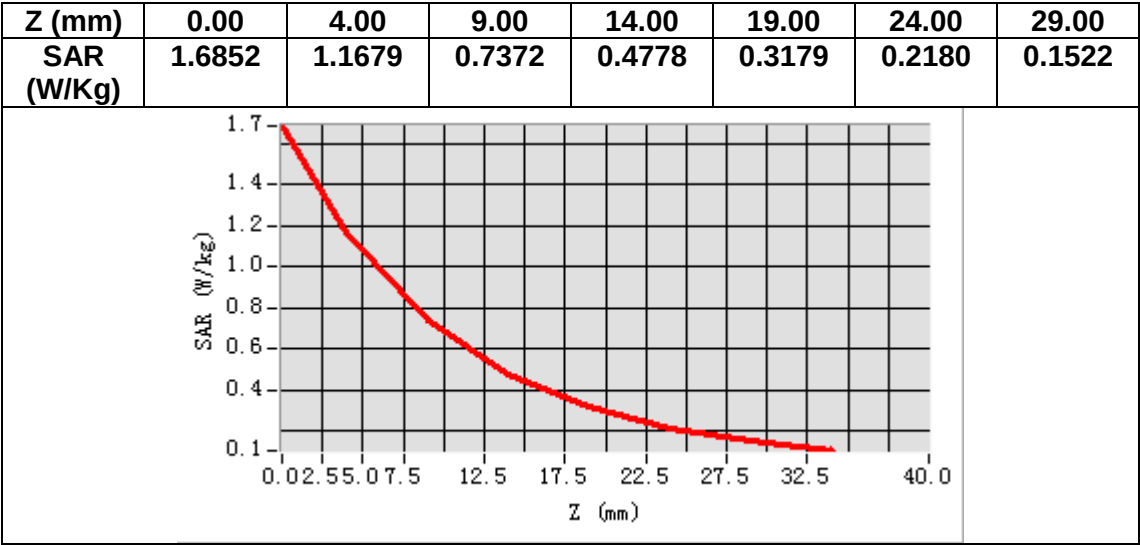
VOLUME SAR



Maximum location: X=-11.00, Y=-26.00

SAR Peak: 1.98 W/kg

SAR 10g (W/Kg)	0.663834
SAR 1g (W/Kg)	1.008246



MEASUREMENT 5

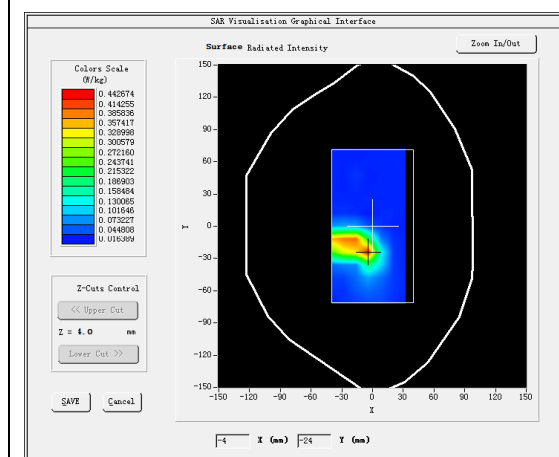
A. Experimental conditions.

<u>Area Scan</u>	<u>dx=12mm dy=12mm, h= 5.00 mm</u>
<u>ZoomScan</u>	<u>7x7x7,dx=5mm dy=5mm dz=5mm</u>
<u>Phantom</u>	<u>Validation plane</u>
<u>Device Position</u>	<u>Body</u>
<u>Band</u>	<u>IEEE 802.11b ISM</u>
<u>Channels</u>	<u>Middle</u>
<u>Signal</u>	<u>IEEE802.11b (Crest factor: 1.0)</u>

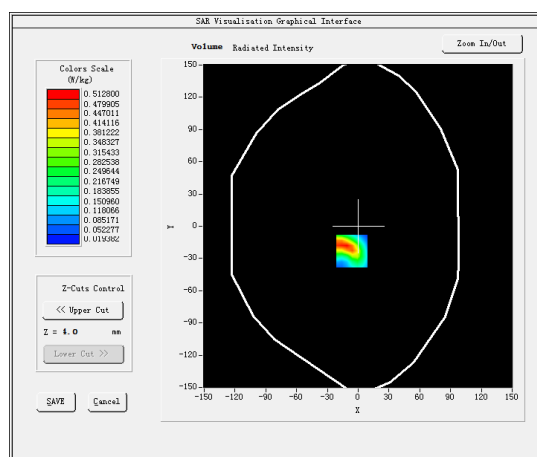
B. SAR Measurement Results

Frequency (MHz)	2437.000000
Relative permittivity (real part)	51.941601
Relative permittivity (imaginary part)	14.785620
Conductivity (S/m)	2.001809
Variation (%)	-0.320000

SURFACE SAR



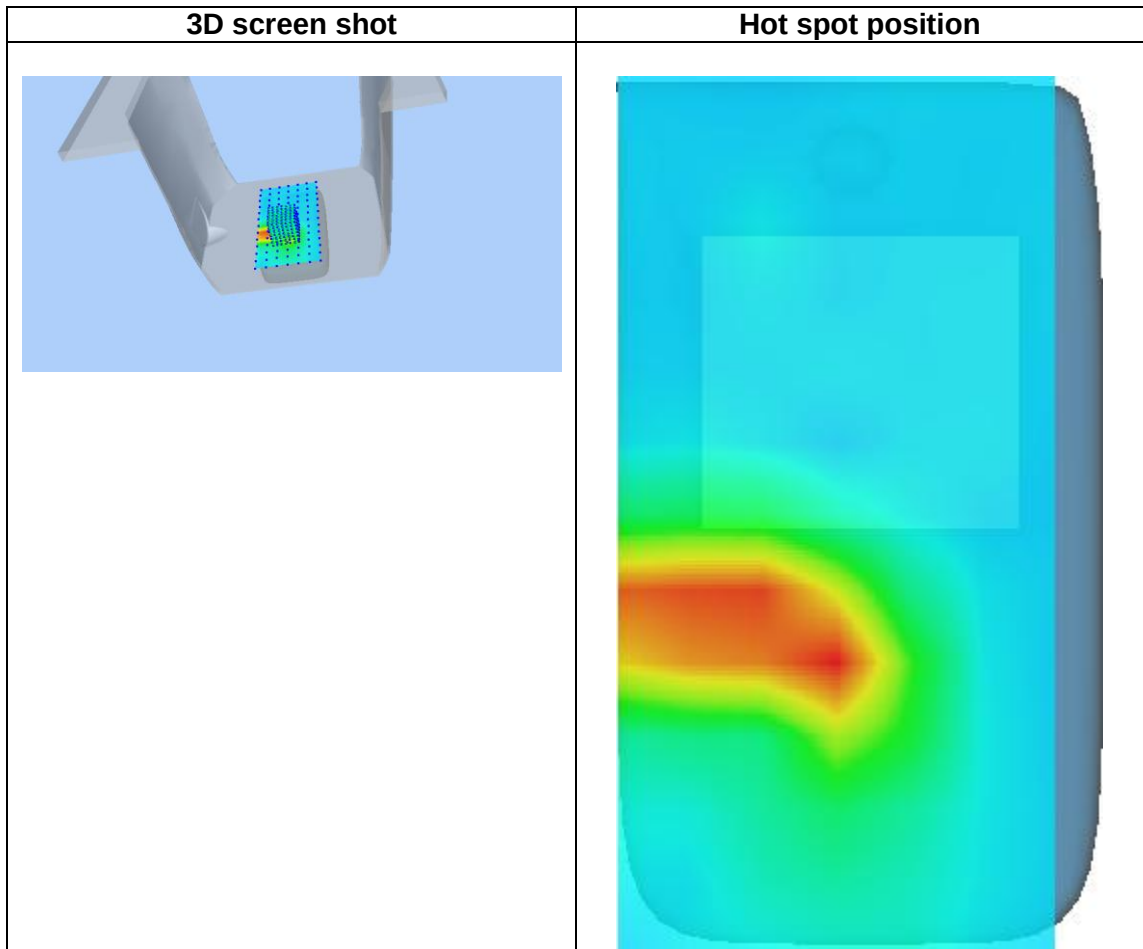
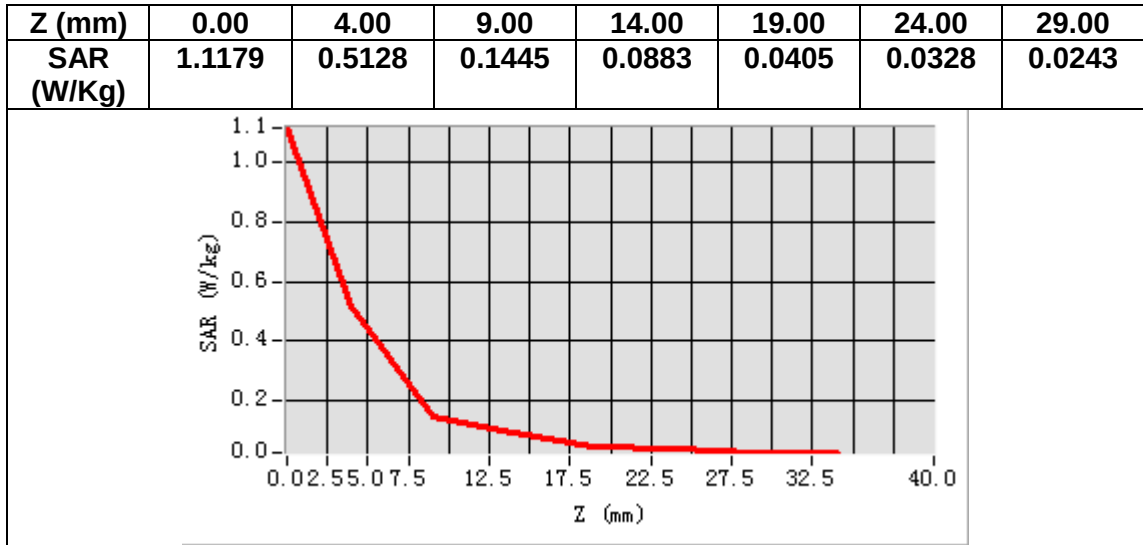
VOLUME SAR



Maximum location: X=-6.00, Y=-23.00

SAR Peak: 0.98 W/kg

SAR 10g (W/Kg)	0.197644
SAR 1g (W/Kg)	0.278096



MEASUREMENT 6

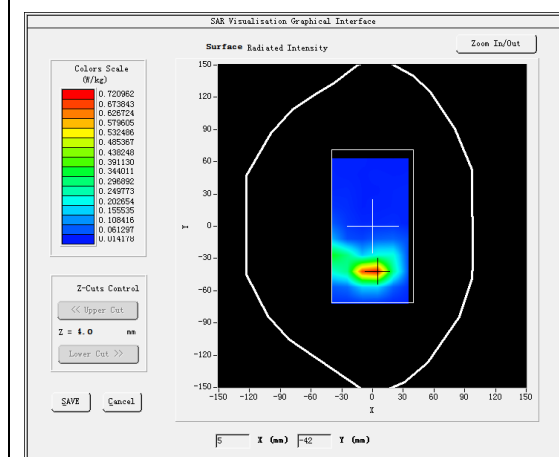
A. Experimental conditions.

<u>Area Scan</u>	<u>dx=15mm dy=15mm, h= 5.00 mm</u>
<u>ZoomScan</u>	<u>5x5x7,dx=8mm dy=8mm dz=5mm</u>
<u>Phantom</u>	<u>Validation plane</u>
<u>Device Position</u>	<u>Body</u>
<u>Band</u>	<u>LTE band 2</u>
<u>Channels</u>	<u>Middle</u>
<u>Signal</u>	<u>LTE (Crest factor: 1.0)</u>

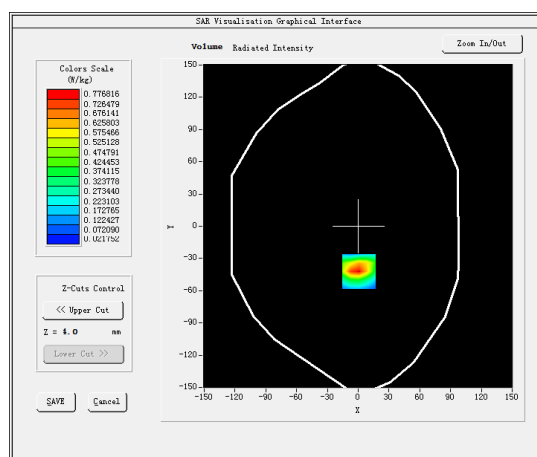
B. SAR Measurement Results

Frequency (MHz)	1880.000000
Relative permittivity (real part)	52.585949
Relative permittivity (imaginary part)	14.946150
Conductivity (S/m)	1.560627
Variation (%)	-2.850000

SURFACE SAR



VOLUME SAR



Maximum location: X=1.00, Y=-42.00

SAR Peak: 1.34 W/kg

SAR 10g (W/Kg)	0.352401
SAR 1g (W/Kg)	0.735278

MEASUREMENT 7

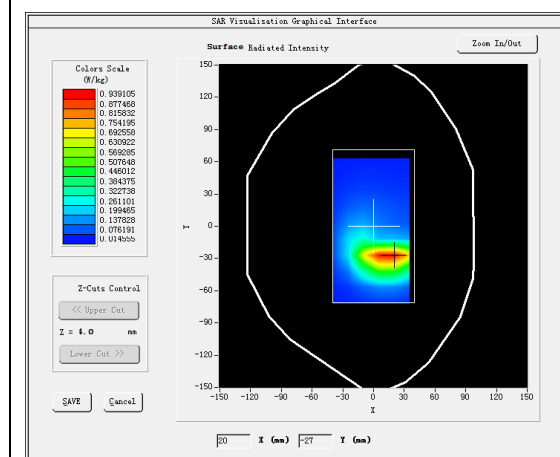
A. Experimental conditions.

<u>Area Scan</u>	<u>dx=15mm dy=15mm, h= 5.00 mm</u>
<u>ZoomScan</u>	<u>5x5x7,dx=8mm dy=8mm dz=5mm</u>
<u>Phantom</u>	<u>Validation plane</u>
<u>Device Position</u>	<u>Body</u>
<u>Band</u>	<u>LTE band 5</u>
<u>Channels</u>	<u>Low</u>
<u>Signal</u>	<u>LTE (Crest factor: 1.0)</u>

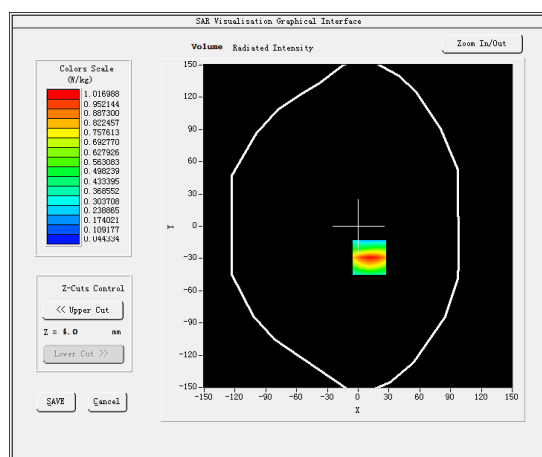
B. SAR Measurement Results

Frequency (MHz)	829.000000
Relative permittivity (real part)	54.358200
Relative permittivity (imaginary part)	21.812851
Conductivity (S/m)	1.003997
Variation (%)	0.340000

SURFACE SAR



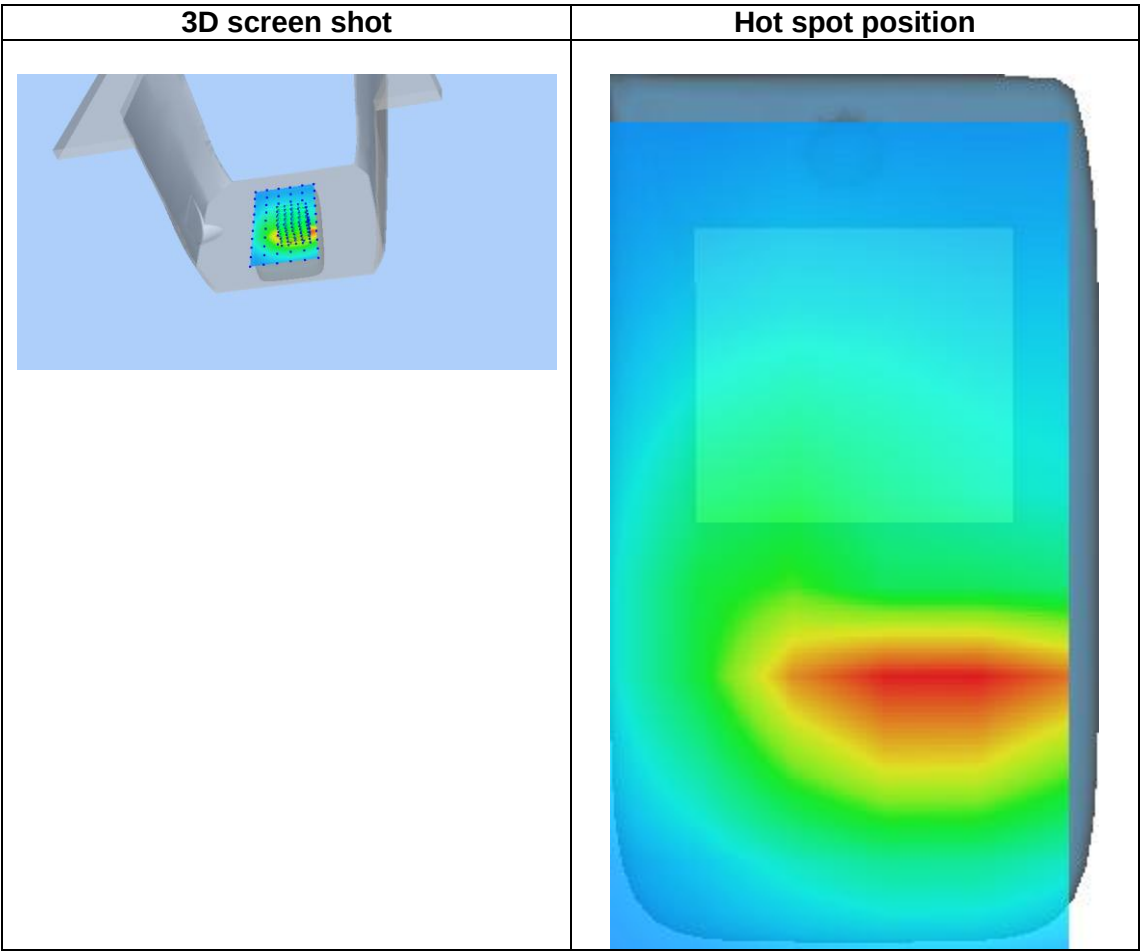
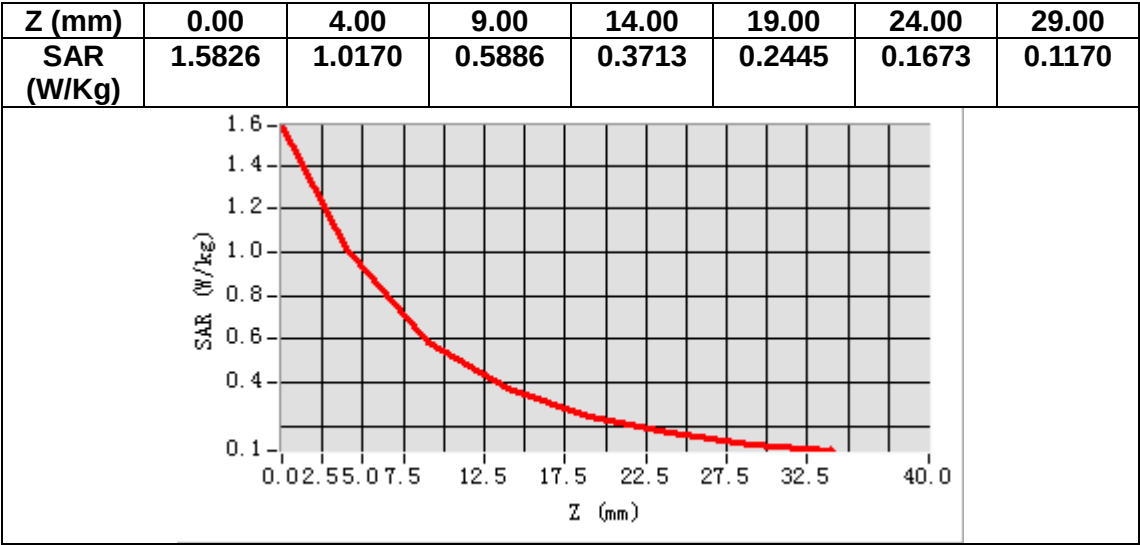
VOLUME SAR



Maximum location: X=11.00, Y=-29.00

SAR Peak: 1.57 W/kg

SAR 10g (W/Kg)	0.531540
SAR 1g (W/Kg)	0.974225



MEASUREMENT 8

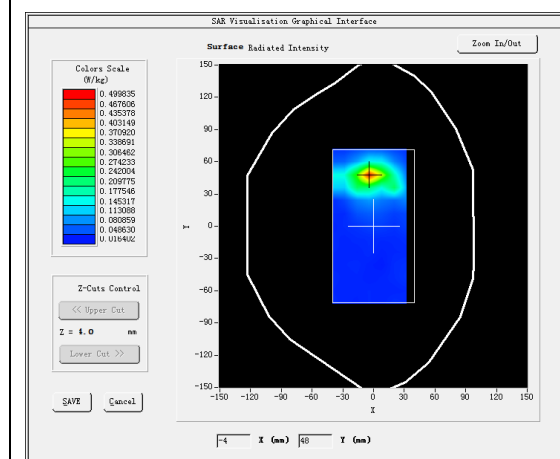
A. Experimental conditions.

<u>Area Scan</u>	<u>dx=12mm dy=12mm, h= 5.00 mm</u>
<u>ZoomScan</u>	<u>7x7x7,dx=5mm dy=5mm dz=5mm</u>
<u>Phantom</u>	<u>Validation plane</u>
<u>Device Position</u>	<u>Body</u>
<u>Band</u>	<u>LTE band 7</u>
<u>Channels</u>	<u>Middle</u>
<u>Signal</u>	<u>LTE (Crest factor: 1.0)</u>

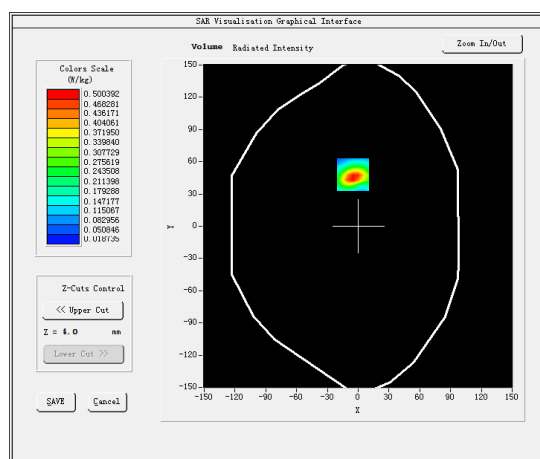
B. SAR Measurement Results

Frequency (MHz)	2535.000000
Relative permittivity (real part)	52.936947
Relative permittivity (imaginary part)	15.147840
Conductivity (S/m)	2.133321
Variation (%)	-2.330000

SURFACE SAR



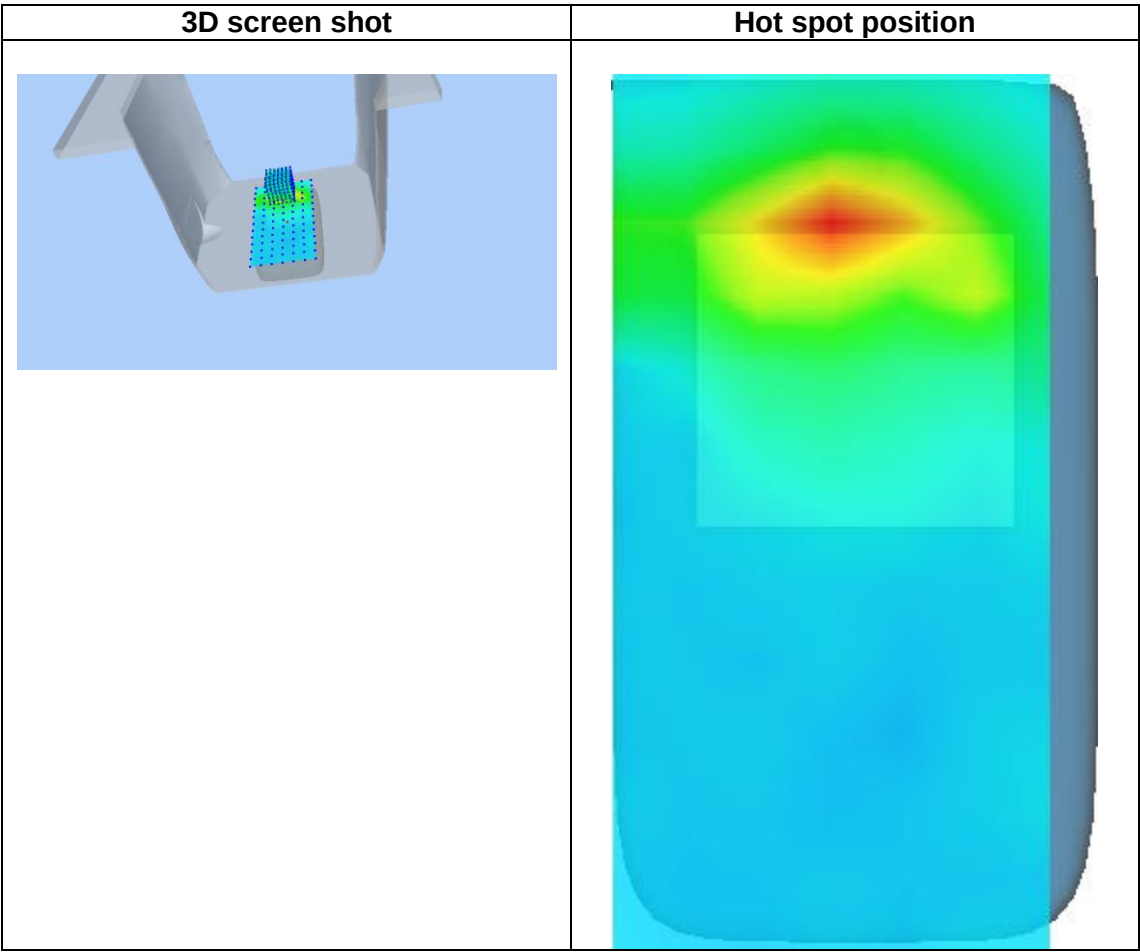
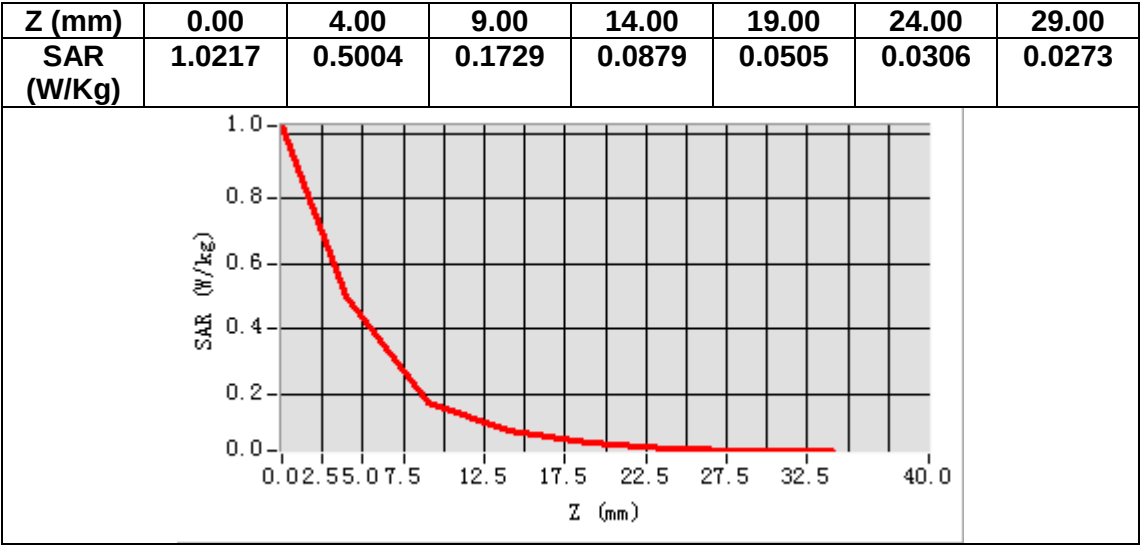
VOLUME SAR



Maximum location: X=-5.00, Y=48.00

SAR Peak: 0.98 W/kg

SAR 10g (W/Kg)	0.195822
SAR 1g (W/Kg)	0.478772



14. Appendix D. Calibration Certificate

Table of contents
E Field Probe - SN 41/18 EPGO330
835 MHz Dipole - SN 03/15 DIP 0G835-347
1900 MHz Dipole - SN 03/15 DIP 1G900-350
2450 MHz Dipole - SN 03/15 DIP 2G450-352
2600 MHz Dipole - SN 03/15 DIP 2G600-356
Extended Calibration Certificate



COMOSAR E-Field Probe Calibration Report

Ref : ACR.142.2.19.SATU.B

SHENZHEN NTEK TESTING TECHNOLOGY CO., LTD.
BUILDING E, FENDA SCIENCE PARK, SANWEI
COMMUNITY, XIXIANG STREET,
BAO'AN DISTRICT, SHENZHEN GUANGDONG, CHINA
MVG COMOSAR DOSIMETRIC E-FIELD PROBE
SERIAL NO.: SN 41/18 EPG0330

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



Calibration Date: 05/21/19

Summary:

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



COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.142.2.19.SATU.B

	<i>Name</i>	<i>Function</i>	<i>Date</i>	<i>Signature</i>
<i>Prepared by :</i>	Jérôme LUC	Product Manager	5/22/2019	
<i>Checked by :</i>	Jérôme LUC	Product Manager	5/22/2019	
<i>Approved by :</i>	Kim RUTKOWSKI	Quality Manager	5/22/2019	

	<i>Customer Name</i>
<i>Distribution :</i>	CCIC SOUTHERN TESTING CO., LTD

<i>Issue</i>	<i>Date</i>	<i>Modifications</i>
A	5/22/2019	Initial release
B	5/27/2019	Change customer name and address



COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.142.2.19.SATU.B

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COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.142.2.19.SATU.B

1 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR DOSIMETRIC E FIELD PROBE
Manufacturer	MVG
Model	SSE2
Serial Number	SN 41/18 EPGO330
Product Condition (new / used)	New
Frequency Range of Probe	0.15 GHz-6GHz
Resistance of Three Dipoles at Connector	Dipole 1: R1=0.186 MΩ Dipole 2: R2=0.191 MΩ Dipole 3: R3=0.201 MΩ

A yearly calibration interval is recommended.

2 PRODUCT DESCRIPTION

2.1 GENERAL INFORMATION

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



Figure 1 – MVG COMOSAR Dosimetric E field Dipole

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

3 MEASUREMENT METHOD

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

3.1 LINEARITY

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



COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.142.2.19.SATU.B

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%



COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.142.2.19.SATU.B

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

5 CALIBRATION MEASUREMENT RESULTS

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

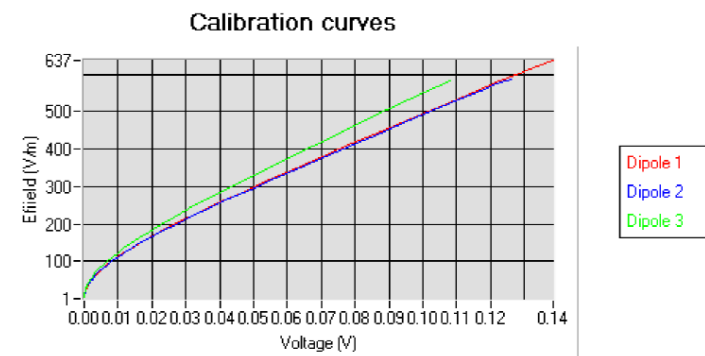
5.1 SENSITIVITY IN AIR

Normx dipole 1 ($\mu\text{V}/(\text{V}/\text{m})^2$)	Normy dipole 2 ($\mu\text{V}/(\text{V}/\text{m})^2$)	Normz dipole 3 ($\mu\text{V}/(\text{V}/\text{m})^2$)
0.92	0.79	0.63

DCP dipole 1 (mV)	DCP dipole 2 (mV)	DCP dipole 3 (mV)
90	97	92

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

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

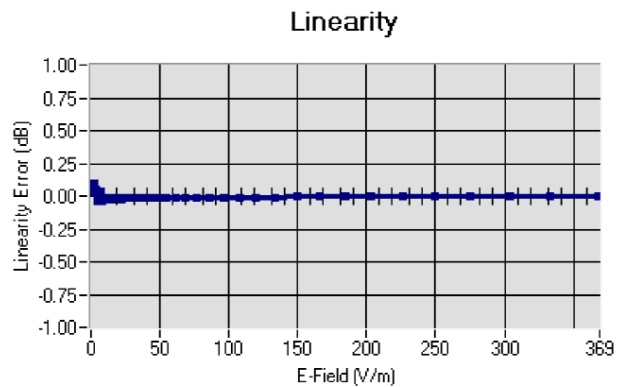




COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.142.2.19.SATU.B

5.2 LINEARITY

Linearity: $\pm 2.36\%$ ($\pm 0.10\text{dB}$)

5.3 SENSITIVITY IN LIQUID

Liquid	Frequency (MHz $\pm$ 100MHz)	Permittivity	Epsilon (S/m)	ConvF
HL750	750	40.76	0.93	1.54
BL750	750	56.70	0.98	1.59
HL850	835	40.86	0.92	1.60
BL850	835	56.35	0.99	1.64
HL900	900	42.84	0.95	1.61
BL900	900	53.25	1.05	1.65
HL1800	1800	39.56	1.40	1.74
BL1800	1800	52.84	1.45	1.81
HL1900	1900	39.67	1.38	2.03
BL1900	1900	52.84	1.59	2.08
HL2000	2000	38.71	1.42	1.86
BL2000	2000	52.03	1.52	1.92
HL2450	2450	38.72	1.80	2.05
BL2450	2450	54.91	1.97	2.12
HL2600	2600	39.98	1.89	2.06
BL2600	2600	54.42	2.18	2.11
HL5200	5200	36.68	4.45	1.85
BL5200	5200	49.02	5.46	1.92
HL5400	5400	36.08	4.69	1.75
BL5400	5400	49.55	5.53	1.83
HL5600	5600	35.34	4.95	1.88
BL5600	5600	47.60	5.77	1.95
HL5800	5800	34.81	5.08	1.89
BL5800	5800	47.81	6.12	1.94

LOWER DETECTION LIMIT: 9mW/kg

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The information contained herein is to be used only for the purpose for which it is submitted and is not to
be released in whole or part without written approval of MVG.*



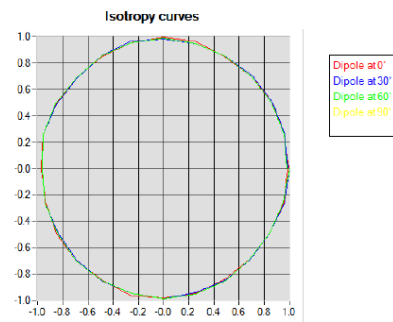
COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.142.2.19.SATU.B

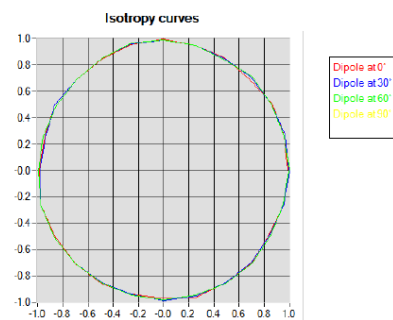
5.4 ISOTROPY

HL900 MHz

- Axial isotropy: 0.05 dB
- Hemispherical isotropy: 0.07 dB

**HL1800 MHz**

- Axial isotropy: 0.06 dB
- Hemispherical isotropy: 0.07 dB



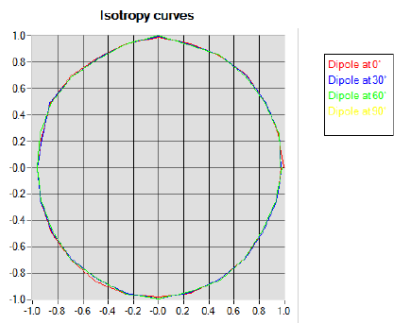


COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.142.2.19.SATU.B

HL5600 MHz

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





COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.142.2.19.SATU.B

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	02/2019	02/2022
Reference Probe	MVG	EP 94 SN 37/08	10/2017	10/2019
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



SAR Reference Dipole Calibration Report

Ref : ACR.109.2.18.SATU.A

SHENZHEN NTEK TESTING TECHNOLOGY CO., LTD.

BUILDING E, FENDA SCIENCE PARK, SANWEI
COMMUNITY, XIXIANG STREET,
BAO'AN DISTRICT, SHENZHEN GUANGDONG, CHINA
MVG COMOSAR REFERENCE DIPOLE

FREQUENCY: 835 MHZ

SERIAL NO.: SN 03/15 DIP 0G835-347

Calibrated at MVG US

2105 Barrett Park Dr. - Kennesaw, GA 30144



Calibration Date: 04/19/2018

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.



SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.109.2.18.SATU.A

	<i>Name</i>	<i>Function</i>	<i>Date</i>	<i>Signature</i>
<i>Prepared by :</i>	Jérôme LUC	Product Manager	4/19/2018	
<i>Checked by :</i>	Jérôme LUC	Product Manager	4/19/2018	
<i>Approved by :</i>	Kim RUTKOWSKI	Quality Manager	4/19/2018	

	<i>Customer Name</i>
<i>Distribution :</i>	SHENZHEN NTEK TESTING TECHNOLOGY CO., LTD.

<i>Issue</i>	<i>Date</i>	<i>Modifications</i>
A	4/19/2018	Initial release



SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.109.2.18.SATU.A

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