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： Medical Guardian FRG01000

Trademark： Omate

Model Name： O3VC

Serial Model： S4, Medical Guardian FRG01000

Report No.： SER180108603001E

FCC ID： 2ABF5-O3VC

Prepared for

Omate Limited

Room 1101,11/F San Toi Building, No.139 Connaught Road, HongKong

Prepared by

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TEST RESULT CERTIFICATION

Applicant's name .....:	Omate Limited
Address.....:	Room 1101,11/F San Toi Building, No.139 Connaught Road, HongKong
Manufacturer's Name.....:	Omate Limited
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Product description

Product name.....:	Medical Guardian FRG01000
Trademark .....:	Omate
Model and/or type reference .:	O3VC
Serial Model.....:	S4, Medical Guardian FRG01000
Standards .....:	FCC 47 CFR Part 2(2.1093) ANSI/IEEE C95.1-1992 IEEE Std 1528-2013 Published RF exposure KDB procedures

This device described above has been tested by 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 .....:	Jan. 23, 2018 ~ Jan. 25, 2018
Date of Issue .....:	Feb. 08, 2018
Test Result.....:	**Pass**

Prepared By (Test Engineer) : Cheng Jiawen

(Cheng Jiawen)

Approved By (Lab Manager) : Sam. Chen

(Sam Chen)

※ ※ Revision History ※ ※

REV.	DESCRIPTION	ISSUED DATE	REMARK
Rev.1.0	Initial Test Report Release	Feb. 08, 2018	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

Face Limit 1.6 W/kg and Wristbands 4.0W/kg

APPLIED TO THIS EUT

1.2. Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for O3VC are as follows.

Band	Max Reported SAR Value(W/kg)		Max. SAR Summation
	1-g Front-of-Face (Separation distance of 10mm)	10-g Back-of-Wristbands (Separation distance of 0mm)	
GSM 850	0.114	0.152	1.391
GSM 1900	0.459	0.953	
WCDMA Band V	0.026	0.420	
WCDMA Band II	0.285	0.986	
WLAN 2.4G	0.364	0.405	

NOTE: The Max. SAR Summation 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	Medical Guardian FRG01000		
Trademark	Omate		
Model Name	O3VC		
Serial Model	S4, Medical Guardian FRG01000		
FCC ID	2ABF5-O3VC		
Device Phase	Identical Prototype		
Exposure Category	General population / Uncontrolled environment		
Antenna	LDS Antenna		
Battery Information	DC 3.7V, 580mAh		
Device Operating Configurations			
Supporting Mode(s)	GSM 850/1900, WCDMA Band V/II, WLAN 2.4G, Bluetooth		
Test Modulation	GSM(GMSK), WCDMA(QPSK), WLAN(DSSS/OFDM), Bluetooth (GFSK, π/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 V	824-849	869-894
	WCDMA Band II	1850-1910	1930-1990
	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	
HSDPA UE Category	14		
HSUPA UE Category	6		
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 V)		
	3, tested with power control “all 1”(WCDMA Band II)		
Test Channels (low-mid-high)	128-189-251(GSM 850)		
	512-661-810(GSM 1900)		
	4132-4182-4233(WCDMA Band V)		
	9262-9400-9538(WCDMA Band II)		
	802.11 b/g/n:1-6-11(WLAN 2.4G)		

1.4. Test specification(s)

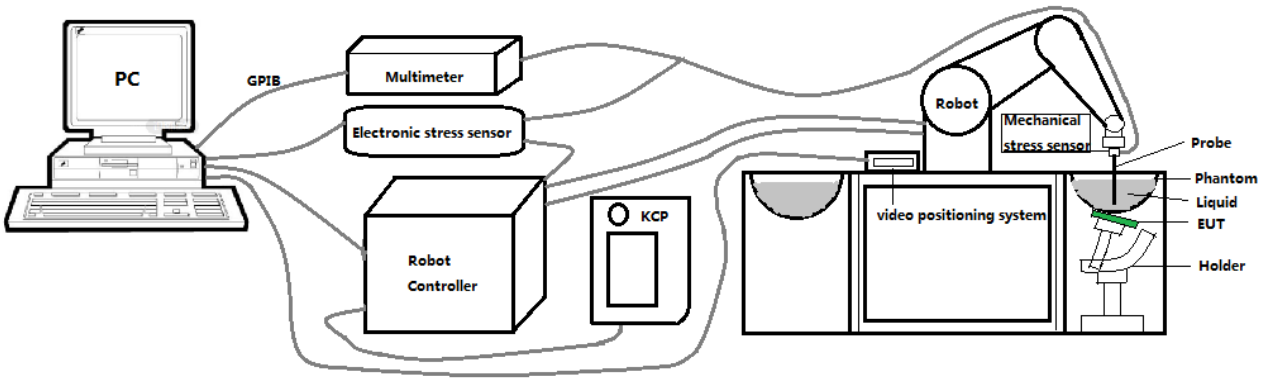
FCC 47 CFR Part 2(2.1093)
ANSI/IEEE C95.1-1992
IEEE Std 1528-2013
KDB 865664 D01 SAR measurement 100 MHz to 6 GHz
KDB 865664 D02 RF Exposure Reporting
KDB 447498 D01 General RF Exposure Guidance
KDB 248227 D01 802.11 Wi-Fi SAR
KDB 941225 D01 3G SAR Procedures

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 08/16 EPGO287 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: ±0.08 dB
- Axial isotropy: <0.25 dB
- Hemispherical Isotropy: <0.50 dB
- Calibration range: 650MHz to 5900MHz for head & body simulating liquid.
- Lower detection limit: 7mW/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 ±10%. The spherical isotropy shall be evaluated and within ±0.25dB. 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.

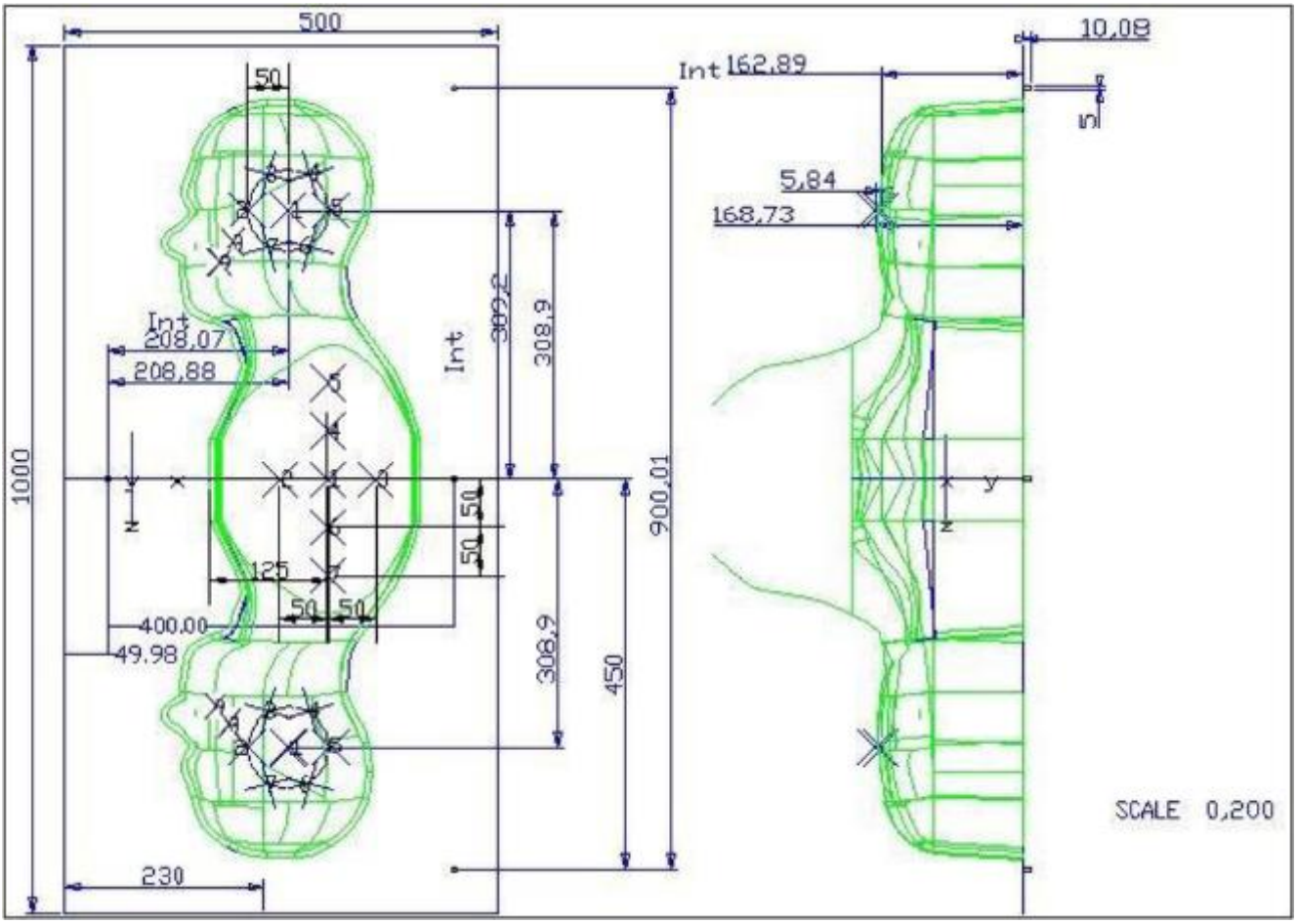
2.4. SAM phantoms

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 ±0.2 mm	27 liters	Length:1000 mm Width:500 mm Height:200 mm	Gelcoat with fiberglass	3.4	0.02

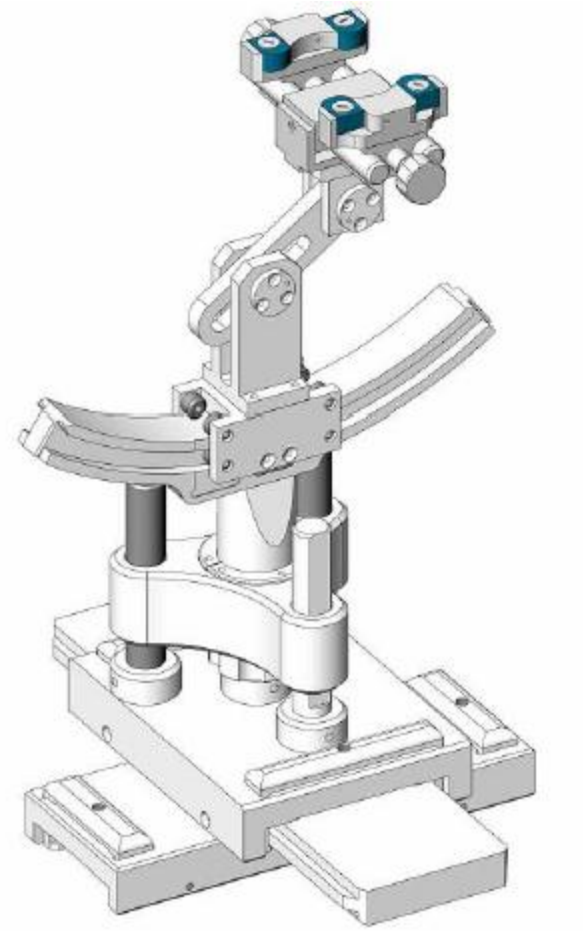


Serial Number	Left Head		Right Head		Flat Part	
SN 16/15 SAM119	2	2.02	2	2.08	1	2.09
	3	2.05	3	2.06	2	2.06
	4	2.07	4	2.07	3	2.08
	5	2.08	5	2.08	4	2.10
	6	2.05	6	2.07	5	2.10
	7	2.05	7	2.05	6	2.07
	8	2.07	8	2.06	7	2.07
	9	2.08	9	2.06	-	-

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

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 08/16 EPGO287	Sep. 18, 2017	Sep. 17, 2018
☐	MVG	450 MHz Dipole	SID450	SN 03/15 DIP 0G450-345	Apr. 06, 2015	Apr. 05, 2018
☐	MVG	750 MHz Dipole	SID750	SN 03/15 DIP 0G750-355	Apr. 06, 2015	Apr. 05, 2018
☒	MVG	835 MHz Dipole	SID835	SN 03/15 DIP 0G835-347	Apr. 06, 2015	Apr. 05, 2018
☐	MVG	900 MHz Dipole	SID900	SN 03/15 DIP 0G900-348	Apr. 06, 2015	Apr. 05, 2018
☐	MVG	1800 MHz Dipole	SID1800	SN 03/15 DIP 1G800-349	Apr. 06, 2015	Apr. 05, 2018
☒	MVG	1900 MHz Dipole	SID1900	SN 03/15 DIP 1G900-350	Apr. 06, 2015	Apr. 05, 2018
☐	MVG	2000 MHz Dipole	SID2000	SN 03/15 DIP 2G000-351	Apr. 06, 2015	Apr. 05, 2018
☒	MVG	2450 MHz Dipole	SID2450	SN 03/15 DIP 2G450-352	Apr. 06, 2015	Apr. 05, 2018
☐	MVG	2600 MHz Dipole	SID2600	SN 03/15 DIP 2G600-356	Apr. 06, 2015	Apr. 05, 2018
☐	MVG	5000 MHz Dipole	SWG5500	SN 13/14 WGA 33	Apr. 06, 2015	Apr. 05, 2018
☒	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. 07, 2017	Aug. 06, 2018
☐	R&S	Wideband radio communication tester	CMW500	103917	Oct. 26, 2017	Oct. 25, 2018
☒	HP	Network Analyzer	8753D	3410J01136	Aug. 07, 2017	Aug. 06, 2018

☒	Agilent	PSG Analog Signal Generator	E8257D	MY51110112	Aug. 07, 2017	Aug. 06, 2018
☒	Agilent	Power meter	E4419B	MY45102538	Aug. 07, 2017	Aug. 06, 2018
☒	Agilent	Power sensor	E9301A	MY41495644	Aug. 07, 2017	Aug. 06, 2018
☒	Agilent	Power sensor	E9301A	US39212148	Aug. 07, 2017	Aug. 06, 2018
☒	MCLI/USA	Directional Coupler	CB11-20	0D2L51502	Aug. 07, 2017	Aug. 06, 2018

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 Wi-Fi/BT power measurement, use engineering software to configure EUT Wi-Fi/BT 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 Wi-Fi/BT output power.

<SAR measurement>
(a) Use base station simulator to configure EUT WWAN transmission in radiated connection, and engineering software to configure EUT Wi-Fi/BT 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.

<table>
<tr><td colspan="3"></td><td>≤ 3 GHz</td><td>> 3 GHz</td></tr>
<tr><td colspan="3">Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface</td><td>5 ± 1 mm</td><td>½·δ·ln(2) ± 0.5 mm</td></tr>
<tr><td colspan="3">Maximum probe angle from probe axis to phantom surface normal at the measurement location</td><td>30° ± 1°</td><td>20° ± 1°</td></tr>
<tr><td colspan="3" rowspan="2">Maximum area scan spatial resolution: Δx_{Area}, Δy_{Area}</td><td>≤ 2 GHz: ≤ 15 mm
2 – 3 GHz: ≤ 12 mm</td><td>3 – 4 GHz: ≤ 12 mm
4 – 6 GHz: ≤ 10 mm</td></tr>
<tr><td colspan="2">When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device.</td></tr>
<tr><td colspan="3">Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}</td><td>≤ 2 GHz: ≤ 8 mm
2 – 3 GHz: ≤ 5 mm*</td><td>3 – 4 GHz: ≤ 5 mm*
4 – 6 GHz: ≤ 4 mm*</td></tr>
<tr><td rowspan="3">Maximum zoom scan spatial resolution, normal to phantom surface</td><td colspan="2">uniform grid: $\Delta z_{Zoom}(n)$</td><td>≤ 5 mm</td><td>3 – 4 GHz: ≤ 4 mm
4 – 5 GHz: ≤ 3 mm
5 – 6 GHz: ≤ 2 mm</td></tr>
<tr><td rowspan="2">graded grid</td><td>$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface</td><td>≤ 4 mm</td><td>3 – 4 GHz: ≤ 3 mm
4 – 5 GHz: ≤ 2.5 mm
5 – 6 GHz: ≤ 2 mm</td></tr>
<tr><td>$\Delta z_{Zoom}(n>1)$: between subsequent points</td><td colspan="2">≤ 1.5·$\Delta z_{Zoom}(n-1)$</td></tr>
<tr><td>Minimum zoom scan volume</td><td colspan="2">x, y, z</td><td>≥ 30 mm</td><td>3 – 4 GHz: ≥ 28 mm
4 – 5 GHz: ≥ 25 mm
5 – 6 GHz: ≥ 22 mm</td></tr>
<tr><td colspan="5">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 <u>reported</u> 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.</td></tr>
</table>

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 ±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
Water	34.40	34.40	34.40	55.36	55.36	57.87	57.87	57.87
NaCl	0.79	0.79	0.79	0.35	0.35	0.16	0.16	0.16
1,2-Propanediol	64.81	64.81	64.81	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
DGBE	0.00	0.00	0.00	13.84	13.84	22.00	22.00	22.00
Ingredients (% of weight)	Body Tissue							
Frequency Band (MHz)	750	835	900	1800	1900	2000	2450	2600
Water	50.30	50.30	50.30	69.91	69.91	71.88	71.88	71.88
NaCl	0.60	0.60	0.60	0.13	0.13	0.16	0.16	0.16
1,2-Propanediol	49.10	49.10	49.10	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
DGBE	0.00	0.00	0.00	19.97	19.97	7.99	7.99	7.99

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 of the dielectric parameter are within the tolerances of the specified target values. The measured conductivity and relative permittivity should be within ±5% of the target values.

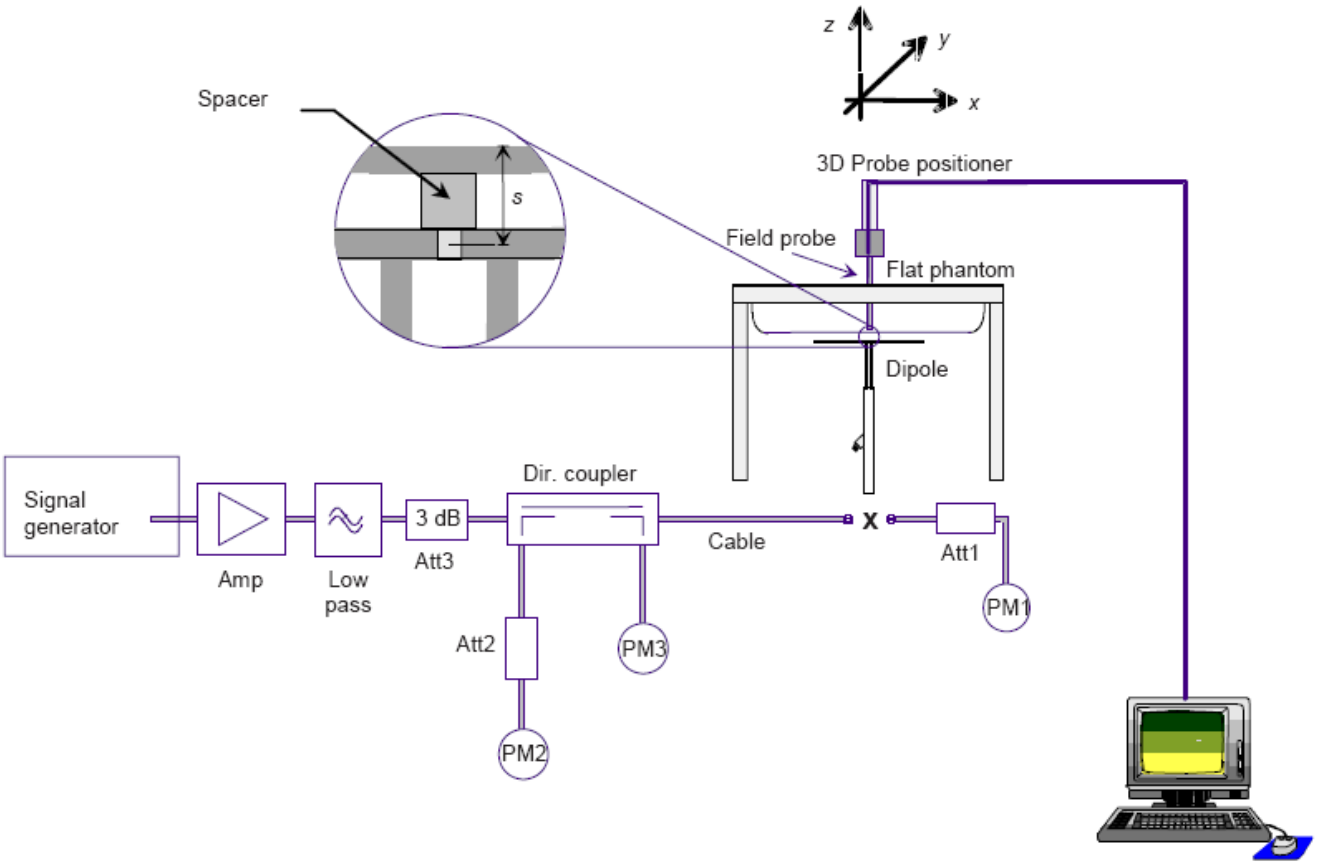
Tissue Type	Measured Frequency (MHz)	Target Tissue		Measured Tissue		Liquid Temp.	Test Date
		εr (±5%)	σ (S/m) (±5%)	εr	σ (S/m)		
Head 850	835	41.50 (39.43~43.57)	0.90 (0.86~0.94)	41.77	0.90	21.4 °C	Jan. 24, 2018
Body 850	835	55.20 (52.44~57.96)	0.97 (0.92~1.01)	55.06	0.99	21.3 °C	Jan. 24, 2018
Head 1900	1900	40.00 (38.00~42.00)	1.40 (1.33~1.47)	39.40	1.43	21.2 °C	Jan. 25, 2018
Body 1900	1900	53.30 (50.64~55.96)	1.52 (1.44~1.59)	53.19	1.55	21.4 °C	Jan. 25, 2018
Head 2450	2450	39.20 (37.24~41.16)	1.80 (1.71~1.89)	39.49	1.78	21.4 °C	Jan. 23, 2018
Body 2450	2450	52.70 (50.07~55.33)	1.95 (1.85~2.04)	52.66	1.95	21.4 °C	Jan. 23, 2018

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 ±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) (±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 Head	9.56 (8.60~10.51)	6.22 (5.60~6.84)	9.84	6.24	21.4 °C	Jan. 24, 2018
835MHz Body	9.48 (8.53~10.42)	6.29 (5.66~6.91)	9.31	6.21	21.3 °C	Jan. 24, 2018
1900MHz Head	39.70 (35.73~43.67)	20.50 (18.45~22.55)	38.50	19.15	21.2 °C	Jan. 25, 2018
1900MHz Body	38.43 (34.59~42.27)	20.34 (18.31~22.37)	39.63	18.87	21.4 °C	Jan. 25, 2018
2450MHz Head	52.40 (47.16~57.64)	24.00 (21.60~26.40)	51.53	24.05	21.4 °C	Jan. 23, 2018
2450MHz Body	49.32 (44.39~54.25)	22.89 (20.60~25.17)	50.15	22.21	21.4 °C	Jan. 23, 2018

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 (~ 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. Wrist watch and wrist-worn transmitters

Refer to KDB 447498 D01. Transmitters that are built-in within a wrist watch or similar wrist-worn devices typically operate in speaker mode for voice communication, with the device worn on the wrist and positioned next to the mouth. Next to the mouth exposure requires 1-g SAR and the wrist-worn condition requires 10-g extremity SAR. The 10-g extremity and 1-g SAR test exclusions may be applied to the wrist and face exposure conditions. When SAR evaluation is required, next to the mouth use is evaluated with the front of the device positioned at 10 mm from a flat phantom filled with head tissue-equivalent medium. The wrist bands should be strapped together to represent normal use conditions. SAR for wrist exposure is evaluated with the back of the device positioned in direct contact against a flat phantom filled with body tissue-equivalent medium. The wrist bands should be unstrapped and touching the phantom.

7. RF Output Power

7.1. Maximum Tune-up Limit

Band	Mode	The Tune-up Maximum Power (Customer Declared)(dBm)	Range	Measured Maximum Output Power(dBm)
GSM 850	GSM (GMSK)	32±1	31~33	32.09
	GPRS(GMSK, 1 Tx slot)	32±1	31~33	32.09
	GPRS(GMSK, 2 Tx slot)	31±1	30~32	31.20
	GPRS(GMSK, 3 Tx slot)	29±1	28~30	29.52
	GPRS(GMSK, 4 Tx slot)	28±1	27~29	28.53
GSM 1900	GSM (GMSK)	29±1	28~30	29.05
	GPRS(GMSK, 1 Tx slot)	29±1	28~30	29.04
	GPRS(GMSK, 2 Tx slot)	28±1	27~29	28.51
	GPRS(GMSK, 3 Tx slot)	27±1	26~28	27.31
	GPRS(GMSK, 4 Tx slot)	26±1	25~27	26.51
WCDMA Band V	RMC 12.2Kbps	22±1	21~23	22.91
	HSDPA Subtest-1	21±1	20~22	21.92
	HSDPA Subtest-2	21±1	20~22	21.44
	HSDPA Subtest-3	21±1	20~22	21.46
	HSDPA Subtest-4	21±1	20~22	21.51
	HSUPA Subtest-1	21±1	20~22	21.44
	HSUPA Subtest-2	21±1	20~22	21.42
	HSUPA Subtest-3	21±1	20~22	21.38
	HSUPA Subtest-4	21±1	20~22	21.45
	HSUPA Subtest-5	21±1	20~22	21.89
WCDMA Band V	RMC 12.2Kbps	22±1	21~23	22.96
	HSDPA Subtest-1	21±1	20~22	21.93
	HSDPA Subtest-2	21±1	20~22	21.49
	HSDPA Subtest-3	21±1	20~22	21.53
	HSDPA Subtest-4	21±1	20~22	21.48
	HSUPA Subtest-1	21±1	20~22	21.50
	HSUPA Subtest-2	21±1	20~22	21.48
	HSUPA Subtest-3	21±1	20~22	21.45
	HSUPA Subtest-4	21±1	20~22	21.51
	HSUPA Subtest-5	21±1	20~22	21.92
WLAN 2.4G	802.11b	14.5±1	13.5~15.5	15.1
	802.11g	12.5±1	11.5~13.5	12.8
	802.11n-HT20	12.5±1	11.5~13.5	12.6

	802.11n-HT40	10.5±1	9.5~11.5	11.3
Bluetooth	BDR+EDR	3±1	2~4	3.19
	BLE	-5±1	-6~-4	-4.53

7.2. GSM Conducted Power

Per KDB 447498 D01, the maximum output power (including tune-up tolerance) channel is used for SAR testing and for further SAR test reduction. Therefore, the EUT was set in GSM850 GPRS (4TS) and GSM1900 GPRS (4TS).

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)	33.00	32.06	32.09	32.05	23.97	23.03	23.06	23.02
GPRS(GMSK, 1 TS)	33.00	32.06	32.09	32.05	23.97	23.03	23.06	23.02
GPRS(GMSK, 2 TS)	32.00	31.20	31.20	31.18	25.98	25.18	25.18	25.16
GPRS(GMSK, 3 TS)	30.00	29.52	29.46	29.38	25.74	25.26	25.20	25.12
GPRS(GMSK, 4 TS)	29.00	28.53	28.51	28.43	25.99	25.52	25.50	25.42
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)	30.00	28.69	29.05	29.02	20.97	19.66	20.02	19.99
GPRS(GMSK, 1 TS)	30.00	28.69	29.04	29.01	20.97	19.66	20.01	19.98
GPRS(GMSK, 2 TS)	29.00	28.12	28.48	28.51	22.98	22.10	22.46	22.49
GPRS(GMSK, 3 TS)	28.00	27.31	27.24	27.28	23.74	23.05	22.98	23.02
GPRS(GMSK, 4 TS)	27.00	26.44	26.39	26.51	23.99	23.43	23.38	23.50

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

7.3. WCDMA Conducted Power

The following tests were conducted according to the test requirements outlines in 3GPP TS 34.121 specification. A summary of these settings are illustrated below:

1. Release99 Setup Configuration

Mode	Subtest	Rel99
WCDMA General Settings	Loopback Mode	Test Mode 1
	Rel99 RMC	12.2kbps RMC
	Power Control Algorithm	Algorithm2
	βc/βd	8/15

2. HSDPA Setup Configuration

	Mode	HSDPA	HSDPA	HSDPA	HSDPA
	Subtest	1	2	3	4
WCDMA General Settings	Loopback Mode	Test Mode 1			
	Rel99 RMC	12.2kbps RMC			
	HSDPA FRC	H-Set1			
	Power Control Algorithm	Algorithm 2			
	βc	2/15	12/15	15/15	15/15
	βd	15/15	15/15	8/15	4/15
	Bd (SF)	64			
	βc/βd	2/15	12/15	15/8	15/4
	βhs	4/15	24/15	30/15	30/15
HSDPA Specific Settings	D_{ACK}	8			
	D_{NAK}	8			
	DCQI	8			
	Ack-Nack repetition factor	3			
	CQI Feedback (Table 5.2B.4)	4ms			
	CQI Repetition Factor (Table 5.2B.4)	2			
	Ahs =βhs/βc	30/15			

3. HSUPA Setup Configuration

	Mode	HSUPA	HSUPA	HSUPA	HSUPA	HSUPA
	Subtest	1	2	3	4	5
WCDMA General Settings	Loopback Mode	Test Mode 1				
	Rel99 RMC	12.2kbps RMC				
	HSDPA FRC	H-Set1				
	HSUPA Test	HSUPA Loopback				
	Power Control Algorithm	Algorithm2				
	βc	11/15	6/15	15/15	2/15	15/15
	βd	15/15	15/15	9/15	15/15	15/15
	βec	209/225	12/15	30/15	2/15	24/15
	βc/βd	11/15	6/15	15/9	2/15	15/15
	βhs	22/15	12/15	30/15	4/15	30/15
	βed	1309/225	94/75	47/15 47/15	56/75	134/15
	CM (dB)	1.0	3.0	2.0	3.0	1.0
HSDPA Specific Settings	D_{ACK}	8				
	D_{NAK}	8				
	DCQI	8				
	Ack-Nack repetition factor	3				
	CQI Feedback (Table 5.2B.4)	4ms				
	CQI Repetition Factor (Table 5.2B.4)	2				
	Ahs = βhs/βc	30/15				
HSUPA Specific Settings	D E-DPCCH	6	8	8	5	7
	DHARQ	0	0	0	0	0
	AG Index	20	12	15	17	21
	ETFCI (from 34.121 Table C.11.1.3)	75	67	92	71	81
	Associated Max UL Data Rate kbps	242.1	174.9	482.8	205.8	308.9

4. WCDMA Conducted Power Results

1) Per KDB 941225 D01, SAR for Head / Hotspot / Body-worn exposure is measured using a 12.2 kbps RMC with TPC bits configured to all “1’s”.

2) Per KDB 941225 D01, RMC 12.2kbps setting is used to evaluate SAR. If the maximum output power and tune-up tolerance specified for production units in HSDPA / HSUPA is ≤ ¼ dB higher than RMC 12.2Kbps or when the highest reported SAR of the RMC12.2Kbps is scaled by the ratio of specified maximum output power and tune-up tolerance of HSDPA / HSUPA to RMC12.2Kbps and the adjusted SAR is ≤ 1.2 W/kg, SAR measurement is not required for HSDPA / HSUPA.

Band	WCDMA Band V			
Tx Channel	Tune-up	4132	4182	4233
Frequency (MHz)		826.4	836.4	846.6
RMC 12.2Kbps	23.00	22.91	22.75	22.51
HSDPA Subtest-1	22.00	21.92	21.79	21.44
HSDPA Subtest-2	22.00	21.44	21.33	20.95
HSDPA Subtest-3	22.00	21.46	21.35	20.96
HSDPA Subtest-4	22.00	21.51	21.32	20.98
HSUPA Subtest-1	22.00	21.44	21.33	21.01
HSUPA Subtest-2	22.00	21.42	21.32	21.05
HSUPA Subtest-3	22.00	21.38	21.35	21.07
HSUPA Subtest-4	22.00	21.45	21.28	20.95
HSUPA Subtest-5	22.00	21.89	21.82	21.53
Band	WCDMA Band II			
Tx Channel	Tune-up	9262	9400	9538
Frequency (MHz)		1852.4	1880	1907.6
RMC 12.2Kbps	23.00	22.58	22.92	22.96
HSDPA Subtest-1	22.00	21.66	21.91	21.93
HSDPA Subtest-2	22.00	21.11	21.38	21.49
HSDPA Subtest-3	22.00	21.15	21.40	21.53
HSDPA Subtest-4	22.00	21.12	21.35	21.48
HSUPA Subtest-1	22.00	21.21	21.39	21.50
HSUPA Subtest-2	22.00	21.25	21.27	21.48
HSUPA Subtest-3	22.00	21.18	21.35	21.45
HSUPA Subtest-4	22.00	21.21	21.31	21.51
HSUPA Subtest-5	22.00	21.65	21.92	21.92

7.4. WLAN & Bluetooth Output Power

7.4.1. Output Power Results Of WLAN

The output power of WLAN is as following:

Mode	Channel	Frequency (MHz)	Tune-up	Output Power (dBm)
802.11b	1	2412	15.5	14.5
	6	2437	15.5	14.7
	11	2462	15.5	15.1
802.11g	1	2412	13.5	12.6
	6	2437	13.5	12.4
	11	2462	13.5	12.8
802.11n (HT20)	1	2412	13.5	11.7
	6	2437	13.5	12.6
	11	2462	13.5	12.6
802.11n (HT40)	3	2422	11.5	10.6
	6	2437	11.5	11.0
	9	2452	11.5	11.3

7.4.2. Output Power Results Of Bluetooth

The output power of Bluetooth is as following:

	Output Power (dBm)				
BDR+EDR	Channel	Tune-up	Data Rates		
			0CH	39CH	78CH
	1M	4.00	2.73	3.19	2.89
	2M	4.00	2.31	2.66	2.23
	3M	4.00	2.55	2.99	2.65

	Channel	Tune-up	Output Power (dBm)
BLE	0CH	-4.00	-4.53
	19CH	-4.00	-4.57
	39CH	-4.00	-5.14

8. Antenna Location

9. Standalone SAR test exclusion and estimated

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:

[(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)]·[$\sqrt{f_{(GHZ)}}$] ≤ 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.

Mode	P_{max} (dBm)	P_{max} (mW)	Distance (mm)	f (GHz)	Calculation Result	SAR Exclusion threshold	SAR test exclusion
Bluetooth	4	2.51	5	2.480	0.79	3.0	Yes
Bluetooth	4	2.51	5	2.480	0.79	7.5	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:

[(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] * [$\sqrt{f_{(GHZ)}}$/x] W/kg for test separation distances ≤ 50mm, 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	Front-of-Face	4	2.51	10	2.480	7.5	0.053
Bluetooth	Back-of-Wristbands	4	2.51	5	2.480	18.75	0.042

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 Front-of-Face with 10mm							
Test channel /Freq.	Test Mode	SAR Value (W/kg)		Power Drift (±5%)	Conducted power (dBm)	Tune-up power (dBm)	Scaled SAR 1-g (W/Kg)
		1-g	10-g				
128/824.2	GPRS(GMSK 4TS)	0.102	0.077	-0.08	28.53	29.00	0.114
Test Position of Back-of-Wristbands with 0mm							
Test channel /Freq.	Test Mode	SAR Value (W/kg)		Power Drift (±5%)	Conducted power (dBm)	Tune-up power (dBm)	Scaled SAR 10-g (W/Kg)
		1-g	10-g				
128/824.2	GPRS(GMSK 4TS)	0.219	0.136	3.40	28.53	29.00	0.152

10.1.2. SAR measurement Result of GSM1900

Test Position of Front-of-Face with 10mm							
Test channel /Freq.	Test Mode	SAR Value (W/kg)		Power Drift (±5%)	Conducted power (dBm)	Tune-up power (dBm)	Scaled SAR 1-g (W/Kg)
		1-g	10-g				
810/1909.8	GPRS(GMSK 4TS)	0.410	0.221	-3.86	26.51	27.00	0.459
Test Position of Back-of-Wristbands with 0mm							
Test channel /Freq.	Test Mode	SAR Value (W/kg)		Power Drift (±5%)	Conducted power (dBm)	Tune-up power (dBm)	Scaled SAR 10-g (W/Kg)
		1-g	10-g				
810/1909.8	GPRS(GMSK 4TS)	1.455	0.851	3.08	26.51	27.00	0.953

10.1.3. SAR measurement Result of WCDMA Band V

Test Position of Front-of-Face with 10mm							
Test channel /Freq.	Test Mode	SAR Value (W/kg)		Power Drift (±5%)	Conducted power (dBm)	Tune-up power (dBm)	Scaled SAR 1-g (W/Kg)
		1-g	10-g				
4132/826.4	RMC12.2K	0.025	0.014	-4.75	22.91	23.00	0.026
Test Position of Back-of-Wristbands with 0mm							
Test channel /Freq.	Test Mode	SAR Value (W/kg)		Power Drift (±5%)	Conducted power (dBm)	Tune-up power (dBm)	Scaled SAR 10-g (W/Kg)
		1-g	10-g				
4132/826.4	RMC12.2K	0.712	0.411	0.38	22.91	23.00	0.420

10.1.4. SAR measurement Result of WCDMA Band II

Test Position of Front-of-Face with 10mm							
Test channel /Freq.	Test Mode	SAR Value (W/kg)		Power Drift (±5%)	Conducted power (dBm)	Tune-up power (dBm)	Scaled SAR 1-g (W/Kg)
		1-g	10-g				
9538/1907.6	RMC12.2K	0.282	0.150	-2.32	22.96	23.00	0.285
Test Position of Back-of-Wristbands with 0mm							
Test channel /Freq.	Test Mode	SAR Value (W/kg)		Power Drift (±5%)	Conducted power (dBm)	Tune-up power (dBm)	Scaled SAR 10-g (W/Kg)
		1-g	10-g				
9538/1907.6	RMC12.2K	1.785	0.977	-0.06	22.96	23.00	0.986

10.1.5. SAR measurement Result of WLAN 2.4G

Test Position of Front-of-Face with 10mm							
Test channel /Freq.	Test Mode	SAR Value (W/kg)		Power Drift (±5%)	Conducted power (dBm)	Tune-up power (dBm)	Scaled SAR 1-g (W/Kg)
		1-g	10-g				
11/2462	802.11 b	0.332	0.138	-4.24	15.10	15.50	0.364
Test Position of Back-of-Wristbands with 0mm							
Test channel /Freq.	Test Mode	SAR Value (W/kg)		Power Drift (±5%)	Conducted power (dBm)	Tune-up power (dBm)	Scaled SAR 10-g (W/Kg)
		1-g	10-g				
11/2462	802.11 b	1.099	0.369	-2.41	15.10	15.50	0.405

10.2. Simultaneous Transmission Analysis

1) This device supported VoIP in GPRS and WCDMA (e.g. 2rd party VoIP).
2) WLAN 2.4GHz and Bluetooth share the same antenna, and cannot transmit simultaneously.
3) EUT will choose each GSM and WCDMA according to the network signal condition; therefore, they will not operate simultaneously at any moment.
4) The Scaled SAR summation is calculated based on the same configuration and test position.

10.3. SAR Summation Scenario

Refer to FCC KDB 447498D01, simultaneous transmission SAR is compliant if,

1) Scalar SAR summation < 1.6W/kg for 1-g SAR, and < 4.0W/kg for 10-g SAR.
2) SPLSR = $(SAR_1 + SAR_2)^{1.5}$ / (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≤0.04 for 1-g SAR and SPLSR≤ 0.10 for 10-g SAR, simultaneously transmission SAR measurement is not necessary.

Test Position	Scaled SAR_{MAX}		∑1-g SAR (W/Kg)	SPLSR	Remark
	GSM 850	WLAN 2.4G			
Front-of-Face	0.114	0.364	0.478	n/a	n/a

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

Test Position	Scaled SAR_{MAX}		∑1-g SAR (W/Kg)	SPLSR	Remark
	GSM 1900	WLAN 2.4G			
Front-of-Face	0.459	0.364	0.823	n/a	n/a

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

Test Position	Scaled SAR_{MAX}		∑1-g SAR (W/Kg)	SPLSR	Remark
	WCDMA Band V	WLAN 2.4G			
Front-of-Face	0.026	0.364	0.390	n/a	n/a

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

Test Position	Scaled SAR_{MAX}		∑1-g SAR (W/Kg)	SPLSR	Remark
	WCDMA Band II	WLAN 2.4G			
Front-of-Face	0.285	0.364	0.649	n/a	n/a

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

Test Position	Scaled SAR_{MAX}		∑1-g SAR (W/Kg)	SPLSR	Remark
	GSM 850	Bluetooth			
Front-of-Face	0.114	0.053	0.166	n/a	n/a

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

Test Position	Scaled SAR_{MAX}		∑1-g SAR (W/Kg)	SPLSR	Remark
	GSM 1900	Bluetooth			
Front-of-Face	0.459	0.053	0.512	n/a	n/a

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

Test Position	Scaled SAR_{MAX}		∑1-g SAR (W/Kg)	SPLSR	Remark
	WCDMA Band V	Bluetooth			
Front-of-Face	0.026	0.053	0.078	n/a	n/a

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

Test Position	Scaled SAR_{MAX}		∑1-g SAR (W/Kg)	SPLSR	Remark
	WCDMA Band II	Bluetooth			
Front-of-Face	0.285	0.053	0.337	n/a	n/a

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

Test Position	Scaled SAR_{MAX}		∑10-g SAR (W/Kg)	SPLSR	Remark
	GSM 850	WLAN 2.4G			
Back-of-Wristbands	0.152	0.405	0.556	n/a	n/a

NOTE: 10-g SAR Simultaneous Tx Combination of GSM850 and WLAN 2.4G.

Test Position	Scaled SAR_{MAX}		∑10-g SAR (W/Kg)	SPLSR	Remark
	GSM 1900	WLAN 2.4G			
Back-of-Wristbands	0.953	0.405	1.357	n/a	n/a

NOTE: 10-g SAR Simultaneous Tx Combination of GSM1900 and WLAN 2.4G.

Test Position	Scaled SAR_{MAX}		∑10-g SAR (W/Kg)	SPLSR	Remark
	WCDMA Band V	WLAN 2.4G			
Back-of-Wristbands	0.420	0.405	0.824	n/a	n/a

NOTE: 10-g SAR Simultaneous Tx Combination of WCDMA Band V and WLAN 2.4G.

Test Position	Scaled SAR_{MAX}		∑10-g SAR (W/Kg)	SPLSR	Remark
	WCDMA Band II	WLAN 2.4G			
Back-of-Wristbands	0.986	0.405	1.391	n/a	n/a

NOTE: 10-g SAR Simultaneous Tx Combination of WCDMA Band II and WLAN 2.4G.

Test Position	Scaled SAR_{MAX}		∑10-g SAR (W/Kg)	SPLSR	Remark
	GSM 850	Bluetooth			
Back-of-Wristbands	0.152	0.042	0.194	n/a	n/a

NOTE: 10-g SAR Simultaneous Tx Combination of GSM850 and Bluetooth.

Test Position	Scaled SAR_{MAX}		∑10-g SAR (W/Kg)	SPLSR	Remark
	GSM 1900	Bluetooth			
Back-of-Wristbands	0.953	0.042	0.995	n/a	n/a

NOTE: 10-g SAR Simultaneous Tx Combination of GSM1900 and Bluetooth.

Test Position	Scaled SAR_{MAX}		∑10-g SAR (W/Kg)	SPLSR	Remark
	WCDMA Band V	Bluetooth			
Back-of-Wristbands	0.420	0.042	0.462	n/a	n/a

NOTE: 10-g SAR Simultaneous Tx Combination of WCDMA Band V and Bluetooth.

Test Position	Scaled SAR_{MAX}		∑10-g SAR (W/Kg)	SPLSR	Remark
	WCDMA Band II	Bluetooth			
Back-of-Wristbands	0.986	0.042	1.028	n/a	n/a

NOTE: 10-g SAR Simultaneous Tx Combination of WCDMA Band II and Bluetooth.

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Liquid depth

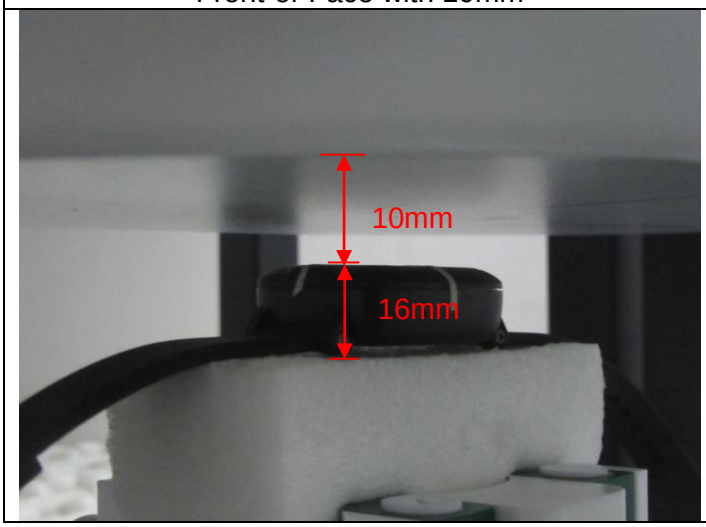
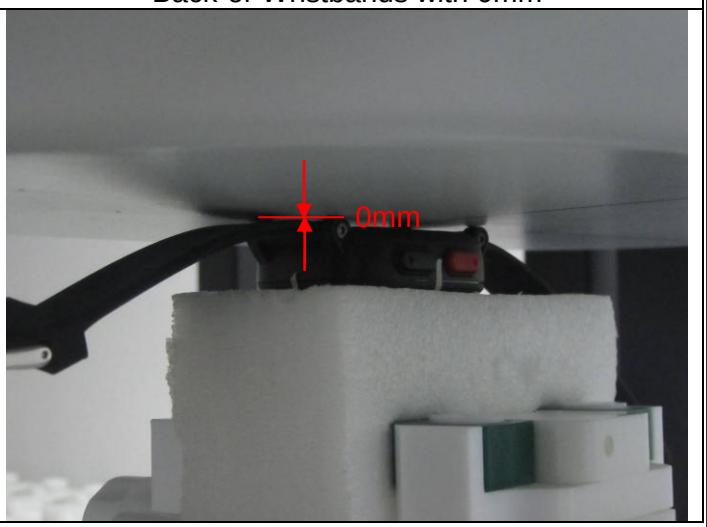
Test Facility

Measurement System SATIMO

Product Photo

Front View	Back View
	

Test Positions

Front-of-Face with 10mm	Back-of-Wristbands with 0mm
	

Liquid depth

Body Position with 850MHz head liquid depth (15.2cm)	Body Position with 850MHz Body liquid depth (15.1cm)
	
Body Position with 1900MHz head liquid depth (15.3cm)	Body Position with 1900MHz Body liquid depth (15.2cm)
	
Body Position with 2450MHz head liquid depth (15.2cm)	Body Position with 2450MHz Body liquid depth (15.3cm)
	

12. Appendix B. System Check Plots

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System Performance Check - SID835 - Body
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System Performance Check - SID2450 - Head
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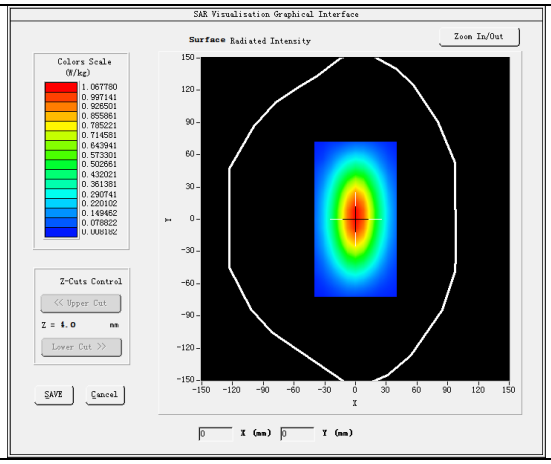
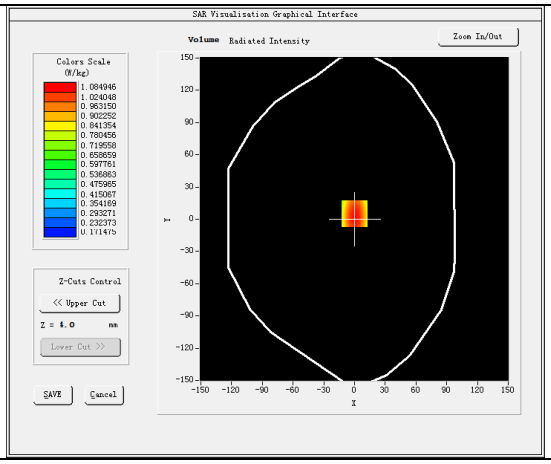
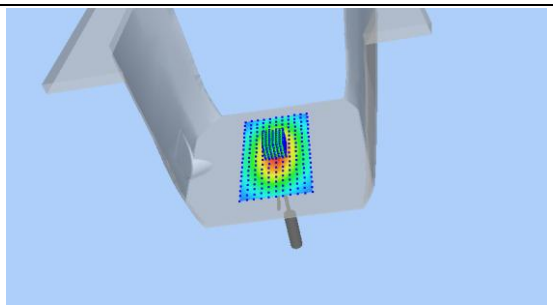
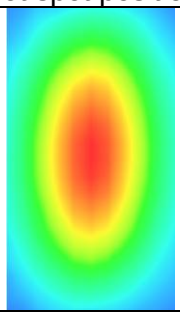
System Performance Check - SID835-Head

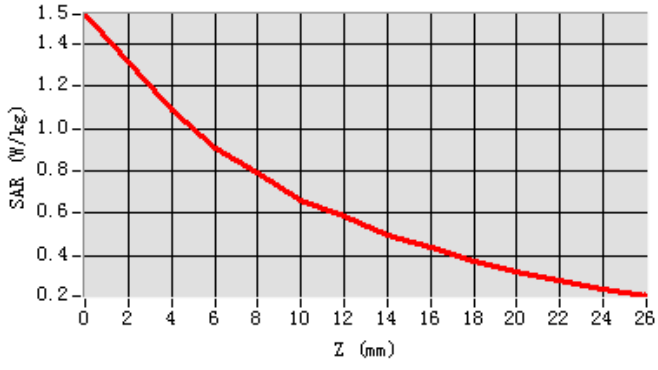
Date of measurement:	Jan. 24, 2018
Signal:	Communication System: CW; Frequency: 835.00MHz; Duty Cycle: 1:1.00
ConvF:	1.48
Liquid Parameters:	Relative permittivity (real part): 41.77; Conductivity (S/m): 0.90;
Device Position:	Dipole
Area Scan:	dx=8mm dy=8mm, h=5.00mm
Zoom Scan:	7x7x12, dx=4mm dy=4mm dz=2mm, h=5.00mm

Surface SAR	Volume SAR
	
3D screen shot	Hot spot position
	

Maximum location: X=0.00, Y=5.00
SAR Peak: 1.52 W/kg

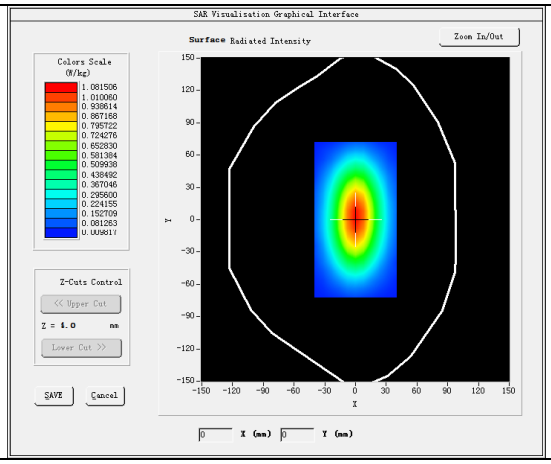
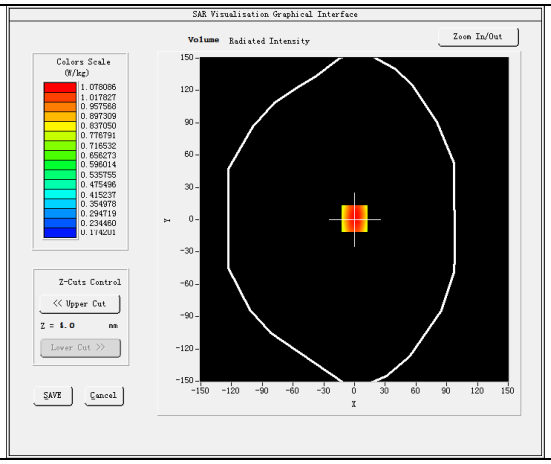
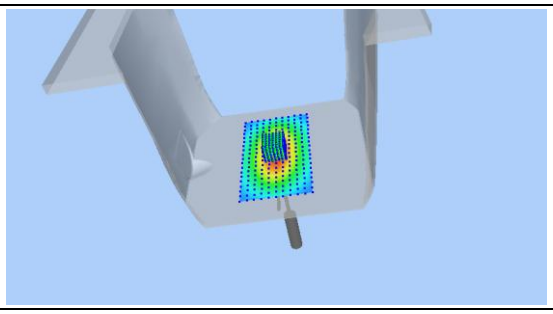
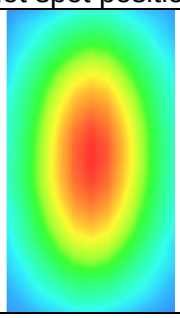
SAR 1g (W/Kg)	0.984
SAR 10g (W/Kg)	0.624
Power Drift (±5%):	-0.04

Z (mm)	0.00	6.00	10.00	14.00	18.00	22.00	24.00
SAR (W/Kg)	1.5410	0.9093	0.6611	0.4956	0.3748	0.2802	0.2415



System Performance Check - SID835-Body

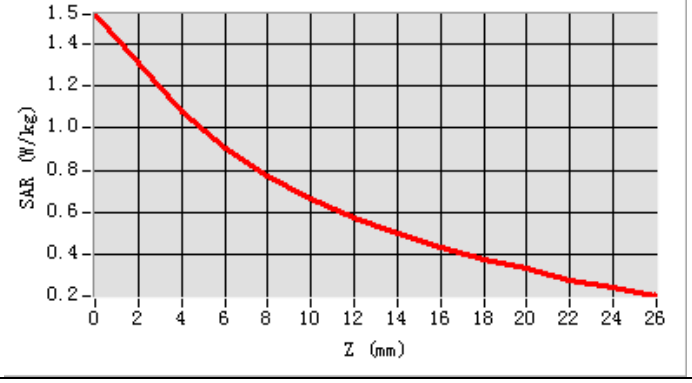
Date of measurement:	Jan. 24, 2018
Signal:	Communication System: CW; Frequency: 835.00MHz; Duty Cycle: 1:1.00
ConvF:	1.53
Liquid Parameters:	Relative permittivity (real part): 55.06; Conductivity (S/m): 0.99;
Device Position:	Dipole
Area Scan:	dx=8mm dy=8mm, h=5.00mm
Zoom Scan:	7x7x12, dx=4mm dy=4mm dz=2mm, h=5.00mm

Surface SAR	Volume SAR
	
3D screen shot	Hot spot position
	

Maximum location: X=0.00, Y=1.00
SAR Peak: 1.55 W/kg

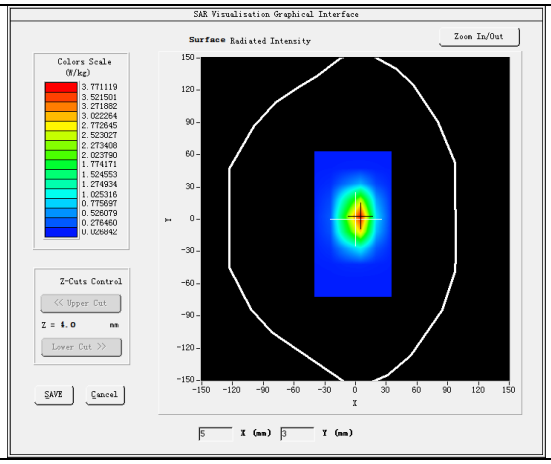
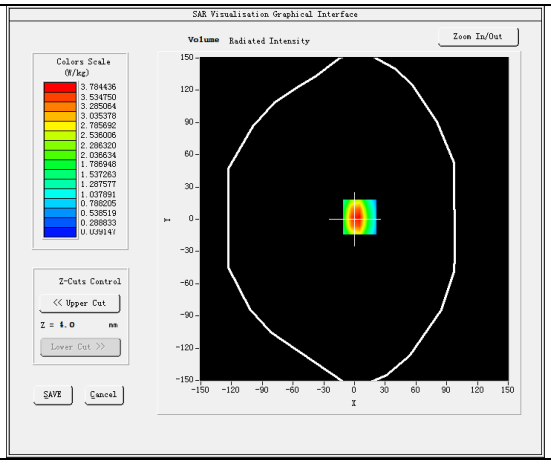
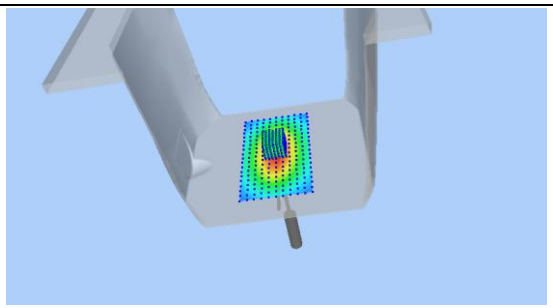
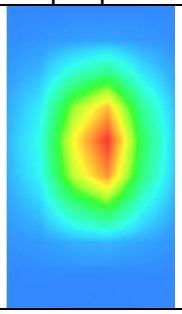
SAR 1g (W/Kg)	0.931
SAR 10g (W/Kg)	0.621
Power Drift (±5%):	0.20

Z (mm)	0.00	6.00	10.00	14.00	18.00	22.00	24.00
SAR (W/Kg)	1.5398	0.9083	0.6645	0.4973	0.3772	0.2811	0.2435



System Performance Check - SID1900-Head

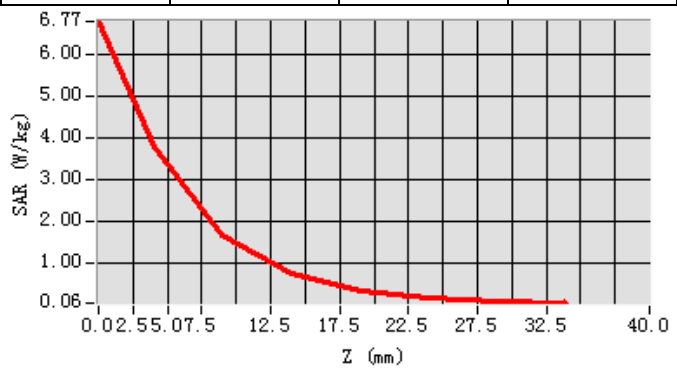
Date of measurement:	Jan. 25, 2018
Signal:	Communication System: CW; Frequency: 1900.00MHz; Duty Cycle: 1:1.00
ConvF:	2.00
Liquid Parameters:	Relative permittivity (real part):39.40; Conductivity (S/m): 1.43;
Device Position:	Dipole
Area Scan:	dx=8mm dy=8mm, h=5.00mm
Zoom Scan:	7x7x12, dx=4mm dy=4mm dz=2mm, h=5.00mm

Surface SAR	Volume SAR
	
3D screen shot	Hot spot position
	

Maximum location: X=5.00, Y=2.00
SAR Peak: 7.11 W/kg

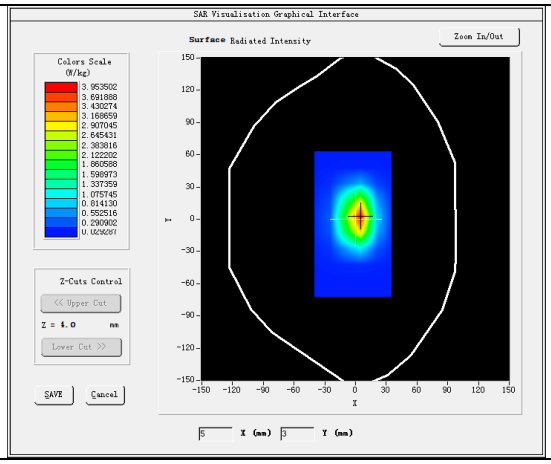
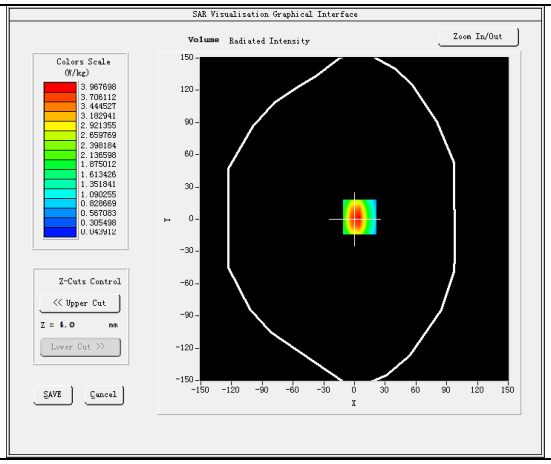
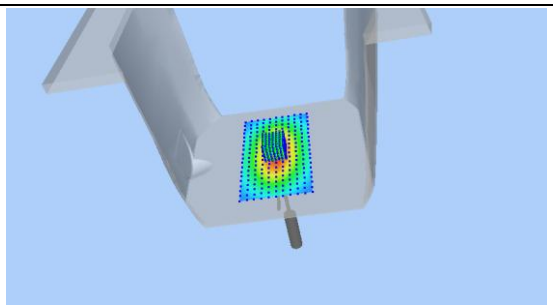
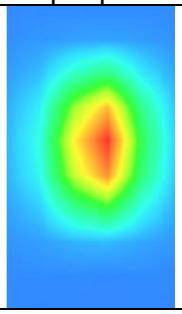
SAR 1g (W/Kg)	3.850
SAR 10g (W/Kg)	1.915
Power Drift (±5%):	-0.04

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	6.7661	3.7844	1.6820	0.7731	0.3664	0.1847	0.1000



System Performance Check - SID1900-Body

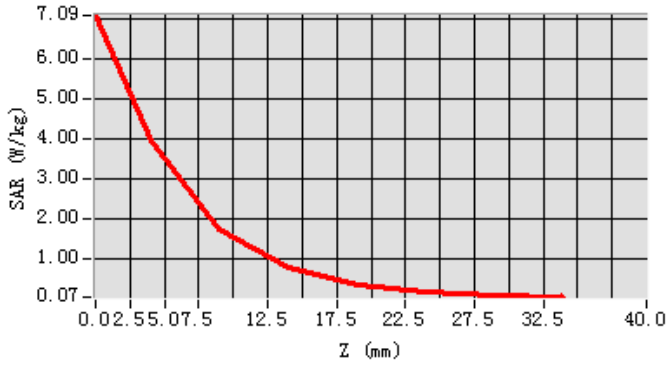
Date of measurement:	Jan. 25, 2018
Signal:	Communication System: CW; Frequency: 1900.00MHz; Duty Cycle: 1:1.00
ConvF:	2.07
Liquid Parameters:	Relative permittivity (real part): 53.19; Conductivity (S/m): 1.55;
Device Position:	Dipole
Area Scan:	dx=8mm dy=8mm, h=5.00mm
Zoom Scan:	7x7x12, dx=4mm dy=4mm dz=2mm, h=5.00mm

Surface SAR	Volume SAR
	
3D screen shot	Hot spot position
	

Maximum location: X=5.00, Y=2.00
SAR Peak: 7.45 W/kg

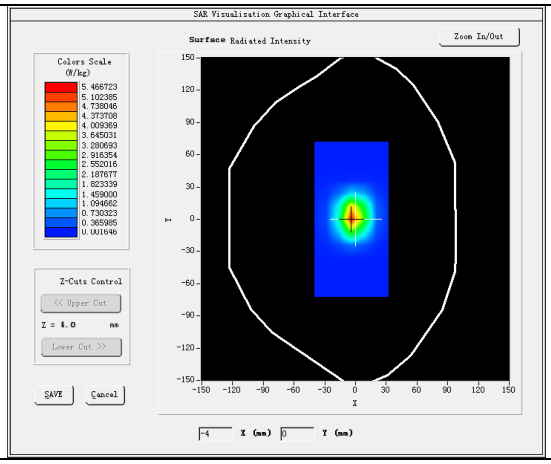
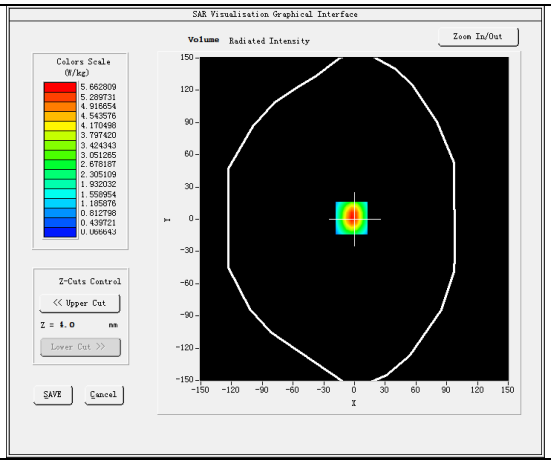
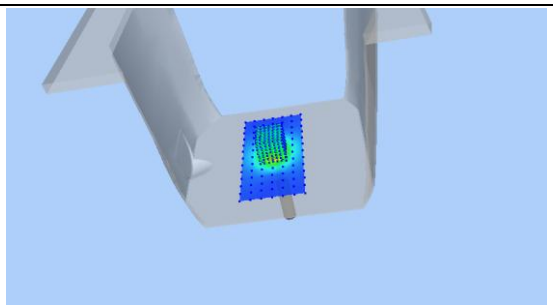
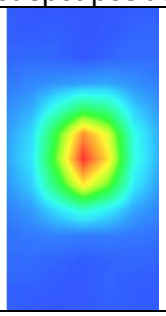
SAR 1g (W/Kg)	3.963
SAR 10g (W/Kg)	1.887
Power Drift (±5%):	0.06

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	7.0908	3.9677	1.7667	0.8143	0.3884	0.1966	0.1063



System Performance Check - SID2450-Head

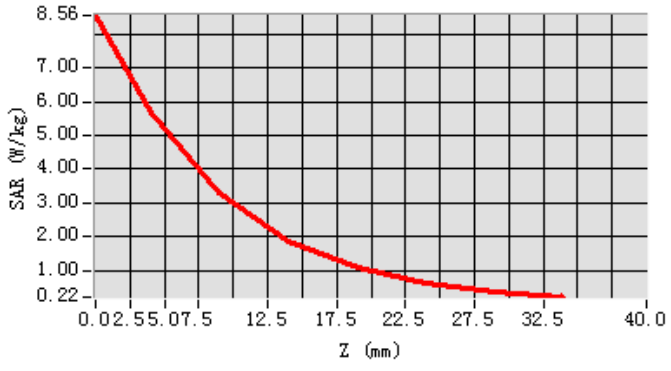
Date of measurement:	Jan. 23, 2018
Signal:	Communication System: CW; Frequency: 2450.00MHz; Duty Cycle: 1:1.00
ConvF:	2.18
Liquid Parameters:	Relative permittivity (real part): 39.49; Conductivity (S/m): 1.78;
Device Position:	Dipole
Area Scan:	dx=8mm dy=8mm, h=5.00mm
Zoom Scan:	7x7x12, dx=4mm dy=4mm dz=2mm, h=5.00mm

Surface SAR	Volume SAR
	
3D screen shot	Hot spot position
	

Maximum location: X=-3.00, Y=1.00
SAR Peak: 8.61 W/kg

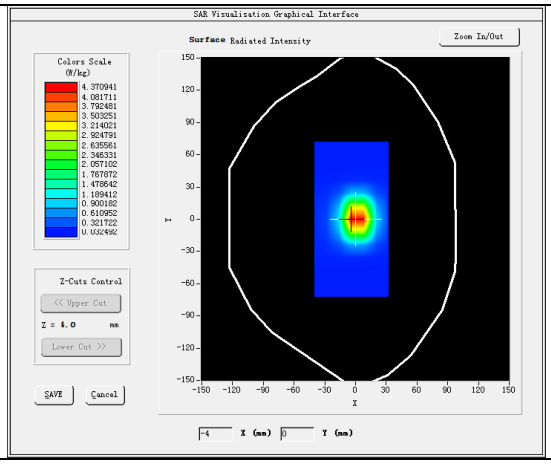
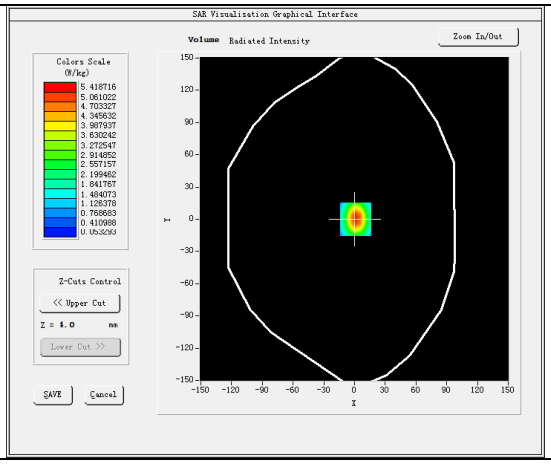
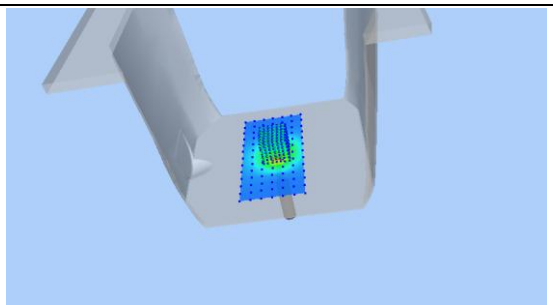
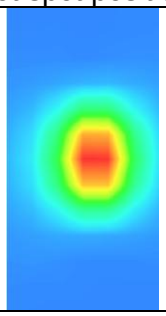
SAR 1g (W/Kg)	5.153
SAR 10g (W/Kg)	2.405
Power Drift (±5%):	-0.27

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	8.5559	5.6628	3.2925	1.8608	1.0801	0.6279	0.3653



System Performance Check - SID2450-Body

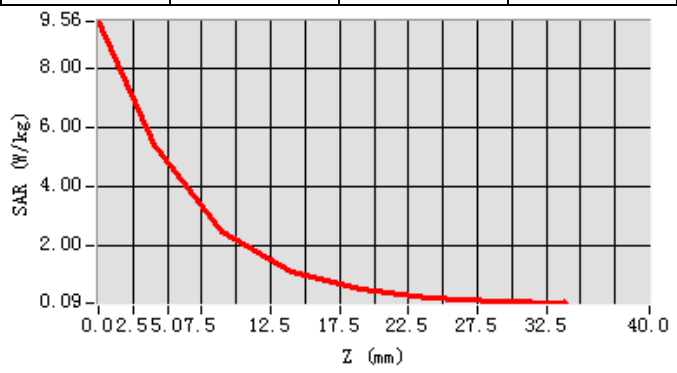
Date of measurement:	Jan. 23, 2018
Signal:	Communication System: CW; Frequency: 2450.00MHz; Duty Cycle: 1:1.00
ConvF:	2.27
Liquid Parameters:	Relative permittivity (real part): 52.66; Conductivity (S/m): 1.95;
Device Position:	Dipole
Area Scan:	dx=8mm dy=8mm, h=5.00mm
Zoom Scan:	7x7x12, dx=4mm dy=4mm dz=2mm, h=5.00mm

Surface SAR	Volume SAR
	
3D screen shot	Hot spot position
	

Maximum location: X=1.00, Y=0.00
SAR Peak: 9.46 W/kg

SAR 1g (W/Kg)	5.015
SAR 10g (W/Kg)	2.221
Power Drift (±5%):	-0.04

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	9.5562	5.4187	2.4710	1.1436	0.5549	0.2762	0.1471

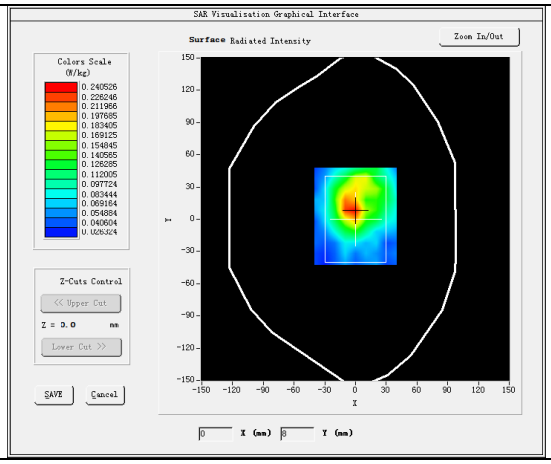
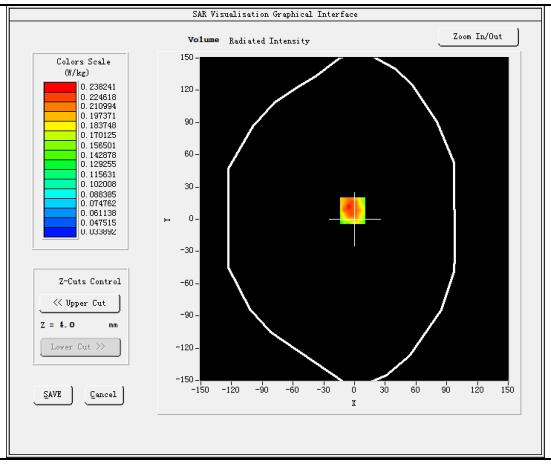
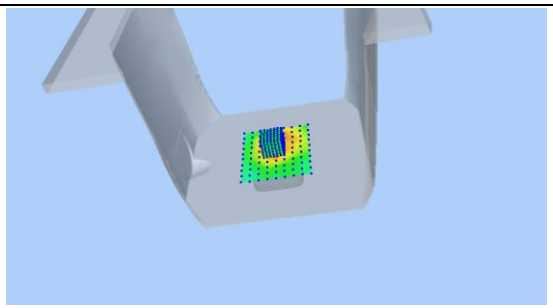
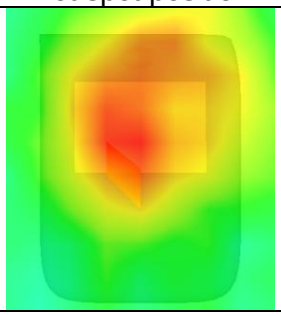


13. Appendix C. Plots of High SAR Measurement

Table of contents
GSM 850
GSM 1900
WCDMA Band V
WCDMA Band II
WLAN 2.4G

GSM850_GPRS(GMSK 4TS)_Ch128_Back-of-Wristbands_0mm

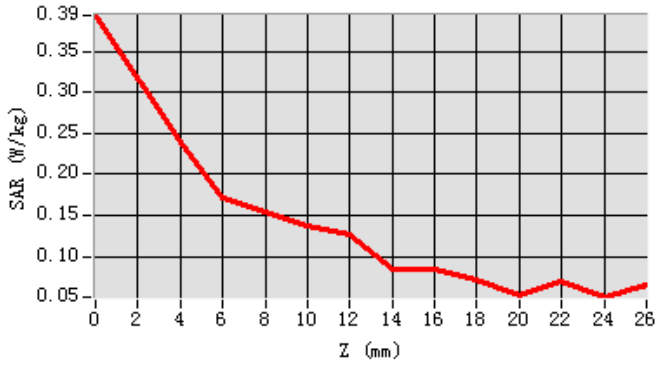
Date of measurement:	Jan. 24, 2018
Signal:	Communication System: GPRS(GMSK 4TS); Frequency: 824.20MHz; Duty Cycle: 1:2.08
ConvF:	1.53
Liquid Parameters:	Relative permittivity (real part): 55.10; Conductivity (S/m):0.97;
Device Position:	Body
Area Scan:	dx=8mm dy=8mm, h=5.00mm
Zoom Scan:	7x7x12, dx=4mm dy=4mm dz=2mm, h=5.00mm

Surface SAR	Volume SAR
	
3D screen shot	Hot spot position
	

Maximum location: X=-2.00, Y=8.00
SAR Peak: 0.39 W/kg

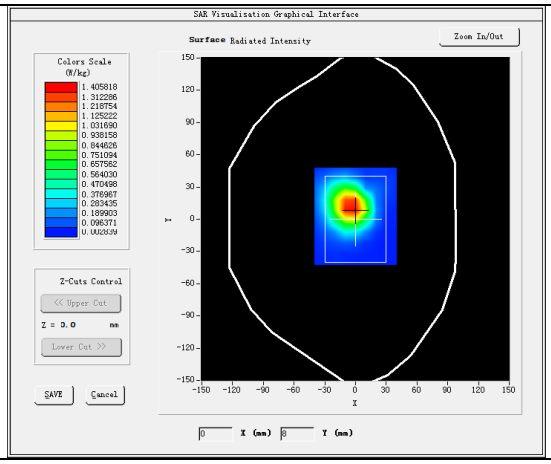
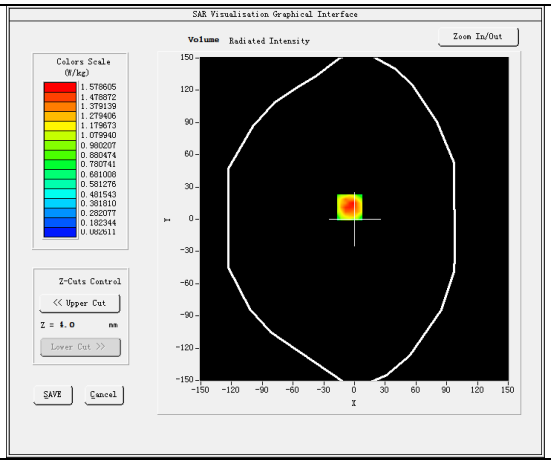
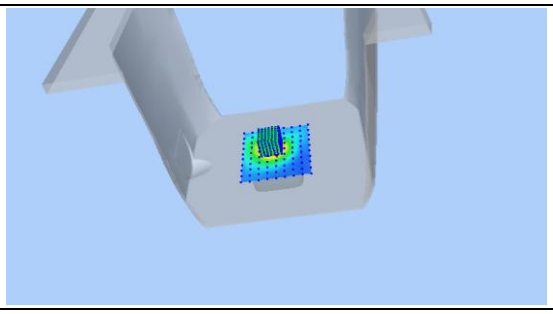
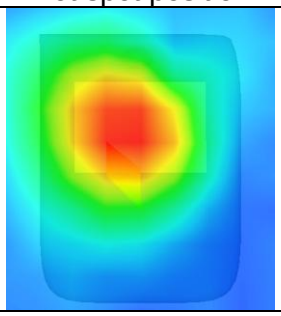
SAR 1g (W/Kg)	0.219
SAR 10g (W/Kg)	0.136
Power Drift (±5%):	3.40

Z (mm)	0.00	6.00	10.00	14.00	18.00	22.00	24.00
SAR (W/Kg)	0.3943	0.1714	0.1367	0.0846	0.0718	0.0683	0.0502



GSM1900_GPRS(GMSK 4TS)_Ch810_Back-of-Wristbands_0mm

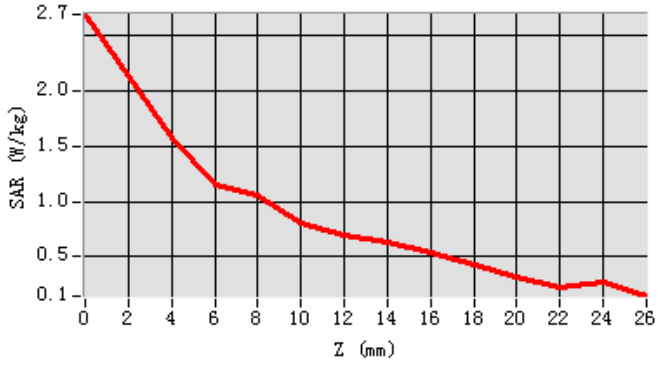
Date of measurement:	Jan. 25, 2018
Signal:	Communication System: GPRS(GMSK 4TS); Frequency: 1909.80MHz; Duty Cycle: 1:2.08
ConvF:	2.07
Liquid Parameters:	Relative permittivity (real part): 53.19; Conductivity (S/m):1.56;
Device Position:	Body
Area Scan:	dx=8mm dy=8mm, h=5.00mm
Zoom Scan:	7x7x12, dx=4mm dy=4mm dz=2mm, h=5.00mm

Surface SAR	Volume SAR
	
3D screen shot	Hot spot position
	

Maximum location: X=-5.00, Y=11.00
SAR Peak: 2.48 W/kg

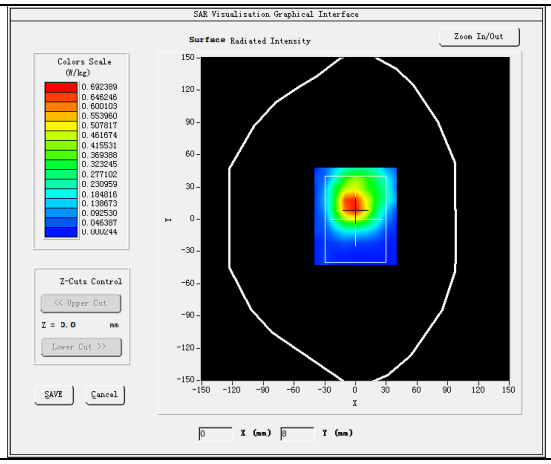
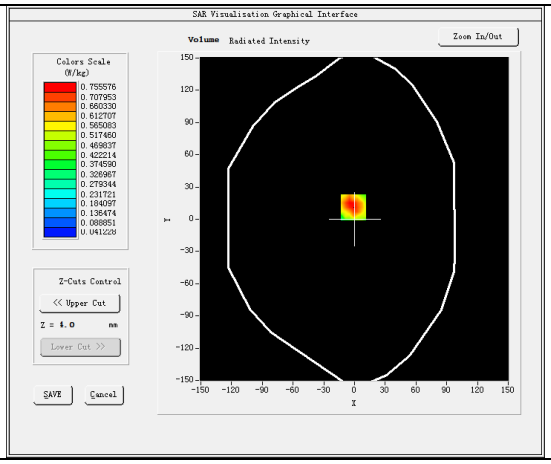
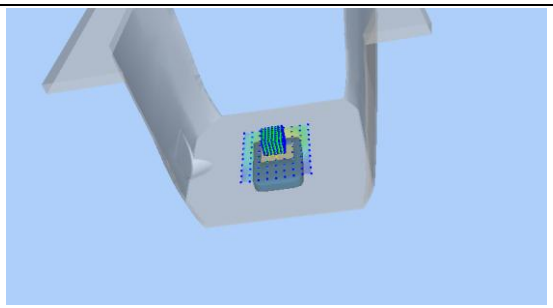
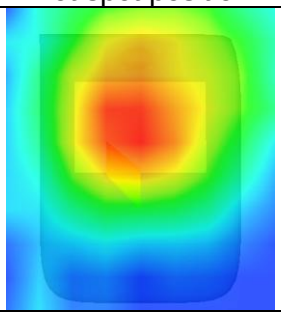
SAR 1g (W/Kg)	1.455
SAR 10g (W/Kg)	0.851
Power Drift (±5%):	3.08

Z (mm)	0.00	6.00	10.00	14.00	18.00	22.00	24.00
SAR (W/Kg)	2.6892	1.1548	0.8047	0.6309	0.4272	0.2193	0.2760



WCDMA Band V_RMC 12.2Kbps_Ch4132_Back-of-Wristbands_0mm

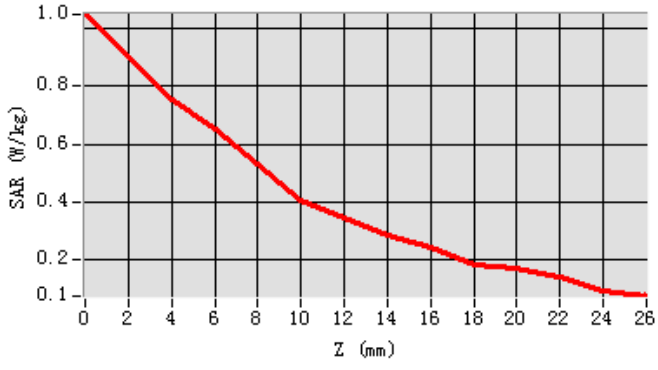
Date of measurement:	Jan. 24, 2018
Signal:	Communication System: WCDMA-FDD(WCDMA); Frequency: 826.40MHz; Duty Cycle: 1:1.00
ConvF:	1.53
Liquid Parameters:	Relative permittivity (real part): 55.15; Conductivity (S/m): 0.97;
Device Position:	Body
Area Scan:	dx=8mm dy=8mm, h=5.00mm
Zoom Scan:	7x7x12, dx=4mm dy=4mm dz=2mm, h=5.00mm

Surface SAR	Volume SAR
	
3D screen shot	Hot spot position
	

Maximum location: X=-1.00, Y=11.00
SAR Peak: 1.35 W/kg

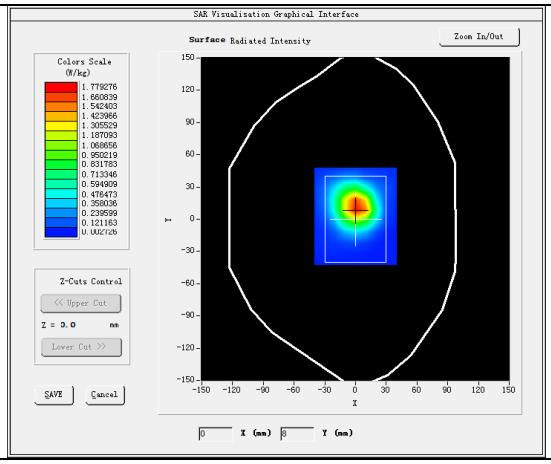
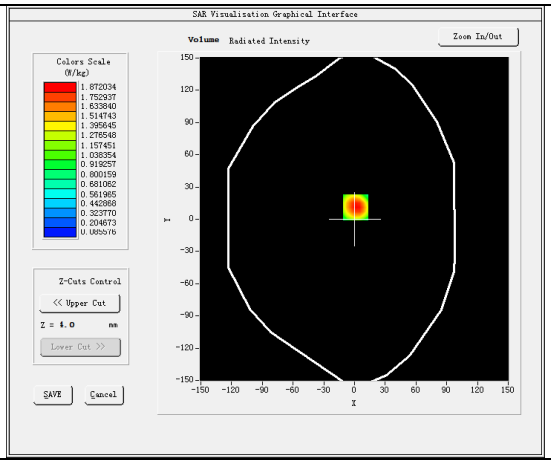
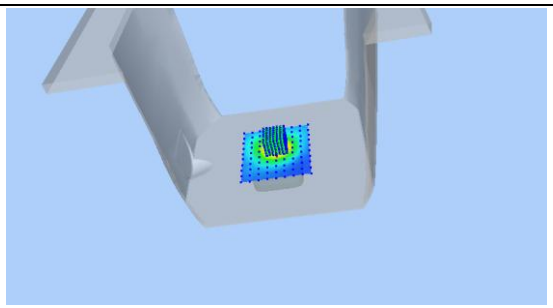
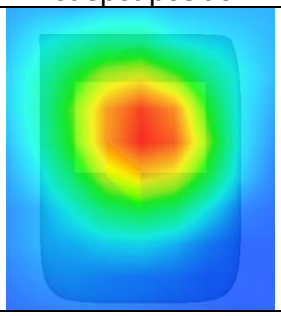
SAR 1g (W/Kg)	0.712
SAR 10g (W/Kg)	0.411
Power Drift (±5%):	0.38

Z (mm)	0.00	6.00	10.00	14.00	18.00	22.00	24.00
SAR (W/Kg)	1.0476	0.6490	0.4074	0.2862	0.1842	0.1415	0.0947



WCDMA Band II_RMC 12.2Kbps_Ch9538_Back-of-Wristbands_0mm

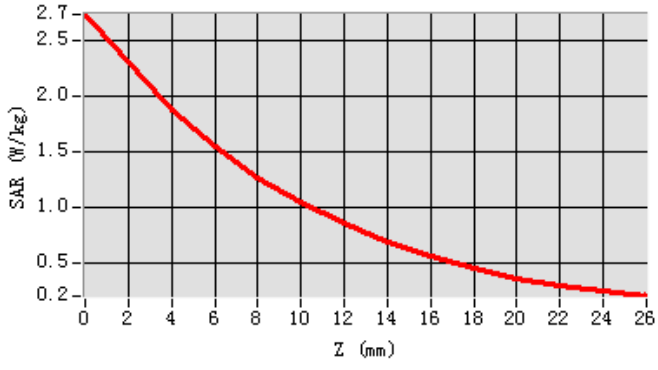
Date of measurement:	Jan. 25, 2018
Signal:	Communication System: WCDMA-FDD(WCDMA); Frequency: 1907.60MHz; Duty Cycle: 1:1.00
ConvF:	2.07
Liquid Parameters:	Relative permittivity (real part): 53.18; Conductivity (S/m): 1.55;
Device Position:	Body
Area Scan:	dx=8mm dy=8mm, h=5.00mm
Zoom Scan:	7x7x12, dx=4mm dy=4mm dz=2mm, h=5.00mm

Surface SAR	Volume SAR
	
3D screen shot	Hot spot position
	

Maximum location: X=1.00, Y=11.00
SAR Peak: 2.77 W/kg

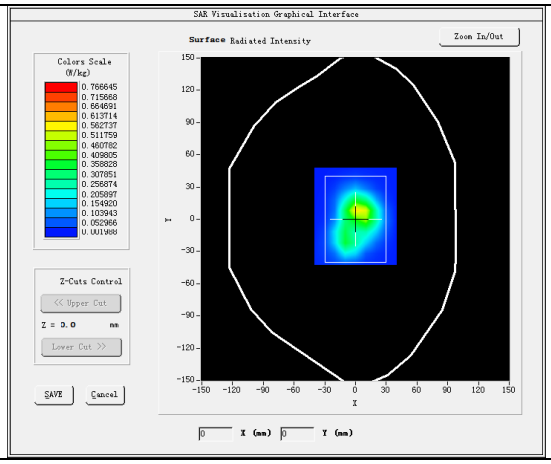
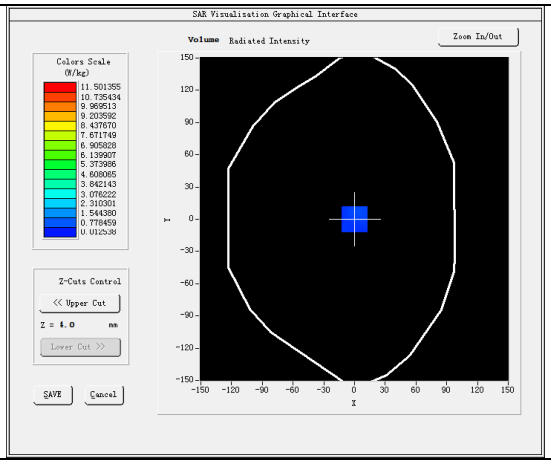
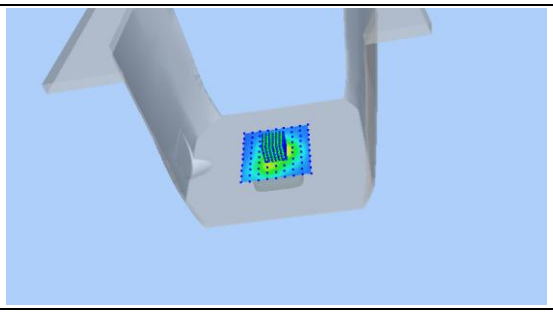
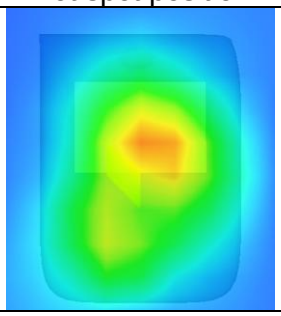
SAR 1g (W/Kg)	1.785
SAR 10g (W/Kg)	0.977
Power Drift (±5%):	-0.06

Z (mm)	0.00	6.00	10.00	14.00	18.00	22.00	24.00
SAR (W/Kg)	2.7331	1.5367	1.0414	0.6888	0.4533	0.2964	0.2383



WLAN 2.4G_802.11b_Ch11_Back-of-Wristbands_0mm

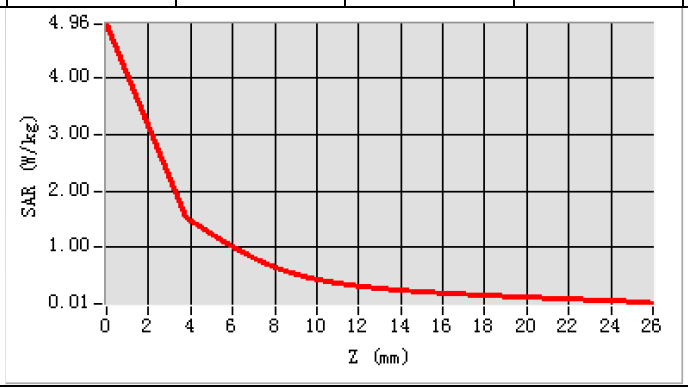
Date of measurement:	Jan. 23, 2018
Signal:	Communication System: WLAN 802.11a/b/g/n/ac; Frequency: 2462.00MHz; Duty Cycle: 1:1.00
ConvF:	2.27
Liquid Parameters:	Relative permittivity (real part): 52.58; Conductivity (S/m): 1.97;
Device Position:	Body
Area Scan:	dx=8mm dy=8mm, h=5.00mm
Zoom Scan:	7x7x12, dx=4mm dy=4mm dz=2mm, h=5.00mm

Surface SAR	Volume SAR
	
3D screen shot	Hot spot position
	

Maximum location: X=0.00, Y=0.00
SAR Peak: 4.94 W/kg

SAR 1g (W/Kg)	1.099
SAR 10g (W/Kg)	0.369
Power Drift (±5%):	-2.41

Z (mm)	0.00	6.00	10.00	14.00	18.00	22.00	24.00
SAR (W/Kg)	4.9566	1.0583	0.5235	0.3001	0.1895	0.1051	0.0642



14. Appendix D. Calibration Certificate

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E Field Probe - SN 08/16 EPGO287
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
Extended Calibration Certificate

COMOSAR E-Field Probe Calibration Report

Ref : ACR.261.2.17.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 DOSIMETRIC E-FIELD PROBE

SERIAL NO.: SN 08/16 EPGO287

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

ACCREDITED
Calibration CERT #2246-02

Calibration Date: 09/18/2017

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	9/18/2017	
Checked by :	Jérôme LUC	Product Manager	9/18/2017	
Approved by :	Kim RUTKOWSKI	Quality Manager	9/18/2017	

	Customer Name
Distribution :	NTEK TESTING TECHNOLOGY CO., LTD.

Issue	*Date*	*Modifications*
A	9/18/2017	Initial release

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