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

FCC SAR EVALUATION REPORT

Product Name：	PDA, Mobile Computer
Trade Mark：	Supoin
Model Name：	S53
Serial Model：	SHT30, SK9030, S3, X-3090, X-3090A, S50, SHT32, X5, X5H, X5A, X5AH, X6, X6A, X6H, X6AH, X7, X7A, S52, S56, R1
Report No.：	NTEK-2016NT11089794HF
FCC ID：	2AKDY-S53

Prepared for

Shenzhen Supoin Technology Corp.

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Prepared by

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TEST RESULT CERTIFICATION

Applicant's name..................	:	Shenzhen Supoin Technology Corp.
Address	:	2401-2408 Room, A Block,World Trade Square, No.9 Fuhong Rd, Futian District, Shenzhen
Manufacturer's Name...........	:	Shenzhen Supoin Technology Corp.
Address	:	2401-2408 Room, A Block,World Trade Square, No.9 Fuhong Rd, Futian District, Shenzhen
Product description		
Product name.........................	:	PDA, Mobile Computer
Trade Mark	:	Supoin
Model and/or type reference	:	S53
Serial Model	:	SHT30, SK9030, S3, X-3090, X-3090A, S50, SHT32, X5, X5H, X5A, X5AH, X6, X6A, X6H, X6AH, X7, X7A, S52, S56, R1
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.

Date of Test

Date (s) of performance of tests.............	:	Dec. 07, 2016 ~ Jan. 04, 2017
Date of Issue	:	Jan. 09, 2017
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	Jan. 09, 2017	Cheng Jiawen

TABLE OF CONTENTS

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
Hands, Wrists, Feet and Ankles
4.0 W/kg
Applied to this EUT

1.2. Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for S53 are as follows.

Band	Max Reported SAR Value(W/kg)	
	10-g Extremity (Separation distance of 0mm)	Max SAR Summation
GSM 850	0.607	1.692
GSM 1900	0.372	
Wi-Fi 2.4G	0.278	
UHF-RFID	1.165	

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 (4.0 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

<table>
<tr><td colspan="4">Device Information</td></tr>
<tr><td>Product Name</td><td colspan="3">PDA, Mobile Computer</td></tr>
<tr><td>Trademark</td><td colspan="3">Supoin</td></tr>
<tr><td>Model Name</td><td colspan="3">S53</td></tr>
<tr><td>Serial Model</td><td colspan="3">SHT30, SK9030, S3, X-3090, X-3090A, S50, SHT32, X5, X5H, X5A, X5AH, X6, X6A, X6H, X6AH, X7, X7A, S52, S56, R1</td></tr>
<tr><td>FCC ID</td><td colspan="3">2AKDY-S53</td></tr>
<tr><td>Device Phase</td><td colspan="3">Identical Prototype</td></tr>
<tr><td>Exposure Category</td><td colspan="3">General population / Uncontrolled environment</td></tr>
<tr><td>Antenna Type</td><td colspan="3">2G: Steel disc Antenna
Wi-Fi 2.4G: FPCB Antenna
UHF-RFID: Ceramic Antenna</td></tr>
<tr><td>Battery Information</td><td colspan="3">DC 3.7V, 2900mAh</td></tr>
<tr><td colspan="4">Device Operating Configurations</td></tr>
<tr><td>Supporting Mode(s)</td><td colspan="3">GSM 850/1900, Wi-Fi 2.4G, UHF-RFID, BT</td></tr>
<tr><td>Test Modulation</td><td colspan="3">GSM(GMSK/8PSK), Wi-Fi(DSSS/OFDM), UHF-RFID(ASK)</td></tr>
<tr><td>Device Class</td><td colspan="3">B</td></tr>
<tr><td rowspan="6">Operating Frequency Range(s)</td><td>Band</td><td>Tx (MHz)</td><td>Rx (MHz)</td></tr>
<tr><td>GSM 850</td><td>824-849</td><td>869-894</td></tr>
<tr><td>GSM 1900</td><td>1850-1910</td><td>1930-1990</td></tr>
<tr><td>Wi-Fi 2.4G</td><td colspan="2">2412-2462</td></tr>
<tr><td>BT</td><td colspan="2">2402-2480</td></tr>
<tr><td>UHF-RFID</td><td colspan="2">902-928</td></tr>
<tr><td rowspan="3">GPRS Multislot Class(12)</td><td colspan="2">Max Number of Timeslots in Uplink</td><td>4</td></tr>
<tr><td colspan="2">Max Number of Timeslots in Downlink</td><td>4</td></tr>
<tr><td colspan="2">Max Total Timeslot</td><td>5</td></tr>
<tr><td rowspan="3">EDGE Multislot Class(12)</td><td colspan="2">Max Number of Timeslots in Uplink</td><td>4</td></tr>
<tr><td colspan="2">Max Number of Timeslots in Downlink</td><td>4</td></tr>
<tr><td colspan="2">Max Total Timeslot</td><td>5</td></tr>
<tr><td rowspan="2">Power Class</td><td colspan="3">4, tested with power level 5(GSM 850)</td></tr>
<tr><td colspan="3">1, tested with power level 0(GSM 1900)</td></tr>
<tr><td rowspan="3">Test Channels (low-mid-high)</td><td colspan="3">128-189-251(GSM 850)</td></tr>
<tr><td colspan="3">512-661-810(GSM 1900)</td></tr>
<tr><td colspan="3">802.11 b/g/n:1-6-11(Wi-Fi 2.4G)</td></tr>
</table>

1.4. Test specification(s)

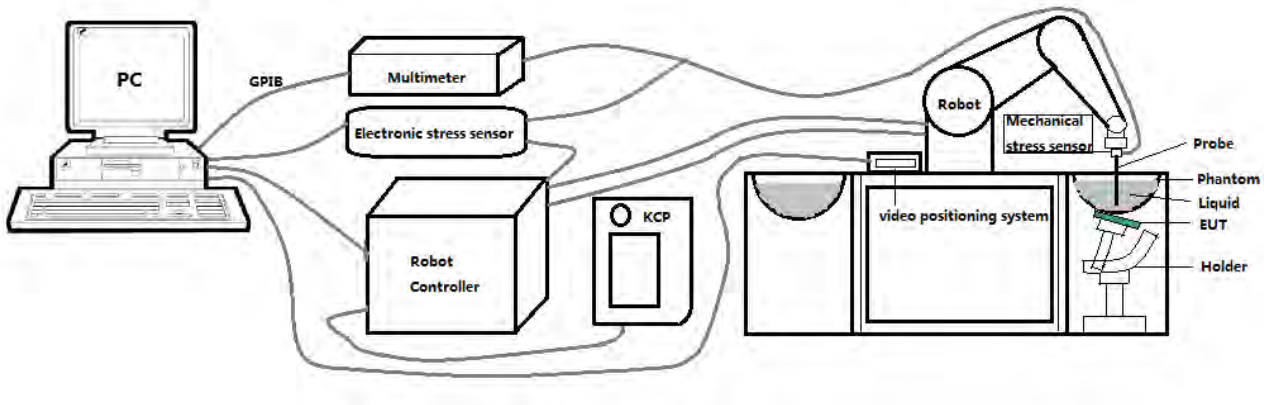
FCC 47 CFR Part 2(2.1093)
ANSI/IEEE C95.1-1992
IEEE Std 1528-2013
KDB 865664 D01 SAR measurement 100 MHz to 6 GHz
KDB 865664 D02 RF Exposure Reporting
KDB 447498 D01 General RF Exposure Guidance
KDB 248227 D01 802.11 Wi-Fi SAR
KDB 941225 D01 3G SAR Procedures

1.5. Ambient Condition

Ambient temperature	20°C – 24℃
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: 4 mm (repeatability better than ±1 mm).
- Probe linearity: ±0.08 dB
- Axial isotropy: <0.25 dB
- Hemispherical Isotropy: <0.50 dB
- Calibration range: 450MHz to 6000MHz for head & body simulating liquid.
- Lower detection limit: 8mW/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.

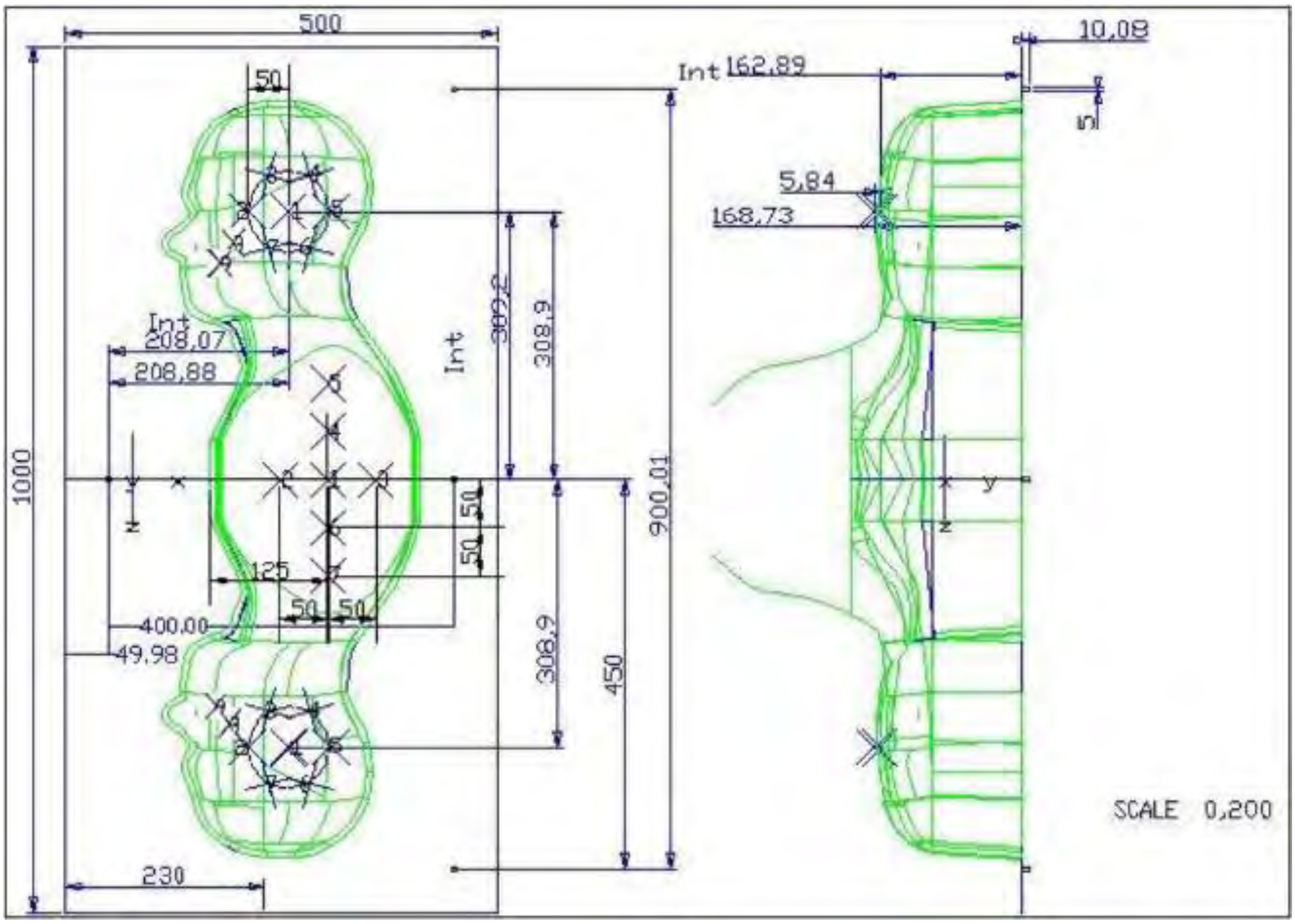
2.4. SAM phantoms

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

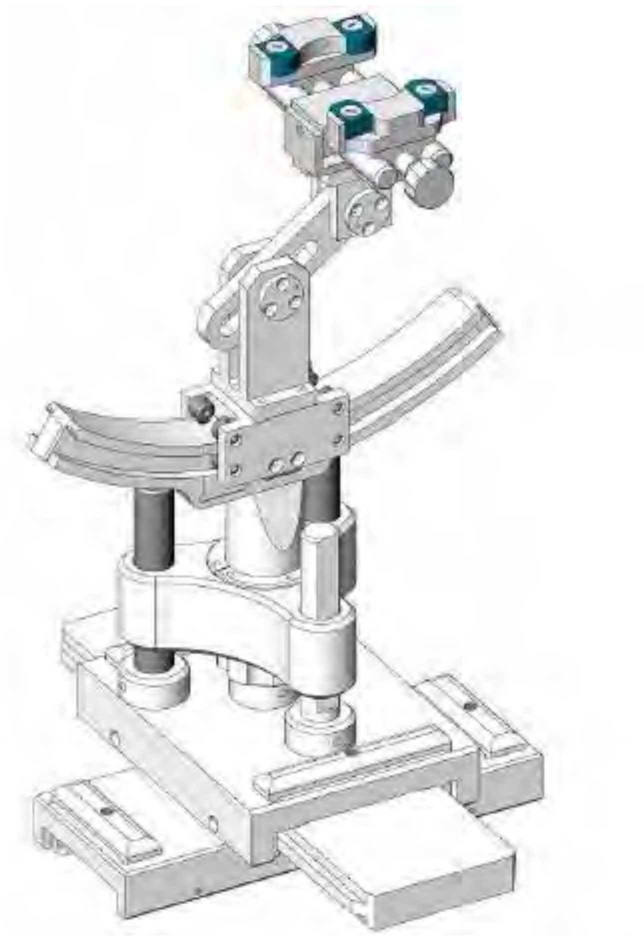


Serial Number	Left Head		Right Head		Flat Part	
SN 16/15 SAM119	2	2.02	2	2.08	1	2.09
	3	2.05	3	2.06	2	2.06
	4	2.07	4	2.07	3	2.08
	5	2.08	5	2.08	4	2.10
	6	2.05	6	2.07	5	2.10
	7	2.05	7	2.05	6	2.07
	8	2.07	8	2.06	7	2.07
	9	2.08	9	2.06	-	-

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. 08, 2016	Sep. 07, 2017
☐	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. 09, 2016	Aug. 08, 2017
☐	R&S	Wideband radio communication tester	CMW500	148500	Jun. 26, 2016	Jun. 25, 2017
☒	HP	Network Analyzer	8753D	3410J01136	Aug. 09, 2016	Aug. 08, 2017

☒	Agilent	PSG Analog Signal Generator	E8257D	MY51110112	Aug. 09, 2016	Aug. 08, 2017
☒	Agilent	Power meter	E4419B	MY45102538	Aug. 09, 2016	Aug. 08, 2017
☒	Agilent	Power sensor	E9301A	MY41495644	Aug. 09, 2016	Aug. 08, 2017
☒	Agilent	Power sensor	E9301A	US39212148	Aug. 09, 2016	Aug. 08, 2017
☒	MCLI/USA	Directional Coupler	CB11-20	0D2L51502	Aug. 09, 2016	Aug. 08, 2017

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 WiFi/BT power measurement, use engineering software to configure EUT WiFi/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 WiFi/BT output power.

<SAR measurement>

(a) Use base station simulator to configure EUT WWAN transmission in radiated connection, and engineering software to configure EUT WiFi/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>$\leq$ 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>$\frac{1}{2}\cdot\delta\cdot\ln(2) \pm 0.5$ 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>$\leq$ 2 GHz: $\leq$ 15 mm
2 – 3 GHz: $\leq$ 12 mm</td><td>3 – 4 GHz: $\leq$ 12 mm
4 – 6 GHz: $\leq$ 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 $\leq$ 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>$\leq$ 2 GHz: $\leq$ 8 mm
2 – 3 GHz: $\leq$ 5 mm*</td><td>3 – 4 GHz: $\leq$ 5 mm*
4 – 6 GHz: $\leq$ 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>$\leq$ 5 mm</td><td>3 – 4 GHz: $\leq$ 4 mm
4 – 5 GHz: $\leq$ 3 mm
5 – 6 GHz: $\leq$ 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>$\leq$ 4 mm</td><td>3 – 4 GHz: $\leq$ 3 mm
4 – 5 GHz: $\leq$ 2.5 mm
5 – 6 GHz: $\leq$ 2 mm</td></tr>
<tr><td>$\Delta z_{Zoom}(n>1)$: between subsequent points</td><td colspan="2">$\leq 1.5\cdot\Delta z_{Zoom}(n-1)$</td></tr>
<tr><td>Minimum zoom scan volume</td><td colspan="2">x, y, z</td><td>$\geq$ 30 mm</td><td>3 – 4 GHz: $\geq$ 28 mm
4 – 5 GHz: $\geq$ 25 mm
5 – 6 GHz: $\geq$ 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 $\leq$ 1.4 W/kg, $\leq$ 8 mm, $\leq$ 7 mm and $\leq$ 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.

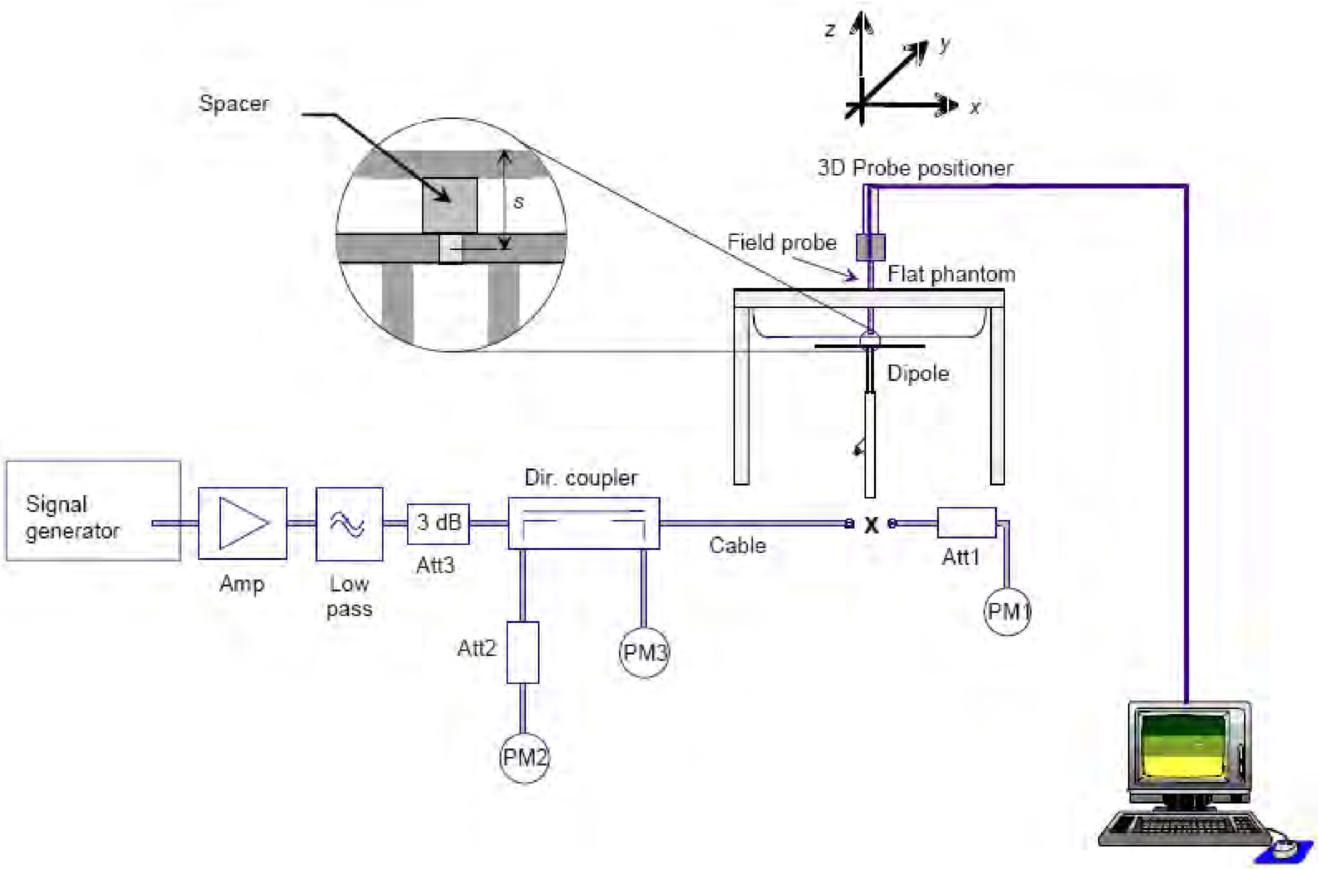
Tissue Type	Measured Frequency (MHz)	Target Tissue		Measured Tissue		Liquid Temp.	Test Date
		εr (±5%)	σ (S/m) (±5%)	εr	σ (S/m)		
Body 850	835	55.20 (52.44~57.96)	0.97 (0.92~1.01)	55.23	0.99	21.5 ℃	Dec. 07, 2016
Body 900	900	55.00 (52.25~57.75)	1.05 (0.99~1.10)	54.79	1.07	21.4 ℃	Dec. 25, 2016
Body 1900	1900	53.30 (50.64~55.96)	1.52 (1.44~1.59)	53.55	1.56	21.6 ℃	Dec. 07, 2016
Body 2450	2450	52.70 (50.07~55.33)	1.95 (1.85~2.04)	51.53	1.92	21.5 ℃	Jan. 04, 2017

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 Body	9.48 (8.53~10.42)	6.29 (5.66~6.91)	9.47	6.33	21.5 ℃	Dec. 07, 2016
900MHz Body	10.95 (9.86~12.04)	7.06 (6.35~7.76)	10.37	6.68	21.4 ℃	Dec. 25, 2016
1900MHz Body	38.43 (34.59~42.27)	20.34 (18.31~22.37)	40.14	20.80	21.6 ℃	Dec. 07, 2016
2450MHz Body	49.32 (44.39~54.25)	22.89 (20.60~25.17)	46.18	21.83	21.5 ℃	Jan. 04, 2017

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. Extremity exposure conditions

Devices that are designed or intended for use on extremities, or mainly operated in extremity only exposure conditions, i.e., hands, wrists, feet and ankles, may require extremity SAR evaluation.

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	GPRS(GMSK, 1 TS)	30±1	29~31	30.26
	GPRS(GMSK, 2 TS)	27±1	26~28	27.51
	GPRS(GMSK, 3 TS)	25±1	24~26	25.61
	GPRS(GMSK, 4 TS)	24±1	23~25	24.41
	EDGE(GMSK, 1 TS)	25±1	24~26	25.36
	EDGE(GMSK, 2 TS)	22±1	21~23	22.61
	EDGE(GMSK, 3 TS)	20±1	19~21	20.74
	EDGE(GMSK, 4 TS)	19±1	18~20	19.71
GSM 1900	GPRS(GMSK, 1 TS)	28±1	27~29	28.42
	GPRS(GMSK, 2 TS)	25±1	24~26	25.61
	GPRS(GMSK, 3 TS)	23±1	22~24	23.75
	GPRS(GMSK, 4 TS)	22±1	21~23	22.63
	EDGE(GMSK, 1 TS)	24±1	23~25	24.41
	EDGE(GMSK, 2 TS)	21±1	20~22	21.35
	EDGE(GMSK, 3 TS)	19±1	18~20	19.56
	EDGE(GMSK, 4 TS)	18±1	17~19	18.54
Wi-Fi 2.4G	802.11b	13±1	12~14	13.50
	802.11g	9±1	8~10	9.60
	802.11n-HT20	9±1	8~10	9.80
BT	3.0	2±1	1~3	2.72
UHF-RFID	ASK	24±1	23~25	24.25

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 GPRS (4Tx slots) for GSM850/GSM1900.

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
GPRS(GMSK, 1 TS)	31.00	30.15	30.22	30.26	21.97	21.12	21.19	21.23
GPRS(GMSK, 2 TS)	28.00	27.51	27.42	27.33	21.98	21.49	21.40	21.31
GPRS(GMSK, 3 TS)	26.00	25.52	25.61	25.49	21.74	21.26	21.35	21.23
GPRS(GMSK, 4 TS)	25.00	24.35	24.39	24.41	21.99	21.34	21.38	21.40
EDGE(GMSK, 1 TS)	26.00	25.16	25.24	25.36	16.97	16.13	16.21	16.33
EDGE(GMSK, 2 TS)	23.00	22.45	22.61	22.53	16.98	16.43	16.59	16.51
EDGE(GMSK, 3 TS)	21.00	20.63	20.74	20.69	16.74	16.37	16.48	16.43
EDGE(GMSK, 4 TS)	20.00	19.54	19.71	19.65	16.99	16.53	16.70	16.64
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
GPRS(GMSK, 1 TS)	29.00	28.42	28.31	28.29	19.97	19.39	19.28	19.26
GPRS(GMSK, 2 TS)	26.00	25.61	25.43	25.41	19.98	19.59	19.41	19.39
GPRS(GMSK, 3 TS)	24.00	23.75	23.61	23.59	19.74	19.49	19.35	19.33
GPRS(GMSK, 4 TS)	23.00	22.63	22.41	22.42	19.99	19.62	19.40	19.41
EDGE(GMSK, 1 TS)	25.00	24.41	24.15	24.26	15.97	15.38	15.12	15.23
EDGE(GMSK, 2 TS)	22.00	21.35	21.25	21.33	15.98	15.33	15.23	15.31
EDGE(GMSK, 3 TS)	20.00	19.56	19.39	19.53	15.74	15.30	15.13	15.27
EDGE(GMSK, 4 TS)	19.00	18.27	18.26	18.54	15.99	15.26	15.25	15.53

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. Wi-Fi Output Power

The output power of Wi-Fi is as following:

Mode	Channel	Frequency (MHz)	Tune-up	Output Power (dBm)
802.11b	1	2412	14.00	13.50
	6	2437	14.00	12.80
	11	2462	14.00	13.00
802.11g	1	2412	10.00	9.20
	6	2437	10.00	9.60
	11	2462	10.00	9.30
802.11n (HT20)	1	2412	10.00	9.10
	6	2437	10.00	9.80
	11	2462	10.00	9.50

7.4. BT Output Power

The output power of BT is as following:

BT	Output Power (dBm)			
	Tune-up	1M	2M	3M
0CH	3.00	2.33	1.88	2.29
39CH	3.00	2.71	2.24	2.72
78CH	3.00	2.46	1.98	2.46

7.5. UHF-RFID Output Power

The output power of UHF-RFID is as following:

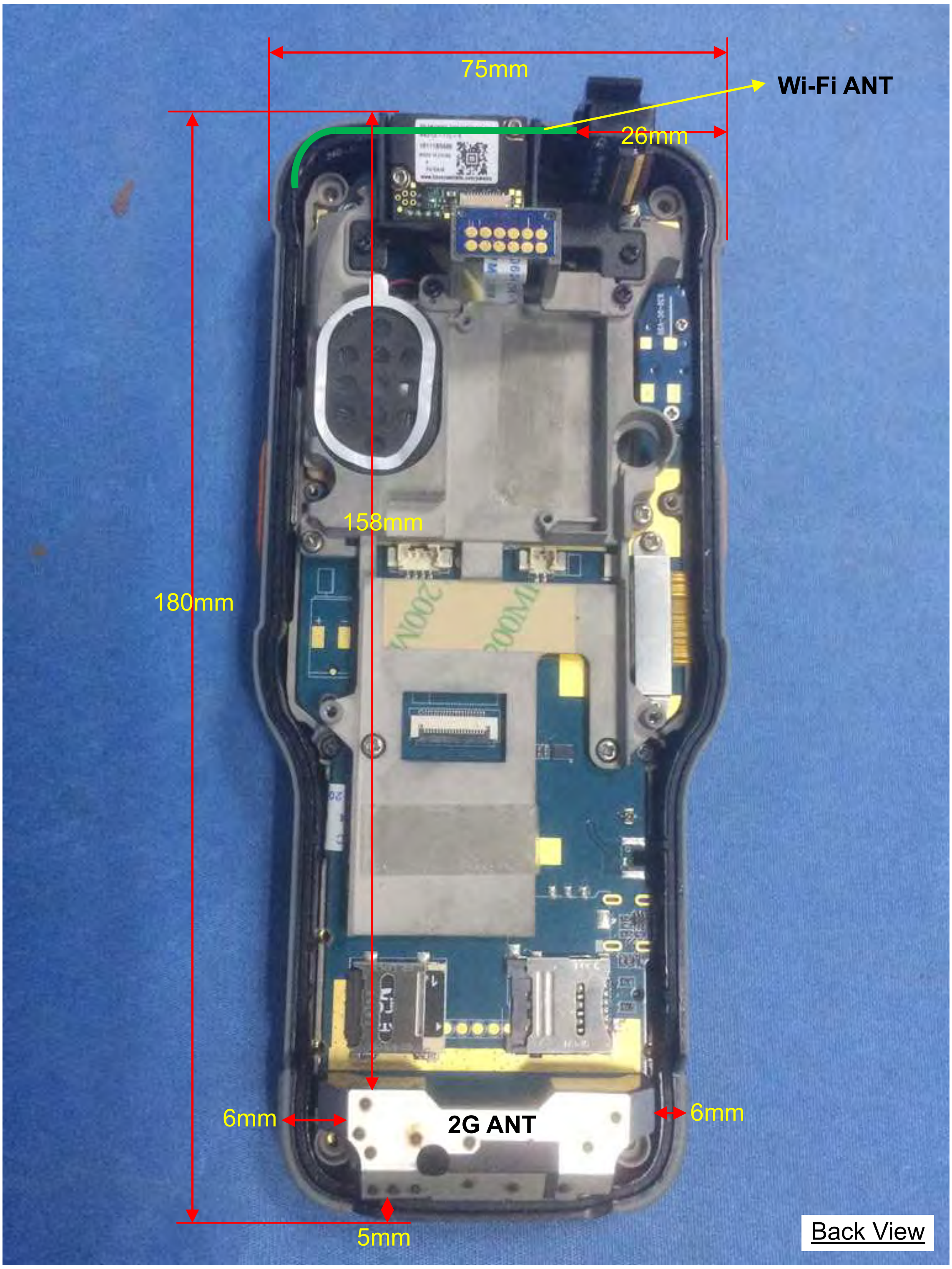
	Frequency (MHz)	Tune-up	Output Power (dBm)
UHF-RFID	902.75	25.00	24.25
	914.75	25.00	24.12
	927.25	25.00	24.01

8. Antenna Location

8.1. 2G and Wi-Fi Antenna Location

Top Side

Right Side



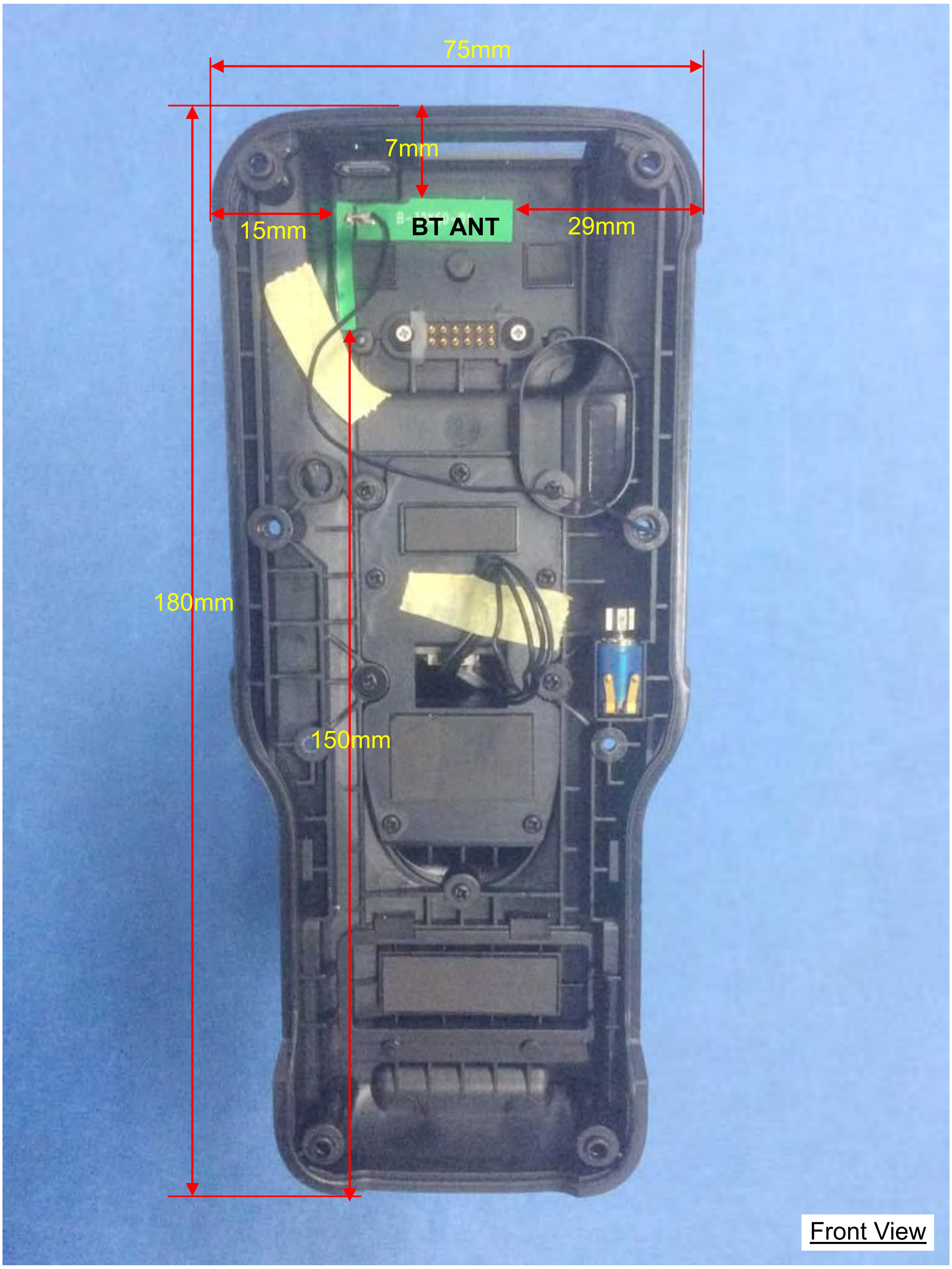
Left Side

Bottom Side

8.2. BT Antenna Location

Top Side

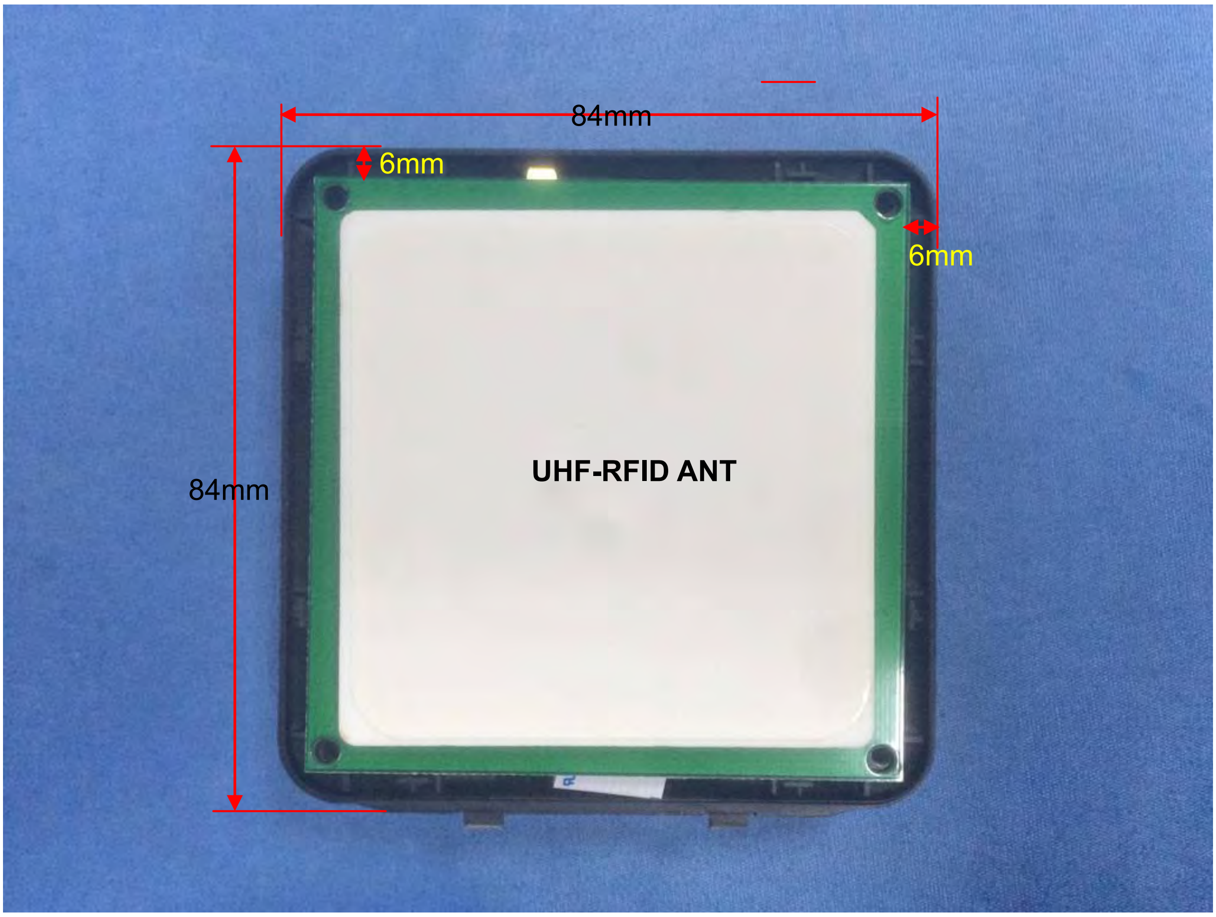
Left Side



Right Side

Bottom Side

8.3. UHF-RFID Antenna Location



9. Stand-alone SAR test exclusion

Refer to KDB 447498 D01, 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
BT	3	2	<5	2.48	0.63	7.5	Yes

NOTE: Standalone SAR test exclusion for BT

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)
BT	Extremity	3	2	<5	2.48	18.75	0.034

NOTE: Estimated SAR calculation for BT

10. SAR Measurement Results

10.1. SAR measurement results

General Notes:

1) Per KDB447498 D01, all measurement SAR results are scaled to the maximum tune-up tolerance limit to demonstrate compliant.

2) Per KDB447498 D01, testing of other required channels within the operating mode of a frequency band is not required when the reported 1-g or 10-g SAR for the mid-band or highest output power channel is: ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz. When the maximum output power variation across the required test channels is > ½ dB, instead of the middle channel, the highest output power channel must be used.

3) Per KDB865664 D01, for each frequency band, repeated SAR measurement is required only when the measured SAR is ≥0.8W/Kg; if the deviation among the repeated measurement is ≤20%,and the measured SAR <1.45W/Kg, only one repeated measurement is required.

4) Per KDB865664 D02, SAR plot is only required for the highest measured SAR in each exposure configuration, wireless mode and frequency band combination; Plots are also required when the measured SAR is > 1.5 W/kg, or > 7.0 W/kg for occupational exposure. The published RF exposure KDB procedures may require additional plots; for example, to support SAR to peak location separation ratio test exclusion and/or volume scan post-processing(Refer to appendix C for details).

10.1.1. SAR measurement Result of GSM850

Test Position of Extremity with 0mm	Test channel /Freq.	Test Mode	SAR Value (W/kg)		Power Drift (±5%)	Conducted power (dBm)	Tune-up power (dBm)	Scaled SAR 10g (W/Kg)
			1g	10g				
Front Side	251/848.8	GPRS(GMSK 4TS)	0.294	0.202	-0.42	24.41	25.00	0.231
Back Side	251/848.8	GPRS(GMSK 4TS)	0.762	0.439	-4.07	24.41	25.00	0.503
Left Side	251/848.8	GPRS(GMSK 4TS)	0.126	0.087	-1.09	24.41	25.00	0.100
Right Side	251/848.8	GPRS(GMSK 4TS)	0.203	0.133	-3.57	24.41	25.00	0.152
Bottom Side	251/848.8	GPRS(GMSK 4TS)	1.009	0.530	-0.47	24.41	25.00	0.607

NOTE: Extremity SAR test results of GSM850

10.1.2. SAR measurement Result of GSM1900

Test Position of Extremity with 0mm	Test channel /Freq.	Test Mode	SAR Value (W/kg)		Power Drift (±5%)	Conducted power (dBm)	Tune-up power (dBm)	Scaled SAR 10g (W/Kg)
			1g	10g				
Front Side	512/1850.2	GPRS(GMSK 4TS)	0.169	0.098	0.79	22.63	23.00	0.107
Back Side	512/1850.2	GPRS(GMSK 4TS)	0.113	0.064	-0.21	22.63	23.00	0.070
Left Side	512/1850.2	GPRS(GMSK 4TS)	0.066	0.038	-3.41	22.63	23.00	0.041
Right Side	512/1850.2	GPRS(GMSK 4TS)	0.211	0.108	-4.48	22.63	23.00	0.118
Bottom Side	512/1850.2	GPRS(GMSK 4TS)	0.694	0.342	-0.73	22.63	23.00	0.372

NOTE: Extremity SAR test results of GSM1900

10.1.3. SAR measurement Result of Wi-Fi 2.4G

Test Position of Extremity with 0mm	Test channel /Freq.	Test Mode	SAR Value (W/kg)		Power Drift (±5%)	Conducted power (dBm)	Tune-up power (dBm)	Scaled SAR 10g (W/Kg)
			1g	10g				
Front Side	1/2412	802.11 b	0.461	0.217	-3.96	13.50	14.00	0.243
Back Side	1/2412	802.11 b	0.466	0.248	-3.83	13.50	14.00	0.278
Right Side	1/2412	802.11 b	0.103	0.075	-1.26	13.50	14.00	0.084
Top Side	1/2412	802.11 b	0.357	0.168	1.67	13.50	14.00	0.188

NOTE: Extremity SAR test results of Wi-Fi 2.4G

10.1.4. SAR measurement Result of UHF-RFID

Test Position of Extremity with 0mm	Frequency	Mode	SAR Value (W/kg)		Power Drift (±5%)	Conducted power (dBm)	Tune-up power (dBm)	Scaled SAR 10g (W/Kg)
			1g	10g				
Front Side	902.75	ASK	0.236	0.135	-0.46	24.25	25.00	0.160
Back Side	902.75	ASK	1.323	0.738	0.60	24.25	25.00	0.877
Left Side	902.75	ASK	1.231	0.637	-3.23	24.25	25.00	0.757
Right Side	902.75	ASK	0.836	0.486	1.78	24.25	25.00	0.578
Top Side	902.75	ASK	1.547	0.980	-0.83	24.25	25.00	1.165

NOTE: Extremity SAR test results of UHF-RFID

10.2. Simultaneous Transmission Possibilities

The Simultaneous Transmission Possibilities of this device are as below:

No.	Configuration	Extremity
1	GPRS(data) + Wi-Fi 2.4GHz(data)	Yes
2	GPRS(data) + UHF-RFID(data)	Yes
3	GPRS(data) + BT(data)	Yes
4	Wi-Fi 2.4GHz(data) + UHF-RFID(data)	Yes
5	Wi-Fi 2.4GHz(data) + BT(data)	Yes
6	UHF-RFID(data) + BT(data)	Yes
7	GPRS(data) + Wi-Fi 2.4GHz(data) + UHF-RFID(data)	Yes
8	GPRS(data) + Wi-Fi 2.4GHz(data) + BT(data)	Yes
9	GPRS(data) + UHF-RFID(data) + BT(data)	Yes
10	Wi-Fi 2.4GHz(data) + UHF-RFID(data) + BT(data)	Yes
11	GPRS(data) + Wi-Fi 2.4GHz(data) + UHF-RFID(data) + BT(data)	Yes

NOTE: The Scaled SAR summation is calculated based on the same configuration and test position.

10.3. SAR Summation Scenario

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

1) Scalar SAR summation < 4.0W/kg.

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 ≤ 0.10, simultaneously transmission SAR measurement is not necessary.

In the above table (See Sec.10.2), four simultaneous transmissions are worst-case, so only the worst is listed.

Test Position	Scaled SAR_{MAX}				Σ 10-g SAR (W/Kg)	SPLSR	Remark
	GSM 850	Wi-Fi 2.4G	UHF-RFID	BT			
Front Side	0.231	0.243	0.160	0.034	0.669	n/a	n/a
Back Side	0.503	0.278	0.877	0.034	1.692	n/a	n/a
Left Side	0.100	n/a	0.757	0.034	0.890	n/a	n/a
Right Side	0.152	0.084	0.578	0.034	0.848	n/a	n/a
Top Side	n/a	0.188	1.165	0.034	1.387	n/a	n/a
Bottom Side	0.607	n/a	n/a	n/a	0.607	n/a	n/a

NOTE: 10-g SAR Simultaneous Tx Combination of GSM850, Wi-Fi 2.4G, UHF-RFID and BT.

Test Position	Scaled SAR_{MAX}				Σ 10-g SAR (W/Kg)	SPLSR	Remark
	GSM 1900	Wi-Fi 2.4G	UHF-RFID	BT			
Front Side	0.107	0.243	0.160	0.034	0.544	n/a	n/a
Back Side	0.070	0.278	0.877	0.034	1.259	n/a	n/a
Left Side	0.041	n/a	0.757	0.034	0.832	n/a	n/a
Right Side	0.118	0.084	0.578	0.034	0.813	n/a	n/a
Top Side	n/a	0.188	1.165	0.034	1.387	n/a	n/a
Bottom Side	0.372	n/a	n/a	n/a	0.372	n/a	n/a

NOTE: 10-g SAR Simultaneous Tx Combination of GSM1900, Wi-Fi 2.4G, UHF-RFID and BT.

11. Appendix A. Photo documentation

Table of contents

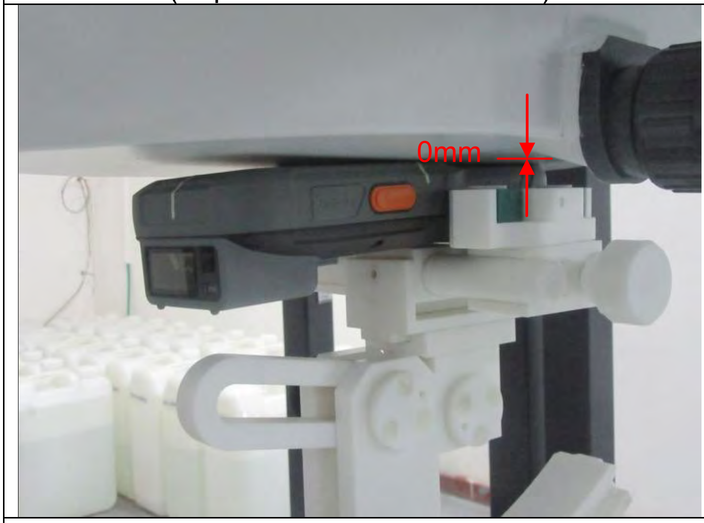
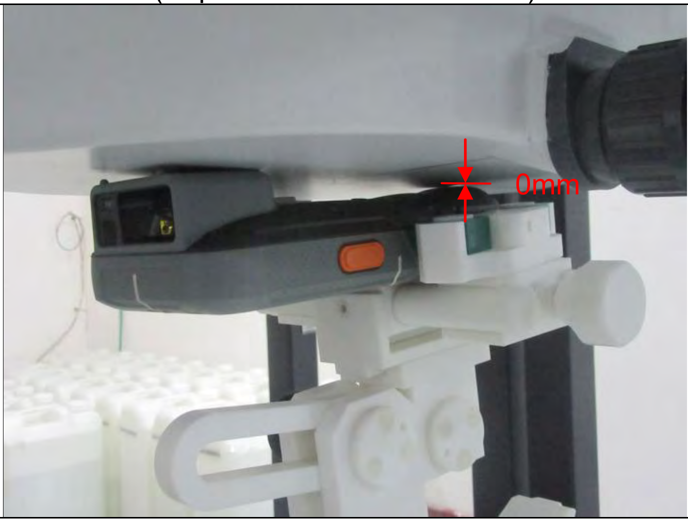
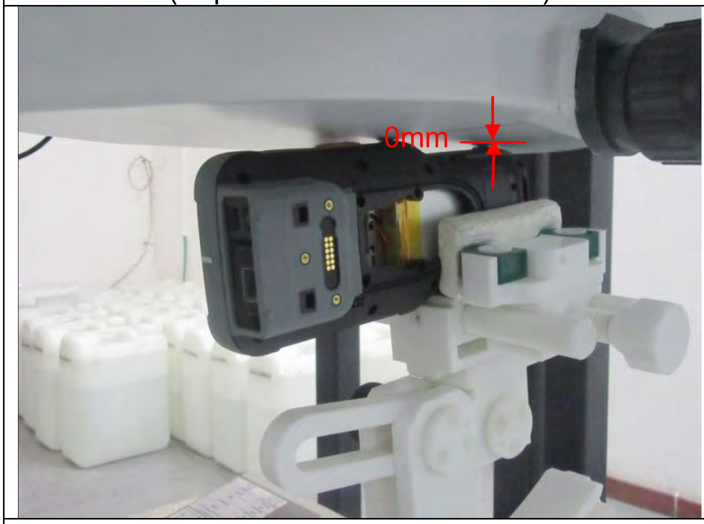
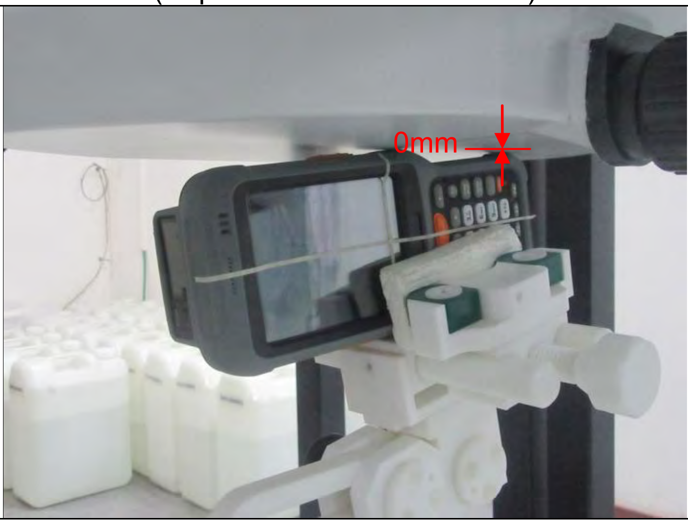
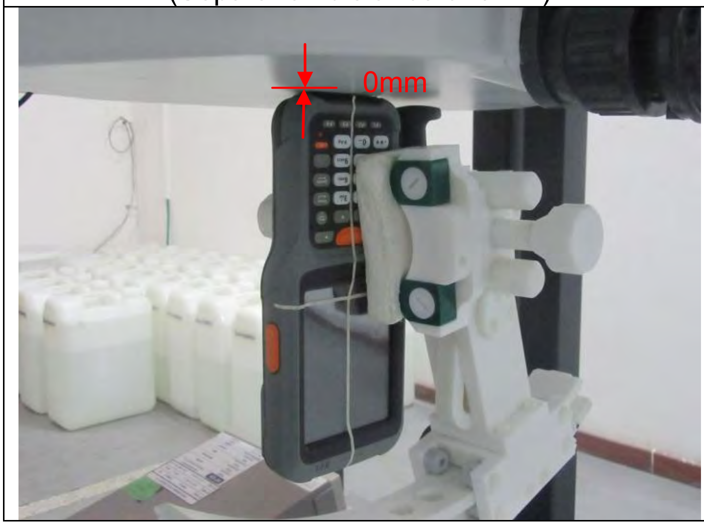
Test Facility

Measurement System SATIMO

Product Photo

Appearance photo	Reference Line
	

2G Antenna Test Positions

<table>
<tr><td>Front Side
(Separation distance of 0mm)</td><td>Back Side
(Separation distance of 0mm)</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Left Side
(Separation distance of 0mm)</td><td>Right Side
(Separation distance of 0mm)</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Bottom Side
(Separation distance of 0mm)</td><td>n/a</td></tr>
<tr><td></td><td>n/a</td></tr>
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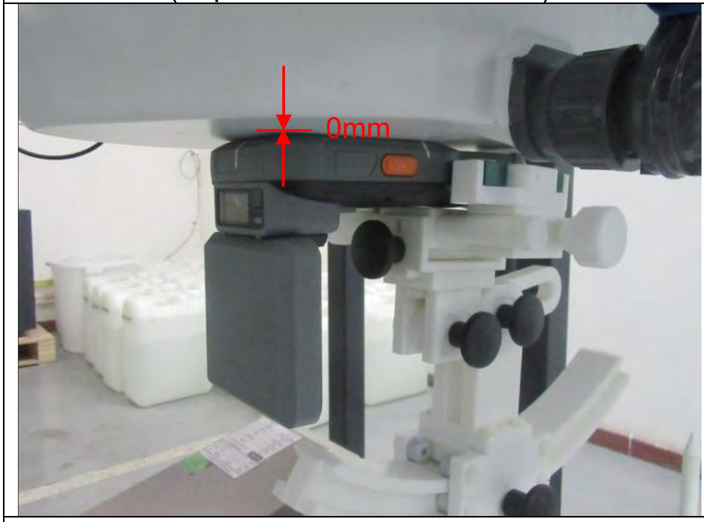
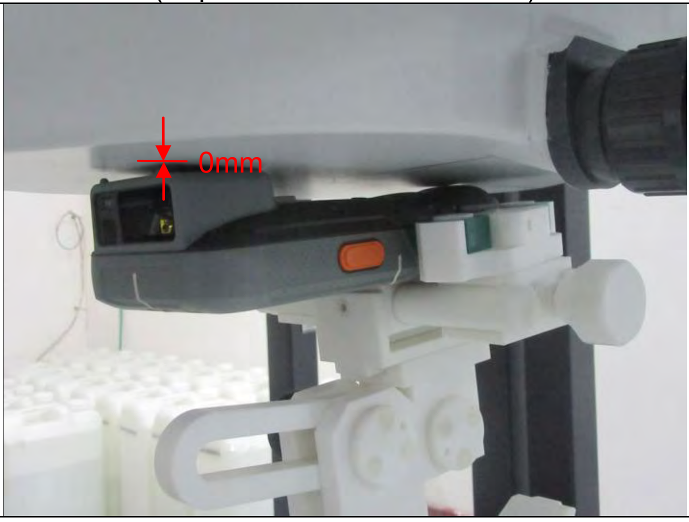
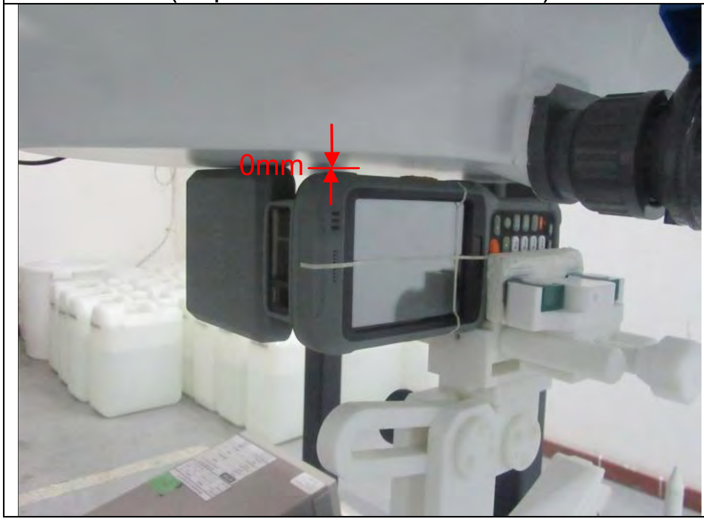
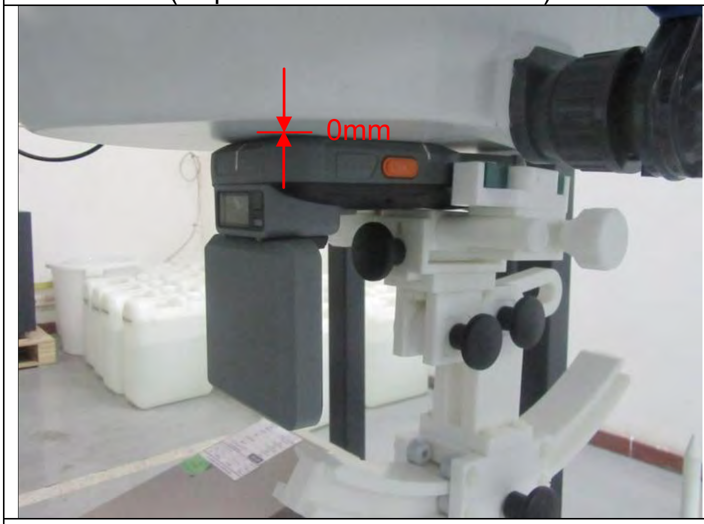
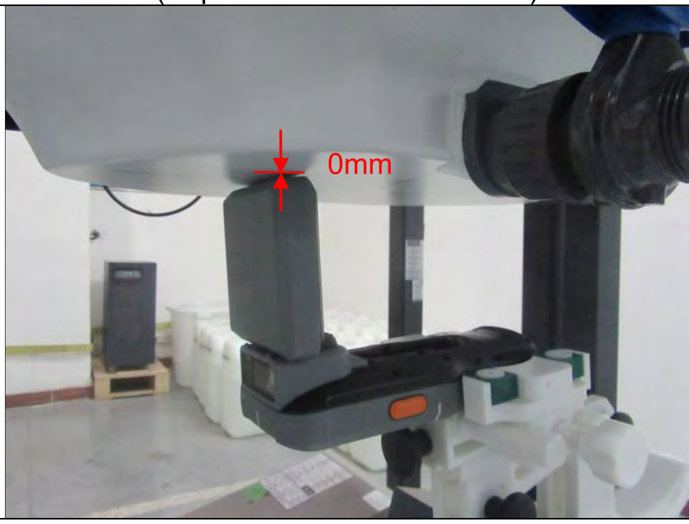
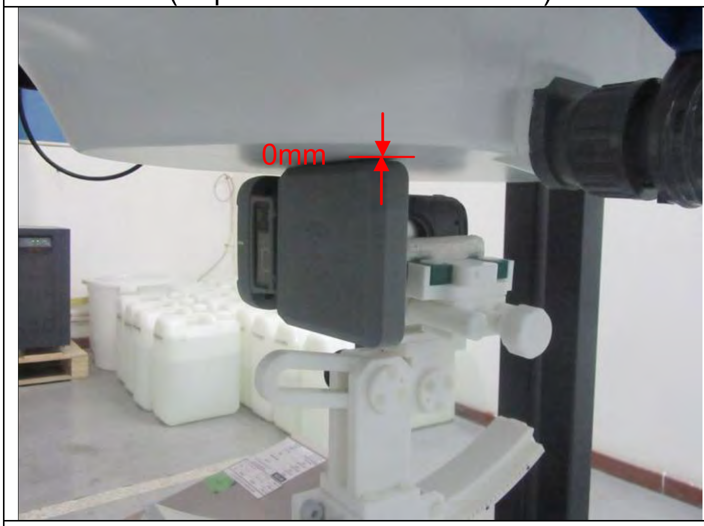
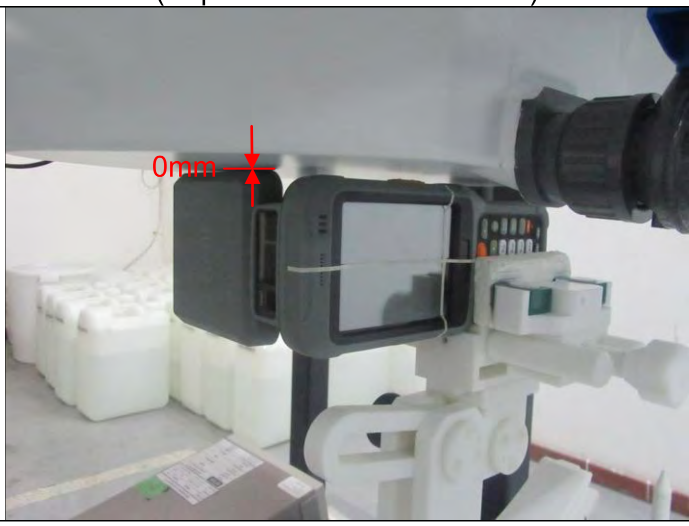
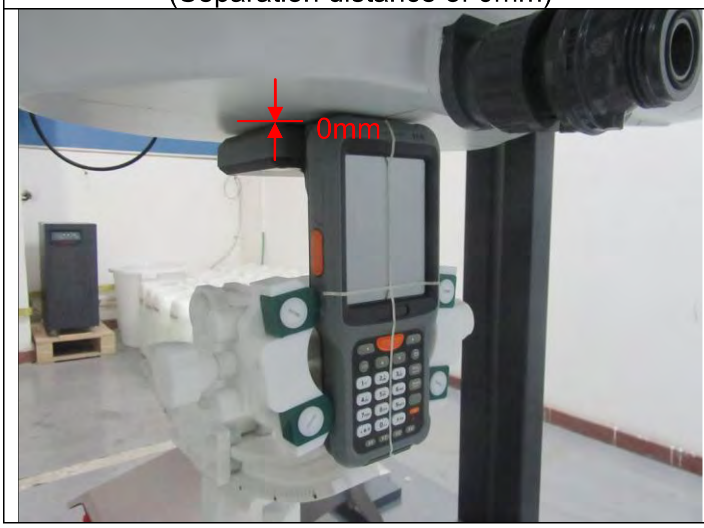
Wi-Fi Antenna Test Positions

Front Side (Separation distance of 0mm)	Back Side (Separation distance of 0mm)
	
Right Side (Separation distance of 0mm)	Top Side (Separation distance of 0mm)
	

UHF-RFID Antenna Test Positions

Front Side (Separation distance of 0mm)	Back Side (Separation distance of 0mm)
	
Left Side (Separation distance of 0mm)	Right Side (Separation distance of 0mm)
	
Top Side (Separation distance of 0mm)	n/a
	n/a

Liquid depth

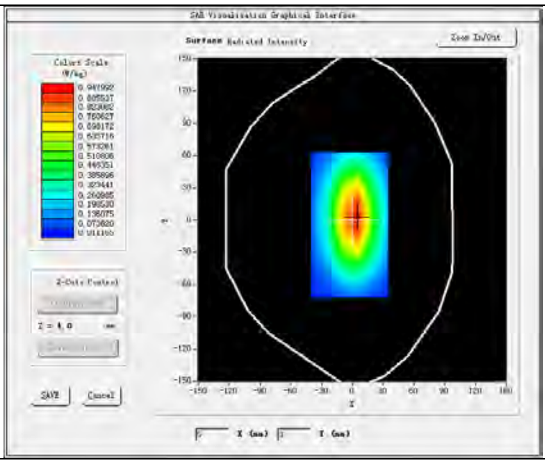
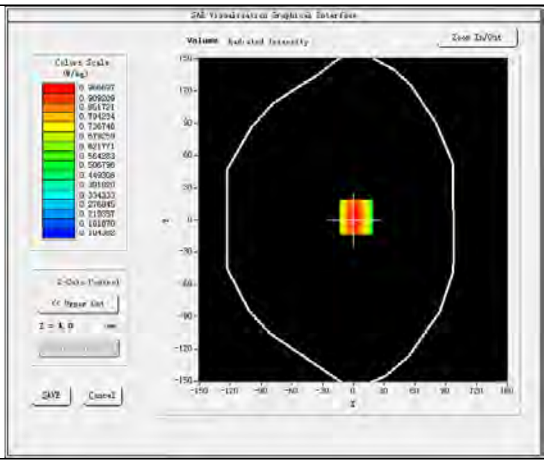
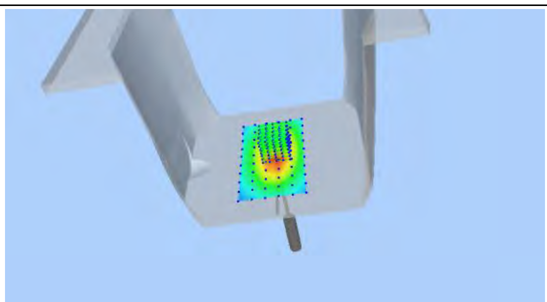
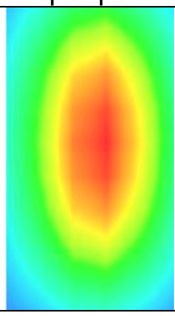
Body 850MHz depth (15.1cm)	Body 900MHz depth (15.1cm)
	
Body 1900MHz depth (15.1cm)	Body 2450MHz depth (15.2cm)
	

12. Appendix B. System Check Plots

Table of contents

System Performance Check - 835MHz

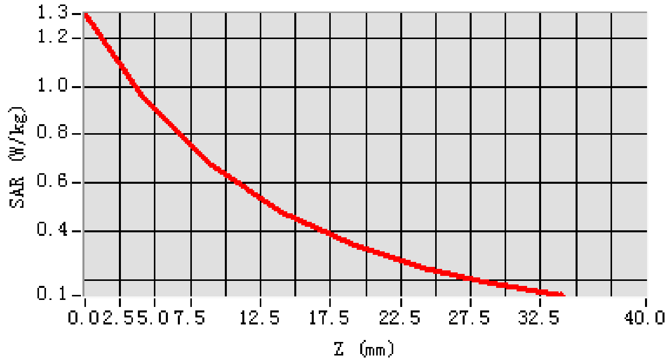
Date of measurement:	Dec. 07, 2016
Signal:	Communication System: CW; Frequency: 835MHz; Duty Cycle: 1:1.00
ConvF:	1.59
Liquid Parameters:	Relative permittivity (real part): 55.23; Conductivity (S/m): 0.99;
Device Position:	Dipole
Area Scan:	dx=15mm dy=15mm, h=5.00mm
Zoom Scan:	5x5x7, dx=8mm dy=8mm dz=5mm, h=5.00mm

Surface SAR	Volume SAR
	
3D screen shot	Hot spot position
	

Maximum location: X=3.00, Y=3.00
SAR Peak: 1.30 W/kg

SAR 1g (W/Kg)	0.947
SAR 10g (W/Kg)	0.633
Power Drift (±5%):	0.02

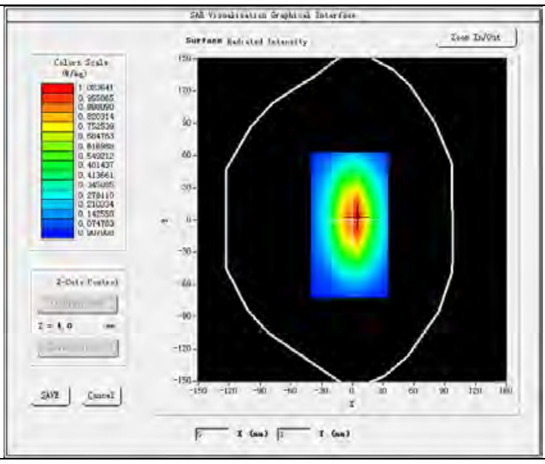
Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	1.2979	0.9667	0.6750	0.4820	0.3482	0.2530	0.1848



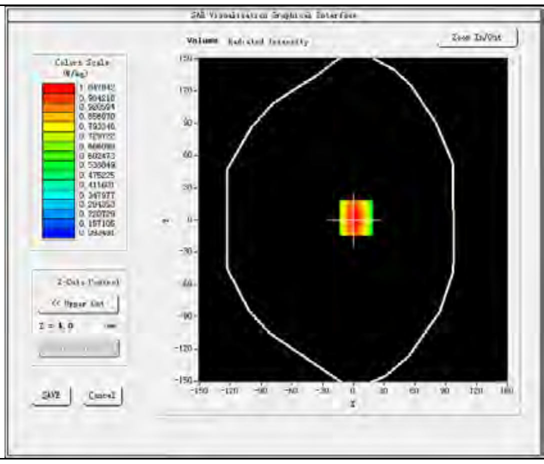
System Performance Check - 900MHz

Date of measurement:	Dec. 25, 2016
Signal:	Communication System: CW; Frequency: 900MHz; Duty Cycle: 1:1.00
ConvF:	1.48
Liquid Parameters:	Relative permittivity (real part): 54.79; Conductivity (S/m): 1.07;
Device Position:	Dipole
Area Scan:	dx=15mm dy=15mm, h=5.00mm
Zoom Scan:	5x5x7, dx=8mm dy=8mm dz=5mm, h=5.00mm

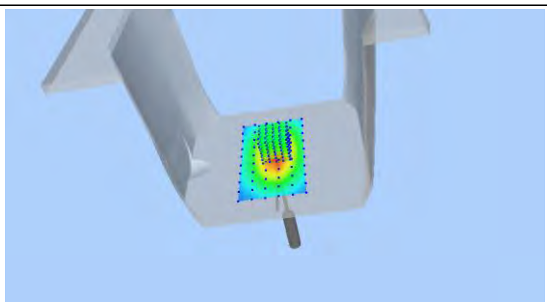
Surface SAR



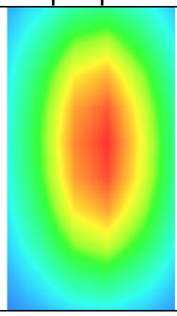
Volume SAR



3D screen shot

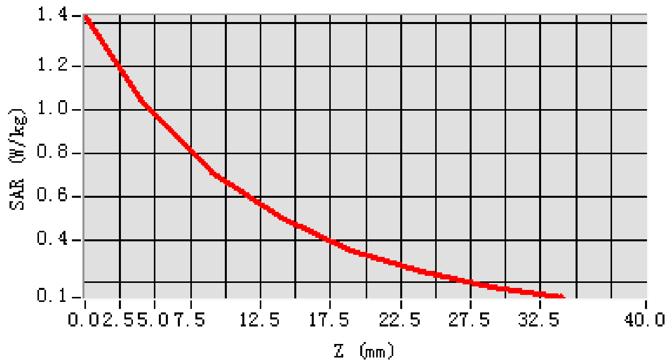


Hot spot position



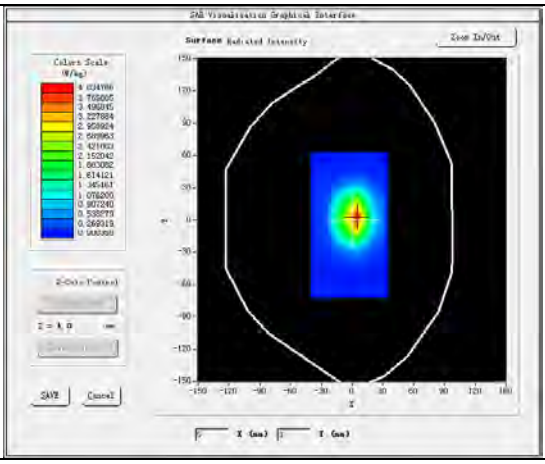
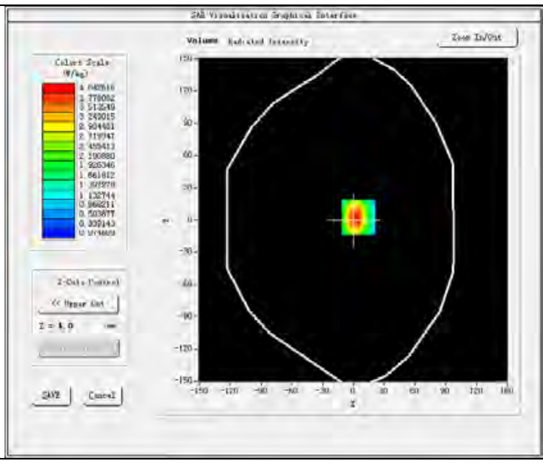
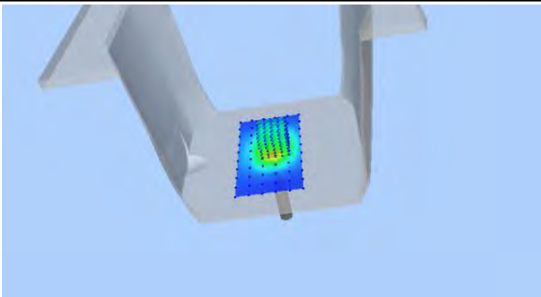
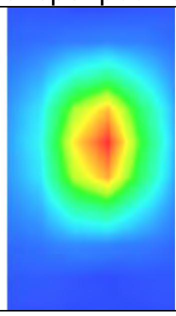
Maximum location: X=3.00, Y=2.00
SAR Peak: 1.44 W/kg

SAR 1g (W/Kg)				1.037			
SAR 10g (W/Kg)				0.668			
Power Drift (±5%):				0.08			
Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	1.4362	1.0478	0.7124	0.4973	0.3518	0.2524	0.1810



System Performance Check - 1900MHz

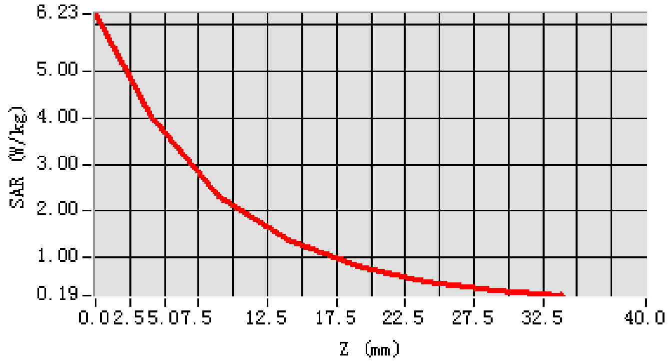
Date of measurement:	Dec. 07, 2016
Signal:	Communication System: CW; Frequency: 1900MHz; Duty Cycle: 1:1.00
ConvF:	2.00
Liquid Parameters:	Relative permittivity (real part): 53.55; Conductivity (S/m): 1.56;
Device Position:	Dipole
Area Scan:	dx=15mm dy=15mm, h=5.00mm
Zoom Scan:	5x5x7, dx=8mm dy=8mm dz=5mm, h=5.00mm

Surface SAR	Volume SAR
	
3D screen shot	Hot spot position
	

Maximum location: X=5.00, Y=3.00
SAR Peak: 6.49 W/kg

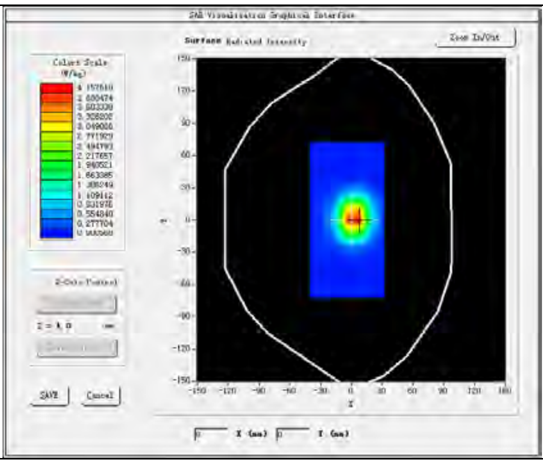
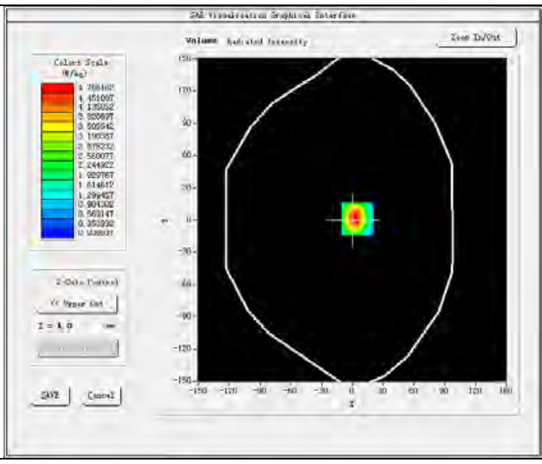
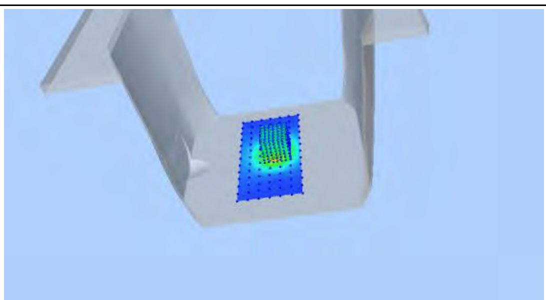
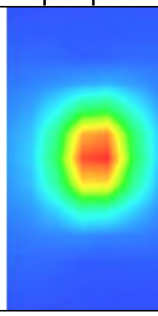
SAR 1g (W/Kg)	4.014
SAR 10g (W/Kg)	2.080
Power Drift (±5%):	-0.09

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	6.2303	4.0426	2.3179	1.3859	0.8285	0.5029	0.3067



System Performance Check - 2450MHz

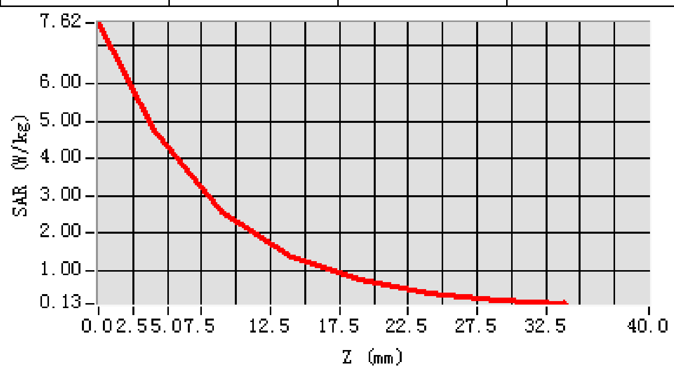
Date of measurement:	Jan. 04, 2017
Signal:	Communication System: CW; Frequency: 2450MHz; Duty Cycle: 1:1.00
ConvF:	2.10
Liquid Parameters:	Relative permittivity (real part): 51.53; Conductivity (S/m): 1.92;
Device Position:	Dipole
Area Scan:	dx=12mm dy=12mm, h=5.00mm
Zoom Scan:	7x7x7, dx=5mm dy=5mm dz=5mm, h=5.00mm

Surface SAR	Volume SAR
	
3D screen shot	Hot spot position
	

Maximum location: X=5.00, Y=1.00
SAR Peak: 7.86 W/kg

SAR 1g (W/Kg)	4.618
SAR 10g (W/Kg)	2.183
Power Drift (±5%):	-0.31

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	7.6174	4.7662	2.5623	1.3810	0.7600	0.4138	0.2288



13. Appendix C. Plots of High SAR Measurement

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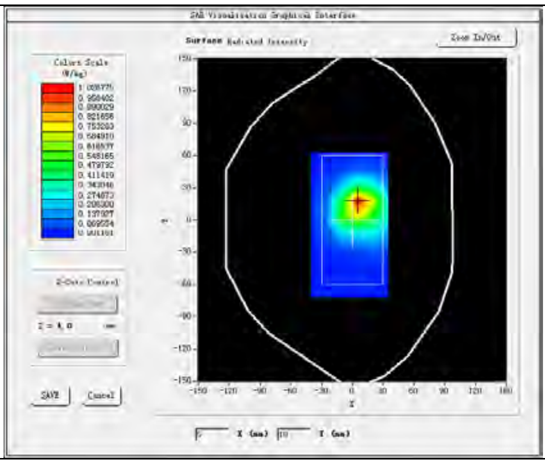
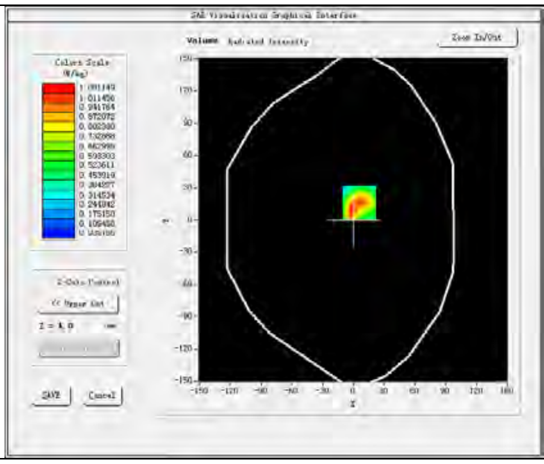
GSM850_GPRS(GMSK 4TS)_Ch251_Bottom Side_0mm

Date of measurement:	Dec. 07, 2016
Signal:	Communication System: GPRS(GMSK 4TS); Frequency: 848.8MHz; Duty Cycle: 1:2.08
ConvF:	1.59
Liquid Parameters:	Relative permittivity (real part): 55.06; Conductivity (S/m): 1.00;
Device Position:	Body
Area Scan:	dx=15mm dy=15mm, h=5.00mm
Zoom Scan:	5x5x7, dx=8mm dy=8mm dz=5mm, h=5.00mm

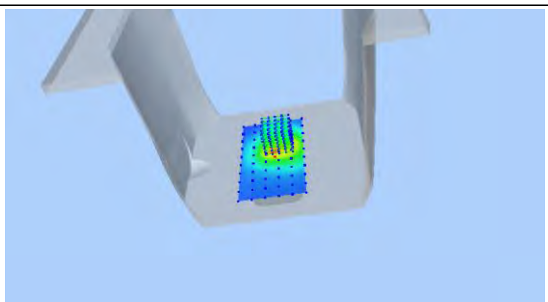
Surface SAR



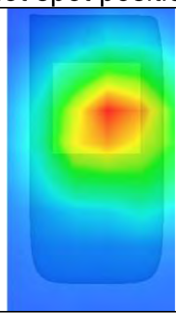
Volume SAR



3D screen shot



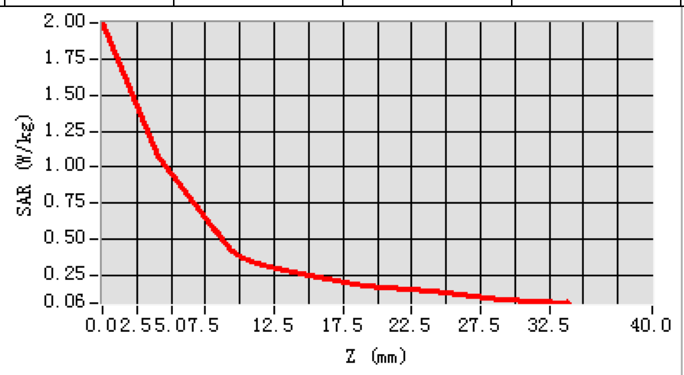
Hot spot position



Maximum location: X=6.00, Y=16.00
SAR Peak: 1.74 W/kg

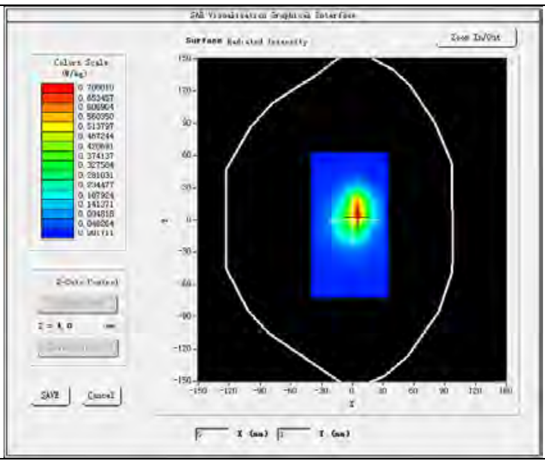
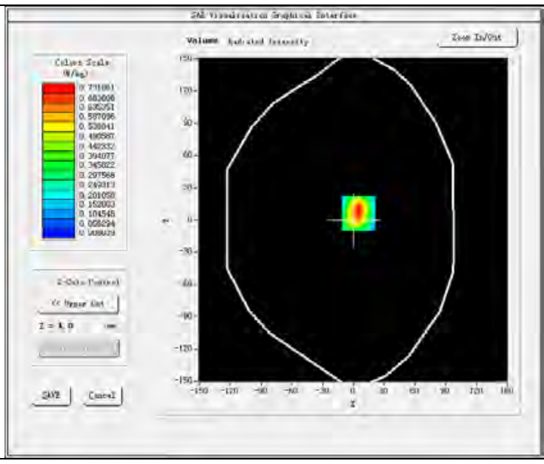
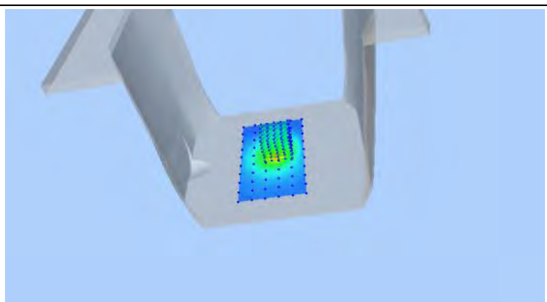
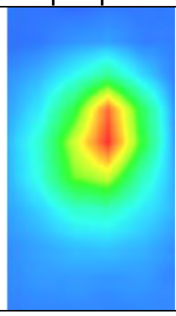
SAR 1g (W/Kg)	1.009
SAR 10g (W/Kg)	0.530
Power Drift (±5%):	-0.47

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	1.9967	1.0811	0.4309	0.2930	0.1839	0.1497	0.0840



GSM1900_GPRS(GMSK 4TS)_Ch512_Bottom Side_0mm

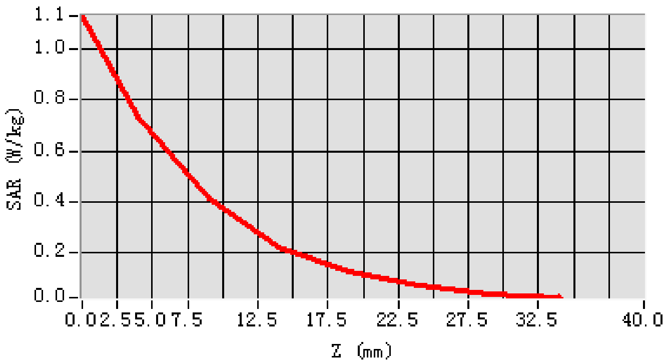
Date of measurement:	Dec. 07, 2016
Signal:	Communication System: GPRS(GMSK 4TS); Frequency: 1850.2MHz; Duty Cycle: 1:2.08
ConvF:	2.00
Liquid Parameters:	Relative permittivity (real part): 53.73; Conductivity (S/m): 1.53;
Device Position:	Body
Area Scan:	dx=15mm dy=15mm, h=5.00mm
Zoom Scan:	5x5x7, dx=8mm dy=8mm dz=5mm, h=5.00mm

Surface SAR	Volume SAR
	
3D screen shot	Hot spot position
	

Maximum location: X=5.00, Y=6.00
SAR Peak: 1.18 W/kg

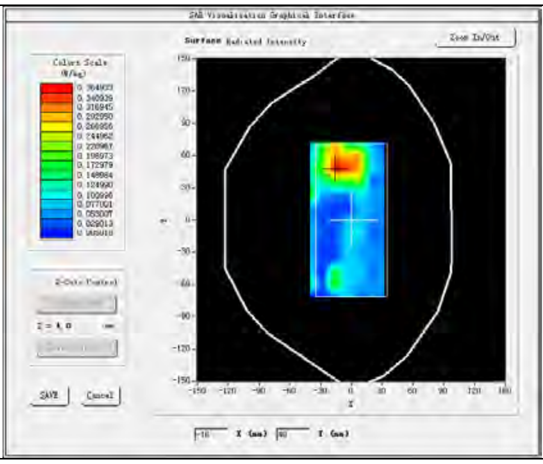
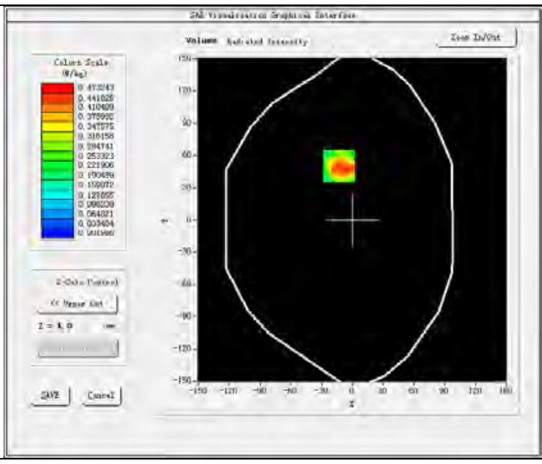
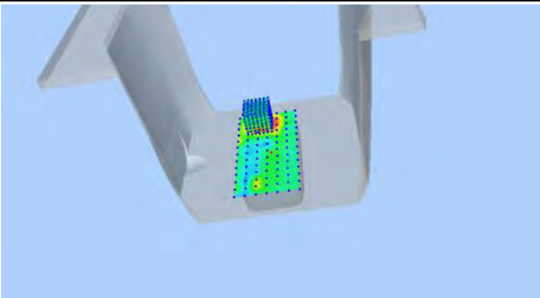
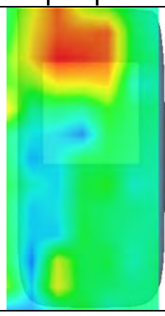
SAR 1g (W/Kg)	0.694
SAR 10g (W/Kg)	0.342
Power Drift (±5%):	-0.73

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	1.1312	0.7319	0.4131	0.2230	0.1285	0.0709	0.0402



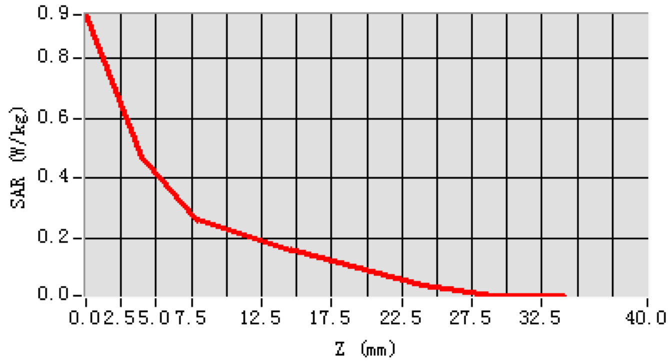
Wi-Fi 2.4G_802.11b_Ch1_Back Side_0mm

Date of measurement:	Jan. 04, 2017
Signal:	Communication System: Wi-Fi 802.11a/b/g/n/ac; Frequency: 2412MHz; Duty Cycle: 1:1.00
ConvF:	2.10
Liquid Parameters:	Relative permittivity (real part): 51.63; Conductivity (S/m): 1.98;
Device Position:	Body
Area Scan:	dx=12mm dy=12mm, h=5.00mm
Zoom Scan:	7x7x7, dx=5mm dy=5mm dz=5mm, h=5.00mm

Surface SAR	Volume SAR
	
3D screen shot	Hot spot position
	

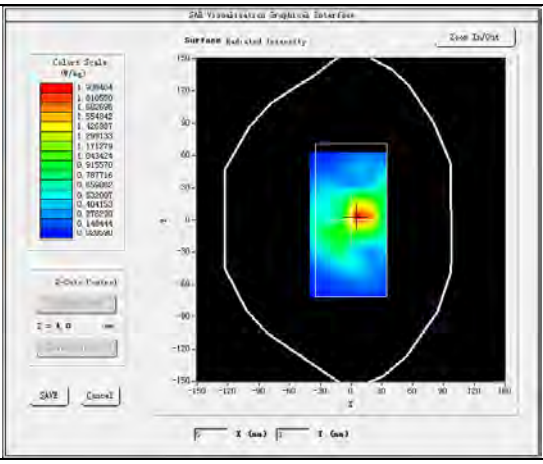
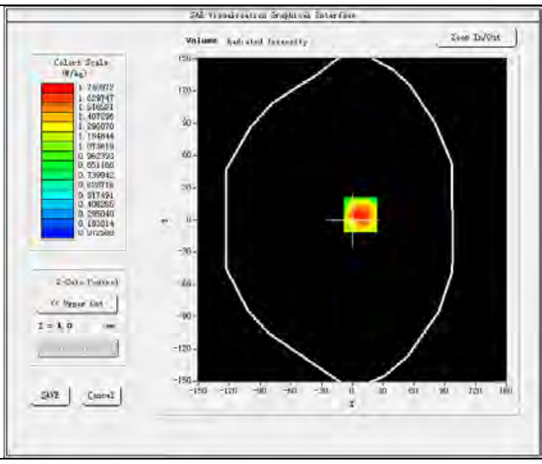
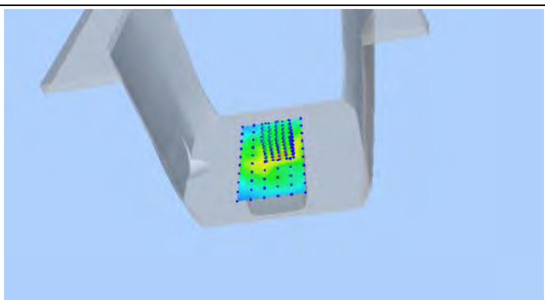
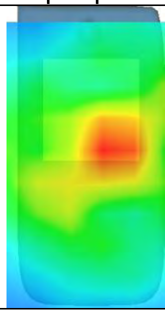
Maximum location: X=-13.00, Y=50.00
SAR Peak: 0.91 W/kg

SAR 1g (W/Kg)				0.466			
SAR 10g (W/Kg)				0.248			
Power Drift (±5%):				-3.83			
Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	0.9463	0.4732	0.2268	0.1718	0.1051	0.0417	0.0066



UHF-RFID_ASK_902.75MHz_Top Side_0mm

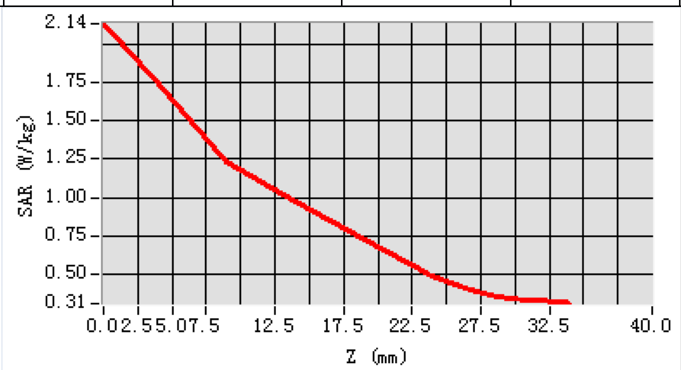
Date of measurement:	Dec. 25, 2016
Signal:	Communication System: UHF-RFID(ASK); Frequency: 902.75MHz; Duty Cycle: 1:1.00
ConvF:	1.48
Liquid Parameters:	Relative permittivity (real part): 54.75; Conductivity (S/m): 1.08;
Device Position:	Body
Area Scan:	dx=15mm dy=15mm, h=5.00mm
Zoom Scan:	5x5x7, dx=8mm dy=8mm dz=5mm, h=5.00mm

Surface SAR	Volume SAR
	
3D screen shot	Hot spot position
	

Maximum location: X=8.00, Y=5.00
SAR Peak: 2.19 W/kg

SAR 1g (W/Kg)	1.547
SAR 10g (W/Kg)	0.980
Power Drift (±5%):	-0.83

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	2.1353	1.7410	1.2376	0.9688	0.7234	0.4893	0.3259



14. Appendix D. Calibration Certificate

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COMOSAR E-Field Probe Calibration Report

Ref : ACR.263.1.16.SATU.A

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

Calibration CERT #2246-02

Calibration Date: 09/08/2016

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	9/19/2016	JS
Checked by :	Jérôme LUC	Product Manager	9/19/2016	JS
Approved by :	Kim RUTKOWSKI	Quality Manager	9/19/2016	Kim Rutkowski

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

Issue	*Date*	*Modifications*
A	9/19/2016	Initial release

TABLE OF CONTENTS

1 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR DOSIMETRIC E FIELD PROBE
Manufacturer	MVG
Model	SSE2
Serial Number	SN 08/16 EPGO287
Product Condition (new / used)	New
Frequency Range of Probe	0.7 GHz-6GHz
Resistance of Three Dipoles at Connector	Dipole 1: R1=0.206 MΩ Dipole 2: R2=0.193 MΩ Dipole 3: R3=0.194 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.

3.2 SENSITIVITY

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

3.3 LOWER DETECTION LIMIT

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

3.4 ISOTROPY

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

3.5 BOUNDARY EFFECT

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

4 MEASUREMENT UNCERTAINTY

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

Uncertainty analysis of the probe calibration in waveguide

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

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

5 CALIBRATION MEASUREMENT RESULTS

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

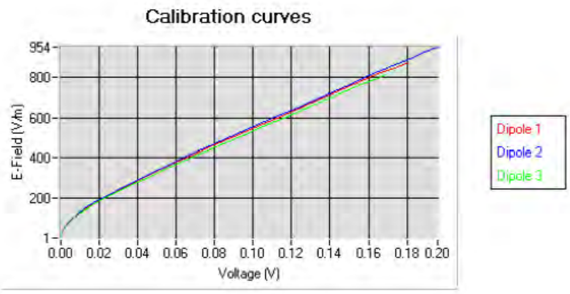
5.1 SENSITIVITY IN AIR

Normx dipole 1 ($\mu V/(V/m)^2$)	Normy dipole 2 ($\mu V/(V/m)^2$)	Normz dipole 3 ($\mu V/(V/m)^2$)
0.70	0.81	0.63

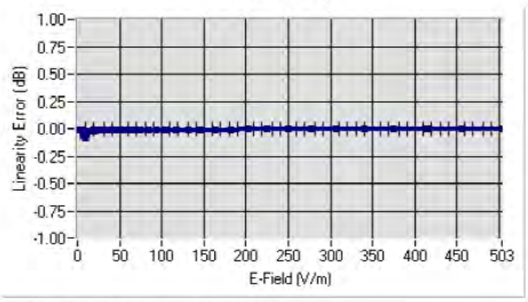
DCP dipole 1 (mV)	DCP dipole 2 (mV)	DCP dipole 3 (mV)
91	90	94

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

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



5.2 LINEARITY



Linearity:+/-1.83% (+/-0.08dB)

5.3 SENSITIVITY IN LIQUID

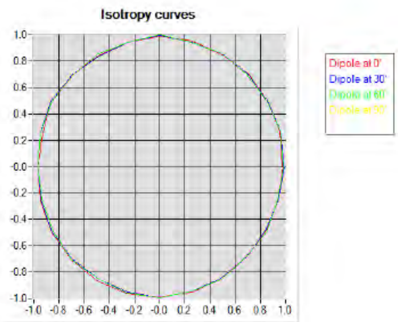
Liquid	Frequency (MHz +/- 100MHz)	Permittivity	Epsilon (S/m)	ConvF
HL450	450	42.17	0.86	1.51
BL450	450	57.65	0.95	1.55
HL750	750	40.03	0.93	1.36
BL750	750	56.83	1.00	1.41
HL850	835	42.19	0.90	1.53
BL850	835	54.67	1.01	1.59
HL900	900	42.08	1.01	1.43
BL900	900	55.25	1.08	1.48
HL1800	1800	41.68	1.46	1.66
BL1800	1800	53.86	1.46	1.69
HL1900	1900	38.45	1.45	1.94
BL1900	1900	53.32	1.56	2.00
HL2000	2000	38.26	1.38	1.87
BL2000	2000	52.70	1.51	1.94
HL2450	2450	37.50	1.80	2.03
BL2450	2450	53.22	1.89	2.10
HL2600	2600	39.80	1.99	2.11
BL2600	2600	52.52	2.23	2.17
HL5200	5200	35.64	4.67	1.99
BL5200	5200	48.64	5.51	2.04
HL5400	5400	36.44	4.87	2.09
BL5400	5400	46.52	5.77	2.16
HL5600	5600	36.66	5.17	2.10
BL5600	5600	46.79	5.77	2.17
HL5800	5800	35.31	5.31	2.02
BL5800	5800	47.04	6.10	2.07

LOWER DETECTION LIMIT: 8mW/kg

5.4 ISOTROPY

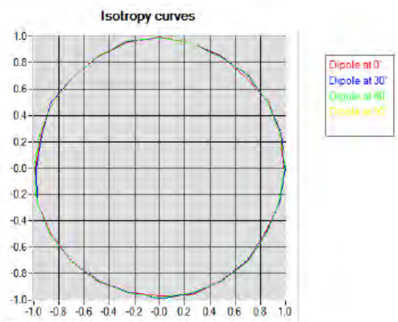
HL900 MHz

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



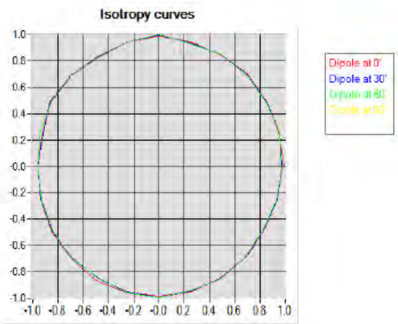
HL1800 MHz

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



HL5600 MHz

- Axial isotropy: 0.06 dB
- Hemispherical isotropy: 0.10 dB



6 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Description	**Manufacturer / Model**	**Identification No.**	**Current Calibration Date**	**Next Calibration Date**
Flat Phantom	MVG	SN-20/09-SAM71	Validated. No cal required.	Validated. No cal required.
COMOSAR Test Bench	Version 3	NA	Validated. No cal required.	Validated. No cal required.
Network Analyzer	Rhode & Schwarz ZVA	SN100132	02/2016	02/2019
Reference Probe	MVG	EP 94 SN 37/08	10/2015	10/2016
Multimeter	Keithley 2000	1188656	12/2013	12/2016
Signal Generator	Agilent E4438C	MY49070581	12/2013	12/2016
Amplifier	Aethercomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	HP E4418A	US38261498	12/2013	12/2016
Power Sensor	HP ECP-E26A	US37181460	12/2013	12/2016
Directional Coupler	Narda 4216-20	01386	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Waveguide	Mega Industries	069Y7-158-13-712	Validated. No cal required.	Validated. No cal required.
Waveguide Transition	Mega Industries	069Y7-158-13-701	Validated. No cal required.	Validated. No cal required.
Waveguide Termination	Mega Industries	069Y7-158-13-701	Validated. No cal required.	Validated. No cal required.
Temperature / Humidity Sensor	Control Company	150798832	10/2015	10/2017

SAR Reference Dipole Calibration Report

Ref : ACR.139.4.15.SATU.A

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

04/06/2015

Summary:

This document presents the method and results from an accredited SAR reference dipole calibration performed in MVG USA using the COMOSAR test bench. All calibration results are traceable to national metrology institutions.

	Name	*Function*	*Date*	*Signature*
Prepared by :	Jérôme LUC	Product Manager	5/19/2015	JS
Checked by :	Jérôme LUC	Product Manager	5/19/2015	JS
Approved by :	Kim RUTKOWSKI	Quality Manager	5/19/2015	Kim Rutkowski

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

Issue	*Date*	*Modifications*
A	5/19/2015	Initial release

TABLE OF CONTENTS

1 INTRODUCTION

This document contains a summary of the requirements set forth by the IEEE 1528, FCC KDBs and CEI/IEC 62209 standards for reference dipoles used for SAR measurement system validations and the measurements that were performed to verify that the product complies with the fore mentioned standards.

2 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR 835 MHz REFERENCE DIPOLE
Manufacturer	MVG
Model	SID835
Serial Number	SN 03/15 DIP 0G835-347
Product Condition (new / used)	New

A yearly calibration interval is recommended.

3 PRODUCT DESCRIPTION

3.1 GENERAL INFORMATION

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

Figure 1 – *MVG COMOSAR Validation Dipole*