# FCC SAR
# Measurement and Test Report

## For

## UrbanHello

## 13 rue Saint Antoine 75004 Paris France

## FCC ID: 2AK6RUH05

| | |
|---|---|
| **FCC Rules:** | FCC Part 2.1093<br>ANSI / IEEE C95.1 :2005<br>ANSI / IEEE C95.3 :2002 |
| **Product Description:** | REMI |
| **Tested Model:** | UH05xxxxx |
| **Report No.:** | STR17028021H |
| **Tested Date:** | 2017-03-06 to 2017-03-07 |
| **Issued Date:** | 2017-03-08 |
| **Tested By:** | Lucy Wei / Engineer — Lucy Wei |
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| **Prepared By:** | |

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# 1. General Information

## 1.1 Product Description for Equipment Under Test (EUT)

**Client Information**

| | |
|---|---|
| Applicant: | UrbanHello |
| Address of applicant: | 13 rue Saint Antoine 75004 Paris France |
| Manufacturer: | Maxway Technology Co., Ltd |
| Address of manufacturer: | Building4, Section A, 3rd industrial zone of Tangtou, Shiyan Town, Bao'an district, Shenzhen, Guangdong 518108, China |

| **General Description of EUT** | |
|---|---|
| Product Name: | REMI |
| Trade Name: | UrbanHello |
| Model No.: | UH05xxxxx |
| Adding Model(s): | / |
| Rated Voltage: | USB 5.0V |
| Power Adapter Model: | Adapter 1(black): YW1200M<br>I/P: AC 100-240V, 50/60Hz, 0.2A; O/P: DC 5V, 1.2A |
| | Adapter 2(white): A062-0501000IU<br>I/P: AC 100-240V, 50/60Hz, 0.3A; O/P: DC 5V, 1000mA |
| *Note: The test data is gathered from a production sample, provided by the manufacturer.* | |

| Technical Characteristics of EUT | |
|---|---|
| **WIFI** | |
| Support Standards: | 802.11b, 802.11g, 802.11n |
| Frequency Range: | 2412-2462MHz for 802.11b/b/n(HT20) |
| RF Output Power: | 18.65dBm (Conducted) |
| Type of Modulation: | CCK, OFDM, QPSK, BPSK, 16QAM, 64QAM |
| Data Rate: | 1-11Mbps, 6-54Mbps, up to 150Mbps |
| Quantity of Channels: | 11 for 802.11b/g/n(HT20) |
| Channel Separation: | 5MHz |
| Type of Antenna: | Integral |
| Antenna Gain: | 3.0dBi |
| **BT** | |
| Bluetooth Version: | V4.0 |
| Frequency Range: | 2402-2480MHz |
| RF Output Power: | 8.767dBm (Conducted) |
| Data Rate: | GFSK, Pi/4 DQPSK, 8DPSK |
| Modulation: | 1Mbps, 2Mbps, 3Mbps |
| Quantity of Channels: | 79/40 |
| Channel Separation: | 1MHz/2MHz |
| Type of Antenna: | Integral |
| Antenna Gain: | 3.0dBi |

## 1.2 Test Standards

The following report is prepared on behalf of the UrbanHello in accordance with FCC 47 CFR Part 2.1093, ANSI/IEEE C95.1-2005 and KDB 248227 D01 v02r02 and KDB 447498 D01 v06 and KDB 865664 D01 v01r04 and KDB 865664 D02 v01r02

The objective is to determine compliance with FCC Part 2.1093 of the Federal Communication Commissions rules.

***Maintenance of compliance*** is the responsibility of the manufacturer. Any modification of the product, which result in lowering the emission, should be checked to ensure compliance has been maintained.

## 1.3 Test Methodology

All measurements contained in this report were conducted with KDB 865664 D01 v01r04 and KDB 865664 D02 v01r02. The public notice KDB 447498 D01 v06 for Mobile and Portable Devices RF Exposure Procedure also.

## 1.4 Test Facility

- **FCC – Registration No.: 934118**
  Shenzhen SEM.Test Technology Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files and the Registration is 934118.

- **Industry Canada (IC) Registration No.: 11464A**
  The 3m Semi-anechoic chamber of Shenzhen SEM.Test Technology Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 11464A.

- **CNAS Registration No.: L4062**
  Shenzhen SEM.Test Technology Co., Ltd. is a testing organization accredited by China National Accreditation Service for Conformity Assessment (CNAS) according to ISO/IEC 17025. The accreditation certificate number is L4062. All measurement facilities used to collect the measurement data are located at 1/F, Building A, Hongwei Industrial Park, Liuxian 2nd Road, Bao'an District, Shenzhen, P.R.C (518101)

## 2. Summary of Test Results

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

| Frequency Band | Body(5mm Gap) | $SAR_{1g}$ Limit (W/kg) |
|---|---|---|
| | Maximum $SAR_{1g}$(W/kg) | |
| WLAN 2.4GHz | **0.484** | 1.6 |
| Simultaneous Transmission | **0.817** | 1.6 |

The 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 2.1093 and ANSI/IEEE C95.1-2005, and had been tested in accordance with the measurement methods and procedure specified in KDB 865664 D01 v01r04 and KDB 865664 D02 v01r02

# 3. Specific Absorption Rate (SAR)

## 3.1 Introduction

SAR is related to the rate at which energy is absorbed per unit mass in an object exposed to a radio field. The SAR distribution in a biological body is complicated and is usually carried out by experimental techiques or numerical modeling. The standard recommends limits for two tiers of groups, occupational/controlled and general population/uncontrolled, based on a person's awareness and ability to exercise control over his or her exposure. In general, occupational/controlled exposure limits are higher than the limits for general population/uncontrolled.

## 3.2 SAR Definition

The SAR definition is the time derivative (rate) of the incremental energy (dW) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dv) of a given density ( $\rho$ ). The equation description is as below:

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

SAR is expressed in units of Watts per kilogram (W/kg)
SAR measurement can be either related to the temperature elevation in tissue by

$$\mathbf{SAR} = C\left(\frac{\delta T}{\delta t}\right)$$

Where: C is the specific heat capacity, $\delta$ T is the temperature rise and $\delta$ t is the exposure duration, or related to the
electrical field in the tissue by

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

Where: $\sigma$ is the conductivity of the tissue, $\rho$ is the mass density of the tissue and E is the RMS electrical field strength.

However for evaluating SAR of low power transmitter, electrical field measurement is typically applied.

# 4. SAR Measurement System

## 4.1 The Measurement System

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

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

The following figure shows the system.

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

## 4.2 Probe

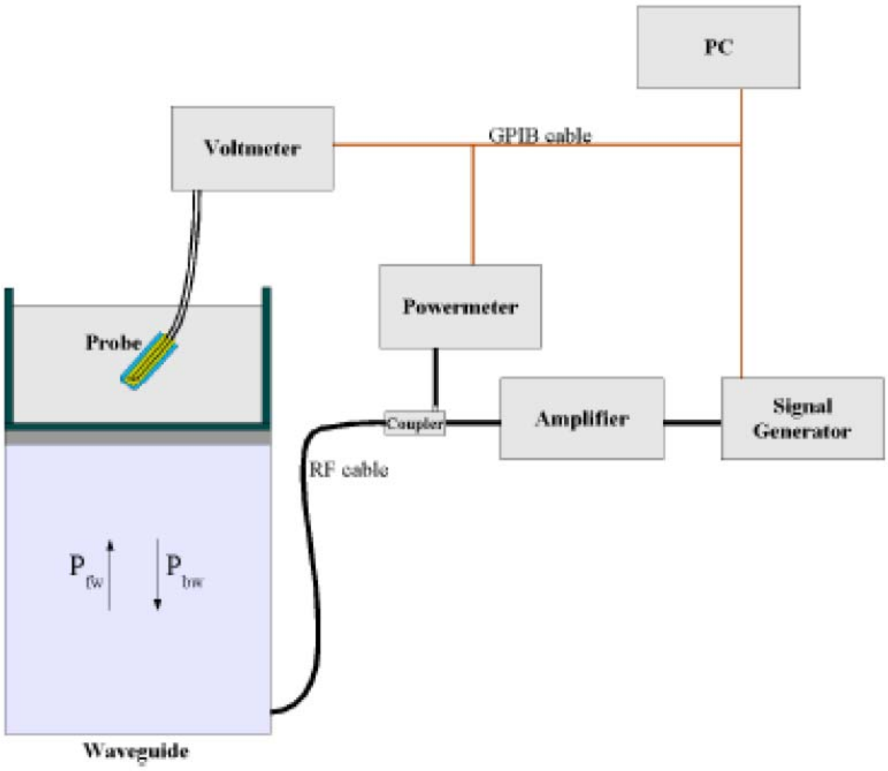
For the measurements the Specific Dosimetric E-Field Probe SSE5 SN 09/13 EP168 with following specifications is used

- Dynamic range: 0.01-100 W/kg
- Probe Length: 330 mm
- Length of Individual Dipoles: 4.5 mm
- Maximum external diameter: 8 mm
- Probe Tip External Diameter : 5 mm
- Distance between dipoles / probe extremity: 2.7mm

- Probe linearity: ＜0.25 dB
- Axial Isotropy: ＜0.25 dB
- Spherical Isotropy: ＜0.50 dB
- Calibration range: 700 to 3000MHz for head & body simulating liquid.

Angle between probe axis (evaluation axis) and suface normal line:1ess than 30°

Probe calibration is realized, in compliance with EN 62209-1 and IEEE 1528 STD, with CALISAR, Antennessa proprietary calibration system. The calibration is performed with the EN 62209-1 annexe technique using reference guide at the five frequencies.




$$SAR = \frac{4\left(P_{fw} - P_{bw}\right)}{ab\delta}\cos^2\left(\pi\frac{y}{a}\right)e^{-(2z/\delta)}$$

Where :

Pfw = Forward Power

Pbw = Backward Power

a and b =Waveguide dimensions

I = Skin depth

Keithley configuration:

Rate = Medium; Filter = ON; RDGS = 10; Filter type = Moving Average; Range auto after each calibration, a SAR measurement is performed on a validation dipole and compared with a NPL calibrated probe, to verify it.

The calibration factors, CF(N), for the 3 sensors corresponding to dipole 1, dipole 2 and dipole 3 are:

CF(N)=SAR(N)/Vlin(N) (N=1,2,3)

The linearised output voltage Vlin(N) is obtained from the displayed output voltage V(N) using

Vlin(N)=V(N)*(1+V(N)/DCP(N)) (N=1,2,3)

where DCP is the diode compression point in mV.

## 4.3 Probe Calibration Process

**Dosimetric Assessment Procedure**

Each E-Probe/Probe Amplifier combination has unique calibration parameters. SATIMO Probe calibration procedure is conducted to determine the proper amplifier settings to enter in the probe parameters. The amplifier settings are determined for a given frequency by subjecting the probe to a known E-field density (1 mW/cm2) using an with CALISAR, Antenna proprietary calibration system.

**Free Space Assessment Procedure**

The free space E-field from amplified probe outputs is determined in a test chamber. This calibration can be performed in a TEM cell if the frequency is below 1 GHz and in a waveguide or other methodologies above 1 GHz for free space. For the free space calibration, the probe is placed in the volumetric center of the cavity and at the proper orientation with the field. The probe is rotated 360 degrees until the three channels show the maximum reading. The power density readings equates to 1mW/cm2.

**Temperature Assessment Procedure**

E-field temperature correlation calibration is performed in a flat phantom filled with the appropriate simulated head tissue. The E-field in the medium correlates with the temperature rise in the dielectric medium. For temperature correlation calibration a RF transparent thermistor-based temperature probe is used in conjunction with the E-field probe.

$$SAR = C\frac{\Delta T}{\Delta t}$$

Where:

$\Delta t$ = exposure time (30 seconds),

C = heat capacity of tissue (brain or muscle),

$\Delta T$ = temperature increase due to RF exposure.

SAR is proportional to $\Delta T/\Delta t$, the initial rate of tissue heating, before thermal diffusion takes place. The electric field in the simulated tissue can be used to estimate SAR by equating the thermally derived SAR to that with the E- field component.

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

Where:

σ = simulated tissue conductivity,

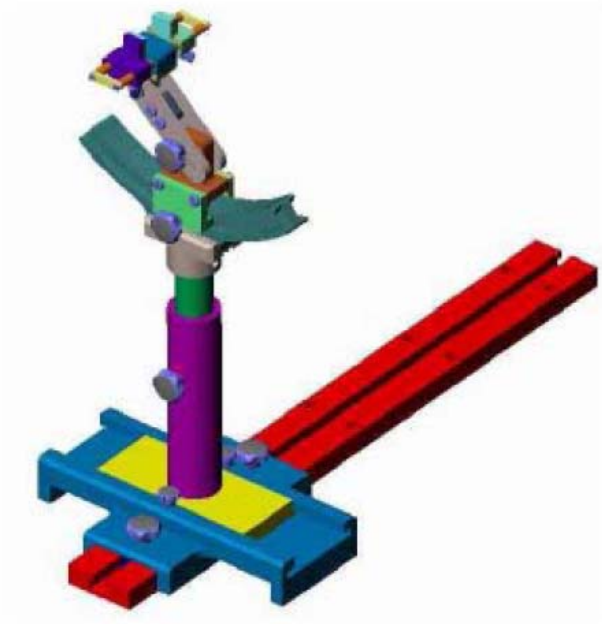
ρ = Tissue density (1.25 g/cm3 for brain tissue)

## 4.4 Phantom

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

## 4.5 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°.



| System Material | Permittivity | Loss Tangent |
|---|---|---|
| Delrin | 3.7 | 0.005 |

## 4.6 Test Equipment List

| Description | Manufacturer | Model | Serial Number | Cal. Date | Due. Date |
|---|---|---|---|---|---|
| E-Field Probe | SATIMO | SSE5 | SN 09/13 EP168 | 2016-06-01 | 2017-05-31 |
| 2450MHz Dipole | SATIMO | SID2450 | SN 13/15 DIP 2G450-364 | 2016-03-20 | 2017-03-19 |
| Dielectric Probe | SATIMO | SCLMP | SN 47/12 OCPG49 | 2016-03-20 | 2017-03-19 |
| SAM Phantom | SATIMO | SAM | SN/ 47/12 SAM95 | N/A | N/A |
| Multi Meter | Keithley | Keithley 2000 | 4006367 | 2016-06-04 | 2017-06-03 |
| Signal Generator | Rohde & Schwarz | SMR20 | 100047 | 2016-06-04 | 2017-06-03 |
| Universal Tester | Rohde & Schwarz | CMU200 | 112012 | 2016-06-04 | 2017-06-03 |
| Network Analyzer | HP | 8753C | 2901A00831 | 2016-06-04 | 2017-06-03 |
| Directional Couplers | Agilent | 778D | 20160 | 2016-06-04 | 2017-06-03 |

# 5. Tissue Simulating Liquids

## 5.1 Composition of Tissue Simulating Liquid

For the measurement of the field distribution inside the SAM phantom with SMTIMO, the phantom must be filled with around 25 liters of homogeneous body tissue simulating liquid. For head SAR testing, the liquid height from the ear reference point (ERP) of the phantom to the liquid top surface is larger than 15 cm. For body SAR testing, the liquid height from the center of the flat phantom to the liquid top surface is larger than 15 cm. Please see the following photos for the liquid height.

**Liquid Height for Body SAR**

**The Composition of Tissue Simulating Liquid**

| Frequency (MHz) | Water (%) | Salt (%) | Sugar (%) | HEC (%) | Preventol (%) | DGBE (%) |
|---|---|---|---|---|---|---|
| **Body** | | | | | | |
| 2450 | 68.6 | 0.1 | 0 | 0 | 0 | 31.3 |

## 5.2 Tissue Dielectric Parameters for Head and Body Phantoms

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

| **Target Frequency (MHz)** | **Head** | | **Body** | |
|---|---|---|---|---|
| | **Conductivity** ($\sigma$) | **Permittivity** ($\varepsilon_r$) | **Conductivity** ($\sigma$) | **Permittivity** ($\varepsilon_r$) |
| 150 | 0.76 | 52.3 | 0.80 | 61.9 |
| 300 | 0.87 | 45.3 | 0.92 | 58.2 |
| 450 | 0.87 | 43.5 | 0.94 | 56.7 |
| 835 | 0.90 | 41.5 | 0.97 | 55.2 |
| 900 | 0.97 | 41.5 | 1.05 | 55.0 |
| 915 | 0.98 | 41.5 | 1.06 | 55.0 |
| 1450 | 1.20 | 40.5 | 1.30 | 54.0 |
| 1610 | 1.29 | 40.3 | 1.40 | 53.8 |
| 1800-2000 | 1.40 | 40.0 | 1.52 | 53.3 |
| **2450** | 1.80 | 39.2 | **1.95** | **52.7** |
| 3000 | 2.40 | 38.5 | 2.73 | 52.0 |
| 5800 | 5.27 | 35.3 | 6.00 | 48.2 |

## 5.3 Tissue Calibration Result

The dielectric parameters of the liquids were verified prior to the SAR evaluation using COMOSAR Dielectric Probe Kit and an Agilent Network Analyzer.

**Calibration Result for Dielectric Parameters of Tissue Simulating Liquid**

| Body Tissue Simulating Liquid | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Freq. MHz.** | **Temp. (℃)** | **Conductivity** | | | **Permittivity** | | | **Limit (%)** | **Date** |
| | | **Reading ($\sigma$)** | **Target ($\sigma$)** | **Delta (%)** | **Reading ($\varepsilon$r)** | **Target ($\varepsilon$r)** | **Delta (%)** | | |
| 2450 | 21.3 | 1.92 | 1.95 | -1.54 | 51.0 | 52.7 | -3.23 | ±5 | 2017-03-06 |

# 6. SAR Measurement Evaluation

## 6.1 Purpose of System Performance Check

The system performance check verifies that the system operates within its specifications. System and operator errors can be detected and corrected. It is recommended that the system performance check be performed prior to any usage of the system in order to guarantee reproducible results. The system performance check uses normal SAR measurements in a simplified setup with a well characterized source. This setup was selected to give a high sensitivity to all parameters that might fail or vary over time. The system check does not intend to replace the calibration of the components, but indicates situations where the system uncertainty is exceeded due to drift or failure.

## 6.2 System Setup

In the simplified setup for system evaluation, the EUT is replaced by a calibrated dipole and the power source is replaced by a continuous wave which comes from a signal generator at frequency 835 MHz and 1900 MHz. The calibrated dipole must be placed beneath the flat phantom section of the SAM twin phantom with the correct distance holder. The distance holder should touch the phantom surface with a light pressure at the reference marking and be oriented parallel to the long side of the phantom.

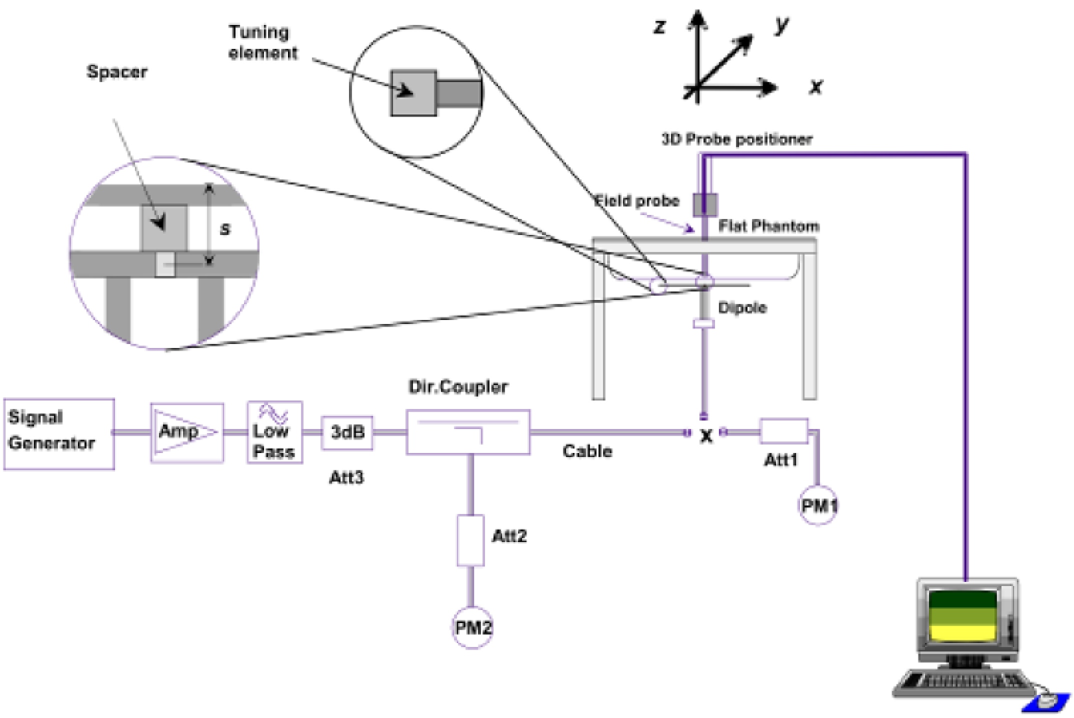



**Fig 6.1 System Verification Setup Block Diagram**

**Fig 6.2 Setup Photo of Dipole Antenna**

The output power on dipole port must be calibrated to 24 dBm (250 mW) before dipole is connected.

## 6.3 Validation Results

Comparing to the original SAR value provided by SATIMO, the validation data should be within its specification of 10 %. Table 6.1 shows the target SAR and measured SAR after normalized to 1W input power. The table below indicates the system performance check can meet the variation criterion.

| **Frequency MHz** | **Targeted $SAR_{1g}$ (W/kg)** | **Measured $SAR_{1g}$ (W/kg)** | **Normalized $SAR_{1g}$ (W/kg)** | **Tolerance (%)** |
|---|---|---|---|---|
| Body | | | | |
| 2450 | 50.41 | 12.61 | 50.44 | 0.06 |

**Targeted and Measurement SAR**

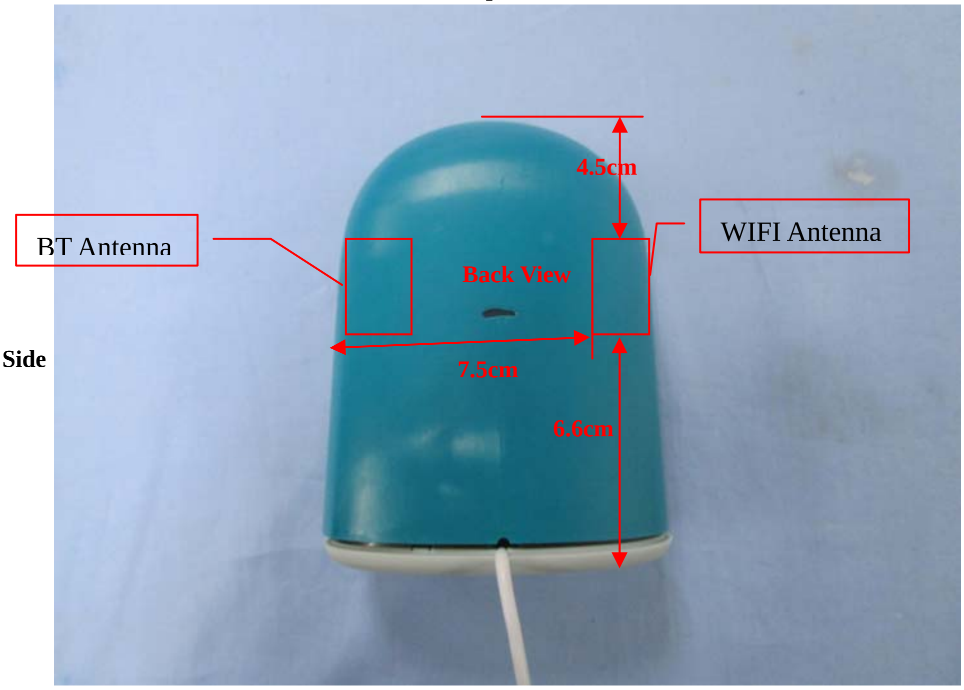
***Please refer to Annex A for the plots of system performance check.***

# 7. EUT Testing Position

## 7.1 EUT Antenna Position

Top Side

Right Side




Left Side

Bottom Side

**Fig 7.1 Block Diagram for EUT Antenna Position**

## 7.2 EUT Testing Position

Body SAR assessments are required for this device. This EUT was tested in different positions for different SAR test modes, more information as below:

| Body SAR tests, Test distance: 5mm | | | | | | |
|---|---|---|---|---|---|---|
| Antennas | **Front** | **Back** | **Right Side** | **Left Side** | **Top Side** | **Bottom Side** |
| WLAN | Yes | Yes | No | Yes | No | No |

**Remark:**

1. Referring to KDB 447498 D01, the test separation distances is 5 mm. SAR must be measured for all sides and surfaces with a transmitting antenna located within 25mm from that surface or edge.

***Please refer to Annex D for the EUT test setup photos.***

# 8. SAR Measurement Procedures

## 8.1 Measurement Procedures

The measurement procedures are as follows:
(a) Use base station simulator (if applicable) or engineering software to transmit RF power continuously (continuous Tx) in the highest power channel.
(b) Keep EUT to radiate maximum output power or 100% factor (if applicable)
(c) Measure output power through RF cable and power meter.
(d) Place the EUT in the positions as Annex D demonstrates.
(e) Set scan area, grid size and other setting on the SATIMO software.
(f) Measure SAR results for the highest power channel on each testing position.
(g) Find out the largest SAR result on these testing positions of each band
(h) Measure SAR results for other channels in worst SAR testing position if the 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

## 8.2 Spatial Peak SAR Evaluation

The procedure for spatial peak SAR evaluation has been implemented according to the test standard. It can be conducted for 1g and 10g, as well as for user-specific masses. The SATIMO software includes all numerical procedures necessary to evaluate the spatial peak SAR value.
The base for the evaluation is a "cube" measurement. The measured volume must include the 1g and 10g cubes with the highest averaged SAR values. For that purpose, the center of the measured volume is aligned to the interpolated peak SAR value of a previously performed area scan.
The entire evaluation of the spatial peak values is performed within the post-processing engine. The system always gives the maximum values for the 1g and 10g cubes. The algorithm to find the cube with highest averaged SAR is divided into the following stages:
(a) Extraction of the measured data (grid and values) from the Zoom Scan
(b) Calculation of the SAR value at every measurement point based on all stored data
(c) Generation of a high-resolution mesh within the measured volume
(d) Interpolation of all measured values form the measurement grid to the high-resolution grid
(e) Extrapolation of the entire 3D field distribution to the phantom surface over the distance from sensor to surface
(f) Calculation of the averaged SAR within masses of 1g and 10g

## 8.3 Area & Zoom Scan Procedures

First Area Scan is used to locate the approximate location(s) of the local peak SAR value(s). The measurement grid within an Area Scan is defined by the grid extent, grid step size and grid offset. Next, in order to determine the EM field distribution in a three-dimensional spatial extension, Zoom Scan is required. The Zoom Scan measures 5x5x7 points with step size 8, 8 and 5 mm for 300 MHz to 3 GHz, and 8x8x8 points with step size 4, 4 and 2.5 mm for 3 GHz to 6 GHz. The Zoom Scan is performed around the highest E-field value to determine the averaged SAR-distribution over 10 g.

## 8.4 Volume Scan Procedures

The volume scan is used for assess overlapping SAR distributions for antennas transmitting in different frequency bands. It is equivalent to an oversized zoom scan used in standalone measurements. The measurement volume will be used to enclose all the simultaneous transmitting antennas. For antennas transmitting simultaneously in different frequency bands, the volume scan is measured separately in each frequency band. In order to sum correctly to compute the 1g aggregate SAR, the EUT remain in the same test position for all measurements and all volume scan use the same spatial resolution and grid spacing (step-size is 4, 4 and 2.5 mm). When all volume scan were completed, the software can combine and subsequently superpose these measurement data to calculating the multiband SAR.

## 8.5 SAR Averaged Methods

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 minimize 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 1mm 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 10g and 1 g requires a very fine resolution in the three dimensional scanned data array.

## 8.6 Power Drift Monitoring

All SAR testing is under the EUT install full charged battery and transmit maximum output power. In SATIMO 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 dB. If the power drift more than 5%, the SAR will be retested.

# 9. SAR Test Result

## 9.1 Conducted RF Output Power

| WLAN - Maximum Average Power | | | | | |
|---|---|---|---|---|---|
| **Test Mode** | **Data Rate** | **Channel** | **Frequency (MHz)** | **Average Power (dBm)** | **Tune-up power (dBm)** |
| 802.11b | 11Mbps | CH 01 | 2412 | 18.65 | 19.0 |
| | | CH 06 | 2437 | 17.76 | 19.0 |
| | | CH 11 | 2462 | 17.2 | 19.0 |
| 802.11g | 54Mbps | CH 01 | 2412 | 16.63 | 18.0 |
| | | CH 06 | 2437 | 17.48 | 18.0 |
| | | CH 11 | 2462 | 16.33 | 18.0 |
| 802.11n (20MHz) | MCS7 | CH 01 | 2412 | 14.6 | 16.0 |
| | | CH 06 | 2437 | 15.7 | 16.0 |
| | | CH 11 | 2462 | 15.1 | 16.0 |

**Remark:**

1. Per KDB 248227 D01 v02r02, For 802.11b DSSS SAR measurements, DSSS SAR procedure applies to fixed exposure test position and initial test position procedure applies to multiple exposure test positions.
2. Per KDB 248227 D01 v02r02, For 802.11b DSSS SAR measurements ,when the reported SAR of the highest measured maximum output power channel (see 3.1) for the exposure configuration is ≤ 0.8 W/kg, no further SAR testing is required for 802.11b DSSS in that exposure configuration. When the reported SAR is > 0.8 W/kg, SAR is required for that exposure configuration using the next highest measured output power channel. When any reported SAR is > 1.2 W/kg, SAR is required for the third channel; i.e., all channels require testing.
3 .For OFDM modes (802.11g/n), SAR is not required when the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and it is <= 1.2W/kg.

| Bluetooth - Maximum Average Power | | | |
|---|---|---|---|
| **Test Mode** | **Data Rate** | **Average Power(dBm)** | **Tune-up power (dBm)** |
| GFSK | 1Mbps | 2.969 | 3.0 |
| Pi/4 QDPSK | 2Mbps | 1.236 | 3.0 |
| 8DPSK | 3Mbps | 1.851 | 3.0 |

| Bluetooth - Maximum Average Power | | | | | |
|---|---|---|---|---|---|
| **Test Mode** | **Data Rate** | **Channel** | **Frequency (MHz)** | **Average Power (dBm)** | **Tune-up power (dBm)** |
| BLE | 1Mbps | CH 00 | 2402 | 8.553 | 9.0 |
| | | CH 20 | 2442 | 8.75 | 9.0 |
| | | CH 39 | 2480 | 8.767 | 9.0 |

**Remark:**

Bluetooth maximum output power is 8.767dBm, and Tune-Up output power is 9.0dBm. Per KDB 447498 D01 V06, the 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by: [(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] · [√f(GHz)] ≤ 3.0 for 1-g SAR and ≤ 7.5 for 10-g extremity SAR,16 where

- f(GHz) is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation17
- The result is rounded to one decimal place for comparison

| Max. Power (dBm) | Max. Power (mW) | Distance (mm) | Frequency (GHz) | Result | Limit |
|---|---|---|---|---|---|
| 9.0 | 7.94 | 5 | 2.480 | 2.51 | 3 |

The exclusion thresholds is 2.51< 3, therefore, the RF exposure evaluation is not required.

## 9.2 Test Results for Standalone SAR Test

**Body SAR**

| WLAN 2.4GHz – Body SAR Test (Gap: 5mm) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Plot No. | Mode | Test Position Body | Frequency | | Output Power (dBm) | Rated Limit (dBm) | Scaling Factor | SAR1g (W/kg) | Scaled SAR1g (W/kg) |
| | | | CH. | MHz | | | | | |
| 1. | 802.11b | Back | 01 | 2412 | 18.65 | 19.0 | 1.0839 | 0.0305 | 0.0331 |
| 2. | 802.11b | Front | 01 | 2412 | 18.65 | 19.0 | 1.0839 | 0.4464 | 0.4839 |
| 3. | 802.11b | Left Side | 01 | 2412 | 18.65 | 19.0 | 1.0839 | 0.0279 | 0.0302 |

**Remark:** 1.Per KDB 447498 D01 v06, if the highest output channel SAR for each exposure position ≤ 0.8 W/kg other channels SAR tests are not necessary.

.

## 9.3 Simultaneous Multi-band Transmission SAR Analysis

**Body SAR**

**WLAN and Bluetooth**

| Position | WIFI Scaled SAR (W/kg) | Bluetooth Scaled SAR (W/kg) | Summed SAR (W/kg) |
|---|---|---|---|
| Back | 0.0331 | 0.3334 | 0.3665 |
| Front | 0.4839 | 0.3334 | **0.8173** |
| Left Side | 0.0302 | 0.3334 | 0.3636 |

**Remark:**

1. According to the KDB 447498 D01v06, 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)]·[√f(GHz)/x] W/kg for test separation distances ≤ 50 mm;

where x = 7.5 for 1-g SAR, and x = 18.75 for 10-g SAR.

For simultaneous transmission analysis, Bluetooth SAR is estimated per KDB 447498 D01v06 as below:

Bluetooth:

| Tune-Up Power (dBm) | Max. Power (mW) | Distance (mm) | Frequency (GHz) | X | SAR(1g) 5mm |
|---|---|---|---|---|---|
| 9.0 | 7.94 | 5 | 2.480 | 7.5 | 0.3334 |

2. The maximum SAR summation is calculated based on the same configuration and test position.

# 10. Measurement Uncertainty

## 10.1 Uncertainty for EUT SAR Test

| a | b | c | d | e= f(d,k) | f | g | h= c*f/e | i= c*g/e | k |
|---|---|---|---|---|---|---|---|---|---|
| **Uncertainty Component** | **Sec.** | **Tol (+- %)** | **Prob. Dist.** | **Div.** | **Ci (1g)** | **Ci (10g)** | **1g Ui (+-%)** | **10g Ui (+-%)** | **Vi** |
| **Measurement System** | | | | | | | | | |
| Probe calibration | E.2.1 | 7.0 | N | 1 | 1 | 1 | 7.00 | 7.00 | ∝ |
| Axial Isotropy | E.2.2 | 2.5 | R | √3 | (1_Cp)^1/2 | (1_Cp)^1/2 | 1.02 | 1.02 | ∝ |
| Hemispherical Isotropy | E.2.2 | 4.0 | R | √3 | (Cp)^1/2 | (Cp)^1/2 | 1.63 | 1.63 | ∝ |
| Boundary effect | E.2.3 | 1.0 | R | √3 | 1 | 1 | 0.58 | 0.58 | ∝ |
| Linearity | E.2.4 | 5.0 | R | √3 | 1 | 1 | 2.89 | 2.89 | ∝ |
| System detection limits | E.2.5 | 1.0 | R | √3 | 1 | 1 | 0.58 | 0.58 | ∝ |
| Readout Electronics | E.2.6 | 0.02 | N | 1 | 1 | 1 | 0.02 | 0.02 | ∝ |
| Reponse Time | E.2.7 | 3.0 | R | √3 | 1 | 1 | 1.73 | 1.73 | ∝ |
| Integration Time | E.2.8 | 2.0 | R | √3 | 1 | 1 | 1.15 | 1.15 | ∝ |
| RF ambient Conditions – Noise | E.6.1 | 3.0 | R | √3 | 1 | 1 | 1.73 | 1.73 | ∝ |
| RF ambient Conditions - Reflections | E.6.1 | 3.0 | R | √3 | 1 | 1 | 1.73 | 1.73 | ∝ |
| Probe positioner Mechanical Tolerance | E.6.2 | 2.0 | R | √3 | 1 | 1 | 1.15 | 1.15 | ∝ |
| Probe positioning with respect to Phantom Shell | E.6.3 | 0.05 | R | √3 | 1 | 1 | 0.03 | 0.03 | ∝ |
| Extrapolation, interpolation and integration Algoritms for Max. SAR Evaluation | E.5 | 5.0 | R | √3 | 1 | 1 | 2.89 | 2.89 | ∝ |
| **Test Sample Related** | | | | | | | | | |
| Test sample positioning | E.4.2 | 0.03 | N | 1 | 1 | 1 | 0.03 | 0.03 | N–1 |
| Device Holder Uncertainty | E.4.1 | 5.00 | N | 1 | 1 | 1 | 5.00 | 5.00 | |
| Output power Variation - SAR drift measurement | E.2.9 | 12.02 | R | √3 | 1 | 1 | 6.94 | 6.94 | ∝ |
| SAR scaling | E6.5 | 0.0 | R | √3 | 1 | 1 | 0.0 | 0.0 | ∝ |
| **Phantom and Tissue Parameters** | | | | | | | | | |
| Phantom Uncertainty (Shape and thickness tolerances) | E.3.1 | 0.05 | R | √3 | 1 | 1 | 0.03 | 0.03 | ∝ |
| Uncertainty in SAR correction for deviations in permittivity and conductivity | E3.2 | 1.9 | R | √3 | 1 | 0.84 | 1.10 | 0.90 | ∝ |
| Liquid conductivity - deviation | E.3.2 | 5.00 | R | √3 | 0.64 | 0.43 | 1.85 | 1.24 | ∝ |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| from target value | | | | | | | | | |
| Liquid conductivity - measurement uncertainty | E.3.3 | 5.00 | N | 1 | 0.64 | 0.43 | 3.20 | 2.15 | ∝ |
| Liquid permittivity - deviation from target value | E.3.2 | 0.37 | R | √3 | 0.6 | 0.49 | 0.13 | 0.10 | ∝ |
| Liquid permittivity - measurement uncertainty | E.3.3 | 10.00 | N | 1 | 0.6 | 0.49 | 6.00 | 4.90 | ∝ |
| Combined Standard Uncertainty | | | RSS | | | | 12.98 | 12.53 | |
| Expanded Uncertainty (95% Confidence interval) | | | K=2 | | | | 25.32 | 24.43 | |

## 10.2 Uncertainty for System Performance Check

| a | b | c | d | e= f(d,k) | f | g | h= c*f/e | i= c*g/e | k |
|---|---|---|---|---|---|---|---|---|---|
| **Uncertainty Component** | **Sec.** | **Tol (+- %)** | **Prob. Dist.** | **Div.** | **Ci (1g)** | **Ci (10g)** | **1g Ui (+-%)** | **10g Ui (+-%)** | **Vi** |
| **Measurement System** | | | | | | | | | |
| Probe calibration | E.2.1 | 7.0 | N | 1 | 1 | 1 | 7.00 | 7.00 | ∝ |
| Axial Isotropy | E.2.2 | 2.5 | R | √3 | (1_Cp)^1/2 | (1_Cp)^1/2 | 1.02 | 1.02 | ∝ |
| Hemispherical Isotropy | E.2.2 | 4.0 | R | √3 | (Cp)^1/2 | (Cp)^1/2 | 1.63 | 1.63 | ∝ |
| Boundary effect | E.2.3 | 1.0 | R | √3 | 1 | 1 | 0.58 | 0.58 | ∝ |
| Linearity | E.2.4 | 5.0 | R | √3 | 1 | 1 | 2.89 | 2.89 | ∝ |
| System detection limits | E.2.5 | 1.0 | R | √3 | 1 | 1 | 0.58 | 0.58 | ∝ |
| Modulation response | E.2.5 | 0 | R | √3 | 0 | 0 | 0.0 | 0.0 | ∝ |
| Readout Electronics | E.2.6 | 0.02 | N | 1 | 1 | 1 | 0.02 | 0.02 | ∝ |
| Reponse Time | E.2.7 | 3.0 | R | √3 | 1 | 1 | 1.73 | 1.73 | ∝ |
| Integration Time | E.2.8 | 2.0 | R | √3 | 1 | 1 | 1.15 | 1.15 | ∝ |
| RF ambient Conditions – Noise | E.6.1 | 3.0 | R | √3 | 1 | 1 | 1.73 | 1.73 | ∝ |
| RF ambient Conditions - Reflections | E.6.1 | 3.0 | R | √3 | 1 | 1 | 1.73 | 1.73 | ∝ |
| Probe positioner Mechanical Tolerance | E.6.2 | 2.0 | R | √3 | 1 | 1 | 1.15 | 1.15 | ∝ |
| Probe positioning with respect to Phantom Shell | E.6.3 | 0.05 | R | √3 | 1 | 1 | 0.03 | 0.03 | ∝ |
| Extrapolation, interpolation and integration Algoritms for Max. | E.5.2 | 5.0 | R | √3 | 1 | 1 | 2.89 | 2.89 | ∝ |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| SAR Evaluation | | | | | | | | | |
| **Dipole** | | | | | | | | | |
| Dipole axis to liquid Distance | 8,E.4.2 | 1.00 | N | √3 | 1 | 1 | 0.58 | 0.58 | N−1 |
| Input power and SAR drift measurement | 8,6.6.2 | 12.02 | R | √3 | 1 | 1 | 6.94 | 6.94 | ∝ |
| Deviation of experimental dipole from numerical dipole | E.6.4 | 5.5 | R | √3 | 1 | 1 | 3.20 | 3.20 | ∝ |
| **Phantom and Tissue Parameters** | | | | | | | | | |
| Phantom Uncertainty (Shape and thickness tolerances) | E.3.1 | 0.05 | R | √3 | 1 | 1 | 0.03 | 0.03 | ∝ |
| Uncertainty in SAR correction for deviations in permittivity and conductivity | E3.2 | 2.0 | R | √3 | 1 | 0.84 | 1.10 | 1.10 | ∝ |
| Liquid conductivity - deviation from target value | E.3.2 | 5.00 | R | √3 | 0.64 | 0.43 | 1.85 | 1.24 | |
| Liquid conductivity - measurement uncertainty | E.3.3 | 5.00 | N | 1 | 0.64 | 0.43 | 3.20 | 2.15 | |
| Liquid permittivity - deviation from target value | E.3.2 | 0.37 | R | √3 | 0.6 | 0.49 | 0.13 | 0.10 | |
| Liquid permittivity - measurement uncertainty | E.3.3 | 10.00 | N | 1 | 0.6 | 0.49 | 6.00 | 4.90 | M |
| Combined Standard Uncertainty | | | RSS | | | | 12.00 | 11.50 | |
| Expanded Uncertainty (95% Confidence interval) | | | K=2 | | | | 23.39 | 22.43 | |

## Annex A. Plots of System Performance Check

# MEASUREMENT 1

**For Body Liquid**

Type: Validation measurement (Fast, 75.00 %)

Date of measurement: 2017/03/06

Measurement duration: 12 minutes 21 seconds

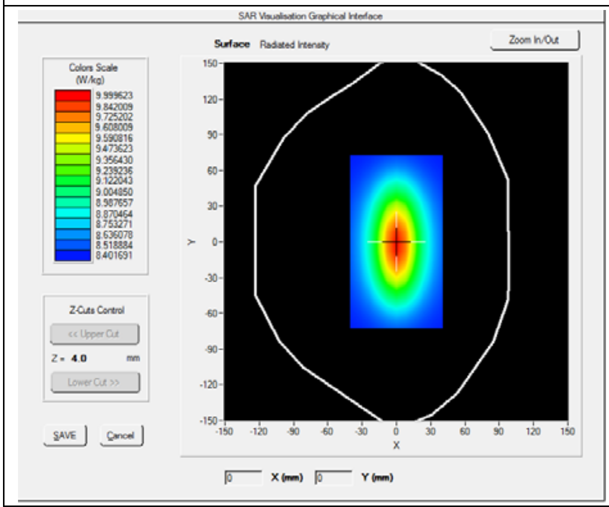
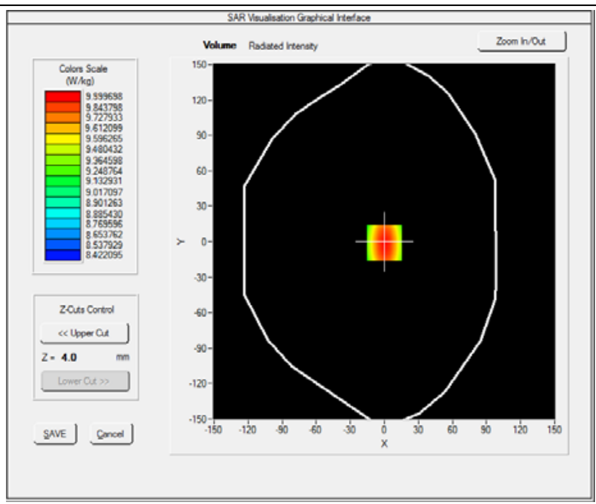
E-field Probe: SSE5 - SN 09/13 EP168; ConvF: 5.80; Calibrated: 2016/06/01

### A. Experimental conditions

| | |
|---|---|
| **Area Scan** | dx=8mm dy=8mm |
| **Phantom** | Validation plane |
| **Device Position** | Dipole |
| **Band** | CW2450 |
| **Signal** | CW (Crest factor: 1.0) |

### B. SAR Measurement Results

| | |
|---|---|
| **Frequency (MHz)** | 2450.000000 |
| **Relative Permittivity (real part)** | 51.021360 |
| **Conductivity (S/m)** | 1.920223 |
| **Power Variation (%)** | 0.542145 |
| **Ambient Temperature** | 21.1 |
| **Liquid Temperature** | 21.2 |

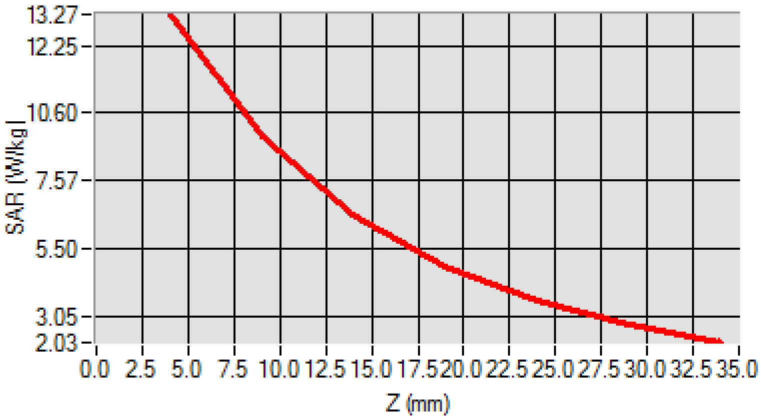
| SURFACE SAR | VOLUME SAR |
|---|---|
|  |  |

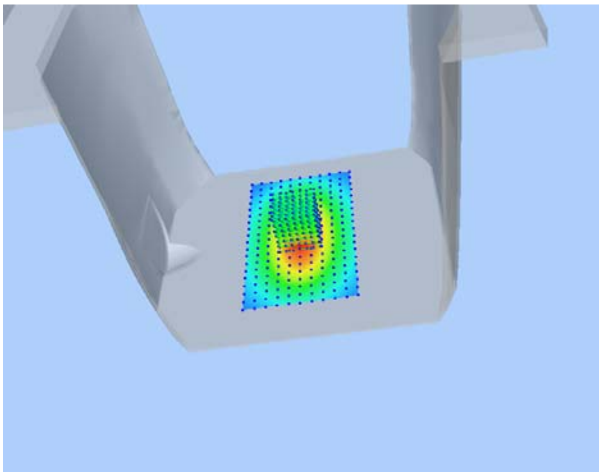
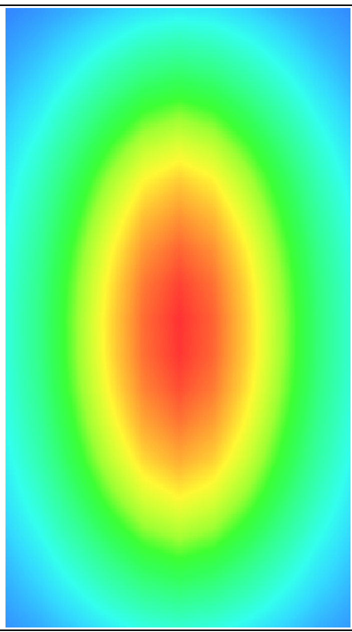
**Maximum location: X=0.00, Y=0.00**

| | |
|---|---|
| **SAR 10g (W/Kg)** | **6.161512** |
| **SAR 1g (W/Kg)** | **12.612580** |

**Z Axis Scan**

| **Z (mm)** | **0.00** | **4.00** | **9.00** | **14.00** | **19.00** | **24.00** | **29.00** |
|---|---|---|---|---|---|---|---|
| **SAR (W/Kg)** | **0.0000** | **13.1202** | **10.5211** | **6.2100** | **4.8511** | **3.0236** | **2.5362** |




| **3D screen shot** | **Hot spot position** |
|---|---|
|  |  |

# Annex B. Plots of SAR Measurement

| **TYPE** | **BAND** | **PARAMETERS** |
|---|---|---|
| **REMI** | **WiFi_802.11b** | Measurement 2: Flat Plane with Front side device position on Low Channel in 802.11b mode |
| *Remark: SAR plot is showed the highest measured SAR in each exposure configuration, wireless mode and frequency band combination.* | | |

# MEASUREMENT 2

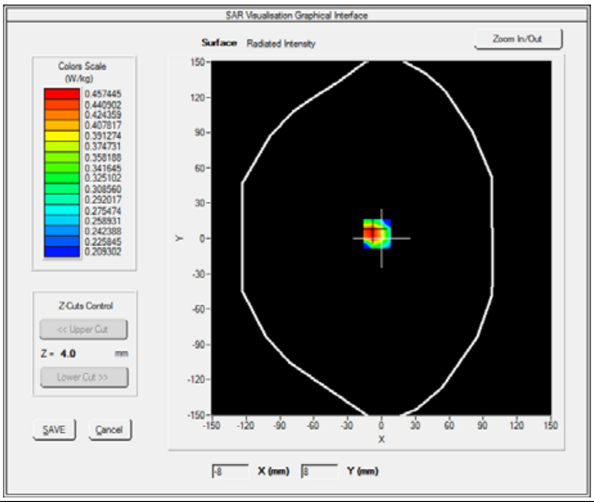
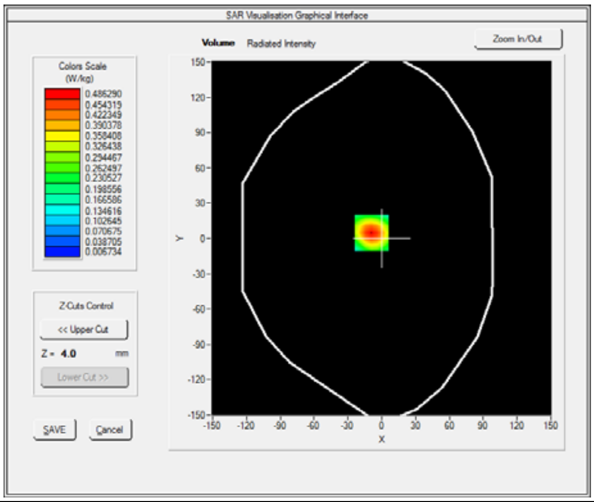
Type: Phone measurement (Complete)
Date of measurement: 2017/03/06
Measurement duration: 12 minutes 3 seconds
E-field Probe: SSE5 - SN 09/13 EP168; ConvF: 5.80; Calibrated: 2016/06/01

## A. Experimental conditions

| | |
|---|---|
| **Area Scan** | sam_direct_droit2_surf8mm.txt |
| **Phantom** | Flat Plane |
| **Device Position** | Front Side |
| **Band** | WiFi_802.11b |
| **Channels** | Low |
| **Signal** | Duty Cycle: 1:1 |

## B. SAR Measurement Results

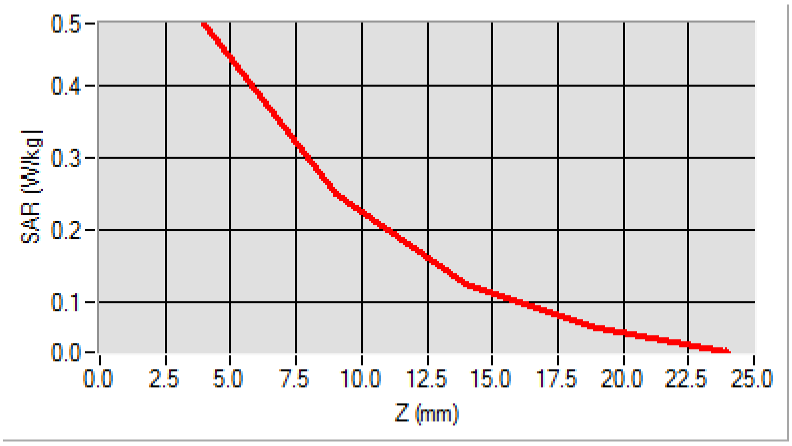
| | |
|---|---|
| **Frequency (MHz)** | 2412.000000 |
| **Relative Permittivity (real part)** | 51.021360 |
| **Conductivity (S/m)** | 1.920223 |
| **Power Variation (%)** | 0.642782 |
| **Ambient Temperature** | 21.1 |
| **Liquid Temperature** | 21.2 |

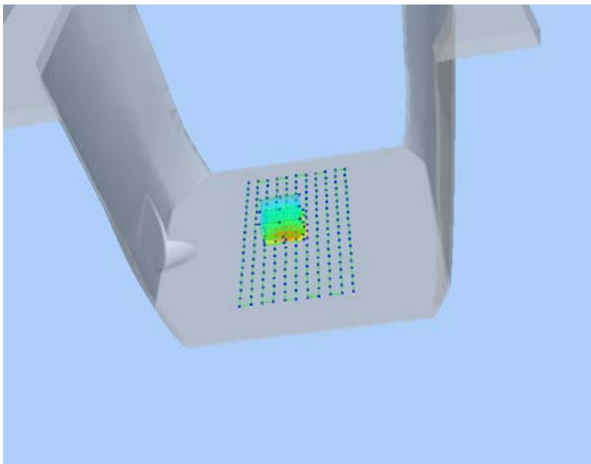
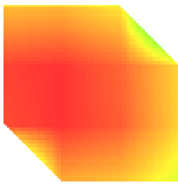
| SURFACE SAR | VOLUME SAR |
|---|---|
|  |  |

**Maximum location: X=-9.00, Y=5.00**

| SAR 10g (W/Kg) | 0.227023 |
|---|---|
| SAR 1g (W/Kg) | 0.446400 |

| Z (mm) | 0.00 | 4.00 | 9.00 | 14.00 | 19.00 |
|---|---|---|---|---|---|
| SAR (W/Kg) | 0.0000 | 0.4863 | 0.2494 | 0.1252 | 0.0642 |

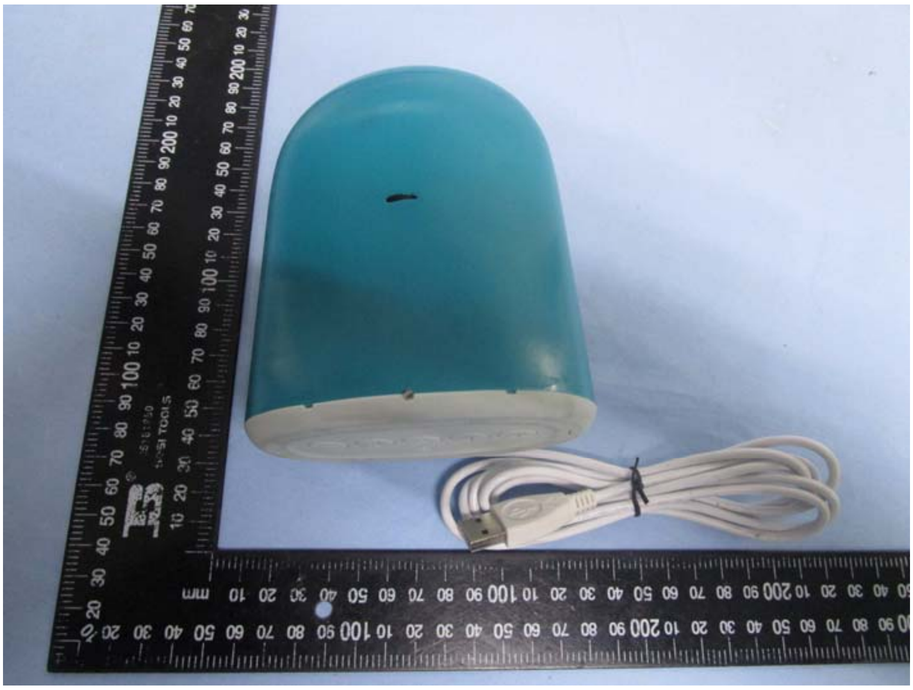



| 3D screen shot | Hot spot position |
|---|---|
|  |  |

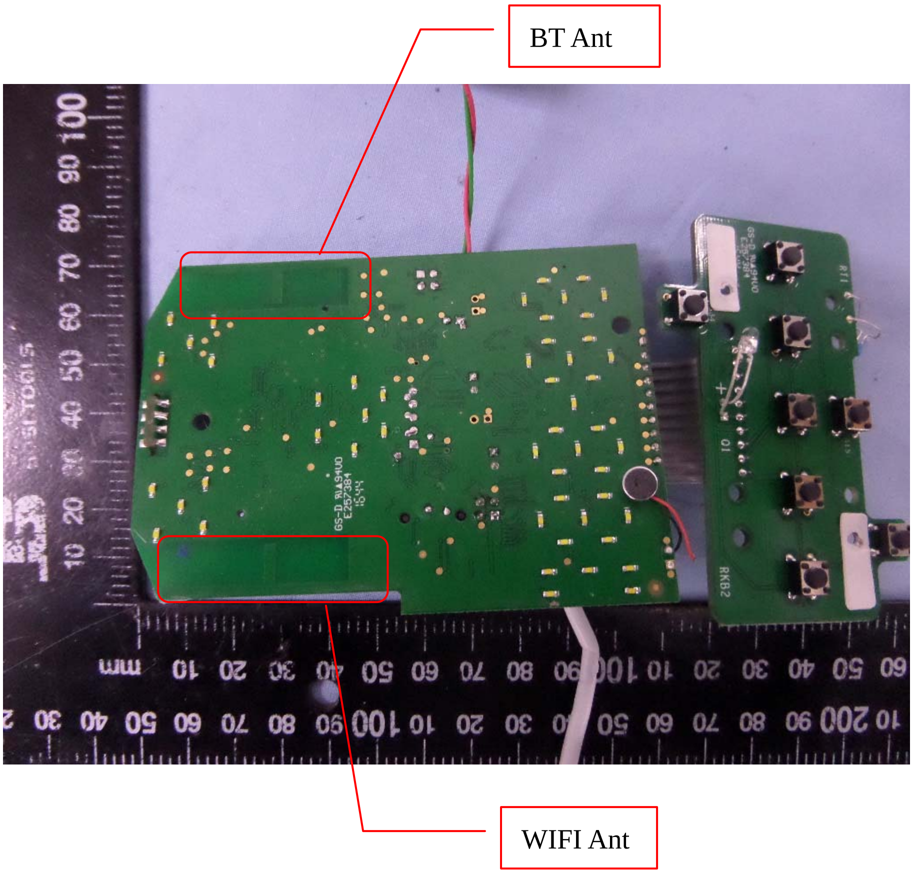
# Annex C. EUT Photos

## EUT View 1

## EUT View 2



**Antenna View**



# Annex D. Test Setup Photos

## Test View

**Body Front**


**Body Back**

**Body Left**

## Annex E. Calibration Certificate

***Please refer to the exhibit for the calibration certificate***

******* END OF REPORT *******