

SAR TEST REPORT**For****GSM GLOBE.COM INC****2G Mobile Phone****Model No.: S1****List Model No.: S1 Plus+, S1 Roma, S1 Flip, S1 Senior, S1 XL**

Prepared for : GSM GLOBE.COM INC
Address : 134 N.E 1 Street, Miami, Florida, United States 33132

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Date of receipt of test sample : May 17, 2018
Number of tested samples : 1
Serial number : Prototype
Date of Test : May 23, 2018~ May 26, 2018
Date of Report : June 05, 2018

SAR TEST REPORT

Report Reference No. : **LCS180515037AEB**

Date Of Issue : June 05, 2018

Testing Laboratory Name..... : **Shenzhen LCS Compliance Testing Laboratory Ltd.**

Address : 1/F., Xingyuan Industrial Park, Tongda Road, Bao'an Avenue, Bao'an District, Shenzhen, Guangdong, China

Testing Location/ Procedure..... : Full application of Harmonised standards ■
Partial application of Harmonised standards □
Other standard testing method □

Applicant's Name..... : **GSM GLOBE.COM INC**

Address : 134 N.E 1 Street, Miami, Florida, United States 33132

Test Specification:

Standard : IEEE 1528:2013/KDB865664
47CFR §2.1093

Test Report Form No. : LCSEMC-1.0

TRF Originator : Shenzhen LCS Compliance Testing Laboratory Ltd.

Master TRF : Dated 2014-09

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Test Item Description. : **2G Mobile Phone**

Trade Mark : GOL

Model/Type Reference : S1

Operation Frequency : GSM 850/PCS1900, Bluetooth2.1+EDR

Modulation Type : GSM(GMSK), Bluetooth(GFSK,8DPSK, $\pi/4$ -DQPSK)

Ratings : DC 3.7V by Rechargeable Li-ion Battery(1200mAh)
Recharged by DC 5V/500mA Travel Charger

Result : **Positive**

Compiled by:



Linda He/ File administrators

Supervised by:



Dick Su/ Technique principal

Approved by:



Gavin Liang/ Manager

SAR -- TEST REPORT

| | |
|---------------------------------------|------------------------|
| Test Report No. : | LCS180515037AEB |
| June 05, 2018 Date of issue | |

Type / Model..... : S1

EUT..... : 2G Mobile Phone

Applicant..... : GSM GLOBE.COM INC

Address..... : 134 N.E 1 Street, Miami, Florida, United States 33132

Telephone..... : /

Fax..... : /

Manufacturer..... : SHENZHEN KECHAODA TECHNOLOGY CO.,LTD

Address..... : Hongxin Industrial Park, Guanlan Street, Baoan District,
Shenzhen, China

Telephone..... : /

Fax..... : /

Factory..... : SHENZHEN KECHAODA TECHNOLOGY CO.,LTD

Address..... : Hongxin Industrial Park, Guanlan Street, Baoan District,
Shenzhen, China

Telephone..... : /

Fax..... : /

| | |
|--------------------|-----------------|
| Test Result | Positive |
|--------------------|-----------------|

The test report merely corresponds to the test sample.

It is not permitted to copy extracts of these test result without the written permission of the test laboratory.

Revision History

| Revision | Issue Date | Revisions | Revised By |
|----------|---------------|---------------|-------------|
| 000 | June 05, 2018 | Initial Issue | Gavin Liang |
| | | | |
| | | | |

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1. TEST STANDARDS AND TEST DESCRIPTION

1.1. Test Standards

[IEEE Std C95.1, 2005](#): IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 KHz to 300 GHz. It specifies the maximum exposure limit of 1.6 W/kg as averaged over any 1 gram of tissue for portable devices being used within 20 cm of the user in the uncontrolled environment.

[IEEE Std 1528™-2013](#): IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques.

[FCC Part 2.1093](#) Radiofrequency Radiation Exposure Evaluation:Portable Devices

[KDB447498 D01 General RF Exposure Guidance](#): Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies

[KDB648474 D04 Handset SAR v01r03](#): SAR Evaluation Considerations for Wireless Handsets

[KDB865664 D01 SAR Measurement 100 MHz to 6 GHz](#): SAR Measurement Requirements for 100 MHz to 6 GHz

[KDB865664 D02 RF Exposure Reporting](#): RF Exposure Compliance Reporting and Documentation Considerations

[KDB941225 D01 3G SAR Procedures](#): 3G SAR MEAUREMENT PROCEDURES

[KDB 941225 D06 Hotspot Mode](#): SAR EVALUATION PROCEDURES FOR PORTABLE DEVICES WITH WIRELESS ROUTER CAPABILITIES

1.2. Test Description

The EUT battery must be fully charged and checked periodically during the test to ascertain uniform power . And Test device is identical prototype.

1.3. General Remarks

| | | |
|--------------------------------|---|--------------|
| Date of receipt of test sample | : | May 23, 2018 |
| Testing commenced on | : | May 26, 2018 |
| Testing concluded on | : | May 26, 2018 |

1.4. Product Description

The **GSM GLOBE.COM INC.**'s Model:**S1** or the "EUT" as referred to in this report; more general information as follows,for more details, refer to the user's manual of the EUT.

| General Description | |
|-----------------------|--|
| Product Name: | 2G Mobile Phone |
| Model/Type reference: | S1 |
| List Model No.: | S1 Plus+, S1 Roma, S1 Flip, S1 Senior, S1 XL |
| Modulation Type: | GMSK for GSM/GPRS |
| Device category: | Portable Device |
| Exposure category: | General population/uncontrolled environment |
| EUT Type: | Production Unit |
| Hardware Version | E11_MB_V2.0 |
| Software Version: | E11_A3_GOL_Mobile_S1_QVGA_M1_V01_20171201_1714 |
| Power supply: | DC 3.7V by Rechargeable Li-ion Battery(1200mAh) Recharged by DC 5V/500mA Travel Charger |

The EUT is GSM mobile phone. the mobile phone is intended for speech and Multimedia Message Service (MMS) transmission. It is equipped with GPRS class 12 for GSM850, PCS1900, and Bluetooth, For more information see the following datasheet

Technical Characteristics

| GSM | |
|------------------|---|
| Support Networks | GSM, GPRS |
| Support Band | GSM850/PCS1900/GPRS850/GPRS1900 |
| Frequency | GSM850: 824.2~848.8MHz GSM1900: 1850.2~1909.8MHz |
| Power Class: | GSM850:Power Class 4 PCS1900:Power Class 1 |
| Modulation Type: | GMSK for GSM/GPRS |

| | |
|-----------------------|--|
| Antenna Gain | 0.3dBi (max.) For GSM 850, 0.7dBi (max.) For PCS 1900; |
| GSM Release Version | R99 |
| GPRS Multislot Class | 12 |
| EGPRS Multislot Class | Not Supported |
| DTM Mode | Not Supported |
| Bluetooth | |
| Bluetooth Version: | 2.1+EDR |
| Modulation: | GFSK(1Mbps) , π/4-DQPSK(2Mbps), 8DPSK(3Mbps) |
| Operation frequency: | 2402MHz~2480MHz |
| Channel number: | 79 |
| Channel separation: | 1MHz |
| Antenna Description | Internal Antenna, 0.0dB |

1.5. Statement of Compliance

The maximum of results of SAR found during testing for S1are follows:

<Highest Reported standalone SAR Summary>

| Classment Class | Frequency Band | Head (Report SAR _{1-g} (W/Kg)) | Body-worn (Report SAR _{1-g} (W/Kg)) |
|-----------------|----------------|---|--|
| PCE | GSM 850 | 0.832 | 1.141 |
| | GSM1900 | 0.485 | 0.499 |

This device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (1.6 W/kg) specified in FCC 47 CFR part 2 (2.1093) and ANSI/IEEE C95.1-2005, and had been tested in accordance with the measurement methods and procedures specified in IEEE 1528-2013.

<Highest Reported simultaneous SAR Summary>

| Exposure Position | Frequency Band | Reported SAR _{1-g} (W/kg) | Classment Class | Highest Reported Simultaneous Transmission SAR _{1-g} (W/Kg) |
|-------------------|----------------|------------------------------------|-----------------|--|
| Body-worn | GSM 850 | 1.141 | PCE | 1.167 |
| | BT | 0.026 | DSS | |

2. TEST ENVIRONMENT

2.1. Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

Site Description

- EMC Lab. : FCC Registration Number. is 254912
 Industry Canada Registration Number. is 9642A-1.
 ESMD Registration Number. is ARCB0108.
 UL Registration Number. is 100571-492.
 TUV SUD Registration Number. is SCN1081.
 TUV RH Registration Number. is UA 50296516-001
 NVLAP Registration Code is 600167-0.

2.2. Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

| | |
|-----------------------|--------------|
| Temperature: | 18-25 ° C |
| Humidity: | 40-65 % |
| Atmospheric pressure: | 950-1050mbar |

2.3. SAR Limits

FCC Limit (1g Tissue)

| EXPOSURE LIMITS | SAR (W/kg) | |
|--|--|--|
| | (General Population / Uncontrolled Exposure Environment) | (Occupational / Controlled Exposure Environment) |
| Spatial Average(averaged over the whole body) | 0.08 | 0.4 |
| Spatial Peak(averaged over any 1 g of tissue) | 1.6 | 8.0 |
| Spatial Peak(hands/wrists/feet/anklesaveraged over 10 g) | 4.0 | 20.0 |

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

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).

2.4. Equipments Used during the Test

| Test Equipment | Manufacturer | Type/Model | Serial Number | Calibration | |
|-------------------------------------|--------------|-----------------|------------------------|------------------|-----------------|
| | | | | Calibration Date | Calibration Due |
| PC | Lenovo | G5005 | MY42081102 | N/A | N/A |
| SAR Measurement system | SATIMO | 4014_01 | SAR_4014_01 | N/A | N/A |
| Signal Generator | Agilent | E4438C | MY42081396 | 11/18/2017 | 11/18/2018 |
| Multimeter | Keithley | MiltiMeter 2000 | 4059164 | 11/18/2017 | 11/18/2018 |
| S-parameter Network Analyzer | Agilent | 8753ES | US38432944 | 11/18/2017 | 11/18/2018 |
| Wireless Communication Test Set | R & S | CMU200 | 105988 | 11/18/2017 | 11/18/2018 |
| Wideband Radia Communication Tester | R&S | CMW500 | 1201.0002K50 | 11/18/2017 | 11/18/2018 |
| Power Meter | R & S | KEITHLEY | 4059164 | 11/18/2017 | 11/18/2018 |
| E-Field PROBE | SATIMO | SSE2 | SN 45/15 EPGO281 | 02/04/2018 | 02/03/2019 |
| DIPOLE 835 | SATIMO | SID 835 | SN 07/14 DIP 0G835-303 | 10/01/2015 | 09/30/2018 |
| DIPOLE 1900 | SATIMO | SID 1900 | SN 30/14 DIP 1G900-333 | 10/01/2015 | 09/30/2018 |
| COMOSAR OPEN Coaxial Probe | SATIMO | OCPG 68 | SN 40/14 OCPG68 | 11/18/2017 | 11/18/2018 |
| SARLocator | SATIMO | VPS51 | SN 40/14 VPS51 | 11/18/2017 | 11/18/2018 |
| Communication Antenna | SATIMO | ANTA57 | SN 39/14 ANTA57 | 11/18/2017 | 11/18/2018 |
| Mobile Phone POSITIONING DEVICE | SATIMO | MSH98 | SN 40/14 MSH98 | N/A | N/A |
| DUMMY PROBE | SATIMO | DP60 | SN 03/14 DP60 | N/A | N/A |
| SAM PHANTOM | SATIMO | SAM117 | SN 40/14 SAM117 | N/A | N/A |
| Liquid measurement Kit | HP | 85033D | 3423A03482 | 11/18/2017 | 11/18/2018 |
| Power meter | Agilent | E4419B | MY45104493 | 06/17/2017 | 06/16/2018 |
| Power meter | Agilent | E4418B | GB4331256 | 06/17/2017 | 06/16/2018 |
| Power sensor | Agilent | E9301H | MY41497725 | 06/17/2017 | 06/16/2018 |
| Power sensor | Agilent | E9301H | MY41495234 | 06/17/2017 | 06/16/2018 |
| Directional Coupler | MCLI/USA | 4426-20 | 0D2L51502 | 06/17/2017 | 06/16/2018 |

Note:

- 1) Per KDB865664D01 requirements for dipole calibration, the test laboratory has adopted three year extended calibration interval. Each measured dipole is expected to evaluate with following criteria at least on annual interval.
 - a) There is no physical damage on the dipole;
 - b) System check with specific dipole is within 10% of calibrated values;
 - c) The most recent return-loss results,measured at least annually,deviates by no more than 20% from the previous measurement;

- d) The most recent measurement of the real or imaginary parts of the impedance, measured at least annually is within 5Ω from the previous measurement.
- 2) Network analyzer probe calibration against air, distilled water and a shorting block performed before measuring liquid parameters.

3.SAR MEASUREMENTS SYSTEM CONFIGURATION

3.1. SAR Measurement Set-up

The OPENSAR system for performing compliance tests consist of the following items:

A standard high precision 6-axis robot (KUKA) with controller and software.

KUKA Control Panel (KCP)

A dosimetric probe, i.e., an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid. The probe is equipped with a Video Positioning System(VPS).

The stress sensor is composed with mechanical and electronic when the electronic part detects a change on the electro-mechanical switch, It sends an “Emergency signal” to the robot controller that to stop robot’s moves

A computer operating Windows XP.

OPENSAR software

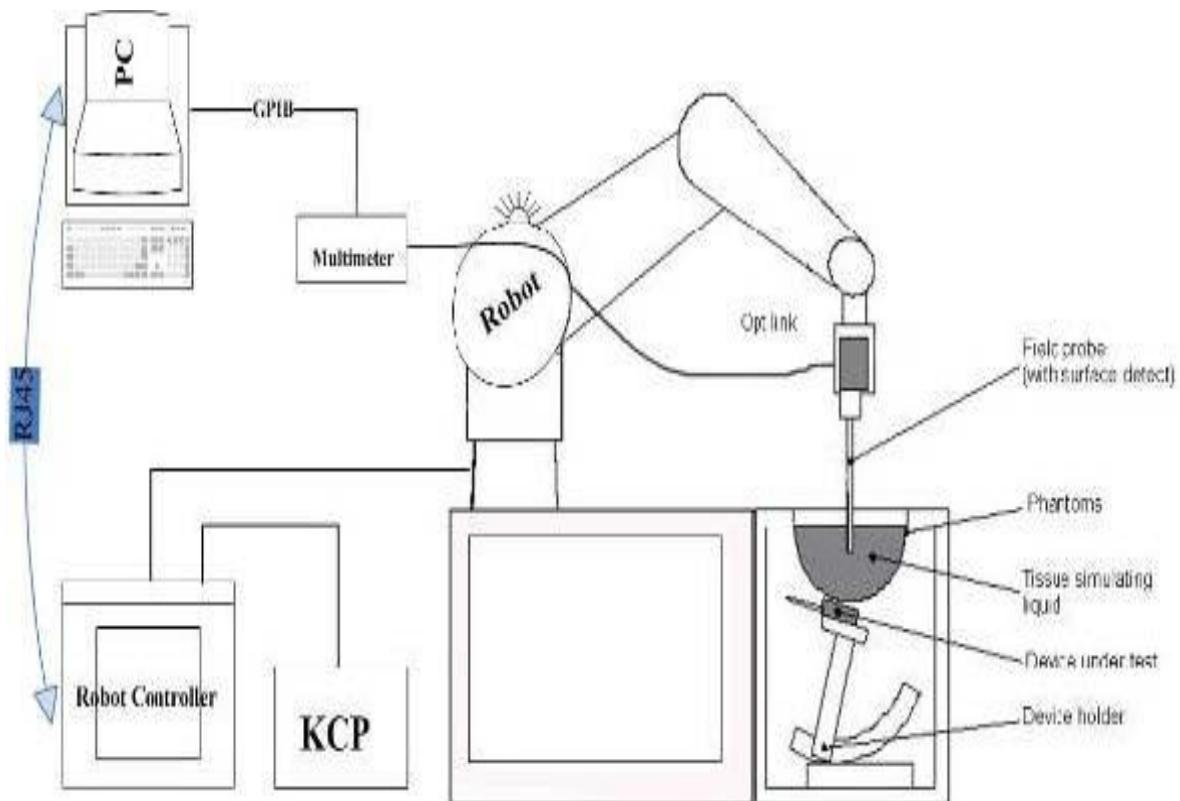
Remote control with teaches pendant and additional circuitry for robot safety such as warning lamps, etc.

The SAM phantom enabling testing left-hand right-hand and body usage.

The Position device for handheld EUT

Tissue simulating liquid mixed according to the given recipes .

System validation dipoles to validate the proper functioning of the system.



3.2. OPENSAR E-field Probe System

The SAR measurements were conducted with the dosimetric probe EPGO281 (manufactured by SATIMO), designed in the classical triangular configuration and optimized for dosimetric evaluation.

Probe Specification

Construction Symmetrical design with triangular core

Interleaved sensors

Built-in shielding against static charges

PEEK enclosure material (resistant to organic solvents, e.g., DGBE)

Calibration ISO/IEC 17025 calibration service available.

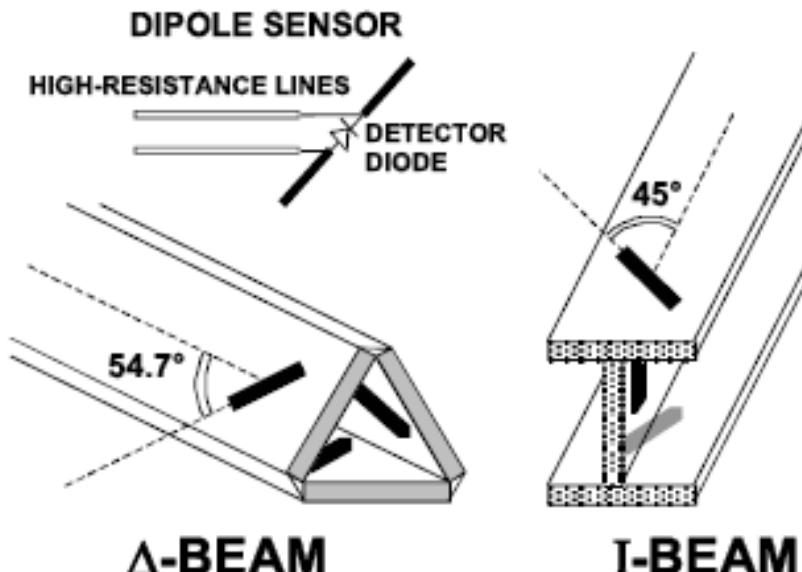
| | |
|---------------|--|
| Frequency | 700 MHz to 3 GHz; Linearity: 0.25dB(700 MHz to 3GHz) |
| Directivity | 0.25 dB in HSL (rotation around probe axis) 0.5 dB in tissue material (rotation normal to probe axis) |
| Dynamic Range | 0.01W/kg to > 100 W/kg; Linearity: 0.25 dB |
| Dimensions | Overall length: 330 mm (Tip: 16mm) Tip diameter: 5 mm (Body: 8 mm) Distance from probe tip to sensor centers: 2.5 mm |
| Application | General dosimetry up to 3 GHz Dosimetry in strong gradient fields Compliance tests of Mobile Phones |



Isotropic E-Field Probe

The isotropic E-Field probe has been fully calibrated and assessed for isotropicity, and boundary effect within a controlled environment. Depending on the frequency for which the probe is calibrated the method utilized for calibration will change.

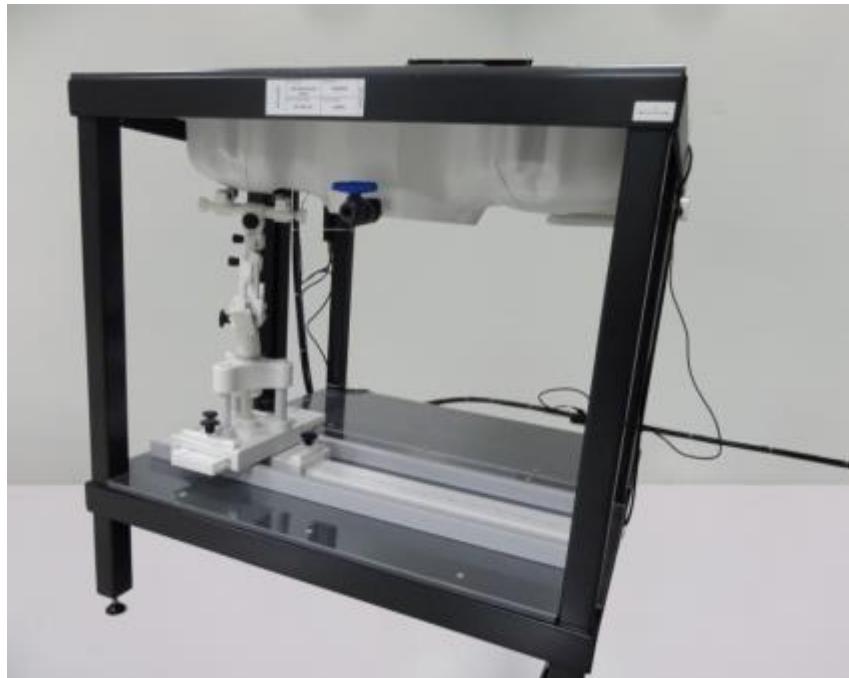
The E-Field probe utilizes a triangular sensor arrangement as detailed in the diagram below:



3.3. Phantoms

The SAM Phantom SAM117 is constructed of a fiberglass shell integrated in a wooden table. The shape of the shell is in compliance with the specification set in IEEE P1528 and CENELEC EN62209-1 , EN62209-2:2010. The phantom enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents the evaporation of the liquid. Reference markings on the Phantom allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points in the robo

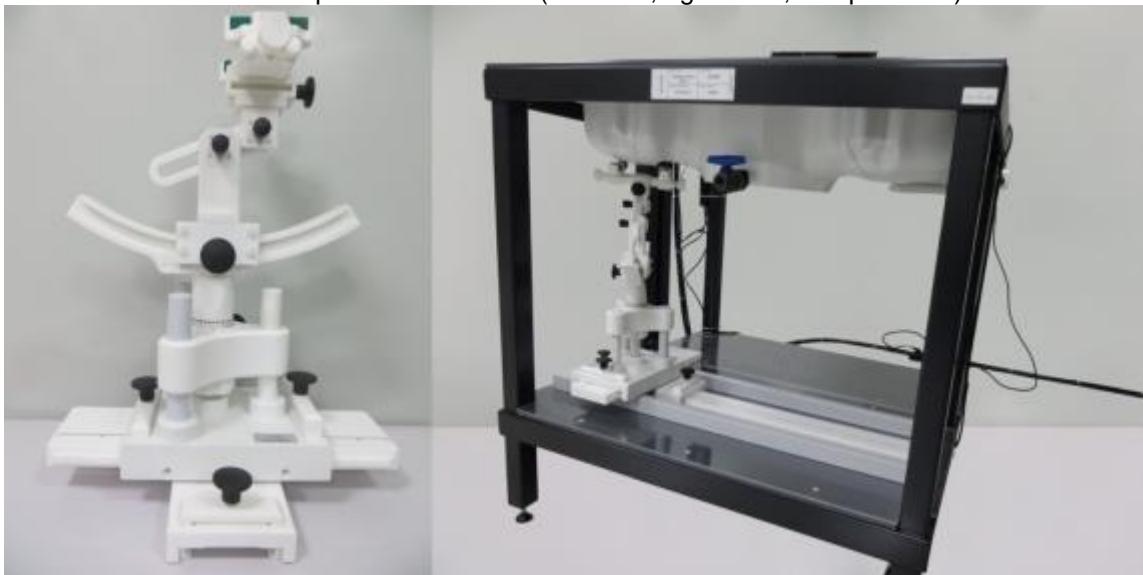
System checking was performed using the flat section, whilst Head SAR tests used the left and right head profile sections. Body SAR testing also used the flat section between the head profiles.



SAM Twin Phantom

3.4. Device Holder

In combination with the Generic Twin Phantom SAM117, the Mounting Device enables the rotation of the mounted transmitter in spherical coordinates whereby the rotation points is the ear opening. The devices can be easily, accurately, and repeatedly positioned according to the FCC and CENELEC specifications. The device holder can be locked at different phantom locations (left head, right head, flat phantom).



Device holder supplied by SATIMO

3.5. Scanning Procedure

The procedure for assessing the peak spatial-average SAR value consists of the following steps

Power Reference Measurement

The reference and drift jobs are useful jobs for monitoring the power drift of the device under test in the batch process. Both jobs measure the field at a specified reference position, at a selectable distance from the phantom surface. The reference position can be either the selected section's grid reference point or a user point in this section. The reference job projects the selected point onto the phantom surface, orients the probe perpendicularly to the surface, and approaches the surface using the selected detection method.

Area Scan

The Area Scan is used as a fast scan in two dimensions to find the area of high field values before running a detailed measurement around the hot spot. Before starting the area scan a grid spacing of 15 mm x 15 mm is set. During the scan the distance of the probe to the phantom remains unchanged. After finishing area scan, the field maxima within a range of 2 dB will be ascertained.

| | ≤ 3 GHz | > 3 GHz |
|--|--|--|
| Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface | $5 \text{ mm} \pm 1 \text{ mm}$ | $\frac{1}{2} \cdot \delta \cdot \ln(2) \text{ mm} \pm 0.5 \text{ mm}$ |
| Maximum probe angle from probe axis to phantom surface normal at the measurement location | $30^\circ \pm 1^\circ$ | $20^\circ \pm 1^\circ$ |
| | $\leq 2 \text{ GHz: } \leq 15 \text{ mm}$ $2 - 3 \text{ GHz: } \leq 12 \text{ mm}$ | $3 - 4 \text{ GHz: } \leq 12 \text{ mm}$ $4 - 6 \text{ GHz: } \leq 10 \text{ mm}$ |
| Maximum area scan spatial resolution: $\Delta x_{\text{Area}}, \Delta y_{\text{Area}}$ | 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. | |

Zoom Scan

Zoom Scans are used to estimate the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g of simulated tissue. The default Zoom Scan is done by 7x7x7 points within a cube whose base is centered around the maxima found in the preceding area scan.

| | | | |
|---|---|---|---|
| Maximum zoom scan spatial resolution: Δx_{Zoom} , Δy_{Zoom} | | $\leq 2 \text{ GHz}: \leq 8 \text{ mm}$ $2 - 3 \text{ GHz}: \leq 5 \text{ mm}^*$ | $3 - 4 \text{ GHz}: \leq 5 \text{ mm}^*$ $4 - 6 \text{ GHz}: \leq 4 \text{ mm}^*$ |
| Maximum zoom scan spatial resolution, normal to phantom surface | uniform grid: $\Delta z_{\text{Zoom}}(n)$ | | $\leq 5 \text{ mm}$ |
| | graded grid | $\Delta z_{\text{Zoom}}(1): \text{between 1}^{\text{st}} \text{ two points closest to phantom surface}$ | $\leq 4 \text{ mm}$ |
| | | $\Delta z_{\text{Zoom}}(n>1): \text{between subsequent points}$ | $\leq 1.5 \cdot \Delta z_{\text{Zoom}}(n-1) \text{ mm}$ |
| Minimum zoom scan volume | x, y, z | $\geq 30 \text{ mm}$ | $3 - 4 \text{ GHz}: \geq 28 \text{ mm}$ $4 - 5 \text{ GHz}: \geq 25 \text{ mm}$ $5 - 6 \text{ GHz}: \geq 22 \text{ mm}$ |

Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see IEEE Std 1528-2013 for details.

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

Power Drift measurement

The drift job measures the field at the same location as the most recent reference job within the same procedure, and with the same settings. The drift measurement gives the field difference in dB from the reading conducted within the last reference measurement. Several drift measurements are possible for one reference measurement. This allows a user to monitor the power drift of the device under test within a batch process. In the properties of the Drift job, the user can specify a limit for the drift and have OPENSAR software stop the measurements if this limit is exceeded.

3.6. Data Storage and Evaluation

Data Storage

The OPENSAR software stores the acquired data from the data acquisition electronics as raw data (in microvolt readings from the probe sensors), together with all necessary software parameters for the data evaluation (probe calibration data, liquid parameters and device frequency and modulation data) in measurement files . The software evaluates the desired unit and format for output each time the data is visualized or exported. This allows verification of the complete software setup even after the measurement and allows correction of incorrect parameter settings. For example, if a measurement has been performed with a wrong crest factor parameter in the device setup, the parameter can be corrected afterwards and the data can be re-evaluated.

The measured data can be visualized or exported in different units or formats, depending on the selected probe type ([V/m], [A/m], [°C], [mW/g], [mW/cm²], [dBrel], etc.). Some of these units are not available in certain situations or show meaningless results, e.g., a SAR output in a lossless media will always be zero. Raw data can also be exported to perform the evaluation with other software packages.

Data Evaluation

The OPENSAR software automatically executes the following procedures to calculate the field units from the microvolt readings at the probe connector. The parameters used in the evaluation are stored in the configuration modules of the software:

| | | |
|--------------------|---------------------------|----------------------|
| Probe parameters: | - Sensitivity | Normi, ai0, ai1, ai2 |
| | - Conversion factor | ConvFi |
| | - Diode compression point | Dcp <i>i</i> |
| Device parameters: | - Frequency | f |
| | - Crest factor | cf |
| Media parameters: | - Conductivity | σ |
| | - Density | ρ |

These parameters must be set correctly in the software. They can be found in the component documents or they can be imported into the software from the configuration files issued for the OPENSAR components. In the direct measuring mode of the multimeter option, the parameters of the actual system setup are used. In the scan visualization and export modes, the parameters stored in the corresponding document files are used.

The first step of the evaluation is a linearization of the filtered input signal to account for the compression characteristics of the detector diode. The compensation depends on the input signal, the diode type and the DC-transmission factor from the diode to the evaluation electronics. If the exciting field is pulsed, the crest factor of the signal must be known to correctly compensate for peak power. The formula for each channel can be given as:

$$V_i = U_i + U_i^2 \cdot \frac{cf}{dcpi}$$

With V_i = compensated signal of channel i ($i = x, y, z$)

U_i = input signal of channel i ($i = x, y, z$)

cf = crest factor of exciting field

dcpi = diode compression point

From the compensated input signals the primary field data for each channel can be evaluated:

$$E - \text{fieldprobes} : E_i = \sqrt{\frac{V_i}{Norm_i \cdot ConvF}}$$

$$H - \text{fieldprobes} : H_i = \sqrt{V_i} \cdot \frac{a_{i0} + a_{i1}f + a_{i2}f^2}{f}$$

With V_i = compensated signal of channel i ($i = x, y, z$)

Normi = sensor sensitivity of channel i [$\text{mV}/(\text{V}/\text{m})^2$ for E-field Probes]

ConvF = sensitivity enhancement in solution

a_{ij} = sensor sensitivity factors for H-field probes
 f = carrier frequency [GHz]
 E_i = electric field strength of channel i in V/m
 H_i = magnetic field strength of channel i in A/m

The RSS value of the field components gives the total field strength (Hermitian magnitude):

$$E_{tot} = \sqrt{E_x^2 + E_y^2 + E_z^2}$$

The primary field data are used to calculate the derived field units.

$$SAR = E_{tot}^2 \cdot \frac{\sigma}{\rho \cdot 1'000}$$

with SAR = local specific absorption rate in mW/g
 E_{tot} = total field strength in V/m
 σ = conductivity in [mho/m] or [Siemens/m]
 ρ = equivalent tissue density in g/cm³

Note that the density is normally set to 1 (or 1.06), to account for actual brain density rather than the density of the simulation liquid.

3.7. Position of the wireless device in relation to the phantom

General considerations

This standard specifies two handset test positions against the head phantom – the “cheek” position and the “tilt” position.

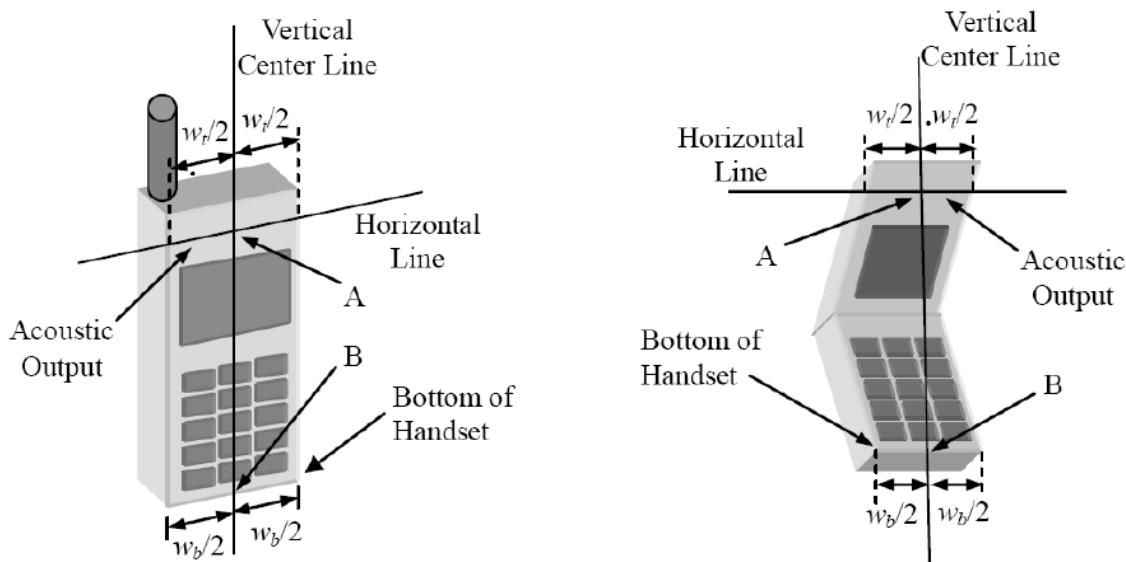
The power flow density is calculated assuming the excitation field as a free space field

$$P_{(pwe)} = \frac{E_{tot}^2}{3770} \text{ or } P_{(pwe)} = H_{tot}^2 \cdot 37.7$$

Where P_{pwe} =Equivalent power density of a plane wave in mW/cm²

E_{tot} =total electric field strength in V/m

H_{tot} =total magnetic field strength in A/m



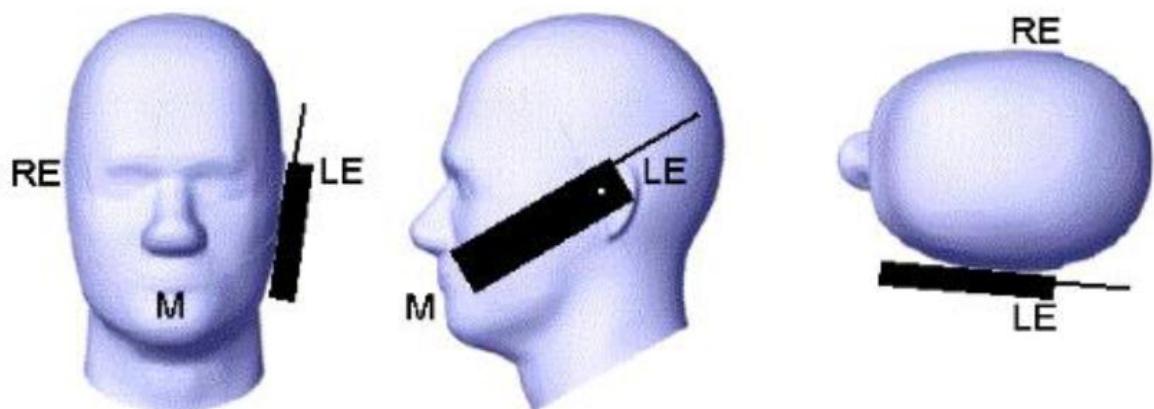
w_t : Width of the handset at the level of the acoustic

w_b : Width of the bottom of the handset

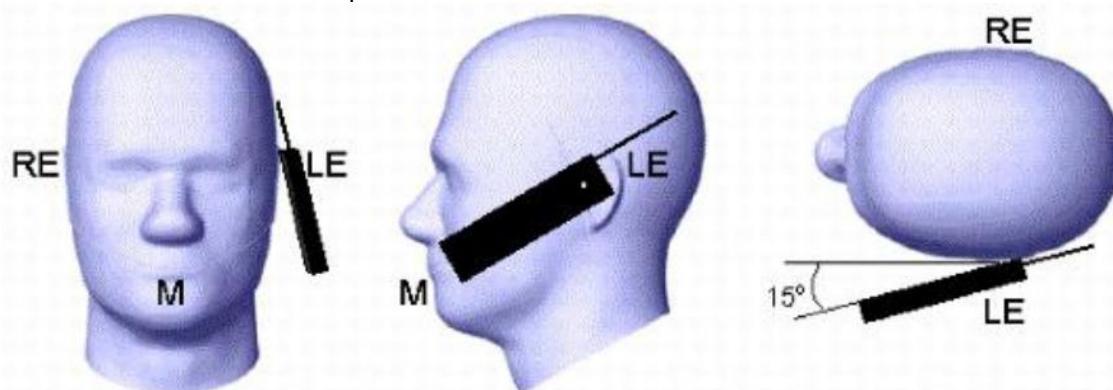
A: Midpoint of the width w_t of the handset at the level of the acoustic output

B: Midpoint of the width w_b of the bottom of the handset

Picture 1-a Typical “fixed” case handset Picture 1-b Typical “clam-shell” case handset



Picture 2 Cheek position of the wireless device on the left side of SAM



Picture 3 Tilt position of the wireless device on the left side of SAM

For body SAR test we applied to FCC KDB941225, KDB447498, KDB248227, KDB648654;

3.8. Tissue Dielectric Parameters for Head and Body Phantoms

The liquid is consisted of water,salt,Glycol,Sugar,Preventol and Cellulose.The liquid has previously been proven to be suited for worst-case.It's satisfying the latest tissue dielectric parameters requirements proposed by the KDB865664.

The composition of the tissue simulating liquid

| Ingredient | 750MHz | | 835MHz | | 1800 MHz | | 1900 MHz | | 2450MHz | | 2600MHz | | 5000MHz | |
|--------------|--------|------|--------|------|----------|-------|----------|-------|---------|-------|---------|-------|---------|------|
| (% Weight) | Head | Body | Head | Body | Head | Body | Head | Body | Head | Body | Head | Body | Head | Body |
| Water | 39.28 | 51.3 | 41.45 | 52.5 | 54.5 | 40.2 | 54.9 | 40.4 | 62.7 | 73.2 | 60.3 | 71.4 | 65.5 | 78.6 |
| Preventol | 0.10 | 0.10 | 0.10 | 0.10 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| HEC | 1.00 | 1.00 | 1.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| DGBE | 0.00 | 0.00 | 0.00 | 0.00 | 45.33 | 59.31 | 44.92 | 59.10 | 36.80 | 26.70 | 39.10 | 28.40 | 0.00 | 0.00 |
| Triton X-100 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 17.2 | 10.7 |

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

3.9. Tissue equivalent liquid properties

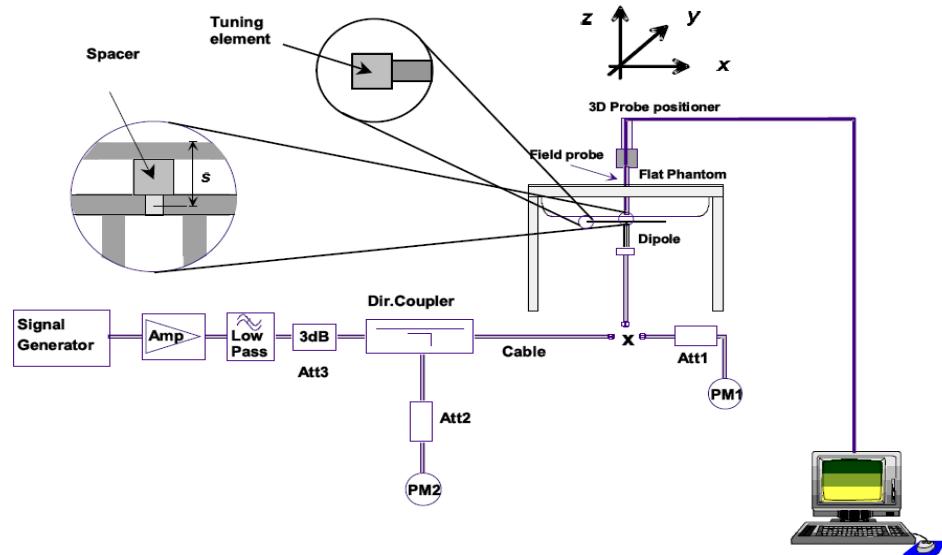
Dielectric Performance of Head and Body Tissue Simulating Liquid

| Tissue Type | Measured Frequency (MHz) | Target Tissue | | Measured Tissue | | | | Liquid Temp. | Test Data |
|-------------|--------------------------|---------------|--------------|-----------------|--------|--------------|--------|--------------|------------|
| | | σ | ϵ_r | σ | Dev. | ϵ_r | Dev. | | |
| 835H | 835 | 0.90 | 41.50 | 0.87 | -3.33% | 41.22 | -0.67% | 21.2 | 05/23/2018 |
| 1900H | 1800 | 1.40 | 40.00 | 1.42 | 1.43% | 40.80 | 2.00% | 20.8 | 05/24/2018 |
| 835B | 835 | 0.97 | 55.20 | 0.99 | 2.06% | 55.13 | -0.13% | 20.5 | 05/25/2018 |
| 1900B | 1800 | 1.52 | 53.30 | 1.55 | 1.97% | 54.25 | 1.78% | 21.0 | 05/26/2018 |

3.10. System Check

The purpose of the system check is to verify that the system operates within its specifications at the device test frequency. The system check is simple check of repeatability to make sure that the system works correctly at the time of the compliance test;

System check results have to be equal or near the values determined during dipole calibration with the relevant liquids and test system ($\pm 10\%$).



The output power on dipole port must be calibrated to 20 dBm (100mW) before dipole is connected.



Photo of Dipole Setup

Justification for Extended SAR Dipole Calibrations

Referring to KDB 865664D01V01r04, if dipoles are verified in return loss (<-20dB, within 20% of prior calibration), and in impedance (within 5 ohm of prior calibration), the annual calibration is not necessary and the calibration interval can be extended. While calibration intervals not exceed 3 years.

SID835SN 07/14 DIP 0G835-303 Extend Dipole Calibrations

| Date of Measurement | Return-Loss (dB) | Delta (%) | Real Impedance (ohm) | Delta (ohm) | Imaginary Impedance (ohm) | Delta (ohm) |
|---------------------|------------------|-----------|----------------------|-------------|---------------------------|-------------|
| 2015-10-01 | -24.46 | | 55.4 | | 2.4 | |
| 2016-09-30 | -25.53 | 4.374 | 56.1 | 0.7 | 1.352 | -1.048 |
| 2017-09-30 | -25.16 | 2.862 | 55.8 | 0.4 | 1.832 | -0.568 |

SID1900 SN 30/14 DIP 1G900-333 Extend Dipole Calibrations

| Date of Measurement | Return-Loss (dB) | Delta (%) | Real Impedance (ohm) | Delta (ohm) | Imaginary Impedance (ohm) | Delta (ohm) |
|---------------------|------------------|-----------|----------------------|-------------|---------------------------|-------------|
| 2015-10-01 | -23.68 | | 51.2 | | 6.4 | |
| 2016-09-30 | -23.40 | -1.182 | 50.188 | -1.012 | 3.562 | -2.838 |
| 2017-09-30 | -23.55 | -0.549 | 50.395 | -0.805 | 4.261 | -2.139 |

| Mixture Type | Frequency (MHz) | Power | SAR _{1g} (W/Kg) | SAR _{10g} (W/Kg) | Drift (%) | 1W Target | | Difference percentage | | Liquid Temp | Date |
|--------------|-----------------|---------------------|--------------------------|---------------------------|-----------|--------------------------|---------------------------|-----------------------|--------|-------------|------------|
| | | | | | | SAR _{1g} (W/Kg) | SAR _{10g} (W/Kg) | 1g | 10g | | |
| Head | 835 | 100 mW | 0.984 | 0.637 | 0.34 | 9.60 | 6.20 | 2.50% | 2.74% | 21.2 | 05/23/2018 |
| | | Normalize to 1 Watt | 9.84 | 6.37 | | | | | | | |
| Body | 835 | 100 mW | 0.977 | 0.636 | 1.36 | 9.90 | 6.39 | -1.31% | -0.47% | 20.5 | 05/25/2018 |
| | | Normalize to 1 Watt | 9.77 | 6.36 | | | | | | | |
| Head | 1900 | 100 mW | 3.927 | 2.006 | -0.05 | 39.84 | 20.20 | -1.43% | -0.69% | 20.8 | 05/24/2018 |
| | | Normalize to 1 Watt | 39.27 | 20.06 | | | | | | | |
| Body | 1900 | 100 mW | 4.118 | 2.056 | -1.40 | 43.33 | 21.59 | -4.96% | -4.77% | 21.0 | 05/26/2018 |
| | | Normalize to 1 Watt | 41.18 | 20.56 | | | | | | | |

3.11. SAR measurement procedure

The measurement procedures are as follows:

3.11.1 Conducted power measurement

- a. For WWAN power measurement, use base station simulator connection with RF cable, at maximum power in each supported wireless interface and frequency band.
- b. Read the WWAN RF power level from the base station simulator.
- c. For WLAN/BT power measurement, use engineering software to configure EUT WLAN/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 WLAN/BT output power.

3.11.2 GSM Test Configuration

SAR tests for GSM 850 and GSM 1900, a communication link is set up with a System Simulator (SS) by air link. Using CMU200 the power level is set to "5" for GSM 850, set to "0" for GSM 1900. Since the GPRS class is 12 for this EUT, it has at most 4 timeslots in uplink and at most 4 timeslots in downlink, the maximum total timeslots is 5. the EGPRS class is 12 for this EUT, it has at most 4 timeslots in uplink and at most 4 timeslots in downlink, the maximum total timeslots is 5.

SAR test reduction for GPRS and EDGE modes is determined by the source-based time-averaged output power specified for production units, including tune-up tolerance. The data mode with highest specified time-averaged output power should be tested for SAR compliance in the applicable exposure conditions. For modes with the same specified maximum output power and tolerance, the higher number time-slot configuration should be tested. GSM voice and GPRS data use GMSK, which is a constant amplitude modulation with minimal peak to average power difference within the time-slot burst. For EDGE, GMSK is used for MCS 1 – MCS 4 and 8-PSK is used for MCS 5 – MCS 9; where 8-PSK has an inherently higher peak-to-average power ratio. The GMSK and 8-PSK EDGE configurations are considered separately for SAR compliance. The GMSK EDGE configurations are grouped with GPRS and considered with respect to time-averaged maximum output power to determine compliance. The 3G SAR test reduction procedure is applied to 8-PSK EDGE with GMSK GPRS/EDGE as the primary mode.

3.12. Power Reduction

The product without any power reduction.

3.13. Power Drift

To control the output power stability during the SAR test, SAR system calculates the power drift by measuring the E-field at the same location at the beginning and at the end of the measurement for each test position. This ensures that the power drift during one measurement is within 5%.

4. TEST CONDITIONS AND RESULTS

4.1. Conducted Power Results

According KDB 447498D01 General RF Exposure Guidance v06 Section 4.1 2) states that "Unless it is specified differently in the published RF exposure KDB procedures, these requirements also apply to test reduction and test exclusion considerations. Time-averaged maximum conducted output power applies to SAR and, as required by § 2.1091(c), time-averaged ERP applies to MPE. When an antenna port is not available on the device to support conducted power measurement, such as FRS and certain Part 15 transmitters with built-in integral antennas, the maximum output power allowed for production units should be used to determine RF exposure test exclusion and compliance."

<GSM Conducted Power>

General Note:

1. Per KDB 447498 D01v06, the maximum output power channel is used for SAR testing and for further SAR test reduction.
2. According to October 2013TCB Workshop, for GSM / GPRS / EGPRS, the number of time slots to test for SAR should correspond to the highest frame-average maximum output power configuration, considering the possibility of e.g. 3rd party VoIP operation for head and body-worn SAR testing, the EUT was set in GPRS (2Tx slot) for GSM850/GSM1900 band due to their highest frame-average power.
3. For body-worn mode SAR testing, GPRS should be evaluated, therefore the EUT was set in GPRS (3 Tx slots) for GSM850/GSM1900 band due to its highest frame-average power.

**Conducted power measurement results for GSM850/PCS1900
<SIM1>**

| GSM 850 | | Tune-up | Burst Conducted power (dBm) | | | Division Factors | Tune-up | Average power (dBm) | | |
|----------------|-----------------|--------------|-----------------------------|---------------|----------------|------------------|--------------|------------------------|---------------|----------------|
| | | | Channel/Frequency(MHz) | | | | | Channel/Frequency(MHz) | | |
| | | Max | 128/ 824.2 | 190/ 836.6 | 251/ 848.8 | | Max | 128/ 824.2 | 190/ 836.6 | 251/84 8.8 |
| GSM | | 33.00 | 32.69 | 32.73 | 32.70 | -9.03dB | 23.97 | 23.66 | 23.70 | 23.67 |
| GPRS (GMSK) | 1TX slot | 33.00 | 32.54 | 32.57 | 32.53 | -9.03dB | 23.97 | 23.51 | 23.54 | 23.50 |
| | 2TX slot | 31.50 | 30.97 | 31.01 | 30.98 | -6.02dB | 25.48 | 24.95 | 24.99 | 24.96 |
| | 3TX slot | 30.00 | 29.52 | 29.55 | 29.49 | -4.26dB | 25.74 | 25.26 | 25.29 | 25.23 |
| | 4TX slot | 29.00 | 28.01 | 28.03 | 27.99 | -3.01dB | 25.99 | 25.00 | 25.02 | 24.98 |
| GSM 1900 | | Tune-up | Burst Conducted power (dBm) | | | Division Factors | Tune-up | Average power (dBm) | | |
| | | | Channel/Frequency(MHz) | | | | | Channel/Frequency(MHz) | | |
| | | Max | 512/ 1850.2 | 661/ 1880 | 810/ 1909.8 | | Max. | 512/ 1850.2 | 661/ 1880 | 810/ 1909.8 |
| GSM | | 30.00 | 29.68 | 29.72 | 29.70 | -9.03dB | 20.97 | 20.65 | 20.69 | 20.67 |
| GPRS (GMSK) | 1TX slot | 30.00 | 29.55 | 29.57 | 29.52 | -9.03dB | 20.97 | 20.52 | 20.54 | 20.49 |
| | 2TX slot | 28.00 | 27.97 | 27.98 | 27.93 | -6.02dB | 21.98 | 21.95 | 21.96 | 21.91 |
| | 3TX slot | 27.00 | 26.49 | 26.51 | 26.47 | -4.26dB | 22.74 | 22.23 | 22.25 | 22.21 |
| | 4TX slot | 25.00 | 24.95 | 24.99 | 24.91 | -3.01dB | 21.99 | 21.94 | 21.98 | 21.90 |

<SIM2>

| GSM 850 | | Burst Average Conducted power (dBm) | | |
|----------------|----------|-------------------------------------|-----------|------------|
| | | Channel/Frequency(MHz) | | |
| | | 128/824.2 | 190/836.6 | 251/848.8 |
| GSM | | 32.67 | 32.70 | 32.63 |
| GPRS (GMSK) | 1TX slot | 32.51 | 32.53 | 32.49 |
| | 2TX slot | 30.94 | 30.97 | 30.91 |
| | 3TX slot | 29.47 | 29.51 | 29.43 |
| | 4TX slot | 27.92 | 28.01 | 27.96 |
| GSM 1900 | | Burst Average Conducted power (dBm) | | |
| | | Channel/Frequency(MHz) | | |
| | | 512/1850.2 | 661/1880 | 810/1909.8 |
| GSM | | 29.61 | 29.66 | 29.59 |
| GPRS (GMSK) | 1TX slot | 29.51 | 29.55 | 29.48 |
| | 2TX slot | 27.91 | 27.95 | 27.87 |
| | 3TX slot | 26.44 | 26.47 | 26.41 |
| | 4TX slot | 24.90 | 24.95 | 24.88 |

Notes:

1. Division Factors

To average the power, the division factor is as follows:

1TX-slot = 1 transmit time slot out of 8 time slots=> conducted power divided by (8/1) => -9.00dB

2TX-slots = 2 transmit time slots out of 8 time slots=> conducted power divided by (8/2) => -6.00dB

3TX-slots = 3 transmit time slots out of 8 time slots=> conducted power divided by (8/3) => -4.26dB

4TX-slots = 4 transmit time slots out of 8 time slots=> conducted power divided by (8/4) => -3.00dB

2. According to the conducted power as above, the GPRS measurements are performed with 2Txslot for GPRS850 and 4TxslotGPRS1900.

<BT Conducted Power>

| Mode | channel | Frequency (MHz) | Conducted AVG output power (dBm) |
|----------------|---------|-----------------|----------------------------------|
| GFSK | 0 | 2402 | 0.573 |
| | 39 | 2441 | -0.195 |
| | 78 | 2480 | -0.491 |
| $\pi/4$ -DQPSK | 0 | 2402 | 0.088 |
| | 39 | 2441 | -0.771 |
| | 78 | 2480 | -1.101 |
| 8DPSK | 0 | 2402 | 0.353 |
| | 39 | 2441 | -0.562 |
| | 78 | 2480 | -0.885 |

Per KDB 447498 D01v06, the 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separationdistances \leq 50 mm are determined by:

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

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

| Bluetooth Turn up Power (dBm) | Separation Distance (mm) | Frequency (GHz) | Exclusion Thresholds |
|-------------------------------|--------------------------|-----------------|----------------------|
| 1.0 | 5 | 2.45 | 0.4 |

Per KDB 447498 D01v06, when the minimum test separation distance is < 5 mm, a distance of 5 mm is applied todetermine SAR test exclusion. The test exclusion threshold is $0.4 < 3.0$, SAR testing is not required.

4.2. Manufacturing tolerance

GSM Speech <SIM1>

| GSM 850 (GMSK) (Burst Average Power) | | | |
|---------------------------------------|-------------|-------------|-------------|
| Channel | Channel 128 | Channel 190 | Channel 251 |
| Target (dBm) | 32.0 | 32.0 | 32.0 |
| Tolerance ±(dB) | 1.0 | 1.0 | 1.0 |
| GSM 1900 (GMSK) (Burst Average Power) | | | |
| Channel | Channel 512 | Channel 661 | Channel 810 |
| Target (dBm) | 29.0 | 29.0 | 29.0 |
| Tolerance ±(dB) | 1.0 | 1.0 | 1.0 |

GSM Speech <SIM2>

| GSM 850 (GMSK) (Burst Average Power) | | | |
|---------------------------------------|-------------|-------------|-------------|
| Channel | Channel 128 | Channel 190 | Channel 251 |
| Target (dBm) | 32.0 | 32.0 | 32.0 |
| Tolerance ±(dB) | 1.0 | 1.0 | 1.0 |
| GSM 1900 (GMSK) (Burst Average Power) | | | |
| Channel | Channel 512 | Channel 661 | Channel 810 |
| Target (dBm) | 29.0 | 29.0 | 29.0 |
| Tolerance ±(dB) | 1.0 | 1.0 | 1.0 |

<SIM1>

| GSM 850 GPRS (GMSK) (Burst Average Power) | | | |
|--|-----------------|------|------|
| Channel | 128 | 190 | 251 |
| 1 Txslot | Target (dBm) | 32.0 | 32.0 |
| | Tolerance ±(dB) | 1.0 | 1.0 |
| 2 Txslot | Target (dBm) | 30.0 | 30.5 |
| | Tolerance ±(dB) | 1.0 | 1.0 |
| 3 Txslot | Target (dBm) | 29.0 | 29.0 |
| | Tolerance ±(dB) | 1.0 | 1.0 |
| 4 Txslot | Target (dBm) | 28.0 | 28.0 |
| | Tolerance ±(dB) | 1.0 | 1.0 |
| GSM 1900 GPRS (GMSK) (Burst Average Power) | | | |
| Channel | 512 | 661 | 810 |
| 1 Txslot | Target (dBm) | 29.0 | 29.0 |
| | Tolerance ±(dB) | 1.0 | 1.0 |
| 2 Txslot | Target (dBm) | 27.0 | 27.0 |
| | Tolerance ±(dB) | 1.0 | 1.0 |
| 3 Txslot | Target (dBm) | 26.0 | 26.0 |
| | Tolerance ±(dB) | 1.0 | 1.0 |
| 4 Txslot | Target (dBm) | 24.0 | 24.0 |
| | Tolerance ±(dB) | 1.0 | 1.0 |

<SIM2>

| GSM 850 GPRS (GMSK) (Burst Average Power) | | | |
|--|-----------------|------|------|
| Channel | 128 | 190 | 251 |
| 1 Txslot | Target (dBm) | 32.0 | 32.0 |
| | Tolerance ±(dB) | 1.0 | 1.0 |
| 2 Txslot | Target (dBm) | 30.0 | 30.0 |
| | Tolerance ±(dB) | 1.0 | 1.0 |
| 3 Txslot | Target (dBm) | 29.0 | 29.0 |
| | Tolerance ±(dB) | 1.0 | 1.0 |
| 4 Txslot | Target (dBm) | 27.0 | 27.5 |
| | Tolerance ±(dB) | 1.0 | 1.0 |
| GSM 1900 GPRS (GMSK) (Burst Average Power) | | | |
| Channel | 512 | 661 | 810 |
| 1 Txslot | Target (dBm) | 29.0 | 29.0 |
| | Tolerance ±(dB) | 1.0 | 1.0 |
| 2 Txslot | Target (dBm) | 27.0 | 27.0 |
| | Tolerance ±(dB) | 1.0 | 1.0 |

| | | | | |
|----------|----------------------|------|------|------|
| 3 Txslot | Target (dBm) | 26.0 | 26.0 | 26.0 |
| | Tolerance \pm (dB) | 1.0 | 1.0 | 1.0 |
| 4 Txslot | Target (dBm) | 24.0 | 24.0 | 24.0 |
| | Tolerance \pm (dB) | 1.0 | 1.0 | 1.0 |

Bluetooth V2.1+EDR**GFSK (Average)**

| Channel | Channel 0 | Channel 39 | Channel 78 |
|----------------------|-----------|------------|------------|
| Target (dBm) | 0.0 | 0.0 | 0.0 |
| Tolerance \pm (dB) | 1.0 | 1.0 | 1.0 |

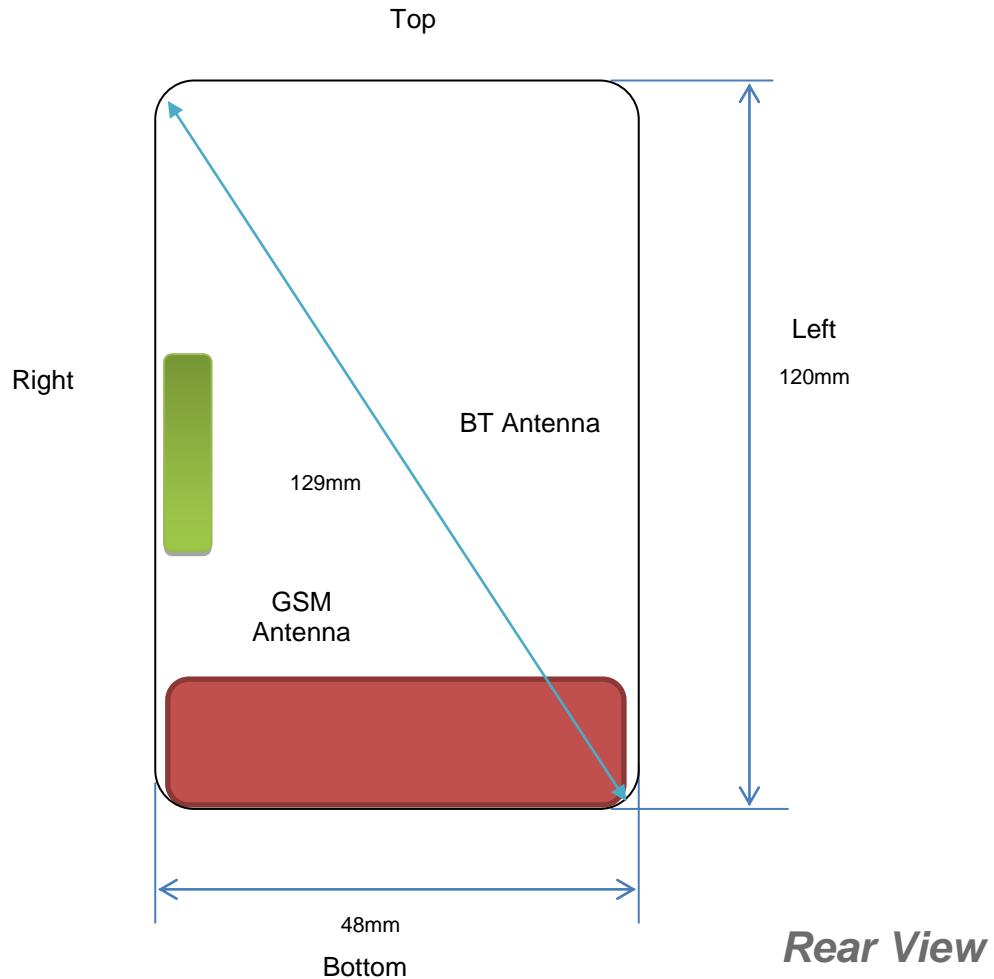
8DPSK (Average)

| Channel | Channel 0 | Channel 39 | Channel 78 |
|----------------------|-----------|------------|------------|
| Target (dBm) | 0.0 | 0.0 | -1.0 |
| Tolerance \pm (dB) | 1.0 | 1.0 | 1.0 |

 $\pi/4$ DQPSK (Average)

| Channel | Channel 0 | Channel 39 | Channel 78 |
|----------------------|-----------|------------|------------|
| Target (dBm) | 0.0 | 0.0 | 0.0 |
| Tolerance \pm (dB) | 1.0 | 1.0 | 1.0 |

4.3. Transmit Antennas and SAR Measurement Position



Antenna information:

| | |
|-------------------|-----------|
| WWAN Main Antenna | GSM TX/RX |
| BT Antenna | BT TX/RX |

Note:

- 1). Per KDB648474 D04, because the overall diagonal distance of this devices is $129\text{mm} < 160\text{mm}$, it is considered as "Phablet" device.
- 2). Per KDB648474 D04, 10-g extremity SAR is not required when Body-Worn mode 1-g reported SAR $< 1.2 \text{ W/Kg}$.

4.4. SAR Measurement Results

The calculated SAR is obtained by the following formula:

$$\text{Reported SAR} = \text{Measured SAR} * 10^{(\text{P}_{\text{target}} - \text{P}_{\text{measured}})/10}$$

$$\text{Scaling factor} = 10^{(\text{P}_{\text{target}} - \text{P}_{\text{measured}})/10}$$

$$\text{Reported SAR} = \text{Measured SAR} * \text{Scaling factor}$$

Where

P_{target} is the power of manufacturing upper limit;

P_{measured} is the measured power;

Measured SAR is measured SAR at measured power which including power drift)

Reported SAR which including Power Drift and Scaling factor

Duty Cycle

| Test Mode | Duty Cycle |
|------------------------|------------|
| Speech for GSM850/1900 | 1:8 |
| GPRS850 | 1:2.67 |
| GPRS1900 | 1:2.67 |

4.4.1 SAR Results

SAR Values [GSM 850]

| Ch. | Freq. (MHz) | Time slots | Test Position | Conducted Power (dBm) | Maximum Allowed Power (dBm) | Power Drift (%) | Scaling Factor | SAR _{1-g} results(W/kg) | | Graph Results |
|--|----------------|---------------|------------------|-----------------------------|--------------------------------------|-----------------------|-------------------|----------------------------------|--------------|------------------|
| | | | | | | | | Measured | Reported | |
| measured / reported SAR numbers -Head<SIM1> | | | | | | | | | | |
| 190 | 836.6 | Voice | Left Cheek | 32.73 | 33.00 | 4.79 | 1.064 | 0.782 | 0.832 | Plot 1 |
| 128 | 824.2 | Voice | Left Cheek | 32.69 | 33.00 | 2.61 | 1.074 | 0.695 | 0.746 | |
| 251 | 848.8 | Voice | Left Cheek | 32.70 | 33.00 | -3.64 | 1.072 | 0.730 | 0.782 | |
| 190 | 836.6 | Voice | Left Tilt | 32.73 | 33.00 | 1.33 | 1.064 | 0.325 | 0.346 | |
| 190 | 836.6 | Voice | Right Cheek | 32.73 | 33.00 | -0.46 | 1.064 | 0.584 | 0.621 | |
| 190 | 836.6 | Voice | Right Tilt | 32.73 | 33.00 | -2.58 | 1.064 | 0.216 | 0.230 | |
| measured / reported SAR numbers - Body (distance 10mm)<SIM1> | | | | | | | | | | |
| 190 | 836.6 | 3Txslots | Front | 29.55 | 30.00 | 1.64 | 1.109 | 0.625 | 0.693 | |
| 190 | 836.6 | 3Txslots | Rear | 29.55 | 30.00 | 2.97 | 1.109 | 1.029 | 1.141 | Plot 2 |
| 128 | 824.2 | 3Txslots | Rear | 29.52 | 30.00 | 4.15 | 1.117 | 0.864 | 0.965 | |
| 251 | 848.8 | 3Txslots | Rear | 29.49 | 30.00 | -0.02 | 1.125 | 0.921 | 1.036 | |

Remark:

1. The value with black color is the maximum SAR Value of each test band.
2. The frame average of GPRS (2Tx slots) higher than GSM and sample can support VoIP function, tested at GPRS (3Tx slots) mode for head.
3. Per FCC KDB Publication 447498 D01, if the reported (scaled) SAR measured at the middle channel or highest output power channel for each test configuration is ≤ 0.8 W/kg then testing at the other channels is optional for such test configuration(s).

SAR Values [GSM 1900]

| Ch. | Freq. (MHz) | time slots | Test Position | Conducted Power (dBm) | Maximum Allowed Power (dBm) | Power Drift (%) | Scaling Factor | SAR _{1-g} results(W/kg) | | Graph Results |
|--|----------------|------------|------------------|-----------------------------|--------------------------------------|-----------------------|-------------------|----------------------------------|--------------|------------------|
| | | | | | | | | Measured | Reported | |
| measured / reported SAR numbers -Head<SIM1> | | | | | | | | | | |
| 661 | 1880.0 | Voice | Left Cheek | 29.72 | 30.00 | 2.69 | 1.067 | 0.327 | 0.349 | |
| 661 | 1880.0 | Voice | Left Tilt | 29.72 | 30.00 | -1.78 | 1.067 | 0.163 | 0.174 | |
| 661 | 1880.0 | Voice | Right Cheek | 29.72 | 30.00 | -3.85 | 1.067 | 0.455 | 0.485 | Plot 3 |
| 661 | 1880.0 | Voice | Right Tilt | 29.72 | 30.00 | 0.49 | 1.067 | 0.201 | 0.214 | |
| measured / reported SAR numbers - Body (distance 10mm) | | | | | | | | | | |
| 661 | 1880.0 | 3Txslots | Front | 24.51 | 25.00 | 0.07 | 1.119 | 0.215 | 0.241 | |
| 661 | 1880.0 | 3Txslots | Rear | 24.51 | 25.00 | 2.36 | 1.119 | 0.446 | 0.499 | Plot 4 |

Remark:

1. The value with black color is the maximum SAR Value of each test band.
2. The frame average of GPRS (4Tx slots) higher than GSM and sample can support VoIP function, tested at GPRS (4Tx slots) mode for head.

3. Per FCC KDB Publication 447498 D01, if the reported (scaled) SAR measured at the middle channel or highest output power channel for each test configuration is $\leq 0.8 \text{ W/kg}$ then testing at the other channels is optional for such test configuration(s).

4.4.2 Standalone SAR Test Exclusion Considerations and Estimated SAR

Per KDB447498 requires when the standalone SAR test exclusion of section 4.3.1 is applied to an antenna that transmits simultaneously with other antennas, the standalone SAR must be estimated according to the following to determine simultaneous transmission SAR test exclusion;

- (max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] • [$\sqrt{f(\text{GHz})/x}$] W/kg for test separation distances $\leq 50 \text{ mm}$; where $x = 7.5$ for 1-g SAR, and $x = 18.75$ for 10-g SAR.
 - 0.4 W/kg for 1-g SAR and 1.0 W/kg for 10-g SAR, when the test separation distances is $> 50 \text{ mm}$
- Per FCC KD B447498 D01, simultaneous transmission SAR test exclusion may be applied when the sum of the 1-g SAR for all the transmitting antenna in a specific physical test configuration is $\leq 1.6 \text{ W/Kg}$. When the sum is greater than the SAR limit, SAR test exclusion is determined by the SAR to peak location separation ratio.

$$\text{Ratio} = \frac{(\text{SAR}_1 + \text{SAR}_2)^{1.5}}{(\text{peak location separation,mm})} < 0.04$$

| Estimated stand alone SAR | | | | | |
|---------------------------|-----------------|---------------|---------------------|--------------------------|-------------------------------------|
| Communication system | Frequency (MHz) | Configuration | Maximum Power (dBm) | Separation Distance (mm) | Estimated SAR _{1-q} (W/kg) |
| Bluetooth* | 2450 | Head | 1.00 | 5 | 0.053 |
| Bluetooth* | 2450 | Body-worn | 1.00 | 10 | 0.026 |

Remark:

1. Bluetooth*- Including Lower power Bluetooth
2. Maximum average power including tune-up tolerance;
3. When the minimum test separation distance is $< 5 \text{ mm}$, a distance of 5 mm is applied to determine SAR test exclusion
4. Body as body use distance is 10mm from manufacturer declaration of user manual

4.5. Simultaneous TX SAR Considerations

4.5.1 Introduction

The following procedures adopted from “FCC SAR Considerations for Cell Phones with Multiple Transmitters” are applicable to handsets with built-in unlicensed transmitters such as Bluetooth devices which may simultaneously transmit with the licensed transmitter.

For the DUT, the BT modules sharing same antenna, GSME modules sharing a single antenna; BT and GSM can simultaneous transmit;

Application Simultaneous Transmission information:

| Air-Interface | Band (MHz) | Type | Simultaneous Transmissions | Voice over Digital Transport(Data) |
|---|------------|------|----------------------------|------------------------------------|
| GSM | 850 | VO | Yes, BT | N/A |
| | 1900 | VO | | |
| BT | 2450 | DT | Yes, BT | N/A |
| Note: VO-Voice Service only; DT-Digital Transport | | | | N/A |

Note:

BT- Classical Bluetooth;

4.5.2 Evaluation of Simultaneous SAR

Head Exposure Conditions

Simultaneous transmission SAR for BT and GSM

| Test Position | GSM850 Reported SAR _{1-g} (W/Kg) | GSM1900 Reported SAR _{1-g} (W/Kg) | BT Estimated SAR _{1-g} (W/Kg) | MAX. ΣSAR _{1-g} (W/Kg) | SAR _{1-g} Limit (W/Kg) | Peak location separation ratio | Simut Meas. Required |
|---------------|---|--|--|---------------------------------|---------------------------------|--------------------------------|----------------------|
| Left Cheek | 0.832 | 0.349 | 0.053 | 0.885 | 1.6 | no | no |
| Left Tilt | 0.346 | 0.174 | 0.053 | 0.399 | 1.6 | no | no |
| Right Cheek | 0.621 | 0.485 | 0.053 | 0.674 | 1.6 | no | no |
| Right Tilt | 0.230 | 0.214 | 0.053 | 0.283 | 1.6 | no | no |

Body-worn Exposure Conditions

Simultaneous transmission SAR for BT and GSM

| Test Position | GSM850 Reported SAR _{1-g} (W/Kg) | GSM1900 Reported SAR _{1-g} (W/Kg) | BT Estimated SAR _{1-g} (W/Kg) | MAX. ΣSAR _{1-g} (W/Kg) | SAR _{1-g} Limit (W/Kg) | Peak location separation ratio | Simut Meas. Required |
|---------------|---|--|--|---------------------------------|---------------------------------|--------------------------------|----------------------|
| Front | 0.693 | 0.241 | 0.026 | 0.719 | 1.6 | no | no |
| Rear | 1.141 | 0.499 | 0.026 | 1.167 | 1.6 | no | no |

Note:

1. The value with black color is the maximum values of standalone
2. The value with blue color is the maximum values of Σ SAR_{1-g}

4.6. SAR Measurement Variability

According to KDB865664, Repeated measurements are required only when the measured SAR is ≥ 0.80 W/kg. If the measured SAR value of the initial repeated measurement is < 1.45 W/kg with $\leq 20\%$ variation, only one repeated measurement is required to reaffirm that the results are not expected to have substantial variations, which may introduce significant compliance concerns. A second repeated measurement is required only if the measured result for the initial repeated measurement is within 10% of the SAR limit and vary by more than 20%, which are often related to device and measurement setup difficulties. The following procedures are applied to determine if repeated measurements are required. The same procedures should be adapted for measurements according to extremity and occupational exposure limits by applying a factor of 2.5 for extremity exposure and a factor of 5 for occupational exposure to the corresponding SAR thresholds.¹⁹ The repeated measurement results must be clearly identified in the SAR report. All measured SAR, including the repeated results, must be considered to determine compliance and for reporting according to KDB 690783. Repeated measurement is not required when the original highest measured SAR is < 0.80 W/kg; steps 2) through 4) do not apply.

- 1) When the original highest measured SAR is ≥ 0.80 W/kg, repeat that measurement once.
- 2) Perform a second repeated measurement only if the ratio of largest to smallest SAR for the original and first repeated measurements is > 1.20 or when the original or repeated measurement is ≥ 1.45 W/kg ($\sim 10\%$ from the 1-g SAR limit).
- 3) 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 .
- 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 .

| Frequency Band (MHz) | Air Interface | RF Exposure Configuration | Test Position | Repeated SAR (yes/no) | Highest Measured SAR _{1-g} (W/Kg) | First Repeated | |
|----------------------|---------------|---------------------------|---------------|-----------------------|--|------------------------------------|-------------------------------|
| | | | | | | Measured SAR _{1-g} (W/Kg) | Largest to Smallest SAR Ratio |
| 850 | GSM850 | Standalone | Body-Rear | no | 1.029 | 0.904 | 0.911 |
| 1900 | GSM1900 | Standalone | Body-Rear | no | 0.446 | n/a | n/a |

Remark:

1. Second Repeated Measurement is not required since the ratio of the largest to smallest SAR for the original and first repeated measurement is not > 1.20 or 3 (1-g or 10-g respectively)

4.7. General description of test procedures

1. The DUT is tested using CMU 200 communications testers as controller unit to set test channels and maximum output power to the DUT, as well as for measuring the conducted peak power.
2. Test positions as described in the tables above are in accordance with the specified test standard.
3. Tests in body position were performed in that configuration, which generates the highest time based averaged output power (see conducted power results).
4. Tests in head position with GSM were performed in voice mode with 1 timeslot unless GPRS/EGPRS/DTM function allows parallel voice and data traffic on 2 or more timeslots.
5. UMTS was tested in RMC mode with 12.2 kbit/s and TPC bits set to 'all 1'.
6. WiFi was tested in 802.11b/g/n mode with 1 Mbit/s and 6 Mbit/s. According to KDB 248227 the SAR testing for 802.11g/n is not required since When the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is $\leq 1.2 \text{ W/kg}$.
7. Required WiFi test channels were selected according to KDB 248227
8. According to FCC KDB pub 248227 D01, When there are multiple test channels with the same measured maximum output power, the channel closest to mid-band frequency is selected for SAR measurement and when there are multiple test channels with the same measured maximum output power and equal separation from mid-band frequency; for example, high and low channels or two mid-band channels, the higher frequency (number) channel is selected for SAR measurement.
9. According to FCC KDB pub 941225 D06 this device has been tested with 10 mm distance to the phantom for operation in WiFi hot spot mode.
10. Per FCC KDB pub 941225 D06 the edges with antennas within 2.5 cm are required to be evaluated for SAR to cover WiFi hot spot function.
11. According to IEEE 1528 the SAR test shall be performed at middle channel. Testing of top and bottom channel is optional.
12. According to KDB 447498 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:
 - $\leq 0.8 \text{ W/kg}$ or 2.0 W/kg , for 1-g or 10-g respectively, when the transmission band is $\leq 100 \text{ MHz}$
 - $\leq 0.6 \text{ W/kg}$ or 1.5 W/kg , for 1-g or 10-g respectively, when the transmission band is between 100 MHz and 200 MHz
 - $\leq 0.4 \text{ W/kg}$ or 1.0 W/kg , for 1-g or 10-g respectively, when the transmission band is $\geq 200 \text{ MHz}$
13. IEEE 1528-2003 require the middle channel to be tested first. This generally applies to wireless devices that are designed to operate in technologies with tight tolerances for maximum output power variations across channels in the band.
14. Per KDB648474 D04 require when the reported SAR for a body-worn accessory, measured without a headset connected to the handset, is $< 1.2 \text{ W/kg}$.
15. Per KDB648474 D04 require when the separation distance required for body-worn accessory testing is larger than or equal to that tested for hotspot mode, using the same wireless mode test configuration for voice and data, such as UMTS, LTE and Wi-Fi, and for the same surface of the phone, the hotspot mode SAR data may be used to support body-worn accessory SAR compliance for that particular configuration (surface)

4.8. Measurement Uncertainty (300MHz-3GHz)

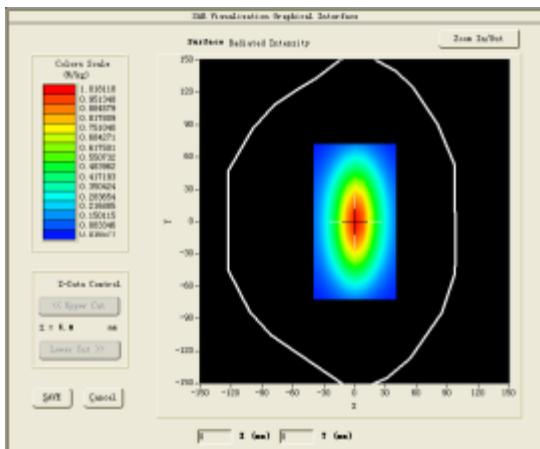
Not required as SAR measurement uncertainty analysis is required in SAR reports only when the highest measured SAR in a frequency band is $\geq 1.5 \text{ W/kg}$ for 1-g SAR according to KDB865664D01.

4.9. System Check Results

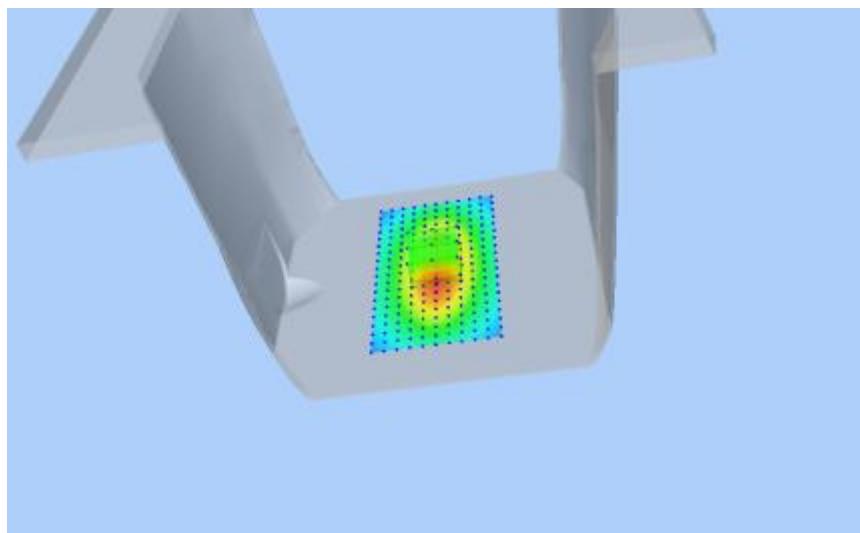
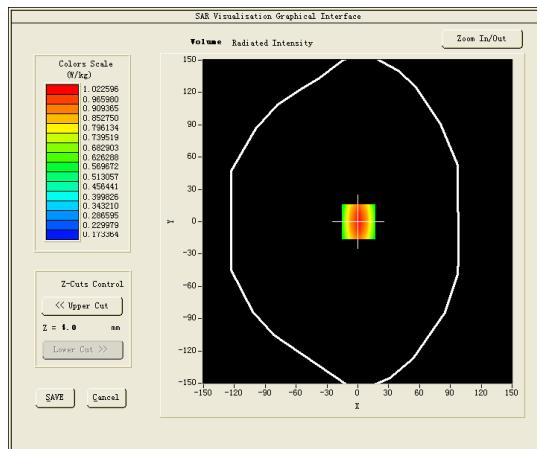
Test mode:835MHz(Head)
 Product Description:Validation
 Model:Dipole SID835
 E-Field Probe:SSE2(SN45/15 EPGO281)
 Test Date:May 23, 2018

| | |
|-----------------------------------|------------|
| Medium(liquid type) | HSL_850 |
| Frequency (MHz) | 835.000000 |
| Relative permittivity (real part) | 40.24 |
| Conductivity (S/m) | 0.88 |
| Input power | 100mW |
| Crest Factor | 1.0 |
| Conversion Factor | 2.04 |
| Variation (%) | 0.340000 |
| SAR 10g (W/Kg) | 0.636971 |
| SAR 1g (W/Kg) | 0.984290 |

SURFACE SAR



VOLUME SAR



Test mode:835MHz(Body)

Product Description:Validation

Model:Dipole SID835

E-Field Probe:SSE2(SN45/15 EPGO281)

Test Date:May 24, 2018

| | |
|-----------------------------------|-------------------|
| Medium(liquid type) | MSL_850 |
| Frequency (MHz) | 835.0000 |
| Relative permittivity (real part) | 54.67 |
| Conductivity (S/m) | 0.97 |
| Input power | 100mW |
| Crest Factor | 1.0 |
| Conversion Factor | 1.85 |
| Variation (%) | 1.3600000 |
| SAR 10g (W/Kg) | 0.635915 |
| SAR 1g (W/Kg) | 0.976885 |
| SURFACE SAR | VOLUME SAR |
| | |
| | |

Test mode:1900MHz(Head)

Product Description:Validation

Model :Dipole SID1900

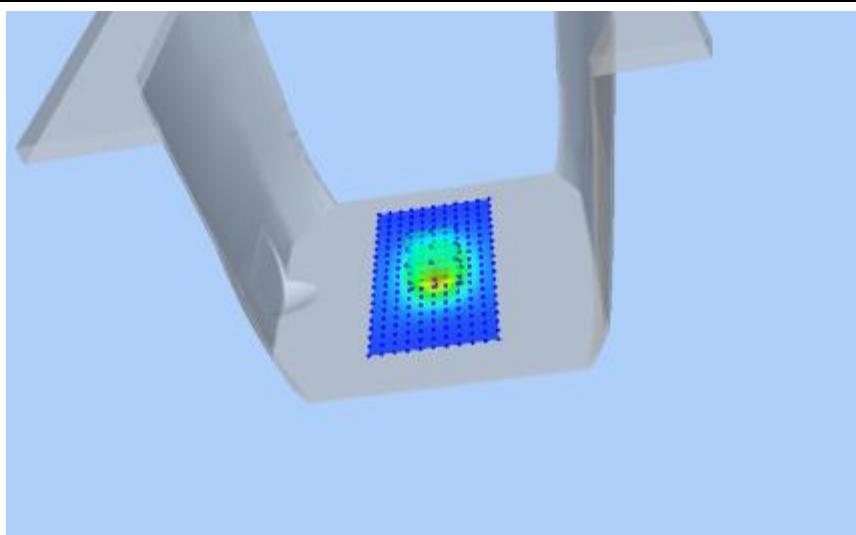
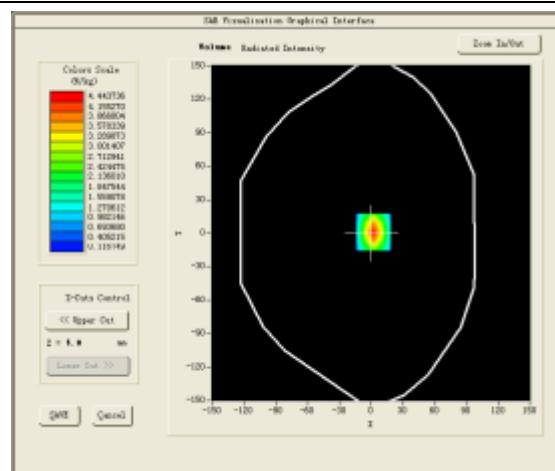
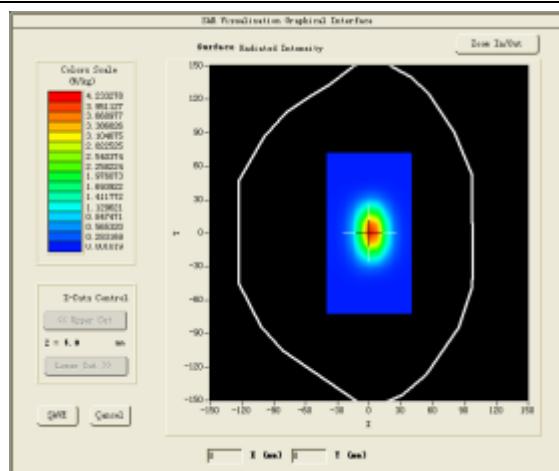
E-Field Probe:SSE2(SN45/15 EPGO281)

Test Date: May 25, 2018

| | |
|-----------------------------------|------------|
| Medium(liquid type) | HSL_1900 |
| Frequency (MHz) | 1900.0000 |
| Relative permittivity (real part) | 44.41 |
| Conductivity (S/m) | 1.43 |
| Input power | 100mW |
| Crest Factor | 1.0 |
| Conversion Factor | 2.10 |
| Variation (%) | -0.0500000 |
| SAR 10g (W/Kg) | 2.005804 |
| SAR 1g (W/Kg) | 3.927491 |

SURFACE SAR

VOLUME SAR



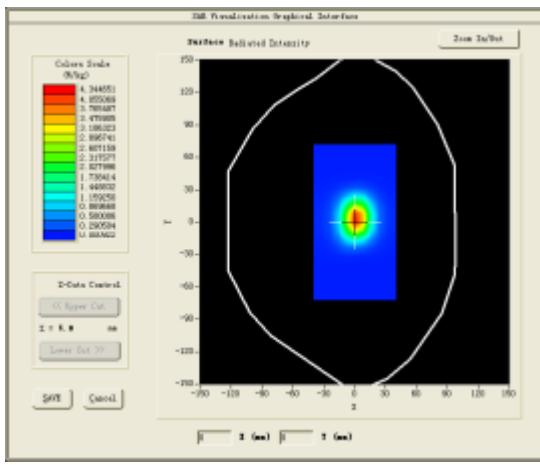
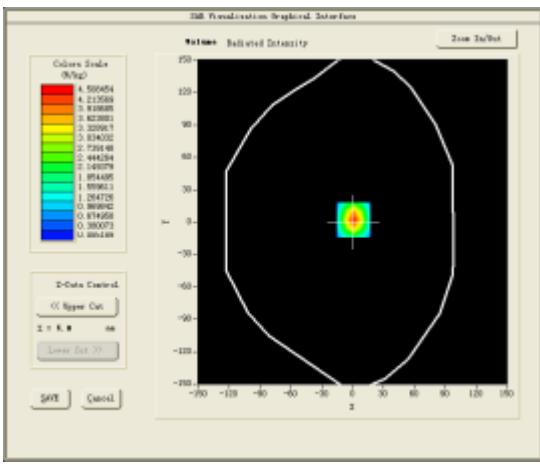
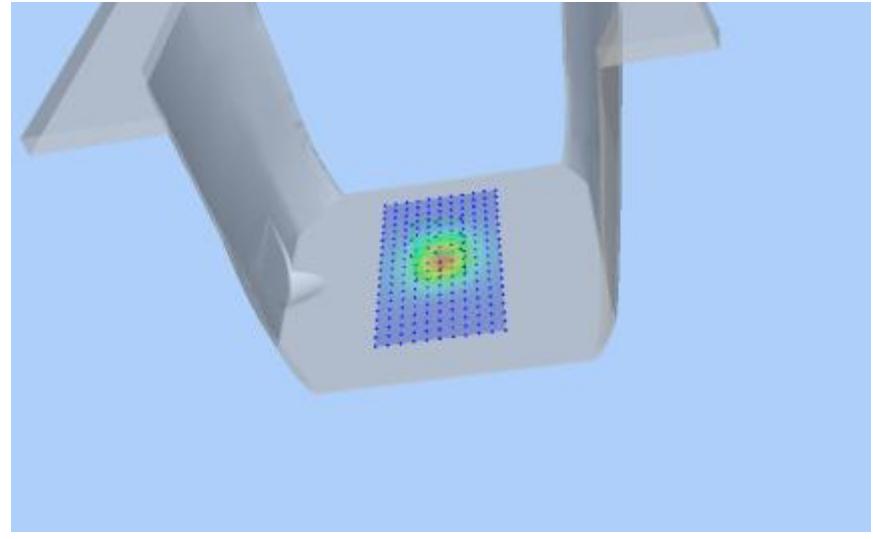
Test mode:1900MHz(Body)

Product Description:Validation

Model :Dipole SID1900

E-Field Probe:SSE2(SN45/15 EPGO281)

Test Date: May 26, 2018

| | |
|--|---|
| Medium(liquid type) | MSL_1900 |
| Frequency (MHz) | 1900.0000 |
| Relative permittivity (real part) | 55.75 |
| Conductivity (S/m) | 1.56 |
| Input power | 100mW |
| Crest Factor | 1.0 |
| Conversion Factor | 2.16 |
| Variation (%) | -1.400000 |
| SAR 10g (W/Kg) | 2.056478 |
| SAR 1g (W/Kg) | 4.117926 |
| SURFACE SAR | VOLUME SAR |
|  |  |
|  | |

4.10 SAR Test Graph Results

SAR plots for the highest measured SAR in each exposure configuration, wireless mode and frequency band combination according to FCC KDB 865664 D02;

#1

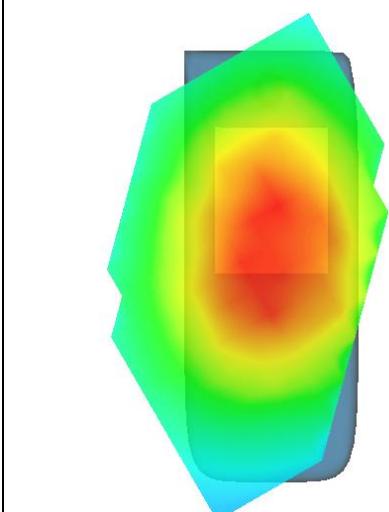
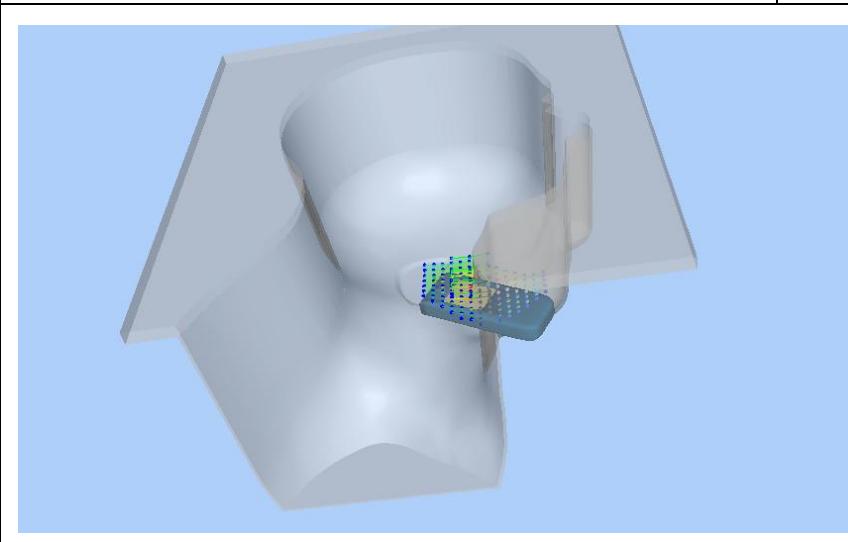
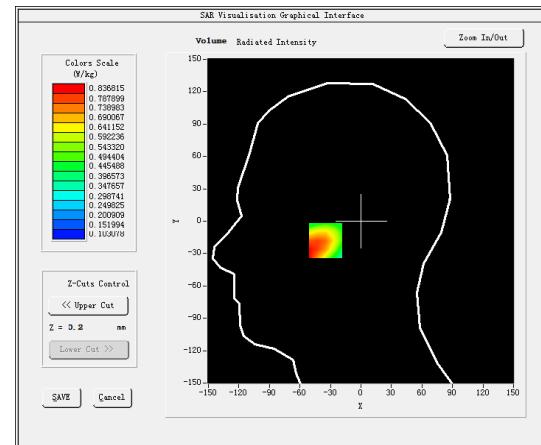
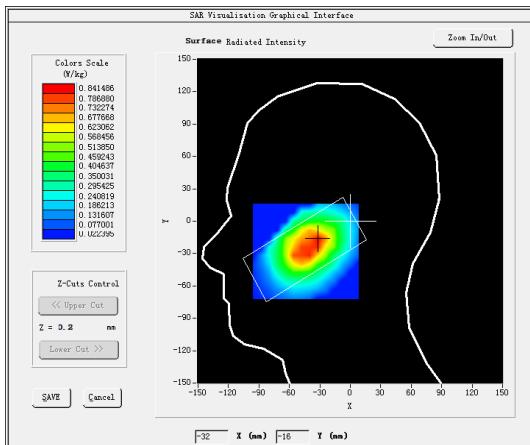
Test Mode:GSM 850MHz,Middle channel(Head Left Cheek)

Product Description:2G Mobile Phone

Model:S1

Test Date:May 23, 2018

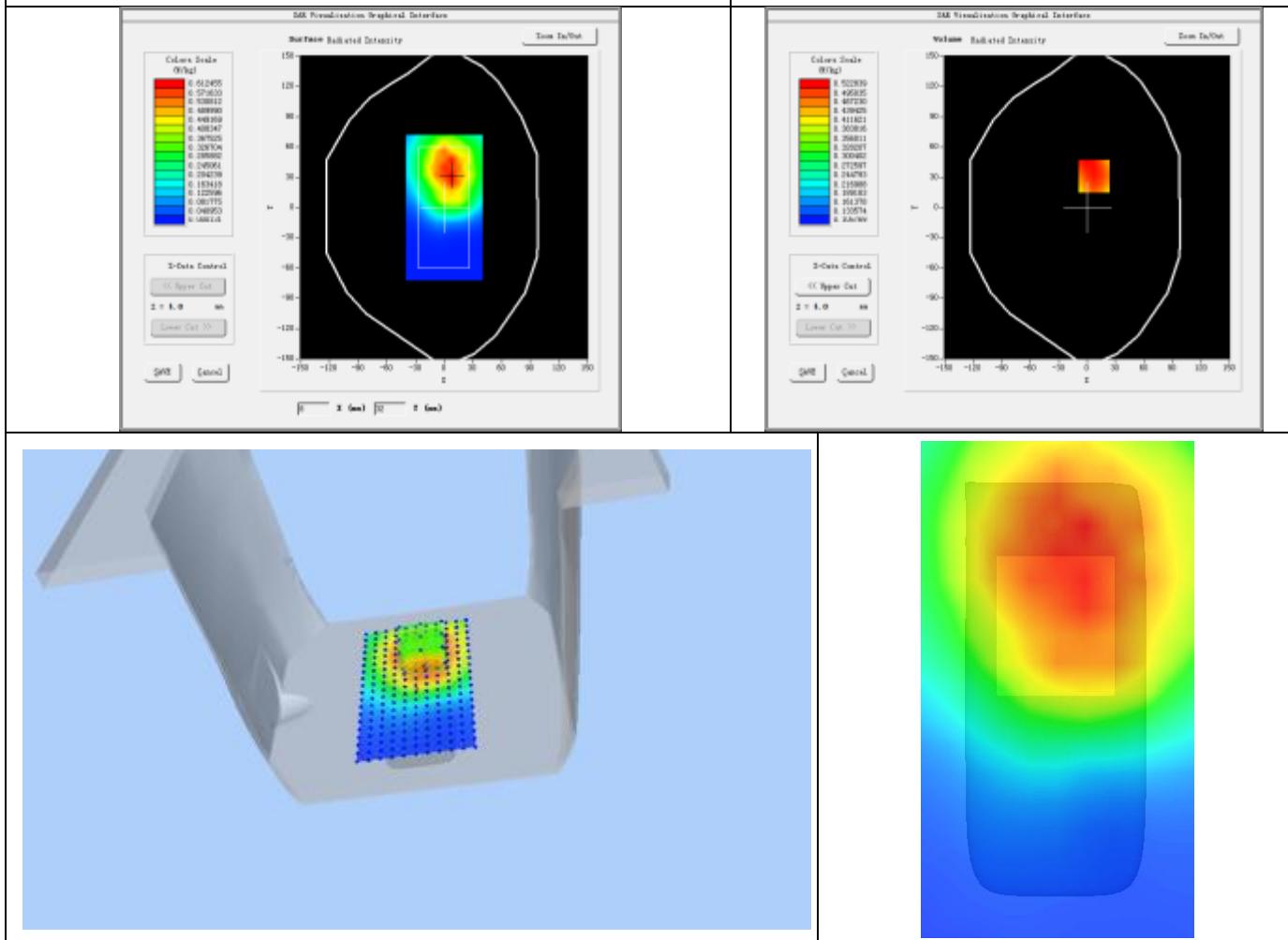
| | |
|-----------------------------------|----------------------------|
| Medium(liquid type) | MSL_850 |
| Frequency (MHz) | 848.80000 |
| Relative permittivity (real part) | 40.24 |
| Conductivity (S/m) | 0.88 |
| E-Field Probe | SN45/15 EPGO281 |
| Crest Factor | 2.67 |
| Conversion Factor | 1.78 |
| Sensor | 4mm |
| Area Scan | dx=8mm dy=8mm |
| Zoom Scan | 5x5x7,dx=8mm dy=8mm dz=5mm |
| Variation (%) | 4.79000 |
| SAR 10g (W/Kg) | 0.538975 |
| SAR 1g (W/Kg) | 0.781668 |
| SURFACE SAR | VOLUME SAR |



#2

Test Mode: GSM850MHz, Middle channel(Body Rear Side)
 Product Description:2G Mobile Phone
 Model:S1
 Test Date:May 24, 2018

| | |
|-----------------------------------|----------------------------|
| Medium(liquid type) | MSL_850 |
| Frequency (MHz) | 824.200000 |
| Relative permittivity (real part) | 54.67 |
| Conductivity (S/m) | 0.97 |
| E-Field Probe | SN45/15 EPGO281 |
| Crest Factor | 2.67 |
| Conversion Factor | 1.85 |
| Sensor | 4mm |
| Area Scan | dx=8mm dy=8mm |
| Zoom Scan | 5x5x7,dx=8mm dy=8mm dz=5mm |
| Variation (%) | 2.970000 |
| SAR 10g (W/Kg) | 0.678844 |
| SAR 1g (W/Kg) | 1.029205 |
| SURFACE SAR | VOLUME SAR |



#3

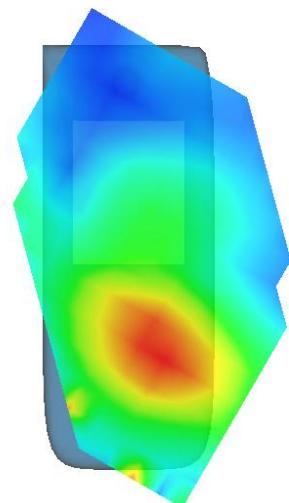
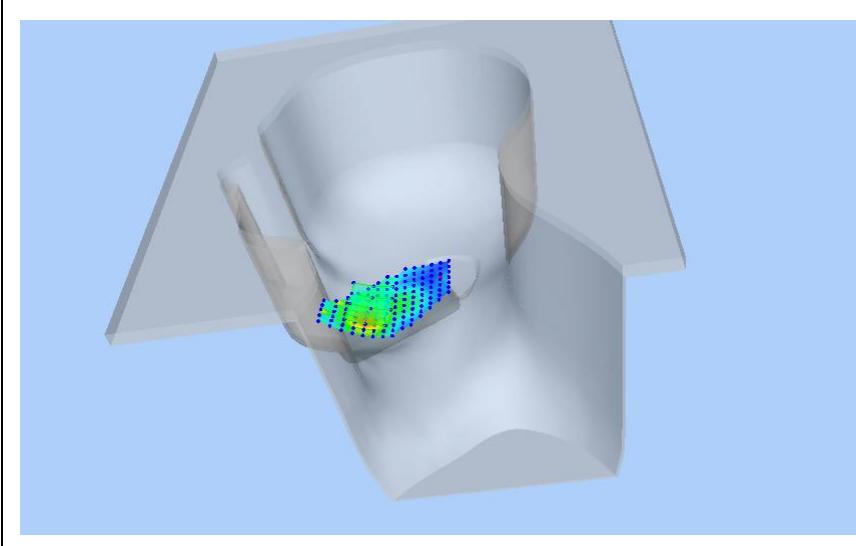
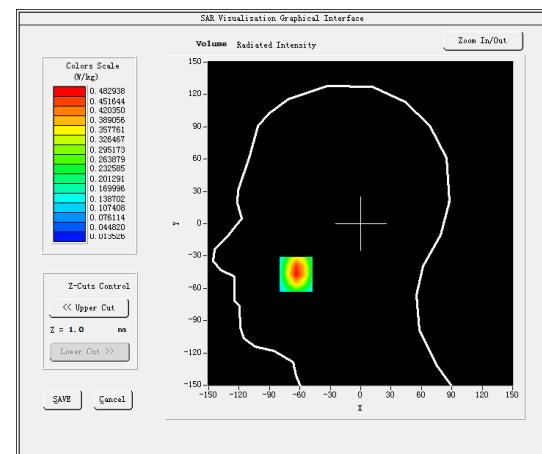
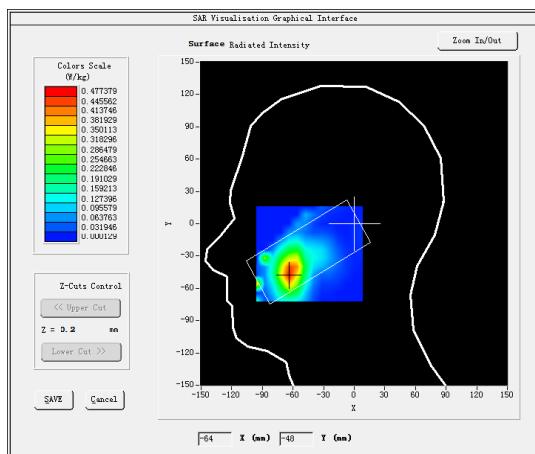
Test Mode:GSM 1900MHz,Middle channel(Head Right Cheek)

Product Description:2G Mobile Phone

Model:S1

Test Date:May 25, 2018

| | |
|-----------------------------------|----------------------------|
| Medium(liquid type) | MSL_1800 |
| Frequency (MHz) | 1880.00000 |
| Relative permittivity (real part) | 41.41 |
| Conductivity (S/m) | 1.43 |
| E-Field Probe | SN45/15 EPGO281 |
| Crest Factor | 2.67 |
| Conversion Factor | 1.83 |
| Sensor | 4mm |
| Area Scan | dx=8mm dy=8mm |
| Zoom Scan | 5x5x7,dx=8mm dy=8mm dz=5mm |
| Variation (%) | -3.850000 |
| SAR 10g (W/Kg) | 0.236449 |
| SAR 1g (W/Kg) | 0.455024 |

SURFACE SAR**VOLUME SAR**

#4

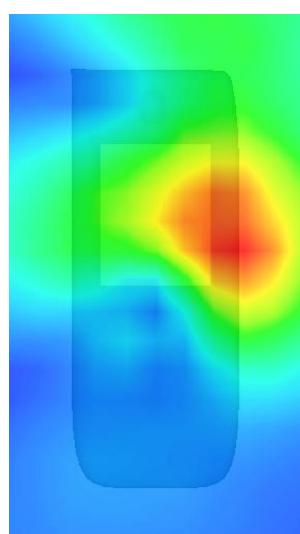
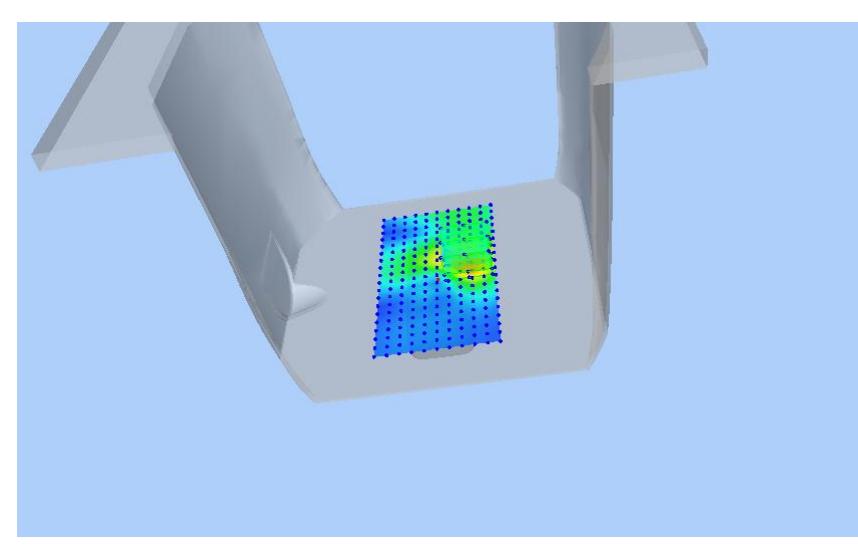
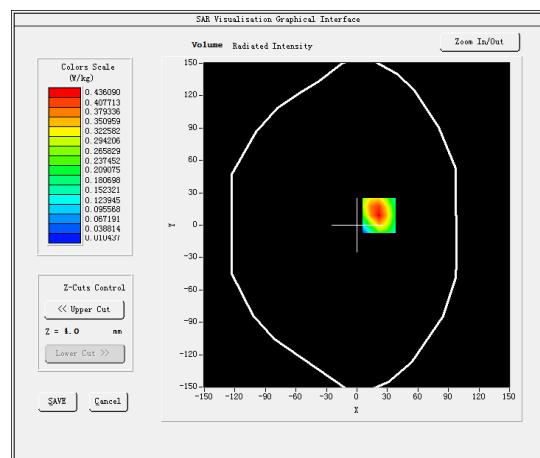
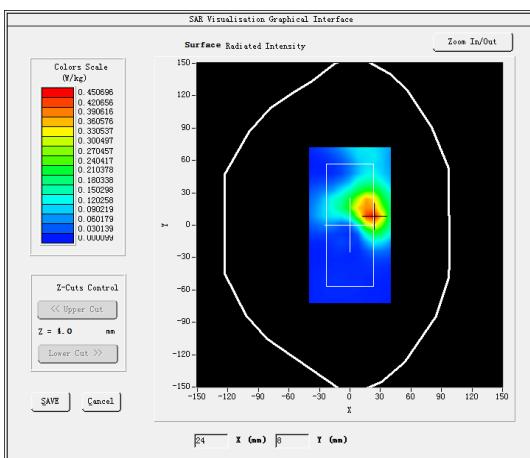
Test Mode: GPRS1900MHz,Middle channel(Body Rear Side)

Product Description:2G Mobile Phone

Model:S1

Test Date:May 26, 2018

| | |
|-----------------------------------|----------------------------|
| Medium(liquid type) | MSL_1800 |
| Frequency (MHz) | 1880.00000 |
| Relative permittivity (real part) | 55.75 |
| Conductivity (S/m) | 1.56 |
| E-Field Probe | SN45/15 EPGO281 |
| Crest Factor | 2.67 |
| Conversion Factor | 1.87 |
| Sensor | 4mm |
| Area Scan | dx=8mm dy=8mm |
| Zoom Scan | 5x5x7,dx=8mm dy=8mm dz=5mm |
| Variation (%) | -2.360000 |
| SAR 10g (W/Kg) | 0.251662 |
| SAR 1g (W/Kg) | 0.446233 |

SURFACE SAR**VOLUME SAR**

5. CALIBRATION CERTIFICATES

5.1 Probe-EPGO281 Calibration Certificate



COMOSAR E-Field Probe Calibration Report

Ref: ACR.348.1.15.SATU.A

**SHENZHEN LCS COMPLIANCE TESTING
LABORATORY LTD.**
**1F., XINGYUAN INDUSTRIAL PARK, TONGDA ROAD,
BAO'AN BLVD**
BAO'AN DISTRICT, SHENZHEN, GUANGDONG, CHINA
MVG COMOSAR DOSIMETRIC E-FIELD PROBE
SERIAL NO.: SN 45/15 EPGO281

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



Calibration Date: 02/04/2018

Summary:

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



COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.348.1.15.SATU.A

| | Name | Function | Date | Signature |
|---------------|---------------|-----------------|------------|-----------|
| Prepared by : | Jérôme LUC | Product Manager | 02/08/2018 | |
| Checked by : | Jérôme LUC | Product Manager | 02/08/2018 | |
| Approved by : | Kim RUTKOWSKI | Quality Manager | 02/08/2018 | |

| | |
|----------------|---|
| | Customer Name |
| Distribution : | Shenzhen LCS Compliance Testing Laboratory Ltd. |

| Issue | Date | Modifications |
|-------|------------|-----------------|
| A | 02/08/2018 | Initial release |
| | | |
| | | |
| | | |

Page: 2/10

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COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR-348.1.15.SATU.A

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COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.348.1.15.SATU.A

1 DEVICE UNDER TEST

| Device Under Test | |
|--|---|
| Device Type | COMOSAR DOSIMETRIC E FIELD PROBE |
| Manufacturer | MVG |
| Model | SSE2 |
| Serial Number | SN 45/15 EPGO281 |
| Product Condition (new / used) | New |
| Frequency Range of Probe | 0.45 GHz-6GHz |
| Resistance of Three Dipoles at Connector | Dipole 1: R1=0.186 MΩ Dipole 2: R2=0.194 MΩ Dipole 3: R3=0.191 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.

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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% |

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COMOSAR E-FIELD PROBE CALIBRATION REPORT

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

5 CALIBRATION MEASUREMENT RESULTS

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

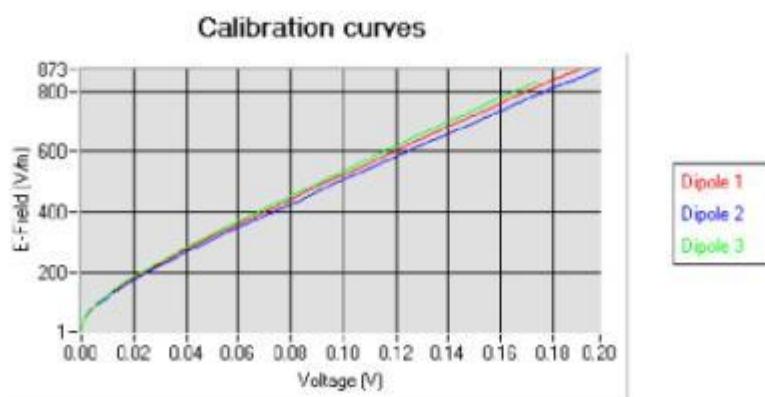
5.1 SENSITIVITY IN AIR

| Normx dipole 1 ($\mu\text{V}/(\text{V}/\text{m})^2$) | Normy dipole 2 ($\mu\text{V}/(\text{V}/\text{m})^2$) | Normz dipole 3 ($\mu\text{V}/(\text{V}/\text{m})^2$) |
|--|--|--|
| 0.77 | 0.83 | 0.67 |

| DCP dipole 1 (mV) | DCP dipole 2 (mV) | DCP dipole 3 (mV) |
|-------------------|-------------------|-------------------|
| 91 | 90 | 95 |

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

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



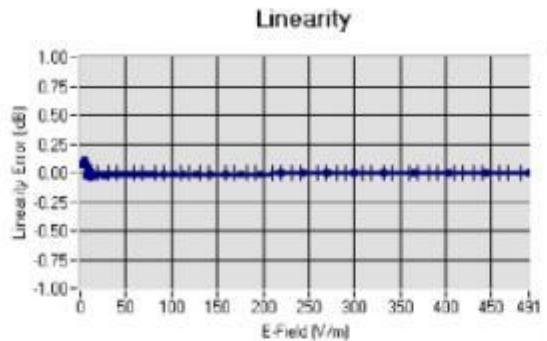
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COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR-348.1.15.SATU.A

5.2 LINEARITYLinearity +/- 2.60% (+/-0.11dB)**5.3 SENSITIVITY IN LIQUID**

| Liquid | Frequency (MHz +/- 100MHz) | Permittivity | Epsilon (S/m) | ConvF |
|--------|----------------------------------|--------------|---------------|-------|
| HL450 | 450 | 44.12 | 0.88 | 1.76 |
| BL450 | 450 | 58.92 | 1.00 | 1.81 |
| HL750 | 750 | 42.24 | 0.90 | 1.53 |
| BL750 | 750 | 56.85 | 0.99 | 1.59 |
| HL850 | 835 | 43.02 | 0.90 | 1.78 |
| BL850 | 835 | 53.72 | 0.98 | 1.85 |
| HL900 | 900 | 42.47 | 0.99 | 1.62 |
| BL900 | 900 | 56.97 | 1.09 | 1.67 |
| HL1800 | 1800 | 42.24 | 1.40 | 1.83 |
| BL1800 | 1800 | 53.53 | 1.53 | 1.87 |
| HL1900 | 1900 | 40.79 | 1.42 | 2.10 |
| BL1900 | 1900 | 54.47 | 1.57 | 2.16 |
| HL2000 | 2000 | 40.52 | 1.44 | 2.01 |
| BL2000 | 2000 | 54.18 | 1.56 | 2.09 |
| HL2450 | 2450 | 38.73 | 1.81 | 2.21 |
| BL2450 | 2450 | 53.23 | 1.96 | 2.28 |
| HL2600 | 2600 | 38.54 | 1.95 | 2.32 |
| BL2600 | 2600 | 52.07 | 2.23 | 2.38 |
| HL5200 | 5200 | 36.80 | 4.84 | 2.46 |
| BL5200 | 5200 | 51.21 | 5.16 | 2.52 |
| HL5400 | 5400 | 36.35 | 4.96 | 2.70 |
| BL5400 | 5400 | 50.51 | 5.70 | 2.79 |
| HL5600 | 5600 | 35.57 | 5.23 | 2.74 |
| BL5600 | 5600 | 49.83 | 5.91 | 2.83 |
| HL5800 | 5800 | 35.30 | 5.47 | 2.53 |
| BL5800 | 5800 | 49.03 | 6.28 | 2.60 |

LOWER DETECTION LIMIT: 9mW/kg

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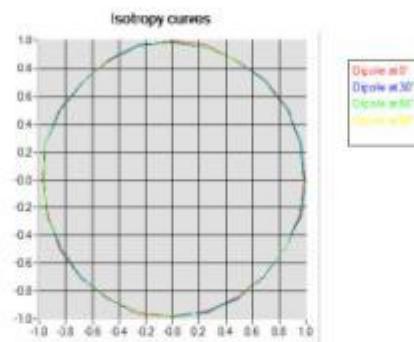


COMOSAR E-FIELD PROBE CALIBRATION REPORT

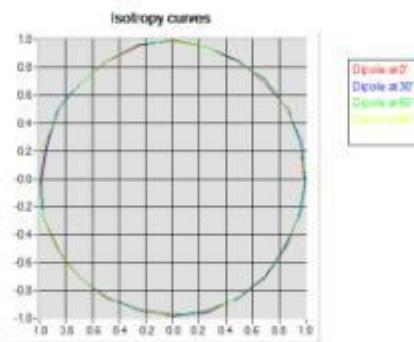
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5.4 ISOTROPY**HL900 MHz**

- Axial isotropy: 0.04 dB
- Hemispherical isotropy: 0.06 dB

**HL1800 MHz**

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



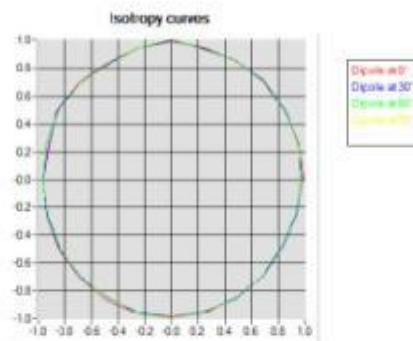


COMOSAR E-FIELD PROBE CALIBRATION REPORT

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HL5600 MHz

- Axial isotropy: 0.06 dB
- Hemispherical isotropy: 0.08 dB



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COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR-348.1.15.SATU.A

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 | 02/2018 | 02/2021 |
| Reference Probe | MVG | EP 94 SN 37/08 | 10/2017 | 10/2018 |
| Multimeter | Keithley 2000 | 1188656 | 12/2015 | 12/2018 |
| Signal Generator | Agilent E4438C | MY49070581 | 12/2015 | 12/2018 |
| Amplifier | Aethercomm | SN 046 | Characterized prior to test. No cal required. | Characterized prior to test. No cal required. |
| Power Meter | HP E4418A | US38261498 | 12/2015 | 12/2018 |
| Power Sensor | HP ECP-E26A | US37181460 | 12/2015 | 12/2018 |
| 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 | 10/2016 | 10/2018 |

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5.2 SID835Dipole Calibration Ceriticate



SAR Reference Dipole Calibration Report

Ref : ACR.287.4.14.SATU.A

**SHENZHEN LCS COMPLIANCE TESTING
LABORATORY LTD.**
**1F., XINGYUAN INDUSTRIAL PARK, TONGDA ROAD,
BAO'AN BLVD**
BAO'AN DISTRICT, SHENZHEN, GUANGDONG, CHINA
SATIMO COMOSAR REFERENCE DIPOLE
FREQUENCY: 835 MHZ
SERIAL NO.: SN 07/14 DIP 0G835-303

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



10/01/2015

Summary:

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



SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.287.4.14.SATU.A

| | Name | Function | Date | Signature |
|---------------|---------------|-----------------|------------|---------------|
| Prepared by : | Jérôme LUC | Product Manager | 10/14/2015 | |
| Checked by : | Jérôme LUC | Product Manager | 10/14/2015 | |
| Approved by : | Kim RUTKOWSKI | Quality Manager | 10/14/2015 | Kim Rutkowski |

| Distribution : | Customer Name |
|----------------|---|
| | Shenzhen LCS Compliance Testing Laboratory Ltd. |

| Issue | Date | Modifications |
|-------|------------|-----------------|
| A | 10/14/2015 | Initial release |
| | | |
| | | |
| | | |

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.287.4.14.SATU.A

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.287.4.14.SATU.A

1 INTRODUCTION

This document contains a summary of the requirements set forth by the IEEE 1528, OET 65 Bulletin C 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 | Satimo |
| Model | SID835 |
| Serial Number | SN 07/14 DIP 0G835-303 |
| Product Condition (new / used) | New |

A yearly calibration interval is recommended.

3 PRODUCT DESCRIPTION

3.1 GENERAL INFORMATION

Satimo's COMOSAR Validation Dipoles are built in accordance to the IEEE 1528, OET 65 Bulletin C and CEI/IEC 62209 standards. The product is designed for use with the COMOSAR test bench only.



Figure 1 – Satimo COMOSAR Validation Dipole



SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.287.4.14.SATU.A

4 MEASUREMENT METHOD

The IEEE 1528, OET 65 Bulletin C and CEI/IEC 62209 standards provide requirements for reference dipoles used for system validation measurements. The following measurements were performed to verify that the product complies with the fore mentioned standards.

4.1 RETURN LOSS REQUIREMENTS

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

4.2 MECHANICAL REQUIREMENTS

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

5 MEASUREMENT UNCERTAINTY

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

5.1 RETURN LOSS

The following uncertainties apply to the return loss measurement:

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

5.2 DIMENSION MEASUREMENT

The following uncertainties apply to the dimension measurements:

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

5.3 VALIDATION MEASUREMENT

The guidelines outlined in the IEEE 1528, OET 65 Bulletin C, CENELEC EN50361 and CEI/IEC 62209 standards were followed to generate the measurement uncertainty for validation measurements.

| Scan Volume | Expanded Uncertainty |
|-------------|----------------------|
| 1 g | 20.3 % |
| 10 g | 20.1 % |

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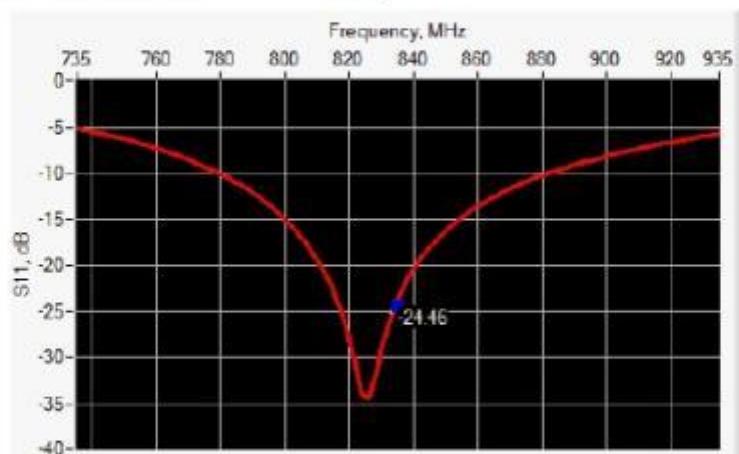


SAR REFERENCE DIPOLE CALIBRATION REPORT

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6 CALIBRATION MEASUREMENT RESULTS

6.1 RETURN LOSS AND IMPEDANCE



| Frequency (MHz) | Return Loss (dB) | Requirement (dB) | Impedance |
|-----------------|------------------|------------------|-----------------------------|
| 835 | -24.46 | -20 | $55.4 \Omega + 2.4 j\Omega$ |

6.2 MECHANICAL DIMENSIONS

| Frequency MHz | l mm | | h mm | | d mm | |
|---------------|-------------|----------|-------------|----------|------------|----------|
| | required | measured | required | measured | required | measured |
| 300 | 420.0 ±1 %. | | 250.0 ±1 %. | | 6.35 ±1 %. | |
| 450 | 290.0 ±1 %. | | 166.7 ±1 %. | | 6.35 ±1 %. | |
| 750 | 176.0 ±1 %. | | 100.0 ±1 %. | | 6.35 ±1 %. | |
| 835 | 161.0 ±1 %. | PASS | 89.8 ±1 %. | PASS | 3.6 ±1 %. | PASS |
| 900 | 149.0 ±1 %. | | 83.3 ±1 %. | | 3.6 ±1 %. | |
| 1450 | 89.1 ±1 %. | | 51.7 ±1 %. | | 3.6 ±1 %. | |
| 1500 | 80.5 ±1 %. | | 50.0 ±1 %. | | 3.6 ±1 %. | |
| 1640 | 79.0 ±1 %. | | 45.7 ±1 %. | | 3.6 ±1 %. | |
| 1750 | 75.2 ±1 %. | | 42.9 ±1 %. | | 3.6 ±1 %. | |
| 1800 | 72.0 ±1 %. | | 41.7 ±1 %. | | 3.6 ±1 %. | |
| 1900 | 68.0 ±1 %. | | 39.5 ±1 %. | | 3.6 ±1 %. | |
| 1950 | 66.3 ±1 %. | | 38.5 ±1 %. | | 3.6 ±1 %. | |
| 2000 | 64.5 ±1 %. | | 37.5 ±1 %. | | 3.6 ±1 %. | |
| 2100 | 61.0 ±1 %. | | 35.7 ±1 %. | | 3.6 ±1 %. | |
| 2300 | 55.5 ±1 %. | | 32.6 ±1 %. | | 3.6 ±1 %. | |
| 2450 | 51.5 ±1 %. | | 30.4 ±1 %. | | 3.6 ±1 %. | |
| 2600 | 48.5 ±1 %. | | 28.8 ±1 %. | | 3.6 ±1 %. | |
| 3000 | 41.5 ±1 %. | | 25.0 ±1 %. | | 3.6 ±1 %. | |
| 3500 | 37.0 ±1 %. | | 26.4 ±1 %. | | 3.6 ±1 %. | |
| 3700 | 34.7 ±1 %. | | 26.4 ±1 %. | | 3.6 ±1 %. | |

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7 VALIDATION MEASUREMENT

The IEEE Std. 1528, OET 65 Bulletin C and CEI/IEC 62209 standards state that the system validation measurements must be performed using a reference dipole meeting the fore mentioned return loss and mechanical dimension requirements. The validation measurement must be performed against a liquid filled flat phantom, with the phantom constructed as outlined in the fore mentioned standards. Per the standards, the dipole shall be positioned below the bottom of the phantom, with the dipole length centered and parallel to the longest dimension of the flat phantom, with the top surface of the dipole at the described distance from the bottom surface of the phantom.

7.1 HEAD LIQUID MEASUREMENT

| Frequency MHz | Relative permittivity (ϵ_r') | | Conductivity (σ) S/m | |
|------------------|---|----------|-------------------------------|----------|
| | required | measured | required | measured |
| 300 | 45.3 ±5 % | | 0.87 ±5 % | |
| 450 | 43.5 ±5 % | | 0.87 ±5 % | |
| 750 | 41.9 ±5 % | | 0.89 ±5 % | |
| 835 | 41.5 ±5 % | PASS | 0.90 ±5 % | PASS |
| 900 | 41.5 ±5 % | | 0.97 ±5 % | |
| 1450 | 40.5 ±5 % | | 1.20 ±5 % | |
| 1500 | 40.4 ±5 % | | 1.23 ±5 % | |
| 1640 | 40.2 ±5 % | | 1.31 ±5 % | |
| 1750 | 40.1 ±5 % | | 1.37 ±5 % | |
| 1800 | 40.0 ±5 % | | 1.40 ±5 % | |
| 1900 | 40.0 ±5 % | | 1.40 ±5 % | |
| 1950 | 40.0 ±5 % | | 1.40 ±5 % | |
| 2000 | 40.0 ±5 % | | 1.40 ±5 % | |
| 2100 | 39.8 ±5 % | | 1.49 ±5 % | |
| 2300 | 39.5 ±5 % | | 1.67 ±5 % | |
| 2450 | 39.2 ±5 % | | 1.80 ±5 % | |
| 2600 | 39.0 ±5 % | | 1.96 ±5 % | |
| 3000 | 38.5 ±5 % | | 2.40 ±5 % | |
| 3500 | 37.9 ±5 % | | 2.91 ±5 % | |

7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

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

| | |
|---|---|
| Software | OPENSAR V4 |
| Phantom | SN 20/09 SAM71 |
| Probe | SN 18/11 EPG122 |
| Liquid | Head Liquid Values: ϵ_r' : 42.3 sigma : 0.92 |
| Distance between dipole center and liquid | 15.0 mm |
| Area scan resolution | dx=8mm/dy=8mm |

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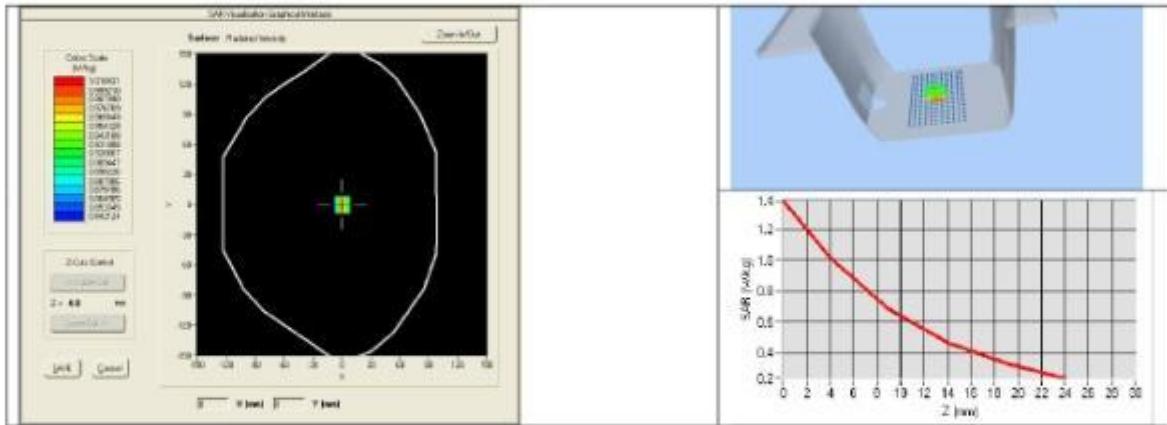


SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.287.4.14.SATU.A

| | |
|----------------------|---------------------|
| Zoon Scan Resolution | dx=8mm/dy=8m/dz=5mm |
| Frequency | 835 MHz |
| Input power | 20 dBm |
| Liquid Temperature | 21 °C |
| Lab Temperature | 21 °C |
| Lab Humidity | 45 % |

| Frequency MHz | 1 g SAR (W/kg/W) | | 10 g SAR (W/kg/W) | |
|------------------|------------------|-------------|-------------------|-------------|
| | required | measured | required | measured |
| 300 | 2.85 | | 1.94 | |
| 450 | 4.58 | | 3.06 | |
| 750 | 8.49 | | 5.55 | |
| 835 | 9.56 | 9.60 (0.96) | 6.22 | 6.20 (0.62) |
| 900 | 10.9 | | 6.99 | |
| 1450 | 29 | | 16 | |
| 1500 | 30.5 | | 16.8 | |
| 1640 | 34.2 | | 18.4 | |
| 1750 | 36.4 | | 19.3 | |
| 1800 | 38.4 | | 20.1 | |
| 1900 | 39.7 | | 20.5 | |
| 1950 | 40.5 | | 20.9 | |
| 2000 | 41.1 | | 21.1 | |
| 2100 | 43.6 | | 21.9 | |
| 2300 | 48.7 | | 23.3 | |
| 2450 | 52.4 | | 24 | |
| 2600 | 55.3 | | 24.6 | |
| 3000 | 63.8 | | 25.7 | |
| 3500 | 67.1 | | 25 | |



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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.287.4.14.SATU.A

7.3 BODY LIQUID MEASUREMENT

| Frequency MHz | Relative permittivity (ϵ_r') | | Conductivity (σ) S/m | |
|------------------|---|----------|-------------------------------|----------|
| | required | measured | required | measured |
| 150 | 61.9 ± 5 % | | 0.80 ± 5 % | |
| 300 | 58.2 ± 5 % | | 0.92 ± 5 % | |
| 450 | 56.7 ± 5 % | | 0.94 ± 5 % | |
| 750 | 55.5 ± 5 % | | 0.96 ± 5 % | |
| 835 | 55.2 ± 5 % | PASS | 0.97 ± 5 % | PASS |
| 900 | 55.0 ± 5 % | | 1.05 ± 5 % | |
| 915 | 55.0 ± 5 % | | 1.06 ± 5 % | |
| 1450 | 54.0 ± 5 % | | 1.30 ± 5 % | |
| 1610 | 53.8 ± 5 % | | 1.40 ± 5 % | |
| 1800 | 53.3 ± 5 % | | 1.52 ± 5 % | |
| 1900 | 53.3 ± 5 % | | 1.52 ± 5 % | |
| 2000 | 53.3 ± 5 % | | 1.52 ± 5 % | |
| 2100 | 53.2 ± 5 % | | 1.62 ± 5 % | |
| 2450 | 52.7 ± 5 % | | 1.95 ± 5 % | |
| 2600 | 52.5 ± 5 % | | 2.16 ± 5 % | |
| 3000 | 52.0 ± 5 % | | 2.73 ± 5 % | |
| 3500 | 51.3 ± 5 % | | 3.31 ± 5 % | |
| 5200 | 49.0 ± 10 % | | 5.30 ± 10 % | |
| 5300 | 48.9 ± 10 % | | 5.42 ± 10 % | |
| 5400 | 48.7 ± 10 % | | 5.53 ± 10 % | |
| 5500 | 48.6 ± 10 % | | 5.65 ± 10 % | |
| 5600 | 48.5 ± 10 % | | 5.77 ± 10 % | |
| 5800 | 48.2 ± 10 % | | 6.00 ± 10 % | |

7.4 SAR MEASUREMENT RESULT WITH BODY LIQUID

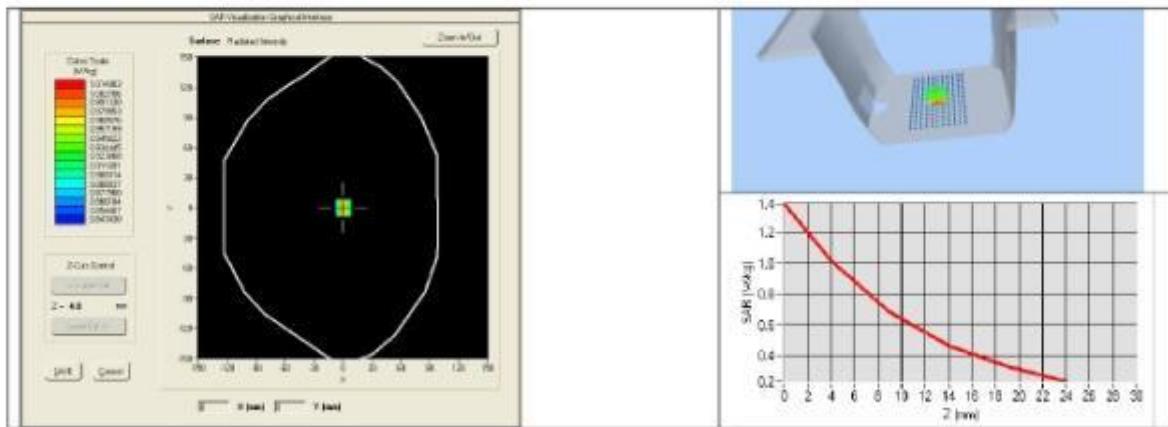
| | |
|---|---|
| Software | OPENSAR V4 |
| Phantom | SN 20/09 SAM71 |
| Probe | SN 18/11 EPG122 |
| Liquid | Body Liquid Values: $\epsilon_r' : 54.1$ sigma : 0.97 |
| Distance between dipole center and liquid | 15.0 mm |
| Area scan resolution | dx=8mm/dy=8mm |
| Zoon Scan Resolution | dx=8mm/dy=8m/dz=5mm |
| Frequency | 835 MHz |
| Input power | 20 dBm |
| Liquid Temperature | 21 °C |
| Lab Temperature | 21 °C |
| Lab Humidity | 45 % |



SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.287.4.14.SATU.A

| Frequency MHz | 1 g SAR (W/kg/W) | 10 g SAR (W/kg/W) |
|------------------|------------------|-------------------|
| | measured | measured |
| 835 | 9.90 (0.99) | 6.39 (0.64) |





SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.287.4.14.SATU.A

8 LIST OF EQUIPMENT

| Equipment Summary Sheet | | | | |
|---------------------------------|----------------------|--------------------|---|---|
| Equipment Description | Manufacturer / Model | Identification No. | Current Calibration Date | Next Calibration Date |
| SAM Phantom | Satimo | 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 | 02/2013 | 02/2016 |
| Calipers | Carrera | CALIPER-01 | 12/2013 | 12/2016 |
| Reference Probe | Satimo | EPG122 SN 18/11 | 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. |
| Temperature and Humidity Sensor | Control Company | 11-661-9 | 8/2013 | 8/2016 |

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5.3 SID1900 Dipole Calibration Certificate



COMOSAR E-Field Probe Calibration Report

Ref : ACR.262.8.14.SATU.A

**SHENZHEN LCS COMPLIANCE TESTING
LABORATORY LTD.**
**1F., XINGYUAN INDUSTRIAL PARK, TONGDA ROAD,
BAO'AN BLVD**
BAO'AN DISTRICT, SHENZHEN, GUANGDONG, CHINA
SATIMO COMOSAR DOSIMETRIC E-FIELD PROBE
FREQUENCY: 1900MHz
SERIAL NO.: SN 30/14 DIP1G900-333

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



10/01/2015

Summary:

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



COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.262.8.14.SATU.A

| | Name | Function | Date | Signature |
|---------------|---------------|-----------------|------------|-----------|
| Prepared by : | Jérôme LUC | Product Manager | 10/14/2015 | |
| Checked by : | Jérôme LUC | Product Manager | 10/14/2015 | |
| Approved by : | Kim RUTKOWSKI | Quality Manager | 10/14/2015 | |

| | Customer Name |
|----------------|---|
| Distribution : | Shenzhen LCS Compliance Testing Laboratory Ltd. |

| Issue | Date | Modifications |
|-------|------------|-----------------|
| A | 10/14/2015 | Initial release |
| | | |
| | | |
| | | |

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.262.8.14.SATU.A

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.262.8.14.SATU.A

1 INTRODUCTION

This document contains a summary of the requirements set forth by the IEEE 1528, OET 65 Bulletin C and CEI/IEC 62209 standards for reference dipoles used for SAR measurement system validations and the measurements that were performed to verify that the product complies with the fore mentioned standards.

2 DEVICE UNDER TEST

| Device Under Test | |
|--------------------------------|-----------------------------------|
| Device Type | COMOSAR 1900 MHz REFERENCE DIPOLE |
| Manufacturer | Satimo |
| Model | SID1900 |
| Serial Number | SN 30/14 DIP1G900-333 |
| Product Condition (new / used) | New |

A yearly calibration interval is recommended.

3 PRODUCT DESCRIPTION

3.1 GENERAL INFORMATION

Satimo's COMOSAR Validation Dipoles are built in accordance to the IEEE 1528, OET 65 Bulletin C and CEI/IEC 62209 standards. The product is designed for use with the COMOSAR test bench only.



Figure 1 – Satimo COMOSAR Validation Dipole



SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.262.8.14.SATU.A

4 MEASUREMENT METHOD

The IEEE 1528, OET 65 Bulletin C and CEI/IEC 62209 standards provide requirements for reference dipoles used for system validation measurements. The following measurements were performed to verify that the product complies with the fore mentioned standards.

4.1 RETURN LOSS REQUIREMENTS

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

4.2 MECHANICAL REQUIREMENTS

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

5 MEASUREMENT UNCERTAINTY

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

5.1 RETURN LOSS

The following uncertainties apply to the return loss measurement:

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

5.2 DIMENSION MEASUREMENT

The following uncertainties apply to the dimension measurements:

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

5.3 VALIDATION MEASUREMENT

The guidelines outlined in the IEEE 1528, OET 65 Bulletin C, CENELEC EN50361 and CEI/IEC 62209 standards were followed to generate the measurement uncertainty for validation measurements.

| Scan Volume | Expanded Uncertainty |
|-------------|----------------------|
| 1 g | 20.3 % |
| 10 g | 20.1 % |

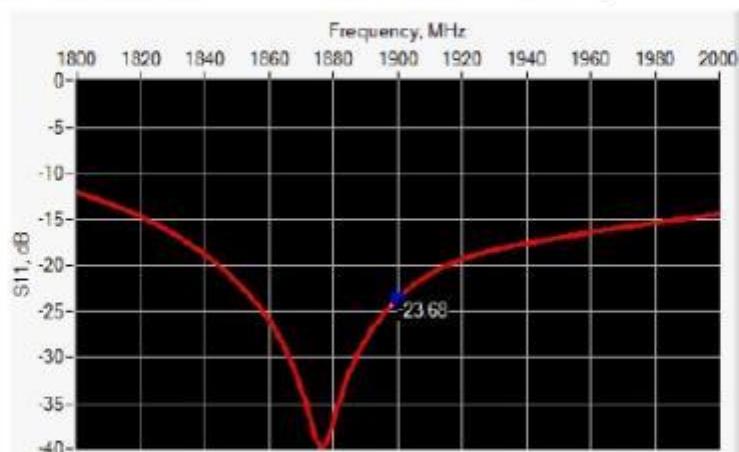
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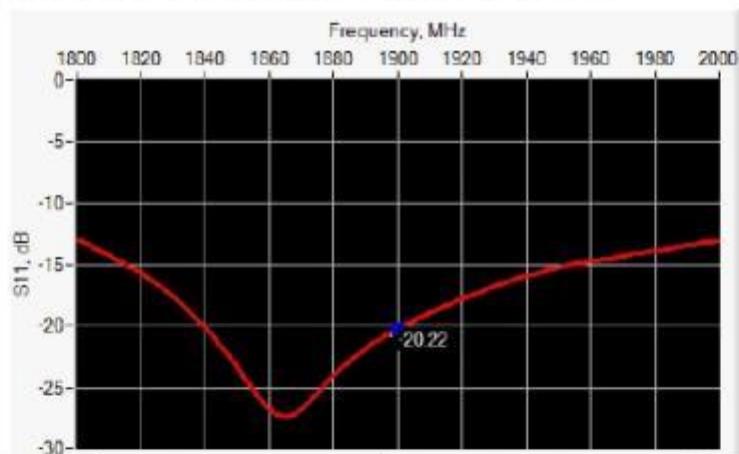


SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.262.8.14.SATU.A

6 CALIBRATION MEASUREMENT RESULTS**6.1 RETURN LOSS AND IMPEDANCE IN HEAD LIQUID**

| Frequency (MHz) | Return Loss (dB) | Requirement (dB) | Impedance |
|-----------------|------------------|------------------|-----------------------------|
| 1900 | -23.68 | -20 | $51.2 \Omega + 6.4 j\Omega$ |

6.2 RETURN LOSS AND IMPEDANCE IN BODY LIQUID

| Frequency (MHz) | Return Loss (dB) | Requirement (dB) | Impedance |
|-----------------|------------------|------------------|-----------------------------|
| 1900 | -20.22 | -20 | $48.8 \Omega + 9.6 j\Omega$ |

6.3 MECHANICAL DIMENSIONS

| Frequency MHz | L mm | | h mm | | d mm | |
|---------------|-------------------|----------|-------------------|----------|------------------|----------|
| | required | measured | required | measured | required | measured |
| 300 | 420.0 $\pm 1\%$. | | 250.0 $\pm 1\%$. | | 6.35 $\pm 1\%$. | |
| 450 | 290.0 $\pm 1\%$. | | 166.7 $\pm 1\%$. | | 6.35 $\pm 1\%$. | |
| 750 | 176.0 $\pm 1\%$. | | 100.0 $\pm 1\%$. | | 6.35 $\pm 1\%$. | |
| 835 | 161.0 $\pm 1\%$. | | 89.8 $\pm 1\%$. | | 3.6 $\pm 1\%$. | |

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Ref: ACR.262.8.14.SATU.A

| | | | | | | |
|------|------------------|------|-----------------|------|----------------|------|
| 900 | 149.0 \pm 1 %. | | 83.3 \pm 1 %. | | 3.6 \pm 1 %. | |
| 1450 | 89.1 \pm 1 %. | | 51.7 \pm 1 %. | | 3.6 \pm 1 %. | |
| 1500 | 80.5 \pm 1 %. | | 50.0 \pm 1 %. | | 3.6 \pm 1 %. | |
| 1640 | 79.0 \pm 1 %. | | 45.7 \pm 1 %. | | 3.6 \pm 1 %. | |
| 1750 | 75.2 \pm 1 %. | | 42.9 \pm 1 %. | | 3.6 \pm 1 %. | |
| 1800 | 72.0 \pm 1 %. | | 41.7 \pm 1 %. | | 3.6 \pm 1 %. | |
| 1900 | 68.0 \pm 1 %. | PASS | 39.5 \pm 1 %. | PASS | 3.6 \pm 1 %. | PASS |
| 1950 | 66.3 \pm 1 %. | | 38.5 \pm 1 %. | | 3.6 \pm 1 %. | |
| 2000 | 64.5 \pm 1 %. | | 37.5 \pm 1 %. | | 3.6 \pm 1 %. | |
| 2100 | 61.0 \pm 1 %. | | 35.7 \pm 1 %. | | 3.6 \pm 1 %. | |
| 2300 | 55.5 \pm 1 %. | | 32.6 \pm 1 %. | | 3.6 \pm 1 %. | |
| 2450 | 51.5 \pm 1 %. | | 30.4 \pm 1 %. | | 3.6 \pm 1 %. | |
| 2600 | 48.5 \pm 1 %. | | 28.8 \pm 1 %. | | 3.6 \pm 1 %. | |
| 3000 | 41.5 \pm 1 %. | | 25.0 \pm 1 %. | | 3.6 \pm 1 %. | |
| 3500 | 37.0 \pm 1 %. | | 26.4 \pm 1 %. | | 3.6 \pm 1 %. | |
| 3700 | 34.7 \pm 1 %. | | 26.4 \pm 1 %. | | 3.6 \pm 1 %. | |

7 VALIDATION MEASUREMENT

The IEEE Std. 1528, OET 65 Bulletin C and CEI/IEC 62209 standards state that the system validation measurements must be performed using a reference dipole meeting the fore mentioned return loss and mechanical dimension requirements. The validation measurement must be performed against a liquid filled flat phantom, with the phantom constructed as outlined in the fore mentioned standards. Per the standards, the dipole shall be positioned below the bottom of the phantom, with the dipole length centered and parallel to the longest dimension of the flat phantom, with the top surface of the dipole at the described distance from the bottom surface of the phantom.

7.1 HEAD LIQUID MEASUREMENT

| Frequency MHz | Relative permittivity (ϵ_r') | | Conductivity (σ) S/m | |
|------------------|---|----------|-------------------------------|----------|
| | required | measured | required | measured |
| 300 | 45.3 \pm 5 % | | 0.87 \pm 5 % | |
| 450 | 43.5 \pm 5 % | | 0.87 \pm 5 % | |
| 750 | 41.9 \pm 5 % | | 0.89 \pm 5 % | |
| 835 | 41.5 \pm 5 % | | 0.90 \pm 5 % | |
| 900 | 41.5 \pm 5 % | | 0.97 \pm 5 % | |
| 1450 | 40.5 \pm 5 % | | 1.20 \pm 5 % | |
| 1500 | 40.4 \pm 5 % | | 1.23 \pm 5 % | |
| 1640 | 40.2 \pm 5 % | | 1.31 \pm 5 % | |
| 1750 | 40.1 \pm 5 % | | 1.37 \pm 5 % | |
| 1800 | 40.0 \pm 5 % | | 1.40 \pm 5 % | |
| 1900 | 40.0 \pm 5 % | PASS | 1.40 \pm 5 % | PASS |
| 1950 | 40.0 \pm 5 % | | 1.40 \pm 5 % | |
| 2000 | 40.0 \pm 5 % | | 1.40 \pm 5 % | |

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.262.8.14.SATU.A

| | | | | |
|------|------------|--|------------|--|
| 2100 | 39.8 ± 5 % | | 1.49 ± 5 % | |
| 2300 | 39.5 ± 5 % | | 1.67 ± 5 % | |
| 2450 | 39.2 ± 5 % | | 1.80 ± 5 % | |
| 2600 | 39.0 ± 5 % | | 1.96 ± 5 % | |
| 3000 | 38.5 ± 5 % | | 2.40 ± 5 % | |
| 3500 | 37.9 ± 5 % | | 2.91 ± 5 % | |

7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

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

| | |
|---|---|
| Software | OPENSAR V4 |
| Phantom | SN 20/09 SAM71 |
| Probe | SN 18/11 EPG122 |
| Liquid | Head Liquid Values: $\epsilon\mu$: 41.1 sigma : 1.42 |
| Distance between dipole center and liquid | 10.0 mm |
| Area scan resolution | dx=8mm/dy=8mm |
| Zoon Scan Resolution | dx=8mm/dy=8m/dz=5mm |
| Frequency | 1900 MHz |
| Input power | 20 dBm |
| Liquid Temperature | 21 °C |
| Lab Temperature | 21 °C |
| Lab Humidity | 45 % |

| Frequency MHz | 1 g SAR (W/kg/W) | | 10 g SAR (W/kg/W) | |
|------------------|------------------|--------------|-------------------|--------------|
| | required | measured | required | measured |
| 300 | 2.85 | | 1.94 | |
| 450 | 4.58 | | 3.06 | |
| 750 | 8.49 | | 5.55 | |
| 835 | 9.56 | | 6.22 | |
| 900 | 10.9 | | 6.99 | |
| 1450 | 29 | | 16 | |
| 1500 | 30.5 | | 16.8 | |
| 1640 | 34.2 | | 18.4 | |
| 1750 | 36.4 | | 19.3 | |
| 1800 | 38.4 | | 20.1 | |
| 1900 | 39.7 | 39.84 (3.98) | 20.5 | 20.20 (2.02) |
| 1950 | 40.5 | | 20.9 | |
| 2000 | 41.1 | | 21.1 | |
| 2100 | 43.6 | | 21.9 | |
| 2300 | 48.7 | | 23.3 | |

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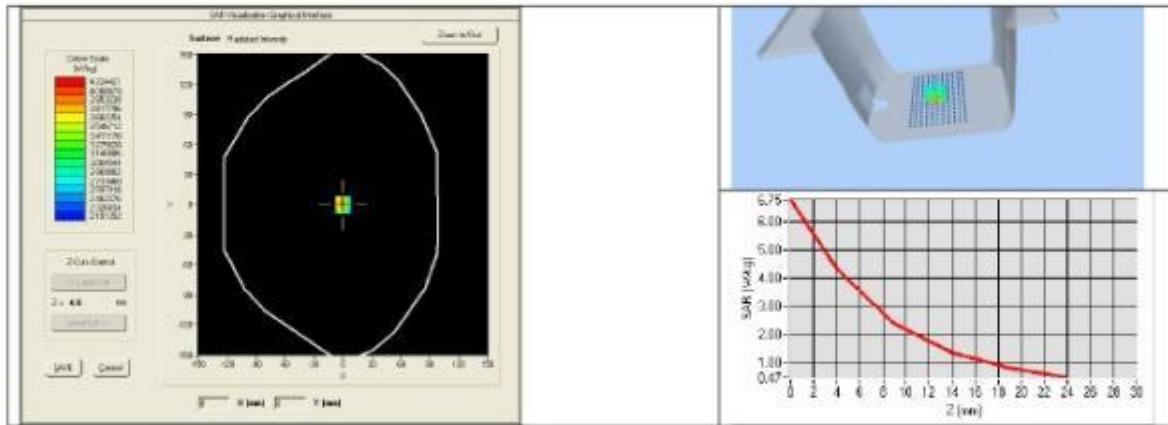
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Ref: ACR.262.8.14.SATU.A

| | | | | |
|------|------|--|------|--|
| 2450 | 52.4 | | 24 | |
| 2600 | 55.3 | | 24.6 | |
| 3000 | 63.8 | | 25.7 | |
| 3500 | 67.1 | | 25 | |



7.3 BODY LIQUID MEASUREMENT

| Frequency MHz | Relative permittivity (ϵ_r') | | Conductivity (σ) S/m | |
|------------------|---|----------|-------------------------------|----------|
| | required | measured | required | measured |
| 150 | 61.9 ± 5 % | | 0.80 ± 5 % | |
| 300 | 58.2 ± 5 % | | 0.92 ± 5 % | |
| 450 | 56.7 ± 5 % | | 0.94 ± 5 % | |
| 750 | 55.5 ± 5 % | | 0.96 ± 5 % | |
| 835 | 55.2 ± 5 % | | 0.97 ± 5 % | |
| 900 | 55.0 ± 5 % | | 1.05 ± 5 % | |
| 915 | 55.0 ± 5 % | | 1.06 ± 5 % | |
| 1450 | 54.0 ± 5 % | | 1.30 ± 5 % | |
| 1610 | 53.8 ± 5 % | | 1.40 ± 5 % | |
| 1800 | 53.3 ± 5 % | | 1.52 ± 5 % | |
| 1900 | 53.3 ± 5 % | PASS | 1.52 ± 5 % | PASS |
| 2000 | 53.3 ± 5 % | | 1.52 ± 5 % | |
| 2100 | 53.2 ± 5 % | | 1.62 ± 5 % | |
| 2450 | 52.7 ± 5 % | | 1.95 ± 5 % | |
| 2600 | 52.5 ± 5 % | | 2.16 ± 5 % | |
| 3000 | 52.0 ± 5 % | | 2.73 ± 5 % | |
| 3500 | 51.3 ± 5 % | | 3.31 ± 5 % | |
| 5200 | 49.0 ± 10 % | | 5.30 ± 10 % | |
| 5300 | 48.9 ± 10 % | | 5.42 ± 10 % | |
| 5400 | 48.7 ± 10 % | | 5.53 ± 10 % | |

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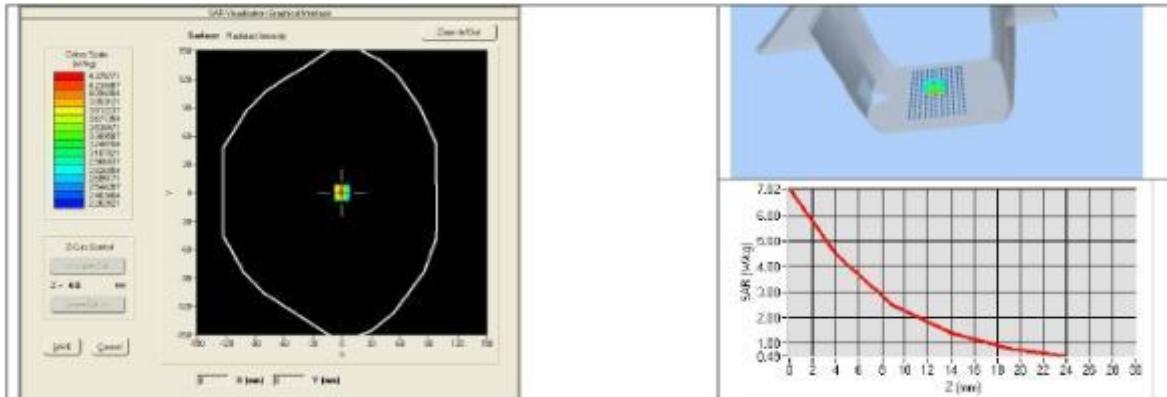
Ref: ACR.262.8.14.SATU.A

| | | | | |
|------|------------|--|------------|--|
| 5500 | 48.6 ±10 % | | 5.65 ±10 % | |
| 5600 | 48.5 ±10 % | | 5.77 ±10 % | |
| 5800 | 48.2 ±10 % | | 6.00 ±10 % | |

7.4 SAR MEASUREMENT RESULT WITH BODY LIQUID

| | |
|---|--|
| Software | OPENSAR V4 |
| Phantom | SN 20/09 SAM71 |
| Probe | SN 18/11 EPG122 |
| Liquid | Body Liquid Values: ϵ_r : 54.2 sigma : 1.54 |
| Distance between dipole center and liquid | 10.0 mm |
| Area scan resolution | $dx=8\text{mm}/dy=8\text{mm}$ |
| Zoon Scan Resolution | $dx=8\text{mm}/dy=8\text{m}/dz=5\text{mm}$ |
| Frequency | 1900 MHz |
| Input power | 20 dBm |
| Liquid Temperature | 21 °C |
| Lab Temperature | 21 °C |
| Lab Humidity | 45 % |

| Frequency MHz | 1 g SAR (W/kg/W) | 10 g SAR (W/kg/W) |
|------------------|------------------|-------------------|
| | measured | measured |
| 1900 | 43.33 (4.33) | 21.59 (2.16) |





SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.262.8.14.SATU.A

8 LIST OF EQUIPMENT

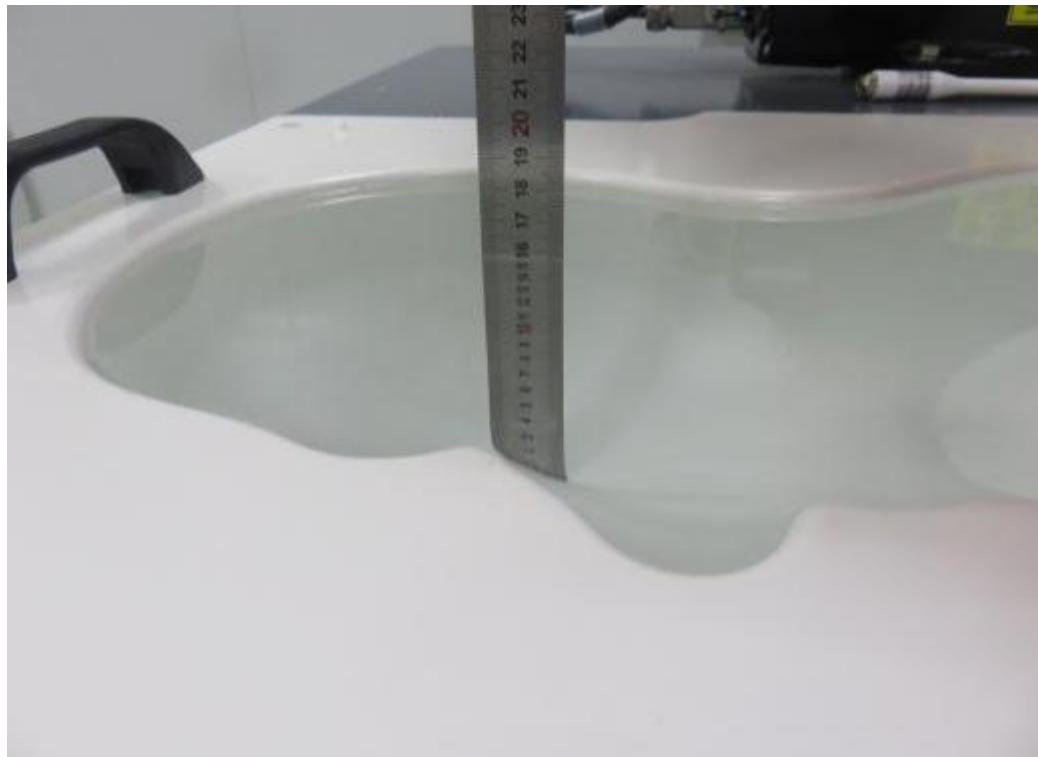
| Equipment Summary Sheet | | | | |
|---------------------------------|----------------------|--------------------|---|---|
| Equipment Description | Manufacturer / Model | Identification No. | Current Calibration Date | Next Calibration Date |
| SAM Phantom | Satimo | SN-20/09-SAM71 | Validated. No 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 | 02/2013 | 02/2016 |
| Calipers | Carrera | CALIPER-01 | 12/2013 | 12/2016 |
| Reference Probe | Satimo | EPG122 SN 18/11 | 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. |
| Temperature and Humidity Sensor | Control Company | 11-661-9 | 8/2013 | 8/2016 |

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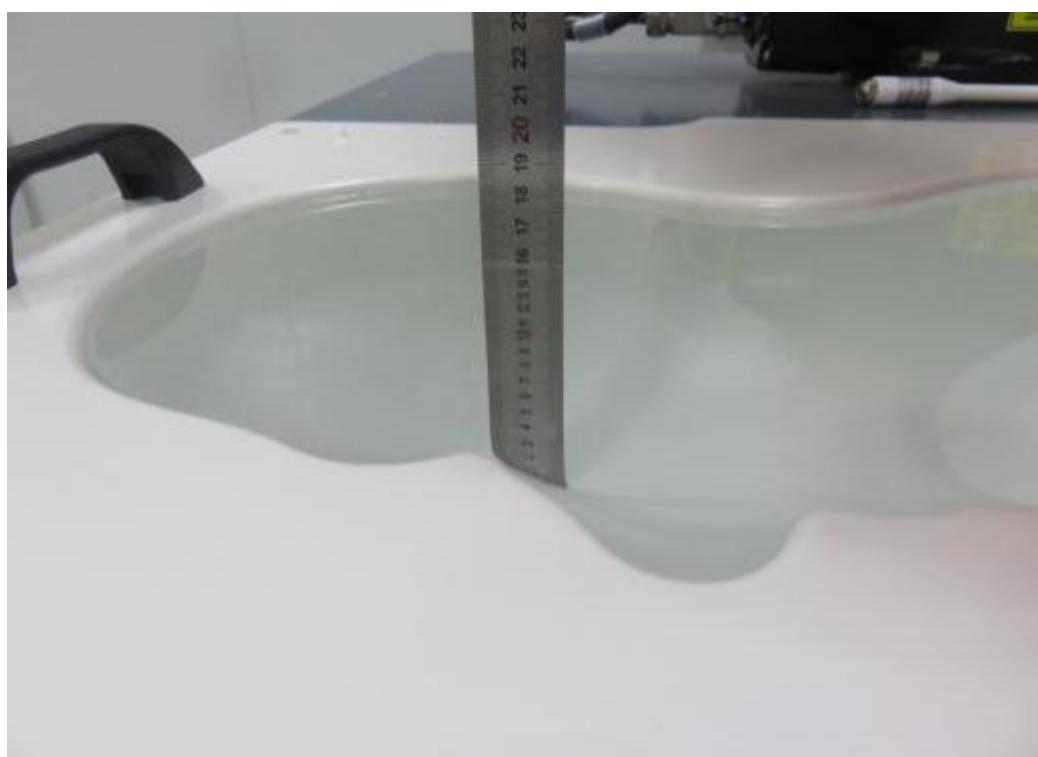
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6. EUT TEST PHOTOGRAPHS

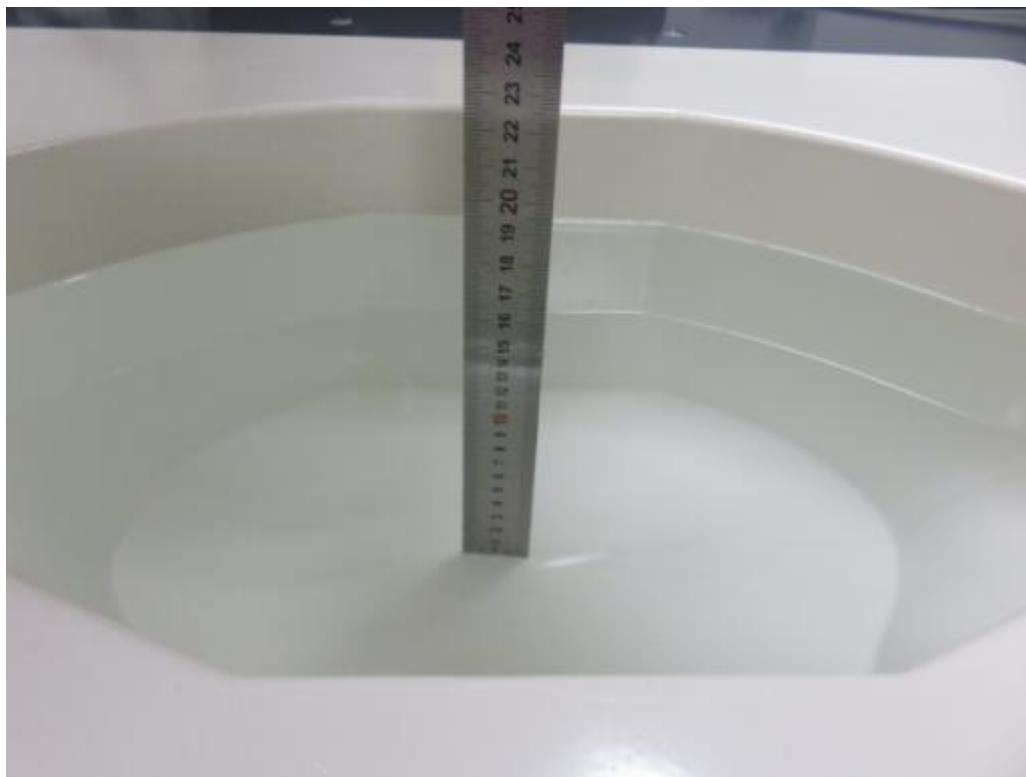
6.1 Photograph of liquiddepth



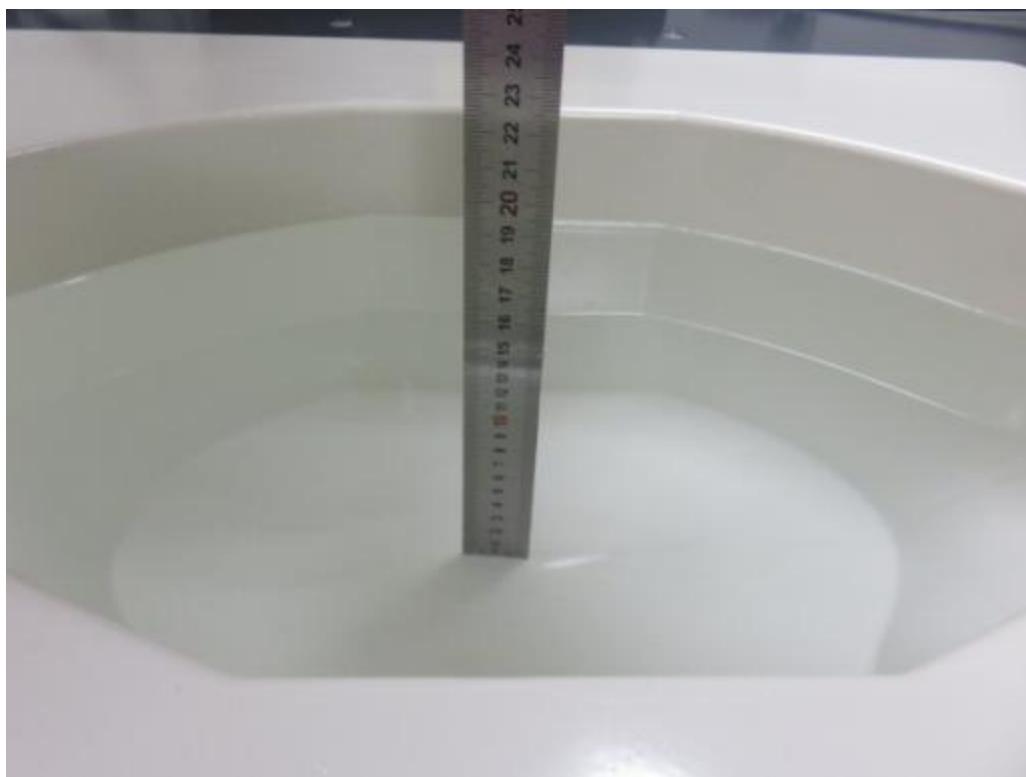
Photograph of the depth in the Head Phantom (835MHz, 15.8cm depth)



Photograph of the depth in the Head Phantom (1800MHz, 15.8cm depth)



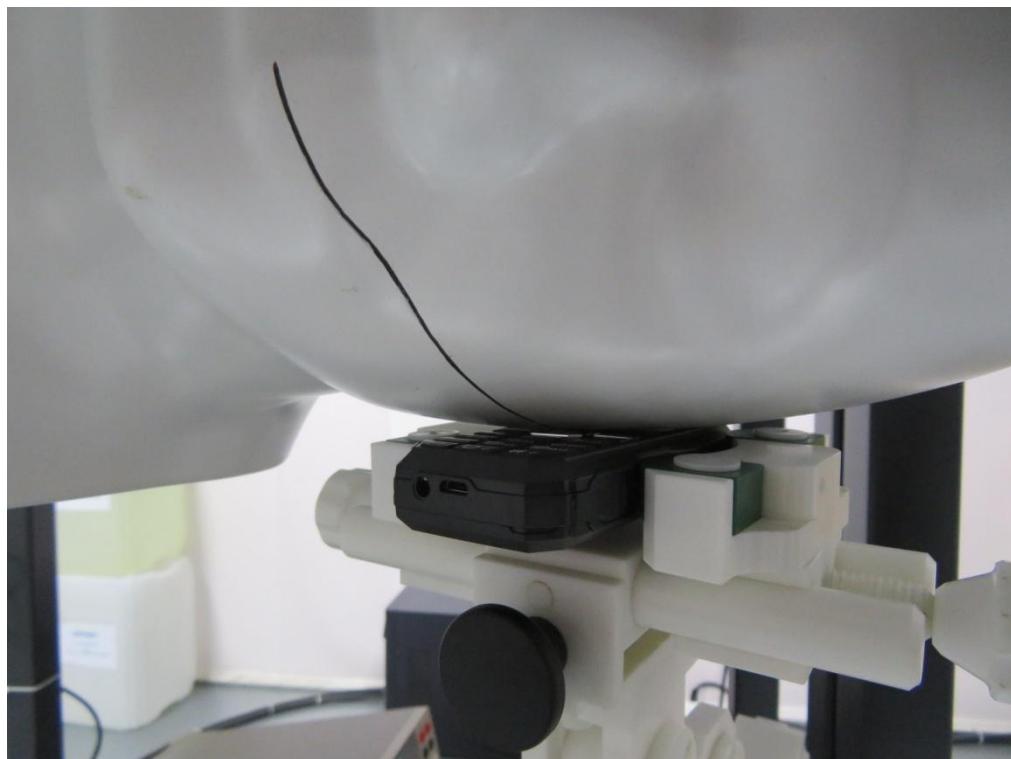
Photograph of the depth in the Body Phantom (835MHz, 16.1cm depth)



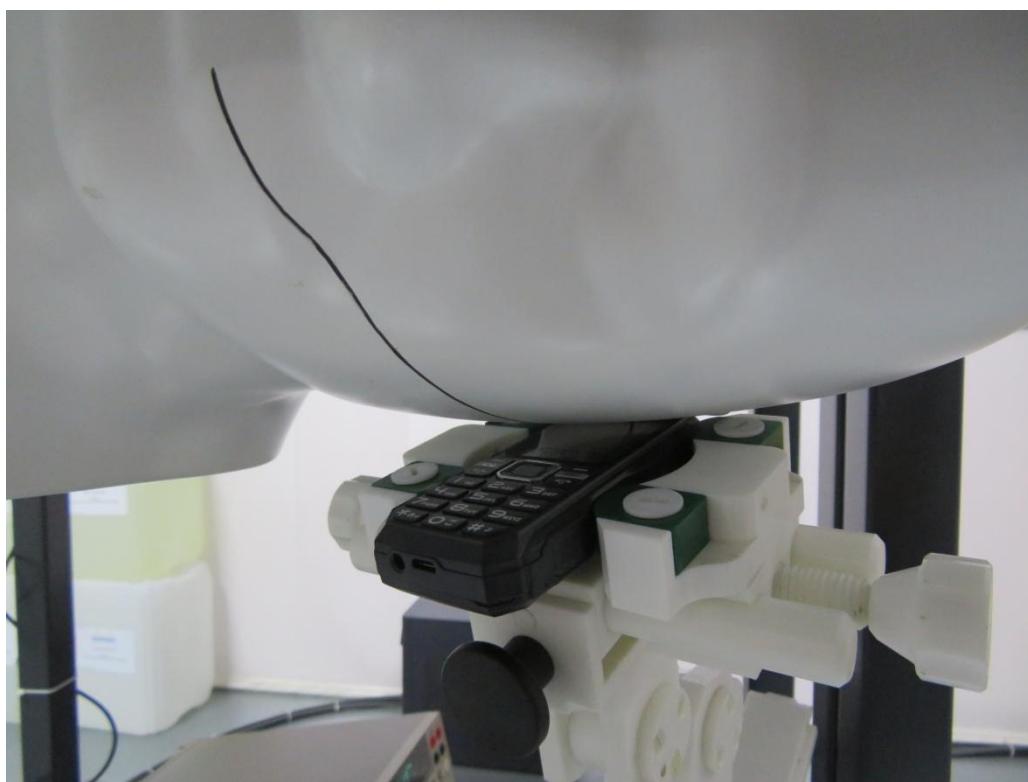
Photograph of the depth in the Body Phantom (1800MHz, 16.0cm depth)

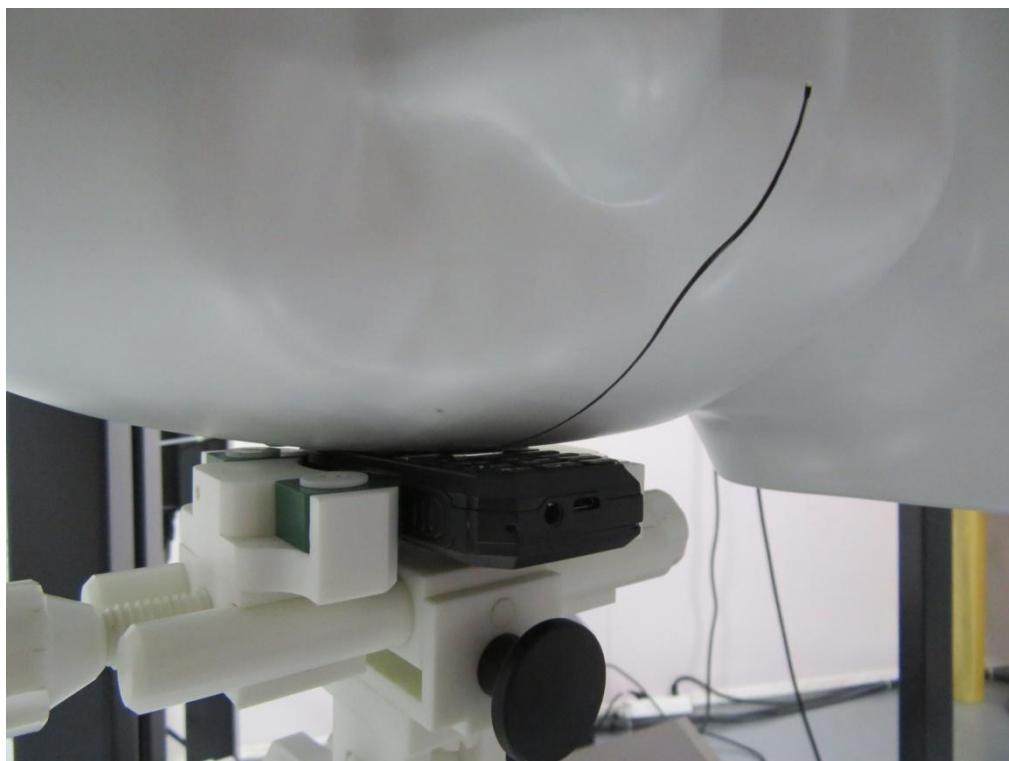
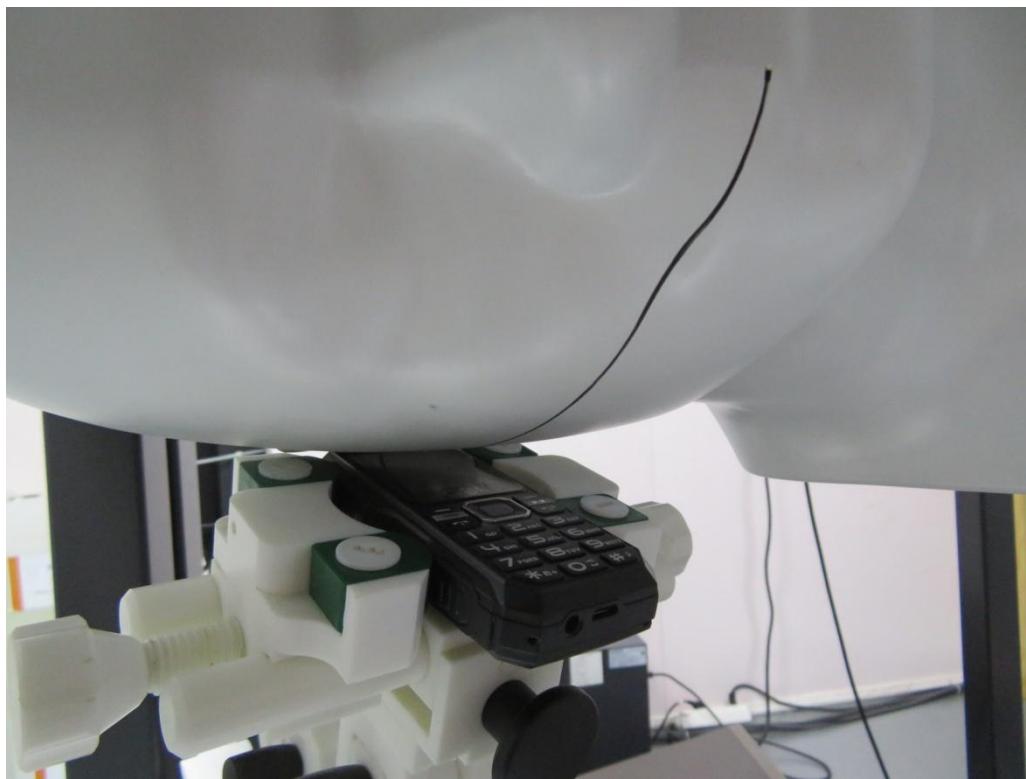
6.2Photograph of the Test

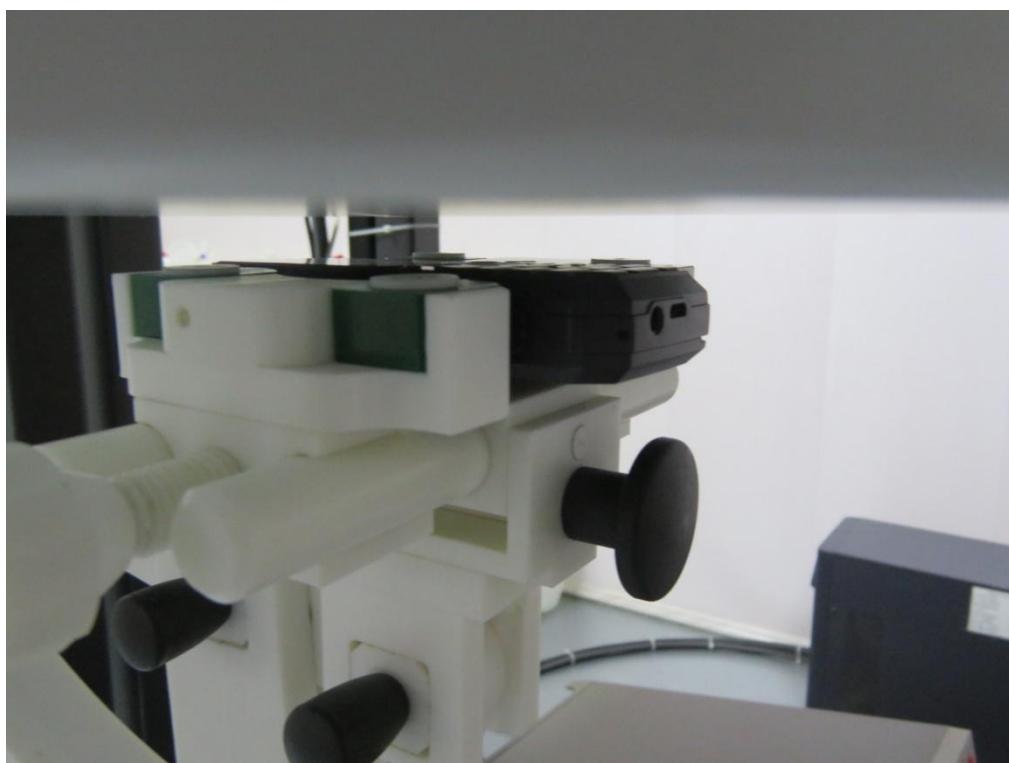
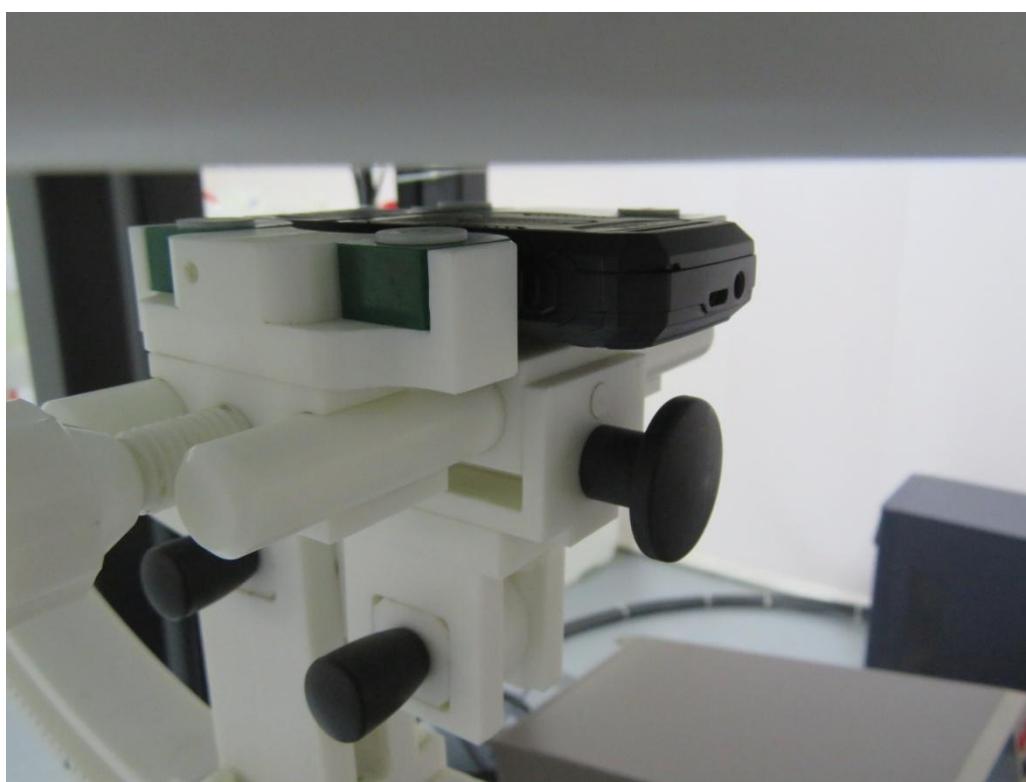
Head Setup Photo(Left Cheek)



Head Setup Photo(Left Tilt)



Head Setup Photo (Right Cheek)**Head Setup Photo(Right Tilt)**

10mm body-worn Back Side Setup Photo**10mm body-worn Front Side Setup Photo**

7. EUT Photographs



.....The End of Test Report.....