# COLLAGE INVESTMENTS LLC

## Mobile phone

**Model: LK100**
**Serial Model: NA**

**March 30th, 2013**
**Report No.: 13050009-FCC-H**
(This report supersedes NONE)

**Modifications made to the product : None**

| This Test Report is Issued Under the Authority of: | | |
|---|---|---|
| Chris You | Alex Liu | |
| Chris You<br>Test Engineer | Alex Liu<br>Technical Manager | |

This test report may be reproduced in full only.
All Test Data Presented in this report is only applicable to presented Test sample.

# SAR Test Report

To: C95.1 , IEEE 1528 , OET Bulletin 65 Suppl. C , IEC 62209-2, RSS 102 and Safety Code 6

SIEMIC, INC.
Accessing global markets

# Laboratory Introduction

SIEMIC, headquartered in the heart of Silicon Valley, with superior facilities in US and Asia, is one of the leading independent testing and certification facilities providing customers with one-stop shop services for Compliance Testing and Global Certifications.

In addition to testing and certification, SIEMIC provides initial design reviews and compliance management through out a project. Our extensive experience with China, Asia Pacific, North America, European, and international compliance requirements, assures the fastest, most cost effective way to attain regulatory compliance for the global markets.

## Accreditations for Conformity Assessment

| Country/Region | Accreditation Body | Scope |
|---|---|---|
| USA | FCC, A2LA | EMC , RF/Wireless , Telecom |
| Canada | IC, A2LA, NIST | EMC, RF/Wireless , Telecom |
| Taiwan | BSMI , NCC , NIST | EMC, RF, Telecom , Safety |
| Hong Kong | OFTA , NIST | RF/Wireless ,Telecom |
| Australia | NATA, NIST | EMC, RF, Telecom , Safety |
| Korea | KCC/RRA, NIST | EMI, EMS, RF , Telecom, Safety |
| Japan | VCCI, JATE, TELEC, RFT | EMI, RF/Wireless, Telecom |
| Mexico | NOM, COFETEL, Caniety | Safety, EMC , RF/Wireless, Telecom |
| Europe | A2LA, NIST | EMC, RF, Telecom , Safety |

## Accreditations for Product Certifications

| Country | Accreditation Body | Scope |
|---|---|---|
| USA | FCC TCB, NIST | EMC , RF , Telecom |
| Canada | IC FCB , NIST | EMC , RF , Telecom |
| Singapore | iDA, NIST | EMC , RF , Telecom |
| EU | NB, NIST | EMC,RF,Safety,Telecom |

This page has been left blank intentionally.

CONTENTS

1 EXECUTIVE SUMMARY & EUT INFORMATION....6

2 TECHNICAL DETAILS....7

3 INTRODUCTION....8

4 SAR MEASUREMENT SETUP....9

5 ANSI/IEEE C95.1 – 1999 RF EXPOSURE LIMIT....20

6 SYSTEM AND LIQUID VALIDATION....21

7 UNCERTAINTY ASSESSMENT....28

8 TEST INSTRUMENT....31

9 OUTPUT POWER VERIFICATION....32

10 SAR TEST RESULTS....34

11 SAR MEASUREMENT REFERENCES....39

ANNEX A CALIBRATION REPORTS....100

ANNEX B SAR SYSTEM PHOTOGRAPHS....131

ANNEX C SETUP PHOTOGRAPHS....132

ANNEX D EUT PHOTOGRAPHS....135

This page has been left blank intentionally.

# 1 Executive Summary & EUT information

The purpose of this test programmed was to demonstrate compliance of the COLLAGE INVESTMENTS LLC. Model: LK100 against the current Stipulated Standards. The Mobile phone has demonstrated compliance with the C95.1, IEEE 1528, OET Bulletin 65 Supplement C , IEC62209-2, RSS-102 Issue 4 and Safety Code 6. The test has demonstrated that this unit complies with stipulated standards.

| EUT Information | |
|---|---|
| **EUT Description** | Mobile phone |
| **Model No** | LK100 |
| **Input Power** | Li-ion Battery<br>Model: LK100<br>Charging Voltage:3.7V , 500mAh<br>Charge Cut-off Voltage: 4.2 V |
| **Maximum Conducted Output Power to Antenna** | Cellular 850(Class 4) : 1.496W (31.75dBm)<br>PCS1900 (Class 1) : 0.748W (28.74dBm) |
| **Highest Reported SAR Level(s)** | 0.95W/Kg 1g Head Tissue (Cellular Band)<br>0.59W/Kg 1g Body Tissue (Cellular Band)<br>1.24W/Kg 1g Head Tissue (PCS Band)<br>0.26W/Kg 1g Body Tissue (PCS Band) |
| **Classification Per Stipulated Test Standard** | Mobile Device , Class B, No GPRS/DTM/Hotspot Mode |
| **Multi-SIM** | SIM 1 and SIM 2 is a chipset unit and tested as single chipset |
| **Co-located TX** | WWAN can transmit simultaneously with Bluetooth |
| **Antenna Separation distances** | 0.5 cm - WWAN antenna-to-Bluetooth antenna |
| **Antenna Type(s)** | PIFA Antenna(GSM) |
| **Accessory** | Earphone |

| **Equipment Class** | **Highest Reported SAR ( W/kg)** | | | |
|---|---|---|---|---|
| | Head | Body-worn | Hotspot | Simultaneous sum SAR |
| GSM/PCE | 1.24 | 0.59 | NA | 1.57 |

# 2 TECHNICAL DETAILS

| | |
|---|---|
| Purpose | Compliance testing of Mobile phone model LK100 with stipulated standard |
| Applicant / Client | COLLAGE INVESTMENTS LLC.<br>11437 NW 34 STREET, DORAL, FLORIDA 33178 U.S.A |
| Manufacturer | NINGBO BIRD CO., LTD.<br>No.999 Dacheng East Road, Fenghua City, Zhejiang |
| Laboratory performing the tests | SIEMIC Laboratories<br>Zone A,Floor 1,Building 2,Wan Ye Long Technology Park, South Side of Zhoushi Road, Bao'an District, Shenzhen 518108 , Guangdong , P.R.C.<br>Tel: +(86) 0755-26014629<br>VIP Line:950-4038-0435 |
| Test report reference number | 13050009-FCC-H |
| Date EUT received | March 19th , 2013 |
| Standard applied | See Page 9 |
| Dates of test (from – to) | March 28th, 2013~ March 29th, 2013 |
| No of Units: | 1 |
| Equipment Category: | PCE |
| Trade Name: | Likuid |
| Model Name: | LK100 |
| RF Operating Frequency (ies) | GSM850 : 824.2 ~ 848.8 MHz(TX) / 869.2 ~ 893.8 MHz(RX)<br>GSM1900 : 1850.2 ~ 1909.8 MHz(TX) / 1930.2 ~ 1989.8 MHz(RX)<br>BT:2402~2480MHz(RX/TX) |
| Modulation: | GSM: GMSK<br>BT:GFSK |
| GPRS Multi-slot class | NA |
| FCC ID | GAOLK100 |

# 3 INTRODUCTION

## Introduction

This measurement report shows compliance of the EUT with FCC OET Bulletin 65 Supplement C (Edition 01-01), IEC62209-2 & RSS 102 Issue 4.0.

The test procedures, as described in ANSI C95.1 – 1999 Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz [2], and ANSI C95.3 – 2002 Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields [3], were employed.

## SAR Definition

Specific Absorption Rate is defined as the time derivative (rate) of the incremental energy (dW) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dV) of a given density (ρ).

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

SAR is expressed in units of watts per kilogram (W/kg). SAR can be related to the electric field at a point by

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

where:

σ = conductivity of the tissue (S/m)
ρ = mass density of the tissue (kg/m3)
E = rms electric field strength (V/m)

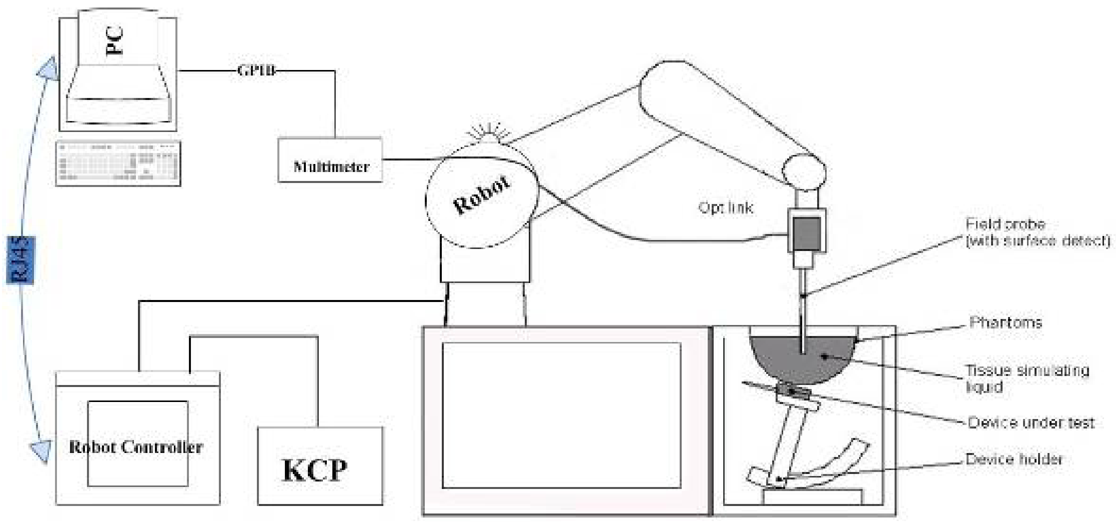
# 4 SAR Measurement Setup

## Dosimetric Assessment System

These measurements were performed with the automated near-field scanning system OPENSAR from SATIMO. The system is based on a high precision robot (working range: 850 mm), which positions the probes with a positional repeatability of better than ± 0.02 mm. Special E- and H-field probes have been developed for measurements close to material discontinuity, the sensors of which are directly loaded with a Schottky diode and connected via highly resistive lines to the data acquisition unit.

The SAR measurements were conducted with dosimetric probe (manufactured by SATIMO), designed in the classical triangular configuration and optimized for dosimetric evaluation. The probe has been calibrated according to the procedure described in SAR standard with accuracy of better than ±10%. The spherical isotropy was evaluated with the procedure described in SAR starndard and found to be better than ±0.25 dB. The phantom used was the SAM Phantom as described in FCC supplement C, IEEE P1528 and CENELEC EN62209-1.

## Measurement System Diagram




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

1. A standard high precision 6-axis robot (KUKA) with controller and software.
2. KUKA Control Panel (KCP).
3. A dosimetric probe, i.e., an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid. The probe is equipped with an optical surface detector system.
4. The functions of the PC plug-in card are to perform the time critical task such as signal filtering, surveillance of the robot operation fast movement interrupts.

5. A computer operating Windows XP.
6. OPENSAR software.
7. Remote control with teaches pendant and additional circuitry for robot safety such as warning lamps, etc.
8. The SAM phantom enabling testing left-hand right-hand and body usage.
9. The Position device for handheld EUT.
10. Tissue simulating liquid mixed according to the given recipes (see Application Note).
11. System validation dipoles to validate the proper functioning of the system.

## EP100 Probe

Construction Symmetrical design with triangular Core. Built-in shielding against static charges Calibration in air from 100 MHz to 2.5 GHz. In brain and muscle simulating tissue at frequencies from 800 to 6000 MHz (accuracy of 8%) .

Frequency 100 MHz to 6 GHz;

Linearity ; 0.25 dB (100 MHz to 6 GHz) ,

Directivity : 0.25 dB in brain tissue (rotation around probe axis) 0.5 dB in brain tissue (rotation normal probe axis)

Dynamic : 0.001W/kg to > 100W/kg;

Range Linearity: 0.25 dB

Surface : 0.2 mm repeatability in air and liquids

Dimensions Overall length: 330 mm

Tip length: 16 mm

Body diameter: 8 mm

Tip diameter: 2.6 mm

Distance from probe tip to dipole centers: <1.5 mm

Application General dosimetric up to 6 GHz

Compliance tests of MOBILE PHONEs

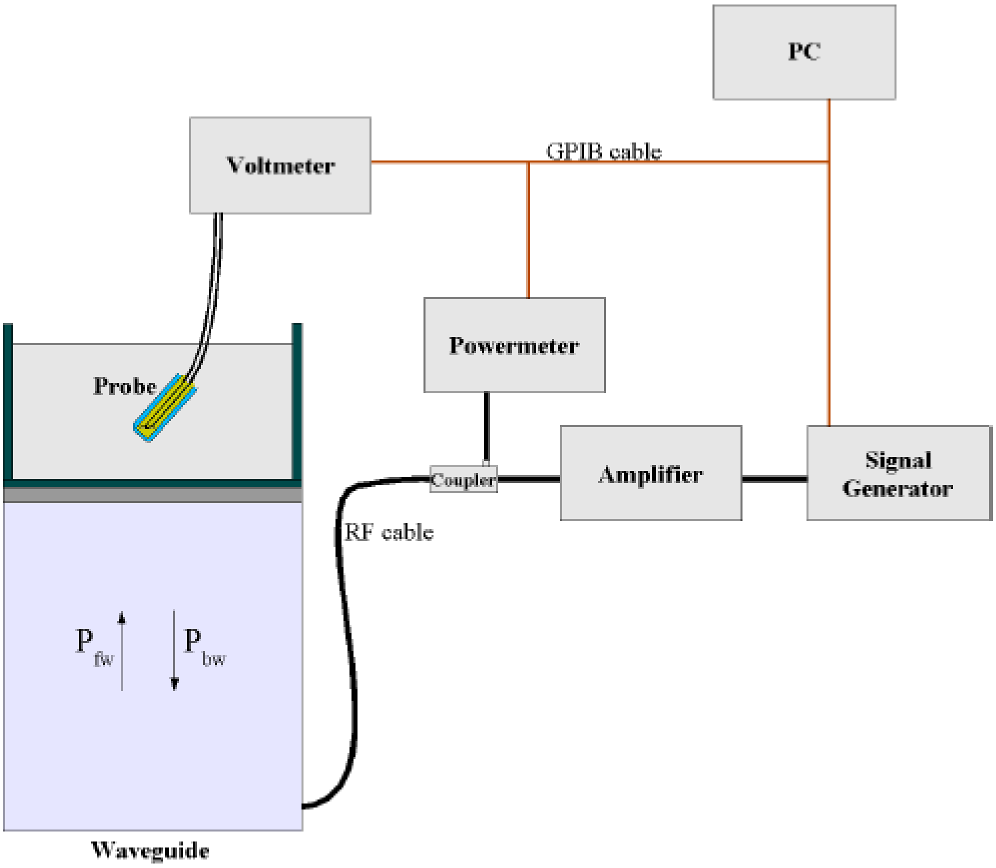
Fast automatic scanning in arbitrary phantoms

The SAR measurements were conducted with the dosimetric probe designed in the classical triangular configuration and optimized for dosimetric evaluation. The probe is constructed using the thick film technique, with printed resistive lines on ceramic substrates.

It is connected to the KRC box on the robot arm and provides an automatic detection of the phantom surface. The 3D file of the phantom is include in OpenSAR software. The Video Positioning System allow the system to take the automatic reference and to move the probe safely and accurately on the phantom.

**E-Field Probe Calibration Process**

Probe calibration is realized, in compliance with CENELEC EN50361; CEI/IEC 62209 and IEEE 1528 std, with CALISAR, SATIMO proprietary calibration system. The calibration is performed with the technique using reference waveguide.




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

Where :

$P_{fw}$ = Forward Power

$P_{bw}$ = Backward Power

a and b = Waveguide dimensions

 = Skin depth

*Keithley configuration:*

Rate = Medium; Filter =ON; RDGS=10; FILTER TYPE =MOVING AVERAGE; RANGE AUTO

*After each calibration, a SAR measurement is performed on a validation dipole and compared with a NPL calibrated probe, to verify it.*

Each probe is calibrated according to a dosimetric assessment procedure described in SAR standard with accuracy better than +/- 10%. The spherical isotropy was evaluated with the procedure described in SAR standard and found to be better than +/-0.25dB. The sensitivity parameters (NormX, NormY, NormZ), the diode compression parameter (DCP) and the conversion factor (ConvF) of the probe are tested.
The free space E-field from probe outputs is determined in a test chamber. This is performed in a TEM cell for frequencies bellow 0.8 GHz, and in a waveguide above 0.8 GHz for free space. For the free space calibration, the probe is placed in the volumetric center of the cavity and at the proper orientation with the field. E-field correlation calibration is performed in a flat phantom filled with the appropriate simulated brain tissue.

## SAM Phantom

The SAM Phantom SAM29 is constructed of a fiberglass shell ntegrated in a wooden table. The shape of the shell is in compliance with the specification set in IEEE P1528 and CENELEC EN62209-1, IEC62209-2.
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 robot.
Shell Thickness: 2 0.2 mm
Filling Volume: Approx. 25 liters
Dimensions (H x L x W): 810 x 1000 x 500 mm
Liquid is filled to at least 15mm from the bottom of Phantom.

## Device Holder

In combination with the Generic Twin Phantom V3.0, 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).

*Note: A simulating human hand is not used due to the complex anatomical and geometrical structure of the hand that may produced infinite number of configurations [10]. To produce the worst-case condition (the hand absorbs antenna output power), the hand is omitted during the tests.*

## Data Evaluation

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

| | | |
|---|---|---|
| Probe Parameters | - Sensitivity | $Norm_i$ |
| | - Conversion factor | ConvFi |
| | - Diode compression point Dcpi | |
| Device Parameter | - Frequency | f |
| | - Crest factor | cf |
| Media Parametrs | - Conductivity | $\sigma$ |
| | - Density | $\rho$ |

These parameters must be set correctly in the software. They can either be found in the component documents or be imported into the software from the configuration files issued for the OPENSAR components.

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

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

*Where* $V_i$ = *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 (DASY parameter)*

$dcp_i$ = *Diode compression point (DASY parameter)*

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

*E-field probes:* $$E_i = \sqrt{\frac{V_i}{Norm_i \cdot ConvF}}$$

*H-field probes:* $$H_i = \sqrt{Vi} \cdot \frac{a_{i10} + a_{i11} f + a_{i12} f^2}{f}$$

*Where* $V_i$ = *Compensated signal of channel i (i = x, y, z)*
$Norm_i$ = *Sensor sensitivity of channel i (i = x, y, z)*
*$\mu$V/(V/m)2 for E0field 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.

$$SAR = E_{tot}^2 \cdot \frac{\sigma}{\rho \cdot 1000}$$

*where SAR = local specific absorption rate in mW/g*
$E_{tot}$ = *total field strength in V/m*
$\sigma$ = *conductivity in [mho/m] or [siemens/m]*
$\rho$ = *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.

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

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

*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*

# SAR Evaluation – Peak Spatial - Average

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 doing a finer measurement around the hot spot. The sophisticated interpolation routines implemented in OPENSAR software can find the maximum locations even in relatively coarse grids. The scan area is defined by an editable grid. This grid is anchored at the grid reference point of the selected section in the phantom. When the area scan's property sheet is brought-up, grid was at to 15 mm by 15 mm and can be edited by a user.

- **Zoom Scan**

  Zoom scans are used to assess the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g of simulated tissue. The default zoom scan measures 5 x 5 x 7 points within a cube whose base faces are centered around the maximum found in a preceding area scan job within the same procedure. If the preceding Area Scan job indicates more then one maximum, the number of Zoom Scans has to be enlarged accordingly (The default number inserted is 1).

- **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.

# SAR Evaluation – Peak SAR

The procedure for spatial peak SAR evaluation has been implemented according to the IEEE1529 standard. It can be conducted for 1 g and 10 g. The OPENSAR system allows evaluations that combine measured data and robot positions, such as:

- maximum search
- extrapolation
- boundary correction
- peak search for averaged SAR

During a maximum search, global and local maximum searches are automatically performed in 2-D after each Area Scan measurement with at least 6 measurement points. It is based on the evaluation of the local SAR gradient calculated by the Quadratic Shepard's method. The algorithm will find the global maximum and all local maxima within -2 dB of the global maxima for all SAR distributions.

**Extrapolation**

Extrapolation routines are used to obtain SAR values between the lowest measurement points and the inner phantom surface. The extrapolation distance is determined by the surface detection distance and the probe sensor offset. Several measurements at different distances are necessary for the extrapolation.
They are used in the Cube Scan to obtain SAR values between the lowest measurement points and the inner phantom surface. The routine uses the fourth order least square polynomial method for extrapolation. For a grid using 5x5x7 measurement points with 5mm resolution amounting to 343 measurement points, the uncertainty of the extrapolation routines is less than 1% for 1 g and 10 g cubes.

## Definition of Reference Points

**Ear Reference Point**

Figure 6.2 shows the front, back and side views of the SAM Phantom. The point “M” is the reference point for the center of the mouth, “LE” is the left ear reference point (ERP), and “RE” is the right ERP. The ERPs are 15mm posterior to the entrance to the ear canal (EEC) along the B-M line (Back-Mouth), as shown in Figure 6.1. The plane passing through the two ear canals and M is defined as the Reference Plane. The line N-F (Neck-Front) is perpendicular to the reference plane and passing through the RE (or LE) is called the Reference Pivoting Line (see Figure 6.1). Line B-M is perpendicular to the N-F line. Both N-F and B-M lines are marked on the external phantom shell to facilitate handset positioning [5].

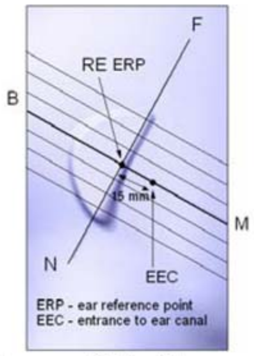



**Figure 6.1 Close-up side view of ERP’s**


**Figure 6.2 Front, back and side view of SAM**

## Device Reference Points

Two imaginary lines on the device need to be established: the vertical centerline and the horizontal line. The test device is placed in a normal operating position with the “test device reference point” located along the “vertical centerline” on the front of the device aligned to the “ear reference point” (See Fig. 6.3). The “test device reference point” is than located at the same level as the center of the ear reference point. The test device is positioned so that the “vertical centerline” is bisecting the front surface of the device at it’s top and bottom edges, positioning the “ear reference point” on the outer surface of both the left and right head phantoms on the ear reference point [5].

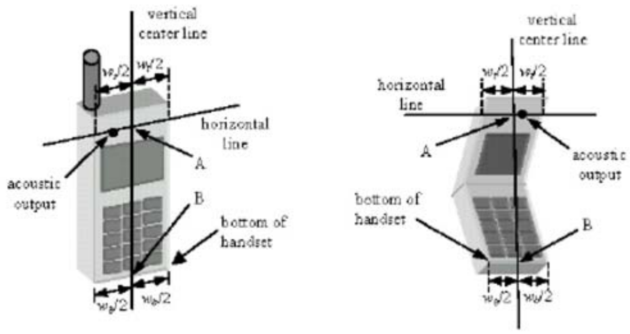



**Figure 6.3 Handset Vertical Center & Horizontal Line Reference Points**

## Test Configuration – Positioning for Cheek / Touch

1. Position the device close to the surface of the phantom such that point A is on the (virtual) extension of the line passing through points RE and LE on the phantom (see Figure below), such that the plane defined by the vertical center line and the horizontal line of the device is approximately parallel to the sagittal plane of the phantom

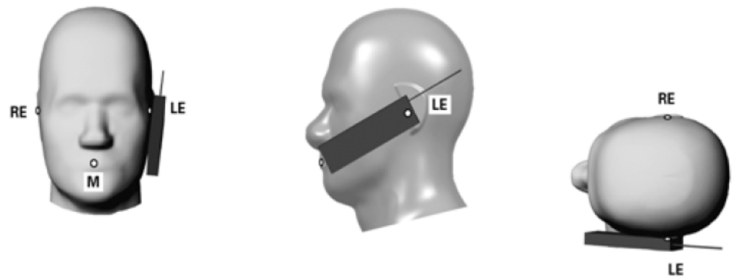



**Figure 7.1 Front, Side and Top View of Cheek/Touch Position**

2. Translate the device towards the phantom along the line passing through RE and LE until the device touches the ear.

3. While maintaining the device in this plane, rotate it around the LE-RE line until the vertical centerline is in the plane normal to MB-NF including the line MB (called the reference plane).
4. Rotate the device around the vertical centerline until the device (horizontal line) is symmetrical with respect to the line NF.

5. While maintaining the vertical centerline in the reference plane, keeping point A on the line passing through RE and LE and maintaining the device contact with the ear, rotate the device about the line NF until any point on the device is in contact with a phantom point below the ear (cheek). See Figure below.

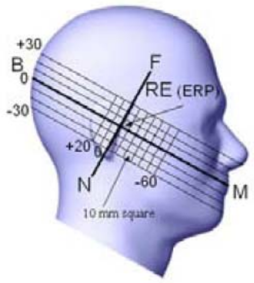



**Figure 7.2 Side view w/ relevant markings**

## Test Configuration – Positioning for Ear / 15° Tilt

With the test device aligned in the Cheek/Touch Position":

1. While maintaining the orientation of the device, retracted the device parallel to the reference plane far enough to enable a rotation of the device by 15 degrees.

2. Rotate the device around the horizontal line by 15 degrees.

3. While maintaining the orientation of the device, move the device parallel to the reference plane until any part of the device touches the head. (In this position, point A is located on the line RE-LE). The tilted position is obtained when the contact is on the pinna. If the contact is at any location other than the pinna, the angle of the device shall be reduced. The tilted position is obtained when any part of the device is in contact with the ear as well as a second part of the device is in contact with the head (see Figure below).

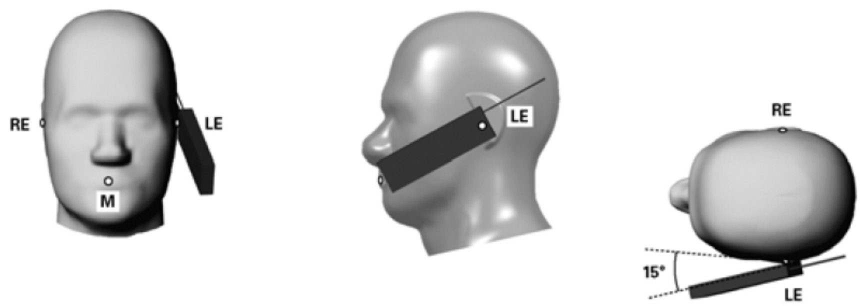
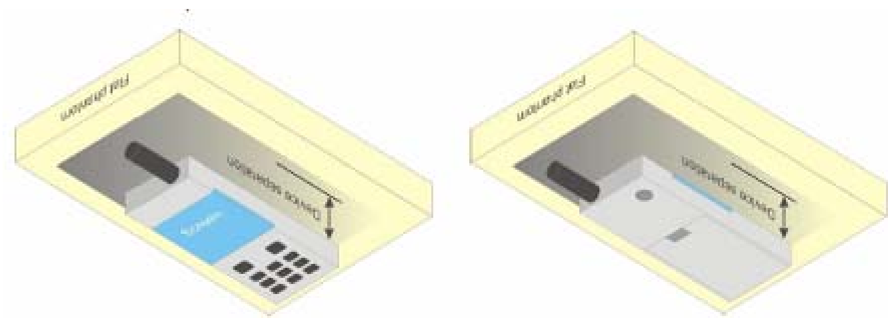



**Figure 7.3 Front, Side and Top View of Ear/15° Tilt Position**

## Test Position – Body Worn Configurations

Body Worn Position

(a) To position the device parallel to the phantom surface with either keypad up or down.
(b) To adjust the device parallel to the flat phantom.
(c) To adjust the distance between the device surface and the flat phantom to 1.5 cm or holster surface and the flat phantom to 0 cm.



# 5 ANSI/IEEE C95.1 – 1999 RF Exposure Limit

In order for users to be aware of the body-worn operating requirements for meeting RF exposure compliance, operating instructions and cautions statements are included in the user's manual.

## Uncontrolled Environment

Uncontrolled Environments are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure. The general population/uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity.

## Controlled Environment

Controlled Environments are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation). In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. This exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means.

**Table 8.1 Human Exposure Limits**

| | UNCONTROLLED ENVIRONMENT<br>General Population<br>(W/kg) or (mW/g) | CONTROLLED ENVIROMENT<br>Professional Population<br>(W/kg) or (mW/g) |
|---|---|---|
| SPATIAL PEAK SAR[1]<br>Brain | 1.60 | 8.00 |
| SPATIAL AVERAGE SAR[2]<br>Whole Body | 0.08 | 0.40 |
| SPATIAL PEAK SAR[3]<br>Hands, Feet, Ankles, Wrists | 4.00 | 20.00 |

1 The Spatial Peak value of the SAR averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.
2 The Spatial Average value of the SAR averaged over the whole body.
3 The Spatial Peak value of the SAR averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

# 6 SYSTEM AND LIQUID VALIDATION

## Basic SAR system validation requirements

The SAR system must be validated against its performance specifications before it is deployed. When SAR probes, system components or software are changed, upgraded or recalibrated, these must be validated with the SAR system(s) that operates with such components. Reference dipoles are used with the required tissue-equivalent media for system validation,

The detailed system validation results are maintained by each test laboratory, which are normally not required for equipment approval. Only a tabulated summary of the system validation status, according to the validation date(s), measurement frequencies, SAR probes and tissue dielectric parameters is required in the SAR report.

Siemic Lab has performed the system validation at 11/01/2012, and all the measured results within 10% of the system calibrated SAR targets.

## System Setup

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

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

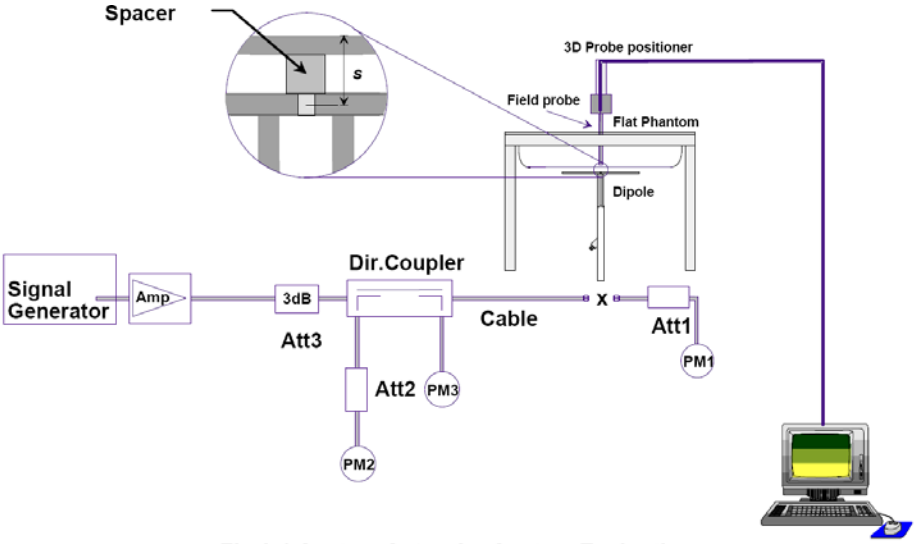



Fig 8.1 System Setup for System Evaluation

1. Signal Generator
2. Amplifier
3. Directional Coupler
4. Power Meter
5. Calibrated Dipole

Note: The output power on dipole port must be calibrated to 30 dBm (1000 mW) before dipole is connected.

## System Verification Results

### Numerical reference SAR values (W/kg) for reference dipole and flat phantom

| Frequency (MHz) | 1 g SAR | 10 g SAR | Local SAR at surface (above feed-point) | Local SAR at surface (y = 2 cm offset from feed-point)[a] |
|---|---|---|---|---|
| 300 | 3.0 | 2.0 | 4.4 | 2.1 |
| 450 | 4.9 | 3.3 | 7.2 | 3.2 |
| 835 | 9.5 | 6.2 | 4.1 | 4.9 |
| 900 | 10.8 | 6.9 | 16.4 | 5.4 |
| 1450 | 29.0 | 16.0 | 50.2 | 6.5 |
| 1800 | 38.1 | 19.8 | 69.5 | 6.8 |
| 1900 | 39.7 | 20.5 | 72.1 | 6.6 |
| 2000 | 41.1 | 21.1 | 74.6 | 6.5 |
| 2450 | 52.4 | 24.0 | 104.2 | 7.7 |
| 3000 | 63.8 | 25.7 | 140.2 | 9.5 |

**Target and measurement SAR after Normalized (1W):**

| Measurement Date | Frequency (MHz) | Liquid Type (head/body) | Target SAR1g (W/kg) | Measured SAR1g (W/kg) | Normalized SAR1g (W/kg) | Deviation (%) |
|---|---|---|---|---|---|---|
| March 28th, 2013 | 835 | head | 9.5 | 0.36 | 9.0 | -5.26 |
| March 28th, 2013 | 835 | body | 9.5 | 0.38 | 9.5 | 0 |
| March 29th, 2013 | 1900 | head | 39.7 | 1.58 | 39.5 | -0.51 |
| March 29th, 2013 | 1900 | body | 39.7 | 1.62 | 40.5 | 2.01 |

Note: system check input power: 40mW

# Liquid Validation

The dielectric parameters were checked prior to assessment using the HP85070C dielectric probe kit. The dielectric parameters measured are reported in each correspondent section.

## IEEE SCC-34/SC-2 P1528 recommended Tissue Dielectric Parameters

The head tissue dielectric parameters recommended by the IEEE SCC-34/SC-2 in P1528 have been incorporated in the following table. These head parameters are derived from planar layer models simulating the highest xpected SAR for the dielectric properties and tissue thickness variations in a human head. Other head and body tissue parameters that have not been specified in P1528 are derived from the tissue dielectric parameters computed from the 4-Cole-Cole equations and extrapolated according to the head parameters specified in P1528

| Target Frequency | Head | | Body | |
|---|---|---|---|---|
| MHz | εr | σ (S/m) | εr | σ (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 |

*Note:* *$\varepsilon_r$ = relative permittivity,* *$\sigma$ = conductivity and* *$\rho$ = 1000 kg/m$^3$*

**Liquid Confirmation Result:**

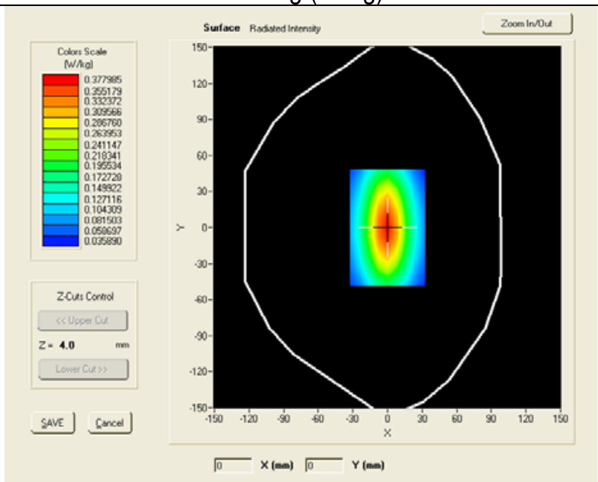
| Temperature: 21°C , Relative humidity: 57% , Measured Date: March 28th, 2013 | | | |
|---|---|---|---|
| 835(MHz) | Description | Dielectric Parameters | |
| | | εr | σ(s/m) |
| Head | Target Value<br>±5% window | 41.50<br>39.43 — 43.58 | 0.90<br>0.855 — 0.945 |
| | Measurement Value | **42.90** | **0.88** |
| Body | Target Value<br>±5% window | 55.2<br>52.25 — 57.75 | 0.97<br>0.922 — 1.018 |
| | Measurement Value | **54.39** | **0.95** |

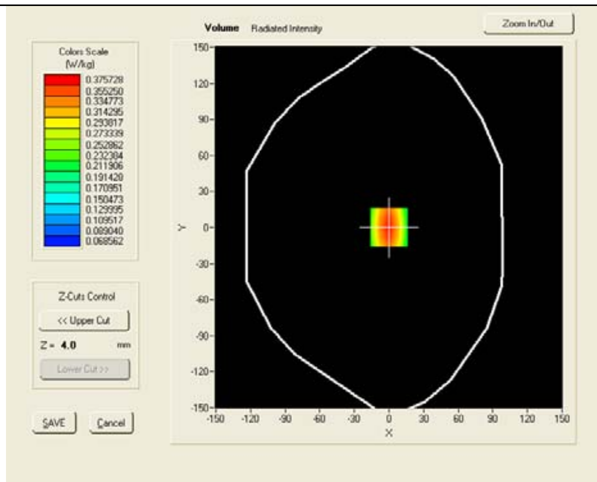
| Temperature: 21°C , Relative humidity: 57% , Measured Date: March 29th, 2013 | | | |
|---|---|---|---|
| 1900(MHz) | Description | Dielectric Parameters | |
| | | εr | σ(s/m) |
| Head | Target Value<br>±5% window | 40.00<br>38.00 — 42.00 | 1.40<br>1.33 — 1.47 |
| | Measurement Value | **39.81** | **1.38** |
| Body | Target Value<br>±5% window | 53.30<br>50.64 — 55.97 | 1.52<br>1.44 — 1.60 |
| | Measurement Value | **53.29** | **1.47** |

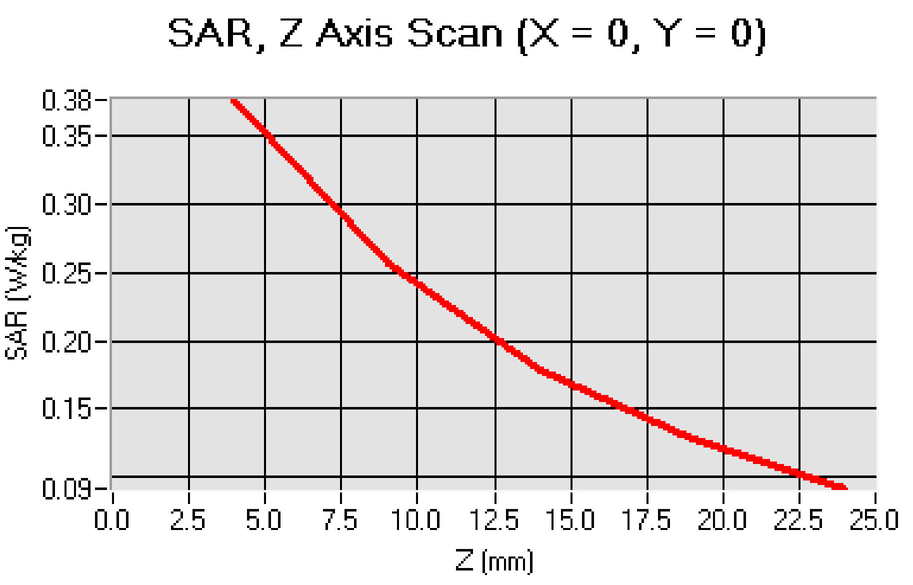
# System Validation Plots

**Product Description: Dipole**
**Model: SID835**
**Test Date: March 28th, 2013**

| | |
|---|---|
| Medium(liquid type) | HSL_850 |
| Frequency (MHz) | 835.000000 |
| Relative permittivity (real part) | 42.9 |
| Conductivity (S/m) | 0.88 |
| Input power | 40mW |
| E-Field Probe | SN 18/11 EPG123 |
| Crest factor | 1.0 |
| Conversion Factor | 7.53 |
| Area Scan | dx=8mm dy=8mm |
| Zoom Scan | 5x5x7,dx=8mm dy=8mm dz=5mm |
| Variation (%) | -0.23000 |
| SAR 10g (W/Kg) | 0.235202 |
| SAR 1g (W/Kg) | 0.361319 |

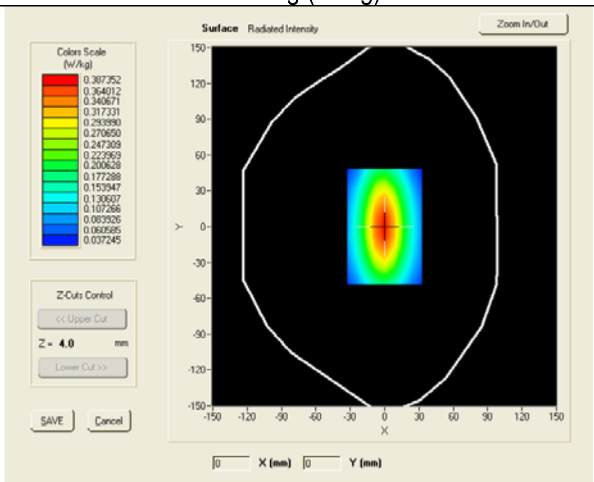


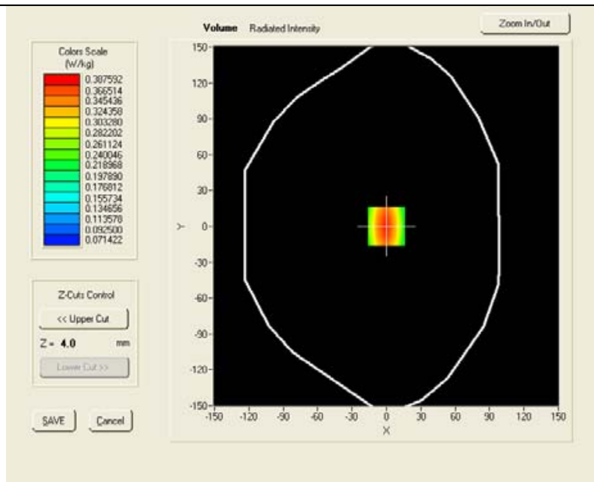



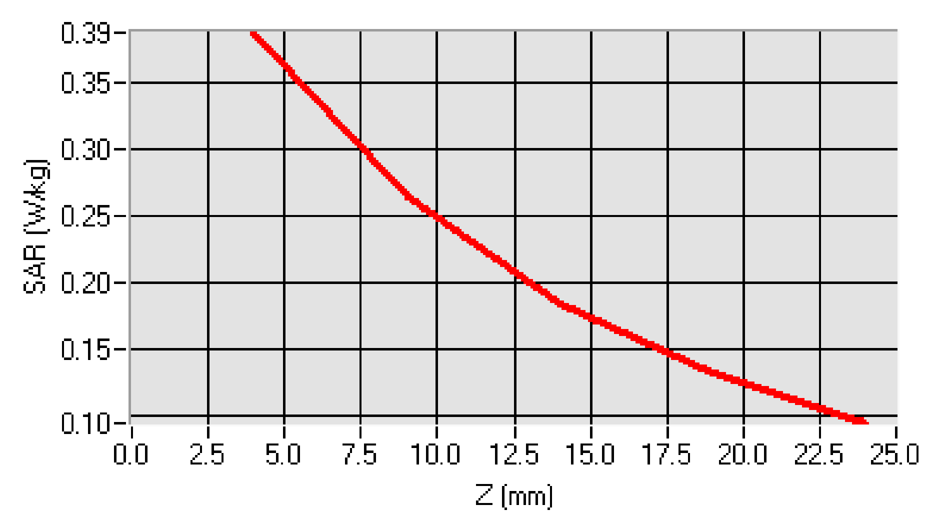
**Product Description: Dipole**
**Model: SID835**
**Test Date: March 28th, 2013**

| | |
|---|---|
| Medium(liquid type) | MSL_850 |
| Frequency (MHz) | 835.000000 |
| Relative permittivity (real part) | 54.39 |
| Conductivity (S/m) | 0.95 |
| Input power | 40mW |
| E-Field Probe | SN 18/11 EPG123 |
| Crest factor | 1.0 |
| Conversion Factor | 7.75 |
| Area Scan | dx=8mm dy=8mm |
| Zoom Scan | 5x5x7,dx=8mm dy=8mm dz=5mm |
| Variation (%) | -0.64000 |
| SAR 10g (W/Kg) | 0.261638 |
| SAR 1g (W/Kg) | 0.382314 |



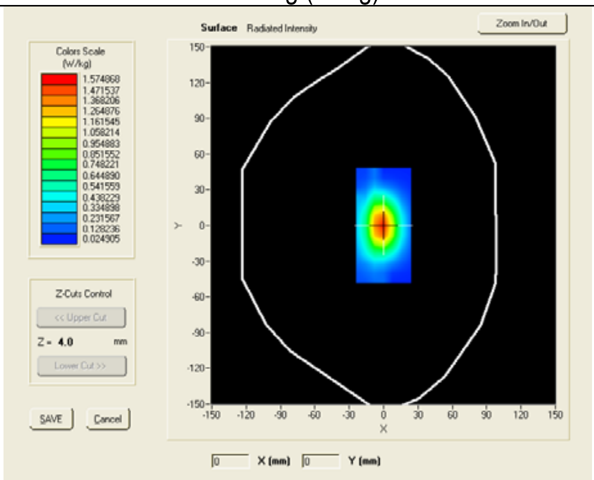



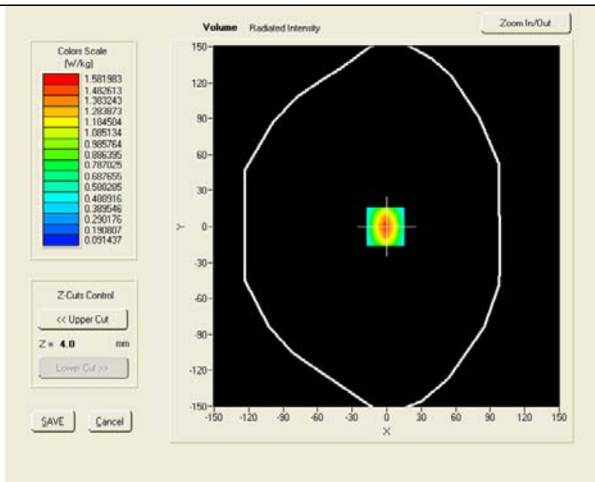

SAR, Z Axis Scan (X = 0, Y = 0)

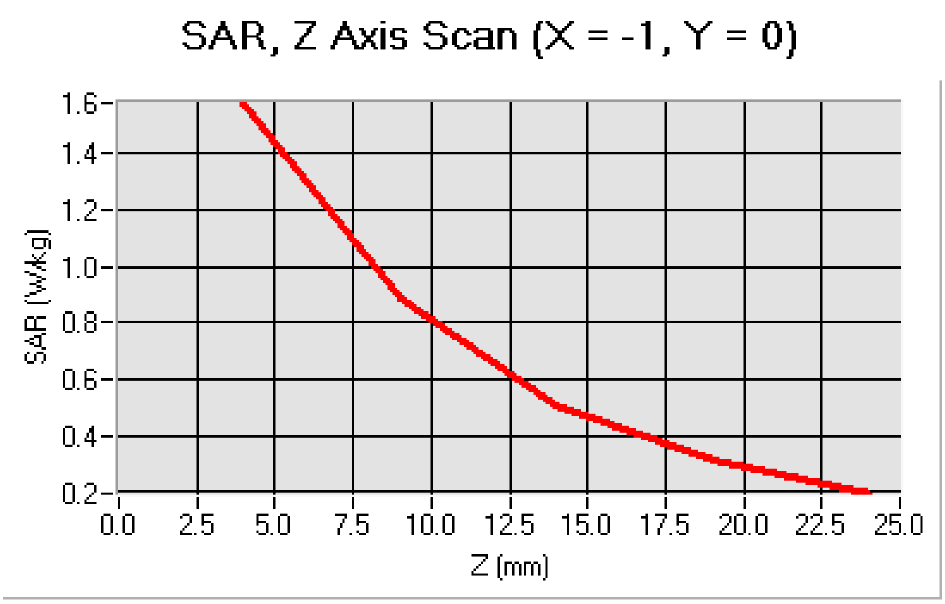


**Product Description: Dipole**
**Model: SID1900**
**Test Date: March 29th, 2013**

| | |
|---|---|
| Medium(liquid type) | HSL_1900 |
| Frequency (MHz) | 1900.000 |
| Relative permittivity (real part) | 39.81 |
| Conductivity (S/m) | 1.38 |
| Input power | 40mW |
| E-Field Probe | SN 18/11 EPG123 |
| Crest factor | 1.0 |
| Conversion Factor | 7.92 |
| Area Scan | dx=8mm dy=8mm |
| Zoom Scan | 5x5x7,dx=8mm dy=8mm dz=5mm |
| Variation (%) | -0.53000 |
| SAR 10g (W/Kg) | 0.836652 |
| SAR 1g (W/Kg) | 1.584423 |

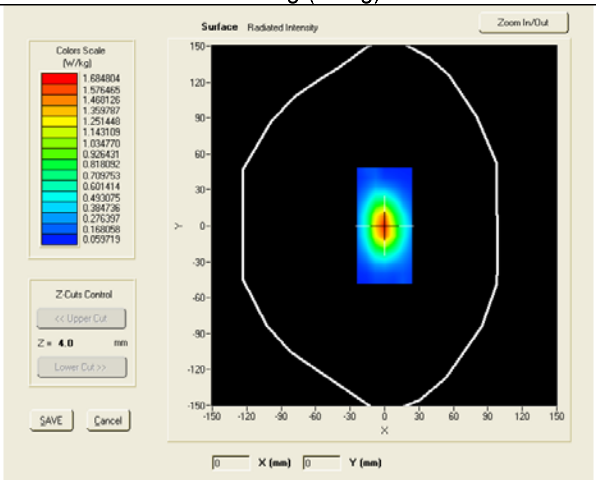


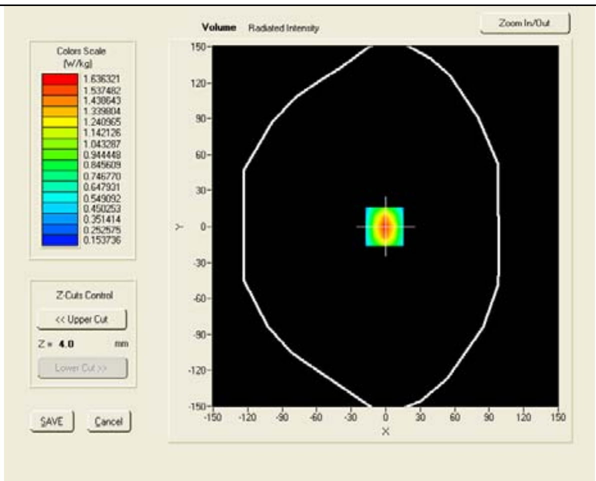



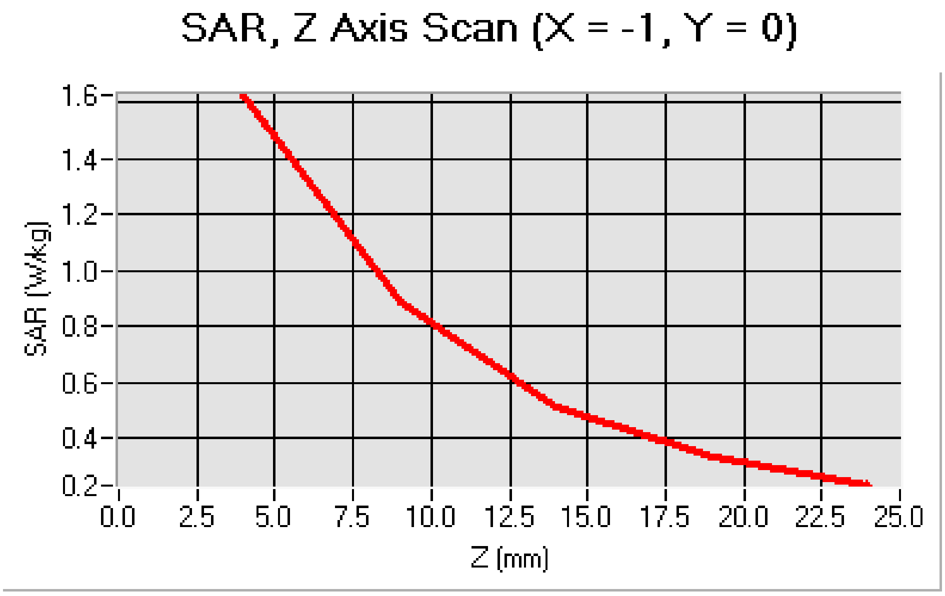



**Product Description: Dipole**
**Model: SID1900**
**Test Date: March 29th, 2013**

| | |
|---|---|
| Medium(liquid type) | MSL_1900 |
| Frequency (MHz) | 1900.000 |
| Relative permittivity (real part) | 53.29 |
| Conductivity (S/m) | 1.47 |
| Input power | 40mW |
| E-Field Probe | SN 18/11 EPG123 |
| Crest factor | 1.0 |
| Conversion Factor | 8.18 |
| Area Scan | dx=8mm dy=8mm |
| Zoom Scan | 5x5x7,dx=8mm dy=8mm dz=5mm |
| Variation (%) | 0.46000 |
| SAR 10g (W/Kg) | 0.838764 |
| SAR 1g (W/Kg) | 1.622416 |



# 7 UNCERTAINTY ASSESSMENT

*The component of uncertainly may generally be categorized according to the methods used to evaluate them. The evaluation of uncertainly by the statistical analysis of a series of observations is termed a Type An evaluation of uncertainty. The evaluation of uncertainty by means other than the statistical analysis of a series of observation is termed a Type B evaluation of uncertainty. Each component of uncertainty, however evaluated, is represented by an estimated standard deviation, termed standard uncertainty, which is determined by the positive square root of the estimated variance*

*A Type A evaluation of standard uncertainty may be based on any valid statistical method for treating data. This includes calculating the standard deviation of the mean of a series of independent observations; using the method of least squares to fit a curve to the data in order to estimate the parameter of the curve and their standard deviations; or carrying out an analysis of variance in order to identify and quantify random effects in certain kinds of measurement.*

*A type B evaluation of standard uncertainty is typically based on scientific judgment using all of the relevant information available. These may include previous measurement data, experience and specification, data provided in calibration reports and uncertainties assigned to reference data taken from handbooks. Broadly speaking, the uncertainty is either obtained from an outdoor source or obtained from an assumed distribution, such as the normal distribution, rectangular or triangular distributions indicated in Table below :*

| | | | | |
|---|---|---|---|---|
| Uncertainty Distribution | Normal | Rectangle | Triangular | U Shape |
| Multi-plying Factor[a] | $1/k^{(b)}$ | $1 / \sqrt{3}$ | $1 / \sqrt{6}$ | $1 / \sqrt{2}$ |

*(a) standard uncertainty is determined as the product of the multiplying factor and the estimated range of variations in the measured quantity*
*(b) κ is the coverage factor*

*Standard Uncertainty for Assumed Distribution*

*The combined standard uncertainty of the measurement result represents the estimated standard deviation of the result. It is obtained by combining the individual standard uncertainties of both Type A and Type -sum-by taking the positive square root of the estimated variances.*

*Expanded uncertainty is a measure of uncertainty that defines an interval about the measurement result within which the measured value is confidently believed to lie. It is obtained by multiplying the combined standard uncertainty by a coverage factor. Typically, the coverage factor ranges from 2 to 3. Using a coverage factor allows the true value of a measured quantity to be specified with a defined probability within the specified uncertainty range. For purpose of this document, a coverage factor two is used, which corresponds to confidence interval of about 95 %.*

*The COMOSAR Uncertainty Budget is show in below table:*

# UNCERTAINTY FOR SYSTEM PERFORMANCE CHECK

| Uncertainty Component | Tol. (± %) | Prob. Dist. | Div. | ci (1 g) | ci (10 g) | 1 g ui (± %) | 10 g ui (± %) | vi |
|---|---|---|---|---|---|---|---|---|
| **Measurement System** | | | | | | | | |
| Probe Calibration | 5,8 | N | 1 | 1 | 1 | 5,8 | 5,8 | ∞ |
| Axial Isotropy | 3,5 | R | √3 | (1-cp)1/2 | (1-cp)1/2 | 1,42887 | 1,42887 | ∞ |
| Hemispherical Isotropy | 5,9 | R | √3 | √Cp | √Cp | 2,40866 | 2,40866 | ∞ |
| Boundary Effect | 1 | R | √3 | 1 | 1 | 0,57735 | 0,57735 | ∞ |
| Linearity | 4,7 | R | √3 | 1 | 1 | 2,71355 | 2,71355 | ∞ |
| System Detection Limits | 1 | R | √3 | 1 | 1 | 0,57735 | 0,57735 | ∞ |
| Readout Electronics | 0,5 | N | 1 | 1 | 1 | 0,5 | 0,5 | ∞ |
| Response Time | 0 | R | √3 | 1 | 1 | 0 | 0 | ∞ |
| Integration Time | 1,4 | R | √3 | 1 | 1 | 0,80829 | 0,80829 | ∞ |
| RF Ambient Conditions | 3 | R | √3 | 1 | 1 | 1,73205 | 1,73205 | ∞ |
| Probe Positioner Mechanical Tolerance | 1,4 | R | √3 | 1 | 1 | 0,80829 | 0,80829 | ∞ |
| Probe Positioning with respect to Phantom Shell | 1,4 | R | √3 | 1 | 1 | 0,80829 | 0,80829 | ∞ |
| Extrapolation, interpolation and Integration Algorithms for Max. SAR Evaluation | 2,3 | R | √3 | 1 | 1 | 1,32791 | 1,32791 | ∞ |
| **Dipole** | | | | | | | | |
| Dipole Axis to Liquid Distance | 2 | N | √3 | 1 | 1 | 1,1547 | 1,1547 | N-1 |
| Input Power and SAR drift measurement | 5 | R | √3 | 1 | 1 | 2,88675 | 2,88675 | ∞ |
| **Phantom and Tissue Parameters** | | | | | | | | |
| Phantom Uncertainty (shape and thickness tolerances) | 4 | R | √3 | 1 | 1 | 2,3094 | 2,3094 | ∞ |
| Liquid Conductivity - deviation from target values | 5 | R | √3 | 0,64 | 0,43 | 1,84752 | 1,2413 | ∞ |
| Liquid Conductivity - measurement uncertainty | 4 | N | 1 | 0,64 | 0,43 | 2,56 | 1,72 | M |
| Liquid Permittivity - deviation from target values | 5 | R | √3 | 0,6 | 0,49 | 1,73205 | 1,41451 | ∞ |
| Liquid Permittivity - measurement uncertainty | 5 | N | 1 | 0,6 | 0,49 | 3 | 2,45 | M |
| Combined Standard Uncertainty | | RSS | | | | 9.6671 | 9.1645 | |
| Expanded Uncertainty (95% CONFIDENCE INTERVAL) | | k | | | | 19.3342 | 18.3290 | |

# UNCERTAINTY EVALUATION FOR HANDSET SAR TEST

| Uncertainty Component | Tol. (± %) | Prob. Dist. | Div. | $c_i$ (1 g) | $c_i$ (10 g) | 1 g $u_i$ (± %) | 10 g $u_i$ (± %) | $v_i$ |
|---|---|---|---|---|---|---|---|---|
| **Measurement System** | | | | | | | | |
| Probe Calibration | 5,8 | N | 1 | 1 | 1 | 5,8 | 5,8 | ∞ |
| Axial Isotropy | 3,5 | R | √3 | $(1-c_p)^{1/2}$ | $(1-c_p)^{1/2}$ | 1,43 | 1,43 | ∞ |
| Hemispherical Isotropy | 5,9 | R | √3 | $\sqrt{C_p}$ | $\sqrt{C_p}$ | 2,41 | 2,41 | ∞ |
| Boundary Effect | 1 | R | √3 | 1 | 1 | 0,58 | 0,58 | ∞ |
| Linearity | 4,7 | R | √3 | 1 | 1 | 2,71 | 2,71 | ∞ |
| System Detection Limits | 1 | R | √3 | 1 | 1 | 0,58 | 0,58 | ∞ |
| Readout Electronics | 0,5 | N | 1 | 1 | 1 | 0,50 | 0,50 | ∞ |
| Response Time | 0 | R | √3 | 1 | 1 | 0,00 | 0,00 | ∞ |
| Integration Time | 1,4 | R | √3 | 1 | 1 | 0,81 | 0,81 | ∞ |
| RF Ambient Conditions | 3 | R | √3 | 1 | 1 | 1,73 | 1,73 | ∞ |
| Probe Positioner Mechanical Tolerance | 1,4 | R | √3 | 1 | 1 | 0,81 | 0,81 | ∞ |
| Probe Positioning with respect to Phantom Shell | 1,4 | R | √3 | 1 | 1 | 0,81 | 0,81 | ∞ |
| Extrapolation, interpolation and Integration Algorithms for Max. SAR Evaluation | 2,3 | R | √3 | 1 | 1 | 1,33 | 1,33 | ∞ |
| **Test sample Related** | | | | | | | | |
| Test Sample Positioning | 2,6 | N | 1 | 1 | 1 | 2,60 | 2,60 | N-1 |
| Device Holder Uncertainty | 3 | N | 1 | 1 | 1 | 3,00 | 3,00 | N-1 |
| Output Power Variation - SAR drift measurement | 5 | R | √3 | 1 | 1 | 2,89 | 2,89 | ∞ |
| **Phantom and Tissue Parameters** | | | | | | | | |
| Phantom Uncertainty (shape and thickness tolerances) | 4 | R | √3 | 1 | 1 | 2,31 | 2,31 | ∞ |
| Liquid Conductivity - deviation from target values | 5 | R | √3 | 0,64 | 0,43 | 1,85 | 1,24 | ∞ |
| Liquid Conductivity - measurement uncertainty | 4 | N | 1 | 0,64 | 0,43 | 2,56 | 1,72 | M |
| Liquid Permittivity - deviation from target values | 5 | R | √3 | 0,6 | 0,49 | 1,73 | 1,41 | ∞ |
| Liquid Permittivity - measurement uncertainty | 5 | N | 1 | 0,6 | 0,49 | 3,00 | 2,45 | M |
| Combined Standard Uncertainty | | RSS | | | | 10.39 | 9.92 | |
| Expanded Uncertainty (95% CONFIDENCE INTERVAL) | | k | | | | 20.78 | 19.84 | |

# 8 TEST INSTRUMENT

## TEST INSTRUMENTATION

| Name of Equipment | Manufacturer | Type/Model | Serial Number | Calibration Date | Calibration Due |
|---|---|---|---|---|---|
| P C | Compaq | PV 3.06GHz | 375052-AA1 | N/A | N/A |
| Signal Generator | Agilent | 8665B-008 | 3744A10293 | 05/15/2012 | 05/15/2013 |
| MultiMeter | Keithley | MiltiMeter 2000 | 1259033 | 06/21/2012 | 06/21/2013 |
| S-Parameter Network Analyzer | Agilent | 8753ES | US39173518 | 08/04/2012 | 08/04/2013 |
| Wireless Communication Test Set | R & S | CMU200 | 111078 | 07/22/2012 | 07/22/2013 |
| Power Meter | HP | 437B | 3038A03648 | 05/17/2012 | 05/17/2013 |
| E-field PROBE | SATIMO | SSE2 | SN 18/11 EPG123 | 06/13/2012 | 06/13/2013 |
| DIPOLE 835 | SATIMO | SID 835 | SN 18/11 DIPC 150 | 06/01/2011 | 06/01/2013 |
| DIPOLE 1900 | SATIMO | SID 1900 | SN 18/11 DIPG 153 | 06/01/2011 | 06/01/2013 |
| COMOSAR Open Coaxial Probe | SATIMO | OCP43 | SN 24/11 OCPG43 | 06/01/2012 | 06/01/2013 |
| Communication Antenna | SATIMO | ANTA3 | SN 20/11 ANTA 3 | 06/20/2012 | 06/20/2013 |
| Laptop POSITIONING DEVICE | SATIMO | LSH15 | SN 24/11 LSH15 | N/A | N/A |
| Mobile phone POSITIONING DEVICE | SATIMO | MSH73 | SN 24/11 MSH73 | N/A | N/A |
| DUMMY PROBE | ANTENNESSA | | DP41 | N/A | N/A |
| SAM PHANTOM | SATIMO | SAM87 | SN 24/11 SAM87 | N/A | N/A |
| Elliptic Phantom | SATIMO | ELLI20 | SN 20/11ELLI20 | N/A | N/A |
| PHANTOM TABLE | SATIMO | N/A | N/A | N/A | N/A |
| 6 AXIS ROBOT | KUKA | KR5 | 949272 | N/A | N/A |
| high Power Solid State Amplifier (80MHz~1000MHz) | Instruments for Industry | CMC150 | M631-0408 | N/A | N/A |
| Medium Power Solid State Amplifier (0.8~4.2GHz) | Instruments for Industry | S41-25 | M629-0408 | N/A | N/A |
| Wave Tube Amplifier 4-8 GHz at 20Watt | Hughes Aircraft Company | 1277H02F000 | 81 | N/A | N/A |

# 9 OUTPUT POWER VERIFICATION

**Test Condition:**

1. Conducted Measurement
   EUT was set for low, mid, high channel with modulated mode and highest RF output power.
   The base station simulator was connected to the antenna terminal.
2. Conducted Emissions Measurement Uncertainty
   All test measurements carried out are traceable to national standards. The uncertainty of the measurement at a confidence level of approximately 95% (in the case where distributions are normal), with a coverage factor of 2, in the range 30MHz – 40GHz is ±1.5dB.
3. Environmental Conditions

| | | |
|---|---|---|
| Environmental Conditions | Temperature | 23°C |
| | Relative Humidity | 53% |
| | Atmospheric Pressure | 1019mbar |

4. Test Date : March 28th, 2013
   Tested By : Chris You

## Test Procedures:

**Mobile phone radio output power measurement**

1. The transmitter output port was connected to base station emulator.
2. Establish communication link between emulator and EUT and set EUT to operate at maximum output power all the time.
3. Select lowest, middle, and highest channels for each band and different possible test mode.
4. Measure the conducted peak burst power and conducted average burst power from EUT antenna port.

### Other radio output power measurement

The output power was measured using power meter at low, mid, and hi channels.

## Test Configuration:

1. EUT supports GSM voice mode

## Source-based Time Averaged Burst Power Calculation:

For TDMA, the following duty cycle factor was used to calculate the source-based time average power

| Number of Time slot | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Duty Cycle | 1:8 | 1:4 | 1:2.66 | 1:2 |
| Duty cycle factor | -9.03 dB | -6.02 dB | -4.26 dB | -3.01 dB |
| Crest Factor | 8 | 4 | 2.66 | 2 |

**Remark:** *Time slot duty cycle factor = 10 * log (1 / Time Slot Duty Cycle)*
*Source based time averaged power = Maximum burst averaged power (1 Uplink) – 9.03 dB*
*Source based time averaged power = Maximum burst averaged power (2 Uplink) – 6.02 dB*
*Source based time averaged power = Maximum burst averaged power (4 Uplink) – 3.01 dB*

## Test Result:

| Burst Average Power (dBm); | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Band** | **GSM850** | | | | **GSM1900** | | | |
| Channel | 128 | 190 | 251 | Tune up Power tolerant | 512 | 661 | 810 | Tune up Power tolerant |
| Frequency (MHz) | 824.2 | 836.6 | 848.8 | / | 1850.2 | 1880 | 1909.8 | / |
| GSM Voice (1 uplink),GMSK | 31.59 | 31.75 | 31.60 | 31+/-1 | 28.62 | 28.74 | 28.58 | 28+/-1 |
| Remark: EUT not support GPRS mode | | | | | | | | |

**Note:** 1. the multiple SIM card with two lines cannot transmitting at the same time.

## Bluetooth Measurement Result

| Channel number | Frequency (MHz) | Max Average Output Power(dBm) | Maximum Power tolerant |
|---|---|---|---|
| 0 | 2402 | 6.80 | 7.0 |
| 39 | 2441 | 6.71 | 7.0 |
| 78 | 2480 | 6.90 | 7.0 |

# 10 SAR TEST RESULTS

## Test Condition:

1. SAR Measurement
   The distance between the EUT and the antenna of the emulator is more than 50 cm and the output power radiated from the emulator antenna is at least 30 dB less than the output power of EUT.

2 Measurement Uncertainty: See page 26 for detail

| | | | |
|---|---|---|---|
| 3 | Environmental Conditions | Temperature | 23$^{o}$C |
| | | Relative Humidity | 53% |
| | | Atmospheric Pressure | 1019mbar |

4 Test Date : March 28th, 2013~ March 29th, 2013
Tested By : Chris You

## Test Procedures:

1. Establish communication link between EUT and base station emulation by air link.
2. Consider the SAR test reduction per FCC KDB guide line. For GSM/GPRS/EGPRS, set EUT into highest output power channel with test mode which has the maximum source-based time-averaged burst power listed in power table. If the source-based time-average output power for each data mode of EGPRS is lower than that in normal GPRS mode, then testing under EGPRS mode is not necessary.
3. Place the EUT in the selected test position. (Cheek, tilt or flat)
4. Perform SAR testing at highest output power channel under the selected test mode. If the measured 1-g SAR is ≤ 0.8 W/kg, then testing for the other channel will not be performed.
5. When SAR is<0.8W/kg, no repeated SAR measurement is required

SAR measurement system will proceed the following basic steps:

1. Initial power reference measurement
2. Area Scan
3. Zoom Scan
4. Power drift measurement

## SAR Summary Test Result:

**GSM850**

| **Date of Measured : March 28th, 2013** | | | | | | **Body-Worn Separation Distance:1.5cm** | | |
|---|---|---|---|---|---|---|---|---|
| Position | Channel | Mode | SAR 1g(W/kg) | Limit (W/kg) | Power Drift (%) | Maximum Turn-up Power(dBm) | measured output power (dBm) | Scaled Maximum SAR(W/kg) |
| Right Head Cheek | Low | GSM voice | 0.771 | 1.6 | 2.5 | 32 | 31.59 | 0.85 |
| | Mid | GSM voice | 0.852 | 1.6 | 2.66 | 32 | 31.75 | 0.90 |
| | Mid | GSM voice | 0.825 | 1.6 | 0.38 | 32 | 31.75 | 0.87 |
| | High | GSM voice | 0.739 | 1.6 | 2.50 | 32 | 31.60 | 0.81 |
| Right Head Tilt | Mid | GSM voice | 0.515 | 1.6 | 3.50 | 32 | 31.75 | 0.55 |
| Left Head Cheek | Low | GSM voice | 0.851 | 1.6 | 0.67 | 32 | 31.59 | 0.94 |
| | Mid | GSM voice | 0.864 | 1.6 | 1.56 | 32 | 31.75 | 0.92 |
| | Mid | GSM voice | 0.900 | 1.6 | 0.77 | 32 | 31.75 | 0.95 |
| | High | GSM voice | 0.780 | 1.6 | 0.97 | 32 | 31.60 | 0.81 |
| Left Head Tilt | Mid | GSM voice | 0.512 | 1.6 | -2.6 | 32 | 31.75 | 0.54 |
| Body-worn LCD Up | Mid | GSM voice | 0.342 | 1.6 | 3.51 | 32 | 31.75 | 0.36 |
| Body-worn LCD Down | Mid | GSM voice | 0.555 | 1.6 | -1.3 | 32 | 31.75 | 0.59 |

**PCS1900:**

| Date of Measured : March 29th, 2013 | | | | | | Body-Worn Separation Distance:1.5cm | | |
|---|---|---|---|---|---|---|---|---|
| Position | Channel | Mode | SAR 1g(W/kg) | Limit (W/kg) | Power Drift (%) | Maximum Turn-up Power(dBm) | measured output power (dBm) | Scaled Maximum SAR(W/kg) |
| Right Head Cheek | Low | GSM voice | 0.915 | 1.6 | 2.67 | 29 | 28.62 | 1.00 |
| | Mid | GSM voice | 1.128 | 1.6 | 1.67 | 29 | 28.74 | 1.20 |
| | Mid | GSM voice | 1.169 | 1.6 | 1.21 | 29 | 28.74 | 1.24 |
| | High | GSM voice | 1.102 | 1.6 | 2.97 | 29 | 28.58 | 1.21 |
| Right Head Tilt | Low | GSM voice | 0.848 | 1.6 | -0.49 | 29 | 28.62 | 0.93 |
| | Mid | GSM voice | 0.988 | 1.6 | -1.41 | 29 | 28.74 | 1.05 |
| | Mid | GSM voice | 1.104 | 1.6 | 3.04 | 29 | 28.74 | 1.17 |
| | High | GSM voice | 1.004 | 1.6 | -0.41 | 29 | 28.58 | 1.10 |
| Left Head Cheek | Low | GSM voice | 0.981 | 1.6 | -0.25 | 29 | 28.62 | 1.07 |
| | Mid | GSM voice | 1.153 | 1.6 | -0.54 | 29 | 28.74 | 1.22 |
| | Mid | GSM voice | 1.162 | 1.6 | -0.24 | 29 | 28.74 | 1.23 |
| | High | GSM voice | 1.113 | 1.6 | -0.25 | 29 | 28.58 | 1.23 |
| Left Head Tilt | Low | GSM voice | 0.912 | 1.6 | 1.14 | 29 | 28.62 | 1.00 |
| | Mid | GSM voice | 1.082 | 1.6 | 2.14 | 29 | 28.74 | 1.15 |
| | Mid | GSM voice | 1.129 | 1.6 | 2.04 | 29 | 28.74 | 1.20 |
| | High | GSM voice | 0.931 | 1.6 | 1.25 | 29 | 28.58 | 1.03 |
| Body-worn LCD up | Mid | GSM voice | 0.245 | 1.6 | -0.06 | 29 | 28.74 | 0.26 |
| Body-worn LCD Down | Mid | GSM voice | 0.220 | 1.6 | -0.87 | 29 | 28.74 | 0.23 |

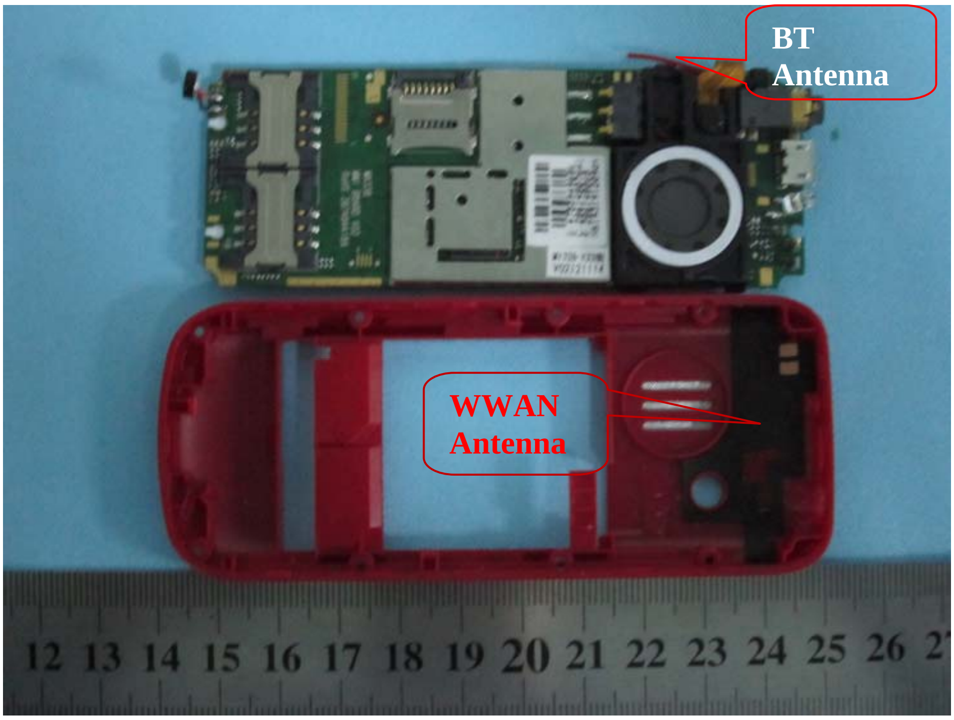
**Repeated SAR measurement:**

| Position | Band | Channel | Mode | SAR 1g(W/kg) | Limit (W/kg) | Power Drift (%) | Maximum Turn-up Power(dBm) | measured output power (dBm) | Scaled Maximum SAR(W/kg) |
|---|---|---|---|---|---|---|---|---|---|
| Right Head Cheek | GSM850 | Mid | GSM voice | 0.852 | 1.6 | 2.66 | 32 | 31.75 | 0.90 |
| | GSM850 | Mid | GSM voice | 0.825 | 1.6 | 0.38 | 32 | 31.75 | 0.87 |
| Left Head Cheek | GSM850 | Mid | GSM voice | 0.864 | 1.6 | 1.56 | 32 | 31.75 | 0.92 |
| | GSM850 | Mid | GSM voice | 0.900 | 1.6 | 0.77 | 32 | 31.75 | **0.95** |
| Right Head Cheek | PCS1900 | Mid | GSM voice | 1.128 | 1.6 | 1.67 | 29 | 28.74 | 1.20 |
| | PCS1900 | Mid | GSM voice | 1.169 | 1.6 | 1.21 | 29 | 28.74 | **1.24** |
| Right Head Tilt | PCS1900 | Mid | GSM voice | 0.988 | 1.6 | -1.41 | 29 | 28.74 | 1.05 |
| | PCS1900 | Mid | GSM voice | 1.104 | 1.6 | 3.04 | 29 | 28.74 | 1.17 |
| Left Head Cheek | PCS1900 | Mid | GSM voice | 1.153 | 1.6 | -0.54 | 29 | 28.74 | 1.22 |
| | PCS1900 | Mid | GSM voice | 1.162 | 1.6 | -0.24 | 29 | 28.74 | 1.23 |
| Left Head Tilt | PCS1900 | Mid | GSM voice | 1.082 | 1.6 | 2.14 | 29 | 28.74 | 1.15 |
| | PCS1900 | Mid | GSM voice | 1.129 | 1.6 | 2.04 | 29 | 28.74 | 1.20 |

**Note:**

1. Per KDB 865664 D01v01, for each frequency band, repeated SAR measurement is required only when the measured SAR is ≥0.8W/kg
2. Per KDB 865664 D01v01, if the deviation among the repeated measurement in less than 20%, and the measured SAR<1.45W/kg, only one repeated measurement is required. The deviation is different in percentage between original and repeated measured SAR.

## Antenna Separation Information:




## Simultaneous Transmission SAR Analysis.

| No. | Applicable Simultaneous Transmission Combination |
|---|---|
| 1. | WWAN+BT |

Note:

1. WWAN and Bluetooth can transmit simultaneously
2. For simultaneous transmission analysis, Bluetooth SAR is estimated per KDB 447498 D01 v05 base on the formula below:
   - (*max. power of channel, including tune-up tolerance, mW*)/(*min. test separation distance, mm*)]·[$\sqrt{f_{(GHz)}}/x$] W/kg for *test separation distances* ≤ 50 mm;
     where $x$ = 7.5 for 1-g SAR, and $x$ = 18.75 for 10-g SAR.
   - 0.4 W/kg for 1-g SAR and 1.0 W/kg for 10-g SAR, when the *test separation distances* is > 50 mm.[21]
3. 
4. If the test separation distances is≤5mm, 5mm is used for estimated SAR calculation.
5. Bluetooth maximum tune up power is 7dBm, and the estimated SAR is listed below.

| Test position | Head(0cm) | Body-worn(1.5cm) |
|---|---|---|
| Estimated SAR(W/kg) | 0.33 | 0.11 |

**Summation:**

| | WWAN | | BT | WWAN+BT |
|---|---|---|---|---|
| position | Band | Max. Scaled SAR | Max. Scaled SAR | |
| Head 0cm | GSM850 | 0.95 | 0.33 | 1.28 |
| Body 1.5cm | GSM850 | 0.59 | 0.11 | 0.70 |
| Head 0cm | GSM1900 | 1.24 | 0.33 | 1.57 |
| Body 1.5cm | GSM1900 | 0.26 | 0.11 | 0.37 |

Note: 1g-SAR scalar summation<1.6W/kg, so no simultaneous SAR is required.

# 11 SAR MEASUREMENT REFERENCES

## References

1. FCC 47 CFR Part 2 "Frequency Allocations and Radio Treaty Matters; General Rules and Regulations"
2. IEEE Std. C95.1-1991, "IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3kHz to 300GHz", 1991
3. IEEE Std. 1528-2003, "Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate(SAR) in the Human Head from Wireless Communication Devices: Measurement Techniques", December 2003
4. FCC OET Bulletin 65(Edition 97-01) Supplement C(Edition 01-01), "Evaluation Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields", June 2001
5. IEC 62209-2, "Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices—Human models, instrumentation, and procedures – Part 2: Procedure to determine the specific absorption rate(SAR) for wireless communication devices used in close proximity to the human body(frequency range of 30MHz to 6GHz)", March 2010
6. FCC KDB 447498 D01 v05, "Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies", Oct 24th, 2012
7. FCC KDB 941225 D04 v01, "Evaluation SAR for GSM/(E)GPRS Dual Transfer Mode", January 27 2010
8. FCC KDB 941225 D03 v01, "Evaluation SAR Test Reduction Procedures for GSM/GPRS/EDGE", December 2008
9. FCC KDB 865664 D01, "SAR Measurement Requirements 100MHz to 6GHz", Oct 24th, 2012