# SAR TEST REPORT

## No. I14Z47990-SEM01

**For**

**Moxee Technologies**

**WCDMA/GSM（GPRS）Dual-Mode Digital Mobile Phone**

**Model name: X1**

**With**

**Hardware MBV1.0**

**Software Version: MOXEE_X1_V1.1**

**FCC ID: 2ADHZ–MOXEE X1**

**Issued Date: 2014-12-11**

TESTING
CNAS L0570

**Note:**

The test results in this test report relate only to the devices specified in this report.This report shall not be reproduced except in full without the written approval of CTTL.

**Test Laboratory:**

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## REPORT HISTORY

| Report Number | Revision | Issue Date | Description |
|---|---|---|---|
| I14Z47990-SEM01 | Rev.0 | 2014-12-01 | Initial creation of test report |
| I14Z47990-SEM01 | Rev.1 | 2014-12-11 | Update the Manufacturer Information in section 3.2 on page 7 |

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# 1 Test Laboratory

## 1.1 Testing Location

| | |
|---|---|
| Company Name: | CTTL(Shouxiang) |
| Address: | No. 51 Shouxiang Science Building, Xueyuan Road, Haidian District, Beijing, P. R. China100191 |

## 1.2 Testing Environment

| | |
|---|---|
| Temperature: | 18°C~25 °C, |
| Relative humidity: | 30%~ 70% |
| Ground system resistance: | < 0.5 Ω |
| Ambient noise & Reflection: | < 0.012 W/kg |

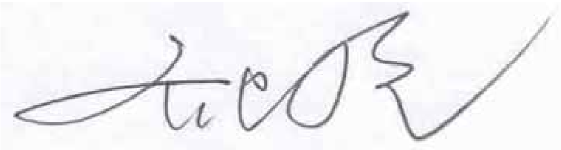
## 1.3 Project Data

| | |
|---|---|
| Project Leader: | Qi Dianyuan |
| Test Engineer: | Lin Xiaojun |
| Testing Start Date: | November 13, 2014 |
| Testing End Date: | November 16, 2014 |

## 1.4 Signature

**Lin Xiaojun**

**(Prepared this test report)**



**Qi Dianyuan**

**(Reviewed this test report)**

**Xiao Li**

**Deputy Director of the laboratory**

**(Approved this test report)**

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## 2 Statement of Compliance

The maximum results of SAR found during testing for Moxee Technologies WCDMA/GSM（GPRS）Dual-Mode Digital Mobile Phone X1 are as follows:

**Table 2.1: Highest Reported SAR (1g)**

| Exposure Configuration | Technology Band | Highest Reported SAR 1g (W/Kg) | Equipment Class |
|---|---|---|---|
| Head (Separation Distance 0mm) | GSM 850 | 0.49 | PCE |
| | PCS 1900 | 0.22 | |
| | UMTS FDD 4 | 0.18 | |
| | UMTS FDD 2 | 0.34 | |
| | WLAN 2.4 GHz | 0.27 | DTS |
| Body-worn (Separation Distance 10mm) | GSM 850 | 0.95 | PCE |
| | PCS 1900 | 1.06 | |
| | UMTS FDD 4 | 0.73 | |
| | UMTS FDD 2 | 1.31 | |
| | WLAN 2.4 GHz | 0.12 | DTS |

The SAR values found for the Mobile Phone are below the maximum recommended levels of 1.6 W/Kg as averaged over any 1g tissue according to the ANSI C95.1-1999.

For body worn operation, this device has been tested and meets FCC RF exposure guidelines when used with any accessory that contains no metal and which provides a minimum separation distance of 10 mm between this device and the body of the user. Use of other accessories may not ensure compliance with FCC RF exposure guidelines.

The EUT battery must be fully charged and checked periodically during the test to ascertain uniform power output.

The measurement together with the test system set-up is described in annex C of this test report. A detailed description of the equipment under test can be found in chapter 4 of this test report.

The highest reported SAR value is obtained at the case of **(Table 2.1),** and the values are**: 1.31 W/kg (1g).**

**Table 2.2: The sum of reported SAR values for main antenna and WiFi**

| | **Position** | **Main antenna** | **WiFi** | **Sum** |
|---|---|---|---|---|
| **Highest reported SAR value for Head** | Left hand, Touch cheek | 0.46 | 0.27 | **0.73** |
| | Right hand, Touch cheek | 0.49 | 0.15 | **0.64** |
| **Highest reported SAR value for Body** | Rear | 1.31 | 0.12 | **1.43** |

**Table 2.3: The sum of reported SAR values for main antenna and Bluetooth**

| | **Position** | **Main antenna** | **BT*** | **Sum** |
|---|---|---|---|---|
| **Highest reported SAR value for Head** | Right hand, Touch cheek | 0.49 | 0.17 | **0.66** |
| **Highest reported SAR value for Body** | Rear | 1.31 | 0.08 | **1.39** |

BT* - Estimated SAR for Bluetooth (see the table 13.3)

According to the above tables, the highest sum of reported SAR values is **1.43 W/kg (1g)**. The detail for simultaneous transmission consideration is described in chapter 13.

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# 3 Client Information

## 3.1 Applicant Information

| | |
|---|---|
| Company Name: | Moxee Technologies |
| Address /Post: | 10900 NE 8$^{th}$ Street, #1000 |
| City: | / |
| Postal Code: | 98004 |
| Country: | / |
| Contact: | Joe Phillips |
| Email: | joephillips@moxeetech.com |
| Telephone: | 425-890-7897 |
| Fax: | / |

## 3.2 Manufacturer Information

| | |
|---|---|
| Company Name: | Moxee Technologies |
| Address /Post: | 10900 NE 8$^{th}$ Street, #1000 |
| City: | / |
| Postal Code: | 98004 |
| Country: | / |
| Contact: | Joe Phillips |
| Email: | joephillips@moxeetech.com |
| Telephone: | 425-890-7897 |
| Fax: | / |

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# 4 Equipment Under Test (EUT) and Ancillary Equipment (AE)

## 4.1 About EUT

| | |
|---|---|
| Description: | WCDMA/GSM（GPRS）Dual-Mode Digital Mobile Phone |
| Model name: | X1 |
| Operating mode(s): | GSM 850/1800/1900, WCDMA 1700/1900, BT, Wi-Fi |
| Tested Tx Frequency: | 825 – 848.8 MHz (GSM 850) |
| | 1850.2 – 1910 MHz (GSM 1900) |
| | 826.4–846.6 MHz (WCDMA850 Band V) |
| | 1712.4 – 1752.6 MHz (WCDMA 1700 Band IV) |
| | 2412 – 2462 MHz (Wi-Fi 2.4G) |
| GPRS Multislot Class: | 12 |
| GPRS capability Class: | B |
| Test device Production information: | Production unit |
| Device type: | Portable device |
| Antenna type: | Integrated antenna |
| Hotspot mode: | Support simultaneous transmission of hotspot and voice(or data) |

## 4.2 Internal Identification of EUT used during the test

| EUT ID* | IMEI | HW Version | SW Version |
|---|---|---|---|
| EUT1 | 862240021000624 | MBV1.0 | MOXEE_X1_V1.1 |
| EUT2 | 862240021000681 | MBV1.0 | MOXEE_X1_V1.1 |
| EUT3 | 866542020000001 | MBV1.0 | MOXEE_X1_V1.1 |

*EUT ID: is used to identify the test sample in the lab internally.

**Note:** It is performed to test SAR with the EUT1&2 and conducted power with the EUT 3.

## 4.3 Internal Identification of AE used during the test

| AE ID* | Description | Model | SN | Manufacturer |
|---|---|---|---|---|
| AE1 | Battery | X1 | / | shenzhen HuaxinEnergy Technology Co.,Ltd |
| AE2 | Headset | JHC20140922004H | / | JHC Sound Electronics Co,.Ltd |

*AE ID: is used to identify the test sample in the lab internally.

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# 5 TEST METHODOLOGY

## 5.1 Applicable Limit Regulations

**ANSI C95.1–1999:** 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.

## 5.2 Applicable Measurement Standards

**IEEE 1528–2013:** Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Experimental Techniques.

**KDB447498 D01: General RF Exposure Guidance v05r02:** Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies.

**KDB648474 D04 Handset SAR v01r02:** SAR Evaluation Considerations for Wireless Handsets.

**KDB941225 D01 3G SAR Procedures v03:** 3G SAR Measurement Procedures.

**KDB941225 D06 Hotspot Mode SAR v01r01:** SAR Evaluation Procedures for Portable Devices with Wireless Router Capabilities.

**KDB248227:** SAR measurement procedures for 802.112abg transmitters.

**KDB 865664 D01 SAR measurement 100 MHz to 6 GHz v01r03:** SAR Measurement Requirements for 100 MHz to 6 GHz.

**KDB 865664 D02 RF Exposure Reporting v01r01:** RF Exposure Compliance Reporting and Documentation Considerations.

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# 6 Specific Absorption Rate (SAR)

## 6.1 Introduction

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

## 6.2 SAR Definition

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

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

SAR is expressed in units of Watts per kilogram (W/kg)

SAR measurement can be either related to the temperature elevation in tissue by

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

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

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

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

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

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# 7 Tissue Simulating Liquids

## 7.1 Targets for tissue simulating liquid

**Table 7.1: Targets for tissue simulating liquid**

| Frequency(MHz) | Liquid Type | Conductivity(σ) | ± 5% Range | Permittivity(ε) | ± 5% Range |
|---|---|---|---|---|---|
| 835 | Head | 0.90 | 0.86～0.95 | 41.5 | 39.4～43.6 |
| 835 | Body | 0.97 | 0.92～1.02 | 55.2 | 52.4～58.0 |
| 1750 | Head | 1.37 | 1.30～1.44 | 40.08 | 38.1～42.1 |
| 1750 | Body | 1.49 | 1.42～1.56 | 53.4 | 50.7～56.1 |
| 1900 | Head | 1.40 | 1.33～1.47 | 40.0 | 38.0～42.0 |
| 1900 | Body | 1.52 | 1.44～1.60 | 53.3 | 50.6～56.0 |
| 2450 | Head | 1.80 | 1.71～1.89 | 39.2 | 37.2～41.2 |
| 2450 | Body | 1.95 | 1.85～2.05 | 52.7 | 50.1～55.3 |

## 7.2 Dielectric Performance

**Table 7.2: Dielectric Performance of Tissue Simulating Liquid**

| Measurement Date (yyyy-mm-dd) | Type | Frequency | Permittivity ε | Drift (%) | Conductivity σ (S/m) | Drift (%) |
|---|---|---|---|---|---|---|
| 2014-11-13 | Head | 835 MHz | 42.62 | 2.70 | 0.919 | 2.11 |
| | Body | 835 MHz | 56.75 | 2.81 | 0.996 | 2.68 |
| 2014-11-14 | Head | 1750 MHz | 40.62 | 1.35 | 1.397 | 1.97 |
| | Body | 1750 MHz | 54.33 | 1.74 | 1.508 | 1.21 |
| 2014-11-15 | Head | 1900 MHz | 40.89 | 2.23 | 1.384 | -1.14 |
| | Body | 1900 MHz | 51.72 | -2.96 | 1.564 | 2.89 |
| 2014-11-16 | Head | 2450 MHz | 40.35 | 2.93 | 1.836 | 2.00 |
| | Body | 2450 MHz | 53.7 | 1.90 | 1.892 | -2.97 |

Note: The liquid temperature is 22.0 ℃

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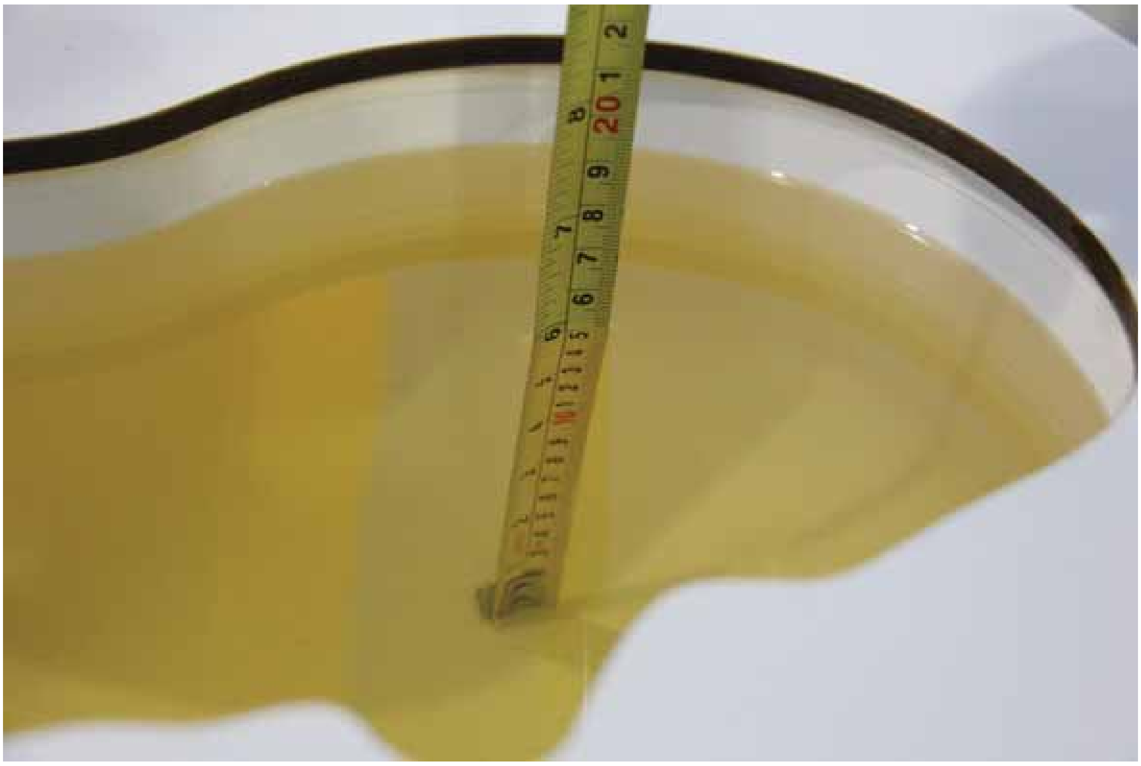
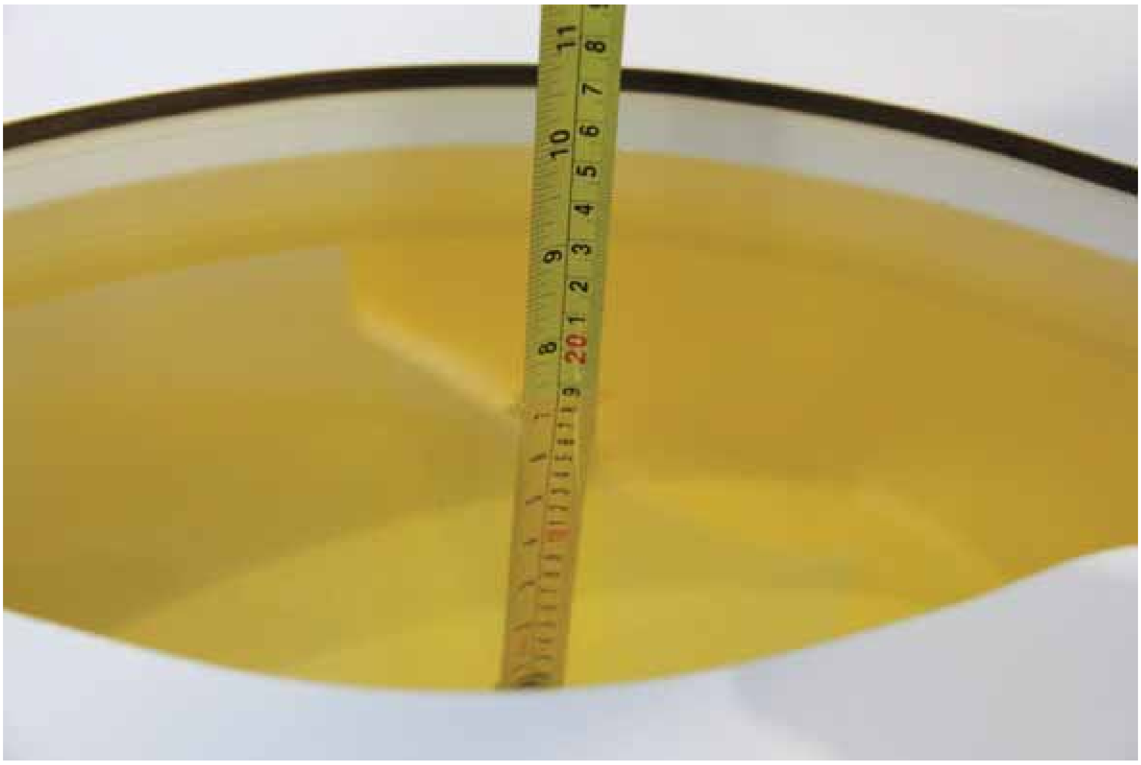


**Picture 7-1 Liquid depth in the Head Phantom (835 MHz)**



**Picture 7-2 Liquid depth in the Flat Phantom (835 MHz)**

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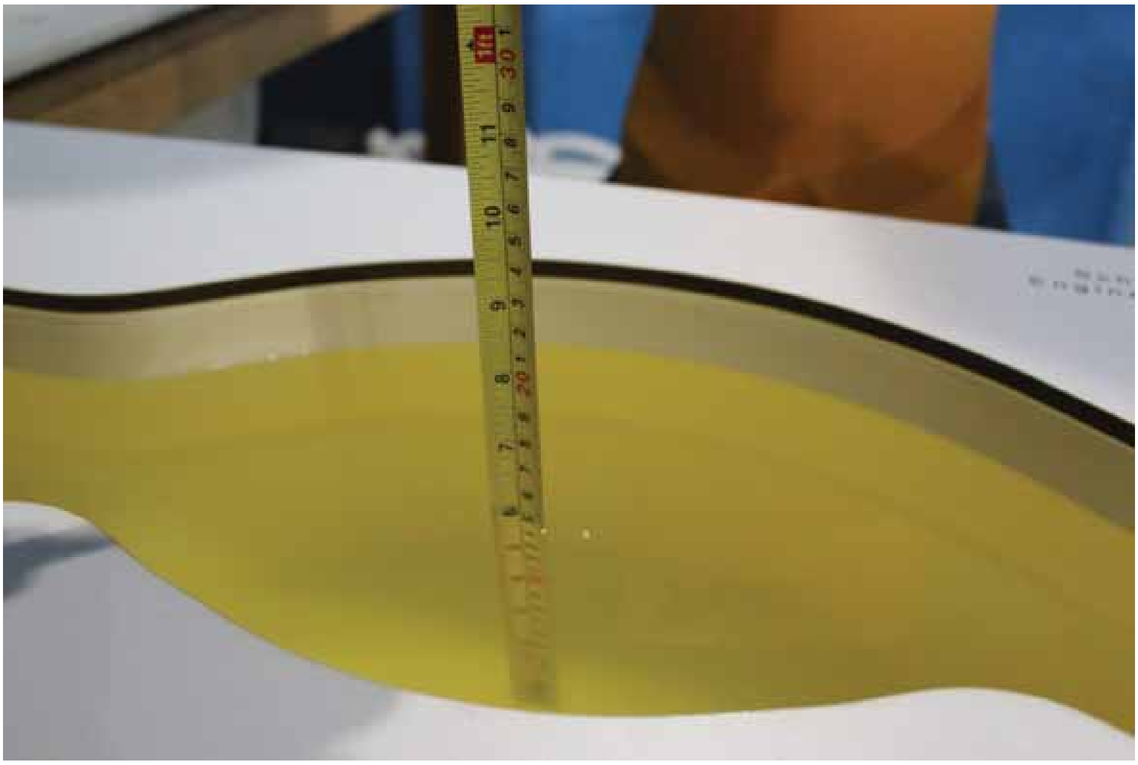
**Picture 7-3 Liquid depth in the Head Phantom (1750 MHz)**



**Picture 7-4 Liquid depth in the Flat Phantom (1750MHz)**

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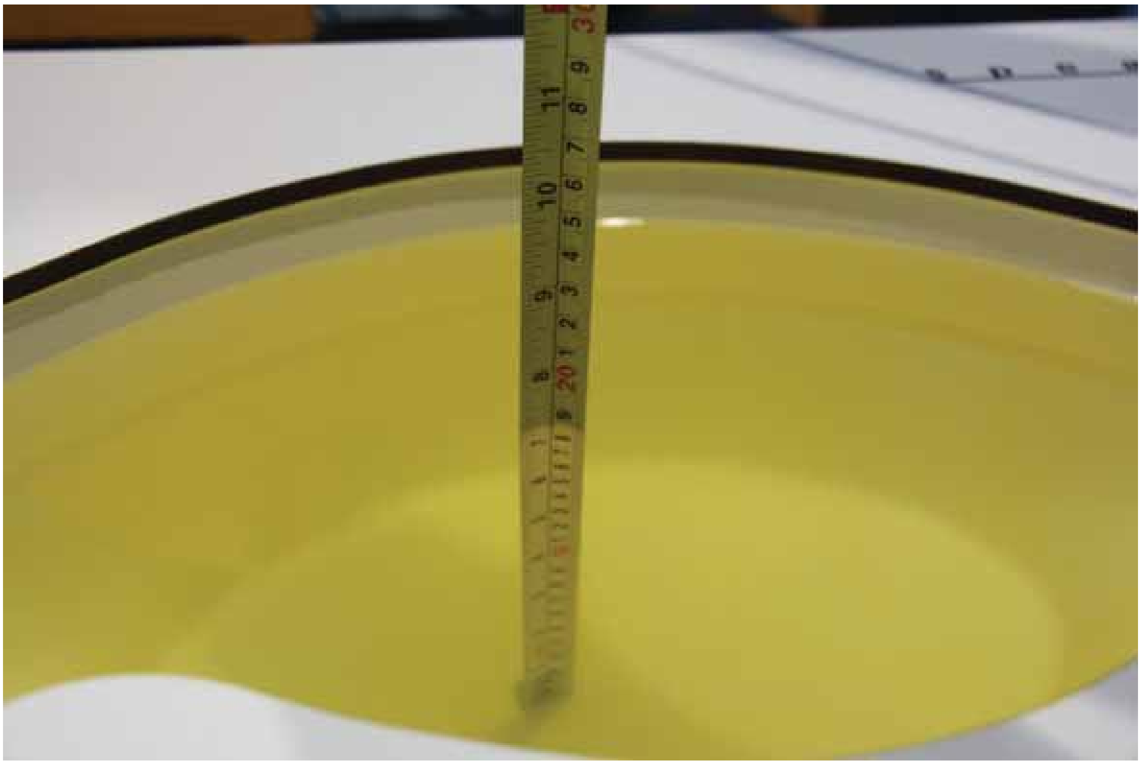
Picture 7-5 Liquid depth in the Head Phantom (1900 MHz)



Picture 7-6 Liquid depth in the Flat Phantom (1900MHz)

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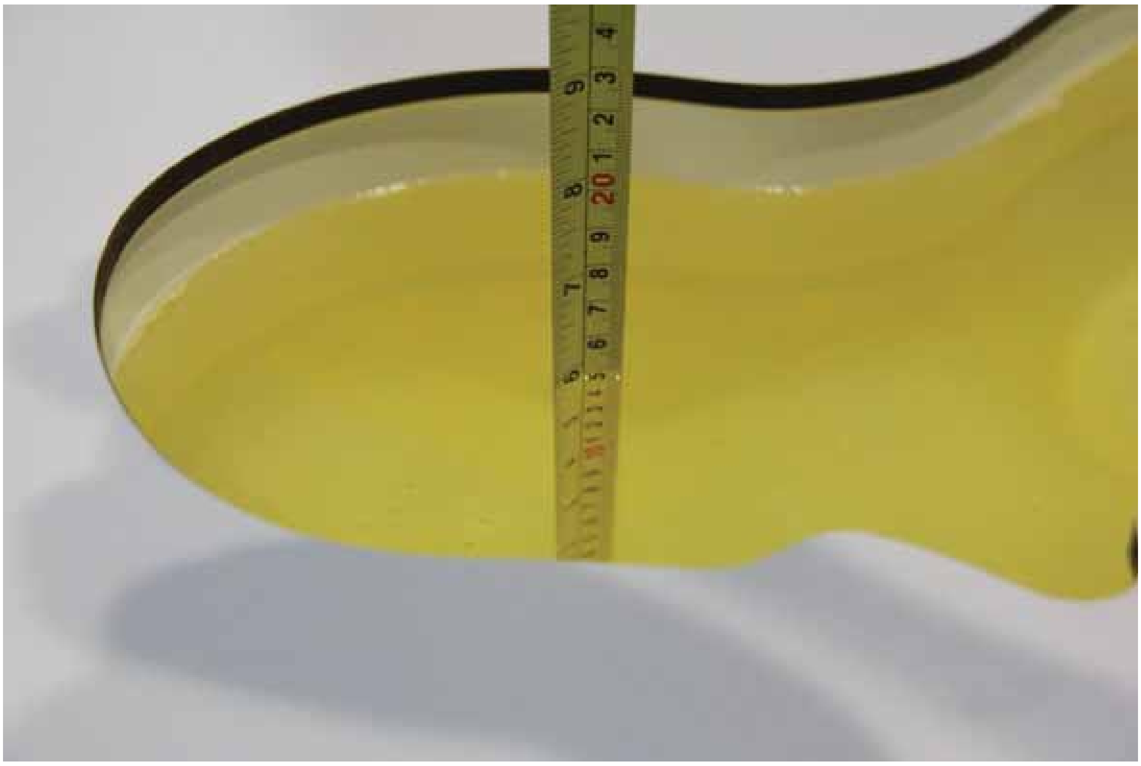
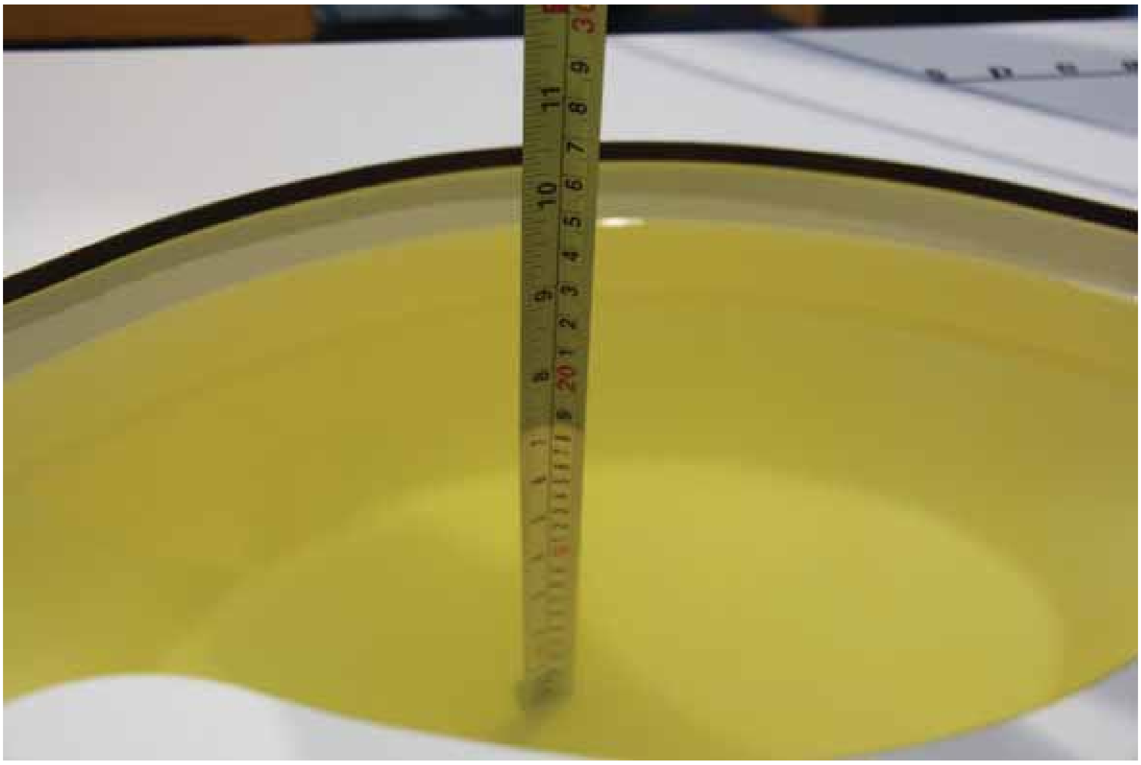


**Picture 7-7 Liquid depth in the Head Phantom (2450MHz)**



**Picture 7-8 Liquid depth in the Flat Phantom (2450MHz)**

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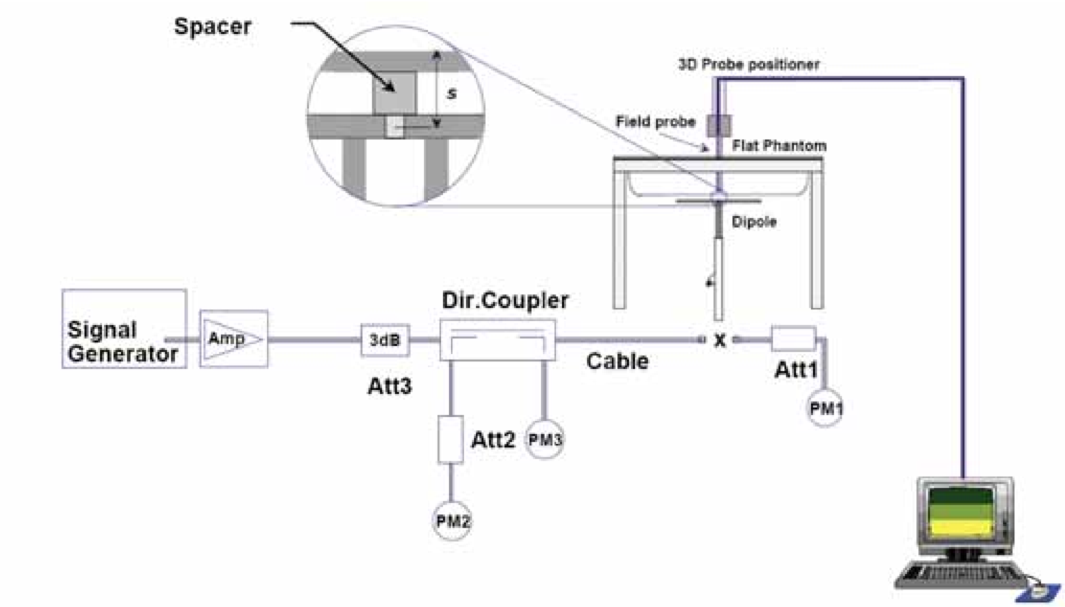
# 8 System verification

## 8.1 System Setup

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:




**Picture 8.1 System Setup for System Evaluation**

**Picture 8.2 Photo of Dipole Setup**

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## 8.2 System Verification

SAR system verification is required to confirm measurement accuracy, according to the tissue dielectric media, probe calibration points and other system operating parameters required for measuring the SAR of a test device. The system verification must be performed for each frequency band and within the valid range of each probe calibration point required for testing the device.

The system verification results are required that the area scan estimated 1-g SAR is within 3% of the zoom scan 1-g SAR. The details are presented in annex B.

**Table 8.1: System Verification of Head**

| Measurement Date (yyyy-mm-dd) | Frequency | Target value (W/kg) | | Measured value (W/kg) | | Deviation | |
|---|---|---|---|---|---|---|---|
| | | 10 g Average | 1 g Average | 10 g Average | 1 g Average | 10 g Average | 1 g Average |
| 2014-11-13 | 835 MHz | 6.17 | 9.43 | 6.36 | 9.76 | 3.08% | 3.50% |
| 2014-11-14 | 1750 MHz | 19.7 | 36.9 | 19.20 | 35.84 | -2.54% | -2.87% |
| 2014-11-15 | 1900 MHz | 21.1 | 40.6 | 20.68 | 39.40 | -1.99% | -2.96% |
| 2014-11-16 | 2450 MHz | 24.7 | 53.2 | 24.44 | 52.40 | -1.05% | -1.50% |

**Table 8.2: System Verification of Body**

| Measurement Date (yyyy-mm-dd) | Frequency | Target value (W/kg) | | Measured value (W/kg) | | Deviation | |
|---|---|---|---|---|---|---|---|
| | | 10 g Average | 1 g Average | 10 g Average | 1 g Average | 10 g Average | 1 g Average |
| 2014-11-13 | 835 MHz | 6.33 | 9.55 | 6.24 | 9.48 | -1.42% | -0.73% |
| 2014-11-14 | 1750 MHz | 20.3 | 37.7 | 19.88 | 37.00 | -2.07% | -1.86% |
| 2014-11-15 | 1900 MHz | 21.4 | 40.4 | 21.64 | 41.20 | 1.12% | 1.98% |
| 2014-11-16 | 2450 MHz | 23.9 | 51.3 | 23.40 | 50.00 | -2.09% | -2.53% |

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# 9 Measurement Procedures

## 9.1 Tests to be performed

In order to determine the highest value of the peak spatial-average SAR of a handset, all device positions, configurations and operational modes shall be tested for each frequency band according to steps 1 to 3 below. A flowchart of the test process is shown in picture 9.1.

**Step 1**: The tests described in 9.2 shall be performed at the channel that is closest to the centre of the transmit frequency band ( $f_c$) for:

a) all device positions (cheek and tilt, for both left and right sides of the SAM phantom, as described in annex D),
b) all configurations for each device position in a), e.g., antenna extended and retracted, and
c) all operational modes, e.g., analogue and digital, for each device position in a) and configuration in b) in each frequency band.

If more than three frequencies need to be tested according to 11.1 (i.e., $N_c$ > 3), then all frequencies, configurations and modes shall be tested for all of the above test conditions.

**Step 2**: For the condition providing highest peak spatial-average SAR determined in Step 1, perform all tests described in 9.2 at all other test frequencies, i.e., lowest and highest frequencies. In addition, for all other conditions (device position, configuration and operational mode) where the peak spatial-average SAR value determined in Step 1 is within 3 dB of the applicable SAR limit, it is recommended that all other test frequencies shall be tested as well.

**Step 3**: Examine all data to determine the highest value of the peak spatial-average SAR found in Steps 1 to 2.

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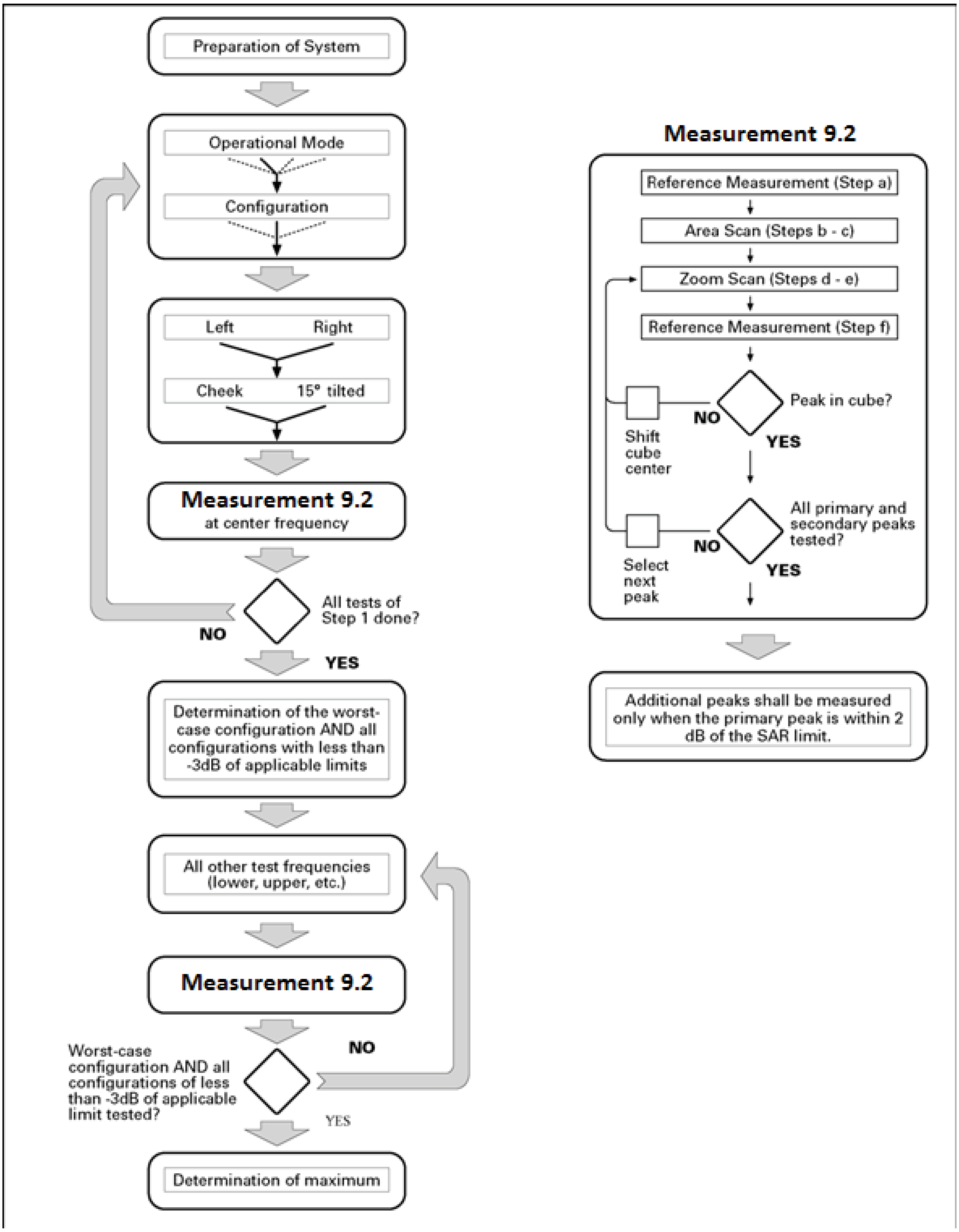


**Picture 9.1 Block diagram of the tests to be performed**

## 9.2 General Measurement Procedure

The area and zoom scan resolutions specified in the table below must be applied to the SAR measurements and fully documented in SAR reports to qualify for TCB approval. Probe boundary effect error compensation is required for measurements with the probe tip closer than half a probe

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tip diameter to the phantom surface. Both the probe tip diameter and sensor offset distance must satisfy measurement protocols; to ensure probe boundary effect errors are minimized and the higher fields closest to the phantom surface can be correctly measured and extrapolated to the phantom surface for computing 1-g SAR. Tolerances of the post-processing algorithms must be verified by the test laboratory for the scan resolutions used in the SAR measurements, according to the reference distribution functions specified in IEEE Std 1528-2003. The results should be documented as part of the system validation records and may be requested to support test results when all the measurement parameters in the following table are not satisfied.

<table>
<tr><th colspan="3"></th><th>$\leq$ 3 GHz</th><th>> 3 GHz</th></tr>
<tr><td colspan="3">Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface</td><td>5 ± 1 mm</td><td>½·δ·ln(2) ± 0.5 mm</td></tr>
<tr><td colspan="3">Maximum probe angle from probe axis to phantom surface normal at the measurement location</td><td>30° ± 1°</td><td>20° ± 1°</td></tr>
<tr><td colspan="3" rowspan="2">Maximum area scan spatial resolution: $\Delta x_{Area}$, $\Delta y_{Area}$</td><td>$\leq$ 2 GHz: $\leq$ 15 mm<br>2 – 3 GHz: $\leq$ 12 mm</td><td>3 – 4 GHz: $\leq$ 12 mm<br>4 – 6 GHz: $\leq$ 10 mm</td></tr>
<tr><td colspan="2">When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be $\leq$ the corresponding x or y dimension of the test device with at least one measurement point on the test device.</td></tr>
<tr><td colspan="3">Maximum zoom scan spatial resolution: $\Delta x_{Zoom}$, $\Delta y_{Zoom}$</td><td>$\leq$ 2 GHz: $\leq$ 8 mm<br>2 – 3 GHz: $\leq$ 5 mm*</td><td>3 – 4 GHz: $\leq$ 5 mm*<br>4 – 6 GHz: $\leq$ 4 mm*</td></tr>
<tr><td rowspan="3">Maximum zoom scan spatial resolution, normal to phantom surface</td><td colspan="2">uniform grid: $\Delta z_{Zoom}(n)$</td><td>$\leq$ 5 mm</td><td>3 – 4 GHz: $\leq$ 4 mm<br>4 – 5 GHz: $\leq$ 3 mm<br>5 – 6 GHz: $\leq$ 2 mm</td></tr>
<tr><td rowspan="2">graded grid</td><td>$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface</td><td>$\leq$ 4 mm</td><td>3 – 4 GHz: $\leq$ 3 mm<br>4 – 5 GHz: $\leq$ 2.5 mm<br>5 – 6 GHz: $\leq$ 2 mm</td></tr>
<tr><td>$\Delta z_{Zoom}(n>1)$: between subsequent points</td><td colspan="2">$\leq 1.5 \cdot \Delta z_{Zoom}(n-1)$</td></tr>
<tr><td>Minimum zoom scan volume</td><td colspan="2">x, y, z</td><td>$\geq$ 30 mm</td><td>3 – 4 GHz: $\geq$ 28 mm<br>4 – 5 GHz: $\geq$ 25 mm<br>5 – 6 GHz: $\geq$ 22 mm</td></tr>
<tr><td colspan="5">Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details.<br>* When zoom scan is required and the <u>reported</u> SAR from the area scan based 1-g SAR estimation procedures of KDB 447498 is $\leq$ 1.4 W/kg, $\leq$ 8 mm, $\leq$ 7 mm and $\leq$ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.</td></tr>
</table>

### 9.3 WCDMA Measurement Procedures for SAR

The following procedures are applicable to WCDMA handsets operating under 3GPP Release99, Release 5 and Release 6. The default test configuration is to measure SAR with an established radio link between the DUT and a communication test set using a 12.2kbps RMC (reference measurement channel) configured in Test Loop Mode 1. SAR is selectively confirmed for other

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physical channel configurations (DPCCH & DPDCH$_n$), HSDPA and HSPA (HSUPA/HSDPA) modes according to output power, exposure conditions and device operating capabilities. Both uplink and downlink should be configured with the same RMC or AMR, when required. SAR for Release 5 HSDPA and Release 6 HSPA are measured using the applicable FRC (fixed reference channel) and E-DCH reference channel configurations. Maximum output power is verified according to applicable versions of 3GPP TS 34.121 and SAR must be measured according to these maximum output conditions. When Maximum Power Reduction (MPR) is not implemented according to Cubic Metric (CM) requirements for Release 6 HSPA, the following procedures do not apply.

**For Release 5 HSDPA Data Devices:**

| Sub-test | $\beta_c$ | $\beta_d$ | $\beta_d$ (SF) | $\beta_c / \beta_d$ | $\beta_{hs}$ | CM/dB |
|---|---|---|---|---|---|---|
| 1 | 2/15 | 15/15 | 64 | 2/15 | 4/15 | 0.0 |
| 2 | 12/15 | 15/15 | 64 | 12/15 | 24/25 | 1.0 |
| 3 | 15/15 | 8/15 | 64 | 15/8 | 30/15 | 1.5 |
| 4 | 15/15 | 4/15 | 64 | 15/4 | 30/15 | 1.5 |

**For Release 6 HSPA Data Devices**

| Sub-test | $\beta_c$ | $\beta_d$ | $\beta_d$ (SF) | $\beta_c / \beta_d$ | $\beta_{hs}$ | $\beta_{ec}$ | $\beta_{ed}$ | $\beta_{ed}$ (SF) | $\beta_{ed}$ (codes) | CM (dB) | MPR (dB) | AG Index | E-TFCI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 11/15 | 15/15 | 64 | 11/15 | 22/15 | 209/225 | 1039/225 | 4 | 1 | 3.5 | 3.5 | 20 | 75 |
| 2 | 6/15 | 15/15 | 64 | 6/15 | 12/15 | 12/15 | 12/15 | 4 | 1 | 3.5 | 3.5 | 12 | 67 |
| 3 | 15/15 | 9/15 | 64 | 15/9 | 30/15 | 30/15 | $\beta_{ed1}$:47/15<br>$\beta_{ed2}$:47/15 | 4 | 2 | 2.5 | 2.5 | 15 | 92 |
| 4 | 2/15 | 15/15 | 64 | 2/15 | 4/15 | 4/15 | 56/75 | 4 | 1 | 3.5 | 3.5 | 17 | 71 |
| 5 | 15/15 | 15/15 | 64 | 15/15 | 24/15 | 30/15 | 134/15 | 4 | 1 | 1.5 | 1.5 | 21 | 81 |

## 9.4 Bluetooth & Wi-Fi Measurement Procedures for SAR

Normal network operating configurations are not suitable for measuring the SAR of 802.11 transmitters in general. Unpredictable fluctuations in network traffic and antenna diversity conditions can introduce undesirable variations in SAR results. The SAR for these devices should be measured using chipset based test mode software to ensure that the results are consistent and reliable.

Chipset based test mode software is hardware dependent and generally varies among manufacturers. The device operating parameters established in a test mode for SAR measurements must be identical to those programmed in production units, including output power levels, amplifier gain settings and other RF performance tuning parameters. The test frequencies should correspond to actual channel frequencies defined for domestic use. SAR for devices with switched diversity should be measured with only one antenna transmitting at a time during each SAR measurement, according to a fixed modulation and data rate. The same data pattern should be used for all measurements.

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### 9.5 Power Drift

To control the output power stability during the SAR test, DASY4 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. These drift values can be found in Table 14.2 to Table 14.21 labeled as: (Power Drift [dB]). This ensures that the power drift during one measurement is within 5%.

## 10 Area Scan Based 1-g SAR

### 10.1 Requirement of KDB

According to the KDB447498 D01 v05, when the implementation is based the specific polynomial fit algorithm as presented at the 29th Bioelectromagnetics Society meeting (2007) and the estimated 1-g SAR is ≤ 1.2 W/kg, a zoom scan measurement is not required provided it is also not needed for any other purpose; for example, if the peak SAR location required for simultaneous transmission SAR test exclusion can be determined accurately by the SAR system or manually to discriminate between distinctive peaks and scattered noisy SAR distributions from area scans.

There must not be any warning or alert messages due to various measurement concerns identified by the SAR system; for example, noise in measurements, peaks too close to scan boundary, peaks are too sharp, spatial resolution and uncertainty issues etc. The SAR system verification must also demonstrate that the area scan estimated 1-g SAR is within 3% of the zoom scan 1-g SAR (See Annex B). When all the SAR results for each exposure condition in a frequency band and wireless mode are based on estimated 1-g SAR, the 1-g SAR for the highest SAR configuration must be determined by a zoom scan.

### 10.2 Fast SAR Algorithms

The approach is based on the area scan measurement applying a frequency dependent attenuation parameter. This attenuation parameter was empirically determined by analyzing a large number of phones. The MOTOROLA FAST SAR was developed and validated by the MOTOROLA Research Group in Ft. Lauderdale.

In the initial study, an approximation algorithm based on Linear fit was developed. The accuracy of the algorithm has been demonstrated across a broad frequency range (136-2450 MHz) and for both 1- and 10-g averaged SAR using a sample of 264 SAR measurements from 55 wireless handsets. For the sample size studied, the root-mean-squared errors of the algorithm are 1.2% and 5.8% for 1- and 10-g averaged SAR, respectively. The paper describing the algorithm in detail is expected to be published in August 2004 within the Special Issue of Transactions on MTT.

In the second step, the same research group optimized the fitting algorithm to an Polynomial fit whereby the frequency validity was extended to cover the range 30-6000MHz. Details of this study can be found in the BEMS 2007 Proceedings.

Both algorithms are implemented in DASY software.

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# 11 Conducted Output Power

## 11.1 Manufacturing tolerance

**Table 11.1: GSM Speech**

| GSM 850 | | | |
|---|---|---|---|
| Channel | Channel 251 | Channel 190 | Channel 128 |
| Target (dBm) | 31.5 | 31.5 | 31.5 |
| Tune-up (dBm) | 33.5 | 33.5 | 33.5 |
| GSM 1900 | | | |
| Channel | Channel 810 | Channel 661 | Channel 512 |
| Target (dBm) | 28.5 | 28.5 | 28.5 |
| Tune-up (dBm) | 30.5 | 30.5 | 30.5 |

**Table 11.2: GPRS and EGPRS**

| GSM 850 GPRS (GMSK) | | | | |
|---|---|---|---|---|
| Channel | | **251** | **190** | **128** |
| 1 Txslot | Target (dBm) | 31.5 | 31.5 | 31.5 |
| | Tune-up (dBm) | 33.5 | 33.5 | 33.5 |
| 2 Txslots | Target (dBm) | 31 | 31 | 31 |
| | Tune-up (dBm) | 33 | 33 | 33 |
| 3 Txslots | Target (dBm) | 29.5 | 29.5 | 29.5 |
| | Tune-up (dBm) | 31.5 | 31.5 | 31.5 |
| 4 Txslots | Target (dBm) | 28 | 28 | 28 |
| | Tune-up (dBm) | 30 | 30 | 30 |
| GSM 1900 GPRS (GMSK) | | | | |
| Channel | | **810** | **661** | **512** |
| 1 Txslot | Target (dBm) | 28.5 | 28.5 | 28.5 |
| | Tune-up (dBm) | 30.5 | 30.5 | 30.5 |
| 2 Txslots | Target (dBm) | 28 | 28 | 28 |
| | Tune-up (dBm) | 30 | 30 | 30 |
| 3 Txslots | Target (dBm) | 26 | 26 | 26 |
| | Tune-up (dBm) | 28 | 28 | 28 |
| 4 Txslots | Target (dBm) | 25 | 25 | 25 |
| | Tune-up (dBm) | 27 | 27 | 27 |

**Table 11.3: WCDMA**

| WCDMA 1700 CS | | | |
|---|---|---|---|
| Channel | Channel 1513 | Channel 1412 | Channel 1312 |
| Target (dBm) | 19.5 | 19.5 | 19.5 |
| Tune-up (dBm) | 21.5 | 21.5 | 21.5 |
| HSUPA (sub-test 1/2/4) | | | |
| Channel | Channel 1513 | Channel 1412 | Channel 1312 |
| Target (dBm) | 16 | 16 | 16 |
| Tune-up (dBm) | 18 | 18 | 18 |

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| HSUPA (sub-test 3) | | | |
|---|---|---|---|
| Channel | Channel 1513 | Channel 1412 | Channel 1312 |
| Target (dBm) | 17 | 17 | 17 |
| Tune-up (dBm) | 19 | 19 | 19 |
| HSUPA (sub-test 5) | | | |
| Channel | Channel 1513 | Channel 1412 | Channel 1312 |
| Target (dBm) | 18 | 18 | 18 |
| Tune-up (dBm) | 20 | 20 | 20 |
| WCDMA 1900 CS | | | |
| Channel | Channel 9538 | Channel 9400 | Channel 9262 |
| Target (dBm) | 21.5 | 21.5 | 21.5 |
| Tune-up (dBm) | 23.5 | 23.5 | 23.5 |
| HSUPA (sub-test 1/2/4) | | | |
| Channel | Channel 9538 | Channel 9400 | Channel 9262 |
| Target (dBm) | 18 | 18 | 18 |
| Tune-up (dBm) | 20 | 20 | 20 |
| HSUPA (sub-test 3) | | | |
| Channel | Channel 9538 | Channel 9400 | Channel 9262 |
| Target (dBm) | 19 | 19 | 19 |
| Tune-up (dBm) | 21 | 21 | 21 |
| HSUPA (sub-test 5) | | | |
| Channel | Channel 9538 | Channel 9400 | Channel 9262 |
| Target (dBm) | 20 | 20 | 20 |
| Tune-up (dBm) | 22 | 22 | 22 |

**Table 11.4: Bluetooth**

| Bluetooth | | | |
|---|---|---|---|
| Channel | Channel 0 | Channel 39 | Channel 78 |
| Target (dBm) | 3 | 3 | 3 |
| Tune-up (dBm) | 6 | 6 | 6 |

**Table 11.5: WiFi**

| Mode | Target (dBm) | Tune-up (dBm) |
|---|---|---|
| 802.11b | 13.5 | 18.5 |
| 802.11g | 11 | 16 |
| 802.11n | 11 | 16 |

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## 11.2 GSM Measurement result

During the process of testing, the EUT was controlled via Agilent Digital Radio Communication tester (E5515C) to ensure the maximum power transmission and proper modulation. This result contains conducted output power for the EUT. In all cases, the measured peak output power should be greater and within 5% than EMI measurement.

**Table 11.6: The conducted power measurement results for GSM850/1900**

| GSM 850MHz | Conducted Power (dBm) | | |
|---|---|---|---|
| | Channel 251(848.8MHz) | Channel 190(836.6MHz) | Channel 128(824.2MHz) |
| | 33.48 | 33.49 | 33.50 |
| GSM 1900MHz | Conducted Power (dBm) | | |
| | Channel 810(1909.8MHz) | Channel 661(1880MHz) | Channel 512(1850.2MHz) |
| | 29.96 | 30.33 | 30.23 |

**Table 11.7: The conducted power measurement results for GPRS and EGPRS**

| GSM 850 GPRS (GMSK) | Measured Power (dBm) | | | calculation | Averaged Power (dBm) | | |
|---|---|---|---|---|---|---|---|
| | **251** | **190** | **128** | | **251** | **190** | **128** |
| 1 Txslot | 33.48 | 33.48 | 33.48 | -9.03dB | 24.45 | 24.45 | 24.45 |
| 2 Txslots | 32.79 | 32.79 | 32.78 | -6.02dB | 26.77 | 26.77 | 26.76 |
| 3Txslots | 31.05 | 31.06 | 31.04 | -4.26dB | 26.79 | 26.80 | 26.78 |
| **4 Txslots** | 29.98 | 30.00 | 29.97 | -3.01dB | **26.97** | **26.99** | **26.96** |
| PCS1900 GPRS (GMSK) | Measured Power (dBm) | | | calculation | Averaged Power (dBm) | | |
| | **810** | **661** | **512** | | **810** | **661** | **512** |
| 1 Txslot | 29.94 | 30.34 | 30.24 | -9.03dB | 20.91 | 21.31 | 21.21 |
| 2 Txslots | 29.16 | 29.57 | 29.47 | -6.02dB | 23.14 | 23.55 | 23.45 |
| 3Txslots | 27.35 | 27.75 | 27.62 | -4.26dB | 23.09 | 23.49 | 23.36 |
| **4 Txslots** | 26.25 | 26.64 | 26.47 | -3.01dB | **23.24** | **23.63** | **23.46** |

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) => -9.03dB

2TX-slots = 2 transmit time slots out of 8 time slots=> conducted power divided by (8/2) => -6.02dB

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) => -3.01dB

**According to the conducted power as above, the body measurements are performed with 4Txslots for GSM850 and GSM1900.**

**Note: According to the KDB941225 D03, "when SAR tests for EDGE or EGPRS mode is necessary, GMSK modulation should be used".**

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## 11.3 WCDMA Measurement result

**Table 11.8: The conducted Power for WCDMA**

| Item | band | FDDIV result | | |
|---|---|---|---|---|
| | ARFCN | 1513 (1752.6MHz) | 1412 (1732.4MHz) | 1312 (1712.4MHz) |
| WCDMA | \ | 21.44 | 21.34 | 21.48 |
| HSUPA | 1 | 17.47 | 17.69 | 17.52 |
| | 2 | 17.47 | 17.68 | 17.48 |
| | 3 | 18.44 | 18.67 | 18.47 |
| | 4 | 16.93 | 17.14 | 17.00 |
| | 5 | 19.43 | 19.65 | 19.46 |
| Item | band | FDDII result | | |
| | ARFCN | 9538 (1907.6MHz) | 9400 (1880MHz) | 9262 (1852.4MHz) |
| WCDMA | \ | 22.95 | 23.08 | 23.12 |
| HSUPA | 1 | 19.37 | 19.42 | 19.19 |
| | 2 | 19.36 | 19.41 | 19.16 |
| | 3 | 20.35 | 20.41 | 20.17 |
| | 4 | 18.83 | 18.89 | 18.66 |
| | 5 | 21.32 | 21.37 | 21.15 |

## 11.4 Wi-Fi and BT Measurement result

The output power of BT antenna is as following:

| Mode | Conducted Power (dBm) | | |
|---|---|---|---|
| | Channel 0 (2402MHz) | Channel 39 (2441MHz) | Channel 78 (2480MHz) |
| GFSK | 5.32 | 5.76 | 5.95 |

The average conducted power for Wi-Fi is as following:

802.11b (dBm)

| Channel\data rate | 1Mbps | 2Mbps | 5.5Mbps | 11Mbps |
|---|---|---|---|---|
| 1 | 18.01 | 18.17 | 17.99 | 18.05 |
| 6 | 18.12 | 18.28 | 18.23 | 18.25 |
| 11 | 17.62 | 17.82 | 17.69 | 17.77 |

802.11g (dBm)

| Channel\data rate | 6Mbps | 9Mbps | 12Mbps | 18Mbps | 24Mbps | 36Mbps | 48Mbps | 54Mbps |
|---|---|---|---|---|---|---|---|---|
| 1 | 15.23 | 15.29 | 15.35 | 15.33 | 15.39 | 15.42 | 15.51 | 15.47 |
| 6 | 14.92 | 14.93 | 14.93 | 14.99 | 14.93 | 15.02 | 15.13 | 15.11 |
| 11 | 14.23 | 14.32 | 14.36 | 14.39 | 14.34 | 14.37 | 14.52 | 14.48 |

802.11n (dBm) - HT20 (2.4G)

| Channel\data rate | MCS0 | MCS1 | MCS2 | MCS3 | MCS4 | MCS5 | MCS6 | MCS7 |
|---|---|---|---|---|---|---|---|---|
| 1 | 15.23 | 15.32 | 15.36 | 15.34 | 15.43 | 15.52 | 15.55 | 15.61 |
| 6 | 14.77 | 14.92 | 14.95 | 14.87 | 14.98 | 15.08 | 15.11 | 15.23 |
| 11 | 14.49 | 14.52 | 14.58 | 14.55 | 14.49 | 14.60 | 14.60 | 14.62 |

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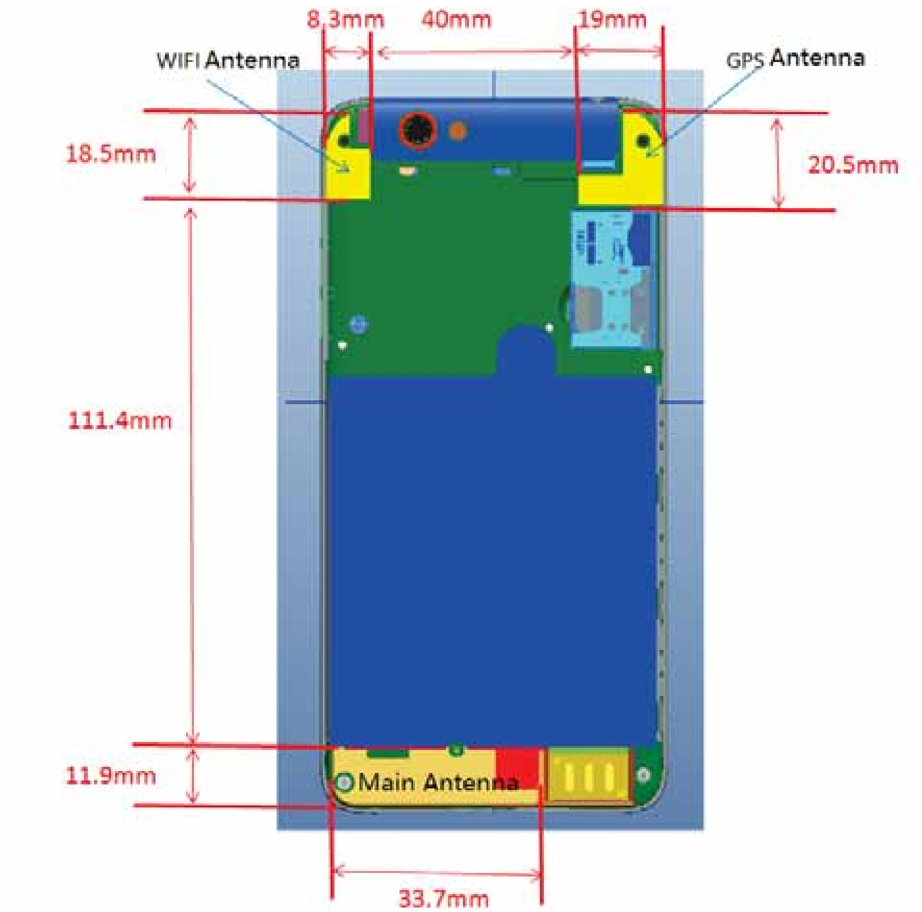
# 12 Simultaneous TX SAR Considerations

## 12.1 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 802.11 a/b/g and Bluetooth devices which may simultaneously transmit with the licensed transmitter. For this device, the BT and Wi-Fi can transmit simultaneous with other transmitters.

## 12.2 Transmit Antenna Separation Distances




**Picture 12.1 Antenna Locations**

## 12.3 SAR Measurement Positions

According to the KDB941225 D06 Hot Spot SAR v01, the edges with less than 2.5 cm distance to the antennas need to be tested for SAR.

| SAR measurement positions | | | | | | |
|---|---|---|---|---|---|---|
| Mode | Front | Rear | Left edge | Right edge | Top edge | Bottom edge |
| Main antenna | Yes | Yes | Yes | Yes | No | Yes |
| WLAN | Yes | Yes | No | Yes | Yes | No |

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### 12.4 Standalone SAR Test Exclusion Considerations

Standalone 1-g head or body SAR evaluation by measurement or numerical simulation is not required when the corresponding SAR Exclusion Threshold condition, listed below, is satisfied. The 1-g SAR test exclusion threshold for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:

[(max. power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm)] · [√f(GHz)] ≤ 3.0 for 1-g SAR, where

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

**Table 12.1: Standalone SAR test exclusion considerations**

| Band/Mode | F(GHz) | Position | SAR test exclusion threshold (mW) | RF output power | | SAR test exclusion |
|---|---|---|---|---|---|---|
| | | | | dBm | mW | |
| Bluetooth | 2.441 | Head | 9.60 | 5.95 | 3.94 | Yes |
| | | Body | 19.20 | 5.95 | 3.94 | Yes |
| 2.4GHz WLAN 802.11 b | 2.45 | Head | 9.58 | 18.28 | 67.30 | No |
| | | Body | 19.17 | 18.28 | 67.30 | No |

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## 13 Evaluation of Simultaneous

**Table 13.1: The sum of reported SAR values for main antenna and WiFi**

| | Position | Main antenna | WiFi | Sum |
|---|---|---|---|---|
| **Highest reported SAR value for Head** | Left hand, Touch cheek | 0.46 | 0.27 | **0.73** |
| | Right hand, Touch cheek | 0.49 | 0.15 | **0.64** |
| **Highest reported SAR value for Body** | Rear | 1.31 | 0.12 | **1.43** |

**Table 13.2: The sum of reported SAR values for main antenna and Bluetooth**

| | Position | Main antenna | BT* | Sum |
|---|---|---|---|---|
| **Highest reported SAR value for Head** | Right hand, Touch cheek | 0.49 | 0.17 | **0.66** |
| **Highest reported SAR value for Body** | Rear | 1.31 | 0.08 | **1.39** |

BT* - Estimated SAR for Bluetooth (see the table 13.3)

**Table 13.3: Estimated SAR for Bluetooth**

| Position | F (GHz) | Distance (mm) | Upper limit of power * | | $\text{Estimated}_{1g}$ (W/kg) |
|---|---|---|---|---|---|
| | | | dBm | mW | |
| Head | 2.441 | 5 | 6 | 3.98 | 0.17 |
| Body | 2.441 | 10 | 6 | 3.98 | 0.08 |

* - Maximum possible output power declared by manufacturer

When standalone SAR test exclusion applies to an antenna that transmits simultaneously with other antennas, the standalone SAR must be estimated according to following to determine simultaneous transmission SAR test exclusion:
(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)]·[$\sqrt{f(GHz)}/x$] W/kg for test separation distances ≤ 50 mm;
where x = 7.5 for 1-g SAR.
When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion

**Conclusion:**
According to the above tables, the sum of reported SAR values is < 1.6W/kg. So the simultaneous transmission SAR with volume scans is not required.

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# 14 SAR Test Result

It is determined by user manual for the distance between the EUT and the phantom bottom.
The distance is 10mm and just applied to the condition of body worn accessory.
It is performed for all SAR measurements with area scan based 1-g SAR estimation (Fast SAR). A zoom scan measurement is added when the estimated 1-g SAR is the highest measured SAR in each exposure configuration, wireless mode and frequency band combination or > 1.2W/kg.
The calculated SAR is obtained by the following formula:

$$\text{Reported SAR} = \text{Measured SAR} \times 10^{(P_{\text{Target}} - P_{\text{Measured}})/10}$$

Where $P_{Target}$ is the power of manufacturing upper limit;
$P_{Measured}$ is the measured power in chapter 11.

**Table 14.1: Duty Cycle**

| **Mode** | **Duty Cycle** |
|---|---|
| Speech for GSM850/1900 | 1:8.3 |
| GPRS&EGPRS | 1:2 |
| WCDMA & WiFi | 1:1 |

## 14.1 SAR results for Fast SAR

**Table 14.2: SAR Values (GSM 850 MHz Band - Head)**

| Ambient Temperature: 22.2°C Liquid Temperature: 21.7 °C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | | Side | Test Position | Figure No. | Conducted Power (dBm) | Max. tune-up Power (dBm) | Measured SAR(10g) (W/kg) | Reported SAR(10g) (W/kg) | Measured SAR(1g) (W/kg) | Reported SAR(1g) (W/kg) | Power Drift (dB) |
| MHz | Ch. | | | | | | | | | | |
| 848.8 | 251 | Left | Touch | / | 33.48 | 33.5 | 0.315 | **0.32** | 0.419 | **0.42** | -0.10 |
| 836.6 | 190 | Left | Touch | / | 33.49 | 33.5 | 0.312 | **0.31** | 0.456 | **0.46** | 0.11 |
| 824.2 | 128 | Left | Touch | / | 33.50 | 33.5 | 0.209 | **0.21** | 0.305 | **0.31** | 0.10 |
| 848.8 | 251 | Left | Tilt | / | 33.48 | 33.5 | 0.199 | **0.20** | 0.285 | **0.29** | -0.05 |
| 836.6 | 190 | Left | Tilt | / | 33.49 | 33.5 | 0.192 | **0.19** | 0.274 | **0.27** | 0.00 |
| 824.2 | 128 | Left | Tilt | / | 33.50 | 33.5 | 0.127 | **0.13** | 0.181 | **0.18** | 0.02 |
| 848.8 | 251 | Right | Touch | / | 33.48 | 33.5 | 0.309 | **0.31** | 0.456 | **0.46** | 0.00 |
| 836.6 | 190 | Right | Touch | Fig.1 | 33.49 | 33.5 | 0.396 | **0.40** | 0.486 | **0.49** | -0.11 |
| 824.2 | 128 | Right | Touch | / | 33.50 | 33.5 | 0.325 | **0.33** | 0.460 | **0.46** | 0.12 |
| 848.8 | 251 | Right | Tilt | / | 33.48 | 33.5 | 0.196 | **0.20** | 0.283 | **0.28** | 0.03 |
| 836.6 | 190 | Right | Tilt | / | 33.49 | 33.5 | 0.234 | **0.23** | 0.337 | **0.34** | 0.03 |
| 824.2 | 128 | Right | Tilt | / | 33.50 | 33.5 | 0.194 | **0.19** | 0.279 | **0.28** | 0.05 |

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**Table 14.3: SAR Values (GSM 850 MHz Band - Body)**

| Ambient Temperature: 22.2°C Liquid Temperature: 21.7 °C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | | Mode (number of timeslots) | Test Position | Figure No. | Conducted Power (dBm) | Max. tune-up Power (dBm) | Measured SAR(10g) (W/kg) | Reported SAR(10g) (W/kg) | Measured SAR(1g) (W/kg) | Reported SAR(1g) (W/kg) | Power Drift (dB) |
| MHz | Ch. | | | | | | | | | | |
| 836.6 | 190 | GPRS (4) | Front | / | 30.00 | 30.0 | 0.579 | **0.58** | 0.738 | **0.74** | -0.01 |
| 848.8 | 251 | GPRS (4) | Rear | Fig.2 | 29.98 | 30.0 | 0.742 | **0.75** | 0.946 | **0.95** | -0.06 |
| 836.6 | 190 | GPRS (4) | Rear | / | 30.00 | 30.0 | 0.555 | **0.56** | 0.782 | **0.78** | -0.10 |
| 824.2 | 128 | GPRS (4) | Rear | / | 29.97 | 30.0 | 0.372 | **0.37** | 0.548 | **0.55** | -0.18 |
| 836.6 | 190 | GPRS (4) | Left | / | 30.00 | 30.0 | 0.359 | **0.36** | 0.532 | **0.53** | -0.06 |
| 836.6 | 190 | GPRS (4) | Right | / | 30.00 | 30.0 | 0.348 | **0.35** | 0.515 | **0.52** | 0.00 |
| 836.6 | 190 | GPRS (4) | Bottom | / | 30.00 | 30.0 | 0.315 | **0.32** | 0.493 | **0.49** | 0.16 |
| 848.8 | 251 | Speech | Rear Headset | / | 33.48 | 33.5 | 0.464 | **0.47** | 0.595 | **0.60** | 0.12 |

Note1: The distance between the EUT and the phantom bottom is 10mm.

**Table 14.4: SAR Values (GSM 1900 MHz Band - Head)**

| Ambient Temperature: 22.2°C Liquid Temperature: 21.7 °C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | | Side | Test Position | Figure No. | Conducted Power (dBm) | Max. tune-up Power (dBm) | Measured SAR(10g) (W/kg) | Reported SAR(10g) (W/kg) | Measured SAR(1g) (W/kg) | Reported SAR(1g) (W/kg) | Power Drift (dB) |
| MHz | Ch. | | | | | | | | | | |
| 1909.8 | 810 | Left | Touch | / | 29.96 | 30.5 | 0.100 | **0.11** | 0.177 | **0.20** | 0.10 |
| 1880 | 661 | Left | Touch | Fig.3 | 30.33 | 30.5 | 0.131 | **0.14** | 0.208 | **0.22** | 0.07 |
| 1850.2 | 512 | Left | Touch | / | 30.23 | 30.5 | 0.106 | **0.11** | 0.184 | **0.20** | 0.12 |
| 1909.8 | 810 | Left | Tilt | / | 29.96 | 30.5 | 0.067 | **0.08** | 0.123 | **0.14** | 0.09 |
| 1880 | 661 | Left | Tilt | / | 30.33 | 30.5 | 0.070 | **0.07** | 0.127 | **0.13** | 0.05 |
| 1850.2 | 512 | Left | Tilt | / | 30.23 | 30.5 | 0.064 | **0.07** | 0.116 | **0.12** | 0.13 |
| 1909.8 | 810 | Right | Touch | / | 29.96 | 30.5 | 0.092 | **0.10** | 0.147 | **0.17** | 0.11 |
| 1880 | 661 | Right | Touch | / | 30.33 | 30.5 | 0.100 | **0.10** | 0.159 | **0.17** | 0.08 |
| 1850.2 | 512 | Right | Touch | / | 30.23 | 30.5 | 0.099 | **0.11** | 0.157 | **0.17** | 0.06 |
| 1909.8 | 810 | Right | Tilt | / | 29.96 | 30.5 | 0.046 | **0.05** | 0.082 | **0.09** | -0.03 |
| 1880 | 661 | Right | Tilt | / | 30.33 | 30.5 | 0.054 | **0.06** | 0.095 | **0.10** | 0.04 |
| 1850.2 | 512 | Right | Tilt | / | 30.23 | 30.5 | 0.049 | **0.05** | 0.085 | **0.09** | 0.03 |

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**Table 14.5: SAR Values (GSM 1900 MHz Band - Body)**

| Ambient Temperature: 22.2°C Liquid Temperature: 21.7 °C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | | Mode (number of timeslots) | Test Position | Figure No. | Conducted Power (dBm) | Max. tune-up Power (dBm) | Measured SAR(10g) (W/kg) | Reported SAR(10g) (W/kg) | Measured SAR(1g) (W/kg) | Reported SAR(1g) (W/kg) | Power Drift (dB) |
| MHz | Ch. | | | | | | | | | | |
| 1880 | 661 | GPRS (4) | Front | / | 26.64 | 27.0 | 0.340 | **0.37** | 0.582 | **0.63** | -0.07 |
| 1909.8 | 810 | GPRS (4) | Rear | / | 26.45 | 27.0 | 0.538 | **0.61** | 0.934 | **1.06** | 0.08 |
| 1880 | 661 | GPRS (4) | Rear | Fig.4 | 26.64 | 27.0 | 0.556 | **0.60** | 0.972 | **1.06** | -0.09 |
| 1850.2 | 512 | GPRS (4) | Rear | / | 26.47 | 27.0 | 0.516 | **0.58** | 0.869 | **0.98** | 0.02 |
| 1880 | 661 | GPRS (4) | Left | / | 26.64 | 27.0 | 0.087 | **0.09** | 0.147 | **0.16** | -0.19 |
| 1880 | 661 | GPRS (4) | Right | / | 26.64 | 27.0 | 0.069 | **0.07** | 0.125 | **0.14** | 0.01 |
| 1880 | 661 | GPRS (4) | Bottom | / | 26.64 | 27.0 | 0.348 | **0.38** | 0.618 | **0.67** | -0.03 |
| 1909.8 | 810 | Speech | Rear Headset | / | 29.96 | 30.5 | 0.341 | **0.39** | 0.604 | **0.68** | 0.09 |

Note1: The distance between the EUT and the phantom bottom is 10mm.

**Table 14.6: SAR Values (WCDMA 1700 MHz Band - Head)**

| Ambient Temperature: 22.0°C Liquid Temperature: 21.5 °C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | | Side | Test Position | Figure No. | Conducted Power (dBm) | Max. tune-up Power (dBm) | Measured SAR(10g) (W/kg) | Reported SAR(10g) (W/kg) | Measured SAR(1g) (W/kg) | Reported SAR(1g) (W/kg) | Power Drift (dB) |
| MHz | Ch. | | | | | | | | | | |
| 1752.6 | 1513 | Left | Touch | / | 21.44 | 21.5 | 0.087 | **0.09** | 0.145 | **0.15** | 0.14 |
| 1732.4 | 1412 | Left | Touch | Fig.5 | 21.34 | 21.5 | 0.110 | **0.11** | 0.176 | **0.18** | 0.11 |
| 1712.4 | 1312 | Left | Touch | / | 21.48 | 21.5 | 0.080 | **0.08** | 0.134 | **0.13** | 0.18 |
| 1752.6 | 1513 | Left | Tilt | / | 21.44 | 21.5 | 0.039 | **0.04** | 0.070 | **0.07** | 0.18 |
| 1732.4 | 1412 | Left | Tilt | / | 21.34 | 21.5 | 0.057 | **0.06** | 0.103 | **0.11** | 0.11 |
| 1712.4 | 1312 | Left | Tilt | / | 21.48 | 21.5 | 0.055 | **0.06** | 0.099 | **0.10** | 0.13 |
| 1752.6 | 1513 | Right | Touch | / | 21.44 | 21.5 | 0.058 | **0.06** | 0.098 | **0.10** | 0.12 |
| 1732.4 | 1412 | Right | Touch | / | 21.34 | 21.5 | 0.072 | **0.07** | 0.118 | **0.12** | 0.18 |
| 1712.4 | 1312 | Right | Touch | / | 21.48 | 21.5 | 0.055 | **0.06** | 0.094 | **0.09** | 0.19 |
| 1752.6 | 1513 | Right | Tilt | / | 21.44 | 21.5 | 0.034 | **0.03** | 0.058 | **0.06** | 0.09 |
| 1732.4 | 1412 | Right | Tilt | / | 21.34 | 21.5 | 0.048 | **0.05** | 0.083 | **0.09** | 0.15 |
| 1712.4 | 1312 | Right | Tilt | / | 21.48 | 21.5 | 0.045 | **0.04** | 0.076 | **0.08** | 0.10 |

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**Table 14.7: SAR Values (WCDMA 1700 MHz Band - Body)**

| Ambient Temperature: 22.0°C Liquid Temperature: 21.5°C | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | | Test Position | Figure No. | Conducted Power (dBm) | Max. tune-up Power (dBm) | Measured SAR(10g) (W/kg) | Reported SAR(10g) (W/kg) | Measured SAR(1g) (W/kg) | Reported SAR(1g) (W/kg) | Power Drift (dB) |
| MHz | Ch. | | | | | | | | | |
| 1732.4 | 1412 | Front | / | 21.34 | 21.5 | 0.326 | **0.34** | 0.541 | **0.56** | -0.08 |
| 1752.6 | 1513 | Rear | Fig.6 | 21.44 | 21.5 | 0.414 | **0.42** | 0.724 | **0.73** | -0.03 |
| 1732.4 | 1412 | Rear | / | 21.34 | 21.5 | 0.350 | **0.36** | 0.606 | **0.63** | -0.09 |
| 1712.4 | 1312 | Rear | / | 21.48 | 21.5 | 0.353 | **0.35** | 0.614 | **0.62** | -0.07 |
| 1732.4 | 1412 | Left | / | 21.34 | 21.5 | 0.081 | **0.08** | 0.135 | **0.14** | 0.00 |
| 1732.4 | 1412 | Right | / | 21.34 | 21.5 | 0.089 | **0.09** | 0.152 | **0.16** | 0.10 |
| 1732.4 | 1412 | Bottom | / | 21.34 | 21.5 | 0.302 | **0.31** | 0.550 | **0.57** | 0.04 |
| 1752.6 | 1513 | Rear Headset | / | 21.44 | 21.5 | 0.396 | **0.40** | 0.686 | **0.70** | -0.07 |

Note1: The distance between the EUT and the phantom bottom is 10mm.

**Table 14.8: SAR Values (WCDMA 1900 MHz Band - Head)**

| Ambient Temperature: 22.2°C Liquid Temperature: 21.7°C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | | Side | Test Position | Figure No. | Conducted Power (dBm) | Max. tune-up Power (dBm) | Measured SAR(10g) (W/kg) | Reported SAR(10g) (W/kg) | Measured SAR(1g) (W/kg) | Reported SAR(1g) (W/kg) | Power Drift (dB) |
| MHz | Ch. | | | | | | | | | | |
| 1907.6 | 9538 | Left | Touch | / | 22.95 | 23.5 | 0.172 | **0.20** | 0.299 | **0.34** | 0.18 |
| 1880 | 9400 | Left | Touch | Fig.7 | 23.08 | 23.5 | 0.190 | **0.21** | 0.309 | **0.34** | 0.07 |
| 1852.4 | 9262 | Left | Touch | / | 23.12 | 23.5 | 0.154 | **0.17** | 0.263 | **0.29** | -0.04 |
| 1907.6 | 9538 | Left | Tilt | / | 22.95 | 23.5 | 0.114 | **0.13** | 0.210 | **0.24** | -0.02 |
| 1880 | 9400 | Left | Tilt | / | 23.08 | 23.5 | 0.099 | **0.11** | 0.180 | **0.20** | -0.03 |
| 1852.4 | 9262 | Left | Tilt | / | 23.12 | 23.5 | 0.096 | **0.10** | 0.174 | **0.19** | -0.01 |
| 1907.6 | 9538 | Right | Touch | / | 22.95 | 23.5 | 0.180 | **0.20** | 0.297 | **0.34** | -0.09 |
| 1880 | 9400 | Right | Touch | / | 23.08 | 23.5 | 0.157 | **0.17** | 0.265 | **0.29** | 0.19 |
| 1852.4 | 9262 | Right | Touch | / | 23.12 | 23.5 | 0.143 | **0.16** | 0.241 | **0.26** | 0.19 |
| 1907.6 | 9538 | Right | Tilt | / | 22.95 | 23.5 | 0.101 | **0.11** | 0.179 | **0.20** | 0.07 |
| 1880 | 9400 | Right | Tilt | / | 23.08 | 23.5 | 0.098 | **0.11** | 0.172 | **0.19** | 0.00 |
| 1852.4 | 9262 | Right | Tilt | / | 23.12 | 23.5 | 0.077 | **0.08** | 0.135 | **0.15** | 0.16 |

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**Table 14.9: SAR Values (WCDMA 1900 MHz Band - Body)**

| Ambient Temperature: 22.2°C Liquid Temperature: 21.7°C | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | | Test Position | Figure No. | Conducted Power (dBm) | Max. tune-up Power (dBm) | Measured SAR(10g) (W/kg) | Reported SAR(10g) (W/kg) | Measured SAR(1g) (W/kg) | Reported SAR(1g) (W/kg) | Power Drift (dB) |
| MHz | Ch. | | | | | | | | | |
| 1880 | 9400 | Front | / | 23.08 | 23.5 | 0.442 | **0.49** | 0.730 | **0.80** | -0.09 |
| 1907.6 | 9538 | Rear | / | 22.95 | 23.5 | 0.636 | **0.72** | 1.12 | **1.27** | -0.08 |
| 1880 | 9400 | Rear | Fig.8 | 23.08 | 23.5 | 0.625 | **0.69** | 1.19 | **1.31** | 0.04 |
| 1852.4 | 9262 | Rear | / | 23.12 | 23.5 | 0.555 | **0.61** | 0.951 | **1.04** | -0.09 |
| 1880 | 9400 | Left | / | 23.08 | 23.5 | 0.088 | **0.10** | 0.164 | **0.18** | -0.10 |
| 1880 | 9400 | Right | / | 23.08 | 23.5 | 0.150 | **0.17** | 0.268 | **0.30** | 0.02 |
| 1880 | 9400 | Bottom | / | 23.08 | 23.5 | 0.361 | **0.40** | 0.681 | **0.75** | 0.00 |
| 1880 | 9400 | Rear Headset | / | 23.08 | 23.5 | 0.585 | **0.64** | 1.08 | **1.19** | -0.10 |

Note1: The distance between the EUT and the phantom bottom is 10mm.

**Table 14.10: SAR Values (Wi-Fi 802.11b - Head)**

| Ambient Temperature: 22.2°C Liquid Temperature: 21.7°C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | | Side | Test Position | Figure No. | Conducted Power (dBm) | Max. tune-up Power (dBm) | Measured SAR(10g) (W/kg) | Reported SAR(10g) (W/kg) | Measured SAR(1g) (W/kg) | Reported SAR(1g) (W/kg) | Power Drift (dB) |
| MHz | Ch. | | | | | | | | | | |
| 2437 | 6 | Left | Touch | Fig.9 | 18.12 | 18.5 | 0.125 | **0.14** | 0.250 | **0.27** | -0.04 |
| 2437 | 6 | Left | Tilt | / | 18.12 | 18.5 | 0.087 | **0.09** | 0.180 | **0.20** | 0.14 |
| 2437 | 6 | Right | Touch | / | 18.12 | 18.5 | 0.079 | **0.09** | 0.141 | **0.15** | 0.14 |
| 2437 | 6 | Right | Tilt | / | 18.12 | 18.5 | 0.090 | **0.10** | 0.179 | **0.20** | 0.13 |

**Table 14.11: SAR Values (Wi-Fi 802.11b - Body)**

| Ambient Temperature: 22.2°C Liquid Temperature: 21.7°C | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | | Test Position | Figure No. | Conducted Power (dBm) | Max. tune-up Power (dBm) | Measured SAR(10g) (W/kg) | Reported SAR(10g) (W/kg) | Measured SAR(1g) (W/kg) | Reported SAR(1g) (W/kg) | Power Drift (dB) |
| MHz | Ch. | | | | | | | | | |
| 2437 | 6 | Front | / | 18.12 | 18.5 | 0.028 | **0.03** | 0.050 | **0.06** | -0.12 |
| 2437 | 6 | Rear | Fig.10 | 18.12 | 18.5 | 0.050 | **0.05** | 0.106 | **0.12** | -0.08 |
| 2437 | 6 | Right | / | 18.12 | 18.5 | 0.016 | **0.02** | 0.030 | **0.03** | 0.11 |
| 2437 | 6 | Top | / | 18.12 | 18.5 | 0.032 | **0.03** | 0.061 | **0.07** | 0.14 |

Note1: The distance between the EUT and the phantom bottom is 10mm.

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## 14.2 SAR results for Standard procedure

There is zoom scan measurement to be added for the highest measured SAR in each exposure configuration/band.

**Table 14.12: SAR Values (GSM 850 MHz Band - Head)**

| Ambient Temperature: 22.2°C Liquid Temperature: 21.7 °C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | | Side | Test Position | Figure No. | Conducted Power (dBm) | Max. tune-up Power (dBm) | Measured SAR(10g) (W/kg) | Reported SAR(10g) (W/kg) | Measured SAR(1g) (W/kg) | Reported SAR(1g) (W/kg) | Power Drift (dB) |
| MHz | Ch. | | | | | | | | | | |
| 836.6 | 190 | Right | Touch | Fig.1 | 33.49 | 33.5 | 0.396 | **0.40** | 0.486 | **0.49** | -0.11 |

**Table 14.13: SAR Values (GSM 850 MHz Band - Body)**

| Ambient Temperature: 22.2°C Liquid Temperature: 21.7 °C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | | Mode (number of timeslots) | Test Position | Figure No. | Conducted Power (dBm) | Max. tune-up Power (dBm) | Measured SAR(10g) (W/kg) | Reported SAR(10g) (W/kg) | Measured SAR(1g) (W/kg) | Reported SAR(1g) (W/kg) | Power Drift (dB) |
| MHz | Ch. | | | | | | | | | | |
| 848.8 | 251 | GPRS (4) | Rear | Fig.2 | 29.98 | 30.0 | 0.742 | **0.75** | 0.946 | **0.95** | -0.06 |

Note1: The distance between the EUT and the phantom bottom is 10mm.

**Table 14.14: SAR Values (GSM 1900 MHz Band - Head)**

| Ambient Temperature: 22.2°C Liquid Temperature: 21.7 °C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | | Side | Test Position | Figure No. | Conducted Power (dBm) | Max. tune-up Power (dBm) | Measured SAR(10g) (W/kg) | Reported SAR(10g) (W/kg) | Measured SAR(1g) (W/kg) | Reported SAR(1g) (W/kg) | Power Drift (dB) |
| MHz | Ch. | | | | | | | | | | |
| 1880 | 661 | Left | Touch | Fig.3 | 30.33 | 30.5 | 0.131 | **0.14** | 0.208 | **0.22** | 0.07 |

**Table 14.15: SAR Values (GSM 1900 MHz Band - Body)**

| Ambient Temperature: 22.2°C Liquid Temperature: 21.7 °C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | | Mode (number of timeslots) | Test Position | Figure No. | Conducted Power (dBm) | Max. tune-up Power (dBm) | Measured SAR(10g) (W/kg) | Reported SAR(10g) (W/kg) | Measured SAR(1g) (W/kg) | Reported SAR(1g) (W/kg) | Power Drift (dB) |
| MHz | Ch. | | | | | | | | | | |
| 1880 | 661 | GPRS (4) | Rear | Fig.4 | 26.64 | 27.0 | 0.556 | **0.60** | 0.972 | **1.06** | -0.09 |

Note1: The distance between the EUT and the phantom bottom is 10mm.

**Table 14.16: SAR Values (WCDMA 1700 MHz Band - Head)**

| Ambient Temperature: 22.0°C Liquid Temperature: 21.5 °C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | | Side | Test Position | Figure No. | Conducted Power (dBm) | Max. tune-up Power (dBm) | Measured SAR(10g) (W/kg) | Reported SAR(10g) (W/kg) | Measured SAR(1g) (W/kg) | Reported SAR(1g) (W/kg) | Power Drift (dB) |
| MHz | Ch. | | | | | | | | | | |
| 1732.4 | 1412 | Left | Touch | Fig.5 | 21.34 | 21.5 | 0.110 | **0.11** | 0.176 | **0.18** | 0.11 |

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**Table 14.17: SAR Values (WCDMA 1700 MHz Band - Body)**

| Ambient Temperature: 22.0°C Liquid Temperature: 21.5°C | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | | Test Position | Figure No. | Conducted Power (dBm) | Max. tune-up Power (dBm) | Measured SAR(10g) (W/kg) | Reported SAR(10g) (W/kg) | Measured SAR(1g) (W/kg) | Reported SAR(1g) (W/kg) | Power Drift (dB) |
| MHz | Ch. | | | | | | | | | |
| 1752.6 | 1513 | Rear | Fig.6 | 21.44 | 21.5 | 0.414 | **0.42** | 0.724 | **0.73** | -0.03 |

Note1: The distance between the EUT and the phantom bottom is 10mm.

**Table 14.18: SAR Values (WCDMA 1900 MHz Band - Head)**

| Ambient Temperature: 22.2°C Liquid Temperature: 21.7°C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | | Side | Test Position | Figure No. | Conducted Power (dBm) | Max. tune-up Power (dBm) | Measured SAR(10g) (W/kg) | Reported SAR(10g) (W/kg) | Measured SAR(1g) (W/kg) | Reported SAR(1g) (W/kg) | Power Drift (dB) |
| MHz | Ch. | | | | | | | | | | |
| 1880 | 9400 | Left | Touch | Fig.7 | 23.08 | 23.5 | 0.190 | **0.21** | 0.309 | **0.34** | 0.07 |

**Table 14.19: SAR Values (WCDMA 1900 MHz Band - Body)**

| Ambient Temperature: 22.2°C Liquid Temperature: 21.7°C | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | | Test Position | Figure No. | Conducted Power (dBm) | Max. tune-up Power (dBm) | Measured SAR(10g) (W/kg) | Reported SAR(10g) (W/kg) | Measured SAR(1g) (W/kg) | Reported SAR(1g) (W/kg) | Power Drift (dB) |
| MHz | Ch. | | | | | | | | | |
| 1880 | 9400 | Rear | Fig.8 | 23.08 | 23.5 | 0.625 | **0.69** | 1.19 | **1.31** | 0.04 |

Note1: The distance between the EUT and the phantom bottom is 10mm.

**Table 14.20: SAR Values (Wi-Fi 802.11b - Head)**

| Ambient Temperature: 22.2°C Liquid Temperature: 21.7°C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | | Side | Test Position | Figure No. | Conducted Power (dBm) | Max. tune-up Power (dBm) | Measured SAR(10g) (W/kg) | Reported SAR(10g) (W/kg) | Measured SAR(1g) (W/kg) | Reported SAR(1g) (W/kg) | Power Drift (dB) |
| MHz | Ch. | | | | | | | | | | |
| 2437 | 6 | Left | Touch | Fig.9 | 18.12 | 18.5 | 0.125 | **0.14** | 0.250 | **0.27** | -0.04 |

**Table 14.21: SAR Values (Wi-Fi 802.11b - Body)**

| Ambient Temperature: 22.2°C Liquid Temperature: 21.7°C | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | | Test Position | Figure No. | Conducted Power (dBm) | Max. tune-up Power (dBm) | Measured SAR(10g) (W/kg) | Reported SAR(10g) (W/kg) | Measured SAR(1g) (W/kg) | Reported SAR(1g) (W/kg) | Power Drift (dB) |
| MHz | Ch. | | | | | | | | | |
| 2437 | 6 | Rear | Fig.10 | 18.12 | 18.5 | 0.050 | **0.05** | 0.106 | **0.12** | -0.08 |

Note1: The distance between the EUT and the phantom bottom is 10mm.

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## 15 SAR Measurement Variability

SAR measurement variability must be assessed for each frequency band, which is determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements. When both head and body tissue-equivalent media are required for SAR measurements in a frequency band, the variability measurement procedures should be applied to the tissue medium with the highest measured SAR, using the highest measured SAR configuration for that tissue-equivalent medium.

The following procedures are applied to determine if repeated measurements are required.

1) Repeated measurement is not required when the original highest measured SAR is < 0.80 W/kg; steps 2) through 4) do not apply.

2) When the original highest measured SAR is ≥ 0.80 W/kg, repeat that measurement once.

3) Perform a second repeated measurement only if the ratio of largest to smallest SAR for the original and first repeated measurements is > 1.20 or when the original or repeated measurement is ≥ 1.45 W/kg (~ 10% from the 1-g SAR limit).

4) Perform a third repeated measurement only if the original, first or second repeated measurement is ≥ 1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.

**Table 15.1: SAR Measurement Variability for Body GSM 850 (1g)**

| Frequency | | Test Position | Spacing (mm) | Original SAR (W/kg) | First Repeated SAR (W/kg) | The Ratio | Second Repeated SAR (W/kg) |
|---|---|---|---|---|---|---|---|
| MHz | Ch. | | | | | | |
| 848.8 | 251 | Rear | 10 | 0.946 | 0.937 | 1.01 | / |

**Table 15.2: SAR Measurement Variability for Body GSM 1900 (1g)**

| Frequency | | Test Position | Spacing (mm) | Original SAR (W/kg) | First Repeated SAR (W/kg) | The Ratio | Second Repeated SAR (W/kg) |
|---|---|---|---|---|---|---|---|
| MHz | Ch. | | | | | | |
| 1909.8 | 810 | Rear | 10 | 0.954 | 0.933 | 1.02 | / |

**Table 15.3: SAR Measurement Variability for Body GSM 1900 (1g)**

| Frequency | | Test Position | Spacing (mm) | Original SAR (W/kg) | First Repeated SAR (W/kg) | The Ratio | Second Repeated SAR (W/kg) |
|---|---|---|---|---|---|---|---|
| MHz | Ch. | | | | | | |
| 1880 | 9400 | Rear | 10 | 1.19 | 1.16 | 1.03 | / |

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# 16 Measurement Uncertainty

## 16.1 Measurement Uncertainty for Normal SAR Tests (300MHz~3GHz)

| No. | Error Description | Type | Uncertainty value | Probably Distribution | Div. | (Ci) 1g | (Ci) 10g | Std. Unc. (1g) | Std. Unc. (10g) | Degree of freedom |
|---|---|---|---|---|---|---|---|---|---|---|
| **Measurement system** | | | | | | | | | | |
| 1 | Probe calibration | B | 5.5 | N | 1 | 1 | 1 | 5.5 | 5.5 | ∞ |
| 2 | Isotropy | B | 4.7 | R | $\sqrt{3}$ | 0.7 | 0.7 | 1.9 | 1.9 | ∞ |
| 3 | Boundary effect | B | 1.0 | R | $\sqrt{3}$ | 1 | 1 | 0.6 | 0.6 | ∞ |
| 4 | Linearity | B | 4.7 | R | $\sqrt{3}$ | 1 | 1 | 2.7 | 2.7 | ∞ |
| 5 | Detection limit | B | 1.0 | R | $\sqrt{3}$ | 1 | 1 | 0.6 | 0.6 | ∞ |
| 6 | Readout electronics | B | 0.3 | R | $\sqrt{3}$ | 1 | 1 | 0.3 | 0.3 | ∞ |
| 7 | Response time | B | 0.8 | R | $\sqrt{3}$ | 1 | 1 | 0.5 | 0.5 | ∞ |
| 8 | Integration time | B | 2.6 | R | $\sqrt{3}$ | 1 | 1 | 1.5 | 1.5 | ∞ |
| 9 | RF ambient conditions-noise | B | 0 | R | $\sqrt{3}$ | 1 | 1 | 0 | 0 | ∞ |
| 10 | RF ambient conditions-reflection | B | 0 | R | $\sqrt{3}$ | 1 | 1 | 0 | 0 | ∞ |
| 11 | Probe positioned mech. restrictions | B | 0.4 | R | $\sqrt{3}$ | 1 | 1 | 0.2 | 0.2 | ∞ |
| 12 | Probe positioning with respect to phantom shell | B | 2.9 | R | $\sqrt{3}$ | 1 | 1 | 1.7 | 1.7 | ∞ |
| 13 | Post-processing | B | 1.0 | R | $\sqrt{3}$ | 1 | 1 | 0.6 | 0.6 | ∞ |
| **Test sample related** | | | | | | | | | | |
| 14 | Test sample positioning | A | 3.3 | N | 1 | 1 | 1 | 3.3 | 3.3 | 71 |
| 15 | Device holder uncertainty | A | 3.4 | N | 1 | 1 | 1 | 3.4 | 3.4 | 5 |
| 16 | Drift of output power | B | 5.0 | R | $\sqrt{3}$ | 1 | 1 | 2.9 | 2.9 | ∞ |
| **Phantom and set-up** | | | | | | | | | | |
| 17 | Phantom uncertainty | B | 4.0 | R | $\sqrt{3}$ | 1 | 1 | 2.3 | 2.3 | ∞ |
| 18 | Liquid conductivity (target) | B | 5.0 | R | $\sqrt{3}$ | 0.64 | 0.43 | 1.8 | 1.2 | ∞ |
| 19 | Liquid conductivity (meas.) | A | 2.06 | N | 1 | 0.64 | 0.43 | 1.32 | 0.89 | 43 |
| 20 | Liquid permittivity (target) | B | 5.0 | R | $\sqrt{3}$ | 0.6 | 0.49 | 1.7 | 1.4 | ∞ |
| 21 | Liquid permittivity (meas.) | A | 1.6 | N | 1 | 0.6 | 0.49 | 1.0 | 0.8 | 521 |

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| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Combined standard uncertainty | $u_c' = \sqrt{\sum_{i=1}^{21} c_i^2 u_i^2}$ | | | | | | 9.25 | 9.12 | 257 |
| Expanded uncertainty (confidence interval of 95 %) | $u_e = 2u_c$ | | | | | | 18.5 | 18.2 | |

## 16.2 Measurement Uncertainty for Normal SAR Tests (3~6GHz)

| No. | Error Description | Type | Uncertainty value | Probably Distribution | Div. | (Ci) 1g | (Ci) 10g | Std. Unc. (1g) | Std. Unc. (10g) | Degree of freedom |
|---|---|---|---|---|---|---|---|---|---|---|
| **Measurement system** | | | | | | | | | | |
| 1 | Probe calibration | B | 6.5 | N | 1 | 1 | 1 | 6.5 | 6.5 | ∞ |
| 2 | Isotropy | B | 4.7 | R | $\sqrt{3}$ | 0.7 | 0.7 | 1.9 | 1.9 | ∞ |
| 3 | Boundary effect | B | 2.0 | R | $\sqrt{3}$ | 1 | 1 | 1.2 | 1.2 | ∞ |
| 4 | Linearity | B | 4.7 | R | $\sqrt{3}$ | 1 | 1 | 2.7 | 2.7 | ∞ |
| 5 | Detection limit | B | 1.0 | R | $\sqrt{3}$ | 1 | 1 | 0.6 | 0.6 | ∞ |
| 6 | Readout electronics | B | 0.3 | R | $\sqrt{3}$ | 1 | 1 | 0.3 | 0.3 | ∞ |
| 7 | Response time | B | 0.8 | R | $\sqrt{3}$ | 1 | 1 | 0.5 | 0.5 | ∞ |
| 8 | Integration time | B | 2.6 | R | $\sqrt{3}$ | 1 | 1 | 1.5 | 1.5 | ∞ |
| 9 | RF ambient conditions-noise | B | 0 | R | $\sqrt{3}$ | 1 | 1 | 0 | 0 | ∞ |
| 10 | RF ambient conditions-reflection | B | 0 | R | $\sqrt{3}$ | 1 | 1 | 0 | 0 | ∞ |
| 11 | Probe positioned mech. restrictions | B | 0.8 | R | $\sqrt{3}$ | 1 | 1 | 0.5 | 0.5 | ∞ |
| 12 | Probe positioning with respect to phantom shell | B | 6.7 | R | $\sqrt{3}$ | 1 | 1 | 3.9 | 3.9 | ∞ |
| 13 | Post-processing | B | 4.0 | R | $\sqrt{3}$ | 1 | 1 | 2.3 | 2.3 | ∞ |
| **Test sample related** | | | | | | | | | | |
| 14 | Test sample positioning | A | 3.3 | N | 1 | 1 | 1 | 3.3 | 3.3 | 71 |
| 15 | Device holder uncertainty | A | 3.4 | N | 1 | 1 | 1 | 3.4 | 3.4 | 5 |
| 16 | Drift of output power | B | 5.0 | R | $\sqrt{3}$ | 1 | 1 | 2.9 | 2.9 | ∞ |
| **Phantom and set-up** | | | | | | | | | | |
| 17 | Phantom uncertainty | B | 4.0 | R | $\sqrt{3}$ | 1 | 1 | 2.3 | 2.3 | ∞ |
| 18 | Liquid conductivity (target) | B | 5.0 | R | $\sqrt{3}$ | 0.64 | 0.43 | 1.8 | 1.2 | ∞ |
| 19 | Liquid conductivity (meas.) | A | 2.06 | N | 1 | 0.64 | 0.43 | 1.32 | 0.89 | 43 |

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| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 20 | Liquid permittivity (target) | B | 5.0 | R | $\sqrt{3}$ | 0.6 | 0.49 | 1.7 | 1.4 | ∞ |
| 21 | Liquid permittivity (meas.) | A | 1.6 | N | 1 | 0.6 | 0.49 | 1.0 | 0.8 | 521 |
| Combined standard uncertainty | | $u_c' = \sqrt{\sum_{i=1}^{21} c_i^2 u_i^2}$ | | | | | | 10.8 | 10.7 | 257 |
| Expanded uncertainty (confidence interval of 95 %) | | $u_e = 2u_c$ | | | | | | 21.6 | 21.4 | |

## 16.3 Measurement Uncertainty for Fast SAR Tests (300MHz~3GHz)

| No. | Error Description | Type | Uncertainty value | Probably Distribution | Div. | (Ci) 1g | (Ci) 10g | Std. Unc. (1g) | Std. Unc. (10g) | Degree of freedom |
|---|---|---|---|---|---|---|---|---|---|---|
| **Measurement system** | | | | | | | | | | |
| 1 | Probe calibration | B | 5.5 | N | 1 | 1 | 1 | 5.5 | 5.5 | ∞ |
| 2 | Isotropy | B | 4.7 | R | $\sqrt{3}$ | 0.7 | 0.7 | 1.9 | 1.9 | ∞ |
| 3 | Boundary effect | B | 1.0 | R | $\sqrt{3}$ | 1 | 1 | 0.6 | 0.6 | ∞ |
| 4 | Linearity | B | 4.7 | R | $\sqrt{3}$ | 1 | 1 | 2.7 | 2.7 | ∞ |
| 5 | Detection limit | B | 1.0 | R | $\sqrt{3}$ | 1 | 1 | 0.6 | 0.6 | ∞ |
| 6 | Readout electronics | B | 0.3 | R | $\sqrt{3}$ | 1 | 1 | 0.3 | 0.3 | ∞ |
| 7 | Response time | B | 0.8 | R | $\sqrt{3}$ | 1 | 1 | 0.5 | 0.5 | ∞ |
| 8 | Integration time | B | 2.6 | R | $\sqrt{3}$ | 1 | 1 | 1.5 | 1.5 | ∞ |
| 9 | RF ambient conditions-noise | B | 0 | R | $\sqrt{3}$ | 1 | 1 | 0 | 0 | ∞ |
| 10 | RF ambient conditions-reflection | B | 0 | R | $\sqrt{3}$ | 1 | 1 | 0 | 0 | ∞ |
| 11 | Probe positioned mech. Restrictions | B | 0.4 | R | $\sqrt{3}$ | 1 | 1 | 0.2 | 0.2 | ∞ |
| 12 | Probe positioning with respect to phantom shell | B | 2.9 | R | $\sqrt{3}$ | 1 | 1 | 1.7 | 1.7 | ∞ |
| 13 | Post-processing | B | 1.0 | R | $\sqrt{3}$ | 1 | 1 | 0.6 | 0.6 | ∞ |
| 14 | Fast SAR z-Approximation | B | 7.0 | R | $\sqrt{3}$ | 1 | 1 | 4.0 | 4.0 | ∞ |
| **Test sample related** | | | | | | | | | | |
| 15 | Test sample positioning | A | 3.3 | N | 1 | 1 | 1 | 3.3 | 3.3 | 71 |
| 16 | Device holder uncertainty | A | 3.4 | N | 1 | 1 | 1 | 3.4 | 3.4 | 5 |
| 17 | Drift of output power | B | 5.0 | R | $\sqrt{3}$ | 1 | 1 | 2.9 | 2.9 | ∞ |

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| Phantom and set-up | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 18 | Phantom uncertainty | B | 4.0 | R | $\sqrt{3}$ | 1 | 1 | 2.3 | 2.3 | ∞ |
| 19 | Liquid conductivity (target) | B | 5.0 | R | $\sqrt{3}$ | 0.64 | 0.43 | 1.8 | 1.2 | ∞ |
| 20 | Liquid conductivity (meas.) | A | 2.06 | N | 1 | 0.64 | 0.43 | 1.32 | 0.89 | 43 |
| 21 | Liquid permittivity (target) | B | 5.0 | R | $\sqrt{3}$ | 0.6 | 0.49 | 1.7 | 1.4 | ∞ |
| 22 | Liquid permittivity (meas.) | A | 1.6 | N | 1 | 0.6 | 0.49 | 1.0 | 0.8 | 521 |
| Combined standard uncertainty | | $u_c^{'} = \sqrt{\sum_{i=1}^{22} c_i^2 u_i^2}$ | | | | | | 10.1 | 9.95 | 257 |
| Expanded uncertainty (confidence interval of 95 %) | | $u_e = 2u_c$ | | | | | | 20.2 | 19.9 | |

## 16.4 Measurement Uncertainty for Fast SAR Tests (3~6GHz)

| No. | Error Description | Type | Uncertainty value | Probably Distribution | Div. | (Ci) 1g | (Ci) 10g | Std. Unc. (1g) | Std. Unc. (10g) | Degree of freedom |
|---|---|---|---|---|---|---|---|---|---|---|
| **Measurement system** | | | | | | | | | | |
| 1 | Probe calibration | B | 6.5 | N | 1 | 1 | 1 | 6.5 | 6.5 | ∞ |
| 2 | Isotropy | B | 4.7 | R | $\sqrt{3}$ | 0.7 | 0.7 | 1.9 | 1.9 | ∞ |
| 3 | Boundary effect | B | 2.0 | R | $\sqrt{3}$ | 1 | 1 | 1.2 | 1.2 | ∞ |
| 4 | Linearity | B | 4.7 | R | $\sqrt{3}$ | 1 | 1 | 2.7 | 2.7 | ∞ |
| 5 | Detection limit | B | 1.0 | R | $\sqrt{3}$ | 1 | 1 | 0.6 | 0.6 | ∞ |
| 6 | Readout electronics | B | 0.3 | R | $\sqrt{3}$ | 1 | 1 | 0.3 | 0.3 | ∞ |
| 7 | Response time | B | 0.8 | R | $\sqrt{3}$ | 1 | 1 | 0.5 | 0.5 | ∞ |
| 8 | Integration time | B | 2.6 | R | $\sqrt{3}$ | 1 | 1 | 1.5 | 1.5 | ∞ |
| 9 | RF ambient conditions-noise | B | 0 | R | $\sqrt{3}$ | 1 | 1 | 0 | 0 | ∞ |
| 10 | RF ambient conditions-reflection | B | 0 | R | $\sqrt{3}$ | 1 | 1 | 0 | 0 | ∞ |
| 11 | Probe positioned mech. Restrictions | B | 0.8 | R | $\sqrt{3}$ | 1 | 1 | 0.5 | 0.5 | ∞ |
| 12 | Probe positioning with respect to phantom shell | B | 6.7 | R | $\sqrt{3}$ | 1 | 1 | 3.9 | 3.9 | ∞ |
| 13 | Post-processing | B | 1.0 | R | $\sqrt{3}$ | 1 | 1 | 0.6 | 0.6 | ∞ |
| 14 | Fast SAR z-Approximation | B | 14.0 | R | $\sqrt{3}$ | 1 | 1 | 8.1 | 8.1 | ∞ |
| **Test sample related** | | | | | | | | | | |

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| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 15 | Test sample positioning | A | 3.3 | N | 1 | 1 | 1 | 3.3 | 3.3 | 71 |
| 16 | Device holder uncertainty | A | 3.4 | N | 1 | 1 | 1 | 3.4 | 3.4 | 5 |
| 17 | Drift of output power | B | 5.0 | R | $\sqrt{3}$ | 1 | 1 | 2.9 | 2.9 | ∞ |
| **Phantom and set-up** | | | | | | | | | | |
| 18 | Phantom uncertainty | B | 4.0 | R | $\sqrt{3}$ | 1 | 1 | 2.3 | 2.3 | ∞ |
| 19 | Liquid conductivity (target) | B | 5.0 | R | $\sqrt{3}$ | 0.64 | 0.43 | 1.8 | 1.2 | ∞ |
| 20 | Liquid conductivity (meas.) | A | 2.06 | N | 1 | 0.64 | 0.43 | 1.32 | 0.89 | 43 |
| 21 | Liquid permittivity (target) | B | 5.0 | R | $\sqrt{3}$ | 0.6 | 0.49 | 1.7 | 1.4 | ∞ |
| 22 | Liquid permittivity (meas.) | A | 1.6 | N | 1 | 0.6 | 0.49 | 1.0 | 0.8 | 521 |
| Combined standard uncertainty | | $u_c' = \sqrt{\sum_{i=1}^{22} c_i^2 u_i^2}$ | | | | | | 13.3 | 13.2 | 257 |
| Expanded uncertainty (confidence interval of 95 %) | | $u_e = 2u_c$ | | | | | | 26.6 | 26.4 | |

## 17 MAIN TEST INSTRUMENTS

### Table 17.1: List of Main Instruments

| No. | Name | Type | Serial Number | Calibration Date | Valid Period |
|---|---|---|---|---|---|
| 01 | Network analyzer | E5071C | MY46110673 | February 15, 2014 | One year |
| 02 | Power meter | NRVD | 102196 | March 15,2014 | One year |
| 03 | Power sensor | NRV-Z5 | 100596 | | |
| 04 | Signal Generator | E4438C | MY49071430 | February08, 2014 | One Year |
| 05 | Amplifier | 60S1G4 | 0331848 | No Calibration Requested | |
| 06 | BTS | E5515C | MY50263375 | January 30, 2014 | One year |
| 07 | E-field Probe | SPEAG EX3DV4 | 3846 | September 24, 2014 | One year |
| 08 | DAE | SPEAG DAE4 | 777 | September 17, 2014 | One year |
| 09 | Dipole Validation Kit | SPEAG D835V2 | 4d069 | August 28, 2014 | One year |
| 10 | Dipole Validation Kit | SPEAG D1750V2 | 1003 | August 18, 2014 | One year |
| 11 | Dipole Validation Kit | SPEAG D1900V2 | 5d101 | July 23, 2014 | One year |
| 12 | Dipole Validation Kit | SPEAG D2450V2 | 853 | July 24, 2014 | One year |

***END OF REPORT BODY***

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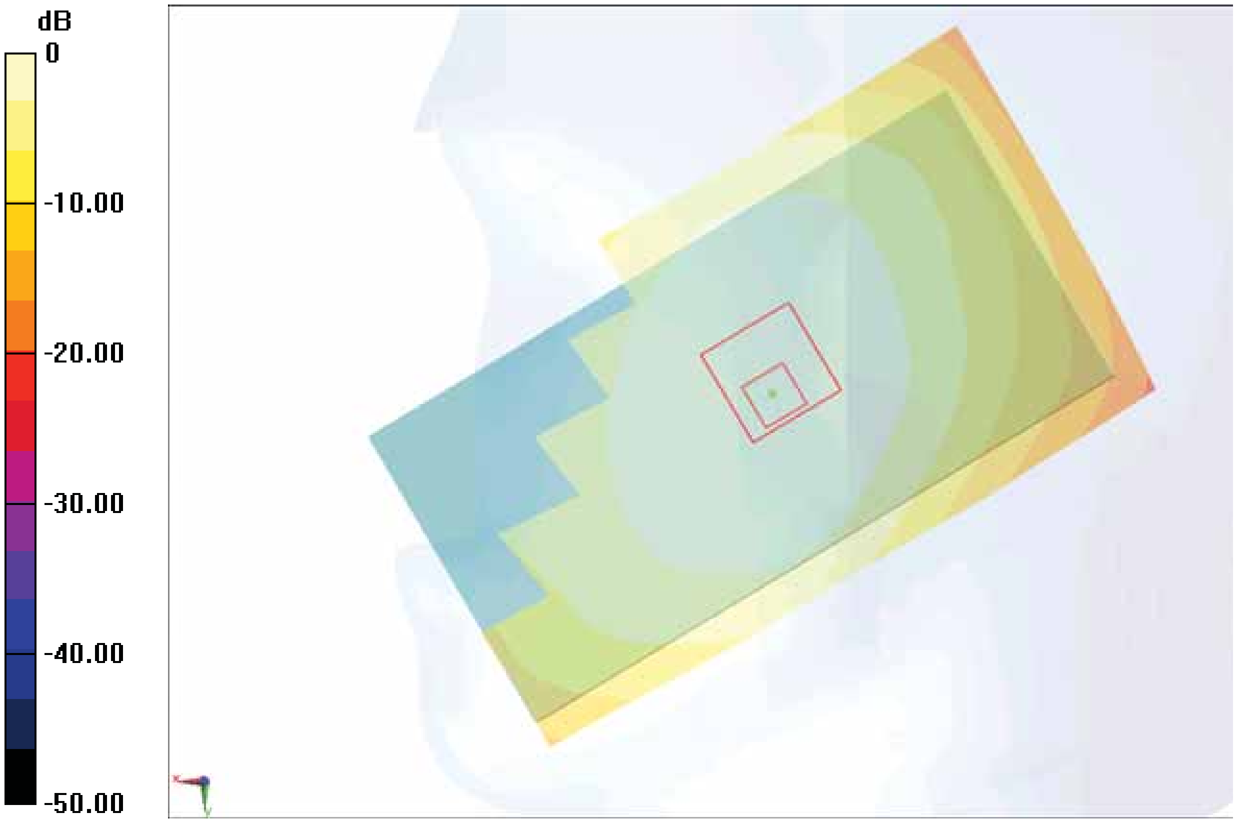
## ANNEX A Graph Results

### 850 Right Cheek Middle

Date: 2014-11-13
Electronics: DAE4 Sn777
Medium: Head 850 MHz
Medium parameters used (interpolated): f = 836.6 MHz; σ = 0.92 mho/m; εr = 42.597; ρ = 1000 kg/m$^3$
Ambient Temperature: 22.2$^o$C Liquid Temperature: 21.7$^o$C
Communication System: GSM 850 Frequency: 836.6 MHz Duty Cycle: 1:8.3
Probe: EX3DV4 - SN3846 ConvF(9.18, 9.18, 9.18)

**Cheek Middle/Area Scan (61x111x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.539 W/kg

**Cheek Middle/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 8.173 V/m; Power Drift = -0.11 dB
Peak SAR (extrapolated) = 0.541 W/kg
**SAR(1 g) = 0.486 W/kg; SAR(10 g) = 0.396 W/kg**
Maximum value of SAR (measured) = 0.512 W/kg




0 dB = 0.539 W/kg = -2.68 dBW/kg

**Fig.1 850MHz CH190**

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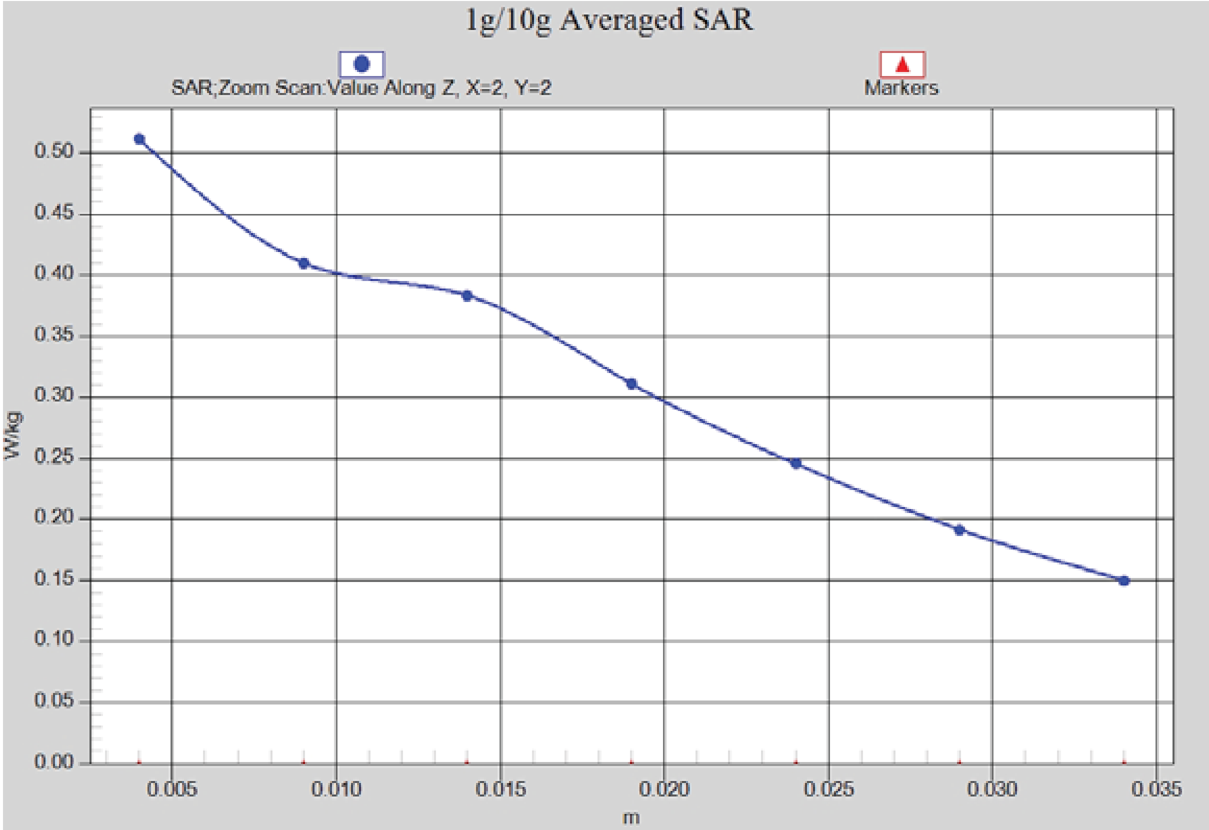


**Fig. 1-1 Z-Scan at power reference point (850 MHz CH190)**

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**850 Body Rear High**

Date: 2014-11-13
Electronics: DAE4 Sn777
Medium: Body 850 MHz
Medium parameters used (interpolated): f = 848.8 MHz; σ = 1.009 mho/m; εr = 56.603; ρ = 1000 kg/m$^3$
Ambient Temperature: 22.2$^o$C    Liquid Temperature: 21.7$^o$C
Communication System: GSM 850 GPRS Frequency: 848.8 MHz Duty Cycle: 1:2
Probe: EX3DV4 - SN3846 ConvF(9.09, 9.09, 9.09)

**Rear High/Area Scan (121x71x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 1.01 W/kg

**Rear High/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 30.88 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 1.16 W/kg
**SAR(1 g) = 0.946 W/kg; SAR(10 g) = 0.742 W/kg**
Maximum value of SAR (measured) = 1.02 W/kg

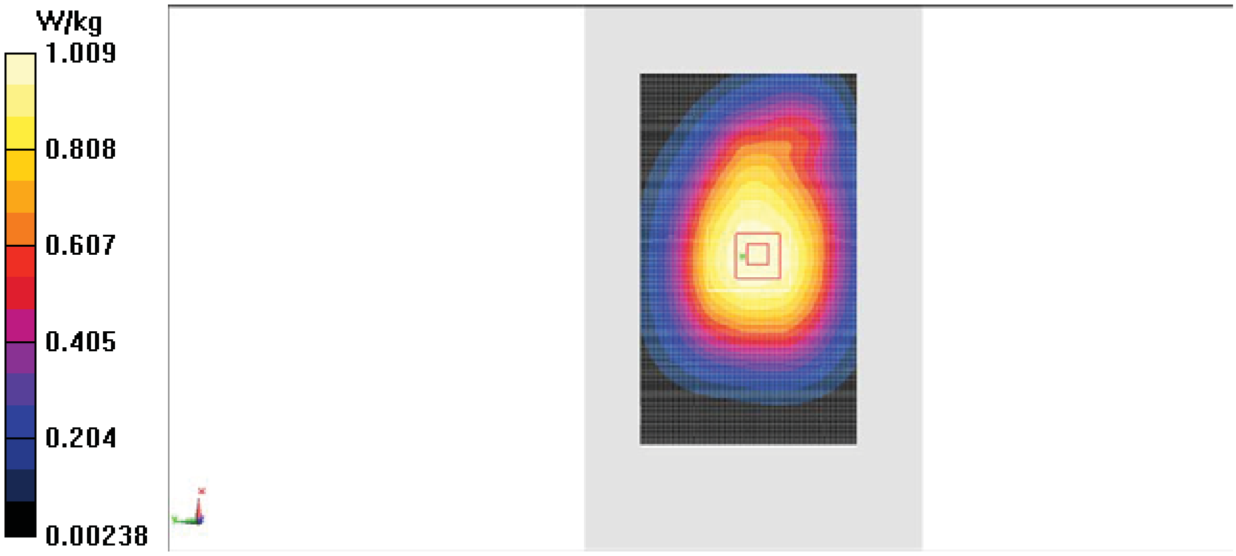


**Fig.2 850 MHz CH251**

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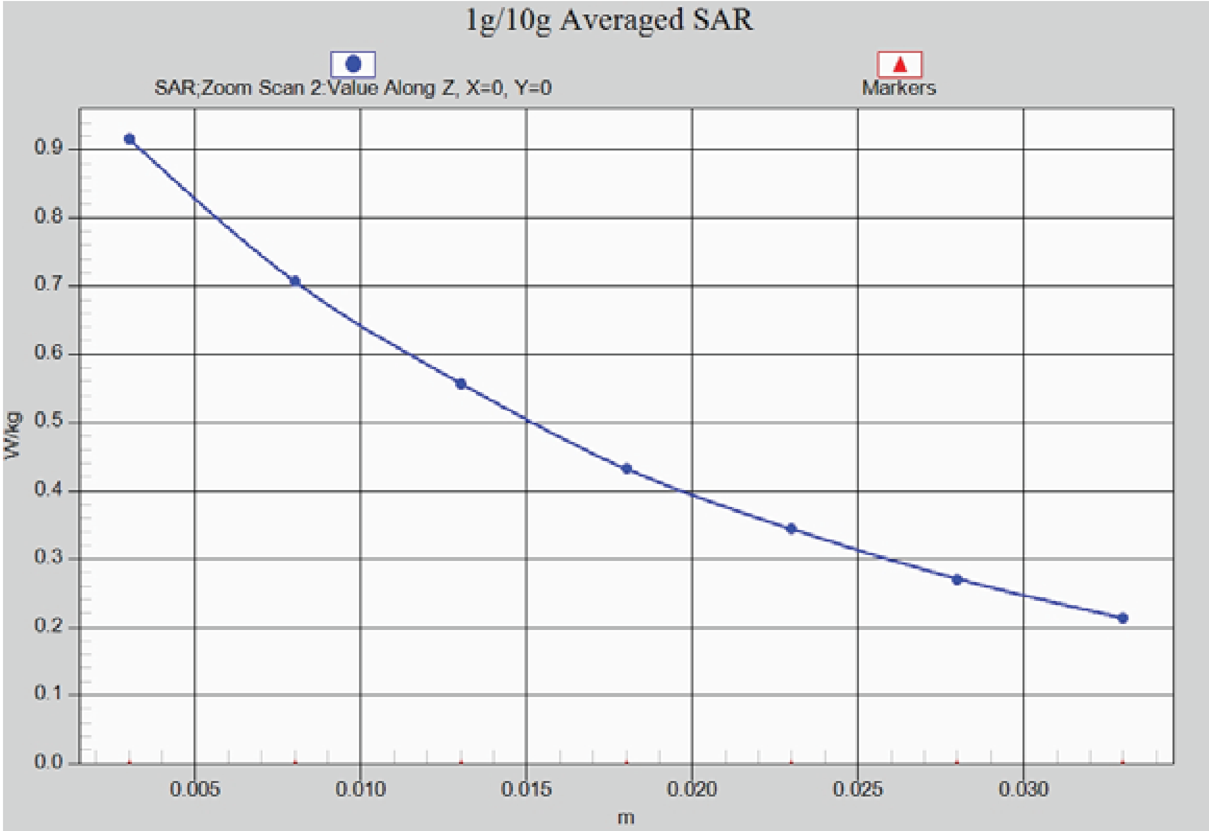


**Fig. 2-1 Z-Scan at power reference point (850 MHz CH251)**

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**1900 Left Cheek Middle**

Date: 2014-11-15
Electronics: DAE4 Sn777
Medium: Head 1900 MHz
Medium parameters used: f = 1880 MHz; $\sigma$ = 1.365 mho/m; $\varepsilon r$ = 40.978; $\rho$ = 1000 kg/m$^3$
Ambient Temperature: 22.2$^o$C Liquid Temperature: 21.7$^o$C
Communication System: GSM 1900MHz Frequency: 1880 MHz Duty Cycle: 1:8.3
Probe: EX3DV4 - SN3846 ConvF(7.26, 7.26, 7.26)

**Cheek Middle/Area Scan (71x121x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.219 W/kg

**Cheek Middle/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 5.772 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 0.314 W/kg
**SAR(1 g) = 0.208 W/kg; SAR(10 g) = 0.131 W/kg**
Maximum value of SAR (measured) = 0.221 W/kg

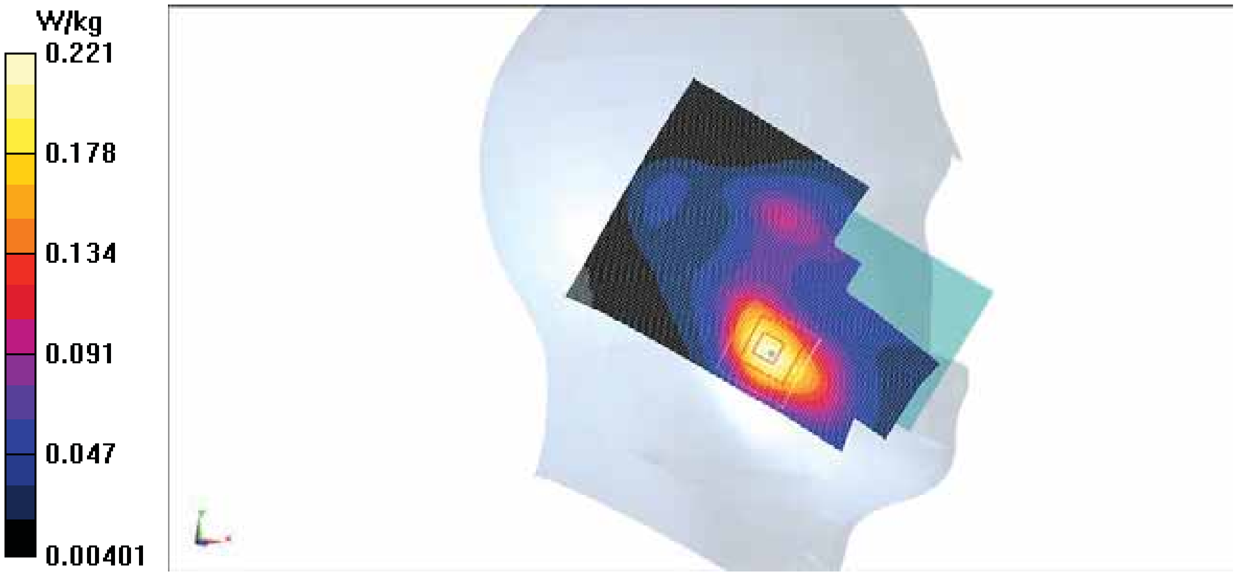


**Fig.4 1900 MHz CH661**

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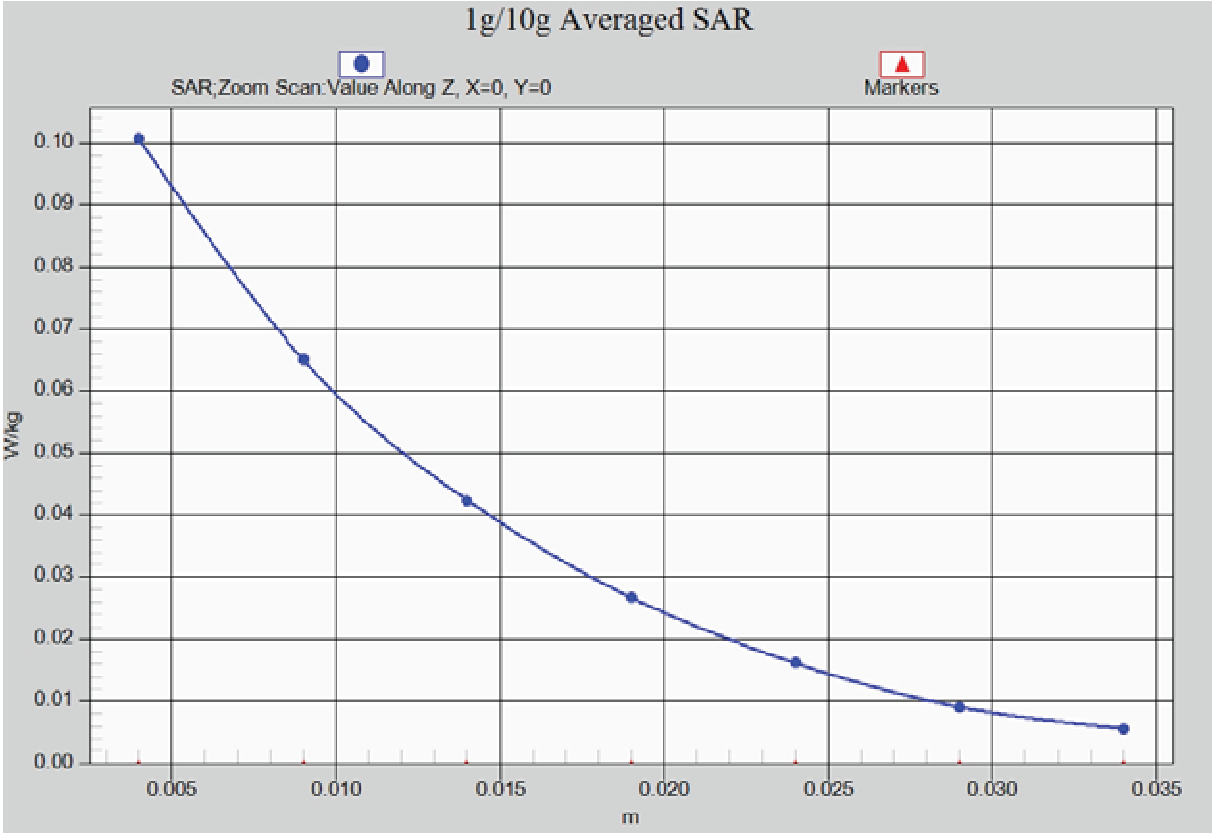


**Fig. 3-1 Z-Scan at power reference point (1900 MHz CH661)**

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**1900 Body Rear Middle**

Date: 2014-11-15
Electronics: DAE4 Sn777
Medium: Body 1900 MHz
Medium parameters used: f = 1880 MHz; σ = 1.47 mho/m; εr = 53.145; ρ = 1000 kg/m$^3$
Ambient Temperature: 22.2$^o$C Liquid Temperature: 21.7$^o$C
Communication System: GSM 1900MHz GPRS Frequency: 1880 MHz Duty Cycle: 1:2
Probe: EX3DV4 - SN3846 ConvF(7.15, 7.15, 7.15)

**Rear Middle/Area Scan (121x71x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 1.35 W/kg

**Rear Middle/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 15.07 V/m; Power Drift = -0.09 dB
Peak SAR (extrapolated) = 1.58 W/kg
**SAR(1 g) = 0.972 W/kg; SAR(10 g) = 0.556 W/kg**
Maximum value of SAR (measured) = 1.20 W/kg

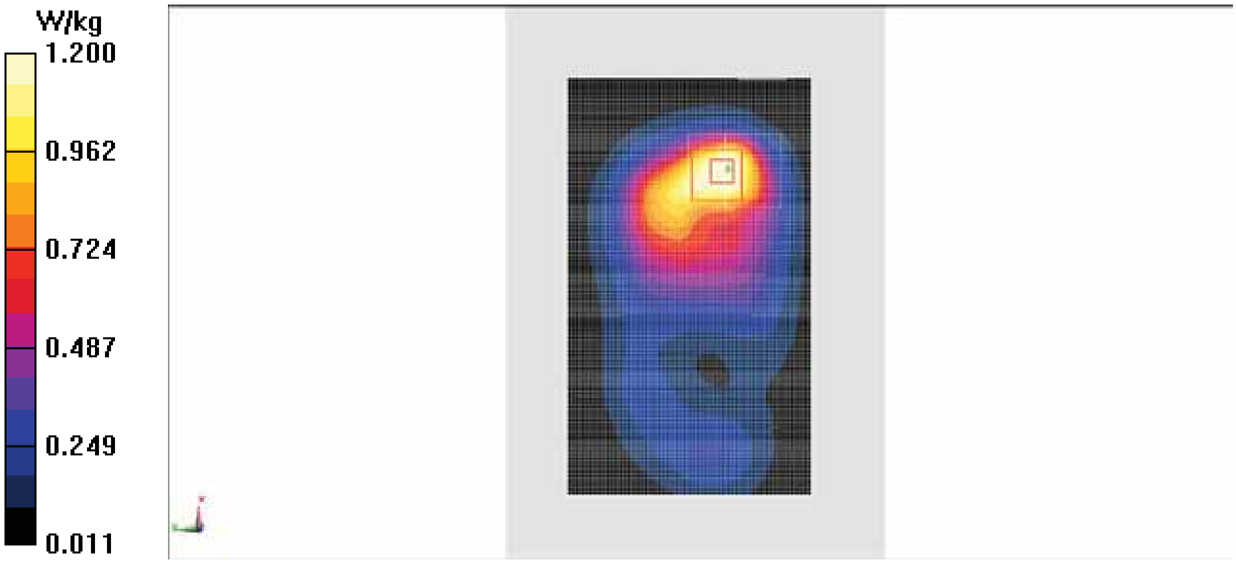


**Fig.4 1900 MHz CH661**

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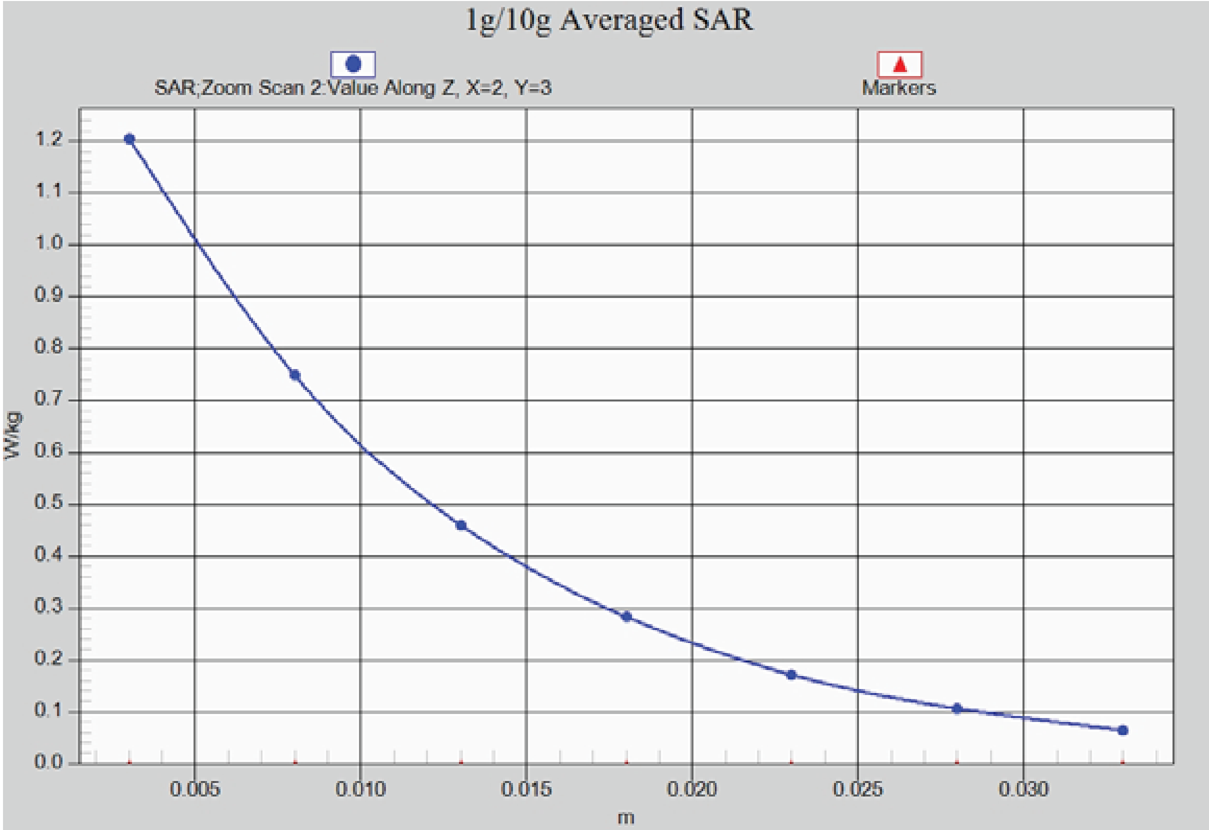


**Fig.4-1 Z-Scan at power reference point (1900 MHz CH661)**

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**WCDMA 1700 Left Cheek Middle**

Date: 2014-11-14
Electronics: DAE4 Sn777
Medium: Head 1750 MHz
Medium parameters used (interpolated): f = 1732.4 MHz; $\sigma$ = 1.379 S/m; $\varepsilon_r$ = 40.718; $\rho$ = 1000 kg/m$^3$
Ambient Temperature: 22.0$^o$C  Liquid Temperature: 21.5$^o$C
Communication System: WCDMA 1700 Frequency: 1732.4 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN3846 ConvF(7.64, 7.64, 7.64)

**Cheek Middle/Area Scan (71x121x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.189 W/kg

**Cheek Middle/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 5.476 V/m; Power Drift = 0.11 dB
Peak SAR (extrapolated) = 0.267 W/kg
**SAR(1 g) = 0.176 W/kg; SAR(10 g) = 0.110 W/kg**
Maximum value of SAR (measured) = 0.184 W/kg

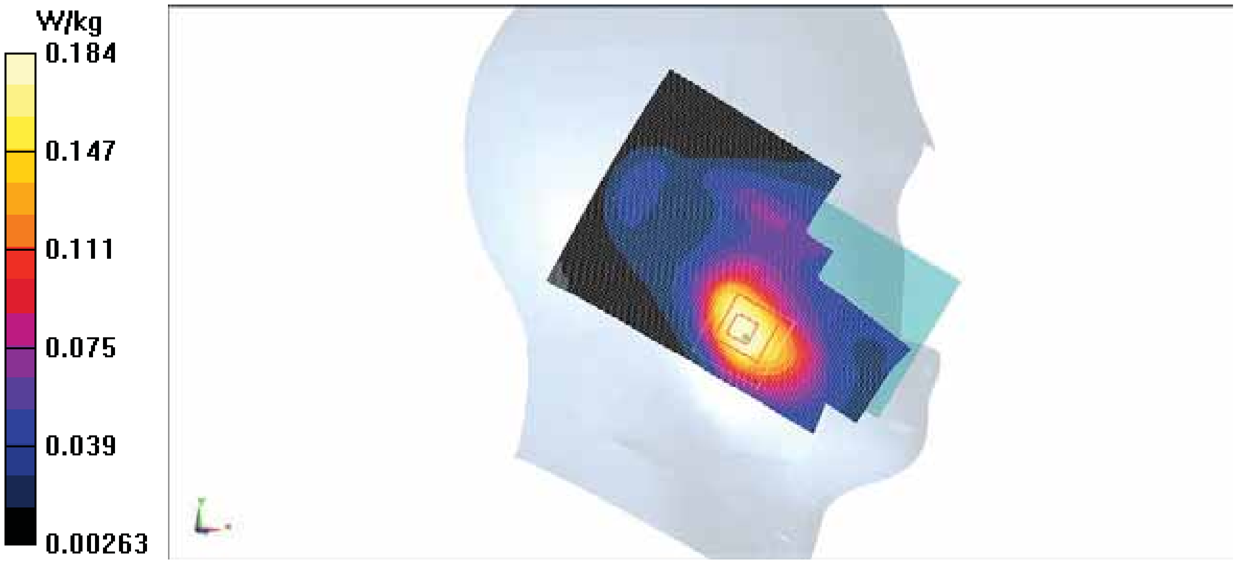


**Fig.5 WCDMA1700 CH1412**

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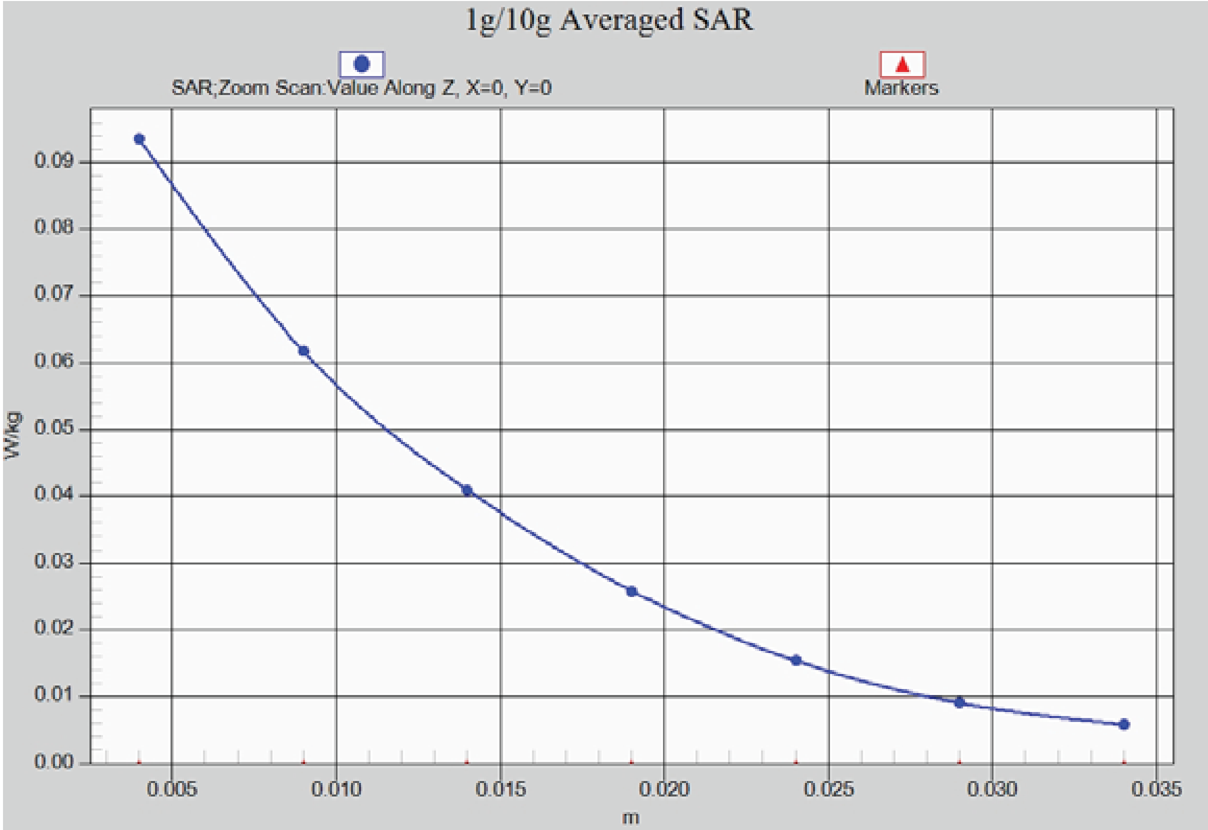


**Fig. 5-1 Z-Scan at power reference point (WCDMA1700 CH1412)**

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**WCDMA 1700 Body Rear High**
Date: 2014-11-14
Electronics: DAE4 Sn777
Medium: Body 1750 MHz
Medium parameters used (interpolated): f = 1752.6 MHz; $\sigma$ = 1.515 S/m; $\varepsilon_r$ = 54.303; $\rho$ = 1000 $kg/m^3$
Ambient Temperature: 22.0°C Liquid Temperature: 21.5°C
Communication System: WCDMA 1700 Frequency: 1752.6 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN3846 ConvF(7.43, 7.43, 7.43)

**Rear High/Area Scan (121x71x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.811 W/kg

**Rear High/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 11.80 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 1.18 W/kg
**SAR(1 g) = 0.724 W/kg; SAR(10 g) = 0.414 W/kg**
Maximum value of SAR (measured) = 0.807 W/kg

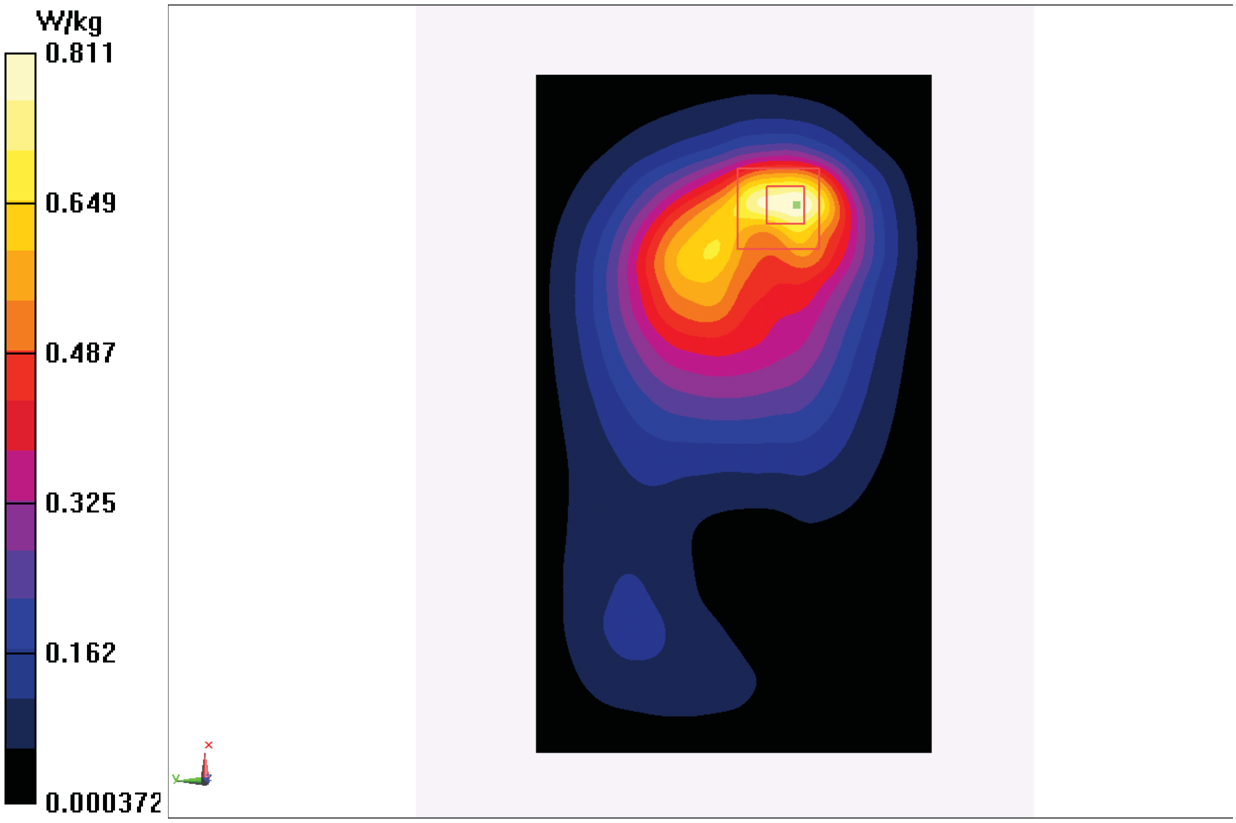


**Fig.6 WCDMA1700 CH1513**

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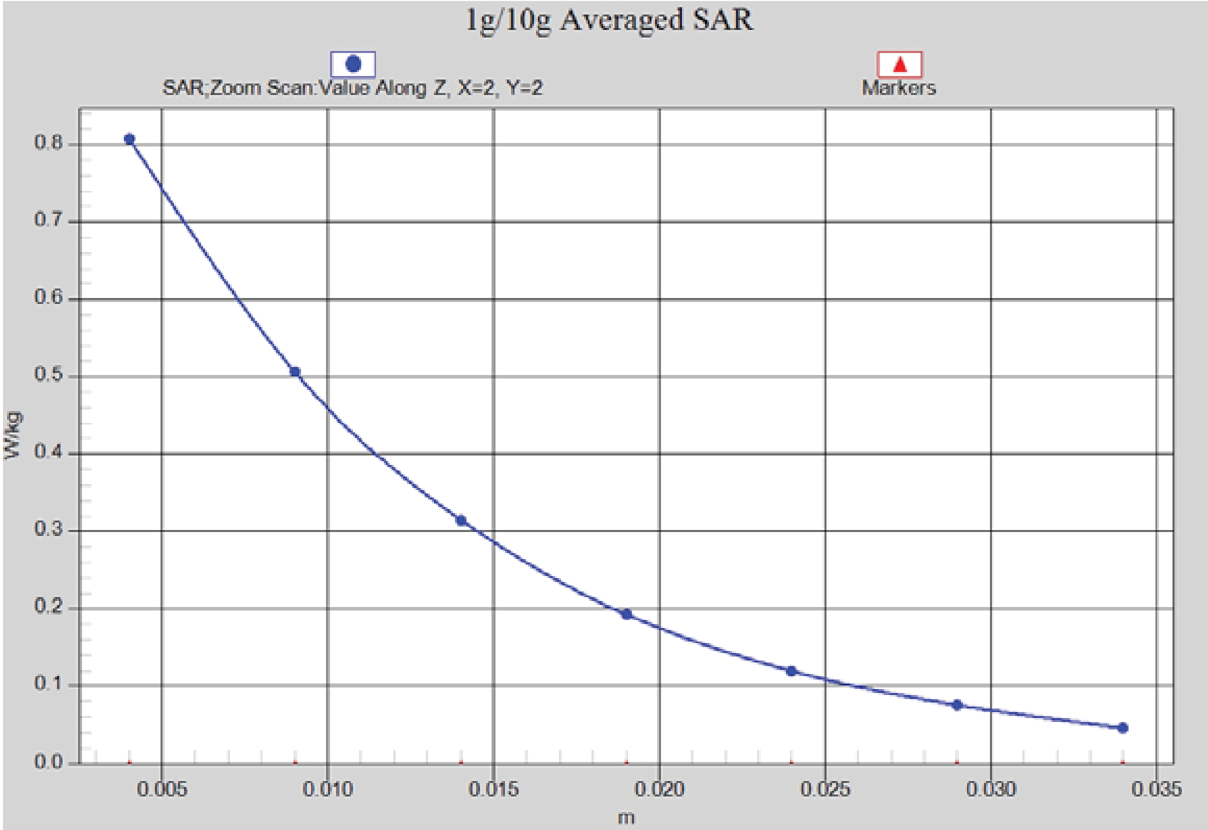


**Fig. 6-1 Z-Scan at power reference point (WCDMA1700 CH1513)**

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**WCDMA 1900 Left Cheek Middle**

Date: 2014-11-15
Electronics: DAE4 Sn777
Medium: Head 1900 MHz
Medium parameters used: f = 1880 MHz; σ = 1.365 mho/m; εr = 40.978; ρ = 1000 kg/m$^3$
Ambient Temperature: 22.2$^o$C    Liquid Temperature: 21.7$^o$C
Communication System: WCDMA 1900 Frequency: 1880 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN3846 ConvF(7.26, 7.26, 7.26)

**Cheek Middle/Area Scan (71x121x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.338 W/kg

**Cheek Middle/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 7.891 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 0.477 W/kg
**SAR(1 g) = 0.309 W/kg; SAR(10 g) = 0.190 W/kg**
Maximum value of SAR (measured) = 0.319 W/kg

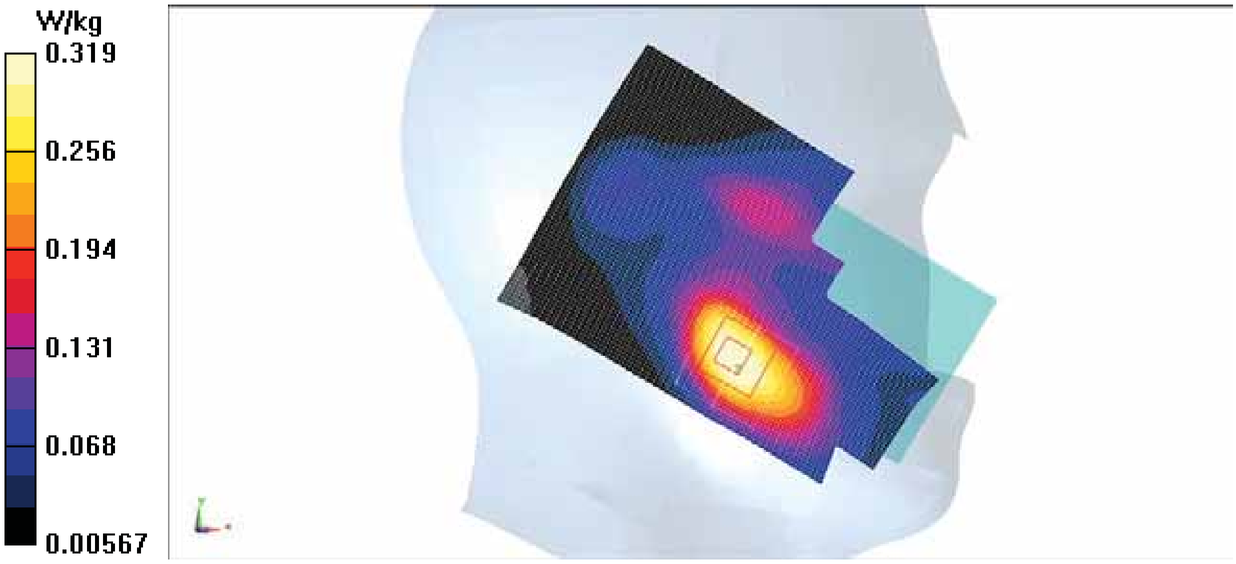


**Fig.7 WCDMA1900 CH9400**

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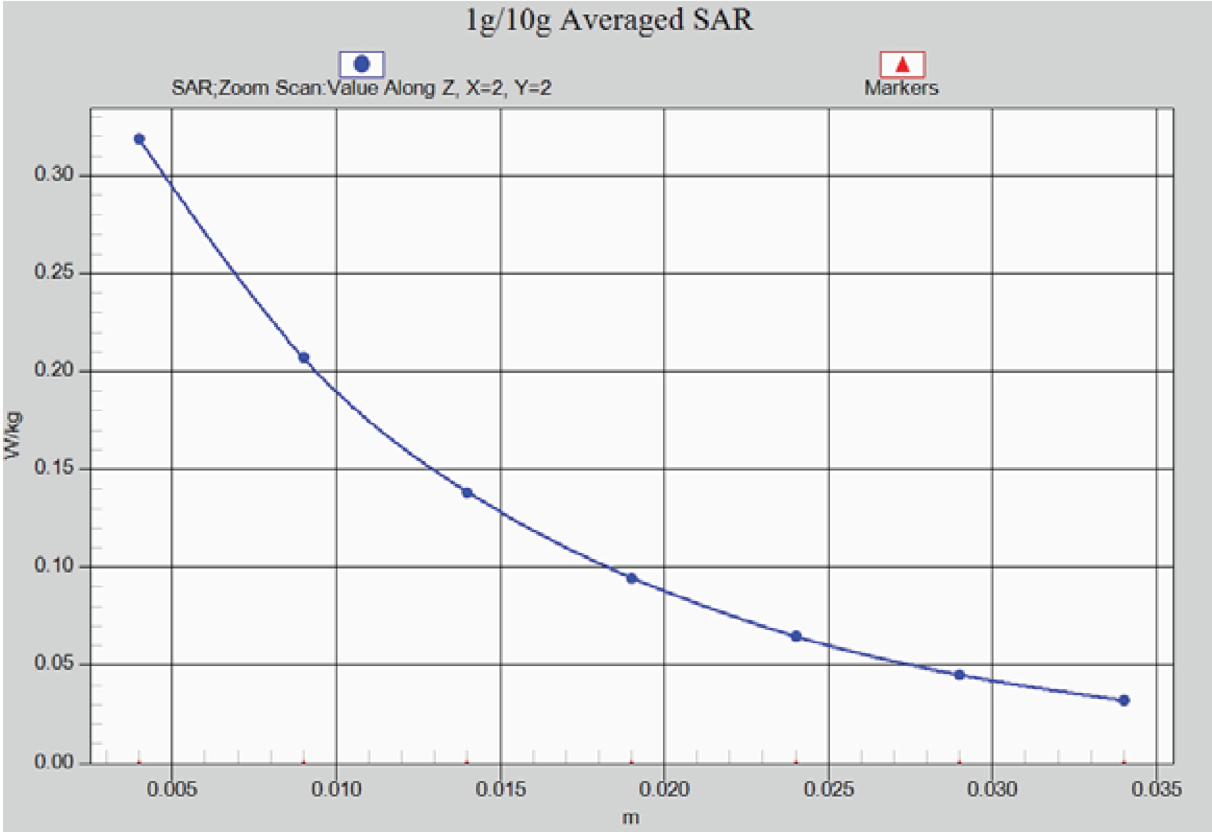


**Fig. 7-1 Z-Scan at power reference point (WCDMA1900 CH9400)**

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**WCDMA 1900 Body Rear Middle**

Date: 2014-11-15
Electronics: DAE4 Sn777
Medium: Body 1900 MHz
Medium parameters used: f = 1880 MHz; $\sigma$ = 1.494 mho/m; $\varepsilon r$ = 53.052; $\rho$ = 1000 kg/m$^3$
Ambient Temperature: 22.2$^o$C Liquid Temperature: 21.7$^o$C
Communication System: WCDMA 1900 Frequency: 1880 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN3846 ConvF(7.15, 7.15, 7.15)

**Rear Middle/Area Scan (121x71x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 1.55 W/kg

**Rear Middle/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 10.95 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 2.11 W/kg
**SAR(1 g) = 1.19 W/kg; SAR(10 g) = 0.625 W/kg**
Maximum value of SAR (measured) = 1.48 W/kg

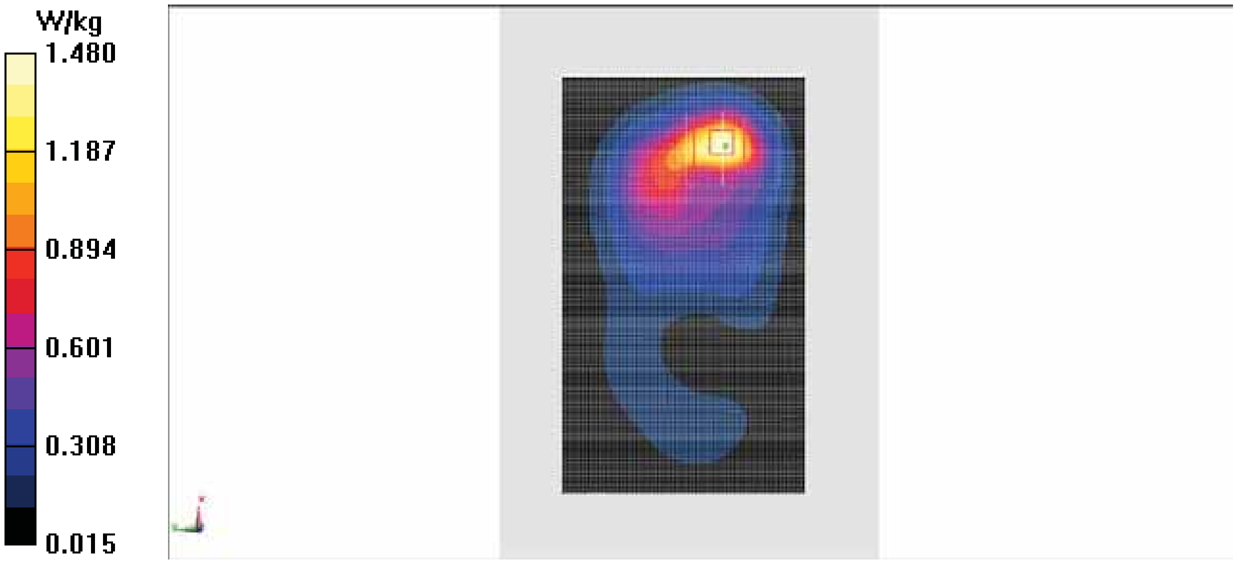


**Fig.8 WCDMA1900 CH9400**

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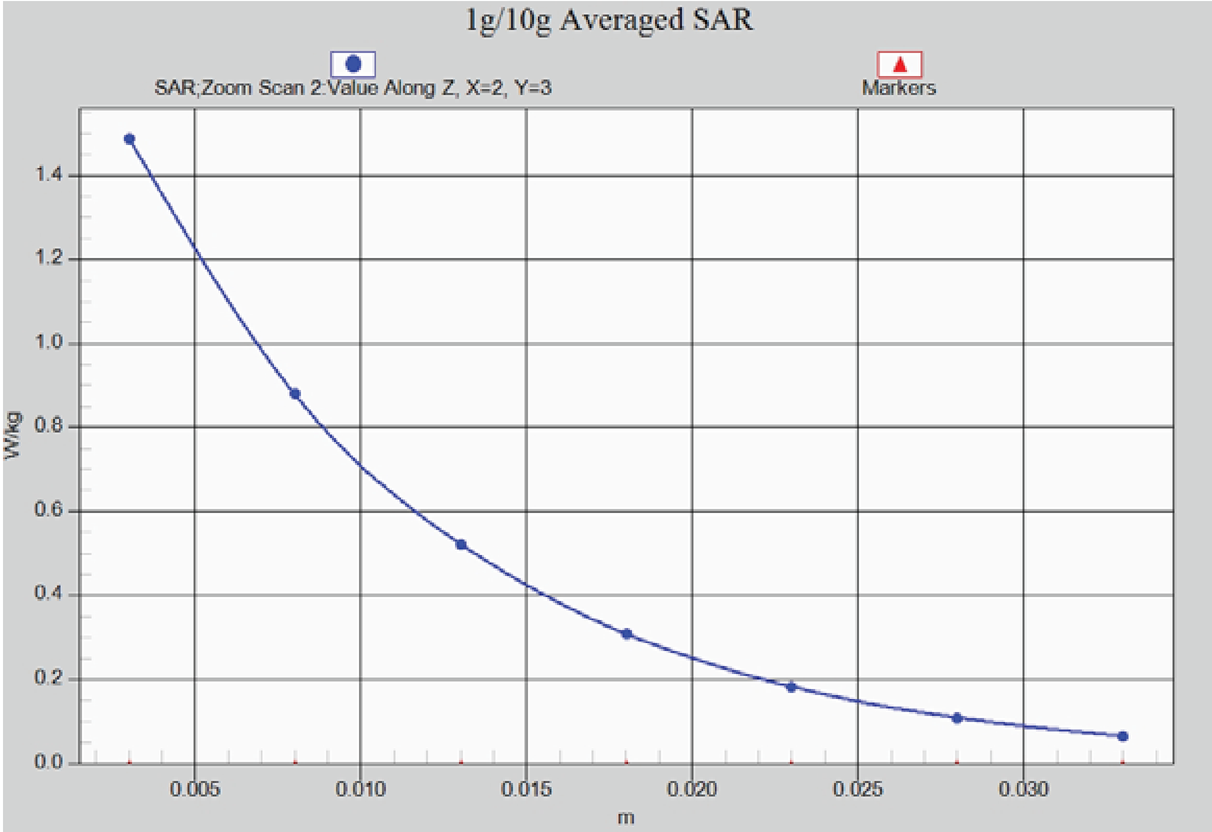


**Fig. 8-1 Z-Scan at power reference point (WCDMA1900 CH9400)**

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**Wifi 802.11b Left Cheek Channel 6**

Date: 2014-11-16
Electronics: DAE4 Sn777
Medium: Head 2450 MHz
Medium parameters used (interpolated): f = 2437 MHz; $\sigma$ = 1.789 mho/m; $\varepsilon_r$ = 40.397; $\rho$ = 1000 kg/m$^3$
Ambient Temperature: 22.2°C Liquid Temperature: 21.7°C
Communication System: WLan 2450 Frequency: 2437 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN3846 ConvF(6.56, 6.56, 6.56)

**Cheek Middle/Area Scan (61x111x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.279 W/kg

**Cheek Middle/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 6.700 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 0.537 W/kg
**SAR(1 g) = 0.250 W/kg; SAR(10 g) = 0.125 W/kg**
Maximum value of SAR (measured) = 0.262 W/kg

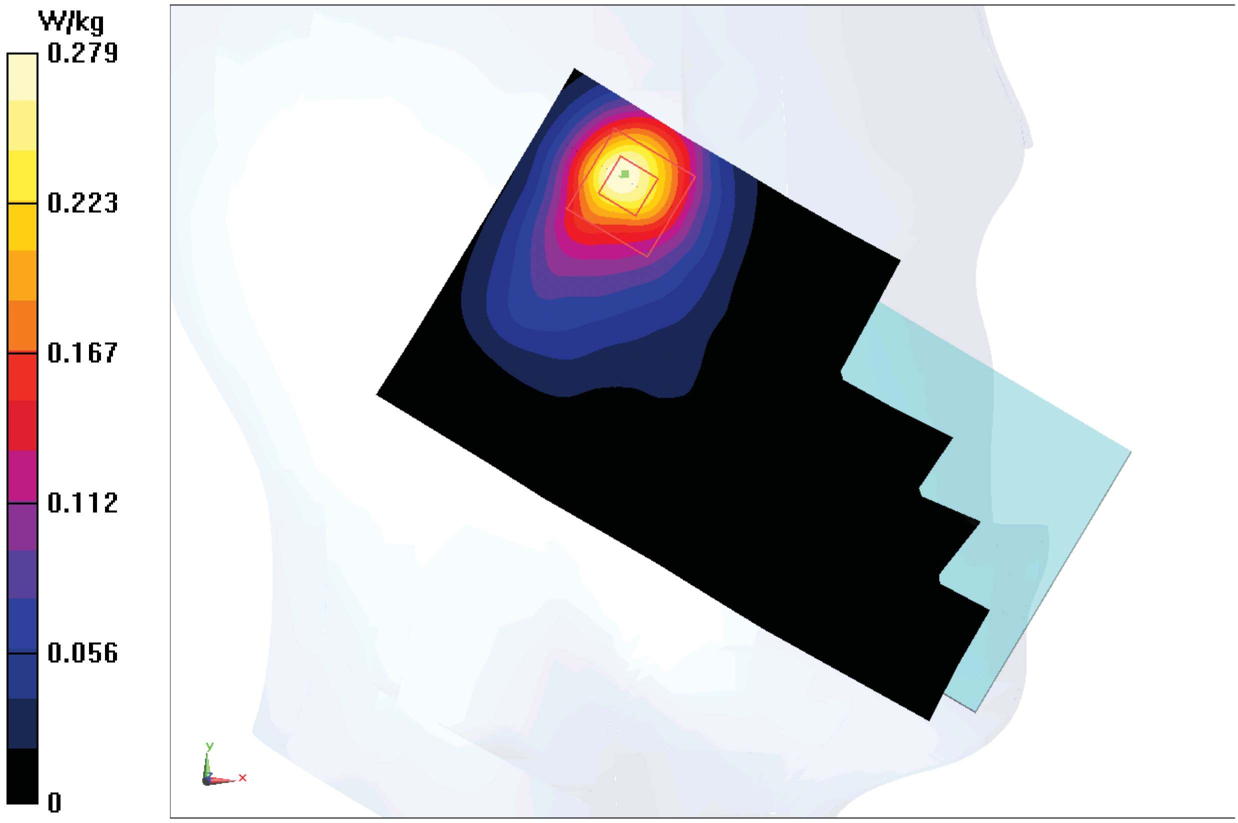


**Fig.9 2450 MHz CH6**

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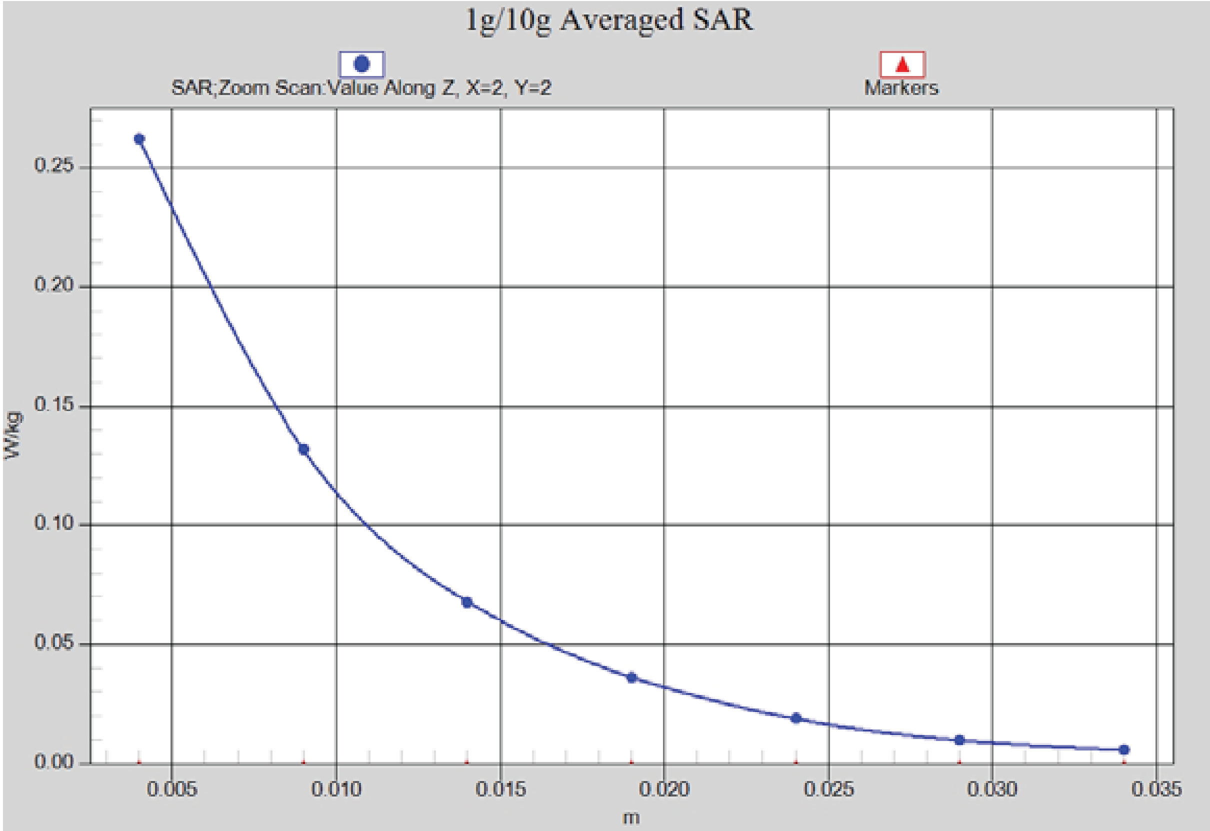


**Fig. 9-1 Z-Scan at power reference point (2450 MHz CH6)**

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**Wifi 802.11b Body Rear Channel 6**

Date: 2014-11-16

Electronics: DAE4 Sn777

Medium: Body 2450 MHz

Medium parameters used (interpolated): f = 2437 MHz; $\sigma$ = 1.883 mho/m; $\varepsilon_r$ = 53.745; $\rho$ = 1000 kg/m$^3$

Ambient Temperature: 22.2$^o$C Liquid Temperature: 21.7$^o$C

Communication System: WLan 2450 Frequency: 2437 MHz Duty Cycle: 1:1

Probe: EX3DV4 - SN3846 ConvF(6.90, 6.90, 6.90)

**Rear Middle/Area Scan (121x71x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 0.170 W/kg

**Rear Middle/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 2.399 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 0.186 W/kg

**SAR(1 g) = 0.106 W/kg; SAR(10 g) = 0.050 W/kg**

Maximum value of SAR (measured) = 0.126 W/kg

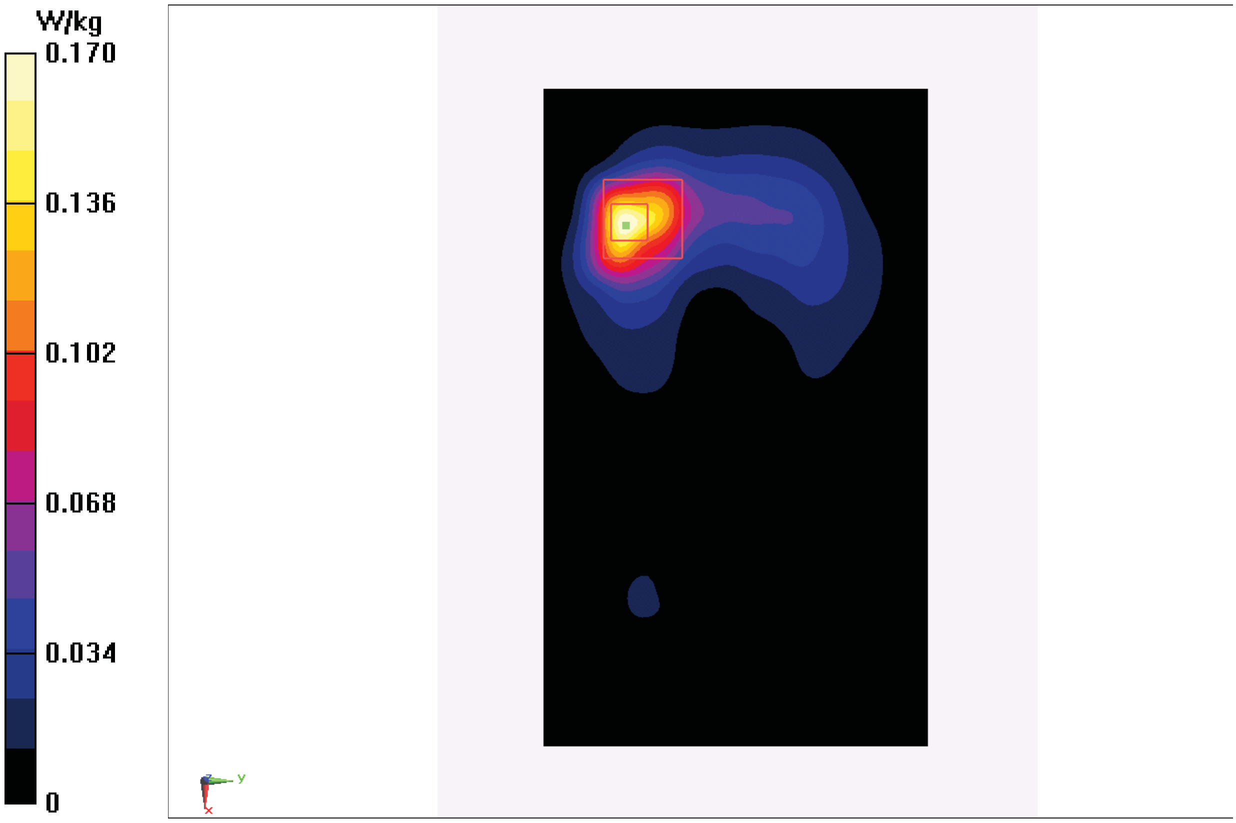


**Fig.10 2450 MHz CH6**

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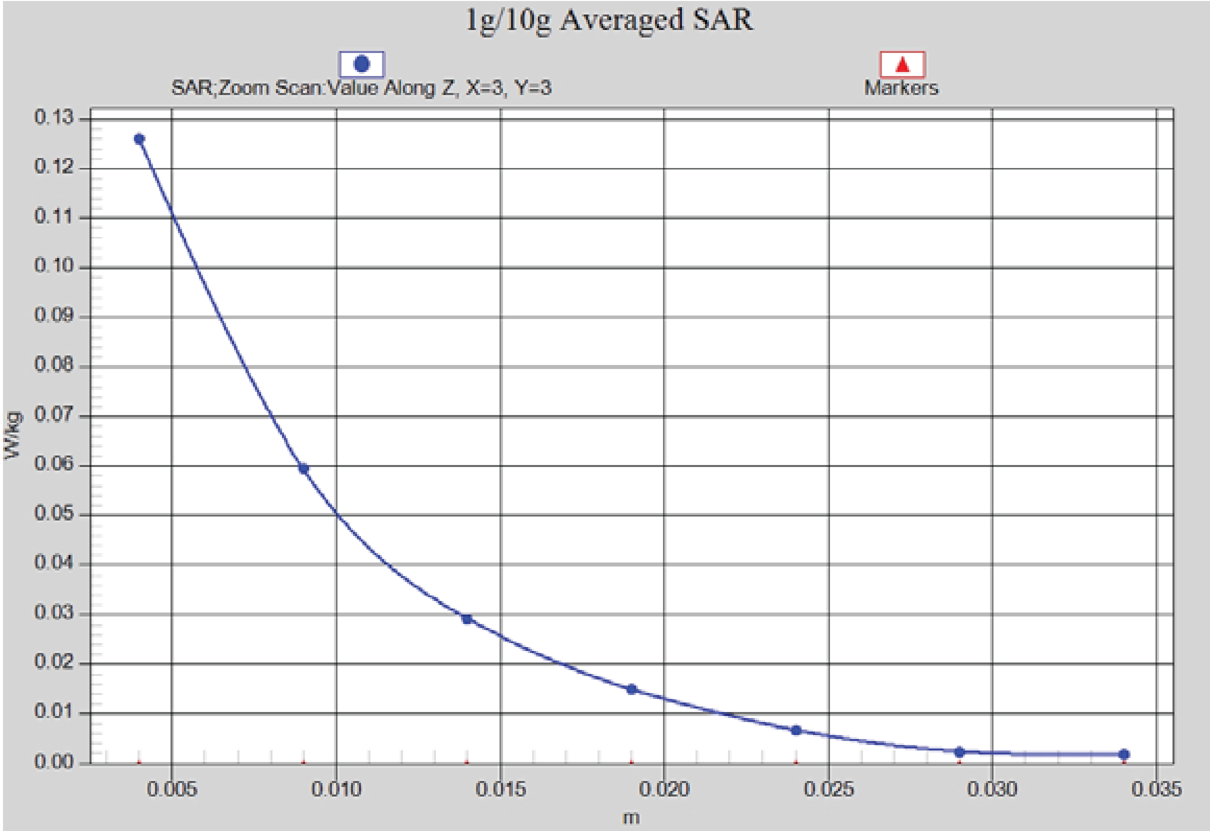


**Fig. 10-1 Z-Scan at power reference point (2450 MHz CH6)**

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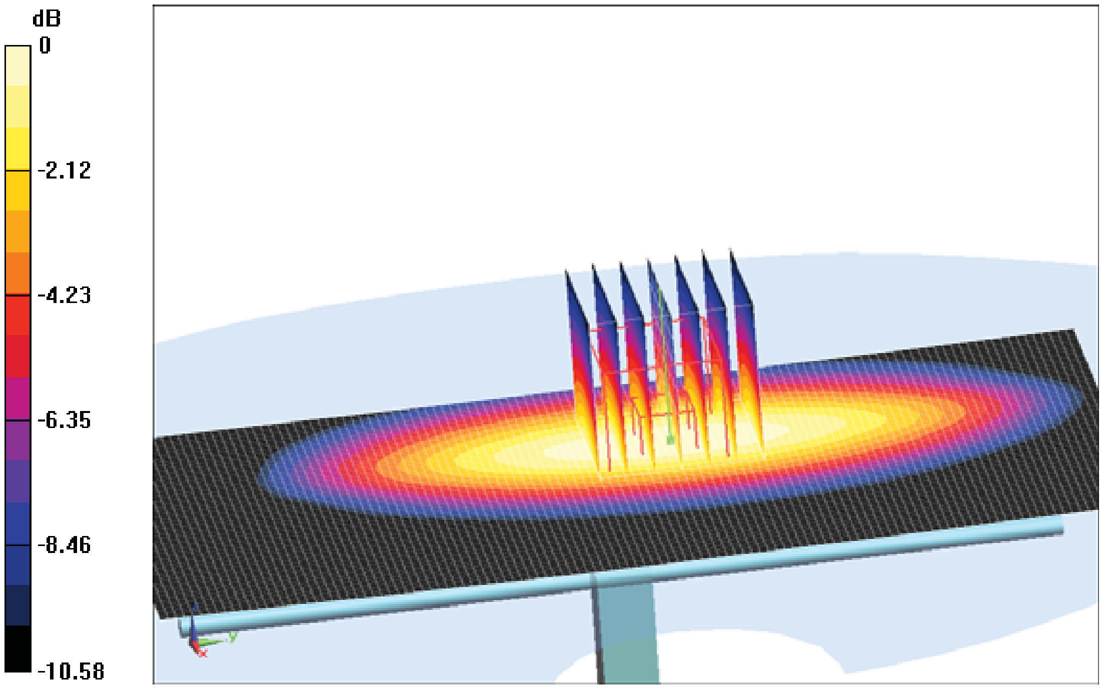
## ANNEX B System Verification Results

### 835MHz

Date: 2014-11-13
Electronics: DAE4 Sn777
Medium: Head 850 MHz
Medium parameters used: f = 835 MHz; $\sigma$ = 0.919 mho/m; $\varepsilon_r$ = 42.62; $\rho$ = 1000 kg/m$^3$
Ambient Temperature: 22.2$^o$C Liquid Temperature: 21.7$^o$C
Communication System: CW Frequency: 835 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN3846 ConvF(9.18, 9.18, 9.18)

**System Validation /Area Scan (61x121x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm
Reference Value = 54.1 V/m; Power Drift = -0.03 dB
**SAR(1 g) = 2.41 W/kg; SAR(10 g) = 1.57 W/kg**
Maximum value of SAR (interpolated) = 2.84 W/kg

**System Validation /Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 54.1 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 3.63 W/kg
**SAR(1 g) = 2.44 W/kg; SAR(10 g) = 1.59 W/kg**
Maximum value of SAR (measured) = 2.86 W/kg




0 dB = 2.86 W/kg = 4.56 dBW/kg

**Fig.B.1 validation 835MHz 250mW**

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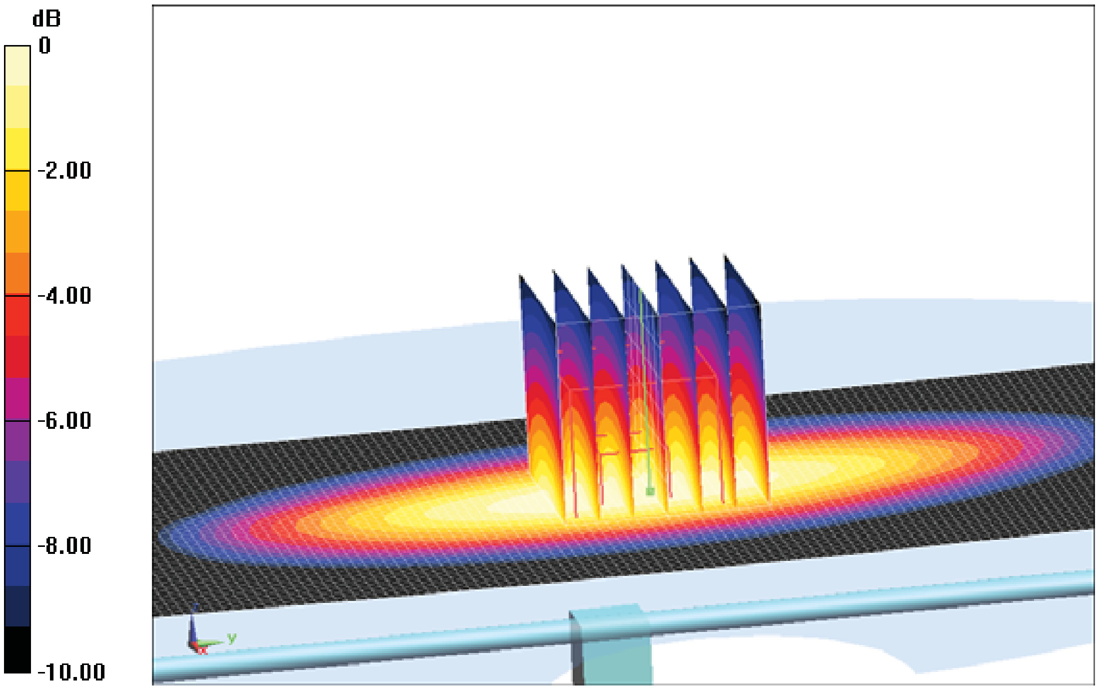
## 835MHz

Date: 2014-11-13
Electronics: DAE4 Sn777
Medium: Body 850 MHz
Medium parameters used: f = 835 MHz; $\sigma$ = 0.996 S/m; $\varepsilon_r$ = 56.75; $\rho$ = 1000 kg/m$^3$
Ambient Temperature: 22.2$^o$C Liquid Temperature: 21.7$^o$C
Communication System: CW Frequency: 835 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN3846 ConvF(9.09, 9.09, 9.09)

**System Validation /Area Scan (61x121x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm
Reference Value = 51.934 V/m; Power Drift = 0.06 dB
**Fast SAR: SAR(1 g) = 2.40 W/kg; SAR(10 g) = 1.58 W/kg**
Maximum value of SAR (interpolated) = 2.76 W/kg

**System Validation /Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 51.934 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 3.42 W/kg
**SAR(1 g) = 2.37 W/kg; SAR(10 g) = 1.56 W/kg**
Maximum value of SAR (measured) = 2.74 W/kg




0 dB = 2.74 W/kg = 4.38 dBW/kg

**Fig.B.2 validation 835MHz 250mW**

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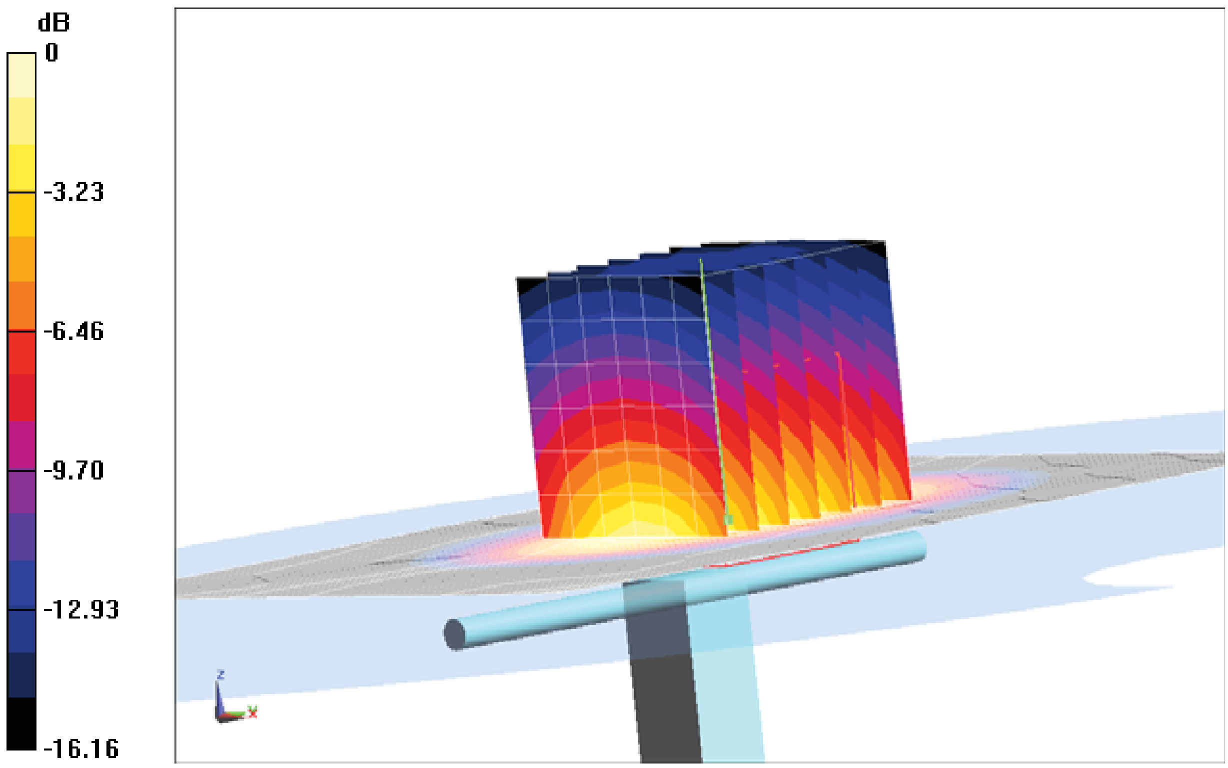
## 1750MHz

Date: 2014-11-14
Electronics: DAE4 Sn777
Medium: Head 1750 MHz
Medium parameters used: f=1750 MHz; σ = 1.397 mho/m; εr = 40.62; ρ = 1000 kg/m$^3$
Ambient Temperature: 22.0$^o$C Liquid Temperature: 21.5$^o$C
Communication System: CW Frequency: 1750 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN3846 ConvF(7.64, 7.64, 7.64)

**System Validation/Area Scan (81x121x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm
Reference Value = 87.409 V/m; Power Drift = 0.04 dB
**Fast SAR: SAR(1 g) = 8.92 W/kg; SAR(10 g) = 4.77 W/kg**
Maximum value of SAR (interpolated) = 9.94 W/kg

**System Validation/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 87.409 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 15.5 W/kg
**SAR(1 g) = 8.96 W/kg; SAR(10 g) = 4.80 W/kg**
Maximum value of SAR (measured) = 9.97 W/kg




0 dB = 9.97 W/kg = 9.99 dB W/kg

**Fig.B.3 validation 1750MHz 250mW**

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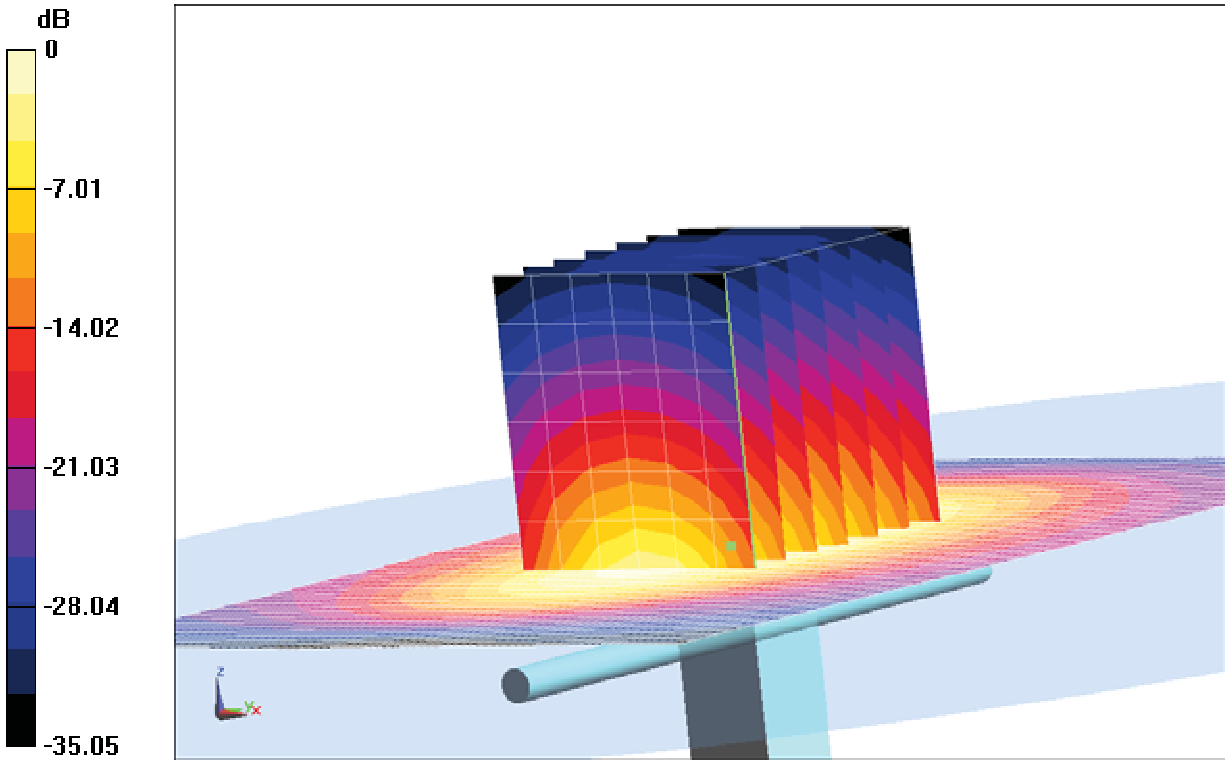
## 1750MHz

Date: 2014-11-14
Electronics: DAE4 Sn777
Medium: Body 1750 MHz
Medium parameters used: f=1750 MHz; $\sigma$ = 1.508 mho/m; $\varepsilon r$ = 54.33; $\rho$ = 1000 kg/m$^3$
Ambient Temperature: 22.0$^o$C Liquid Temperature: 21.5$^o$C
Communication System: CW Frequency: 1750 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN3846 ConvF(7.43, 7.43, 7.43)

**System Validation/Area Scan (81x121x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm
Reference Value = 93.971 V/m; Power Drift = -0.05 dB
**Fast SAR: SAR(1 g) = 9.39 W/kg; SAR(10 g) = 5.08 W/kg**
Maximum value of SAR (interpolated) = 10.6 W/kg

**System Validation/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 93.971 V/m; Power Drift = -0.05 dB
Peak SAR (extrapolated) = 16.22 W/kg
**SAR(1 g) = 9.25 W/kg; SAR(10 g) = 4.97 W/kg**
Maximum value of SAR (measured) = 10.4 W/kg




0 dB = 10.4 W/kg = 10.17 dB W/kg

**Fig.B.4 validation 1750MHz 250mW**

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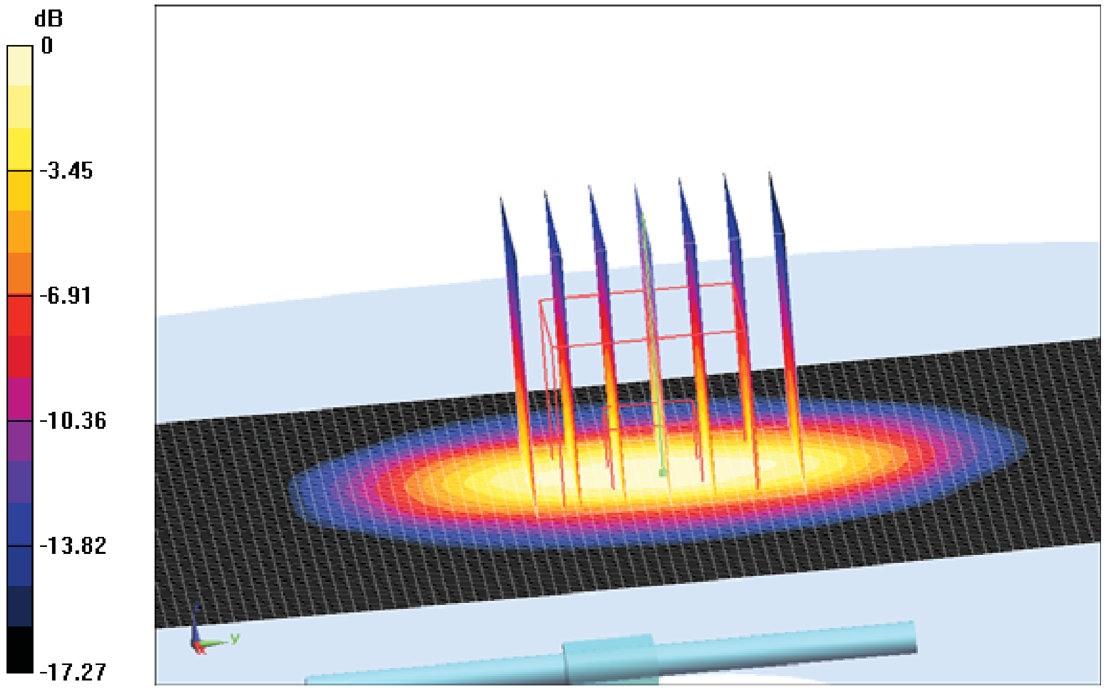
## 1900MHz

Date: 2014-11-15
Electronics: DAE4 Sn777
Medium: Head 1900 MHz
Medium parameters used: f = 1900 MHz; $\sigma$ = 1.384 mho/m; $\varepsilon_r$ = 40.89; $\rho$ = 1000 kg/m$^3$
Ambient Temperature: 22.2$^o$C Liquid Temperature: 21.7$^o$C
Communication System: CW Frequency: 1900 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN3846 ConvF(7.26, 7.26, 7.26)

**System Validation /Area Scan (61x81x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm
Reference Value = 92.253 V/m; Power Drift = 0.02 dB
**SAR(1 g) = 10.0 W/kg; SAR(10 g) = 5.31 W/kg**
Maximum value of SAR (interpolated) = 12.5 W/kg

**System Validation /Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 92.253 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 18.15 W/kg
**SAR(1 g) = 9.85 W/kg; SAR(10 g) = 5.17 W/kg**
Maximum value of SAR (measured) = 12.2 W/kg




0 dB = 12.2 W/kg = 10.86 dBW/kg

**Fig.B.5 validation 1900MHz 250mW**

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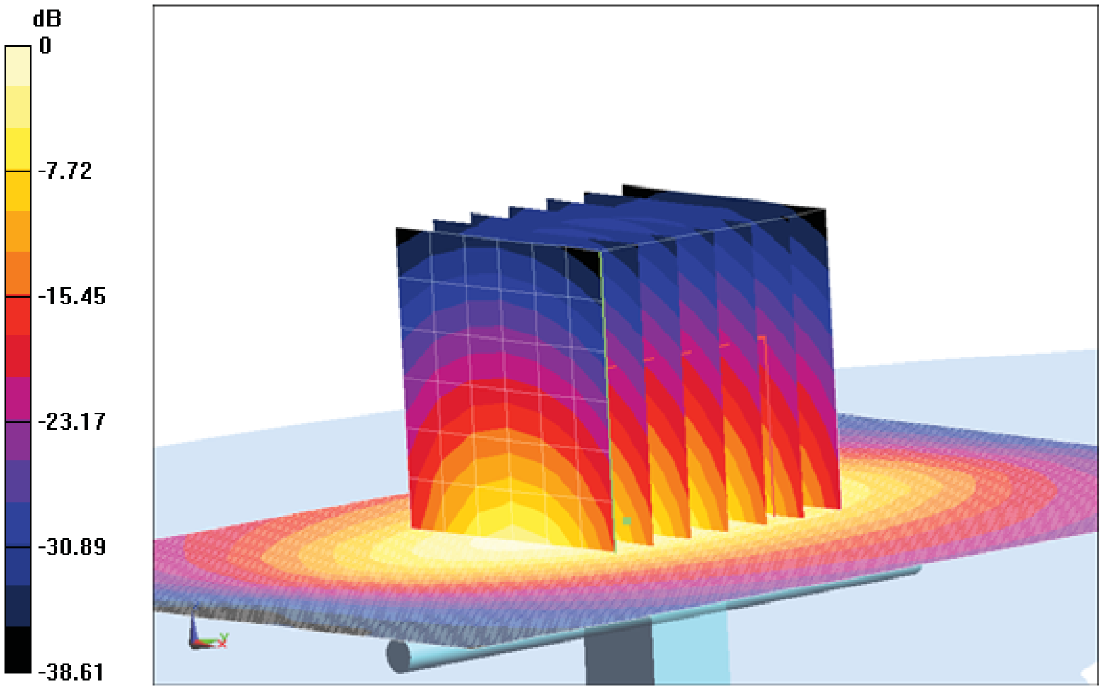
## 1900MHz

Date: 2014-11-15
Electronics: DAE4 Sn777
Medium: Body 1900 MHz
Medium parameters used: f = 1900 MHz; $\sigma$ = 1.564 S/m; $\varepsilon_r$ = 51.72; $\rho$ = 1000 kg/m$^3$
Ambient Temperature: 22.2$^o$C     Liquid Temperature: 21.7$^o$C
Communication System: CW Frequency: 1900 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN3846 ConvF(7.15, 7.15, 7.15)

**System Validation/Area Scan (81x121x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm
Reference Value = 91.849 V/m; Power Drift = -0.02 dB
**Fast SAR: SAR(1 g) = 10.4 W/kg; SAR(10 g) = 5.51 W/kg**
Maximum value of SAR (interpolated) = 12.3 W/kg

**System Validation/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 91.849 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 18.9 W/kg
**SAR(1 g) = 10.3 W/kg; SAR(10 g) = 5.41 W/kg**
Maximum value of SAR (measured) = 12.2 W/kg




0 dB = 12.2 W/kg = 10.86 dB W/kg

**Fig.B.6 validation 1900MHz 250mW**

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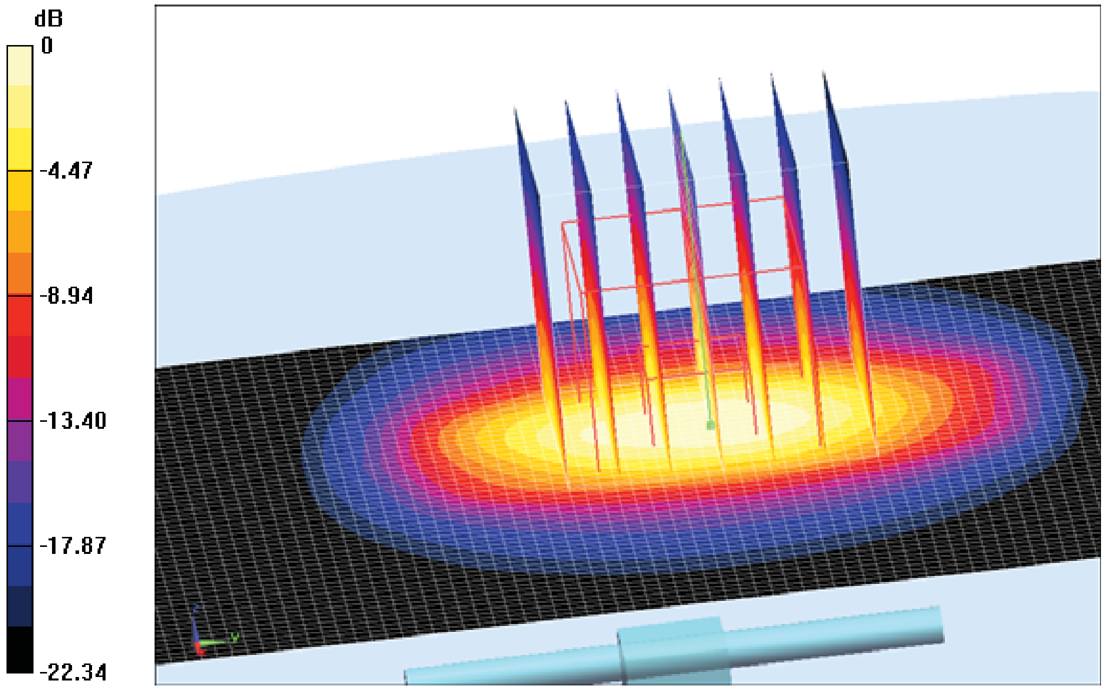
## 2450MHz

Date: 2014-11-16
Electronics: DAE4 Sn777
Medium: Head 2450 MHz
Medium parameters used: f = 2450 MHz; $\sigma$ = 1.836 mho/m; $\varepsilon_r$ = 40.35; $\rho$ = 1000 kg/$m^3$
Ambient Temperature: 22.2°C Liquid Temperature: 21.7°C
Communication System: CW Frequency: 2450 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN3846 ConvF(6.56, 6.56, 6.56)

**System Validation /Area Scan (61x81x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm
Reference Value = 88.921 V/m; Power Drift = -0.05 dB
**SAR(1 g) = 13.3 W/kg; SAR(10 g) = 6.26 W/kg**
Maximum value of SAR (interpolated) = 16.7 W/kg

**System Validation /Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 88.921 V/m; Power Drift = -0.05 dB
Peak SAR (extrapolated) = 27.2 W/kg
**SAR(1 g) = 13.1 W/kg; SAR(10 g) = 6.11 W/kg**
Maximum value of SAR (measured) = 16.5 W/kg




0 dB = 16.5 W/kg = 12.17 dBW/kg

**Fig.B.7 validation 2450MHz 250mW**

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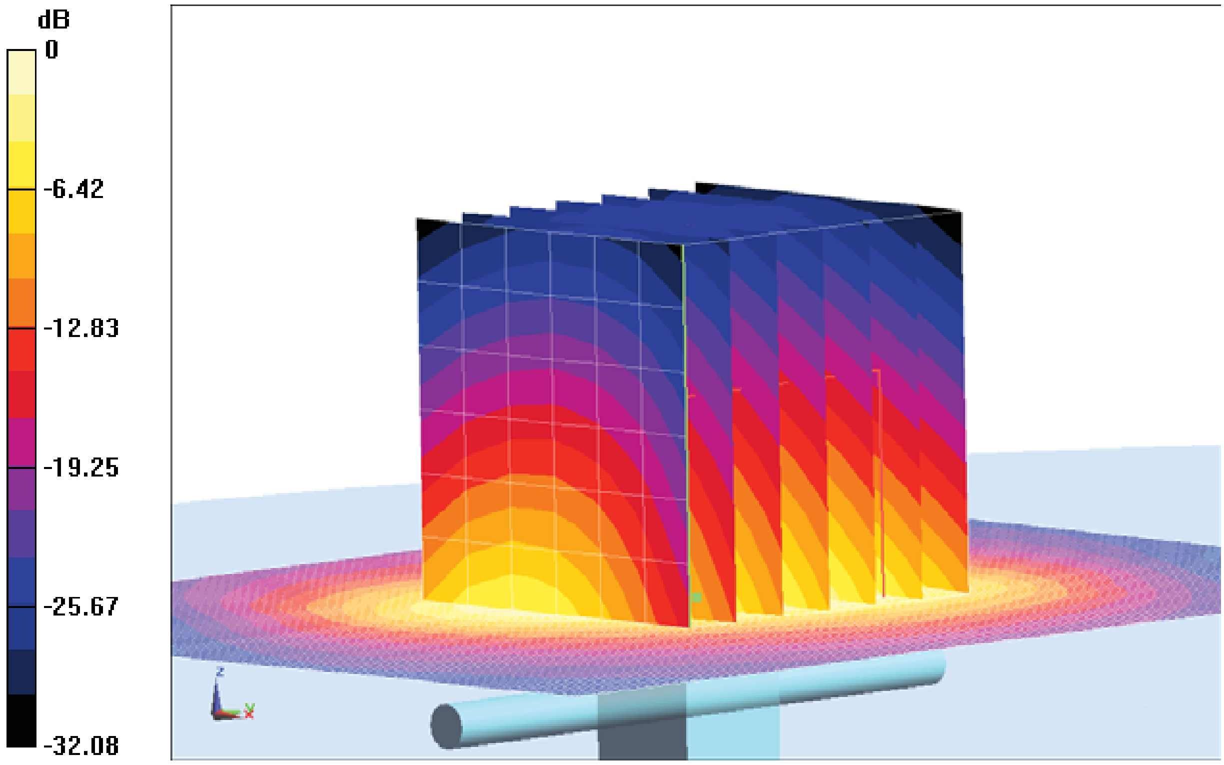
## 2450MHz

Date: 2014-11-16
Electronics: DAE4 Sn777
Medium: Body 2450 MHz
Medium parameters used: f = 2450 MHz; $\sigma$ = 1.892 S/m; $\varepsilon_r$ = 53.7; $\rho$ = 1000 kg/m$^3$
Ambient Temperature: 22.2$^o$C Liquid Temperature: 21.7$^o$C
Communication System: CW Frequency: 2450 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN3846 ConvF(6.90, 6.90, 6.90)

**System Validation/Area Scan (81x101x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm
Reference Value = 88.548 V/m; Power Drift = 0.03 dB
**SAR(1 g) = 12.4 W/kg; SAR(10 g) = 5.76 W/kg**
Maximum value of SAR (interpolated) = 14.5 W/kg

**System Validation/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 88.548 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 24.8 W/kg
**SAR(1 g) = 12.5 W/kg; SAR(10 g) = 5.85 W/kg**
Maximum value of SAR (measured) = 14.6 W/kg




0 dB = 14.6 W/kg = 11.64 dB W/kg

**Fig.B.8 validation 2450MHz 250mW**

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The SAR system verification must be required that the area scan estimated 1-g SAR is within 3% of the zoom scan 1-g SAR.

**Table B.1 Comparison between area scan and zoom scan for system verification**

| Band | Position | Area scan (1g) | Zoom scan (1g) | Drift (%) |
|---|---|---|---|---|
| 835 | Head | 2.41 | 2.44 | -1.23 |
| 835 | Body | 2.40 | 2.37 | 1.27 |
| 1750 | Head | 8.92 | 8.96 | -0.45 |
| 1750 | Body | 9.39 | 9.25 | 1.51 |
| 1900 | Head | 10.0 | 9.85 | 1.52 |
| 1900 | Body | 10.4 | 10.3 | 0.97 |
| 2450 | Head | 13.3 | 13.1 | 1.53 |
| 2450 | Body | 12.4 | 12.5 | -0.80 |

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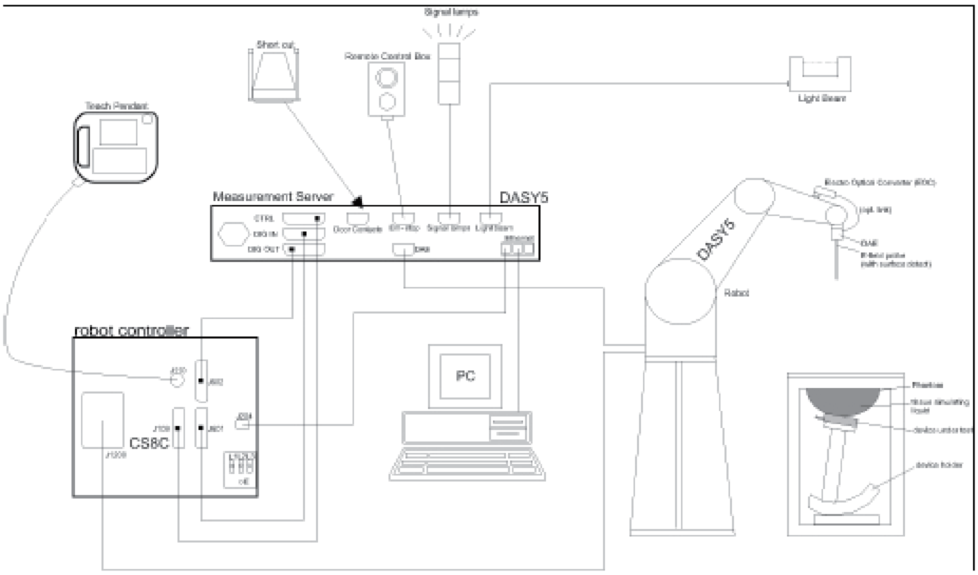
# ANNEX C SAR Measurement Setup

## C.1 Measurement Set-up

The Dasy4 or DASY5 system for performing compliance tests is illustrated above graphically. This system consists of the following items:




**Picture C.1 SAR Lab Test Measurement Set-up**

- A standard high precision 6-axis robot (Stäubli TX=RX family) with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- An isotropic field probe optimized and calibrated for the targeted measurement.
- A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- The Electro-optical converter (EOC) performs the conversion from optical to electrical signals for the digital communication to the DAE. To use optical surface detection, a special version of the EOC is required. The EOC signal is transmitted to the measurement server.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- The Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positioning.
- A computer running WinXP and the DASY4 or DASY5 software.
- Remote control and teach pendant as well as additional circuitry for robot safety such as
- warning lamps, etc.
- The phantom, the device holder and other accessories according to the targeted measurement.

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## C.2 Dasy4 or DASY5 E-field Probe System

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. The probe is equipped with an optical multifiber line ending at the front of the probe tip. It is connected to the EOC box on the robot arm and provides an automatic detection of the phantom surface. Half of the fibers are connected to a pulsed infrared transmitter, the other half to a synchronized receiver. As the probe approaches the surface, the reflection from the surface produces a coupling from the transmitting to the receiving fibers. This reflection increases first during the approach, reaches maximum and then decreases. If the probe is flatly touching the surface, the coupling is zero. The distance of the coupling maximum to the surface is independent of the surface reflectivity and largely independent of the surface to probe angle. The DASY4 or DASY5 software reads the reflection durning a software approach and looks for the maximum using 2$^{nd}$ ord curve fitting. The approach is stopped at reaching the maximum.

**Probe Specifications:**

**Model:** ES3DV3, EX3DV4

**Frequency Range:** 10MHz — 6.0GHz(EX3DV4)
10MHz — 4GHz(ES3DV3)

**Calibration:** In head and body simulating tissue at Frequencies from 835 up to 5800MHz

**Linearity:** ± 0.2 dB(30 MHz to 6 GHz) for EX3DV4
± 0.2 dB(30 MHz to 4 GHz) for ES3DV3

**Dynamic Range:** 10 mW/kg — 100W/kg

**Probe Length:** 330 mm

**Probe Tip Length:** 20 mm

**Body Diameter:** 12 mm

**Tip Diameter:** 2.5 mm (3.9 mm for ES3DV3)

**Tip-Center:** 1 mm (2.0mm for ES3DV3)

**Application:** SAR Dosimetry Testing
Compliance tests of mobile phones
Dosimetry in strong gradient fields

**Picture C.2 Near-field Probe**

**Picture C.3 E-field Probe**

## C.3 E-field Probe Calibration

Each E-Probe/Probe Amplifier combination has unique calibration parameters. A TEM cell calibration procedure is conducted to determine the proper amplifier settings to enter in the probe parameters. The amplifier settings are determined for a given frequency by subjecting the probe to a known E-field density (1 mW/cm$^2$) using an RF Signal generator, TEM cell, and RF Power Meter.

The free space E-field from amplified probe outputs is determined in a test chamber. This calibration can be performed in a TEM cell if the frequency is below 1 GHz and inn a waveguide or other methodologies above 1 GHz for free space. For the free space calibration, the probe is placed

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in the volumetric center of the cavity and at the proper orientation with the field. The probe is then rotated 360 degrees until the three channels show the maximum reading. The power density readings equates to 1 mW/ $cm^2$.

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

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

Where:

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

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

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

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

Where:

σ = Simulated tissue conductivity,

ρ = Tissue density ($kg/m^3$).

## C.4 Other Test Equipment

### C.4.1 Data Acquisition Electronics(DAE)

The data acquisition electronics consist of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder with a control logic unit. Transmission to the measurement server is accomplished through an optical downlink for data and status information, as well as an optical uplink for commands and the clock.

The mechanical probe mounting device includes two different sensor systems for frontal and sideways probe contacts. They are used for mechanical surface detection and probe collision detection.

The input impedance of the DAE is 200 MOhm; the inputs are symmetrical and floating. Common mode rejection is above 80 dB.

**PictureC.4: DAE**

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### C.4.2 Robot

The SPEAG DASY system uses the high precision robots (DASY4: RX90XL; DASY5: RX160L) type from Stäubli SA (France). For the 6-axis controller system, the robot controller version from Stäubli is used. The Stäubli robot series have many features that are important for our application:

- High precision (repeatability 0.02mm)
- High reliability (industrial design)
- Low maintenance costs (virtually maintenance free due to direct drive gears; no belt drives)
- Jerk-free straight movements (brushless synchron motors; no stepper motors)
- Low ELF interference (motor control fields shielded via the closed metallic construction shields)

Picture C.5 DASY 4


Picture C.6 DASY 5

### C.4.3 Measurement Server

The Measurement server is based on a PC/104 CPU broad with CPU (dasy4: 166 MHz, Intel Pentium; DASY5: 400 MHz, Intel Celeron), chipdisk (DASY4: 32 MB; DASY5: 128MB), RAM (DASY4: 64 MB, DASY5: 128MB). The necessary circuits for communication with the DAE electronic box, as well as the 16 bit AD converter system for optical detection and digital I/O interface are contained on the DASY I/O broad, which is directly connected to the PC/104 bus of the CPU broad.

The measurement server performs all real-time data evaluation of field measurements and surface detection, controls robot movements and handles safety operation. The PC operating system cannot interfere with these time critical processes. All connections are supervised by a watchdog, and disconnection of any of the cables to the measurement server will automatically disarm the robot and disable all program-controlled robot movements. Furthermore, the measurement server is equipped with an expansion port which is reserved for future applications. Please note that this expansion port does not have a standardized pinout, and therefore only devices provided by SPEAG can be connected. Devices from any other supplier could seriously damage the measurement server.

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Picture C.7 Server for DASY 4


Picture C.8 Server for DASY 5

### C.4.4 Device Holder for Phantom

The SAR in the phantom is approximately inversely proportional to the square of the distance between the source and the liquid surface. For a source at 5mm distance, a positioning uncertainty of ±0.5mm would produce a SAR uncertainty of ±20%. Accurate device positioning is therefore crucial for accurate and repeatable measurements. The positions in which the devices must be measured are defined by the standards.

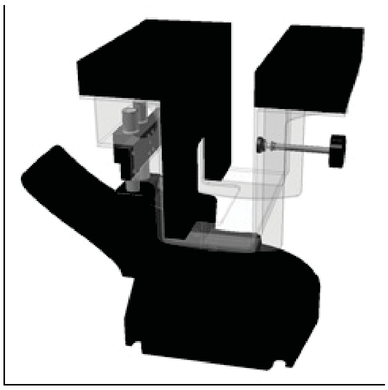
The DASY device holder is designed to cope with the different positions given in the standard. It has two scales for device rotation (with respect to the body axis) and device inclination (with respect to the line between the ear reference points). The rotation centers for both scales is the ear reference point (ERP). Thus the device needs no repositioning when changing the angles.

The DASY device holder is constructed of low-loss POM material having the following dielectric parameters: relative permittivity $\varepsilon$ =3 and loss tangent $\delta$ =0.02. The amount of dielectric material has been reduced in the closest vicinity of the device, since measurements have suggested that the influence of the clamp on the test results could thus be lowered.

<Laptop Extension Kit>

The extension is lightweight and made of POM, acrylic glass and foam. It fits easily on the upper part of the Mounting Device in place of the phone positioner. The extension is fully compatible with the Twin-SAM and ELI phantoms.

**Picture C.9-1: Device Holder**



**Picture C.9-2: Laptop Extension Kit**

### C.4.5 Phantom

The SAM Twin Phantom V4.0 is constructed of a fiberglass shell integrated in a table. The shape of the shell is based on data from an anatomical study designed to Represent the 90$^{th}$ percentile of the population. The phantom enables the dissymmetric evaluation

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of SAR for both left and right handed handset usage, as well as body-worn usage using the flat phantom region. 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. The shell phantom has a 2mm shell thickness (except the ear region where shell thickness increases to 6 mm).

Shell Thickness: 2 ± 0. 2 mm
Filling Volume: Approx. 25 liters
Dimensions: 810 x l000 x 500 mm (H x L x W)
Available: Special

**Picture C.10: SAM Twin Phantom**

Phantom for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. ELI is fully compatible with the IEC 62209-2 standard and all known tissue simulating liquids. ELI has been optimized regarding its performance and can be integrated into our standard phantom tables. A cover prevents evaporation of the liquid. Reference markings on the phantom allow installation of the complete setup, including all predefined phantom positions and measurement grids, by teaching three points. The phantom is compatible with all SPEAG dosimetric probes and dipoles.

Shell Thickness: 2 ± 0. 2 mm
Filling Volume: Approx. 30 liters
Dimensions: Major axis: 600 mm, Minor axis: 400 mm

**Picture C.11: ELI Phantom**

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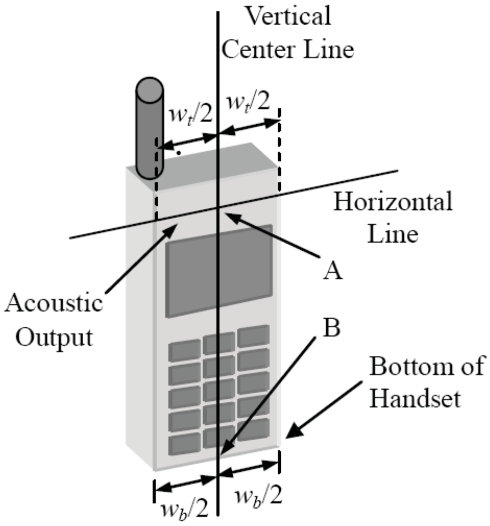
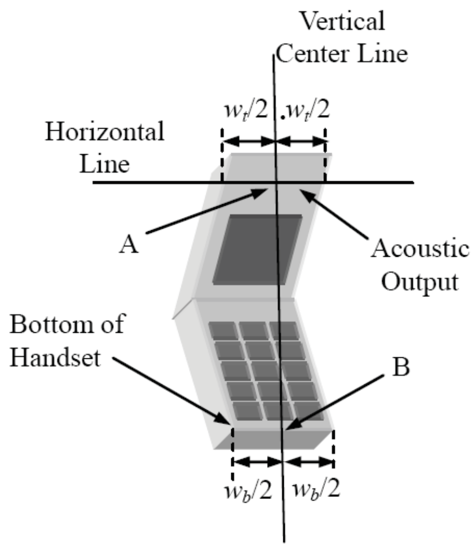
# ANNEX D Position of the wireless device in relation to the phantom

## D.1 General considerations

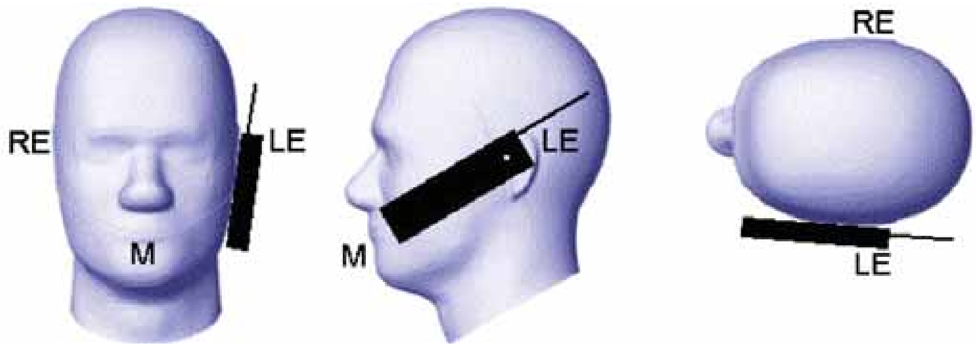
This standard specifies two handset test positions against the head phantom – the “cheek” position and the “tilt” position.




| | |
|---|---|
| $w_t$ | 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 D.1-a Typical “fixed” case handset** **Picture D.1-b Typical “clam-shell” case handset**




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

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