# SAR TEST REPORT

## No. I17N00558-SAR

**For**

**Yulong Computer Telecommunication Scientific (Shenzhen) Co., Ltd**

**Smart Watch**

**Model Name: coolpad 301A**

**With**

**Hardware Version: V2**

**Software Version: GROVCN00X1000DPX1706083**

**FCC:R38YL301A**

**Issued Date: 2017-07-06**

**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 |
|---|---|---|---|
| I17N00558-SAR | Rev.0 | 2017-07-06 | Initial creation of test report |

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# 1 Test Laboratory

## 1.1 Testing Location

| | |
|---|---|
| Company Name: | CTTL(Shenzhen) |
| Address: | TCL International E City No.1001 Zhongshanyuan Road, Nanshan District, Shenzhen, Guangdong Province P.R.China |

## 1.2 Testing Environment

| | |
|---|---|
| Temperature: | 18°C~25 °C |
| Relative humidity: | 30%~ 70% |
| Ground system resistance: | < 4Ω |
| Ambient noise & Reflection: | < 0.012 W/kg |

## 1.3 Project Data

| | |
|---|---|
| Project Leader: | Zhang Yunzhuan |
| Test Engineer: | Li Yongfu |
| Testing Start Date: | June 25, 2017 |
| Testing End Date: | June 25, 2017 |

## 1.4 Signature

**Li Yongfu**

**(Prepared this test report)**

**Zhang Yunzhuan**

**(Reviewed this test report)**

**Cao Junfei**

**Deputy Director of the laboratory**

**(Approved this test report)**

## 2 Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for Yulong Computer Telecommunication Scientific (Shenzhen) Co., LtdSmart Watchcoolpad 301Aare as follows:

**Table 2.1: HighestReported SAR (1g)**

| ExposureConfiguration | Technology Band | HighestReportedSAR | Equipment Class | Limited (W/kg) |
|---|---|---|---|---|
| Next to the mouth (SeparationDistance 10mm)1g(W/kg) | GSM850 | 0.47 | PCE | 1.6 |
| | PCS1900 | 1.05 | | |
| | UMTSFDD 5 | 0.32 | | |
| | UMTSFDD 2 | **1.32** | | |
| | UMTSFDD 4 | 0.86 | | |
| | LTEBand2 | 1.05 | | |
| | LTEBand4 | 0.93 | | |
| wrist-worn (Separation Distance 0mm)10g(W/kg) | GSM850 | 0.56 | PCE | 4.0 |
| | PCS1900 | 0.74 | | |
| | UMTSFDD 5 | 0.43 | | |
| | UMTSFDD 2 | 0.25 | | |
| | UMTSFDD 4 | 0.97 | | |
| | LTEBand2 | 0.96 | | |
| | LTEBand 4 | 0.78 | | |

The SAR values found for the EUT are below the maximum recommended levels of 1.6 W/Kg as averaged over any 1g tissue and 4.0 W/Kg as averaged over any 10g tissue according to the ANSI C95.1-1999.

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 highestreported SAR value is obtained at the case of **(Table 2.1),** and the values are**: 1.32W/kg(1g).**

**Table2.3: Thesumofreported SAR values formainantennaandBT**

| | Position | Main antenna | BT* | Sum | Limited (W/kg) |
|---|---|---|---|---|---|
| **Highest reported SAR 1g(W/Kg)** | Next to the mouth | 1.32 | 0.15 | **1.47** | 1.6 |
| **Highest reported SAR 10g(W/Kg)** | wrist-worn | 0.97 | 0.26 | **1.23** | 4.0 |

BT*-EstimatedSAR forBluetooth (seethetable12.2)

According to the above tables, the highest sum of reported SAR values is **1.47W/kg (1g)**. The detail for simultaneous transmission consideration is described in chapter 12.

# 3 Client Information

## 3.1 Applicant Information

| | |
|---|---|
| Company Name: | Yulong Computer Telecommunication Scientific (Shenzhen) Co., Ltd |
| Address /Post: | Coolpad Information Harbor, High-tech Industrial Park (North), Nanshan District, Shenzhen, P.R.C. |
| Contact: | amei lii |
| Email: | liamei@yulong.com |
| Telephone: | +86 13410415799 |
| Fax: | / |

## 3.2 Manufacturer Information

| | |
|---|---|
| Company Name: | Yulong Computer Telecommunication Scientific (Shenzhen) Co., Ltd |
| Address /Post: | Coolpad Information Harbor, High-tech Industrial Park (North), Nanshan District, Shenzhen, P.R.C. |
| Contact: | haocai |
| Email: | liamei@yulong.com |
| Telephone: | +86 13410415799 |
| Fax: | / |

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

## 4.1 About EUT

| | |
|---|---|
| Description: | Smart Watch |
| Model Name: | coolpad 301A |
| Operating mode(s): | GSM 850/1900, WCDMA 850/1700/1900,<br>LTE_FDD Band 2/4/, BT |
| 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 (WCDMA1700 Band IV) |
| | 1852.4–1907.6 MHz (WCDMA1900 Band II) |
| | 1850.7–1909.3 MHz (LTE_FDD Band 2) |
| | 1710.7–1754.3 MHz (LTE_FDD Band 4) |
| GPRS&EGPRS Multislot Class: | 12 |
| GPRS capability Class: | / |
| WCDMA Category: | HSDPA: 10 |
| | HSUPA: 6 |
| | HSPA+(Uplink): 6 |
| | HSPA+(downlink): 14 |
| | DC-HSDPA: 24 |
| Release Version: | GSM: R99 |
| | GPRS: R99 |
| | UMTS: 9 |
| Test device Production information: | Production unit |
| Device type: | Portable device |
| Antenna type: | Integrated antenna |

## 4.2 Internal Identification of EUT used during the test

| EUT ID* | SN or IMEI | HW Version | SW Version |
|---|---|---|---|
| EUT1 | IMEI: 865188030010653 | V2 | GROVCN00X1000DPX1706083 |
| EUT2 | IMEI: 865188030000563 | V2 | GROVCN00X1000DPX1706083 |

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

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

## 4.3 Internal Identification of AE used during the test

| AE ID* | Description | Model | SN | Manufacturer |
|---|---|---|---|---|
| AE1 | Battery | ZS05WA | / | SCUD (FUJIAN) Electronics Co., Ltd. |

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

# 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.

**KDB 447498 D01 General RF Exposure Guidance v06:** Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies.

**KDB941225 D01 SAR test for 3G devices v03r01:**SAR MeasurementProceduresfor3GDevices

**KDB941225D05SAR forLTEDevicesv02r05:**SAR EvaluationConsiderationsforLTEDevices

**KDB 865664 D01SAR measurement 100 MHz to 6 GHz v01r04:** SAR Measurement Requirements for 100 MHz to 6 GHz.

**KDB 865664 D02 RF Exposure Reporting v01r02:** RF Exposure Compliance Reporting and Documentation Considerations

# 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.

# 7 Tissue Simulating Liquids

## 7.1 Targets for tissue simulating liquid

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

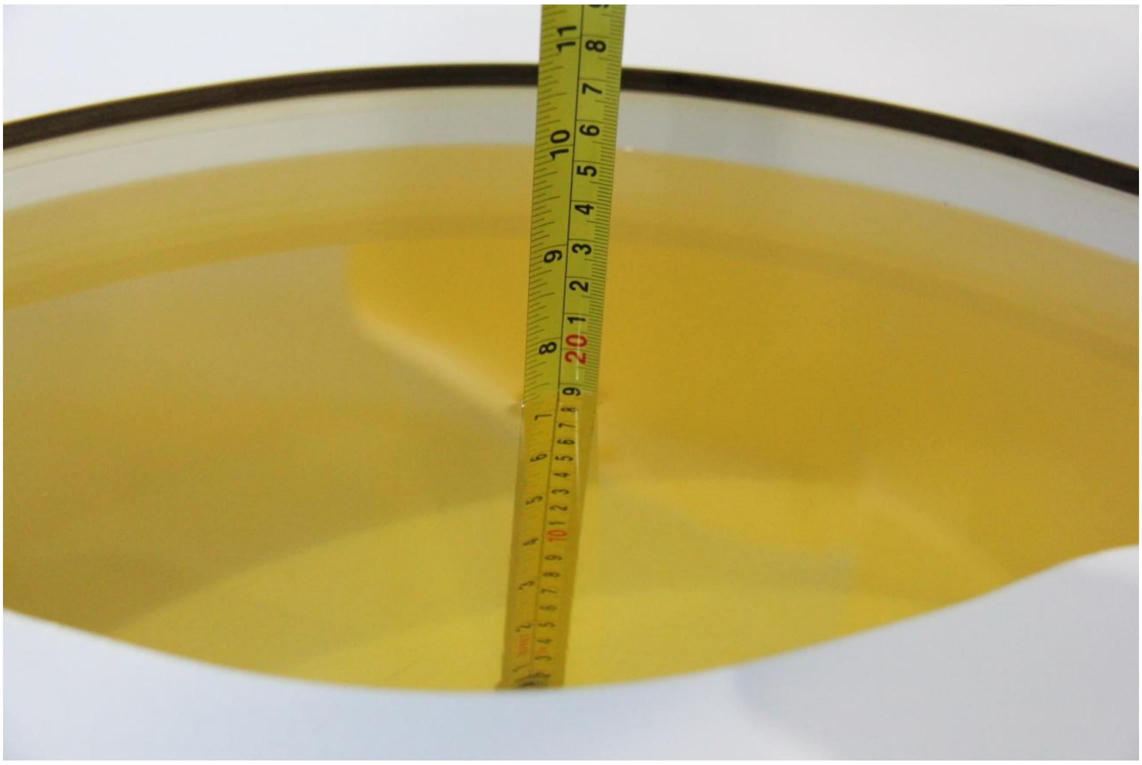
| Frequency (MHz) | Liquid Type | Conductivity (σ) | ± 5% Range | Permittivity (ε) | ± 5% Range |
|---|---|---|---|---|---|
| 835 | Head | 0.90 | 0.86～0.95 | 41.5 | 39.4～43.6 |
| 835 | Body | 0.97 | 0.92～1.02 | 55.2 | 52.4～58.0 |
| 1800 | Head | 1.40 | 1.33～1.47 | 40.0 | 38.0～42.0 |
| 1800 | Body | 1.52 | 1.44～1.60 | 53.5 | 50.8～56.1 |
| 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 |

## 7.2 Dielectric Performance

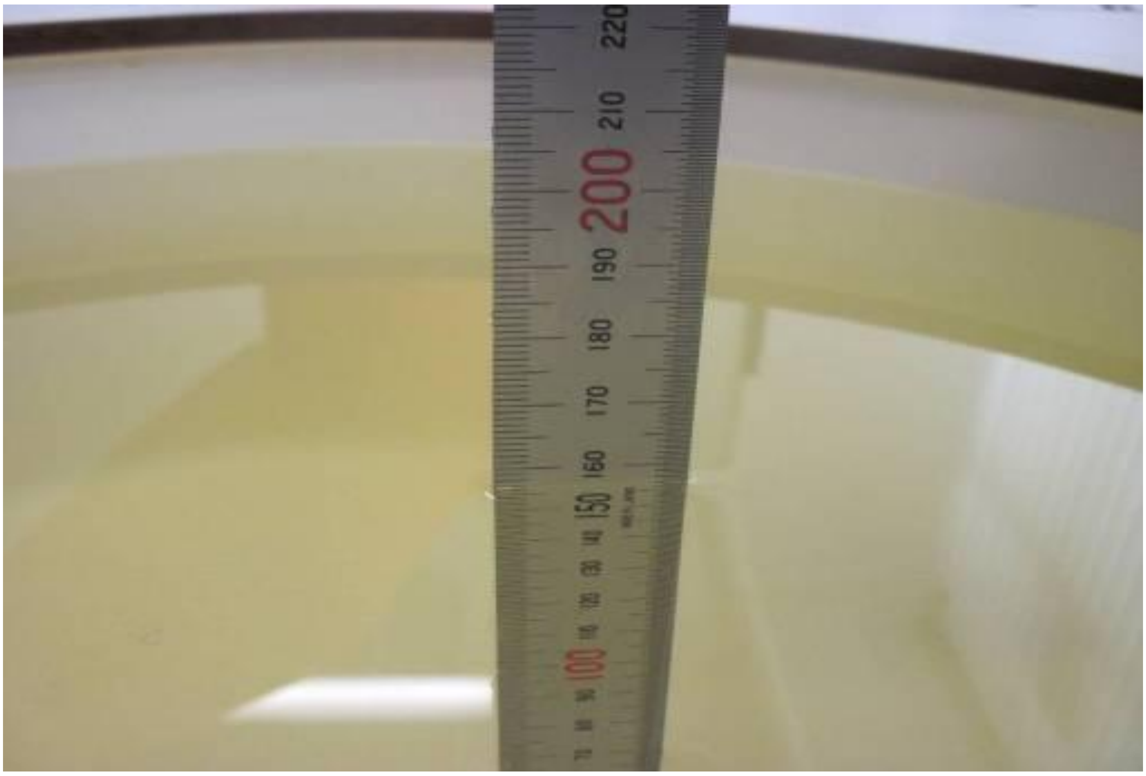
**Table 7.2: Dielectric Performance of Tissue Simulating Liquid**

| Measurement Date (yyyy-mm-dd) | Type | Frequency | Conductivity σ (S/m) | Drift (%) | Permittivity ε | Drift (%) |
|---|---|---|---|---|---|---|
| 2017-6-25 | Head | 835 | 0.886 | -1.56 | 41.86 | 0.87 |
| 2017-6-25 | Body | 835 | 0.955 | -1.55 | 55.83 | 1.14 |
| 2017-6-25 | Head | 1800 | 1.428 | 2.00 | 39.29 | -1.78 |
| 2017-6-25 | Body | 1800 | 1.545 | 1.64 | 52.37 | -2.11 |
| 2017-6-25 | Head | 1900 | 1.406 | 0.43 | 38.74 | -3.15 |
| 2017-6-25 | Body | 1900 | 1.512 | -0.53 | 54.33 | 1.93 |

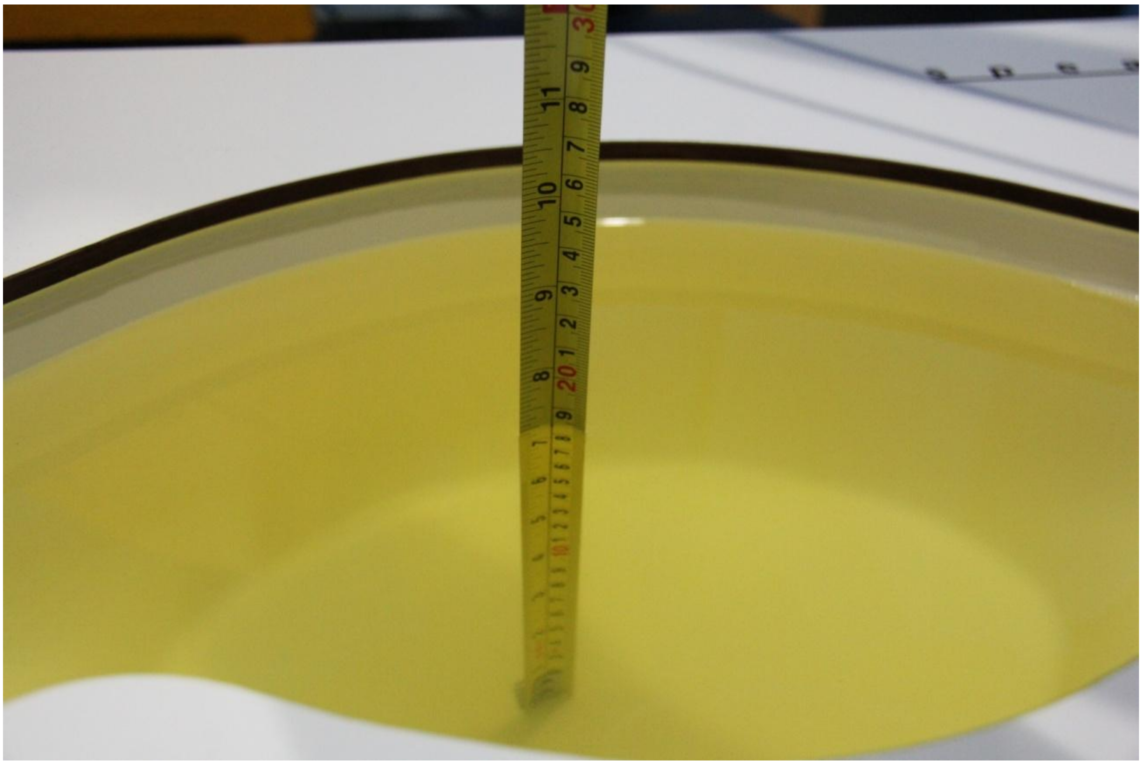
Note: The liquid temperature is 22.0°C



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



**Picture 7-2: Liquid depth in the Flat Phantom (1800MHz)**

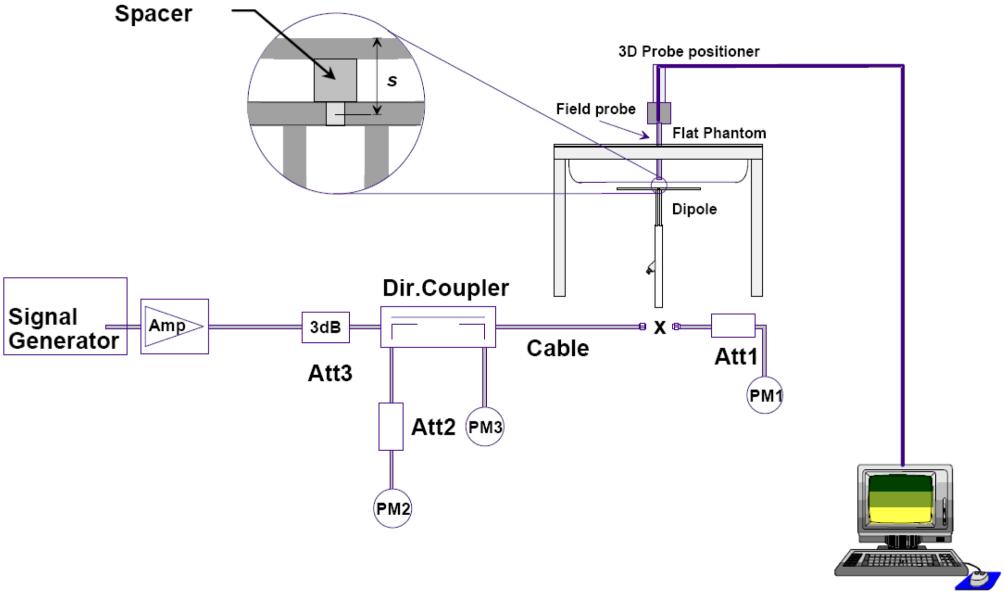


**Picture 7-3: Liquid depth in the Flat Phantom (1900MHz)**

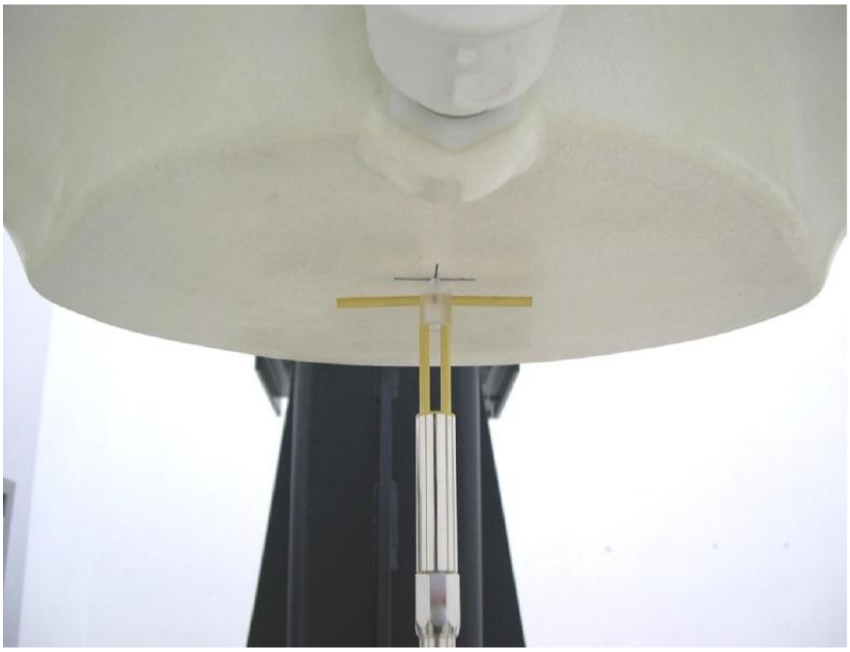
# 8System verification

## 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**

## 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 |
| 2017-6-25 | 835 MHz | 6.03 | 9.22 | 5.80 | 8.88 | -3.81 | -3.69 |
| 2017-6-25 | 1800 MHz | 20.6 | 38.8 | 20.76 | 39.48 | 0.78 | 1.75 |
| 2017-6-25 | 1900 MHz | 21.0 | 40.8 | 20.64 | 39.40 | -1.71 | -3.43 |

**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 |
| 2017-6-25 | 835 MHz | 6.20 | 9.44 | 6.00 | 9.04 | -3.23 | -4.24 |
| 2017-6-25 | 1800 MHz | 21.1 | 39.6 | 20.48 | 38.28 | -2.94 | -3.33 |
| 2017-6-25 | 1900 MHz | 21.3 | 41.1 | 21.80 | 42.40 | 2.35 | 3.16 |

# 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.

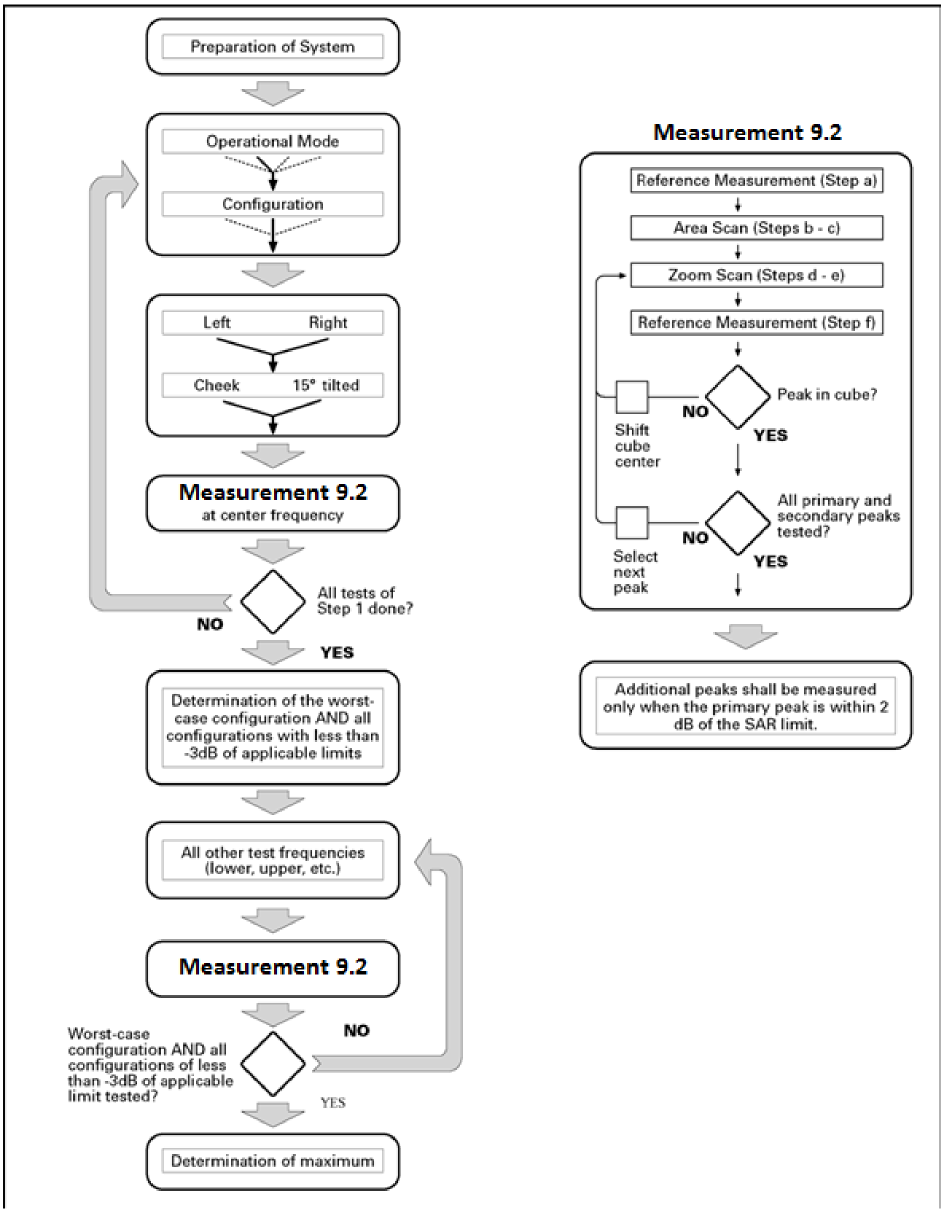
**Step 1**: The tests described in 9.2 shall be performed at the channel that is closest to the center of the transmit frequency band ( $f_c$ ) for:

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.




**Picture 9.1Block 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 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 1528-2013. 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><td colspan="3"></td><td>≤ 3 GHz</td><td>> 3 GHz</td></tr>
<tr><td colspan="3">Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface</td><td>5 ± 1 mm</td><td>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>≤ 2 GHz: ≤ 15 mm<br>2 – 3 GHz: ≤ 12 mm</td><td>3 – 4 GHz: ≤ 12 mm<br>4 – 6 GHz: ≤ 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 ≤ 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>≤ 2 GHz: ≤ 8 mm<br>2 – 3 GHz: ≤ 5 mm*</td><td>3 – 4 GHz: ≤ 5 mm*<br>4 – 6 GHz: ≤ 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>≤ 5 mm</td><td>3 – 4 GHz: ≤ 4 mm<br>4 – 5 GHz: ≤ 3 mm<br>5 – 6 GHz: ≤ 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>≤ 4 mm</td><td>3 – 4 GHz: ≤ 3 mm<br>4 – 5 GHz: ≤ 2.5 mm<br>5 – 6 GHz: ≤ 2 mm</td></tr>
<tr><td>$\Delta z_{Zoom}(n>1)$: between subsequent points</td><td colspan="2">≤ 1.5·$\Delta z_{Zoom}(n-1)$</td></tr>
<tr><td>Minimum zoom scan volume</td><td colspan="2">x, y, z</td><td>≥ 30 mm</td><td>3 – 4 GHz: ≥ 28 mm<br>4 – 5 GHz: ≥ 25 mm<br>5 – 6 GHz: ≥ 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 ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 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 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 | 1.0 | 0.0 | 20 | 75 |
| 2 | 6/15 | 15/15 | 64 | 6/15 | 12/15 | 12/15 | 12/15 | 4 | 1 | 3.0 | 2.0 | 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 | 2.0 | 1.0 | 15 | 92 |
| 4 | 2/15 | 15/15 | 64 | 2/15 | 4/15 | 4/15 | 56/75 | 4 | 1 | 3.0 | 2.0 | 17 | 71 |
| 5 | 15/15 | 15/15 | 64 | 15/15 | 24/15 | 30/15 | 134/15 | 4 | 1 | 1.0 | 0.0 | 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.

## 9.5 SAR Measurement for LTE

SAR tests for LTE are performed with a base station simulator, Anristu MT8820C. Closed loop power control was used so the UE transmits with maximum output power during SAR testing.All powers were measured with the Anristu MT8820C.It is performed for conducted power and SAR based on the KDB941225 D05.

SAR is evaluated separately according to the following procedures for the different test positions in each exposure condition – head, body, body-worn accessories and other use conditions. The procedures in the following subsections are applied separately to test each LTE frequency band.

1) QPSK with 1 RB allocation
Start with the largest channel bandwidth and measure SAR for QPSK with 1 RB allocation, using the RB offset and required test channel combination with the highest maximum output power among RB offsets at the upper edge, middle and lower edge of each required test channel. When the reported SAR is ≤ 0.8 W/kg, testing of the remaining RB offset configurations and required test channels is not required for 1 RB allocation; otherwise, SAR is required for the remaining required test channels and only for the RB offset configuration with the highest output power for that channel. When the reported SAR of a required test channel is > 1.45 W/kg, SAR is required for all three RB offset configurations for that required test channel.
2) QPSK with 50% RB allocation
The procedures required for 1 RB allocation in 1) are applied to measure the SAR for QPSK with 50% RB allocation.
3) QPSK with 100% RB allocation
For QPSK with 100% RB allocation, SAR is not required when the highest maximum output power for 100 % RB allocation is less than the highest maximum output power in 50% and 1 RB allocations and the highest reported SAR for 1 RB and 50% RB allocation in 1) and 2) are ≤ 0.8 W/kg. Otherwise, SAR is measured for the highest output power channel; and if the reported SAR is > 1.45 W/kg, the remaining required test channels must also be tested.

## 9.6 Power Drift

To control the output power stability during the SAR test, DASY5 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 Section14 labeled as: (Power Drift [dB]). This ensures that the power drift during one measurement is within 5%.

# 10 Conducted Output Power

## 10.1 Manufacturing tolerance

**Table 10.1: GSM Speech**

| **GSM 850** | | | |
|---|---|---|---|
| Channel | Channel 251 | Channel 190 | Channel 128 |
| Target (dBm) | 32 | 32 | 32 |
| Tolerance ±(dB) | 1 | 1 | 1 |
| **GSM 1900** | | | |
| Channel | Channel 810 | Channel 661 | Channel 512 |
| Target (dBm) | 30 | 30 | 30 |
| Tolerance ±(dB) | 1 | 1 | 1 |

**Table 10.2: GPRS & EGPRS**

| **GSM 850** GPRS/ EGPRS(GMSK) | | | | |
|---|---|---|---|---|
| Channel | | 251 | 190 | 128 |
| 1Txslot | Target (dBm) | 32 | 32 | 32 |
| | Tolerance ±(dB) | 1 | 1 | 1 |
| 2Txslots | Target (dBm) | 30.5 | 30.5 | 30.5 |
| | Tolerance ±(dB) | 1 | 1 | 1 |
| 3Txslots | Target (dBm) | 30 | 30 | 30 |
| | Tolerance ±(dB) | 1 | 1 | 1 |
| 4Txslots | Target (dBm) | 29.5 | 29.5 | 29.5 |
| | Tolerance ±(dB) | 1 | 1 | 1 |
| **GSM 1900** GPRS/ EGPRS (GMSK) | | | | |
| Channel | | 810 | 661 | 512 |
| 1Txslot | Target (dBm) | 30 | 30 | 30 |
| | Tolerance ±(dB) | 1 | 1 | 1 |
| 2Txslots | Target (dBm) | 29.5 | 29.5 | 29.5 |
| | Tolerance ±(dB) | 1 | 1 | 1 |
| 3Txslots | Target (dBm) | 29 | 29 | 29 |
| | Tolerance ±(dB) | 1 | 1 | 1 |
| 4Txslots | Target (dBm) | 29 | 29 | 29 |
| | Tolerance ±(dB) | 1 | 1 | 1 |

**Table 10.3: WCDMA**

| UMTS Band V | | Conducted Power (dBm) | | |
|---|---|---|---|---|
| | | Channel 4233 | Channel 4182 | Channel 4132 |
| CS | Target (dBm) | 22 | 22 | 22 |
| | Tolerance ±(dB) | 1 | 1 | 1 |
| HSUPA sub-test 1-5 | Target (dBm) | 20 | 20 | 20 |
| | Tolerance ±(dB) | 1 | 1 | 1 |
| HSDPA sub-test1-4 | Target (dBm) | 22 | 22 | 22 |
| | Tolerance ±(dB) | 1 | 1 | 1 |
| UMTS Band IV | | Conducted Power(dBm) | | |
| | | Channel 1513 | Channel 1413 | Channel 1312 |
| CS | Target (dBm) | 22 | 22 | 22 |
| | Tolerance ±(dB) | 1 | 1 | 1 |
| HSUPA sub-test 1-5 | Target (dBm) | 20 | 20 | 20 |
| | Tolerance ±(dB) | 1 | 1 | 1 |
| HSDPA sub-test 1-4 | Target (dBm) | 22 | 22 | 22 |
| | Tolerance ±(dB) | 1 | 1 | 1 |
| UMTS Band II | | Conducted Power(dBm) | | |
| | | Channel 9538 | Channel 9400 | Channel 9262 |
| CS | Target (dBm) | 21 | 21 | 21 |
| | Tolerance ±(dB) | 1 | 1 | 1 |
| HSUPA sub-test 1-5 | Target (dBm) | 20 | 20 | 20 |
| | Tolerance ±(dB) | 1 | 1 | 1 |
| HSDPA sub-test 1-4 | Target (dBm) | 21 | 21 | 21 |
| | Tolerance ±(dB) | 1 | 1 | 1 |

**Table 10.4: LTE**

| LTE Band 2 | | | |
|---|---|---|---|
| Channel | Channel 19100 | Channel 18900 | Channel 18700 |
| Target (dBm) | 22.5 | 22.5 | 22.5 |
| Tolerance ±(dB) | 1 | 1 | 1 |
| LTE Band 4 | | | |
| Channel | Channel 20300 | Channel 20175 | Channel 20050 |
| Target (dBm) | 23 | 23 | 23 |
| Tolerance ±(dB) | 1 | 1 | 1 |

LTE MPR will follow up 3GPP setting as below:

| Modulation | Channel bandwidth / Transmission bandwidth (NRB) | | | | | | MPR (dB) |
|---|---|---|---|---|---|---|---|
| | 1.4MHz | 3.0MHz | 5MHz | 10MHz | 15MHz | 20MHz | |
| QPSK | > 5 | > 4 | > 8 | > 12 | > 16 | > 18 | 1 |
| 16 QAM | ≤ 5 | ≤ 4 | ≤ 8 | ≤ 12 | ≤ 16 | ≤ 18 | 1 |
| 16 QAM | > 5 | > 4 | > 8 | > 12 | > 16 | > 18 | 2 |

**Table 10.5: Bluetooth**

| Mode | | 2402MHz（Ch0） | 2441MHz（Ch39） | 2480MHz（Ch78） |
|---|---|---|---|---|
| GFSK | Target (dBm) | 5 | 7 | 5 |
| | Tolerance ±(dB) | 1 | 1 | 1 |
| EDR2M-4_DQPSK | Target (dBm) | 5 | 7 | 5 |
| | Tolerance ±(dB) | 1 | 1 | 1 |
| EDR3M-8DPSK | Target (dBm) | 5 | 7 | 5 |
| | Tolerance ±(dB) | 1 | 1 | 1 |
| GFSK(BLE) | Target (dBm) | -3 | -1 | -3 |
| | Tolerance ±(dB) | 1 | 1 | 1 |

## 10.2 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 10.6: 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) |
| | 32.21 | 32.18 | 32.02 |
| GSM 1900MHz | Conducted Power(dBm) | | |
| | Channel 810(1909.8MHz) | Channel 661(1880MHz) | Channel 512(1850.2MHz) |
| | 30.32 | 30.37 | 30.31 |

**Table 10.7: The conducted power measurement results for GPRS and EGPRS**

| GSM 850 | | Measured Power (dBm) | | | calculation | Average Power (dBm) | | |
|---|---|---|---|---|---|---|---|---|
| | | 251 | 190 | 128 | | 251 | 190 | 128 |
| GPRS/ EGPRS | 1Txslots | 32.17 | 32.15 | 31.98 | -9.03dB | 23.14 | 23.12 | 22.95 |
| | 2Txslots | 31.39 | 31.41 | 31.45 | -6.02dB | 25.37 | 25.39 | 25.43 |
| | 3Txslots | 30.87 | 30.71 | 30.57 | -4.26dB | 26.61 | 26.45 | 26.31 |
| | 4Txslots | 30.02 | 30.11 | 30.14 | -3.01dB | **27.01** | **27.1** | **27.13** |
| EGPRS (8PSK) | 1Txslots | 26.42 | 26.47 | 26.38 | -9.03dB | 17.39 | 17.44 | 17.35 |
| | 2Txslots | 25.72 | 25.78 | 25.81 | -6.02dB | 19.70 | 19.76 | 19.79 |
| | 3Txslots | 25.25 | 25.42 | 25.36 | -4.26dB | 20.99 | 21.16 | 21.10 |
| | 4Txslots | 25.14 | 25.12 | 25.11 | -3.01dB | 22.13 | 22.11 | 22.10 |

| GSM 1900 | | Measured Power (dBm) | | | calculation | Average Power (dBm) | | |
|---|---|---|---|---|---|---|---|---|
| | | 810 | 661 | 512 | | 810 | 661 | 512 |
| GPRS/ EGPRS | 1Txslots | 30.34 | 30.38 | 30.33 | -9.03dB | 21.31 | 21.35 | 21.3 |
| | 2Txslots | 30.07 | 30.15 | 30.17 | -6.02dB | 24.05 | 24.13 | 24.15 |
| | 3Txslots | 29.93 | 29.94 | 29.95 | -4.26dB | 25.67 | 25.68 | 25.69 |
| | 4Txslots | 29.67 | 29.75 | 29.74 | -3.01dB | **26.66** | **26.74** | **26.73** |
| EGPRS (8PSK) | 1Txslots | 25.87 | 26.02 | 26.35 | -9.03dB | 16.84 | 16.99 | 17.32 |
| | 2Txslots | 25.38 | 25.56 | 25.84 | -6.02dB | 19.36 | 19.54 | 19.82 |
| | 3Txslots | 25.04 | 25.25 | 25.59 | -4.26dB | 20.78 | 20.99 | 21.33 |
| | 4Txslots | 24.72 | 24.91 | 25.22 | -3.01dB | 21.71 | 21.9 | 22.21 |

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 GSM 850andGSM 1900.**

### 10.3 WCDMA Measurement result

**Table 10.8: The conducted Power for WCDMA850/1700/1900**

| Item | band | **FDDBand 5 result** | | |
|---|---|---|---|---|
| | ARFCN | 4233 (846.6MHz) | 4182(836.4MHz) | 4132 (826.4MHz) |
| WCDMA | \ | **21.8** | **21.8** | **21.9** |
| HSDPA | 1 | 21.8 | 21.5 | 21.8 |
| | 2 | 21.8 | 21.5 | 21.8 |
| | 3 | 21.3 | 21.1 | 21.2 |
| | 4 | 21.4 | 21.2 | 21.2 |
| HSUPA | 1 | 20.1 | 20.9 | 20.9 |
| | 2 | 19.3 | 19.9 | 19.9 |
| | 3 | 19.4 | 19.8 | 19.4 |
| | 4 | 20.3 | 20.4 | 20.4 |
| | 5 | 20.8 | 20.7 | 20.8 |

| Item | band | **FDD Band4 result** | | |
|---|---|---|---|---|
| | ARFCN | 1513 (1752.6MHz) | 1413(1732.6MHz) | 1312 (1712.4MHz) |
| WCDMA | \ | **21.3** | **21.3** | **21.7** |
| HSDPA | 1 | 21.3 | 21.2 | 21.3 |
| | 2 | 21.3 | 21.2 | 21.3 |
| | 3 | 20.8 | 20.7 | 20.8 |
| | 4 | 20.9 | 20.7 | 20.7 |
| HSUPA | 1 | 20.4 | 20.4 | 20.8 |
| | 2 | 19.4 | 19.3 | 19.7 |
| | 3 | 19.0 | 18.9 | 19.8 |
| | 4 | 19.9 | 20.0 | 20.2 |
| | 5 | 20.4 | 20.4 | 20.8 |
| Item | band | **FDD Band2 result** | | |
| | ARFCN | 9538 (1907.6MHz) | 9400 (1880MHz) | 9262 (1852.4MHz) |
| WCDMA | \ | **21.8** | **21.6** | **21.6** |
| HSDPA | 1 | 21.2 | 21.3 | 21.4 |
| | 2 | 21.1 | 21.3 | 21.3 |
| | 3 | 20.6 | 20.8 | 20.7 |
| | 4 | 20.6 | 20.8 | 20.7 |
| HSUPA | 1 | 19.9 | 20.5 | 19.8 |
| | 2 | 19.7 | 19.6 | 19.6 |
| | 3 | 19.2 | 19.6 | 19.0 |
| | 4 | 20.2 | 20.1 | 20.0 |
| | 5 | 20.6 | 20.6 | 20.5 |

## 10.4LTE-FDD Measurement result

**Table 10.9: The conducted Power for LTE-FDD**

| LTE-FDD Band 2 | | | | Actual output Power (dBm) | | |
|---|---|---|---|---|---|---|
| Band-width | RBallocation | RBoffset | Modulation | High | Middle | Low |
| 1.4 MHz | | | | **1909.3MHz** | **1880MHz** | **1850.7MHz** |
| | 1RB | High | QPSK | 21.98 | 22.86 | 22.66 |
| | | | 16QAM | 20.67 | 20.14 | 21.13 |
| | | Middle | QPSK | 22.30 | 22.91 | 22.56 |
| | | | 16QAM | 20.89 | 20.15 | 21.17 |
| | | Low | QPSK | 22.22 | 22.85 | 22.41 |
| | | | 16QAM | 20.92 | 21.43 | 21.12 |
| | 3RB | High | QPSK | 22.47 | 22.91 | 22.80 |
| | | | 16QAM | 21.01 | 21.74 | 21.45 |
| | | Middle | QPSK | 22.59 | 22.94 | 22.77 |
| | | | 16QAM | 21.52 | 21.82 | 21.50 |
| | | Low | QPSK | 22.48 | 22.87 | 22.59 |
| | | | 16QAM | 21.51 | 21.84 | 21.50 |
| | 6RB | / | QPSK | 21.31 | 21.93 | 20.54 |
| | | | 16QAM | 19.72 | 22.15 | 19.65 |
| 3 MHz | | | | **1908.5MHz** | **1880MHz** | **1851.5MHz** |
| | 1RB | High | QPSK | 22.22 | 22.99 | 22.69 |
| | | | 16QAM | 21.22 | 21.65 | 21.19 |
| | | Middle | QPSK | 22.69 | 22.98 | 22.55 |
| | | | 16QAM | 21.33 | 21.60 | 21.11 |
| | | Low | QPSK | 22.77 | 22.74 | 22.63 |
| | | | 16QAM | 21.32 | 21.55 | 21.34 |
| | 8RB | High | QPSK | 21.34 | 22.07 | 21.86 |
| | | | 16QAM | 19.12 | 19.69 | 20.94 |
| | | Middle | QPSK | 21.53 | 21.21 | 21.71 |
| | | | 16QAM | 19.22 | 20.11 | 20.31 |
| | | Low | QPSK | 22.25 | 22.39 | 21.66 |
| | | | 16QAM | 21.01 | 21.12 | 20.82 |
| | 15RB | / | QPSK | 21.99 | 21.97 | 21.85 |
| | | | 16QAM | 21.12 | 21.00 | 20.77 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 5 MHz | | | | **1907.5MHz** | **1880MHz** | **1852.5MHz** |
| | 1RB | High | QPSK | 22.25 | 22.76 | 22.66 |
| | | | 16QAM | 20.77 | 21.40 | 21.81 |
| | | Middle | QPSK | 23.17 | 22.64 | 22.81 |
| | | | 16QAM | 21.94 | 21.63 | 21.64 |
| | | Low | QPSK | 22.98 | 22.46 | 22.63 |
| | | | 16QAM | 21.52 | 21.30 | 21.30 |
| | 12RB | High | QPSK | 21.60 | 21.85 | 21.79 |
| | | | 16QAM | 20.40 | 20.89 | 20.63 |
| | | Middle | QPSK | 21.97 | 21.92 | 21.75 |
| | | | 16QAM | 20.73 | 20.99 | 20.70 |
| | | Low | QPSK | 21.97 | 21.75 | 21.63 |
| | | | 16QAM | 20.76 | 20.71 | 20.60 |
| | 25RB | / | QPSK | 21.85 | 21.88 | 21.65 |
| | | | 16QAM | 20.81 | 21.13 | 20.62 |
| 10 MHz | | | | **1905MHz** | **1880MHz** | **1855MHz** |
| | 1RB | High | QPSK | 22.57 | 22.72 | 22.55 |
| | | | 16QAM | 20.72 | 21.67 | 21.24 |
| | | Middle | QPSK | 23.17 | 22.86 | 22.83 |
| | | | 16QAM | 21.88 | 21.53 | 21.22 |
| | | Low | QPSK | 22.97 | 22.63 | 22.67 |
| | | | 16QAM | 21.72 | 21.56 | 20.77 |
| | 25RB | High | QPSK | 22.00 | 21.98 | 21.83 |
| | | | 16QAM | 20.99 | 21.13 | 20.95 |
| | | Middle | QPSK | 21.96 | 21.93 | 21.83 |
| | | | 16QAM | 21.11 | 20.96 | 20.94 |
| | | Low | QPSK | 21.97 | 21.84 | 21.75 |
| | | | 16QAM | 21.11 | 20.75 | 20.84 |
| | 50RB | / | QPSK | 22.08 | 21.96 | 21.81 |
| | | | 16QAM | 21.11 | 21.05 | 20.80 |

| | | | | 1902.5MHz | 1880MHz | 1857.5MHz |
|---|---|---|---|---|---|---|
| 15 MHz | 1RB | High | QPSK | 22.76 | 22.95 | 22.08 |
| | | | 16QAM | 21.09 | 22.43 | 21.40 |
| | | Middle | QPSK | 22.66 | 21.88 | 21.06 |
| | | | 16QAM | 20.10 | 21.23 | 20.36 |
| | | Low | QPSK | 21.42 | 22.04 | 20.83 |
| | | | 16QAM | 20.11 | 21.08 | 19.73 |
| | 36RB | High | QPSK | 21.45 | 21.11 | 21.01 |
| | | | 16QAM | 20.56 | 20.01 | 21.78 |
| | | Middle | QPSK | 21.22 | 21.16 | 22.02 |
| | | | 16QAM | 20.63 | 20.07 | 21.85 |
| | | Low | QPSK | 21.41 | 22.14 | 22.89 |
| | | | 16QAM | 20.47 | 21.83 | 21.78 |
| | 75RB | / | QPSK | 21.96 | 22.38 | 22.18 |
| | | | 16QAM | 21.01 | 20.98 | 20.87 |
| 20 MHz | | | | **1900MHz** | **1880MHz** | **1860MHz** |
| | 1RB | High | QPSK | 22.32 | 22.84 | 21.81 |
| | | | 16QAM | 21.21 | 21.94 | 20.94 |
| | | Middle | QPSK | **23.01** | 22.84 | 22.62 |
| | | | 16QAM | 22.72 | 22.04 | 21.93 |
| | | Low | QPSK | 22.89 | 22.85 | 22.61 |
| | | | 16QAM | 21.48 | 21.45 | 21.88 |
| | 50RB | High | QPSK | 21.91 | 22.03 | 21.86 |
| | | | 16QAM | 20.71 | 20.90 | 20.37 |
| | | Middle | QPSK | **22.11** | 22.02 | 21.70 |
| | | | 16QAM | 20.74 | 20.94 | 20.22 |
| | | Low | QPSK | 22.10 | 21.79 | 21.63 |
| | | | 16QAM | 21.23 | 20.79 | 20.22 |
| | 100RB | / | QPSK | 21.96 | **22.07** | 21.59 |
| | | | 16QAM | 20.55 | 20.91 | 20.66 |

| LTE-FDD Band 4 | | | | Actual output Power (dBm) | | |
|---|---|---|---|---|---|---|
| Band-width | RB allocation | RB offset | Modulation | High | Middle | Low |
| 1.4 MHz | | | | **1754.3MHz** | **1732.5MHz** | **1710.7MHz** |
| | 1RB | High | QPSK | 22.80 | 23.06 | 23.57 |
| | | | 16QAM | 20.75 | 21.38 | 22.20 |
| | | Middle | QPSK | 22.80 | 23.07 | 23.60 |
| | | | 16QAM | 21.00 | 21.39 | 22.42 |
| | | Low | QPSK | 22.72 | 23.01 | 23.59 |
| | | | 16QAM | 20.91 | 22.22 | 22.23 |
| | 3RB | High | QPSK | 22.59 | 23.15 | 23.82 |
| | | | 16QAM | 21.26 | 22.17 | 22.48 |
| | | Middle | QPSK | 22.61 | 23.09 | 23.86 |
| | | | 16QAM | 21.40 | 22.07 | 22.60 |
| | | Low | QPSK | 22.55 | 23.08 | 23.68 |
| | | | 16QAM | 21.20 | 22.03 | 22.51 |
| | 6RB | / | QPSK | 21.73 | 22.07 | 22.64 |
| | | | 16QAM | 20.33 | 21.17 | 21.34 |
| 3 MHz | | | | **1753.5MHz** | **1732.5MHz** | **1711.5MHz** |
| | 1RB | High | QPSK | 22.77 | 22.95 | 23.53 |
| | | | 16QAM | 21.47 | 21.51 | 22.10 |
| | | Middle | QPSK | 22.61 | 22.95 | 23.61 |
| | | | 16QAM | 21.36 | 21.60 | 22.52 |
| | | Low | QPSK | 22.49 | 23.14 | 23.40 |
| | | | 16QAM | 21.12 | 21.62 | 22.29 |
| | 8RB | High | QPSK | 21.61 | 21.99 | 22.91 |
| | | | 16QAM | 20.63 | 21.15 | 21.86 |
| | | Middle | QPSK | 21.55 | 21.94 | 22.76 |
| | | | 16QAM | 20.67 | 21.15 | 21.73 |
| | | Low | QPSK | 21.71 | 22.14 | 22.71 |
| | | | 16QAM | 20.54 | 21.18 | 21.70 |
| | 15RB | / | QPSK | 21.53 | 21.15 | 22.68 |
| | | | 16QAM | 20.58 | 20.89 | 21.66 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 5 MHz | | | | **1752.5MHz** | **1732.5MHz** | **1712.5MHz** |
| | 1RB | High | QPSK | 22.82 | 22.83 | 23.29 |
| | | | 16QAM | 21.46 | 22.05 | 22.45 |
| | | Middle | QPSK | 22.97 | 23.09 | 23.46 |
| | | | 16QAM | 21.24 | 22.13 | 22.42 |
| | | Low | QPSK | 22.86 | 23.16 | 23.37 |
| | | | 16QAM | 21.78 | 21.87 | 22.27 |
| | 12RB | High | QPSK | 21.75 | 22.11 | 22.64 |
| | | | 16QAM | 20.87 | 21.22 | 21.61 |
| | | Middle | QPSK | 21.87 | 21.96 | 22.68 |
| | | | 16QAM | 20.95 | 21.14 | 21.56 |
| | | Low | QPSK | 21.93 | 22.20 | 22.64 |
| | | | 16QAM | 20.90 | 21.43 | 21.45 |
| | 25RB | / | QPSK | 21.78 | 22.33 | 22.63 |
| | | | 16QAM | 20.98 | 21.54 | 21.67 |
| 10 MHz | | | | **1750MHz** | **1732.5MHz** | **1715MHz** |
| | 1RB | High | QPSK | 23.23 | 23.27 | 24.02 |
| | | | 16QAM | 21.79 | 21.64 | 22.18 |
| | | Middle | QPSK | 23.24 | 23.31 | 23.94 |
| | | | 16QAM | 21.85 | 21.88 | 22.27 |
| | | Low | QPSK | 23.19 | 23.39 | 23.74 |
| | | | 16QAM | 21.82 | 22.10 | 21.80 |
| | 25RB | High | QPSK | 22.09 | 22.44 | 22.86 |
| | | | 16QAM | 20.72 | 21.20 | 22.09 |
| | | Middle | QPSK | 22.26 | 22.28 | 22.88 |
| | | | 16QAM | 21.06 | 21.23 | 21.98 |
| | | Low | QPSK | 22.32 | 22.57 | 22.85 |
| | | | 16QAM | 21.08 | 21.36 | 22.03 |
| | 50RB | / | QPSK | 22.19 | 22.40 | 22.85 |
| | | | 16QAM | 20.93 | 21.29 | 21.80 |

| | | | | 1747.5MHz | 1732.5MHz | 1717.5MHz |
|---|---|---|---|---|---|---|
| 15 MHz | 1RB | High | QPSK | 23.23 | 23.51 | 24.01 |
| | | | 16QAM | 22.14 | 21.55 | 22.98 |
| | | Middle | QPSK | 23.25 | 23.70 | 23.97 |
| | | | 16QAM | 21.74 | 21.95 | 22.58 |
| | | Low | QPSK | 23.30 | 24.01 | 23.72 |
| | | | 16QAM | 21.68 | 22.12 | 22.29 |
| | 36RB | High | QPSK | 23.33 | 23.65 | 24.01 |
| | | | 16QAM | 22.20 | 22.72 | 22.81 |
| | | Middle | QPSK | 23.28 | 23.62 | 23.82 |
| | | | 16QAM | 21.82 | 22.36 | 22.76 |
| | | Low | QPSK | 23.35 | 23.87 | 23.81 |
| | | | 16QAM | 21.81 | 22.57 | 22.76 |
| | 75RB | / | QPSK | 22.41 | 22.80 | 22.90 |
| | | | 16QAM | 21.02 | 21.68 | 21.86 |
| 20 MHz | | | | **1745MHz** | **1732.5MHz** | **1720MHz** |
| | 1RB | High | QPSK | 23.00 | 23.00 | 23.65 |
| | | | 16QAM | 21.65 | 21.84 | 22.10 |
| | | Middle | QPSK | 23.37 | 23.13 | **23.89** |
| | | | 16QAM | 22.25 | 22.54 | 22.55 |
| | | Low | QPSK | 23.64 | 23.89 | 23.72 |
| | | | 16QAM | 21.96 | 22.15 | 21.81 |
| | 50RB | High | QPSK | 22.15 | 22.02 | 22.54 |
| | | | 16QAM | 20.80 | 21.32 | 21.96 |
| | | Middle | QPSK | 22.30 | 22.17 | 22.81 |
| | | | 16QAM | 20.98 | 21.38 | 22.14 |
| | | Low | QPSK | 22.37 | 22.57 | **22.86** |
| | | | 16QAM | 21.44 | 21.57 | 21.95 |
| | 100RB | / | QPSK | 22.09 | 22.27 | **22.78** |
| | | | 16QAM | 21.16 | 21.61 | 21.96 |

## 10.5 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 | 5.28 | 7.25 | 5.37 |
| π/4 DQPSK | 5.40 | **7.37** | 5.47 |
| 8DPSK | 5.77 | 7.73 | 5.87 |
| BLE | -3.62 | -1.80 | -2.57 |

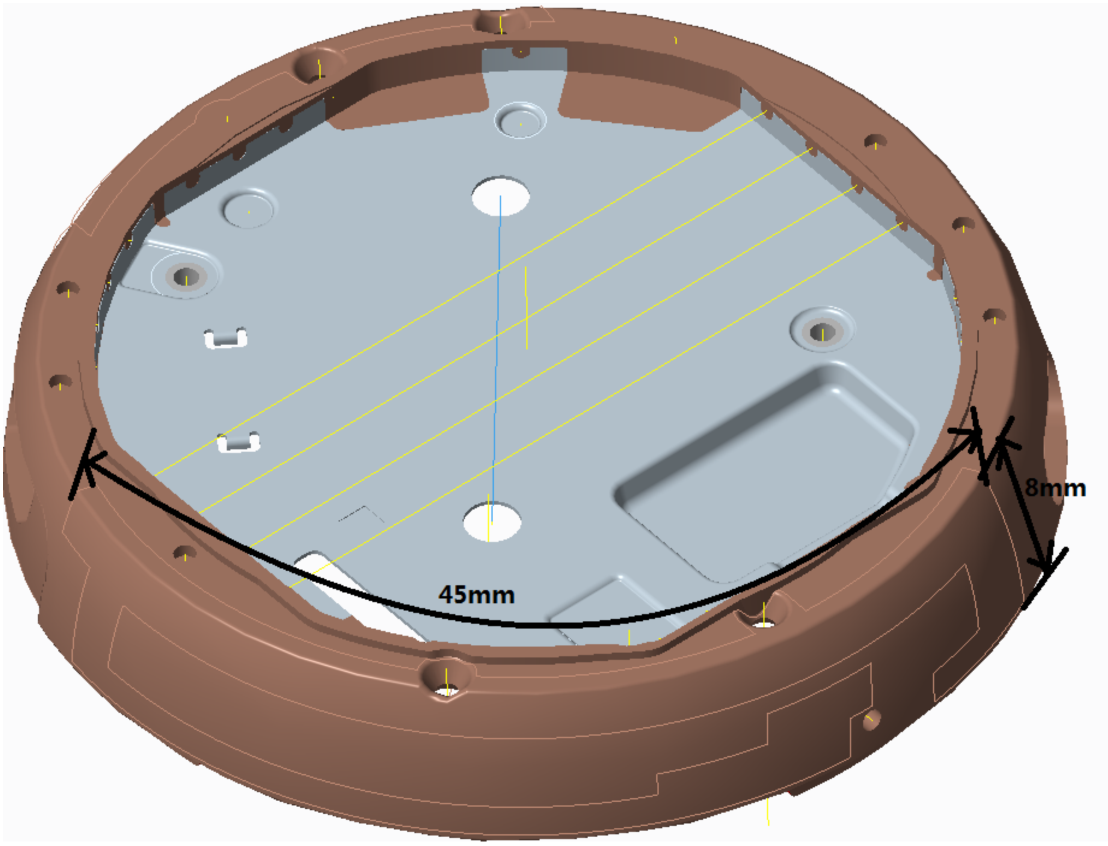
# 11 Simultaneous TX SAR Considerations

## 11.1 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.

## 11.2 Antenna Locations




**Picture 11.1 Antenna Locations**

## 11.3Standalone 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 | 8 | 6.31 | Yes |
| | | Body | 19.20 | 8 | 6.31 | Yes |

## 12 Evaluation of Simultaneous

**Table 12.1: The sum of reported SAR values for main antenna and Bluetooth**

| | Position | Main antenna | BT* | Sum | Limited (W/kg) |
|---|---|---|---|---|---|
| Highest reported SAR 1g(W/Kg) | Next to the mouth | 1.32 | 0.15 | **1.47** | 1.6 |
| Highest reported SAR 10g(W/Kg) | wrist-worn | 0.97 | 0.26 | **1.23** | 4.0 |

BT* - Estimated SAR for Bluetooth (see the table 12.2)

**Table 12.2: Estimated SAR for Bluetooth**

| Position | f (GHz) | Distance (mm) | Upper limit of power * | | Estimated$_{1g}$ (W/kg) |
|---|---|---|---|---|---|
| | | | dBm | mW | |
| Next to the mouth | 2.441 | 10 | 8 | 6.31 | 0.15 |
| wrist-worn | 2.441 | 5 | 8 | 6.31 | 0.26 |

* - 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)]·[√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.

# 13 SARTest Result

The calculated SAR is obtained by the following formula:

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

Where $P_{Target}$ is the power of manufacturing upper limit;

$P_{Measured}$ is the measured power in chapter 10.

**Table 13.1: Duty Cycle**

| **Mode** | **Duty Cycle** |
|---|---|
| Speech for GSM850/1900 | 1:8.3 |
| GPRS&EGPRS for GSM1900 | 1:2 |
| WCDMA850/1700/1900 | 1:1 |
| FDD_LTE Band 2/4 | 1:1 |

**Table 13.2: SAR Values (GSM 850 MHz - Next to the mouth)**

| Frequency | | Test Position | Figure No. | Conducted Power (dBm) | Max. tune-upPower (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 | Front | Fig.1 | 32.18 | 33 | 0.242 | **0.29** | 0.388 | **0.47** | -0.08 |

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

**Table 13.3: SAR Values (GSM 850 MHz - wrist-worn)**

| 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. | | | | | | | | | |
| 836.6 | 190 | Rear | Fig.2 | 30.11 | 30.5 | 0.516 | **0.56** | 0.843 | **0.92** | 0.09 |
| 836.6 | 190 | RearEGPRS | / | 30.11 | 30.5 | 0.488 | **0.53** | 0.825 | **0.90** | -0.06 |

Note: The distance between the EUT and the phantom bottom is 0mm.

**Table 13.4: SAR Values (GSM 1900 MHz - Next to the mouth)**

| Frequency | | Test Position | Figure No. | Conducted Power (dBm) | Max. tune-upPower (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 | Front | | 30.32 | 31 | 0.412 | **0.48** | 0.856 | **1.00** | -0.10 |
| 1880 | 661 | Front | Fig.3 | 30.37 | 31 | 0.449 | **0.52** | 0.910 | **1.05** | 0.04 |
| 1850.2 | 512 | Front | / | 30.31 | 31 | 0.432 | **0.51** | 0.884 | **1.04** | 0.05 |

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

**Table 13.5: SAR Values (GSM 1900 MHz - wrist-worn)**

| Frequency | | Test Position | Figure No. | Conducted Power (dBm) | Max. tune-upPower (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 | Rear | Fig.4 | 29.75 | 30 | 0.695 | **0.74** | 1.380 | **1.46** | 0.05 |
| 1880 | 661 | RearEGPRS | / | 29.75 | 30 | 0.687 | **0.73** | 1.270 | **1.35** | 0.07 |

Note: The distance between the EUT and the phantom bottom is 0mm.

**Table 13.6: SAR Values (WCDMA 850 MHz - Next to the mouth)**

| Frequency | | Test Position | Figure No. | Conducted Power (dBm) | Max. tune-upPower (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. | | | | | | | | | |
| 836.4 | 4182 | Front | Fig.5 | 21.8 | 23 | 0.150 | **0.20** | 0.243 | **0.32** | -0.02 |

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

**Table 13.7: SAR Values (WCDMA 850 MHz - wrist-worn)**

| Frequency | | Test Position | Figure No. | Conducted Power (dBm) | Max. tune-upPower (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. | | | | | | | | | |
| 836.4 | 4182 | Rear | Fig.6 | 21.8 | 23 | 0.328 | **0.43** | 0.520 | **0.69** | -0.04 |

Note: The distance between the EUT and the phantom bottom is 0mm.

**Table 13.8: SAR Values (WCDMA1900 MHz - Next to the mouth)**

| Frequency | | Test Position | Figure No. | Conducted Power (dBm) | Max. tune-upPower (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 | Front | Fig.7 | 21.8 | 22 | 0.777 | **0.81** | 1.260 | **1.32** | 0.12 |
| 1880 | 9400 | Front | / | 21.6 | 22 | 0.537 | **0.59** | 1.080 | **1.18** | -0.08 |
| 1852.4 | 9262 | Front | / | 21.6 | 22 | 0.469 | **0.51** | 0.867 | **0.95** | 0.10 |

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

**Table 13.9: SAR Values (WCDMA1900 MHz-wrist-worn)**

| Frequency | | Test Position | Figure No. | Conducted Power (dBm) | Max. tune-upPower (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 | 21.6 | 22 | 0.238 | **0.25** | 0.421 | **0.44** | 0.13 |

Note: The distance between the EUT and the phantom bottom is 0mm.

**Table 13.10: SAR Values (WCDMA1700 MHz - Next to the mouth)**

| Frequency | | Test Position | Figure No. | Conducted Power (dBm) | Max. tune-upPower (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. | | | | | | | | | |
| 1732.6 | 1413 | Front | Fig.9 | 21.3 | 23 | 0.319 | **0.47** | 0.582 | **0.86** | 0.02 |
| 1752.6 | 1513 | Front | / | 21.3 | 23 | 0.302 | **0.45** | 0.554 | **0.82** | 0.07 |
| 1712.4 | 1312 | Front | / | 21.7 | 23 | 0.326 | **0.44** | 0.608 | **0.82** | -0.05 |

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

**Table 13.11: SAR Values (WCDMA1700 MHz - wrist-worn)**

| Frequency | | Test Position | Figure No. | Conducted Power (dBm) | Max. tune-upPower (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. | | | | | | | | | |
| 1732.6 | 1413 | Rear | Fig.10 | 21.3 | 23 | 0.653 | **0.97** | 1.100 | **1.63** | 0.10 |

Note: The distance between the EUT and the phantom bottom is 0mm.

**Table 13.12: SAR Values (LTE Band 2-Next to the mouth)**

| Frequency | | Configuration | Test Position | Conduct-ed Power (dBm) | Max. tune-up Power (dBm) | Figure No. | 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. | | | | | | | | | | |
| 1900 | 19100 | 1RB_Mid | Front | 23.01 | 23.5 | Fig.11 | 0.476 | **0.53** | 0.939 | **1.05** | 0.12 |
| 1900 | 19100 | 50RB_Mid | Front | 22.11 | 22.5 | / | 0.367 | **0.40** | 0.683 | **0.75** | 0.03 |
| 1880 | 18900 | 1RB_Mid | Front | 22.84 | 23.5 | / | 0.384 | **0.45** | 0.726 | **0.85** | -0.06 |
| 1860 | 18700 | 1RB_Mid | Front | 22.62 | 23.5 | / | 0.412 | **0.50** | 0.784 | **0.96** | -0.02 |
| 1880 | 18900 | 100RB | Front | 22.07 | 22.5 | / | 0.384 | **0.42** | 0.695 | **0.77** | 0.09 |

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

**Table 13.13: SAR Values (LTE Band 2-wrist-worn)**

| Frequency | | Configuration | Test Position | Conduct-ed Power (dBm) | Max. tune-up Power (dBm) | Figure No. | 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. | | | | | | | | | | |
| 1900 | 19100 | 1RB_Mid | Rear | 23.01 | 23.5 | Fig.12 | 0.858 | **0.96** | 1.780 | **1.99** | -0.09 |
| 1900 | 19100 | 50RB_Mid | Rear | 22.11 | 22.5 | / | 0.756 | **0.83** | 1.540 | **1.68** | -0.04 |

Note: The distance between the EUT and the phantom bottom is 0mm.

**Table 13.14: SAR Values (LTE Band 4-Next to the mouth)**

| Frequency | | Configuration | Test Position | Conduct-ed Power (dBm) | Max. tune-up Power (dBm) | Figure No. | 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. | | | | | | | | | | |
| 1720 | 20050 | 1RB_Mid | Front | 23.89 | 24 | Fig.13 | 0.529 | **0.54** | 0.908 | **0.93** | -0.06 |
| 1720 | 20050 | 50RB_Low | Front | 22.86 | 23 | / | 0.397 | **0.41** | 0.707 | **0.73** | -0.15 |
| 1745 | 20300 | 1RB_Mid | Front | 23.37 | 24 | / | 0.442 | **0.51** | 0.786 | **0.91** | 0.08 |
| 1732.5 | 20175 | 1RB_Mid | Front | 23.13 | 24 | / | 0.405 | **0.49** | 0.678 | **0.83** | 0.10 |
| 1720 | 20050 | 100RB | Front | 22.78 | 23 | / | 0.386 | **0.41** | 0.663 | **0.70** | 0.05 |

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

**Table 13.15: SAR Values (LTE Band 4-wrist-worn)**

| Frequency | | Configuration | Test Position | Conduct-ed Power (dBm) | Max. tune-up Power (dBm) | Figure No. | 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. | | | | | | | | | | |
| 1720 | 20050 | 1RB_Mid | Rear | 23.89 | 24 | Fig.14 | 0.765 | **0.78** | 1.290 | **1.32** | -0.07 |
| 1720 | 20050 | 50RB_Low | Rear | 22.86 | 23 | / | 0.696 | **0.72** | 1.030 | **1.06** | -0.11 |

Note: The distance between the EUT and the phantom bottom is 0mm.

## 14SAR Measurement Variability

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

The following procedures are applied to determine if repeatedmeasurements are required.

1) Repeated measurement is not required when the original highest measured SAR is < 0.80 W/kg; steps2) 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 originaland first repeated measurements is > 1.20 or when the original or repeated measurement is ≥ 1.45W/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 repeatedmeasurements is > 1.20.

**Table 14.1: SAR Measurement Variability for GSM 1900 MHz - Next to the mouth (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 | 661 | Front | 10 | 0.910 | 0.902 | 1.01 | / |

**Table 14.2: SAR Measurement Variability for WCDMA1900 MHz - Next to the mouth (1g)**

| Frequency | | Test Position | Spacing (mm) | Original SAR (W/kg) | First Repeated SAR (W/kg) | The Ratio | Second Repeated SAR (W/kg) |
|---|---|---|---|---|---|---|---|
| MHz | Ch. | | | | | | |
| 1907.6 | 9538 | Front | 10 | 1.260 | 1.22 | 1.03 | / |

**Table 14.2: SAR Measurement Variability for LTE Band 2- Next to the mouth (1g)**

| Frequency | | Test Position | Spacing (mm) | Original SAR (W/kg) | First Repeated SAR (W/kg) | The Ratio | Second Repeated SAR (W/kg) |
|---|---|---|---|---|---|---|---|
| MHz | Ch. | | | | | | |
| 1900 | 19100 | Front | 10 | 0.939 | 0.928 | 1.01 | / |

**Table 14.2: SAR Measurement Variability for LTE Band 4- Next to the mouth (1g)**

| Frequency | | Test Position | Spacing (mm) | Original SAR (W/kg) | First Repeated SAR (W/kg) | The Ratio | Second Repeated SAR (W/kg) |
|---|---|---|---|---|---|---|---|
| MHz | Ch. | | | | | | |
| 1720 | 20050 | Front | 10 | 0.908 | 0.887 | 1.02 | / |

# 15 Measurement Uncertainty

## 15.1 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 | 6.0 | N | 1 | 1 | 1 | 6.0 | 6.0 | ∞ |
| 2 | Isotropy | B | 4.7 | R | $\sqrt{3}$ | 1 | 1 | 1.6 | 1.6 | ∞ |
| 3 | Boundary effect | B | 1.0 | R | $\sqrt{3}$ | 1 | 1 | 6.4 | 6.4 | ∞ |
| 4 | Linearity | B | 4.7 | R | $\sqrt{3}$ | 1 | 1 | 0.5 | 0.5 | ∞ |
| 5 | Detection limit | B | 1.0 | N | 1 | 1 | 1 | 1 | 1 | ∞ |
| 6 | Readout electronics | B | 0.3 | R | $\sqrt{3}$ | 1 | 1 | 0.6 | 0.6 | ∞ |
| 7 | Response time | B | 0.8 | R | $\sqrt{3}$ | 1 | 1 | 0.0 | 0.0 | ∞ |
| 8 | Integration time | B | 2.6 | R | $\sqrt{3}$ | 1 | 1 | 1.0 | 1.0 | ∞ |
| 9 | RFambient conditions-noise | B | 0 | R | $\sqrt{3}$ | 1 | 1 | 1.7 | 1.7 | ∞ |
| 10 | RFambient conditions-reflection | B | 0 | R | $\sqrt{3}$ | 1 | 1 | 1.7 | 1.7 | ∞ |
| 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 | 1.2 | 1.2 | ∞ |
| 14 | Probe modulation response | B | 2.3 | R | $\sqrt{3}$ | 1 | 1 | 1.21 | 1.21 | ∞ |
| **Test sample related** | | | | | | | | | | |
| 15 | Test sample positioning | A | 3.3 | N | 1 | 1 | 1 | 3.3 | 3.3 | 5 |
| 16 | Device holder uncertainty | A | 3.4 | N | 1 | 1 | 1 | 3.4 | 3.4 | 5 |
| 17 | Power scaling | B | 2.4 | R | $\sqrt{3}$ | 1 | 1 | 2.4 | 2.4 | ∞ |
| 18 | Drift of output power | B | 5.0 | R | $\sqrt{3}$ | 1 | 1 | 2.9 | 2.9 | ∞ |
| **Phantom and set-up** | | | | | | | | | | |
| 19 | Phantom uncertainty | B | 4.0 | R | $\sqrt{3}$ | 1 | 1 | 2.3 | 2.3 | ∞ |
| 20 | Liquid conductivity (target) | B | 5.0 | R | $\sqrt{3}$ | 0.64 | 0.43 | 1.8 | 1.2 | ∞ |
| 21 | Liquid conductivity (meas.) | A | 2.06 | N | 1 | 0.64 | 0.43 | 1 | 0.28 | 9 |
| 22 | Liquid permittivity (target) | B | 5.0 | R | $\sqrt{3}$ | 0.6 | 0.49 | 1.7 | 1.4 | ∞ |
| 23 | Liquid permittivity (meas.) | A | 1.6 | N | 1 | 0.6 | 0.49 | 0.31 | 0.25 | 9 |
| 24 | Algorithm for correcting SAR for deviations in permittivity and conductivity | B | 1.9 | N | 1 | 1 | 1 | 1.9 | 1.9 | ∞ |
| Combined standard uncertainty | | $u_c' = \sqrt{\sum_{i=1}^{21} c_i^2 u_i^2}$ | | | | | | 11.9 | 11.8 | 323 |
| Expanded uncertainty (Confidence interval of 95 %) | | $u_e = 2u_c$ | | | | | | 23.8 | 23.7 | |

# 16MAIN TEST INSTRUMENTS

**Table 16.1: List of Main Instruments**

| No. | Name | Type | Serial Number | Calibration Date | Valid Period |
|---|---|---|---|---|---|
| 01 | Network analyzer | Agilent E5071C | MY46103759 | 2016-11-19 | One year |
| 02 | Dielectricprobe | 85070E | MY44300317 | / | |
| 03 | Power meter | NRP | 102603 | 2017-01-06 | One year |
| 04 | Power sensor | NRP-Z51 | 102211 | | |
| 05 | Signal Generator | E8257D | MY47461211 | 2017-06-06 | One year |
| 06 | Amplifier | VTL5400 | 0404 | / | |
| 07 | DAE | SPEAG DAE4 | 786 | 2016-12-08 | One year |
| 08 | E-field Probe | SPEAG EX3DV4 | 3633 | 2017-01-23 | One year |
| 09 | Dipole Validation Kit | SPEAG D835V2 | 4d057 | 2015-10-22 | Three year |
| 10 | Dipole Validation Kit | SPEAG D1800V2 | 2d147 | 2015-11-03 | Three year |
| 11 | Dipole Validation Kit | SPEAG D1900V2 | 5d088 | 2015-11-04 | Three year |
| 12 | BTS | E5515C | GB47460389 | 2017-01-06 | One year |
| 13 | Radio Communication Analyzer | Anristu MT8820C | 6201563767 | 2017-01-06 | One year |

***END OF REPORT BODY***

## ANNEX A Graph Results

## GSM850 Next to the mouth

Date: 2017-6-25

Electronics: DAE4 Sn786

Medium: Head 835 MHz

Medium parameters used (interpolated): f = 836.6 MHz; σ = 0.888 S/m; $\varepsilon_r$ = 41.832; ρ = 1000 kg/m$^3$

Ambient Temperature:22.0$^o$C    Liquid Temperature:21.5$^o$C

Communication System: UID 0, GSM (0) Frequency: 836.6 MHz Duty Cycle: 1:8.3

Probe: EX3DV4 - SN3633 ConvF(9.04, 9.04, 9.04);

**Front side Mid /Area Scan (61x61x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 0.456 W/kg

**Front side Mid /Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 17.85 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 0.647 W/kg

**SAR(1 g) = 0.388 W/kg; SAR(10 g) = 0.242 W/kg**

Maximum value of SAR (measured) = 0.412 W/kg

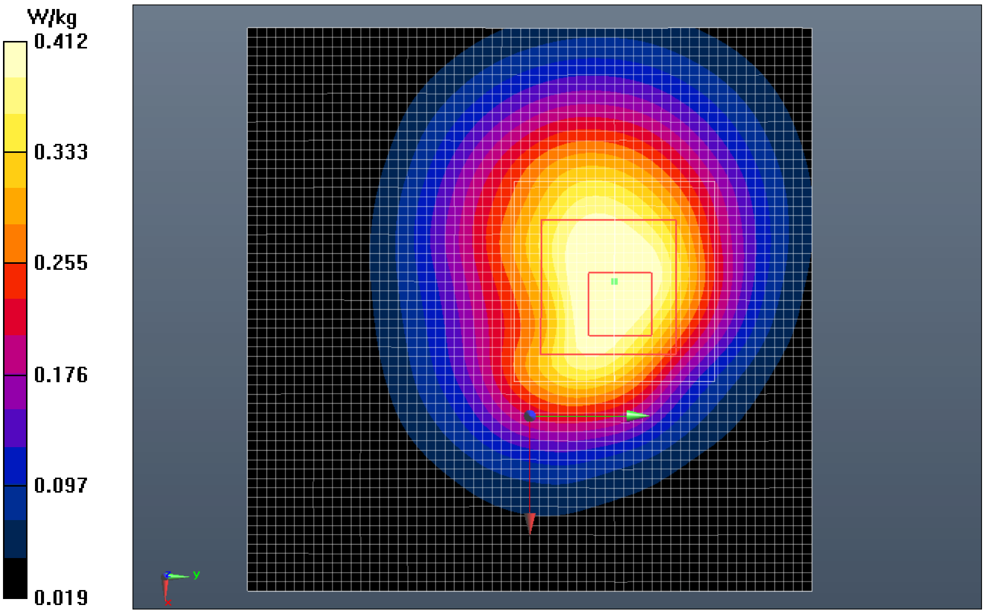



**Fig.1 GSM 850MHz**

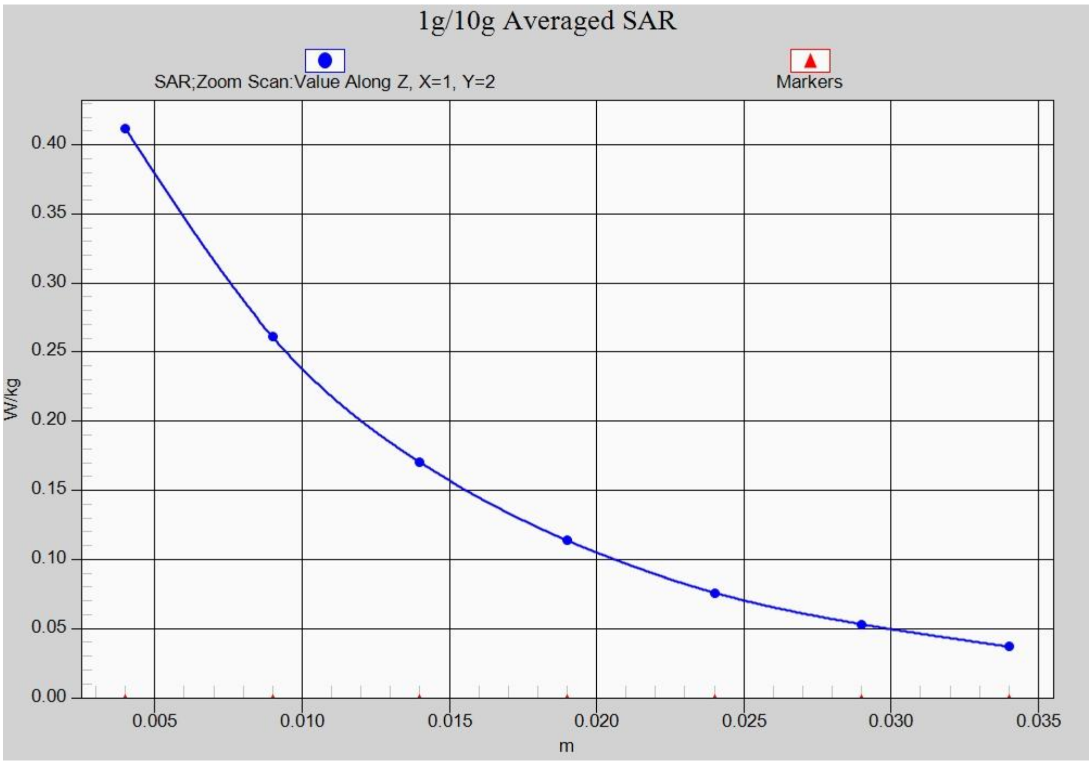



**Fig.1-1 Z-Scan at power reference point (GSM 850 MHz)**

## GSM850 wrist-worn

Date: 2017-6-25

Electronics: DAE4 Sn786

Medium: Body 835 MHz

Medium parameters used (interpolated): f = 836.6 MHz; σ = 0.957 S/m; $\varepsilon_r$ = 55.807; ρ = 1000 kg/$m^3$

Ambient Temperature:22.0$^o$C Liquid Temperature:21.5$^o$C

Communication System: UID 0, 4 slot GPRS (0) Frequency: 836.6 MHz Duty Cycle: 1:2

Probe: EX3DV4 - SN3633 ConvF(9.41, 9.41, 9.41);

**Rear side Mid/Area Scan (51x51x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 1.01 W/kg

**Rear side Mid/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 16.07 V/m; Power Drift = 0.09 dB

Peak SAR (extrapolated) = 1.37 W/kg

**SAR(1 g) = 0.843 W/kg; SAR(10 g) = 0.516 W/kg**

Maximum value of SAR (measured) = 0.891 W/kg

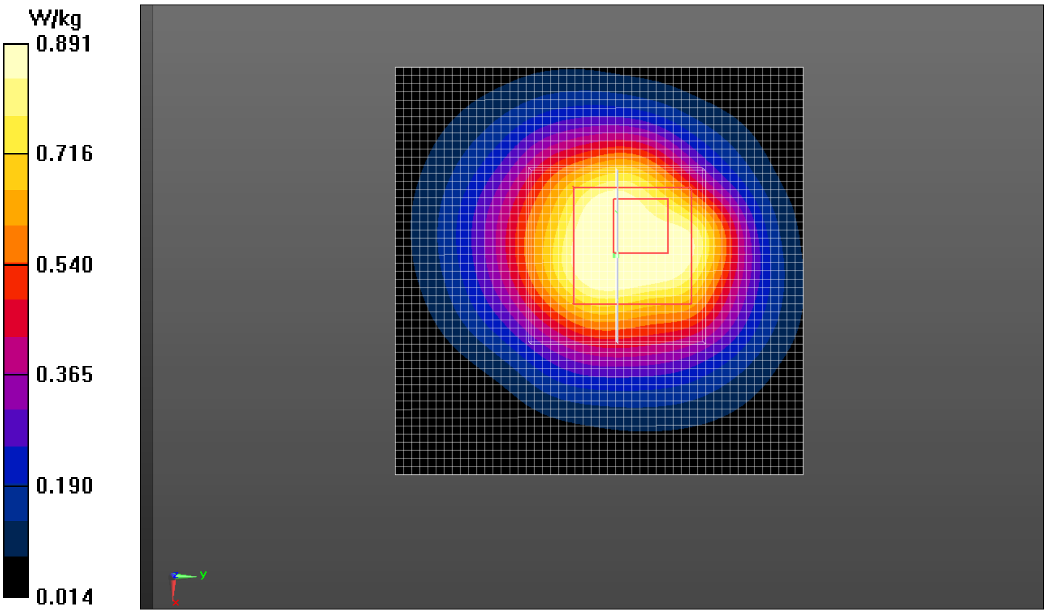



**Fig.2 GSM 850 MHz**

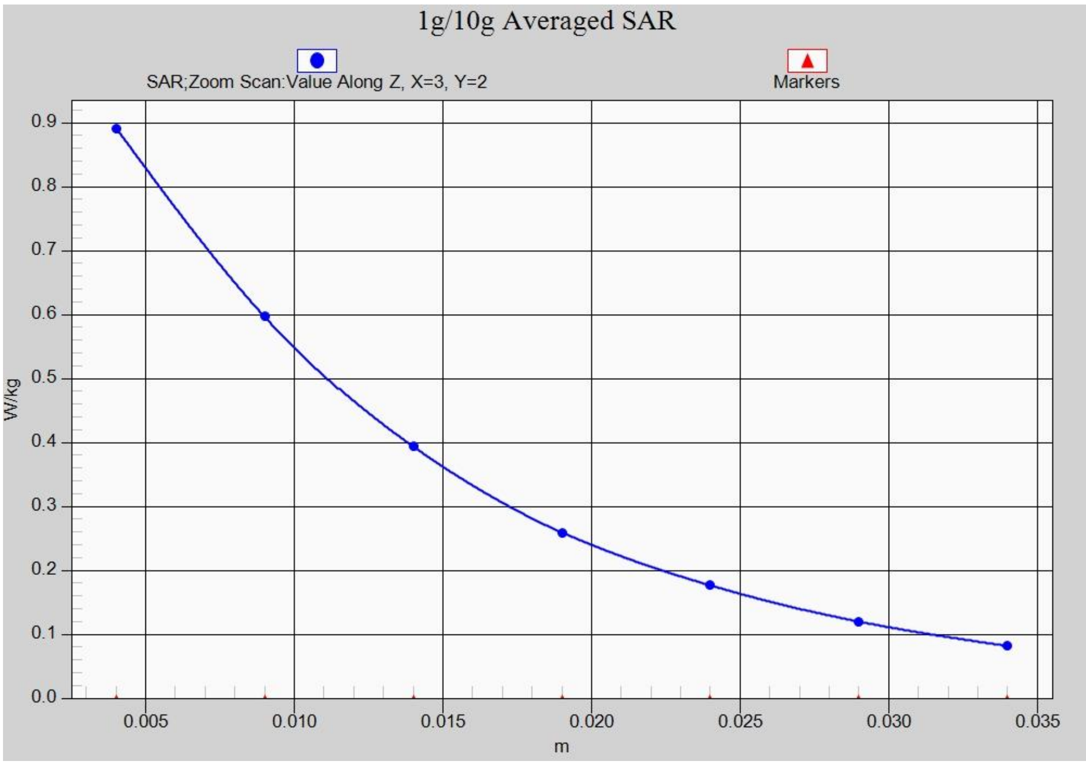



**Fig.2-1 Z-Scan at power reference point (GSM 850 MHz)**

## GSM1900 Next to the mouth

Date: 2017-6-25

Electronics: DAE4 Sn786

Medium: Head 1900 MHz

Medium parameters used: f = 1880 MHz; σ = 1.387 S/m; $\varepsilon_r$ = 38.833; ρ = 1000 kg/$m^3$

Ambient Temperature:22.0°C Liquid Temperature:21.5°C

Communication System: UID 0, GSM (0) Frequency: 1880 MHz Duty Cycle: 1:8.3

Probe: EX3DV4 - SN3633 ConvF(8, 8, 8);

**Front side Mid/Area Scan (61x61x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 1.08 W/kg

**Front side Mid/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 12.91 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 1.72 W/kg

**SAR(1 g) = 0.910 W/kg; SAR(10 g) = 0.449 W/kg**

Maximum value of SAR (measured) = 1.00 W/kg

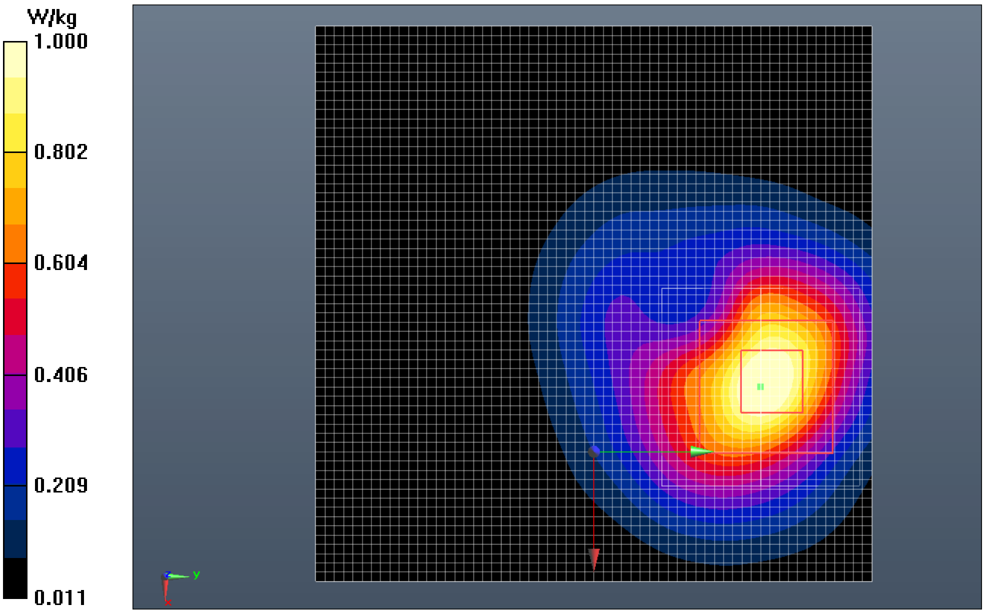



**Fig.3 GSM 1900 MHz**

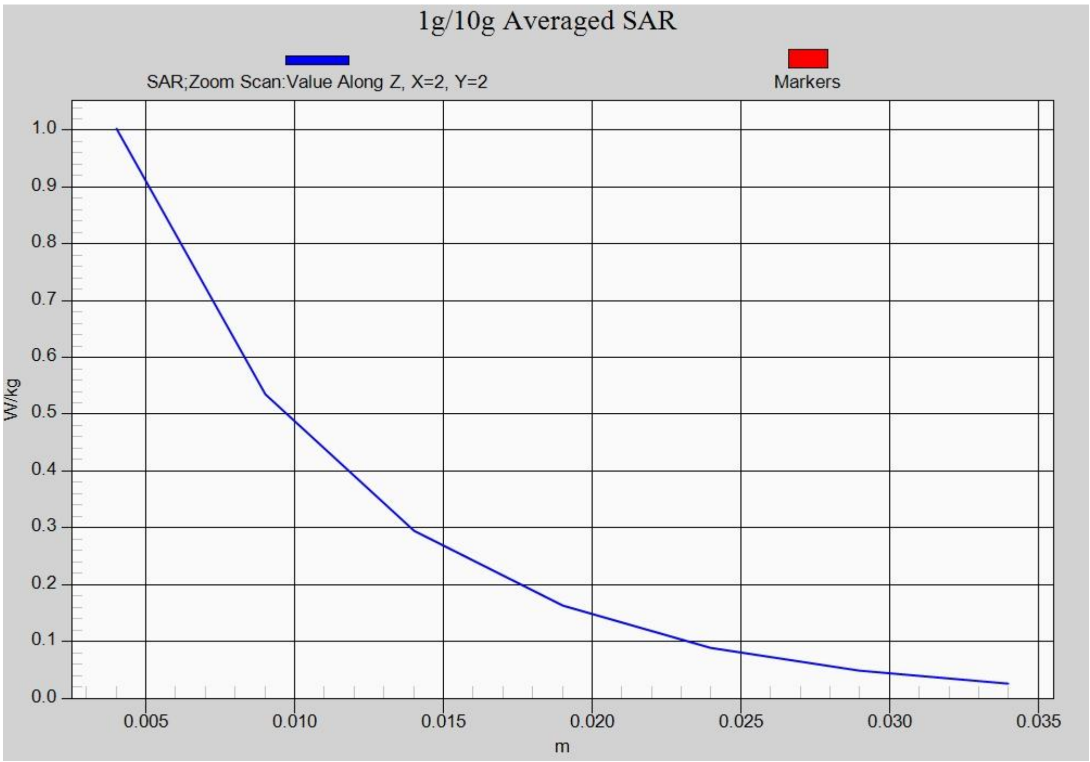



**Fig.3-1 Z-Scan at power reference point (GSM 1900 MHz)**

## GSM1900 wrist-worn

Date: 2017-6-25
Electronics: DAE4 Sn786
Medium: Body 1900 MHz
Medium parameters used: f = 1880 MHz; σ = 1.493 S/m; $\varepsilon_r$ = 54.361; ρ = 1000 kg/m$^3$
Ambient Temperature:22.0$^o$C Liquid Temperature:21.5$^o$C
Communication System: UID 0, 4 slot GPRS (0) Frequency: 1880 MHz Duty Cycle: 1:2
Probe: EX3DV4 - SN3633 ConvF(7.55, 7.55, 7.55);

**Rear side Mid/Area Scan (61x61x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 1.61 W/kg

**Reaside Mid/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 14.11 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 2.41 W/kg
**SAR(1 g) = 1.38 W/kg; SAR(10 g) = 0.695 W/kg**
Maximum value of SAR (measured) = 1.56 W/kg

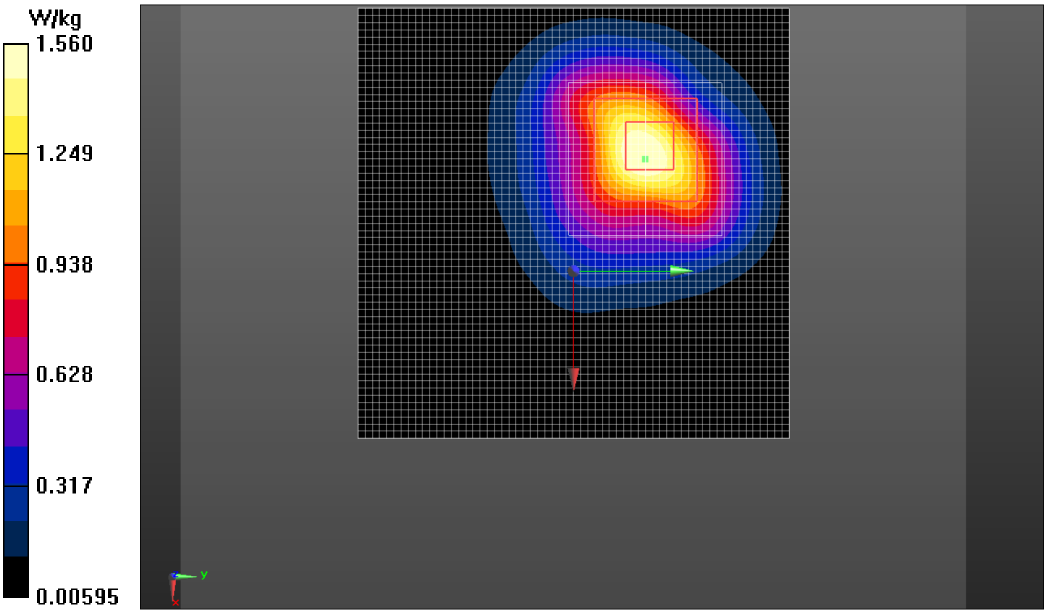



**Fig.4 GSM 1900 MHz**

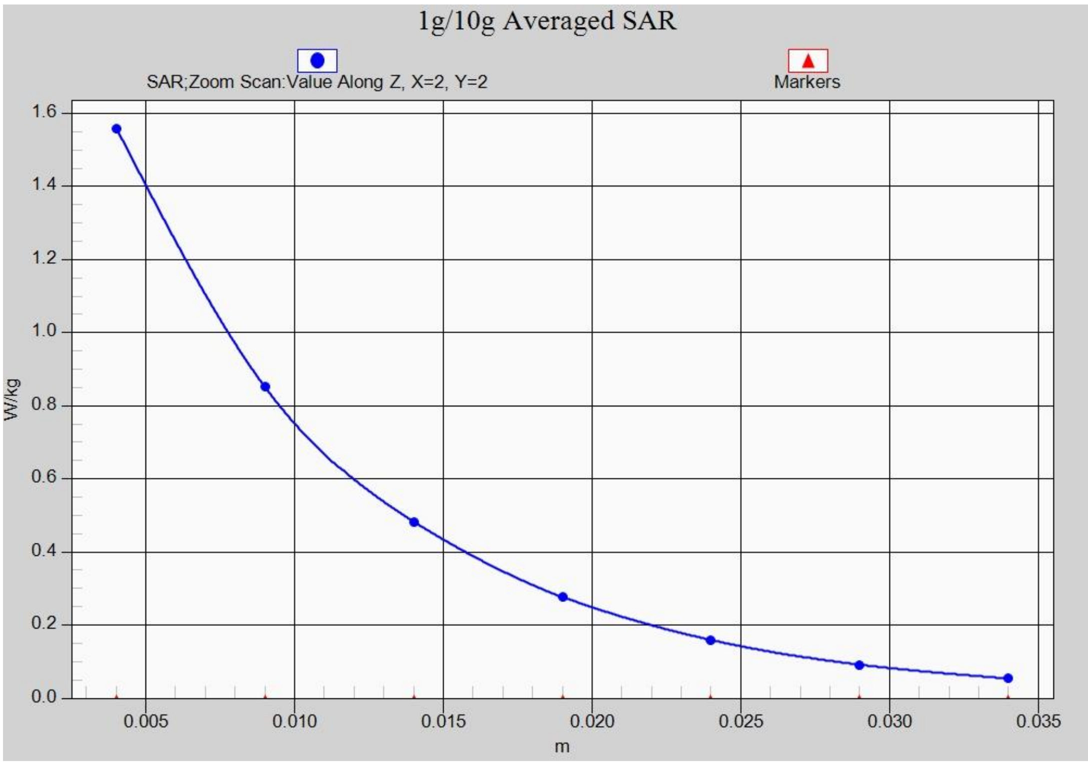



**Fig.4-1 Z-Scan at power reference point (GSM 1900 MHz CH661)**

## WCDMA 850 Next to the mouth

Date: 2017-6-25
Electronics: DAE4 Sn786
Medium: Head 835 MHz
Medium parameters used (interpolated): f = 836.4 MHz; σ = 0.888 S/m; $\varepsilon_r$ = 41.835; ρ = 1000 kg/$m^3$
Ambient Temperature:22.0°C Liquid Temperature:21.5°C
Communication System: UID 0, WCDMA (0) Frequency: 836.4 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN3633 ConvF(9.04, 9.04, 9.04);

**Front side Mid /Area Scan (61x61x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.283 W/kg

**Front side Mid /Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 10.66 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 0.406 W/kg
**SAR(1 g) = 0.243 W/kg; SAR(10 g) = 0.150 W/kg**
Maximum value of SAR (measured) = 0.259 W/kg

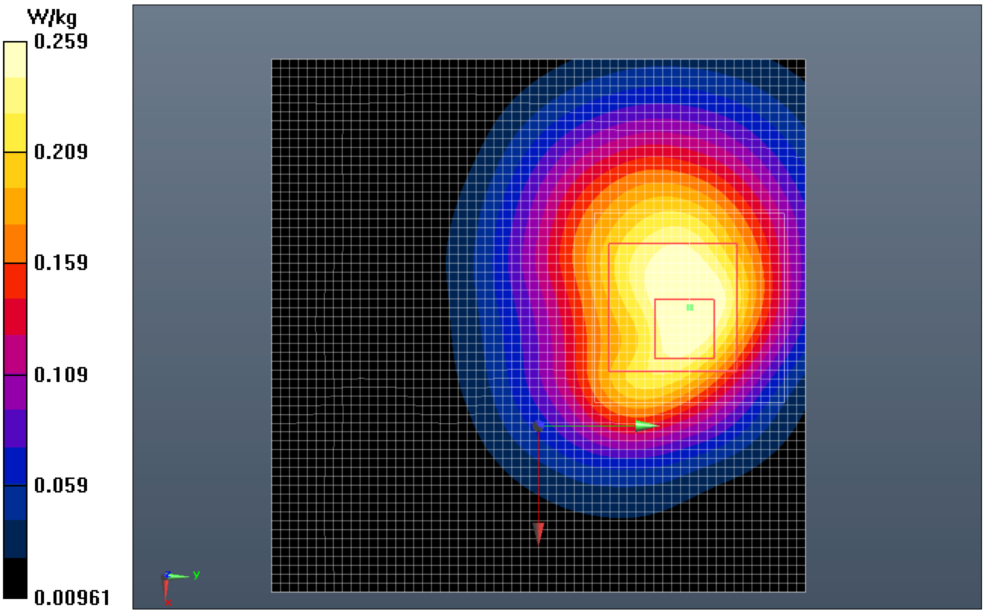



**Fig.5 WCDMA 850**

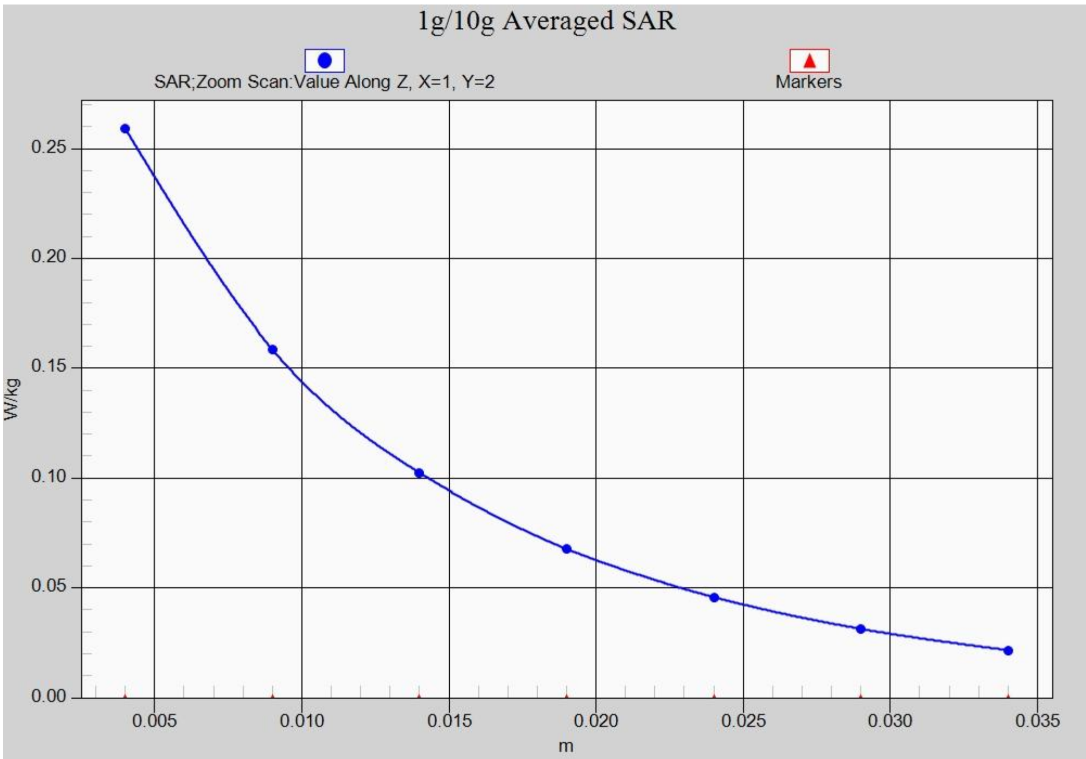



**Fig.5-1 Z-Scan at power reference point (WCDMA850)**

## WCDMA 850 wrist-worn

Date: 2017-6-25
Electronics: DAE4 Sn786
Medium: Body 835 MHz
Medium parameters used (interpolated): f = 836.4 MHz; σ = 0.957 S/m; $\varepsilon_r$ = 55.81; ρ = 1000 kg/m$^3$
Ambient Temperature:22.0$^o$C Liquid Temperature:21.5$^o$C
Communication System: UID 0, WCDMA (0) Frequency: 836.4 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN3633 ConvF(9.41, 9.41, 9.41);

**Rear side Mid /Area Scan (61x61x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.605 W/kg

**Rear side Mid /Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 14.46 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 0.881 W/kg
**SAR(1 g) = 0.520 W/kg; SAR(10 g) = 0.328 W/kg**
Maximum value of SAR (measured) = 0.542 W/kg

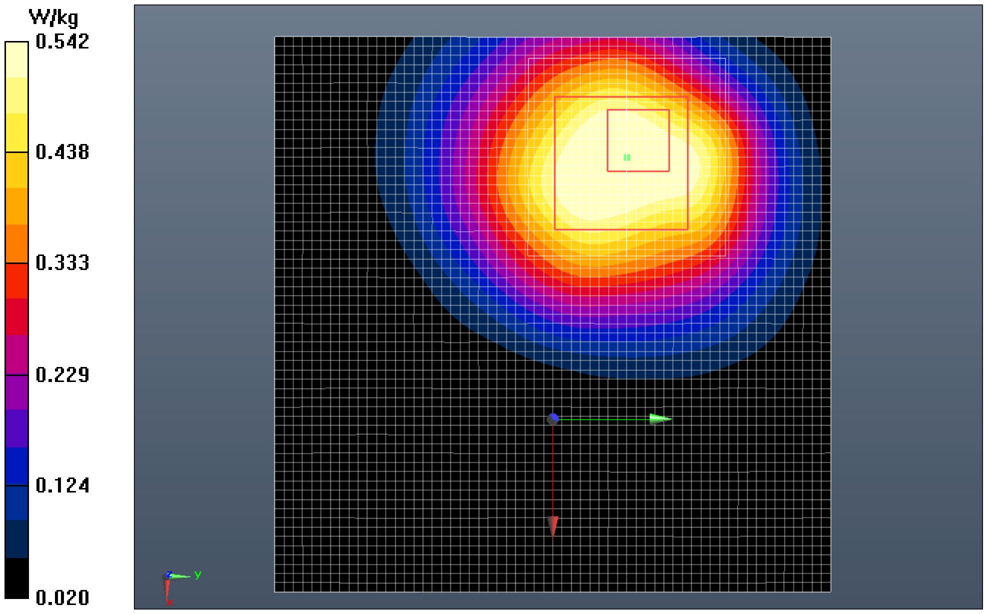



**Fig.6 WCDMA 850**

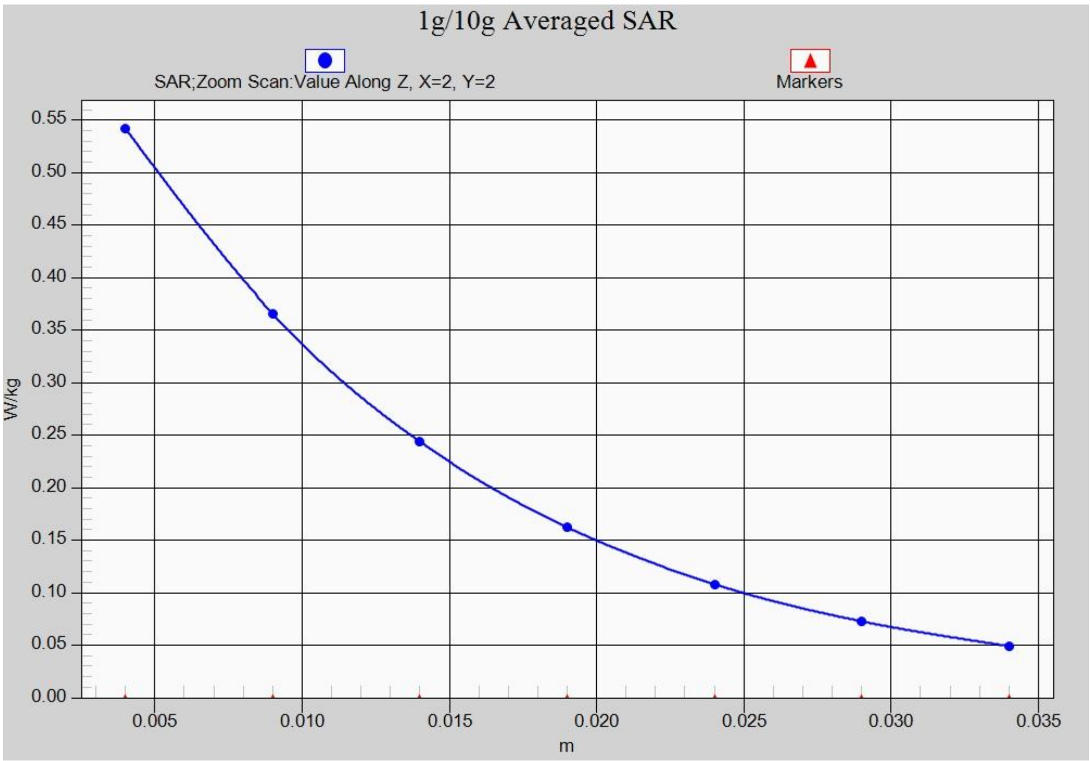



**Fig.6-1 Z-Scan at power reference point (WCDMA850)**

## WCDMA 1900 Next to the mouth

Date: 2017-6-25
Electronics: DAE4 Sn786
Medium: Head 1900 MHz
Medium parameters used: f = 1908 MHz; σ = 1.413 S/m; $\varepsilon_r$ = 38.701; ρ = 1000 kg/$m^3$
Ambient Temperature:22.0°C Liquid Temperature:21.5°C
Communication System: UID 0, WCDMA (0) Frequency: 1908 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN3633 ConvF(8, 8, 8);

**Front side High /Area Scan (51x51x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 1.51 W/kg

**Front side High /Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 14.94 V/m; Power Drift = 0.12 dB
Peak SAR (extrapolated) = 2.53 W/kg
**SAR(1 g) = 1.26 W/kg; SAR(10 g) = 0.777 W/kg**
Maximum value of SAR (measured) = 1.71 W/kg

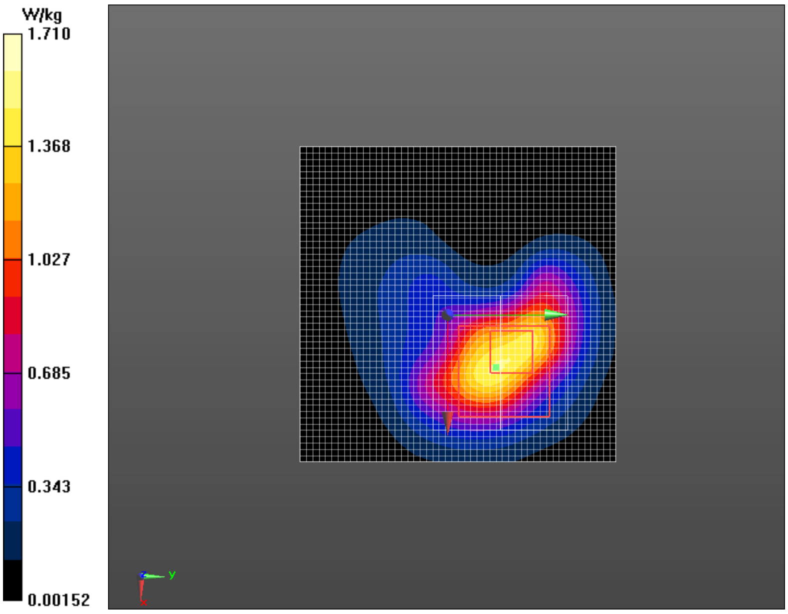



**Fig.7 WCDMA1900**

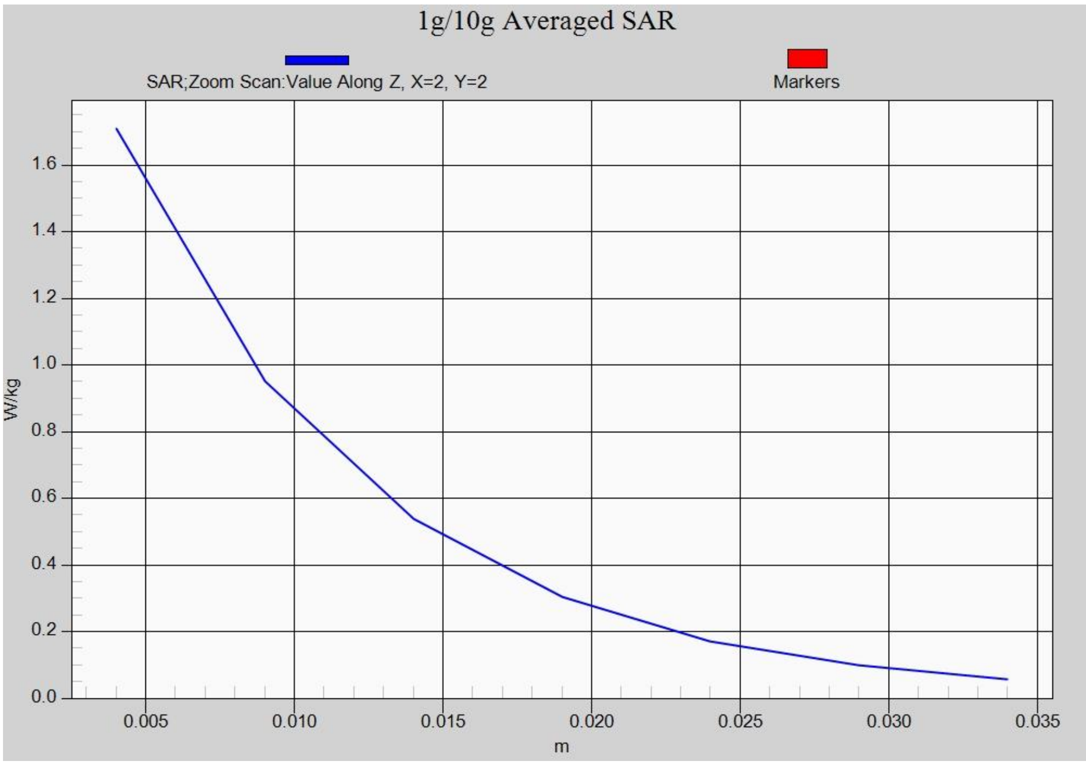



**Fig.7-1 Z-Scan at power reference point (WCDMA1900)**

## WCDMA 1900 wrist-worn

Date: 2017-6-25
Electronics: DAE4 Sn786
Medium: Body 1900 MHz
Medium parameters used: f = 1880 MHz; σ = 1.493 S/m; $\varepsilon_r$ = 54.361; ρ = 1000 kg/$m^3$
Ambient Temperature:22.0$^o$C    Liquid Temperature:21.5$^o$C
Communication System: UID 0, WCDMA (0) Frequency: 1880 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN3633 ConvF(7.55, 7.55, 7.55);

**Rear side Mid/Area Scan (51x61x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.742 W/kg

**Rear sideMid/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 14.12 V/m; Power Drift = 0.13 dB
Peak SAR (extrapolated) = 0.76 W/kg
**SAR(1 g) = 0.421 W/kg; SAR(10 g) = 0.238 W/kg**
Maximum value of SAR (measured) = 0.676 W/kg

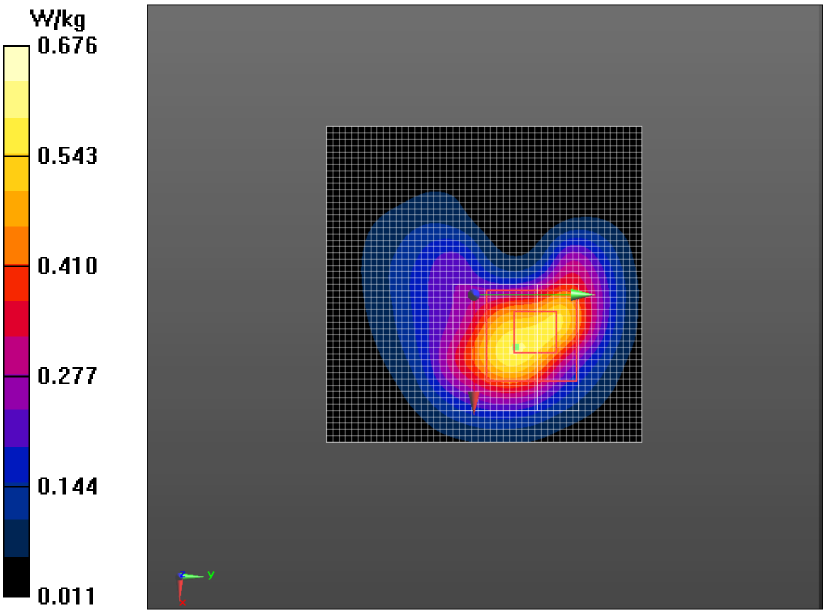



**Fig.8 WCDMA1900**

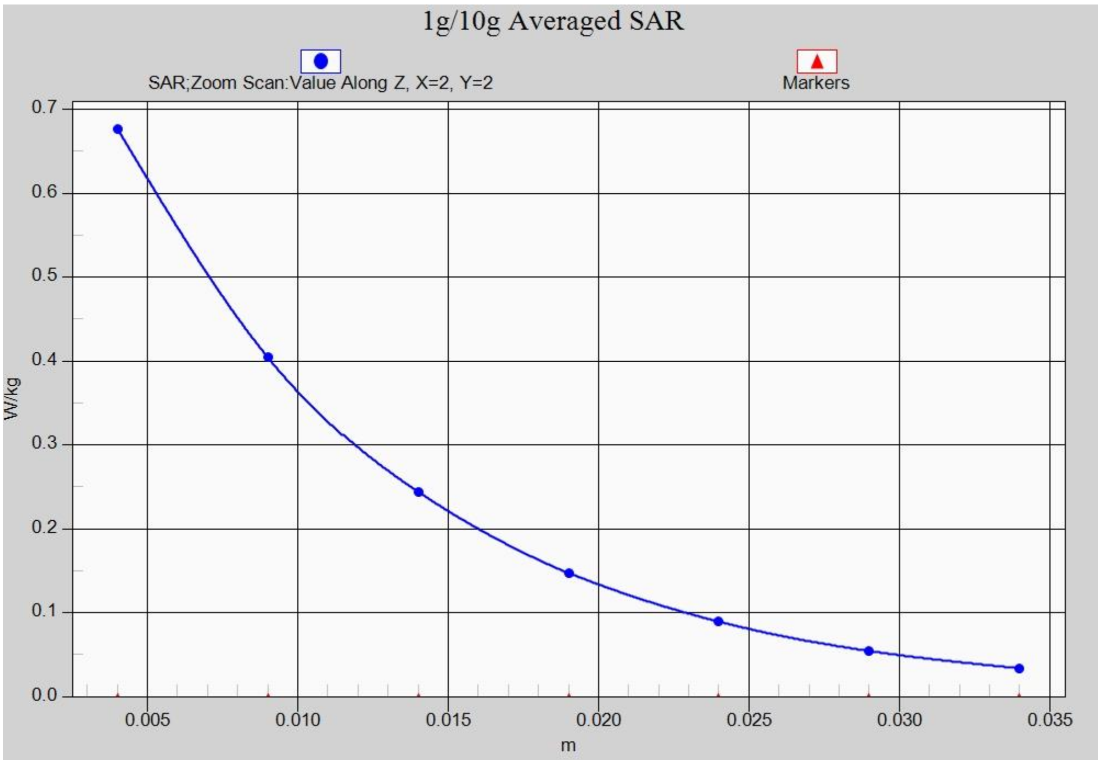



**Fig.8-1 Z-Scan at power reference point (WCDMA1900)**

## WCDMA 1700 Next to the mouth

Date: 2017-6-25

Electronics: DAE4 Sn786

Medium: Head 1800 MHz

Medium parameters used (interpolated): f = 1732.6 MHz; σ = 1.355 S/m; $\varepsilon_r$ = 39.481; ρ = 1000 $kg/m^3$

Ambient Temperature:22.0°C Liquid Temperature:21.5°C

Communication System: UID 0, WCDMA (0) Frequency: 1732.6 MHz Duty Cycle: 1:1

Probe: EX3DV4 - SN3633 ConvF(8.08, 8.08, 8.08);

**Front Side Mid/Area Scan (61x61x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 0.702 W/kg

**Front Side Mid/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 19.00 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 1.06 W/kg

**SAR(1 g) = 0.582 W/kg; SAR(10 g) = 0.319 W/kg**

Maximum value of SAR (measured) = 0.717 W/kg

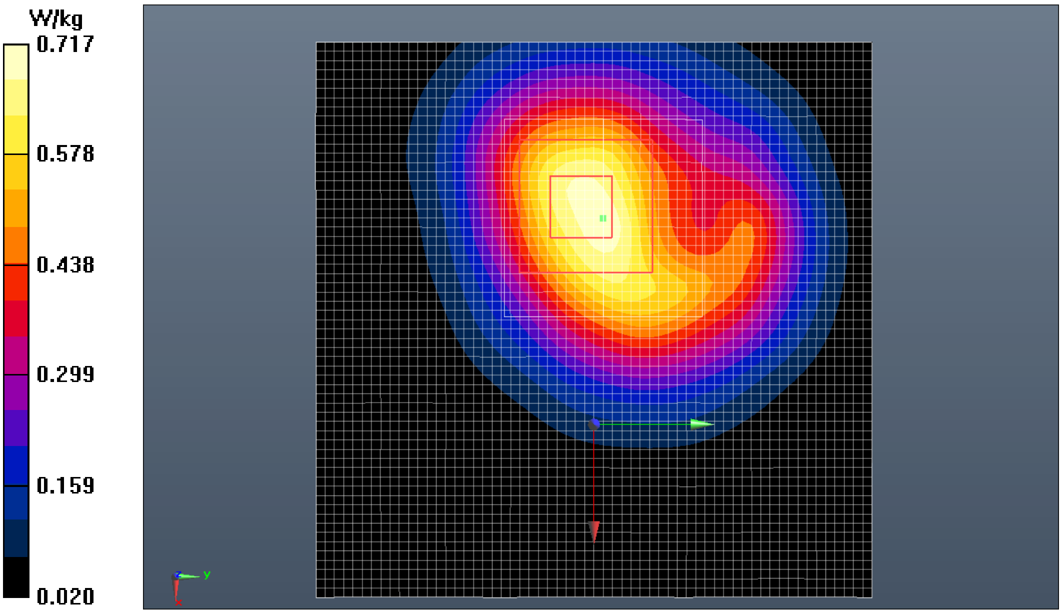



**Fig.9 WCDMA1700**

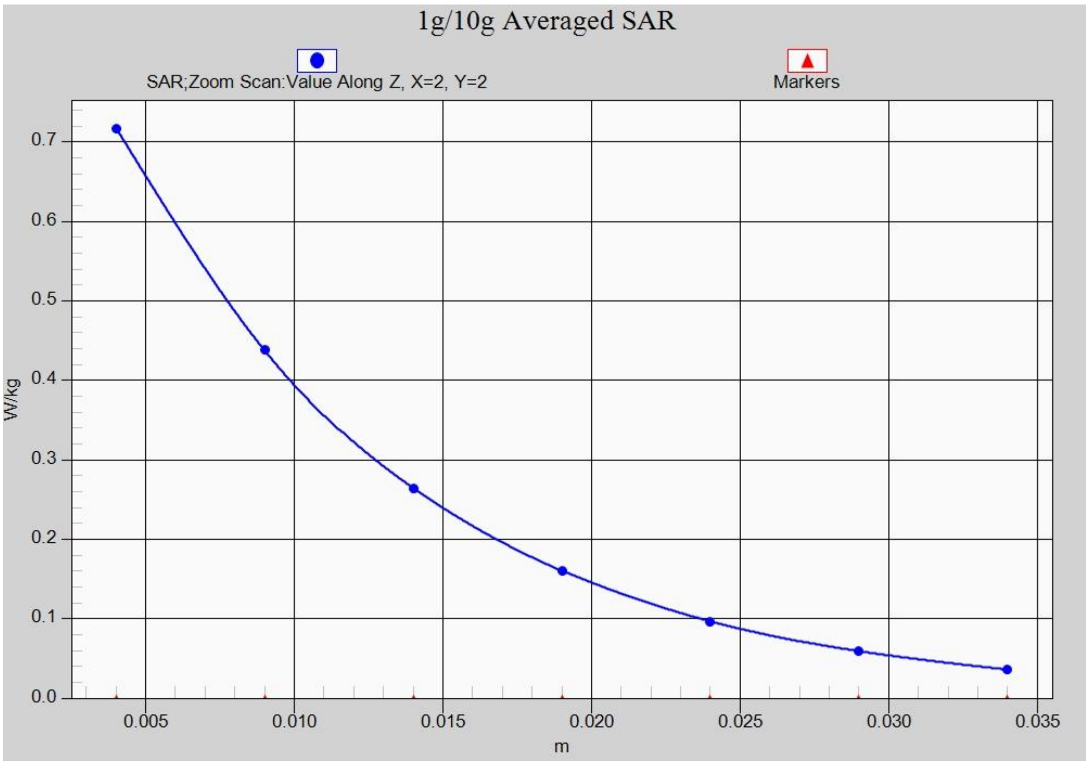



**Fig.9-1 Z-Scan at power reference point (WCDMA1700)**

## WCDMA 1700 wrist-worn

Date: 2017-6-25

Electronics: DAE4 Sn786

Medium: Body 1800 MHz

Medium parameters used (interpolated): f = 1732.6 MHz; $\sigma$ = 1.483 S/m; $\varepsilon_r$ = 52.572; $\rho$ = 1000 $kg/m^3$

Ambient Temperature:22.0°C    Liquid Temperature:21.5°C

Communication System: UID 0, WCDMA (0) Frequency: 1732.6 MHz Duty Cycle: 1:1

Probe: EX3DV4 - SN3633 ConvF(7.9, 7.9, 7.9);

**Rear Side Mid/Area Scan (61x61x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 1.30 W/kg

**Rear Side Mid/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 14.69 V/m; Power Drift = 0.10 dB

Peak SAR (extrapolated) = 1.72 W/kg

**SAR(1 g) = 1.1 W/kg; SAR(10 g) = 0.653 W/kg**

Maximum value of SAR (measured) = 1.21 W/kg

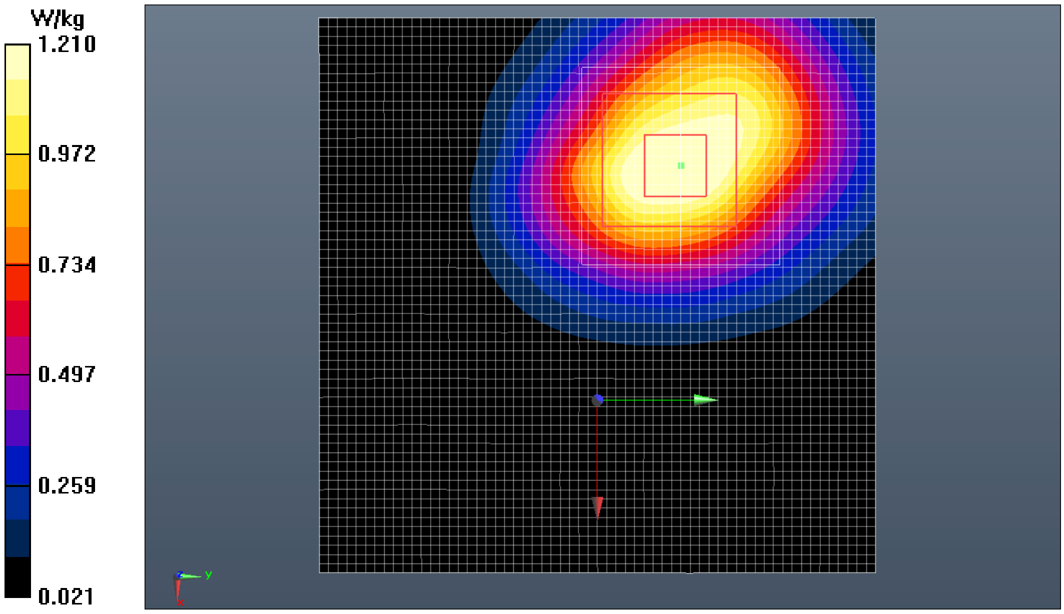



**Fig.10 WCDMA1700**

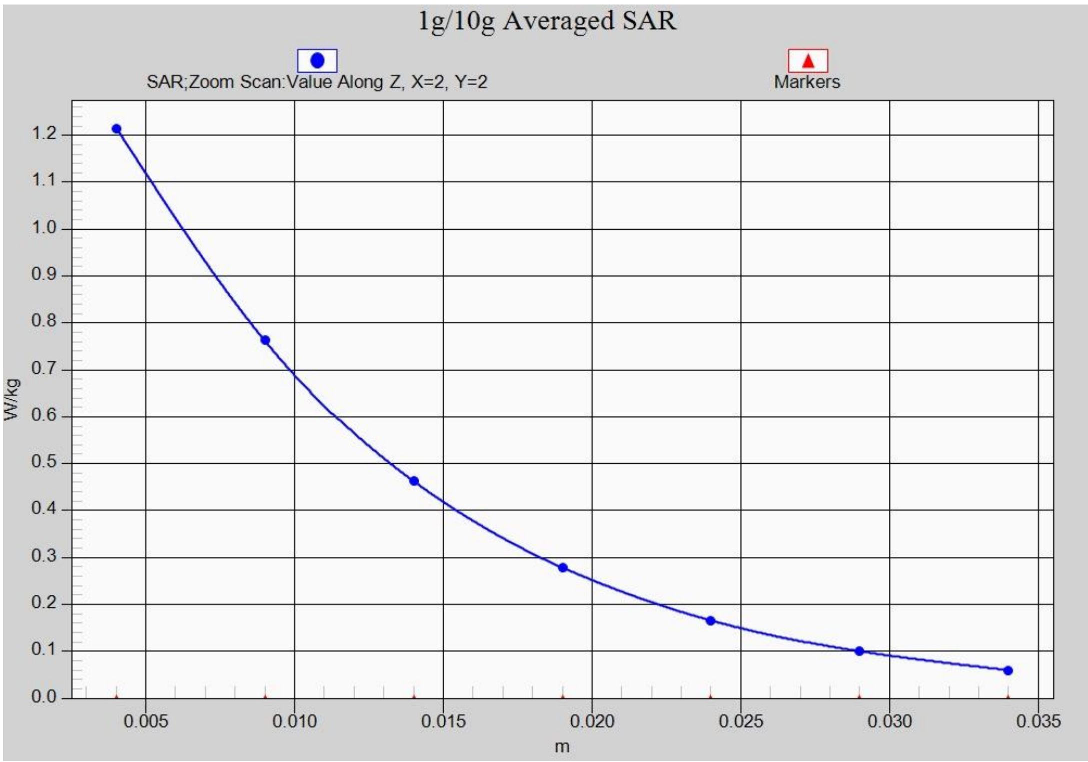



**Fig.10-1 Z-Scan at power reference point (WCDMA1700)**

## LTE Band 2Next to the mouth

Date: 2017-6-25
Electronics: DAE4 Sn786
Medium: Head 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.406 S/m; $\varepsilon_r$ = 38.742; ρ = 1000 kg/m$^3$
Ambient Temperature:22.0$^o$C Liquid Temperature:21.5$^o$C
Communication System: UID 0, LTE_FDD (0) Frequency: 1900 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN3633 ConvF(8, 8, 8);

**Front side High1RB_Mid/Area Scan (51x51x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 1.09 W/kg

**Front side High1RB_Mid/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 13.27 V/m; Power Drift = 0.12 dB
Peak SAR (extrapolated) = 1.75 W/kg
**SAR(1 g) = 0.939 W/kg; SAR(10 g) = 0.476 W/kg**
Maximum value of SAR (measured) = 1.04 W/kg

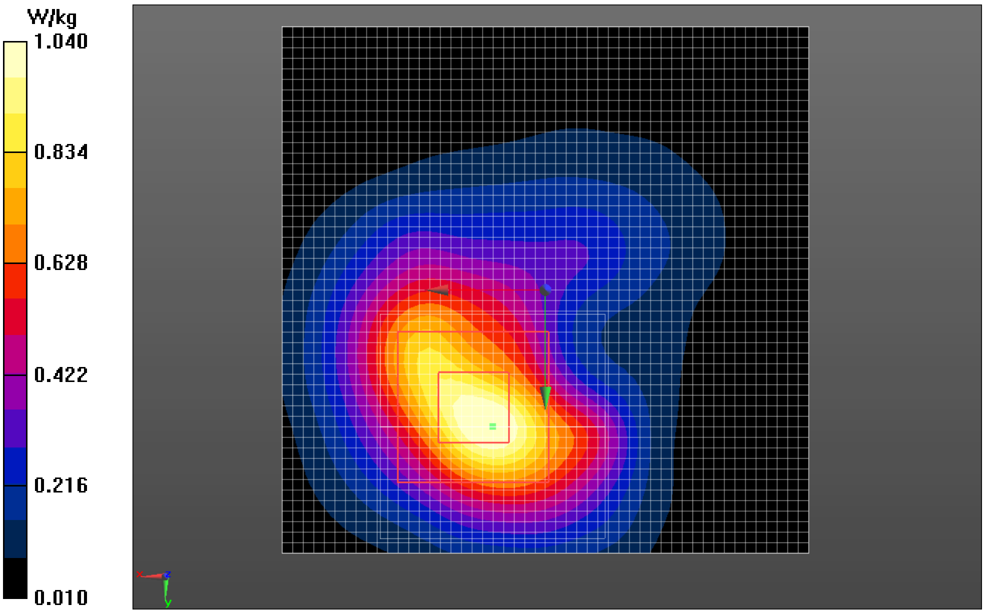



**Fig.11 LTE Band 2**

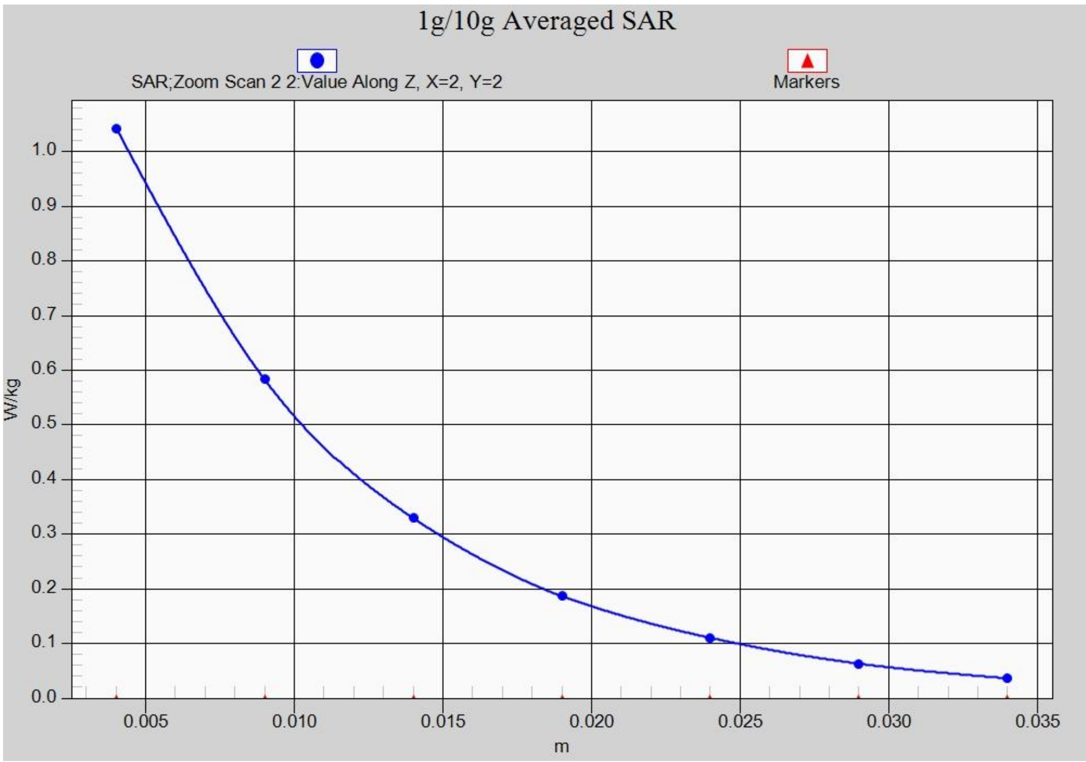



**Fig.11-1 Z-Scan at power reference point (LTE Band 2)**

## LTE Band 2 wrist-worn

Date: 2017-6-25

Electronics: DAE4 Sn786

Medium: Body 1900 MHz

Medium parameters used: f = 1900 MHz; σ = 1.512 S/m; $\varepsilon_r$ = 54.328; ρ = 1000 kg/m$^3$

Ambient Temperature:22.0$^o$C    Liquid Temperature:21.5$^o$C

Communication System: UID 0, LTE_FDD (0) Frequency: 1900 MHz Duty Cycle: 1:1

Probe: EX3DV4 - SN3633 ConvF(7.55, 7.55, 7.55);

**Rear Side High 1RB_Mid/Area Scan (61x61x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 1.86 W/kg

**Rear Side High 1RB_Middle/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 13.81 V/m; Power Drift = -0.09 dB

Peak SAR (extrapolated) = 3.63 W/kg

**SAR(1 g) = 1.78 W/kg; SAR(10 g) = 0.858 W/kg**

Maximum value of SAR (measured) = 2.01 W/kg

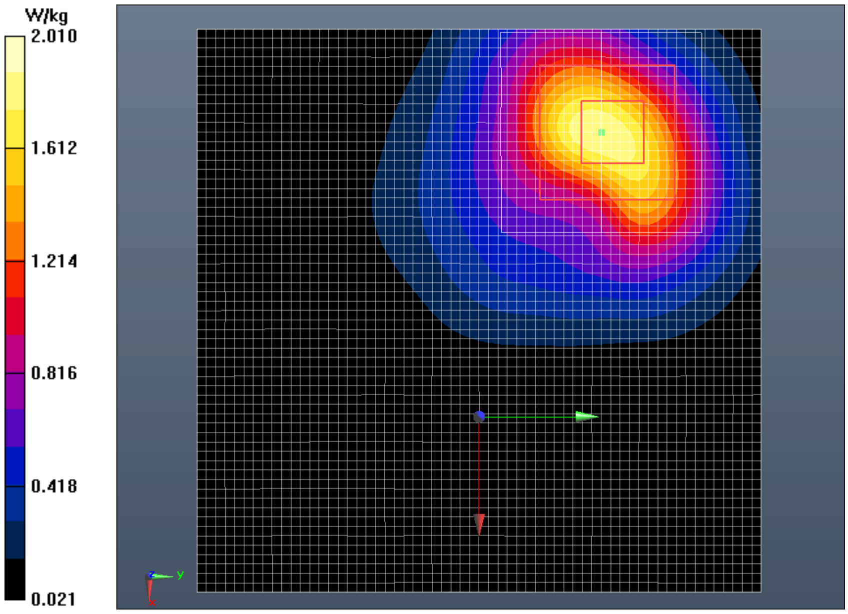



**Fig.12 LTE Band 2**

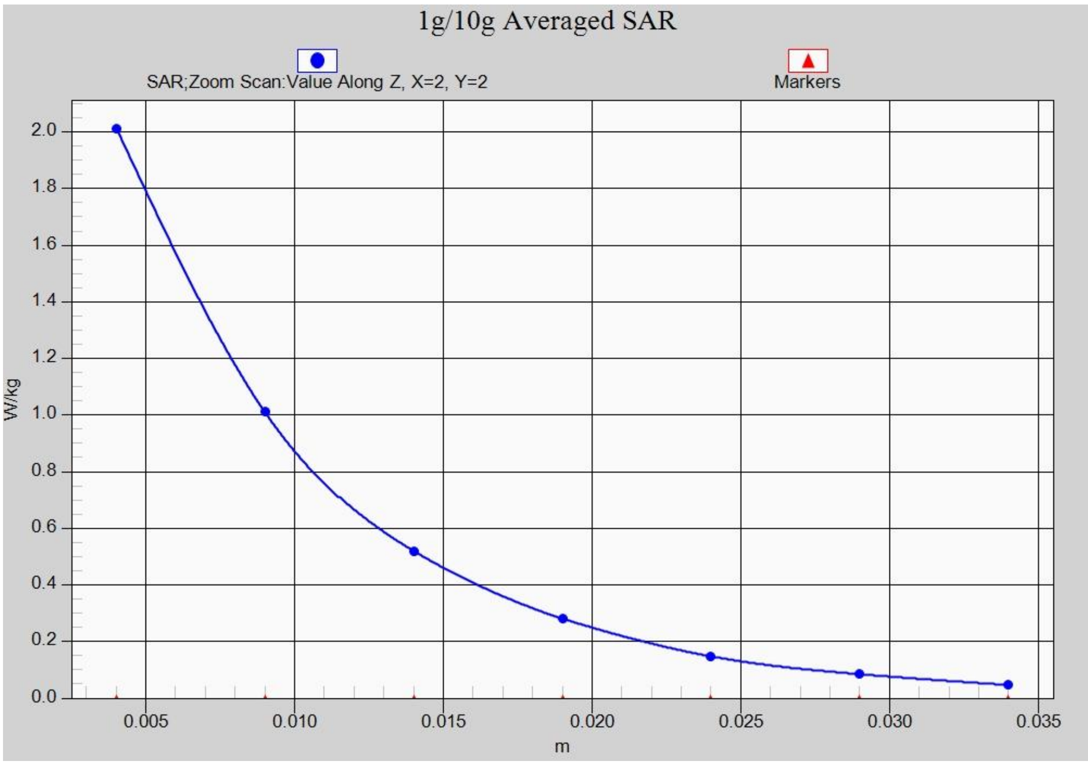



**Fig.12-1 Z-Scan at power reference point (LTE Band 2)**

## LTE Band 4Next to the mouth

Date: 2017-6-25
Electronics: DAE4 Sn786
Medium: Head 1800 MHz
Medium parameters used (interpolated): f = 1720 MHz; σ = 1.343 S/m; $\varepsilon_r$ = 39.544; ρ = 1000 kg/m$^3$
Ambient Temperature:22.0$^o$C Liquid Temperature:21.5$^o$C
Communication System: UID 0, LTE_FDD (0) Frequency: 1720 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN3633 ConvF(8.08, 8.08, 8.08);

**Front side Low1RB_Mid/Area Scan (51x51x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 1.09 W/kg

**Front side Low1RB_Mid/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 26.96 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 1.42 W/kg
**SAR(1 g) = 0.908 W/kg; SAR(10 g) = 0.529 W/kg**
Maximum value of SAR (measured) = 0.997 W/kg

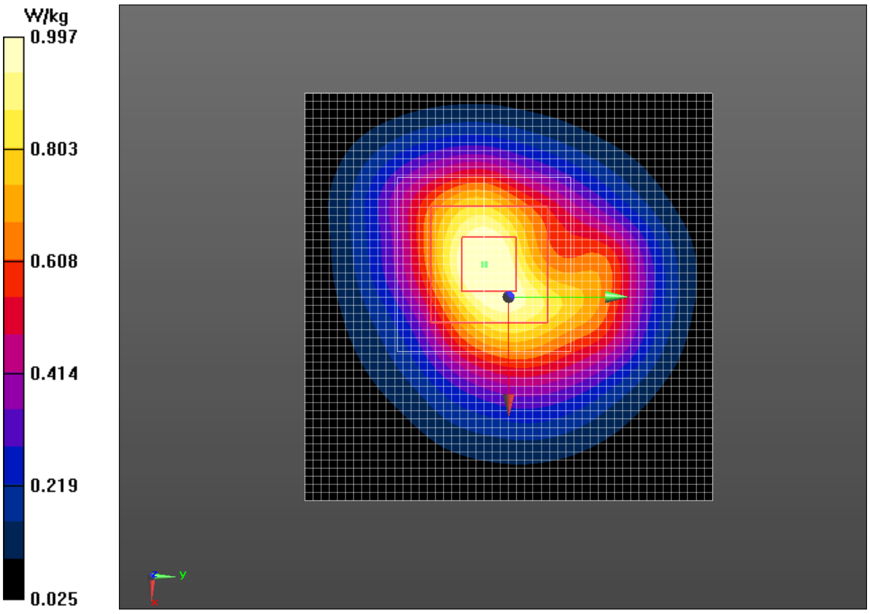



**Fig.13 LTE Band4**

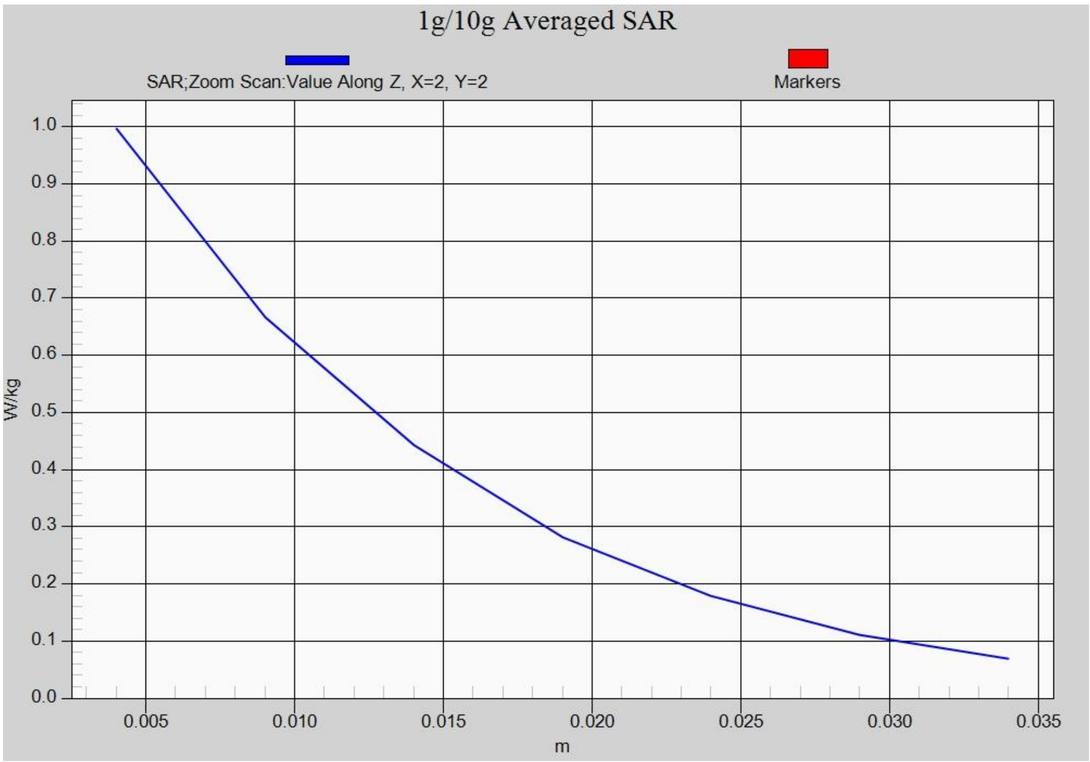



**Fig.13-1 Z-Scan at power reference point (LTE Band 4)**

## LTE Band 4 wrist-worn

Date: 2017-6-25
Electronics: DAE4 Sn786
Medium: Body 1800 MHz
Medium parameters used (interpolated): f = 1720 MHz; σ = 1.471 S/m; $\varepsilon_r$ = 52.648; ρ = 1000 kg/$m^3$
Ambient Temperature:22.0°C          Liquid Temperature:21.5°C
Communication System: UID 0, LTE_FDD (0) Frequency: 1720 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN3633 ConvF(7.9, 7.9, 7.9);

**Rear Side Low 1RB_Mid/Area Scan (61x61x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 1.51 W/kg

**Rear Side Low 1RB_Mid/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 14.05 V/m; Power Drift = -0.07 dB
Peak SAR (extrapolated) = 2.03 W/kg
**SAR(1 g) = 1.29 W/kg; SAR(10 g) = 0.765 W/kg**
Maximum value of SAR (measured) = 1.39 W/kg

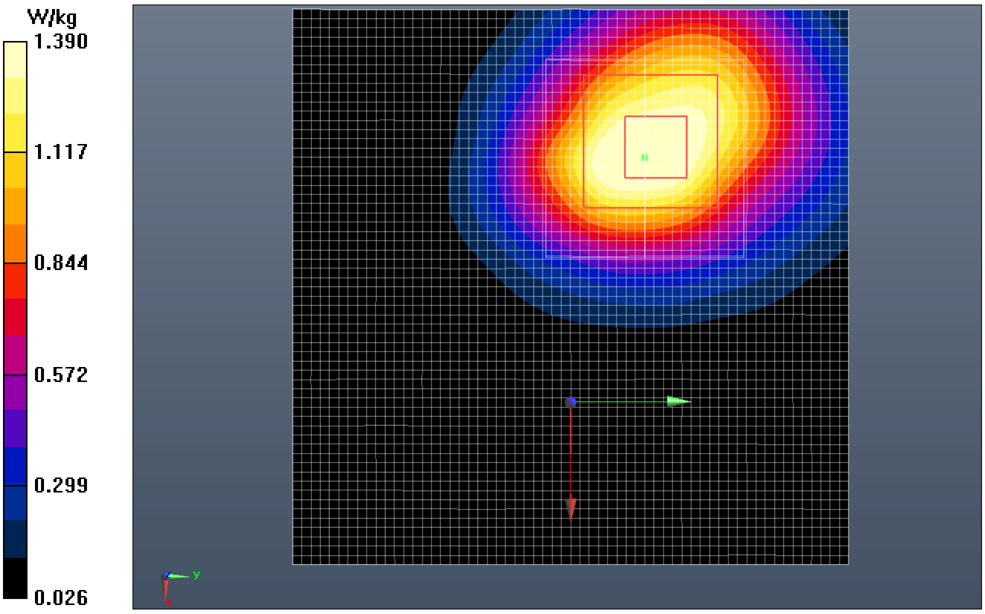



**Fig.14 LTE Band 4**

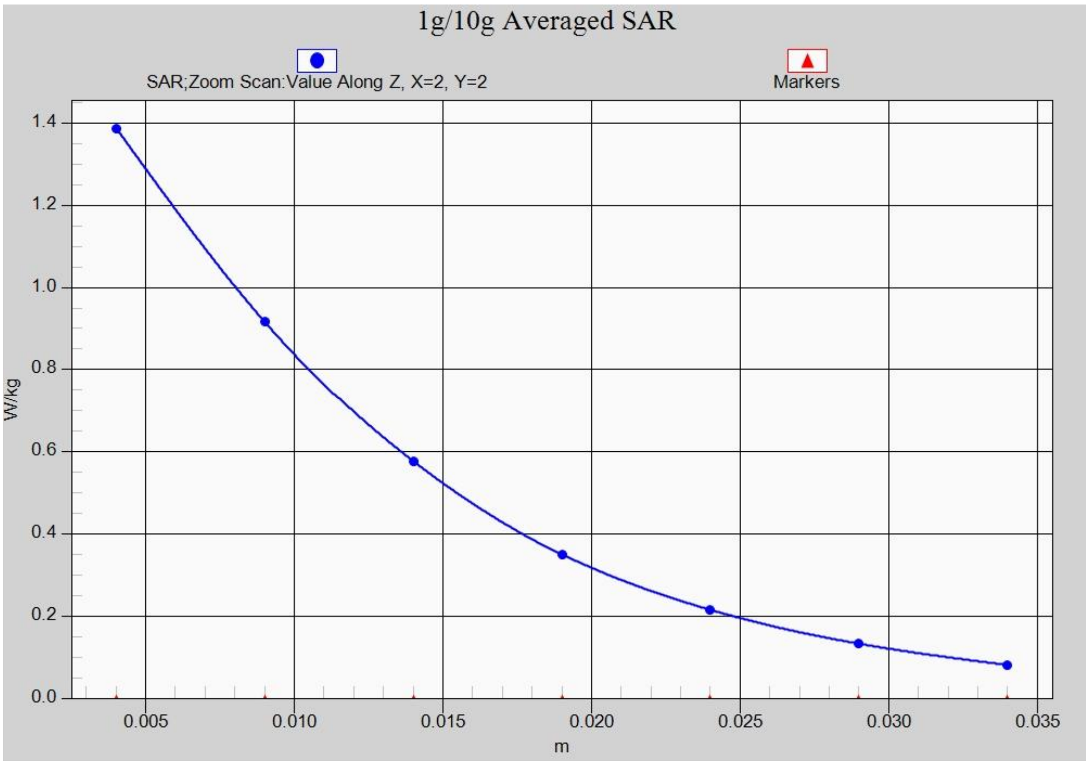



**Fig.14-1 Z-Scan at power reference point (LTE Band 4)**

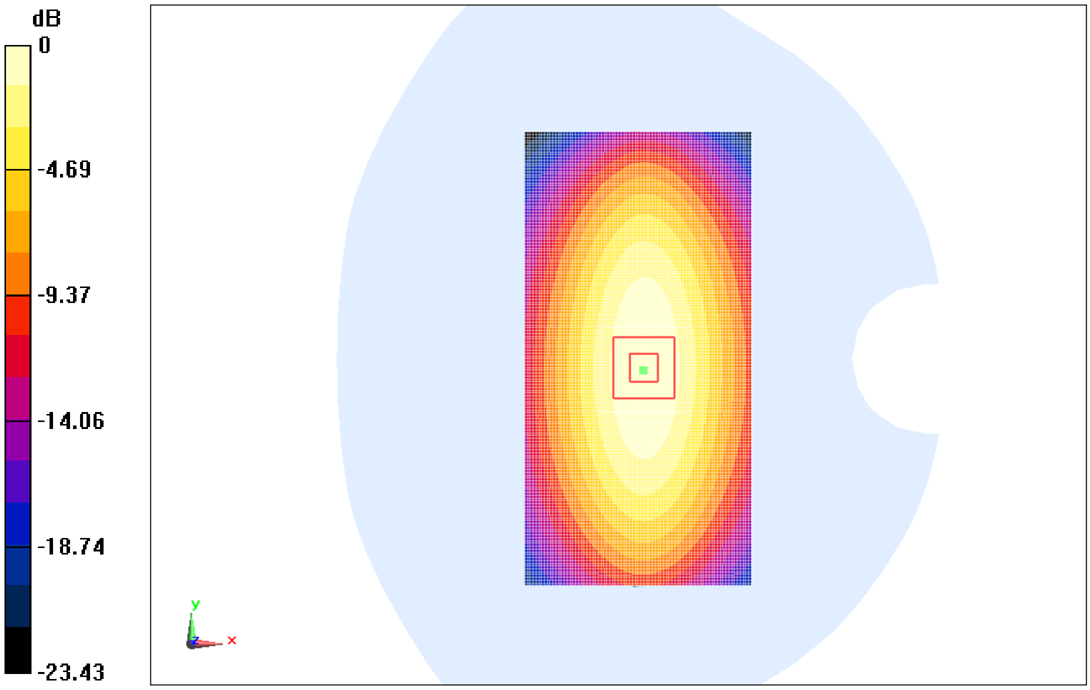
## ANNEX B SystemVerification Results

### 835MHz

Date: 2017-6-25
Electronics: DAE4 Sn786
Medium: Head 835 MHz
Medium parameters used: f = 835 MHz; σ = 0.886 S/m; $\varepsilon_r$ = 41.864; ρ = 1000 kg/m$^3$
Ambient Temperature: 22.9°C    Liquid Temperature: 22.5°C
Communication System: CW Frequency: 835 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN3633ConvF (9.04, 9.04, 9.04)

**System Validation /Area Scan (81x161x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm
Reference Value = 52.758 V/m; Power Drift = 0.05 dB
**Fast SAR: SAR(1 g) = 2.24 W/kg; SAR(10 g) = 1.50 W/kg**
Maximum value of SAR (interpolated) = 2.47 W/kg

**System Validation /Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 52.758 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 3.25 W/kg
**SAR(1 g) = 2.22W/kg; SAR(10 g) = 1.45W/kg**
Maximum value of SAR (measured) = 2.44 W/kg




0 dB = 2.44 W/kg = 3.87 dBW/kg

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

## 835MHz

Date: 2017-6-25

Electronics: DAE4 Sn786

Medium: Body 835 MHz

Medium parameters used: f = 835 MHz; $\sigma$ = 0.955 S/m; $\varepsilon_r$ = 55.832; $\rho$ = 1000 kg/m$^3$

Ambient Temperature: 22.9$^o$C Liquid Temperature: 22.5$^o$C

Communication System: CW Frequency: 835 MHz Duty Cycle: 1:1

Probe: EX3DV4 - SN3633ConvF (9.41, 9.41, 9.41)

**System Validation /Area Scan (81x171x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm

Reference Value = 55.685 V/m; Power Drift = -0.07 dB

**Fast SAR: SAR(1 g) = 2.31 W/kg; SAR(10 g) = 1.54 W/kg**

Maximum value of SAR (interpolated) = 2.62 W/kg

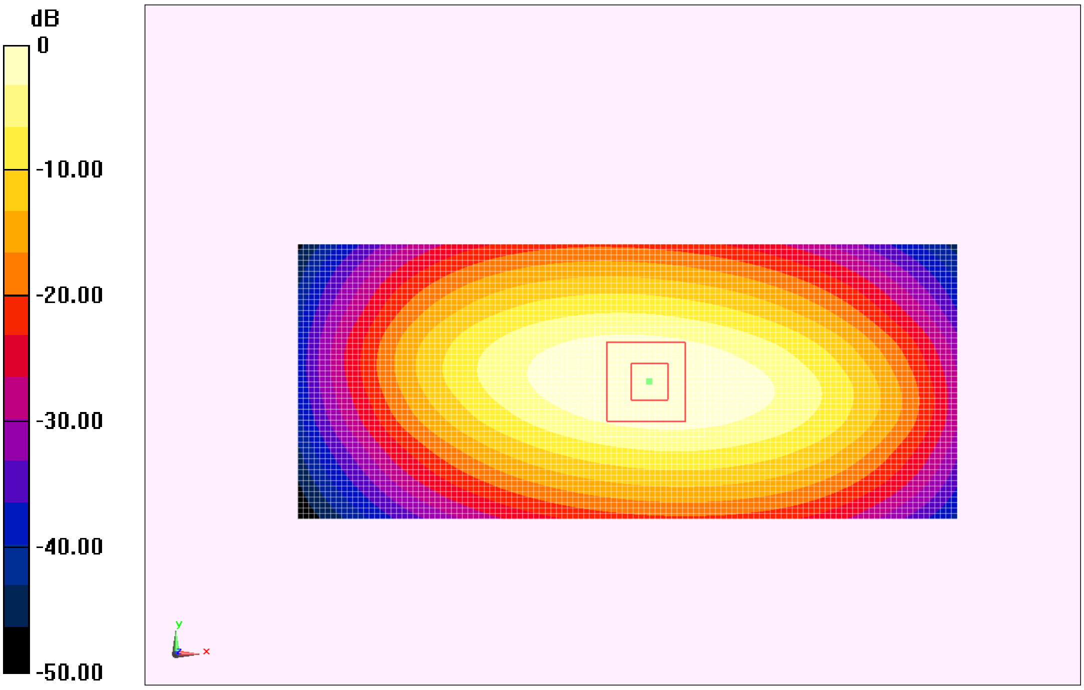
**System Validation /Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 55.685 V/m; Power Drift = -0.07 dB

Peak SAR (extrapolated) = 3.59 W/kg

**SAR(1 g) = 2.26 W/kg; SAR(10 g) = 1.50 W/kg**

Maximum value of SAR (measured) = 2.54 W/kg




0 dB = 2.54 W/kg = 4.05 dBW/kg

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

**1800MHz**

Date: 2017-6-25

Electronics: DAE4 Sn786

Medium: Head 1800 MHz

Medium parameters used: f = 1800 MHz; $\sigma$ = 1.428 S/m; $\varepsilon_r$ = 39.287; $\rho$ = 1000 kg/$m^3$

Ambient Temperature: 22.0°C  Liquid Temperature: 21.5°C

Communication System: CW_TMC Frequency: 1800 MHz Duty Cycle: 1:1

Probe: EX3DV4 - SN3633ConvF (8.08, 8.08, 8.08);

**System Validation/Area Scan (61x121x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm

Reference Value = 80.362 V/m; Power Drift = -0.02 dB

**Fast SAR: SAR(1 g) = 9.66 W/kg; SAR(10 g) = 5.15 W/kg**

Maximum value of SAR (interpolated) = 12.2 W/kg

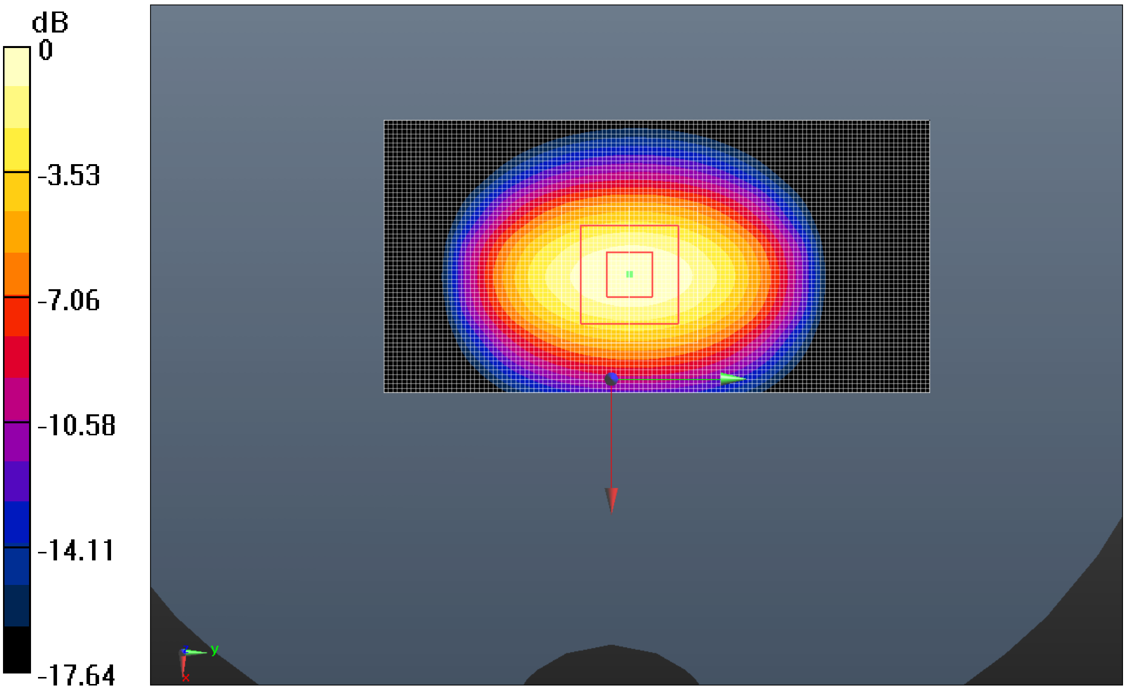
**System Validation/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 80.362 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 19.3 W/kg

**SAR(1 g) = 9.87 W/kg; SAR(10 g) = 5.19 W/kg**

Maximum value of SAR (measured) = 12.7 W/kg




0 dB = 12.7 W/kg = 11.04 dBW/kg

**Fig.B.3 validation 1800MHz 250mW**

**1800MHz**

Date: 2017-6-25

Electronics: DAE4 Sn786

Medium: Body 1800 MHz

Medium parameters used: f = 1800 MHz; σ = 1.545 S/m; $\varepsilon_r$ = 52.365; ρ = 1000 kg/$m^3$

Ambient Temperature: 22.0°C Liquid Temperature: 21.5°C

Communication System: CW_TMC Frequency: 1800 MHz Duty Cycle: 1:1

Probe: EX3DV4 - SN3633ConvF (7.9, 7.9, 7.9);

**System Validation/Area Scan (61x121x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm

Reference Value = 77. 824 V/m; Power Drift = -0.10 dB

**Fast SAR: SAR(1 g) = 9.68 W/kg; SAR(10 g) = 5.22 W/kg**

Maximum value of SAR (interpolated) = 12.5 W/kg

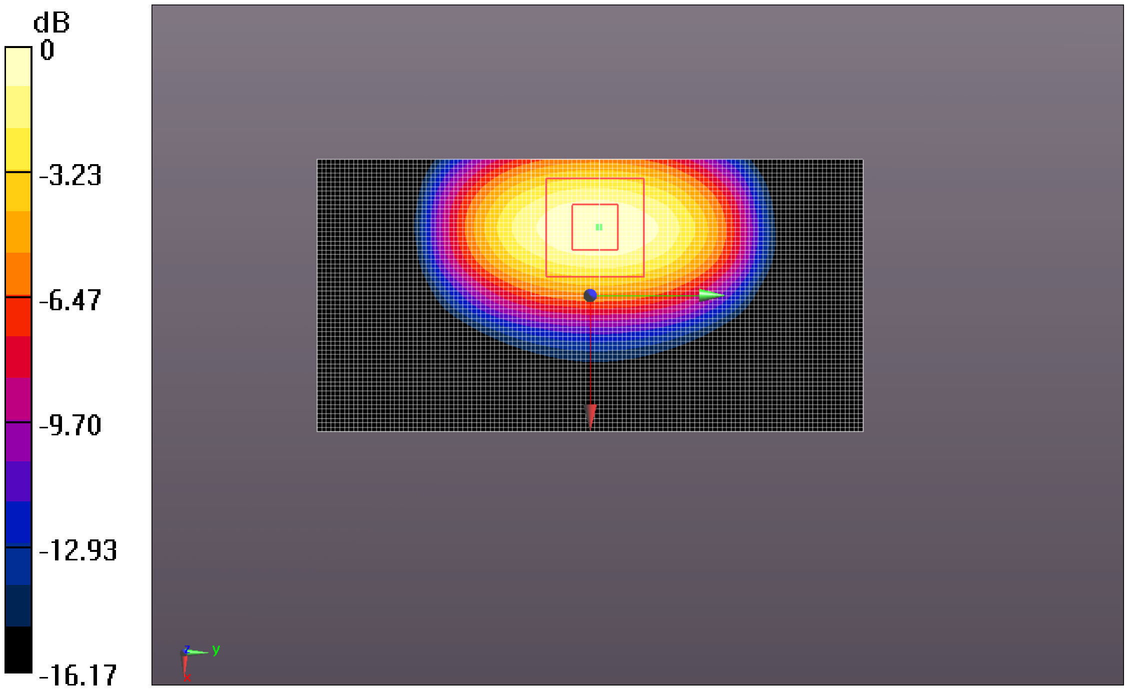
**System Validation/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 77. 824 V/m; Power Drift = -0.10 dB

Peak SAR (extrapolated) = 16.9 W/kg

**SAR(1 g) = 9.57 W/kg; SAR(10 g) = 5.12 W/kg**

Maximum value of SAR (measured) = 11.6 W/kg




0 dB = 11.6 W/kg = 10.64 dBW/kg

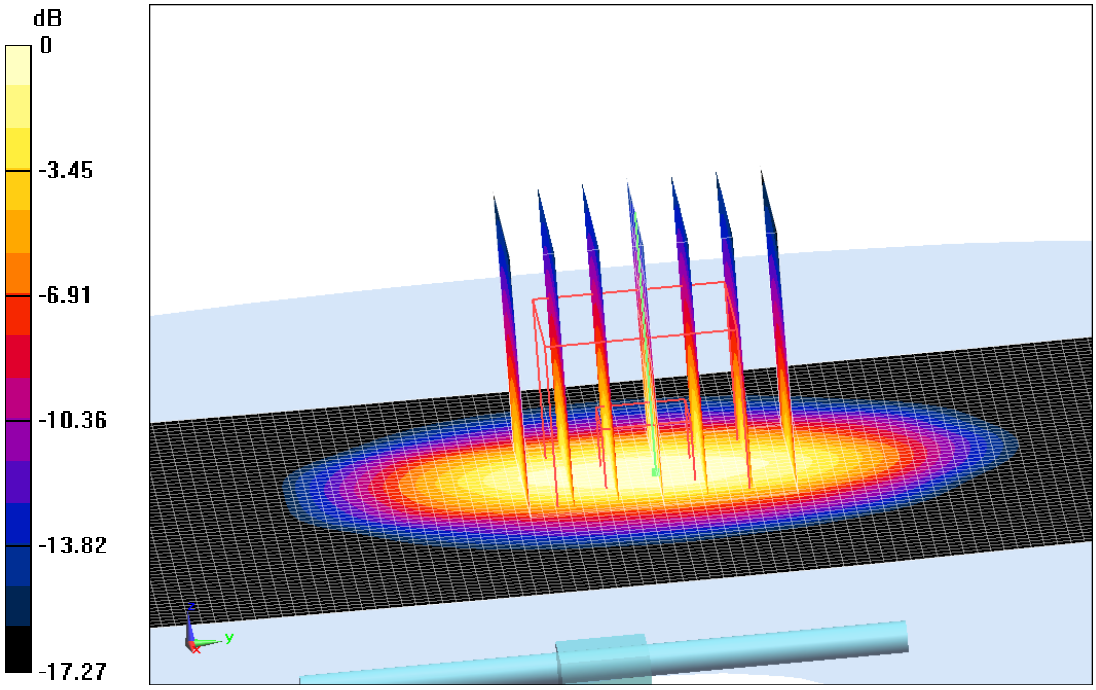
**Fig.B.4 validation 1800MHz 250mW**

## 1900MHz

Date: 2017-6-25
Electronics: DAE4 Sn786
Medium: Head 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.406 S/m; $\varepsilon_r$ = 38.742; ρ = 1000 kg/m$^3$
Ambient Temperature: 22.9°C Liquid Temperature: 22.5°C
Communication System: CW Frequency: 1900 MHz Duty Cycle: 1:1
Probe:EX3DV4 - SN3633ConvF (8, 8, 8);

**System Validation /Area Scan (81x121x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm
Reference Value = 86.382 V/m; Power Drift = -0.04dB
**Fast SAR: SAR(1 g) = 10.1 W/kg; SAR(10 g) = 5.22 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 = 86. 382 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 17.7 W/kg
**SAR(1 g) = 9.85 W/kg; SAR(10 g) = 5.16 W/kg**
Maximum value of SAR (measured) = 11.8 W/kg




0 dB = 11.8 W/kg = 10.72 dBW/kg

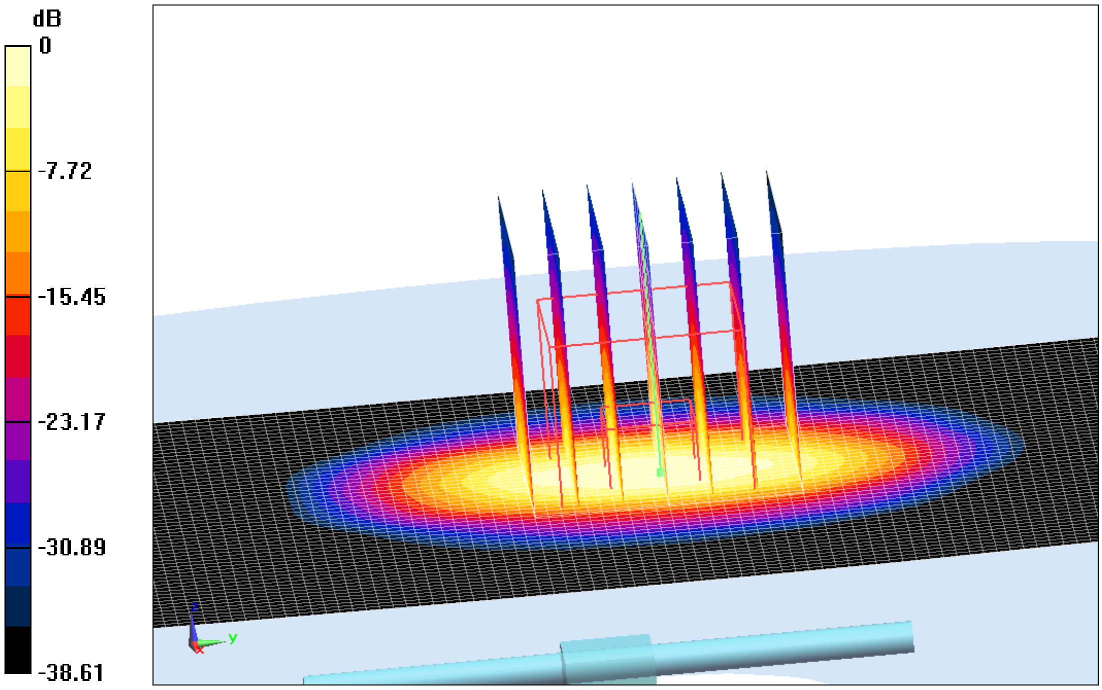
**Fig.B.5validation 1900MHz 250mW**

## 1900MHz

Date: 2017-6-25
Electronics: DAE4 Sn786
Medium: Body 1900 MHz
Medium parameters used: f = 1900 MHz; $\sigma$ = 1.512 S/m; $\varepsilon_r$ = 54.328; $\rho$ = 1000 kg/$m^3$
Ambient Temperature: 22.9°C Liquid Temperature: 22.5°C
Communication System: CW Frequency: 1900 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN3633ConvF (7.55, 7.55, 7.55)

**System validation /Area Scan (81x121x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm
Reference Value = 68.183 V/m; Power Drift = -0.06 dB
**Fast SAR: SAR(1 g) = 10.9 W/kg; SAR(10 g) = 5.51 W/kg**
Maximum value of SAR (interpolated) = 13.1 W/kg

**System validation /Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 68.183 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 18.9 W/kg
**SAR(1 g) = 10.6 W/kg; SAR(10 g) = 5.45 W/kg**
Maximum value of SAR (measured) = 12.5 W/kg



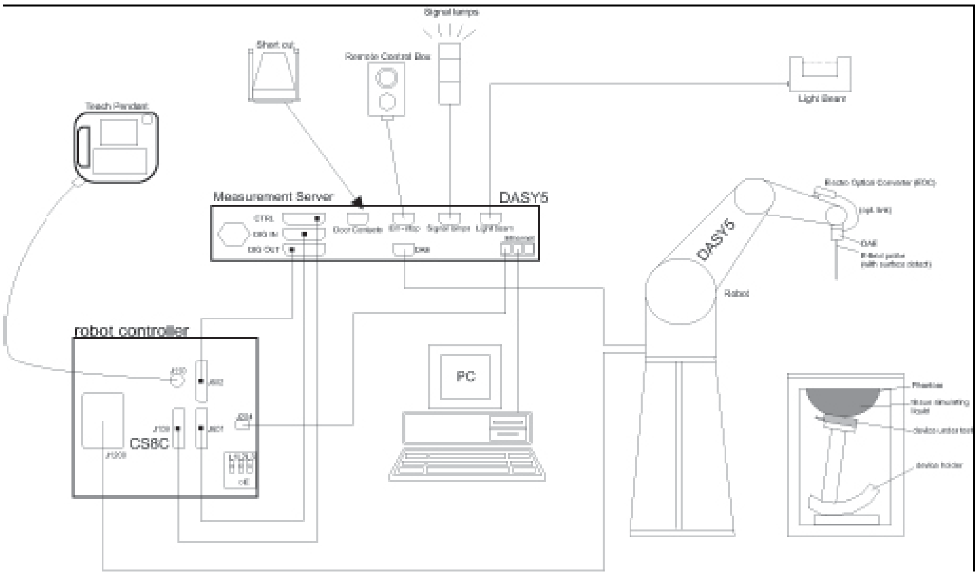

0 dB = 12.5 W/kg = 10.97 dBW/kg

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

# ANNEX C SAR Measurement Setup

## C.1 Measurement Set-up

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 (StäubliTX=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 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.

## C.2 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 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
**DynamicRange:** 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 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**

### C.4.2 Robot

The SPEAG DASY system uses the high precision robots (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 5**

### C.4.3 Measurement Server

The Measurement server is based on a PC/104 CPU broad with CPU (DASY5: 400 MHz, Intel Celeron), chipdisk (DASY5:128MB), RAM (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.


**Picture C.6 Server for DASY 5**

### C.4.4 Device Holder for Phantom

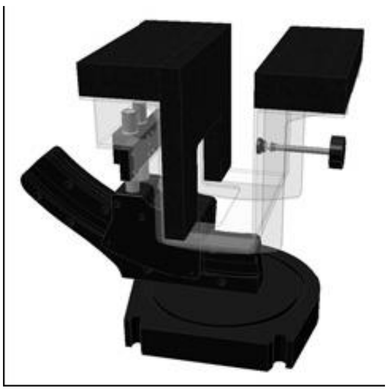
The SAR in the phantom is approximately inversely proportional to the square of the distance between the source and the liquid surface. For a source at 5mm distance, a positioning uncertainty of ±0.5mm would produce a SAR uncertainty of ±20%. Accurate device positioning is therefore crucial for accurate 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.7-1: Device Holder Picture C.7-2: 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 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).

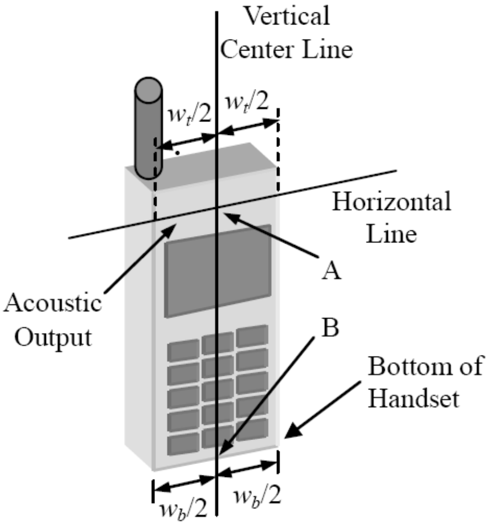
Shell Thickness: 2 ± 0. 2 mm
Filling Volume: Approx. 25 liters
Dimensions: 810 x l000 x 500 mm (H x L x W)
Available: Special

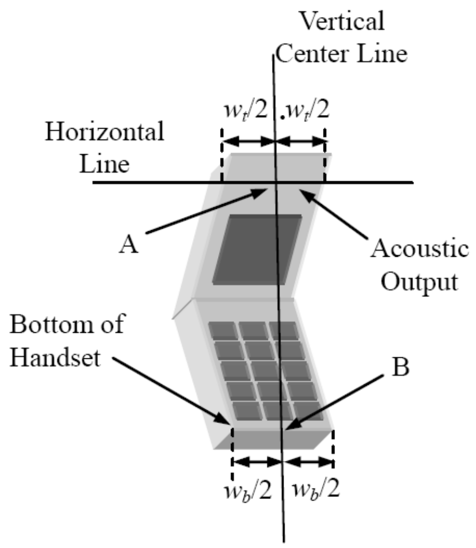
**Picture C.8: SAM Twin Phantom**

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

## D.1 General considerations

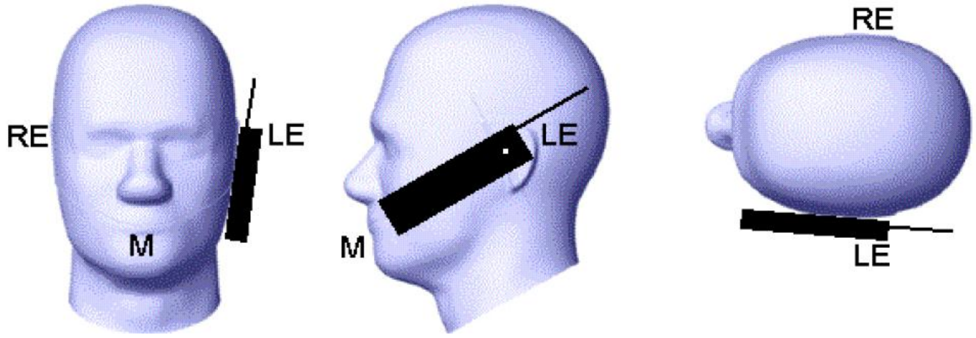
This standard specifies two handset test positions against the head phantom – the “cheek” position and the “tilt” position.



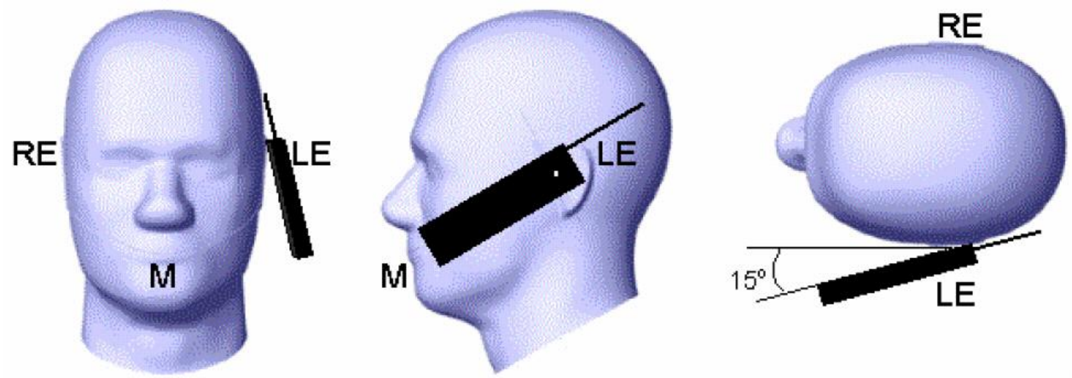




| | |
|---|---|
| $w_t$ | Width of the handset at the level of the acoustic |
| $w_b$ | Width of the bottom of the handset |
| A | Midpoint of the width $w_t$ of the handset at the level of the acoustic output |
| B | Midpoint of the width $w_b$ of the bottom of the handset |

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



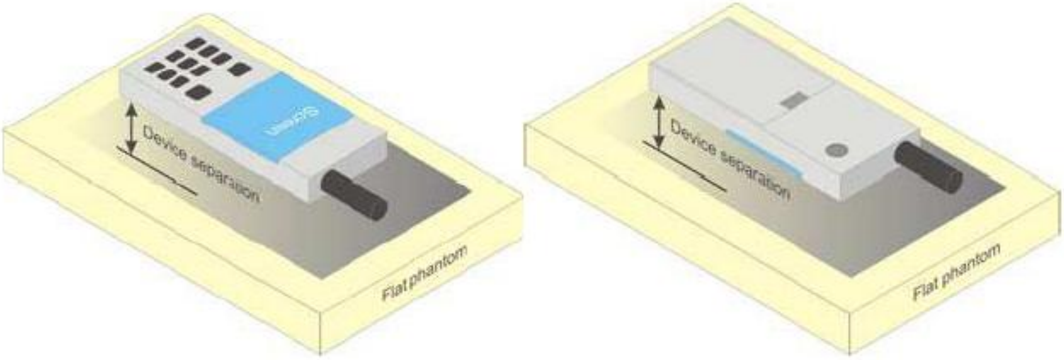

**Picture D.2 Cheek position of the wireless device on the left side of SAM**




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

## D.2 Body-worn device

A typical example of a body-worn device is a mobile phone, wireless enabled PDA or other battery operated wireless device with the ability to transmit while mounted on a person's body using a carry accessory approved by the wireless device manufacturer.




**Picture D.4 Test positions for body-worn devices**

## D.3 Desktop device

A typical example of a desktop device is a wireless enabled desktop computer placed on a table or desk when used.

The DUT shall be positioned at the distance and in the orientation to the phantom that corresponds to the intended use as specified by the manufacturer in the user instructions. For devices that employ an external antenna with variable positions, tests shall be performed for all antenna positions specified. Picture 8.5 show positions for desktop device SAR tests. If the intended use is not specified, the device shall be tested directly against the flat phantom.