Shenzhen CTL Testing Technology Co., Ltd.
Tel: +86-755-89486194 Fax: +86-755-26636041

# TEST REPORT

| | | |
|---|---|---|
| **Report Reference No.** ..................: | **CTL1606012027-SAR** | |
| Compiled by:<br>( position+printed name+signature) | Jacky Chen<br>(File administrators) | Jackychen |
| Tested by:<br>( position+printed name+signature) | Allen Wang<br>(Test Engineer) | Allen Wang |
| Approved by:<br>( position+printed name+signature) | Tracy Qi<br>(Manager) | Tracy Qi |

| | |
|---|---|
| **Product Name**...............................: | Smartwatch |
| **Model/Type reference** ..................: | HB03 |
| **List Model(s)**................................: | HB04, HB05, HB06, HB07, HB08, G4, G5, G6, G7 |
| **Trade Mark** ....................................: | HOPU |
| **FCC ID** ............................................: | **2AIZ6-HB03** |
| **Applicant's name** ........................: | **Shenzhen HOPU Smart-Tech Co.,Limited** |
| **Address of applicant** ..................: | F5, Bldg4, Hua Feng No.1 Science &Technology Zone, Xixiang street, Bao'an District, Shenzhen, China |
| **Authorized Lab.**.............................: | **Shenzhen CTL Testing Technology Co., Ltd.** |
| **Address**..........................................: | Floor 1-A, Baisha Technology Park, No.3011, Shahexi Road, Nanshan District, Shenzhen, China 518055 |
| **Test specification**.........................: | |
| Standard.........................................: | **ANSI C95.1–1999**<br>**47CFR §2.1093**<br>**KDB 447498** |
| TRF Originator ..............................: | Shenzhen CTL Testing Technology Co., Ltd. |
| Master TRF ....................................: | Dated 2011-01 |
| **Date of Receipt**.............................: | Jun. 02, 2016 |
| **Date of Test Date**..........................: | Jul. 03, 2016 –Jul. 04, 2016 |
| **Data of Issue**.................................: | Jul. 05, 2016 |
| **Result**............................................: | Pass |

# TEST REPORT

| Test Report No. : | CTL1606012027-SAR | Jul. 05, 2016<br>Date of issue |
|---|---|---|

| | | |
|---|---|---|
| Equipment under Test | : | Smartwatch |
| Model /Type | : | HB03 |
| Listed Models | : | HB04, HB05, HB06, HB07, HB08, G4, G5, G6, G7 |
| **Applicant** | : | **Shenzhen HOPU Smart-Tech Co.,Limited** |
| Address | : | F5, Bldg4, Hua Feng No.1 Science &Technology Zone, Xixiang street, Bao'an District, Shenzhen, China |
| **Manufacturer** | : | **Shenzhen YQT Electronic Technology Co.,Ltd** |
| Address | : | F5, Bldg4, Hua Feng No.1 Science &Technology Zone, Xixiang street, Bao'an District, Shenzhen, China |

| **Test result** | **Pass *** |
|---|---|

∗ In the configuration tested, the EUT complied with the standards specified page 5.

The test report merely corresponds to the test sample.
It is not permitted to copy extracts of these test result without the written permission of the test laboratory.

# ** Modified History **

| Revisions | Description | Issued Data | Report No. | Remark |
|---|---|---|---|---|
| Version 1.0 | Initial Test Report Release | 2016-07-05 | CTL1606012027-SAR | Tracy Qi |
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# 1 SUMMARY

## 1.1 TEST STANDARDS

IEEE Std 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.

IEEE Std 1528™-2003: IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques.

FCC Part 2.1093 Radiofrequency Radiation Exposure Evaluation: Portable Devices

KDB 447498 D01 Mobile Portable RF Exposure v6: Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies

KDB 865664 D01 SAR measurement 100 MHz to 6 GHz v01r04: SAR Measurement Requirements for 100 MHz to 6 GHz

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

KDB 648474 D04 Handset SAR V01r03: SAR Evaluation Considerations for Wireless Handsets.

## 1.2 Summary SAR Results

***Mouth-worn Configuration***

| Mode | Test Position | Channel /Frequency(MHz) | Limit $SAR_{1g}$ 1.6 W/kg | |
|---|---|---|---|---|
| | | | **Measured $SAR_{1g}$ (W/kg)** | **Reported $SAR_{1g}$ (W/kg)** |
| GSM 850 | Next to the mouth (10mm distance) | 190/836.6 | **0.261** | **0.283** |
| GSM 1900 | Next to the mouth (10mm distance) | 661/1880 | 0.255 | 0.258 |

***Wrist-worn Configuration***

| Mode | Test Position | Channel /Frequency(MHz) | Limit $SAR_{10g}$ 4.0 W/kg | |
|---|---|---|---|---|
| | | | **Measured $SAR_{10g}$ (W/kg)** | **Reported $SAR_{10g}$ (W/kg)** |
| GSM 850 | Wrist-worn (0mm distance) | 190/836.6 | 0.460 | 0.499 |
| GSM 1900 | Wrist-worn (0mm distance) | 661/1880 | 0.397 | 0.402 |

The SAR values found for the Smartwatch are below the maximum recommended levels of 1.6W/Kg as averaged over any 1g tissue for Mouth-worn and 4.0W/Kg averaged over any 10g tissue for Wirst-worn as accordintg to the KDB 447498 D01.
For body worn operation, this devices has been tested and meets FCC RF exposure guidelines when used with any accessory that conrtains no metal and which provides a minimum separation distance of 0mm between this devices and the body of the user. User of other accessories may not ensure compliance with FCC RF exposure guidelines.
The EUT battery must be fully charged and checked periodically during the test to ascertain inform power output.

## 1.3 Test Facility

### 1.3.1 Address of the test laboratory

**SHENZHEN YIDAJIETONG INFORMATION TECHNOLOGY CO., LTD**
No.12 Building Shangsha, Innovation & Technology Park, Futian District, Shenzhen, P.R.China

### 1.3.2 Test Lab Facility

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

**CNAS-Lab Code: 7547**

SHENZHEN YIDA JIETONG INFORMATION TECHNOLOGY CO., LTD has been assessed and proved to be in compliance with CNAS-CL01 Accreditation Criteria for Testing and Calibration Laboratories (identical to ISO/IEC 17025: 2005 General Requirements) for the Competence of Testing and Calibration Laboratories, Date of Registration: Mar 17, 2015. Valid time is until Mar 17, 2018.

## 1.4 Statement of the measurement uncertainty

| 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 | 6.55% | N | 1 | 1 | 1 | 6.55% | 6.55% | ∞ |
| 2 | Axial isotropy | B | 4.70% | R | $\sqrt{3}$ | 0.7 | 0.7 | 1.90% | 1.90% | ∞ |
| 3 | Hemispherical isotropy | B | 9.60% | R | $\sqrt{3}$ | 0.7 | 0.7 | 3.88% | 3.88% | ∞ |
| 4 | Boundary Effects | B | 1.00% | R | $\sqrt{3}$ | 1 | 1 | 0.58% | 0.58% | ∞ |
| 5 | Probe Linearity | B | 4.70% | R | $\sqrt{3}$ | 1 | 1 | 2.71% | 2.71% | ∞ |
| 6 | Detection limit | B | 1.00% | R | $\sqrt{3}$ | 1 | 1 | 0.58% | 0.58% | ∞ |
| 7 | Readout Electronics | A | 0.30% | N | 1 | 1 | 1 | 0.30% | 0.30% | ∞ |
| 8 | Response Time | B | 0.00% | R | $\sqrt{3}$ | 1 | 1 | 0.00% | 0.00% | ∞ |
| 9 | Integration Time | B | 0.00% | R | $\sqrt{3}$ | 1 | 1 | 0.00% | 0.00% | ∞ |
| 10 | RF ambient conditions-noise | B | 1.00% | R | $\sqrt{3}$ | 1 | 1 | 0.58% | 0.58% | ∞ |
| 11 | RF ambient conditions-reflection | B | 1.00% | R | $\sqrt{3}$ | 1 | 1 | 0.58% | 0.58% | ∞ |
| 12 | Probe positioned mech. restrictions | B | 0.80% | R | $\sqrt{3}$ | 1 | 1 | 0.46% | 0.46% | ∞ |
| 13 | Probe positioning with respect to phantom shell | B | 6.70% | R | $\sqrt{3}$ | 1 | 1 | 3.87% | 3.87% | ∞ |
| 14 | Max.SAR evaluation | B | 2.00% | R | $\sqrt{3}$ | 1 | 1 | 1.15% | 1.15% | ∞ |
| Test Sample Related | | | | | | | | | | |
| 15 | Test sample positioning | A | 1.86% | N | 1 | 1 | 1 | 1.86% | 1.86% | ∞ |
| 16 | Device holder uncertainty | A | 1.70% | N | 1 | 1 | 1 | 1.70% | 1.70% | ∞ |
| 17 | Drift of output | B | 5.00% | R | $\sqrt{3}$ | 1 | 1 | 2.89% | 2.89% | ∞ |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | power | | | | | | | | | |
| Phantom and Set-up | | | | | | | | | | |
| 18 | Phantom uncertainty | B | 4.00% | R | $\sqrt{3}$ | 1 | 1 | 2.31% | 2.31% | ∞ |
| 19 | Liquid conductivity (target) | B | 5.00% | R | $\sqrt{3}$ | 0.64 | 0.43 | 1.85% | 1.24% | ∞ |
| 20 | Liquid conductivity (meas.) | A | 2.50% | N | 1 | 0.64 | 0.43 | 1.60% | 1.08% | ∞ |
| 21 | Liquid permittivity (target) | B | 5.00% | R | $\sqrt{3}$ | 0.60 | 0.49 | 1.73% | 1.41% | ∞ |
| 22 | Liquid permittivity (meas.) | A | 2.50% | N | 1 | 0.60 | 0.49 | 1.50% | 1.23% | ∞ |
| Combined standard uncertainty | $u_c = \sqrt{\sum_{i=1}^{22} c_i^2 u_i^2}$ | | / | / | / | / | / | 10.87% | 10.63% | ∞ |
| Expanded uncertainty (confidence interval of 95 %) | $u_e = 2u_c$ | | / | R | K=2 | / | / | 21.73% | 21.27% | ∞ |

## 1.5 System Check Uncertainty

| 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 | 6.55% | N | 1 | 1 | 1 | 6.55% | 6.55% | ∞ |
| 2 | Axial isotropy | B | 4.70% | R | $\sqrt{3}$ | 0.7 | 0.7 | 1.90% | 1.90% | ∞ |
| 3 | Hemispherical isotropy | B | 9.60% | R | $\sqrt{3}$ | 0.7 | 0.7 | 3.88% | 3.88% | ∞ |
| 4 | Boundary Effects | B | 1.00% | R | $\sqrt{3}$ | 1 | 1 | 0.58% | 0.58% | ∞ |
| 5 | Probe Linearity | B | 4.70% | R | $\sqrt{3}$ | 1 | 1 | 2.71% | 2.71% | ∞ |
| 6 | Detection limit | B | 1.00% | R | $\sqrt{3}$ | 1 | 1 | 0.58% | 0.58% | ∞ |
| 7 | Readout Electronics | A | 0.30% | N | 1 | 1 | 1 | 0.30% | 0.30% | ∞ |
| 8 | Response Time | B | 0.00% | R | $\sqrt{3}$ | 1 | 1 | 0.00% | 0.00% | ∞ |
| 9 | Integration Time | B | 0.00% | R | $\sqrt{3}$ | 1 | 1 | 0.00% | 0.00% | ∞ |
| 10 | RF ambient conditions-noise | B | 1.00% | R | $\sqrt{3}$ | 1 | 1 | 0.58% | 0.58% | ∞ |
| 11 | RF ambient conditions-reflection | B | 1.00% | R | $\sqrt{3}$ | 1 | 1 | 0.58% | 0.58% | ∞ |
| 12 | Probe positioned mech. restrictions | B | 0.80% | R | $\sqrt{3}$ | 1 | 1 | 0.46% | 0.46% | ∞ |
| 13 | Probe positioning with respect to phantom shell | B | 6.70% | R | $\sqrt{3}$ | 1 | 1 | 3.87% | 3.87% | ∞ |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 14 | Max.SAR evaluation | B | 2.00% | R | $\sqrt{3}$ | 1 | 1 | 1.15% | 1.15% | ∞ |
| Dipole Related | | | | | | | | | | |
| 15 | Dev. of experimental dipole | B | 5.50% | R | $\sqrt{3}$ | 1 | 1 | 3.18% | 3.18% | ∞ |
| 16 | Dipole Axis to Liquid Dist. | B | 2.00% | R | $\sqrt{3}$ | 1 | 1 | 1.15% | 1.15% | ∞ |
| 17 | Input power & SAR drift | B | 3.40% | R | $\sqrt{3}$ | 1 | 1 | 1.96% | 1.96% | ∞ |
| Phantom and Setup | | | | | | | | | | |
| 18 | Phantom uncertainty | B | 4.00% | R | $\sqrt{3}$ | 1 | 1 | 2.31% | 2.31% | ∞ |
| 19 | SAR correction | B | 1.90% | R | $\sqrt{3}$ | 1 | 0.84 | 1.10% | 0.92% | |
| 20 | Liquid conductivity (meas.) | A | 2.50% | N | 1 | 0.78 | 0.71 | 1.95% | 1.78% | ∞ |
| 21 | Liquid permittivity (meas.) | A | 2.50% | N | 1 | 0.26 | 0.26 | 0.65% | 0.65% | ∞ |
| 22 | Temp. unc. - Conductivity | B | 1.70% | R | $\sqrt{3}$ | 0.78 | 0.71 | 0.77% | 0.70% | ∞ |
| 23 | Temp. unc. - Permittivity | B | 0.30% | R | $\sqrt{3}$ | 0.23 | 0.26 | 0.04% | 0.05% | ∞ |
| Combined standard uncertainty | $u_C = \sqrt{\sum_{i=1}^{23} c_i^2 u_i^2}$ | / | / | / | / | / | 10.65% | 10.60% | ∞ | |
| Expanded uncertainty (confidence interval of 95 %) | $u_e = 2u_c$ | / | R | K=2 | / | / | 21.31% | 21.20% | ∞ | |

# 2 GENERAL INFORMATION

## 2.1 Environmental conditions

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

| | |
|---|---|
| Normal Temperature | 15°C - 35°C |
| Relative Humidity | 25% - 55 % |
| Air Pressure | 101 kPa |

## 2.2 General Description of EUT

| | |
|---|---|
| Product Name: | Smartwatch |
| Model/Type reference: | HB03 |
| Power supply: | DC 3.7V from battery |
| Hardware version: | R02S_V3.1 |
| Software version: | V4.0 |
| **2G** | |
| Operation Band: | GSM850, GSM900, DCS1800, PCS1900 |
| Supported type: | GSM |
| Power Class: | GSM850,GSM900:Power Class 4<br>DCS1800, PCS1900:Power Class 1 |
| Modulation Type: | GMSK for GSM |
| GSM Release Version | R99 |
| GPRS Multisport Class | Not support |
| EGPRS Multislot Class | Not support |
| Antenna type: | PIFA antenna |
| Antenna gain: | GSM850:0.25dBi, PCS1900: 0.35dBi |
| **Bluetooth** | |
| Version: | Supported BT3.0 |
| Modulation: | GFSK, π/4DQPSK, 8DPSK |
| Operation frequency: | 2402MHz~2480MHz |
| Channel number: | 79 |
| Channel separation: | 1MHz |
| Antenna type: | FIFA Antenna |
| Antenna gain: | -0.61dBi |
| **Bluetooth** | |
| Supported type: | Version 4.0 for low Energy |
| Modulation: | GFSK |
| Operation frequency: | 2402MHz to 2480MHz |
| Channel number: | 40 |
| Channel separation: | 2 MHz |
| Antenna type: | FIFA Antenna |
| Antenna gain: | -0.61dBi |

Note: For more detailed features description, please refer to the manufacturer’s specifications or the User's Manual.

## 2.3 Description of Test Modes

The EUT battery must be fully charged and checked periodically during the test to ascertain uniform power the EUT has been tested under typical operating condition and The Transmitter was operated in the normal operating mode. The TX frequency was fixed which was for the purpose of the measurements.

## 2.4 Equipments Used during the Test

| Test Equipment | Manufacturer | Type/Model | Serial Number | Calibration | |
|---|---|---|---|---|---|
| | | | | Last Calibration | Calibration Interval |
| Data Acquisition Electronics DAEx | SPEAG | DAE4 | 905 | 2015.07.16 | 1 |
| E-field Probe | SPEAG | ES3DV4 | 3842 | 2015-08-26 | 1 |
| System Validation Dipole D1900V2 | SPEAG | D1900V2 | 5d194 | 2015.01.07 | 3 |
| System Validation Dipole D900V2 | SPEAG | D900V2 | 1d086 | 2013.08.09 | 3 |
| Network analyzer | Agilent | E5071B | MY42404001 | 2015-11-21 | 1 |
| Universal Radio Communication Tester | ROHDE & SCHWARZ | E5515C | GB47200762 | 2015-08-29 | 1 |
| Dielectric Probe Kit | Agilent | 85070E | NA#F-EP-00777 | / | / |
| Power meter | Agilent | NRVD | 835843/014 | 2015-12-02 | 1 |
| Power meter | Agilent | NRVD | 835843/017 | 2015-12-02 | 1 |
| Power meter | Agilent | NRVD | 835843/025 | 2015-12-02 | 1 |
| Power sensor | Agilent | NRV-Z2 | 100211 | 2015-12-02 | 1 |
| Power sensor | Agilent | NRV-Z2 | 100219 | 2015-12-02 | 1 |
| Power sensor | Agilent | NRV-Z2 | 100220 | 2015-12-02 | 1 |
| Signal generator | ROHDE & SCHWARZ | SME03 | 100029 | 2015-11-25 | 1 |
| Amplifier | AR | 2HL-42W-S | 100206 | / | / |

## 2.5 SAR Measurements System

### 2.5.1 SAR Measurement Set-up

The DASY4 system for performing compliance tests consists of the following items:

A standard high precision 6-axis robot (Stäubli RX family) with controller and software. An arm extension for accommodating the data acquisition electronics (DAE).

A dosimetric probe, i.e. an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid. The probe is equipped with an optical surface detector system.

A data acquisition electronic (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.

A unit to operate the optical surface detector which is connected to the EOC.

The Electro-Optical Coupler (EOC) performs the conversion from the optical into a digital electric signal of the DAE. The EOC is connected to the DASY4 measurement server.

The DASY4 measurement server, which performs all real-time data evaluation for field measurements and surface detection, controls robot movements and handles safety operation. A computer operating Windows 2003.

DASY4 software and SEMCAD data evaluation software.

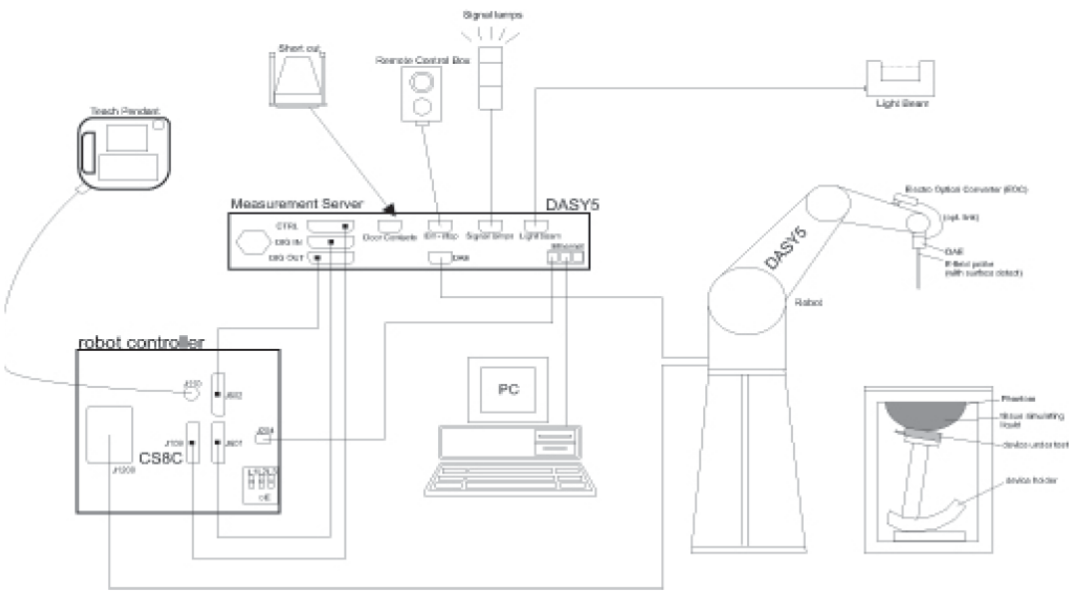
Remote control with teach panel and additional circuitry for robot safety such as warning lamps, etc.

The generic twin phantom enabling the testing of left-hand and right-hand usage.

The device holder for handheld Mobile Phones.

Tissue simulating liquid mixed according to the given recipes.

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



## 2.5.2 DASY4 E-field Probe System

The SAR measurements were conducted with the dosimetric probe ES3DV3 (manufactured by SPEAG), designed in the classical triangular configuration and optimized for dosimetric evaluation.

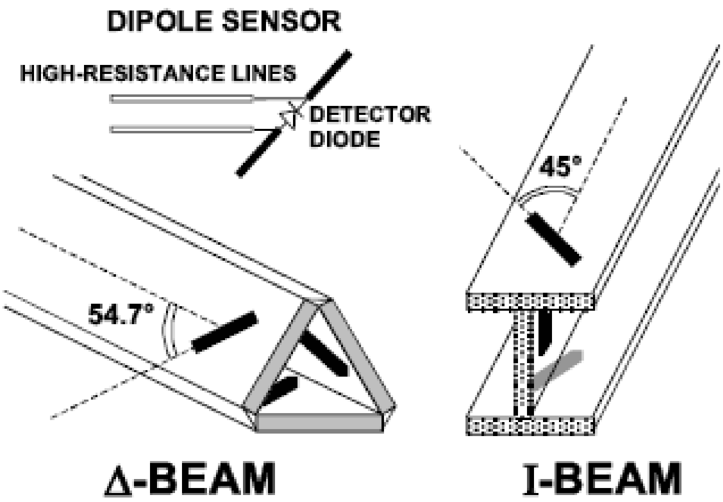
Probe Specification

| | |
|---|---|
| Construction | Symmetrical design with triangular core<br>Interleaved sensors<br>Built-in shielding against static charges<br>PEEK enclosure material (resistant to organic solvents, e.g., DGBE) |
| Calibration | ISO/IEC 17025 calibration service available. |
| Frequency | 10 MHz to 4 GHz;<br>Linearity: ± 0.2 dB (30 MHz to 4 GHz) |
| Directivity | ± 0.2 dB in HSL (rotation around probe axis)<br>± 0.3 dB in tissue material (rotation normal to probe axis) |
| Dynamic Range | 5 μW/g to > 100 mW/g;<br>Linearity: ± 0.2 dB |
| Dimensions | Overall length: 337 mm (Tip: 20 mm)<br>Tip diameter: 3.9 mm (Body: 12 mm)<br>Distance from probe tip to dipole centers: 2.0 mm |
| Application | General dosimetry up to 4 GHz<br>Dosimetry in strong gradient fields<br>Compliance tests of Mobile Phones |
| Compatibility | DASY3, DASY4, DASY52 SAR and higher,<br>EASY4/MRI |

Isotropic E-Field Probe

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

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



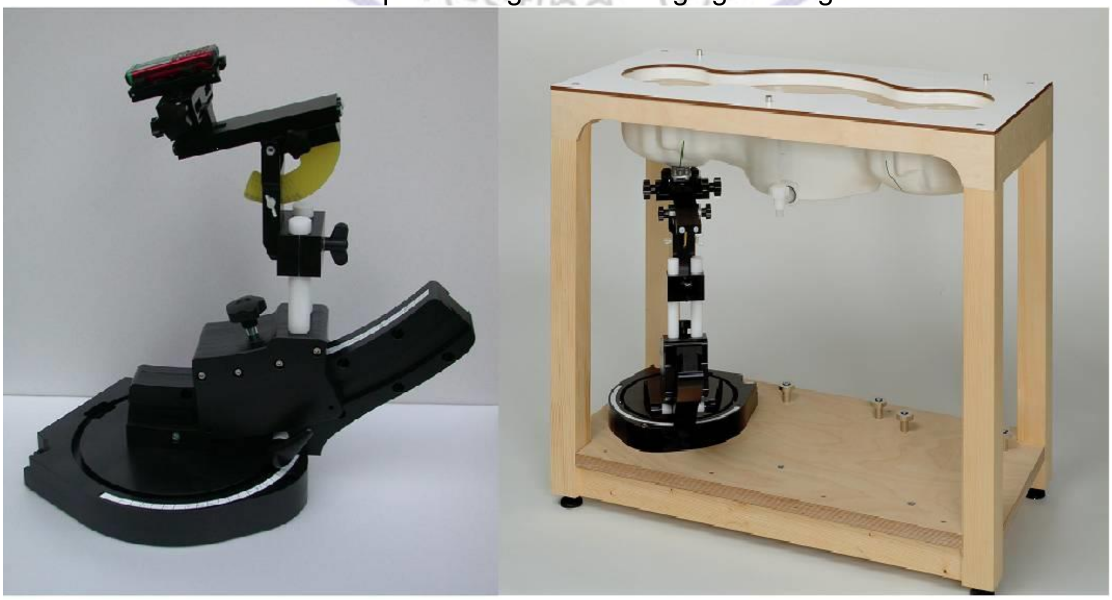
### 2.5.3 Phantoms

The phantom used for all tests i.e. for both system checks and device testing, was the twin-headed "SAM Phantom", manufactured by SPEAG. The SAM twin phantom is a fiberglass shell phantom with 2mm shell thickness (except the ear region, where shell thickness increases to 6mm).
System checking was performed using the flat section, whilst Head SAR tests used the left and right head profile sections. Body SAR testing also used the flat section between the head profiles.

SAM Twin Phantom

### 2.5.4 Device Holder

The device was placed in the device holder (illustrated below) that is supplied by SPEAG as an integral part of the DASY system.
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.



Device holder supplied by SPEAG

### 2.5.5 Scanning Procedure

The DASY4 installation includes predefined files with recommended procedures for measurements and validation. They are read-only document files and destined as fully defined but unmeasured masks. All test positions (head or body-worn) are tested with the same configuration of test steps differing only in the grid definition for the different test positions.

The “reference” and “drift” measurements are located at the beginning and end of the batch process. They measure the field drift at one single point in the liquid over the complete procedure. The indicated drift is mainly the variation of the DUT’s output power and should vary max. ± 5 %.

The “surface check” measurement tests the optical surface detection system of the DASY5 system by repeatedly detecting the surface with the optical and mechanical surface detector and comparing the results. The output gives the detecting heights of both systems, the difference between the two systems and the standard deviation of the detection repeatability. Air bubbles or refraction in the liquid due to separation of the sugar-water mixture gives poor repeatability (above ± 0.1mm). To prevent wrong results tests are only executed when the liquid is free of air bubbles. The difference between the optical surface detection and the actual surface depends on the probe and is specified with each probe (It does not depend on the surface reflectivity or the probe angle to the surface within ± 30°.)

According to the test standard, the recommended procedure for assessing the peak spatial-average SAR value consists of the following steps:

(a) Power reference measurement

(b) Area scan

(c) Zoom scan

(d) Power drift measurement

**Power Reference Measurement**

The Power Reference Measurement and Power Drift Measurements are for monitoring the power drift of the device under test in the batch process. The minimum distance of probe sensors to surface determines the closest measurement point to phantom surface. This distance cannot be smaller than the distance of sensor calibration points to probe tip as defined in the probe properties.

**Area Scan**

The area scan is used as a fast scan in two dimensions to find the area of high field values, before doing a fine measurement around the hot spot. The sophisticated interpolation routines implemented in DASY software can find the maximum found in the scanned area, within a range of the global maximum. The range (in dB0 is specified in the standards for compliance testing. For example, a 2 dB range is required in IEEE standard 1528 and IEC 62209 standards, whereby 3 dB is a requirement when compliance is assessed in accordance with the ARIB standard (Japan), if only one zoom scan follows the area scan, then only the absolute maximum will be taken as reference. For cases where multiple maximums are detected, the number of zoom scans has to be increased accordingly.

Area scan parameters extracted from FCC KDB 865664 D01 SAR measurement 100 MHz to 6 GHz.

<table>
<tr><td></td><td>≤ 3 GHz</td><td>> 3 GHz</td></tr>
<tr><td>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>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 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>
</table>

**Zoom Scan**

Zoom scans are used assess the peak spatial SAR values within a cubic averaging volume containing 1 gram and 10 gram of simulated tissue. The zoom scan measures points (refer to table below) within a cube shoes base faces are centered on the maxima found in a preceding area scan job within the same procedure. When the measurement is done, the zoom scan evaluates the averaged SAR for 1 gram and 10 gram and displays these values next to the job's label.

Zoom scan parameters extracted from FCC KDB 865664 D01 SAR measurement 100 MHz to 6 GHz.

<table>
<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">$\leq 1.5 \cdot \Delta z_{Zoom}(n-1)$</td></tr>
<tr><td>Minimum zoom scan volume</td><td colspan="2">x, y, z</td><td>≥ 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>

**Volume Scan Procedures**

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

**Power Drift Monitoring**

All SAR testing is under the EUT install full charged battery and transmit maximum output power. In DASY measurement software, the power reference measurement and power drift measurement procedures are used for monitoring the power drift of EUT during SAR test. Both these procedures measure the field at a specified reference position before and after the SAR testing. The software will calculate the field difference in dB. If the power drifts more than 5%, the SAR will be retested.

**Spatial Peak Detection**

The procedure for spatial peak SAR evaluation has been implemented according to the test standard. It can be conducted for 1g and 10g, as well as for user-specific masses. The DASY software includes all numerical procedures necessary to evaluate the spatial peak SAR value.

The base for the evaluation is a "cube" measurement. The measured volume must include the 1g and 10g cubes with the highest averaged SAR values. For that purpose, the center of the measured volume is aligned to the interpolated peak SAR value of a previously performed area scan.

The entire evaluation of the spatial peak values is performed within the post-processing engine (SEMCAD). The system always gives the maximum values for the 1g and 10g cubes. The algorithm to find the cube with highest averaged SAR is divided into the following stages:

(a) Extraction of the measured data (grid and values) from the Zoom Scan

(b) Calculation of the SAR value at every measurement point based on all stored data (A/D values and measurement parameters)

(c) Generation of a high-resolution mesh within the measured volume

(d) Interpolation of all measured values form the measurement grid to the high-resolution grid

(e) Extrapolation of the entire 3-D field distribution to the phantom surface over the distance from sensor to surface

(f) Calculation of the averaged SAR within masses of 1g and 10g

### 2.5.6 Data Storage and Evaluation

**Data Storage**

The DASY4 software stores the acquired data from the data acquisition electronics as raw data (in microvolt readings from the probe sensors), together with all necessary software parameters for the data evaluation (probe calibration data, liquid parameters and device frequency and modulation data) in measurement files with the extension ".DA4". The software evaluates the desired unit and format for output each time the data is visualized or exported. This allows verification of the complete software setup even after the measurement and allows correction of incorrect parameter settings. For example, if a measurement has been performed with a wrong crest factor parameter in the device setup, the parameter can be corrected afterwards and the data can be re-evaluated.

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

**Data Evaluation**

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

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

These parameters must be set correctly in the software. They can be found in the component documents or they can be imported into the software from the configuration files issued for the DASY4 components. In the direct measuring mode of the multimeter option, the parameters of the actual system setup are used. In the scan visualization and export modes, the parameters stored in the corresponding document files are used.

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

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

With Vi = compensated signal of channel i ( i = x, y, z )
Ui = input signal of channel i ( i = x, y, z )
cf = crest factor of exciting field (DASY parameter)
dcpi = diode compression point (DASY parameter)

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

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

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

With Vi = compensated signal of channel i (i = x, y, z)
Normi = sensor sensitivity of channel i (i = x, y, z)
[mV/(V/m)2] for E-field Probes
ConvF = sensitivity enhancement in solution
aij = sensor sensitivity factors for H-field probes

f = carrier frequency [GHz]
Ei = electric field strength of channel i in V/m
Hi = magnetic field strength of channel i in A/m

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

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

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

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

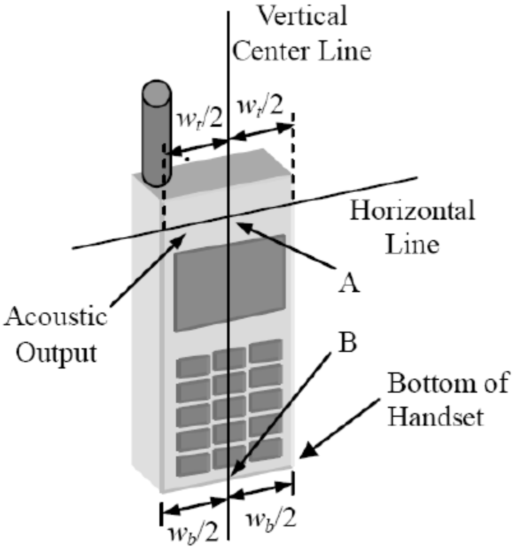
with SAR = local specific absorption rate in mW/g
Etot = total field strength in V/m
σ = conductivity in [mho/m] or [Siemens/m]
ρ = equivalent tissue density in g/cm3

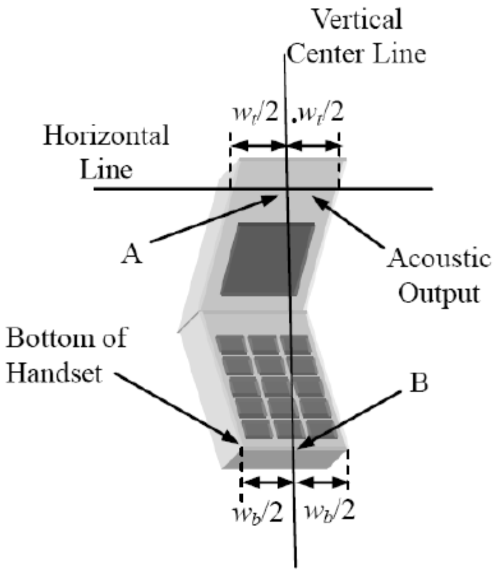
Note that the density is normally set to 1 (or 1.06), to account for actual brain density rather than the density of the simulation liquid.

# 3 Position of the wireless device in relation to the phantom

## 3.1 General considerations

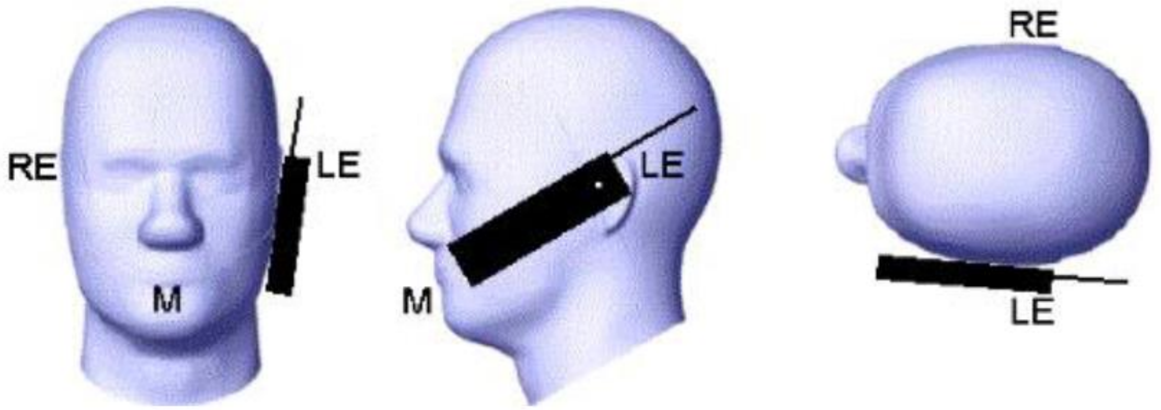
This standard specifies two handset test positions against the head phantom – the “cheek” position and the “tilt” position.



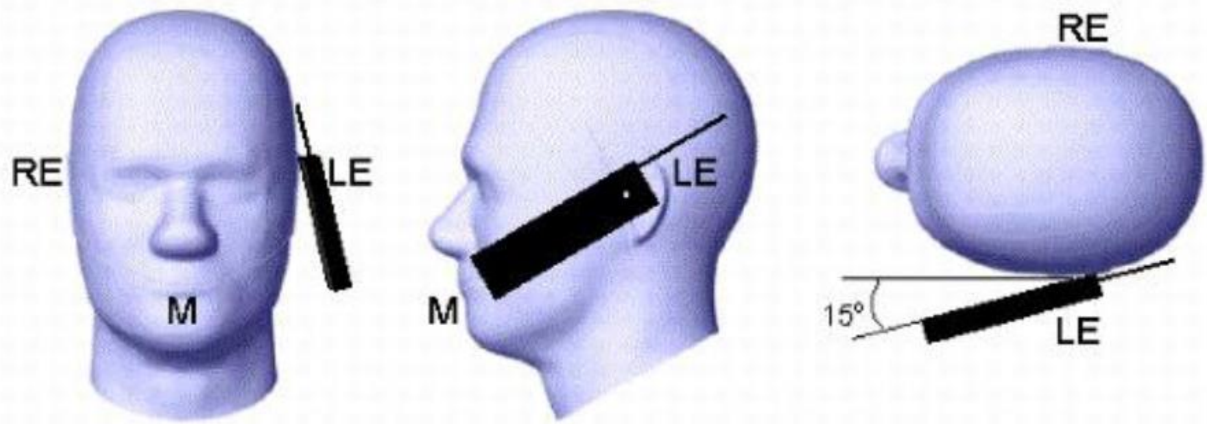




$W_t$ Width of the handset at the level of the acoustic
$W_b$ Width of the bottom of the handset
A Midpoint of the width $w_t$ of the handset at the level of the acoustic output
B Midpoint of the width $w_b$ of the bottom of the handset

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



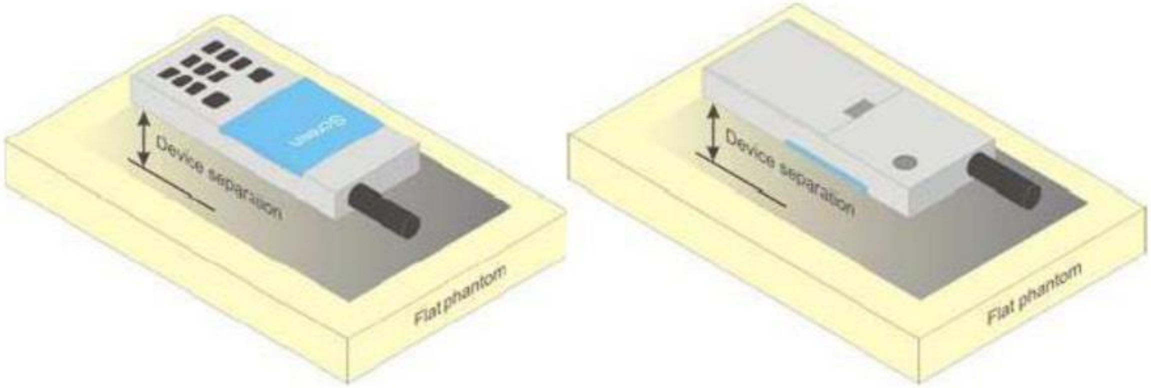

Picture 2 Cheek position of the wireless device on the left side of SAM




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

## 3.2 Body-worn device

A typical example of a body-worn device is aMoblie 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 4 Test positions for body-worn devices

# 4 Measurement Procedures

The measurement procedures are as follows:

## 4.1 Conducted power measurement

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

## 4.2 SAR measurement

### 4.2.1 GSM Test Configuration

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

When SAR tests for EGPRS mode is necessary, GMSK modulation should be used to minimize SAR measurement error due to higher peak-to-average power (PAR) ratios inherent in 8-PSK.

According to specification 3GPP TS 51.010, the maximum power of the GSM can do the power reduction for the multi-slot. The allowed power reduction calculation method are shown in chapter8.1 NOTES 1).

# 5 TISSUE SIMULATING LIQUID

For SAR measurement of the field distribution inside the phantom, the phantom must be filled with homogeneous tissue simulating liquid to a depth of at least 15cm. For head SAR testing the liquid height from the ear reference point (ERP) of the phantom to the liquid top surface is larger than 15cm For body SAR testing, the liquid height from the center of the flat phantom to the liquid top surface is larger than 15cm.The nominal dielectric values of the tissue simulating liquids in the phantom and the tolerance of 5% are listed in 5.2

## 5.1 The composition of the tissue simulating liquid

| Ingredient | 835MHz | | 1900MHz | | 2450MHz | |
|---|---|---|---|---|---|---|
| (% Weight) | Head | Body | Head | Body | Head | Body |
| Water | 41.45 | 52.5 | 55.242 | 69.91 | 62.7 | 73.2 |
| Salt | 1.45 | 1.40 | 0.306 | 0.13 | 0.50 | 0.10 |
| Sugar | 56 | 45.0 | 0.00 | 0.00 | 0.00 | 0.00 |
| Preventol | 0.10 | 0.10 | 0.00 | 0.00 | 0.00 | 0.00 |
| HEC | 1.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| DGBE | 0.00 | 0.00 | 44.452 | 29.96 | 36.8 | 26.7 |

## 5.2 Tissue Calibration Result

The dielectric parameters of the liquids were verified prior to the SAR evaluation using Agilent Dielectric Probe Kit and Agilent Network Analyzer 8753E.

| Frequency (MHz) | | Dielectric Parameters (±5%) | | Tissue Temp [º C] | Test Date |
|---|---|---|---|---|---|
| 835 | Head | εr<br>39.425-43.575 | δ[s/m]<br>0.885-0.945 | 22 | Jul. 03, 2016 |
| | | 40.22 | 0.91 | | |
| 835 | Body | εr<br>52.44-57.96 | δ[s/m]<br>0.9215-1.0185 | 22 | Jul. 03, 2016 |
| | | 55.87 | 0.95 | | |

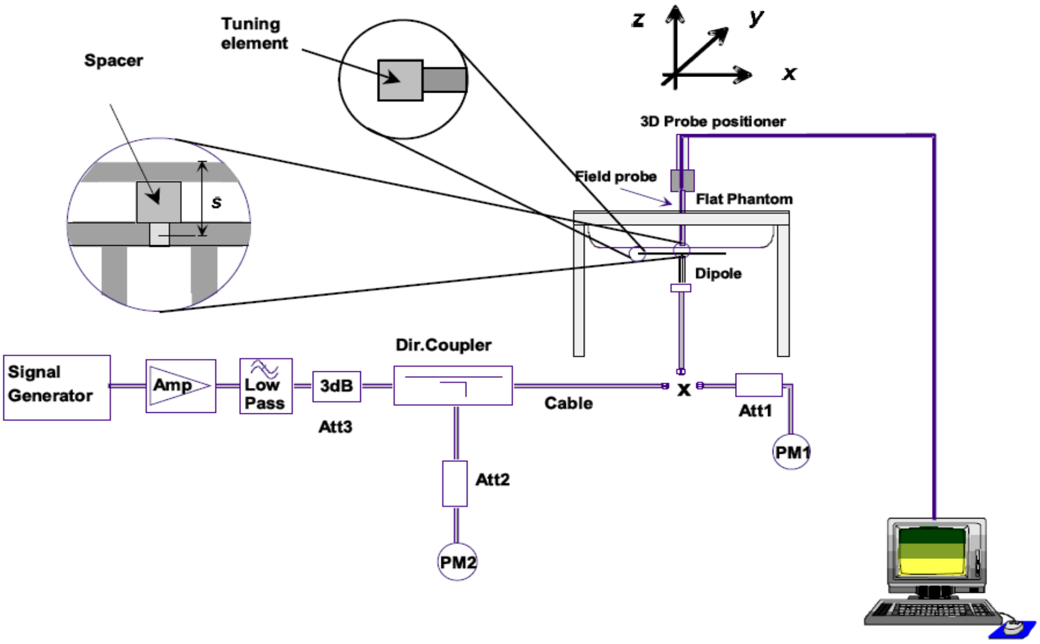
| Frequency (MHz) | | Dielectric Parameters (±5%) | | Tissue Temp [º C] | Test Date |
|---|---|---|---|---|---|
| 1900 | Head | εr<br>38-42 | δ[s/m]<br>1.33-1.47 | 22 | Jul. 04, 2016 |
| | | 39.54 | 1.41 | | |
| 1900 | Body | εr<br>50.635-55.965 | δ[s/m]<br>1.444-1.596 | 22 | Jul. 04, 2016 |
| | | 51.33 | 1.56 | | |

# 6 System Check

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

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

System check is performed regularly on all frequency bands where tests are performed with the DASY5 system.




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

Photo of Dipole Setup

System Check in Head Tissue Simulating Liquid

| Measurement is made at temperature 22.0 ℃ and relative humidity 55%. | | | | | | | | Measurement Date |
|---|---|---|---|---|---|---|---|---|
| Verification results | Frequency (MHz) | Target value (W/kg) | | Measured value (W/kg) | | Deviation | | |
| | | 1 g Average | 10 g Average | 1 g Average | 10 g Average | 1 g Average | 10 g Average | Jul. 03, 2016 |
| | 835 | 10.70 | 6.87 | 10.58 | 6.79 | -1.12% | -1.16% | |
| | 1900 | 40.60 | 21.30 | 39.56 | 20.32 | -2.56% | -4.60% | Jul. 04, 2016 |
| Note：1. The graph results see Chapter 9.<br>2. Target Values used derive from the calibration certificate | | | | | | | | |

System Check in Body Tissue Simulating Liquid

| Measurement is made at temperature 22.0 ℃ and relative humidity 55%. | | | | | | | | Measurement Date |
|---|---|---|---|---|---|---|---|---|
| Verification results | Frequency (MHz) | Target value (W/kg) | | Measured value (W/kg) | | Deviation | | |
| | | 1 g Average | 10 g Average | 1 g Average | 10 g Average | 1 g Average | 10 g Average | Jul. 03, 2016 |
| | 835 | 10.7 | 6.94 | 10.41 | 6.69 | -2.71% | -3.60% | |
| | 1900 | 40.1 | 21.3 | 39.68 | 20.89 | -1.05% | -1.92% | Jul. 04, 2016 |
| Note：1. The graph results see Chapter 9.<br>2. Target Values used derive from the calibration certificate | | | | | | | | |

# 7 TEST CONDITIONS AND RESULTS

## 7.1 Conducted Power Results

Max Conducted power measurement results and power drift from tune-up tolerance provide by manufacturer:

***Conducted power measurement results (GSM850/1900)***

| Mode | Burst Average Power (dBm) | | | Tune-up Limit (dBm) |
|---|---|---|---|---|
| | 128 | 190 | 251 | |
| GSM 835 (GMSK) | 32.58 | 32.65 | 32.41 | 33.00 |
| Mode | Burst Average Power (dBm) | | | Tune-up Limit (dBm) |
| | 512 | 661 | 810 | |
| PCS 1900 (GMSK) | 29.89 | 29.95 | 29.41 | 30.00 |

***Conducted Power Measurement Results (Bluetooth)***

| Mode | Channel | Frequency (MHz) | Conducted Peak Output Power | |
|---|---|---|---|---|
| | | | (dBm) | (mW) |
| GFSK | 00 | 2402 | 2.482 | 1.771 |
| | 39 | 2441 | 2.271 | 1.687 |
| | 78 | 2480 | 2.004 | 1.586 |
| π/4DQPSK | 00 | 2402 | 1.965 | 1.572 |
| | 39 | 2441 | 1.760 | 1.500 |
| | 78 | 2480 | 1.456 | 1.398 |
| 8DPSK | 00 | 2402 | 1.835 | 1.526 |
| | 39 | 2441 | 1.680 | 1.472 |
| | 78 | 2480 | 1.429 | 1.390 |
| BLE (GFSK) | 00 | 2402 | -2.85 | 0.519 |
| | 19 | 2440 | -2.59 | 0.551 |
| | 39 | 2480 | -2.78 | 0.527 |

Note:
Per KDB 447498 D01, the 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances≤50 mm are determined by:
[(max. power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm)] . [$\sqrt{}$f(GHz)] ≤ 3 for 1-g SAR and] ≤ 7.5 for 10-g extremity SAR

- 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

| Bluetooth Max Power Allowed (dBm) | Bluetooth Max Power Rounded (mW) | Calculated Value Rounded | Separation Distance (mm) | Frequency (GHz) | Position | Exclusion thresholds |
|---|---|---|---|---|---|---|
| 3 | 2 | 0.6 | 5 | 2402 | Next to the mouth | 3 |
| 3 | 2 | 0.6 | 5 | 2402 | Wrist-Worn | 7.5 |

Note:
Per KDB 447498 D01, when the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion. The test exclusion threshold is 0.6 which is≤ 3 for 1-g SAR and≤7.5 for 10-g SAR, Standalone SAR testing is not required.

## 7.2 SAR Test Results Summary

### 7.2.1 General Remark

1. The DUT is tested using CMU 200 communications testers as controller unit to set test channels and maximum output power to the DUT, as well as for measuring the conducted peak power.
2. Test positions as described in the tables above are in accordance with the specified test standard.
3. Tests in body position were performed in that configuration, which generates the highest time based averaged output power (see conducted power results).
4. Tests in head position with GSM were performed in voice mode with 1 timeslot.
5. According to IEEE 1528 the SAR test shall be performed at middle channel. Testing of top and bottom channel is optional.
6. According to KDB 447498 D01 testing of other required channels within the operating mode of a frequency band is not required when the reported 1-g or 10-g SAR for the mid-band or highest output power channel is:
   - ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz
   - ≤ 0.6 W/kg or 1.5 W/kg, for 1-g or 10-g respectively, when the transmission band is between 100 MHz and 200 MHz
   - ≤ 0.4 W/kg or 1.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≥ 200 MHz
7. IEEE 1528-2003 requires the middle channel to be tested first. This generally applies to wireless devices that are designed to operate in technologies with tight tolerances for maximum output power variations across channels in the band. When the maximum output power variation across the required test channels is > ½ dB, instead of the middle channel, the highest output power channel must be used.
8. Per KDB648474 D04 require when the reported SAR for a body-worn accessory, measured without a headset connected to the handset, is < 1.2 W/kg.
9. Per KDB648474 D04 require when the separation distance required for body-worn accessory testing is larger than or equal to that tested for hotspot mode, using the same wireless mode test configuration for voice and data, such as UMTS, LTE and Wi-Fi, and for the same surface of the phone, the hotspot mode SAR data may be used to support body-worn accessory SAR compliance for that particular configuration (surface)
10. Maximum Scaling SAR in order to calculate the Maximum SAR values to test under the standard Peak Power, Calculation method is as follows:
    Maximum Scaling SAR =tested SAR (Max.) × [maximum turn-up power (mw)/ maximum measurement output power(mw) ]
11. For wrist-worn SAR testing, the neck region of SAM phantom was used, which the distance of EUT include antenna can keep touch the phantom (0mm distance) during the test.

### 7.2.2 Standalone SAR

| Test Position | Channel/ Frequency(MHz) | Test Mode | Duty Cycle | Maximum Allowed Power (dBm) | Conducted Power (dBm) | Drift ±0.21dB | Limit $SAR_{1g}$ 1.6 W/kg | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Drift (dB) | Measured $SAR_{1g}$ (W/kg) | Scaling Factor | Reported $SAR_{1g}$ (W/kg) | Graph Results |
| Mouth Worn (distance 10mm) | | | | | | | | | | |
| Next to the mouth | 190/836.6 | Voice | 1:1 | 33.00 | 32.65 | 0.04 | 0.261 | 1.08 | 0.283 | Figure.1 |
| Next to the mouth | 661/1880.0 | Voice | 1:1 | 30.00 | 29.95 | 0.05 | 0.255 | 1.01 | 0.258 | Figure.3 |

| Test Position | Channel/ Frequency(MHz) | Test Mode | Duty Cycle | Maximum Allowed Power (dBm) | Conducted Power (dBm) | Drift ±0.21dB | Limit $SAR_{10g}$ 4.0 W/kg | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Drift (dB) | Measured $SAR_{10g}$ (W/kg) | Scaling Factor | Reported $SAR_{10g}$ (W/kg) | Graph Results |
| Wrist-worn (0mm distance) | | | | | | | | | | |
| Wrist-Worn | 190/836.6 | Voice | 1:1 | 33.00 | 32.65 | -0.02 | 0.460 | 1.08 | 0.499 | Figure.2 |
| Wrist-Worn | 661/1880.0 | Voice | 1:1 | 30.00 | 29.95 | -0.05 | 0.397 | 1.01 | 0.402 | Figure.4 |

### 7.2.3 Simultaneous SAR Evaluation

**Application Simultaneous Transmission information:**

| NO. | Simultaneous Transmission Configurations | Smartphone | | Note |
|---|---|---|---|---|
| | | Head | Body | |
| 1 | GSM(Voice) + WLAN2.4GHz(data) | NO | NO | - |
| 2 | WCDMA(Voice) + WLAN2.4GHz(data) | NO | NO | - |
| 3 | GSM(Voice) + Bluetooth(data) | Yes | Yes | - |
| 4 | WCDMA((Voice) + Bluetooth(data) | NO | NO | - |
| 5 | GPRS/EDGE(Data) + WLAN2.4GHz(data) | NO | NO | |
| 6 | WCDMA(Data) + WLAN2.4GHz(data) | NO | NO | |
| 7 | GPRS/EDGE(Data) + Bluetooth(data) | NO | NO | |
| 8 | WCDMA(Data) + Bluetooth(data) | NO | NO | |

NOTE:

1) The Reported SAR summation is calculated based on the same configuration and test position.
2) Per KDB 447498 D01, simultaneous transmission SAR is compliant if,
   a) Scalar SAR summation < SAR Limit.
   b) SPLSR = (SAR1 + SAR2) $^{1.5}$ / (min. separation distance, mm), and the peak separation distance is determined from the square root of \[(x1-x2)$^2$ + (y1-y2)$^2$ + (z1-z2)$^2$], where (x1, y1, z1) and (x2, y2, z2) are the coordinates of the extrapolated peak SAR locations in the zoom scan
   c) If SPLSR≦ 0.04 for 1-g SAR and SPLSR≦ 0.1 for 10-g SAR, simultaneously transmission SAR measurement is not necessary
3) For simultaneous transmission analysis, Bluetooth SAR is estimated per KDB 447498 D01 based on the formula below.
   a) (max. power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm)] .[ √f(GHz)/ x] W/kg for test separation distances≦50 mm; where x = 7.5 for 1-g SAR, and x = 18.75 for 10-g SAR.
   b) When the minimum separation distance is < 5mm, the distance is used 5mm to determine SAR test exclusion.
   c) 0.4 W/kg for 1-g SAR and 1.0 W/kg for 10-g SAR, when the test separation distances is > 50 mm.
   d) Bluetooth estimated SAR is conservatively determined by 5mm separation, for all applicable exposure positions.

**Estimated SAR of Bluetooth**

| Bluetooth Max Power Allowed (dBm) | Bluetooth Max Power Rounded(mW) | Exposure Position | Estimated SAR (W/kg) |
|---|---|---|---|
| 3 | 2 | Next to the mouth | 0.083 |
| 3 | 2 | Wrist-Worn | 0.033 |

**Simultaneous transmission SAR for Bluetooth and GSM**

| SAR(W/kg) / Test Position | GSM 850 | GSM 1900 | Estimated SAR of Bluetooth (W/kg) | MAX. ΣSAR | Peak location separation ratio |
|---|---|---|---|---|---|
| Next to the mouth | **0.283** | 0.258 | 0.083* | 0.366 | N/A |
| Wrist-Worn | **0.499** | 0.402 | 0.033* | 0.532 | N/A |

Note: 1.The value with blue color is estimated by the maximum tune-up power per KDB 447498 D01.

MAX. $\Sigma SAR_{1g}$ = 0.366 W/kg <1.6 W/kg, so the Simultaneous transmission SAR with volume scan are not required for BT and GSM

MAX. $\Sigma SAR_{10g}$ = 0.532W/kg <4 W/kg, so the Simultaneous transmission SAR with volume scan are not required for BT and GSM

## 7.3 System Check Results

**System Performance Check at 835 MHz Head**
Date: 07/03/2016

DUT: Dipole 900MHz; Type: D900V2; Serial: 1d086

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

Medium parameters used: f = 835 MHz; σ = 0.91 mho/m; εr = 40.22.; ρ = 1000 kg/m3

Phantom section: Flat Section

DASY4 Configuration:

- •Probe: ES3DV4 – SN3842; ConvF (8.92, 8.92, 8.92); Calibrated: 8/26/2015
- •Sensor-Surface: 4mm (Mechanical Surface Detection)
- •Electronics: DAE4 Sn905; Calibrated: 7/16/2015
- •Phantom: SAM 1; Type: SAM;
- •Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6824)

**Area Scan (61x61x1):** Measurement grid: dx=15.00 mm, dy=15.00 mm

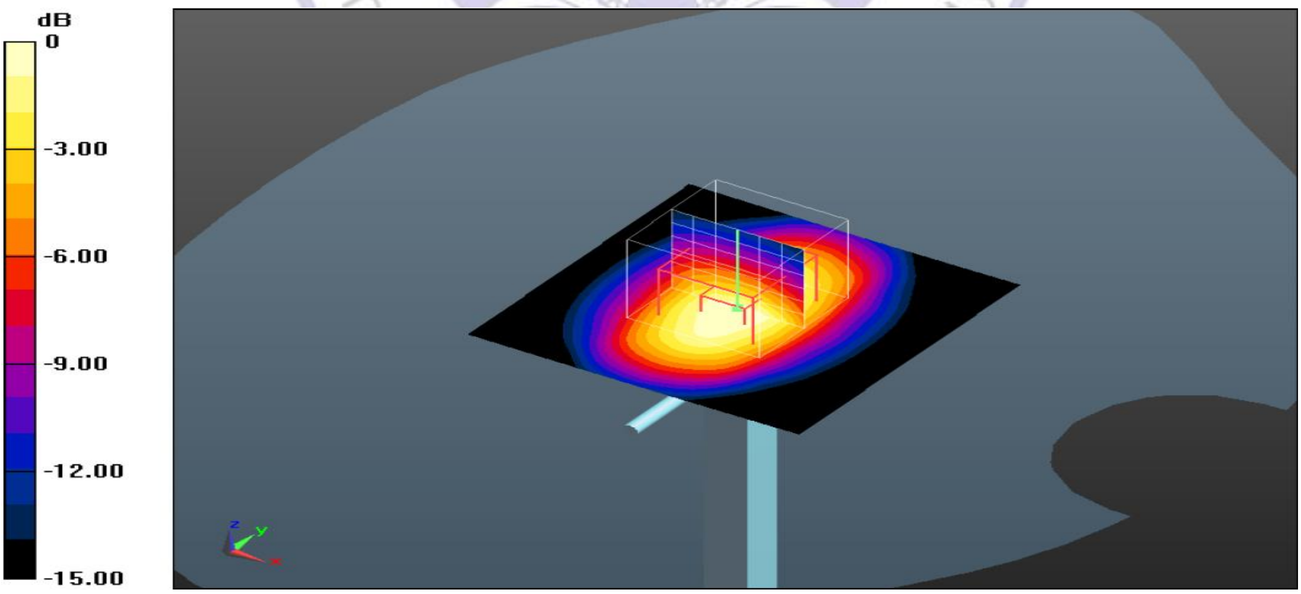
Maximum value of SAR (interpolated) = 10.0 W/Kg

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

Reference Value = 100.875 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 12.10 W/Kg

**SAR(1 g) = 10.58 W/Kg; SAR(10 g) = 6.79 W/Kg**
Maximum value of SAR (measured) = 11.2 W/Kg




0 dB = 11.2 W/Kg=20.98dB W/Kg

System Performance Check 835MHz Head 1000 mW

**System Performance Check at 835 MHz Body**
Date: 07/03/2016

DUT: Dipole 900MHz; Type: D900V2; Serial: 1d086

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

Medium parameters used: f = 835 MHz; σ = 0.95 mho/m; εr = 55.87; ρ = 1000 kg/m3

Phantom section: Flat Section

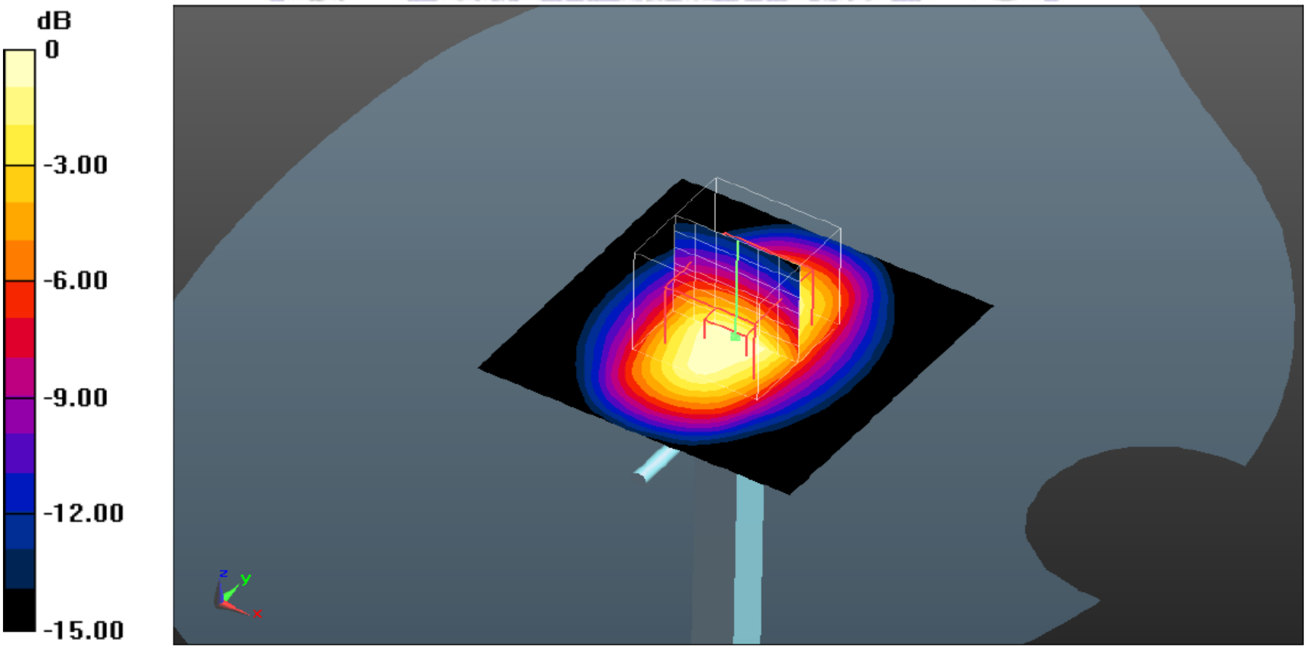
DASY4 Configuration:

- Probe: ES3DV4 – SN3842; ConvF (9.11, 9.11, 9.11); Calibrated: 8/26/2015
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn905; Calibrated: 7/16/2015
- Phantom: SAM 1; Type: SAM;
- Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6824)

**Area Scan (61x61x1):** Measurement grid: dx=15.00 mm, dy=15.00 mm
Maximum value of SAR (interpolated) = 11.8 W/Kg

**Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 109.568 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 14.78 W/Kg

**SAR(1 g) = 10.41 W/Kg; SAR(10 g) = 6.69 W/Kg**
Maximum value of SAR (measured) = 14.50 W/Kg




0 dB = 14.50 W/Kg = 23.23 dB W/Kg

System Performance Check 835MHz Body 1000mW

**System Performance Check at 1900 MHz Head**
Date: 07/04/2016

DUT: Dipole 1900MHz; Type: D1900V2; Serial: 5d194

Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium parameters used (interpolated): f = 1900 MHz; σ = 1.41 mho/m; εr = 39.54; ρ = 1000 kg/m3

Phantom section: Flat Section

DASY4 Configuration:

- •Probe: ES3DV4 – SN3842; ConvF (7.54, 7.54, 7.54); Calibrated: 8/26/2015
- •Sensor-Surface: 4mm (Mechanical Surface Detection)
- •Electronics: DAE4 Sn905; Calibrated: 7/16/2015
- •Phantom: SAM 1; Type: SAM;
- •Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6824)

**Area Scan (61x61x1):** Measurement grid: dx=15.00 mm, dy=15.00 mm

Maximum value of SAR (interpolated) = 53.2 W/Kg

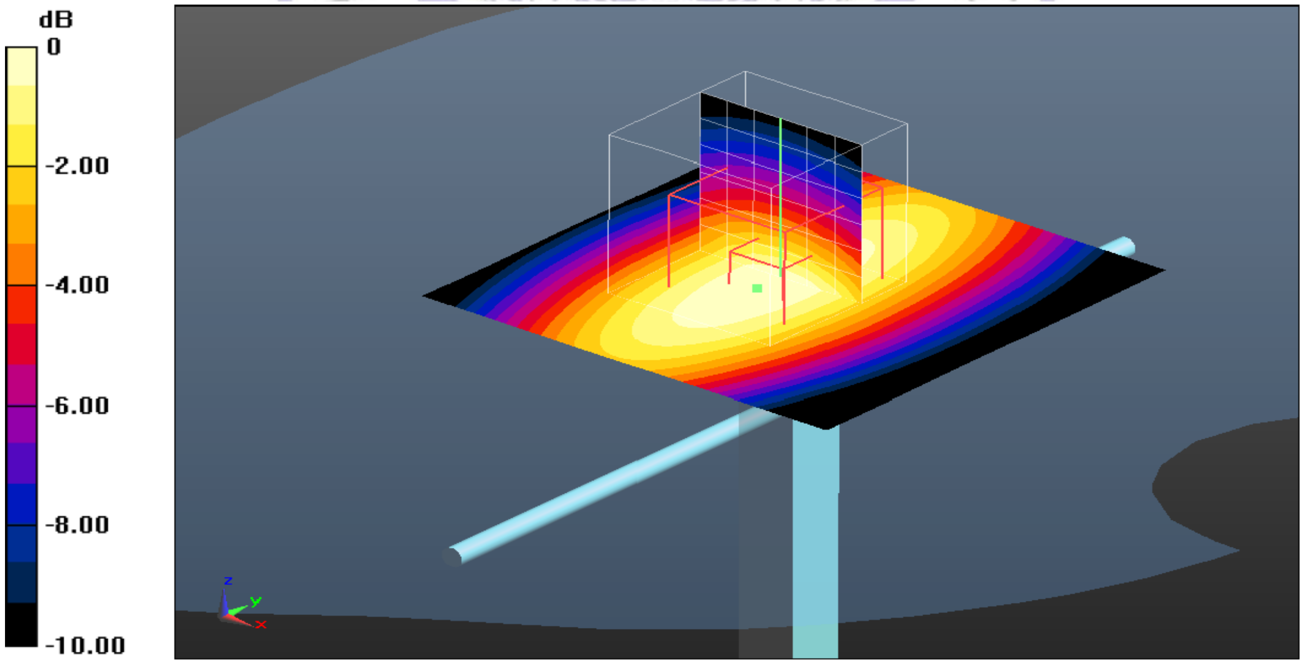
**Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 178.57 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 69.7 W/Kg

**SAR(1 g) = 39.56 W/Kg; SAR(10 g) = 20.32 W/Kg**

Maximum value of SAR (measured) = 48.7 W/Kg




0 dB = 48.70 W/Kg = 33.75 dB W/Kg

System Performance Check 1900MHz Head 1000mW

**System Performance Check at 1900 MHz Body**
Date: 07/04/2016

DUT: Dipole 1900MHz; Type: D1900V2; Serial: 5d194

Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium parameters used (interpolated): f = 1900 MHz; σ = 1.56 mho/m; εr = 51.33; ρ = 1000 kg/m3

Phantom section: Flat Section

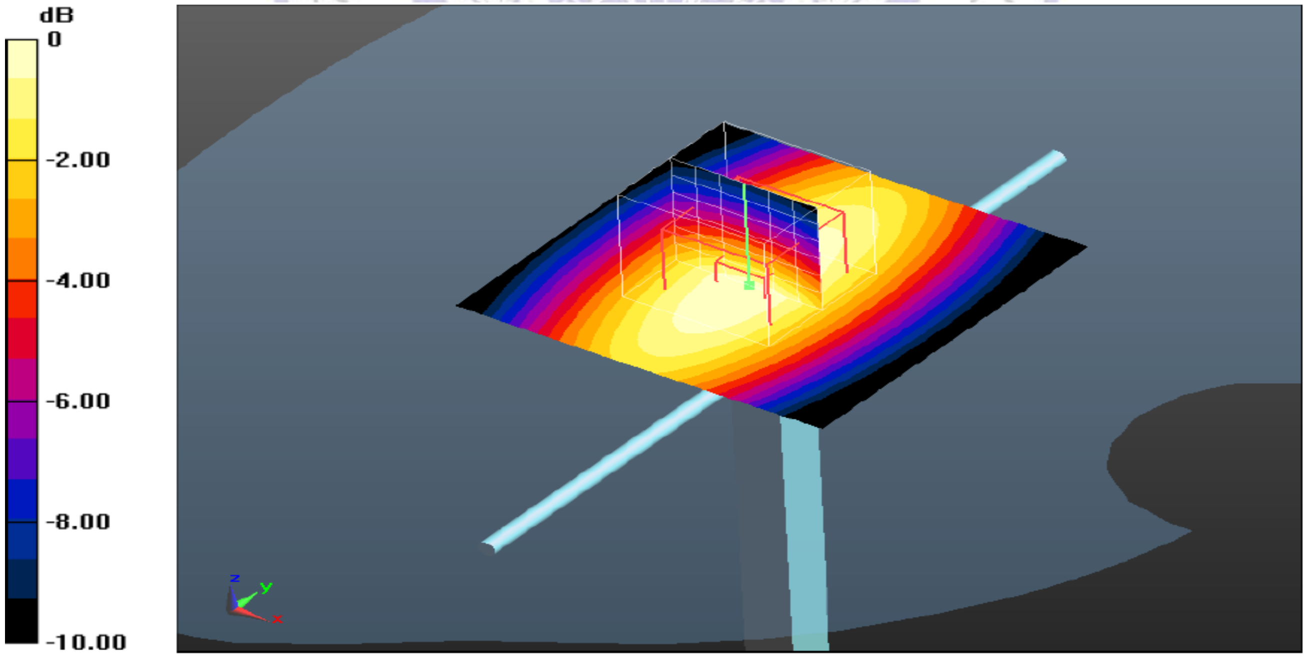
DASY4 Configuration:

- •Probe: ES3DV4 – SN3842; ConvF (7.29, 7.29, 7.29); Calibrated: 8/26/2015
- •Sensor-Surface: 4mm (Mechanical Surface Detection)
- •Electronics: DAE4 Sn905; Calibrated: 7/16/2015
- •Phantom: SAM 1; Type: SAM;
- •Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6824)

**Area Scan (61x61x1):** Measurement grid: dx=15.00 mm, dy=15.00 mm
Maximum value of SAR (interpolated) = 48.25 W/Kg

**Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 175.341 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 50.41 W/Kg

**SAR(1 g) = 39.68 W/Kg; SAR(10 g) = 20.89 W/Kg**
Maximum value of SAR (measured) = 54.14 W/Kg




0 dB = 54.14 W/Kg = 34.67 dB W/Kg

System Performance Check 1900MHz Body 1000mW

## 7.4 SAR Test Graph Results

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

**GSM850 Next to the mouth Middle Channel**

Date: 2016-07-03

Communication System: GSM 850; Frequency: 836.6 MHz; Duty Cycle: 1:1

Medium parameters used (interpolated): f =836.6 MHz; σ = 0.941 mho/m; εr = 40.87; ρ = 1000 kg/m3;

Phantom section: Flat Section

DASY4 Configuration:

- •Probe: ES3DV4 - SN3842; ConvF (8.92, 8.92, 8.92); Calibrated: 8/26/2015
- •Sensor-Surface: 4mm (Mechanical Surface Detection)
- •Electronics: DAE4 Sn905; Calibrated: 7/16/2015
- •Phantom: SAM 1; Type: SAM;
- •Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6824)

**Area Scan (47x47x1):** Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.292 W/Kg

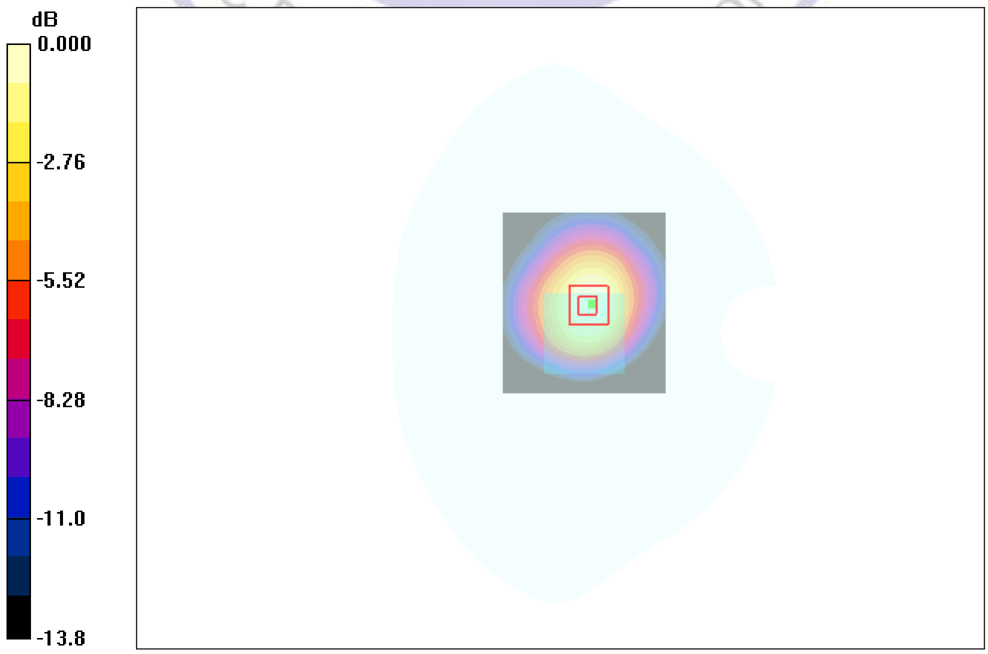
**Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 13.9 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 0.398 W/kg

**SAR(1 g) = 0.261 W/Kg; SAR(10 g) = 0.160 W/Kg**

Maximum value of SAR (measured) = 0.283 W/Kg




0 dB = 0.283W/Kg

Figure 1: Mouth-Worn (GSM850 Middle Channel)

**GSM850 Body Wrist Worn Middle Channel**

Date: 2016-07-03

Communication System: GSM 850; Frequency: 836.6 MHz; Duty Cycle: 1:1

Medium parameters used (interpolated): f =836.6 MHz; σ = 1.012 mho/m; εr = 54.23; ρ = 1000 kg/m3;

Phantom section: Flat Section

DASY4 Configuration:

- •Probe: ES3DV4 - SN3842; ConvF (9.11, 9.11, 9.11); Calibrated: 8/26/2015
- •Sensor-Surface: 4mm (Mechanical Surface Detection)
- •Electronics: DAE4 Sn905; Calibrated: 7/16/2015
- •Phantom: SAM 1; Type: SAM;
- •Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6824)

**Area Scan (47x47x1):** Interpolated grid: dx=1.00 mm, dy=1.00 mm
Maximum value of SAR (interpolated) = 1.01 W/Kg

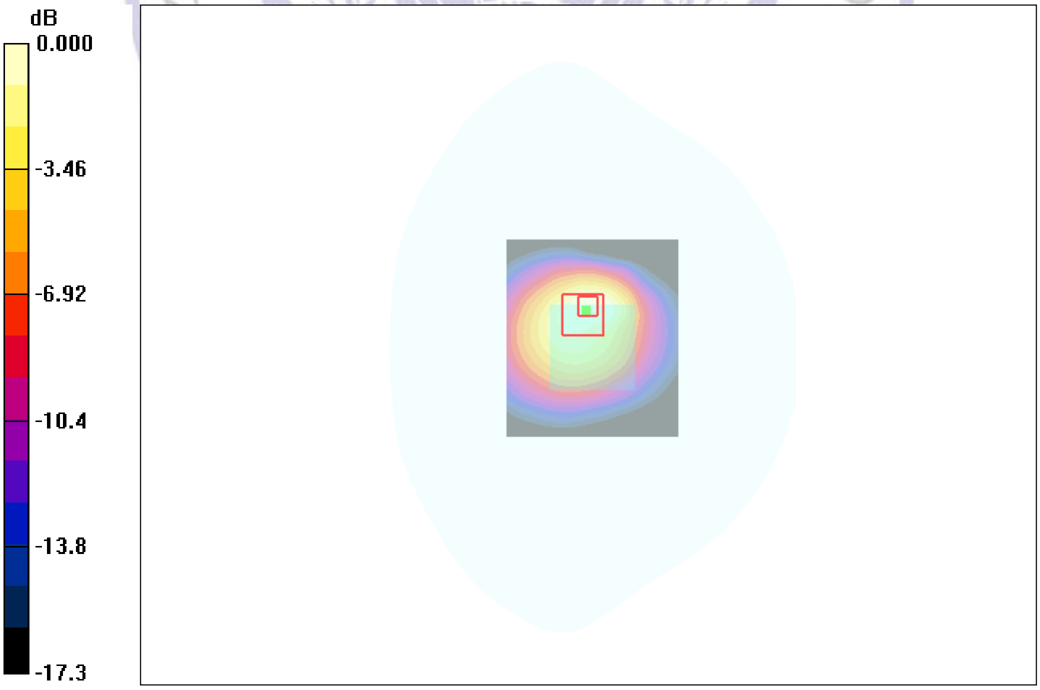
**Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 22.7 V/m; Power Drift = 0.05dB

Peak SAR (extrapolated) = 1.51 W/kg

**SAR(1 g) = 0.804 W/Kg; SAR(10 g) = 0.460 W/Kg**

Maximum value of SAR (measured) = 0.878 W/Kg




0 dB = 0.878 W/Kg

Figure 2: Wrist-Worn (GSM850 Middle Channel)

**PCS1900 Next to the mouth Middle Channel**

Date: 2016-07-04

Communication System: PCS1900; Frequency: 1880 MHz; Duty Cycle: 1:1

Medium parameters used (interpolated): f =1880 MHz; σ = 1.35mho/m; εr = 39.68; ρ = 1000 kg/m3;

Phantom section: Flat Section

DASY4 Configuration:

- •Probe: ES3DV4 - SN3842; ConvF (7.54, 7.54, 7.54); Calibrated: 8/26/2015
- •Sensor-Surface: 4mm (Mechanical Surface Detection)
- •Electronics: DAE4 Sn905; Calibrated: 7/16/2015
- •Phantom: SAM 1; Type: SAM;
- •Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6824)

**Area Scan (47x47x1):** Interpolated grid: dx=1.00 mm, dy=1.00 mm
Maximum value of SAR (interpolated) = 0.268 W/Kg

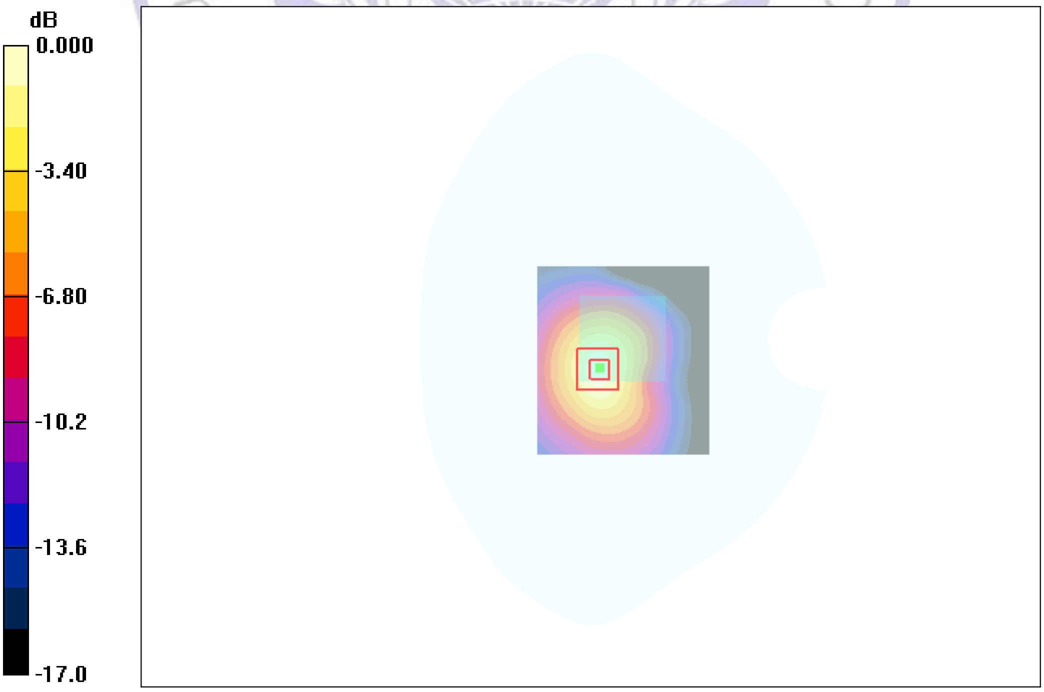
**Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 12.7 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 0.314 W/Kg

**SAR(1 g) = 0.255 W/Kg; SAR(10 g) = 0.154 W/Kg**

Maximum value of SAR (measured) = 0.355 W/Kg




0 dB = 0.355 W/Kg

Figure 3: Mouth-Worn (PCS1900 Middle Channel)

**PCS1900 Body Wrist Worn Middle Channel**

Date: 2016-07-04

Communication System: PCS1900; Frequency: 1880 MHz; Duty Cycle: 1:1

Medium parameters used (interpolated): f =1880 MHz; σ = 1.49mho/m; εr = 52.74; ρ = 1000 kg/m3;

Phantom section: Flat Section

DASY4 Configuration:

- •Probe: ES3DV4 - SN3842; ConvF (7.29, 7.29, 7.29); Calibrated: 8/26/2015
- •Sensor-Surface: 4mm (Mechanical Surface Detection)
- •Electronics: DAE4 Sn905; Calibrated: 7/16/2015
- •Phantom: SAM 1; Type: SAM;
- •Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6824)

**Area Scan (47x47x1):** Interpolated grid: dx=1.00 mm, dy=1.00 mm
Maximum value of SAR (interpolated) = 0.958 W/Kg

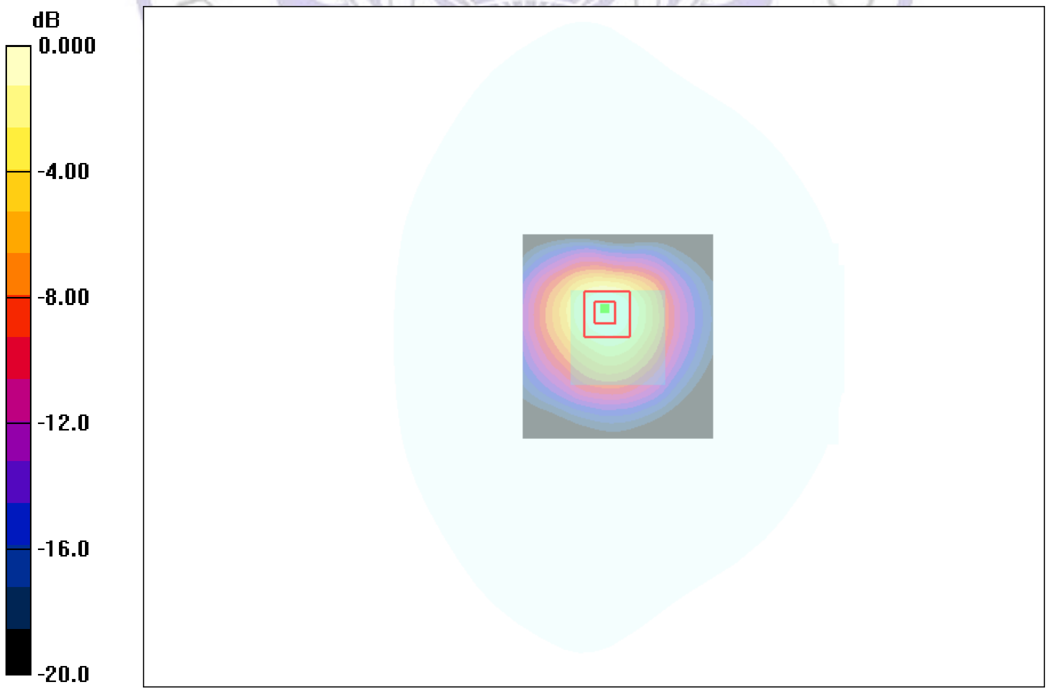
**Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 21.69 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 1.125W/Kg

**SAR(1 g) = 0.735 mW/g; SAR(10 g) = 0.397 W/Kg**

Maximum value of SAR (measured) = 0.978 W/Kg




0 dB = 0.978 W/Kg

Figure 4: Wrist-Worn (PCS1900 Middle Channel)