# SAR TEST REPORT

| | |
|---|---|
| **Report Reference No.................... :** | **UNI170405079-E** |
| **FCC ID........................................... :** | **2AEJAGOLTEAM7** |
| Compiled by<br>( position+printed name+signature)..: | File administrators Eric Xie |
| Supervised by<br>( position+printed name+signature)..: | Test Engineer Dora Qin |
| Approved by<br>( position+printed name+signature)..: | Manager Kait Chen |
| Date of issue....................................: | Apr. 13, 2017 |
| **Representative Laboratory Name** ..: | **Laboratory of Shenzhen United Testing Technology Co., Ltd** |
| Address............................................: | Room 316-319, Block B, Honghualing Industrial Park of the Fifth Zone, Taoyuan Street, Nanshan District, Shenzhen, Guangdong, China |
| **Testing Laboratory Name** ..............: | **The Testing and Technology Center for Industrial Products of Shenzhen Entry-Exit Inspection and Quarantine Bureau** |
| Address............................................: | No.149,Gongye 7th Rd. Nanshan District, Shenzhen, China |
| **Applicant's name** ............................: | **GSM GLOBE. COM INC** |
| Address............................................: | 134 N.E 1 Street, Miami, FL 33132, USA |
| **Test specification** .......................... : | |
| Standard ..........................................: | **ANSI C95.1–2005**<br>**47CFR §2.1093** |
| TRF Originator.................................: | **Shenzhen Global Test Service Co.,Ltd.** |
| **Test item description** .....................: | Tablet PC |
| Trade Mark .......................................: | GOL |
| **Manufacturer**..................................: | **Shenzhen Forward Technology Co., LTD.** |
| Model/Type reference.......................: | TEAM 7, Pro, PLUS+, Super |
| Listed Models .................................: | / |
| Operation Frequency......................... | GSM 850/PCS1900,WCDMA Band V/ WCMA Band II,WLAN2.4G, Bluetooth |
| Modulation Type ............................... | GSM(GMSK),WCDMA/HSDPA/HSUPA(QPSK), WIFI(DSSS,OFDM),Bluetooth(GFSK,8DPSK, π/4DQPSK), |
| Hardware version .............................: | / |
| Software version ..............................: | / |
| Rating ...............................................: | DC 3.7V |
| Result...............................................: | **PASS** |

# TEST REPORT

| Test Report No. : | UNI170405079-E | Apr. 13, 2017<br>Date of issue |
|---|---|---|

| | | |
|---|---|---|
| Equipment under Test | : | Tablet PC |
| Model /Type | : | TEAM 7 |
| Listed Models | : | **Pro, PLUS+, Super** |
| **Applicant** | : | **GSM GLOBE. COM INC** |
| Address | : | 134 N.E 1 Street, Miami, FL 33132, USA |
| **Manufacturer** | : | **Shenzhen Forward Technology Co., LTD.** |
| Address | : | 5F B-blog, Hengmingzhu Industrial Park, QianjinEr Rd., Xixiang Sub-district, Bao'An Dist., Shenzhen City, China. |

| **Test Result**: | **PASS** |
|---|---|

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.

# Contents

# 1. TEST STANDARDS

The tests were performed according to following standards:

IEEE Std C95.1, 2005: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 KHz to 300 GHz. It specifies the maximum exposure limit of 1.6 W/kg as averaged over any 1 gram of tissue for portable devices being used within 20 cm of the user in the uncontrolled environment.
IEEE Std 1528™-2013: IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques.
FCC Part 2.1093 Radiofrequency Radiation Exposure Evaluation:Portable Devices
KDB447498 D01 General RF Exposure Guidance v06 : Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies
KDB648474 D04, Handset SAR v01r03: SAR Evaluation Considerations for Wireless Handsets
KDB865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04 : SAR Measurement Requirements for 100 MHz to 6 GHz
KDB865664 D02 RF Exposure Reporting v01r02: RF Exposure Compliance Reporting and Documentation Considerations
KDB248227 D01 802.11 Wi-Fi SAR v02r02: SAR GUIDANCE FOR IEEE 802.11 (Wi-Fi) TRANSMITTERS
KDB941225 D01 3G SAR Procedures v03r01: 3G SAR MEAUREMENT PROCEDURES
KDB616217 D04 SAR for laptop and tablets v01r02: SAR Evaluation considerations for laptop, notbook, netbook and tablet computers.

# 2. SUMMARY

## 2.1. General Remarks

| | | |
|---|---|---|
| Date of receipt of test sample | : | Apr. 8, 2017 |
| | | |
| | | |
| Testing commenced on | : | Apr. 9, 2017 |
| | | |
| | | |
| Testing concluded on | : | Apr. 11, 2017 |

## 2.2. Product Description

The **GSM GLOBE. COM INC**'s Model: TEAM 7 or the "EUT" as referred to in this report; more general information as follows, for more details, refer to the user's manual of the EUT.

| General Description | |
|---|---|
| Name of EUT | Tablet PC |
| Model Number | TEAM 7 |
| Modilation Type | GMSK for GSM/GPRS/EGPRS;<br>QPSK for WCDMA;DSSS/OFDM for WIFI2.4G;<br>GFSK/8DPSK/π/4DQPSK for Bluetooth |
| Antenna Type | Internal |
| Device category | Portable Device |
| Exposure category | General population/uncontrolled environment |
| EUT Type | Production Unit |
| Rated Vlotage | DC 3.70 Battery |
| The EUT is a Tablet PC. the Tablet PC is intended for speech and Multimedia Message Service (MMS) transmission. It is equipped with GPRS/EDGE class 12 for GSM850, PCS1900, WCDMA Band V, WCDMA Band II and Bluetooth, WiFi, and camera functions. For more information see the following datasheet | |

| Technical Characteristics | |
|---|---|
| 2G | |
| Support Networks | GSM, GPRS, EGPRS |
| Support Band | GSM850/PCS1900 |
| Frequency | GSM850: 824.2~848.8MHz<br>GSM1900: 1850.2~1909.8MHz |
| Type of Modulation | GMSK, |
| Antenna Type | Internal Antenna |
| GPRS Class | Class 12 |
| GSM Release Version | R99 |
| GPRS operation mode | Class B |
| DTM Mode | Not Supported |
| 3G | |
| Support Networks | WCDMA RMC12.2K,HSDPA,HSUPA |
| Support Band | WCDMA Band V/WCDMA Band II |
| Frequency Range | WCDMA Band V: 826.4~846.6MHz<br>WCDMA Band II: 1852.4~1907.6MHz |
| Type of Modulation | QPSK |
| HSDPA UE Category | 10 |
| HSUPA UE Category | 6 |
| DC-HSDPA | Not Supported |
| Antenna Type | Internal Antenna |
| WiFi | |
| Support Standards | IEEE 802.11b, IEEE 802.11g, IEEE 802.11n |
| Frequency Range | 2412-2462MHz for 11b/g/n(HT20),(HT40) |
| Type of Modulation | CCK, OFDM, QPSK, BPSK, 16QAM, |
| Data Rate | 1-11Mbps, 6-54Mbps, up to 150Mbps |
| Quantity of Channels | 11 for 11b/g/n(HT20),(HT40) |
| Channel Separation | 5MHz |

| | |
|---|---|
| Antenna Type | Internal Antenna |
| Bluetooth | |
| Bluetooth Version | V3.0+EDR,Bluetooth v4.0 BLE |
| Frequency Range | 2402-2480MHz |
| Data Rate | 1Mbps, 2Mbps, 3Mbps |
| Modulation | GFSK, π/4 QDPSK, 8DPSK |
| Quantity of Channels | 79 |
| Channel Separation | 1MHz |
| Antenna Type | Internal Antenna |

## 2.3. Statement of Compliance

The maximum of results of SAR found during testing are follows:

<Highest Reported standalone SAR Summary>

| Classment Class | Frequency Band | Head (Report 1g SAR(W/Kg) | Body (Report 1g SAR(W/Kg) |
|---|---|---|---|
| PCE | GSM850 | 0.242 | 0.942 |
| | GSM1900 | 0.12 | 1.16 |
| | WCDMA Band V | 0.245 | 0.971 |
| | WCDMA Band II | 0.134 | 1.16 |
| DTS | WIFI2.4G | 0.293 | 0.357 |

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

<Highest Reported simultaneous SAR Summary>

| Exposure Position | Frequency Band | Reported 1-g SAR (W/kg) | Classment Class | Highest Reported Simultaneous Transmission 1-g SAR (W/kg) |
|---|---|---|---|---|
| Back | WCDMA Band II | 1.16 | PCE | **1.517** |
| | WIFI2.4G | 0.357 | DTS | |

## 2.4. EUT configuration

**The following peripheral devices and interface cables were connected during the measurement:**

● - supplied by the manufacturer

○ - supplied by the lab

| | | | |
|---|---|---|---|
| ○ | / | M/N: | / |
| | | Manufacturer: | / |

## 2.5. Modifications

No modifications were implemented to meet testing criteria.

# 3. TEST ENVIRONMENT

## 3.1. Address of the test laboratory

**The Testing and Technology Center for Industrial Products of Shenzhen Entry-Exit Inspection and Quarantine Bureau**
No.149,Gongye 7th Rd. Nanshan District, Shenzhen, China

## 3.2. Test Facility

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

CNAS-Lab Code: L2872

## 3.3. Environmental conditions

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

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

## 3.4. SAR Limits

FCC Limit (1g Tissue)

| EXPOSURE LIMITS | SAR (W/kg) | |
|---|---|---|
| | (General Population /Uncontrolled Exposure Environment) | (Occupational /Controlled Exposure Environment) |
| Spatial Average (averaged over the whole body) | 0.08 | 0.4 |
| Spatial Peak (averaged over any 1 g of tissue) | 1.60 | 8.0 |
| Spatial Peak (hands/wrists/feet/ankles averaged over 10 g) | 4.0 | 20.0 |

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

Occupational/Controlled Environments are defined as locations where there is exposure that may be incurred by people who are aware of the potential for exposure (i.e. as a result of employment or occupation).

## 3.5. Equipments Used during the Test

| Test Equipment | Manufacturer | Type/Model | Serial Number | Calibration | |
|---|---|---|---|---|---|
| | | | | Last Calibration | Calibration Interval |
| Data Acquisition Electronics DAEx | SPEAG | DAE4 | 1315 | 2016/07/26 | 1 |
| E-field Probe | SPEAG | ES3DV3 | 3292 | 2016/09/02 | 1 |
| System Validation Dipole D835V2 | SPEAG | D835V2 | 4d069 | 2016/07/20 | 3 |
| System Validation Dipole 1900V2 | SPEAG | D1900V2 | 5d194 | 2015/01/07 | 3 |
| System Validation Dipole D2450V2 | SPEAG | D2450V2 | 955 | 2015/01/08 | 3 |
| Network analyzer | Agilent | 8753E | US37390562 | 2017/03/11 | 1 |
| Wideband Communication Tester | R&S | CMW500 | 116581 | 2016/06/18 | 1 |
| Dielectric Probe Kit | Agilent | 85070E | US44020288 | / | / |
| Dual Directional Coupler | Agilent | 778D | 50127 | 2016/06/18 | 1 |
| Dual Directional Coupler | Agilent | 772D | 50348 | 2016/06/18 | 1 |
| Attenuator | PE | PE7005-10 | E048 | 2016/06/18 | 1 |
| Attenuator | PE | PE7005-3 | E049 | 2016/06/18 | 1 |
| Attenuator | Woken | WK0602-XX | E050 | 2016/06/18 | 1 |
| Power meter | Agilent | E4417A | GB41292254 | 2016/06/18 | 1 |
| Power Meter | Agilent | E7356A | GB54762536 | 2016/06/18 | 1 |
| Power sensor | Agilent | 8481H | MY41095360 | 2016/06/18 | 1 |
| Power Sensor | Agilent | E9327A | Us40441788 | 2016/06/18 | 1 |
| Signal generator | IFR | 2032 | 203002/100 | 2016/06/18 | 1 |
| Amplifier | AR | 75A250 | 302205 | 2016/06/18 | 1 |

Note:
1) Per KDB865664D01 requirements for dipole calibration, the test laboratory has adopted three year extended calibration interval. Each measured dipole is expected to evalute with following criteria at least on annual interval.
   a) There is no physical damage on the dipole;
   b) System check with specific dipole is within 10% of calibrated values;
   c) The most recent return-loss results,measued at least annually,deviates by no more than 20% from the previous measurement;
   d) The most recent measurement of the real or imaginary parts of the impedance, measured at least annually is within 5Ω from the provious measurement.
2) Network analyzer probe calibration against air, distilled water and a shorting block performed before measuring liquid parameters.

# 4. SAR Measurements System configuration

## 4.1. SAR Measurement Set-up

The DASY5 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 DASY5 measurement server.

The DASY5 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.

DASY5 software and SEMCAD data evaluation software.

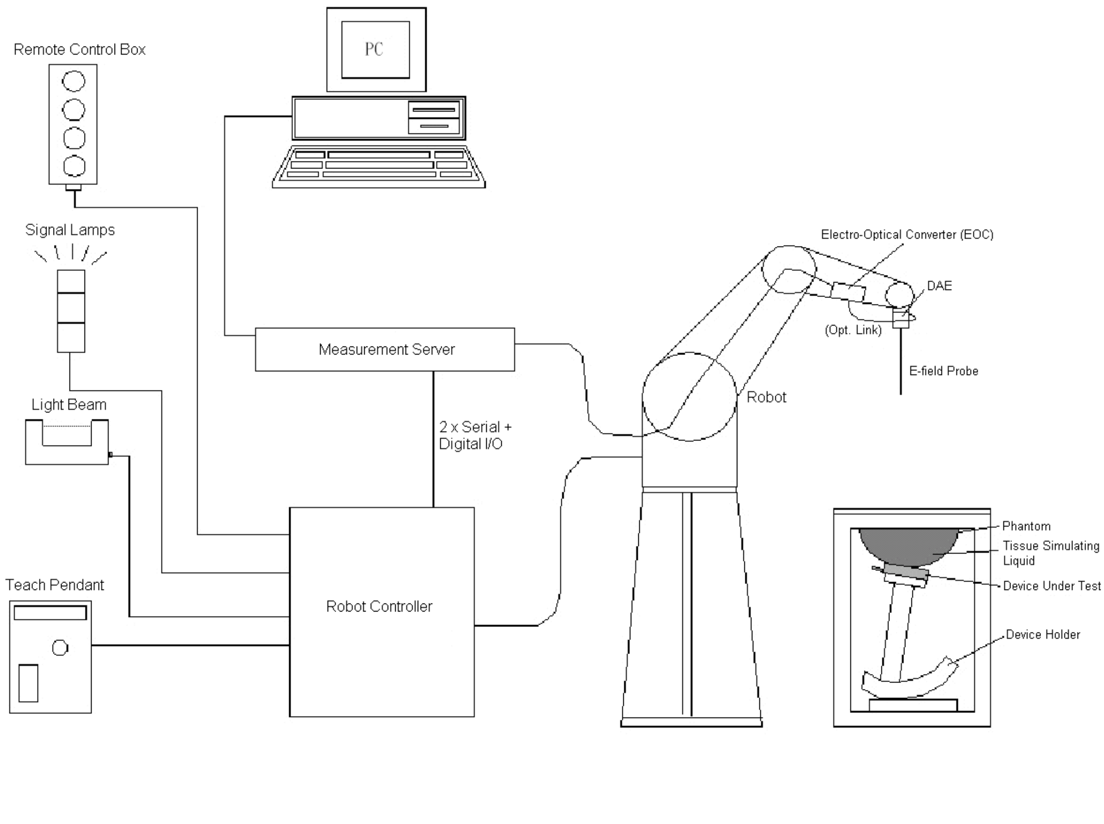
Remote control with teach panel and additional circuitry for robot safety such as warning lamps, etc.

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.



## 4.2. DASY5 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.

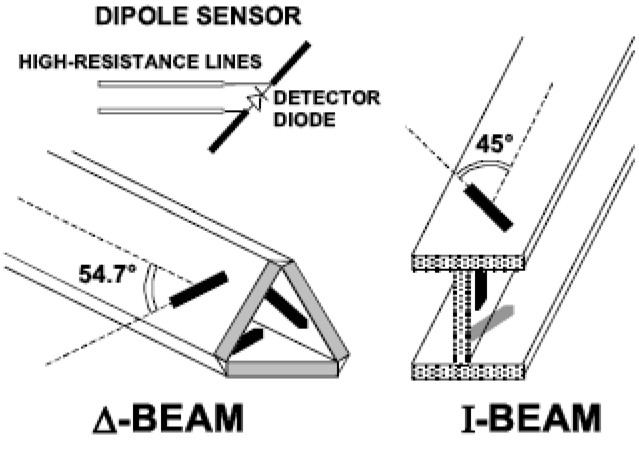
Probe Specification

| | |
|---|---|
| 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, 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:



## 4.3. Phantoms

**<SAM Twin Phantom>**

| | |
|---|---|
| **Shell Thickness** | 2 ± 0.2 mm;<br>Center ear point: 6 ± 0.2 mm |
| **Filling Volume** | Approx. 25 liters |
| **Dimensions** | Length: 1000 mm; Width: 500 mm;<br>Height: adjustable feet |
| **Measurement Areas** | Left Hand, Right Hand, Flat Phantom |

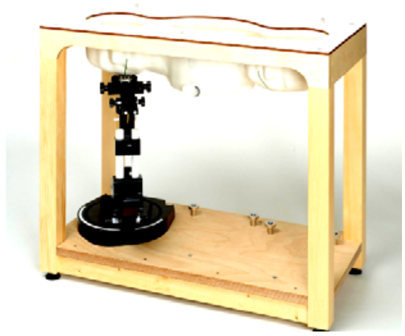


**Photo of SAM Phantom**

The bottom plate contains three pair of bolts for locking the device holder. The device holder positions are adjusted to the standard measurement positions in the three sections. A white cover is provided to tap the phantom during off-periods to prevent water evaporation and changes in the liquid parameters. On the phantom top, three reference markers are provided to identify the phantom position with respect to the robot.

**<ELI4 Phantom>**

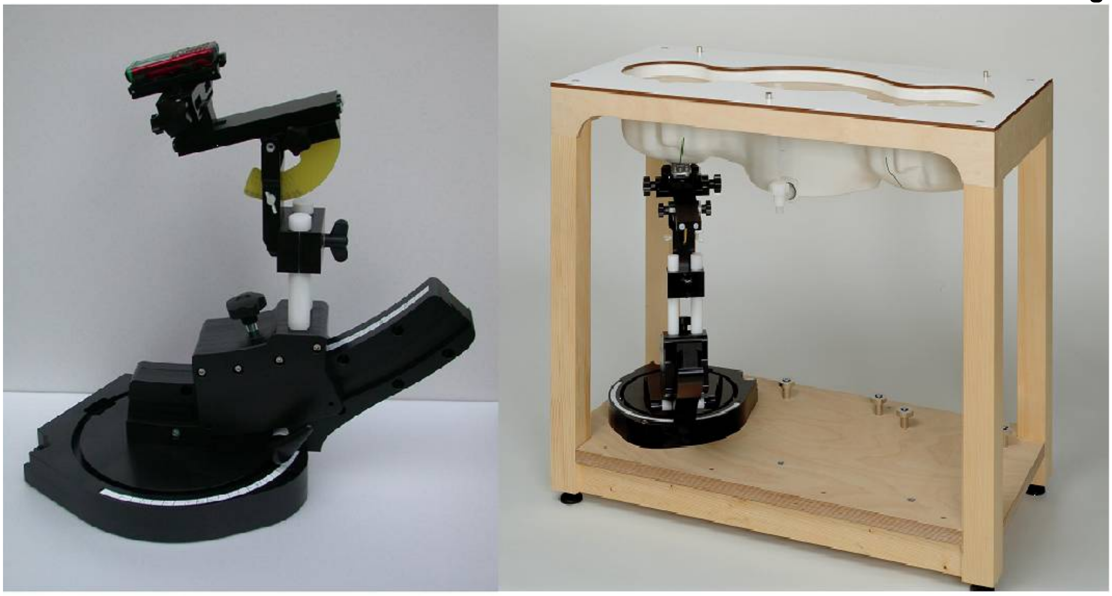
| | |
|---|---|
| **Shell Thickness** | 2 ± 0.2 mm (sagging: <1%) |
| **Filling Volume** | Approx. 30 liters |
| **Dimensions** | Major ellipse axis: 600 mm<br>Minor axis:400 mm |

**Photo of ELI4 Phantom**

The ELI4 phantom is intended for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. ELI4 is fully compatible with standard and all known tissue simulating liquids.

## 4.4. 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

## 4.5. Scanning Procedure

The DASY5 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°.)

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

<table>
<tr><th></th><th>≤ 3 GHz</th><th>> 3 GHz</th></tr>
<tr><td>Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface</td><td>5 mm ± 1 mm</td><td>$\frac{1}{2}\cdot\delta\cdot\ln(2)$ mm ± 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 to estimate the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g of simulated tissue. The default Zoom Scan is done by 7x7x7 points within a cube whose base is centered around the maxima found in the preceding area scan.

<table>
<tr><td colspan="3">Maximum zoom scan spatial resolution: $\Delta x_{Zoom}$, $\Delta y_{Zoom}$</td><td>$\leq$ 2 GHz: $\leq$ 8 mm<br>2 – 3 GHz: $\leq$ 5 mm*</td><td>3 – 4 GHz: $\leq$ 5 mm*<br>4 – 6 GHz: $\leq$ 4 mm*</td></tr>
<tr><td rowspan="3">Maximum zoom scan spatial resolution, normal to phantom surface</td><td colspan="2">uniform grid: $\Delta z_{Zoom}(n)$</td><td>$\leq$ 5 mm</td><td>3 – 4 GHz: $\leq$ 4 mm<br>4 – 5 GHz: $\leq$ 3 mm<br>5 – 6 GHz: $\leq$ 2 mm</td></tr>
<tr><td rowspan="2">graded grid</td><td>$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface</td><td>$\leq$ 4 mm</td><td>3 – 4 GHz: $\leq$ 3 mm<br>4 – 5 GHz: $\leq$ 2.5 mm<br>5 – 6 GHz: $\leq$ 2 mm</td></tr>
<tr><td>$\Delta z_{Zoom}(n>1)$: between subsequent points</td><td colspan="2">$\leq 1.5 \cdot \Delta z_{Zoom}(n-1)$ mm</td></tr>
<tr><td>Minimum zoom scan volume</td><td colspan="2">x, y, z</td><td>$\geq$ 30 mm</td><td>3 – 4 GHz: $\geq$ 28 mm<br>4 – 5 GHz: $\geq$ 25 mm<br>5 – 6 GHz: $\geq$ 22 mm</td></tr>
<tr><td colspan="5">Note: $\delta$ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see IEEE Std 1528-2013 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 Publication 447498 is $\leq$ 1.4 W/kg, $\leq$ 8 mm, $\leq$ 7 mm and $\leq$ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.</td></tr>
</table>

Spatial Peak Detection

The procedure for spatial peak SAR evaluation has been implemented and can determine values of masses of 1g and 10g, as well as for user-specific masses.The DASY5 system allows evaluations that combine measured data and robot positions, such as: • maximum search • extrapolation • boundary correction • peak search for averaged SAR During a maximum search, global and local maxima searches are automatically performed in 2-D after each Area Scan measurement with at least 6 measurement points. It is based on the evaluation of the local SAR gradient calculated by the Quadratic Shepard's method. The algorithm will find the global maximum and all local maxima within -2 dB of the global maxima for all SAR distributions.

Extrapolation routines are used to obtain SAR values between the lowest measurement points and the inner phantom surface. The extrapolation distance is determined by the surface detection distance and the probe sensor offset. Several measurements at different distances are necessary for the extrapolation. Extrapolation routines require at least 10 measurement points in 3-D space. They are used in the Zoom Scan to obtain SAR values between the lowest measurement points and the inner phantom surface. The routine uses the modified Quadratic Shepard's method for extrapolation. For a grid using 7x7x7 measurement points with 5mm resolution amounting to 343 measurement points, the uncertainty of the extrapolation routines is less than 1% for 1g and 10g cubes.

A Z-axis scan measures the total SAR value at the x-and y-position of the maximum SAR value found during the cube 7x7x7 scan. The probe is moved away in z-direction from the bottom of the SAM phantom in 5mm steps.

## 4.6. Data Storage and Evaluation

Data Storage

The DASY5 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 DASY5 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 primary 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 primary field data are used to calculate the derived field units.

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

with SAR = local specific absorption rate in mW/g
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.

## 4.7. Tissue Dielectric Parameters for Head and Body Phantoms

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

The composition of the tissue simulating liquid

| Ingredient | 835MHz | | 1900MHz | | 1750 MHz | | 2450MHz | | 2600MHz | |
|---|---|---|---|---|---|---|---|---|---|---|
| (% Weight) | Head | Body | Head | Body | Head | Body | Head | Body | Head | Body |
| Water | 41.45 | 52.5 | 55.242 | 69.91 | 55.782 | 69.82 | 62.7 | 73.2 | 62.3 | 72.6 |
| Salt | 1.45 | 1.40 | 0.306 | 0.13 | 0.401 | 0.12 | 0.50 | 0.10 | 0.20 | 0.10 |
| Sugar | 56 | 45.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Preventol | 0.10 | 0.10 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| HEC | 1.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| DGBE | 0.00 | 0.00 | 44.452 | 29.96 | 43.817 | 30.06 | 36.8 | 26.7 | 37.5 | 27.3 |

| Target Frequency (MHz) | Head | | Body | |
|---|---|---|---|---|
| | $\varepsilon_r$ | $\sigma(S/m)$ | $\varepsilon_r$ | $\sigma(S/m)$ |
| 150 | 52.3 | 0.76 | 61.9 | 0.80 |
| 300 | 45.3 | 0.87 | 58.2 | 0.92 |
| 450 | 43.5 | 0.87 | 56.7 | 0.94 |
| 835 | 41.5 | 0.90 | 55.2 | 0.97 |
| 900 | 41.5 | 0.97 | 55.0 | 1.05 |
| 915 | 41.5 | 0.98 | 55.0 | 1.06 |
| 1450 | 40.5 | 1.20 | 54.0 | 1.30 |
| 1610 | 40.3 | 1.29 | 53.8 | 1.40 |
| 1800-2000 | 40.0 | 1.40 | 53.3 | 1.52 |
| 2450 | 39.2 | 1.80 | 52.7 | 1.95 |
| 2600 | 39.0 | 1.96 | 52.5 | 2.16 |
| 3000 | 38.5 | 2.40 | 52.0 | 2.73 |
| 5800 | 35.3 | 5.27 | 48.2 | 6.00 |

## 4.8. Tissue equivalent liquid properties

Dielectric performance of Head and Body tissue simulating liquid

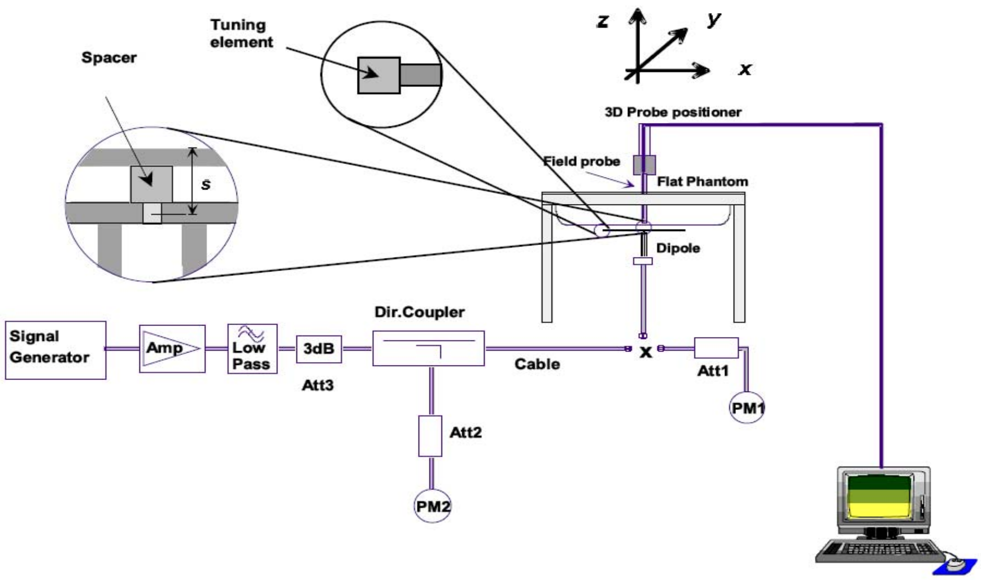
| Tissue Type | Measured Frequency (MHz) | Target Tissue | | Measured Tissue | | | | Liquid Temp. | Test Data |
|---|---|---|---|---|---|---|---|---|---|
| | | $\varepsilon_r$ | $\sigma$ | $\varepsilon_r$ | Dev. | $\sigma$ | Dev. | | |
| 835H | 835 | 41.5 | 0.97 | 42.8 | 3.1% | 0.95 | -2.1% | 22.4 | 2017.04.09 |
| 1900H | 1900 | 40.0 | 1.40 | 41.3 | 3.2% | 1.44 | 2.9% | 22.1 | 2017.04.09 |
| 2450H | 2450 | 39.2 | 1.80 | 38.19 | -2.6% | 1.83 | 1.7% | 22.6 | 2017.04.11 |
| 835B | 835 | 55.0 | 1.05 | 57.01 | 3.7% | 1.02 | -2.9% | 22.3 | 2017.04.10 |
| 1900B | 1900 | 53.3 | 1.52 | 55.2 | 3.6% | 1.58 | 3.9% | 22.2 | 2017.04.10 |
| 2450B | 2450 | 52.7 | 1.95 | 50.59 | -4.0% | 1.90 | -2.6% | 22.3 | 2017.04.11 |

## 4.9. System Check

The purpose of the system check is to verify that the system operates within its specifications at the decice 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 24 dBm (250mW) before dipole is connected.

Photo of Dipole Setup

**System Check in Head Tissue Simulating Liquid**

| Frequency | Test Date | Dielectric Parameters | | Temp | 250mW Measured $SAR_{1g}$ | 1W Normalized $SAR_{1g}$ | 1W Target $SAR_{1g}$ | Limit (±10% Deviation) |
|---|---|---|---|---|---|---|---|---|
| | | $\varepsilon_r$ | σ(s/m) | (℃) | (W/Kg) | | | |
| 835 MHz | 04/09/2017 | 0.95 | 42.80 | 22.4 | 2.26 | 9.04 | 9.44 | -4.4% |
| 1900 MHz | 04/09/2017 | 1.44 | 41.30 | 22.1 | 10.35 | 41.4 | 40.60 | 1.9% |
| 2450 MHz | 04/11/2017 | 1.83 | 38.19 | 22.6 | 13.3 | 53.2 | 52.40 | 1.5% |

**System Check in Body Tissue Simulating Liquid**

| Frequency | Test Date | Dielectric Parameters | | Temp | 250mW Measured $SAR_{1g}$ | 1W Normalized $SAR_{1g}$ | 1W Target $SAR_{1g}$ | Limit (±10% Deviation) |
|---|---|---|---|---|---|---|---|---|
| | | $\varepsilon_r$ | σ(s/m) | (℃) | (W/Kg) | | | |
| 835MHz | 04/10/2017 | 1.02 | 57.01 | 22.3 | 2.53 | 10.12 | 9.69 | 4.2% |
| 1900MHz | 04/10/2017 | 1.58 | 55.20 | 22.2 | 9.95 | 39.8 | 40.10 | -0.8% |
| 2450MHz | 04/11/2017 | 1.90 | 50.59 | 22.3 | 13.5 | 54 | 53.70 | 0.6% |

Note:
1. The graph results see system check.
2. Target Values used derive from the calibration certificate

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

D1900V2, Serial No.: 5d194 Extend Dipole Calibrations

| 1900 MHz Head | | | | | | |
|---|---|---|---|---|---|---|
| Date of Measurement | Return-Loss (dB) | Delta (%) | Real Impedance (ohm) | Delta (ohm) | Imaginary Impedance (ohm) | Delta (ohm) |
| 2015-01-07 | -24.5 | | 53.700 | | 4.900 | |
| 2016-01-02 | -24.5 | 0.00% | 53.779 | 0.079 | 4.041 | -0.859 |
| 2016-12-25 | -25.6 | -4.49% | 54.610 | 0.91 | 3.915 | -0.985 |

D2450V2, Serial No.: 955 Extend Dipole Calibrations

| 2450 MHz Head | | | | | | |
|---|---|---|---|---|---|---|
| Date of Measurement | Return-Loss (dB) | Delta (%) | Real Impedance (ohm) | Delta (ohm) | Imaginary Impedance (ohm) | Delta (ohm) |
| 2015-01-08 | -24.9 | | 54.800 | | 3.500 | |
| 2016-01-02 | -25.559 | -2.65% | 54.985 | 0.185 | 2.411 | -1.089 |
| 2016-12-25 | -25.8 | -3.61% | 55.260 | 0.46 | 3.100 | 0.4 |

D1900V2, Serial No.: 5d194 Extend Dipole Calibrations

| 1900 MHz Body | | | | | | |
|---|---|---|---|---|---|---|
| Date of Measurement | Return-Loss (dB) | Delta (%) | Real Impedance (ohm) | Delta (ohm) | Imaginary Impedance (ohm) | Delta (ohm) |
| 2015-01-07 | -25.6 | | 48.900 | | 5.100 | |
| 2016-01-02 | -24.5 | 4.3% | 47.779 | -1.121 | 4.041 | -1.059 |
| 2016-12-25 | -25.3 | 1.17% | 47.650 | -1.25 | 5.730 | 0.63 |

D2450V2, Serial No.: 955 Extend Dipole Calibrations

| 2450 MHz Body | | | | | | |
|---|---|---|---|---|---|---|
| Date of Measurement | Return-Loss (dB) | Delta (%) | Real Impedance (ohm) | Delta (ohm) | Imaginary Impedance (ohm) | Delta (ohm) |
| 2015-01-08 | -26 | | 51.200 | | 4.900 | |
| 2016-01-02 | -25.559 | 1.7% | 51.985 | 0.785 | 4.411 | -0.489 |
| 2016-12-25 | -25.1 | 3.46% | 50.512 | -0.688 | 4.135 | -0.765 |

## 4.10. SAR measurement procedure

The procedure for assessing the average SAR value consists of the following steps:

- Power Reference Measurement

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

- Area Scan

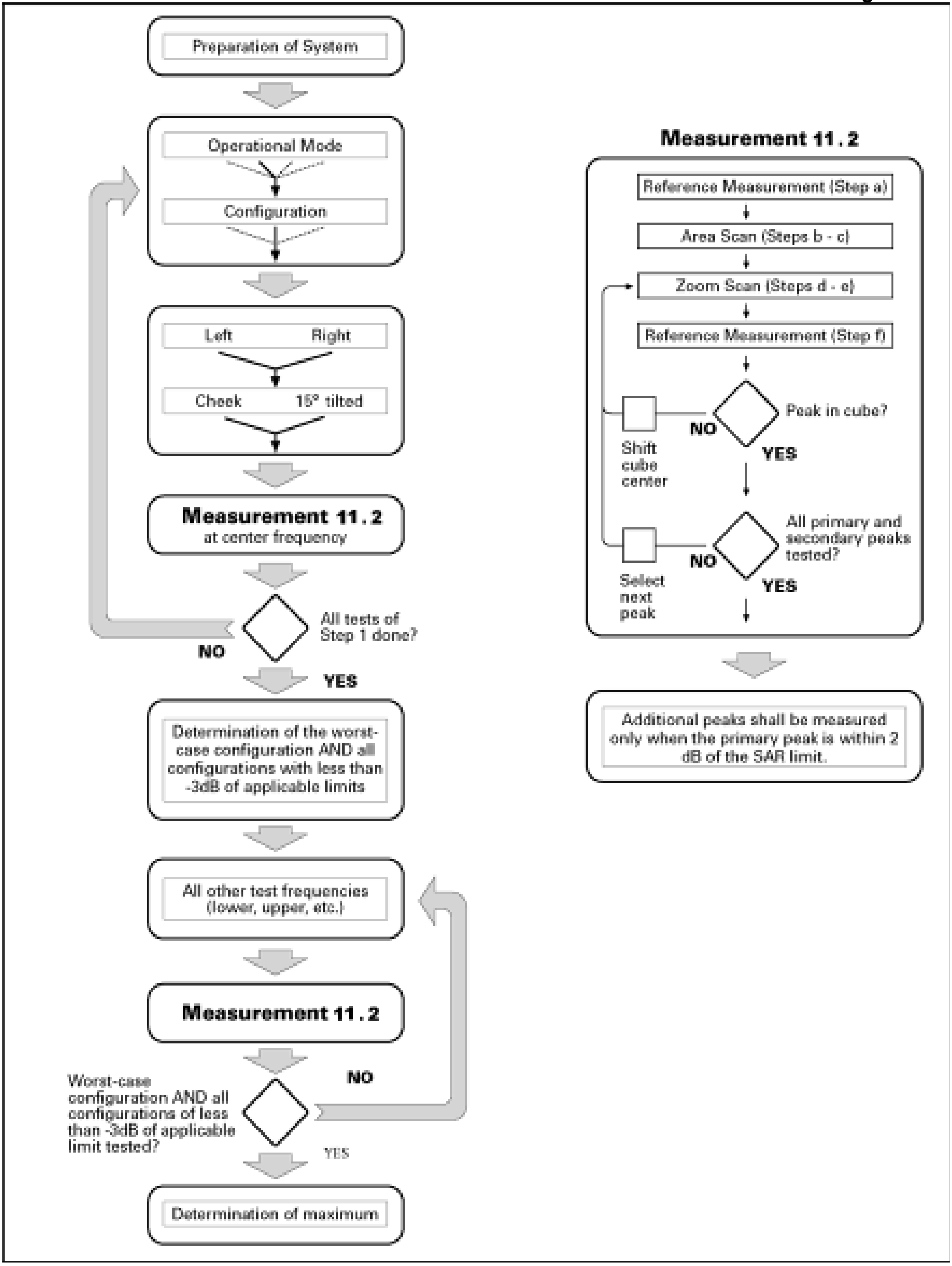
  The Area Scan is used as a fast scan in two dimensions to find the area of high field values, before doing a finer measurement around the hot spot. The sophisticated interpolation routines implemented in DASY5 software can find the maximum locations even in relatively coarse grids. The scanning area is defined by an editable grid. This grid is anchored at the grid reference point of the selected section in the phantom. When the Area Scan's property sheet is brought-up, grid settings can be edited by a user.

- Zoom Scan

  Zoom Scans are used to assess the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g of simulated tissue. The default Zoom Scan measures 7 x 7 x 7 points (5mmE545mmE545mm) within a cube whose base faces are centered on the maxima found in a preceding area scan job within the same procedure.

- Power Drift Measurement

  The Power Drift Measurement job measures the field at the same location as the most recent power reference measurement job within the same procedure, and with the same settings. The Power Drift Measurement gives the field difference in dB from the reading conducted within the last Power Reference Measurement.




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

# 5. TEST CONDITIONS AND RESULTS

## 5.1. Conducted Power Results

**<GSM Conducted Power>**
General Note:
1. Per KDB 447498 D01v06, the maximum output power channel is used for SAR testing and for further SAR test reduction.
2. According to October 2013TCB Workshop, for GSM / GPRS / EGPRS, the number of time slots to test for SAR should correspond to the highest frame-average maximum output power configuration, considering the possibility of e.g. 3rd party VoIP operation for head and body-worn SAR testing, the EUT was set in GPRS (4Tx slot) for GSM850/GSM1900 band due to their highest frame-average power.

**Conducted Power Measurement Results(GSM 850/1900)**

| **GSM 850** | | **Burst Conducted power (dBm)** | | | / | **Average power (dBm)** | | |
|---|---|---|---|---|---|---|---|---|
| | | **Channel/Frequency(MHz)** | | | | **Channel/Frequency(MHz)** | | |
| | | **128/824.2** | **190/836.6** | **251/848.8** | | **128/824.2** | **190/836.6** | **251/848.8** |
| GSM | | **32.69** | 32.33 | 32.28 | -9.03dB | 23.66 | 23.30 | 23.25 |
| GPRS (GMSK) | 1TX slot | 32.80 | 32.39 | 32.32 | -9.03dB | 23.77 | 23.36 | 23.29 |
| | 2TX slot | 31.99 | 31.59 | 31.58 | -6.02dB | 25.97 | 25.57 | 25.56 |
| | 3TX slot | 30.51 | 30.16 | 30.14 | -4.26dB | 26.25 | 25.90 | 25.88 |
| | 4TX slot | 29.79 | 29.40 | 29.42 | -3.01dB | **26.78** | 26.39 | 26.41 |
| **GSM 1900** | | **Burst Conducted power (dBm)** | | | / | **Average power (dBm)** | | |
| | | **Channel/Frequency(MHz)** | | | | **Channel/Frequency(MHz)** | | |
| | | **512/ 1850.2** | **661/ 1880** | **810/ 1909.8** | | **512/ 1850.2** | **661/ 1880** | **810/ 1909.8** |
| GSM | | 28.56 | **28.81** | 28.57 | -9.03dB | 19.53 | 19.78 | 19.54 |
| GPRS (GMSK) | 1TX slot | 28.64 | 28.87 | 28.63 | -9.03dB | 19.61 | 19.84 | 19.60 |
| | 2TX slot | 27.57 | 28.12 | 28.06 | -6.02dB | 21.55 | 22.10 | 22.04 |
| | 3TX slot | 25.83 | 26.59 | 26.47 | -4.26dB | 21.57 | 22.33 | 22.21 |
| | 4TX slot | 25.04 | 25.84 | 25.56 | **-3.01dB** | 22.03 | **22.83** | 22.55 |

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
2) According to the conducted power as above, the GPRS measurements are performed with 4Txslots for GPRS850 and GPRS1900.

**<UMTS Conducted Power>**
The following tests were conducted according to the test requirements outlines in 3GPP TS 34.121 specification. A summary of these settings are illustrated below:

**HSDPA Setup Configuration:**
a. The EUT was connected to Base Station E5515C referred to the Setup Configuration.
b. The RF path losses were compensated into the measurements.
c. A call was established between EUT and Base Station with following setting:
   i. Set Gain Factors ($\beta_c$ and $\beta_d$) and parameters were set according to each
   ii. Specific sub-test in the following table, C10.1.4, quoted from the TS 34.121
   iii. Set RMC 12.2Kbps + HSDPA mode.
   iv. Set Cell Power = -86 dBm
   v. Set HS-DSCH Configuration Type to FRC (H-set 1, QPSK)
   vi. Select HSDPA Uplink Parameters
   vii. Set Delta ACK, Delta NACK and Delta CQI = 8
   viii. Set Ack-Nack Repetition Factor to 3
   ix. Set CQI Feedback Cycle (k) to 4 ms
   x. Set CQI Repetition Factor to 2
   xi. Power Ctrl Mode = All Up bits
d. The transmitted maximum output power was recorded.

Table C.10.1.4: β values for transmitter characteristics tests with HS-DPCCH

| Sub-test | $\beta_c$ | $\beta_d$ | $\beta_d$ (SF) | $\beta_c/\beta_d$ | $\beta_{HS}$ (Note1, Note 2) | CM (dB) (Note 3) | MPR (dB) (Note 3) |
|---|---|---|---|---|---|---|---|
| 1 | 2/15 | 15/15 | 64 | 2/15 | 4/15 | 0.0 | 0.0 |
| 2 | 12/15 (Note 4) | 15/15 (Note 4) | 64 | 12/15 (Note 4) | 24/15 | 1.0 | 0.0 |
| 3 | 15/15 | 8/15 | 64 | 15/8 | 30/15 | 1.5 | 0.5 |
| 4 | 15/15 | 4/15 | 64 | 15/4 | 30/15 | 1.5 | 0.5 |

Note 1: $\Delta_{ACK}$, $\Delta_{NACK}$ and $\Delta_{CQI}$ = 30/15 with $\beta_{hs} = 30/15 * \beta_c$.

Note 2: For the HS-DPCCH power mask requirement test in clause 5.2C, 5.7A, and the Error Vector Magnitude (EVM) with HS-DPCCH test in clause 5.13.1A, and HSDPA EVM with phase discontinuity in clause 5.13.1AA, $\Delta_{ACK}$ and $\Delta_{NACK}$ = 30/15 with $\beta_{hs} = 30/15 * \beta_c$, and $\Delta_{CQI}$ = 24/15 with $\beta_{hs} = 24/15 * \beta_c$.

Note 3: CM = 1 for $\beta_c/\beta_d$ =12/15, $\beta_{hs}/\beta_c$=24/15. For all other combinations of DPDCH, DPCCH and HS-DPCCH the MPR is based on the relative CM difference. This is applicable for only UEs that support HSDPA in release 6 and later releases.

Note 4: For subtest 2 the $\beta_c/\beta_d$ ratio of 12/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1, TF1) to $\beta_c$ = 11/15 and $\beta_d$ = 15/15.

**Setup Configuration**

**HSUPA Setup Configuration:**

a. The EUT was connected to Base Station R&S CMU200 referred to the Setup Configuration.
b. The RF path losses were compensated into the measurements.
c. A call was established between EUT and Base Station with following setting * :
   i. Call Configs = 5.2B, 5.9B, 5.10B, and 5.13.2B with QPSK
   ii. Set the Gain Factors ($\beta_c$ and $\beta_d$) and parameters (AG Index) were set according to each specific sub-test in the following table, C11.1.3, quoted from the TS 34.121
   iii. Set Cell Power = -86 dBm
   iv. Set Channel Type = 12.2k + HSPA
   v. Set UE Target Power
   vi. Power Ctrl Mode= Alternating bits
   vii. Set and observe the E-TFCI
   viii. Confirm that E-TFCI is equal to the target E-TFCI of 75 for sub-test 1, and other subtest's E-TFCI
d. The transmitted maximum output power was recorded.

Table C.11.1.3: β values for transmitter characteristics tests with HS-DPCCH and E-DCH

| Sub-test | $\beta_c$ | $\beta_d$ | $\beta_d$ (SF) | $\beta_c/\beta_d$ | $\beta_{HS}$ (Note1) | $\beta_{ec}$ | $\beta_{ed}$ (Note 5) (Note 6) | $\beta_{ed}$ (SF) | $\beta_{ed}$ (Codes) | CM (dB) (Note 2) | MPR (dB) (Note 2) | AG Index (Note 6) | E-TFCI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 11/15 (Note 3) | 15/15 (Note 3) | 64 | 11/15 (Note 3) | 22/15 | 209/225 | 1309/225 | 4 | 1 | 1.0 | 0.0 | 20 | 75 |
| 2 | 6/15 | 15/15 | 64 | 6/15 | 12/15 | 12/15 | 94/75 | 4 | 1 | 3.0 | 2.0 | 12 | 67 |
| 3 | 15/15 | 9/15 | 64 | 15/9 | 30/15 | 30/15 | $\beta_{ed}$1: 47/15<br>$\beta_{ed}$2: 47/15 | 4<br>4 | 2 | 2.0 | 1.0 | 15 | 92 |
| 4 | 2/15 | 15/15 | 64 | 2/15 | 4/15 | 2/15 | 56/75 | 4 | 1 | 3.0 | 2.0 | 17 | 71 |
| 5 | 15/15 (Note 4) | 15/15 (Note 4) | 64 | 15/15 (Note 4) | 30/15 | 24/15 | 134/15 | 4 | 1 | 1.0 | 0.0 | 21 | 81 |

Note 1: $\Delta_{ACK}$, $\Delta_{NACK}$ and $\Delta_{CQI}$ = 30/15 with $\beta_{hs} = 30/15 * \beta_c$.

Note 2: CM = 1 for $\beta_c/\beta_d$ =12/15, $\beta_{hs}/\beta_c$=24/15. For all other combinations of DPDCH, DPCCH, HS- DPCCH, E-DPDCH and E-DPCCH the MPR is based on the relative CM difference.

Note 3: For subtest 1 the $\beta_c/\beta_d$ ratio of 11/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1, TF1) to $\beta_c$ = 10/15 and $\beta_d$ = 15/15.

Note 4: For subtest 5 the $\beta_c/\beta_d$ ratio of 15/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1, TF1) to $\beta_c$ = 14/15 and $\beta_d$ = 15/15.

Note 5: In case of testing by UE using E-DPDCH Physical Layer category 1, Sub-test 3 is omitted according to TS25.306 Table 5.1g.

Note 6: $\beta_{ed}$ can not be set directly, it is set by Absolute Grant Value.

**Setup Configuration**

**General Note**

1. Per KDB 941225 D01, RMC 12.2kbps setting is used to evaluate SAR. If AMR 12.2kbps power is < 0.25dB higher than RMC 12.2kbps, SAR tests with AMR 12.2kbps can be excluded.
2. By design, AMR and HSDPA/HSUPA RF power will not be larger than RMC 12.2kbps, detailed information is included in Tune-up Procure exhibit.
3. It is expected by the manufacturer that MPR for some HSDPA/HSUPA subtests may differ from the specification of 3GPP, according to the chipset implementation in this model. The implementation and expected deviation are detailed in tune-up procedure exhibit.

**Conducted Power Measurement Results(WCDMA Band V/II)**

| Band | WCDMA V | | | WCDMA II | | |
|---|---|---|---|---|---|---|
| TX Channel | 4132 | 4182 | 4233 | 9262 | 9400 | 9538 |
| Rx Channel | 4357 | 4407 | 4458 | 9662 | 9800 | 9938 |
| Frequency (MHz) | 826.4 | 836.4 | 846.6 | 1852.4 | 1880 | 1907.6 |
| AMR 12.2Kbps | 22.54 | 22.23 | 22.32 | 22.75 | 22.51 | 22.49 |
| RMC 12.2Kbps | **22.55** | 22.24 | 22.35 | **22.77** | 22.56 | 22.50 |
| HSDPA Subtest-1 | 20.70 | 20.16 | 21.31 | 21.67 | 21.04 | 20.98 |
| HSDPA Subtest-2 | 20.84 | 20.64 | 21.03 | 21.38 | 21.46 | 21.40 |
| HSDPA Subtest-3 | 20.63 | 20.41 | 20.81 | 21.14 | 20.22 | 21.17 |
| HSDPA Subtest-4 | 20.40 | 20.18 | 20.57 | 20.90 | 20.97 | 20.92 |
| HSUPA Subtest-1 | 20.16 | 20.01 | 21.68 | 21.79 | 20.97 | 21.15 |
| HSUPA Subtest-2 | 20.13 | 20.02 | 20.35 | 20.32 | 20.43 | 20.88 |
| HSUPA Subtest-3 | 20.67 | 20.49 | 20.87 | 21.03 | 20.20 | 21.13 |
| HSUPA Subtest-4 | 20.37 | 20.51 | 20.91 | 20.81 | 20.12 | 20.64 |
| HSUPA Subtest-5 | 21.12 | 20.88 | 21.31 | 21.49 | 20.62 | 20.59 |

**<WLAN 2.4GHz Conducted Power>**

| Mode | Channel | Frequency (MHz) | Conducted Average Output Power(dBm) | Test Rate Data |
|---|---|---|---|---|
| **802.11b** | 1 | 2412 | **14.21** | 1 Mbps |
| | 6 | 2437 | 14.13 | 1 Mbps |
| | 11 | 2462 | 14.02 | 1 Mbps |
| **802.11g** | 1 | 2412 | 13.81 | 6 Mbps |
| | 6 | 2437 | 13.67 | 6 Mbps |
| | 11 | 2462 | 13.35 | 6 Mbps |
| **802.11n(20MHz)** | 1 | 2412 | 11.54 | MCS0 |
| | 6 | 2437 | 11.28 | MCS0 |
| | 11 | 2462 | 11.07 | MCS0 |
| **802.11n(40MHz)** | 3 | 2422 | 10.12 | MCS0 |
| | 6 | 2437 | 10.05 | MCS0 |
| | 9 | 2452 | 9.81 | MCS0 |

***Note:*** SAR is not required for the following 2.4 GHz OFDM conditions as the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg.

**<Bluetooth Conducted Power>**

| Mode | Channel | Frequency (MHz) | Conducted Average Power (dBm) |
|---|---|---|---|
| **BLE-GFSK** | 00 | 2402 | -3.94 |
| | 19 | 2440 | -5.22 |
| | 39 | 2480 | -7.32 |
| **GFSK** | 00 | 2402 | **-3.23** |
| | 39 | 2441 | -5.24 |
| | 78 | 2480 | -6.86 |
| **8DPSK** | 00 | 2402 | -3.89 |
| | 39 | 2441 | -5.91 |
| | 78 | 2480 | -7.38 |
| **π/4DQPSK** | 00 | 2402 | -3.92 |
| | 39 | 2441 | -5.95 |
| | 78 | 2480 | -7.48 |

**Manufacturing tolerance**

**GSM Speech**

| **GSM 850 (GMSK) (Burst Average Power)** | | | |
|---|---|---|---|
| Channel | Channel 128 | Channel 190 | Channel 251 |
| Target (dBm) | 32.0 | 32.0 | 32.0 |
| Tolerance ±(dB) | 1.0 | 1.0 | 1.0 |
| **GSM 1900 (GMSK) (Burst Average Power)** | | | |
| Channel | Channel 512 | Channel 661 | Channel 810 |
| Target (dBm) | 28.0 | 28.0 | 28.0 |
| Tolerance ±(dB) | 1.0 | 1.0 | 1.0 |

| **GSM 850 GPRS (GMSK) (Burst Average Power)** | | | | |
|---|---|---|---|---|
| Channel | | 128 | 190 | 251 |
| 1 Txslot | Target (dBm) | 32.0 | 32.0 | 32.0 |
| | Tolerance ±(dB) | 1.0 | 1.0 | 1.0 |
| 2 Txslot | Target (dBm) | 31.0 | 31.0 | 31.0 |
| | Tolerance ±(dB) | 1.0 | 1.0 | 1.0 |
| 3 Txslot | Target (dBm) | 29.50 | 29.50 | 29.50 |
| | Tolerance ±(dB) | 1.0 | 1.0 | 1.0 |
| 4 Txslot | Target (dBm) | 29.0 | 29.0 | 29.0 |
| | Tolerance ±(dB) | 1.0 | 1.0 | 1.0 |
| **GSM 1900 GPRS (GMSK) (Burst Average Power)** | | | | |
| Channel | | 512 | 661 | 810 |
| 1 Txslot | Target (dBm) | 28.0 | 28.0 | 28.0 |
| | Tolerance ±(dB) | 1.0 | 1.0 | 1.0 |
| 2 Txslot | Target (dBm) | 27.5 | 27.5 | 27.5 |

| | | | | |
|---|---|---|---|---|
| | Tolerance ±(dB) | 1.0 | 1.0 | 1.0 |
| 3 Txslot | Target (dBm) | 26.0 | 26.0 | 26.0 |
| | Tolerance ±(dB) | 1.0 | 1.0 | 1.0 |
| 4 Txslot | Target (dBm) | 25.0 | 25.0 | 25.0 |
| | Tolerance ±(dB) | 1.0 | 1.0 | 1.0 |

***UMTS***

| **UMTS Band V** | | | |
|---|---|---|---|
| Channel | Channel 4132 | Channel 4182 | Channel 4233 |
| Target (dBm) | 22.0 | 22.0 | 22.0 |
| Tolerance ±(dB) | 1.0 | 1.0 | 1.0 |
| **UMTS Band V HSDPA(sub-test 1)** | | | |
| Channel | Channel 4132 | Channel 4182 | Channel 4233 |
| Target (dBm) | 20.50 | 20.50 | 20.50 |
| Tolerance ±(dB) | 1.0 | 1.0 | 1.0 |
| **UMTS Band V HSDPA(sub-test 2)** | | | |
| Channel | Channel 4132 | Channel 4182 | Channel 4233 |
| Target (dBm) | 20.50 | 20.50 | 20.50 |
| Tolerance ±(dB) | 1.0 | 1.0 | 1.0 |
| **UMTS Band V HSDPA(sub-test 3)** | | | |
| Channel | Channel 4132 | Channel 4182 | Channel 4233 |
| Target (dBm) | 20.0 | 20.0 | 20.0 |
| Tolerance ±(dB) | 1.0 | 1.0 | 1.0 |
| **UMTS Band V HSDPA(sub-test 4)** | | | |
| Channel | Channel 4132 | Channel 4182 | Channel 4233 |
| Target (dBm) | 20.0 | 20.0 | 20.0 |
| Tolerance ±(dB) | 1.0 | 1.0 | 1.0 |
| **UMTS Band V HSUPA(sub-test 1)** | | | |
| Channel | Channel 4132 | Channel 4182 | Channel 4233 |
| Target (dBm) | 21.0 | 21.0 | 21.0 |
| Tolerance ±(dB) | 1.0 | 1.0 | 1.0 |
| **UMTS Band V HSUPA(sub-test 2)** | | | |
| Channel | Channel 4132 | Channel 4182 | Channel 4233 |
| Target (dBm) | 20.5 | 20.5 | 20.5 |
| Tolerance ±(dB) | 1.0 | 1.0 | 1.0 |
| **UMTS Band V HSUPA(sub-test 3)** | | | |
| Channel | Channel 4132 | Channel 4182 | Channel 4233 |
| Target (dBm) | 20.0 | 20.0 | 20.0 |
| Tolerance ±(dB) | 1.0 | 1.0 | 1.0 |
| **UMTS Band V HSUPA(sub-test 4)** | | | |
| Channel | Channel 4132 | Channel 4182 | Channel 4233 |
| Target (dBm) | 20.0 | 20.0 | 20.0 |
| Tolerance ±(dB) | 1.0 | 1.0 | 1.0 |
| **UMTS Band V HSUPA(sub-test 5)** | | | |
| Channel | Channel 4132 | Channel 4182 | Channel 4233 |
| Target (dBm) | 20.5 | 20.5 | 20.5 |
| Tolerance ±(dB) | 1.0 | 1.0 | 1.0 |

| **UMTS Band II** | | | |
|---|---|---|---|
| Channel | Channel 9262 | Channel 9400 | Channel 9538 |
| Target (dBm) | 22.0 | 22.0 | 22.0 |
| Tolerance ±(dB) | 1.0 | 1.0 | 1.0 |
| **UMTS Band V HSDPA(sub-test 1)** | | | |
| Channel | Channel 4132 | Channel 4182 | Channel 4233 |
| Target (dBm) | 21.0 | 21.0 | 21.0 |
| Tolerance ±(dB) | 1.0 | 1.0 | 1.0 |
| **UMTS Band V HSDPA(sub-test 2)** | | | |
| Channel | Channel 4132 | Channel 4182 | Channel 4233 |
| Target (dBm) | 21.0 | 21.0 | 21.0 |
| Tolerance ±(dB) | 1.0 | 1.0 | 1.0 |
| **UMTS Band V HSDPA(sub-test 3)** | | | |
| Channel | Channel 4132 | Channel 4182 | Channel 4233 |
| Target (dBm) | 20.5 | 20.5 | 20.5 |
| Tolerance ±(dB) | 1.0 | 1.0 | 1.0 |
| **UMTS Band V HSDPA(sub-test 4)** | | | |

| Channel | Channel 4132 | Channel 4182 | Channel 4233 |
|---|---|---|---|
| Target (dBm) | 20.0 | 20.0 | 20.0 |
| Tolerance ±(dB) | 1.0 | 1.0 | 1.0 |
| **UMTS Band V HSUPA(sub-test 1)** | | | |
| Channel | Channel 4132 | Channel 4182 | Channel 4233 |
| Target (dBm) | 21.0 | 21.0 | 21.0 |
| Tolerance ±(dB) | 1.0 | 1.0 | 1.0 |
| **UMTS Band V HSUPA(sub-test 2)** | | | |
| Channel | Channel 4132 | Channel 4182 | Channel 4233 |
| Target (dBm) | 20.0 | 20.0 | 20.0 |
| Tolerance ±(dB) | 1.0 | 1.0 | 1.0 |
| **UMTS Band V HSUPA(sub-test 3)** | | | |
| Channel | Channel 4132 | Channel 4182 | Channel 4233 |
| Target (dBm) | 20.5 | 20.5 | 20.5 |
| Tolerance ±(dB) | 1.0 | 1.0 | 1.0 |
| **UMTS Band V HSUPA(sub-test 4)** | | | |
| Channel | Channel 4132 | Channel 4182 | Channel 4233 |
| Target (dBm) | 20.0 | 20.0 | 20.0 |
| Tolerance ±(dB) | 1.0 | 1.0 | 1.0 |
| **UMTS Band V HSUPA(sub-test 5)** | | | |
| Channel | Channel 4132 | Channel 4182 | Channel 4233 |
| Target (dBm) | 20.5 | 20.5 | 20.5 |
| Tolerance ±(dB) | 1.0 | 1.0 | 1.0 |

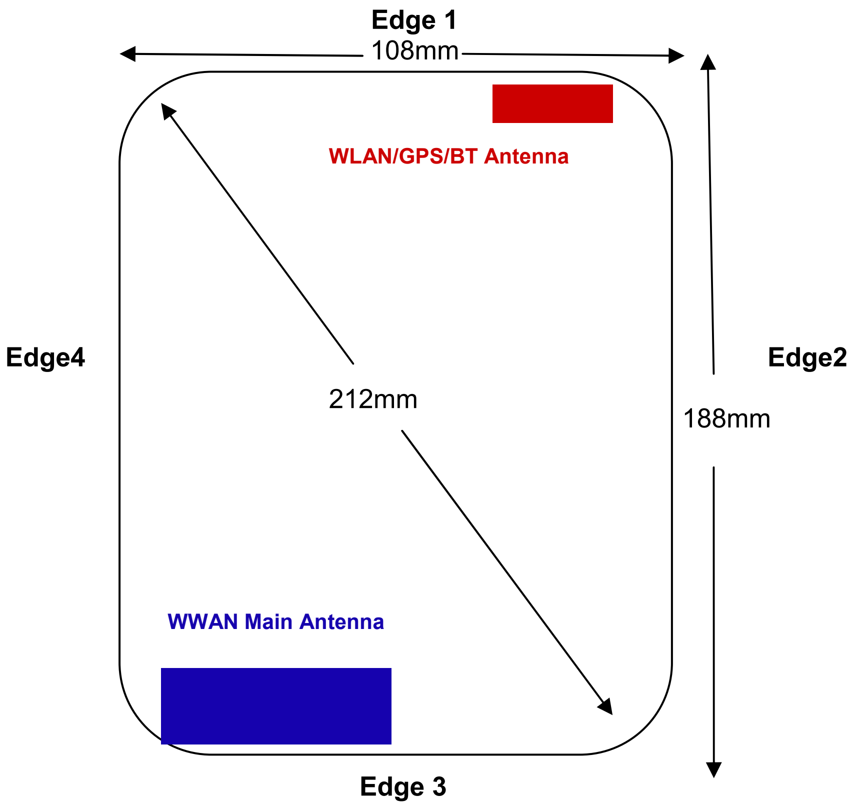
***WiFi***

| **IEEE 802.11b (Average)** | | | |
|---|---|---|---|
| Channel | Channel 1 | Channel 6 | Channel 11 |
| Target (dBm) | 13.50 | 13.50 | 13.50 |
| Tolerance ±(dB) | 1.0 | 1.0 | 1.0 |
| **IEEE 802.11g (Average)** | | | |
| Channel | Channel 1 | Channel 6 | Channel 11 |
| Target (dBm) | 13.0 | 13.0 | 13.0 |
| Tolerance ±(dB) | 1.0 | 1.0 | 1.0 |
| **IEEE 802.11n HT20 (Average)** | | | |
| Channel | Channel 1 | Channel 6 | Channel 11 |
| Target (dBm) | 11.0 | 11.0 | 11.0 |
| Tolerance ±(dB) | 1.0 | 1.0 | 1.0 |
| **IEEE 802.11n HT40 (Average)** | | | |
| Channel | Channel 3 | Channel 6 | Channel 9 |
| Target (dBm) | 9.50 | 9.50 | 9.50 |
| Tolerance ±(dB) | 1.0 | 1.0 | 1.0 |

**Bluetooth**

| **BLE GFSK (Average)** | | | |
|---|---|---|---|
| Channel | Channel | Channel 39 | Channel 78 |
| Target (dBm) | -4.0 | -5.0 | -7.0 |
| Tolerance ±(dB) | 1.0 | 1.0 | 1.0 |
| **GFSK (Average)** | | | |
| Channel | Channel | Channel 39 | Channel 78 |
| Target (dBm) | -4.0 | -5.0 | -7.0 |
| Tolerance ±(dB) | 1.0 | 1.0 | 1.0 |
| **8DPSK (Average)** | | | |
| Channel | Channel 0 | Channel 39 | Channel 78 |
| Target (dBm) | -4.0 | -5.0 | -7.0 |
| Tolerance ±(dB) | 1.0 | 1.0 | 1.0 |
| **π/4DQPSK (Average)** | | | |
| Channel | Channel 0 | Channel 39 | Channel 78 |
| Target (dBm) | -4.0 | -5.0 | -7.0 |
| Tolerance ±(dB) | 1.0 | 1.0 | 1.0 |

## 5.2. Transmit Antennas and SAR Measurement Position




**Back View**

**Antenna information:**

| | |
|---|---|
| WWAN Main Antenna | GSM/UMTS TX/RX |
| WLAN/GPS/BT Antenna | WLAN/BT TX/RX |

| Distance of The Antenna to the EUT surface and edge | | | | | |
|---|---|---|---|---|---|
| **Antennas** | **Back** | **Edge 1** | **Edge 2** | **Edge 3** | **Edge 4** |
| **WWAN** | <5mm | 163mm | 48mm | <5mm | <5mm |
| **BT&WLAN** | <5mm | <5mm | <5mm | 175mm | 73mm |

| Positions for SAR tests | | | | | |
|---|---|---|---|---|---|
| **Antennas** | **Back** | **Edge 1** | **Edge 2** | **Edge 3** | **Edge 4** |
| **WWAN** | Yes | No | Yes | Yes | Yes |
| **BT&WLAN** | Yes | Yes | Yes | No | No |

Note:
1). Per KDB616217 D04, because the overall diagonal distance of this devices is 212mm＞200mm,so
The RF exposure test requirements for transmitters and antennas operating in standalone and simultaneous transmission configurations are applied in conjunction with the test reduction and exclusion provisions in KDB Publication 447498 D01.
2). Per KDB 447498 D01, the 1-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)] · [√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

## 5.3. Standalone SAR Test Exclusion Considerations

Per KDB447498 for 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 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)] ·[ √ f(GHz)] ≤ 3.0 for 1-g SAR and ≤ 7.5 for 10-g extremity 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
- 3.0 and 7.5 are referred to as the numeric thresholds in the step 2 below

| Standalone SAR test exclusion considerations | | | | | | | |
|---|---|---|---|---|---|---|---|
| Modulation | Frequency (MHz) | Configuration | Maximum Average Power (dBm) | Separation Distance (mm) | Calculation Result | SAR Exclusion Thresholds | Standalone SAR Exclusion |
| IEEE 802.11b | 2450 | Head | 14.50 | 5 | 8.82 | 3.0 | no |
| | | Body* | 14.50 | 5 | 8.82 | 3.0 | no |
| IEEE 802.11g | 2450 | Head | 14.00 | 5 | 7.86 | 3.0 | no |
| | | Body* | 14.00 | 5 | 7.86 | 3.0 | no |
| IEEE 802.11n HT20 | 2450 | Head | 12.00 | 5 | 4.96 | 3.0 | no |
| | | Body* | 12.00 | 5 | 4.96 | 3.0 | no |
| IEEE 802.11n HT40 | 2450 | Head | 10.50 | 5 | 3.51 | 3.0 | no |
| | | Body* | 10.50 | 5 | 3.51 | 3.0 | no |
| Bluetooth* | 2450 | Head | -3.00 | 5 | 0.16 | 3.0 | yes |
| | | Body* | -3.00 | 5 | 0.16 | 3.0 | yes |

*Remark:*
1. *Maximum average power including tune-up tolerance;*
2. *Bluetooth including Lower Energy Bluetooth and classical Bluetooth;*
3. *When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion*

## 5.4. Estimated SAR

Per KDB447498 requires when the standalone SAR test exclusion of section 4.3.1 is applied to an antenna that transmits simultaneously with other antennas, the standalone SAR must be estimated according to the following to determine simultaneous transmission SAR test exclusion;
- (max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] • [ √ f(GHz)/x] W/kg for test separation distances ≤ 50 mm;
where x = 7.5 for 1-g SAR, and x = 18.75 for 10-g SAR.
- 0.4 W/kg for 1-g SAR and 1.0 W/kg for 10-g SAR, when the test separation distances is > 50 mm

Per FCC KD B447498 D01,simultaneous transmission SAR test exclusion may be applied when the sum of the 1-g SAR for all the transmitting antenna in a specific a physical test configuration is ≤1.6 W/Kg.When the sum is greater than the SAR limit,SAR test exclusion is determined by the SAR to peak location separation ratio.

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

| Estimated stand alone SAR | | | | | |
|---|---|---|---|---|---|
| Communication system | Frequency (MHz) | Configuration | Maximum Power (dBm) | Separation Distance (mm) | Estimated $SAR_{1-g}$ (W/kg) |
| Bluetooth* | 2450 | Head | -3.00 | 5 | 0.021 |
| Bluetooth* | 2450 | Body | -3.00 | 5 | 0.021 |

*Remark:*
1. *Maximum average power including tune-up tolerance;*
2. *Bluetooth including Lower Energy Bluetooth and classical Bluetooth;*
3. *When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion*

## 5.5. SAR Measurement Results

It is determined by user manual for the distance between the EUT and the phantom bottom.
The distance is 0mm
The calculated SAR is obtained by the following formula:
Reported SAR=Measured SAR$\times 10^{(PTarget-Pmeasured)/10}$
Where $P_{Target}$ is the power of manufacturing upper limit;
$P_{Measured}$ is the measured power

Duty Cycle

| Mode | Duty Cycle |
|---|---|
| Speech for GSM850/1900 | 1:8 |
| GPRS for GSM850 | 1:2 |
| GPRS for GSM1900 | 1:2 |
| WCDMA Band V | 1:1 |
| WCDMA Band II | 1:1 |
| WiFi | 1:1 |

SAR Values [GSM 850]

| Ch. | Freq. (MHz) | Time slots | Test Position | Conducted Power (dBm) | Maximum Allowed Power (dBm) | Power drift | Scaling Factor | $SAR_{1-g}$ results(W/kg) | | Graph Results |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Measured | Reported | |
| ***measured / reported SAR numbers - Head*** | | | | | | | | | | |
| 128 | 824.2 | GSM | Right Cheek | 32.69 | 33.00 | -0.08 | 1.074 | 0.215 | 0.231 | |
| 128 | 824.2 | GSM | Right Tilt | 32.69 | 33.00 | 0.09 | 1.074 | 0.124 | 0.133 | |
| 128 | 824.2 | GSM | Left Cheek | 32.69 | 33.00 | 0.05 | 1.074 | 0.225 | **0.242** | **#1** |
| 128 | 824.2 | GSM | Left Tilt | 32.69 | 33.00 | -0.04 | 1.074 | 0.137 | 0.147 | |
| ***measured / reported SAR numbers - Body (distance 0mm)*** | | | | | | | | | | |
| 128 | 824.2 | 4Txslots | Back | 29.79 | 30.00 | -0.09 | 1.050 | 0.898 | **0.942** | **#2** |
| 128 | 824.2 | 4Txslots | Edge 2 | 29.79 | 30.00 | 0.11 | 1.050 | 0.257 | 0.270 | |
| 128 | 824.2 | 4Txslots | Edge 3 | 29.79 | 30.00 | 0.04 | 1.050 | 0.521 | 0.547 | |
| 128 | 824.2 | 4Txslots | Edge 4 | 29.79 | 30.00 | -0.08 | 1.050 | 0.415 | 0.436 | |
| 190 | 836.6 | 4Txslots | Back | 29.40 | 30.00 | -0.06 | 1.148 | 0.815 | 0.936 | |
| 251 | 848.8 | 4Txslots | Back | 29.42 | 30.00 | 0.11 | 1.143 | 0.771 | 0.881 | |

SAR Values [GSM 1900]

| Ch. | Freq. (MHz) | time slots | Test Position | Conducted Power (dBm) | Maximum Allowed Power (dBm) | Power drift | Scaling Factor | $SAR_{1-g}$ results(W/kg) | | Graph Results |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Measured | Reported | |
| ***measured / reported SAR numbers - Head*** | | | | | | | | | | |
| 661 | 1880.0 | GSM | Right Cheek | 28.81 | 29.00 | -0.08 | 1.045 | 0.115 | **0.120** | **#3** |
| 661 | 1880.0 | GSM | Right Tilt | 28.81 | 29.00 | 0.10 | 1.045 | 0.084 | 0.088 | |
| 661 | 1880.0 | GSM | Left Cheek | 28.81 | 29.00 | 0.06 | 1.045 | 0.108 | 0.113 | |
| 661 | 1880.0 | GSM | Left Tilt | 28.81 | 29.00 | -0.05 | 1.045 | 0.067 | 0.070 | |
| ***measured / reported SAR numbers – Body (distance 0mm)*** | | | | | | | | | | |
| 661 | 1880.0 | 4Txslots | Back | 25.84 | 26.00 | -0.09 | 1.038 | 1.06 | 1.100 | |
| 661 | 1880.0 | 4Txslots | Edge 2 | 25.84 | 26.00 | 0.11 | 1.038 | 0.34 | 0.353 | |
| 661 | 1880.0 | 4Txslots | Edge 3 | 25.84 | 26.00 | 0.08 | 1.038 | 0.76 | 0.789 | |
| 661 | 1880.0 | 4Txslots | Edge 4 | 25.84 | 26.00 | 0.07 | 1.038 | 0.53 | 0.550 | |
| 512 | 1850.2 | 4Txslots | Back | 25.04 | 26.00 | -0.08 | 1.247 | 0.93 | **1.160** | **#4** |
| 810 | 1909.8 | 4Txslots | Back | 25.56 | 26.00 | -0.06 | 1.107 | 1.03 | 1.140 | |

SAR Values [WCDMA Band V]

| Ch. | Freq. (MHz) | Channel Type | Test Position | Conducted Power (dBm) | Maximum Allowed Power (dBm) | Power drift | Scaling Factor | $SAR_{1-g}$ results(W/kg) | | Graph Results |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Measured | Reported | |
| ***measured / reported SAR numbers - Head*** | | | | | | | | | | |
| 4132 | 826.4 | RMC | Right Cheek | 22.55 | 23.00 | -0.11 | 1.109 | 0.208 | 0.231 | |
| 4132 | 826.4 | RMC | Right Tilt | 22.55 | 23.00 | -0.12 | 1.109 | 0.114 | 0.126 | |
| 4132 | 826.4 | RMC | Left Cheek | 22.55 | 23.00 | 0.13 | 1.109 | 0.221 | **0.245** | **#5** |
| 4132 | 826.4 | RMC | Left Tilt | 22.55 | 23.00 | -0.11 | 1.109 | 0.137 | 0.152 | |
| ***measured / reported SAR numbers - Body (distance 0mm)*** | | | | | | | | | | |
| 4132 | 826.4 | RMC | Back | 22.55 | 23.00 | -0.12 | 1.109 | 0.853 | 0.946 | |
| 4132 | 826.4 | RMC | Edge 2 | 22.55 | 23.00 | 0.08 | 1.109 | 0.217 | 0.241 | |
| 4132 | 826.4 | RMC | Edge 3 | 22.55 | 23.00 | -0.09 | 1.109 | 0.507 | 0.562 | |
| 4132 | 826.4 | RMC | Edge 4 | 22.55 | 23.00 | 0.10 | 1.109 | 0.389 | 0.431 | |
| 4182 | 836.4 | RMC | Back | 22.24 | 23.00 | -0.08 | 1.109 | 0.815 | **0.971** | **#6** |
| 4233 | 846.6 | RMC | Back | 22.35 | 23.00 | -0.08 | 1.109 | 0.827 | 0.961 | |

**SAR Values [WCDMA Band II]**

| Ch. | Freq. (MHz) | Channel Type | Test Position | Conducted Power (dBm) | Maximum Allowed Power (dBm) | Power drift | Scaling Factor | $SAR_{1-g}$ results(W/kg) | | Graph Results |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Measured | Reported | |
| ***measured / reported SAR numbers - Head*** | | | | | | | | | | |
| 9262 | 1852.4 | RMC | Right Cheek | 22.77 | 23.00 | -0.11 | 1.054 | 0.127 | **0.134** | **#7** |
| 9262 | 1852.4 | RMC | Right Tilt | 22.77 | 23.00 | -0.12 | 1.054 | 0.089 | 0.094 | |
| 9262 | 1852.4 | RMC | Left Cheek | 22.77 | 23.00 | 0.13 | 1.054 | 0.112 | 0.118 | |
| 9262 | 1852.4 | RMC | Left Tilt | 22.77 | 23.00 | -0.11 | 1.054 | 0.074 | 0.078 | |
| ***measured / reported SAR numbers - Body (distance 0mm)*** | | | | | | | | | | |
| 9262 | 1852.4 | RMC | Back | 22.77 | 23.00 | -0.12 | 1.054 | 1.1 | **1.160** | **#8** |
| 9262 | 1852.4 | RMC | Edge 2 | 22.77 | 23.00 | 0.08 | 1.054 | 0.42 | 0.443 | |
| 9262 | 1852.4 | RMC | Edge 3 | 22.77 | 23.00 | -0.09 | 1.054 | 0.73 | 0.770 | |
| 9262 | 1852.4 | RMC | Edge 4 | 22.77 | 23.00 | 0.10 | 1.054 | 0.55 | 0.580 | |
| 9400 | 1880 | RMC | Back | 22.56 | 23.00 | -0.08 | 1.054 | 1.04 | 1.151 | |
| 9538 | 1907.6 | RMC | Back | 22.50 | 23.00 | -0.08 | 1.054 | 1.01 | 1.133 | |

**SAR Values [WIFI2.4G]**

| Ch. | Freq. (MHz) | Service | Test Position | Maximum Allowed Power (dBm) | Conducted Power (dBm) | Power drift | Scaling Factor | $SAR_{1-g}$ results(W/kg) | | Graph Results |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Measured | Reported | |
| ***measured / reported SAR numbers - Head*** | | | | | | | | | | |
| 1 | 2412 | DSSS | Right Cheek | 14.21 | 14.50 | 0.08 | 1.069 | 0.231 | 0.247 | |
| 1 | 2412 | DSSS | Right Tilt | 14.21 | 14.50 | -0.11 | 1.069 | 0.168 | 0.180 | |
| 1 | 2412 | DSSS | Left Cheek | 14.21 | 14.50 | 0.09 | 1.069 | 0.274 | **0.293** | **#9** |
| 1 | 2412 | DSSS | Left Tilt | 14.21 | 14.50 | -0.07 | 1.069 | 0.187 | 0.200 | |
| ***measured / reported SAR numbers – Body(distance 0mm)*** | | | | | | | | | | |
| 1 | 2412 | DSSS | Back | 14.21 | 14.50 | -0.12 | 1.069 | 0.334 | **0.357** | **#10** |
| 1 | 2412 | DSSS | Edge1 | 14.21 | 14.50 | 0.10 | 1.069 | 0.186 | 0.199 | |
| 1 | 2412 | DSSS | Edge 2 | 14.21 | 14.50 | -0.08 | 1.069 | 0.114 | 0.122 | |

Note:
1. The value with black color is the maximum Reported SAR Value of each test band.
2. Per FCC KDB Publication 447498 D01, if the reported (scaled) SAR measured at the middle channel or highest output power channel for each test configuration is ≤ 0.8 W/kg then testing at the other channels is optional for such test configuration(s).
3. Per KDB 941225 D01, RMC 12.2kbps setting is used to evaluate SAR. If HSDPA/HSUPA output power is < 0.25dB higher than RMC, or reported SAR with RMC 12.2kbps setting is ≤ 1.2W/kg, HSDPA/HSUPA SAR evaluation can be excluded.
4. Per KDB 248227 D01, When the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg.

**Repeat SAR**

| No. | Band | Mode | Test Position | Maximum Allowed Power (dBm) | Conducted Power (dBm) | Power drift | Scaling Factor | $SAR_{1-g}$ results(W/kg) | | Ratio |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Measured | Reported | |
| 1st | GSM850 | 4Tx slots | Back | 29.79 | 30.00 | -0.09 | 1.050 | 0.898 | **0.942** | 1 |
| 2nd | GSM850 | 4Tx slots | Back | 29.79 | 30.00 | 0.04 | 1.050 | 0.891 | **0.935** | 1.01 |
| 1st | WCDMA Band II | RMC | Back | 22.77 | 23.00 | -0.12 | 1.054 | 1.1 | **1.160** | 1 |
| 2nd | WCDMA Band II | RMC | Back | 22.77 | 23.00 | -0.11 | 1.054 | 1.09 | **1.149** | 1.01 |

General Note:
1. Per KDB 865664 D01, for each frequency band, repeated SAR measurement is required only when the measured SAR is ≥0.8W/kg
2. Per KDB 865664 D01, if the ratio among the repeated measurement is ≤ 1.2 and the measured SAR <1.45W/kg, only one repeated measurement is required.
3. The ratio is the difference in percentage between original and repeated measured SAR.

## 5.6. Simultaneous TX SAR Considerations

### 5.6.1 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/n and Bluetooth devices which may simultaneously transmit with the licensed transmitter.
For the DUT,the BT and WiFi modules sharing same antenna,GSM and WCDMA module sharing a single antenna;

Application Simultaneous Transmission information:

| **Air-Interface** | **Band (MHz)** | **Type** | **Simultaneous Transmissions** | **Voice over Digital Transport(Data)** |
|---|---|---|---|---|
| GSM | 850 | VO | Yes,WLAN or BT/BLE | N/A |
| | 1900 | VO | | |
| | GPRS/EDGE | DT | Yes,WLAN or BT/BLE | N/A |
| WCDMA | BandV/Band II | DT | Yes,WLAN or BT/BLE | N/A |
| WLAN | 2450 | DT | Yes,GSM,GPRS,EGPRS,UMTS | Yes |
| BT/BLE | 2450 | DT | Yes,GSM,GPRS,EGPRS,UMTS | N/A |
| Note:VO-Voice Service only;DT-Digital Transport | | | | |

Note: BT and WLAN share the same antenna,so they can‘t transmit at the same time.

## 5.6.2 Evaluation of Simultaneous SAR

### *Head Exposure Conditions*

**Simultaneous transmission SAR for WiFi and GSM/WCDMA**

| Test Position | GSM850 Reported $SAR_{1-g}$ (W/Kg) | GSM1900 Reported $SAR_{1-g}$ (W/Kg) | WCDMA Band V Reported $SAR_{1-g}$ (W/Kg) | WCDMA Band II Reported $SAR_{1-g}$ (W/Kg) | WiFi Reported $SAR_{1-g}$ (W/Kg) | MAX. $\Sigma SAR_{1-g}$ (W/Kg) | $SAR_{1-g}$ Limit (W/Kg) | Peak location separation ratio | Simut. Meas. Required |
|---|---|---|---|---|---|---|---|---|---|
| Right Cheek | 0.231 | **0.12** | 0.231 | **0.134** | 0.247 | **0.478** | 1.6 | no | no |
| Right Tilt | 0.133 | 0.088 | 0.126 | 0.094 | 0.18 | **0.313** | 1.6 | no | no |
| Left Cheek | **0.242** | 0.113 | 0.245 | 0.118 | **0.293** | **0.538** | 1.6 | no | no |
| Left Tilt | 0.147 | 0.07 | 0.152 | 0.078 | 0.2 | **0.352** | 1.6 | no | no |

**Simultaneous transmission SAR for Bluetooth and GSM/WCDMA**

| Test Position | GSM850 Reported $SAR_{1-g}$ (W/Kg) | GSM1900 Reported $SAR_{1-g}$ (W/Kg) | WCDMA Band V Reported $SAR_{1-g}$ (W/Kg) | WCDMA Band II Reported $SAR_{1-g}$ (W/Kg) | Bluetooth Estimated $SAR_{1-g}$ (W/Kg) | MAX. $\Sigma SAR_{1-g}$ (W/Kg) | $SAR_{1-g}$ Limit (W/Kg) | Peak location separation ratio | Simut. Meas. Required |
|---|---|---|---|---|---|---|---|---|---|
| Right Cheek | 0.231 | **0.12** | 0.231 | **0.134** | 0.021 | **0.252** | 1.6 | no | no |
| Right Tilt | 0.133 | 0.088 | 0.126 | 0.094 | 0.021 | **0.154** | 1.6 | no | no |
| Left Cheek | **0.242** | 0.113 | 0.245 | 0.118 | 0.021 | **0.266** | 1.6 | no | no |
| Left Tilt | 0.147 | 0.07 | 0.152 | 0.078 | 0.021 | **0.173** | 1.6 | no | no |

### *Hotsopt Exposure Conditions*

**Simultaneous transmission SAR for WiFi and GSM/WCDMA**

| Test Position | GSM850 Reported $SAR_{1-g}$ (W/Kg) | GSM1900 Reported $SAR_{1-g}$ (W/Kg) | WCDMA Band V Reported $SAR_{1-g}$ (W/Kg) | WCDMA Band II Reported $SAR_{1-g}$ (W/Kg) | WiFi Reported $SAR_{1-g}$ (W/Kg) | MAX. $\Sigma SAR_{1-g}$ (W/Kg) | $SAR_{1-g}$ Limit (W/Kg) | Peak location separation ratio | Simut. Meas. Required |
|---|---|---|---|---|---|---|---|---|---|
| Back | **0.942** | **1.16** | **0.971** | **1.16** | **0.357** | **1.517** | 1.6 | no | no |
| Edge 1 | / | / | / | / | 0.199 | **0.199** | 1.6 | no | no |
| Edge 2 | 0.27 | 0.353 | 0.241 | 0.443 | 0.122 | **0.565** | 1.6 | no | no |
| Edge 3 | 0.547 | 0.789 | 0.562 | 0.77 | / | **0.789** | 1.6 | no | no |
| Edge 4 | 0.436 | 0.55 | 0.431 | 0.58 | / | **0.58** | 1.6 | no | no |

**Simultaneous transmission SAR for Bluetooth and GSM/WCDMA**

| Test Position | GSM850 Reported $SAR_{1-g}$ (W/Kg) | GSM1900 Reported $SAR_{1-g}$ (W/Kg) | WCDMA Band V Reported $SAR_{1-g}$ (W/Kg) | WCDMA Band II Reported $SAR_{1-g}$ (W/Kg) | Bluetooth Estimated $SAR_{1-g}$ (W/Kg) | MAX. $\Sigma SAR_{1-g}$ (W/Kg) | $SAR_{1-g}$ Limit (W/Kg) | Peak location separation ratio | Simut. Meas. Required |
|---|---|---|---|---|---|---|---|---|---|
| Back | **0.942** | **1.16** | **0.971** | **1.16** | 0.021 | **1.181** | 1.6 | no | no |
| Edge 1 | / | / | / | / | 0.021 | **0.021** | 1.6 | no | no |
| Edge 2 | 0.27 | 0.353 | 0.241 | 0.443 | 0.021 | **0.464** | 1.6 | no | no |
| Edge 3 | 0.547 | 0.789 | 0.562 | 0.77 | 0.021 | **0.81** | 1.6 | no | no |
| Edge 4 | 0.436 | 0.55 | 0.431 | 0.58 | 0.021 | **0.601** | 1.6 | no | no |

Note:
1. The WiFi and BT share same antenna, so cannot transmit at same time.
2. The value with block color is the maximum values of standalone
3. The value with blue color is the maximum values of $\sum SAR_{1-g}$

## 5.7. Measurement Uncertainty (300MHz-3GHz)

Not required as SAR measurement uncertainty analysis is required in SAR reports only when the highest measured SAR in a frequency band is ≥ 1.5 W/kg for 1-g SAR accoridng to KDB865664D01.

## 5.8. System Check Results

Date: 4/9/2017

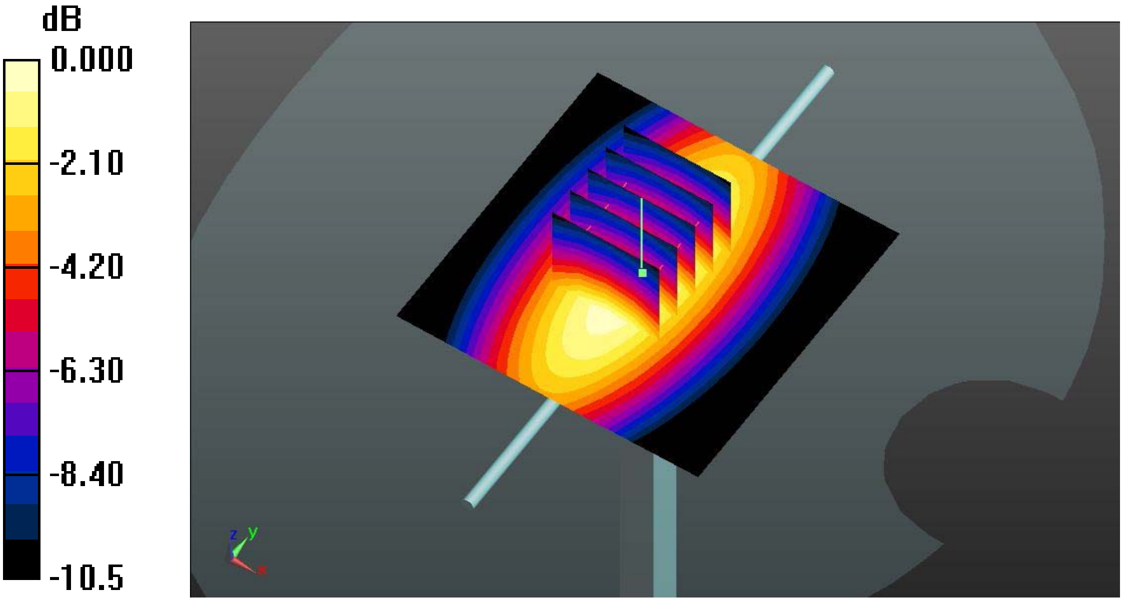
**DUT: Dipole 835MHz; Type: D835V2; Serial: D835V2 - SN: 4d069**
**Program Name: System Performance Check Head at 835 MHz**

Communication System: CW; Frequency: 835 MHz;Duty Cycle: 1:1
Medium parameters used: f = 835 MHz; $\sigma$ = 0.95 mho/m; $\varepsilon_r$ = 42.8; $\rho$ = 1000 kg/$m^3$
Phantom section: Flat Section

DASY5 Configuration:
-Probe: ES3DV3 - SN3292;ConvF(6.53, 6.53, 6.53); Calibrated: 09/02/2016;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
-Electronics: DAE4 Sn1315; Calibrated: 7/26/2016
- Phantom: SAM 2; Type: SAM; Serial: TP-1432
- Measurement SW: DASY5, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

**d=15mm, Pin=250mW/Area Scan (61x131x1):** Interpolated grid: dx=1.5mm, dy=1.5mm
Maximum value of SAR (interpolated) = 2.61 mW/g

**d=15mm, Pin=250mW/Zoom Scan (7X7x7) Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 50.235 V/m; Power Drift = 0.07dB
Peak SAR (extrapolated) = 3.43 W/kg
**SAR(1 g) = 2.26 mW/g; SAR(10 g) = 1.50 mW/g**
Maximum value of SAR (measured) = 2.68 mW/g




0 dB = 2.68 mW/g

Date: 4/10/2017

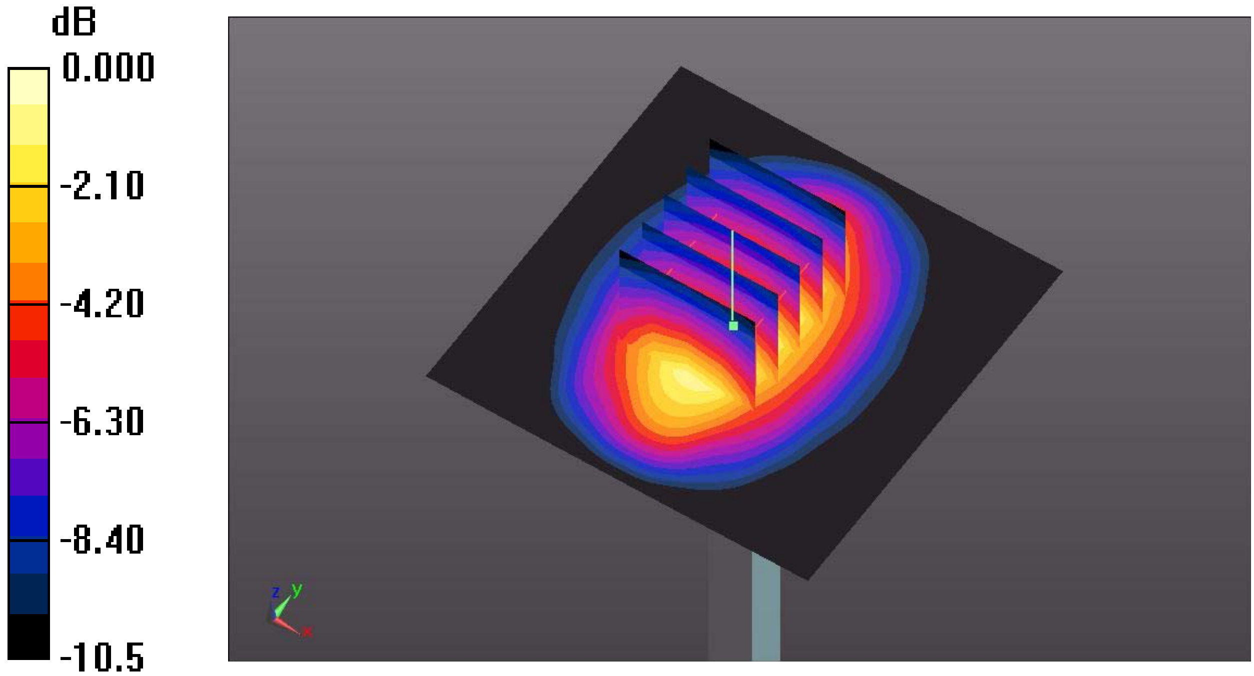
**DUT: Dipole 835MHz; Type: D835V2; Serial: D835V2 - SN: 4d069**
**Program Name: System Performance Check at 835 MHz Body**

Communication System: CW; Frequency: 835 MHz;Duty Cycle: 1:1
Medium parameters used: f = 835 MHz; σ = 1.02 mho/m; $\varepsilon_r$ = 57.01; ρ = 1000 kg/m$^3$
Phantom section: Flat Section

DASY5 Configuration:
-Probe: ES3DV3 - SN3292;ConvF(6.27, 6.27, 6.27); Calibrated: 09/02/2016;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
-Electronics: DAE4 Sn1315; Calibrated: 7/26/2016
- Phantom: SAM 3; Type: SAM; Serial: TP-1132
- Measurement SW: DASY5, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

**d=15mm, Pin=250mW/Area Scan (61x131x1):** Interpolated grid: dx=1.5mm, dy=1.5mm
Maximum value of SAR (interpolated) = 2.849 mW/g

**d=15mm, Pin=250mW/Zoom Scan (7X7x7) /Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 57.585 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 3.871 W/kg
**SAR(1 g) = 2.53 mW/g; SAR(10 g) = 1.65 mW/g**
Maximum value of SAR (measured) = 3.302 mW/g




0 dB = 3.302 mW/g

Date: 4/9/2017

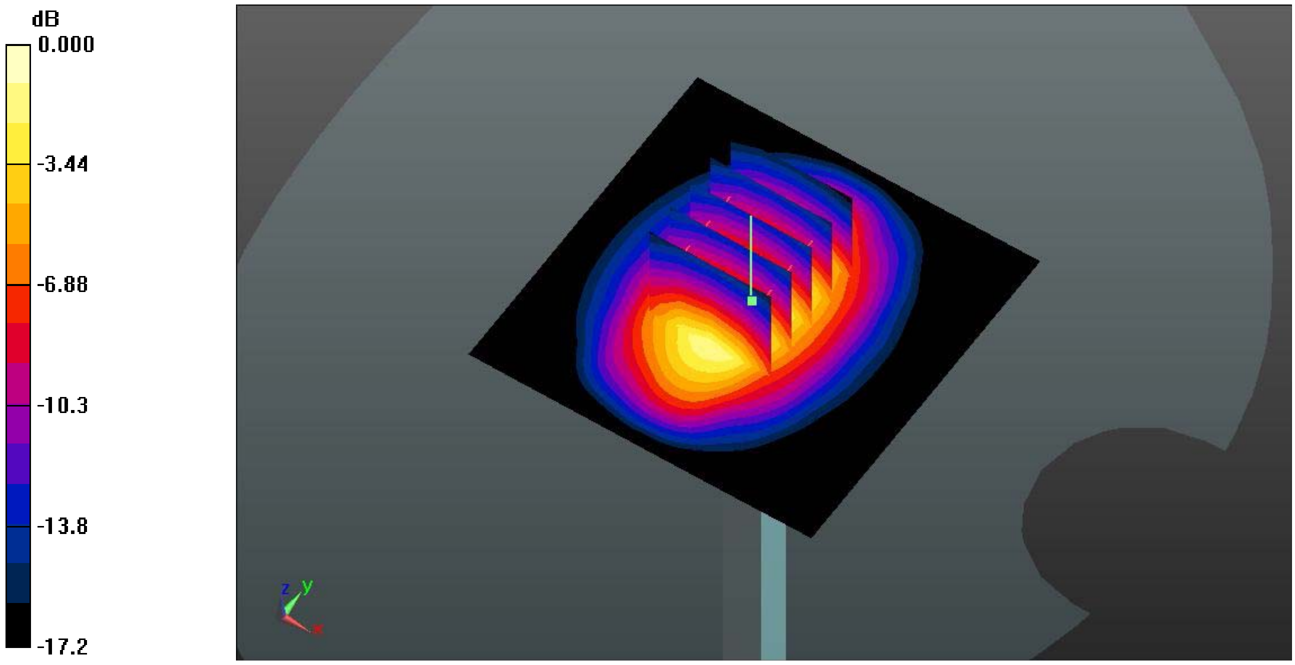
**DUT: Dipole 1900MHz; Type: D1900V2; Serial: 5d194**
**Program Name: System Performance Check Head at 1900 MHz**

Communication System: CW; Frequency: 1900 MHz;Duty Cycle: 1:1
Medium parameters used: f = 1900 MHz; $\sigma$ = 1.44 mho/m; $\varepsilon_r$ = 41.3; $\rho$ = 1000 kg/$m^3$
Phantom section: Flat Section

DASY5 Configuration:
-Probe: ES3DV3 - SN3292;ConvF(6.40, 6.40, 6.40); Calibrated: 09/02/2016;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
-Electronics: DAE4 Sn1315; Calibrated: 7/26/2016
- Phantom: SAM 2; Type: SAM; Serial: TP-1432
- Measurement SW: DASY5, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

**d=15mm, Pin=250mW/Area Scan (61x131x1):** Interpolated grid: dx=1.5mm, dy=1.5mm
Maximum value of SAR (interpolated) = 13.476 mW/g

**d=15mm, Pin=250mW/Zoom Scan Scan (7X7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 93.267 V/m; Power Drift = -0.05 dB
Peak SAR (extrapolated) = 19.227 W/kg
**SAR(1 g) = 10.35 mW/g; SAR(10 g) = 5.32 mW/g**
Maximum value of SAR (measured) = 13.5 mW/g




0 dB = 13.5 mW/g

Date: 4/10/2017

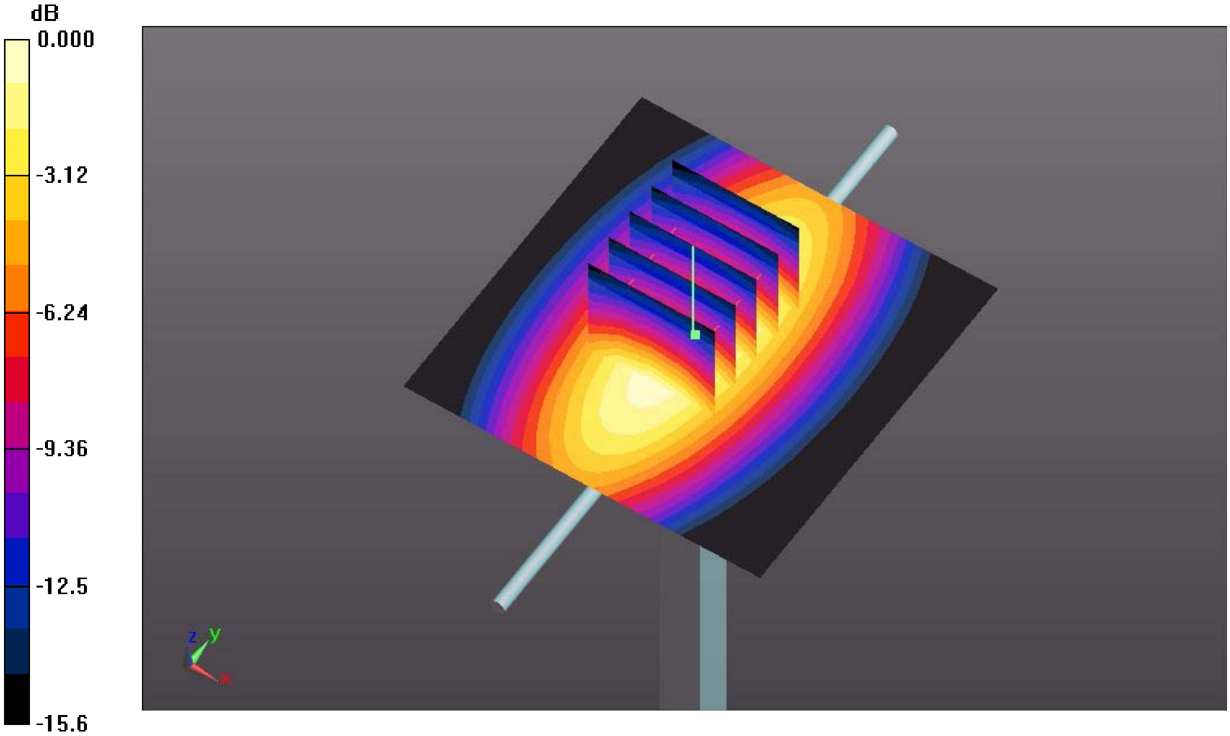
**DUT: Dipole 1900MHz; Type: D1900V2; Serial: 5d194**
**Program Name: System Performance Check at Body 1900 MHz**

Communication System: CW; Frequency: 1900 MHz;Duty Cycle: 1:1
Medium parameters used: f = 1900 MHz; $\sigma$ = 1.58 mho/m; $\varepsilon_r$ = 55.2; $\rho$ = 1000 kg/$m^3$
Phantom section: Flat Section

DASY5 Configuration:
-Probe: ES3DV3 - SN3292;ConvF(5.05, 5.05, 5.05); Calibrated: 09/02/2016;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
-Electronics: DAE4 Sn1315; Calibrated: 7/26/2016
- Phantom: SAM 3; Type: SAM; Serial: TP-1132
- Measurement SW: DASY5, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

**d=15mm, Pin=250mW/Area Scan (61x131x1):** Interpolated grid: dx=1.5mm, dy=1.5mm
Maximum value of SAR (interpolated) = 13.4 mW/g

**d=15mm, Pin=250mW/Zoom Scan (5X5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 91.52 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 18.7 W/kg
**SAR(1 g) = 9.95 mW/g; SAR(10 g) = 5.09 mW/g**
Maximum value of SAR (measured) = 12.8 mW/g




0 dB = 12.8 mW/g

Date: 4/11/2017

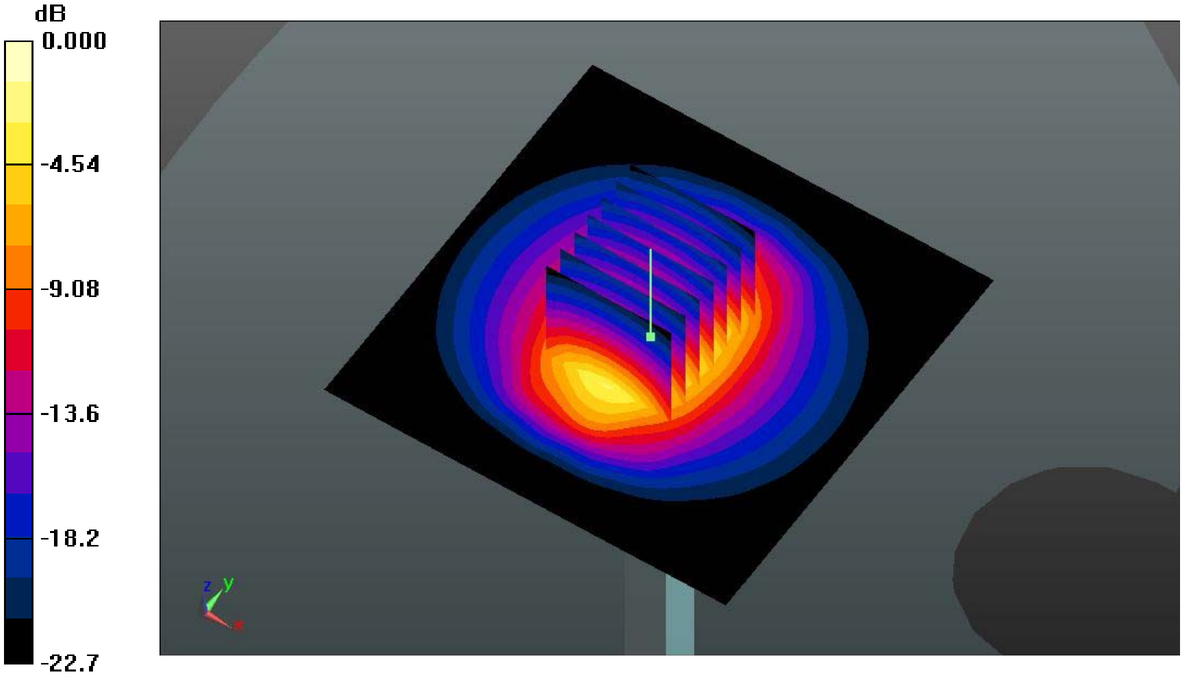
**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: 955**
**Program Name: System Performance Check Head at 2450 MHz**

Communication System: CW; Frequency: 2450 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2450 MHz; σ = 1.83 mho/m; $\varepsilon_r$ = 38.19; ρ = 1000 kg/$m^3$
Phantom section: Flat Section

DASY5 Configuration:
-Probe: ES3DV3 - SN3292;ConvF(4.97, 4.97, 4.97); Calibrated: 09/02/2016;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
-Electronics: DAE4 Sn1315; Calibrated: 7/26/2016
- Phantom: SAM 2; Type: SAM; Serial: TP-1432
- Measurement SW: DASY5, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

**d=15mm, Pin=250mW/Area Scan (61x131x1):** Interpolated grid: dx=1.2mm, dy=1.2mm
Maximum value of SAR (interpolated) = 16.7 mW/g

**d=15mm, Pin=250mW/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 87.0 V/m; Power Drift = 0.019 dB
Peak SAR (extrapolated) = 30.7 W/kg
**SAR(1 g) = 13.3 mW/g; SAR(10 g) = 6.45 mW/g**
Maximum value of SAR (measured) = 16.2 mW/g




0 dB = 16.2 mW/g

Date: 4/11/2017

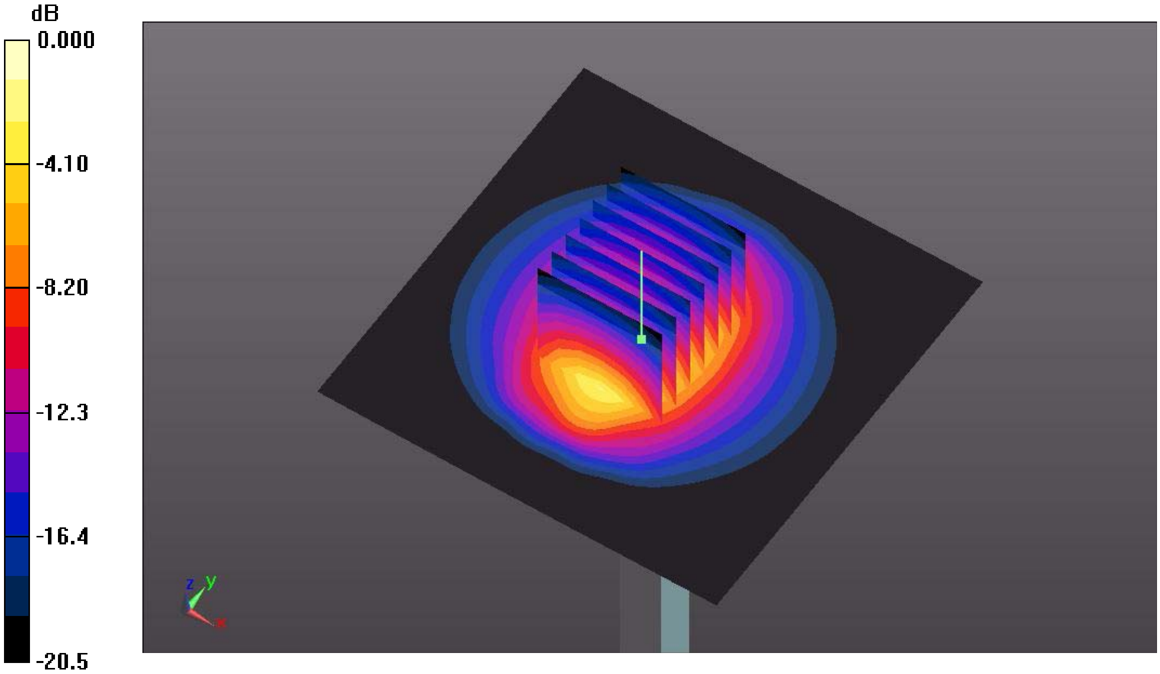
**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: 955**
**Program Name: System Performance Check Body at 2450 MHz**

Communication System: CW; Frequency: 2450 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2450 MHz; $\sigma$ = 1.90 mho/m; $\varepsilon_r$ = 50.59; $\rho$ = 1000 kg/$m^3$
Phantom section: Flat Section

DASY5 Configuration:
-Probe: ES3DV3 - SN3292;ConvF(4.70, 4.70, 4.70); Calibrated: 09/02/2016;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
-Electronics: DAE4 Sn1315; Calibrated: 7/26/2016
- Phantom: SAM 3; Type: SAM; Serial: TP-1132
- Measurement SW: DASY5, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

**d=10mm, Pin=250mW/Area Scan (91x91x1):** Interpolated grid: dx=1.2mm, dy=1.2mm
Maximum value of SAR (interpolated) = 16.2 mW/g

**d=10mm, Pin=250mW/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 89.5 V/m; Power Drift = 0.017 dB
Peak SAR (extrapolated) = 27.0 W/kg
**SAR(1 g) = 13.5 mW/g; SAR(10 g) = 6.34 mW/g**
Maximum value of SAR (measured) = 15.4 mW/g




0 dB = 15.4 mW/g

## 5.9. SAR Test Graph Results

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

**#1**

**GSM850_GSM Voice_Left Cheek_Ch128**

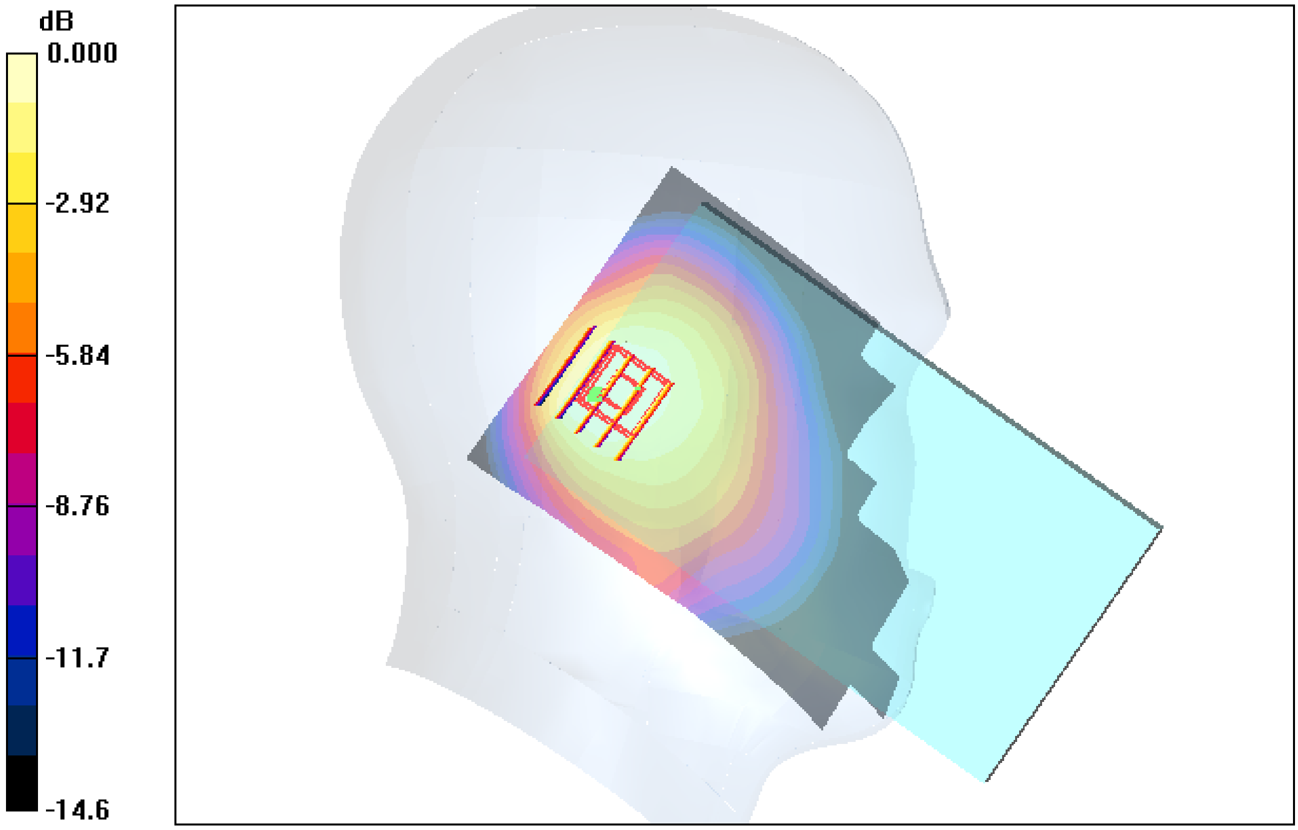
Date: 4/9/2017

Communication System: GSM850; Frequency: 824.2 MHz;
Medium parameters used (interpolated): f = 824.2 MHz; σ = 0.978 mho/m; $\varepsilon_r$ = 41.1; ρ = 1000 kg/$m^3$ ;
Phantom section: Left Section

DASY5 Configuration:
-Probe: ES3DV3 - SN3292;ConvF(6.53, 6.53, 6.53); Calibrated: 09/02/2016;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
-Electronics: DAE4 Sn1315; Calibrated: 7/26/2016
- Phantom: SAM 2; Type: SAM; Serial: TP-1432
- Measurement SW: DASY5, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

**Ch128/Area Scan (81x141x1):** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.273 mW/g

**Ch128/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 15.3 V/m; Power Drift = -0.08 dB
Peak SAR (extrapolated) = 0.355 W/kg
**SAR(1 g) = 0.225 mW/g; SAR(10 g) = 0.151 mW/g**
Maximum value of SAR (measured) = 0.271 mW/g



**#2**

**GSM850_GPRS(4 Tx slots)_Back_0cm_Ch128**

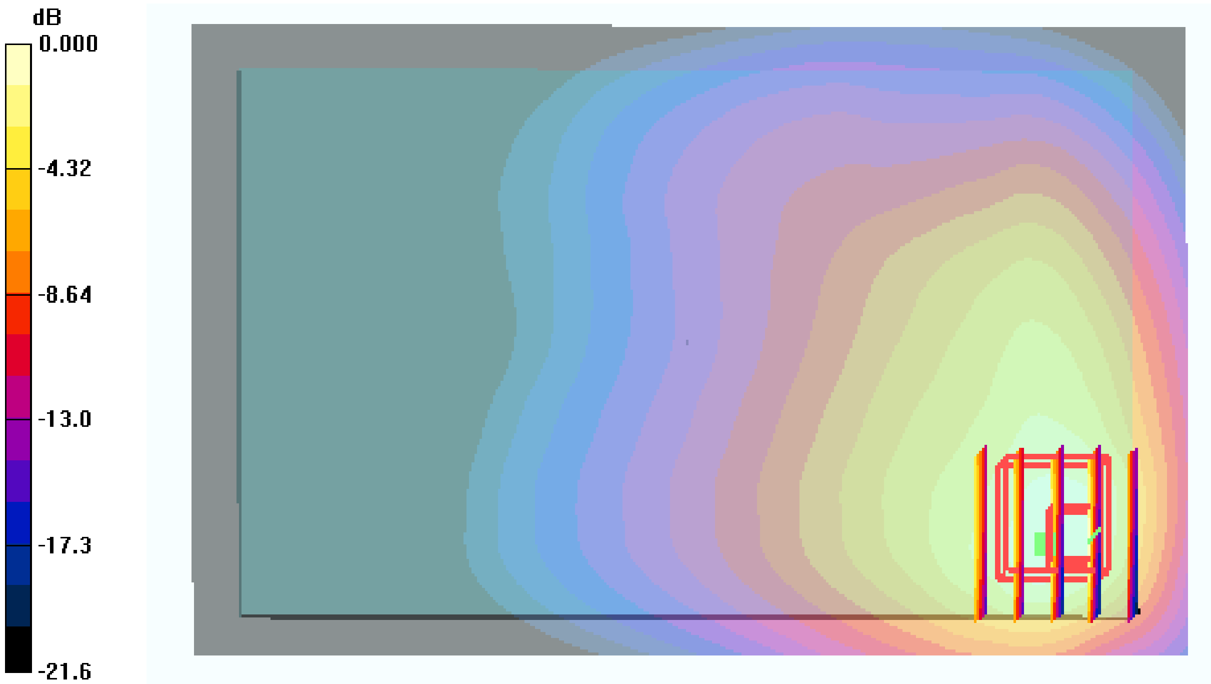
Date: 4/10/2017

Communication System: GPRS 850 class12; Frequency: 824.2 MHz;
Medium parameters used (interpolated): f = 824.2 MHz; $\sigma$ = 1.01 mho/m; $\varepsilon_r$ = 57.32; $\rho$ = 1000 kg/$m^3$ ;
Phantom section: Flat Section

DASY5 Configuration:
-Probe: ES3DV3 - SN3292;ConvF(6.27, 6.27, 6.27); Calibrated: 09/02/2016;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
-Electronics: DAE4 Sn1315; Calibrated: 7/26/2016
- Phantom: SAM 3; Type: SAM; Serial: TP-1132
- Measurement SW: DASY5, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

**Ch128/Area Scan (81x141x1):** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 1.14 mW/g

**Ch128/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 8.05 V/m; Power Drift = -0.09 dB
Peak SAR (extrapolated) = 1.46 W/kg
**SAR(1 g) = 0.898 mW/g; SAR(10 g) = 0.451 mW/g**
Maximum value of SAR (measured) = 1.10 mW/g



#3

**GSM1900_GSM Voice_Right Cheek_Ch661**

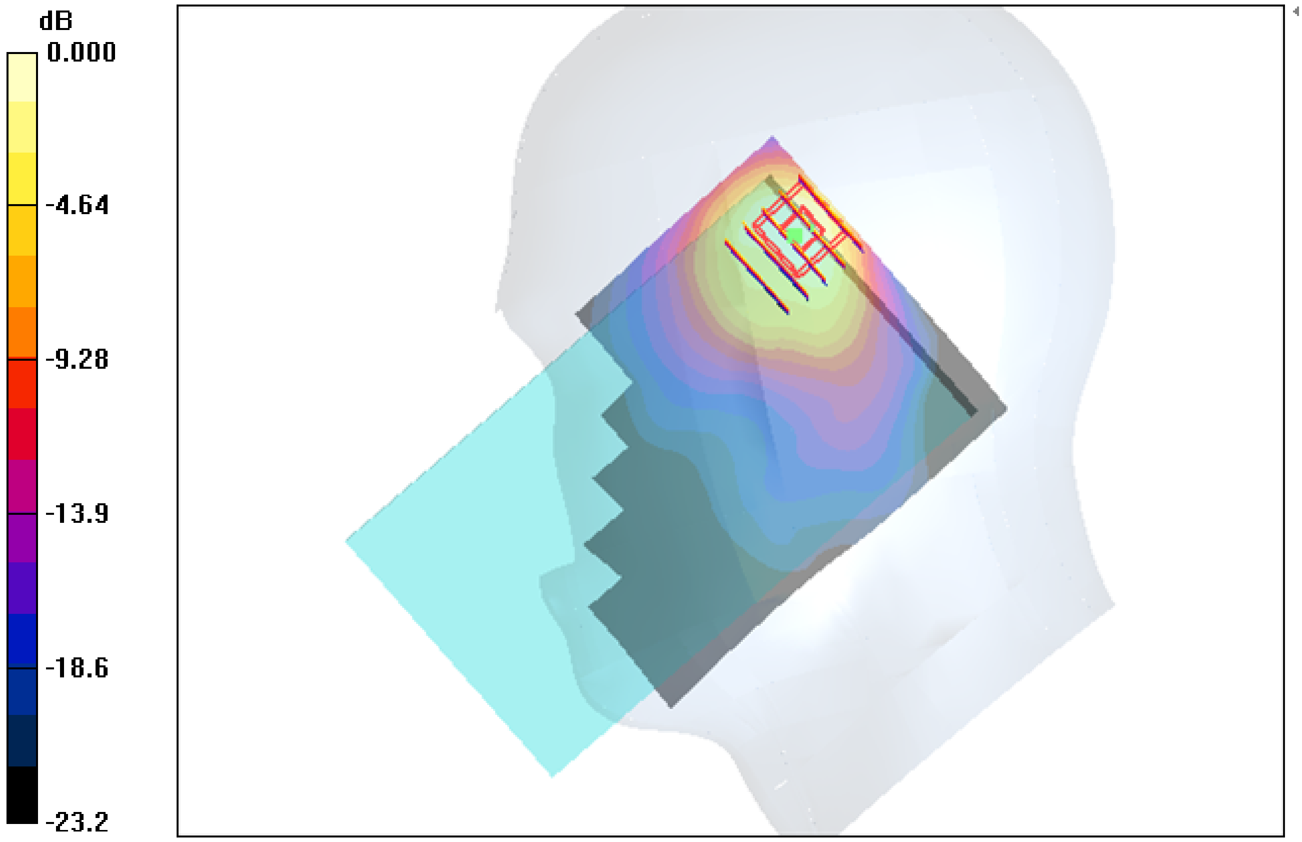
Date: 4/9/2017

Communication System: GSM 1900; Frequency: 1880 MHz;
Medium parameters used: f = 1880 MHz; σ = 1.40 mho/m; $\varepsilon_r$ = 42.2; ρ = 1000 kg/m$^3$ ;
Phantom section: Flat Section

DASY5 Configuration:
-Probe: ES3DV3 - SN3292;ConvF(6.40, 6.40, 6.40); Calibrated: 09/02/2016;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
-Electronics: DAE4 Sn1315; Calibrated: 7/26/2016
- Phantom: SAM 2; Type: SAM; Serial: TP-1432
- Measurement SW: DASY5, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

**Ch661/Area Scan (81x141x1):** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.145 mW/g

**Ch661/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 18.8 V/m; Power Drift = -0.08 dB
Peak SAR (extrapolated) = 0.27 W/kg
**SAR(1 g) = 0.115 mW/g; SAR(10 g) = 0.083 mW/g**
Maximum value of SAR (measured) = 0.129 mW/g



#4

**GSM1900_GPRS(4 Tx slots)_Back_0cm_Ch512**

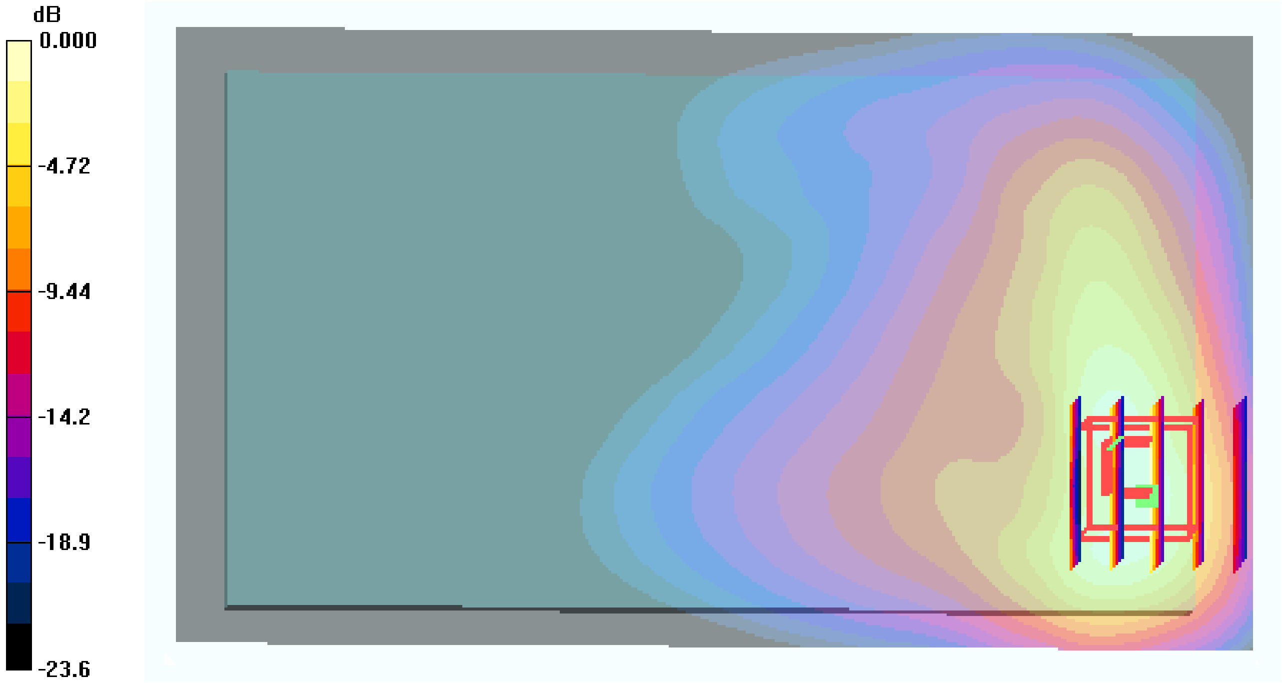
Date: 4/10/2017

Communication System: GPRS 1900 class 12; Frequency: 1850.2 MHz;
Medium parameters used: f = 1850.2 MHz; $\sigma$ = 1.57 mho/m; $\varepsilon_r$ = 55.6; $\rho$ = 1000 kg/$m^3$ ;
Phantom section: Flat Section

DASY5 Configuration:
-Probe: ES3DV3 - SN3292;ConvF(5.05, 5.05, 5.05); Calibrated: 09/02/2016;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
-Electronics: DAE4 Sn1315; Calibrated: 7/26/2016
- Phantom: SAM 3; Type: SAM; Serial: TP-1132
- Measurement SW: DASY5, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

**Ch512/Area Scan (81x141x1):** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 1.09 mW/g

**Ch512/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 4.93 V/m; Power Drift = -0.08 dB
Peak SAR (extrapolated) = 1.8 W/kg
**SAR(1 g) = 0.93 mW/g; SAR(10 g) = 0.51 mW/g**
Maximum value of SAR (measured) =1.08 mW/g



**#5**

**WCDMA V_RMC 12.2K_Left Cheek_Ch4132**

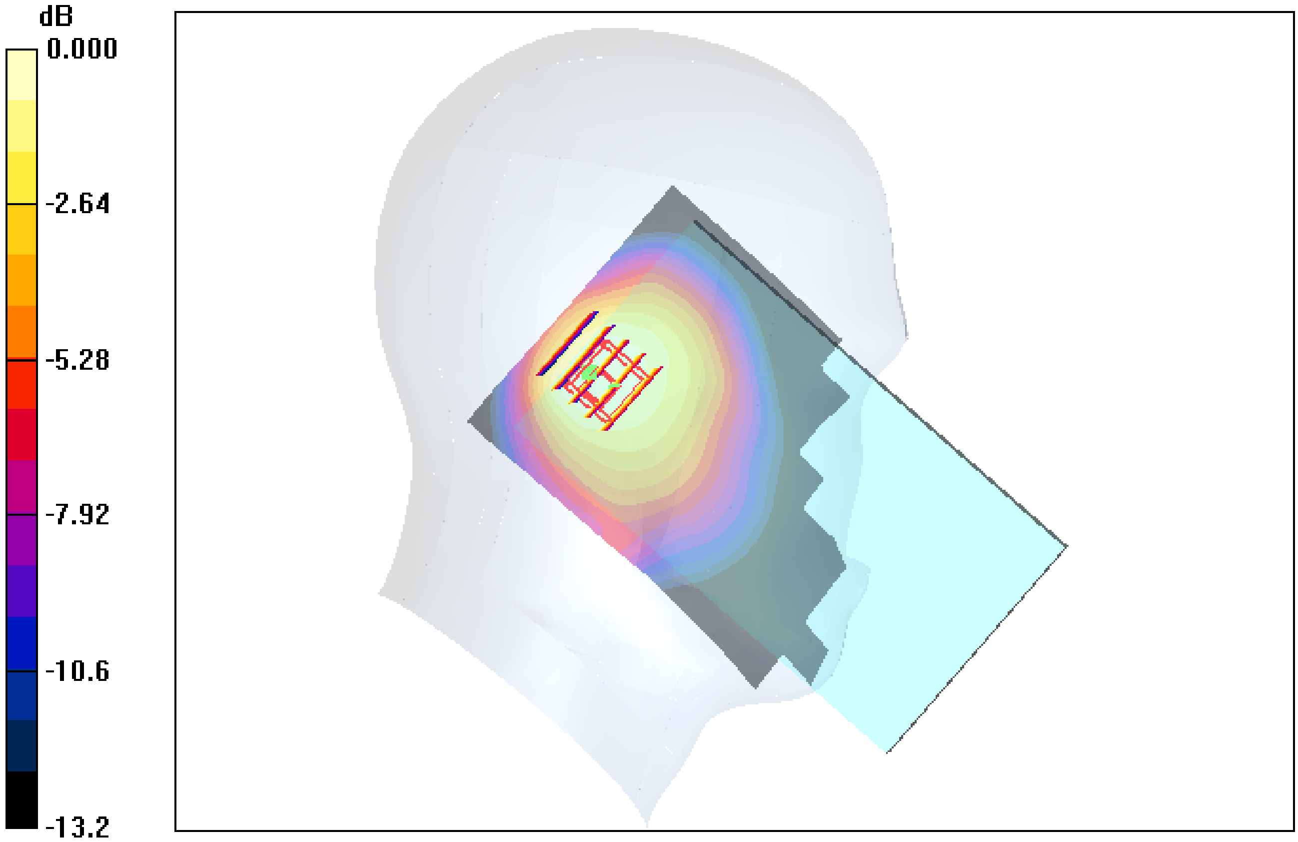
Date: 4/9/2017

Communication System: WCDMA FDD V; Frequency: 826.4 MHz;
Medium parameters used (interpolated): f = 826.4 MHz; σ = 0.98 mho/m; $\varepsilon_r$ = 41.01; ρ = 1000 kg/m$^3$ ;
Phantom section: Left Section

DASY5 Configuration:
-Probe: ES3DV3 - SN3292;ConvF(6.53, 6.53, 6.53); Calibrated: 09/02/2016;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
-Electronics: DAE4 Sn1315; Calibrated: 7/26/2016
- Phantom: SAM 2; Type: SAM; Serial: TP-1432
- Measurement SW: DASY5, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

**Ch4132/Area Scan (81x141x1):** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.23 mW/g

**Ch4132/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 14.0 V/m; Power Drift = 0.13 dB
Peak SAR (extrapolated) = 0.381 W/kg
**SAR(1 g) = 0.221 mW/g; SAR(10 g) = 0.141 mW/g**
Maximum value of SAR (measured) = 0.24 mW/g



#6

**WCDMA V_RMC 12.2K_Back_0cm_Ch4182**

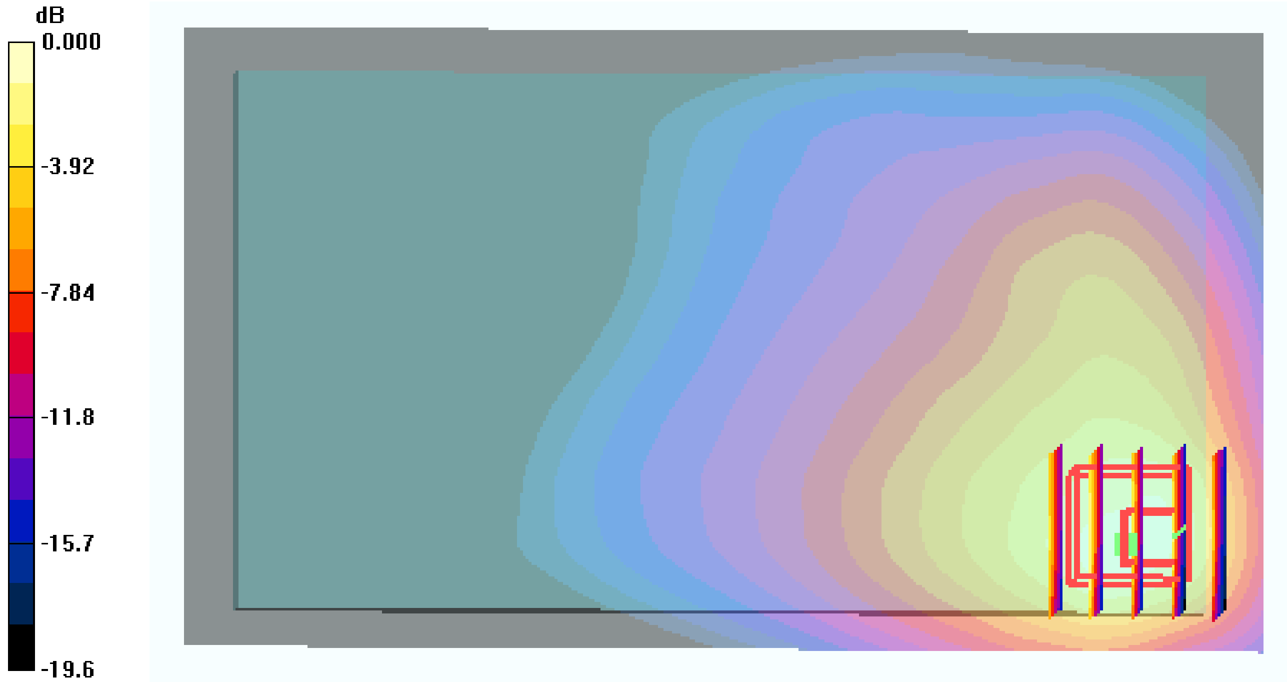
Date: 4/10/2017

Communication System: WCDMA FDD V; Frequency: 836.4 MHz;
Medium parameters used: f = 836.4 MHz; σ = 1.02 mho/m; $\varepsilon_r$ = 57.21; ρ = 1000 kg/m$^3$ ;
Phantom section: Flat Section

DASY5 Configuration:
-Probe: ES3DV3 - SN3292;ConvF(6.27, 6.27, 6.27); Calibrated: 09/02/2016;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
-Electronics: DAE4 Sn1315; Calibrated: 7/26/2016
- Phantom: SAM 3; Type: SAM; Serial: TP-1132
- Measurement SW: DASY5, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

**Ch4182/Area Scan (81x141x1):** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.965 mW/g

**Ch4182/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 5.20 V/m; Power Drift = -0.08 dB
Peak SAR (extrapolated) = 1.53 W/kg
**SAR(1 g) = 0.815 mW/g; SAR(10 g) = 0.473 mW/g**
Maximum value of SAR (measured) = 0.961 mW/g



**#7**

**WCDMA II_RMC 12.2K_Right Cheek_Ch9262**

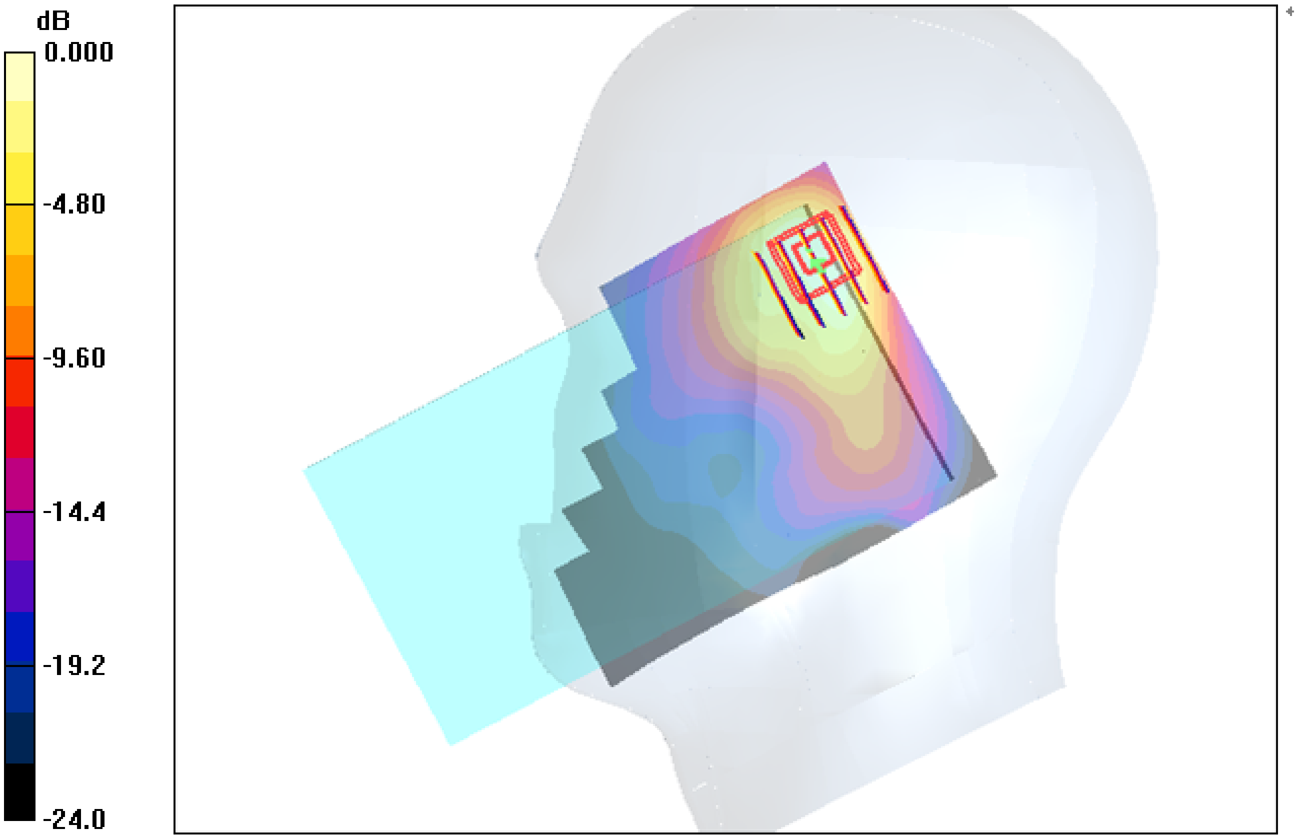
Date: 4/9/2017

Communication System: WCDMA FDDII; Frequency: 1852.4 MHz;
Medium parameters used: f = 1852.4 MHz; $\sigma$ = 1.38 mho/m; $\varepsilon_r$ = 42.5; $\rho$ = 1000 kg/m$^3$ ;
Phantom section: Flat Section

DASY5 Configuration:
-Probe: ES3DV3 - SN3292;ConvF(6.40, 6.40, 6.40); Calibrated: 09/02/2016;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
-Electronics: DAE4 Sn1315; Calibrated: 7/26/2016
- Phantom: SAM 2; Type: SAM; Serial: TP-1432
- Measurement SW: DASY5, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

**Ch9262/Area Scan (101x81x1):** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.25 mW/g

**Ch9262/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 13.5 V/m; Power Drift = -0.11 dB
Peak SAR (extrapolated) = 0.35 W/kg
**SAR(1 g) = 0.127 mW/g; SAR(10 g) = 0.089 mW/g**
Maximum value of SAR (measured) = 0.27 mW/g



**#8**

**WCDMA II_RMC 12.2K_Back_0cm_Ch9262**

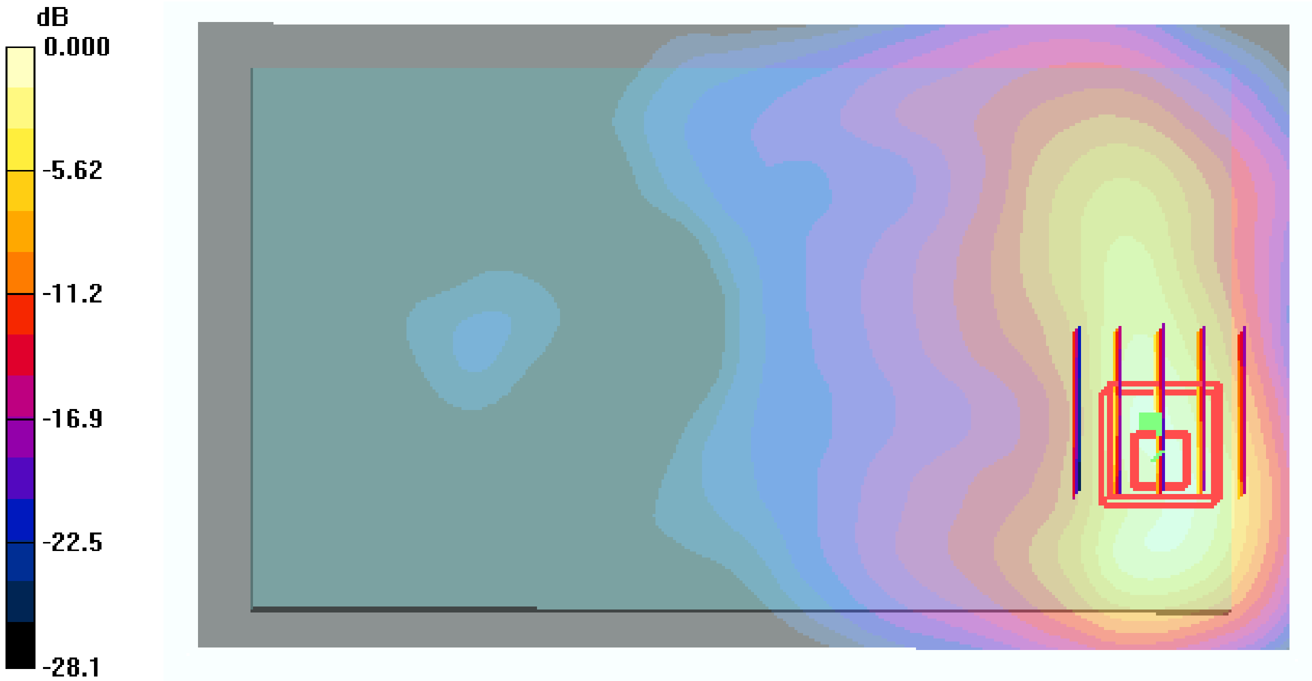
Date: 4/10/2017

Communication System: WCDMA FDDII; Frequency: 1852.4 MHz;
Medium parameters used: f = 1852.4 MHz; σ = 1.53 mho/m; $\varepsilon_r$ = 55.4; ρ = 1000 kg/$m^3$ ;
Phantom section: Flat Section

DASY5 Configuration:
-Probe: ES3DV3 - SN3292;ConvF(5.05, 5.05, 5.05); Calibrated: 09/02/2016;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
-Electronics: DAE4 Sn1315; Calibrated: 7/26/2016
- Phantom: SAM 3; Type: SAM; Serial: TP-1132
- Measurement SW: DASY5, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

**Ch9262/Area Scan (81x141x1):** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 1.29 mW/g

**Ch9262/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 3.75 V/m; Power Drift = -0.12 dB
Peak SAR (extrapolated) = 2.07 W/kg
**SAR(1 g) = 1.1 mW/g; SAR(10 g) = 0.653 mW/g**
Maximum value of SAR (measured) = 1.31 mW/g



**#9**

**WLAN2.4G_802.11b_Left Cheek_Ch1**

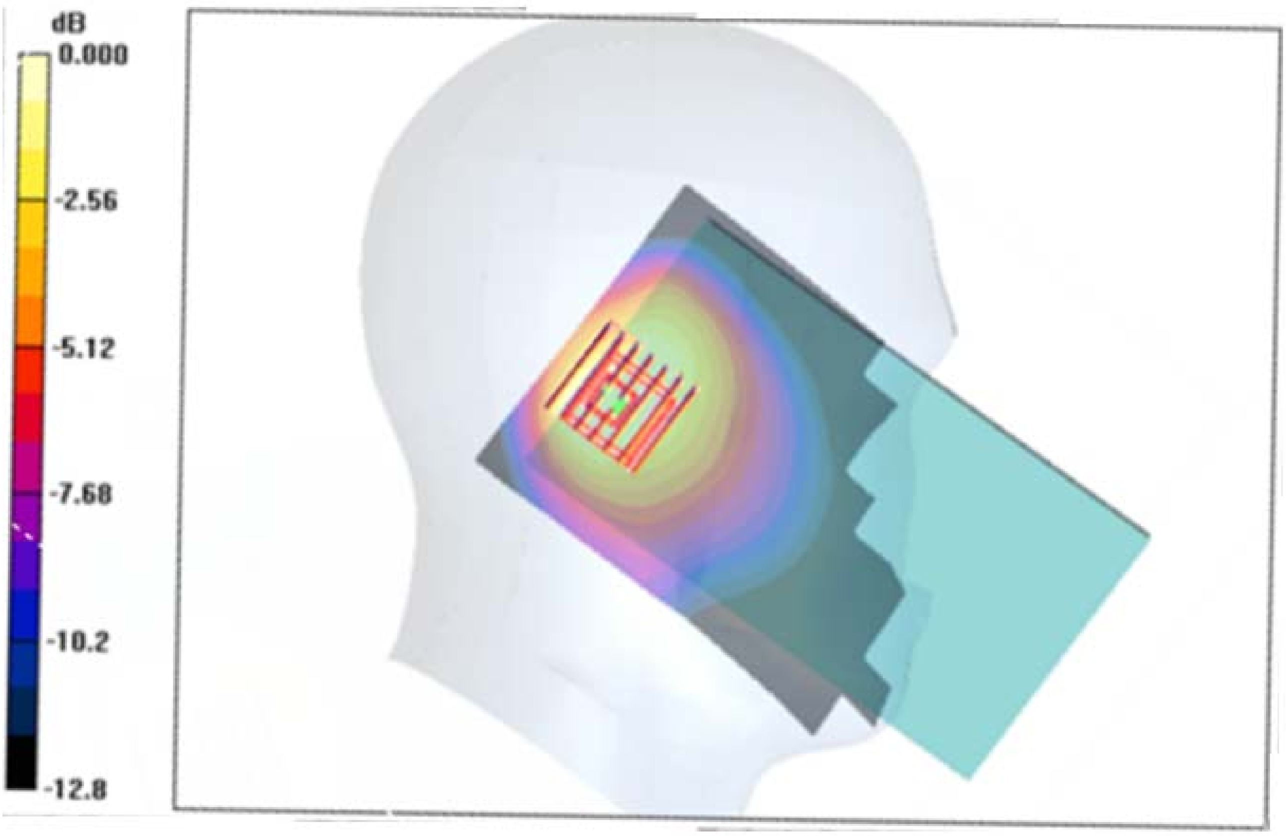
Date: 4/11/2017

Communication System: 802.11b; Frequency: 2412 MHz;
Medium parameters used: f = 2412 MHz; $\sigma$ = 1.81 mho/m; $\varepsilon_r$ = 38.31; $\rho$ = 1000 kg/$m^3$ ;
Phantom section: Flat Section

DASY5 Configuration:
-Probe: ES3DV3 - SN3292;ConvF(4.97, 4.97, 4.97); Calibrated: 09/02/2016;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
-Electronics: DAE4 Sn1315; Calibrated: 7/26/2016
- Phantom: SAM 2; Type: SAM; Serial: TP-1432
- Measurement SW: DASY5, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

**Ch1/Area Scan (81x141x1):** Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (interpolated) = 0.402 mW/g

**Ch1/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 3.5 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 0.58 W/kg
**SAR(1 g) = 0.274 mW/g; SAR(10 g) = 0.182 mW/g**
Maximum value of SAR (measured) = 0.426 mW/g



**#10**

**WLAN2.4G_802.11b_Back_0cm_Ch1**

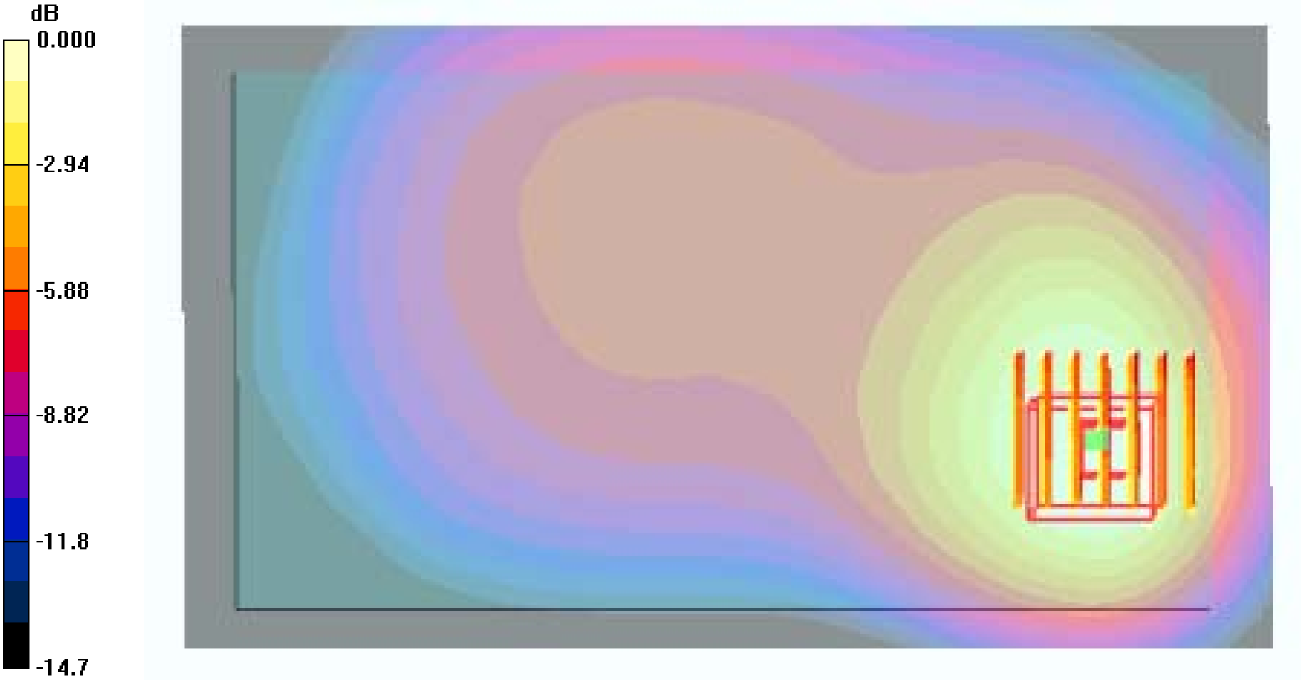
Date: 4/11/2017

Communication System: 802.11b; Frequency: 2412 MHz;
Medium parameters used: f = 2412 MHz; σ = 1.85 mho/m; $\varepsilon_r$ = 50.71; ρ = 1000 kg/$m^3$ ;
Phantom section: Flat Section

DASY5 Configuration:
-Probe: ES3DV3 - SN3292;ConvF(4.70, 4.70, 4.70); Calibrated: 09/02/2016;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
-Electronics: DAE4 Sn1315; Calibrated: 7/26/2016
- Phantom: SAM 3; Type: SAM; Serial: TP-1132
- Measurement SW: DASY5, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

**Ch1/Area Scan (81x141x1):** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.522 mW/g

**Ch1/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 0.353 V/m; Power Drift = -0.12 dB
Peak SAR (extrapolated) = 0.89 W/kg
**SAR(1 g) = 0.334 mW/g; SAR(10 g) = 0.240 mW/g**
Maximum value of SAR (measured) = 0.520 mW/g



# 6. Calibration Certificate

## 6.1. Probe Calibration Certificate

**Calibration Laboratory of**
**Schmid & Partner**
**Engineering AG**
Zeughausstrasse 43, 8004 Zurich, Switzerland

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
S Servizio svizzero di taratura
S Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **CIQ-SZ (Auden)**

Certificate No: **ES3-3292_Sep16**

## CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | ES3DV3 - SN:3292 |
| Calibration procedure(s) | QA CAL-01.v9, QA CAL-12.v9, QA CAL-23.v5, QA CAL-25.v6<br>Calibration procedure for dosimetric E-field probes |
| Calibration date: | September 2, 2016 |

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards | ID | Cal Date (Certificate No.) | Scheduled Calibration |
|---|---|---|---|
| Power meter NRP | SN: 104778 | 06-Apr-16 (No. 217-02288/02289) | Apr-17 |
| Power sensor NRP-Z91 | SN: 103244 | 06-Apr-16 (No. 217-02288) | Apr-17 |
| Power sensor NRP-Z91 | SN: 103245 | 06-Apr-16 (No. 217-02289) | Apr-17 |
| Reference 20 dB Attenuator | SN: S5277 (20x) | 05-Apr-16 (No. 217-02293) | Apr-17 |
| Reference Probe ES3DV2 | SN: 3013 | 31-Dec-15 (No. ES3-3013_Dec15) | Dec-16 |
| DAE4 | SN: 660 | 23-Dec-15 (No. DAE4-660_Dec15) | Dec-16 |
| | | | |
| Secondary Standards | ID | Check Date (in house) | Scheduled Check |
| Power meter E4419B | SN: GB41293874 | 06-Apr-16 (in house check Jun-16) | In house check: Jun-18 |
| Power sensor E4412A | SN: MY41498087 | 06-Apr-16 (in house check Jun-16) | In house check: Jun-18 |
| Power sensor E4412A | SN: 000110210 | 06-Apr-16 (in house check Jun-16) | In house check: Jun-18 |
| RF generator HP 8648C | SN: US3642U01700 | 04-Aug-99 (in house check Jun-16) | In house check: Jun-18 |
| Network Analyzer HP 8753E | SN: US37390585 | 18-Oct-01 (in house check Oct-15) | In house check: Oct-16 |

| | Name | Function | Signature |
|---|---|---|---|
| Calibrated by: | Michael Weber | Laboratory Technician | M.Weber |
| Approved by: | Katja Pokovic | Technical Manager | |

Issued: September 2, 2016

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

**Calibration Laboratory of**
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
S Servizio svizzero di taratura
S Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
**The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates**

Accreditation No.: **SCS 0108**

## Glossary:

| | |
|---|---|
| TSL | tissue simulating liquid |
| NORMx,y,z | sensitivity in free space |
| ConvF | sensitivity in TSL / NORMx,y,z |
| DCP | diode compression point |
| CF | crest factor (1/duty_cycle) of the RF signal |
| A, B, C, D | modulation dependent linearization parameters |
| Polarization φ | φ rotation around probe axis |
| Polarization ϑ | ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., ϑ = 0 is normal to probe axis |
| Connector Angle | information used in DASY system to align probe sensor X to the robot coordinate system |

## Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

## Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization ϑ = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the $E^2$-field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,y,z * frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- *DCPx,y,z:* DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- *PAR:* PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- *Ax,y,z; Bx,y,z; Cx,y,z; Dx,y,z; VRx,y,z: A, B, C, D* are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. *VR* is the maximum calibration range expressed in RMS voltage across the diode.
- *ConvF and Boundary Effect Parameters:* Assessed in flat phantom using E-field (or Temperature Transfer Standard for f ≤ 800 MHz) and inside waveguide using analytical field distributions based on power measurements for f > 800 MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to *NORMx,y,z * ConvF* whereby the uncertainty corresponds to that given for *ConvF*. A frequency dependent *ConvF* is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- *Spherical isotropy (3D deviation from isotropy):* in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- *Sensor Offset:* The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- *Connector Angle:* The angle is assessed using the information gained by determining the *NORMx* (no uncertainty required).

# Probe ES3DV3

## SN:3292

| | |
|---|---|
| Manufactured: | July 6, 2010 |
| Repaired: | August 29, 2016 |
| Calibrated: | September 2, 2016 |

Calibrated for DASY/EASY Systems

(Note: non-compatible with DASY2 system!)

# DASY/EASY - Parameters of Probe: ES3DV3 - SN:3292

## Basic Calibration Parameters

| | Sensor X | Sensor Y | Sensor Z | Unc (k=2) |
|---|---|---|---|---|
| Norm ($\mu V/(V/m)^2$)[A] | 0.94 | 0.95 | 0.93 | ± 10.1 % |
| DCP (mV)[B] | 105.7 | 101.2 | 111.7 | |

## Modulation Calibration Parameters

| UID | Communication System Name | | A dB | B dB$\sqrt{\mu V}$ | C | D dB | VR mV | Unc[E] (k=2) |
|---|---|---|---|---|---|---|---|---|
| 0 | CW | X | 0.0 | 0.0 | 1.0 | 0.00 | 205.6 | ±3.5 % |
| | | Y | 0.0 | 0.0 | 1.0 | | 212.6 | |
| | | Z | 0.0 | 0.0 | 1.0 | | 204.7 | |

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

[A] The uncertainties of Norm X,Y,Z do not affect the $E^2$-field uncertainty inside TSL (see Pages 5 and 6).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

# DASY/EASY - Parameters of Probe: ES3DV3 - SN:3292

## Calibration Parameter Determined in Head Tissue Simulating Media

| f (MHz) [C] | Relative Permittivity [F] | Conductivity (S/m) [F] | ConvF X | ConvF Y | ConvF Z | Alpha [G] | Depth [G] (mm) | Unc (k=2) |
|---|---|---|---|---|---|---|---|---|
| 450 | 43.5 | 0.87 | 7.12 | 7.12 | 7.12 | 0.20 | 1.30 | ± 13.3 % |
| 750 | 41.9 | 0.89 | 6.76 | 6.76 | 6.76 | 0.80 | 1.19 | ± 12.0 % |
| 835 | 41.5 | 0.90 | 6.53 | 6.53 | 6.53 | 0.43 | 1.64 | ± 12.0 % |
| 900 | 41.5 | 0.97 | 6.40 | 6.40 | 6.40 | 0.53 | 1.43 | ± 12.0 % |
| 1750 | 40.1 | 1.37 | 5.54 | 5.54 | 5.54 | 0.80 | 1.15 | ± 12.0 % |
| 1900 | 40.0 | 1.40 | 5.26 | 5.26 | 5.26 | 0.55 | 1.47 | ± 12.0 % |
| 2450 | 39.2 | 1.80 | 4.97 | 4.97 | 4.97 | 0.64 | 1.41 | ± 12.0 % |
| 2600 | 39.0 | 1.96 | 4.77 | 4.77 | 4.77 | 0.80 | 1.28 | ± 12.0 % |

[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

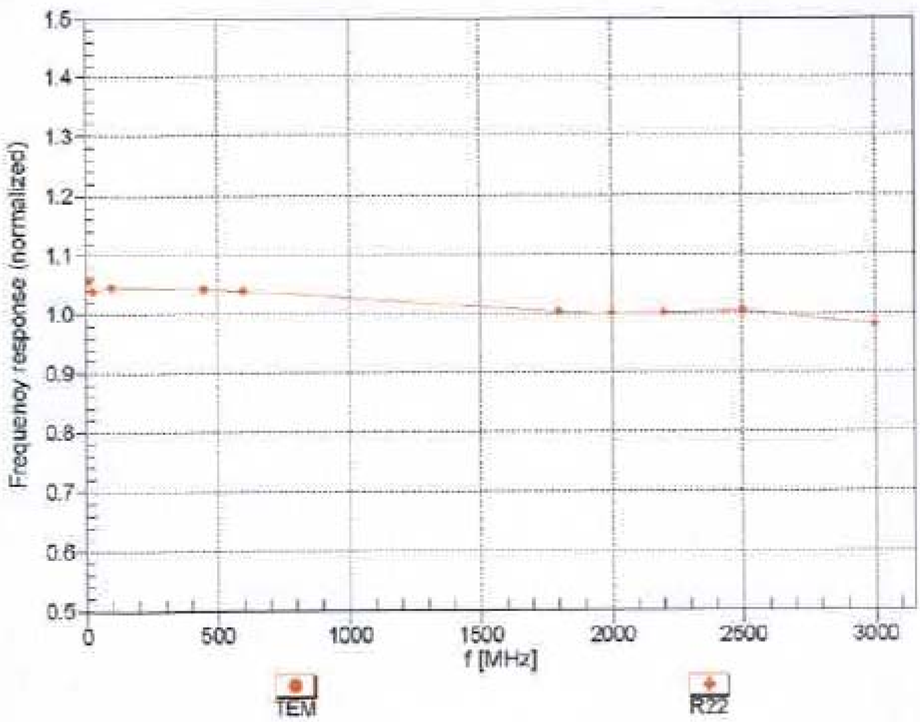
# DASY/EASY - Parameters of Probe: ES3DV3 - SN:3292

## Calibration Parameter Determined in Body Tissue Simulating Media

| f (MHz) [C] | Relative Permittivity [F] | Conductivity (S/m) [F] | ConvF X | ConvF Y | ConvF Z | Alpha [G] | Depth [G] (mm) | Unc (k=2) |
|---|---|---|---|---|---|---|---|---|
| 450 | 56.7 | 0.94 | 7.33 | 7.33 | 7.33 | 0.13 | 1.50 | ± 13.3 % |
| 750 | 55.5 | 0.96 | 6.25 | 6.25 | 6.25 | 0.38 | 1.66 | ± 12.0 % |
| 835 | 55.2 | 0.97 | 6.27 | 6.27 | 6.27 | 0.47 | 1.56 | ± 12.0 % |
| 900 | 55.0 | 1.05 | 6.16 | 6.16 | 6.16 | 0.80 | 1.15 | ± 12.0 % |
| 1750 | 53.4 | 1.49 | 5.28 | 5.28 | 5.28 | 0.70 | 1.36 | ± 12.0 % |
| 1900 | 53.3 | 1.52 | 5.05 | 5.05 | 5.05 | 0.64 | 1.44 | ± 12.0 % |
| 2450 | 52.7 | 1.95 | 4.70 | 4.70 | 4.70 | 0.74 | 1.22 | ± 12.0 % |
| 2600 | 52.5 | 2.16 | 4.52 | 4.52 | 4.52 | 0.80 | 1.13 | ± 12.0 % |

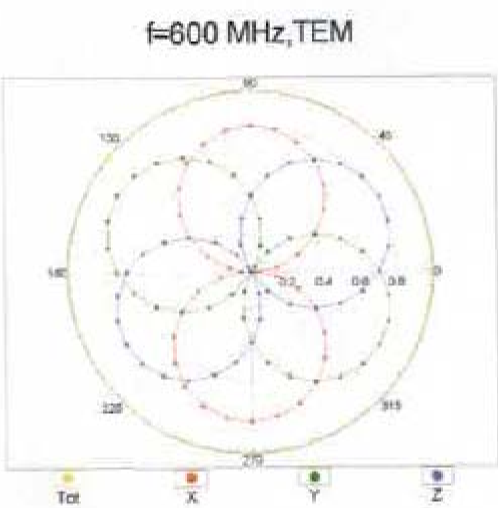
[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

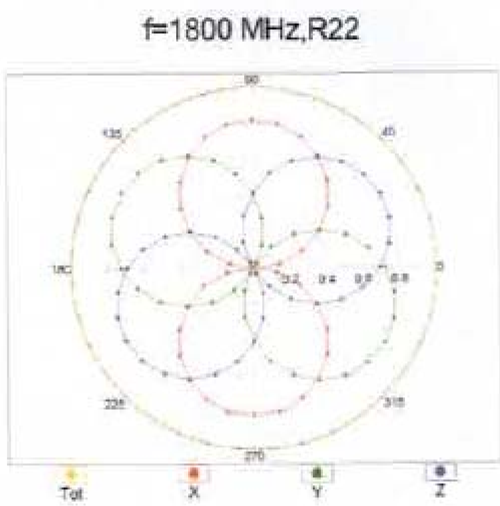
# Frequency Response of E-Field
## (TEM-Cell:ifi110 EXX, Waveguide: R22)

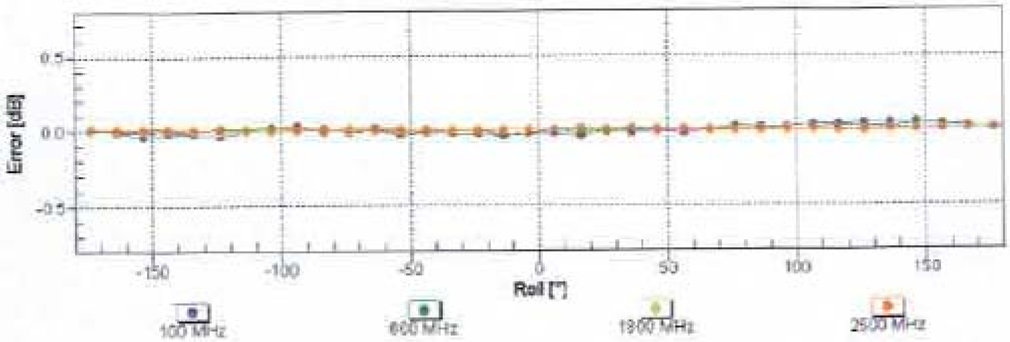



**Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)**

# Receiving Pattern (ϕ), $\vartheta = 0°$



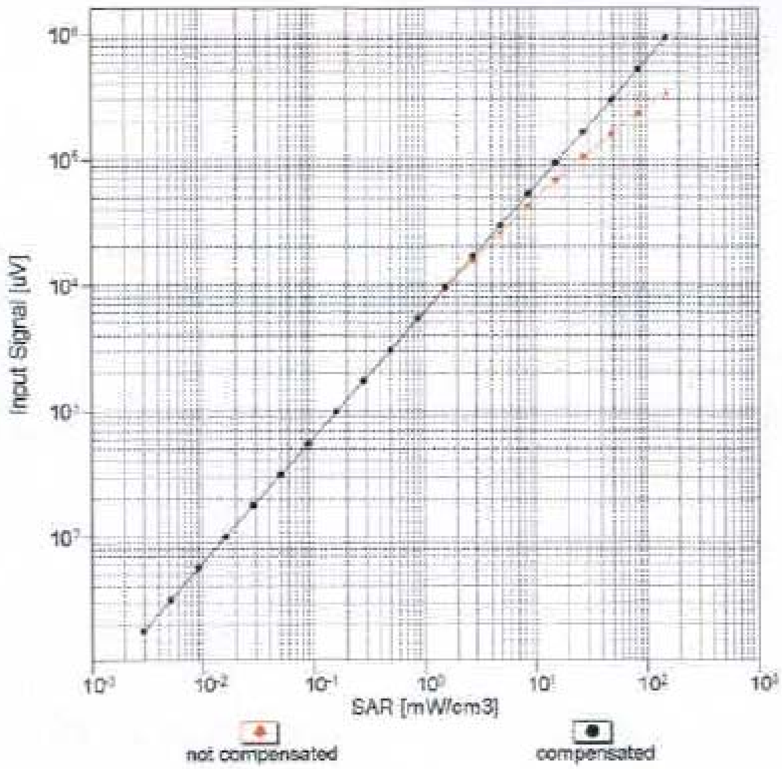



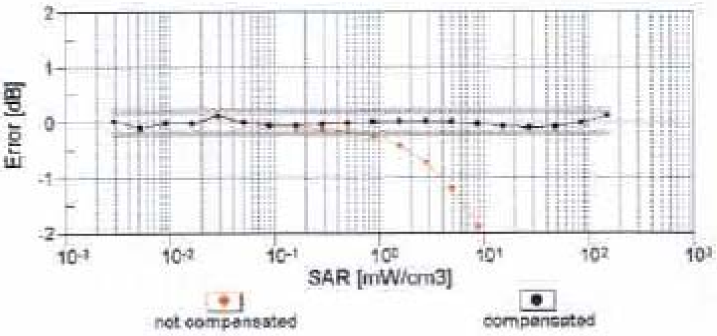




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

# Dynamic Range f($SAR_{head}$)

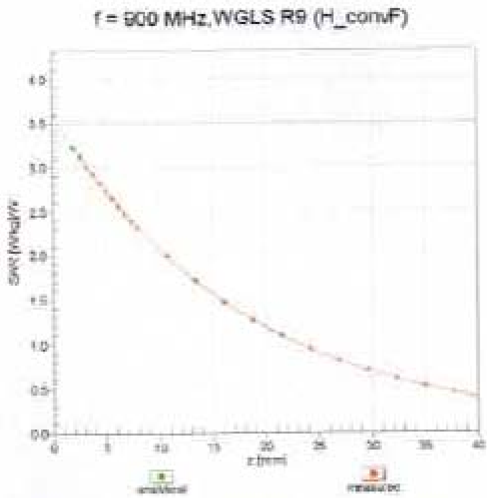
**(TEM cell , $f_{eval}$= 1900 MHz)**

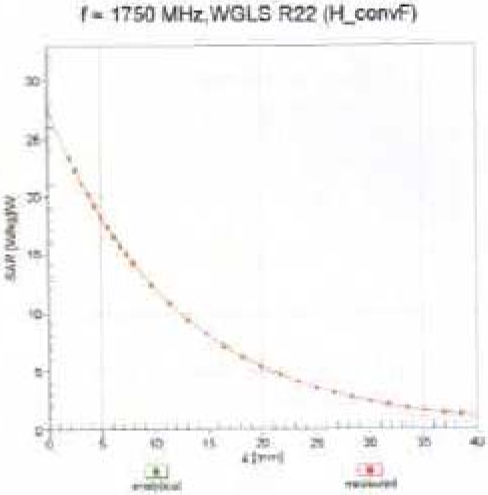



**Uncertainty of Linearity Assessment: ± 0.6% (k=2)**

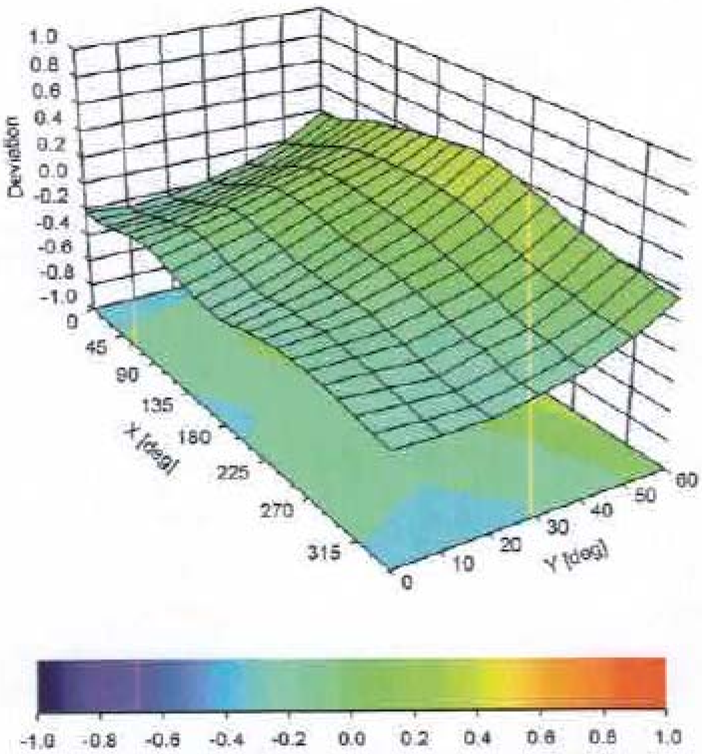
# Conversion Factor Assessment




# Deviation from Isotropy in Liquid

**Error (ϕ, ϑ), f = 900 MHz**




**Uncertainty of Spherical Isotropy Assessment: ± 2.6% (k=2)**

## 6.2. D835V2 Dipole Calibration Certificate

**Calibration Laboratory of**
Schmid & Partner
Engineering AG
**Zeughausstrasse 43, 8004 Zurich, Switzerland**

**S** Schweizerischer Kalibrierdienst
**C** Service suisse d'étalonnage
Servizio svizzero di taratura
**S** Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
**The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates**

Accreditation No.: **SCS 0108**

Client **CTTL-BJ (Auden)**

Certificate No: **D835V2-4d069_Jul16**

# CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | D835V2 - SN:4d069 |
| Calibration procedure(s) | QA CAL-05.v9<br>Calibration procedure for dipole validation kits above 700 MHz |
| Calibration date: | July 20, 2016 |

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards | ID # | Cal Date (Certificate No.) | Scheduled Calibration |
|---|---|---|---|
| Power meter NRP | SN: 104778 | 06-Apr-16 (No. 217-02288/02289) | Apr-17 |
| Power sensor NRP-Z91 | SN: 103244 | 06-Apr-16 (No. 217-02288) | Apr-17 |
| Power sensor NRP-Z91 | SN: 103245 | 06-Apr-16 (No. 217-02289) | Apr-17 |
| Reference 20 dB Attenuator | SN: 5058 (20k) | 05-Apr-16 (No. 217-02292) | Apr-17 |
| Type-N mismatch combination | SN: 5047.2 / 06327 | 05-Apr-16 (No. 217-02295) | Apr-17 |
| Reference Probe EX3DV4 | SN: 7349 | 15-Jun-16 (No. EX3-7349_Jun16) | Jun-17 |
| DAE4 | SN: 601 | 30-Dec-15 (No. DAE4-601_Dec15) | Dec-16 |

| Secondary Standards | ID # | Check Date (in house) | Scheduled Check |
|---|---|---|---|
| Power meter EPM-442A | SN: GB37480704 | 07-Oct-15 (No. 217-02222) | In house check: Oct-16 |
| Power sensor HP 8481A | SN: US37292783 | 07-Oct-15 (No. 217-02222) | In house check: Oct-16 |
| Power sensor HP 8481A | SN: MY41092317 | 07-Oct-15 (No. 217-02223) | In house check: Oct-16 |
| RF generator R&S SMT-06 | SN: 100972 | 15-Jun-15 (in house check Jun-15) | In house check: Oct-16 |
| Network Analyzer HP 8753E | SN: US37390585 | 18-Oct-01 (in house check Oct-15) | In house check: Oct-16 |

| | Name | Function | Signature |
|---|---|---|---|
| Calibrated by: | Michael Weber | Laboratory Technician | M.Weber |
| Approved by: | Katja Pokovic | Technical Manager | |

Issued: July 22, 2016

**Calibration Laboratory of**
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

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S Servizio svizzero di taratura
S Swiss Calibration Service

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The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

**Glossary:**

| | |
|---|---|
| TSL | tissue simulating liquid |
| ConvF | sensitivity in TSL / NORM x,y,z |
| N/A | not applicable or not measured |

**Calibration is Performed According to the Following Standards:**

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

**Additional Documentation:**

e) DASY4/5 System Handbook

**Methods Applied and Interpretation of Parameters:**

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- *Feed Point Impedance and Return Loss:* These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- *Electrical Delay:* One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

## Measurement Conditions

DASY system configuration, as far as not given on page 1.

| | | |
|---|---|---|
| **DASY Version** | DASY5 | V52.8.8 |
| **Extrapolation** | Advanced Extrapolation | |
| **Phantom** | Modular Flat Phantom | |
| **Distance Dipole Center - TSL** | 15 mm | with Spacer |
| **Zoom Scan Resolution** | dx, dy, dz = 5 mm | |
| **Frequency** | 835 MHz ± 1 MHz | |

## Head TSL parameters

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|---|---|---|
| **Nominal Head TSL parameters** | 22.0 °C | 41.5 | 0.90 mho/m |
| **Measured Head TSL parameters** | (22.0 ± 0.2) °C | 40.6 ± 6 % | 0.94 mho/m ± 6 % |
| **Head TSL temperature change during test** | < 0.5 °C | ---- | ---- |

## SAR result with Head TSL

| **SAR averaged over 1 $cm^3$ (1 g) of Head TSL** | Condition | |
|---|---|---|
| SAR measured | 250 mW input power | 2.45 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **9.44 W/kg ± 17.0 % (k=2)** |

| **SAR averaged over 10 $cm^3$ (10 g) of Head TSL** | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 1.59 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **6.18 W/kg ± 16.5 % (k=2)** |

## Body TSL parameters

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|---|---|---|
| **Nominal Body TSL parameters** | 22.0 °C | 55.2 | 0.97 mho/m |
| **Measured Body TSL parameters** | (22.0 ± 0.2) °C | 54.9 ± 6 % | 1.01 mho/m ± 6 % |
| **Body TSL temperature change during test** | < 0.5 °C | ---- | ---- |

## SAR result with Body TSL

| **SAR averaged over 1 $cm^3$ (1 g) of Body TSL** | Condition | |
|---|---|---|
| SAR measured | 250 mW input power | 2.50 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | **9.69 W/kg ± 17.0 % (k=2)** |

| **SAR averaged over 10 $cm^3$ (10 g) of Body TSL** | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 1.63 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | **6.36 W/kg ± 16.5 % (k=2)** |

## Appendix (Additional assessments outside the scope of SCS 0108)

### Antenna Parameters with Head TSL

| | |
|---|---|
| Impedance, transformed to feed point | 51.9 Ω - 2.1 jΩ |
| Return Loss | - 31.1 dB |

### Antenna Parameters with Body TSL

| | |
|---|---|
| Impedance, transformed to feed point | 48.8 Ω - 2.5 jΩ |
| Return Loss | - 31.0 dB |

### General Antenna Parameters and Design

| | |
|---|---|
| Electrical Delay (one direction) | 1.394 ns |

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

### Additional EUT Data

| | |
|---|---|
| Manufactured by | SPEAG |
| Manufactured on | November 09, 2007 |

## DASY5 Validation Report for Head TSL

Date: 20.07.2016

Test Laboratory: SPEAG, Zurich, Switzerland

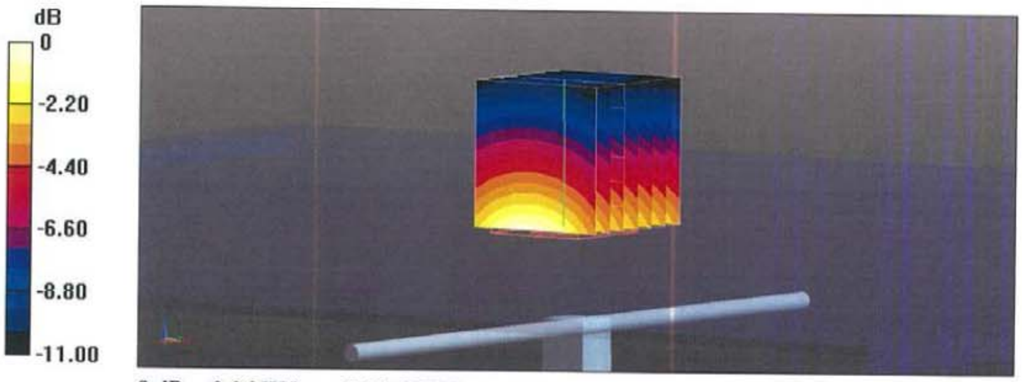
**DUT: Dipole 835 MHz D835V2; Type: D835V2; Serial: D835V2 - SN:4d069**

Communication System: UID 0 - CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; $\sigma$ = 0.94 S/m; $\varepsilon_r$ = 40.6; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

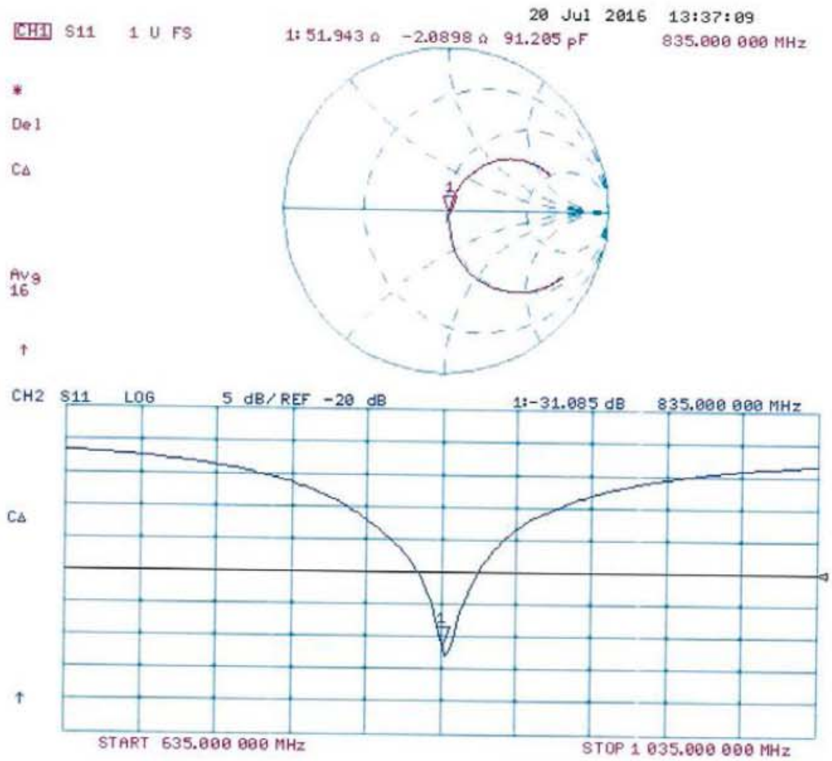
- Probe: EX3DV4 - SN7349; ConvF(9.72, 9.72, 9.72); Calibrated: 15.06.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

**Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:**
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 62.09 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 3.70 W/kg
**SAR(1 g) = 2.45 W/kg; SAR(10 g) = 1.59 W/kg**
Maximum value of SAR (measured) = 3.26 W/kg




0 dB = 3.26 W/kg = 5.13 dBW/kg

Impedance Measurement Plot for Head TSL



## DASY5 Validation Report for Body TSL

Date: 20.07.2016

Test Laboratory: SPEAG, Zurich, Switzerland

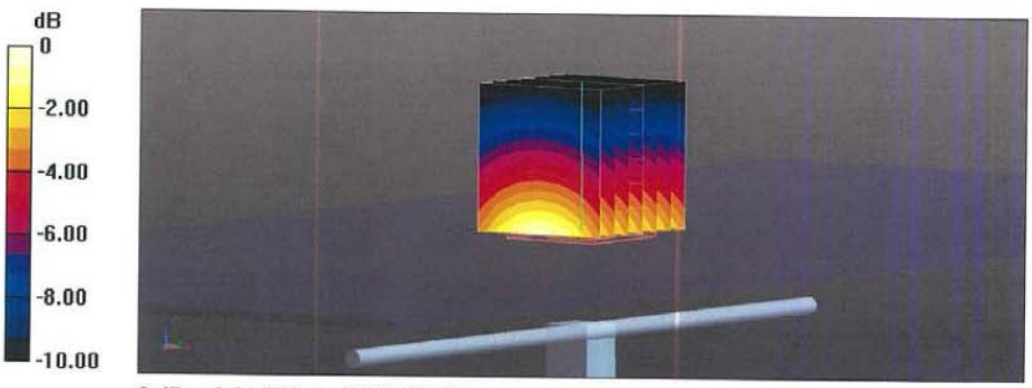
**DUT: Dipole 835 MHz D835V2; Type: D835V2; Serial: D835V2 - SN: 4d069**

Communication System: UID 0 - CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; $\sigma$ = 1.01 S/m; $\varepsilon_r$ = 54.9; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

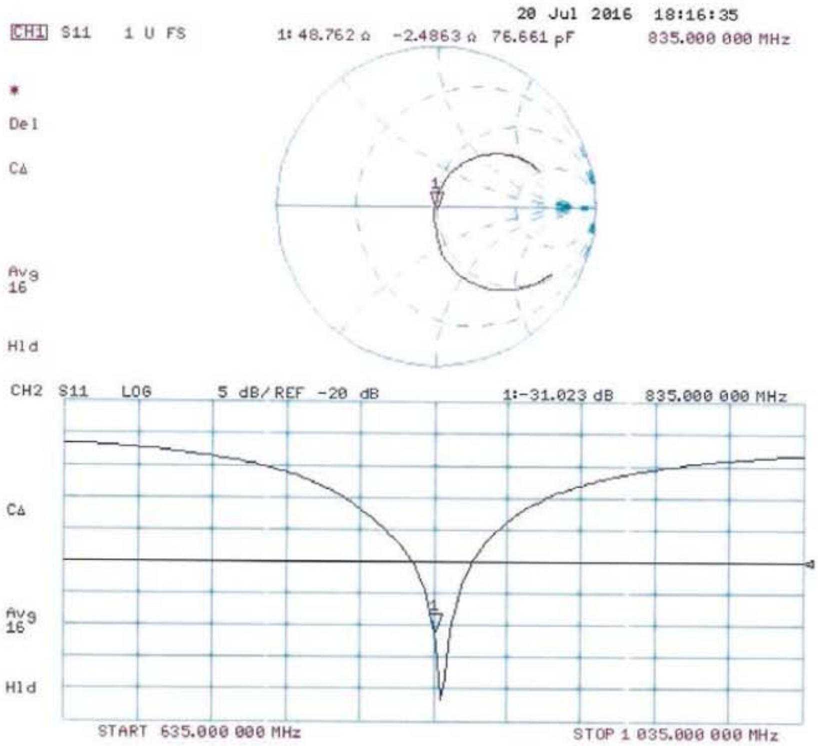
- Probe: EX3DV4 - SN7349; ConvF(9.73, 9.73, 9.73); Calibrated: 15.06.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

**Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:**
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 60.64 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 3.68 W/kg
**SAR(1 g) = 2.5 W/kg; SAR(10 g) = 1.63 W/kg**
Maximum value of SAR (measured) = 3.31 W/kg




0 dB = 3.31 W/kg = 5.20 dBW/kg

Impedance Measurement Plot for Body TSL



## 6.3. D1900V2 Dipole Calibration Certificate

**Calibration Laboratory of**
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Accreditation No.: SCS 0108

Client SMQ (Auden)

Certificate No: D1900V2-5d194_Jan15

# CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | D1900V2 - SN: 5d194 |
| Calibration procedure(s) | QA CAL-05.v9<br>Calibration procedure for dipole validation kits above 700 MHz |
| Calibration date: | January 07, 2015 |

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards | ID # | Cal Date (Certificate No.) | Scheduled Calibration |
|---|---|---|---|
| Power meter EPM-442A | GB37480704 | 07-Oct-14 (No. 217-02020) | Oct-15 |
| Power sensor HP 8481A | US37292783 | 07-Oct-14 (No. 217-02020) | Oct-15 |
| Power sensor HP 8481A | MY41092317 | 07-Oct-14 (No. 217-02021) | Oct-15 |
| Reference 20 dB Attenuator | SN: 5058 (20k) | 03-Apr-14 (No. 217-01918) | Apr-15 |
| Type-N mismatch combination | SN: 5047.2 / 06327 | 03-Apr-14 (No. 217-01921) | Apr-15 |
| Reference Probe ES3DV3 | SN: 3205 | 30-Dec-14 (No. ES3-3205_Dec14) | Dec-15 |
| DAE4 | SN: 601 | 18-Aug-14 (No. DAE4-601_Aug14) | Aug-15 |

| Secondary Standards | ID # | Check Date (in house) | Scheduled Check |
|---|---|---|---|
| RF generator R&S SMT-06 | 100005 | 04-Aug-99 (in house check Oct-13) | In house check: Oct-16 |
| Network Analyzer HP 8753E | US37390585 S4206 | 18-Oct-01 (in house check Oct-14) | In house check: Oct-15 |

| | Name | Function | Signature |
|---|---|---|---|
| Calibrated by: | Claudio Leubler | Laboratory Technician | |
| Approved by: | Katja Pokovic | Technical Manager | |

Issued: January 7, 2015

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

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Accreditation No.: **SCS 0108**

**Glossary:**

| | |
|---|---|
| TSL | tissue simulating liquid |
| ConvF | sensitivity in TSL / NORM x,y,z |
| N/A | not applicable or not measured |

**Calibration is Performed According to the Following Standards:**

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
c) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

**Additional Documentation:**

d) DASY4/5 System Handbook

**Methods Applied and Interpretation of Parameters:**

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- *Feed Point Impedance and Return Loss:* These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- *Electrical Delay:* One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

## Measurement Conditions

DASY system configuration, as far as not given on page 1.

| | | |
|---|---|---|
| **DASY Version** | DASY5 | V52.8.8 |
| **Extrapolation** | Advanced Extrapolation | |
| **Phantom** | Modular Flat Phantom | |
| **Distance Dipole Center - TSL** | 10 mm | with Spacer |
| **Zoom Scan Resolution** | dx, dy, dz = 5 mm | |
| **Frequency** | 1900 MHz ± 1 MHz | |

## Head TSL parameters

The following parameters and calculations were applied.

| | **Temperature** | **Permittivity** | **Conductivity** |
|---|---|---|---|
| **Nominal Head TSL parameters** | 22.0 °C | 40.0 | 1.40 mho/m |
| **Measured Head TSL parameters** | (22.0 ± 0.2) °C | 40.1 ± 6 % | 1.39 mho/m ± 6 % |
| **Head TSL temperature change during test** | < 0.5 °C | ---- | ---- |

## SAR result with Head TSL

| **SAR averaged over 1 $cm^3$ (1 g) of Head TSL** | Condition | |
|---|---|---|
| SAR measured | 250 mW input power | 10.1 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **40.6 W/kg ± 17.0 % (k=2)** |

| **SAR averaged over 10 $cm^3$ (10 g) of Head TSL** | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 5.32 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **21.3 W/kg ± 16.5 % (k=2)** |

## Body TSL parameters

The following parameters and calculations were applied.

| | **Temperature** | **Permittivity** | **Conductivity** |
|---|---|---|---|
| **Nominal Body TSL parameters** | 22.0 °C | 53.3 | 1.52 mho/m |
| **Measured Body TSL parameters** | (22.0 ± 0.2) °C | 53.3 ± 6 % | 1.50 mho/m ± 6 % |
| **Body TSL temperature change during test** | < 0.5 °C | ---- | ---- |

## SAR result with Body TSL

| **SAR averaged over 1 $cm^3$ (1 g) of Body TSL** | Condition | |
|---|---|---|
| SAR measured | 250 mW input power | 9.95 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | **40.1 W/kg ± 17.0 % (k=2)** |

| **SAR averaged over 10 $cm^3$ (10 g) of Body TSL** | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 5.31 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | **21.3 W/kg ± 16.5 % (k=2)** |

## Appendix (Additional assessments outside the scope of SCS108)

### Antenna Parameters with Head TSL

| | |
|---|---|
| Impedance, transformed to feed point | 53.7 Ω + 4.9 jΩ |
| Return Loss | - 24.5 dB |

### Antenna Parameters with Body TSL

| | |
|---|---|
| Impedance, transformed to feed point | 48.9 Ω + 5.1 jΩ |
| Return Loss | - 25.6 dB |

### General Antenna Parameters and Design

| | |
|---|---|
| Electrical Delay (one direction) | 1.201 ns |

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

### Additional EUT Data

| | |
|---|---|
| Manufactured by | SPEAG |
| Manufactured on | May 06, 2014 |

**DASY5 Validation Report for Head TSL**

Date: 07.12.2015

Test Laboratory: SPEAG, Zurich, Switzerland

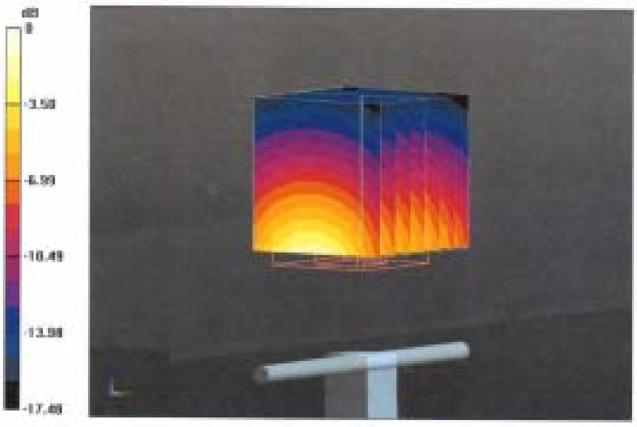
**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d194**

Communication System: UID 0 - CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; $\sigma$ = 1.39 S/m; $\varepsilon_r$ = 40.1; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

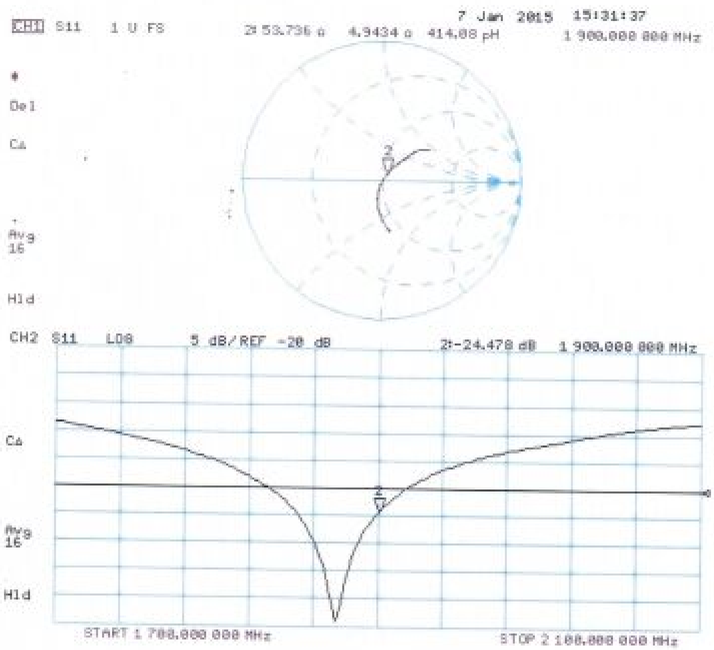
- Probe: ES3DV3 - SN3205; ConvF(5, 5, 5); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

**Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:**
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 98.35 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 18.5 W/kg
**SAR(1 g) = 10.1 W/kg; SAR(10 g) = 5.32 W/kg**
Maximum value of SAR (measured) = 12.7 W/kg




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

Impedance Measurement Plot for Head TSL



### DASY5 Validation Report for Body TSL

Date: 07.01.2015

Test Laboratory: SPEAG, Zurich, Switzerland

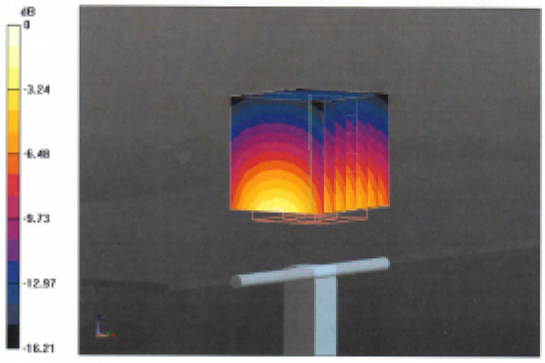
**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d194**

Communication System: UID 0 - CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; $\sigma$ = 1.5 S/m; $\varepsilon_r$ = 53.3; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

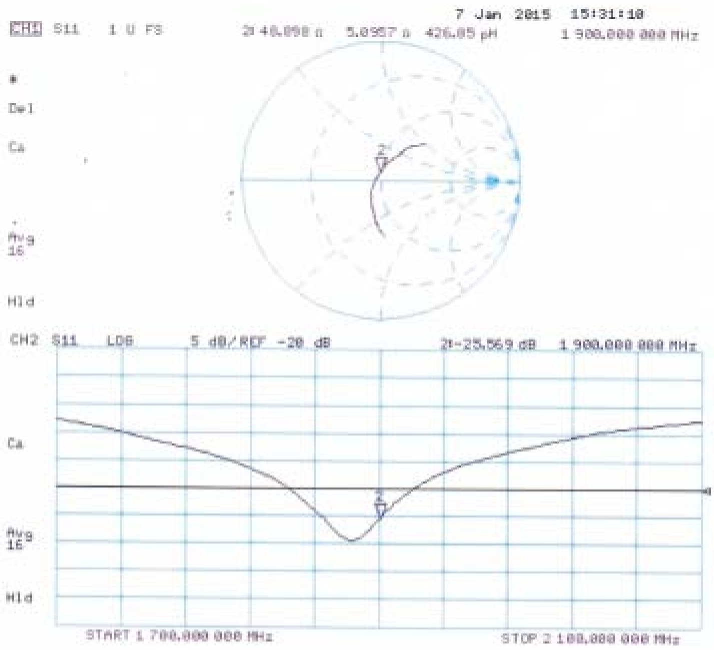
- Probe: ES3DV3 - SN3205; ConvF(4.65, 4.65, 4.65); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

**Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:**
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 95.88 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 16.8 W/kg
**SAR(1 g) = 9.95 W/kg; SAR(10 g) = 5.31 W/kg**
Maximum value of SAR (measured) = 12.6 W/kg




0 dB = 12.6 W/kg = 11.00 dBW/kg

## Impedance Measurement Plot for Body TSL



## 6.4. D2450V2 Dipole Calibration Certificate

**Calibration Laboratory of**
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Zeughausstrasse 43, 8004 Zurich, Switzerland

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Accreditation No.: **SCS 0108**

Client **SMQ (Auden)**

Certificate No: **D2450V2-955_Jan15/2**

# CALIBRATION CERTIFICATE (Replacement of No: D2450V2-955_Jan15)

| | |
|---|---|
| Object | D2450V2 - SN: 955 |
| Calibration procedure(s) | QA CAL-05.v9<br>Calibration procedure for dipole validation kits above 700 MHz |
| Calibration date: | January 08, 2015 |

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards | ID # | Cal Date (Certificate No.) | Scheduled Calibration |
|---|---|---|---|
| Power meter EPM-442A | GB37480704 | 07-Oct-14 (No. 217-02020) | Oct-15 |
| Power sensor HP 8481A | US37292783 | 07-Oct-14 (No. 217-02020) | Oct-15 |
| Power sensor HP 8481A | MY41092317 | 07-Oct-14 (No. 217-02021) | Oct-15 |
| Reference 20 dB Attenuator | SN: 5058 (20k) | 03-Apr-14 (No. 217-01918) | Apr-15 |
| Type-N mismatch combination | SN: 5047.2 / 06327 | 03-Apr-14 (No. 217-01921) | Apr-15 |
| Reference Probe ES3DV3 | SN: 3205 | 30-Dec-14 (No. ES3-3205_Dec14) | Dec-15 |
| DAE4 | SN: 601 | 18-Aug-14 (No. DAE4-601_Aug14) | Aug-15 |

| Secondary Standards | ID # | Check Date (in house) | Scheduled Check |
|---|---|---|---|
| RF generator R&S SMT-06 | 100005 | 04-Aug-99 (in house check Oct-13) | In house check: Oct-16 |
| Network Analyzer HP 8753E | US37390585 S4206 | 18-Oct-01 (in house check Oct-14) | In house check: Oct-15 |

| | Name | Function | Signature |
|---|---|---|---|
| Calibrated by: | Claudio Leubler | Laboratory Technician | |
| Approved by: | Katja Pokovic | Technical Manager | |

Issued: February 10, 2015

**Calibration Laboratory of**
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Accreditation No.: **SCS 0108**

**Glossary:**

| | |
|---|---|
| TSL | tissue simulating liquid |
| ConvF | sensitivity in TSL / NORM x,y,z |
| N/A | not applicable or not measured |

**Calibration is Performed According to the Following Standards:**

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
c) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

**Additional Documentation:**

d) DASY4/5 System Handbook

**Methods Applied and Interpretation of Parameters:**

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- *Feed Point Impedance and Return Loss:* These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- *Electrical Delay:* One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

## Measurement Conditions

DASY system configuration, as far as not given on page 1.

| | | |
|---|---|---|
| **DASY Version** | DASY5 | V52.8.8 |
| **Extrapolation** | Advanced Extrapolation | |
| **Phantom** | Modular Flat Phantom | |
| **Distance Dipole Center - TSL** | 10 mm | with Spacer |
| **Zoom Scan Resolution** | dx, dy, dz = 5 mm | |
| **Frequency** | 2450 MHz ± 1 MHz | |

## Head TSL parameters

The following parameters and calculations were applied.

| | **Temperature** | **Permittivity** | **Conductivity** |
|---|---|---|---|
| **Nominal Head TSL parameters** | 22.0 °C | 39.2 | 1.80 mho/m |
| **Measured Head TSL parameters** | (22.0 ± 0.2) °C | 39.7 ± 6 % | 1.84 mho/m ± 6 % |
| **Head TSL temperature change during test** | < 0.5 °C | ---- | ---- |

## SAR result with Head TSL

| **SAR averaged over 1 $cm^3$ (1 g) of Head TSL** | Condition | |
|---|---|---|
| SAR measured | 250 mW input power | 13.2 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **52.4 W/kg ± 17.0 % (k=2)** |

| **SAR averaged over 10 $cm^3$ (10 g) of Head TSL** | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 6.12 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **24.4 W/kg ± 16.5 % (k=2)** |

## Body TSL parameters

The following parameters and calculations were applied.

| | **Temperature** | **Permittivity** | **Conductivity** |
|---|---|---|---|
| **Nominal Body TSL parameters** | 22.0 °C | 52.7 | 1.95 mho/m |
| **Measured Body TSL parameters** | (22.0 ± 0.2) °C | 51.0 ± 6 % | 2.03 mho/m ± 6 % |
| **Body TSL temperature change during test** | < 0.5 °C | ---- | ---- |

## SAR result with Body TSL

| **SAR averaged over 1 $cm^3$ (1 g) of Body TSL** | Condition | |
|---|---|---|
| SAR measured | 250 mW input power | 13.8 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | **53.7 W/kg ± 17.0 % (k=2)** |

| **SAR averaged over 10 $cm^3$ (10 g) of Body TSL** | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 6.36 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | **25.0 W/kg ± 16.5 % (k=2)** |

## Appendix (Additional assessments outside the scope of SCS108)

### Antenna Parameters with Head TSL

| | |
|---|---|
| Impedance, transformed to feed point | 54.8 Ω + 3.5 jΩ |
| Return Loss | - 24.9 dB |

### Antenna Parameters with Body TSL

| | |
|---|---|
| Impedance, transformed to feed point | 51.2 Ω + 4.9 jΩ |
| Return Loss | - 26.0 dB |

### General Antenna Parameters and Design

| | |
|---|---|
| Electrical Delay (one direction) | 1.165 ns |

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

### Additional EUT Data

| | |
|---|---|
| Manufactured by | SPEAG |
| Manufactured on | August 05, 2014 |

## DASY5 Validation Report for Head TSL

Date: 08.01.2015

Test Laboratory: SPEAG, Zurich, Switzerland

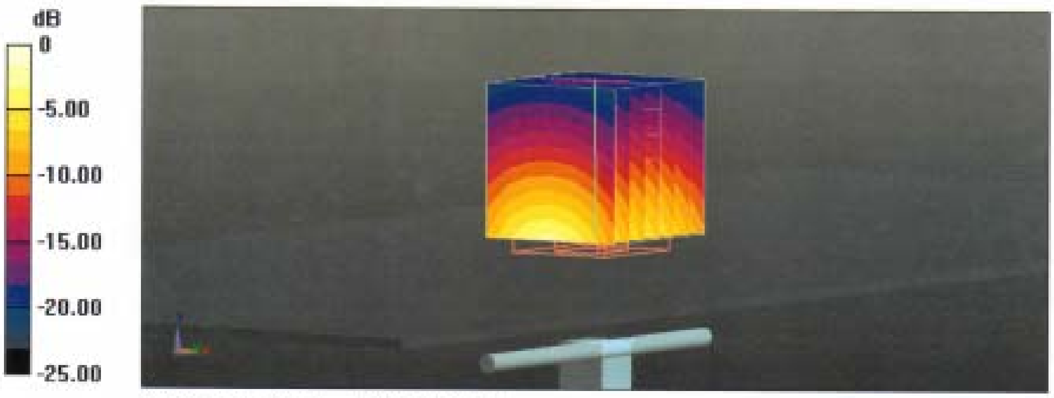
**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 955**

Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; $\sigma$ = 1.84 S/m; $\varepsilon_r$ = 39.7; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

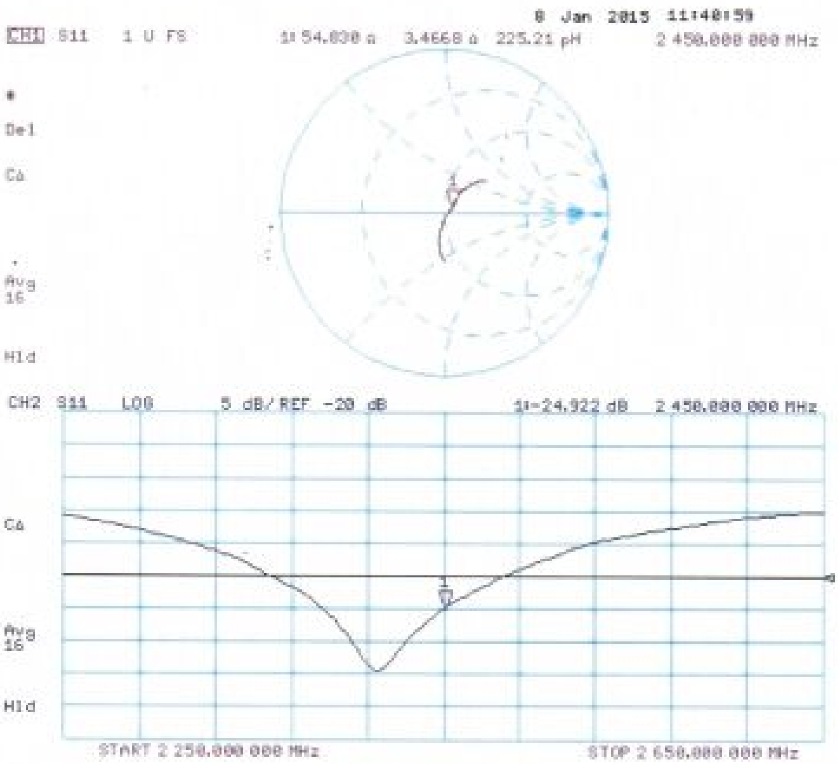
- Probe: ES3DV3 - SN3205; ConvF(4.45, 4.45, 4.45); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

**Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:**
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 101.2 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 27.5 W/kg
**SAR(1 g) = 13.2 W/kg; SAR(10 g) = 6.12 W/kg**
Maximum value of SAR (measured) = 17.5 W/kg




0 dB = 17.5 W/kg = 12.43 dBW/kg

Impedance Measurement Plot for Head TSL



## DASY5 Validation Report for Body TSL

Date: 08.01.2015

Test Laboratory: SPEAG, Zurich, Switzerland

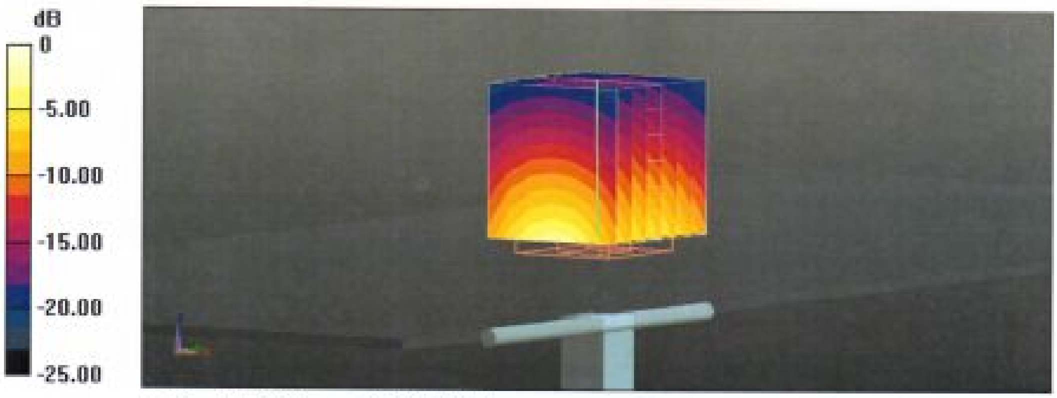
**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 955**

Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; $\sigma$ = 2.03 S/m; $\varepsilon_r$ = 51; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

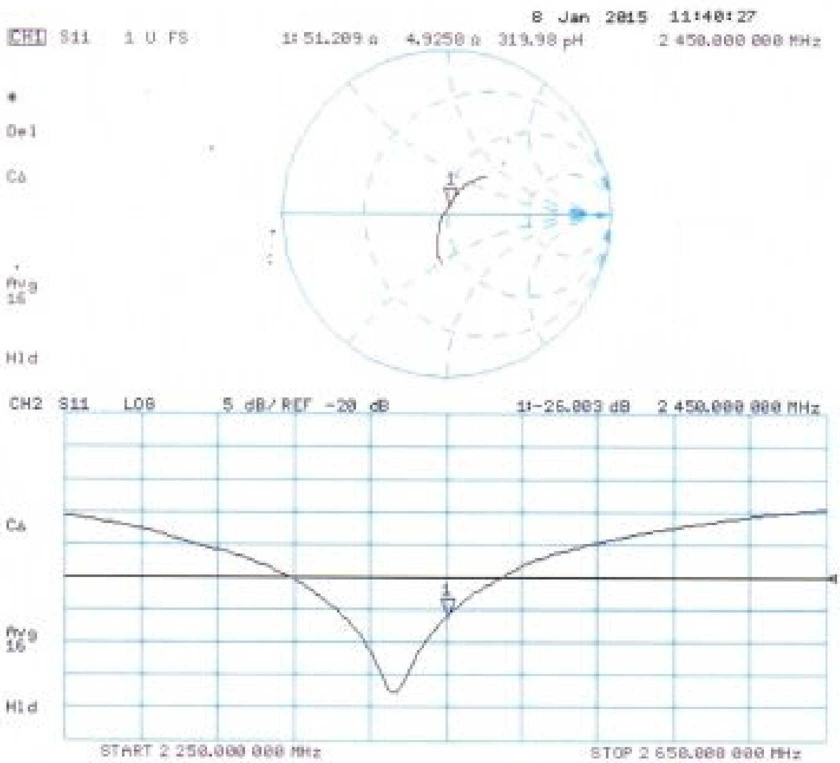
- Probe: ES3DV3 - SN3205; ConvF(4.17, 4.17, 4.17); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

**Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:**
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 97.96 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 28.8 W/kg
**SAR(1 g) = 13.8 W/kg; SAR(10 g) = 6.36 W/kg**
Maximum value of SAR (measured) = 18.3 W/kg




0 dB = 18.3 W/kg = 12.62 dBW/kg

## Impedance Measurement Plot for Body TSL



## 6.5. DAE4 Calibration Certificate

In Collaboration with
s p e a g
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2218 Fax: +86-10-62304633-2209
E-mail: cttl@chinattl.com Http://www.chinattl.cn

Client : CIQ(Shenzhen) Certificate No: Z16-97120

# CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | DAE4 - SN: 1315 JD462 |
| Calibration Procedure(s) | FD-Z11-2-002-01<br>Calibration Procedure for the Data Acquisition Electronics (DAEx) |
| Calibration date: | July 26, 2016 |

This calibration Certificate documents the traceability to national standards, which realize the physical units of measurements(SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature(22±3)℃ and humidity<70%.

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards | ID # | Cal Date(Calibrated by, Certificate No.) | Scheduled Calibration |
|---|---|---|---|
| Process Calibrator 753 | 1971018 | 27-June-16 (CTTL, No:J16X04778) | June-17 |

| | Name | Function | Signature |
|---|---|---|---|
| Calibrated by: | Yu Zongying | SAR Test Engineer | |
| Reviewed by: | Qi Dianyuan | SAR Project Leader | |
| Approved by: | Lu Bingsong | Deputy Director of the laboratory | |

Issued: July 27, 2016

In Collaboration with
speag
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2218 Fax: +86-10-62304633-2209
E-mail: cttl@chinattl.com Http://www.chinattl.cn

**Glossary:**

| | |
|---|---|
| DAE | data acquisition electronics |
| Connector angle | information used in DASY system to align probe sensor X to the robot coordinate system. |

**Methods Applied and Interpretation of Parameters:**

- *DC Voltage Measurement*: Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.
- *Connector angle*: The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.
- The report provide only calibration results for DAE, it does not contain other performance test results.

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E-mail: cttl@chinattl.com Http://www.chinattl.cn

## DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = 6.1μV , full range = -100...+300 mV

Low Range: 1LSB = 61nV , full range = -1.......+3mV

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

| Calibration Factors | X | Y | Z |
|---|---|---|---|
| High Range | 405.179 ± 0.15% (k=2) | 405.018 ± 0.15% (k=2) | 404.98 ± 0.15% (k=2) |
| Low Range | 3.99015 ± 0.7% (k=2) | 3.98549 ± 0.7% (k=2) | 3.98861 ± 0.7% (k=2) |

## Connector Angle

| | |
|---|---|
| **Connector Angle** to be used in DASY system | 20.5° ± 1 ° |

OET

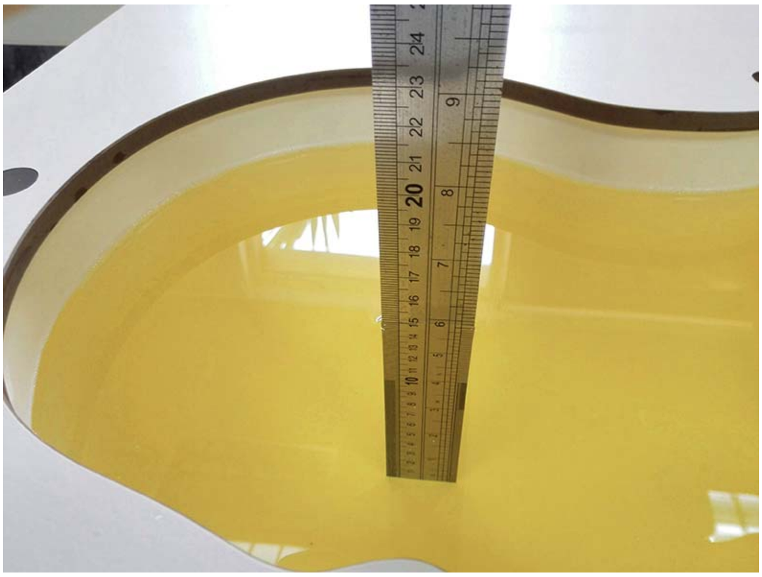
February 24, 2015

**Acceptable Conditions for SAR Measurements Using Probes and Dipoles Calibrated under the SPEAG-CTTL Dual-Logo Calibration Program to Support FCC Equipment Certification**

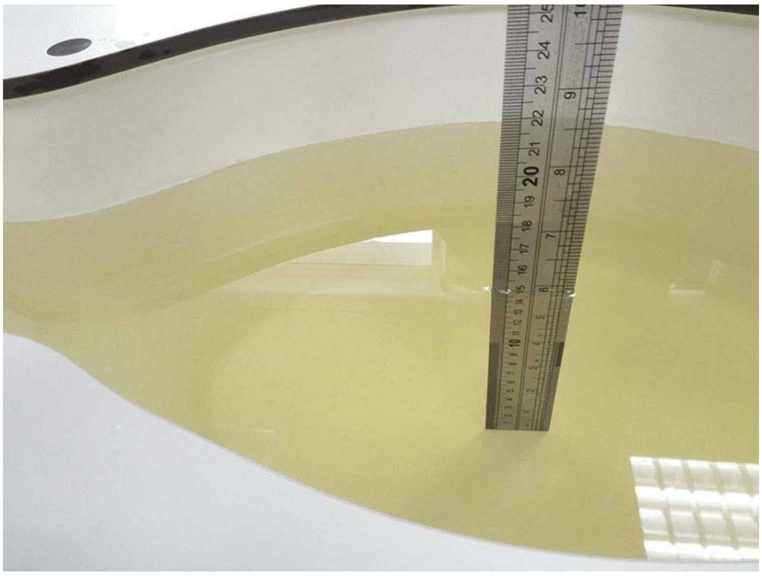
The acceptable conditions for SAR measurements using probes, dipoles and DAEs calibrated by CTTL (*China Telecommunication Technology Labs*), under the Dual-Logo Calibration Certificate program and quality assurance (QA) protocols established between SPEAG (*Schmid & Partner Engineering AG, Switzerland*) and CTTL, to support FCC (*U.S. Federal Communications Commission*) equipment certification are defined and described in the following. The conditions in this KDB are valid until December 31, 2015.

1) The agreement established between SPEAG and CTTL is only applicable to calibration services performed by CTTL where its clients (companies and divisions of such companies) are headquartered in the Greater China Region, including Taiwan and Hong Kong. CTTL shall inform the FCC of any changes or early termination to the agreement.
2) Only a subset of the calibration services specified in the SPEAG-CTTL agreement, while it remains valid, are applicable to SAR measurements performed using such equipment for supporting FCC equipment certification. These are identified in the following.
   a) Calibration of dosimetric (SAR) probes EX3DVx, ET3DVx and ES3DVx.
      i) Free-space E-field and H-field probes, including those used for HAC (hearing aid compatibility) evaluation, temperature probes, other probes or equipment not identified in this document, when calibrated by CTTL, are excluded and cannot be used for measurements to support FCC equipment certification.
      ii) Signal specific and bundled probe calibrations based on PMR (probe modulation response) characteristics or probe sensor model based linearization methods that are not fully described in SAR standards are excluded and cannot be used for measurements to support FCC equipment certification.
   b) Calibration of SAR system validation dipoles, excluding HAC dipoles.
   c) Calibration of data acquisition electronics DAE3Vx, DAE4Vx and DAEasyVx.
   d) For FCC equipment certification purposes, the frequency range of SAR probe and dipole calibrations is limited to 700 MHz - 6 GHz and provided it is supported by the equipment identified in the CTTL QA protocol (a separate attachment to this document).
   e) The identical system and equipment setup, measurement configurations, hardware, evaluation algorithms, calibration and QA protocols, including the format of calibration certificates and reports used by SPEAG shall be applied by CTTL. Equivalent test equipment and measurement configurations may be considered only when agreed by both SPEAG and the FCC.
   f) The calibrated items are only applicable to SPEAG DASY 4 and DASY 5 systems or higher version systems that satisfy the requirements of this KDB.
3) The SPEAG-CTTL agreement includes specific protocols identified in the following to ensure the quality of calibration services provided by CTTL under this SPEAG-

## 7. Liquid depth



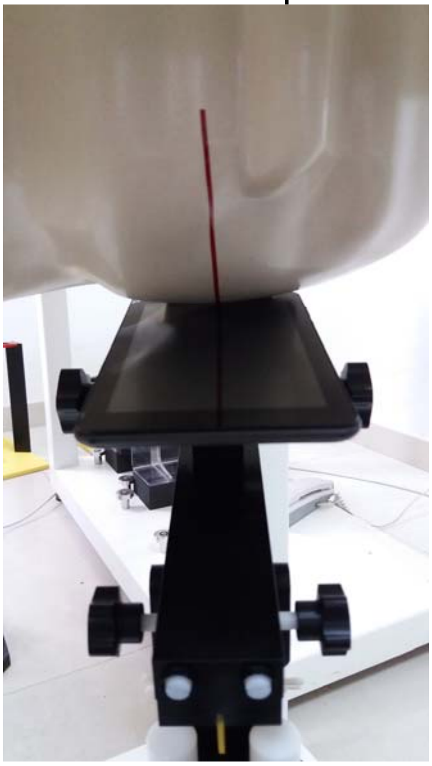
**Photograph of the depth in the Head Phantom**



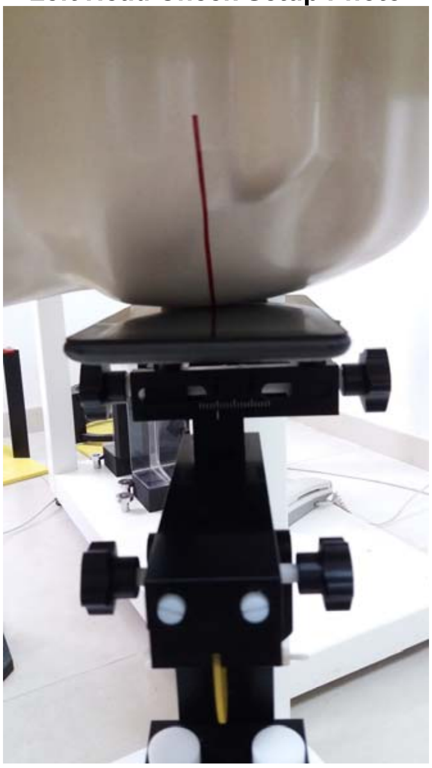
**Photograph of the depth in the Body Phantom**

# 8. Test Setup Photos

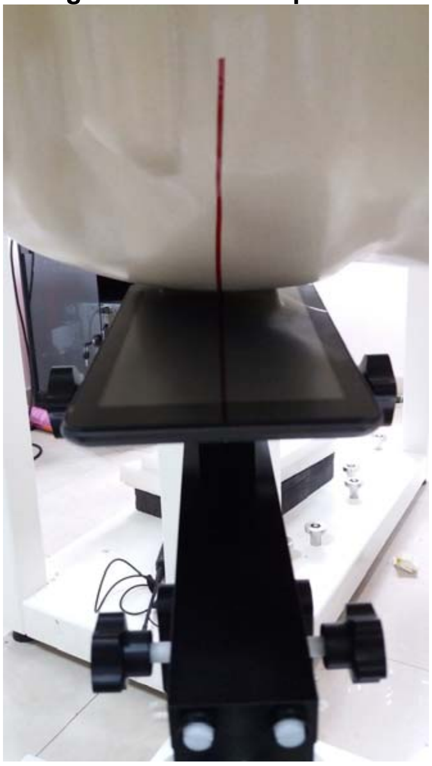
Left Head Tilt Setup Photo



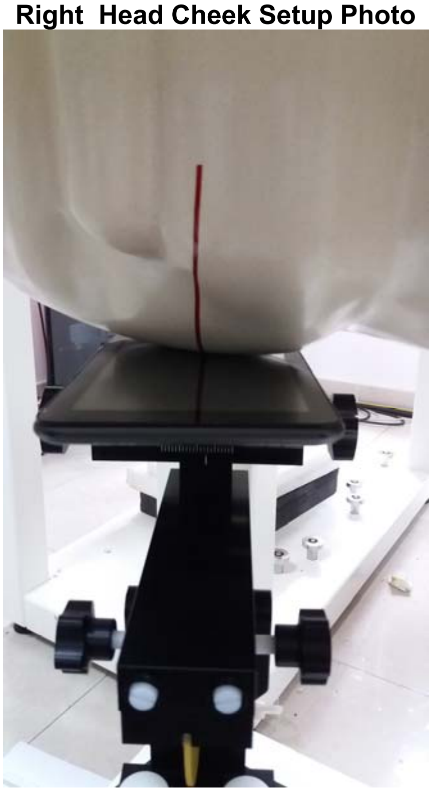
Left Head Cheek Setup Photo



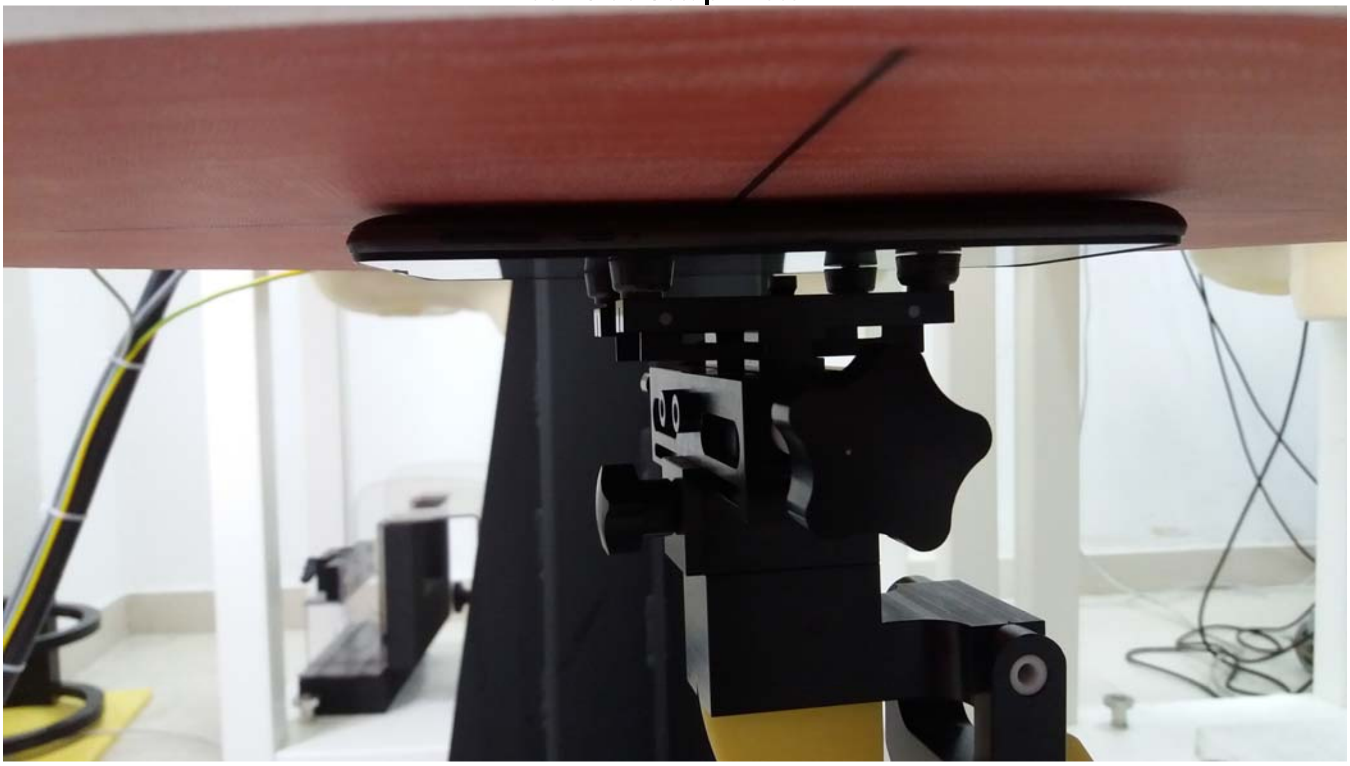
**Right Head Tilt Setup Photo**



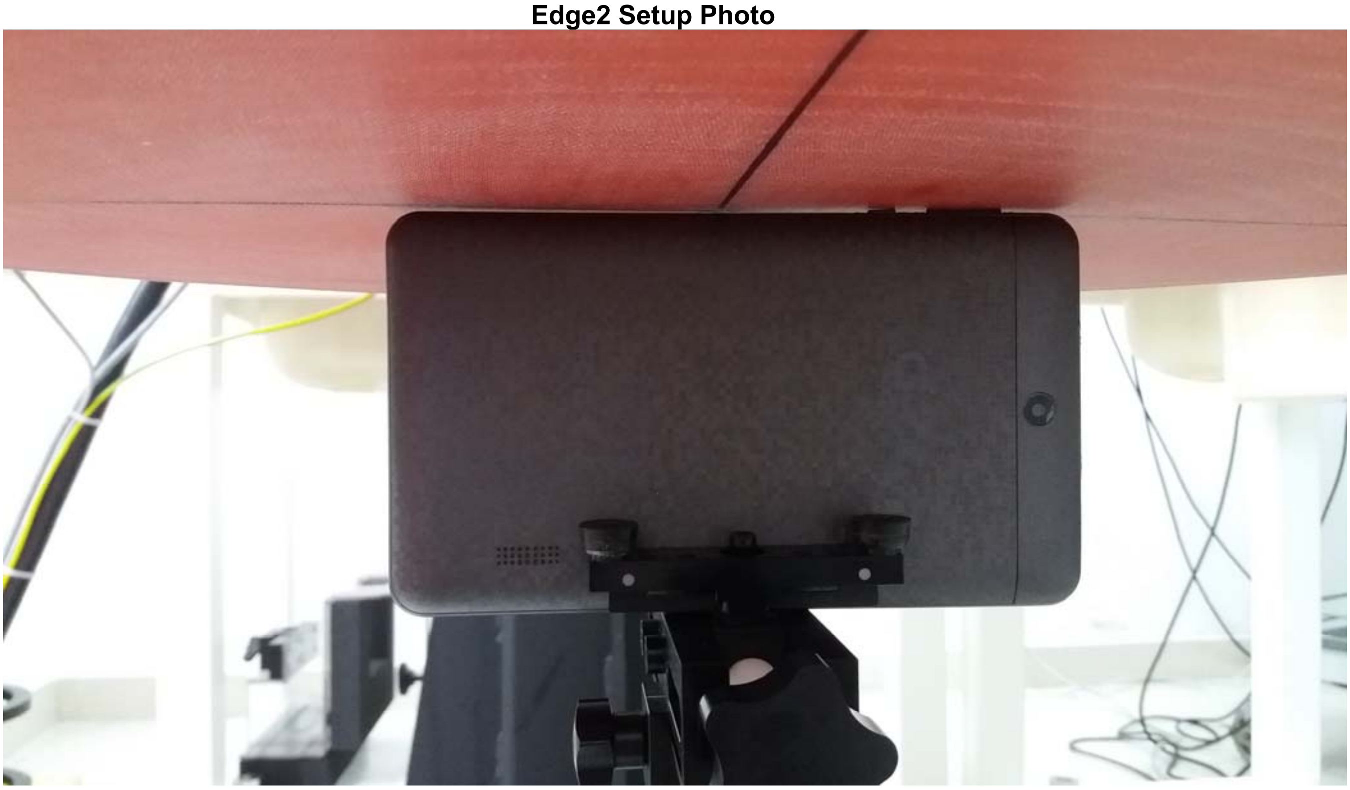
**Right  Head Cheek Setup Photo**



**Back Side Setup Photo**



**Edge2 Setup Photo**



**Edge4 Setup Photo**

**Edge1 Setup Photo**

Edge3 Side Setup Photo

**....................End of Report........................**