



## SAR TEST REPORT

Report Reference No..... : JTT201605033

FCC ID..... : 2AIDD-TABT970S

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Date of issue.....: May 30, 2016

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Applicant's name .....: Pacific-Technologies Globe Corp

Address.....: Room 601, Building 34, Fengherili Garden, Longhua, Shenzhen City, Guangdong Province, China

Test specification .....:

**FCC 47 CFR §1.1093**

Standard .....: **Published RF exposure KDB procedures**

**IEEE Std 1528-2013**

TRF Originator.....: Shenzhen Yidajietong Test Technology Co., Ltd.

Master TRF.....: Dated 2014-01

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Test item description .....: **Tablet PC**

Trade Mark .....: N/A

Manufacturer .....: **Pacific-Technologies Globe Corp**

Model/Type reference.....: Tab T970S

Listed Models .....: /

Ratings.....: DC 3.70V

EUT Type .....: Production Unit

Exposure category.....: General population / Uncontrolled environment

Hardware version .....: K107V4.0

Software version.....: Android 5.1

Android version.....: Android 6.0

Result.....: **PASS**

**TEST REPORT**

|                                       |               |
|---------------------------------------|---------------|
| <b>Test Report No. :</b> JTT201605033 | May 30, 2016  |
|                                       | Date of issue |

Equipment under Test : Tablet PC

Model /Type : Tab T970S

Listed Models : /

**Applicant** : **Pacific-Technologies Globe Corp**

Address : Room 601,Building 34,Fengherili Garden, Longhua,  
Shenzhen City, Guangdong Province, China

**Manufacturer** : **Pacific-Technologies Globe Corp**

Address : Room 601,Building 34,Fengherili Garden, Longhua,  
Shenzhen City, Guangdong Province, China

|                     |             |
|---------------------|-------------|
| <b>Test Result:</b> | <b>PASS</b> |
|---------------------|-------------|

The test report merely corresponds to the test sample.

It is not permitted to copy extracts of these test result without the written permission of the test laboratory.

**\*\* Modified History \*\***

| Revision     | Description                 | Issued Data | Remark    |
|--------------|-----------------------------|-------------|-----------|
| Revision 1.0 | Initial Test Report Release | 2016-05-30  | Eric Wang |
|              |                             |             |           |
|              |                             |             |           |

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## 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 \(October 23, 2015\)](#): Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies

[KDB447498 D03 Supplement C Cross-Reference v01 \(January 17, 2014\)](#): 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 \(August 7, 2015\)](#): SAR Measurement Requirements for 100 MHz to 6 GHz

[KDB865664 D02 RF Exposure Reporting v01r02 \(October 23, 2015\)](#): RF Exposure Compliance Reporting and Documentation Considerations

[KDB248227 D01 802.11 Wi-Fi SAR v02r02](#): SAR GUIDANCE FOR IEEE 802.11 (Wi-Fi) TRANSMITTERS

[KDB616217 D04 SAR for laptop and tablets v01r02 \(October 23, 2015\)](#): SAR EVALUATION CONSIDERATIONS FOR LAPTOP, NOTEBOOK, NETBOOK AND TABLET COMPUTERS.

[KDB941225 D01 3G SAR Procedures v03r01 \(October 23, 2015\)](#): 3G SAR Measurement Procedures

## 2. SUMMARY

### 2.1. General Remarks

|                                |   |              |
|--------------------------------|---|--------------|
| Date of receipt of test sample | : | May 08, 2016 |
|                                |   |              |
| Testing commenced on           | : | May 22, 2016 |
|                                |   |              |
| Testing concluded on           | : | May 22, 2016 |

### 2.2. Product Description

The **Pacific-Technologies Globe Corp.**'s Model: Tab T970S 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                                                                                                                                                                                                                                                                                                                                       |                                                                                                                     |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|
| Product Name:                                                                                                                                                                                                                                                                                                                                             | Tablet PC                                                                                                           |
| Trade Mark:                                                                                                                                                                                                                                                                                                                                               | N/A                                                                                                                 |
| Model/Type reference:                                                                                                                                                                                                                                                                                                                                     | Tab T970S                                                                                                           |
| Listed Model(s):                                                                                                                                                                                                                                                                                                                                          | Tab T970S                                                                                                           |
| Modulation Type:                                                                                                                                                                                                                                                                                                                                          | GMSK for GSM/GPRS and 8PSK For EGPRS;QPSK for UMTS; DSSS/OFDM for WLAN2.4G; GFSK/8DPSK/ $\pi$ /4DQPSK for Bluetooth |
| Device category:                                                                                                                                                                                                                                                                                                                                          | Portable Device                                                                                                     |
| Exposure category:                                                                                                                                                                                                                                                                                                                                        | General population/uncontrolled environment                                                                         |
| EUT Type:                                                                                                                                                                                                                                                                                                                                                 | Production Unit                                                                                                     |
| Hardware Version                                                                                                                                                                                                                                                                                                                                          | K107V4.0                                                                                                            |
| Software Version:                                                                                                                                                                                                                                                                                                                                         | Android 5.1                                                                                                         |
| Android Version:                                                                                                                                                                                                                                                                                                                                          | Android 6.0                                                                                                         |
| Power supply:                                                                                                                                                                                                                                                                                                                                             | DC 3.7V by battery(4000mAh)<br>Recharge Voltage: DC 5V/2A                                                           |
| <p><i>The EUT is a Tablet PC with GSM/UMTS. Tablet PC is intended for Multimedia Message Service (MMS) transmission. It is equipped with GPRS/EDGE class 12 for GSM850, PCS1900, UmtS Band I/II/V in hardware, disable UMTS Band II/V in software, and Bluetooth, WiFi2.4G and camera functions. For more information see the following datasheet</i></p> |                                                                                                                     |

| Technical Characteristics |                                                                  |
|---------------------------|------------------------------------------------------------------|
| GSM                       |                                                                  |
| Support Networks          | GSM, GPRS, EDGE                                                  |
| Support Band              | GSM850, PCS1900                                                  |
| Frequency                 | GSM850: 824.2~848.8MHz<br>GSM1900: 1850.2~1909.8MHz              |
| Power Class:              | GSM850:Power Class 5<br>PCS1900:Power Class 0                    |
| Modulation Type:          | GMSK for GSM/GPRS; GMSK/8PSK For EGPRS                           |
| Antenna Type              | PIFA Antenna, 1.0dBi(Max.)                                       |
| GSM Release Version       | R99                                                              |
| GPRS Multislot Class      | 12                                                               |
| EGPRS Multislot Class     | 12                                                               |
| DTM Mode                  | Not Supported                                                    |
| UMTS                      |                                                                  |
| Support Networks          | WCDMA RMC12.2K,HSDPA,HSUPA                                       |
| Operation Band:           | UMTS Band I/II/V in hardware, disable UMTS Band II/V by software |
| Modulation Type:          | QPSK for WCDMA/HSUPA/HSDPA                                       |
| Power Class:              | Class 3                                                          |
| WCDMA Release Version:    | R99                                                              |
| HSDPA Release Version:    | R10                                                              |
| HSUPA Release Version:    | R6                                                               |
| DC-HSUPA Release Version: | Not Supported                                                    |
| Antenna Type              | PIFA Antenna, 1.0dBi(Max.)                                       |

|                      |                                                   |
|----------------------|---------------------------------------------------|
| <b>WLAN</b>          |                                                   |
| Supported Standards: | IEEE 802.11b/IEEE 802.11g/IEEE 802.11n HT20       |
| Operation frequency: | 2412-2462MHz                                      |
| Type of Modulation:  | CCK, OFDM, QPSK, BPSK, 16QAM, 64QAM               |
| Data Rate:           | 1-11Mbps, 6-54Mbps, up to 150Mbps                 |
| Channel number:      | 11                                                |
| Channel separation:  | 5MHz                                              |
| Antenna Description  | PIFA Antenna, 0dBi(Max.)                          |
| <b>Bluetooth</b>     |                                                   |
| Bluetooth Version:   | V4.0                                              |
| Modulation:          | GFSK(1Mbps) , $\pi/4$ -DQPSK(2Mbps), 8DPSK(3Mbps) |
| Operation frequency: | 2402MHz~2480MHz                                   |
| Channel number:      | 40/79                                             |
| Channel separation:  | 1MHz/2MHz                                         |
| Antenna Description  | PIFA Antenna, 0dBi(Max.)                          |

## 2.1. Statement of Compliance

The maximum of results of SAR found during testing for Tab T970S are follows:

<Highest Reported standalone SAR Summary>

### Body Configuration

| Mode                       | Test Position | Channel /Frequency(MHz) | Limit SAR <sub>1g</sub> 1.6 W/Kg  |                                   |
|----------------------------|---------------|-------------------------|-----------------------------------|-----------------------------------|
|                            |               |                         | Measured SAR <sub>1g</sub> (W/kg) | Reported SAR <sub>1g</sub> (W/kg) |
| GPRS 850, 4 Txslots        | Rear Side     | 190/836.6               | <b>0.955</b>                      | <b>1.028</b>                      |
| GPRS 1900, 4 Txslots       | Rear Side     | 661/1880.0              | 0.797                             | 0.960                             |
| 2.4GHzWLAN (IEEE 802.11 b) | Rear Side     | 11/2462                 | 0.430                             | 0.464                             |

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>

| Maximum SAR <sub>1-g</sub> Values Reported (W/Kg) |                            |                |       |
|---------------------------------------------------|----------------------------|----------------|-------|
|                                                   |                            | PCE (Licensed) | DTS   |
| Body worn 0 mm distance                           |                            | 1.028          | 0.464 |
| Simultaneous Transmission                         | ΣSAR evaluation            | 1.492          |       |
|                                                   | SPLSR <sub>i</sub> ≤ 0.040 | n/a            |       |

## 2.2. Equipment under Test

### Power supply system utilised

|                      |   |                                                                   |                                   |
|----------------------|---|-------------------------------------------------------------------|-----------------------------------|
| Power supply voltage | : | <input type="radio"/> 120V / 60 Hz                                | <input type="radio"/> 115V / 60Hz |
|                      |   | <input type="radio"/> 12 V DC                                     | <input type="radio"/> 24 V DC     |
|                      |   | <input checked="" type="radio"/> Other (specified in blank below) |                                   |

DC 3.70 V

## 2.3. EUT operation mode

The spatial peak SAR values were assessed for Tablet PC. Battery and accessories shall be specified by the manufacturer. The EUT battery must be fully charged and checked periodically during the test to ascertain uniform power output.

### 3. TEST ENVIRONMENT

#### 3.1. Address of the test laboratory

##### **Shenzhen Yidajietong Test Technology Co., Ltd.**

3/F., Building 12, Shangsha Innovation & Technology Park, Futian District, Shenzhen, Guangdong, China

#### 3.2. Test Facility

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

##### **CNAS-Lab Code: L7547**

The Testing and Technology Center for Shenzhen Yidajietong Test Technology Co., Ltd. has been assessed and proved to be in compliance with CNAS-CL01 Accreditation Criteria for Testing and Calibration Laboratories (identical to ISO/IEC 17025: 2005 General Requirements) for the Competence of Testing and Calibration Laboratories, Date of Registration: March, 2015. Valid time is until March, 2018.

#### 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<br>(averaged over the whole body)             | 0.08                                                     | 0.4                                              |
| Spatial Peak<br>(averaged over any 1 g of tissue)             | 1.60                                                     | 8.0                                              |
| Spatial Peak<br>(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          | 2015/07/22       | 1                    |
| E-field Probe                        | SPEAG           | EX3DV4     | 3842          | 2015/08/26       | 1                    |
| System Validation Dipole D835V2      | SPEAG           | D835V2     | 4d141         | 2015/09/24       | 3                    |
| System Validation Dipole D1900V2     | SPEAG           | D1900V2    | 5d162         | 2015/09/16       | 3                    |
| System Validation Dipole D2450V2     | SPEAG           | D2450V2    | 818           | 2015/09/14       | 3                    |
| Network analyzer                     | Agilent         | 8753E      | US37390562    | 2015/03/18       | 1                    |
| Dielectric Probe Kit                 | Agilent         | 85070E     | US44020288    | /                | /                    |
| Power meter                          | Agilent         | E4417A     | GB41292254    | 2015/12/15       | 1                    |
| Power sensor                         | Agilent         | 8481H      | MY41095360    | 2015/12/15       | 1                    |
| Power sensor                         | Agilent         | 8481H      | MY41095361    | 2015/12/15       | 1                    |
| Signal generator                     | IFR             | 2032       | 203002/100    | 2015/10/12       | 1                    |
| Amplifier                            | AR              | 75A250     | 302205        | 2015/10/12       | 1                    |
| Universal Radio Communication Tester | ROHDE & SCHWARZ | CMU200     | 100122        | 2015/10/12       | 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 evaluate 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, measured 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 50  $\Omega$  from the previous 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.

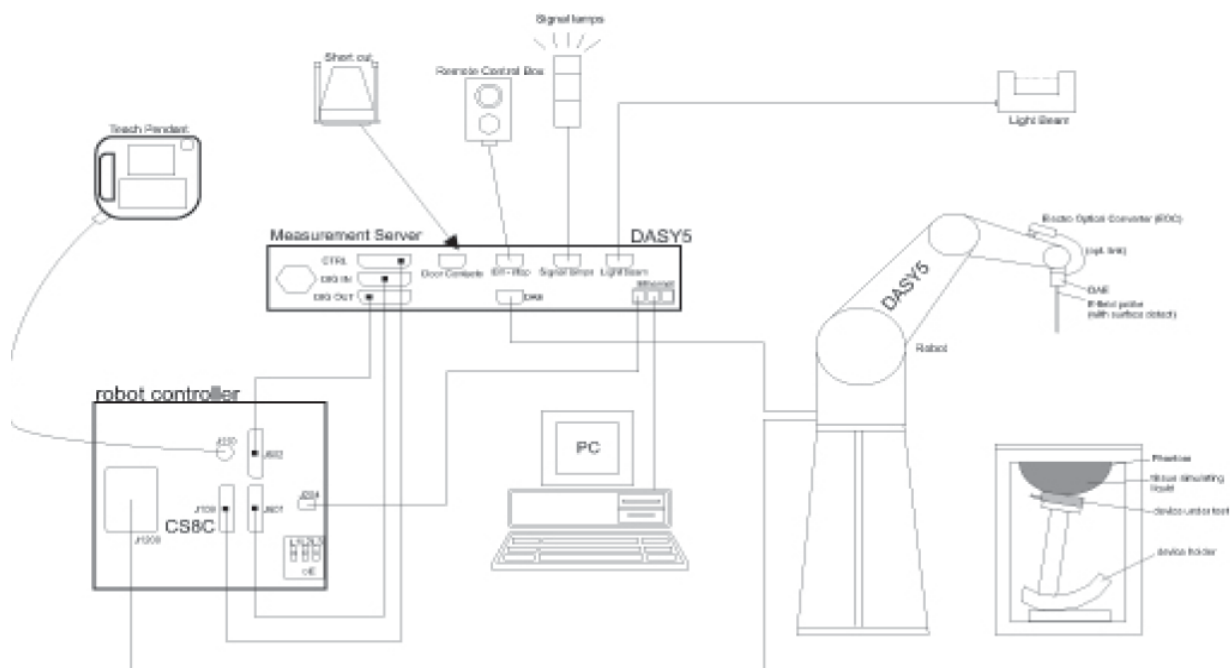
Remote control with teach panel and additional circuitry for robot safety such as warning lamps, etc.

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

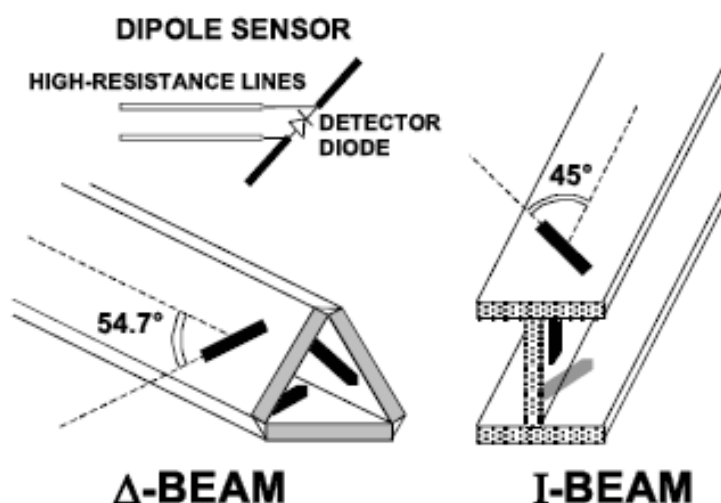
|               |                                                                                                                                                                                    |
|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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: $\pm 0.2$ dB (30 MHz to 4 GHz)                                                                                                                      |
| Directivity   | $\pm 0.2$ dB in HSL (rotation around probe axis)<br>$\pm 0.3$ dB in tissue material (rotation normal to probe axis)                                                                |
| Dynamic Range | 5 $\mu$ W/g to > 100 mW/g;<br>Linearity: $\pm 0.2$ 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

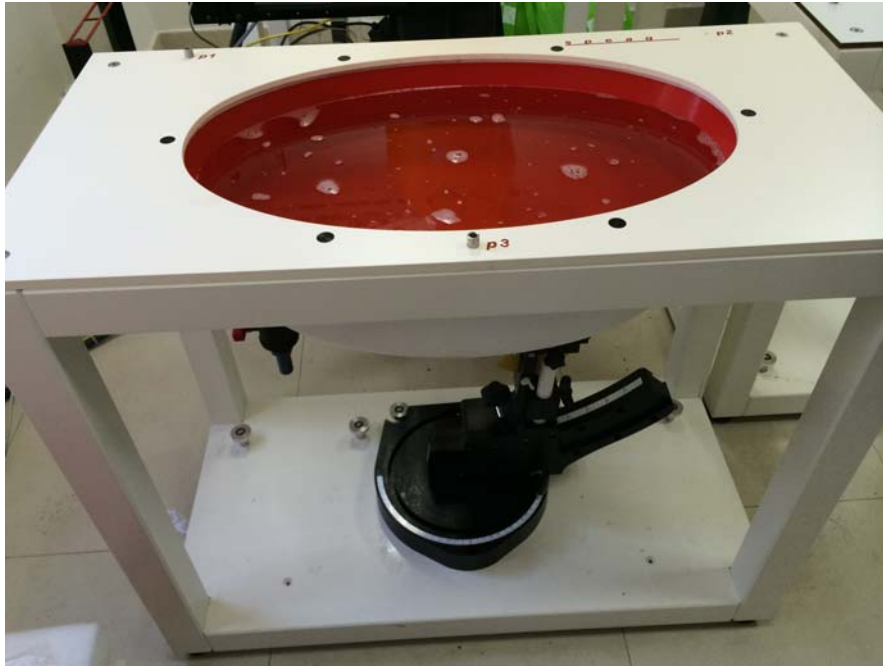
The isotropic E-Field probe has been fully calibrated and assessed for isotropicity, and boundary effect within a controlled environment. Depending on the frequency for which the probe is calibrated the method utilized for calibration will change.

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



## 4.3. Phantoms

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

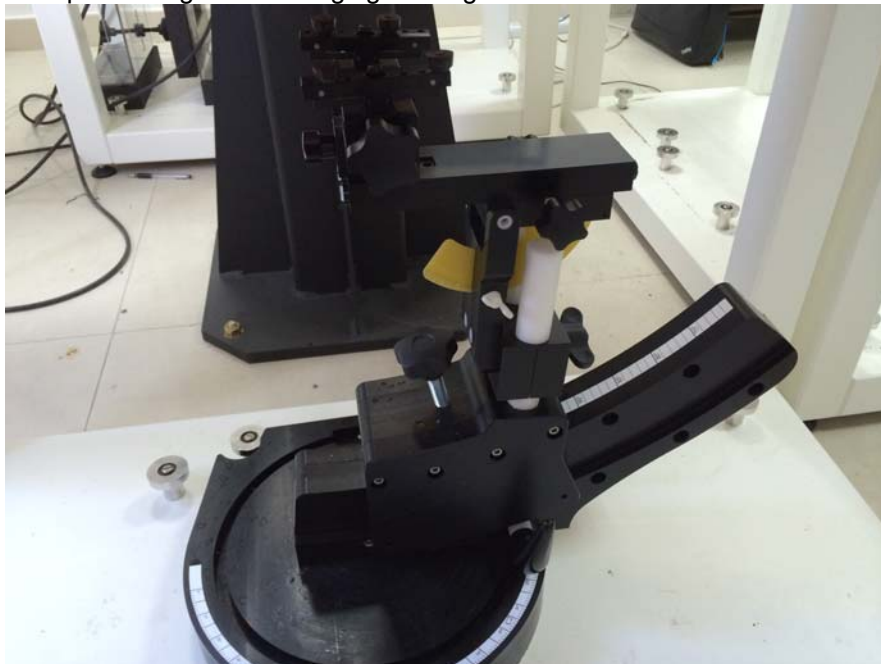


ELI Phantom

#### 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.  $\pm 5\%$ .

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  $\pm 0.1\text{ mm}$ ). 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  $\pm 30^\circ$ .)

#### 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.

|                                                                                                        | $\leq 3\text{ GHz}$                                                                                                                                                                                                                                                    | $> 3\text{ GHz}$                                                                 |
|--------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|
| Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface | $5\text{ mm} \pm 1\text{ mm}$                                                                                                                                                                                                                                          | $\frac{1}{2} \cdot \delta \cdot \ln(2)\text{ mm} \pm 0.5\text{ mm}$              |
| Maximum probe angle from probe axis to phantom surface normal at the measurement location              | $30^\circ \pm 1^\circ$                                                                                                                                                                                                                                                 | $20^\circ \pm 1^\circ$                                                           |
| Maximum area scan spatial resolution: $\Delta x_{\text{Area}}, \Delta y_{\text{Area}}$                 | $\leq 2\text{ GHz: } \leq 15\text{ mm}$<br>$2 - 3\text{ GHz: } \leq 12\text{ mm}$                                                                                                                                                                                      | $3 - 4\text{ GHz: } \leq 12\text{ mm}$<br>$4 - 6\text{ GHz: } \leq 10\text{ mm}$ |
|                                                                                                        | When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be $\leq$ the corresponding x or y dimension of the test device with at least one measurement point on the test device. |                                                                                  |

#### 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.

|                                                                                        |                                           |                                                                                             |                                                                                   |                                                                                                                            |
|----------------------------------------------------------------------------------------|-------------------------------------------|---------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|
| Maximum zoom scan spatial resolution: $\Delta x_{\text{Zoom}}, \Delta y_{\text{Zoom}}$ |                                           |                                                                                             | $\leq 2\text{ GHz: } \leq 8\text{ mm}$<br>$2 - 3\text{ GHz: } \leq 5\text{ mm}^*$ | $3 - 4\text{ GHz: } \leq 5\text{ mm}^*$<br>$4 - 6\text{ GHz: } \leq 4\text{ mm}^*$                                         |
| Maximum zoom scan spatial resolution, normal to phantom surface                        | uniform grid: $\Delta z_{\text{Zoom}}(n)$ |                                                                                             | $\leq 5\text{ mm}$                                                                | $3 - 4\text{ GHz: } \leq 4\text{ mm}$<br>$4 - 5\text{ GHz: } \leq 3\text{ mm}$<br>$5 - 6\text{ GHz: } \leq 2\text{ mm}$    |
|                                                                                        | graded grid                               | $\Delta z_{\text{Zoom}}(1)$ : between 1 <sup>st</sup> two points closest to phantom surface | $\leq 4\text{ mm}$                                                                | $3 - 4\text{ GHz: } \leq 3\text{ mm}$<br>$4 - 5\text{ GHz: } \leq 2.5\text{ mm}$<br>$5 - 6\text{ GHz: } \leq 2\text{ mm}$  |
|                                                                                        |                                           | $\Delta z_{\text{Zoom}}(n>1)$ : between subsequent points                                   | $\leq 1.5 \cdot \Delta z_{\text{Zoom}}(n-1)\text{ mm}$                            |                                                                                                                            |
| Minimum zoom scan volume                                                               | x, y, z                                   |                                                                                             | $\geq 30\text{ mm}$                                                               | $3 - 4\text{ GHz: } \geq 28\text{ mm}$<br>$4 - 5\text{ GHz: } \geq 25\text{ mm}$<br>$5 - 6\text{ GHz: } \geq 22\text{ mm}$ |

Note:  $\delta$  is the penetration depth of a plane-wave at normal incidence to the tissue medium; see IEEE Std 1528-2013 for details.

\* When zoom scan is required and the *reported* SAR from the *area scan based 1-g SAR estimation* procedures of KDB Publication 447498 is  $\leq 1.4\text{ W/kg}$ ,  $\leq 8\text{ mm}$ ,  $\leq 7\text{ mm}$  and  $\leq 5\text{ mm}$  zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.

#### 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:

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

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

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

$$\text{E - fieldprobes : } E_i = \sqrt{\frac{V_i}{\text{Norm}_i \cdot \text{ConvF}}}$$

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

With  $V_i$  = compensated signal of channel i (i = x, y, z)  
 $\text{Norm}_i$  = sensor sensitivity of channel i (i = x, y, z)  
 [mV/(V/m)<sup>2</sup>] for E-field Probes  
 $\text{ConvF}$  = sensitivity enhancement in solution  
 $a_{ij}$  = sensor sensitivity factors for H-field probes  
 $f$  = carrier frequency [GHz]  
 $E_i$  = electric field strength of channel i in V/m  
 $H_i$  = magnetic field strength of channel i in A/m

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

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

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

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

with  $SAR$  = local specific absorption rate in mW/g  
 $E_{tot}$  = total field strength in V/m  
 $\sigma$  = conductivity in [mho/m] or [Siemens/m]  
 $\rho$  = equivalent tissue density in g/cm<sup>3</sup>

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. SAR Measurement System

The SAR measurement system being used is the DASY5 system, the system is controlled remotely from a PC, which contains the software to control the robot and data acquisition equipment. The software also displays the data obtained from test scans.

In operation, the system first does an area (2D) scan at a fixed depth within the liquid from the inside wall of the phantom. When the maximum SAR point has been found, the system will then carry out a 3D scan centred at that point to determine volume averaged SAR level.

##### 4.7.1 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<br>(% Weight) | 835MHz |      | 1900MHz |       | 1750 MHz |       | 2450MHz |      | 2600MHz |      |
|--------------------------|--------|------|---------|-------|----------|-------|---------|------|---------|------|
|                          | 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         |                |
|------------------------|--------------|----------------|--------------|----------------|
|                        | $\epsilon_r$ | $\sigma$ (S/m) | $\epsilon_r$ | $\sigma$ (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

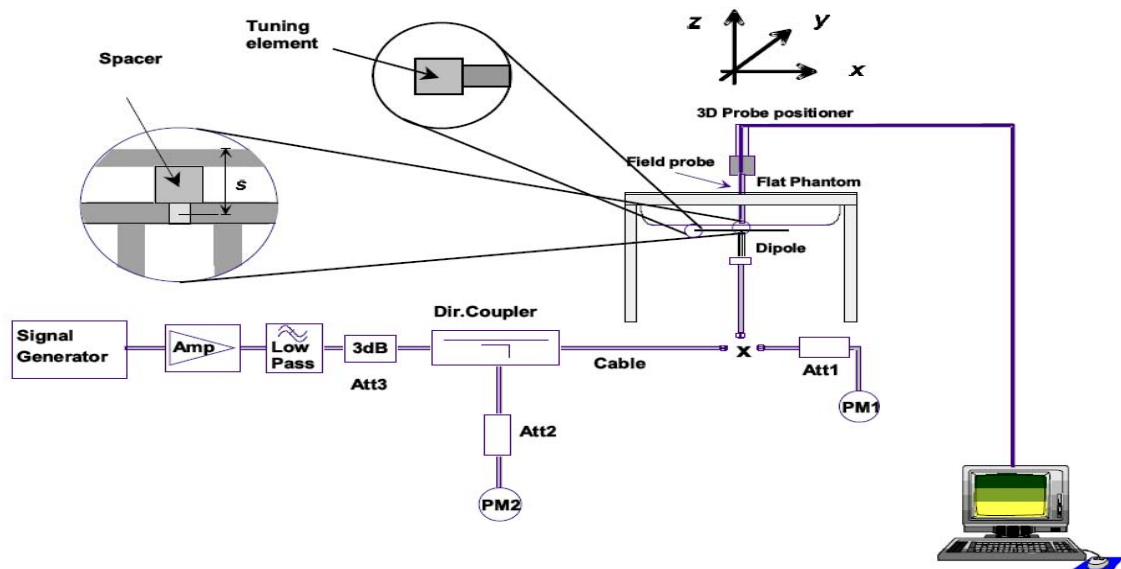
| Tissue Type | Measured Frequency (MHz) | Target Tissue |          | Measured Tissue |        |          |        | Liquid Temp. | Test Data  |
|-------------|--------------------------|---------------|----------|-----------------|--------|----------|--------|--------------|------------|
|             |                          | $\epsilon_r$  | $\sigma$ | $\epsilon_r$    | Dev. % | $\sigma$ | Dev. % |              |            |
| 850B        | 824                      | 55.24         | 0.97     | 57.1            | 3.37%  | 0.94     | -3.09% | 22.2 degree  | 2016-05-22 |
|             | 835                      | 55.20         | 0.97     | 56.8            | 2.90%  | 0.95     | -2.06% |              |            |
|             | 837                      | 55.19         | 0.97     | 56.8            | 2.92%  | 0.95     | -2.06% |              |            |
|             | 849                      | 55.16         | 0.99     | 56.2            | 1.89%  | 0.97     | -2.02% |              |            |
| 1900B       | 1850                     | 53.30         | 1.52     | 55.8            | 4.69%  | 1.48     | -2.63% | 22.2 degree  | 2016-05-22 |
|             | 1880                     | 53.30         | 1.52     | 55.5            | 4.13%  | 1.48     | -2.63% |              |            |
|             | 1900                     | 53.30         | 1.52     | 55.1            | 3.38%  | 1.51     | -0.66% |              |            |
|             | 1910                     | 53.30         | 1.52     | 55.0            | 3.19%  | 1.51     | -0.66% |              |            |
| 2450B       | 2412                     | 52.75         | 1.91     | 55.2            | 4.64%  | 1.94     | 1.57%  | 22.2 degree  | 2016-05-22 |
|             | 2437                     | 52.72         | 1.94     | 54.9            | 4.14%  | 1.95     | 0.52%  |              |            |
|             | 2450                     | 52.70         | 1.95     | 54.4            | 3.23%  | 1.97     | 1.03%  |              |            |
|             | 2462                     | 52.68         | 1.97     | 54.2            | 2.89%  | 1.99     | 1.02%  |              |            |

#### 4.9. System Check

The purpose of the system check is to verify that the system operates within its specifications at the device test frequency. The system check is a 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 ( $\pm 10\%$ ).

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.

#### Justification for Extended SAR Dipole Calibrations

Referring to KDB 865664D01V01r03, if dipoles are verified in return loss ( $< -20\text{dB}$ , 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.

**System Check in Body Tissue Simulating Liquid**

| Frequency | Test Date  | Dielectric Parameters |                      | Temp<br>(°C) | 1W<br>Measured<br>SAR <sub>1g</sub> | 1W<br>Normalized<br>SAR <sub>1g</sub><br>(W/Kg) | 1W<br>Target<br>SAR <sub>1g</sub> | Limit<br>(±10%<br>Deviation) |
|-----------|------------|-----------------------|----------------------|--------------|-------------------------------------|-------------------------------------------------|-----------------------------------|------------------------------|
|           |            | $\epsilon_r$          | $\sigma(\text{s/m})$ |              |                                     |                                                 |                                   |                              |
| 835MHz    | 2015/05/22 | 56.8                  | 0.95                 | 22.2         | 2.56                                | 10.24                                           | 9.51                              | 7.68%                        |
| 1900MHz   | 2015/05/22 | 55.1                  | 1.51                 | 22.2         | 10.20                               | 40.80                                           | 41.20                             | -0.97%                       |
| 2450MHz   | 2015/05/22 | 54.4                  | 1.97                 | 22.2         | 12.70                               | 50.80                                           | 51.10                             | -0.59%                       |

Note:

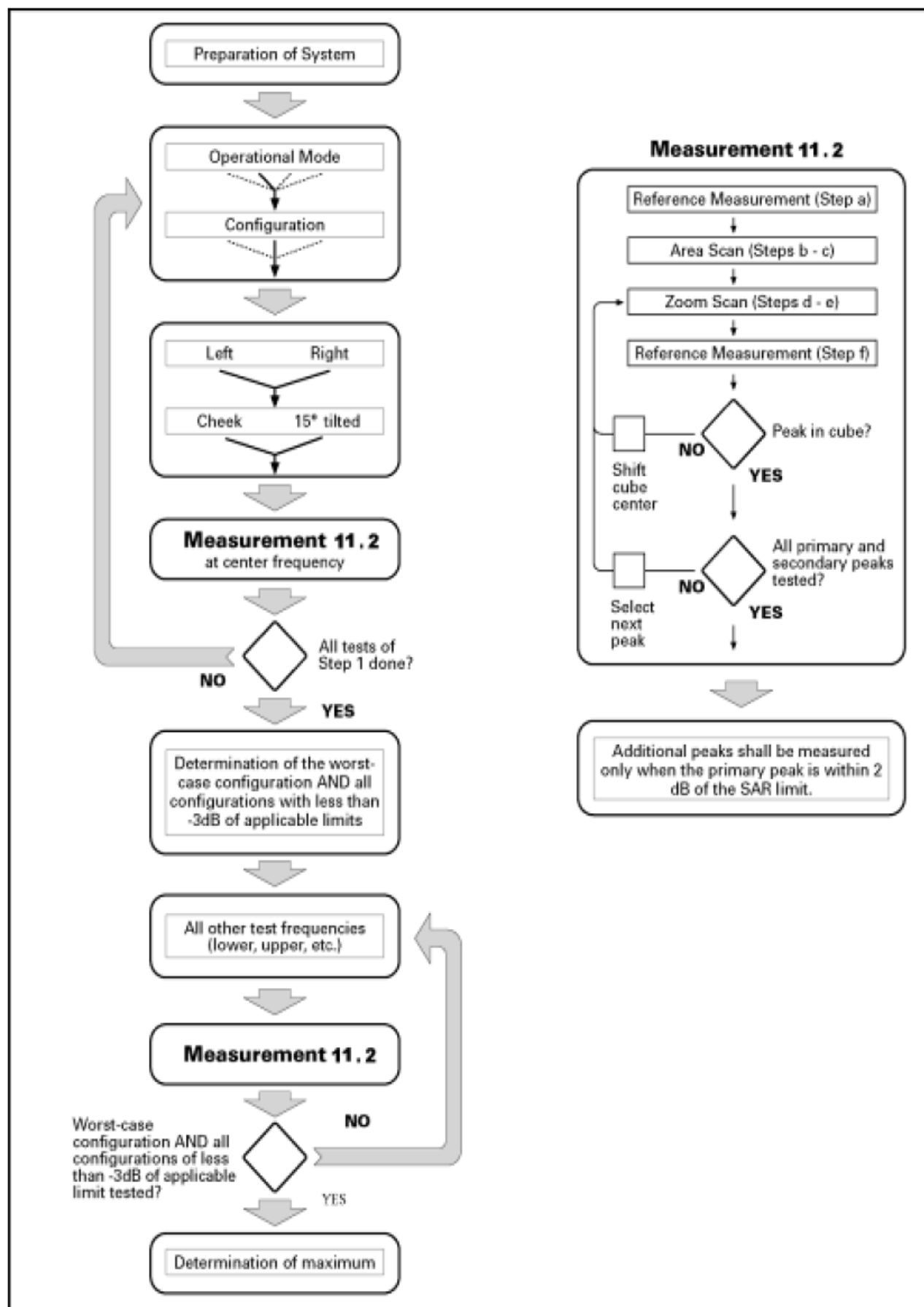
1. The graph results see system check.
2. Target Values used derive from the calibration certificate

#### 4.10. Measurement Procedures

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 DASY4 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  $7 \times 7 \times 7$  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.



Picture 11 Block diagram of the tests to be performed

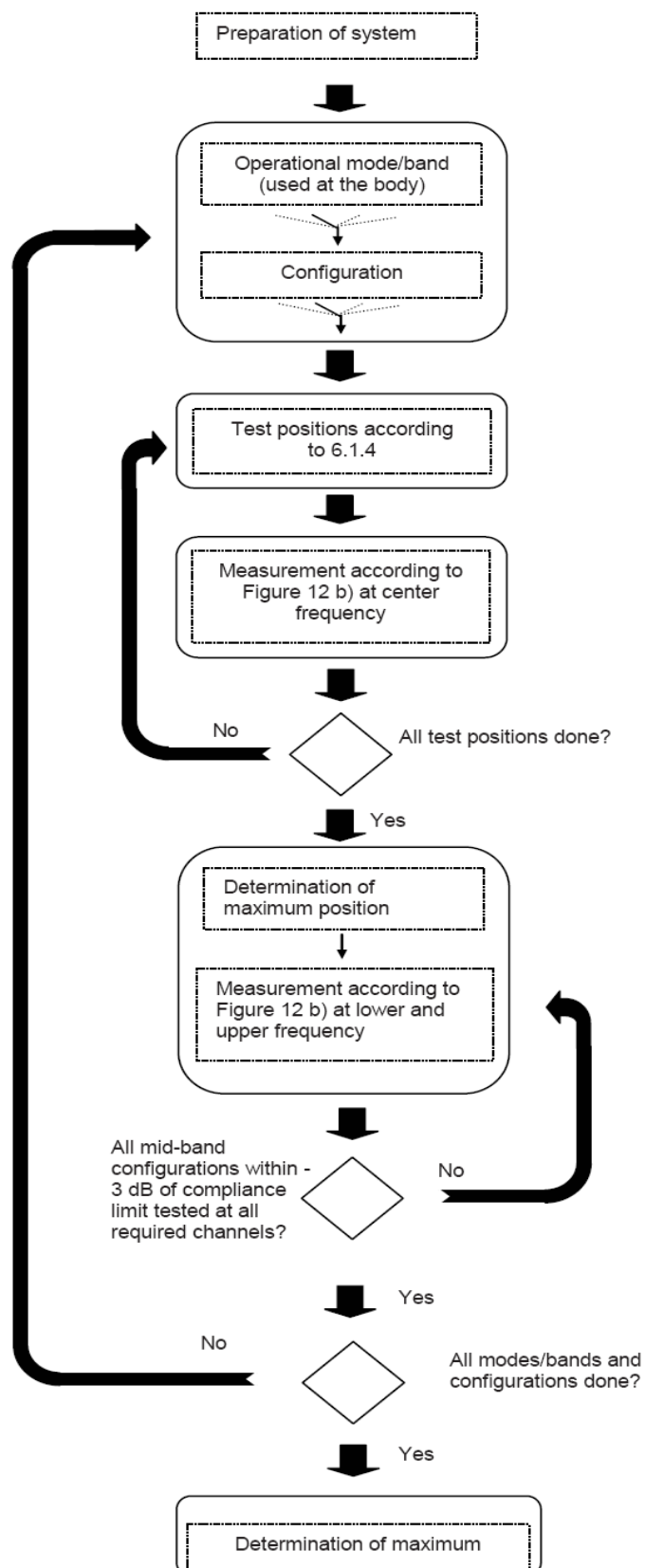


Figure 12a – Tests to be performed

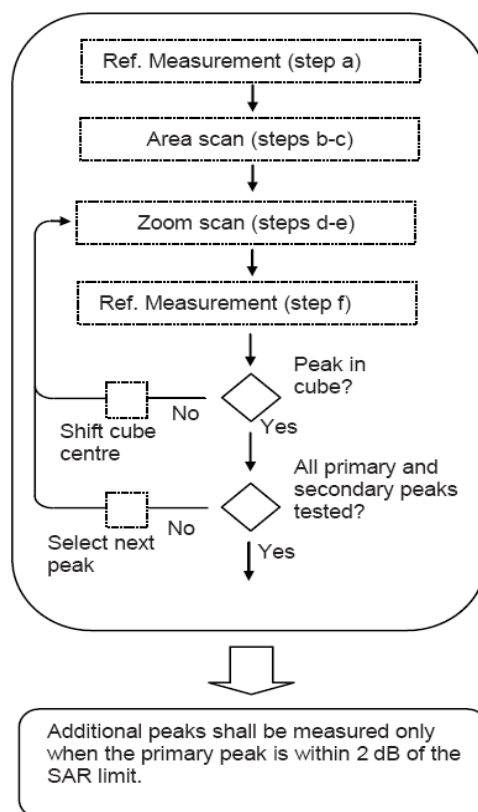


Figure 12b – General procedure

Picture 12 Block diagram of the tests to be performed

### Measurement procedure

The following procedure shall be performed for each of the test conditions (see Picture 11) described in 11.1:

- Measure the local SAR at a test point within 8 mm or less in the normal direction from the inner surface of the phantom.
- Measure the two-dimensional SAR distribution within the phantom (area scan procedure). The boundary of the measurement area shall not be closer than 20 mm from the phantom side walls. The distance between the measurement points should enable the detection of the location of local maximum with an

accuracy of better than half the linear dimension of the tissue cube after interpolation. A maximum grip spacing of 20 mm for frequencies below 3 GHz and  $(60/f \text{ [GHz]})$  mm for frequencies of 3 GHz and greater is recommended. The maximum distance between the geometrical centre of the probe detectors and the inner surface of the phantom shall be 5 mm for frequencies below 3 GHz and  $\delta \ln(2)/2$  mm for frequencies of 3 GHz and greater, where  $\delta$  is the plane wave skin depth and  $\ln(x)$  is the natural logarithm. The maximum variation of the sensor-phantom surface shall be  $\pm 1$  mm for frequencies below 3 GHz and  $\pm 0.5$  mm for frequencies of 3 GHz and greater. At all measurement points the angle of the probe with respect to the line normal to the surface should be less than  $5^\circ$ . If this cannot be achieved for a measurement distance to the phantom inner surface shorter than the probe diameter, additional measurement distance to the phantom inner surface shorter than the probe diameter, additional

- c) From the scanned SAR distribution, identify the position of the maximum SAR value, in addition identify the positions of any local maxima with SAR values within 2 dB of the maximum value that are not within the zoom-scan volume; additional peaks shall be measured only when the primary peak is within 2 dB of the SAR limit. This is consistent with the 2 dB threshold already stated;
- d) Measure the three-dimensional SAR distribution at the local maxima locations identified in step
- e) The horizontal grid step shall be  $(24 / f \text{ [GHz]})$  mm or less but not more than 8 mm. The minimum zoom size of 30 mm by 30 mm and 30 mm for frequencies below 3 GHz. For higher frequencies, the minimum zoom size of 22 mm by 22 mm and 22 mm. The grip step in the vertical direction shall be  $(8-f \text{ [GHz]})$  mm or less but not more than 5 mm, if uniform spacing is used. If variable spacing is used in the vertical direction, the maximum spacing between the two closest measured points to the phantom shell shall be  $(12 / f \text{ [GHz]})$  mm or less but not more than 4 mm, and the spacing between father points shall increase by an incremental factor not exceeding 1.5. When variable spacing is used, extrapolation routines shall be tested with the same spacing as used in measurements. The maximum distance between the geometrical centre of the probe detectors and the inner surface of the phantom shall be 5 mm for frequencies below 3 GHz and  $\delta \ln(2)/2$  mm for frequencies of 3 GHz and greater, where  $\delta$  is the plane wave skin depth and  $\ln(x)$  is the natural logarithm. Separate grids shall be centered on each of the local SAR maxima found in step c). Uncertainties due to field distortion between the media boundary and the dielectric enclosure of the probe should also be minimized, which is achieved is the distance between the phantom surface and physical tip of the probe is larger than probe tip diameter. Other methods may utilize correction procedures for these boundary effects that enable high precision measurements closer than half the probe diameter. For all measurement points, the angle of the probe with respect to the flat phantom surface shall be less than  $5^\circ$ . If this cannot be achieved an additional uncertainty evaluation is needed.
- f) Use post processing( e.g. interpolation and extrapolation ) procedures to determine the local SAR values at the spatial resolution needed for mass averaging.

### Measurement procedure

The following procedure shall be performed for each of the test conditions (see Picture 11) described in 11.1:

- g) Measure the local SAR at a test point within 8 mm or less in the normal direction from the inner surface of the phantom.
- h) Measure the two-dimensional SAR distribution within the phantom (area scan procedure). The boundary of the measurement area shall not be closer than 20 mm from the phantom side walls. The distance between the measurement points should enable the detection of the location of local maximum with an accuracy of better than half the linear dimension of the tissue cube after interpolation. A maximum grip spacing of 20 mm for frequencies below 3 GHz and  $(60/f \text{ [GHz]})$  mm for frequencies of 3 GHz and greater is recommended. The maximum distance between the geometrical centre of the probe detectors and the inner surface of the phantom shall be 5 mm for frequencies below 3 GHz and  $\delta \ln(2)/2$  mm for frequencies of 3 GHz and greater, where  $\delta$  is the plane wave skin depth and  $\ln(x)$  is the natural logarithm. The maximum variation of the sensor-phantom surface shall be  $\pm 1$  mm for frequencies below 3 GHz and  $\pm 0.5$  mm for frequencies of 3 GHz and greater. At all measurement points the angle of the probe with respect to the line normal to the surface should be less than  $5^\circ$ . If this cannot be achieved for a measurement distance to the phantom inner surface shorter than the probe diameter, additional measurement distance to the phantom inner surface shorter than the probe diameter, additional
- i) From the scanned SAR distribution, identify the position of the maximum SAR value, in addition identify the positions of any local maxima with SAR values within 2 dB of the maximum value that are not within the zoom-scan volume; additional peaks shall be measured only when the primary peak is within 2 dB of the SAR limit. This is consistent with the 2 dB threshold already stated;
- j) Measure the three-dimensional SAR distribution at the local maxima locations identified in step
- k) The horizontal grid step shall be  $(24 / f \text{ [GHz]})$  mm or less but not more than 8 mm. The minimum zoom size of 30 mm by 30 mm and 30 mm for frequencies below 3 GHz. For higher frequencies, the minimum zoom size of 22 mm by 22 mm and 22 mm. The grip step in the vertical direction shall be  $(8-f \text{ [GHz]})$  mm or less but not more than 5 mm, if uniform spacing is used. If variable spacing is used in the vertical direction, the maximum spacing between the two closest measured points to the phantom shell shall be  $(12 / f \text{ [GHz]})$  mm or less but not more than 4 mm, and the spacing between father points shall increase by an incremental factor not exceeding 1.5. When variable spacing is used, extrapolation routines shall be tested with the same spacing as used in measurements. The maximum distance between the geometrical

centre of the probe detectors and the inner surface of the phantom shall be 5 mm for frequencies below 3 GHz and  $\delta \ln(2)/2$  mm for frequencies of 3 GHz and greater, where  $\delta$  is the plane wave skin depth and  $\ln(x)$  is the natural logarithm. Separate grids shall be centered on each of the local SAR maxima found in step c). Uncertainties due to field distortion between the media boundary and the dielectric enclosure of the probe should also be minimized, which is achieved if the distance between the phantom surface and physical tip of the probe is larger than probe tip diameter. Other methods may utilize correction procedures for these boundary effects that enable high precision measurements closer than half the probe diameter. For all measurement points, the angle of the probe with respect to the flat phantom surface shall be less than 5°. If this cannot be achieved an additional uncertainty evaluation is needed.

- l) Use post processing( e.g. interpolation and extrapolation ) procedures to determine the local SAR values at the spatial resolution needed for mass averaging.

#### **Conducted power measurement**

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

### **4.11. Operational Conditions during Test**

#### **4.11.1. General Description of Test Procedures**

A communication link is set up with a System Simulator (SS) by air link, and a call is established. The EUT is commanded to operate at maximum transmitting power.

Connection to the EUT is established via air interface with CMU 200, and the EUT is set to maximum output power by CMU 200. The EUT battery must be fully charged and checked periodically during the test to ascertain uniform power output. The antenna connected to the output of the base station simulator shall be placed at least 50 cm away from the EUT. The signal transmitted by the simulator to the antenna feeding point shall be lower than the output power level of the EUT by at least 30 dB.

### **4.12. Position of the wireless device in relation to the phantom**

#### **4.12.1 Body Configuration**

The overall diagonal dimension of the display section of a tablet is 27 cm > 20 cm, Per FCC KDB 616217 Tablet host platform test requirements, the back surface and edges of the tablet should be tested for SAR compliance with the tablet touching the phantom. Exposures from antennas through the front (top) surface of the display section of a full-size tablet, away from the edges, are generally limited to the user's hands. Exposures to hands for typical consumer transmitters used in tablets are not expected to exceed the extremity SAR limit; therefore, SAR evaluation for the front surface of tablet display screens are generally not necessary, except for tablets that are designed to require continuous operations with the hand(s) next to the antenna(s). Per KDB 648474 SAR Evaluation Considerations for Wireless Handsets, when the over diagonal dimension of the device is > 20.0 cm. Hotspot mode SAR is not required when normal tablet procedures are applied. Extremity 10-g SAR is also not required for the front (top) surface of large form factor full size tablets. The more conservative tablet SAR results can be used to support the 10-g extremity SAR for phablet mode.

- Test Position 1: The rear surface of the EUT towards the bottom of the flat phantom;
- Test Position 2: The left surface of the EUT towards the bottom of the flat phantom;
- Test Position 3: The right surface of the EUT towards the bottom of the flat phantom;
- Test Position 4: The top surface of the EUT towards the bottom of the flat phantom;
- Test Position 5: The bottom surface of the EUT towards the bottom of the flat phantom;

### **4.13. Test Configuration**

#### **4.13.1. GSM Test Configuration**

SAR tests for GSM 850 and GSM 1900, a communication link is set up with a System Simulator (SS) by air link. Using CMU200 to measure the power level is set to "5" for GSM 850, set to "0" for GSM 1900. Since the

GPRS class is 12 for this EUT, it has at most 4 timeslots in uplink and at most 4 timeslots in downlink, the maximum total timeslots is 5. Since the EGPRS class is 12 for this EUT, it has at most 4 timeslots in uplink and at most 4 timeslots in downlink, the maximum total timeslots is 5.

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

According to specification 3GPP TS 51.010, the maximum power of the GSM can do the power reduction for the multi-slot. The allowed power reduction in the multi-slot configuration is as following: Output power of reductions:

The allowed power reduction in the multi-slot configuration

| Number of timeslots in uplink assignment | Permissible nominal reduction of maximum output power, (dB) |
|------------------------------------------|-------------------------------------------------------------|
| 1                                        | 0                                                           |
| 2                                        | 0 to 3.0                                                    |
| 3                                        | 1.8 to 4.8                                                  |
| 4                                        | 3.0 to 6.0                                                  |

## UMTS Test Configuration

### 3G SAR Test Reduction Procedure

In the following procedures, the mode tested for SAR is referred to as the primary mode. The equivalent modes considered for SAR test reduction are denoted as secondary modes. Both primary and secondary modes must be in the same frequency band. When the maximum output power and tune-up tolerance specified for production units in a secondary mode is  $\leq \frac{1}{4}$  dB higher than the primary mode or when the highest reported SAR of the primary mode is scaled by the ratio of specified maximum output power and tune-up tolerance of secondary to primary mode and the adjusted SAR is  $\leq 1.2$  W/kg, SAR measurement is not required for the secondary mode.<sup>3</sup> This is referred to as the 3G SAR test reduction procedure in the following SAR test guidance, where the primary mode is identified in the applicable wireless mode test procedures and the secondary mode is wireless mode being considered for SAR test reduction by that procedure. When the 3G SAR test reduction procedure is not satisfied, it is identified as “otherwise” in the applicable procedures; SAR measurement is required for the secondary mode.

### Output power Verification

Maximum output power is verified on the high, middle and low channels according to procedures described in section 5.2 of 3GPP TS 34.121, using the appropriate RMC or AMR with TPC (transmit power control) set to all “1’s” for WCDMA/HSDPA or by applying the required inner loop power control procedures to maintain maximum output power while HSUPA is active. Results for all applicable physical channel configurations (DPCCH, DPDCHn and spreading codes, HSDPA, HSPA) are required in the SAR report. All configurations that are not supported by the handset or cannot be measured due to technical or equipment limitations must be clearly identified.

### Head SAR

SAR for next to the ear head exposure is measured using a 12.2 kbps RMC with TPC bits configured to all “1’s”. The 3G SAR test reduction procedure is applied to AMR configurations with 12.2 kbps RMC as the primary mode. Otherwise, SAR is measured for 12.2 kbps AMR in 3.4 kbps SRB (signaling radio bearer) using the highest reported SAR configuration in 12.2 kbps RMC for head exposure.

### Body-Worn Accessory SAR

SAR for body-worn accessory configurations is measured using a 12.2 kbps RMC with TPC bits configured to all “1’s”. The 3G SAR test reduction procedure is applied to other spreading codes and multiple DPDCHn configurations supported by the handset with 12.2 kbps RMC as the primary mode. Otherwise, SAR is measured using an applicable RMC configuration with the corresponding spreading code or DPDCHn, for the highest reported body-worn accessory exposure SAR configuration in 12.2 kbps RMC. When more than 2 DPDCHn are supported by the handset, it may be necessary to configure additional DPDCHn using FTM (Factory Test Mode) or other chipset based test approaches with parameters similar to those used in 384 kbps and 768 kbps RMC.

### Handsets with Release 5 HSDPA

The 3G SAR test reduction procedure is applied to HSDPA body-worn accessory configurations with 12.2 kbps RMC as the primary mode. Otherwise, SAR is measured for HSDPA using the HSDPA body SAR

procedures in the “Release 5 HSDPA Data Devices” section of this document, for the highest reported SAR body-worn accessory exposure configuration in 12.2 kbps RMC. Handsets with both HSDPA and HSUPA are tested according to Release 6 HSPA test procedures.

HSDPA should be configured according to the UE category of a test device. The number of HSDSCH/ HS-PDSCHs, HARQ processes, minimum inter-TTI interval, transport block sizes and RV coding sequence are defined by the H-set. To maintain a consistent test configuration and stable transmission conditions, QPSK is used in the H-set for SAR testing. HS-DPCCH should be configured with a CQI feedback cycle of 4 ms with a CQI repetition factor of 2 to maintain a constant rate of active CQI slots. DPCCH and DPDCH gain factors ( $\beta_c$ ,  $\beta_d$ ), and HS-DPCCH power offset parameters ( $\Delta_{ACK}$ ,  $\Delta_{NACK}$ ,  $\Delta_{CQI}$ ) should be set according to values indicated in the Table below. The CQI value is determined by the UE category, transport block size, number of HS-PDSCHs and modulation used in the H-set.

Table 1: Subtests for UMTS Release 5 HSDPA

| Sub-set | $\beta_c$         | $\beta_d$         | $\beta_d$<br>(SF) | $\beta_c/\beta_d$ | $\beta_{hs}$<br>(note 1, note 2) | CM(dB)<br>(note 3) | MPR(dB) |
|---------|-------------------|-------------------|-------------------|-------------------|----------------------------------|--------------------|---------|
| 1       | 2/15              | 15/15             | 64                | 2/15              | 4/15                             | 0.0                | 0.0     |
| 2       | 12/15<br>(note 4) | 15/15<br>(note 4) | 64                | 12/15<br>(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     |

Note1:  $\Delta_{ACK}$ ,  $\Delta_{NACK}$  and  $\Delta_{CQI} = 8$   $\Rightarrow A_{hs} = \beta_{hs}/\beta_c = 30/15$   $\Rightarrow \beta_{hs} = 30/15 * \beta_c$   
Note2: CM=1 for  $\beta_c/\beta_d = 12/15$ ,  $\beta_{hs}/\beta_c = 24/15$ .  
Note3: 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 signaled gain factors for the reference TFC (TFC1, TF1) to  $\beta_c = 11/15$  and  $\beta_d = 15/15$ .

### HSUPA Test Configuration

The 3G SAR test reduction procedure is applied to HSPA (HSUPA/HSDPA with RMC) body-worn accessory configurations with 12.2 kbps RMC as the primary mode. Otherwise, SAR is measured for HSPA using the HSPA body SAR procedures in the “Release 6 HSPA Data Devices” section of this document, for the highest reported body-worn accessory exposure SAR configuration in 12.2 kbps RMC. When VOIP is applicable for next to the ear head exposure in HSPA, the 3G SAR test reduction procedure is applied to HSPA with 12.2 kbps RMC as the primary mode; otherwise, the same HSPA configuration used for body-worn accessory measurements is tested for next to the ear head exposure.

Due to inner loop power control requirements in HSPA, a communication test set is required for output power and SAR tests. The 12.2 kbps RMC, FRC H-set 1 and E-DCH configurations for HSPA are configured according to the  $\beta$  values indicated in Table 2 and other applicable procedures described in the ‘WCDMA Handset’ and ‘Release 5 HSDPA Data Devices’ sections of this document

Table 2: Sub-Test 5 Setup for Release 6 HSUPA

| Sub-set | $\beta_c$            | $\beta_d$            | $\beta_d$<br>(SF) | $\beta_c/\beta_d$    | $\beta_{hs}^{(1)}$ | $\beta_{ec}$ | $\beta_{ed}$                                 | $\beta_{ed}$<br>(SF) | $\beta_{ed}$<br>(codes) | CM <sup>(2)</sup><br>(dB) | MPR<br>(dB) | AG <sup>(4)</sup><br>Index | E-TFCI |
|---------|----------------------|----------------------|-------------------|----------------------|--------------------|--------------|----------------------------------------------|----------------------|-------------------------|---------------------------|-------------|----------------------------|--------|
| 1       | 11/15 <sup>(3)</sup> | 15/15 <sup>(3)</sup> | 64                | 11/15 <sup>(3)</sup> | 22/15              | 209/225      | 1039/225                                     | 4                    | 1                       | 1.0                       | 0.0         | 20                         | 75     |
| 2       | 6/15                 | 15/15                | 64                | 6/15                 | 12/15              | 12/15        | 94/75                                        | 4                    | 1                       | 3.0                       | 2.0         | 12                         | 67     |
| 3       | 15/15                | 9/15                 | 64                | 15/9                 | 30/15              | 30/15        | $\beta_{ed1}: 47/15$<br>$\beta_{ed2}: 47/15$ | 4                    | 2                       | 2.0                       | 1.0         | 15                         | 92     |
| 4       | 2/15                 | 15/15                | 64                | 2/15                 | 4/15               | 2/15         | 56/75                                        | 4                    | 1                       | 3.0                       | 2.0         | 17                         | 71     |
| 5       | 15/15 <sup>(4)</sup> | 15/15 <sup>(4)</sup> | 64                | 15/15 <sup>(4)</sup> | 30/15              | 24/15        | 134/15                                       | 4                    | 1                       | 1.0                       | 0.0         | 21                         | 81     |

Note 1:  $\Delta_{ACK}$ ,  $\Delta_{NACK}$  and  $\Delta_{CQI} = 8 \Rightarrow A_{hs} = \beta_{hs}/\beta_c = 30/15 \Rightarrow \beta_{hs} = 30/15 * \beta_c$ .  
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 signaled 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 signaled gain factors for the reference TFC (TF1, TF1) to  $\beta_c = 14/15$  and  $\beta_d = 15/15$ .  
Note 5: Testing UE using E-DPDCH Physical Layer category 1 Sub-test 3 is not required according to TS 25.306 Figure 5.1g.  
Note 6:  $\beta_{ed}$  can not be set directly; it is set by Absolute Grant Value.

Table 3: HSUPA UE category

| UE E-DCH Category | Maximum E-DCH Codes Transmitted | Number of HARQ Processes | E-DCH TTI (ms) | Minimum Spreading Factor | Maximum E-DCH Transport Block Bits | Max Rate (Mbps) |
|-------------------|---------------------------------|--------------------------|----------------|--------------------------|------------------------------------|-----------------|
| 1                 | 1                               | 4                        | 10             | 4                        | 7110                               | 0.7296          |
| 2                 | 2                               | 8                        | 2              | 4                        | 2798                               | 1.4592          |
|                   | 2                               | 4                        | 10             | 4                        | 14484                              |                 |
| 3                 | 2                               | 4                        | 10             | 4                        | 14484                              | 1.4592          |
| 4                 | 2                               | 8                        | 2              | 2                        | 5772                               | 2.9185          |
|                   | 2                               | 4                        | 10             | 2                        | 20000                              | 2.00            |
| 5                 | 2                               | 4                        | 10             | 2                        | 20000                              | 2.00            |
| 6<br>(No DPDCH)   | 4                               | 8                        | 2              | 2 SF2 & 2 SF4            | 11484                              | 5.76            |
|                   | 4                               | 4                        | 10             |                          | 20000                              | 2.00            |
| 7<br>(No DPDCH)   | 4                               | 8                        | 2              | 2 SF2 & 2 SF4            | 22996                              | ?               |
|                   | 4                               | 4                        | 10             |                          | 20000                              | ?               |

NOTE: When 4 codes are transmitted in parallel, two codes shall be transmitted with SF2 and two with SF4. UE Categories 1 to 6 supports QPSK only. UE Category 7 supports QPSK and 16QAM. (TS25.306-7.3.0)

### HSPA, HSPA+ and DC-HSDPA Test Configuration

measurement is required for HSPA, HSPA+ or DC-HSDPA, a KDB inquiry is required to confirm that the wireless mode configurations in the test setup have remained stable throughout the SAR measurements.<sup>35</sup> Without prior KDB confirmation to determine the SAR results are acceptable, a PBA is required for TCB approval.

SAR test exclusion for HSPA, HSPA+ and DC-HSDPA is determined according to the following:

- 1) The HSPA procedures are applied to configure 3GPP Rel. 6 HSPA devices in the required sub-test mode(s) to determine SAR test exclusion.
- 2) SAR is required for Rel. 7 HSPA+ when SAR is required for Rel. 6 HSPA; otherwise, the 3G SAR test reduction procedure is applied to (uplink) HSPA+ with 12.2 kbps RMC as the primary mode.<sup>36</sup> Power is measured for HSPA+ that supports uplink 16 QAM according to configurations in Table C.11.1.4 of 3GPP TS 34.121-1 to determine SAR test reduction.
- 3) SAR is required for Rel. 8 DC-HSDPA when SAR is required for Rel. 5 HSDPA; otherwise, the 3G SAR test reduction procedure is applied to DC-HSDPA with 12.2 kbps RMC as the primary mode. Power is measured for DC-HSDPA according to the H-Set 12, FRC configuration in Table C.8.1.12 of 3GPP TS 34.121-1 to determine SAR test reduction. A primary and a secondary serving HS-DSCH Cell are required to perform the power measurement and for the results to be acceptable.
- 4) Regardless of whether a PBA is required, the following information must be verified and included in the SAR report for devices supporting HSPA, HSPA+ or DC-HSDPA: a) The output power measurement results and applicable release version(s) of 3GPP TS 34.121.

i) Power measurement difficulties due to test equipment setup or availability must be resolved between the grantee and its test lab.

b) The power measurement results are in agreement with the individual device implementation and specifications. When Enhanced MPR (E-MPR) applies, the normal MPR targets may be modified according to the Cubic Metric (CM) measured by the device, which must be taken into consideration.

c) The UE category, operating parameters, such as the  $\beta$  and  $\Delta$  values used to configure the device for testing, power setback procedures described in 3GPP TS 34.121 for the power measurements, and HSPA/HSPA+ channel conditions (active and stable) for the entire duration of the measurement according to the required E-TFCI and AG index values.

5) When SAR measurement is required, the test configurations, procedures and power measurement results must be clearly described to confirm that the required test parameters are used, including E-TFCI and AG index stability and output power conditions.

### **WLAN Test Configuration**

For WiFi SAR testing, WiFi engineering testing software installed on the DUT can provide continuous transmitting RF signal. This RF signal utilized in SAR measurement has almost 100% duty cycle and its crest factor is 1.

The SAR measurement and test reduction procedures are structured according to either the DSSS or OFDM transmission mode configurations used in each standalone frequency band and aggregated band. For devices that operate in exposure configurations that require multiple test positions, additional SAR test

reduction may be applied. The maximum output power specified for production units, including tune-up tolerance, are used to determine initial SAR test requirements for the 802.11 transmission modes in a frequency band. SAR is measured using the highest measured maximum output power channel for the initial test configuration. SAR measurement and test reduction for the remaining 802.11 modes and test channels are determined according to measured or specified maximum output power and reported SAR of the initial measurements. The general test reduction and SAR measurement approaches are summarized in the following:

1. The maximum output power specified for production units are determined for all applicable 802.11 transmission modes in each standalone and aggregated frequency band. Maximum output power is measured for the highest maximum output power configuration(s) in each frequency band according to the default power measurement procedures.
2. For OFDM transmission configurations in the 2.4 GHz and 5 GHz bands, an "initial test configuration" is first determined for each standalone and aggregated frequency band according to the maximum output power and tune-up tolerance specified for production units.
  - a. When the same maximum power is specified for multiple transmission modes in a frequency band, the largest channel bandwidth, lowest order modulation, lowest data rate and lowest order 802.11a/g/n/ac mode is used for SAR measurement, on the highest measured output power channel in the initial test configuration, for each frequency band.
  - b. SAR is measured for OFDM configurations using the initial test configuration procedures. Additional frequency band specific SAR test reduction may be considered for individual frequency bands
  - c. Depending on the reported SAR of the highest maximum output power channel tested in the initial test configuration, SAR test reduction may apply to subsequent highest output channels in the initial test configuration to reduce the number of SAR measurements.
3. The Initial test configuration does not apply to DSSS. The 2.4 GHz band SAR test requirements and 802.11b DSSS procedures are used to establish the transmission configurations required for SAR measurement.
4. An "initial test position" is applied to further reduce the number of SAR tests for devices operating in next to the ear, UMPC mini-tablet mode exposure configurations that require multiple test positions.
  - a. SAR is measured for 802.11b according to the 2.4 GHz DSSS procedure using the exposure condition established by the initial test position.
  - b. SAR is measured for 2.4 GHz and 5 GHz OFDM configurations using the initial test configuration. 802.11b/g/n operating modes are tested independently according to the service requirements in each frequency band. 802.11b/g/n modes are tested on the maximum average output channel.
5. The Initial test position does not apply to devices that require a fixed exposure test position. SAR is measured in a fixed exposure test position for these devices in 802.11b according to the 2.4 GHz DSSS procedure or in 2.4 GHz and 5 GHz OFDM configurations using the initial test configuration procedures.
6. The "subsequent test configuration" procedures are applied to determine if additional SAR measurements are required for the remaining OFDM transmission modes that have not been tested in the initial test configuration. SAR test exclusion is determined according to reported SAR in the initial test configuration and maximum output power specified or measured for these other OFDM configurations.

#### SAR Procedures

Separate SAR procedures are applied to DSSS and OFDM configurations in the 2.4 GHz band to simplify DSSS test requirements. For 802.11b DSSS SAR measurements, DSSS SAR procedure applies to fixed exposure test position and initial test position procedure applies to multiple exposure test positions. When SAR measurement is required for an OFDM configuration, the initial test configuration, subsequent test configuration and initial test position procedures are applied. The SAR test exclusion requirements for 802.11g/n OFDM configurations are described in section 5.2.2.

##### 1. 802.11b DSSS SAR Test Requirements

SAR is measured for 2.4 GHz 802.11b DSSS using either a fixed test position or, when applicable, the initial test position procedure. SAR test reduction is determined according to the following:

- a. When the reported SAR of the highest measured maximum output power channel (section 3.1) for the exposure configuration is  $\leq 0.8$  W/kg, no further SAR testing is required for 802.11b DSSS in that exposure configuration.
- b. When the reported SAR is  $> 0.8$  W/kg, SAR is required for that exposure configuration using the next highest measured output power channel. When any reported SAR is  $> 1.2$  W/kg, SAR is required for the third channel; i.e., all channels require testing.

##### 1. 2.4 GHz 802.11g/n OFDM SAR Test Exclusion Requirements

When SAR measurement is required for 2.4 GHz 802.11g/n OFDM configurations, the measurement and test reduction procedures for OFDM are applied (section 5.3). SAR is not required for the following 2.4 GHz OFDM conditions.

- a. When KDB Publication 447498 SAR test exclusion applies to the OFDM configuration
  - b. 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  $\leq 1.2$  W/kg.
2. SAR Test Requirements for OFDM Configurations

When SAR measurement is required for 802.11 a/g/n/ac OFDM configurations, each standalone and frequency aggregated band is considered separately for SAR test reduction. When the same transmitter and antenna(s) are used for U-NII-1 and U-NII-2A bands, additional SAR test reduction applies. When band gap channels between U-NII-2C band and 5.8 GHz U-NII-3 or §15.247 band are supported, the highest maximum output power transmission mode configuration and maximum output power channel across the bands must be used to determine SAR test reduction, according to the initial test configuration and subsequent test configuration requirements.<sup>20</sup> In applying the initial test configuration and subsequent test configuration procedures, the 802.11 transmission configuration with the highest specified maximum output power and the channel within a test configuration with the highest measured maximum output power should be clearly distinguished to apply the procedures.

### 3. OFDM Transmission Mode SAR Test Configuration and Channel Selection Requirements

The initial test configuration for 2.4 GHz and 5 GHz OFDM transmission modes is determined by the 802.11 configuration with the highest maximum output power specified for production units, including tune-up tolerance, in each standalone and aggregated frequency band. SAR for the initial test configuration is measured using the highest maximum output power channel determined by the default power measurement procedures (section 4). When multiple configurations in a frequency band have the same specified maximum output power, the initial test configuration is determined according to the following steps applied sequentially.

- a. The largest channel bandwidth configuration is selected among the multiple configurations with the same specified maximum output power.
- b. If multiple configurations have the same specified maximum output power and largest channel bandwidth, the lowest order modulation among the largest channel bandwidth configurations is selected.
- c. If multiple configurations have the same specified maximum output power, largest channel bandwidth and lowest order modulation, the lowest data rate configuration among these configurations is selected.
- d. When multiple transmission modes (802.11a/g/n/ac) have the same specified maximum output power, largest channel bandwidth, lowest order modulation and lowest data rate, the lowest order 802.11 mode is selected; i.e., 802.11a is chosen over 802.11n then 802.11ac or 802.11g is chosen over 802.11n. After an initial test configuration is determined, if multiple test channels have the same measured maximum output power, the channel chosen for SAR measurement is determined according to the following. These channel selection procedures apply to both the initial test configuration and subsequent test configuration(s), with respect to the default power measurement procedures or additional power measurements required for further SAR test reduction. The same procedures also apply to subsequent highest output power channel(s) selection.
  - a. When there are multiple test channels with the same measured maximum output power, the channel closest to mid-band frequency is selected for SAR measurement.
  - b. When there are multiple test channels with the same measured maximum output power and equal separation from mid-band frequency; for example, high and low channels or two mid-band channels, the higher frequency (number) channel is selected for SAR measurement.

#### Initial Test Configuration Procedures

An initial test configuration is determined for OFDM transmission modes according to the channel bandwidth, modulation and data rate combination(s) with the highest maximum output power specified for production units in each standalone and aggregated frequency band. SAR is measured using the highest measured maximum output power channel. For configurations with the same specified or measured maximum output power, additional transmission mode and test channel selection procedures are required (see section 5.3.2). SAR test reduction of subsequent highest output test channels is based on the reported SAR of the initial test configuration.

For next to the ear and UMC mini-tablet exposure configurations where multiple test positions are required, the initial test position procedure is applied to minimize the number of test positions required for SAR measurement using the initial test configuration transmission mode.<sup>23</sup> For fixed exposure conditions that do not have multiple SAR test positions, SAR is measured in the transmission mode determined by the initial test configuration. When the reported SAR of the initial test configuration is  $> 0.8$  W/kg, SAR measurement is required for the subsequent next highest measured output power channel(s) in the initial test configuration until the reported SAR is  $\leq 1.2$  W/kg or all required channels are tested.

### 4. Subsequent Test Configuration Procedures

SAR measurement requirements for the remaining 802.11 transmission mode configurations that have not been tested in the initial test configuration are determined separately for each standalone and aggregated frequency band, in each exposure condition, according to the maximum output power specified for production units. The initial test position procedure is applied to next to the ear, UMPC mini-tablet mode configurations. When the same maximum output power is specified for multiple transmission modes, the procedures in section 5.3.2 are applied to determine the test configuration. Additional power measurements may be required to determine if SAR measurements are required for subsequent highest output power channels in a subsequent test configuration. The subsequent test configuration and SAR measurement procedures are described in the following.

- a. When SAR test exclusion provisions of KDB Publication 447498 are applicable and SAR measurement is not required for the initial test configuration, SAR is also not required for the next highest maximum output

power transmission mode subsequent test configuration(s) in that frequency band or aggregated band and exposure configuration.

- b. When the highest reported SAR for the initial test configuration (when applicable, include subsequent highest output channels), according to the initial test position or fixed exposure position requirements, is adjusted by the ratio of the subsequent test configuration to initial test configuration specified maximum output power and the adjusted SAR is  $\leq 1.2$  W/kg, SAR is not required for that subsequent test configuration.
- C. The number of channels in the initial test configuration and subsequent test configuration can be different due to differences in channel bandwidth. When SAR measurement is required for a subsequent test configuration and the channel bandwidth is smaller than that in the initial test configuration, all channels in the subsequent test configuration that overlap with the larger bandwidth channel tested in the initial test configuration should be used to determine the highest maximum output power channel. This step requires additional power measurement to identify the highest maximum output power channel in the subsequent test configuration to determine SAR test reduction.
  - 1). SAR should first be measured for the channel with highest measured output power in the subsequent test configuration.
  - 2). SAR for subsequent highest measured maximum output power channels in the subsequent test configuration is required only when the reported SAR of the preceding higher maximum output power channel(s) in the subsequent test configuration is  $> 1.2$  W/kg or until all required channels are tested.
    - a) For channels with the same measured maximum output power, SAR should be measured using the channel closest to the center frequency of the larger channel bandwidth channel in the initial test configuration.
- D. SAR measurements for the remaining highest specified maximum output power OFDM transmission mode configurations that have not been tested in the initial test configuration (highest maximum output) or subsequent test configuration(s) (subsequent next highest maximum output power) is determined by applying the subsequent test configuration procedures in this section to the remaining configurations according to the following:
  - 1) replace "subsequent test configuration" with "next subsequent test configuration" (i.e., subsequent next highest specified maximum output power configuration)
  - 2) replace "initial test configuration" with "all tested higher output power configurations."

#### 4.14. Power Drift

To control the output power stability during the SAR test, DASY5 system calculates the power drift by measuring the E-field at the same location at the beginning and at the end of the measurement for each test position. These drift values can be found in Table 14.1 to Table 14.11 labeled as: (Power Drift [dB]). This ensures that the power drift during one measurement is within 5%.

#### 4.15. Power Reduction

The product without any power reduction.

## 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.
3. For hotspot mode SAR testing, GPRS / EDGE should be evaluated, therefore the EUT was set in GPRS (4 Tx slots) for GSM850/GSM1900 band due to its highest frame-average power.

**Conducted Power Measurement Results(GSM900/1800)**

| 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      |
| GPRS<br>(GMSK)  | 1TX slot | 32.94                       | 33.08        | 33.00          | -9.03dB | 23.91                  | 24.05        | 23.97          |
|                 | 2TX slot | 30.50                       | 30.68        | 30.62          | -6.02dB | <b>24.48</b>           | <b>24.66</b> | <b>24.60</b>   |
|                 | 3TX slot | 28.64                       | 28.74        | 28.65          | -4.26dB | 24.38                  | 24.48        | 24.39          |
|                 | 4TX slot | 27.44                       | 27.35        | 27.42          | -3.01dB | 24.43                  | 24.34        | 24.41          |
| EGPRS<br>(8PSK) | 1TX slot | 26.64                       | 26.67        | 26.70          | -9.03dB | 17.61                  | 17.64        | 17.67          |
|                 | 2TX slot | 23.94                       | 24.15        | 23.97          | -6.02dB | 17.92                  | 18.13        | 17.95          |
|                 | 3TX slot | 22.03                       | 22.05        | 22.07          | -4.26dB | 17.77                  | 17.79        | 17.81          |
|                 | 4TX slot | 20.70                       | 20.83        | 20.81          | -3.01dB | 17.69                  | 17.82        | 17.80          |
| GSM 1900        |          | Burst Conducted power (dBm) |              |                | /       | Average power (dBm)    |              |                |
|                 |          | Channel/Frequency(MHz)      |              |                |         | Channel/Frequency(MHz) |              |                |
|                 |          | 512/<br>1850.2              | 661/<br>1880 | 810/<br>1909.8 |         | 512/<br>1850.2         | 661/<br>1880 | 810/<br>1909.8 |
| GPRS<br>(GMSK)  | 1TX slot | 29.95                       | 29.93        | 29.87          | -9.03dB | 20.92                  | 20.90        | 20.84          |
|                 | 2TX slot | 27.67                       | 27.87        | 27.77          | -6.02dB | 21.65                  | 21.85        | 21.75          |
|                 | 3TX slot | 26.14                       | 26.19        | 26.12          | -4.26dB | <b>21.88</b>           | <b>21.93</b> | <b>21.86</b>   |
|                 | 4TX slot | 24.70                       | 24.79        | 24.66          | -3.01dB | 21.69                  | 21.78        | 21.65          |
| EGPRS<br>(8PSK) | 1TX slot | 25.75                       | 25.83        | 25.80          | -9.03dB | 16.72                  | 16.80        | 16.77          |
|                 | 2TX slot | 23.52                       | 23.57        | 23.56          | -6.02dB | 17.50                  | 17.55        | 17.54          |
|                 | 3TX slot | 21.59                       | 21.78        | 21.52          | -4.26dB | 17.33                  | 17.52        | 17.26          |
|                 | 4TX slot | 19.73                       | 19.69        | 19.65          | -3.01dB | 16.72                  | 16.68        | 16.64          |

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

#### <WLAN 2.4GHz Conducted Power>

| Mode         | Channel | Frequency (MHz) | Data rate (Mbps) | Average Output Power (dBm) |
|--------------|---------|-----------------|------------------|----------------------------|
| IEEE 802.11b | 1       | 2412            | 1                | 10.92                      |
|              |         |                 | 2                | 10.76                      |
|              |         |                 | 5.5              | 10.55                      |
|              |         |                 | 11               | 10.49                      |
|              | 6       | 2437            | 1                | 11.41                      |
|              |         |                 | 2                | 11.33                      |
|              |         |                 | 5.5              | 11.17                      |
|              |         |                 | 11               | 10.98                      |
|              | 11      | 2462            | 1                | <b>11.67</b>               |
|              |         |                 | 2                | 11.59                      |

|                      |    |      |      |       |
|----------------------|----|------|------|-------|
|                      |    |      | 5.5  | 11.44 |
|                      |    |      | 11   | 11.25 |
| IEEE 802.11g         | 1  | 2412 | 6    | 10.75 |
|                      |    |      | 9    | 10.71 |
|                      |    |      | 12   | 10.58 |
|                      |    |      | 18   | 10.45 |
|                      |    |      | 24   | 10.39 |
|                      |    |      | 36   | 10.31 |
|                      |    |      | 48   | 10.16 |
|                      |    |      | 54   | 10.04 |
|                      | 6  | 2437 | 6    | 10.86 |
|                      |    |      | 9    | 10.80 |
|                      |    |      | 12   | 10.67 |
|                      |    |      | 18   | 10.59 |
|                      |    |      | 24   | 10.51 |
|                      |    |      | 36   | 10.34 |
|                      |    |      | 48   | 10.28 |
|                      |    |      | 54   | 10.22 |
|                      | 11 | 2462 | 6    | 10.98 |
|                      |    |      | 9    | 10.91 |
|                      |    |      | 12   | 10.77 |
|                      |    |      | 18   | 10.72 |
|                      |    |      | 24   | 10.56 |
|                      |    |      | 36   | 10.49 |
|                      |    |      | 48   | 10.44 |
|                      |    |      | 54   | 10.32 |
| IEEE 802.11n<br>HT20 | 1  | 2412 | MCS0 | 8.92  |
|                      |    |      | MCS1 | 8.88  |
|                      |    |      | MCS2 | 8.82  |
|                      |    |      | MCS3 | 8.75  |
|                      |    |      | MCS4 | 8.69  |
|                      |    |      | MCS5 | 8.61  |
|                      |    |      | MCS6 | 8.53  |
|                      |    |      | MCS7 | 8.47  |
|                      | 6  | 2437 | MCS0 | 9.65  |
|                      |    |      | MCS1 | 9.59  |
|                      |    |      | MCS2 | 9.53  |
|                      |    |      | MCS3 | 9.46  |
|                      |    |      | MCS4 | 9.33  |
|                      |    |      | MCS5 | 9.20  |
|                      |    |      | MCS6 | 9.15  |
|                      |    |      | MCS7 | 9.09  |
|                      | 11 | 2462 | MCS0 | 9.89  |
|                      |    |      | MCS1 | 9.80  |
|                      |    |      | MCS2 | 9.73  |
|                      |    |      | MCS3 | 9.67  |
|                      |    |      | MCS4 | 9.61  |
|                      |    |      | MCS5 | 9.54  |
|                      |    |      | MCS6 | 9.42  |
|                      |    |      | MCS7 | 9.30  |

**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  $\leq 1.2$  W/kg.

## &lt;Bluetooth Conducted Power&gt;

| Mode          | Channel | Frequency (MHz) | Conducted Average Power (dBm) |
|---------------|---------|-----------------|-------------------------------|
| BLE-GFSK      | 00      | 2402            | -8.87                         |
|               | 19      | 2440            | -8.04                         |
|               | 39      | 2480            | -8.22                         |
| GFSK          | 00      | 2402            | -0.55                         |
|               | 39      | 2441            | -0.07                         |
|               | 78      | 2480            | -0.75                         |
| 8DPSK         | 00      | 2402            | -1.77                         |
|               | 39      | 2441            | -1.44                         |
|               | 78      | 2480            | -1.88                         |
| $\pi/4$ DQPSK | 00      | 2402            | -1.72                         |
|               | 39      | 2441            | -1.50                         |
|               | 78      | 2480            | -1.96                         |

## 5.2. Manufacturing tolerance

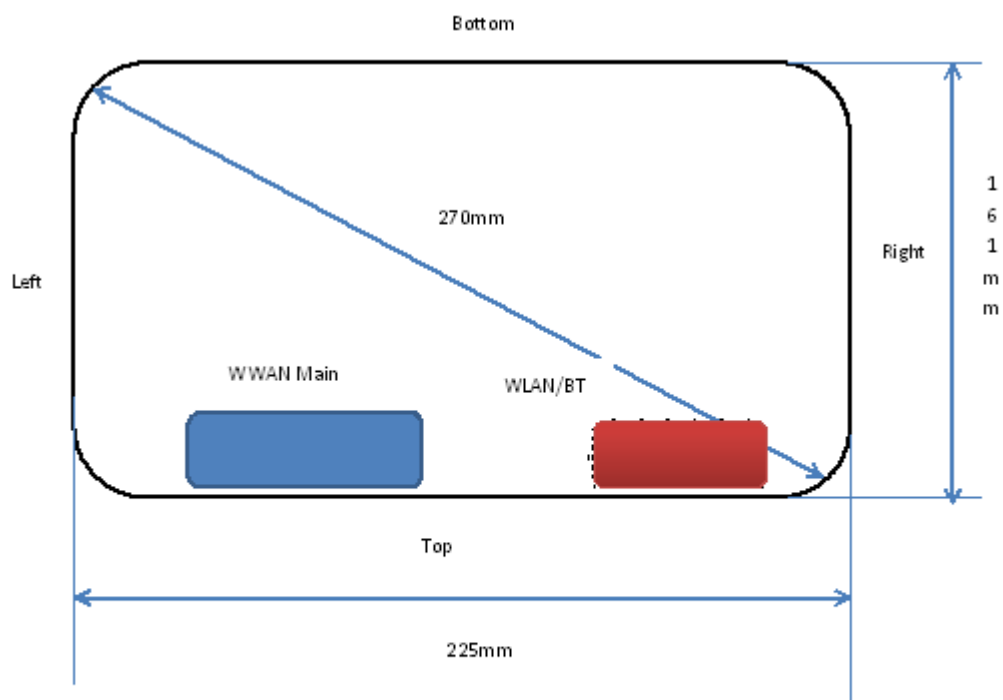
| GSM 850 GPRS (GMSK) (Burst Average Power)  |                      |      |      |      |
|--------------------------------------------|----------------------|------|------|------|
| Channel                                    |                      | 128  | 190  | 251  |
| 1 Txslot                                   | Target (dBm)         | 33.0 | 33.0 | 33.0 |
|                                            | Tolerance $\pm$ (dB) | 1.0  | 1.0  | 1.0  |
| 2 Txslot                                   | Target (dBm)         | 30.0 | 30.0 | 30.0 |
|                                            | Tolerance $\pm$ (dB) | 1.0  | 1.0  | 1.0  |
| 3 Txslot                                   | Target (dBm)         | 28.0 | 28.0 | 28.0 |
|                                            | Tolerance $\pm$ (dB) | 1.0  | 1.0  | 1.0  |
| 4 Txslot                                   | Target (dBm)         | 27.0 | 27.0 | 27.0 |
|                                            | Tolerance $\pm$ (dB) | 1.0  | 1.0  | 1.0  |
| GSM 850 EDGE (8PSK) (Burst Average Power)  |                      |      |      |      |
| Channel                                    |                      | 128  | 190  | 251  |
| 1 Txslot                                   | Target (dBm)         | 26.0 | 26.0 | 26.0 |
|                                            | Tolerance $\pm$ (dB) | 1.0  | 1.0  | 1.0  |
| 2 Txslot                                   | Target (dBm)         | 24.0 | 24.0 | 24.0 |
|                                            | Tolerance $\pm$ (dB) | 1.0  | 1.0  | 1.0  |
| 3 Txslot                                   | Target (dBm)         | 22.0 | 22.0 | 22.0 |
|                                            | Tolerance $\pm$ (dB) | 1.0  | 1.0  | 1.0  |
| 4 Txslot                                   | Target (dBm)         | 20.0 | 20.0 | 20.0 |
|                                            | Tolerance $\pm$ (dB) | 1.0  | 1.0  | 1.0  |
| GSM 1900 GPRS (GMSK) (Burst Average Power) |                      |      |      |      |
| Channel                                    |                      | 512  | 661  | 810  |
| 1 Txslot                                   | Target (dBm)         | 29.0 | 29.0 | 29.0 |
|                                            | Tolerance $\pm$ (dB) | 1.0  | 1.0  | 1.0  |
| 2 Txslot                                   | Target (dBm)         | 27.0 | 27.0 | 27.0 |
|                                            | Tolerance $\pm$ (dB) | 1.0  | 1.0  | 1.0  |
| 3 Txslot                                   | Target (dBm)         | 26.0 | 26.0 | 26.0 |
|                                            | Tolerance $\pm$ (dB) | 1.0  | 1.0  | 1.0  |
| 4 Txslot                                   | Target (dBm)         | 24.0 | 24.0 | 24.0 |
|                                            | Tolerance $\pm$ (dB) | 1.0  | 1.0  | 1.0  |
| GSM 1900 EDGE (8PSK) (Burst Average Power) |                      |      |      |      |
| Channel                                    |                      | 512  | 661  | 810  |
| 1 Txslot                                   | Target (dBm)         | 25.0 | 25.0 | 25.0 |
|                                            | Tolerance $\pm$ (dB) | 1.0  | 1.0  | 1.0  |
| 2 Txslot                                   | Target (dBm)         | 23.0 | 23.0 | 23.0 |
|                                            | Tolerance $\pm$ (dB) | 1.0  | 1.0  | 1.0  |
| 3 Txslot                                   | Target (dBm)         | 21.0 | 21.0 | 21.0 |
|                                            | Tolerance $\pm$ (dB) | 1.0  | 1.0  | 1.0  |
| 4 Txslot                                   | Target (dBm)         | 19.0 | 19.0 | 19.0 |
|                                            | Tolerance $\pm$ (dB) | 1.0  | 1.0  | 1.0  |

**2.4GHzWLAN**

| <b>IEEE 802.11b (Average)</b>      |           |           |            |
|------------------------------------|-----------|-----------|------------|
| Channel                            | Channel 1 | Channel 6 | Channel 11 |
| Target (dBm)                       | 10.0      | 11.0      | 11.0       |
| Tolerance $\pm$ (dB)               | 1.0       | 1.0       | 1.0        |
| <b>IEEE 802.11g (Average)</b>      |           |           |            |
| Channel                            | Channel 1 | Channel 6 | Channel 11 |
| Target (dBm)                       | 10.0      | 10.0      | 10.0       |
| Tolerance $\pm$ (dB)               | 1.0       | 1.0       | 1.0        |
| <b>IEEE 802.11n HT20 (Average)</b> |           |           |            |
| Channel                            | Channel 1 | Channel 6 | Channel 11 |
| Target (dBm)                       | 9.0       | 9.0       | 9.0        |
| Tolerance $\pm$ (dB)               | 1.0       | 1.0       | 1.0        |

**Bluetooth**

| <b>BLE-GFSK (Average)</b>                |            |            |            |
|------------------------------------------|------------|------------|------------|
| Channel                                  | Channel 00 | Channel 19 | Channel 39 |
| Target (dBm)                             | -8.0       | -8.0       | -8.0       |
| Tolerance $\pm$ (dB)                     | 1.0        | 1.0        | 1.0        |
| <b>GFSK (Average)</b>                    |            |            |            |
| Channel                                  | Channel 00 | Channel 39 | Channel 78 |
| Target (dBm)                             | 0.0        | 0.0        | 0.0        |
| Tolerance $\pm$ (dB)                     | 1.0        | 1.0        | 1.0        |
| <b>8DPSK (Average)</b>                   |            |            |            |
| Channel                                  | Channel 00 | Channel 39 | Channel 78 |
| Target (dBm)                             | -1.0       | -1.0       | -1.0       |
| Tolerance $\pm$ (dB)                     | 1.0        | 1.0        | 1.0        |
| <b><math>\pi/4</math>DQPSK (Average)</b> |            |            |            |
| Channel                                  | Channel 00 | Channel 39 | Channel 78 |
| Target (dBm)                             | -1.0       | -1.0       | -1.0       |
| Tolerance $\pm$ (dB)                     | 1.0        | 1.0        | 1.0        |

**5.3. Transmit Antennas Position****Rear View**

Antenna information:

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

| Distance of The Antenna to the EUT surface and edge |       |      |          |             |           |            |
|-----------------------------------------------------|-------|------|----------|-------------|-----------|------------|
| Antennas                                            | Front | Back | Top Side | Bottom Side | Left Side | Right Side |
| WWAN                                                | <5mm  | <5mm | <5mm     | 139mm       | 21mm      | 149mm      |
| BT/WLAN                                             | <5mm  | <5mm | <5mm     | 151mm       | 144mm     | 53mm       |

#### 5.4. 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  $\leq 50$  mm are determined by::

$[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] \cdot [\sqrt{f(\text{GHz})}] \leq 3.0$  for 1-g SAR and  $\leq 7.5$  for 10-g extremity SAR, where

- $f(\text{GHz})$  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 |                 |               |                             |                          |                    |                          |                          |
|----------------------------------------------|-----------------|---------------|-----------------------------|--------------------------|--------------------|--------------------------|--------------------------|
| Communication system                         | Frequency (MHz) | Configuration | Maximum Average Power (dBm) | Separation Distance (mm) | Calculation Result | SAR Exclusion Thresholds | Standalone SAR Exclusion |
| GSM 850                                      | 850             | Rear Side     | 24.98                       | 5                        | 58.0               | 3.0                      | no                       |
|                                              |                 | Left Side     | 24.98                       | 21                       | 13.8               | 3.0                      | no                       |
|                                              |                 | Right Size    | 24.98                       | 149                      | 24.98              | 28.60                    | yes                      |
|                                              |                 | Top Size      | 24.98                       | 5                        | 13.8               | 3.0                      | no                       |
|                                              |                 | Bottom Size   | 24.98                       | 139                      | 24.98              | 28.24                    | yes                      |
| GSM 1900                                     | 1900            | Rear Side     | 22.74                       | 5                        | 51.8               | 3.0                      | no                       |
|                                              |                 | Left Side     | 22.74                       | 21                       | 12.3               | 3.0                      | no                       |
|                                              |                 | Right Size    | 22.74                       | 149                      | 22.74              | 30.41                    | yes                      |
|                                              |                 | Top Size      | 22.74                       | 5                        | 12.3               | 3.0                      | no                       |
|                                              |                 | Bottom Size   | 22.74                       | 139                      | 22.74              | 29.                      | yes                      |

Remark:

1. 2.4GWLAN and Bluetooth Standalone SAR Test Exclusion Considerations for another table per KDB248227 D01.

2. Maximum average power including tune-up tolerance;

3. When the minimum test separation distance is  $< 5$  mm, a distance of 5 mm is applied to determine SAR test exclusion

4. Body as body use distance is 0mm from manufacturer declaration of user manual.

5. When voice mode is supported on a tablet and it is limited to speaker mode or headset operations only, additional SAR testing for this type of voice use is not required refer to KDB 616217 D04;

| 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            | Rear Side     | 12.00                       | 5                        | 5.0                | 3.0                      | no                       |
|                                              |                 | Left Side     | 12.00                       | 144                      | 12.00              | 30.15                    | yes                      |
|                                              |                 | Right Size    | 12.00                       | 54                       | 12.00              | 21.33                    | yes                      |
|                                              |                 | Top Size      | 12.00                       | 5                        | 5.0                | 3.0                      | no                       |
|                                              |                 | Bottom Size   | 12.00                       | 151                      | 12.00              | 30.44                    | yes                      |
| IEEE 802.11g                                 | 2450            | Rear Side     | 11.00                       | 5                        | 3.9                | 3.0                      | no                       |
|                                              |                 | Left Side     | 11.00                       | 144                      | 11.00              | 30.15                    | yes                      |
|                                              |                 | Right Size    | 11.00                       | 54                       | 11.00              | 21.33                    | yes                      |
|                                              |                 | Top Size      | 11.00                       | 5                        | 3.9                | 3.0                      | no                       |
|                                              |                 | Bottom Size   | 11.00                       | 151                      | 11.00              | 30.44                    | yes                      |
| IEEE 802.11n HT20                            | 2450            | Rear Side     | 10.00                       | 5                        | 3.1                | 3.0                      | no                       |
|                                              |                 | Left Side     | 10.00                       | 144                      | 10.00              | 30.15                    | yes                      |
|                                              |                 | Right Size    | 10.00                       | 54                       | 10.00              | 21.33                    | yes                      |
|                                              |                 | Top Size      | 10.00                       | 5                        | 3.1                | 3.0                      | no                       |
|                                              |                 | Bottom Size   | 10.00                       | 151                      | 10.00              | 30.44                    | yes                      |
| Bluetooth*                                   | 2450            | Rear Side     | 1.00                        | 5                        | 0.4                | 3.0                      | yes                      |
|                                              |                 | Left Side     | 1.00                        | 144                      | 1.00               | 30.15                    | yes                      |
|                                              |                 | Right Size    | 1.00                        | 54                       | 1.00               | 21.33                    | yes                      |
|                                              |                 | Top Size      | 1.00                        | 5                        | 0.4                | 3.0                      | yes                      |
|                                              |                 | Bottom Size   | 1.00                        | 151                      | 1.00               | 30.44                    | yes                      |

Remark:

1. Maximum average power including tune-up tolerance;
2. Bluetooth including BLE-Lower Power 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
4. Per KDB 648474, if overall diagonal dimension of the display section of a tablet larger than 20 cm, no need consider Hotspot mode.

## 5.5. Standalone 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 <sub>1-g</sub> (W/kg) |
| Bluetooth*                | 2450            | Rear Side     | 1.00                | 5.00                     | 0.053                               |
|                           | 2450            | Top Size      | 1.00                | 5.00                     | 0.053                               |

Remark:

1. Maximum average power including tune-up tolerance;
2. Bluetooth including BLE-Lower Power 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

## 5.6. Standalone SAR Measurement Results

The calculated SAR is obtained by the following formula:

$$\text{Reported SAR} = \text{Measured SAR} * 10^{(P_{\text{target}} - P_{\text{measured}})/10}$$

$$\text{Scaling factor} = 10^{(P_{\text{target}} - P_{\text{measured}})/10}$$

$$\text{Reported SAR} = \text{Measured SAR} * \text{Scaling factor}$$

Where  $P_{\text{target}}$  is the power of manufacturing upper limit;

$P_{\text{measured}}$  is the measured power;

Measured SAR is measured SAR at measured power which including power drift)

Reported SAR which including Power Drift and Scaling factor

### Duty Cycle

| Test Mode | Duty Cycle |
|-----------|------------|
| GPRS850   | 1:4        |
| GPRS850   | 1:2.67     |
| 2.4GWLAN  | 1:1        |

Table 5: SAR Values [GSM 850 (GPRS)]

| Ch.                                                   | Freq. (MHz) | Time slots | Test Position | Maximum Allowed Power (dBm) | Conducted Power (dBm) | Power drift | Scaling Factor | SAR <sub>1-g</sub> results(W/Kg) |              | Graph Results |
|-------------------------------------------------------|-------------|------------|---------------|-----------------------------|-----------------------|-------------|----------------|----------------------------------|--------------|---------------|
|                                                       |             |            |               |                             |                       |             |                | Measured                         | Reported     |               |
| measured / reported SAR numbers - Body (distance 0mm) |             |            |               |                             |                       |             |                |                                  |              |               |
| 128                                                   | 824.20      | 2Txslots   | Rear Side     | 31.00                       | 30.50                 | -0.06       | 1.122          | 0.718                            | 0.806        |               |
| 190                                                   | 836.60      | 2Txslots   |               | 31.00                       | 30.68                 | -0.12       | 1.076          | <b>0.955</b>                     | <b>1.028</b> |               |
| 251                                                   | 848.80      | 2Txslots   |               | 31.00                       | 30.62                 | -0.15       | 1.091          | 0.525                            | 0.573        |               |
| 190                                                   | 836.60      | 2Txslots   | Right Side    | 31.00                       | 30.68                 | 0.05        | 1.076          | 0.244                            | 0.263        |               |
| 128                                                   | 824.20      | 2Txslots   | Top Side      | 31.00                       | 30.50                 | -0.14       | 1.122          | 0.699                            | 0.784        |               |
| 190                                                   | 836.60      | 2Txslots   |               | 31.00                       | 30.68                 | -0.01       | 1.076          | 0.917                            | 0.987        |               |
| 251                                                   | 848.80      | 2Txslots   |               | 31.00                       | 30.62                 | -0.09       | 1.091          | 0.444                            | 0.484        |               |

Remark:

1. The value with blue color is the maximum 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. When multiple slots are used, SAR should be tested to account for the maximum source-based time-averaged output power.

4. When voice mode is supported on a tablet and it is limited to speaker mode or headset operations only, additional SAR testing for this type of voice use is not required refer to KDB 616217 D04

Table 6: SAR Values [GSM 1900 (GPRS)]

| Ch.                                                   | Freq. (MHz) | time slots | Test Position | Maximum Allowed Power (dBm) | Conducted Power (dBm) | Power drift | Scaling Factor | SAR <sub>1-g</sub> results(W/Kg) |              | Graph Results |
|-------------------------------------------------------|-------------|------------|---------------|-----------------------------|-----------------------|-------------|----------------|----------------------------------|--------------|---------------|
|                                                       |             |            |               |                             |                       |             |                | Measured                         | Reported     |               |
| measured / reported SAR numbers – Body (distance 0mm) |             |            |               |                             |                       |             |                |                                  |              |               |
| 512                                                   | 1850.2      | 3Txslots   | Rear Side     | 27.00                       | 26.14                 | 0.09        | 1.219          | 0.588                            | 0.717        | 2             |
| 661                                                   | 1880.0      | 3Txslots   |               | 27.00                       | 26.19                 | -0.12       | 1.205          | <b>0.797</b>                     | <b>0.960</b> |               |
| 810                                                   | 1909.8      | 3Txslots   |               | 27.00                       | 26.12                 | 0.07        | 1.225          | 0.574                            | 0.703        |               |
| 661                                                   | 1880.0      | 3Txslots   | Right Side    | 26.00                       | 25.62                 | 0.17        | 1.205          | 0.217                            | 0.261        |               |
| 512                                                   | 1850.2      | 3Txslots   | Top Side      | 27.00                       | 26.14                 | 0.11        | 1.219          | 0.563                            | 0.686        |               |
| 661                                                   | 1880.0      | 3Txslots   |               | 27.00                       | 26.19                 | -0.13       | 1.205          | 0.775                            | 0.934        |               |
| 810                                                   | 1909.8      | 3Txslots   |               | 27.00                       | 26.12                 | -0.08       | 1.225          | 0.558                            | 0.684        |               |

Remark:

1. The value with blue color is the maximum 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. When multiple slots are used, SAR should be tested to account for the maximum source-based time-averaged output power.

4. When voice mode is supported on a tablet and it is limited to speaker mode or headset operations only, additional SAR testing for this type of voice use is not required refer to KDB 616217 D04

**Table 7: SAR Values [2.4GWLAN IEEE 802.11b/g/n]**

| Ch.                                                   | Freq. (MHz) | Service | Test Position | Maximum Allowed Power (dBm) | Conducted Power (dBm) | Power drift | Scaling Factor | SAR <sub>1-g</sub> results(W/Kg) |          | Graph Results |
|-------------------------------------------------------|-------------|---------|---------------|-----------------------------|-----------------------|-------------|----------------|----------------------------------|----------|---------------|
|                                                       |             |         |               |                             |                       |             |                | Measured                         | Reported |               |
| measured / reported SAR numbers – Body (distance 0mm) |             |         |               |                             |                       |             |                |                                  |          |               |
| 6                                                     | 2462        | DSSS    | Rear Side     | 12.00                       | 11.67                 | 0.10        | 1.079          | 0.430                            | 0.464    | 3             |
| 6                                                     | 2462        | DSSS    | Top Side      | 12.00                       | 11.67                 | -0.15       | 1.079          | 0.417                            | 0.450    |               |

Remark:

1. The value with blue color is the maximum 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  $\leq 0.8$  W/kg then testing at the other channels is optional for such test configuration(s).

3. 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  $\leq 1.2$  W/kg.

## 5.7. Simultaneous TX SAR Considerations

### 5.7.1 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 2.4GWLAN modules sharing same antenna, GSM and UMTS module sharing a single antenna; 2.4GWLAN and UMTS/GSM share difference antenna, can simultaneous transmitter, need consider simultaneous.

Application Simultaneous Transmission information:

| Air-Interface | Band (MHz) | Type | Simultaneous Transmissions | Voice over Digital Transport(Data) |
|---------------|------------|------|----------------------------|------------------------------------|
| GSM           | GPRS/EDGE  | DT   | Yes, 2.4GWLAN or BT/BLE    | N/A                                |
| WLAN          | 2450       | DT   | Yes, GSM, GPRS, EDGE       | Yes                                |
| BT/BLE        | 2450       | DT   | Yes, GSM, GPRS, EDGE       | N/A                                |

Note: VO-Voice Service only; DT-Digital Transport

Remark:

BT and WiFi can be active at the same time, but only with interleaving of packages switched on board level. That means that they don't transmit at the same time.

BLE-Bluetooth Low Energy;

BT- Classical Bluetooth

### 5.7.2 Evaluation of Simultaneous SAR

The following tables list information which is relevant for the decision if a simultaneous transmit evaluation is necessary according to FCC KDB 447498D01 General RF Exposure Guidance v06.

| reported SAR WWAN and WLAN 2.4GHz, $\Sigma$ SAR evaluation, SPLSRi |                |                             |              |                       |                 |                    |
|--------------------------------------------------------------------|----------------|-----------------------------|--------------|-----------------------|-----------------|--------------------|
| Frequency band                                                     | Position       | SAR <sub>1-gmax</sub> /W/kg |              | $\Sigma$ SAR <1.6W/Kg | Distance Ri, mm | Ratio $\leq 0.040$ |
|                                                                    |                | WWAN                        | WLAN         |                       |                 |                    |
| GSM 850                                                            | rear side 0mm  | <b>1.028</b>                | <b>0.464</b> | <b>1.492</b>          |                 |                    |
|                                                                    | right side 0mm | 0.263                       | n/a          | 0.263                 |                 |                    |
|                                                                    | Top side 0mm   | 0.987                       | 0.450        | 1.437                 |                 |                    |
| GSM 1900                                                           | rear side 0mm  | <b>0.960</b>                | <b>0.464</b> | 1.424                 |                 |                    |
|                                                                    | right side 0mm | 0.261                       | n/a          | 0.261                 |                 |                    |
|                                                                    | Top side 0mm   | 0.934                       | 0.450        | 1.384                 |                 |                    |

| reported SAR WWAN and BT 2.4GHz, $\Sigma$ SAR evaluation, SPLSRi |                |                             |       |                       |                 |                    |
|------------------------------------------------------------------|----------------|-----------------------------|-------|-----------------------|-----------------|--------------------|
| Frequency band                                                   | Position       | SAR <sub>1-gmax</sub> /W/kg |       | $\Sigma$ SAR <1.6W/Kg | Distance Ri, mm | Ratio $\leq 0.040$ |
|                                                                  |                | WWAN                        | BT    |                       |                 |                    |
| GSM 850                                                          | rear side 0mm  | <b>1.028</b>                | 0.053 | <b>1.081</b>          |                 |                    |
|                                                                  | right side 0mm | 0.263                       | n/a   | 0.263                 |                 |                    |
|                                                                  | Top side 0mm   | 0.987                       | 0.053 | 1.040                 |                 |                    |
| GSM 1900                                                         | rear side 0mm  | <b>0.960</b>                | 0.053 | 1.013                 |                 |                    |
|                                                                  | right side 0mm | 0.261                       | n/a   | 0.261                 |                 |                    |
|                                                                  | Top side 0mm   | 0.934                       | 0.053 | 0.987                 |                 |                    |

Remark:

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  $\Sigma$ SAR<sub>1-g</sub>

### 5.7.3 Conclusion:

$\Sigma$ SAR < 1.6 W/Kg, no need consider SAR-to-(peak-locations spacing) ratio (SPLSRi), therefore simultaneous transmissions SAR measurement with the enlarged zoom scan measurement and volume scan post-processing procedures is not required.

### 5.7.4 SAR Peak Location Separation

Not required as  $\Sigma$ SAR < 1.6 W/Kg

## 5.8. SAR Measurement Variability

According to KDB865664, Repeated measurements are required only when the measured SAR is  $\geq 0.80$  W/kg. If the measured SAR value of the initial repeated measurement is < 1.45 W/kg with  $\leq 20\%$  variation, only one repeated measurement is required to reaffirm that the results are not expected to have substantial variations, which may introduce significant compliance concerns. A second repeated measurement is required only if the measured result for the initial repeated measurement is within 10% of the SAR limit and vary by more than 20%, which are often related to device and measurement setup difficulties. The following procedures are applied to determine if repeated measurements are required. The same procedures should be adapted for measurements according to extremity and occupational exposure limits by applying a factor of 2.5 for extremity exposure and a factor of 5 for occupational exposure to the corresponding SAR thresholds.<sup>19</sup> The repeated measurement results must be clearly identified in the SAR report. All measured SAR, including the repeated results, must be considered to determine compliance and for reporting according to KDB 690783. Repeated measurement is not required when the original highest measured SAR is < 0.80 W/kg; steps 2) through 4) do not apply.

- 1) When the original highest measured SAR is  $\geq 0.80$  W/kg, repeat that measurement once.
- 2) Perform a second repeated measurement only if the ratio of largest to smallest SAR for the original and first repeated measurements is > 1.20 or when the original or repeated measurement is  $\geq 1.45$  W/kg ( $\sim 10\%$  from the 1-g SAR limit).
- 3) Perform a third repeated measurement only if the original, first or second repeated measurement is  $\geq 1.5$  W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.
- 4) Perform a third repeated measurement only if the original, first or second repeated measurement is  $\geq 1.5$  W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20

| Frequency Band | Air Interface | RF Exposure Configuration | Test Position | Repeated SAR (yes/no) | Highest Measured SAR <sub>1-g</sub> (W/Kg) | First Repeated                     |                               |
|----------------|---------------|---------------------------|---------------|-----------------------|--------------------------------------------|------------------------------------|-------------------------------|
|                |               |                           |               |                       |                                            | Measured SAR <sub>1-g</sub> (W/Kg) | Largest to Smallest SAR Ratio |
| 850            | GSM 850       | Standalone                | Rear          | yes                   | 0.955                                      | 0.981                              | 1.03                          |
| 1900           | GSM 1900      | Standalone                | Rear          | yes                   | 0.797                                      | n/a                                | n/a                           |
| 2450           | 2.4GWLAN      | Standalone                | Rear          | yes                   | 0.430                                      | n/a                                | n/a                           |

Remark:

1. Second Repeated Measurement is not required since the ratio of the largest to smallest SAR for the original and first repeated measurement is not > 1.20 or 3 (1-g or 10-g respectively)

## 5.9. Measurement Uncertainty (300-3GHz)

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

## 5.10. System Check Results

### System Performance Check at 835 MHz Body TSL

DUT: Dipole 835 MHz; Type: D835V2; Serial: 4d141

Date/Time: 05/22/2016 08:45:11 AM

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

Medium parameters used (interpolated):  $f = 835 \text{ MHz}$ ;  $\sigma = 0.95 \text{ S/m}$ ;  $\epsilon_r = 56.8$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

DASY5 Configuration:

Probe: EX3DV4 - SN3842; ConvF(9.18, 9.18, 9.18); Calibrated: 8/26/2015;

Sensor-Surface: 2mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1315; Calibrated: 07/22/2015

Phantom: ELI 4.0; Type: QDOVA001BA;

Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6824)

**System Performance Check at 835MHz / Area Scan (51x51x1):** Interpolated grid:  $dx=1.500 \text{ mm}$ ,  $dy=1.50 \text{ mm}$

Maximum value of SAR (interpolated) =  $3.21 \text{ mW/g}$

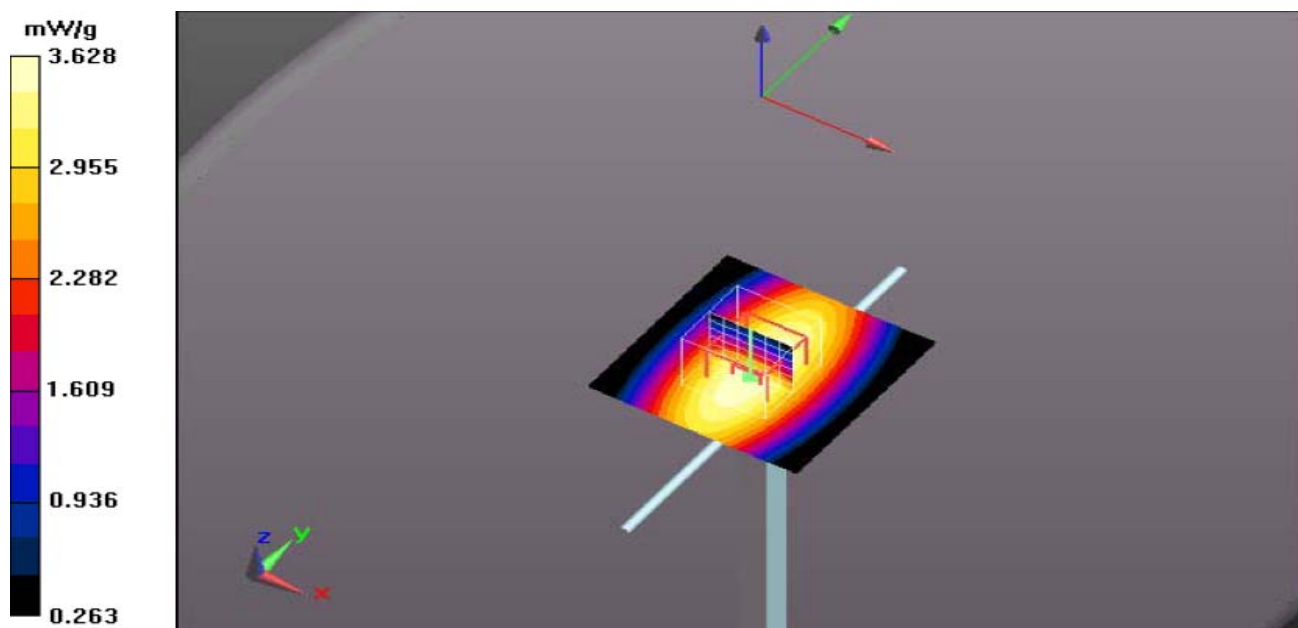
**System Performance Check at 835MHz / Zoom Scan (7x7x7)/Cube 0:** Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value =  $61.03 \text{ V/m}$ ; Power Drift =  $0.03 \text{ dB}$

Peak SAR (extrapolated) =  $4.24 \text{ mW/g}$

**SAR(1 g) =  $2.56 \text{ mW/g}$ ; SAR(10 g) =  $1.78 \text{ mW/g}$**

Maximum value of SAR (measured) =  $11.3 \text{ mW/g}$



System Performance Check 835MHz Body 250mW

**System Performance Check at 1900 MHz Body TSL**

DUT: Dipole1900 MHz; Type: D1900V2; Serial: 5d162

Date/Time: 05/22/2016 12:11:23 AM

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

Medium parameters used (interpolated):  $f = 1900$  MHz;  $\sigma = 1.51$  S/m;  $\epsilon_r = 55.1$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

DASY5 Configuration:

Probe: EX3DV4 - SN3842; ConvF(7.29, 7.29, 7.29); Calibrated: 8/26/2015;

Sensor-Surface: 2mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1315; Calibrated: 07/22/2015

Phantom: ELI 4.0; Type: QDOVA001BA;

Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6824)

**System Performance Check at 1900MHz / Area Scan (51x51x1):** Interpolated grid: dx=1.500 mm, dy=1.50 mm

Maximum value of SAR (interpolated) = 10.7 mW/g

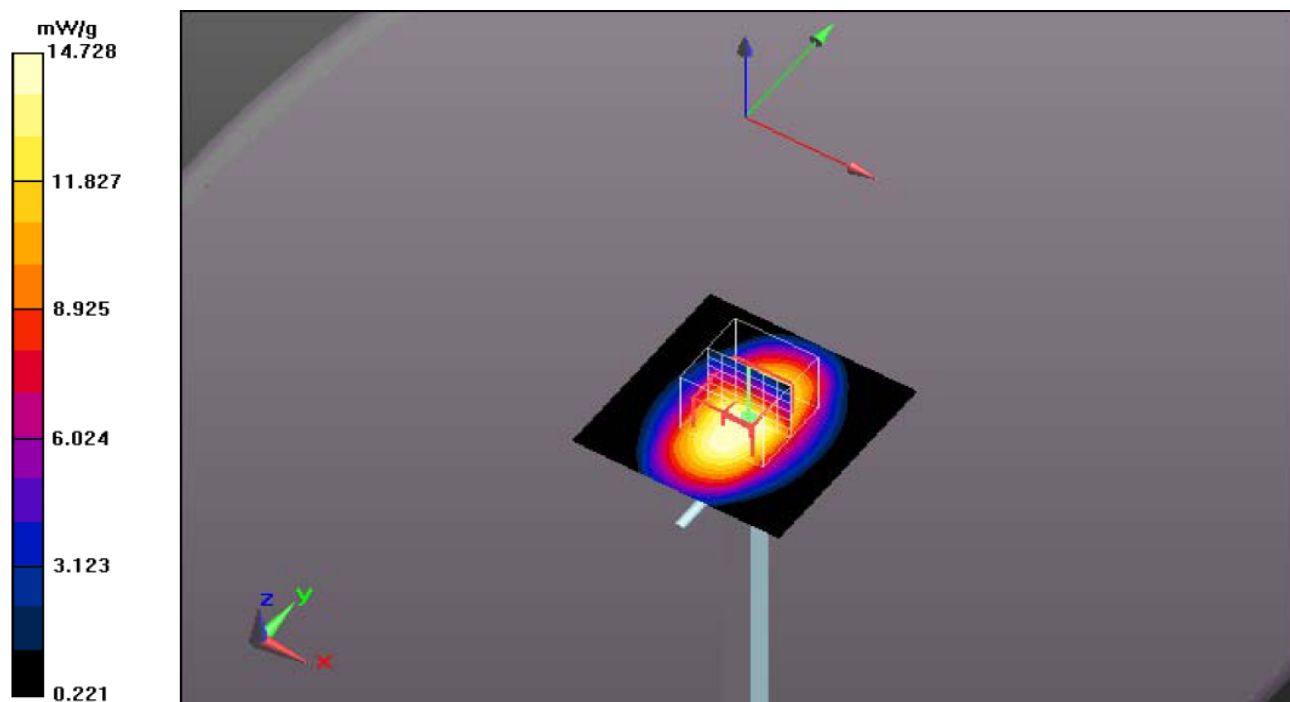
**System Performance Check at 1900MHz / Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 104.3 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 18.84 mW/g

**SAR(1 g) = 10.2 mW/g; SAR(10 g) = 5.29 mW/g**

Maximum value of SAR (measured) = 14.728 mW/g



System Performance Check 1900MHz Body 250mW

**System Performance Check at 2450 MHz Body TSL**

DUT: Dipole2450 MHz; Type: D2450V2; Serial: 818

Date/Time: 05/22/2016 16:03:44 PM

Communication System: DuiJiangJi; Frequency: 2450MHz;Duty Cycle: 1:1

Medium parameters used (interpolated):  $f = 2450$  MHz;  $\sigma = 1.97$  S/m;  $\epsilon_r = 54.4$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

DASY5 Configuration:

Probe: EX3DV4 - SN3842; ConvF(6.87, 6.87, 6.87); Calibrated: 8/26/2015;

Sensor-Surface: 2mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1315; Calibrated: 07/22/2015

Phantom: ELI 4.0; Type: QDOVA001BA;

Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6824)

**System Performance Check at 2450MHz / Area Scan (51x51x1):** Interpolated grid: dx=1.500 mm, dy=1.50 mm

Maximum value of SAR (interpolated) = 12.78 mW/g

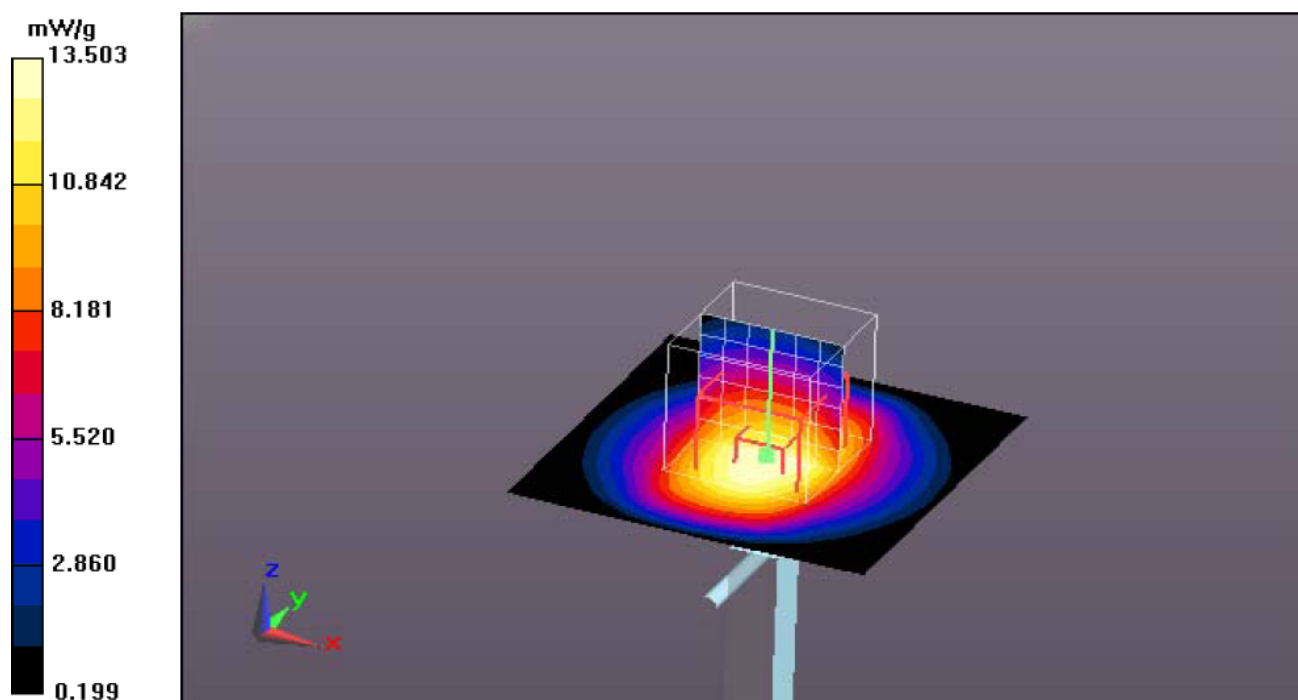
**System Performance Check at 2450MHz / Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 99.88 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 17.65 mW/g

**SAR(1 g) = 12.70 mW/g; SAR(10 g) = 5.93 mW/g**

Maximum value of SAR (measured) = 13.503 mW/g



System Performance Check 2450MHz Body 250mW

## 5.11. 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

### Body- Worn GSM 850, Front towards Ground 836.60 MHz

Communication System: GSM 850; Frequency: 836.6 MHz; Duty Cycle: 1:4

Medium parameters used (interpolated):  $f = 837.0$  MHz;  $\sigma = 0.95$  S/m;  $\epsilon_r = 56.8$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section : Flat Section

Probe: EX3DV4 - SN3842; ConvF(9.18, 9.18, 9.18); Calibrated: 8/26/2015;

Sensor-Surface: 2mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1315; Calibrated: 07/22/2015

Phantom: ELI 4.0; Type: QDOVA001BA;

Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6824)

**Front Towards Phantom GSM850 / Area Scan (201x261x1):** Interpolated grid:  $dx=1.500$  mm,  $dy=1.500$  mm

Maximum value of SAR (interpolated) = 1.48 mW/g

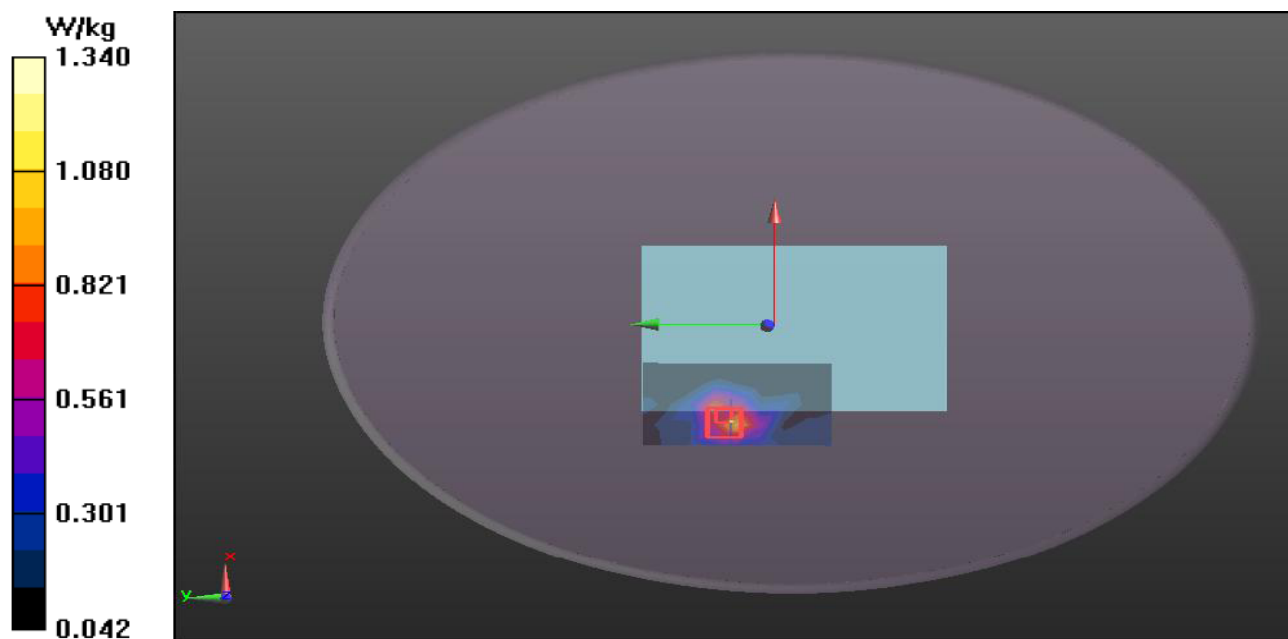
**Front Towards Phantom GSM850 / Zoom Scan (7x7x7)/Cube 0:** Measurement grid:  $dx=5$ mm,  $dy=5$ mm,  $dz=5$ mm

Reference Value = 16.455 V/m; Power Drift = -0.12 dB

Peak SAR (extrapolated) = 1.762 mW/g

**SAR(1 g) = 0.955 mW/g; SAR(10 g) = 0.588 mW/g**

Maximum value of SAR (measured) = 1.34 mW/g



Date/Time: 05/22/2016 11:12:44 AM

Plot 1: Body-worn for GSM850; Front towards Ground 836.6 MHz

**Body- Worn GSM 1900, Front towards Ground 1880.0 MHz**

Communication System: GSM 1900; Frequency: 1880.0 MHz; Duty Cycle: 1:2.67

Medium parameters used (interpolated):  $f = 1880.0$  MHz;  $\sigma = 1.48$  S/m;  $\epsilon_r = 55.5$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Probe: EX3DV4 - SN3842; ConvF(7.29, 7.29, 7.29); Calibrated: 8/26/2015;

Sensor-Surface: 2mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1315; Calibrated: 07/22/2015

Phantom: ELI 4.0; Type: QDOVA001BA;

Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6824)

**Front Towards Phantom GSM1900 / Area Scan (201x261x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 1.03 mW/g

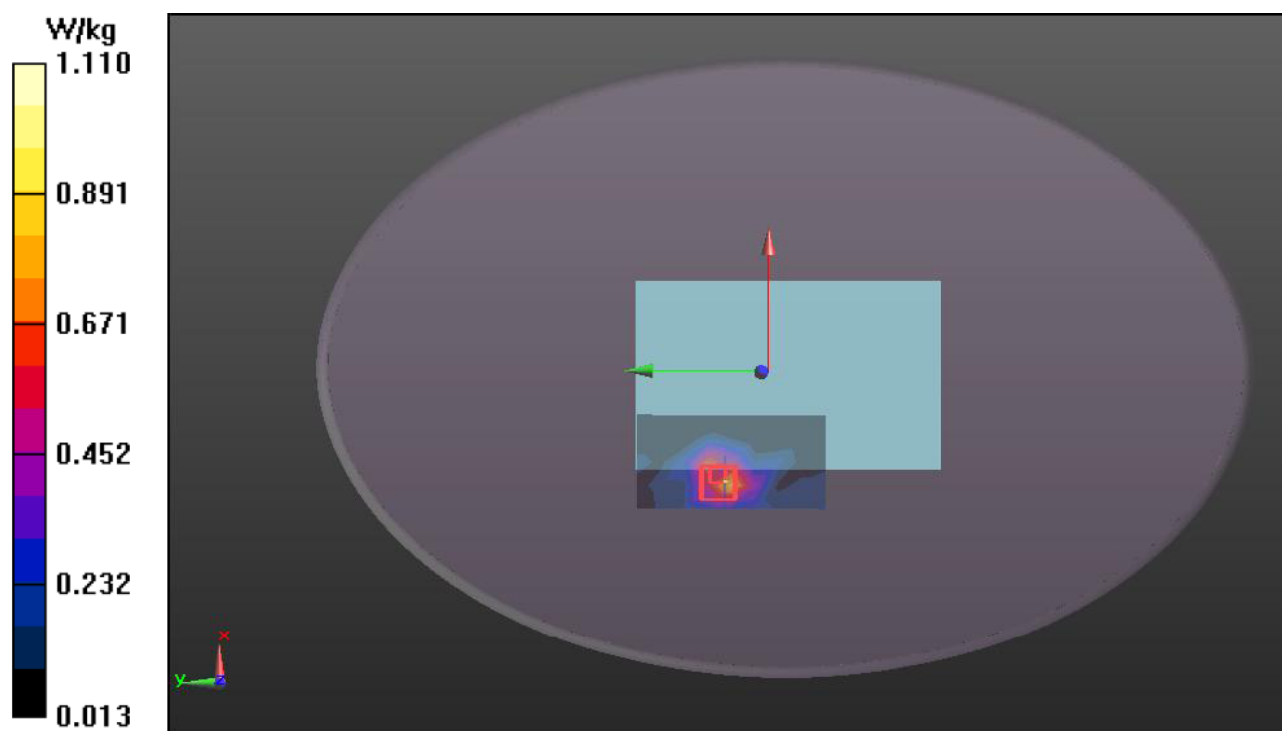
**Front Towards Phantom GSM1900 / Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 6.16 V/m; Power Drift = -0.12 dB

Peak SAR (extrapolated) = 1.378 mW/g

**SAR(1 g) = 0.797 mW/g; SAR(10 g) = 0.444 mW/g**

Maximum value of SAR (measured) = 1.110 mW/g



Date/Time: 05/22/2016 15:33:52 PM

Plot 2: Body-worn for GSM1900; Front towards Ground 1880.0 MHz

**Body- Worn 2.4GWLAN, Front towards Ground 2462 MHz**

Communication System: 2.4GWLAN; Frequency: 2462.0 MHz; Duty Cycle: 1:1

Medium parameters used (interpolated):  $f = 2462.0$  MHz;  $\sigma = 1.99$  S/m;  $\epsilon_r = 54.2$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section : Flat Section

Probe: EX3DV4 - SN3842; ConvF(9.04, 9.04, 9.04); Calibrated: 8/26/2015;

Sensor-Surface: 2mm (Mechanical Surface Detection)

Electronics: DAE4 Sn876; Calibrated: 03/09/2015

Phantom: ELI4; Type: Triple Modular;

Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6824)

**Front Towards Phantom 2.4GWLAN / Area Scan (201x261x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 0.455 mW/g

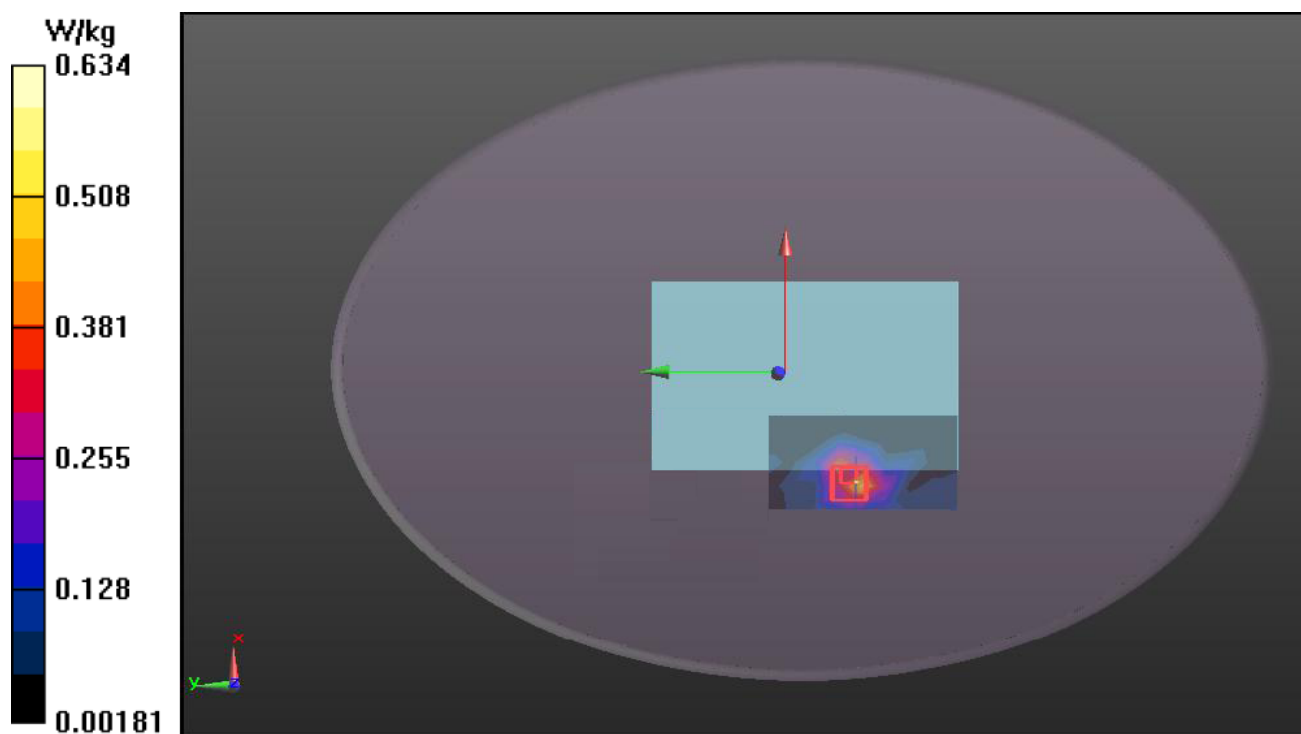
**Front Towards Phantom 2.4GWLAN / Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 1.755 V/m; Power Drift = 0.10 dB

Peak SAR (extrapolated) = 0.966 mW/g

**SAR(1 g) = 0.430 mW/g; SAR(10 g) = 0.187 mW/g**

Maximum value of SAR (measured) = 0.634 mW/g



Date/Time: 05/22/2016 19:43:00 PM

Plot 3: Body-worn for 2.4GWLAN; Front towards Ground 2462 MHz

## 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 (SAF)  
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 (Shenzhen)**

Certificate No: **EX3-3842\_Aug15**

### CALIBRATION CERTIFICATE

Object **EX3DV4 - SN:3842**

Calibration procedure(s) **QA CAL-01.v9, QA CAL-12.v9, QA CAL-23.v5, QA CAL-25.v6  
Calibration procedure for dosimetric E-field probes**

Calibration date: **August 26, 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  $(22 \pm 3)^\circ\text{C}$  and humidity  $< 70\%$ .

Calibration Equipment used (MR/IE critical for calibration)

| Primary Standards          | ID              | Cal Date (Certificate No.)        | Scheduled Calibration  |
|----------------------------|-----------------|-----------------------------------|------------------------|
| Power meter E4419B         | GB41293874      | 01-Apr-15 (No. 217-02128)         | Mar-16                 |
| Power sensor E4412A        | MY41498987      | 01-Apr-15 (No. 217-02128)         | Mar-16                 |
| Reference 3 dB Attenuator  | SN: S5054 (3c)  | 01-Apr-15 (No. 217-02129)         | Mar-16                 |
| Reference 20 dB Attenuator | SN: S5277 (20x) | 01-Apr-15 (No. 217-02132)         | Mar-16                 |
| Reference 30 dB Attenuator | SN: S5129 (30b) | 01-Apr-15 (No. 217-02133)         | Mar-16                 |
| Reference Probe ES3DV2     | SN: 3013        | 30-Dec-14 (No. ES3-3013_Dec14)    | Dec-15                 |
| DAE4                       | SN: 660         | 14-Jan-15 (No. DAE4-660_Jan15)    | Jan-16                 |
| Secondary Standards        | ID              | Check Date (in house)             | Scheduled Check        |
| RF generator HP 8648C      | US3642U01700    | 4-Aug-99 (in house check Apr-13)  | In house check: Apr-16 |
| Network Analyzer HP 8753E  | US37390585      | 18-Oct-01 (in house check Oct-14) | In house check: Oct-15 |

|                         |                                |                                          |               |
|-------------------------|--------------------------------|------------------------------------------|---------------|
| Calibrated by:          | Name<br><b>Claudio Leubler</b> | Function<br><b>Laboratory Technician</b> | Signature<br> |
| Approved by:            | <b>Katja Pokovic</b>           | <b>Technical Manager</b>                 |               |
| Issued: August 27, 2015 |                                |                                          |               |

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

**Calibration Laboratory of  
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**S** Schweizerischer Kalibrierdienst  
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**S** Servizio svizzero di taratura  
**S** Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 0108**

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

#### Glossary:

|                          |                                                                                                                                                         |
|--------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| TSL                      | tissue simulating liquid                                                                                                                                |
| NORM <sub>x,y,z</sub>    | sensitivity in free space                                                                                                                               |
| ConvF                    | sensitivity in TSL / NORM <sub>x,y,z</sub>                                                                                                              |
| DCP                      | diode compression point                                                                                                                                 |
| CF                       | crest factor (1/duty_cycle) of the RF signal                                                                                                            |
| A, B, C, D               | modulation dependent linearization parameters                                                                                                           |
| Polarization $\varphi$   | $\varphi$ rotation around probe axis                                                                                                                    |
| Polarization $\vartheta$ | $\vartheta$ rotation around an axis that is in the plane normal to probe axis (at measurement center),<br>i.e., $\vartheta = 0$ 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:

- 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
- 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
- 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
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

#### Methods Applied and Interpretation of Parameters:

- NORM<sub>x,y,z</sub>**: Assessed for E-field polarization ( $\vartheta = 0$ ) ( $f < 900$  MHz in TEM-cell;  $f > 1800$  MHz: R22 waveguide). NORM<sub>x,y,z</sub> are only intermediate values, i.e., the uncertainties of NORM<sub>x,y,z</sub> does not affect the  $E^2$ -field uncertainty inside TSL (see below ConvF).
- NORM(f)<sub>x,y,z</sub> = NORM<sub>x,y,z</sub> \* 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.
- DCP<sub>x,y,z</sub>**: 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
- A<sub>x,y,z</sub>; B<sub>x,y,z</sub>; C<sub>x,y,z</sub>; D<sub>x,y,z</sub>; VR<sub>x,y,z</sub>; 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  $f \leq 800$  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 NORM<sub>x,y,z</sub> \* 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  $\pm 50$  MHz to  $\pm 100$  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 NORM<sub>x</sub> (no uncertainty required).

EX3DV4 – SN:3842

August 26, 2015

# Probe EX3DV4

## SN:3842

Manufactured: October 25, 2011  
Calibrated: August 26, 2015

Calibrated for DASY/EASY Systems  
(Note: non-compatible with DASY2 system!)

EX3DV4- SN:3842

August 26, 2015

**DASY/EASY - Parameters of Probe: EX3DV4 - SN:3842****Basic Calibration Parameters**

|                                                           | Sensor X | Sensor Y | Sensor Z | Unc (k=2)     |
|-----------------------------------------------------------|----------|----------|----------|---------------|
| Norm ( $\mu\text{V}/(\text{V}/\text{m})^2$ ) <sup>A</sup> | 0.34     | 0.53     | 0.42     | $\pm 10.1 \%$ |
| DCP (mV) <sup>B</sup>                                     | 101.6    | 99.9     | 99.5     |               |

**Modulation Calibration Parameters**

| UID | Communication System Name |   | A<br>dB | B<br>dB $\sqrt{\mu\text{V}}$ | C   | D<br>dB | VR<br>mV | Unc <sup>E</sup><br>(k=2) |
|-----|---------------------------|---|---------|------------------------------|-----|---------|----------|---------------------------|
| 0   | CW                        | X | 0.0     | 0.0                          | 1.0 | 0.00    | 152.0    | $\pm 3.0 \%$              |
|     |                           | Y | 0.0     | 0.0                          | 1.0 |         | 143.5    |                           |
|     |                           | Z | 0.0     | 0.0                          | 1.0 |         | 147.4    |                           |

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%.

<sup>A</sup> The uncertainties of Norm X,Y,Z do not affect the E<sup>2</sup> field uncertainty inside TSL (see Pages 5 and 6).

<sup>B</sup> Numerical linearization parameter; uncertainty not required.

<sup>E</sup> Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

EX3DV4 - SN:3842

August 26, 2015

## DASY/EASY - Parameters of Probe: EX3DV4 - SN:3842

### Calibration Parameter Determined in Head Tissue Simulating Media

| f (MHz) <sup>c</sup> | Relative Permittivity <sup>f</sup> | Conductivity (S/m) <sup>f</sup> | ConvF X | ConvF Y | ConvF Z | Alpha <sup>g</sup> | Depth <sup>g</sup> (mm) | Unc (k=2) |
|----------------------|------------------------------------|---------------------------------|---------|---------|---------|--------------------|-------------------------|-----------|
| 450                  | 43.5                               | 0.94                            | 10.24   | 10.24   | 10.24   | 0.18               | 1.20                    | ± 13.3 %  |
| 750                  | 41.9                               | 0.89                            | 9.45    | 9.45    | 9.45    | 0.34               | 0.93                    | ± 12.0 %  |
| 835                  | 41.5                               | 0.90                            | 9.04    | 9.04    | 9.04    | 0.18               | 1.60                    | ± 12.0 %  |
| 900                  | 41.5                               | 0.97                            | 8.92    | 8.92    | 8.92    | 0.22               | 1.45                    | ± 12.0 %  |
| 1750                 | 40.1                               | 1.37                            | 7.80    | 7.80    | 7.80    | 0.35               | 0.80                    | ± 12.0 %  |
| 1900                 | 40.0                               | 1.40                            | 7.54    | 7.54    | 7.54    | 0.29               | 0.80                    | ± 12.0 %  |
| 2450                 | 39.2                               | 1.80                            | 6.82    | 6.82    | 6.82    | 0.35               | 0.86                    | ± 12.0 %  |
| 2600                 | 39.0                               | 1.96                            | 6.74    | 6.74    | 6.74    | 0.37               | 0.92                    | ± 12.0 %  |

<sup>c</sup> 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.

<sup>f</sup> At frequencies below 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) 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 ( $\epsilon$  and  $\sigma$ ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

<sup>g</sup> 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.

EX3DV4- SN:3842

August 26, 2015

## DASY/EASY - Parameters of Probe: EX3DV4 - SN:3842

### Calibration Parameter Determined in Body Tissue Simulating Media

| f (MHz) <sup>C</sup> | Relative Permittivity <sup>F</sup> | Conductivity (S/m) <sup>F</sup> | ConvF X | ConvF Y | ConvF Z | Alpha <sup>G</sup> | Depth <sup>G</sup> (mm) | Unc (k=2) |
|----------------------|------------------------------------|---------------------------------|---------|---------|---------|--------------------|-------------------------|-----------|
| 450                  | 56.7                               | 0.94                            | 10.28   | 10.28   | 10.28   | 0.10               | 1.20                    | ± 13.3 %  |
| 750                  | 55.5                               | 0.96                            | 9.38    | 9.38    | 9.38    | 0.35               | 1.02                    | ± 12.0 %  |
| 835                  | 55.2                               | 0.97                            | 9.18    | 9.18    | 9.18    | 0.27               | 1.22                    | ± 12.0 %  |
| 900                  | 55.0                               | 1.05                            | 9.11    | 9.11    | 9.11    | 0.26               | 1.17                    | ± 12.0 %  |
| 1750                 | 53.4                               | 1.49                            | 7.46    | 7.46    | 7.46    | 0.35               | 0.80                    | ± 12.0 %  |
| 1900                 | 53.3                               | 1.52                            | 7.29    | 7.29    | 7.29    | 0.40               | 0.86                    | ± 12.0 %  |
| 2450                 | 52.7                               | 1.95                            | 6.87    | 6.87    | 6.87    | 0.34               | 0.80                    | ± 12.0 %  |
| 2600                 | 52.5                               | 2.16                            | 6.76    | 6.76    | 6.76    | 0.32               | 0.80                    | ± 12.0 %  |

<sup>C</sup> 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.

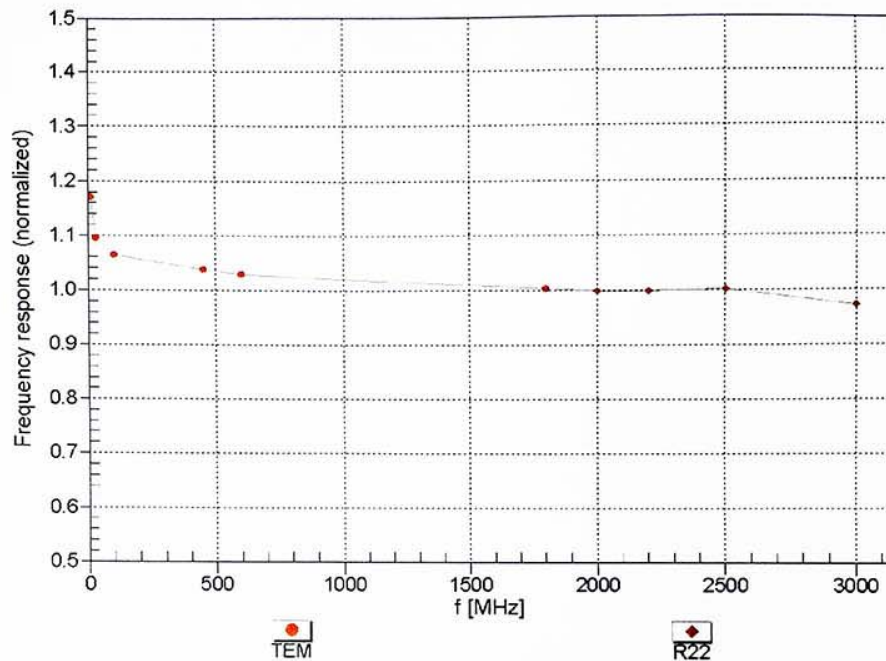
<sup>F</sup> At frequencies below 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

<sup>G</sup> 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.

EX3DV4- SN:3842

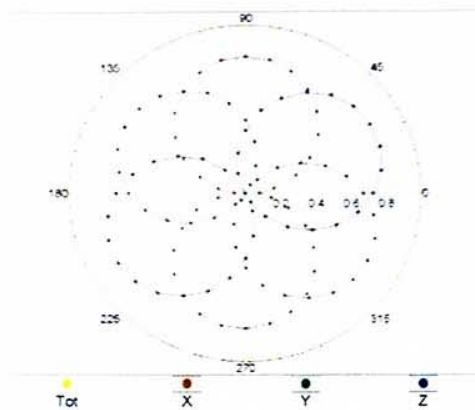
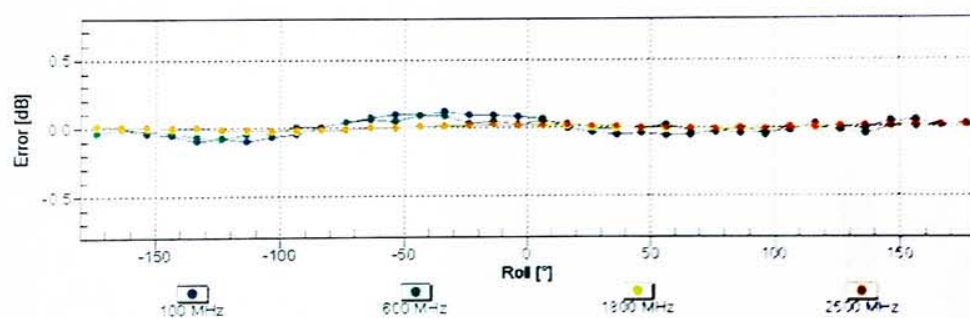
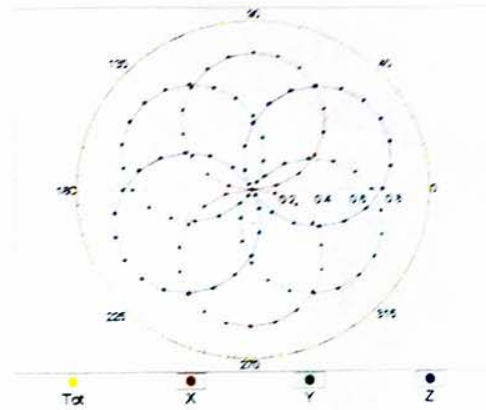
August 26, 2015

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

Uncertainty of Frequency Response of E-field:  $\pm 6.3\%$  ( $k=2$ )

EX3DV4- SN 3842

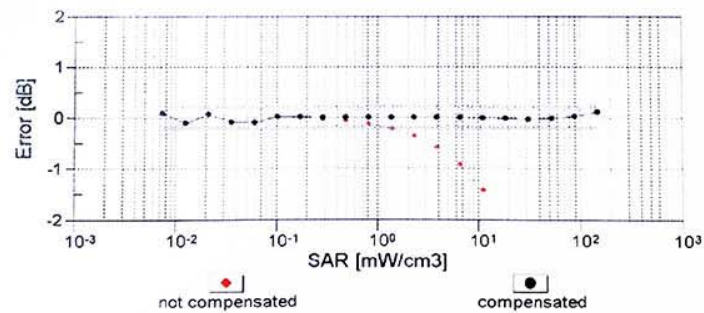
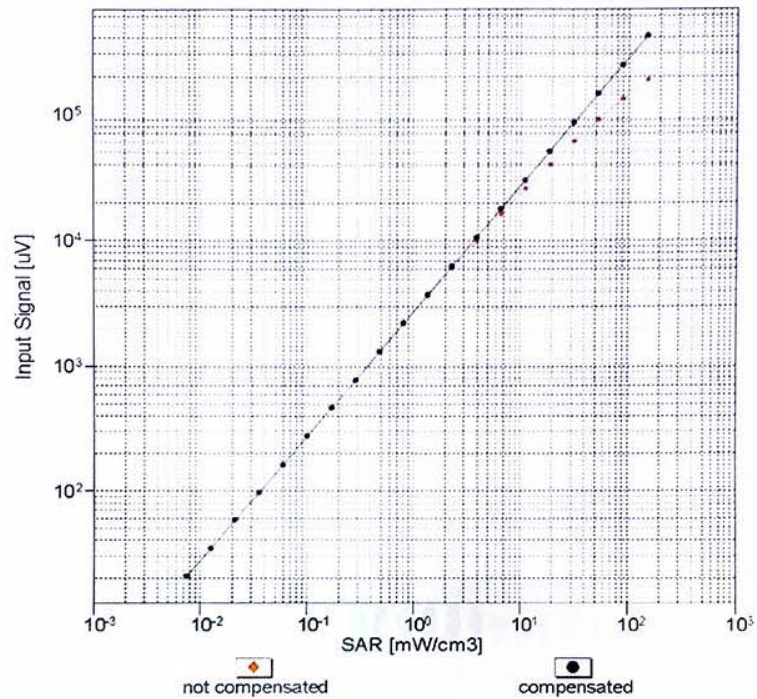
Rev 2.0 26, 27, 15

**Receiving Pattern ( $\phi$ ),  $\theta = 0^\circ$** **f=600 MHz,TEM****f=1800 MHz,R22**Uncertainty of Axial Isotropy Assessment:  $\pm 0.5\%$  (k=2)

EX3DV4- SN:3842

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### Dynamic Range $f(\text{SAR}_{\text{head}})$ (TEM cell , $f_{\text{eval}} = 1900 \text{ MHz}$ )

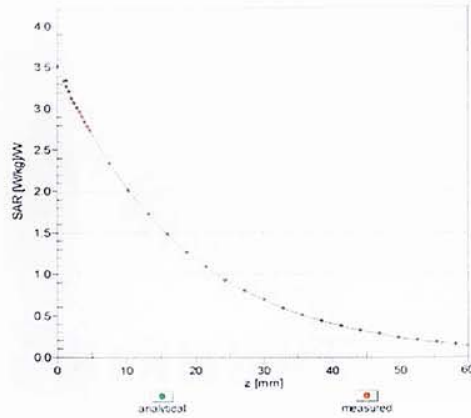
Uncertainty of Linearity Assessment:  $\pm 0.6\%$  ( $k=2$ )

EX3DV4- SN:3842

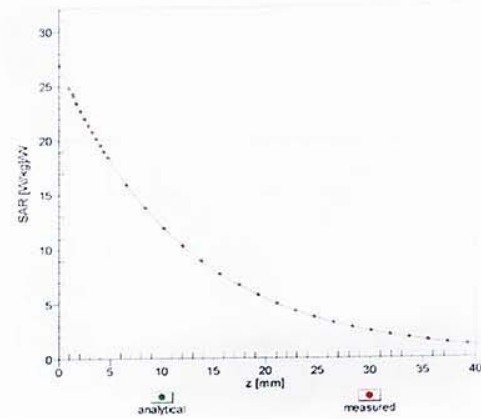
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## Conversion Factor Assessment

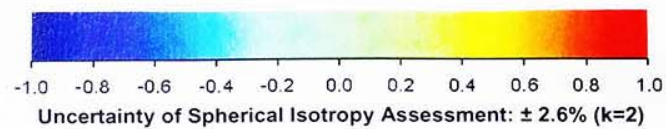
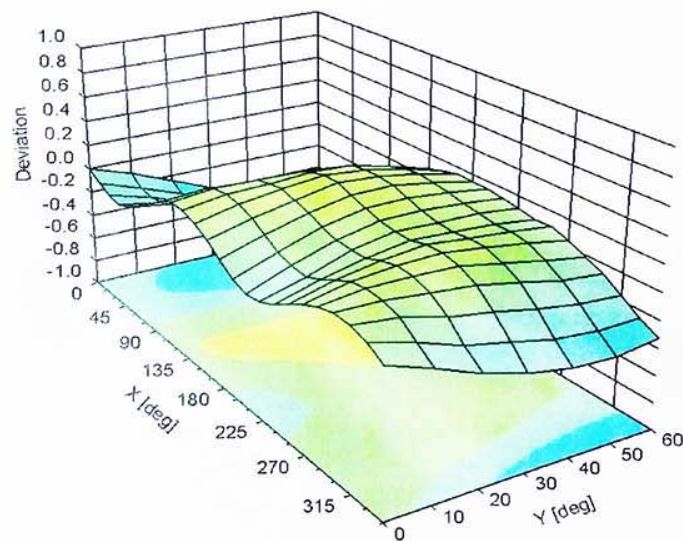
f = 900 MHz, WGLS R9 (H\_convF)



f = 1750 MHz, WGLS R22 (H\_convF)



## Deviation from Isotropy in Liquid

Error ( $\phi$ ,  $\theta$ ), f = 900 MHzUncertainty of Spherical Isotropy Assessment:  $\pm 2.6\%$  (k=2)

EX3DV4- SN:3842

August 26, 2015

**DASY/EASY - Parameters of Probe: EX3DV4 - SN:3842****Other Probe Parameters**

|                                               |            |
|-----------------------------------------------|------------|
| Sensor Arrangement                            | Triangular |
| Connector Angle (°)                           | 66.3       |
| Mechanical Surface Detection Mode             | enabled    |
| Optical Surface Detection Mode                | disabled   |
| Probe Overall Length                          | 337 mm     |
| Probe Body Diameter                           | 10 mm      |
| Tip Length                                    | 9 mm       |
| Tip Diameter                                  | 2.5 mm     |
| Probe Tip to Sensor X Calibration Point       | 1 mm       |
| Probe Tip to Sensor Y Calibration Point       | 1 mm       |
| Probe Tip to Sensor Z Calibration Point       | 1 mm       |
| Recommended Measurement Distance from Surface | 1.4 mm     |

## 6.2. D835V2 Dipole Calibration Certificate



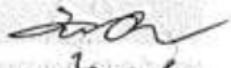
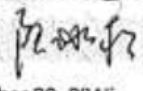
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CALIBRATION  
No. L0570

Client **SMQ**
Certificate No: **Z15-97116**

| CALIBRATION CERTIFICATE                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                      |                                          |                                                                                                    |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|------------------------------------------|----------------------------------------------------------------------------------------------------|
| Object                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | D835V2 - SN: 4d141                                                   |                                          |                                                                                                    |
| Calibration Procedure(s)                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | FD-Z11-2-003-01<br>Calibration Procedures for dipole validation kits |                                          |                                                                                                    |
| Calibration date:                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | September 24, 2015                                                   |                                          |                                                                                                    |
| <p>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.</p> <p>All calibrations have been conducted in the closed laboratory facility: environment temperature(22±3)℃ and humidity&lt;70%.</p> <p>Calibration Equipment used (M&amp;TE critical for calibration)</p> |                                                                      |                                          |                                                                                                    |
| Primary Standards                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | ID #                                                                 | Cal Date(Calibrated by, Certificate No.) | Scheduled Calibration                                                                              |
| Power Meter NRP2                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 101919                                                               | 01-Jul-15 (CTTL, No.J15X04256)           | Jun-16                                                                                             |
| Power sensor NRP-Z91                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 101547                                                               | 01-Jul-15 (CTTL, No.J15X04256)           | Jun-16                                                                                             |
| Reference Probe EX3DV4                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | SN 3846                                                              | 24-Sep-14(SPEAG,No.EX3-3846_Sep14)       | Sep-15                                                                                             |
| DAE4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | SN 910                                                               | 16-Jun-15(SPEAG,No.DAE4-910_Jun15)       | Jun-16                                                                                             |
| Secondary Standards                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | ID #                                                                 | Cal Date(Calibrated by, Certificate No.) | Scheduled Calibration                                                                              |
| Signal Generator E4438C                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | MY49071430                                                           | 02-Feb-15 (CTTL, No.J15X00729)           | Feb-16                                                                                             |
| Network Analyzer E5071C                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | MY46110673                                                           | 03-Feb-15 (CTTL, No.J15X00728)           | Feb-16                                                                                             |
| Calibrated by:                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Name<br>Zhao Jing                                                    | Function<br>SAR Test Engineer            | Signature<br> |
| Reviewed by:                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Qi Dianyuan                                                          | SAR Project Leader                       |               |
| Approved by:                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Lu Bingsong                                                          | Deputy Director of the laboratory        |               |
| Issued: September 29, 2015                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                      |                                          |                                                                                                    |
| This calibration certificate shall not be reproduced except in full without written approval of the laboratory.                                                                                                                                                                                                                                                                                                                                                                           |                                                                      |                                          |                                                                                                    |



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**Glossary:**

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

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

- 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
- 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 300MHz to 3GHz)", February 2005
- KDB865664, SAR Measurement Requirements for 100 MHz to 6 GHz

**Additional Documentation:**

- 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%.



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### Measurement Conditions

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

|                              |                          |             |
|------------------------------|--------------------------|-------------|
| DASY Version                 | DASY52                   | 52.8.8.1222 |
| Extrapolation                | Advanced Extrapolation   |             |
| Phantom                      | Triple Flat Phantom 5.1C |             |
| Distance Dipole Center - TSL | 15 mm                    | with Spacer |
| Zoom Scan Resolution         | dx, dy, dz = 5 mm        |             |
| Frequency                    | 835 MHz $\pm$ 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 $\pm$ 0.2) °C | 42.0 $\pm$ 6 % | 0.89 mho/m $\pm$ 6 % |
| Head TSL temperature change during test | <1.0 °C             | ----           | ----                 |

### SAR result with Head TSL

|                                                |                    |                                |
|------------------------------------------------|--------------------|--------------------------------|
| SAR averaged over 1 $cm^3$ (1 g) of Head TSL   | Condition          |                                |
| SAR measured                                   | 250 mW input power | 2.33 mW / g                    |
| SAR for nominal Head TSL parameters            | normalized to 1W   | 9.45 mW / g $\pm$ 20.8 % (k=2) |
| SAR averaged over 10 $cm^3$ (10 g) of Head TSL | Condition          |                                |
| SAR measured                                   | 250 mW input power | 1.51 mW / g                    |
| SAR for nominal Head TSL parameters            | normalized to 1W   | 6.11 mW / g $\pm$ 20.4 % (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 $\pm$ 0.2) °C | 56.0 $\pm$ 6 % | 0.98 mho/m $\pm$ 6 % |
| Body TSL temperature change during test | <1.0 °C             | ----           | ----                 |

### SAR result with Body TSL

|                                                |                    |                                |
|------------------------------------------------|--------------------|--------------------------------|
| SAR averaged over 1 $cm^3$ (1 g) of Body TSL   | Condition          |                                |
| SAR measured                                   | 250 mW input power | 2.39 mW / g                    |
| SAR for nominal Body TSL parameters            | normalized to 1W   | 9.51 mW / g $\pm$ 20.8 % (k=2) |
| SAR averaged over 10 $cm^3$ (10 g) of Body TSL | Condition          |                                |
| SAR measured                                   | 250 mW input power | 1.57 mW / g                    |
| SAR for nominal Body TSL parameters            | normalized to 1W   | 6.25 mW / g $\pm$ 20.4 % (k=2) |



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## Appendix

### Antenna Parameters with Head TSL

|                                      |               |
|--------------------------------------|---------------|
| Impedance, transformed to feed point | 48.2Ω- 4.66jΩ |
| Return Loss                          | - 25.9dB      |

### Antenna Parameters with Body TSL

|                                      |               |
|--------------------------------------|---------------|
| Impedance, transformed to feed point | 45.7Ω- 5.94jΩ |
| Return Loss                          | - 22.3dB      |

### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.441 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 |
|-----------------|-------|



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#### DASY5 Validation Report for Head TSL

Date: 09.18.2015

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d141**

Communication System: UID 0, CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium parameters used:  $f = 835$  MHz;  $\sigma = 0.886$  S/m;  $\epsilon_r = 41.95$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Left Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: EX3DV4 - SN3846; ConvF(9.18, 9.18, 9.18); Calibrated: 9/24/2014;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn910; Calibrated: 6/16/2015
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/I
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

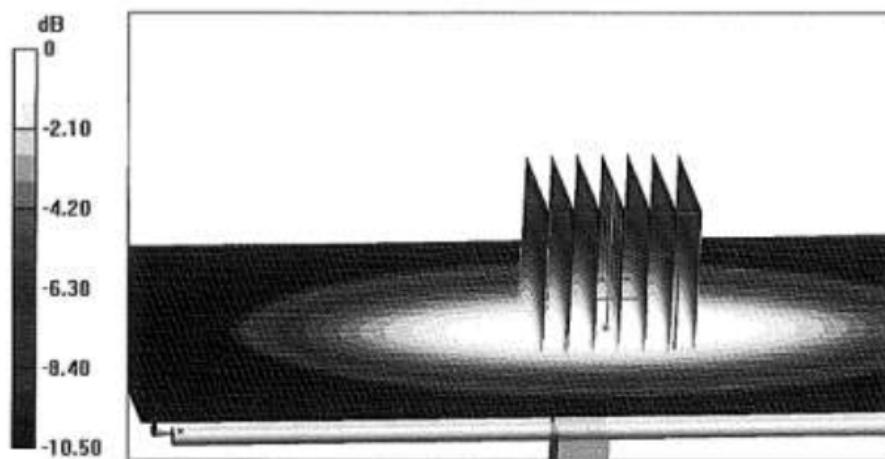
**Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 59.07 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 3.48 W/kg

SAR(1 g) = 2.33 W/kg; SAR(10 g) = 1.51 W/kg

Maximum value of SAR (measured) = 2.95 W/kg



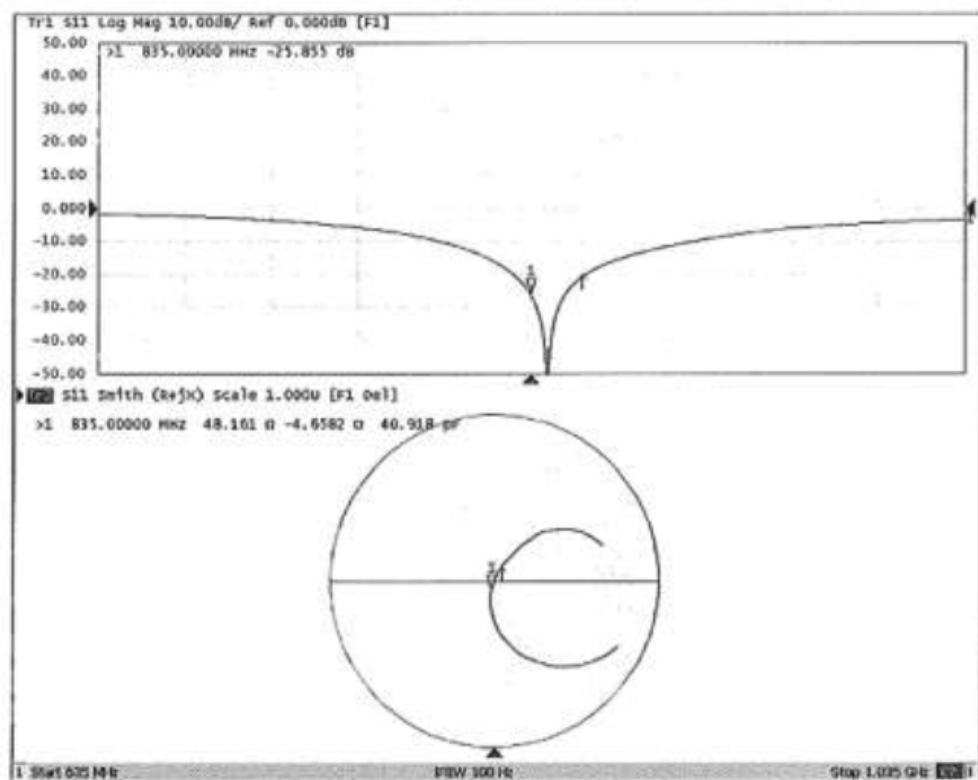
0 dB = 2.95 W/kg = 4.70 dBW/kg



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### Impedance Measurement Plot for Head TSL





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**DASY5 Validation Report for Body TSL**

Date: 09.18.2015

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d141**

Communication System: UID 0, CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium parameters used:  $f = 835$  MHz;  $\sigma = 0.981$  S/m;  $\epsilon_r = 55.99$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Right Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

**DASY5 Configuration:**

- Probe: EX3DV4 - SN3846; ConvF(9.09,9.09, 9.09); Calibrated: 9/24/2014;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn910; Calibrated: 6/16/2015
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

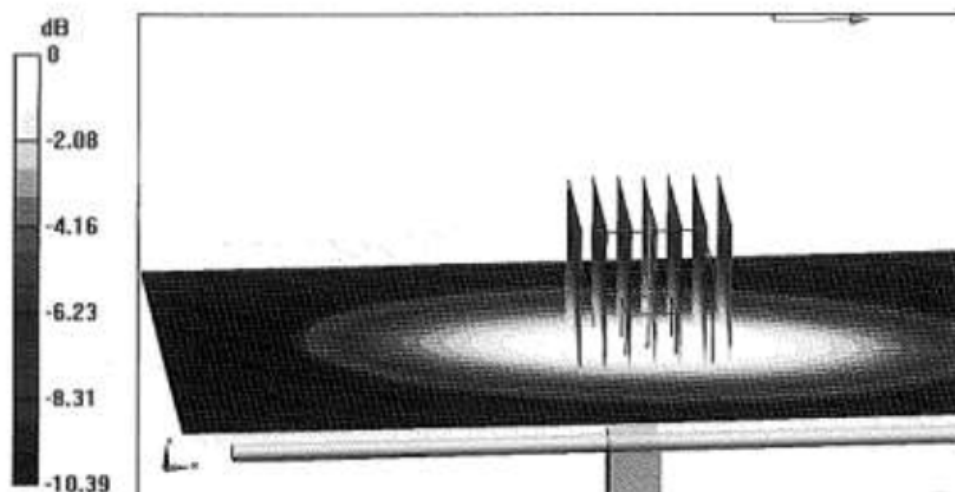
**Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 56.07 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 3.58 W/kg

**SAR(1 g) = 2.39 W/kg; SAR(10 g) = 1.57 W/kg**

Maximum value of SAR (measured) = 3.04 W/kg



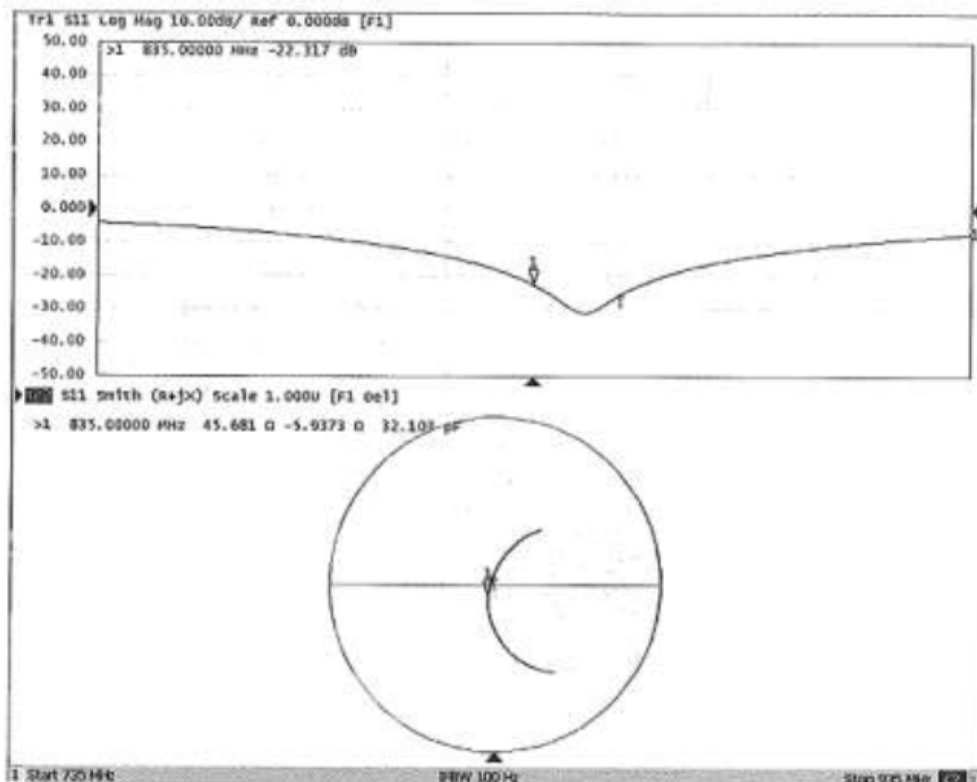
0 dB = 3.04 W/kg = 4.83 dBW/kg



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**Impedance Measurement Plot for Body TSL**

## 6.3. D1900V2 Dipole Calibration Certificate



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Client

SMQ

Certificate No: Z15-97117

**CALIBRATION CERTIFICATE**

Object D1900V2 - SN: 5d162

Calibration Procedure(s) FD-Z11-2-003-01  
Calibration Procedures for dipole validation kits

Calibration date: September 16, 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%.

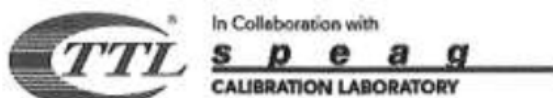
Calibration Equipment used (M&amp;TE critical for calibration)

| Primary Standards       | ID #       | Cal Date(Calibrated by, Certificate No.) | Scheduled Calibration |
|-------------------------|------------|------------------------------------------|-----------------------|
| Power Meter NRP2        | 101919     | 01-Jul-15 (CTTL, No.J15X04256)           | Jun-16                |
| Power sensor NRP-Z91    | 101547     | 01-Jul-15 (CTTL, No.J15X04256)           | Jun-16                |
| Reference Probe EX3DV4  | SN 3846    | 24-Sep-14(SPEAG,No.EX3-3846_Sep14)       | Sep-15                |
| DAE4                    | SN 910     | 16-Jun-15(SPEAG,No.DAE4-910_Jun15)       | Jun-16                |
| Secondary Standards     | ID #       | Cal Date(Calibrated by, Certificate No.) | Scheduled Calibration |
| Signal Generator E4438C | MY49071430 | 02-Feb-15 (CTTL, No.J15X00729)           | Feb-16                |
| Network Analyzer E5071C | MY46110673 | 03-Feb-15 (CTTL, No.J15X00728)           | Feb-16                |

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

Issued: September 23, 2015

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



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**Glossary:**

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

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

- 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
- 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 300MHz to 3GHz)", February 2005
- KDB865664, SAR Measurement Requirements for 100 MHz to 6 GHz

**Additional Documentation:**

- 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%.